Final
Stream and Wetland Mitigation Plan
Browns Summit Creek Restoration Project

Guilford County, North Carolina

NCDMS Project ID No. 96313

Cape Fear River Basin: 03030002-010020

USACE Action ID No: SAW-2014-01642

Prepared for:

NC Department of Environment and Natural Resources
Division of Mitigation Services (NCDMS)
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

January 2016

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Prepared by:

Michael Baker
INTERNATIONAL

January 2016

EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) proposes to restore 3,846 linear feet (LF) of jurisdictional stream and enhance 2,535 LF of stream (of which 559 is for stormwater BMPs) along an unnamed tributaries (UT) to the Haw River and to restore 4.44 acres of wetland. The unnamed tributary (mainstem) has been renamed Browns Summit Creek for this project. In addition, Baker proposes to construct two stormwater best management practices (BMPs) within the conservation easement boundary. The Browns Summit Creek Restoration Project (project) is located in Guilford County, North Carolina (NC) (Figure 2.1) approximately three miles northwest of the Community of Browns Summit. The project is located in the NC Division of Water Resources (NCDWR) subbasin 03-06-01 and the NC Division of Mitigation Services (NCDMS) Targeted Local Watershed (TLW) 03030002-010020 (the Haw River Headwaters) of the Cape Fear River Basin. The purpose of the project is to restore and/or enhance the degraded stream, wetland, and riparian buffer functions within the site. A recorded conservation easement consisting of 20.2 acres (Figure 3.1) will protect all stream reaches, wetlands, and riparian buffers in perpetuity. Examination of the available hydrology and soil data indicate the project will potentially provide numerous water quality and ecological benefits within the Haw River watershed, and the Cape Fear River Basin.

Based on the NCDMS 2009 Cape Fear River Basin Restoration Priority (RBRP) Plan, the Browns Summit Creek Restoration Project area is located in an existing targeted local watershed (TLW) within the Cape Fear River Basin (2009 Cape Fear RBRP), but is not located in a Local Watershed Planning (LWP) area. The restoration strategy for the Cape Fear River Basin targets specific projects, which focuses on developing creative strategies for improving water quality flowing to the Haw River in order to reduce non-point source (NPS) pollution to Jordan Lake.

The primary goals of the project are to improve ecologic functions and to manage nonpoint source loading to the riparian system as described in the NCDMS 2009 Cape Fear RBRP. These are identified below:

- Create geomorphically stable conditions along the unnamed tributaries across the site,
- Implement agricultural BMPs to reduce nonpoint source inputs to receiving waters,
- Address known and obvious water quality and habitat stressors present on site,
- Restore stream and floodplain connectivity, and
- Restore and protect riparian buffer functions and corridor habitat.

To accomplish these goals, the following objectives have been identified:

- Restore existing incised, eroding, and channelized streams by creating stable dimension and connecting them to their relic floodplains,
- Re-establish and rehabilitate site wetlands that have been impacted by cattle, spoil pile disposal, channelization, subsequent channel incision, and wetland vegetation loss,
- Prevent cattle from accessing the conservation easement boundary by installing permanent fencing and thus reduce excessive stream bank erosion and undesired nutrient inputs,
- Increase aquatic habitat value by improving bedform diversity, riffle substrate, and in-stream cover, creating natural scour pools, adding woody debris, and reducing sediment loading from accelerated stream bank erosion,
- Construct a wetland BMP on the upstream extent of Reach R6 to capture and retain stormwater run-off from adjacent cattle pastures to allow for the biological removal of nutrient pollutant loads and for sediment to settle out of the water column,

- Construct a step pool BMP channel to capture and disperse stormwater volumes and velocities by allowing stormwater discharge from a low density residential development to spread across the floodplain of Reach R4; thereby, diffusing energies and promoting nutrient uptake within the riparian buffer,
- Plant native species within the riparian corridor to increase stormwater runoff filtering capacity, improve stream bank stability and riparian habitat connectivity, and shade the stream to decrease water temperature,
- Control invasive species vegetation within the project area and, if necessary, continue treatments during the monitoring period, and
- Establish a conservation easement to protect the project area in perpetuity.

Nutrients and temperature will not be measured; however, by providing improved conditions for denitrification (more wetland area with aerobic/anaerobic boundaries) and shade (through increased riparian buffer), nutrient inputs and stream temperature are reasonably expected to decline.

The proposed project aligns with overall NCDMS goals, which focus on restoring streams and riparian area values such as maintaining and enhancing water quality, increasing storage of floodwaters, and improving fish and wildlife habitat, as well as specific NCDMS RBRP goals including, but not limited to, nutrient and other non-point source pollutant management. The proposed natural channel design approach will result in a stable riparian stream system that will reduce excess sediment and nutrient inputs to the Haw River Headwaters subwatershed, while improving water quality conditions that support terrestrial and aquatic species, including priority species identified in the Cape Fear River Basin.

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 Division of Mitigation Services In-Lieu Fee Instrument signed and dated July 28, 2010.

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

Table ES.1 Project Overview (Streams)
Browns Summit Creek Restoration Project

Reach	Design Approach	Existing Reach Length (LF)	Design Reach Length (LF)	SMU Credit Ratio	Potential SMUs	Stationing	Comment
Stream Reaches (Reaches R1, R2, R3, R4, R5, R6, T1, T2, T3, and T4)							
R1	R	1,217	1,233	1:1	1,233	51+77 to 64+10	Restoration will follow a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the existing floodplain. The remnant stream channel will be partially to completely filled.
R2 (downstream section)	E II	167	191	2.5:1	76	49+86 to 51+77	An Enhancement Level II approach will involve livestock exclusion, permanent fencing and invasive species vegetation removal.
R2	E I	701	614	1.5:1	406	43+72 to 49+86	An Enhancement Level I approach will continue from Reach R3. Two meander

(upstream section)							bends will be realigned, spoil piles will be removed, and bank stabilization practices will be implemented.
R3 (downstream section)	E I	362	352	1.5:1	234	39+60 to 43+72*	Enhancement Level I will be implemented. Vertical banks will be laid back or benched, and invasive species will be removed.
R3 (upstream section)	R	1,224	1,102	1:1	1,196	28+58 to 39+60	Restoration will continue using a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the existing floodplain. The remnant stream channel will be partially to completely filled and the existing downstream pond removed.
R4	R	1,350	1,296	1:1	1,296	15+62 to 28+58	Restoration will follow a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the existing floodplain. The remnant stream channel will be partially to completely filled and the upstream pond at the top of the Reach will be removed.
R5	E II	536	536	2.5:1	214	10+26 to 15+62	Enhancement Level II is proposed for this reach. A riparian buffer will be planted and a livestock exclusion fence will be installed on the conservation easement perimeter. A gradient control structure will be installed below the spring to stop a headcut. Isolated eroding streambank will be repaired.
R6	BMP	501	442 (valley length)	1.5:1	294	10+00 to 15+46	A water quality BMP will be installed as a replacement for the existing farm pond. It will function as a stormwater wetland feature. Riparian vegetation, livestock exclusion fencing, and a conservation easement will be established around the BMP feature.
T1	R	121	145	1:1	145	10+00 to 11+45	Restoration will follow a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the existing floodplain. The remnant stream channel will be partially to completely filled.
T2	E II	283	283	2.5:1	113	10+00 to 12+83	Enhancement Level II is proposed for the reach. Work will include minor stream bank sloping and stabilization, limited use of in-stream structures to prevent headcut migration, vegetation planting in disturbed riparian buffer areas, and permanent cattle exclusion fencing around the easement.
T3	R	83	70	1:1	70	10+30 to 11+00	An active headcut will be stabilized and the stream bed elevation will be raised to tie in to the Priority Level I restoration on the mainstem.
T4	BMP	47	117 (valley length)	1.5:1	78	10+50 to 11+78	A second BMP feature will be installed on the newly graded floodplain to treat runoff discharge from a 30-inch culvert located beyond the existing right bank. A rock-lined step-pool channel will be constructed to convey the stormwater runoff from the outlet

							to the floodplain and restored channel. Discharge below the step-pool sequence will spread across the floodplain, diffusing energy and promoting nutrient uptake within the buffer.
Total		**6,592**	**6,381**	**-**	**5,264**	*Crossing length (60 LF) subtracted from R3 downstream	

Table ES.2 Project Overview (Wetlands) - Browns Summit Creek Restoration Project

Design Approach	Existing Area (AC)	Design Area (AC)	WMU Credit Ratio	Potential WMUs	Comments
R (1-functioning wetlands)	1.53	1.53	3:1	0.51	Wetland rehabilitation will include site grading, wetland vegetation planting, and cattle exclusion to restore wetland hydrology and function. Credit reduced because minimal effort required and functional uplift limited.
R (2 - degraded wetlands)	0.43	0.43	1.5:1	0.29	Wetland rehabilitation will include wetland vegetation planting, ditch filling, and cattle exclusion to allow areas of hydric soils to become fully functioning wetlands.
R (3 - partially-functioning wetlands)	1.76	1.76	1.5:1	1.17	Wetland rehabilitation will include site grading, wetland vegetation planting, and cattle exclusion to restore wetland hydrology and function. Microtopography will be reintroduced and overbank flooding regimes will be restored.
R (4 - filled wetlands)	0.45	0.45	1:1	0.45	Wetland re-establishment will include spoil removal, site grading, wetland vegetation planting, and cattle exclusion to restore wetland hydrology and function.
R (5 – hydric soils)*	0.27	0.27	3.5:1	0.08*	Another category of wetland restoration will include re-establishing wetland hydrology to an area with hydric soils. Wetland hydrology is currently absent due to adjacent channel incision.
TOTALS	**4.44**	**4.44**	**-**	**2.50***	
*Design approach for Wetland Type 5 was included to meet contracted WMUs for the project.					

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1.0 RESTORATION PROJECT GOALS AND OBJECTIVES

The North Carolina Division of Mitigation Services (NCDMS) develops River Basin Restoration Priorities (RBRPs) to guide its mitigation activities within each of the state's 17 major river basins and 54 cataloging units. RBRPs designate specific watersheds that exhibit both the need and opportunity for wetland, stream and riparian buffer restoration. These watersheds, designated as Targeted Local Watersheds (TLWs), receive priority for NCDMS planning and restoration project funds. The 2009 Cape Fear River Basin RBRP identified hydrologic unit (HU) 03030002-010020 as a TLW (2009 Cape Fear RBRP).

Browns Summit Creek is located in the Haw River Headwaters subwatershed, also identified as HU 03030002-010020. The subwatershed covers 83 square miles, including 198 miles of stream. Approximately 22 percent of stream reaches within the subwatershed lack adequate riparian buffers. The subwatershed is characterized by agricultural (39 percent), forested (53 percent), and impervious (1 percent) land uses. The designated land use of the remaining seven percent of the subwatershed remains unclassified (NCDMS, 2009). In addition to inadequate riparian buffers, there are ten animal operations, two of which are permitted dairy cattle operations, in the subwatershed. This leads to multiple opportunities to restore, enhance, or preserve streams and riparian buffers throughout this area.

The project will involve the restoration and enhancement of a rural Piedmont stream system (USACE, 2010 and Schafale, 2012) which has been degraded due to historic agricultural conversion and cattle grazing. Due to the productivity and accessibility of these smaller stream systems, many have experienced heavy human and cattle disturbance. Five ponds have been installed along the mainstem, two of which have failed due to a head cut breaching the dam and two more are in jeopardy of failing. In general, the system is vertically stable but has recently experienced active widening.

Restoration practices will involve raising the existing streambed to reconnect the stream to its relic floodplain and restoring natural flows to areas previously drained by ditching activities. The existing channels to be abandoned within the restoration areas will be partially filled to decrease surface and subsurface drainage and raise the local water table. Fencing will be provided around all proposed reaches and riparian buffers to exclude cattle accessing the areas; however, fencing will not be implemented where cattle lack access on Reach R4 along the Broad Ridge Court cul-de-sac. Vegetation buffers in excess of 50 feet will be established along both sides of the reaches and a recorded conservation easement consisting of 20.2 acres (AC) will protect the site in perpetuity.

Wastewater Treatment Plant (WWTP) discharge and runoff from agriculture and impervious surfaces have contributed to poor biological health, which indicates impaired water quality, in the Haw River Headwaters subwatershed. To improve watershed health and "due to the mix of ecological assets and environmental stressors", the 2009 Cape Fear RBRP emphasized the need for a mix of restoration and preservation measures in the Haw River Headwaters subwatershed. Nutrients, sedimentation, stream bank erosion, livestock access to streams, channel modification and the loss of wetlands and riparian buffers were observed stressors within the watershed.

Additionally, the 2005 NCDWR Cape Fear River Basinwide Water Quality Plan recommends protection and restoration of streams in urbanizing and existing urban areas in subbasin 03-06-01. Additionally, all land uses and discharges of stormwater in this area contribute nutrients to Jordan Reservoir. Jordan Reservoir has a total maximum daily load (TMDL) that was developed in 2007 for nitrogen and phosphorus to meet the chlorophyll *a* standard.

Based on the NCDMS 2009 Cape Fear River Basin Restoration Priority (RBRP) Plan, the Browns Summit Creek Restoration Project area is located in an existing targeted local watershed (TLW) within the Cape Fear River Basin TLW (2009 Cape Fear RBRP), although it is not located in a Local Watershed

Planning (LWP) area. The restoration strategy for the Cape Fear River Basin targets specific projects that focus on developing creative strategies for improving water quality flowing to the Haw River in order to reduce NPS pollution to Jordan Lake.

The primary goals of the project are to improve ecologic functions and to manage nonpoint source loading to the riparian system as described in the NCDMS 2009 Cape Fear RBRP. These are identified below:

- Create geomorphically stable conditions along the unnamed tributaries across the site,
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- Restore stream and floodplain connectivity, and
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- Control invasive species vegetation within the project area and, if necessary, continue treatments during the monitoring period, and
- Establish a conservation easement to protect the project area in perpetuity.

The proposed project aligns with overall NCDMS goals, which focus on restoring streams and riparian area values such as maintaining and enhancing water quality, increasing storage of floodwaters, and improving fish and wildlife habitat, as well as specific NCDMS RBRP goals including, but not limited to, nutrient and other non-point source pollutant management. The proposed natural channel design (NCD) approach will result in a stable riparian stream system that will reduce excess sediment and nutrient inputs to the Haw River Headwaters subwatershed, while improving water quality conditions that support terrestrial and aquatic species, including priority species identified in the Cape Fear River Basin.

2.0 SITE SELECTION

2.1 Directions to Site

The Browns Summit Creek Restoration Project site (site) is located in Guilford County, NC, approximately three miles northwest of the Community of Browns Summit, as shown on the Project Site Vicinity Map (Figure 2.1). To access the site from Raleigh, take Interstate 40 and head west on I-40 towards Greensboro, for approximately 68 miles. Take the exit ramp to E. Lee St. (exit 224) towards Greensboro and continue for 2 miles before turning onto U.S. Highway 29 North. Once on U.S. Highway 29 North, travel north for approximately 10 miles before exiting and turning on to NC-150 West. Continue west on NC-150 for 5 miles. The project site is located along and between NC-150 and Spearman Rd., with access points through residences on Middleland Dr. and Broad Ridge Ct.

2.2 Site Selection

The site is located in the NC Division of Water Resources (NCDWR) subbasin 03-06-01 of the Cape Fear River Basin. The site includes an unnamed tributary (UT) to the Haw River and several smaller channels connecting to it. The primary unnamed tributary has been named Browns Summit Creek for this project. Soils information (Figure 2.3) indicates that the area contains primarily Codorus loam, Poplar Forest clay loam, and Clifford sandy loam. The Codorus mapping unit is classified as hydric by the NRCS for Guilford County and contains inclusions of Hatboro loam in the floodplain. Hatboro soils are also classified as hydric by the NRCS. The area proposed for wetland restoration is along the floodplain of Reach R1 at the downstream end of the project. This area has been heavily manipulated and degraded and is mapped primarily as hydric soils, including the Codorus and Hatboro soils as described above.

The project site is located in the Charlotte Belt (Figure 2.1), which is part of the Charlotte and Milton Group. The project site includes rock from the Churchland Plutonic Suite (Western group) which is intrustive, granitic igneous rock. Observations by field staff in the watershed indicate that the project area has very few bedrock outcrops. It appears to weather to gravel because that is the coarsest particle found in the stream substrate.

The geomorphic setting is at the headwaters of the Browns Summit Creek subwatershed. Many of the project reaches are zero- and first-order. The zero-order streams include Reaches R5, R6, T1, T2, T3, and T4. The first-order streams include Reaches R1, R2, R3 and R4. With the exception of Reaches R1 and R2, which have wider available floodplains, the floodplains on the project site are generally narrow.

Project Reaches R1, R2, R3, and R4 are shown as solid blue-line streams on the USGS topographic quadrangle map (Figure 2.2). Project Reaches R5, R6, T1, T2 and T3 are not shown as blue-line streams, dashed or solid. The presence of historic valleys for each of the project stream systems can be seen from LiDAR (Light Detection and Ranging) imagery for the site (Figure 2.6), and are obvious during field investigations.

Field evaluations of intermittent/perennial stream status were made in late September 2013. These evaluations were based on NCDWR's Methodology for Identification of Intermittent and Perennial Streams and Their Origins, (v 4.11, Effective Date: September 1, 2010) stream assessment protocols. Table 1 below presents the results of the field evaluations along with the assessed status of each project reach. Copies of the supporting field forms may be found in Appendix B.

Table 1. Summary Information for Field Investigations to Determine Intermittent/Perennial Status
Browns Summit Creek Restoration Project

Project Reach Designation	Existing Project Reach Length (ft)	NCDWR Stream Classification Form Score	Watershed Drainage Area (acres) [1]	Stream Status Based on Field Analyses
R1	1,113	35.5	438	Perennial
R2	815	35.5	299	Perennial
R3	1,455	41.5	242	Perennial
R4	1,340	25/41.5	95/138	Intermittent/Perennial
R5	536	28.5	24	Intermittent
R6	442	18	61	Ephemeral (BMP)
T1	133	26.75	55	Intermittent
T2	283	27.25	47	Intermittent
T3	65	19	41	Intermittent
T4	117	-	10	Ephemeral (BMP)

Note 1: Watershed drainage areas were approximated based on USGS topographic and LiDAR information at the downstream end of each reach.

Wetlands

A preliminary jurisdictional determination field walk with United States Army Corps of Engineers (USACE) and NCDWR representatives was conducted in July of 2014 and found that a significant portion of the lower easement along Reach R1 consists of existing wetlands in various states of degradation. After discussions with the North Carolina Interagency Review Team (NCIRT), it was agreed that they would be divided into four categories for mitigation purposes: functioning, partially functioning, degraded, and filled (see Figure 2.4b). Additionally, small areas of existing wetlands were identified along Reaches R4 and R5. Appendix B includes the Jurisdictional Determination information.

The different areas may be generally categorized as follows:

1. "Functioning" wetlands – forested areas with hydrology and hydric soils, such as along the right bank of Reach R1. The hydrology and vegetation are present but in many areas cattle trampling has impacted the soil structure and ability to percolate water.
2. Degraded wetlands – areas with no wetland vegetation and partial/limited hydrology such as along the corrugated metal pipe at the beginning of Reach R1.
3. Partially-functioning wetlands – saturated, cattle-trampled areas along the left bank of the middle of Reach R1 that lack wetland vegetation.
4. Filled wetlands – areas where spoil has been placed on top of delineated hydric soils, such as upper Reach R2 and the downstream end of Reach R1.

Because credit ratio negotiations between Baker and the IRT yielded less credits than Baker's contracted amount with NCDMS, Baker further investigated the site for additional areas with wetland potential. During this investigation, another category of wetland mitigation was discovered and will be sought only to provide the additional 0.08 WMUs needed to meet the contracted WMU amount of 2.5. The inclusion of this fifth category and its proposed credit allotment was confirmed by the NCIRT on 8/6/2015 during a phone conversation and was subsequently documented in an email summarization. A copy of the email is included in Appendix D. The fifth category is defined as follows:

5. Hydric soils – areas with hydric soils but lacking wetland hydrology due to adjacent, severe stream channel incision, such as along lower Reach R4. This area is shown in Figure 2.4c and a slightly smaller version of it proposed for wetland re-establishment are shown in Figure 2.4d.

2.2.1 Historical Land Use and Development Trends

The project area is situated in a developing section of northern Guilford County. Land use within the project's drainage area of 438 acres is approximately 79 percent agricultural, 14 percent forested, and 5 percent developed, with approximately 90 percent of stream reaches lacking adequate riparian buffers. Recent land use of the project site includes active agricultural land managed as pasture for cattle grazing, residential development, and unmanaged forests.

Figure 2.2 shows the topography of the project watershed for the project area. Soils data for the project are shown in Figure 2.3. The project area (proposed conservation easement area) encompasses 20.2 acres of land that includes agricultural fields, cattle pastures, clear cuts, riparian wetlands, and narrow forested buffer lands (Figure 2.4). Potential for land use change or future development in the area adjacent and upstream to the conservation easement is moderate, given the newly developed suburban neighborhoods within the surrounding setting.

Over time, the project channels have become incised and disconnected from their historic floodplain. Additionally, the riparian buffer has been cleared or narrowed in numerous locations to increase pastureland. These processes and practices have contributed excessive sediment and nutrient loading to the Browns Summit Creek and its receiving waters: the Haw River, and eventually Jordan Reservoir and the Cape Fear River.

2.2.2 Successional Trends

To convert the land for agricultural use, landowners historically cleared portions of the mature forest and manipulated site streams to increase land for grazing and agriculture. Over time, the stream channels became incised and floodplain connectivity was further reduced. More recently, landowners cleared portions of the remaining riparian buffer area within the site boundary to provide additional land for pasture (Figure 2.4). Historical aerial photographs from 1937 and 1951 show a wider riparian buffer, particularly on Reaches R2, R3, R4, and R5, than what is present now (Figures 2.5a and 2.5b).

A historical aerial photograph from 1937 (Figure 2.5a) shows that much of the buffer area in the easement was forestland except for the lower sections along Reaches R1, T1, and T2, which clearly show a straightened stream and cleared buffer, presumably used for agriculture. Additionally, portions of the buffer along R2, R4, and R6 appear cleared as well. However, a 1951 historical aerial photograph (Figure 2.5b) shows much of the buffer area around Reaches R1, R2, T1, and T2 in the process of reforestation, along with some of previously cleared areas along R4 and R6. These include many of same areas that are presently open for grazing. Figure 2.4 uses a more recent aerial photograph (2010) and reveals significant clearing along Reaches R2, R3, R4, R6, T2, and T3, resulting in very narrow buffers (~10 feet) along much of the project length.

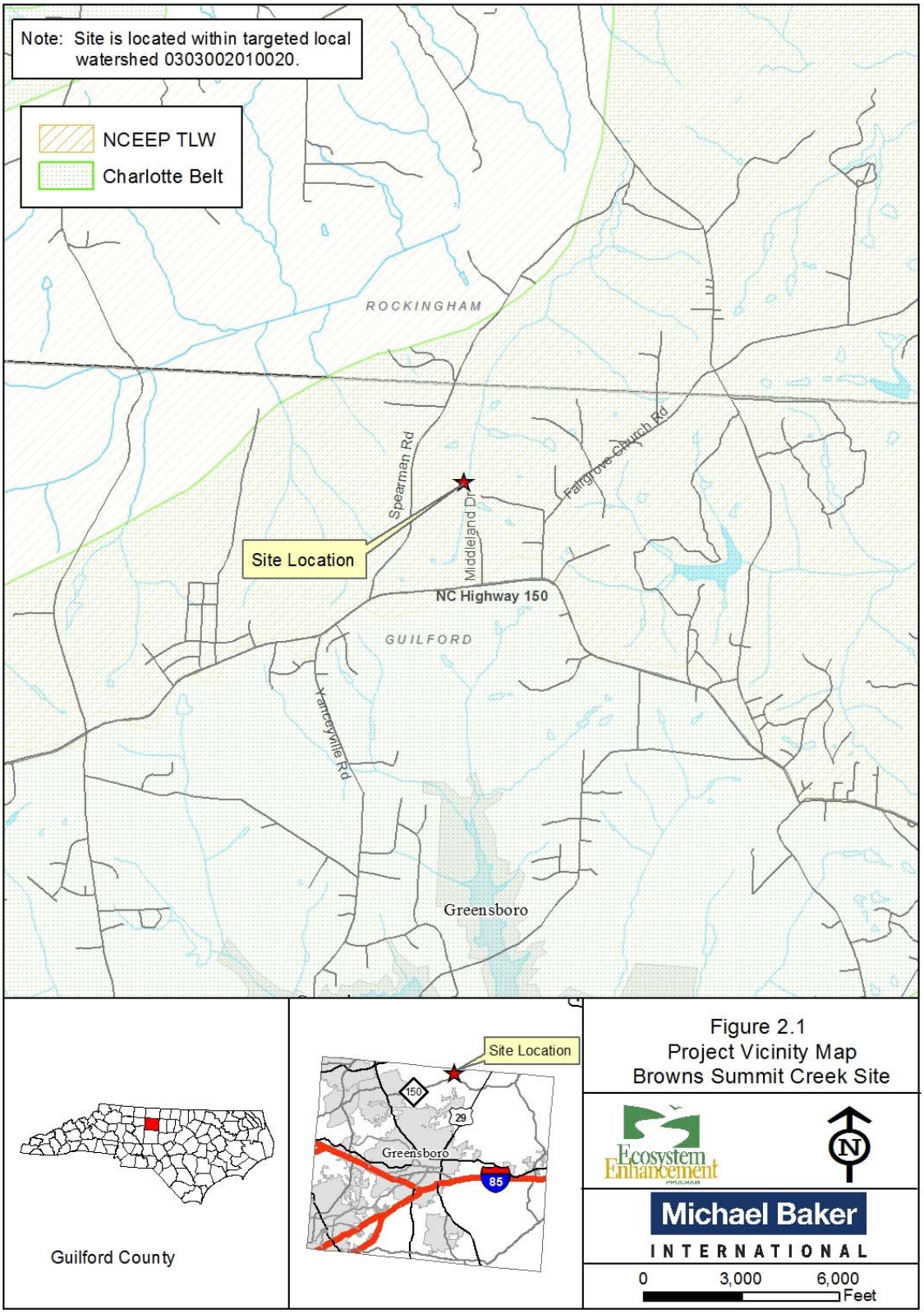
A pond was formerly located on the downstream end of R1. Within the remnant pond area, the existing stream pattern is irregular and the floodplain is hummocky or lumpy. The stream pattern upstream of the former pond is straight for such a wide valley, suggesting that channel straightening may have taken place in the past. Channelization is clearly confirmed by the historical aerial photo from 1937 (Figure 2.5a). This is further evidenced by the relic spoil piles present in several locations along the reach. The Catena Group, in their hydric soil delineation of Reaches R1 and R2 (see Appendix 16.6), noted significant manipulation of the soils by human and livestock activity.

A failed dam situated along Reach 4 does not appear to have historical significance. The aerial photograph from 1951 (Figure 2.5b) clearly does not show a dam and its associated pond. This

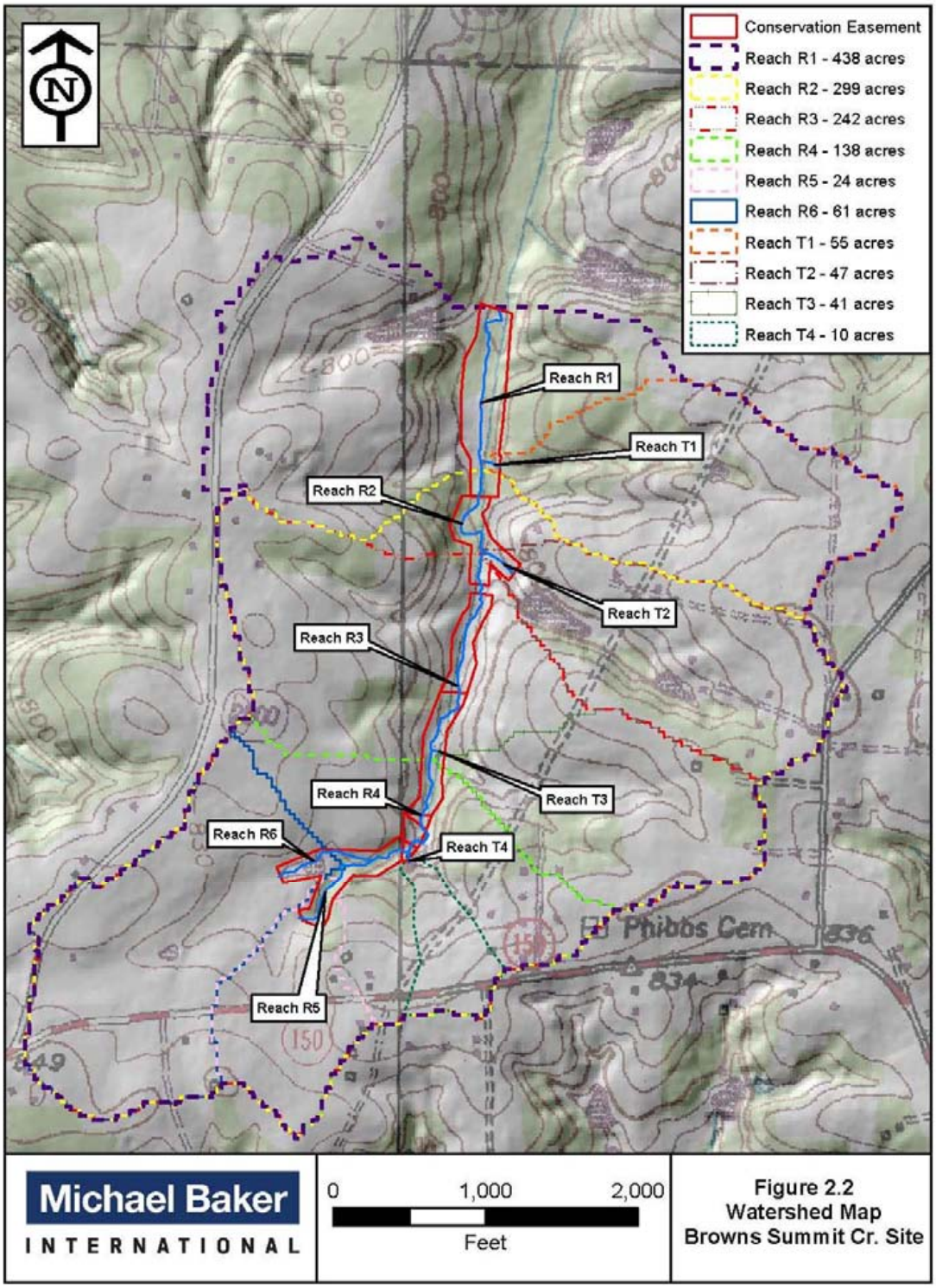
indicates that unless the dam was built prior to 1964, it should not hold any historical significance. Furthermore, the dam is now located within the boundaries of a residential neighborhood.

Project reaches has been heavily impacted from historic land use practices, predominantly cattle farming and forestry uses. Approximately 90 percent of the streambanks have inadequate (less than 50 feet wide) riparian buffers on both the right and the left floodplains. Hoof shear and/or shear stress have severely impacted the streambanks along Reaches R1, R2, R3, R4, and R6. The lack of adequate and quality buffer vegetation, past land use disturbances, and current cattle activities present a significant opportunity for water quality and ecosystem improvements through the implementation of this project.

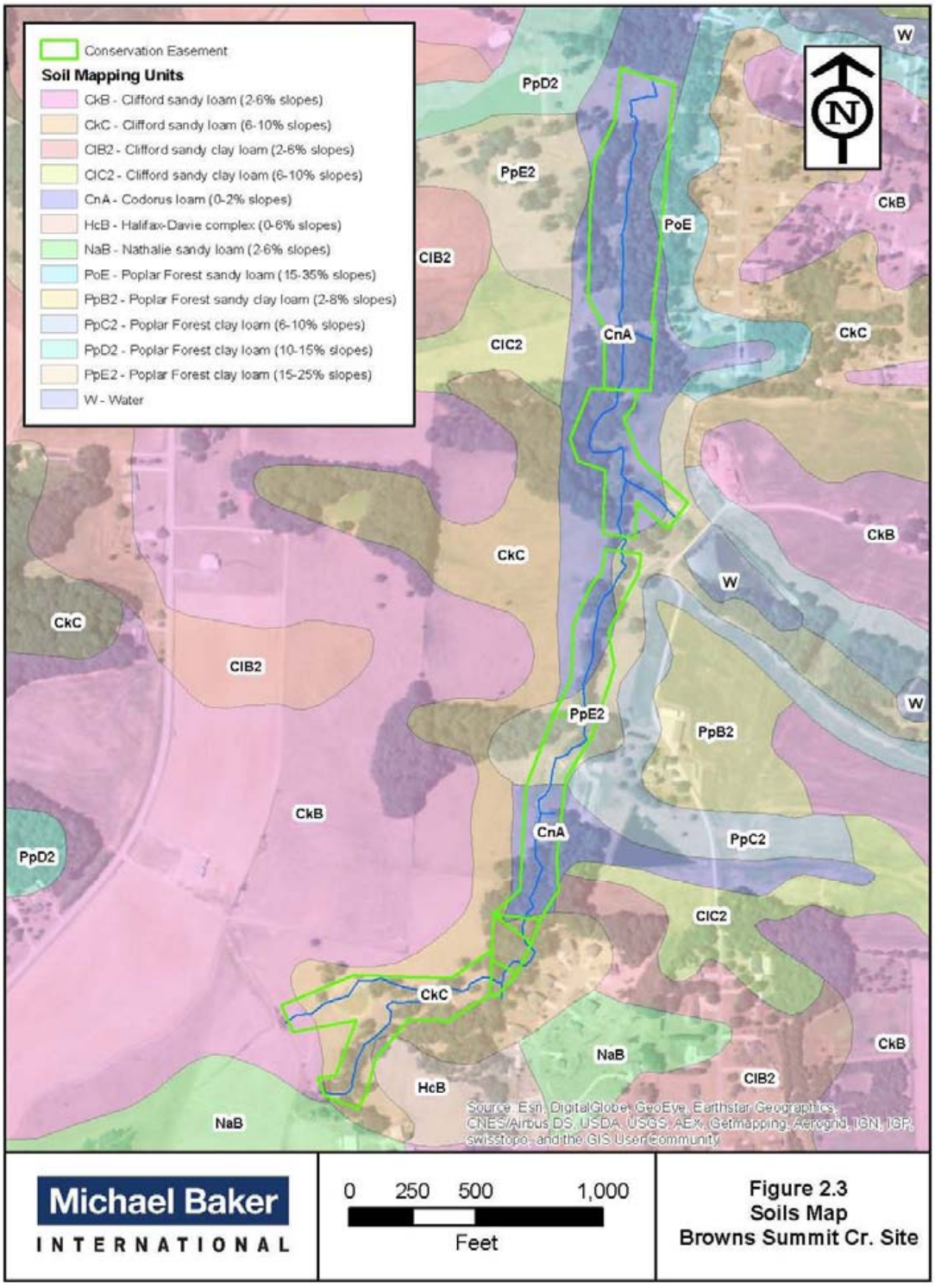
2.3 Vicinity Map



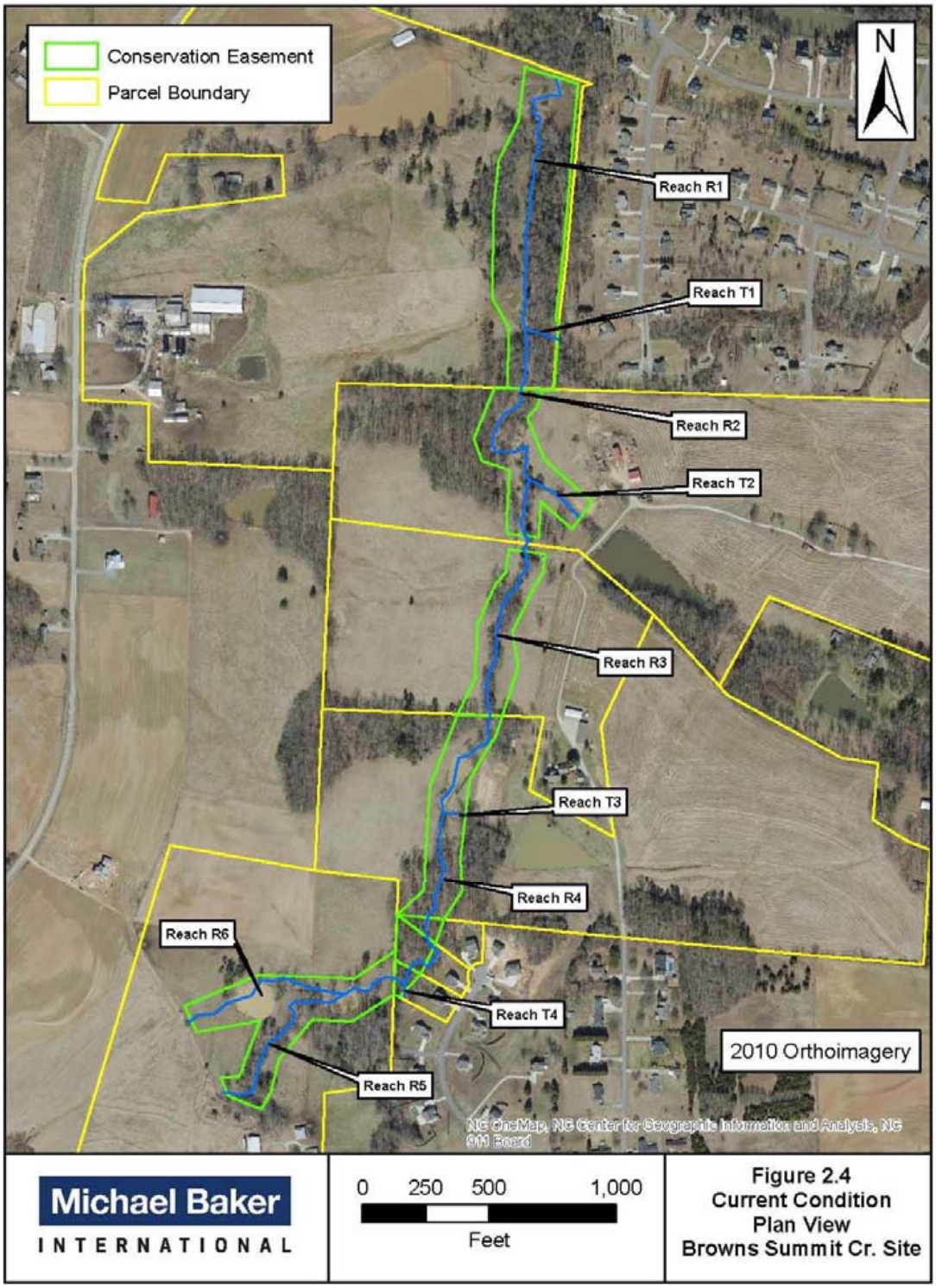
2.4 Watershed Map



2.5 Soils Map


Conservation Easement
Soil Mapping Units
CkB - Clifford sandy loam (2-6% slopes)
CkC - Clifford sandy loam (6-10% slopes)
ClB2 - Clifford sandy clay loam (2-6% slopes)
ClC2 - Clifford sandy clay loam (6-10% slopes)
CnA - Codorus loam (0-2% slopes)
HcB - Halifax-Davie complex (0-6% slopes)
NaB - Nathalie sandy loam (2-6% slopes)
PoE - Poplar Forest sandy loam (15-35% slopes)
PpB2 - Poplar Forest sandy clay loam (2-8% slopes)
PpC2 - Poplar Forest clay loam (6-10% slopes)
PpD2 - Poplar Forest clay loam (10-15% slopes)
PpE2 - Poplar Forest clay loam (15-25% slopes)
W - Water
N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Michael Baker INTERNATIONAL
0 250 500 1,000
Feet
Figure 2.3
Soils Map
Browns Summit Cr. Site

2.6 Current Conditions Map



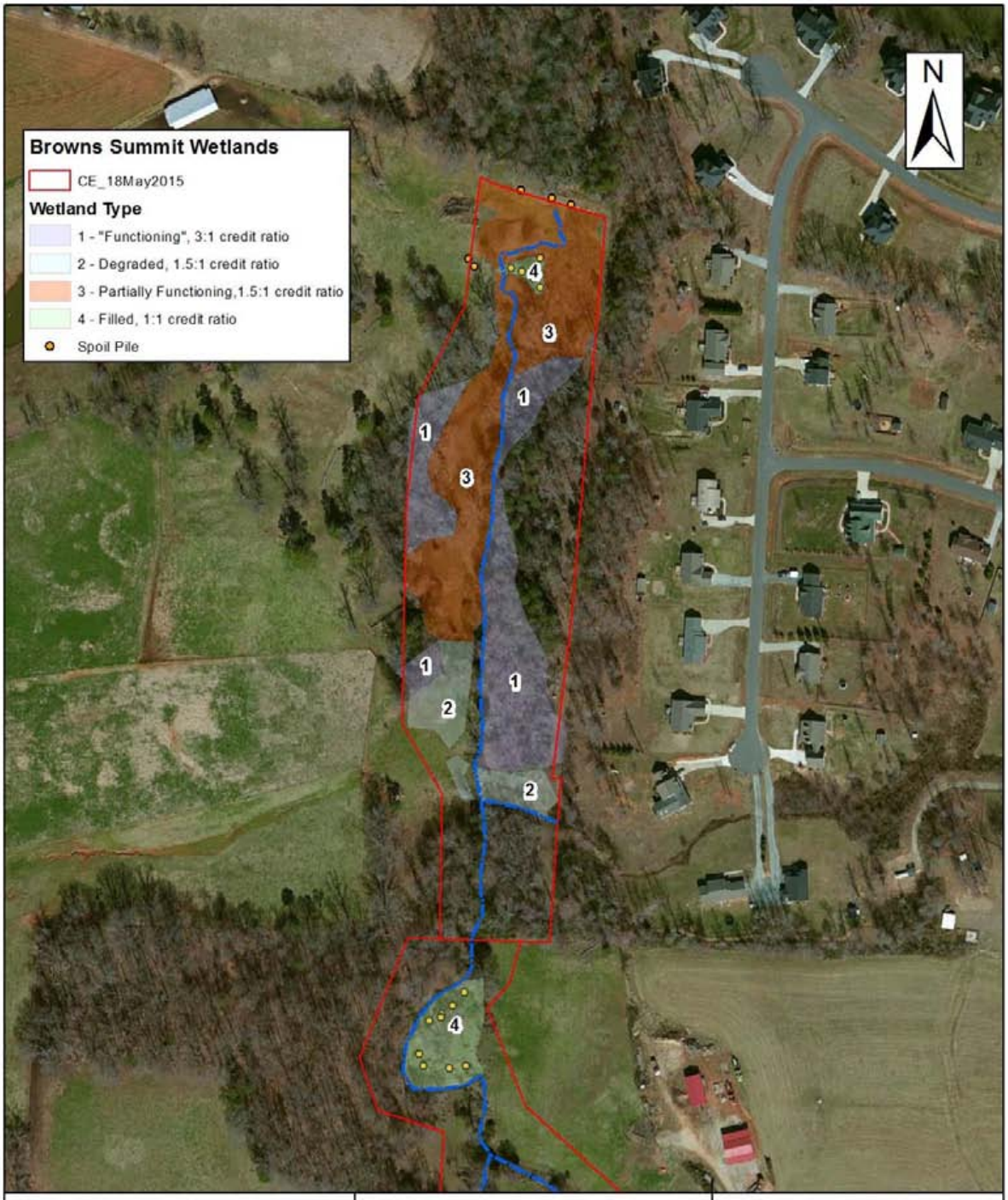
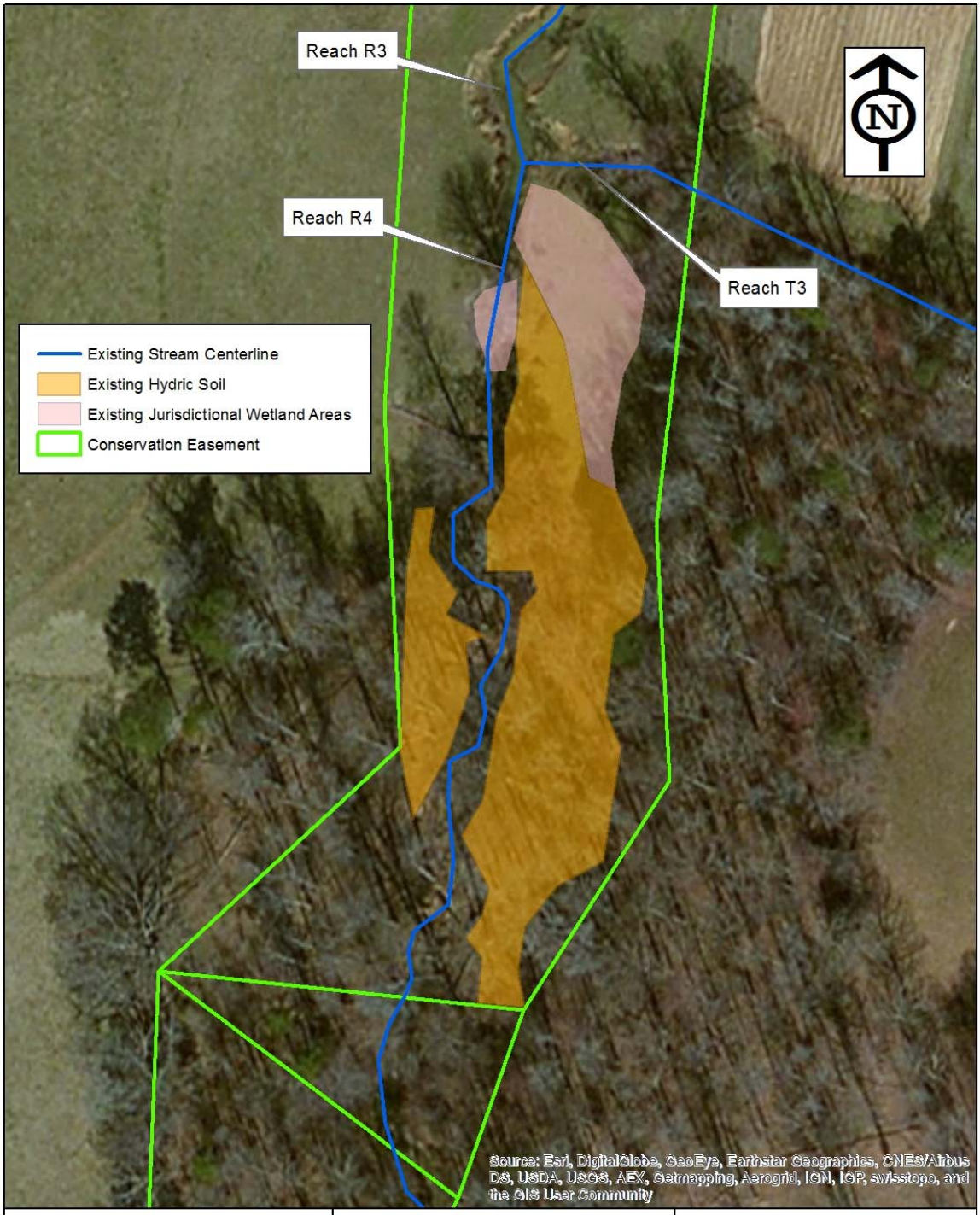


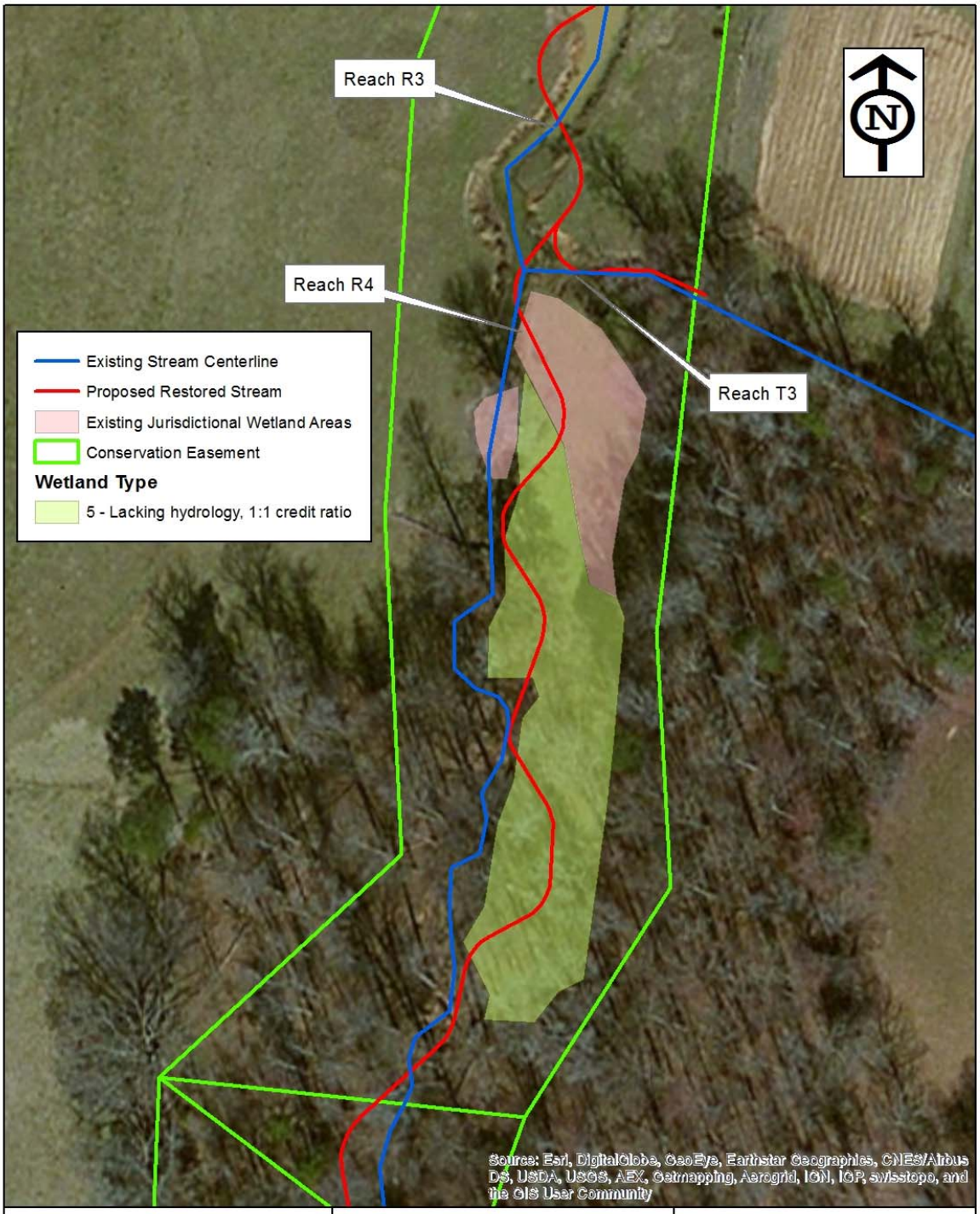
Figure 2.4b
Current Condition Wetlands
Plan View
Browns Summit Cr. Site



Michael Baker INTERNATIONAL

0 25 50 100
Feet

Figure 2.4c
Current Condition
Hydric Soils
Browns Summit Cr. Site

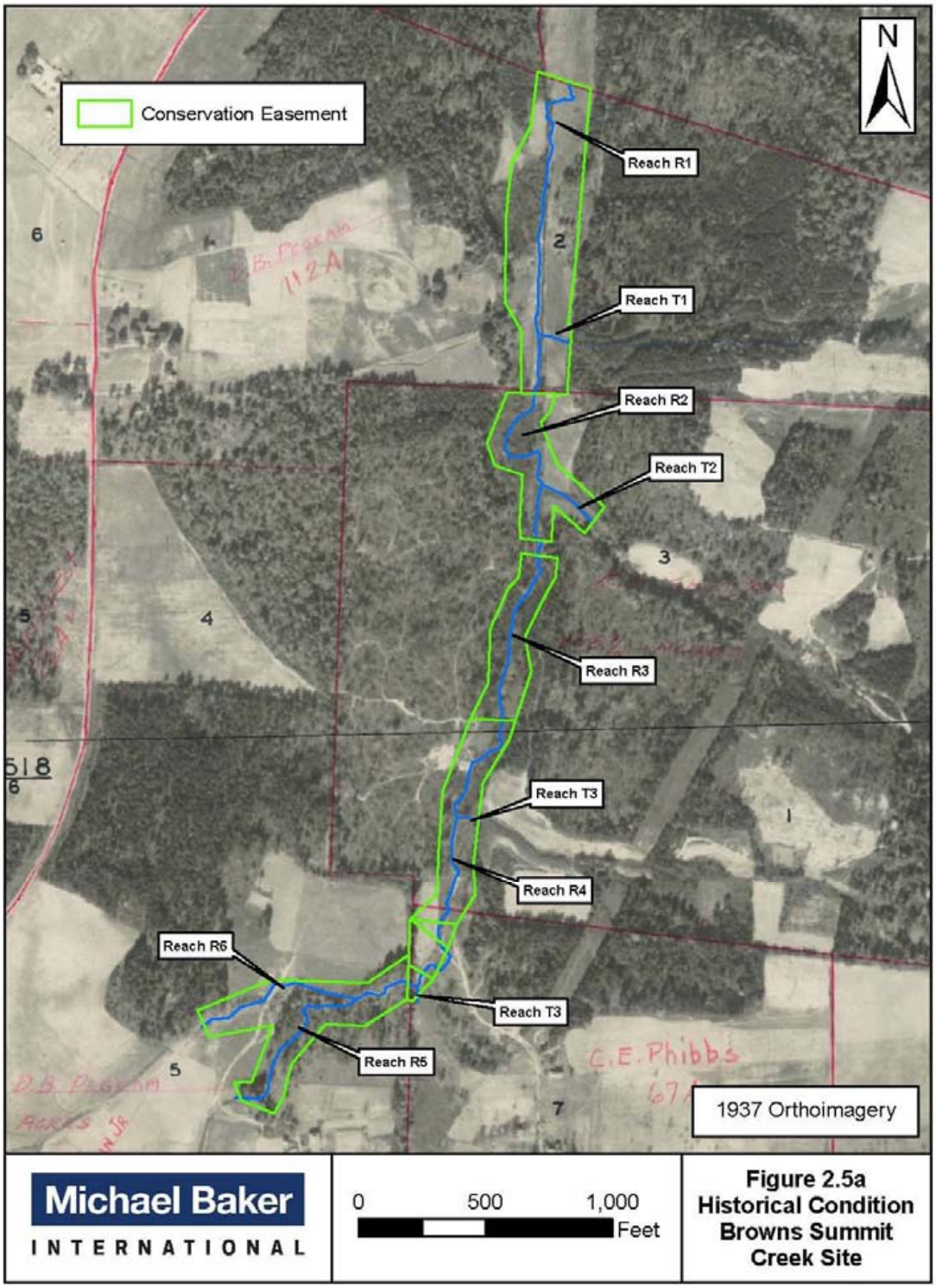


Michael Baker INTERNATIONAL

0 25 50 100
Feet

Figure 2.4d
Proposed Wetland Restoration Area
Browns Summit Cr. Site

2.7 Historical Conditions Maps



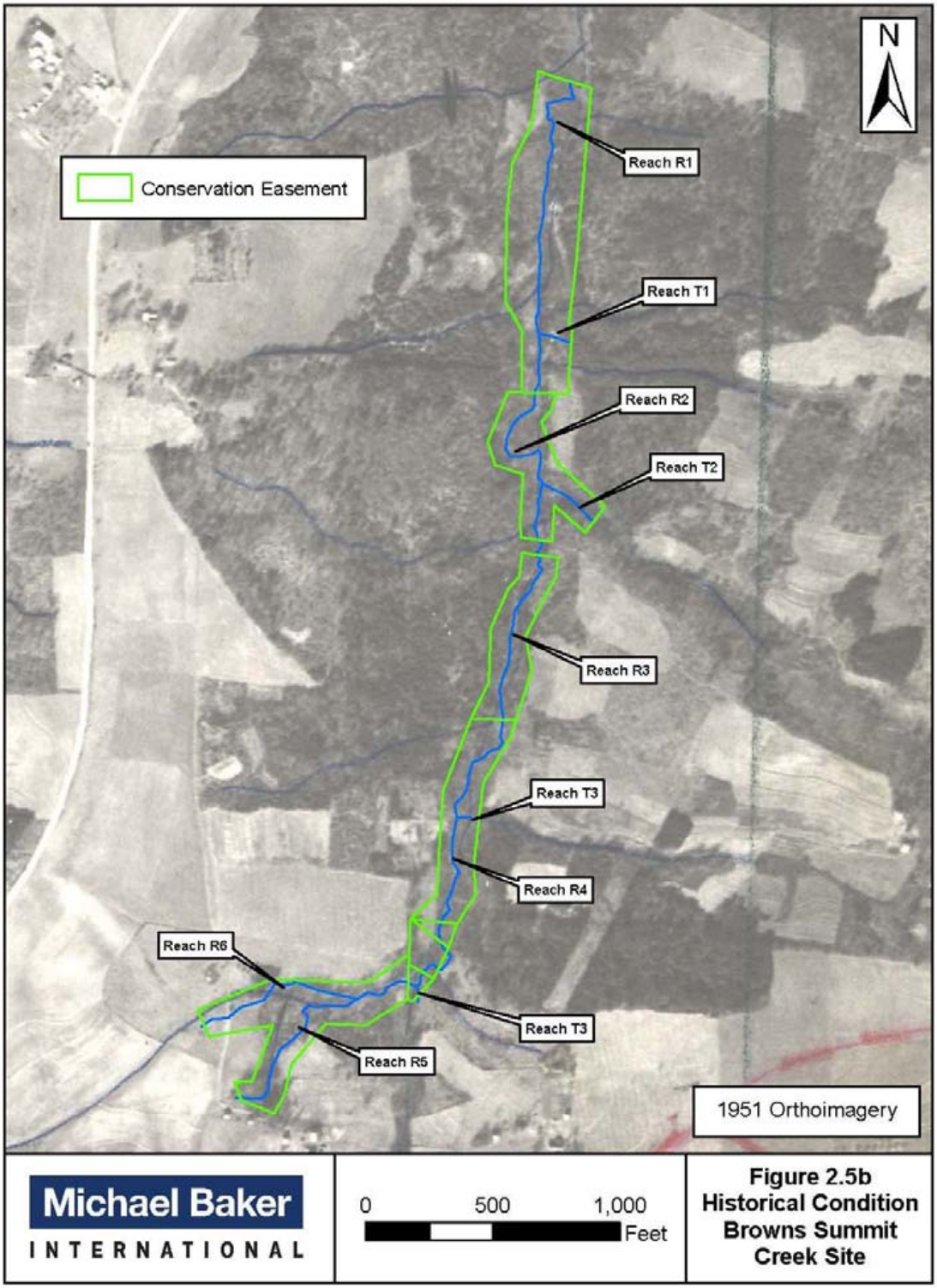
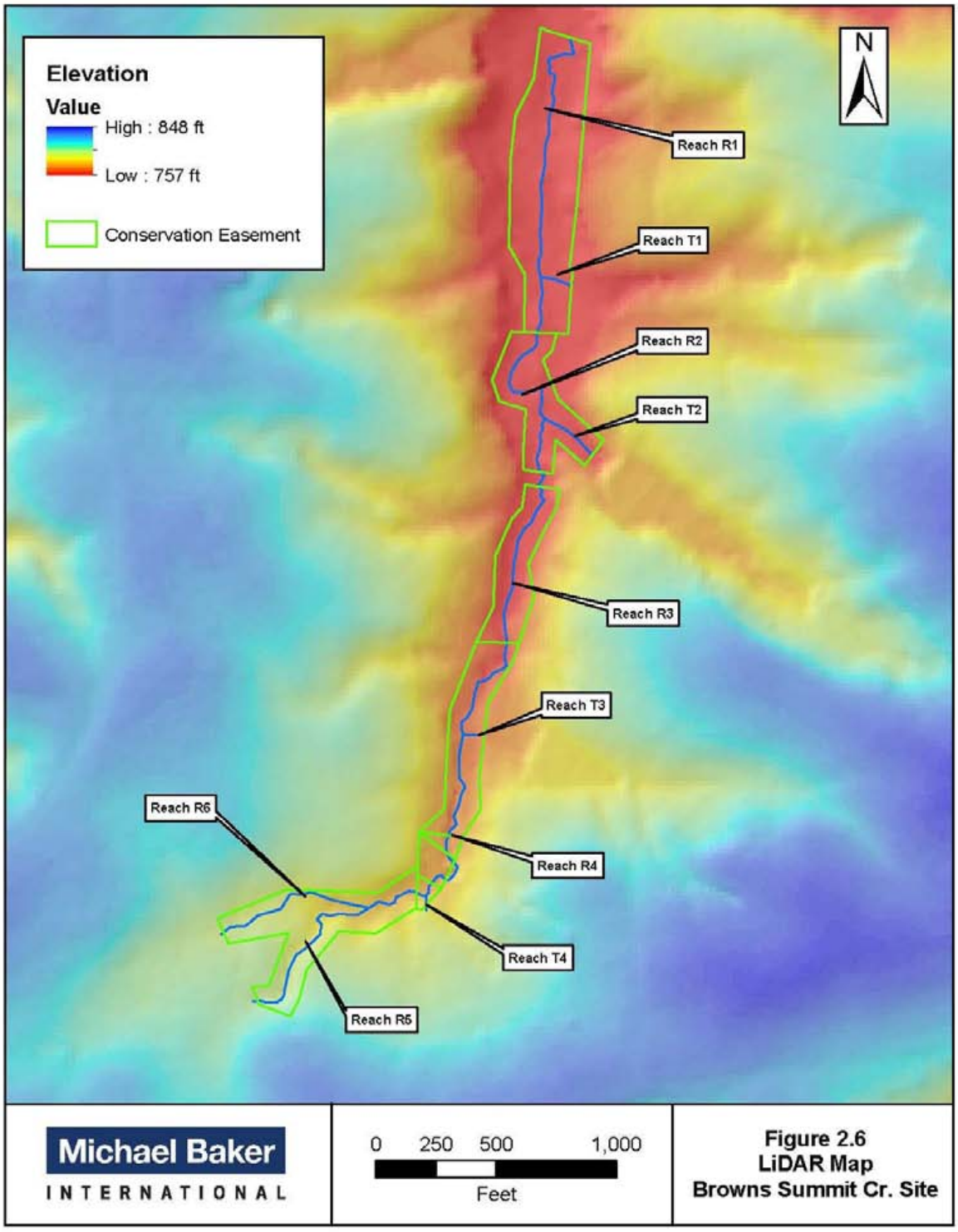


Figure 2.5b
Historical Condition
Browns Summit Creek Site

2.8 LiDAR Map


Elevation
Value
High : 848 ft
Low : 757 ft
Conservation Easement
N
Reach R1
Reach T1
Reach R2
Reach T2
Reach R3
Reach T3
Reach R6
Reach R4
Reach T4
Reach R5
Michael Baker
INTERNATIONAL
0 250 500 1,000
Feet
Figure 2.6
LiDAR Map
Browns Summit Cr. Site

2.9 Site Photographs

2.9.1 Reach R1

Culvert acting as cattle crossing at upper end of Reach R1. This culvert will be removed. (6/4/13)

View looking upstream at confluence of Reaches T1 (left) and R2 (right) forming Reach R1. (6/4/13)

Right bank of Reach R1 trampled by cattle hooves. (6/4/13)

View looking upstream at minimal vegetation buffer along proposed restoration after recent rain event. (6/4/13)

View looking at floodplain on left bank along Reach R1. This area is targeted for wetland rehabilitation. (6/4/13)

Culvert at downstream end of project will be replaced and the dam will be enhanced to prevent piping. (10/10/13)

2.9.2 **Reach R2**

View looking downstream on Reach R2. (2/27/12)

View looking downstream along Reach R2. Floodplain area on left bank is targeted for riparian wetland reestablishment (2/27/12)

View looking downstream at stream bank erosion and channel incision near upstream end. (2/27/12)

View looking upstream along Reach R2 at bank erosion on right bank and lack of riparian buffer. (2/27/12)

View looking across Reach R2 at plowed land and deficient riparian buffer.(10/3/13)

View looking downstream along Reach R2 shows active erosion and deficient riparian buffer. (6/4/13)

2.9.3 **Reach R3**

View looking downstream from where Reach R3 begins. The farm pond in the background will be removed. (2/27/12)

Eroding outside bend on Reach R3. The restored channel will be moved away from this bank. (2/27/12)

Existing stream crossing on Reach R3. This culvert will be replaced and the crossing will be widened. (2/27/12)

Reach R3 where tree roots are holding the grade. The design will attempt to preserve this and other mature trees. (2/27/12)

Streambed sediment on Reach R3. Project mainstem has mostly sand and gravel. (10/17/13)

Unstable section of Reach R3 showing vertical banks and lack of floodplain access, mass wasting/failing streambank, and lack of riparian buffer. (10/17/13)

2.9.4 **Reach R4**

Lower end of pond on Reach R4. Headcut threatens pond dam. Pond will be removed as part of restoration. (9/10/13)

View looking downstream along Reach R4 along Broad Ridge Ct. Dam failure lead to deep incision. (9/10/13)

Downstream view along lower Reach R4. Reach T3 enters in background on right, marking the beginning of R3. (2/27/12)

View looking downstream along lower Reach R4. Channel widening has progressed. (2/27/12)

Right bank along Reach R4 where stormwater inputs from Broad Ridge Ct. have initiated a headcut. (10/17/13)

Pond along Reach R4 to be removed. High sediment and nutrient loading is apparent in this photo. (10/10/13)

2.9.5 Reaches R5 and R6

Cattle crossing along Reach R5 that will be closed. (10/10/13)

Reach R5, though somewhat incised, is largely stable and will be planted, fenced, and protected. (6/4/13)

Upper end of Reach R5 where a spring is located. (6/4/13)

A headcut has migrated through Reach R6 and cattle use it as a wallow. (6/4/13)

View looking downstream down Reach R6. Concrete and other debris have been placed to stop headcut migration. (6/4/13)

The upper end of Reach R6. This pond will be removed as part of the project. (10/17/13)

2.9.6 Reaches T1, T2, T3, Haw River State Park reference reach

View looking upstream at northern property line on Reach T1. (10/17/13)

View looking upstream at Reach T1. Cattle have trampled banks and invasive multiflora rose has become established. (6/4/13)

View looking downstream at Reach T2, which will be planted, fenced, and protected. (10/10/13)

View looking upstream at the dam above Reach T2. (10/10/13)

Reach T3 can be seen entering the right bank in the middle of this photo. A headcut from the mainstem has migrated through lower T3. (2/27/12)

View looking upstream along reference reach cross section in Haw River State Park. (12/8/14)

3.0 SITE PROTECTION INSTRUMENT

3.1 Site Protection Instrument Summary Information

The land required for the construction, management, and stewardship of this mitigation project includes portions of the following parcels. A copy of the land protection instrument is included in Appendix A.

Table 3.1 Site Protection Instrument Summary

Browns Summit Creek Restoration Project

Easement Area	Landowner	PIN	County	Site Protection Instrument	Deed Book and Page Numbers	Acreage Protected
CE-1	Sarah Elledge	7970842313	Guilford	Conservation Easement	007007 / 01094	4.28
CE-2	Renee Matthews	7970940511	Guilford	Conservation Easement	007370 / 00354	0.19
CE-3	Latricia and Arnold Irving	7970940634	Guilford	Conservation Easement	007536 / 00524	0.49
CE-4	James and Erma Marshall	7970940765	Guilford	Conservation Easement	007370 / 02398	0.21
CE-5	Donna Carter and Sarah O'Bryant	7970957284	Guilford	Conservation Easement	005106 / 01731	2.89
CE-6	Steven and Donna Carter	7970952956	Guilford	Conservation Easement	003890 / 00365	2.32
CE-7	Deborah Stepp and Sarah O'Bryant	7980061382	Guilford	Conservation Easement	005106 / 01734	2.95
CE-8	Janie Bowman	7970876658	Guilford	Conservation Easement	005439 / 01271	2.84
CE-9	Janie Bowman	7970876658	Guilford	Conservation Easement	005439 / 01271	4.13

Baker has obtained signed option agreements for a conservation easement from the current landowners for the entire project area. The conservation easement deed and survey plat draft versions will be submitted to NCDMS and State Property Office (SPO) in 2016. After approval and recordation, it will be held by the State of North Carolina. The secured conservation easement will allow Baker to proceed with the restoration project and restricts the land use in perpetuity.

3.1.1 Potential Constraints

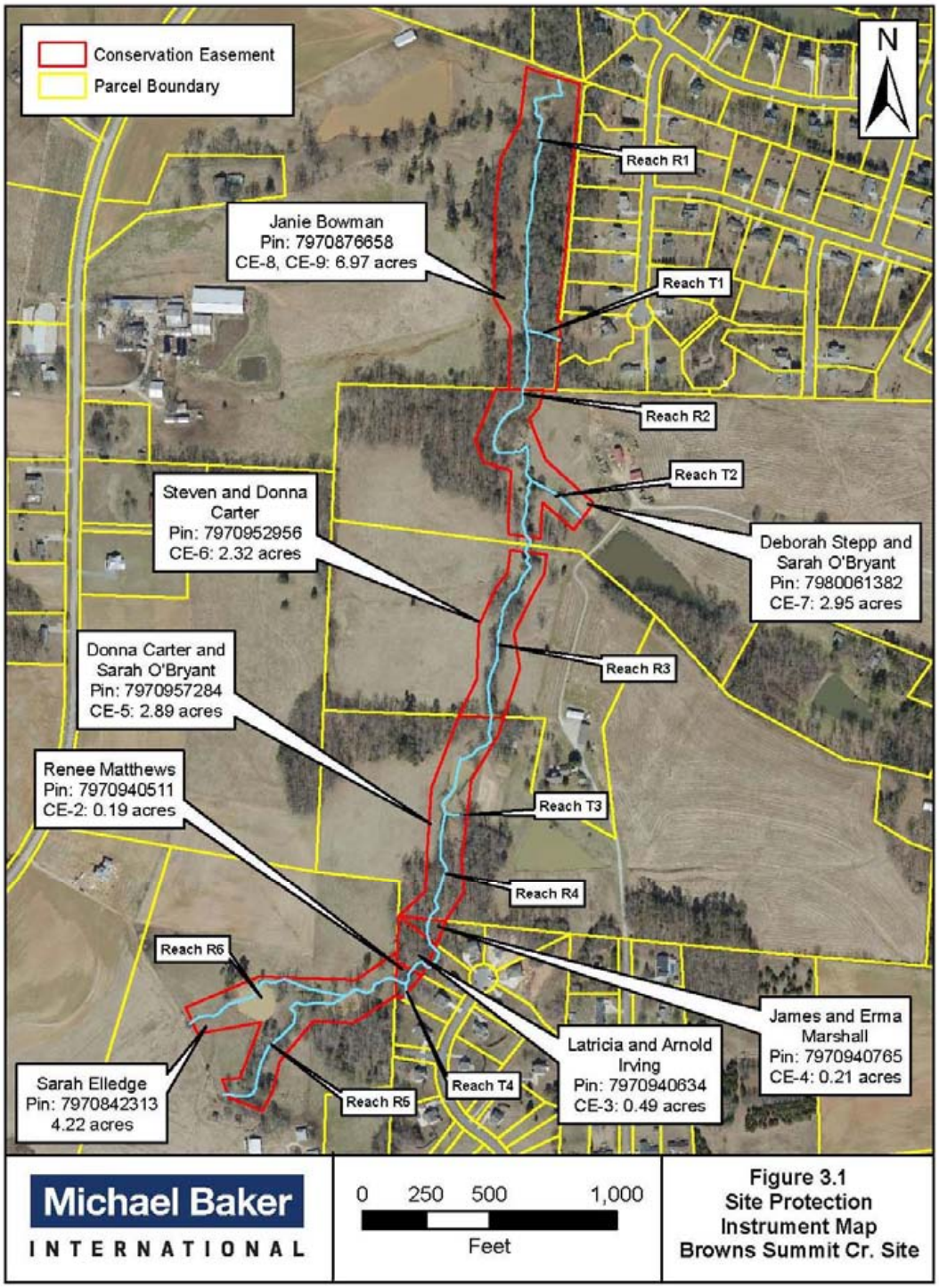
No fatal flaws have been identified at the time of this mitigation plan. One existing farm crossing along lower Reach R3 will be moved downstream approximately 100 feet and improved as part of this project. No existing or proposed easements for power and telephone utilities are located within the conservation easement. Riparian buffer widths will extend at least 50 feet from the top of stream banks (100 foot minimum total buffer width) for the proposed stream reaches. There are two exceptions. One is at the beginning of Reach R5 and the other is along the upstream property on Broad Ridge Ct. None of the project reaches are located in a FEMA regulated floodplain (Figure 16.1); thus, FEMA permitting or documentation are not required. Baker has notified the County floodplain administrator and applied

for the necessary land use permits. Additionally, hydrologic trespass will not result from the proposed project. Other regulatory factors discussed in Section 16, Appendix B were also not determined to pose potential site constraints. Construction access and staging areas have been identified and will be determined during final design.

3.2 Site Protection Instrument Figure

The conservation easement for the project area is shown in Figure 3.1 and a copy of the preliminary survey plat is included in Section 15, Appendix A.

Figure 3.1 Site Protection Instrument Map



4.0 BASELINE INFORMATION

Table 4.1 Baseline Information
Browns Summit Creek Restoration Project

Project Information					
Project Name	Browns Summit Creek Restoration Project				
County	Guilford				
Project Area (acres)	20.2				
Project Coordinates (latitude and longitude)	36.237 N, -79.749 W				
Project Watershed Summary Information					
Physiographic Province	Piedmont				
River Basin	Cape Fear				
USGS Hydrologic Unit 8-digit and 14-digit	03030002 / 03030002010020				
NCDWR Sub-basin	03-06-01				
Project Drainage Area (acres)	438				
Project Drainage Area Percent Impervious	1%				
CGIA Land Use Classification	2.01.01.01, 2.03.01, 2.99.01, 3.02 / Forest (53%) Agriculture (39%) Impervious Cover (1%) Unclassified (7%)				
Reach Summary Information					
Parameters	**Reach R1**	**Reach R2**	**Reach R3**	**Reach R4**	**Reach R5**
Length of Reach (linear feet)	1,233	805	1,454	1,296	536
Valley Classification (Rosgen)	VII	VII	VII	VII	VII
Drainage Area (acres)	438	299	242	138/95	24
NCDWR Stream Identification Score	35.5	35.5	41.5	41.5/25	28.5
NCDWR Water Quality Classification	C; NSW				
Morphological Description (Rosgen stream type)	E	Bc incised	Bc incised	Gc	Bc
Evolutionary Trend	Incised E→Gc→F	Bc→G→F	Bc→G→F	G→F	Bc→G
Underlying Mapped Soils	CnA	CnA	CnA, PpE2	CnA, CkC	CkC
Drainage Class	Somewhat Poorly Drained	Somewhat Poorly Drained	Somewhat Poorly Drained and Well Drained	Somewhat Poorly Drained and Well Drained	Well Drained
Soil Hydric Status	Hydric	Hydric	Partially Hydric	Partially Hydric	Upland
Average Channel Slope (ft/ft)	0.0069	0.0068	0.0095	0.017	0.0230
FEMA Classification	N/A	N/A	N/A	N/A	N/A
Native Vegetation Community	Piedmont Headwater Stream Forest				
Percent Composition of Exotic/Invasive Vegetation	25%	15%	5%	<5%	<5%
Parameters	**Reach R6**	**Reach T1**	**Reach T2**	**Reach T3**	**Reach T4**
Length of Reach (linear feet)	442	145	283	70	117
Valley Classification (Rosgen)	VII	VII	VII	VII	VII
Drainage Area (acres)	61	55	47	41	10
NCDWR Stream Identification Score	18	26.75	27.25	19	-
NCDWR Water Quality Classification	C; NSW				
Morphological Description (Rosgen stream type)	Bc incised	E incised	F	E incised	-

Table 4.1 Baseline Information
Browns Summit Creek Restoration Project

Evolutionary Trend	Bc→G→F	E→G→F	Bc→G→F	E→G→F	
Underlying Mapped Soils	CkC	CnA	CnA, PpE2	CnA	CkC
Drainage Class	Well Drained	Somewhat Poorly Drained	Somewhat Poorly Drained and Well Drained	Somewhat Poorly Drained	Well Drained
Soil Hydric Status	Upland	Hydric	Partially Hydric	Hydric	Upland
Average Channel Slope (ft/ft)	0.014	0.024	0.022	0.02	-
FEMA Classification	N/A	N/A	N/A	N/A	N/A
Native Vegetation Community	Piedmont Headwater Stream Forest				
Percent Composition of Exotic/Invasive Vegetation	5%	10%	10%	10%	10%

Regulatory Considerations

Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Categorical Exclusion (Appendix B)
Waters of the United States – Section 401	Yes	Yes	Categorical Exclusion (Appendix B)
Endangered Species Act	No	N/A	Categorical Exclusion (Appendix B)
Historic Preservation Act	No	N/A	Categorical Exclusion (Appendix B)
Coastal Area Management Act (CAMA)	No	N/A	Categorical Exclusion (Appendix B)
FEMA Floodplain Compliance	No	N/A	Categorical Exclusion (Appendix B)
Essential Fisheries Habitat	No	N/A	Categorical Exclusion (Appendix B)

5.0 DETERMINATION OF CREDITS

Table 5.1 Project Components and Mitigation Credits
Browns Summit Creek Restoration Project

Mitigation Credits								
	Stream	**Riparian Wetland**		**Non-riparian Wetland**		**Buffer**	**Nitrogen Nutrient Offset**	**Phosphorus Nutrient Offset**
Type	R, E1, E2, BMP	R	E					
Totals	5,264 SMU	2.50 WMU	0.0					

Project Components						
Project Component or Reach ID	**Stationing/ Location**	**Existing Footage/ Acreage**	**Approach**	**Restoration/ Restoration Equivalent**	**Restoration Footage or Acreage**	**Mitigation Ratio**
Reach R1	51+77 to 64+10	1,217 LF	Restoration	1,233 SMU	1,233 LF	1:1
Reach R2 (downstream section)	49+86 to 51+77	167 LF	Enhancement Level II	76 SMU	191 LF	2.5:1
Reach R2 (upstream section)	43+72 to 49+86	701 LF	Enhancement Level I	409 SMU	614 LF	1.5:1
Reach R3 (downstream section)* 60' easement break subtracted from stream lengths	39+60 to 43+72	362 LF*	Enhancement Level I	234 SMU	352 LF*	1.5:1
Reach R3 (upstream section)	28+58 to 39+60	1,224 LF	Restoration	1,102 SMU	1,102 LF	1:1
Reach R4	15+62 to 28+58	1,350 LF	Restoration	1,296 SMU	1,296 LF	1:1
Reach R5	10+26 to 15+62	536 LF	Enhancement Level II	214 SMU	536 LF	2.5:1
Reach R6	9+96 to 15+46	536 LF	Enhancement Level I/BMP	294SMU	442 LF (valley length)	1.5:1
Reach T1	10+00 to 11+45	121 LF	Restoration	145 SMU	145 LF	1:1
Reach T2	10+00 to 12+83	283 LF	Enhancement Level II	113 SMU	283 LF	2.5:1
Reach T3	10+30 to 11+00	83 LF	Restoration	70 SMU	70 LF	1:1
Reach T4	10+50 to 11+78	47 LF	Enhancement Level I/BMP	78 SMU	117 LF (valley length)	1.5:1
Wetland Area - Type 1	See plan sheets	1.53 AC	Rehabilitation	0.52 WMU	1.57 AC	3:1
Wetland Area - Type 2	See plan sheets	0.43 AC	Rehabilitation	0.33 WMU	0.49 AC	1.5:1
Wetland Area - Type 3	See plan sheets	1.76 AC	Rehabilitation	1.37 WMU	2.06 AC	1.5:1
Wetland Area - Type 4	See plan sheets	0.45 AC	Re-establishment	0.49 WMU	0.49 AC	1:1
Wetland Area – Type 5	See plan sheet	0.27 AC	Re-establishment	0.08 WMU	0.27 AC	3.5:1

Component Summation						
Restoration Level	**Stream (LF)**	**Riparian Wetland (AC)**		**Non-riparian Wetland (AC)**	**Buffer (SF)**	**Upland (AC)**
		Riverine	Non-Riverine			
Restoration	3,846	4.44				

Table 5.1 Project Components and Mitigation Credits
Browns Summit Creek Restoration Project

Enhancement I/BMP	966/559					
Enhancement II	1,010					
Creation						
Preservation						
High Quality Preservation						

BMP Elements

Element	Location	Purpose/Function	Notes
SW	Reach R6	Detain runoff to reduce discharge velocities, allow for sediment to settle out of the water column and to allow for the uptake of nutrient loads from biological processes	
NI	Reach T4	Detain runoff to disperse stormwater volumes into the floodplain of Reach R4, reduce discharge velocities, and promote nutrient uptake within the riparian buffer	

BMP Elements: BR= Bioretention Cell; SF= Sand Filter; SW= Stormwater Wetland; WDP= Wet Detention Pond; DDP= Dry Detention Pond; FS= Filter Strip; S= Grassed Swale; LS= Level Spreader; NI=Natural Infiltration Area

6.0 CREDIT RELEASE SCHEDULE

All credit releases will be based on the total credit generated as reported by the as-built survey of the mitigation site. Under no circumstances shall any mitigation project be debited until the necessary Department of the Army (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 NCIRT, 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 in Table 6.1 as follows:

Table 6.1 Credit Release Schedule
Browns Summit Creek Restoration Project

Forested Wetland 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 NCDMS to discontinue hydrologic monitoring after the fifth year, 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 closeout approval.	10%	100%
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 "Subsequent Credit Releases" paragraph below.**

Initial Allocation of Released Credits

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

a. Approval of the Final Mitigation Plan.

b. Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property.

c. Completion of project construction (the initial physical and biological improvements to the mitigation site) pursuant to the mitigation plan; Per the NCDMS 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.

Subsequent Credit Releases

All subsequent credit releases must be approved by the DE, in consultation with the NCIRT, based on a determination that required performance standards have been achieved. For stream projects a reserve of 15% of a site's total stream credits shall be released after two bankfull events have occurred, in separate years, provided the channel is stable and all other performance standards are met. The reserve will be 10% for 7 year monitoring timeframes. In the event that less than two bankfull events occur during the monitoring period, release of these reserve credits shall be at the discretion of the NCIRT. As projects approach milestones associated with credit release, the NCDMS 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.

7.0 MITIGATION WORK PLAN

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

7.1.1 Target Stream Types

The primary goal when targeting a stream type was to select a site-specific design approach that would return rural Piedmont stream functions to a stable state prior to past disturbances. This goal could be accomplished where Priority Level I restoration is implemented. In other areas, the target is a current day stable condition. Current assessment methods and data analyses were utilized for identifying lost or degraded functions at the site and to determine overall mitigation potential. Among these are reviewing existing hydrogeomorphic conditions, historical aerials and LiDAR mapping, evaluating stable reference reaches, and a comparison of results from similar past projects in rural Piedmont stream systems.

After examining the assessment data collected at the site and exploring the potential for restoration, an approach was developed that would address restoration of stream functions within the project area. Topography and soils on the site indicate that the project area most likely functioned in the past as small tributary stream system, eventually flowing downstream into the larger Haw River system. This condition has changed with the construction of several dams, as well as channel straightening and downcutting. For the most part, except where minimal enhancement is implemented, the project area will be returned to a small tributary stream system.

Assigning an appropriate stream type for the corresponding valley that accommodates the existing and future hydrologic conditions and sediment supply was considered prior to selecting the proposed design approach. This decision was based primarily on the range of the reference reach data available and the desired performance of the site.

7.1.2 Target Wetland Types

The restoration approach for the riparian wetland areas targets species consistent with those of a "Piedmont Headwater Stream Forest" (Typic subtype), as identified by Schafale (2012) and a "Headwater Forest" as identified by the North Carolina Wetland Assessment Method (NC WAM, 2010), due to a relatively narrow easement widths and true forest viability. Hydrology of this palustrine system will be "intermittently inundated by surface water or seasonally saturated to semi-permanently saturated". The goal of the wetland design component of the project is to restore functions in areas where evidence of hydric soil conditions are present. The wetland restoration approach is based on a detailed soil analyses by a licensed soil scientist, hydrologic monitoring using rainfall data and groundwater level monitoring wells, as well as other assessment data collected at the site. Four main activities will be employed to restore on-site wetlands:

- Minor grading, which is anticipated to be less than 6 inches in all proposed wetland restoration areas, to remove overburden and spoil piles from buried hydric soil layers in limited areas,
- Planting native wetland species vegetation to establish buffer vegetation,
- Connecting channels to their relic floodplains, and
- Permanently excluding cattle from the buffer to restore soil structure and reduce compaction.

As a result of raising the streambeds and reconnecting the streams to their relic floodplains, significant hydrologic lift will occur across the project area, raising the local water table and restoring wetland hydrology to drained hydric soils adjacent to the steam and wetland system.

7.1.3 Target Plant Communities

Native species of riparian vegetation will be established in the riparian buffer throughout the site. Schafale's (2012) guidance on vegetation communities as well as the USACE Wetland Research Program (WRP) Technical Note VN-RS-4.1 (1997) were referenced during the development of riparian

and adjacent wetland planting lists for the site. In general, bare root vegetation will be planted at a target density of 680 stems per acre. Live stakes will be planted along the channels at a target density of 400 stakes per 1,000 linear feet. Using triangular spacing along the stream banks, the live stakes will be spaced two to three feet apart in meander bends and six to eight feet apart in the riffle sections between the toe of the stream bank and bankfull elevation. Site variations may require slightly different spacing. Invasive species vegetation, such as Chinese privet (*Ligustrum sinense*), tree-of-heaven (*Ailanthus altissima*), multiflora rose (*Rosa multiflora*), and princess tree (*Paulownia tomentosa*), will be removed and to allow native species plants to become established within the conservation easement. Larger native tree species will be preserved and harvested woody material will be utilized to provide stream bank stabilization cover and/or nesting habitat. Hardwood species will be planted to provide the appropriate vegetation for the restored riparian buffer areas. Species will include river birch (*Betula nigra*), green ash (*Fraxinus pennsylvanica*), tulip poplar (*Liriodendron tulipifera*), and American sycamore (*Platanus occidentalis*).

7.2 Design Parameters

Selection of design criteria is based on a combination of approaches, including review of reference reach data, regime equations, evaluation of monitoring results from past projects, and best professional judgment. Evaluating data from reference reach surveys and monitoring results from multiple Piedmont stream projects provided pertinent background information to determine the appropriate design parameters given the existing conditions and overall site potential. The design parameters for the site (shown in Section 17, Appendix C) also considered current guidelines from the USACE.

Justification for the restoration and enhancement activities and structural elements are as follows:

1. Many of the stream sections are incised (bank height ratios greater than 1.5),
2. Cattle access has resulted in significant degradation throughout the site,
3. Past agricultural and silvicultural activities, such as timber production, channelization, and pond construction/failure, have resulted in stream bank erosion, sedimentation and the loss of woody vegetation within the riparian zone, and
4. Enhancement or preservation measures alone would not achieve the highest possible level of functional lift for many portions of the degraded stream system.

For design purposes, the stream channels were divided into twelve reaches labeled R1, R2 (lower), R2 (upper), R3 (lower), R3 (upper), R4, R5, R6, T1, T2, T3, and T4, as shown in Table 7.1. Selection of a general restoration approach was the first step in selecting design criteria for the project reaches. The approach was based on the potential for restoration as determined during the site assessment and the specific design parameters were developed so that plan view layout, cross-section dimensions, and profiles could be described for developing construction documents. The design philosophy is to use these design parameters as conservative values for the selected stream types and to allow natural variability in stream dimension, facet slope, and bed features to form over long periods under the processes of flooding, re-colonization of vegetation, and watershed influences.

Table 7.1 Project Design Stream Types

Browns Summit Creek Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

Reach	Proposed Stream Type	Approach/Rationale
Reach R1	E	Restoration: Priority 1 Restoration will be implemented from the confluence of Reaches R2 and T1. The restored channel will be constructed off-line, mostly along the existing left bank, and will be designed as a Rosgen E type channel. The existing, unstable channel will be partially to completely filled along its length using a combination of existing spoil piles that are located along the reach and fill material excavated from construction of the restored channel. Riparian buffers in excess of 50 feet will be restored or protected along both sides of Reach R1. Invasive species control will be conducted. The culvert at the downstream end of the project will be replaced with a reinforced concrete pipe.
Reach R2	Bc	Enhancement: Continuing from Reach R3, Level I Enhancement will be implemented in the upper 539 feet of Reach R2. A bench will be constructed on the left bank initially, followed by realignment of the channel to remove two stream bends that point up valley, as well as spoil pile removal in just downstream of the realignment. At the property line, the approach will change to Level II Enhancement. In this case, the only measures proposed are cattle exclusion and invasive species control. No work will be done to the channel per IRT recommendation. Riparian buffers in excess of 50 feet will be restored or protected along both sides of Reach R2.
Reach R3	E/Bc	Restoration: Initially, Priority Level I Restoration will be implemented on Reach R3 as it continues from Reach R4. The alignment will generally follow the existing backwatered channel and farm pond, which will be removed, then continue crossing back and forth over the existing channel to make use of available floodplain. Cattle will be excluded and riparian buffers in excess of 50 feet will be restored or protected along both sides of the reach. A Rosgen E stream type with a width-to-depth ratio of 11 is targeted for the restoration section of this reach. Enhancement: Level I Enhancement will be implemented below an improved stream crossing. Riffle structures will be incorporated to raise the bed, vertical banks will be laid back and benched. Additionally, large woody debris will be incorporated in the form of toe wood, log vanes and/or weirs, and invasive species such as privet will be treated.
Reach R4	Bc/C	Restoration: With the exception of a 200-foot stretch below the upper farm pond, restoration will follow a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the existing floodplain. The remnant stream channel will be partially to completely filled and the upper pond at the top of the reach will be removed. Below the upper pond, restoration will be on-line and follow a Rosgen Priority Level II approach in order to maintain baseflow. Riparian buffers in excess of 50 feet will be restored or protected along both sides of Reach R4. Invasive species will be treated.

Table 7.1 Project Design Stream Types

Browns Summit Creek Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

Reach	Proposed Stream Type	Approach/Rationale
Reach R5	Bc	Enhancement: Enhancement Level II is proposed for this reach. A riparian buffer will be planted and a livestock exclusion fence will be installed on the conservation easement perimeter. A gradient control structure will be installed below the spring to stop a headcut. Isolated eroding streambank will be repaired. Riparian buffers in excess of 50 feet will be restored or protected along both sides of Reach R5, with the exception of the right bank in the first 50 feet. Here, existing fencing must be maintained to allow cattle rotation and this limits the easement width. Overall, the buffers for Reach R5 will average more than 50 feet. Invasive species will be treated.
Reach R6	Bc	BMP: A constructed headwater wetland will be installed as a replacement for the existing farm pond. It will function as a wetland-type feature with a concrete weir outlet. Riparian vegetation, livestock exclusion fencing, and a conservation easement will be established around the feature. Riparian buffers in excess of 50 feet will be restored or protected along both sides of Reach R6. Invasive species will be treated.
T1	C	Restoration: Restoration will follow a Rosgen Priority Level I approach. A single thread meandering channel will be constructed off-line across the existing floodplain. The remnant stream channel will be partially to completely filled. Riparian buffers in excess of 50 feet will be restored or protected along both sides of Reach T1. Invasive species will be treated.
T2	F	Enhancement: Enhancement Level II is proposed for this reach. A riparian buffer will be planted and a livestock exclusion fence will be installed on the conservation easement perimeter. A gradient control structure will be installed below close to Reach R3/R2 to stop a headcut. Riparian buffers in excess of 50 feet will be restored or protected along both sides of Reach T2. Invasive species will be treated.
T3	C/E	Restoration: Restoration will follow a Rosgen Priority Level I approach. A single thread meandering channel will be constructed to raise the elevation to match that of the adjacent mainstem. Riparian buffers in excess of 50 feet will be restored or protected along both sides of Reach T3. Invasive species will be treated.
T4	Bc	BMP: A rock lined step pool channel will be implemented below a 30-inch culvert outfall. The BMP will include a series of shallow riffles and pools along the Reach R4 floodplain. A riparian buffer in excess of 50 feet will be restored or protected along the left side of Reach T4. It is not possible to include a 50-foot buffer on the right right side because this reach is on a small residential parcel. However, overland runoff is not a concern here since the drainage comes from a stormwater culvert and will be contained in the easement area. Invasive species will be treated.

7.3 Data Analysis

Baker compiled and assessed watershed information such as drainage areas, historical land use, geologic setting, soil types, and terrestrial plant communities. The results of the existing condition analyses along with reference reach data from previous projects were used to develop a proposed stream restoration

design for the project reaches. Numerous sections of the existing channels throughout the project have been straightened/channelized or moved in the past. This manipulation has impacted channels so that they are now overly wide and deep for their respective drainage areas. Additionally, detailed topographic surveys were conducted along the channel and floodplain to determine the elevation of the stream where it flows throughout property, and to validate the valley signatures shown on the LiDAR imagery (Figure 2.6).

The design approach follows a step-wise methodology in which dimensionless ratios from successful past project experience, and to a lesser extent reference reaches, are used to restore stable dimension, pattern, and profile, as well as proper bankfull sediment transport competency for the proposed reaches. The stream channel design included analysis of the hydrology, hydraulics, shear stress, sediment transport, and appropriate channel dimensions. Critical shear stress and boundary shear stress analyses were used verify that the design channels will not aggrade nor degrade.

The Browns Summit Creek project includes two headwater reaches (Reaches R4 and R5) that are steeper and have narrow valleys. Often this setting may be associated with Bc stream types. However, the entrenchment ratio on the restored channels will, for the most part, be greater than 2.2, which makes either an E or a C channel. Though the channels will no longer be incised or entrenched, narrower valley widths and boundary conditions prevent pattern adjustments commonly associated with C or E meander geometry. This translates to shorter riffles with higher slopes, and thus higher stream power. Higher stream power is ameliorated to some extent by increasing the width-to-depth ratio above that of the nearby reference reach. Additionally, constructing higher width-to-depth ratios (e.g., 13-14) will put less stress on the newly constructed streambanks. The channel may narrow with time as vegetation becomes established and if sediment deposits along the channel.

The channel substrate throughout the project area is predominately sand and gravel. Consequently, Baker collected bulk sediment samples in order to evaluate bed material characteristics, classify the stream type, and complete sediment transport and stability analyses.

Regional curve equations, developed for the North Carolina Piedmont, (Harman et al., 1999) estimate a bankfull cross-sectional area of approximately 16.5 square feet for the downstream terminus of Reach R1's 0.68 square mile watershed (see Appendix C, Table 17.5). Rosgen's stream classification system (Rosgen, 1996) depends on the proper identification of the bankfull elevation. This was feasible in the project area because several good indicators were present (top-of-bank on R1, benches on R3, and a nearby reference reach).

The existing higher sections of the main stem (Reach R2, R3, & R4) classify as channelized B5c-G5c stream types based on their calculated entrenchment ratios, channel slope, and channel substrate (sand/gravel). Entrenchment ratios of greater than 1.4 but less than 2.2 put the channel in the Bc category though the channel is clearly incised with bank height ratios of 2.1 to 6.8.

Bedform diversity and riffle/pool feature formation throughout the site is poor and habitat diversity is minimal. The pools in the impacted project reaches are typically not noticeably deeper than the riffles. The riparian buffer vegetation is scattered and marginal along most the reach areas. Each stream displays limited meander geometry due to their current channelized conditions.

The existing and proposed conditions data indicate that the mitigation activities will result in the re-establishment of a functional stream and floodplain ecosystem. The restoration and enhancement efforts, including site protection through a conservation easement, will promote the greatest ecological benefit, a rapid recovery period, and a justifiable and reduced environmental impact over a natural recovery that would otherwise occur through erosional processes with associated impacts on water quality and flooding. Currently, sediment, excess nutrients, and cattle excrement are entering the system from adjacent farm fields and pastures where existing riparian buffer widths are marginal or non-existent. Stabilizing streambanks, revegetating riparian buffers, and removing cattle along project reaches will provide ecological uplift by reducing nonpoint source loading to the receiving waters and promoting the

restoration of diverse aquatic and terrestrial habitats appropriate for the piedmont ecoregion and landscape setting.

Additionally, by raising the streambed and connecting with active floodplains, the maximum degree of potential uplift will be provided, restoring stream, buffer, and wetland functions wherever and whenever possible. Uplift will also be provided to the system by improving and extending wildlife corridors that connect with wooded areas near the downstream extent of the project. Approximately 20.2 acres of riparian buffer will be restored and/or protected in perpetuity by a conservation easement.

8.0 MAINTENANCE PLAN

The site will be monitored on a regular basis and a physical inspection of the site will be performed at least once a 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 will be most likely in the first two years following site construction and may include the following components as described in Table 8.1.

Table 8.1 Routine Maintenance Components

Browns Summit Creek Restoration Project

Component/Feature	Maintenance through project close-out
Stream	Routine channel maintenance and repair activities may include modifying in-stream structures to prevent piping, securing loose coir matting, and supplemental installations of live stakes and other target vegetation along the project reaches. Areas of concentrated stormwater and floodplain flows that intercept the channel may also require maintenance to prevent stream bank failures and head-cutting until vegetation becomes established.
Wetland	Routine wetland maintenance and repair activities may include securing of loose coir matting and supplemental installations of target vegetation within the wetland. Areas of concentrated stormwater and floodplain flows that intercept the wetland may also require maintenance to prevent scour.
Vegetation	Vegetation will be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, and fertilizing. Exotic invasive plant species will controlled by mechanical and/or chemical methods. Any invasive plant species control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
Site Boundary	Site boundaries will be demarcated in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, 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.
Road Crossing	The farm road crossings within the site may be maintained only as allowed by the recorded Conservation Easement, deed restrictions, rights of way, or corridor agreements.
Utility Right-of-Way	Utility rights-of-way within the site may be maintained only as allowed by the recorded Conservation Easement or existing easement(s), deed restrictions, rights of way, or corridor agreements.
Beaver Management	Routine maintenance and repair activities caused by beaver activity may include supplemental planting, pruning, and dam breeching/dewatering and/or removal. Beaver management will be performed in accordance with US Department of Agriculture (USDA) rules and regulations using accepted trapping and removal techniques only within the project boundary.
Stormwater Management Device	Stormwater Management Devices will be monitored semi-annually and maintenance measures will be implemented as needed during the monitoring period. Measure may include replacing dead vegetative material and removing excess sedimentation from the forebay of the constructed wetland and its permanent pool, as well as the plunge pools along T4 during the monitoring period. Should the outlet of the constructed wetland become unstable during the monitoring period, corrective measures will be implemented to rectify the instability issues during the monitoring period.

9.0 PERFORMANCE STANDARDS

Baker has obtained regulatory approval for numerous stream mitigation plans involving North Carolina Department of Transportation (NCDOT) and NCDMS full-delivery projects. The success criteria for the project site will follow the mitigation plans developed for these projects, as well as the *Stream Mitigation Guidelines* (SMG) issued in April 2003 and October 2005 (USACE and NCDWR) and NCDMS's recent supplemental guidance document *Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation* dated November 7, 2011. All monitoring activities will be conducted for a period of 7 years, unless the site demonstrates complete success by year 5 and no concerns have been identified. An early closure provision may be requested by the provider for some or all of the monitoring components. Early closure may only be obtained through written approval from the USACE in consultation with the NCIRT.

Based on the design approaches, different monitoring methods are proposed for the project reaches. For reaches that involve a combination of traditional Restoration (Rosgen Priority Levels I and/or II) and Enhancement Level I (stream bed/bank stabilization) approaches, geomorphic monitoring methods will follow those recommended by the 2003 SMG and the 2011 NCDMS supplemental guidance. For reaches involving Enhancement Level II approaches, monitoring efforts will focus primarily on visual inspections, photo documentation, and vegetation assessments. The monitoring parameters shall be consistent with the requirements described in the Federal Rule for compensatory mitigation sites in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.5 paragraphs (a) and (b). Specific success criteria components and evaluation methods are described below and report documentation will follow the NCDMS Baseline Monitoring Document template and guidance (v 2.0, dated 10/14/2010).

Further description of the performance standards are provided below; however, a brief synopsis is listed here:

- Two bankfull discharge events within a seven year period (two events cannot be in the same calendar year)
- Cross sections will be surveyed to demonstrate channel stability.
- Pattern (planimetric survey) and profile (longitudinal profile survey) are measured as part of the baseline survey (year 0) and should be checked by visual monitoring in subsequent years.
- One constructed riffle substrate sample will be compared to existing riffle substrate data collected during the design phase and any significant changes (i.e.; aggradation, degradation) will be noted after streambank vegetation becomes established and a minimum of two bankfull flows or greater have been documented.
- At year five, planted tree stem density must be no less than 260, 5-year old, planted trees per acre. The final vegetative success criteria will be the survival of 210, 7-year old, planted trees per acre at the end of the seven-year monitoring period.

9.1 Stream Monitoring

Geomorphic monitoring of the proposed restoration reaches will be conducted once a year for five to seven years following the completion of construction to evaluate the effectiveness of the restoration practices. Monitored stream parameters for channel stability will include all Restoration and Enhancement I reaches. These parameters include stream dimension (cross sections), pattern (planimetric survey), profile (longitudinal profile survey), and visual observation with photographic documentation. The success criteria for the proposed Enhancement Level II reaches/sections will follow the methods described under Photo Reference Stations and Vegetation Monitoring. The methods used and related success criteria are described below for each parameter. Figure 9.1 shows approximate locations of the proposed monitoring devices throughout the project site.

9.1.1 Bankfull Events and Flooding Functions

The occurrence of bankfull events within the monitoring period will be documented by the use of a manual crest gage and photographs. The crest gage will be installed within the floodplain of R3 approximately five to ten feet (horizontal) of the restored channel. Installing the instruments on the floodplain reduces the risk of damage by stormflow. The crest gage will record the highest watermark between site visits, and the gage will be checked at each site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits.

Two bankfull flow events must be documented within the seven-year monitoring period. The two bankfull events must occur in separate years; otherwise, the monitoring will continue until two bankfull events have been documented in separate years.

9.1.2 Flow Documentation

Monitoring of flow will be conducted to demonstrate that the restored stream system classified as intermittent exhibits base flow for some portion of the year during a year with normal rainfall conditions. In order to determine if rainfall amounts are normal for the given year, the rainfall data collected from the rain gage installed as part of the documentation for wetland hydrology (See Section 9.3.2) will be used to compare precipitation amounts from nearest from the NC A&T Research Farm (NCAT) ECONET station. Data from the weather station can be obtained from the CRONOS Database located on the State Climate Office of North Carolina's website. If a normal year of precipitation does not occur during the first seven years of monitoring, flow conditions will continue to be monitored on the site until it documents that the intermittent streams have been flowing during the appropriate times of the year.

The proposed monitoring of each restored intermittent reach will include the documentation of a combination of photographic and baseflow monitoring data. A flow camera will be installed to collect a regular and continuous series of remote photos over time. These photos will be used to subjectively evaluate channel flow conditions throughout the year. More specifically, the longitudinal photos should indicate the presence of flow within the channel in order to discern water levels within the pools and riffles. The visual monitoring effort, including the photo locations with descriptions, will be included with NCDMS's annual monitoring reports. Each pressure transducer will be installed towards the downstream portion of restored intermittent reaches, R4, T1 and T3. The device will be inspected on a quarterly/semi-annual basis to document surface hydrology and provide a basis for evaluating general flow response to rainfall events and surface runoff during various water tables levels throughout the monitoring period. Success criteria will include 30 days of consecutive baseflow for monitoring wells installed in T1 and T3 during a normal rainfall year.

9.1.3 Cross Sections

Permanent cross sections will be installed at an approximate rate of one cross section per twenty bankfull widths or an average distance interval (not to exceed 500 LF) of restored stream, with approximately twelve (12) cross sections located at riffles, and five (5) located at pools. Each cross section will be marked on both streambanks with permanent monuments using rebar cemented in place to establish the exact transect used. A common benchmark will be used for cross sections and to facilitate easy comparison of year-to-year data. The cross-section surveys will occur in years one, two, three, five, and seven, and must include measurements of Bank Height Ratio (BHR) and Entrenchment Ratio (ER). The monitoring survey will include points measured at all breaks in slope, including top of streambanks, bankfull, inner berm, edge of water, and thalweg, if the features are present. Riffle cross sections will be classified using the Rosgen Stream Classification System.

There should be little change in as-built cross sections. If changes do take place, they will be documented in the survey data and evaluated to determine if they represent a movement toward a more

unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the streambanks, or decrease in width/depth ratio). Using the Rosgen Stream Classification System, all monitored cross sections should fall within the quantitative parameters (i.e. BHR no more than 1.2 and ER no less than 2.2 for 'C' stream types) defined for channels of the design stream type. Given the smaller channel sizes and meander geometry of the proposed streams, bank pins will not be installed unless monitoring results indicate active lateral erosion.

Reference photo transects will be taken at each permanent cross section. Lateral photos should not indicate excessive erosion or continuing degradation of the streambanks. Photographs will be taken of both streambanks at each cross section. The survey tape will be centered in the photographs of the streambanks. The water line will be located in the lower edge of the frame, and as much of the streambank as possible will be included in each photo. Photographers shall make a consistent effort to maintain the same area in each photo over time.

9.1.4 Pattern

The plan view measurements such as sinuosity, radius of curvature, meander width ratio will be taken on newly constructed meanders during baseline (year-0) only. Subsequent visual monitoring will be conducted twice a year, at least five months apart, to document any changes or excessive lateral movement in the plan view of the restored channel.

9.1.5 Longitudinal Profile

A longitudinal profile will be surveyed for the entire length of restored channel immediately after construction to document as-built baseline conditions for the first year of monitoring only. The survey will be tied to a permanent benchmark and measurements will include thalweg, water surface, bankfull, and top of low bank. Each of these measurements will be taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth. The longitudinal profile should show that the bedform features installed are consistent with intended design stream type. The longitudinal profiles will not be taken during subsequent monitoring years unless vertical channel instability has been documented or remedial actions/repairs are deemed necessary.

9.1.6 Bed Material Analyses

After construction, there should be minimal change in the bulk sample data over time given the current watershed conditions and sediment supply regime. Significant changes in particle sizes or size distribution in otherwise stable riffles and pools could warrant additional sediment transport analyses and calculations. A substrate sample will be collected where certain constructed riffles are installed as part of the project. One constructed riffle substrate sample will be compared to existing riffle substrate data collected during the design phase and any significant changes (i.e.; aggradation, degradation) will be noted after streambank vegetation becomes established and a minimum of two bankfull flows or greater have been documented.

9.1.7 Visual Assessment

Visual monitoring assessments of all stream sections will be conducted by qualified personnel twice per monitoring year with at least five months in between each site visit. Photographs will be used to visually document system performance and any areas of concern related to streambank stability, condition of in-stream structures, channel migration, headcuts, live stake mortality, impacts from invasive plant species or animal species, and condition of pools and riffles. The photo locations and descriptions will be shown on a plan view map per NCDMS's monitoring report guidance (v1.5, June 2012).

The photographs will be taken from a height of approximately five to six feet to ensure that the same locations (and view directions) at the site are documented in each monitoring period. A series of photos

over time will be also be used to subjectively evaluate channel aggradation (bar formations) or degradation, streambank erosion, successful maturation of riparian vegetation, and effectiveness of sedimentation and erosion control measures.

9.2 Vegetation Monitoring

Successful restoration of the vegetation on a site is dependent upon hydrologic restoration, planting of preferred canopy species, and volunteer regeneration of the native plant community. In order to determine if the criteria are achieved, vegetation-monitoring quadrants will be installed and monitored across the restoration site in accordance with the CVS-NCDMS Protocol for Recording Vegetation, Version 4.1 (Lee at al., 2007). The vegetation monitoring plots shall be a minimum of 2% of the planted portion of the site with a minimum of five (5) plots established randomly within the planted buffer areas per Monitoring Levels 1 and 2. No monitoring quadrants will be established within the undisturbed wooded areas of Reaches R3, R4, R5, and R6. The size of individual quadrants will be 100 square meters.

Vegetation monitoring will occur in the fall, prior to the loss of leaves. Individual quadrant data will be provided and will include species diameter, height, density, and coverage quantities. Relative values will be calculated, and importance values will be determined. Individual seedlings will be marked such that they can be found in succeeding monitoring years. Mortality will be determined from the difference between the previous year's living, planted seedlings and the current year's living, planted seedlings.

At the end of the first full growing season (from baseline/year 0) or after 180 days between March 1st and November 30th, species composition, stem density, height, and survival will be evaluated. For each subsequent year, vegetation plots shall be monitored for seven years in years 1, 2, 3, 5 and 7 or until the final success criteria are achieved. The restored site will be evaluated between March and November. The interim measure of vegetative success for the site will require the survival of at least 320, 3-year old, planted trees per acre at the end of year three of the monitoring period. At year five, density must be no less than 260, 5-year old, planted trees per acre. The final vegetative success criteria will be the survival of 210, 7-year old, planted trees per acre. Additionally, the average height of the 7-year old planted trees will range from 7 feet to 10 feet tall. Certain native species, which are appropriate to plant on-site to provide a diverse vegetation community, do not typically grow to these heights in 7 years and will be excluded from the height performance standard. These excluded species composed primarily of understory species are Persimmon, American Hornbeam, American Holly, Witchhazel, Strawberry Bush, Black Gum, and Winterberry. If the performance standards are met by year 5 and stem densities are greater than 260, 5-year old stems/acre, vegetation monitoring may be terminated with approval by the USACE and the NCIRT.

While measuring species density and height is the current accepted methodology for evaluating vegetation success on mitigation projects, species density and height alone may be inadequate for assessing plant community health. For this reason, the vegetation monitoring plan will incorporate the evaluation of additional plant community indices, native volunteer species, and the presence of invasive species vegetation to assess overall vegetative success. .

Baker will provide required remedial action on a case-by-case basis, such as: replanting more wet/drought tolerant species vegetation, conducting beaver management/dam removal, and removing undesirable/ invasive species vegetation, and will continue to monitor vegetation performance until the corrective actions demonstrate that the site is trending towards or meeting the standard requirement. Existing mature woody vegetation will be visually monitored during annual site visits to document any mortality, due to construction activities or changes to the water table, that negatively impact existing forest cover or favorable buffer vegetation.

Additionally, herbaceous vegetation, primarily native species grasses, will be seeded/planted throughout the site. During and immediately following construction activities, all ground cover at the project site must be in compliance with the NC Erosion and Sedimentation Control Ordinance.

9.3 Wetland Monitoring

9.3.1 Groundwater Data Collection

Five (5) groundwater monitoring wells will be installed in the wetland mitigation area to document hydrologic conditions of the restored wetland area. These wells will be used to evaluate wetland hydrology during each growing season for seven years of hydrologic monitoring, or until success criteria have been met, whichever occurs later. To meet the hydrologic success criteria, the monitoring gage data must show that for each normal year within the monitoring period, the site has been inundated or saturated for a certain hydroperiod. The targeted hydroperiod will be based on the range of wetness conditions for the type of wetland system to be restored and will be compared to hydrology data collected from the reference wetland site during the same monitoring period.

9.3.2 Hydrology

In order to determine if the hydrologic success criteria are achieved, automated groundwater-monitoring stations will be installed across the restored site and monitored year-round. Groundwater monitoring stations will follow the USACE standard methods found in the WRP Technical Notes ERDC TN-WRAP-00-02, (July 2000). In the event that there are years of normal precipitation during the monitoring period, and the data for those years do not show that the site has been inundated or saturated for the appropriate hydroperiod during the normal precipitation year, the review agencies may require remedial action. Baker will provide any required remedial action and continue to monitor hydrology on the site until it displays that the site has been inundated or saturated for the appropriate hydroperiod.

The objective is for the monitoring data to show the site exhibits an increased frequency of flooding. Groundwater levels will be compared to pre-restoration conditions and reference conditions. The success criteria for wetland hydrology will follow a range from 9-12 percent, depending on the specific wetland location and the mitigation activity proposed. The wetland areas along Reach R1 and the large bend of Reach 2 will meet success criteria for wetland hydrology when the soils are saturated within 12 inches of the soil surface for 12 percent of the growing season or twenty eight (28) or more consecutive days during the growing season (229 days). The saturated conditions should occur during a period when antecedent precipitation has been normal or drier than normal for a minimum frequency of 5 years in 10 (USACE, 2005 and 2010b).

The hydroperiod for success for the wetlands located along lower Reach R4 (Wetland Type 5) will be 9 percent of the growing season or twenty-one (21) or more consecutive days. Priority Level I restoration is proposed along this area and a significant amount of earth will be needed to fill the existing channel. This may delay re-establishment of wetland hydrology but the hydric soils indicate that the area once was wetland.

In order to determine if the rainfall is normal for the given year, a rainfall gage will be installed on the site to compare precipitation amounts using tallied data obtained from the NC A&T Research Farm (NCAT) ECONET station approximately 10 miles to the south. Data from this station can be obtained from the CRONOS Database located on the State Climate Office of North Carolina's website. If a normal year of precipitation does not occur during the first seven years of monitoring, Baker will continue to monitor hydrology on the site until it documents that the site has been inundated or saturated for the appropriate hydroperiod.

If the rainfall data for any given year during the monitoring period are abnormal, it is possible that the desired hydrology for the site may not meet specific success criteria. However, reference wetland data will be assessed to determine if there is a positive correlation between the underperformance of the project site and the natural hydrology of the reference site.

9.4 Stormwater Management Monitoring

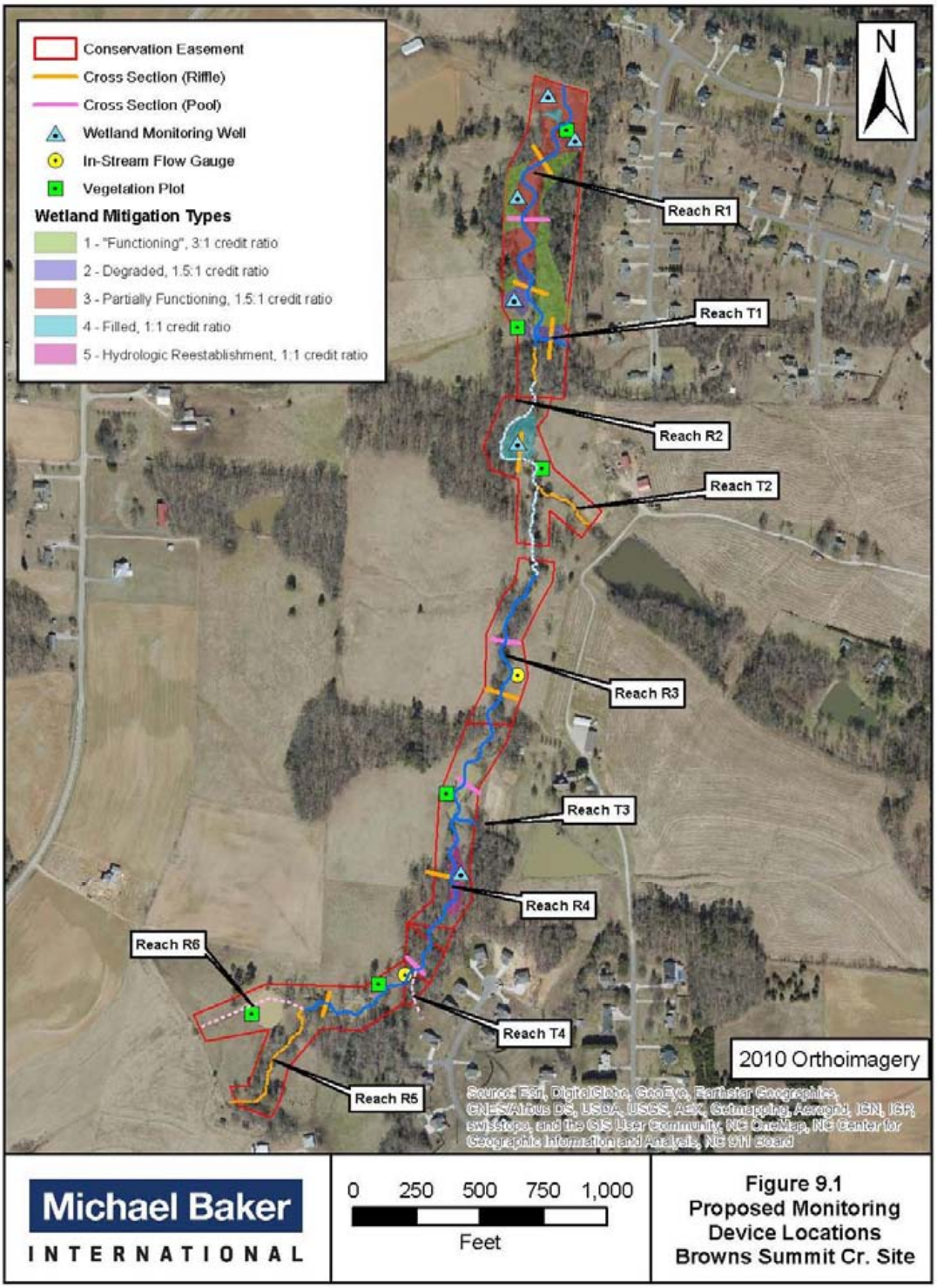
This project includes the implementation of two stormwater BMPs. A constructed wetland, which will function as a headwater wetland, will be installed along Reach R6, and a rock lined step-pool channel stormwater control measure will be installed along Reach T4. Both BMPs will be visually monitored semi-annually for vegetative survival, outlet stability, and storage capacity using photo documentation during the 7-Year monitoring period. A vegetation plot will also be established along the planted portion of Reach R6 and will be included as part of the vegetation monitoring outlined in Section 9.2. Maintenance measures will be implemented during the monitoring period to replace dead vegetative material and to remove excess sedimentation, as needed, from the forebay of the constructed wetland and its permanent pool, as well as the plunge pools along Reach T4. Should the outlet of the constructed wetland become unstable during the 7-Year monitoring period, corrective measures will be implemented to rectify the instability issues.

The Stormwater BMPs success criteria will include the following:

- step-pool channels (R6 outlet and T4) are considered successful if stability has been attained as agreed upon by the IRT at closeout.
- Constructed Wetland (R6) vegetation will be considered successful with a visual assessment of 70 percent native vegetation coverage as defined in the NCDWR BMP manual (page 9-21 of the NCDWR BMP manual). Native volunteers can be included within the visual assessment. The vegetation plot in the buffer area of the BMP with planted stems will have the same standard success criteria as other veg plots. All yearly maintenance and repairs, photopoints, replantings, and invasive treatments will be documented in the monitoring reports. Sediment buildup should be minimal and not require repeated maintenance at closeout as agreed upon by the IRT for the constructed wetland to be considered successful.
- NCDWR BMP field inspection - One field visit by NCDWR should be conducted between years 2-5 to inspect the BMPs. Baker will invite NCDWR staff to the site. Annual monitoring may be requested by Baker instead of bi-annual monitoring for the BMPs after five years until closeout if the stormwater control measure structures are stable and have not required maintenance in the past year.

Long-term management of the proposed BMP structures is not anticipated by USACE provided the structures remain stable and functioning throughout the 7-year monitoring period.

Figure 9.1 Proposed Monitoring Device Locations



10.0 MONITORING REQUIREMENTS

Annual monitoring reports containing the information defined within Table 10.1 below will be submitted to NCDMS by November 30th of the each year during which the monitoring was conducted. The monitoring report shall provide a project data chronology for NCDMS to document the project status and trends, population of NCDMS databases for analysis, research purposes, and assist in decision making regarding project close-out. Project success criteria must be met by the final monitoring year prior to project closeout, or monitoring will continue until unmet criteria are successfully met.

Table 10.1 Monitoring Requirements

Browns Summit Creek Restoration Project Mitigation Plan- NCDMS Project No. 96313

Required	Parameter	Quantity	Frequency	Notes
X	Pattern	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines	As-built Year and as needed	Pattern data, including bank erosion pins/arrays in pool cross-sections, will be collected only if there are indications through profile and dimensional data that significant geomorphological adjustments occurred.
X	Dimension	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines and November 2011 NCDMS Monitoring Requirements	Monitoring Years 1, 2, 3, 5 and 7	Cross sections to be monitored over seven (7) years and shall include assessment of bank height ratio (BHR) and entrenchment ratio (ER).
X	Profile	As per November 2011 NCDMS Monitoring Requirements	As-built Year and as needed	For Restoration or Enhancement I activities, a baseline survey (Year 0) will be conducted for the entire length of the channel. Survey will only be conducted in subsequent monitoring years if the channel is experiencing vertical instability, in which case survey will be collected within the area of concern.
X	Substrate	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines and November 2011 NCDMS Monitoring Requirements	Monitoring Years 1, 2, 3, 5 and 7	A substrate sample will be collected if constructed riffles are installed as part of the project. One constructed riffle substrate sample will be compared to existing riffle substrate data collected during the design phase.
X	Surface Water Hydrology	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines	Annually	A Crest Gage and/or Pressure Transducer will be installed on site; the device will be inspected on a quarterly/semi-annual basis to document the occurrence of bankfull events on the project.
X	Vegetation	NCDMS-CVS Guidance	Monitoring Years 1, 2, 3, 5 and 7	Vegetation will be monitored using the Carolina Vegetation Survey (CVS) protocols.
X	Exotic and Nuisance Vegetation		Semi-Annually	Locations of exotic and nuisance vegetation will be visually assessed and mapped a minimum of 5 months apart.
X	Visual Assessment	As per November 2011 NCDMS Monitoring Requirements	Semi-Annually and as needed	Representative photographs will be taken to capture the state of the restored channel, the vegetated buffer conditions, and restored wetland conditions. Stream and wetland photos will be preferably taken in the same location when the vegetation is minimal to document any areas of concern or to identify trends.

Table 10.1 Monitoring Requirements Browns Summit Creek Restoration Project Mitigation Plan- NCDMS Project No. 96313				
X	Project Boundary		Semi-Annually	Locations of fence damage, vegetation damage, boundary encroachments, etc. will be mapped
X	Stormwater BMPs		Semi-Annually	Stormwater wetland BMPs located at Reaches R6 and T4 will be visually monitored for stability and vegetation survival during the 7-year monitoring period.
X	Ground Water Hydrology	As appropriate to encompass the array of conditions across the different wetland types.	Continuously throughout the growing season of Monitoring Years 1 – 7.	Ground water gage data will be collected in each Wetland Type (1 – 5) to document wetland hydrology within the area.

11.0 LONG-TERM MANAGEMENT PLAN

Upon approval for close-out by the Interagency Review Team (IRT) the Site will be transferred to the NCDENR Division of Natural Resource Planning and Conservation's Stewardship Program. This party shall be responsible for periodic inspection of the Site to ensure that restrictions required in the conservation easement or the deed restriction document(s) are upheld. Endowment funds required to uphold easement and deed restrictions shall be negotiated prior to Site transfer to the responsible party. The NCDENR Division of Natural Resource Planning and Conservation's Stewardship Program currently houses DMS stewardship endowments within the non-reverting, interest-bearing Conservation Lands Stewardship Endowment Account. The use of funds from the Endowment Account is governed by North Carolina General Statue GS 113A-232(d)(3). Interest gained by the endowment fund may be used only for the purpose of stewardship, monitoring, stewardship administration, and land transaction costs, if applicable. The 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.

12.0 ADAPTIVE MANAGEMENT PLAN

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

13.0 FINANCIAL ASSURANCES

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

14.0 OTHER INFORMATION

14.1 Definitions

This document is consistent with the requirements of the federal rule for compensatory mitigation 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). Specifically the document addresses the following requirements of the federal rule:

(3) *Site selection.* A description of the factors considered during the site selection process. This should include consideration of watershed needs, onsite alternatives where applicable, and the practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the compensatory mitigation site. (See § 332.3(d).)

(4) *Site protection instrument.* A description of the legal arrangements and instrument, including site ownership, that will be used to ensure the long-term protection of the compensatory mitigation site (see § 332.7(a)).

(5) *Baseline information.* A description of the ecological characteristics of the proposed compensatory mitigation site and, in the case of an application for a DA permit, the impact site. This may include descriptions of historic and existing plant communities, historic and existing hydrology, soil conditions, a map showing the locations of the impact and mitigation site(s) or the geographic coordinates for those site(s), and other site characteristics appropriate to the type of resource proposed as compensation. The baseline information should also include a delineation of waters of the United States on the proposed compensatory mitigation site. A prospective permittee planning to secure credits from an approved mitigation bank or in-lieu fee program only needs to provide baseline information about the impact site, not the mitigation bank or in-lieu fee site.

(6) *Determination of credits.* A description of the number of credits to be provided, including a brief explanation of the rationale for this determination. (See § 332.3(f).)

(7) *Mitigation work plan.* Detailed written specifications and work descriptions for the compensatory mitigation project, including, but not limited to, the geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water, including connections to existing waters and uplands; methods for establishing the desired plant community; plans to control invasive plant species; the proposed grading plan, including elevations and slopes of the substrate; soil management; and erosion control measures. For stream compensatory mitigation projects, the mitigation work plan may also include other relevant information, such as plan form geometry, channel form (e.g. typical channel cross-sections), watershed size, design discharge, and riparian area plantings.

(8) *Maintenance plan.* A description and schedule of maintenance requirements to ensure the continued viability of the resource once initial construction is completed.

(9) *Performance standards.* Ecologically-based standards that will be used to determine whether the compensatory mitigation project is achieving its objectives. (See § 332.5.)

(10) *Monitoring requirements.* A description of parameters to be monitored in order to determine if the compensatory mitigation project is on track to meet performance standards and if adaptive management is needed. A schedule for monitoring and reporting on monitoring results to the district engineer must be included. (See § 332.6.)

(11) *Long-term management plan.* A description of how the compensatory mitigation project will be managed after performance standards have been achieved to ensure the long-term sustainability of the

resource, including long-term financing mechanisms and the party responsible for long-term management. (See § 332.7(d).)

(12) *Adaptive management plan.* A management strategy to address unforeseen changes in site conditions or other components of the compensatory mitigation project, including the party or parties responsible for implementing adaptive management measures. The adaptive management plan will guide decisions for revising compensatory mitigation plans and implementing measures to address both foreseeable and unforeseen circumstances that adversely affect compensatory mitigation success. (See § 332.7(c).)

(13) *Financial assurances.* A description of financial assurances that will be provided and how they are sufficient to ensure a high level of confidence that the compensatory mitigation project will be successfully completed, in accordance with its performance standards (see § 332.3(n)).

14.2 References

33 CFR 328.3, (b), (c)

40 CFR 230.3, (t)

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15.0 APPENDIX A - SITE PROTECTION INSTRUMENT

OWNER(S) CERTIFICATE

PIN: 7970842313 PIN: 7970952956
PIN: 7970940511 PIN: 7980061382
PIN: 7970940634 PIN: 7970876658
PIN: 7970940765 PIN: 7970876658
PIN: 7970957284

WE, RENEE M. MATTHEWS (UNMARRIED), ARNOLD IRVING, LATRICIA IRVING, JAMES E. MARSHALL AND WIFE ERMA L. MARSHALL, SARAH B. ELLEDGE AND HUSBAND ARNOLD D. ELLEDGE, DONNA O. CARTER AND HUSBAND STEVEN D. CARTER, SARAH R. O'BYRANT (A WIDOW), DEBORAH O. STEPP AND HUSBAND WYMAN RAY STEPP AND JANIE M. BOWMAN BY HER ATTORNEY IN FACT, SUE B. ROBBINS, HEREBY CERTIFY THAT WE ARE THE OWNERS OF THE PROPERTIES SHOWN AND DESCRIBED HEREON, WHICH WERE CONVEYED TO US BY DEEDS RECORDED IN DB 7370, PG 354, DB 7536, PG 524, DB 7341, PG 2398, DB 7007, PG 1094, DB 5106, PG 1731, DB 3890, PG 365, DB 5106, PG 1734, DB 5439, PG 1271 AND DB 5043, PG 1485, OF THE GUILFORD COUNTY REGISTRY, NORTH CAROLINA REGISTRY; AND THAT WE ADOPT THIS PLAN OF SUBDIVISION AND GRANT AND CONVEY THE EASEMENTS HEREIN WITH FREE CONSENT. FURTHER, WE HEREBY CERTIFY THAT THE LAND AS SHOWN HEREON IS WITHIN THE SUBDIVISION REGULATION JURISDICTIONS OF GUILFORD COUNTY, NORTH CAROLINA.

RENEE M. MATTEWS (UNMARRIED) DATE

ARNOLD IRVING DATE

LATRICIA IRVING DATE

JAMES E. MARSHALL

ERMA MARSHALL DATE

SARAH R. O'BYRANT (A WIDOW) DATE

SARAH B. ELLEDGE DATE

ARNOLD D. ELLEDGE DATE

DONNA O. CARTER DATE

STEVEN D. CARTER DATE

DEBORAH O. STEPP DATE

WYMAN RAY STEPP DATE

JANIE M. BOWMAN, BY HER ATTORNEY-IN-FACT, SUE B.ROBBINS DATE

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, THE UNDERSIGNED NOTARY PUBLIC, CERTIFY THAT RENEE M. MATTHEWS, UNMARRIED, PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED TO ME THAT SHE VOLUNTARILY SIGNED THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS_____DAY OF_____, 2015.

_____
NOTARY PUBLIC

MY COMMISSION EXPIRES: _____

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, THE UNDERSIGNED NOTARY PUBLIC, CERTIFY THAT ARNOLD IRVING AND WIFE, LATRICIA IRVING, PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED TO ME THAT THEY VOLUNTARILY SIGNED THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS_____DAY OF_____, 2015.

_____
NOTARY PUBLIC

MY COMMISSION EXPIRES: _____

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, THE UNDERSIGNED NOTARY PUBLIC, CERTIFY THAT JAMES E. MARSHALL AND WIFE ERMA MARSHALL, PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED TO ME THAT THEY VOLUNTARILY SIGNED THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS_____DAY OF_____, 2015.

_____
NOTARY PUBLIC

MY COMMISSION EXPIRES: _____

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, THE UNDERSIGNED NOTARY PUBLIC, CERTIFY THAT SARAH R. O'BRYANT, A WIDOW, PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED TO ME THAT SHE VOLUNTARILY SIGNED THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS_____DAY OF_____, 2015.

_____
NOTARY PUBLIC

MY COMMISSION EXPIRES: _____

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, THE UNDERSIGNED NOTARY PUBLIC, CERTIFY THAT SARAH B. ELLEDGE AND HUSBAND, ARNOLD D. ELLEDGE, PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED TO ME THAT THEY VOLUNTARILY SIGNED THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS_____DAY OF_____, 2015.

_____
NOTARY PUBLIC

MY COMMISSION EXPIRES: _____

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, THE UNDERSIGNED NOTARY PUBLIC, CERTIFY THAT DONNA O. CARTER NAD HUSBAND, STEVEN D. CARTER, PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED TO ME THAT THEY VOLUNTARILY SIGNED THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS_____DAY OF_____, 2015.

_____
NOTARY PUBLIC

MY COMMISSION EXPIRES: _____

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, THE UNDERSIGNED NOTARY PUBLIC, CERTIFY THAT DEBORAH O. STEPP AND HUSBAND, WYMAN RAY STEPP, PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED TO ME THAT THEY VOLUNTARILY SIGNED THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS_____DAY OF_____, 2015.

_____
NOTARY PUBLIC

MY COMMISSION EXPIRES: _____

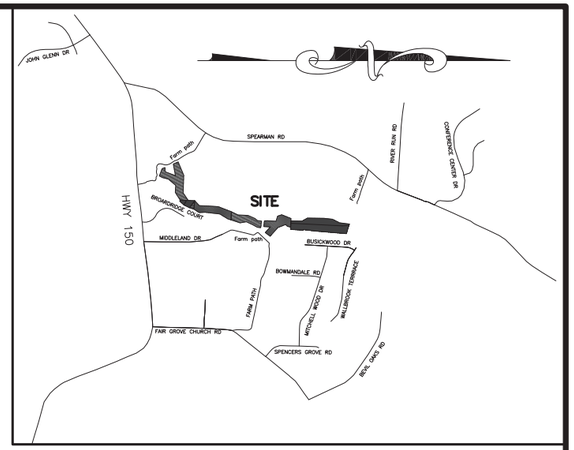
STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, A NOTARY PUBLIC OF THE COUNTY AND STATE AFORESAID, DO HEREBY CERTIFY THAT SUE B. ROBBINS, ATTORNEY-IN-FACT FOR JANIE M. BOWMAN PERSONALLY APPEARED BEFORE ME THIS DAY, AND BEING BY ME DULY SWORN, SAYS THAT SHE EXECUTED THE FORGOING AND ANNEXED INSTUMENT FOR AND ON BEHALF OF JANIE M. BOWMAN, AND THAT HER AUTHORITY TO EXECUTE AND ACKNOWLEDGED SAID INSTRUMENT IS CONTAINED IN AN INSTRUMNENT DULY EXECUTED, ACKNOWLEDGE, AND RECORDED IN THE OFFICE OF THE REGISTER OF DEEDS OF GUILFORD COUNTY, NORTH CAROLINA ON THE 29TH DAY OF OCTOBER, 2008, IN BOOK 6947, PAGE 2931, AND THAT THIS INSTRUMENT WAS EXECUTED UNDER AND BY VIRTUE OF THE AUTHORITY GIVEN BY SAID INSTUMENT GRANTING HER POWER OF ATTORNEY; THAT THE SAID SUE B. ROBBINS ACKNOWLEDGED THE DUE EXECUTION OF THE FOREGOING AND ANNEXED INSTRUMENT FOR THE PURPOSES THERIN EXPRESSED FOR AND IN BEHALF OF THE SAID JANIE M. BOWMAN.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS_____DAY OF_____, 2015.

_____
NOTARY PUBLIC

MY COMMISSION EXPIRES: _____



CONSERVATION EASEMENT AREA SUMMARY

CE-1 PIN: 7970842313	4.24 Acres	(SARAH B. ELLEDGE)
CE-2 PIN: 7970940511	0.19 Acres	(RENEE M. MATTEWS)
CE-3 PIN: 7970940634	0.49 Acres	(ARNOLD IRVING)
CE-4 PIN: 7970940765	0.21 Acres	(JAMES E. MARSHALL)
CE-5 PIN: 7970957284	2.89 Acres	(DONNA O. CARTER)
CE-6 PIN: 7970952956	2.32 Acres	(DONNA O.. CARTER)
CE-7 PIN: 7980061382	2.95 Acres	(DEBORAH O. STEPP)
CE-8 PIN: 7970876658	2.84 Acres	(JANIE M. BOWMAN)
CE-9 PIN: 7970876658	4.11 Acres	(JANIE M. BOWMAN)

TOTAL ACRES: 20.24 Acres

VICINITY MAP
NTS

REFERENCES
GUILFORD COUNTY REGISTRY

DB 7007, PG 01094
DB 7370, PG 354
DB 7536, PG 524-525
DB 7341, PG 2398
DB 5106, PG 1731
DB 3890, PG 365
DB 5106, PG 1734
DB 5043, PG 1485
DB 5439, PG 1271-1274
P.B. 101 PG. 62
P.B. 56 PG. 149
P.B. 155 PG. 094
P.B. 144 PG. 004
P.B. 138 PG. 144
P.B. 176 PG. 136
P.B. 170 PG. 27
P.B. 150 PG. 024

GUILFORD COUNTY CERTIFICATION

I, _____ PLANNING DIRECTOR AND REVIEW OFFICER OF GUILFORD COUNTY, CERTIFY THAT THIS PLAT DOES NOT CONSTITUTE A SUBDIVISION AND THAT IT MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING. BECAUSE OF ITS "EXEMPT" STATUS, THE COUNTY HAS NOT REVIEWED THIS PLAT FOR COMPLIANCE WITH APPLICABLE LOT STANDARDS AND OTHER SUBDIVISION REGULATIONS (e.g., road standards). PROSPECTIVE PURCHASERS SHOULD BE AWARE THAT PLANS FOR BUILDING AND DEVELOPMENT MAY BE DENIED FOR LOTS THAT DO NOT MEET APPLICABLE COUNTY STANDARDS.

_____ _____
DATE PLANNING DIRECTOR/REVIEW OFFICER

SURVEYOR'S CERTIFICATION

I, MARSHALL WIGHT, DO HEREBY CERTIFY THAT THIS SURVEY IS OF ANOTHER CATEGORY AND IS AN EXCEPTION TO THE DEFINITION OF SUBDIVISION.

_____
MARSHALL WIGHT, PLS L-5034

I, MARSHALL WIGHT, CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION USING REFERENCES SHOWN HEREON; THAT THE BOUNDARIES NOT SURVEYED ARE SHOWN AS BROKEN LINES PLOTTED FROM INFORMATION SHOWN HEREON; THAT THE RATIO OF PRECISION AS CALCULATED IS 1:10,000+; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS_____DAY OF_____, 2014.

_____
MARSHALL WIGHT, PLS L-5034

I, MARSHALL WIGHT CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL GPS (OR GNSS) SURVEY MADE UNDER MY SUPERVISION AND THE FLOLLOWING INFORMATION WAS USED TO PERFORM THE SURVEY.

CLASS OF SURVEY: CLASS C
POSITIONAL ACCURACY: .15' (NETWORK RTK)
TYPE OF GPS (GNSS) FIELD PROCEDURE: VRS
DATE(S) OF SURVEY: 06/17/14
DATUM/EPOCH: NAD 83 (2011)(EPOCH: 2010.000)
PUBLISHED FIXED CONTROL: N/A-VRS
GEOID MODEL: GEOID 12A
COMBINED GRID FACTOR: 0.99998806
UNITS: US FEET
HORIZONTAL POSITIONS ARE REFERENCED TO NAD83\NSRS (2011)
VERTICAL POSITIONS ARE REFERENCED TO NAVD88 USING (GEIOD12A)

EEP PROJECT NAME: 'BROWNS SUMMIT' Drawing No. BROWNS_SUMMIT_XXXXX_CE_Baker_DRAFT.dwg

Michael Baker INTERNATIONAL
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

BROWNS SUMMIT CONSERVATION EASEMENT SURVEY
FOR
STATE OF NORTH CAROLINA-DEPARTMENT OF ADMINISTRATION-DIVISION OF MITIGATION SERVICES
ON THE PROPERTY OF
RENEE M. MATTEWS, ARNOLD IRVING, LATRICIA IRVING, JAMES E. MARSHALL, ERMA L. MARSHALL, SARAH B. ELLEDGE, ARNOLD D. ELLEDGE, SARAH R. O'BRYANT, DONNA O. CARTER, STEVEN D. CARTER, DEBORAH O. STEPP, WYMAN RAY STEPP AND JANIE M. BOWMAN
MONROE TOWNSHIP GUILFORD COUNTY NORTH CAROLINA

SPO FILE No.
DMS Project No.:
BE Project No.: 140048
Date: FEBUARY 27, 2015
Scale: 1"=200'

NC NAD 83 (2011)– CF 0.99998806

CE–1

LINE	BEARING	DISTANCE
L1	S 57°32'13" W	196.90'
L2	N 87°21'20" W	154.97'
L3	S 40°18'06" W	207.84'
L4	S 13°42'20" W	127.95'
L5	S 28°23'35" W	79.42'
L6	N 68°28'37" W	139.48'
L7	N 21°12'11" W	76.83'
L8	N 85°34'05" E	70.18'
L9	N 20°24'19" E	234.57'
L10	S 79°41'05" W	253.82'
L11	N 24°11'05" W	114.04'
L12	N 67°17'26" E	313.98'
L13	S 87°56'58" E	380.65'
L14	N 55°37'01" E	197.12'
L15	S 02°19'54" W	39.14'
L16	S 02°18'27" W	135.34'

AREA: 4.24 Acres
PIN: 7970842313

CE–2

LINE	BEARING	DISTANCE
L16	S 02°18'27" W	135.34'
L17	S 61°04'06" E	113.50'
L18	S 42°46'45" W	123.12'
L19	N 64°36'02" W	23.42'

AREA: 0.19 Acres
PIN: 7970940511

CE–3

LINE	BEARING	DISTANCE
L15	N 02°19'31" E	39.14'
L20	N 02°19'31" E	140.72'
L21	S 52°50'13" E	188.50'
L22	N 25°43'42" E	134.04'
L17	N 61°04'06" W	113.50'

AREA: 0.49 Acres
PIN: 7970940634

CE–4

LINE	BEARING	DISTANCE
L23	S 83°49'51" E	184.23'
L24	N 19°17'57" E	99.67'
L21	N 52°50'13" W	188.50'

AREA: 0.21 Acres
PIN: 7970940765

CE–5

LINE	BEARING	DISTANCE
L25	N 47°17'09" E	143.24'
L26	N 02°30'01" E	185.47'
L27	N 03°49'14" E	225.08'
L28	N 21°03'22" E	304.30'
L29	S 87°46'25" E	176.97'
L30	S 17°56'22" W	75.99'
L31	S 31°20'15" W	202.77'
L32	S 06°29'14" W	317.88'
L33	S 03°03'57" E	127.62'
L34	S 32°30'04" W	136.58'
L23	N 83°49'51" W	184.23'

AREA: 2.89 Acres
PIN: 7970957284

CE–6

LINE	BEARING	DISTANCE
L35	N 25°59'59" E	158.81'
L36	N 02°26'35" E	212.74'
L37	N 23°51'57" E	169.27'
L38	N 41°12'26" E	65.01'
L39	N 07°45'46" E	93.54'
L40	S 82°44'15" E	142.97'
L41	S 06°48'29" W	74.65'
L42	S 28°54'33" W	107.01'
L43	S 25°35'02" W	157.13'
L44	S 09°50'41" E	138.70'
L45	S 17°56'22" W	204.23'
L29	N 87°46'25" W	176.97'

AREA: 2.32 Acres
PIN: 7970952956

CE–7

LINE	BEARING	DISTANCE
L46	S 02°51'13" E	61.11'
L47	N 03°27'37" E	189.42'
L48	N 72°04'08" W	115.40'
L49	N 19°09'15" W	93.69'
L50	N 22°01'24" E	214.83'
L51	N 88°10'18" W	53.18'
L52	N 88°10'18" W	49.32'
L53	S 88°08'04" E	85.60'
L54	S 14°51'10" W	72.00'
L55	S 42°43'17" W	56.23'
L56	S 21°25'31" E	175.24'
L57	S 47°57'13" E	253.42'
L58	S 36°47'34" W	130.68'
L59	N 48°45'31" W	162.78'
L60	S 03°40'28" W	142.01'
L61	N 82°44'15" W	123.23'

AREA: 2.95 Acres
PIN: 7980061382

CE–8

LINE	BEARING	DISTANCE
L62	N 00°47'05" E	241.24'
L63	N 29°30'41" W	133.89'
L64	N 01°02'55" E	359.44'
L65	N 06°10'37" E	183.82'
L66	N 26°46'16" E	170.80'
L67	N 07°11'12" E	215.87'
L68	S 66°29'10" E	33.79'
L78	S 03°26'24" E	143.06'
L77	S 02°58'56" W	1113.33'
L52	N 88°10'18" W	49.32'

AREA: 2.84 Acres
PIN: 7970876658

CE–9

LINE	BEARING	DISTANCE
L76	N 88°13'43" W	48.47'
L53	N 88°08'04" W	85.60'
L77	S 02°58'49" W	1113.30'
L78	S 03°26'24" E	143.06'
L69	S 73°17'03" E	184.71'
L70	S 04°51'07" W	682.27'
L71	S 06°48'46" W	254.40'
L72	S 83°11'14" E	15.00'
L73	S 06°48'46" W	22.69'
L74	S 03°57'02" W	161.21'
L75	S 03°32'33" W	88.38'

AREA: 4.13 Acres
PIN: 7970876658

EASEMENT CORNERS

Point	Northing	Easting
1	904514.79	1778884.09
2	904409.11	1778717.88
3	904416.26	1778563.07
4	904257.74	1778428.64
5	904133.44	1778398.32
6	904063.56	1778360.56
7	904114.74	1778230.80
8	904186.37	1778203.01
9	904191.79	1778272.99
10	904411.64	1778354.77
11	904366.19	1778105.05
12	904470.21	1778058.33
13	904591.43	1778347.97
14	904577.81	1778728.37
15	904689.13	1778891.05
16	904650.02	1778889.46
17	904595.12	1778988.79
18	904504.75	1778905.17
19	904829.74	1778896.76
20	904715.86	1779046.98
21	904809.94	1779079.92
22	904926.90	1779002.00
23	905112.19	1779010.09
24	905336.77	1779025.09
25	905620.75	1779134.42
26	905763.49	1779204.03
27	905976.04	1779213.10
28	906130.84	1779281.59
29	906179.75	1779324.42
30	906272.43	1779337.05
31	906254.35	1779478.88
32	906180.23	1779470.03
33	906086.55	1779418.30
34	905944.83	1779350.44
35	905808.18	1779374.16

Point	Northing	Easting
36	905613.88	1779311.25
37	905541.59	1779287.85
38	905368.40	1779182.39
39	905052.56	1779146.48
40	904925.12	1779153.31
41	906333.65	1779331.31
42	906394.68	1779328.26
43	906583.75	1779339.70
44	906619.28	1779229.90
45	906707.78	1779199.16
46	906906.93	1779279.72
47	906905.24	1779332.87
48	907146.46	1779336.18
49	907262.98	1779270.22
50	907622.36	1779276.80
51	907805.11	1779296.58
52	907957.60	1779373.51
53	908171.77	1779400.32
54	908158.29	1779431.50
55	908105.16	1779608.41
56	907425.33	1779550.70
57	907172.73	1779520.52
58	907170.95	1779535.42
59	907148.42	1779532.73
60	906987.59	1779521.62
61	906899.38	1779516.16
62	906900.88	1779467.72
63	906831.28	1779449.26
64	906789.97	1779411.11
65	906626.84	1779475.12
66	906457.12	1779663.31
67	906352.47	1779585.05
68	906459.78	1779462.65
69	906318.07	1779453.54
70	908015.48	1779440.09

SPEARMAN ROAD (60' PUBLIC R/W)

ETHAN EDWARD BOWMAN
DB 7542, PG 2006
PIN: 7970757022

GPS CONTROL POINT No.1
N=904,390.02 (Y)
E=1,778,287.53 (X)

ARNOLD D. ELLEDGE
&
SARAH B. ELLEDGE
DB 7007, PG 01094
PIN: 7970842313
ZONING AG

TIE LINE
N 59°08'16" E
626.35'

GPS CONTROL POINT No.2
N=904,711.32 (Y)
E=1,778,825 (X)

TIE LINE
S 16°39'40" E
205.14'

GPS CONTROL POINT No.3
N=905,248.78 (Y)
E=1,778,985.24 (X)

TIE LINE
S 11°55'22" W
428.29'

TIE LINE
S 07°22'09" W
329.50'

CONTROL POINT No.4
N=905,947.53 (Y)
E=1,779,176.68 (X)

TIE LINE
N 21°49'29" E
415.92'

TIE LINE
N 75°22'40" E
98.11'

GPS CONTROL POINT No.6
N=906,568.33 (Y)
E=1,779,529.28 (X)

GPS CONTROL POINT No.7
N=906,874.53 (Y)
E=1,779,421.22 (X)

GPS CONTROL POINT No.8
N=907,253.72 (Y)
E=1,779,217.65 (X)

GPS CONTROL POINT No.9
N=907,869.57 (Y)
E=1,779,154.06 (X)

N 05°53'43" W
619.13'

S 18°17'45" E
267.04'

N 02°37'01" E
635.82'

N 02°38'12" E
750.84'

N 02°46'17" E
535.78'

S 59°25'56" W
476.92'

N 15°19'18" E
724.50'

N 19°26'14" W
324.70'

S 88°13'28" E
116.42'

S 04°51'07" W
708.97'

N 02°09'58" E
136.70'

N 82°07'08" W
329.75'

S 88°10'18" E
718.45'

Proposed fence approx 2' outside CE

Existing cattle fence to be removed

110' DRAINAGE AND STREAM BUFFER EASEMENT, BROADRIDGE SUBDIVISION PB 170 PG 27

EXISTING STREAM

Easement coincides with property line

FARM ROAD ACCESS
SEE NOTE 8.
(SHEET 1 OF 3)

JANIE M. BOWMAN
DB 5043, PG 1485
PIN: 7970876658
ZONING AG

STEVEN D. CARTER
&
DONNA O. CARTER
DB 3890, PG 365
PIN: 7970952956
ZONING AG

SARAH R. O'BYRANT L/T
&
DONNA O. CARTER
DB 5106, PG 1731
PIN: 7970957284
ZONING AG

SARAH R. O'BYRANT L/T
&
DEBORAH O. STEPP
DB 5106, PG 1734
PIN: 7980061382
ZONING AG

DAVID K. TUCKER
&
ANN B. TUCKER
DB 7631, PG 454
PIN: 7970851765

LOT 1 P.B. 56 PG. 149 A
LOT 2 P.B. 170 PG. 27 B
LOT 3 P.B. 170 PG. 27 C
LOT 4 P.B. 170 PG. 27 D
LOT 5 P.B. 170 PG. 27 E
LOT 6 P.B. 170 PG. 27 F
LOT 23 P.B. 144 PG. 004 / P.B. 155 PG. 094 H
LOT 22 P.B. 144 PG. 004 I
LOT 21 P.B. 144 PG. 004 J
LOT 20 P.B. 144 PG. 004 K
LOT 19 P.B. 144 PG. 004 L
LOT 18 P.B. 144 PG. 004 M
LOT 17 P.B. 144 PG. 004 N
LOT 16 P.B. 144 PG. 004 O
LOT 24 P.B. 144 PG. 004 / P.B. 155 PG. 094 G
LOT 83 P
LOT 84 Q

BROAD RIDGE COURT
BROAD RIDGE SUBDIVISION
PRIVATE DR
FARM PATH
MIDDLELAND DR
20' ACCESS EASEMENT
TRANSMISSION RIGHT OF WAY 68' R6819 2935-2944
60' DRAINAGE EASEMENT
SPENCERSGROVE SUBDIVISION
BUSICKWOOD DRIVE
MITCHELL WOOD DRIVE
WALBROOK TERRACE

PRELIMINARY
NOT TO BE USED FOR RECORDATION SALES, OR CONVEYANCE

LANDOWNERS AND ADJOINERS

A	HUGH H. SMITH SANDRA B SMITH DB 7524, PG 2865 PIN:7970837839
B	WELLS FARGO BANK DB 7602, PG 2525 PIN: 7970849167
C	TRACY F. GASKINS DB 7595, PG 2580 PIN:7970849388
D	RENEE M. MATTHEWS DB 7370, PG 3545 PIN: 7970940511
E	ARNOLD IRVING LATRICIA IRVING DB 7536, PG 524–525 PIN: 7970940634
F	JAMES E. MARSHALL ERMA L. MARSHALL DB 7341, PG 2398 PIN:7970940765

LANDOWNERS AND ADJOINERS

G	DAVID WAYNE ANDERSON DB 7380, PG 01519 PIN:7970966995
H	ERIC MCCARTHY FERNANDA MCCARTHY DB 6698, PG 01186 PIN:7970976160
I	KEVIN S. DALY DB 5949, PG 02618 PIN:7970976286
J	ERIC BANCROFT SABRENAM. BANCROFT DB 5579, PG 01609 PIN:7970976398
K	JIMMY RAY KENT JR JOYCE B. KENT DB 6121, PG 02719 PIN:7970977500
L	PAUL D. TALBERT NORMA TALBERT DB 7387, PG 1855 PIN:7970977613
M	WILLIAM ALLEN VIII DB 6640, PG 2733 PIN:7970977725

N	HEATHER M. ELLINGTON DB 6964, PG 783 PIN:7970977837
O	STEPHEN BEELER DILLINGHAM REBECCA CAROL QUATE DB 5982, PG 931 PIN:7970851940
P	BLAKE THORNSBERRY LYNN M. THORNSBERRY DB 6757, PG 2209 PIN:7970851773
Q	ADAM S. WILSON KIMBERLY W. WILSON DB 6733, PG 1868 PIN:7970987219
R	WELLINGTON HOMEOWNERS ASSOC OF BROWN SUMMIT INC. DB 7059, PG 2084 PIN:7980080435
S	THOMAS C. WALL ANNA R. WALL DB 6778, PG 1120 PIN:7970869642
T	JANIE M. BOWMAN DB 5439, PG 1271–1274 PIN: 7970876658

LEGEND

PROPERTY LINE SURVEYED.....
PROPERTY LINE(R/W) NOT SURVEYED.....
CONSERVATION EASEMENT.....
OTHER EASEMENTS .....
EXISTING FENCE.....
PROPOSED FENCE.....
EXISTING IRON PIPE/ROD(EIP).....
EASEMENT MONUMENT SET.....
CONTROL POINT SET.....
PIN..... PARCEL IDENTIFICATION NUMBER

GRAPHIC SCALE
0 200 400 600
1"=200'
(US Ft.)

EEP PROJECT NAME: 'BROWNS SUMMIT' Drawing No. BROWNS_SUMMIT_XXXXX_CE_Baker_DRAFT.dwg

Michael Baker INTERNATIONAL
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F–1084

BROWNS SUMMIT CONSERVATION EASEMENT SURVEY

FOR

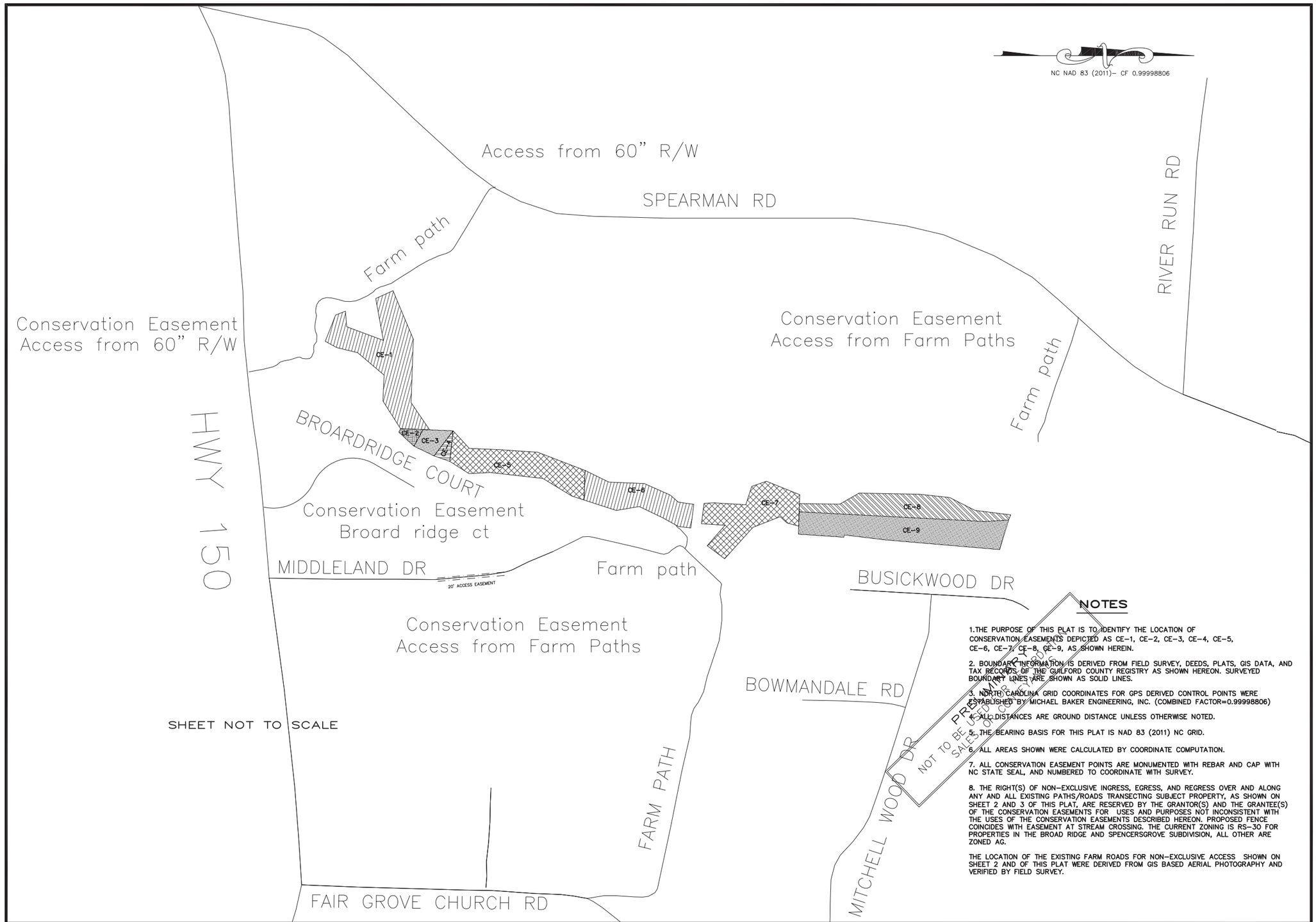
STATE OF NORTH CAROLINA–DEPARTMENT OF ADMINISTRATION–DIVISION OF MITIGATION SERVICES

ON THE PROPERTY OF

RENEE M. MATTEWS, ARNOLD IRVING, LATRICIA IRVING, JAMES E. MARSHALL, ERMA L. MARSHALL, SARAH B. ELLEDGE, ARNOLD D. ELLEDGE, SARAH R. O'BRYANT, DONNA O. CARTER, STEVEN D. CARTER, DEBORAH O. STEPP, WYMAN RAY STEPP AND JANIE M. BOWMAN

MONROE TOWNSHIP GUILFORD COUNTY NORTH CAROLINA

SPO FILE No.
DMS Project No.:
BE Project No.: 140048
Date: FEBUARY 27, 2015
Scale: 1"=200'



NOTES

1. THE PURPOSE OF THIS PLAT IS TO IDENTIFY THE LOCATION OF CONSERVATION EASEMENTS DEPICTED AS CE-1, CE-2, CE-3, CE-4, CE-5, CE-6, CE-7, CE-8, CE-9, AS SHOWN HEREIN.

2. BOUNDARY INFORMATION IS DERIVED FROM FIELD SURVEY, DEEDS, PLATS, GIS DATA, AND TAX RECORDS OF THE GUILFORD COUNTY REGISTRY AS SHOWN HEREON. SURVEYED BOUNDARY LINES ARE SHOWN AS SOLID LINES.

3. NORTH CAROLINA GRID COORDINATES FOR GPS DERIVED CONTROL POINTS WERE ESTABLISHED BY MICHAEL BAKER ENGINEERING, INC. (COMBINED FACTOR=0.99998806)

4. ALL DISTANCES ARE GROUND DISTANCE UNLESS OTHERWISE NOTED.

5. THE BEARING BASIS FOR THIS PLAT IS NAD 83 (2011) NC GRID.

6. ALL AREAS SHOWN WERE CALCULATED BY COORDINATE COMPUTATION.

7. ALL CONSERVATION EASEMENT POINTS ARE MONUMENTED WITH REBAR AND CAP WITH NC STATE SEAL, AND NUMBERED TO COORDINATE WITH SURVEY.

8. THE RIGHT(S) OF NON-EXCLUSIVE INGRESS, EGRESS, AND REGRESS OVER AND ALONG ANY AND ALL EXISTING PATHS/ROADS TRANSECTING SUBJECT PROPERTY, AS SHOWN ON SHEET 2 AND 3 OF THIS PLAT, ARE RESERVED BY THE GRANTOR(S) AND THE GRANTEE(S) OF THE CONSERVATION EASEMENTS FOR USES AND PURPOSES NOT INCONSISTENT WITH THE USES OF THE CONSERVATION EASEMENTS DESCRIBED HEREON. PROPOSED FENCE COINCIDES WITH EASEMENT AT STREAM CROSSING. THE CURRENT ZONING IS RS-30 FOR PROPERTIES IN THE BROAD RIDGE AND SPENCERSGROVE SUBDIVISION, ALL OTHER ARE ZONED AG.

THE LOCATION OF THE EXISTING FARM ROADS FOR NON-EXCLUSIVE ACCESS SHOWN ON SHEET 2 AND OF THIS PLAT WERE DERIVED FROM GIS BASED AERIAL PHOTOGRAPHY AND VERIFIED BY FIELD SURVEY.

Michael Baker INTERNATIONAL
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

BROWNS SUMMIT CONSERVATION EASEMENT SURVEY

FOR

STATE OF NORTH CAROLINA–DEPARTMENT OF ADMINISTRATION–DIVISION OF MITIGATION SERVICES

ON THE PROPERTY OF

RENEE M. MATTEWS, ARNOLD IRVING, LATRICIA IRVING, JAMES E. MARSHALL, ERMA L. MARSHALL, SARAH B. ELLEDGE, ARNOLD D. ELLEDGE, SARAH R. O'BRYANT, DONNA O. CARTER, STEVEN D. CARTER, DEBORAH O. STEPP, WYMAN RAY STEPP AND JANIE M. BOWMAN

MONROE TOWNSHIP GUILFORD COUNTY NORTH CAROLINA

SPO FILE No.
DMS Project No.:
BE Project No.: 140048
Date: FEBUARY 27, 2015
Scale: 1"=200'

16.0 APPENDIX B - BASELINE INFORMATION DATA

16.1 USACE Routine Wetland Determination Forms – per regional supplement to 1987 Manual

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **SAW-2014-01642** County: **Guilford** U.S.G.S. Quad: **NC-LAKE BRANDT**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Agent: **Baker Engineering**
attn: Scott King
Address: **8000 Regency Parkway, Suite 600**
Cary , NC, 27518

Size (acres)	**19**	Nearest Town	**Brown Summit**
Nearest Waterway	**Haw River**	River Basin	**Haw. North Carolina.**
USGS HUC	**3030002**	Coordinates	**36.237525 N, -79.748703 W**

Location description: **The site is located along an approximately 4200 foot section of UT to the Haw River, approximately 0.15 mile north of NC 150 and approximately 0.25 mile east of Spearman Road in Browns Summit, Guilford County, North Carolina.**

Indicate Which of the Following Apply:

A. Preliminary Determination

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

B. Approved Determination

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

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

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

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

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

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

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

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

C. Basis For Determination: **The site exhibits features with Ordinary High Water and wetlands as defined in the 1987 wetland delineation manual and applicable regional supplements. The waters on site include five Unnamed Tributaries (UTs) to Haw River, all Relatively Permanent Waters (RPWs), which flow into the Haw River, an RPW that becomes a Traditionally Navigable Water – and abutting wetlands. This determination is based on field verifications by David E. Bailey (USACE) on 4/14/2014 and 7/15/2014.**

D. Remarks: **The wetlands and other Waters of the US within the property were originally flagged by Michael Baker Engineering, Inc. with changes made in the field by David E. Bailey (USACE), and are approximated on the attached sheets labeled "Browns Summit Creek Restoration Site Stream Resources", and zoomed in views labeled "Browns Summit Creek Restoration Site Wetland Areas (upper)" and "Browns Summit Creek Restoration Site Wetland Areas (lower)" sent via e-mail on 7/23/2014.**

E. Attention USDA Program Participants

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

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

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

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

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR part 331.5, and that it has been received by the Division Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be received at the above address by **November 14, 2014**.

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

Corps Regulatory Official: 

Date: **September 15, 2014** Expiration Date: **September 15, 2019**

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 our Customer Satisfaction Survey, located online at http://regulatory.usacesurvey.com/.

Copy furnished:
Sue Homewood, NCDENR-DWR, 585 Waughtown Street, Winston-Salem, NC 27107
Sarah B. Elledge, 4025 NC Hwy 150, Browns Summit, NC 27214
Renee Maria Matthews, 8109 Broad Ridge Court, Browns Summit, NC 27214
James and Erma Marshall, 8113 Broad Ridge Court, Browns Summit, NC 27214
Arnold and Latricia Irving, 8111 Broad Ridge Court, Browns Summit, NC 27214
Donna Carter and Sarah O'Bryant, 8401 Middleland Drive, Browns Summit, NC 27214
Steven and Donna Carter, 8401 Broad Ridge Court, Browns Summit, NC 27214
Deborah Stepp, 8241 Fairgrove Church Road, Browns Summit, NC 27214
Janie M. Bowman, 8151 Spearman Road, Browns Summit, NC 27214

North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

John E. Skvarla, III
Secretary

July 23, 2014

Mr. Scott King
Michael Baker Engineering Inc
8000 Regnecy Parkway, Suite 600
Cary NC 28518

Subject Property: Browns Summit Creek Restoration Site, Guilford County

On-Site Determination for Applicability to the Mitigation Rules (15A NCAC 2H .0500)
On-Site Determination for Applicability to the Jordan Buffer Rules (15A NCAC 2B .0267)

Dear Mr. King:

On July 15, 2014, at your request and in your attendance, Sue Homewood conducted an on-site determination to review features located on the subject project for stream determinations with regards to the above noted state regulations. David Bailey with the US Army Corps of Engineers (USACE) was also present at the site visit.

The Division acknowledges the areas and boundaries identified as jurisdictional wetlands by the USACE. The attached map accurately depicts all stream determinations conducted during the site visit.

Please note that at the time of this letter, all intermittent and perennial stream channels and jurisdictional wetlands found on the property are subject to the mitigation rules cited above. These regulations are subject to change in the future.

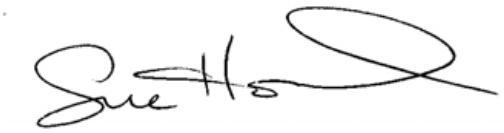
The owner (or future owners) should notify the Division (and other relevant agencies) of this decision in any future correspondences concerning this property. This on-site determination shall expire five (5) years from the date of this letter.

Winston-Salem Regional Office
Location: 585 Waughtown St. Winston-Salem, North Carolina 27107
Phone: 336-771-5000 \ FAX: 336-771-4630 \ Customer Service: 1-877-623-6748
Internet: www.ncwaterquality.org

Landowners or affected parties that dispute a determination made by the Division or Delegated Local Authority that a surface water exists and that it is subject to the buffer rule may request a determination by the Director. A request for a determination by the Director shall be referred to the Director in writing c/o Wetlands and Buffers Permitting and Compliance Unit, 1650 Mail Service Center, Raleigh, NC 27699-1650. Individuals that dispute a determination by the Division or Delegated Local Authority that "exempts" surface water from the buffer rule may ask for an adjudicatory hearing. You must act within 60 days of the date that you receive this letter. Applicants are hereby notified that the 60-day statutory appeal time does not start until the affected party (including downstream and adjacent landowners) is notified of this decision. The Division recommends that the applicant conduct this notification in order to be certain that third party appeals are made in a timely manner. To ask for a hearing, send a written petition, which conforms to Chapter 150B of the North Carolina General Statutes to the Office of Administrative Hearings, 6714 Mail Service Center, Raleigh, N.C. 27699-6714. This determination is final and binding unless you ask for a hearing within 60 days.

This letter only addresses the applicability to the mitigation rules and the buffer rules and does not approve any activity within Waters of the United States or Waters of the State or their associated buffers. If you have any additional questions or require additional information please contact me at 336-771-4964 or sue.homewood@ncdenr.gov.

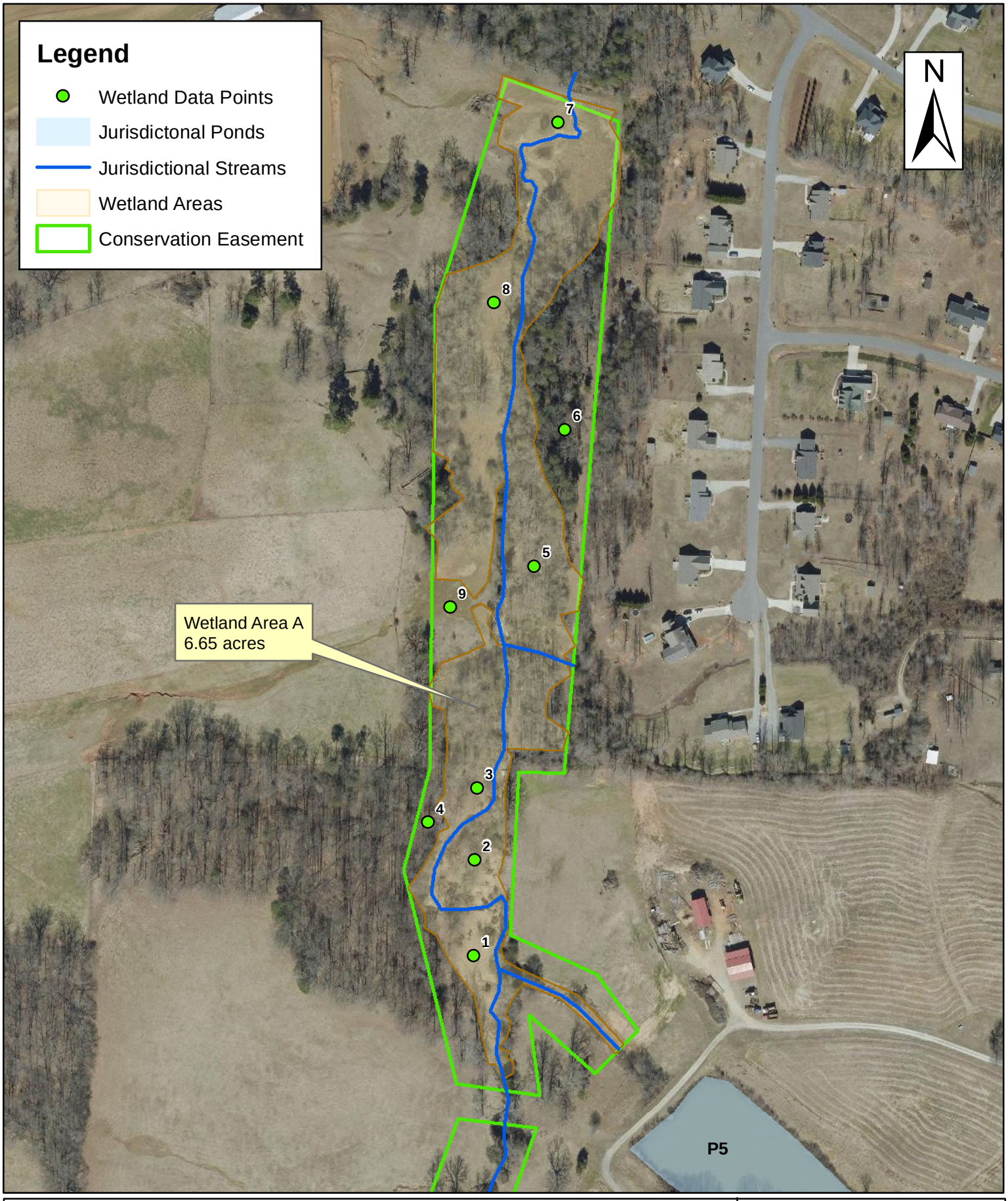
Sincerely,



Sue Homewood
Winston-Salem Regional Office

Enclosures: Baker provided Topo Map
Baker Stream Map
Baker Wetland Maps

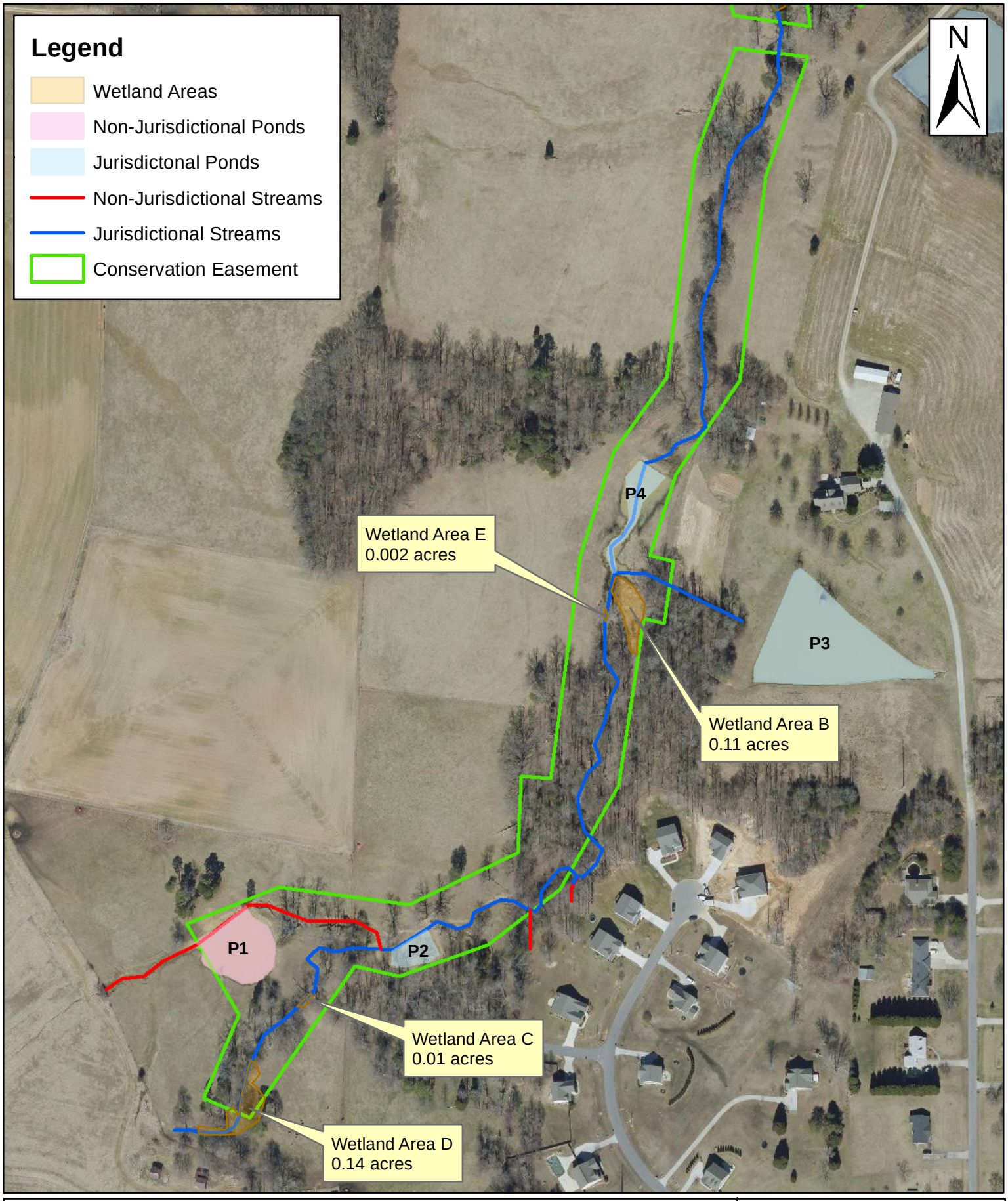
cc: David Bailey, USACE Raleigh Regulatory Field Office (via email)
DWR, Winston-Salem Regional Office



Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490

0 125 250 500
Feet

Browns Summit Creek Restoration Site
Wetland Areas (lower)
16 July 2014



Baker
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8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490

0 125 250 500
Feet

Browns Summit Creek Restoration Site
Wetland Areas (upper)
16 July 2014

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Browns Summit City/County: Guilford Sampling Date: 5/2/14

Applicant/Owner: Raleigh Engineering State: NC Sampling Point: 1

Investigator(s): Scott King Section, Township, Range: –

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): valley Slope (%): 1%

Subregion (LRR or MLRA): P-136 Lat: 36.23854 Long: -79.74816 Datum: NAD83

Soil Map Unit Name: Colfax loam NWI classification: none

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

Are Vegetation X, 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:
Dairy cows have access to this site and periodically graze here.

HYDROLOGY

Wetland Hydrology Indicators:

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

- X Surface Water (A1)
- X High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No _____	Depth (inches): 2"
Water Table Present?	Yes X	No _____	Depth (inches): 6"
Saturation Present? (includes capillary fringe)	Yes _____	No _____	Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

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

Remarks:
Wetland hydrology present

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: 1

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. none			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size: 30')			
1. Liriodendron tulipifera	10	Y	FACU
2. Juniperus virginiana	1	N	FACU
3. Ligustrum sinense	2	N	FACU
4.			
5.			
6.			
7.			
8.			
9.			
	13 = Total Cover		
50% of total cover: 6.5	20% of total cover: 2.6		
Herb Stratum (Plot size: 15')			
1. Carex lurida	25%	Y	OBL
2. Juncus effusus	15%	Y	FACW
3. Polygonum pensylvaticum	10%	N	FACW
4. Ranunculus sp.	10%	N	-
5. Microstegium vimineum	10%	N	FAC
6. Impatiens capensis	1%	N	FACW
7. Lonicera japonica	1%	N	FAC
8. Rubus argutus	1%	N	FACU
9. Liquidambar styraciflua	1%	N	FAC
10.			
11.			
	74 = Total Cover		
50% of total cover: 37	20% of total cover: 14.8		
Woody Vine Stratum (Plot size: 15')			
1. Campsis radicans	2%	Y	FAC
2.			
3.			
4.			
5.			
	2 = Total Cover		
50% of total cover: 1	20% of total cover: .4		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

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

Percent of Dominant Species That Are OBL, FACW, or FAC: 75% (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]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 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: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation present here

SOIL Sampling Point: 1

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
0-4	10YR 4/2	100	–				silt loam	
4-7	10YR 6/3	60	2.5YR 4/6	40	C	M	"	
7-12	10YR 4/2	60	2.5YR 4/6	40	C	M	sa cl loam	

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

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ 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 X No ____

Remarks:

Hydric Soil present

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Browns Summit City/County: Guilford County Sampling Date: 5/2/14

Applicant/Owner: Baley Engineering State: NC Sampling Point: 2

Investigator(s): Scott King Section, Township, Range: —

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): valley Slope (%): 1%

Subregion (LRR or MLRA): P-136 Lat: 36.23902 Long: -79.74816 Datum: NAD83

Soil Map Unit Name: Codorus loam NWI classification: none

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

Are Vegetation X, 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.

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

Remarks:
Dairy cows have access to the site and graze here periodically.

HYDROLOGY

Wetland Hydrology Indicators:

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

- ___ Surface Water (A1)
- X 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)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes X	No ____	Depth (inches): 10"
Saturation Present? (includes capillary fringe)	Yes ____	No ____	Depth (inches): ____

Wetland Hydrology Present? Yes X No ____

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

Remarks:
Wetland hydrology present

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: 2

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	90%	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	90 = Total Cover		
50% of total cover: 45	20% of total cover: 18		
Sapling/Shrub Stratum (Plot size: 30')			
1. Alnus serrulata	5%	Y	OBL
2. Ligustrum sinense	5%	Y	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	10 = Total Cover		
50% of total cover: 5	20% of total cover: 2		
Herb Stratum (Plot size: 10')			
1. Microstegium vimineum	2%	N	FAC
2. Polygonum pensylvanicum	5%	Y	FACW
3. Viola sororia	5%	Y	FAC
4. Lonicera japonica	2%	N	FAC
5. Smilax rotundifolia	5%	Y	FAC
6. Duchesnea indica	5%	Y	FACU
7. Carex lurida	10%	Y	OBL
8. Sambucus canadensis	1%	N	NI
9. Toxicodendron radicans	2%	N	FAC
10.			
11.			
	37 = Total Cover		
50% of total cover: 18.5	20% of total cover: 7.4		
Woody Vine Stratum (Plot size: 30')			
1. Vitis rotundifolia	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: 7 (A)

Total Number of Dominant Species Across All Strata: 9 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 78% (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]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 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: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation present

SOIL Sampling Point: 2

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
0-2	10YR 3/1	98	7.5YR 5/6	2	C	M	si. loam	
2-8	10YR 4/2	75	5YR 5/6	25	C	M	si. loam	Redox concentrations
8-12	10YR 4/1	60	10YR 6/1	40	D	M	SA, si. loam	

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

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ 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 X No ____

Remarks:

Hydric soil present

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Browns Summit City/County: Guilford County Sampling Date: 5/2/14

Applicant/Owner: Balk Engineering State: NC Sampling Point: 3

Investigator(s): Scott King Section, Township, Range: -

Landform (hillslope, terrace, etc.): flood plain Local relief (concave, convex, none): valley Slope (%): 1%

Subregion (LRR or MLRA): P-136 Lat: 36.23938 Long: -79.74815 Datum: NAD 83

Soil Map Unit Name: Codorus loam NWI classification: none

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

Are Vegetation X, 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.

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

Remarks:
Dairy cows have access to site and graze here periodically.

HYDROLOGY

Wetland Hydrology Indicators:

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

- ___ Surface Water (A1)
- X 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)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No X	Depth (inches): _____
Water Table Present?	Yes X	No _____	Depth (inches): 8"
Saturation Present? (includes capillary fringe)	Yes _____	No _____	Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

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

Remarks:
Hydrology present

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: 3

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	60%	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	60 = Total Cover		
50% of total cover: 30	20% of total cover: 12		
Sapling/Shrub Stratum (Plot size: 30')			
1. Viburnum dentatum	10%	Y	FAC
2. Acer rubrum	5%	Y	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	15 = Total Cover		
50% of total cover: 7.5	20% of total cover: 3		
Herb Stratum (Plot size: 10')			
1. Microstegium vimineum	50%	Y	FAC
2. Impatiens capensis	5%	N	FACW
3. Polygonum pensylvanicum	5%	N	FACW
4. Lonicera japonica	2%	N	FAC
5. Carex lurida	2%	N	OBL
6.			
7.			
8.			
9.			
10.			
11.			
	64 = Total Cover		
50% of total cover: 32	20% of total cover: 12.8		
Woody Vine Stratum (Plot size: 30')			
1. Smilax rotundifolia	2%	Y	FAC
2.			
3.			
4.			
5.			
	2 = Total Cover		
50% of total cover: 1%	20% of total cover: .4%		

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

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

Definitions of Four Vegetation Strata:

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

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 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: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation is present

SOIL Sampling Point: 3

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
0-1	10YR 3/3	90	10YR 3/1	10	C	M	sa. loam	
1-5	10YR 6/4	75	10YR 3/1	20	C	M	sa. loam	soft masses
			+ 5YR 4/3	5	C	M	"	"
5-12	10YR 4/1	85	10YR 6/2	5	D	M	si. cl. loam	soft masses
			+ 10YR 4/6	10	C	M	"	"

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

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ 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 X No ____

Remarks:

Hydric soil present

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Brown Summit City/County: Guilford Sampling Date: 5/2/14

Applicant/Owner: Balen Engineering State: NC Sampling Point: 4

Investigator(s): Scott King Section, Township, Range: -

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): concave (valley) Slope (%): 1%

Subregion (LRR or MLRA): P - 136 Lat: 36.24049 Long: -79.747813 Datum: NAD 83

Soil Map Unit Name: Codorus loam NWI classification: -

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

Are Vegetation X, 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:
Dairy cows have access to the site and periodically graze here.

HYDROLOGY

Wetland Hydrology Indicators:

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

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

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

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

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

Wetland Hydrology Present? Yes _____ No X

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

Remarks:
No indicators of hydrology present

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: 4

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Liriodendron tulipifera	30%	Y	FACU
2. Acer rubrum	15	Y	FAC
3. Liquidambar styraciflua	15	Y	FAC
4.			
5.			
6.			
7.			
	60 = Total Cover		
50% of total cover: 30	20% of total cover: 12		
Sapling/Shrub Stratum (Plot size: 30')			
1. none	–		
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size: 15')			
1. Microstegium vimineum	30%	Y	FAC
2. Lonicera japonica	5	N	FAC
3. Viola sororia	20	Y	FAC
4. Rosa multiflora	1	N	FACU
5. Smilax rotundifolia	5	N	FAC
6. Galium aparine	2	N	FACU
7.			
8.			
9.			
10.			
11.			
	63 = Total Cover		
50% of total cover: 31.5	20% of total cover: 12.6		
Woody Vine Stratum (Plot size: 15')			
1. Campsis radicans	2%	Y	FAC
2.			
3.			
4.			
5.			
	2 = Total Cover		
50% of total cover: 1	20% of total cover: .4		

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

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

Definitions of Four Vegetation Strata:

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

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 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: (Include photo numbers here or on a separate sheet.)

Hydrophytic Vegetation present

SOIL Sampling Point: 4

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
0-2	10YR 3/3		-				loam	
2-12+	2.5YR 4/6		-				loamy clay	

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

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ 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 X

Remarks:

Hydric Soil not present

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Browns Summit City/County: Guilford Sampling Date: 5/2/14

Applicant/Owner: Baker Engineering State: NC Sampling Point: 5

Investigator(s): Scott King Section, Township, Range: –

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): concave (valley) Slope (%): 1%

Subregion (LRR or MLRA): P-136 Lat: 36.24049 Long: -79.747813 Datum: NAD 83

Soil Map Unit Name: Cadoria loam NWI classification: –

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

Are Vegetation X, Soil X, 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.

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

Remarks: Dairy cows have access to this area and graze here. Damage to vegetation and soil structure are evident.

HYDROLOGY

Wetland Hydrology Indicators:

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

- X Surface Water (A1)
- X 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)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ____ Depth (inches): 1/2"

Water Table Present? Yes X No ____ Depth (inches): 9"

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

Wetland Hydrology Present? Yes X No ____

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

Remarks:

Wetland hydrology present

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: 5

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	75%	Y	FAC
2. Liriodendron tulipifera	5	N	FACU
3. Ulmus rubra	5	N	FAC
4.			
5.			
6.			
7.			
	85 = Total Cover		
50% of total cover: 42.5	20% of total cover: 17		
Sapling/Shrub Stratum (Plot size: 30')			
1. Acer rubrum	25%	Y	FAC
2. Liquidambar styraciflua	5	N	FAC
3. Rosa multiflora	20	Y	FACU
4. Ligustrum sinense	5	N	FACU
5. Viburnum dentatum	2	N	FAC
6.			
7.			
8.			
9.			
	57 = Total Cover		
50% of total cover: 28.5	20% of total cover: 11.4		
Herb Stratum (Plot size: 15')			
1. Rosa multiflora	30%	Y	FACU
2. Lonicera japonica	15	N	FAC
3. Impatiens capensis	15	N	FACW
4. Ligustrum sinense	20	Y	FACU
5. Liquidambar styraciflua	10	N	FAC
6.			
7.			
8.			
9.			
10.			
11.			
	90 = Total Cover		
50% of total cover: 45	20% of total cover: 18		
Woody Vine Stratum (Plot size: 15')			
1. Toxicodendron radicans	10%	Y	FAC
2. Smilax rotundifolia	1	N	FAC
3.			
4.			
5.			
	11 = Total Cover		
50% of total cover: 5.5	20% of total cover: 2.2		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (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
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 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: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation present

SOIL Sampling Point: 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
0-2	10YR 3/4		—				silty loam	
2-9	10YR 4/2		7.5YR 7/6	10%	C	M	silty loam	
9-12	10YR 4/1		10YR 4/6	2%	C	M	silty loam	

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

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ 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 X No ____

Remarks:

Hydric soil present

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Bruns Summit City/County: Guilford Sampling Date: 5/2/14

Applicant/Owner: Balen Engineering State: NC Sampling Point: 6

Investigator(s): Sam King Section, Township, Range: –

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): concave (valley) Slope (%): 1%

Subregion (LRR or MLRA): P-136 Lat: 36.241173 Long: -79.74763 Datum: NAD83

Soil Map Unit Name: Codorus loam NWI classification: none

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

Are Vegetation X, 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.

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

Remarks: Dairy cattle have access to this area and often graze here. Damage to vegetation is likely.

HYDROLOGY

Wetland Hydrology Indicators:

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

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

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

Wetland Hydrology Present? Yes _____ No X

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

Remarks:

No indicators of hydrology present here

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: 6

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Juniperus virginiana	20%	Y	FACU
2. Liriodendron tulipifera	15	Y	FACU
3. Acer rubrum	5	N	FAC
4. Liquidambar styraciflua	10	Y	FAC
5.			
6.			
7.			
	50 = Total Cover		
50% of total cover: 25	20% of total cover: 10		
Sapling/Shrub Stratum (Plot size: 30')			
1. Juniperus virginiana	10%	Y	FACU
2. Ligustrum sinense	5	N	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	15 = Total Cover		
50% of total cover: 7.5	20% of total cover: 3		
Herb Stratum (Plot size: 15')			
1. Ligustrum sinense	5%	Y	FACU
2. Lonicera japonica	5	Y	FAC
3. Liquidambar styraciflua	2	N	FAC
4. Toxicodendron radicans	2	N	FAC
5. Rosa multiflora	1	N	FACU
6. Viola sororia	1	N	
7. Viburnum dentatum	2	N	FAC
8. Campsis radicans	1	N	FAC
9. Potentilla simplex	1	N	FACU
10.			
11.			
	20 = Total Cover		
50% of total cover: 10	20% of total cover: 4		
Woody Vine Stratum (Plot size: 15')			
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: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33% (A/B)

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

__ 1 - Rapid Test for Hydrophytic Vegetation

__ 2 - Dominance Test is >50%

__ 3 - Prevalence Index is ≤3.0[1]

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

__ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 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 X

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

Hydrophytic vegetation not present here

SOIL Sampling Point: 6

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
0-2"	10YR 3/4		-				silty loam	
2-8"	2.5YR 3/6		-				clay	
8-12"	2.5YR 3/6	70%	10YR 7/8	30%	C	M	silty clay	

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

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ 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 X

Remarks:

Hydric soil not present here.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Brown's Summit City/County: Guilford Sampling Date: 5/2/14

Applicant/Owner: Baker Engineering State: NC Sampling Point: 7

Investigator(s): Scott King Section, Township, Range: –

Landform (hillslope, terrace, etc.): Stream plain Local relief (concave, convex, none): concave (valley) Slope (%): 1%

Subregion (LRR or MLRA): P-136 Lat: 36.242709 Long: -79.747686 Datum: NAD83

Soil Map Unit Name: Codorus loam NWI classification: –

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

Are Vegetation X, Soil X, 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.

Hydrophytic Vegetation Present?	Yes ____ No X (see below)	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:
this area highly disturbed. Artificial management of vegetation maintains a narrow non-hydrophytic range of species but naturally it would vegetate with wetland species as in the adjacent area that is similar in hydrology & geomorphology.

HYDROLOGY

Wetland Hydrology Indicators:

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

- X Surface Water (A1)
- X High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ____ Depth (inches): ½"

Water Table Present? Yes X No ____ Depth (inches): 8"

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

Wetland Hydrology Present? Yes X No ____

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

Remarks:
Area contains multiple shallow depressional geomorphic pools of standing water. Has high water table.
Indicators of hydrology present.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: 7

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

50% of total cover: _____ 20% of total cover: _____

Sapling/Shrub Stratum (Plot size: 30')			
1. none			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Herb Stratum (Plot size: 15')			
1. Festuca arundinacia	90%	Y	FACU
2. Trifolium repens	5	N	FACU
3. Ranunculus sp.	25	N	—
4. Juncus effusus	5	N	FACW
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	130 = Total Cover		

50% of total cover: 65 20% of total cover: 26

Woody Vine Stratum (Plot size: 15')			
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: 0 (A)

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

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalence Index worksheet:

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

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

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

See Remarks below

Hydrophytic Vegetation Present? Yes _____ No X

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

This area is highly disturbed. It is maintained as pasture for grazing and has been physically altered in the past. It was once a dammed pond. Adjacent vegetation in the forested, non-maintained wetland area (hydrologically + geomorphically similar) is clearly hydrophytic.

SOIL Sampling Point: 7

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
(1)	0-5"	10YR 3/2	80	5YR 5/6	20%	C	M	loam	
	5-8"	10YR 6/1	70	5YR 5/6	30%	C	M	loamy sand / sand	
	8-12"	10YR 4/1	65	5YR 5/6	25%	C	M	sandy loam	
			and	10YR 6/2	10%	D	M		
(2)	0-2"	10YR 4/2	90	2.5YR 4/6	10%	C	PL	loam	(oxidized rhizospheres)
	2-12"	10YR 5/6	60	10YR 5/2	20%	D	M	sandy loam	
			and	5YR 5/6	20%	C	M		

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

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ 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 X No ____

Remarks:

Hydric soil present here.

Due to significant physical manipulation of the soil here, profiles/borings are highly variable (2 borings were reported above only feet apart). This area was once a dammed pond and accumulated sediment. Once the dam was removed, some filling occured as well as downcutting, cattle impact, and flooding.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Browns Summit City/County: Guilford Sampling Date: 3/2/14

Applicant/Owner: Baker Engineering State: NC Sampling Point: 8

Investigator(s): Scott King Section, Township, Range: -

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): concave valley Slope (%): 1%

Subregion (LRR or MLRA): P - 136 Lat: 36.241805 Long: -79.748072 Datum: NAD83

Soil Map Unit Name: Codorus loam NWI classification: -

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

Are Vegetation X, Soil X, 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.

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

Remarks:
Dairy cow have access to this area and have disturbed the vegetation and soil through grazing.

HYDROLOGY

Wetland Hydrology Indicators:

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

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No _____	Depth (inches): 1/2"
Water Table Present?	Yes X	No _____	Depth (inches): 11"
Saturation Present? (includes capillary fringe)	Yes X	No _____	Depth (inches): 9"

Wetland Hydrology Present? Yes X No _____

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

Remarks:
Wetland hydrology present here

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: 8

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	40%	Y	FAC
2. Liquidambar styraciflua	5	N	FAC
3. Ulmus rubra	5	N	FAC
4. Juniperus virginiana	2	N	FACU
5.			
6.			
7.			
	52 = Total Cover		
50% of total cover: 26	20% of total cover: 10.4		

Sapling/Shrub Stratum (Plot size: 30')			
1. Alnus serrulata	10%	Y	OBL
2. Rosa multiflora	5	N	FACU
3. Ligustrum sinense	5	N	FACU
4.			
5.			
6.			
7.			
8.			
9.			
	20 = Total Cover		
50% of total cover: 10	20% of total cover: 4		

Herb Stratum (Plot size: 15')			
1. Microstegium vimineum	50%	Y	FAC
2. Viola sororia	5	N	FAC
3. Lonicera japonica	5	N	FAC
4. Smilax rotundifolia	10	N	FAC
5. Impatiens capensis	1	N	FACW
6. Ligustrum sinense	5	N	FACU
7.			
8.			
9.			
10.			
11.			
	76 = Total Cover		
50% of total cover: 38	20% of total cover: 15.2		

Woody Vine Stratum (Plot size: 15')			
1. –			
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: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (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]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 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: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation present here.

SOIL Sampling Point: 8

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
0-3"	10YR 4/1		5YR 5/6	30%	C	M	silt loam	
3-12"	10YR 4/1		7.5YR 5/6	10%	C	PL	silt loam	
			5YR 5/6	20%	C	M	silt loam	

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

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ 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 X No ____

Remarks:

Hydric soil present here

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Browns Summit City/County: Guilford Sampling Date: 5/2/14

Applicant/Owner: Baker Engineering State: NC Sampling Point: 9

Investigator(s): Sam King Section, Township, Range: -

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): concave valley Slope (%): 1%

Subregion (LRR or MLRA): P-136 Lat: 36.240282 Long: -79.748329 Datum: NAD83

Soil Map Unit Name: Codorus loam NWI classification: none

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

Are Vegetation X, Soil X, 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.

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

Remarks:
Dairy cow have access to this area and have impacted the vegetation & soil here. Area appears to have been tilled in the past and is currently maintained as grassy pasture.

HYDROLOGY

Wetland Hydrology Indicators:

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

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No ____	Depth (inches): ____
Water Table Present?	Yes ____	No ____	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No ____	Depth (inches): ____

Wetland Hydrology Present? Yes ____ No X

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

Remarks:
No indicators of hydrology are present.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: 9

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. –			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Sapling/Shrub Stratum (Plot size: 30')			
1. –			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Herb Stratum (Plot size: 15')			
1. Festuca arundinacea	95%	Y	FACU
2. Trifolium repens	15	N	FACU
3. Ranunculus sp.	5	N	–
4. Taraxacum officinale	1	N	FACU
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	116 = Total Cover		

50% of total cover: 58 20% of total cover: 23.2

Woody Vine Stratum (Plot size: 15')			
1. –			
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: 0 (A)

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

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalence Index worksheet:

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

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

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

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 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 X

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

Hydrophytic vegetation not present

SOIL

Sampling Point: 9

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
0-1"	10YR 3/4		-				silty loam	
2-12"	5YR 4/3		-				sandy loam	

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

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ 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):

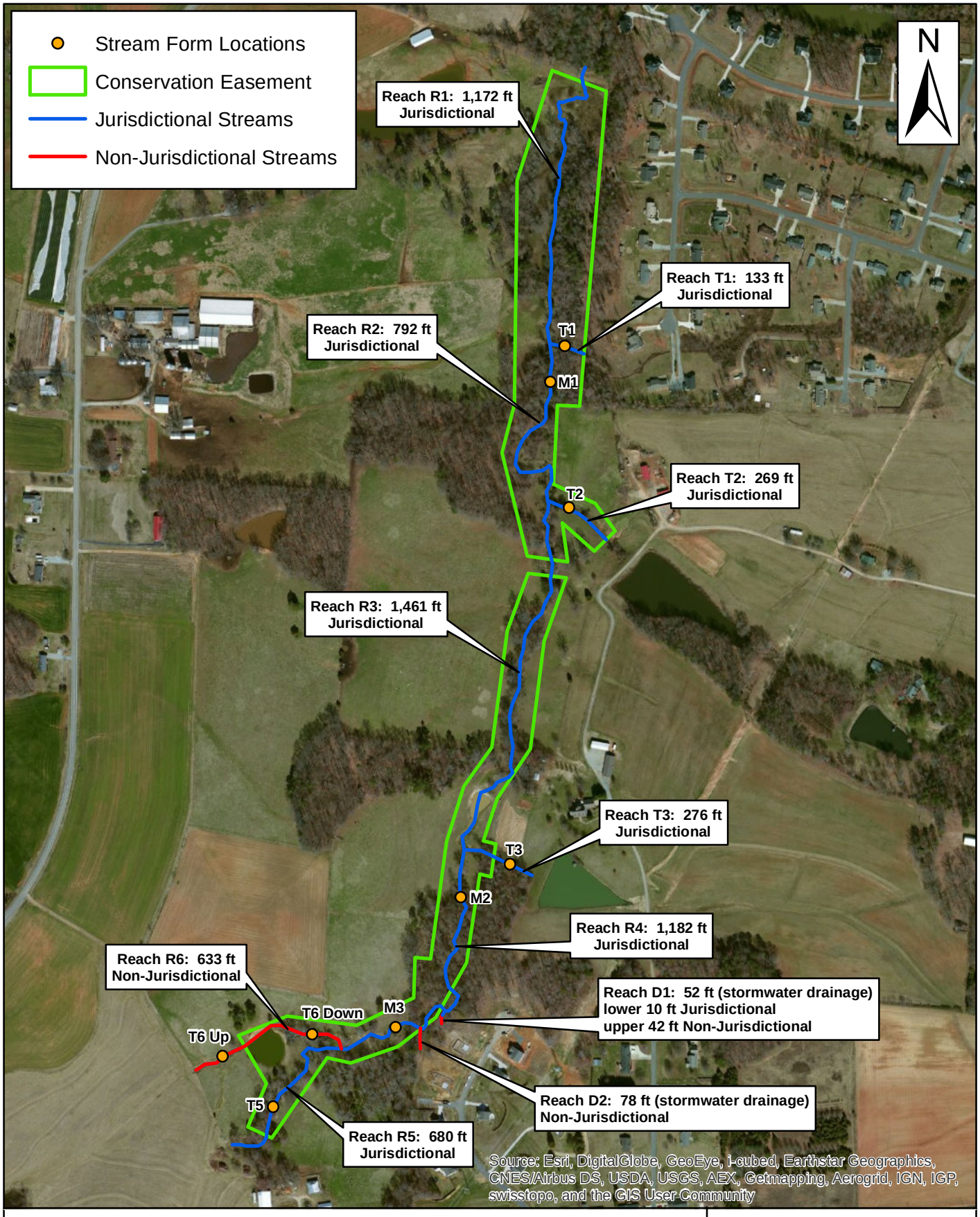
Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No X

Remarks:

Hydric soil not present.



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Browns Summit Creek Restoration Site
Stream Resources
16 July 2014

~~TIP:~~ _____

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream: SR4 (at M2 Data Point)

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: Baker Engineering
2. Evaluator's name: Scott King
3. Date of evaluation: 5/9/14
4. Time of evaluation: 2 pm
5. Name of stream: Browns Summit Creek
6. River basin: Cape Fear
7. Approximate drainage area: 120 acres (.19 mi^2)
8. Stream order: 1st
9. Length of reach evaluated: 50'
10. County: Guilford
11. Site coordinates (if known): prefer in decimal degrees.
12. Subdivision name (if any): –

Latitude (ex. 34.872312): 36.234378 Longitude (ex. -77.556611): -79.749084

Method location determined (circle): GPS Topo Sheet (Ortho (Aerial) Photo/GIS) Other GIS Other_____

13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): See stream map – near data point M2
14. Proposed channel work (if any): stream restoration project
15. Recent weather conditions: warm and dry (no rain for almost 2 weeks)
16. Site conditions at time of visit: sunny and warm
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? (YES) NO If yes, estimate the water surface area: .25 acre farm pond
19. Does channel appear on USGS quad map? (YES) NO
20. Does channel appear on USDA Soil Survey? (YES) NO
21. Estimated watershed land use: 25 % Residential ___% Commercial ___% Industrial 65 % Agricultural 10 % Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width:_____
23. Bank height (from bed to top of bank):_____
24. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ___Straight X Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

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

Total Score (from reverse): 25 **Comments:**

Stream highly impacted from upstream dairy cow grazing and from physical manipulation (through historical) of the moderate upstream area (it was once a dammed pond).

Evaluator's Signature Scott King **Date** 5/12/14

This channel evaluation form is intended to be used only as a guide to assist landowners and environmental professionals in gathering the data required by the United States Army Corps of Engineers to make a preliminary assessment of stream quality. The total score resulting from the completion of this form is subject to USACE approval and does not imply a particular mitigation ratio or requirement. Form subject to change – version 06/03. To Comment, please call 919-876-8441 x 26.

Baker

TIP: _____

Stream: R4 (at M2 Data Point)

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	4
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	0
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	2
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	0
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	0
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	0
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	0
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	3
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	2
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	1
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						25

* These characteristics are not assessed in coastal streams.

~~TIP:~~ _____

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream: R2 (at M1 data point)

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: Baker Engineering
2. Evaluator's name: Scott King
3. Date of evaluation: 5/9/14
4. Time of evaluation: 11 AM
5. Name of stream: Brams Summit Creek
6. River basin: Cape Fear
7. Approximate drainage area: 320 ac (.5 mi²)
8. Stream order: 2nd
9. Length of reach evaluated: 50'
10. County: Guilford
11. Site coordinates (if known): prefer in decimal degrees.
12. Subdivision name (if any): –

Latitude (ex. 34.872312): 36.239706 Longitude (ex. -77.556611): -79.747993

Method location determined (circle): GPS Topo Sheet (Ortho (Aerial) Photo/GIS) Other GIS Other_____

13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): see map - near data point M1
14. Proposed channel work (if any): stream restoration effort
15. Recent weather conditions: warm and dry (no rain in almost 2 weeks)
16. Site conditions at time of visit: Sunny, warm/hot
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? (YES) NO If yes, estimate the water surface area: 2.5 acres from 4 farm ponds
19. Does channel appear on USGS quad map? (YES) NO
20. Does channel appear on USDA Soil Survey? (YES) NO
21. Estimated watershed land use: 10% Residential ___% Commercial ___% Industrial 80% Agricultural 10% Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width: 6'
23. Bank height (from bed to top of bank): 4'
24. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: X Straight ___Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

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

Total Score (from reverse): 39 **Comments:** Stream highly impacted from dairy cow grazing.

Evaluator's Signature Scott King **Date** 5/12/14

This channel evaluation form is intended to be used only as a guide to assist landowners and environmental professionals in gathering the data required by the United States Army Corps of Engineers to make a preliminary assessment of stream quality. The total score resulting from the completion of this form is subject to USACE approval and does not imply a particular mitigation ratio or requirement. Form subject to change – version 06/03. To Comment, please call 919-876-8441 x 26.

Baker

TIP: _____

Stream: S R2 (at M1 Data Point)

STREAM QUALITY ASSESSMENT WORKSHEET

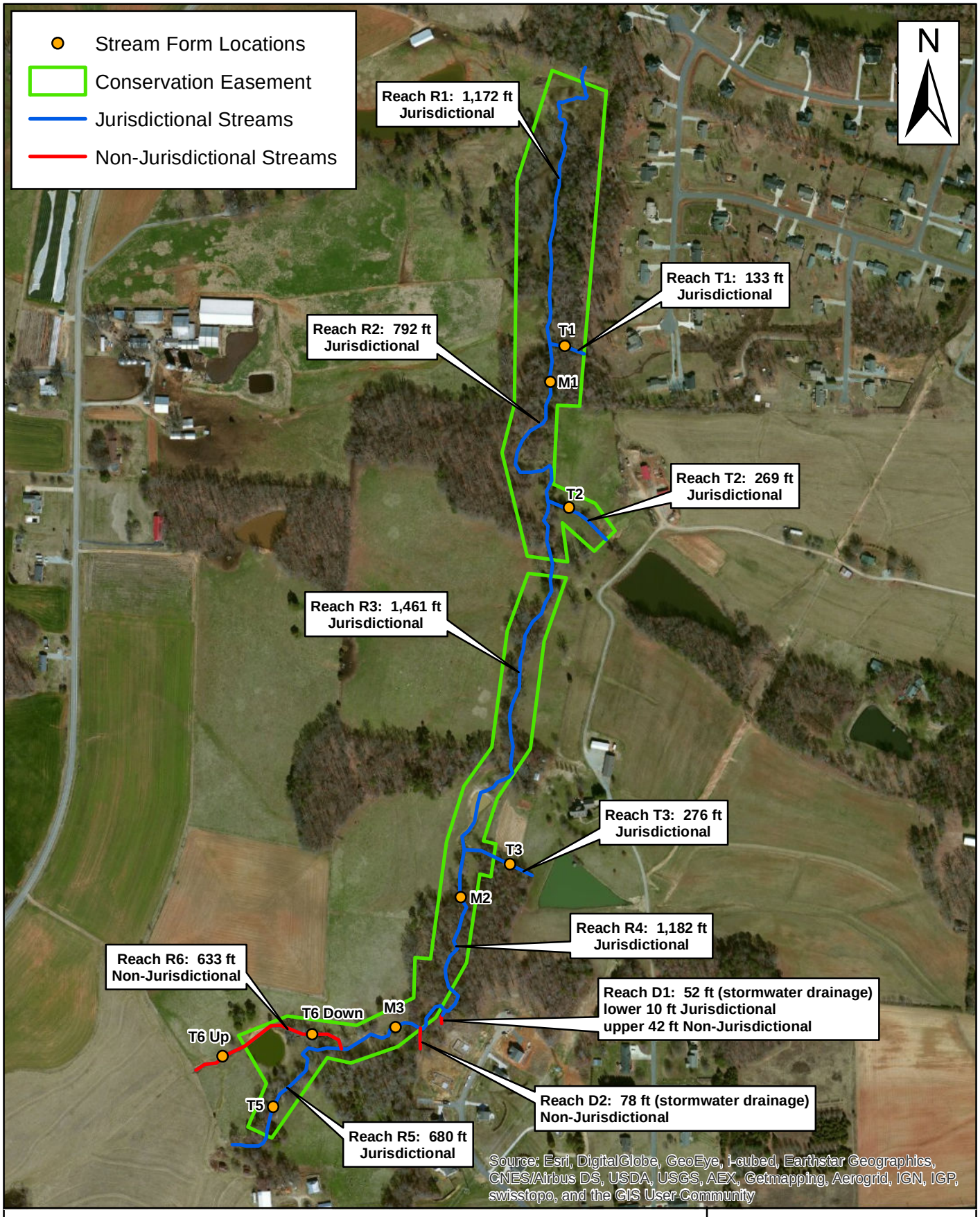
	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max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

* These characteristics are not assessed in coastal streams.

16.2 NCWAM Forms – Existing Wetlands

NC Wetland Assessment Method (NCWAM) Forms were not included for this project, as the NC Division of Water Resources and the USACE did not require them at the time this project was evaluated.

16.3 NCDWR Stream Classification Forms



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Browns Summit Creek Restoration Site
Stream Resources
16 July 2014

NC DWQ Stream Identification Form Version 4.11 Brown's Summit Crk

Date: 9/24/2013	Project/Site: M1	Latitude: 36.259717
Evaluator: D. Huneycutt	County: Guilford	Longitude: -79.748033
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 35.5	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other Brown's Summit *e.g. Quad Name:*

A. Geomorphology (Subtotal = 18)	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

2.5 8 7.5

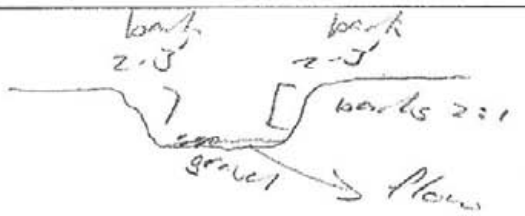
B. Hydrology (Subtotal = 8.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	(0)	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 9)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed (1) Algae R/L (3)	(3)	2	1	0
20. Macrobenthos (note diversity and abundance) low div.	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 (no veg in channel)	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes:

Sketch:



NC DWQ Stream Identification Form Version 4.11 — Brown's Summit Crk

Date: 9/24/2013	Project/Site: M2	Latitude: 36.234188
Evaluator: D. Hunegnaw	County: Guilford	Longitude: -79.749159
Total Points: 41.5 *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30**	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other Lake Brandt *e.g. Quad Name:*

A. Geomorphology (Subtotal = 22.5)	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

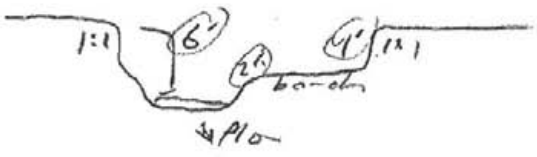
B. Hydrology (Subtotal = 10)				
12. Presence of Baseflow	0	1	(2)	3
13. Iron oxidizing bacteria	0	1	2	(3)
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 9)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed none	(3)	2	1	0
20. Macrobenthos (note diversity and abundance) 2 midges	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish (-2)	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 no veg	FACW = 0.75; OBL = 1.5 Other = (0)			

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

Notes: Deep channel, very defined pools + riffles, strong flow channel

Sketch:



NC DWQ Stream Identification Form Version 4.11 — Brown's Summit Crk

Date: 9/24/2013	Project/Site: MJ	Latitude: 36.233034
Evaluator: D. Hungerford	County: Guilford	Longitude: -79.749886
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 25.0	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other Lak Brandt *e.g. Quad Name:*

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

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

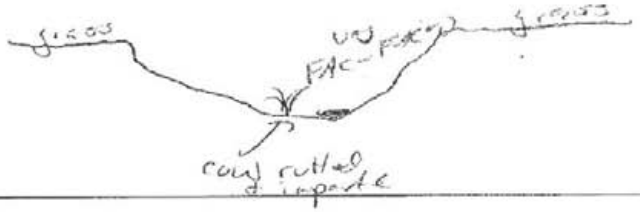
B. Hydrology (Subtotal = 6.5)				
12. Presence of Baseflow	0	(1)	2	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	(0)	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 7.5)				
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 in standing water	0	0.5	(1)	1.5
26. Wetland plants in streambed grasses	FACW = 0.75; OBL = 1.5 Other = (0)			

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

Notes: on standing water, cattle impacted

Sketch:



NC DWQ Stream Identification Form Version 4.11 Brown's Summit Creek

Date: 9/24/2013	Project/Site: T1	Latitude: 36.239770
Evaluator: P. Honeycutt	County: Guilford	Longitude: -79.747657
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 26.75	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other Brown's Summit *e.g. Quad Name:*

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

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

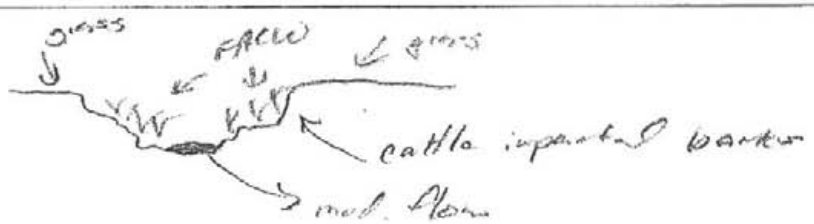
B. Hydrology (Subtotal = 9.5)				
12. Presence of Baseflow	0	1	(2)	3
13. Iron oxidizing bacteria	0	1	2	(3)
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	(0)	0.5	1	1.5
16. Organic debris lines or piles	(0)	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 11.25)				
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) amphipods	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish many tadpoles	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: tadpoles & amphipods (strong hydric soils)

Sketch:



NC DWQ Stream Identification Form Version 4.11 Brown's Summit Crk

Date: 9/24/2013	Project/Site: T2	Latitude: 36.238353
Evaluator: D. Huntcott	County: Guilford	Longitude: -79.747617
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 27.25	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other Brown's Summit *e.g. Quad Name:*

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

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

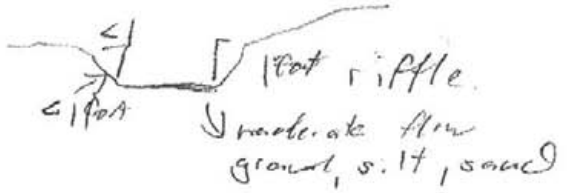
B. Hydrology (Subtotal = 7)				
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 11.25)				
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) only amphipods ~10	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: lots of true thumb in swampy portions

Sketch:



NC DWQ Stream Identification Form Version 4.11 Browns Summit Creek

Date: 9/24/2013	Project/Site: T3	Latitude: 36.234727	
Evaluator: D. Huneycutt	County: Guilford	Longitude: -79.748487	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 19.0	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other e.g. Quad Name: Browns Summit Lake Brandt	

A. Geomorphology (Subtotal = 6)	Absent	Weak	Moderate	Strong
1* Continuity of channel bed and bank ditch	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	

*artificial ditches are not rated; see discussions in manual

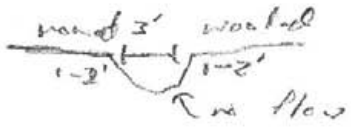
B. Hydrology (Subtotal = 6)				
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 7)				
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed none	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 no veg	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: no water in channel

Sketch:



no water in ch.

A form done for channel from pond p.pe to fence line

NC DWQ Stream Identification Form Version 4.11 — Brown's Summit Crk

Date: 9/24/2013	Project/Site: T5	Latitude: 36.231965
Evaluator: D. Honeycutt	County: Guilford	Longitude: -79.751513
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 28.5	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other Lake Brandt *e.g. Quad Name:*

A. Geomorphology (Subtotal = 10.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	(1)	2	3
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	(0)	1	2	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

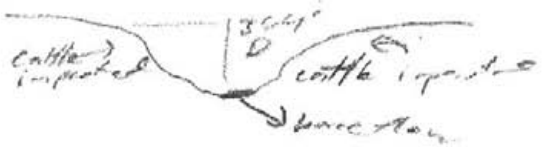
B. Hydrology (Subtotal = 7)				
12. Presence of Baseflow	0	1	(2)	3
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	(0)	0.5	1	1.5
16. Organic debris lines or piles	(0)	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 10.75)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance) (2) diversity low	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 cow manure	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: little to no flow

Sketch:



NC DWQ Stream Identification Form Version 4.11

Brown's Summit Crk

Date: 9/24/2013	Project/Site: T6 upstr	Latitude: 36.232658
Evaluator: D. Hunnycutt	County: Guilford	Longitude: -79.752259
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 17.25	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other Lake Brandt *e.g. Quad Name:*

A. Geomorphology (Subtotal = 5.5)	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 = 4.5)				
12. Presence of Baseflow	(0)	1	2	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	(0)	0.5	1	1.5
16. Organic debris lines or piles	(0)	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 7.25)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed FAC - FACW	(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			

no water or flow

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

Notes: no flow, cows impacts have destroyed many characteristics

Sketch:

NC DWQ Stream Identification Form Version 4.11

Brown's Summit Crk

Date: 9/24/2013	Project/Site: T6 downstr	Latitude: 36.232958
Evaluator: D. Hunegnett	County: Guilford	Longitude: -79.751089
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 19.5	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other Lake Brandt *e.g. Quad Name:*

A. Geomorphology (Subtotal = 11)	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 = 2)				
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	

nor hydric

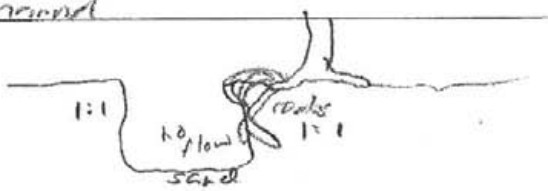
C. Biology (Subtotal = 6.5)				
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians	0	0.5	1	1.5
25. Algae	0	0.5	1	1.5
26. Wetland plants in streambed FAC plants	FACW = 0.75; OBL = 1.5 Other = 0			

no wet

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

Notes: no flow, cattle impacts, concrete channel in channel

Sketch:



No Hydric soils

16.4 FHWA Categorical Exclusion Form

Baker

August 27, 2014

Jeff Schaffer
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Subject: NCEEP stream mitigation project in Guilford County EEP# 96313.

Dear Mr. Schaffer,

Please find enclosed two hard copies of the Categorical Exclusion (CE) for the Browns Summit Creek Restoration Project in Guilford County, North Carolina. The project site is located approximately 3 miles northwest of the community of Browns Summit, within North Carolina Department of Environment and Natural Resources (NCDENR) sub-basin 03-06-01 and the targeted local watershed 03030002-010020 of the Cape Fear River Basin, and the project reaches drain into the Haw River.

The proposed project is a full-delivery effort for the North Carolina Ecosystem Enhancement Program (EEP) in response to RFP#: 16-005568. Project goals include the restoration and enhancement of nearly 6,085 feet of stream for the purpose of obtaining stream mitigation credit in the Cape Fear River Basin. The project mitigation plan is under development, but based on estimates following the site visit with the IRT, it is anticipated to include 3,803 feet of Priority I Restoration, 464 feet of Enhancement I/WQ BMPs, and 1,818 feet of Enhancement 2, plus up to 2.5 wetland mitigation units (WMUs) on 4.63 acres of wetlands.

Based on information from the US Fish and Wildlife Service (USFWS) and the North Carolina Wildlife Resources Commission (NCWRC) the following federally listed species have been found in Guilford County (see Table 1). As shown in the enclosed copies of letters to these agencies, the proposed project has been found to have no effect on any federally listed threatened or endangered species or the bald eagle. In addition, neither of these agencies has replied with concerns about the project; however, the USFWS encouraged the incorporation of conservation measures for the Northern long-eared bat into project plans (see http://www.fws.gov/midwest/endangered/mammals/nlba/pdf/nlebinterimguidance6jan2014.pdf).

Table 1. Federally Protected Species for Guilford County.

Scientific Name	*Common Name*	*Federal Status*
Isotria medeoloides	Small Whorled Pogonia	T
Myotis septentrionalis	Northern long-eared bat	PE
Haliaeetus leucocephalus	Bald Eagle	BGPA

Notes: E – Endangered denotes a species in danger of extinction throughout all or a significant portion of its range.

T – Threatened denotes a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
PE – Proposed endangered denotes that a species has been proposed as Endangered.
BGPA – Bald and Golden Eagle Protection Act

Based on our review and field surveys, we have developed the following conclusions on the potential effects of this project on federally listed species:

Haliaeetus leucocephalus (Bald eagle)
Federal Status: Protected by the Bald and Golden Eagle Protection Act
Animal Family: Accipitridae

Adult bald eagles can be identified by their large white head and short white tail. The body plumage is dark-brown to chocolate-brown in color. In flight, bald eagles can be identified by their flat wing soar. Eagle nests are found in close proximity to water (within 0.5 mile) with a clear flight path to the water, in the largest living tree in an area, and having an open view of the surrounding land.

Human disturbance can cause an eagle to abandon otherwise suitable habitat. The breeding season for the bald eagle begins in December or January. Fish are the major food source for bald eagles. Other sources include coots, herons, and wounded ducks. Food may be live or carrion.

Biological Conclusion: No Effect

Based on a search of the Natural Heritage database (May 6, 2014), no populations of the species are listed within 2 miles of the project study area. A desktop-GIS assessment of the project study area, as well as the area within a 2-mile radius of the project limits, was performed on May 2, 2014 using Google Earth color aerials. Brooks Lake is large enough and sufficiently open to be considered a potential feeding source and is approximately 1 mile east of the project study area. Lake Townsend is larger than Brooks Lake, and its northern edge is approximately 1.5 miles south of the project. Since foraging habitat is located within the review area, a survey of the project study area was conducted. No nests were observed, although large pines were present. Due to the distance to the nearest large body of water and minimal impact anticipated for this project, it has been determined that this project will not affect this species.

Isotria medeoloides **(**Small Whorled Pogonia**)**
Federal Status: Threatened
Animal Family: Orchidaceae
Federally Listed: September 9, 1982

Small-whorled pogonia (*Isotria medeoloides*) is a small, perennial member of the family Orchidaceae. These plants arise from long, slender roots with hollow stems terminating in a whorl of five or six, light green leaves. The single flower is approximately one inch long, with yellowish-green to white petals and three longer green sepals. This orchid blooms in late spring from mid-May to mid-June. Populations of this plant are reported to have extended periods of dormancy and to bloom sporadically. This small, spring, ephemeral

orchid is not observable outside of the spring growing season. When not in flower, young plants of Indian cucumber-root (*Medeola virginiana*) also resemble small whorled pogonia. However, the hollow stout stem of Isotria will separate it from the genus Medeola, which has a solid, more slender stem.

Biological Conclusion: No Effect

Based on a search of the Natural Heritage database (May 6, 2014), no populations of the species are listed within 2 miles of the project study area. A survey of potential habitat for the species was conducted on May 28, 2014 during the blooming window for the species. Neither individuals nor the appropriate habitat were encountered during the survey. The construction of this project is anticipated to have no effect on the species.

Myotis septentrionalis **(**Northern long-eared bat**)**
Federal Status: Proposed Endangered
Animal Family: Vespertilionidae
Federally Listed: TBD

During the summer, *Myotis septentrionalis* roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. The bat species will utilize tree species which can retain bark or have suitable bark (i.e. *Quercus velutina, Quercus rubra, Acer saccharinum, Robinia pseudoacacia, Fagus grandifolia, Acer saccharum, Oxydendron arboretum,* and *Pinus echinata)* or can provide cavities or crevices on the tree. *Myotis septentrionalis* tends to roost on upper and middle slopes (higher elevations) rather than lower slopes possibly due to a preference for greater solar exposure. They may also use abandoned buildings for roosting. In addition, males and reproductive females infrequently utilize caves and mines for roosting in summer months as well. Primary foraging habitat for *Myotis septentrionalis* includes forested hillsides and ridges, mature forests with less foraging occurring along forest clearings, water, and roads.

The bat species overwinters in hibernacula such as caves and abandoned mines that have large passages and entrances. However, individuals utilize small cracks and crevices within these features for roosting. The preferred hibernacula conditions for this species are cool, constant temperatures (32 to 48°F), high humidity, and no air currents.

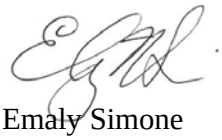
Biological Conclusion: Not Required

The enclosed documentation also covers correspondence with the North Carolina Historic Preservation Office (NC-HPO) and the Natural Resources Conservation Service (NRCS).

This project would be considered a “Ground-Disturbing Activity” and the entire CE “checklist” has been completed. Please note that only one set of figures is included in the submittal; identical figures were sent to: USFWS, NCWRC, NC-HPO, and NRCS. The actions associated with the construction of the referenced project have been determined not to individually or cumulatively have a significant effect on the environment. Submission of this CE document fulfills the environmental documentation requirements mandated under

the National Environmental Policy Act (NEPA; 40 CFR Parts 1500-1508). If you have any questions, please feel free to contact me at 919-481-5721 or via email at emaly.simone@mbakerintl.com.

Sincerely,



Emaly Simone
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Phone: (919) 481-5721
Email: emaly.simone@mbakerintl.com

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:	Brown Summit Creek Restoration Project
County Name:	Guilford
EEP Number:	96313
Project Sponsor:	Michael Baker International
Project Contact Name:	Chris Roessler
Project Contact Address:	8000 Regency Parkway, Suite 600, Cary, NC 27518
Project Contact E-mail:	croessler@mbakerintl.com
EEP Project Manager:	Jeff Scaffer (jeff.schaffer@ncdenr.gov)

Project Description

The Brown Summit Creek Restoration Project will provide stream and wetland mitigation units in the Cape Fear River Basin (Cataloging Unit 03030002). The project is located in Guilford County, approximately three miles northwest of the Community of Browns Summit. The project site is located in the DENR sub-basin 03-06-01 in the Cape Fear River Basin, and project reaches drain into the Haw River.

The project will involve the restoration, enhancement, and protection of nine stream reaches that are part of the Browns Summit Creek drainage area. Restoration will include a combination of Priority I Restoration, Enhancement 1, and Enhancement 2. Each of these stream reaches and the riparian wetlands have been previously impacted by unrestricted cattle access and/or channelization for agricultural drainage associated with hay cultivation, cow pastures, or timber management.

For Official Use Only

Reviewed By:

9/3/14
Date

Jeff Schaffer
EEP Project Manager

Conditional Approved By:

Date

For Division Administrator
FHWA

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

Final Approval By:

9-2-14
Date

For Division Administrator
FHWA

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

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

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

Baker

Gary Jordan
US Fish and Wildlife Service
Raleigh Field Office
P.O. Box 33726
Raleigh, NC 27636

June 19, 2013

Subject: EEP stream and wetland mitigation project in Guilford County

Dear Mr. Jordan,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with a potential wetland and stream restoration project on the attached site (USGS site maps with approximate property lines and areas of potential ground disturbance are enclosed).

The Brown Summit Creek site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and/or wetland impacts. Several sections of channel have been identified as significantly degraded by past channelization and agricultural practices.

We have already obtained an updated species list for Guilford County from your web site (http://www.fws.gov/raleigh/species/cntylist/wake.html). The listed species are shown below.

Scientific Name	Common Name	Federal Status
Haliaeetus leucocephalus	Bald Eagle	BGPA
Isotria medeoloides	Small Whorled Pogonia	Threatened
Myotis septentrionalis	Northern long-eared bat	Proposed Endangered

Based on our review and field surveys, we have developed the following conclusions on the potential effects of this project on federally listed species:

Haliaeetus leucocephalus (Bald eagle)
Federal Status: Protected by the Bald and Golden Eagle Protection Act
Animal Family: Accipitridae

Adult bald eagles can be identified by their large white head and short white tail. The body plumage is dark-brown to chocolate-brown in color. In flight, bald eagles can be identified by their flat wing soar. Eagle nests are found in close proximity to water (within 0.5 mile) with a clear flight path to the water, in the largest living tree in an area, and having an open view of the surrounding land.

Human disturbance can cause an eagle to abandon otherwise suitable habitat. The breeding season for the bald eagle begins in December or January. Fish are the major food source for bald eagles. Other sources include coots, herons, and wounded ducks. Food may be live or carrion.

Biological Conclusion: No Effect

Based on a search of the Natural Heritage database (May 6, 2014), no populations of the species are listed within 2 miles of the project study area. A desktop-GIS assessment of the project study area, as well as the area within a 2-mile radius of the project limits, was performed on May 2, 2014 using Google Earth color aerials. Brooks Lake is large enough and sufficiently open to be considered a potential feeding source and is approximately 1 mile east of the project study area. Lake Townsend is larger than Brooks Lake, and its northern edge is approximately 1.5 miles south of the project. Since foraging habitat is located within the review area, a survey of the project study area was conducted. No nests were observed, although large pines were present. Due to the distance to the nearest large body of water and minimal impact anticipated for this project, it has been determined that this project will not affect this species.

Isotria medeoloides **(**Small Whorled Pogonia**)**
Federal Status: Threatened
Animal Family: Orchidaceae
Federally Listed: September 9, 1982

Small-whorled pogonia (*Isotria medeoloides*) is a small, perennial member of the family Orchidaceae. These plants arise from long, slender roots with hollow stems terminating in a whorl of five or six, light green leaves. The single flower is approximately one inch long, with yellowish-green to white petals and three longer green sepals. This orchid blooms in late spring from mid-May to mid-June. Populations of this plant are reported to have extended periods of dormancy and to bloom sporadically. This small, spring, ephemeral orchid is not observable outside of the spring growing season. When not in flower, young plants of Indian cucumber-root (*Medeola virginiana*) also resemble small whorled pogonia. However, the hollow stout stem of Isotria will separate it from the genus Medeola, which has a solid, more slender stem.

Biological Conclusion: No Effect

Based on a search of the Natural Heritage database (May 6, 2014), no populations of the species are listed within 2 miles of the project study area. A survey of potential habitat for the species was conducted on May 28, 2014 during the blooming window for the species. Neither individuals nor the appropriate habitat were encountered during the survey. The construction of this project is anticipated to have no effect on the species.

Myotis septentrionalis **(**Northern long-eared bat**)**
Federal Status: Proposed Endangered
Animal Family: Vespertilionidae
Federally Listed: TBD

During the summer, *Myotis septentrionalis* roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. The bat species will utilize tree species which can retain bark or have suitable bark (i.e. *Quercus velutina, Quercus rubra, Acer saccharinum, Robinia pseudoacacia, Fagus grandifolia, Acer saccharum, Oxydendron*

arboretum, and *Pinus echinata)* or can provide cavities or crevices on the tree. *Myotis septentrionalis* tends to roost on upper and middle slopes (higher elevations) rather than lower slopes possibly due to a preference for greater solar exposure. They may also use abandoned buildings for roosting. In addition, males and reproductive females infrequently utilize caves and mines for roosting in summer months as well. Primary foraging habitat for *Myotis septentrionalis* includes forested hillsides and ridges, mature forests with less foraging occurring along forest clearings, water, and roads.

The bat species overwinters in hibernacula such as caves and abandoned mines that have large passages and entrances. However, individuals utilize small cracks and crevices within these features for roosting. The preferred hibernacula conditions for this species are cool, constant temperatures (32 to 48°F), high humidity, and no air currents.

Biological Conclusion: Not Required

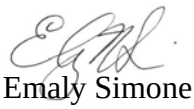
Based on a search of the Natural Heritage database (May 6, 2014), no populations of the species are listed within 2 miles of the project study area. The species is not currently listed as endangered. No impacts to the species are anticipated during project construction.

Please provide comments on any possible issues that might emerge with respect to endangered species, migratory birds or other trust resources from the construction of a wetland and/or stream restoration project on the subject property. A USGS map showing the approximate property lines and areas of potential ground disturbance is enclosed.

If we have not heard from you in 30 days we will assume that our species list and conclusions are correct, that you do not have any comments regarding associated laws, and that you do not have any information relevant to this project at the current time.

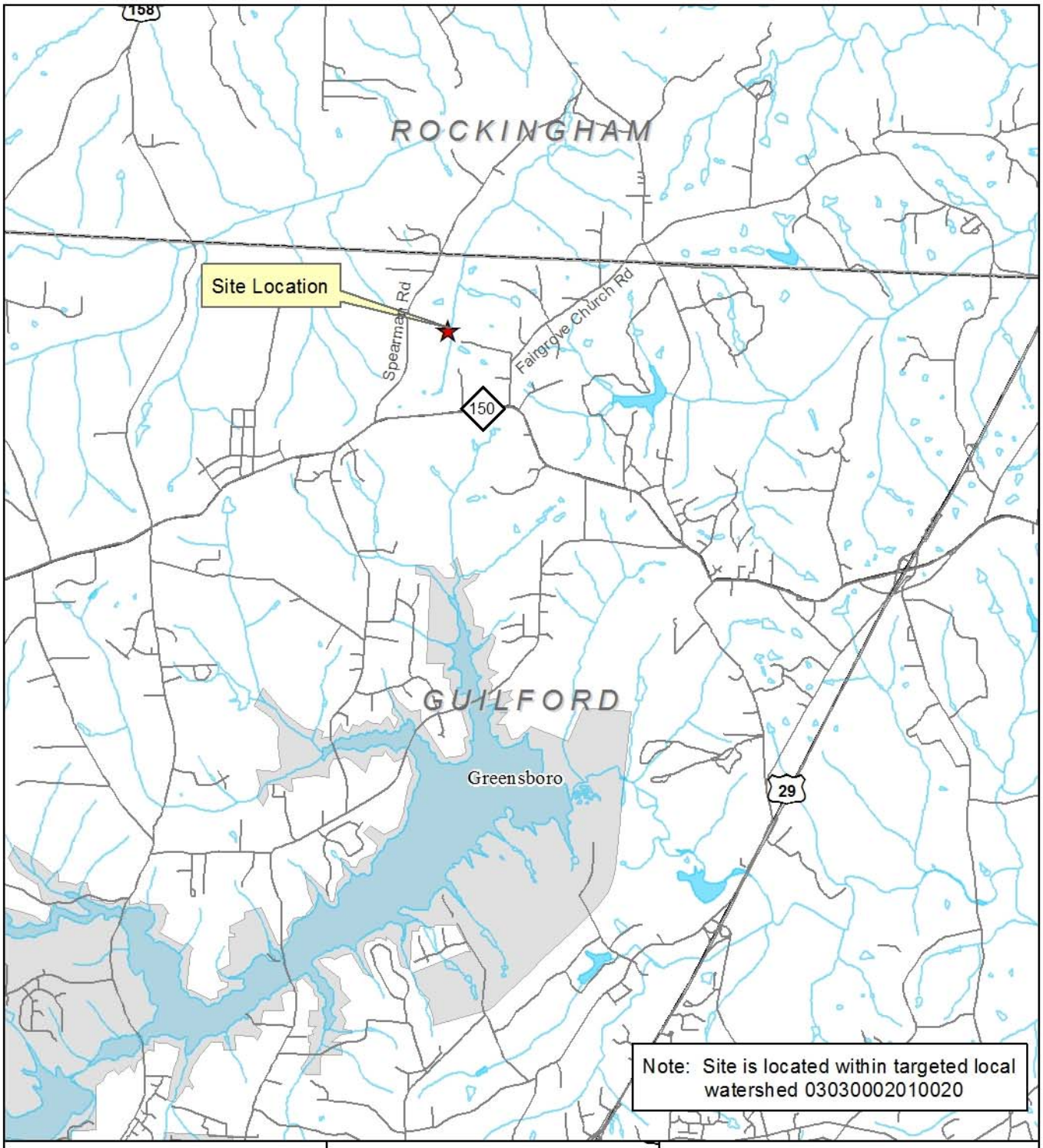
We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,



Emaly Simone
Michael Baker Engineering, Inc.
8000 Regency Parkway, Suite 600
Cary, NC 27518

Phone: (919) 481-5721
Email: emaly.simone@mbakerintl.com



Guilford County

Figure 2.1
Project Vicinity Map
Browns Summit Creek Site

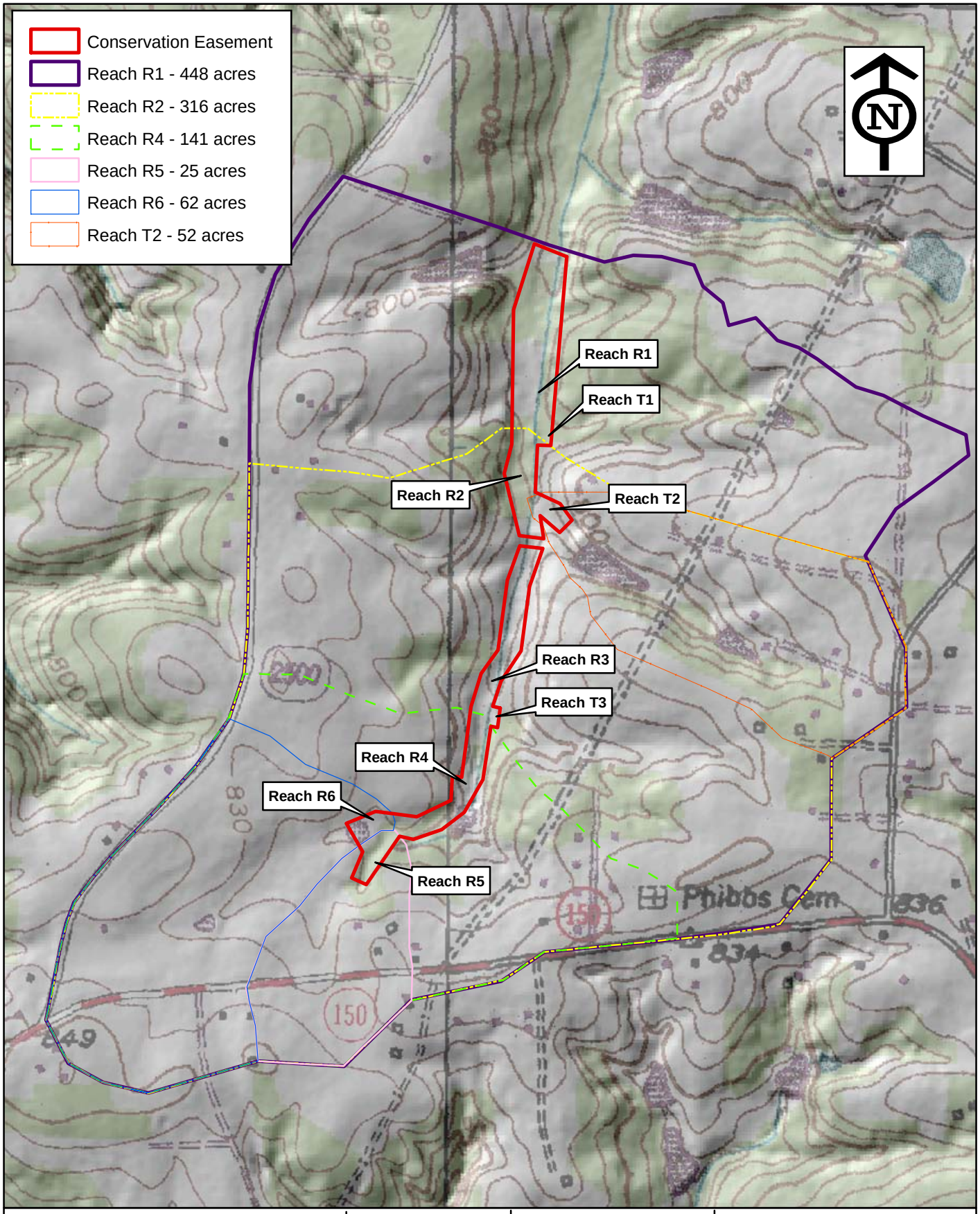
Ecosystem Enhancement Program

N

Baker

Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490

0 0.5 1 2 Miles



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Michael Baker Engineering, Inc.
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Cary, North Carolina 27518
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Fax: 919.463.5490

Ecosystem Enhancement Program

0 250 500 1,000
Feet

Figure 2.2
Watershed Map
Browns Summit Cr. Site

United States Department of the Interior

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

July 15, 2014

Emaly Simone
Michael Baker Engineering, Inc.
8000 Regency Parkway, suite 600
Cary, NC 27518

Subject: Browns Summit Creek Stream and Wetland Mitigation
Guilford County

Dear Ms. Simone:

This letter is in response to your June 19, 2014 request for information concerning federally-listed species at the Browns Summit Creek Stream and Wetland Mitigation Site, located near NC Hwy 150, in Browns Summit, Guilford County, North Carolina. The U.S. Fish and Wildlife Service (Service) has reviewed the maps provided for the proposed project and various sources of information concerning the area. According to the submitted information, the project site is has been identified for the purpose of providing in-kind mitigation for stream and wetland impacts. Currently, the site consists of sparsely wooded lands and agricultural fields.

Federally Protected Species

If your project contains suitable habitat for any of the federally-listed species known to be present within Rockingham County, the proposed action has the potential to adversely affect those species. The Service has reviewed its Geographic Information System (GIS) database for recorded locations of federally listed threatened and endangered species on or adjacent to the proposed project site. The GIS database is a compilation of data received from several sources. The only current Federally-listed species that is known to be present in the county is small whorled pogonia (*Isotria medeoloides*). The northern long-eared bat (*Myotis septentrionalis*), which is proposed to be listed as an endangered species, may also occur in Guilford County. The bald eagle, protected by the Bald and Golden Eagle Protection Act (BGEPA) is also listed in the county. Additional guidance concerning these species may be found on our website at http://www.fws.gov/raleigh/es_tes.html.

The Service agrees with your determination that the project should have no effect on the bald eagle and the smalled whorled pogonia. We also recognize that no determination is required at this time for the northern long-eared bat. However, due to the location of the site and the lack of information concerning the project timing and construction methods, please be aware of potential future requirements associated with the northern long-eared bat.

Northern long-eared bat

On June 24, 2014, the Service extended its decision deadline for the final listing decision on the northern long-eared bat as endangered under the Endangered Species Act (ESA). The Service will make a final determination on the listing of the bat by April 25, 2015.

The northern long-eared bat is a medium-sized bat about 3 to 3.7 inches but with a wingspan of 9 to 10 inches. Its fur color can be medium to dark brown on the back and tawny to pale-brown on the underside. As its name suggests, this bat is distinguished by its long ears, particularly as compared to other bats in its genus, *Myotis*. In the North Carolina mountains, northern long-eared bats spend winter hibernating in caves and mines. They typically use large caves or mines with large passages and entrances; constant temperatures; and high humidity with no air currents. Specific areas where they hibernate have very high humidity, so much so that droplets of water are often seen on their fur. Within hibernacula, surveyors find them in small crevices or cracks, often with only the nose and ears visible. It is currently unclear if northern long-eared bats hibernate or otherwise overwinter in the eastern piedmont and coastal plain of North Carolina.

During spring and summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat seems opportunistic in selecting roosts, using tree species based on suitability to retain bark or provide cavities or crevices. It has also been found, rarely, roosting in structures like barns and sheds. Breeding begins in late summer or early fall when males begin swarming near hibernacula. After copulation, females store sperm during hibernation until spring, when they emerge from their hibernacula, ovulate, and the stored sperm fertilizes an egg. Pregnant females migrate to summer areas where they roost in small colonies and give birth to a single pup. Maternity colonies, with young, generally have 30 to 60 bats, although larger maternity colonies have been observed. Most females within a maternity colony give birth around the same time, which may occur from late May or early June to late July, depending where the colony is located within the species' range. Young bats start flying by 18 to 21 days after birth. Adult northern long-eared bats can live up to 19 years.

Northern long-eared bats emerge at dusk to fly through the understory of forested hillsides and ridges feeding on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in

flight using echolocation. This bat also feeds by gleaning motionless insects from vegetation and water surfaces.

Recommendations

The Service has acoustic evidence of northern long-eared bats in Guilford County, within two miles of the project site. We are currently conducting further analysis on the acoustic data, and we recognize that acoustic data is not as strong evidence as a physical capture of a specimen. However, we encourage you to incorporate bat conservation measures into project planning. For more information, please refer to the Northern Long-Eared Bat Interim Conference and Planning Guidance (particularly Appendix D), found at http://www.fws.gov/midwest/endangered/mammals/nlba/pdf/NLEBinterimGuidance6Jan2014.pdf.

We appreciate the opportunity to comment on this project. If you have any questions concerning these comments, please contact Kathy Matthews at (919) 856-4520, Ext. 27, or by e-mail at <kathryn_matthews@fws.gov>.

Sincerely,

Pete Benjamin
Field Supervisor

Please see additional discussion of the NLEB as it relates to this mitigation project several pages ahead. Additional information and discussion were available in May, 2015.

Baker

Shari L. Bryant
North Carolina Wildlife Resources Commission
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699

June 19, 2014

Subject: EEP stream and wetland mitigation project in Guilford County

Dear Ms. Bryant,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with a potential wetland and stream restoration project on the attached site (USGS site maps with approximate property lines and areas of potential ground disturbance are enclosed).

The Brown Summit Creek site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and/or wetland impacts. Several sections of channel have been identified as significantly degraded by past channelization and agricultural practices.

We have already obtained an updated species list for Guilford County from your web site (http://portal.ncdenr.org/web/nhp/database-search). The listed species are shown below.

Scientific Name	Common Name	Federal Status
Haliaeetus leucocephalus	Bald Eagle	BGPA
Isotria medeoloides	Small Whorled Pogonia	Threatened
Myotis septentrionalis	Northern long-eared bat	Proposed Endangered

Based on our review and field surveys, we have developed the following conclusions on the potential effects of this project on federally listed species:

Haliaeetus leucocephalus (Bald eagle)
Federal Status: Protected by the Bald and Golden Eagle Protection Act
Animal Family: Accipitridae

Adult bald eagles can be identified by their large white head and short white tail. The body plumage is dark-brown to chocolate-brown in color. In flight, bald eagles can be identified by their flat wing soar. Eagle nests are found in close proximity to water (within 0.5 mile) with a clear flight path to the water, in the largest living tree in an area, and having an open view of the surrounding land.

Human disturbance can cause an eagle to abandon otherwise suitable habitat. The breeding season for the bald eagle begins in December or January. Fish are the major food source for bald eagles. Other sources include coots, herons, and wounded ducks. Food may be live or carrion.

Biological Conclusion: No Effect

Based on a search of the Natural Heritage database (May 6, 2014), no populations of the species are listed within 2 miles of the project study area. A desktop-GIS assessment of the project study area, as well as the area within a 2-mile radius of the project limits, was performed on May 2, 2014 using Google Earth color aerials. Brooks Lake is large enough and sufficiently open to be considered a potential feeding source and is approximately 1 mile east of the project study area. Lake Townsend is larger than Brooks Lake and is location approximately 1.5 miles south of the project. Since foraging habitat is located within the review area, a survey of the project study area was conducted. No nests were observed, although large pines were present. Due to the distance to the nearest large body of water and minimal impact anticipated for this project, it has been determined that this project will not affect this species.

Isotria medeoloides **(**Small Whorled Pogonia**)**
Federal Status: Threatened
Animal Family: Orchidaceae
Federally Listed: September 9, 1982

Small-whorled pogonia (*Isotria medeoloides*) is a small, perennial member of the family Orchidaceae. These plants arise from long, slender roots with hollow stems terminating in a whorl of five or six, light green leaves. The single flower is approximately one inch long, with yellowish-green to white petals and three longer green sepals. This orchid blooms in late spring from mid-May to mid-June. Populations of this plant are reported to have extended periods of dormancy and to bloom sporadically. This small, spring, ephemeral orchid is not observable outside of the spring growing season. When not in flower, young plants of Indian cucumber-root (*Medeola virginiana*) also resemble small whorled pogonia. However, the hollow stout stem of Isotria will separate it from the genus Medeola, which has a solid, more slender stem.

Biological Conclusion: No Effect

Based on a search of the Natural Heritage database (May 6, 2014), no populations of the species are listed within 2 miles of the project study area. A survey of potential habitat for the species was conducted on May 28, 2014 during the blooming window for the species. Neither individuals nor the appropriate habitat were encountered during the survey. The construction of this project is anticipated to have no effect on the species.

Myotis septentrionalis **(**Northern long-eared bat**)**
Federal Status: Proposed Endangered
Animal Family: Vespertilionidae
Federally Listed: TBD

During the summer, *Myotis septentrionalis* roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. The bat species will utilize tree species which can retain bark or have suitable bark (i.e. *Quercus velutina, Quercus rubra, Acer saccharinum, Robinia pseudoacacia, Fagus grandifolia, Acer saccharum, Oxydendron arboretum,* and *Pinus echinata)* or can provide cavities or crevices on the tree. *Myotis septentrionalis* tends to roost on upper and middle slopes (higher elevations) rather than lower slopes possibly due to a preference for greater solar exposure. They may also use

abandoned buildings for roosting. In addition, males and reproductive females infrequently utilize caves and mines for roosting in summer months as well.

Primary foraging habitat for *Myotis septentrionalis* includes forested hillsides and ridges, mature forests with less foraging occurring along forest clearings, water, and roads.

The bat species overwinters in hibernacula such as caves and abandoned mines that have large passages and entrances. However, individuals utilize small cracks and crevices within these features for roosting. The preferred hibernacula conditions for this species are cool, constant temperatures (32 to 48°F), high humidity, and no air currents.

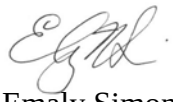
Biological Conclusion: Not Required

Based on a search of the Natural Heritage database (May 6, 2014), no populations of the species are listed within 2 miles of the project study area. The species is not currently listed as endangered. No impacts to the species are anticipated during project construction.

If we have not heard from you in 30 days we will assume that our species list is correct and that NCWRC does not have any information relevant to this project at the current time.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,



Emaly Simone
Michael Baker Engineering, Inc.
8000 Regency Parkway, Suite 600
Cary, NC 27518

Phone: (919) 481-5721
Email: emaly.simone@mbakerintl.com

Please see additional discussion of the NLEB as it relates to this mitigation project on the following page. Additional information and discussion were available in May, 2015.

Roessler, Chris

From: King, Scott
Sent: Wednesday, April 29, 2015 9:26 AM
To: Roessler, Chris
Subject: FW: Browns Summit restoration site and the Northern Long-Eared Bat

Chris,
Browns Summit is clear for Northern Long-Eared Bat issues. All we stated was that we would hold off on any burning until after the summer months.
Thanks,
Scott

Scott King, LSS, PWS | Environmental Specialist | Ecosystem Restoration Group | Michael Baker International
8000 Regency Parkway – Suite 600, Cary, NC 27518 | [Office] 919-481-5731 | [Fax] 919-463-5490
scott.king@mbakerintl.com | www.mbakerintl.com

From: Bryant, Shari L. [mailto:shari.bryant@ncwildlife.org]
Sent: Wednesday, April 29, 2015 9:22 AM
To: King, Scott
Cc: Darling, Richard; Gilland, Ken; Simone, Emaly
Subject: RE: Browns Summit restoration site and the Northern Long-Eared Bat

Mr. King,

We are deferring to the USFWS regarding potential impacts and recommendations related to the Northern long-eared bat.

Shari Bryant
N.C. Wildlife Resources Commission
P.O. Box 129
Sedalia, NC 27342-0129
336.449.7625
shari.bryant@ncwildlife.org

From: King, Scott [mailto:Scott.King@mbakerintl.com]
Sent: Tuesday, April 28, 2015 4:16 PM
To: Bryant, Shari L.
Cc: Darling, Richard; Gilland, Ken; Simone, Emaly
Subject: RE: Browns Summit restoration site and the Northern Long-Eared Bat

Good afternoon Ms. Bryant,

Baker Engineering is nearing construction on a stream and wetland restoration project in Guilford County (the Browns Summit site), for which we had previously coordinated with you as part of our Categorical Exclusion effort (see attached letter). It has come to our attention that the northern long-eared bat (*Myotis septentrionalis*) will be listed as a Threatened species effective this May and we have been asked by the Division of Mitigation Services or DMS (previously the Ecosystem Enhancement Program or EEP) to contact both the FWS and NCWRC to obtain a simple email agreement to our No Effect determination to include with our Categorical Exclusion for the project. This morning Ms. Kathryn Matthews of the FWS emailed us back with her agreement (see her response below), and now we would request your review as well. As such, please consider the following:

Myotis septentrionalis (Northern long-eared bat or NLEB)
Federal Status: Threatened
Animal Family: Vespertilionidae
Federally Listed: May 4, 2015

During the summer, Myotis septentrionalis roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. The bat species will utilize tree species which can retain bark or have suitable bark (i.e. Quercus velutina, Quercus rubra, Acer saccharinum, Robinia pseudoacacia, Fagus grandifolia, Acer saccharum, Oxydendron arboretum, and Pinus echinata) or can provide cavities or crevices on the tree. Myotis septentrionalis tends to roost on upper and middle slopes (higher elevations) rather than lower slopes possibly due to a preference for greater solar exposure. They may also use abandoned buildings for roosting. In addition, males and reproductive females infrequently utilize caves and mines for roosting in summer months as well. Primary foraging habitat for Myotis septentrionalis includes forested hillsides and ridges, mature forests with less foraging occurring along forest clearings, water, and roads.

The bat species overwinters in hibernacula such as caves and abandoned mines that have large passages and entrances. However, individuals utilize small cracks and crevices within these features for roosting. The preferred hibernacula conditions for this species are cool, constant temperatures (32 to 48°F), high humidity, and no air currents.

Biological Conclusion: No Effect

Based on a search of the Natural Heritage database (May 6, 2014), no populations of the species are listed within two miles of the project study area, though Baker was informed in a July 15, 2014 USFWS letter that the Service has acoustic evidence of NLEB in Guilford County within two miles of the project site. Yet no impacts to the species are anticipated during project construction due to the following:
-The project design has minimized tree clearing, with all larger trees having been surveyed to avoid impacts wherever possible. There is only one small area behind the house on Broad Ridge Ct. where any significant clearing is planned, and that consists of mostly smaller successional trees. The conservation easement being placed around the project currently contains a significant amount of open land, which will be replanted with native species, ultimately increasing the forested acreage along the creek.
-No stands of any of the identified preferred tree species listed above are located on the project site, and no individual specimens have been noted in any of the previous vegetation surveys (though some number of individual specimens may nevertheless be present on site undetected). Furthermore, no tree species with the preferred exfoliating or shaggy bark such as white oak (Quercus alba), swamp chestnut oak (Quercus michauxii), or shagbark hickory (Carya ovata) were identified on site either.
-There are no abandoned buildings or man-made structures located on the project site that might be attractive to bats as summer roosting habitat.
-To further help avoid impacts to any potentially roosting bats in the project area during construction, no burning will be allowed during the summer months to avoid disturbance or death through smoke inhalation or scorching (as per the USFWS Northern Long-Eared Bat Interim Conference and Planning Guidance – January 6, 2014, page 5).

Please do not hesitate to contact me if you have any questions or comments about this issue.
Thank you very much for your time,

Scott

Scott King, LSS, PWS | Environmental Specialist | Ecosystem Restoration Group | Michael Baker International
8000 Regency Parkway – Suite 600, Cary, NC 27518 | [Office] 919-481-5731 | [Fax] 919-463-5490
scott.king@mbakerintl.com | www.mbakerintl.com

From: Matthews, Kathryn [mailto:kathryn_matthews@fws.gov]
Sent: Tuesday, April 28, 2015 8:41 AM
To: King, Scott
Cc: Darling, Richard; Gilland, Ken
Subject: Re: Browns Summit restoration site and the Northern Long-Eared Bat

We concur.

Thanks,
Kathy

On Fri, Apr 24, 2015 at 3:11 PM, King, Scott <Scott.King@mbakerintl.com> wrote:

Good afternoon Kathy,

As we discussed in our conversation earlier today, Baker is nearing construction of a stream and wetland restoration project for the NC Division of Mitigation Services or DMS (previously the Ecosystem Enhancement Program or EEP) located in northern Guilford County (see attached maps). Recently, it has come to our attention that the northern long-eared bat (*Myotis septentrionalis*) will be listed as a threatened species effective this May. The DMS has requested that we contact the F&WS to obtain a simple email agreement to our No Effect determination to include with our Categorical Exclusion for the project. As such, please consider the following:

Myotis septentrionalis **(**Northern long-eared bat or NLEB**)**

Federal Status: Threatened

Animal Family: Vespertilionidae

Federally Listed: May 4, 2015

During the summer, *Myotis septentrionalis* roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. The bat species will utilize tree species which can retain bark or have suitable bark (i.e. *Quercus velutina*, *Quercus rubra*, *Acer saccharinum*, *Robinia pseudoacacia*, *Fagus grandifolia*, *Acer saccharum*, *Oxydendron arboretum*, and *Pinus echinata)* or can provide cavities or crevices

on the tree. *Myotis septentrionalis* tends to roost on upper and middle slopes (higher elevations) rather than lower slopes possibly due to a preference for greater solar exposure. They may also use abandoned buildings for roosting. In addition, males and reproductive females infrequently utilize caves and mines for roosting in summer months as well. Primary foraging habitat for *Myotis septentrionalis* includes forested hillsides and ridges, mature forests with less foraging occurring along forest clearings, water, and roads.

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No stands of any of the identified preferred tree species listed above are located on the project site, and no individual specimens have been noted in any of the previous vegetation surveys (though some number of individual specimens may nevertheless be present on site undetected). Furthermore, no tree species with the preferred exfoliating or shaggy bark such as white oak (Quercus alba), swamp chestnut oak (Quercus michauxii), or shagbark hickory (Carya ovata) were identified on site either.

There are no abandoned buildings or man-made structures located on the project site that might be attractive to bats as summer roosting habitat.

To further help avoid impacts to any potentially roosting bats in the project area during construction, no burning will be allowed during the summer months to avoid disturbance or death through smoke inhalation or scorching (as per the USFWS Northern Long-Eared Bat Interim Conference and Planning Guidance – January 6, 2014, page 5).

Please do not hesitate to contact me if you have any questions or comments about this issue.

Thank you very much for your time,

Scott

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8000 Regency Parkway – Suite 600, Cary, NC 27518 | [Office] 919-481-5731 | [Fax] 919-463-5490
scott.king@mbakerintl.com | www.mbakerintl.com

We Make a Difference

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Kathy Matthews
Fish and Wildlife Biologist
Raleigh Ecological Services
U.S. Fish and Wildlife Service
P.O. Box 33726
Raleigh, NC 27636-3726
Phone 919-856-4520 x27
Email kathryn_matthews@fws.gov

FWS.GOV/RALEIGH | Facebook | YouTube | Flickr |

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

1 July 2014

Emaly Simone
Michael Baker Engineering, Inc.
8000 Regency Parkway, Suite 600
Cary, North Carolina 27518

Subject: EEP Stream and Wetland Mitigation Project, Guilford County

Dear Ms. Simone:

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

The proposed project would provide in-kind mitigation for unavoidable stream and/or wetland impacts. Several sections of stream channel have been identified as significantly degraded due to past channelization and agricultural practices. The project site includes an unnamed tributary to Haw River in the Cape Fear River basin. There are records for the state special concern four-toed salamander (*Hemidactylium scutatum*) and mole salamander (*Ambystoma talpoideum*), and the state significantly rare Carolina ladle crayfish (*Cambarus davidi*) near the project site. The Significant Natural Heritage Area – Troublesome Creek/Benaja Creek Wetlands and Slopes – is located downstream of the project area.

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

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

Sincerely,

Shari L. Bryant

Shari L. Bryant
Piedmont Region Coordinator
Habitat Conservation Program

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

Baker

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

May 21, 2014

Subject: EEP stream mitigation project in Guilford County.

Dear Ms. Gledhill-Earley,

The Ecosystem Enhancement Program (EEP) requests review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential stream restoration project on the attached site (USGS site maps with approximate property lines, areas of potential ground disturbance are enclosed).

The Brown Summit Creek site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and/or wetland impacts. Several sections of channel have been identified as significantly degraded by past channelization and agricultural practices.

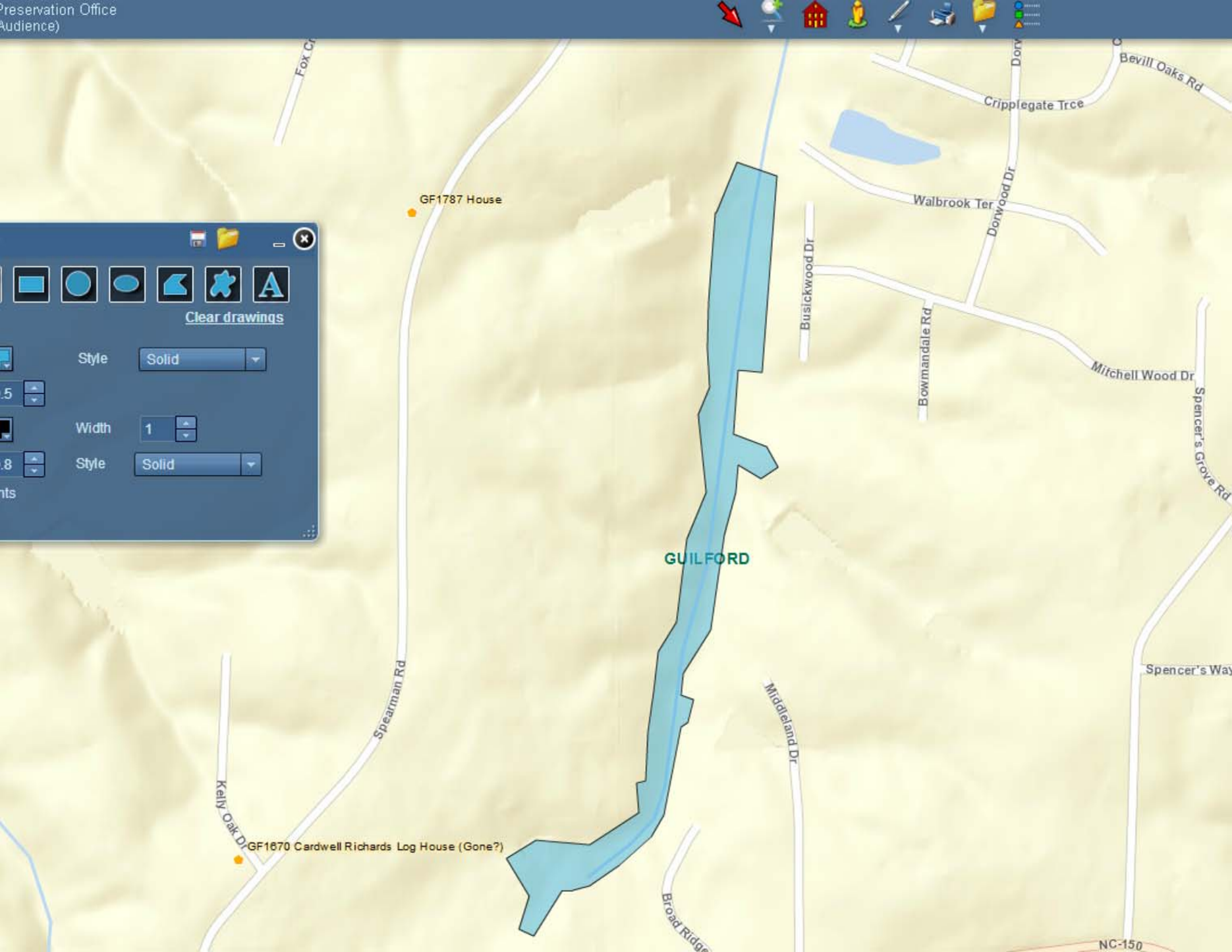
No architectural structures or archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. As shown in the enclosed maps generated through HPOWEB, the nearest NRHP-listed site to the project area is the Parker-Troxler House (1976) (GF1594), which is approximately 1.6 miles to the southeast of the project midpoint. We ask that you review this site based on the attached information to determine the presence of any historic properties.

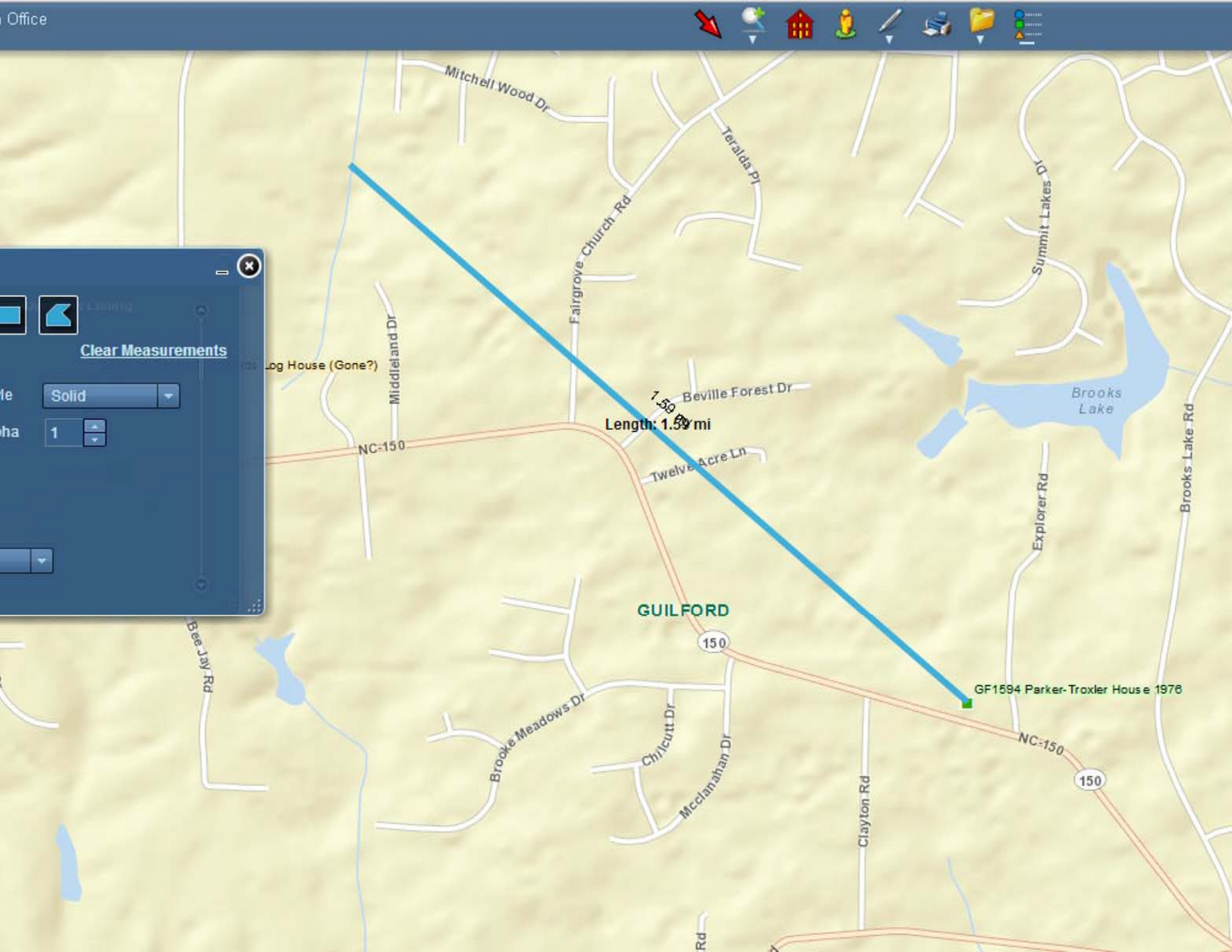
We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Emaly N. Simone
Michael Baker Engineering, Inc.
8000 Regency Parkway, Suite 600
Cary, NC 27518

Phone: (919) 481-5721
Email: emaly.simone@mbakerintl.com


Preservation Office
Audience)
Clear drawings
Style
Solid
Width
1
Style
Solid
GF1787 House
GUILFORD
GF1670 Cardwell Richards Log House (Gone?)
Fox Cr
Bevill Oaks Rd
Cripplegate Trce
Walbrook Ter
Dorwood Dr
Busickwood Dr
Bowmandale Rd
Mitchell Wood Dr
Spencer's Grove Rd
Spencer's Way
Spearman Rd
Kelly Oak Dr
Middleland Dr
Broad Ridge
NC-150


Office
Clear Measurements
Solid
1
Mitchell Wood Dr
Teralda Pl
Fairgrove Church Rd
Summit Lakes Dr
Middleland Dr
Log House (Gone?)
Beville Forest Dr
Length: 1.59 mi
NC-150
Twelve Acre Ln
Brooks Lake
Explorer Rd
Brooks Lake Rd
GUILFORD
150
Bee Jay Rd
Brooke Meadows Dr
Chilcutt Dr
Mcclanahan Dr
Clayton Rd
GF1594 Parker-Troxler House 1976
NC-150
150

North Carolina Department of Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Pat McCrory
Secretary Susan Kluttz

Office of Archives and History
Deputy Secretary Kevin Cherry

May 29, 2014

Emaly Simone
Michael Baker Engineering, Inc.
8000 Regency Parkway, Suite 600
Cary, NC 27518

Re: Brown Summit Creek Stream Mitigation, Guilford County, ER 14-1080

Dear Ms. Simone:

Thank you for your letter of May 21, 2014, concerning the above project.

We have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or renee.gledhill-earley@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

Baker

Ms. Kristin May
Resource Soil Scientist
530 West Innes Street
Salisbury, NC 28144

May 21, 2014

Subject: Prime and Important Farmland Soils RE: NCEEP Project, Brown Summit Creek Stream Restoration Site, Guilford, NC

Dear Ms. May:

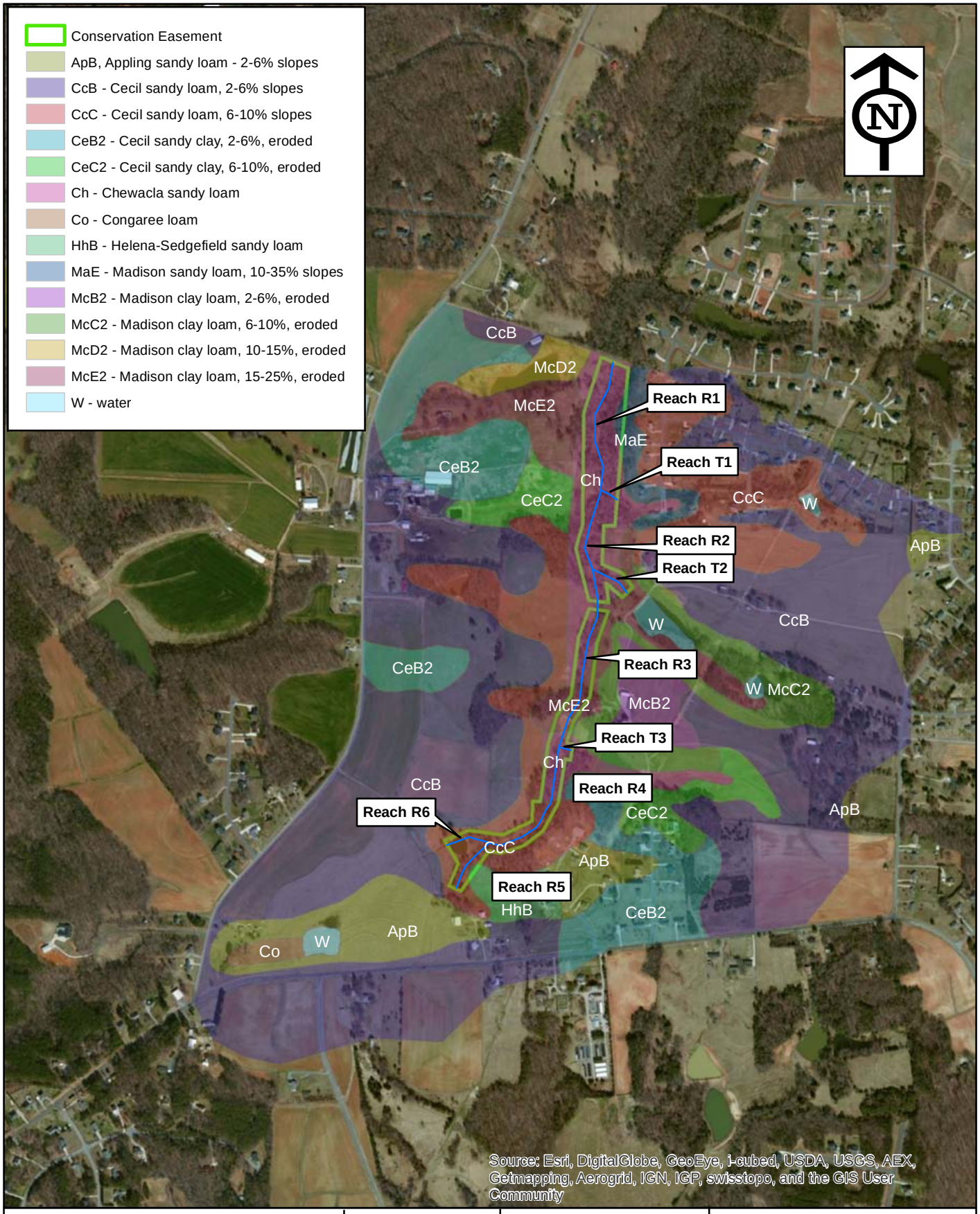
Enclosed please find a draft copy of the Farmland Conversion Impact Rating form (AD-1006) and associated mapping for the subject site. The site is located in Guilford County between Spearman Road and Fairgrove Church Road, northwest of the Community of Browns Summit, as shown in Figures 2.1 and 2.2. This stream restoration site proposes to restore Brown Summit Creek, which is an unnamed tributary to the Haw River. Figure 2.3 is a map of the soils encountered at the project site. Additional information about these soils is provided in the table below.

Soil Code	Soil Description	Acres	Soil Designation
CcC	Cecil sandy loam, 6-10% slopes	3.8	Farmland of statewide importance
Ch	Chewacla sandy loam	13.0	Prime
HhB	Helena-Sedgefield sandy loam	0.1	Prime
MaE	Madison sandy loam, 10-35% slopes	0.4	
McE2	Madison clay loam, 15-25% slopes, eroded	2.0	
Total Acreage		19.3	
Total Prime Farmland Acreage		13.1	Prime
Total Acreage of Farmland of Statewide Importance		3.8	Farmland of statewide importance

We appreciate your assistance with the project. I would be glad to provide a hard copy of the final information if it would be better for you. If you have any questions, please feel free to contact me at emaly.simone@mbakerintl.com or by phone at (919) 481-5721. Thank you again for your assistance in this matter.

Sincerely,

Emaly N. Simone
Baker Engineering, NY, Inc.
8000 Regency Parkway, Suite 600
Cary, NC 27518



Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490

Ecosystem Enhancement Program

0 500 1,000
Feet

Figure 2.3
Soils Map
Browns Summit Cr. Site

USDA
United States Department of Agriculture
Natural Resources Conservation Service
4407 Bland Road, Suite 117
Raleigh, North Carolina 27609

Milton Cortés, Assistant State Soil Scientist
Telephone No.: (919) 873-2171
Fax No.: (919) 873-2157
E-mail: milton.cortes@nc.usda.gov

August 20, 2014

Emaly N. Simone
Baker Engineering, NY, Inc.
8000 Regency Parkway, Suite 600
Cary, NC 27518

Ms. Simone;

The following information is in response to your review request in the Prime and Important Farmland Soils RE: NCEEP Project, Brown Summit Creek Stream Restoration Site, and Guilford, NC

Projects are subject to Farmland Protection Policy Act (FPPA) requirements if they may irreversibly convert farmland (directly or indirectly) to nonagricultural use and are completed by a Federal agency or with assistance from a Federal agency.

For the purpose of FPPA, farmland includes prime farmland, unique farmland, and land of statewide or local importance. Farmland subject to FPPA requirements does not have to be currently used for cropland. It can be forest land, pastureland, cropland, or other land, but not water or urban built-up land.

Farmland means prime or unique farmlands as defined in section 1540(c)(1) of the Act or farmland that is determined by the appropriate state or unit of local government agency or agencies with concurrence of the Secretary to be farmland of statewide of local importance.

“Farmland" does not include land already in or committed to urban development or water storage. Farmland ``already in" urban development or water storage includes all such land with a density of 30 structures per 40-acre area. Farmland already in urban development also includes lands identified as ``urbanized area" (UA) on the Census Bureau Map, or as urban area mapped with a ``tint overprint" on the USGS topographical maps, or as ``urban-built-up" on the USDA Important Farmland Maps. See over for more information.

The area in question meets one or more of the above criteria for Farmland. Farmland area will be affected or converted. Enclosed is the Farmland Conversion Impact Rating form AD1006 with PARTS II, IV and V completed by NRCS. The corresponding agency will need to complete the evaluation, according to the Code of Federal Regulation 7CFR 658, Farmland Protection Policy Act.

If you have any questions, please contact me at number above.

Sincerely,

Milton Cortés
Assistant State Soil Scientist

cc. Tim Beard. State Conservationist, USDA NRCS, NC
Kent Clary, State Soil Scientist, USDA NRCS, NC

Projects and Activities Subject to FPPA

Projects are subject to FPPA requirements if they may irreversibly convert farmland (directly or indirectly) to nonagricultural use and are completed by a Federal agency or with assistance from a Federal agency.

Assistance from a Federal agency includes:

- Acquiring or disposing of land.
- Providing financing or loans.
- Managing property.
- Providing technical assistance

Activities that may be subject to FPPA include:

- State highway construction projects, (through the Federal Highway Administration)
- Airport expansions
- Electric cooperative construction projects
- Railroad construction projects
- Telephone company construction projects
- Reservoir and hydroelectric projects
- Federal agency projects that convert farmland
- Other projects completed with Federal assistance.

Activities not subject to FPPA include:

- Federal permitting and licensing
- Projects planned and completed without the assistance of a Federal agency
- Projects on land already in urban development or used for water storage
- Construction within an existing right-of-way purchased on or before August 4, 1984
- Construction for national defense purposes
- Construction of on-farm structures needed for farm operations
- Surface mining, where restoration to agricultural use is planned
- Construction of new minor secondary structures such as a garage or storage shed.

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 5/21/14
Name Of Project Brown Summit Creek Restoration Project	Federal Agency Involved FHWA
Proposed Land Use Stream Restoration	County And State Guilford, NC
PART II *(To be completed by NRCS)*	Date Request Received By NRCS

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).* Yes ☑ No ☐		Acres Irrigated none	Average Farm Size 100 acres
Major Crop(s) CORN	Farmable Land In Govt. Jurisdiction Acres: 331,434 acres % 79	Amount Of Farmland As Defined in FPPA Acres: 331.434 acres % 79	
Name Of Land Evaluation System Used Guilford Co., NC LESA	Name Of Local Site Assessment System none	Date Land Evaluation Returned By NRCS 08/20/2014	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	19.3			
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	19.3	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	13.1			
B. Total Acres Statewide And Local Important Farmland	3.8			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.0051			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	48.5			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	76	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use		14			
2. Perimeter In Nonurban Use		10			
3. Percent Of Site Being Farmed		15			
4. Protection Provided By State And Local Government		20			
5. Distance From Urban Builtup Area		10			
6. Distance To Urban Support Services		0			
7. Size Of Present Farm Unit Compared To Average		5			
8. Creation Of Nonfarmable Farmland					
9. Availability Of Farm Support Services					
10. On-Farm Investments					
11. Effects Of Conversion On Farm Support Services					
12. Compatibility With Existing Agricultural Use					
TOTAL SITE ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	76	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	74	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	150	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Clear Form

Form AD-1006 (10-83)

The Reidsville Review

1921 VANCE STREET P.O. BOX 2157 REIDSVILLE, NC 27320 336-349-4331

ice Of An Opportunity For An Informational Public On The Use Of Property For The Restoration Of Streams

Guilford County

ker Engineering, Inc., proposes to acquire a preservation easement on a ct of land in Guilford County, NC, northwest of the Browns Summit com- e purpose of using this property is to provide mitigation for unavoidable reams that will result from existing or future development in this area. The restore Brown Summit Creek, an unnamed tributary to the Haw River.

ring that an informational public meeting be held for this proposed action uch a request by registered letter to Michael Baker Engineering, Inc., at cy Parkway, Suite 600 Cary, NC 27518. Requests must be made by August additional information is required, please contact Emaly Simone at 919-

em Enhancement Program reserves the right to determine if a public meet- ıeld.

AFFIDAVIT OF PUBLICATION

NORTH CAROLINA

ROCKINGHAM COUNTY

Before the undersigned, a Notary Public of Said County and State, duly commissioned, qualified, and authorized by law to administer oaths, personally appeared Pam Durham, who being first duly sworn, deposes and says. That she is an official of Media General of Reidsville, Inc. engaged in the publication of a newspaper known as The Reidsville Review, published, issued and entered as second class mail in the City of Reidsville, in said County and State; that she is authorized to make this affidavit and sworn statement, that the notice or other legal advertisement, a true copy of which is attached hereto, was published in The Reidsville Review on the following dates:

July 20, 23, 2014

and that the said newspaper in which such notice, paper document, or legal advertisement was published was, at the time of each and every such publication, a newspaper meeting all of the requirements and qualifications of Section I-597 of the General Statutes of North Carolina and was qualified newspaper within the meaning of Section I-597 of the General Statutes of North Carolina.

This 5th day of August 2014

Pam Thompson

Sworn to and subscribed before me, this 5th day of August, 2014

Sarah D Gentry Notary Public

My commission expires the 31 day of Jan. 2017

SARAH D. GENTRY
Notary Public
Commonwealth of Virginia
Reg. #320673
My Commission Expires 1-31-17

Brown Summit Creek
8401 Middleland Drive
Browns Summit, NC 27214

Inquiry Number: 3935116.2s
May 06, 2014

The EDR Radius Map™ Report

EDR® Environmental Data Resources Inc

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-13) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

8401 MIDDLELAND DRIVE
BROWNS SUMMIT, NC 27214

COORDINATES

Latitude (North):	36.2371000 - 36° 14' 13.56''
Longitude (West):	79.7485000 - 79° 44' 54.60''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	612461.5
UTM Y (Meters):	4010771.8
Elevation:	792 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	36079-B6 BROWNS SUMMIT, NC
Most Recent Revision:	1994
North Map:	36079-C6 REIDSVILLE, NC
Most Recent Revision:	1994
West Map:	36079-B7 LAKE BRANDT, NC
Most Recent Revision:	1994
Northwest Map:	36079-C7 BETHANY, NC
Most Recent Revision:	1997

AERIAL PHOTOGRAPHY IN THIS REPORT

Photo Year:	2012
Source:	USDA

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

EXECUTIVE SUMMARY

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL ---------- National Priority List
Proposed NPL ---------- Proposed National Priority List Sites
NPL LIENS ---------- Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ---------- National Priority List Deletions

Federal CERCLIS list

CERCLIS ---------- Comprehensive Environmental Response, Compensation, and Liability Information System
FEDERAL FACILITY ---------- Federal Facility Site Information listing

Federal CERCLIS NFRAP site List

CERC-NFRAP ---------- CERCLIS No Further Remedial Action Planned

Federal RCRA CORRACTS facilities list

CORRACTS ---------- Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF ---------- RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG ---------- RCRA - Large Quantity Generators
RCRA-SQG ---------- RCRA - Small Quantity Generators
RCRA-CESQG ---------- RCRA - Conditionally Exempt Small Quantity Generator

Federal institutional controls / engineering controls registries

US ENG CONTROLS ---------- Engineering Controls Sites List
US INST CONTROL ---------- Sites with Institutional Controls
LUCIS ---------- Land Use Control Information System

Federal ERNS list

ERNS ---------- Emergency Response Notification System

State- and tribal - equivalent NPL

NC HSDS ---------- Hazardous Substance Disposal Site

EXECUTIVE SUMMARY

State- and tribal - equivalent CERCLIS

SHWS ---------- Inactive Hazardous Sites Inventory

State and tribal landfill and/or solid waste disposal site lists

SWF/LF ---------- List of Solid Waste Facilities
OLI ---------- Old Landfill Inventory

State and tribal leaking storage tank lists

LUST ---------- Regional UST Database
LUST TRUST ---------- State Trust Fund Database
LAST ---------- Leaking Aboveground Storage Tanks
INDIAN LUST ---------- Leaking Underground Storage Tanks on Indian Land

State and tribal registered storage tank lists

UST ---------- Petroleum Underground Storage Tank Database
AST ---------- AST Database
INDIAN UST ---------- Underground Storage Tanks on Indian Land
FEMA UST ---------- Underground Storage Tank Listing

State and tribal institutional control / engineering control registries

INST CONTROL ---------- No Further Action Sites With Land Use Restrictions Monitoring

State and tribal voluntary cleanup sites

VCP ---------- Responsible Party Voluntary Action Sites
INDIAN VCP ---------- Voluntary Cleanup Priority Listing

State and tribal Brownfields sites

BROWNFIELDS ---------- Brownfields Projects Inventory

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS ---------- A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

DEBRIS REGION 9 ---------- Torres Martinez Reservation Illegal Dump Site Locations
ODI ---------- Open Dump Inventory
SWRCY ---------- Recycling Center Listing
HIST LF ---------- Solid Waste Facility Listing
INDIAN ODI ---------- Report on the Status of Open Dumps on Indian Lands

Local Lists of Hazardous waste / Contaminated Sites

US CDL ---------- Clandestine Drug Labs

US HIST CDL ..... National Clandestine Laboratory Register

Local Land Records

LIENS 2 ..... CERCLA Lien Information

Records of Emergency Release Reports

HMIRS ..... Hazardous Materials Information Reporting System
IMD ..... Incident Management Database
SPILLS 80 ..... SPILLS 80 data from FirstSearch
SPILLS 90 ..... SPILLS 90 data from FirstSearch

Other Ascertainable Records

RCRA NonGen / NLR ..... RCRA - Non Generators
DOT OPS ..... Incident and Accident Data
DOD ..... Department of Defense Sites
FUDS ..... Formerly Used Defense Sites
CONSENT ..... Superfund (CERCLA) Consent Decrees
ROD ..... Records Of Decision
UMTRA ..... Uranium Mill Tailings Sites
US MINES ..... Mines Master Index File
TRIS ..... Toxic Chemical Release Inventory System
TSCA ..... Toxic Substances Control Act
FTTS ..... FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
HIST FTTS ..... FIFRA/TSCA Tracking System Administrative Case Listing
SSTS ..... Section 7 Tracking Systems
ICIS ..... Integrated Compliance Information System
PADS ..... PCB Activity Database System
MLTS ..... Material Licensing Tracking System
RADINFO ..... Radiation Information Database
FINDS ..... Facility Index System/Facility Registry System
RAATS ..... RCRA Administrative Action Tracking System
RMP ..... Risk Management Plans
UIC ..... Underground Injection Wells Listing
DRYCLEANERS ..... Drycleaning Sites
NPDES ..... NPDES Facility Location Listing
INDIAN RESERV ..... Indian Reservations
SCRD DRYCLEANERS ..... State Coalition for Remediation of Drycleaners Listing
2020 COR ACTION ..... 2020 Corrective Action Program List
LEAD SMELTERS ..... Lead Smelter Sites
PRP ..... Potentially Responsible Parties
US AIRS ..... Aerometric Information Retrieval System Facility Subsystem
US FIN ASSUR ..... Financial Assurance Information
Financial Assurance ..... Financial Assurance Information Listing
PCB TRANSFORMER ..... PCB Transformer Registration Database
COAL ASH EPA ..... Coal Combustion Residues Surface Impoundments List
COAL ASH ..... Coal Ash Disposal Sites
COAL ASH DOE ..... Steam-Electric Plant Operation Data
EPA WATCH LIST ..... EPA WATCH LIST

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP ..... EDR Proprietary Manufactured Gas Plants

EDR US Hist Auto Stat ------- EDR Exclusive Historic Gas Stations
EDR US Hist Cleaners ------- EDR Exclusive Historic Dry Cleaners

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

RGA LUST ---------- Recovered Government Archive Leaking Underground Storage Tank
RGA LF ---------- Recovered Government Archive Solid Waste Facilities List
RGA HWS ---------- Recovered Government Archive State Hazardous Waste Facilities List

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were not identified.

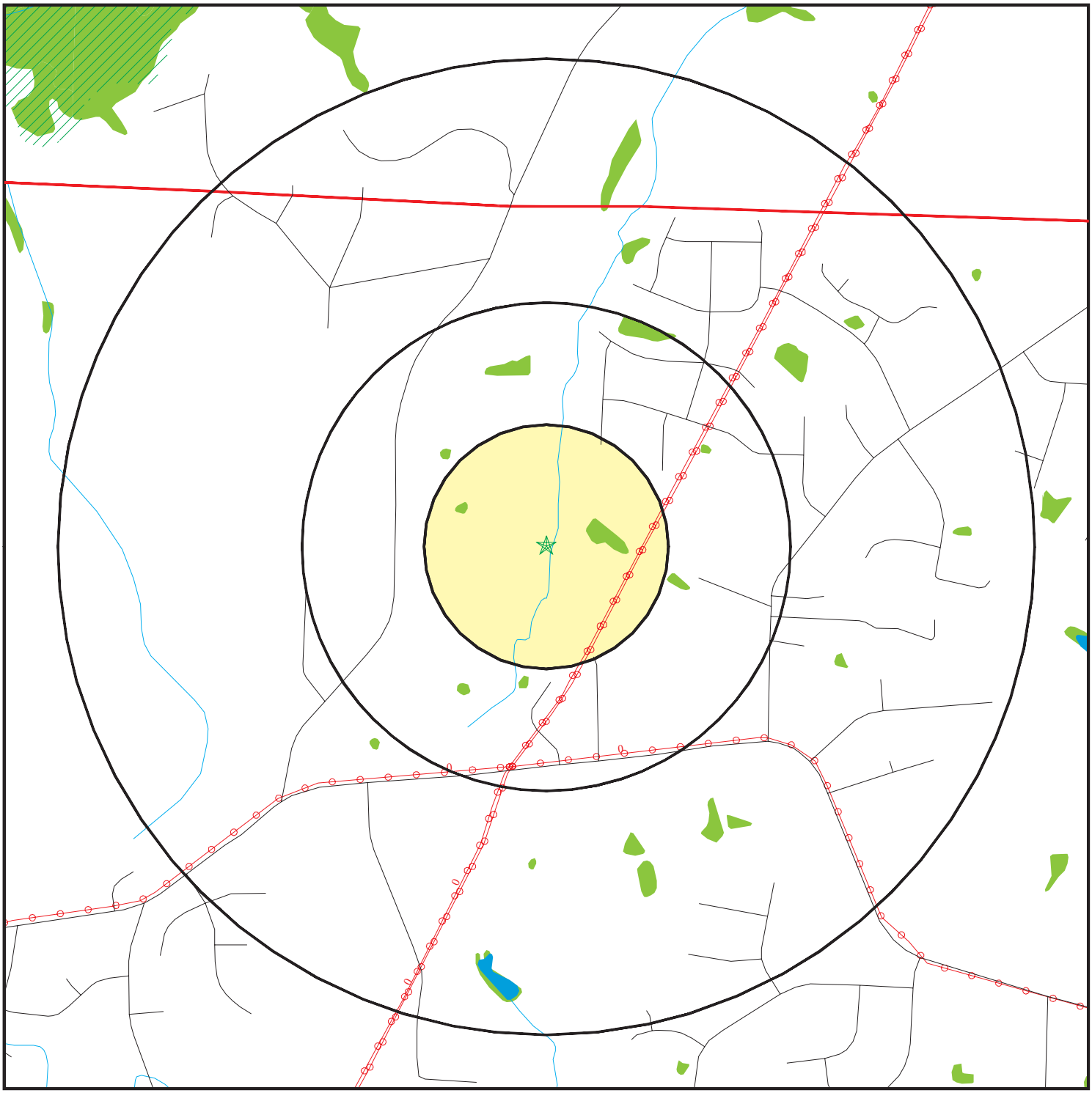
Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped. Count: 27 records.

Site Name	Database(s)
FINISH LINE TRANSPORT	LAST
TRIANGLE RESOURCE INDUSTRIES	CERC-NFRAP, MANIFEST
AT&T COMMUNICATIONS - BROWN SUMMIT	LUST
COMER PROPERTY, PATRICIA	LUST, LUST TRUST
BROWN PROPERTY, JOE	LUST
J & E MARKET	LUST
CORNELL PROPERTY	LUST TRUST
BROWN SUMMIT GROCERY	UST
ANDY'S GROCERY	UST
ADKINS GROCERY	UST
MIDWAY GROC.	UST
RUTH T. CARTER	UST
J.W. MORRICK EXXON	UST
REX COUNTRY STORE	UST
WILSON GROCERY	UST
SSC REIDSVILLE SERVICE	UST
COLLINS GROCERY	UST
PEP-CO SERVICE STATION	UST
COUNCIL ON MENTAL RETARDATION	UST
731ST MAINT. CO (NC NAT'L GUARD)	UST
D B & J'S	UST
MIDWAY MARKET	UST
G B GREEN & SON INC	UST
WILSON TRUCKING CORP.	UST
G. W. WALKER'S STORE	UST
COMB'S GULF	UST
SMITH CAROLINA CORP	RCRA NonGen / NLR

OVERVIEW MAP - 3935116.2s



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites

0 1/4 1/2 1 Miles

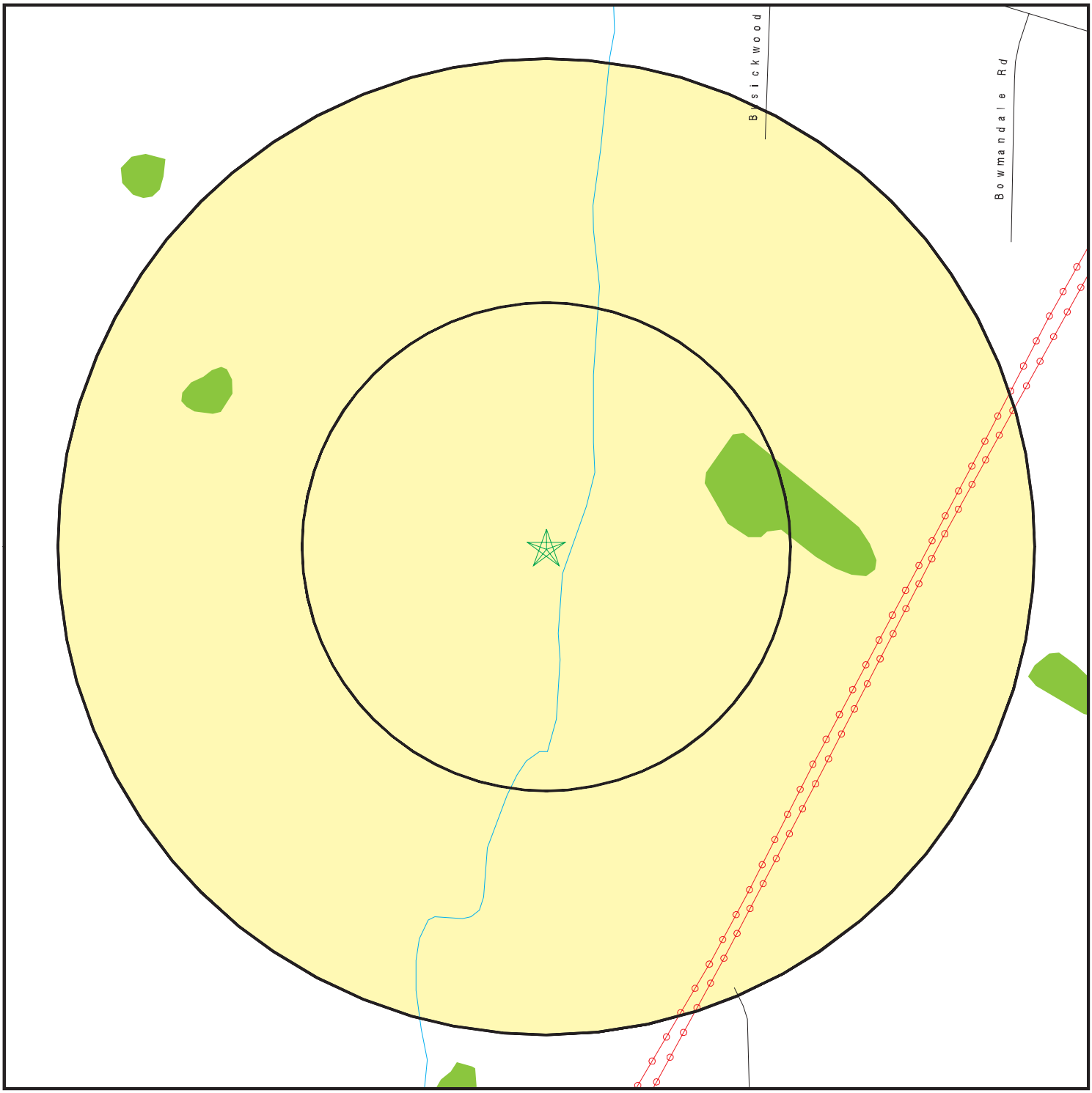
- Indian Reservations BIA
- County Boundary
- Power transmission lines
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

N

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Brown Summit Creek ADDRESS: 8401 Middleland Drive Browns Summit NC 27214 LAT/LONG: 36.2371 / 79.7485	CLIENT: Michael Baker Engineering, Inc. CONTACT: Emily INQUIRY #: 3935116.2s DATE: May 06, 2014 11:11 am

DETAIL MAP - 3935116.2s



0 1/16 1/8 1/4 Miles

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Power transmission lines
- Oil & Gas pipelines from USGS
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Brown Summit Creek ADDRESS: 8401 Middleland Drive Browns Summit NC 27214 LAT/LONG: 36.2371 / 79.7485	CLIENT: Michael Baker Engineering, Inc. CONTACT: Emily INQUIRY #: 3935116.2s DATE: May 06, 2014 11:13 am

16.5 FEMA Compliance - NCDMS Floodplain Requirements Checklist

A review of Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) for Guilford County indicates Project site is currently not located within a FEMA-identified flood zone (NCFMP, 2008) and will not require a "No-Rise/No-Impact" certification. The topography of the site supports the design without creating the threat of hydrological trespass and any rise in floodplain elevation will be contained within the Project site, and should not pose any threat to adjacent landowners or roadways. The NCDMS Floodplain Checklist has been provided to the Guilford County Floodplain Manager along with this report. Baker is in the process of obtaining floodplain permits.

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:	Browns Summit Creek Restoration Project
Name if stream or feature:	Browns Summit Creek (UT to Haw River)
County:	Guilford
Name of river basin:	Cape Fear
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Guilford County
DFIRM panel number for entire site:	3710797000J (7970J)
Consultant name:	Chris Roessler Michael Baker Engineering, Inc.
Phone number:	919-481-5737
Address:	8000 Regency Parkway, Suite 600 Cary, NC 27518

Design Information

Michael Baker Engineering, Inc. proposes to restore 3,785 linear feet (LF) of stream, and enhance 2,646 LF of stream along Browns Summit Creek (UT to Haw River) and several of its tributaries. The project site is located approximately three miles northwest Browns Summit, NC (see Figure 1). The project site is located in the NC Division of Water Quality subbasin 03-06-01 and the NC Ecosystem Enhancement Program's Targeted Local Watershed 03030002-010020 of the Cape Fear River Basin. The purpose of the project is to restore and/or enhance stream and riparian buffer functions and improve area water quality where impaired stream channel flows through the site. The project will provide numerous water quality and ecological benefits within the Thomas Creek and Harris Lake watersheds, and the Cape Fear River Basin. A recorded conservation easement consisting of approximately 20.35 acres will protect all stream reaches and riparian buffers in perpetuity.

Reach	**Length**	**Priority**
Reach R1	*1,221 LF*	*Restoration*
Reach R2	*550 LF (upstream) and 242 LF (downstream)*	*Enhancement I Enhancement II*
Reach R3	*1,399 LF (upstream) and 296 LF (downstream)*	*Restoration Enhancement I*
Reach R4	*1,296 LF*	*Restoration*
Reach R5	*142 LF*	*Enhancement II*
Reach R6	*431 LF*	*Enhancement I (BMP)*
Reach T1	*145 LF*	*Enhancement II*
Reach T2	*283 LF*	*Restoration*
Reach T3	*90 LF*	*Enhancement II*
Reach T4	*145 LF*	*Enhancement I (BMP)*

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: Frank Park
Phone Number: 336-641-3753

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 (CLOMR)

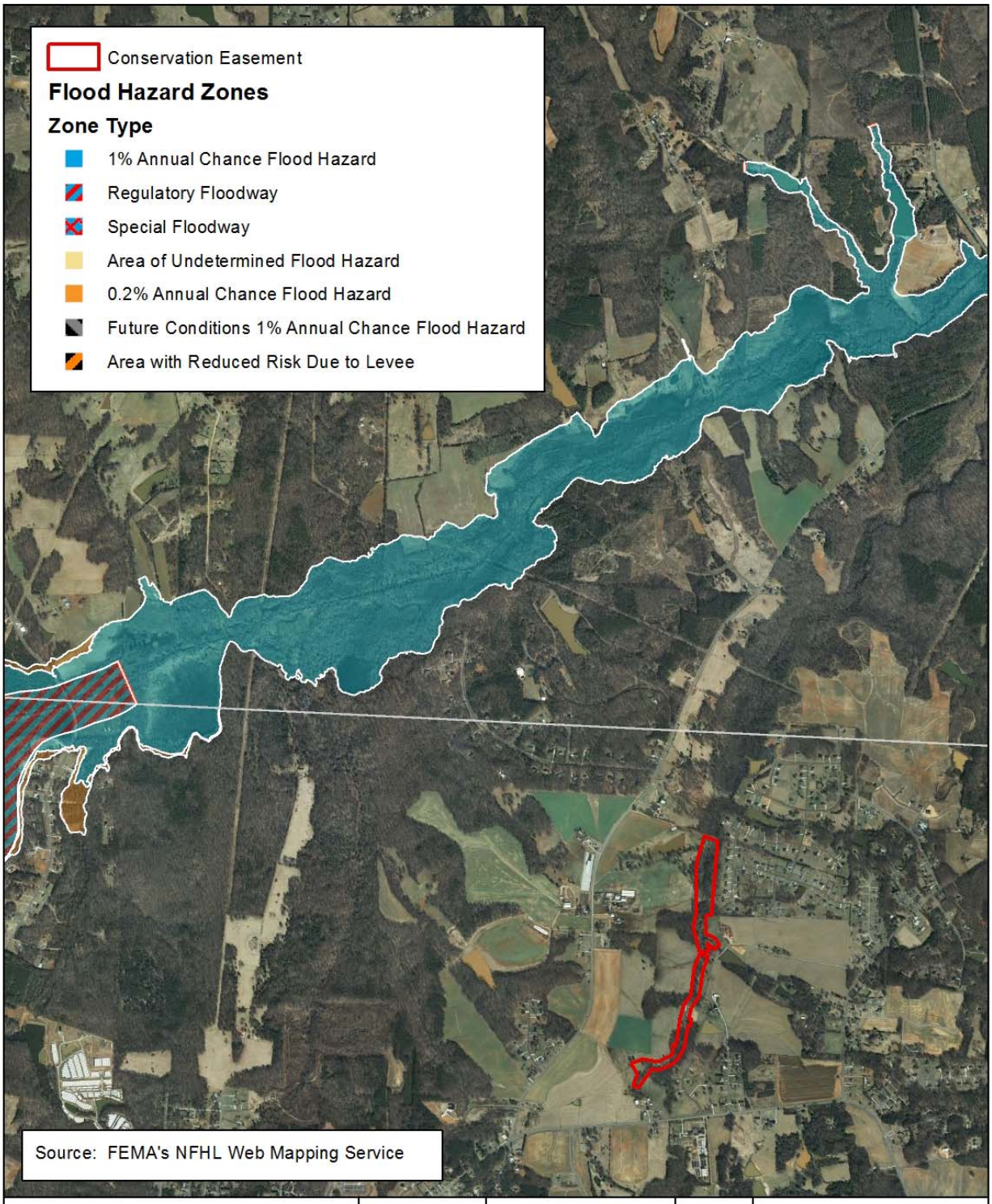
☐ Other Requirements

List other requirements:

Comments:

Name: Chris Roessler Signature: 

Title: Technical Manager Date: 3/19/2015



Michael Baker INTERNATIONAL

Ecosystem Enhancement Program

0 1,000 2,000 Feet

N

Figure 16.1
FEMA Floodplain Map
Browns Summit Site

16.6 Browns Summit Hydric Soils Report – Catena Group

HYDRIC SOIL INVESTIGATION

Brown Summit Mitigation Site

Guilford County, North Carolina

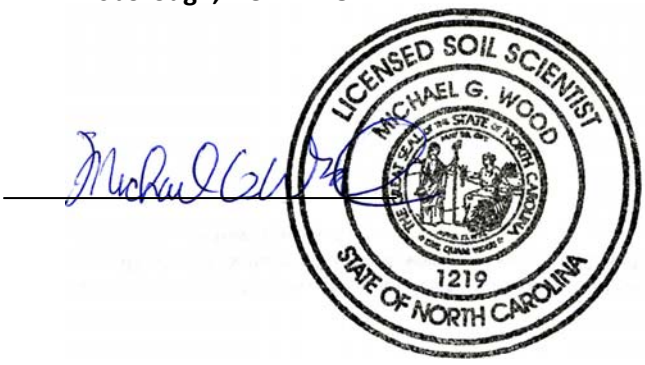
Prepared for:

Michael Baker Engineering, Inc.
8000 Regency Parkway, Suite 600
Cary, NC 27518

Prepared by:

The Catena Group

410B Millstone Drive
Hillsborough, NC 27278



October 18, 2013

INTRODUCTION

Baker Engineering, Inc. is investigating the feasibility of constructing a mitigation site along Middleland Drive in Brown Summit, Guilford County, NC. The Catena Group (Catena) has been retained to perform a soil and site evaluation that describes and classifies the soil throughout the study area and to make a determination as to its hydric status. The site is primarily used for livestock, with wooded and open areas. There is a small, separate 0.7-acre additional parcel that is primarily agriculture.

METHODOLOGY

Prior to performing the evaluation, NRCS soils maps and USGS topographic maps were reviewed. The field investigation was performed on October 15, 2013. Eighteen (18) hand-turned soil auger borings were advanced throughout the study area (Figure 1). Soil boring locations were located with a GPS Unit with sub-meter accuracy. Hydric soil status is based upon the NRCS Field Indicators of Hydric Soils in the Unities States - A Guide for Identifying and Delineating Hydric Soils (Version 7.0, 2010).

RESULTS

There is clear evidence of substantial human manipulation throughout the study area. The original soil has been cut/eroded to the deeper subsoil horizons and replaced with fill material from various sources at various times. Much of the deposition appears to have happened fairly recently, likely within the last 50 years, as the fill material in many spots doesn't reflect the physical characteristics that would be expected given the landscape positions. Further compromising the evaluation was the effect of the livestock. In most all of the "wet" areas, the top 12-15 inches have been continually mixed and churned by the livestock passing.

Nevertheless, certain soil characteristics were apparent in the wetter areas, including lower chroma soils and varying redoximorphic features. These features, combined with vegetation and visual saturation, were used to delineate two Soil Units:

Soil Unit 1 - Hydric Soil. Soils in this area were visually saturated, had similar vegetation, lower chromas, and redoximorphic features. Two relatively intact soil borings were recorded, B3 and B7. These borings meet hydric soil indicator F3, depleted matrix:

F3 Depleted Matrix. A layer that has a depleted matrix with 60 percent or more chroma of 2 or less and that has a minimum thickness of either:

a. 5 cm (2 inches) if the 5 cm is entirely within the upper 15 cm (6 inches) of the soil, or
b. 15 cm (6 inches), starting within 25 cm (10 inches) of the soil surface.

However, the majority of these soils had been well mixed to a depth of 12-15 inches by livestock, effectively removing the redoximorphic features along with structure. As such, these soils generally do not meet any hydric soil indicator, as reflected in boring B5. They do, however, have some general patterns that can be used to identify them:

- Structureless surface horizon
- Low chroma surface horizon
- Subsurface horizons (beginning between 12 and 15 inches) with low chromas and distinct to prominent redoximorphic concentrations

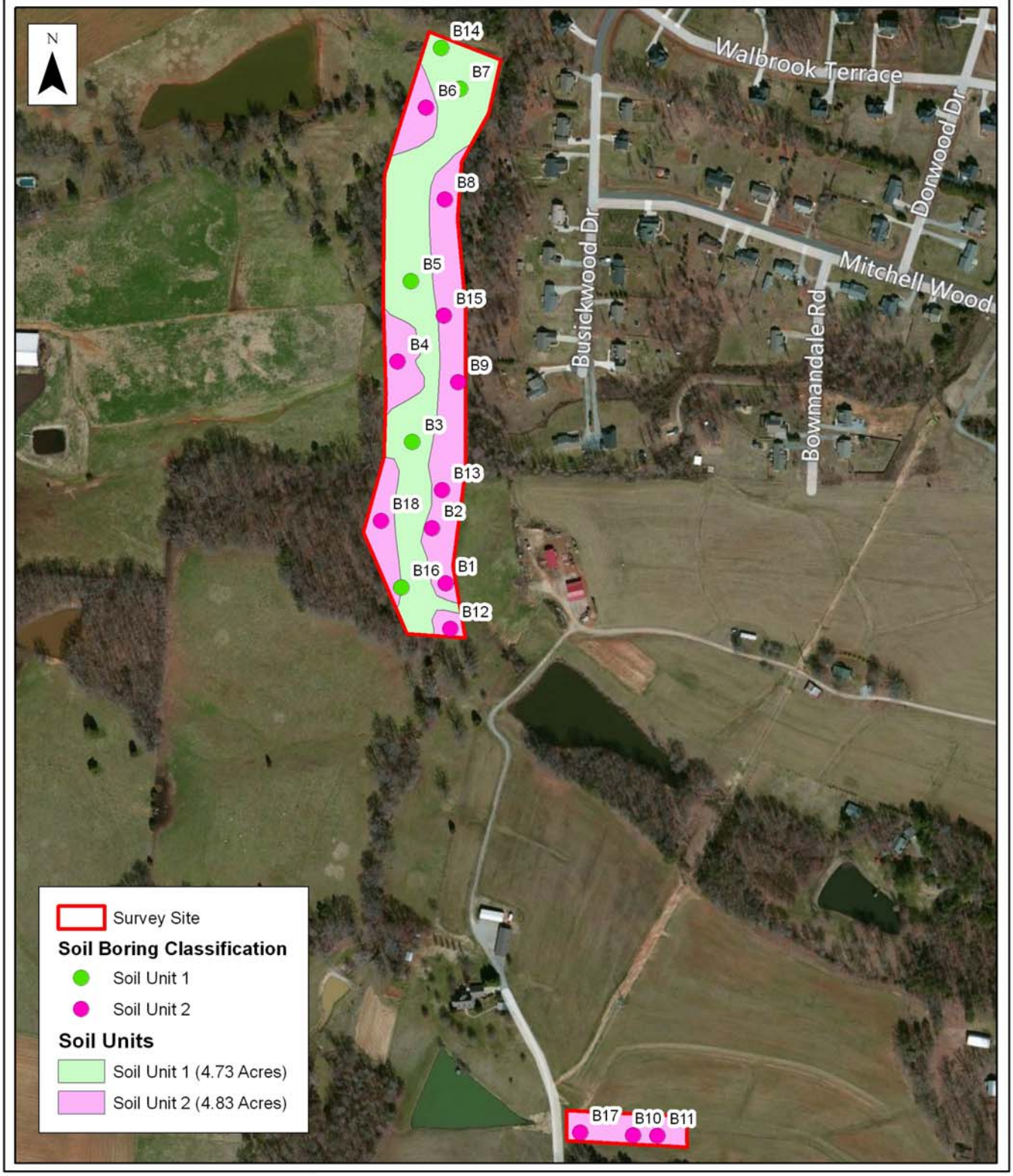
Soil Unit 1 would likely be considered a jurisdictional wetland that has been severely degraded by a combination of human and livestock. As such, it is prime candidate for rehabilitation. This soil unit totals 4.73 acres.

Soil Unit 2. While Soil Unit 2 had also been manipulated, there was generally less re-deposition of material from when the original soil was truncated. These soils had higher chromas, less redoximorphic features, and were "drier" when compared to Soil Unit 1, and therefore were not prone to the churning from livestock. If the soil did not the criteria for Soil Unit 1, then it was placed in Soil Unit 2. Three example profiles (borings B1, B8 and B15) are appended. There is no evidence that these areas do, or ever did, support wetlands. This soil unit totals 4.83 acres.

CONCLUSION

Soil Unit 1 is a prime candidate for wetland restoration through rehabilitation. It is anticipated that through Priority 1 stream restoration, removal of the livestock, and revegetation, the hydrology will be restored and the soils will eventually form structure, which will allow the wetland to regain its normal functions. Soil Unit 2 does not appear adequate to support wetlands.

The findings presented herein represent Catena's professional opinion based on our Hydric Soil Investigation and knowledge of the current regulations regarding wetland mitigation in North Carolina and national criteria for determining hydric soil.



The Catena Group

Hydric Soil Evaluation

Browns Summit

Guilford County, North Carolina

Date: October 2013

Scale 0 150 300 Feet

Job No.: 4167

Figure 1

SOIL EVALUATION FORM

The Catena Group, Inc
410-B Millstone Drive
Hillsborough, NC 27278
919.732.1300

Catena Job: 4167 Browns Summit
County: Guilford
Date: 10-15-13
Sheet: 1 of 2

Profile #	Horizon	Horizon Depth (In)	Structure / Texture	Consistence / Mineralogy	Matrix Color	Mottle Colors (Quantity, Size, Contrast, Color)
B3		3	1,m,gr / l	fr / SS,SP	2.5Y 4/2	C,2,D 10YR 4/6 ; C,2,P 7.5YR 5/6
		5	1,m,sbk / cl	fr / SS,SP	2.5Y 4/1	m,2,D 7.5YR 4/4 ; m,2,D 7.5YR 4/6
		11	1,m,sbk / cl	fr / SS,SP	5Y 4/2	m,2,P 7.5YR 4/4
		18	0,M / sl	fr / NS,NP	5Y 4/2	C,2,P 10YR 4/6
B5		12	0,m / l	fr / SS,SP	2.5Y 4/3	
		17	0,m / l	fr / SS,SP	2.5Y 4/3	C,2,D 2.5Y 6/4
		24	0,M / sl	fr / SS,SP	2.5Y 5/3	m,2,D 10YR 4/4
		24+	0,M / sl	fr / SS,SP	2.5Y 4/2	m,1,D 10YR 4/4
B7		4	0,m / sl	fr / SS,SP	5Y 4/1	m,2,D 10YR 4/4 ; m,2,P 7.5YR 4/4
		8	0,m / sl	fr / SS,SP	5Y 5/2	m,2,P 10YR 5/6
		12	0,m / co-sl	fr / NS,NP	5Y 5/2	m,3,P 10YR 4/6
		16	0,m / co. ls	fr / NS,NP	5Y 5/1	m,3,P 10YR 4/6
		23+	0,M / cl	fr / S,P	2.5Y 4/2	C,2,D 5Y 5/4
B8		3	1,m,gr / l	fr / SS,SP	7.5YR 3/3	
		14	1,m,sbk / c	fi / S,P	2.5YR 4/6	
		20	1,m,sbk / c	fi / S,P	5YR 5/6	C,2,P 10YR 4/6
		24	1,m,sbk / c	fi / SS,SP	7.5YR 5/6	m,2,F 7.5YR 4/6 ; m,2,D 10YR 6/3
		32	1,m,sbk / cl	fi / SS,SP	10YR 5/6	m,3,F 10YR 5/8 ; m,1,P 10YR 5/6
		36	0,M / cl	fi / SS,SP	variegated	
B15		8	1 m GR / sl	fr / SS SP	10YR 5/6	
		13	1 m sbk / sl	FR / SS SP	10YR 5/4	C,2,D 2.5Y 5/3 ; M:2:F 10YR 5/6
		21	1 m sbk cl	FR / SS SP	2.5Y 5/2	M,2,D 10YR 4/6 AND 10YR 5/6
		34+	0 M / C	FI / SS SP	2.5Y 4/1	M,3,P 7.5YR 5/6 ; C,2,D 10YR 6/3

Evaluated by: JCR, MW

SOIL EVALUATION FORM

The Catena Group, Inc
410-B Millstone Drive
Hillsborough, NC 27278
919.732.1300

Catena Job: 4167 Browns Summit
County: Guilford
Date: 10-15-13
Sheet: 2 of 2

Profile #	Horizon	Horizon Depth (In)	Structure / Texture	Consistence / Mineralogy	Matrix Color	Mottle Colors (Quantity, Size, Contrast, Color)
B1		7	1, M, GR / SL	VFR / NS NP	10YR 4/4	
		10	1 M GR / SL	FR / NS NP	10YR 5/2	C, 2, D 10YR 4/3 + 10YR 5/6
			POCKETS SCL			
		13	1 M SBK / SCL	FR / SS SP	10YR 5/2	C, 2, D 10YR 4/4 + 10YR 5/6
		16	1 M SBK / SL	FR / NS NP	10YR 4/2	" "
		27	1 M SBK / SL	FR / SS SP	2.5Y 7/2	M, 2, D 2.5Y 6/6 + 6/8
		32+	D M / SC	FI / SS SP	2.5Y 7/2	M, 2, P 7.5YR 5/6

Evaluated by: SCR, MW

17.0 APPENDIX C - MITIGATION WORK PLAN DATA AND ANALYSES

17.1 Channel Morphology

17.1.1 Existing Conditions

17.1.1.1 Reach Classifications

The project focuses on Browns Summit Creek, which is technically an unnamed tributary to the Haw River. The mainstem begins at the confluence of Reaches R5 and R6 with a drainage area of 85 acres. It continues downstream adding three tributaries and one sizeable stormwater outlet en route (Figure 2.2). Reach R3 has a drainage area of 242 acres, Reach R2 has a drainage area of 299 acres. The combined, total watershed area at the bottom of Reach R1 is 438 acres. Historically, the project streams have been negatively impacted due to agricultural conversion and cattle grazing. The mainstem of Browns Summit Creek (Reaches R1, R2, R3, and R4) is sparsely vegetated, and some sections have become noticeably unstable and are actively incising and widening.

For analysis purposes, Baker labeled the existing unnamed tributaries Reach R1, R2, R3, R4, R5, R6, T1, T2, T3, and T4. The existing reach locations are shown on Figures 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 17.2, and 17.4. The mainstem begins toward the southern end of the project as Reach R4 and flows east then north towards the project terminus.

During field verification with the USACE of intermittent or perennial status and subsequent site visits with NCDMS, Reaches R1, R2, R3, and lower R4 were determined to be a perennial based on a minimum score of 30 for perennial streams and/or the presence of biological indicators using the NCDWR Determination of the Origin of Perennial Streams stream assessment protocols and guidelines (DWQ, 2010; see NCDWR stream forms in Appendix B). The remaining project reaches (upper R4, R5, T1, T2, and T3) were similarly determined to be intermittent. Reaches R6 and T4 were considered - non-jurisdictional and will be treated as stormwater control reaches.

Baker staff conducted geomorphic field assessments that included an existing conditions survey and photographic documentation to evaluate and document the impacts of past land use management practices and current site conditions for each project stream reach. Data collected on the reaches included representative cross sections, longitudinal profiles, and sediment samples. The following paragraphs summarize these findings and the results were used to assign the geomorphic conditions for the project stream reaches. Sections 7 and 17 further describe the restoration approaches

Reach R1

Reach R1 extends from the downstream extent of the project at the property line upstream to the confluence between Reach R2 and Reach T1. Reach R1 has an existing length of 1,217 feet and a drainage area of 438 acres. Cattle have direct access to the entire reach. Reach R1 has a low valley gradient and has noticeable floodplain wetting. The bank height ratios range from 1.0 to 1.3 and erosion is present on approximately 10 to 30 percent of the streambanks. The observed erosion is typically in the form of surficial scour though cattle hoof shear is causing mass wasting in some locations.

A pond was formerly located on the downstream end of R1. The remnants of the pond are a sinuous channel and a lumpy floodplain. The stream pattern upstream from the former pond is surprisingly straight for such a wide valley, suggesting that channel straightening

may have taken place in the past. Channelization is clearly confirmed by the historical aerial photo from 1937 (Figure 8). This is further evidenced by the relic spoil piles present in several locations along the reach. The Catena Group, in their hydric soil delineation of Reaches R1 and R2 (see Appendix 16.6), noted significant manipulation of the soils by human and livestock activity.

Reach R1 has very few mature trees along the streambank; as such, these should be saved as part of the restoration design. Invasive species vegetation such as Chinese privet clusters are common along the streambanks. Approximately 60 percent of the length of Reach R1 has no trees, including both of the streambanks. Based on existing conditions, Reach R1 is classified as an incised "E" Rosgen stream type. The lack of a natural stream pattern is one of the primary drivers for Restoration of Reach R1.

Cattle have access to all of Reach R1. The bed material in Reach R1 is composed of 70 percent sand, 29 percent gravel, and 1 percent silt/clay.

Reach R2

Reach R2 begins at the confluence of Reaches T2 and R3 and flows northward through lightly grazed pasture to its confluence with Reach T1. The existing length of Reach R2 is approximately 868 feet. Reach R2 has a drainage area of 299 acres. Bank erosion on Reach R2 is most severe at the downstream section of the reach (40 percent), best in the middle (10 percent), and moderate on the upstream section (30 percent). This erosion is in the form of surficial scour, with no mass wasting. Reach R2 has been degraded through the removal of the riparian buffer vegetaion and through cattle access.

The degree of incision along Reach R2 is variable, but the bank height ratio is frequently greater than 1.5. Streambank cover is mostly limited to fescue and other typical pasture grasses and forbs; however, the buffer in the top half of the reach has a few trees scattered along the streambank. The bottom half of the reach is comprised mostly of Chinese privet on the left bank and grass on the right bank. As such, more than 60 percent of the length of left and right banks of Reach R2 have longitudinal breaks or interruptions of the existing tree line greater than 20 feet in length. The Reach R2 floodplain is apparently unaltered in the upper 60 percent but has been formerly straightened in the lower section (see Figure 8). The entire length of Reach R2 is actively subject to water quality stressors, mainly in the form of direct livestock access.

Based on existing conditions, Reach R2 has a Rosgen stream type classification of "Bc", with bank height ratios greater than 2.0. The existing conditions cross-sectional survey of the middle portion of Reach R2 in the vicinity of the spoil piles shows a bank height ratio of 2.3 and an entrenchment ratio of 2.2. Another cross section along Reach R2 had bank height ratio of 2.1. Erosion is not widespread but many of the streambanks on the outside bends are vertical and eroding.

Cattle have access to all of Reach R2. The bed material in Reach R1 is composed of 78 percent sand, 21 percent gravel, and 1 percent silt/clay.

Reach R3

Reach R3 originates at the confluence of Reaches R4 and T3. The drainage area for Reach R3 is estimated to be 242 acres and the existing length is 1,586 feet. Reach R3 is backwatered initially because of an in-line pond along its upper section. The riparian buffer is less than 50 feet wide along the entire length of both streambanks, and often less than 10 feet. However, mature trees or understory species are present along much of the reach. Invasive species vegetation are present though not abundant. The entire length of Reach R3 is consistently incised with bank height ratios above 1.5. Active channel scour

is low to moderate, typically 20 to 30 percent, because tree roots along the streambanks are providing protection from excessive erosion. Bedform diversity is lacking due to a low percentage of riffles. Below the pond; however, 50 percent of the streambanks are severely eroding for several hundred feet before the bank erosion becomes less acute in the lower section of the reach. The floodplain along Reach R3 does not appear to have been altered.

Based on existing conditions, Reach R3 has a Rosgen stream type classification of "Bc", with a bank height ratio of 2.1 and entrenchment ratio of 2.0 in the measured cross section. Another cross section was measured in the lower end of the reach with a bank height ratio of 1.8.

Cattle have direct access to all of Reach R3.

Reach R4

Reach R4 begins at the confluence of Reaches R5 and R6 near the southern extent of the project area and runs 1,350 feet to the confluence with Reach T3. The drainage area is estimated to be 138 acres at the downstream extent. Reach R4 flows 100 feet before entering an in-line farm pond for another 100 feet. The pond dam is very close to failing as result of an active headcut (see photo on cover and in Section 2.9.4). Cattle commonly wallow in this pond and abundant algae visible on water surface indicate that nutrient loading to the pond is high. Below the farm pond, Reach R4 flows for another 130 feet before it leaves the cow pasture and enters a forested section adjacent to a small residential development. An active headcut marks the boundary between the upstream pasture and downstream forested area. The channel is more than 10 feet deep through this forested section as result of a pond dam failure and subsequent channel incision (photos in Section 2.9.4). Stormwater runoff from the residential development is causing an additional headcut on the channel bank back towards the stormwater outlet. The incised channel continues to flow through a forested area, below the residential development, to which livestock have access.

Bank erosion along Reach R4 is severe, with 70-90 percent of its length containing at least one eroding bank. Incision is pronounced, with a bank height ratio on excess of 6.8 and entrenchment of 1.2 in the measured cross section. The riparian buffer is limited to grass in the upper 300 feet and then mostly forested for the next 750 feet. In the bottom 400 feet, the understory is limited due to cattle grazing. The floodplain has been altered in the upper half of the reach because of two ponds (one existing and close to failing, and one already failed). Based on existing conditions, Reach R4 has a Rosgen stream type classification of "Gc", with bank height ratios typically greater than 3.0.

The bed material in Reach R4 is composed of 93 percent sand, 4 percent gravel, and 3 percent silt/clay. Cattle have access to all but the middle 260 feet of the reach.

Reach R5

Reach R5 begins at the upstream project extent at a spring. The drainage area is estimated to be 24 acres and the existing length is approximately 536 feet. The channel is an incised "Bc" with a measured bank height ratio of 5.8. The riparian buffer has scattered single trees along the streambank but is mostly grass. Cattle have direct access to this entire reach. The floodplain does not appear to have been altered.

Reach R6

Reach R6 also begins at the upstream extent of the project as an existing farm pond. Below the dam, the channel is very eroded and has been filled with concrete slabs. The

drainage area for Reach R6 is estimated to be 61 acres and it has been classified as a non-jurisdictional channel. The valley length of the reach is approximately 442 feet with 180 feet in the pond. The riparian buffer is limited to grass with minimal to no mature woody vegetation. The measured cross section indicates the channel is an incised "Bc" with a bank height ratio of 5.2. Cattle have access to the entire reach and use the pond to wallow.

Reach T1

Reach T1 is a tributary that enters Browns Summit Creek between Reaches R1 and R2. It has a drainage area of approximately 55 acres, draining through a neighborhood development. The existing length of Reach T1 is 121 feet. It is located in active pasture and has no trees along its banks. Buffer vegetation is largely limited to fescue and other typical pasture grasses. Approximately 30 percent of the channel length has bank scour. It appears that the floodplain has been altered because the channel does not follow the bottom of the valley. A cross section was surveyed and indicates a Rosgen stream classification of "E" with a bank height ratio of 1.6. It is not entrenched, however. Cattle have access to the entire reach.

Reach T2

Reach T2 is a tributary that emanates below a pond and enters Browns Summit Creek between Reaches R2 and R3. It has a drainage area of 47 acres. A channel length of 283 feet of Reach T2 is included in the project. The project section starts more than 100 feet below the pond dam. Cattle have access to the reach though they do not appear to use it, at present. A headcut is present approximately 100 feet from Browns Summit Creek. The upper section is stable but the buffer is limited to herbaceous vegetation. Bank scour is not present on the upper half of the reach and estimated at 20 percent on the lower half. A cross section was surveyed and indicates a Rosgen stream classification of "F" with a bank height ratio of 3.0.

Reach T3

Reach T3 is a tributary that enters Browns Summit Creek between Reaches R3 and R4. It has a drainage area of approximately 41 acres, draining through mostly cropland and a large pond. Sixty-five linear feet of Reach T3 are included in the project. This section is located on the floodplain of Browns Summit Creek and a headcut has migrated through it. There are little to no trees along the banks. Buffer vegetation is largely limited to herbaceous grasses. Approximately 50 percent of the channel length has bank scour. The floodplain appears to not have been altered, but the lower T3 channel is backwatered by the farm pond in Reach R3. A cross section was surveyed and indicates a Rosgen stream classification of "E" with a bank height ratio of 1.7.

Reach T4

Reach T4 is a small runoff source entering Browns Summit Creek from a 30-inch culvert that discharges runoff from much of Broad Ridge Court, a newly developed subdivision. It has a drainage area of approximately 10 acres. A second BMP feature will be created on the new floodplain to treat runoff discharge from a 30-inch culvert located just above and beyond the right bank.

The valley length of this BMP is estimated to be 170 feet, though only 117 feet will be included in the project because of easement area restrictions by the landowner. The outlet is currently causing a major headcut that will continue to migrate. This is a non-jurisdictional channel.

Table 17.1 Representative Existing Conditions Geomorphic Data for Project Reaches:
Stream Channel Classification Level II
Browns Summit Creek Restoration Project

Parameter	Reach R1	Reach R2	Reach R3
	XSR1	XSR2	XSR3
Existing Reach Length (ft)	1,217	868	1,586
Drainage Area (sq. mi.)	0.68	0.47	0.38
Bankfull Discharge, Q_{bkf} (cfs)*	58	43	34.5
Feature Type	Riffle	Riffle	Riffle
Rosgen Stream Type	E	Bc	Bc
Bankfull Width (W_{bkf}) (ft)	12.32	10.06	8.5
Bankfull Mean Depth, (d_{bkf}) (ft)	1.32	1.11	1.15
Width to Depth Ratio (W_{bkf}/d_{bkf})	9.33	9.1	7.15
Cross-Sectional Area, A_{bkf} (sq ft)	16.3	11.1	9.7
Bankfull Max Depth (d_{mbkf}) (ft)	2.10	2.0	1.82
Floodprone Width (W_{fpa}) (ft)	>100	22.1	17.8
Entrenchment Ratio (W_{fpa}/W_{bkf}) (ft)	8.7	2.2	2.0
Bank Height Ratio**	1	2.3	2.1
Longitudinal Stationing of Cross-Section Along Existing Thalweg (ft)	58+67	47+46	35+50
Bankfull Mean Velocity, $V_{bkf}= (Q_{bkf}/A_{bkf})$ (ft/s)	3.56	3.87	3.56
Channel Materials (Particle Size Index – d50)***			
d_{16} / d_{35} / d_{50} / d_{84} / d_{95} (mm)	0.3/0.5/0.8/5.8/10.2	0.2/0.4/0.6/2.9/6.9	0.1/0.2/0.4/10.4/22.4
Average Valley Slope (ft/ft)	0.0069	0.0068	0.0095
Average Water Surface Slope (S)	0.0058	0.0054	0.0082
Average Channel Sinuosity (K)****	1.12	1.35	1.10

*Bankfull discharge estimated in Table 17.7 (Section 17.2.3) for Reaches R1-R4, and by using published NC Piedmont Regional Curve (Harman et al., 1999) for others.
**High bank height ratios (values greater than 2.0 indicate systemwide self-recovery is unlikely)
***Sediment samples taken along main stem only (Reaches R4 & R5) given shorter reach lengths, proximity to upstream impoundments, and similar substrate material.
****Additional meander geometry information such as meander width, meander length, and radius of curvature were not measured. The channel exhibits minimal pattern since it has been straightened/channelized, and/or is classified as a step-pool channel.

Table 17.1 continued Representative Existing Conditions Geomorphic Data for Project Reaches:
Stream Channel Classification Level II
Browns Summit Creek Restoration Project

Parameter	Reach R4	Reach R5	Reach R6
	XSR4	XSR5	XSR6
Existing Reach Length (ft)	1,350	536	501
Drainage Area (sq. mi.)	0.22	0.04	0.10
Bankfull Discharge, Q_{bkf} (cfs)*	24	12.7	16.5
Feature Type	Riffle	Riffle	Riffle
Rosgen Stream Type	Gc	Bc	Bc
Bankfull Width (W_{bkf}) (ft)	7.60	7.38	9.09
Bankfull Mean Depth, (d_{bkf}) (ft)	0.86	0.44	0.48
Width to Depth Ratio (W_{bkf}/d_{bkf})	8.8	16.77	18.94
Cross-Sectional Area, A_{bkf} (sq ft)	6.5	3.2	4.4
Bankfull Max Depth (d_{mbkf}) (ft)	1.39	0.67	0.85
Floodprone Width (W_{fpa}) (ft)	9.1	11.8	12.7
Entrenchment Ratio (W_{fpa}/W_{bkf}) (ft)	1.2	1.6	1.4
Bank Height Ratio**	6.8	5.8	5.2
Longitudinal Stationing of Cross-Section Along Existing Thalweg (ft)	22+33	13+49	14+73
Bankfull Mean Velocity, V_{bkf}= (Q_{bkf}/A_{bkf}) (ft/s)	3.69	3.97	3.75
Channel Materials (Particle Size Index – d50)***			
d_{16} / d_{35} / d_{50} / d_{84} / d_{95} (mm)	0.2 / 0.3/ 0.4/ 0.9/ 1.8	-	-
Average Valley Slope (ft/ft)	0.017	0.020	0.015
Average Water Surface Slope (S)	0.016	0.017	0.014
Average Channel Sinuosity (K)****	1.15	1.14	1.07

*Bankfull discharge estimated in Table 17.7 (Section 17.2.3) for Reaches R1-R4, and by using published NC Piedmont Regional Curve (Harman et al., 1999) for others.
**High bank height ratios (values greater than 2.0 indicate systemwide self-recovery is unlikely)
***Sediment samples taken along main stem only (Reaches R4 & R5) given shorter reach lengths, proximity to upstream impoundments, and similar substrate material.
****Additional meander geometry information such as meander width, meander length, and radius of curvature were not measured. The channel exhibits minimal pattern since it has been straightened/channelized, and/or is classified as a step-pool channel.

Table 17.1 continued Representative Existing Conditions Geomorphic Data for Project Reaches:
Stream Channel Classification Level II
Browns Summit Creek Restoration Project

Parameter	Reach T1	Reach T2	Reach T3
Existing Reach Length (ft)	121	283	47
Drainage Area (sq. mi.)	0.09	0.07	0.06
Bankfull Discharge, Q_{bkf} (cfs)*	16.9	14.4	11.7
Feature Type	Riffle	Riffle	Riffle
Rosgen Stream Type	E	F	E
Bankfull Width (W_{bkf}) (ft)	6.80	18.00	2.93
Bankfull Mean Depth, (d_{bkf}) (ft)	0.67	0.22	1.12
Width to Depth Ratio (W_{bkf}/d_{bkf})	10.15	81.82	2.62
Cross-Sectional Area, A_{bkf} (sq ft)	4.5	4.0	3.3
Bankfull Max Depth (d_{mbkf}) (ft)	1.53	0.78	1.76
Floodprone Width (W_{fpa}) (ft)	89.1	23.4	66.5
Entrenchment Ratio (W_{fpa}/W_{bkf}) (ft)	13.1	1.3	22.7
Bank Height Ratio**	1.6	3.0	1.7
Longitudinal Stationing of Cross-Section Along Existing Thalweg (ft)	10+75	12+00	10+60
Bankfull Mean Velocity, V_{bkf}= (Q_{bkf}/A_{bkf}) (ft/s)	3.76	3.6	3.55
Channel Materials (Particle Size Index – d50)***			
d_{16} / d_{35} / d_{50} / d_{84} / d_{95} (mm)	-	-	-
Average Valley Slope (ft/ft)	0.025	0.024	0.029
Average Water Surface Slope (S)	0.024	0.022	0.02
Average Channel Sinuosity (K)****	1.06	1.12	1.06

*Bankfull discharge estimated in Table 17.7 (Section 17.2.3) for Reaches R1-R4, and by using published NC Piedmont Regional Curve (Harman et al., 1999) for others.
**High bank height ratios (values greater than 2.0 indicate systemwide self-recovery is unlikely)
***Sediment samples taken along main stem only (Reaches R4 & R5) given shorter reach lengths, proximity to upstream impoundments, and similar substrate material.
****Additional meander geometry information such as meander width, meander length, and radius of curvature were not measured. The channel exhibits minimal pattern since it has been straightened/channelized, and/or is classified as a step-pool channel.

17.1.1.2 Wetlands Proposed for Mitigation

As described in Section 2.2, the wetlands along Reaches R2 and R1 are proposed for rehabilitation and re-establishment.

The different types areas may be categorized as follows:

1. "Functioning" wetlands – forested areas with hydrology and hydric soils, such as along the right bank of Reach R1. The hydrology and vegetation are present but in many areas

cattle trampling has impacted the soil structure and ability to percolate water. A 3:1 credit ratio for this wetland type was agreed to by the IRT at the post contract field meetings.

2. Degraded wetlands – areas with no wetland vegetation and some hydrology such as along the corrugated metal pipe at the beginning of Reach R1. A 1.5:1 credit ratio for this wetland type was agreed to by the IRT at the post contract field meetings.
3. Partially-functioning wetlands – saturated areas along the left bank of the middle of Reach R1 that lack wetland vegetation. A 1.5:1 credit ratio for this wetland type was agreed to by the IRT at the post contract field meetings.
4. Filled wetlands – areas where spoil has been placed on top of delineated hydric soils, such as upper Reach R2 and the downstream end of Reach R1. A 1:1 credit ratio for this wetland type was agreed to by the IRT at the post contract field meetings.
5. Hydric soils – areas that have hydric soils but lack wetland hydrology, such as the right bank along lower Reach R4. Priority Level I restoration will re-establish wetland hydrology by replacing a 6-8 foot deep channel with one that is approximately 1 foot deep. This area is proposed for wetland re-establishment, but will only seek a 3.5:1 credit ratio, in order to meet Baker's contracted credit requirement.

The locations of these different types of wetlands are shown in Figure 2.4b, 2.4c, and 2.4d, as well as in the plan sheets (Appendix F).

17.1.1.3 Valley Classification

The Browns Summit Creek Site is located in north central Guilford County within the Piedmont hydrophysiographic region of North Carolina. Undisturbed Piedmont valleys in this region are generally classified as Valley Type 'VII' (Rosgen, 2006) and the province is characterized by broad, rolling, interstream divides across variable steep slopes along well-defined drainage ways. The underlying geologic unit of the project area consists of the Paleozoic granitic rock (PPg) within the Charlotte and Milton Belts geologic formation and Level III Ecoregion. (Geologic Map of North Carolina, NC Geological Survey, 1998). The area receives moderately high rainfall amounts with precipitation averaging 43.14 inches per year (USDA Climate Data for Guilford County, WETS Station: Piedmont Triad Intl Airport in Greensboro, NC).

17.1.1.4 Channel Morphology and Stability Assessment

Baker performed general topographic and planimetric surveying of the project site and produced a 1-foot contour map based on survey data in order to create plan set base mapping (see Section 20.0, Appendix F). Nine representative cross sections and a longitudinal profile survey were also surveyed to assess the current condition and overall stability of the stream channels. The existing riffle cross-section data and locations are shown in Figure 17.1 and compared with the Rosgen Channel Stability Assessment shown in Table 17.2.

Consistent bankfull indicators were not abundant in the field, though there was evidence of them in Reach R1 and Reach R3. The indicators yielded bankfull cross-sectional areas that were lower than the estimates from the NC Rural Piedmont Regional Curve by as much as 20 percent; however, top-of-bank measurements on Reach R1 were just 2% below the published regional curve. Thus, for the most part, Baker sized the channels so that they were about 15 percent below the published regional curve. Coincidentally, perhaps, these numbers are frequently about 15 percent above the revised Piedmont regional curve.

The representative riffle cross-sections have a typical Bank Height Ratio (BHR) greater than 1.5. Some of the cross-section data illustrate the presence of existing berms or overburden from channelization and the lack of natural floodplain deposits.

The longitudinal profiles show the channel slopes vary from 0.005 to 0.016 ft/ft and have average valley slopes of 0.007 to 0.017 ft/ft with several long riffle sections and infrequently spaced pools. The sinuosity for the reaches is approximately 1.1, a result of prior straightening/channelization and valley morphology. Large sections of the project reaches are moderately to severely entrenched and highly unstable as shown on the cross-section data. This likely indicates a movement toward a more unstable condition (e.g., downcutting, stream bank erosion), especially in portions of the reach where numerous active headcuts are present (vertical instability) or stream banks are actively eroding (lateral instability).

Table 17.2 Rosgen Channel Stability Assessment

Browns Summit Creek Restoration Project

Stability Rating	**Bank Height Ratio (BHR)**
Stable (low risk of degradation)	1.0-1.05
Moderately unstable	1.06-1.3
Unstable (high risk of degradation)	1.3-1.5
Highly unstable	>1.5

Notes: Rosgen, D. L. (2001) A stream channel stability assessment methodology. Proceedings of the Federal Interagency Sediment Conference. Reno, NV. March, 2001.

Figure 17.1 Existing Cross-Section Locations for Project Reaches

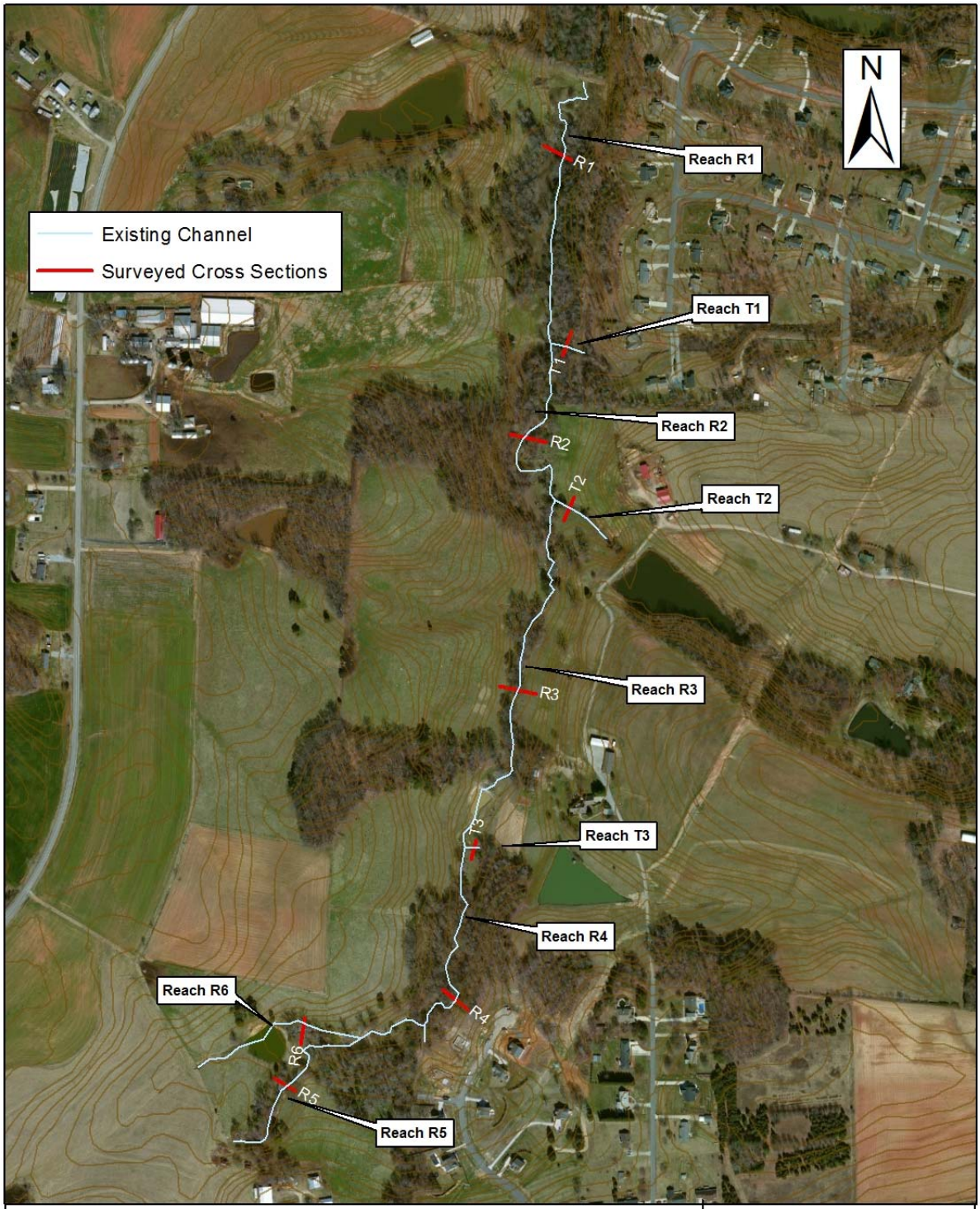
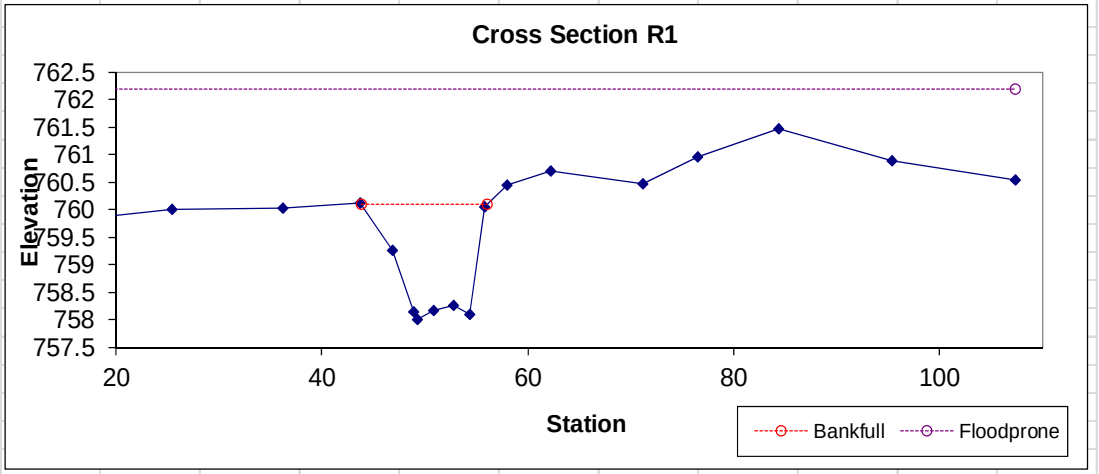
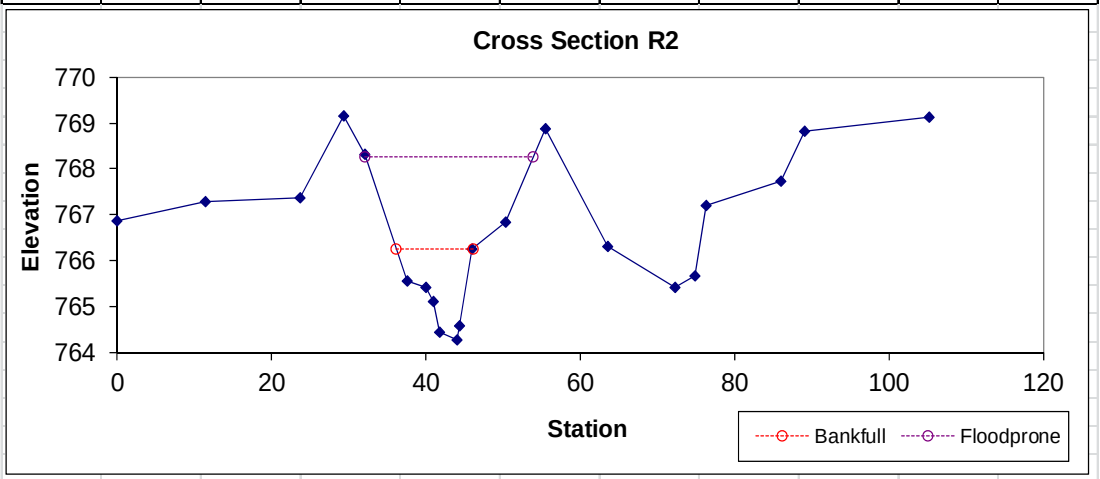


Figure 17.2 Existing Cross Section Data for Project Reaches

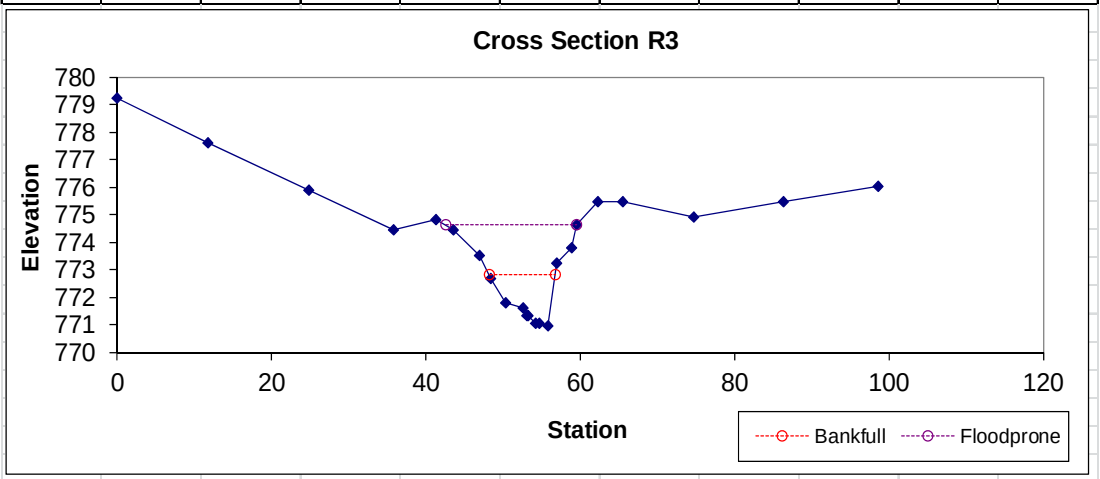
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	16.3	12.32	1.32	2.1	9.33	1	8.7	760.1	760.13



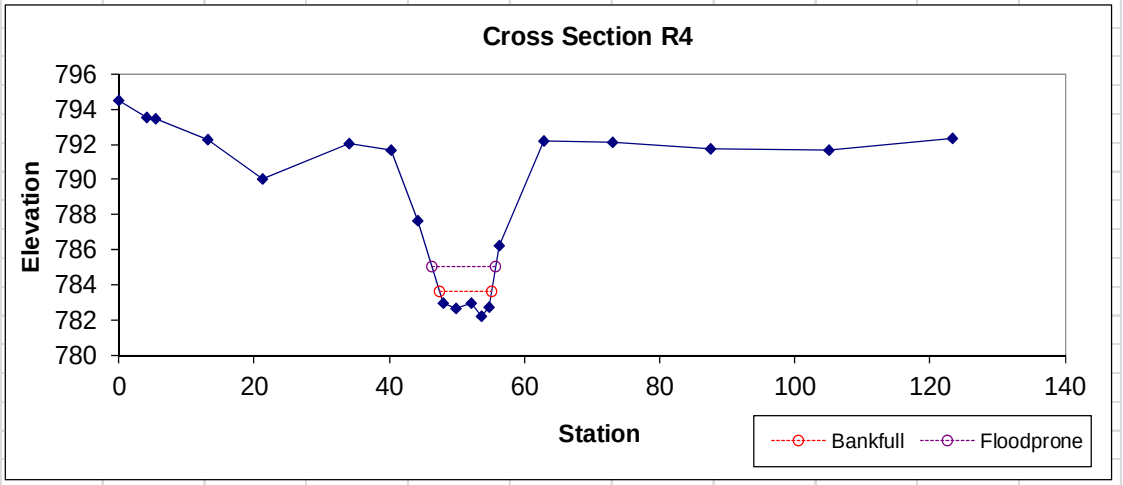
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	11.1	10.06	1.1	2	9.13	2.3	2.2	766.26	768.87



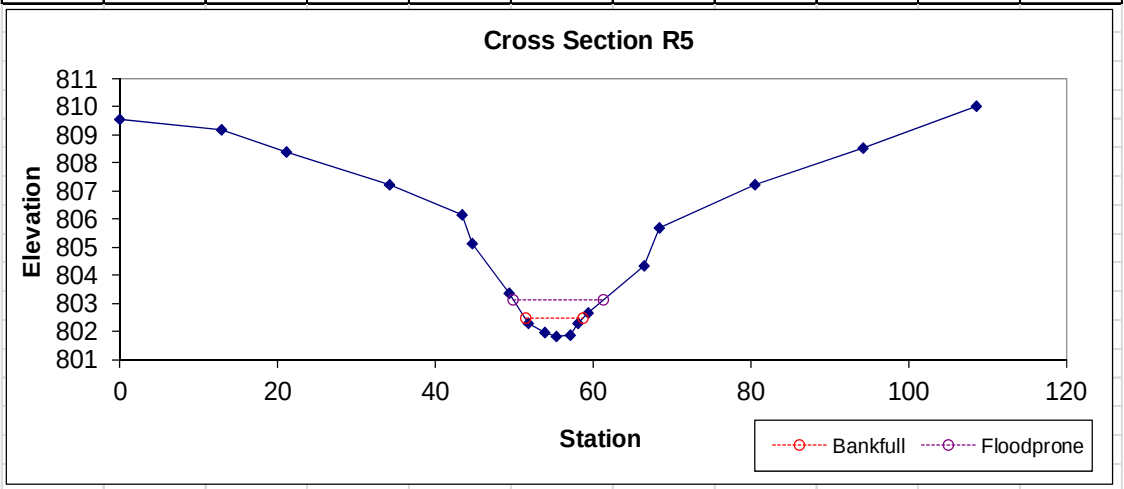
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	9.7	8.5	1.15	1.82	7.42	2.1	2	772.8	774.84



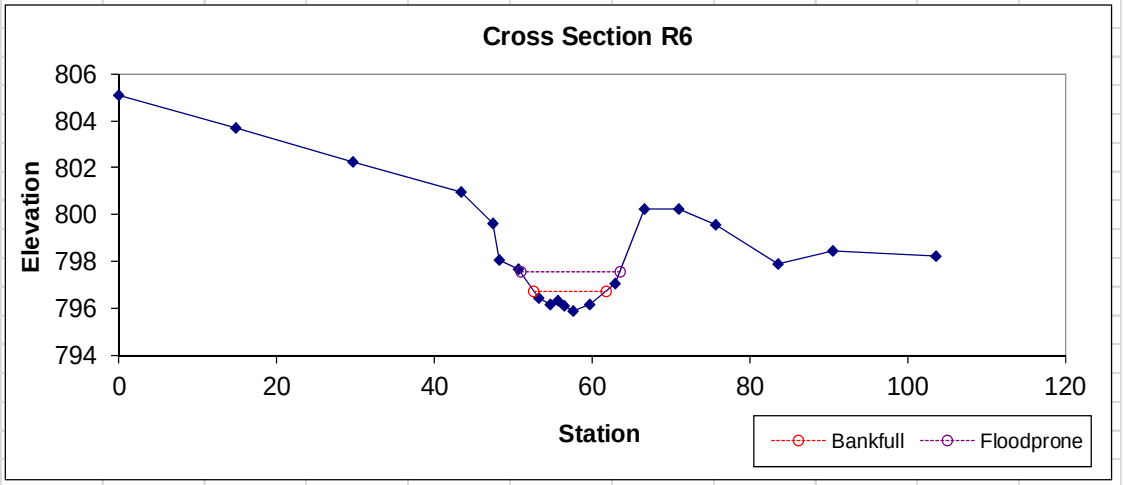
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Gc	6.5	7.6	0.86	1.39	8.85	6.8	1.2	783.63	791.66



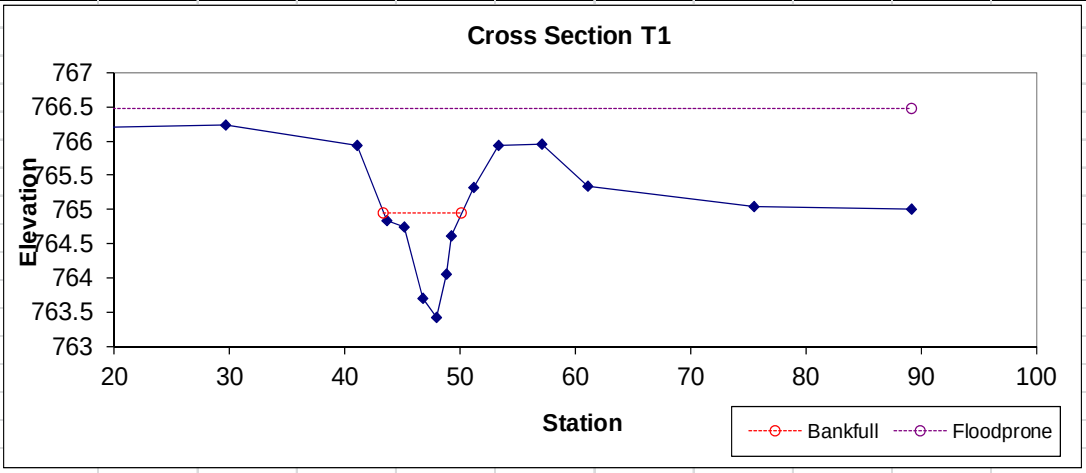
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	3.2	7.38	0.44	0.67	16.91	5.8	1.6	802.47	805.7



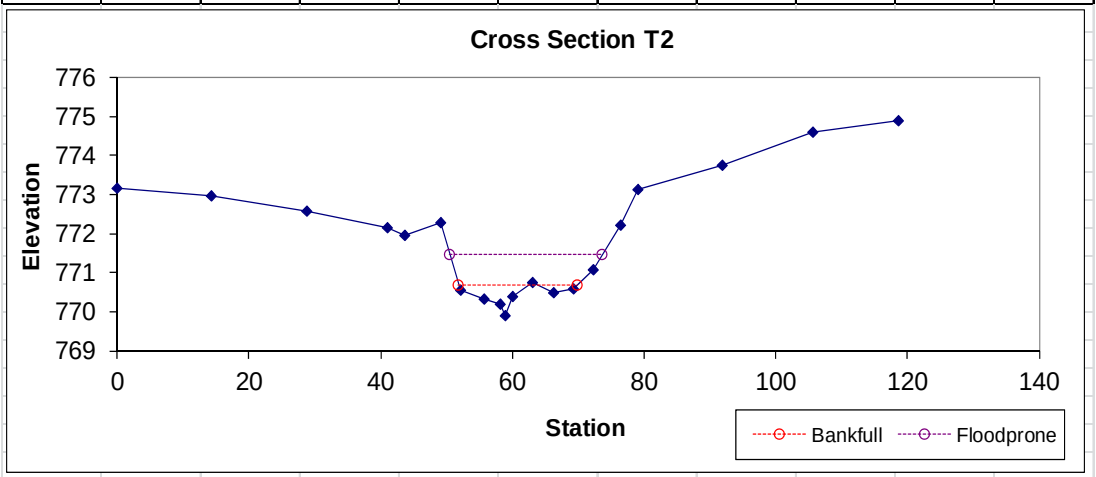
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	4.4	9.09	0.48	0.85	18.8	5.2	1.4	796.7	800.23



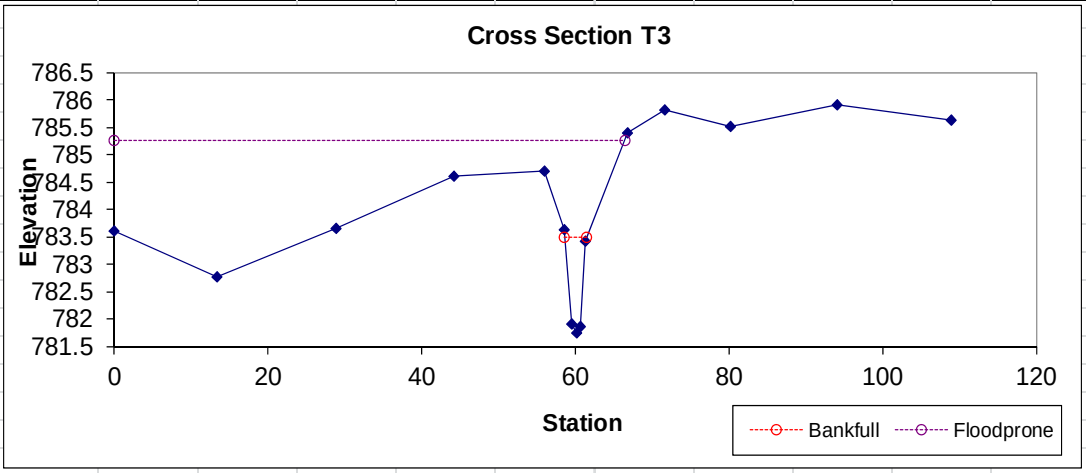
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	4.5	6.8	0.67	1.53	10.2	1.6	13.1	764.95	765.94



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	F	4	18	0.22	0.78	82	3	1.3	770.68	772.27



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	3.3	2.93	1.12	1.76	2.62	1.7	22.7	783.5	784.7



17.1.1.5 Bank Erosion Prediction (BEHI/NBS)

Sedimentation from streambank erosion is a significant pollutant to water quality and aquatic habitat. Predicting streambank erosion rates and annual sediment yields using the Bank Assessment for Non-point source Consequences of Sediment (BANCS) method (Rosgen 1996, 2001a) considers two streambank erodibility estimation tools: the Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS). This rating method is used to describe existing streambank conditions and statistically quantify the erosion potential of a stream reach in feet/year. Since it is an estimation/prediction method, the intent is to be used as a relative comparison for pre- and post-restoration conditions.

Published curve data were initially developed from sites in Colorado with varying sediment sources, vegetation, and fluvial geomorphic processes characteristic of that region. Although the published BEHI/NBS curve is not directly applicable to piedmont streams in North Carolina, it can provide a framework to develop similar relations in other hydrophysiographic regions. Therefore, Baker used local unpublished NC piedmont BEHI and NBS ratings (obtained through personal communication with NRCS, Walker, 2011) to estimate sediment loss and support field observations and streambank height measurements taken during existing conditions assessment.

The BEHI/NBS estimates for the existing conditions (pre-construction) were determined in the field. The majority of BEHI ratings varied from 'low' to 'moderate' with the area behind Broad Ridge Court and immediately downstream (Reach R4) in the 'high' to 'very high' category based on changes in the velocity gradient and shear stress and depth of incision. This is typical of a partially degraded stream system with active streambank erosion in localized areas. After stabilizing streambanks using the proposed restoration measures, post-construction BEHI/NBS estimates will predict a significant decrease in sediment loading throughout the entire project area, especially considering the limited sediment supply entering the system from the upstream drainages.

17.1.1.6 Channel Evolution

Observed stream response to induced instability, as described by Simon's (1989) Channel Evolution Model, involve extensive modifications to channel form resulting in profile, cross-sectional, and plan form changes, which often take decades or longer to achieve resolution. The Simon (1989) Channel Evolution Model characterizes typical evolution in six stages:

1. Pre-modified
2. Channelized
3. Degradation
4. Degradation and widening
5. Aggradation and widening
6. Quasi-equilibrium.

The project reaches are predominantly in Stages 4 or 5 of the Simon Channel Evolution Model. This indicates that the floodplain connection has been severely compromised by vertical degradation and the channels will likely experience continued erosion prior to the channel form stabilizing on its own (Stage 6 – Quasi-equilibrium). Whether a given reach is in Stage 4 or 5 largely depends on when the headcut passed through; if it has been recently then the channel is likely to be in Stages 3 or 4, while if widening has already occurred then it is likely to be in Stage 5. Reaches that are in Stage 5 include R2, R3, lower R4, and T3. Reaches that are in Stage 4 include upper R4, R6, and T1. Reach R1 has been channelized but due to the relatively flat valley slope, degradation is limited to one head cut and it is mostly widening, which is most indicative of Stage 5. Reach R5 is

already in Stage 6, though a knick point at the upstream end is holding back further degradation.

Where Reaches are in Stage 5, Priority 2 restoration tends to be more appropriate to advance the channel to Stage 6. In other reaches, Priority 1 restoration can essentially move the channel back more or less to Stage 1.

17.1.2 Proposed Morphological Conditions

After examining the assessment data collected at the site and exploring the potential for restoration, an approach was developed that would address restoration and enhancement of stream functions within the project area while minimizing disturbance to existing wooded areas and protecting existing, USACE-verified jurisdictional wetlands. Prior to impacts from past channel manipulation, topography and soils on the site indicate that the project area most likely functioned in the past as a small tributary stream system with associated hillslope seep and floodplain wetlands, eventually flowing into the larger Haw River system.

Therefore, a design approach was formulated to restore and/or enhance this type of system. First, an appropriate stream type for the valley type, slope, and desired stream functions was selected and designed to improve historic flow patterns within the project area. Then a design plan was developed in order improve the floodplain hydrology and base flow interaction impacted by channelization, current cattle impacts, active degradation, and other agricultural land manipulations.

17.1.2.1 Proposed Design Approach and Criteria Selection

For design purposes, the stream channels used the same nine reach labels as the existing reaches: R1, R2, R3, R4, R5, R6, T1, T2, T3, and T4 (see Figure 17.3). Selection of a general restoration approach was the first step in selecting design criteria for all reaches. The approach was based on the potential for restoration as determined during the site assessment. Next, specific design parameters were developed so that plan view layout, cross-section dimensions, and a longitudinal profile could be implemented for developing construction documents. The design philosophy is to use these parameters as conservative values for the selected stream types and to allow natural variability in stream dimension, facet slope, and bed features to form over long periods under the processes of flooding, re-colonization of vegetation, and local watershed influences.

After selecting an appropriate design approach for the site based on field assessments and functional lift potential, proposed stream design values and design criteria were selected using common reference ratios and guidelines (Harman, Starr, 2011). Table 17.3 presents the design parameters used for the proposed reaches. Following initial application of the design criteria, Baker staff made detailed refinements to accommodate the existing valley type and channel morphology. This step minimizes unnecessary disturbance of the riparian area, can help reduce the number of in-stream structures, and allows for some natural channel adjustment following construction. The design plans have been tailored to produce a cost- and resource-efficient design that corresponds to the tools of construction.

One overarching design comment about the Browns Summit Creek site is warranted since there are generally steeper valley slopes, particularly in the upper half of the project area, combined with sand/gravel bed streams. This makes grade control challenging because there is higher stream power and shear stress, but not adequate bed material size or resistance to match those erosive forces. Consequently, the risk of channel degradation is high. Stability in the reference reaches has primarily been maintained through a combination of appropriate/natural meander geometry, grade control structures, and

mature tree roots running along and beneath the streambed. Meander geometry can help flatten channel slopes and is achievable through the design process, but mature tree roots in the streambed are generally not achievable at the early stages right after construction.

Baker has considered this design challenge and offers the following solution. First, frequent grade control is necessary. Limiting this to the riffle sections is preferred since this is where most gradient is typically lost in a stream. Second, using more natural grade control to mimic natural conditions is preferred. This favors woody material in the form of log jam constructed riffles, log rollers, and log weirs. These structures will be used in perennial streams (submersion prevents rapid breakdown of wood by fungi) and where woody material is available (i.e., within a particular reach if clearing is needed to implement restoration/enhancement). However, rock material will be incorporated to build constructed riffles and step pools in intermittent streams and in locations where trees are not abundant (upper Reach R4). These structures are necessary to maintain grade control given the steeper channel/riffle slopes and sand/gravel bed material.

Reach R1 Restoration

Reach R1 ends at a culvert that is currently at existing grade; it is not sunk to prevent overtopping since it passes beneath a farm access road. Therefore, Priority Level I restoration is proposed for the entire reach since it will not be necessary to transition with Priority Level II restoration. The main benefits of this restoration approach will allow for a more natural channel pattern, with minimized earthwork required, as well as reducing the bank height ratio to 1.0 throughout the reach and stabilizing isolated eroding banks. The restoration approach in this area will promote more frequent over bank flooding into the hydric soils area; thereby, creating increased opportunity for wetland rehabilitation.

The restored channel will be constructed off-line as much as possible throughout the existing pasture, and will be designed as a Rosgen E type channel. This approach will minimize the number of existing trees that will need to be removed to construct the project. Design calculations indicate that a width-to-depth ratio of 11 will be stable. In-stream structures such as log weirs and grade control log jams will be installed to control grade, dissipate scour energies, and eliminate the potential for upstream channel incision. Additionally, root wads/brush toe and log rollers will be incorporated for step-pool formation, bank stability, and habitat diversity.

The existing, unstable channel will be partially to completely filled along its length using suitable fill material excavated from construction of the restored channel. Vernal pools will be strategically located along the filled abandoned channel to provide habitat diversity and improved detention and treatment of concentrated stormwater runoff.

Riparian buffers in excess of 50 feet will be restored and protected along all of Reach R1. In fact, because extra property was required to secure the easement, the riparian buffer will average approximately 100 feet on each bank of Reach R1. No stream crossings or other breaks in the easement are proposed along this reach and permanent fencing will be installed to exclude cattle from the entire reach.

The riparian area along the entire length of Reach R1 is proposed for wetland rehabilitation as described below.

The culvert at the downstream end of Reach R1 will be replaced with a reinforced concrete pipe. The dam will be fitted with a diaphragm filter around the pipe to prevent piping and/or failure.

Reach R2 Enhancement

Due to its partially degraded nature, an Enhancement Level I approach will be implemented to provide functional uplift to the upper 701 feet of Reach R2 at a 1.5:1 credit ratio. The 167 feet on the lower end downstream from the property line will be limited to Enhancement Level II at a 2.5:1 credit ratio. In the lower segment, improvements will be limited to cattle exclusion and invasive species control. Supplemental buffer planting is not planned in the lower segment because the existing vegetation is satisfactory.

In the upper segment of Reach R2 below the easement break/crossing, a floodplain bench will be cut along the left bank to increase the entrenchment ratio to greater than 2.0 and provide an area for flooding. This will remove vertical, eroding streambanks and allow the stream to reach Stage 6 of Simons channel evolution, albeit without addressing stream pattern. Additionally, two locations in the existing channel have riffles that are oriented up valley; just upstream from this the flow vectors are pointed into vertical streambanks and the stream has nowhere to go without causing significant erosion. The channel will be realigned in these two areas to redirect the streamflow down valley and eliminate the vertical eroding banks.

Additionally, the channel will be raised to encourage floodplain access. Spoil piles along the right bank of middle Reach R2 will be removed, except where mature woody vegetation would be impacted, to reconnect the channel with its floodplain and re-establish wetlands in this area.

This reach section will be enhanced through the appropriate use of in-stream structures to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Channel banks will be graded to stable slopes, and the historic floodplain connection will be reestablished in the vicinity of the spoil piles to further promote stability and re-establishment of riparian vegetation.

Riparian buffers in excess of 50 feet will be restored and protected along all of Reach R2. As with Reach R1, the lower 300 feet will have riparian buffers that, on average, exceed 100 feet on each bank. Additionally, permanent fencing will be installed to exclude cattle. Invasive species, such as Chinese privet, will be treated.

Mapped jurisdictional wetlands in the upper Reach R2 floodplain will be protected during the construction process. Wetland re-establishment will be achieved in the area with removal of spoil piles and reconnection of the floodplain. Additionally, wetland vegetation will be improved.

Reach R3 Restoration and Enhancement

Work along Reach R3 will initially involve Priority Level I restoration continuing from Reach R4 to provide floodplain reconnection and long-term channel stability. Below a proposed easement break/stream crossing toward the downstream end of Reach R3, an Enhancement Level I approach will be implemented, as described above for upper Reach R2.

Reach R3 begins at the confluence Reaches R4 and T3 just above a farm pond. The farm pond will be removed as part of the channel restoration. Below the existing pond, many mature single trees are located intermittently along both sides of the stream channel. The larger trees of significance have been identified during the field survey and the proposed design pattern includes avoidance of these trees whenever feasible. This approach will involve raising the existing bed elevation and an attempt to preserve and/or incorporate trees that currently provide bank stability and are not undermined or likely threatened in

the future. Trees that are appropriately removed will be incorporated as materials for proposed in-stream structures.

This reach will be designed as a Rosgen E type channel with a width-to-depth ratio of 11. The employed techniques will allow restoration of a stable channel form with appropriate bedform diversity, as well as improved channel function through improved aquatic habitat, active floodplain connection, restoration of riparian and terrestrial habitats, exclusion of cattle, and decreased erosion and sediment loss from bank erosion.

An easement break is proposed toward the downstream end of Reach R3 at an existing culvert crossing that will be improved. The easement break will be 60 feet wide to allow for future access to the land west of the stream project, but the proposed culvert crossing will be initially limited to approximately 20 feet.

Below this crossing in the lower segment of Reach R3, a floodplain bench will be cut along the left bank to increase the entrenchment ratio to greater than 2.0 and provide an area for bankfull flooding. This will remove vertical, eroding streambanks and allow the stream to reach Stage 6 of Simons channel evolution, albeit without addressing stream pattern.

Since the primary source of impairment for Reach R3 is direct cattle access and channel incision, wood structures will be incorporated into the channel, where appropriate, to promote stable bedform sequences and habitat diversity. Riparian buffers in excess of 50 feet will be restored along all of Reach R3.

Mapped jurisdictional wetlands limited to lower Reach R3 will be protected during the construction process. Wetland vegetation will be improved in the jurisdictional areas. Additionally, new wetlands may be created along upper Reach R3 by raising the stream bed as part of Priority 1 restoration, thus increasing the hydro period, as well as the wetted area.

Riparian buffers in excess of 50 feet will be restored along all of Reach R3. One stream crossing/easement break is proposed along Reach R3. An existing culvert crossing will be enhanced. Invasive species will be treated.

Reach R4 Restoration

Work proposed along Reach R4 will primarily involve a Priority Level I Restoration approach. The channel begins just upstream from a farm pond at the confluence of Reaches R5 and R6. This confluence will be moved upstream and to the southwest from the existing confluence as part of the Reach R6 proposed mitigation (see above). The farm pond along Reach R4 is proposed to be removed, and the channel bed elevation downstream will be raised so that the bank height ratio is 1.0. A 180-foot section of shallow Priority Level II restoration will be implemented between the farm pond and the property line. This approach will continue downstream to the property line, at which point the incision and channel erosion become more pronounced. Once past the property line, the channel will be re-routed slightly to the northeast to line up with the low point of the valley. Here, the old channel will be partially to completely filled and the failed pond dam will be removed to provide a higher functioning floodplain connection. The trees on the relic floodplain are mostly small and unremarkable. The trees on the east side of the existing channel will be preserved to be part of the restored channel buffer.

Below the residential development, Priority Level I restoration will continue by weaving through the area with the mature trees. The existing channel will be plugged and targeted for vernal pools where runoff concentrates.

A width-to-depth ratio of 13 is proposed for the entire reach, which will reduce shear stress by providing shallower bankfull depths to compensate for steeper valley slopes. The proposed C channel will meander through available floodplain, incorporating old channel features where possible.

Cattle will be excluded from all of Reach R4 and riparian buffers of at least 50 feet will be established. More rock structures will be used on upper Reach R4 compared to other reaches to guard against wood degradation in a higher and less wet proposed channel. Harvested wood will be used to fill the old channel and for log vanes at meander bends.

It is worth noting that the dam on the pond at the top of Reach R4 is close to failing (see Reach R4 photos in Section 2.9.4). A migrating headcut has only about 6 feet to travel before the dam breaches. Removing the pond will eliminate a large source of sediment and pollutants from the Browns Summit Creek system.

No channel crossings are proposed for Reach R4. Invasive species will be treated.

Reach R5 Enhancement and Restoration

Work along Reach R5 will involve Enhancement Level II practices to maintain stability of the channel. The existing channel is incised but bank erosion is isolated and limited. Consequently, Baker proposes to install one grade control structure, plant a riparian buffer, and permanently exclude livestock. The spring at the head of the reach will be incorporated in the project area. A cattle crossing will be established around the top of the reach so that there will be no break in the enhanced channel.

Livestock will be excluded and the buffer will be planted. The riparian buffer will average greater than 50 feet, though the buffer beyond uppermost right bank will be less than 50 feet because of existing pasture fencing on the outside of the easement area and a need to allow cattle to move through this area. Invasive species control will be implemented.

Reach R6 BMP Enhancement

Work along Reach R6 will involve an Enhancement Level I/BMP approach to remove an existing non-jurisdiction farm pond and re-establish and stabilize the eroding channel below it. The pond will be converted to a constructed headwater wetland feature with a low-maintenance, concrete weir outlet. The wetland has been designed following the NCDWR BMP manual with the exception of the outlet, due to the low maintenance requirement. Thus, it will feature diverse topography and vegetation, as well as a forebay and permanent pools. The channel leading into and out of the wetland will feature step pools. The upstream segment will incorporate bench features where even small storm flows will interact with the floodplain, thereby dissipating energy.

The constructed wetland was designed to detain discharge quantities from the 1-inch rainfall event. A V-notched weir will be implemented to slowly release discharges over a 48 hour period thereby reducing downstream discharge velocities. The extended draw down time will also allow for sediments to settle out of the water column and for the uptake of nutrients from wetland plantings. The constructed wetland was designed to meet stormwater pollutant removal rates using the design parameters outlined in the NCDENR BMP Manual. Design elements for the constructed wetland will include the following wetland zones:

- *Deep Pools:*
    - *Non-Forebay: 18-36" (include one at the outlet structure for proper drawdown).*

    - *Forebay: 18-36" plus additional depth for sediment accumulation (deepest near inlet to dissipate energy, more shallow near the exit).*
- *Shallow Water (low marsh): 3-6".*
- *Shallow Land (high marsh): Up to 12". This is the depth of the temporary pool.*
- *Upland: Up to 4 feet above the shallow land zone.*

The conservation easement and buffer plantings will be extended approximately 15 - 30 feet beyond the footprint of the BMP to allow the buffer vegetation to act as pre-treatment feature for both suspended sediment and nutrient loads. In addition, the area along the channel will also be planted and placed within the conservation easement. A cattle crossing will be constructed immediately upstream from the easement.

A 1.5:1 credit ratio for the valley length is proposed for this BMP feature. The valley length is 442 feet.

See Appendix E for design calculations.

Reach T1 Restoration

Work on Reach T1 will involve a Priority Level I restoration approach. Priority Level II restoration will only be needed for a short distance to transition to raise the streambed to a Priority Level I depth. The restored channel will follow the low point of the valley, as it currently does not, and it will tie in to the Reach R2 at its newly restored elevation. The primary source of impairment is livestock access and permanent exclusion fencing will end this practice.

Rock and wood structures will be incorporated into the channel where appropriate to promote stable bedform sequences and habitat diversity. A native riparian buffer is proposed and because of the orientation of Reach T1, it will extend at least 200 feet from the left bank. The top fifteen feet of the right bank will have a 55-foot buffer but the lower 100 feet will have a buffer that approaches 1,000 feet. Invasive species control will be conducted along Reach T1.

Reach T2 Enhancement

Work on Reach T2 will involve an Enhancement Level II approach to stabilize the channel through planting and livestock exclusion. A grade control structure will be incorporated to prevent a headcut that has formed near the confluence with Reach R2/R3 from continuing up the reach.

Riparian buffers in excess of 50 feet will be established along all of Reach T2. Invasive species control will be implemented and cattle exclusion fencing will be installed.

Reach T3 Restoration

Work on Reach T3 will involve a Priority Level I restoration to connect with the restored main channel at the interface of Reaches R3 and R4. The targeted section of Reach T3 is currently extremely incised from a headcut that has migrated from the main channel through the reach. The bed elevation will be raised so that it ties to the restored main channel. Structures will be incorporated to provide bedform diversity and prevent future headcutting. Riparian buffers in excess of 50 feet will be established along all of Reach T3.

Reach T4 BMP Enhancement

A second stormwater BMP feature will be created to stabilize a migrating headcut on Reach T4 that is located at the outfall of a 30-inch stormwater culvert, which drains much of the Broad Ridge Court subdivision. The rock-lined step-pool channel will be

constructed to bring the stormwater runoff from the outlet to the floodplain elevation. A properly-sized basin will capture the runoff, diffuse its energy, and allow water to spread across the vegetated floodplain, promoting nutrient uptake within the buffer. A stable outlet channel will be constructed to deliver the runoff to the project reach. Baker proposes 1.5:1 credit ratio for the valley length of this BMP, similar to the BMP along Reach R6. The valley length of this BMP is estimated to be 170 feet, though only 117 feet will be included in the project because of easement area restrictions by the landowner.

The riparian buffer of this BMP will not reach 50 feet beyond the right bank because it is within a smaller residential parcel. However, this BMP is designed to dissipate and treat stormwater runoff and not overland flow through the buffer.

Table 17.3 Natural Channel Design Criteria for Project Reaches

Browns Summit Creek Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

Parameter	Composite Reference Values		Design Values		Rationale
	Reach R1	Reach R2	Reach R1	Reach R2	
Rosgen Stream Type	E5	E5	E5	E5	Note 1
Bankfull Discharge, Qbkf (cfs)	-	-	49.0	32.3	Note 2
Bankfull Mean Velocity, Vbkf (ft/s)	4 - 6	4 - 6	3.2	2.91	V=Q/A
Bankfull Riffle XSEC Area, Abkf (sq ft)	-	-	15.2	11.1	Note 7
Bankfull Riffle Width, Wbkf (ft)	-	-	12.9	11.0	$\sqrt{Abkf * W / D}$
Bankfull Riffle Mean Depth, Dbkf (ft)	-	-	1.2	1.0	d=A/W
Width to Depth Ratio, W/D (ft/ft)	10 – 12	10 – 12	11	11	Note 3
Width Floodprone Area, Wfpa (ft)	-	-	> 100	-	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	> 2.2	> 2.2	> 6.7	-	Note 4
Riffle Max Depth @ bkf, Dmax (ft)	-	-	1.5	1.3	
Riffle Max Depth Ratio, Dmax/Dbkf	1.1 – 1.3	1.1 – 1.3	1.25	1.3	Note 5
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0 – 1.1	1.0 – 1.1	1.0	1.0	Note 6
Meander Length, Lm (ft)	-	-	140 – 170	NA	Note 7
Meander Length Ratio, Lm/Wbkf	5 – 12	5 – 12	10 - 13	NA	Note 7
Radius of Curvature, Rc (ft)	-	-	26 – 39	22 - 33	Note 7
Rc Ratio, Rc/Wbkf *	2 - 3	2 - 3	2 – 3	2 – 3	Note 7
Belt Width, Wblt (ft)	-	-	50 - 75	-	Note 7
Meander Width Ratio, Wblt/Wbkf	3.5 - 10	3.5 - 10	4 - 6	-	Note 7
Sinuosity, K (TW length/ Valley length)	1.3 – 1.6	1.3 – 1.6	1.4	-	Note 7
Valley Slope, Sval (ft/ft)	.002 –.006	.002 –.006	0.0069	0.0068	Sval / K
Channel Slope, Schan (ft/ft)	-	-	0.0058	0.0054	
Average Slope Riffle, Srif (ft/ft)	-	-	0.013	-	
Riffle Slope Ratio, Srif/Schan	1.2 – 2.0	1.2 – 2.0	2.0	-	Note 8
Slope Pool, Spool (ft/ft)	-	-	0.001	-	
Pool Slope Ratio, Spool/Schan	0.0 – 0.2	0.0 – 0.2	0.0	-	Note 8
Pool Max Depth, Dmaxpool (ft)	-	-	2.7	2.2	
Pool Max Depth Ratio, Dmaxpool/Dbkf	1.2 – 2.5	1.2 – 2.5	2.2	2.2	Note 7
Pool Width, Wpool (ft)	-	-	17.4	14.9	
Pool Width Ratio, Wpool/Wbkf	1.1 – 1.5	1.1 – 1.5	1.3	1.3	Note 9
Pool-Pool Spacing, Lps (ft)	-	-	50 – 87	-	
Pool-Pool Spacing Ratio, Lps/Wbkf	3.5 - 5	3.5 - 5	3.9 - 7	-	Note 7

Notes:

1 A 'C' stream type is appropriate for a lower slopes (generally less than 0.015 ft/ft), wider alluvial valleys (generally greater than 100 ft). A 'Bc' stream type is appropriate for higher slopes (generally greater than 0.015 ft/ft), in more confined valleys. The channel dimension was based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

2 Bankfull discharge analysis was estimated using Manning's equation (n = 0.04) to represent post-construction conditions.

3 The W/D ratio was selected based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

4 Required for Rosgen stream classification.

5 Ratio was based on past project evaluation of similar design channels as well NC Piedmont reference reach streams.

6 A bank height ratio near 1.0 ensures that all flows greater than bankfull will spread onto a floodplain. This minimizes shear stress in the channel and maximizes floodplain functionality, resulting in lower risk of channel instability.

7 Design Values were chosen based on small piedmont stream reference reach data and past project evaluation.

8 Due to the small channel sizes, facet slopes were not calculated for the proposed design. Past project experience has shown that these minor changes in slope between bedform features form naturally within the constructed channel, provided that the overall design channel slope is maintained after construction.

9 Design Values were chosen based on reference reach comparison and past project evaluation. It is more conservative to design a pool wider than the riffle. Over time, the pool width may narrow from sediment deposits and vegetation growth, which is considered to be a positive evolutionary step towards stability.

Parameter	Composite Reference Values		Design Values		Rationale
	Reach R3	Reach R4	Reach R3	Reach R4 lower/upper	
Rosgen Stream Type	E5	C5	E5	C5	Note 1
Bankfull Discharge, Qbkf (cfs)	-	-	31.9	24.8/21.0	Note 2
Bankfull Mean Velocity, Vbkf (ft/s)	4 - 6	3.5 - 5	3.3	3.8/4.2	V=Q/A
Bankfull Riffle XSEC Area, Abkf (sq ft)	-	-	9.7	6.5/5.0	Note 7
Bankfull Riffle Width, Wbkf (ft)	-	-	10.3	9.2/8.1	$\sqrt{Abkf * W / D}$
Bankfull Riffle Mean Depth, Dbkf (ft)	-	-	0.9	0.7/0.6	d=A/W
Width to Depth Ratio, W/D (ft/ft)	10 – 12	10 - 14	11	13	Note 3
Width Floodprone Area, Wfpa (ft)	-	-	> 23	>19 / >17	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	> 2.2	> 2.2	> 2.2	> 2.2	Note 4
Riffle Max Depth @ bkf, Dmax (ft)	-	-	1.2	0.9/0.8	
Riffle Max Depth Ratio, Dmax/Dbkf	1.1 – 1.3	1.1 – 1.4	1.3	1.3/1.3	Note 5
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0 – 1.1	1.0 – 1.1	1.0	1.0	Note 6
Meander Length, Lm (ft)	-	-	90 - 130	80 – 120/	Note 7
Meander Length Ratio, Lm/Wbkf	5 – 12	7 - 14	9.3 – 13.4	12 – 18/	Note 7
Radius of Curvature, Rc (ft)	-	-	20 – 30	18 – 28/16-25	Note 7
Rc Ratio, Rc/Wbkf *	2 - 3	2 - 3	2 - 3	2 – 3.1	Note 7
Belt Width, Wblt (ft)	-	-	35 – 56	30-42/22-43	Note 7

Meander Width Ratio, Wblt/Wbkf	3.5 - 10	3.5 - 8	3.6 – 5.8	4.6-6.5/2.7-12	Note 7
Sinuosity, K (TW length/ Valley length)	1.3 – 1.6	1.2 – 1.5	1.2	1.13/1.23	Note 7
Valley Slope, Sval (ft/ft)	.002 –.006	0.002 – 0.01	0.0095	0.0167/0.0175	
Channel Slope, Schan (ft/ft)	-	-	0.0082	0.011/0.016	
Average Slope Riffle, Srif (ft/ft)	-	-	0.018	0.019	
Riffle Slope Ratio, Srif/Schan	1.2 – 1.5	1.1 – 2.0	2.0	1.7	Note 8
Slope Pool, Spool (ft/ft)	-	-	0.003	0.003	
Pool Slope Ratio, Spool/Schan	0.0 – 0.2	0.0 – 0.2	0.3	0.3	Note 8
Pool Max Depth, Dmaxpool (ft)	-	-	2.0	1.8/1.5	
Pool Max Depth Ratio, Dmaxpool/Dbkf	1.2 – 2.5	1.2 – 2.5	2.2	2.0/1.9	Note 7
Pool Width, Wpool (ft)	-	-	13.9	12.4/10.9	
Pool Width Ratio, Wpool/Wbkf	1.1 – 1.5	1.1 – 1.7	1.3	1.3/1.3	Note 9
Pool-Pool Spacing, Lps (ft)	-	-	47 - 70	36-64/29-52	
Pool-Pool Spacing Ratio, Lps/Wbkf	3.5 - 5	3.5 – 7	4.8 – 7.2	3.9-7/3.6-6.4	Note 7

Notes:

1 A 'C' stream type is appropriate for a lower slopes (generally less than 0.015 ft/ft), wider alluvial valleys (generally greater than 100 ft). A 'Bc' stream type is appropriate for higher slopes (generally greater than 0.015 ft/ft), in more confined valleys. The channel dimension was based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

2 Bankfull discharge analysis was estimated using Manning's equation (n = ~0.04) to represent post-construction conditions.

3 The W/D ratio was selected based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

4 Required for Rosgen stream classification.

5 Ratio was based on past project evaluation of similar design channels as well NC Piedmont reference reach streams.

6 A bank height ratio near 1.0 ensures that all flows greater than bankfull will spread onto a floodplain. This minimizes shear stress in the channel and maximizes floodplain functionality, resulting in lower risk of channel instability.

7 Design Values were chosen based on small piedmont stream reference reach data and past project evaluation.

8 Due to the small channel sizes, facet slopes were not calculated for the proposed design. Past project experience has shown that these minor changes in slope between bedform features form naturally within the constructed channel, provided that the overall design channel slope is maintained after construction.

9 Design Values were chosen based on reference reach comparison and past project evaluation. It is more conservative to design a pool wider than the riffle. Over time, the pool width may narrow from sediment deposits and vegetation growth, which is considered to be a positive evolutionary step towards stability.

Parameter	Composite Reference Values		Design Values		Rationale
	Reach R6	Reach T1	Reach R6	Reach T1	
Rosgen Stream Type	B5c	C5	B5c	C5	Note 1
Bankfull Discharge, Qbkf (cfs)	-	-	16		Note 2
Bankfull Mean Velocity, Vbkf (ft/s)	4 – 6	3.5 - 5	5.2		V=Q/A
Bankfull Riffle XSEC Area, Abkf (sq ft)	-	-	3.1	3.8	Note 7

Bankfull Riffle Width, Wbkf (ft)	-	-	6.1	7.0	$\sqrt{Abkf * W / D}$
Bankfull Riffle Mean Depth, Dbkf (ft)	-	-	0.5	0.5	d=A/W
Width to Depth Ratio, W/D (ft/ft)	12 – 18	10 - 14	14	13	Note 3
Width Floodprone Area, Wfpa (ft)	-	-	13		
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	1.4 – 2.2	> 2.2	< 2.2		Note 4
Riffle Max Depth @ bkf, Dmax (ft)	-	-	0.6	0.7	
Riffle Max Depth Ratio, Dmax/Dbkf	1.2 – 1.4	1.1 – 1.4	1.2	1.4	Note 5
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0 – 1.1	1.0 – 1.1	1.0	1.0	Note 6
Meander Length, Lm (ft)	N/a	-	-	60	Note 7
Meander Length Ratio, Lm/Wbkf	N/a	7 - 14	-	8.6	Note 7
Radius of Curvature, Rc (ft)	N/a	-	-	14 - 21	Note 7
Rc Ratio, Rc/Wbkf *	N/a	2 - 3	-	2 - 3	Note 7
Belt Width, Wblt (ft)	N/a	-	-	28	Note 7
Meander Width Ratio, Wblt/Wbkf	N/a	3.5 - 8	-	4.0	Note 7
Sinuosity, K (TW length/ Valley length)	1.1 – 1.3	1.2 – 1.5	-	1.12	Note 7
Valley Slope, Sval (ft/ft)	0.005 – 0.015	0.005 – 0.015	0.019	0.027	
Channel Slope, Schan (ft/ft)	-	-	0.016	0.019	
Average Slope Riffle, Srif (ft/ft)	-	-	0.06	0.029	
Riffle Slope Ratio, Srif/Schan	1.1 – 1.8	1.1 – 2.0	3.8	1.5	Note 8
Slope Pool, Spool (ft/ft)	-	-	0.02	0.0001	
Pool Slope Ratio, Spool/Schan	0.0 – 0.4	0.0 – 0.4	1.2	0.1	Note 8
Pool Max Depth, Dmaxpool (ft)	-	-	1.7	1.2	
Pool Max Depth Ratio, Dmaxpool/Dbkf	1.2 – 2.5	1.2 – 2.5	2.8	2.4	Note 7
Pool Width, Wpool (ft)	-	-	10.0	9.5	
Pool Width Ratio, Wpool/Wbkf	1.1 – 1.5	1.1 – 1.5	1.4	1.4	Note 9
Pool-Pool Spacing, Lps (ft)	-	-	30 - 54	27 - 35	
Pool-Pool Spacing Ratio, Lps/Wbkf	2 – 6	3.5 – 7	4.3 – 7.7	3.9 – 5.0	Note 7

Notes:

1 A 'C' stream type is appropriate for a lower slopes (generally less than 0.015 ft/ft), wider alluvial valleys (generally greater than 100 ft). A 'Bc' stream type is appropriate for higher slopes (generally greater than 0.015 ft/ft), in more confined valleys. The channel dimension was based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

2 Bankfull discharge analysis was estimated using Manning's equation (n = ~0.04) to represent post-construction conditions.

3 The W/D ratio was selected based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

4 Required for Rosgen stream classification.

5 Ratio was based on past project evaluation of similar design channels as well NC Piedmont reference reach streams.

6 A bank height ratio near 1.0 ensures that all flows greater than bankfull will spread onto a floodplain. This minimizes shear stress in the channel and maximizes floodplain functionality, resulting in lower risk of channel instability.

7 Design Values were chosen based on small piedmont stream reference reach data and past project evaluation.

8 Due to the small channel sizes, facet slopes were not calculated for the proposed design. Past project experience has shown that these minor changes in slope between bedform features form naturally within the constructed channel, provided that the overall design channel slope is maintained after construction.

9 Design Values were chosen based on reference reach comparison and past project evaluation. It is more conservative to design a pool wider than the riffle. Over time, the pool width may narrow from sediment deposits and vegetation growth, which is considered to be a positive evolutionary step towards stability.

Parameter	Composite Reference Values		Design Values		Rationale
	Reach T3	Reach T4	Reach T3	Reach T4	
Rosgen Stream Type	B5c	B5c	B5c	B5c	Note 1
Bankfull Discharge, Qbkf (cfs)	-	-	6.4	10.4	Note 2
Bankfull Mean Velocity, Vbkf (ft/s)	4 – 6	4 – 6	2.3	3.7	V=Q/A
Bankfull Riffle XSEC Area, Abkf (sq ft)	-	-	2.8	2.8	Note 7
Bankfull Riffle Width, Wbkf (ft)	-	-	5.8	5.8	$\sqrt{Abkf * W / D}$
Bankfull Riffle Mean Depth, Dbkf (ft)	-	-	0.5	0.5	d=A/W
Width to Depth Ratio, W/D (ft/ft)	12 – 18	12 – 18	12	12	Note 3
Width Floodprone Area, Wfpa (ft)	-	-	15	12	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	1.4 – 2.2	1.4 – 2.2	< 2.2	< 2.2	Note 4
Riffle Max Depth @ bkf, Dmax (ft)	-	-	0.6	0.6	
Riffle Max Depth Ratio, Dmax/Dbkf	1.2 – 1.4	1.2 – 1.4	1.2	1.9	Note 5
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0 – 1.1	1.0 – 1.1	1.0	1.0	Note 6
Meander Length, Lm (ft)	N/a	N/a	-	-	Note 7
Meander Length Ratio, Lm/Wbkf	N/a	N/a	-	-	Note 7
Radius of Curvature, Rc (ft)	N/a	N/a	-	-	Note 7
Rc Ratio, Rc/Wbkf *	N/a	N/a	2 - 3	-	Note 7
Belt Width, Wblt (ft)	N/a	N/a	12 - 17	-	Note 7
Meander Width Ratio, Wblt/Wbkf	N/a	N/a	-	-	Note 7

Sinuosity, K (TW length/ Valley length)	1.1 – 1.3	1.1 – 1.3	1.2	1.2	Note 7
Valley Slope, Sval (ft/ft)	0.005 – 0.015	0.005 – 0.015	0.017	0.017	Sval / K
Channel Slope, Schan (ft/ft)	-	-	0.014	0.047	
Average Slope Riffle, Srif (ft/ft)	-	-	0.033	0.051	
Riffle Slope Ratio, Srif/Schan	1.1 – 1.8	1.1 – 1.8	2.4	1.1	Note 8
Slope Pool, Spool (ft/ft)	-	-	0.01	0.078	
Pool Slope Ratio, Spool/Schan	0.0 – 0.4	0.0 – 0.4	0.7	1.7	Note 8
Pool Max Depth, Dmaxpool (ft)	-	-	0.9	1.9	
Pool Max Depth Ratio, Dmaxpool/Dbkf	1.2 – 2.5	1.2 – 2.5	1.8	3.2	Note 7
Pool Width, Wpool (ft)	-	-	7.5	7.5	
Pool Width Ratio, Wpool/Wbkf	1.1 – 1.5	1.1 – 1.5	1.3	1.3	Note 9
Pool-Pool Spacing, Lps (ft)	-	-	36	14	
Pool-Pool Spacing Ratio, Lps/Wbkf	2 – 6	2 – 6	6.2	2.4	Note 7

Notes:

1 A ‘C’ stream type is appropriate for a lower slopes (generally less than 0.015 ft/ft), wider alluvial valleys (generally greater than 100 ft). A ‘Bc’ stream type is appropriate for higher slopes (generally greater than 0.015 ft/ft), in more confined valleys. The channel dimension was based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

2 Bankfull discharge analysis was estimated using Manning’s equation (n = ~0.04) to represent post-construction conditions.

3 The W/D ratio was selected based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

4 Required for Rosgen stream classification.

5 Ratio was based on past project evaluation of similar design channels as well NC Piedmont reference reach streams.

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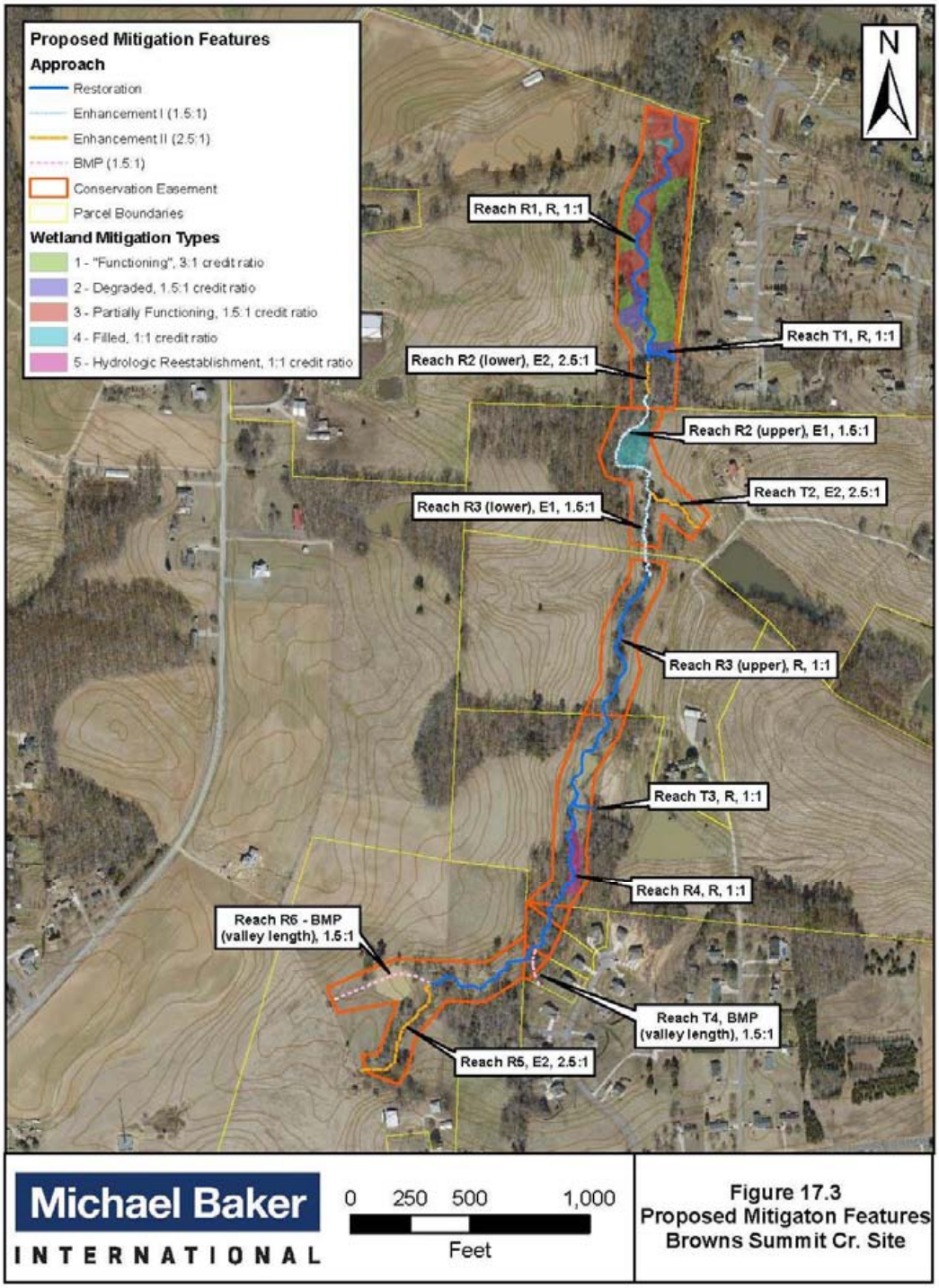
8 Due to the small channel sizes, facet slopes were not calculated for the proposed design. Past project experience has shown that these minor changes in slope between bedform features form naturally within the constructed channel, provided that the overall design channel slope is maintained after construction.

9 Design Values were chosen based on reference reach comparison and past project evaluation. It is more conservative to design a pool wider than the riffle. Over time, the pool width may narrow from sediment deposits and vegetation growth, which is considered to be a positive evolutionary step towards stability.

Figure 17.3 Mitigation Work Plan



17.1.3 Reference Reach Data Indicators

Reference reach surveys can be valuable tools used for comparison. The morphologic data obtained such as dimension, pattern, and profile can be used as a template for design of a stable stream in a similar valley type with similar bed material, as well as with similar watershed land use. In order to extract the morphological relationships observed in a stable system, dimensionless ratios are developed from the surveyed reference reach. These ratios can be applied to a stream design to allow the designer to 'mimic' the natural, stable form of the target channel type.

While reference reach data can be a useful aid in designing channel dimension, pattern, and profile, there are limitations in smaller stream systems. The flow patterns and channel formation for most reference reach quality streams is often controlled by slope, drainage areas and large trees and/or other deep rooted vegetation. Some meander geometry parameters, such as radius of curvature, are particularly affected by vegetation control. Pattern ratios observed in reference reaches may not be applicable or are often adjusted in the design criteria to create more conservative designs that are less likely to erode after construction, before the permanent vegetation is established. Often the best reference data is from adjacent stable stream reaches, or reaches within the same watershed.

Baker used several nearby reference reaches, including two previous NCDMS projects, Buckhorn Creek and UT to Reedy Fork, and one neighboring unrestored stable reach, an unnamed tributary in Haw River State Park, as shown on Figure 17.4. The NCDMS projects are located approximately 11 miles southeast of the project site in the Carolina Slate Belt. The Browns Summit project site and the Haw River State Park site are in the Charlotte Belt.

Buckhorn Creek was restored as part of the Holly Grove mitigation project, developed by Restoration Systems, while UT to Reedy Fork was developed by Mulkey Engineers. Both of these projects were constructed in 2007. Baker selected the Middle Branch reach on the Buckhorn Creek project because its drainage area of 128 acres and valley slope of 0.015 ft/ft are similar to that of the mid to upper Browns Summit reaches. Middle Branch was designed as a Rosgen B4c stream type but it is more of an E/C4 stream type with ER greater than 2.2 and width-to-depth ratios of 11-13. Land use in the Middle Branch watershed is commensurate with that of Browns Summit: 50 percent agriculture (mostly hay), 10 percent pasture, 35 percent forest, and 5 percent residential.

Similarly, Reach R2-3 from the UT to Reedy Fork project is useful for the lower reaches of Browns Summit because of its similar drainage area (211 acres) and valley slope (0.0075). Reach R2-3 is a Rosgen C4 stream type with width-to-depth ratios of greater than 20. Land use for the Reedy Fork project was 67 percent pasture/hay, 25 percent forested, 5 percent row crops, and 3 percent residential. Like Browns Summit, the land use will have shifted to a higher percentage of forest following implementation of the mitigation project.

Monitoring reports show that both have remained stable since construction. Pattern data are available for the NCDMS projects (see Table 17.4), while survey of the closer reference reaches was limited to cross sections.

The primary soil series mapped for the riparian area along Middle Branch of the Buckhorn Creek reference site is Chewacla sandy loam, though smaller inclusions of Cecil sandy loam and Coronaca clay loam are also present. Chewacla is described as being a somewhat poorly drained alluvial soil commonly found on floodplains, with a low runoff rate and hydric inclusions. This is very similar in description to the Codorus loam found in most of the riparian areas of the Browns Summit restoration site. In fact, Chewacla and Codorus are in taxonomically related families. The Cecil and Coronaca soils are both described as well-drained, non-hydric soils with medium to rapid runoff rates found on upland Piedmont side

slopes. They are very similar to the Poplar Forest and Clifford soils found on the Browns Summit site, which are described in a like manner.

Prior to restoration, the land adjacent to Middle Branch was heavily impacted by agricultural activity and had very sparse vegetation. Aside from the managed pasture grasses and planted row crops, the riparian areas primarily contained a mix of briars and invasive species such as multiflora rose (*Rosa multiflora*), blackberry (*Rubus spp*.), Chinese privet (*Ligustrum sinense*), and greenbriar (*Smilax rotundifolia*). Isolated tree and sapling species included tulip poplar (*Liriodendron tulipifera*), American sycamore (*Platanus occidentalis*), ironwood (*Carpinus caroliniana*), and sweetgum (*Liquidambar styraciflua*). For restoration, the target plant community selected was a Mesic Mixed Hardwood Forest (Piedmont subtype) with dominant planted tree species of American sycamore (*Platanus occidentalis*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), and river birch (*Betula nigra*) in the floodplain, with American beech (*Fagus grandifolia*), American elm (*Ulmus Americana*), white ash (*Fraxinus americana*), and bitternut hickory (*Carya cordiformis*) in the more upland areas.

The primary soil series mapped for the riparian area along Reach R2-3 of the UT to Reedy Fork reference site is Chewacla sandy loam, though smaller inclusions of Enon fine sandy loam are also present. Chewacla soils are described as being somewhat poorly drained alluvial soils commonly found on floodplains with low runoff rates and hydric inclusions, very similar to the Codorus loam found in most of riparian areas of the Browns Summit restoration site. Enon fine sandy loams are described as well-drained, non-hydric soils with medium to rapid runoff rates found along Piedmont side-slopes, very similar to the Poplar Forest and Clifford soils found at the proposed restoration site.

Prior to restoration, the riparian buffers along UT to Reedy Fork were almost non-existent, with a very narrow buffer of scattered individual trees found along portions of some reaches. Managed dairy cow pasture was the overall dominant land use within the buffer areas, which heavily impacted the vegetation found on site. The most common species found in the sparse riparian areas that do exist includes red cedar (*Juniperus virginiana*), sweetgum (*Liquidambar styraciflua*), tulip poplar (*Liriodendron tulipifera*), American sycamore (*Platanus occidentalis*), persimmon (*Diospyros virginiana*), black willow (*Salix nigra*), honeysuckle (*Lonicera japonica*), red maple (*Acer rubrum*), and elderberry (*Sambuca canadensis*). As part of the restoration effort, the target plant community of Piedmont/Low Mountain Alluvial Forest was selected (Schafale and Weakley, 1990). Dominant species planted in the riparian areas included river birch (*Betula nigra*), silky dogwood (*Cornus amomum*), green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), swamp chestnut oak (*Quercus michauxii*), spicebush (*Lindera benzoin*), elderberry (*Sambuca canadensis*), and buttonbush (*Cephalanthus occidentalis*).

The Haw River State Park reference reach is located one mile west of the Browns Summit project site and is essentially a very similar watershed and setting. The drainage area is 156 acres and the valley slope is 0.012 ft/ft. The land use is also relatively similar with slightly more forest in the state park site, but also an elementary school that raises the percent impervious cover to approximately 8 percent (Browns Summit is 5 percent). Soils in the vicinity of this reference reach are Poplar Forest clay loam (15-25%), which is the same as that around Reach R3 of Browns Summit. Existing vegetation found here includes red maple (*Acer rubrum*), ironwood (*Carpinus caroliniana*), sweetgum (*Liquidambar styraciflua*), Chinese privet (*Ligustrum sinense*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), greenbriar (*Smilax rotundifolia*), and muscadine grape (*Vitis rotundifolia*). A cross section was measured at the top of bank with a bank height ratio of 1.0. The measured bankfull area was as 6.45 square feet, which is 79 percent of the area estimated from the 1999 Piedmont regional curve. It is a Rosgen E5 stream type with a width-to-depth ratio of 9.0 and

an entrenchment ratio of greater than 10. This reference reach provides valuable dimension information for the middle to lower reaches of Browns Summit since they have similar watershed characteristics. The valley slopes of the upper Browns Summit Reaches are higher and thus a higher width-to-depth ratio is recommended.

These data helped to provide a basis for evaluating the valley slope and topography of the project site and determining the stream systems that may have been present historically and/or how they may have been influenced by changes within the watershed.

The reference reaches fall within the same climatic, topographical, physiographic, and ecological region as the Browns Summit restoration site. These systems exist as smaller intermittent/perennial streams in which flows tend to be relatively steady, with floods of short duration, and seasonal periods of low or even no flow.

Table 17.4 Reference Reach Parameters Used to Inform Design Ratios

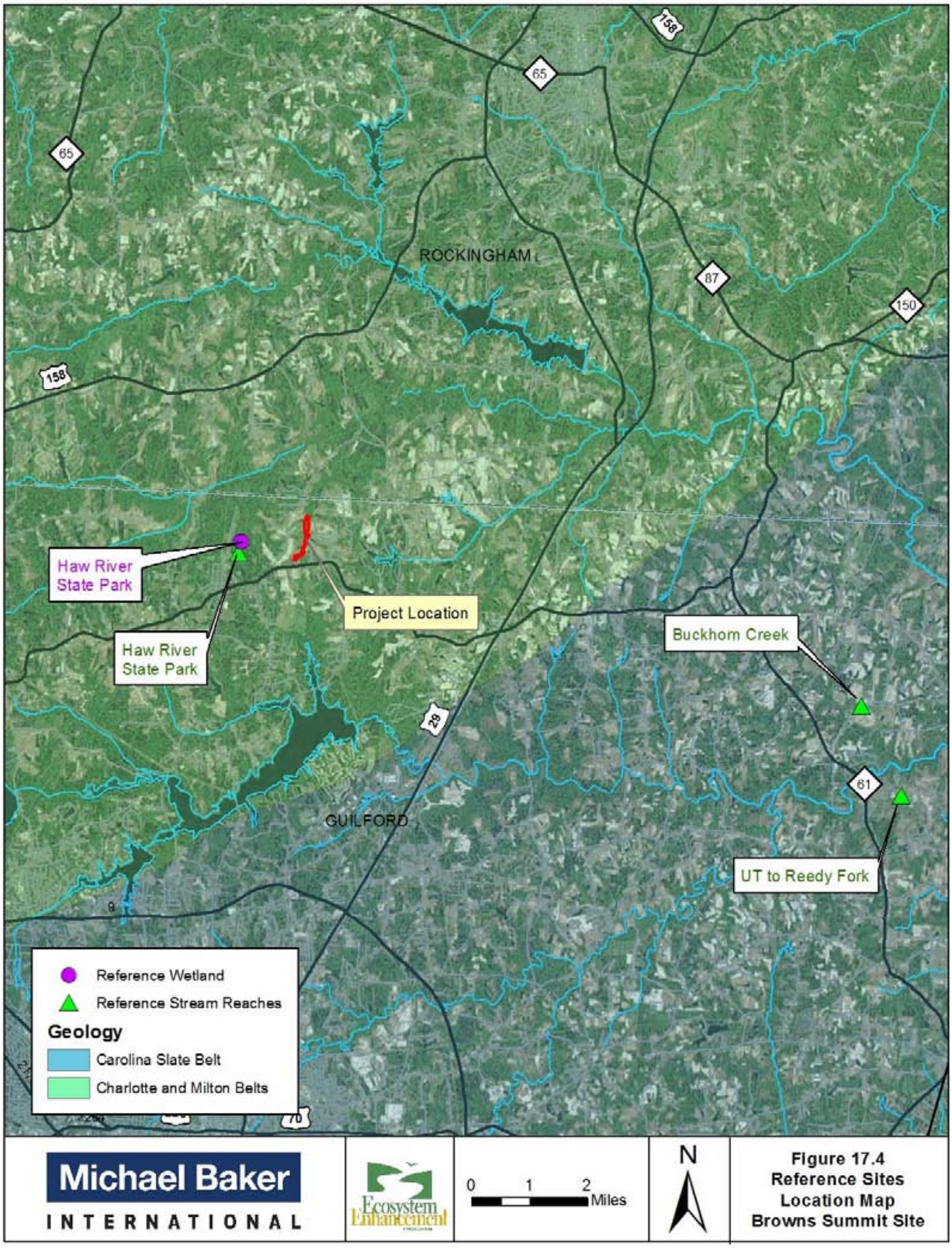
Browns Summit Creek Restoration Project

Parameter	UT to Reedy Fork*		Buckhorn Creek – Middle Branch**	
	MIN	MAX	MIN	MAX
Drainage Area, DA (sq mi)	0.33		0.2	
Stream Type (Rosgen)	C4/1		E4	
Bankfull Discharge, Qbkf (cfs)	40		28	
Bankfull Width, Wbkf (ft)	11.3		7.7	
Bankfull Riffle Cross-Sectional Area, Abkf (sq ft)	6.1		5.4	
Bankfull Mean Velocity, Vbkf (ft/s)	6.6		5.2	
Width to Depth Ratio, W/D (ft/ft)	21	28	11	13
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	6.2	6.8	> 2.2	6.0
Riffle Max Depth Ratio, Dmax/Dbkf	2.3	2.4	1.7	2.0
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0	1.1	1.0	1.1
Meander Length Ratio, Lm/Wbkf	5.1	8.7	2.0	9.0
Rc Ratio, Rc/Wbkf	1.2	4.0	2.0	3.0
Meander Width Ratio, Wblt/Wbkf	1.3	4.9	1.5	3.0
Sinuosity, K	1.33		1.2	
Valley Slope, Sval (ft/ft)	0.0075		0.015	
Channel Slope, Schan (ft/ft)	0.0056		0.013	
Pool Max Depth Ratio, Dmaxpool/Dbkf	2.3	2.7	2.3	2.8
Pool Width Ratio, Wpool/Wbkf	0.8	1.0	1.0	1.2
Pool-Pool Spacing Ratio, Lps/Wbkf	2.5	7.3	4.0	6.0
d16 (mm)			1.0	
d35 (mm)			12.7	
d50 (mm)	0.2 (existing)/4.0 (MY 4)		25.6	
d84 (mm)	6.1 (existing)/12.2 (MY 4)		66	
d95 (mm)			110	

*Used Reach R2-3, Year 4 monitoring.

**Used Reach 5, Year 5 monitoring

Figure 17.4 Reference Stream and Wetland Location Map



17.2 Bankfull Verification Analysis

17.2.1 Bankfull Stage and Discharge

Bankfull stage and its corresponding discharge are the primary variables used to develop a natural channel design. However, the correct identification of the bankfull stage in the field can be difficult and subjective (Williams, 1978; Knighton, 1984; and Johnson and Heil, 1996). Numerous definitions exist of bankfull stage and methods for its identification in the field (Wolman and Leopold, 1957; Nixon, 1959; Schumm, 1960; Kilpatrick and Barnes, 1964; and Williams, 1978). The identification of bankfull stage in the humid Southeast can be especially difficult because of dense understory vegetation and a long history of channel modification and subsequent adjustment in channel morphology.

It is generally accepted that bankfull stage corresponds with the discharge that fills a channel to the elevation of the active floodplain and represents a breakpoint between processes of channel formation and floodplain development. The bankfull discharge, which also corresponds with the dominant discharge or effective discharge, is thought to be the flow that moves the most sediment over time in stable alluvial channels.

Field indicators include the back of point bars, significant breaks in slope, changes in vegetation, the highest scour line, or the top of the stream bank (Leopold, 1994). The most consistent bankfull indicators for streams in the Piedmont of North Carolina are the backs of point bars, breaks in slope at the front of flat bankfull benches, or the top of the stream banks (Harman et al., 1999).

Upon completion of the field survey, accurate identification of bankfull stage could not be made in all reach sections throughout the site due to incised/degraded channel conditions. However, bankfull indicators were apparent in portions of Reaches R1 (occasional top of bank) and R3 (isolated benches). This information and bankfull area from the nearby Haw River State Park reference reach were considered in context with regional curve data. This process is described below.

17.2.2 Bankfull Hydraulic Geometry Relationships (Regional Curves)

Hydraulic geometry relationships are often used to predict channel morphology features and their corresponding dimensions. The stream channel hydraulic geometry theory developed by Leopold and Maddock (1953) describes the interrelations between dependent variables such as width, depth, and area as functions of independent variables such as watershed area or discharge. These relationships can be developed at a single cross-section or across many stations along a reach (Merigliano, 1997). Hydraulic geometry relationships are empirically derived and can be developed for a specific river or extrapolated to a watershed in the same physiographic region with similar rainfall/runoff relationships (FISRWG, 1998).

Regional curves developed by Dunne and Leopold (1978) relate bankfull channel dimensions to drainage area. A primary purpose for developing regional curves is to aid in identifying bankfull stage and dimension in ungaged watersheds, as well as to help estimate the bankfull dimension and discharge for natural channel designs (Rosgen, 1994). Gage station analyses throughout the United States have shown that the bankfull discharge has an average return interval of 1.5 years or 66.7% annual exceedence probability on the maximum annual series (Dunne and Leopold, 1978; Leopold, 1994).

Regional curves are available for a range of stream types and physiographic provinces. The NC Rural Piedmont Regional Curve (Harman et al., 1999) and an unpublished NC Piedmont Regional Curve developed by the Natural Resources Conservation Service (A. Walker private communication, 2012) were used for comparison with other site-specific methods of estimating bankfull discharge. Baker has successfully implemented a large number of stream

restoration projects in North Carolina using the published curve data and has produced "mini-curves" specific to many these projects. The NC Rural Piedmont Regional curve equations developed from the study are shown below in Table 17.5.

Table 17.5 NC Rural Piedmont Regional Curve Equations

Browns Summit Creek Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

NC Piedmont Rural Regional Curve Equations (Harman et al., 1999)		NC Piedmont Rural Regional Curve Equations (Unpublished Revised NC Rural Piedmont Regional Curve (NRCS, 2008)	
$Q_{bkf} = 66.57\ A_w^{0.89}$	$R^2=0.97$	$Q_{bkf} = 58.26\ A_w^{0.78}$	$R^2=0.99$
$A_{bkf} = 21.43\ A_w^{0.68}$	$R^2=0.95$	$A_{bkf} = 15.65 A_w^{0.69}$	$R^2=0.99$
$W_{bkf} = 11.89\ A_w^{0.43}$	$R^2=0.81$	$W_{bkf} = 11.64\ A_w^{0.46}$	$R^2=0.98$
$D_{bkf} = 1.50\ A_w^{0.32}$	$R^2=0.88$	$D_{bkf} = 1.15\ A_w^{0.28}$	$R^2=0.96$

Based on observations made in small rural piedmont streams, the growing number of data points provides supporting evidence for the selection of bankfull indicators that produce smaller dimensions and flow rates than the published regional data. This appears to be the case with Browns Summit Creek because measurements taken around the project area provided similar results; the published (1999) Piedmont regional curve was generally higher than the bankfull area from field measurements (see Table 17.6). In one case, the measured bankfull area was larger than that estimated by the regional curve. Thus, it appears that published Piedmont regional curves bracket the smaller Charlotte Belt streams that are part of the Browns Summit Creek project.

As a comparison of representative stable cross sections identified in Reach R1, the NC Piedmont Regional Curve estimates a bankfull cross-sectional area (Abkf) of approximately 16.5 sf and a bankfull discharge (Qbkf) of approximately 46.9 cfs for a 0.675 mi^2 watershed. The revised rural piedmont regional curve estimates the Abkf of 12.0 sf and the Qbkf of 42.9 cfs. The existing surveyed channel dimension has cross-sectional area at the top-of-streambank/bankfull indicator of 16.2 sf. Additionally, for Reach R3 bankfull indicators were present in the form of floodplain benches and those yielded cross-sectional areas of approximately 7.5. The bankfull areas from the published regional curve is estimated to be 9.3, while that from the revised regional curve is 6.5 sf. Finally, a top-of-bank indicator from nearby Haw River State Park yielded a bankfull area of 6.5 sf, while the published and revised regional curve estimates are 8.2 and 5.9, respectively.

Thus, as described in Section 17.1.1.3, the geomorphological form for the site's stream dimension often lies roughly halfway between the two regional curves.

Table 17.6 Comparison of Bankfull Areas

Browns Summit Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

Reach	DA (sq mi)	Estimate from 1999 Regional Curve (sq ft)	Measured At Bankfull Indicator (sq ft)	Estimate from Revised Regional Curve (sq ft)
R1	0.675	16.5	16.2	12.0
R3	0.289	9.3	7.4, 7.7	6.5
Haw R. State Park	0.241	8.2	6.5	5.9

Note: drainage areas in this table apply to cross section locations, not the outlet point of each reach.

17.2.3 Conclusions for Channel Forming Discharge

As described above in Section 17.2.1, Rosgen's stream classification system (Rosgen, 1996) depends on the proper field identification of consistent geomorphic features related to the active floodplain. Although bankfull stage verification was not possible in the field for all reaches under current conditions, the cross-section data used for the above regional curve comparison are within an acceptable range of values given the existing channel conditions, geologic features, and flow regime/dentritic drainage patterns.

Table 17.7 provides a bankfull discharge analysis based on the bankfull regional curves, the Manning's equation discharges calculated from the representative cross sections for each reach, and the bankfull design discharge estimations based on the proposed design cross sections for all project reaches.

Manning's roughness (n) was estimated using the USGS paper "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Floodplains" (Arcement and Schneider, 1989). Although selecting a Manning's roughness coefficient can be somewhat subjective, the goals was to select a design value representative of a sand bed channel immediately after construction with some influence from debris, meandering, and minimal vegetation (e.g, livestakes, log jams, log vanes, herbaceous growth, etc.). The stream power is higher and the sediment supply should be lower for this system, so a conservative n value was chosen. Considering additional bedform roughness will be created (e.g., log jams, constructed riffles), over time the roughness should increase as vegetation establishes so that n values may range from 0.07 to greater than 0.10.

Table 17.7 Bankfull Discharge Analysis
Browns Summit Creek Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

Estimating Method	Bankfull Velocity (ft/sec)	Bankfull Discharge (cfs)
	Reach R1	
NC Rural Piedmont Regional Curve[1]	4.09	67.4
NRCS NC Rural Piedmont Regional Curve[2]	3.60	43.2
Friction Factor to Relative Roughness Ratio method[3]	3.94	64.3
Manning's "n" from friction factor and relative roughness[3]	3.16	51.4
Manning's "n" from stream type[3]	2.18	35.6
Baker Design Estimate	3.56	58.0
	Reach R2	
NC Rural Piedmont Regional Curve[1]	4.03	51.6
NRCS NC Rural Piedmont Regional Curve[2]	3.50	32.4
Friction Factor to Relative Roughness Ratio method[3]	3.57	41.4
Manning's "n" from friction factor and relative roughness[3]	2.95	34.0
Manning's "n" from stream type[3]	2.04	23.5
Baker Design Estimate	3.87	43.0
	Reach R3	
NC Rural Piedmont Regional Curve[1]	3.97	41.7
NRCS NC Rural Piedmont Regional Curve[2]	3.42	25.7
Friction Factor to Relative Roughness Ratio method[3]	4.22	41.0
Manning's "n" from friction factor and relative roughness[3]	3.47	33.6
Manning's "n" from stream type[3]	2.39	23.2
Baker Design Estimate	3.51	34.5
	Reach R4	

Table 17.7 Bankfull Discharge Analysis
Browns Summit Creek Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

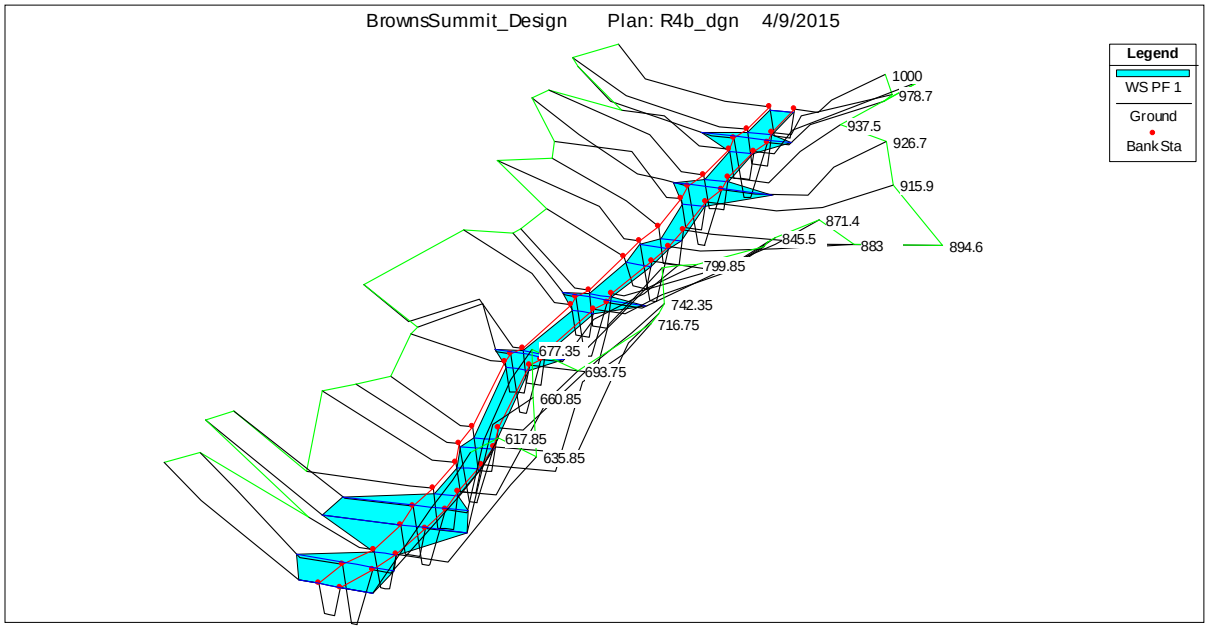
Estimating Method	Bankfull Velocity (ft/sec)	Bankfull Discharge (cfs)
NC Rural Piedmont Regional Curve[1]	3.90	29.8
NRCS NC Rural Piedmont Regional Curve[2]	3.29	17.9
Friction Factor to Relative Roughness Ratio method[3]	4.72	30.7
Manning's "n" from friction factor and relative roughness[3]	4.02	26.1
Manning's "n" from stream type[3]	2.78	18.1
Baker Design Estimate	3.69	24.0

Notes:
[1] NC Piedmont Regional Curve (Harman et al., 1999).
[2] Unpublished Revised NC Rural Piedmont Regional Curve developed by NRCS (A. Walker personal communication, 2008).
[3] WARSSS, 2006 spreadsheet. Bankfull discharge estimates vary based on Manning's Equation for the riffle cross-section. Bankfull stage roughness estimates (*n*-values) ranged from approximately 0.035 to 0.055 based on channel slopes, depth, bed material size, and vegetation influence.

17.2.4 HEC RAS Modeling

To check the bankfull cross-sectional area and design estimate for discharges, Baker constructed a HEC RAS model of lower Reach R4, from station 23+59 to station 27+59. This is an area of Priority Level I restoration that includes steeper riffle slopes which approach three percent. Figure 17.5 shows the model results with the prescribed bankfull cross-sectional areas (9.2 sf for riffles, 12.4 sf for pools) and design bankfull discharge of 24 cfs. The results show that incipient flooding is occurring in the pools and at the downstream end of the modeled segment. The upper riffles are steeper and bankfull discharge is typically one or two tenths of a foot below the bankfull elevation. It is expected that the pools will flood first and also within an acceptable range given model uncertainty.

Figure 17.5 HEC RAS Model Output for Lower Reach R4 at Bankfull Discharge



17.3 Sediment Transport Analysis

17.3.1 Background and Methodology

The purpose of a sediment transport analysis is to ensure that the stream restoration design creates a stable channel that does not aggrade or degrade over time. The overriding assumption is that the site streams should be transporting the total sediment load delivered from upstream sources. The ability of the stream to transport its total sediment load can be quantified through two measures: sediment transport competency (force) and sediment transport capacity (power). Lane (1955) describes a generalized relationship of stream stability and dynamic equilibrium wherein the product of sediment load and sediment size is proportional to the product of stream slope and discharge.

Sediment transport capacity is a stream's ability to move a mass of sediment through a cross-section dimension, and is a measurement of stream power, often expressed in units of watts/square meter (Watts/meter^2). Transport competency is a stream's ability to move particles of a given size and is a measurement of force, often expressed as units of pounds per square foot (lbs/ft^2). A stream's competency is estimated in terms of the relationship between critical and actual depth, at a given slope, and occurs when the critical depth produces enough shear stress to move the largest (d100) particle size.

In sand/gravel bed streams, such as Browns Summit Creek and its tributaries, sediment transport capacity is the critical analysis. The total volume of sediment transported through a cross section consists of bedload plus suspended load fractions. Suspended load is normally composed of fine sand, silt, and clay particles transported in the water column. The bedload generally includes relatively larger particles, such as coarser sand and gravel, which are mobilized by rolling, sliding, or bouncing (saltating) along the bed.

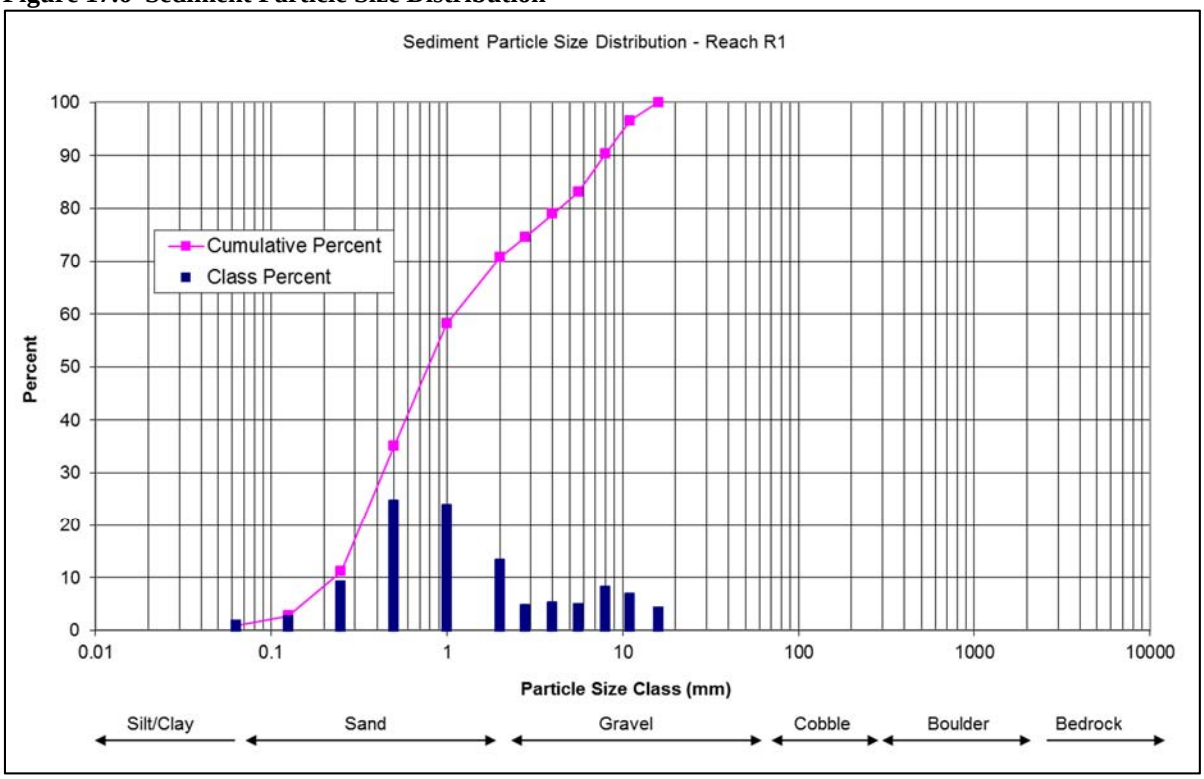
Given the steeper slopes of the project reaches, there is ample stream power (i.e., capacity) to move the sediment load and very little risk of aggradation. Thus, to guard against degradation, very frequent constructed threshold riffles that are immobile have been included in the design. This is one of the recommendations from a study of Piedmont sand bed streams conducted by Buck Engineer (now Baker) for NCDMS (Buck Engineering, 2007). The watershed does not appear to be sediment supply limited, so material that is transported from riffle beds may be replaced by sediment supply from upstream. However, given the high stream power and channel stabilization measures (which will reduce sediment supply) undertaken as part of this project, incorporating frequent grade control in the riffles provides insurance against channel degradation. Additionally, should the watershed further develop, riffle grade control will protect against a flashier hydrologic response.

17.3.2 Sampling Data Results

Sediment samples, consisting of bulk samples across the active channel bed, were collected along the project reaches and dry sieved in a lab to obtain a sediment size distribution. The sample locations are shown on Figure 17.1. The sieve data shown in Figure 17.6 show that all samples have a d50 in the 0.4-0.8 mm range, indicating that the dominant bed material in the stream channel is medium to coarse sand under current conditions. Additionally, the largest particles are fine to coarse gravel in all cases, with the largest particles typically less than 16 mm, though up to 40 mm. This is essentially a unimodal size distribution since everything is finer than medium gravel with no separation between the fractions.

It should be noted that the modified Wolman pebble count (Rosgen, 1994) is not appropriate for sand-bed systems; therefore, a bulk sample procedure was only used to characterize the bed material for all of the Browns Summit Creek sediment samples. All of the reaches contain gravel and sand, with less than 5 percent silt substrate due to the parent geology and soil, as well as cattle impacts. Gravel composes approximately four (R4) to 23 (R1) percent of the substrate in all locations.

Figure 17.6 Sediment Particle Size Distribution



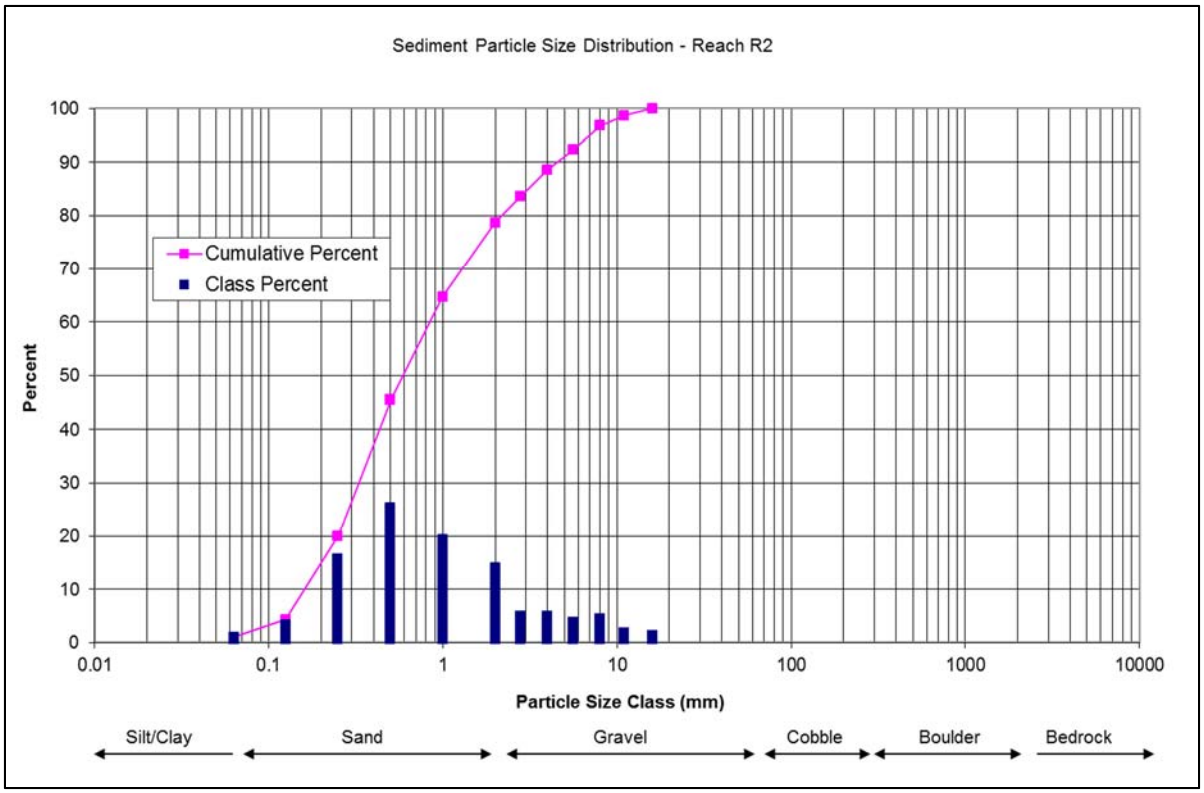
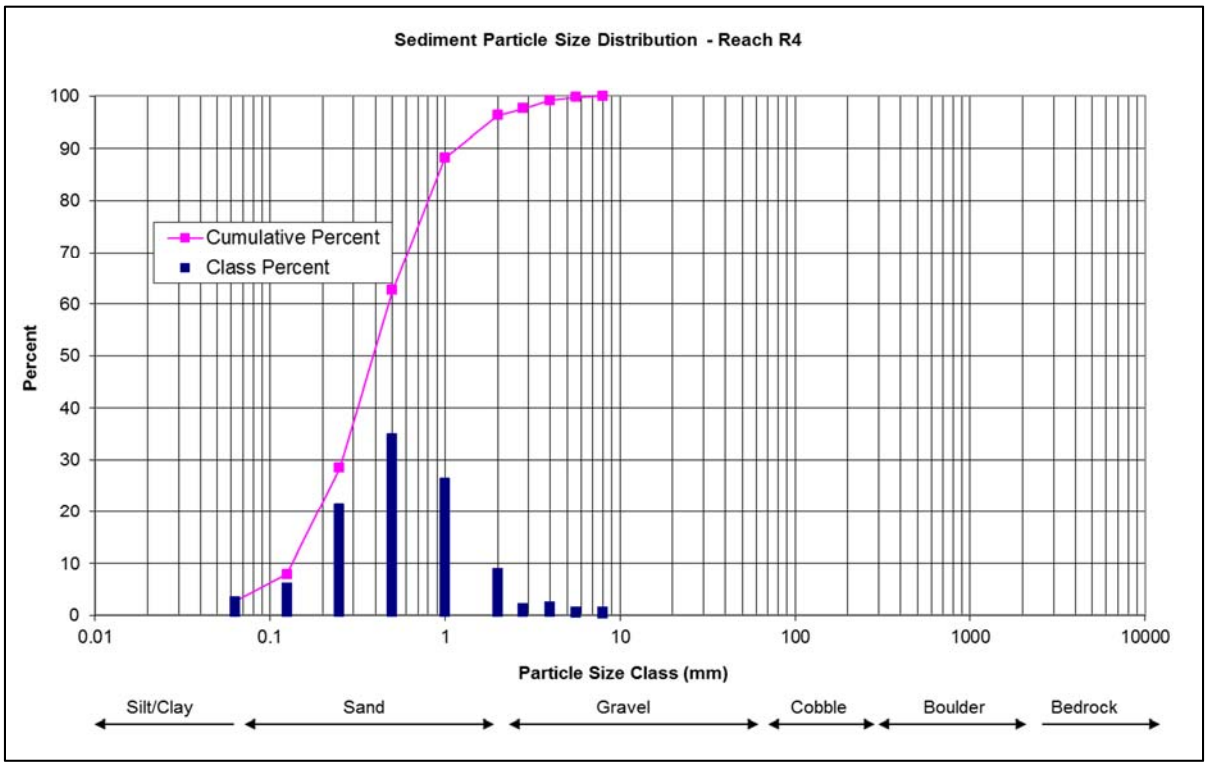


Figure 17.6 Sediment Particle Size Distribution (Continued)



17.3.3 Predicted Channel Response

The existing streams have sand beds, with roughly 20 percent gravel. Based on field observations and position within the upper watershed, the streams receive mostly fine materials from bank erosion and minimal sediment loading from the upstream drainage. Further investigations confirmed that the sediment supply from upstream sources is limited during larger storm events due to impoundments (farm ponds), smaller headwater drainages, and controlling vegetative cover. While it is predicted that the restoration and enhancement efforts will reduce localized stream bed/bank erosion, the channels still must transport smaller bedload material from upstream sources while maintaining stream bed/bank stability.

The proposed design grain-size distribution is for it to remain essentially the same or become finer (e.g., less gravel) as the existing distribution (i.e., primarily sand with approximately 5-20 percent gravel). Any potential reduction of the gravel composition stems from observations that gravel transport rates increase by as much as several orders of magnitude with an increase in sand content of the bulk sediment (Wilcock et al., 2001). We don't necessarily expect the sand content to increase, but if it does then additional gravel may be transported through the project stream network. The sand content could increase if, for example, saprolite that is currently exposed by incision is covered by fill as part of Priority Level I restoration. The saprolite may be a source of channel gravel material.

Sediment transport competency/entrainment and capacity were compared for the existing channels and the design conditions for restored stream systems. Table 17.8 shows bankfull boundary shear stress and stream power values for existing and design conditions. Bankfull boundary shear stress and stream power values are somewhat lower for the proposed conditions than the existing conditions, because the design channels are wider and shallower than the existing, generally incised channels. The proposed conditions are still high enough, however, to move the expected sediment load.

Using another sediment transport competency comparison, boundary shear stress was plotted on Shield's Curve to estimate the largest moveable particle. Not surprisingly, in all reaches, as shown in

Table 17.8, the Shield's Curve predicts the mobility of particles much larger than the d100 observed in the existing bulk samples. However, the Shield's Curve also informs the size of the d100 in the design constructed riffle. This competency analysis ensures that the d100 of the proposed riffle material will not mobilize at the design discharge.

As a design consideration, the proposed substrate material mix (riffle armor) will contain particle sizes larger than those predicted to move based on the Shield's Curve to achieve vertical stability immediately after construction. The site has both steep (> 0.02 ft/ft) and flatter channel slopes throughout the tributaries and the main stem. In general, the proposed design channels with riffle slopes greater than 1.5% will be constructed using larger particles. Any concerns regarding further channel degradation and vertical stability will be addressed by installing a combination of grade control structures such as constructed riffles, grade control log jams, and log/rock step pools.

The prediction calculations shown on Table 17.8 include shear stress, tractive force, and critical dimensionless shear stress, which help to determine a particle size class (e.g., sand, gravel, cobble) that is mobile, or entrained, under various flow conditions (WARSS, 2006).

Table 17.8 Boundary Shear Stress and Stream Power for Existing and Proposed Conditions
Browns Summit Creek Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

Parameter	Reach R1 Existing Conditions	Reach R1 Proposed Conditions	Reach R2 Existing Conditions	Reach R2 Proposed Conditions
Bankfull Discharge Estimate, Q (cfs)	58	58	43	43
Bankfull XS Area (square feet)	16.3	15.2	11.1	11.1
Mean Bankfull Velocity (ft/sec)	3.56	3.82	3.87	3.87
Bankfull Width, W (feet)	12.3	12.9	10.1	11.0
Bankfull Mean Depth, D (feet)	1.3	1.2	1.1	1.0
Width to Depth Ratio, w/d (feet/ foot)	9.3	11	9.1	11
Wetted Perimeter (feet)	15.0	15.3	12.3	13.0
Hydraulic Radius, R (feet)	1.09	1.0	0.9	0.85
Channel Slope (feet/foot)	0.0058	0.0048	0.0054	0.0055
Boundary Shear Stress, τ (lbs/ft^2)	0.47	0.36	0.37	0.34
Subpavement d_{100} (mm)	13.5	13.5	13.5	13.5
Largest Moveable Particle (mm) per Modified Shield's Curve	114	88	100	90
Predicted Critical Depth (feet)	0.17	0.2	0.18	0.18
Predicted Critical Slope (feet/ foot)	0.001	0.001	0.001	0.001
Stream Power (W/m^2)	25.7	20.3	20.4	19.1
Parameter	**Reach R3 Existing Conditions**	**Reach R3 Proposed Conditions**	**Reach R4 Existing Conditions**	**Reach R4 Proposed Conditions**
Bankfull Discharge Estimate, Q (cfs)	34	34	24	24

Table 17.8 Boundary Shear Stress and Stream Power for Existing and Proposed Conditions
Browns Summit Creek Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

Parameter	Reach R1 Existing Conditions	Reach R1 Proposed Conditions	Reach R2 Existing Conditions	Reach R2 Proposed Conditions
Bankfull XSC Area (square feet)	9.7	9.7	6.5	6.5
Mean Bankfull Velocity (ft/sec)	3.51	3.51	3.69	3.69
Bankfull Width, W (feet)	8.5	10.3	7.6	9.2
Bankfull Mean Depth, D (feet)	1.15	0.9	0.86	0.7
Width to Depth Ratio, W/D (ft/ft)	7.4	11	8.8	13
Wetted Perimeter (feet)	10.8	12.2	9.3	10.6
Hydraulic Radius, R (feet)	0.9	0.8	0.7	0.6
Channel Slope (feet/foot)	0.0082	0.0085	0.0164	0.0135
Boundary Shear Stress, τ (lbs/ft^2)	0.59	0.48	0.88	0.59
Subpavement d_{100} (mm)	13.5	13.5	6.8	6.8
Largest Moveable Particle (mm) per Modified Shield's Curve	141	116	208	141
Predicted Critical Depth (feet)	0.29	0.28	0.15	0.18
Predicted Critical Slope (feet/ foot)	0.002	0.003	0.003	0.003
Stream Power (W/m^2)	30.7	26.2	45.1	30.7

17.4 Existing Vegetation Assessment

The riparian areas within and adjacent to the proposed project area primarily consist of pasture, agricultural fields, and mature successional forest, as described by Schafale and Weakley (1990). Historic land management surrounding the project area has been primarily for agricultural and silvicultural purposes through the alteration of drainage patterns and the significant removal of native species vegetation in and around much of the riparian zone. The forested portions of the site primarily consist of Piedmont Alluvial Forest (Schafale and Weakley, 1990). Many of these areas lack understory vegetation due to extensive livestock use and grazing. The riparian buffer areas overall ranged from somewhat disturbed to very disturbed and a general description of each community follows.

17.4.1 Maintained/Disturbed

The maintained or disturbed areas are found in the upper and middle sections of the project around managed farm ponds adjacent to cattle pasture and hay production areas. The outfall areas for each pond are disturbed with unstable, eroding channels. The surrounding areas are maintained for their respective agricultural uses.

17.4.2 Agricultural Fields and Pasture Areas

This community covers approximately 50-60 percent of the project area perimeter. Currently, the majority of pasture areas are used for dairy cattle grazing. The vegetation within the open fields and pasture areas is primarily comprised of fescues and clovers, along with a scattered variety of weeds including dandelion (*Taraxacum officinale*), buttercup (*Ranunculus sp.*), and dog fennel (*Eupatorium*

capillifolium). In the scattered wooded areas within the pastures and fields, the canopy is dominated by red maple (*Acer rubrum*), red cedar (*Juniperus virginiana*), sycamore (*Platanus occidentalis*), and loblolly pine (*Pinus taeda*).

17.4.3 Piedmont Alluvial Forest

These forested areas comprise approximately 40-50 percent of the project area, mostly in the lowermost portion of the project. The mature canopy is dominated by red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), and loblolly pine (*Pinus taeda*), but also includes some slippery elm (*Ulmus rubra*) and red cedar (*Juniperus virginiana*). Much of the understory is fairly open due to extensive livestock grazing, though woody shrub and vine species include poison ivy (*Toxicodendron radicans*), honeysuckle (*Lonicera japonica*), greenbrier (*Smilax rotundifolia*), grape vine (*Vitis rotundifolia*), and tag alder (*Alnus serrulata*). Herbaceous species of note include jewelweed (*Impatiens capensis*), soft rush (*Juncus effuses*), and various sedges (*Carex spp.*) found scattered throughout the wetter areas.

17.4.4 Invasive Species Vegetation

The primary invasive species vegetation present on the project site are primarily Chinese privet (*Ligustrum sinense*), Multiflora rose (*Rosa multiflora*), and Japanese stiltgrass (*Microstegium vimineum*), which were found interspersed throughout the riparian buffer areas and stream banks. Invasive species vegetation will be sprayed, cut and painted, or grubbed in areas infested within the easement. Treatments will be conducted to control the invasive species vegetation with the easement during the monitoring period as needed.

17.5 Site Wetlands

On-site investigations of the areas proposed for wetland mitigation were conducted on October 15, 2013 by a licensed soil scientist with the Catena Group, LLC (see Appendix 16.6 for the hydric soil investigation), as required by the RFP. Their findings indicate the presence of hydric soils along the floodplain of Reaches R1 and R2. The soils in this area were identified as "Soil Unit 1 – Hydric Soil" in the hydric soil investigation. Catena noted that "Soil Unit 1 would likely be considered jurisdictional wetland that has been severely degraded by a combination of human and livestock [activities]. As such, it is a prime candidate for rehabilitation." Catena further concluded that "Soil Unit 1 is a prime candidate for wetland restoration through rehabilitation. It is anticipated that through Priority 1 stream restoration, removal of livestock, and revegetation, the hydrology will be restored and the soils will eventually form structure, which will allow the wetland to regain its normal functions." Hydric soil findings were based on hand-turned soil auger borings and the "NRCS Field Indicators of Hydric Soils in the United States – Guide for Identifying and Delineating Hydric Soils (Version 7.0, 2010)".

17.5.1 Jurisdictional Wetland Assessment

The proposed project area was reviewed for the presence of wetlands and waters of the United States in accordance with the provisions on Executive Order 11990, the Clean Water Act, and subsequent federal regulations. Wetlands have been defined by the USACE as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3(b) and 40 CFR 230.3 (t)). The areas in the project boundaries that displayed one or more wetland characteristics were reviewed to determine the presence of wetlands. The wetland characteristics included:

1. Prevalence of hydrophytic vegetation.
2. Permanent of periodic inundation or saturation.
3. Hydric soils.

On June 5, 2007, the USACE and US Environmental Protection Agency (USEPA) issued joint guidance for their field offices for Clean Water Act jurisdictional determinations in response to the Supreme Court's decision in the consolidated cases of Rapanos v. United States and Carabell v. United States (USEPA and USACE, 2007). Based on this guidance, the agencies will assert jurisdiction over the following waters:

- Traditional navigable waters (TNWs)
- Wetlands adjacent to TNWs
- Non-navigable tributaries of TNWs that are considered relatively permanent waters (RPWs). Such tributaries flow year-round or exhibit continuous flow for at least 3 months.
- Wetlands that directly abut RPWs.

The agencies will decide jurisdiction over the following waters based on a standardized analysis to determine whether they have a significant nexus with a traditional navigable water:

- Non-navigable tributaries that are not relatively permanent waters (non-RPWs)
- Wetlands adjacent to non-RPWs
- Wetlands that are adjacent to but do not directly abut an RPW.

The significant nexus analysis is fact-specific and assesses the flow characteristics of a tributary and the functions performed by all its adjacent wetlands to determine if they significantly affect the physical, chemical, and biological integrity of downstream TNWs. A significant nexus exists when a tributary, in combination with its adjacent wetlands, has more than a speculative or insubstantial effect on the physical, chemical, or biological integrity of a TNW.

The USACE and USEPA will apply the significant nexus standard within the limits of jurisdiction specified by the Supreme Court decision in the case of Solid Waste Agency of Northern Cook County (SWANCC) v. US Army Corps of Engineers. Under the SWANCC decision, the USACE and USEPA cannot regulate isolated wetlands and waters that lack links to interstate commerce sufficient to serve as a basis for jurisdiction under the Clean Water Act. Though isolated wetlands and waters are not regulated by the USACE, within the state of North Carolina isolated wetlands and waters are considered "waters of the state" and are regulated by the NCDWR under the isolated wetlands rules (15A NCAC 2H .1300).

Following a desktop review of the National Wetland Inventory (NWI), NRCS soil survey and USGS quadrangle maps, the project area was evaluated for potential impacts to jurisdictional wetlands. Baker wetland scientists conducted a field survey of the project area in May of 2014 to investigate potential wetlands within hydric soils areas and confirm previously identified perennial and intermittent streams in the project area. In total, the field survey identified four separate wetland areas containing hydric soil indicators and a predominance of hydrophytic vegetation and wetland hydrology. These areas were identified, flagged, and mapped. Wetland data forms are also provided in Section 16.1. Most of the identified areas are currently subject to cattle grazing, which had a significant impact on the vegetation as a result. These areas were field verified by the USACE and NCDWR in July 2014, and the proposed mitigation plan for the site will seek to enhance and minimize disturbance of these wetland areas, if possible, to restore a stable stream system.

17.5.2 Wetland Impacts and Considerations

It is almost certain that wetlands were historically present in the proposed wetland restoration area at the bottom of the project, based on the existing topography, soils, hydrology and hydrophytic vegetation found there. The original plant community located in these wetlands was most likely indicative of other forested alluvial wetlands in the region, but past and current agricultural land use practices have altered the composition of the plant community presently found there. Wetland stressors such as cattle grazing, man-made dams, ditching, and channel straightening have altered the vegetation and hydrological connections within the project area.

After completing the proposed stream restoration practices, these areas will likely experience a more natural hydrology and flooding regime, and the riparian and adjacent wetland areas will be planted with a more diverse range of native vegetation species that are more tolerant of wetter conditions. The design approach will also enhance any potential areas of adjacent fringe or marginal wetlands through higher water table conditions (elevated stream profile) and a more frequent over-bank flooding regime. Furthermore, with the exclusion of cattle from the wetland areas, soil structure can begin to reform after decades of severe degradation. Improved soil structure leads directly to increased water infiltration and retention, improved soil porosity, increased plant root growth, reduced soil erosion, and decreased overland flow volumes and velocities. It will also result in an improvement in the biogeochemical processes important to wetland function.

17.5.3 Climatic Conditions

The average growing season (defined as the period in which air temperatures are maintained above 28° Fahrenheit at a frequency of 5 years in 10) for the project locale is 229 days, beginning on March 25th and ending November 10th (USDA Climate Data for Guilford County, WETS Station: Piedmont Triad Intl Airport in Greensboro, NC). The area experiences an average annual rainfall of 43.14 inches as shown on Table 17.9. During 2014, the nearest weather station (NCAT – NC A&T University Research Farm, an ECONet type station) located roughly 10 miles to the south recorded 39.97 inches of rain. In much of the southeastern US, average rainfall exceeds average evapotranspiration losses and these areas experience a moisture excess during most years. Excess water leaves a site by groundwater flow, surface runoff, channelized surface flow, or deep seepage. Annual losses due to deep seepage, or percolation of water to confined aquifer systems, are usually small and are not considered a significant loss pathway for excess water. Although groundwater flow can be significant in some systems, most excess water is lost via surface and shallow subsurface flow.

Table 17.9 Comparison of Monthly Rainfall Amounts for Project Site vs. Long-term Averages
Browns Summit Creek Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

Month-Year	Observed Monthly Precipitation (in)	WETS Table Average Monthly Precipitation (in)	Deviation of Observed from Average (in)
Jan-2014	3.86	3.54	0.32
Feb-2014	2.74	3.10	-0.36
Mar-2014	6.28	3.85	2.43
Apr-2014	4.31	3.43	0.88
May-2014	0.84	3.95	-3.11
Jun-2014	3.49	3.53	-0.04
Jul-2014	2.78	4.44	-1.66
Aug-2014	2.38	3.71	-1.33
Sept-2014	2.10	4.30	-2.20
Oct-2014	2.15	3.27	-1.12
Nov-2014	5.72	2.96	2.76
Dec-2014	3.32	3.06	0.26
Sum	**39.97**	**43.14**	**-3.17**

17.5.4 Hydrological Characterization

The presence of hydric soils over much of the lower portion of the project site is evidence that the site did historically support a wetland ecosystem there. Like many other rural areas in the region, site hydrology was altered in a variety of ways to either to maximize the availability of arable lands or to support livestock. At this site, man-made impacts such as damming for farm ponds, ditching, placement of spoil piles, and channel straightening, along with intense cattle grazing and historic timbering have altered the hydrological connection between stream and wetland within the project area.

Five automated groundwater wells were installed within the project area to evaluate the pre-construction hydrologic conditions of the site. The data collected will provide a basis for comparing pre-and post-construction hydrology for the project. All wells were installed to a depth of at least 36 inches below ground surface. Automated loggers (In Situ Inc. brand Rugged TROLL® 100 Data Logger units) were programmed to record water table levels every hour.

17.5.5 Soil Characterization

Soils at the project site were initially determined using NRCS web soil survey data for Guilford County (2014 survey data revision). The areas proposed for stream restoration and enhancement are mapped as Codorus, Poplar Forest, and Clifford soils. Codorus soils are hydric soils, while the others are non-hydric. The majority of the project site is underlain by Codorus soils, though the uppermost portion of the easement including Reach R5 and R6 is underlain by Clifford soils, and a portion of Reach R3 is underlain by Poplar Forest soils. Figure 2.3 shows soil conditions throughout the project area and the soil descriptions are shown on Table 17.10.

Soils information found using NRCS Web Soil Survey data for Guilford County (2014 survey data revision) indicates that the area contains primarily Codorus loam, Poplar Forest clay loam, and Clifford sandy loam. The Codorus mapping unit includes Hatboro undrained soils in the floodplain. Hatboro soils are also classified as hydric. The area proposed for wetland restoration is along the floodplain of Reach R1 at the downstream end of the project. This area has been heavily manipulated and degraded and is mapped primarily as hydric soils, including Hatboro.

To further investigate the soil conditions present on the site, Baker contracted with the Catena Group, LLC to perform a detailed soils evaluation of the site to determine the location and depth of hydric soil conditions and the presence of buried hydric soil layers in the project area. A licensed soil scientist conducted a hydric soils investigation on October 15, 2013 (see Section 16, Appendix B). The report findings indicate the presence of hydric soils along the floodplain of Reaches R1 and R2, based on boring information and presence of at least one hydric indicator and observed inclusions.

Table 17.10 Soil Mapping Units (NRCS Web Soil Survey, Guilford County, 2014 data revision)
Browns Summit Creek Restoration Project Stream Mitigation Plan - NCDMS Project No. 96313

Soil Name	Landform	Hydric Soil	Description
Codorus loam	Floodplains	Yes	Typically very deep, moderately well to somewhat poorly drained soils found along level floodplains. Slope ranges from 0 to 2%, frequently flooded.
Poplar Forest clay loam	Hillslopes	No	Typically well drained, moderately permeable soils found on gently sloping to steep hillslopes in uplands. Slope ranges from 15 to 35%.
Clifford sandy loam	Hillslopes	No	Typically very deep, well drained soils found along hillslopes in uplands. Slopes range from 6 to 10%.

17.5.6 Plant Community Characterization

Currently, a majority of the proposed stream and wetland restoration area is comprised of mature successional vegetation and active pasture. Historically, based on both older aerials and landowner verification, the area has been used for agriculture and cattle production, and several locations along the stream were once dammed with significant ponded areas. Current canopy vegetation within the existing delineated wetlands is dominated by red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), and slippery elm (*Ulmus rubra*). Understory and woody shrub species include red maple (*Acer rubrum*), tag alder (*Alnus serrulata*), multiflora rose (*Rosa multiflora*), southern arrowwood (*Viburnum dentatum*), and Chinese privet (*Ligustrum sinense*). Herbaceous and vine species are suppressed due to grazing but consist of soft rush (*Juncus effuses*), smartweed (*Polygonum pensylvanicum*), jewelweed (*Impatiens capensis*), Japanese stiltgrass (Microstegium vimineum), honeysuckle (*Lonicera japonica*) and greenbrier (*Smilax rotundifolia*).

17.6 Reference Wetlands

17.6.1 Wetland Description

An existing wetland and stream system that is representative of the system to be restored at the Browns Summit Restoration Project site was identified very near the project area. The site falls within the same climatic, physiographic, and ecological region as the restoration site. It also contains the same soil series as the proposed wetland restoration area and encompasses a very similar drainage area.

The reference site is located along a small stream in a narrow valley within the Haw River State Park, approximately 1 mile west of the Browns Summit Restoration Project site (see Figure 17.4). The reference site is an example of a "Piedmont Alluvial Forest" as described by Schafale and Weakley (1990). These systems exist along river and stream floodplains in Piedmont mesic forest communities in which separate fluvial landforms and associated vegetation zones are too small to distinguish. Hydrology of these systems is palustrine – seasonally or intermittently flooded.

Based on discussions with Park employees and from historic aerial photographs dating back to 1937, there is no evidence the reference site has experienced any significant disturbances recently, particularly from timbering operations. However, the cutting of timber or use in agriculture may have occurred long ago. Nevertheless, a mature canopy of vegetation now exists across the site, especially in the wetland areas surrounding the stream channel itself.

17.6.2 Hydrological Characterization

The site classifies as a jurisdictional wetland, utilizing criteria identified in the USACE 1987 Wetlands Delineation Manual. These criteria include oxidized root channels, high water table, water-stained leaves, saturation, drainage patterns, and geomorphic position. Climatic conditions of the reference site are the same as those described for the project site (Section 17.5.3). Site hydrology is controlled primarily by the small unnamed tributary that flows through the site. Due to the shallow, stable condition of the stream through the site, high water table conditions are maintained across the active floodplain for prolonged hydroperiods. One automated groundwater monitoring well was installed in the reference wetland area to evaluate the range of hydrologic conditions observed on-site. Data from this se well will provide a basis for evaluating the success of the post-restoration wetland hydrology for the project. The wells were installed to a depth of 36 inches below ground surface, and the automated loggers (In Situ Inc. brand Rugged TROLL® 100 Data Logger units) were programmed to record water table levels every 6 hours.

17.6.3 Soil Characterization

Codorus loam is the soil mapping unit found on the reference wetland site, the same hydric soil identified on the project's proposed wetland restoration area. As described in Section 17.5.2, Codorus loam soils are classified as hydric, very deep, moderately well to somewhat poorly drained soils found

along level floodplains. The reference area is prone to frequent flooding from the adjacent stream channel. The surrounding soil mapping unit found along the adjacent slopes to the valley is Poplar Forest clay loam, a non-hydric soil.

17.6.4 Plant Community Characterization

Within the reference wetland area, the canopy vegetation community is dominated by Red maple (*Acer rubrum*), Sweetgum (*Liquidambar styraciflua*), and American elm (*Ulmus americana*). Sub-canopy and understory species primarily consist of Ironwood (*Carpinus caroliniana*), Green ash (*Fraxinus pennsylvanica*), Red maple (*Acer rubrum*), River birch (*Betula nigra*), Blackgum (*Nyssa sylvatica*), and Chinese privet (*Ligustrum sinense*). Dominant vines include Muscadine grape (*Vitis rotundifolia*), Poison ivy (*Toxicodendron radicans*), and Greenbriar (*Smilax rotundifolia*).

There was remarkably little herbaceous vegetation present at the time of site inspection in the late winter. However, as the lower sub-canopy of a wetland system is often an important expression of the native seed bank, any herbaceous wetland species found later in the growing season within the reference wetland may be incorporated into the project's proposed wetland vegetation planting plan. The reference site is comprised of greater than 50% facultative and wetter species and therefore meets the hydrophytic vegetation requirement.

17.7 Restoration of Wetland Hydrology

The forested area in the downstream valley along Reach R1 is predominantly a large wetland area, which can generally be divided into sub-areas that have been impacted to various degrees by human and/or animal activity, and that have differing levels of existing wetland function. Reach R1 has been straightened and is slightly incised, both of which impact the drainage and flooding patterns of the area as a whole. To improve wetland hydrology functions to the site, the existing straightened stream channel will be abandoned, to be replaced by a new, more sinuous channel built at the appropriate floodplain elevation, thereby restoring their historical connection and improving flow dynamics between the stream and wetland complex. The abandoned sections of channelized stream will be fully to partially filled to eliminate the drainage effect caused by these features. Fill material will be generated when creating the new, sinuous channel.

A wetland area along Reach R2 will be re-established by raising the stream bed and cutting back stream banks prone to erosion to restore natural benching features. Spoil piles created from historical channel relocation will also be removed from this area. Baker proposes third wetland area along lower Reach R4 where hydric soils are situated on an abandoned floodplain. The existing channel is severely incised and approximately 6-8 feet below the floodplain. Priority Level I restoration is proposed to raise the channel thalweg to about 1.0 feet below the floodplain. As described above, the existing channel will be partially to completely filled; earth will need to be imported to fill this channel. These measures will restore wetland hydrology to this section of the project.

When complete filling of any abandoned stream section is not possible, ditch plugs will be installed from compacted earth. Ditch plugs will also be used in locations where the restored stream channel will cross the existing stream channel. In areas where restored stream flows will contact fill material, root wads or other protective measures will be installed to provide additional protection and deflect stream energies. Due to the relatively small size of the restored channel and the low energy nature of the system, these practices will be sufficient to prevent erosion and channel avulsion.

These practices have been used on numerous other projects with excellent results. Some sections of existing channel may be only partially filled depending on the amount of fill material that can be produced and the existing valley features. These partially filled areas will be discontinuous and will mimic small floodplain pools or tree throws within the wetland areas that will add to the diversity of habitat on the project site.

Grading activities will focus on restoring pre-disturbance valley topography by removing the numerous spoil piles, surface drains/swales, and some filled areas located in this area. The restored topography will be patterned after the natural floodplain found in the stream and wetland reference sites, and will include the removal of spoil piles and surface drains/swales. It will also include benching along sections of stream channel where Priority Level I restoration is not feasible (Reach R2), as well as the restoration of minor depressions in the adjacent buffer and floodplain that promote a diversity of hydrologic conditions and habitats common to natural wetland areas (Reach R1). This wetland microtopography contributes to the beneficial properties of forest soils and to the diversity and patterns of plant communities (Stephens, 1956; Bratton, 1976). This technique will be instrumental to the restoration of site hydrology by promoting surface ponding and subsequent infiltration, and encouraging more dynamic water table conditions in the fringe wetland areas.

Additionally, with the exclusion of cattle and the re-establishment of woody vegetation within the wetland areas, soil structure can begin to reform after decades of severe degradation. Improved soil structure leads directly to improved wetland hydrological function through increased water infiltration and retention, improved soil porosity, increased plant root growth, reduced soil erosion, and decreased overland flow volumes and velocities. This will also result in an improvement in the biogeochemical processes important to overall wetland function.

The restoration design for the wetland is based on a targeted "Piedmont Alluvial Forest" riparian wetland type, as identified by Schafale and Weakley (1990). Hydrology of this system will be palustrine and intermittently, temporarily, or seasonally flooded, as the restored channel is designed to carry the bankfull flow and to flood at discharges greater than bankfull. The revegetation plan for the overall riparian system will consider the combination of existing on-site native vegetation and riparian communities identified for a "Piedmont Alluvial Forest" by Schafale and Weakley (1990). The planting areas will be designated by zones to represent site conditions that include both drier riparian buffer conditions as well as wetland riparian buffers as shown on the project plan sheets (Section 20.0, Appendix F).

17.7.1 Proposed Wetland Mitigation Credit

The activities described above will be implemented on the specific wetland areas depicted in Figure 17.3 at the following credit ratios, as agreed upon with the NCIRT at the post-contract meetings in April and June, 2014.

1. "Functioning" wetlands – forested areas with hydrology and hydric soils, such as along the right bank of Reach R1. The hydrology and vegetation are present but in many areas cattle trampling has impacted the soil structure and ability to percolate water. These areas will be rehabilitated at a 3:1 credit ratio.
2. Degraded wetlands – areas with no wetland vegetation and partial hydrology such as along the corrugated metal pipe at the beginning of Reach R1. These areas will be rehabilitated as described in Section 17.7 at a 1.5:1 credit ratio.
3. Partially-functioning wetlands – cattle-trampled areas along the left bank of the middle of Reach R1 that lack wetland vegetation. These areas will be rehabilitated as described in Section 17.7 at a 1.5:1 credit ratio.
4. Filled wetlands – areas where spoil has been placed on top of delineated hydric soils, such as upper Reach R2 and the downstream end of Reach R1. These areas will be re-established at a 1:1 credit ratio by removing the spoil piles and, along Reach R2, by raising the water table.

Baker added another category of wetland mitigation during the mitigation plan development in order to provide additional credit to meet the contracted amount of 2.5 acres. This will be a fifth category, defined as follows:

5. Hydric soils – areas with hydric soils but lacking wetland hydrology due to adjacent, severe stream channel incision, such as along lower Reach R4. This area is shown in Figure 2.4c and a slightly

smaller version of it proposed for wetland re-establishment is shown in Figure 2.4d. Wetland vegetation is also sparse in this area.

Priority Level I restoration will re-establish wetland hydrology by replacing a 6-8 foot deep channel with one that is approximately 1 foot deep. This area is proposed for wetland re-establishment at a 3.5:1 credit ratio in order to provide the additional 0.08 WMUs needed to meet the contracted WMU amount of 2.5. As mentioned above, hydric soils are present throughout this entire area. It was not determined to be a jurisdictional wetland by Baker and the Corps during the JD, though it is adjacent to a jurisdictional wetland area. The adjacent jurisdictional area was delineated based on the presence of wetland hydrology and vegetation.

17.7.2 Proposed Riparian Vegetation Plantings

The vegetative components of this project include stream bank, floodplain, wetland and transitional upland planting and described as the riparian buffer zone. The planting areas are shown on the revegetation plan sheets in Section 20.0, Appendix F. In addition to riparian buffer zone, any areas of the site that lack diversity, are disturbed or adversely impacted by the construction process, will be planted.

Bare-root trees, live stakes, herbaceous plugs and permanent seedlings will be planted within designated areas of the conservation easement. A minimum 50-foot buffer will be established along both stream banks (100 foot total minimum width) for all of the proposed stream reaches within the project boundary. In many areas, the buffer width will be in excess of 50 feet along one or both stream banks (more than 100 foot total width) and will encompass adjacent jurisdictional wetland areas. In general, bare-root vegetation will be planted at a total target density of 680 stems per acre. Planting will be conducted during the dormant season, with all trees installed between the last week of November and the third week of March.

Selected species for hardwood revegetation planting are presented in Table 17.11. Tree species selected for restoration and enhancement areas will be weak to tolerant of flooding. Weakly tolerant species are able to survive and grow in areas where the soil is saturated or flooded for relatively short periods of time. Moderately tolerant species are able to survive in soils that are saturated or flooded for several months during the growing season. Flood tolerant species are able to survive on sites in which the soil is saturated or flooded for extended periods during the growing season (WRP, 1997).

Observations will be made during construction of the site regarding the relative wetness of areas to be planted as compared to the revegetation plan. The planting zone will be determined based on these comparisons, and planted species will be matched according to their wetness tolerance and the anticipated wetness of the planting area.

Once trees are transported to the site, they will be planted within two days. Disturbed soils across the site will be prepared by sufficiently loosening to a depth of three inches prior to planting as described in the technical specifications. In any areas where excavation depths exceed ten inches, topsoil shall be separated from rocks, brush, or foreign materials, stockpiled, and placed back over these areas to a depth of eight inches to achieve design grades and create a soil base for vegetation. Trees will be planted by manual labor using a dibble bar, mattock, planting bar, or other approved method. Planting holes for the trees will be sufficiently deep to allow the roots to spread out and down without "J-rooting." Soil will be loosely compacted around trees once they have been planted to prevent roots from drying out.

Live stakes will be installed at a minimum of 400 stakes per 1,000 square feet and stakes will be spaced two to three feet apart in meander bends and six to eight feet apart in the riffle sections using triangular spacing along the stream banks between the toe of the stream bank and bankfull elevation. Site variations may require slightly different spacing.

Permanent seed mixtures will be applied to all disturbed areas of the project site. Table 17.12 lists the species, mixtures, and application rates that will be used. A mixture is provided that is suitable for stream bank, floodplain, and adjacent wetland areas. Mixtures will also include temporary seeding (rye grain or browntop millet) to allow for application with mechanical broadcast spreaders. To provide rapid growth of herbaceous ground cover and biological habitat value, the permanent seed mixture specified will be applied to all disturbed areas outside the stream banks of the restored stream channel. The species provided are deep-rooted and have been shown to proliferate along restored stream channels, providing long-term stability.

Temporary seeding will be applied to all disturbed areas of the site that are susceptible to erosion. These areas include constructed stream banks, access roads, side slopes, and spoil piles. If temporary seeding is applied from November through April, rye grain will be used and applied at a rate of 130 pounds per acre. If applied from May through October, temporary seeding will consist of browntop millet, applied at a rate of 40 pounds per acre.

Table 17.11 Proposed Bare-Root and Livestake Species
Browns Summit Creek Restoration Project

Botanical Name	Common Name	% Planted by Species	Wetland Tolerance
Riparian Buffer Plantings – Overstory (For all reaches except R1, R2) 8' x 8' spacing - 680 stems/Acre			
Fraxinus pennsylvanica	Green Ash	10%	FACW
Betula nigra	River Birch	10%	FACW
Liriodendron tulipifera	Tulip Poplar	10%	FAC
Quercus michauxii	Swamp Chestnut Oak	10%	FACW
Diospyros virginiana	Persimmon	5%	FAC
Platanus occidentalis	American Sycamore	10%	FACW
Ulmus americana	American Elm	5%	FACW
Riparian Buffer Plantings – Understory (For all reaches except R1, R2) 8' x 8' spacing - 680 stems/Acre			
Carpinus caroliniana	American Hornbeam	10%	FAC
Ilex opaca	American Holly	8%	FAC
Hamamelis virginiana	Witchhazel	6%	FACU
Viburnum dentatum	Arrowwood Viburnum	8%	FAC
Euonymus americanus	Strawberry Bush	8%	FAC
Wetland Buffer Plantings – Overstory (For Reaches R1, R2) 8' x 8' spacing - 680 stems/Acre			
Fraxinus pennsylvanica	Green Ash	10%	FACW
Betula nigra	River Birch	10%	FACW
Quercus lyrata	Overcup Oak	10%	OBL
Acer negundo	Box Elder	10%	FACW
Platanus occidentalis	American Sycamore	10%	FACW
Celtis laevigata	Sugarberry	5%	FACW
Nyssa sylvatica	Black gum	5%	FAC

Wetland Buffer Plantings – Understory (For Reaches R1, R2) 8' x 8' spacing - 680 stems/Acre			
Carpinus caroliniana	American Hornbeam	10%	FAC
Alnus serrulata	Tag Alder	10%	OBL
Ilex verticillata	Winterberry	10%	FACW
Viburnum nudum	Possumhaw	10%	OBL
Riparian Live Stake Plantings			
Salix sericea	Silky Willow	25%	OBL
Sambucus canadensis	Elderberry	25%	FACW
Cephalanthus occidentalis	Buttonbush	15%	OBL
Cornus amomum	Silky Dogwood	25%	FACW
Salix nigra	Black Willow	10%	OBL
Note: Final species selection may change due to refinement or availability at the time of planting. If species substitution is required, the planting contractor will submit a revised planting list to Baker for approval prior to the procurement of plant stock.			

Table 17.12 Proposed Permanent Seed Mixture
Browns Summit Creek Restoration Project

Botanical Name	Common Name	% Planted by Species	Density (lbs/ac)	Wetland Tolerance
Andropogon gerardii	Big blue stem	10%	1.50	FAC
Dichanthelium clandestinum	Deer tongue	15%	2.25	FAC
Carex crinita	Fringed sedge	10%	1.50	OBL
Elymus virginicus	Virginia wild rye	10%	1.50	FACW
Juncus effusus	Soft rush	10%	1.50	FACW
Panicum virgatum	Switchgrass	15%	2.25	FAC
Schizachyrium scoparium	Little blue stem	10%	1.50	FACU
Sorghastrum nutans	Indiangrass	10%	1.50	FACU
Impatiens capensis	Jewelweed	10%	1.50	FACW
	Total	100%	15.00	

Note: Final species selection may change due to refinement or availability at the time of planting. If species substitution is required, the planting Contractor will submit a revised planting list to Baker for approval prior to the procurement of plant stock.

Table 17.13 Proposed Plug Species for Reach R6 Constructed Wetland
Browns Summit Creek Restoration Project

Botanical Name	Common Name	% Planted by Species	Wetland Tolerance
Deep Pool Plantings Four Cubic Inch Herbaceous Plugs to be Installed 4' On Center			
Lemna spp.	Duckweed	25%	OBL

Nuphar lutea ssp. Advena	Yellow pond-lily	25%	OBL
Nelumbo lutea	American lotus	25%	OBL
Eleocharis acicularis	Needle spikerush	25%	OBL
High Marsh Plantings Four Cubic Inch Herbaceous Plugs to be Installed 3' On Center			
Lobelia cardinalis	Cardinal Flower	10%	FACW
Eupatoriadelphus fistulosus	Joe Pye Weed	15%	FACW
Hibiscus coccineus	Scarlet Rose Mallow	15%	OBL
Lobelia elongata	Longleaf lobelia	15%	OBL
Rhynchospora colorata	Starrush whitetop	20%	FACW
Carex tenera	Quill sedge	25%	FAC
Low Marsh Plantings Four Cubic Inch Herbaceous Plugs to be Installed 3' On Center			
Sagittaria lancifolia	Bulltongue	10%	OBL
Iris pseudacorus	Yellow Flag	15%	OBL
Acorus americanus	Sweetflag	15%	OBL
Peltandra virginica	Arrow arum	15%	OBL
Pontederia cordata	Pickerelweed	20%	OBL
Scirpus cyperinus	Woolgrass	25%	FACW

17.8 Site Construction

17.8.1 Site Grading, In-stream Structures, and Other Construction Elements

A stream reaches will be constructed using a combination of Rosgen Priority Level I and Level II restoration approaches. Priority Level I approach will involve raising the stream bed so that the bankfull elevation matches the existing floodplain. Due to the degree of incision, portions of the stream reaches will also be constructed as Priority Level II restoration, and a new floodplain bench will be excavated at an elevation below the existing floodplain. Existing berms and/or spoil piles will be removed or flattened to provide the stream access to its floodplain.

The proposed stream construction will result in a new channel that will meander across the floodplain in order to mimic a natural piedmont stream. The reconstructed channel banks will be constructed with stable side slopes, biodegradable erosion control matting, and planted with native vegetation for long-term stability. The design channel will be constructed to flood the adjacent floodplain, wetlands, and vernal pools more frequently and thereby improving hydrology across the site. Vernal pools will be constructed at appropriate locations within the existing channel. These features will consist of small floodplain depressions that will provide additional storage during larger flood events.

Additionally, the grading plan for the project site is will restore and enhance wetland functions by grading portions of the site to improve groundwater hydrology and promote surface storage. Any areas disturbed during construction will be planted with native species vegetation. The site will be protected by a permanent conservation easement.

A variety of in-stream structures are proposed for the project site. Structures such as log vanes, constructed riffles, root wads, log weirs, and grade control j-hook vanes will be used to provide grade control, stabilize the newly-restored stream and improve habitat functions. Existing trees and woody

debris will be harvested through the construction of this project and incorporated whenever possible. However, significant canopy trees to be protected will be marked prior to construction. A general construction sequence is provided in the project plan sheets and describes the general construction approach. Table 17.13 summarizes the use of in-stream structures at the site.

Table 17.13 Proposed In-Stream Structure Types and Locations
Browns Summit Creek Restoration Project

Structure Type	Location
Root Wads	In locations along outside of meander bends or against one stream bank in straight reaches to increase pool diversity and provide refugium for fish.
Grade Control J-Hook Vanes	In locations where grade control is necessary to prevent to prevent possible downcutting or headcut migration, and stream bed/bank erosion.
Grade Control Log Jam	In locations where grade control is necessary to prevent possible downcutting or headcut migration, and bed erosion.
Log Vanes	Located throughout various meander bends to prevent to prevent possible stream bank erosion.
Log Weirs / Step Pools	In locations where grade control is necessary to prevent to prevent possible downcutting or headcut migration, and bed erosion.
Cover Logs / Toe Wood	Located along outside bends or against one stream bank in straight reaches to increase pool diversity and provide refugium for fish.
Constructed Riffles	In locations where grade control is necessary to prevent possible downcutting or headcut migration, and bed erosion.
Ditch Plug / Channel Block	Installed along some or all of remnant channel segments to prevent subsurface flow.
Vegetation Transplants	In locations outside of meander bends to increase stream bank stability and cover.
Vegetated Geolift	In locations outside of meander bends to create and/or increase stream bank stability and reduce near bank stress.

Root Wads

Root wads are placed at the toe of the stream bank along the outside of meander bends for the creation of habitat and for stream bank protection. Root wads include the root mass or root ball of a tree plus a portion of the trunk. They are used to armor a stream bank and reduce near bank stress by deflecting stream flows away from the stream bank. In addition to stream bank protection, they provide structural support to the stream bank and habitat for fish and other aquatic animals. They also serve as a food source for aquatic insects. Root wads will be placed throughout the project reaches primarily to improve aquatic habitat and provide cover.

Grade Control J-Hook Vanes

Grade control j-hook vanes are utilized to provide grade control and protect the stream banks. These vanes may be constructed out of logs and/or rock boulders. The structure arms turn water away from the stream banks and re-direct flow energies toward the center of the channel. In addition to providing stability to stream banks, grade control j-hook vanes also promote pool scour and provide structure within the pool habitat. Grade control j-hooks have two to three boulders placed in a hook shape at the upstream end of the vane. The primary difference between regular j-hooks and grade control j-hooks is the way that the "hook" part of the structure is constructed. Regular j-hooks are constructed to have gaps between the header boulders in the hook to promote flow convergence. Grade control j-hooks do not have gaps between the header boulders in the hook and also have a boulder sill built from the outside of the hook over to the opposite stream bank such that the structure can serve as a grade control feature. Grade control j-hooks still promote scour in the downstream pool, thus providing habitat benefit.

Grade Control Log Jams

A grade control log jam is created by placing woody material in the stream at specific riffle locations along the profile. The purpose of this structure is to provide initial grade control and establish riffle habitat within the restored channel, prior to the formation of a stabilized streambed. These structures can be substituted for traditional constructed riffles using rock material, in a similar way as natural riffles; the surfaces and interstitial spaces are crucial to the life cycles of many aquatic species.

Log Vanes

A log vane is used to provide cover for aquatic organisms in the downstream scour pool and with a potential secondary benefit of protecting stream banks by reducing near-bank stress and redirecting flow away from the stream bank. The length of a single vane structure can span one-half to two-thirds the bankfull channel width. Vanes are located just downstream of the point where the stream flow intersects the stream bank at an acute angle in a meander bend.

Log Weirs / Step Pools

Log weirs and step pools are used to provide grade control as well as provide a secondary pool habitat benefit for aquatic organisms. A log weir consists of two logs stacked (a header log and a footer log) and installed perpendicular to the direction of flow. This center structure sets the invert elevation of the streambed. A step pool sequence or log/rock "rollers" are also commonly used in confined settings where sinuosity is less than 1.2 and in drainage areas less than 3 square miles, and located based on pool-to-pool spacing ratios. They can be used as floodplain interceptors to intercept concentrated floodplain flows from swales, ditches, low points, oxbow pond or vernal pool drains, etc. and to drain such flow to the restored channel in a stable and natural manner.

Cover Logs

A cover log is placed along the outside of a meander bend to provide habitat in the pool area. It is most often installed in conjunction with root wads. The log is buried into the outside stream bank of the meander bend; the opposite end extends through the deepest part of the pool and may be buried in the inside of the meander bend, in the bottom of the point bar. The placement of the cover log near the bottom of the stream bank slope on the outside of the bend encourages scour in the pool. This increased scour provides a deeper pool for bedform variability.

Constructed Riffles

A constructed riffle is installed by placing coarse bed material (gravel, cobble, and small boulders) in the stream at specific riffle locations along the profile. The purpose of this structure is to provide initial grade control and establish riffle habitat within the restored channel, prior to the natural establishment of an armored streambed. Wood material can also be incorporated with rock for these structures, and function in a similar way as natural riffles; the surfaces and interstitial spaces are crucial to the life cycles of many aquatic macroinvertebrate species.

Ditch Plug / Channel Block

A compacted earth plug will be installed by filling the existing ditch to prevent subsurface flows and improve site hydrology. The fill material used for ditch plugs shall come from a nearby borrow area and be free of debris, rocks, trash, etc. and shall consist of compactable soil material.

Vegetation Transplants

Vegetation transplants will be identified before starting construction as viable candidates (species and size) for uprooting and relocation. Areas that must be cleared will maximize the harvesting of transplants; transplants will be taken from other areas as suitable to enhance the rapid development of vegetative growth along the constructed channel.

Vegetated Geolift

Geolifts are a bioengineering measure used to stabilize stream banks. Geolifts are most commonly used along the outside of stream meander bends. They are essentially a series of large overlapping soil "burritos," or "lifts", constructed using coir fiber erosion control matting and native soils. Live cutting materials, or whips, from specific woody native species plants are planted in the layers between the lifts. A stone or woody brush toe base is typically installed to provide protection at the toe of the stream bank and to provide a foundation for the geolifts. The geolifts are installed on top of the base material to comprise the entire restored stream bank up to the bankfull channel elevation. Geolifts can be used to effectively stabilize restored stream banks for all sizes of streams simply by varying the number of lifts required to form the stream bank.

18.0 APPENDIX D – REGULATORY CORRESPONDENCE

18.1 IRT MEETING MINUTES

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Meeting Minutes

BROWNS SUMMIT CREEK RESTORATION PROJECT

EEP Contract No. 5792

Date Prepared:	April 15, 2014
Meeting Date, Time, Location:	April 14, 2014, 1:45 pm On-site (Guilford County, NC)
Attendees:	USACE –Tyler Crumbley, David Bailey NCDWR – Eric Kulz, Ginny Baker NCEEP –Guy Pearce, Jeff Schaffer, Greg Melia Baker – Scott Hunt, Chris Roessler, Scott King
Subject:	Post-Contract Site visit w/ NCIRT
Recorded By:	Chris Roessler

An on-site meeting was held on April 14th, 2014 at approximately 1:45 PM to discuss the Browns Summit Creek Restoration (Full Delivery) Project in Guilford County, NC. The purposes of this meeting were to:

1. Familiarize the NCIRT with the stream and wetland restoration project and discuss basic concepts for the proposed mitigation plan;
2. Reach agreement on mitigation approaches and credit ratios for each project reach and section;
3. Identify and discuss potential concerns/issues based on field observations.

After introductions, Chris Roessler provided background approaches for the project. Essentially, Baker proposes a watershed-based approach to include nearly all of the intermittent and perennial reaches on the properties. Primarily restoration, but also enhancement approaches are proposed to provide functional uplift. The site visit began at the upper end of the site on Reaches R5 and R6 and proceeded downstream through the project area. All of the project stream reaches (Reaches R1, R2, R3, R4, R5, R6, T1, T2, and T3) and wetland restoration areas were observed and discussed. Observations and conclusions for each reach and area are noted below.

Note: maps from the proposal and following this visit are included with this memo.

Reach R5

The group walked along Reach R5 below the spring and agreed with the proposed Enhancement Level II approach at a 2.5:1 credit ratio. Livestock will be excluded and the buffer will be planted. A gradient control structure will be installed to prevent the headcut located just below the spring from progressing.

Reach R6

Baker proposed to remove the pond at the head of Reach R6 and stabilize the channel below it with essentially Priority I restoration, though Enhancement Level I with a credit ratio of 1.5:1 was specified since this is not a perennial reach.

The Corps concluded that this is not a jurisdictional channel but rather a livestock watering pond in an upland setting. Consequently, the group decided that a water quality BMP might be more appropriate for the replacement of the pond. In effect the pond would be converted to a wetland-type feature with a low-maintenance weir outlet. The area would be planted and placed within the conservation easement.

Below the pond, the Corps appeared to consider that the channel is still non-jurisdictional, though this determination was less definitive than upstream from the pond. **If the Corps considers the entire Reach R6 channel to be non-jurisdictional at this stage, then the BMP and a short channel will be constructed to quickly connect into Reach R5 and begin Reach R4**. If a jurisdictional determination must still be made, the mitigation approach should be postponed. **Baker requests the Corps' input on the jurisdictional determination at this stage**.

The credit ratio for developing a BMP and outlet channel for Reach R6 was not agreed upon. Instead, it will be up to Baker to provide performance standards or measures tied to functional uplift in the mitigation plan which will help to determine the credit ratio. Generally, the valley length of the BMP at a 1.5:1 or 1:1 credit ratio, similar to the original Enhancement Level I approach, was discussed as potential mitigation compensation. Under this approach, the existing spillway channel below the pond, which is actively eroding and filled with concrete debris, will be filled and stabilized. **Baker requests the IRT's input at this stage on how it intends to assign credit for the BMP.**

Reach R4
This reach will begin where the future Reach R5 and R6 join. Presently, this confluence is located on the delta at the head of the second pond. It is anticipated that this confluence will be moved upstream and to the southwest from the existing confluence as part of the Reach R6 proposed mitigation (see above).

The pond at the head of Reach R4 will be removed and replaced with Priority I or shallow Priority II restoration. This approach will continue downstream to the property line, at which point the incision and channel erosion become more pronounced.

Once past the property line, the channel will be re-routed slightly to the northeast to line up with the low point of the valley. The floodplain in this section will be leveled to fill in the existing eroding channel and remove the relic pond dam. A second BMP feature will be created on the new floodplain to treat runoff discharge by a 30-inch culvert located just above and beyond the right bank.

The Corps acknowledged that some of the mature trees toward the lower end of Reach R4 would be need to be removed for construction but that tree removal should be minimized.

Reach T3
This reach enters the mainstem from the right bank and forms Reach R3 below it. The channel is overly deep and wide in this location due to a headcut progressing from the mainstem. However, the channel is also barely intermittent above the headcut.

Baker proposes to remove the headcut and raise the stream to tie in to the Priority 1 restoration on the mainstem. The reach length in the proposal of 102 feet will be shortened to 50 feet, which should be within the area of the higher water table created by restoration of the mainstem.

Reach R3
Reach R3 begins at the confluence of Reaches T3 and R4. The upper section is currently backwatered due to a farm pond just downstream. The pond will be removed as part of the Priority 1 restoration of this reach. Tyler noted the narrow valley width in the lower part of the reach and the need to switch sides of the channel to save some of the mature trees along it. Chris commented that the assumed sinuosity is about 1.15. It's actually 1.18 but this can be worked out in the design process.

Reach T2
The group didn't discuss Reach T2. Most of this reach is covered by low vegetation. A headcut has migrated slightly upstream from the mainstem and then it's a small ditch flowing from a pond above.

The proposed work is Enhancement Level II at a 2.5:1 credit ratio to plant and remove livestock from this reach.

Reach R2
Reach R2 begins at the confluence of Reaches T2 and R3. It is eroding and fairly incised initially but the bank height ratios tend to decrease moving downstream. Spoil piles are evident in the middle of the reach beyond the right bank. The spoil piles will be removed and stable channel pattern will be restored following a Priority I approach.

The wetlands proposed for mitigation are located along much of Reaches R2 and R1. These will be discussed in the following section of the meeting minutes.

Reach T1
Reach T1 enters from the east on the downstream most property. It has a drainage area of 62 acres and 144 feet of Priority I restoration are proposed. As with all reaches, Baker will describe the functional uplift that will be attained through restoration in the mitigation plan.

Reach R1
Reach R1 begins at the confluence of Reaches R2 and T1. The bank height ratios are not particularly high, though there is channel erosion on the upstream and middle sections. The channel has been straightened in the past so Priority I restoration is proposed to reestablish natural pattern and eliminate bank erosion. The downstream end of Reach R1 has been previously manipulated and spoil piles remain in this area. These will be removed as part of an effort to rehabilitate the wetlands in this section.

Wetland Mitigation
In the proposal, Baker lumped all of the areas mapped as hydric soils as candidates for wetland rehabilitation. The Corps noted that some splitting of these areas into more specific categories should be done because there are several different circumstances present, which would result in varying approaches for functional improvement. The different areas may be generally categorized as follows:

1. Functioning wetlands – forested areas with hydrology and hydric soils, such as along the right bank of Reaches R1 and lower R2.
2. Degraded wetlands – areas with no wetland vegetation and some hydrology such as along the corrugated metal pipe at the beginning of Reach R1.
3. Partially-functioning wetlands – mucky areas along the left bank of the middle of Reach R1 that lacked wetland vegetation.
4. Filled wetlands – areas where spoil has been placed on top of presumed hydric soils, such as upper Reach R2 and the downstream end of Reach R1.

NCEEP explained that it is important for all wetland mitigation to be used by this project be in the restoration category (re-establishment or rehabilitation), otherwise it cannot be used according to the RFP. He emphasized that the credit ratios were certainly up for discussion. The federal definitions for wetland restoration and enhancement are listed below.

The Corps suggested we break out the four areas above and make a case for an appropriate credit ratio based on functional uplift and the federal definitions. Baker will make another site visit to delineate and map these different areas and then schedule for a return visit to the site with the Corps to go over the mapping of the different areas and determination of appropriate credit ratios. Initial thoughts on credit ratios, from both the Corps and Baker are provided herein:

1. Functioning wetlands – the Corps suggested credit ratios in the range of 2:1 to 3:1. One comment about these is that this is a wetter time of year and some of the areas may be drier much of the year.
2. Degraded wetlands – the Corps suggested possibly 1:1 credit for rehabilitation in these areas. The hydrology would be improved, as well as the vegetation.
3. Partially-functioning wetlands – the Corps suggested possibly 2:1 for these areas with the idea that hydrology is present and may be adversely affected by Priority I restoration. Baker proposes 1.5:1 for these areas because we believe that livestock trampling has adversely affected hydrology and soil structure in these areas. Baker believes that a compacted layer is promoting surface ponding and preventing suitable/natural drainage. By removing the livestock and planting appropriate wetland vegetation, Baker believes the soil structure will be rehabilitated and wetland function will significantly improve.
4. Filled wetlands – the Corps didn't specify but this appears to be suitable for wetland re-establishment at a 1:1 credit ratio. By removing the spoil, hydric soils will be exposed and wetland hydrologic function will be re-established. Wetland planting will complete the picture.

Thus it appears that the partially-functioning wetlands (Item 3.) are where there is slight disagreement between the Corps and Baker. This and other credit ratio details can be finalized after further mapping and the follow-up field meeting with Todd Tugwell.

Federal wetland definitions in 33 CFR PART 332:

Enhancement means the manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Re-establishment means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Contacts

- Jeff Schaffer will serve as the NCEEP Project Manager for this project with and Greg Melia will provide technical assistance during project development and in review of deliverables. Chris Roessler will be the Baker Project Manager and coordinate/submit project deliverables directly with Jeff for distribution to all NCIRT team members.

Action Items and Next Steps

- Project Schedule – Baker will map the four different wetland areas and conduct their jurisdictional determination of the streams and wetlands in the next two weeks. In the meantime, a follow-up meeting with the Corps and NCEEP will be scheduled to review the results of Baker's wetland mitigation mapping. A separate meeting will be held to conduct the jurisdictional determination with the Corps.
- After the jurisdictional determination has been conducted, any wetland areas that will be impacted by the proposed work (filled or drained) will need to be identified and functional replacement for those losses should be proposed and discussed in the draft mitigation plan.

- USACE requires Jurisdictional (JD) stream/wetland calls for the project. Baker will coordinate with David Bailey for on-site JD verification prior to mitigation plan submittal.
- Signage will be needed on all conservation easement areas.

This represents Baker Engineering's interpretation of the meeting discussions. If you should find any information contained in these meeting notes to be in error and/or incomplete based on individual comments or conversations, please notify me with corrections/additions as soon as possible.

Sincerely,

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Meeting Minutes

BROWNS SUMMIT CREEK RESTORATION PROJECT

EEP Contract No. 5792

Date Prepared:	June 20, 2014
Meeting Date, Time, Location:	June 6, 2014, 1:00 pm On-site (Guilford County, NC)
Attendees:	USACE – Todd Tugwell NCEEP – Greg Melia Baker – Scott Hunt, Chris Roessler
Subject:	Second of Two Post-Contract Site visits w/ NCIRT
Recorded By:	Chris Roessler

A second on-site meeting was held on June 6th, 2014 at approximately 1:00 PM to discuss the Browns Summit Creek Restoration (Full Delivery) Project in Guilford County, NC. A meeting was previously held on April 14th with other members of the IRT – the unchanged results from that meeting are included in this memo. The purposes of this meeting were to:

1. Determine the credit ratio for the BMP-approach on non-jurisdictional Reach R6;
2. Reach agreement on mitigation approaches and credit ratios for the wetland areas that were further delineated by Baker;
3. Identify and discuss potential concerns/issues based on field observations.

The site visit began at the upper end of the site on Reaches R5 and R6 and proceeded downstream through the project area. Observations and conclusions for each reach and area are noted below.

Note: separate maps for the stream and wetland components following this visit are included with this memo.

Reach R5 (notes are unchanged from previous meeting on April 14, 2014)
The group walked along Reach R5 below the spring and agreed with the proposed Enhancement Level II approach at a 2.5:1 credit ratio. Livestock will be excluded and the buffer will be planted. A gradient control structure will be installed to prevent the headcut located just below the spring from progressing. Baker will try to include as much as the channel as possible and still allow cattle to move around the head of the reach.

Reach R6 (updated from the previous meeting on April 14, 2014)
The Corps and Baker have concluded that this is not a jurisdictional channel but rather a livestock watering pond in an upland setting. The group has decided that a water quality BMP will be more appropriate for the replacement of the pond. In effect the pond will be converted to a wetland-type feature with a low-maintenance weir outlet. It is possible that there will be several tiers of wetland cells because the Corps recommended that the work extend as far upstream as possible in order to exclude cattle from the eroded channel. The area included in the project will be planted and placed within the conservation easement. A cattle crossing will be constructed immediately above the easement.

The credit ratio for developing a BMP channel for Reach R6 was agreed upon at 1.5:1 for the valley length of the BMP. Under this approach, the existing spillway channel below the pond, which is actively eroding and filled with concrete debris, will be filled and stabilized.

Reach R4 (notes are from previous meeting on April 14, 2014 except that credit is proposed for a second stormwater BMP – see fourth paragraph in this section)
This reach will begin where the future Reach R5 and R6 join. Presently, this confluence is located on the delta at the head of the second pond. It is anticipated that this confluence will be moved upstream and to the southwest from the existing confluence as part of the Reach R6 proposed mitigation (see above).

The pond at the head of Reach R4 will be removed and replaced with Priority I or shallow Priority II restoration. This approach will continue downstream to the property line, at which point the incision and channel erosion become more pronounced.

Once past the property line, the channel will be re-routed slightly to the northeast to line up with the low point of the valley. The floodplain in this section will be leveled to fill in the existing eroding channel and remove the relic pond dam.

A second BMP feature will be created on the new floodplain to treat runoff discharge from a 30-inch culvert located just above and beyond the right bank. The culvert discharges runoff from much of Broad Ridge Court, a newly developed subdivision. Baker proposes 1.5:1 credit ratio for the valley length of this BMP, similar to the BMP along Reach R6. The valley length of this BMP is estimated to be 60-75 feet. The outlet is currently causing a major headcut that will continue to migrate. To correct this, a rock-lined step-pool channel will be constructed to bring the stormwater runoff from the outlet to the floodplain elevation. Next, a properly-sized basin will capture the runoff, diffuse its energy, and allow water to spread across the vegetated floodplain, promoting nutrient uptake within the buffer. A stable outlet channel will be constructed to deliver the runoff to the project reach.

The Corps acknowledged that some of the mature trees toward the lower end of Reach R4 would be need to be removed for construction but that tree removal should be minimized.

Reach T3 (notes are unchanged from previous meeting on April 14, 2014)
This reach enters the mainstem from the right bank and forms Reach R3 below it. The channel is overly deep and wide in this location due to a headcut progressing from the mainstem. However, the channel is also barely intermittent above the headcut.

Baker proposes to remove the headcut and raise the stream to tie in to the Priority 1 restoration on the mainstem. The reach length in the proposal of 102 feet will be shortened to 50 feet, which should be within the area of the higher water table created by restoration of the mainstem.

Reach R3 (includes a change on the lower part of the reach from restoration to E2)
Reach R3 begins at the confluence of Reaches T3 and R4. The upper section is currently backwatered due to a farm pond just downstream. The pond will be removed as part of the Priority 1 restoration of this reach. Tyler noted the narrow valley width in the lower part of the reach and the need to switch sides of the channel to save some of the mature trees along it. Chris commented that the assumed sinuosity is about 1.15. It's actually 1.18 but this can be worked out in the design process.

Below the stream crossing, the approach will change to Enhancement Level II at a 5:1 credit ratio, per Todd Tugwell's request. The work will be limited to livestock exclusion fencing and supplemental planting. No work will be done in the channel below the stream crossing.

Reach T2 (notes are unchanged from previous meeting on April 14, 2014)
The group didn't discuss Reach T2. Most of this reach is covered by low vegetation. A headcut has migrated slightly upstream from the mainstem and then it's a small ditch flowing from a pond above. The proposed work is Enhancement Level II at a 2.5:1 credit ratio to plant and remove livestock from this reach. A grade control structure will be added to stop the headcut.

Reach R2 (includes a change from restoration to E2)
Reach R2 begins at the confluence of Reaches T2 and R3. Spoil piles are evident in the middle of the reach beyond the right bank in the middle of the reach. The spoil piles will be removed as discussed in the wetland mitigation section below.

Following this second meeting, Todd Tugwell requested Enhancement Level II at a 5:1 credit ratio for this reach. The work will be limited to livestock exclusion fencing and supplemental planting. No work will be done in the channel.

Reach T1 (notes are unchanged from previous meeting on April 14, 2014)
Reach T1 enters from the east on the downstream most property. It has a drainage area of 62 acres and 144 feet of Priority I restoration are proposed. As with all reaches, Baker will describe the functional uplift that will be attained through restoration in the mitigation plan.

Reach R1 (notes are unchanged from previous meeting on April 14, 2014)
Reach R1 begins at the confluence of Reaches R2 and T1. The bank height ratios are not particularly high, though there is some channel erosion on the upstream and middle sections. The channel has been straightened in the past so Priority I restoration is proposed to reestablish natural pattern and eliminate bank erosion. The IRT accepted this approach because the impacts from implementing it will not be as high as the reach upstream, which has more mature vegetation.

The downstream end of Reach R1 has been previously manipulated and spoil piles remain in this area. These will be removed as part of an effort to re-establish and rehabilitate the wetlands in this section.

Wetland Mitigation
The previous iteration of the minutes explained that Baker would map the wetlands to divide them into different categories according to their existing condition in terms of vegetation and hydrology. This was done in preparation for the June 6th meeting with Todd Tugwell.

The different areas may be generally categorized as follows:

1. "Functioning" wetlands – forested areas with hydrology and hydric soils, such as along the right bank of Reach R1. The hydrology and vegetation are present but in many areas cattle trampling has impacted the soil structure and ability to percolate water.
2. Degraded wetlands – areas with no wetland vegetation and some hydrology such as along the corrugated metal pipe at the beginning of Reach R1.
3. Partially-functioning wetlands – mucky areas along the left bank of the middle of Reach R1 that lacked wetland vegetation.
4. Filled wetlands – areas where spoil has been placed on top of presumed hydric soils, such as upper Reach R2 and the downstream end of Reach R1.

NCEEP explained that it is important for all wetland mitigation to be used by this project be in the restoration category (re-establishment or rehabilitation), otherwise it cannot be used according to the RFP. The federal definitions for wetland restoration and enhancement are listed below.

At the June 6th meeting, Todd Tugwell expressed that any wetland mitigation would appear to be linked to changes to the stream channel. Consequently, the wetland mitigation along Reaches R3 (lower) and R2 will be removed, with the exception of the wetland re-establishment along Reach R2 where spoil piles will be removed and hydric soils will be at the ground surface.

The credit ratios for the four types of wetland areas are proposed as follows:

1. "Functioning" wetlands – the Corps suggested credit ratios of 3:1.

2. Degraded wetlands – Baker proposes 1.5:1 credit for rehabilitation in these areas. The hydrology would be improved, as well as the vegetation.
3. Partially-functioning wetlands – Baker proposes 1.5:1 for these areas. Livestock trampling has adversely affected hydrology and soil structure in these areas. Baker believes that a compacted layer is promoting surface ponding and preventing suitable/natural drainage. By removing the livestock and planting appropriate wetland vegetation, Baker believes the soil structure will be rehabilitated and wetland function will significantly improve.
4. Filled wetlands – Baker proposes wetland re-establishment at a 1:1 credit ratio. By removing the spoil, hydric soils will be exposed and wetland hydrologic function will be re-established. Wetland planting will complete the picture.

Contacts

- Jeff Schaffer will serve as the NCEEP Project Manager for this project with and Greg Melia will provide technical assistance during project development and in review of deliverables. Chris Roessler will be the Baker Project Manager and coordinate/submit project deliverables directly with Jeff for distribution to all NCIRT team members.

Action Items and Next Steps

- Project Schedule – A separate meeting will be held to conduct the jurisdictional determination with the Corps. Baker will update NCEEP separately on the expected stream and wetland mitigation credits following the changes recommended by the IRT.
- After the jurisdictional determination has been conducted, any wetland areas that will be impacted by the proposed work (filled or drained) will need to be identified and functional replacement for those losses should be proposed and discussed in the draft mitigation plan.
- USACE requires Jurisdictional (JD) stream/wetland calls for the project. Baker will coordinate with David Bailey for on-site JD verification prior to mitigation plan submittal.
- Signage will be needed on all conservation easement areas.

This represents Baker Engineering's interpretation of the meeting discussions. If you should find any information contained in these meeting notes to be in error and/or incomplete based on individual comments or conversations, please notify me with corrections/additions as soon as possible.

Sincerely,

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Michael Baker
INTERNATIONAL

Meeting Minutes

BROWNS SUMMIT CREEK RESTORATION PROJECT

EEP Contract No. 5792

Date Prepared:	November 10, 2014
Meeting Date, Time, Location:	November 7, 2014, 10:00 pm On-site (Guilford County, NC)
Attendees:	USACE – Todd Tugwell, David Bailey NCEEP – Jeff Schaffer, Periann Russell NCDWR – Ginny Baker, Sue Homewood Baker – Chris Roessler
Subject:	Third Post-Contract Site visit w/ NCIRT
Recorded By:	Chris Roessler

A third on-site meeting was held on November 7th, 2014 at approximately 10:00 PM to discuss the Browns Summit Creek Restoration (Full Delivery) Project in Guilford County, NC. Meetings with the IRT were previously held on April 14th and June 6th – the unchanged results from those meetings are included in this memo. The purpose of this meeting was to review lower Reach R3 and upper Reach R2 to come to an agreement on the approach. Priority Level I Restoration was initially proposed by Baker but this was changed to Enhancement Level II (E2) at a 5:1 credit ratio in the second IRT meeting. After the site had been surveyed, Baker reviewed the approach and thought enough problems were evident that corrective measures beyond E2 were needed.

Prior to the November 7 meeting, Chris Roessler distributed a PDF titled BrownsSummit_postSurvey_Restoration_v_Enhancement_R2_lowerR3.pdf, which showed topography, photos, and cross sections of the reach sections in question. The bankfull cross sectional areas are estimated to be 9.7 sf for lower Reach R3 and 12.0 for upper Reach R2. These areas correspond to bank height ratios of approximately 1.8 to 2.1. Erosion is not widespread but many of the streambanks on the outside bends are vertical and eroding.

Chris Roessler presented Baker's case to do Priority Level I restoration by stating that the evolutionary trend for the stream reaches is likely to be down because the channel is incised and widening to create space for a floodplain bench is expected. The channel is currently 7 to 12 feet wide and it would appear to need floodprone widths of approximately 15 to 25 feet to be stable (i.e., to reach entrenchment ratios of > 2.2). Additionally, two locations have riffles that are oriented up valley, which means that flow vectors are pointed into vertical streambanks and the stream has nowhere to go without causing significant erosion. Spoil piles are present along the right bank of upper Reach R2, and indicate past channel manipulation. Finally, floodplain area is available along the existing channel without having to remove mature trees, making Priority I Restoration more feasible. By reconnecting the channel with its floodplain and restoring appropriate pattern and dimension, Baker is confident the channel would remain stable indefinitely.

Todd Tugwell's perspective on the section is that it is currently not very degraded and falls in the middle category of streams in North Carolina (i.e., not exceptional, but not very degraded). He thinks that if it were tied to streams that are impacted, the mitigation ratio would not be very high. Also, he believes

that the functional uplift potential for the section is not very high. Todd generally agreed that more work than fencing out cattle and planting a buffer is warranted.

Given these differing approaches, Chris Roessler suggested a compromise of Enhancement Level I at a 1.5:1 ratio. The two sharp bends will be smoothed, riffle structures will be incorporated to raise the bed, vertical banks will be laid back and possibly benched, and the spoil piles will be removed, as long as mature woody vegetation would not be harmed in the process. Additionally, large woody debris will be incorporated in the form of toe wood, log vanes and/or weirs, and invasive species such as privet will be treated.

NCDWR thought that Enhancement Level I (E1) is an appropriate approach for this section. Sue Homewood stated that the mitigation plan should incorporate additional language about functional uplift that is specific to this section of the project. David Bailey agreed with the E1 approach and stated that the spoil piles should be removed as part of this effort.

Note: a map for the stream component following this visit is included with this memo.

Reach R5 (notes are unchanged from previous meeting on April 14, 2014)
The group walked along Reach R5 below the spring and agreed with the proposed Enhancement Level II approach at a 2.5:1 credit ratio. Livestock will be excluded and the buffer will be planted. A gradient control structure will be installed to prevent the headcut located just below the spring from progressing. Baker will try to include as much as the channel as possible and still allow cattle to move around the head of the reach.

Reach R6 (updated from the previous meeting on April 14, 2014)
The Corps and Baker have concluded that this is not a jurisdictional channel but rather a livestock watering pond in an upland setting. The group has decided that a water quality BMP will be more appropriate for the replacement of the pond. In effect the pond will be converted to a wetland-type feature with a low-maintenance weir outlet. It is possible that there will be several tiers of wetland cells because the Corps recommended that the work extend as far upstream as possible in order to exclude cattle from the eroded channel. The area included in the project will be planted and placed within the conservation easement. A cattle crossing will be constructed immediately above the easement.

The credit ratio for developing a BMP channel for Reach R6 was agreed upon at 1.5:1 for the valley length of the BMP. Under this approach, the existing spillway channel below the pond, which is actively eroding and filled with concrete debris, will be filled and stabilized.

Reach R4 (notes are from previous meeting on April 14, 2014 except that credit is proposed for a second stormwater BMP – see fourth paragraph in this section)
This reach will begin where the future Reach R5 and R6 join. Presently, this confluence is located on the delta at the head of the second pond. It is anticipated that this confluence will be moved upstream and to the southwest from the existing confluence as part of the Reach R6 proposed mitigation (see above).

The pond at the head of Reach R4 will be removed and replaced with Priority I or shallow Priority II restoration. This approach will continue downstream to the property line, at which point the incision and channel erosion become more pronounced.

Once past the property line, the channel will be re-routed slightly to the northeast to line up with the low point of the valley. The floodplain in this section will be leveled to fill in the existing eroding channel and remove the relic pond dam.

A second BMP feature will be created on the new floodplain to treat runoff discharge from a 30-inch culvert located just above and beyond the right bank. The culvert discharges runoff from much of Broad

Ridge Court, a newly developed subdivision. Baker proposes 1.5:1 credit ratio for the valley length of this BMP, similar to the BMP along Reach R6. The valley length of this BMP is estimated to be 60-75 feet. The outlet is currently causing a major headcut that will continue to migrate. To correct this, a rock-lined step-pool channel will be constructed to bring the stormwater runoff from the outlet to the floodplain elevation. Next, a properly-sized basin will capture the runoff, diffuse its energy, and allow water to spread across the vegetated floodplain, promoting nutrient uptake within the buffer. A stable outlet channel will be constructed to deliver the runoff to the project reach.

The Corps acknowledged that some of the mature trees toward the lower end of Reach R4 would be need to be removed for construction but that tree removal should be minimized.

Reach T3 (notes are unchanged from previous meeting on April 14, 2014)
This reach enters the mainstem from the right bank and forms Reach R3 below it. The channel is overly deep and wide in this location due to a headcut progressing from the mainstem. However, the channel is also barely intermittent above the headcut.

Baker proposes to remove the headcut and raise the stream to tie in to the Priority 1 restoration on the mainstem. The reach length in the proposal of 102 feet will be shortened to 50 feet, which should be within the area of the higher water table created by restoration of the mainstem.

Reach R3 (includes a change on the lower part of the reach from restoration to E2)
Reach R3 begins at the confluence of Reaches T3 and R4. The upper section is currently backwatered due to a farm pond just downstream. The pond will be removed as part of the Priority 1 restoration of this reach. Tyler noted the narrow valley width in the lower part of the reach and the need to switch sides of the channel to save some of the mature trees along it. Chris commented that the assumed sinuosity is about 1.15. It's actually 1.18 but this can be worked out in the design process.

~~Below the stream crossing, the approach will change to Enhancement Level II at a 5:1 credit ratio, per Todd Tugwell's request. The work will be limited to livestock exclusion fencing and supplemental planting. No work will be done in the channel below the stream crossing.~~
Per the November 7, 2014 meeting, below the existing and proposed stream crossing Enhancement Level I at a 1.5:1 credit ratio, as described above, will be implemented for lower Reach R3.

Reach T2 (notes are unchanged from previous meeting on April 14, 2014)
The group didn't discuss Reach T2. Most of this reach is covered by low vegetation. A headcut has migrated slightly upstream from the mainstem and then it's a small ditch flowing from a pond above. The proposed work is Enhancement Level II at a 2.5:1 credit ratio to plant and remove livestock from this reach. A grade control structure will be added to stop the headcut.

Reach R2 (includes a change from restoration to E2)
Reach R2 begins at the confluence of Reaches T2 and R3. Spoil piles are evident in the middle of the reach beyond the right bank in the middle of the reach. The spoil piles will be removed as discussed in the wetland mitigation section below.

~~Following this second meeting, Todd Tugwell requested Enhancement Level II at a 5:1 credit ratio for this reach. The work will be limited to livestock exclusion fencing and supplemental planting. No work will be done in the channel.~~
Per the November 7, 2014 meeting, Enhancement Level I at a 1.5:1 credit ratio, as described above, will be implemented for upper Reach R2 to the barbed wire fence at the property line.

Reach T1 (notes are unchanged from previous meeting on April 14, 2014)

Reach T1 enters from the east on the downstream most property. It has a drainage area of 62 acres and 144 feet of Priority I restoration are proposed. As with all reaches, Baker will describe the functional uplift that will be attained through restoration in the mitigation plan.

Reach R1 (notes are unchanged from previous meeting on April 14, 2014)
Reach R1 begins at the confluence of Reaches R2 and T1. The bank height ratios are not particularly high, though there is some channel erosion on the upstream and middle sections. The channel has been straightened in the past so Priority I restoration is proposed to reestablish natural pattern and eliminate bank erosion. The IRT accepted this approach because the impacts from implementing it will not be as high as the reach upstream, which has more mature vegetation.

The downstream end of Reach R1 has been previously manipulated and spoil piles remain in this area. These will be removed as part of an effort to re-establish and rehabilitate the wetlands in this section.

Wetland Mitigation
The previous iteration of the minutes explained that Baker would map the wetlands to divide them into different categories according to their existing condition in terms of vegetation and hydrology. This was done in preparation for the June 6th meeting with Todd Tugwell.

The different areas may be generally categorized as follows:

1. "Functioning" wetlands – forested areas with hydrology and hydric soils, such as along the right bank of Reach R1. The hydrology and vegetation are present but in many areas cattle trampling has impacted the soil structure and ability to percolate water.
2. Degraded wetlands – areas with no wetland vegetation and some hydrology such as along the corrugated metal pipe at the beginning of Reach R1.
3. Partially-functioning wetlands – mucky areas along the left bank of the middle of Reach R1 that lacked wetland vegetation.
4. Filled wetlands – areas where spoil has been placed on top of presumed hydric soils, such as upper Reach R2 and the downstream end of Reach R1.

NCEEP explained that it is important for all wetland mitigation to be used by this project be in the restoration category (re-establishment or rehabilitation), otherwise it cannot be used according to the RFP. The federal definitions for wetland restoration and enhancement are listed below.

At the June 6th meeting, Todd Tugwell expressed that any wetland mitigation would appear to be linked to changes to the stream channel. Consequently, the wetland mitigation along Reaches R3 (lower) and R2 will be removed, with the exception of the wetland re-establishment along Reach R2 where spoil piles will be removed and hydric soils will be at the ground surface.

The credit ratios for the four types of wetland areas are proposed as follows:

1. "Functioning" wetlands – the Corps suggested credit ratios of 3:1.
2. Degraded wetlands – Baker proposes 1.5:1 credit for rehabilitation in these areas. The hydrology would be improved, as well as the vegetation.
3. Partially-functioning wetlands – Baker proposes 1.5:1 for these areas. Livestock trampling has adversely affected hydrology and soil structure in these areas. Baker believes that a compacted layer is promoting surface ponding and preventing suitable/natural drainage. By removing the livestock and planting appropriate wetland vegetation, Baker believes the soil structure will be rehabilitated and wetland function will significantly improve.
4. Filled wetlands – Baker proposes wetland re-establishment at a 1:1 credit ratio. By removing the spoil, hydric soils will be exposed and wetland hydrologic function will be re-established. Wetland planting will complete the picture.

Contacts

- Jeff Schaffer will serve as the NCEEP Project Manager for this project with and Greg Melia will provide technical assistance during project development and in review of deliverables. Chris Roessler will be the Baker Project Manager and coordinate/submit project deliverables directly with Jeff for distribution to all NCIRT team members.

Action Items and Next Steps

- Project Schedule – A separate meeting will be held to conduct the jurisdictional determination with the Corps. Baker will update NCEEP separately on the expected stream and wetland mitigation credits following the changes recommended by the IRT.
- After the jurisdictional determination has been conducted, any wetland areas that will be impacted by the proposed work (filled or drained) will need to be identified and functional replacement for those losses should be proposed and discussed in the draft mitigation plan.
- USACE requires Jurisdictional (JD) stream/wetland calls for the project. Baker will coordinate with David Bailey for on-site JD verification prior to mitigation plan submittal.
- Signage will be needed on all conservation easement areas.

This represents Baker Engineering's interpretation of the meeting discussions. If you should find any information contained in these meeting notes to be in error and/or incomplete based on individual comments or conversations, please notify me with corrections/additions as soon as possible.

Sincerely,

Chris Roessler, Project Manager
Michael Baker Engineering, Inc.
8000 Regency Parkway, Suite 600
Cary, NC 27518
Phone: 919.481.5737
Email: croessler@mbakercorp.com

Michael Baker
INTERNATIONAL

Meeting Minutes

BROWNS SUMMIT STREAM RESTORATION PROJECT

DMS Contract No. 5792

Date Prepared:	November 25, 2015
Meeting Date, Time, Location:	November 24, 2015, 10:00 am On-site (Guilford County, NC)
Attendees:	USACE – Todd Tugwell, Andrea Hughes Baker – Scott King
Subject:	Lower Reach R2 mitigation approach type
Recorded By:	Scott King

An on-site meeting was held on November 24th, 2015 at approximately 10:00 AM to discuss the Browns Summit Creek Restoration (Full Delivery) Project in Guilford County, NC. This meeting was held at the request of USACE following an SMU credit modification request by Baker for the Lower R2 stream section. There were at least two previous meetings onsite with other Baker staff members and the IRT, the results of which are discussed in previous meeting minutes. This memo will only focus on the discussion on Nov 24th.

Prior to the November 24th meeting, Scott King distributed a document titled:
Browns Summit SMU Credit Modification Request_16Oct2015.pdf, which showed photographs and cross sections of the Lower R2 reach section in question, along with a proposal to change the restoration approach from Enhancement II at a 5:1 ratio to Enhancement I at a 1.5:1 ratio.

After walking the section in question, Todd Tugwell and Andrea Hughes generally took the position that this stream section isn't too badly degraded, appears stable, and has mature trees close to the channel. Thus they are not inclined to believe that Enhancement I is an appropriate or especially beneficial approach to take here. They also pointed out that this stream's current condition isn't too far off from sections of stream mitigation currently being approved at final close-out meetings. Scott King presented Baker's case by emphasizing the channel incision and the sections of steep bare sideslopes. After discussion, Todd and Andrea proposed that perhaps the uppermost and lowermost portions of this section (which appeared to be the most degraded) would be suitable for more significant levels of restoration. The uppermost section of Lower R2 (later measured in the field at 74 feet along stream centerline) could be included in with the adjacent upstream section of stream mitigation (Reach R2 Upper) at an Enhancement Level I at 1.5:1 ratio, while the lowermost section of Lower R2 (later measured in the field at 42 feet along stream centerline) could be included in with the adjacent downstream section of mitigation (Reach R1) using a Restoration approach at a 1:1 ratio. They also agreed that the middle section of Lower R2, while still using an Enhancement Level II approach, might be more appropriate at 2.5:1 ratio rather than the current 5:1 ratio.

Todd and Andrea also stated that they didn't think these changes needed to be brought before the IRT for another full review. Instead the revisions can be made to the mitigation plan and submitted with the permit application.

This represents Baker Engineering's interpretation of the meeting discussions. If you should find any information contained in these meeting notes to be in error and/or incomplete based on individual comments or conversations, please notify me with corrections/additions as soon as possible.

Sincerely,

Scott King
Michael Baker Engineering, Inc.
8000 Regency Parkway, Suite 600
Cary, NC 27518
Phone: 919-481-5731
Email: scott.king@mbakerintl.com

18.2 EMAIL DOCUMENTATION – PER MS. HUGHES AND MR. KING

Suggs, Kristi

From: King, Scott
Sent: Thursday, August 06, 2015 4:42 PM
To: andrea.w.hughes@usace.army.mil
Cc: Schaffer, Jeff; Tomsic, Christopher; Suggs, Kristi
Subject: Browns Summit mitigation site wetlands issue
Attachments: BrownsSummit_HydricSoils_WetlandType5.pdf; BrownsSummit_WetlandType5.pdf; BrownsSummit_SoilsMap.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Good afternoon Andrea,
I just wanted to email everyone a quick summary of what we discussed earlier over the phone regarding the addition of the "Wetland Type 5" area to the wetland restoration credit of the Browns Summit mitigation site. Please reply back if I have presented anything incorrectly.
You expressed your reluctance to include additional wetlands that had not been previously discussed at the IRT field meetings on site, but stated that you **will** allow us to include these in the mitigation plan based on the following considerations:
-We are not seeking to expand our contracted WMU credit payment, we are only trying to ensure that we fulfill that contracted amount. Only after credit ratio negotiations for the bulk of wetland areas located at the bottom of the project were concluded did we fully realize we would be slightly short (0.08 credits) of our contracted amount.
-The small acreage of the wetlands in question makes this less contentious issue in your view, as we are only seeking 0.08 acres of paid credit from 0.33 acres of restored wetlands. That's 0.25 acres of restored wetlands the state gets free – a $17,000 value!
-You seemed to agree that this was not viewed as an attempt to slip something by the IRT surreptitiously. Baker has given a sincere, professional, and thorough evaluation to the area in question, had discussed this with DMS (though admittedly more recently than would be ideal), and would very much appreciate the chance to include it in our mitigation plan. We felt it was better to discuss it now than attempt to add wetland areas in two years down the road.

And when we next go out to download data from our pre-construction monitoring wells, I will invite you to meet us in the field to investigate and confirm this area for restoration. We look forward to meeting you then!

Most sincerely,
Scott

As for the attached maps, please consider the following:
Project Soils Map: Note that the area of interest is mapped as a Codorus loam hydric soil by the NRCS.

Wetland Type-5 Hydric Soils Map: The presence of hydric soil was confirmed and mapped in the field by Scott King on May 14, 2015 and subsequently surveyed that same day. Please note, the hydric soil map previously presented in the mitigation plan had slightly erroneous hydric soil boundaries on the western bank (field map boundaries were used in place of surveyed lines).

Wetland Type-5 Map: The area requested for restoration correctly totals 0.33 acres (erroneously noted previously as 0.27 acres). This is smaller than the total hydric soil acreage as we are only submitting the bulk of the eastern bank for restoration credit. Again, we are not attempting to go beyond our contracted WMU credits.

Scott King, LSS, PWS | Environmental Specialist | Ecosystem Restoration Group | Michael Baker International
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scott.king@mbakerintl.com | www.mbakerintl.com

19.0 APPENDIX E – DESIGN CALCULATIONS FOR REACH R6

OBJECTID	Area__AC_	Landuse	MUSYM	SOIL TYPE	CN		
1.00	9.38	Fallow Good	NaB	B	83.00	778.64	
2.00	1.25	Fallow Good	W	W	98.00	122.38	
3.00	1.88	Fallow Good	DaA	C	88.00	165.06	
4.00	2.01	Fallow Good	CkC	A	74.00	149.02	
5.00	29.16	Fallow Good	CkB	A	74.00	2157.72	
6.00	1.31	2 acre lot	NaB	B	65.00	85.24	
7.00	0.12	2 acre lot	DaA	A	46.00	5.68	
8.00	0.51	2 acre lot	CkB	A	46.00	23.28	
9.00	2.43	2 acre lot	CkB	A	46.00	111.65	
10.00	12.67	Fallow Good	CkB	A	74.00	937.73	
11.00	0.73	Impervious	CkB	A	98.00	72.00	
12.00	0.01	Fallow Good	CkB	A	74.00	0.71	
13.00	0.01	Impervious	CkB	A	98.00	0.94	
TOTAL	61.47					4610.04	
					AVERAGE CN	**74.99**	

I_A 0.01 For Simple Method Calcuations

Browns Summit Full Delivery
Hydrology Worksheet for Constructed Wetland (T6)

DA = 61.47 Total DA to US Farm Road is 61.47 AC

US Elev 839 DS Elev 835

Time of Concentration

Unpaved Sheet Flow	Max Length Unpaved Sheet 300 feet							
1	Slope	Length	P (2-yr 24 hr)	Mannings n			Travel Time	Travel Time
	(ft/ft)	(ft)		Factor			(hrs)	(min)
Cultivated Soils (Residue >20%)	0.013289037	301	3.37	0.17			0.50	30.01

Notes P based on NOAA ATLAS 14 Greensboro Pump Station

US Elev 835 DS Elev 814

Shallow Concentrated	Max Length Shallow Concentrated 1000 feet							
2	Slope	Length		Assumes n=0.02		Velocity	Travel Time	Travel Time
	(ft/ft)	(ft)				(fps)	(sec)	(min)
	0.023178808	906				2.22	408.11	6.80

Note: Velocity taken from Figure 3-1 (Unpaved) in TR-55 Manual

US Elev 814 DS Elev 802

Channel/Ditch Flow											
3	Slope	Length	n	depth	width	Velocity	Travel Time	Travel Time	area	wp	Rh
	(ft/ft)	(ft)	Factor			(fps)	(sec)	(min)			
	0.016129032	744	0.04	1	3	2.64	282.21	4.70	1.5	3.6	0.4

Note: Velocity calculated from existing condtio
ranged from 3.17 to 3.81 w/ average of 3.45.

Total Tc **41.51 min**

Lag Time **24.91 min**

Simple Method **(Simple method used to calculate water volumes for Constructed Wetland)**

$R_v = 0.05+0.9*I_A$ *Runoff coefficient (unitless)*

Where:

I_A=fractional impervious area (unitless)

$V = 3630*R_D*R_v*A$ *Volume of Runoff (cuft)*

Where:

R_D= Design storm rainfall depth (in) (typically 1" to 1.5")

A = Watershed area (ac)

		Units		
DA	61.47	ac	2677633 ft2	0.096047
R_D=	1.00	in		
I_A=	0.01	unitless		
R_v =	0.06	unitless		
V =	13588.32	cuft		
V =	3.74	ac-in		

Discrete SCS Curve Number Method

$Q^* = (P-0.2S)^2/(P+0.8S)$

S = (1000/CN)-10

V = Q*DA

DA = Drainage Area (ac)

Q* = Runoff Depth (in)

P = Rainfall Depth (in). Typically 1.0" to 1.5"

S = Potential maximum retention after rainfall begins (in)

V = Required treatment volume (ft^3)

		Units
S =	3.33	in
P =	1.00	in
Q* =	0.03	in

Wetland, Stage/Discharge

Water Quality		
N =	0	
D =	0	in
Cd =	0.6	
Inv =	0	ft

Channel Protection		
N =	0	
D =	0	in
Cd =	0	
Inv =	0	ft

Riser (box)		
N =	0	
Length =	0	ft
Width =	0	ft
Cw =	3.0	
Zcr =	0	ft

Barrel		
Db =	0	in
Co=	0.6	
Zin =	0	ft
Length	0	ft

Emergency Spillway (weir)	
L (ft)	25
Cw	3
Zcr (ft)	804.5

V-Notch Weir (Sharp Crested)	
Angle (deg)	30.00
Angle (rad)	0.524
Zcr (ft)	803.5

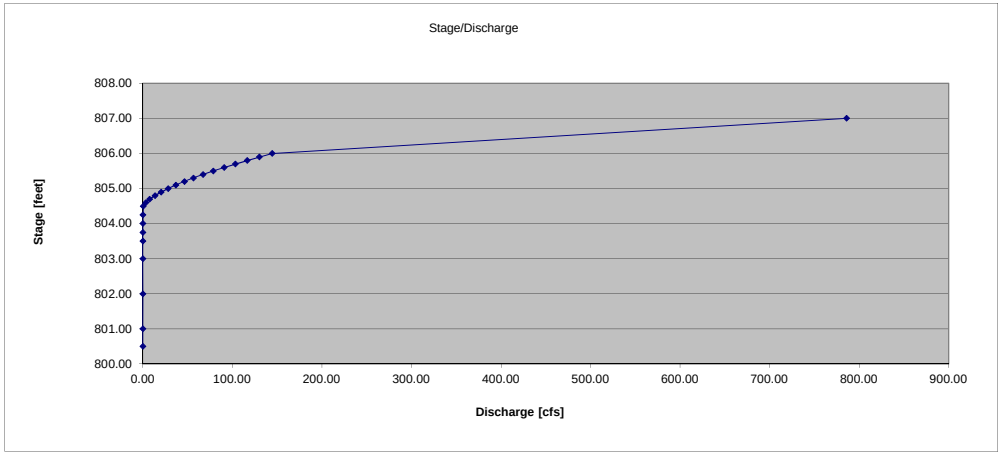
Dam Weir (Broad Crested)	
L (ft)	158
Cw	3
Zcr (ft)	806

Q=Ce*8/15*(2*g)^0.5*tan (angle/2)*h^2.5
Ce = 0.585 for 30 deg angle

Stage [ft]	Discharge [cfs]	WQ Orifice [cfs]	CP Orifice [cfs]	Riser(weir) [cfs]	Riser(orif.) [cfs]	Barrel [cfs]	Riser & Barrel [cfs]	Em. Spillway (weir) [cfs]	Sq-Notch (weir) [cfs]	Dam (weir) [cfs]
800.50	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00
801.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00
802.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00
803.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00
803.50	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00
803.75	0.02	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.02	0.00
804.00	0.12	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.12	0.00
804.25	0.33	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.33	0.00
804.50	0.67	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.67	0.00
804.60	3.22	0.00	0.00	0.0	0.0	0.0	0.0	2.37	0.85	0.00
804.70	7.77	0.00	0.00	0.0	0.0	0.0	0.0	6.71	1.06	0.00
804.80	13.62	0.00	0.00	0.0	0.0	0.0	0.0	12.32	1.29	0.00
804.90	20.53	0.00	0.00	0.0	0.0	0.0	0.0	18.97	1.56	0.00
805.00	28.37	0.00	0.00	0.0	0.0	0.0	0.0	26.52	1.85	0.00
805.10	37.03	0.00	0.00	0.0	0.0	0.0	0.0	34.86	2.17	0.00
805.20	46.45	0.00	0.00	0.0	0.0	0.0	0.0	43.92	2.53	0.00
805.30	56.58	0.00	0.00	0.0	0.0	0.0	0.0	53.67	2.92	0.00
805.40	67.37	0.00	0.00	0.0	0.0	0.0	0.0	64.04	3.34	0.00
805.50	78.80	0.00	0.00	0.0	0.0	0.0	0.0	75.00	3.80	0.00
805.60	90.81	0.00	0.00	0.0	0.0	0.0	0.0	86.53	4.29	0.00
805.70	103.41	0.00	0.00	0.0	0.0	0.0	0.0	98.59	4.82	0.00
805.80	116.55	0.00	0.00	0.0	0.0	0.0	0.0	111.17	5.38	0.00
805.90	130.22	0.00	0.00	0.0	0.0	0.0	0.0	124.24	5.99	0.00
806.00	144.41	0.00	0.00	0.0	0.0	0.0	0.0	137.78	6.63	0.00
807.00	785.84	0.00	0.00	0.0	0.0	0.0	0.0	296.46	15.38	474.00

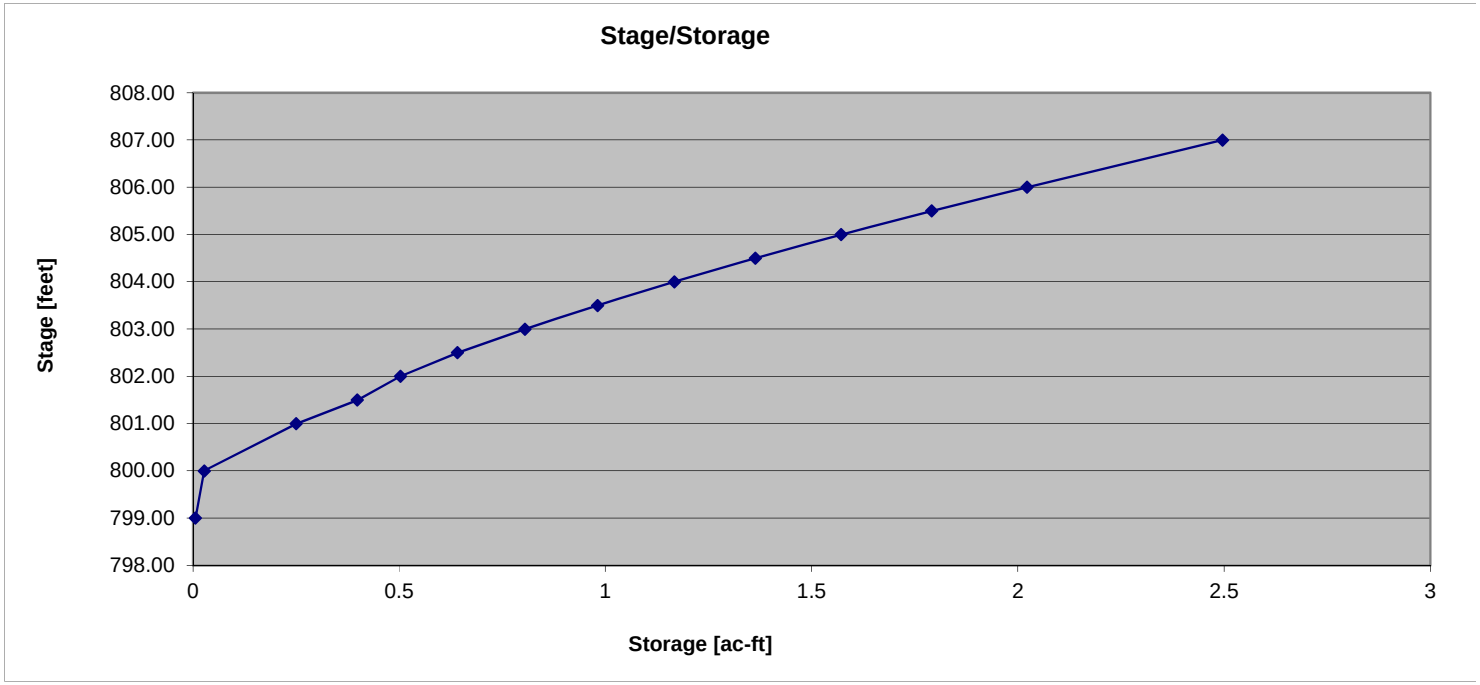
Drawdown of Water Quality Volume Using Static Method (Assume pond immediately fills up with storm event to treat and then drawdown starts thereafter)

1" Storm Voulume	3.74	ac-in
1" Storm Voulume	0.312	ac-ft
Detention Time	2	day
Release Rate	0.074	cfs



Total Volume

Elevation	Area (sf)	Area (ac)	Avg. Area (ac)	Height (ft)	Inc vol (ac-ft)	Acc vol (ac-ft)	Notes
798.50	424	0.010					
799.00	568	0.013	0.011	0.5	0.01	0.01	
800.00	1286.98	0.030	0.021	1	0.02	0.03	
801.00	18167	0.417	0.223	1	0.22	0.25	
801.50	7606	0.175	0.296	0.5	0.15	0.40	
802.00	10588	0.243	0.209	0.5	0.10	0.50	
802.50	13571	0.312	0.277	0.5	0.14	0.64	
803.00	14887	0.342	0.327	0.5	0.16	0.80	
803.50	15786	0.362	0.352	0.5	0.18	0.98	
804.00	16635	0.382	0.372	0.5	0.19	1.17	
804.50	17632	0.405	0.393	0.5	0.20	1.36	
805.00	18563	0.426	0.415	0.5	0.21	1.57	
805.50	19657	0.451	0.439	0.5	0.22	1.79	
806.00	20651	0.474	0.463	0.5	0.23	2.02	
807.00	20651	0.474	0.474	1	0.47	2.50	



Constructed Wetland Volume and Surface Area

V =	1.86	ac-in	SCS
V =	6752.40	ft^3	SCS
V =	3.74	ac-in	Simple
V =	13588.32	ft^3	Simple
Ponding Depth =	12.00	in	
Surface Area =	0.16	ac	SCS
Surface Area =	6752.40	ft^2	SCS
Surface Area =	0.31	ac	Simple
Surface Area =	13588.32	ft^2	Simple

Non-Forebay Surface Area =	1358.83	ft^2	10%
Forebay Surface Area =	1358.83	ft^2	10%
Shallow Water (low marsh) Surface Area =	5435.33	ft^2	40%
Shallow Land (high marsh) Surface Area =	5435.33	ft^2	40%

Actual Surface Area =

According to the DWQ BMP design manual, the BMP must be designed to treat a volume at least as large as the volume calculated using the simple method
DWQ recommends 9" but requires ponding depth to be less then 12"

Surface area of wetland is divided up into the zones as described below (Per NCDENR BMP Manual)

Deep Pools	
Non-Forebay	5-10%
Forebay	10%
Shallow Water (low marsh)	40%
Shallow Land (high marsh)	30-40%

Design Depth of Each Wetland Zone (Per NCDENR BMP Manual)

Non-Forebay	18-36"	include one at outlet structure for drawdown) if applicable
Forebay	18-36"	
Shallow Water (low marsh)	3-6"	don't make to deep!
Shallow Land (high marsh)	Up to 12"	surface area calculation. Also depth of permanent pool.

Percentages and depths are as follows for this design (Per design decision)

Non-Forebay 10%, Forebay 10%, Shallow water 40%, Shallow land 40%
Non-Forebay 36", Forebay 36", Shallow water 3", Shallow land 12"

20.0 APPENDIX F - PROJECT PLAN SHEETS

STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	140048	1	
NCDMS ID No. 96313			

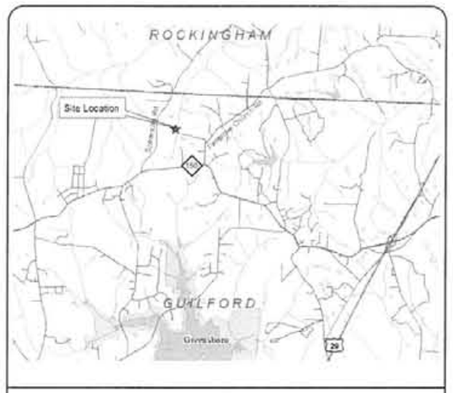
BROWNS SUMMIT

PROJECT: 140048

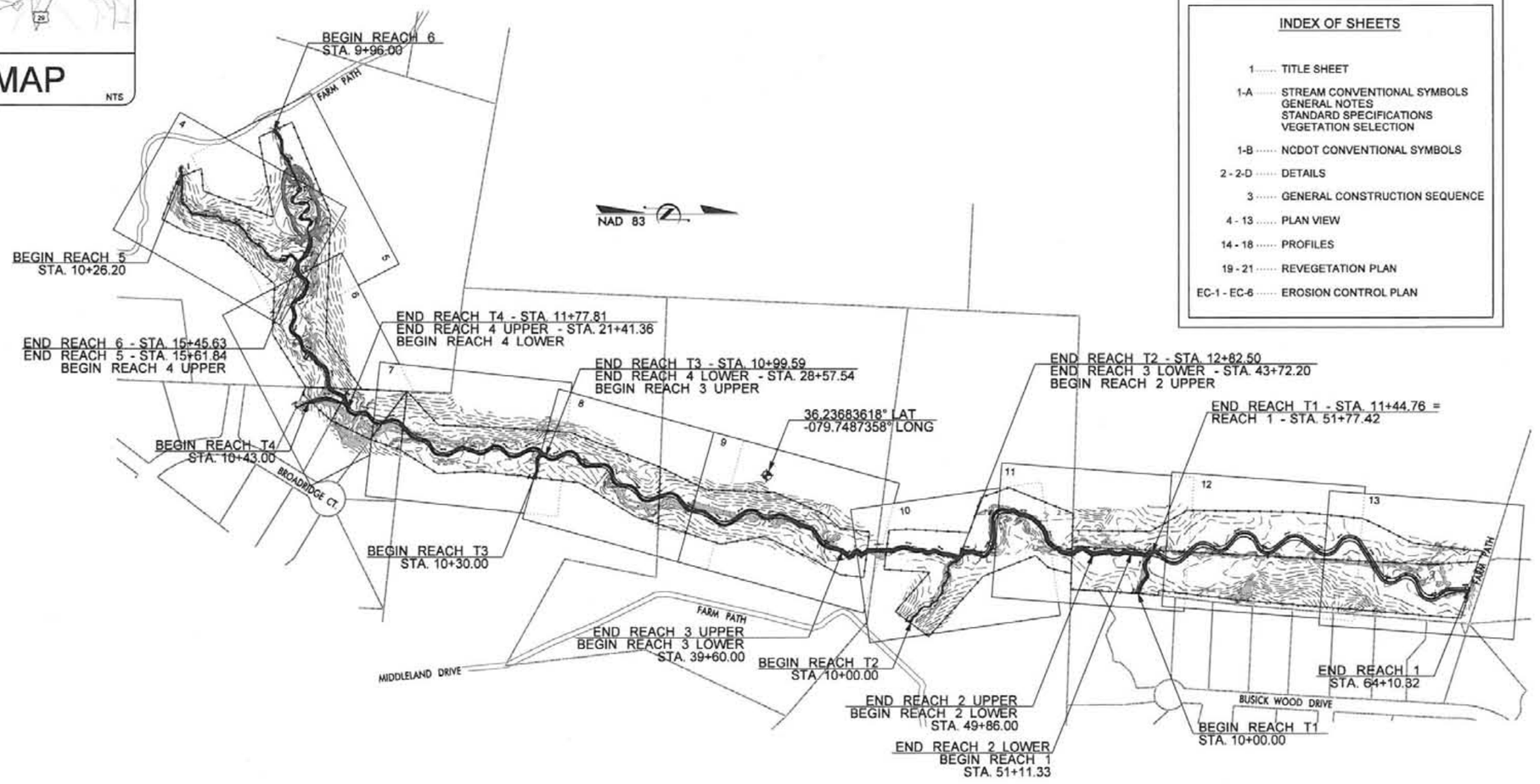
NORTH CAROLINA
DIVISION OF MITIGATION SERVICES

GUILFORD COUNTY

LOCATION: APPROX. 3 MILES NORTHWEST OF BROWNS SUMMIT
TYPE OF WORK: STREAM AND WETLAND RESTORATION AND ENHANCEMENT

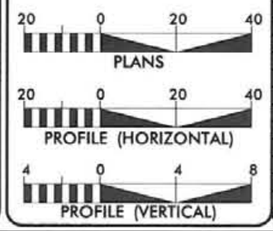


VICINITY MAP NTS



INDEX OF SHEETS

GRAPHIC SCALES



DESIGN SUMMARY

REACH NAME	EXISTING LENGTH (LF)	PROPOSED LENGTH (LF)
REACH 1	1,217	1,233
REACH 2 UPPER	701	614
REACH 2 LOWER	167	191
REACH 3	1,586	1,515
REACH 4 UPPER	464	580
REACH 4 LOWER	886	716
REACH 5	536	536
REACH 6	501	550
T1	121	145
T2	283	283
T3	83	70
T4	47	135
TOTAL	6,592	6,568

PREPARED FOR THE OFFICE OF:

NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

CONTACT: JEFF SCHAFFER
PROJECT MANAGER

PREPARED IN THE OFFICE OF:

Michael Baker INTERNATIONAL
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8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

LETTING DATE:

JACOB M. BYERS, PE
PROJECT ENGINEER

KATHLEEN M. McKEITHAN, PE
PROJECT MANAGER

PROJECT ENGINEER

PROGRESS DRAWING
FOR REVIEW PURPOSES ONLY
DO NOT USE FOR CONSTRUCTION

SIGNATURE: *P.E.*

2/25/03

STREAM CONVENTIONAL SYMBOLS
SUPERCEDES SHEET 1-B

- ROCK J-HOOK
- ROCK VANE
- OUTLET PROTECTION
- ROCK CROSS VANE
- DOUBLE DROP ROCK CROSS VANE
- SINGLE WING DEFLECTOR
- DOUBLE WING DEFLECTOR
- TEMPORARY SILT CHECK
- ROOT WAD
- LOG J-HOOK
- LOG VANE
- LOG WEIR
- LOG CROSS VANE
- LOG STEP POOL
- GRADE CONTROL LOG JAM
- CONSTRUCTED RIFFLE
- BOULDER CLUSTER
- ROCK STEP POOL
- SAFETY FENCE
- TF — TAPE FENCE
- FP — 100 YEAR FLOOD PLAIN
- CE — CONSERVATION EASEMENT
- 435 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- LIMITS OF DISTURBANCE
- PROPERTY LINE
- FOOT BRIDGE
- TEMPORARY STREAM CROSSING
- PERMANENT STREAM CROSSING
- TRANSPLANTED VEGETATION
- TREE REMOVAL
- TREE PROTECTION
- DITCH PLUG
- CHANNEL FILL
- BRUSH MATTRESS
- GEOLIFT WITH BRUSH TOE

**NOTE: ALL ITEMS ABOVE MAY NOT BE USED ON THIS PROJECT

GENERAL NOTES

1. THE CONTRACTOR IS REQUIRED TO INSTALL IN-STREAM STRUCTURES USING A TRACK HOE WITH A HYDRAULIC THUMB OF SUFFICIENT SIZE TO PLACE BOULDERS (3'x2'x2'), LOGS AND ROOTWADS.
2. WORK IS BEING PERFORMED AS AN ENVIRONMENTAL RESTORATION PLAN. THE CONTRACTOR SHOULD MAKE ALL REASONABLE EFFORTS TO REDUCE SEDIMENT LOSS AND MINIMIZE DISTURBANCE OF THE SITE WHILE PERFORMING THE CONSTRUCTION WORK.
3. CONSTRUCTION IS SCHEDULED TO BEGIN EARLY 2016.
4. CONTRACTOR SHOULD CALL NORTH CAROLINA "ONE-CALL" BEFORE EXCAVATION STARTS. (1-800-632-4949)
5. ENGINEER WILL FLAG TREES TO BE SAVED PRIOR TO CONSTRUCTION.

PROJECT REFERENCE NO.	SHEET NO.
140048	1-A

PROJECT ENGINEER

PROGRESS DRAWING
FOR REVIEW PURPOSES ONLY
DO NOT USE FOR CONSTRUCTION

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NCDMS ID No. 96313

STANDARD SPECIFICATIONS

NORTH CAROLINA
EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL
MARCH 2009 (REV 2013)

6.05 TREE PROTECTION
6.06 TEMPORARY GRAVEL CONSTRUCTION ENTRANCE
6.24 RIPARIAN AREA SEEDING
6.60 TEMPORARY SEDIMENT TRAP
6.62 TEMPORARY SILT FENCE
6.63 TEMPORARY ROCK DAM
6.70 TEMPORARY STREAM CROSSING

VEGETATION SELECTION

Proposed Plug Species for Reach R6 Constructed Wetland
Browns Summit Creek Restoration Project

Botanical Name	Common Name	% Planted by Species	Wetland Tolerance
Deep Pool Plantings			
Four Cubic Inch Herbaceous Plugs to be Installed 4' On Center			
Lemna spp	Duckweed	25%	OBL
Nuphar lutea ssp. Advena	Yellow pond-lily	25%	OBL
Nelumbo lutea	American lotus	25%	OBL
Eleocharis acicularis	Needle spikerush	25%	OBL
High Marsh Plantings			
Four Cubic Inch Herbaceous Plugs to be Installed 3' On Center			
Lobelia cardinalis	Cardinal Flower	10%	FACW
Eupatoriadelphus fistulosus	Joe Pye Weed	15%	FACW
Hibiscus coccineus	Scarlet Rose Mallow	15%	OBL
Lobelia elongata	Longleaf lobelia	15%	OBL
Rhynchospora colorata	Starrush whitetop	20%	FACW
Carex tenera	Quill sedge	25%	FAC
Low Marsh Plantings			
Four Cubic Inch Herbaceous Plugs to be Installed 3' On Center			
Sagittaria lancifolia	Bulltongue	10%	OBL
Iris pseudacorus	Yellow Flag	15%	OBL
Acorus americanus	Sweetflag	15%	OBL
Peltandra virginica	Arrow arum	15%	OBL
Pontederia cordata	Pickerelweed	20%	OBL
Scirpus cyperinus	Woolgrass	25%	FACW

Proposed Permanent Seed Mixture
Browns Summit Creek Restoration Project

Botanical Name	Common Name	% Planted by Species	Density (lbs/ac)	Wetland Tolerance
Andropogon gerardii	Big blue stem	10%	1.5	FAC
Dichanthelium clandestinum	Deer tongue	15%	2.25	FAC
Carex crinita	Fringed sedge	10%	1.5	OBL
Elymus virginicus	Virginia wild rye	10%	1.5	FACW
Juncus effusus	Soft rush	10%	1.5	FACW
Panicum virgatum	Switchgrass	15%	2.25	FAC
Schizachyrium scoparium	Little blue stem	10%	1.5	FACU
Sorghastrum nutans	Indiangrass	10%	1.5	FACU
Impatiens capensis	Jewelweed	10%	1.5	FACW
	Total	100%	15	

Note: Final species selection may change due to refinement or availability at the time of planting. If species substitution is required, the planting Contractor will submit a revised planting list to Baker for approval prior to the procurement of plant stock.

Proposed Bare-Root and Livestake Species
Browns Summit Creek Restoration Project

Botanical Name	Common Name	% Planted by Species	Wetland Tolerance
Riparian Buffer Plantings – Overstory (For all reaches <u>except</u> R1, R2) 8' x 8' spacing - 680 stems/Acre			
Fraxinus pennsylvanica	Green Ash	10%	FACW
Betula nigra	River Birch	10%	FACW
Liriodendron tulipifera	Tulip Poplar	10%	FAC
Quercus michauxii	Swamp Chestnut Oak	10%	FACW
Diospyros virginiana	Persimmon	5%	FAC
Platanus occidentalis	American Sycamore	10%	FACW
Ulmus americana	American Elm	5%	FACW
Riparian Buffer Plantings – Understory (For all reaches <u>except</u> R1, R2) 8' x 8' spacing - 680 stems/Acre			
Carpinus caroliniana	American Hornbeam	10%	FAC
Ilex opaca	American Holly	8%	FAC
Hamamelis virginiana	Witchhazel	6%	FACU
Viburnum dentatum	Arrowwood Viburnum	8%	FAC
Euonymus americanus	Strawberry Bush	8%	FAC

Botanical Name	Common Name	% Planted by Species	Wetland Tolerance
Wetland Buffer Plantings – Overstory (For Reaches R1, R2) 8' x 8' spacing - 680 stems/Acre			
Fraxinus pennsylvanica	Green Ash	10%	FACW
Betula nigra	River Birch	10%	FACW
Quercus lyrata	Overcup Oak	10%	OBL
Acer negundo	Box Elder	10%	FACW
Platanus occidentalis	American Sycamore	10%	FACW
Celtis laevigata	Sugarberry	5%	FACW
Nyssa sylvatica	Black gum	5%	FAC
Wetland Buffer Plantings – Understory (For Reaches R1, R2) 8' x 8' spacing - 680 stems/Acre			
Carpinus caroliniana	American Hornbeam	10%	FAC
Alnus serrulata	Tag Alder	10%	OBL
Ilex verticillata	Winterberry	10%	FACW
Viburnum nudum	Possumhaw	10%	OBL
Riparian Live Stake Plantings			
Salix sericea	Silky Willow	25%	OBL
Sambucus canadensis	Elderberry	25%	FACW
Cephalanthus occidentalis	Buttonbush	15%	OBL
Cornus amomum	Silky Dogwood	25%	FACW
Salix nigra	Black Willow	10%	OBL

Note: Final species selection may change due to refinement or availability at the time of planting. If species substitution is required, the planting contractor will submit a revised planting list to Baker for approval prior to the procurement of plant stock.

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NCDMS ID No. 96313	

PROGRESS DRAWING
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*S.U.E = SUBSURFACE UTILITY ENGINEER

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

CONVENTIONAL SYMBOLS

BOUNDARIES AND PROPERTY:

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin (IP)
- Property Corner
- Property Monument (CM)
- Parcel/Sequence Number (123)
- Existing Fence Line
- Proposed Woven Wire Fence
- Proposed Chain Link Fence
- Proposed Barbed Wire Fence
- Existing Wetland Boundary (WLB)
- Proposed Wetland Boundary (WLB)
- Existing Endangered Animal Boundary (EAB)
- Existing Endangered Plant Boundary (EPB)

BUILDINGS AND OTHER CULTURE:

- Gas Pump Vent or U/G Tank Cap
- Sign
- Well
- Small Mine
- Foundation
- Area Outline
- Cemetery
- Building
- School
- Church
- Dam

HYDROLOGY:

- Stream or Body of Water
- Hydro, Pool or Reservoir
- Jurisdictional Stream (JS)
- Buffer Zone 1 (BZ 1)
- Buffer Zone 2 (BZ 2)
- Flow Arrow
- Disappearing Stream
- Spring
- Wetland
- Proposed Lateral, Tail, Head Ditch (Fill)
- False Sump

RAILROADS:

- Standard Gauge (CSX TRANSPORTATION)
- RR Signal Milepost (MILEPOST 35)
- Switch (SWITCH)
- RR Abandoned
- RR Dismantled

RIGHT OF WAY:

- Baseline Control Point
- Existing Right of Way Marker
- Existing Right of Way Line
- Proposed Right of Way Line
- Proposed Right of Way Line with Iron Pin and Cap Marker
- Proposed Right of Way Line with Concrete or Granite Marker
- Existing Control of Access
- Proposed Control of Access
- Existing Easement Line (E)
- Proposed Temporary Construction Easement (E)
- Proposed Temporary Drainage Easement (TDE)
- Proposed Permanent Drainage Easement (PDE)
- Proposed Permanent Utility Easement (PUE)
- Proposed Temporary Utility Easement (TUE)
- Proposed Permanent Easement with Iron Pin and Cap Marker

ROADS AND RELATED FEATURES:

- Existing Edge of Pavement
- Existing Curb
- Proposed Slope Stakes Cut (C)
- Proposed Slope Stakes Fill (F)
- Proposed Wheel Chair Ramp (WCR)
- Existing Metal Guardrail
- Proposed Guardrail
- Existing Cable Guiderail
- Proposed Cable Guiderail
- Equality Symbol
- Pavement Removal

VEGETATION:

- Single Tree
- Single Shrub
- Hedge
- Woods Line
- Orchard
- Vineyard (Vineyard)

EXISTING STRUCTURES:

MAJOR:
- Bridge, Tunnel or Box Culvert (CONC)
- Bridge Wing Wall, Head Wall and End Wall (CONC WW)

MINOR:
- Head and End Wall (CONC HW)
- Pipe Culvert
- Footbridge
- Drainage Box: Catch Basin, DI or JB (CB)
- Paved Ditch Gutter
- Storm Sewer Manhole (S)
- Storm Sewer (S)

UTILITIES:

POWER:
- Existing Power Pole
- Proposed Power Pole
- Existing Joint Use Pole
- Proposed Joint Use Pole
- Power Manhole (P)
- Power Line Tower
- Power Transformer
- U/G Power Cable Hand Hole (HH)
- H-Frame Pole
- Recorded U/G Power Line (P)
- Designated U/G Power Line (S.U.E.*) (P)

TELEPHONE:
- Existing Telephone Pole
- Proposed Telephone Pole
- Telephone Manhole (T)
- Telephone Booth
- Telephone Pedestal (T)
- Telephone Cell Tower
- U/G Telephone Cable Hand Hole (HH)
- Recorded U/G Telephone Cable (T)
- Designated U/G Telephone Cable (S.U.E.*) (T)
- Recorded U/G Telephone Conduit (TC)
- Designated U/G Telephone Conduit (S.U.E.*) (TC)
- Recorded U/G Fiber Optics Cable (T FO)
- Designated U/G Fiber Optics Cable (S.U.E.*) (T FO)

WATER:
- Water Manhole (W)
- Water Meter
- Water Valve
- Water Hydrant
- Recorded U/G Water Line (W)
- Designated U/G Water Line (S.U.E.*) (W)
- Above Ground Water Line (A/G Water)

TV:
- TV Satellite Dish
- TV Pedestal (T)
- TV Tower
- U/G TV Cable Hand Hole (HH)
- Recorded U/G TV Cable (TV)
- Designated U/G TV Cable (S.U.E.*) (TV)
- Recorded U/G Fiber Optic Cable (TV FO)
- Designated U/G Fiber Optic Cable (S.U.E.*) (TV FO)

GAS:
- Gas Valve
- Gas Meter
- Recorded U/G Gas Line (G)
- Designated U/G Gas Line (S.U.E.*) (G)
- Above Ground Gas Line (A/G Gas)

SANITARY SEWER:
- Sanitary Sewer Manhole
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line (SS)
- Above Ground Sanitary Sewer (A/G Sanitary Sewer)
- Recorded SS Forced Main Line (FSS)
- Designated SS Forced Main Line (S.U.E.*) (FSS)

MISCELLANEOUS:
- Utility Pole
- Utility Pole with Base
- Utility Located Object
- Utility Traffic Signal Box (S)
- Utility Unknown U/G Line (W/S)
- U/G Tank; Water, Gas, Oil
- A/G Tank; Water, Gas, Oil
- U/G Test Hole (S.U.E.*)
- Abandoned According to Utility Records (AATUR)
- End of Information (E.O.I.)

2/26/03

12/31/2015
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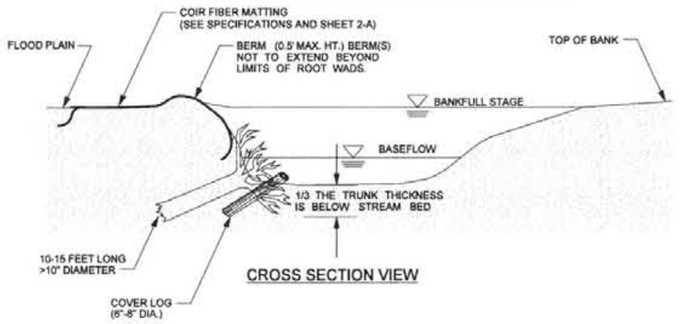
2/26/03

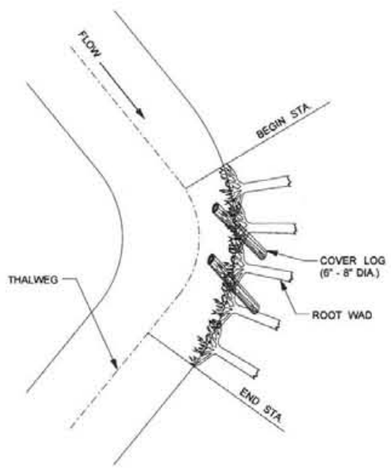
ROOT WADS

ROOT WADS WITHOUT TRANSPLANTS
USE IF TRANSPLANTS ARE NOT AVAILABLE ON-SITE

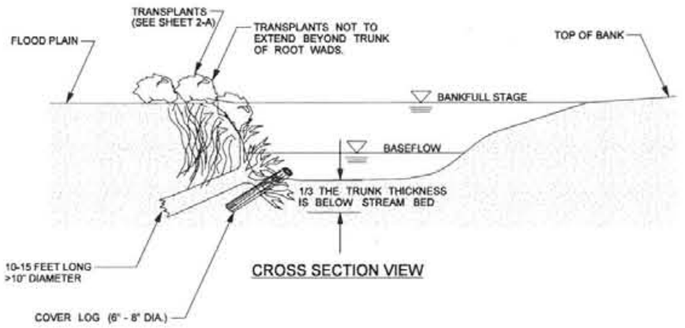


CROSS SECTION VIEW

PLAN VIEW



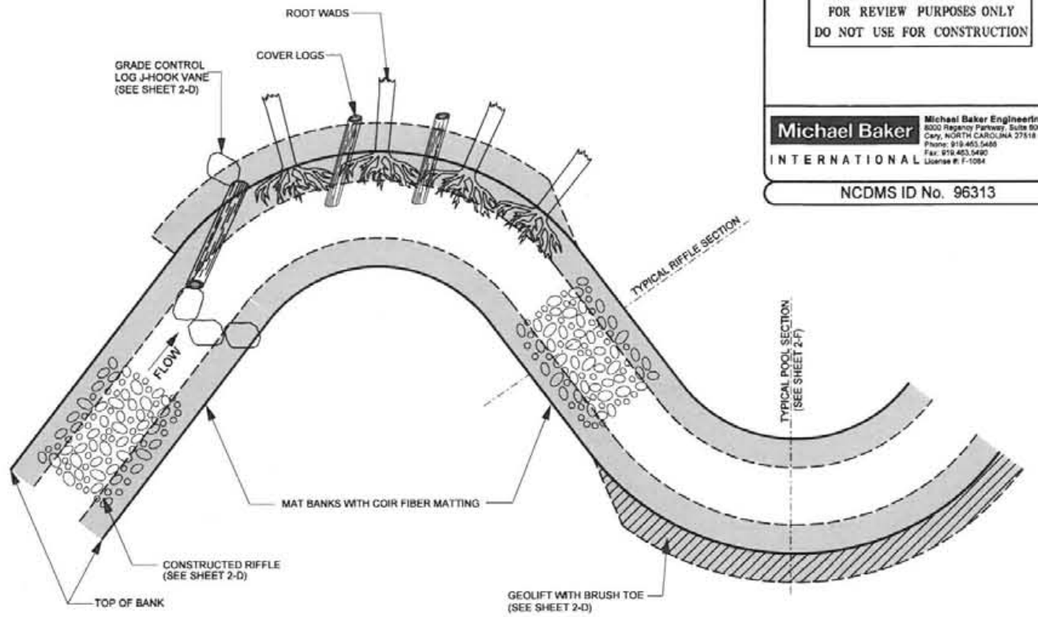
ROOT WADS WITH TRANSPLANTS
USE IF TRANSPLANTS ARE AVAILABLE ON-SITE



CROSS SECTION VIEW

NOTES:
1. INSTALLATION USING THE TRENCHING METHOD REQUIRES THAT A TRENCH BE EXCAVATED FOR THE LOG PORTION OF THE ROOT WAD. ONE-THIRD OF THE ROOT WAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS OR CHANNEL BOTTOM.
2. THE NUMBER OF ROOTWADS ESTIMATED MAY VARY DEPENDING ON THE ROOTMASS SIZE. IN GENERAL, ROOTWADS SHOULD PROTECT THE OUTER MEANDER BEND AS SHOWN. SEE STRUCTURE TABLE FOR APPROXIMATE STATION AND LOCATION.
3. INSTALL COVER LOGS BETWEEN ROOTWADS TO PROVIDE HABITAT ONLY WHEN AVAILABLE FROM ON-SITE HARVESTING.

TYPICAL STRUCTURE PLACEMENT



STRUCTURE NOTES:
1. GENERALLY CONSTRUCTED RIFFLES, ROOT WADS, LOG VANES AND COIR FIBER MATTING WILL BE INSTALLED IN THE LOCATION AND SEQUENCE AS SHOWN.
2. ANY CHANGES TO NUMBER OR LOCATION OF STRUCTURES DURING CONSTRUCTION MUST BE APPROVED BY THE DESIGN ENGINEER.
3. COIR FIBER MATTING TO BE INSTALLED ON ALL RESTORED STREAMBANKS, FLOODPLAIN BENCHING, AND TERRACE SLOPES AS DESCRIBED IN THE TECHNICAL SPECIFICATIONS.
4. ROOTWADS MAY BE REPLACED WITH GEOLIFT.

BAKER PROJECT REFERENCE NO.	SHEET NO.
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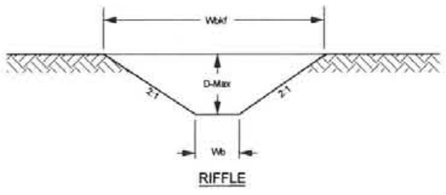
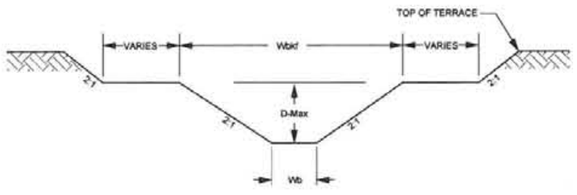
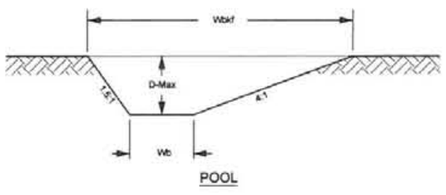
TYPICAL RIFFLE, POOL, AND BANKFULL BENCH CROSS-SECTIONS



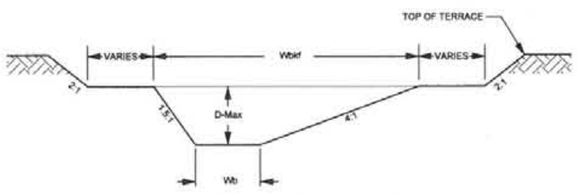
RIFFLE



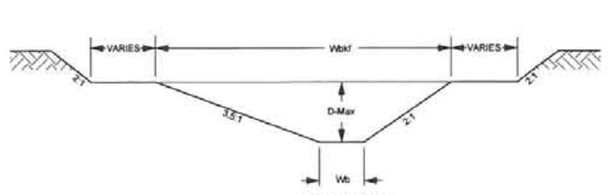
RIFFLE WITH BANKFULL BENCH



POOL



POOL WITH BANKFULL BENCH



STEP - POOL

NOTES:
1. DURING CONSTRUCTION CORNERS OF DESIGN CHANNEL WILL BE ROUNDED AND A THALWEG WILL BE SHAPED PER DIRECTION OF ENGINEER.
2. POOLS SHOWN ABOVE ARE LEFT POOLS FOR MEANDER CHANNELS.

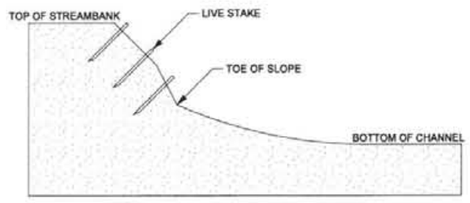
R1		R2		R3		
RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	
12.9	17.4	11.0	14.9	10.3	13.9	WIDTH OF BANKFULL (Wbkf)
1.5	2.7	1.3	2.2	1.2	2.0	MAXIMUM DEPTH (D-Max)
11.0	11.2	11.0	11.4	11.0	11.5	WIDTH TO DEPTH RATIO (Wbkf / D)
15.2	26.9	11.1	19.5	9.7	16.8	BANKFULL AREA (Abkf)
6.8	2.6	5.8	2.8	5.4	2.9	BOTTOM WIDTH (Wb)

R4 - UPPER		R4 - LOWER		R6 Bc STREAM		
RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	
8.1	10.9	9.2	12.4	7.0	10.0	WIDTH OF BANKFULL (Wbkf)
0.8	1.5	0.9	1.8	0.6	1.5	MAXIMUM DEPTH (D-Max)
13.0	11.7	13.0	11.5	14.0	12.4	WIDTH TO DEPTH RATIO (Wbkf / D)
5.0	10.2	6.5	13.4	3.5	8.0	BANKFULL AREA (Abkf)
5.0	2.7	5.7	2.5	4.6	3.4	BOTTOM WIDTH (Wb)

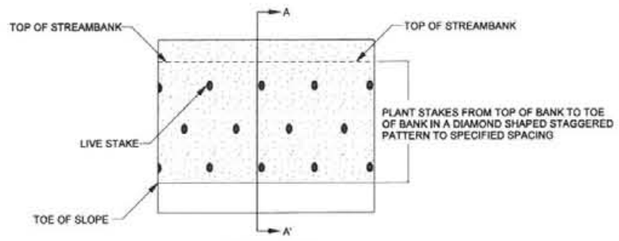
R6 C/E STREAM		T1		T3 / T4		
RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	
8.1	7.9	7.0	9.5	5.8	7.5	WIDTH OF BANKFULL (Wbkf)
0.6	0.9	0.7	1.2	0.6	0.9	MAXIMUM DEPTH (D-Max)
12.0	12.8	13.0	12.1	12.0	12.4	WIDTH TO DEPTH RATIO (Wbkf / D)
3.1	4.9	3.8	7.4	2.8	4.5	BANKFULL AREA (Abkf)
3.5	3.0	4.4	2.9	3.3	2.6	BOTTOM WIDTH (Wb)

2/26/23

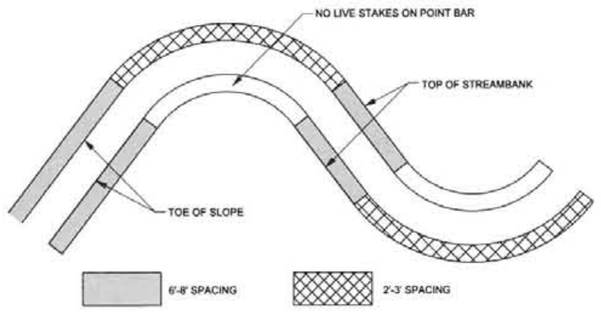
LIVE STAKING



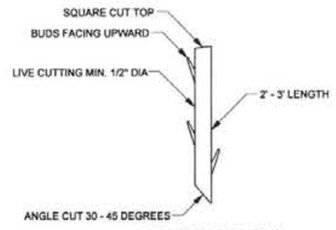
SECTION A - A'



PLAN VIEW



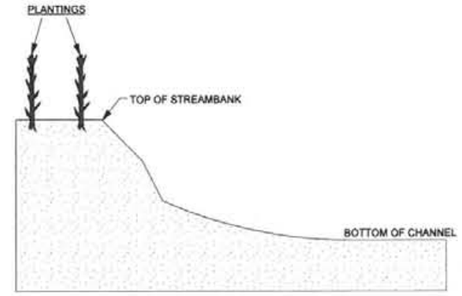
LIVE STAKE SPACING PLAN VIEW



LIVE STAKE DETAIL

NOTES:
1. STAKES SHOULD BE CUT AND INSTALLED ON THE SAME DAY.
2. DO NOT INSTALL STAKES THAT HAVE BEEN SPLIT.
3. STAKES MUST BE INSTALLED WITH BUDS POINTING UPWARDS.
4. STAKES SHOULD BE INSTALLED PERPENDICULAR TO BANK.
5. STAKES SHOULD BE 1/2 TO 2 INCHES IN DIAMETER AND 2 TO 3 FT LONG.
6. STAKES SHOULD BE INSTALLED LEAVING 1/5 OF STAKE ABOVE GROUND.

PLANTING SPECIFICATIONS



CROSS SECTION VIEW OF BARE ROOT PLANTING

NOTES:
1. PLANT BARE ROOT SHRUBS AND TREES TO THE WIDTH OF THE BUFFER/PLANTING ZONE AS SHOWN ON THE PLANS.
2. ALLOW FOR 6-10 FEET BETWEEN PLANTINGS, DEPENDING ON SIZE.
3. LOOSEN COMPACTED SOIL.
4. PLANT IN HOLES MADE BY A MATTOCK, DIBBLE, PLANTING BAR, OR OTHER APPROVED MEANS.
5. PLANT IN HOLES DEEP AND WIDE ENOUGH TO ALLOW THE ROOTS TO SPREAD OUT AND DOWN WITHOUT J-ROOTING.
6. KEEP ROOTS MOIST WHILE DISTRIBUTING OR WAITING TO PLANT BY MEANS OF WET CANVAS, BURLAP, OR STRAW.
7. HEEL-IN PLANTS IN MOIST SOIL OR SAWDUST IF NOT PROMPTLY PLANTED UPON ARRIVAL TO PROJECT SITE.

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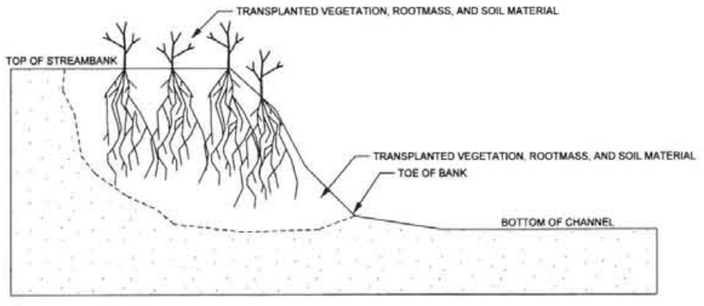
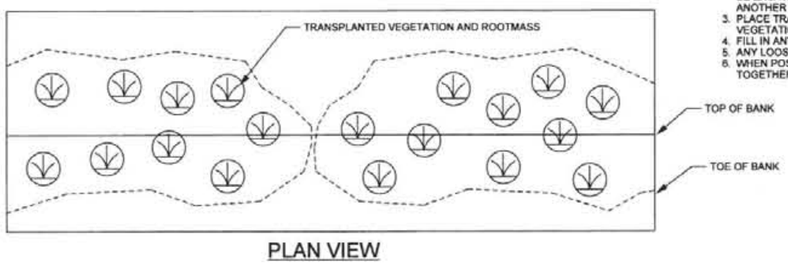
TRANSPLANTED VEGETATION



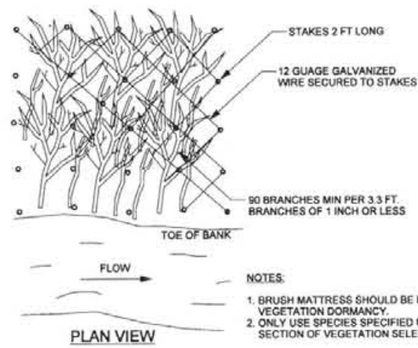
CROSS SECTION VIEW



PLAN VIEW

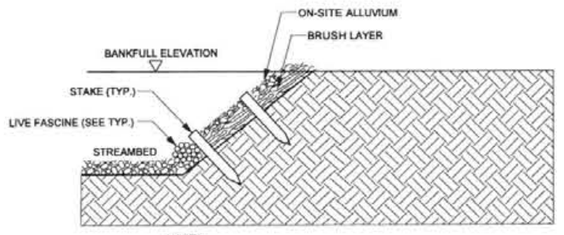
NOTES:
1. EXCAVATE A HOLE IN THE BANK TO BE STABILIZED THAT WILL ACCOMMODATE THE SIZE OF TRANSPLANT TO BE PLACED. BEGIN EXCAVATION AT THE TOE OF THE BANK.
2. EXCAVATE THE ENTIRE ROOT MASS AND AS MUCH ADDITIONAL SOIL MATERIAL AS POSSIBLE. IF ENTIRE ROOT MASS CAN NOT BE EXCAVATED AT ONCE, THE TRANSPLANT IS TOO LARGE AND ANOTHER SHOULD BE SELECTED.
3. PLACE TRANSPLANT IN THE BANK TO BE STABILIZED SO THAT VEGETATION IS ORIENTATED VERTICALLY.
4. FILL IN ANY HOLES AROUND THE TRANSPLANT AND COMPACT.
5. ANY LOOSE SOIL LEFT IN THE STREAM SHOULD BE REMOVED.
6. WHEN POSSIBLE, PLACE MULTIPLE TRANSPLANTS CLOSE TOGETHER SUCH THAT THEY TOUCH.

BRUSH MATTRESS



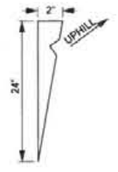
PLAN VIEW

NOTES:
1. BRUSH MATTRESS SHOULD BE INSTALLED DURING VEGETATION DORMANCY.
2. ONLY USE SPECIES SPECIFIED UNDER LIVE STAKES SECTION OF VEGETATION SELECTION.



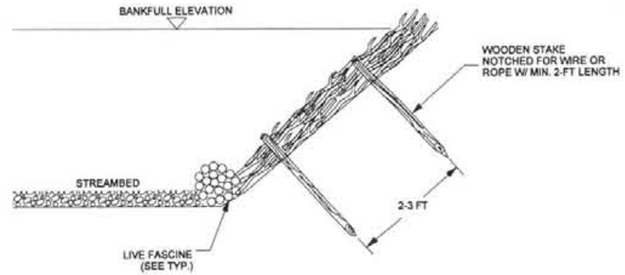
NOTES:
1. CREATE 12" DEEP TRENCH.
2. STAKE AND WIRE BRUSH LAYER INTO TRENCH.
3. BACK FILL 3" OF ON-SITE ALLUVIUM OVER BRUSH LAYER

CROSS SECTION



TYPICAL STAKE

NOTES:
1. BOARD FOR STAKE SHOULD BE 2" x 4" x 24".
2. SAW 2" x 4" TIMBER DIAGONALLY TO PRODUCE 2 DEAD STOUT STAKES.



2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	2-B

PROJECT ENGINEER

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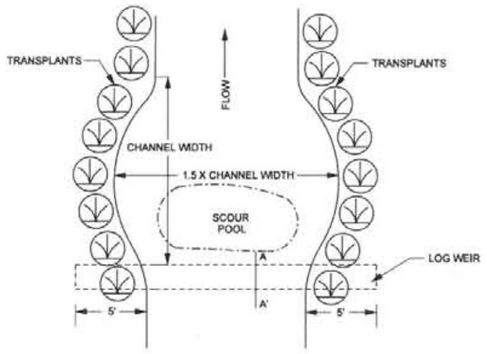
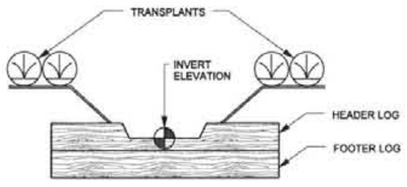
NCDMS ID No. 96313

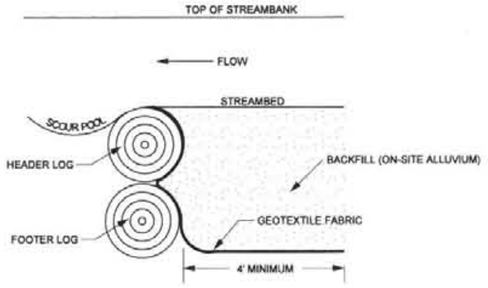
LOG WEIR



PLAN VIEW



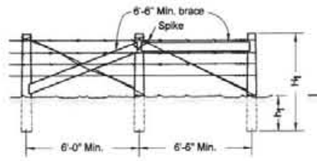
CROSS SECTION VIEW



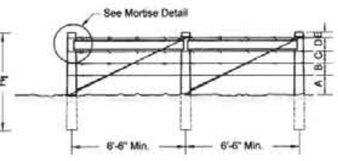
SECTION A-A'

NOTES:
1. LOGS SHOULD BE AT LEAST 12 INCHES IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. LOGS >24 INCHES IN DIAMETER MAY BE USED ALONE WITHOUT AN ADDITIONAL LOG. GEOTEXTILE FABRIC SHOULD STILL BE USED TO SEAL AROUND LOG
3. PLACE FOOTER LOGS FIRST AND THEN HEADER (TOP) LOG. SET HEADER LOG APPROXIMATLEY 3 INCHES ABOVE THE INVERT ELEVATION.
4. CUT A NOTCH IN THE HEADER LOG APPROXIMATLEY 50 PERCENT OF THE CHANNEL BOTTOM WIDTH AND EXTENDING DOWN TO THE INVERT ELEVATION.
5. USE GEOTEXTILE FABRIC TO SEAL GAPS BETWEEN LOGS.
6. PLACE TRANSPLANTS FROM TOE OF STREAMBANK TO TOP OF STREAMBANK.

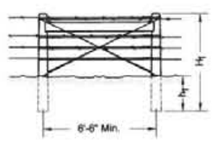
4-WIRE BARBED WIRE FENCE



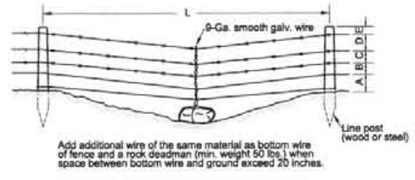
END PANEL-TYPE I



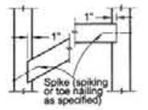
END PANEL-TYPE II



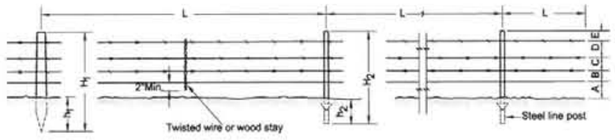
STRESS PANEL



PANEL AT MINOR DEPRESSION



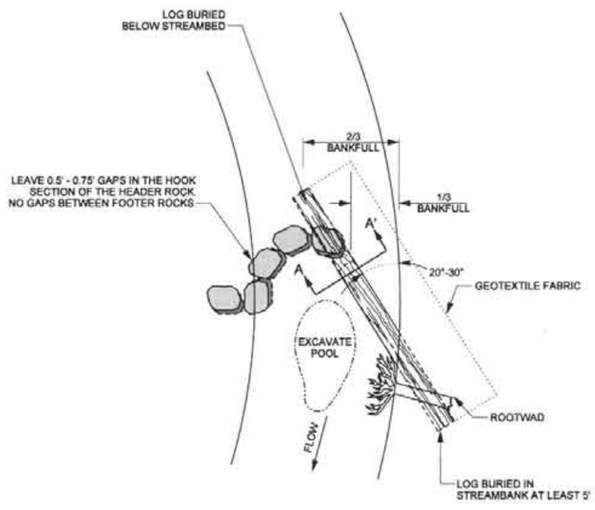
MORTISE DETAIL



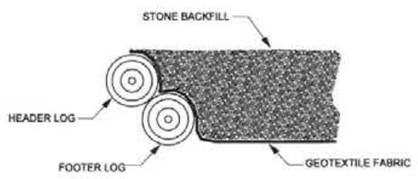
LINE PANELS

NOTE:
1. See specifications for the following:
a. Ratio of steel ot wood line posts.
b. Post spacing, length and depth in ground.
c. Type of end panel to be used.
d. Type of wire to be used.
e. Spacing between wires.
f. Number of stays per span (L).

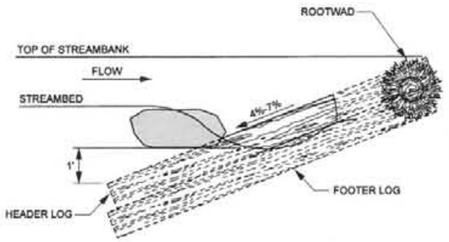
GRADE CONTROL LOG J-HOOK VANE



PLAN VIEW



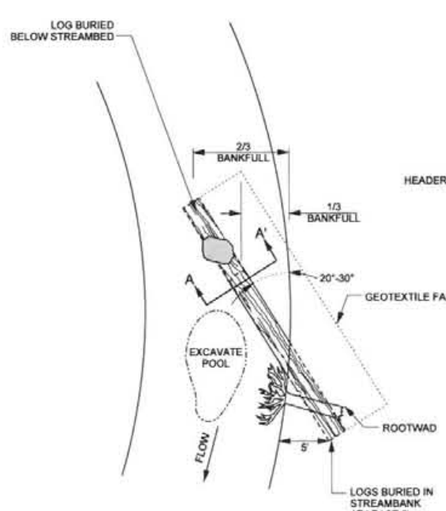
SECTION A - A'



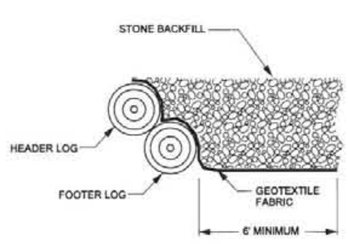
PROFILE VIEW

NOTES:
1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. BOULDERS MUST BE AT LEAST 3' x 2' x 2'.
3. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
4. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
5. BOULDERS SHOULD BE PLACED ON TOP OF HEADER LOG FOR ACHORING.
6. HEADER BOULDERS TO BE PLACED 0.5 TO 0.75 FEET APART.
7. GEOTEXTILE FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
8. TRANSPLANTS CAN BE USED INSTEAD OF ROOWADS, PER DIRECTION OF ENGINEER.

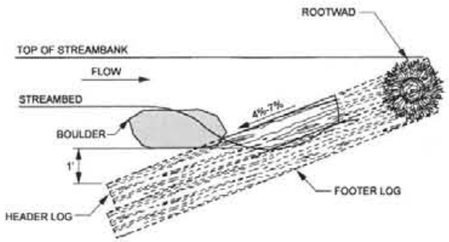
LOG VANE



PLAN VIEW



SECTION A - A'



PROFILE VIEW

NOTES:
1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. BOULDERS MUST BE OF SUFFICIENT SIZE TO ANCHOR LOGS.
3. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOGS.
4. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
5. BOULDER SHOULD BE PLACED ON TOP OF HEADER LOG FOR ANCHORING.
6. GEOTEXTILE FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
7. TRANSPLANTS CAN BE USED INSTEAD OF ROOTWADS, PER DIRECTION OF ENGINEER.

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6/1/2006

BAKER PROJECT REFERENCE NO.	SHEET NO.
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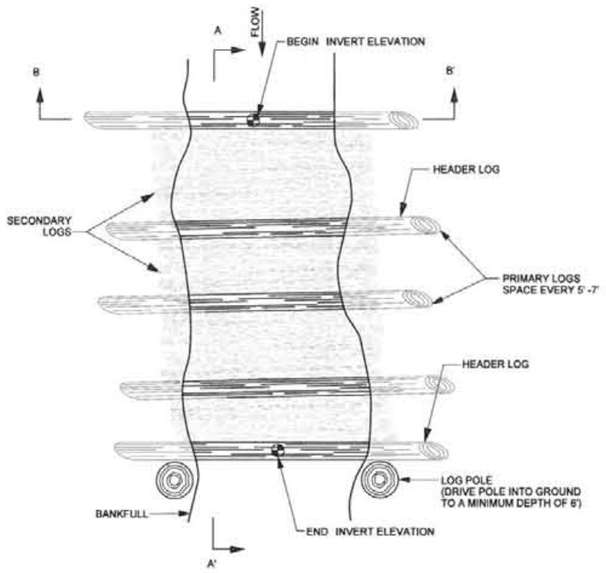
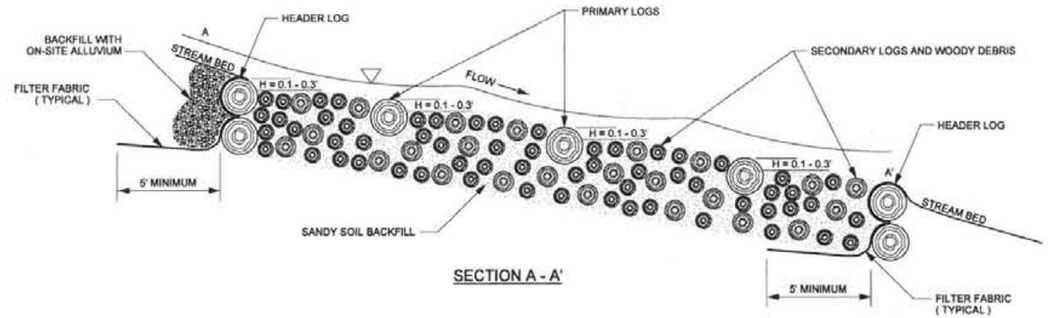
License #: F-1084

NCDMS ID No. 96313

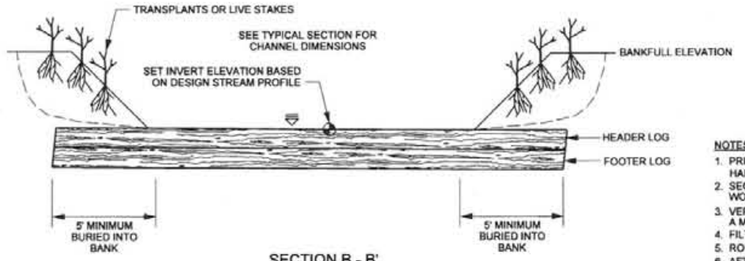
GRADE CONTROL LOG JAM



PLAN VIEW



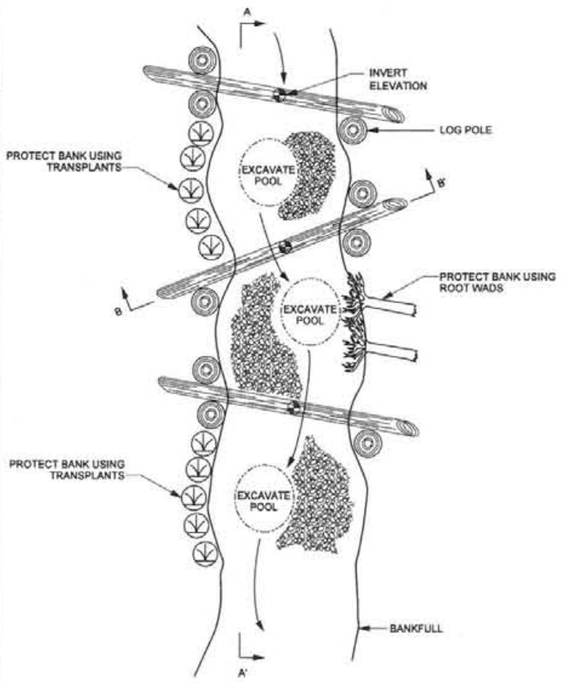
SECTION A - A'



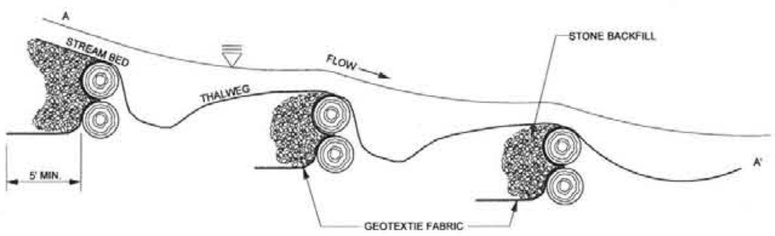
SECTION B - B'

NOTES:
1. PRIMARY LOGS SHOULD BE AT LEAST 10" OR MORE IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD PREFERRED, AND RECENTLY HARVESTED AND EXTENDING INTO THE BANK 5' ON EACH SIDE.
2. SECONDARY LOGS SHOULD BE AT LEAST 1" IN DIAMETER AND NO LARGER THAN 10", AND EXTEND INTO THE BANK 2 FEET ON EACH SIDE. WOOD MATERIAL SHALL BE VARYING DIAMETER TO ALLOW MATERIAL TO BE COMPACTED.
3. VERTICAL POSTS SHOULD BE AT LEAST 10" IN DIAMETER AND SHOULD BE DRIVEN INTO THE GROUND A MINIMUM OF 6'.
4. FILTER FABRIC SHOULD BE NAILED TO THE HEADER LOG BELOW THE BACKFILL.
5. ROOTWADS AND COIR FIBER MATTING CAN BE USED INSTEAD OF TRANSPLANTS OR LIVE STAKES, PER DIRECTION OF ENGINEER.
6. AFTER TRENCH HAS BEEN EXCAVATED A LAYER OF SECONDARY LOGS AND WOODY DEBRIS SHOULD BE PLACED WITH MINIMAL GAPS. A LAYER OF ON-SITE ALLUVIUM SHOULD BE APPLIED TO FILL VOIDS BETWEEN SECONDARY LOGS BEFORE ADDITIONAL LAYERS ARE PLACED.

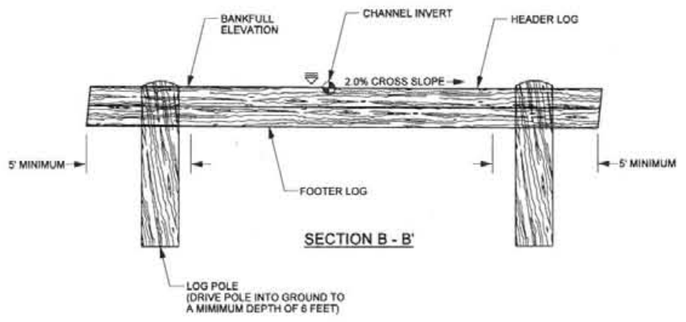
LOG ROLLER



PLAN VIEW



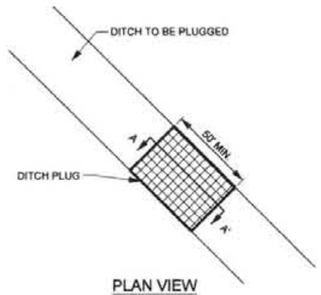
SECTION A - A'



SECTION B - B'

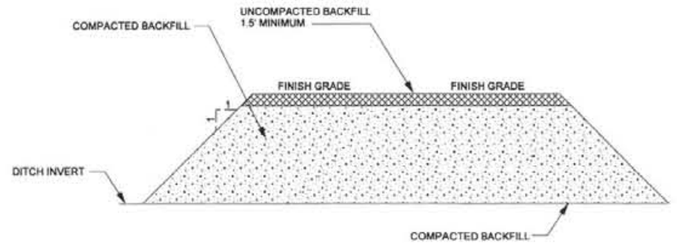
NOTES:
1. LOGS (ROLLERS AND POLES) SHOULD BE AT LEAST 10" OR MORE IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD PREFERRED, RECENTLY HARVESTED AND EXTENDING INTO THE BANK 5' ON EACH SIDE.
2. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
3. FILTER FABRIC SHOULD BE NAILED (1' ON CENTER) TO THE LOG BELOW THE BACKFILL.
4. TRANSPLANTS CAN BE USED INSTEAD OF ROOT WADS, PER DIRECTION OF OWNER.

DITCH PLUG



PLAN VIEW

NOTE:
COMPACT BACKFILL USING ON-SITE HEAVY EQUIPMENT IN 10 INCH LIFTS.



SECTION A - A'

2/26/13

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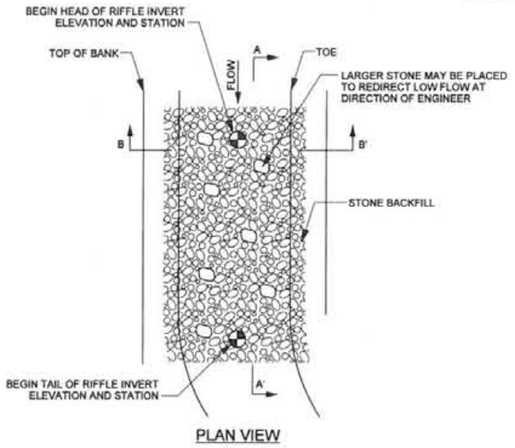
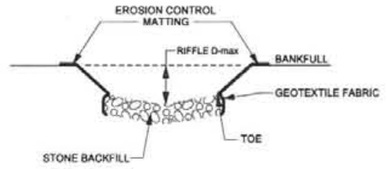
NCDMS ID No. 96313

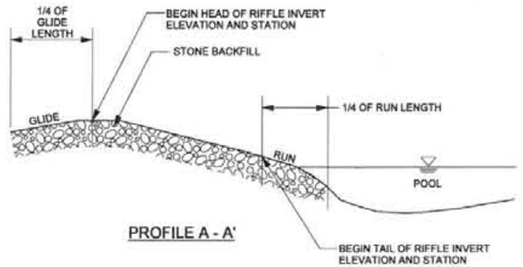
CONSTRUCTED RIFFLE



PLAN VIEW



SECTION B - B'



PROFILE A - A'

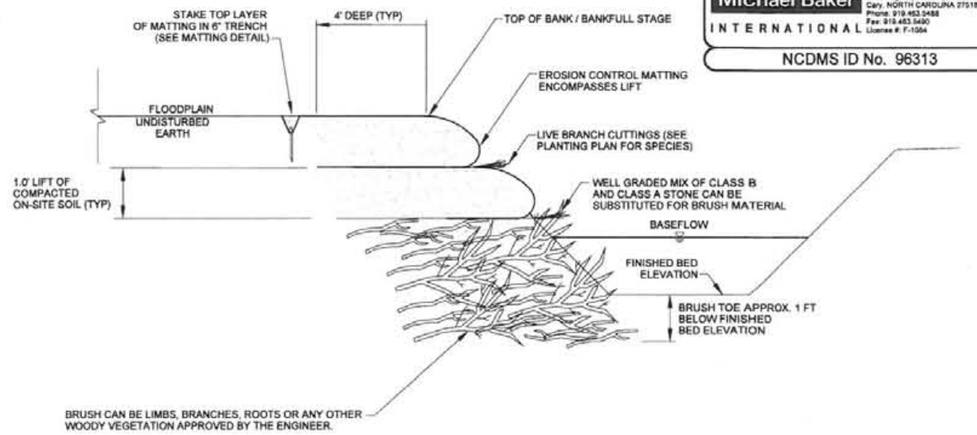
NOTES:

1. UNDERCUT CHANNEL BED ELEVATION AS NEEDED TO ALLOW FOR LAYERS OF STONE TO ACHIEVE FINAL GRADE.
2. INSTALL EROSION CONTROL MATTING ALONG COMPLETED BANKS SUCH THAT THE EROSION CONTROL MATTING AT THE TOE OF THE BANK EXTENDS DOWN TO THE UNDERCUT ELEVATION.
3. INSTALL STONE BACKFILL, COMPACTED TO GRADE.
4. FINAL CHANNEL BED SHAPE SHOULD BE ROUNDED, SMOOTH, AND CONCAVE, WITH THE ELEVATION OF THE BED 0.2 FT DEEPER IN THE CENTER THAN AT THE EDGES.

GEOLIFT WITH BRUSH TOE

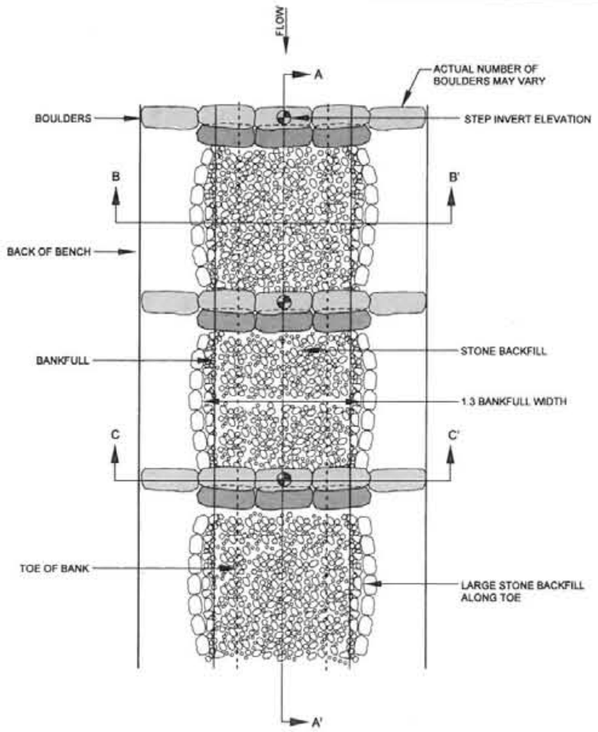
NOTES:

1. LIVE BRANCH CUTTINGS SHALL BE THE SAME SPECIES AS THE LIVE STAKES AND SHALL BE INSTALLED DURING VEGETATION DORMANCY.
2. LIVE BRANCH CUTTINGS SHALL BE INSTALLED AT A DENSITY OF 20-30 CUTTINGS PER LINEAR FOOT AND A MAXIMUM DIAMETER OF 2.5 INCHES.
3. NUMBER OF SOIL LIFTS MAY VARY. IN GENERAL LIFTS SHALL EXTEND TO THE TOP OF BANK OR BANKFULL STAGE.
4. GEOLIFTS TO BE INSTALLED IN CHANNEL SECTIONS ALONG SIDE SLOPES STEEPER THAN 2:1 AND/OR ADJACENT TO HILL SLOPES.

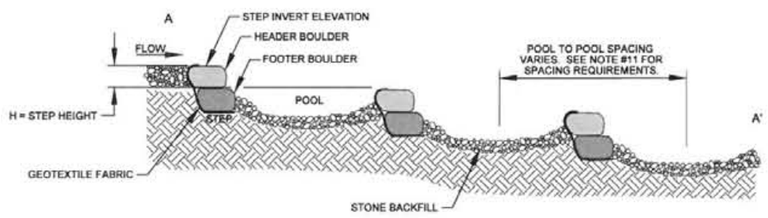


NOTES:
1. WHEN GEOLIFTS ARE BUILT ABOVE ROOTWAD CLUSTER, USE LARGE STONE BACKFILL BEHIND ROOT MASS TO BUILT FOUNDATION.

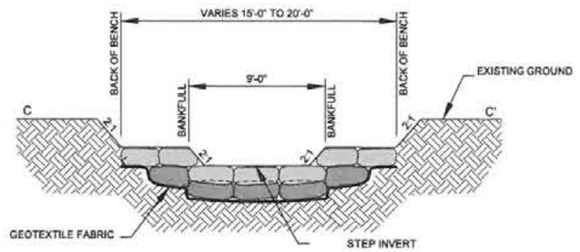
ROCK STEP POOL CHANNEL



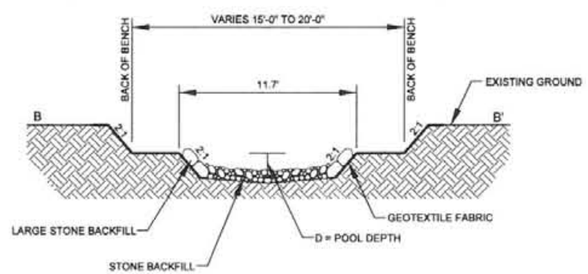
PLAN VIEW



PROFILE VIEW A-A'



POOL CROSS SECTION C-C'



POOL CROSS SECTION B-B'

NOTES:

1. BOULDERS MUST BE AT LEAST 2' X 2' X 3' AND NOT EXCEED 4' X 3' X 2'.
2. FOOTERS SHALL BE INSTALLED SUCH THAT 1/4 TO 1/3 OF THE LENGTH IS DOWNSTREAM OF THE HEADER.
3. SOIL SHALL BE WELL COMPACTED AROUND BURIED PORTION OF FOOTERS WITH BUCKET OF TRACK HOE.
4. INSTALL COIR FIBER MATTING UNDERNEATH FOOTER BOULDERS.
5. UNDERCUT POOL BED ELEVATION 8 INCHES TO ALLOW FOR LAYER OF STONE.
6. INSTALL COIR FIBER MATTING ALONG COMPLETED BANKS SUCH THAT THE GEOTEXTILE FABRIC AT THE TOE OF THE BANK EXTENDS DOWN TO THE UNDERCUT ELEVATION.
7. INSTALL LARGE STONE BACKFILL ALONG SIDE SLOPES.
8. FINAL CHANNEL BED SHAPE SHOULD BE ROUNDED, COMPACTED, AND CONCAVE, WITH THE ELEVATION OF THE BED APPROXIMATELY 0.5 FT DEEPER IN THE CENTER THAN AT THE EDGES.
9. STEP HEIGHT (H) SHALL NOT EXCEED 0.8 FT.
10. MINIMUM POOL DEPTH (D) SHALL BE NO LESS THAN 1.7 FT.
11. IN GENERAL, POOL TO POOL SPACING SHALL BE NO LESS THAN 9 FT AND NO GREATER THAN 37 FT BASED ON EXISTING CONDITIONS SUCH AS SLOPE AND SUITABLE FILL MATERIAL. CONSTRUCTED RIFFLES MAY BE SUBSTITUTED IN AREAS WHERE EXISTING SLOPES EXCEED 10% AS DETERMINED IN THE FIELD BY THE CONTRACTOR AND ENGINEER.

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2/7/2013

2/26/03

GENERAL CONSTRUCTION SEQUENCE

MICHAEL BAKER ENGINEERING, INC. WILL PROVIDE CONSTRUCTION OBSERVATION DURING THE CONSTRUCTION PHASE OF THIS PROJECT. THE FOLLOWING CONSTRUCTION SEQUENCE SHALL BE USED DURING IMPLEMENTATION OF THE PLAN. CONTRACTOR SHALL REFER TO THE APPROVED EROSION AND SEDIMENTATION CONTROL PLAN FOR SPECIFIC CONSTRUCTION SEQUENCE ITEMS AND SHALL BE RESPONSIBLE FOR FOLLOWING THE APPROVED PLANS AND PERMIT CONDITIONS.

1. CONTRACTOR SHALL CONTACT NORTH CAROLINA "ONE CALL" CENTER (1.800.632.4949) BEFORE ANY EXCAVATION.
2. CONTRACTOR SHALL PREPARE STABILIZED CONSTRUCTION ENTRANCES AND HAUL ROADS AS INDICATED ON THE PLANS.
3. THE CONTRACTOR SHALL MOBILIZE EQUIPMENT, MATERIALS, PREPARE STAGING AREA(S) AND STOCKPILE AREA(S) AS SHOWN ON THE PLANS.
4. CONSTRUCTION TRAFFIC SHALL BE RESTRICTED TO THE AREA DENOTED AS "LIMITS OF DISTURBANCE" OR "HAUL ROADS" ON THE PLANS.
5. THE CONTRACTOR SHALL INSTALL TEMPORARY ROCK DAMS AT LOCATIONS INDICATED ON THE PLANS.
6. THE CONTRACTOR SHALL INSTALL TEMPORARY SILT FENCE AROUND THE STAGING AREA(S). TEMPORARY SILT FENCING WILL ALSO BE PLACED AROUND THE TEMPORARY STOCKPILE AREAS AS MATERIAL IS STOCKPILED THROUGHOUT THE CONSTRUCTION PERIOD.
7. THE CONTRACTOR SHALL INSTALL ALL TEMPORARY AND PERMANENT STREAM CROSSINGS AS SHOWN ON THE PLANS IN ACCORDANCE WITH THE NC EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL. THE EXISTING CHANNEL AND DITCHES ON SITE WILL REMAIN OPEN DURING THE INITIAL STAGES OF CONSTRUCTION TO ALLOW FOR DRAINAGE AND TO MAINTAIN SITE ACCESSIBILITY.
8. THE CONTRACTOR SHALL CLEAR AND GRUB AN AREA ADEQUATE TO CONSTRUCT THE STREAM CHANNEL AND GRADING OPERATIONS AFTER ALL EROSION AND SEDIMENTATION CONTROL PRACTICES HAVE BEEN INSTALLED AND APPROVED. IN GENERAL, THE CONTRACTOR SHALL WORK FROM UPSTREAM TO DOWNSTREAM AND IN-STREAM STRUCTURES AND CHANNEL FILL MATERIAL SHALL BE INSTALLED USING A PUMP-AROUND OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLANS.
9. THE CONTRACTOR SHALL APPLY TEMPORARY SEED AND MULCH TO ALL DISTURBED AREAS AT THE END OF EACH WORK DAY.
10. THE CONTRACTOR WILL BEGIN CONSTRUCTION BY EXCAVATING CHANNEL FILL MATERIAL IN AREAS SHOWN ON THE PLANS. THE CONTRACTOR MAY FILL DITCHES WHICH DO NOT CONTAIN ANY WATER DURING THE GRADING OPERATIONS. ALONG DITCHES WITH WATER OR STREAM REACHES, EXCAVATED MATERIAL SHOULD BE STOCKPILED IN AREAS SHOWN ON THE PLANS. IN ANY AREAS WHERE EXCAVATION DEPTHS WILL EXCEED 10 INCHES, TOPSOIL SHALL BE STRIPPED, STOCKPILED AND PLACED BACK OVER THESE AREAS TO A MINIMUM DEPTH OF EIGHT INCHES TO ACHIEVE DESIGN GRADES AND CREATE A SOIL BASE FOR VEGETATION.
11. THE CONTRACTOR SHALL BEGIN CONSTRUCTION ON STREAM REACH R5 AND PROCEED IN A DOWNSTREAM DIRECTION. TRIBUTARIES SHALL BE COMPLETED AS THEY ARE REACHED (E.G. R5 AND R6 SHALL BE COMPLETED PRIOR TO PROCEEDING WITH R4 UPPER). PORTIONS OF THE NEW DESIGN CHANNEL WILL BE CONSTRUCTED OFFLINE AND IN THE DRY WHENEVER POSSIBLE. THE CONTRACTOR SHALL EXCAVATE THE CHANNELS TO DESIGN GRADES IN ALL AREAS EXCEPT WITHIN 10 FEET OF THE TOP OF EXISTING STREAM BANKS.
12. AFTER EXCAVATING THE CHANNEL TO DESIGN GRADES, INSTALL IN-STREAM STRUCTURES, SEEDING, MATTING, AND TRANSPLANTS IN THIS SECTION, AND READY THE CHANNEL TO ACCEPT FLOW PER APPROVAL BY THE ENGINEER.
13. FLOW WILL BE TURNED INTO THE CONSTRUCTED CHANNEL ONCE THE AREA IN AND AROUND THE NEW CHANNEL HAS BEEN STABILIZED WITH EROSION CONTROL MATTING AND GROUND COVER. IMMEDIATELY BEGIN PLUGGING, FILLING, AND GRADING THE ABANDONED CHANNEL, AS SHOWN ON PLANS, MOVING IN A DOWNSTREAM DIRECTION TO ALLOW FOR DRAINAGE OF THE OLD CHANNELS. NO FLOWING WATER SHALL BE TURNED INTO ANY SECTION OF CHANNEL PRIOR TO THE CHANNEL BEING COMPLETELY STABILIZED WITH ALL STRUCTURES INSTALLED AND APPROVED BY THE ENGINEER.
14. THE NEW CHANNEL SECTIONS SHALL REMAIN OPEN ON THE DOWNSTREAM END TO ALLOW FOR DRAINAGE DURING RAIN EVENTS.
15. ANY GRADING ACTIVITIES ADJACENT TO THE STREAM CHANNEL SHALL BE COMPLETED PRIOR TO TURNING WATER INTO THE NEW STREAM CHANNEL SEGMENTS. GRADING ACTIVITIES SHALL NOT BE PERFORMED WITHIN 10 FEET OF THE NEW STREAM CHANNEL BANKS.
16. ONCE THE STREAM WORK IS COMPLETE, APPLY TEMPORARY SEEDING, PERMANENT SEEDING, AND MULCHING TO ANY AREAS DISTURBED DURING CONSTRUCTION. TEMPORARY AND PERMANENT SEEDING SHALL BE APPLIED IN ALL AREAS SUSCEPTIBLE TO EROSION (I.E. DISTURBED DITCH BANKS, SLOPES STEEPER THAN 3H:1V, AND SPOIL AREAS) SUCH THAT GROUND COVER STABILIZATION IS ESTABLISHED WITHIN FOURTEEN (14) WORKING DAYS FOLLOWING COMPLETION OF GRADING. ALL SLOPES STEEPER THAN 3H:1V SHALL BE STABILIZED AS SOON AS PRACTICABLE WITHIN SEVEN (7) CALENDAR DAYS. SHEET 1-A FOR VEGETATION SPECIES SELECTION.
17. THE CONTRACTOR SHALL IMPROVE AND CONSTRUCT THE EXISTING FARM ROAD CROSSINGS BY INSTALLING PERMANENT CULVERTS AND/OR FORD CROSSINGS. STABILIZING SIDE SLOPES, AND MODIFYING THE FARM ROAD BED ELEVATIONS ACCORDING TO THE PLANS AND SPECIFICATIONS.
18. THE CONTRACTOR SHALL REMOVE TEMPORARY STREAM CROSSINGS AND ANY IN-STREAM TEMPORARY ROCK DAMS. ALL WASTE MATERIAL MUST BE REMOVED FROM THE PROJECT SITE TO AN ARE APPROVED BY THE ENGINEER.
19. THE CONTRACTOR SHALL TREAT AREAS OF INVASIVE SPECIES VEGETATION THROUGHOUT THE PROJECT AREA ACCORDING TO THE PLANS AND SPECIFICATIONS PRIOR TO DEMOBILIZATION.
20. THE CONTRACTOR SHALL PLANT SPECIES VEGETATION ACCORDING TO THE PLANTING DETAILS AND SPECIFICATIONS. THE CONTRACTOR SHALL COMPLETE THE REFORESTATION PHASE OF THE PROJECT AND APPLY ADDITIONAL PERMANENT SEEDING AT THE APPROPRIATE TIME OF THE YEAR.
21. THE CONTRACTOR SHALL ENSURE THAT THE SITE IS FREE OF TRASH AND LEFTOVER MATERIALS PRIOR TO DEMOBILIZATION OF EQUIPMENT FROM THE SITE.

PROJECT REFERENCE NO.	SHEET NO.
140048	3

PROJECT ENGINEER

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140048	4

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BEGIN REACH 5
STA. 10+26.20

10+00

PROPOSED FENCE APPROX. 2'
OUTSIDE CONSERVATION EASEMENT

NAD 83

REACH 5

INSTALL ROCK LINED
CATTLE CROSSING

11+00

12+00

13+00

14+00

15+00

MATCH LINE STA. 15+00
SHEET 5

STABILIZE BANKS,
SEED AND MAT

INSTALL CONSTRUCTED RIFFLE
AND STABILIZE HEADCUT

CHANNEL FILL

DITCH PLUG

BROWNS SUMMIT
PLAN VIEW

20 0 20 40
SCALE (FT)

2/26/13

12/2/2015
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BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	5

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NAD 83

PROPOSED FENCE APPROX. 2' OUTSIDE CONSERVATION EASEMENT

INSTALL LOG WEIR (TYP.)

GRADE SLOPE BEYOND BANKS AT A 4:1 OR FLATTER

REACH 6

IMPROVE EXISTING DAM

INSTALL ROCK STER POOL (TYP.)

END REACH 6 - STA. 15+45.63
END REACH 5 - STA. 15+61.84
BEGIN REACH 4 UPPER

BEGIN REACH 6
STA. 9+96.00

10+00

11+00

12+00

13+00

14+00

15+00

16+00

REACH 4 UPPER

MATCH LINE STA. 15+00
SHEET 4

INSTALL CONSTRUCTED RIFFLE (TYP.)

MATCH LINE STA. 17+00
SHEET 6

CHANNEL FILL

DITCH PLUG

BROWNS SUMMIT PLAN VIEW

20 0 20 40
SCALE (FT)

2/25/13

1/4/2013
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BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	6

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NAD 83

MATCH LINE STA. 17+00
SHEET 5

MATCH LINE STA. 23+00
SHEET 7

REACH 4 UPPER

PROPOSED FENCE APPROX. 2' OUTSIDE CONSERVATION EASEMENT

REMOVE EXISTING DAM

REMOVE EXISTING 12" PLASTIC PIPE

INSTALL CONSTRUCTED RIFFLE (TYP.)

INSTALL LOG WEIR (TYP.)

INSTALL GRADE CONTROL LOG JAM (TYP.)

INSTALL LOG STEP POOL (TYP.)

INSTALL ROCK STEP POOL/ INLET PROTECTION

INSTALL GEOLIFT (TYP.)

REMOVE FAILED DAM

END REACH T4 - STA. 11+77.81
END REACH 4 UPPER - STA. 21+41.36
BEGIN REACH 4 LOWER

BEGIN REACH T4
STA. 10+43.00

CHANNEL FILL

DITCH PLUG

BROWNS SUMMIT PLAN VIEW

20 0 20 40
SCALE (FT)

2/26/03

12/21/2005
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140048	7

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NAD 83

REMOVE EXISTING FENCE WITHIN CONSERVATION EASEMENT

INSTALL LOG AND ROCK J- HOOK VANE (TYP.)

INSTALL CONSTRUCTED RIFFLE (TYP.)

PROPOSED FENCE APPROX. 2' OUTSIDE CONSERVATION EASEMENT

END REACH T3 - STA. 10+99.59
END REACH 4 LOWER - STA. 28+57.54
BEGIN REACH 3 UPPER

REACH 4 LOWER

INSTALL GEOLIFT (TYP.)

INSTALL LOG VANE (TYP.)

INSTALL LOG STEP POOL (TYP.)

INSTALL LOG WEIR (TYP.)

INSTALL LOG WEIR (TYP.)

REMOVE EXISTING FENCE WITHIN CONSERVATION EASEMENT

MATCH LINE STA. 23+00 SHEET 6

MATCH LINE STA. 29+00 SHEET 8

BEGIN REACH T3
STA. 10+30.00

CHANNEL FILL

DITCH PLUG

BROWNS SUMMIT PLAN VIEW

20 0 20 40
SCALE (FT)

BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	8

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NAD 83

PROPOSED FENCE APPROX. 2' OUTSIDE CONSERVATION EASEMENT

INSTALL LOG STEP POOL (TYP.)

REACH 3 UPPER

INSTALL CONSTRUCTED RIFFLE (TYP.)

INSTALL LOG VANE (TYP.)

INSTALL LOG WEIR (TYP.)

INSTALL GEOLIFT (TYP.)

REMOVE EXISTING DAM

BENCH LIMITS

30+00 31+00 32+00 33+00 34+00 35+00

7885 7880 7880 7880 7880 7880

MATCH LINE STA. 29+00 SHEET 7

MATCH LINE STA. 35+00.00 SHEET 9

CHANNEL FILL

DITCH PLUG

BROWNS SUMMIT PLAN VIEW

20 0 20 40
SCALE (FT)

2/26/13

1/4/2013
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2/26/13

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140048	9

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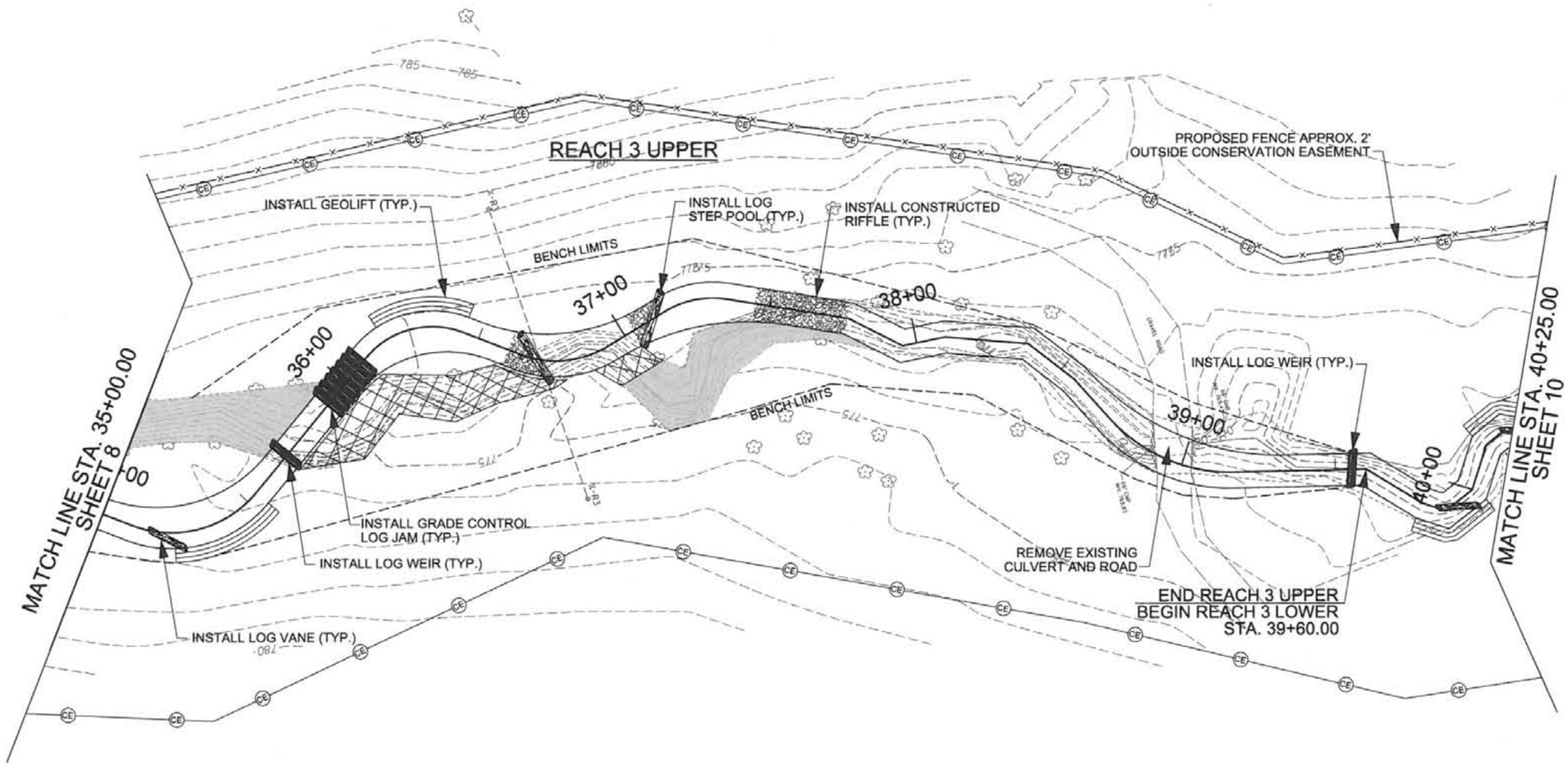
NAD 83



BROWNS SUMMIT
PLAN VIEW

20 0 20 40
SCALE (FT)

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2/26/2013

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140048	10

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NAD 83

MATCH LINE STA. 40+25.00
SHEET 9

MATCH LINE STA. 46+25
SHEET 11

2 - 20 LF
30" RCP

PROPOSED FENCE APPROX. 2'
OUTSIDE CONSERVATION EASEMENT

REMOVE
SPOIL PILES

REACH 3 LOWER

REACH 2 UPPER

BENCH LIMITS

41+00

42+00

43+00

44+00

45+00

46+00

STA. 40+67.38

STA. 41+28.83

INSTALL ROCK STEP POOL/
INLET PROTECTION

INSTALL LOG VANE (TYP.)

INSTALL GEOLIFT (TYP.)

END REACH T2 - STA. 12+82.50
END REACH 3 LOWER - STA. 43+72.20
BEGIN REACH 2 UPPER

REACH T2

12+00

11+00

10+00

BEGIN REACH T2
STA. 10+00.00

CHANNEL FILL

DITCH PLUG

BROWNS SUMMIT
PLAN VIEW

20 0 20 40
SCALE (FT)

2/26/03

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BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	11

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NAD 83

PROPOSED FENCE APPROX. 2' OUTSIDE CONSERVATION EASEMENT

REACH 2 UPPER

REACH 2 LOWER

REACH 1

REACH T1

MATCH LINE STA. 46+25 SHEET 10

MATCH LINE STA. 52+50 SHEET 12

47+00

48+00

49+00

50+00

51+00

52+00

11+00

10+00

BENCH LIMITS

REMOVE SPOIL PILES

INSTALL LOG WEIR (TYP.)

END REACH T1 - STA. 11+44.76 = REACH 1 - STA. 51+77.42

FILL DITCH/SWALE

INSTALL GRADE CONTROL LOG JAM (TYP.)

END REACH 2 LOWER
BEGIN REACH 1
STA. 51+11.33

END REACH 2 UPPER
BEGIN REACH 2 LOWER
STA. 49+86.00

BEGIN REACH T1
STA. 10+00.00

CHANNEL FILL

DITCH PLUG

BROWNS SUMMIT
PLAN VIEW

20 0 20 40
SCALE (FT)

2/26/03

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140048	12

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CHANNEL FILL

DITCH PLUG

NAD 83

PROPOSED FENCE APPROX. 2' OUTSIDE CONSERVATION EASEMENT

REACH 1

INSTALL LOG VANE (TYP.)

INSTALL LOG STEP POOL (TYP.)

INSTALL LOG WEIR (TYP.)

INSTALL WEIR (TYP.)

INSTALL GEOLIFT (TYP.)

52+00

53+00

54+00

55+00

56+00

57+00

58+00

59+00

MATCH LINE STA. 52+50 SHEET 11

MATCH LINE STA. 59+00 SHEET 13

BROWNS SUMMIT PLAN VIEW

20 0 20 40
SCALE (FT)

12/2/2005
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PROPOSED FENCE APPROX. 2' OUTSIDE CONSERVATION EASEMENT

NAD 83

MATCH LINE STA. 59+00 SHEET 13

INSTALL LOG STEP POOL (TYP.)

INSTALL GRADE CONTROL LOG JAM (TYP.)

REACH 1

60+00

61+00

62+00

63+00

64+00

END REACH 1
STA. 64+10.32

2 - 20 LF
30" RCP

REMOVE SPOIL PILES

INSTALL GEOLIFT (TYP.)

INSTALL CONSTRUCTED RIFFLE (TYP.)

INSTALL LOG VANE (TYP.)

CHANNEL FILL

DITCH PLUG

BROWNS SUMMIT
PLAN VIEW

20 0 20 40
SCALE (FT)

2/26/03

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2/26/03

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140048	14

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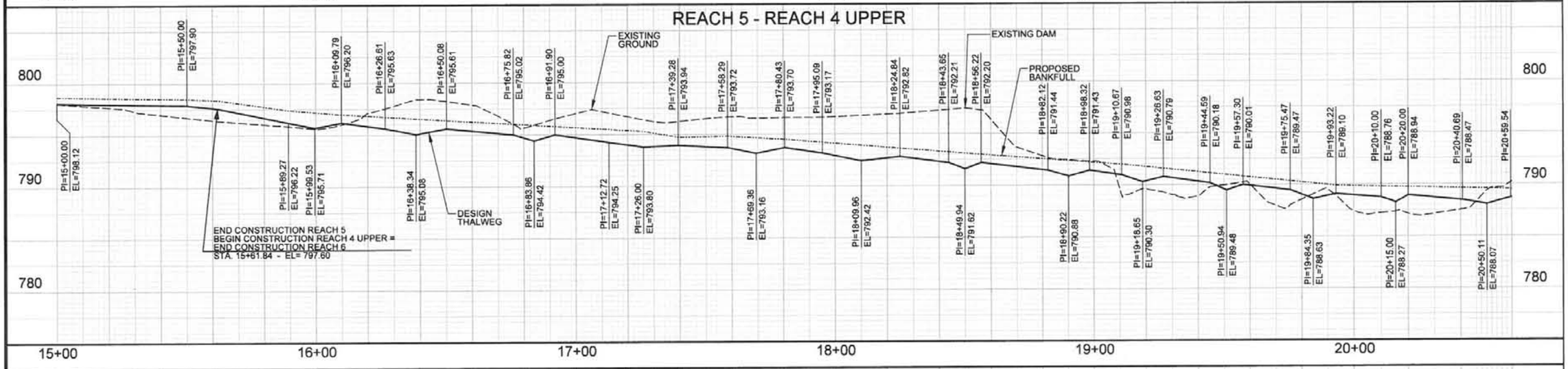
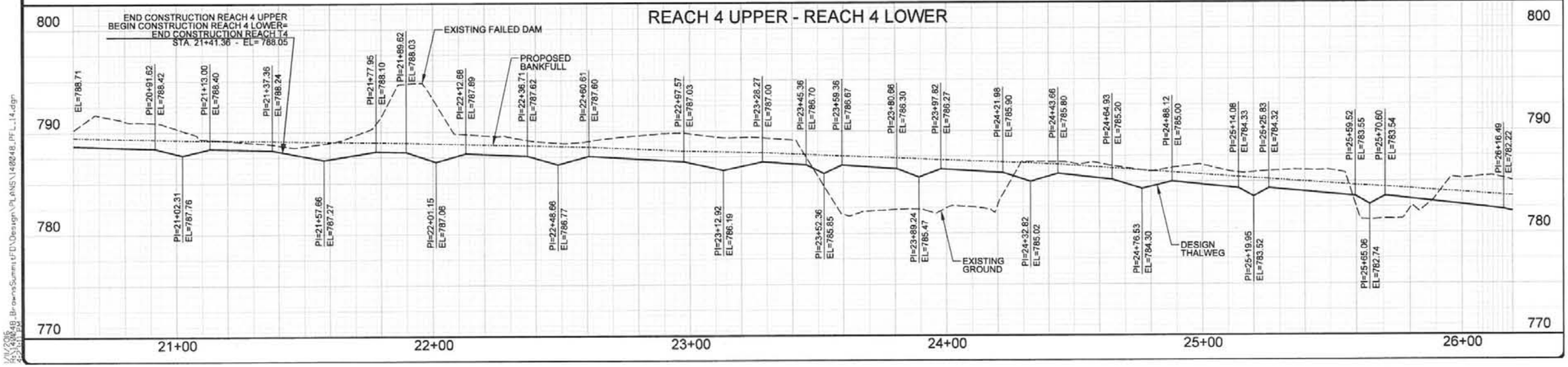
REACH 5

REACH 5 - REACH 4 UPPER



REACH 4 UPPER - REACH 4 LOWER



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REACH 4 LOWER - REACH 3 UPPER

790
780
770

PI=26+29.16 EL=781.57
PI=26+41.82 EL=782.20
PI=26+50.00 EL=781.22
PI=26+65.14 EL=781.61
PI=26+81.54 EL=780.86
PI=26+97.94 EL=781.58
PI=27+22.97 EL=781.13
EXISTING GROUND
PI=27+40.97 EL=780.38
PI=27+58.97 EL=781.10
DESIGN THALWEG
PI=27+75.36 EL=780.80
PI=27+82.36 EL=779.95
PI=27+89.36 EL=780.76
PI=28+01.94 EL=780.46
PI=28+14.84 EL=779.66
PI=28+27.74 EL=780.44
PI=28+63.75 EL=780.03
PI=28+78.20 EL=778.95
PI=28+92.85 EL=779.70
END CONSTRUCTION REACH 4 LOWER
BEGIN CONSTRUCTION REACH 3 UPPER =
END CONSTRUCTION REACH T3
STA. 28+57.54 - EL= 780.10
PI=29+26.20 EL=779.24
PI=29+46.95 EL=778.54
PI=29+67.69 EL=779.20
PI=29+83.20 EL=778.92
PI=29+96.01 EL=778.20
PROPOSED BANKFULL
PI=30+14.81 EL=778.89
EXISTING DAM
PI=30+61.07 EL=778.37
PI=30+80.18 EL=777.66
PI=30+99.28 EL=778.34
PI=31+16.81 EL=778.03

27+00 28+00 29+00 30+00 31+00

REACH 3 UPPER

780
770
760

PI=31+33.93 EL=777.31
PI=31+49.05 EL=778.01
PI=31+91.79 EL=776.89
PI=31+80.34 EL=777.61
PI=32+03.24 EL=777.58
PI=32+31.46 EL=777.06
PI=32+48.91 EL=776.37
PI=32+62.36 EL=777.03
EXISTING GROUND
PI=33+18.54 EL=776.14
PI=33+39.78 EL=775.50
PI=33+61.02 EL=776.10
DESIGN THALWEG
PI=33+94.55 EL=775.79
PI=34+07.06 EL=775.04
PI=34+19.58 EL=775.77
PI=34+50.21 EL=775.41
PI=34+56.53 EL=774.70
PI=34+62.86 EL=775.40
PROPOSED BANKFULL
PI=35+10.12 EL=773.98
PI=35+32.02 EL=773.49
PI=35+53.92 EL=773.94
PI=35+60.36 EL=772.72
PI=35+70.00 EL=773.60
PI=35+90.00 EL=773.30
PI=36+10.19 EL=772.60
PI=36+27.43 EL=771.96
PI=36+44.67 EL=772.49
PI=36+63.99 EL=771.95
PI=36+78.86 EL=771.14

32+00 33+00 34+00 35+00 36+00

REACH 3 UPPER - REACH 3 LOWER

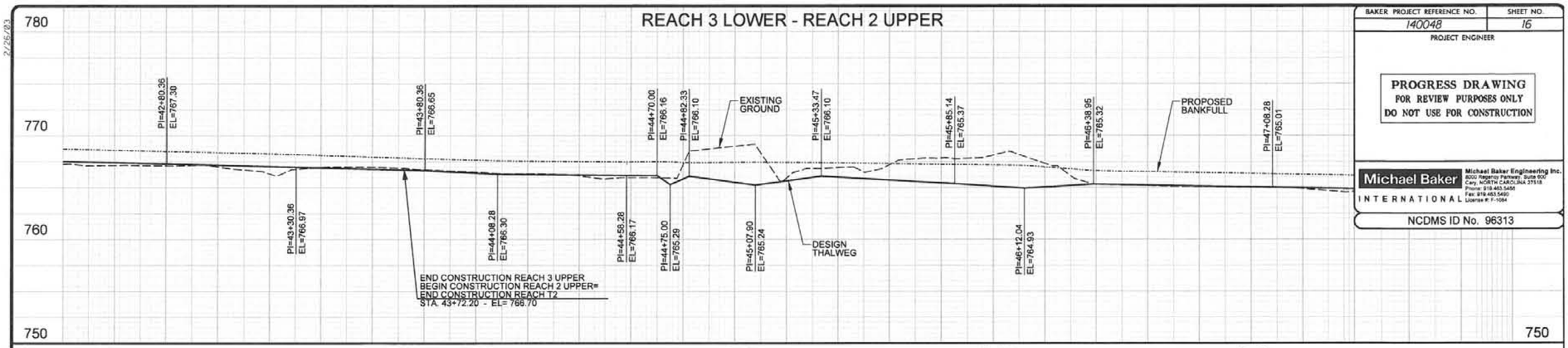
780
770
760
750

PI=36+63.74 EL=771.70
PI=37+15.13 EL=771.32
PI=37+25.71 EL=770.60
PI=37+36.28 EL=771.30
PI=37+60.00 EL=771.07
PI=38+10.00 EL=770.37
PROPOSED BANKFULL
PI=38+27.36 EL=769.68
PI=38+50.36 EL=770.33
PI=38+80.36 EL=770.13
EXISTING GROUND
PI=38+95.00 EL=769.23
END CONSTRUCTION REACH 3 UPPER
BEGIN CONSTRUCTION REACH 3 LOWER
STA. 39+60.00 - EL= 769.25
PI=39+30.36 EL=769.80
PI=39+58.00 EL=769.30
PI=39+80.36 EL=768.66
PI=40+00.00 EL=769.33
PI=40+12.00 EL=769.10
DESIGN THALWEG
PI=40+30.36 EL=768.33
PI=40+50.00 EL=769.00
PI=40+80.36 EL=768.76
PI=41+30.36 EL=768.38
PI=41+80.36 EL=767.99
PI=42+30.36 EL=767.57

37+00 38+00 39+00 40+00 41+00 42+00

2/25/03

REACH 3 LOWER - REACH 2 UPPER



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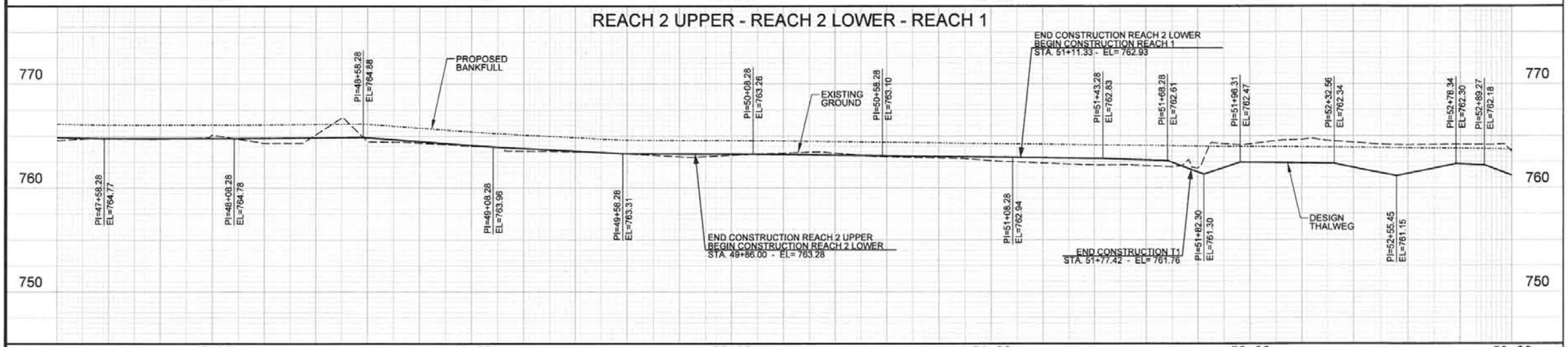
REACH 2 UPPER - REACH 2 LOWER - REACH 1



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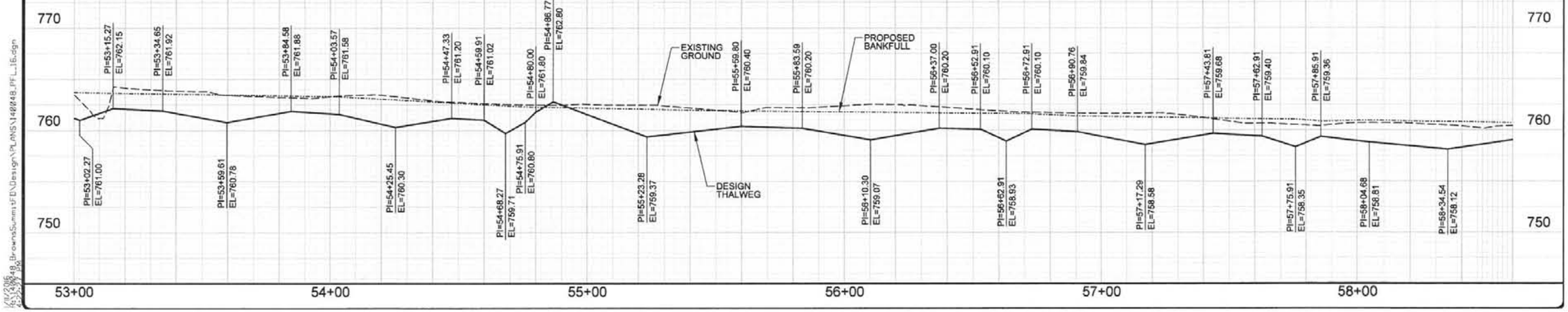

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BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	17

PROJECT ENGINEER

PROGRESS DRAWING
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NCDMS ID No. 96313

REACH 1

770 / 760 / 750 / 740

PROPOSED BANKFULL
EXISTING GROUND
DESIGN THALWEG

PI=58+64.41 EL=759.20
PI=58+92.53 EL=758.80
PI=59+24.52 EL=757.66
PI=59+56.50 EL=758.68
PI=59+88.00 EL=757.60
PI=59+93.00 EL=757.27
PI=60+06.27 EL=758.38
PI=60+10.00 EL=757.01
PI=60+15.00 EL=757.15
PI=60+58.27 EL=758.10
PI=60+80.38 EL=757.79
PI=61+09.63 EL=756.62
PI=61+38.88 EL=757.66
PI=61+53.48 EL=757.45
PI=61+75.00 EL=756.26
PI=61+81.17 EL=757.42
PI=61+95.00 EL=756.15
PI=62+08.85 EL=757.27
PI=62+41.79 EL=756.80
PI=62+77.43 EL=755.70
PI=63+13.06 EL=756.70
PI=63+30.34 EL=756.47
PI=63+40.10 EL=755.14
PI=63+49.86 EL=756.21

59+00 / 60+00 / 61+00 / 62+00 / 63+00

REACH 1

770 / 760 / 750 / 740

PROPOSED BANKFULL
EXISTING GROUND
DESIGN THALWEG
END CONSTRUCTION REACH 1
STA. 64+10.32 - EL= 755.40

64+00

REACH T1

770 / 760 / 750

PROPOSED BANKFULL
EXISTING GROUND
DESIGN THALWEG
BEGIN CONSTRUCTION REACH T1
STA. 10+00.00 - EL= 764.20
END CONSTRUCTION REACH T1 =
STA. 11+44.76 EL= 761.76

PI=10+30.89 EL=763.43
PI=10+35.57 EL=763.01
PI=10+40.24 EL=763.42
PI=10+57.56 EL=762.88
PI=10+63.06 EL=762.48
PI=10+68.57 EL=762.87
PI=10+87.68 EL=762.13
PI=10+98.01 EL=761.80
PI=11+08.34 EL=762.10

10+00 / 11+00

REACH 6

810 / 800 / 790

PROPOSED BANKFULL
DESIGN THALWEG
EXISTING GROUND
BEGIN CONSTRUCTION REACH 6
STA. 10+00.00 EL= 808.10

PI=10+05.00 EL=806.02
PI=10+10.00 EL=805.94
PI=10+15.00 EL=805.86
PI=10+20.00 EL=805.78
PI=10+25.00 EL=805.53
PI=10+30.00 EL=805.32
PI=10+35.00 EL=805.53
PI=10+40.00 EL=805.45
PI=10+45.00 EL=805.37
PI=10+50.00 EL=805.29
PI=10+55.00 EL=805.21
PI=10+60.00 EL=805.13
PI=10+65.00 EL=805.05
PI=10+70.00 EL=804.81
PI=10+75.00 EL=804.59
PI=10+80.00 EL=804.65
PI=10+85.00 EL=804.73
PI=10+90.00 EL=804.81
PI=10+95.00 EL=804.57
PI=11+00.00 EL=804.32
PI=11+06.00 EL=804.09
PI=11+10.00 EL=804.32
PI=11+15.00 EL=804.24
PI=11+20.00 EL=804.16
PI=11+25.00 EL=804.08
PI=11+30.00 EL=804.00
PI=11+35.00 EL=802.33

10+00 / 11+00

REACH 6

810 / 800 / 790

PROPOSED BANKFULL
EXISTING GROUND
DESIGN THALWEG
END CONTRUCTION REACH 6 =
END CONSTRUCTION REACH 5 =
BEGIN CONSTRUCTION REACH 4 UPPER
STA. 15+45.63 EL= 797.60

PI=11+40.00 EL=801.25
PI=11+45.00 EL=799.50
PI=11+48.00 EL=799.00
PI=11+55.00 EL=798.80
PI=11+60.00 EL=798.80
PI=11+65.00 EL=798.80
PI=11+70.00 EL=799.00
PI=11+75.00 EL=800.00
PI=11+80.00 EL=801.15
PI=11+84.00 EL=801.30
PI=11+92.07 EL=801.10
PI=12+04.45 EL=799.00
PI=12+16.84 EL=801.10
PI=12+31.27 EL=801.10
PI=12+37.91 EL=799.80
PI=12+44.55 EL=799.80
PI=12+53.44 EL=801.10
PI=12+70.34 EL=801.10
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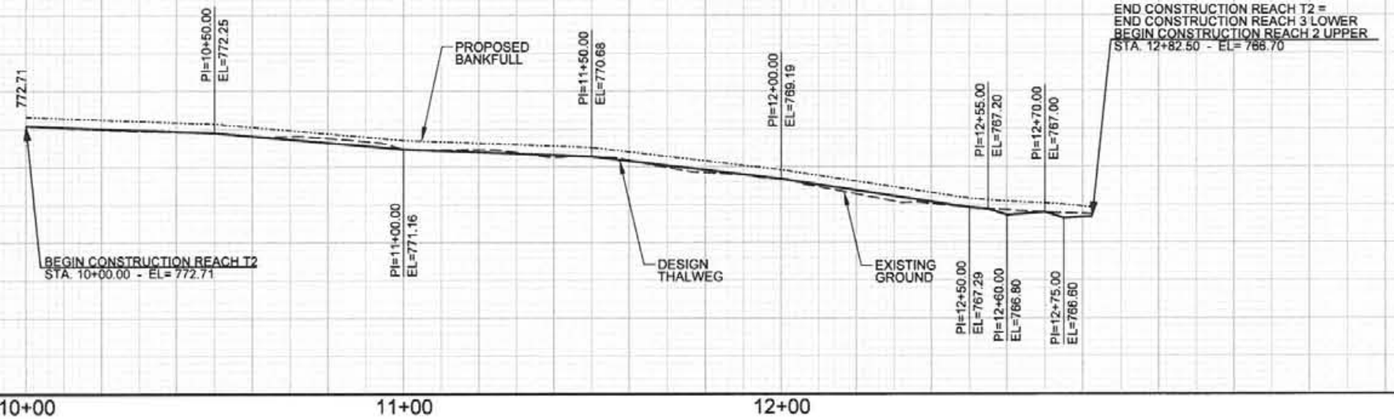
PI=15+30.00 EL=797.18
PI=15+35.00 EL=798.05
PI=15+40.00 EL=797.85
PI=15+45.00 EL=797.63

12+00 / 13+00 / 14+00 / 15+00

2/26/23

REACH T2



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140048	18

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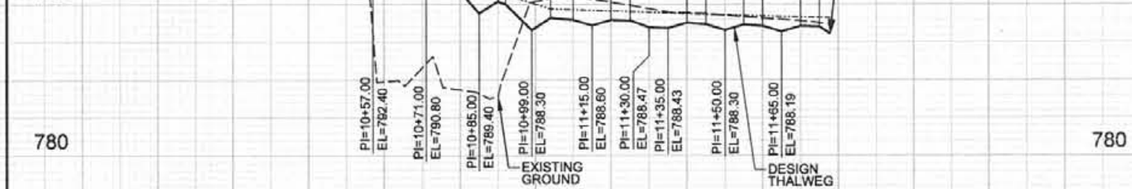
REACH T3

REACH T4



2/26/03

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140048	19

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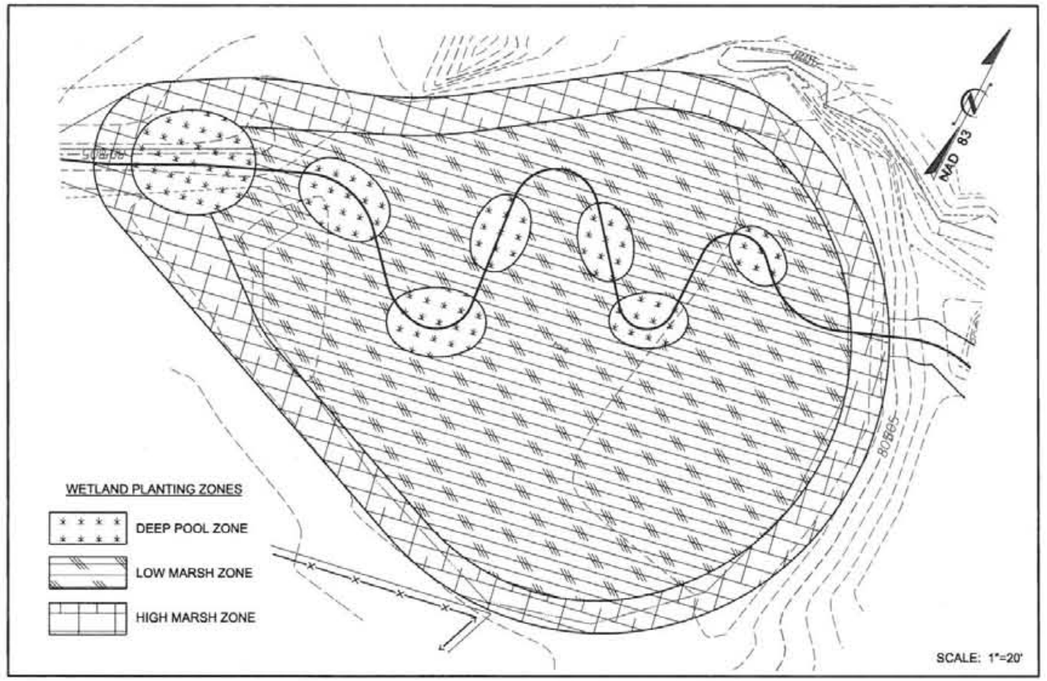

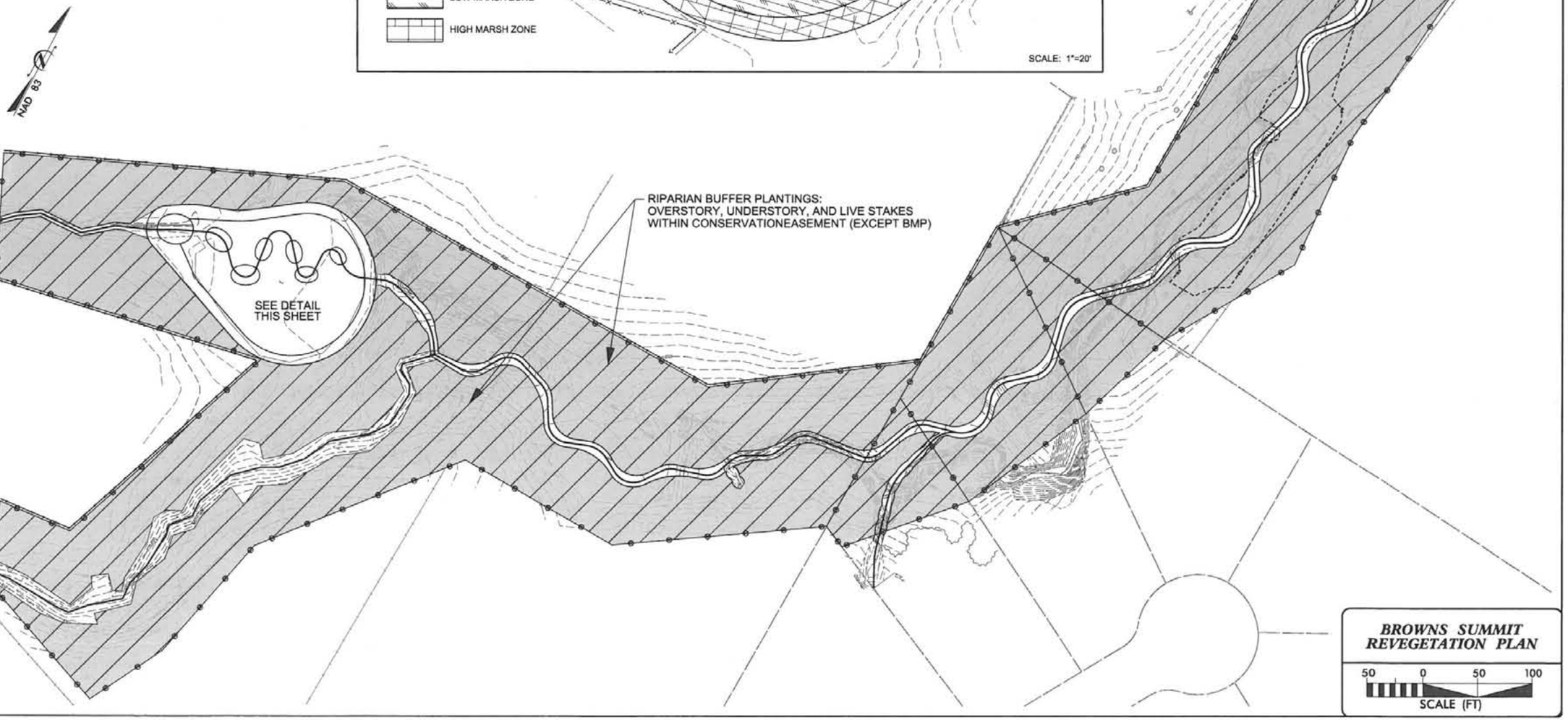

BROWNS SUMMIT REVEGETATION PLAN

50 0 50 100
SCALE (FT)

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2/26/13

BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	20

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NCDMS ID NO. 96313

NAD 83

WETLAND BUFFER PLANTINGS:
OVERSTORY, UNDERSTORY, AND LIVE STAKES
WITHIN CONSERVATION EASEMENT

MATCH LINE - SHEET 21

MATCH LINE
SHEET 19

RIPARIAN BUFFER PLANTINGS:
OVERSTORY, UNDERSTORY, AND LIVE STAKES
WITHIN CONSERVATION EASEMENT (EXCEPT BMP)

BROWNS SUMMIT REVEGETATION PLAN

50 0 50 100
SCALE (FT)

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2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	21

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NCDMS ID NO. 96313

NAD 83

WETLAND BUFFER PLANTINGS:
OVERSTORY, UNDERSTORY, AND LIVE STAKES
WITHIN CONSERVATION EASEMENT

SHEET NO. 22

MATCH LINE - SHEET 20

BROWNS SUMMIT REVEGETATION PLAN

50 0 50 100
SCALE (FT)

STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	140048	EC-1	
NCDMS ID No. 96313			

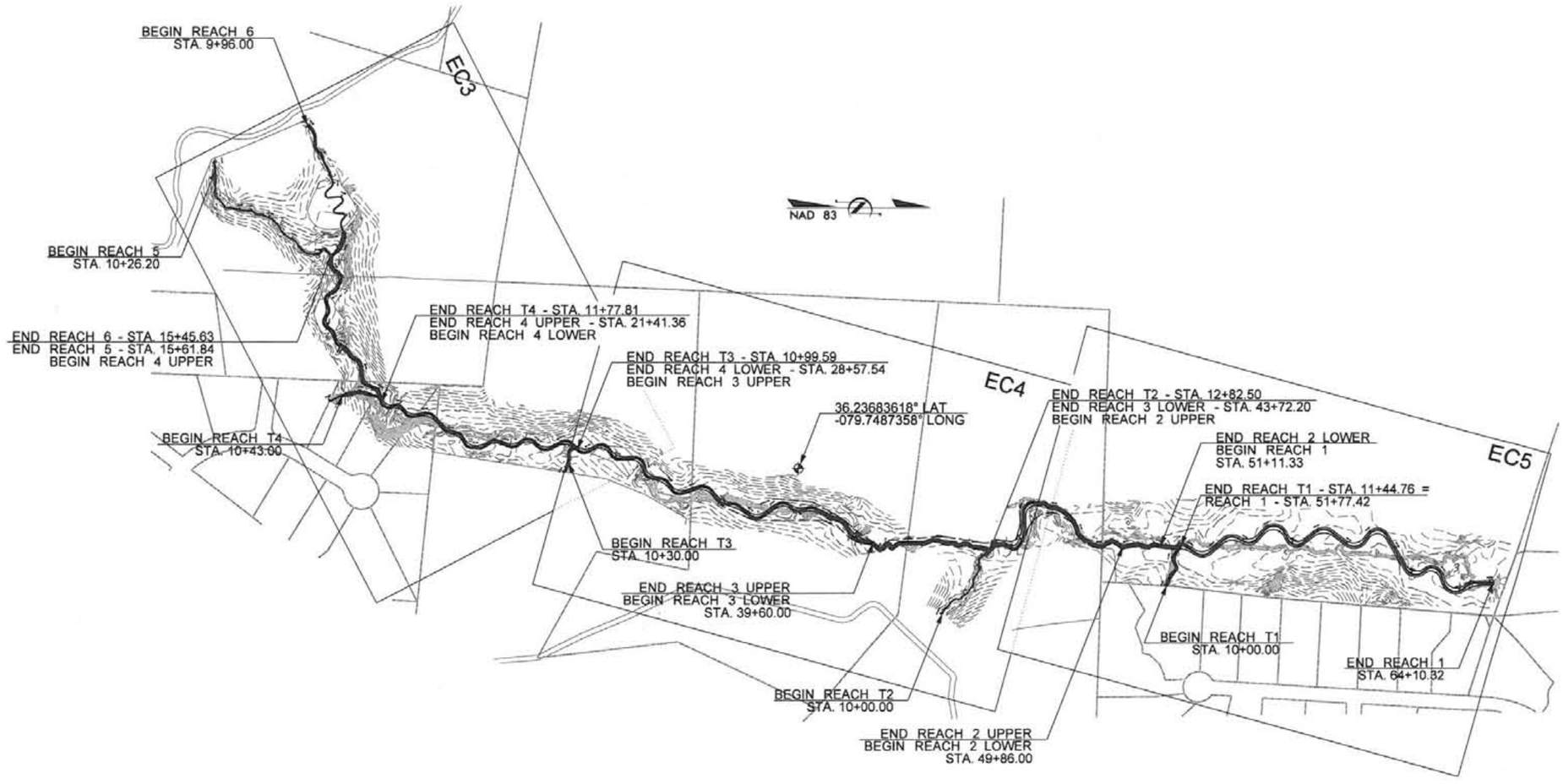
BROWNS SUMMIT

PROJECT: 140048

STD. NO.	DESCRIPTION	SYMBOL
6.06	TEMPORARY GRAVEL CONSTRUCTION ACCESS	
6.60	TEMPORARY SEDIMENT TRAP	
6.62	SILT FENCE	
6.63	TEMPORARY ROCK DAM	

EROSION CONTROL PLAN

LOCATION: APPROX. 3 MILES NORTHWEST OF BROWNS SUMMIT
TYPE OF WORK: STREAM AND WETLAND RESTORATION AND ENHANCEMENT



GRAPHIC SCALES

50 0 50 100
PLANS

THIS PROJECT CONTAINS EROSION CONTROL PLANS FOR ALL PHASES OF CONSTRUCTION.

TOTAL DISTURBED AREA = 22.1 Acres

PROJECT STANDARDS

THE FOLLOWING STANDARDS AS THEY APPEAR IN THE "NC EROSION CONTROL PLANNING AND DESIGN MANUAL" AND ARE APPLICABLE TO THIS PROJECT AND BY REFERENCE HEREBY ARE CONSIDERED PART OF THE PLANS.

6.06	TEMPORARY GRAVEL CONSTRUCTION ACCESS
6.60	TEMPORARY SEDIMENT TRAP
6.62	SILT FENCE
6.63	TEMPORARY ROCK DAM

PREPARED IN THE OFFICE OF:
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LETTING DATE:

JACOB M. BYERS, PE
PROJECT ENGINEER

KATHLEEN M. McKEITHAN, PE
PROJECT MANAGER

PROJECT ENGINEER

PROGRESS DRAWING
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SIGNATURE: *P.E.*

BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	EC2

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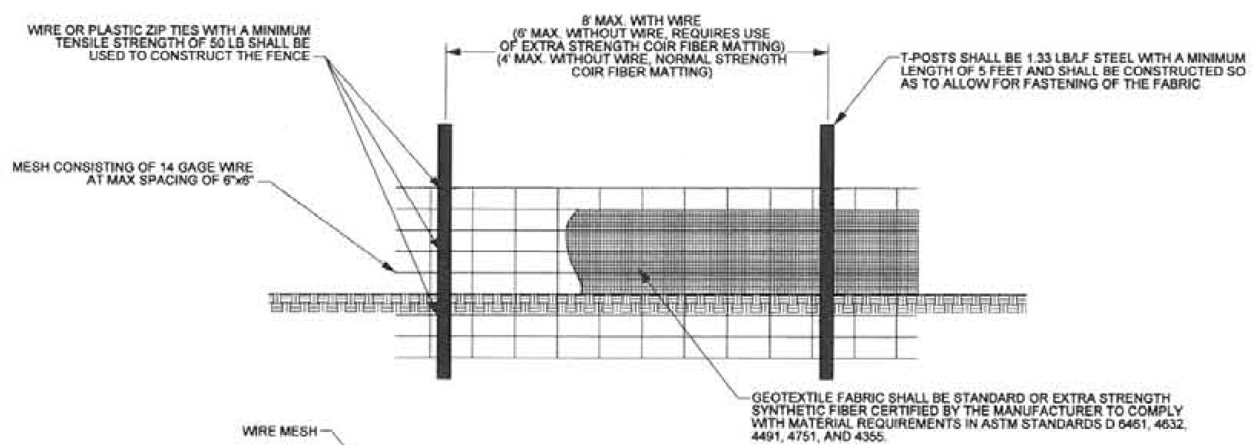
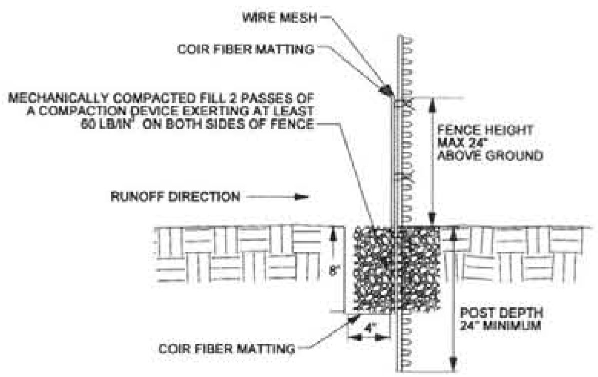
NCDMS ID No. 96313

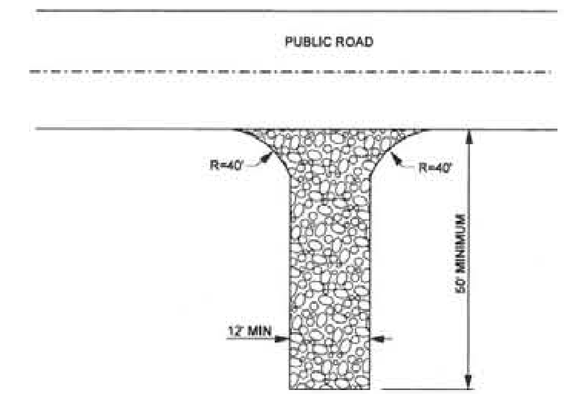
TEMPORARY SILT FENCE

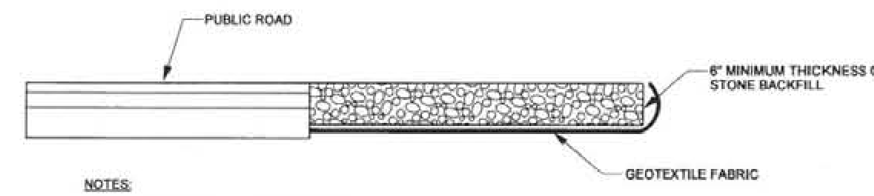




NOTES:
1. AVOID JOINTS. UNAVOIDABLE JOINTS MUST HAVE 4 FEET OF CLOTH OVERLAP AND SHOULD TIE INTO THE NEXT ADJACENT POST
2. PLACE ON CONTOUR EXCEPT ENDS WHICH SHOULD BE 1' ABOVE GRADE TO PREVENT CUT AROUND
3. WRAP APPROX. 6" OF GEOTEXTILE FABRIC AROUND END POSTS AND SECURE WITH TIES
4. REMOVE ONCE AREA IS STABLE

TEMPORARY GRAVEL CONSTRUCTION ENTRANCE

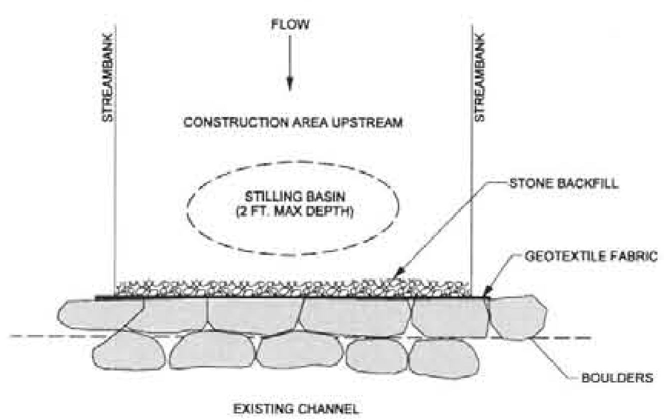




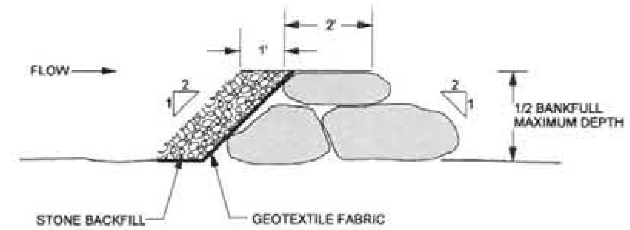
NOTES:

SPECIFICATION NO. 6.06 - CONSTRUCTION ACCESS "N.C. EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL MARCH 2009"

SILT CHECK / IMPERVIOUS DIKE



PLAN VIEW

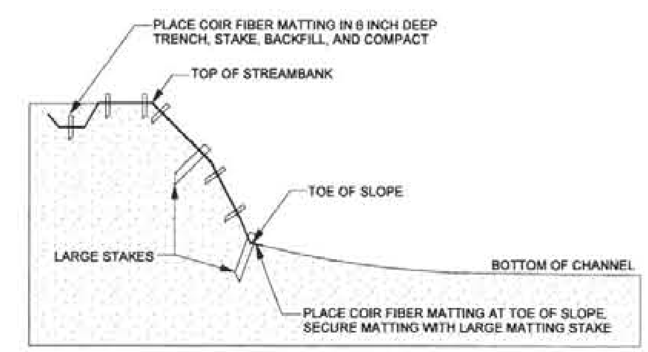


CROSS SECTION

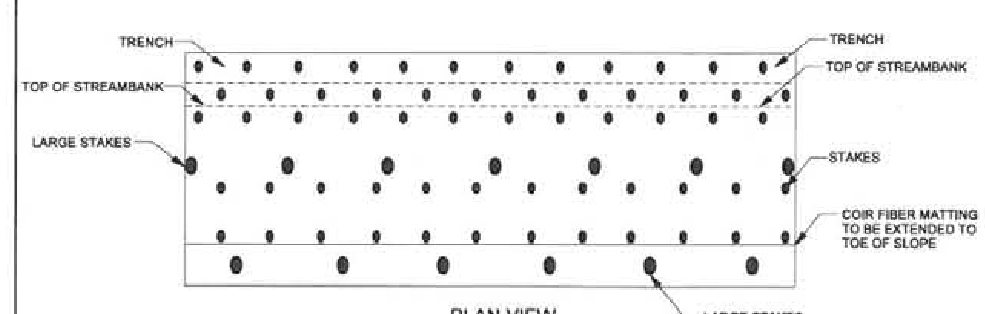
NOTES:

CLEAN OUT STILLING BASIN OF TRAPPED SEDIMENT PRIOR TO REMOVAL.

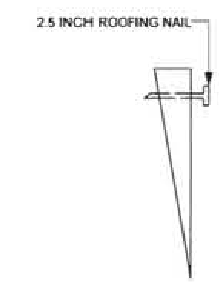
COIR FIBER MATTING



CROSS SECTION VIEW

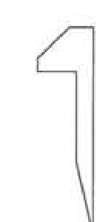


PLAN VIEW



TYPICAL LARGE MATTING STAKE

LEG LENGTH	17.00 IN (43.18 CM) (TAPERED TO POINT)
WIDTH	1.5 IN (3.81 CM)
THICKNESS	1.5 IN (3.81 CM)



TYPICAL SMALL MATTING STAKE

LEG LENGTH	11.00 IN (27.94 CM)
HEAD WIDTH	1.25 IN (3.18 CM)
HEAD THICKNESS	0.40 IN (1.02 CM)
LEG WIDTH	0.60 IN (1.52 CM) (TAPERED TO POINT)
LEG THICKNESS	0.40 IN (1.02 CM)
TOTAL LENGTH	12.00 IN (30.48 CM)

NOTES:
1. BANKS SHOULD BE SEEDED PRIOR TO PLACEMENT OF MATTING.
2. USE COIR FIBER MATTING.
3. LARGE STAKES SHOULD NOT BE SPACED FURTHER THAN 18" APART.
4. PLACE LARGE STAKES ALONG ALL SEAMS, IN THE CENTER OF BANK, AND TOE OF SLOPE.

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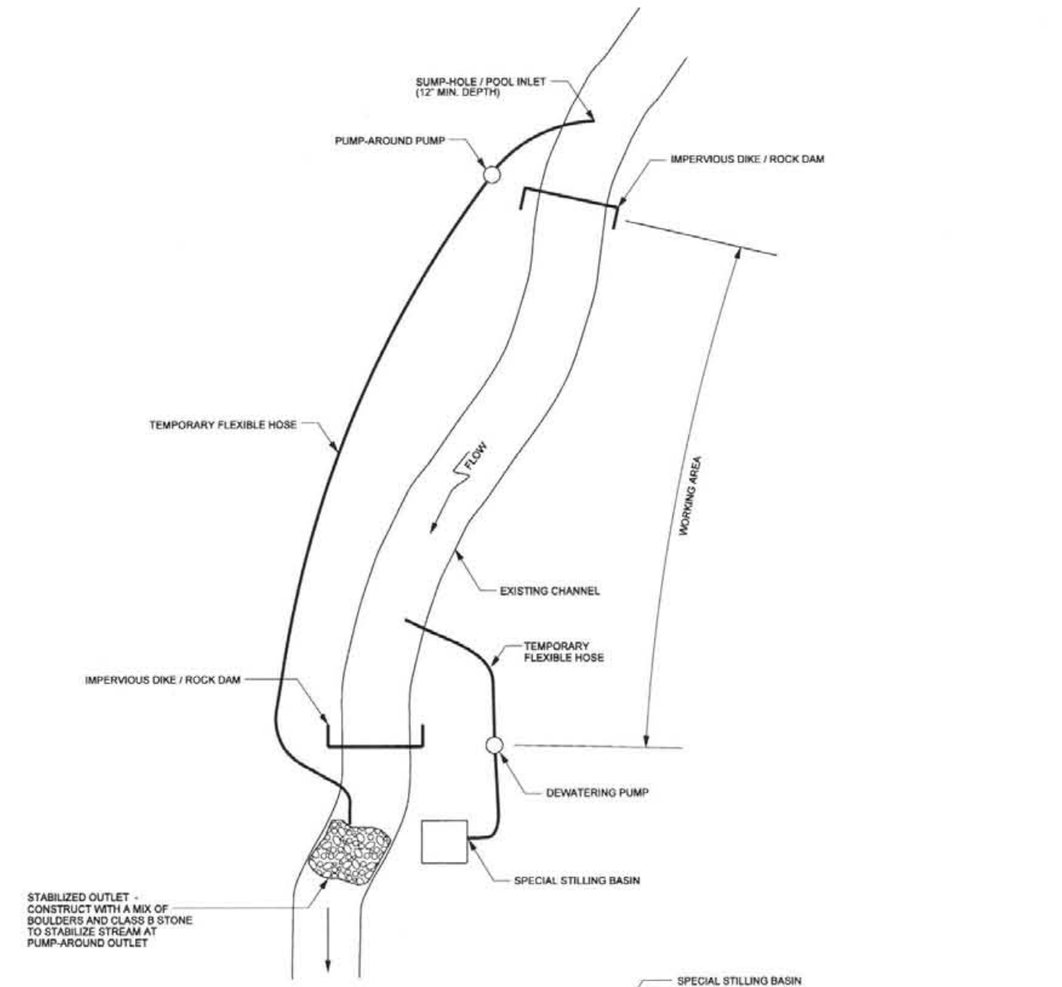
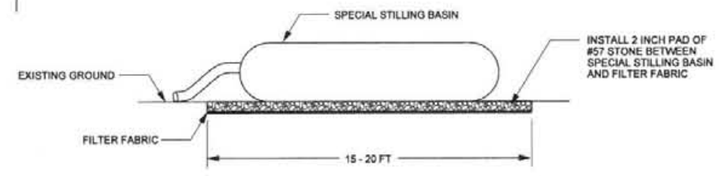
TYPICAL PUMP-AROUND OPERATION





SEQUENCE OF CONSTRUCTION FOR TYPICAL PUMP-AROUND

1. INSTALL STABILIZED OUTLET AT THE DOWNSTREAM END OF THE DESIGNATED PROJECT WORKING AREA.
2. THE CONTRACTOR WILL INSTALL THE PUMP-AROUND PUMP AND THE TEMPORARY FLEXIBLE HOSE THAT WILL CONVEY THE BASE FLOW FROM UPSTREAM OF THE WORK SITE TO THE SPECIAL STILLING BASIN OR STABILIZED OUTLET.
3. INSTALL UPSTREAM IMPERVIOUS DIKE AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.
4. INSTALL THE DOWNSTREAM IMPERVIOUS DIKE AND PUMPING APPARATUS IF NEEDED TO DEWATER THE ENTRAPPED AREA. THE PUMP AND HOSE FOR THIS PURPOSE SHALL BE OF SUFFICIENT SIZE TO DEWATER THE WORK AREA. THIS WATER WILL FLOW INTO A SPECIAL STILLING BASIN.
5. THE CONTRACTOR WILL PERFORM STREAM RESTORATION WORK IN ACCORDANCE WITH THE PLAN AND FOLLOWING THE GENERAL CONSTRUCTION SEQUENCE.
6. THE CONTRACTOR WILL EXCAVATE ANY ACCUMULATED SILT AND DEWATER BEFORE REMOVAL OF THE IMPERVIOUS DIKE. REMOVE IMPERVIOUS DIKES, PUMPS, AND TEMPORARY FLEXIBLE HOSE STARTING WITH THE DOWNSTREAM DIKE FIRST.
7. THE CONTRACTOR WILL COMPLETE ALL GRADING AND STABILIZATION IN ONE DAY WITHIN THE PUMP-AROUND AREA BETWEEN THE IMPERVIOUS DIKES.
8. ONCE THE WORKING AREA IS COMPLETED, REMOVE THE SPECIAL STILLING BASIN AND STABILIZED OUTLET AND STABILIZE DISTURBED AREAS WITH SEED AND MULCH.

NOTES:

1. EXCAVATION SHALL BE PERFORMED IN ONLY DRY SECTIONS OF CHANNEL.
2. IMPERVIOUS DIKES SHOULD BE USED TO ISOLATE WORK AREAS FROM STREAM FLOW.
3. THE CONTRACTOR SHALL NOT DISTURB MORE AREA THAN CAN BE STABILIZED IN ONE WORKING DAY.
4. THE PUMP-AROUND PUMP SHOULD ADEQUATELY CONVEY BASEFLOW CONDITIONS OF THE STREAM.

BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	EC-2A

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BAKER PROJECT REFERENCE NO.	SHEET NO.
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NAD 83

LIMITS OF DISTURBANCE

LIMITS OF DISTURBANCE

BROWNS SUMMIT EROSION CONTROL PLAN OVERVIEW

50 0 50 100
SCALE (FT)

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2/26/03

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EROSION & SEDIMENTATION CONTROL NOTES:

1. THE CONTRACTOR SHALL INSTALL THE EROSION AND SEDIMENTATION CONTROL MEASURES AS SHOWN ON THE PLANS PRIOR TO ANY GRADING ACTIVITIES. SEE SHEET 3 FOR GENERAL CONSTRUCTION SEQUENCE.
2. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED PER THE PLANS AND TECHNICAL SPECIFICATIONS. TEMPORARY AND PERMANENT SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS BY THE END OF EACH WORK DAY. SLOPES FLATTER THAN 3H:1V SHALL BE STABILIZED WITH GROUND COVER WITHIN FOURTEEN (14) CALENDAR DAYS FROM THE LAST LAND-DISTURBING ACTIVITY. ALL SLOPES STEEPER THAN 3H:1V SHALL BE STABILIZED AS SOON AS PRACTICABLE WITHIN SEVEN (7) CALENDAR DAYS. SEE SHEET 1-A FOR VEGETATION SELECTION.
3. CONTRACTOR SHALL MINIMIZE DISTURBANCE TO EXISTING BUFFER VEGETATION AND CONSTRUCTION CORRIDOR TO THE EXTENT PRACTICAL. CLEARING AND GRUBBING ACTIVITIES SHALL BE LIMITED TO THE MINIMAL AMOUNT NECESSARY FOR HAUL ROADS, CHANNEL RELOCATIONS, AND STOCKPILE AREAS.
4. ALL EXISTING ROADS OR FARM PATHS USED FOR CONSTRUCTION ACTIVITES SUCH AS HAUL ROADS AND SITE ACCESS SHALL BE REPAIRED, IF NECESSARY, TO THE PRE-CONSTRUCTION CONDITION OR BETTER.
5. THE CONTRACTOR SHALL MAINTAIN EROSION AND SEDIMENTATION CONTROL DEVICES IN ACCORDANCE WITH THE APPROPRIATE EROSION AND SEDIMENTATION CONTROL ORDINANCES. EROSION CONTROL MATTING SHALL BE INSTALLED ON ALL RESTORED STREAMBANKS AND SIDE SLOPES STEEPER THAN AS SHOWN IN THE PLANS AND DETAILS.
6. THE CONTRACTOR MUST ESTABLISH GROUND COVER VEGETATION IN ACCORDANCE WITH THE PLANS AND TECHNICAL SPECIFICATIONS BEFORE TURNING WATER INTO THE NEW STREAM CHANNEL SEGMENTS.
7. THE CONTRACTOR SHALL WORK IN THE DRY AND UTILIZE A PUMP-AROUND OPERATION OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLAN SHEETS.
8. THE ENGINEER MUST APPROVE ALL GRADING ACTIVITIES AND GROUNDCOVER STABILIZATION PRIOR TO RIPARIAN VEGETATION PLANTING.
9. ROCK DAMS SHALL BE BELOW ACTIVE WORK AS NEEDED.

NAD 83

MATCH LINE STA. 29+00 - SHEET EC-5

FARM ROAD ACCESS

TEMPORARY GRAVEL CONSTRUCTION ENTRANCE

BEGIN REACH 6

STAGING/STOCKPILE AREA

HAUL ROAD

LIMITS OF DISTURBANCE

END REACH 6
END REACH 5
BEGIN REACH 4 UPPER

INSTALL TEMPORARY ROCK DAM (TYP.)

INSTALL EROSION CONTROL MATTING ALONG ALL CONSTRUCTED BANKS (TYP.)

END REACH T4
END REACH 4 UPPER
BEGIN REACH 4 LOWER

END REACH T3
END REACH 4 LOWER
BEGIN REACH 3 UPPER

BEGIN REACH T3

PUMP-AROUND 8 IF FLOWING

END PUMP-AROUND 6
BEGIN PUMP-AROUND 7

BEGIN PUMP-AROUND 1 IF FLOWING

LIMITS OF DISTURBANCE

BEGIN REACH 5

END PUMP-AROUND 1 AND 2
BEGIN PUMP-AROUND 3

PUMP-AROUND 4 IF FLOWING

BEGIN REACH T4

END PUMP-AROUND 3 AND 5
BEGIN PUMP-AROUND 6

BEGIN PUMP-AROUND 2 IF FLOWING

BEGIN PUMP-AROUND 5 IF FLOWING

BROAD RIDGE SUBDIVISION (NO ACCESS)

BROWNS SUMMIT EROSION CONTROL PLAN

50 0 50 100
SCALE (FT)

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	EC-5

PROGRESS DRAWING
FOR REVIEW PURPOSES ONLY
DO NOT USE FOR CONSTRUCTION

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License #: F-1084

NCDMS ID NO. 96313

EROSION & SEDIMENTATION CONTROL NOTES:

1. THE CONTRACTOR SHALL INSTALL THE EROSION AND SEDIMENTATION CONTROL MEASURES AS SHOWN ON THE PLANS PRIOR TO ANY GRADING ACTIVITIES. SEE SHEET 3 FOR GENERAL CONSTRUCTION SEQUENCE.
2. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED PER THE PLANS AND TECHNICAL SPECIFICATIONS. TEMPORARY AND PERMANENT SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS BY THE END OF EACH WORK DAY. SLOPES FLATTER THAN 3H:1V SHALL BE STABILIZED WITH GROUND COVER WITHIN FOURTEEN (14) CALENDAR DAYS FROM THE LAST LAND-DISTURBING ACTIVITY. ALL SLOPES STEEPER THAN 3H:1V SHALL BE STABILIZED AS SOON AS PRACTICABLE WITHIN SEVEN (7) CALENDAR DAYS. SEE SHEET 1.A FOR VEGETATION SELECTION.
3. CONTRACTOR SHALL MINIMIZE DISTURBANCE TO EXISTING BUFFER VEGETATION AND CONSTRUCTION CORRIDOR TO THE EXTENT PRACTICAL. CLEARING AND GRUBBING ACTIVITIES SHALL BE LIMITED TO THE MINIMAL AMOUNT NECESSARY FOR HAUL ROADS, CHANNEL RELOCATIONS, AND STOCKPILE AREAS.
4. ALL EXISTING ROADS OR FARM PATHS USED FOR CONSTRUCTION ACTIVITES SUCH AS HAUL ROADS AND SITE ACCESS SHALL BE REPAIRED, IF NECESSARY, TO THE PRE-CONSTRUCTION CONDITION OR BETTER.
5. THE CONTRACTOR SHALL MAINTAIN EROSION AND SEDIMENTATION CONTROL DEVICES IN ACCORDANCE WITH THE APPROPRIATE EROSION AND SEDIMENTATION CONTROL ORDINANCES. EROSION CONTROL MATTING SHALL BE INSTALLED ON ALL RESTORED STREAMBANKS AND SIDE SLOPES STEEPER THAN AS SHOWN IN THE PLANS AND DETAILS.
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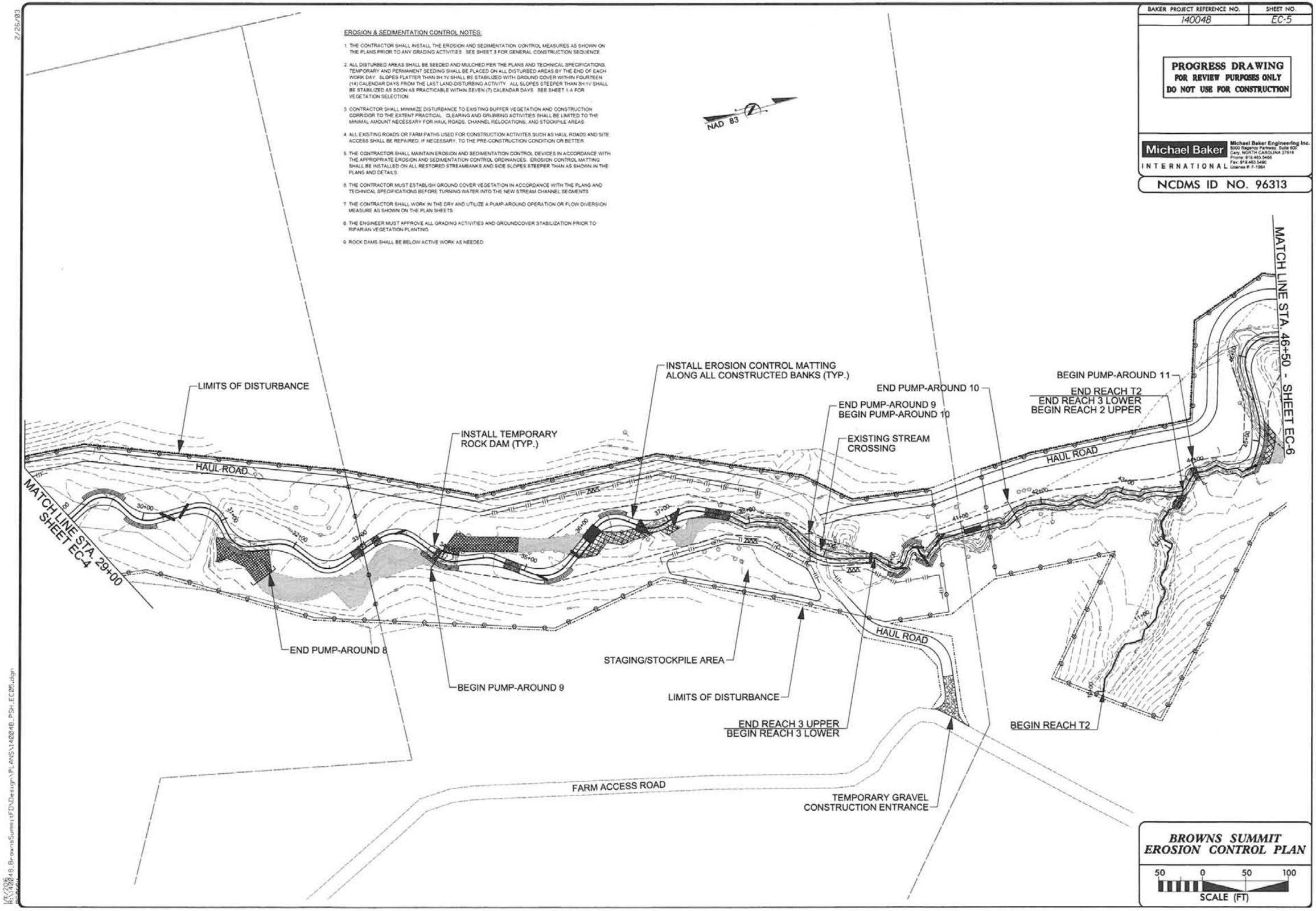

BROWNS SUMMIT EROSION CONTROL PLAN

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SCALE (FT)

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2/25/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
140048	EC-6

PROGRESS DRAWING
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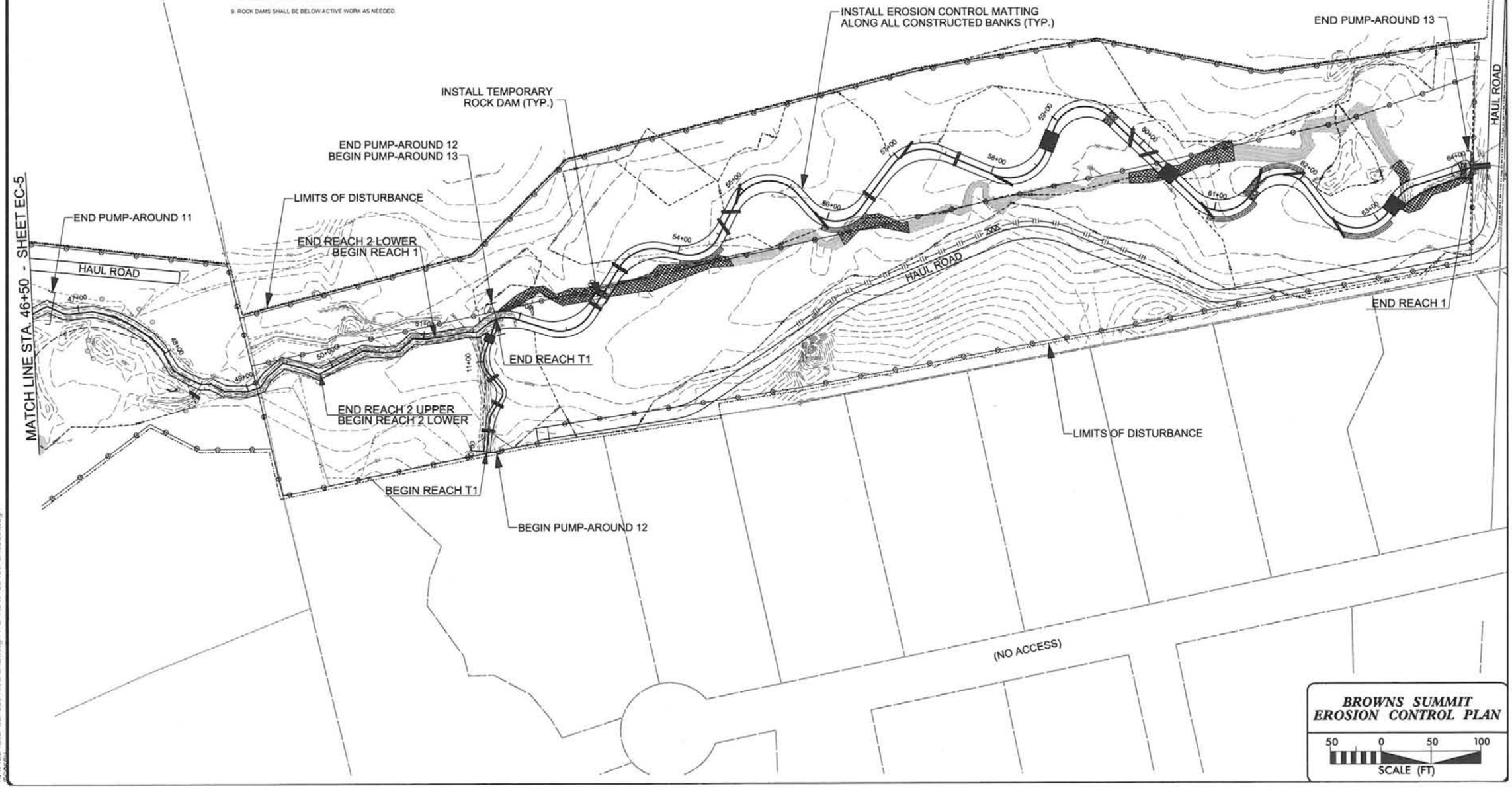

BROWNS SUMMIT EROSION CONTROL PLAN

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SCALE (FT)

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