MITIGATION PLAN

UNNAMED TRIBUTARY TO MILLERS CREEK STREAM AND WETLAND MITIGATION SITE

Duplin County, North Carolina
NCEEP Project No. 95719

Cape Fear River Basin
Cataloging Unit 03030006

Prepared for:

NCDENR-Ecosystem Enhancement Program
1652 Mail Service Center, Raleigh, NC 27699-1601
217 West Jones Street, Suite 3000A, Raleigh, NC 27603

September 17, 2014

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Prepared by:

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5121 Kingdom Way, Suite 100

Raleigh, North Carolina 27607

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September 2014

EXECUTIVE SUMMARY

The UT to Millers Creek Stream and Wetland Mitigation Site (Site) is located approximately one-half (0.5) mile west of Magnolia in Duplin County, North Carolina. The Site contains an unnamed tributary to Millers Creek (UT) and associated riparian hydric soils. The Site is located within North Carolina Ecosystem Enhancement Program (NCEEP) Targeted Local Watershed Catalogue Unit (CU) 03030006. Millers Creek (Stream Index #/Assessment Unit # 18-68-2-10-3) flows into Stewarts Creek, which flows into Six Runs Creek, which flows into the Black River approximately 16 miles southwest of the Site. Millers Creek is classified as Class C Water, with a supplemental classification of Sw (Swamp Waters). Millers Creek is not on the 2010 303 (d) list and there are no high quality waters at the Site. The Natural Heritage Program (NHP) has not identified elemental occurrences at the Site; however, records at the NHP indicate that one extant elemental occurrence is located approximately one mile southwest of the Site (Southern hognose snake). In addition, there is one Significant Natural Heritage Area located approximately one mile west of the Site along another unnamed tributary to Millers Creek. The area is titled Millers Creek Limesinks.

The Site is comprised of one property owned by William Jeffrey Hatcher and wife Susan King Hatcher (PIN # 247100987405).

The proposed work plan includes:

- Restoring 2,100 existing linear feet of the UT (2,679 restored feet) beginning near the southern property boundary and ending near the confluence with another unnamed tributary near the northern property boundary;
- Restore wetland hydrology to 8.77 acres of drained and modified (ditched and ponded) hydric soils to restore riparian wetlands adjacent to the UT.
- Restore native vegetation to 10.71 acres of riparian buffers that are currently cultivated as a pine plantation, ponded (excavated pond) or within disturbed areas.

The Cape Fear River Basin Restoration Priorities 2009 Report states, “Goals for this [03030006] watershed include completion of a Local Watershed Plan in the Great Coharie Creek headwaters, focus on water quality improvement in the South and Black River, and continued protection of the Outstanding Resource Waters” (NCEEP 2009).

The primary goals of this stream restoration project focus on:

1. Reduce stressors to water quality,
2. Providing/enhancing flood attenuation,
3. Restoring and enhancing aquatic, semi-aquatic and riparian habitat, and
4. Restoring and enhancing habitat connectivity with adjacent natural habitats.

This Mitigation Plan has been written in conformance with the requirements of the following:

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

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

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1.0 RESTORATION PROJECT GOALS AND OBJECTIVES

The Site is located in the 03030006 CU, in the Cape Fear River Basin. The Cape Fear River Basin Restoration Priorities 2009 Report states (NCEEP 2009):

> *This watershed contains the South River and Great Coharie Creek, which form the Black River. South River and Great Coharie Creek is on the 303(d) list for low dissolved oxygen but could be due to natural swamp conditions. However, both feed into the Black River where NCWRC has reported lower levels of dissolved oxygen than can support the species of concern in this river. This watershed also contains a significant number of animal operations. Goals for this watershed include completion of a Local Watershed Plan in the Great Coharie Creek headwaters, focus on water quality improvement in the South and Black River, and continued protection of the Outstanding Resource Waters.*

Division of Water Resources has since removed Great Coharie Creek from the 303(d) list due to low dissolved oxygen being attributed to the swamp stream's natural and expected state.

The following goals and objectives were developed to address the primary issues within the sub-basin and assist NCEEP in meeting planning goals.

The primary goals of this stream restoration project focus on:
1. Reducing stressors to water quality,
2. Providing/enhancing flood attenuation,
3. Restoring and enhancing aquatic, semi-aquatic and riparian habitat, and
4. Restoring and enhancing habitat connectivity with adjacent natural habitats.

These goals will be accomplished through the following objectives:
1. Removing stressors to water quality and increasing attenuation will be directly tied to:
   a. Restoring the existing deeply incised and entrenched UT as a Priority I (PI) restoration where bankfull and larger flows will access the historic floodplain allowing the nutrients, sedimentation, trash and debris from upstream urban runoff to settle from floodwaters.
   b. Restoring the UT as PI restoration will allow the Site to mitigate flood flows by reconnecting bankfull and higher flows to its historic floodplain.
   c. Restoring riparian buffers and wetlands adjacent to the UT (i.e. restore an existing pond and ditch back to riparian wetlands) that will attenuate floodwaters, in turn reducing stressors from upstream impacts.
   d. Restoring wetland hydrology within the riparian buffer that will support hydrophytic vegetation which will assist in the uptake, storage and fixation of nutrients and sedimentation from overbank flows. Adjacent low quality pine plantations will be removed and planted with native hydrophytic vegetation.

2. Restoring and enhancing aquatic, semi-aquatic and terrestrial habitat will be directly tied to:
    a. Woody materials such as overhanging planted vegetation, log sills, soil lifts and toe wood will be included within the restored channel to assist in providing a diversity of shading, bed form and foraging opportunities for aquatic organisms, benthic macroinvertebrate, and fish propagation.
    b. Restoring native vegetation to the stream channel banks and the adjacent riparian corridor that is currently pine plantation will diversify flora and provide an abundance of available foraging and cover habitat for amphibians, reptiles, mammals and birds.
    c. Restoration of wetland hydrology and introducing floodwaters back to the historic floodplain will provide a diversity of habitats for semi-aquatic flora and fauna that may have not been seen on the Site since before channel manipulation.
3. Habitat restoration and connectivity can be directly tied to:
    a. The removal of the existing pine plantation and replanting with native vegetation will mimic the maturely wooded communities immediately downstream of the Site.
    b. Protection of the restored community will ensure a protected habitat corridor between the Site and the downstream mature riparian buffers and upland habitats.

The UT to Miller Creek Project was identified as a stream, wetland and buffer restoration opportunity to improve water quality, habitat, and hydrology within the CU.

2.0SITE SELECTION

2.1 Direction to Project Site

The Site is located approximately one-half (0.5) mile west of Magnolia in Duplin County, North Carolina (Figure 1). The properties included in this proposal are located immediately west of SR 1003 (NC 903) and north of SR 1104 (Beasleys Road).

Directions from Raleigh, NC:

- Take I-40 East to exit 373.
- Turn right on NC 903 and proceed 2.7 miles.
- Turn right onto N Pope Street in 489 feet continue onto Cemetery Street.
- Google maps the site as Cemetery Street, Magnolia, NC 28453 (34.895893, -78.066702). Estimated travel time from NCEEP's Raleigh office is 1 hour 15 minutes.

2.2 Site Selection

2.2.1 Historical Condition

The Environmental Data Resources (EDR) Aerial Photo Decade Package provides aerial photography back to March of 1951 (Figures 6 – 6D) (EDR 2013). The 1951 aerial photograph appears to depict the UT as flowing through a mature hardwood forest. There appears to be some agricultural fields along the eastern border of the property in which the Site is located, however it is unclear if the UT has been modified at the time the photo was taken. It does not appear that there are any other ditches on-site (i.e. Ditch 1 does not appear to be dug at this point and there are no ditches in the location of the current pond).. The 1993 historic aerial photograph depicts the UT as a straightened stream channel beginning at the southern property boundary. It is of note that an area immediately south of the property boundary, and consequently immediately upstream of the UT, is dark on the 1993 aerial, which could indicate standing water upstream of the Site. This is of important note, because all aerials that have been studied since 1993 show backwater beginning at the property boundary, apparently due to beaver activity. It is also evident in the 1993 aerial that agricultural fields have expanded on the property to include nearly all land east of the UT and a field immediately west of the UT at the southern end of the property. Additionally, the 1993 aerial shows Ditch 1 (Figure 6A) clearly while also showing a ditch in the current vicinity of the pond. The 2007 aerial photograph clearly shows that the pond is being dug at the time of aerial capture.

2.2.2 Site Modifications

The following modifications are depicted on Figures 5 and 6 – 6D.

The UT has been ditched and channelized as a result of past agricultural practices. Spoil piles exist along both banks (primarily the left bank) that cover drained hydric soils. The stream flows straight down the valley's fall line lacking the typical meander geometry of a Coastal Plain stream channel. The channel bed is uniform and lacks deeps and shallows, which is typical of a channelized sand bed system

Ditch 1 has been dug along the eastern portion of the Site, in what appears to be an attempt at draining a low riparian wetland crenulation that naturally drained through the Site and into the UT. It is not clear the exact year the ditch was dug through the crenulation; however it is believed to be between 1951 and 1993 based on historical aerial photographs. The effects of the ditch were evident in the soil profiles documented on the Site (Appendix C-5). For example, in natural conditions, many of the very poorly drained soils would have exhibited a mucky surface layer resulting from reduced conditions. However, oxidation of organic matter in these surface layers was noted in many of the borings. Additionally, many of the poorly drained soils within the riparian corridor may not have had muck surfaces prior to the drainage, yet still have met the 404 criteria for wetlands. In these soils, a relatively high percentage of uncoated sand grains were observed in each soil profile. Another indicator of drainage was the presence of redoximorphic soil features at depths greater than 12 inches (and in many instances greater than 20 inches) below the ground surface. The presence of these features at greater depths is indicative of long-term drainage of the site (particularly when observed in soil series that are typically saturated to the surface for extended periods or intermittently flooded).

A pond has been dug on the northern portions of the Site. A ditch was in place in the location of the pond prior to excavation. The ditch is evident in the 1993 aerial photograph, but a date of excavation is not known. The pond was being excavated in 2007 as evidenced by historic aerial photography (Figure 6C). The pond has been excavated from drained hydric soils. Soils evaluations adjacent to the pond suggest that excavated material from pond construction has been spread over hydric soils. Based on site investigations, it appears as though the extent of fill around the pond averages approximately 18 inches in depth (Appendix C-6).

Natural vegetative stands have been removed for the use of agricultural and silvicultural practices. The 1951 aerial photograph shows what appear to be cleared areas along the eastern portions of the Site which were used for agricultural practices until approximately 2008. Following 2008 the Site was converted to a pine plantation.

2.2.3 Evolutionary and/or Successional Trends

The UT is a modified natural stream due to channelization and straightening. The UT is aggrading in sections due to blockages caused by beaver dams. Materials within aggrading sections are primarily composed of detritus with minor influences from sediments. It does not appear that the channel experiences substantial washing of sediments from upstream or on-site. The current Rosgen stream channel classification based off of morphological conditions is a G5. It is expected that in its current state the UT's successional trend will progress in a manner similar to the following (assumed ***geologic*** trend without human interference):

G→B→E

It is expected that the existing channel that displays G type channel attributes would stabilize into a B type channel with a small bench/sloped floodplain. Eventually the channel would scour a level floodplain at a much lower elevation than the terrace (relic floodplain) that is currently found on-site.

2.3 Vicinity Map

See Figure 1 for the Vicinity Map.

2.4 Watershed Map

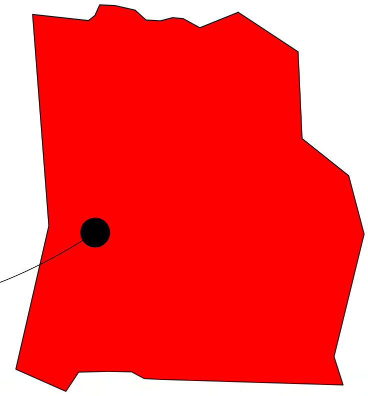
See Figure 2 for the Watershed Map. The map is based on the USGS topographic map Warsaw South, NC 1984 quadrangle (USGS 1984). Land use within the watershed is shown in Figure 3. The watershed area draining to the Site is approximately 250 acres (0.39 mi^2).

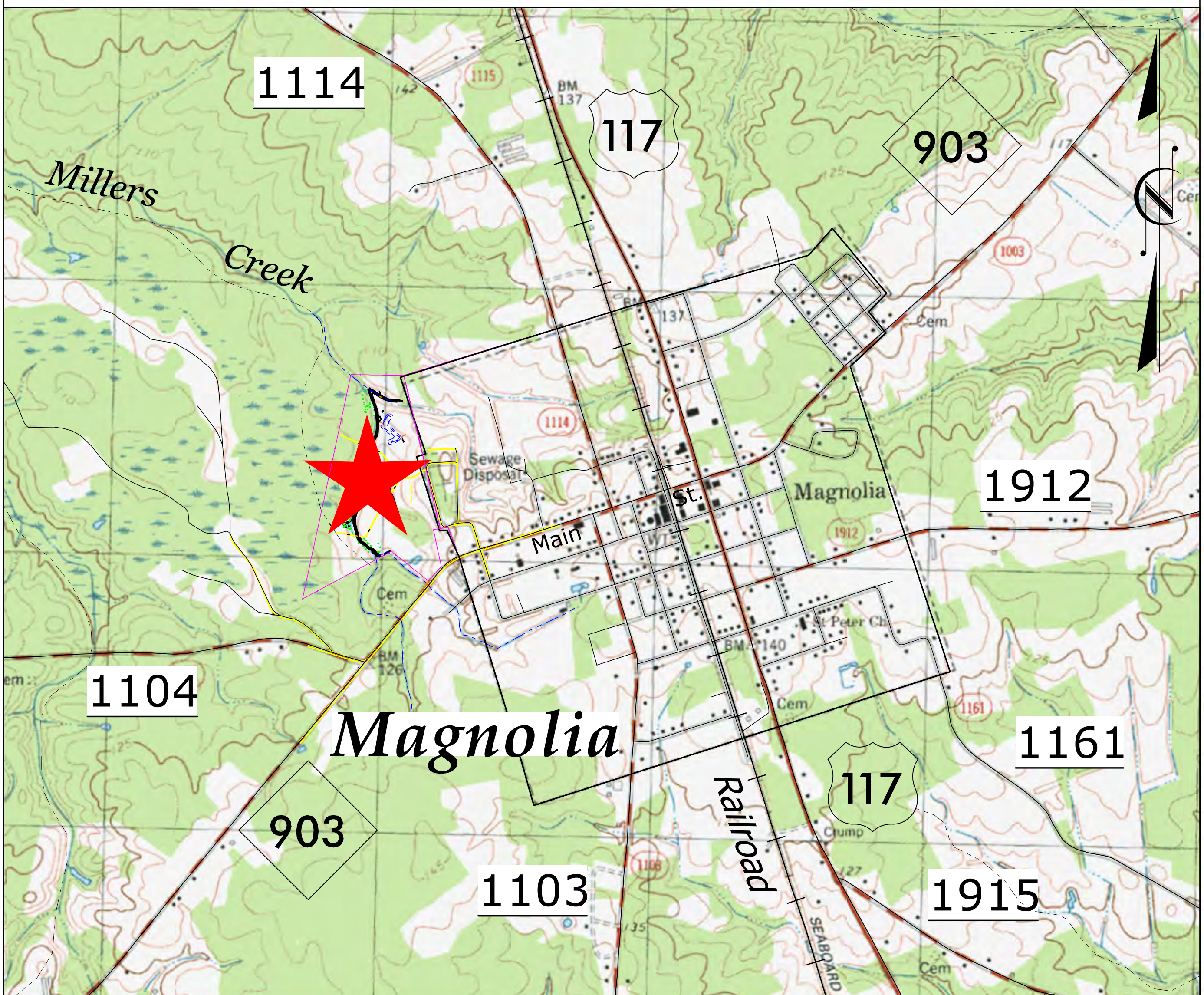
Duplin County
North Carolina

0 2000 4000

FEET

PROJECT SITE





Ecosystem Enhancement PROGRAM

ICA Engineering

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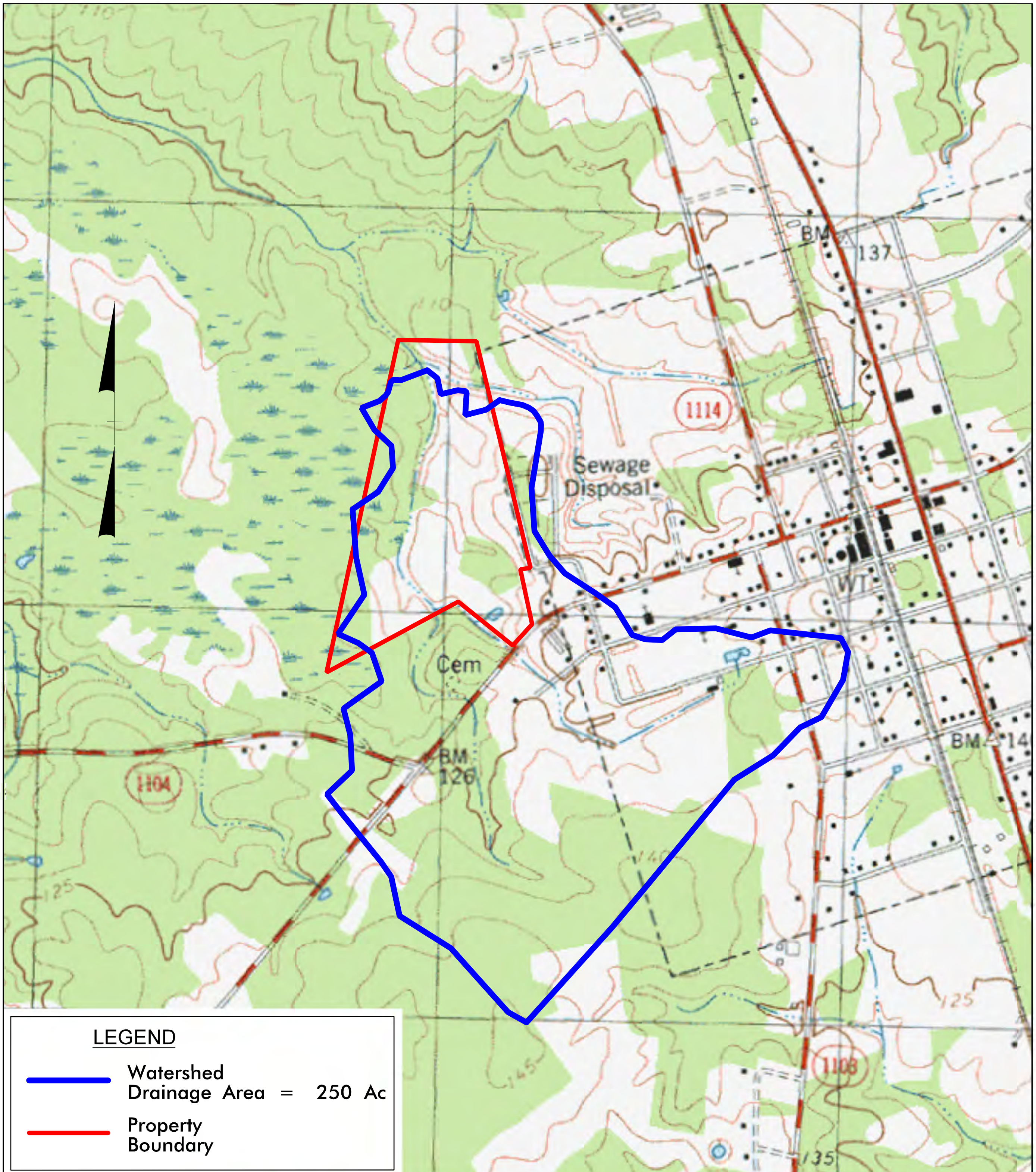
Vicinity Map

Mitigation Plan
UT Millers Creek
Duplin County, North Carolina

Date:	07/17/13	Figure:	1



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Watershed Map

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UT Millers Creek
Duplin County, North Carolina

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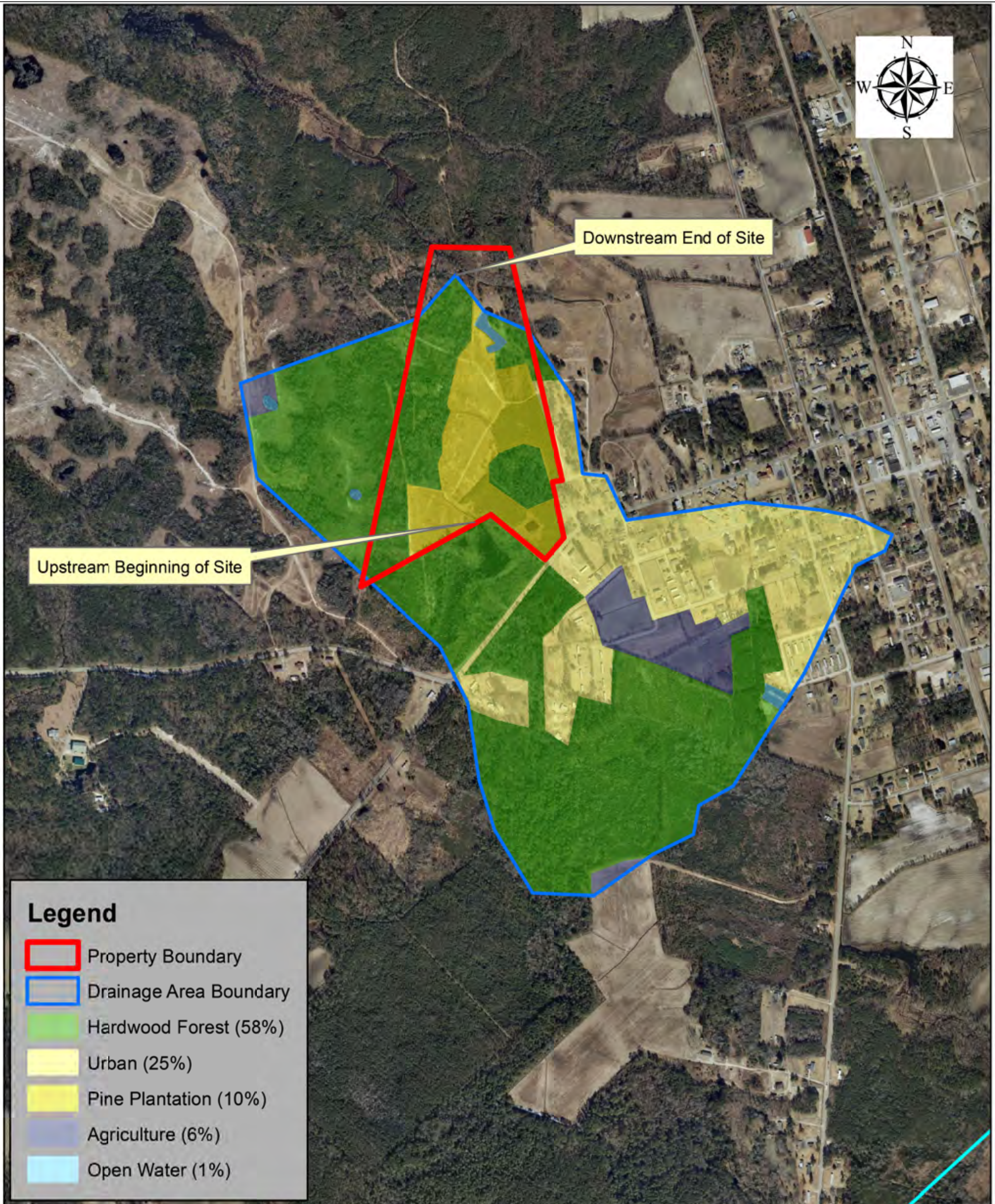
Date: 08/13/13

Figure: 2



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Land Use Map

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Date: 07/17/13

Figure: 3

2.5 Soil Survey

Historic (1958) and contemporary Natural Resource Conservation Service (NRCS) soil surveys of the Site are depicted on Figures 4a and 4b. A soil map and descriptions of soils of the Site completed by a licensed soil scientist are included in Appendix C-5.

Floodplain Adjacent to UT to Millers Creek
Bibb sandy loam, frequently flooded (BbA) – These are very deep, poorly drained, moderately permeable soils that formed in stratified loamy and sandy alluvium. These soils are found on floodplains of streams in the Coastal Plain.

Torhunta mucky fine sandy loam, 0 to 1 percent slopes (ToA) – These soils are very poorly drained and usually found in upland bays and on stream terraces in the Coastal Plain.

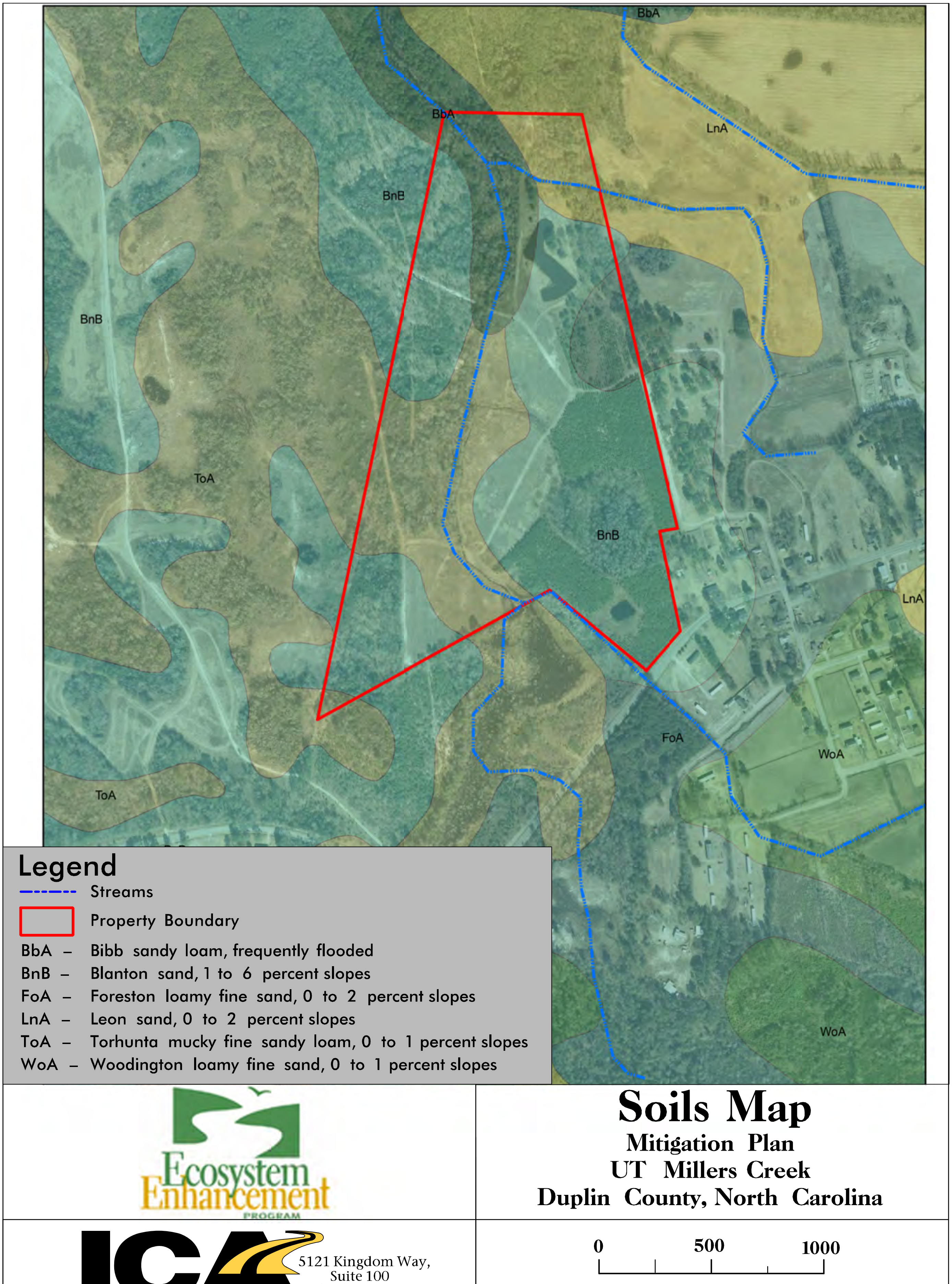
Uplands Adjacent to the UT to Millers Creek Floodplain
Blanton sand, 1 to 6 percent slopes (BnB) – These soils consist of very deep, somewhat excessively drained to moderately well drained, moderately to slowly permeable soils on uplands and stream terraces in the Coastal Plain.

Hydric Soils (Historic Wetlands)
Landscape position and hydric soil data collected adjacent to the UT and associated on-site drainages suggest that wetlands that once existed at the Site have either been drained by the UT and ditches or converted into a pond (Figure 5). Historically, the wetlands that existed in the floodplain of the UT were likely characteristic of a Bottomland Hardwood Forest as described by the NC Wetland Functional Assessment (NCWAM) dichotomous key (WFAT 2010). The wetland that once existed in the crenulation that is presently ditched was likely characteristic of a Headwater Wetland as described by the NCWAM dichotomous key (WFAT 2010).

The 1958 US Department of Agriculture (USDA) Duplin Soil Survey (Figure 4b) depicts the presence of a stream bisecting the site; the location of which resembles the proximal setting of the existing incised UT. At the time of the survey publication, the soils along this corridor were mapped as a ‘Mixed Alluvial’ series. As the nomenclature suggests, this classification is associated with unconsolidated sediments of the floodplains of major streams in the county. According to the 1959 series description, lands mapped in this series are of no value for crops or pasture since “the risk of overflow is great”. The Survey further states that “until stream channels are improved, forest is the best use for this soil”. In the contemporary NRCS records, the mapped soil units of the identified riparian corridor include Bibb sandy loam (associated with floodplains of streams) and Torhunta fine sandy loam (associated with stream terraces).

Licensed soil scientists of Land Management Group, Inc. (LMG) performed soils investigations to identify the limits of hydric soils on the Site. Detailed soil borings indicate the presence of the above mentioned series and other series associated with floodplains and stream terraces. Field data collected by LMG indicate a progression of fine and fine-loamy (Cape Fear/Rains soil series) sediments at the head of the UT and headwater valleys to coarse-loamy to sandy (Plummer/Rutlege/Mascotte/Lynn Haven soil series) sediments down-gradient, as the stream flows north through the Site. The Cape Fear, Rains, Plummer, Rutlege, Mascotte and Lynn Haven series are poorly and very poorly drained soils associated with headwater flats and lower stream terraces of streams in the middle and lower Coastal Plain. Appendix C-5 contains detailed soil profile descriptions and a boring location map. The official soil series description for the Cape Fear, Rains, Plummer, Rutlege and Lynn Haven Soil series are also provided for reference in Appendix C-5.

Soil evaluations demonstrated that historic drainage from agricultural/sivicultural practices have caused long term drainage effects in the upper 1 to 2 feet of the riparian hydric soil units of the site. Each soil profile was examined carefully for contemporary and historic indicators of hydric conditions. Oxidation of organic matter in the surface layers was documented throughout the Site. In natural conditions, many of the observed series would exhibit a prominent surface layer of organic matter (i.e. muck) resulting from reduced conditions (particularly in the headwater forests areas). In addition, a relatively high percentage of uncoated sand grains were noted in each soil profile. Redoximorphic soil indicators were noted in the lower parts of the surface soil and upper subsoil layers greater than 12 inches (and in some instances greater than 20 inches) below the ground surface. The presence of these features at greater depths is indicative of long-term drainage of the site (particularly when observed in soil series that are typically saturated to the surface for extended periods or intermittently flooded).



Soils Map

Mitigation Plan
UT Millers Creek
Duplin County, North Carolina

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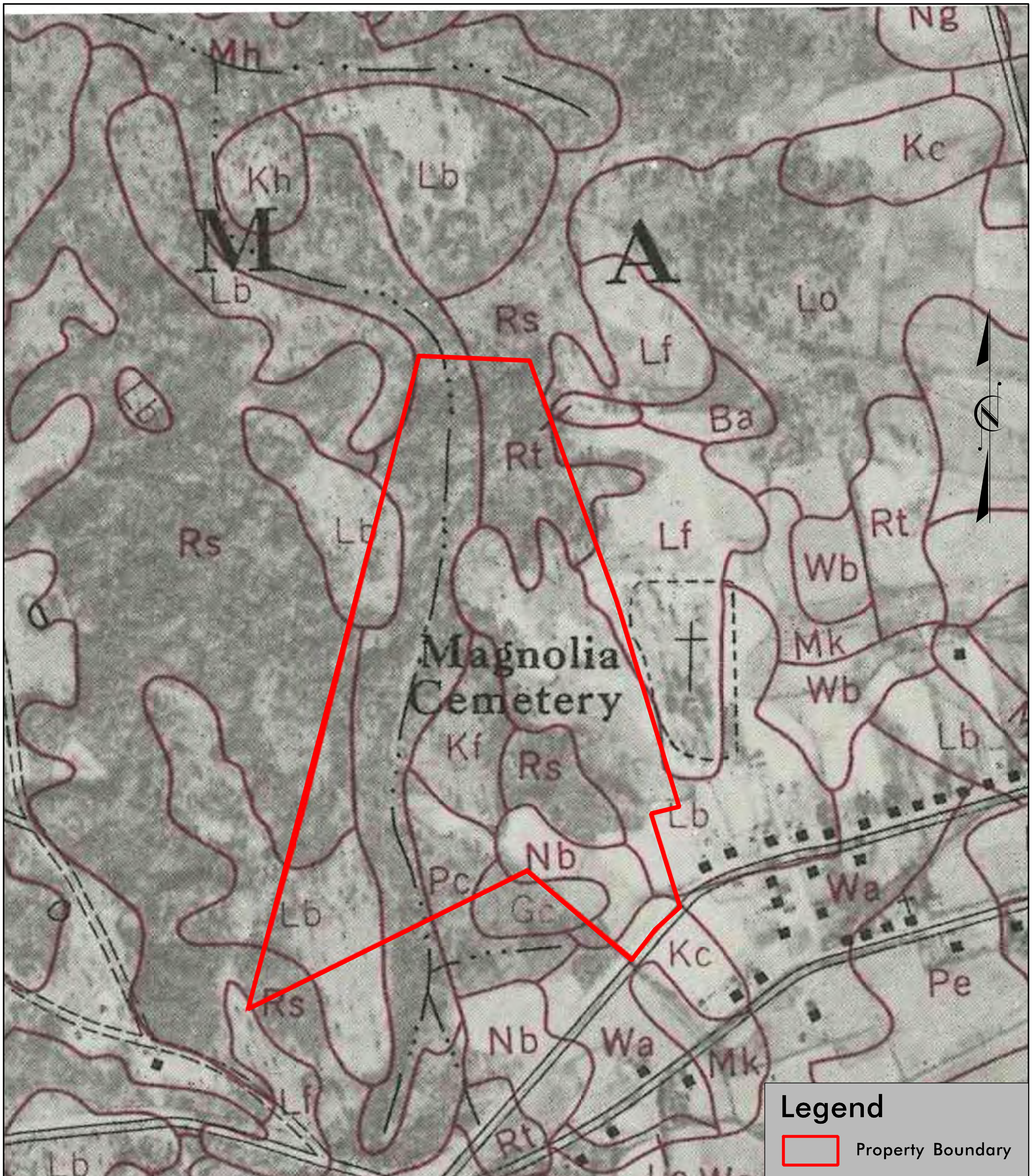
Date: 07/17/13

Figure: 4A



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Historic Soils Map 1958

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Date:	**07/17/13**	**Figure:**	**4B**

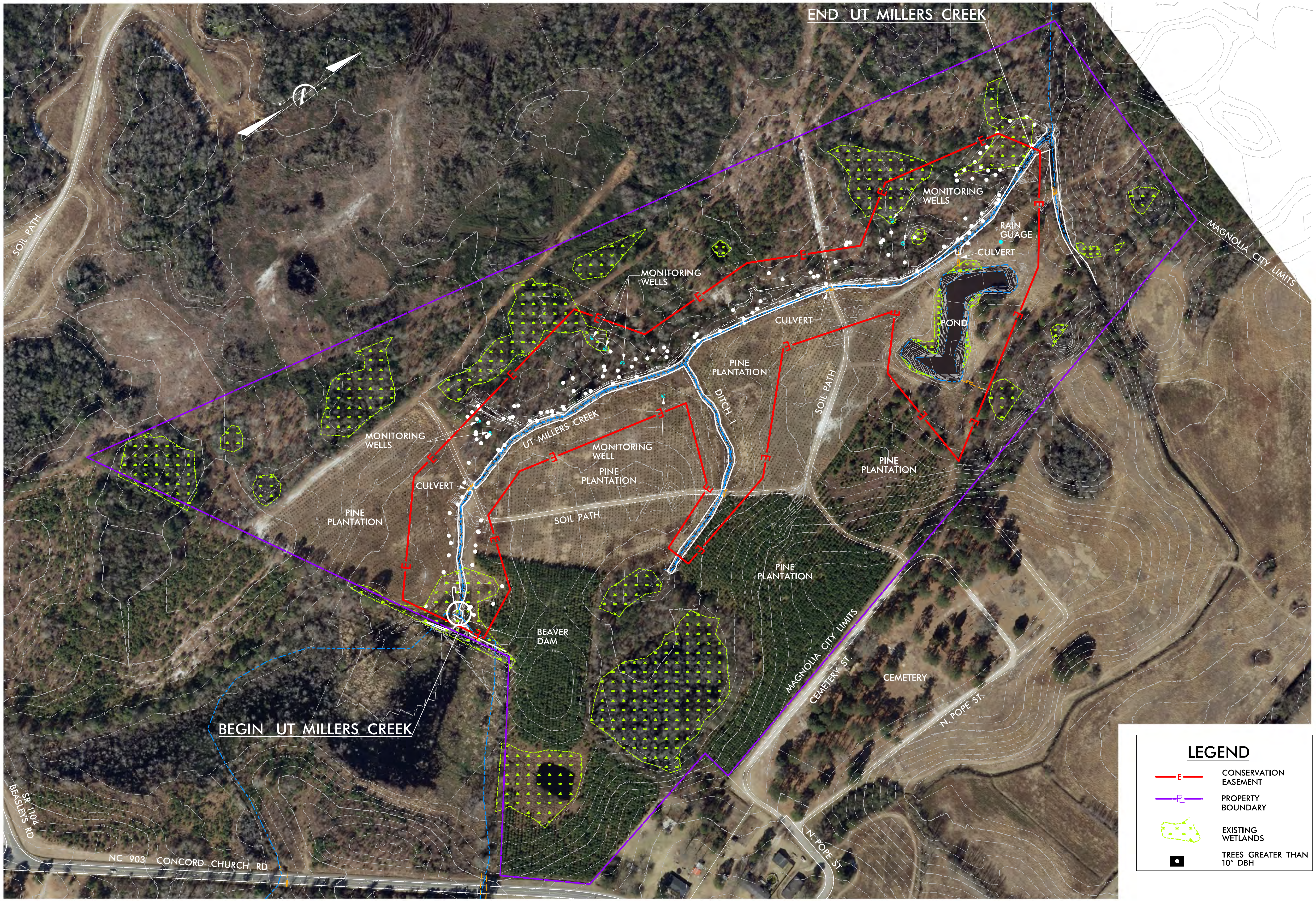
2.6 Current Condition Plan View

See Figure 5 for Project Site Current Condition Plan View.

2.7 Historical Condition Plan View

See Figure 6 through 6D for Historical Condition Plan Views. Representative historical aerials have been provided (1951, 1993, 2005,2007 and 2010). Between 1951 and 1993, the aerial shows a substantial increase in agricultural activities on the site. The 2007 historic aerial photograph depicts the pond being constructed and waste material from excavation being spread on the Site.

EXISTING CONDITIONS OVERVIEW MAP



INCOMPLETE PLANS

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

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ICA Engineering
f/k/a Florence & Hutcheson, Inc.

UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
125 0 125 250
PLANS

DATE: 07-30-13

PROJECT SITE CURRENT CONDITIONS PLAN VIEW

FIGURE
5

4/21/2014
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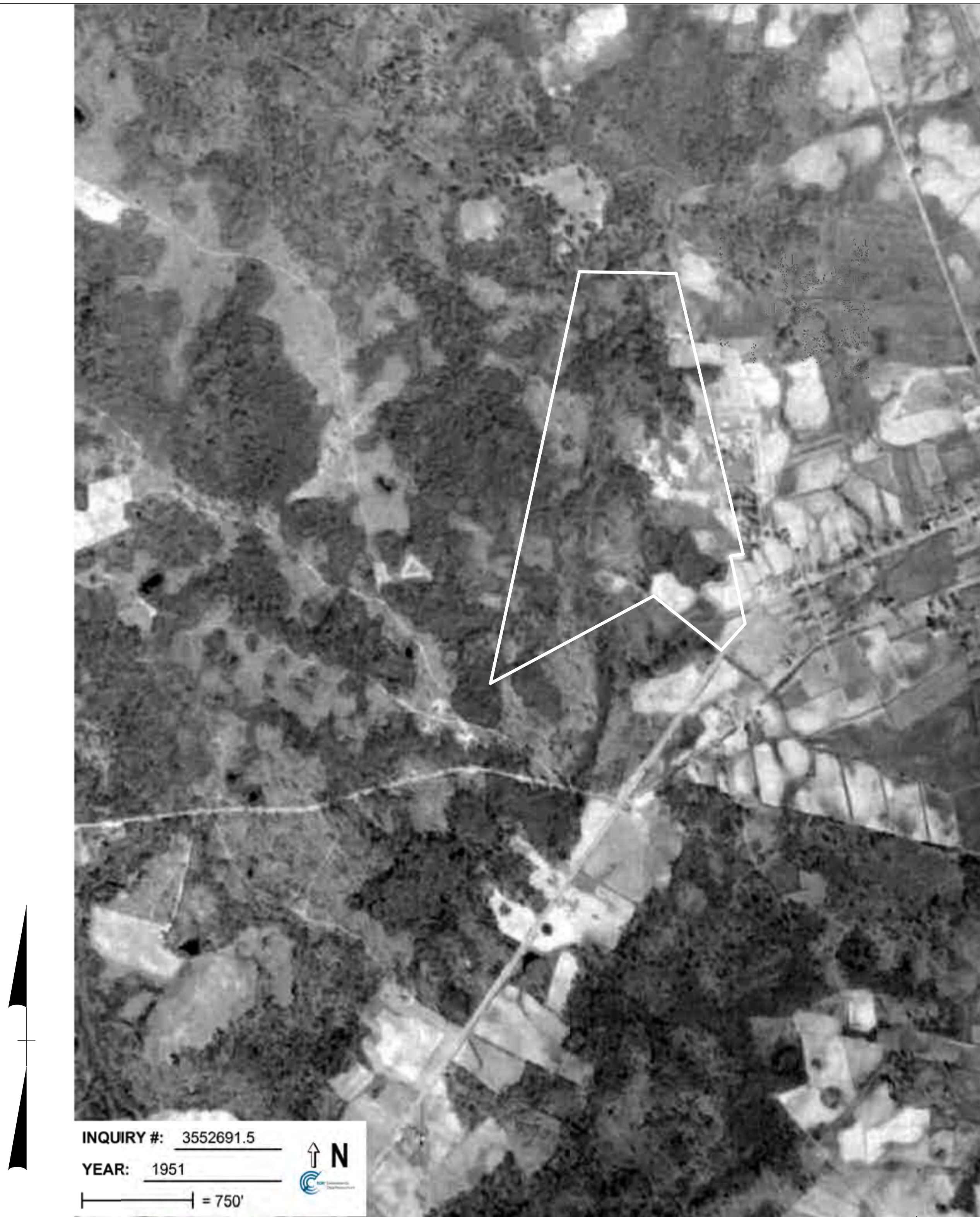

Project Site Historical Condition Plan View

Mitigation Plan
UT Millers Creek
Duplin County, North Carolina

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Figure: 6

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Project Site Historical Condition Plan View

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UT Millers Creek
Duplin County, North Carolina

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Figure: 6A

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Project Site Historical Condition Plan View

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UT Millers Creek
Duplin County, North Carolina

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Figure: 6B

Project Site Historical Condition Plan View

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UT Millers Creek
Duplin County, North Carolina

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0 500 1000
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Photo Date: 2007
Date: 07/17/13

Figure: 6C

Project Site Historical Condition Plan View

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UT Millers Creek
Duplin County, North Carolina

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Date: 07/17/13

Figure: 6D

2.8 Site Photographs

Looking upstream from culvert near Southern property boundary
taken March 20, 2012

Looking downstream at straightened channel, spoil on left bank,
typical cross-section location taken March 20, 2012

Looking upstream at straightened channel taken March 20, 2012

Looking upstream at straightened channel taken March 20, 2012

Abandoned floodplain, left overbank taken March 20, 2012

Abandoned floodplain, left overbank taken March 20, 2012

Looking downstream at abandoned floodplain,
right overbank (pine plantation) taken March 20, 2012

Looking upstream at abandoned floodplain,
right overbank (pine plantation) taken March 8, 2012

Abandoned floodplain, right overbank (pine plantation) taken March 8, 2012

Existing channel downstream taken March 8, 2012

Existing pond taken March 14, 2012

3.0 SITE PROTECTION INSTRUMENT

3.1 Site Protection Instrument(s) Summary Information

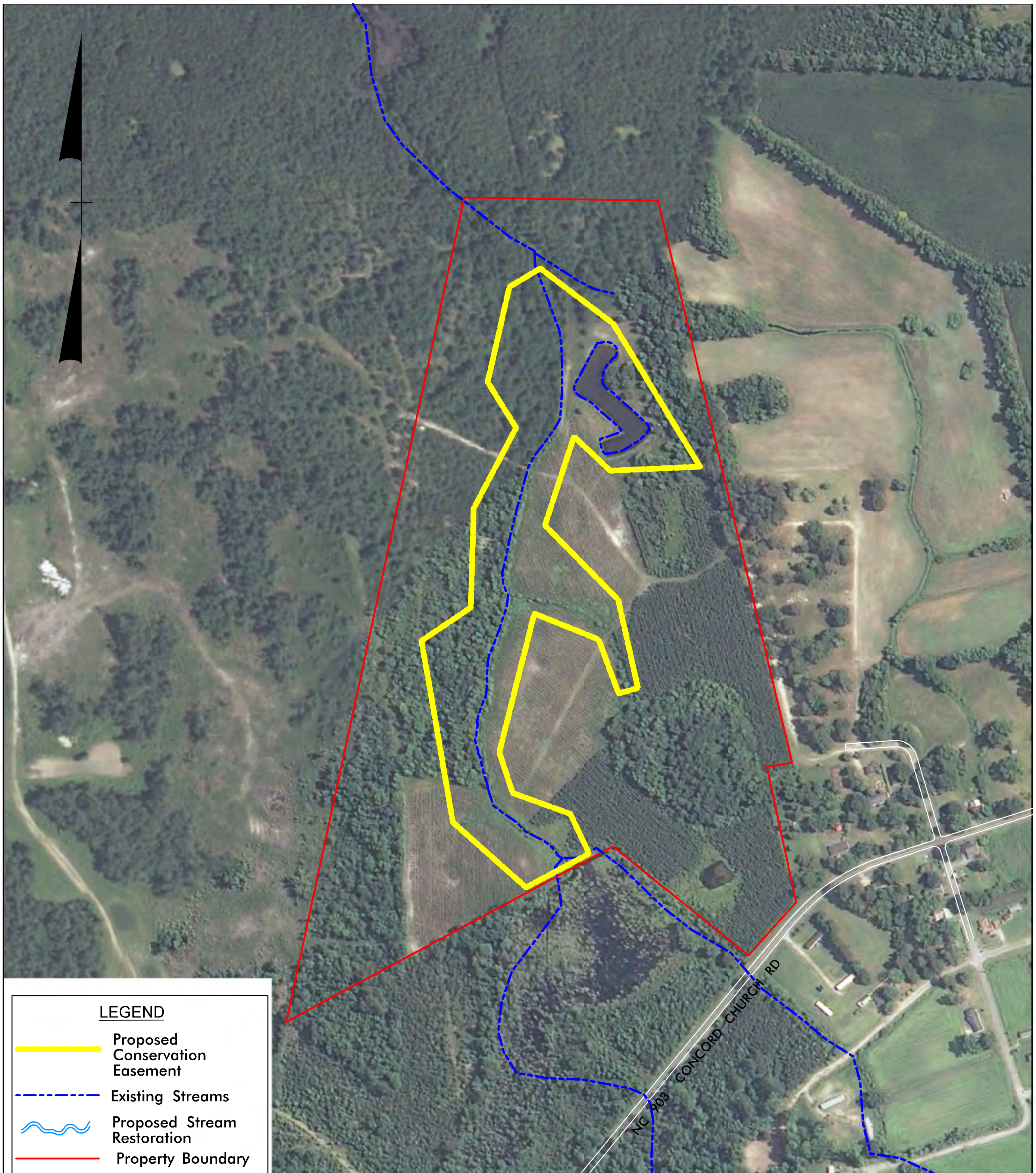
The land required for the construction, management, and stewardship of this mitigation project includes portions of the following parcel. The land protection instrument (i.e. conservation easement) has been closed, recorded in the County Register of Deeds and included in Appendix A.

Table 1. Site Protection Instrument

Landowner	PIN	County	Site Protection Instrument	Deed Book and Page Number	Acreage Protected
William Jeffrey Hatcher and wife Susan King Hatcher	247100987405	Duplin	Conservation Easement	Original Parcel: Book: 1501 Page: 465 Easement: Book: 1761 Page: 881-892 Deed: Book: 27 Page: 160-161 Affidavit of Correction of Minor Error: Book: 1761 Page: 881-892	15.944

3.2 Site Protection Instrument Figure

See Figure 7 for the conservation easement. See Appendix A for the Conservation Easement's recorded legal description and plat.



Proposed Conservation Easement

Mitigation Plan
UT Millers Creek
Duplin County, North Carolina

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Aerial Date: 2010
Date: 08/13/13

Figure: 7

4.0BASELINE INFORMATION

Table 2. Project Information

Project Information			
Project Name		UT to Millers Creek Stream and Wetland Mitigation Site	
County		Duplin	
Project Area (acres)		15.944 AC	
Project Coordinates (latitude and longitude)		34.894467,-78.067625	
Project Watershed Summary Information			
Physiographic Province		Coastal Plain	
River Basin		Cape Fear	
USGS Hydrologic Unit 8-digit	03030006	USGS Hydrologic Unit 14-digit	03030006110040
DWQ Sub-basin		03-06-19	
Project Drainage Area (acres)		250 AC	
Project Drainage Area Percentage of Impervious Area		4%	
CGIA Land Use Classification		Cultivated, Southern Yellow Pine, Bottomland Forest / Hardwood Swamps	
Reach Summary Information			
Parameters		**UT to Millers Creek**	
Length of reach (linear feet)		2,100 existing linear feet 2,679 restored linear feet	
Valley Classification		X	
Drainage Area (acres)		250 AC	
NCDWQ Stream Identification Score		36	
NCDWQ Water Quality Classification		C, Sw	
Morphological Description (stream type)		G/5	
Evolutionary Trend		G – B – E	
Underlying Mapped Soils		Bibb sandy loam and Torhunta fine sandy loam (USDA/NRCS records) Cape Fear, Rains, Plummer, Rutlege and Lynn Haven Soil series (Additional series mapped by LMG)	
Drainage Class		Poorly and very poorly	
Soil Hydric Status		Bibb sandy loam (hydric) Torhunta mucky fine sandy loam (hydric)	
Slope		0.0021	
FEMA Classification		Zone X	
Native Vegetation Community		Mixed stand of hardwoods and pine	
Percent Composition of Exotic Invasive Vegetation		<5%	

Wetland Summary Information			
Parameters	**Wetland 1**	**Wetland 2**	**Wetland 3**
Size of Wetland (acres)	0.21	0.12	0.59
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian Non-Riverine	Riparian Non-Riverine	Riparian Non-Riverine
Mapped Soil Series	BbA	ToA	BnB
Drainage Class	Poorly Drained	Very Poorly Drained	Moderately Well Drained
Soil Hydric Status	Hydric	Hydric	Partially Hydric
Source of Hydrology	Groundwater	Groundwater	Groundwater
Hydrologic Impairment	Stream Incision	Stream Incision	Stream Incision/Beavers
Native Vegetation Community	Forested	Forested	Emergent
Percent Composition of Exotic Invasive Vegetation	0%	0%	0%
Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	To Be Permitted	
Waters of the United States – Section 401	Yes	To Be Permitted	
Endangered Species Act	No	Yes	NCNHP
Historic Preservation Act	No	Yes	NCNHP
Coastal Zone Management (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	
FEMA Floodplain Compliance	Yes	Yes	HEC-RAS
Essential Fisheries Habitat	No	N/A	

4.1 Watershed Summary Information

The Site is located within the 03030006110040 14-digit Hydrologic Unit, which is also an NCEEP Targeted Hydrologic Unit for Cataloging Unit 03030006 of the Cape Fear River Basin. The Site contains one unnamed tributary to Millers Creek (UT). A second unnamed tributary to Millers Creek converges with the UT within the same property (near the downstream terminus of the property boundary); however, this other unnamed tributary is not within the Site boundaries (i.e. it is not within the proposed easement).

The Site is situated in Cape Fear River Subbasin 03-06-19. Land Use within the Subbasin is dominated by forestland (approximately 87 percent) and pasture/managed herbaceous land (approximately 12 percent) as noted in the Cape Fear River Basinwide Water Quality Plan (NCDENR 2005). The majority of the Site was once used as an agricultural field but has been recently planted in loblolly pine. Land use within the drainage area for the UT consists of hardwood forest (58 percent), urban land (Town of Magnolia) (25 percent), pine plantation (10 percent), agriculture (6 percent), and open water (1 percent) (Figure 3). Approximately 4 percent of the watershed consists of impervious surfaces, most of which are located within the urban areas of the Town of Magnolia.

The Duplin County Agricultural Protection Plan states that "land use patterns in the region are changing rapidly as the suburban reach of military related growth at Camp Lejune and Fort Bragg places pressure on land resources in counties that are critical to maintaining a healthy agricultural infrastructure. This development manifests itself as low-density residential development and attendant retail-commercial development." (ACDS 2010). However, the Site is approximately one hour to one and half hour away from Camp Lejune and Fort Bragg respectively. Significant developmental pressures near or on the Site are not anticipated in the near future.

4.2 Reach Summary Information

The project area lies within a topographic crenulation characteristic of fluvial systems. Elevations range between 105 ft MSL (within the riparian corridor) to 120 ft MSL on the interstream ridges adjacent to the project. The UT enters the Site as a low-gradient, second order tributary (USGS 1984). As a second order tributary, the UT flows south to north across the Site approximately 2,100 feet before converging with a first order tributary and exiting the Site. The UT is a sand-bed tributary that has been ditched and channelized as evidenced by spoil piles along both banks (primarily the left bank), and the stream flows straight down the fall line of the valley without any noticeable meander geometry. Channel bed form displays relatively no deeps and shallows that are commonly found in highly functional sinuous Coastal Plain stream channels. Channel banks are near vertical due to channel dredging and alteration.

An assessment of the channel's cross-section and profile through the Site revealed that the channel has been dug to a depth of over 4.2 feet from the top of the lowest bank (Appendix B-6). The UT has a watershed drainage area of approximately 250 acres at the downstream terminus of the Site (Figure 2). The "Coastal Plain Regional Curve" (i.e. *Hydraulic Geometry Relationships for Rural North Carolina Coastal Plain Streams* (Doll et al. 2006)) suggests that a channel with similar watershed acreage within the Coastal Plain would have a bankfull depth of approximately 1.0 foot. Existing conditions morphological data reveals that bankfull maximum depth is approximately 1.1 feet, so bankfull flows are entrenched nearly four feet below the existing top of bank (i.e. bank height ratio of approximately 3.8), which deters bankfull and higher flows from accessing the historic floodplain. Existing geomorphological data suggests that the channel is classified as a G5 type stream (Rosgen 1996). The existing channel's substrate is comprised of sand and detritus (due to backwater from in-line beaver dams). The NC Division of Water Quality (NCDWQ) Stream Identification Form is located in Appendix B-3.

4.3 Wetland Summary Information

The project area consists of a small stream swamp community and a low-gradient second order stream characteristic of the Coastal Plain. Prior logging practices have influenced the vegetative composition of the Ste. The western side of the existing channel consists of a mixed stand of hardwoods and pine of varying age. Canopy species generally consist of sweet gum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), water oak (*Quercus nigra*) and loblolly pine (*Pinus taeda*). Sub-canopy and shrub strata are dominated by red maple saplings, red bay (*Persea palustris*), and wax myrtle (*Morella cerifera*). Nearly the entire length of the eastern side of the channel had been historically cleared and cultivated into agricultural fields. Approximately 8 years ago the owner planted these fields in loblolly pine. Several understory species adapted to drier conditions are prevalent within the riparian corridor. These include dog fennel (*Eupatorium capillifolium*), bracken fern (*Pteridium aquilinum*), horse sugar (*Symplocos tinctoria*), yellow jasmine (*Gelsemium sempervirens*), and oldfield blackberry (*Rubus alumnus*). Wetland Determination Data Forms, Notification of Jurisdictional Determination, and the NC WAM Field Assessments are located in Appendix B.

Based upon the depth of the existing channel (as a result of historic excavation) and identified soil series, it is believed that the existing incised stream exerts a lateral drainage influence of 100 ft to 200 ft. It is believed that this represents a conservative estimate based upon standard methods for determining the lateral hydrologic influence of a drainage feature. According to the NRCS Drainage Guidelines (NRCS 1998), a 4-ft channel within a non-sandy Group B (e.g. Cape Fear) and Group C (e.g. Rains) series, exerts a lateral drainage effect of 95 ft to 225 ft. The same channel in sandy Group C (e.g. Rains) and Group D (e.g. Rutlege/Plummer/Lynn Haven) series exerts a lateral drainage influence of 260 ft to 685 ft. Ditching of other tributaries that tie to the main restoration channel also has influenced hydrology via drawdown of groundwater levels and interception of surface inflows.

Drainage has been documented via field indicators, groundwater level monitoring, and DRAINMOD analysis. Continuous daily groundwater level data over a nearly four-month period (March 22, 2013 through July 12, 2013) also depict relatively rapid discharge of groundwater levels below 12 inches from the soil surface within the lateral zone of influence of the deepened and incised stream channel (Appendix C-3). Depending on specific ground surface elevations and soil type, the lateral zone of influence is generally 100 to 150 feet from the top of bank. It should be noted that the Magnolia area experienced normal to above normal rainfall throughout the monitoring period with precipitation for June totaling 13.38 inches (compared to the long-term mean of 3.92 inches). Groundwater level data and rainfall data (with 30^{th} and 70^{th} percentile ranges) are graphically displayed in Appendix C-3.

Groundwater level data was also used to calibrate DRAINMOD analyses of hydrology within the restoration corridor. Based upon a calibrated model, DRAINMOD indicates that gauges located within the approximate 100-ft zone of influence of the ditched stream did not meet a 5 percent wetland hydrologic criterion (i.e. water within 12 inches of the soil surface for a minimum of 5 percent of the growing season – equivalent to 15 consecutive days). Groundwater gauges beyond the 100-ft zone of influence exhibited increased duration of hydroperiods and met the minimum hydrologic criterion for jurisdictional wetlands. A more detailed description of the DRAINMOD analyses with findings is provided in Appendix C-2).

Note that a pond has also been excavated from drained hydric soils near the northern terminus of the project. Prior to historic impacts, this area consisted of a broad riparian floodplain. Soils evaluations adjacent to the pond suggest that excavated material was spread over hydric soils (Appendix C-5) adjacent to the pond and adjacent to Ditch 1. Based on site investigations, it appears as though the extent of fill around the pond averages approximately 18 inches in depth.

4.4 Regulatory Considerations

4.4.1 Protected Species

Duplin County has two federally listed species as Threatened or Endangered. These species are the American alligator (Threatened due to Similarity of Appearance) and Red-cockaded woodpecker (Endangered). Records at the NHP do not indicate an occurrence of a federally threatened or endangered species on the Site. Based on site assessments, the Site does not currently provide habitat for the American alligator or the red-cockaded woodpecker. Records at the NHP indicated that one extant elemental occurrence is located approximately one mile southwest of the Site (Southern hognose snake). The southern hognose snake inhabits sandy woods, particularly pine-oak sandhills. The Site provides habitat for the southern hognose snake, but no individuals have been recorded on-site.

Table 3. Elemental Occurrences (LeGrand et. al. 2010)

Common Name	Scientific Name	State Status	Rank
Southern hognose snake	*Heterodon simus*	SC	S2

- SC (Special Concern) - "Any species of wild animal native or once native to North Carolina which is determined by the Wildlife Resources Commission to require monitoring but which may be taken under regulations adopted under the provisions of this Article." (Article 25 of Chapter 113 of the General Statutes; 1987).

- S2 (Imperiled) - Imperiled in North Carolina due to extreme rarity or some factor(s) making it very vulnerable to extirpation (local extinction) from the state. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000).

4.4.2 Cultural Resources

Natural Heritage Program

There is one Significant Natural Heritage Area located approximately one mile west of the Site along an unnamed tributary to Millers Creek (NHP 2009). The area is titled Millers Creek Limesinks and described as follows: "This site contains a series of small wetland depressions that support two wet depression communities: Small Depression Pond Open Lily Pond Subtype and Small Depression Pond Maidencane Subtype of the 4th Approximation." There are no Significant Natural Areas located at the Site.

State Historic Preservation Office

Records were checked at the State Historic Preservation office to determine if any potential resources could hinder Site mitigation plans. There were no records of historic resources at the Site. Two cemeteries are located adjacent to the Site. One is located on the property to the south of the Site and the other is located on the property to the east of the Site. Restoration activities are not expected to impact these adjacent cemeteries. The Federal Highway Administration (FHWA) Categorical Exclusion approval is located in Appendix B-4.

4.4.3 Floodplain Compliance

Review of the Floodplain Mapping Program website and the effective FIRM (Map Number 3720246000J, Effective Date February 16, 2006) on March 23, 2012 and August 7, 2013 indicates that neither a limited detailed nor a detailed flood study was performed along the UT to Millers Creek. A Hydrologic Engineering Centers River Analysis System (HEC-RAS) analysis was prepared to verify that no hydraulic trespass occurs on upstream property; however, a Conditional Letter of Map Revision (CLOMR) and/or Letter of Map Revision (LOMR) will not be required as part of this project. NCEEP Floodplain Requirements Checklist is located in Appendix B-5.

4.4.4 Constraints

The primary constraint of the Site was to determine if restoring the UT as a PI stream at the property boundary would cause backwater on the upstream landowner (i.e. hydrological trespass). Currently a large beaver dam is located on the UT near the southern property boundary of the Site. The existing dam appears to cause backwater on the upstream landowner. Historic aerial photography appears to confirm that the upstream property has experienced backwater since at least 1993, presumably due to the beaver dam near on the UT near the property boundary. The proposed mitigation plan calls for removal of the existing dam and restoring the UT as a PI through the Site. The HEC-RAS analysis has confirmed that the 100-year storm should slightly lower water surface elevations on the upstream landowner (Appendix C-1) in the proposed condition. More dramatically, however are the shorter recurrence interval storms, which indicate that water surfaces will be lowered substantially on the upstream landowner (by over two feet during the bankfull flow for example).

5.0 DETERMINATION OF CREDITS

Mitigation credits presented in these tables are projections based upon site design. Upon completion of site construction the project components and credits data will be revised to be consistent with the as-built condition. It is noted that a site visiting was conducted with members of the IRT on February 19th, 2013. A discussion was held following the site walk in which members of the Interagency Review Team (IRT), NCEEP and ICA Engineering staff discussed credit ratios for the Site. Primary discussions centered on credit ratios for wetland restoration. Specifically, there were questions as to what credit ratio should be generated for restored wetlands within existing mature woodlands on the Site. Several scenarios were discussed in which ratios from 1.25:1 to 1.5:1 were deemed possibly suitable for wetland restoration within existing mature woods. Based off of conversations with members of the IRT and NCEEP, ICA Engineering proposes a credit ratio of 1 .25:1 for wetlands restored within mature woods.

A discussion was held with the IRT concerning the removal of spoil/waste material from historic wetlands adjacent to the UT and pond. The IRT mentioned that waste material spread over wetlands adjacent to ponds typically is able to generate restoration credits if the action has occurred “recently (5 to 15 years)”. It is of note that the pond was excavated in 2007, which was 7 years ago. Therefore, removal of waste material from adjacent to the Pond (and over hydric soils) is being proposed as wetland restoration at a 1:1 ratio. Additionally, a discussion was held regarding the removal of spoil berms over drained hydric soils adjacent to the UT. Spoil berms adjacent to the UT were placed over hydric soils in historic wetlands. These berms will be removed and used as fill into the exiting UT. Removal of the berms within riparian hydric soils is proposed to be restored at a 1:1 credit ratio.

Land within the current footprint of the pond will be filled with overburden that was spread over historic wetlands adjacent to the pond. The existing pond is a jurisdictional surface water based off of the Preliminary Jurisdictional Determination; however, it has been documented that a ditch was in the place of the current footprint of the pond prior to the pond being excavated. The ditch was draining hydric soils and presumably riparian wetlands. ICA proposes restoration credits within the footprint of the Pond at a reduced credit ratio of 1.5:1, per the definition of rehabilitation under the premise of restoration as defined in the 2008 Mitigation Rule. See Figure 8 for Asset Map Overview.

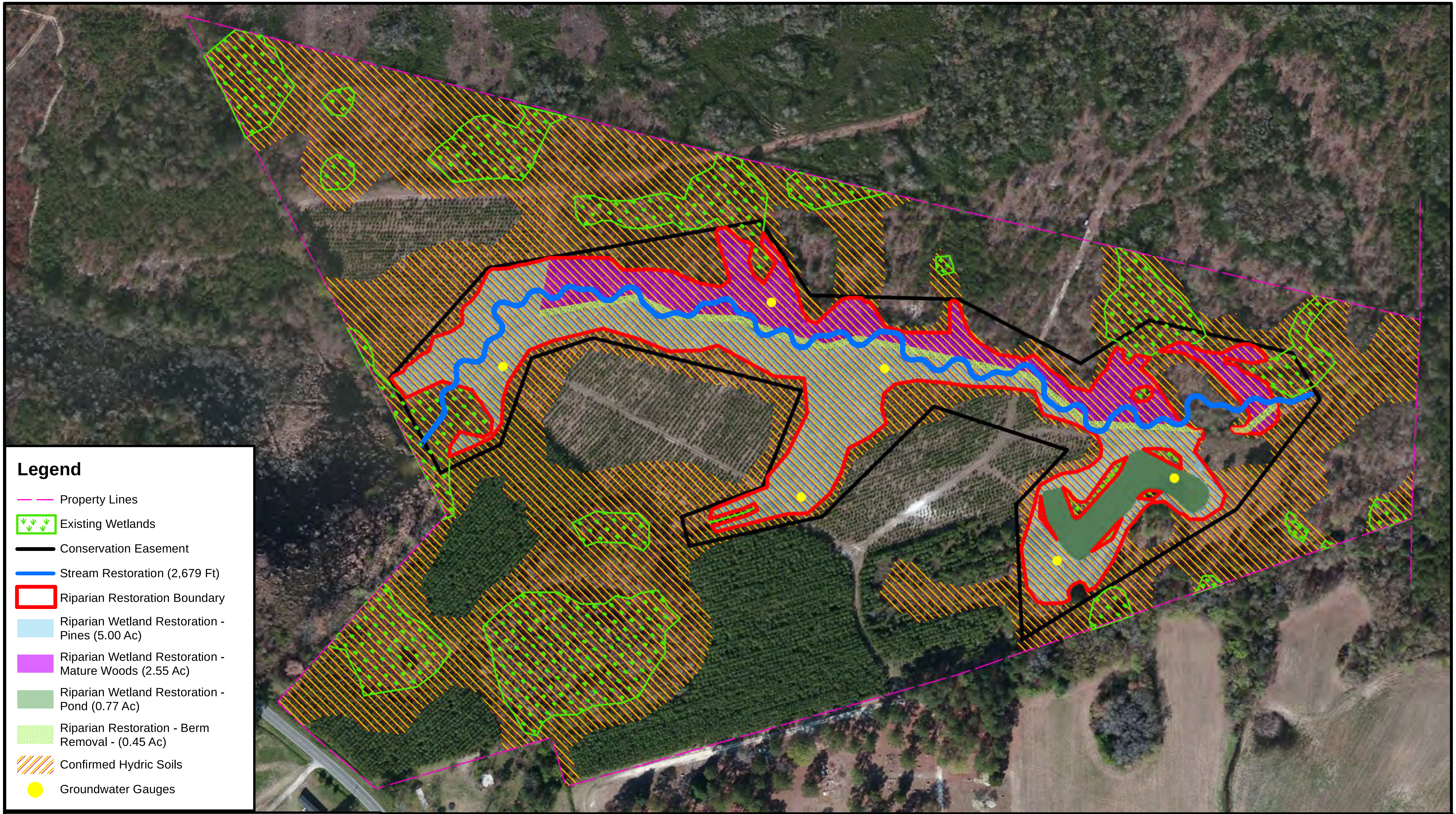
Table 4. Determination of Credits

UT to the Millers Creek, Duplin County Contract No. 005000									
Credit Summation									
	Stream (SMU)		Riparian Wetland (WMU)		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE	--	--	--
Totals	2,679		8.00						

Project Component or Reach ID	Stationing/ Location	Existing Footage/ Acreage	Approach (PI, PII, etc.)	Restoration or Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio	SMU or WMU
Project Components							
UT Millers Creek	10+17 – 36+96	2,100	PI	Restoration	2,679	1:1	2,679
Drained Wetland (Pines)	NA	5.00	NA	Restoration	5.00	1:1	5.00
Drained Wetland (Mature Woods)	NA	2.55	NA	Restoration	2.55	1.25:1	2.04
Drained Wetland (Berm/Spoil Along UT)	NA	0.45	NA	Restoration	0.45	1:1	0.45
Pond	NA	0.77	NA	Restoration	0.77	1.5:1	0.51
TOTAL	NA	2,100/8.77	P1/NA	Restoration	2,679/8.77	1 – 1.5:1	2,679/8.00

Component Summation						
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	2,679	8.77				

BMP Elements			
Element	Location	Purpose/Function	Notes
Forested Buffer	UT Millers buffer	Buffer to protect stream	Filter nutrients and provide cover, foraging areas, habitat, woody debris, and wildlife corridor



ICA Engineering

Asset Map Overview

UT Millers Creek, Duplin County, North Carolina

0 120 240 480 720 960 Feet

Ecosystem Enhancement Program

W N S E

Figure 8

6.0CREDIT 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 5. Forested Wetland Credits

Forested Wetlands 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%
3	Third year monitoring report demonstrates performance standards are being met	10%	60%
4	Fourth year monitoring report demonstrates performance standards are being met	10%	70%
5	Fifth year monitoring report demonstrates performance standards are being met; Provided that all performance standards are met, the IRT may allow the NCEEP to discontinue hydrologic monitoring after the fifth year, but vegetation monitoring must continue for an additional two years after the fifth year for a total of seven years.	10%	80%
6	Sixth year monitoring report demonstrates performance standards are being met	10%	90%
7	Seventh year monitoring report demonstrates performance standards are being met, and project has received close-out approval	10%	100%

Table 6. Stream Credits

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 project has received closeout approval	10%	90% (100%*)

*See Section 6.2 regarding bankfull events. 10% reserve of credits to be held back until the bankfull event performance standard has been met.

6.1 Initial Allocation of Released Credits

The initial allocation of released credits, as specified in the Mitigation Plan can be released by the NCEEP 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 US Army Corps of Engineers (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 NCEEP 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.

6.2 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 15 percent 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 NCEEP 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.

7.0MITIGATION WORK PLAN

7.1 Target Stream Type(s), Wetland Types(s), and Plant Communities

The proposed mitigation includes the following (Sheets 1 – 9, Sheets PL-1 – PL-2, and Sheets X-1 – X-3):

- Restore 2,100 existing linear feet of the UT (2,679 restored feet) and a native riparian buffer beginning at the southern property boundary and ending at the confluence with another unnamed tributary near the northern property boundary;
- Restore 8.77 acres of riparian wetlands. These wetlands are located in the floodplain of the UT, along a headwater wetland (currently ditched) and within the current location of a pond (that will be filled).

7.1.1 UT to Millers Creek

Stream channel restoration of pattern, profile, dimension and riparian buffer is proposed for approximately 2,679 linear feet of the UT (See Sheets Section of document). This reach of the UT is highly incised, as evidenced by bank height ratios averaging 3.8, and historic straightening and channelization. Higher than bankfull flows rarely reach the UT's historic floodplain, causing high stress within the terrace banks of the channel with no flow attenuation. Additionally, the natural riparian buffer along the east side of the UT has been replaced with a pine plantation.

The UT will be restored as a PI restoration where the bankfull elevation matches the historic floodplain. Several in-stream woody structures such as densely vegetated soil lifts, toe wood, and log sills are incorporated into the channel design. The proposed channel is designed as a moderately low width to depth ratio E type channel that conveys a bankfull discharge of approximately 8.4 cfs (proposed cross-sections shown on Sheets X-1 through X-3). Proposed morphological conditions can be found in Table 7 Morphological Conditions. The contributing drainage area of 0.39 square miles through this reach is more than sufficient to maintain a perennial flow under normal rain conditions. Spoil along the existing channel that currently acts as a levee to the natural floodplain will be removed and used as fill material during grading activities. Removal of the spoil will allow above bankfull flows to access the natural floodplain throughout the Site. Removal of spoil piles along the channel will also allow for the restoration of wetlands within its current footprint.

A riparian buffer populated with native vegetative species will average 250 feet through the Site (buffer width includes the required 50 foot stream buffer and adjacent riparian wetland). Modifications of the buffer off of the left bank of the channel (i.e. to the west of the channel) will occur only to remove spoil between the restored stream channel and the buffer/restored riparian wetlands, and to allow the restored stream pattern to access portions of the buffer that may represent the low point of the valley. ICA Engineering had all trees 10 inches and greater in diameter at breast height (dbh) within the buffer surveyed. The survey was used during the stream channel design to ensure that mature tree disturbance is limited during construction. Any portion of the existing buffer that is removed to facilitate restoration of the UT will be replanted with native vegetation characteristic of a Coastal Plain Small Stream Swamp forest (Schafale & Weakley 1990). Additionally, it is anticipated that the large majority of woody material removed from the mature buffer will be utilized back into the channel in the form of woody structures such as toe wood and log sills.

It is anticipated that construction of the UT will begin at the upstream extents of the channel on-site and work downstream to the confluence with another unnamed tributary near the northern property boundary. Standard construction equipment including CAT 320 (or equivalent) track hoes, dozers, and track trucks will be utilized to construct the channel. Erosion control measures such as a pump around operation with silt bags, silt checks, erosion control matting, seeding and mulch will be implemented during construction. Earthwork is anticipated to be minimal since the bankfull channel will be reconnected to the original floodplain for the entire length of the restoration.

Soil amendments may be added during and following construction to promote grass and tree growth within the disturbed areas on-site (outside of wetland areas). Signs will be posted along the easement boundary to clearly demarcate the easement boundary for the landowners. A boundary marking plan is depicted on Sheet 10.

7.1.2 Wetland Types and Plant Communities

The target wetland type to be restored is Coastal Plain Small Stream Swamp forest, Blackwater Subtype (Schafale & Weakley 1990). These communities occur on various alluvial or organic soils throughout the inner Coastal Plain. The hydrology is intermittently to seasonally flooded with variable flow regimes. The canopy is variable but typically dominated by species such as bald cypress (*Taxodium distichum*), swamp tupelo (*Nyssa biflora*), laurel oak (*Quercus laurifolia*), cherrybark oak (*Quercus lyrata*), swamp chestnut oak (*Quercus michauxii*), river birch (*Betula nigra*), American elm (*Ulmus americana*), sweet-gum, tulip poplar (*Liriodendron tulipifera*), and red maple. The understory is also variable but may include species such as ironwood (*Carpinus caroliniana*), American holly (*Ilex opaca*), sweetbay (*Magnolia virginiana*), swamp redbay, and titi (*Cyrilla racemiflora*). Shrub and herb species include swamp doghobble (*Leucothoe racemosa*), fetterbush (*Lyonia lucida*), Elliott's blueberry (*Vaccinium elliottii*), and giant cane (*Arundinaria gigantean*).

According to NCWAM, the primary target wetland type to be restored is Bottomland Hardwood Forest (WFAT 2010). Bottomland Hardwood Forests only occur in geomorphic floodplains of second-order and larger streams. This wetland type historically existed in the floodplain of the UT. Based upon a comprehensive wetland delineation of the site, fragmented wetland areas continue to occur within the historic floodplain. However, these areas are relatively small, disjunct, and impaired via hydrologic modifications. Unaltered bottomland hardwood forest wetlands tend to exhibit intermittent to seasonal flooding. Typical canopy species include bald cypress, swamp tupelo, swamp chestnut oak, ashes (*Fraxinus* spp.) and sycamore (*Platanus occidentalis*).

A second wetland community type is targeted for the zero-order tributary (relatively permanent water or RPW) that connects to the main tributary on the site (approximately 1,000 ft north of the southern property line). The RPW occurs within a topographic crenulation and has been historically ditched. Based upon NCWAM classification, the target community type for this former wetland is Headwater Forest (WFAT 2010). This community type occurs in geomorphic floodplains of first-order or smaller streams and in topographic crenulations without streams. Headwater Forests generally occur on mineral soils. Hydrology is drier relative to Bottomland Hardwood Forests and ranges from seasonal saturation to intermittent inundation. Typical canopy species include bald cypress, swamp tupelo, and water tupelo (*Nyssa aquatica*).

7.1.3 Summary of Activities

It is anticipated that all mitigation activities described in the preceding paragraphs will substantially increase net ecological and hydraulic functions to the stream channel, adjacent riparian buffers and wetlands and downstream receiving waters. Functional uplift will include the following:

- Stabilizing stream channel side slopes and invert through properly sized bankfull channel restoration, coir fiber matting, and establishment of permanent native vegetation (grasses and trees).
- Introduction of woody materials into the channel such as vegetated soil lifts, toe wood, and logs sills that will provide refuge habitat for fish and semiaquatic species, foraging habitat for macrobenthos, channel depth variability, stream shading, and invert stabilization.
- Installation of riparian and bank vegetation that will add woody debris to the channel for foraging and refuge and will shade the channel which will regulate temperatures and stabilize dissolved oxygen.
- Connecting higher than bankfull flows to the historic floodplain which will decrease channel shear stress; promote attenuation of water across the floodplain; store suspended solids on the floodplain; filter and nutrients, pesticides and other pollutants; and rehydrate the riparian buffer to allow for greater groundwater and surface water storage.
- Planting a native riparian buffer will promote terrestrial, aquatic and semiaquatic foraging, propagation, and cover habitat; connect the UT's native riparian corridor within the Site; minimize encroachment of invasive plant species, and enhance the floodplains ability to uptake nutrients and settle other pollutants from above bankfull events.
- Restoration of wetland hydrology and introducing floodwaters back to the historic floodplain will provide a diversity of habitats for semi-aquatic flora and fauna that may have not been seen on the Site since before channel manipulation.
- Restoration of wetland hydrology will allow for increased nutrient uptake/transformation and sediment retention, which will retard delivery of pollutants to down-gradient waters.

7.1.4 Watershed Assessment

UT Millers Creek's watershed was assessed through several different variables, including aerial photographic review, topographical (USGS and LiDAR) review, discussions with municipal and County officials and on-the-ground verification of collected data. The watershed assessment was used to verify land use, drainage networks and existing/potential soil loss. A detailed analysis of watershed conditions was used in the determination of a sediment budget, which is discussed more in-depth in section 7.3 and Appendix D Sediment Analysis.

7.2 Design Parameters

7.2.1 Reference Streams

Stream reference reaches have been incorporated into the Natural Channel Design to obtain morphological design parameters for the UT (Table 7). ICA Engineering has restored numerous streams within the Coastal Plan Physiographic Provence, where the Site is located, and has previously identified and surveyed several suitable reference streams that have been approved through agency coordination and used in several mitigation plans.

UT to Wildcat Branch and the UT Brick Bound Swamp reference reach sites have been incorporated into the design parameters. Watersheds for both reference reaches and the Site were assessed. Both reference channels are located in similar settings (low slope, sand bed systems in within the Coastal Plain Physiographic Province) as the proposed restored reach of the UT. See Appendix C-6 for reference vicinity maps, watershed maps, soil survey maps and photographs.

UT to Wildcat Branch

The UT to Wildcat Branch watershed is dominated by mature forests (approximately 60 percent of the watershed). Deforestation is occurring within the watershed; however, most cleared areas have been replanted with pine. The remainder of the watershed is comprised primarily of agricultural land use practices (approximately 40 percent of the watershed).

The UT to Wildcat Branch is classified as an E5 type channel. The E descriptor is designated because the channel displays a width to depth ratio of 8.0 and entrenchment ratio of 15.9 which would indicate that the channel falls well within E type channel parameters. The channel's substrate is dominated by sand which is indicated by the 5 descriptor. The bankfull discharge on UT to Wildcat Branch at the point of the survey is estimated to be 8.5 cubic feet per second. The stream maintains a moderate width/depth ratio and a low bank height ratio which allows the stream to access its floodplain at flows greater than bankfull. Morphological conditions of the UT to Wildcat Branch are consistent with a stable, low slope sand bed system that will correlate well as a reference in the design of the UT.

The UT to Wildcat Branch is surrounded by a mature (50 years or older) vegetated floodplain. The vegetated floodplain extends a minimum of 250 feet from both the left and right banks throughout the study area. Dominant vegetation within the floodplain includes giant cane, red maple, sweet gum, red bay, sweet bay, yellow poplar, greenbrier (*Smilax rotundifolia*), American holly, and black gum.

UT Brick Bound Swamp

The UT Brick Bound Swamp watershed is dominated by mature forest (approximately 90 percent of the watershed). UT to Brick Bound Swamp is classified as a stable E5 stream type with moderate to high sinuosity. The E descriptor is designated because the channel displays a width to depth ratio of 12.2 and entrenchment ratio of 4.02 which would indicate that the channel falls well within E type channel parameters. The channel's substrate is dominated by sand which is indicated by the 5 descriptor. The bankfull discharge on UT Brick Bound Swamp at the point of the survey is estimated to be 3.0 cubic feet per second. The stream maintains a moderate width/depth ratio and a low bank height ratio which allows the stream to access its floodplain at flows greater than bankfull. Morphological conditions of the UT to Brick Bound Swamp are consistent with a stable, low slope sand bed system that will correlate well as a reference in the design of the UT.

UT to Brick Bound Swamp is surrounded by forested land representative of a Small Stream Swamp community. Dominant vegetation on the upslope adjacent to the floodplain includes loblolly pine (*Pinus taeda*), American beech (*Fagus grandifolia*) and dogwood (*Cornus florida*). Floodplain species were dominated by green ash, sweet gum, American holly, willow oak, wax myrtle (*Morella cerifera*), yellow poplar and ironwood (*Carpinus caroliniana*).

7.2.2 Stream Crossing

There are no planned stream crossings bisecting the proposed conservation easement.

7.2.3 Invasive Removal and Riparian Vegetation Planting

Invasive and nuisance species such as Chinese privet and sea myrtle will be cleared, grubbed and burned or removed from the site to ensure that re-colonization is deterred.

The proposed plantings will reintroduce native species to zones along the channel and its associated floodplain that currently has little vegetation or is dominated by loblolly pine. The vegetated buffer will extend through the required 50 foot stream buffer and through adjacent wetlands to the proposed conservation easement boundary. Vegetation to be planted on the channel's banks will be species that root quickly to help add stability to the already disturbed soils in and adjacent to the channel. Vegetation to be planted in the riparian wetlands will be characteristic of a Coastal Plain Small Stream Swamp community (Schafale & Weakley 1990). Plantings will focus on vegetation which will provide long-term foraging and habitat for wildlife.

Planting of a riparian buffer zone on-site will benefit both aquatic and terrestrial flora and fauna due to the lack of existing vegetation and the pine monoculture within the conservation eaement boundary. A mature, vegetated buffer zone will filter nutrients from sheet flow and overbank flows, provide cover and foraging areas for terrestrial animals, provide new habitat for a diversity of local vegetation that will voluntarily root inside of the undisturbed easement, provide woody debris to the restored stream channel to promote aquatic life propagation and cover, and provide a wildlife corridor for terrestrial animals, amphibians, and aquatic fauna.

7.2.4 Wetlands

Prior site disturbances have resulted in the loss and/or degradation of characteristic riparian wetland function. Hydrologic alteration of the Site has resulted in diminished nutrient uptake/transformation and sediment retention. The consequence of these impacts is the rapid delivery of pollutants to down-gradient waters. In addition, flood attenuation and wildlife habitat has also been compromised. The proposed project will seek to restore these functions by re-establishing the UT to its historic elevation, which will restore wetland hydrology to the floodplain and allow stream flows to access the floodplain during greater than bankfull events.

The existing pond will be drained and filled to natural elevations to restore wetland function to that area of the floodplain. Material to fill the pond will be borrowed from areas adjacent to the pond and Ditch 1 that were used to waste material when the pond was originally excavated (i.e. the pond will be filled with the same soil that was originally excavated from the pond). Appendix C-5 depicts a graphic that shows where excavated soil from the pond was wasted on-site. The majority of land that the excavated soil was wasted over contains historically drained hydric soils (confirmed by a licensed soil scientist). Removal of wasted material from above hydric soils in correlation with filling the pond, restoring the UT and the filling of Ditch 1 will allow for wetland restoration in areas where the excavated soil was spread. Once the pond is drained and graded it will be planted with native wetland vegetation characteristic of a Coastal Plain Small Stream Swamp forest.

Ditch 1 currently drains out of a riparian Headwater Wetland through a natural topographic crenulation and into the UT (Figure 5). Ditch 1 will be filled in order to restore a riparian Headwater Wetland (WFAT 2010) in this natural crenulation. Additionally, as mentioned in the previous paragraph, wasted soil from excavation of the pond was placed over historically drained hydric soils in areas adjacent to Ditch 1. The wasted soil will be removed to allow for the restoration of wetlands in those areas. The riparian Headwater Wetland will be planted with vegetation characteristic of a Coastal Plain Small Stream Swamp forest. The pine plantation that currently exists within the conservation easement boundary will be removed and replanted with native vegetation. Planting densities of bare root species at approximately 700 trees per acre are proposed for restored wetland areas.

Habitat function within the restored wetlands may be enhanced by the placement of large woody debris throughout the floodplain. Woody debris serves as a food source for a variety of insects, which in turn creates a foraging opportunity for small mammals, birds, reptiles and amphibians. The woody debris also provides much needed cover habitat for reptiles and amphibians to protect them from predation.

Approximately 8.77 acres of riparian wetlands will be restored at the Site.

7.2.5 Reference Wetlands

Based upon reconnaissance of several potential reference areas, suitable reference wetlands have been identified approximately 8 miles northeast of the Site adjacent to NCSR 1301 (Bowdens Road) on a tract owned by Duplin County. The reference site contains both of the targeted NCWAM community types: Bottomland Hardwood Forest and Headwater Forest. The reference wetlands occur in similar landscape positions and soil types as the Site and are associated with second-order and zero-order tributaries. In addition, hydrology and vegetation remain largely unaltered. Based upon site evaluations and long-term indicators of hydrology, it is apparent that the wetlands are intermittently to seasonally flooded with saturation to the surface for extended periods during the growing season. Dominant canopy species include swamp black gum, sweet-gum, tulip poplar and red maple. The understory consists of ironwood, red bay, and American holly. Shrubs include highbush blueberry (*Vaccinium corymbosum*) and fetterbush (*Lyonia lucida*). Dominant herbaceous species include cinnamon fern (*Osmunda cinnamomea*) and hobblebush (*Viburnum lantanoides*). Site maps (including vicinity map, soils map, and LiDAR) and representative photographs of the reference wetland site are provided in Appendix C-7.

7.3 Data Analysis

7.3.1 Stream

Existing morphological characteristics of the UT were collected during a Rosgen Level II survey. The Morphological Characteristics Table, shown in Table 7, includes a summary of existing and proposed dimension, profile, and pattern data as well as reference stream data for UT to Wildcat Branch and UT Brick Bound Swamp.

It should be noted that existing conditions information obtained from the channelized reach of UT display minimal bankfull features and natural meander geometry, thus several of the fields are not applicable. Anthropogenic disturbances to the stream channel (straightening and channelization) have caused the existing channel to have a planar bed form and homogenous channel dimension with very little variation.

The UT is designed as E5 type stream channel with width-to-depth ratios of 9.5. The channel type is consistent with the UT to Wildcat Branch and the UT to Brick Bound Swamp reference reach sites' channel type (E5). Valley slope and width have allowed for a channel sinuosity of 1.26. The channel will be restored as a PI restoration starting at upstream most extents of the Site where the bankfull (top of bank) elevation will mimic or closely mimic existing ground, which is the historic floodplain of the UT. The channel will meander through the Site with the bankfull elevation at or near the historic floodplain. The channel has been designed to cause minimal take of existing mature hardwood vegetation within the historic floodplain of the Site. This design philosophy will utilize existing trees for shade, soil stabilization and as inputs of woody debris and organic matter into the stream channel.

Sediment Transport Analysis

One of the primary goals of this project is to construct a stable channel that will transport its sediment and flow such that, over time, the stream system neither aggrades nor degrades. This stability is achieved when the sediment input to the design reach equals the sediment output. Sediment concentration and unit stream power have been utilized to model the channel's ability to transport potential sediment loads enter the Site. Below is a discussion of both sediment concentration and stream power and their relation to stability in the design. In addition, a sediment budget was created for the Site.

Sediment Concentration

The Engelund-Hansen function was used to analyze sediment transport capacity through the designed channels on-site. The basic principal of the Engelund-Hansen function is to determine if sediment input to the design stream equals the sediment output from the design stream. If sediment input equals or is adequately close to sediment output then the channel is considered a stable channel in equilibrium. Below is the Enguland-Hansen function:

$$g = 0.535\ D^{1/2}\ S^{3/2}\ V\ Q\ /\ d$$

where;
g = sediment discharge (lbs/s)
D = water depth (ft)
S = channel slope (ft/ft)
V = average velocity (ft/s)
Q = discharge (cubic ft/s)
d = median particle diameter of stream bed material (ft)

The Engelund-Hansen function is appropriate for a small drainage area as it was developed from research using flumes. In "Transport of sediment in large sand-bed rivers" in 2001, Molinas and Wu concluded that relationships derived from flume experiments with shallow flows cannot be universally applied to large rivers with deep flows (Molias 2001). The comparisons between computed and measured sediment concentrations indicate that the commonly used Engelund and Hansen, Ackers and White, and Yang equations which were developed using mainly flume experiments are not applicable for large rivers. The HEC-RAS Hydraulic Reference Manual states that the Engelund-Hansen function has been extensively tested and found to be fairly consistent with field data, and that it is applicable for sandy streams with sediment sizes between 0.19 and 0.93 mm, and the median particle diameter for the Site is 0.3 mm.

Below is the equation for sediment concentration:

$$SC = g/Q$$

where:
SC = sediment concentration (lbs/ft^3)
g = sediment discharge (lbs/s)
Q = discharge (ft^3/s)

The sediment output for the proposed design of the UT is 0.01 lbs/ft^3. The design sediment concentration is appropriate for the given watershed; therefore, the design channel is considered stable and in equilibrium.

Sediment Budget

A sediment budget has been created for the Site which estimates annual sediment loading at the upstream limit of the project as well as the downstream limit. A detailed analysis of the sediment budget and sediment transport analysis can be found in Appendix D. A summary of that report is below. It should be noted that a watershed assessment of existing conditions of contributing waters to the upstream limits of the Site revealed that the large majority of contributing channels are physically stable with little noticeable soil loss. This was expected due to the slope (low slope), size (relatively small) and abundance of existing vegetation along channel banks within the watershed. Therefore, the sediment budget does not rely upon soil loss from contributing channels as a primary supplier of sediment. The sediment budget was created by first using the Revised Universal Soil Loss Equation (RUSLE) to estimate the average annual erosion found within the watershed. GIS software was utilized in breaking up the watershed for UT Miller's Creek into discrete units with similar morphological qualities, such as land use, soil type, and slope. RUSLE estimated an annual soil loss due to erosion of approximately 71 tons per year for the watershed.

The "Certified Professional in Erosion and Sediment Control" manual from 2001 from the International Erosion Control Association states that RUSLE only estimates soil loss due to erosion and not sediment yield (CPESC 2001). Sediment yield is defined as the amount of eroded soil that is delivered to a point in the watershed that is remote form the origin of the detached particles. The Sediment Delivery Distributed (SEDD) model which was developed by Ferro and Porto in 2000 was then used to estimate the amount of the annual erosion from the watershed that is transferred to the project side as a sediment loading. The SEDD model incorporates the estimated annual soil loss due to erosion from RUSLE along with a Sediment Delivery Ratio which is based on surface roughness as well as travel time. This method helps to account for sediment particles which detach from their original position during erosion, but then settle in another location before reaching the point of interest in the watershed. The SEDD model estimated an annual sediment loading of approximately 10 tons per year.

Dune Formation

Dune/wave height was estimated using Equation 7 from "Sand-Dune Geometry of Large Rivers During Floods" by Julien and Klaassen which can be found below. This equation was developed by further analysis of the equations and results presented by van Rijn in "Sediment Transport, Part III: Bed Forms and Alluvial Roughness."

$$\Delta = \acute{\varepsilon} h \left(\frac{d50}{h}\right)^{0.3}$$

where:
Δ = Dune height (ft)
$\acute{\varepsilon}$ = Dune height coefficient
h = Average flow depth (ft)
d50 = mean bed particle diameter (ft)

Average flow depth for the bankfull event is 0.92 ft, and the mean bed particle diameter was observed on site to be .00098 ft (0.3mm). The acceptable range for the dimensionless dune height coefficient is 0.8 – 8. This value should be selected relative to the transport-stage parameter which is based on the relationship between flow depth and median particle size. Since UT Miller's Creek consists of much smaller average flow depths than the rivers that were investigated to develop this equation, the dune height coefficient was selected as 0.8. This produces an estimated Dune/Wave height of 0.09 feet at bankfull stage. However the beaver dam at top of project site will limit the material being transported through the system, thus the occurrence of dunes within the system will be negligible.

HEC-RAS Analysis
Given that the project involves modifications to a stream channel, it is important to analyze the effect of these changes on flood elevations. Floodwater elevations were analyzed using HEC-RAS. HEC-RAS is a software package designed to perform one-dimensional, steady flow, analysis of water surface profiles for a network of natural and constructed channels. HEC-RAS uses two equations, energy and/or momentum, depending upon the water surface profile. The model is based on the energy equation. The energy losses are evaluated by friction (Manning's equation) and contraction/expansion (coefficient multiplied by the change in velocity head). The momentum equation is used in situations where the water surface profile rapidly varies, such as hydraulic jumps and stream junctions.

Backwater analysis was performed for the existing and proposed conditions for the bankfull, 2-times bankfull, 2-year, 5-year, 10-year and 100-year recurrence events. In addition to steady flow data, geometric data is also required to run HEC-RAS. Geometric data consists of establishing the connectivity of the river system, which includes cross-section data, reach lengths, energy loss coefficients (friction losses, contraction, and expansion losses), and stream junction information.

Bankfull Discharge Analysis
HEC-RAS Version 3.1.3 was used to evaluate how the discharge of the restored channel flows within the proposed channel geometry. This evaluation verifies that the proposed plan, dimension, and profile would adequately convey the discharge at the bankfull stage; the point where water begins to overflow onto the floodplain. Bankfull discharge estimates were determined using on-site conditions and using the regional curve as discussed above.

No-Rise and Hydrologic Trespass

A HEC-RAS analysis has been prepared and completed on existing and proposed conditions of the project channel(s). The resulting data output was analyzed to determine if a rise, fall, or no-rise in water surface elevations occurs in specific storm events. Appendix C-1 includes detailed output data for HEC-RAS models run for existing and proposed conditions under bankfull, 2-times bankfull, 2-year, 5-year, 10-year and 100-year recurrence events. It is noted that there is no rise in water surface elevations on the upstream landowner during any of the modeled events. However, it should also be noted that there is a substantial reduction in water surface elevations on the upstream landowner during the bankfull, 2-times bankfull, 2-year, 5-year and 10-year events. Reduction of water surface elevations on the upstream landowner can primarily be attributed to removal of in-stream blockages within the Site (i.e. beaver dam and culverts).

Table 7. Morphological Characteristics

Morphological Characteristics of UT to Millers Creek and Reference Reaches								
Restoration Plan:	**UT to the Millers Creek Site**							
Reach:	**UT to Millers Creek**							
County:	**Duplin County, NC**							
Design by:	**KMM**							
Checked by:	**RVS/RKW**							
ITEM	Existing Conditions		Reference Reach		Reference Reach		Proposed Conditions	
LOCATION	UT to Millers		UT to WildCat Branch		UT Brick Bound Swamp Reference Reach		UT to the Millers Creek Site	
STREAM TYPE	G-F/5		E5		E5		E5	
DRAINAGE AREA, Ac - Sq Mi	250 Ac -	0.39 Sq Mi	282 Ac -	0.44 Sq Mi	70 Ac -	0.11 Sq Mi	250 Ac -	0.39 Sq Mi
BANKFULL DISCHARGE, cfs	8.4	cfs	8.5	cfs	3.0	cfs	8.4	cfs
BANKFULL X-SECTION AREA (A_{bkf}), ft^2	7.22	ft^2	8.5	ft^2	3.05	ft^2	8.3	ft^2
BANKFULL MEAN VELOCITY, fps	1.16	fps	1.0	fps	0.97	fps	0.8	fps
BANKFULL WIDTH (W_{bkf}), ft	9.7	ft	8.2	ft	6.1	ft	8.8	ft
BANKFULL MEAN DEPTH (d_{bkf}), ft	0.75	ft	1.03	ft	0.50	ft	0.92	ft
WIDTH/DEPTH RATIO (W_{bkf}/d_{bkf})	12.9		8.0		12.2		9.5	
BANKFULL MAX DEPTH (d_{max}), ft	1.08	ft	1.57	ft	1.02	ft	1.40	ft
BANK HEIGHT RATIO	4.83		1.09		1.00		1.00	
TYPICAL BANK HEIGHT	5.22	ft	1.70	ft	1.02	ft	1.40	ft
WIDTH Flood-Prone Area (W_{fpa}), ft	12.3	ft	130.0	ft	24.5	ft	125.00 ft	
ENTRENCHMENT RATIO (ER)	1.27		15.9		4.02		14.3	
MEANDER LENGTH (Lm), ft	Stream has been channelized and straightened through the vally, displaying no natural meander pattern.		22.5 -	29.0 ft	23 -	29 ft	14.0 -	56.0 ft
RATIO OF Lm TO W_{bkf}			2.7 -	3.5	3.7 -	4.8	1.6 -	6.4
RADIUS OF CURVATURE, ft			10.9 -	15.3 ft	5 -	9 ft	20.1 -	22.8 ft
RATIO OF Rc TO W_{bkf}			1.3 -	1.9	0.9 -	1.5	2.3 -	2.6
BELT WIDTH, ft			13.8 -	19.4 ft	13.83 -	19.42 ft	17.5 -	52.5 ft
MEANDER WIDTH RATIO			1.7 -	2.4	2.27 -	3.18 ft	2.0 -	6.0
SINUOSITY (K)	1.10		1.15		1.35		1.26	
VALLEY SLOPE, ft/ft	0.0012	ft/ft*	0.0027	ft/ft	0.0021	ft/ft	0.0012	ft/ft
AVERAGE SLOPE (S), ft/ft	0.0011	ft/ft**	0.0024	ft/ft**	0.0016	ft/ft	0.0005	ft/ft
RIFFLE SLOPE, ft/ft	Stream has been channelized, displaying a uniform profile.		0.0022	ft/ft	0.0012	ft/ft	0.0007	ft/ft
RATIO OF RIFFLE SLOPE TO AVERAGE SLOPE			0.9		0.8		1.4	
POOL SLOPE, ft/ft	Pool data not completed because discrete pools are not discernible due to aggraded channel conditions and backwater from blockages.		0.0013	ft/ft	0.0004	ft/ft	0.0000	ft/ft
RATIO OF POOL SLOPE TO AVERAGE SLOPE			0.6		0.3		0.0	
MAX POOL DEPTH, ft			1.75	ft	1.25	ft	1.75	ft
RATIO OF POOL DEPTH TO AVERAGE BANKFULL DEPTH			1.7		2.5		1.9	
POOL WIDTH, ft			8.83	ft	6.7	ft	10.50	ft
RATIO OF POOL WIDTH TO BANKFULL WIDTH			1.08		1.1		1.20	
POOL TO POOL SPACING, ft			14.0 -	16.6 ft	15.29 -	27.81 ft	20.1 -	84.9 ft
RATIO OF POOL TO POOL SPACING TO BANKFULL WIDTH			1.7 -	2.0	2.51 -	4.56	2.3 -	9.7

* Valley Slope, and Sinuosity were taken from topographical data obtained on the entire site for existing conditions (i.e. data was not taken along reach lengths).

** Average Slope was taken along a reach length for existing conditions.

7.3.2 Wetland Hydrology

Approximately 8.77 acres of riparian wetlands adjacent to the UT to Millers Creek stream channel will be restored via re-establishment of riparian wetland hydroperiods and the planting of target tree species. Hydrologic restoration will be principally accomplished by PI stream restoration and the backfilling of the existing canal and pond. The proposed channel restoration will raise the bed elevation, thus minimizing subsurface drainage and concurrently increasing the frequency of overbank flooding of the adjacent riparian wetlands. As a result, both groundwater and surface water inflows will be restored. The proposed limits of restoration are premised on comprehensive site evaluations and water budget modeling (DRAINMOD Version 6.0). The calibrated model runs were utilized to predict wetland hydroperiods over a 30-year period (Appendix C-2). Utilizing estimated, site-specific hydraulic conductivity rates and post-restoration conditions of the design channel, it is predicted that the proposed restoration corridor will achieve a minimum 12.5 percent hydroperiod for 16 of 30 years (for Gauge #5) to 23 of 30 years (for Gauges #2,#7, and #8). In addition, output from the HEC-RAS modeling projects bankfull flows to be at the top of bank. When compared with existing conditions, this suggests that there will be a substantial increase in overbank flooding within the restored riparian wetland areas. The increased frequency of overbank flooding coupled with the elevation of groundwater levels (as verified through calibrated modeling) will re-establish characteristic hydrology of the riparian wetlands. A detailed analysis and discussion of DRAINMOD, methods and results for the Site is included in Appendix C-2.

Grading associated with stream restoration work will include removal of spoil piles located adjacent to the existing UT. In addition, the existing pond excavated from hydric soils will be drained and backfilled with the adjacent overburden to reestablish the natural contours of this section of the floodplain. Detailed soil assessments within the vicinity of the pond have been performed to determine the extent and depth of the overburden. Based upon the LiDAR Digital Elevation Modeling (DEM) (Appendix C-2) of the site and the detailed mapping of the depth of fill (Appendix C-5), the original contours of the riparian area can be estimated. The 1984 USGS topographic quadrangle (Warsaw South) (Appendix C-2) was used as an additional reference for approximating pre-disturbance contours. Utilizing this information, target elevations for the restored riparian wetlands in the vicinity of the pond will range from 110 ft MSL near the up-gradient limits to 108 ft MSL within lower depressions of the floodplain. Vegetation that is currently growing on the spoil material will be mechanically removed prior to grading work. Upon completion of final grades, the area will be stabilized with a permanent seed mix characteristic of riparian wetlands and replanted with characteristic tree species (see below).

Additional riparian wetland restoration (headwater forest community type) will be achieved within the valley of Ditch 1. Ditch 1 originates near an existing non-riparian wetland on the eastern portion of the property and flows approximately 500 ft to the UT. Ditch 1 will be backfilled and natural valley contours will be re-established. Target elevations for the restored headwater forest area will range from 113 ft MSL at the up-gradient limits to 110 ft MSL within lower depressions. Similar to above, the area will be immediately stabilized with the riparian wetland seed mix and subsequently re-planted with characteristic tree species.

Vegetation restoration of the site is described further below.

7.3.3 Planting Plan

Grading associated with the backfill of the existing incised channel, removal of spoil piles adjacent to the existing channel, and construction of the single-thread channel will be confined to an identified construction corridor intended to minimize disturbance within the riparian area. Prior to construction, specimen trees will be identified and flagged to help preserve remnant canopy species characteristic of the target wetland community. In addition, all trees with DBH (diameter above breast height) 12 inches and greater were surveyed and accounted for during the design in an attempt to avoided and minimize their take during construction activities. The relatively young loblolly pine stand within the conservation easement boundary will be removed using mechanical equipment.

All cleared or disturbed areas within the conservation easement will be planted with species typical of a Coastal Plain Small Stream Swamp community with slight shifts in species composition corresponding with changes in topography and soil conditions of the Site. Based upon the proposed contours, landscape positions, and soil types, five (5) planting zones have been identified. Refer to Table 8 below identifying the proposed species composition for each planting zone. A plan view of the planting zones is depicted on Sheets PL-1 through PL-2. Trees will be planted on an approximately 8-ft spacing, corresponding to approximately 700 stems per acre in areas outside of the stream bank. The stream bank will be planted at a density of one stem per four feet of stream bank. It is expected that other characteristic species will recruit naturally into these areas subsequent to completion of construction.

Table 8. Planting Plan

Streamside Assemblage	**5,538 Feet of Stream Bank**	**Streamside Assemblage (4' spacing)**	
Common Name	**Scientific Name**	**% Composition**	**# Planted**
Black Willow	*Salix nigra*	25	347
Button Bush	*Cephalanthus occidentalis*	25	347
Silky Dogwood	*Cornus amomum*	25	347
River Birch	*Betula nigra*	25	347
		TOTAL	1,388
Zone 1	**3.4 AC**	**Riparian Restoration (8' centers)**	
Common Name	**Scientific Name**	**% Composition**	**# Planted**
Bald Cypress	*Taxodium distichum*	30	695
River Birch	*Betula nigra*	20	463
Swamp Chestnut Oak	*Quercus michauxii*	15	348
Tulip Poplar	*Liriodendron tulipifera*	15	348

Willow Oak	*Quercus phellos*	10	232
Sweet Bay	*Magnolia virginiana*	10	232
		TOTAL	2,318
Zone 2	**0.5 AC**	**Riparian Restoration (8' centers)**	
Common Name	**Scientific Name**	**% Composition**	**# Planted**
Bald Cypress	*Taxodium distichum*	30	103
River Birch	*Betula nigra*	25	86
Wax Myrtle	*Morella cerifera*	10	35
Willow Oak	*Quercus phellos*	15	52
American Sycamore	*Platanus occidentalis*	20	69
		TOTAL	345
Zone 3	**0.4 AC**	**Riparian Restoration (8' centers)**	
Common Name	**Scientific Name**	**% Composition**	**# Planted**
Bald Cypress	*Taxodium distichum*	35	96
River Birch	*Betula nigra*	30	82
Swamp Tupelo	*Nyssa biflora*	25	69
Smooth Alder	*Alnus serrulata*	10	28
		TOTAL	275
Zone 4	**6.3 AC**	**Riparian Restoration (8' centers)**	
Common Name	**Scientific Name**	**% Composition**	**# Planted**
Bald Cypress	*Taxodium distichum*	25	1,072
Green Ash	*Fraxinus pennsylvannica*	25	1,072
Swamp Chestnut Oak	*Quercus michauxii*	15	644
Willow Oak	*Quercus phellos*	15	644
Tulip Poplar	*Liriodendron tulipifera*	20	858
		TOTAL	4,290
Zone 5	**0.2 AC**	**Riparian Restoration (8' centers)**	
Common Name	**Scientific Name**	**% Composition**	**# Planted**
Pond Cypress	*Taxodium ascendens*	40	55
Water Tupelo	*Fraxinus pennsylvannica*	30	41
Bald Cypress	*Taxodium distichum*	20	28
Smooth Alder	*Alnus serrulata*	10	14
		TOTAL	138

7.3.4 Maintenance Plan

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

Table 9. Maintenance Plan

Component/Feature	Maintenance through project close-out
Stream	Routine channel maintenance and repair activities may include chinking of in-stream structures to prevent piping, securing of loose coir matting, and supplemental installations of live stakes and other target vegetation along the channel. Areas where stormwater and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting.
Wetland	Routine wetland maintenance and repair activities may include securing of loose coir matting and supplemental installations of live stakes and other target vegetation within the wetland. Areas where stormwater and floodplain flows intercept the wetland may also require maintenance to prevent scour.
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.

7.3.5 Performance Standards

The performance standards shall be consistent with the requirements described in Federal rule for compensatory mitigation project sites as described in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.5 paragraphs (a) and (b).

Monitoring of restoration efforts will be performed until success criteria are fulfilled. Monitoring is proposed for the stream channel/hydraulics, wetland hydrology, and vegetation. In general, the restoration success criteria, and required remediation actions, are based on the *Stream Mitigation Guidelines* (USACE et al. 2003) and the *Ecosystem Enhancement Program Monitoring Requirements and Performance Standards for stream and/or Wetland Mitigation* (NCEEP 2011).

7.4 Streams

The restored stream reaches are proposed to be monitored for geometric activity. Annual fall/winter monitoring will include development of channel cross-sections on riffles and pools and a water surface profile of the channel in addition to visual observation of channel stability.

7.4.1 Stream Dimension

General maintenance of a stable cross-section and hydrologic access to the floodplain features over the course of the monitoring period will generally represent success in dimensional stability. Some changes in dimension (such as lowering of bankfull width-to-depth ratio) should be expected. Riffle sections should generally maintain a Bank Height ratio approaching 1.0 – 1.2, with some variation in this ratio naturally occurring, and display an entrenchment ratio of no less than 2.2. Pool sections naturally adjust based on recent flows and time between flows, especially in sand bed systems; therefore more leeway on pool section geometry is expected.

7.4.2 Stream Pattern and Profile

Pattern features should show little adjustment over the standard 7 year monitoring period.

The profile should not demonstrate significant trends towards degradation or aggradation over a significant portion of a reach. Additionally, bed form variables, most commonly in pools may vary in sand bed systems.

7.4.3 Substrate

Sampling of the substrate distribution will not be completed because the substrate is dominated by sand and silts.

7.4.4 Sediment Transport

There should be an absence of any significant trend in the aggradational or depositional potential of the channel.

7.4.5 Hydraulics

A minimum of two bankfull events must be documented within the 7 year monitoring period. The two bankfull events shall occur within separate years.

7.5 Wetlands

The hydrologic criteria for restored wetlands at the Site are identified below by community type:

a. **For the riparian bottomland hardwood forest community,** the hydrologic criterion will be the establishment of a static water table at, or within, 12 inches of the soil surface for a minimum of **12.5 percent** of the growing season, equivalent to 38 days based upon hydrologic monitoring undertaken from Feb 1st through Nov 30th of each monitoring year (see Appendix C-2 for more detailed information on growing season, etc.).

b. For the **headwater riparian community (zero-order geomorphic position),** the hydrologic criterion will be the establishment of a static water table at, or within, 12 inches of the soil surface for **10 percent** of the growing season, equivalent to 30 days based upon hydrologic monitoring undertaken from Feb 1st through Nov 30th of each monitoring year (see Appendix C-2 for more detailed information on growing season, etc.).

In addition, hydrologic data from reference wetlands of similar landscape position and soil types will be collected and evaluated in comparison to hydrologic data of the restored wetlands. Hydroperiods of the restored wetlands should track (both in duration and amplitude) the hydroperiods of the reference wetlands. Given the natural variability of hydrologic conditions between wetland sites and even within a single wetland area, there will be no specific quantitative criteria attached to this comparison. However, data will be qualitatively assessed to assist in the evaluation of hydrologic conditions of the restoration site (particularly during periods of abnormally low rainfall when the minimum hydrologic criteria identified above are not met).

7.6 Vegetation

Vegetation success at the Site will be measured by survivability over a 7-year monitoring period. Vegetation survival must be at a minimum 320 stems per acre after Year 3, 260 stems per acre after Year 5, and 210 stems per acre after Year 7. Planted vegetation must average 10 feet in height in each plot at year 7.

Should an abundance of any non-planted exotic, invasive or nuisance species including pine trees be identified during the visual assessments, it will be noted in the Annual Monitoring Report. If the exotic, invasive or nuisance species appear to be hindering the survival of planted species, a Plan of Corrective Action will be determined in concurrence with NCEEP and the USACE.

8.0MONITORING REQUIREMENTS

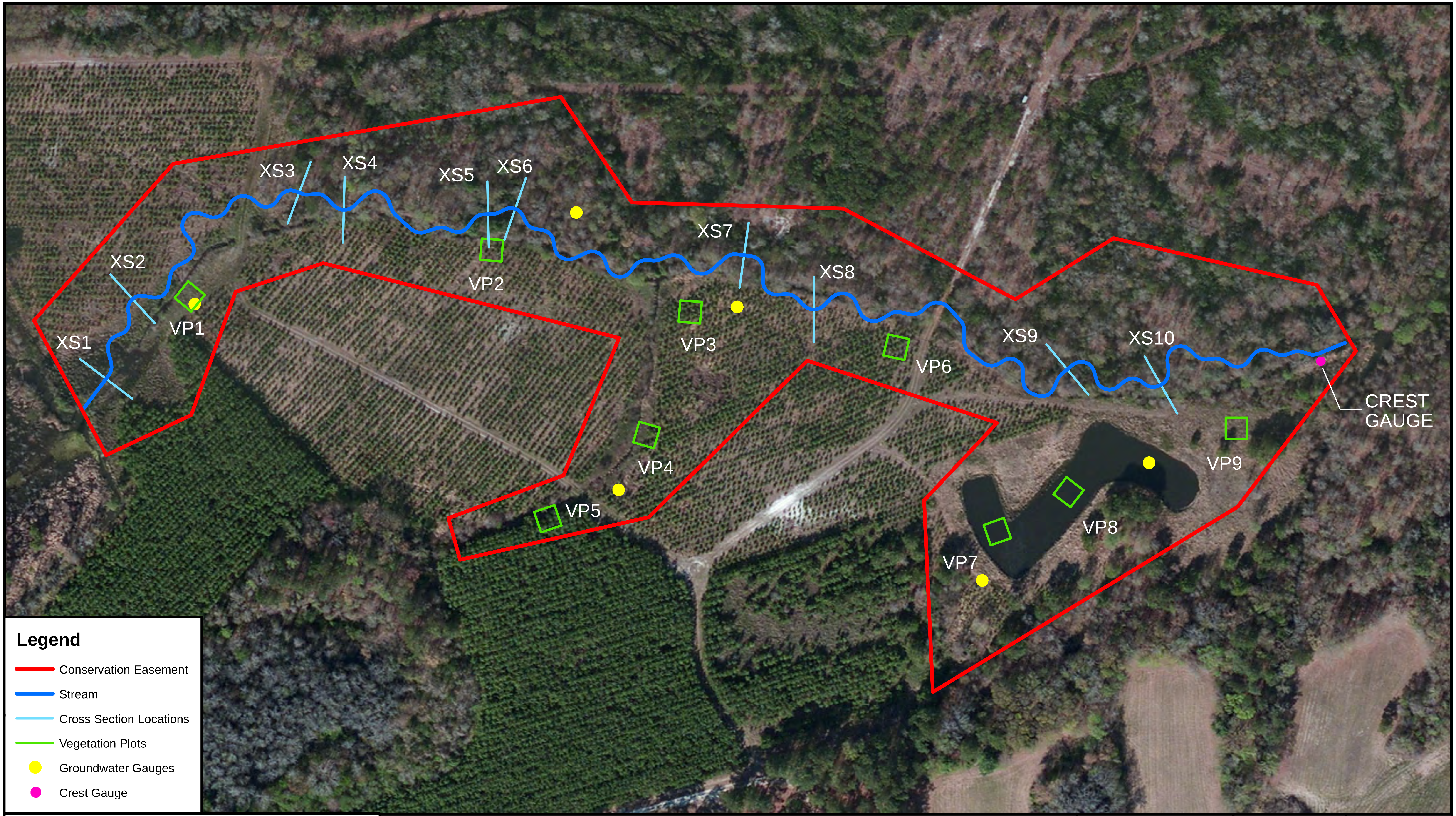
Annual monitoring data will be reported using the NCEEP monitoring template. The monitoring report shall provide a project data chronology that will facilitate an understanding of project status and trends, population of NCEEP databases for analysis, research purposes, and assist in decision making regarding project close-out. See Figure 9 for Monitoring Overview.

Table 10. Monitoring Requirements

Required	Parameter	Quantity*	Frequency	Notes
Yes	Pattern	Surveyed if monitoring reveals substantial adjustments in channel dimension and profile	Established during Baseline/As Built, Year 5 (as needed)	
Yes	Dimension	5 riffle cross-sections 5 pool cross-sections	Established during Baseline/As Built, Years 1, 2, 3, 5, 7	Channel width (riffle = 8.8') is very low; cross-sections placed every 30 bankfull widths
Yes	Profile	Site is less than 3,000 feet, thus the entire length is to be surveyed.	Established during Baseline/As Built	
No	Substrate	Visual	annual	Project is a sand bed system requiring no formal monitoring parameters.
Yes	Surface Water Hydrology	1 Crest Gauge within restoration reach of UT	annual	The device will be inspected on a quarterly/semi-annual basis to document the occurrence of bankfull events on the project
Yes	Groundwater Hydrology	6 (RDS, Inc. gauges)	annual	Data will be downloaded on average every two months during the growing season
Yes	Vegetation	9 vegetation plots	Years 1, 2, 3, 5, 7	Vegetation will be monitored using the Carolina Vegetation Survey (CVS) protocols
Yes	Exotic and nuisance vegetation		annual	Locations of exotic and nuisance vegetation and the occurrence of beaver dams and approximate inundation limits will be mapped

Required	Parameter	Quantity*	Frequency	Notes
Yes	Project boundary		Semi-annual	Locations vegetation damage, boundary encroachments, etc. will be mapped
Yes	Stream and wetland visual monitoring/ photo documentation		Annual	Throughout project Site.

*2003 USACE Wilmington District Stream Mitigation Guidelines, 2011 *NCEEP Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation* and WRAP Technical Note 00-02 (Sprecher 2000) are used for determining monitoring guidance.



ICA Engineering

Monitoring Overview

UT Millers Creek, Duplin County, North Carolina

0 85 170 340 510 680 Feet

Ecosystem Enhancement PROGRAM

W N S E

Figure 9

8.1 Monitoring Reports

Monitoring reports will be completed for seven years and will be provided to the NCEEP for review by December 31 of each year. Monitoring standards are determined using the 2003 USACE Wilmington District Stream Mitigation Guidelines, 2011 *NCEEP Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation* and WRAP Technical Note 00-02 (Sprecher 2000).

8.2 Stream Monitoring Standards

<u>As-builts and Baseline Conditions</u>
As-built surveys shall be conducted upon completion of channel construction to document baseline conditions. As-built surveys will include all measurements typically documented during subsequent channel geomorphological surveys. A longitudinal profile of the thalweg, water surface, bankfull, and top of bank, will be collected during the as-built survey of the constructed channel to compare with future geomorphological data, if necessary. Longitudinal profiles will not be required during routine channel stability monitoring (years 1 through 7) unless the monitoring efforts demonstrate channel bank or bed instability, in which case additional longitudinal profiles may be required along channel reaches of concern to track changes in the channel and demonstrate stability.

<u>Channel Cross-sections</u>
Per the 2003 Stream Mitigation Guidelines very narrow streams generally require two cross-sections per 1,000 feet. The Site's proposed stream channel width in the ripple is 8.8 feet which would be considered very narrow. It is assumed that six cross-sections are insufficient for this site, therefore ICA Engineering proposes that one cross-section is placed at approximately every 30 bankfull widths through the Site, which would total 10 permanent cross-sections (approximately 5 pools and 5 ripples). Channel cross-sections shall be monitored for 7 years, with monitoring events occurring in years 1, 2, 3, 5, and 7. If supplemental monitoring is conducted, results may be considered towards meeting performance standards.

Cross-sectional measurements will at a minimum include Bank Height Ratio and Entrenchment Ratio.

Bank pin arrays will be installed on the outside bend of each meander in which a cross-section is located. Pins will be a minimum of 3 feet in length at intervals of 2 foot in depth on the facing of the channel bank. Pins will be installed at the monumented cross-section in the upstream third of the meander bend and in the downstream third of the meander bend. Pins will be installed flush with the face of the stream bank. The length of exposed pin from the bank will be measured each monitoring year and reported. The pin will be will be hammered flush with the bank following measurement of the pin exposure length. Lateral exposure will be included in each monitoring report.

Profile

Per NCEEP's 2010 Baseline Monitoring Document Format, Data Requirements, and Content Guidance (Version 2.0) the Site's entire profile should be survived. The guidance states, "For restoration or enhancement I components, 3000 linear feet or less, the entire length is to be surveyed." The Site's proposed stream channel length is 2,100 existing linear feet of the UT (2,679 restored feet).

Visual Monitoring

Visual monitoring of all sections of the project shall be conducted in each of the required seven years of monitoring to identify areas of concern in both the vegetated buffer and restored stream channel. Visual monitoring of all sections of the stream project will be conducted twice per monitoring year. Generally, one visual monitoring event will be completed in conjunction with other stream channel stability monitoring (e.g., cross-sections, bank pins, etc.). At least 5 months shall separate each visual monitoring event.

Within the stream channel, visual monitoring shall be conducted along the entire length of the channel to identify and document excessive lateral movement of the channel, bank instability, instability/failure of in-stream structures, structure piping, headcuts, beaver activity, excessive live stake mortality, invasive species, aggradation/excessive sediment deposition, or other potential problems with the channel. Visual monitoring of streams shall be conducted only by individuals that have been properly trained to assess the stability of streams and condition of in-stream structures.

Within the vegetated buffer, visual monitoring will be conducted by walking throughout the entire Site to identify and document areas of low stem density or poor plant vigor, invasive species, beaver activity, herbivory, encroachments, indicators of livestock access, or other areas of concern.

The results of the visual assessment will be included in a plan view of the channel identifying the location of each feature of concern, along with a written assessment and photographic documentation of the feature. Once a feature of concern has been identified, that same feature shall be reassessed on all subsequent visual assessments. Photographs should be taken from the same location year-to-year to document progression of the problem. The monitoring reports shall identify all features of concern and recommended courses of action, which may include continued monitoring, repair or other remedial action.

8.3 Wetland Monitoring Standards

Groundwater Gauge Data Collection

Shallow groundwater hydrology will be monitored via six (6) automated gauges (RDS, Inc. WM-20s) located within the riparian wetland restoration areas. Gauges will be installed in accordance with installation methods outlined in the Wetlands Regulatory Assistance Program (WRAP) Technical Note 00-02 (Sprecher, 2000). Water levels will be recorded once daily.

Data will be downloaded from the gauges every two months. Data from well downloads will be compiled and graphically displayed to demonstrate hydroperiods of monitored areas. Gauge data will be collected and reported to NCEEP in each of the 7 years of monitoring. The data will be analyzed in the context of the antecedent rainfall conditions which will also be displayed on well hydrographs.

Visual Assessment

Visual monitoring of all wetland restoration areas will be conducted 2 times per year and a minimum of 5 months apart, in each of the required 7 years of monitoring. Visual monitoring will include walking throughout the entire Site to identify and document areas of low stem density or poor plant vigor, invasive species, beaver activity, herbivory, encroachments, indicators of livestock access, or other areas of concern.

The results of the visual assessment will be included in a plan view of the project identifying the location of each area of concern, along with a written assessment and photographic documentation of the area. Once an area of concern has been identified, that same feature shall be reassessed on all subsequent visual assessments. Photographs will be taken from the same location year-to-year to document progression of the problem. The monitoring reports shall identify all areas of concern and recommended courses of action, which may include continued monitoring, repair or other remedial action.

8.4 Vegetation Monitoring Standards

Permanent Vegetation Plots

Nine (9) permanent plots (totaling greater than 2 percent of planted area within the Site) will be established within the proposed restoration corridor. Vegetation will be monitored using the Carolina Vegetation Survey (CVS) protocols.

Vegetation plots will be monitored for 7 years, with monitoring events occurring in years 1, 2, 3, 5, and 7. If supplemental monitoring occurs, results may be considered towards meeting performance standards. Year 1 monitoring will occur at least 180 days, occurring between March 1 and November 30, following the completion of initial vegetation planting.

Individual plot data for planted species must be provided. Plot data shall not be averaged over the entire site to obtain a single figure for stem density. Enumeration of the density of planted species: density = number of living, planted stems per acre. Stems are defined as individual plants, where plants with multiple shoots are treated as a single stem. Live stakes planted on the stream banks will not count toward meeting the stem density requirements.

Volunteer plants growing within plots may be considered on a case-by-case basis in determining whether a project has met the overall goal of re-establishing the vegetated buffer; however, volunteer plants will be counted separately from planted vegetation in the monitoring reports.

Monitoring events will also be used as a time to evaluate the presence of invasive species which will be noted in the monitoring report. Should an abundance of any non-planted exotic, invasive or nuisance species including pine trees be noted during the visual assessments, it will be noted in the Monitoring Report. If the exotic, invasive or nuisance species appear to be hindering the survival of planted species, a Plan of Corrective Action will be determined in concurrence with NCEEP and the USACE.

9.0LONG-TERM MANAGEMENT PLAN

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

10.0 ADAPTIVE MANAGEMENT PLAN

Upon completion of site construction NCEEP 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, NCEEP 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 Plan of Corrective Action is prepared and finalized NCEEP will:

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

11.0 FINANCIAL ASSURANCES

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

12.0 OTHER INFORMATION

12.1 Definitions

Morphological description – the stream type; stream type is determined by quantifying channel entrenchment, dimension, pattern, profile, and boundary materials; as described in Rosgen, D. (1996), *Applied River Morphology, 2nd edition*

Native vegetation community – a distinct and reoccurring assemblage of populations of plants, animals, bacteria and fungi naturally associated with each other and their population; as described in Schafale, M.P. and Weakley, A. S. (1990), *Classification of the Natural Communities of North Carolina, Third Approximation*

Project Area - includes all protected lands associated with the mitigation project

12.2 References

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United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Southeast Coastal States Wetland Team. 1998. NRCS Drainage Guidelines. North Carolina Scope & Effect Guide.

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USGS, 1984. Warsaw South Quadrangle, North Carolina, 7.5 Minute Series (Topographic). Washington, D. C.

Wetland Functional Assessment Team (WFAT). 2010. N.C. Wetland Assessment Method (NCWAM) User Manual, Version 4.1 (October 2010). 127 pp.

Appendix A. Site Protection Instrument

STATE OF NORTH CAROLINA
COUNTY OF DUPLIN
This instrument has been filed for Registration on the Date, Time and in the Book and Page shown on the First Page hereof, and is being returned for your safekeeping.
Davis H. Brinson, Register of Deeds

(12) # 26.00

This instrument was prepared by Smith & Blizzard, P.A.

STATE OF NORTH CAROLINA

AFFIDAVIT OF CORRECTION OF MINOR ERROR

COUNTY OF DUPLIN

The undersigned Affiant, being first duly sworn, pursuant to North Carolina General Statutes 47-36.1, hereby swears that the Deed, recorded on September 20, 2013, in Book 27, at Pages 160-161, Duplin County Registry, by and between William Jeffrey Hatcher and Wife, Susan King Hatcher hereinafter referred to as the "Grantors"; and the State of North Carolina, hereinafter referred to as the Grantees; contained the following typographical or other minor error:

The date of map on page 2 was omitted
Plat Seal Date was on September 16th, 2013

Affiant makes her Affidavit for the purpose of correcting the above-described Deed. Affiant is knowledgeable of the agreement and intention of the parties in this regard. Affiant is the closing attorney of the transaction involving the instrument being corrected.

A copy of the original instrument is attached.

Melissa B. Stevens (SEAL)
Melissa B. Stevens
Attorney At Law/Settlement Agent

JILL M. SMITH
NOTARY PUBLIC
DUPLIN COUNTY, NC

NORTH CAROLINA
DUPLIN COUNTY

Witness my hand and official stamp or seal, this the 21 day of October, 2013.

Jill M. Smith
Notary Public

My Commission Expires: 7-31-2015

B1761 P0882 10-21-2013 16:47:36.002
Duplin County, NC Register of Deeds Davis H. Brinson PROP page 2 of 12

B1760 P0195 09-27-2013 14:08:06.000
Duplin County, NC Register of Deeds Davis H. Brinson PROP page 1 of 11

This instrument was prepared by Smith & Blizzard, P.A.

(11) $26.00

STATE OF NORTH CAROLINA

AFFIDAVIT OF CORRECTION OF MINOR ERROR

COUNTY OF DUPLIN

The undersigned Affiant, being first duly sworn, pursuant to North Carolina General Statutes 47-36.1, hereby swears that the Deed, recorded on September 20, 2013, in Book 27, at Pages 160-161, Duplin County Registry, by and between William Jeffrey Hatcher and Wife, Susan King Hatcher hereinafter referred to as the "Grantors"; and the State of North Carolina, hereinafter referred to as the Grantees; contained the following typographical or other minor error:

The date of the map on page 2 was omitted.

Affiant makes her Affidavit for the purpose of correcting the above-described Deed. Affiant is knowledgeable of the agreement and intention of the parties in this regard. Affiant is the closing attorney of the transaction involving the instrument being corrected.

A copy of the original instrument is attached.

Melissa B. Stevens (SEAL)
Melissa B. Stevens
Attorney At Law/Settlement Agent

State of North Carolina
County of Duplin
Signed and sworn to before me this 26 day of September, 2013.

Jill M. Smith
Notary Name

Jill M. Smith
Notary Public

JILL M. SMITH
NOTARY PUBLIC
DUPLIN COUNTY, NC

My commission expires: 7-31-2015

B1759 P0740 09-20-2013 10:13:21.001
Davis H. Brinson PROP
Duplin County, NC Register of Deeds page 1 of 10

STATE OF NORTH CAROLINA
COUNTY OF DUPLIN
This Instrument has been filed for Registration on the Date, Time and in the Book and Page shown on the First Page hereof, and is being returned for your safekeeping.
Davis H. Brinson, Register of Deeds
DUPLIN COUNTY NORTH CAROLINA

Davis H. Brinson Register of Deeds
09-20-2013 10:13:21.001 Duplin County, NC
NC REVENUE STAMP: $146.00 (#178246)

$146.00 stamps
(10) $26.00

B1760 P0196 09-27-2013 14:09:06.000
Davis H. Brinson PROP
Duplin County, NC Register of Deeds page 2 of 11

B1761 P0883 10-21-2013 16:47:36.002
Davis H. Brinson PROP
Duplin County, NC Register of Deeds page 3 of 12

STATE OF NORTH CAROLINA

CONSERVATION EASEMENT PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT

DUPLIN COUNTY
SPO File Number: 31-Z
Prepared by: Office of the Attorney General
Property Control Section
Return to: NC Department of Administration
State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

THIS CONSERVATION EASEMENT DEED, made this 20th day of September, 2013, by *William Jeffrey Hatcher and Wife, Susan King Hatcher,* ("**Grantor**"), whose mailing address is *582 South NC HWY 111, Chinquapin, North Carolina,* to the State of North Carolina, ("**Grantee**"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations of Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. § 143-214.8 et seq., the State of North Carolina has established the Ecosystem Enhancement Program (formerly known as the Wetlands Restoration Program) within the Department of Environment and Natural Resources for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between *ICA Engineering, Inc, 5121 Kingdom Way, Suite 100, Raleigh, NC 27607* and the North Carolina Department of Environment and Natural Resources, to provide stream, wetland and/or buffer mitigation pursuant to the North Carolina Department of Environment and Natural Resources Purchase and Services Contract Number *5000*.

WHEREAS, The State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (MOA) duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Ecosystem Enhancement Program is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Ecosystem Enhancement Program in the Department of Environment and Natural Resources, which has been delegated the authority authorized by the Governor and Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple certain real property situated, lying, and being in _Magnolia_ Township, _Duplin_ County, North Carolina (the "**Property**"), and being more particularly described as that certain parcel of land containing approximately _58.94_ acres and being conveyed to the Grantor by deed as recorded in **Deed Book _1501_ at Page _465_** of the _Duplin_ County Registry, North Carolina; and

WHEREAS, Grantor is willing to grant a Conservation Easement over the herein described areas of the Property, thereby restricting and limiting the use of the included areas of the Property to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept such Conservation Easement. This Conservation Easement shall be for the protection and benefit of _UT Millers Creek._

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement along with a general Right of Access.

The Easement Area consists of the following:

Tract Number 247100987405 containing a total of 15.944 **acres** as shown on the plats of survey entitled "Final Plat, Conservation Easement for North Carolina Ecosystem Enhancement Program, Project Name: _UT Millers Creek_, SPO File No. 31-Z, EEP Site No. 95719, Property of _William Jeffrey Hatcher and Wife, Susan King Hatcher_," dated September 16, 2013 by _Herbert H. Proctor, Jr._, PLS Number L-3621 and recorded in the _Duplin_ County, North Carolina Register of Deeds at **Plat Book** 27 **Pages** 160 - 161.

See attached "**Exhibit A**", Legal Description of area of the Property hereinafter referred to as the "Easement Area"

The purposes of this Conservation Easement are to maintain, restore, enhance, construct, create and preserve wetland and/or riparian resources in the Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with, and be a continuing restriction upon the use of, the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, agents, lessees, and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITES

The Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. **Recreational Uses.** Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Easement Area for the purposes thereof.

B. **Motorized Vehicle Use.** Motorized vehicle use in the Easement Area is prohibited.

C. **Educational Uses.** The Grantor reserves the right to engage in and permit others to engage in educational uses in the Easement Area not inconsistent with this Conservation Easement, and the right of access to the Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the property shall not alter vegetation, hydrology or topography of the site.

D. **Vegetative Cutting.** Except as related to the removal of non-native plants, diseased or damaged trees, or vegetation that destabilizes or renders unsafe the Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Easement Area is prohibited.

E. **Industrial, Residential and Commercial Uses.** All industrial, residential and commercial uses are prohibited in the Easement Area.

F. **Agricultural Use.** All agricultural uses are prohibited within the Easement Area including any use for cropland, waste lagoons, or pastureland.

G. **New Construction.** There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Easement Area.

H. **Roads and Trails.** There shall be no construction of roads, trails, walkways, or paving in the Easement Area.

I. **Signs.** No signs shall be permitted in the Easement Area except interpretive signs describing restoration activities and the conservation values of the Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, signs giving directions, or signs prescribing rules and regulations for the use of the Easement Area.

J. **Dumping or Storing.** Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or any other material in the Easement Area is prohibited.

K. **Grading, Mineral Use, Excavation, Dredging.** There shall be no grading, filling, excavation, dredging, mining, drilling; removal of topsoil, sand, gravel, rock, peat, minerals, or other materials.

L. **Water Quality and Drainage Patterns.** There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water in the Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored, enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticide or biocides in the Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Easement Area may temporarily be used for good cause shown as needed for the survival of livestock and agricultural production on the Property.

M. **Subdivision and Conveyance.** Grantor voluntarily agrees that no subdivision, partitioning, or dividing of the underlying Property owned by the Grantor in fee simple ("fee") that is subject to this Easement is allowed. Unless agreed to by the Grantee in writing, any future conveyance of the underlying fee and the rights conveyed herein shall be as a single block of property. Any future transfer of the fee simple shall be subject to this Conservation Easement. Any transfer of the fee is subject to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Easement Area for the purposes set forth herein.

N. **Development Rights.** All development rights are permanently removed from the Easement Area and are non-transferrable.

O. **Disturbance of Natural Features.** Any change, disturbance, alteration or impairment of the natural features of the Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is not inconsistent with the purposes of this Conservation Easement, and the Grantor obtains advance written approval from the N.C. Ecosystem Enhancement Program, whose mailing address is 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. **Right of Access, Construction, and Inspection.** The Grantee, its employees and agents, successors and assigns, receive a perpetual Right of Access to the Easement Area over the Property at reasonable times to undertake any activities to restore, construct, manage, maintain, enhance, and monitor the stream, wetland and any other riparian resources in the Easement Area, in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. **Restoration Activities.** These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. **Signs.** The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities within the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. **Fences.** The Grantee, its employees and agents, successors or assigns, shall be permitted to place fencing on the Property to restrict livestock access. Although the Grantee is not responsible for fence maintenance, the Grantee reserves the right to repair the fence, at its sole discretion.

IV. ENFORCEMENT AND REMEDIES

A. **Enforcement.** To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Easement Area that is inconsistent with the purposes of this Easement and to require the restoration of such areas or features in the Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor-in writing of such breach and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. **Inspection.** The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the terms, conditions and restrictions of this Conservation Easement.

C. **Acts Beyond Grantor's Control.** Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury or change in the Easement Area caused by third parties, resulting from causes beyond the Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life, or damage to the Property resulting from such causes.

D. **Costs of Enforcement.** Beyond regular and typical monitoring expenses, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor, including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. **No Waiver.** Enforcement of this Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown herein or to other addresses as either party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in writing signed by all parties hereto, or their successors or assigns, if such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the U.S. Army Corps of Engineers in writing sixty (60) days prior to the initiation of any transfer of all or any part of the Property. Such notification shall be addressed to: Justin McCorkle, General Counsel, US Army Corps of Engineers, 69 Darlington Avenue, Wilmington, NC 28403

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Easement Area, and the right of quiet enjoyment of the Easement Area

TO HAVE AND TO HOLD, the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes.

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same is free from encumbrances and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever.

IN TESTIMONY WHEREOF, the Grantor has hereunto set his hand and seal, the day and year first above written.

William Jeffy Hatcher (SEAL)

Susan King Hatcher (SEAL)

NORTH CAROLINA
COUNTY OF Duplin

I, Melissa B. Stevens, a Notary Public in and for the County and State aforesaid, do hereby certify that William Jeffrey Hatcher & Susan King Hatcher, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the 20 day of Sept., 2013.

Melissa B. Stevens
Notary Public

MELISSA B. STEVENS
NOTARY PUBLIC
DUPLIN COUNTY, NC

My commission expires:
12/14/13

Exhibit A
Legal Description

LEGAL DESCRIPTION

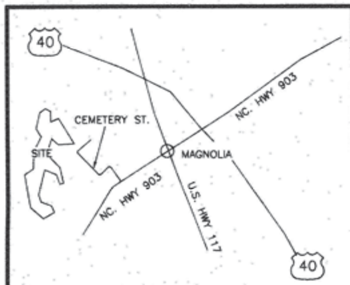
Lying and being situated in Duplin County, North Carolina and being more particularly described as follows:

Being that certain parcel of land in Magnolia Township, Duplin county, North Carolina and lying north of Hwy 903 and west of the Town of Magnolia and being more particularly described as follows:

Beginning at a re-bar (#1) set, said re-bar being South 01° 10' 36" East from an existing iron blade, said blade being the northeast corner of the property now or formerly standing in the name of William and Susan Hatcher as recorded at Deed Book 1501, Page 465, and having N.C. Grid Coordinates (NAD 83) of N=419,883.0385 feet and E= 2,279856.0091 feet;

thence South 31° 15' 24" East 545.65 feet to a re-bar (#2) set: thence South 87° 24' 41" West 293.46 feet to a re-bar (#3) set; thence North 46° 39' 58" West 162.96 feet to a re=bar (#4) set; thence South 18° 07' 11" West 305.45 feet to a re-bar (#5) set; thence South 44° 36' 56" East 340.78 feet to a re=bar (#6) set; thence South 12° 38' 39" East 296.02 feet to a re-bar (#7) set; thence South 74° 33' 22" West 65.99 feet to a re=bar (#8) set; thence North 20° 15' 26" West 187.75 feet to a re-bar (#9) set; thence North 68° 04' 03" West 226.61 feet to a re=bar (#10) set; thence South 14° 11' 04" West 466.77 feet to a re-bar (#11) set; thence South 18° 06' 08" East 140.72 feet to a re=bar (#12) set; thence South 70° 08' 05" West 200.34 feet to a re-bar (#13) set; thence South 25° 12' 17" East 143.39 feet to a re=bar (#14) set; thence South 61° 46' 56" West 233.57 feet to a re-bar (#15) set; thence North 48° 20' 36" West 320.25 feet to a re=bar (#16) set; thence North 09° 47' 00" West 601.64 feet to a re-bar (#17) set; thence North 55° 58' 00" East 194.53 feet to a re=bar (#18) set; thence North 01° 37' 21" East 323.50 feet to a re-bar (#19) set; thence North 27° 47' 33" East 297.46 feet to a re=bar (#20) set; thence North 31° 55' 04" West 176.52 feet to a re-bar (#21) set; thence North 12° 57' 43" East 319.39 feet to a re=bar (#22) set; thence North 59° 17' 40" East 117.17 feet to a re-bar (#23) set; thence South 52° 48' 06" East 299.56 feet to the point and place of beginning and containing 15.944 acres.

Map BK 27 Pg 160



VICINITY MAP (no scale)

NOTES
1. AREA BY COORDINATE CALCULATION.
2. PROPERTY IS SUBJECT TO ALL EASEMENTS AND RIGHT-OF-WAYS OF RECORD PRIOR TO THE DATE OF
3. ALL DISTANCES SHOWN ARE HORIZONTAL GROUND DISTANCES, UNLESS NOTED OTHERWISE
4. THIS PLAT IS A CORRECT REPRESENTATION OF THE LAND PLATTED AND HAS BEEN PREPARED IN CONFORMITY WITH NORTH CAROLINA STANDARDS, GS47-30, AND REQUIREMENTS OF LAW, BUT A NORTH CAROLINA LICENSED ATTORNEY-AT-LAW SHOULD BE CONSULTED REGARDING CORRECT OWNERSHIP, WIDTH AND OWNERSHIP OF EASEMENTS AND OTHER TITLE QUESTIONS REVEALED BY A TITLE EXAMINATION.
5. DASHED LINES REPRESENT LINES NOT SURVEYED.

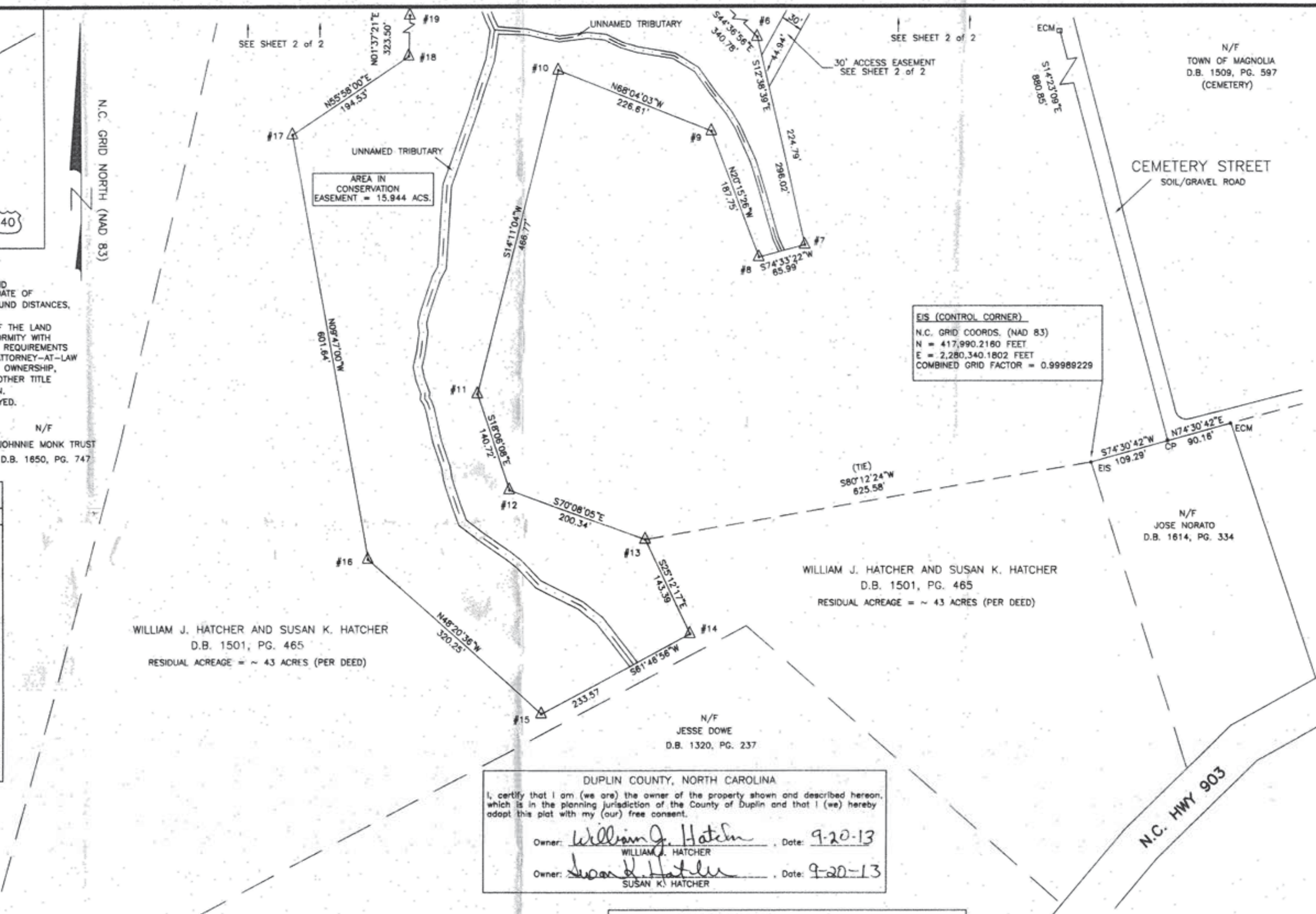


TABLE OF COORDINATES EASEMENT CORNERS			
#	NORTH	EAST	DESC.
1	419484.5740	2279864.1940	ERB/CAP
2	419018.1220	2280147.3170	ERB/CAP
3	419004.8690	2279854.1600	ERB/CAP
4	419116.7030	2279735.6260	ERB/CAP
5	418826.4010	2279640.6300	ERB/CAP
6	418583.8240	2279879.9720	ERB/CAP
7	418294.9830	2279944.7700	ERB/CAP
8	418277.4040	2279881.1680	ERB/CAP
9	418453.5410	2279816.1620	ERB/CAP
10	418538.1830	2279605.9540	ERB/CAP
11	418085.6400	2279491.5740	ERB/CAP
12	417951.8860	2279535.2970	ERB/CAP
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16	417856.4920	2279339.6970	ERB/CAP
17	418449.3800	2279237.4640	ERB/CAP
18	418558.2530	2279398.6730	ERB/CAP
19	418881.6200	2279407.8320	ERB/CAP
20	419144.7650	2279546.5290	ERB/CAP
21	419294.5980	2279453.2020	ERB/CAP
22	419605.8500	2279524.8420	ERB/CAP
23	419665.6790	2279625.5830	ERB/CAP

DUPLIN COUNTY, NORTH CAROLINA

I, certify that I am (we are) the owner of the property shown and described hereon, which is in the planning jurisdiction of the County of Duplin and that I (we) hereby adopt this plat with my (our) free consent.

Owner: William J. Hatcher, Date: 9-20-13
WILLIAM J. HATCHER

Owner: Susan K. Hatcher, Date: 9-20-13
SUSAN K. HATCHER

LEGEND

EIP = EXISTING IRON PIPE
EIS = EXISTING IRON STAKE
EIB = EXISTING I-BEAM
ECM = EXISTING CONCRETE MONUMENT
CP = CALCULATED POINT (NOT SET)
= POWER POLE
OHE = OVERHEAD POWER
℄ = CENTERLINE
R/W = RIGHT-OF-WAY
N/F = NOW OR FORMERLY
△ = 5/8" (#5) RE-BAR SET ALONG WITH ALUMINUM CAPS.

NOTE 5/8" (#5) RE-BAR SET AT ALL EASEMENT CORNERS ALONG WITH ALUMINUM CAPS.

THIS PROPERTY IS NOT LOCATED IN A F.E.M.A. 100 YEAR FLOOD HAZARD AREA.
REFERENCE: F.E.M.A. COMMUNITY PANEL NO. 3720246000J
DATED: FEBRUARY 16, 2006

REVIEW OFFICER CERTIFICATE

STATE OF NORTH CAROLINA
COUNTY OF DUPLIN
I, JAMES S. BLANCHARD REVIEW OFFICER FOR THE ABOVE COUNTY AND STATE, CERTIFY THAT THE MAP OR PLAT TO WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS OF RECORDING.

REVIEW OFFICER — DATE 9-20-13

B0027 P0160 09-20-2013 10:13:21.000
Davis H. Brinson PLAT
Duplin County, NC Register of Deeds page 1 of 2

SHEET 1 OF 2

I, Herbert H. Proctor Jr., certify that this survey is an existing parcel of land and does not create a new street or change an existing street.

I, Herbert H. Proctor Jr., certify that this plat was drawn under my supervision from an actual survey made under my supervision; that the ratio of precision as calculated by latitudes and departures is 1/ 10,000 + ; that the boundaries not surveyed are shown as broken lines plotted from information found in Book - page - ; that this plat was prepared in accordance with G.S. 47-30 as amended. Witness my original signature, registration number and seal this 16th day of SEPTEMBER 2013

L-3621

NORTH CAROLINA PROFESSIONAL SEAL L-3621 LAND SURVEYOR HERBERT H. PROCTOR, JR.

9/16/13

STEWART-PROCTOR
ENGINEERING and SURVEYING
319 CHAPANOKE ROAD STE 106
RALEIGH, NC 27603
TEL. 919 779-1855 FAX 919 779-1661

CONSERVATION EASEMENT SURVEY FOR
THE STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM
UT MILLERS CREEK
EEP #95719 – SPO #31-Z
PROPERTY OF
WILLIAM J. HATCHER AND WIFE SUSAN K. HATCHER
DEED REFERENCE: DEED BOOK 1501, PAGE 465

REFERENCES
1. DEED BOOK 1501, PG. 465
2. ALL DEEDS AND MAPS WITH ADJOINERS
3. DUPLIN COUNTY GIS.

OWNERS:
WILLIAM AND SUSAN HATCHER
582 S NC HWY 111
CHINQUAPIN, N.C. 28521

DATE 09/16/2013	SURVEYED BY	JOB	MAGNOLIA TOWNSHIP	NORTH CAROLINA
SCALE 1"=100'	DRAWN BY	DWG. NO. UT-MILLERS-CE-PLAT-1-09-04-13	DUPLIN COUNTY	OWNER
REVISIONS			ZONED	P.I.N.: 247100987405

Map BK 27 Pg 161

EIP (CONTROL CORNER)
N.C. GRID COORDS. (NAD 83)
N = 419,883.2875 FEET
E = 2,279,426.8322 FEET
COMBINED GRID FACTOR = 0.99989229

LEGEND

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EIS = EXISTING IRON STAKE
EIB = EXISTING I-BEAM
ECM = EXISTING CONCRETE MONUMENT
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△ = 5/8" (#5) RE-BAR SET ALONG WITH ALUMINUM CAPS

REFERENCES

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N/F
JOHNNIE MONK TRUST
D.B. 1650, PG. 747

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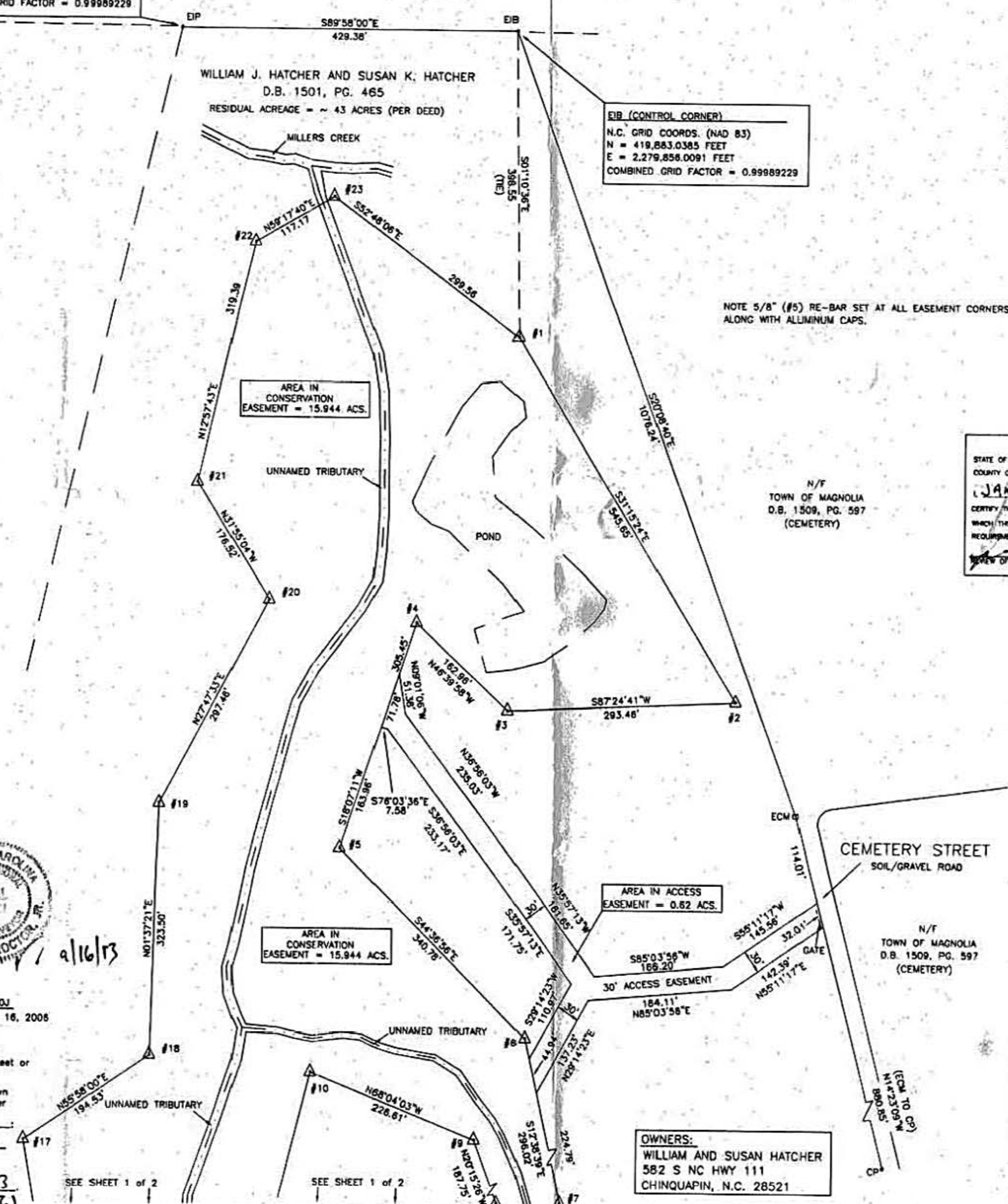

HERBERT H. PROCTOR, JR. PROFESSIONAL LAND SURVEYOR SEAL L-3621

9/16/13

THIS PROPERTY IS NOT LOCATED IN A F.E.M.A. 100 YEAR FLOOD HAZARD AREA.
REFERENCE: F.E.M.A. COMMUNITY PANEL NO. 3720246000J
DATED: FEBRUARY 16, 2005

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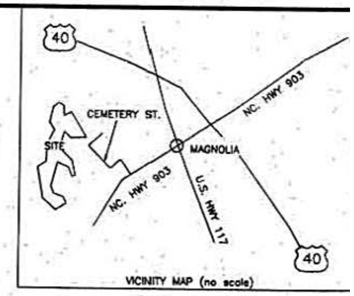
I, Herbert H. Proctor Jr., certify that this plat was drawn under my supervision from an actual survey made under my supervision; that the ratio of precision as calculated by latitudes and departures is 1/ 10,000 + ; that the boundaries not surveyed are shown as broken lines plotted from information found in Book - page - ; that this plat was prepared in accordance with G.S. 47-30 as amended. Witness my original signature, registration number and seal this 16th day of September, 2013.

L-3621



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STATE OF NORTH CAROLINA
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I, James S Blanchard REVIEW OFFICER FOR THE ABOVE COUNTY AND STATE, CERTIFY THAT THE MAP OR PLAT TO WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS OF RECORDING.
REVIEW OFFICER 9-20-13
DATE

B0027 P0161 09-20-2013 10:13:21.000
Davis H. Brinson PLAT
Duplin County, NC Register of Deeds page 2 of 2

SHEET 2 OF 2

CONSERVATION EASEMENT SURVEY FOR
THE STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM
UT MILLERS CREEK
EEP #95719 - SPO #31-Z
PROPERTY OF
WILLIAM J. HATCHER AND WIFE SUSAN K. HATCHER
DEED REFERENCE: DEED BOOK 1501, PAGE 465

MAGNOLIA TOWNSHIP	NORTH CAROLINA
DUPLIN COUNTY	OWNER
ZONED	P.I.N.: 247100987405

STEWART-PROCTOR
ENGINEERING and SURVEYING
319 CHAPANOKE ROAD STE 106
RALEIGH, NC 27603
TEL 919 779-1855 FAX 919 779-1661

DATE 08/16/2013	SURVEYED BY	JOB
SCALE 1"=100'	DRAWN BY	
REVISIONS		DWG. NO. UT-MILLERS-CE-PLAT-2-09-04-13

OWNERS:
WILLIAM AND SUSAN HATCHER
582 S NC HWY 111
CHINQUAPIN, N.C. 28521

Appendix B. Baseline Information

1. Preliminary Jurisdictional Determination
2. NCWAM Data Forms
3. NCDWQ Stream Classification Form
4. Categorical Exclusion Form
5. NCEEP Floodplain Requirements Checklist
6. Stream Existing Conditions

B.1 Preliminary Jurisdictional Determination

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **SAW-2013-00386** County: **Duplin** U.S.G.S. Quad: **Warsaw South**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Property Owner: **Jeffery Hatcher**
Address: **582 NC Hwy 111 S**
Chinquapin, NC 28521

Applicant: **Florence & Hutchinson (ICA Engineering, Inc.)**
attn: Ryan V. Smith
Address: **5121 Kingdom Way, Suite 100**
Raleigh, NC 27607

Property description:

Size (acres) **~58**
Nearest Waterway **UT to Millers Creek**
USGS HUC **03030006**
Nearest Town **Magnolia**
River Basin **Black**
Coordinates **34.896505 N -78.067095 W**

Location description: **The property is located on the west side of NC 903, approximately 0.25 mi. north of its intersection with Beasleys Road, in Magnolia, Duplin County, North Carolina. PIN: 247100987405.**

Indicate Which of the Following Apply:

A. Preliminary Determination

X Based on preliminary information, there may be waters of the U.S. including wetlands on the above described property. We strongly suggest you have this property inspected to determine the extent of Department of the Army (DA) jurisdiction. To be considered final, a jurisdictional determination must be verified by the Corps. This preliminary determination is not an appealable action under the Regulatory Program Administrative Appeal Process (Reference 33 CFR Part 331).

B. Approved Determination

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

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

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

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

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

_ There are no waters of the U.S., to include wetlands, present on the above described project area which are subject to the permit requirements of Section 404 of the Clean Water Act (33 USC 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

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

Placement of dredged or fill material within waters of the US and/or wetlands without a Department of the Army permit may constitute a violation of Section 301 of the Clean Water Act (33 USC § 1311). If you have any questions regarding this determination and/or the Corps regulatory program, please contact **Mr. David E. Bailey** at **(910) 251-4469 / David.E.Bailey2@usace.army.mil**.

C. Basis For Determination

The project area exhibits water bodies with ordinary high water and wetland criteria as defined in the 1987 wetland delineation manual. The water bodies on the site are listed on the attached "Preliminary Jurisdictional Determination form". This determination is based a site visit and verification by David E. Bailey (USACE) on 7/30/2013.

D. Remarks

The wetlands and other Waters of the US on the property were flagged by Land Management Group, Inc. with changes made in the field by David E. Bailey (USACE), and are approximated on the attached figure entitled "Post COE Meeting Revised Delineation Sketch."

E. Attention USDA Program Participants

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

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

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

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

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

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

Corps Regulatory Official: ______________________

Date **August 8, 2013** Expiration Date

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

Copy furnished:
Chad Coburn , NCDENR-DWQ, 127 Cardinal Drive Extension, Wilmington, NC 28405
Christian Preziosi, Land Management Group, Inc., 3805 Wrightsville Avenue, Wilmington, NC 28403

ATTACHMENT

PRELIMINARY JURISDICTIONAL DETERMINATION FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PRELIMINARY JURISDICTIONAL DETERMINATION (JD): 8/8/2013

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:

Ryan V. Smith
Florence & Hutcheson (ICA Engineering, Inc.)
5121 Kingdom Way, Suite 100
Raleigh, NC 27607

C. DISTRICT OFFICE, FILE NAME, AND NUMBER:

Wilmington, Hatcher Tract (UT to Millers Creek), SAW-2013-00386

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION:
(USE THE ATTACHED TABLE TO DOCUMENT MULTIPLE WATERBODIES AT DIFFERENT SITES)

State: NC County/parish/borough: Duplin City: Magnolia
Center coordinates of site (lat/long in degree decimal format): Lat. 34.896505° N, Long. -78.067095° **W.**
Universal Transverse Mercator: 17S / 768003.43 mE / 3865490.74 mN

Name of nearest waterbody: Unnamed tributary to Millers Creek

Identify (estimate) amount of waters in the review area:

Non-wetland waters: 3,200 linear feet: 6 width (ft) and/or acres.
Cowardin Class: R3SB4
Stream Flow: Perennial
Wetlands: 7.91 acres.
Cowardin Class: PFO1/3

Name of any water bodies on the site that have been identified as Section 10 waters:

Tidal:

Non-Tidal:

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☐ Office (Desk) Determination. Date:

☒ Field Determination. Date(s): 7/30/2013

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or

to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable. This preliminary JD finds that there *"may be"* waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA. Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: USACE Data Package.

☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.

- ☒ Office concurs with data sheets/delineation report.
- ☐ Office does not concur with data sheets/delineation report.

☐ Data sheets prepared by the Corps: .

☐ Corps navigable waters' study: .

☐ U.S. Geological Survey Hydrologic Atlas: .

- ☐ USGS NHD data.
- ☐ USGS 8 and 12 digit HUC maps.

☒ U.S. Geological Survey map(s). Cite scale & quad name:Warsaw South Quad; 1"=600'.

☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Duplin County NRCS Soil Survey GIS Data.

☐ National wetlands inventory map(s). Cite name: .

☐ State/Local wetland inventory map(s): .

☐ FEMA/FIRM maps: .

☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)

☒ Photographs: ☒ Aerial (Name & Date):NAPP 1998; BING 2013.
or ☐ Other (Name & Date): .

☐ Previous determination(s). File no. and date of response letter: .

☒ Other information (please specify): LiDAR (NC Flood maps)

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

Signature and date of
Regulatory Project Manager
(REQUIRED)

2013-08-06

Signature and date of
person requesting preliminary JD
(REQUIRED, unless obtaining
the signature is impracticable)

For Jeff Hatcher

Site number	Latitude	Longitude	Cowardin Class	Estimated amount of aquatic resource in review area	Class of aquatic resource
1 (A1-10)	34.899854	-78.066564	PFO3	0.08 acre	non-section 10 – wetland
2 (B1-4)	34.899523	-78.066325	PFO1	0.007 acre	non-section 10 – wetland
3 (C1-8)	34.899324	-78.066466	PFO1	0.036 acre	non-section 10 – wetland
4 (D1-4A)	34.898806	-78.066073	PFO1	0.02 acre	non-section 10 – wetland
5 (E1-7)	34.898289	-78.065835	PFO1	0.13 acre	non-section 10 – wetland
6 (F1-15)	34.893993	-78.065520	PEM1	0.79 acre	non-section 10 – wetland
7 (G1-28)	34.894868	-78.065770	PFO1	2.04 acre	non-section 10 – wetland
8 (H1-11)	34.895189	-78.066531	PFO1	0.23 acre	non-section 10 – wetland
9 (I1-22)	34.894106	-78.067168	PEM1	0.75 acre	non-section 10 – wetland
10 (J1-12)	34.893166	-78.069611	PFO3	0.61 acre	non-section 10 – wetland
11 (K1-7)	34.893652	-78.069571	PFO1	0.07 acre	non-section 10 – isolated-wetland
12 (Na1-8)	34.893634	-78.069085	PFO1	0.10 acre	non-section 10 – isolated-wetland
13 (L1-19)	34.894538	-78.069370	PFO3	0.65 acre	non-section 10 – wetland
14 (M1-11; Nb1-28)	34.895951	-78.068867	PFO3	0.94 acre	non-section 10 – wetland
15 (N1-9)	34.896538	-78.068930	PFO3	0.21 acre	non-section 10 – wetland
16 (O1-22)	34.898420	-78.067988	PFO3	0.69 acre	non-section 10 – wetland

17 (P1-22)	34.899376	-78.067612	PFO3	0.41 acre	non-section 10 – wetland
18 (Nc1-7)	34.898430	-78.067414	PFO1	0.026 acre	non-section 10 – wetland
19 (E1-6)	34.897249	-78.068366	PFO1	0.029 acre	non-section 10 – wetland
20 (CP401-405)	34.898570	-78.066979	PEM1	0.035 acre	non-section 10 – wetland
21 (CP1-9)	34.898211	-78.066826	PEM1	0.079 acre	non-section 10 – wetland
22 (CP101-104)	34.897822	-78.066570	PEM1	0.01 acre	non-section 10 – wetland
23 (CP201-203)	34.898250	-78.066409	PEM1	0.017 acre	non-section 10 – wetland
24 (CP301-303)	34.898496	-78.066719	PEM1	0.014 acre	non-section 10 – wetland
25 (Linear Wetland)	34.895952	-78.066580	PFO1	0.02 acre	non-section 10 – wetland
26 (Open Water)	34.898494	-78.066717	PUB2	0.77 acre	non-section 10 – open water

Smith, Ryan

From: Jeff Hatcher <wjeffhatcher@yahoo.com>
Sent: Tuesday, August 06, 2013 1:56 PM
To: Smith, Ryan
Subject: Re: Magnolina Property - Army Corps of Engineers Document

Ryan, you have my permission to sign as my agent. Jeff

From: "Smith, Ryan" <rsmith@icaeng.com>
To: "William Jeffrey "Jeff" Hatcher (wjeffhatcher@yahoo.com)" <wjeffhatcher@yahoo.com>
Cc: "Smith, Ryan" <rsmith@icaeng.com>; "Williams, Kevin" <kwilliams@icaeng.com>
Sent: Tuesday, August 6, 2013 1:44 PM
Subject: Magnolina Property - Army Corps of Engineers Document

Mr. Hatcher,

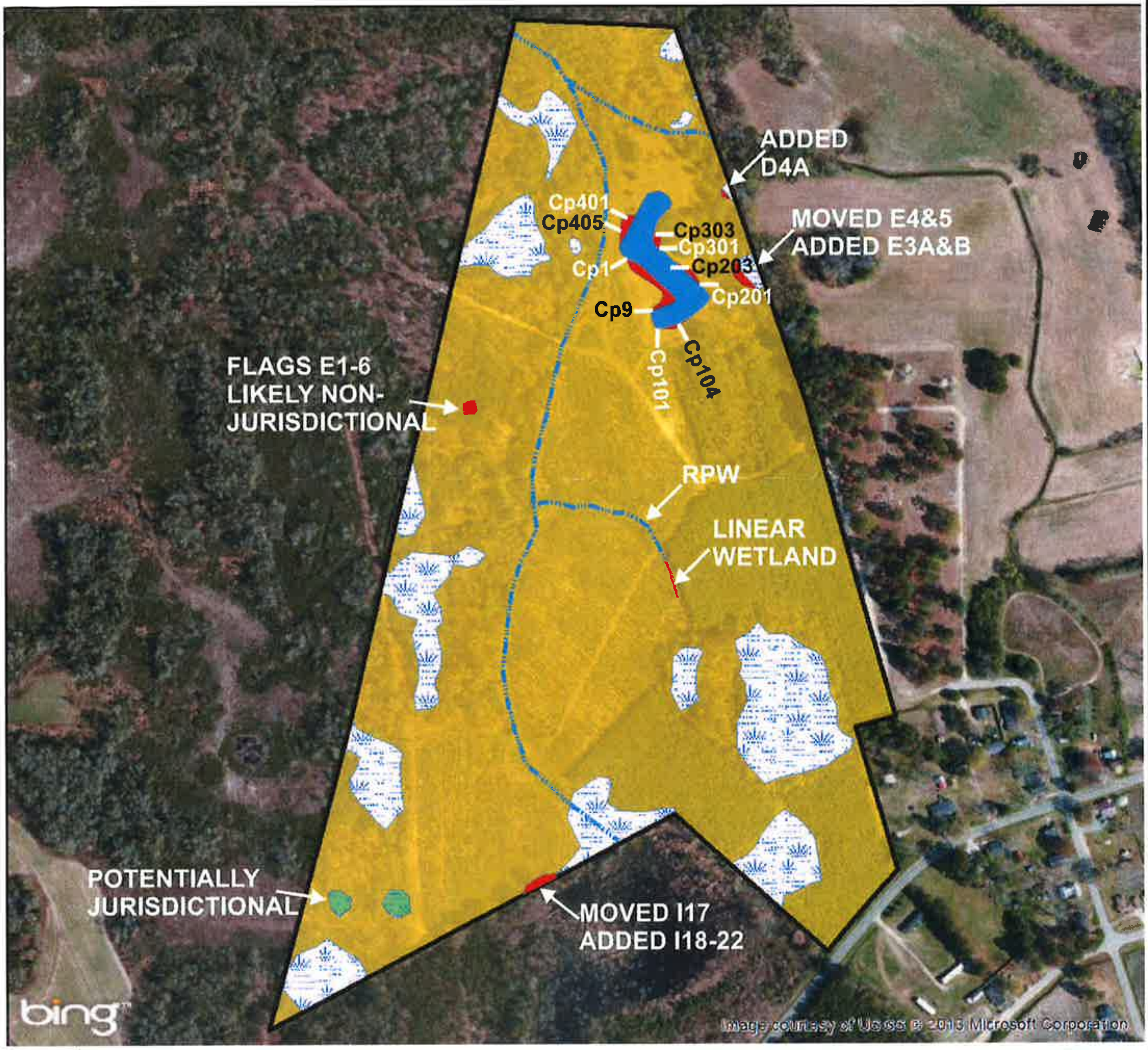
Attached is a document that is to be sent to the USACE to complete a jurisdictional determination for your property (i.e. a determination of wetlands and streams on your property). As you can see on Page 4, there is a space to be signed by the person requesting the jurisdictional determination. On Page 1, I (Ryan V. Smith) am listed as requesting the jurisdictional determination.

Please respond back to this e-mail and confirm that you would like for me to sign this document as your agent. If you have any additional questions on it please let me know.

Thanks,

Ryan V. Smith, CPESC, PWS
Ecological Restoration
ICA Engineering, Inc.
5121 Kingdom Way, Suite 100
Raleigh, NC 27607
O: 919.851.6066 | **D:** 919.900.1628 | **M:** 919.306.8095 | **F:** 919.851.6846
rsmith@icaeng.com | www.icaeng.com

ICA Engineering



Areas considered to be uplands

Areas originally delineated as jurisdictional wetlands

Potential non-jurisdictional wetlands (isolated or lacking significant nexus) - pending COE/EPA review

Additional wetlands added at COE meeting

Areas considered to be jurisdictional tributary (RPW)

Jurisdictional Open Water

NOTE: This is not a survey. All boundaries and distances are considered approximate. This represents a preliminary sketch prepared from field notes. This delineation was verbally approved by the COE on July 30, 2013.

N

SCALE 1" = 400'

L:\WETLANDS\2013 WETLANDS FILES\40-13-064 --- UT to Millers Creek, Ryan Smith

UT to Millers Creek
Magnolia Tract
Florence & Hutcheson
Duplin County, NC
July 31, 2013
40-13-064

LMG
LAND MANAGEMENT GROUP INC.
Environmental Consultants
www.LMGroup.net
Phone: 910.452.0001 • 1.866.LMG.1078
Fax: 910.452.0060
3805 Wrightsville Avenue
Wilmington, NC 28403

Post COE Meeting
Revised Delineation
Sketch

(Map Source: BING Aerial Photography)

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 5/2/13

Applicant/Owner: Florence & Hutcheson/Ryan Smith State: NC Sampling Point: Up-1

Investigator(s): Wes Fryar/Nick Howell Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): convex Slope (%): 0-2

Subregion (LRR or MLRA): P/133A Lat: 34.898508 Long: -78.067553 Datum: NAD83

Soil Map Unit Name: BbA: Bibb sandy loam, 0-1% slopes NWI classification: Upland

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 ☐
Hydric Soil Present?	Yes ☐	No ☑
Wetland Hydrology Present?	Yes ☐	No ☑

Is the Sampled Area within a Wetland? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches):
Water Table Present?	Yes ☐	No ☑	Depth (inches): >33"
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): >33"

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: Up-1

Tree Stratum (Plot size: 30' Ra)	Absolute % Cover	Dominant Species?	Indicator Status
1. Quercus nigra	40	Yes	FAC
2. Prunus serotina	15	Yes	FACU
3. Liriodendron tulipifera	10	No	FAC
4.			
5.			
6.			
7.			
8.			
	65 = Total Cover		
50% of total cover: 32.5	20% of total cover: 13		

Sapling/Shrub Stratum (Plot size: 30' Ra)	Absolute % Cover	Dominant Species?	Indicator Status
1. Ilex glabra	20	Yes	FACW
2. Leucothoe axillaris	10	Yes	FACW
3. Vaccinium corymbosum	8	No	FACW
4. Persea palustris	5	No	FACW
5.			
6.			
7.			
8.			
	43 = Total Cover		
50% of total cover: 21.5	20% of total cover: 8.6		

Herb Stratum (Plot size: 30' rad)	Absolute % Cover	Dominant Species?	Indicator Status
1. Gelsemium sempervirens	2	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	2 = Total Cover		
50% of total cover: 1	20% of total cover: 0.2		

Woody Vine Stratum (Plot size: 30' rad)	Absolute % Cover	Dominant Species?	Indicator Status
1. Vitis rotundifolia	15	Yes	FAC
2.			
3.			
4.			
5.			
	15 = Total Cover		
50% of total cover: 7.5	20% of total cover: 3		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 83 (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]
- ☐ 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: (If observed, list morphological adaptations below).

SOIL

Sampling Point: Up-1

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 %	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 3/1						LS	A
4-19	10YR 5/6						LS	Bw1
19-27	10YR 3/3						LS	Bw2
27-33	2.5Y 6/2						S	Cg

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.
[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: Bh:spodic

Depth (inches): 16"

Hydric Soil Present? Yes ☐ No ☑

Remarks:

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 5/2/13

Applicant/Owner: Florence & Hutcheson/Ryan Smith State: NC Sampling Point: Wet-1

Investigator(s): Wes Fryar/Nick Howell Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): depression Local relief (concave, convex, none): concave Slope (%): 0-2

Subregion (LRR or MLRA): P/133A Lat: 34.898391 Long: -78.067739 Datum: NAD83

Soil Map Unit Name: BbA: Bibb sandy loam, 0-1% slopes NWI classification: NCWAM:RivSwFrst

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:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☑ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☑ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches):	
Water Table Present?	Yes ☑	No ☐	Depth (inches): 8"	
Saturation Present? (includes capillary fringe)	Yes ☑	No ☐	Depth (inches): 8"	**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: Wet-1

Tree Stratum (Plot size: 30' Radi)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	70	Yes	FAC
2. Magnolia virginiana	10	No	FACW
3.			
4.			
5.			
6.			
7.			
8.			
	80 = Total Cover		

50% of total cover: 40 20% of total cover: 16

Sapling/Shrub Stratum (Plot size: 30' Radi)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	10	No	FAC
2. Magnolia virginiana	5	No	FACW
3. Vaccinium corymbosum	8	No	FACW
4. Lyonia lucida	10	No	FACW
5. Leucothoe axillaris	8	No	FACW
6. Cyrilla racemiflora	12	Yes	FACW
7.			
8.			
	53 = Total Cover		

50% of total cover: 26.5 20% of total cover: 10.6

Herb Stratum (Plot size: 30' radi)	Absolute % Cover	Dominant Species?	Indicator Status
1. Osmunda cinnamomea	2	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	2 = Total Cover		

50% of total cover: 1 20% of total cover: 0.4

Woody Vine Stratum (Plot size: 30' radi)	Absolute % Cover	Dominant Species?	Indicator Status
1. Smilax laurifolia	30	Yes	FACW
2.			
3.			
4.			
5.			
	30 = Total Cover		

50% of total cover: 15 20% of total cover: 6

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]
- ☐ 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: (If observed, list morphological adaptations below).

SOIL

Sampling Point: Wet-1

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 %	Type[1]	Loc[2]	Texture	Remarks
0-7	N 2/0						MuS	A
7-16	2.5Y 5/2						S	Eg
16-22	10YR 3/3						LS	Bh

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: Bh:spodic

Depth (inches): 16"

Hydric Soil Present? Yes ☑ No ☐

Remarks:

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 5/2/13

Applicant/Owner: Florence & Hutcheson/Ryan Smith State: NC Sampling Point: Up-2

Investigator(s): Wes Fryar/Nick Howell Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): convex Slope (%): 0-2

Subregion (LRR or MLRA): P/133A Lat: 34.895756 Long: -78.066224 Datum: NAD83

Soil Map Unit Name: BnB: Blanton sand, 1 to 6% slopes NWI classification: Upland

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 ☐
Hydric Soil Present?	Yes ☐	No ☑
Wetland Hydrology Present?	Yes ☐	No ☑

Is the Sampled Area within a Wetland? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches):
Water Table Present?	Yes ☐	No ☑	Depth (inches): >24"
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): >24"

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: Up-2

Tree Stratum (Plot size: 30' Radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Pinus taeda	80	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	80 = Total Cover		
50% of total cover: 40	20% of total cover: 16		

Sapling/Shrub Stratum (Plot size: 30' Radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Morella cerifera	15	Yes	FAC
2. Liquidambar styraciflua	8	Yes	FAC
3. Rubus argutus	5	No	FACU
4.			
5.			
6.			
7.			
8.			
	28 = Total Cover		
50% of total cover: 14	20% of total cover: 5.6		

Herb Stratum (Plot size: 30' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Lonicera japonica	35	Yes	FAC
2. Gelsemium sempervirens	10	Yes	FAC
3. Asplenium platyneuron	2	No	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	47 = Total Cover		
50% of total cover: 23.5	20% of total cover: 9.4		

Woody Vine Stratum (Plot size: 30' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Vitis rotundifolia	15	Yes	FAC
2. Parthenocissus quinquefolia	15	Yes	FAC
3.			
4.			
5.			
	30 = Total Cover		
50% of total cover: 15	20% of total cover: 6		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 7 (A)

Total Number of Dominant Species Across All Strata: 7 (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]
- ☐ 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: (If observed, list morphological adaptations below).

SOIL

Sampling Point: Up-2

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 %	Type[1]	Loc[2]	Texture	Remarks
0 - 4	10YR 3/1						LS	A - 60%coated
4 - 7	10YR 3/3						LS	Bw
7 - 24	2.5Y 6/1	75	2.5Y 5/6	25	C	M	SL	Btg

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.
[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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 – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 5/2/13

Applicant/Owner: Florence & Hutcheson/Ryan Smith State: NC Sampling Point: Wet-2

Investigator(s): Wes Fryar/Nick Howell Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): depression - gum hole Local relief (concave, convex, none): concave Slope (%): 0-2

Subregion (LRR or MLRA): P/133A Lat: 34.895323 Long: -78.065896 Datum: NAD83

Soil Map Unit Name: BnB: Blanton sand, 1-6% slopes NWI classification: NCWAM:HdWtrFrst

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 ☐
Hydric Soil Present?	Yes ☑	No ☐
Wetland Hydrology Present?	Yes ☑	No ☐

Is the Sampled Area within a Wetland? Yes ☑ No ☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☑ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☑ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches):
Water Table Present?	Yes ☑	No ☐	Depth (inches): 3'
Saturation Present? (includes capillary fringe)	Yes ☑	No ☐	Depth (inches): 3"

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: Wet-2

Tree Stratum (Plot size: 30' Radi)	Absolute % Cover	Dominant Species?	Indicator Status
1. Nyssa sylvatica	75	Yes	OBL
2. Acer rubrum	20	No	FAC
3. Magnolia virginiana	15	No	FACW
4.			
5.			
6.			
7.			
8.			
	110 = Total Cover		
50% of total cover: 55	20% of total cover: 22		

Sapling/Shrub Stratum (Plot size: 30' Radi)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	10	Yes	FAC
2. Vaccinium corymbosum	8	Yes	FACW
3. Magnolia virginiana	5	No	FACW
4. Persea palustris	5	No	FACW
5.			
6.			
7.			
8.			
	28 = Total Cover		
50% of total cover: 14	20% of total cover: 5.6		

Herb Stratum (Plot size: 30' radi)	Absolute % Cover	Dominant Species?	Indicator Status
1. Polygonum pensylvanicum	35	Yes	FACW
2. Saururus cernuus	8	No	OBL
3. Boehmeria cylindrica	2	No	FACW
4. Woodwardia areolata	2	No	OBL
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	47 = Total Cover		
50% of total cover: 23.5	20% of total cover: 9.4		

Woody Vine Stratum (Plot size: 30' radi)	Absolute % Cover	Dominant Species?	Indicator Status
1. Vitis rotundifolia	15	Yes	FAC
2.			
3.			
4.			
5.			
	15 = Total Cover		
50% of total cover: 7.5	20% of total cover: 3		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (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]
- ☐ 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: (If observed, list morphological adaptations below).

SOIL

Sampling Point: Wet-2

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 %	Type[1]	Loc[2]	Texture	Remarks
0-13	N 2/0						Mu	Oa
13-18	N 2/0						MuS	A - 100% coated
18-24	5Y 5/2						SCL	Btg

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (If observed):

Type: Bh:spodic

Depth (inches): 16"

Hydric Soil Present? Yes ☑ No ☐

Remarks:

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/8/13

Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: Well 2

Investigator(s): Corey Novak / Nick Howell - LMG Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): drained floodplain Local relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR or MLRA): LRR T Lat: 34.898313 Long: -78.067522 Datum: NAD 83

Soil Map Unit Name: BbA - Bibb sandy loam, 0 to 1 % slopes, frequently flooded NWI classification: upland on map

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 ☐
Hydric Soil Present?	Yes ☑	No ☐
Wetland Hydrology Present?	Yes ☐	No ☑

Is the Sampled Area within a Wetland? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches): N/A
Water Table Present?	Yes ☐	No ☑	Depth (inches): 20
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): 20

Wetland Hydrology Present? Yes ☐ No ☑

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

monitoring well data

Remarks:

Geomorphic position is not applicable in areas with functioning drainage systems. Above normal precip.

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

Sampling Point: Well 2

Tree Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Liquidambar styraciflua	30	Y	FAC
2. Quercus nigra	10	N	FAC
3. Magnolia virginiana	40	Y	FACW
4. Acer rubrum	5	N	FAC
5.			
6.			
7.			
8.			
	85 = Total Cover		
50% of total cover: 42.5	20% of total cover: 17		

Sapling/Shrub Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Vaccinium corymbosum	10	Y	FACW
2. Clethra alnifolia	20	Y	FACW
3. Ilex coriacea	15	Y	FACW
4.			
5.			
6.			
7.			
8.			
	45 = Total Cover		
50% of total cover: 22.5	20% of total cover: 9		

Herb Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Osmunda cinnamomea	15	Y	FACW
2. Woodwardia aereolata	5	N	OBL
3. Clethra alnifolia	5	N	FACW
4. Ilex opaca	5	N	FAC
5. Ilex coriacea	10	Y	FACW
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	40 = Total Cover		
50% of total cover: 20	20% of total cover: 8		

Woody Vine Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Vitis rotundifolia	15	Y	FAC
2. Smilax glauca	5	N	FAC
3. Cuscuta sp.	5	N	N/A
4. Gelsemium sempervirens	10	Y	FAC
5.			
	35 = Total Cover		
50% of total cover: 17.5	20% of total cover: 7		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 9 (A)

Total Number of Dominant Species Across All Strata: 9 (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
- [x] 2 - Dominance Test is >50%
- [ ] 3 - Prevalence Index is ≤3.0[1]
- [ ] 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 [x] No [ ]

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

SOIL

Sampling Point: Well 2

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 %	Type[1]	Loc[2]	Texture	Remarks
0-18	N 2/0	100					ML	
18-33	10YR 4/2	100					SCL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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 – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/8/13

Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: Well 5

Investigator(s): Corey Novak / Nick Howell - LMG Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): drained floodplain Local relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR or MLRA): LRR T Lat: 34.896157 Long: -78.068114 Datum: NAD 83

Soil Map Unit Name: ToA - Torhunta mucky fine sandy loam, 0-1% slopes NWI classification: upland on map

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:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches): N/A
Water Table Present?	Yes ☐	No ☑	Depth (inches): 17
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): 17

Wetland Hydrology Present? Yes ☐ No ☑

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

monitoring well data

Remarks:

Geomorphic position is not applicable in areas with functioning drainage systems. Above normal precip.

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

Sampling Point: Well 5

Tree Stratum (Plot size: 30' rad.)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Liquidambar styraciflua	40	Y	FAC
2. Acer rubrum	35	Y	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	75 = Total Cover		

50% of total cover: 37.5 20% of total cover: 15

Sapling/Shrub Stratum (Plot size: 30' rad.)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	2	Y	FAC
2. Clethra alnifolia	8	Y	FACW
3.			
4.			
5.			
6.			
7.			
8.			
	10 = Total Cover		

50% of total cover: 5 20% of total cover: 2

Herb Stratum (Plot size: 30' rad.)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Osmunda cinnamomea	5	Y	FACW
2. Woodwardia aereolata	10	Y	OBL
3. Liquidambar styraciflua	5	Y	FAC
4. Rubus argutus	2	N	FAC
5. Quercus nigra	2	Y	FAC
6. Ilex opaca	5	Y	FAC
7. Persea borbonia	2	N	FACW
8. Clethra alnifolia	15	Y	FACW
9. Panicum sp	5	Y	N/A
10.			
11.			
12.			
	51 = Total Cover		

50% of total cover: 25.5 20% of total cover: 10.2

Woody Vine Stratum (Plot size: 30' rad.)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Vitis rotundifolia	12	Y	FAC
2. Smilax rotundifolia	8	Y	FAC
3.			
4.			
5.			
	20 = Total Cover		

50% of total cover: 10 20% of total cover: 4

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 10 (A)

Total Number of Dominant Species Across All Strata: 10 (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]
- ☐ 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: (If observed, list morphological adaptations below).

SOIL

Sampling Point: Well 5

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
0-9	10YR 3/1	100					MLS	
9-15	10YR 4/1	100					LS	
15-28	10YR 4/2	100					SL	
28-50	10YR 5/2	100					SCL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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 – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/8/13

Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: Well 8

Investigator(s): Corey Novak / Nick Howell - LMG Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): drained floodplain Local relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR or MLRA): LRR T Lat: 34.895135 Long: -78.068315 Datum: NAD 83

Soil Map Unit Name: ToA - Torhunta mucky fine sandy loam, 0-1% slopes NWI classification: upland on map

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:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐ No ☑	Depth (inches): N/A	
Water Table Present?	Yes ☐ No ☑	Depth (inches): 41	
Saturation Present? (includes capillary fringe)	Yes ☐ No ☑	Depth (inches): 41	**Wetland Hydrology Present? Yes ☐ No ☑**

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

monitoring well data

Remarks:

Geomorphic position is not applicable in areas with functioning drainage systems. Above normal precip.

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

Sampling Point: Well 8

Tree Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Liquidambar styraciflua	45	Y	FAC
2. Acer rubrum	10	N	FAC
3. Pinus taeda	25	Y	FAC
4.			
5.			
6.			
7.			
8.			
	80 = Total Cover		
50% of total cover: 40	20% of total cover: 16		

Sapling/Shrub Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Quercus nigra	10	Y	FAC
2. Liquidambar styraciflua	10	Y	FAC
3. Acer rubrum	10	Y	FAC
4. Magnolia virginiana	5	N	FACW
5. Magnolia grandiflora	5	N	FAC
6.			
7.			
8.			
	40 = Total Cover		
50% of total cover: 20	20% of total cover: 8		

Herb Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Panicum sp.	35	Y	N/A
2. Arundinaria tecta	25	Y	FACW
3. Persea borbonia	5	Y	FACW
4. Quercus nigra	5	N	FAC
5. Ilex opaca	2	Y	FAC
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	72 = Total Cover		
50% of total cover: 36	20% of total cover: 14.4		

Woody Vine Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Gelsemium sempervirens	5	Y	FAC
2.			
3.			
4.			
5.			
	5 = Total Cover		
50% of total cover: 2.5	20% of total cover: 1		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 9 (A)

Total Number of Dominant Species Across All Strata: 9 (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]
- ☐ 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: (If observed, list morphological adaptations below).

SOIL

Sampling Point: Well 8

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 %	Type[1]	Loc[2]	Texture	Remarks
0-11	10YR 2/1						LS	85% coated w/out lens
11-14	2.5Y 4/2	100					LS	
14-26	2.5Y 5/2	100					SL	
26-52	2.5Y 6/2	100					SCL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

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

Soil would likely meet S7 if not drained. Soil is believed to meet the hydric definition but lacks indicators.

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/30/13

Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: E6 Up

Investigator(s): Corey Novak/Christian Preziosi - LMG Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): convex Slope (%): 2

Subregion (LRR or MLRA): LRR T Lat: 34.898114 Long: -78.065867 Datum: NAD 83

Soil Map Unit Name: BnB - Blanton Sand, 1 to 6 percent slopes NWI classification: upland

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 ☐
Hydric Soil Present?	Yes ☐	No ☑
Wetland Hydrology Present?	Yes ☐	No ☑

Is the Sampled Area within a Wetland? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches): N/A
Water Table Present?	Yes ☐	No ☑	Depth (inches): >24
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): >24

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: E6 Up

Tree Stratum (Plot size: 30' rad.)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Pinus taeda	50	Y	FAC
2. Liquidambar styraciflua	30	Y	FAC
3. Prunus serotina	8	N	FACU
4. Ilex opaca	5	N	FAC
5.			
6.			
7.			
8.			
	93 = Total Cover		

50% of total cover: 46.5 20% of total cover: 18.6

Sapling/Shrub Stratum (Plot size: 30' rad.)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Ligustrum sinense	5	Y	FAC
2. Liquidambar styraciflua	15	Y	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	20 = Total Cover		

50% of total cover: 10 20% of total cover: 4

Herb Stratum (Plot size: 30' rad.)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Quercus nigra	10	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	10 = Total Cover		

50% of total cover: 5 20% of total cover: 2

Woody Vine Stratum (Plot size: 30' rad.)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Vitis rotundifolia	15	Y	FAC
2. Toxicodendron radicans	10	Y	FAC
3. Gelsemium sempervirens	5	N	FAC
4.			
5.			
	30 = Total Cover		

50% of total cover: 15 20% of total cover: 6

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 7 (A)

Total Number of Dominant Species Across All Strata: 7 (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]
- ☐ 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: (If observed, list morphological adaptations below).

SOIL

Sampling Point: E6 Up

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 %	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 3/2	100					FS	
6-10	10YR 4/4	100					FS	
10-14	10YR 2/1	100					FS	
14-18	10YR 7/1	100					FS	
18-22	10YR 3/1	100					SCL	spodic
22-24	10YR 6/1	60					CL	mixed matrix
22-24	10YR 2/2	40					CL	mixed matrix

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: spodic

Depth (inches): 18-22

Hydric Soil Present? Yes ☐ No ☑

Remarks:

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/30/13

Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: E6 Wet

Investigator(s): Corey Novak/Christian Preziosi - LMG Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): depression Local relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR or MLRA): LRR T Lat: 34.898162 Long: -78.065788 Datum: NAD 83

Soil Map Unit Name: BnB - Blanton Sand, 1 to 6 percent slopes NWI classification: upland on map

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 ☐
Hydric Soil Present?	Yes ☑	No ☐
Wetland Hydrology Present?	Yes ☑	No ☐

Is the Sampled Area within a Wetland? Yes ☑ No ☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches): N/A
Water Table Present?	Yes ☐	No ☑	Depth (inches): 14
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): 14

Wetland Hydrology Present? Yes ☑ No ☐

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

Remarks:

Dry-season water table not applicable due to abundant recent precipitation

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

Sampling Point: E6 Wet

Tree Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	60	Y	FAC
2. Liquidambar styraciflua	20	Y	FAC
3. Viburnum dentatum	5	N	FAC
4.			
5.			
6.			
7.			
8.			
	85	= Total Cover	
50% of total cover: 42.5	20% of total cover: 17		

Sapling/Shrub Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Ligustrum sinense	5	Y	FAC
2. Liquidambar styraciflua	12	Y	FAC
3. Acer rubrum	5	Y	FAC
4.			
5.			
6.			
7.			
8.			
	22	= Total Cover	
50% of total cover: 11	20% of total cover: 4.4		

Herb Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Microstegium vimineum	70	Y	FAC
2. Boehmeria cylindrica	5	N	FACW
3. Ligustrum sinense	3	N	FAC
4. Ilex opaca	1	N	FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	79	= Total Cover	
50% of total cover: 39.5	20% of total cover: 15.8		

Woody Vine Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Smilax walteri	2	Y	OBL
2. Smilax laurifolia	8	Y	FACW
3.			
4.			
5.			
	10	= Total Cover	
50% of total cover: 5	20% of total cover: 2		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 8 (A)

Total Number of Dominant Species Across All Strata: 8 (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]
- ☐ 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: (If observed, list morphological adaptations below).

SOIL

Sampling Point: E6 Wet

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 %	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 2/1	100					SL	
5-18	10YR 4/2	77	10YR 5/8	3	C	PL	FS	
5-18	10YR 4/1	20					FS	
18->22	10YR 2/1	100					CL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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 – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/30/13

Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: I11 Up

Investigator(s): Corey Novak/Christian Preziosi - LMG Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): convex Slope (%): 2

Subregion (LRR or MLRA): LRR T Lat: 34.894598 Long: -78.067428 Datum: NAD 83

Soil Map Unit Name: BnB - Blanton Sand, 1 to 6 percent slopes NWI classification: upland

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 ☐
Hydric Soil Present?	Yes ☐	No ☑
Wetland Hydrology Present?	Yes ☐	No ☑

Is the Sampled Area within a Wetland? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches): N/A
Water Table Present?	Yes ☐	No ☑	Depth (inches): >18
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): >18

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: I11 Up

Tree Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Pinus taeda	65	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	65 = Total Cover		
50% of total cover: 32.5	20% of total cover: 13		
Sapling/Shrub Stratum (Plot size: 30' rad.)			
1. Liquidambar styraciflua	12	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	12 = Total Cover		
50% of total cover: 6	20% of total cover: 2.4		
Herb Stratum (Plot size: 30' rad.)			
1. Quercus nigra	5	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	5 = Total Cover		
50% of total cover: 2.5	20% of total cover: 1		
Woody Vine Stratum (Plot size: 30' rad.)			
1. Campsis radicans	60	Y	FAC
2. Gelsemium sempervirens	10	N	FAC
3. Vitis rotundifolia	5	N	FAC
4.			
5.			
	75 = Total Cover		
50% of total cover: 37.5	20% of total cover: 15		

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
- [x] 2 - Dominance Test is >50%
- [ ] 3 - Prevalence Index is ≤3.0[1]
- [ ] 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 [x] No [ ]

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

SOIL

Sampling Point: I11 Up

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 %	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 3/1						FS	70% coated w/out lens
4-15	10YR 2/1						FS	70% coated w/out lens
15->18	10YR 2/1	100					FS	nearly 100% coated w/out lens

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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 – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/30/13

Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: I11 Wet

Investigator(s): Corey Novak/Christian Preziosi - LMG Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR or MLRA): LRR T Lat: 34.894401 Long: -78.067335 Datum: NAD 83

Soil Map Unit Name: BnB - Blanton Sand, 1 to 6 percent slopes NWI classification: upland on map

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 ☐
Hydric Soil Present?	Yes ☑	No ☐
Wetland Hydrology Present?	Yes ☑	No ☐

Is the Sampled Area within a Wetland? Yes ☑ No ☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches): N/A
Water Table Present?	Yes ☐	No ☑	Depth (inches): 18
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): 18

Wetland Hydrology Present? Yes ☑ No ☐

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

Remarks:

Dry-season water table not applicable due to abundant recent precipitation

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

Sampling Point: I11 Wet

Tree Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. none			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		

50% of total cover: ______ 20% of total cover: ______

Sapling/Shrub Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. none			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		

50% of total cover: ______ 20% of total cover: ______

Herb Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Juncus effusus	40	Y	OBL
2. Polygonum hydropyperoides	40	Y	OBL
3. Carex lurida	5	N	OBL
4. Scirpus cyperinus	2	N	OBL
5. Rubus argutus	10	N	FAC
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	97 = Total Cover		

50% of total cover: 47.5 20% of total cover: 19.4

Woody Vine Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. none			
2.			
3.			
4.			
5.			
	= Total Cover		

50% of total cover: ______ 20% of 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:

- [x] 1 - Rapid Test for Hydrophytic Vegetation
- [x] 2 - Dominance Test is >50%
- [ ] 3 - Prevalence Index is ≤3.0[1]
- [ ] 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 [x] No [ ]

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

SOIL

Sampling Point: I11 Wet

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 %	Type[1]	Loc[2]	Texture	Remarks
0-16	7.5YR 2.5/1	100					FSL	
16->18	10YR 2/1	100					FSL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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 – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/30/13

Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: NA8 Up

Investigator(s): Corey Novak/Christian Preziosi - LMG Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): convex Slope (%): 2

Subregion (LRR or MLRA): LRR T Lat: 34.893494 Long: -78.069250 Datum: NAD 83

Soil Map Unit Name: BnB - Blanton Sand, 1 to 6 percent slopes NWI classification: upland

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 ☐
Hydric Soil Present?	Yes ☐	No ☑
Wetland Hydrology Present?	Yes ☐	No ☑

Is the Sampled Area within a Wetland? Yes ☐ No ☑

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches): N/A
Water Table Present?	Yes ☐	No ☑	Depth (inches): >18
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches): >18

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: NA8 Up

Tree Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Quercus nigra	45	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	45 = Total Cover		
50% of total cover: 22.5	20% of total cover: 9		

Sapling/Shrub Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Quercus nigra	5	N	FAC
2. Magnolia virginiana	10	N	FACW
3. Quercus laevis	5	N	UPL
4. Persea borbonia	8	N	FACW
5. Nyssa sylvatica	5	N	FAC
6. Ilex glabra	20	Y	FACW
7. Clethra alnifolia	15	Y	FACW
8.			
	68 = Total Cover		
50% of total cover: 34	20% of total cover: 13.6		

Herb Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Pteridium aquilinum	60	Y	FACU
2. Vaccinium corymbosum	5	N	FACW
3. Symplocos tinctoria	10	N	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	75 = Total Cover		
50% of total cover: 37.5	20% of total cover: 15		

Woody Vine Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Gelsemium sempervirens	5	Y	FAC
2.			
3.			
4.			
5.			
	5 = Total Cover		
50% of total cover: 2.5	20% of total cover: 1		

Dominance Test worksheet:

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

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (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
- [x] 2 - Dominance Test is >50%
- [ ] 3 - Prevalence Index is ≤3.0[1]
- [ ] 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 [x] No [ ]

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

SOIL

Sampling Point: NA8 Up

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 %	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 3/2	100					FS	
4-11	10YR 7/1	100					FS	
11-16	10YR 3/2	100					FS	
16->18	10YR 4/4	100					FS	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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 – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/30/13

Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: NA8 Wet

Investigator(s): Corey Novak/Christian Preziosi - LMG Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): depression Local relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR or MLRA): LRR T Lat: 34.893607 Long: -78.069144 Datum: NAD 83

Soil Map Unit Name: BnB - Blanton Sand, 1 to 6 percent slopes NWI classification: upland on map

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:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☑ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes ☐ No ☑	Depth (inches): N/A	
Water Table Present?	Yes ☑ No ☐	Depth (inches): 0	
Saturation Present? (includes capillary fringe)	Yes ☑ No ☐	Depth (inches): 0	**Wetland Hydrology Present?** Yes ☑ No ☐

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

Remarks:

Inundation nearby. Other = buttressed trees.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: NA8 Wet

Tree Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	25	Y	FAC
2. Nyssa biflora	20	Y	OBL
3. Cyrilla racemiflora	35	Y	FACW
4.			
5.			
6.			
7.			
8.			
	80	= Total Cover	

50% of total cover: 40 20% of total cover: 16

Sapling/Shrub Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Cyrilla racemiflora	5	Y	FACW
2. Persea borbonia	5	Y	FACW
3.			
4.			
5.			
6.			
7.			
8.			
	10	= Total Cover	

50% of total cover: 5 20% of total cover: 2

Herb Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Persea borbonia	2	Y	FACW
2. Woodwardia virginica	2	Y	OBL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	4	= Total Cover	

50% of total cover: 2 20% of total cover: 0.8

Woody Vine Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. none			
2.			
3.			
4.			
5.			
		= Total Cover	

50% of total cover: ______ 20% of total cover: ______

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 7 (A)

Total Number of Dominant Species Across All Strata: 7 (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]
- ☐ 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: (If observed, list morphological adaptations below).

Buttressed trees

SOIL Sampling Point: NA8 Wet

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 %	Type[1]	Loc[2]	Texture	Remarks
0->18	10YR 2/1	100					FS	nearly 100% coated w/out hand lens

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ 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 – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/30/13

Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: NB4 Up

Investigator(s): Corey Novak/Christian Preziosi - LMG Section, Township, Range: Magnolia

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): convex Slope (%): 2

Subregion (LRR or MLRA): LRR T Lat: 34.895122 Long: -78.068595 Datum: NAD 83

Soil Map Unit Name: ToA - Torhunta mucky fine sandy loam, 0-1% slopes NWI classification: upland

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

Are Vegetation [ ], Soil [ ], or Hydrology [ ] significantly disturbed? Are "Normal Circumstances" present? Yes [x] 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.

	Yes	No
Hydrophytic Vegetation Present?	[x]	[ ]
Hydric Soil Present?	[ ]	[x]
Wetland Hydrology Present?	[ ]	[x]

Is the Sampled Area within a Wetland? Yes [ ] No [x]

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- [ ] Surface Soil Cracks (B6)
- [ ] Sparsely Vegetated Concave Surface (B8)
- [ ] Drainage Patterns (B10)
- [ ] Moss Trim Lines (B16)
- [ ] Dry-Season Water Table (C2)
- [ ] Crayfish Burrows (C8)
- [ ] Saturation Visible on Aerial Imagery (C9)
- [ ] Geomorphic Position (D2)
- [ ] Shallow Aquitard (D3)
- [ ] FAC-Neutral Test (D5)
- [ ] Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?	[ ]	[x]	N/A
Water Table Present?	[ ]	[x]	>20
Saturation Present? (includes capillary fringe)	[ ]	[x]	>20

Wetland Hydrology Present? Yes [ ] No [x]

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

Remarks:

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

Sampling Point: NB4 Up

Tree Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Pinus taeda	20	Y	FAC
2. Liquidambar styraciflua	25	Y	FAC
3. Prunus serotina	10	N	FACU
4. Acer rubrum	35	Y	FAC
5.			
6.			
7.			
8.			
	90 = Total Cover		
50% of total cover: 45	20% of total cover: 18		

Sapling/Shrub Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Liquidambar styraciflua	5	Y	FAC
2. Quercus nigra	2	Y	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	7 = Total Cover		
50% of total cover: 3.5	20% of total cover: 1.4		

Herb Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Arundinaria tecta	5	N	FACW
2. Pteridium aquilinum	15	N	FACU
3. Panicum sp.	60	Y	N/A
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		
50% of total cover: 40	20% of total cover: 16		

Woody Vine Stratum (Plot size: 30' rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. Smilax rotundifolia	8	Y	FAC
2. Vitis rotundifolia	15	Y	FAC
3.			
4.			
5.			
	23 = Total Cover		
50% of total cover: 11.5	20% of total cover: 4.6		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 7 (A)

Total Number of Dominant Species Across All Strata: 7 (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]
- ☐ 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: (If observed, list morphological adaptations below).

SOIL

Sampling Point: NB4 Up

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 %	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 3/2						FS	30% coated
12->20	10YR 3/3	50					FS	mixed matrix
12->20	10YR 3/2	50					FS	weakly cemented

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: spodic

Depth (inches): 12->20

Hydric Soil Present? Yes ☐ No ☑

Remarks:

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: UT to Millers Creek City/County: Duplin Sampling Date: 7/30/13
Applicant/Owner: Florence & Hutcheson / Ryan Smith State: NC Sampling Point: NB4 Wet
Investigator(s): Corey Novak/Christian Preziosi - LMG Section, Township, Range: Magnolia
Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): concave Slope (%): 2
Subregion (LRR or MLRA): LRR T Lat: 34.895119 Long: -78.068749 Datum: NAD 83
Soil Map Unit Name: ToA - Torhunta mucky fine sandy loam, 0-1% slopes NWI classification: upland on map
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 ☐
Hydric Soil Present? Yes ☑ No ☐
Wetland Hydrology Present? Yes ☑ No ☐

Is the Sampled Area within a Wetland? Yes ☑ No ☐

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches): N/A
Water Table Present? Yes ☐ No ☑ Depth (inches): 14
Saturation Present? (includes capillary fringe) Yes ☐ No ☑ Depth (inches): 14

Wetland Hydrology Present? Yes ☑ **No** ☐

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

Remarks:

Dry-season water table not applicable due to abundant recent precipitation

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

Sampling Point: NB4 Wet

Tree Stratum (Plot size: 30' rad.)

	Absolute % Cover	Dominant Species?	Indicator Status
1. Magnolia virginiana	10	N	FACW
2. Acer rubrum	35	Y	FAC
3. Liquidambar styraciflua	20	Y	FAC
4. Pinus taeda	5	N	FAC
5. Persea borbonia	5	N	FACW
6.			
7.			
8.			
	75 = Total Cover		

50% of total cover: 37.5 20% of total cover: 15

Sapling/Shrub Stratum (Plot size: 30' rad.)

1. Acer rubrum	10	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	10 = Total Cover		

50% of total cover: 5 20% of total cover: 2

Herb Stratum (Plot size: 30' rad.)

1. Arundinaria tecta	60	Y	FACW
2. Woodwardia aereolata	12	N	OBL
3. Leucothoe axillaris	5	N	FACW
4. Panicum sp.	5	N	N/A
5. Persea borbonia	5	N	FACW
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	87 = Total Cover		

50% of total cover: 43.6 20% of total cover: 17.4

Woody Vine Stratum (Plot size: 30' rad.)

1. Smilax rotundifolia	10	Y	FAC
2.			
3.			
4.			
5.			
	10 = Total Cover		

50% of total cover: 5 20% of total cover: 2

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (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]
- ☐ 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: (If observed, list morphological adaptations below).

SOIL

Sampling Point: NB4 Wet

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 %	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 2/1	100					ML	
12-16	10YR 3/1	100					FSL	
16->18	10YR 4/1	100					CL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

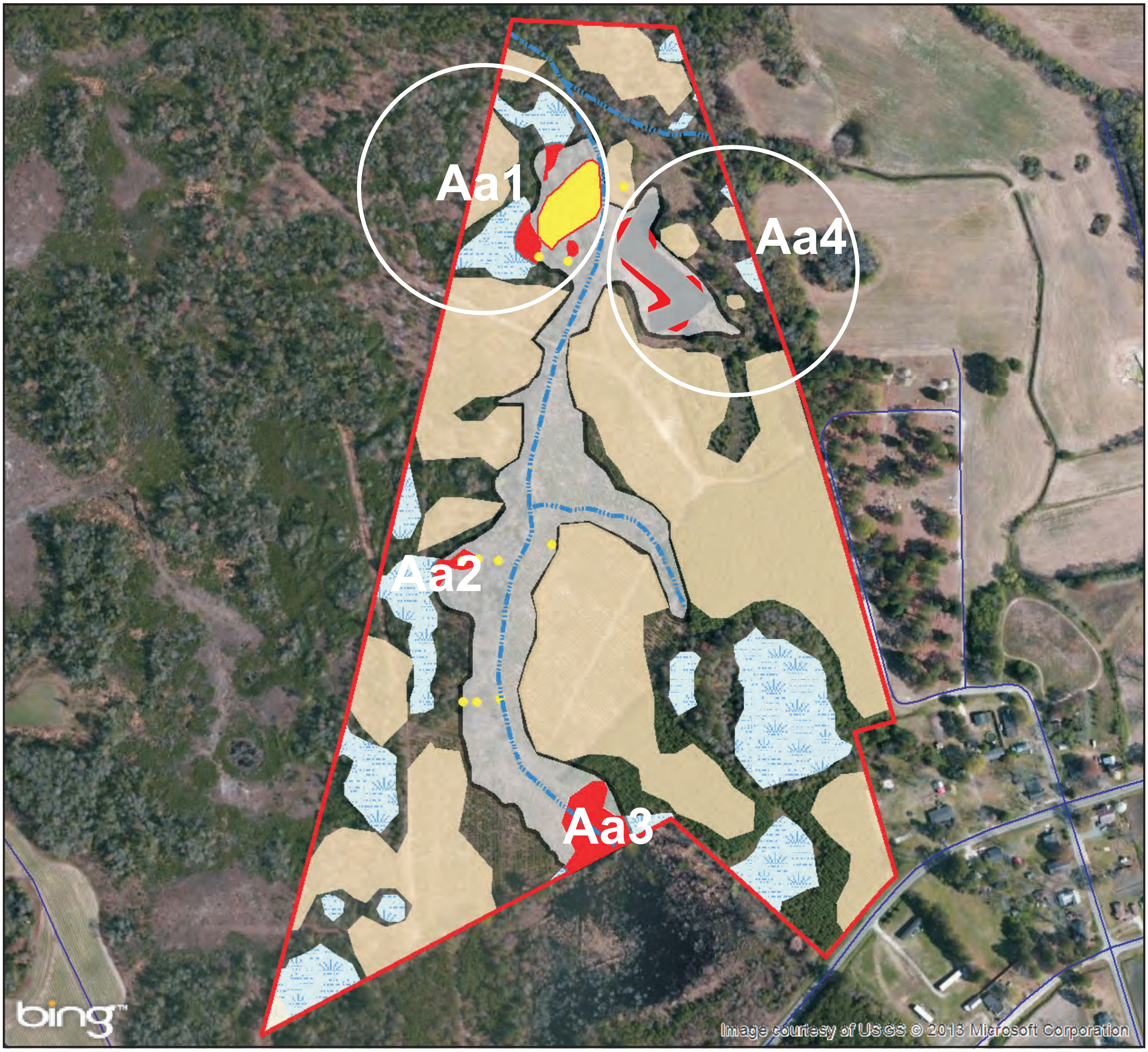
Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ☑ No ☐

Remarks:

B.2 NCWAM Data Forms



- Flagged Wetland Boundary (~7.8 Acres)
- Mapped Alluvium (Non-Hydric) (~0.5 Acres)
- Wetlands in Riparian Area (~ 1.08 Acres)
- Non-Hydric Soils
- Current Proposed Riparian Wetland Corridor
- Monitoring Gauge

NOTE: This is not a survey. All boundaries and distances are considered approximate. This represents a preliminary sketch prepared from field notes. A survey of delineated areas and review and approval by the US Army Corps of Engineers is recommended prior to specific site planning.

N

L:\WETLANDS\2013 WETLANDS FILES\40-13-064 --- UT to Millers Creek, Ryan Smith
Map Source: BING Aerial Photography

SCALE 1" = 400'

UT to Millers Creek Florence & Hutcheson Magnolia Tract Duplin County, NC March 2013	LMG LAND MANAGEMENT GROUP INC Environmental Consultants www.LMGroup.net Phone: 910.452.0001 •1.866.LMG.1078 Fax: 910.452.0060 P.O. Box 2522, Wilmington, NC 28402	NC WAM Assessment Areas

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 4.1
Rating Calculator Version 4.1

Wetland Site Name	UT to Millers Creek 1 - west of well 1	**Date**	7/8/13
Wetland Type	Bottomland Hardwood Forest	**Assessor Name/Organization**	Corey Novak / LMG
Level III Ecoregion	Middle Atlantic Coastal Plain	**Nearest Named Water Body**	Millers Creek
River Basin	Cape Fear	**USGS 8-Digit Catalogue Unit**	03030006
☐ **Yes** ☒ **No**	**Precipitation within 48 hrs?**	**Latitude/Longitude (deci-degrees)**	34.898521, -78.067897

Evidence of stressors affecting the assessment area (may not be within the assessment area)
Please circle and/or make note on the last page if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, within 10 years). Noteworthy stressors include, but are not limited to the following.

- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ☐ Yes ☒ No

Regulatory Considerations (select all that apply to the assessment area.)
☐ Anadromous fish
☐ Federally protected species or State endangered or threatened species
☐ NCDWQ riparian buffer rule in effect
☐ Abuts a Primary Nursery Area (PNA)
☐ Publicly owned property
☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
☐ Designated NCNHP reference community
☐ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (check all that apply)
☒ Blackwater
☐ Brownwater
☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

Is the assessment area on a coastal island? ☐ Yes ☒ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☐ Yes ☒ No

Does the assessment area experience overbank flooding during normal rainfall conditions? ☐ Yes ☒ No

1. **Ground Surface Condition/Vegetation Condition – assessment area condition metric**

Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence an effect.

GS	VS	
☒A	☒A	Not severely altered
☐B	☐B	Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], hydrologic alteration)

2. **Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric**

Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. Refer to the current NRCS lateral effect of ditching guidance for North Carolina hydric soils (see USACE Wilmington District website) for the zone of influence of ditches in hydric soils. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
☒A	☒A	Water storage capacity and duration are not altered.
☐B	☐B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
☐C	☐C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines).

3. **Water Storage/Surface Relief – assessment area/wetland type condition metric (answer for non-marsh wetlands only)**

Check a box in each column. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

	AA	WT	
3a.	☐A	☐A	Majority of wetland with depressions able to pond water > 1 deep
	☒B	☒B	Majority of wetland with depressions able to pond water 6 inches to 1 foot deep
	☐C	☐C	Majority of wetland with depressions able to pond water 3 to 6 inches deep
	☐D	☐D	Depressions able to pond water < 3 inches deep

3b. ☐A Evidence that maximum depth of inundation is greater than 2 feet
☐B Evidence that maximum depth of inundation is between 1 and 2 feet
☒C Evidence that maximum depth of inundation is less than 1 foot

4. **Soil Texture/Structure – assessment area condition metric**

Check a box from each of the three soil property groups below. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the top 12 inches. Use most recent National Technical Committee for Hydric Soils guidance for regional indicators.

4a. ☒A Sandy soil
☐B Loamy or clayey soils exhibiting redoximorphic features (concentrations, depletions, or rhizospheres)
☐C Loamy or clayey soils not exhibiting redoximorphic features
☐D Loamy or clayey gleyed soil
☐E Histosol or histic epipedon

4b. ☒A Soil ribbon < 1 inch
☐B Soil ribbon ≥ 1 inch

4c. ☐A No peat or muck presence
☒B A peat or muck presence

5. **Discharge into Wetland – opportunity metric**

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
☒A	☒A	Little or no evidence of pollutants or discharges entering the assessment area
☐B	☐B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
☐C	☐C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation, odor)

6. **Land Use – opportunity metric**

Check all that apply (at least one box in each column). Evaluation involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles and within the watershed draining to the assessment area (5M), and within 2 miles and within the watershed draining to the assessment area (2M).

WS	5M	2M	
☐A	☐A	☐A	≥ 10% impervious surfaces
☐B	☐B	☐B	< 10% impervious surfaces
☐C	☐C	☐C	Confined animal operations (or other local, concentrated source of pollutants
☐D	☐D	☐D	≥ 20% coverage of pasture
☐E	☐E	☐E	≥ 20% coverage of agricultural land (regularly plowed land)
☐F	☐F	☐F	≥ 20% coverage of maintained grass/herb
☐G	☐G	☐G	≥ 20% coverage of clear-cut land
☒H	☒H	☒H	Little or no opportunity to improve water quality. Lack of opportunity may result from hydrologic alterations that prevent drainage or overbank flow from affecting the assessment area.

7. **Wetland Acting as Vegetated Buffer – assessment area/wetland complex condition metric**

7a. Is assessment area within 50 feet of a tributary or other open water?
☐Yes ☒No If Yes, continue to 7b. If No, skip to Metric 8.
Wetland buffer need only be present on one side of the water body. Make buffer judgment based on the average width of wetland. Record a note if a portion of the buffer has been removed or disturbed.

7b. How much of the first 50 feet from the bank is wetland? Descriptor E should be selected if ditches effectively bypass the buffer.
☐A ≥ 50 feet
☐B From 30 to < 50 feet
☐C From 15 to < 30 feet
☐D From 5 to < 15 feet
☐E < 5 feet or buffer bypassed by ditches

7c. Tributary width. If the tributary is anastomosed, combine widths of channels/braids for a total width.
☐≤ 15-feet wide ☐> 15-feet wide ☐ Other open water (no tributary present)

7d. Do roots of assessment area vegetation extend into the bank of the tributary/open water?
☐Yes ☐No

7e. Is stream or other open water sheltered or exposed?
☐Sheltered – adjacent open water with width < 2500 feet and no regular boat traffic.
☐Exposed – adjacent open water with width ≥ 2500 feet or regular boat traffic.

8. **Wetland Width at the Assessment Area – wetland type/wetland complex condition metric (evaluate for riparian wetlands only)**

Check a box in each column for riverine wetlands only. Select the average width for the wetland type at the assessment area (WT) and the wetland complex at the assessment area (WC). See User Manual for WT and WC boundaries.

WT	WC	
☒A	☒A	≥ 100 feet
☐B	☐B	From 80 to < 100 feet
☐C	☐C	From 50 to < 80 feet
☐D	☐D	From 40 to < 50 feet
☐E	☐E	From 30 to < 40 feet
☐F	☐F	From 15 to < 30 feet
☐G	☐G	From 5 to < 15 feet
☐H	☐H	< 5 feet

9. **Inundation Duration – assessment area condition metric**

Answer for assessment area dominant landform.

☒A Evidence of short-duration inundation (< 7 consecutive days)
☐B Evidence of saturation, without evidence of inundation
☐C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

10. **Indicators of Deposition – assessment area condition metric**

Consider recent deposition only (no plant growth since deposition).

☒A Sediment deposition is not excessive, but at approximately natural levels.
☐B Sediment deposition is excessive, but not overwhelming the wetland.
☐C Sediment deposition is excessive and is overwhelming the wetland.

11. **Wetland Size – wetland type/wetland complex condition metric**

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the wetland complex (WC), and the size of the forested wetland (FW) (if applicable, see User Manual). See the User Manual for boundaries of these evaluation areas. If assessment area is clear-cut, select "K" for the FW column.

WT	WC	FW (if applicable)	
☐A	☐A	☐A	≥ 500 acres
☐B	☐B	☐B	From 100 to < 500 acres
☐C	☐C	☐C	From 50 to < 100 acres
☐D	☐D	☐D	From 25 to < 50 acres
☐E	☐E	☐E	From 10 to < 25 acres
☐F	☐F	☐F	From 5 to < 10 acres
☐G	☐G	☐G	From 1 to < 5 acres
☒H	☒H	☒H	From 0.5 to < 1 acre
☐I	☐I	☐I	From 0.1 to < 0.5 acre
☐J	☐J	☐J	From 0.01 to < 0.1 acre
☐K	☐K	☐K	< 0.01 acre or assessment area is clear-cut

12. **Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)**

☐A Pocosin is the full extent (≥ 90%) of its natural landscape size.
☐B Pocosin type is < 90% of the full extent of its natural landscape size.

13. **Connectivity to Other Natural Areas – landscape condition metric**

13a. **Check appropriate box(es) (a box may be checked in each column).** Involves a GIS effort with field adjustment. This metric evaluates whether the wetland is well connected (Well) and/or loosely connected (Loosely) to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate). Boundaries are formed by four-lane roads, regularly maintained utility line corridors the width of a four-lane road or wider, urban landscapes, maintained fields (pasture and agriculture), or open water > 300 feet wide.

Well	Loosely	
☒A	☐A	≥ 500 acres
☐B	☐B	From 100 to < 500 acres
☐C	☐C	From 50 to < 100 acres
☐D	☐D	From 10 to < 50 acres
☐E	☐E	< 10 acres
☐F	☐F	Wetland type has a poor or no connection to other natural habitats

13b. **Evaluate for marshes only**.

☐Yes ☐No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

14. **Edge Effect – wetland type condition metric (skip for all marshes)**

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include non-forested areas ≥ 40 feet wide such as fields, development, roads, regularly maintained utility line corridors, and clear-cuts. Consider the eight main points of the compass.

☒A No artificial edge within 150 feet in all directions
☐B No artificial edge within 150 feet in four (4) to seven (7) directions
☐C An artificial edge occurs within 150 feet in more than four (4) directions or assessment area is clear-cut

15. **Vegetative Composition – assessment area condition metric (skip for all marshes and Pine Flat)**

☐A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
☒B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
☐C
Vegetation severely altered from reference in composition. Expected species are unnaturally absent (planted stands of non-characteristic species or at least one stratum inappropriately composed of a single species). Exotic species are dominant in at least one stratum.

16. Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)

☐A Vegetation diversity is high and is composed primarily of native species (< 10% cover of exotics).
☐B Vegetation diversity is low or has > 10% to 50% cover of exotics.
☐C Vegetation is dominated by exotic species (> 50 % cover of exotics).

17. Vegetative Structure – assessment area/wetland type condition metric

17a. Is vegetation present?
☒Yes ☐No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of assessment area vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.
☐A ≥ 25% coverage of vegetation
☐B < 25% coverage of vegetation

17c. **Check a box in each column for each stratum**. Evaluate this portion of the metric **for non-marsh wetlands**. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

	AA	WT	
Canopy	☐A	☐A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
	☒B	☒B	Canopy present, but opened more than natural gaps
	☐C	☐C	Canopy sparse or absent
Mid-Story	☐A	☐A	Dense mid-story/sapling layer
	☒B	☒B	Moderate density mid-story/sapling layer
	☐C	☐C	Mid-story/sapling layer sparse or absent
Shrub	☒A	☒A	Dense shrub layer
	☐B	☐B	Moderate density shrub layer
	☐C	☐C	Shrub layer sparse or absent
Herb	☐A	☐A	Dense herb layer
	☒B	☒B	Moderate density herb layer
	☐C	☐C	Herb layer sparse or absent

18. Snags – wetland type condition metric

☐A Large snags (more than one) are visible (> 12 inches DBH, or large relative to species present and landscape stability).
☒B Not A

19. Diameter Class Distribution – wetland type condition metric

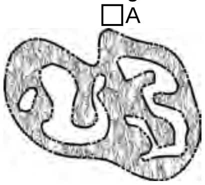
☐A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
☒B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12 inch DBH.
☐C Majority of canopy trees are < 6 inches DBH or no trees.

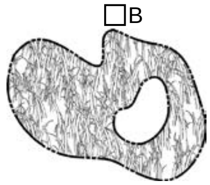
20. Large Woody Debris – wetland type condition metric

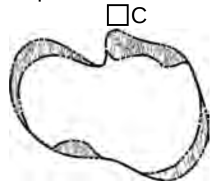
Include both natural debris and man-placed natural debris.
☐A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
☒B Not A

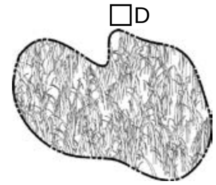
21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

☐A


☐B


☐C


☐D


22. Hydrologic Connectivity – assessment area condition metric (evaluate for riparian wetlands only)

Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision.
☐A Overbank <u>and</u> overland flow are not severely altered in the assessment area.
☒B Overbank flow is severely altered in the assessment area.
☐C Overland flow is severely altered in the assessment area.
☐D Both overbank <u>and</u> overland flow are severely altered in the assessment area.

Notes
Beaver activity has occurred in the past but is not currently widespread. Since this assessment area represents three wetland polygons, averages were used for wetland size. Overbank flow does not affect the assessment area since the on-site stream is channelized with spoil berms. Overland flow appears to be normal for this wetland type and was observed near well 1.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 4.1
Rating Calculator Version 4.1

Wetland Site Name	UT to Millers Creek 1 - west of well 1	Date of Assessment	7/8/13
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Corey Novak / LMG

Notes on Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	NO
Wetland is intensively managed (Y/N)	NO
Assessment area is located within 50 feet of a natural tributary or other open water (Y/N)	NO
Assessment area is substantially altered by beaver (Y/N)	NO
Assessment area experiences overbank flooding during normal rainfall conditions (Y/N)	NO
Assessment area is on a coastal island (Y/N)	NO

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**MEDIUM**
	Sub-surface Storage and Retention	Condition	**HIGH**
Water Quality	Pathogen Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Soluble Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Physical Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
Habitat	Physical Structure	Condition	**MEDIUM**
	Landscape Patch Structure	Condition	**HIGH**
	Vegetation Composition	Condition	**MEDIUM**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**HIGH**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**LOW**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**HIGH**

Overall Wetland Rating **HIGH**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 4.1
Rating Calculator Version 4.1

Wetland Site Name	UT to Millers Creek 2 - west of well 3	**Date**	7/8/13
Wetland Type	Bottomland Hardwood Forest	**Assessor Name/Organization**	Corey Novak / LMG
Level III Ecoregion	Middle Atlantic Coastal Plain	**Nearest Named Water Body**	Millers Creek
River Basin	Cape Fear	**USGS 8-Digit Catalogue Unit**	03030006
☐ **Yes** ☒ **No**	**Precipitation within 48 hrs?**	**Latitude/Longitude (deci-degrees)**	34.896110, -78.068651

Evidence of stressors affecting the assessment area (may not be within the assessment area)
Please circle and/or make note on the last page if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, within 10 years). Noteworthy stressors include, but are not limited to the following.
- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ☐ Yes ☒ No

Regulatory Considerations (select all that apply to the assessment area.)
☐ Anadromous fish
☐ Federally protected species or State endangered or threatened species
☐ NCDWQ riparian buffer rule in effect
☐ Abuts a Primary Nursery Area (PNA)
☐ Publicly owned property
☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
☐ Designated NCNHP reference community
☐ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (check all that apply)
☒ Blackwater
☐ Brownwater
☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

Is the assessment area on a coastal island? ☐ Yes ☒ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☐ Yes ☒ No
Does the assessment area experience overbank flooding during normal rainfall conditions? ☐ Yes ☒ No

1. Ground Surface Condition/Vegetation Condition – assessment area condition metric

Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence an effect.

GS	VS	
☒A	☒A	Not severely altered
☐B	☐B	Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], hydrologic alteration)

2. Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric

Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. Refer to the current NRCS lateral effect of ditching guidance for North Carolina hydric soils (see USACE Wilmington District website) for the zone of influence of ditches in hydric soils. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
☒A	☒A	Water storage capacity and duration are not altered.
☐B	☐B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
☐C	☐C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines).

3. Water Storage/Surface Relief – assessment area/wetland type condition metric (answer for non-marsh wetlands only)

Check a box in each column. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

	AA	WT	
3a.	☐A	☐A	Majority of wetland with depressions able to pond water > 1 deep
	☐B	☐B	Majority of wetland with depressions able to pond water 6 inches to 1 foot deep
	☒C	☒C	Majority of wetland with depressions able to pond water 3 to 6 inches deep
	☐D	☐D	Depressions able to pond water < 3 inches deep

3b. ☐A Evidence that maximum depth of inundation is greater than 2 feet
☐B Evidence that maximum depth of inundation is between 1 and 2 feet
☒C Evidence that maximum depth of inundation is less than 1 foot

4. Soil Texture/Structure – assessment area condition metric

Check a box from each of the three soil property groups below. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the top 12 inches. Use most recent National Technical Committee for Hydric Soils guidance for regional indicators.

4a. ☒A Sandy soil
☐B Loamy or clayey soils exhibiting redoximorphic features (concentrations, depletions, or rhizospheres)
☐C Loamy or clayey soils not exhibiting redoximorphic features
☐D Loamy or clayey gleyed soil
☐E Histosol or histic epipedon

4b. ☒A Soil ribbon < 1 inch
☐B Soil ribbon ≥ 1 inch

4c. ☐A No peat or muck presence
☒B A peat or muck presence

5. Discharge into Wetland – opportunity metric

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
☒A	☒A	Little or no evidence of pollutants or discharges entering the assessment area
☐B	☐B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
☐C	☐C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation, odor)

6. Land Use – opportunity metric

Check all that apply (at least one box in each column). Evaluation involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles <u>and</u> within the watershed draining to the assessment area (5M), <u>and</u> within 2 miles and within the watershed draining to the assessment area (2M).

WS	5M	2M	
☐A	☐A	☐A	≥ 10% impervious surfaces
☐B	☐B	☐B	< 10% impervious surfaces
☐C	☐C	☐C	Confined animal operations (or other local, concentrated source of pollutants
☐D	☐D	☐D	≥ 20% coverage of pasture
☐E	☐E	☐E	≥ 20% coverage of agricultural land (regularly plowed land)
☐F	☐F	☐F	≥ 20% coverage of maintained grass/herb
☐G	☐G	☐G	≥ 20% coverage of clear-cut land
☒H	☒H	☒H	Little or no opportunity to improve water quality. Lack of opportunity may result from hydrologic alterations that prevent drainage or overbank flow from affecting the assessment area.

7. Wetland Acting as Vegetated Buffer – assessment area/wetland complex condition metric

7a. Is assessment area within 50 feet of a tributary or other open water?
☐Yes ☒No If Yes, continue to 7b. If No, skip to Metric 8.
Wetland buffer need only be present on one side of the water body. Make buffer judgment based on the average width of wetland. Record a note if a portion of the buffer has been removed or disturbed.

7b. How much of the first 50 feet from the bank is wetland? Descriptor E should be selected if ditches effectively bypass the buffer.
☐A ≥ 50 feet
☐B From 30 to < 50 feet
☐C From 15 to < 30 feet
☐D From 5 to < 15 feet
☐E < 5 feet <u>or</u> buffer bypassed by ditches

7c. Tributary width. If the tributary is anastomosed, combine widths of channels/braids for a total width.
☐≤ 15-feet wide ☐> 15-feet wide ☐ Other open water (no tributary present)

7d. Do roots of assessment area vegetation extend into the bank of the tributary/open water?
☐Yes ☐No

7e. Is stream or other open water sheltered or exposed?
☐Sheltered – adjacent open water with width < 2500 feet <u>and</u> no regular boat traffic.
☐Exposed – adjacent open water with width ≥ 2500 feet <u>or</u> regular boat traffic.

8. Wetland Width at the Assessment Area – wetland type/wetland complex condition metric (evaluate for riparian wetlands only)

Check a box in each column for riverine wetlands only. Select the average width for the wetland type at the assessment area (WT) and the wetland complex at the assessment area (WC). See User Manual for WT and WC boundaries.

WT	WC	
☒A	☒A	≥ 100 feet
☐B	☐B	From 80 to < 100 feet
☐C	☐C	From 50 to < 80 feet
☐D	☐D	From 40 to < 50 feet
☐E	☐E	From 30 to < 40 feet
☐F	☐F	From 15 to < 30 feet
☐G	☐G	From 5 to < 15 feet
☐H	☐H	< 5 feet

9. Inundation Duration – assessment area condition metric

Answer for assessment area dominant landform.
- ☒A Evidence of short-duration inundation (< 7 consecutive days)
- ☐B Evidence of saturation, without evidence of inundation
- ☐C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

10. Indicators of Deposition – assessment area condition metric

Consider recent deposition only (no plant growth since deposition).
- ☒A Sediment deposition is not excessive, but at approximately natural levels.
- ☐B Sediment deposition is excessive, but not overwhelming the wetland.
- ☐C Sediment deposition is excessive and is overwhelming the wetland.

11. Wetland Size – wetland type/wetland complex condition metric

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the wetland complex (WC), and the size of the forested wetland (FW) (if applicable, see User Manual). See the User Manual for boundaries of these evaluation areas. If assessment area is clear-cut, select "K" for the FW column.

WT	WC	FW (if applicable)	
☐A	☐A	☐A	≥ 500 acres
☐B	☐B	☐B	From 100 to < 500 acres
☐C	☐C	☐C	From 50 to < 100 acres
☒D	☒D	☒D	From 25 to < 50 acres
☐E	☐E	☐E	From 10 to < 25 acres
☐F	☐F	☐F	From 5 to < 10 acres
☐G	☐G	☐G	From 1 to < 5 acres
☐H	☐H	☐H	From 0.5 to < 1 acre
☐I	☐I	☐I	From 0.1 to < 0.5 acre
☐J	☐J	☐J	From 0.01 to < 0.1 acre
☐K	☐K	☐K	< 0.01 acre <u>or</u> assessment area is clear-cut

12. Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)
- ☐A Pocosin is the full extent (≥ 90%) of its natural landscape size.
- ☐B Pocosin type is < 90% of the full extent of its natural landscape size.

13. Connectivity to Other Natural Areas – landscape condition metric

13a. **Check appropriate box(es) (a box may be checked in each column).** Involves a GIS effort with field adjustment. This metric evaluates whether the wetland is well connected (Well) and/or loosely connected (Loosely) to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate). Boundaries are formed by four-lane roads, regularly maintained utility line corridors the width of a four-lane road or wider, urban landscapes, maintained fields (pasture and agriculture), or open water > 300 feet wide.

Well	Loosely	
☒A	☐A	≥ 500 acres
☐B	☐B	From 100 to < 500 acres
☐C	☐C	From 50 to < 100 acres
☐D	☐D	From 10 to < 50 acres
☐E	☐E	< 10 acres
☐F	☐F	Wetland type has a poor or no connection to other natural habitats

13b. **Evaluate for marshes only**.
☐Yes ☐No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

14. Edge Effect – wetland type condition metric (skip for all marshes)

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include non-forested areas ≥ 40 feet wide such as fields, development, roads, regularly maintained utility line corridors, and clear-cuts. Consider the eight main points of the compass.
- ☒A No artificial edge within 150 feet in all directions
- ☐B No artificial edge within 150 feet in four (4) to seven (7) directions
- ☐C An artificial edge occurs within 150 feet in more than four (4) directions <u>or</u> assessment area is clear-cut

15. Vegetative Composition – assessment area condition metric (skip for all marshes and Pine Flat)
- ☐A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
- ☒B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
- ☐C

Vegetation severely altered from reference in composition. Expected species are unnaturally absent (planted stands of non-characteristic species or at least one stratum inappropriately composed of a single species). Exotic species are dominant in at least one stratum.

16. Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)
- ☐A Vegetation diversity is high and is composed primarily of native species (< 10% cover of exotics).
- ☐B Vegetation diversity is low or has > 10% to 50% cover of exotics.
- ☐C Vegetation is dominated by exotic species (> 50 % cover of exotics).

17. Vegetative Structure – assessment area/wetland type condition metric

17a. Is vegetation present?
☒Yes ☐No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of assessment area vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.
☐A ≥ 25% coverage of vegetation
☐B < 25% coverage of vegetation

17c. **Check a box in each column for each stratum**. Evaluate this portion of the metric **for non-marsh wetlands**. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

	AA	WT	
Canopy	☐A	☐A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
	☒B	☒B	Canopy present, but opened more than natural gaps
	☐C	☐C	Canopy sparse or absent
Mid-Story	☐A	☐A	Dense mid-story/sapling layer
	☒B	☒B	Moderate density mid-story/sapling layer
	☐C	☐C	Mid-story/sapling layer sparse or absent
Shrub	☒A	☒A	Dense shrub layer
	☐B	☐B	Moderate density shrub layer
	☐C	☐C	Shrub layer sparse or absent
Herb	☐A	☐A	Dense herb layer
	☒B	☒B	Moderate density herb layer
	☐C	☐C	Herb layer sparse or absent

18. Snags – wetland type condition metric

☐A Large snags (more than one) are visible (> 12 inches DBH, or large relative to species present and landscape stability).
☒B Not A

19. Diameter Class Distribution – wetland type condition metric

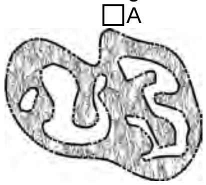
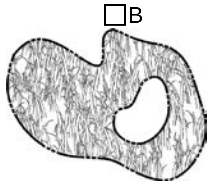
☐A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
☒B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12 inch DBH.
☐C Majority of canopy trees are < 6 inches DBH or no trees.

20. Large Woody Debris – wetland type condition metric

Include both natural debris and man-placed natural debris.
☐A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
☒B Not A

21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

☐A

☐B

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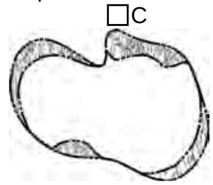
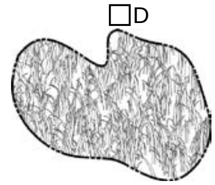

☐D


22. Hydrologic Connectivity – assessment area condition metric (evaluate for riparian wetlands only)

Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision.
☐A Overbank <u>and</u> overland flow are not severely altered in the assessment area.
☒B Overbank flow is severely altered in the assessment area.
☐C Overland flow is severely altered in the assessment area.
☐D Both overbank <u>and</u> overland flow are severely altered in the assessment area.

Notes
Beaver activity has occurred in the past but is not currently widespread. Overbank flow does not affect the assessment area since the on-site stream is channelized with spoil berms. Overland flow appears to be normal for this wetland type, although the assessment was conducted after above normal precipitation. Soil is mucky fine sand.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 4.1
Rating Calculator Version 4.1

Wetland Site Name	UT to Millers Creek 2 - west of well 3	Date of Assessment	7/8/13
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Corey Novak / LMG

Notes on Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	NO
Wetland is intensively managed (Y/N)	NO
Assessment area is located within 50 feet of a natural tributary or other open water (Y/N)	NO
Assessment area is substantially altered by beaver (Y/N)	NO
Assessment area experiences overbank flooding during normal rainfall conditions (Y/N)	NO
Assessment area is on a coastal island (Y/N)	NO

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**MEDIUM**
	Sub-surface Storage and Retention	Condition	**HIGH**
Water Quality	Pathogen Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Soluble Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Physical Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
Habitat	Physical Structure	Condition	**MEDIUM**
	Landscape Patch Structure	Condition	**HIGH**
	Vegetation Composition	Condition	**MEDIUM**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**HIGH**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**LOW**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**HIGH**

Overall Wetland Rating **HIGH**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 4.1
Rating Calculator Version 4.1

Wetland Site Name	UT to Millers Creek 3 - south boundary	**Date**	7/8/13
Wetland Type	Bottomland Hardwood Forest	**Assessor Name/Organization**	Corey Novak / LMG
Level III Ecoregion	Middle Atlantic Coastal Plain	**Nearest Named Water Body**	Millers Creek
River Basin	Cape Fear	**USGS 8-Digit Catalogue Unit**	03030006
☐ **Yes** ☒ **No**	**Precipitation within 48 hrs?**	**Latitude/Longitude (deci-degrees)**	34.894431, -78.067295

Evidence of stressors affecting the assessment area (may not be within the assessment area)
Please circle and/or make note on the last page if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, within 10 years). Noteworthy stressors include, but are not limited to the following.
- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ☐ Yes ☒ No

Regulatory Considerations (select all that apply to the assessment area.)
☐ Anadromous fish
☐ Federally protected species or State endangered or threatened species
☐ NCDWQ riparian buffer rule in effect
☐ Abuts a Primary Nursery Area (PNA)
☐ Publicly owned property
☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
☐ Designated NCNHP reference community
☐ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (check all that apply)
☒ Blackwater
☐ Brownwater
☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

Is the assessment area on a coastal island? ☐ Yes ☒ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☒ Yes ☐ No
Does the assessment area experience overbank flooding during normal rainfall conditions? ☐ Yes ☒ No

1. Ground Surface Condition/Vegetation Condition – assessment area condition metric

Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence an effect.

GS	VS	
☒A	☐A	Not severely altered
☐B	☒B	Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], hydrologic alteration)

2. Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric

Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. Refer to the current NRCS lateral effect of ditching guidance for North Carolina hydric soils (see USACE Wilmington District website) for the zone of influence of ditches in hydric soils. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
☐A	☐A	Water storage capacity and duration are not altered.
☒B	☒B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
☐C	☐C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines).

3. Water Storage/Surface Relief – assessment area/wetland type condition metric (answer for non-marsh wetlands only)

Check a box in each column. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

	AA	WT	
3a.	☐A	☐A	Majority of wetland with depressions able to pond water > 1 deep
	☐B	☐B	Majority of wetland with depressions able to pond water 6 inches to 1 foot deep
	☒C	☒C	Majority of wetland with depressions able to pond water 3 to 6 inches deep
	☐D	☐D	Depressions able to pond water < 3 inches deep

3b. ☐A Evidence that maximum depth of inundation is greater than 2 feet
☐B Evidence that maximum depth of inundation is between 1 and 2 feet
☒C Evidence that maximum depth of inundation is less than 1 foot

4. Soil Texture/Structure – assessment area condition metric

Check a box from each of the three soil property groups below. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the top 12 inches. Use most recent National Technical Committee for Hydric Soils guidance for regional indicators.

4a. ☐A Sandy soil
☒B Loamy or clayey soils exhibiting redoximorphic features (concentrations, depletions, or rhizospheres)
☐C Loamy or clayey soils not exhibiting redoximorphic features
☐D Loamy or clayey gleyed soil
☐E Histosol or histic epipedon

4b. ☐A Soil ribbon < 1 inch
☒B Soil ribbon ≥ 1 inch

4c. ☒A No peat or muck presence
☐B A peat or muck presence

5. Discharge into Wetland – opportunity metric

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
☒A	☒A	Little or no evidence of pollutants or discharges entering the assessment area
☐B	☐B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
☐C	☐C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation, odor)

6. Land Use – opportunity metric

Check all that apply (at least one box in each column). Evaluation involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles <u>and</u> within the watershed draining to the assessment area (5M), <u>and</u> within 2 miles and within the watershed draining to the assessment area (2M).

WS	5M	2M	
☒A	☒A	☒A	≥ 10% impervious surfaces
☐B	☐B	☐B	< 10% impervious surfaces
☐C	☐C	☐C	Confined animal operations (or other local, concentrated source of pollutants
☐D	☐D	☐D	≥ 20% coverage of pasture
☐E	☐E	☐E	≥ 20% coverage of agricultural land (regularly plowed land)
☐F	☐F	☐F	≥ 20% coverage of maintained grass/herb
☐G	☐G	☐G	≥ 20% coverage of clear-cut land
☐H	☐H	☐H	Little or no opportunity to improve water quality. Lack of opportunity may result from hydrologic alterations that prevent drainage or overbank flow from affecting the assessment area.

7. Wetland Acting as Vegetated Buffer – assessment area/wetland complex condition metric

7a. Is assessment area within 50 feet of a tributary or other open water?
☒Yes ☐No If Yes, continue to 7b. If No, skip to Metric 8.
Wetland buffer need only be present on one side of the water body. Make buffer judgment based on the average width of wetland. Record a note if a portion of the buffer has been removed or disturbed.

7b. How much of the first 50 feet from the bank is wetland? Descriptor E should be selected if ditches effectively bypass the buffer.
☒A ≥ 50 feet
☐B From 30 to < 50 feet
☐C From 15 to < 30 feet
☐D From 5 to < 15 feet
☐E < 5 feet <u>or</u> buffer bypassed by ditches

7c. Tributary width. If the tributary is anastomosed, combine widths of channels/braids for a total width.
☒≤ 15-feet wide ☐> 15-feet wide ☐ Other open water (no tributary present)

7d. Do roots of assessment area vegetation extend into the bank of the tributary/open water?
☒Yes ☐No

7e. Is stream or other open water sheltered or exposed?
☒Sheltered – adjacent open water with width < 2500 feet <u>and</u> no regular boat traffic.
☐Exposed – adjacent open water with width ≥ 2500 feet <u>or</u> regular boat traffic.

8. Wetland Width at the Assessment Area – wetland type/wetland complex condition metric (evaluate for riparian wetlands only)

Check a box in each column for riverine wetlands only. Select the average width for the wetland type at the assessment area (WT) and the wetland complex at the assessment area (WC). See User Manual for WT and WC boundaries.

WT	WC	
☒A	☒A	≥ 100 feet
☐B	☐B	From 80 to < 100 feet
☐C	☐C	From 50 to < 80 feet
☐D	☐D	From 40 to < 50 feet
☐E	☐E	From 30 to < 40 feet
☐F	☐F	From 15 to < 30 feet
☐G	☐G	From 5 to < 15 feet
☐H	☐H	< 5 feet

9. Inundation Duration – assessment area condition metric

Answer for assessment area dominant landform.

☒A Evidence of short-duration inundation (< 7 consecutive days)
☐B Evidence of saturation, without evidence of inundation
☐C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

10. Indicators of Deposition – assessment area condition metric

Consider recent deposition only (no plant growth since deposition).

☒A Sediment deposition is not excessive, but at approximately natural levels.
☐B Sediment deposition is excessive, but not overwhelming the wetland.
☐C Sediment deposition is excessive and is overwhelming the wetland.

11. Wetland Size – wetland type/wetland complex condition metric

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the wetland complex (WC), and the size of the forested wetland (FW) (if applicable, see User Manual). See the User Manual for boundaries of these evaluation areas. If assessment area is clear-cut, select "K" for the FW column.

WT	WC	FW (if applicable)	
☐A	☒A	☐A	≥ 500 acres
☐B	☐B	☐B	From 100 to < 500 acres
☐C	☐C	☐C	From 50 to < 100 acres
☐D	☐D	☐D	From 25 to < 50 acres
☒E	☐E	☐E	From 10 to < 25 acres
☐F	☐F	☐F	From 5 to < 10 acres
☐G	☐G	☐G	From 1 to < 5 acres
☐H	☐H	☐H	From 0.5 to < 1 acre
☐I	☐I	☐I	From 0.1 to < 0.5 acre
☐J	☐J	☐J	From 0.01 to < 0.1 acre
☐K	☐K	☒K	< 0.01 acre or assessment area is clear-cut

12. Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)

☐A Pocosin is the full extent (≥ 90%) of its natural landscape size.
☐B Pocosin type is < 90% of the full extent of its natural landscape size.

13. Connectivity to Other Natural Areas – landscape condition metric

13a. **Check appropriate box(es) (a box may be checked in each column).** Involves a GIS effort with field adjustment. This metric evaluates whether the wetland is well connected (Well) and/or loosely connected (Loosely) to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate). Boundaries are formed by four-lane roads, regularly maintained utility line corridors the width of a four-lane road or wider, urban landscapes, maintained fields (pasture and agriculture), or open water > 300 feet wide.

Well	Loosely	
☒A	☐A	≥ 500 acres
☐B	☐B	From 100 to < 500 acres
☐C	☐C	From 50 to < 100 acres
☐D	☐D	From 10 to < 50 acres
☐E	☐E	< 10 acres
☐F	☐F	Wetland type has a poor or no connection to other natural habitats

13b. **Evaluate for marshes only**.
☐Yes ☐No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

14. Edge Effect – wetland type condition metric (skip for all marshes)

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include non-forested areas ≥ 40 feet wide such as fields, development, roads, regularly maintained utility line corridors, and clear-cuts. Consider the eight main points of the compass.

☒A No artificial edge within 150 feet in all directions
☐B No artificial edge within 150 feet in four (4) to seven (7) directions
☐C An artificial edge occurs within 150 feet in more than four (4) directions or assessment area is clear-cut

15. Vegetative Composition – assessment area condition metric (skip for all marshes and Pine Flat)

☐A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
☐B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
☒C
Vegetation severely altered from reference in composition. Expected species are unnaturally absent (planted stands of non-characteristic species or at least one stratum inappropriately composed of a single species). Exotic species are dominant in at least one stratum.

16. Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)

☐A Vegetation diversity is high and is composed primarily of native species (< 10% cover of exotics).
☐B Vegetation diversity is low or has > 10% to 50% cover of exotics.
☐C Vegetation is dominated by exotic species (> 50 % cover of exotics).

17. Vegetative Structure – assessment area/wetland type condition metric

17a. Is vegetation present?
☒Yes ☐No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of assessment area vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.
☐A ≥ 25% coverage of vegetation
☐B < 25% coverage of vegetation

17c. **Check a box in each column for each stratum**. Evaluate this portion of the metric **for non-marsh wetlands**. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

	AA	WT	
Canopy	☐A	☐A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
	☐B	☐B	Canopy present, but opened more than natural gaps
	☒C	☒C	Canopy sparse or absent
Mid-Story	☐A	☐A	Dense mid-story/sapling layer
	☐B	☐B	Moderate density mid-story/sapling layer
	☒C	☒C	Mid-story/sapling layer sparse or absent
Shrub	☐A	☐A	Dense shrub layer
	☐B	☐B	Moderate density shrub layer
	☒C	☒C	Shrub layer sparse or absent
Herb	☒A	☒A	Dense herb layer
	☐B	☐B	Moderate density herb layer
	☐C	☐C	Herb layer sparse or absent

18. Snags – wetland type condition metric

☒A Large snags (more than one) are visible (> 12 inches DBH, or large relative to species present and landscape stability).
☐B Not A

19. Diameter Class Distribution – wetland type condition metric

☐A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
☐B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12 inch DBH.
☒C Majority of canopy trees are < 6 inches DBH or no trees.

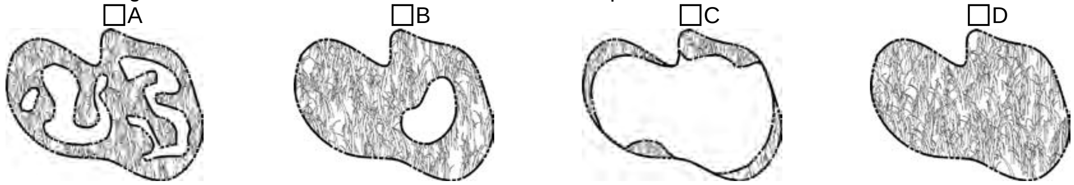
20. Large Woody Debris – wetland type condition metric

Include both natural debris and man-placed natural debris.
☐A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
☒B Not A

21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

☐A ☐B ☐C ☐D



22. Hydrologic Connectivity – assessment area condition metric (evaluate for riparian wetlands only)

Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision.
☐A Overbank <u>and</u> overland flow are not severely altered in the assessment area.
☐B Overbank flow is severely altered in the assessment area.
☐C Overland flow is severely altered in the assessment area.
☒D Both overbank <u>and</u> overland flow are severely altered in the assessment area.

Notes
Beavers were active in the area at the time of the site visit. Overbank and overland flow are altered by channelization, beaver dams, and stream incision. The entire upstream watershed is within 2 miles.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 4.1
Rating Calculator Version 4.1

Wetland Site Name	UT to Millers Creek 3 - south boundary	Date of Assessment	7/8/13
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Corey Novak / LMG

Notes on Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	NO
Wetland is intensively managed (Y/N)	NO
Assessment area is located within 50 feet of a natural tributary or other open water (Y/N)	YES
Assessment area is substantially altered by beaver (Y/N)	YES
Assessment area experiences overbank flooding during normal rainfall conditions (Y/N)	NO
Assessment area is on a coastal island (Y/N)	NO

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**LOW**
	Sub-surface Storage and Retention	Condition	**LOW**
Water Quality	Pathogen Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Soluble Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Physical Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
Habitat	Physical Structure	Condition	**LOW**
	Landscape Patch Structure	Condition	**HIGH**
	Vegetation Composition	Condition	**LOW**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**LOW**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**LOW**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**LOW**

Overall Wetland Rating **LOW**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 4.1
Rating Calculator Version 4.1

Wetland Site Name	UT to Millers Creek 4 - Pond Fringe	**Date**	7/8/13
Wetland Type	Non-Tidal Freshwater Marsh	**Assessor Name/Organization**	Corey Novak / LMG
Level III Ecoregion	Middle Atlantic Coastal Plain	**Nearest Named Water Body**	Millers Creek
River Basin	Cape Fear	**USGS 8-Digit Catalogue Unit**	03030006
☐ **Yes** ☒ **No**	**Precipitation within 48 hrs?**	**Latitude/Longitude (deci-degrees)**	34.898256, -78.066892

Evidence of stressors affecting the assessment area (may not be within the assessment area)
Please circle and/or make note on the last page if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, within 10 years). Noteworthy stressors include, but are not limited to the following.

- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ☐ Yes ☒ No

Regulatory Considerations (select all that apply to the assessment area.)
☐ Anadromous fish
☐ Federally protected species or State endangered or threatened species
☐ NCDWQ riparian buffer rule in effect
☐ Abuts a Primary Nursery Area (PNA)
☐ Publicly owned property
☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
☐ Designated NCNHP reference community
☐ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (check all that apply)
☒ Blackwater
☐ Brownwater
☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

Is the assessment area on a coastal island? ☐ Yes ☒ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☐ Yes ☒ No

Does the assessment area experience overbank flooding during normal rainfall conditions? ☐ Yes ☒ No

1. Ground Surface Condition/Vegetation Condition – assessment area condition metric

Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence an effect.

GS	VS	
☐A	☒A	Not severely altered
☒B	☐B	Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], hydrologic alteration)

2. Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric

Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. Refer to the current NRCS lateral effect of ditching guidance for North Carolina hydric soils (see USACE Wilmington District website) for the zone of influence of ditches in hydric soils. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
☒A	☒A	Water storage capacity and duration are not altered.
☐B	☐B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
☐C	☐C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines).

3. Water Storage/Surface Relief – assessment area/wetland type condition metric (answer for non-marsh wetlands only)

Check a box in each column. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

	AA	WT	
3a.	☐A	☐A	Majority of wetland with depressions able to pond water > 1 deep
	☐B	☐B	Majority of wetland with depressions able to pond water 6 inches to 1 foot deep
	☐C	☐C	Majority of wetland with depressions able to pond water 3 to 6 inches deep
	☐D	☐D	Depressions able to pond water < 3 inches deep

3b. ☐A Evidence that maximum depth of inundation is greater than 2 feet
☐B Evidence that maximum depth of inundation is between 1 and 2 feet
☐C Evidence that maximum depth of inundation is less than 1 foot

4. **Soil Texture/Structure – assessment area condition metric**

Check a box from each of the three soil property groups below. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the top 12 inches. Use most recent National Technical Committee for Hydric Soils guidance for regional indicators.

4a. ☐A Sandy soil
☐B Loamy or clayey soils exhibiting redoximorphic features (concentrations, depletions, or rhizospheres)
☒C Loamy or clayey soils not exhibiting redoximorphic features
☐D Loamy or clayey gleyed soil
☐E Histosol or histic epipedon

4b. ☐A Soil ribbon < 1 inch
☒B Soil ribbon ≥ 1 inch

4c. ☐A No peat or muck presence
☒B A peat or muck presence

5. **Discharge into Wetland – opportunity metric**

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
☒A	☒A	Little or no evidence of pollutants or discharges entering the assessment area
☐B	☐B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
☐C	☐C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation, odor)

6. **Land Use – opportunity metric**

Check all that apply (at least one box in each column). Evaluation involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles <u>and</u> within the watershed draining to the assessment area (5M), <u>and</u> within 2 miles and within the watershed draining to the assessment area (2M).

WS	5M	2M	
☐A	☐A	☐A	≥ 10% impervious surfaces
☐B	☐B	☐B	< 10% impervious surfaces
☐C	☐C	☐C	Confined animal operations (or other local, concentrated source of pollutants
☐D	☐D	☐D	≥ 20% coverage of pasture
☐E	☐E	☐E	≥ 20% coverage of agricultural land (regularly plowed land)
☐F	☐F	☐F	≥ 20% coverage of maintained grass/herb
☐G	☐G	☐G	≥ 20% coverage of clear-cut land
☒H	☒H	☒H	Little or no opportunity to improve water quality. Lack of opportunity may result from hydrologic alterations that prevent drainage or overbank flow from affecting the assessment area.

7. **Wetland Acting as Vegetated Buffer – assessment area/wetland complex condition metric**

7a. Is assessment area within 50 feet of a tributary or other open water?
☒Yes ☐No If Yes, continue to 7b. If No, skip to Metric 8.
Wetland buffer need only be present on one side of the water body. Make buffer judgment based on the average width of wetland. Record a note if a portion of the buffer has been removed or disturbed.

7b. How much of the first 50 feet from the bank is wetland? Descriptor E should be selected if ditches effectively bypass the buffer.
☐A ≥ 50 feet
☐B From 30 to < 50 feet
☐C From 15 to < 30 feet
☐D From 5 to < 15 feet
☒E < 5 feet <u>or</u> buffer bypassed by ditches

7c. Tributary width. If the tributary is anastomosed, combine widths of channels/braids for a total width.
☐≤ 15-feet wide ☐> 15-feet wide ☒ Other open water (no tributary present)

7d. Do roots of assessment area vegetation extend into the bank of the tributary/open water?
☒Yes ☐No

7e. Is stream or other open water sheltered or exposed?
☒Sheltered – adjacent open water with width < 2500 feet <u>and</u> no regular boat traffic.
☐Exposed – adjacent open water with width ≥ 2500 feet <u>or</u> regular boat traffic.

8. **Wetland Width at the Assessment Area – wetland type/wetland complex condition metric (evaluate for riparian wetlands only)**

Check a box in each column for riverine wetlands only. Select the average width for the wetland type at the assessment area (WT) and the wetland complex at the assessment area (WC). See User Manual for WT and WC boundaries.

WT	WC	
☐A	☐A	≥ 100 feet
☐B	☐B	From 80 to < 100 feet
☐C	☐C	From 50 to < 80 feet
☐D	☐D	From 40 to < 50 feet
☐E	☐E	From 30 to < 40 feet
☐F	☐F	From 15 to < 30 feet
☒G	☒G	From 5 to < 15 feet
☐H	☐H	< 5 feet

9. **Inundation Duration – assessment area condition metric**

Answer for assessment area dominant landform.
☐A Evidence of short-duration inundation (< 7 consecutive days)
☒B Evidence of saturation, without evidence of inundation
☐C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

10. **Indicators of Deposition – assessment area condition metric**

Consider recent deposition only (no plant growth since deposition).
☒A Sediment deposition is not excessive, but at approximately natural levels.
☐B Sediment deposition is excessive, but not overwhelming the wetland.
☐C Sediment deposition is excessive and is overwhelming the wetland.

11. **Wetland Size – wetland type/wetland complex condition metric**

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the wetland complex (WC), and the size of the forested wetland (FW) (if applicable, see User Manual). See the User Manual for boundaries of these evaluation areas. If assessment area is clear-cut, select "K" for the FW column.

WT	WC	FW (if applicable)	
☐A	☐A	☐A	≥ 500 acres
☐B	☐B	☐B	From 100 to < 500 acres
☐C	☐C	☐C	From 50 to < 100 acres
☐D	☐D	☐D	From 25 to < 50 acres
☐E	☐E	☐E	From 10 to < 25 acres
☐F	☐F	☐F	From 5 to < 10 acres
☐G	☐G	☐G	From 1 to < 5 acres
☐H	☐H	☐H	From 0.5 to < 1 acre
☒I	☒I	☐I	From 0.1 to < 0.5 acre
☐J	☐J	☐J	From 0.01 to < 0.1 acre
☐K	☐K	☒K	< 0.01 acre or assessment area is clear-cut

12. **Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)**

☐A Pocosin is the full extent (≥ 90%) of its natural landscape size.
☐B Pocosin type is < 90% of the full extent of its natural landscape size.

13. **Connectivity to Other Natural Areas – landscape condition metric**

13a. **Check appropriate box(es) (a box may be checked in each column).** Involves a GIS effort with field adjustment. This metric evaluates whether the wetland is well connected (Well) and/or loosely connected (Loosely) to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate). Boundaries are formed by four-lane roads, regularly maintained utility line corridors the width of a four-lane road or wider, urban landscapes, maintained fields (pasture and agriculture), or open water > 300 feet wide.

Well	Loosely	
☐A	☐A	≥ 500 acres
☐B	☐B	From 100 to < 500 acres
☐C	☐C	From 50 to < 100 acres
☐D	☐D	From 10 to < 50 acres
☐E	☐E	< 10 acres
☒F	☒F	Wetland type has a poor or no connection to other natural habitats

13b. **Evaluate for marshes only**.
☐Yes ☒No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

14. **Edge Effect – wetland type condition metric (skip for all marshes)**

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include non-forested areas ≥ 40 feet wide such as fields, development, roads, regularly maintained utility line corridors, and clear-cuts. Consider the eight main points of the compass.
☐A No artificial edge within 150 feet in all directions
☐B No artificial edge within 150 feet in four (4) to seven (7) directions
☐C An artificial edge occurs within 150 feet in more than four (4) directions or assessment area is clear-cut

15. **Vegetative Composition – assessment area condition metric (skip for all marshes and Pine Flat)**

☐A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
☐B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
☐C
Vegetation severely altered from reference in composition. Expected species are unnaturally absent (planted stands of non-characteristic species or at least one stratum inappropriately composed of a single species). Exotic species are dominant in at least one stratum.

16. Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)
☐A Vegetation diversity is high and is composed primarily of native species (< 10% cover of exotics).
☒B Vegetation diversity is low or has > 10% to 50% cover of exotics.
☐C Vegetation is dominated by exotic species (> 50 % cover of exotics).

17. Vegetative Structure – assessment area/wetland type condition metric

17a. Is vegetation present?
☒Yes ☐No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of assessment area vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.
☒A ≥ 25% coverage of vegetation
☐B < 25% coverage of vegetation

17c. **Check a box in each column for each stratum**. Evaluate this portion of the metric **for non-marsh wetlands**. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

	AA	WT	
Canopy	☐A	☐A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
	☐B	☐B	Canopy present, but opened more than natural gaps
	☐C	☐C	Canopy sparse or absent
Mid-Story	☐A	☐A	Dense mid-story/sapling layer
	☐B	☐B	Moderate density mid-story/sapling layer
	☐C	☐C	Mid-story/sapling layer sparse or absent
Shrub	☐A	☐A	Dense shrub layer
	☐B	☐B	Moderate density shrub layer
	☐C	☐C	Shrub layer sparse or absent
Herb	☐A	☐A	Dense herb layer
	☐B	☐B	Moderate density herb layer
	☐C	☐C	Herb layer sparse or absent

18. Snags – wetland type condition metric

☐A Large snags (more than one) are visible (> 12 inches DBH, or large relative to species present and landscape stability).
☒B Not A

19. Diameter Class Distribution – wetland type condition metric

☐A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
☐B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12 inch DBH.
☒C Majority of canopy trees are < 6 inches DBH or no trees.

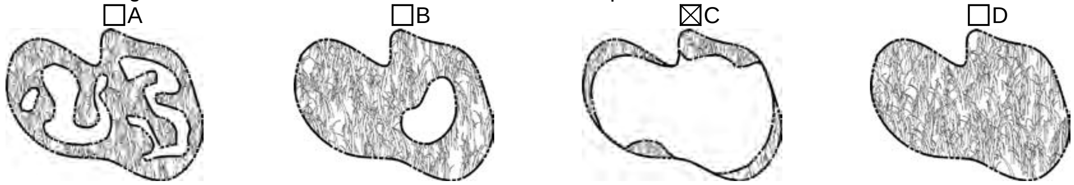
20. Large Woody Debris – wetland type condition metric

Include both natural debris and man-placed natural debris.
☐A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
☒B Not A

21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

☐A ☐B ☒C ☐D



22. Hydrologic Connectivity – assessment area condition metric (evaluate for riparian wetlands only)

Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision.
☐A Overbank and overland flow are not severely altered in the assessment area.
☒B Overbank flow is severely altered in the assessment area.
☐C Overland flow is severely altered in the assessment area.
☐D Both overbank and overland flow are severely altered in the assessment area.

Notes
The assessment area is the fringe of a man-made pond. Beaver activity has occurred in the past but is not currently widespread. Overbank flow does not affect the assessment area since the on-site stream is channelized with spoil berms. Connectivity to other natural areas only applies to other marshes for this wetland type. This assessment area appears to only have a subsurface connection to open water. Vegetation diversity is low (mostly juncus). Overland flow appears to be normal for this wetland type.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 4.1
Rating Calculator Version 4.1

Wetland Site Name	UT to Millers Creek 4 - Pond Fringe	Date of Assessment	7/8/13
Wetland Type	Non-Tidal Freshwater Marsh	Assessor Name/Organization	Corey Novak / LMG

Notes on Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	NO
Wetland is intensively managed (Y/N)	NO
Assessment area is located within 50 feet of a natural tributary or other open water (Y/N)	YES
Assessment area is substantially altered by beaver (Y/N)	NO
Assessment area experiences overbank flooding during normal rainfall conditions (Y/N)	NO
Assessment area is on a coastal island (Y/N)	NO

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	NA
	Sub-surface Storage and Retention	Condition	NA
Water Quality	Pathogen Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
	Particulate Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
	Soluble Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
	Physical Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
Habitat	Physical Structure	Condition	**LOW**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**MEDIUM**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**MEDIUM**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**LOW**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**LOW**

Overall Wetland Rating **LOW**

B.3 NCDWQ Stream Classification Form

NC DWQ Stream Identification Form Version 4.11

Date: 3/20/12	Project/Site: UT MILLERS CREEK	Latitude: 34°53'43"N
Evaluator: WEC	County: DUPLIN	Longitude: 78°04'05"W
Total Points: 36 *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30**	**Stream Determination (circle one)** **Ephemeral Intermittent Perennial**	**Other** NEAR MAGNOLIA *e.g. Quad Name:*

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

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

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

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

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

Notes: CHANNEL HAS BEEN MODIFIED

Sketch:

B.4 Categorical Exclusion Form

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

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

Part 1: General Project Information	
Project Name:	UT Millers Creek Stream and Wetland Mitigation Site
County Name:	Duplin
EEP Number:	5000
Project Sponsor:	ICA/Florence & Hutcheson
Project Contact Name:	Ryan Smith
Project Contact Address:	5121 Kingdom Way, Raleigh, NC 27607
Project Contact E-mail:	rsmith@flohut.com
EEP Project Manager:	Ryan Smith

Project Description

Stream and wetland restoration for mitigation to unavoidable impacts.

For Official Use Only

Reviewed By:

5-31-13

Date

Keliigus

EEP Project Manager

Conditional Approved By:

Date

For Division Administrator FHWA

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

Final Approval By:

5-31-13

Date

For Division Administrator FHWA

B. 5 NCEEP Floodplain Requirements 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:	UT to Millers Creek Site
Name if stream or feature:	UT to Millers Creek
County:	Duplin
Name of river basin:	Cape Fear
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Magnolia, NC Duplin County
DFIRM panel number for entire site:	2480J
Consultant name:	ICA Engineering
Phone number:	919-85-6066
Address:	5121 Kingdom Way, Suite 100 Raleigh, NC 27607

Design Information

The Site is comprised of one property owned by William Jeffrey Hatcher and wife Susan King Hatcher (PIN # 247100987405). The Mitigation Option proposed includes the following:

- Restore 2,100 existing linear feet of the UT (2,696 restored feet) beginning at the southern property boundary and ending at the confluence with another unnamed tributary near the northern property boundary; and
- Restore 4.5 acres of riparian wetland in the floodplain of the UT.

See Figure 7 for overview of Mitigation Components.

Summary of stream reaches and wetland areas according to their restoration priority.

Feature	Length/Area	Priority
UT to Millers Creek	*2,100 ft existing* *2,696 ft restored*	*One (Restoration)*
Wetland	*4.5 acres*	*NA (Restoration)*

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

☐ 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:

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: Duplin County Emergency Management
Phone Number: 910-296-2160

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:

Comments:

Name: K.McKeithan Signature: Kathleen McKeithan

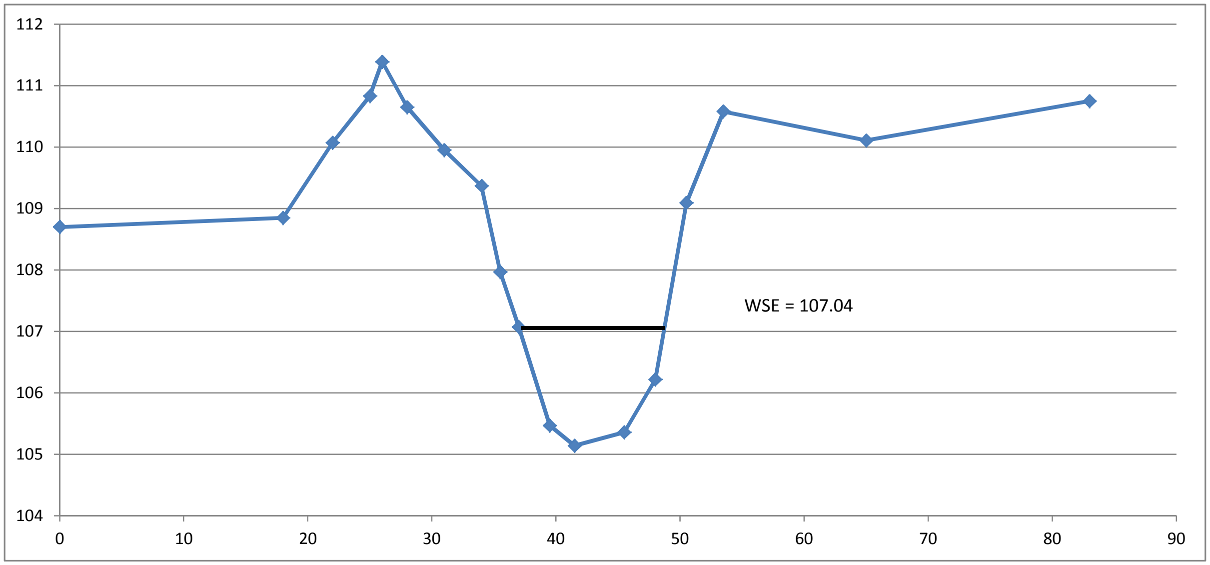
Title: Engineer Date: August 14, 2013

B.6 Stream Existing Conditions

UT to Millers Creek
Existing Condition Example Cross Section

Cross Section @ Sta. 21

Sta.	Elev.	Desc.
0	108.7	
18	108.85	Toe Spoil
22	110.07	
25	110.83	
26	111.39	Top Spoil
28	110.65	
31	109.95	
34	109.37	Top LT Bank
35.5	107.97	
37	107.07	
39.5	105.47	
41.5	105.14	TW 1.90
45.5	105.36	
48	106.22	
50.5	109.09	
53.5	110.58	Top RT Bank
65	110.11	
83	110.75	



Appendix C. Mitigation Workplan Data Analysis

1. HEC-RAS Summary Tables and Attenuation Graphic
2. Wetland Restoration Groundwater Modeling and Analysis
3. Preliminary Gauge Data
4. Soils Delineation (Professional Soil Scientist)
5. Historic Fill Map
6. Stream Reference
7. Wetland Reference

C.1 HEC-RAS Summary Tables and Attenuation Graphic

HECRAS PROPOSED CROSS–SECTION OVERVIEW MAP

INCOMPLETE PLANS

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

5121 Kingdom Way,
Suite 100
Raleigh, NC 27607
NC License No. F-0258

ICA Engineering

UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
100 0 100 200
PLANS

DATE: 05-07-14

HECRAS PROPOSED CROSS-SECTION OVERVIEW MAP

SHEET

EEP# 95719

5/8/2014
R:\stream\Proj\HECRAS\UTMillersCrk_XSect_Overview.dgn

PROJECT NAME	UT to Millers Creek		
PROJ NO.	1300100	SHEET	1 of 1
COMPS BY:	JMW	DATE	7/26/2013
CKD BY:	RKW	DATE	9/3/2013

MANNINGS n VALUES FOR CHANNELS (WET)

Channel n = ($n_b + n_1 + n_2 + n_3 + n_4$) m

n_b = 0.030 Base value of n, channel materials (0.011 - 0.07)

n_1 = 0.003 Surface Irregularities (0.00 - 0.02)

n_2 = 0.003 Varation of Channel Cross-section Shape (0.000 - 0.015)

n_3 = 0.000 Obstructions (0.000 - 0.050)

n_4 = 0.005 Vegetation and Flow Conditions (0.002 - 0.100)

m = 1.000 Channel Meandering - Sinuosity (1.00 - 1.30)

Valley Length: 2150 ft

Stream Length: 2160 ft

Sinuosity 1.005

<u>Channel n =</u> **<u>0.040</u>** = (0.03 + 0.0025 + 0.0025 + 0 + 0.005) 1

MANNINGS n VALUES FOR FLOOD PLAINS

Channel n = ($n_b + n_1 + n_2 + n_3 + n_4$) m

n_b = 0.013 Base value of n, flood plains natural bare soil surface materials (0.011 - 0.07)

n_1 = 0.010 Surface Irregularities (0.00 - 0.02)

n_2 = 0.000 Varation of Channel Cross-section Shape - NOT APPLICABLE (0.000)

n_3 = 0.002 Obstructions (0.000 - 0.030)

n_4 = 0.075 Vegetation and Flow Conditions (0.001 - 0.200)

m = 1.000 Channel Meandering - NOT APPLICABLE (1.00)

<u>Flood Plain n =</u> **<u>0.10</u>** = (0.013 + 0.01 + 0 + 0.002 + 0.075) 1

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
4357	EX	114.94	114.97	115.06	115.09	115.16	115.48
4357	PROP	112.63	113.05	113.81	114.02	114.36	115.40
4233	EX	114.94	114.97	115.05	115.09	115.15	115.46
4233	PROP	112.60	113.01	113.76	113.97	114.31	115.37
4109	EX	114.94	114.97	115.05	115.09	115.15	115.45
4109	PROP	112.59	112.99	113.75	113.96	114.30	115.36
3975	EX	114.94	114.97	115.05	115.08	115.15	115.44
3975	PROP	112.56	112.96	113.73	113.94	114.29	115.35
3784	EX	114.94	114.97	115.04	115.07	115.12	115.29
3784	PROP	112.44	112.81	113.59	113.80	114.15	115.17
3696	EX	114.94	114.97	115.04	115.07	115.12	115.30
3696	PROP	112.33	112.70	113.50	113.73	114.10	115.16
3678							
3648	EX	111.24	111.58	112.83	113.05	113.53	114.84
3648	PROP	112.30	112.68	113.48	113.72	114.09	115.15
3616	PROP	112.28	112.65	113.47	113.70	114.08	115.14
3606	PROP	112.28	112.65	113.47	113.70	114.08	115.14
3597	EX	111.23	111.55	112.80	113.03	113.51	114.83
3597	PROP	112.27	112.64	113.47	113.70	114.07	115.13
3578	PROP	112.25	112.63	113.46	113.69	114.07	115.13
3563	PROP	112.25	112.63	113.45	113.68	114.06	115.12
3549	EX	111.23	111.55	112.78	113.00	113.46	114.79
3549	PROP	112.24	112.61	113.44	113.67	114.05	115.12
3540	PROP	112.23	112.60	113.43	113.66	114.04	115.11
3527	PROP	112.23	112.60	113.42	113.65	114.02	115.10
3514	PROP	112.22	112.58	113.38	113.62	114.00	115.09
3498	EX	111.19	111.47	112.68	112.88	113.36	114.73
3498	PROP	112.21	112.57	113.37	113.60	113.98	115.08

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
3480	PROP	112.20	112.56	113.37	113.60	113.98	115.07
3461	PROP	112.19	112.54	113.36	113.59	113.97	115.06
3447	EX	110.66	111.10	112.59	112.77	113.29	114.70
3447	PROP	112.18	112.53	113.35	113.59	113.96	115.06
3431	PROP	112.17	112.53	113.34	113.58	113.96	115.05
3416	PROP	112.16	112.52	113.34	113.57	113.95	115.05
3397	EX	110.68	111.15	112.60	112.78	113.29	114.70
3397	PROP	112.15	112.50	113.34	113.58	113.96	115.04
3388	PROP	112.15	112.51	113.34	113.58	113.96	115.04
3378	PROP	112.14	112.51	113.34	113.58	113.96	115.04
3362	PROP	112.15	112.51	113.34	113.58	113.96	115.04
3344	EX	110.66	111.13	112.59	112.78	113.29	114.69
3344	PROP	112.15	112.51	113.34	113.57	113.95	115.03
3326	PROP	112.13	112.51	113.33	113.57	113.95	115.03
3312	EX	110.57	111.07	112.58	112.76	113.28	114.68
3312	PROP	112.12	112.51	113.33	113.57	113.95	115.03
3286	PROP	112.11	112.50	113.33	113.57	113.95	115.03
3260	PROP	112.09	112.48	113.33	113.57	113.94	115.02
3246	EX	110.33	110.96	112.52	112.75	113.26	114.67
3246	PROP	112.08	112.47	113.32	113.56	113.94	115.02
3229	PROP	112.08	112.46	113.30	113.54	113.92	115.00
3213	EX	110.34	110.96	112.51	112.70	113.21	114.63
3213	PROP	112.07	112.45	113.30	113.54	113.92	115.00
3205							
3204	PROP	112.06	112.44	113.30	113.53	113.92	114.99
3182	EX	110.30	110.81	112.34	112.70	113.23	114.63
3182	PROP	112.06	112.43	113.29	113.53	113.91	114.98
3160	PROP	112.04	112.42	113.28	113.52	113.90	114.97

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
3154	EX	110.29	110.79	112.30	112.67	113.21	114.62
3154	PROP	112.03	112.41	113.27	113.51	113.89	114.97
3136	PROP	112.03	112.41	113.26	113.50	113.87	114.94
3118	PROP	112.01	112.39	113.25	113.49	113.87	114.93
3111	PROP	112.01	112.38	113.24	113.48	113.86	114.93
3097	EX	110.22	110.71	112.22	112.58	113.11	114.55
3097	PROP	112.01	112.38	113.23	113.47	113.85	114.90
3083	PROP	111.99	112.36	113.21	113.45	113.82	114.90
3072	PROP	111.99	112.35	113.19	113.43	113.81	114.89
3068	PROP	111.99	112.35	113.19	113.42	113.80	114.88
3064	PROP	111.98	112.34	113.17	113.41	113.80	114.88
3051	EX	110.13	110.64	112.18	112.53	113.06	114.50
3051	PROP	111.97	112.33	113.15	113.39	113.78	114.87
3041	PROP	111.97	112.33	113.15	113.39	113.77	114.83
3031	PROP	111.96	112.31	113.13	113.37	113.75	114.80
3017	PROP	111.95	112.30	113.11	113.35	113.73	114.75
3000	EX	110.05	110.57	112.13	112.47	112.99	114.35
3000	PROP	111.95	112.29	113.10	113.33	113.70	114.68
2982	PROP	111.93	112.27	113.07	113.30	113.67	114.64
2959	EX	109.98	110.50	112.07	112.40	112.89	114.12
2959	PROP	111.92	112.25	113.04	113.26	113.62	114.61
2939	PROP	111.91	112.24	113.03	113.25	113.60	114.61
2916	PROP	111.89	112.21	112.98	113.20	113.55	114.57
2900	EX	109.97	110.49	112.07	112.41	112.89	114.16
2900	PROP	111.88	112.20	112.96	113.18	113.53	114.54
2895	PROP	111.88	112.20	112.96	113.18	113.52	114.52
2890	PROP	111.88	112.19	112.94	113.16	113.49	114.50
2858	EX	109.92	110.44	112.02	112.34	112.80	113.99

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
2858	PROP	111.85	112.15	112.89	113.10	113.43	114.41
2847	PROP	111.85	112.15	112.88	113.10	113.42	114.40
2835	PROP	111.84	112.13	112.85	113.06	113.39	114.37
2817	PROP	111.83	112.11	112.82	113.03	113.36	114.33
2809	PROP	111.83	112.11	112.82	113.02	113.35	114.32
2802	EX	109.83	110.36	111.97	112.29	112.74	113.96
2802	PROP	111.82	112.09	112.80	113.01	113.34	114.32
2792	PROP	111.81	112.08	112.78	112.99	113.33	114.30
2778	PROP	111.81	112.07	112.78	112.99	113.32	114.30
2764	PROP	111.79	112.05	112.77	112.98	113.31	114.30
2752	EX	109.77	110.30	111.92	112.23	112.69	113.92
2752	PROP	111.78	112.03	112.75	112.97	113.30	114.30
2742	PROP	111.78	112.03	112.74	112.95	113.29	114.29
2733	PROP	111.77	112.01	112.73	112.94	113.28	114.29
2719	PROP	111.76	111.99	112.72	112.94	113.29	114.29
2714	PROP	111.76	111.99	112.72	112.94	113.29	114.29
2708	PROP	111.75	111.98	112.72	112.94	113.29	114.29
2698	EX	109.64	110.20	111.87	112.18	112.65	113.93
2698	PROP	111.75	111.97	112.72	112.94	113.29	114.29
2682	PROP	111.74	111.98	112.72	112.94	113.28	114.28
2666	PROP	111.73	111.98	112.72	112.94	113.28	114.28
2656	PROP	111.72	111.98	112.72	112.94	113.28	114.28
2647	EX	109.47	110.12	111.88	112.20	112.67	113.93
2647	PROP	111.72	111.98	112.72	112.94	113.28	114.28
2637	PROP	111.71	111.98	112.72	112.93	113.28	114.28
2625	PROP	111.70	111.98	112.71	112.93	113.28	114.28
2612	PROP	111.69	111.98	112.71	112.93	113.28	114.27

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
2599	EX	109.39	110.06	111.88	112.20	112.66	113.92
2599	PROP	111.68	111.98	112.71	112.93	113.28	114.27
2591	PROP	111.67	111.98	112.71	112.93	113.28	114.27
2570	PROP	111.67	111.98	112.71	112.93	113.28	114.26
2549	EX	109.35	110.03	111.86	112.18	112.65	113.90
2549	PROP	111.65	111.98	112.71	112.93	113.27	114.25
2529	PROP	111.63	111.97	112.70	112.92	113.27	114.24
2512	PROP	111.63	111.96	112.69	112.91	113.26	114.23
2495	EX	109.30	110.00	111.84	112.16	112.62	113.88
2495	PROP	111.61	111.94	112.68	112.90	113.25	114.22
2482	PROP	111.60	111.93	112.67	112.89	113.24	114.21
2460	PROP	111.59	111.92	112.66	112.88	113.22	114.19
2438	PROP	111.57	111.91	112.65	112.87	113.22	114.18
2428	PROP	111.56	111.91	112.65	112.87	113.22	114.18
2417	PROP	111.56	111.91	112.65	112.87	113.21	114.17
2406	PROP	111.54	111.90	112.65	112.87	113.21	114.17
2395	EX	109.21	109.94	111.82	112.14	112.60	113.86
2395	PROP	111.53	111.90	112.65	112.87	113.21	114.17
2390	PROP	111.54	111.90	112.65	112.87	113.21	114.17
2385	PROP	111.53	111.90	112.65	112.87	113.21	114.17
2373	PROP	111.51	111.90	112.65	112.87	113.21	114.17
2358	EX	109.20	109.93	111.81	112.13	112.60	113.86
2358	PROP	111.51	111.90	112.64	112.86	113.21	114.17
2343	PROP	111.49	111.90	112.64	112.86	113.21	114.16
2330	PROP	111.48	111.90	112.64	112.86	113.21	114.16
2312	PROP	111.47	111.89	112.64	112.86	113.20	114.16
2294	EX	109.18	109.91	111.79	112.11	112.58	113.84

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
2294	PROP	111.45	111.87	112.62	112.84	113.19	114.14
2264	PROP	111.43	111.84	112.60	112.82	113.16	114.13
2255	PROP	111.42	111.84	112.59	112.81	113.15	114.12
2247	EX	109.15	109.87	111.74	112.06	112.52	113.79
2247	PROP	111.41	111.83	112.59	112.81	113.15	114.11
2223	PROP	111.39	111.81	112.57	112.79	113.12	114.09
2209	PROP	111.38	111.81	112.56	112.78	113.11	114.08
2195	EX	109.12	109.83	111.66	111.96	112.43	113.74
2195	PROP	111.36	111.79	112.55	112.77	113.11	114.07
2175	PROP	111.34	111.77	112.53	112.75	113.09	114.06
2159	PROP	111.33	111.76	112.51	112.73	113.06	114.03
2142	EX	109.09	109.79	111.59	111.86	112.27	113.60
2142	PROP	111.31	111.74	112.48	112.70	113.04	114.00
2130	PROP	111.30	111.72	112.44	112.65	112.99	113.97
2120	PROP	111.29	111.72	112.43	112.63	112.96	113.94
2110	PROP	111.28	111.70	112.40	112.60	112.93	113.93
2096	EX	109.06	109.76	111.53	111.80	112.18	113.54
2096	PROP	111.26	111.68	112.38	112.59	112.92	113.92
2078	PROP	111.25	111.67	112.37	112.58	112.90	113.90
2061	PROP	111.22	111.64	112.33	112.54	112.86	113.86
2044	EX	109.02	109.73	111.52	111.78	112.16	113.45
2044	PROP	111.20	111.61	112.27	112.47	112.80	113.81
2022	PROP	111.18	111.60	112.23	112.42	112.72	113.64
1999	EX	108.96	109.67	111.44	111.67	111.96	113.12
1999	PROP	111.15	111.55	112.16	112.34	112.64	113.58
1984	PROP	111.12	111.52	112.14	112.33	112.62	113.55
1964	PROP	111.11	111.51	112.12	112.31	112.61	113.52
1944	EX	108.91	109.61	111.34	111.52	111.71	112.81

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
1944	PROP	111.07	111.46	112.07	112.26	112.56	113.48
1928	PROP	111.04	111.43	112.00	112.20	112.51	113.41
1921	PROP	111.04	111.43	111.98	112.16	112.44	113.34
1913	PROP	111.02	111.39	111.84	112.00	112.25	113.13
1897	PROP	110.98	111.36	111.78	111.93	112.18	113.01
1888	EX	108.89	109.59	111.35	111.53	111.72	112.78
1888	PROP	110.98	111.38	111.84	112.01	112.27	113.11
1879	PROP	110.95	111.38	111.85	112.01	112.28	113.14
1867	PROP	110.91	111.31	111.85	112.01	112.28	113.14
1850							
1849	PROP	110.89	111.29	111.84	112.00	112.27	113.12
1831	EX	108.73	109.27	110.60	110.90	111.39	112.70
1831	PROP	110.83	111.22	111.83	111.99	112.26	113.09
1804	EX	108.69	109.21	110.47	110.73	111.09	112.65
1804	PROP	110.68	111.08	111.62	111.78	112.04	112.92
1796	PROP	110.68	111.08	111.63	111.79	112.06	112.92
1787	PROP	110.58	111.00	111.61	111.78	112.05	112.93
1785	PROP	110.55	110.98	111.60	111.77	112.05	112.92
1780	PROP	110.60	111.01	111.61	111.78	112.05	112.91
1775	PROP	110.57	110.98	111.61	111.77	112.04	112.90
1770	PROP	110.54	110.96	111.60	111.76	112.03	112.89
1760	PROP	110.54	110.96	111.59	111.75	112.01	112.84
1749	EX	108.60	109.10	110.41	110.72	111.17	112.67
1749	PROP	110.48	110.90	111.56	111.72	111.99	112.80
1747	PROP	110.47	110.90	111.55	111.71	111.98	112.79
1742	PROP	110.49	110.92	111.55	111.71	111.97	112.75
1737	PROP	110.47	110.89	111.52	111.68	111.93	112.71

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
1724	PROP	110.45	110.86	111.47	111.62	111.87	112.62
1710	PROP	110.44	110.86	111.45	111.59	111.83	112.55
1696	PROP	110.40	110.81	111.39	111.53	111.77	112.50
1692	PROP	110.39	110.80	111.38	111.52	111.76	112.48
1670	PROP	110.38	110.78	111.33	111.45	111.65	112.24
1647	PROP	110.33	110.71	111.26	111.39	111.60	112.22
1633	PROP	110.29	110.66	111.18	111.30	111.51	112.14
1621	PROP	110.28	110.65	111.15	111.26	111.42	111.98
1609	PROP	110.23	110.59	110.93	111.06	111.23	111.77
1600	EX	108.28	108.75	110.05	110.35	110.74	112.67
1600	PROP	110.19	110.54	111.04	110.69	110.69	111.92
1585	PROP	110.17	110.52	110.44	110.68	110.82	111.92
1570	PROP	110.09	110.40	110.66	110.66	110.82	111.92
1553	PROP	109.74	109.99	110.66	110.66	110.82	111.92
1548	PROP	109.73	110.05	110.52	110.61	110.82	111.92
1544	PROP	109.64	109.93	110.52	110.61	110.82	111.92
1541	PROP	109.47	109.78	110.43	110.61	110.82	111.92
1536	PROP	109.51	109.90	110.42	110.03	110.82	111.92
1531	PROP	109.42	109.80	110.42	110.39	110.82	111.92
1529	PROP	109.34	109.75	110.42	110.39	110.81	111.92
1524	PROP	109.41	109.81	110.42	110.39	110.81	111.91
1519	PROP	109.37	109.76	110.01	110.39	110.81	111.91
1517	PROP	109.35	109.75	110.14	110.39	110.81	111.91
1502	EX	108.04	108.50	109.71	110.09	110.54	112.67
1502	PROP	109.34	109.73	110.14	110.38	110.81	111.91

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
1483	PROP	109.22	109.59	110.13	110.38	110.81	111.91
1480	PROP	109.19	109.57	110.13	110.38	110.81	111.91
1475	PROP	109.23	109.62	110.13	110.38	110.81	111.91
1470	PROP	109.21	109.63	110.13	110.38	110.81	111.91
1467	PROP	109.19	109.63	110.13	110.38	110.81	111.91
1448	PROP	109.18	109.58	110.13	110.38	110.81	111.91
1429	PROP	109.11	109.50	110.13	110.38	110.81	111.91
1414	PROP	109.03	109.43	110.13	110.38	110.81	111.91
1401	EX	107.96	108.41	109.59	109.98	110.59	112.67
1401	PROP	109.02	109.41	110.13	110.38	110.81	111.90
1393	PROP	108.94	109.33	110.13	110.38	110.81	111.90
1390	PROP	108.91	109.31	110.13	110.38	110.81	111.90
1385	PROP	108.95	109.38	110.13	110.37	110.80	111.90
1380	PROP	108.93	109.37	110.13	110.37	110.80	111.90
1376	PROP	108.91	109.37	110.12	110.37	110.80	111.90
1354	PROP	108.89	109.32	110.11	110.36	110.79	111.89
1327	PROP	108.80	109.23	110.11	110.36	110.79	111.89
1325	PROP	108.79	109.22	110.11	110.36	110.79	111.89
1320	PROP	108.81	109.24	110.10	110.36	110.79	111.89
1315	PROP	108.80	109.23	110.10	110.36	110.79	111.89
1312	EX	107.89	108.31	109.45	109.83	110.45	112.66
1312	PROP	108.79	109.22	110.08	110.36	110.79	111.89
1288	PROP	108.78	109.21	110.07	110.36	110.79	111.89
1264	PROP	108.74	109.16	110.05	110.33	110.79	111.89
1248	EX	107.76	108.15	109.22	109.58	110.18	112.30
1248	PROP	108.71	109.13	110.03	110.32	110.77	111.88

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
1240	PROP	108.71	109.13	110.02	110.30	110.76	111.88
1231	PROP	108.69	109.10	110.00	110.28	110.75	111.87
1219	PROP	108.66	109.07	109.97	110.25	110.70	111.87
1212	PROP	108.66	109.08	109.97	110.25	110.69	111.86
1206	EX	107.57	107.93	108.99	109.35	109.97	112.15
1206	PROP	108.64	109.05	109.95	110.23	110.68	111.86
1192	PROP	108.61	109.01	109.88	110.15	110.58	111.84
1178	PROP	108.60	109.00	109.85	110.11	110.52	111.32
1163	PROP	108.55	108.94	109.76	110.02	110.42	110.85
1149	EX	107.24	107.61	108.59	108.91	109.40	110.82
1149	PROP	108.51	108.89	109.73	109.99	110.41	110.67
1136	PROP	108.50	108.88	109.72	109.99	110.41	110.97
1122	PROP	108.44	108.80	109.63	109.90	110.31	110.94
1110	PROP	108.38	108.73	109.52	109.78	110.18	110.85
1101	EX	107.12	107.48	108.41	108.70	109.14	109.90
1101	PROP	108.38	108.73	109.52	109.78	110.18	110.77
1093	PROP	108.31	108.63	109.34	109.59	109.98	110.67
1085	PROP	108.22	108.54	108.97	109.21	109.61	110.50
1077	PROP	108.22	108.54	109.10	109.26	109.45	109.93
1072	PROP	108.00	108.26	109.07	109.24	109.47	110.14
1067	PROP	108.00	108.35	109.13	109.30	109.53	110.19
1062	PROP	107.92	108.23	109.13	109.30	109.53	110.20
1059	PROP	107.89	108.21	109.13	109.30	109.53	110.19
1051	PROP	107.89	108.21	109.03	109.22	109.45	110.12
1044	PROP	107.74	108.01	108.81	109.01	109.22	109.91
1041	PROP	107.61	107.86	108.56	108.89	109.16	109.87

Cross Section	Plan	Bankfull W.S. Elev (ft)	2x Bankfull W.S. Elev (ft)	2-yr W.S. Elev (ft)	5-yr W.S. Elev (ft)	10-yr W.S. Elev (ft)	100-yr W.S. Elev (ft)
1036	PROP	107.56	107.88	108.70	108.96	109.23	109.85
1031	PROP	107.50	107.80	108.57	108.86	109.15	109.78
1026	PROP	107.29	107.54	108.21	108.49	108.93	109.71
1021	PROP	107.15	107.47	108.31	108.58	109.00	109.72
1016	PROP	106.93	107.18	107.90	108.16	108.63	109.64
1000	EX	106.80	107.10	107.93	108.20	108.62	109.57
1000	PROP	106.84	107.13	107.96	108.24	108.62	109.56

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

BANKFULL

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
4357		0.46			0.01	
4233		0.45			0.01	
4109		0.44			0.01	
3975		0.54			0.01	
3784	0.27	1.57	0.05	0.04	0.13	
3696	0.02	0.97	0.02	0.00	0.04	
3648	0.02	0.79	0.16	0.00	0.03	0.01
3616	0.02	0.86	0.02	0.00	0.03	
3606	0.02	0.68	0.01	0.00	0.02	0.00
3597	0.02	0.90	0.02	0.00	0.04	0.00
3578	0.04	0.91	0.03	0.00	0.04	0.00
3563	0.01	0.69	0.02		0.02	0.00
3549	0.02	0.94	0.03		0.04	0.00
3540	0.01	0.94	0.02		0.04	0.00
3527	0.01	0.70	0.01		0.02	0.00
3514	0.02	0.92	0.02		0.04	
3498	0.02	0.94	0.03		0.04	0.00
3480	0.01	0.69	0.02		0.02	0.00
3461	0.02	0.94	0.01		0.04	0.00
3447	0.06	0.94	0.01	0.00	0.04	
3431	0.07	0.69	0.01	0.00	0.02	
3416	0.11	0.89	0.01	0.01	0.04	
3397	0.08	0.90	0.01	0.00	0.04	
3388	0.06	0.71	0.01	0.00	0.02	
3378	0.12	0.88	0.01	0.01	0.04	
3362	0.02	0.11	0.06	0.00	0.00	0.00
3344	0.01	0.24	0.08	0.00	0.00	0.00
3326	0.02	0.93	0.04		0.04	0.00
3312	0.02	0.94	0.03		0.04	0.00
3286	0.02	0.68	0.02		0.02	0.00
3260	0.02	0.94	0.03		0.04	0.00
3246	0.02	0.92	0.02		0.04	0.00
3229	0.02	0.69	0.02		0.02	0.00
3213	0.02	0.94	0.03		0.04	0.00
3204	0.02	0.95	0.03		0.04	0.00
3182	0.01	0.68	0.02		0.02	0.00
3160	0.02	0.95	0.03		0.04	0.00
3154	0.02	0.95	0.03		0.04	0.00
3136	0.05	0.68	0.02	0.00	0.02	
3118	0.07	0.94	0.03	0.00	0.04	0.00
3111	0.03	0.94	0.03	0.00	0.04	0.00
3097	0.02	0.69	0.02		0.02	0.00
3083	0.02	0.93	0.03		0.04	0.00
3072	0.02	0.88	0.02		0.04	0.00
3068	0.01	0.71	0.02		0.02	

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

BANKFULL

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
3064	0.02	0.87	0.02		0.04	
3051	0.01	0.92	0.02		0.04	
3041	0.01	0.70	0.02		0.02	0.00
3031	0.01	0.91	0.02		0.04	0.00
3017	0.01	0.94	0.01		0.04	
3000	0.01	0.69	0.01		0.02	
2982	0.01	0.93	0.01		0.04	
2959		0.93	0.02		0.04	0.00
2939	0.01	0.70	0.01		0.02	0.00
2916	0.01	0.95	0.01		0.04	0.00
2900		0.91			0.04	
2895	0.01	0.72	0.01		0.02	
2890	0.01	0.88			0.04	
2858	0.01	0.91			0.04	
2847	0.00	0.70			0.02	
2835	0.00	0.92			0.04	
2817		0.92			0.04	
2809		0.72			0.02	
2802		0.93			0.04	
2792		0.96			0.04	
2778		0.70			0.02	
2764		0.96			0.04	
2752		0.94			0.04	
2742		0.70			0.02	
2733		0.94			0.04	
2719		0.92			0.04	
2714		0.74			0.02	
2708		0.94	0.01		0.04	
2698	0.01	0.99	0.03		0.05	0.00
2682		0.70	0.03		0.02	0.00
2666		0.99	0.03		0.05	0.00
2656		0.97	0.01		0.04	
2647	0.02	0.72			0.02	
2637		0.96			0.04	
2625		0.98			0.05	
2612		0.72			0.02	
2599		0.99			0.05	
2591		1.01			0.05	
2570		0.72			0.02	
2549		0.99			0.05	
2529		0.99			0.05	
2512		0.73			0.02	
2495		1.01			0.05	
2482		1.02			0.05	
2460		0.73			0.02	

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

BANKFULL

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
2438		1.04			0.05	
2428		1.02			0.05	
2417		0.75			0.03	
2406		1.02			0.05	
2395		0.97			0.04	
2390		0.74			0.02	
2385		0.97			0.04	
2373		1.04			0.05	
2358		0.75			0.03	
2343		1.04			0.05	
2330		1.06			0.05	
2312		0.76			0.03	
2294		1.04			0.05	
2264		1.01			0.05	
2255		0.79			0.03	
2247		1.04			0.05	
2223		1.07			0.05	
2209		0.79			0.03	
2195		1.10			0.06	
2175		1.11			0.06	
2159		0.80			0.03	
2142		1.14			0.06	
2130		1.12			0.06	
2120		0.82			0.03	
2110		1.14			0.06	
2096		1.18			0.07	
2078		0.83			0.03	
2061		1.19			0.07	
2044		1.24			0.08	
2022		0.86			0.03	
1999		1.27			0.08	
1984		1.29			0.08	
1964		0.90			0.04	
1944		1.34			0.09	
1928		1.33			0.09	
1921		0.95			0.04	
1913		1.35			0.09	
1897		1.40	0.12		0.10	0.01
1888		1.01			0.05	
1879		1.49			0.11	
1867		1.59			0.13	
1849		1.07			0.06	
1831		1.68			0.15	
1804		2.01			0.22	
1796		1.37			0.09	

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

BANKFULL

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
1787		2.39			0.32	
1785		2.43			0.33	
1780		0.95			0.04	
1775		1.47			0.11	
1770		1.69			0.15	
1760		1.16			0.07	
1749		1.80			0.17	
1747		1.75			0.16	
1742		0.81			0.03	
1737		1.20			0.07	
1724		1.31			0.09	
1710		0.94			0.04	
1696		1.43			0.10	
1692		1.47			0.11	
1670		0.97			0.04	
1647		1.51			0.12	
1633		1.54			0.12	
1621		1.06			0.05	
1609		1.68	0.07		0.15	0.01
1600		1.77			0.17	
1585		1.17			0.07	
1570		1.98			0.21	
1553		3.58			0.80	
1548		1.23			0.07	
1544		2.39			0.33	
1541		3.67			0.83	
1536		1.14			0.06	
1531		2.33			0.31	
1529		2.86			0.47	
1524		1.01			0.05	
1519		1.68			0.15	
1517		1.82			0.18	
1502		1.20			0.07	
1483		2.32			0.30	
1480		2.36			0.31	
1475		0.93			0.04	
1470		1.33			0.09	
1467		1.58			0.13	
1448		1.06			0.05	
1429		1.75			0.16	
1414		1.90			0.19	
1401		1.27			0.08	
1393		2.11			0.25	
1390		2.33			0.30	
1385		0.93			0.04	

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

BANKFULL

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
1380		1.28			0.08	
1376		1.56			0.13	
1354		1.05			0.05	
1327		1.76			0.16	
1325		1.78			0.17	
1320		0.79			0.03	
1315		1.07			0.06	
1312		1.26			0.08	
1288		0.88			0.04	
1264		1.30			0.08	
1248		1.29			0.08	
1240		0.93			0.04	
1231		1.31			0.09	
1219		1.33			0.09	
1212		0.94			0.04	
1206		1.36			0.09	
1192		1.46			0.11	
1178		1.00			0.05	
1163		1.52			0.12	
1149		1.59			0.13	
1136		1.09			0.06	
1122		1.76			0.16	
1110		1.83			0.18	
1101		1.26			0.08	
1093		2.09			0.24	
1085		2.38			0.32	
1077		1.54			0.12	
1072		3.61			0.81	
1067		1.15			0.06	
1062		2.32			0.30	
1059		2.28			0.29	
1051		1.50			0.11	
1044		2.94			0.51	
1041		3.58			0.79	
1036		1.21			0.07	
1031		2.04			0.23	
1026		3.59			0.80	
1021		1.39			0.10	
1016		3.62			0.82	
1000		1.76			0.18	

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
2 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
4357	0.20	1.39	0.20	0.01	0.07	0.01
4233	0.16	0.94	0.16	0.01	0.03	0.01
4109	0.10	0.57	0.11	0.00	0.01	0.00
3975	0.14	0.74	0.14	0.01	0.02	0.01
3784	0.51	2.50	0.45	0.08	0.24	0.07
3696	0.27	1.70	0.30	0.03	0.10	0.03
3648	0.25	1.30	0.21	0.02	0.06	0.02
3616	0.23	1.27	0.19	0.02	0.06	0.01
3606	0.19	1.05	0.19	0.01	0.04	0.01
3597	0.19	1.00	0.21	0.01	0.04	0.01
3578	0.22	1.17	0.23	0.02	0.05	0.02
3563	0.19	1.27	0.23	0.01	0.06	0.02
3549	0.21	1.51	0.27	0.02	0.08	0.02
3540	0.21	1.57	0.30	0.02	0.09	0.03
3527	0.19	1.55	0.28	0.01	0.08	0.03
3514	0.27	1.99	0.31	0.03	0.14	0.03
3498	0.25	1.90	0.36	0.02	0.13	0.04
3480	0.18	1.60	0.30	0.01	0.09	0.03
3461	0.27	1.67	0.34	0.03	0.10	0.04
3447	0.31	1.61	0.29	0.03	0.09	0.03
3431	0.27	1.44	0.22	0.02	0.07	0.02
3416	0.29	1.47	0.26	0.03	0.08	0.02
3397	0.18	0.94	0.25	0.01	0.03	0.02
3388	0.14	0.75	0.22	0.01	0.02	0.01
3378	0.13	0.61	0.21	0.01	0.01	0.01
3362	0.09	0.40	0.18	0.00	0.01	0.01
3344	0.10	0.55	0.20	0.00	0.01	0.01
3326	0.12	0.69	0.22	0.00	0.02	0.01
3312	0.11	0.70	0.21	0.00	0.02	0.01
3286	0.09	0.72	0.20	0.00	0.02	0.01
3260	0.12	0.81	0.22	0.01	0.02	0.01
3246	0.16	1.00	0.24	0.01	0.04	0.02
3229	0.22	1.40	0.22	0.02	0.07	0.02
3213	0.23	1.36	0.28	0.02	0.07	0.02
3204	0.20	1.28	0.29	0.01	0.06	0.02
3182	0.17	1.18	0.26	0.01	0.05	0.02
3160	0.23	1.32	0.31	0.02	0.06	0.03
3154	0.27	1.41	0.32	0.02	0.07	0.03
3136	0.28	1.45	0.25	0.02	0.07	0.02
3118	0.32	1.58	0.30	0.03	0.09	0.03
3111	0.30	1.61	0.32	0.03	0.09	0.03
3097	0.21	1.56	0.31	0.02	0.08	0.03
3083	0.25	1.85	0.39	0.02	0.12	0.05
3072	0.25	1.96	0.38	0.03	0.14	0.05
3068	0.23	1.88	0.32	0.02	0.12	0.03

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
2 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
3064	0.25	2.06	0.37	0.03	0.15	0.05
3051	0.23	2.19	0.39	0.02	0.17	0.05
3041	0.20	1.86	0.33	0.02	0.12	0.04
3031	0.30	2.11	0.36	0.03	0.16	0.05
3017	0.36	2.10	0.41	0.05	0.16	0.05
3000	0.34	1.88	0.32	0.04	0.12	0.03
2982	0.41	2.13	0.40	0.05	0.16	0.05
2959	0.45	2.19	0.46	0.06	0.17	0.07
2939	0.30	1.83	0.38	0.03	0.12	0.04
2916	0.38	2.25	0.44	0.05	0.18	0.06
2900	0.41	2.23	0.38	0.06	0.18	0.05
2895	0.36	2.02	0.33	0.04	0.15	0.04
2890	0.42	2.24	0.38	0.06	0.18	0.05
2858	0.41	2.30	0.38	0.06	0.19	0.05
2847	0.34	2.01	0.32	0.04	0.14	0.04
2835	0.41	2.36	0.39	0.06	0.21	0.05
2817	0.39	2.33	0.39	0.06	0.20	0.06
2809	0.33	2.10	0.33	0.04	0.16	0.04
2802	0.39	2.32	0.37	0.05	0.20	0.05
2792	0.41	2.28	0.39	0.06	0.19	0.05
2778	0.34	1.87	0.30	0.04	0.13	0.03
2764	0.40	1.98	0.38	0.05	0.15	0.05
2752	0.38	1.93	0.37	0.05	0.14	0.05
2742	0.31	1.81	0.32	0.03	0.12	0.04
2733	0.32	2.06	0.38	0.03	0.16	0.05
2719	0.27	1.85	0.33	0.02	0.13	0.04
2714	0.22	1.59	0.29	0.02	0.09	0.03
2708	0.21	1.53	0.32	0.02	0.09	0.03
2698	0.19	1.31	0.29	0.01	0.06	0.03
2682	0.17	0.81	0.18	0.01	0.02	0.01
2666	0.15	0.49	0.11	0.01	0.01	0.00
2656	0.14	0.44	0.09	0.01	0.01	0.00
2647	0.13	0.44	0.08	0.00	0.01	0.00
2637	0.13	0.40	0.07	0.00	0.01	0.00
2625	0.13	0.34	0.06	0.00	0.00	0.00
2612	0.14	0.37	0.06	0.00	0.00	0.00
2599	0.16	0.42	0.08	0.01	0.01	0.00
2591	0.17	0.45	0.08	0.01	0.01	0.00
2570	0.17	0.51	0.07	0.01	0.01	0.00
2549	0.21	0.62	0.11	0.01	0.01	0.00
2529	0.25	0.87	0.16	0.02	0.03	0.01
2512	0.27	1.14	0.19	0.02	0.05	0.01
2495	0.32	1.44	0.23	0.03	0.08	0.02
2482	0.35	1.54	0.20	0.04	0.09	0.02
2460	0.29	1.35	0.23	0.03	0.07	0.02

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

2 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
2438	0.27	1.16	0.27	0.02	0.05	0.02
2428	0.26	1.09	0.27	0.02	0.04	0.02
2417	0.22	1.04	0.25	0.02	0.04	0.02
2406	0.21	1.00	0.26	0.01	0.04	0.02
2395	0.18	0.85	0.23	0.01	0.03	0.02
2390	0.08	0.40	0.12	0.00	0.01	0.00
2385	0.09	0.43	0.13	0.00	0.01	0.00
2373	0.12	0.50	0.15	0.00	0.01	0.01
2358	0.14	0.61	0.15	0.01	0.01	0.01
2343	0.17	0.67	0.17	0.01	0.02	0.01
2330	0.19	0.73	0.17	0.01	0.02	0.01
2312	0.18	0.84	0.18	0.01	0.02	0.01
2294	0.28	1.33	0.25	0.02	0.06	0.02
2264	0.21	1.55	0.30	0.02	0.09	0.03
2255	0.24	1.46	0.28	0.02	0.08	0.02
2247	0.26	1.56	0.32	0.02	0.09	0.03
2223	0.27	1.58	0.35	0.03	0.09	0.04
2209	0.21	1.50	0.31	0.02	0.08	0.03
2195	0.30	1.64	0.35	0.03	0.10	0.04
2175	0.37	1.72	0.32	0.04	0.11	0.03
2159	0.34	1.74	0.19	0.04	0.11	0.02
2142	0.43	2.15	0.25	0.06	0.17	0.03
2130	0.43	2.38	0.30	0.06	0.21	0.04
2120	0.34	2.17	0.28	0.04	0.17	0.03
2110	0.43	2.44	0.40	0.06	0.22	0.06
2096	0.44	2.25	0.36	0.07	0.19	0.05
2078	0.35	1.91	0.30	0.04	0.13	0.03
2061	0.44	2.31	0.36	0.07	0.20	0.05
2044	0.45	2.61	0.41	0.07	0.26	0.06
2022	0.35	2.36	0.35	0.05	0.21	0.05
1999	0.52	2.79	0.46	0.09	0.30	0.08
1984	0.54	2.50	0.38	0.10	0.24	0.06
1964	0.41	2.05	0.29	0.06	0.16	0.03
1944	0.50	2.49	0.37	0.09	0.24	0.05
1928	0.49	2.74	0.42	0.09	0.30	0.07
1921	0.39	2.58	0.36	0.06	0.26	0.05
1913	0.45	3.60	0.47	0.09	0.53	0.10
1897	0.40	3.34	0.71	0.08	0.46	0.18
1888	0.19	1.56	0.59	0.02	0.10	0.09
1879	0.12	0.98	0.47	0.01	0.04	0.05
1867	0.12	0.79	0.38	0.01	0.03	0.03
1849	0.13	0.88	0.36	0.01	0.03	0.03
1831	0.12	1.13	0.45	0.01	0.05	0.05
1804	0.70	3.63	0.49	0.19	0.56	0.10
1796	0.60	2.74	0.37	0.12	0.31	0.06

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

2 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
1787	0.69	2.80	0.44	0.16	0.33	0.08
1785	0.68	2.79	0.43	0.16	0.33	0.08
1780	0.43	2.04	0.29	0.06	0.16	0.03
1775	0.52	2.20	0.37	0.09	0.19	0.05
1770	0.54	2.23	0.38	0.09	0.20	0.06
1760	0.46	2.01	0.31	0.07	0.16	0.04
1749	0.54	2.28	0.36	0.10	0.21	0.05
1747	0.54	2.31	0.37	0.10	0.21	0.05
1742	0.37	1.91	0.25	0.05	0.13	0.02
1737	0.46	2.31	0.32	0.07	0.20	0.04
1724	0.48	2.58	0.37	0.08	0.26	0.06
1710	0.38	2.32	0.32	0.05	0.20	0.04
1696	0.49	2.83	0.47	0.09	0.31	0.08
1692	0.49	2.82	0.49	0.09	0.31	0.09
1670	0.33	2.48	0.39	0.05	0.24	0.06
1647	0.47	2.87	0.44	0.09	0.33	0.08
1633	0.49	3.08	0.40	0.10	0.39	0.07
1621	0.39	2.71	0.30	0.06	0.29	0.04
1609	0.47	4.25	0.77	0.11	0.79	0.22
1600	0.27	1.77	0.64	0.03	0.13	0.11
1585		5.70			1.50	
1570	0.03	0.26	0.13	0.00	0.00	0.00
1553	0.04	0.29	0.14	0.00	0.00	0.01
1548	0.04	0.41	0.15	0.00	0.01	0.01
1544	0.05	0.37	0.15	0.00	0.01	0.01
1541	0.04	0.38	0.17	0.00	0.01	0.01
1536	0.05	0.48	0.15	0.00	0.01	0.01
1531	0.05	0.45	0.16	0.00	0.01	0.01
1529	0.06	0.44	0.16	0.00	0.01	0.01
1524	0.06	0.49	0.14	0.00	0.01	0.01
1519	0.37	4.95	0.39	0.09	1.10	0.10
1517	0.07	0.60	0.21	0.00	0.02	0.01
1502	0.12	0.60	0.18	0.01	0.01	0.01
1483	0.16	0.46	0.16	0.01	0.01	0.01
1480	0.16	0.46	0.16	0.01	0.01	0.01
1475	0.14	0.50	0.15	0.01	0.01	0.01
1470	0.14	0.47	0.15	0.01	0.01	0.01
1467	0.14	0.46	0.15	0.01	0.01	0.01
1448	0.12	0.41	0.14	0.00	0.01	0.01
1429	0.12	0.37	0.14	0.00	0.01	0.01
1414	0.12	0.44	0.16	0.00	0.01	0.01
1401	0.10	0.52	0.17	0.00	0.01	0.01
1393	0.07	0.54	0.19	0.00	0.01	0.01
1390	0.08	0.55	0.19	0.00	0.01	0.01
1385	0.09	0.63	0.18	0.00	0.01	0.01

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

2 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
1380	0.11	0.71	0.20	0.00	0.02	0.01
1376	0.13	0.82	0.22	0.01	0.03	0.01
1354	0.16	1.09	0.22	0.01	0.04	0.02
1327	0.14	0.91	0.21	0.01	0.03	0.01
1325	0.11	0.88	0.20	0.00	0.03	0.01
1320	0.10	0.82	0.16	0.00	0.02	0.01
1315	0.13	0.80	0.17	0.01	0.02	0.01
1312	0.30	1.67	0.34	0.03	0.10	0.04
1288	0.24	1.51	0.29	0.02	0.08	0.03
1264	0.29	1.72	0.36	0.03	0.11	0.04
1248	0.29	1.75	0.31	0.03	0.11	0.03
1240	0.28	1.77	0.32	0.03	0.11	0.02
1231	0.34	2.03	0.43	0.04	0.15	0.04
1219	0.35	2.10	0.46	0.04	0.16	0.07
1212	0.29	1.89	0.39	0.03	0.13	0.05
1206	0.36	2.20	0.48	0.05	0.18	0.07
1192	0.43	2.68	0.53	0.07	0.27	0.09
1178	0.37	2.44	0.37	0.05	0.22	0.05
1163	0.48	3.09	0.47	0.09	0.36	0.09
1149	0.45	2.93	0.55	0.08	0.33	0.11
1136	0.35	2.41	0.44	0.05	0.22	0.07
1122	0.46	3.06	0.57	0.09	0.37	0.12
1110	0.48	3.50	0.47	0.10	0.49	0.09
1101	0.38	2.93	0.38	0.06	0.33	0.06
1093	0.49	4.10	0.50	0.11	0.70	0.12
1085	0.22	5.69	0.22	0.04	1.49	0.05
1077	0.24	3.28	0.68	0.04	0.46	0.17
1072	0.28	3.56	0.91	0.05	0.56	0.29
1067	0.19	1.85	0.55	0.02	0.13	0.08
1062	0.24	1.79	0.65	0.02	0.13	0.11
1059	0.24	1.74	0.62	0.02	0.12	0.10
1051	0.34	2.72	0.37	0.05	0.29	0.06
1044	0.44	4.21	0.38	0.10	0.77	0.08
1041	0.28	5.41	0.13	0.06	1.36	
1036	0.25	2.91	0.32	0.03	0.33	0.05
1031	0.32	3.78	0.41	0.05	0.59	0.08
1026	0.07	5.63	0.07		1.47	
1021	0.33	3.10	0.32	0.05	0.38	0.05
1016	0.10	5.58	0.10		1.42	
1000		3.20			0.43	

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
5 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
4357	0.25	1.63	0.26	0.02	0.09	0.02
4233	0.19	1.00	0.18	0.01	0.03	0.01
4109	0.11	0.58	0.12	0.00	0.01	0.00
3975	0.15	0.76	0.16	0.01	0.02	0.01
3784	0.59	2.64	0.49	0.10	0.25	0.08
3696	0.30	1.72	0.30	0.03	0.10	0.03
3648	0.27	1.30	0.23	0.02	0.06	0.02
3616	0.24	1.22	0.21	0.02	0.05	0.01
3606	0.20	1.08	0.21	0.01	0.04	0.01
3597	0.18	1.04	0.24	0.01	0.04	0.02
3578	0.23	1.18	0.25	0.02	0.05	0.02
3563	0.20	1.29	0.26	0.01	0.06	0.02
3549	0.23	1.50	0.30	0.02	0.08	0.03
3540	0.25	1.65	0.31	0.02	0.09	0.03
3527	0.24	1.69	0.30	0.02	0.10	0.03
3514	0.30	2.07	0.36	0.03	0.15	0.04
3498	0.27	2.08	0.37	0.03	0.15	0.05
3480	0.24	1.75	0.31	0.02	0.10	0.03
3461	0.31	1.77	0.35	0.03	0.11	0.04
3447	0.34	1.69	0.30	0.04	0.10	0.03
3431	0.30	1.53	0.25	0.03	0.08	0.02
3416	0.31	1.54	0.29	0.03	0.08	0.03
3397	0.20	1.00	0.28	0.01	0.03	0.02
3388	0.16	0.82	0.25	0.01	0.02	0.02
3378	0.15	0.68	0.24	0.01	0.02	0.01
3362	0.11	0.47	0.21	0.00	0.01	0.01
3344	0.12	0.63	0.22	0.00	0.01	0.01
3326	0.14	0.75	0.24	0.01	0.02	0.01
3312	0.13	0.76	0.24	0.01	0.02	0.01
3286	0.11	0.79	0.23	0.00	0.02	0.01
3260	0.15	0.86	0.25	0.01	0.03	0.02
3246	0.19	1.04	0.27	0.01	0.04	0.02
3229	0.25	1.41	0.26	0.02	0.07	0.02
3213	0.25	1.40	0.31	0.02	0.07	0.03
3204	0.23	1.34	0.31	0.02	0.06	0.03
3182	0.20	1.28	0.29	0.01	0.05	0.02
3160	0.27	1.44	0.32	0.02	0.07	0.03
3154	0.30	1.51	0.35	0.03	0.08	0.03
3136	0.31	1.58	0.28	0.03	0.08	0.03
3118	0.35	1.69	0.34	0.04	0.10	0.03
3111	0.33	1.71	0.36	0.03	0.10	0.04
3097	0.25	1.70	0.36	0.02	0.10	0.04
3083	0.30	1.99	0.44	0.03	0.14	0.06
3072	0.32	2.10	0.42	0.04	0.15	0.05
3068	0.29	2.05	0.36	0.02	0.14	0.04

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
5 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
3064	0.31	2.20	0.41	0.03	0.17	0.05
3051	0.31	2.29	0.42	0.03	0.18	0.06
3041	0.27	2.02	0.37	0.03	0.14	0.04
3031	0.36	2.26	0.42	0.05	0.18	0.06
3017	0.43	2.30	0.47	0.06	0.18	0.07
3000	0.41	2.13	0.38	0.05	0.15	0.05
2982	0.48	2.36	0.46	0.07	0.19	0.07
2959	0.54	2.47	0.54	0.09	0.21	0.09
2939	0.34	2.09	0.46	0.04	0.15	0.06
2916	0.46	2.50	0.52	0.07	0.22	0.08
2900	0.48	2.49	0.46	0.07	0.22	0.07
2895	0.43	2.29	0.40	0.06	0.18	0.05
2890	0.50	2.53	0.45	0.08	0.23	0.07
2858	0.49	2.57	0.44	0.08	0.23	0.07
2847	0.41	2.27	0.39	0.05	0.18	0.05
2835	0.48	2.63	0.39	0.08	0.25	0.06
2817	0.47	2.58	0.45	0.07	0.24	0.07
2809	0.38	2.38	0.39	0.05	0.20	0.05
2802	0.44	2.53	0.43	0.07	0.23	0.06
2792	0.48	2.46	0.44	0.07	0.22	0.07
2778	0.41	2.06	0.35	0.05	0.15	0.04
2764	0.47	2.16	0.38	0.07	0.17	0.05
2752	0.44	2.08	0.40	0.06	0.16	0.05
2742	0.36	1.99	0.36	0.04	0.14	0.04
2733	0.33	2.15	0.41	0.03	0.17	0.05
2719	0.26	1.83	0.35	0.02	0.12	0.04
2714	0.23	1.58	0.31	0.02	0.09	0.03
2708	0.23	1.47	0.32	0.02	0.08	0.03
2698	0.21	1.27	0.30	0.01	0.06	0.03
2682	0.18	0.83	0.19	0.01	0.02	0.01
2666	0.16	0.55	0.13	0.01	0.01	0.00
2656	0.15	0.51	0.12	0.01	0.01	0.00
2647	0.15	0.50	0.10	0.01	0.01	0.00
2637	0.15	0.46	0.09	0.01	0.01	0.00
2625	0.15	0.41	0.08	0.01	0.01	0.00
2612	0.16	0.46	0.09	0.01	0.01	0.00
2599	0.18	0.49	0.10	0.01	0.01	0.00
2591	0.19	0.53	0.10	0.01	0.01	0.00
2570	0.20	0.59	0.09	0.01	0.01	0.00
2549	0.23	0.70	0.12	0.01	0.02	0.01
2529	0.27	0.95	0.18	0.02	0.03	0.01
2512	0.27	1.23	0.23	0.02	0.05	0.02
2495	0.31	1.51	0.28	0.03	0.08	0.03
2482	0.36	1.59	0.26	0.04	0.09	0.02
2460	0.32	1.46	0.26	0.03	0.07	0.02

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
5 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
2438	0.29	1.23	0.30	0.02	0.05	0.03
2428	0.28	1.16	0.30	0.02	0.05	0.02
2417	0.25	1.12	0.28	0.02	0.04	0.02
2406	0.22	1.08	0.29	0.02	0.04	0.02
2395	0.20	0.93	0.26	0.01	0.03	0.02
2390	0.09	0.44	0.14	0.00	0.01	0.00
2385	0.11	0.47	0.15	0.00	0.01	0.01
2373	0.13	0.56	0.16	0.01	0.01	0.01
2358	0.16	0.67	0.17	0.01	0.02	0.01
2343	0.19	0.72	0.18	0.01	0.02	0.01
2330	0.20	0.77	0.19	0.01	0.02	0.01
2312	0.20	0.88	0.19	0.01	0.03	0.01
2294	0.31	1.40	0.24	0.03	0.07	0.02
2264	0.22	1.62	0.33	0.02	0.09	0.03
2255	0.26	1.57	0.31	0.02	0.08	0.03
2247	0.30	1.65	0.35	0.03	0.10	0.04
2223	0.32	1.76	0.38	0.03	0.11	0.04
2209	0.23	1.69	0.34	0.02	0.10	0.04
2195	0.35	1.79	0.37	0.04	0.11	0.04
2175	0.42	1.86	0.33	0.05	0.12	0.04
2159	0.40	1.89	0.23	0.05	0.12	0.02
2142	0.49	2.32	0.24	0.07	0.19	0.02
2130	0.49	2.62	0.27	0.08	0.25	0.03
2120	0.41	2.47	0.24	0.06	0.21	0.02
2110	0.50	2.73	0.28	0.08	0.27	0.04
2096	0.51	2.49	0.28	0.08	0.22	0.03
2078	0.41	2.12	0.35	0.05	0.16	0.04
2061	0.51	2.52	0.42	0.08	0.23	0.06
2044	0.52	2.87	0.43	0.09	0.30	0.07
2022	0.43	2.71	0.42	0.07	0.26	0.06
1999	0.60	3.11	0.53	0.12	0.36	0.10
1984	0.63	2.75	0.44	0.12	0.28	0.07
1964	0.50	2.27	0.35	0.08	0.19	0.04
1944	0.59	2.64	0.41	0.11	0.26	0.06
1928	0.59	2.86	0.47	0.12	0.31	0.08
1921	0.50	2.88	0.45	0.09	0.31	0.07
1913	0.58	4.07	0.60	0.14	0.65	0.15
1897	0.52	3.77	0.84	0.11	0.57	0.24
1888	0.25	1.84	0.69	0.03	0.13	0.12
1879	0.17	1.19	0.55	0.01	0.06	0.07
1867	0.17	0.96	0.45	0.01	0.04	0.05
1849	0.17	1.05	0.42	0.01	0.04	0.04
1831	0.16	1.33	0.52	0.01	0.07	0.07
1804	0.80	3.83	0.63	0.23	0.60	0.15
1796	0.68	2.94	0.48	0.15	0.34	0.09

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

5 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
1787	0.75	2.88	0.53	0.18	0.34	0.10
1785	0.75	2.86	0.52	0.18	0.33	0.10
1780	0.51	2.26	0.36	0.08	0.19	0.04
1775	0.60	2.40	0.43	0.11	0.22	0.06
1770	0.62	2.42	0.45	0.12	0.23	0.07
1760	0.55	2.23	0.37	0.09	0.19	0.05
1749	0.63	2.48	0.43	0.12	0.24	0.07
1747	0.63	2.52	0.43	0.12	0.25	0.07
1742	0.45	2.19	0.30	0.06	0.17	0.03
1737	0.55	2.60	0.39	0.10	0.25	0.06
1724	0.58	2.90	0.45	0.11	0.32	0.08
1710	0.48	2.66	0.40	0.08	0.26	0.06
1696	0.60	3.16	0.56	0.13	0.38	0.11
1692	0.60	3.15	0.58	0.12	0.38	0.12
1670	0.40	2.89	0.50	0.06	0.31	0.09
1647	0.57	3.13	0.53	0.12	0.38	0.11
1633	0.60	3.45	0.47	0.14	0.47	0.10
1621	0.50	3.14	0.38	0.10	0.38	0.06
1609	0.65	4.46	0.82	0.19	0.84	0.24
1600	0.14	3.55	1.36	0.01	0.59	0.55
1585	0.02	0.25	0.13	0.00	0.00	0.00
1570	0.03	0.34	0.17	0.00	0.01	0.01
1553	0.05	0.38	0.18	0.00	0.01	0.01
1548	0.05	0.50	0.18	0.00	0.01	0.01
1544	0.06	0.46	0.19	0.00	0.01	0.01
1541	0.07	0.45	0.19	0.00	0.01	0.01
1536		5.78			1.46	
1531	0.07	0.61	0.22	0.00	0.02	0.01
1529	0.08	0.60	0.22	0.00	0.02	0.01
1524	0.08	0.67	0.20	0.00	0.02	0.01
1519	0.09	0.63	0.20	0.00	0.02	0.01
1517	0.10	0.63	0.20	0.00	0.02	0.01
1502	0.13	0.62	0.19	0.01	0.02	0.01
1483	0.17	0.49	0.17	0.01	0.01	0.01
1480	0.17	0.49	0.16	0.01	0.01	0.01
1475	0.16	0.53	0.15	0.01	0.01	0.01
1470	0.16	0.51	0.16	0.01	0.01	0.01
1467	0.16	0.49	0.16	0.01	0.01	0.01
1448	0.14	0.46	0.15	0.01	0.01	0.01
1429	0.14	0.42	0.15	0.01	0.01	0.01
1414	0.14	0.49	0.17	0.01	0.01	0.01
1401	0.12	0.57	0.19	0.00	0.01	0.01
1393	0.09	0.61	0.21	0.00	0.01	0.01
1390	0.09	0.61	0.21	0.00	0.01	0.01
1385	0.10	0.69	0.19	0.00	0.02	0.01

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
5 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
1380	0.13	0.76	0.21	0.01	0.02	0.01
1376	0.15	0.85	0.23	0.01	0.03	0.01
1354	0.18	1.06	0.23	0.01	0.04	0.02
1327	0.13	0.87	0.20	0.00	0.03	0.01
1325	0.10	0.84	0.20	0.00	0.03	0.01
1320	0.12	0.80	0.17	0.01	0.02	0.01
1315	0.14	0.78	0.17	0.01	0.02	0.01
1312	0.15	0.77	0.17	0.01	0.02	0.01
1288	0.13	0.76	0.16	0.01	0.02	0.01
1264	0.31	1.72	0.40	0.03	0.10	0.05
1248	0.29	1.63	0.29	0.03	0.09	0.02
1240	0.30	1.75	0.30	0.03	0.10	0.02
1231	0.37	2.04	0.39	0.04	0.15	0.03
1219	0.40	2.23	0.52	0.05	0.18	0.08
1212	0.35	2.05	0.46	0.04	0.15	0.06
1206	0.41	2.34	0.54	0.06	0.19	0.09
1192	0.51	2.92	0.61	0.09	0.31	0.11
1178	0.46	2.77	0.47	0.07	0.27	0.07
1163	0.58	3.41	0.57	0.12	0.43	0.11
1149	0.54	3.17	0.64	0.10	0.37	0.13
1136	0.43	2.66	0.52	0.06	0.25	0.09
1122	0.55	3.28	0.66	0.11	0.40	0.14
1110	0.60	3.79	0.61	0.14	0.54	0.14
1101	0.49	3.27	0.49	0.09	0.39	0.09
1093	0.64	4.43	0.66	0.17	0.77	0.17
1085	0.60	5.98	0.61	0.19	1.53	0.20
1077	0.37	3.62	0.84	0.07	0.53	0.24
1072	0.41	3.68	1.02	0.09	0.57	0.33
1067	0.26	2.08	0.63	0.03	0.16	0.11
1062	0.31	1.98	0.72	0.04	0.15	0.13
1059	0.31	1.91	0.68	0.04	0.14	0.12
1051	0.42	2.80	0.45	0.07	0.30	0.08
1044	0.58	4.29	0.52	0.15	0.76	0.13
1041	0.57	4.86	0.52	0.16	1.00	0.14
1036	0.35	3.09	0.42	0.05	0.35	0.07
1031	0.44	3.80	0.54	0.09	0.56	0.12
1026	0.45	5.71	0.55	0.11	1.39	0.16
1021	0.35	3.40	0.45	0.05	0.43	0.08
1016	0.58	5.82	0.55	0.18	1.44	0.16
1000	0.09	3.47		0.01	0.49	

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
10 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
4357	0.35	2.04	0.35	0.04	0.14	0.04
4233	0.23	1.07	0.22	0.01	0.04	0.01
4109	0.13	0.60	0.14	0.00	0.01	0.01
3975	0.17	0.78	0.18	0.01	0.02	0.01
3784	0.71	2.90	0.56	0.14	0.29	0.10
3696	0.34	1.73	0.33	0.03	0.10	0.03
3648	0.28	1.31	0.26	0.02	0.06	0.02
3616	0.26	1.24	0.24	0.02	0.05	0.02
3606	0.22	1.10	0.24	0.01	0.04	0.02
3597	0.21	1.05	0.26	0.01	0.04	0.02
3578	0.19	1.24	0.29	0.01	0.05	0.02
3563	0.20	1.34	0.30	0.01	0.06	0.02
3549	0.25	1.52	0.34	0.02	0.08	0.03
3540	0.27	1.65	0.35	0.02	0.09	0.04
3527	0.28	1.81	0.34	0.02	0.11	0.03
3514	0.34	2.23	0.37	0.04	0.16	0.04
3498	0.31	2.23	0.40	0.03	0.16	0.05
3480	0.31	1.89	0.34	0.03	0.12	0.03
3461	0.35	1.93	0.37	0.04	0.12	0.04
3447	0.36	1.83	0.34	0.04	0.11	0.03
3431	0.34	1.67	0.29	0.03	0.09	0.03
3416	0.35	1.62	0.32	0.03	0.09	0.03
3397	0.23	1.10	0.32	0.01	0.04	0.02
3388	0.19	0.95	0.29	0.01	0.03	0.02
3378	0.18	0.81	0.28	0.01	0.02	0.02
3362	0.14	0.60	0.25	0.01	0.01	0.01
3344	0.16	0.75	0.27	0.01	0.02	0.02
3326	0.17	0.85	0.28	0.01	0.02	0.02
3312	0.16	0.86	0.28	0.01	0.02	0.02
3286	0.15	0.91	0.27	0.01	0.03	0.02
3260	0.19	0.98	0.29	0.01	0.03	0.02
3246	0.23	1.15	0.31	0.01	0.04	0.02
3229	0.28	1.48	0.31	0.02	0.07	0.03
3213	0.29	1.49	0.34	0.02	0.07	0.03
3204	0.27	1.45	0.35	0.02	0.07	0.03
3182	0.25	1.42	0.33	0.02	0.06	0.03
3160	0.32	1.55	0.35	0.03	0.08	0.03
3154	0.36	1.69	0.35	0.04	0.09	0.03
3136	0.37	1.78	0.33	0.04	0.10	0.03
3118	0.39	1.84	0.39	0.04	0.11	0.04
3111	0.38	1.86	0.42	0.04	0.11	0.05
3097	0.31	1.89	0.42	0.03	0.12	0.05
3083	0.35	2.20	0.50	0.03	0.16	0.07
3072	0.35	2.24	0.47	0.03	0.16	0.06
3068	0.34	2.21	0.42	0.03	0.16	0.05

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
10 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
3064	0.36	2.32	0.46	0.04	0.18	0.06
3051	0.37	2.35	0.47	0.04	0.18	0.06
3041	0.38	2.20	0.44	0.04	0.16	0.05
3031	0.44	2.47	0.51	0.06	0.20	0.07
3017	0.51	2.61	0.57	0.08	0.22	0.09
3000	0.51	2.54	0.48	0.07	0.21	0.07
2982	0.58	2.74	0.57	0.10	0.25	0.09
2959	0.61	2.94	0.66	0.06	0.29	0.12
2939	0.36	2.54	0.56	0.02	0.21	0.09
2916	0.50	2.93	0.64	0.08	0.29	0.12
2900	0.57	2.93	0.57	0.10	0.29	0.10
2895	0.53	2.78	0.48	0.09	0.26	0.07
2890	0.61	3.05	0.48	0.11	0.31	0.08
2858	0.61	3.05	0.43	0.11	0.31	0.07
2847	0.55	2.70	0.35	0.09	0.24	0.04
2835	0.62	2.97	0.46	0.11	0.30	0.07
2817	0.56	2.96	0.54	0.10	0.30	0.09
2809	0.46	2.78	0.49	0.07	0.26	0.08
2802	0.52	2.81	0.51	0.09	0.27	0.08
2792	0.60	2.77	0.41	0.11	0.26	0.06
2778	0.52	2.39	0.31	0.07	0.19	0.04
2764	0.55	2.39	0.41	0.08	0.20	0.05
2752	0.49	2.28	0.45	0.05	0.18	0.06
2742	0.36	2.19	0.42	0.03	0.16	0.05
2733	0.30	2.24	0.46	0.03	0.17	0.06
2719	0.29	1.68	0.35	0.02	0.10	0.04
2714	0.24	1.54	0.33	0.02	0.08	0.03
2708	0.24	1.42	0.33	0.02	0.07	0.03
2698	0.22	1.23	0.31	0.02	0.05	0.03
2682	0.20	0.89	0.22	0.01	0.03	0.01
2666	0.18	0.66	0.16	0.01	0.01	0.01
2656	0.17	0.59	0.14	0.01	0.01	0.01
2647	0.17	0.58	0.13	0.01	0.01	0.00
2637	0.17	0.55	0.12	0.01	0.01	0.00
2625	0.18	0.51	0.11	0.01	0.01	0.00
2612	0.20	0.58	0.12	0.01	0.01	0.00
2599	0.22	0.60	0.12	0.01	0.01	0.00
2591	0.23	0.66	0.13	0.01	0.01	0.01
2570	0.24	0.73	0.12	0.01	0.02	0.00
2549	0.27	0.83	0.16	0.02	0.02	0.01
2529	0.30	1.06	0.23	0.02	0.04	0.01
2512	0.30	1.31	0.27	0.02	0.06	0.02
2495	0.32	1.54	0.32	0.03	0.08	0.03
2482	0.35	1.68	0.32	0.04	0.10	0.03
2460	0.31	1.67	0.32	0.03	0.09	0.03

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

10 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
2438	0.26	1.46	0.36	0.02	0.07	0.04
2428	0.23	1.41	0.37	0.02	0.07	0.04
2417	0.27	1.30	0.33	0.02	0.06	0.03
2406	0.25	1.23	0.33	0.02	0.05	0.03
2395	0.24	1.06	0.29	0.01	0.04	0.02
2390	0.12	0.53	0.17	0.00	0.01	0.01
2385	0.12	0.56	0.18	0.00	0.01	0.01
2373	0.13	0.65	0.19	0.00	0.01	0.01
2358	0.16	0.74	0.20	0.01	0.02	0.01
2343	0.20	0.79	0.21	0.01	0.02	0.01
2330	0.21	0.84	0.21	0.01	0.02	0.01
2312	0.22	0.94	0.22	0.01	0.03	0.01
2294	0.33	1.42	0.26	0.02	0.07	0.02
2264	0.28	1.78	0.34	0.03	0.11	0.03
2255	0.22	1.82	0.33	0.02	0.11	0.03
2247	0.25	1.89	0.38	0.02	0.12	0.04
2223	0.27	2.07	0.40	0.03	0.14	0.05
2209	0.28	1.97	0.36	0.03	0.13	0.04
2195	0.37	2.03	0.38	0.04	0.14	0.04
2175	0.44	2.09	0.35	0.06	0.15	0.04
2159	0.44	2.18	0.28	0.06	0.16	0.03
2142	0.57	2.50	0.30	0.09	0.21	0.03
2130	0.57	2.83	0.33	0.10	0.27	0.04
2120	0.51	2.81	0.30	0.08	0.27	0.04
2110	0.59	3.00	0.33	0.11	0.31	0.04
2096	0.59	2.76	0.29	0.10	0.26	0.03
2078	0.51	2.48	0.20	0.07	0.21	0.02
2061	0.61	2.85	0.37	0.11	0.28	0.05
2044	0.62	3.18	0.49	0.12	0.35	0.08
2022	0.56	3.24	0.51	0.10	0.36	0.09
1999	0.75	3.60	0.58	0.17	0.46	0.12
1984	0.78	3.22	0.42	0.17	0.37	0.07
1964	0.63	2.65	0.45	0.11	0.24	0.07
1944	0.73	2.95	0.42	0.15	0.31	0.07
1928	0.75	3.13	0.56	0.16	0.35	0.11
1921	0.61	3.38	0.58	0.12	0.40	0.11
1913	0.81	4.71	0.81	0.23	0.83	0.23
1897	0.72	4.40	1.03	0.19	0.74	0.33
1888	0.39	2.35	0.84	0.05	0.20	0.17
1879	0.27	1.56	0.70	0.03	0.09	0.11
1867	0.25	1.26	0.57	0.02	0.06	0.07
1849	0.24	1.35	0.54	0.02	0.07	0.07
1831	0.24	1.67	0.65	0.02	0.10	0.10
1804	0.87	4.06	0.79	0.25	0.64	0.20
1796	0.79	3.20	0.61	0.19	0.38	0.13

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

10 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
1787	0.84	3.03	0.63	0.20	0.35	0.13
1785	0.83	3.00	0.62	0.20	0.35	0.13
1780	0.63	2.56	0.46	0.11	0.23	0.07
1775	0.72	2.69	0.52	0.14	0.27	0.08
1770	0.74	2.71	0.53	0.15	0.27	0.08
1760	0.68	2.59	0.47	0.13	0.24	0.07
1749	0.77	2.82	0.53	0.17	0.30	0.09
1747	0.77	2.86	0.52	0.17	0.30	0.09
1742	0.60	2.60	0.40	0.10	0.23	0.05
1737	0.69	3.03	0.49	0.14	0.33	0.08
1724	0.74	3.38	0.60	0.17	0.41	0.12
1710	0.64	3.18	0.52	0.13	0.36	0.10
1696	0.77	3.64	0.68	0.19	0.49	0.16
1692	0.76	3.62	0.71	0.18	0.48	0.17
1670	0.54	3.55	0.66	0.11	0.46	0.15
1647	0.72	3.54	0.66	0.17	0.47	0.15
1633	0.75	3.87	0.60	0.19	0.57	0.14
1621	0.68	3.86	0.40	0.17	0.56	0.07
1609	0.90	5.07	0.96	0.31	1.04	0.33
1600	0.21	5.25	2.01	0.03	1.29	1.21
1585	0.04	0.34	0.17	0.00	0.01	0.01
1570	0.06	0.46	0.22	0.00	0.01	0.01
1553	0.08	0.51	0.24	0.00	0.01	0.01
1548	0.09	0.62	0.22	0.00	0.02	0.01
1544	0.10	0.58	0.23	0.00	0.01	0.01
1541	0.10	0.57	0.23	0.00	0.01	0.01
1536	0.10	0.65	0.21	0.00	0.02	0.01
1531	0.11	0.61	0.22	0.00	0.01	0.01
1529	0.11	0.60	0.22	0.00	0.01	0.01
1524	0.11	0.66	0.20	0.00	0.02	0.01
1519	0.12	0.62	0.21	0.00	0.01	0.01
1517	0.12	0.62	0.21	0.00	0.01	0.01
1502	0.12	0.61	0.19	0.00	0.01	0.01
1483	0.16	0.52	0.18	0.01	0.01	0.01
1480	0.16	0.52	0.18	0.01	0.01	0.01
1475	0.16	0.56	0.17	0.01	0.01	0.01
1470	0.16	0.54	0.17	0.01	0.01	0.01
1467	0.16	0.53	0.17	0.01	0.01	0.01
1448	0.17	0.53	0.16	0.01	0.01	0.01
1429	0.17	0.49	0.16	0.01	0.01	0.01
1414	0.17	0.55	0.18	0.01	0.01	0.01
1401	0.15	0.65	0.20	0.01	0.01	0.01
1393	0.11	0.69	0.22	0.00	0.02	0.01
1390	0.12	0.70	0.22	0.00	0.02	0.01
1385	0.12	0.77	0.21	0.00	0.02	0.01

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
10 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
1380	0.14	0.83	0.23	0.01	0.02	0.01
1376	0.16	0.89	0.24	0.01	0.03	0.02
1354	0.19	1.05	0.24	0.01	0.04	0.02
1327	0.12	0.84	0.19	0.01	0.02	0.01
1325	0.15	0.81	0.19	0.01	0.02	0.01
1320	0.15	0.80	0.17	0.01	0.02	0.01
1315	0.16	0.78	0.17	0.01	0.02	0.01
1312	0.17	0.77	0.17	0.01	0.02	0.01
1288	0.14	0.77	0.17	0.01	0.02	0.01
1264	0.16	0.86	0.18	0.01	0.02	0.01
1248	0.28	1.48	0.25	0.02	0.07	0.02
1240	0.30	1.60	0.27	0.03	0.08	0.02
1231	0.36	1.84	0.33	0.04	0.11	0.02
1219	0.47	2.46	0.61	0.07	0.20	0.10
1212	0.43	2.32	0.55	0.06	0.18	0.08
1206	0.50	2.60	0.63	0.07	0.22	0.11
1192	0.63	3.29	0.73	0.12	0.37	0.15
1178	0.60	3.32	0.62	0.11	0.37	0.12
1163	0.67	3.92	0.74	0.15	0.53	0.17
1149	0.62	3.59	0.77	0.12	0.44	0.17
1136	0.55	3.06	0.64	0.10	0.32	0.12
1122	0.67	3.67	0.75	0.15	0.47	0.17
1110	0.75	4.26	0.78	0.19	0.64	0.20
1101	0.65	3.81	0.66	0.14	0.50	0.14
1093	0.84	4.95	0.87	0.25	0.89	0.26
1085	0.94	6.40	0.95	0.36	1.60	0.36
1077	0.57	4.44	1.14	0.14	0.77	0.40
1072	0.58	4.12	1.20	0.14	0.68	0.43
1067	0.38	2.52	0.78	0.05	0.23	0.16
1062	0.42	2.36	0.86	0.06	0.21	0.18
1059	0.42	2.26	0.81	0.06	0.19	0.16
1051	0.54	3.04	0.59	0.10	0.34	0.12
1044	0.78	4.77	0.69	0.23	0.90	0.19
1041	0.79	5.02	0.70	0.24	1.00	0.20
1036	0.51	3.53	0.55	0.10	0.44	0.11
1031	0.61	4.12	0.66	0.14	0.63	0.16
1026	0.72	5.38	0.79	0.21	1.12	0.25
1021	0.47	3.66	0.59	0.08	0.47	0.12
1016	0.70	5.82	0.86	0.19	1.30	0.29
1000	0.41	3.95	0.24	0.08	0.59	0.03

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

100 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
4357	0.67	3.38	0.67	0.12	0.34	0.12
4233	0.35	1.37	0.35	0.03	0.06	0.03
4109	0.19	0.73	0.19	0.01	0.02	0.01
3975	0.25	0.96	0.25	0.01	0.03	0.01
3784	1.11	3.93	0.44	0.28	0.47	0.07
3696	0.40	1.87	0.39	0.04	0.10	0.04
3648	0.34	1.51	0.37	0.03	0.07	0.03
3616	0.32	1.44	0.34	0.03	0.06	0.03
3606	0.30	1.37	0.34	0.02	0.06	0.03
3597	0.29	1.32	0.35	0.02	0.05	0.03
3578	0.28	1.42	0.38	0.02	0.06	0.03
3563	0.27	1.54	0.39	0.02	0.07	0.04
3549	0.28	1.71	0.44	0.02	0.09	0.04
3540	0.29	1.84	0.46	0.02	0.10	0.05
3527	0.30	2.01	0.46	0.03	0.12	0.05
3514	0.33	2.19	0.50	0.03	0.14	0.06
3498	0.34	2.23	0.50	0.03	0.15	0.06
3480	0.36	2.10	0.46	0.04	0.13	0.05
3461	0.42	2.07	0.45	0.05	0.13	0.05
3447	0.44	2.03	0.42	0.05	0.12	0.05
3431	0.44	2.02	0.40	0.05	0.12	0.04
3416	0.44	1.93	0.42	0.05	0.11	0.04
3397	0.35	1.59	0.42	0.03	0.07	0.04
3388	0.31	1.48	0.41	0.02	0.06	0.04
3378	0.30	1.35	0.41	0.02	0.05	0.03
3362	0.26	1.13	0.39	0.02	0.04	0.03
3344	0.28	1.28	0.39	0.02	0.05	0.03
3326	0.29	1.33	0.39	0.02	0.05	0.03
3312	0.28	1.33	0.40	0.02	0.05	0.03
3286	0.25	1.39	0.40	0.02	0.06	0.03
3260	0.32	1.46	0.42	0.03	0.06	0.04
3246	0.36	1.61	0.44	0.03	0.08	0.04
3229	0.42	1.91	0.45	0.04	0.11	0.05
3213	0.42	1.93	0.48	0.04	0.11	0.05
3204	0.41	1.93	0.49	0.04	0.11	0.06
3182	0.39	1.97	0.48	0.04	0.11	0.05
3160	0.46	2.03	0.49	0.05	0.12	0.06
3154	0.50	2.14	0.48	0.06	0.13	0.06
3136	0.55	2.39	0.46	0.07	0.17	0.05
3118	0.57	2.44	0.53	0.08	0.18	0.07
3111	0.56	2.50	0.56	0.08	0.18	0.08
3097	0.49	2.63	0.58	0.06	0.20	0.08
3083	0.46	2.44	0.55	0.06	0.18	0.07
3072	0.49	2.49	0.51	0.06	0.18	0.07
3068	0.49	2.54	0.46	0.06	0.19	0.06

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
100 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
3064	0.51	2.58	0.47	0.07	0.20	0.06
3051	0.51	2.56	0.50	0.07	0.19	0.07
3041	0.61	2.93	0.59	0.10	0.25	0.09
3031	0.72	3.29	0.67	0.13	0.32	0.12
3017	0.82	3.72	0.72	0.17	0.41	0.14
3000	0.89	3.96	0.63	0.19	0.46	0.11
2982	1.09	4.20	0.72	0.28	0.53	0.15
2959	0.57	3.96	0.78	0.10	0.47	0.16
2939	0.47	3.14	0.61	0.07	0.29	0.10
2916	0.50	3.47	0.68	0.08	0.36	0.12
2900	0.52	3.57	0.62	0.09	0.38	0.11
2895	0.51	3.61	0.57	0.08	0.39	0.10
2890	0.55	3.84	0.59	0.10	0.45	0.10
2858	0.56	4.06	0.61	0.10	0.50	0.11
2847	0.51	3.81	0.58	0.09	0.43	0.10
2835	0.53	3.99	0.67	0.09	0.48	0.13
2817	0.49	3.92	0.71	0.08	0.47	0.14
2809	0.46	3.71	0.66	0.07	0.42	0.12
2802	0.50	3.62	0.66	0.08	0.40	0.12
2792	0.54	3.62	0.58	0.09	0.40	0.10
2778	0.47	3.12	0.54	0.07	0.29	0.08
2764	0.45	2.83	0.58	0.06	0.24	0.09
2752	0.40	2.54	0.57	0.05	0.20	0.08
2742	0.38	2.34	0.52	0.04	0.17	0.07
2733	0.39	2.08	0.48	0.04	0.13	0.06
2719	0.35	1.69	0.40	0.03	0.09	0.04
2714	0.33	1.58	0.37	0.03	0.08	0.03
2708	0.32	1.48	0.37	0.03	0.07	0.03
2698	0.30	1.35	0.35	0.02	0.06	0.03
2682	0.26	1.18	0.30	0.02	0.04	0.02
2666	0.24	0.92	0.23	0.01	0.03	0.01
2656	0.24	0.88	0.21	0.01	0.02	0.01
2647	0.23	0.89	0.20	0.01	0.02	0.01
2637	0.24	0.87	0.20	0.01	0.02	0.01
2625	0.23	1.05	0.24	0.01	0.03	0.01
2612	0.23	1.22	0.27	0.01	0.04	0.02
2599	0.25	1.31	0.29	0.02	0.05	0.02
2591	0.27	1.40	0.30	0.02	0.06	0.02
2570	0.28	1.54	0.30	0.02	0.07	0.02
2549	0.28	1.64	0.36	0.02	0.08	0.03
2529	0.27	1.81	0.43	0.02	0.10	0.05
2512	0.26	1.99	0.46	0.02	0.12	0.05
2495	0.27	2.11	0.50	0.03	0.14	0.06
2482	0.30	2.26	0.50	0.03	0.16	0.06
2460	0.29	2.36	0.47	0.03	0.17	0.06

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE
100 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
2438	0.25	2.02	0.49	0.02	0.12	0.06
2428	0.22	1.94	0.48	0.02	0.11	0.06
2417	0.20	1.92	0.47	0.01	0.11	0.05
2406	0.20	1.82	0.47	0.01	0.10	0.05
2395	0.19	1.65	0.44	0.01	0.08	0.04
2390	0.10	0.89	0.29	0.00	0.02	0.02
2385	0.11	0.92	0.30	0.00	0.03	0.02
2373	0.13	1.01	0.32	0.01	0.03	0.02
2358	0.13	1.12	0.33	0.01	0.04	0.02
2343	0.15	1.19	0.35	0.01	0.04	0.03
2330	0.17	1.26	0.36	0.01	0.05	0.03
2312	0.18	1.39	0.37	0.01	0.06	0.03
2294	0.21	1.81	0.44	0.02	0.10	0.05
2264	0.32	1.93	0.47	0.03	0.11	0.05
2255	0.28	2.05	0.48	0.02	0.13	0.06
2247	0.28	2.17	0.52	0.03	0.14	0.07
2223	0.37	2.44	0.58	0.04	0.18	0.08
2209	0.39	2.40	0.55	0.04	0.17	0.07
2195	0.47	2.38	0.55	0.06	0.17	0.08
2175	0.54	2.46	0.54	0.07	0.18	0.07
2159	0.59	2.72	0.53	0.09	0.22	0.08
2142	0.66	3.10	0.60	0.08	0.29	0.10
2130	0.66	3.29	0.64	0.12	0.33	0.11
2120	0.62	3.30	0.63	0.11	0.33	0.11
2110	0.67	3.28	0.64	0.12	0.33	0.11
2096	0.69	3.03	0.59	0.12	0.28	0.10
2078	0.67	2.98	0.53	0.11	0.27	0.08
2061	0.77	3.37	0.57	0.15	0.35	0.10
2044	0.82	3.82	0.68	0.18	0.45	0.13
2022	0.90	4.58	0.83	0.22	0.65	0.20
1999	1.06	4.68	0.96	0.29	0.69	0.25
1984	1.11	4.47	0.81	0.31	0.63	0.19
1964	1.05	4.07	0.64	0.27	0.52	0.13
1944	1.13	4.17	0.72	0.31	0.55	0.16
1928	1.15	4.39	0.89	0.33	0.62	0.22
1921	1.13	4.62	0.92	0.33	0.68	0.24
1913	1.30	6.05	1.23	0.47	1.21	0.44
1897	1.22	6.12	1.49	0.44	1.25	0.54
1888	0.79	4.11	1.27	0.18	0.55	0.37
1879	0.56	3.04	1.15	0.10	0.31	0.28
1867	0.44	2.51	0.99	0.06	0.21	0.20
1849	0.51	2.51	0.90	0.07	0.20	0.17
1831	0.58	2.96	0.97	0.10	0.29	0.21
1804	0.88	4.62	1.11	0.24	0.72	0.34
1796	0.92	3.95	0.96	0.23	0.52	0.25

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

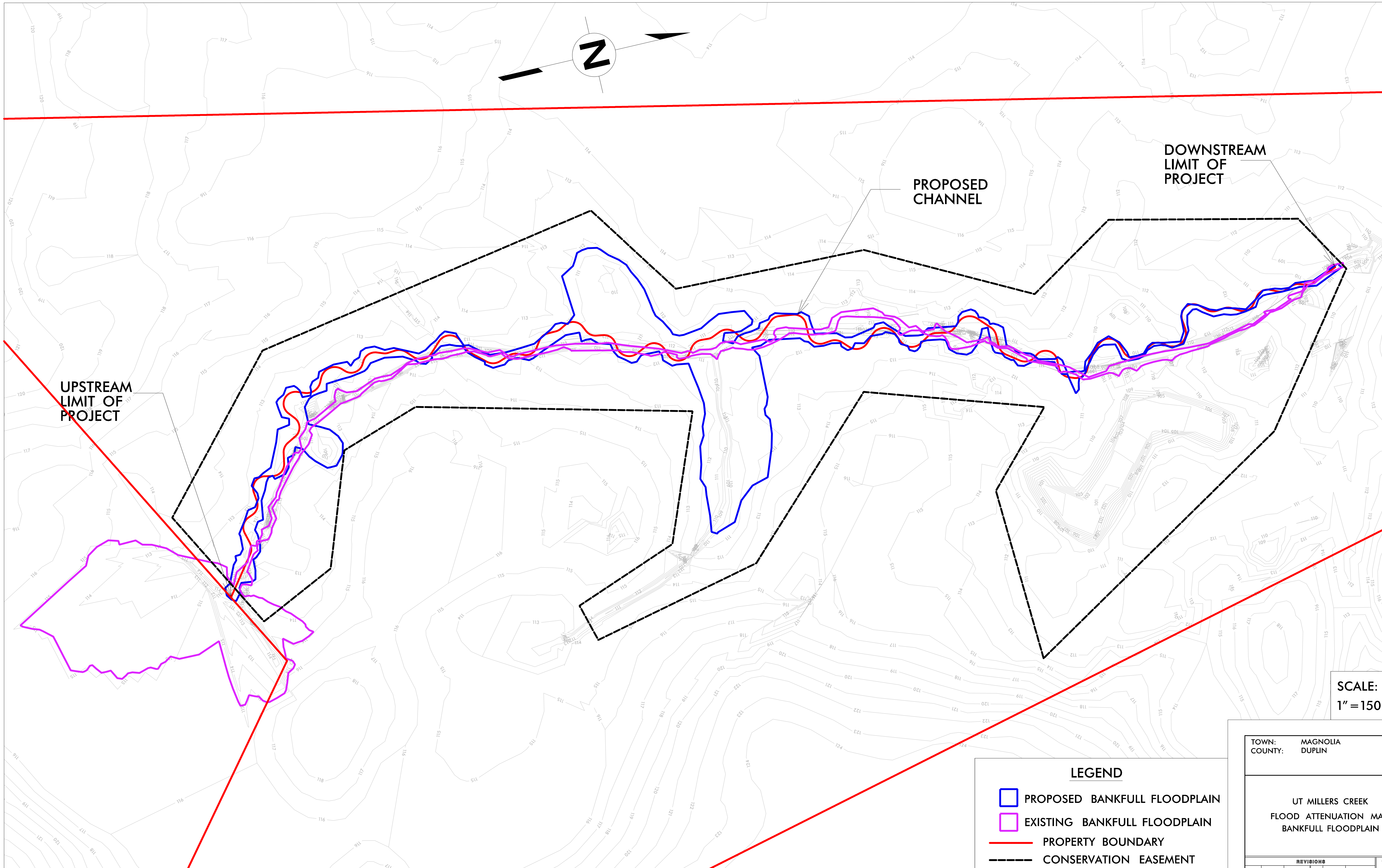
100 YEAR

River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
1787	0.97	3.67	0.94	0.24	0.45	0.23
1785	0.98	3.66	0.93	0.25	0.45	0.23
1780	0.87	3.47	0.79	0.19	0.38	0.17
1775	0.95	3.56	0.82	0.22	0.41	0.18
1770	1.00	3.63	0.81	0.25	0.43	0.18
1760	1.04	3.85	0.77	0.27	0.48	0.17
1749	1.15	4.16	0.94	0.33	0.57	0.24
1747	1.15	4.23	0.95	0.33	0.59	0.25
1742	0.99	4.13	0.84	0.25	0.54	0.19
1737	1.11	4.59	0.98	0.32	0.68	0.26
1724	1.23	4.93	1.09	0.39	0.79	0.32
1710	1.14	4.90	0.87	0.34	0.78	0.23
1696	1.24	5.15	1.01	0.41	0.88	0.30
1692	1.22	5.13	1.04	0.40	0.87	0.32
1670	1.01	5.72	1.14	0.32	1.09	0.39
1647	1.15	4.96	1.01	0.37	0.84	0.30
1633	1.19	5.11	0.94	0.40	0.90	0.28
1621	1.23	5.63	0.83	0.44	1.09	0.25
1609	1.51	6.88	1.41	0.70	1.73	0.63
1600	0.12	0.53	0.24	0.00	0.01	0.01
1585	0.13	0.56	0.23	0.00	0.01	0.01
1570	0.15	0.62	0.25	0.01	0.01	0.01
1553	0.16	0.70	0.27	0.01	0.02	0.02
1548	0.16	0.77	0.26	0.01	0.02	0.02
1544	0.17	0.75	0.26	0.01	0.02	0.02
1541	0.17	0.75	0.26	0.01	0.02	0.02
1536	0.17	0.83	0.26	0.01	0.02	0.02
1531	0.18	0.82	0.26	0.01	0.02	0.02
1529	0.18	0.82	0.26	0.01	0.02	0.02
1524	0.17	0.89	0.26	0.01	0.02	0.02
1519	0.19	0.87	0.26	0.01	0.02	0.02
1517	0.18	0.82	0.27	0.01	0.02	0.02
1502	0.21	0.79	0.25	0.01	0.02	0.01
1483	0.23	0.73	0.25	0.01	0.02	0.01
1480	0.23	0.73	0.25	0.01	0.02	0.01
1475	0.22	0.77	0.24	0.01	0.02	0.01
1470	0.23	0.75	0.24	0.01	0.02	0.01
1467	0.23	0.75	0.24	0.01	0.02	0.01
1448	0.23	0.77	0.24	0.01	0.02	0.01
1429	0.24	0.76	0.25	0.01	0.02	0.01
1414	0.24	0.81	0.26	0.01	0.02	0.01
1401	0.22	0.92	0.29	0.01	0.03	0.02
1393	0.16	0.98	0.31	0.01	0.03	0.02
1390	0.16	0.98	0.32	0.01	0.03	0.02
1385	0.17	1.05	0.31	0.01	0.03	0.02

UT MILLERS CREEK HEC-RAS OUTPUT SUMMARY TABLE

100 YEAR

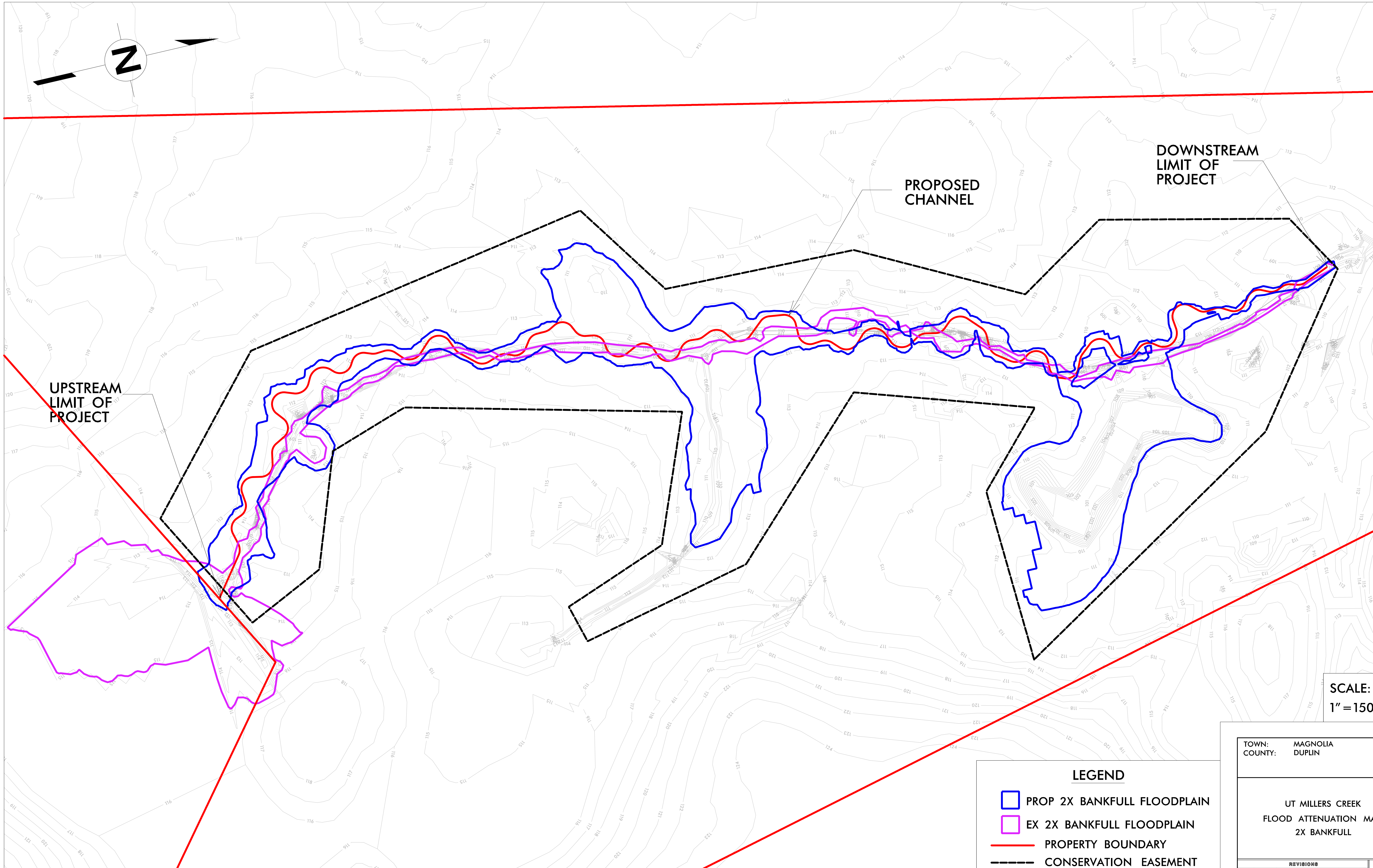
River Sta.	Vel. Left (ft/s)	Vel. Chan. (ft/s)	Vel. Right (ft/s)	Shear Left (lb/sq ft)	Shear Chan. (lb/sq ft)	Shear Right (lb/sq ft)
1380	0.19	1.08	0.32	0.01	0.04	0.02
1376	0.21	1.15	0.33	0.01	0.04	0.02
1354	0.20	1.17	0.31	0.01	0.04	0.02
1327	0.19	0.88	0.26	0.01	0.02	0.01
1325	0.20	0.86	0.25	0.01	0.02	0.01
1320	0.20	0.87	0.24	0.01	0.02	0.01
1315	0.20	0.85	0.24	0.01	0.02	0.01
1312	0.21	0.84	0.24	0.01	0.02	0.01
1288	0.18	0.86	0.24	0.01	0.02	0.01
1264	0.19	0.91	0.25	0.01	0.02	0.01
1248	0.27	1.28	0.31	0.02	0.05	0.02
1240	0.29	1.43	0.32	0.02	0.06	0.03
1231	0.34	1.58	0.35	0.03	0.07	0.03
1219	0.38	1.79	0.37	0.04	0.09	0.04
1212	0.38	1.83	0.36	0.04	0.10	0.03
1206	0.42	1.91	0.38	0.04	0.11	0.04
1192	0.36	2.25	0.39	0.04	0.15	0.04
1178	1.22	6.13	1.19	0.40	1.15	0.39
1163	1.44	8.06	1.66	0.63	2.12	0.78
1149	1.42	8.04	1.78	0.63	2.15	0.88
1136	0.86	4.74	1.03	0.22	0.71	0.28
1122	0.97	4.63	1.04	0.26	0.70	0.29
1110	1.03	5.06	1.05	0.30	0.83	0.31
1101	0.98	5.16	1.00	0.28	0.86	0.29
1093	1.13	5.86	1.18	0.38	1.14	0.40
1085	1.20	6.54	1.29	0.45	1.45	0.50
1077	1.23	8.10	2.34	0.55	2.36	1.44
1072	1.09	5.32	1.68	0.37	1.00	0.71
1067	0.82	3.92	1.26	0.19	0.51	0.36
1062	0.85	3.62	1.31	0.20	0.44	0.38
1059	0.84	3.48	1.25	0.19	0.41	0.34
1051	0.96	4.10	1.03	0.25	0.56	0.28
1044	1.37	5.81	1.06	0.53	1.18	0.37
1041	1.38	5.91	1.14	0.54	1.22	0.41
1036	1.12	5.37	0.98	0.36	0.95	0.29
1031	1.26	5.85	1.10	0.46	1.15	0.37
1026	1.35	6.21	1.15	0.53	1.32	0.42
1021	1.06	5.28	0.99	0.32	0.89	0.29
1016	1.24	5.98	1.18	0.44	1.18	0.41
1000	1.01	5.17	0.68	0.30	0.88	0.17



TOWN: MAGNOLIA
COUNTY: DUPLIN

UT MILLERS CREEK
FLOOD ATTENUATION MAP
BANKFULL FLOODPLAIN

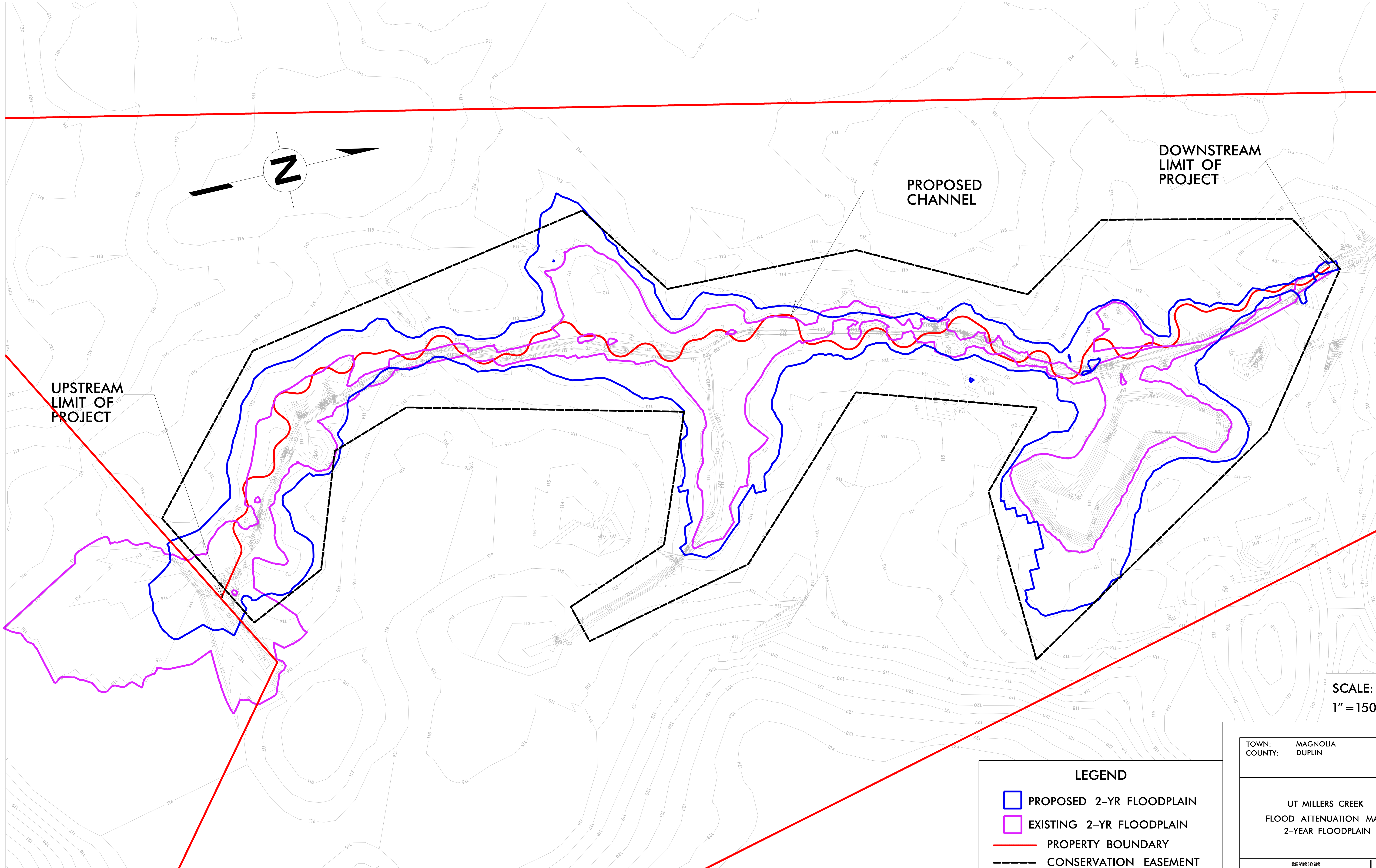
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			TOTAL SHEETS
2			4			



TOWN: MAGNOLIA
COUNTY: DUPLIN

UT MILLERS CREEK
FLOOD ATTENUATION MAP
2X BANKFULL

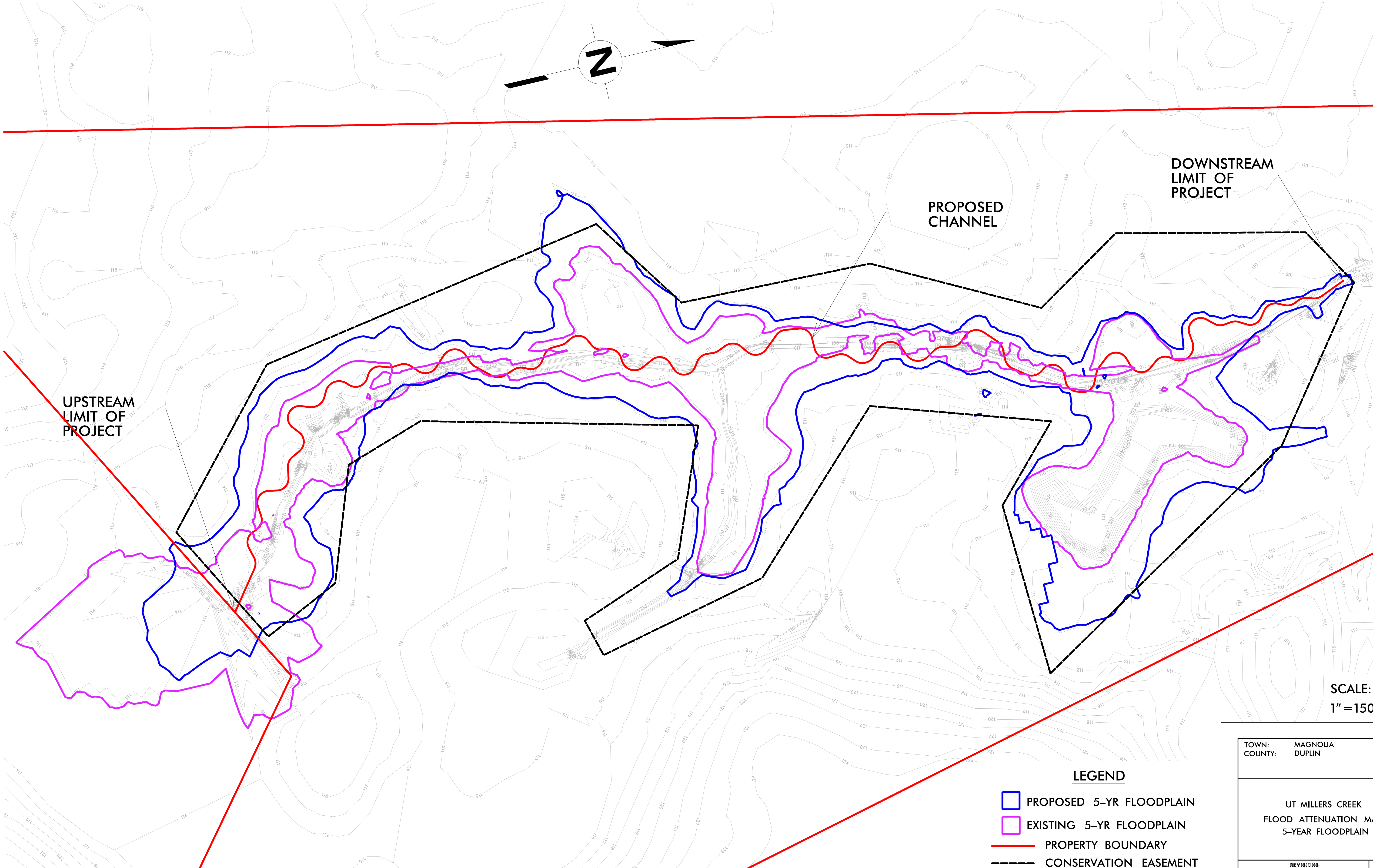
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			TOTAL SHEETS
2			4			



TOWN: MAGNOLIA
COUNTY: DUPLIN

UT MILLERS CREEK
FLOOD ATTENUATION MAP
2-YEAR FLOODPLAIN

REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	
1			3			TOTAL SHEETS
2			4			



SCALE: 1"=150'

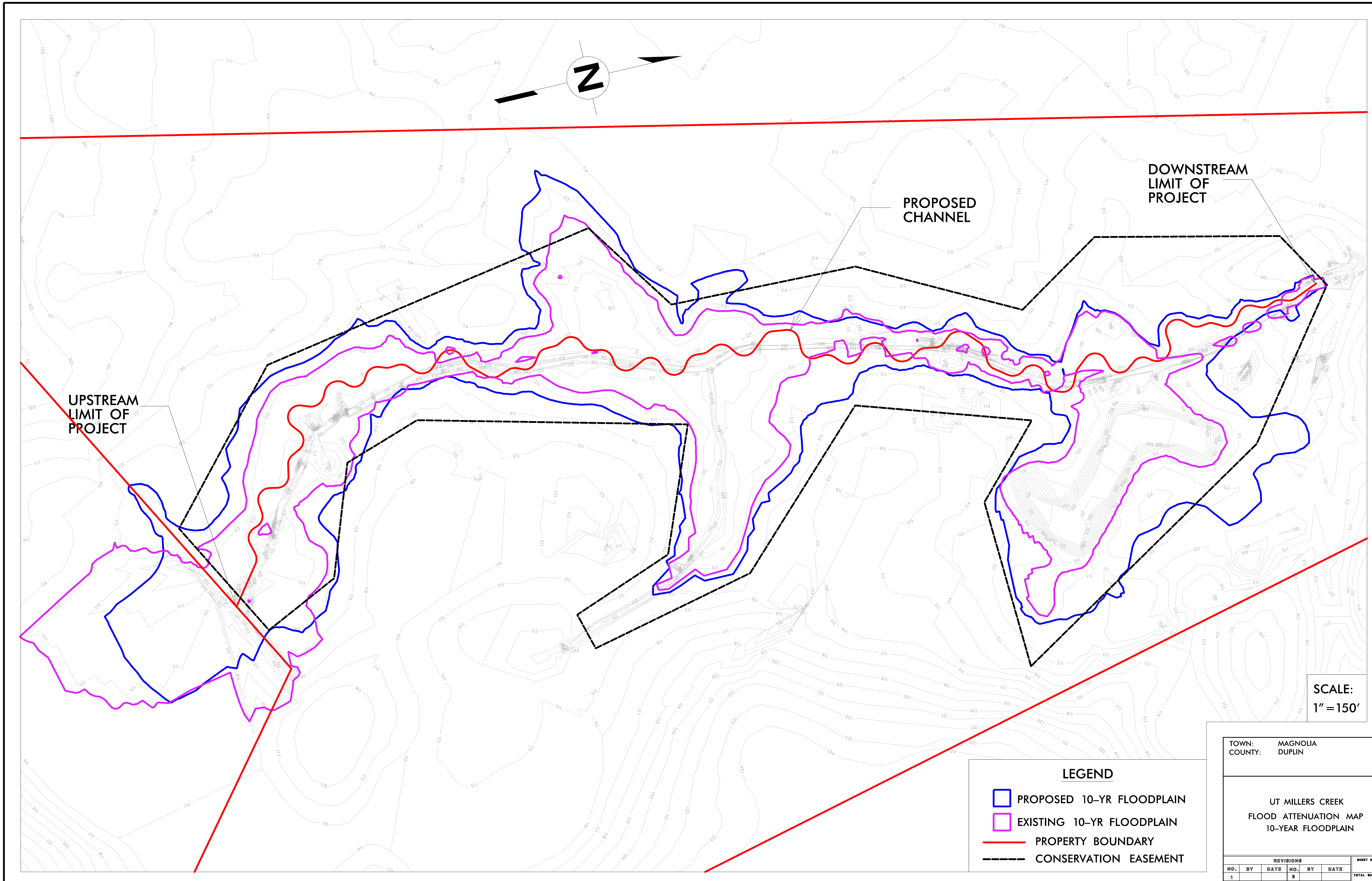
LEGEND

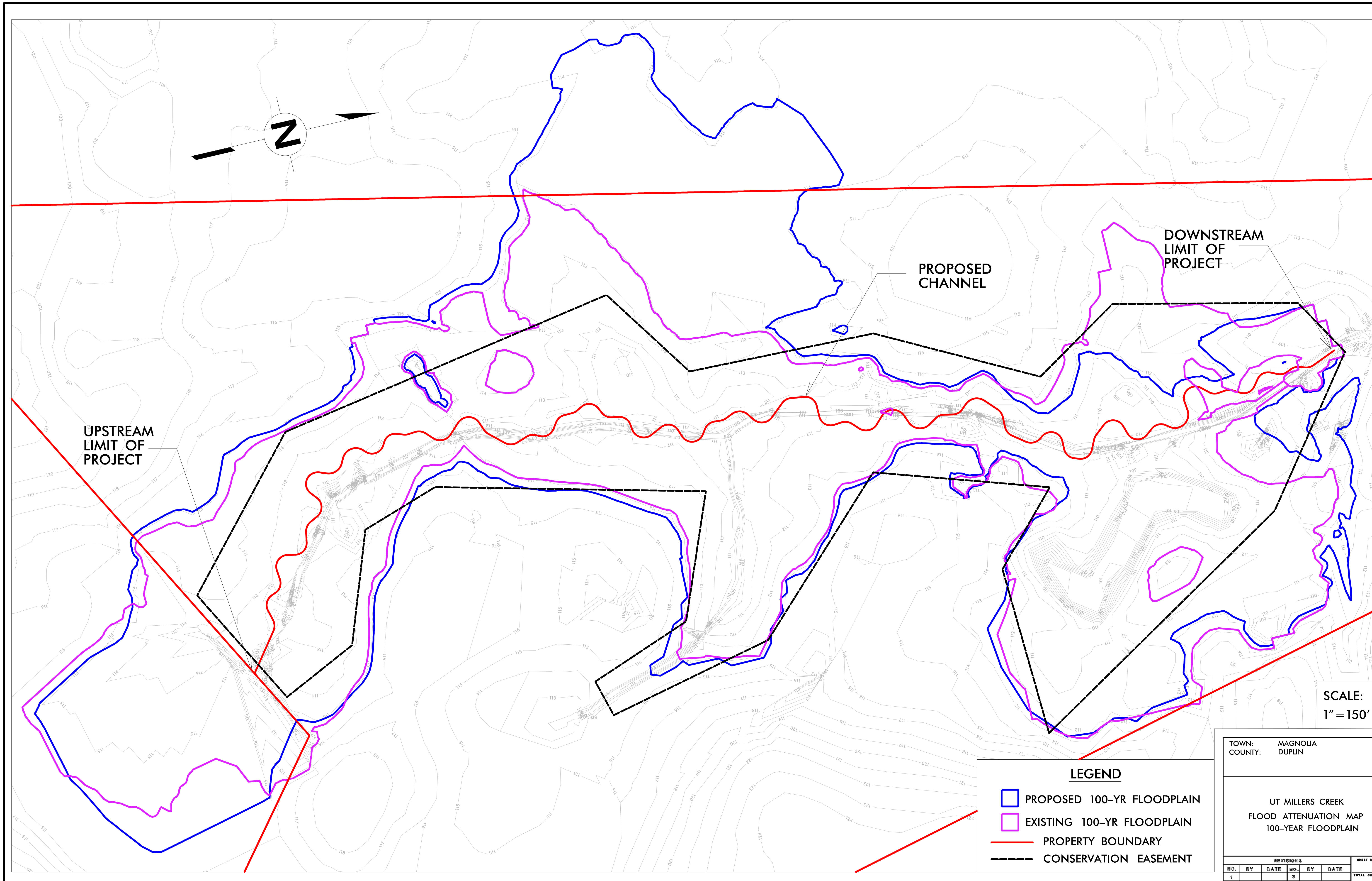
- PROPOSED 5-YR FLOODPLAIN
- EXISTING 5-YR FLOODPLAIN
- PROPERTY BOUNDARY
- CONSERVATION EASEMENT

TOWN: MAGNOLIA
COUNTY: DUPLIN

UT MILLERS CREEK
FLOOD ATTENUATION MAP
5-YEAR FLOODPLAIN

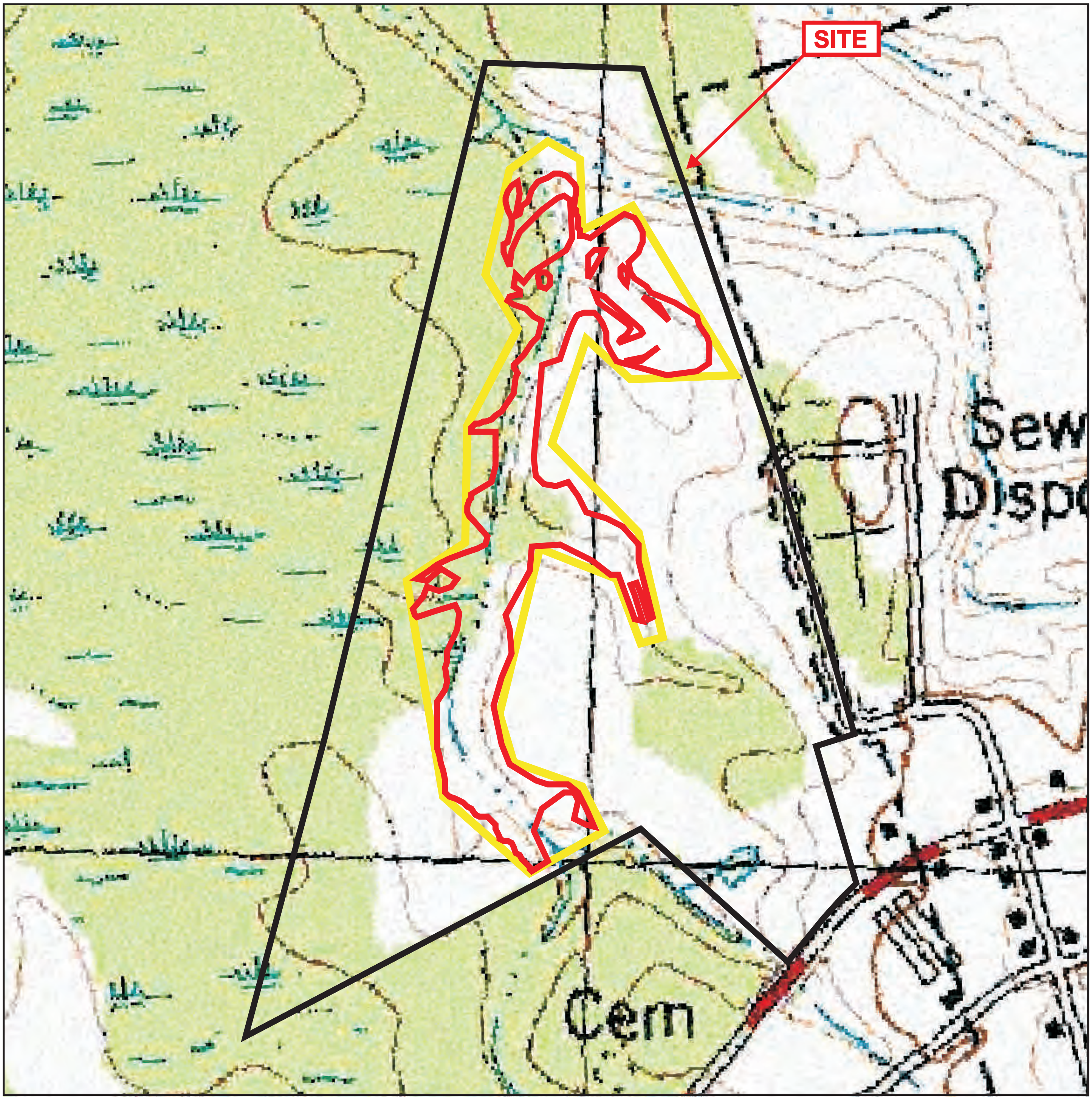
REVISIONS						SHEET NO.
NO.	BY	DATE	NO.	BY	DATE	TOTAL SHEETS
1			3			
2			4			


N
DOWNSTREAM LIMIT OF PROJECT
PROPOSED CHANNEL
UPSTREAM LIMIT OF PROJECT
SCALE:
1"=150'
LEGEND
PROPOSED 10-YR FLOODPLAIN
EXISTING 10-YR FLOODPLAIN
PROPERTY BOUNDARY
CONSERVATION EASEMENT
TOWN: MAGNOLIA
COUNTY: DUPLIN
UT MILLERS CREEK
FLOOD ATTENUATION MAP
10-YEAR FLOODPLAIN
REVISIONS
NO. BY DATE NO. BY DATE
SHEET NO.
TOTAL SHEETS



UPSTREAM LIMIT OF PROJECT
PROPOSED CHANNEL
DOWNSTREAM LIMIT OF PROJECT
SCALE: 1"=150'
LEGEND
PROPOSED 100-YR FLOODPLAIN
EXISTING 100-YR FLOODPLAIN
PROPERTY BOUNDARY
CONSERVATION EASEMENT
TOWN: MAGNOLIA
COUNTY: DUPLIN
UT MILLERS CREEK
FLOOD ATTENUATION MAP
100-YEAR FLOODPLAIN
REVISIONS
NO. BY DATE NO. BY DATE
1 3
2 4
SHEET NO.
TOTAL SHEETS

C.2 Wetland Restoration Groundwater Modeling and Analysis



- Proposed Conservation Easement Boundary

- Proposed Riparian Restoration Boundary

N

SCALE 1" = 400'

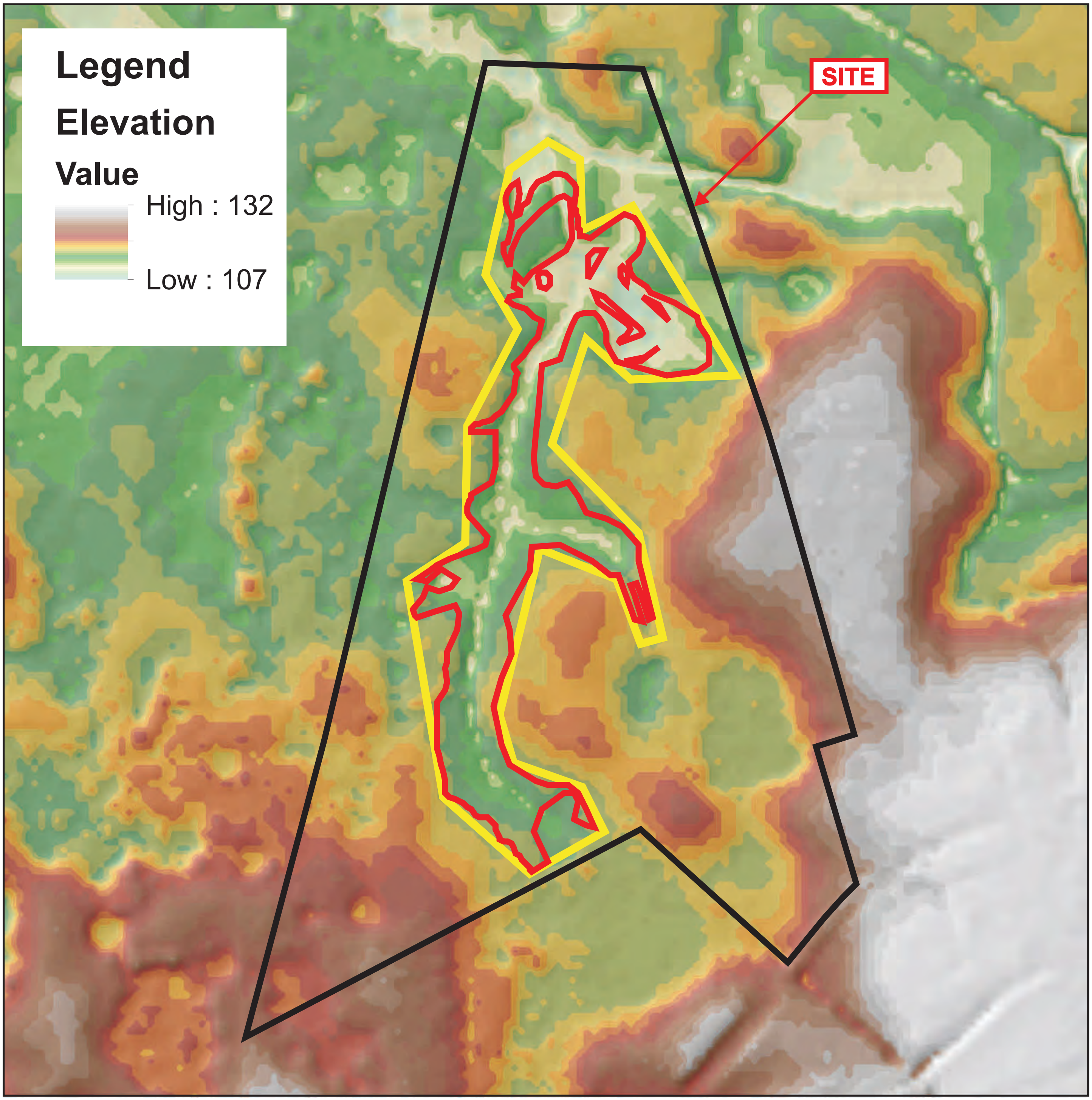
L:\WETLANDS\2013 WETLANDS FILES\40-13-064 --- UT to Millers Creek, Ryan Smith

UT to Millers Creek
Magnolia Tract
Florence & Hutcheson
Duplin County, NC
July 31, 2013
40-13-064

LMG
LAND MANAGEMENT GROUP INC.
Environmental Consultants
www.LMGroup.net
Phone: 910.452.0001 • 1.866.LMG.1078
Fax: 910.452.0060
3805 Wrightsville Avenue
Wilmington, NC 28403

USGS Topographic Quad
w/ Conservation Easement
and Riparian Corridor Overlay

(Map Source: USGS Warsaw South 7.5 Minute Topographic Quad)



- Proposed Conservation Easement Boundary

- Proposed Riparian Restoration Boundary

N

SCALE 1" = 400'

L:\WETLANDS\2013 WETLANDS FILES\40-13-064 --- UT to Millers Creek, Ryan Smith

UT to Millers Creek Magnolia Tract Florence & Hutcheson Duplin County, NC July 31, 2013 40-13-064	LMG LAND MANAGEMENT GROUP INC. Environmental Consultants www.LMGroup.net Phone: 910.452.0001 • 1.866.LMG.1078 Fax: 910.452.0060 3805 Wrightsville Avenue Wilmington, NC 28403	LiDAR Map w/ Conservation Easement and Riparian Corridor Overlay (Map Source: NC DOT LiDAR Map)

APPENDIX C-1. ATTACHMENT 1
DRAINMOD ASSESSMENT FOR UT TO MILLERS CREEK SITE

I. INTRODUCTION

Land Management Group, Inc (LMG) has prepared the following DRAINMOD assessment for the UT to Millers Creek Tract. The UT to Millers Creek Tract is located immediately west of the intersection of US 117 and NC 903 (west of Interstate 40), near Magnolia (Duplin County), NC. The former agriculture/silviculture site contains a low-gradient second order stream (unnamed tributary to Millers Creek). The UT to Millers Creek Tract consists of riparian small stream swamp wetlands historically degraded or removed via drainage improvements. Channelization (deepening and straightening) of on-site tributaries has altered characteristic hydrology via drawdown of groundwater, interception of surface water inflow, and the disconnection of stream reaches from the adjacent floodplain. Channel modifications such as these have been cited as sources of water quality impairments by contributing to increased sedimentation and nutrient loading to downstream waters.

Site specific soils information, current drainage conditions, and geomorphological data were used to perform DRAINMOD (Version 6.0) computer modeling. DRAINMOD is a field-scale hydrologic model originally developed for the design of subsurface drainage systems. Its application is now widely used for the purposes of evaluating lateral drainage effects of existing ditches and modeling for wetland restoration purposes. The model incorporates long-term climatological data in conjunction with site-specific model inputs. In order to determine the drainage response relative to existing ditch size, multiple DRAINMOD analyses were conducted utilizing various input parameters. These models incorporated typical channel geometry documented for the excavated channel at each observation well transect. DRAINMOD utilizes Reference Wetland Simulation (RWS) in which typical reference soil and drainage inputs are used to determine minimum hydrology requirements satisfying Section 404 jurisdictional wetland criteria. Additional simulations are then performed analyzed to evaluate current versus proposed drainage alterations.

The results of these evaluations were used to identify the drainage effects of ditches occurring within the UT to Millers site and to predict hydroperiods subsequent to the completion of the proposed restoration work.

II. SITE CONDITIONS

The UT to Millers Creek Tract consists of a mixture of former and existing small stream swamp communities. The small stream swamp community is comprised of floodplains of small streams underlain by fluvial or organic soils. Remnant areas of this wetland community type are still present, though fragmented and smaller in size as a result of prior drainage modifications. A comprehensive wetland delineation performed by LMG indicates that approximately 7.9 acres of jurisdictional wetlands (including non-riparian wetlands unaffected by site drainage) remain on the entire tract. LMG has received verbal concurrence on the delineation findings by the USACE (per USACE site review on July 30, 2013), and a final jurisdictional determination is pending. The wetland type targeted for restoration is riparian small stream swamp forest (NCWAM wetland types Bottomland Hardwood Forest and Headwater Forest). Based upon the Cowardin classification for wetland and deepwater habitats (Cowardin et al. 1979), the wetland community type to be restored is Palustrine Forested Wetland (broad-leaved deciduous).

III. DRAINAGE MODELING

A. Model Set-Up

DRAINMOD software, an approved hydrologic modeling tool, was utilized to determine the extent of drainage throughout the site. This software models the cumulative effects of parallel drainage features using long-term climate data and user supplied inputs. The user supplied inputs allow for site-specific drainage spacing, ditch depths, and soil conductivity rates to be modeled over multiple decades. This long-term approach provides information on the hydrology of the site in a variety of climatic conditions, which can aid in the determination of the effective later drainage distance of a channelized tributary.

The calibration process consisted of adjusting soil property inputs so the model predictions match, as closely as possible, the measured water table fluctuations in response to measured rainfall and calculated evapotranspiration (ET). Soil properties vary between soil series, and from point to point within a given soil series. Calibration provides a method of determining the field effective soil property values for each observation well. Model calibration is considered successful when the standard error and average absolute deviation are <20 cm (Vepraskas et al. 2002). The model was calibrated separately for each observation well location using a short-term record of observed weather data and water table measurements recorded across a 3-month period from April 1, 2013 to June 30, 2013. This period was chosen because the precipitation record includes a range of conditions from below normal, to normal, and above normal precipitation. The full range of rainfall totals during this period provides the calibration procedure its greatest accuracy when fitting the model to a wide range of soil moisture levels.

The calibration of the model to determine 404 jurisdictional wetland and post restoration requirements utilized general DRAINMOD supplied data for soil horizon depths and conductivity rates. Model inputs are summarized in Table 1. The growing season has been defined to start on February 1 and end on November 30 (equivalent to 302 days) in accordance with recent guidance by the USACE and the North Carolina Interagency Review Team (IRT). The 5% criterion for a 404 jurisdictional wetland determination is therefore considered to be 15 days. Subsequent analyses were completed utilizing a 12.5% (38 day) criterion for post-restoration conditions which more closely resembles the target wetland hydroperiod of small stream swamp communities. Climate data from an onsite rain gauge and Kenansville, NC were used for modeling input.

DRAINMOD utilizes Reference Wetland Simulation (RWS) in which typical reference soil and drainage inputs are used to determine maximum hydrology requirements satisfying 404 wetland jurisdictional criteria. Threshold settings for each configuration were based on the number of consecutive days necessary to meet the wetland hydrology criteria. This criteria states that a site must exhibit water table depths within 12 inches of the surface for 15 consecutive number of days of the growing season (for the 5% criterion). When these conditions are met for >50% of the years during a given study, the site is considered to be jurisdictional wetlands. As indicated above, post-restoration conditions were modeled utilizing a 12.5% criterion (equivalent to 38 consecutive days of groundwater within 12 inches of the soil surface).

Table 1. Inputs for UT to Millers DrainMod Study		
Input	**ft**	**cm**
Depth to Drain	0.6	19
	3.1	95
	4.2	128
Drain Spacing	16	500
	25	762
	100	3048
	125	3810
	678	20668
	1995	60800
	3280	100000
Effective Radius of Drains	5 cm - 17.5 cm	
Distance to Restrictive Layer	42 cm - 150 cm	
Drainage Coefficient	0.1 - 25 cm / day	
Kirkhams Coefficient	variable	
Initial Depth to Water Table	variable	
Maximum Surface Storage	0.0 - 2.54 cm	
Depth of Flow to Drains	0.0 - 2.54 cm	
Climate Data	Greenville, NC	
Time Period	1965-1994	
Critical Water Table Depth	12 inches / 30.5 cm	
Critical Duration	404 Jurisdictional Determination - 5% = 15 days	
	Post Restoration - 12.5% = 38 days	

B. Model Results

Plots of the measured and predicted water tables for each well are shown in the attached output sheets. These sheets depict DRAINMOD output data for each of the seven observation wells. The first page of each output data package shows the plot of measured versus predicted water table.

Table 2 contains the summary statistic comparing the actual water table data with the predicted water table. Observed and statistical comparisons exhibit minimal deviation between predicted and measured water table depths on the site. Over the observation wells calibrated, the Average Absolute Deviation (AAD) varied from 1.74 to 6.59 cm ($\bar{x}$ = 3.96 cm) for the 5% model simulations and from 3.49 cm to 5.30 cm ($\bar{x}$ = 4.21 cm). For reference, AAD values less than 15 cm are generally considered good fits for water table predictions. Note that deviations for model runs at the UT to Millers Creek site are well below published values for original tests of DRAINMOD and other water table models (Skaggs, 1999, page 476), and more recently by Youssef et al. (2006) for heavily instrumented field studies at the Tidewater Research Station near Plymouth, NC. Deviations are also well below the 20 cm (8 inch) AAD standard commonly applied to wastewater modeling applications in the state of North Carolina (Rule 15A NCAC 18A.1942), (Skaggs, Personal Communication, 2009).

Table 2: Summary of Statistic Quantifying Agreement Between Predicted and Observed Water Table Depth

Observation Well	**Average Absolute Deviation (cm)**	
	5% Simulations	**12.5% Simulations**
1	3.51	3.51
2	1.74	3.87
3	3.47	3.49
4	6.59	5.30
5	3.97	4.53
7	3.87	4.18
8	4.57	4.57
Mean	3.96	4.21

<u>1. Assessment Utilizing 5% Hydroperiod (Pre-Restoration Condition)</u>

In order to determine the potential for wetland hydrology on this site, thirty-year simulations were run to predict how many years the hydrology criterion would be met. Results of the long-term simulations are summarized in Table 3. The table shows the number of years out of 30 that the predicted water table remained in the top 30 cm (12 inches) of the soil profile for 5% of the growing season (equivalent to 15 consecutive days) at the location of each observation well. Locations (wells) meeting the above threshold conditions in 50% of the years or more (in this case 15 or more years) would satisfy the wetland hydrologic criterion.

Table 3. Results from UT to Millers Tract DrainMod Study (5% Growing Season)

Well	Elevation	Ditch Depth (cm)	Ditch Spacing (cm)	Number of Years Meeting Wetland Hydrology	Length of Study (yrs)	Percentage (>50% = Wet)
1	110.7	128	60800	30	30	100%
2	110	128	3048	2	30	7%
3	110.3	95	3810	7	30	23%
4	109.8	95	20668	22	30	73%
5	110.5	95	20668	8	30	27%
7	113.5	128	762	0	30	0%
8	112.9	128	500	0	30	0%

Results of the DRAINMOD simulations generally align with both observed field indicators and the available groundwater level monitoring data. Specifically, simulations for Well #1 and Well #4 predict that the wetland hydrologic criterion is met for 30 out of 30 years and 23 out of 30 years, respectively. Conversely, well locations situated closer to the excavated channel (particularly Well #2 and Well #5) do not meet long term wetland hydrology based upon model simulations. In addition, these same locations exhibited surficial oxidation of organic material as documented during site evaluations by LMG soil scientists. Groundwater levels recorded for Well #7 and Well #8 over the monitoring period remained relatively low and exhibited more rapid discharge subsequent to rain events. Accordingly, model simulations predicted that wetland hydrology would be not be met during the 30 year period. While Well #3 did not meet wetland hydrology according to the model simulations, this area was included just within the flagged wetland boundary based upon the presence of a thin muck surface observed in the field.

2. Assessment Utilizing 12.5% Hydroperiod (Post-Restoration Condition)

Additional simulations were modeled utilizing a 12.5% criterion which more closely resembles the target wetland hydroperiod. The models were configured to account for post-restoration site conditions, in which drainage influences are consistent with the proposed stream channel design. The results from the post-restoration configurations are presented in Table 3. Raising the effective depth to the drain (i.e. simulating stream restoration and elevating the bed elevation of the stream channel) resulted in a pronounced change in predicted hydroperiods for those well locations currently shown to be influenced by drainage. In particular, Wells #2, #3, #5, #7, and #8 are predicted to meet the 12.5% standard between 53% and 77% of the years during the 30-year simulation.

Table 4. Results from UT to Millers Tract DrainMod Study (12.5% Growing Season)

Well	Elevation	Ditch Depth (cm)	Ditch Spacing (cm)	Number of Years Meeting Wetland Hydrology	Length of Study (yrs)	Percentage (>50% = Wet)
1	110.7	31	100000	30	30	100%
2	110	31	100000	23	30	77%
3	110.3	31	100000	23	30	77%
4	109.8	31	100000	20	30	67%
5	110.5	31	100000	16	30	53%
7	113.5	31	100000	23	30	77%
8	112.9	31	100000	23	30	77%

IV. CONCLUSION

Based on the combination of field observations, monitoring well data, and DRAINMOD results, approximately 8.7 acres of the riparian corridor appear to have been effectively drained and may be suitable for riparian wetland restoration. Final restoration limits will be dependent upon stream design and final grading. Note that site evaluations and DRAINMOD analyses also provide evidence of hydrologic modifications within the existing wetlands, although these areas may still maintain water table depths sufficient to meet the wetland hydrology criteria. As such, proposed restoration work will likely result in hydrologic benefits to areas beyond the proposed limits of restoration.

V. <u>SOURCES OF INFORMATION</u>

Vepraskas, M. J., X.He, D. L Londbo, and Skaggs. 2002. Predicting long-term wetland hydrology from hydric soil field indicators. WRRI Report 342. 55p.

Amoozegar, A., 1992. Compact Constant Head Permeameter: A Convenient Device for Measuring Hydraulic Conductivity,

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Skaggs, R.W., D. Amatya, R.O. Evans, and J.E. Parsons. 1994. Characterization and evaluation of proposed hydrologic criteria for wetlands. J. Soil Water Conserv. 49:501–510.

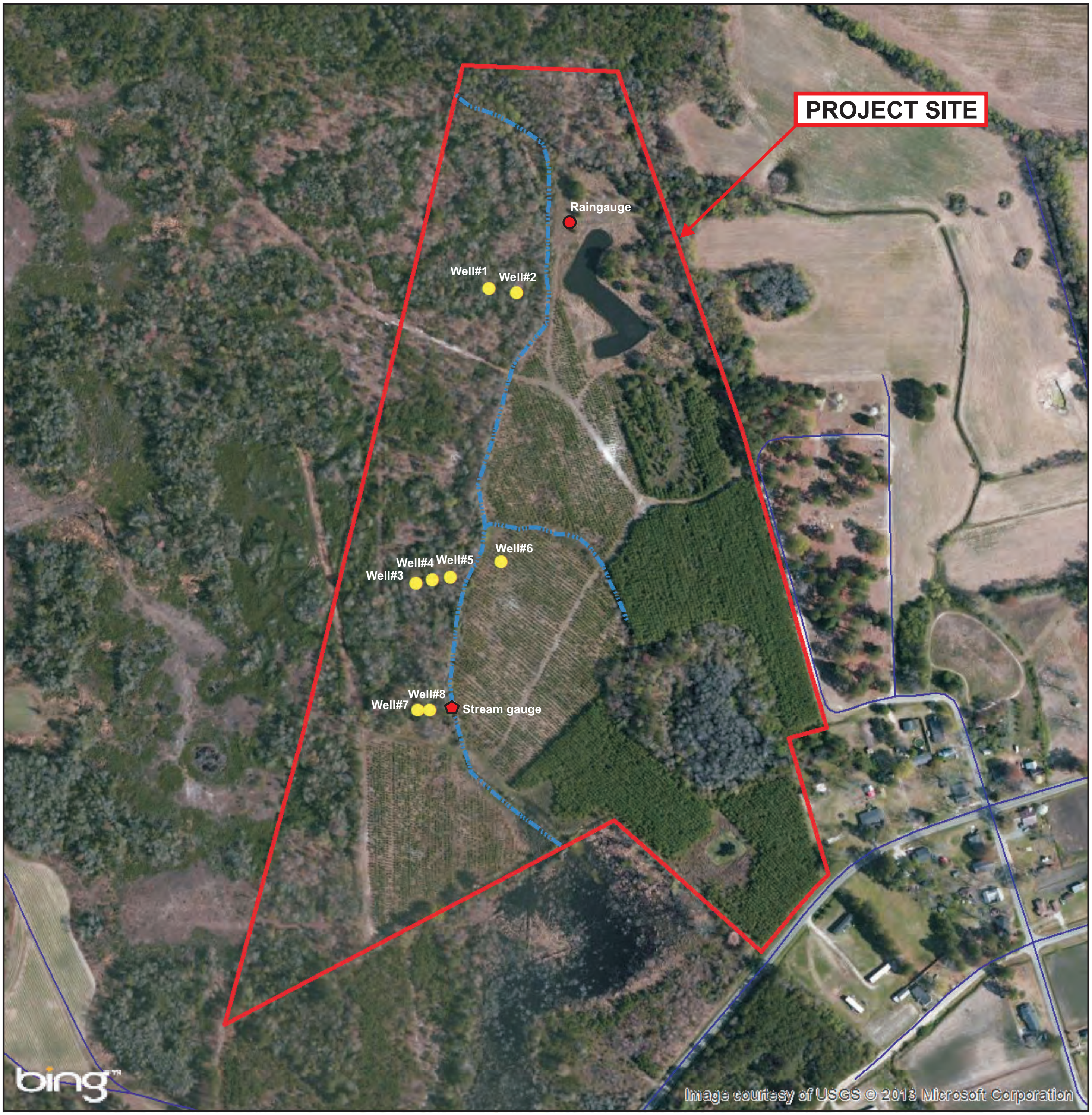
Skaggs, R.W. 1999. Drainage simulation models. p. 461–492. *In* R.W. Skaggs et al. (ed.) Agricultural drainage. Agron. Monogr. 38. ASA, CSSA, and SSSA, Madison, WI.

Skaggs, R.W., G.M. Chescheir and B.D. Phillips. 2005. Methods to determine lateral effect of a drainage ditch on wetland hydrology. Trans. ASAE, 48(2):577-584.

Skaggs, Personal Communication, (2009).

USACE. 2005. Technical Standard for Water-Table Monitoring of Potential Wetland Sites, ERDC-TN-WRAP-05-2.

Youssef, M.A., R.W. Skaggs, J.W. Gilliam and G.M. Chescheir. 2006. Field evaluation of a model or predicting nitrogen losses from drained lands.
JEQ, 35: 2026-2042.



L:\WETLANDS\2013 WETLANDS FILES\40-13-064 --- UT to Millers Creek, Ryan Smith

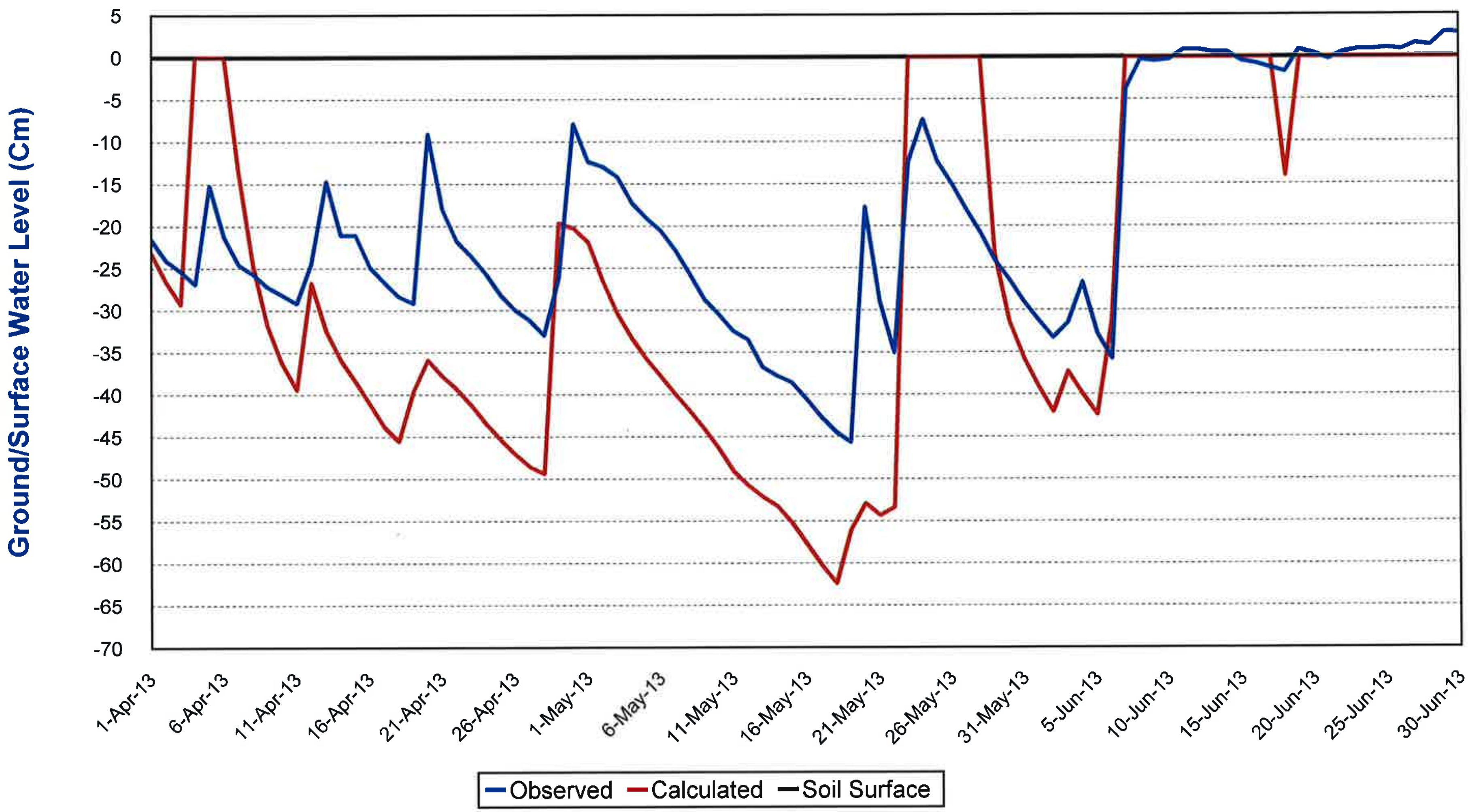
NOTE: This is not a survey. All boundaries and distances are considered approximate.

Map Source: BING Aerial Photography

UT to Millers Creek Florence & Hutcheson Magnolia Tract Duplin County, NC March 2013	LMG LAND MANAGEMENT GROUP INC Environmental Consultants www.LMGroup.net Phone: 910.452.0001 •1.866.LMG.1078 Fax: 910.452.0060 P.O. Box 2522, Wilmington, NC 28402	Gauge Location Map

Drainage Assessment

(statistical difference = 3.51 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 1
- April 1, 2013 to June 30, 2013

Land Management Group, Inc.
www.lmgroup.net

Slide A

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--------------------------------------------------------
*                 DRAINMOD version 6.1                 *
* Copyright 1980-2011 North Carolina State University *
--------------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #1 LT
Onsite Raingauge, Magnolia NC Temperature Data
****

```
 ----------RUN STATISTICS ----------          time:  7/26/2013  @ 10:47
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage                 and yields not calculated
               drain spacing =    60800. cm   drain depth =  128.0 cm
-------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 15 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 15 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	2.	68.
1966	2.	51.
1967	2.	39.
1968	4.	58.
1969	4.	86.
1970	2.	81.
1971	2.	76.
1972	5.	78.
1973	3.	44.
1974	4.	63.
1975	1.	83.
1976	2.	17.
1977	2.	59.
1978	2.	51.
1979	6.	60.
1980	2.	69.
1981	1.	62.
1982	3.	61.
1983	1.	90.
1984	3.	109.
1985	1.	39.
1986	1.	59.
1987	1.	97.
1988	4.	61.
1989	4.	61.
1990	3.	42.
1991	2.	59.
1992	4.	45.
1993	2.	91.
1994	1.	71.

Number of Years with at least one period = 30. out of 30 years.

****

D R A I N M O D 6.1

LAST UPDATE: January 2011
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #1 LT
Onsite Raingauge, Magnolia NC Temperature Data

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\DrainMod\weather\greenville.RAI			
FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM			
RAINFALL STATION NUMBER.........................	(RAINID)	313638	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	313638	
STARTING YEAR OF SIMULATION.................	(START YEAR)	1965	YEAR
STARTING MONTH OF SIMULATION................	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	1994	YEAR
ENDING MONTH OF SIMULATION..................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.52	DEG.MIN
HEAT INDEX..	(HID)	81.00	

ET MULTIPLICATION FACTOR FOR EACH MONTH
2.01 2.32 2.10 1.72 1.23 1.00 .86 .82 .92 1.05 1.22 1.44

DRAINAGE SYSTEM DESIGN
****

*** CONVENTIONAL DRAINAGE ***

JOB TITLE:

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Rip
Onsite Raingauge, Magnolia NC Temperature Data

```
              STMAX = 2.54 CM                        SOIL SURFACE
+        __/)__________________________________________________________/)__
             :                                                   :
             :                                                   :
             :                                                   :
             :                                                   :
       ADEPTH =150. CM                                  DDRAIN =128. CM
             :                                                   :
             :                                                   :
             :    O------------SDRAIN =60800. CM -----------O    -
             :    *                                              :
             : EFFRAD =**** CM                                   :
             :                                          HDRAIN = 22. CM
             :                                                   :
             :                                                   :
         - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
             :
             :
             :                                     IMPERMEABLE LAYER
+        __________________________________________________________________
         //////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 46.0	1.270
46.0 - 91.0	.250
91.0 - 152.0	1.270

DEPTH TO DRAIN = 128.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 22.0 CM
DISTANCE BETWEEN DRAINS = 60800.0 CM
MAXIMUM DEPTH OF SURFACE PONDING = 2.54 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 150.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = .10 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 150.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = 2.54 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 6.97

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 554.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 19.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	128.0	128.0	128.0	128.0	128.0	128.0
DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	128.0	128.0	128.0	128.0	128.0	128.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		

-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00

WORKING TIMES

-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

Start Day = 32 End Day = 334
Threshold Water Table Depth (cm) = 30.5
Threshold Consecutive Days = 15

Fixed Monthly Pet Values

1 1.00 2 1.00 3 1.00 4 1.00 5 1.00 6 1.00 7 1.00 8 1.00
9 1.00 10 1.00 11 1.00 12 1.00

```
  Mrank indicator =  1


******************************* END OF INPUTS *******************************

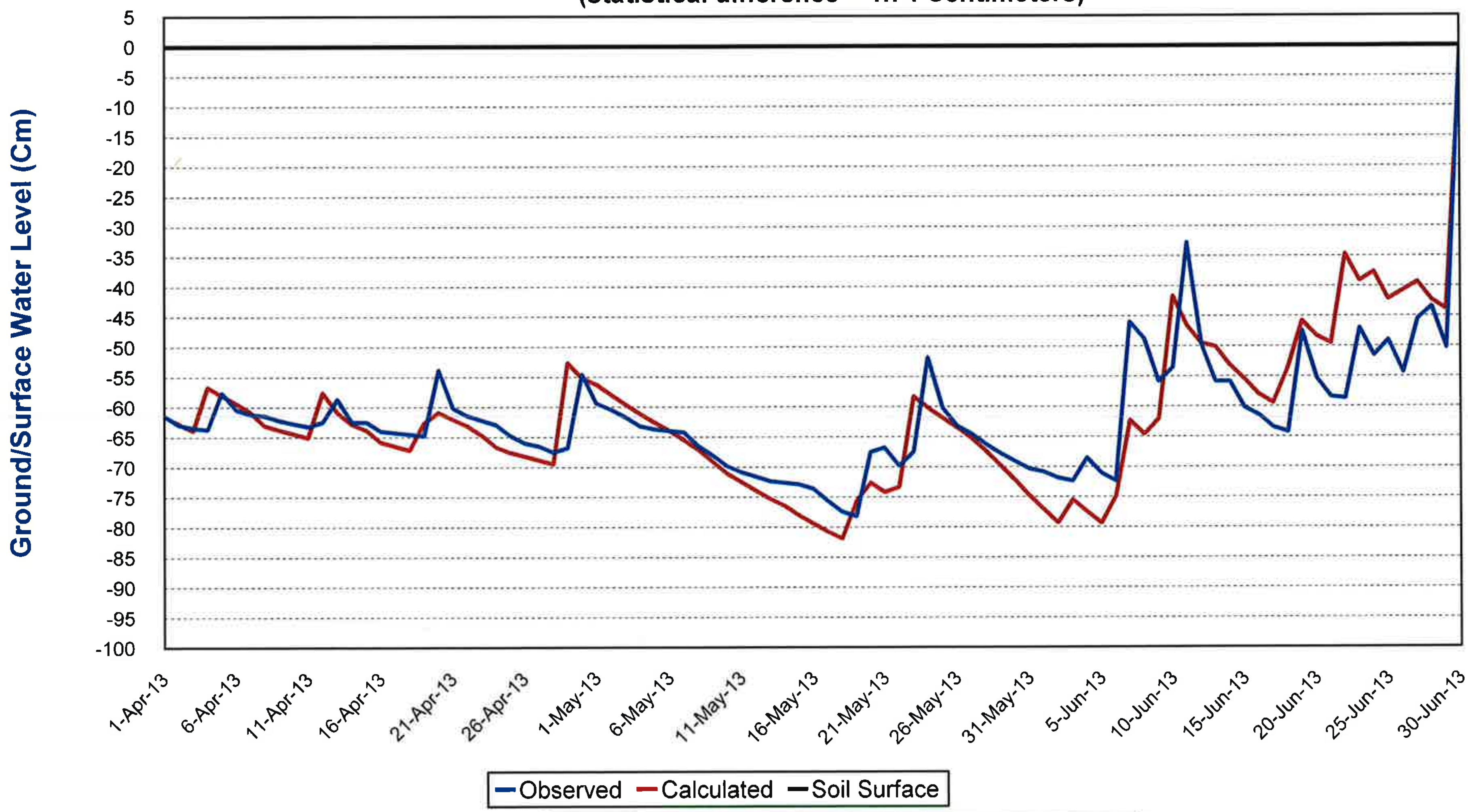
 ----------RUN STATISTICS ----------          time:  7/26/2013  @ 10:47
input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
parameters:    free drainage                 and yields not calculated
              drain spacing =   60800. cm   drain depth =  128.0 cm
-------------------------------------------------------------------------



**> Computational Statistics       <**
**> Start Computations     = 647.771
**> End Computations       = 647.795
**> Total simulation time =     1.4 seconds.
```

Drainage Assessment

(statistical difference = 1.74 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 2
- April 1, 2013 to June 30, 2013

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Slide B

millers_well2_LT.WET

```
---------------------------------------------------
*              DRAINMOD version 6.1               *
* Copyright 1980-2011 North Carolina State University *
---------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #2 LT
Onsite Raingauge, Magnolia NC Temperature Data
****

```
 ----------RUN STATISTICS ----------           time:  7/16/2013  @ 13:27
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage                  and yields not calculated
               drain spacing =    3048. cm    drain depth =  128.0 cm
-------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 15 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 15 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	0.	1.
1966	0.	0.
1967	0.	0.
1968	0.	0.
1969	0.	0.
1970	0.	0.
1971	0.	6.
1972	0.	0.
1973	0.	1.
1974	0.	0.
1975	0.	0.
1976	0.	0.
1977	0.	0.
1978	0.	10.
1979	0.	2.
1980	0.	0.
1981	0.	0.
1982	1.	23.
1983	0.	8.
1984	0.	2.
1985	0.	0.
1986	0.	0.
1987	1.	17.
1988	0.	0.
1989	0.	9.
1990	0.	0.
1991	0.	0.
1992	0.	0.
1993	0.	4.
1994	0.	7.

Number of Years with at least one period = 2. out of 30 years.

****

D R A I N M O D 6.1

LAST UPDATE: January 2011
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #2 LT
Onsite Raingauge, Magnolia NC Temperature Data

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\DrainMod\weather\greenville.RAI			
FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM			
RAINFALL STATION NUMBER........................	(RAINID)	313638	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	313638	
STARTING YEAR OF SIMULATION..................	(START YEAR)	1965	YEAR
STARTING MONTH OF SIMULATION................	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	1994	YEAR
ENDING MONTH OF SIMULATION...................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.52	DEG.MIN
HEAT INDEX...	(HID)	81.00	

ET MULTIPLICATION FACTOR FOR EACH MONTH
2.01 2.32 2.10 1.72 1.23 1.00 .86 .82 .92 1.05 1.22 1.44

DRAINAGE SYSTEM DESIGN
****

*** CONVENTIONAL DRAINAGE ***

JOB TITLE:

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Rip
Onsite Raingauge, Magnolia NC Temperature Data

```
              STMAX =   .00 CM                         SOIL SURFACE
+        __/)_____________________________________________________________/)__
              :                                                   :
              :                                                   :
              :                                                   :
          ADEPTH =150. CM                                 DDRAIN =128. CM
              :                                                   :
              :    O------------SDRAIN = 3048. CM -----------O    -
              :    *                                              :
              : EFFRAD =**** CM                                   :
              :                                           HDRAIN = 22. CM
              :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
              :
              :                                       IMPERMEABLE LAYER
+         ______________________________________________________________________
          //////////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 46.0	1.270
46.0 - 91.0	.250
91.0 - 152.0	1.270

DEPTH TO DRAIN = 128.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 22.0 CM
DISTANCE BETWEEN DRAINS = 3048.0 CM
MAXIMUM DEPTH OF SURFACE PONDING = .00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 150.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = .10 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 150.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = .00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 6.97

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 554.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 60.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	128.0	128.0	128.0	128.0	128.0	128.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	128.0	128.0	128.0	128.0	128.0	128.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		

-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00

WORKING TIMES

-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

Start Day = 32 End Day = 334
Threshold Water Table Depth (cm) = 30.5
Threshold Consecutive Days = 15

Fixed Monthly Pet Values

1 1.00 2 1.00 3 1.00 4 1.00 5 1.00 6 1.00 7 1.00 8 1.00
9 1.00 10 1.00 11 1.00 12 1.00

```
Mrank indicator =  1


****************************** END OF INPUTS ******************************

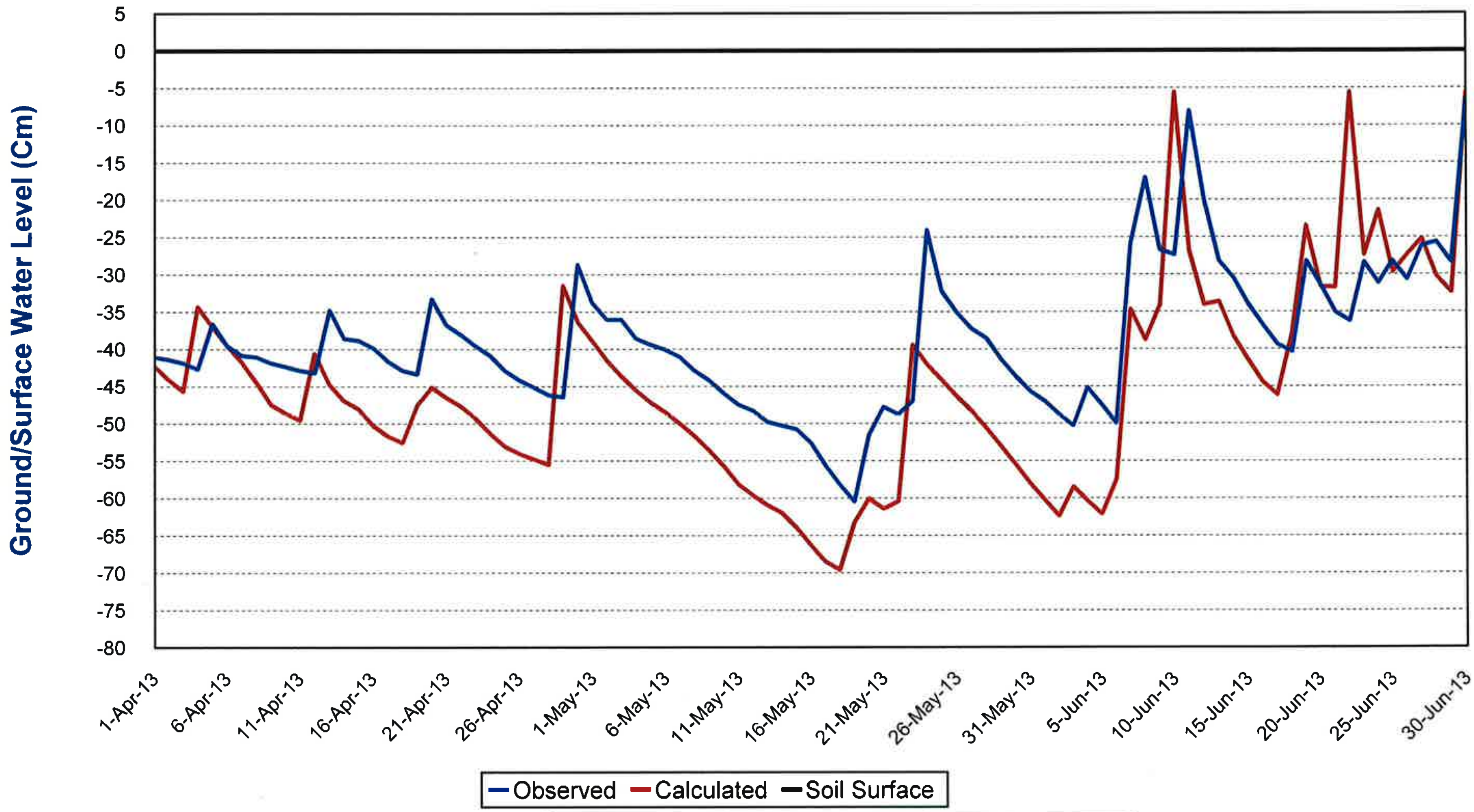
 ----------RUN STATISTICS ----------          time:  7/16/2013  @ 17: 9
input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
parameters:     free drainage              and yields not calculated
              drain spacing =    3048. cm   drain depth =  128.0 cm
-------------------------------------------------------------------------



**> Computational Statistics       <**
**> Start Computations    =1029.808
**> End Computations      =1029.829
**> Total simulation time =     1.3 seconds.
```

Drainage Assessment

(statistical difference = 3.47 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 3
- April 1, 2013 to June 30, 2013

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millers_well3_LT.WET

```
 -----------------------------------------------------
 *                DRAINMOD version 6.1               *
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 -----------------------------------------------------
```


EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #3 LT
Onsite Raingauge, Magnolia NC Temperature Data

```
**********************************************************************************

  ----------RUN STATISTICS ----------          time:  7/16/2013  @ 17:27
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage               and yields not calculated
               drain spacing =    3810. cm   drain depth =   95.0 cm
--------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 15 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 15 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	0.	7.
1966	0.	12.
1967	0.	11.
1968	0.	2.
1969	1.	20.
1970	0.	6.
1971	1.	18.
1972	0.	6.
1973	0.	10.
1974	0.	10.
1975	0.	3.
1976	0.	4.
1977	0.	3.
1978	0.	12.
1979	0.	8.
1980	1.	15.
1981	0.	7.
1982	1.	17.
1983	1.	15.
1984	0.	10.
1985	1.	16.
1986	0.	0.
1987	1.	16.
1988	0.	7.
1989	0.	12.
1990	0.	0.
1991	0.	3.
1992	0.	0.
1993	0.	9.
1994	0.	7.

Number of Years with at least one period = 7. out of 30 years.

```
*******************************************************************************

                              D R A I N M O D  6.1

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                         LAST UPDATE: January 2011
                          LANGUAGE FORTRAN 77/90

          DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
          THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
          DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
          AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
          UNDER THE DIRECTION OF R. W. SKAGGS.

*******************************************************************************


 DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #3 LT
 Onsite Raingauge, Magnolia NC Temperature Data



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                                    (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA .............C:\DrainMod\weather\greenville.RAI
 FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM
 RAINFALL STATION NUMBER.........................(RAINID)     313638
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)     313638
 STARTING YEAR OF SIMULATION..................(START YEAR)      1965   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)         1   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)      1994   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)        12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.52   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00


 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44

                              DRAINAGE SYSTEM DESIGN
                              **********************

                             *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well
                   Onsite Raingauge, Magnolia NC Temperature Data
```

```
                 STMAX =    .00 CM                         SOIL SURFACE
+       __/)_____________________________________________________________/)__
              :                                                  :
              :                                                  :
              :                                                  :
              :                                                  :
        ADEPTH =150. CM                                  DDRAIN = 95. CM
              :                                                  :
              :                                                  :
              :    O------------SDRAIN = 3810. CM -----------O   -
              :    *                                             :
              : EFFRAD =**** CM                                  :
              :                                          HDRAIN = 55. CM
              :                                                  :
              :                                                  :
        - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
              :
              :
              :                                     IMPERMEABLE LAYER
+       ___________________________________________________________________
        ///////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 61.0	5.080
61.0 - 91.4	.250
91.4 - 152.4	.030

DEPTH TO DRAIN = 95.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 55.0 CM
DISTANCE BETWEEN DRAINS = 3810.0 CM
MAXIMUM DEPTH OF SURFACE PONDING = .00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 150.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = 10.00 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 150.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = .00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 5.25

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

Vertical Deep Seepage
  hydraulic head in aquifer (cm)= 0.000000E+00
  thickness of impeading layer (cm)= 100.000000
  vertical conductivity of impeading layer (cm/hr)= 1.000000E-05

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 384.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 40.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	95.0	95.0	95.0	95.0	95.0	95.0
DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	95.0	95.0	95.0	95.0	95.0	95.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

Start Day = 32 End Day = 334
Threshold Water Table Depth (cm) = 30.5
Threshold Consecutive Days = 15

Fixed Monthly Pet Values

```
   1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
 9 1.00   10 1.00   11 1.00   12 1.00


  Mrank indicator =  1

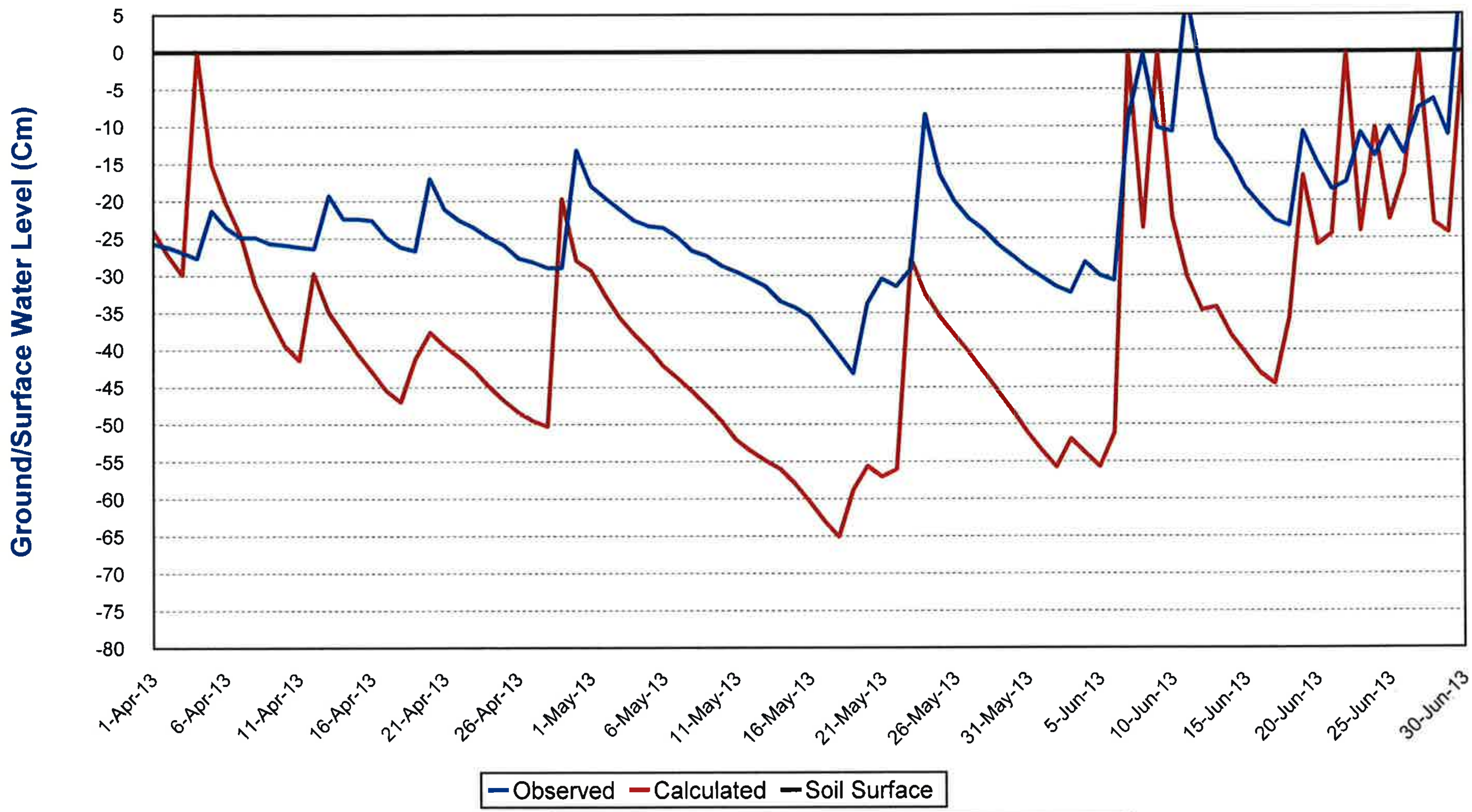

 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  7/16/2013  @ 17:27
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage              and yields not calculated
               drain spacing =    3810. cm   drain depth =   95.0 cm
 -------------------------------------------------------------------------


**> Computational Statistics       <**
**> Start Computations     =1047.866
**> End Computations       =1047.886
**> Total simulation time =     1.2 seconds.
```

Drainage Assessment

(statistical difference = 6.59 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 4
- April 1, 2013 to June 30, 2013

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millers_well4_LT.WET

```
-----------------------------------------------------
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-----------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #4 LT
Onsite Raingauge, Magnolia NC Temperature Data
****

```
 ----------RUN STATISTICS ----------          time:  7/19/2013  @ 14:30
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:     free drainage             and yields not calculated
              drain spacing =   20668. cm   drain depth =   95.0 cm
--------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 15 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 15 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	1.	31.
1966	1.	25.
1967	1.	16.
1968	0.	11.
1969	1.	49.
1970	1.	34.
1971	2.	20.
1972	1.	17.
1973	1.	34.
1974	1.	28.
1975	1.	19.
1976	0.	10.
1977	0.	14.
1978	1.	42.
1979	1.	32.
1980	1.	39.
1981	1.	24.
1982	1.	32.
1983	1.	31.
1984	1.	23.
1985	1.	23.
1986	0.	0.
1987	2.	35.
1988	1.	26.
1989	1.	27.
1990	0.	8.
1991	0.	11.
1992	0.	4.
1993	1.	38.
1994	0.	12.

Number of Years with at least one period =   22. out of   30 years.

****

D R A I N M O D 6.1

LAST UPDATE: January 2011
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #4 LT
Onsite Raingauge, Magnolia NC Temperature Data

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\DrainMod\weather\greenville.RAI			
FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM			
RAINFALL STATION NUMBER..........................	(RAINID)	313638	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	313638	
STARTING YEAR OF SIMULATION.................	(START YEAR)	1965	YEAR
STARTING MONTH OF SIMULATION...............	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	1994	YEAR
ENDING MONTH OF SIMULATION...................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.52	DEG.MIN
HEAT INDEX..	(HID)	81.00	

ET MULTIPLICATION FACTOR FOR EACH MONTH

2.01	2.32	2.10	1.72	1.23	1.00	.86	.82	.92	1.05	1.22	1.44

DRAINAGE SYSTEM DESIGN
****

*** CONVENTIONAL DRAINAGE ***

JOB TITLE:

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well
Onsite Raingauge, Magnolia NC Temperature Data

```
                STMAX =   .01 CM                  SOIL SURFACE
+        __/)___________________________________________________________/)__
              :                                                       :
              :                                                       :
              :                                                       :
         ADEPTH =113. CM                                      DDRAIN = 95. CM
              :                                                       :
              :     O-------------SDRAIN =20668. CM -----------O      -
              :     *                                                 :
              : EFFRAD =**** CM                                        :
              :                                               HDRAIN = 18. CM
              :                                                       :
         - - -:- - - - - - - - - - - - - - - - - - - - - - - - - - - -:- - - -
              :
              :
              :                                       IMPERMEABLE LAYER
+        ____________________________________________________________________
         ////////////////////////////////////////////////////////////////////
```

```
                  DEPTH       SATURATED HYDRAULIC CONDUCTIVITY
                  (CM)                     (CM/HR)

                 .0 -   61.0                1.250
               61.0 -   91.4                 .100
               91.4 -  152.4                 .030
```

```
DEPTH TO DRAIN =  95.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER =  18.0 CM
DISTANCE BETWEEN DRAINS = 20668.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .01 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  113.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =  1.00 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 113.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .01 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 6.09

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   Vertical Deep Seepage
      hydraulic head in aquifer (cm)=    0.000000E+00
      thickness of impeading layer (cm)=      200.000000
      vertical conductivity of impeading layer (cm/hr)=    1.000000E-04

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 384.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00
```

INITIAL WATER TABLE DEPTH = 20.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	95.0	95.0	95.0	95.0	95.0	95.0
DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	95.0	95.0	95.0	95.0	95.0	95.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

Start Day = 32 End Day = 334
Threshold Water Table Depth (cm) = 30.5
Threshold Consecutive Days = 15

Fixed Monthly Pet Values

```
   1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
 9 1.00   10 1.00   11 1.00   12 1.00



  Mrank indicator =  1



 ****************************** END OF INPUTS ******************************

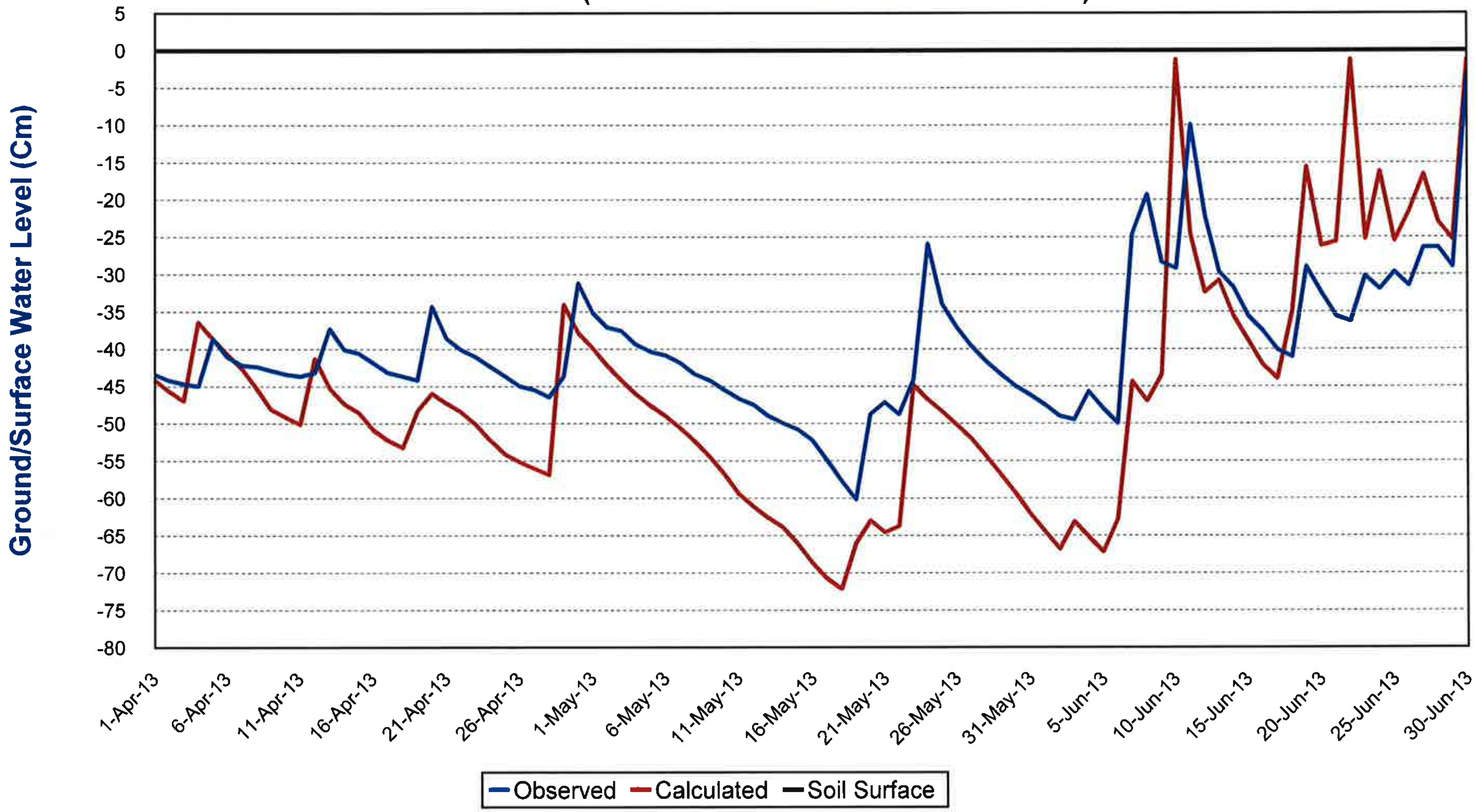
  ----------RUN STATISTICS ----------          time:  7/19/2013  @ 14:30
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage                 and yields not calculated
               drain spacing =   20668. cm   drain depth =   95.0 cm
------------------------------------------------------------------------




**> Computational Statistics       <**
**> Start Computations     = 870.144
**> End Computations       = 870.165
**> Total simulation time =     1.2 seconds.
```

Drainage Assessment

(statistical difference = 3.97 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 5
- April 1, 2013 to June 30, 2013

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Slide E

millers_well5_LT.WET

```
---------------------------------------------------
*                DRAINMOD version 6.1             *
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---------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #5 LT
Onsite Raingauge, Magnolia NC Temperature Data
****

```
 ----------RUN STATISTICS ----------            time:  7/16/2013  @ 15:18
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:     free drainage                  and yields not calculated
              drain spacing =    20668. cm   drain depth =    95.0 cm
-----------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 15 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 15 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	1.	16.
1966	0.	0.
1967	0.	0.
1968	0.	0.
1969	0.	11.
1970	0.	0.
1971	0.	10.
1972	0.	0.
1973	0.	14.
1974	0.	3.
1975	0.	7.
1976	0.	7.
1977	0.	5.
1978	1.	25.
1979	0.	12.
1980	0.	5.
1981	0.	7.
1982	1.	23.
1983	1.	25.
1984	0.	11.
1985	1.	18.
1986	0.	0.
1987	2.	18.
1988	0.	11.
1989	1.	17.
1990	0.	0.
1991	0.	0.
1992	0.	0.
1993	1.	25.
1994	0.	9.

Number of Years with at least one period = 8. out of 30 years.

****

D R A I N M O D 6.1

LAST UPDATE: January 2011
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #5 LT
Onsite Raingauge, Magnolia NC Temperature Data

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\DrainMod\weather\greenville.RAI			
FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM			
RAINFALL STATION NUMBER..........................	(RAINID)	313638	
TEMPERATURE/PET STATION NUMBER...................	(TEMPID)	313638	
STARTING YEAR OF SIMULATION.................	(START YEAR)	1965	YEAR
STARTING MONTH OF SIMULATION................	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	1994	YEAR
ENDING MONTH OF SIMULATION...................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.52	DEG.MIN
HEAT INDEX..	(HID)	81.00	

ET MULTIPLICATION FACTOR FOR EACH MONTH
2.01 2.32 2.10 1.72 1.23 1.00 .86 .82 .92 1.05 1.22 1.44

DRAINAGE SYSTEM DESIGN
****

*** CONVENTIONAL DRAINAGE ***

JOB TITLE:

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Rip
Onsite Raingauge, Magnolia NC Temperature Data

```
              STMAX =   .00 CM                          SOIL SURFACE
+        __/)_______________________________________________________________/)__
              :                                                    :
              :                                                    :
              :                                                    :
         ADEPTH =113. CM                                  DDRAIN = 95. CM
              :                                                    :
              :      O------------SDRAIN =20668. CM -----------O   -
              :      *                                             :
              : EFFRAD =**** CM                           HDRAIN = 18. CM
              :                                                    :
         - - -:- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
              :
              :                                        IMPERMEABLE LAYER
+        ______________________________________________________________________
         //////////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 46.0	1.270
46.0 - 91.0	.250
91.0 - 152.0	1.270

DEPTH TO DRAIN = 95.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 18.0 CM
DISTANCE BETWEEN DRAINS = 20668.0 CM
MAXIMUM DEPTH OF SURFACE PONDING = .00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 113.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = .10 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 113.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = .00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 6.09

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

Vertical Deep Seepage
   hydraulic head in aquifer (cm)= 0.000000E+00
   thickness of impeading layer (cm)= 75.000000
   vertical conductivity of impeading layer (cm/hr)= 1.000000E-03

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 384.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 42.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	95.0	95.0	95.0	95.0	95.0	95.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	95.0	95.0	95.0	95.0	95.0	95.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1

TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

Start Day = 32 End Day = 334
Threshold Water Table Depth (cm) = 30.5
Threshold Consecutive Days = 15

Fixed Monthly Pet Values

```
    1 1.00     2 1.00     3 1.00     4 1.00     5 1.00     6 1.00     7 1.00     8 1.00
 9 1.00    10 1.00    11 1.00    12 1.00



   Mrank indicator =  1



 ****************************** END OF INPUTS ******************************

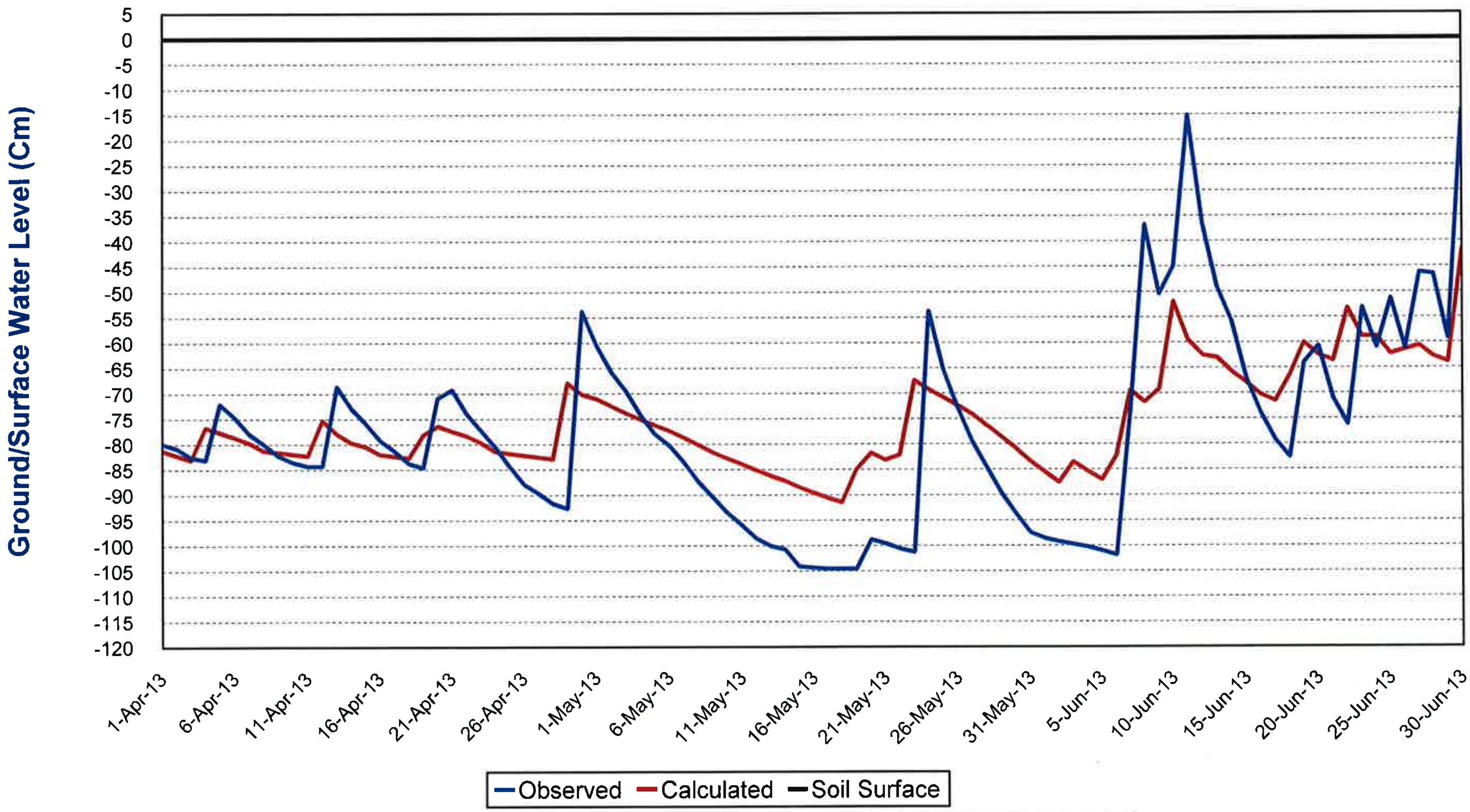
  ----------RUN STATISTICS ----------          time:  7/16/2013  @ 17:21
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage              and yields not calculated
               drain spacing =   20668. cm   drain depth =   95.0 cm
 ------------------------------------------------------------------------



**> Computational Statistics       <**
**> Start Computations    =1041.307
**> End Computations      =1041.329
**> Total simulation time =     1.4 seconds.
```

Drainage Assessment

(statistical difference = 3.87 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 7
- April 1, 2013 to June 30, 2013

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Slide F

millers_well7_LT.WET

```
 ---------------------------------------------------
 *               DRAINMOD version 6.1              *
 * Copyright 1980-2011 North Carolina State University *
 ---------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #7 LT
Onsite Raingauge, Magnolia NC Temperature Data

```
**********************************************************************************

 ----------RUN STATISTICS ----------          time:  7/19/2013  @ 14:17
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:     free drainage                  and yields not calculated
               drain spacing =     762. cm   drain depth =  128.0 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least   15 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 15 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	0.	0.
1966	0.	0.
1967	0.	0.
1968	0.	0.
1969	0.	0.
1970	0.	0.
1971	0.	0.
1972	0.	0.
1973	0.	0.
1974	0.	0.
1975	0.	0.
1976	0.	0.
1977	0.	0.
1978	0.	0.
1979	0.	0.
1980	0.	0.
1981	0.	0.
1982	0.	0.
1983	0.	0.
1984	0.	0.
1985	0.	0.
1986	0.	0.
1987	0.	0.
1988	0.	0.
1989	0.	0.
1990	0.	0.
1991	0.	0.
1992	0.	0.
1993	0.	0.
1994	0.	0.

Number of Years with at least one period =   0. out of   30 years.

```
*******************************************************************************

                        D R A I N M O D   6.1

          Copyright 1980-2011 North Carolina State University
                      LAST UPDATE: January 2011
                        LANGUAGE FORTRAN 77/90

        DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
        THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
        DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
        AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
        UNDER THE DIRECTION OF R. W. SKAGGS.

*******************************************************************************


 DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #7 LT
 Onsite Raingauge, Magnolia NC Temperature Data


                       CLIMATE INPUTS
                       ******* ******

     DESCRIPTION                                 (VARIABLE)     VALUE    UNIT
 ---------------------------------------------------------------------------------
 FILE FOR RAINDATA .............C:\DrainMod\weather\greenville.RAI
 FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM
 RAINFALL STATION NUMBER.........................(RAINID)     313638
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)     313638
 STARTING YEAR OF SIMULATION.................(START YEAR)       1965    YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)          1    MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       1994    YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)         12    MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.52    DEG.MIN
 HEAT INDEX...........................................(HID)      81.00


 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                              DRAINAGE SYSTEM DESIGN
                              **********************

                            *** CONVENTIONAL DRAINAGE ***

         JOB TITLE:

                  EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well
                  Onsite Raingauge, Magnolia NC Temperature Data
```

```
              STMAX =   .10 CM                    SOIL SURFACE
+       __/)_____________________________________________________/)__
              :                                            :
              :                                            :
              :                                            :
         ADEPTH =150. CM                          DDRAIN =128. CM
              :                                            :
              :    O------------SDRAIN =  762. CM -----------O  -
              :    *                                       :
              : EFFRAD =**** CM                            :
              :                                   HDRAIN = 22. CM
              :                                            :
        - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
              :
              :
              :                              IMPERMEABLE LAYER
+       _______________________________________________________________
        ///////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 61.0	5.080
61.0 - 91.4	.250
91.4 - 152.4	.030

DEPTH TO DRAIN = 128.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 22.0 CM
DISTANCE BETWEEN DRAINS = 762.0 CM
MAXIMUM DEPTH OF SURFACE PONDING = .10 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 150.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = 25.00 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 150.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = .10 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 6.97

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 487.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 80.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	128.0	128.0	128.0	128.0	128.0	128.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	128.0	128.0	128.0	128.0	128.0	128.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		

```
   -MINIMUM AIR VOLUME IN SOIL (CM):                         3.90        3.90
   -MAXIMUM ALLOWABLE DAILY RAINFALL(CM):                    1.20        1.20
   -MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:     2.00        2.00

 WORKING TIMES
   -DATE TO BEGIN COUNTING WORK DAYS:                        4/ 1       12/32
   -DATE TO STOP COUNTING WORK DAYS:                         5/ 1       12/32
   -FIRST WORK HOUR OF THE DAY:                               8           8
   -LAST WORK HOUR OF THE DAY:                               20          20
```

CROP
****

```
SOIL MOISTURE AT  WILTING POINT =     .17

HIGH WATER STRESS:  BEGIN STRESS PERIOD ON    4/10
                    END STRESS PERIOD ON      8/18
                    CROP IS IN STRESS WHEN WATER TABLE IS ABOVE  30.0 CM

DROUGHT STRESS:     BEGIN STRESS PERIOD ON    4/10
                    END STRESS PERIOD ON      8/18
```

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

```
    NO WASTEWATER IRRIGATION SCHEDULED:
    -----------------------------------

  ***** Wetlands Parameter Estimation *****

           Start Day =   32          End Day =   334
           Threshold Water Table Depth (cm) =  30.5
           Threshold Consecutive Days       =    15


Fixed Monthly Pet Values

    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

```
  Mrank indicator =  1


 ****************************** END OF INPUTS ******************************

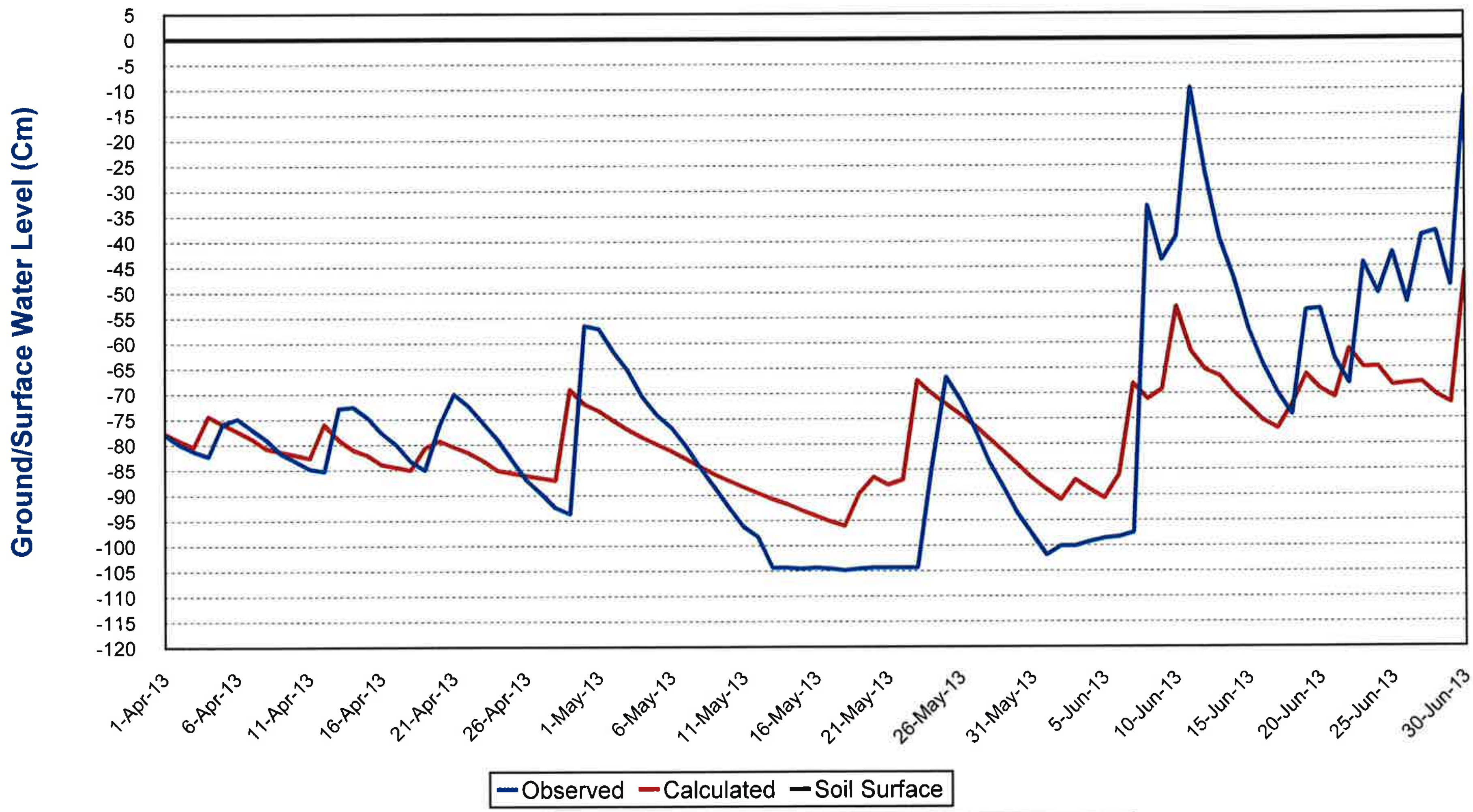
  ----------RUN STATISTICS ----------           time:  7/19/2013  @ 14:17
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage              and yields not calculated
               drain spacing =     762. cm   drain depth =  128.0 cm
------------------------------------------------------------------------



**> Computational Statistics       <**
**> Start Computations     = 857.760
**> End Computations       = 857.780
**> Total simulation time =     1.2 seconds.
```

Drainage Assessment

(statistical difference = 4.57 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 8
- April 1, 2013 to June 30, 2013

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Slide G

millers_well8_LT.WET

```
----------------------------------------------------
*                 DRAINMOD version 6.1                *
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----------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #8 LT
Onsite Raingauge, Magnolia NC Temperature Data

```
*******************************************************************************

 ----------RUN STATISTICS ----------            time:  7/19/2013  @ 14:19
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage               and yields not calculated
               drain spacing =     500. cm   drain depth =  128.0 cm
-------------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least   15 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 15 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	0.	0.
1966	0.	0.
1967	0.	0.
1968	0.	0.
1969	0.	0.
1970	0.	0.
1971	0.	0.
1972	0.	0.
1973	0.	0.
1974	0.	0.
1975	0.	0.
1976	0.	0.
1977	0.	0.
1978	0.	0.
1979	0.	0.
1980	0.	0.
1981	0.	0.
1982	0.	0.
1983	0.	0.
1984	0.	0.
1985	0.	0.
1986	0.	0.
1987	0.	0.
1988	0.	0.
1989	0.	0.
1990	0.	0.
1991	0.	0.
1992	0.	0.
1993	0.	0.
1994	0.	0.

Number of Years with at least one period =   0. out of   30 years.

```
******************************************************************************

                            D R A I N M O D   6.1

              Copyright 1980-2011 North Carolina State University
                          LAST UPDATE: January 2011
                            LANGUAGE FORTRAN 77/90

          DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
          THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
          DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
          AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
          UNDER THE DIRECTION OF R. W. SKAGGS.

******************************************************************************


 DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
 Cream selector (0=no, 1=yes) =  0

                         TITLE OF RUN
                         ************


 EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #8 LT
 Onsite Raingauge, Magnolia NC Temperature Data


                        CLIMATE INPUTS
                        ******* ******

     DESCRIPTION                                (VARIABLE)     VALUE   UNIT
 ----------------------------------------------------------------------------
 FILE FOR RAINDATA .............C:\DrainMod\weather\greenville.RAI
 FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM
 RAINFALL STATION NUMBER........................(RAINID)     313638
 TEMPERATURE/PET STATION NUMBER.................(TEMPID)     313638
 STARTING YEAR OF SIMULATION.................(START YEAR)      1965   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)         1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)      1994   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)        12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)     34.52   DEG.MIN
 HEAT INDEX..........................................(HID)     81.00


 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                               DRAINAGE SYSTEM DESIGN
                               **********************

                             *** CONVENTIONAL DRAINAGE ***

        JOB TITLE:

                   EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well
                   Onsite Raingauge, Magnolia NC Temperature Data
```

```
                 STMAX = 1.00 CM                            SOIL SURFACE
+        __/)_____________________________________________________________/)__
              :                                                  :
              :                                                  :
              :                                                  :
              :                                                  :
           ADEPTH =150. CM                              DDRAIN =128. CM
              :                                                  :
              :                                                  :
              :     O------------SDRAIN =  500. CM -----------O  -
              :     *                                            :
              : EFFRAD =**** CM                                  :
              :                                         HDRAIN = 22. CM
              :                                                  :
              :                                                  :
         - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
              :
              :
              :                                       IMPERMEABLE LAYER
+        _________________________________________________________________
         /////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 61.0	5.080
61.0 - 91.4	.250
91.4 - 152.4	.030

DEPTH TO DRAIN = 128.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 22.0 CM
DISTANCE BETWEEN DRAINS = 500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING = 1.00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 150.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = 1.00 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 150.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = 1.00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 7.05

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 487.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 76.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	128.0	128.0	128.0	128.0	128.0	128.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	128.0	128.0	128.0	128.0	128.0	128.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD

```
    -MINIMUM AIR VOLUME IN SOIL (CM):                        3.90         3.90
    -MAXIMUM ALLOWABLE DAILY RAINFALL(CM):                   1.20         1.20
    -MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:    2.00         2.00

 WORKING TIMES
    -DATE TO BEGIN COUNTING WORK DAYS:                       4/ 1        12/32
    -DATE TO STOP COUNTING WORK DAYS:                        5/ 1        12/32
    -FIRST WORK HOUR OF THE DAY:                              8            8
    -LAST WORK HOUR OF THE DAY:                              20           20
```

CROP
****

```
SOIL MOISTURE AT  WILTING POINT =     .17

HIGH WATER STRESS:  BEGIN STRESS PERIOD ON    4/10
                    END STRESS PERIOD ON      8/18
                    CROP IS IN STRESS WHEN WATER TABLE IS ABOVE  30.0 CM

DROUGHT STRESS:     BEGIN STRESS PERIOD ON    4/10
                    END STRESS PERIOD ON      8/18
```

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

```
***** Wetlands Parameter Estimation *****

            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    15


Fixed Monthly Pet Values

   1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

```
 Mrank indicator =  1

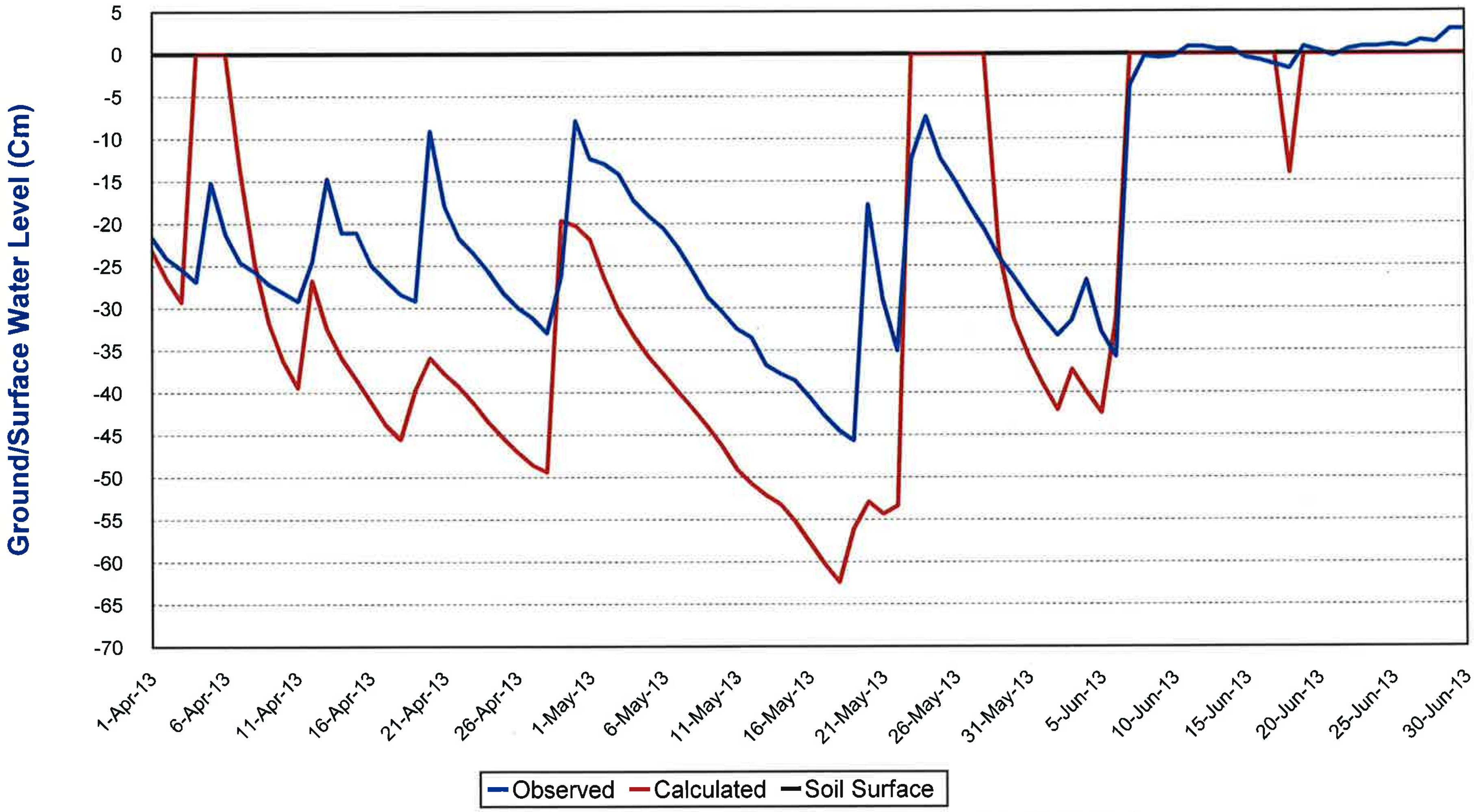

****************************** END OF INPUTS ******************************

 ----------RUN STATISTICS ----------          time:  7/19/2013  @ 14:19
input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
parameters:    free drainage               and yields not calculated
              drain spacing =     500. cm   drain depth =  128.0 cm
------------------------------------------------------------------------


**> Computational Statistics       <**
**> Start Computations    = 859.452
**> End Computations      = 859.472
**> Total simulation time =     1.2 seconds.
```

Drainage Assessment

(statistical difference = 3.51 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 1
- April 1, 2013 to June 30, 2013

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Slide A

millers_well1_LT.WET

```
---------------------------------------------------
*               DRAINMOD version 6.1              *
* Copyright 1980-2011 North Carolina State University *
---------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #1 LT
Onsite Raingauge, Magnolia NC Temperature Data

```
*******************************************************************************

 ----------RUN STATISTICS ----------           time:  7/26/2013  @ 10:49
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:     free drainage                 and yields not calculated
               drain spacing =   100000. cm   drain depth =    31.0 cm
------------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least 38 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 38 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	2.	68.
1966	1.	51.
1967	1.	39.
1968	2.	58.
1969	1.	86.
1970	2.	81.
1971	2.	76.
1972	1.	78.
1973	1.	44.
1974	1.	67.
1975	1.	83.
1976	1.	41.
1977	2.	59.
1978	1.	51.
1979	3.	60.
1980	2.	69.
1981	1.	62.
1982	2.	61.
1983	1.	90.
1984	1.	109.
1985	1.	39.
1986	1.	59.
1987	1.	97.
1988	2.	61.
1989	2.	66.
1990	2.	42.
1991	2.	67.
1992	1.	45.
1993	2.	91.
1994	1.	71.

Number of Years with at least one period =   30. out of   30 years.

****

D R A I N M O D 6.1

LAST UPDATE: January 2011
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #1 LT
Onsite Raingauge, Magnolia NC Temperature Data

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\DrainMod\weather\greenville.RAI			
FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM			
RAINFALL STATION NUMBER.........................	(RAINID)	313638	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	313638	
STARTING YEAR OF SIMULATION.................	(START YEAR)	1965	YEAR
STARTING MONTH OF SIMULATION................	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	1994	YEAR
ENDING MONTH OF SIMULATION....................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE...................	(TEMP LAT)	34.52	DEG.MIN
HEAT INDEX..	(HID)	81.00	

ET MULTIPLICATION FACTOR FOR EACH MONTH

2.01	2.32	2.10	1.72	1.23	1.00	.86	.82	.92	1.05	1.22	1.44

DRAINAGE SYSTEM DESIGN
****

*** CONVENTIONAL DRAINAGE ***

JOB TITLE:

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Rip
Onsite Raingauge, Magnolia NC Temperature Data

```
                    STMAX = 2.54 CM                        SOIL SURFACE
+        __/)________________________________________________________________/)__
              :                                                     :
              :                                                     :
              :                                                     :
              :                                                     :
              :                                                     :
         ADEPTH = 42. CM                                   DDRAIN = 31. CM
              :                                                     :
              :     O-------------SDRAIN =****** CM -----------O    -
              :     *                                               :
              : EFFRAD =5.00 CM                                     :
              :                                            HDRAIN = 11. CM
              :                                                     :
         - - -  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
              :
              :
              :
              :                                       IMPERMEABLE LAYER
+        ______________________________________________________________________
         //////////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 46.0	1.270
46.0 - 91.0	.250
91.0 - 152.0	1.270

DEPTH TO DRAIN = 31.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 11.0 CM
DISTANCE BETWEEN DRAINS = ******* CM
MAXIMUM DEPTH OF SURFACE PONDING = 2.54 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 42.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = .10 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 42.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = 2.54 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 5.92

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 554.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 19.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0
DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		

-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00

WORKING TIMES

-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

Start Day = 32 End Day = 334
Threshold Water Table Depth (cm) = 30.5
Threshold Consecutive Days = 38

Fixed Monthly Pet Values

1 1.00 2 1.00 3 1.00 4 1.00 5 1.00 6 1.00 7 1.00 8 1.00
9 1.00 10 1.00 11 1.00 12 1.00

```
  Mrank indicator =  1

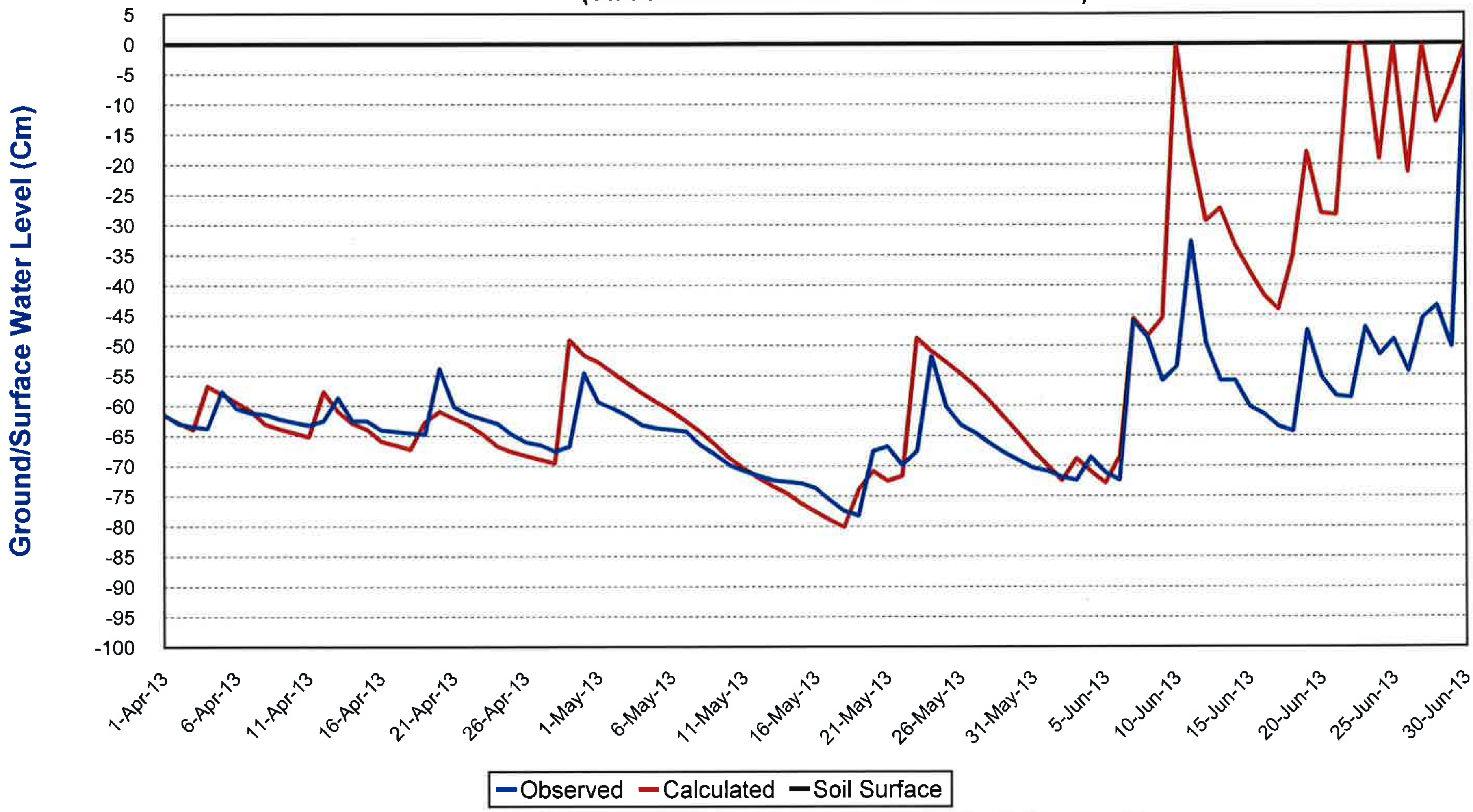

 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  7/26/2013  @ 10:49
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage              and yields not calculated
               drain spacing =  100000. cm   drain depth =   31.0 cm
------------------------------------------------------------------------


**> Computational Statistics       <**
**> Start Computations     = 649.531
**> End Computations       = 649.554
**> Total simulation time =     1.4 seconds.
```

Drainage Assessment

(statistical difference = 3.87 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 2
- April 1, 2013 to June 30, 2013

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Slide B

millers_well2_LT.WET

```
 ----------------------------------------------------
 *                DRAINMOD version 6.1              *
 * Copyright 1980-2011 North Carolina State University *
 ----------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #2 LT
Onsite Raingauge, Magnolia NC Temperature Data

```
********************************************************************************

 ----------RUN STATISTICS -----------            time:  7/26/2013  @ 11:21
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage                   and yields not calculated
               drain spacing =  100000. cm   drain depth =   31.0 cm
--------------------------------------------------------------------------

                DRAINMOD --- WET PERIOD EVALUATION
                ****** Version 6.1 ******

        Number of periods with water table closer than  30.50 cm
              for at least   38 days.  Counting starts on day
               32 and ends on day  334 of each year
```

YEAR	Number of Periods of 38 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	1.	50.
1966	1.	48.
1967	0.	28.
1968	1.	51.
1969	1.	61.
1970	2.	71.
1971	1.	50.
1972	1.	39.
1973	1.	38.
1974	0.	31.
1975	1.	53.
1976	1.	41.
1977	2.	44.
1978	1.	48.
1979	1.	58.
1980	2.	64.
1981	0.	29.
1982	1.	58.
1983	1.	66.
1984	1.	65.
1985	0.	26.
1986	1.	40.
1987	1.	70.
1988	1.	57.
1989	2.	43.
1990	1.	38.
1991	0.	20.
1992	0.	34.
1993	2.	59.
1994	0.	37.

Number of Years with at least one period =   23. out of   30 years.

****

D R A I N M O D 6.1

LAST UPDATE: January 2011
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #2 LT
Onsite Raingauge, Magnolia NC Temperature Data

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\DrainMod\weather\greenville.RAI			
FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM			
RAINFALL STATION NUMBER...........................	(RAINID)	313638	
TEMPERATURE/PET STATION NUMBER...................	(TEMPID)	313638	
STARTING YEAR OF SIMULATION.................	(START YEAR)	1965	YEAR
STARTING MONTH OF SIMULATION................	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	1994	YEAR
ENDING MONTH OF SIMULATION...................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.52	DEG.MIN
HEAT INDEX..	(HID)	81.00	

ET MULTIPLICATION FACTOR FOR EACH MONTH

2.01	2.32	2.10	1.72	1.23	1.00	.86	.82	.92	1.05	1.22	1.44

DRAINAGE SYSTEM DESIGN
****

*** CONVENTIONAL DRAINAGE ***

JOB TITLE:

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Rip
Onsite Raingauge, Magnolia NC Temperature Data

```
                STMAX = 1.00 CM                       SOIL SURFACE
+        __/)_____________________________________________________________/)__
            :                                                    :
            :                                                    :
            :                                                    :
            :                                                    :
         ADEPTH = 42. CM                                   DDRAIN = 31. CM
            :                                                    :
            :                                                    :
            :     O------------SDRAIN =****** CM -----------O    -
            :     *                                              :
            : EFFRAD =5.00 CM                                    :
            :                                              HDRAIN = 11. CM
            :                                                    :
            :                                                    :
         - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
            :
            :
            :                                        IMPERMEABLE LAYER
+        _________________________________________________________________
         /////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 46.0	1.270
46.0 - 91.0	.250
91.0 - 152.0	1.270

DEPTH TO DRAIN = 31.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 11.0 CM
DISTANCE BETWEEN DRAINS = ******* CM
MAXIMUM DEPTH OF SURFACE PONDING = 1.00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 42.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = .10 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 42.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = 1.00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 5.92

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 60.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0
DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD

-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

Start Day = 32 End Day = 334
Threshold Water Table Depth (cm) = 30.5
Threshold Consecutive Days = 38

Fixed Monthly Pet Values

1 1.00 2 1.00 3 1.00 4 1.00 5 1.00 6 1.00 7 1.00 8 1.00
9 1.00 10 1.00 11 1.00 12 1.00

```
  Mrank indicator =  1


 ****************************** END OF INPUTS ******************************

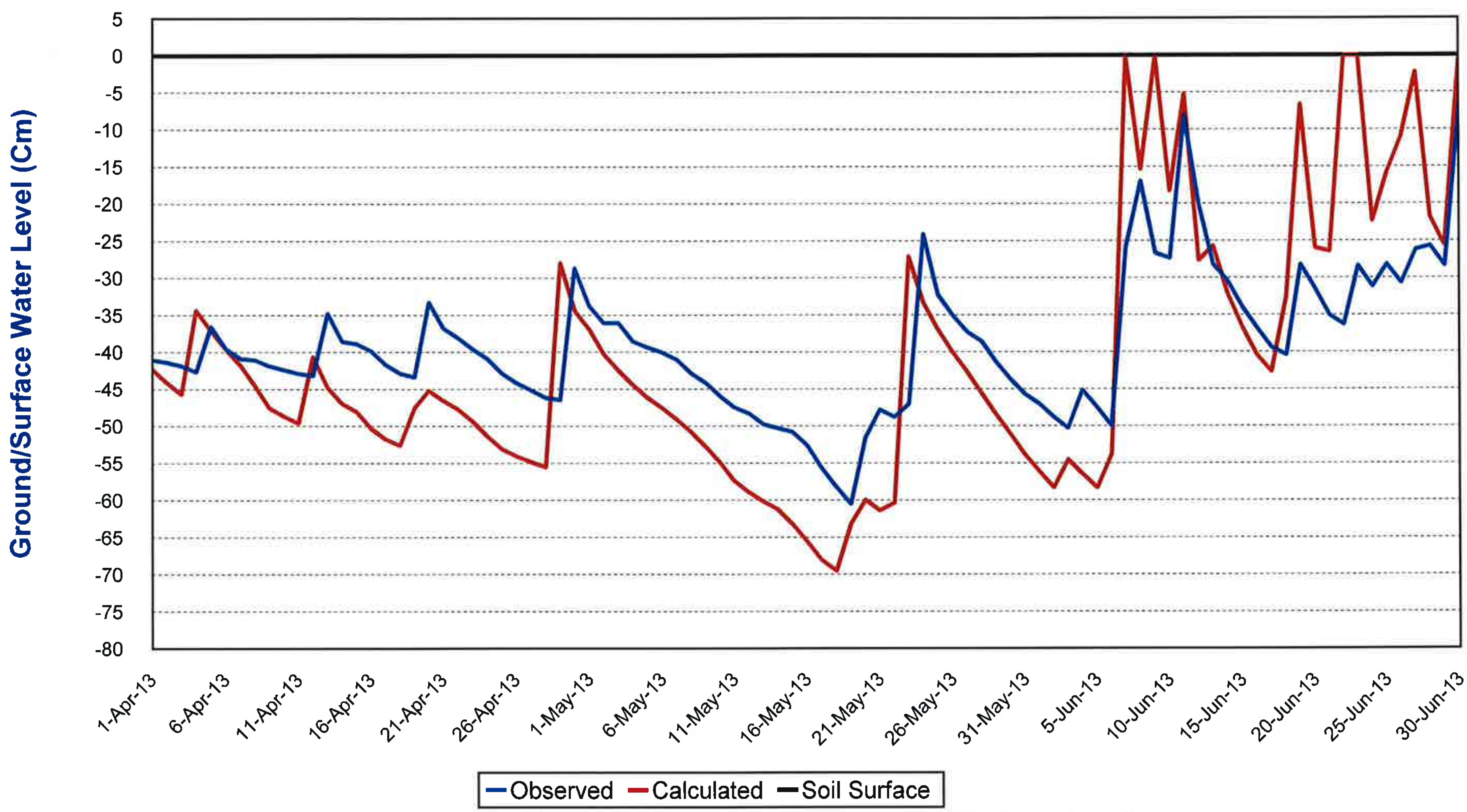
  ----------RUN STATISTICS ----------           time:  7/26/2013  @ 11:21
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage              and yields not calculated
               drain spacing =  100000. cm   drain depth =   31.0 cm
--------------------------------------------------------------------------



**> Computational Statistics        <**
**> Start Computations    = 681.012
**> End Computations      = 681.033
**> Total simulation time =     1.3 seconds.
```

Drainage Assessment

(statistical difference = 3.49 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 3
- April 1, 2013 to June 30, 2013

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Slide C

millers_well3_LT.WET

```
-----------------------------------------------------
*               DRAINMOD version 6.1                 *
* Copyright 1980-2011 North Carolina State University *
-----------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #3 LT
Onsite Raingauge, Magnolia NC Temperature Data
****

```
 ----------RUN STATISTICS -----------          time:  7/26/2013  @ 11:31
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage              and yields not calculated
               drain spacing =  100000. cm   drain depth =   31.0 cm
------------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 38 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 38 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	1.	50.
1966	1.	48.
1967	0.	28.
1968	1.	51.
1969	1.	61.
1970	2.	71.
1971	1.	50.
1972	1.	39.
1973	1.	38.
1974	0.	31.
1975	1.	53.
1976	1.	41.
1977	2.	44.
1978	1.	48.
1979	1.	58.
1980	2.	64.
1981	0.	29.
1982	1.	58.
1983	1.	66.
1984	1.	65.
1985	0.	26.
1986	1.	40.
1987	1.	70.
1988	1.	57.
1989	2.	43.
1990	1.	38.
1991	0.	20.
1992	0.	34.
1993	1.	59.
1994	0.	37.

Number of Years with at least one period = 23. out of 30 years.

```
*******************************************************************************

                              D R A I N M O D   6.1

              Copyright 1980-2011 North Carolina State University
                          LAST UPDATE: January 2011
                            LANGUAGE FORTRAN 77/90

          DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
          THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
          DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
          AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
          UNDER THE DIRECTION OF R. W. SKAGGS.

*******************************************************************************


 DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #3 LT
 Onsite Raingauge, Magnolia NC Temperature Data


                        CLIMATE INPUTS
                        ******* ******

      DESCRIPTION                                  (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA .............C:\DrainMod\weather\greenville.RAI
 FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM
 RAINFALL STATION NUMBER..........................(RAINID)     313638
 TEMPERATURE/PET STATION NUMBER...................(TEMPID)     313638
 STARTING YEAR OF SIMULATION.................(START YEAR)       1965   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       1994   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.52   DEG.MIN
 HEAT INDEX...........................................(HID)      81.00


 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44

                              DRAINAGE SYSTEM DESIGN
                              **********************

                            *** CONVENTIONAL DRAINAGE ***

         JOB TITLE:

                  EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well
                  Onsite Raingauge, Magnolia NC Temperature Data
```

```
                STMAX = 1.00 CM                        SOIL SURFACE
+      __/)________________________________________________________/)__
           :                                                  :
           :                                                  :
           :                                                  :
      ADEPTH = 42. CM                                   DDRAIN = 31. CM
           :                                                  :
           :    O------------SDRAIN =****** CM -----------O   -
           :    *                                             :
           :  EFFRAD =5.00 CM                                 :
           :                                            HDRAIN = 11. CM
           :                                                  :
      - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
           :
           :
           :                                         IMPERMEABLE LAYER
+      ____________________________________________________________________
       ////////////////////////////////////////////////////////////////////
```

```
            DEPTH       SATURATED HYDRAULIC CONDUCTIVITY
            (CM)                    (CM/HR)

            .0 -    61.0             5.080
          61.0 -    91.4              .250
          91.4 -   152.4              .030
```

```
DEPTH TO DRAIN =  31.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER =  11.0 CM
DISTANCE BETWEEN DRAINS = ******* CM
MAXIMUM DEPTH OF SURFACE PONDING =  1.00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =   42.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = 10.00 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER =  42.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = 1.00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 5.92

   *** SEEPAGE LOSS INPUTS ***

    No seepage due to field slope

    Vertical Deep Seepage
       hydraulic head in aquifer (cm)=    0.000000E+00
       thickness of impeding layer (cm)=      100.000000
       vertical conductivity of impeding layer (cm/hr)=    1.000000E-05

    No seepage due to lateral deep seepage

  *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 384.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00
```

INITIAL WATER TABLE DEPTH = 40.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1

TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

Start Day = 32 End Day = 334
Threshold Water Table Depth (cm) = 30.5
Threshold Consecutive Days = 38

Fixed Monthly Pet Values

```
   1 1.00     2 1.00     3 1.00     4 1.00     5 1.00     6 1.00     7 1.00     8 1.00
 9 1.00    10 1.00    11 1.00    12 1.00



   Mrank indicator =  1



 ****************************** END OF INPUTS ******************************

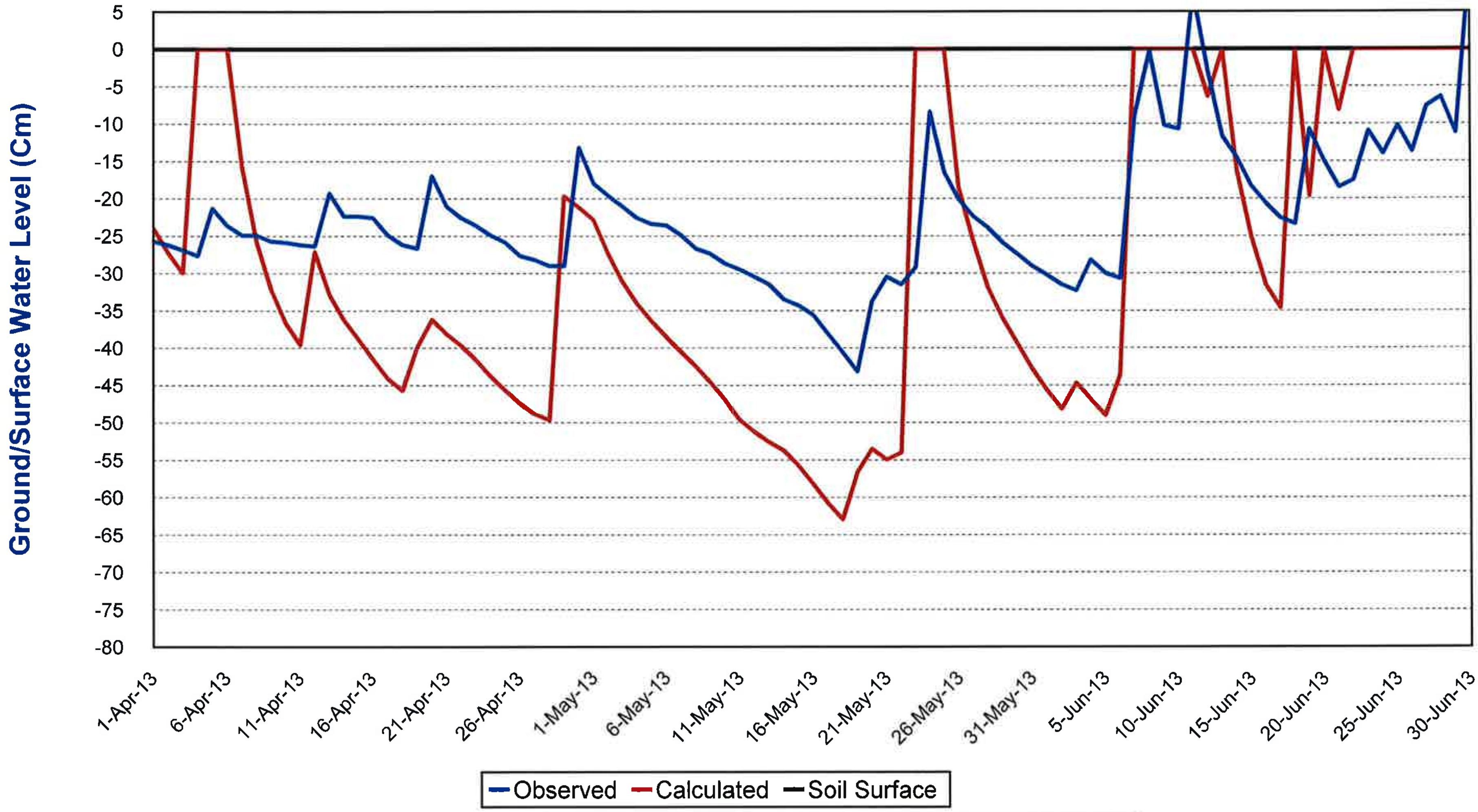
  ----------RUN STATISTICS ----------          time:  7/26/2013  @ 11:31
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage              and yields not calculated
               drain spacing =  100000. cm   drain depth =   31.0 cm
 --------------------------------------------------------------------------



**> Computational Statistics      <**
**> Start Computations    = 691.266
**> End Computations      = 691.288
**> Total simulation time =     1.4 seconds.
```

Drainage Assessment

(statistical difference = 5.30 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 4
- April 1, 2013 to June 30, 2013

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Slide D

millers_well4_LT.WET

```
---------------------------------------------------------
*                  DRAINMOD version 6.1                 *
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---------------------------------------------------------

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #4 LT
Onsite Raingauge, Magnolia NC Temperature Data
*********************************************************************************

 ----------RUN STATISTICS ----------          time:  7/26/2013  @ 11:34
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage               and yields not calculated
               drain spacing =  100000. cm   drain depth =   31.0 cm
--------------------------------------------------------------------------

                DRAINMOD --- WET PERIOD EVALUATION
                ****** Version 6.1 ******

         Number of periods with water table closer than  30.50 cm
               for at least   38 days.  Counting starts on day
                32 and ends on day  334 of each year
```

YEAR	Number of Periods of 38 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	1.	50.
1966	1.	48.
1967	0.	28.
1968	1.	51.
1969	1.	61.
1970	2.	71.
1971	1.	50.
1972	1.	39.
1973	1.	38.
1974	0.	31.
1975	1.	53.
1976	0.	22.
1977	2.	44.
1978	1.	48.
1979	1.	58.
1980	2.	64.
1981	0.	29.
1982	1.	58.
1983	0.	33.
1984	1.	65.
1985	0.	26.
1986	1.	40.
1987	1.	70.
1988	1.	57.
1989	2.	43.
1990	0.	36.
1991	0.	19.
1992	0.	34.
1993	1.	59.
1994	0.	37.

Number of Years with at least one period =   20. out of   30 years.

****

D R A I N M O D 6.1

LAST UPDATE: January 2011
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #4 LT
Onsite Raingauge, Magnolia NC Temperature Data

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\DrainMod\weather\greenville.RAI			
FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM			
RAINFALL STATION NUMBER..........................	(RAINID)	313638	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	313638	
STARTING YEAR OF SIMULATION.................	(START YEAR)	1965	YEAR
STARTING MONTH OF SIMULATION...............	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	1994	YEAR
ENDING MONTH OF SIMULATION..................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.52	DEG.MIN
HEAT INDEX..	(HID)	81.00	

ET MULTIPLICATION FACTOR FOR EACH MONTH
2.01 2.32 2.10 1.72 1.23 1.00 .86 .82 .92 1.05 1.22 1.44

DRAINAGE SYSTEM DESIGN
****

*** CONVENTIONAL DRAINAGE ***

JOB TITLE:

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well
Onsite Raingauge, Magnolia NC Temperature Data

```
              STMAX = 1.00 CM                      SOIL SURFACE
+      __/)_______________________________________________________________/)__
             :                                                   :
             :                                                   :
             :                                                   :
       ADEPTH = 42. CM                                     DDRAIN = 31. CM
             :                                                   :
             :     O------------SDRAIN =****** CM -----------O   -
             :     *                                             :
             : EFFRAD =5.00 CM                                   :
             :                                             HDRAIN = 11. CM
             :                                                   :
       - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
             :
             :
             :                                    IMPERMEABLE LAYER
+      ___________________________________________________________________
       ///////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 61.0	1.250
61.0 - 91.4	.100
91.4 - 152.4	.030

DEPTH TO DRAIN = 31.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 11.0 CM
DISTANCE BETWEEN DRAINS = ******* CM
MAXIMUM DEPTH OF SURFACE PONDING = 1.00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 42.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = 1.00 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 42.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = 1.00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 5.92

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

Vertical Deep Seepage
  hydraulic head in aquifer (cm)= 0.000000E+00
  thickness of impeading layer (cm)= 200.000000
  vertical conductivity of impeading layer (cm/hr)= 1.000000E-04

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 384.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 20.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0
DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1

TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

Start Day = 32 End Day = 334
Threshold Water Table Depth (cm) = 30.5
Threshold Consecutive Days = 38

Fixed Monthly Pet Values

```
    1 1.00     2 1.00     3 1.00     4 1.00     5 1.00     6 1.00     7 1.00     8 1.00
 9 1.00    10 1.00    11 1.00    12 1.00


   Mrank indicator =  1


 ****************************** END OF INPUTS ******************************

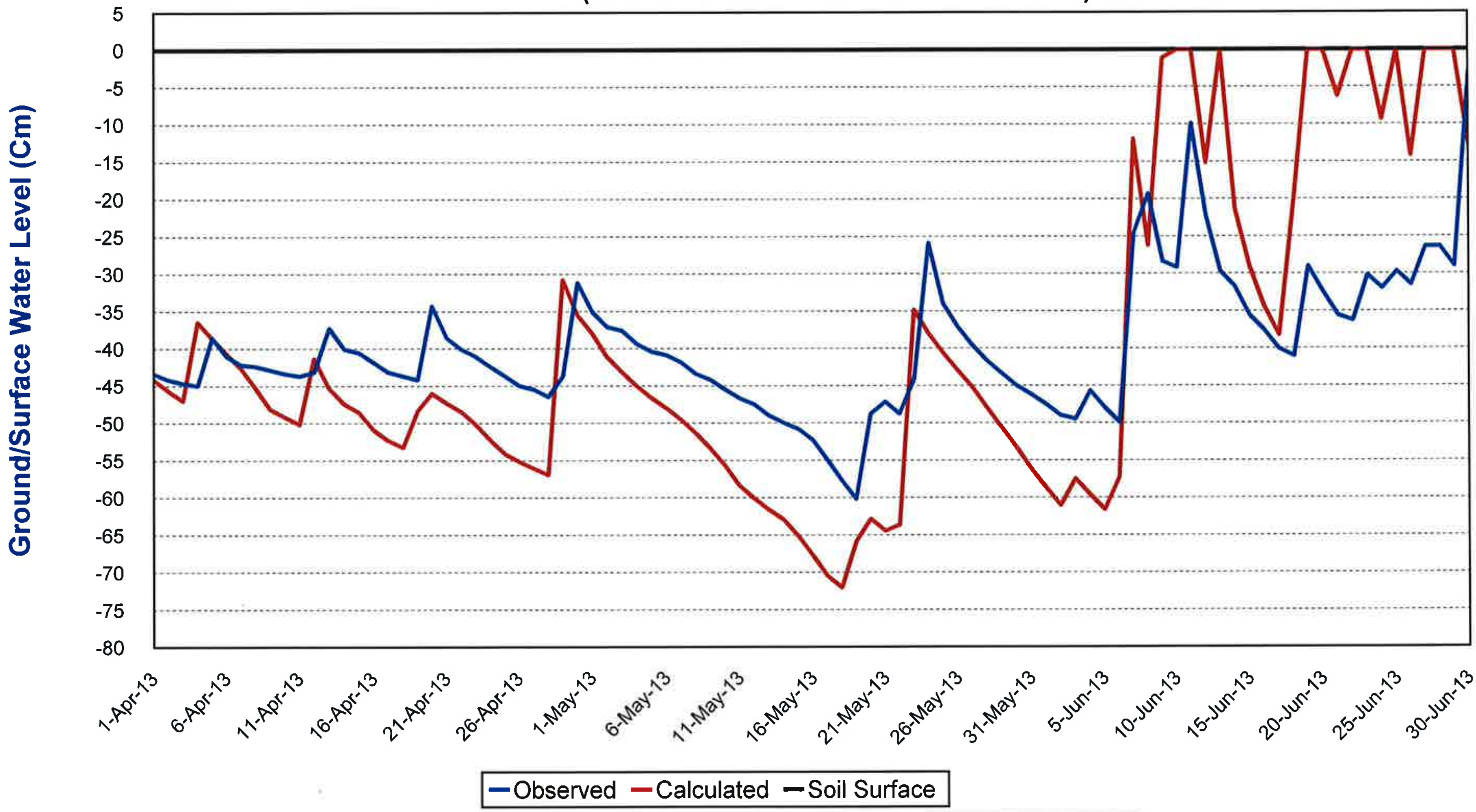
  ----------RUN STATISTICS ----------          time:  7/26/2013  @ 11:34
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage               and yields not calculated
               drain spacing =  100000. cm   drain depth =   31.0 cm
 ------------------------------------------------------------------------



**> Computational Statistics       <**
**> Start Computations     = 694.548
**> End Computations       = 694.570
**> Total simulation time =     1.3 seconds.
```

Drainage Assessment

(statistical difference = 4.53 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 5
- April 1, 2013 to June 30, 2013

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millers_well5_LT.WET

```
 ---------------------------------------------------------
 *                 DRAINMOD version 6.1                   *
 * Copyright 1980-2011 North Carolina State University *
 ---------------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #5 LT
Onsite Raingauge, Magnolia NC Temperature Data
****

```
 ----------RUN STATISTICS ----------            time:  7/26/2013  @ 11:38
 input file:    C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:     free drainage              and yields not calculated
                drain spacing =  100000. cm   drain depth =   31.0 cm
 ------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least 38 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 38 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	1.	49.
1966	1.	42.
1967	0.	28.
1968	0.	18.
1969	1.	60.
1970	0.	37.
1971	1.	42.
1972	0.	31.
1973	0.	37.
1974	0.	30.
1975	1.	52.
1976	0.	13.
1977	1.	44.
1978	1.	47.
1979	1.	50.
1980	1.	64.
1981	0.	28.
1982	1.	40.
1983	0.	33.
1984	1.	52.
1985	0.	25.
1986	1.	38.
1987	1.	68.
1988	1.	41.
1989	1.	39.
1990	0.	21.
1991	0.	19.
1992	0.	27.
1993	1.	59.
1994	0.	21.

Number of Years with at least one period =   16. out of   30 years.

****

D R A I N M O D 6.1

LAST UPDATE: January 2011
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Riparian, Well #5 LT
Onsite Raingauge, Magnolia NC Temperature Data

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\DrainMod\weather\greenville.RAI			
FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM			
RAINFALL STATION NUMBER.........................	(RAINID)	313638	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	313638	
STARTING YEAR OF SIMULATION.................	(START YEAR)	1965	YEAR
STARTING MONTH OF SIMULATION...............	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	1994	YEAR
ENDING MONTH OF SIMULATION..................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.52	DEG.MIN
HEAT INDEX...	(HID)	81.00	

ET MULTIPLICATION FACTOR FOR EACH MONTH
2.01 2.32 2.10 1.72 1.23 1.00 .86 .82 .92 1.05 1.22 1.44

DRAINAGE SYSTEM DESIGN
****

*** CONVENTIONAL DRAINAGE ***

JOB TITLE:

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rutlage_Rip
Onsite Raingauge, Magnolia NC Temperature Data

```
              STMAX = 1.00 CM                      SOIL SURFACE
+      __/)______________________________________________________/)__
          :                                                 :
          :                                                 :
     ADEPTH = 42. CM                                   DDRAIN = 31. CM
          :                                                 :
          :    O------------SDRAIN =****** CM -----------O  -
          :    *                                            :
          : EFFRAD =5.00 CM                             HDRAIN = 11. CM
          :                                                 :
       - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
          :
          :                                       IMPERMEABLE LAYER
+      ______________________________________________________________
       //////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 46.0	1.270
46.0 - 91.0	.250
91.0 - 152.0	1.270

DEPTH TO DRAIN = 31.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 11.0 CM
DISTANCE BETWEEN DRAINS = ******* CM
MAXIMUM DEPTH OF SURFACE PONDING = 1.00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 42.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = .10 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 42.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = 1.00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 5.92

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

Vertical Deep Seepage
   hydraulic head in aquifer (cm)= 0.000000E+00
   thickness of impeading layer (cm)= 75.000000
   vertical conductivity of impeading layer (cm/hr)= 1.000000E-03

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 384.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 42.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

```
                                                                 FIRST        SECOND
REQUIREMENTS                                                     PERIOD       PERIOD
   -MINIMUM AIR VOLUME IN SOIL (CM):                              3.90         3.90
   -MAXIMUM ALLOWABLE DAILY RAINFALL(CM):                         1.20         1.20
   -MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:          2.00         2.00

WORKING TIMES
   -DATE TO BEGIN COUNTING WORK DAYS:                             4/ 1        12/32
   -DATE TO STOP COUNTING WORK DAYS:                              5/ 1        12/32
   -FIRST WORK HOUR OF THE DAY:                                    8            8
   -LAST WORK HOUR OF THE DAY:                                    20           20


                                  CROP
                                  ****

SOIL MOISTURE AT  WILTING POINT =    .17

HIGH WATER STRESS:  BEGIN STRESS PERIOD ON    4/10
                    END STRESS PERIOD ON      8/18
                    CROP IS IN STRESS WHEN WATER TABLE IS ABOVE  30.0 CM

DROUGHT STRESS:     BEGIN STRESS PERIOD ON    4/10
                    END STRESS PERIOD ON      8/18


                             MO   DAY   ROOTING DEPTH(CM)
                              1    1          3.0
                              4   16          3.0
                              5    4          4.0
                              5   17         15.0
                              6    1         25.0
                              6   20         30.0
                              7   18         30.0
                              8   20         20.0
                              9   24         10.0
                              9   25          3.0
                             12   31          3.0


                             WASTEWATER IRRIGATION
                             *********************


    NO WASTEWATER IRRIGATION SCHEDULED:
    -----------------------------------


  ***** Wetlands Parameter Estimation *****

             Start Day =    32           End Day =  334
             Threshold Water Table Depth (cm) =  30.5
             Threshold Consecutive Days       =    38


Fixed Monthly Pet Values
```

```
   1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
 9 1.00   10 1.00   11 1.00   12 1.00


   Mrank indicator =  1

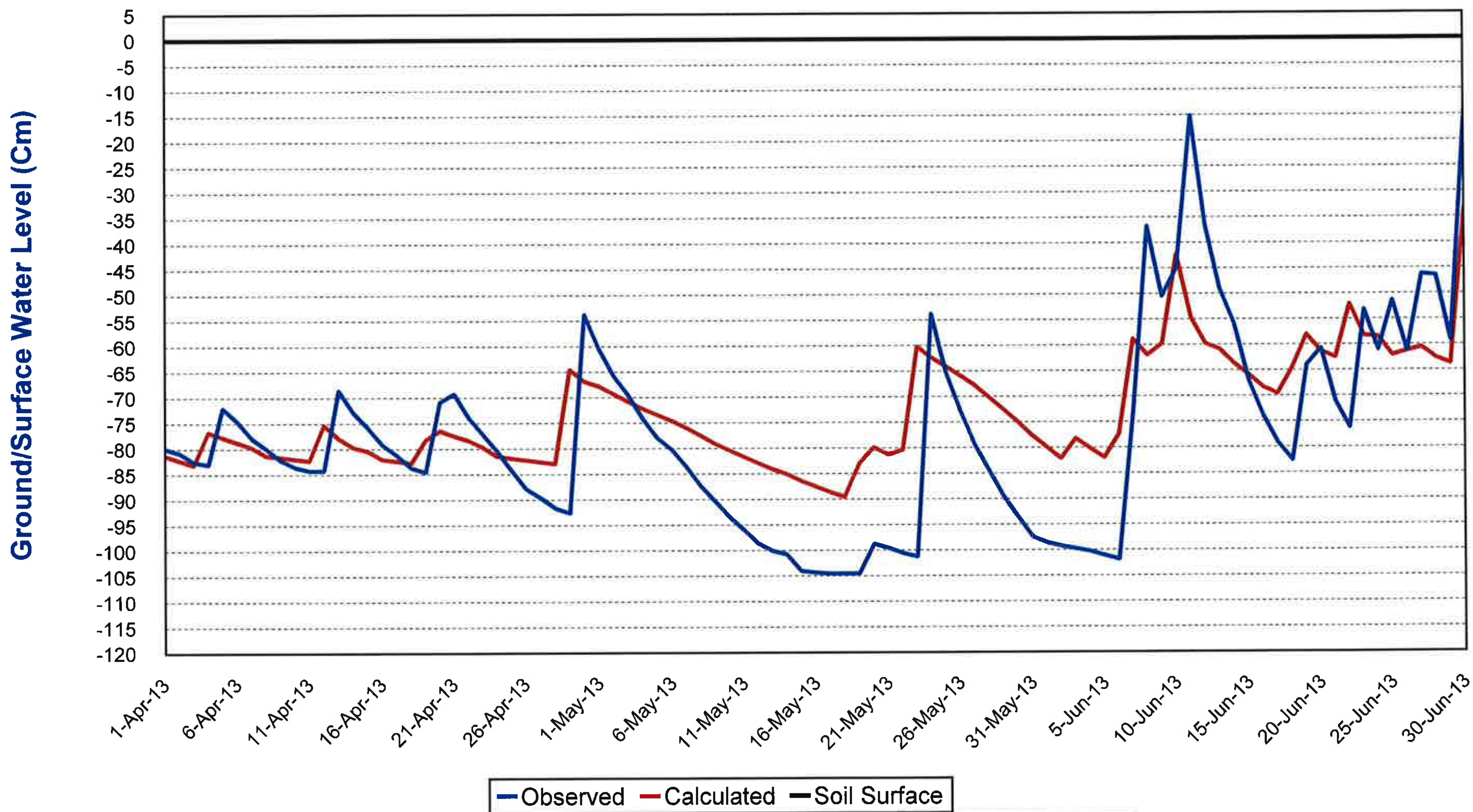

 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  7/26/2013  @ 11:38
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage              and yields not calculated
               drain spacing =  100000. cm   drain depth =   31.0 cm
-------------------------------------------------------------------------


**> Computational Statistics       <**
**> Start Computations     = 698.177
**> End Computations       = 698.199
**> Total simulation time =     1.4 seconds.
```

Drainage Assessment

(statistical difference = 4.18 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 7
- April 1, 2013 to June 30, 2013

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```
------------------------------------------------------
*                DRAINMOD version 6.1                *
* Copyright 1980-2011 North Carolina State University *
------------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #7 LT
Onsite Raingauge, Magnolia NC Temperature Data

```
----------RUN STATISTICS ----------        time:  7/26/2013  @ 11:41
input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
parameters:     free drainage              and yields not calculated
              drain spacing =  100000. cm   drain depth =   31.0 cm
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 38 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 38 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	1.	49.
1966	1.	48.
1967	0.	28.
1968	1.	51.
1969	1.	61.
1970	2.	71.
1971	1.	50.
1972	1.	39.
1973	1.	38.
1974	0.	31.
1975	1.	53.
1976	1.	41.
1977	2.	44.
1978	1.	48.
1979	1.	58.
1980	2.	64.
1981	0.	29.
1982	1.	58.
1983	1.	66.
1984	1.	65.
1985	0.	26.
1986	1.	40.
1987	1.	70.
1988	1.	57.
1989	2.	43.
1990	1.	38.
1991	0.	20.
1992	0.	34.
1993	2.	59.
1994	0.	37.

Number of Years with at least one period = 23. out of 30 years.

****

D R A I N M O D 6.1

LAST UPDATE: January 2011
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #7 LT
Onsite Raingauge, Magnolia NC Temperature Data

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\DrainMod\weather\greenville.RAI			
FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM			
RAINFALL STATION NUMBER.........................	(RAINID)	313638	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	313638	
STARTING YEAR OF SIMULATION.................	(START YEAR)	1965	YEAR
STARTING MONTH OF SIMULATION................	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	1994	YEAR
ENDING MONTH OF SIMULATION....................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.52	DEG.MIN
HEAT INDEX..	(HID)	81.00	

ET MULTIPLICATION FACTOR FOR EACH MONTH
2.01 2.32 2.10 1.72 1.23 1.00 .86 .82 .92 1.05 1.22 1.44

DRAINAGE SYSTEM DESIGN
****

*** CONVENTIONAL DRAINAGE ***

JOB TITLE:

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well
Onsite Raingauge, Magnolia NC Temperature Data

```
                STMAX = 1.00 CM                          SOIL SURFACE
+       __/)__________________________________________________________/)__
            :                                                 :
            :                                                 :
            :                                                 :
     ADEPTH = 42. CM                                  DDRAIN = 31. CM
            :                                                 :
            :    O------------SDRAIN =****** CM -----------O  -
            :    *                                            :
            : EFFRAD =5.00 CM                         HDRAIN = 11. CM
            :                                                 :
    - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
            :
            :                                 IMPERMEABLE LAYER
+       _________________________________________________________________
        /////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 61.0	5.080
61.0 - 91.4	.250
91.4 - 152.4	.030

DEPTH TO DRAIN = 31.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 11.0 CM
DISTANCE BETWEEN DRAINS = ******* CM
MAXIMUM DEPTH OF SURFACE PONDING = 1.00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 42.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = 25.00 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 42.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
CAN MOVE TO DRAIN = 1.00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 5.92

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 487.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 80.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		

```
   -MINIMUM AIR VOLUME IN SOIL (CM):                              3.90        3.90
   -MAXIMUM ALLOWABLE DAILY RAINFALL(CM):                         1.20        1.20
   -MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:          2.00        2.00

 WORKING TIMES
   -DATE TO BEGIN COUNTING WORK DAYS:                             4/ 1       12/32
   -DATE TO STOP COUNTING WORK DAYS:                              5/ 1       12/32
   -FIRST WORK HOUR OF THE DAY:                                    8           8
   -LAST WORK HOUR OF THE DAY:                                    20          20
```

CROP
****

```
SOIL MOISTURE AT  WILTING POINT =     .17

HIGH WATER STRESS:  BEGIN STRESS PERIOD ON    4/10
                    END STRESS PERIOD ON      8/18
                    CROP IS IN STRESS WHEN WATER TABLE IS ABOVE  30.0 CM

DROUGHT STRESS:     BEGIN STRESS PERIOD ON    4/10
                    END STRESS PERIOD ON      8/18
```

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
        Start Day =    32           End Day =  334
        Threshold Water Table Depth (cm) =  30.5
        Threshold Consecutive Days        =    38
```

Fixed Monthly Pet Values

```
   1 1.00     2 1.00     3 1.00     4 1.00     5 1.00     6 1.00     7 1.00     8 1.00
9 1.00    10 1.00    11 1.00    12 1.00
```

```
 Mrank indicator =  1


******************************* END OF INPUTS *******************************

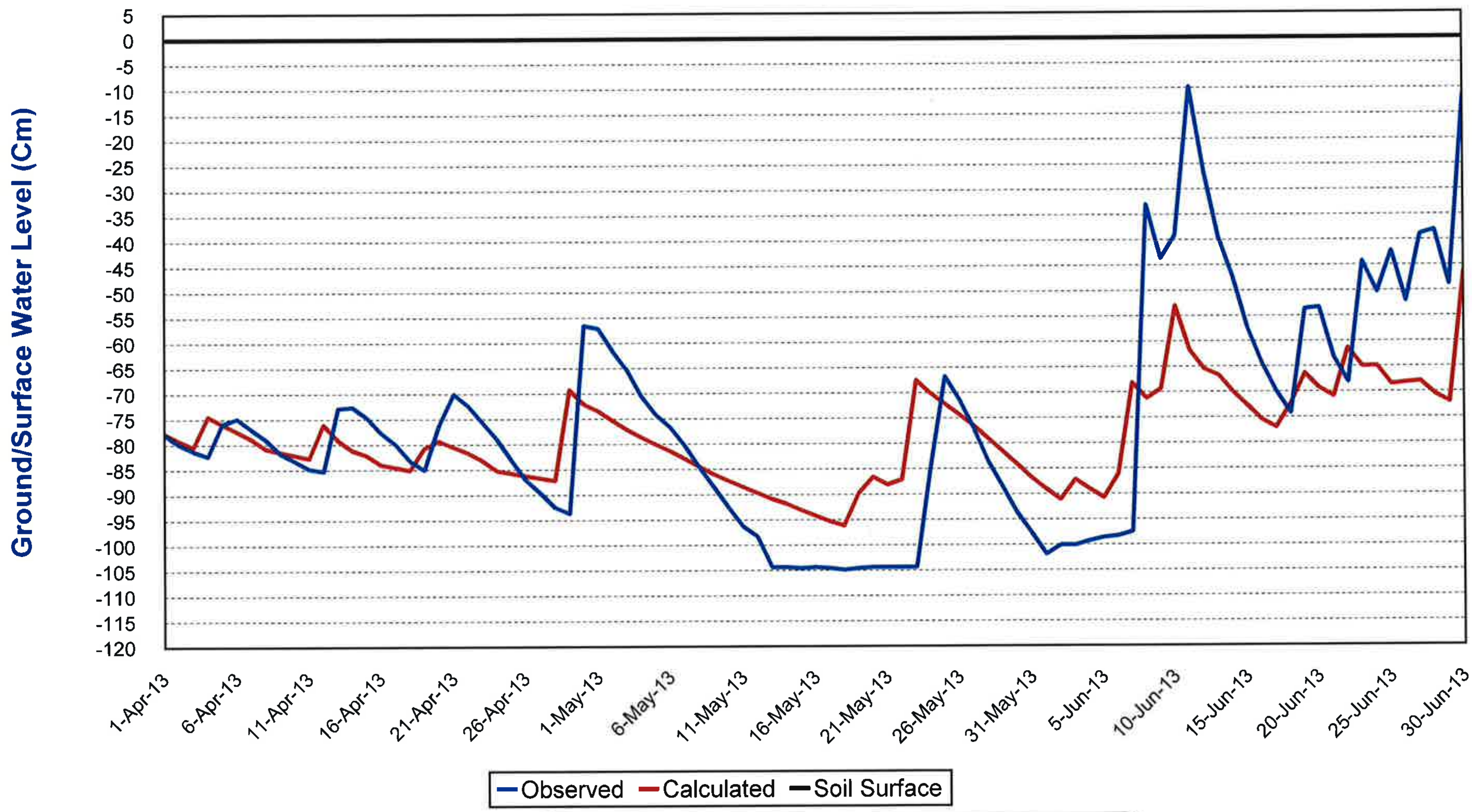
 ----------RUN STATISTICS ----------          time:  7/26/2013  @ 11:41
input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
parameters:    free drainage              and yields not calculated
              drain spacing =  100000. cm   drain depth =   31.0 cm
-------------------------------------------------------------------------



**> Computational Statistics       <**
**> Start Computations    = 701.294
**> End Computations      = 701.315
**> Total simulation time =     1.2 seconds.
```

Drainage Assessment

(statistical difference = 4.57 Centimeters)



- EEP - UT to Millers Creek, Ryan Smith (40-13-064)
- Duplin County, NC
- Monitoring Device Location 8
- April 1, 2013 to June 30, 2013

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millers_well8_LT.WET

```
----------------------------------------------------
*                  DRAINMOD version 6.1            *
* Copyright 1980-2011 North Carolina State University *
----------------------------------------------------
```

EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #8 LT
Onsite Raingauge, Magnolia NC Temperature Data
****

```
 ----------RUN STATISTICS ----------         time:  7/26/2013  @ 11:43
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage              and yields not calculated
               drain spacing =  100000. cm   drain depth =    31.0 cm
-----------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 38 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 38 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1965	1.	50.
1966	1.	48.
1967	0.	28.
1968	1.	51.
1969	1.	61.
1970	2.	71.
1971	1.	50.
1972	1.	39.
1973	1.	38.
1974	0.	31.
1975	1.	53.
1976	1.	41.
1977	2.	44.
1978	1.	48.
1979	1.	58.
1980	2.	64.
1981	0.	29.
1982	1.	58.
1983	1.	66.
1984	1.	65.
1985	0.	26.
1986	1.	40.
1987	1.	70.
1988	1.	57.
1989	2.	43.
1990	1.	38.
1991	0.	20.
1992	0.	34.
1993	2.	59.
1994	0.	37.

Number of Years with at least one period = 23. out of 30 years.

```
*******************************************************************************

                         D R A I N M O D   6.1

           Copyright 1980-2011 North Carolina State University
                       LAST UPDATE: January 2011
                        LANGUAGE FORTRAN 77/90

       DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
       THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
       DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
       AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
       UNDER THE DIRECTION OF R. W. SKAGGS.

*******************************************************************************


 DATA READ FROM INPUT FILE: C:\DrainMod\inputs\UT to Millers Creek\millers_w
 Cream selector (0=no, 1=yes) =  0

                         TITLE OF RUN
                         ************


 EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well #8 LT
 Onsite Raingauge, Magnolia NC Temperature Data


                         CLIMATE INPUTS
                         ******* ******

     DESCRIPTION                                (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA .............C:\DrainMod\weather\greenville.RAI
 FILE FOR TEMPERATURE/PET DATA ..C:\DrainMod\weather\greenville.TEM
 RAINFALL STATION NUMBER.........................(RAINID)      313638
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)      313638
 STARTING YEAR OF SIMULATION.................(START YEAR)        1965   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)        1994   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)          12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)       34.52   DEG.MIN
 HEAT INDEX.........................................(HID)       81.00


 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                              DRAINAGE SYSTEM DESIGN
                               *********************

                             *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                 EEP-UT to Millers Creek (40-13-064), Ryan Smith, Rains, Well
                 Onsite Raingauge, Magnolia NC Temperature Data
```

```
                     STMAX = 1.00 CM                       SOIL SURFACE
+        __/)__________________________________________________________/)__
              :                                                      :
              :                                                      :
              :                                                      :
              :                                                      :
         ADEPTH = 42. CM                                     DDRAIN = 31. CM
              :                                                      :
              :     O------------SDRAIN =****** CM -----------O      -
              :     *                                                :
              : EFFRAD =5.00 CM                                      :
              :                                              HDRAIN = 11. CM
              :                                                      :
         - - -:- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
              :
              :
              :                                        IMPERMEABLE LAYER
+        ______________________________________________________________________
         //////////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 61.0	5.080
61.0 - 91.4	.250
91.4 - 152.4	.030

DEPTH TO DRAIN = 31.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 11.0 CM
DISTANCE BETWEEN DRAINS = ******* CM
MAXIMUM DEPTH OF SURFACE PONDING = 1.00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 42.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = 1.00 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 42.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = 1.00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 5.92

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 487.0 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 76.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	31.0	31.0	31.0	31.0	31.0	31.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	31.4
2.0	42.1
3.0	50.0
4.0	57.2
5.0	63.7
6.0	69.8
7.0	75.8
8.0	81.5
9.0	87.1
10.0	92.6
11.0	97.8
12.0	103.0
13.0	108.2
14.0	113.4
15.0	118.7
16.0	124.1
17.0	129.7
18.0	135.2
19.0	140.8
20.0	146.3
21.0	152.0
22.0	157.8
23.0	163.6
24.0	169.4
25.0	175.3
26.0	181.1
27.0	186.9
28.0	192.7
29.0	198.6
30.0	203.6
35.0	227.4
40.0	251.2
45.0	275.0
50.0	298.8
60.0	346.4
70.0	394.0
80.0	441.6
90.0	489.2

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.4500	.00	.5000
10.0	.4420	.05	.3995
20.0	.4340	.32	.0400
30.0	.4260	.89	.0137
40.0	.4180	1.77	.0060
50.0	.4100	3.00	.0033
60.0	.4080	4.38	.0016
70.0	.4060	6.03	.0011
80.0	.4040	7.74	.0007
90.0	.4020	9.51	.0004
100.0	.4000	11.43	.0003
110.0	.3980	13.34	.0002
120.0	.3960	15.26	.0001
130.0	.3940	17.06	.0001
140.0	.3920	18.86	.0000
150.0	.3900	20.66	.0000
160.0	.3880	22.38	.0000
170.0	.3860	24.10	.0000
180.0	.3840	25.81	.0000
190.0	.3820	27.53	.0000
200.0	.3800	29.25	.0000
210.0	.3780	31.35	.0000
220.0	.3760	33.45	.0000
230.0	.3740	35.55	.0000
240.0	.3720	37.65	.0000
250.0	.3700	39.75	.0000
260.0	.3690	41.85	.0000
270.0	.3680	43.95	.0000
280.0	.3670	46.05	.0000
290.0	.3660	48.16	.0000
300.0	.3650	50.26	.0000
350.0	.3600	60.76	.0000
400.0	.3567	71.26	.0000
450.0	.3533	81.77	.0000
500.0	.3500	92.27	.0000
600.0	.3440	93.82	.0000
700.0	.3380	95.36	.0000
800.0	.3320	96.91	.0000
900.0	.3260	98.45	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	2.000
10.000	.170	1.710
20.000	.220	1.120
40.000	.330	.820
60.000	.380	.730
80.000	.340	.590
100.000	.370	.590
150.000	1.100	.590
200.000	1.100	.590
1000.000	1.100	.590

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD

-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00

WORKING TIMES

-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0
9	24	10.0
9	25	3.0
12	31	3.0

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

Start Day = 32 End Day = 334
Threshold Water Table Depth (cm) = 30.5
Threshold Consecutive Days = 38

Fixed Monthly Pet Values

1 1.00 2 1.00 3 1.00 4 1.00 5 1.00 6 1.00 7 1.00 8 1.00
9 1.00 10 1.00 11 1.00 12 1.00

```
  Mrank indicator =  1

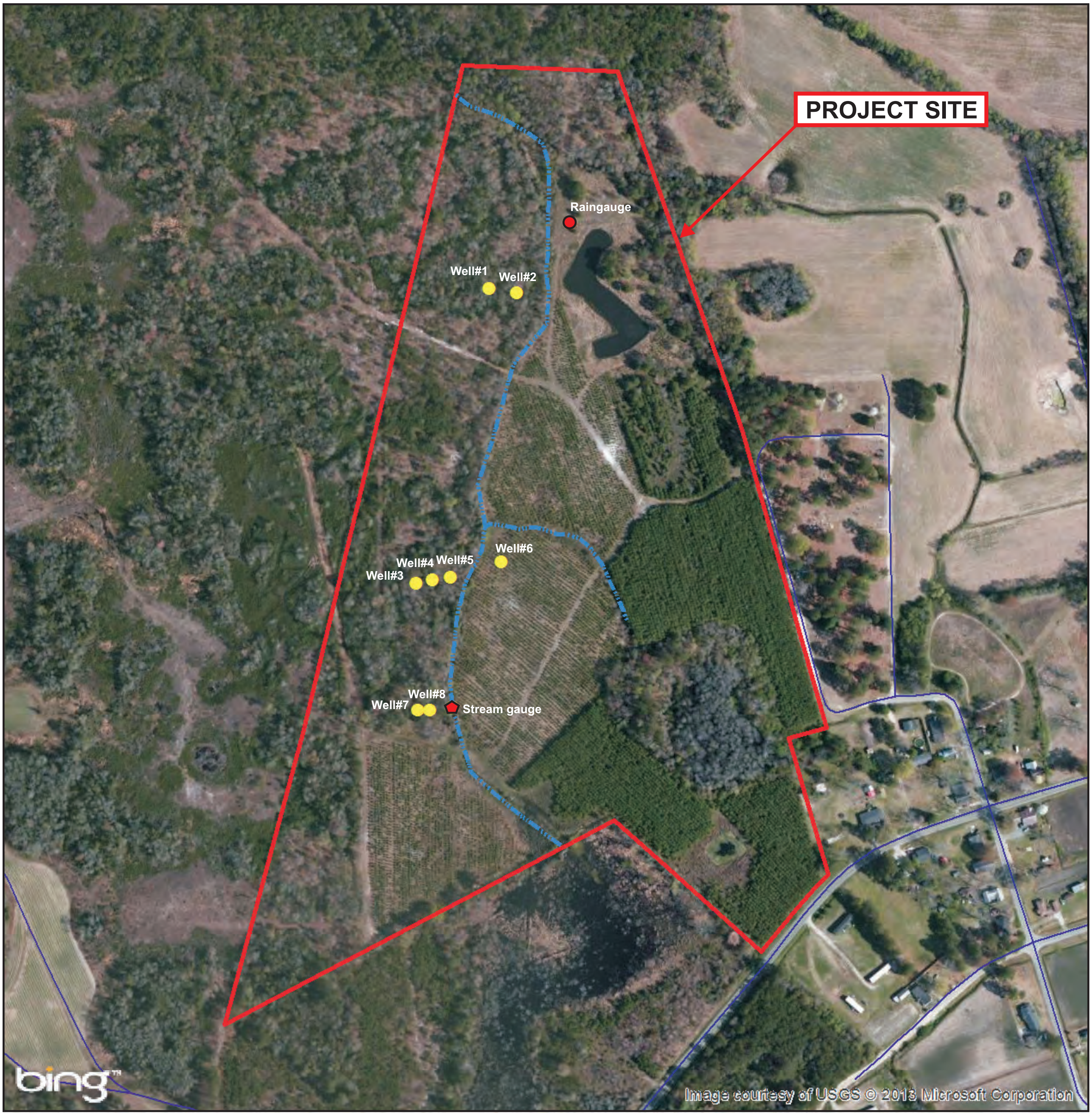

 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  7/26/2013  @ 11:43
 input file:   C:\DrainMod\inputs\UT to Millers Creek\millers_w
 parameters:    free drainage              and yields not calculated
               drain spacing =  100000. cm   drain depth =   31.0 cm
 ------------------------------------------------------------------------



**> Computational Statistics       <**
**> Start Computations    = 703.916
**> End Computations      = 703.937
**> Total simulation time =     1.2 seconds.
```

C.3 Preliminary Gauge Data



N

L:\WETLANDS\2013 WETLANDS FILES\40-13-064 --- UT to Millers Creek, Ryan Smith

NOTE: This is not a survey. All boundaries and distances are considered approximate.

Map Source: BING Aerial Photography

SCALE 1" = 400'

UT to Millers Creek
Florence & Hutcheson
Magnolia Tract
Duplin County, NC
March 2013

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LAND MANAGEMENT GROUP INC
Environmental Consultants
www.LMGroup.net
Phone: 910.452.0001 •1.866.LMG.1078
Fax: 910.452.0060
P.O. Box 2522, Wilmington, NC 28402

Gauge Location Map

Hydrology Assessment

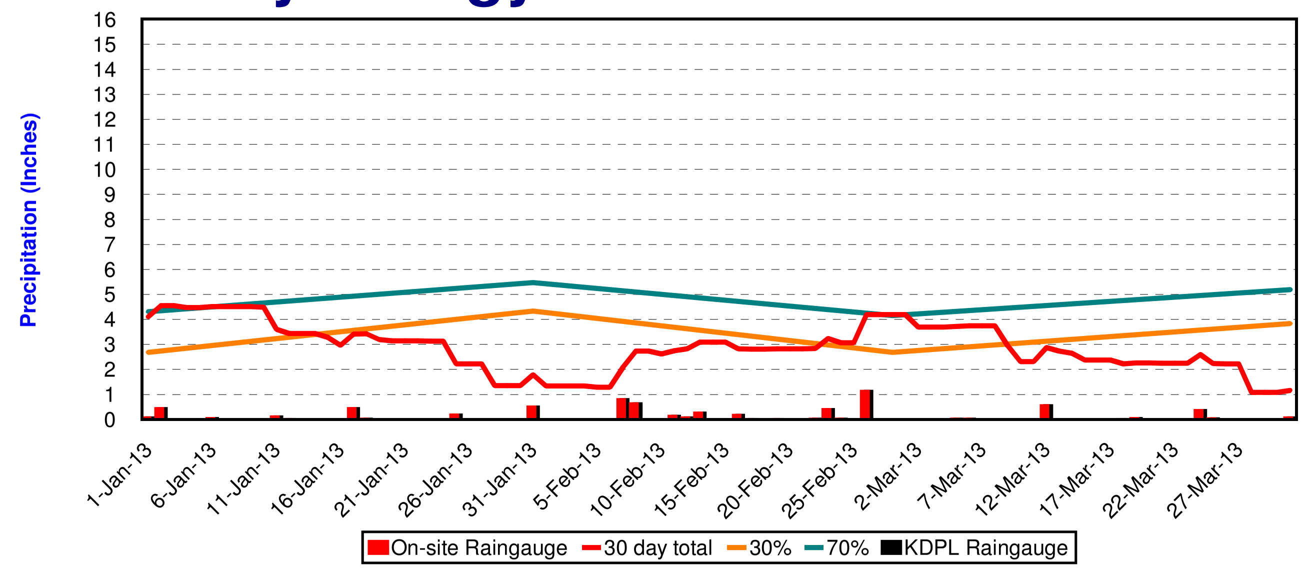
March 2013

Precipitation data obtained from: On-site rain gauge and Duplin County Airport (KDPL) (www.nc-climate.ncsu.edu)

30% & 70% precipitation data obtained from average of surrounding counties (wcc.nrcs.usda.gov)

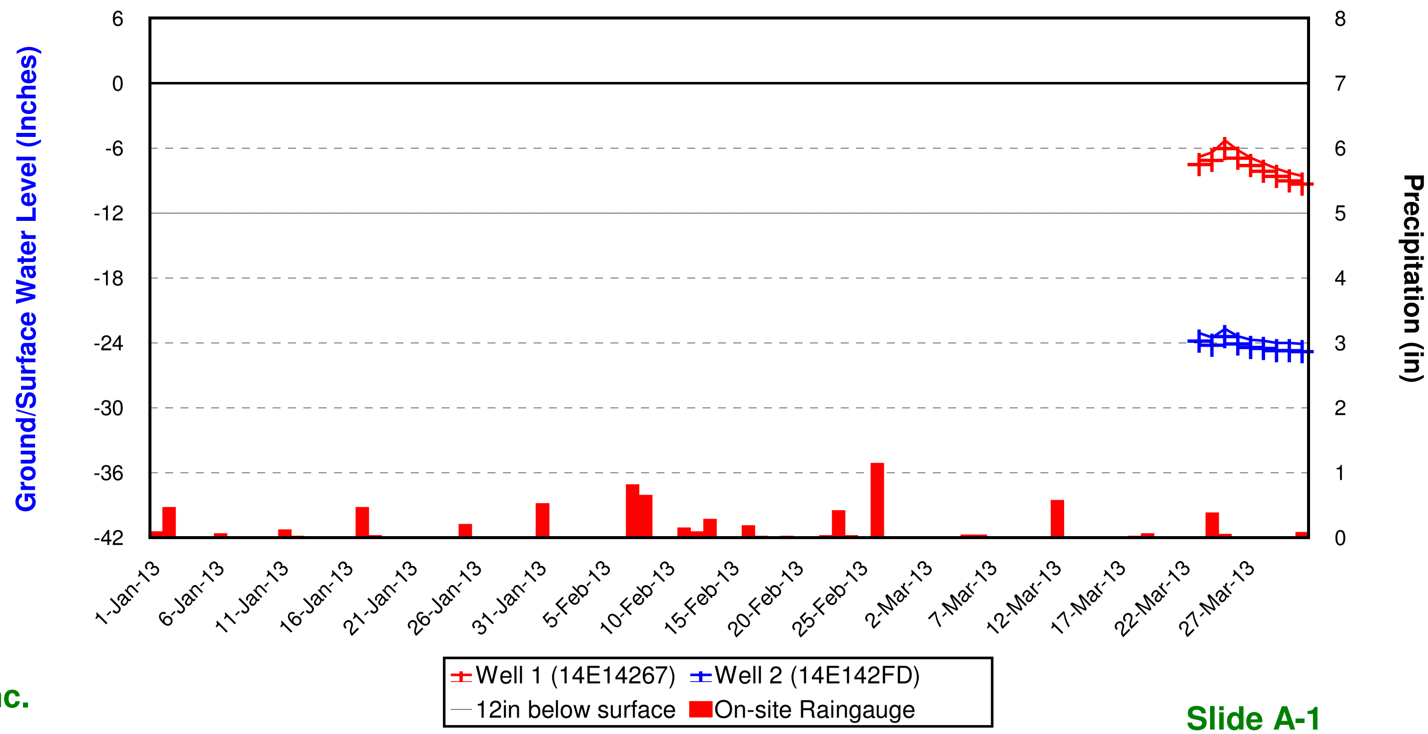
*Wells installed 3-22-13

*30 day precipitation totals from onsite raingauge begin 4-21-13



Monitoring Well Record

- UT to Millers Creek
- Duplin County, NC
- 40-13-064
- Wells 1, 2
- Ecotone WM 40
- January 1, 2013 to March 31, 2013
- One reading per day at 7:00 am



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Slide A-1

Hydrology Assessment

June 2013

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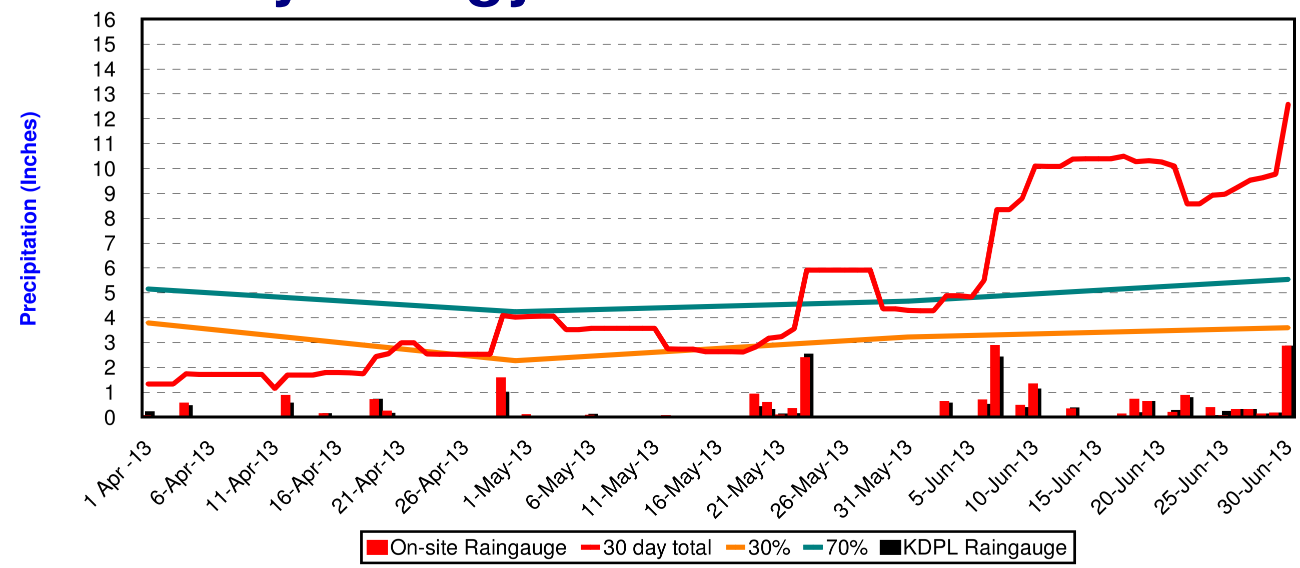
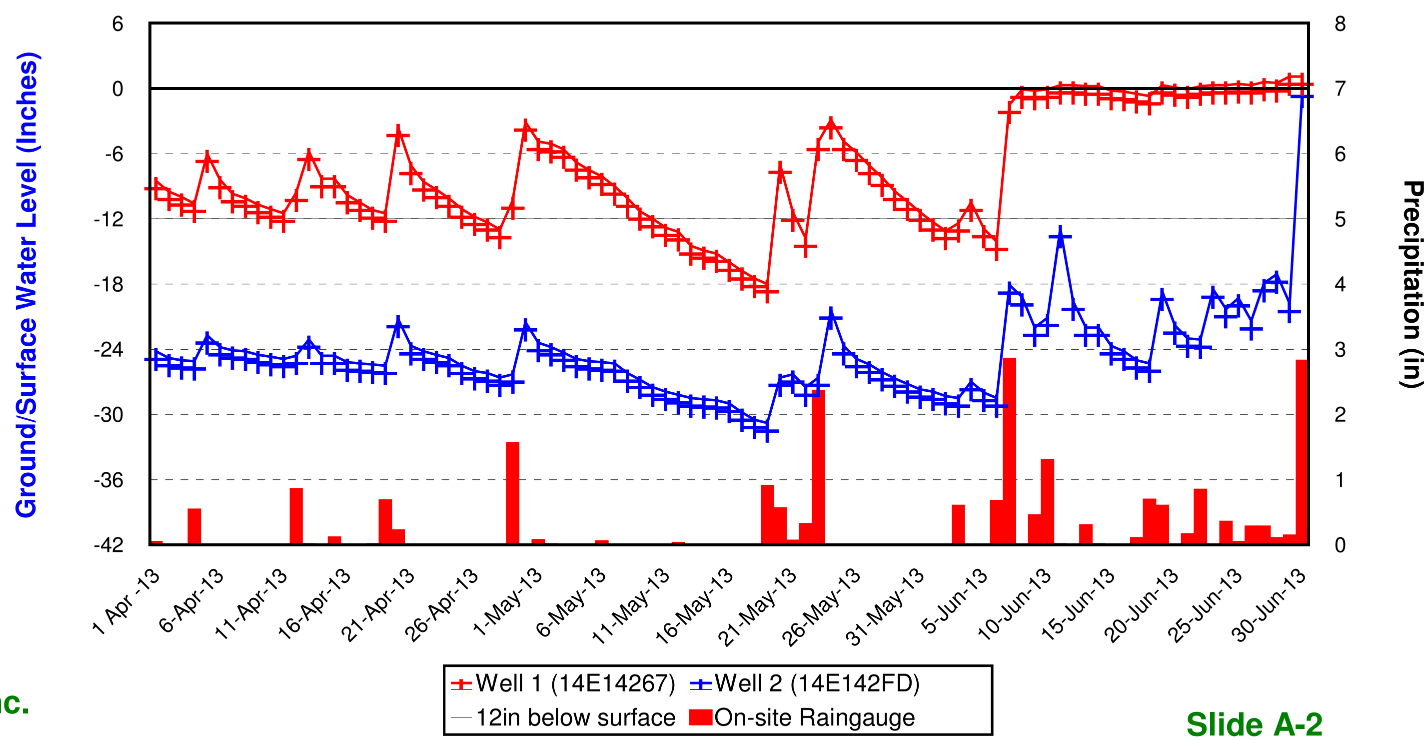


Monitoring Well Record

- UT to Millers Creek
- Duplin County, NC
- 40-13-064
- Wells 1, 2
- Ecotone WM 40
- April 1, 2013 to June 30, 2013
- One reading per day at 7:00 am



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Slide A-2

Hydrology Assessment

September 2013

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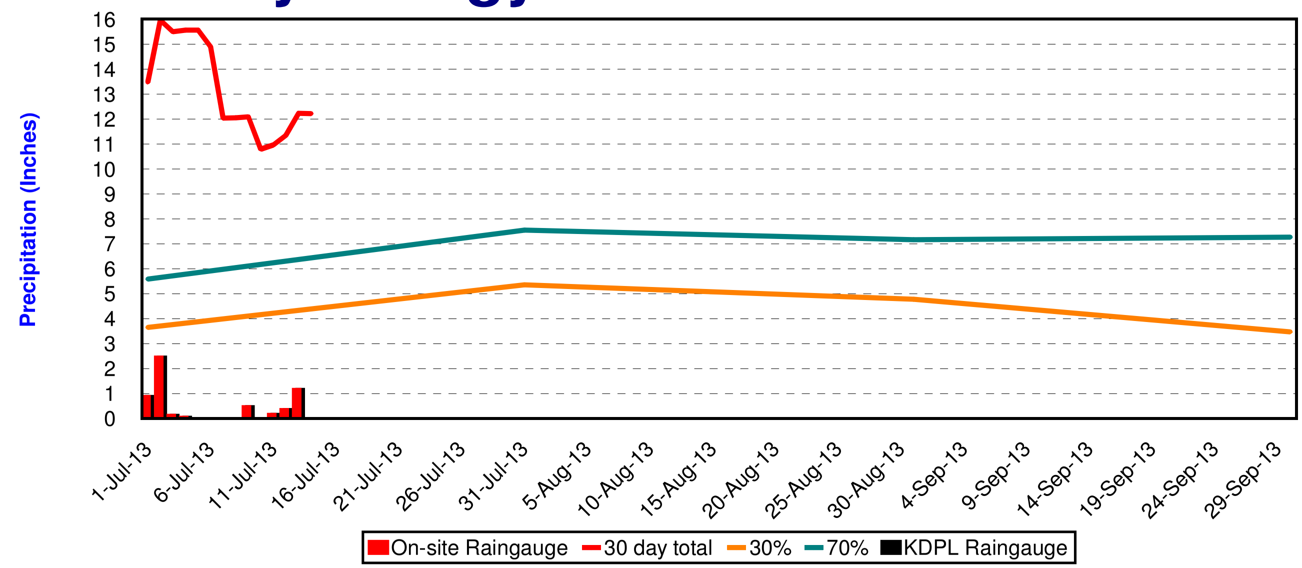

Monitoring Well Record

- UT to Millers Creek
- Duplin County, NC
- 40-13-064
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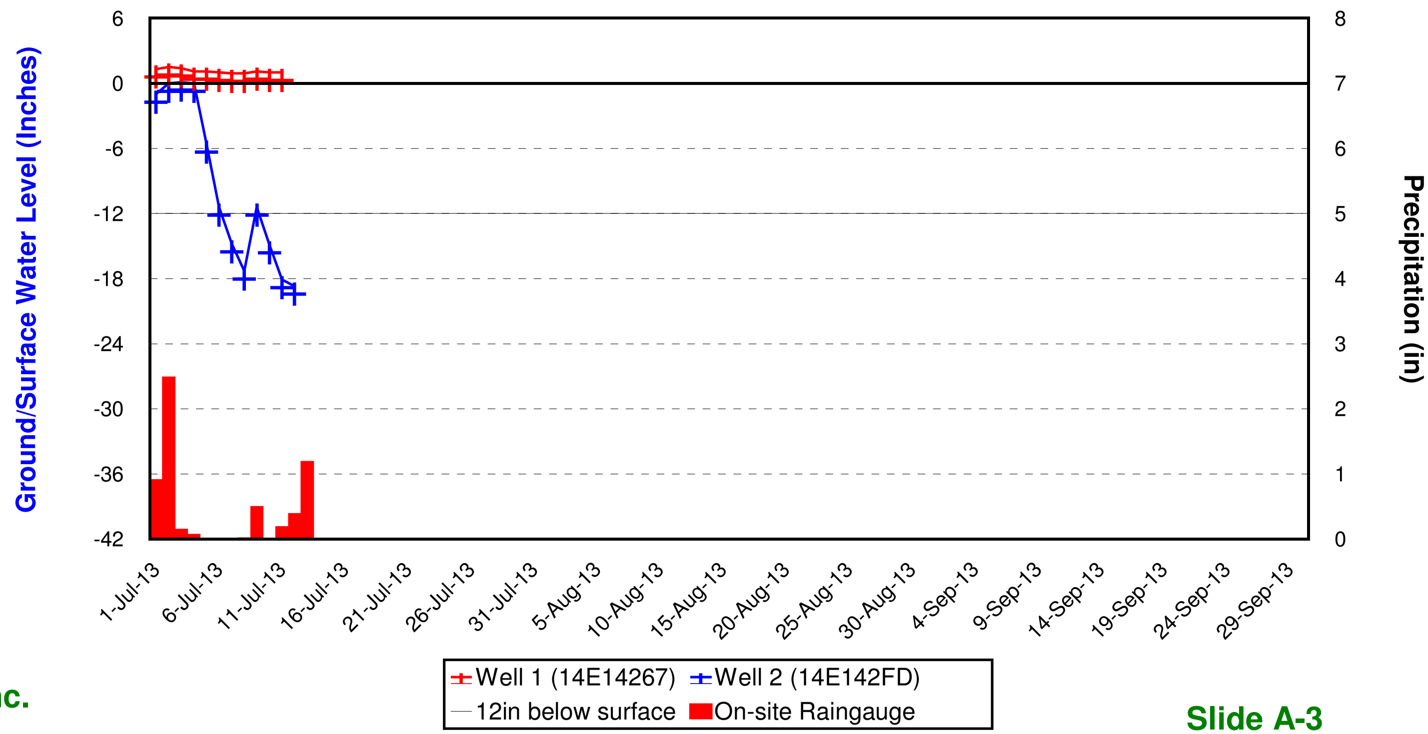
- July 1, 2013 to September 30, 2013
- One reading per day at 7:00 am



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Hydrology Assessment

March 2013

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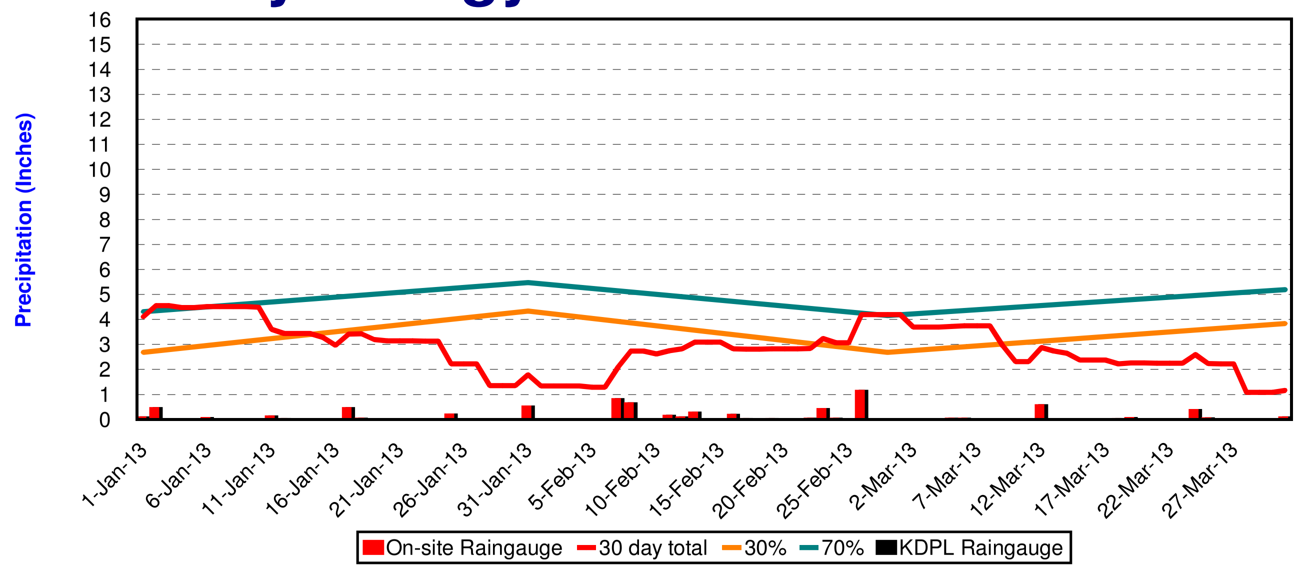
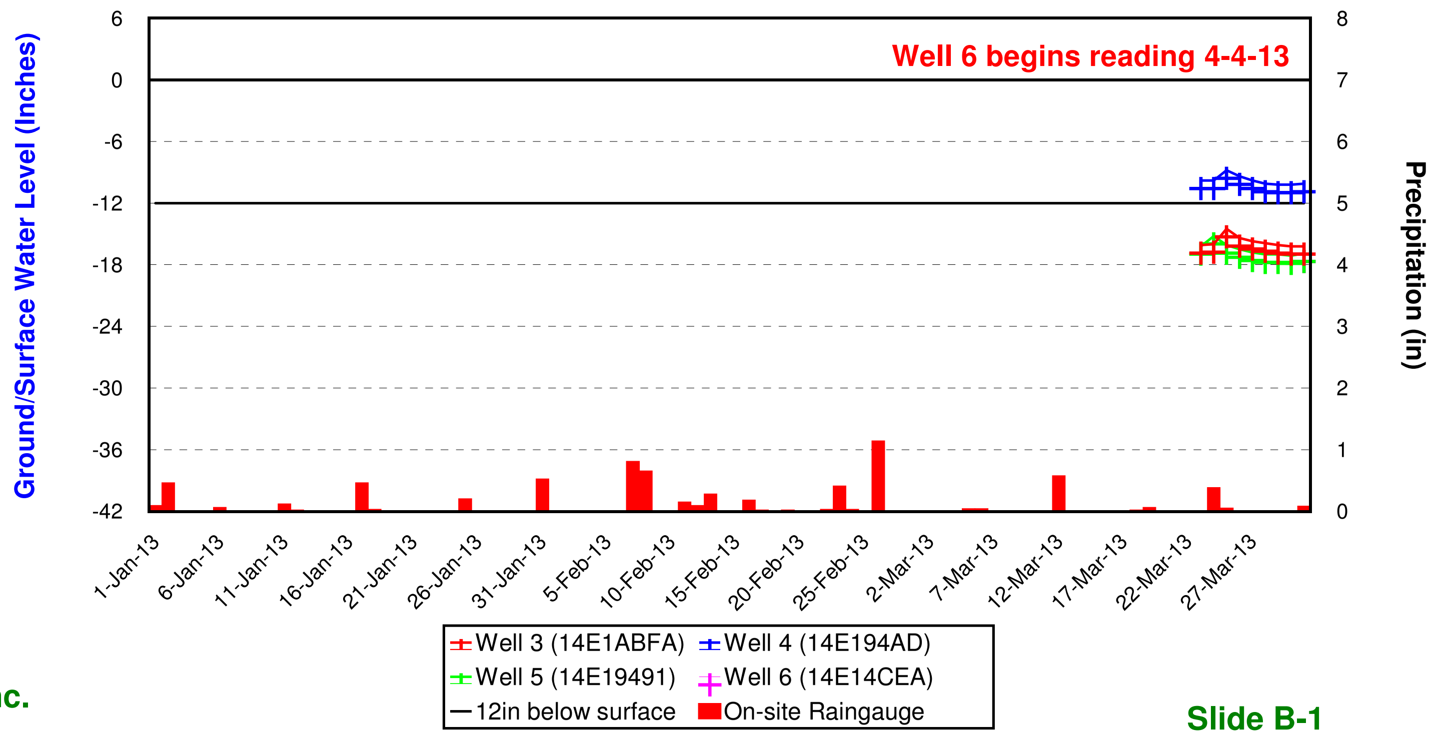


Monitoring Well Record

- UT to Millers Creek
- Duplin County, NC
- 40-13-064
- Wells 3, 4, 5, 6
- Ecotone WM 40
- January 1, 2013 to March 31, 2013
- One reading per day at 7:00 am



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Slide B-1

Hydrology Assessment

June 2013

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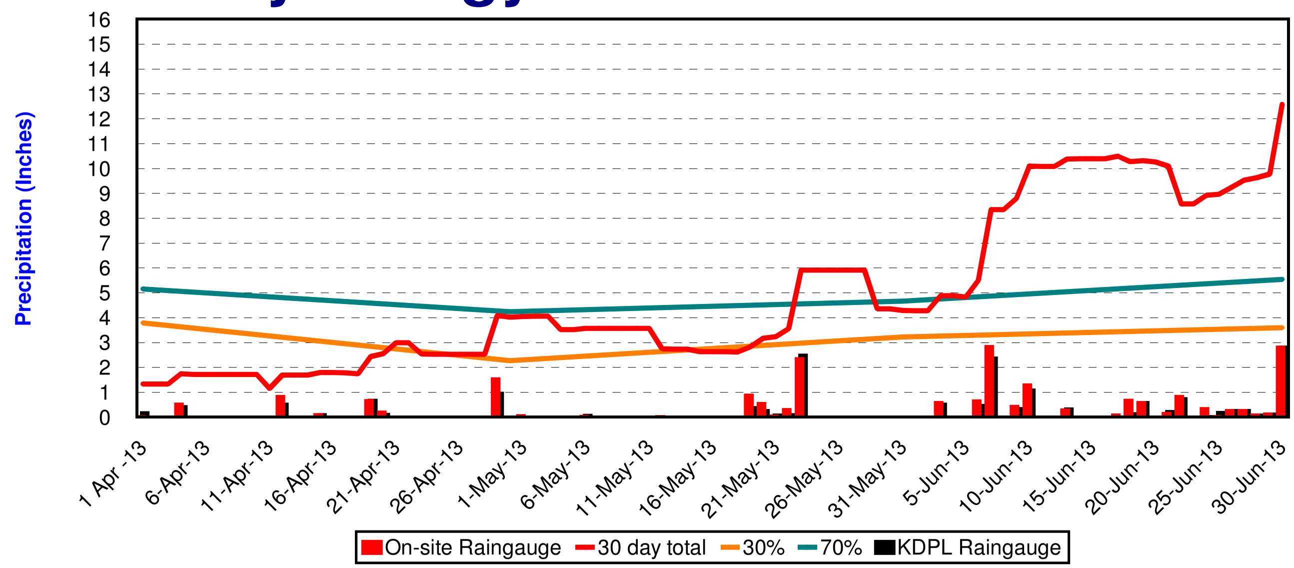

Monitoring Well Record

- UT to Millers Creek
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- Wells 3, 4, 5, 6
- Ecotone WM 40
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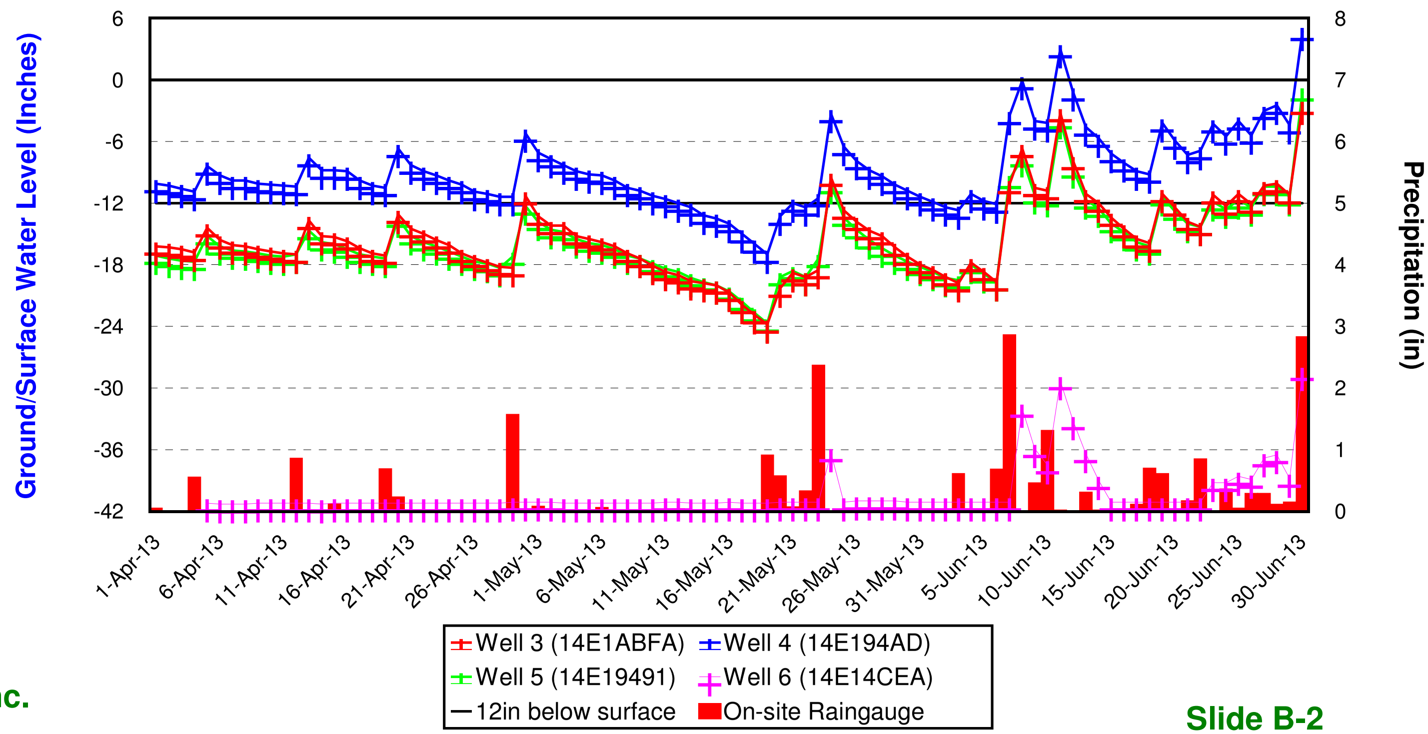

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Slide B-2

Hydrology Assessment

September 2013

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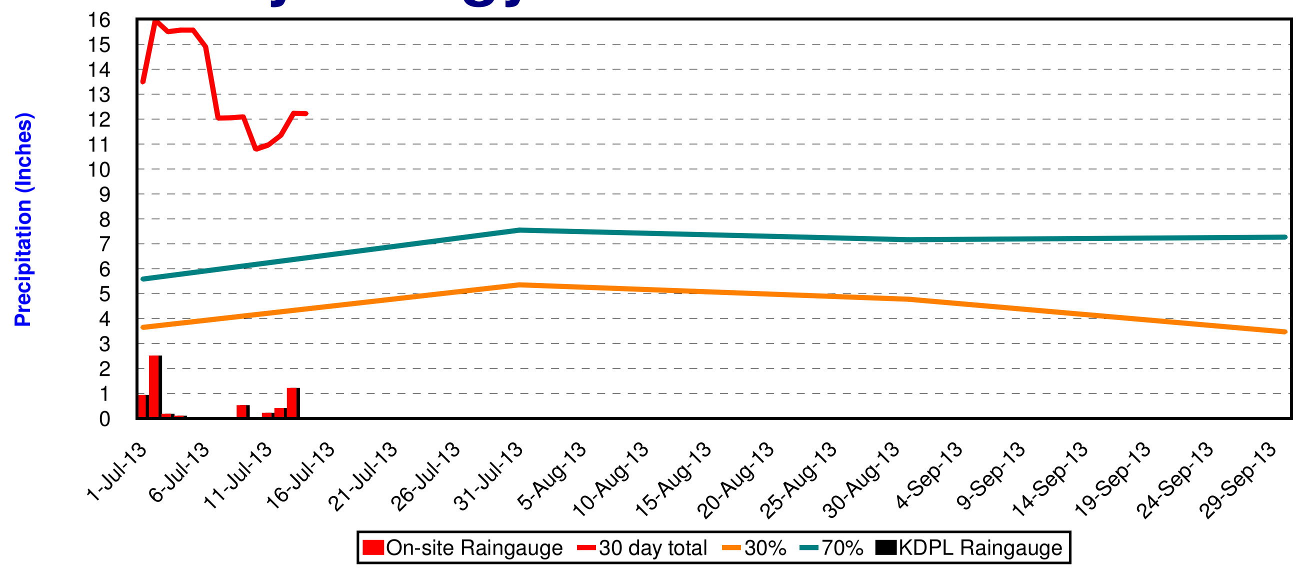

Monitoring Well Record

- UT to Millers Creek
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- Wells 3, 4, 5, 6
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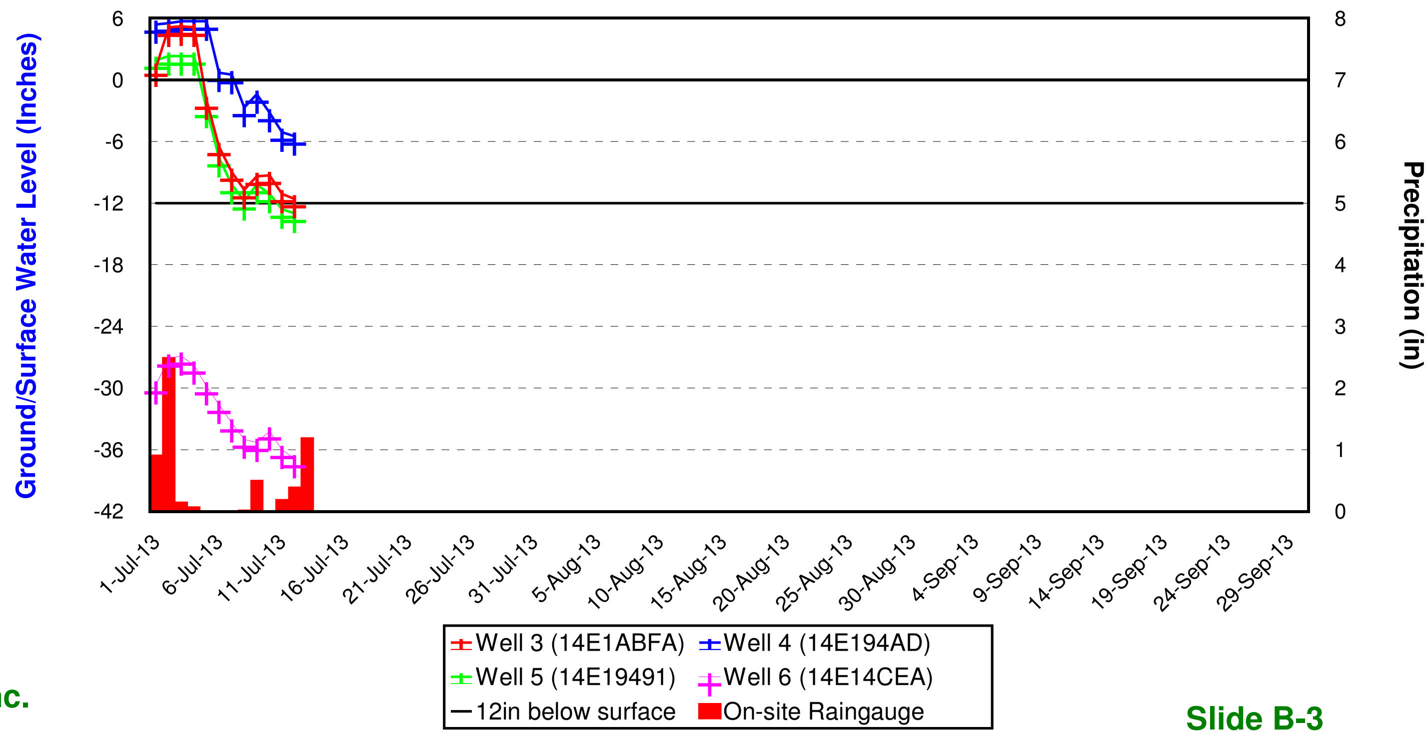

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Hydrology Assessment

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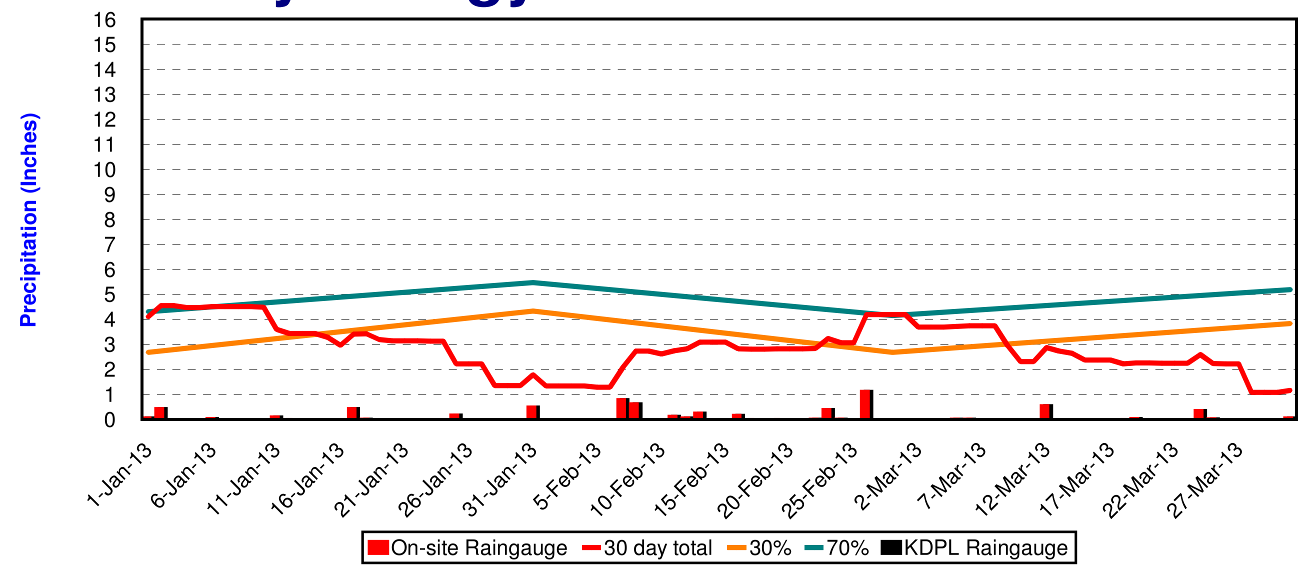
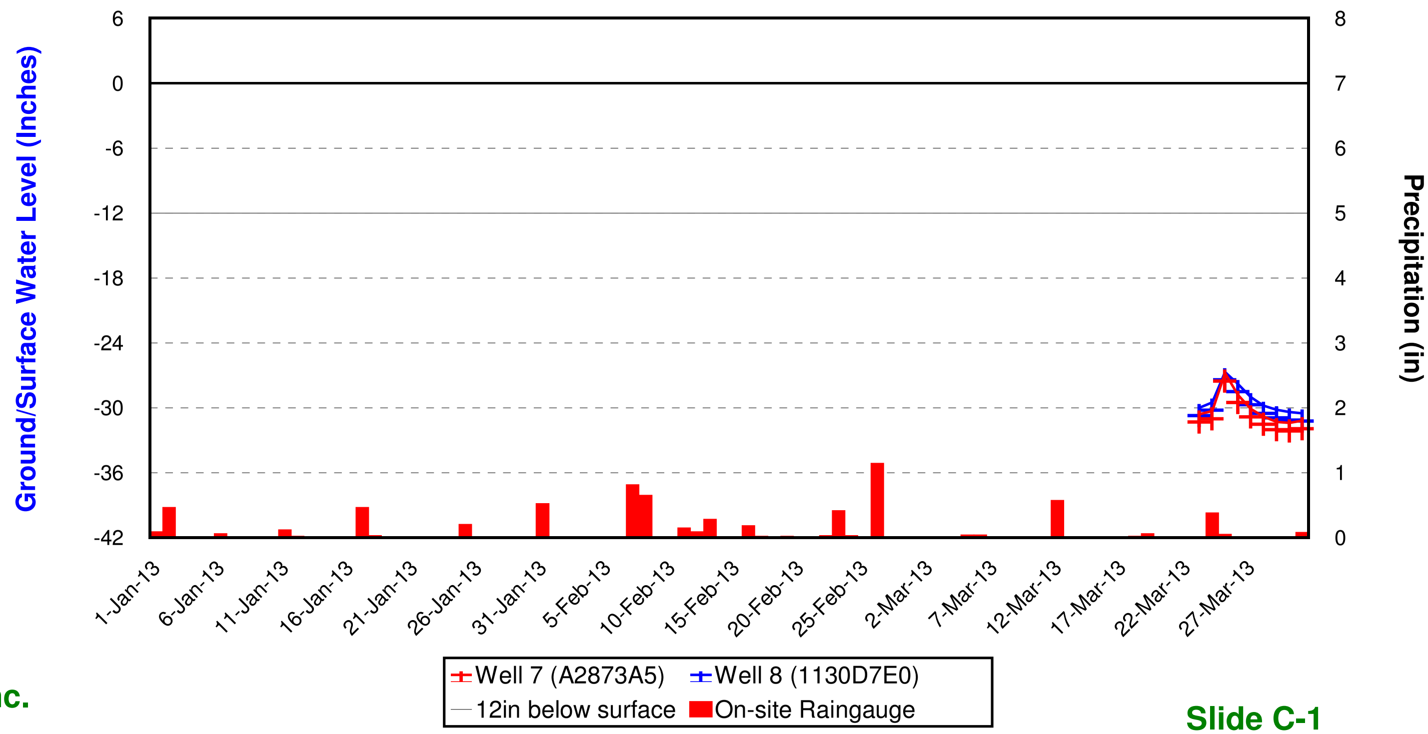


Monitoring Well Record

- UT to Millers Creek
- Duplin County, NC
- 40-13-064
- Wells 7, 8
- Ecotone WM 40
- January 1, 2013 to March 31, 2013
- One reading per day at 7:00 am



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Hydrology Assessment

June 2013

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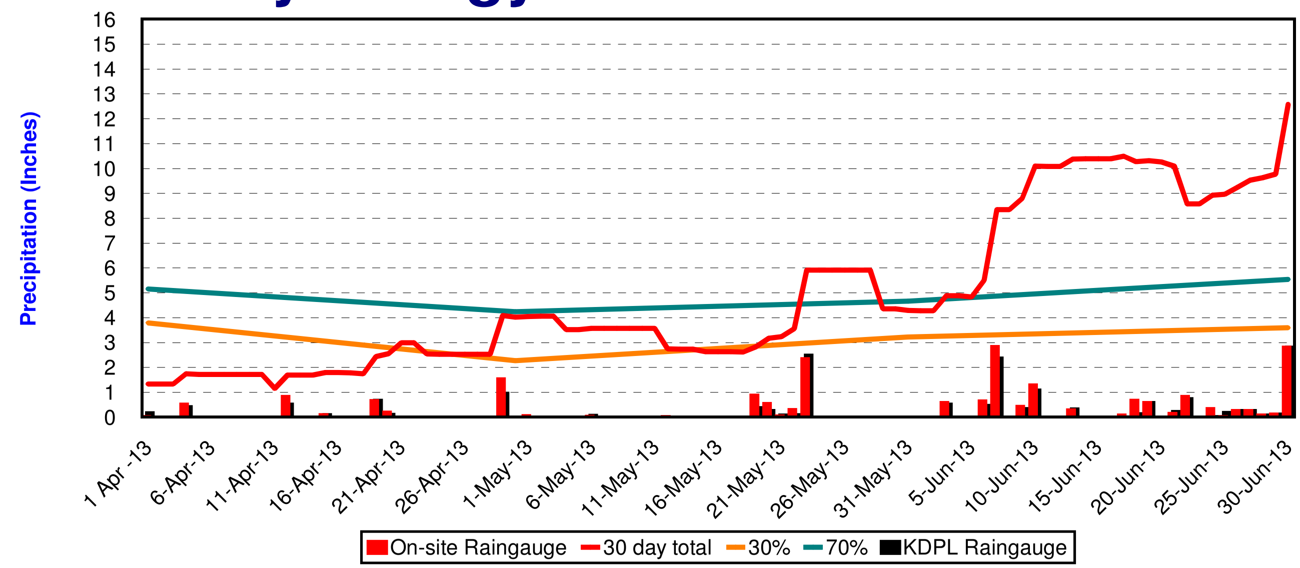

Monitoring Well Record

- UT to Millers Creek
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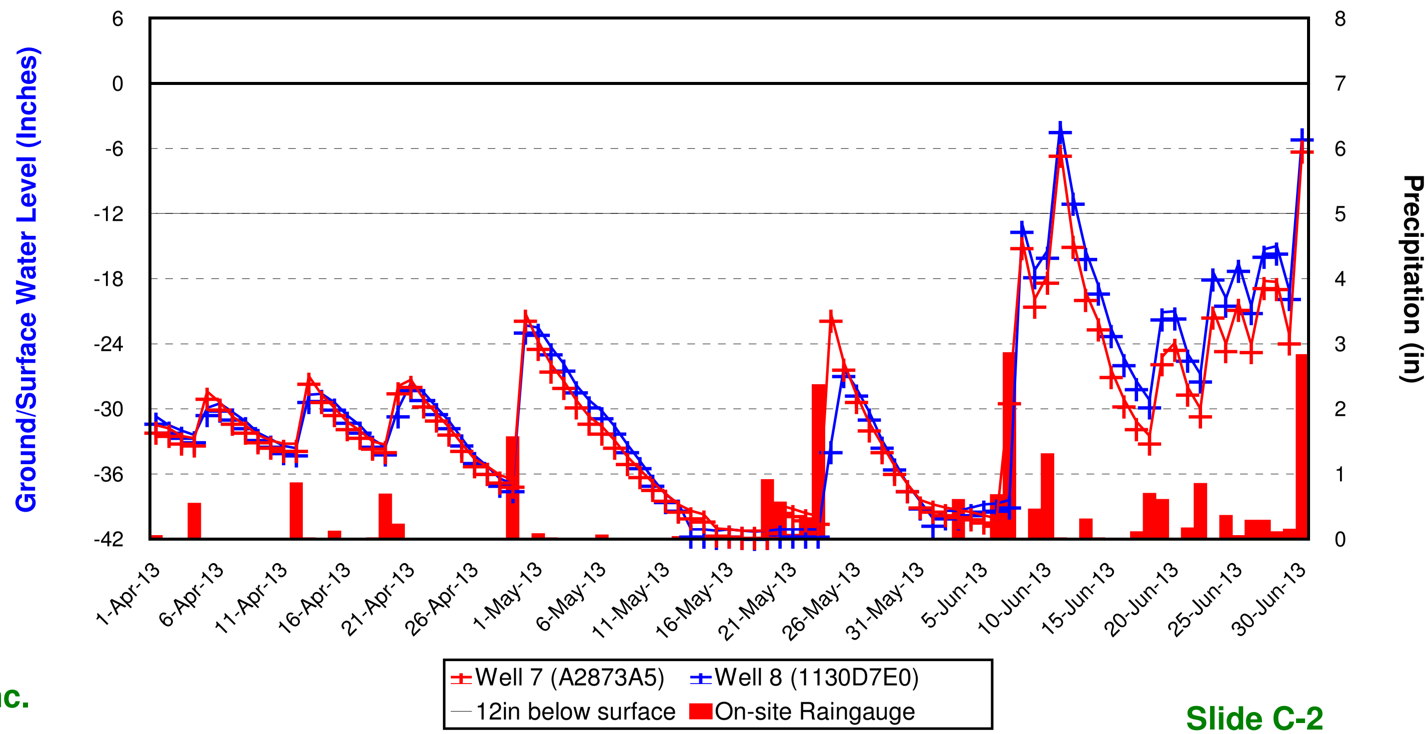

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Hydrology Assessment

September 2013

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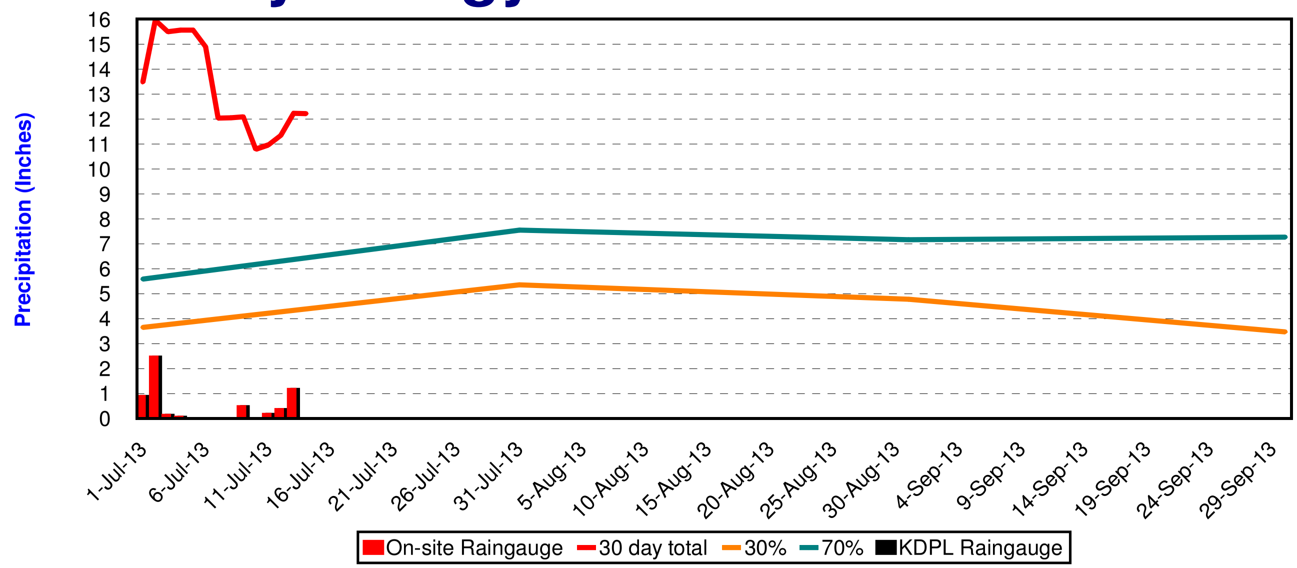

Monitoring Well Record

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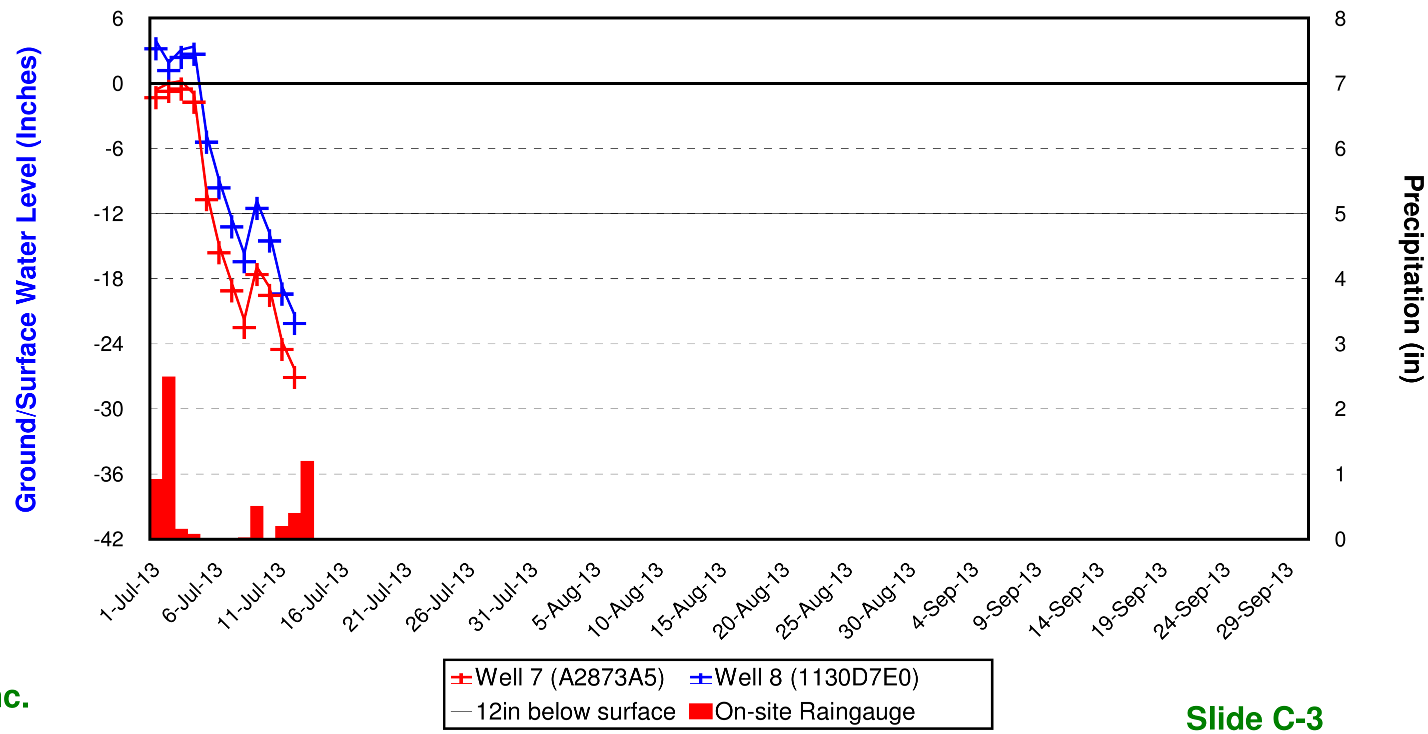

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Hydrology Assessment

March 2013

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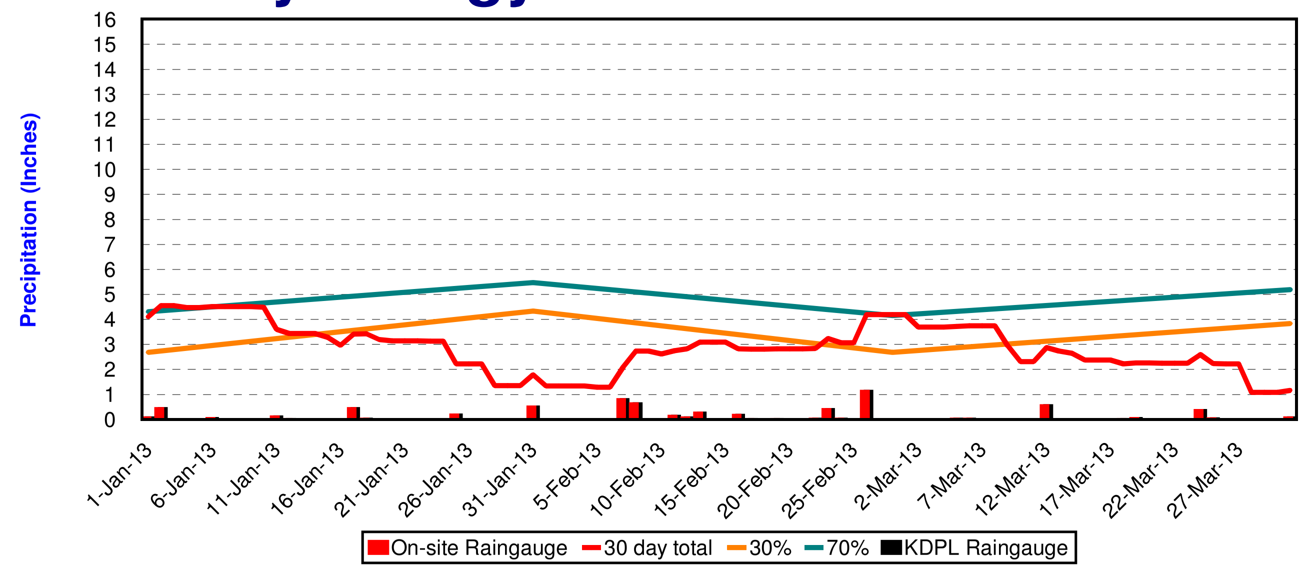

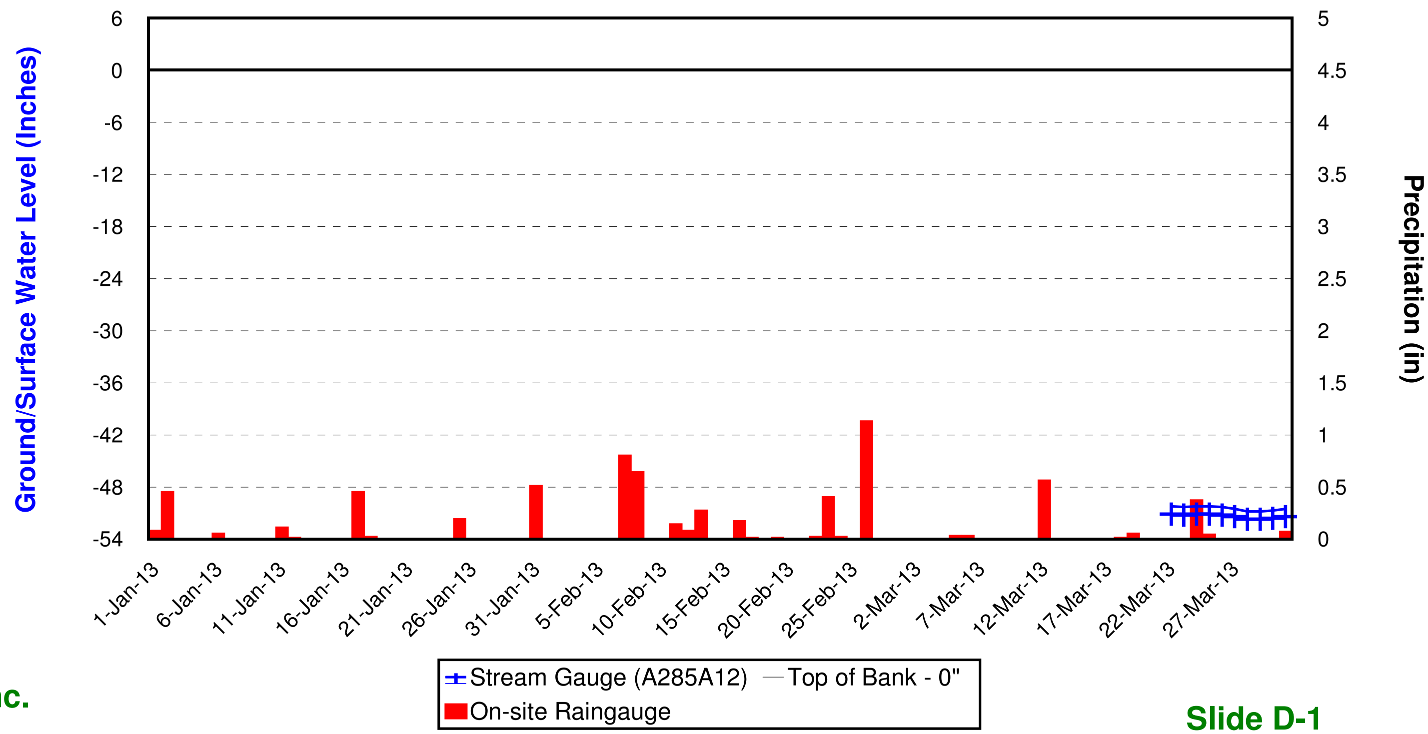

Monitoring Well Record

- UT to Millers Creek
- Duplin County, NC
- 40-13-064
- Stream Gauge
- Ecotone WM 40
- January 1, 2013 to March 31, 2013
- One reading per day at 7:00 am

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Slide D-1

Hydrology Assessment

June 2013

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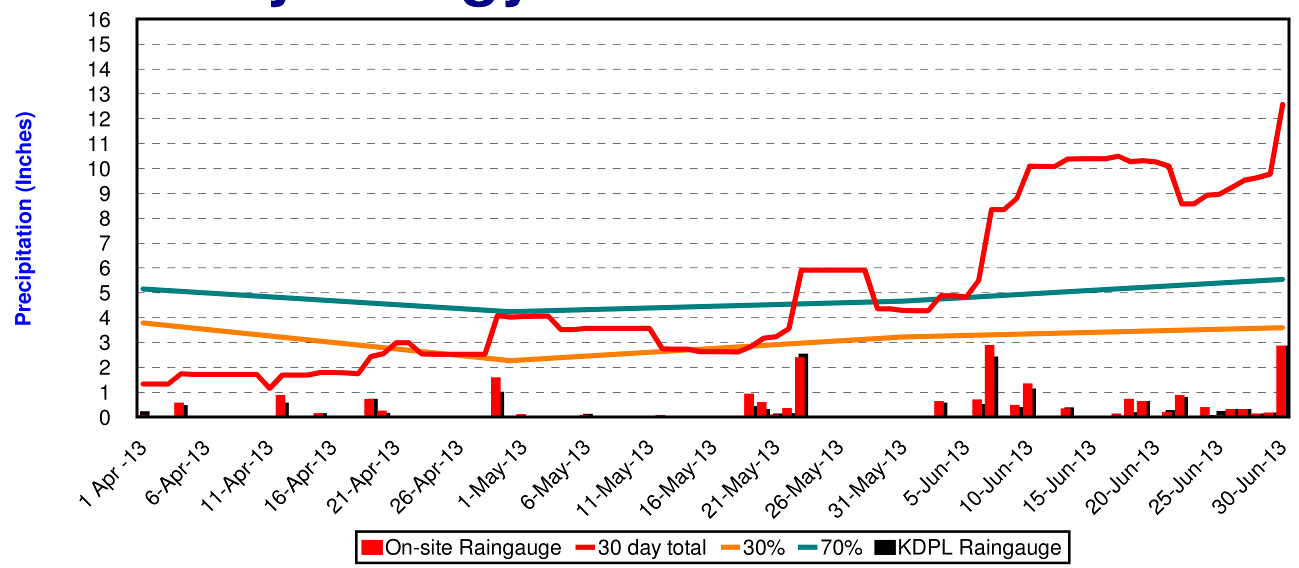

Monitoring Well Record

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- 40-13-064
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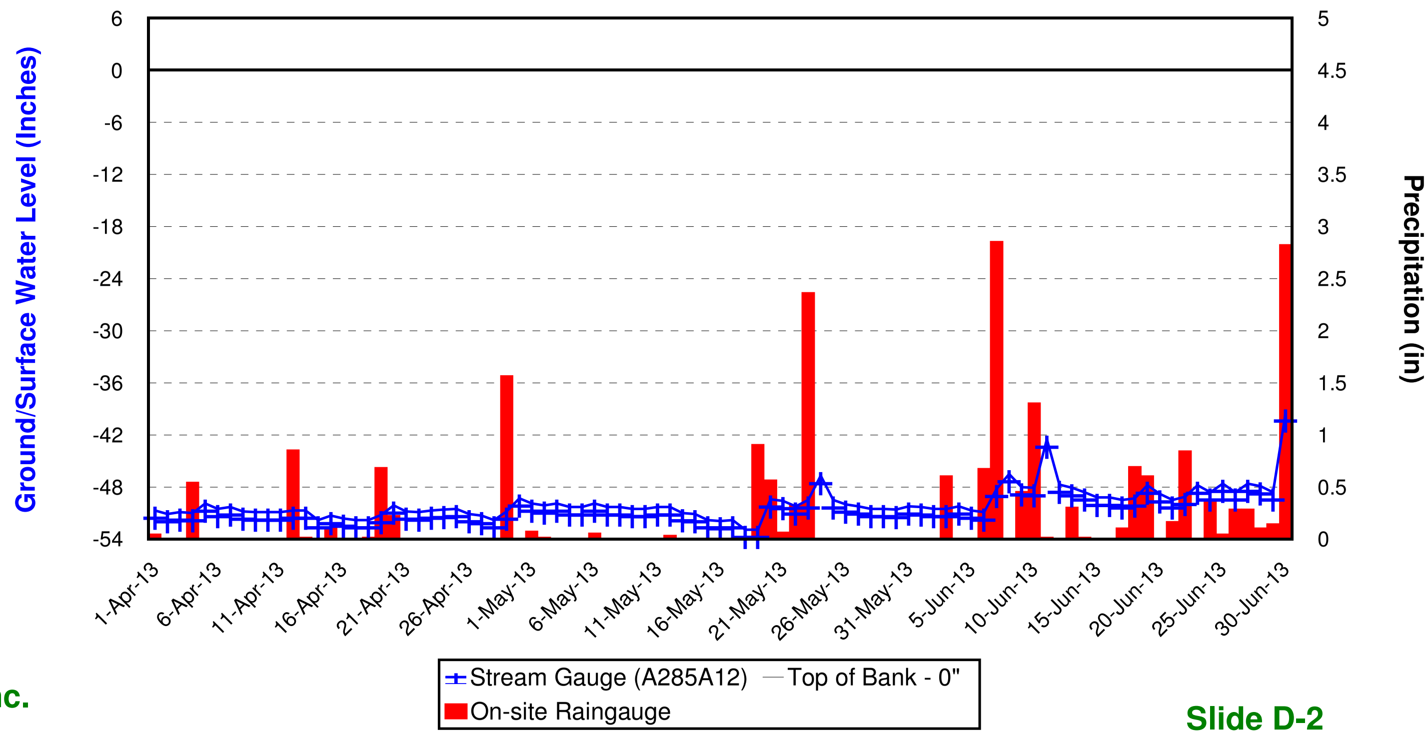

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Slide D-2

Hydrology Assessment

September 2013

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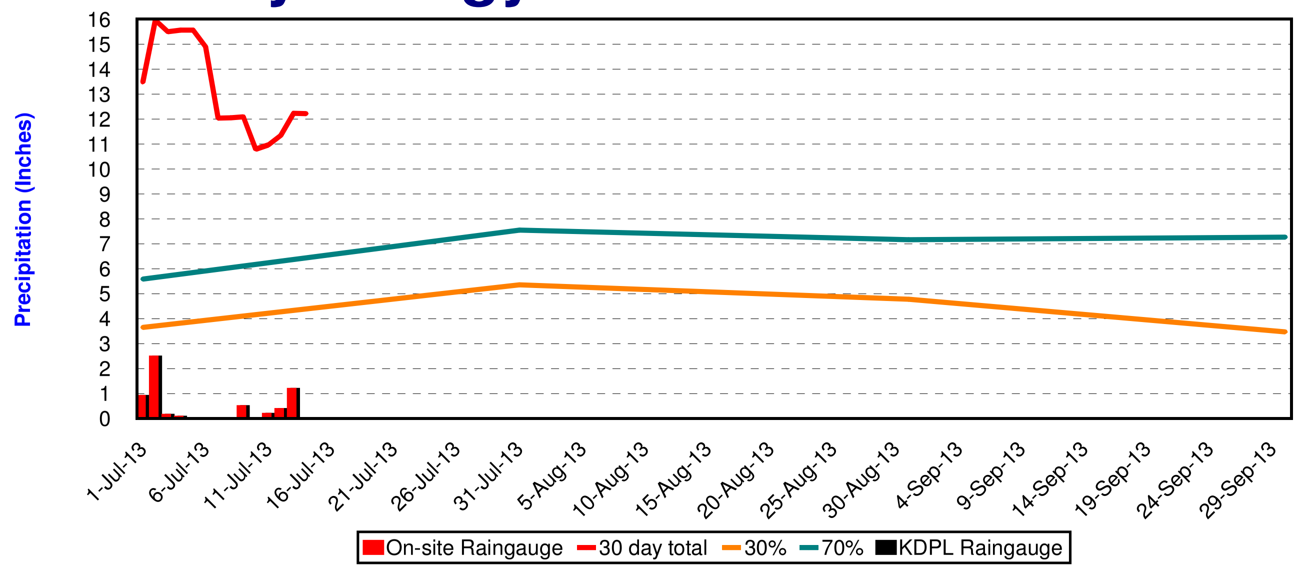

Monitoring Well Record

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- Duplin County, NC
- 40-13-064
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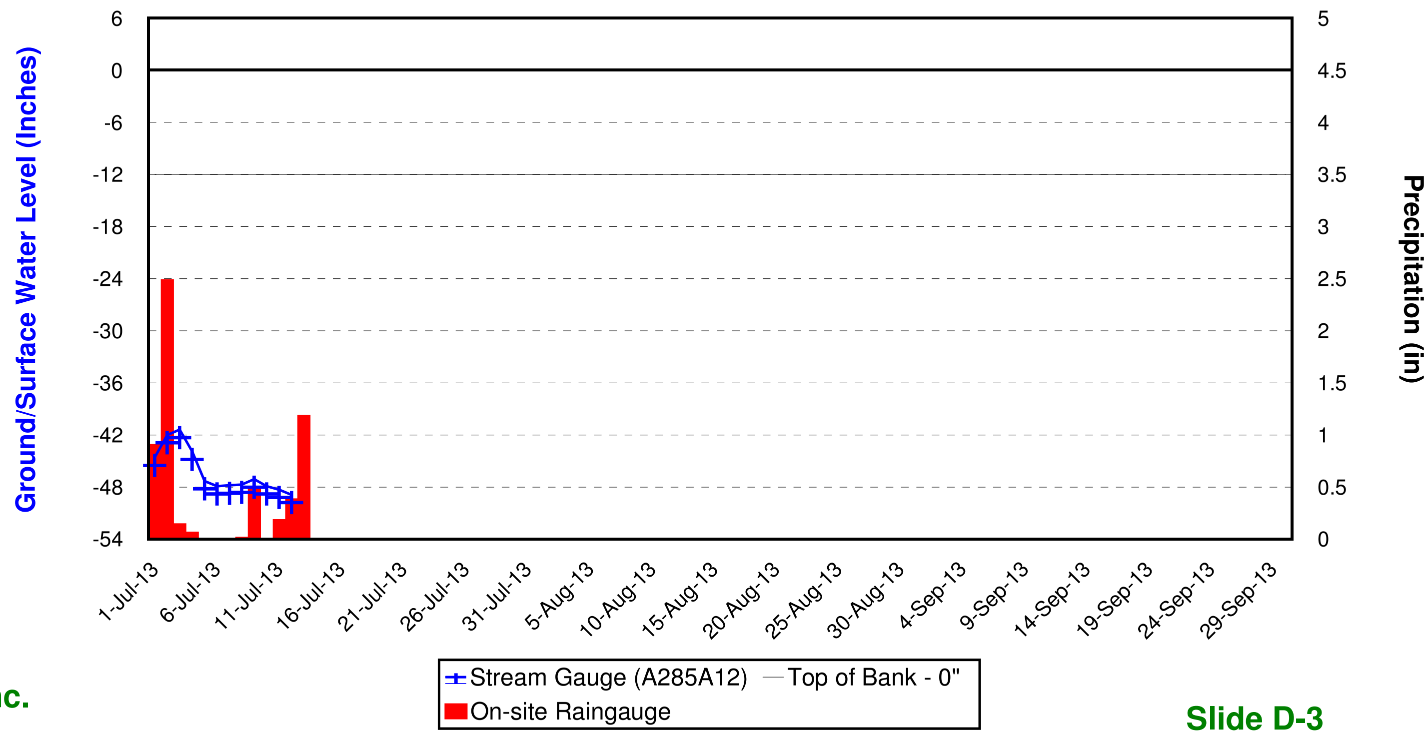

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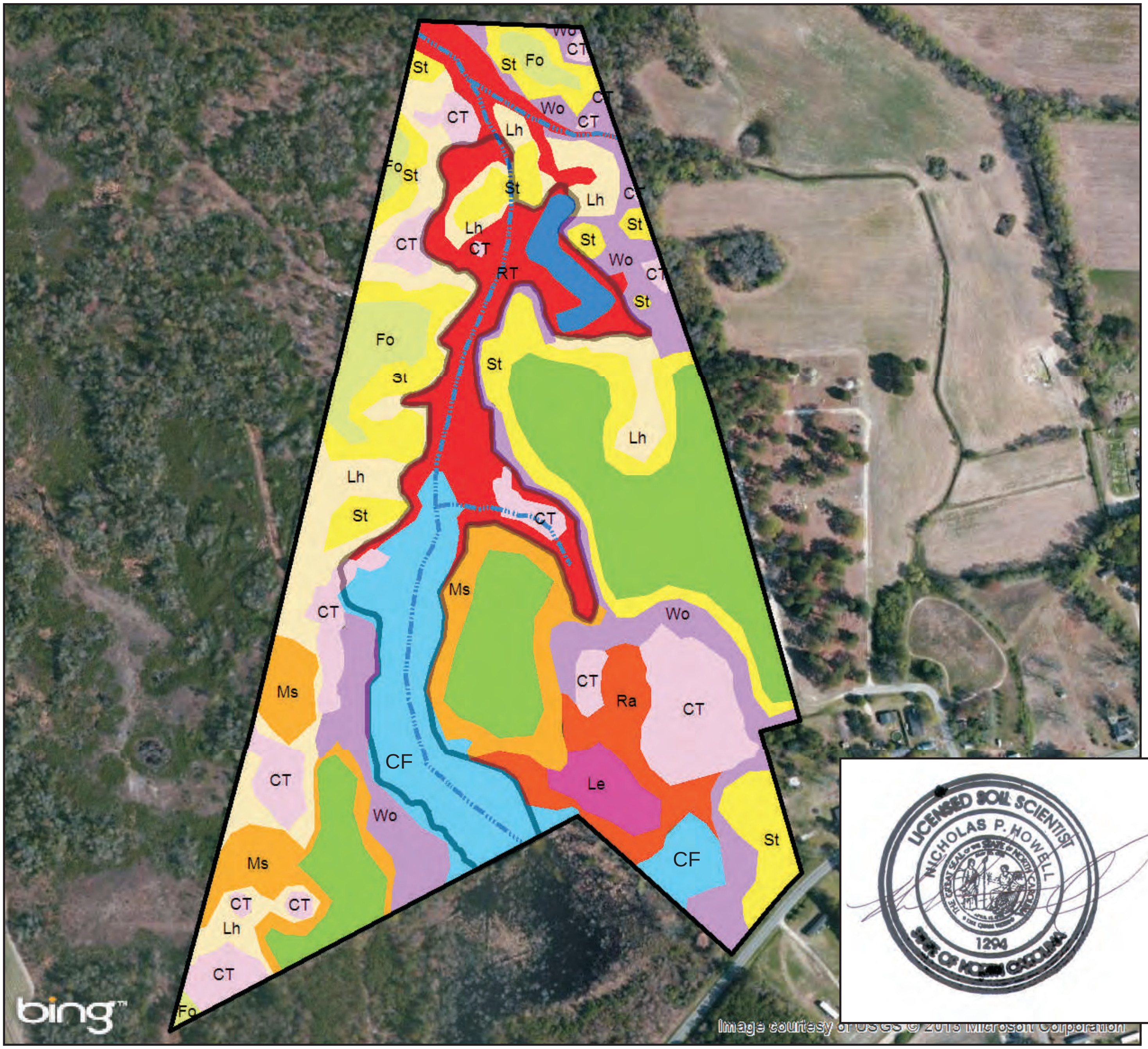
Slide D-3

C.4 Soils Delineation (Professional Soil Scientist)



Series Map Unit	Series Name	Series Description	Drainage Class
Bn	Blanton	Loamy, siliceous, semiactive, thermic Grossarenic Paleudults	Somewhat Excessively Well Drained to Moderately Well Drained
Fo	Foreston	Coarse-loamy ,siliceous, semiactive, thermic Aquic Paleudults	Moderately Well Drained
St	Stallings	Coarse-loamy ,siliceous, semiactive, thermic Aeric Paleaquults	Somewhat Poorly Drained
Le	Lenoir	Fine, mixed, semiactive, thermic Aeric Paleaquults	Somewhat Poorly Drained
Ms*	Mascotte	Sandy over loamy, siliceous, active, thermic Ultic Alaquods	Somewhat Poorly to Poorly Drained Phase
Wo	Woodington	Coarse-loamy, siliceous, semiactive, thermic Typic Paleaquults	Poorly Drained
Ra	Rains	Fine-loamy, siliceous, semiactive, thermic Typic Paleaquults	Poorly Drained
Lh	Lynn Haven	Sandy, siliceous, thermic Typic Alaquods	Poorly to Very Poorly Drained
CF*	Cape Fear	Fine, mixed, semiactive, thermic Arenic Umbraquults	Very Poorly Drained
CT	Croatan	Loamy, siliceous, dysic, thermic Terric Haplosaprists	Very Poorly Drained
RT*	Rutlege-Torhunta Complex	Sandy, siliceous, thermic Typic Humaquepts and Coarse-loamy, siliceous, active, acid, thermic Typic Huaquepts	Very Poorly Drained

*These Series are taxajunct and represent the closest related series to the soils present onsite

NOTE: This is not a survey. All boundaries and distances are considered approximate. This represents a preliminary sketch prepared from field notes.

Riparian Restoration Zone

Existing Channelized Stream

N

SCALE 1" = 400'

L:\WETLANDS\2013 WETLANDS FILES\40-13-064 --- UT to Millers Creek, Ryan Smith

UT to Millers Creek
Magnolia Tract
Florence & Hutcheson
Duplin County, NC
July 2013
40-13-064

LMG
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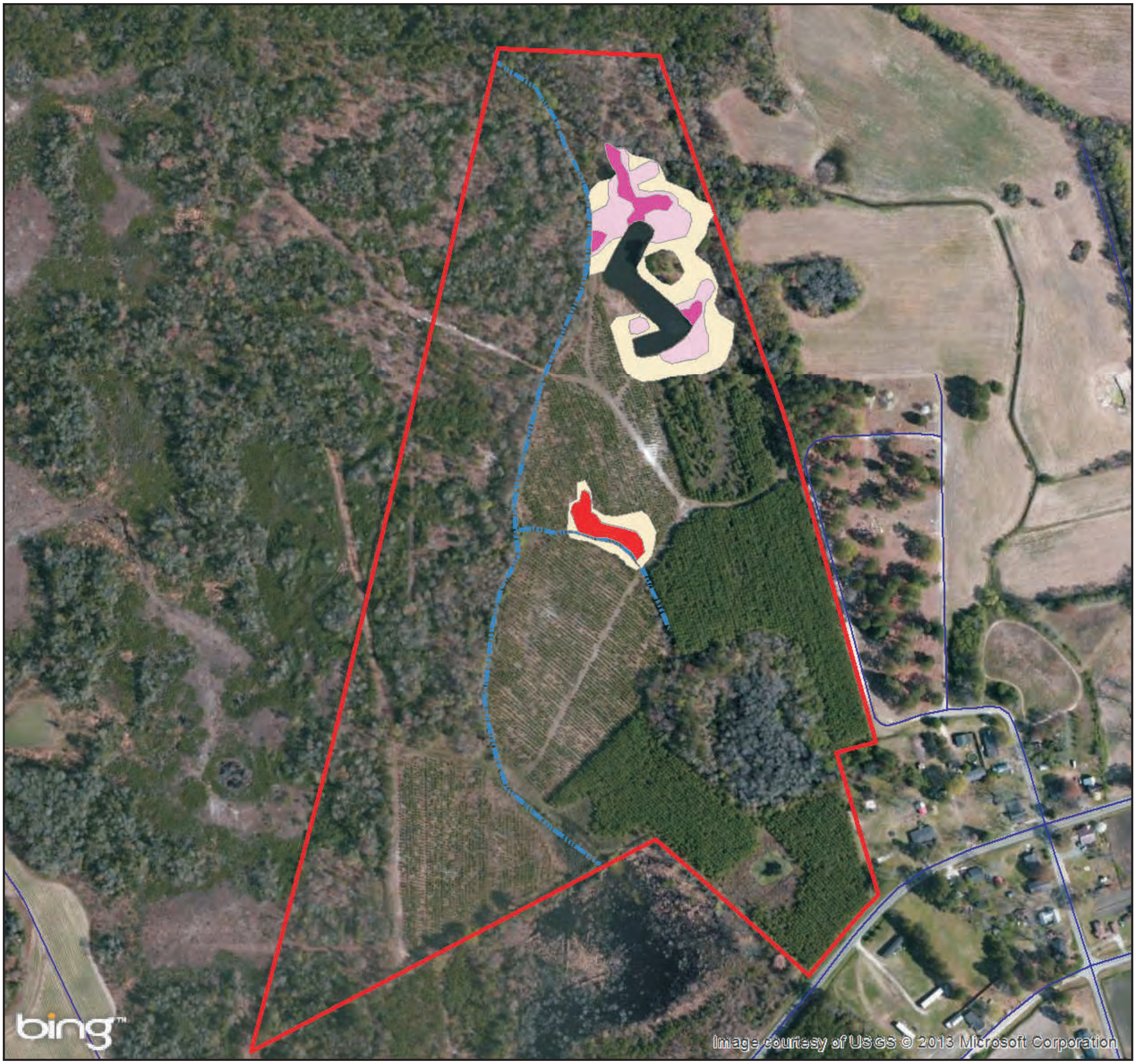
Fax: 910.452.0060
3805 Wrightsville Avenue
Wilmington, NC 28403

Soil Series Map

(Map Source: BING Aerial Photography)

Map Source: BING Aerial Photography

UT to Millers Creek Florence & Hutcheson Magnolia Tract Duplin County, NC March 2013	LMG LAND MANAGEMENT GROUP INC. Environmental Consultants www.LMGroup.net Phone: 910.452.0001 •1.866.LMG.1078 Fax: 910.452.0060 P.O. Box 2522, Wilmington, NC 28402	Soil Boring Locations



- 3 to 4 feet of fill material (~0.27 Acres)
- 2 to 3 feet of fill material (~0.33 Acres)
- 1 to 2 feet of fill material (~0.90 Acres)
- 0 to 1 feet of fill material (~1.88 Acres)

NOTE: This is not a survey. All boundaries and distances are considered approximate. This represents a preliminary sketch prepared from field notes. A survey of delineated areas and review and approval by the US Army Corps of Engineers is recommended prior to specific site planning.

N

L:\WETLANDS\2013 WETLANDS FILES\40-13-064 --- UT to Millers Creek, Ryan Smith
Map Source: BING Aerial Photography

SCALE 1" = 400'

UT to Millers Creek
Florence & Hutcheson
Magnolia Tract
Duplin County, NC
May 2013

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Fill Material Present within the Proposed Riparian Restoration Corridor

Cape Fear EEP 06 Magnolia Site
Detailed Soil Profiles
April 5, 2012

Boring 1

Lynn Haven/Rutlege Complex
A1 – 0-8" 10YR 2/1 65% coated grains, Loamy Sand, granular, very friable, non sticky non plastic.
A2 – 8-18" 10YR 2/1 65% coated grains, Loamy Sand, with %5 2.5Y 6/2 Stripped Matrix reductions @ 12" and 10% 10YR 3/6 iron concentrations @15", granular, very friable non sticky non plastic.
Eg – 18-25" 2.5Y 6/1 Sand, with 10YR 2/1 Organic stains on root channels, granular, very friable non sticky non plastic.
Bw – 25-48"+ 10YR 3/3 Loamy Sand, with 20% 2.5Y 6/2 reductions and 20% 10YR 5/4 iron concretions @25-27", subangular blocky, friable non sticky non plastic.

Boring 2

Lynn Haven/Rutlege Complex
A1 – 0-9" 10YR 2/1 60% coated grains, Loamy Sand granular, very friable, non sticky non plastic.
A2 – 9-19" 10YR 2/1 65% coated grains, Loamy Sand, with 25% 10YR 3/6 iron concentrations, granular, very friable non sticky non plastic.
Eg – 19-26" 2.5Y 5/1 Sand, granular, very friable non sticky non plastic.
Bg – 26-48"+ 2.5Y 4/2 Loamy Sand, subangular blocky, friable non sticky non plastic.

Boring 3

Plummer/Rutlege complex
A1 – 0-7" 10YR 2/1 60% coated grains, Loamy Sand, granular, very friable non sticky non plastic,
A2 – 7-10" 10YR 2/1 65% coated grains, Loamy Sand, 30% 10YR 3/6 iron concentrations, granular, very friable non sticky non plastic.
A3 – 10-19" 10YR 4/2 Loamy Sand, granular, very friable non sticky non plastic,
Bg- 19-30" 2.5Y 4/2 Loamy Sand, common 2.5Y 5/4 Sandy Loam Bodies with 10% 7.5YR 5/8 iron concentrations, subangular blocky friable non sticky non plastic.
Cg 0 30-37" 2.5Y 5/2 Fine Sand, 15% 2.5Y 6/1 depletions, massive, friable non sticky non plastic.
C – 37-48"+ 10YR 5/8 Loamy Fine Sand with common Fine Sandy Loam bodies, 20% 10YR 7/1 stripped sands between large peds, massive parting to coarse subangular blocky, friable non sticky non plastic.

Boring 4
Mascotte Soil Series
A – 0-11" 10YR 3/1 50% Coated Grains, Loamy Sand, granular very friable non sticky non plastic.
Eg -11-19" 2.5Y 5/2, Sand, granular, very friable non sticky non plastic.
Bh – 19-27" 10YR 2/1 weakly cemented Loamy Sand, subangular blocky friable non sticky non plastic.
Btg – 27-48"+ 10YR 4/2 Sandy Loam, with 25% 2.5Y 5/2 reductions and 25% 10YR 3/6 concentrations, subangular blocky friable slightly sticky non plastic.

Boring 5
Rains Soil Series
A – 0-10" 10YR 2/1 slight Muck presence, 65% coated Loamy Sand, granular friable non sticky non plastic.
Eg – 10-16" 10YR 4/2 Sand, granular very friable non sticky non plastic.
Btg1 – 16-21" 10YR 6/1 Sandy Loam, with 5% 10YR 3/6 iron concentrations, subangular blocky, friable slightly sticky non plastic.
Btg2 – 21-36" 10YR 6/1 Sandy Clay Loam, with 20% 10YR 6/6 and 25% 10YR 5/8 iron concentrations, subangular blocky friable slightly sticky slightly plastic.
Btg3 – 36-48" 5Y 5/1 Clay Loam, with 10% 7.5YR 5/8 and 10% 10YR 5/8 iron concentrations, subangular blocky friable, moderately sticky moderately plastic.

Boring 6
Rains Soil Series
A – 0-9" 10YR 3/1 50% coated grains Loamy Sand, granular very friable non sticky non plastic.
Eg – 9-13" 2.5Y 6/2 Loamy Sand, granular very friable non sticky non plastic.
Btg1 – 13-18" 2.5Y 6/2 Sandy Loam with 10% 2.5Y 5/4 iron concentrations, subangular blocky friable slightly sticky non plastic.
Btg2 18-27" 5Y 6/1 Clay Loam, with 15% 10YR 5/8 and 10% 7.5YR 5/8 iron concentrations, subangular blocky, firm, moderately sticky moderately plastic.
BCg – 27-33" 5Y 6/1 Sandy Loam, with 10% 2.5Y 5/4 iron concentrations, subangular blocky, friable slightly sticky non plastic.
Cg – 33-44" 5Y 6/1 Loamy Sand with 5% 2.5Y 5/4 iron concentrations, single grained, loose non sticky non plastic.
Ab – 44-48"+ 10YR 2/1 Loamy Sand with 20% N 2/0 Mucky Sandy Clay Loam bodies, massive, friable non sticky non plastic.

Boring 7

Cape Fear Soil Series

A – 0-7" 10YR 2/1 65% coated grains Sandy Loam, granular friable slightly sticky non plastic.

BEg – 7-10" 2.5Y 4/2 Sandy Loam, granular, very friable non sticky non plastic.

Btg1 – 10-18" 2.5y 5/2 Clay Loam, with 10% 10YR 5/8 iron concentrations @13" subangular blocky, firm, moderately sticky moderately plastic.

Btg2 – 18-27" 5Y 6/2 Clay, with 15% 7/5YR 5/8 iron concentrations, subangular blocky firm moderately sticky moderately plastic.

Btg3 – 27-45" 5Y 6/1 Clay, 10% 10YR 5/8 and 5% 7.5YR 5/8 iron concentrations massive parting to very coarse subangular blocky, firm, very sticky very plastic.

Ab – 45-48" N 2/0 Mucky Sandy Clay Loam, massive, friable moderately sticky slightly plastic.

Boring 8

Lynn Haven / Rutlege Complex

A – 0-7" 10YR 3/1 60% coated grains, Loamy Sand, granular, very friable non sticky non plastic.

Eg – 7-12" 2.5Y 5/2 Sand, granular, very friable non sticky non plastic.

Bh – 12-17" 10YR 3/2 weakly cemented Loamy Sand, subangular blocky friable non sticky non plastic

Bg – 17-48"+ 10YR 4/2 Loamy Sand, subangular blocky, friable non sticky non plastic.

Borings Collected and Described By:

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LOCATION RUTLEGE SC+FL GA NC

Established Series
BNS,RLV, Rev. MHC
05/2003

RUTLEGE SERIES

MLRA(s): 133A, 153A, 153B
MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Raleigh, North Carolina
Depth Class: very deep
Drainage Class (Agricultural): very poorly drained
Internal Free Water Occurrence: very shallow, persistent
Index Surface Runoff: negligible
Permeability: rapid
Landscape: lower and middle coastal plain
Landform: flats, depressions, flood plains
Geomorphic Component: talfs, dips, treads
Parent Material: marine or fluvial sediments
Slope: 0 to 2 percent
Elevation (type location):
Mean Annual Air Temperature (type location): 63 degrees F.
Mean Annual Precipitation (type location): 45 inches

TAXONOMIC CLASS: Sandy, siliceous, thermic Typic Humaquepts

TYPICAL PEDON: Rutlege loamy sand - forested.

A--0 to 15 inches; black (10YR 2/1) loamy sand; weak medium granular structure; loose; common fine and medium roots; very strongly acid; gradual smooth boundary. (Combined thickness of the A horizon is 10 to 24 inches)

Cg1--15 to 35 inches; dark gray (10YR 4/1) sand; single grain; loose; few fine roots; very strongly acid; gradual wavy boundary.

Cg2--35 to 70 inches; grayish brown (10YR 5/2) sand; single grain; loose; few fine roots in upper part; tends to flow when saturated; very strongly acid.

TYPE LOCATION: Marion County, South Carolina; 1.25 miles north of Nichols and 500 feet east of S. C. Highway 9 .

RANGE IN CHARACTERISTICS:
Depth to Bedrock: Greater than 60 inches
Depth to Seasonal High Water Table: 0 to 6 inches, December to May
Soil Reaction: extremely acid to strongly acid, except where limed

Other Features: Silt plus clay in the 10 to 40 inch control section averages 5 to 15 percent

RANGE OF INDIVIDUAL HORIZONS:

A horizon:
Color--hue of 10YR to 5Y, value of 2 or 3, and chroma of 0 to 2
Texture (fine-earth fraction)-- sand, fine sand, loamy sand, or loamy fine sand and their mucky analogues

Cg horizon:
Color--hue of 10YR to 5Y, value of 4 to 7, and chroma of 0 to 2
Texture (fine-earth fraction)-- sand, loamy sand, fine sand, or loamy fine sand
Redoximorphic features (if they occur)-- have value of 5 to 8, and chroma of 1 to 6

COMPETING SERIES:
Cadelake soils - have Bg horizons and on average have less organic matter in the umbric epipedon

There are no other known series in the same family. The Dawhoo, Johnston, Osier, Pickney, Plummer, Lynn Haven, Scarboro, and Torhunta series are similar soils in related families. Dawhoo soils have mixed mineralogy. Johnston and Pickney soils have umbric epipedons that are more than 24 inches thick. Osier and Plummer soils do not have an umbric epipedon. The Lynn Haven soils have spodic horizons. Scarboro soils have average annual soil temperatures of 47 to 59 degrees F. Torhunta soils have sandy loam or fine sandy loam texture in the particle-size control section.

GEOGRAPHIC SETTING:
Landscape: Coastal Plain
Landform: upland flats or depressions, flood plains
Geomorphic Component: talfs, dips, treads
Parent Material: marine or fluvial sediments
Elevation: 0 to 300 feet
Mean Annual Air Temperature: 59 to 70 degrees
Mean Annual Precipitation: 38 to 60 inches
Frost Free Period: 190 to 300 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Alaga soils-- are well drained and do not have an umbric horizon
Blanton soils-- have an argillic horizon and do not have an umbric horizon
Chipley soils-- moderately well drained and do not have an umbric horizon
Dragston soils-- have an argillic horizon and do not have an umbric horizon
Johnston soils-- have umbric epipedons that are more than 24 inches thick
Lakeland soils-- are excessively drained and do not have an umbric horizon
Leon soils-- have a spodic horizon and do not have an umbric horizon
Lynn Haven soils -- have spodic horizons
Pelham soils-- have an argillic horizon and do not have an umbric horizon
Plummer soils-- have an argillic horizon and do not have an umbric horizon
Rimini soils-- have a spodic horizon and do not have an umbric horizon
Rumford soils-- have an argillic horizon and do not have an umbric horizon

DRAINAGE AND PERMEABILITY:
Drainage Class (Agricultural): very poorly drained
Internal Free Water Occurrence: very shallow, persistent
Index Surface Runoff: negligible, ponding is common in depressional areas
Permeability: rapid

USE AND VEGETATION:
Major Uses: truck crops, forest
Dominant Vegetation: Where cultivated-- for corn, soybeans, blueberries, hay and pasture. Where wooded--blackgum, Carolina ash, red maple, sweetbay, tulip popular, water oak, pin oak, pond pine, slash pine, and loblolly pine. The understory is huckleberry, wax myrtle, greenbriar, grasses and sedges. Some ponded areas consist of entirely grasses and sedges.

DISTRIBUTION AND EXTENT:
Distribution: Virginia, North Carolina, South Carolina, Georgia, Florida
Extent: large

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Raleigh, North Carolina

SERIES ESTABLISHED: Camburton Soil Conservation District, New Jersey, 1943.

REMARKS: This revision changes the type location from Maryland to South Carolina to meet the temperature requirements for thermic. Diagnostic horizons and features recognized in this pedon are:

Umbric epipedon--The zone from the surface of the soil to a depth of 15 inches (A horizon).

ADDITIONAL DATA:

TABULAR SERIES DATA:

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SOI-5  Soil Name    Slope   Airtemp FrFr/Seas Precip  Elevation
SC0148 RUTLEGE      0-  2    59- 70  190-300  38- 60     0- 300
SC0149 RUTLEGE      0-  2    59- 70  190-300  38- 60     0- 300


SOI-5  FloodL FloodH Watertable Kind    Months   Bedrock Hardness
SC0148 NONE   COMMON   0-0.5   APPARENT DEC-MAY   60-60
SC0149 NONE              -     APPARENT    -      60-60


SOI-5  Depth  Texture                3-Inch  No-10  Clay%   -CEC-
SC0148  0-18  LS LFS                  0-  0  95-100  2-10  20- 30
SC0148  0-18  MK-S MK-FS MK-LS        0-  0  95-100  2-10  25- 35
SC0148  0-18  S FS                    0-  0  95-100  2-10  20- 30
SC0148 18-60  S LS LFS                0-  0  95-100  2-10   2-  6
SC0149  0-18  LS LFS                  0-  0  95-100  2-10  20- 30
SC0149  0-18  S FS                    0-  0  95-100  2-10  20- 30
SC0149  0-18  MK-S MK-FS MK-LS        0-  0  95-100  2-10  25- 35
SC0149 18-60  S LS LFS                0-  0  95-100  2-10   2-  6


SOI-5  Depth    -pH-     O.M.  Salin  Permeab    Shnk-Swll
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SC0148	0-18	3.6- 5.5	3.-9.	0- 0	6.0-	20	LOW
SC0148	0-18	3.6- 5.5	10-20	0- 0	6.0-	20	LOW
SC0148	0-18	3.6- 5.5	3.-9.	0- 0	6.0-	20	LOW
SC0148	18-60	3.6- 5.5	.5-3.	0- 0	6.0-	20	LOW
SC0149	0-18	3.6- 5.5	3.-9.	0- 0	6.0-	20	LOW
SC0149	0-18	3.6- 5.5	3.-9.	0- 0	6.0-	20	LOW
SC0149	0-18	3.6- 5.5	10-20	0- 0	6.0-	20	LOW
SC0149	18-60	3.6- 5.5	.5-3.	0- 0	6.0-	20	LOW

National Cooperative Soil Survey
U.S.A.

LOCATION RAINS SC+AL FL GA NC VA

Established Series
DJD-CMO/Rev. JAK
09/2006

RAINS SERIES

MLRA(s): 133A-Southern Coastal Plain, 153A-Atlantic Coast Flatwoods, 137-Carolina and Georgia Sand Hills
MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Raleigh, North Carolina
Depth Class: Very deep
Drainage Class (Agricultural): Poorly drained
Internal Free Water Occurrence: Very shallow, persistent
Flooding Frequency and Duration: None, very rare, rare, occasional, frequent for brief to
Ponding Frequency and Duration: None
Index Surface Runoff: Negligible
Permeability: Moderate (Saturated Hydraulic Conductivity: Moderately high
Shrink-Swell Potential: Low
Landscape: Lower, middle, upper coastal plain
Landform: Flats, depressions, Carolina bays
Geomorphic Component: Talfs, dips
Parent Material: Marine deposits, fluviomarine deposits
Slope: 0 to 2 percent
Elevation (type location): Unknown
Mean Annual Air Temperature (type location): 62 degrees F.
Mean Annual Precipitation (type location): 45 inches

TAXONOMIC CLASS: Fine-loamy, siliceous, semiactive, thermic Typic Paleaquults

TYPICAL PEDON: Rains loamy sand--forested. (Colors are for moist soil, unless otherwise indicated.)

A--0 to 7 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many fine and medium roots; very strongly acid; clear smooth boundary. (4 to 10 inches thick)

Eg--7 to 12 inches; light brownish gray (10YR 6/2) sandy loam; weak fine granular structure; very friable; many fine and few medium roots; many fine pores; few fingers of A horizon in upper part; very strongly acid; clear wavy boundary. (0 to 11 inches thick)

Btg1--12 to 20 inches; gray (10YR 6/1) sandy loam; weak coarse subangular blocky structure; friable; few fine and medium roots; many fine pores; many clay bridging between sand grains; few medium prominent yellowish brown (10YR 5/6) masses of oxidized iron in lower half; very strongly acid; gradual wavy boundary.

Btg2--20 to 40 inches; gray (10YR 6/1) sandy clay loam; weak medium subangular blocky structure; friable;

few fine and medium roots; many fine pores; few faint clay films on faces of peds; few coarse pockets of gray sandy loam; common medium prominent yellowish brown (10YR 5/6) masses of oxidized iron; few fine prominent red (2.5YR 4/6) masses of oxidized iron; very strongly acid; gradual wavy boundary.

Btg3--40 to 52 inches; gray (10YR 6/1) sandy clay loam; weak medium subangular blocky structure; firm; few fine pores; few faint clay films on faces of peds; few fine and medium prominent red (2.5YR 4/6) and yellowish brown (10YR 5/6) masses of oxidized iron; very strongly acid; gradual wavy boundary.

Btg4--52 to 62 inches; gray (10YR 6/1) sandy clay loam; weak medium subangular blocky structure; friable; few faint clay films on faces of peds; few medium prominent brownish yellow (10YR 6/6) masses of oxidized iron; very strongly acid; gradual wavy boundary. (Combined thickness of the Btg horizon is more than 40 inches.)

BCg--62 to 79 inches; gray (10YR 6/1) sandy clay loam; weak coarse subangular blocky structure; friable; few fine distinct brownish yellow (10YR 6/6) masses of oxidized iron; very strongly acid; gradual wavy boundary. (0 to 20 inches thick)

2Cg--79 to 85 inches; light gray (10YR 7/1) sand; single grain; loose; very strongly acid.

TYPE LOCATION: Florence County, South Carolina; about 2.0 miles southeast of Timmonsville; 1.1 miles south of intersection of State Highway 45 and U.S. Highway 76; 150 feet west of State Highway 45.

RANGE IN CHARACTERISTICS:
Thickness of the surface and subsurface layers: 4 to 19 inches
Depth to top of the argillic horizon: 4 to 19 inches
Depth to the base of the argillic horizon: 60 to more than 80 inches
Depth to bedrock: Greater than 80 inches
Depth to seasonal high water table: 0 to 12 inches, December to April
Rock fragment content: 0 to 5 percent throughout
Soil reaction: Extremely acid to strongly throughout, unless limed
Depth to lithologic discontinuity (abrupt textural change): Greater than 40 inches
Other soil features--The upper 20 inches of the argillic horizon has less than 30 percent silt.

RANGE OF INDIVIDUAL HORIZONS:
A horizon or Ap horizon (where present):
Color--hue of 10YR or 2.5Y, value of 2 to 5, chroma of 1 to 2, or is neutral with value of 2 to 5
Texture--sand, loamy coarse sand, loamy sand, loamy fine sand, coarse sandy loam, sandy loam, fine sandy loam, very fine sandy loam, or loam

Eg horizon:
Color--hue of 10YR to 5Y, value of 4 to 7, chroma of 0 to 2, or is neutral with value of 4 to 7
Texture--sand, loamy coarse sand, loamy sand, loamy fine sand, coarse sandy loam, sandy loam, fine sandy loam, very fine sandy loam, or loam
Redoximorphic features (where present)--iron depletions in shades of brown, yellow, olive, or gray and masses of oxidized iron or iron-manganese masses in shades of red, yellow, or brown

Btg horizon:

Color--hue of 10YR to 5Y, value of 4 to 7, chroma of 1 to 2, or is neutral with value of 4 to 7
Texture--typically, sandy clay loam or clay loam and includes sandy loam, fine sandy loam, or loam in the upper part and sandy clay in the lower part.
Redoximorphic features--iron depletions in shades of brown, yellow, olive, or gray and masses of oxidized iron or iron-manganese masses in shades of red, yellow, or brown

BCg horizon or BCtg horizon (where present):
Color--hue of 10YR to 5Y, value of 4 to 7, chroma of 1 to 2, or is neutral with value of 4 to 7
Texture--sandy loam, fine sandy loam, sandy clay loam, or sandy clay
Redoximorphic features--iron depletions in shades of brown, yellow, olive, or gray and masses of oxidized iron or iron-manganese masses in shades of red, yellow, or brown

Cg horizon (where present):
Color--hue of 10YR to 5Y, value of 4 to 7, chroma of 1 or 2, or is neutral with value of 4 to 7
Texture--coarse sandy loam, sandy loam, fine sandy loam, loam, sandy clay loam, or clay loam, and may be stratified with finer or coarser-textured materials
Redoximorphic features--iron depletions in shades of brown, yellow, olive, or gray and masses of oxidized iron or iron-manganese masses in shades of red, yellow, or brown

2Cg horizon:
Color--hue of 10YR to 5Y, value of 4 to 7, chroma of 1 or 2, or is neutral with value of 4 to 7
Texture--coarse sand, sand, fine sand, loamy coarse sand, or loamy sand and may be stratified with finer-textured material

COMPETING SERIES: None

GEOGRAPHIC SETTING:
Landscape: Lower, middle, upper coastal plain
Landform: Flats, depressions, Carolina bays
Geomorphic Component: Talfs, dips
Parent Material: Marine deposits, fluviomarine deposits
Elevation: 40 to 450 feet
Mean Annual Air Temperature: 57 to 70 degrees F.
Mean Annual Precipitation: 35 to 55 inches
Frost Free Period: 190 to 245 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Chipley soils--do not have an argillic horizon
Coxville soils---have more than 35 percent clay in the top 20 inches of the Bt horizon
Dunbar soils--have more than 35 percent clay in the top 20 inches of the Bt horizon
Goldsboro soils--have dominant chroma of 3 or more between the base of the A or Ap horizons and depths of 30 inches
Lynchburg soils--have higher chroma between the base of the A or Ap
horizon and a depth of 30 inches
Noboco soils--are better drained and have a seasonal high water table at 30 to 40 inches below the soil surface
Norfolk soils--are better drained and have a seasonal high water table at more than 40 inches below the soil surface

Ocilla soils--have sandy A and E horizons more than 20 inches thick
Pantego soils--have an umbric epipedon
Paxville soils--have an umbric epipedon
Pelham soils--have sandy A and E horizons more than 20 inches thick
Scranton soils--do not have an argillic horizon
Stallings soils--have less than 18 percent clay in the top 20 inches of the Bt horizon
Woodington soils--have less than 18 percent clay in the top 20 inches of the Bt horizon

DRAINAGE AND PERMEABILITY:
Depth Class: Very deep
Drainage Class (Agricultural): Poorly drained
Internal Free Water Occurrence: Very shallow, persistent
Flooding Frequency and Duration: None, very rare, rare, occasional, frequent for brief to
Ponding Frequency and Duration: None
Index Surface Runoff: Negligible
Permeability: Moderate (Saturated Hydraulic Conductivity: Moderately high
Shrink-Swell Potential: Low

USE AND VEGETATION:
Major Uses: Forest, cropland
Dominant Vegetation: Where cultivated--corn, soybeans, and small grains. Where wooded--pond pine, loblolly pine, and hardwoods.

DISTRIBUTION AND EXTENT:
Distribution: Alabama, Florida, Georgia, North Carolina, South Carolina, and Virginia
Extent: Large

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Raleigh, North Carolina

SERIES ESTABLISHED: Berkeley County, South Carolina, 1948

REMARKS: The central concept for the Rains series does not include a flooding hazard. However, the series has been correlated in flood plain positions. Additional research is needed to determine if areas of Rains soils that are subject to flooding have haplic or pale clay distribution.

Diagnostic horizons, soil characteristics, and special features recognized in this pedon:
Ochric epipedon--the zone from the surface of the soil to 12 inches (A, E horizons)
Argillic horizon--the zone from 12 to 62 inches (Btg1, Btg2, Btg3, and Btg4 horizons)
Aquults feature--dominant chroma of 1 in the matrix of the argillic horizon, with masses of oxidized iron
Aquic conditions--periodic saturation and reduction in a zone from 0 to 80 inches of the soil surface at some time during the year (endosaturation)
Lithologic discontinuity--abrupt textural change starting at a depth of 79 inches (2Cg horizon)

ADDITIONAL DATA:

TABULAR SERIES DATA:

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SOI-5  Soil Name   Slope  Airtemp FrFr/Seas  Precip  Elevation
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FL0129	RAINS	0-2	-	-	-	-
SC0020	RAINS	0-2	57-70	190-245	38-52	40-450
SC0102	RAINS	0-2	57-70	190-225	38-52	300-450
SC0116	RAINS	0-2	57-70	190-245	38-52	40-450

SOI-5	FloodL	FloodH	Watertable	Kind	Months	Bedrock	Hardness
FL0129	NONE		0-1.0	APPARENT	JUN-JAN	>80	-
SC0020	NONE		0-1.0	APPARENT	NOV-APR	>80	-
SC0102	NONE		0-1.0	APPARENT	NOV-MAR	>80	-
SC0116	COMMON		0-1.0	APPARENT	NOV-APR	>80	-

SOI-5	Depth	Texture	3-Inch	No-10	Clay%	-CEC-
FL0129	0-12	S FS	0- 0	98-100	2-5	-
FL0129	12-62	SCL	0- 0	98-100	18-35	-
FL0129	62-85	LS LFS SL	0- 0	95-100	2-15	-
SC0020	0-12	LS LFS S	0- 0	95-100	2-10	1-4
SC0020	0-12	SL FSL VFSL	0- 0	95-100	5-20	1-5
SC0020	0-12	L	0- 0	95-100	7-27	2-6
SC0020	12-40	FSL SCL SL	0- 0	95-100	18-35	2-5
SC0020	40-62	SCL CL SC	0- 0	98-100	18-40	2-7
SC0020	62-79	SL SCL SC	0- 0	95-100	15-45	1-6
SC0102	0-14	SL	0- 2	95-100	5-20	1-5
SC0102	14-36	SCL SL	0- 2	90-100	18-35	2-5
SC0102	36-46	CEM	-	-	-	-
SC0116	0-12	SL FSL	0- 0	92-100	5-20	1-5
SC0116	0-12	VFSL L	0- 0	92-100	7-24	1-6
SC0116	12-40	SCL CL	0- 0	95-100	18-35	2-5
SC0116	40-62	SCL CL SC	0- 0	95-100	18-40	2-7
SC0116	62-79	SL SCL SC	0- 0	95-100	15-45	1-6

SOI-5	Depth	-pH-	O.M.	Salin	Permeab	Shnk-Swll
FL0129	0-12	3.5-5.5	1.0-6.0	0-0	2.0-6.0	LOW
FL0129	12-62	3.5-5.5	-	0-0	0.6-2.0	LOW
FL0129	62-85	3.5-5.5	-	0-0	0.6-6.0	LOW
SC0020	0-12	3.5-5.5	1.0-6.0	0-0	6.0-20	LOW
SC0020	0-12	3.5-5.5	1.0-6.0	0-0	2.0-6.0	LOW
SC0020	0-12	3.5-5.5	1.0-6.0	0-0	0.6-2.0	LOW
SC0020	12-40	3.5-5.5	0.5-1.0	0-0	0.6-2.0	LOW
SC0020	40-62	3.5-5.5	0.5-1.0	0-0	0.6-2.0	LOW
SC0020	62-79	3.6-5.5	0.5-1.0	0-0	0.6-2.0	LOW
SC0102	0-14	3.5-5.5	1.0-6.0	0-0	2.0-6.0	LOW
SC0102	14-36	3.5-5.5	-	0-0	0.6-2.0	LOW
SC0102	36-46	-	-	-	-	-
SC0116	0-12	3.5-5.5	1.0-6.0	0-0	2.0-6.0	LOW

SC0116	0-12	3.5-5.5	1.0-6.0	0-0	2.0-6.0	LOW
SC0116	12-40	3.5-5.5	0.5-1.0	0-0	0.6-2.0	LOW
SC0116	40-62	3.5-5.5	0.5-1.0	0-0	0.6-2.0	LOW
SC0116	62-79	3.5-5.5	0.5-1.0	0-0	0.6-2.0	LOW

National Cooperative Soil Survey
U.S.A.

LOCATION PLUMMER GA+AL FL MS NC SC TX VA

Established Series
KSL/Rev. JAK
03/2009

PLUMMER SERIES

MLRA(s): 133A-Southern Coastal Plain, 133B-Western Coastal Plain, 153A-Atlantic Coast Flatwoods, and 153B-Tidewater Area
Depth Class: Very deep
Drainage Class (Agricultural): Poorly or very poorly drained
Internal Free Water Occurrence: Very shallow, persistent
Flooding Frequency and Duration: None
Ponding Frequency and Duration: None to frequent; long or very long periods
Index Surface Runoff: Negligible to low
Saturated Hydraulic Conductivity: Moderately high
Shrink-swell Potential: Low
Landscape: Upper, middle, and lower coastal plains
Landform: Flats, depressions
Geomorphic Component: Talfs, dips
Hillslope Profile Position: Not assigned
Parent Material: Marine or fluviomarine deposits
Slope: 0 to 5 percent, dominantly less than 1 percent
Elevation (type location): Unknown
Frost Free Period (type location): 240 days
Mean Annual Air Temperature (type location): 19.2 degrees C (66.5 degrees F.)
Mean Annual Precipitation (type location): 1240 millimeters (49 inches)

TAXONOMIC CLASS: Loamy, siliceous, subactive, thermic Grossarenic Paleaquults

TYPICAL PEDON: Plummer sand on a 1 percent slope, in woodland. (Colors are for moist soil unless otherwise stated.)

A--0 to 23 centimeters (about 0 to 9 inches); dark gray (N 4/) sand; weak fine granular structure; very friable; many medium and fine roots; many clean sand grains in lower part; very strongly acid; clear wavy boundary. (10 to 30 centimeters thick)

Eg1--23 to 71 centimeters (about 9 to 28 inches); gray (5Y 6/1) sand; single grain; loose; few roots in upper part; common root holes with brown stains; very strongly acid; gradual wavy boundary.

Eg2--71 to 127 centimeters (about 28 to 50 inches); light gray (5Y 7/1) sand; single grain; loose; very strongly acid; gradual irregular boundary. (Combined thickness of the E horizon is 90 to 170 centimeters)

Btg--127 to 200 centimeters (about 50 to 80 inches); light gray (5Y 7/1) sandy loam with bodies of sandy clay loam; common medium and fine prominent yellowish brown (10YR 5/6) masses of oxidized iron; weak medium granular and subangular blocky structure; friable; sand grains bridged with clay; very strongly acid.

TYPE LOCATION: Wayne County, Georgia; about 2.6 miles east of Gardi along U.S. Highway 341 and south on county road 4.2 miles to crossroads; 0.2 mile east.

RANGE IN CHARACTERISTICS:
Depth to top of argillic horizon: 100 to 195 centimeters (about 40 to 75 inches), commonly 125 to 180 centimeters (about 50 to 70 inches)
Depth to base of argillic horizon: 150 to 200 centimeters or more (about 60 to 80 inches), commonly more than 2500 centimeters (about 100 inches)
Depth to bedrock: Greater than 200 centimeters (about 80 inches)
Depth to seasonal high water table: 0 to 25 centimeters (about 0 to 10 inches) December to July
Thickness of the sandy surface and subsurface layers: Greater than 100 centimeters (about 40 inches)
Content and size of rock fragments: 0 to 10 percent, by volume throughout, mostly fine quartz gravel or ironstone nodules or concretions
Effective Cation Exchange Capacity: 3 to 10 milliequivalents per 100 grams of soil in the A horizon; 1 to 3 in E horizons; and 3 to 5 in the B horizon
Soil Reaction: Extremely acid to strongly acid, except where limed

RANGE OF INDIVIDUAL HORIZONS:
Oa horizon (where present):
Color--hue of 10YR, 2.5Y or 5Y; value of 2 to 4, chroma of 1 or 2; or is neutral with value of 2 to 4
Texture--muck, 2 to 20 centimeters thick

A horizon:
Color--hue of 10YR to 5Y; value of 2 to 4, chroma of 1 or 2; or is neutral with value of 2 to 4. Where moist value and chroma are 3 or less, thickness of the A horizon is less than 25 centimeters (about 10 inches).
Texture--sand, fine sand, loamy fine sand or, loamy sand, or their mucky analogues
Clay content: 1 to 10 percent

Eg horizon:
Color--hue of 10YR to 5Y, value of 5 to 8, chroma of 1 or 2; or is neutral with value of 5 to 8
Texture--sand, fine sand, loamy fine sand, or loamy sand
Clay content: 1 to 10 percent
Redoximorphic features--iron depletions in shades of brown, yellow, or gray and masses of oxidized iron in shades of red, yellow, or brown. Iron depletions may be zones of uncoated sand grains.

BEg horizon (where present):
Color--hue of 10YR to 5Y, value of 5 to 7, chroma of 1 or 2; or is neutral with value of 5 to 7
Texture--loamy sand or loamy fine sand
Clay content: 1 to 12 percent
Redoximorphic features--iron depletions in shades of brown, yellow, or gray and masses of oxidized iron in shades of red, yellow, or brown. Iron depletions may be zones of uncoated sand grains.

Btg horizon:
Color--hue of 10YR to 5Y, value of 5 to 7, chroma of 1 or 2; or is neutral with value of 5 to 7

Texture--sandy loam, fine sandy loam or sandy clay loam and may have pockets of loamy sand or sandy clay
Clay content: 12 to 35 percent
Redoximorphic features--iron depletions in shades of brown, yellow, or gray and masses of oxidized iron in shades of red, yellow, or brown

COMPETING SERIES:
Starke soils--have an umbric epipedon

GEOGRAPHIC SETTING:
Landscape: Upper, middle, and lower coastal plains
Landform: Flats, depressions
Geomorphic Component: Talfs, dips
Hillslope Profile Position: Not assigned
Parent Material: Marine or fluviomarine deposits
Slope: 0 to 5 percent, dominantly less than 1 percent
Elevation: 5 to 135 meters (about 15 to 450 feet)
Mean Annual Air Temperature: 14 to 21 degrees C. (about 59 to 70 degrees F.)
Mean Annual Precipitation: 965 to 1320 millimeters (about 38 to 52 inches)
Frost Free Period: 190 to 275 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Alapaha soils--have an arenic epipedon and have plinthite in the Bt horizons
Atmore soils--have 6 to 18 percent clay in upper 50 centimeters of the Bt horizon and plinthite in the lower Bt horizon
Ellabelle soils--have an umbric epipedon
Johnston soils--have a thick umbric epipedon
Leefield soils--have combined A and E horizons of less than 100 centimeters thick
Leon soils--have a spodic horizon
Lynn Haven soils--have a spodic horizon
Mascotte soils--have a spodic horizon
Ocilla soils--have combined A and E horizons of less than 100 centimeters thick
Olustee soils--have a spodic horizon
Osier soils--do not have an argillic horizon
Pelham soils--have an arenic epipedon
Rains soils--have combined A and E horizons of less than 100 centimeters thick
Rutlege soils--have an umbric epipedon
Surrency soils--have an umbric epipedon
Torhunta soils--have a thick umbric epipedon

DRAINAGE AND PERMEABILITY:
Drainage Class (Agricultural): Poorly or very poorly drained
Internal Free Water Occurrence: Very shallow, persistent
Flooding Frequency and Duration: None
Ponding Frequency and Duration: Depressional areas are occasionally or frequently ponded for long or very long periods
Index Surface Runoff: Negligible to low

Saturated Hydraulic Conductivity: Moderately high (4.2 to 14.1 micrometers per second)
Shrink-swell Potential: Low

USE AND VEGETATION:
Major Uses: Woodland
Dominant Vegetation: Where wooded--mixed stands of slash, loblolly, and longleaf pine with swamp tupelo and bald cypress and an understory of gallberry, waxmyrtle, southern bayberry, wiregrass, pitcher plants, and bracken fern. Where cleared--pasture.

DISTRIBUTION AND EXTENT:
Distribution: Georgia, Alabama, Delaware, Florida, Maryland, Mississippi, North Carolina, South Carolina, and Virginia
Extent: Large

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Raleigh, North Carolina

SERIES ESTABLISHED: Duval County, Florida; 1910.

REMARKS: Diagnostic horizons and soil characteristics recognized in this pedon are:
Ochric epipedon--the zone from the surface of the soil to a depth of about 127 centimeters.(A, Eg1, and Eg2 horizons)
Grossarenic feature--sandy materials from the surface of the soil to a depth of approximately 127 centimeters (A, Eg1, and Eg2 horizons)
Argillic horizon--the zone from approximately 127 to 200 centimeters (Btg horizon)
Aquic conditions--periodic saturation and reduction in a zone from the soil surface to 200 centimeters at some time during the year (endosaturation).
Redox concentrations--the zone from 127 to 200 centimeters (Btg horizon)
Redox depletions with chroma of 2 or less--the zone from the soil surface to 200 centimeters (A, Eg, and Btg horizons)
Series control section--the zone from 0 to 200 centimeters

ADDITIONAL DATA:
Laboratory Data: Characterization data are not available from NRCS-Soil Survey Laboratory, Lincoln, NE.
Database Information:
Data Mapunit ID--To be developed
Typical Pedon User Pedon ID--To be developed

National Cooperative Soil Survey
U.S.A.

LOCATION LYNN HAVEN FL+GA NC SC

Established Series
Rev. GRB
03/2009

LYNN HAVEN SERIES

The Lynn Haven series consists of very deep, poorly and very poorly drained, moderate or moderately rapid permeable soils in low areas and depressions the Gulf Coast and Atlantic Flatwoods. They formed in thick deposits of sandy marine sediments. Near the type location, the mean annual temperature is about 68 degrees F., and the mean annual precipitation is about 55 inches. Slopes range from 0 to 5 percent.

TAXONOMIC CLASS: Sandy, siliceous, thermic Typic Alaquods

TYPICAL PEDON: Lynn Haven fine sand--range. (Colors are for moist soil)

A--0 to 12 inches; black (10YR 2/1) fine sand; weak fine granular structure; friable; many fine and medium roots; strongly acid; clear wavy boundary. (8 to 20 inches thick)

Eg--12 to 16 inches; gray (N 6/0) fine sand; single grain; loose; common fine and medium roots; many uncoated sand grains; very strongly acid; abrupt wavy boundary. (2 to 18 inches thick)

Bh1--16 to 22 inches; dark reddish brown (5YR 3/2) fine sand; weak fine granular structure; friable; many fine and medium roots; few fine and medium pores; sand grains coated with organic matter; very strongly acid; gradual wavy boundary.

Bh2--22 to 30 inches; dark brown (7.5YR 3/2) fine sand; weak fine granular structure; friable; few fine roots; few fine pores; most sand grains are coated with organic matter; few small pockets of uncoated sand grains; very strongly acid; gradual wavy boundary. (Combined thickness of the Bh horizons is from 6 to more than 50 inches thick.)

Cg--30 to 75 inches; gray (5Y 6/1) fine sand; single grain; loose; common medium distinct brown (10YR 5/3) and light yellowish brown (10YR 6/4) masses of iron accumulation; very strongly acid.

TYPE LOCATION: Bay County, Florida. Approximately 1 mile south of intersection of U. S. Highway 98 and State Highway 392 and about 50 feet east of Highway 392 in Sec. 4, T. 4 S., R. 15 W.

RANGE IN CHARACTERISTICS: Reaction ranges from extremely acid to strongly acid throughout the profile.

The Oa, horizon, where present, is less than 7 inches thick. It has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 to 3. Texture is muck.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2; or is neutral with value of 2 or 3. When dry, this horizon has a salt-and-pepper appearance due to mixing of organic matter and white sand grains.

Texture is sand, fine sand or mucky fine sand.

The Eg or E horizon, where present, has hue of 10YR or 2.5YR, value of 4 to 7, and chroma of 1 or 2; or is neutral with value of 5 to 7. Redoximorphic features in shades of yellow and brown range from none to common. Texture is sand or fine sand.

The Bh horizon has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 to 4. Sand grains are coated with organic matter. Vertical or horizontal tongues or pockets of grayish sand occur in the Bh horizon in some pedons. Texture is sand, fine sand, loamy sand or loamy fine sand.

Some pedons have a C/B horizon with hue of 10YR to 5YR, value of 3 to 5, and chroma of 3 or 4 with redoximorphic features in shades of gray, brown, or yellow. Texture is sand, fine sand, loamy sand or loamy fine sand.

Some pedons have a bisequum of E'g and B'h. Colors and textures are similar to the Eg and Bh horizons.

The Cg horizon has hue of 7.5YR to 5Y, value of 4 to 7, and chroma of 1 to 3. Redoximorphic features in shades of brown, yellow, or red range from few to many. Texture is sand, fine sand, loamy sand or loamy fine sand.

COMPETING SERIES: These include Boulogne and the very poorly drained Wesconnett series. Boulogne and Wesconnett soils do not have E horizons immediately below the A horizon.

GEOGRAPHIC SETTING: Lynn Haven soils are on low areas and in depressions of the Gulf Coast and Atlantic Flatwoods. They formed in thick beds of marine sand. The climate is warm and humid. Slopes range from 0 to 5 percent. The average annual air temperature ranges from 65 to 70 degrees F., and the average annual precipitation ranges from 50 to 60 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These include the Allanton, Baymeade, Blanton, Evergreen, Hurricane, Kershaw, Kingsferry, Kureb, Lakeland, Leon, Mandarin, Murville, Olustee, Osier, Plummer, Pottsburg, Rutlege, Scranton, and Seagate series. Allanton, Hurricane and Pottsburg soils have a Bh horizon at depths greater than 50 inches. The Baymeade, Blanton, Kershaw, Kureb, Lakeland, Osier, Plummer, Rutlege, and Scranton soils do not have Bh horizons. Evergreen soils have a histic epipedon. Kingsferry soils have a Bh horizon between a depth of 30 and 50 inches. Leon soils lack an umbric epipedon. Olustee soils have Bt horizons below the Bh horizon. Murville soils do not have E horizons immediately below the A horizon. Seagate soils are better drained and have argillic horizons beneath the Bh horizons.

DRAINAGE AND PERMEABILITY: poorly or very poorly drained; moderately rapid or moderate permeability.

USE AND VEGETATION: Most areas of Lynn Haven soils remain in their natural state. A few small areas are used for truck crops and pasture land. The native vegetation consists of slash pine, longleaf pine, or cypress and bay trees with an undergrowth of sawpalmetto, gallberry, fedderbush, huckleberry, and pineland threeawn. In depressions, cypress and bay trees are denser along with blackgum, red maple, and Ogeechee lime. The shrubs include fetterbush, Virginia willow, buttonbush, and waxmyrtle. Common herbaceous plants and vines include muscadine grape, greenbriars, and poison-ivy, along with maidencane grass, cinnamon fern and sphagnum.

DISTRIBUTION AND EXTENT: Florida, Georgia, North Carolina and South Carolina. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Auburn, Alabama.

SERIES ESTABLISHED: Florence and Sumter Counties, South Carolina; 1969.

REMARKS: The water table is at 0 to 6 inches for periods of 2 to 6 months annually and within a depth of 40 inches for more than 6 months during most years; during extended dry periods it is below 40 inches. Depressional areas are ponded for long duration in most years.

Diagnostic horizons and features recognized in this pedon:

Umbric epipedon - The zone extending from the surface to a depth of 12 inches. (A horizon).

Albic horizon - The zone between 12 and 16 inches. (E horizon).

Spodic horizon - The zone between 16 and 30 inches. (Bh1 and Bh2 horizons).

National Cooperative Soil Survey
U.S.A.

LOCATION CAPE FEAR NC+GA SC

Established Series
Rev. BJW:AG:PLT
02/2000

CAPE FEAR SERIES

MLRA(s): 133A, 152A, 153A, 153B
MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Raleigh, North Carolina
Depth Class: Very deep
Drainage Class: Very poorly drained
Permeability: Slow
Surface Runoff: Slow
Parent Material: clayey marine and fluvial sediments
Slope: 0 to 2 percent
Mean Annual Air Temperature (type location): 61 degrees F.
Mean Annual Precipitation (type location): 46 inches

TAXONOMIC CLASS: Fine, mixed, semiactive, thermic Typic Umbraquults

TYPICAL PEDON: Cape Fear loam--cultivated. (Colors are for moist soil)

Ap--O to 7 inches; black (10YR 2/1) loam, weak fine granular structure; friable; common fine roots; common fine and medium pores; few clean sand grains; slightly acid; clear smooth boundary. (6 to 10 inches thick)

A--7 to 16 inches; black (10YR 2/1) loam, weak medium granular structure; friable; common fine roots; common fine and medium pores; few clean sand grains; moderately acid; clear wavy boundary. (4 to 10 inches thick)

Btg1--16 to 20 inches; dark gray (10YR 4/1) clay loam, weak fine subangular blocky structure; firm; moderately sticky; moderately plastic, few fine roots; common fine and medium pores; common amounts of A1 material in old root holes; few fine flakes of mica and white mineral grains; strongly acid; clear wavy boundary.

Btg2--20 to 38 inches; gray (10YR 5/1) clay; weak medium subangular blocky structure; firm; moderately sticky; moderately plastic, few fine pores; common amounts of A1 material and very dark grayish brown (10YR 3/2) material in root holes; common fine flakes of mica and white mineral grains; strongly acid; gradual wavy boundary.

Btg3--38 to 45 inches; gray (10YR 6/1) clay; weak medium subangular blocky structure; firm; moderately sticky, moderately plastic, common flakes of mica, and red and white mineral grains; this horizon contains more sand than the above horizon; strongly acid; gradual wavy boundary. (Combined thickness of the Btg horizons is 15 to 40 inches)

BCg--45 to 52 inches; light brownish gray (2.5Y 6/2) sandy clay loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; few flakes of mica and red and white mineral grains; common pockets of loamy sand; strongly acid; gradual smooth boundary. (0 to 12 inches thick)

2Cg--52 to 62 inches; light brownish gray (10YR 6/2) sand; single grained; loose; few flakes of mica and common red and white mineral grains; strongly acid.

TYPE LOCATION: Cumberland County, North Carolina; 3 miles east of Fayetteville on State Road 1834; 1.6 miles east of intersection of State Road 1834 and North Carolina Highway 24; 150 feet north of State Road 1834 in cultivated field.

RANGE IN CHARACTERISTICS:
Solum Thickness: 30 to 60 inches
Depth to Bedrock: Greater than 60 inches
Depth to Seasonal High Water Table: 0 to 12, December to May
Soil Reaction: very strongly acid to moderately acid, except where limed

A or Ap horizon:
Color--hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2, or N, value of 2 or 3
Texture--loam, sandy loam, silt loam, fine sandy loam, very fine sandy loam, or their mucky analogues

BA or BE horizon (if it occurs)
Color--hue of 10YR to 5Y, value of 3 or 4, and chroma of 1 or 2, or is neutral with value of 3 or 4
Texture--clay loam, silty clay loam, sandy clay loam, or loam.

Btg horizon:
Color--hue of 10YR or 5GY, value of 4 or 7, and chroma of 1 or 2, or is neutral with value of 4 to 6
Texture--clay, sandy clay, clay loam, or silty clay with upper 20 inches containing 35 to 60 percent clay.
Redoximorphic features (if they occur)--iron masses in shades of brown, yellow, or red and iron depletions in shades of olive or gray

BCg horizon (if it occurs):
Color--hue of 10YR to 5GY value of 4 to 7, and chroma of 1 or 2, or it is neutral with values of 4 to 7
Texture--sandy clay loam, clay loam, sandy clay, loam, or sandy loam
Redoximorphic features (if they occur)--iron masses in shades of brown, yellow, or red and iron depletions in shades of olive or gray

2Cg horizon:
Color--hue of 10YR to 5GY value of 4 to 7, and chroma of 1 or 2, or it is neutral with values of 4 to 7
Texture--sand, sandy loam, loam, or loamy sand; gravel content ranges from 0 to 10 percent.
Redoximorphic features (if they occur)--iron masses in shades of brown, yellow, or red and iron depletions in shades of olive or gray

COMPETING SERIES: There are no other known series in the same family

GEOGRAPHIC SETTING:
Landscape: Coastal Plain
Landform: Marine Terrace

Elevation: Less than 25 feet above mean sea level
Parent Material: clayey marine and fluvial sediments
Mean Annual Air Temperature: 58 to 70 degrees
Mean Annual Precipitation: 38 to 55 inches
Frost Free Period: 200 to 270 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Altavista soils--moderately well drained soils (seasonal high water table 18 to 30 inches) on higher landscapes
Arapahoe soils--very poorly drained soils (seasonal high water table 0 to 12 inches) in coarse-loamy family on similar landscapes
Deloss soils--very poorly drained soils (seasonal high water table 0 to 12 inches) in fine-loamy family on similar landscapes
Dogue soils--moderately well drained soils (seasonal high water table 18 to 30 inches) on higher landscapes
Hyde soils--very poorly drained soils (seasonal high water table 0 to 12 inches) in fine-silty family on flats and in slight depressions
Portsmouth soils--very poorly drained soils (seasonal high water table 0 to 12 inches) in fine-loamy family on flats and in slight depressions
Roanoke soils--poorly drained soils (seasonal high water table 0 to 12 inches) on flats and in slight depressions
Roper soils--very poorly drained soils (seasonal high water table 0 to 12 inches) in fine-silty family with organic surface layers 8 to 16 inches thick on similar landscapes
Tomotley soils--poorly drained soils (seasonal high water table 0 to 12 inches) in fine-loamy family on similar landscapes
Wahee soils--somewhat poorly drained soils (seasonal high water table 12 to 18 inches) on higher landscapes
Wasda soils--very poorly drained soils (seasonal high water table 0 to 12 inches) in fine-loamy family with organic surface layers 8 to 16 inches thick on similar landscapes
Weeksville soils--very poorly drained soils (seasonal high water table 0 to 12 inches) in coarse-silty family on similar landscapes
Wickham soils--well drained soils (seasonal high water table is below 6 feet) on higher landscapes

DRAINAGE AND PERMEABILITY:
Agricultural Drainage Class: Very poorly drained
Permeability: slow

USE AND VEGETATION:
Major Uses: Mostly cultivated
Dominant Vegetation: Where cultivated--corn, oats, soybeans, small grain, and pasture. Where wooded--swamp blackgum, sweetgum, cypress, willow, ash, maple, pin oak, pond pine, and an undergrowth of reeds, bay bushes, and gallberry.

DISTRIBUTION AND EXTENT:
Distribution: Georgia, North Carolina, South Carolina, and Virginia
Extent: Large

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Raleigh, North Carolina

SERIES ESTABLISHED: Cumberland County, North Carolina; 1922.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Umbric epipedon - the zone from the surface to a depth of 16 inches. (the Ap and A horizons)

Argillic horizon - the zone between 16 and 45 inches. (Btg1, Btg2, and Btg3 horizons)

Aquic conditions - colors with chroma of 2 or less below the surface layer caused by saturation.

Used in MLRA: 133A, 153A, 152A, 153B SIR: NC0061

ADDITIONAL DATA: None

TABULAR SERIES DATA:

SOI-5	Soil Name	Slope	Airtemp	FrFr/Seas	Precip	Elevation
NC0061	CAPE FEAR	0- 2	58- 70	200-270	38- 55	5- 25

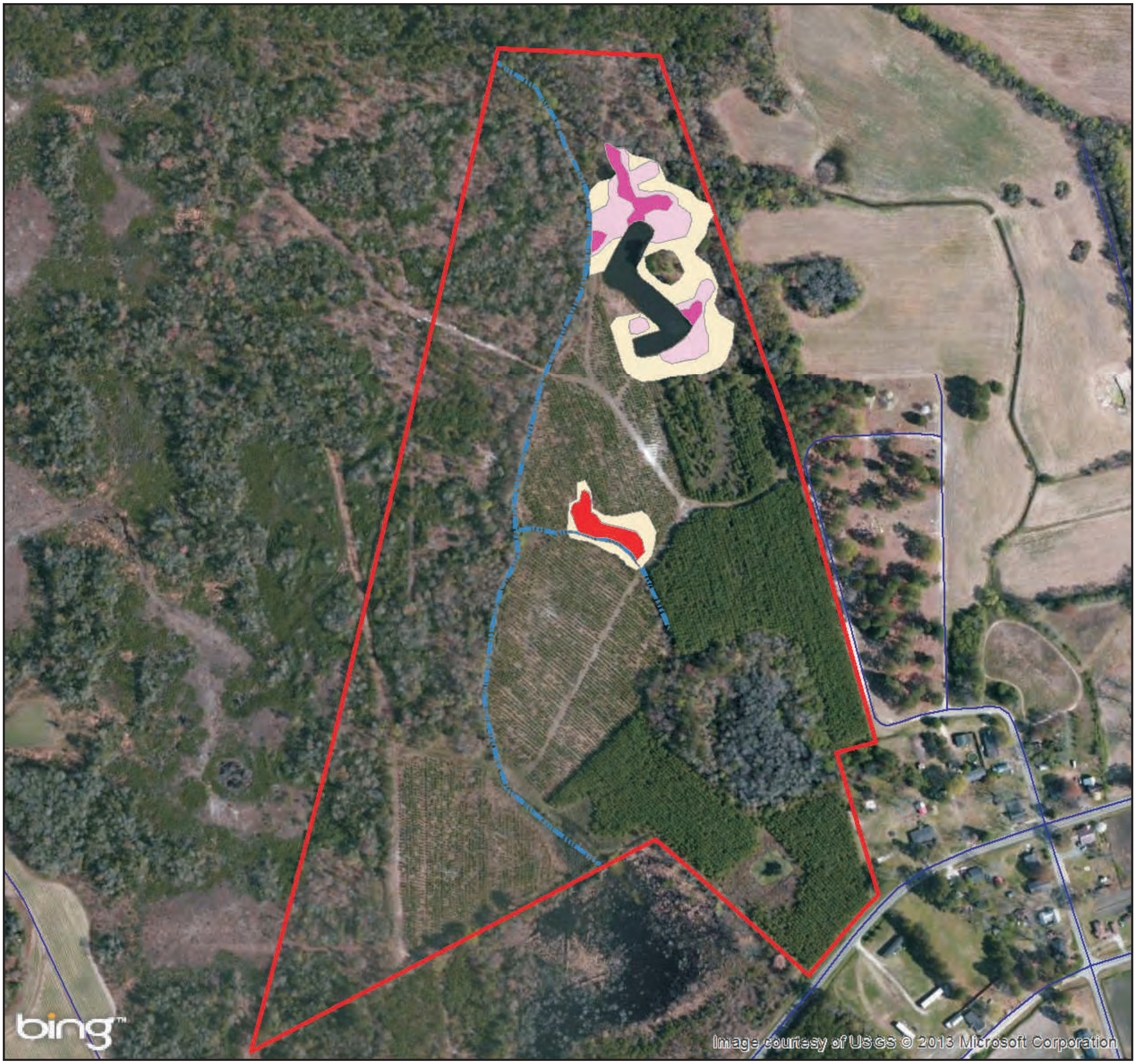
SOI-5	FloodL	FloodH	Watertable	Kind	Months	Bedrock Hardness
NC0061	NONE	RARE	0-1.0	APPARENT	NOV-MAY	60-60

SOI-5	Depth	Texture	3-Inch	No-10	Clay%	-CEC-
NC0061	0-16	L SIL	0-0	95-100	5-15	6-18
NC0061	0-16	FSL VFSL	0-0	95-100	5-15	6-18
NC0061	16-52	CL C SIC	0-0	95-100	35-60	8-15
NC0061	52-62	VAR	-	-	-	-

SOI-5	Depth	-pH-	O.M.	Salinity	Permeability	Shrink-Swell
NC0061	0-16	4.5-6.5	5.-15	0-0	0.6-6.0	LOW
NC0061	0-16	4.5-6.5	5.-15	0-0	2.0-6.0	LOW
NC0061	16-52	3.5-6.0	.5-3.	0-0	0.06-0.2	MODERATE
NC0061	52-62	-	-	-	-	

National Cooperative Soil Survey
U.S.A.

C.5 Historic Fill Map



- 3 to 4 feet of fill material (~0.27 Acres)
- 2 to 3 feet of fill material (~0.33 Acres)
- 1 to 2 feet of fill material (~0.90 Acres)
- 0 to 1 feet of fill material (~1.88 Acres)

NOTE: This is not a survey. All boundaries and distances are considered approximate. This represents a preliminary sketch prepared from field notes. A survey of delineated areas and review and approval by the US Army Corps of Engineers is recommended prior to specific site planning.

N

L:\WETLANDS\2013 WETLANDS FILES\40-13-064 --- UT to Millers Creek, Ryan Smith
Map Source: BING Aerial Photography

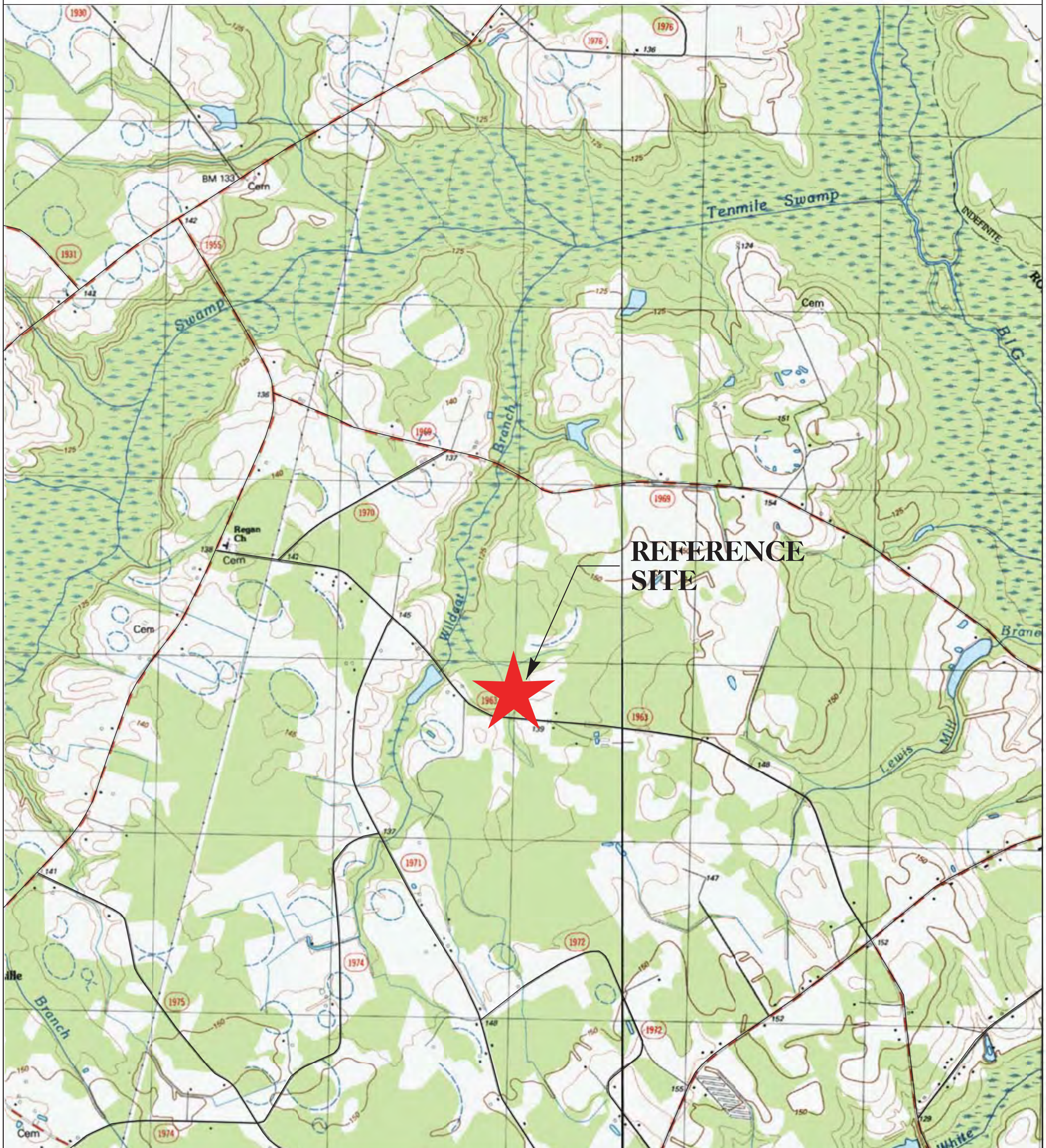
SCALE 1" = 400'

UT to Millers Creek
Florence & Hutcheson
Magnolia Tract
Duplin County, NC
May 2013

LMG
LAND MANAGEMENT GROUP INC.
Environmental Consultants
www.LMGroup.net
Phone: 910.452.0001 •1.866.LMG.1078
Fax: 910.452.0060
P.O. Box 2522, Wilmington, NC 28402

Figure X2 -
Fill Material Present within
the Proposed Riparian
Restoration Corridor

C.6 Stream Reference



Reference Site Vicinity Map

UT to Wildcat Branch

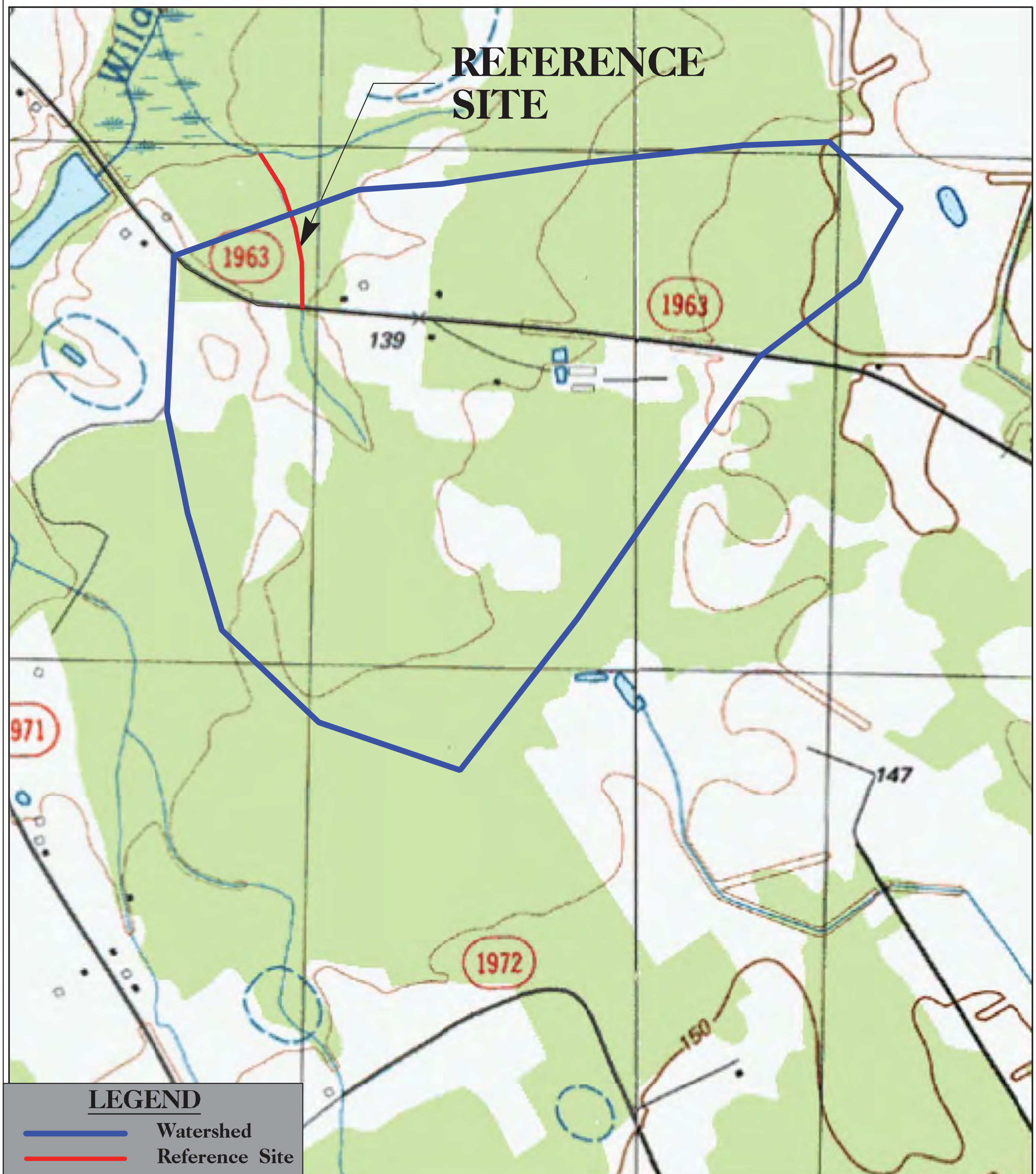
Mitigation Plan
UT Millers Creek
Duplin County, North Carolina

0 2000 4000
FEET

Date: 07/17/13

Ecosystem Enhancement Program

ICA Engineering
5121 Kingdom Way,
Suite 100
Raleigh, NC 27607
NC License No: F-0258



Reference Site Watershed Map

UT to Wildcat Branch

Mitigation Plan
UT Millers Creek
Duplin County, North Carolina

Ecosystem Enhancement Program

ICA Engineering
5121 Kingdom Way, Suite 100
Raleigh, NC 27607
NC License No: F-0258

0 500 1000
FEET

Date: 07/17/13

Ecosystem Enhancement PROGRAM

ICA Engineering
5121 Kingdom Way,
Suite 100
Raleigh, NC 27607
NC License No: F-0258

Reference Site Soil Survey Map

UT to Wildcat Branch

Mitigation Plan
UT Millers Creek
Duplin County, North Carolina

0 500 1000
FEET

Date: 08/17/13

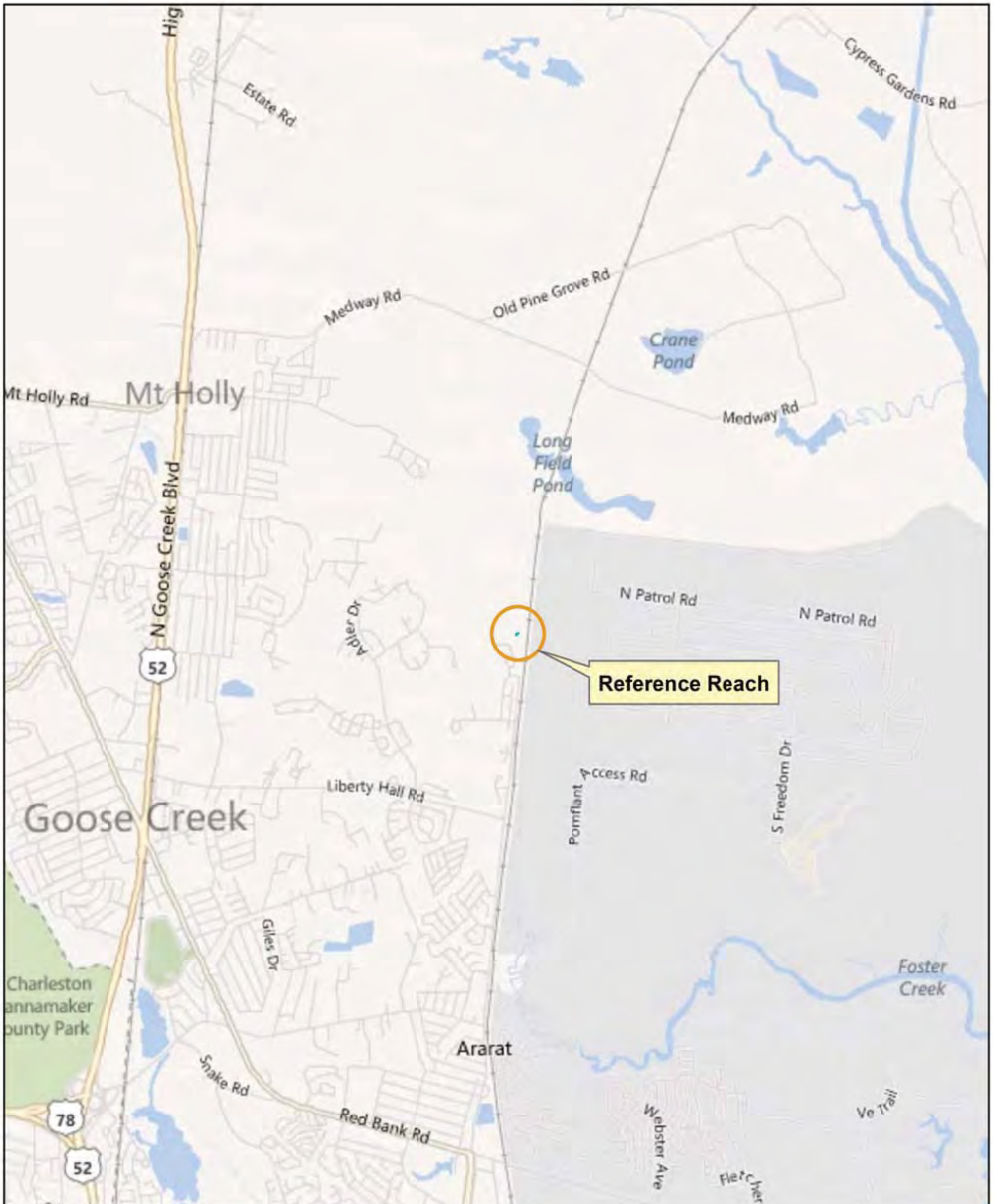
UT to Wildcat Branch – Reference Reach Photographs

Looking downstream at beginning of reference reach.

Looking downstream at riffle.

Looking downstream at riffle.

Looking downstream through middle of reach at sinuous channel.



Reference Site Location Map

Brick Bound Swamp

Mitigation Plan

UT Millers Creek

Duplin County, North Carolina

0 1000 2000

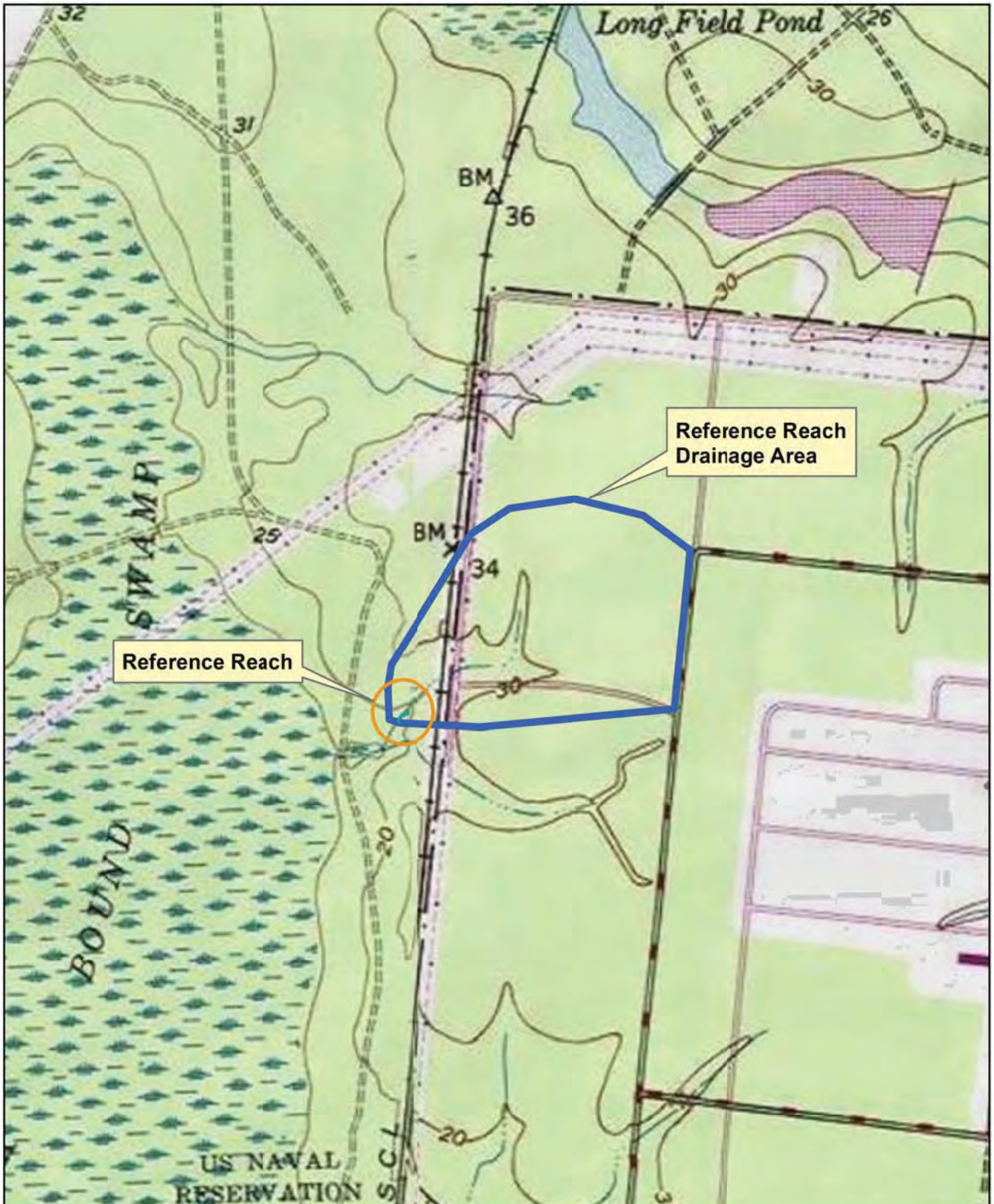
FEET

Date: 08/14/13

Ecosystem Enhancement PROGRAM

ICA Engineering

5121 Kingdom Way,
Suite 100
Raleigh, NC 27607
NC License No: F-0258



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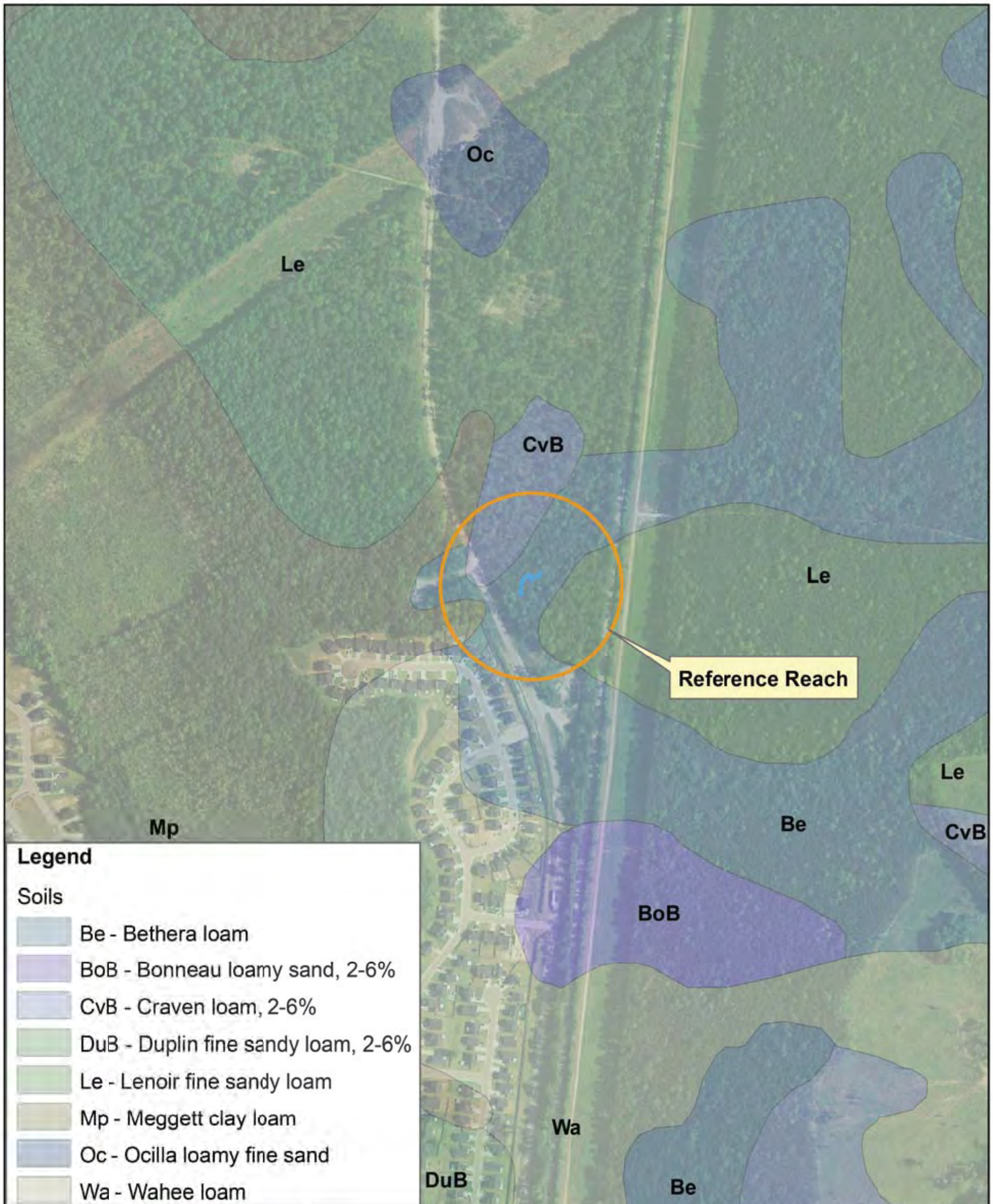
Reference Site Watershed Map

Brick Bound Swamp

Mitigation Plan
UT Millers Creek
Duplin County, North Carolina

0 1000 2000
FEET

Date: 08/14/13



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Reference Site Soils Map

Brick Bound Swamp

Mitigation Plan
UT Millers Creek
Duplin County, North Carolina

0 1000 2000
FEET

Date: 08/14/13

UT Brick Bound Swamp – Reference Reach Photographs

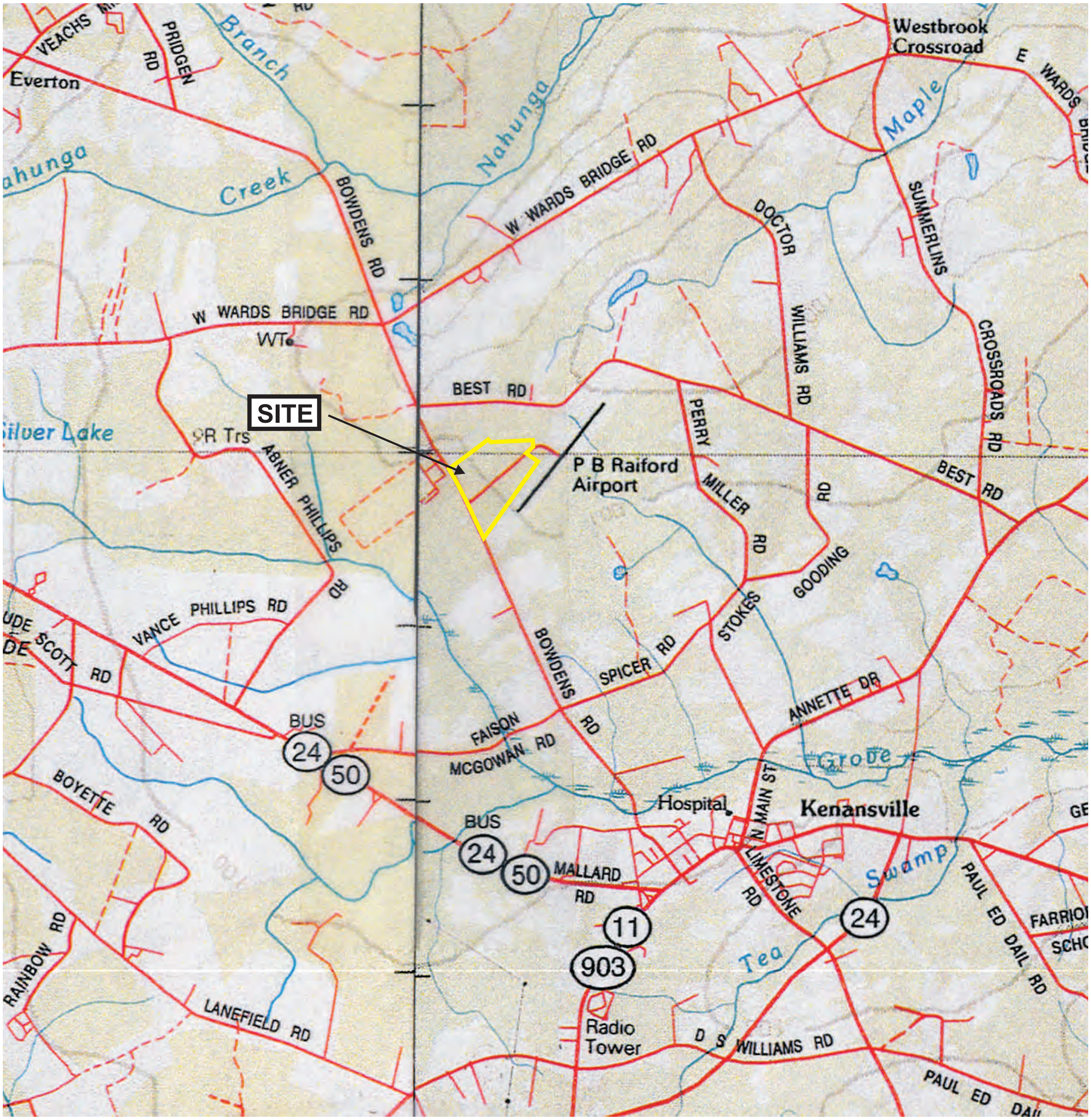
Looking downstream at beginning of reference reach.

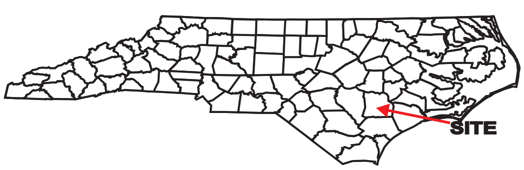
Looking downstream at cross section 1 (riffle).

Looking downstream at cross section 2 (pool).

Looking downstream through middle of reach.

C.7 Wetland Reference





N

SCALE 1" = 1 Mile

Map Source: DeLorme: North Carolina Atlas and Gazetteer., 2006 p. 75 &76.

UT to Millers Creek
Magnolia Tract
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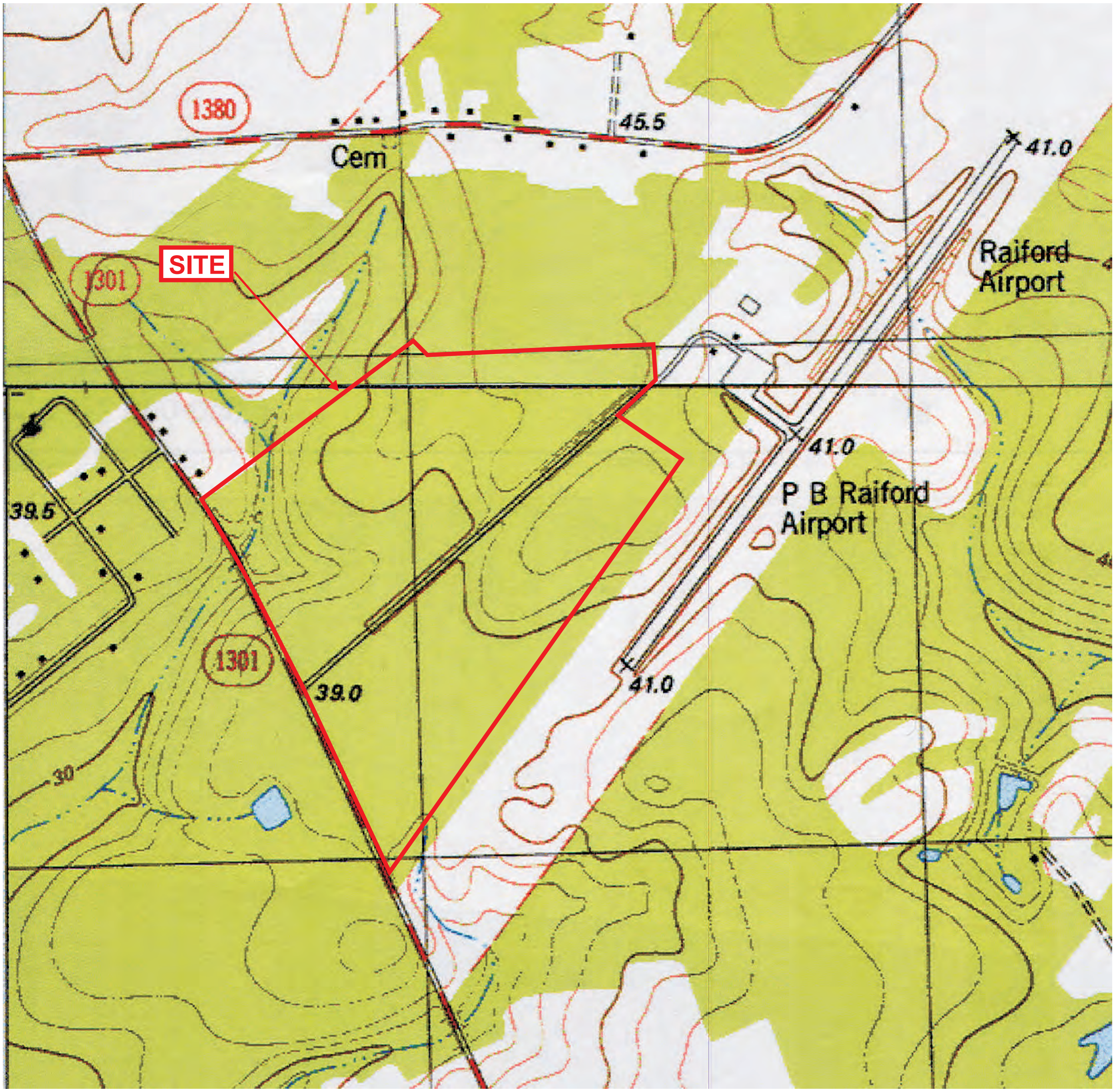
Duplin County, NC
July 2013
40-13-064

LMG
LAND MANAGEMENT GROUP INC.
Environmental Consultants
www.LMGroup.net
Phone: 910.452.0001 •1.866.LMG.1078
Fax: 910.452.0060
P.O. Box 2522, Wilmington, NC 28402

Figure 1
Reference Wetlands
Vicinity Map



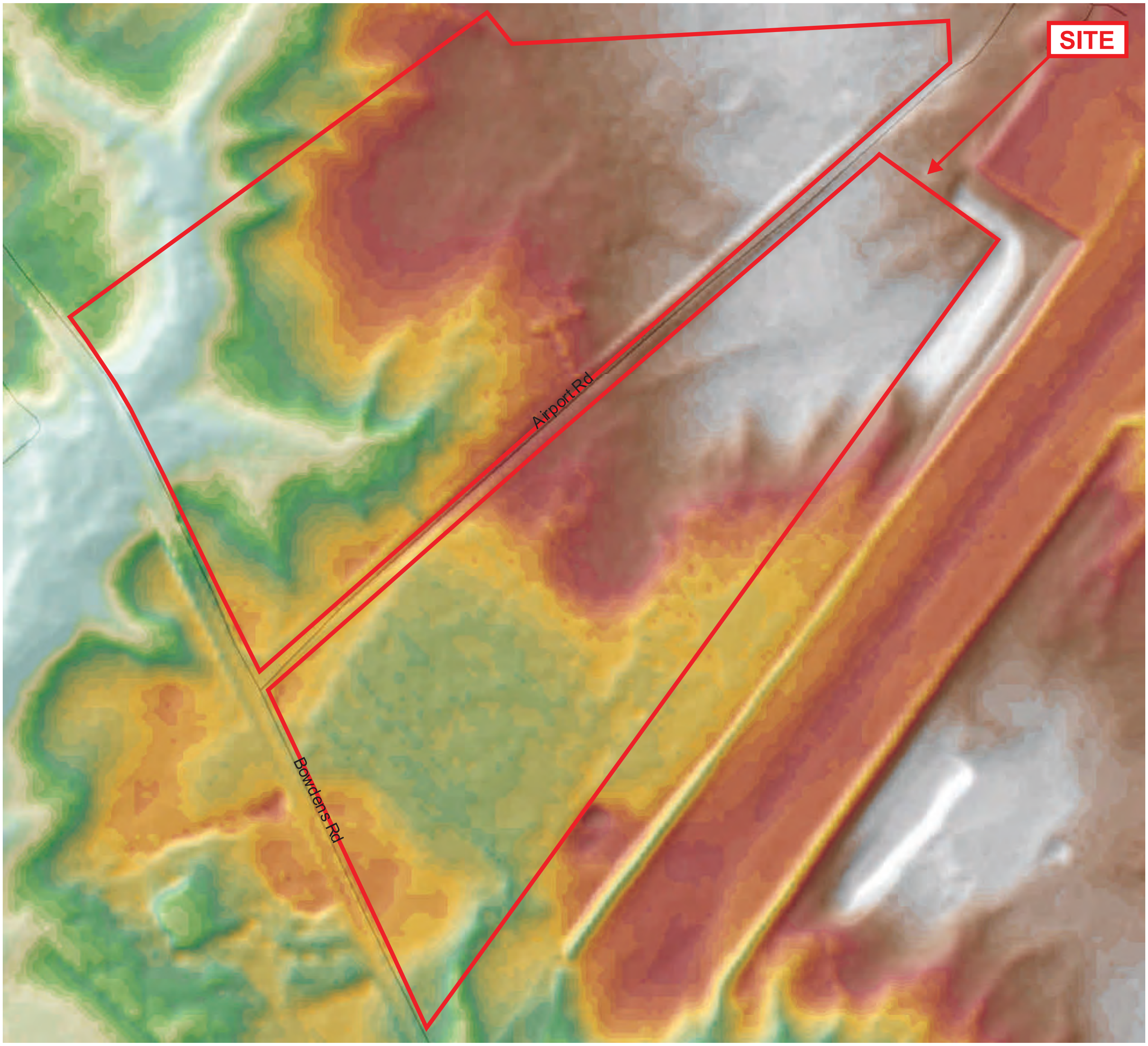
*Boundaries are approximate and are
not meant to be absolute.

Map Source: Summerlins and Kenansville, N.C.,
1980, USGS 7.5' Topographic quadrangle.

N

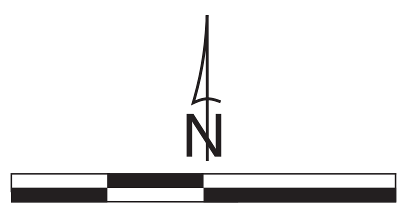
SCALE 1" = 1000'

UT to Millers Creek Magnolia Tract ICA Engineering Duplin County, NC July 2013 40-13-064	LMG LAND MANAGEMENT GROUP INC. Environmental Consultants www.LMGroup.net Phone: 910.452.0001 •1.866.LMG.1078 Fax: 910.452.0060 P.O. Box 2522, Wilmington, NC 28402	**Figure 2** **Reference Wetlands** **USGS Topographic Map**



*Boundaries are approximate and are
not meant to be absolute.

Map Source: NCDOT LiDAR data.



SCALE 1" = 500'

UT to Millers Creek Magnolia Tract ICA Engineering Duplin County, NC July 2013 40-13-064	www.LMGroup.net Phone: 910.452.0001 •1.866.LMG.1078 Fax: 910.452.0060 P.O. Box 2522, Wilmington, NC 28402	**Figure 3 Reference Wetlands LiDAR Map**

*Boundaries are approximate and are not meant to be absolute.

Map Source: NRCS Soil Survey.

N

SCALE 1" = 500'

UT to Millers Creek Magnolia Tract ICA Engineering Duplin County, NC July 2013 40-13-064	LMG LAND MANAGEMENT GROUP INC. Environmental Consultants www.LMGroup.net Phone: 910.452.0001 •1.866.LMG.1078 Fax: 910.452.0060 P.O. Box 2522, Wilmington, NC 28402	**Figure 4** **Reference Wetlands** **Soils Map**

*Boundaries are approximate and are not meant to be absolute.

Map Source: 1998 NAPP Aerial Photography

N

SCALE 1" = 500'

UT to Millers Creek Magnolia Tract ICA Engineering Duplin County, NC July 2013 40-13-064	LMG LAND MANAGEMENT GROUP INC. Environmental Consultants www.LMGroup.net Phone: 910.452.0001 •1.866.LMG.1078 Fax: 910.452.0060 P.O. Box 2522, Wilmington, NC 28402	**Figure 5** **Reference Wetlands** **Infrared Aerial Photograph**

Map Source: 2010 NC OneMap Aerial Photography

N

SCALE 1" = 500’

UT to Millers Creek
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P.O. Box 2522, Wilmington, NC 28402

Figure 6
Reference Wetlands
Aerial Photograph

Map Source: Microsoft Bing Aerial Photography

UT to Millers Creek
Magnolia Tract
ICA Engineering
Duplin County, NC
July 2013
40-13-064

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Fax: 910.452.0060
P.O. Box 2522, Wilmington, NC 28402

Figure 7
Reference Wetlands
Aerial Photograph

REFERENCE WETLAND – SITE PHOTOGRAPHS

1. View of riparian wetland associated with zero-order valley.

2. View of low-gradient, second-order tributary and adjacent floodplain wetlands.

3. View of second-order tributary and adjacent wetlands.

4. Typical wetland vegetation assemblage adjacent to second-order tributary.

Appendix D. Sediment Analysis

UT Miller's Creek
Sediment Transport

ICA Engineering Project No. 1300100

May 13, 2014

Table of Contents

1.0 Objective

The objective of this exercise was to develop a sediment budget for UT Miller's Creek and to use HEC-RAS to determine if channel aggradation or degradation would occur for the project site.

2.0 Engineering Methods

2.1 Determination of Sediment Loading

Development of a sediment budget was the first step in analyzing sediment transport for UT Miller's Creek. The sediment budget was created by first using the Revised Universal Soil Loss Equation (RUSLE) from the International Erosion Control Association's 2001 manual "Certified Professional in Erosion and Sediment Control" (CEPSC) which is shown below.

A = R*K*LS*C*P

Where
A = Annual Soil Loss due to erosion
R = Rainfall-Runoff Erosivity Factor
K = Soil –Erodibility factor
LS= Topographic Factors
C = Cover Management Factor
P = Support Practice Factor

GIS software was utilized in dissecting the watershed for UT Miller's Creek into discrete units with similar morphological qualities, such as land use, soil type, and slope.

The Rainfall-Runoff Erosivity Factor (R) was determined from Figure 3-1 of the CEPSC manual which is an Isoerodent Map of the Eastern United States. An R value of 325 was applied to each morphological unit in the watershed since the drainage area is relatively small in comparison to the scale of the Isoerodent Map, and therefore does not reach regions with different R values. Figure 3-1 is included in Sediment Analysis Section B.

Soil –Erodibility factors (K) were determined from Table 16 of the USGS Soil Survey of Sampson County, North Carolina from August 1985. The soil survey for Sampson County was utilized since a soil survey that contained soil erodibility values could not be found for Duplin County. Characteristics for soil types found in the project area could be found in the soil survey for Sampson County since it is adjacent to Duplin County. Soil–Erodibility factors were selected from the top soil category for each soil type. A summary of the selected K values can be seen in Table 1 below.

Table 1: Soil–Erodibility Factors

Soil Type	K
Bibb sandy loam	0.15
Blanton sand	0.10
Foreston loamy fine sand	0.15
Leon sand	0.10
Torhunta mucky fine sandy loam	0.15
Woodington loamy fine sand	0.10

Topographic Factors (LS) were determined from Table 3-3 of the CEPSC manual which contains values for soils where most erosion is caused by surface flow. Values were selected from Table 3-3 for each morphological unit based on the unit's slope length as well as slope angle, which were determined from contour lines developed from LiDAR terrain data. Table 3-3 is included in Sediment Analysis Section B.

Cover Management Factors (C) were determined from Table 3-4 of the CEPSC manual, which is included in Sediment Analysis Section B. Values were selected from Table 3-4 for each morphological unit based on the unit's land use classification. The range of selected C values can be seen in Table 2 below.

Support Practice Factors (P) were determined from Table 3-5 of the CEPSC manual, which is included in the Sediment Analysis Section B. Values were selected from Table 3-5 for each morphological unit based on the unit's land use classification. A value of 1.0 was selected for all land use classifications since no area contained practices implemented to control erosion.

Table 2: Cover Management Factors

Land Use	C
Agriculture	0.25
Bottomland Hardwood Forest	0.01
Open Water	0.00
Pine Plantation	0.20
Residential	0.10
Urban	0.10

After R, K, LS, C, and P values were selected an estimated annual soil loss due to erosion was calculated for each morphological unit. These individual unit values for soil loss were then summed for the entire watershed to produce a total soil loss due to erosion of approximately 76 tons per year.

Once estimated soil loss due to erosion was calculated, the next step was to determine how much of the eroded soil was actually transported as a sediment load to the project site. The CEPSC manual states that RUSLE only estimates soil loss due to erosion and does not estimate sediment yield. Sediment yield is defined as the amount of eroded soil that is delivered to a point in the watershed that is remote from the origin of the detached particles.

The "Sediment Delivery Distributed (SEDD) Model" by Ferro and Porto was then used to estimate the amount of the annual erosion from the watershed that is transferred to the project site as sediment loading. The SEDD model incorporates the estimated annual soil loss due to erosion from RUSLE along with a Sediment Delivery Ratio which is based on surface roughness as well as travel time. This method helps to account for sediment particles which detach from their original position during erosion, but then settle in another location before reaching the point of interest in the watershed.

Surface roughness factors (β) were selected from Table 2 in "Sediment Delivery Distributed (SEDD) Model" by Ferro and Porto which is included in Sediment Analysis Section B. These values were based on land use classifications for each morphological unit and range from 0.0165 to 0.0201. Travel time was calculated by first determining the distance from a morphological unit to the closest channel, which were selected as blue line streams from the Warsaw South USGS Quad Map. This distance was then divided by the square root of the slope. Surface roughness and travel time were then used to calculate a Sediment Delivery Ratio (SDR) for each morphological unit.

Sediment yield was determined by multiplying the Sediment Delivery Ratio, morphological unit size, and soil loss due to erosion for each morphological unit. These results were then summed to produce a total estimated sediment yield of approximately 10 tons per year at the project site. The sediment budget calculation can be found in Sediment Analysis Section C. It should be noted that a watershed assessment of existing conditions of contributing waters to the upstream limits of the Site revealed that the large majority of contributing channels are physically stable with little noticeable soil loss. This was expected due to the slope (low slope), size (relatively small) and abundance of existing vegetation along channel banks within the watershed. Therefore, the sediment budget does not rely upon soil loss from contributing channels as a primary supplier of sediment.

2.2 Selection of HEC-RAS Sediment Analysis Function

There are several sediment analysis tools now available in HEC-RAS. Each tool is discussed below along with the reasoning used for the selection of the appropriate HEC-RAS function for this exercise.

<u>Sediment Transport</u>: This HEC-RAS sediment analysis function performs a mobile bed analysis of the reach, which is the predicted change in the stream bed. The HEC-RAS Hydraulics Reference Manual describes this tool to predict bed change as fundamentally uncertain, and the theory that is employed is empirical and highly sensitive to a wide array of physical variables. This tool requires creating a quasi-unsteady flow series, which approximates a continuous hydrograph with a series of steady flow files. This HEC-RAS function is not utilized because it is both highly sensitive and uncertain.

<u>Sediment Transport Capacity</u>: This HEC-RAS sediment analysis function has the capability of predicting transport capacity for non-cohesive sediment at one or more cross sections based on existing hydraulic parameters and known bed sediment properties. It does not take into account sediment inflow, erosion, or deposition in the computations. The results from this function can be used to develop sediment discharge rating curves which help to understand and predict the fluvial processes found in natural rivers and streams. This HEC-RAS function was not selected as it does not allow the user to account for sediment inflow, as well as it predicts only carrying capacity and not specifically stream aggradation or degradation.

<u>Sediment Impact Analysis Method, SIAM</u>: This HEC-RAS sediment analysis function is a sediment budget tool that compares annualized sediment transport capacities to supplies. The results map potential imbalances and instabilities in a channel network which can then indicate reaches of overall sediment surplus or deficit. This function does not predict intermediate or final morphological patterns and does not update channel cross sections, but rather indicates trends in the system for potential sediment surpluses or deficits. SIAM is used to model aggradational or degradational trends of the proposed stream design.

2.3 Sediment Transport Analysis

Sediment impact models were created for both the Existing Conditions and Proposed Conditions of UT Miller's Creek using HEC-RAS's SIAM tool within "Hydraulic Design Functions." The sediment reach was selected as the same reach modeled in the Existing and Proposed Conditions by setting equal to cross sections 4357 and 1000 respectively.

The "Bed Mat'l" tab was selected and edited to consist of particle sizes around a size of 0.3mm which is consistent with observed particle sizes at the project site. Since HEC-RAS has preset particle size distributions, the particle size was set at preset category of 0.25 mm as it was the closest category to the field observed particle size of 0.3 mm.

The "Hydro" tab is automatically populated with every profile contained in the model's Steady Flow Data. A new Steady Flow Data was created from the original file that contained only information in regard to the bankfull flow event of 8.4 cfs. The duration time of was set at 365 days as specified on page 18-4 of the HEC-RAS User's Manual. Water temperate was set at 65 degrees.

The following sediment transport functions are available to model project site conditions: Ackers-White, Engelund-Hansen, Laursen, Meyer-Peter Muller, Toffaleti, and Yang. The Engelund-Hansen function is appropriate for a small drainage area as it was developed from research using flumes. In "Transport of sediment in large sand-bed rivers" in 2001, Molinas and Wu concluded that relationships derived from flume experiments with shallow flows cannot be universally applied to large rivers with deep flows. The comparisons between computed and measured sediment concentrations indicate that the commonly used Engelund and Hansen, Ackers and White, and Yang equations which were developed using mainly flume experiments are not applicable for large rivers. The HEC-RAS Hydraulic Reference Manual states that the Engelund-Hansen function has been extensively tested and found to be fairly consistent with field data, and that it is applicable for sandy streams with sediment sizes between 0.19 and 0.93 mm. The median particle diameter for the project site is 0.3 mm.

The "Fall Velocity Method" was left as "Default", and the "Wash Load Max Class Diameter" was selected as "7, FS, 0.25" which is the maximum size in mm of the particles found in the wash load within the channel. Specific Gravity of the sediment was set to 2.65.

One sediment source was created under the "Sources" tab as the sediment boundary condition for the project site. A value of 10 tons per year, which was calculated by the sediment budget discussed in Section 2.1, was then set as the sediment source. Since HEC-RAS has preset particle size distributions, the size category of 0.25mm was used since this is the closest preset category to the field observed particle size of 0.3 mm.

Results from the HEC-RAS model which are summarized in Table 3 below indicate that no aggradation or degradation would occur along UT Miller's Creek.

Table 3: HEC-RAS Results

Sediment Reach	Conditions	Total Aggradation or Degradation (tons/year)
UT Miller's Creek	Existing	0.00E+00
UT Miller's Creek	Proposed	0.00E+00

2.4 Sediment Capacity

Cross sections 3784, 2647, and 1248 were selected form HEC-RAS to represent the upper, middle, and lower regions of the project site. Data for water depth, channel slope, average velocity, and discharge for these three cross sections was selected from the Existing Conditions and Proposed Conditions HEC-RAS models and used in conjunction with the Engelund-Hansen function (Engelund and Hansen 1967) equation shown below in order to calculate sediment transport capacity.

$$g = 0.535\ D^{1/2}\ S^{3/2}\ V\ Q\ /\ d$$

g = sediment discharge (lb/s)
D = water depth (ft)
S = channel slope (ft/ft)
V = average velocity (ft/s)
Q = discharge (cubic ft/s)
d = median particle diameter of stream bed material (ft)

Values for sediment transport capacity were then compared between the Existing Conditions and Proposed Conditions HEC-RAS models (at the bankfull discharge) as seen in Table 4 on the following page. Sediment capacity calculations for these three cross sections indicate similar levels of sediment carrying capacity between the Existing and Proposed Conditions. It should be noted that field observations of the Existing channel revealed no evidence of bed aggradation or degradation. For this reason, it is assumed that if the sediment capacity of the proposed channel is similar to the existing channel, then equilibrium is assumed. As can be seen in the following table, the Existing and Proposed models sediment capacity are similar, indicating that Proposed conditions have the capacity to transport watershed sediment contribution through the project site without aggrading or degrading. The largest percent difference was calculated at cross section 3784, which represents the upper region of the project. This is to be expected as a beaver dam can be found in the Existing Conditions which slows the average velocity and decreases the sediment carrying capacity of the stream.

Table 4: Sediment Capacity

Cross section 3784 (Upstream of Existing Beaver dam)	Existing	Proposed

D	Water Depth	(ft)	3.54	1.23
S	Channel Slope	(ft/ft)	0.0005	0.0003
V	Average Velocity	(ft/s)	0.13	0.46
Q	Discharge	(cfs)	8.40	8.40
d	d50	(ft)	0.00098	0.00098
g	Sediment Capacity	(lb/s)	0.01071	0.01216
	Percent Difference	%	12%	
Cross section 2647 (Middle of Project)			Existing	Proposed
D	Water Depth	(ft)	0.97	1.72
S	Channel Slope	(ft/ft)	0.0005	0.0007
V	Average Velocity	(ft/s)	1.47	0.72
Q	Discharge	(cfs)	8.40	8.40
d	d50	(ft)	0.00098	0.00098
g	Sediment Capacity	(lb/s)	0.07647	0.08020
	Percent Difference	%	5%	
Cross section 1248 (Downstream Project Limit)			Existing	Proposed
D	Water Depth	(ft)	1.00	1.12
S	Channel Slope	(ft/ft)	0.0004	0.0005
V	Average Velocity	(ft/s)	1.57	1.29
Q	Discharge	(cfs)	8.40	8.40
d	d50	(ft)	0.00098	0.00098
g	Sediment Capacity	(lb/s)	0.05760	0.05976
	Percent Difference	%	4%	

3.0 Results

The Sediment Impact Analysis Method function in HEC-RAS as well as the verification calculation using Engelund-Hansen resulted in a stable system for both the Existing and Proposed Conditions with no bed aggradation or degradation for UT Miller’s Creek. The result of a stable Existing Conditions is consistent with observed characteristics of the project site.

Sediment Analysis Section A: References

Forrest, C., Lake, D., Scherer, J., and Harding, M. (2001) “Certified Professional in Erosion and Sediment Control Review Session and Exam Workbook.” CPESC Council. 3-4 – 3-30.

Ferro, V., Porto, P., (2000) “Sediment Delivery Distributed (SEDD) Model.” 411-419.

Brunner, G. (2010) “HEC-RAS, River analysis System Hydraulic Reference Manual.” 12-41

Sediment Analysis Section B: Sediment Budget Calculation Figures and Tables

Figure 3-1
ISOERODENT MAP OF EASTERN UNITED STATES

Units are hundreds ft • tonf·in(ac·h·yr)$^{-1}$

Table 3-3
LS FOR THAWING SOILS

Values for topographic factor, LS, for moderate ratio of rill to interrill erosion.[1]

	Horizontal slope length (ft)												
Slope (%)	15	25	50	75	100	150	200	250	300	400	600	800	1000
0.2	0.02	0.03	0.04	0.05	0.06	0.07	0.09	0.10	0.10	0.12	0.15	0.17	0.19
0.5	0.04	0.05	0.07	0.09	0.10	0.12	0.14	0.16	0.17	0.20	0.24	0.28	0.31
1.0	0.06	0.08	0.11	0.14	0.16	0.20	0.23	0.26	0.28	0.32	0.40	0.46	0.51
2.0	0.11	0.14	0.20	0.25	0.29	0.35	0.41	0.46	0.50	0.58	0.71	0.82	0.91
3.0	0.16	0.21	0.29	0.36	0.42	0.51	0.59	0.66	0.72	0.83	1.02	1.17	1.31
4.0	0.21	0.27	0.38	0.47	0.54	0.66	0.77	0.86	0.94	1.08	1.33	1.53	1.71
5.0	0.26	0.33	0.47	0.58	0.67	0.82	0.94	1.06	1.16	1.34	1.64	1.89	2.11
6.0	0.31	0.40	0.56	0.69	0.79	0.97	1.12	1.26	1.38	1.59	1.95	2.25	2.51
8.0	0.41	0.52	0.74	0.91	1.05	1.28	1.48	1.65	1.81	2.09	2.56	2.96	3.31
10.0	0.48	0.62	0.88	1.08	1.25	1.53	1.77	1.98	2.16	2.50	3.06	3.54	3.95
12.0	0.54	0.70	0.98	1.21	1.39	1.71	1.97	2.20	2.41	2.78	3.41	3.94	4.40
14.0	0.59	0.76	1.08	1.32	1.53	1.87	2.16	2.41	2.64	3.05	3.74	4.31	4.82
16.0	0.64	0.82	1.17	1.43	1.65	2.02	2.33	2.61	2.86	3.30	4.04	4.67	5.22
20.0	0.73	0.94	1.33	1.63	1.88	2.30	2.66	2.97	3.25	3.76	4.60	5.31	5.94
25.0	0.83	1.07	1.51	1.85	2.13	2.61	3.02	3.37	3.69	4.27	5.23	6.03	6.75
30.0	0.91	1.18	1.67	2.05	2.36	2.89	3.34	3.73	4.09	4.72	5.78	6.68	7.47
40.0	1.07	1.38	1.95	2.39	2.75	3.37	3.90	4.36	4.77	5.51	6.75	7.79	8.71
50.0	1.19	1.54	2.18	2.67	3.08	3.77	4.35	4.87	5.33	6.16	7.54	8.71	9.74
60.0	1.30	1.67	2.37	2.90	3.35	4.10	4.74	5.30	5.80	6.70	8.20	9.47	10.59

[1]Such as for row-cropped agricultural and other moderately consolidated soil conditions with little-to-moderate cover (not applicable to thawing soil).

Table 3-4

COVER INDEX FACTOR C -- CONSTRUCTION SITES

Type of Cover	Application Rate Tons Per Acre	Factor C	Percent[1]
None (fallow ground)		1.0	0.0
Temporary Seedings (90 percent stand):			
Ryegrass (perennial type)		0.05	95
Ryegrass (annuals)		0.1	90
Small grain		0.05	95
Millet or sudan grass		0.05	95
Field bromegrass		0.03	97
Permanent Seedings (90 percent stand):		0.01	99
Sod (laid immediately):		0.01	99
Mulch:			
Hay	.50	0.25	75
Hay	1.00	0.13	87
Hay	1.50	0.07	93
Hay	2.00	0.02	98
Small grain straw	2.00	0.02	98
Wood chips	6.00	0.06	94
Wood cellulose	1.75	0.10	90

[1] Percent soil loss reduction as compacted/with fallow ground.

Source: USDA-NRCS, Connecticut Technical Guide.

Table 3-5

PRACTICE FACTOR P
SURFACE CONDITION FOR CONSTRUCTION SITES

Surface Condition with No Cover	Factor P[1]
Compact and smooth, scraped with bulldozer or scraper up and downhill.	1.3
Same condition, except raked with bulldozer root rake up and downhill.	1.2
Compact and smooth, scraped with bulldozer or scraper across the slope.	1.2
Same condition, except raked with bulldozer root rake across the slope.	0.9
Loose as a disked plow layer.	1.0
Rough, irregular surface equipment tracks in all directions.	0.9
Loose with rough surface greater than 12″ depth.	0.8
Loose with smooth surface greater than 12″ depth.	0.9

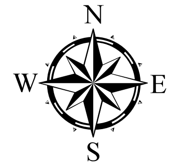
[1] Values based on estimates.

Source: USDA-NRCS, Connecticut Technical Guide.

TABLE 2. Values of β_m Coefficient of Each Investigated Basin

Basin	Eq. (5)			Eq. (6)		
	a = 1; *b* = 0 (2)	*a* = *b* = 0.5 (3)	*a* = 0.3; *b* = 0.7 (4)	*a* = 1; *b* = 0 (5)	*a* = *b* = 0.5 (6)	*a* = 0.3; *b* = 0.7 (7)
W1	0.0201	0.0135	0.0082	0.0418	0.0314	0.0231
W2	0.0157	0.0073	0.0032	0.031	0.0212	0.0163
W3	0.0165	0.0114	0.0085	0.0197	0.0143	0.011

Sediment Analysis Section C: Sediment Budget Calculation



ICA Engineering

Morphological Units Map

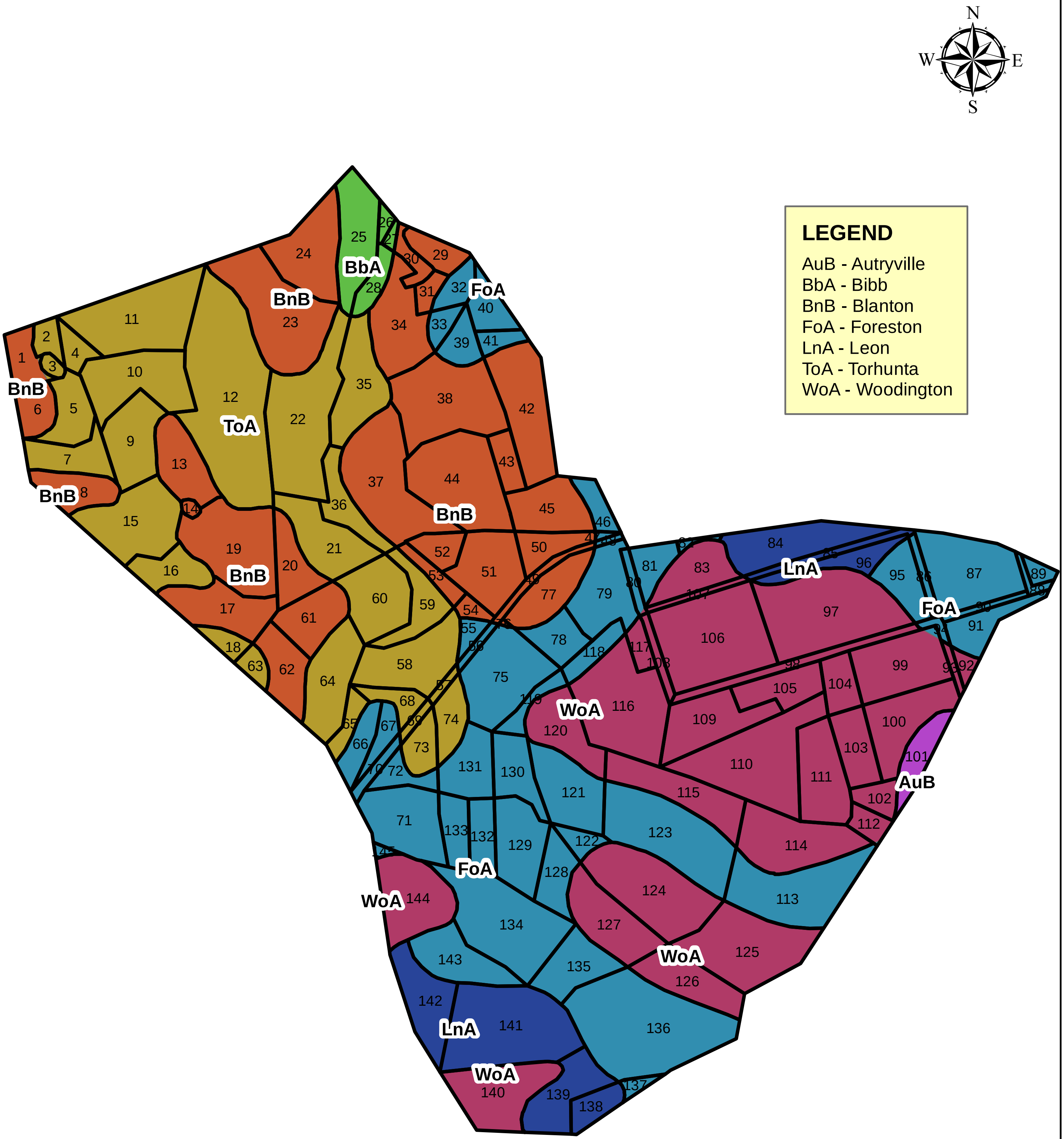
UT to Miller's Creek Mitigation Site, Duplin County, NC

0 250 500 1,000 1,500 2,000 Feet

1 inch = 667 feet

Figure

1



ICA Engineering

Soils Map

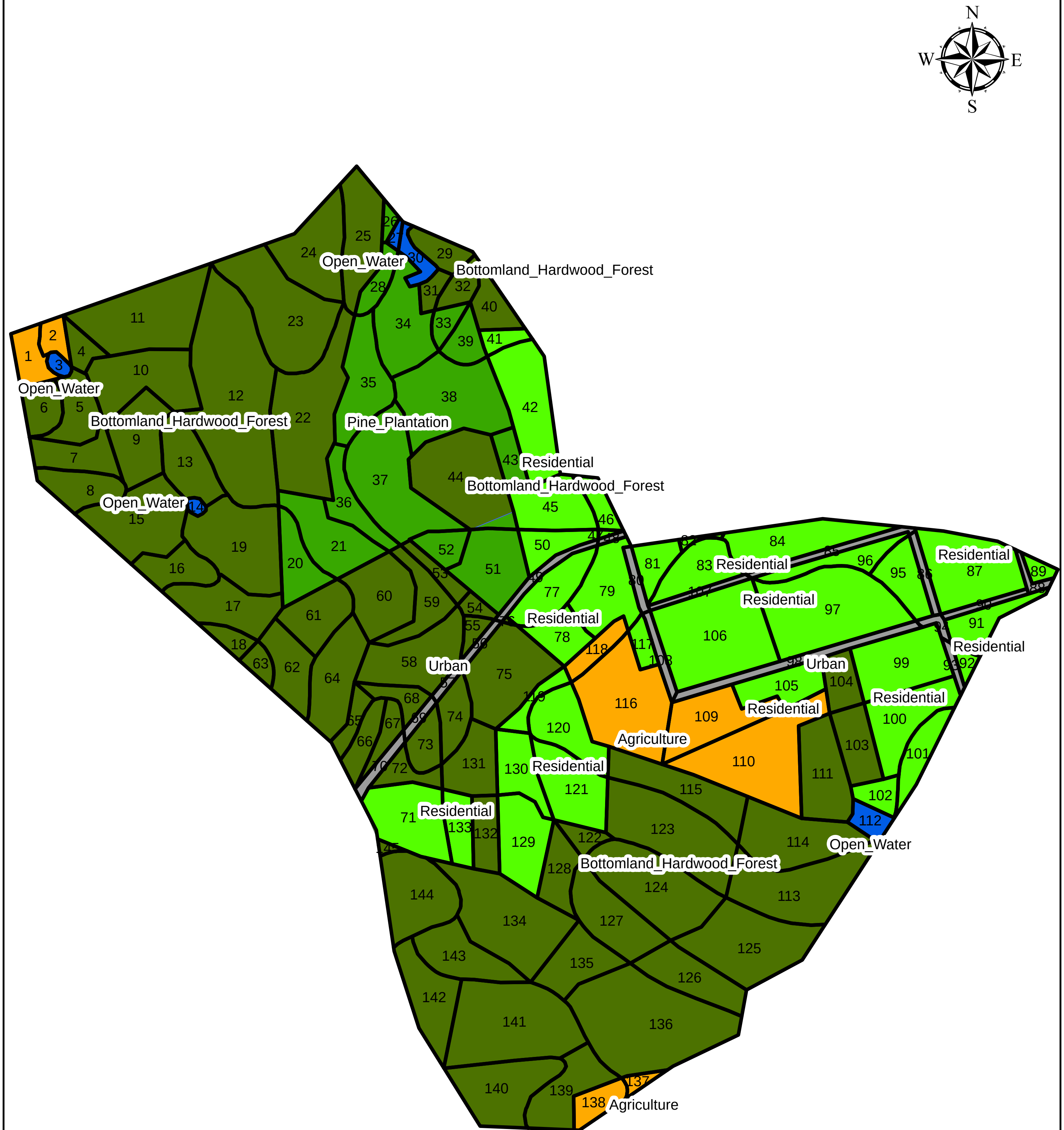
UT to Miller's Creek Mitigation Site, Duplin County, NC

0 250 500 1,000 1,500 2,000 Feet

1 inch = 667 feet

Figure

2



Land Use Map

UT to Miller's Creek Mitigation Site, Duplin County, NC

0 250 500 1,000 1,500 2,000 Feet

1 inch = 667 feet

ICA Engineering

Figure

3

			Unit Characteristics						RUSLE						SEDD Method					
Unit ID	Soil Type	Land Use	Unit Slope Length (ft)	Unit Slope Height (ft)	Hydro Path Length (ft)	Slope (ft/ft)	Slope (%)	Slope Angle (Radians)	R	K	LS	C	P	A (tons/(acre-yr))	β	Time (hrs)	SDR	Area (acre)	A (tons/(acre-yr))	Yield (tons/yr)
1	BnB	Agriculture	85	3	1551	0.0353	3.53	0.0353	325	0.10	0.4400	0.250	0.7	2.50	0.0201	45	0.4028	1.03	2.50	1.04
2	ToA	Agriculture	143	2	1626	0.0140	1.40	0.0140	325	0.15	0.3200	0.250	0.7	2.73	0.0201	121	0.0880	0.58	2.73	0.14
3	ToA	Open_Water	119	1	1483	0.0084	0.84	0.0084	325	0.15	0.1400	0.000	0.0	0.00	0.0186	130	0.0894	0.25	0.00	0.00
4	ToA	Bottomland_Hardwood_Forest	166	2	1447	0.0120	1.20	0.0120	325	0.15	0.2000	0.010	1.0	0.10	0.0165	151	0.0825	0.67	0.10	0.01
5	ToA	Bottomland_Hardwood_Forest	160	4	1402	0.0250	2.50	0.0250	325	0.15	0.4300	0.010	1.0	0.21	0.0165	101	0.1883	1.58	0.21	0.06
6	BnB	Bottomland_Hardwood_Forest	140	1	1542	0.0071	0.71	0.0071	325	0.10	0.1300	0.010	1.0	0.04	0.0165	166	0.0650	1.09	0.04	0.00
7	ToA	Bottomland_Hardwood_Forest	256	2	1552	0.0078	0.78	0.0078	325	0.15	0.2400	0.010	1.0	0.12	0.0165	290	0.0084	1.62	0.12	0.00
8	BnB	Bottomland_Hardwood_Forest	174	2	1726	0.0115	1.15	0.0115	325	0.10	0.2100	0.010	1.0	0.07	0.0165	162	0.0687	1.56	0.07	0.01
9	ToA	Bottomland_Hardwood_Forest	275	2	1759	0.0073	0.73	0.0073	325	0.15	0.2100	0.010	1.0	0.10	0.0165	322	0.0049	2.44	0.10	0.00
10	ToA	Bottomland_Hardwood_Forest	545	1	1241	0.0018	0.18	0.0018	325	0.10	0.1500	0.010	1.0	0.05	0.0165	1272	0.0000	3.34	0.05	0.00
11	ToA	Bottomland_Hardwood_Forest	319	1	1379	0.0031	0.31	0.0031	325	0.10	0.1000	0.010	1.0	0.03	0.0165	570	0.0001	4.46	0.03	0.00
12	ToA	Bottomland_Hardwood_Forest	415	3	735	0.0072	0.72	0.0072	325	0.15	0.2500	0.010	1.0	0.12	0.0165	488	0.0003	8.90	0.12	0.00
13	BnB	Bottomland_Hardwood_Forest	244	2	1181	0.0082	0.82	0.0082	325	0.10	0.2400	0.010	1.0	0.08	0.0165	270	0.0117	2.13	0.08	0.00
14	BnB	Open_Water	82	1	1263	0.0122	1.22	0.0122	325	0.10	0.1400	0.000	0.0	0.00	0.0186	74	0.2513	0.15	0.00	0.00
15	ToA	Bottomland_Hardwood_Forest	491	2	2218	0.0041	0.41	0.0041	325	0.15	0.2200	0.010	1.0	0.11	0.0165	769	0.0000	3.47	0.11	0.00
16	ToA	Bottomland_Hardwood_Forest	144	4	2363	0.0278	2.78	0.0278	325	0.15	0.5000	0.010	1.0	0.24	0.0165	86	0.2404	1.45	0.24	0.09
17	BnB	Bottomland_Hardwood_Forest	221	3	1010	0.0136	1.36	0.0136	325	0.10	0.2300	0.010	1.0	0.07	0.0165	190	0.0437	2.47	0.07	0.01
18	ToA	Bottomland_Hardwood_Forest	31	1	1041	0.0323	3.23	0.0322	325	0.15	0.1600	0.010	1.0	0.08	0.0165	17	0.7522	0.57	0.08	0.03
19	BnB	Bottomland_Hardwood_Forest	452	4	787	0.0088	0.88	0.0088	325	0.10	0.3300	0.010	1.0	0.11	0.0165	480	0.0004	4.13	0.11	0.00
20	BnB	Pine_Plantation	298	5	513	0.0168	1.68	0.0168	325	0.10	0.3700	0.200	1.0	2.41	0.0165	230	0.0225	1.59	2.41	0.09
21	ToA	Pine_Plantation	215	4	215	0.0186	1.86	0.0186	325	0.15	0.4100	0.200	1.0	4.00	0.0165	158	0.0742	2.59	4.00	0.77
22	ToA	Bottomland_Hardwood_Forest	242	2	242	0.0083	0.83	0.0083	325	0.15	0.2400	0.010	1.0	0.12	0.0165	266	0.0124	5.28	0.12	0.01
23	BnB	Bottomland_Hardwood_Forest	401	3	547	0.0075	0.75	0.0075	325	0.10	0.2500	0.010	1.0	0.08	0.0165	464	0.0005	4.86	0.08	0.00
24	BnB	Bottomland_Hardwood_Forest	364	4	499	0.0110	1.10	0.0110	325	0.10	0.3000	0.010	1.0	0.10	0.0165	347	0.0032	3.00	0.10	0.00
25	BbA	Bottomland_Hardwood_Forest	134	2	134	0.0149	1.49	0.0149	325	0.15	0.2400	0.010	1.0	0.12	0.0165	110	0.1637	2.66	0.12	0.05
26	BbA	Pine_Plantation	60	1	60	0.0167	1.67	0.0167	325	0.15	0.1600	0.200	1.0	1.56	0.0165	46	0.4645	0.25	1.56	0.18
27	BbA	Open_Water	65	1	125	0.0154	1.54	0.0154	325	0.15	0.1600	0.000	0.0	0.00	0.0186	52	0.3773	0.16	0.00	0.00
28	BbA	Pine_Plantation	86	1	86	0.0116	1.16	0.0116	325	0.15	0.1400	0.200	1.0	1.37	0.0165	80	0.2682	0.77	1.37	0.28
29	BnB	Bottomland_Hardwood_Forest	138	3	472	0.0217	2.17	0.0217	325	0.10	0.3300	0.010	1.0	0.11	0.0165	94	0.2135	0.92	0.11	0.02
30	BnB	Open_Water	233	1	358	0.0043	0.43	0.0043	325	0.10	0.1300	0.000	0.0	0.00	0.0186	356	0.0013	0.58	0.00	0.00
31	BnB	Bottomland_Hardwood_Forest	103	1	462	0.0097	0.97	0.0097	325	0.10	0.1600	0.010	1.0	0.05	0.0165	105	0.1782	0.47	0.05	0.00
32	FoA	Bottomland_Hardwood_Forest	147	3	591	0.0204	2.04	0.0204	325	0.15	0.3500	0.010	1.0	0.17	0.0165	103	0.1831	0.78	0.17	0.02
33	FoA	Pine_Plantation	126	1	676	0.0079	0.79	0.0079	325	0.15	0.1300	0.200	1.0	1.27	0.0165	141	0.0969	0.55	1.27	0.07
34	BnB	Pine_Plantation	259	7	669	0.0270	2.70	0.0270	325	0.10	0.5600	0.200	1.0	3.64	0.0165	158	0.0743	2.87	3.64	0.78
35	ToA	Pine_Plantation	270	1	270	0.0037	0.37	0.0037	325	0.15	0.1000	0.200	1.0	0.98	0.0165	444	0.0007	2.75	0.98	0.00
36	ToA	Pine_Plantation	88	2	140	0.0227	2.27	0.0227	325	0.15	0.3500	0.200	1.0	3.41	0.0165	58	0.3817	1.46	3.41	1.90
37	BnB	Pine_Plantation	449	1	449	0.0022	0.22	0.0022	325	0.10	0.1500	0.200	1.0	0.98	0.0165	951	0.0000	4.73	0.98	0.00
38	BnB	Pine_Plantation	529	14	800	0.0265	2.65	0.0265	325	0.10	0.7600	0.200	1.0	4.94	0.0165	325	0.0047	4.56	4.94	0.11
39	FoA	Pine_Plantation	217	7	894	0.0323	3.23	0.0322	325	0.15	0.6400	0.200	1.0	6.24	0.0165	121	0.1362	0.93	6.24	0.79
40	FoA	Bottomland_Hardwood_Forest	294	10	885	0.0340	3.40	0.0340	325	0.15	0.8300	0.010	1.0	0.40	0.0165	159	0.0721	1.08	0.40	0.03
41	FoA	Residential	74	1	960	0.0135	1.35	0.0135	325	0.15	0.1400	0.030	1.0	0.20	0.0201	64	0.2782	0.51	0.20	0.03
42	BnB	Residential	270	1	1072	0.0037	0.37	0.0037	325	0.10	0.1000	0.030	1.0	0.10	0.0201	444	0.0001	3.55	0.10	0.00
43	BnB	Pine_Plantation	122	4	1056	0.0328	3.28	0.0328	325	0.10	0.4700	0.200	1.0	3.06	0.0165	67	0.3290	0.85	3.06	0.85
44	BnB	Bottomland_Hardwood_Forest	485	1	934	0.0021	0.21	0.0021	325	0.10	0.1500	0.010	1.0	0.05	0.0165	1068	0.0000	4.50	0.05	0.00
45	BnB	Residential	367	5	1465	0.0136	1.36	0.0136	325	0.10	0.3000	0.030	1.0	0.29	0.0201	314	0.0018	2.21	0.29	0.00
46	FoA	Residential	90	1	1555	0.0111	1.11	0.0111	325	0.15	0.1600	0.030	1.0	0.23	0.0201	85	0.1798	0.72	0.23	0.03
47	FoA	Residential	31	1	1587	0.0323	3.23	0.0322	325	0.15	0.1600	0.030	1.0	0.23	0.0201	17	0.7069	0.08	0.23	0.01
48	FoA	Urban	46	1	1632	0.0217	2.17	0.0217	325	0.15	0.2000	0.030	1.0	0.29	0.0201	31	0.5341	0.10	0.29	0.02
49	BnB	Urban	202	3	626	0.0149	1.49	0.0149	325	0.10	0.3300	0.030	1.0	0.32	0.0201	166	0.0357	0.52	0.32	0.01
50	BnB	Residential	328	6	594	0.0183	1.83	0.0183	325	0.10	0.5000	0.030	1.0	0.49	0.0201	243	0.0076	1.15	0.49	0.00
51	BnB	Pine_Plantation	266	6	266	0.0226	2.26	0.0226	325	0.10	0.4600	0.200	1.0	2.99	0.0165	177	0.0538	2.64	2.99	0.43
52	BnB	Pine_Plantation	153	2	153	0.0131	1.31	0.0131	325	0.10	0.2000	0.200	1.0	1.30	0.0165	134	0.1099	0.88	1.30	0.13
53	BnB	Bottomland_Hardwood_Forest	73	1	73	0.0137	1.37	0.0137	325	0.10	0.1400	0.010	1.0	0.05	0.0165	62	0.3573	0.64	0.05	0.01
54	BnB	Bottomland_Hardwood_Forest	114	3	114	0.0263	2.63	0.0263	325	0.10	0.3500	0.010	1.0	0.11	0.0165	70	0.3136	0.36	0.11	0.01
55	FoA	Bottomland_Hardwood_Forest	146	5	261	0.0342	3.42	0.0342	325	0.15	0.5400	0.010	1.0	0.26	0.0165	79	0.2721	0.41	0.26	0.03
56	FoA	Urban	154	1	154	0.0065	0.65	0.0065	325	0.15	0.1400	0.030	1.0	0.20	0.0201	191	0.0215	0.25	0.20	0.00
57	ToA	Urban	222	4	222	0.0180	1.80	0.0180	325	0.15	0.4200	0.030	1.0	0.61	0.0201	165	0.0360	0.20	0.61	0.00
58	ToA	Bottomland_Hardwood_Forest	305	6	305	0.0197	1.97	0.0197	325	0.15	0.5000	0.010	1.0	0.24	0.0165	217	0.0277	3.08	0.24	0.02
59	ToA	Bottomland_Hardwood_Forest	218	1	218	0.0046	0.46	0.0046	325	0.15	0.1400	0.010	1.0	0.07	0.0165	322	0.0049	1.61	0.07	0.00
60	ToA	Bottomland_Hardwood_Forest	291	1	291	0.0034	0.34	0.0034	325	0.15	0.1000	0.010	1.0	0.05	0.0165	496	0.0003	2.62	0.05	0.00
61	BnB	Bottomland_Hardwood_Forest	437	7	728	0.0160	1.60	0.0160	325	0.10	0.4500	0.010	1.0	0.15	0.0165	345	0.0034	1.94	0.15	0.00
62	BnB	Bottomland_Hardwood_Forest	194	1	422	0.0052	0.52	0.0052	325	0.10	0.1400	0.010	1.0	0.05	0.0165	270	0.0116	1.80	0.05	0.00
63	ToA	Bottomland_Hardwood_Forest	176	1	598	0.0057	0.57	0.0057	325	0.15	0.1300	0.010	1.0	0.06	0.0165	233	0.0212	0.51	0.06	0.00
64	ToA	Bottomland_Hardwood_Forest	228	5	228	0.0219	2.19	0.0219	325	0.15	0.4300	0.010	1.0	0.21	0.0165	154	0.0788	2.74	0.21	0.05
65	ToA	Bottomland_Hardwood_Forest	297	1	297	0.0034	0.34	0.0034	325	0.15	0.1000	0.010	1.0	0.05	0.0165	512	0.0002	0.67	0.05	0.00
66	FoA	Bottomland_Hardwood_Forest	140	5	437	0.0357	3.57	0.0357	325	0.15	0.5400	0.010	1.0	0.26	0.0165	74	0.2945	1.03	0.26	0.08
67	FoA	Bottomland_Hardwood_Forest	369	6	522	0.0163	1.63	0.0163	325	0.15	0.3900	0.010	1.0	0.19	0.0165	289	0.0084	0.72	0.19	0.00
68	ToA	Bottomland_Hardwood_Forest	152	2	152	0.0132	1.32	0.0132	325	0.15	0.2000	0.010	1.0	0.10	0.0165	133	0.1123	0.77	0.10	0.01
69	ToA	Urban	229	4	229	0.0175	1.75	0.0175	325	0.15	0.3300	0.030	1.0	0.48	0.0201	173	0.0307	0.24	0.48	0.00
70	FoA	Urban	413	6	642	0.0145	1.45	0.0145	325	0.15	0.4500	0.030	1.0	0.66	0.0201	343	0.0010	0.43	0.66	0.00
71	FoA	Residential	271	4	271	0.0148	1.48	0.0148	325	0.15	0.3400	0.030	1.0	0.50	0.0201	223	0.0113	3.00	0.50	0.02
72	FoA	Bottomland_Hardwood_Forest	156	3	156	0.0192	1.92	0.0192	325	0.15	0.3500	0.010	1.0	0.17	0.0165	112	0.1563	0.82	0.17	0.02
73	ToA	Bottomland_Hardwood_Forest	140	4	140	0.0286	2.86	0.0286	325	0.15	0.5000	0.010	1.0	0.24	0.0165	83	0.2550	1.00	0.24	0.06

		Unit Characteristics							RUSLE						SEDD Method					
Unit ID	Soil Type	Land Use	Unit Slope Length (ft)	Unit Slope Height (ft)	Hydro Path Length (ft)	Slope (ft/ft)	Slope (%)	Slope Angle (Radians)	R	K	LS	C	P	A (tons/(acre-yr))	β	Time (hrs)	SDR	Area (acre)	A (tons/(acre-yr))	Yield (tons/yr)
74	ToA	Bottomland_Hardwood_Forest	130	6	130	0.0462	4.62	0.0461	325	0.15	0.6600	0.010	1.0	0.32	0.0165	61	0.3685	1.19	0.32	0.14
75	FoA	Bottomland_Hardwood_Forest	150	6	375	0.0400	4.00	0.0400	325	0.15	0.6600	0.010	1.0	0.32	0.0165	75	0.2901	3.60	0.32	0.34
76	BnB	Bottomland_Hardwood_Forest	31	1	31	0.0323	3.23	0.0322	325	0.10	0.1600	0.010	1.0	0.05	0.0165	17	0.7522	0.03	0.05	0.00
77	BnB	Residential	322	8	353	0.0248	2.48	0.0248	325	0.10	0.6100	0.030	1.0	0.59	0.0201	204	0.0165	1.90	0.59	0.02
78	FoA	Residential	189	8	189	0.0423	4.23	0.0423	325	0.15	0.7500	0.030	1.0	1.10	0.0201	92	0.1578	1.28	1.10	0.22
79	FoA	Residential	305	2	888	0.0066	0.66	0.0066	325	0.15	0.1700	0.030	1.0	0.25	0.0201	377	0.0005	2.56	0.25	0.00
80	FoA	Urban	48	1	843	0.0208	2.08	0.0208	325	0.15	0.2000	0.030	1.0	0.29	0.0201	33	0.5125	0.35	0.29	0.05
81	FoA	Residential	249	1	1092	0.0040	0.40	0.0040	325	0.15	0.1400	0.030	1.0	0.20	0.0201	393	0.0004	0.99	0.20	0.00
82	FoA	Residential	161	1	1254	0.0062	0.62	0.0062	325	0.15	0.1300	0.030	1.0	0.19	0.0201	204	0.0165	0.14	0.19	0.00
83	WoA	Residential	319	1	1364	0.0031	0.31	0.0031	325	0.10	0.1000	0.030	1.0	0.10	0.0201	570	0.0000	1.88	0.10	0.00
84	LnA	Residential	315	1	115	0.0032	0.32	0.0032	325	0.10	0.1000	0.030	1.0	0.10	0.0201	559	0.0000	2.85	0.10	0.00
85	LnA	Urban	45	1	800	0.0222	2.22	0.0222	325	0.10	0.2000	0.030	1.0	0.20	0.0201	30	0.5451	0.66	0.20	0.07
86	FoA	Urban	41	1	440	0.0244	2.44	0.0244	325	0.15	0.2400	0.030	1.0	0.35	0.0201	26	0.5900	0.39	0.35	0.08
87	FoA	Residential	471	6	915	0.0127	1.27	0.0127	325	0.15	0.3500	0.030	1.0	0.51	0.0201	417	0.0002	3.69	0.51	0.00
88	FoA	Urban	25	1	944	0.0400	4.00	0.0400	325	0.15	0.2100	0.030	1.0	0.31	0.0201	13	0.7778	0.24	0.31	0.06
89	FoA	Residential	152	1	1096	0.0066	0.66	0.0066	325	0.15	0.1400	0.030	1.0	0.20	0.0201	187	0.0231	0.34	0.20	0.00
90	FoA	Urban	300	3	947	0.0100	1.00	0.0100	325	0.15	0.2800	0.030	1.0	0.41	0.0201	300	0.0024	0.32	0.41	0.00
91	FoA	Residential	513	4	1001	0.0078	0.78	0.0078	325	0.15	0.2800	0.030	1.0	0.41	0.0201	581	0.0000	1.35	0.41	0.00
92	WoA	Residential	123	1	629	0.0081	0.81	0.0081	325	0.10	0.1400	0.030	1.0	0.14	0.0201	136	0.0644	0.31	0.14	0.00
93	WoA	Urban	37	1	505	0.0270	2.70	0.0270	325	0.10	0.2400	0.030	1.0	0.23	0.0201	23	0.6361	0.23	0.23	0.03
94	FoA	Urban	65	3	454	0.0462	4.62	0.0461	325	0.15	0.4700	0.030	1.0	0.69	0.0201	30	0.5444	0.21	0.69	0.08
95	FoA	Residential	130	2	400	0.0154	1.54	0.0154	325	0.15	0.2400	0.030	1.0	0.35	0.0201	105	0.1216	1.53	0.35	0.07
96	LnA	Residential	86	1	755	0.0116	1.16	0.0116	325	0.10	0.1400	0.030	1.0	0.14	0.0201	80	0.2013	1.28	0.14	0.04
97	WoA	Residential	285	2	285	0.0070	0.70	0.0070	325	0.10	0.1700	0.030	1.0	0.17	0.0201	340	0.0011	5.66	0.17	0.00
98	WoA	Urban	78	1	356	0.0128	1.28	0.0128	325	0.10	0.1400	0.030	1.0	0.14	0.0201	69	0.2504	1.25	0.14	0.04
99	WoA	Residential	468	7	468	0.0150	1.50	0.0150	325	0.10	0.4600	0.030	1.0	0.45	0.0201	383	0.0005	3.09	0.45	0.00
100	WoA	Residential	495	7	1340	0.0141	1.41	0.0141	325	0.10	0.4900	0.030	1.0	0.48	0.0201	416	0.0002	2.63	0.48	0.00
101	AuB	Residential	350	3	1330	0.0086	0.86	0.0086	325	0.00	0.2900	0.030	1.0	0.00	0.0201	378	0.0005	1.29	0.00	0.00
102	WoA	Residential	252	2	981	0.0079	0.79	0.0079	325	0.10	0.2400	0.030	1.0	0.23	0.0201	283	0.0034	0.75	0.23	0.00
103	WoA	Bottomland_Hardwood_Forest	180	1	865	0.0056	0.56	0.0056	325	0.10	0.1400	0.010	1.0	0.05	0.0165	241	0.0186	1.61	0.05	0.00
104	WoA	Bottomland_Hardwood_Forest	196	2	196	0.0102	1.02	0.0102	325	0.10	0.2300	0.010	1.0	0.07	0.0165	194	0.0407	1.11	0.07	0.00
105	WoA	Residential	130	1	180	0.0077	0.77	0.0077	325	0.10	0.1400	0.030	1.0	0.14	0.0201	148	0.0508	1.65	0.14	0.01
106	WoA	Residential	403	2	691	0.0050	0.50	0.0050	325	0.10	0.2000	0.030	1.0	0.20	0.0201	572	0.0000	5.56	0.20	0.00
107	WoA	Urban	40	1	1486	0.0250	2.50	0.0250	325	0.10	0.2400	0.030	1.0	0.23	0.0201	25	0.6014	0.35	0.23	0.05
108	WoA	Urban	63	1	580	0.0159	1.59	0.0159	325	0.10	0.1600	0.030	1.0	0.16	0.0201	50	0.3660	0.44	0.16	0.03
109	WoA	Agriculture	240	1	240	0.0042	0.42	0.0042	325	0.10	0.1400	0.250	0.7	0.80	0.0201	372	0.0006	2.71	0.80	0.00
110	WoA	Agriculture	485	1	485	0.0021	0.21	0.0021	325	0.10	0.1500	0.250	0.7	0.85	0.0201	1068	0.0000	5.08	0.85	0.00
111	WoA	Bottomland_Hardwood_Forest	216	1	684	0.0046	0.46	0.0046	325	0.10	0.1400	0.010	1.0	0.05	0.0165	317	0.0053	2.69	0.05	0.00
112	WoA	Open_Water	193	1	980	0.0052	0.52	0.0052	325	0.10	0.1400	0.000	0.0	0.00	0.0186	268	0.0068	0.63	0.00	0.00
113	FoA	Bottomland_Hardwood_Forest	445	2	1287	0.0045	0.45	0.0045	325	0.15	0.1900	0.010	1.0	0.09	0.0165	664	0.0000	4.14	0.09	0.00
114	WoA	Bottomland_Hardwood_Forest	244	1	841	0.0041	0.41	0.0041	325	0.10	0.1400	0.010	1.0	0.05	0.0165	381	0.0019	3.40	0.05	0.00
115	WoA	Bottomland_Hardwood_Forest	136	2	136	0.0147	1.47	0.0147	325	0.10	0.2400	0.010	1.0	0.08	0.0165	112	0.1572	2.76	0.08	0.03
116	WoA	Agriculture	240	2	517	0.0083	0.83	0.0083	325	0.10	0.2400	0.250	0.7	1.37	0.0201	263	0.0051	4.80	1.37	0.03
117	WoA	Residential	178	1	611	0.0056	0.56	0.0056	325	0.10	0.1400	0.030	1.0	0.14	0.0201	237	0.0085	0.55	0.14	0.00
118	FoA	Agriculture	400	5	400	0.0125	1.25	0.0125	325	0.15	0.3200	0.250	0.7	2.73	0.0201	358	0.0008	0.82	2.73	0.00
119	FoA	Residential	54	1	429	0.0185	1.85	0.0185	325	0.15	0.2000	0.030	1.0	0.29	0.0201	40	0.4504	0.68	0.29	0.09
120	WoA	Residential	175	3	175	0.0171	1.71	0.0171	325	0.10	0.3200	0.030	1.0	0.31	0.0201	134	0.0681	2.26	0.31	0.05
121	FoA	Residential	440	4	1075	0.0091	0.91	0.0091	325	0.15	0.3200	0.030	1.0	0.47	0.0201	461	0.0001	2.68	0.47	0.00
122	FoA	Bottomland_Hardwood_Forest	169	1	1244	0.0059	0.59	0.0059	325	0.15	0.1300	0.010	1.0	0.06	0.0165	220	0.0266	0.55	0.06	0.00
123	FoA	Bottomland_Hardwood_Forest	294	2	431	0.0068	0.68	0.0068	325	0.15	0.1700	0.010	1.0	0.08	0.0165	356	0.0028	4.79	0.08	0.00
124	WoA	Bottomland_Hardwood_Forest	300	2	733	0.0067	0.67	0.0067	325	0.10	0.1700	0.010	1.0	0.06	0.0165	367	0.0023	4.38	0.06	0.00
125	WoA	Bottomland_Hardwood_Forest	400	2	1687	0.0050	0.50	0.0050	325	0.10	0.2000	0.010	1.0	0.07	0.0165	566	0.0001	4.31	0.07	0.00
126	WoA	Bottomland_Hardwood_Forest	161	1	1873	0.0062	0.62	0.0062	325	0.10	0.1300	0.010	1.0	0.04	0.0165	204	0.0344	2.25	0.04	0.00
127	WoA	Bottomland_Hardwood_Forest	310	2	1253	0.0065	0.65	0.0065	325	0.10	0.1700	0.010	1.0	0.06	0.0165	386	0.0017	2.74	0.06	0.00
128	FoA	Bottomland_Hardwood_Forest	275	2	890	0.0073	0.73	0.0073	325	0.15	0.2100	0.010	1.0	0.10	0.0165	322	0.0049	1.42	0.10	0.00
129	FoA	Residential	311	4	615	0.0129	1.29	0.0129	325	0.15	0.2800	0.030	1.0	0.41	0.0201	274	0.0040	2.48	0.41	0.00
130	FoA	Residential	286	3	628	0.0105	1.05	0.0105	325	0.15	0.2800	0.030	1.0	0.41	0.0201	279	0.0037	1.68	0.41	0.00
131	FoA	Bottomland_Hardwood_Forest	210	7	340	0.0333	3.33	0.0333	325	0.15	0.6800	0.010	1.0	0.33	0.0165	115	0.1499	1.88	0.33	0.09
132	FoA	Bottomland_Hardwood_Forest	142	7	303	0.0493	4.93	0.0493	325	0.15	0.8100	0.010	1.0	0.39	0.0165	64	0.3481	1.16	0.39	0.16
133	FoA	Residential	245	10	245	0.0408	4.08	0.0408	325	0.15	0.8600	0.030	1.0	1.26	0.0201	121	0.0874	1.16	1.26	0.13
134	FoA	Bottomland_Hardwood_Forest	675	7	1001	0.0104	1.04	0.0104	325	0.15	0.4400	0.010	1.0	0.21	0.0165	663	0.0000	4.86	0.21	0.00
135	FoA	Bottomland_Hardwood_Forest	201	3	1115	0.0149	1.49	0.0149	325	0.15	0.3300	0.010	1.0	0.16	0.0165	165	0.0662	2.04	0.16	0.02
136	FoA	Bottomland_Hardwood_Forest	500	1	2347	0.0020	0.20	0.0020	325	0.15	0.1500	0.010	1.0	0.07	0.0165	1118	0.0000	7.17	0.07	0.00
137	FoA	Agriculture	101	1	2462	0.0099	0.99	0.0099	325	0.15	0.1600	0.250	0.7	1.37	0.0201	102	0.1300	0.28	1.37	0.05
138	LnA	Agriculture	305	1	2790	0.0033	0.33	0.0033	325	0.10	0.1000	0.250	0.7	0.57	0.0201	533	0.0000	0.92	0.57	0.00
139	LnA	Bottomland_Hardwood_Forest	240	1	3019	0.0042	0.42	0.0042	325	0.10	0.1400	0.010	1.0	0.05	0.0165	372	0.0022	2.24	0.05	0.00
140	WoA	Bottomland_Hardwood_Forest	357	1	1862	0.0028	0.28	0.0028	325	0.10	0.1200	0.010	1.0	0.04	0.0165	675	0.0000	3.09	0.04	0.00
141	LnA	Bottomland_Hardwood_Forest	437	1	1488	0.0023	0.23	0.0023	325	0.10	0.1200	0.010	1.0	0.04	0.0165	914	0.0000	5.62	0.04	0.00
142	LnA	Bottomland_Hardwood_Forest	483	4	1246	0.0083	0.83	0.0083	325	0.10	0.3300	0.010	1.0	0.11	0.0165	531	0.0002	2.39	0.11	0.00
143	FoA	Bottomland_Hardwood_Forest	233	3	233	0.0129	1.29	0.0129	325	0.15	0.2300	0.010	1.0	0.11	0.0165	205	0.0338	2.28	0.11	0.01
144	WoA	Bottomland_Hardwood_Forest	454	7	762	0.0154	1.54	0.0154	325	0.10	0.4600	0.010	1.0	0.15	0.0165	366	0.0024	3.06	0.15	0.00
145	FoA	Bottomland_Hardwood_Forest	33	2	304	0.0606	6.06	0.0605	325	0.15	0.4100	0.010	1.0	0.20	0.0165	13	0.8016	0.12	0.20	0.02

Total UT Miller's Creek = Annual Soil Loss due to erosion (tons/(acre-yr)): 76

Total UT Miller's Creek = Annual Sediment Load (tons/yr): 10

DESIGN SHEETS

Sheet 1 – 9	Proposed Conditions
Sheet 10	Boundary Marking Plan
Sheet PL-1 – PL-2	Planting Plan

CONTRACT: UT MILLERS CREEK EEP PROJECT #: 95719

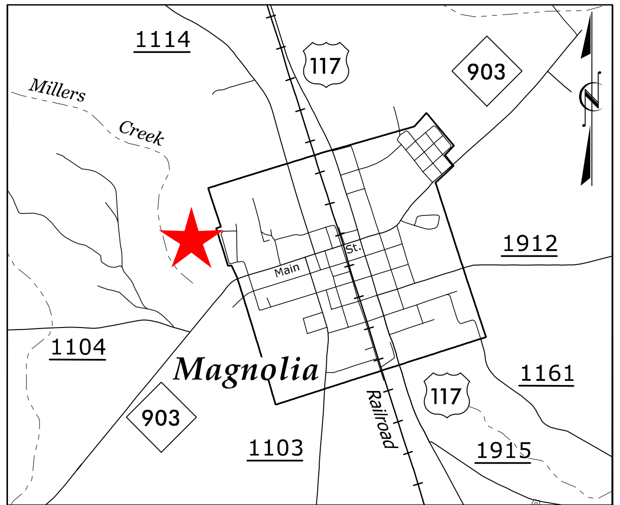
STATE	UT MILLERS CREEK	SHEET NO.
N.C.		1

MITIGATION PLANS
UT MILLERS CREEK

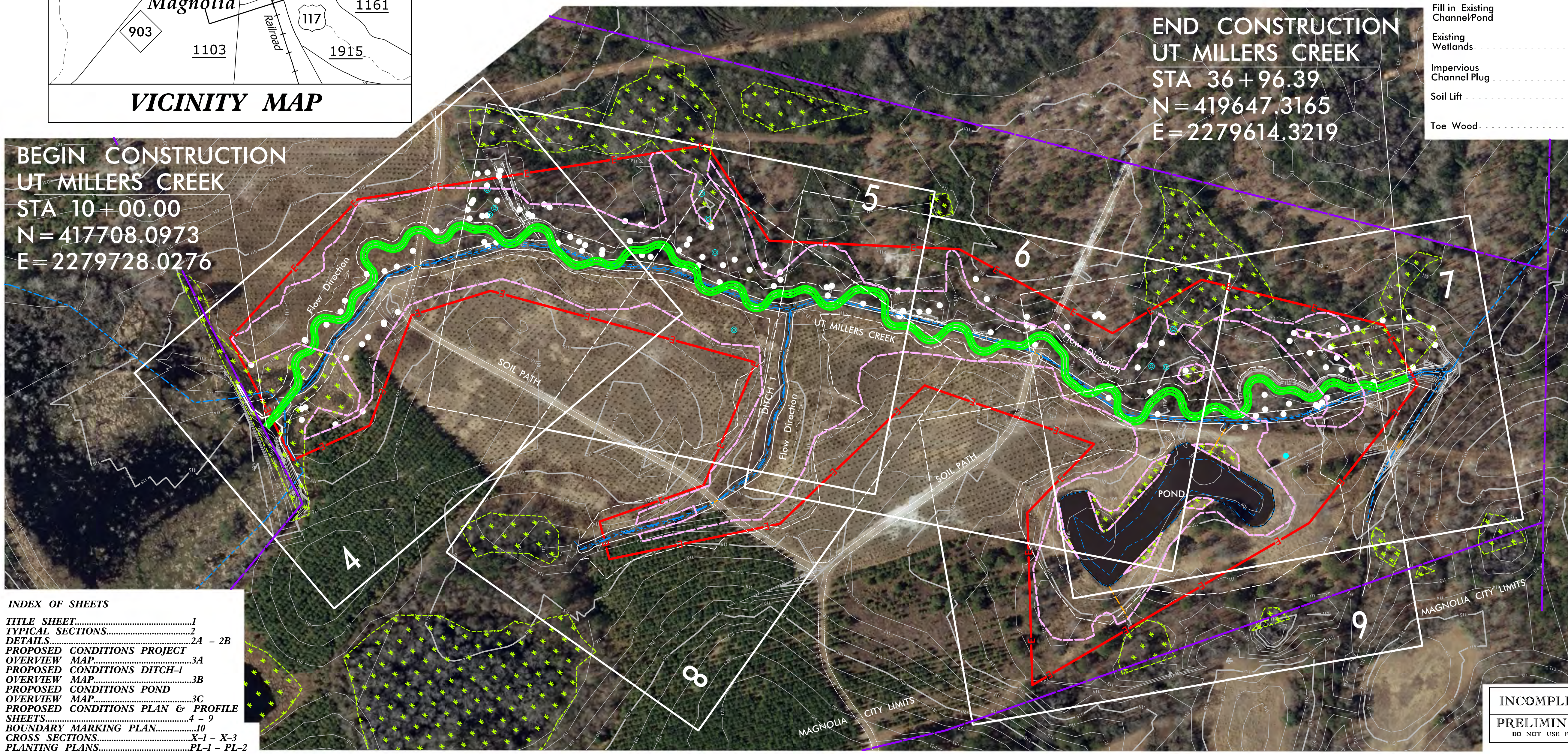
LOCATION: DUPLIN COUNTY, NORTH CAROLINA

LAT: 35°22' 24" N LONG: 77°59' 40" W

TYPE OF WORK: STREAM RESTORATION (CLEARING, GRUBBING, GRADING, EROSION CONTROL AND PLANTING)



VICINITY MAP



CONVENTIONAL SYMBOLS

- Conservation Easement
- Riparian Restoration Area
- Stream or Body of Water
- Pipe Culvert
- Existing Top of Bank
- Property Line
- Single Tree
- Log Sill
- Fill in Existing Channel/Pond
- Existing Wetlands
- Impervious Channel Plug
- Soil Lift
- Toe Wood

INDEX OF SHEETS

INCOMPLETE PLANS

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

GRAPHIC SCALES

50 25 0 50 100
PLANS

10 5 0 10 20
PROFILE (HORIZONTAL)

20 10 0 20 40
PROFILE (VERTICAL)

DESIGN DATA

DESIGN STREAM TYPE	=	E5
BANKFULL AREA (FT^2) CROSS-SECTIONED	=	8.10
BANKFULL WIDTH (FT)	=	8.75
MAX DEPTH (FT)	=	1.40
WIDTH /DEPTH RATIO	=	9.50
DRAINAGE AREA (MI^2)	=	0.39
BANKFULL SLOPE(FT/FT)	=	0.0005

PROJECT LENGTH

EXISTING STREAM LENGTH	=	2,100 FT
PROPOSED DESIGN STREAM LENGTH	=	2,679 FT

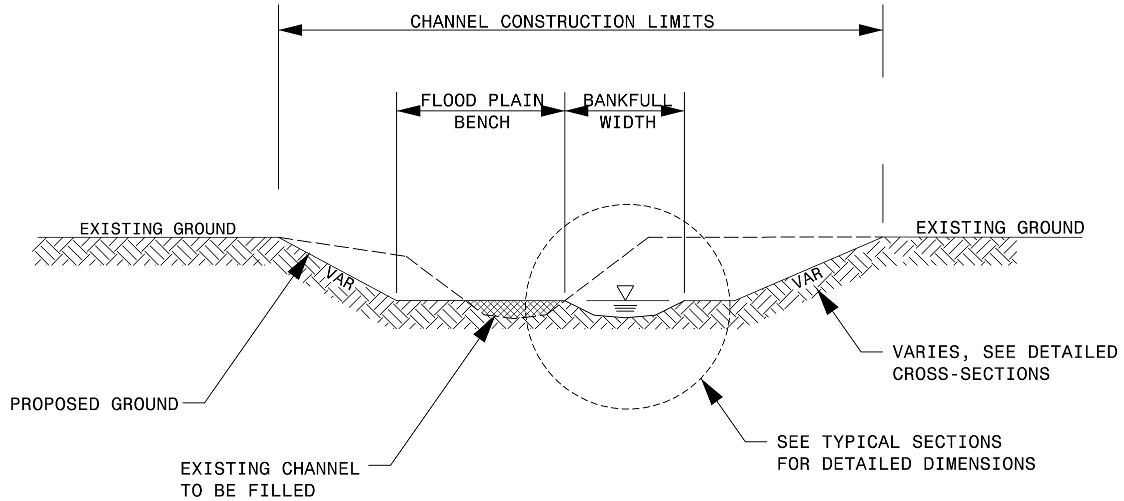
KATIE McKEITHIAN
PROJECT DESIGNER /ENGINEER

RYAN V. SMITH
PROJECT MANAGER

Prepared in the Office of:

ICA Engineering
5121 Kingdom Way,
Suite 100
Raleigh, NC 27607
NC License No: F-0258

9/15/2014
R:\stream\Proj\Mitigation Plans\UTMillersCrk_psh_01.dgn
Florence & Hutcheson, Inc.



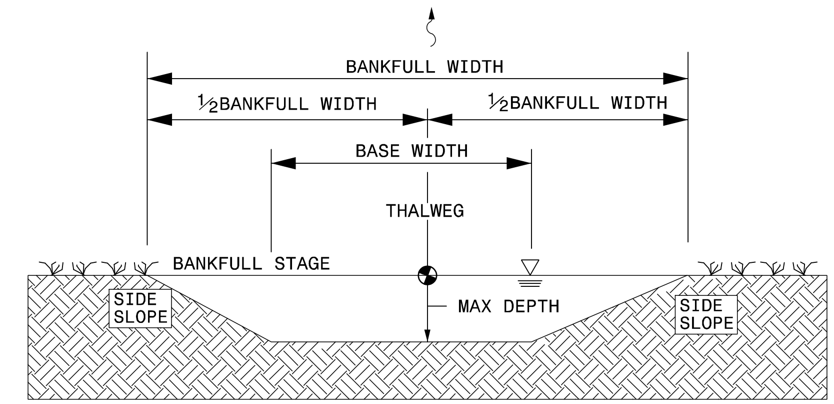
TYPICAL CHANNEL SECTION

VARIABLE	STATION - STATION
UT MILLERS CREEK	10+00.00 - 36+96.39

TYPICAL SECTION - SHALLOW

SCALE: NTS
ALL UNITS ARE IN FEET

VARIABLE	UT MILLERS CREEK
BANKFULL WIDTH	8.75
BASE WIDTH	3.2
MAXIMUM DEPTH	1.40
SIDE SLOPE	2:1



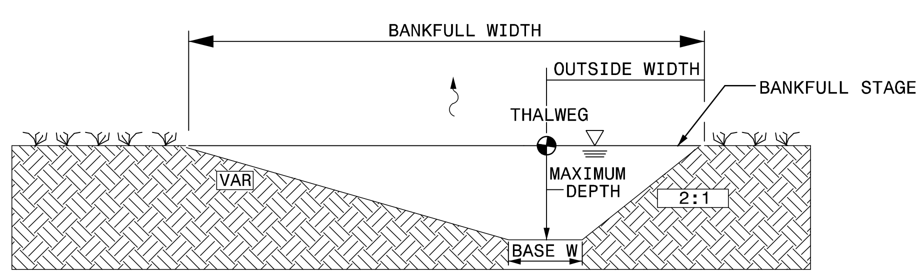
THALWEG (DEEPEST POINT IN CROSS SECTION)
IS LOCATED IN CENTER OF CHANNEL IN A RIFFLE.

NOTES:
- ALL CROSS SECTIONS ARE SHOWN LOOKING IN THE (DOWNSTREAM) DIRECTION.
- GRADE POINT IS THE ELEVATION SHOWN ON PROFILE.
- ALL SHARP CORNERS SHOULD BE ROUNDED

TYPICAL SECTION - POOL RIGHT

SCALE: NTS
ALL UNITS ARE IN FEET

VARIABLE	UT MILLERS CREEK
BANKFULL WIDTH	10.5
BASE WIDTH	3.32
MAX DEPTH	1.75
OUTSIDE WIDTH	5.16
BAR SIDE SLOPE	2.11
RIGHT BANK SIDE SLOPE	1.25



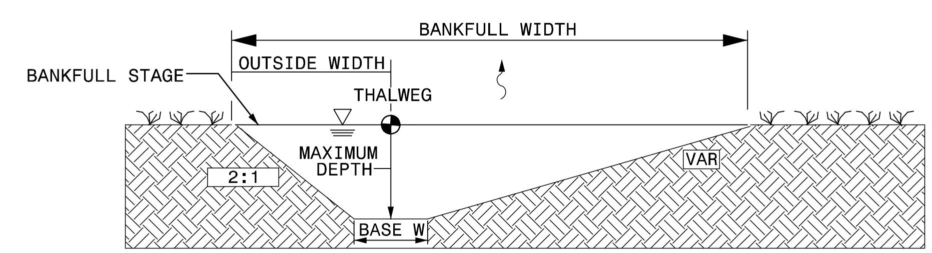
THALWEG (DEEPEST POINT IN A CROSS SECTION)
IS LOCATED IN THE MIDDLE OF THE BASE WIDTH.

NOTES:
- ALL CROSS SECTIONS ARE SHOWN LOOKING IN THE (DOWNSTREAM) DIRECTION.
- GRADE POINT IS THE ELEVATION SHOWN ON PROFILE.
- ALL SHARP CORNERS SHOULD BE ROUNDED

TYPICAL SECTION - POOL LEFT

SCALE: NTS
ALL UNITS ARE IN FEET

VARIABLE	UT MILLERS CREEK
BANKFULL WIDTH	10.5
BASE WIDTH	3.32
MAX DEPTH	1.75
OUTSIDE WIDTH	5.16
BAR SIDE SLOPE	2.11
LEFT BANK SIDE SLOPE	1.25



THALWEG (DEEPEST POINT IN A CROSS SECTION)
IS LOCATED IN THE MIDDLE OF THE BASE WIDTH.

NOTES:
- ALL CROSS SECTIONS ARE SHOWN LOOKING IN THE (DOWNSTREAM) DIRECTION.
- GRADE POINT IS THE ELEVATION SHOWN ON PROFILE.
- ALL SHARP CORNERS SHOULD BE ROUNDED

INCOMPLETE PLANS
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

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Raleigh, NC 27607
NC License No. F-0258

UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

NOT TO SCALE

DATE: 8-12-13

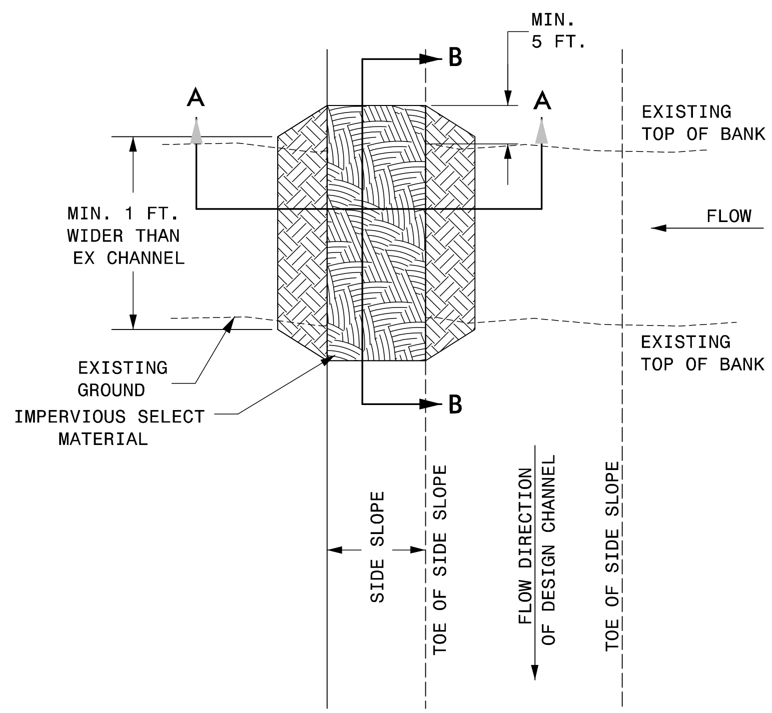
TYPICAL SECTIONS

SHEET 2

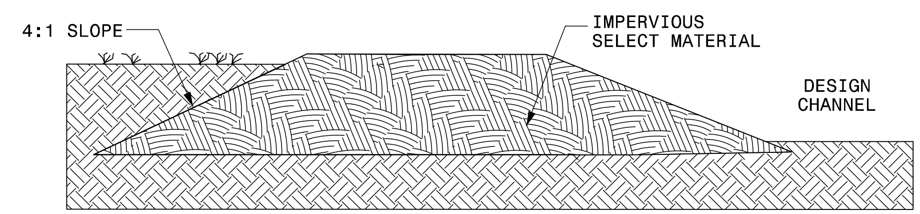
EEP# 95719

IMPERVIOUS CHANNEL PLUG

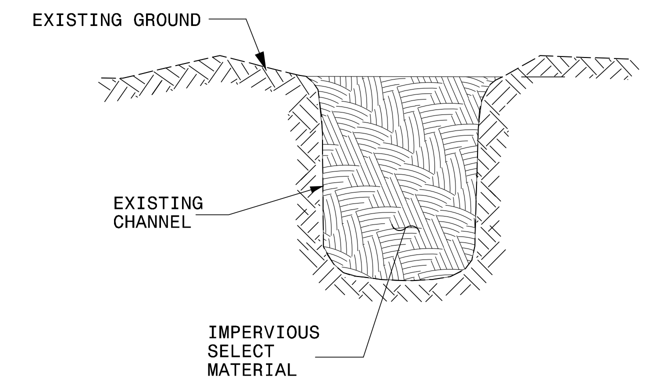
SCALE: NTS



PLAN VIEW



SECTION A-A



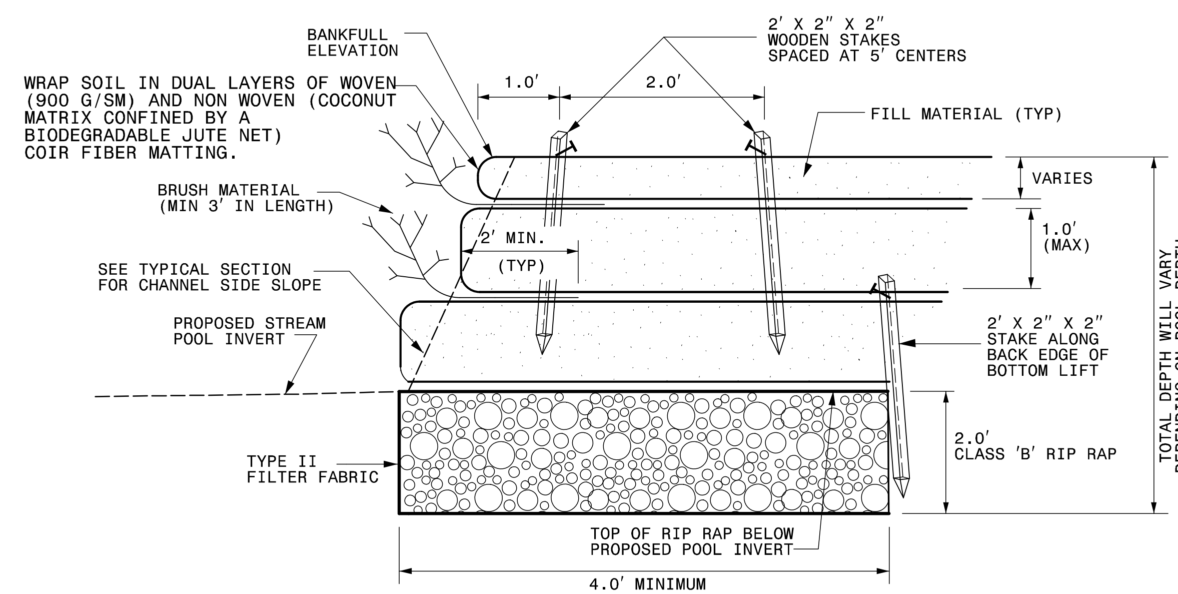
SECTION B-B

SOIL LIFT

SCALE: NTS

NOTES:

1. WOODEN STAKES SHALL HAVE A 2″ GALVANIZED ROOFING NAIL INSERTED AT THE TOP TO HOLD MATTING IN PLACE.
2. WOODEN STAKES SHALL BE SPACED AT 5′ CENTER AT THE TOP OF SLOPE.
3. BRUSH MATERIAL SHALL CONSIST OF BLACK WILLOW LIMBS (OR OTHER SPECIES APPROVED BY DESIGNER) NO LESS THAN 0.25″ DIAMETER, SPACED NO GREATER THAN 0.5′ APART.
4. BRUSH MATERIAL SHALL BE A MINIMUM OF 3′ IN LENGTH, PROTRUDING 1.0′ OUT INTO THE CHANNEL.
5. CONTRACTOR IS TO USE 10′ WIDE COIR FIBER MATTING TO WRAP SOIL LIFTS.
6. WOVEN COIR FIBER MATTING SHALL BE HEAVY DUTY MINIMUM 900 G/SM. NON WOVEN COIR FIBER MATTING SHALL BE A COCONUT MATRIX 9.5 OZ/SY CONFINED BY A BIODEGRADABLE JUTE NET.
7. FILL MATERIAL SHALL BE COMPOSED OF MATERIALS OBTAINED ON SITE AND APPROVED BY DESIGNER.
8. THE CONTRACTOR IS TO MECHANICALLY COMPACT FILL MATERIAL UPON COMPLETION OF EACH LIFT.
9. THE CONTRACTOR IS TO BRUSH SEED ONTO THE FACE OF THE ENTIRE SOIL LIFT AFTER IT IS COMPLETED.



INCOMPLETE PLANS
PRELIMINARY PLANS
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ICA Engineering

UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

NOT TO SCALE

DATE: 8-12-13

DETAILS

SHEET
2A

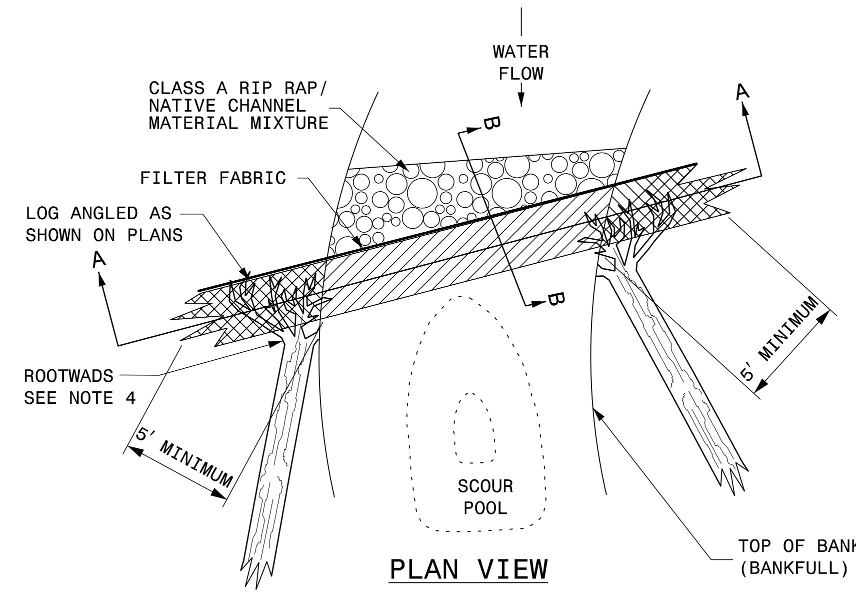
EEP# 95719

9/15/2014

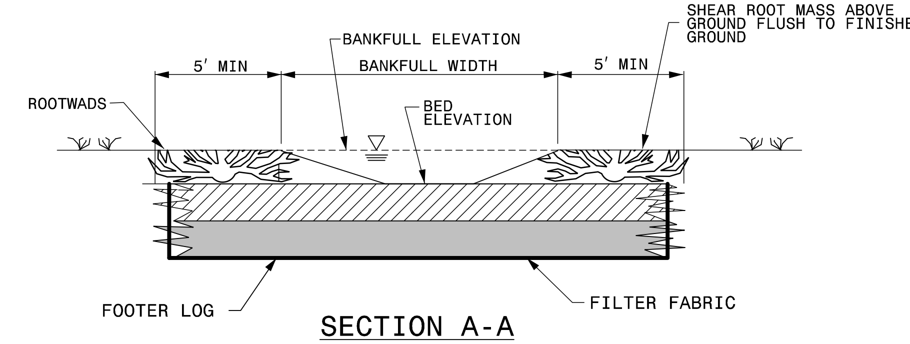
LOG SILL
SCALE: NTS

NOTES:

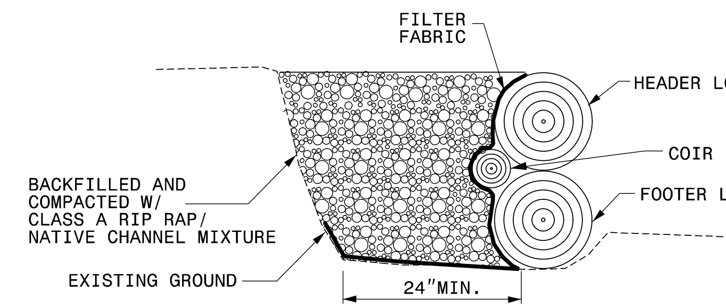
1. LOG SILL LOGS SHALL BE OF A HARDWOOD SPECIES, AND SHALL BE A MINIMUM 18" IN DIAMETER, MEASURED AT ANY POINT ALONG THE LOG (FOOTER LOG MAY BE SUBSTITUTED WITH PINE).
2. LOG SILL SHALL BE CONSTRUCTED WITH 1 FOOTER LOG AND 1 HEADER LOG.
3. ANGLE OF LOGS IN CHANNEL SHALL MATCH THE ANGLE OF THE LOG AS SHOWN ON THE PLAN VIEW WITHIN THE PLANS OR DIRECTED BY DESIGNER.
4. ROOTWADS SHALL BE PLACED AT THE CHANNEL EDGE ABOVE THE SILL ON BOTH THE LEFT AND RIGHT BANKS. ROOTWADS TO BE BURIED BELOW OR CUT TO FINISHED GRADE.
5. LENGTH OF LOG SHALL EXTEND A MINIMUM OF 5' INTO EACH BANK.
6. COIR LOG SHALL BE A MINIMUM OF 6" IN DIAMETER. USE COIR LOG TO PLUG GAPS BETWEEN THE HEADER AND FOOTER LOGS. USE A MINIMUM 8" GALVANIZED SMOOTH SPIKE ON 3' SPACING.



PLAN VIEW



SECTION A-A

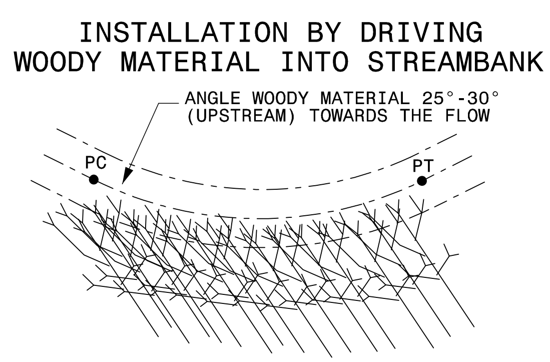


SECTION B-B

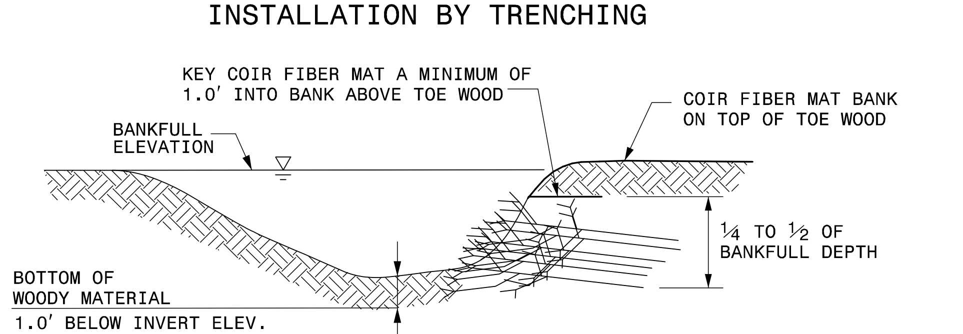
TOE WOOD
SCALE: NTS

NOTES:

1. WOODY MATERIAL SHALL BE HARDWOOD SPECIES, AND SHOULD NOT BE DETERIORATED AT THE TIME OF INSTALLATION.
2. WHEN BACKFILLING OVER AND AROUND WOODY MATERIAL PACK FIRMLY TO SECURE ALL CONNECTIONS AND GAPS. THERE SHOULD BE NO GAP BETWEEN BOTTOM OF WOODY MATERIAL & STREAMBED.
3. WOODY MATERIAL SHALL OVERLAP.
4. SIDE SLOPES SHALL BE MATTED.
5. WOODY MATERIAL SHALL BE A MINIMUM OF 3" DIAMETER AND A MINIMUM OF 4' IN LENGTH.
6. WOODY MATERIAL SHALL BE DENSLY PACKED TO FILL AND PROTECT STREAMBANK TOE.

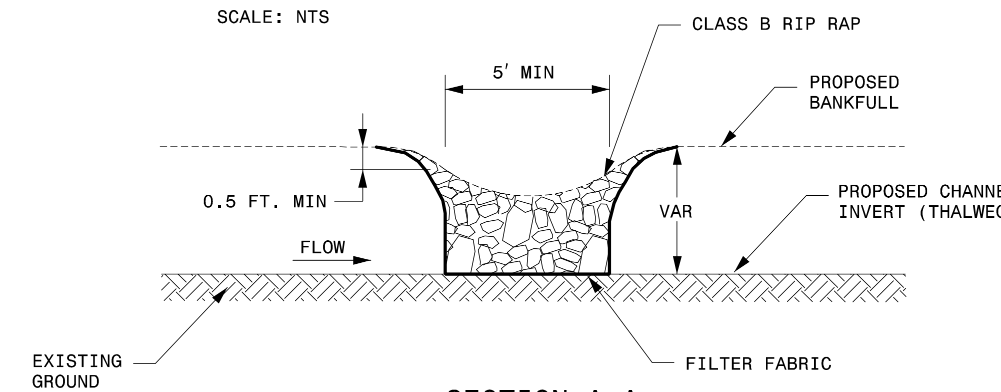


PLAN VIEW

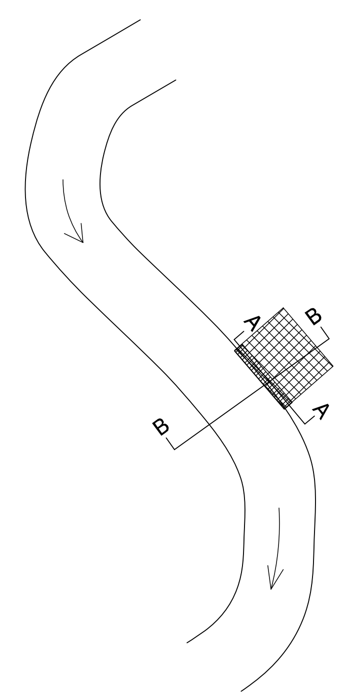


WOODY MATERIAL - CROSS-SECTION (CUT)

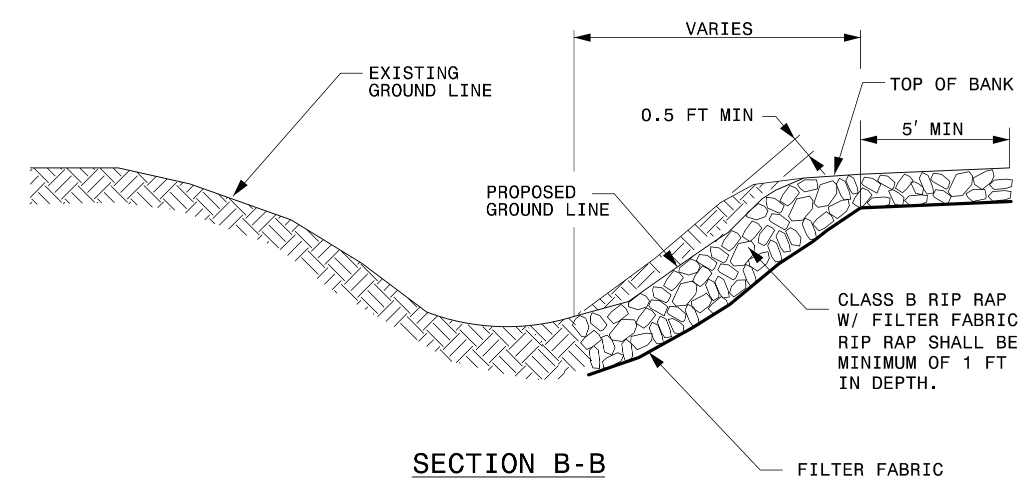
FLOODPLAIN INTERCEPTOR
SCALE: NTS



SECTION A-A



PLAN VIEW



SECTION B-B

NOTE:
FLOODPLAIN INTERCEPTORS SHALL BE PLACED ON-SITE AT AREAS SPECIFIED IN PLANS AND/OR ONSITE BY DESIGNER.

INCOMPLETE PLANS
PRELIMINARY PLANS
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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

NOT TO SCALE

DATE: 8-12-13

DETAILS

SHEET
2B

EEP# 95719

9/5/2014
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CONSTRUCTION SEQUENCE

The Contractor is responsible for the following sequence of construction in accordance with the Construction Plans and the Special Provisions. All items under I. Initial Site Preparation shall be completed prior to any other phase of work. Sections II. Channel Construction, III. Mulching Operation, IV. Ditch 1, and V. Pond Work may be constructed simultaneously if multiple crews are utilized. Ditch 1 shall be completed prior to channel work reaching station 22+00. Pond shall be completed prior to channel work reach station 33+00.

I. Initial Site Preparation

1. Stake and mark sensitive areas with boundary marking material to the limits as indicated on the construction plans.
2. Prepare staging and stockpiling areas in areas located on the construction plans.
3. Install construction entrances.
4. Stake construction and limits of construction as shown on the construction plans.
5. Install sediment and erosion control devices.
6. Install and maintain an onsite rain gauge and log book to record the rainfall amounts and dates.

II. Channel Construction

UT to Millers Creek Station approximately 11+00 to 17+00

1.Reach will be constructed from the upstream end, working in the downstream direction and working offline from existing stream flow.
2. Install sediment and erosion control devices.
3. Construct the proposed stream channel. Open up only that portion of the channel that can be completed, stabilized, and matted within the same day.
4. Construct the proposed stream channel to the grade specified in the cross-sections and profile. Stockpile and separate all soil suitable for fill or topsoil in stockpile areas shown on the construction plans. Any soil unsuitable for fill shall be disposed of appropriately offsite.
5. Install structures (Toe Wood, Log Sills, etc.).
6. Seed (with appropriate seed mix) and straw mulch areas where coir fiber matting is to be installed.
7. Install coir fiber matting.
8. Seed and mulch all disturbed areas at the end of each work day.

UT to Millers Creek Station approximately 10+00 to 11+00

9. Reach will be constructed from the upstream end, working in the downstream direction, along the existing stream channel.
10. **Install pump around operation** and temporary impervious channel plug.
11. Install all other sediment and erosion control devices.
12. Breach beaver dam and construct the proposed stream channel. Open up only that portion of the channel that can be completed, stabilized, and matted within the same day.
13. Construct the proposed stream channel to the grade specified in the cross-sections and profile. Stockpile and separate all soil suitable for fill or topsoil in stockpile areas shown on the construction plans. Any soil unsuitable for fill shall be disposed of appropriately offsite.
14. Install structures (Toe Wood, Log Sills, etc.).
15. Seed (with appropriate seed mix) and straw mulch areas where coir fiber matting is to be installed.
16. Install coir fiber matting.
17. Divert water into constructed channel, remove pump around operation, remove temporary impervious channel plug, and complete all stabilization activities.
18. Seed and mulch all disturbed areas at the end of each work day.
19. The channel, floodplain and banks shall be completed and stabilized prior to further construction.
20. Fill in the abandoned channel with suitable material excavated during construction of new channel and remove spoil piles (station 10+00 to 17+00). Remove existing 30” CMP.

UT to Millers Creek Station approximately 17+00 to 37+00 (Ditch 1 shall be completed prior to reach station 22+00 and Pond shall be completed prior to reach station 33+00)

21. Reach will be constructed from the upstream end, working in the downstream direction, along the existing stream channel.
22. **Install pump around operation** and temporary impervious channel plug.
23. Install all other sediment and erosion control devices.
24. Construct the proposed stream channel. Open up only that portion of the channel that can be completed, stabilized, and matted within the same day.
25. Construct the proposed stream channel to the grade specified in the cross-sections and profile. Stockpile and separate all soil suitable for fill or topsoil in stockpile areas shown on the construction plans. Any soil unsuitable for fill shall be disposed of appropriately offsite.
26. Install structures (Toe Wood, Log Sills, etc.).
27. Seed (with appropriate seed mix) and straw mulch areas where coir fiber matting is to be installed.
28. Install coir fiber matting.
29. Divert water into constructed channel, remove pump around operation, remove temporary impervious channel plug, and complete all stabilization activities.
30. Seed and mulch all disturbed areas at the end of each work day.
31. The channel, floodplain and banks shall be completed and stabilized prior to further construction.
32. Fill in the abandoned channel with suitable material excavated during construction of new channel and remove spoil piles. Remove 36” CMP and rip soil paths.

III. Mulching Operation

1. All Pine Plantation areas within the Conservation Easement shall be mulched.

IV. Ditch 1

1. Reach will be constructed from the upstream end, working in the downstream direction, along the existing ditch.
2. **Install pump around operation** and temporary impervious channel plug as needed.
3. Install all other sediment and erosion control devices.
4. Fill in the existing channel and remove spoil piles to the grade specified in the cross-sections and profile. Open up only that portion of the ditch that can be completed, and stabilized within the same day. Remove existing 12” SIPP and soil path.
5. Seed and mulch all disturbed areas at the end of each work day.

V. Pond

1. Pond shall be filled from the upstream end, working in the downstream direction, along the existing pond.
2. Install pump around operation and temporary impervious channel plug.
3. Install all other sediment and erosion control devices.
4. Drain pond.
5. Fill in pond and remove any spoil piles to the grade specified in the cross-sections and profile.
6. Remove 6” CPP and 8”PVC.
7. Seed and mulch all disturbed areas at the end of each work day.

VI. Site Stabilization

1. Repair all disturbed areas.
2. Remove sediment and erosion control devices, any temporary fencing, staking, sensitive area marking material, trash, etc. from the site.
3. Seed and mulch staging, stockpiling, and any bare areas with permanent seed mixture.

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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

NOT TO SCALE

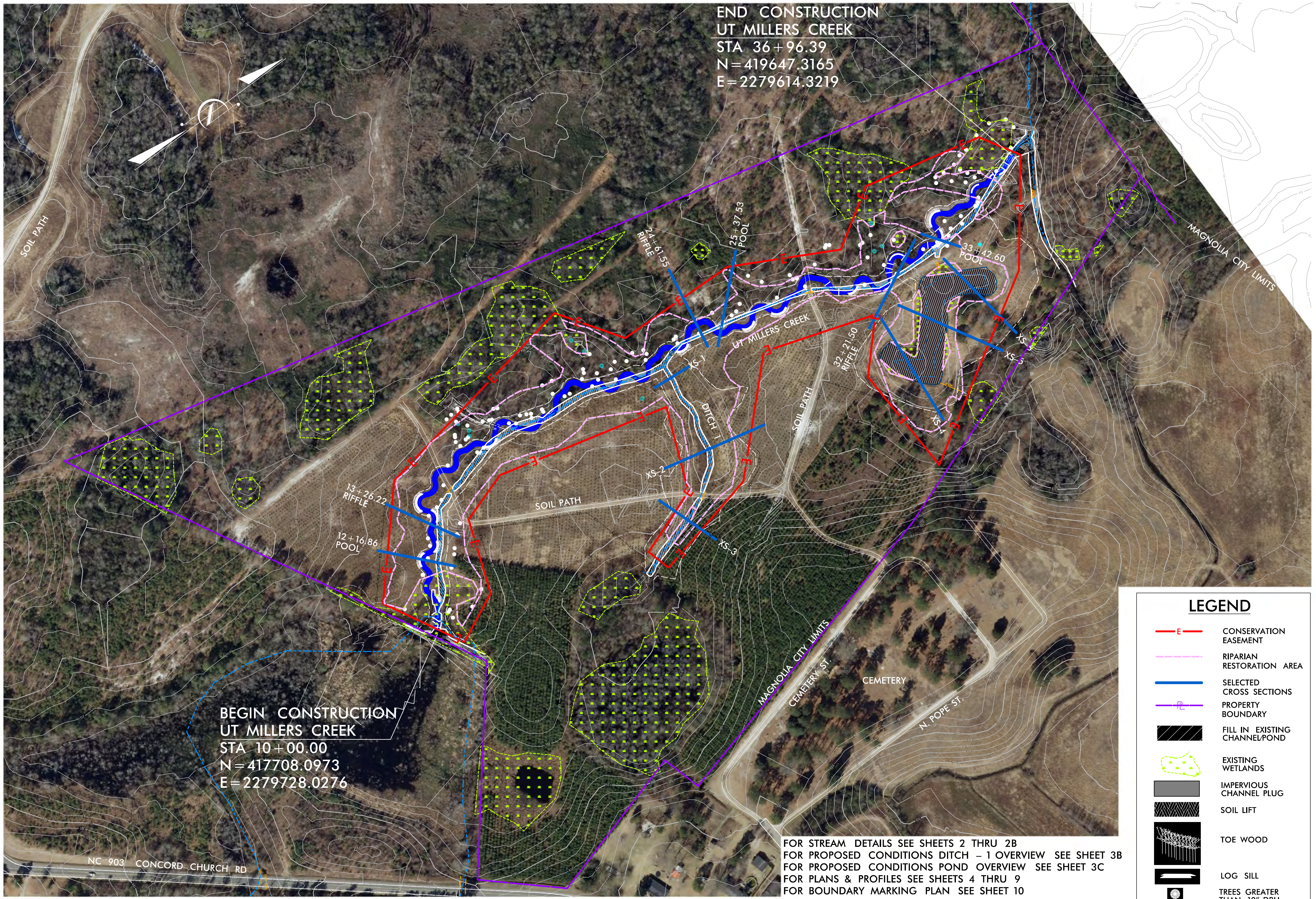
DATE: 8-12-13

CONSTRUCTION SEQUENCE

SHEET 2C

EEP# 95719

PROPOSED CONDITIONS PROJECT OVERVIEW MAP



FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS DITCH – 1 OVERVIEW SEE SHEET 3B
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
FOR BOUNDARY MARKING PLAN SEE SHEET 10

LEGEND

- CONSERVATION EASEMENT
- RIPARIAN RESTORATION AREA
- SELECTED CROSS SECTIONS
- PROPERTY BOUNDARY
- FILL IN EXISTING CHANNEL/POND
- EXISTING WETLANDS
- IMPERVIOUS CHANNEL PLUG
- SOIL LIFT
- TOE WOOD
- LOG SILL
- TREES GREATER THAN 10" DBH

INCOMPLETE PLANS
PRELIMINARY PLANS
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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
250 125 0 125
PLANS

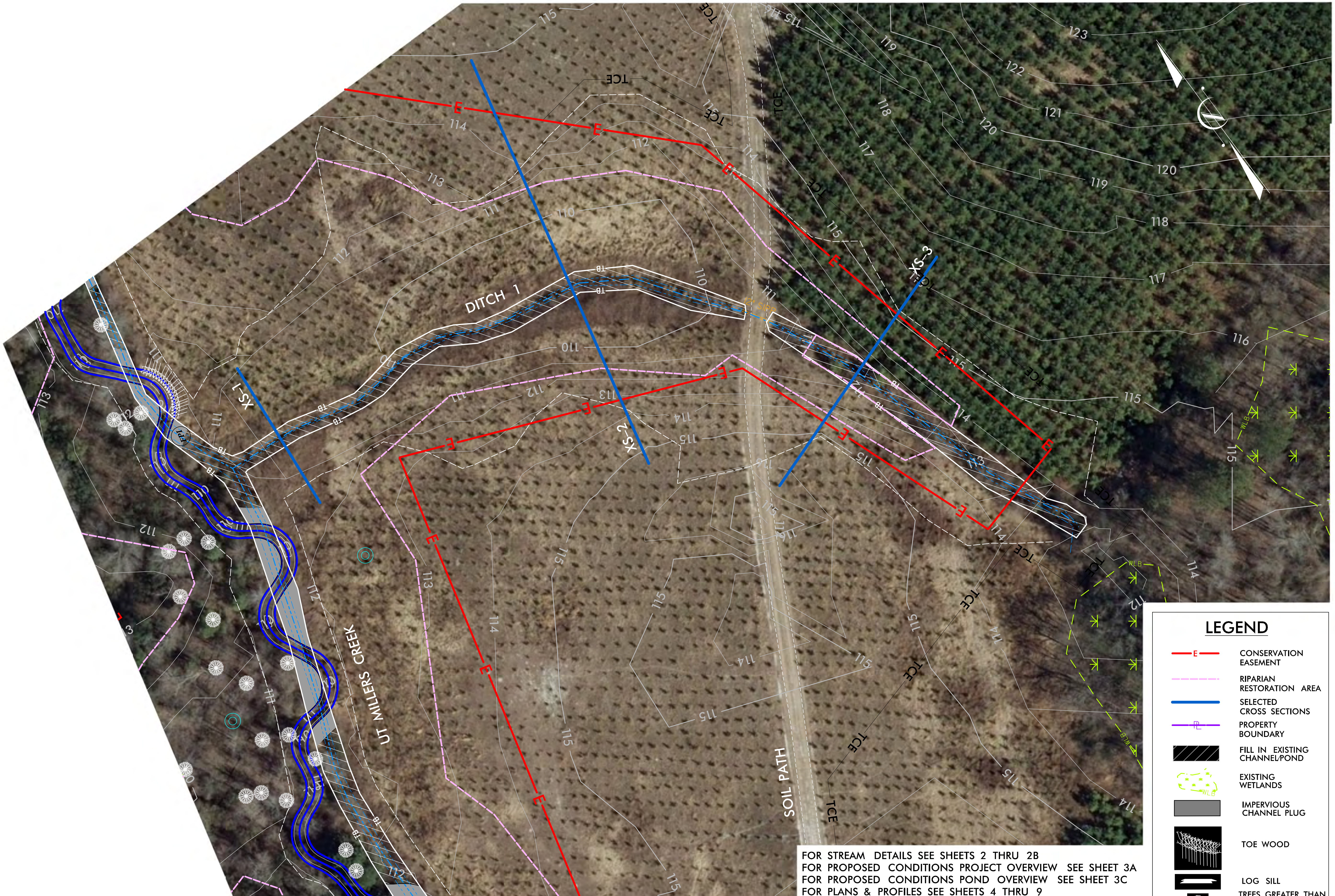
DATE: 07-30-13

PROPOSED CONDITIONS OVERVIEW MAP

SHEET 3A

EEP# 95719

PROPOSED CONDITIONS – DITCH 1
OVERVIEW MAP



FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
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LEGEND

- CONSERVATION EASEMENT
- RIPARIAN RESTORATION AREA
- SELECTED CROSS SECTIONS
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INCOMPLETE PLANS

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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
60 30 0 30
PLANS

DATE: 07-30-13

PROPOSED CONDITIONS – DITCH 1 OVERVIEW MAP

SHEET 3B

EEP# 95719

9/15/2014
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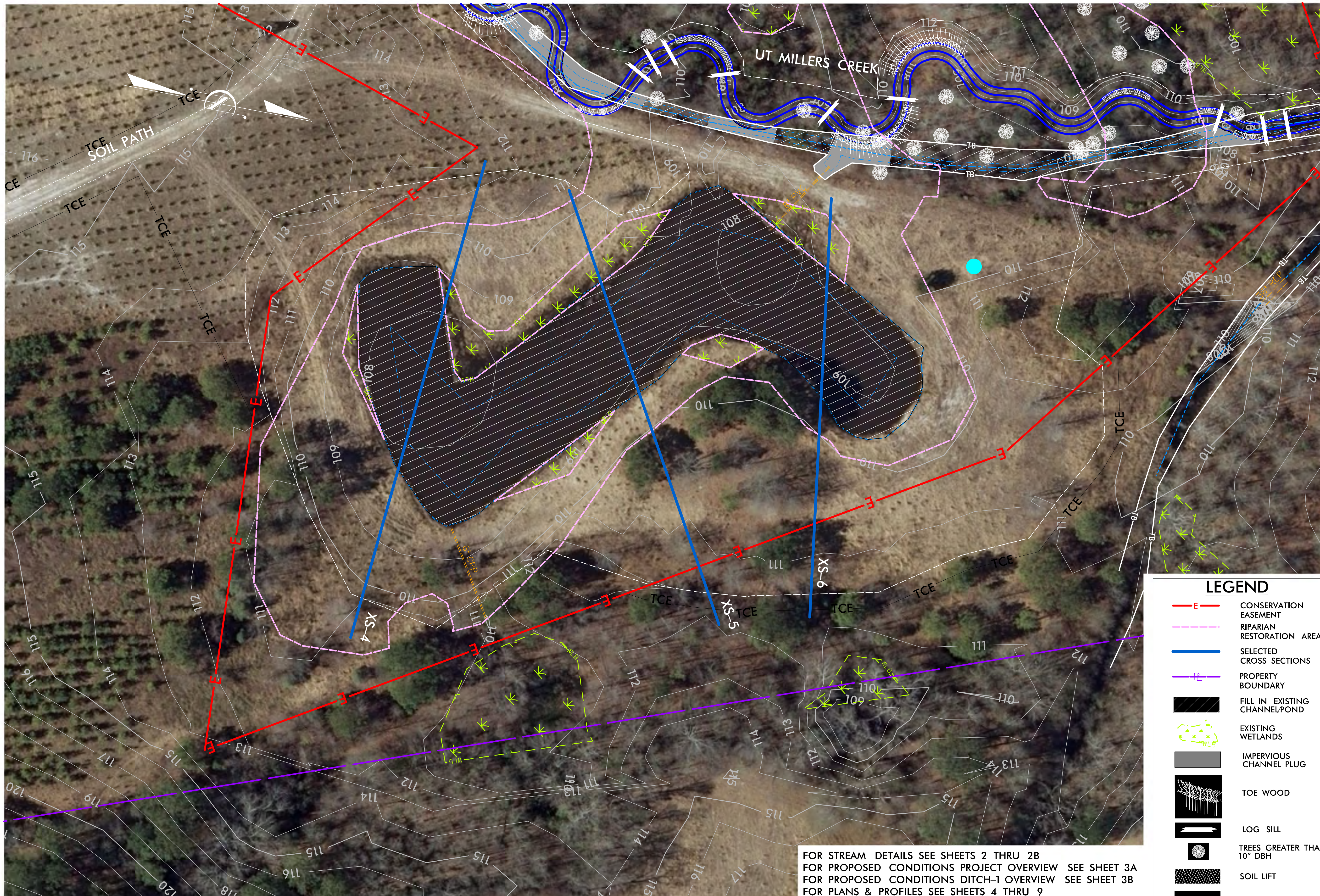
PROPOSED CONDITIONS – POND OVERVIEW MAP



LEGEND

- CONSERVATION EASEMENT
- RIPARIAN RESTORATION AREA
- SELECTED CROSS SECTIONS
- PROPERTY BOUNDARY
- FILL IN EXISTING CHANNEL/POND
- EXISTING WETLANDS
- IMPERVIOUS CHANNEL PLUG
- TOE WOOD
- LOG SILL
- TREES GREATER THAN 10" DBH
- SOIL LIFT
- LOG SILL

FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS DITCH-1 OVERVIEW SEE SHEET 3B
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
FOR BOUNDARY MARKING PLAN SEE SHEET 10

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UT MILLERS CREEK STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
60 30 0 30
PLANS

DATE: 07-30-13

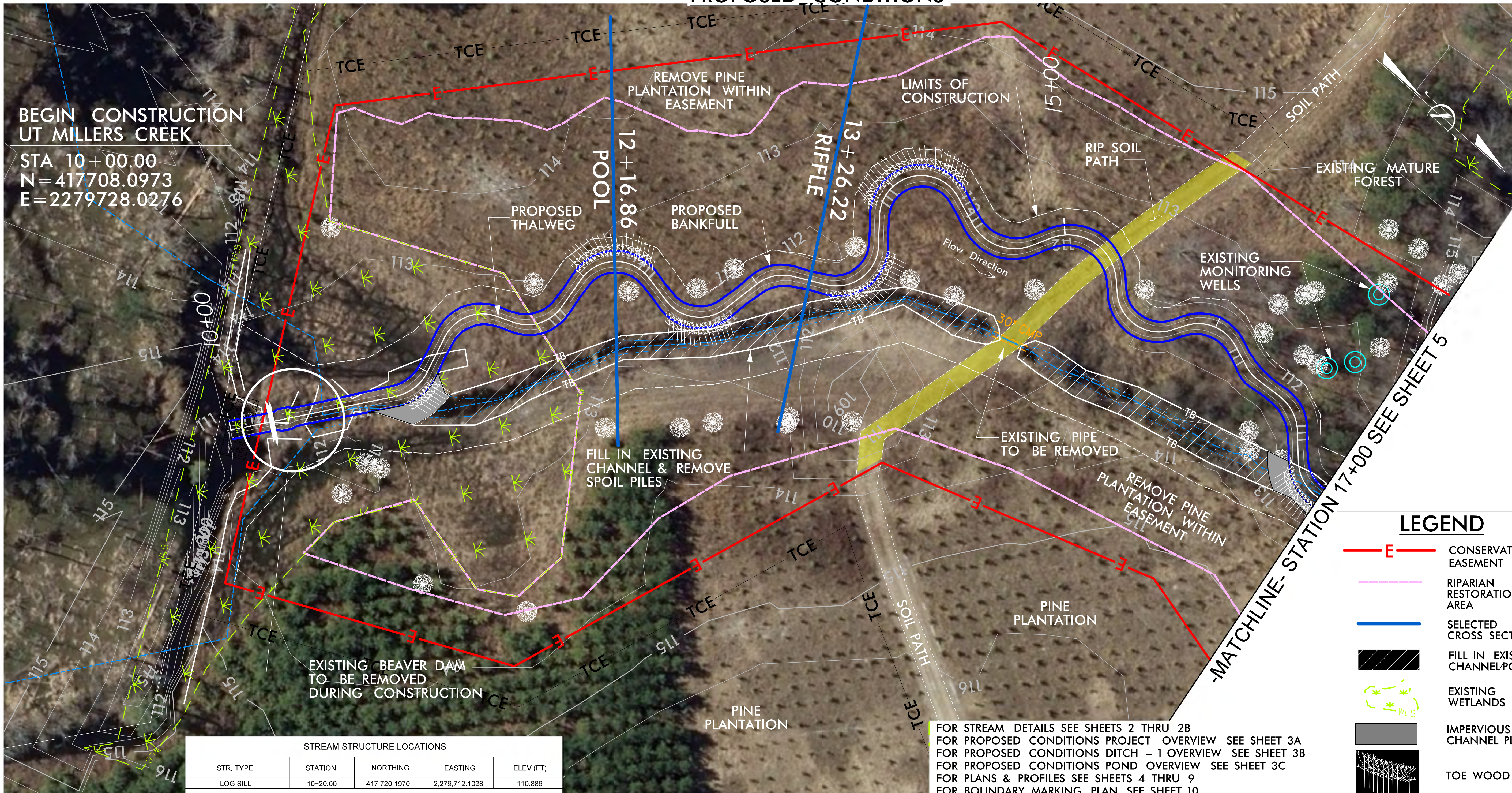
PROPOSED CONDITIONS – POND OVERVIEW MAP

SHEET 3C

EEP# 95719

9/15/2014

PROPOSED CONDITIONS



STREAM STRUCTURE LOCATIONS

STR. TYPE	STATION	NORTHING	EASTING	ELEV (FT)
LOG SILL	10+20.00	417,720.1970	2,279,712.1028	110.886

FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS DITCH – 1 OVERVIEW SEE SHEET 3B
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
FOR BOUNDARY MARKING PLAN SEE SHEET 10

LEGEND

- CONSERVATION EASEMENT
- RIPARIAN RESTORATION AREA
- SELECTED CROSS SECTIONS
- FILL IN EXISTING CHANNEL/POND
- EXISTING WETLANDS
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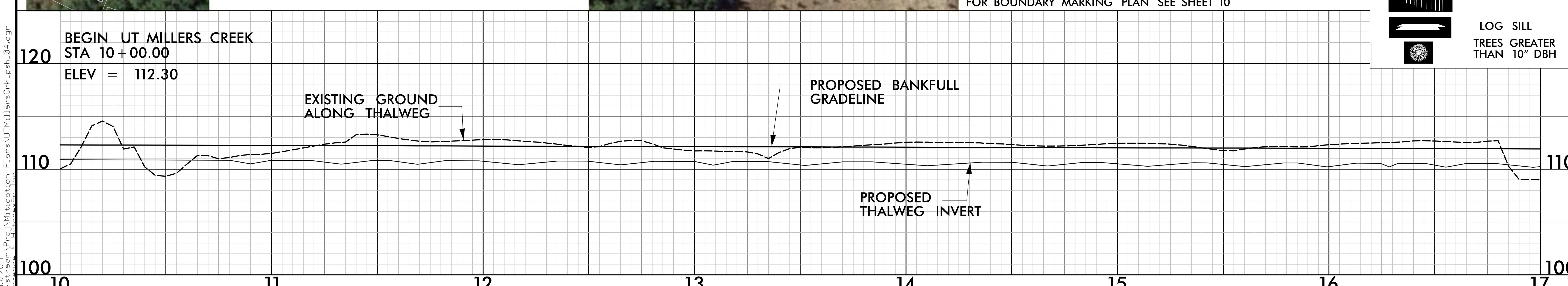
- TOE WOOD
- LOG SILL
- TREES GREATER THAN 10" DBH



INCOMPLETE PLANS

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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA
STA 10+00 – STA 17+00

GRAPHIC SCALE
PLANS
50 25 0 25

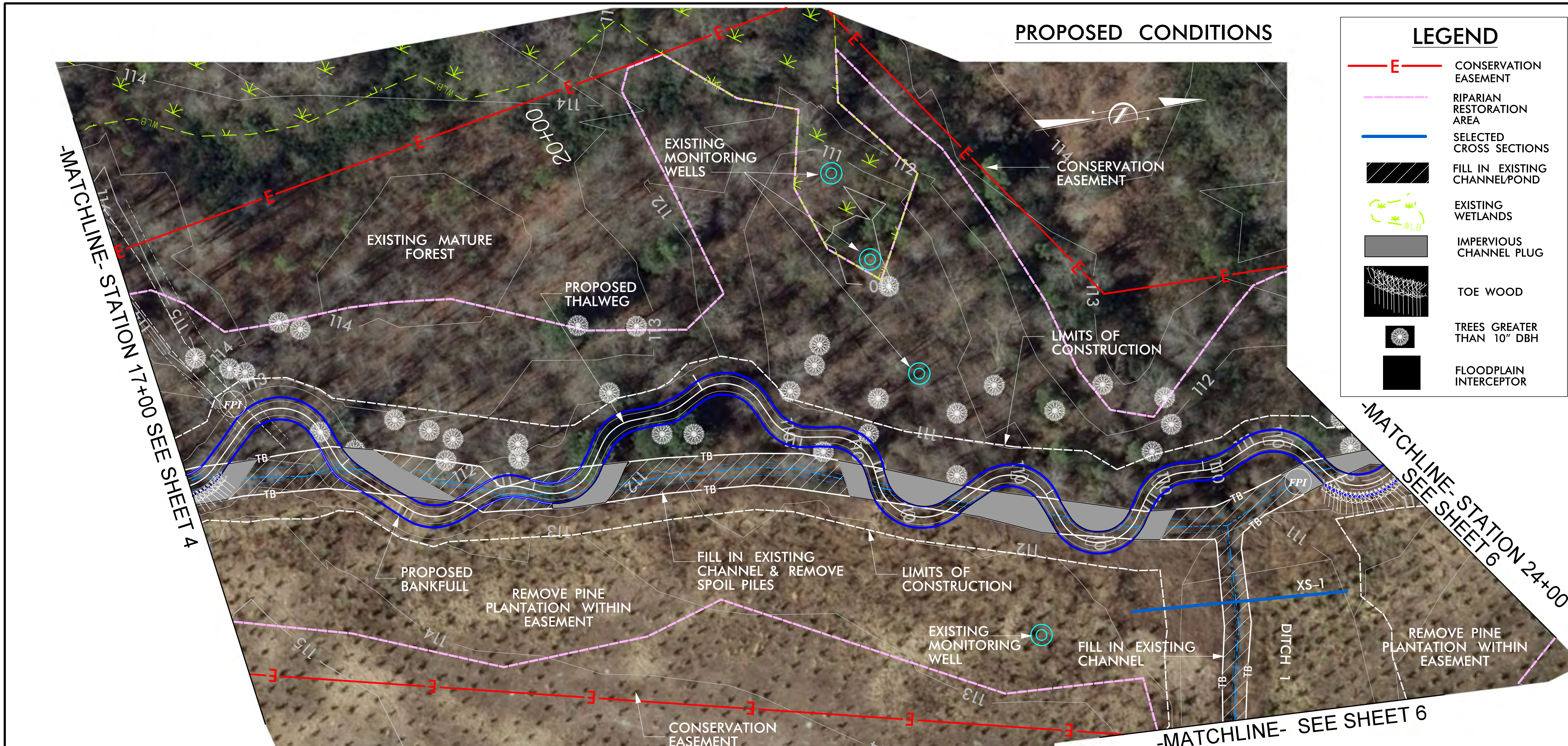
DATE: 08-05-13

PROPOSED CONDITIONS

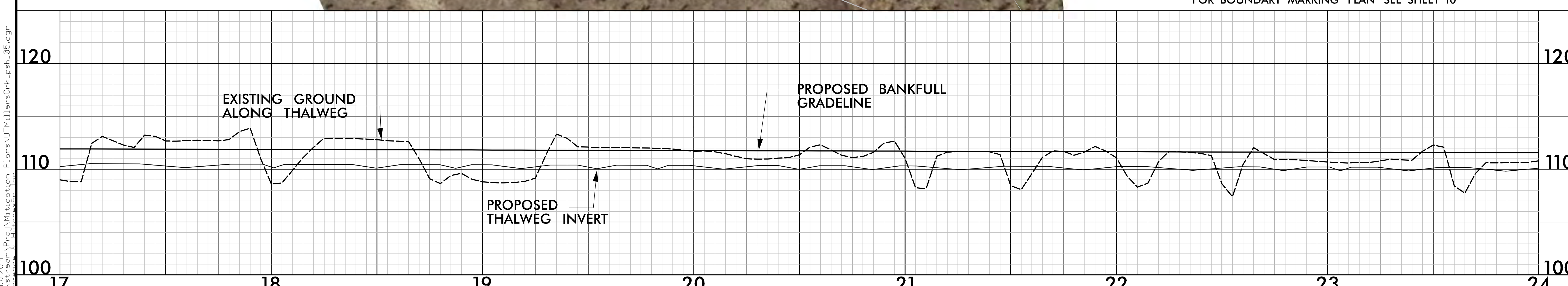
SHEET 4

EEP# 95719

PROPOSED CONDITIONS



FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS DITCH – 1 OVERVIEW SEE SHEET 3B
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
FOR BOUNDARY MARKING PLAN SEE SHEET 10



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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA
STA 17+00 – STA 24+00

GRAPHIC SCALE
PLANS
50 25 0 25

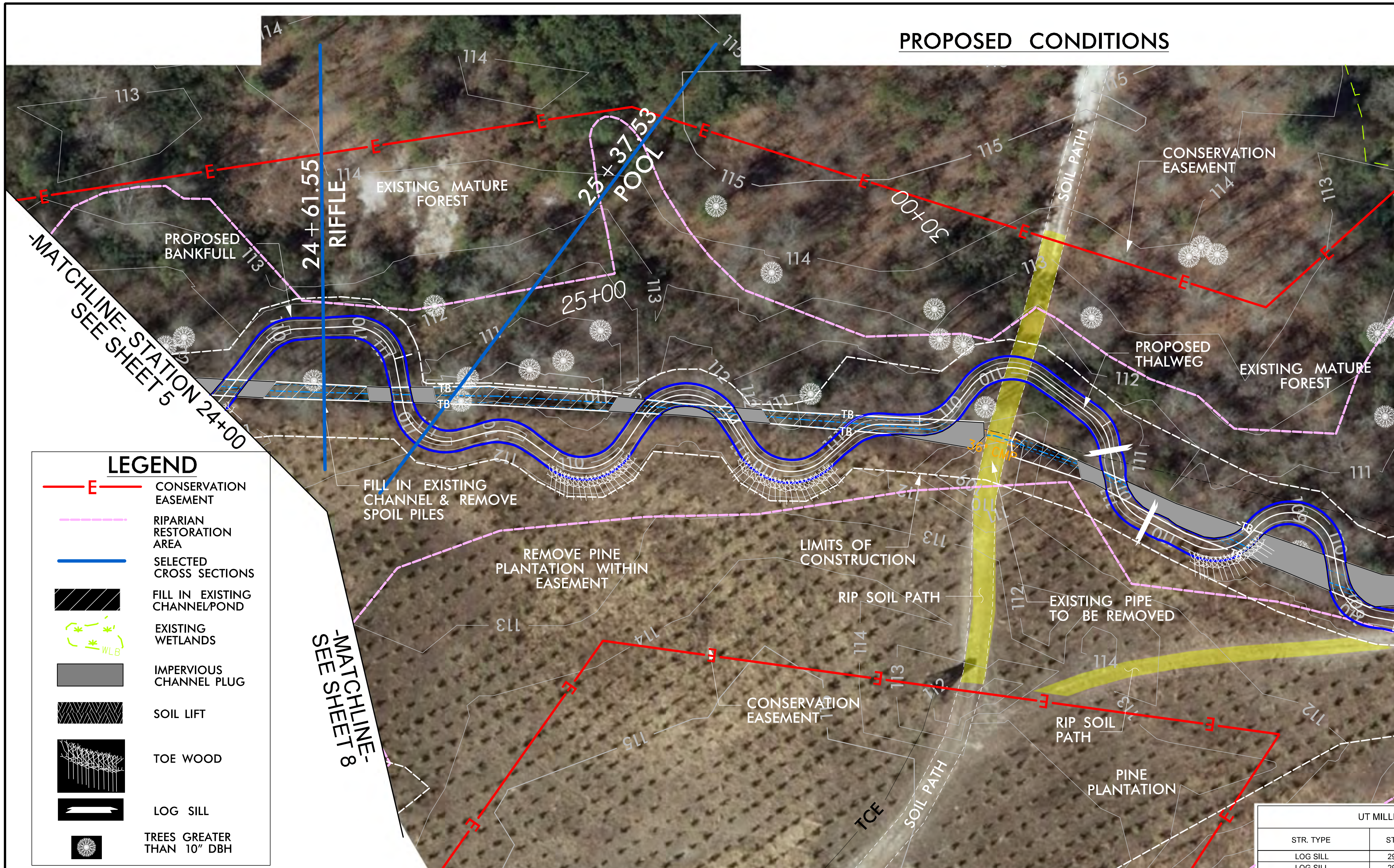
DATE: 08-05-13

PROPOSED CONDITIONS

SHEET
5

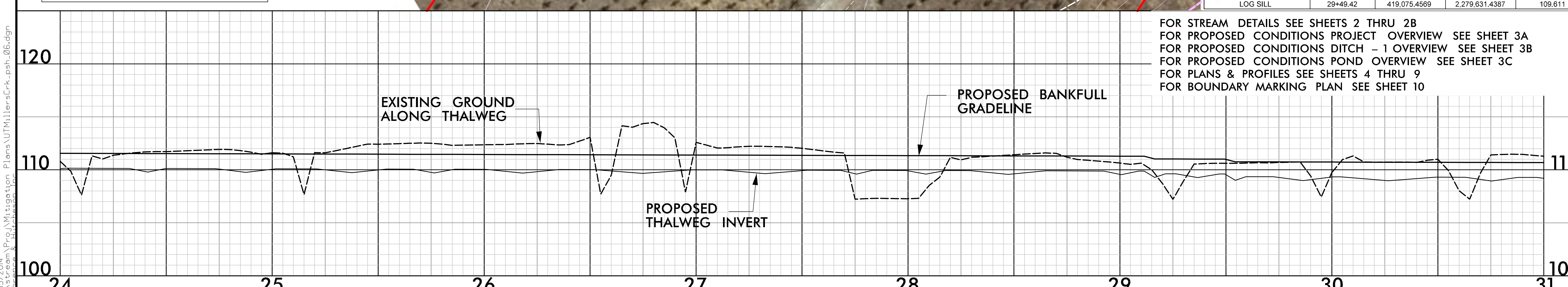
EEP# 95719

PROPOSED CONDITIONS



UT MILLERS CREEK STRUCTURE LOCATIONS				
STR. TYPE	STATION	NORTHING	EASTING	ELEV (FT)
LOG SILL	29+11.43	419,064.8211	2,279,597.2545	109.881
LOG SILL	29+49.42	419,075.4569	2,279,631.4387	109.611

FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS DITCH – 1 OVERVIEW SEE SHEET 3B
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
FOR BOUNDARY MARKING PLAN SEE SHEET 10



INCOMPLETE PLANS

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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA
STA 24+00 – STA 31+00

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 08–05–13

PROPOSED CONDITIONS

SHEET
6

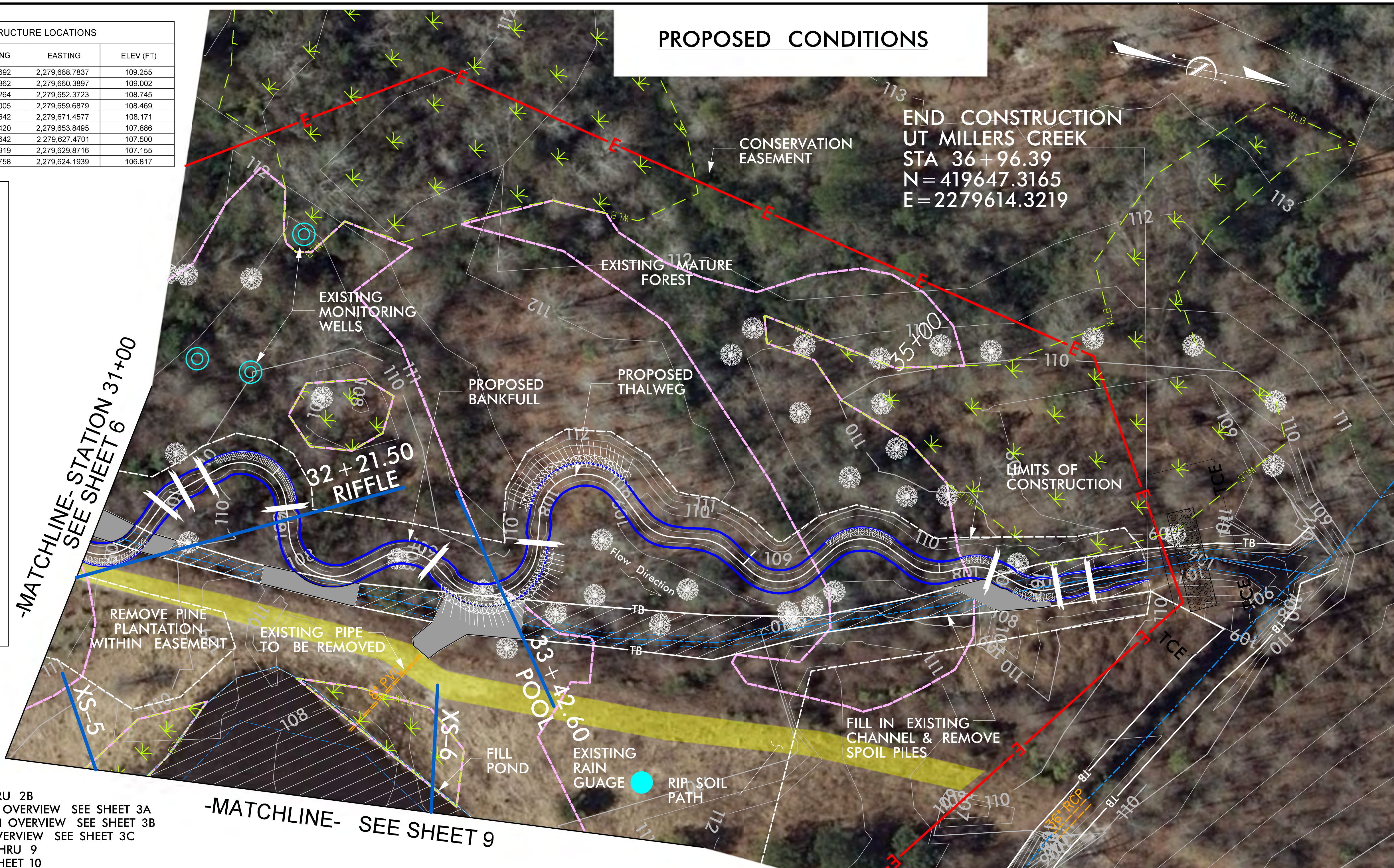
EEP# 95719

UT MILLERS CREEK STRUCTURE LOCATIONS				
STR. TYPE	STATION	NORTHING	EASTING	ELEV (FT)
LOG SILL	31+43.88	419,209.0692	2,279,668.7837	109.255
LOG SILL	31+67.53	419,216.2362	2,279,660.3897	109.002
LOG SILL	32+16.23	419,225.8264	2,279,652.3723	108.745
LOG SILL	33+05.99	419,263.8005	2,279,659.6879	108.469
LOG SILL	33+71.86	419,332.7642	2,279,671.4577	108.171
LOG SILL	36+24.05	419,377.1420	2,279,653.8495	107.886
LOG SILL	36+24.05	419,579.1642	2,279,627.4701	107.500
LOG SILL	36+55.31	419,609.2919	2,279,629.8716	107.155
LOG SILL	36+70.31	419,623.1758	2,279,624.1939	106.817

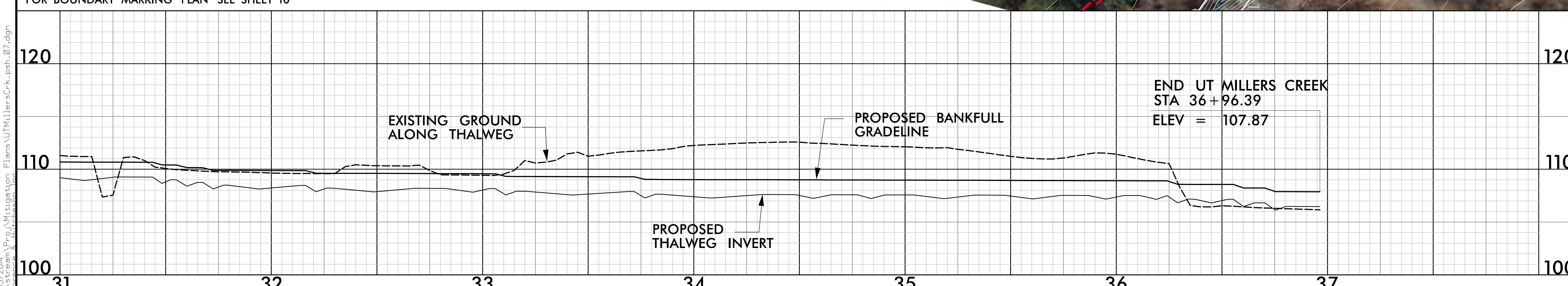
LEGEND

- CONSERVATION EASEMENT
- RIPARIAN RESTORATION AREA
- SELECTED CROSS SECTIONS
- FILL IN EXISTING CHANNEL/POND
- EXISTING WETLANDS
- IMPERVIOUS CHANNEL PLUG
- SOIL LIFT
- TOE WOOD
- LOG SILL
- TREES GREATER THAN 10" DBH

PROPOSED CONDITIONS



FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS DITCH – 1 OVERVIEW SEE SHEET 3B
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
FOR BOUNDARY MARKING PLAN SEE SHEET 10



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UT MILLERS CREEK STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA
STA 31+00 – STA 36+96.39

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 08-05-13

PROPOSED CONDITIONS

SHEET 7

EEP# 95719

PROPOSED CONDITIONS

LEGEND

CONSERVATION EASEMENT

RIPARIAN RESTORATION AREA

SELECTED CROSS SECTIONS

FILL IN EXISTING CHANNEL

EXISTING WETLANDS

FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS DITCH – 1 OVERVIEW SEE SHEET 3B
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
FOR BOUNDARY MARKING PLAN SEE SHEET 10

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UT MILLERS CREEK STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
25 0 25 50
PLANS

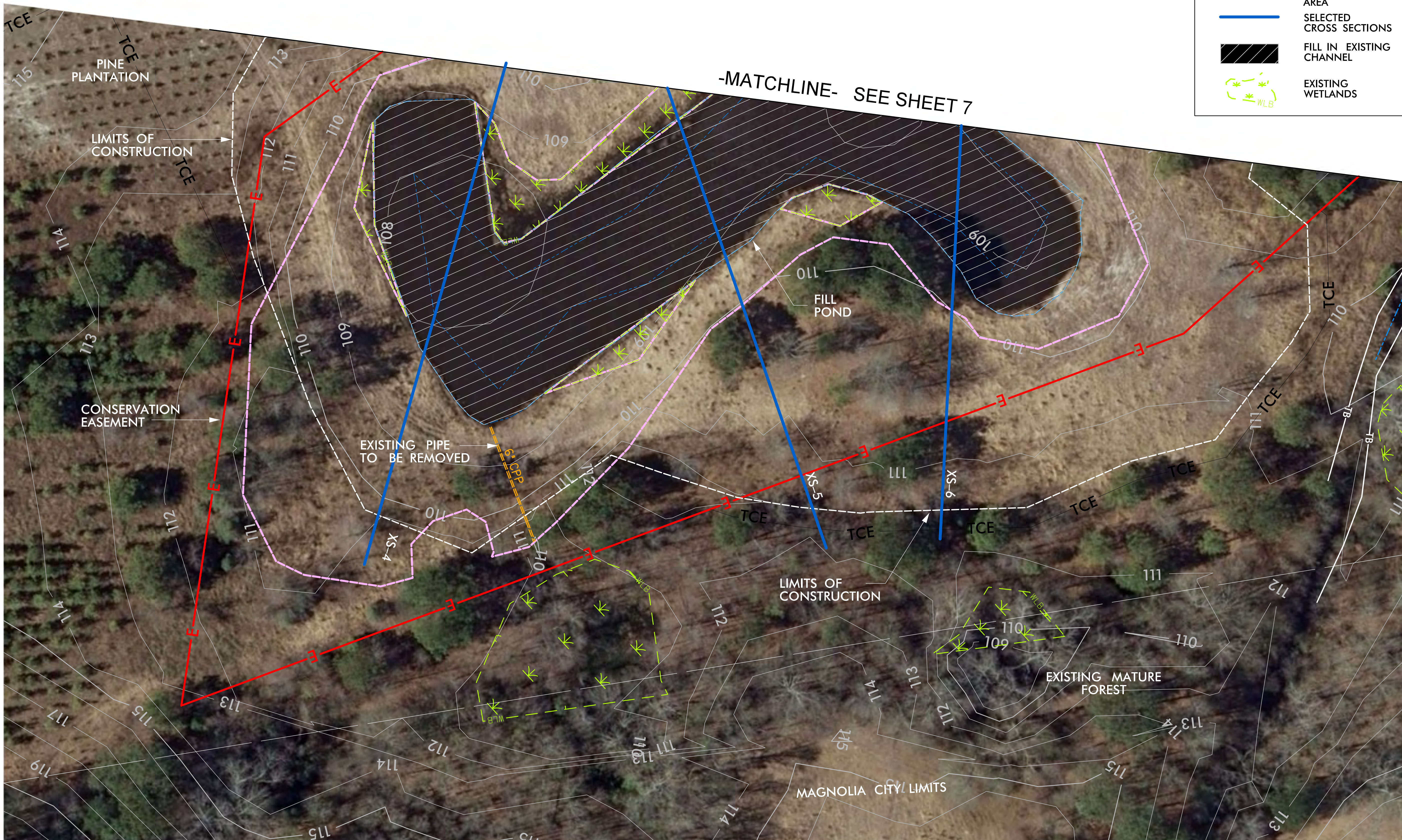
DATE: 07-30-13

PROPOSED CONDITIONS

SHEET 8

EEP# 95719

PROPOSED CONDITIONS



LEGEND

- CONSERVATION EASEMENT
- RIPARIAN RESTORATION AREA
- SELECTED CROSS SECTIONS
- FILL IN EXISTING CHANNEL
- EXISTING WETLANDS

FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS DITCH – 1 OVERVIEW SEE SHEET 3B
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
FOR BOUNDARY MARKING PLAN SEE SHEET 10

INCOMPLETE PLANS
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

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UT MILLERS CREEK STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
25 0 25 50
PLANS

DATE: 07-30-13

PROPOSED CONDITIONS

SHEET
9

EEP# 95719

9/15/2014
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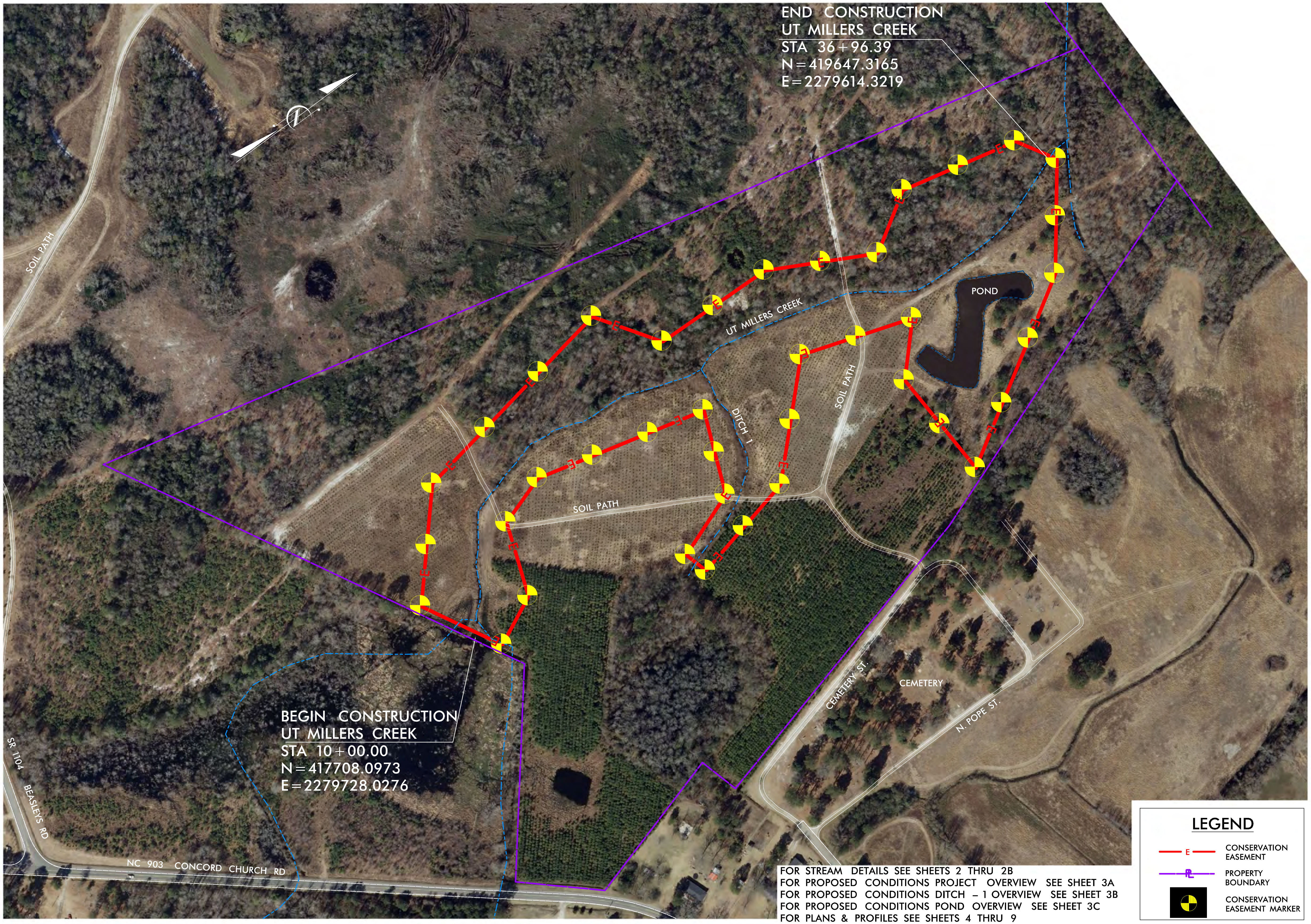
BOUNDARY MARKING PLAN



FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS DITCH - 1 OVERVIEW SEE SHEET 3B
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9

LEGEND

- CONSERVATION EASEMENT
- PROPERTY BOUNDARY
- CONSERVATION EASEMENT MARKER

INCOMPLETE PLANS
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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
125 0 125 250
PLANS

DATE: 07-30-13

BOUNDARY MARKING PLAN

SHEET 10

EEP# 95719

9/15/2014
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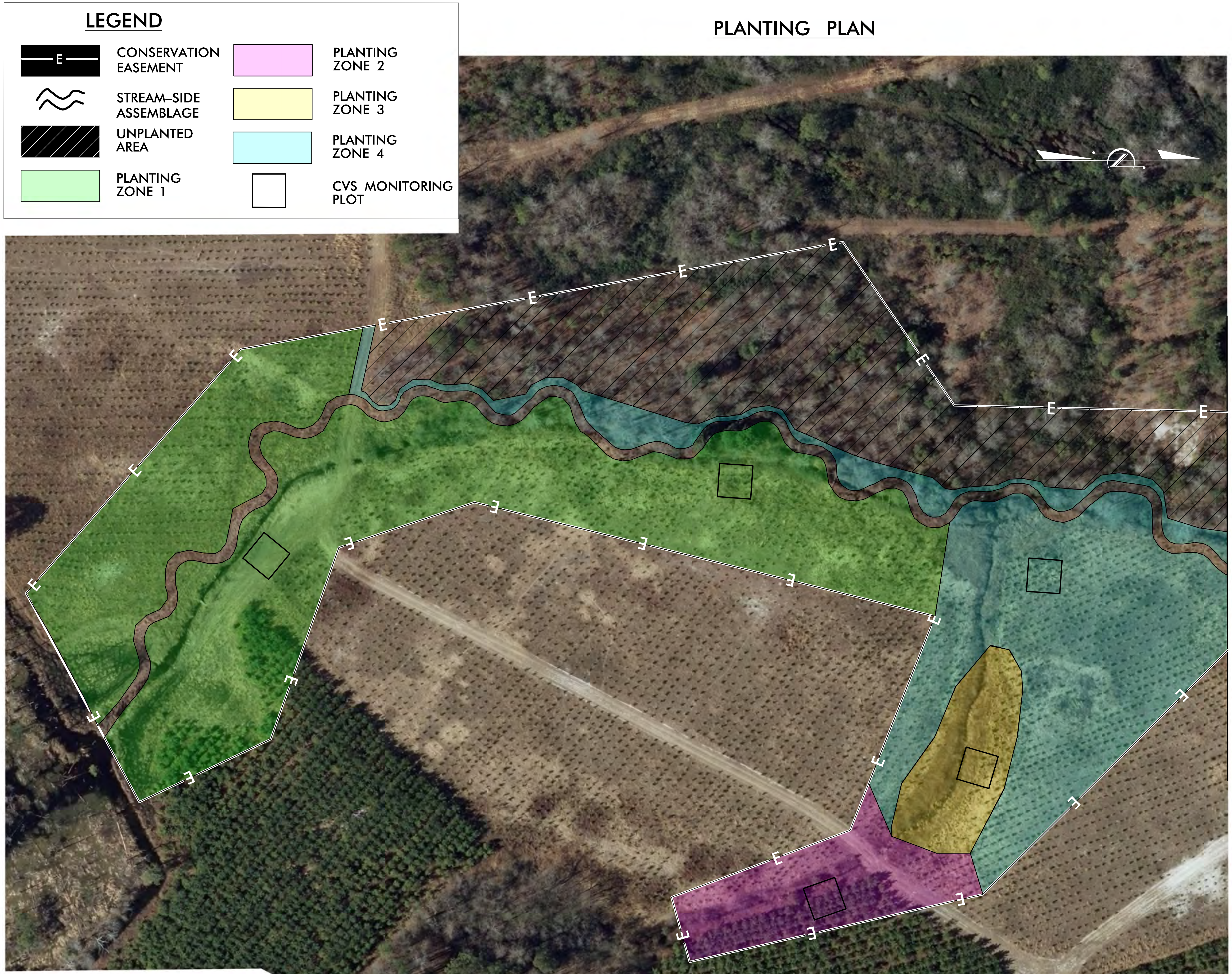
PLANTING PLAN



FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS DITCH – 1 OVERVIEW SEE SHEET 3B
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
FOR BOUNDARY MARKING PLAN SEE SHEET 10

-MATCHLINE- SEE SHEET PL-2

Streamside Assemblage	5,538 Feet of Stream Bank	Streamside Assemblage (4' spacing)	
Common Name	Scientific Name	% Composition	# Planted
Black Willow	*Salix nigra*	25	347
Button Bush	*Cephalanthus occidentalis*	25	347
Silky Dogwood	*Cornus amomum*	25	347
River Birch	*Betula nigra*	25	347
		TOTAL	1,388

Zone 1	3.4 AC	Riparian Restoration (8' centers)	
Common Name	Scientific Name	% Composition	# Planted
Bald Cypress	*Taxodium distichum*	30	695
River Birch	*Betula nigra*	20	463
Swamp Chestnut Oak	*Quercus michauxii*	15	348
Tulip Poplar	*Liriodendron tulipifera*	15	348
Willow Oak	*Quercus phellos*	10	232
Sweet Bay	*Magnolia virginiana*	10	232
		TOTAL	2,318

Zone 2	0.5 AC	Riparian Restoration (8' centers)	
Common Name	Scientific Name	% Composition	# Planted
Bald Cypress	*Taxodium distichum*	30	103
River Birch	*Betula nigra*	25	86
Wax Myrtle	*Morella cerifera*	10	35
Willow Oak	*Quercus phellos*	15	52
American Sycamore	*Platanus occidentalis*	20	69
		TOTAL	345

Zone 3	0.4 AC	Riparian Restoration (8' centers)	
Common Name	Scientific Name	% Composition	# Planted
Bald Cypress	*Taxodium distichum*	35	96
River Birch	*Betula nigra*	30	82
Swamp Tupelo	*Nyssa biflora*	25	69
Smooth Alder	*Alnus serrulata*	10	28
		TOTAL	275

Zone 4	6.3 AC	Riparian Restoration (3' centers)	
Common Name	Scientific Name	% Composition	# Planted
Bald Cypress	*Taxodium distichum*	25	1,072
Green Ash	*Fraxinus pennsylvannica*	25	1,072
Swamp Chestnut Oak	*Quercus michauxii*	15	644
Willow Oak	*Quercus phellos*	15	644
Tulip Poplar	*Liriodendron tulipifera*	20	858
		TOTAL	4,290

Zone 5	0.2 AC	Riparian Restoration (3' centers)	
Common Name	Scientific Name	% Composition	# Planted
Pond Cypress	*Taxodium ascendens*	40	55
Water Tupelo	*Fraxinus pennsylvannica*	30	41
Bald Cypress	*Taxodium distichum*	20	28
Smooth Alder	*Alnus serrulata*	10	14
		TOTAL	138

INCOMPLETE PLANS
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

ICA Engineering
5121 Kingdom Way, Suite 100
Raleigh, NC 27607
NC License No: F-0258

UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
50 0 50 100
PLANS

DATE: 07-14

PLANTING PLAN

SHEET
PL-1

EEP# 95719

9/17/2014
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PLANTING PLAN

-MATCHLINE- SEE SHEET PL-1

LEGEND

- CONSERVATION EASEMENT (E)
- STREAM-SIDE ASSEMBLAGE
- UNPLANTED AREA
- PLANTING ZONE 4
- PLANTING ZONE 5
- CVS MONITORING PLOT

Streamside Assemblage	5,538 Feet of Stream Bank	Streamside Assemblage (4' spacing)	
Common Name	Scientific Name	% Composition	# Planted
Black Willow	*Salix nigra*	25	347
Button Bush	*Cephalanthus occidentalis*	25	347
Silky Dogwood	*Cornus amomum*	25	347
River Birch	*Betula nigra*	25	347
		TOTAL	1,388

Zone 1	3.4 AC	Riparian Restoration (8' centers)	
Common Name	Scientific Name	% Composition	# Planted
Bald Cypress	*Taxodium distichum*	30	695
River Birch	*Betula nigra*	20	463
Swamp Chestnut Oak	*Quercus michauxii*	15	348
Tulip Poplar	*Liriodendron tulipifera*	15	348
Willow Oak	*Quercus phellos*	10	232
Sweet Bay	*Magnolia virginiana*	10	232
		TOTAL	2,318

Zone 2	0.5 AC	Riparian Restoration (8' centers)	
Common Name	Scientific Name	% Composition	# Planted
Bald Cypress	*Taxodium distichum*	30	103
River Birch	*Betula nigra*	25	86
Wax Myrtle	*Morella cerifera*	10	35
Willow Oak	*Quercus phellos*	15	52
American Sycamore	*Platanus occidentalis*	20	69
		TOTAL	345

Zone 3	0.4 AC	Riparian Restoration (8' centers)	
Common Name	Scientific Name	% Composition	# Planted
Bald Cypress	*Taxodium distichum*	35	96
River Birch	*Betula nigra*	30	82
Swamp Tupelo	*Nyssa biflora*	25	69
Smooth Alder	*Alnus serrulata*	10	28
		TOTAL	275

Zone 4	6.3 AC	Riparian Restoration (8' centers)	
Common Name	Scientific Name	% Composition	# Planted
Bald Cypress	*Taxodium distichum*	25	1,072
Green Ash	*Fraxinus pennsylvanica*	25	1,072
Swamp Chestnut Oak	*Quercus michauxii*	15	644
Willow Oak	*Quercus phellos*	15	644
Tulip Poplar	*Liriodendron tulipifera*	20	858
		TOTAL	4,290

Zone 5	0.2 AC	Riparian Restoration (8' centers)	
Common Name	Scientific Name	% Composition	# Planted
Pond Cypress	*Taxodium ascendens*	40	55
Water Tupelo	*Fraxinus pennsylvanica*	30	41
Bald Cypress	*Taxodium distichum*	20	28
Smooth Alder	*Alnus serrulata*	10	14
		TOTAL	138

FOR STREAM DETAILS SEE SHEETS 2 THRU 2B
FOR PROPOSED CONDITIONS PROJECT OVERVIEW SEE SHEET 3A
FOR PROPOSED CONDITIONS DITCH – 1 OVERVIEW SEE SHEET 3B
FOR PROPOSED CONDITIONS POND OVERVIEW SEE SHEET 3C
FOR PLANS & PROFILES SEE SHEETS 4 THRU 9
FOR BOUNDARY MARKING PLAN SEE SHEET 10

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PL-2

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