BROCK STREAM RESTORATION SITE
Monitoring Year 3 (2011)

Jones County, North Carolina
EEP Project No. 92333

Prepared for the
NC Department of Environment and Natural Resources
Ecosystem Enhancement Program

1652 Mail Service Center, Raleigh, NC 27699-1652

Final Monitoring Report

September 2011

Prepared by:

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This report follows methodologies consistent with the Content, Format and Data Requirements for EEP Monitoring Reports, Version 1.2 (11/16/06)

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SECTION I. EXECUTIVE SUMMARY/ PROJECT ABSTRACT

Ecological Engineering, LLP (Ecological Engineering) entered into contract with the NC Department of Environment and Natural Resources, Ecosystem Enhancement Program (EEP) in October 2009 to conduct annual monitoring assessments at the Brock Site in Jones County, North Carolina. The following document depicts our findings and recommendation with regard to the Year 3 (2011) monitoring assessment.

The Brock Stream Restoration Project was implemented using methodologies consistent with Coastal Plain headwater stream and buffer restoration. The stream, an unnamed tributary (UT) to Chinquapin Branch, was restored using a modified Priority 3 level of restoration. Specifically, the project involved the excavation of a floodplain along the entire 1,850 linear-foot stream reach. Excavation was limited to the right side of the channel facing downstream due to a cemetery and other constraints occurring along the left stream bank.

Vegetation Monitoring

Year 3 vegetation monitoring assessments were performed using Carolina Vegetation Survey (CVS) Level II Assessment Protocols. Four permanent plot locations were established and located during the as-built surveys. Each plot covers 100 square meters and is shaped in the form of a 10-meter by 10-meter square. The number of plots was determined by CVS software and individual locations were randomly selected based on the planned community types.

All planted areas at the Brock Site are associated with either the generation of Stream Mitigation Unit (SMU), Buffer Mitigation Unit (BMU) or Nutrient Offset Nitrogen Reduction Buffer Restoration. Based on the Year 3 findings, two of three vegetation plots met the vegetation success criteria for stream mitigation credit and three of four total vegetation plots met the success criteria for BMU or Nutrient Offset Buffer Restoration mitigation credit. EEP will oversee a supplemental planting of the areas exhibiting low stem densities during the 2011-2012 dormant season. This planting will consist of native species, consistent with those noted in the original planting plan, averaging 2.0 to 2.5 feet in height. Species identification tags will be placed on each stem.

Stream Restoration Monitoring

Stream monitoring assessments were conducted using surveys and comparisons of three existing cross sections along the UT. No problems were noted. Bankfull dimensions differed from last year's results; however, no erosion, entrenchment or incision was observed. Based on the data collected and visual observations, the Brock Site is functioning similar to that of a Coastal Plain headwater stream system.

A bankfull event has been measured each of the past three years of monitoring, thus exceeding the minimum success criteria established for hydrology.

Monitoring efforts will continue in 2012.

SECTION II. PROJECT BACKGROUND

A. Project Objectives

According to EEP (2010), the project specific goals at the Brock Site needed to achieve desired ecological function include:

- Improvement of water quality by limiting bank erosion;
- Creation of 1,850 linear feet of stable stream channel (Stream Enhancement category II);
- Restoration of 6.2 acres of riparian buffer along the project reach (4.23 acres associated with the 50-foot buffer and 1.97 acres associated with the buffer beyond 50 feet);
- Improvement of aquatic and terrestrial habitat within the UT to Big Chinquapin Branch; and,
- The 40-foot wide floodplain bench will dissipate the flow and maintain channel stability during moderate to high discharge events.

The Project Site is located in Jones County and surrounded by areas of intense agricultural land use (Figure 1). As part of project implementation, the riparian buffer was reforested along the restored floodplain. This buffer restoration reconnects existing forested buffers along Big Chinquapin Branch and provides a wooded, although very narrow corridor for wildlife. The buffer also intercepts overland flow from a swale draining the agricultural fields on the Brock property (EEP, 2006). In addition, EEP (2006) states that buffer reforestation at this site will reduce the input of nutrients from the fields to the waters downstream of the unnamed tributary to Big Chinquapin Branch, designated as nutrient sensitive waters by the NC Division of Water Quality (NCDWQ). A project asset map is depicted in Figure 2.

The project will provide an ecological uplift for the entire basin.

B. Project Structure, Restoration Type and Approach

The watershed encompassing the project site is located in the eastern portion of the Coastal Plain Physiographic Province. Slopes are generally less than four percent. Elevations on the Brock Site range from approximately 39 to 52 feet above mean sea level. The soil survey for Jones County (Barnhill, 1981) indicates that the area is underlain by Goldsboro loamy sand, Grifton fine sandy loam, Lynchburg fine sandy loam, Muckalee loam, and Norfolk loamy sand (EEP, 2006).

The watershed is a mixture of forested lands, agricultural row crops, two-lane roadways, farm roads, cemeteries, minor culverts, and a few single-family homes. Agricultural drainage features, including ditches and drain tiles, have been constructed and maintained on the Brock and neighboring properties. The Brock Site and adjacent properties are utilized primarily for agricultural purposes (EEP, 2006).

According to EEP (2010), the project reach was designed using Stream Enhancement Level II methodologies. Prior to restoration, the UT to Big Chinquapin Branch was incised and could not easily access its floodplain. Pre-restoration existing shear stress and stream power were compared with the design in order to evaluate aggradation and degradation. The state of the channel before restoration was shown to be capable of handling the system's flow and sediment supply. Buffer reforestation was conducted along the restoration reaches extending beyond 50 feet on either side of the channel to the limits of the conservation easement. The planting plan was based on the hydrology of the site, the surrounding vegetative communities, and

available supply of native species. The plan is modeled after mature, unaltered systems as outlined in the *Natural Communities of North Carolina* (Schafale and Weakley, 1990). The newly excavated floodplain was planted with a Coastal Plain Bottomland Hardwood Forest community. Remaining areas outside the floodplain, excluding a small cemetery along the left bank, were planted as a Mesic Mixed Hardwood Forest Coastal Plain Subtype (EEP, 2010).

The US Army Corps of Engineers and NC Division of Water Quality (USACE, 2005) released a draft mitigation guidance document related to stream restoration in the outer Coastal Plain of North Carolina in 2005. This guidance, developed in cooperation with NCDWQ, addresses mitigation credits for headwater streams. Many natural headwater streams and wetlands in the Coastal Plain were historically channelized for agricultural purposes. A number of these channels, including the UT associated with the Brock Site, are eroding and lack functionality and habitat. While many of these areas would benefit from restoration, traditional natural channel design with pattern and profile has been determined to be inappropriate for all coastal headwater streams. The driving factor behind this guidance is that it is difficult to discern the original condition of these first order channels: whether they were historically intermittent streams or headwater wetlands. Emphasis is now being placed on restoring habitat and floodplain functionality to these types of channels. The Brock Site is one of the pioneer EEP projects utilizing these updated guidelines. As a result, traditional yearly monitoring activities have been revised to better address this type of restoration.

The health of a watershed is dependent on the quality of the headwater system(s), individual tributaries, and major channels. High quality tributaries with vegetated buffers filter contaminants, maintain moderate water temperatures, provide high quality aquatic and terrestrial habitat and regulate flows downstream. Big Chinquapin Branch is a major tributary to the Trent River, and both water bodies are nutrient sensitive (NCDWQ, 1998). In addition, Big Chinquapin Branch is managed by a Drainage District. Agricultural land use practices have narrowed or removed many natural, vegetated buffers along streams within the Trent River watershed as well as draining and converting non-riverine wet hardwood forests to cropland (EEP, 2006).

According to EEP (2006), this restoration will enhance functional elements of the unnamed tributary. The Brock Restoration Plan outlines the restoration of the UT to Chinquapin Branch and the reforestation of the associated riparian buffer. This involves the creation of a stable channel, riverine floodplain, and associated riparian buffer. Priority 3 stream restoration was implemented on the unnamed tributary. This involved reconnecting the stream channel to its floodplain, allowing for periodic overbank flooding. To reduce construction costs and avoid disturbing the cemetery, a bankfull bench was excavated along east side of the existing channel. Water quality functions will be improved due to the creation of more storage for floodwaters and increased filtering of pollutants. Wetlands are expected to form within portions of the newly created bankfull bench, especially in the downstream section of the project where backwater from Chinquapin Branch will affect the stream. Barring water quality issues outside of the Brock Site, the restoration should improve aquatic species diversity and abundance in the stream channel. The restoration of riparian buffers along the restored stream channel will improve water quality. The reestablishment of the riparian buffers with hardwood species will also improve wildlife habitat on the property. These measures will improve the physical, chemical, and biological components of the unnamed tributary and the Brock property, as well as Big Chinquapin Branch and other downstream waters (EEP, 2006).

C. Location and Setting

The Project Site is situated in Jones County, approximately 12 miles southeast of Kinston and eight miles west-northwest of Trenton (Figure 1) along a UT to Big Chinquapin Branch. Its watershed is part of the Coastal Plain physiographic province, covering approximately 315 acres.

The following directions are provided for accessing the Brock Project Site:

- From US 70 in Kinston, Proceed east on NC 58 approximately 12 miles.
- Turn left onto gravel farm road approximately one-third mile after passing the intersection with the second loop of Pine Street on the left.
- Proceed approximately 800 feet along gravel farm road.
- Project Site is located to the immediate east (right side) of road.

D. History and Background

The project is undergoing its third formal year of monitoring. The following exhibit tables depict the components for restoration, project activity and reporting, contact information for all individuals responsible for implementation and project background information.

Exhibit Table I. Project Restoration Components
Brock Site (EEP Project No. 92333)

Project Segment or Reach ID	Existing Feet	Type	Approach	Mitigation Ratio	Mitigation Units	Stationing	Comment
Reach 1 – UT to Big Chinquapin Branch	1,850	EII	P3	1.5:1	1,233	0+00 - 28+50.16	
Nutrient Offset Nitrogen Reduction Credit (>50' from Top of Bank)	n/a	n/a	n/a	n/a	149.27 lbs/year	n/a	Calculated by 77.57N lbs/ac/yr x 1.97 acres
Neuse Buffer (<50' from Top of Bank)	n/a	R	n/a	1:1	4.23	n/a	
Nutrient Offset Buffer (>50' from Top of Bank)	n/a	R	n/a	1:1	1.97	n/a	

Mitigation Unit Summations

Stream (lf)	Riparian Wetland (ac)	Non-riparian Wetland (ac)	Total Wetland (ac)	Buffer (ac)	Nutrient Offset Nitrogen Reduction Credit
1,233				6.20*	149.27 lbs/yr for 30 years

EII = Enhancement II R = Restoration P3 = Priority Level III *Source: EEP, 2010*
Nutrient Offset calculations are per NCDWQ recommendation.

Exhibit Table II. Project Activity and Reporting History Brock Site (EEP Project No. 92333)		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	May 2006	May 2006
Final Design (90%)	n/a	April 2008
Construction	n/a	June 2009
Temporary S&E Mix Applied	n/a	June 2009
Permanent Seed Mix Applied	n/a	June 2009
Bare Root Seedling Installation	n/a	Unknown
Mitigation Plan/ As-Built (Year 0 Monitoring- baseline)	n/a	August 2010
Year 1 Monitoring	December 2009	January 2011
Supplemental Planting	n/a	February 2010
Year 2 Monitoring	July 2010	January 2011
Year 3 Monitoring	August 2011	September 2011
Year 4 Monitoring		
Year 5 Monitoring		

Source: EEP, 2010

Exhibit Table III. Project Contact Table Brock Site (EEP Project No. 92333)	
Designer Primary Project Design POC	Stantec Consulting Services, Inc. 801 Jones Franklin Road Suite 300 Raleigh, NC 27606 Nathan Jean (919) 865-7387
Construction Contractor Construction Contractor POC	Shamrock Environmental Corporation 6106 Corporate Park Drive Browns Summit, NC 27214 Unknown
Planting Contractor Planting Contractor POC	Natives 550 E. Westinghouse Blvd. Charlotte, NC 28273 Gregory Antemann (336) 375-1989
Seeding Contractor Planting Contractor POC	Seal Brothers Contracting P.O Box 86 Dobson, NC 27017 Mari Seal (336) 786-2263
Seed Mix Source	Unknown
Nursery Stock Suppliers	Natives 550 E. Westinghouse Blvd. Charlotte, NC 28273 (704) 527-1177
Monitoring Performer	Ecological Engineering, LLP 128 Raleigh Street Holly Springs, NC 27540
Stream Monitoring POC	G. Lane Sauls Jr. (919) 557-0929
Vegetation Monitoring POC	G. Lane Sauls Jr. (919) 557-0929

Source: EEP, 2010

Exhibit Table IV. Project Background Table Brock Site (EEP Project No. 92333)	
Project County	Jones County
Drainage Area	315 acres (0.5 sq. miles) – Unnamed Tributary
Impervious Cover Estimate	Less than 5%
Stream Order	1 – Unnamed Tributary
Physiographic Region	Coastal Plain
Ecoregion (Griffith and Omernik)	Carolina Flatwoods
Rosgen Classification of As-built	E5
Cowardin Classification	n/a
Dominant Soil Types	Goldsboro loamy sand, Grifton fine sandy loam, Lynchburg fine sandy loam, Muckalee loam and Norfolk loamy sand
Reference Site ID	Unknown/ Not Applicable
USGS HUC for Project and Reference	03020204010060
NCDWQ Sub-basin for Project and Reference	03-04-11
Any Portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment.	No
Reason for 303d listing or stressor	Not Applicable
Percent of project easement fenced	0%

Source: EEP, 2010

E. Monitoring Plan View

The Monitoring Plan View drawings associated with the project are provided as part of Figure 3.

SECTION III. PROJECT CONDITION AND MONITORING RESULTS

As previously mentioned, monitoring activities at the Brock Site are tailored to assessing Coastal Plain headwater stream systems and their corresponding buffers. Ecological Engineering conducted vegetation assessments and stream assessments as part of yearly monitoring requirements.

A. Vegetation Assessment

Four 100 meter^2 vegetation plots were monitored using Carolina Vegetation Survey (CVS) protocol Level II assessments. The remaining portions of the Project Site were visually assessed.

1. Stem Counts

Stem counts were conducted within four strategically placed 10 meter by 10 meter plots. The plots were located based on a representative sample of the entire area of disturbance. They are scattered throughout the Project Site in order to cover the majority of the habitat variations. Vegetation Plots #1, #2 and #4 are related to stream and buffer mitigation credit and occur within the 50-foot buffer of the channel. Vegetation Plot #3 is outside of the 50-foot zone and falls under either buffer mitigation credit or Nutrient Offset Nitrogen Reduction credit. The success criteria for stream mitigation credit (Vegetation Plots #1, #2 and #4) is a minimum of 320 stems per acre after three years and 260 stems per acre after five years. The success criteria for buffer mitigation and Nutrient Offset Nitrogen Reduction credits however, is a minimum of 320 planted, hardwood, native stems per acre after five years.

Planted stem counts increased during 2011 as a result of a warranty planting completed by the contractor in February 2010 and the observation of several additional planted stems that were not obvious during the Year 2 assessment. The increase was most noticeable with respect to the annual mean, which increased from 505 planted stems per acre in 2010 to 526 planted stems per acre in 2011. Actual stem per acre increases were observed in Vegetation Plots #1, #3 and #4. Vegetation Plot #2 results were the same as last year and still below the success criteria. The chart below provides a summary of the Year 3 counts.

Vegetation Plot No.	Total Stem Count/ Acre (SMU Credit)	Planted Stem Count/ Acre	Planted, Hardwood Stem Count/ Acre (BMU or Nutrient Offset N Credit)
1	1,740	971	971
2	283	283	283
3	n/a	283	323
4	728	445	526

Vegetation Plots #1, #3 and #4 met the success criteria required for buffer mitigation or Nutrient Offset Nitrogen credit and Vegetation Plots #1 and #4 met the success criteria for stream mitigation credit. Vegetation Plot #2 failed to meet the same criteria for both mitigation types. A complete breakdown of this information is provided in Appendix A along with photographs of each vegetation plot taken during the assessment.

2. Vegetative Problem Areas

Vegetative problem areas are defined as those areas either lacking vegetation or containing exotic vegetation and are generally categorized within the following categories: Bare Bank, Bare Bench, Bare Floodplain or Invasive Population. Based on the monitoring site assessment, vegetation problem areas currently exist within the Project Site from a stem count basis. Visual assessments however, did not reveal any previous areas void of vegetation. The majority of the bare floodplain areas that were observed during 2009 filled in with vegetation prior to the Year 2 assessment and have remained consistent through Year 3. Vegetation problem areas are summarized in Appendix A - Table 7 and are depicted on Figure 4.

As previously mentioned, a supplemental planting was conducted during February 2010 as part of the contractor's vegetation warranty. This planting increased total stem counts throughout the project area but failed to increase the counts above the Year 3 minimum success criteria in one of the four vegetation plots. The extent of the supplemental planting is also shown on Figure 4.

EEP will oversee a supplemental planting during the 2011-2012 dormant season in the areas exhibiting low stem densities. This planting will consist of native species, consistent with those noted in the original planting plan, averaging 2.0 to 2.5 feet in height. Species identification tags will be placed on each stem.

B. Stream Assessment

1. Procedural Items

Under normal circumstances, stream monitoring includes collection of morphometric criteria, specifically dimension and profile measurements. The recommended procedures follow protocol depicted within the USACE Draft Stream Mitigation Guidelines (2003) document. The Brock Site however, offers a method of mitigation that is not consistent with these guidelines. Therefore, monitoring protocols have been updated to better address the monitoring issues at the Project Site.

Morphometric Criteria

Three cross sections were established along the unnamed tributary. These cross sections are situated at Stations 11+00, 15+00 and 23+00. Appendix B depicts the data, which provides a year-by-year comparison. Exhibit Table V provides baseline data of cross section values with regard to bankfull and dimensions. According to the data collected, the average bankfull area along the stream reach is approximately 5.7 square feet; an increase in approximately 0.5 square feet from the previous year. This can be attributed to several possible situations: (1) vegetation within the channel; (2) variable flow rates; and, (3) survey differences. Since this is a first order channel, the dimension is expected to vary based on flow rates. The data below denotes a qualitative comparison of the channel characteristics. Based on visual observations, this channel appears stable. No erosion is present. The numbers reveal differences in several of the attributes; however, this data is only a snapshot and does not account for the ever-changing conditions of this type of channel. These cross sections will be monitored throughout the following years to ensure that it remains stable.

Exhibit Table V. Cross Section Comparison Brock Site (EEP Project No. 92333)															
Attribute	**Cross Section #1 Station 11+00**					**Cross Section #2 Station 15+00**					**Cross Section #3 Station 23+00**				
Monitoring Year	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Bankfull area (sq. feet)	7.2	4.6	5.7			6.9	6.4	7.7			7.2	4.6	3.7		
Bankfull width (feet)	8.7	7.8	7.8			8.3	8.0	8.8			29.0	9.3	7.9		
Bankfull mean depth (feet)	0.8	0.6	0.7			0.8	0.8	0.9			0.4	0.5	0.5		
Bankfull max depth (feet)	1.4	0.9	1.0			1.4	1.4	1.5			0.7	0.9	0.8		
Width-depth ratio	10.5	13.2	10.8			9.9	10.0	10.0			82.3	18.6	17.0		
Flood prone area width (feet)	52.4	44.3	48.0			49.9	49.2	49.8			51.0	52.1	50.6		
Entrenchment ratio	6.0	5.7	6.1			6.0	6.2	5.6			1.8	5.6	6.4		
Low bank height ratio	1.0	1.0	1.4			1.1	1.0	1.0			1.0	1.0	1.0		

Hydrologic Criteria

Bankfull events during the monitoring period are being documented via a crest gage located in the vicinity of Station No. 18+65. In order to meet hydrologic success criteria, a minimum of two events must occur during the five-year monitoring period. In addition, the events must occur in separate monitoring years. The gage is being visited approximately three times per year. Based on our findings, at least one bankfull event has occurred during 2011. Approximately 2.61 inches of rain were associated with a storm event in April 2011. This information is depicted in Exhibit Table VI below. In addition, actual precipitation data from a nearby weather station is provided in Appendix C. Based on these results and the data captured during the previous years' monitoring, at least two bankfull events have been recorded during separate years at the Project Site. Therefore, the hydrologic criteria associated with stream restoration have been satisfied for the project. Rainfall monitoring will continue however, throughout the five-year monitoring period.

Exhibit Table VI. Verification of Bankfull Events Brock Site (EEP Project No. 92333)					
Date of Data Collection	**Date(s) of Occurrence**	**Method**	**Calculated Bankfull Elevation**	**Measured High Water Elevation**	**Photo # (if available)**
10/24/09	Unknown	Crest gage	14 inches	35 inches	Not available
11/13/10	7/4/10, 9/27/10 thru 10/1/10	Crest gage	14 inches	40 inches	Not available
7/7/11	4/27/11 thru 4/29/11 (assumed)	Crest gage	14 inches	15 inches	Not available

Bank Stability Assessments

EEP requires that detailed Bank Erosion Hazard Index (BEHI) and Near Bank Shear Stress (NBS) be performed in Year 5, post-construction which correlates to Year 2013. The purpose is to describe the proportion of bank footage in the various hazard categories and to produce sediment export rates in tonnage per annum. Due to the nature of this type of mitigation, EEP will determine the extent of assessment required during Monitoring Year 5.

2. Stream Problem Areas

No significant changes to the dimension were observed during Year 3 monitoring activities. A visual assessment of the channel was conducted throughout its length and no problem areas were noted. Although elevation changes were observed based on the data collected, the visual assessments did not locate any obvious areas of instability and/or erosion.

A visual inspection was completed during the monitoring assessment to locate and/or identify areas of inadequate performance. This inspection generally includes an assessment and mental judgment of physical conditions, including structural features. Bank condition was the only feature assessed at the Brock Site. Results of the assessment are depicted below in Exhibit Table VII.

Exhibit Table VII. Categorical Stream Feature Visual Stability Assessment
Brock Site (EEP Project No. 92333)
Segment/Reach: Entire (1,850 linear feet)

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
Bank Condition	100%	100%	100%	100%	-	-

3. Fixed Station Photographs

Photographic documentation was taken at 16 permanent photo stations, established during the as-built survey. The documentation ranges between views of the channel and buffer, to vegetation plots and cross sections. Appendix D provides an ongoing comparison of yearly photographs for each station.

SECTION IV. Methodology Section

This document employs methodologies according to the post-construction monitoring plan and standard regulatory guidance and procedures documents. References are provided below.

Barnhill, W.L., 1981. Soil Survey of Jones County, North Carolina. US Department of Agriculture, Soil Conservation Service.

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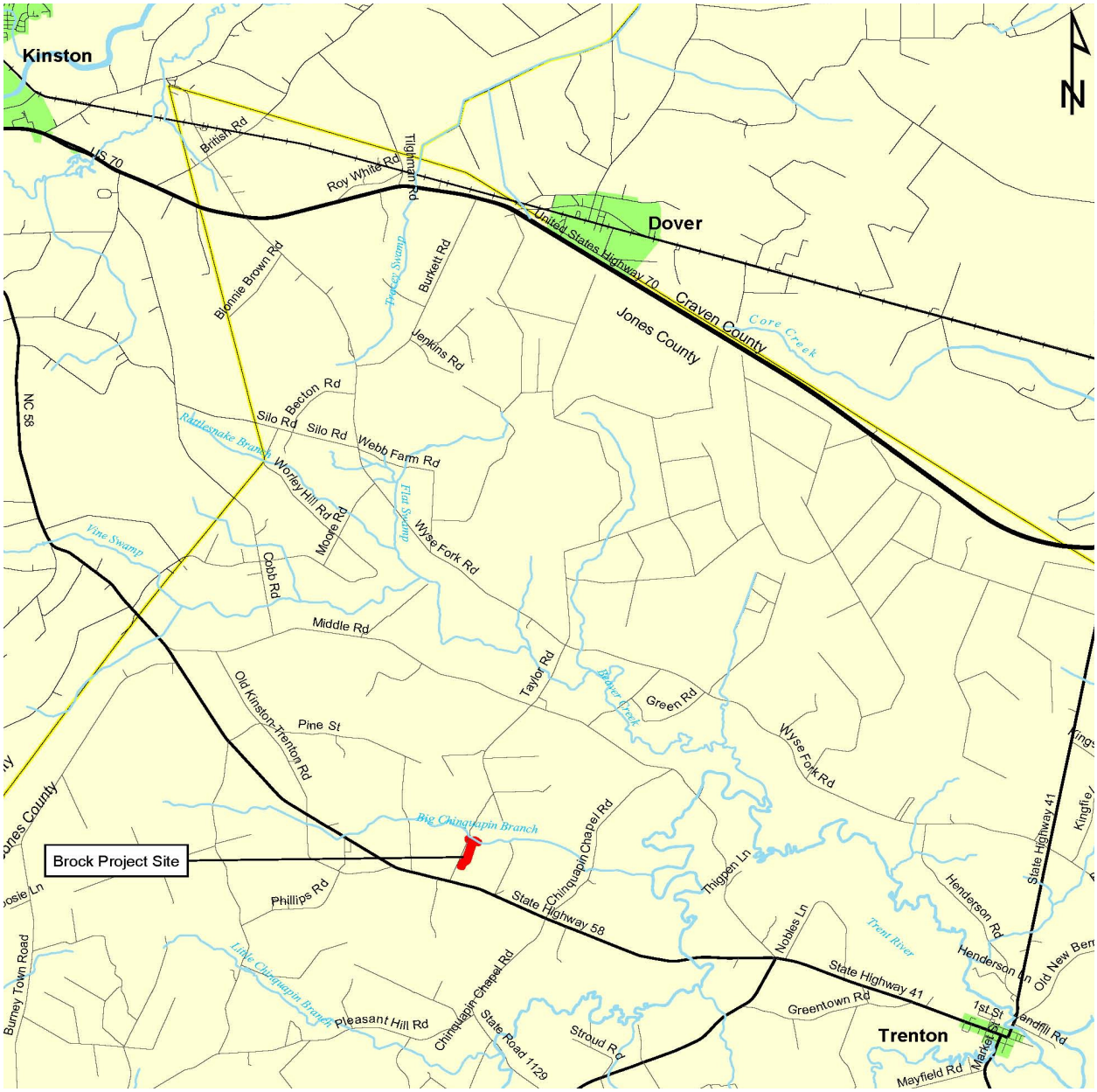
US Army Corps of Engineers (USACE), US Environmental Protection Agency (USEPA), NC Wildlife Resources Commission (NCWRC) and NC Division of Water Quality (NCDWQ), 2003. Draft Stream Mitigation Guidelines, April 2003.

US Environmental Protection Agency (USEPA), US Department of Agriculture, Natural Resources Conservation Service and NC Department of Environment and Natural Resources, 2002. Level III and Level IV Ecoregions of North Carolina Map.



As-Built & Baseline Monitoring Plan
April 2010

- Local Roads
- Major Roads
- Railroads
- Site Boundary
- County Boundary
- Streams
- Municipality

0 0.5 1 2 3 Miles

Directions to the Brock Stream Restoration Site: From Raleigh, take HWY 70 East to Kinston, NC. The Brock Restoration Site is located approximately 12 miles southeast of Kinston, North Carolina and lies in northern Jones County. From US 70 East in Kinston turn right on NC 58 and travel approximately 12 miles. The site is located on the left approximately three miles past the beginning of the Pine Street loop (SR 1301).

Figure Courtesy of Stantec Consulting Services, Inc., 2010

Ecological Engineering LLP

VICINITY MAP

Brock Stream Restoration Site, Jones County, NC
EEP Project No. 92333
August 18, 2010

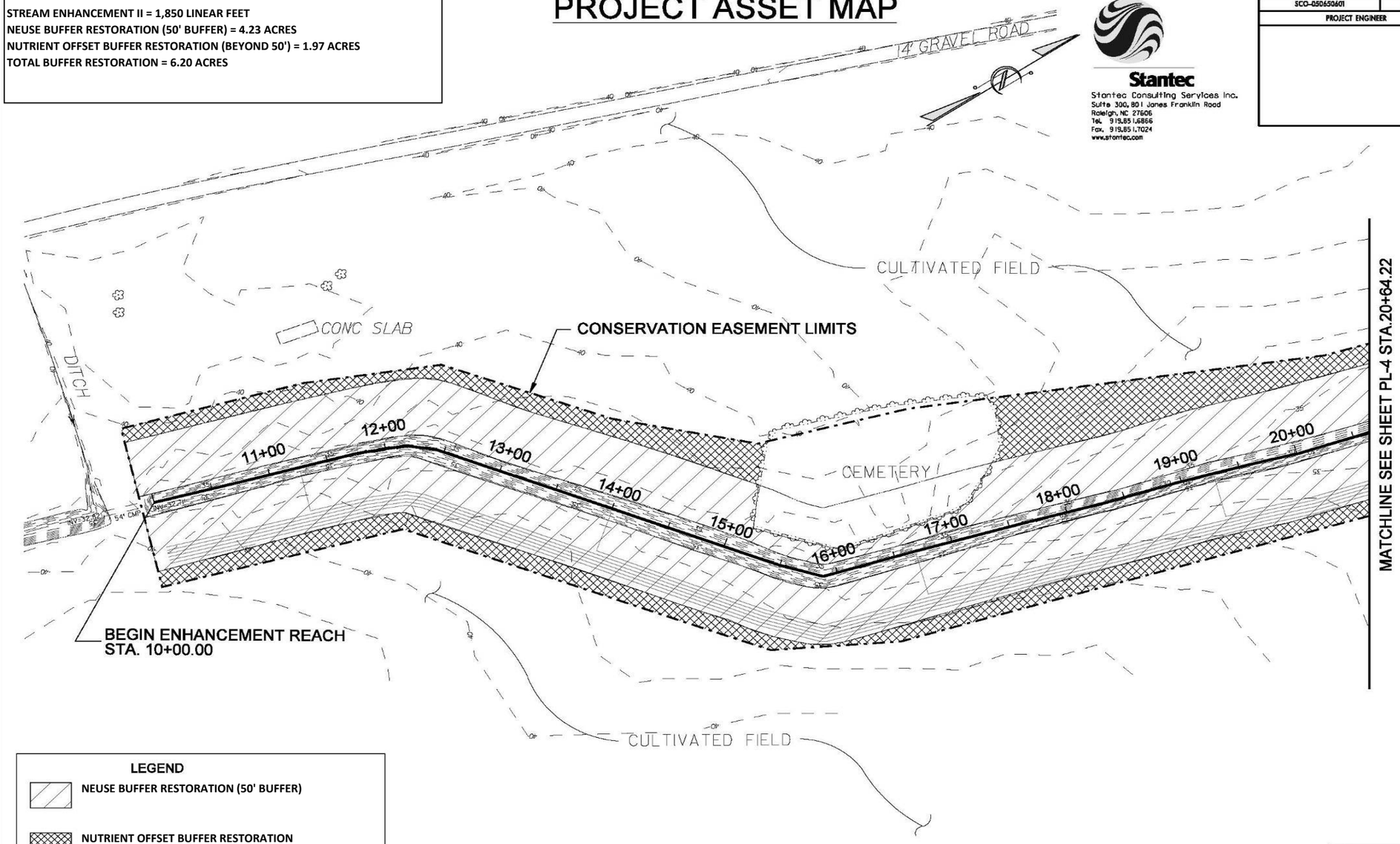
Ecosystem Enhancement Program

PROJECT ASSET MAP

STREAM ENHANCEMENT II = 1,850 LINEAR FEET
NEUSE BUFFER RESTORATION (50' BUFFER) = 4.23 ACRES
NUTRIENT OFFSET BUFFER RESTORATION (BEYOND 50') = 1.97 ACRES
TOTAL BUFFER RESTORATION = 6.20 ACRES

PROJECT REFERENCE NO.	SHEET NO.
SCO-050650601	SHEET 1
PROJECT ENGINEER	

Stantec
Stantec Consulting Services Inc.
Suite 300, 801 Jones Franklin Road
Raleigh, NC 27606
Tel. 919.851.6866
Fax. 919.851.7024
www.stantec.com



LEGEND

- NEUSE BUFFER RESTORATION (50' BUFFER)
- NUTRIENT OFFSET BUFFER RESTORATION (BEYOND 50')

NOTE:
ENHANCEMENT STA. 10+00.00 TO STA.20+64.22

SCALE: 20 0 40

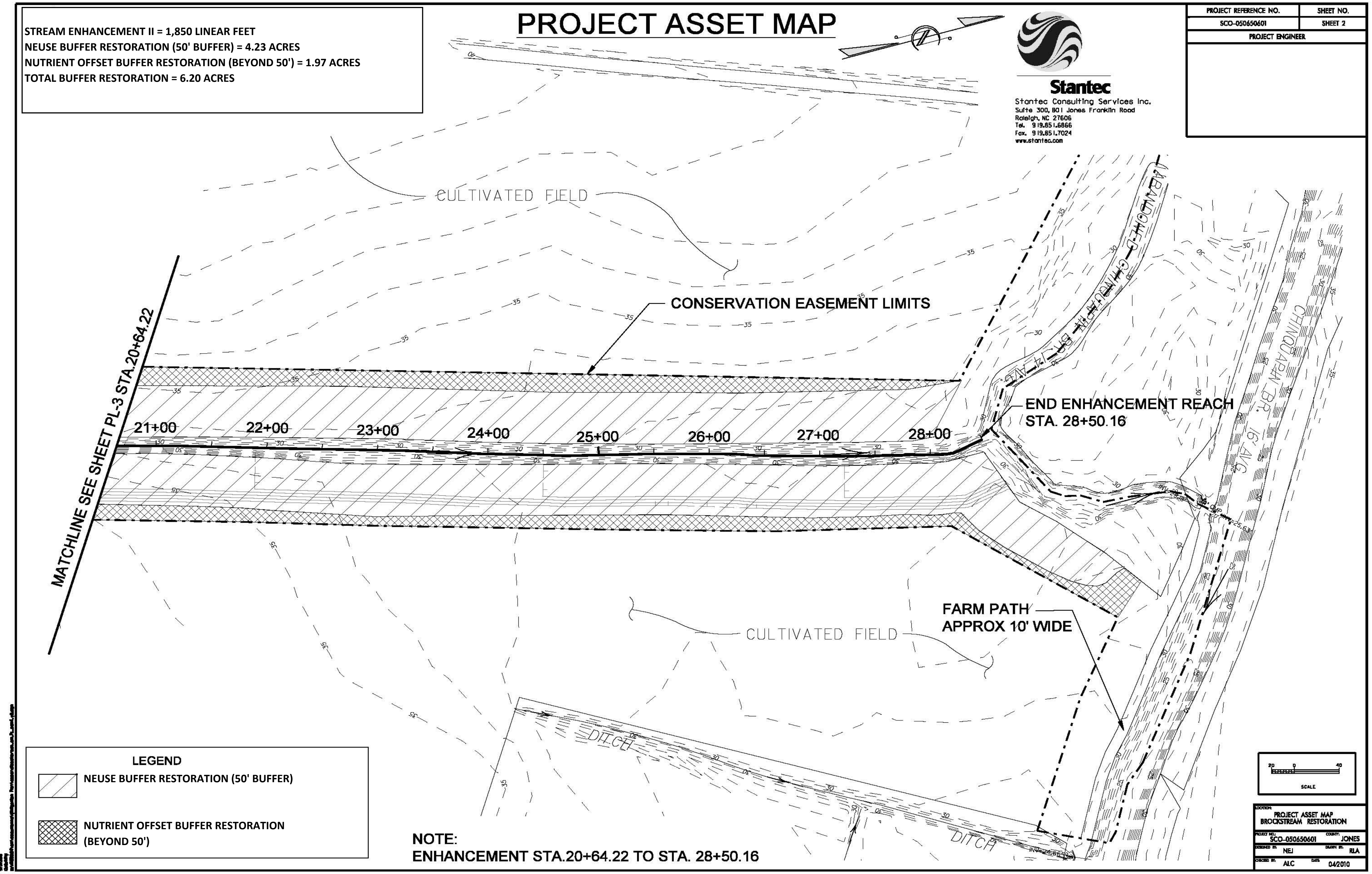
DESIGN:	PROJECT ASSET MAP BROCK STREAM ENHANCMENT
PROJECT NO.:	SCO-0506506O1
COUNTY:	JONES
DESIGNED BY:	NEJ
DRAWN BY:	RLA
CHECKED BY:	ALC
DATE:	04/2010

Figure 2

PROJECT ASSET MAP - SHEET 1
Brock Site (EEP Project No. 92333)
Jones County, North Carolina
January 4, 2010
Basemap Source: EEP, 2010

Ecosystem Enhancement Program

Ecological Engineering PC
137 Raleigh Street
Holly Springs, North Carolina 27540
(919) 557-7029



STREAM ENHANCEMENT II = 1,850 LINEAR FEET
NEUSE BUFFER RESTORATION (50' BUFFER) = 4.23 ACRES
NUTRIENT OFFSET BUFFER RESTORATION (BEYOND 50') = 1.97 ACRES
TOTAL BUFFER RESTORATION = 6.20 ACRES
PROJECT ASSET MAP
PROJECT REFERENCE NO.
SCO-050650601
SHEET NO.
SHEET 2
PROJECT ENGINEER
Stantec
Stantec Consulting Services Inc.
Suite 300, 801 Jones Franklin Road
Raleigh, NC 27606
Tel. 919.851.6866
Fax. 919.851.7024
www.stantec.com
CULTIVATED FIELD
CONSERVATION EASEMENT LIMITS
MATCHLINE SEE SHEET PL-3 STA.20+64.22
21+00
22+00
23+00
24+00
25+00
26+00
27+00
28+00
END ENHANCEMENT REACH
STA. 28+50.16
FARM PATH
APPROX 10' WIDE
CULTIVATED FIELD
DITCH
DITCH
LEGEND
NEUSE BUFFER RESTORATION (50' BUFFER)
NUTRIENT OFFSET BUFFER RESTORATION (BEYOND 50')
NOTE:
ENHANCEMENT STA.20+64.22 TO STA. 28+50.16
SCALE
PROJECT ASSET MAP
BROCKSTREAM RESTORATION
SCO-050650601
JONES
NEJ
RLA
ALC
04/2010

Figure 2

PROJECT ASSET MAP - SHEET 2

Brock Site (EEP Project No. 92333)

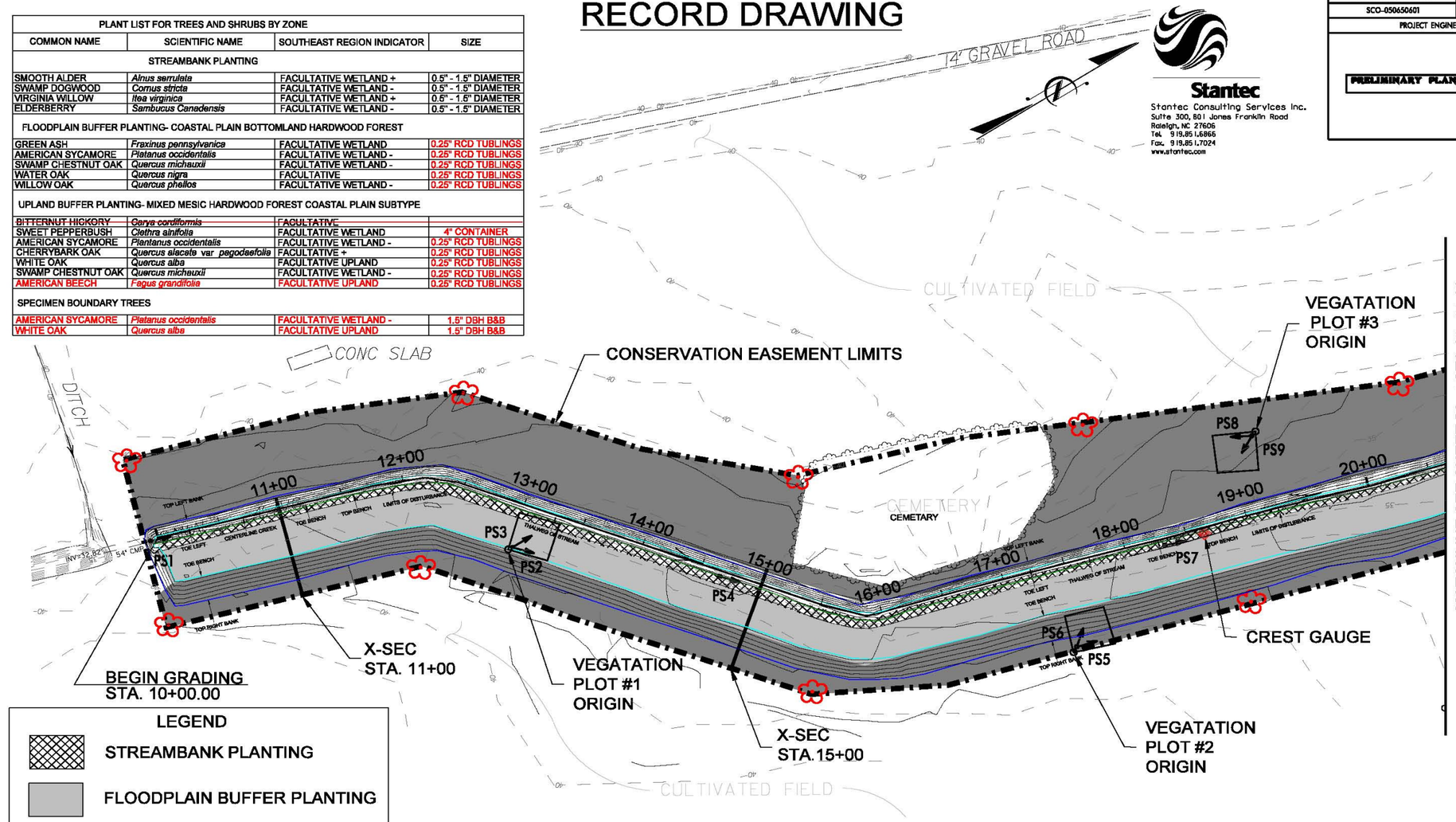
Jones County, North Carolina

January 4, 2010

Basemap Source: EEP, 2010

RECORD DRAWING

PLANT LIST FOR TREES AND SHRUBS BY ZONE			
COMMON NAME	SCIENTIFIC NAME	SOUTHEAST REGION INDICATOR	SIZE
STREAMBANK PLANTING			
SMOOTH ALDER	*Alnus serrulata*	FACULTATIVE WETLAND +	0.5" - 1.5" DIAMETER
SWAMP DOGWOOD	*Cornus stricta*	FACULTATIVE WETLAND -	0.5" - 1.5" DIAMETER
VIRGINIA WILLOW	*Itea virginica*	FACULTATIVE WETLAND +	0.5" - 1.5" DIAMETER
ELDERBERRY	*Sambucus Canadensis*	FACULTATIVE WETLAND -	0.5" - 1.5" DIAMETER
FLOODPLAIN BUFFER PLANTING- COASTAL PLAIN BOTTOMLAND HARDWOOD FOREST			
GREEN ASH	*Fraxinus pennsylvanica*	FACULTATIVE WETLAND	0.25" RCD TUBLINGS
AMERICAN SYCAMORE	*Platanus occidentalis*	FACULTATIVE WETLAND -	0.25" RCD TUBLINGS
SWAMP CHESTNUT OAK	*Quercus michauxii*	FACULTATIVE WETLAND -	0.25" RCD TUBLINGS
WATER OAK	*Quercus nigra*	FACULTATIVE	0.25" RCD TUBLINGS
WILLOW OAK	*Quercus phellos*	FACULTATIVE WETLAND -	0.25" RCD TUBLINGS
UPLAND BUFFER PLANTING- MIXED MESIC HARDWOOD FOREST COASTAL PLAIN SUBTYPE			
~~BITTERNUT HICKORY~~	~~*Carya cordiformis*~~	~~FACULTATIVE~~	
SWEET PEPPERBUSH	*Clethra alnifolia*	FACULTATIVE WETLAND	4" CONTAINER
AMERICAN SYCAMORE	*Plantanus occidentalis*	FACULTATIVE WETLAND -	0.25" RCD TUBLINGS
CHERRYBARK OAK	*Quercus slacata var pegodaefolia*	FACULTATIVE +	0.25" RCD TUBLINGS
WHITE OAK	*Quercus alba*	FACULTATIVE UPLAND	0.25" RCD TUBLINGS
SWAMP CHESTNUT OAK	*Quercus michauxii*	FACULTATIVE WETLAND -	0.25" RCD TUBLINGS
AMERICAN BEECH	*Fagus grandifolia*	FACULTATIVE UPLAND	0.25" RCD TUBLINGS
SPECIMEN BOUNDARY TREES			
AMERICAN SYCAMORE	*Platanus occidentalis*	FACULTATIVE WETLAND -	1.5" DBH B&B
WHITE OAK	*Quercus alba*	FACULTATIVE UPLAND	1.5" DBH B&B



PT. NAME	LATITUDE	LONGITUDE
X-SEC 11+00 LT	35d 05m 48.42553s	77d 28m 03.26289s
X-SEC 11+00 RT	35d 05m 48.14250s	77d 28m 02.27370s
X-SEC 15+00 LT	35d 05m 51.30393s	77d 28m 00.07048s
X-SEC 15+00 RT	35d 05m 50.80525s	77d 27m 59.40507s
VEG. PLOT #1 ORIGIN	35d 05m 49.70404s	77d 28m 01.60066s
VEG. PLOT #1	35d 05m 49.90930s	77d 28m 01.30033s
VEG. PLOT #1	35d 05m 50.15822s	77d 28m 01.54822s
VEG. PLOT #1	35d 05m 49.94774s	77d 28m 01.85500s

PT. NAME	LATITUDE	LONGITUDE
VEG. PLOT #2 ORIGIN	35d 05m 52.92220s	77d 28m 57.74959s
VEG. PLOT #2	35d 05m 53.23564s	77d 27m 57.60521s
VEG. PLOT #2	35d 05m 53.32958s	77d 27m 57.97970s
VEG. PLOT #2	35d 05m 53.03343s	77d 27m 58.10576s
VEG. PLOT #3 ORIGIN	35d 05m 54.69609s	77d 27m 58.52392s
VEG. PLOT #3	35d 05m 54.97705s	77d 27m 58.33375s
VEG. PLOT #3	35d 05m 55.13508s	77d 27m 58.67760s
VEG. PLOT #3	35d 05m 54.83470s	77d 27m 58.86883s

SCALE 20 0 40

PROJECT REFERENCE NO.	SHEET NO.
SCO-050650601	PL-3
PROJECT ENGINEER	

PRELIMINARY PLANS

Stantec
Stantec Consulting Services Inc.
Suite 300, 801 Jones Franklin Road
Raleigh, NC 27606
Tel 919.851.6866
Fax 919.851.7024
www.stantec.com

LOCATION	AS-BUILT PLANTING PLANS FOR BROCK STREAM RESTORATION	
PROJECT NO.	SCO-050650601	COUNTY: JONES
DESIGNED BY:	CWG	DRAWN BY: CWG
CHECKED BY:	ALC	DATE: 09-04-09

Figure 3

MONITORING PLAN VIEW - SHEET 1 OF 2

Brock Site (EEP Project No. 92333)

Jones County, North Carolina

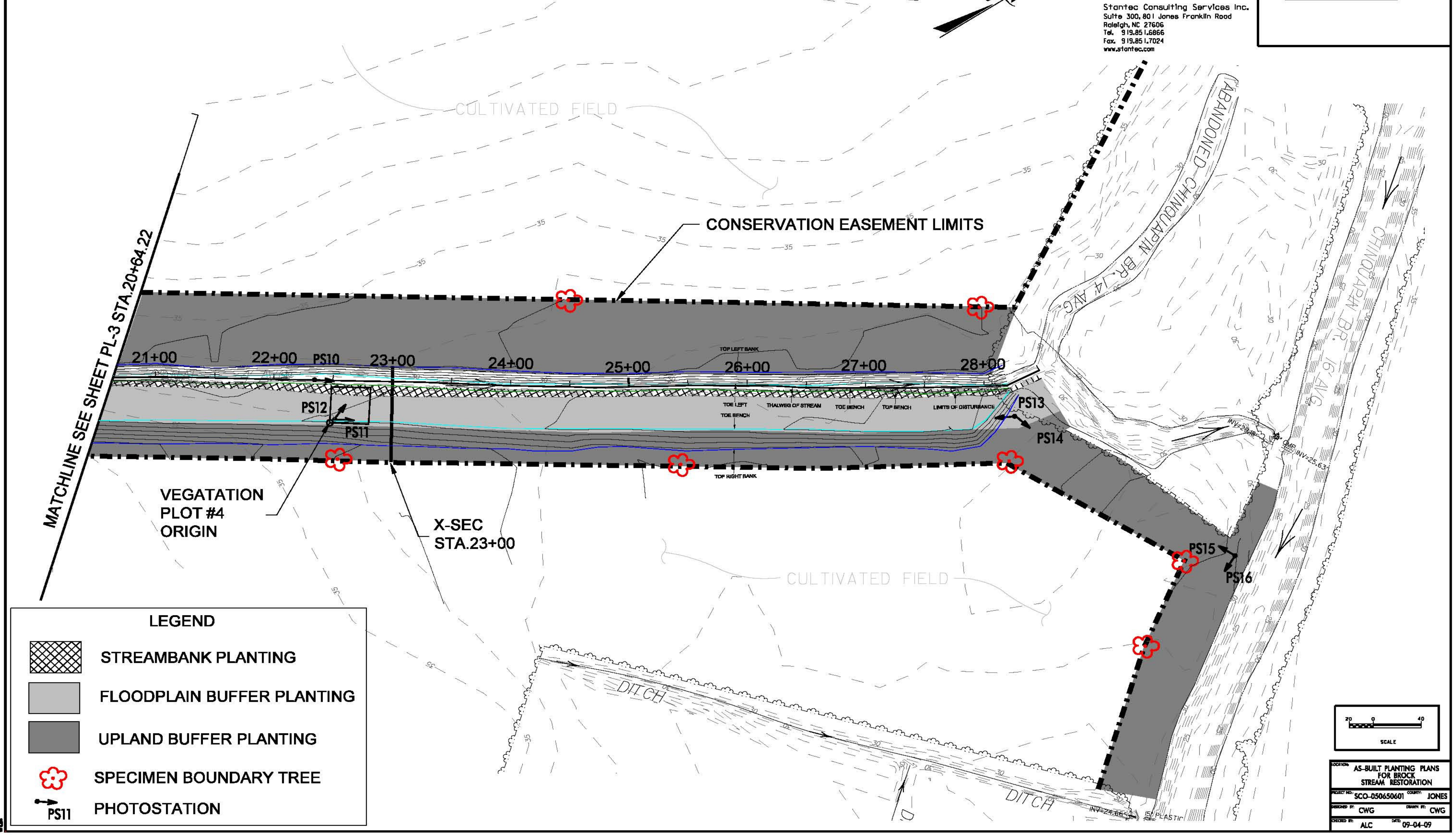
August 18, 2010

Basemap Source: EEP, 2010

Ecosystem Enhancement Program
Ecological Engineering
128 Raleigh Street
Holly Springs, North Carolina 27540
(919) 557-0529

RECORD DRAWING

PT. NAME	LATITUDE	LONGITUDE
VEG. PLOT#4 ORIGIN	35d 05m 57.84614s	77d 27m 56.29291s
VEG. PLOT#4	35d 05m 58.15282s	77d 27m 56.16520s
VEG. PLOT#4	35d 05m 58.26524s	77d 27m 56.54235s
VEG. PLOT#4	35d 05m 57.95164s	77d 27m 56.66096s
X-SEC 23+00 LT	35d 05m 58.49527s	77d 27m 56.70047s
X-SEC 23+00 RT	35d 05m 58.23462s	77d 27m 55.70590s



Stantec
Stantec Consulting Services Inc.
Suite 300, 801 Jones Franklin Road
Raleigh, NC 27606
Tel. 919.851.6866
Fax. 919.851.7024
www.stantec.com
PROJECT REFERENCE NO.
SHEET NO.
SCO-050650601
PL-4
PROJECT ENGINEER
PRELIMINARY PLANS
CULTIVATED FIELD
CONSERVATION EASEMENT LIMITS
MATCHLINE SEE SHEET PL-3 STA.20+64.22
ABANDONED CHINQUAPIN BR. 14' AVG.
CHINQUAPIN BR. 16' AVG.
21+00
22+00
PS10
23+00
24+00
25+00
26+00
27+00
28+00
PS12
PS11
PS13
PS14
PS15
PS16
VEGATATION PLOT #4 ORIGIN
X-SEC STA.23+00
CULTIVATED FIELD
DITCH
DITCH
LEGEND
STREAMBANK PLANTING
FLOODPLAIN BUFFER PLANTING
UPLAND BUFFER PLANTING
SPECIMEN BOUNDARY TREE
PS11
PHOTOSTATION
AS-BUILT PLANTING PLANS FOR BROCK STREAM RESTORATION
SCO-050650601
JONES
CWG
CWG
ALC
09-04-09

Figure 3

MONITORING PLAN VIEW - SHEET 2 OF 2

Brock Site (EEP Project No. 92333)

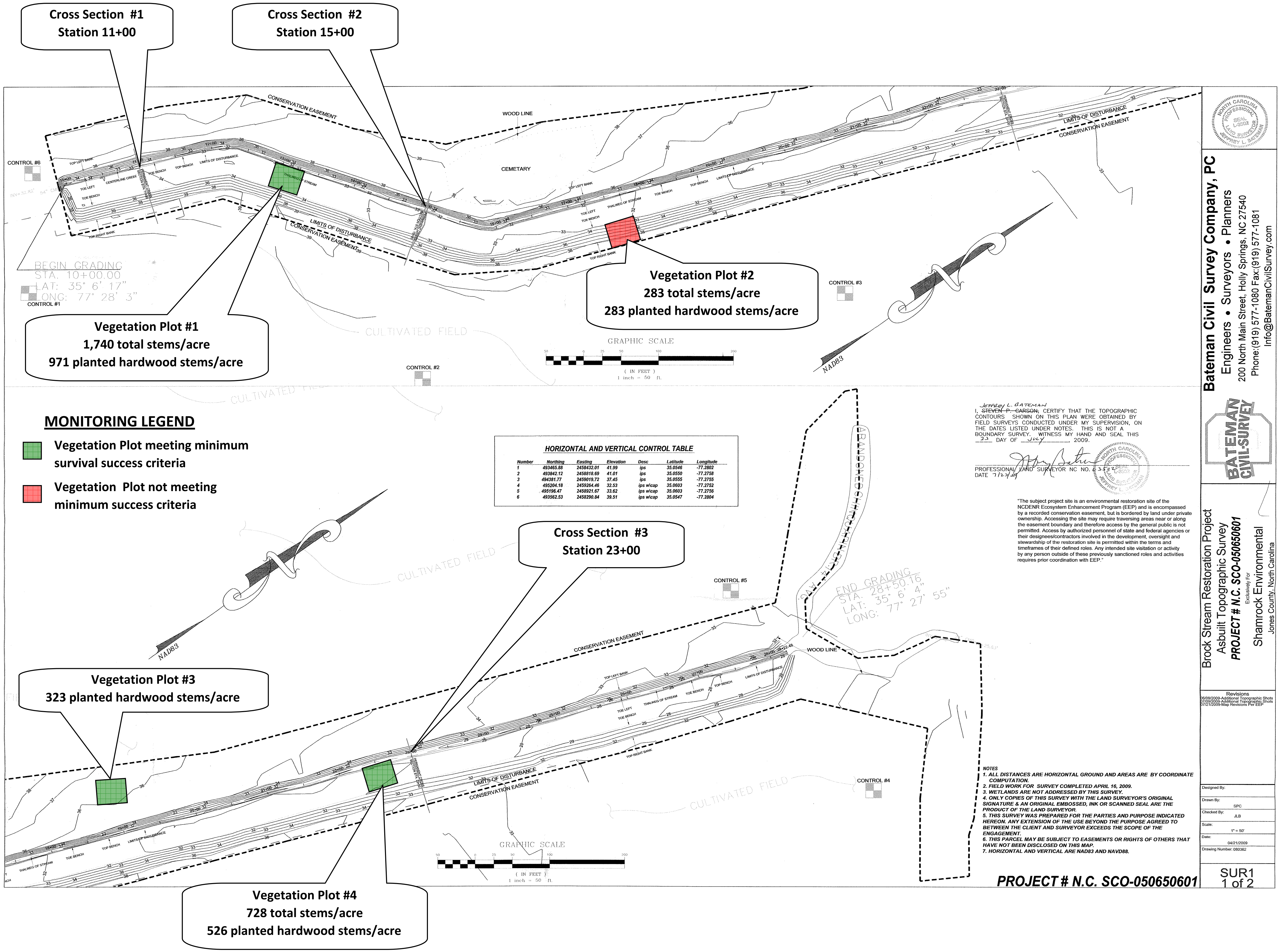
Jones County, North Carolina

August 18, 2010

Basemap Source: EEP, 2010

Ecosystem Enhancement PROGRAM

Ecological Engineering LLP



HORIZONTAL AND VERTICAL CONTROL TABLE

Number	Northing	Easting	Elevation	Desc	Latitude	Longitude
1	493465.88	2458432.01	41.99	ips	35.0546	-77.2802
2	493842.12	2458818.69	41.01	ips	35.0550	-77.2758
3	494381.77	2459019.72	37.45	ips	35.0555	-77.2755
4	495204.18	2459264.46	32.53	ips w\cap	35.0603	-77.2752
5	495196.47	2458921.67	33.62	ips w\cap	35.0603	-77.2756
6	493562.53	2458290.84	39.51	ips w\cap	35.0547	-77.2804

I, Jeffrey L. Bateman, certify that the topographic contours shown on this plan were obtained by field surveys conducted under my supervision, on the dates listed under notes. This is not a boundary survey. Witness my hand and seal this 23 day of July, 2009.

PROFESSIONAL LAND SURVEYOR NC NO. L-3502

"The subject project site is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activities requires prior coordination with EEP."

NOTES

1. ALL DISTANCES ARE HORIZONTAL GROUND AND AREAS ARE BY COORDINATE COMPUTATION.
2. FIELD WORK FOR SURVEY COMPLETED APRIL 16, 2009.
3. WETLANDS ARE NOT ADDRESSED BY THIS SURVEY.
4. ONLY COPIES OF THIS SURVEY WITH THE LAND SURVEYOR'S ORIGINAL SIGNATURE & AN ORIGINAL EMBOSSED, INK OR SCANNED SEAL ARE THE PRODUCT OF THE LAND SURVEYOR.
5. THIS SURVEY WAS PREPARED FOR THE PARTIES AND PURPOSE INDICATED HEREON. ANY EXTENSION OF THE USE BEYOND THE PURPOSE AGREED TO BETWEEN THE CLIENT AND SURVEYOR EXCEEDS THE SCOPE OF THE ENGAGEMENT.
6. THIS PARCEL MAY BE SUBJECT TO EASEMENTS OR RIGHTS OF OTHERS THAT HAVE NOT BEEN DISCLOSED ON THIS MAP.
7. HORIZONTAL AND VERTICAL ARE NAD83 AND NAVD88.

Bateman Civil Survey Company, PC
Engineers • Surveyors • Planners
200 North Main Street, Holly Springs, NC 27540
Phone:(919) 577-1080 Fax:(919) 577-1081
Info@BatemanCivilSurvey.com

Brock Stream Restoration Project
Asbuilt Topographic Survey
PROJECT # N.C. SCO-050650601
Exclusively For
Shamrock Environmental
Jones County, North Carolina

Revisions
06/09/2009-Additional Topographic Shots
07/09/2009-Additional Topographic Shots
07/21/2009-Map Revisions Per EEP

Designed By:
Drawn By: SPC
Checked By: JLB
Scale: 1" = 50'
Date: 04/21/2009
Drawing Number: 080362

SUR1
1 of 2

Figure 4

CURRENT CONDITION PLAN VIEW

Brock Site (EEP Project No. 92333)
Jones County, North Carolina
August 8, 2011
Basemap Source: EEP, 2010

Ecosystem Enhancement Program

Ecological Engineering LLP
128 Raleigh Street
Holly Springs, North Carolina 27540
(919) 557-0929

APPENDIX A

Vegetation Raw Data and Monitoring Plot Photographs

Appendix A provides a series of tables (Table 1, 2, 3, 4, 5, 6 and 9) automatically generated by the Data Entry Tool designed in conjunction with the CVS-EEP Protocol for Recording Vegetation Version 4.0 (Lee et. al., 2006). Tables 7 and 8 are based on visual observation during the monitoring assessment and comparison with minimum success criteria numbers, respectively..

Appendix A - Table 1. CVS Vegetation Metadata
Brock Site (EEP Project No. 92333)

Report Prepared By	Lane Sauls
Date Prepared	8/8/2011 14:13
database name	EcoEng-2011-B.mdb
database location	S:\Projects\50000 State\EEP 50512\50512-004 EEP Brock Site\2011 Year 3 Monitoring
computer name	LANE
file size	38313984
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	92333
project Name	Brock Stream Restoration
Description	EEP Brock Stream Restoration, Jones County, NC
River Basin	Neuse
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	0

Appendix A - Table 2. CVS Vigor by Species
Brock Site (EEP Project No. 92333)

	Species	CommonName	4	3	2	1	0	Missing	Unknown
	Fraxinus pennsylvanica	green ash	11	3					
	Quercus michauxii	swamp chestnut oak	1	3	1				
	Quercus nigra	water oak		3	1				
	Quercus pagoda	cherrybark oak	1	2	1	1	1		
	Quercus phellos	willow oak		1	8			1	
	Salix nigra	black willow		2					
	Liriodendron tulipifera	tuliptree	1	1					
	Platanus occidentalis	American sycamore	2	9				2	
TOT:	**8**	**8**	**16**	**24**	**11**	**1**	**1**	**3**	

Appendix A - Table 3. CVS Damage by Species
Brock Site (EEP Project No. 92333)

	Species	CommonName	Count of Damage Categories	(no damage)	Unknown	Vine Strangulation
	Fraxinus pennsylvanica	green ash	1	13		1
	Liriodendron tulipifera	tuliptree	0	2		
	Platanus occidentalis	American sycamore	0	13		
	Quercus michauxii	swamp chestnut oak	1	4	1	
	Quercus nigra	water oak	1	3	1	
	Quercus pagoda	cherrybark oak	3	3	3	
	Quercus phellos	willow oak	8	2	8	
	Salix nigra	black willow	0	2		
TOT:	**8**	**8**	**14**	**42**	**13**	**1**

Appendix A - Table 4. CVS Damage by Plot
Brock Site (EEP Project No. 92333)

	plot	Count of Damage Categories	(no damage)	Unknown	Vine Strangulation
	92333-ALC-0001-year:3	7	18	6	1
	92333-ALC-0002-year:3	3	7	3	
	92333-ALC-0003-year:3	2	6	2	
	92333-ALC-0004-year:3	2	11	2	
TOT:	**4**	**14**	**42**	**13**	**1**

Appendix A - Table 5. CVS Stems by Plot
Brock Site (EEP Project No. 92333)

	Comment	Species	CommonName	Total Planted Stems	#plots	avg# stems	plot 92333-ALC-0001-year:3	plot 92333-ALC-0002-year:3	plot 92333-ALC-0003-year:3	plot 92333-ALC-0004-year:3
		Fraxinus pennsylvanica	green ash	14	1	14	14			
		Liriodendron tulipifera	tuliptree	2	1	2			2	
		Platanus occidentalis	American sycamore	11	3	3.67	3	4		4
		Quercus michauxii	swamp chestnut oak	5	3	1.67	1		1	3
		Quercus nigra	water oak	4	1	4				4
		Quercus pagoda	cherrybark oak	5	1	5			5	
		Quercus phellos	willow oak	9	2	4.5	6	3		
		Salix nigra	black willow	2	1	2				2
TOT:	**0**	**8**	**8**	**52**	**8**		**24**	**7**	**8**	**13**

Appendix A - Table 6. CVS All Stems by Plot
Brock Site (EEP Project No. 92333)

	Comment	Species	CommonName	Total Stems	#plots	avg# stems	92333-ALC-0001-year:3	92333-ALC-0002-year:3	92333-ALC-0003-year:3	92333-ALC-0004-year:3
		Acer negundo	boxelder	1	1	1			1	
		Fraxinus pennsylvanica	green ash	14	1	14	14			
		Liriodendron tulipifera	tuliptree	2	1	2			2	
		Platanus occidentalis	American sycamore	11	3	3.67	3	4		4
		Quercus michauxii	swamp chestnut oak	5	3	1.67	1		1	3
		Quercus nigra	water oak	4	1	4				4
		Quercus pagoda	cherrybark oak	6	2	3		1	5	
		Quercus phellos	willow oak	9	2	4.5	6	3		
		Salix nigra	black willow	26	2	13	19			7
		Ulmus	elm	1	1	1			1	
TOT:	**0**	**10**	**10**	**79**	**10**		**43**	**8**	**10**	**18**

Appendix A - Table 7. Vegetative Problem Areas Brock Site (EEP Project No. 92333)			
Feature/Issue	**Station #/ Range**	**Probable Cause**	**Photo #**
Bare Bank	n/a	n/a	n/a
Bare Bench	n/a	n/a	n/a
Bare Floodplain	n/a	n/a	n/a
Bare Buffer	n/a	n/a	n/a
Invasive/Exotic Populations	n/a	n/a	n/a

Appendix A - Table 8. Vegetation Plot Criteria Attainment Brock Site (EEP Project No. 92333)			
Stream Criteria			
Tract	**Vegetation Plot ID**	**Vegetation Survival Threshold Met?**	**Tract Mean**
UT	VP 1	Yes	75%
UT	VP 2	No	
UT	VP 3	n/a	
UT	VP 4	Yes	
Buffer Criteria			
Tract	**Vegetation Plot ID**	**Vegetation Survival Threshold Met?**	**Tract Mean**
UT	VP 1	Yes	100%
UT	VP 2	No	
UT	VP 3	Yes	
UT	VP 4	Yes	

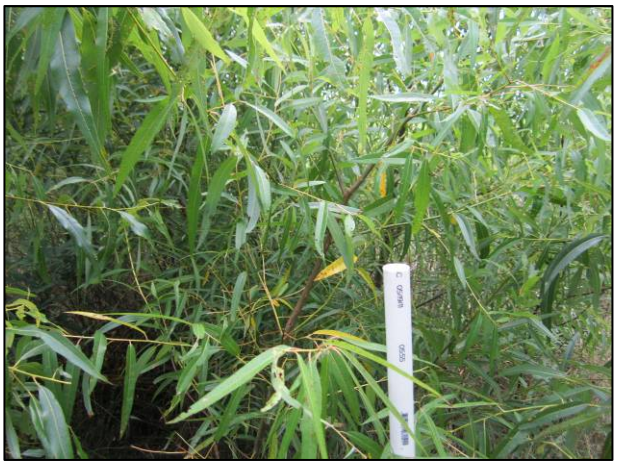
Appendix A - Table 9. CVS Plot Summary Data
Brock Site (EEP Project No. 92333)

Scientific Name	Common Name	Species Type	Current Plot Data (MY3 2011)												Annual Means											
			E92333-ALC-0001			E92333-ALC-0002			E92333-ALC-0003			E92333-ALC-0004			MY3 (2011)			MY2 (2010)			MY1 (2009)			MY0 (2009)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree									1						1			1						
Baccharis halimifolia	eastern baccharis	Shrub Tree																		1						
Clethra alnifolia	coastal sweetpepperbush	Shrub																						2	2	2
Cornus foemina	stiff dogwood	Shrub Tree																							4	4
Fraxinus pennsylvanica	**green ash**	**Tree**	14	14	14										14	14	14	14	14	14	14	14	14	14	14	14
Liriodendron tulipifera	**tuliptree**	**Tree**							2	2	2				2	2	2	2	2	2	3	3	3	3	3	3
Platanus occidentalis	**American sycamore**	**Tree**	3	3	3	4	4	4				4	4	4	11	11	11	11	11	11	9	9	9	14	14	14
Quercus	**oak**	**Shrub Tree**																			1	1	1	1	1	1
Quercus michauxii	**swamp chestnut oak**	**Tree**	1	1	1				1	1	1	3	3	3	5	5	5	6	6	6	7	7	7	7	7	7
Quercus nigra	**water oak**	**Tree**										4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Quercus pagoda	**cherrybark oak**	**Tree**							5	5	5				5	5	5	4	4	4	1	1	1	1	1	1
Quercus phellos	**willow oak**	**Tree**	5	6	6	3	3	3							8	9	9	6	7	7	6	7	7	9	10	10
Salix nigra	black willow	Tree			19							1	2	7	1	2	26	1	2	20			4			
Ulmus	**elm**	**Tree**									1						1									
Unknown		unknown																							3	3
Stem count			23	24	43	7	7	7	8	8	10	12	13	18	50	52	78	48	50	70	45	46	50	55	63	63
size (ares)			1			1			1			1			4			4			4			4		
size (ACRES)			0.02			0.02			0.02			0.02			0.10			0.10			0.10			0.10		
Species count			4	4	5	2	2	2	3	3	5	4	4	4	8	8	10	8	8	10	8	8	9	9	11	11
Stems per ACRE			930.78	971.25	1740.1	283.28	283.28	283.28	323.75	323.75	404.69	485.62	526.09	728.43	505.86	526.09	789.14	485.62	505.86	708.2	455.27	465.39	505.86	556.44	637.38	637.38

Note: Trees in bold are considered Planted Hardwood Species with regards to Riparian Buffer Restoration Criteria.

Monitoring Plot Photographs

Vegetation Plot #1



Photostation 2.
Facing northeast across Vegetation Plot #1.
Taken July 2011

Photostation 3.
Facing north across Vegetation Plot #1.
Taken July 2011

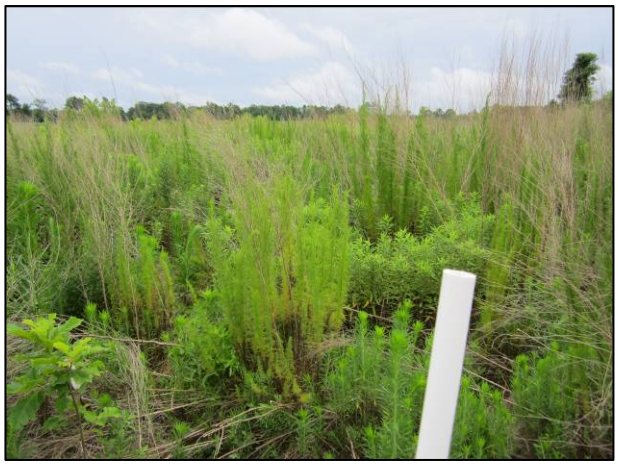
Vegetation Plot #2

Photostation 5.
Facing north across Vegetation Plot #2.
Taken July 2011

Photostation 6.
Facing northwest across Vegetation Plot #2.
Taken July 2011

Vegetation Plot #3

Photostation 8.
Facing southwest across Vegetation Plot #3.
Taken July 2011



Photostation 9.
Facing southeast across Vegetation Plot #3.
Taken July 2011

Vegetation Plot #4

Photostation 11.
Facing northeast across Vegetation Plot #4.
Taken July 2011

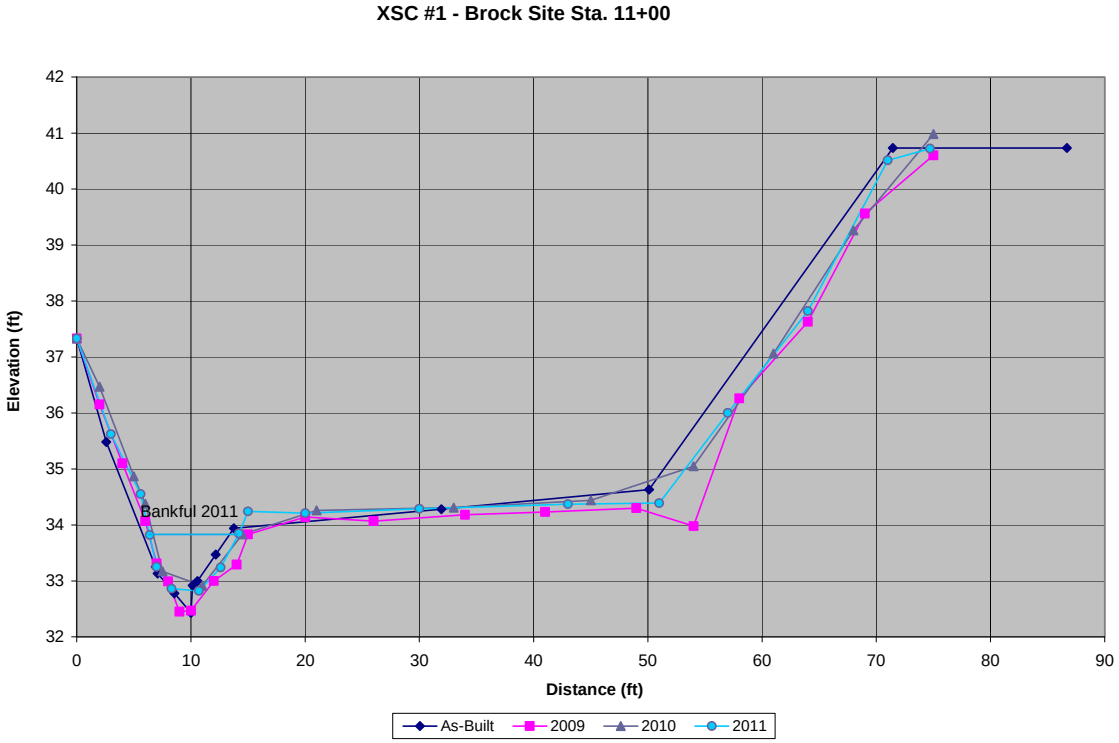
Photostation 12.
Facing north across Vegetation Plot #4.
Taken July 2011

APPENDIX B

Geomorphic Raw Data

This appendix is consistent with the USACE and NCDWQ draft mitigation guidance document (USACE, 2005) related to stream restoration in outer Coastal Plain of North Carolina. Traditional natural channel design monitoring protocols with pattern and profile has been determined to be inappropriate for coastal headwater streams, such as the unnamed tributary at the Brock Site. Therefore, the geomorphic raw data included within this appendix is restricted only to cross section comparisons.

Cross Section #1 Comparison
Station 11+00



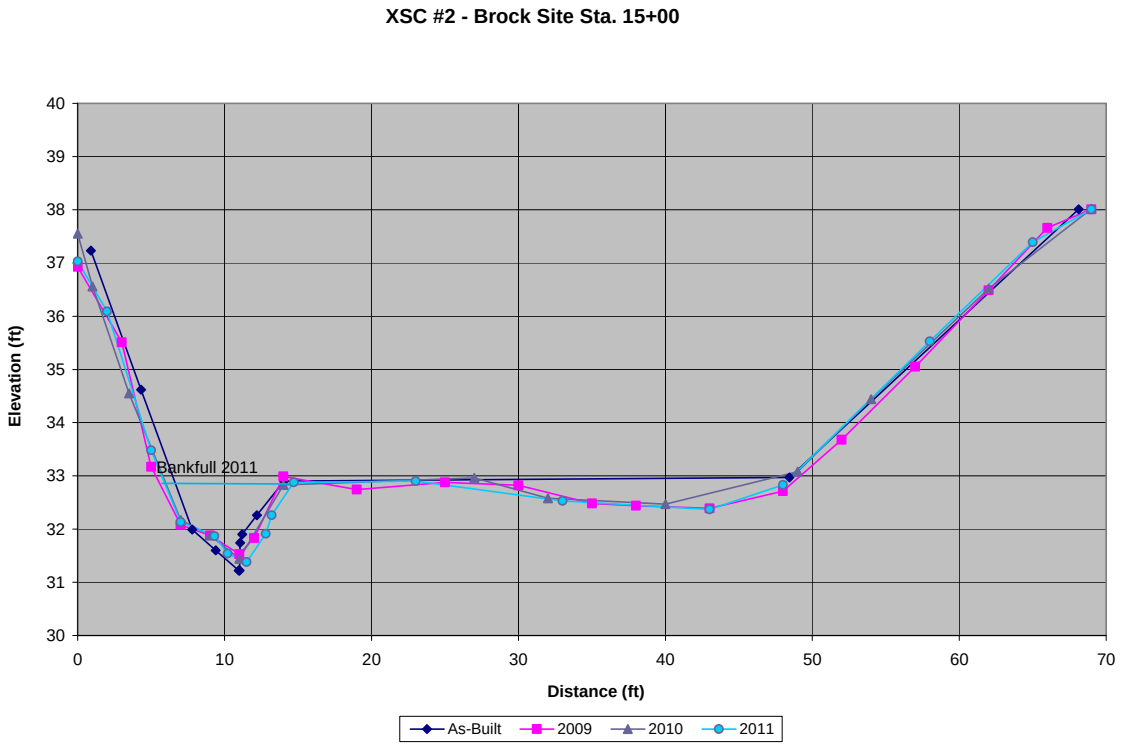
Note: The as-built survey data was based on compilation of topographic contours and not an actual cross section survey. As a result, variability exists between the actual cross section survey (conducted as part of monitoring efforts) and as-built data.

Year 3 (2011) Cross Section Photographs

Facing north along the west side of Cross Section #1.
Taken July 2011

Facing west across Cross Section #1.
Taken July 2011

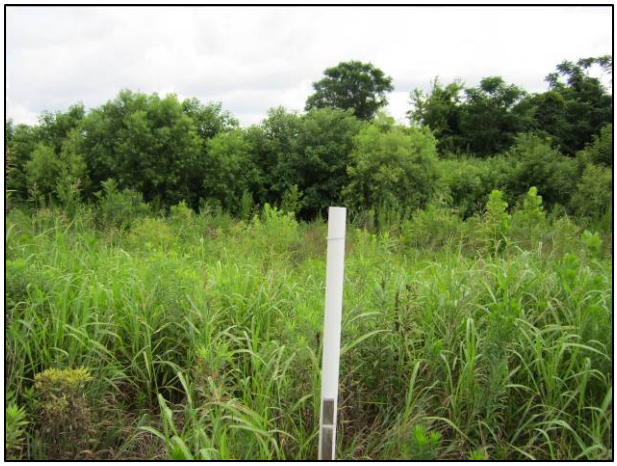
Cross Section #2 Comparison
Station 15+00



Note: The as-built survey data was based on compilation of topographic contours and not an actual cross section survey. As a result, variability exists between the actual cross section survey (conducted as part of monitoring efforts) and as-built data.

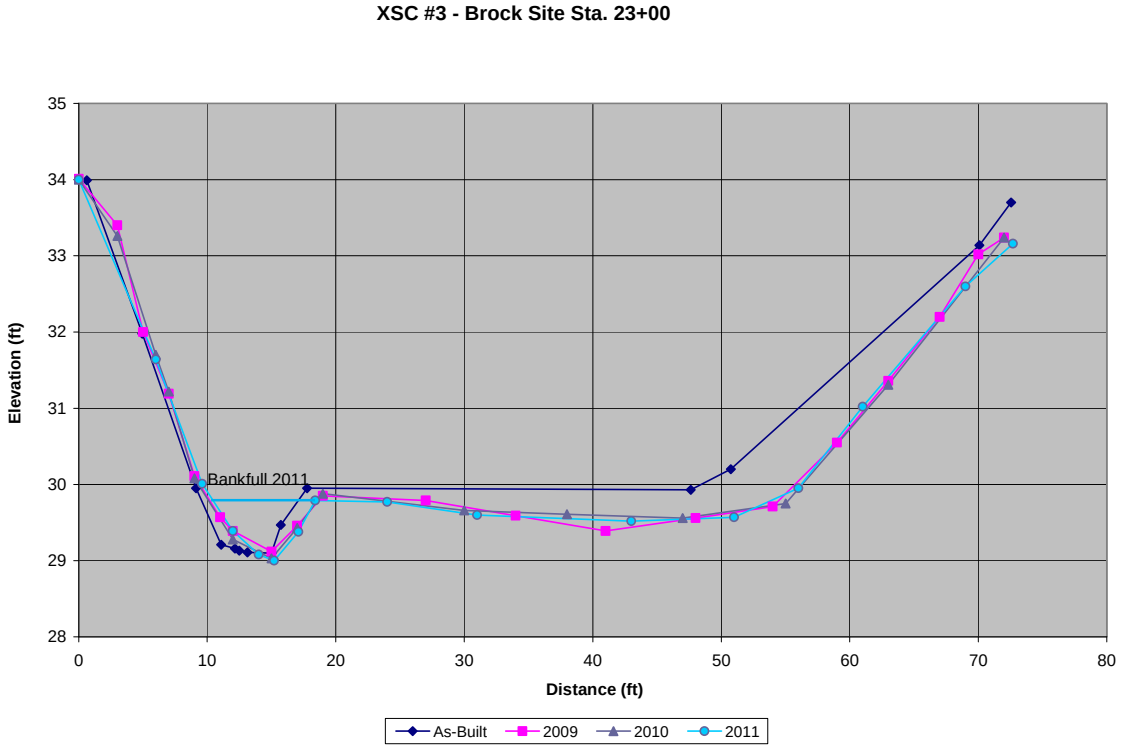
Year 3 (2011) Cross Section Photographs

Facing northeast along the west side of Cross Section #2. Taken July 2011



Facing northwest along the west side of Cross Section #2. Taken July 2010

Cross Section #3 Comparison
Station 23+00



Note: The as-built survey data was based on compilation of topographic contours and not an actual cross section survey. As a result, variability exists between the actual cross section survey (conducted as part of monitoring efforts) and as-built data.

Year 3 (2011) Cross Section Photographs

Facing northeast along the west side of Cross Section #3. Taken July 2011.

Facing northwest along the west side of Cross Section #3. Taken July 2011.

Cross Section Data Summary

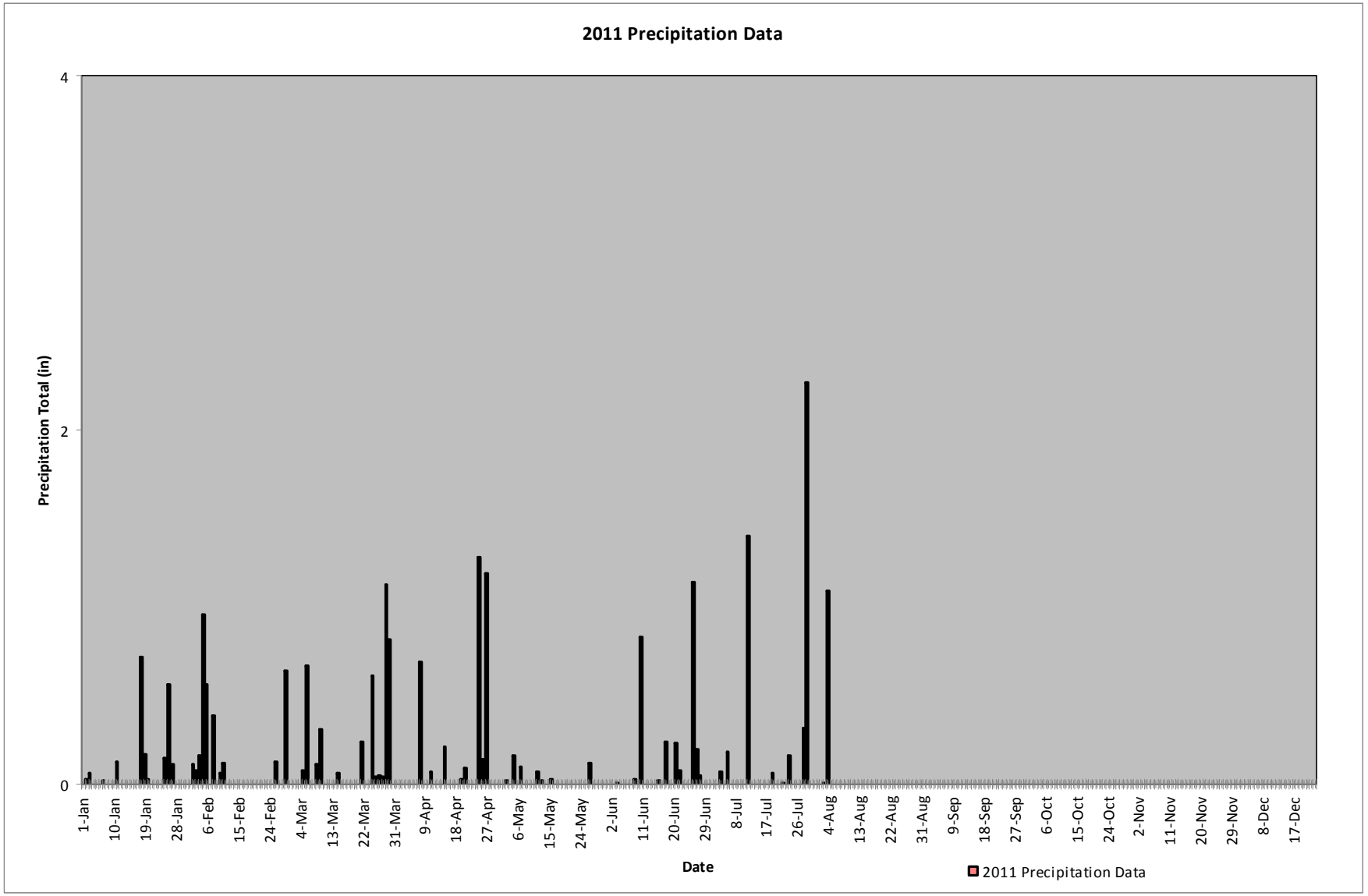
BROCK SITE CROSS SECTION NO. 1 STATION 11+00																	
As-built			Year 1			Year 2			Year 3			Year 4			Year 5		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	37.33		0	37.33		0	37.33		0	37.33							
2.58	35.48		2	36.15		2	36.47		3	35.62							
6.9	33.25		4	35.1		5	34.87		5.6	34.55							
7.09	33.13		6	34.07		6	34.38		6.4	33.82							
8.55	32.78		7	33.31		7.5	33.17		7	33.25							
10	32.43		8	32.99		11	32.91		8.3	32.86							
10.14	32.92		9	32.45		14.5	33.83		10.7	32.82							
10.57	33		10	32.47		21	34.26		12.6	33.24							
12.16	33.47		12	33		33	34.31		14.2	33.85							
13.75	33.94		14	33.29		45	34.44		15	34.24							
31.93	34.28		15	33.83		54	35.05		20	34.21							
50.11	34.63		20	34.14		61	37.06		30	34.29							
71.44	40.73		26	34.07		68	39.26		43	34.37							
86.69	40.73		34	34.18		75	40.98		51	34.39							
			41	34.23					57	36							
			49	34.3					64	37.82							
			54	33.98					71	40.51							
			58	36.26					74.7	40.72							
			64	37.63													
			69	39.56													
			75	40.6													
HI			HI	45.73		HI	45.24		HI	45.29		HI			HI		

BROCK SITE CROSS SECTION NO. 2 STATION NO. 15+00																	
As-built			Year 1			Year 2			Year 3			Year 4			Year 5		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.9	37.23		0	36.93		0	37.55		0	37.03							
4.31	34.62		3	35.51		1	36.56		2	36.09							
7.79	31.99		5	33.17		3.5	34.55		5	33.48							
9.39	31.6		7	32.08		7	32.17		7	32.13							
10.96	31.22		9	31.88		9	31.88		9.3	31.87							
11	31.22		11	31.53		11	31.44		10.2	31.54							
11.01	31.22		12	31.83		14	32.83		11.5	31.38							
11.06	31.74		14	32.99		27	32.96		12.8	31.91							
11.19	31.9		19	32.74		32	32.58		13.2	32.26							
12.2	32.26		25	32.88		40	32.47		14.7	32.88							
14.04	32.9		30	32.82		49	33.08		23	32.9							
48.44	32.97		35	32.48		54	34.44		33	32.53							
68.13	38.01		38	32.44		62	36.52		43	32.37							
			43	32.39		69	38.02		48	32.83							
			48	32.71					58	35.53							
			52	33.68					65	37.39							
			57	35.05					69	38.01							
			62	36.49													
			66	37.66													
			69	38.01													
HI			HI	43.12		HI	42.37		HI	43.13		HI			HI		

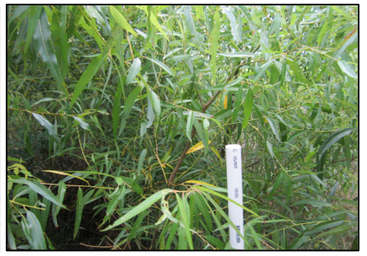
BROCK SITE CROSS SECTION NO. 3 STATION NO. 23+00																	
As-built			Year 1			Year 2			Year 3			Year 4			Year 5		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.63	33.99		0	34.01		0	34		0	34							
4.94	31.98		3	33.4		3	33.26		6	31.64							
9.13	29.95		5	32		6	31.7		9.6	30.01							
11.08	29.21		7	31.19		7	31.22		12	29.39							
12.15	29.16		9	30.11		9	30.08		14	29.08							
12.49	29.13		11	29.57		12	29.28		15.2	29							
13.13	29.11		12	29.39		15	29.03		17.1	29.38							
15	29.1		15	29.12		17	29.43		18.4	29.79							
15.72	29.47		17	29.46		19	29.88		24	29.77							
17.77	29.95		19	29.85		30	29.66		31	29.6							
47.62	29.93		27	29.79		38	29.61		43	29.52							
50.74	30.2		34	29.59		47	29.56		51	29.57							
70.09	33.14		41	29.39		55	29.75		56	29.95							
72.56	33.7		48	29.56		63	31.31		61	31.02							
			54	29.71		72	33.24		69	32.6							
			59	30.55					72.7	33.16							
			63	31.36													
			67	32.2													
			70	33.02													
			72	33.24													
HI			HI	38.37		HI	37.88		HI	38.2		HI			HI		

APPENDIX C

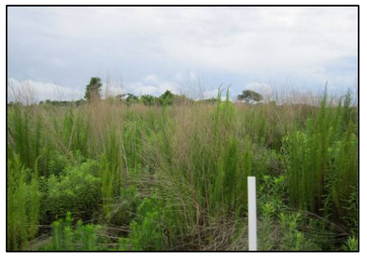
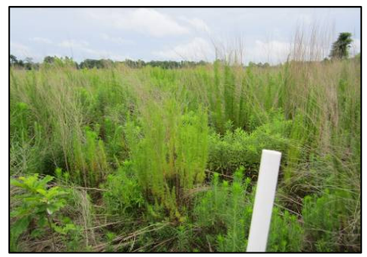
Rainfall Data Summary


2011 Precipitation Data
Precipitation Total (in)
4
2
0
1-Jan
10-Jan
19-Jan
28-Jan
6-Feb
15-Feb
24-Feb
4-Mar
13-Mar
22-Mar
31-Mar
9-Apr
18-Apr
27-Apr
6-May
15-May
24-May
2-Jun
11-Jun
20-Jun
29-Jun
8-Jul
17-Jul
26-Jul
4-Aug
13-Aug
22-Aug
31-Aug
9-Sep
18-Sep
27-Sep
6-Oct
15-Oct
24-Oct
2-Nov
11-Nov
20-Nov
29-Nov
8-Dec
17-Dec
Date
2011 Precipitation Data

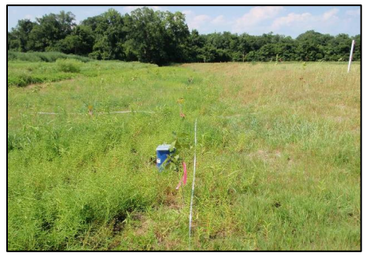
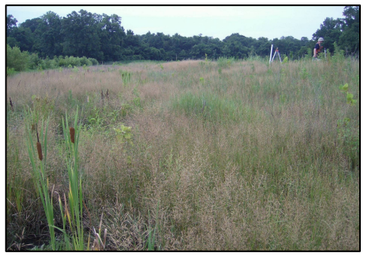
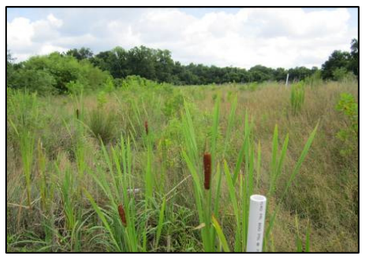
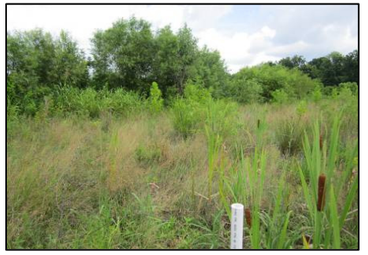
APPENDIX D: MONITORING PHOTOGRAPH SUMMARY

Photostation Number and Location	Year 0 Baseline - Taken July 2009	Year 1 - Taken November 2009	Year 2 - Taken July 2010	Year 3 - Taken July 2011
#1 Facing north from beginning of project at Station 10+00				
#2 Facing northeast along the eastern side of Vegetation Plot #1				
#3 Facing north acros Vegetation Plot #1				
#4 Facing downstream at Cross Section #1				
#5 Facing northeast along the east side of Vegetation Plot #2				

APPENDIX D: MONITORING PHOTOGRAPH SUMMARY CONTINUED

Photostation Number and Location	Year 0 Baseline - Taken July 2009	Year 1 - Taken November 2009	Year 2 - Taken July 2010	Year 3 - Taken July 2011
#6 Facing northwest across Vegetation Plot #2				
#7 Facing north-northeast at Crest Gage situated near Station 18+65				
#8 Facing southwest along western axis of Vegetation Plot #3				
#9 Facing southeast across Vegetation Plot #3				
#10 Facing northeast along tributary in the vicinity of Station 22+50				

APPENDIX D: MONITORING PHOTOGRAPH SUMMARY CONTINUED

Photostation Number and Location	Year 0 Baseline - Taken July 2009	Year 1 - Taken November 2009	Year 2 - Taken July 2010	Year 3 - Taken July 2011
#11 Facing northeast along the eastern axis of Vegetation Plot #4				
#12 Facing northwest across Vegetation Plot #4				
#13 Facing southwest (upstream) along the tributary from Station 28+25				
#14 Facing northeast along buffer area associated with tributary from Station 28+25				

APPENDIX D: MONITORING PHOTOGRAPH SUMMARY CONTINUED

Photostation Number and Location	Year 0 Baseline - Taken July 2009	Year 1 - Taken November 2009	Year 2 - Taken July 2010	Year 3 - Taken July 2011
#15 Facing southwest from Chinquapin Branch				
#16 Facing southeast at buffer area along Chinquapin Branch