FINAL

Baseline Monitoring Document and As-Built Baseline Report
UT to Cane Creek Restoration Project

Alamance County, North Carolina

EEP Project ID No. 95729

Cape Fear River Basin: 03030002-050050

Prepared for:

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

Data Collection Period – July 2014

Submission Date – August 2014

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) restored 3,314 linear feet (LF) of perennial and intermittent stream and enhanced 2,911 LF of channel. Baker also planted approximately 14.0 acres (AC) of native riparian vegetation within the recorded conservation easement areas along the restored and enhanced reaches (Reach R1, R3, R4, R5 and R5a). The UT to Cane Creek Restoration Project (Site) is located in Alamance County, approximately three miles south of the Town of Saxapahaw (Figure 1). The Site is located in the NC Division of Water Resources (NCDWR) subbasin 03-06-04 and the NC Ecosystem Enhancement Program (NCEEP) Targeted Local Watershed (TLW) 03030002-050050 of the Cape Fear River Basin. The project involved the restoration and enhancement of a Rural Piedmont Stream (NC WAM 2010, Schafale and Weakley 1990) which had been impaired due to past agricultural conversion and cattle grazing.

Based on the NCEEP 2009 Cape Fear River Basin Restoration Priority (RBRP) Plan, the UT to Cane Creek Restoration Project area is located in an existing targeted local watershed (TLW) within the Cape Fear River Basin, although it is not located in a Local Watershed Planning (LWP) area. The restoration strategy for the Cape Fear River Basin targets specific projects which focus 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 were to improve ecologic functions and to manage NPS inputs to the impaired areas as described in the NCEEP 2009 Cape Fear RBRP and as identified below:

- Create geomorphically stable conditions along the unnamed tributaries across the Site,
- Implement agricultural BMPs to reduce NPS inputs to receiving waters,
- Protect and improve water quality by reducing stream bank erosion, and nutrient and sediment inputs,
- Restore stream and floodplain interaction by connecting historic flow paths and promoting natural flood processes, and
- Restore and protect riparian buffer functions and corridor habitat in perpetuity by establishing a permanent conservation easement.

To accomplish these goals, the following objectives were identified:

- Restore existing incised, eroding, and channelized streams by providing them access to their relic floodplains,
- 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 providing more bedform diversity, creating natural scour pools and reducing sediment from accelerated stream bank erosion,
- Plant native species riparian buffer vegetation along stream bank and floodplain areas, protected by a permanent conservation easement, to increase stormwater runoff filtering capacity, improve stream bank stability and riparian habitat connectivity, and shade the stream to decrease water temperature,
- Improve aquatic and terrestrial habitat through improved substrate and in-stream cover, addition of woody debris, and reduction of water temperature, and
- Control invasive species vegetation within the project area and, if necessary, continue treatments during the monitoring period.

This report documents the completion of the restoration construction activities and presents as-built monitoring data for the post-construction monitoring period. Table 1 summarizes project conditions before and after restoration, as well as the conditions predicted in the previously approved project Mitigation Plan. Table 1 is located in Appendix A.

2.0 PROJECT GOALS, BACKGROUND AND ATTRIBUTES

2.1 Project Location and Description

The Site is located in Alamance County, NC, approximately three miles south of the Town of Saxapahaw, as shown on the Vicinity Map (Figure 1). The project is located in the NC Division of Water Resources (NCDWR) sub-basin 03-06-04 of the Cape Fear River Basin and hydrologic unit 03030002-050050. The project includes four unnamed headwater tributaries (UTs) to Cane Creek and is located in the Piedmont physiographic region. The four UTs were divided into individual Reaches (R1, R3, R4, R5 and R5a) as shown in Figure 2.

Project Reaches R1 and R3 are dashed blue-line streams on the USGS topographic quadrangle map and project Reaches R4 and R5 are both shown as solid blue-line streams along their entire length within the project limits. Reaches R1, R3, R4, and R5a are shown as intermittent (unclassified) streams within the project limits on the 1960 Alamance County Soil Survey. The presence of historic valleys for each of the project stream systems is clearly evident on LIDAR imagery, which was confirmed during field investigations and on-site jurisdictional determination with the USACE and NCDWR. The preliminary jurisdictional determination was approved on October 13, 2013.

Based on the NCEEP 2009 Cape Fear River Basin Restoration Priority (RBRP) Plan, the UT to Cane Creek Restoration Project area is located in an existing targeted local watershed (TLW) within the Cape Fear River Basin, although it is not located in a Local Watershed Planning (LWP) area. The restoration strategy for the Cape Fear River Basin targets specific projects which focus on developing creative strategies for improving water quality flowing to the Haw River in order to reduce NPS pollution to Jordan Lake.

2.2 Site Directions

To access the Site from Raleigh, take US-1 south and head west on US-64 towards Pittsboro, for approximately 25 miles. Take the exit ramp to NC 87 north towards Burlington and continue for 13 miles before turning left onto East Greensboro Chapel Hill Road. Once on East Greensboro Chapel Hill Road, travel west for approximately 1.2 miles before turning left onto Stockard Road. Then proceed 1.0 mile while heading south towards the end of the paved road. The Site is located where the farm access road continues towards a farm pond crossing near an unnamed tributary to Cane Creek.

2.3 Project Goals and Objectives

The primary goals of the project are to improve ecologic functions and to manage NPS inputs to the impaired areas as described in the NCEEP 2009 Cape Fear RBRP and are identified below:

- Create geomorphically stable conditions along the unnamed tributaries across the Site,
- Implement agricultural BMPs to reduce NPS inputs to receiving waters,
- Protect and improve water quality by reducing stream bank erosion, and nutrient and sediment inputs,
- Restore stream and floodplain interaction by connecting historic flow paths and promoting natural flood processes, and
- Restore and protect riparian buffer functions and corridor habitat in perpetuity by establishing a permanent conservation easement.

To accomplish these goals, the following objectives were identified:

- Restore existing incised, eroding, and channelized streams by providing them access to their relic floodplains,
- 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 providing more bedform diversity, creating natural scour pools and reducing sediment from accelerated stream bank erosion,
- Plant native species riparian buffer vegetation along stream bank and floodplain areas, protected by a permanent conservation easement, to increase stormwater runoff filtering capacity, improve stream bank stability and riparian habitat connectivity, and shade the stream to decrease water temperature,
- Improve aquatic and terrestrial habitat through improved substrate and in-stream cover, addition of woody debris, and reduction of water temperature, and
- Control invasive species vegetation within the project area and, if necessary, continue treatments during the monitoring period.

3.0 PROJECT STRUCTURE, RESTORATION TYPE AND APPROACH

3.1 Project Components

The project area consists of the restoration and enhancement of four unnamed headwater tributaries (UTs) to Cane Creek and is located in the Piedmont physiographic region. For assessment and design purposes, the four UTs were divided into individual Reaches (R1, R3, R4, R5 and R5a). Native species riparian buffer vegetation was established and/or protected at least 50 feet from the top of both bank along all project reaches. Lastly, cattle were excluded along all project reaches (except Reach R1) through permanent fencing outside of the conservation easement. The reach designations have remained in the same order to be consistent throughout the document.

3.2 Restoration Approach

Based on the post-construction as-built survey, the project consisted of 1,045 LF of restoration on Reach R1, 398 LF of restoration on Reach R3, 2,333 LF of Enhancement II on Reach R4 (upstream), 410 LF of restoration on Reach R4 (downstream), 1,461 LF of restoration on Reach R5 (upstream), 433 LF of Enhancement I on Reach R5 (downstream) and 145 LF of Enhancement II on Reach R5a. A recorded conservation easement consisting of 19.9 acres protects and preserves all stream reaches, existing wetland areas, and riparian buffers in perpetuity.

The project involved the restoration and enhancement of a Rural Piedmont Stream System (NC WAM 2010, Schafale and Weakley 1990) which had been impaired due to past agricultural conversion and cattle grazing. Restoration practices involved raising the existing streambed and reconnecting the stream to the relic floodplain, and restoring natural flows to areas previously drained by ditching activities. The existing channels abandoned within the restoration areas were partially to completely filled to decrease surface and subsurface drainage and raise the local water table. Permanent cattle exclusion fencing was provided around all proposed reaches and riparian buffers, with the exception of Reach R1, where cattle lack access.

The vegetative components of this project include stream bank, floodplain, and transitional upland planting and described as the riparian buffer zone. The Site was planted with native species riparian buffer vegetation as shown in Table 7 and Table 8 (Appendix C) and now protected through a permanent conservation easement. Table 1 and Figure 2 (Appendix A) provide a summary of the project components.

3.2.1 Reach R1 Restoration

Due to the degraded nature of Reach R1, and the ability to fully restore stream functions and floodplain connection, a Priority Level I restoration approach was implemented. The lowest part of the stream valley runs along the field edge to the north of the existing stream channel. Starting at the outlet of the upstream pond dam, the restored channel was raised to provide reconnection to the relic floodplain. This approach was feasible because the pond outlet is significantly higher than the existing bed of the stream channel. In-stream structures included constructed riffles for grade control and aquatic habitat (bed material for the existing stream is sand/gravel), log vanes, and log step-pools for stream bed/bank stability, and habitat diversity.

At the downstream end of the reach, the restored channel transitions down to the water surface elevation of Cane Creek; therefore, rock and log step-pools and constructed riffle structures were installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Along this downstream transition section, channel banks were graded to stable slopes, and bankfull benches were graded to further promote stability and re-establishment of riparian vegetation to the confluence.

The existing, unstable channel was partially to completely filled along its length using a combination of existing spoil piles that were located along the reach and fill material excavated from construction of the restored channel. Vernal pools were incorporated along the filled abandoned channel to provide habitat diversity and improved detention of runoff.

Riparian buffers in excess of 50 feet were restored or protected along all of Reach R1. No stream crossing or breaks in the easement were installed along this reach. Since cattle do not have access to the reach, permanent fencing will not be required.

3.2.2 Reach R3 Restoration

Work along Reach R3 involved a combination of Priority Level I and II restoration approaches to provide floodplain reconnection and promote long-term channel stability. In its existing condition, the reach was incised and eroding. Much of the adjacent timber had recently been harvested; therefore, restoration activities were conducted with minimal impact to existing trees. Due to the short length of the reach before its confluence with Reach R4, it was practical to use a Priority Level I approach that raised the stream back to its historic floodplain. Therefore, restoration activities involved a combination of raising the streambed along the upstream portion of the reach, and narrow benching further downstream along a portion of the right floodplain to increase the floodprone area width. These techniques allowed restoration of a stable channel form with appropriate bedform diversity, as well as improved channel function through improved aquatic habitat, more frequent overbank flooding, improved riparian and terrestrial habitats, exclusion of cattle and associated pollutants, and decreased erosion and sediment loss from stream bank erosion.

Riparian buffers in excess of 50 feet were restored along all of Reach R3. No stream crossings or breaks in the easement were installed along Reach R3.

3.2.3 Reach R4 Enhancement and Restoration

Work on Reach R4 primarily involved enhancement approaches on the majority of the upstream portion of the reach, and restoration approaches on a short section of the downstream end near its confluence with Cane Creek. The primary source of impairment for Reach R4 is direct cattle access to the stream; therefore, Enhancement Level II approaches were incorporated along the upper portion of Reach R4 to permanently exclude cattle from the system. Due to the presence of bedrock along much of this reach, the stream showed little indication of channel incision, downcutting, or past channelization. Minor channel bank stabilization work and structure installation occurred throughout upper portions of the reach where the riparian buffer had been the most impacted and cattle access had been most detrimental to channel dimension and stream bank erosion. Portions of the riparian buffer along Reach R4 were recently thinned and cleared as a result of timber harvest, increasing the importance of restoring appropriate riparian species and removing invasive species vegetation.

Along the downstream 410 LF of Reach R4, the channel condition was very poor due to channel incision and heavy use by cattle. This reach section was restored through the use of j-hooks/constructed riffle structures to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Log vanes were added for additional bank protection and channel banks were graded to stable slopes. Bioengineering measures (vegetated geolifts) and bankfull benches were incorporated to further promote stability and re-establishment of riparian vegetation to the confluence.

Riparian buffers in excess of 50 feet were restored along all of Reach R4. Two existing stream crossings on Reach R4 were improved and the crossings were fenced to exclude cattle from entering the restored streams.

To accommodate NRCS watering system requirements for cattle management, one additional ford crossing was installed on Reach R4 upstream during construction. This crossing is located at station

33+00 and allows cattle to move from pastures on opposite sides of the conservation easement, thus reducing the distances traveled to other areas of the farm. The channel length at the ford crossing is 20 LF and the length reduction has been accounted for in the stream credit calculations as shown in Table 1.

3.2.4 Reach R5 Enhancement and Restoration

Work on Reach R5 involved full restoration of the upstream portion of the reach down to the culverted stream crossing, and enhancement approaches on a short section of the downstream end below the existing crossing. The primary source of impairment for Reach R5 was its incised and unstable condition, although direct cattle access to the stream was also a major contributor to its degraded condition. From the northern property line and moving downstream, Reach R5 was deeply incised, with vertical eroding stream banks and limited to no floodplain access. Due to the rapid drop in grade after the reach enters the project property, a Priority Level I restoration approach was feasible for the upper portion of Reach R5. This approach involved constructing the restored channel off-line and along the lowest part of the valley (to the left side of the existing channel). The benefits of this approach were that floodplain connection was restored, as well as limited impact to desirable native species trees along the existing channel, and the ability to provide full restoration of stream functions and a more appropriate channel pattern for the valley type. Many of the existing trees along Reach R5 were Tree-of-heaven (*Ailanthus altissima*), an invasive exotic species; therefore, removal of these particular trees was completed to encourage establishment of native species.

A Rosgen Bc stream type was designed for the restoration reach, similar to the approach described for Reach R3. At the downstream end of the reach, above the culverted stream crossing, floodplain benches were graded to transition the restored reach back to the existing bed elevation at the crossing. Along the downstream 433 LF of Reach R5 below the stream crossing, channel incision decreased and the primary source of impairment was direct cattle access. Because the stream mostly connected to its floodplain along this reach, Enhancement Level I approaches were implemented for this section of Reach R5. These approaches included permanent exclusion of cattle, minor grading of the stream banks, and limited use of structures to promote channel stability, bedform diversity, stabilize an active headcut, and establish an appropriate riparian buffer.

Riparian buffers in excess of 50 feet were restored along all of Reach R5. The existing culverted stream crossing near the downstream end of Reach R5 was replaced and improved as part of the proposed project. A new, culverted crossing was installed to provide access across the stream. The crossing was designed to pass a 10-year return period event, with excess capacity on the floodplain to pass larger events without damaging the crossing. The new crossing was fenced to exclude cattle from entering the restored stream.

3.2.5 Reach R5a Enhancement

Reach R5a begins at the northeastern end of the Site at the property line and flows southwestward approximately 145 LF to the confluence with Reach R5. Reach R5a was only slightly degraded, and had incised down to bedrock in some locations, causing minor lateral instability. A few of the existing riffles along the degraded Reach R5a were observed to have exposed bedrock and coarse gravel accumulations imbedded with fine sediment. Most of Reach R5a was exhibiting moderate incision, with typical BHRs of 1.3 or more. Two constructed riffles were installed to provide vertical stability and prevent any potential headcutting.

The right buffer along this section of Reach R5a can be described as wooded with frequent breaks in continuity of canopy of trees insufficient to form a definable, single line of native trees along the top of the stream banks. The uppermost end of Reach R5a, near the property line exhibits a small area with a more "natural" buffer, though actively accessed by cattle. Invasive vegetation species such as Tree-of-heaven (*Ailanthus altissima*) and Multiflora rose were removed along the left bank and the

slopes were stabilized and planted with native species buffer vegetation. A majority of Reach R5a was actively subject to water quality stressors in the form of buffer with direct livestock herd access. The reach was fenced to exclude cattle from entering the restored stream.

3.3 Project History, Contacts, and Attribute Data

Baker implemented the project under a full delivery contract with NCEEP to provide stream mitigation credits in the Cape Fear River Basin. The chronology of the project is presented in Table 2. The contact information for all designers, contractors, and relevant suppliers is presented in Table 3. Relevant project background information is presented in Table 4. Tables 2, 3, and 4 are located in Appendix A of this report. As-built stationing is outlined in the Construction Summary, below, and in Table 1 in Appendix A.

3.3.1 Construction Summary

In accordance with the approved Mitigation Plan and regulatory permits (i.e., 401/404, S&EC), construction activities began in early March 2014 with site preparation, installation of sedimentation and erosion control measures, and the establishment of staging areas, haul roads, and stockpile areas. The construction contractor was River Works, Inc. (River Works). Materials were stockpiled as needed for the initial stages of construction. Suitable channel fill material and alluvium was harvested on-site from existing spoil piles and within the existing streambed. Survey grade stakes were set along the thalweg and limits of disturbance to direct the grading activities. Actual in-stream structure location and placement varied slightly from the design plans in various sections due to exposed bedrock as well as to promote bedform diversity and increase vertical stability.

Construction began on the upstream portion of Reaches R5 and R5a at station 10+00 and proceeded downstream along Reach R5 towards the culverted stream crossing. The work involved the construction of a defined single thread channel that was built mostly offline using a pump around operation. The existing degraded channel was filled in and graded back to match the surrounding natural topographic contours. The entire length of Reach R5 was designed as a combination step-pool system with some natural channel meanders. The new channel was reconnected with its floodplain using a Priority Level I approach and graded as to let higher flow energies dissipate across the existing land surface. Upon completion of new channel segments, in-stream structures, coir fiber matting, and vegetation plantings, including permanent seeding, were installed before moving to the next section. Downstream of the culverted stream crossing, from station 25+00 to station 29+18, enhancement activities included invasive species vegetation removal, stabilizing stream banks, and installing in-stream structures. All disturbed areas were seeded with temporary and permanent seed and covered with straw before mobilizing to the next project area. The as-built length of Reach R5 after construction is 1,925 LF.

After completing the upstream Reach R5, work along Reach R3 began on the upstream portion (station 10+00) near the wooded area and proceeded downstream. The contractor used care as to not disturb mature hardwood trees within this section. Most of this reach was built within the existing channel corridor and followed the confined valley contours. In-stream structures such as constructed riffles and grade control j-hooks were installed to provide channel stability. A floodplain bench was excavated along the right stream bank to increase the floodprone area width. The as-built length of Reach R3 after construction is 398 LF.

Construction activities continued downstream along the mainstem, Reach R4 (station 29+18). Construction procedures and activities were consistent with the upstream reaches (Reach R5 and R3) and for the remainder of the project, however the contractor did not disturb vegetation within the Enhancement areas unless it was necessary to remove existing invasive species vegetation or trees that were damaged or stressed due to significant bank erosion. Enhancement activities included

heavy invasive species removal, as well as localized in-stream structure installation and vegetation planting.

Similar to Reach R3, a majority of the stream work along Reach R4 (upstream and downstream section) was conducted within the existing stream channel corridor due to the existing topography and channel conditions. Construction activities included heavy invasive species removal (Chinese Privet) and regrading/matting/planting channel banks from station 29+18 to station 33+50. Further downstream, an existing ford stream crossing was improved near station 33+00 for landowner access and site monitoring purposes. Bioengineering measures (vegetated geolifts) and in-stream structures were added to stabilize stream banks and large woody debris was removed from the channel between Sta. 38+00 and Sta. 44+50.

Restoration work continued along Reach R4, station 52+70 with the installation of a pump-around operation and permanent ford stream crossing. A floodplain bench was excavated along the right bank until station 57+00 and in-stream structures were installed per the approved design plans to provide grade control and bank protection. Additionally, a constructed riffle was added near station 53+50 and 54+50 to provide grade control. Upon completion of the Reach R4 channel segments, coir fiber matting was installed along the banks and all disturbed areas were covered with temporary and permanent seed and straw.

Lastly, Reach R1 was constructed offline from the existing dam to the confluence with Cane Creek. As the restored channel transitions down to the water surface elevation of Cane Creek, rock and log step-pools and constructed riffle structures were installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Along this reach section, channel banks were graded to stable slopes, and the floodplain was reconnected to further promote stability and re-establishment of native riparian vegetation. The existing, unstable channel was partially to completely filled along its length using a combination of existing spoil piles that were located along the reach and fill material excavated from construction of the restored channel. Vernal pools were incorporated along the filled abandoned channel to provide habitat diversity and improved detention of runoff. The as-built length of Reach R1 after construction is 1,045 LF.

Minimal site modifications involved the location and selection of some in-stream structures and bank stabilization practices. Substitutions and/or relocations were made based on existing field conditions and best professional judgment. All riparian buffer areas within the project boundaries are a minimum of 50 feet along both stream banks and are protected in perpetuity by a recorded conservation easement that totals 19.9 acres. Permanent cattle exclusion fencing (woven wire) was installed outside the conservation easement boundary along all reaches, except Reach R1, with access gates near each stream crossing as shown on the As-built Plan Sheets in Appendix C. In addition, Baker is coordinating with the landowner to install permanent watering systems for the cattle outside of the project boundary.

As-built plan sheets/record drawings depict actual surveyed areas within the project area and depict any changes from the final design plans to what was implemented on-site during construction. The as-built plan sheets/record drawings are located in Appendix C. The as-built results for the project totaled 6,225 LF of stream and are outlined in Table 1.

Upon completion of stream work within the Site, sedimentation and erosion control measures such as temporary stream crossings, rock check dams, and silt fence were removed and all disturbed areas were stabilized with temporary and permanent seed and mulch before de-mobilizing from the Site. In addition, the planting of bare-root trees and shrubs began in April (Reach R5) and completed in June 2014 (Reach R1). Baker and River Works met on-site June 20, 2014 and conducted a preliminary final walk through inspection, and generated a punch-list of final items to be completed. River Works completed this punch list and demobilized in early July 2014 after the final walk inspection walk through on June 24, 2014.

4.0 PERFORMANCE STANDARDS

Baker has obtained regulatory approval for numerous stream mitigation plans involving NCDOT and NCEEP full-delivery projects. The success criteria for the 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 NCEEP'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 NCEEP 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 in Section 5.0 and report documentation will follow the NCEEP Baseline Monitoring Document template and guidance (v 2.0, dated 10/14/10).

5.0 MONITORING PLAN AND SUCCESS CRITERIA

5.1 Stream Monitoring

Geomorphic monitoring of the proposed restoration reaches will be conducted once a year for a minimum of seven years following the completion of construction to evaluate the effectiveness of the restoration practices. Monitored stream 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 in sections 5.1.6 and 5.2. The methods used and related success criteria are described below for each parameter.

5.1.1 Bankfull Events and Flooding Functions

The occurrence of bankfull events within the monitoring period will be documented by the use of a crest gauge and photographs. The crest gauge will be installed on the floodplain within ten feet (horizontal) of the restored channel. The crest gauge will record the highest watermark between site visits, and the gauge 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 a 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 during the seven-year post construction monitoring period.

5.1.2 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 eight (8) cross-sections located at riffles, and four (4) located at pools. Each cross-section will be marked on both stream banks with permanent monuments using rebar cemented in place to establish the exact transect used. A common benchmark will be used for cross-sections and consistently used to facilitate easy comparison of year-to-year data. The cross-section surveys will occur in Years 1, 2, 3, 5, and 7, 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 stream banks, 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 stream banks, or decrease in width/depth ratio). Using the Rosgen Stream Classification System, and 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 steams, 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 stream banks. Photographs will be taken of both stream banks at each cross-section. The survey tape will be centered in the photographs of the stream banks. The water line will be located in the lower edge of the frame, and as much of the

stream bank as possible will be included in each photo. Photographers should make an effort to consistently maintain the same area in each photo over time.

5.1.3 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.

5.1.4 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.

5.1.5 Bed Material Analysis

After construction, there should be minimal change in the pebble count 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 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 stream bank vegetation becomes established and a minimum of two bankfull flows or greater have been documented.

5.1.6 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 stream bank 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 NCEEP'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, stream bank erosion, successful maturation of riparian vegetation, and effectiveness of sedimentation and erosion control measures.

5.2 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 were installed and will be monitored across the Site in accordance with the CVS-NCEEP Protocol for Recording Vegetation, Version 4.1 (2007). The vegetation monitoring plots are a minimum of 2 percent of the planted portion of the Site

with a minimum of nine plots established randomly within the planted riparian buffer areas per Monitoring Levels 1 and 2. The size of individual quadrants are 100 square meters for woody tree species.

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.

Construction of the Site was completed in June 2014 including all buffer vegetation planting. The approved contract with NCEEP requires that all vegetation must be planted at least six months (180 days) before Baseline (Year 0) monitoring activities are conducted at the end of the first full growing season. Since the final vegetation planting was completed in June 2014, the NCEEP requested that the species composition, stem density, and survivability be assessed once more in early 2015, before accepting the data for the Year 1 Monitoring Report. Due to the installation timing and condition of the bare-root stems, supplemental vegetation monitoring will be completed upon leaf-out in the early spring of 2015 to further document a successful first year for the vegetation plots on the Site. The data collected in early 2015 will be included as part of the Year 1 Monitoring Report for the Site.

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 3 of the monitoring period. At Year 5, 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, which must average 10 feet in height (DBH). However, if the performance standard is 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 Interagency review Team (IRT).

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 any required remedial action on a case-by-case basis, such as replanting more wet/drought tolerant species, beaver management/dam removal, or removing undesirable/invasive species vegetation, and continue to monitor vegetation performance until the corrective actions demonstrate that the Site is trending towards or meeting the standard requirement.

Additionally, herbaceous vegetation, primarily native grasses and forbs, was seeded/planted throughout the Site. During and immediately following construction activities, all ground cover at the project Site was in compliance with the NC Erosion and Sedimentation Control requirements.

5.3 Wetland Monitoring

No wetlands were proposed for the Site, therefore, no such monitoring is required.

5.4 Stormwater Management Monitoring

No stormwater BMPs were proposed for the Site. therefore, no such monitoring is required.

6.0 AS-BUILT DATA DOCUMENTATION

Stream and vegetation components will be monitored for seven years post-construction to evaluate project success, unless the Site demonstrates complete success by Year 5 and no areas of concern have been identified. The specific locations of vegetation plots, flow/crest gauges, and cross-sections are shown on the as-built plan sheets.

6.1 Stream Data

For monitoring stream success criteria, twelve permanent cross-sections were installed along all restored and enhanced reaches on the Site. The permanent cross-sections will be used to monitor channel dimension and bank stability over time. Two crest gauges were installed along the restored channels on Reach R3 and Reach R5. The crest gauges will be used to document the occurrence of bankfull events. In addition, a longitudinal survey was completed for the restored stream channels (Reach R1, Reach R3, Reach R4 and Reach R5) to provide a baseline for evaluating changes in bed conditions over time. The as-built permanent cross-sections (with photos) and as-built longitudinal data as well as the quantitative pre-construction, reference reach, design data used to determine restoration approach as well as as-built data including one Reach 5 substrate sample are provided in Appendix B. As-built data will be used for comparison to post-construction monitoring data. The locations of the permanent cross-sections and the crest gauges are shown on the as-built plan sheets in Appendix D. Photographs of the selected portions of the restored reaches are provided in Appendix E.

6.2 Vegetation Data

Bare-root trees and shrubs were planted within restoration and enhancement areas of the conservation easement. A minimum 50-foot buffer was established and/or protected along both banks of all stream reaches. Planting of bare-root trees and shrubs and live stakes began in April 2014 and was completed on June 18, 2014.

The Mitigation Plan for the Site specifies that the number of quadrants required shall be based on the CVS-NCEEP monitoring guidance (2007). The total number of quadrants was calculated using the CVS-NCEEP Entry Tool Database version 2.2.7 (CVS-NCEEP, 2007). The sizes of individual quadrants are 100 square meters. A total of six (6) vegetation plots were installed throughout the project Site. The initial planted density within each of the vegetation monitoring plots is provided in Table 8. The average density of planted bare root stems, based on the data from the six vegetation monitoring plots, is 693 stems per acre. The locations of the vegetation plots are shown on the as-built plan sheets in Appendix D.

6.3 Areas of Concern

Per observations made during the final punch-list walk through and a NCEEP site visit on September 18, 2014, woody species vegetation planted along Reach R1 (left floodplain buffer) appear to have low survivability. Planted stems within some of these buffer areas are experiencing problems due to heavy competition with a thick herbaceous layer, planting just outside of the dormant season, and/or unfavorable soil conditions. Section 7.3 describes a specific corrective action plan that will be implemented for these areas of concern.

7.0 MAINTENANCE AND CONTINGENCY PLANS

Maintenance requirements vary from site to site and are generally driven by the following conditions:

- Projects without established, woody floodplain vegetation are more susceptible to erosion from floods than those with a mature, hardwood forest.
- Projects with sandy, non-cohesive soils are more prone to bank erosion than cohesive soils or soils with high gravel and cobble content.
- Alluvial valley channels with access to their floodplain are less vulnerable to erosion than channels that have been disconnected from their floodplain.
- Wet weather during construction can make accurate channel and floodplain excavations difficult.
- Extreme and/or frequent flooding can cause floodplain and channel erosion.
- Extreme hot, cold, wet, or dry weather during and after construction can limit vegetation growth, particularly temporary and permanent seed.
- The presence and aggressiveness of invasive vegetation species can affect the extent to which a native species vegetation buffer can be established.
- The presence of beaver can affect vegetation survivability and stream function.

The Site will be monitored on a regular basis and as well as a physical inspection of the Site 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. Maintenance issues and recommended remediation measures will be detailed and documented in the post-construction monitoring reports. Factors that may have caused any maintenance needs, including any of the conditions listed above, shall be discussed. Routine maintenance will be most likely in the first two years following site construction and may include the following components as described below.

7.1 Streams

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.

7.2 Wetland

No wetland mitigation was proposed for the Site; therefore, no such maintenance is required.

7.3 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.

Due to the low stem count observed in Reach R1 and other localized buffer areas, a corrective action plan will be initiated to address areas of concern as described in Section 6.3. Supplemental replanting

will take place in the upcoming 2014 dormant season and include buffer areas along Reaches R1, R3, R4, and R5. Approximately 2,000 woody stems (bare-roots) will be planted at a target density of 436 stems per acre, in a 10-foot by 10-foot grid pattern. In addition, supplemental live stakes will be planted along Reach R1 steam banks as necessary.

The vegetation plantings will be documented in the Year 1 Monitoring Report and areas of concern will be observed closely during subsequent monitoring periods to determine if further corrective action is required to meet the interim vegetative success criteria of 260 stems per acre at the end of five years.

7.4 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.

7.5 Farm 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.

7.6 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.

8.0 REFERENCES

Carolina Vegetation Survey (CVS) and NC Ecosystem Enhancement Program (NCEEP). 2007. CVS-NCEEP Data Entry Tool v. 2.2.7. University of North Carolina, Raleigh, NC.

Lee, M., Peet R., Roberts, S., Wentworth, T. CVS-NCEEP Protocol for Recording Vegetation, Version 4.1, 2007.

North Carolina Ecosystem Enhancement Program.. 2011. Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation. November 7, 2011.

Rosgen, D. L. 1994. A classification of natural rivers. Catena 22:169-199.

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Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. North Carolina Natural Heritage Program. Division of Parks and Recreation, NCDENR. Raleigh, NC.

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___. 2003. Stream Mitigation Guidelines, April 2003, U.S. Army Corps of Engineers. Wilmington District.

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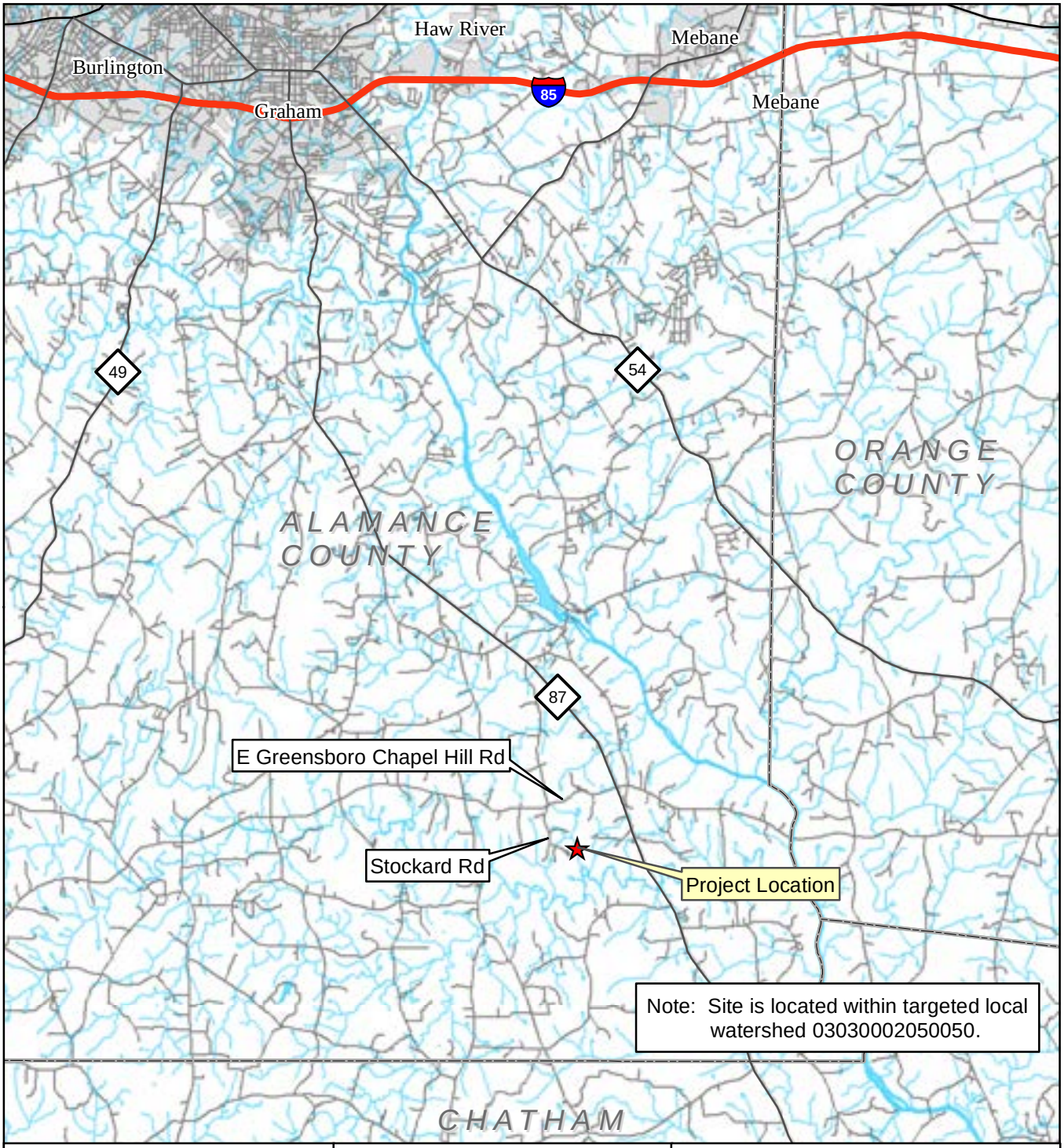
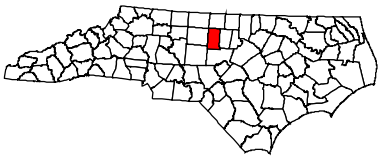
APPENDIX A

Figures 1 - 3, Tables 1 - 4





Alamance County

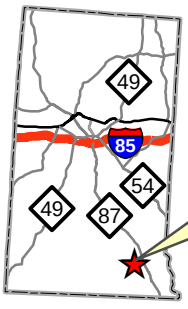


Figure 1
Project Vicinity Map
UT to Cane Creek Site

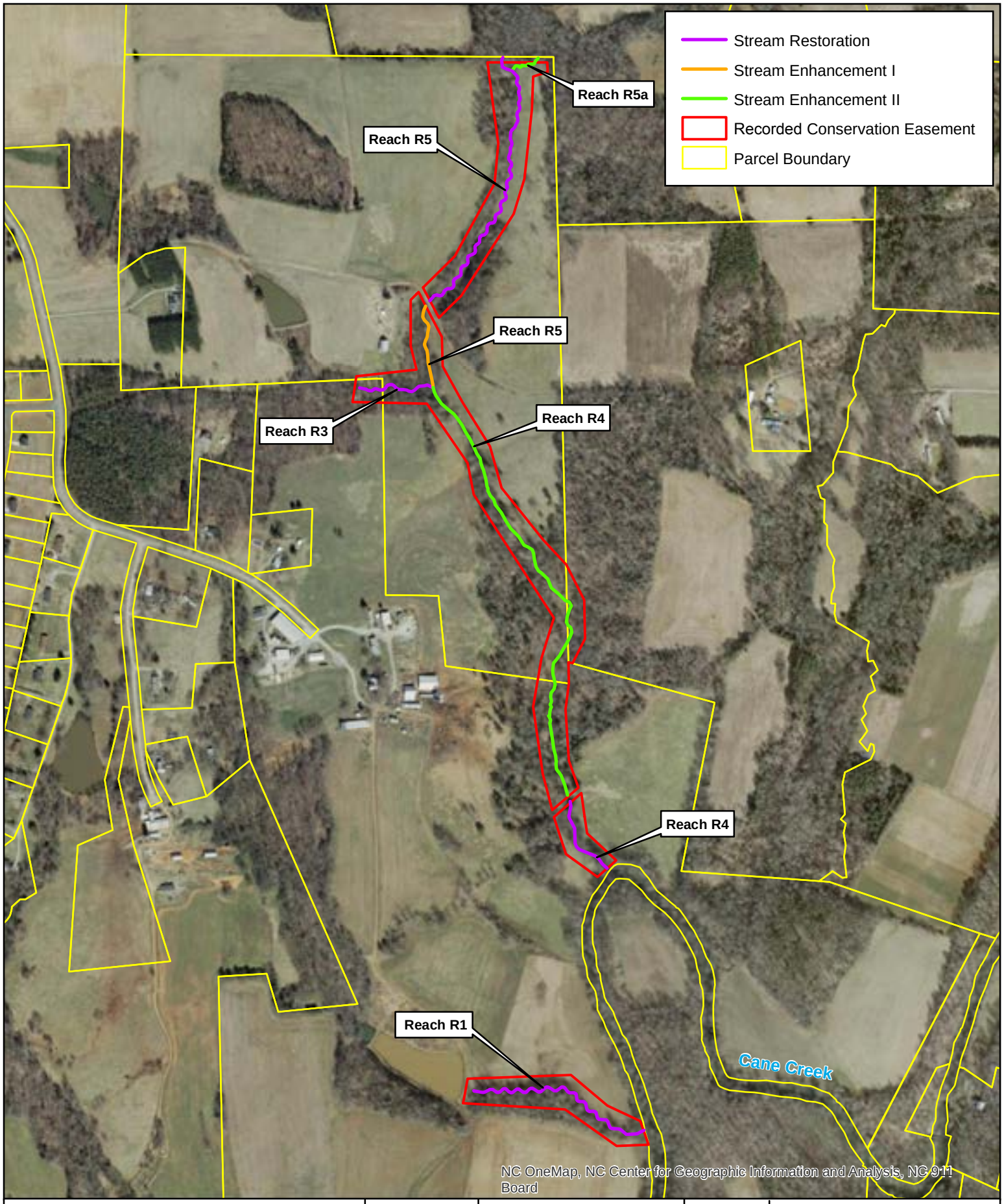
Ecosystem Enhancement

N

Baker

Michael Baker Engineering, Inc.

0 0.5 1 2 3
Miles



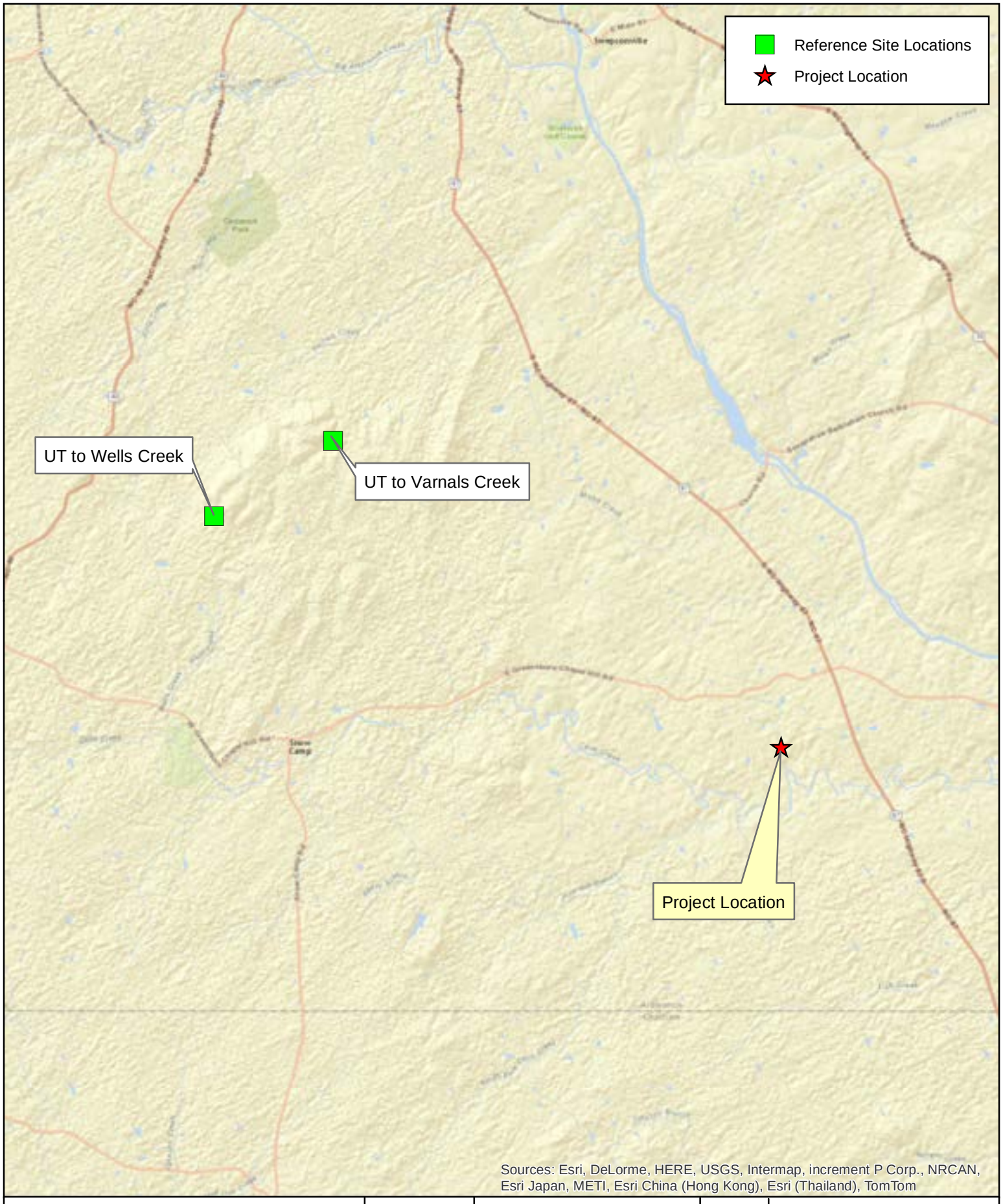
Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490

Ecosystem Enhancement Program

0 350 700 Feet

N

Figure 2
Mitigation Work Plan
UT to Cane Creek Site



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Ecosystem Enhancement

0 1 2 Miles

N

EEP Project #95729

Figure 3
Reference Reach Location Map
UT to Cane Creek Site

Table 1. Project Components and Mitigation Credits

UT to Cane Creek Restoration Project: EEP Project No ID. 95729

Mitigation Credits								
	Stream	**Riparian Wetland**		**Non-riparian Wetland**		**Buffer**	**Nitrogen Nutrient Offset**	**Phosphorus Nutrient Offset**
Type	R, E1, EII	R	E					
Totals	4,594 SMU	0	0					

Project Components						
Project Component or Reach ID	**Stationing/ Location**	**Existing Footage/ Acreage (LF)**	**Approach**	**Restoration/ Restoration Equivalent (SMU)**	**Restoration Footage or Acreage (LF)**	**Mitigation Ratio**
Reach 1	10+00 – 20+45	944	Restoration	1,045	1,045	1:1
Reach 3	10+00 – 13+98	425	Restoration	398	398	1:1
Reach 4 (Upstream section)	29+32 – 52+86	2,346	Enhancement Level II	933	2,333	2.5:1
Reach 4 (Downstream section)	53+20 – 57+30	411	Restoration	410	410	1:1
Reach 5 (Upstream section)	10+03 – 24+64	1,386	Restoration	1,461	1,461	1:1
Reach 5 (Downstream section)	25+00 – 29+32	426	Enhancement Level I	289	433	1.5:1
Reach 5a	10+02 – 11+47	144	Enhancement Level II	58	145	2.5:1

Component Summation						
Restoration Level	**Stream (LF)**	**Riparian Wetland (AC)**		**Non-riparian Wetland (AC)**	**Buffer (SF)**	**Upland (AC)**
		Riverine	Non-Riverine			
Restoration	3,314					
Enhancement I	433					
Enhancement II	2,478					
Creation	0					
Preservation	0					
High Quality Preservation	0					

BMP Elements			
Element	Location	Purpose/Function	Notes

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

Table 2. Project Activity and Reporting History			
UT to Cane Creek Restoration Project: EEP Project No ID. 95729			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan Prepared	N/A	N/A	Aug-13
Mitigation Plan Amended	N/A	N/A	Oct-13
Mitigation Plan Approved	May-13	N/A	Dec-13
Final Design – (at least 90% complete)	N/A	N/A	Feb-14
Construction Begins	Nov-13	N/A	Mar-14
Temporary S&E mix applied to entire project area	Feb-14	N/A	Jun-14
Permanent seed mix applied to entire project area	Feb-14	N/A	Jun-14
Planting of live stakes	Feb-14	N/A	Jun-14
Planting of bare root trees	Feb-14	N/A	Jun-14
End of Construction	Feb-14	N/A	Jun-14
Survey of As-built conditions (Year 0 Monitoring-baseline)	Apr-14	Jul-14	Aug-14
Baseline Monitoring Report	Apr-14	Jul-14	Aug-14
Year 1 Monitoring	Dec-14	N/A	N/A
Year 2 Monitoring	Dec-15	N/A	N/A
Year 3 Monitoring	Dec-16	N/A	N/A
Year 4 Monitoring	Dec-17	N/A	N/A
Year 5 Monitoring	Dec-18	N/A	N/A
Year 6 Monitoring	Dec-19	N/A	N/A
Year 7 Monitoring	Dec-20	N/A	N/A

Table 3. Project Contacts UT to Cane Creek Restoration Project: EEP Project ID No. 95729	
Designer	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 600 Cary, NC 27518 Contact: Kayne Van Stell, Tel. 919-481-5730
Construction Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Planting Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Seeding Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Seed Mix Sources	Green Resources, Tel. 336-855-6363
Nursery Stock Suppliers	Mellow Marsh Farm, 919-742-1200 ArborGen, 843-528-3204
Monitoring Performers	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 600 Cary, NC 27518 Contact:
Stream Monitoring Point of Contact	Dwayne Huneycutt, Tel. 919-481-5745
Vegetation Monitoring Point of Contact	Dwayne Huneycutt, Tel. 919-481-5745

Table 4. Project Attributes
UT to Cane Creek Restoration Project: EEP Project ID No. 95729

Project Information					
Project Name	UT to Cane Creek Restoration Project				
County	Alamance				
Project Area (acres)	19.9				
Project Coordinates (latitude and longitude)	35.8934 N, -79.3187 W				
Project Watershed Summary Information					
Physiographic Province	Piedmont				
River Basin	Cape Fear				
USGS Hydrologic Unit 8-digit and 14-digit	03030002 / 03030002050050				
NCDWR Sub-basin	3-06-04				
Project Drainage Area (acres)	452 (Reach R4 main stem at downstream confluence w/ Cane Creek)				
Project Drainage Area Percent Impervious	<1%				
CGIA / NCEEP Land Use Classification	2.01.01.01, 2.03.01, 2.99.01, 3.02 / Forest (49%) Agriculture (46%) Impervious Cover (1%)				
Reach Summary Information					
Parameters	**Reach R1**	**Reach R3**	**Reach R4**	**Reach R5**	**Reach R5a**
Length of Reach (linear feet)	1,052	400	2,731	1,925	145
Valley Classification (Rosgen)	VII	VII	VII	VII	VII
Drainage Area (acres)	80	91	452	290	14
NCDWR Stream Identification Score	30.5	36	42.5	38.5	33.5
NCDWR Water Quality Classification	WS V; NSW				
Morphological Description (Rosgen stream type)	Incised E	G	Bc (upstream)/ F (downstream)	G	B
Evolutionary Trend	Incised E→Gc→F	Bc→G→Fb	Bc→G→Fb	Bc→G→Fb	B→G
Underlying Mapped Soils	We, GaE, Cg, DbB	We	We, GbD3, Mc, Cg, TaD	We	We
Drainage Class	Poorly drained	Poorly drained	Poorly	Poorly drained	Poorly
Soil Hydric Status	Hydric	Hydric	Hydric	Hydric	Hydric
Average Channel Slope (ft/ft)	0.0127	0.0168	0.0169	0.0126	0.0223
FEMA Classification	N/A	Zone AE	Zone AE	N/A	N/A
Native Vegetation Community	Piedmont Small Stream				
Percent Composition of Exotic/Invasive Vegetation	<5%	<5%	<5%	<5%	<5%

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	Yes	Yes	Categorical Exclusion (Appendix B)
Essential Fisheries Habitat	No	N/A	Categorical Exclusion (Appendix B)

APPENDIX B

Morphological Summary Data

(Tables 5 and 6)

Table 5. Baseline Stream Summary
UT to Cane Creek Restoration Project: EEP Project ID No. 95729

Reach 1 (1,045 LF)

Parameter	USGS Gauge	Regional Curve Interval (Harman et al, 1999)*			Pre-Existing Condition[1]						Reference Reach(es) Data												Design						As-built					
											UT to Wells Creek						UT to Varnals Creek																	
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																																		
BF Width (ft)	-----	23.0	80.0	4.9	5.6	-----	-----	7.3	-----	-----	-----	8	-----	-----	-----	-----	-----	9.7	-----	-----	-----	-----	-----	6.9	-----	-----	-----	-----	7.2	-----	-----	9.1	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	6.8	-----	-----	>30	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	>20	-----	-----	-----	-----	65.6	-----	-----	84.4	-----	-----
BF Mean Depth (ft)	-----	2.3	5.8	0.8	0.7	-----	-----	0.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.5	-----	-----	-----	-----	0.5	-----	-----	1.0	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	1.1	-----	-----	1.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.7	-----	-----	-----	-----	0.7	-----	-----	1.9	-----	-----
BF Cross-sectional Area (ft²)	-----	80.0	300.0	5.2	5.1	-----	-----	5.2	-----	-----	-----	5.3	-----	-----	-----	-----	-----	7.9	-----	-----	-----	-----	-----	3.7	-----	-----	-----	-----	4.0	-----	-----	8.7	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	6.1	-----	-----	10.5	-----	-----	7	-----	-----	26	-----	-----	8	-----	-----	18	-----	-----	-----	13.0	-----	-----	-----	-----	9.6	-----	-----	15.2	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	1.2	-----	-----	9.5	-----	-----	2.0	-----	-----	3.4	-----	-----	1.9	-----	-----	3.9	-----	-----	-----	>2.2	-----	-----	-----	-----	6.9	-----	-----	10.8	-----	-----
Bank Height Ratio	-----	-----	-----	-----	1.6	-----	-----	4.3	-----	-----	1.4	-----	-----	2.5	-----	-----	1.1	-----	-----	1.5	-----	-----	-----	1.0	-----	-----	-----	-----	1.0	-----	-----	1.3	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																																		
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	25.0	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.0	-----	-----	21.0	-----	-----	-----	-----	-----	-----	-----	-----
Rc:Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.3	-----	-----	4.0	-----	-----	0.8	-----	-----	2.3	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.4	-----	-----	8.8	-----	-----	4.9	-----	-----	6.9	-----	-----	50.0	-----	-----	80.0	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.3	-----	-----	4.4	-----	-----	1.2	-----	-----	1.8	-----	-----	3.6	-----	-----	6.5	-----	-----	-----	-----	-----	-----	-----	-----
Profile																																		
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.1	-----	-----	7.9	-----	-----	2.9	-----	-----	5.0	-----	-----	28.0	-----	-----	42.0	-----	-----	-----	-----	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.7	-----	-----	1.6	-----	-----	2.3	-----	-----	-----	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft³)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																																		
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----									0.1 / 0.6/ 4.5 / 53 / 96							0.2 / 2.5/ 8 / 92 / 1,536						-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																		
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.125	-----	-----	-----	-----	-----	0.13	-----	-----	-----	-----	-----	0.24	-----	-----	-----	-----	-----	0.125	-----	-----	-----	-----	-----	0.125	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	G5c		-----	E5	-----	-----	-----	-----	-----	C4/1	-----	-----	-----	-----	-----	B4/1a	-----	-----	-----	E4/C4	-----	-----	-----	-----	-----	E4/C4	-----	-----	-----	-----
BF Velocity (fps)	-----	-----	-----	-----	0.8	-----	-----	1.2	-----	-----	-----	-----	-----	5.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.5	-----	-----	-----	-----	-----	3.5	-----	-----	-----	-----
BF Discharge (cfs)	-----	290.0	2000.0	19.8	-----	-----	-----	19.8	-----	-----	-----	-----	-----	25.2	-----	-----	-----	-----	-----	46.6	-----	-----	-----	13	-----	-----	-----	-----	-----	13	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	859.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel length (ft)	-----	-----	-----	-----	-----	-----	-----	943	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1044.9	-----	-----	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.09	-----	-----	-----	-----	-----	1.40	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.20	-----	-----	-----	-----	-----	1.2	-----	-----	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0127	-----	-----	-----	-----	-----	0.0197	-----	-----	-----	-----	-----	0.0405	-----	-----	-----	0.012	-----	-----	-----	-----	-----	0.0123	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0135	-----	-----	-----	-----	-----	0.028	-----	-----	-----	-----	-----	0.0458	-----	-----	-----	0.015	-----	-----	-----	-----	-----	0.0150	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

* Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. Wildland Hydrology. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

[1] Existing conditions survey data is compiled for the entire UT1 Reach within the project limits.

[2] Bulk samples taken since pebble count procedure is not applicable for sand-bed streams.

[3] Values were chosen based on sand-bed reference reach data and past project evaluations.

[4] Composite reference reach information from Johannah Creek, Johnston County; Panther Branch, Brunswick County; Rocky Swamp, Halifax County; and Beaver Dam Branch, Jones County

Table 5. Baseline Stream Summary (continued)
UT to Cane Creek Restoration Project: EEP Project ID No. 95729

Reach 3 (398 LF)

Parameter	USGS Gauge	Regional Curve Interval (Harman et al, 1999)*			Pre-Existing Condition[1]						Reference Reach(es) Data												Design						As-built					
											UT to Wells Creek						UT to Varnals Creek																	
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																																		
BF Width (ft)	-----	23.0	80.0	5.1	-----	-----	-----	7.6	-----	-----	-----	8	-----	-----	-----	-----	-----	9.7	-----	-----	-----	-----	-----	7.2	-----	-----	-----	-----	8.9	-----	-----	9.0	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	>16.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	12	-----	-----	20.0	-----	-----	24.4	-----	-----	36.3	-----	-----
BF Mean Depth (ft)	-----	2.3	5.8	0.8	-----	-----	-----	0.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.6	-----	-----	-----	-----	0.4	-----	-----	0.6	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.7	-----	-----	-----	-----	0.8	-----	-----	1.1	-----	-----
BF Cross-sectional Area (ft²)	-----	80.0	300.0	5.7	-----	-----	-----	5.6	-----	-----	-----	5.3	-----	-----	-----	-----	-----	7.9	-----	-----	-----	-----	-----	4.0	-----	-----	-----	-----	3.7	-----	-----	5.3	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	9.9	-----	-----	7	-----	-----	26	-----	-----	8	-----	-----	18	-----	-----	-----	13.0	-----	-----	-----	-----	15.3	-----	-----	21.7	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	2.2	-----	-----	2.0	-----	-----	3.4	-----	-----	1.9	-----	-----	3.9	-----	-----	1.8	-----	-----	2.2	-----	-----	2.7	-----	-----	4.0	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	1.4	-----	-----	2.5	-----	-----	1.1	-----	-----	1.5	-----	-----	-----	1.0	-----	-----	-----	-----	1.0	-----	-----	1.0	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																																		
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rc:Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.3	-----	-----	4.0	-----	-----	0.8	-----	-----	2.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.4	-----	-----	8.8	-----	-----	4.9	-----	-----	6.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.3	-----	-----	4.4	-----	-----	1.2	-----	-----	1.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile																																		
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.1	-----	-----	7.9	-----	-----	2.9	-----	-----	5.0	-----	-----	11	-----	-----	36	-----	-----	-----	-----	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.7	-----	-----	1.6	-----	-----	2.3	-----	-----	1.5	-----	-----	1.5	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft³)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																																		
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----										0.1 / 0.6/ 4.5 / 53 / 96										0.2 / 2.5/ 8 / 92 / 1,536			-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																		
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.1	-----	-----	-----	-----	-----	0.13	-----	-----	-----	-----	-----	0.24	-----	-----	-----	0.1	-----	-----	-----	-----	-----	0.1	-----	-----	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	B4c	-----	-----	-----	-----	-----	C4/1	-----	-----	-----	-----	-----	B4/1a	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Velocity (fps)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	290.0	2000.0	21.7	-----	-----	-----	21.7	-----	-----	-----	-----	-----	25.2	-----	-----	-----	-----	-----	46.6	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	356.8	-----	-----	-----	-----
Channel length (ft)	-----	-----	-----	-----	-----	-----	-----	425	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	389.1	-----	-----	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.16	-----	-----	-----	-----	-----	1.40	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.18	-----	-----	-----	-----	-----	1.1	-----	-----	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0195	-----	-----	-----	-----	-----	0.0197	-----	-----	-----	-----	-----	0.0405	-----	-----	-----	0.016	-----	-----	-----	-----	-----	0.0172	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0168	-----	-----	-----	-----	-----	0.028	-----	-----	-----	-----	-----	0.0458	-----	-----	-----	0.018	-----	-----	-----	-----	-----	0.0187	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

* Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. Wildland Hydrology. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

[1] Existing conditions survey data is compiled for the entire UT1 Reach within the project limits.

[2] Bulk samples taken since pebble count procedure is not applicable for sand-bed streams.

[3] Values were chosen based on sand-bed reference reach data and past project evaluations.

[4] Composite reference reach information from Johannah Creek, Johnston County; Panther Branch, Brunswick County; Rocky Swamp, Halifax County; and Beaver Dam Branch, Jones County

Table 5. Baseline Stream Summary (continued)
UT to Cane Creek Restoration Project: EEP Project ID No. 95729

Reach 4 (2,333 LF)

Parameter	USGS Gauge	Regional Curve Interval (Harman et al, 1999)*			Pre-Existing Condition[1]						Reference Reach(es) Data												Design						As-built					
											UT to Wells Creek						UT to Varnals Creek																	
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																																		
BF Width (ft)	-----	23.0	80.0	10.2	15.4	-----	-----	16.7	-----	-----	-----	8	-----	-----	-----	-----	-----	9.7	-----	-----	-----	-----	-----	14.0	-----	-----	-----	-----	10.1	-----	-----	13.8	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	18.4	-----	-----	26.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	>30	-----	-----	-----	-----	80.1	-----	-----	105.0	-----	-----
BF Mean Depth (ft)	-----	2.3	5.8	1.3	0.9	-----	-----	1.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----	0.6	-----	-----	1.2	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	1.3	-----	-----	1.6	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----	-----	-----	1.1	-----	-----	2.0	-----	-----
BF Cross-sectional Area (ft²)	-----	80.0	300.0	16.9	14.8	-----	-----	15.5	-----	-----	-----	5.3	-----	-----	-----	-----	-----	7.9	-----	-----	-----	-----	-----	14.0	-----	-----	-----	-----	7.5	-----	-----	12.3	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	15.4	-----	-----	19.0	-----	-----	7	-----	-----	26	-----	-----	8	-----	-----	18	-----	-----	-----	14.0	-----	-----	-----	-----	8.3	-----	-----	19.4	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	1.2	-----	-----	1.6	-----	-----	2.0	-----	-----	3.4	-----	-----	1.9	-----	-----	3.9	-----	-----	-----	>2.2	-----	-----	-----	-----	7.9	-----	-----	9.4	-----	-----
Bank Height Ratio	-----	-----	-----	-----	1.3	-----	-----	2.8	-----	-----	1.4	-----	-----	2.5	-----	-----	1.1	-----	-----	1.5	-----	-----	-----	1.0	-----	-----	-----	-----	1.0	-----	-----	1.1	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																																		
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	38.0	79.0	-----	120.0	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	21.0	26.0	-----	31.0	-----	-----
Rc:Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.3	-----	-----	4.0	-----	-----	0.8	-----	-----	2.3	-----	-----	-----	-----	-----	-----	-----	-----	38.0	79.0	-----	120.0	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.4	-----	-----	8.8	-----	-----	4.9	-----	-----	6.9	-----	-----	-----	-----	-----	-----	-----	-----	72.0	104.0	-----	124.0	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.3	-----	-----	4.4	-----	-----	1.2	-----	-----	1.8	-----	-----	-----	-----	-----	-----	-----	-----	3.5	6.0	-----	8.0	-----	-----
Profile																																		
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.0046	0.0043	-----	0.0039	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.1	-----	-----	7.9	-----	-----	2.9	-----	-----	5.0	-----	-----	42	-----	-----	84	-----	-----	41	-----	72	57	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.7	-----	-----	1.6	-----	-----	2.3	-----	-----	-----	2.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft³)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																																		
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			24.2 / 50.6 / 69.4 / 50.6 / 24.2						0.1 / 0.6 / 4.5 / 53 / 96						0.2 / 2.5 / 8 / 92 / 1,536						-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/ft²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																		
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.7	-----	-----	-----	-----	-----	0.13	-----	-----	-----	-----	-----	0.24	-----	-----	-----	-----	-----	0.7	-----	-----	-----	-----	-----	0.7	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	B3c	-----	-----	F5	-----	-----	-----	-----	-----	C4/1	-----	-----	-----	-----	-----	B4/1a	-----	-----	-----	B3c	-----	-----	-----	-----	-----	B3c	-----	-----	-----	-----
BF Velocity (fps)	-----	-----	-----	-----	4.4	-----	-----	4.6	-----	-----	-----	-----	-----	5.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.0	-----	-----	-----	-----	-----	3.0	-----	-----	-----	-----
BF Discharge (cfs)	-----	290.0	2000.0	69.2	-----	-----	-----	69.2	-----	-----	-----	-----	-----	25.2	-----	-----	-----	-----	-----	46.6	-----	-----	-----	56.0	-----	-----	-----	-----	-----	56.0	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	349	-----	-----	-----	-----
Channel length (ft)	-----	-----	-----	-----	-----	-----	-----	2,783	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	386	-----	-----	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.04	-----	-----	-----	-----	-----	1.40	-----	-----	-----	-----	-----	1.20	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.10	-----	-----	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0169	-----	-----	-----	-----	-----	0.0197	-----	-----	-----	-----	-----	0.0405	-----	-----	-----	0.015	-----	-----	-----	-----	-----	0.0074	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0148	-----	-----	-----	-----	-----	0.028	-----	-----	-----	-----	-----	0.0458	-----	-----	-----	0.017	-----	-----	-----	-----	-----	0.0082	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

* Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. Wildland Hydrology. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

[1] Existing conditions survey data is compiled for the entire UT1 Reach within the project limits.

[2] Bulk samples taken since pebble count procedure is not applicable for sand-bed streams.

[3] Values were chosen based on sand-bed reference reach data and past project evaluations.

[4] Composite reference reach information from Johannah Creek, Johnston County; Panther Branch, Brunswick County; Rocky Swamp, Halifax County; and Beaver Dam Branch, Jones County

Table 5. Baseline Stream Summary (continued)
UT to Cane Creek Restoration Project: EEP Project ID No. 95729

Reach 5 (1,461 LF)

Parameter	USGS Gauge	Regional Curve Interval (Harman et al, 1999)*			Pre-Existing Condition[1]						Reference Reach(es) Data												Design						As-built					
											UT to Wells Creek						UT to Varnals Creek																	
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																																		
BF Width (ft)	-----	23.0	80.0	8.4	-----	-----	-----	8.9	-----	-----	-----	8	-----	-----	-----	-----	-----	9.7	-----	-----	-----	-----	-----	10.8	-----	-----	-----	-----	10.2	-----	-----	12.0	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	11.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	>25	-----	-----	-----	-----	76.0	-----	-----	103.7	-----	-----
BF Mean Depth (ft)	-----	2.3	5.8	1.2	-----	-----	-----	1.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.8	-----	-----	-----	-----	0.7	-----	-----	1.4	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.1	-----	-----	-----	-----	1.2	-----	-----	2.8	-----	-----
BF Cross-sectional Area (ft²)	-----	80.0	300.0	12.5	-----	-----	-----	10.9	-----	-----	-----	5.3	-----	-----	-----	-----	-----	7.9	-----	-----	-----	-----	-----	9.0	-----	-----	-----	-----	7.1	-----	-----	15.8	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	7.2	-----	-----	7	-----	-----	26	-----	-----	8	-----	-----	18	-----	-----	-----	13.0	-----	-----	-----	-----	8.0	-----	-----	17.8	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	1.3	-----	-----	2.0	-----	-----	3.4	-----	-----	1.9	-----	-----	3.9	-----	-----	-----	>2.2	-----	-----	-----	-----	3.2	-----	-----	9.2	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	2.6	-----	-----	1.4	-----	-----	2.5	-----	-----	1.1	-----	-----	1.5	-----	-----	-----	1.0	-----	-----	-----	-----	1.0	-----	-----	1.0	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																																		
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rc:Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.3	-----	-----	4.0	-----	-----	0.8	-----	-----	2.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.4	-----	-----	8.8	-----	-----	4.9	-----	-----	6.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.3	-----	-----	4.4	-----	-----	1.2	-----	-----	1.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile																																		
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.1	-----	-----	7.9	-----	-----	2.9	-----	-----	5.0	-----	-----	32.0	-----	65.0	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.7	-----	-----	1.6	-----	-----	2.3	-----	-----	-----	2.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft³)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																																		
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			16.6/31.2/47.0/85.3/116.1						0.1 / 0.6/ 4.5 / 53 / 96						0.2 / 2.5/ 8 / 92 / 1,536						-----	-----	-----	-----	-----	-----			6.74 / 20.49 / 29.79 / 63.73 / 118.25			
Reach Shear Stress (competency) lb/ft²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																		
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.5	-----	-----	-----	-----	-----	0.13	-----	-----	-----	-----	-----	0.24	-----	-----	-----	-----	-----	0.5	-----	-----	-----	-----	-----	0.5	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	G4	-----	-----	-----	-----	-----	C4/1	-----	-----	-----	-----	-----	B4/1a	-----	-----	-----	B4c	-----	-----	-----	-----	-----	B4c	-----	-----	-----	-----
BF Velocity (fps)	-----	-----	-----	-----	-----	-----	-----	4.5	-----	-----	-----	-----	-----	5.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.4	-----	-----	-----	-----	-----	4.4	-----	-----	-----	-----
BF Discharge (cfs)	-----	290.0	2000.0	50.0	-----	-----	-----	50	-----	-----	-----	-----	-----	25.2	-----	-----	-----	-----	-----	46.6	-----	-----	-----	40	-----	-----	-----	-----	-----	40	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel length (ft)	-----	-----	-----	-----	-----	-----	-----	1848	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.07	-----	-----	-----	-----	-----	1.40	-----	-----	-----	-----	-----	1.20	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0144	-----	-----	-----	-----	-----	0.0197	-----	-----	-----	-----	-----	0.0405	-----	-----	-----	0.014	-----	-----	-----	-----	-----	0.014	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0128	-----	-----	-----	-----	-----	0.028	-----	-----	-----	-----	-----	0.0458	-----	-----	-----	0.017	-----	-----	-----	-----	-----	0.017	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

* Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. Wildland Hydrology. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

[1] Existing conditions survey data is compiled for the entire UT1 Reach within the project limits.

[2] Bulk samples taken since pebble count procedure is not applicable for sand-bed streams.

[3] Values were chosen based on sand-bed reference reach data and past project evaluations.

[4] Composite reference reach information from Johannah Creek, Johnston County; Panther Branch, Brunswick County; Rocky Swamp, Halifax County; and Beaver Dam Branch, Jones County

Table 5. Baseline Stream Summary (continued)
UT to Cane Creek Restoration Project: EEP Project ID No. 95729

Reach 5a (145 LF)

Parameter	USGS Gauge	Regional Curve Interval (Harman et al, 1999)*			Pre-Existing Condition[1]						Reference Reach(es) Data												Design						As-built					
											UT to Wells Creek						UT to Varnals Creek																	
Dimension and Substrate - Riffle		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	-----	23.0	80.0	2.4	-----	-----	-----	13.6	-----	-----	-----	8	-----	-----	-----	-----	-----	9.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	16.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Mean Depth (ft)	-----	2.3	5.8	0.5	-----	-----	-----	0.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	0.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Cross-sectional Area (ft²)	-----	80.0	300.0	1.7	-----	-----	-----	4.2	-----	-----	-----	5.3	-----	-----	-----	-----	-----	7.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	45.0	-----	-----	7	-----	-----	26	-----	-----	8	-----	-----	18	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	1.3	-----	-----	2.0	-----	-----	3.4	-----	-----	1.9	-----	-----	3.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	1.4	-----	-----	2.5	-----	-----	1.1	-----	-----	1.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																																		
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rc:Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.3	-----	-----	4.0	-----	-----	0.8	-----	-----	2.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.4	-----	-----	8.8	-----	-----	4.9	-----	-----	6.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.3	-----	-----	4.4	-----	-----	1.2	-----	-----	1.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile																																		
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.1	-----	-----	7.9	-----	-----	2.9	-----	-----	5.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.7	-----	-----	1.6	-----	-----	2.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft³)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																																		
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----										0.1 / 0.6/ 4.5 / 53 / 96													-----	-----	-----	-----	-----	-----	-----	-----	-----
Reach Shear Stress (competency) lb/ft²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																		
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.025	-----	-----	-----	-----	-----	0.13	-----	-----	-----	-----	-----	0.24	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	C4/1	-----	-----	-----	-----	-----	B4/1a	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Velocity (fps)	-----	-----	-----	-----	-----	-----	-----	1.7	-----	-----	-----	-----	-----	5.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	290.0	2000.0	6.2	-----	-----	-----	7.1	-----	-----	-----	-----	-----	25.2	-----	-----	-----	-----	-----	46.6	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel length (ft)	-----	-----	-----	-----	-----	-----	-----	144	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.19	-----	-----	-----	-----	-----	1.40	-----	-----	-----	-----	-----	1.20	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0236	-----	-----	-----	-----	-----	0.0197	-----	-----	-----	-----	-----	0.0405	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0224	-----	-----	-----	-----	-----	0.028	-----	-----	-----	-----	-----	0.0458	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

* Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. Wildland Hydrology. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

[1] Existing conditions survey data is compiled for the entire UT1 Reach within the project limits.

[2] Bulk samples taken since pebble count procedure is not applicable for sand-bed streams.

[3] Values were chosen based on sand-bed reference reach data and past project evaluations.

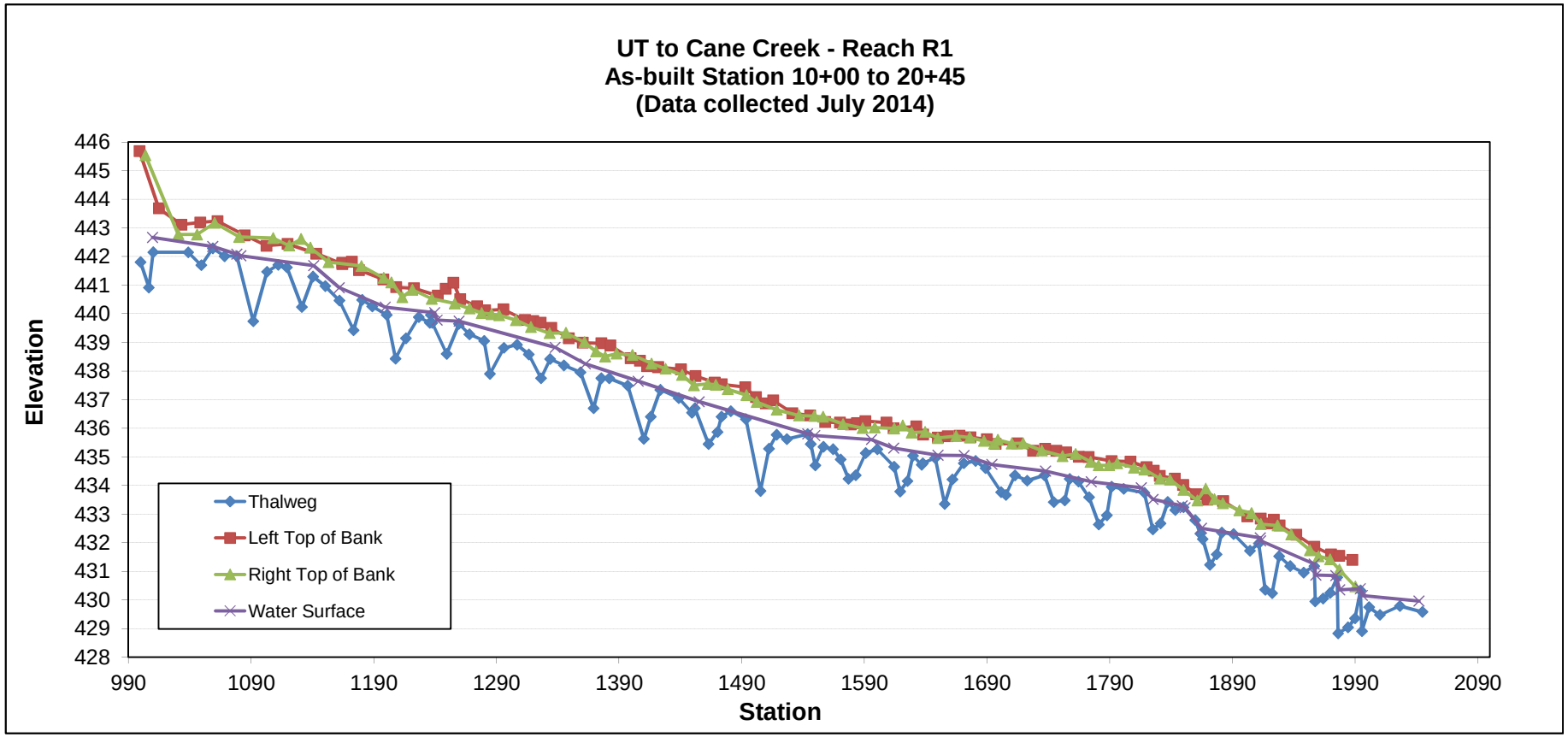
[4] Composite reference reach information from Johannah Creek, Johnston County; Panther Branch, Brunswick County; Rocky Swamp, Halifax County; and Beaver Dam Branch, Jones County

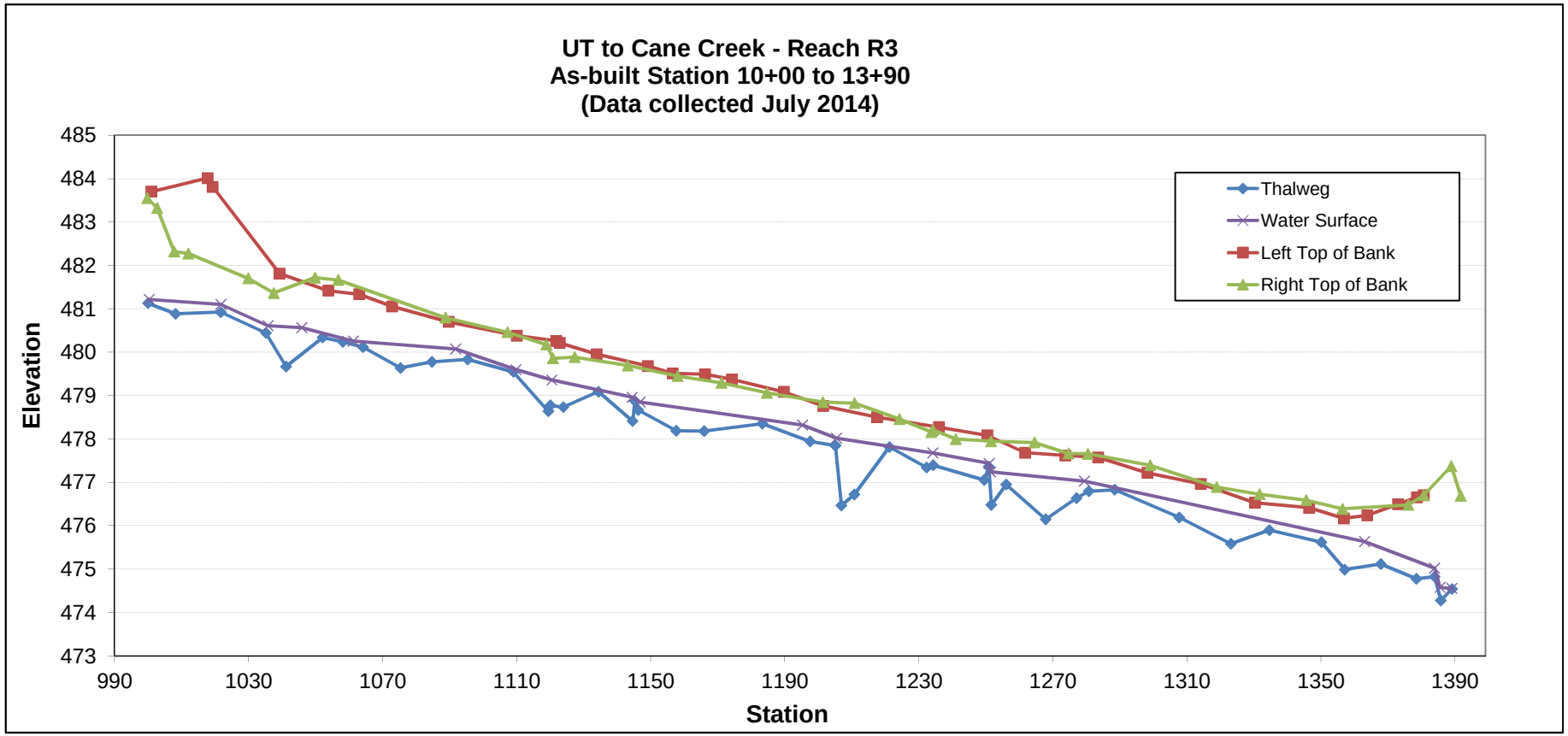
Table 6. Morphology and Hydraulic Monitoring Summary
UT to Cane Creek Restoration Project: EEP Project ID No. 95729

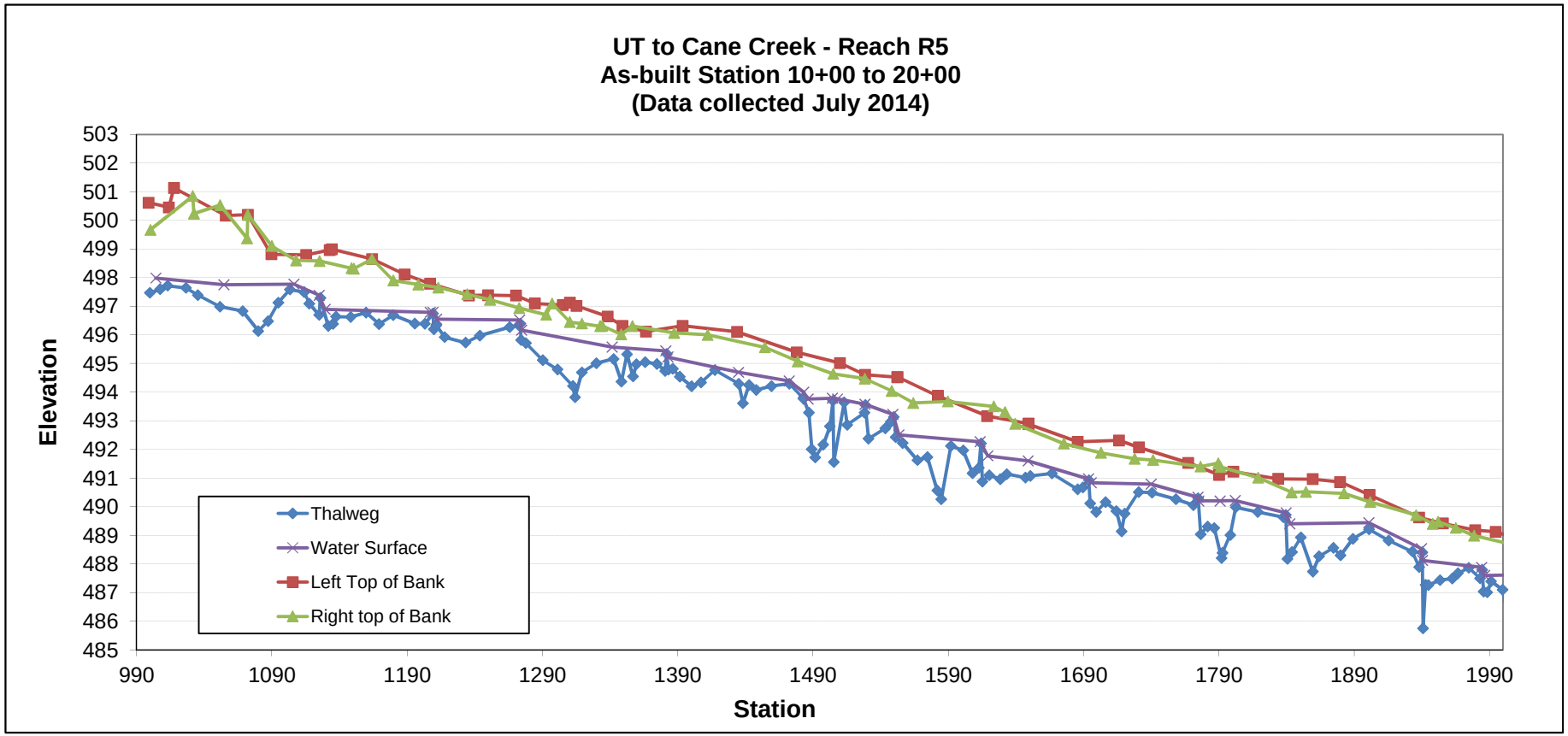
Reach 5 (1,461 LF)																										
	Cross-section X-1 (Riffle)							**Cross-section X-2 (Pool)**							**Cross-section X-3 (Riffle)**							**Cross-section X-4 (Riffle)**						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Based on current/developing bankfull feature																												
BF Width (ft)	10.41							11.24							12.00							10.16						
BF Mean Depth (ft)	0.68							1.41							0.68							0.81						
Width/Depth Ratio	15.2							8.0							17.8							12.5						
BF Cross-sectional Area (ft²)	7.1							15.8							8.1							8.3						
BF Max Depth (ft)	1.19							2.79							1.16							1.33						
Width of Floodprone Area (ft)	85.1							103.7							76.0							32.2						
Entrenchment Ratio	8.2							9.2							6.3							3.2						
Bank Height Ratio	1.0							1.0							1.0							1.0						
Wetted Perimeter (ft)	11.8							14.1							13.4							11.8						
Hydraulic Radius (ft)	0.6							1.1							0.6							0.7						
Cross Sectional Area between end pins (ft²)	-							-																				
d50 (mm)	-							-																				
Reach 3 (398 LF)																												
	Cross-section X-5 (Riffle)							**Cross-section X-6 (Pool)**																				
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Based on current/developing bankfull feature																												
BF Width (ft)	8.94							8.98																				
BF Mean Depth (ft)	0.41							0.59																				
Width/Depth Ratio	21.7							15.3																				
BF Cross-sectional Area (ft²)	3.7							5.3																				
BF Max Depth (ft)	0.76							1.13																				
Width of Floodprone Area (ft)	24.4							36.3																				
Entrenchment Ratio	2.7							4.0																				
Bank Height Ratio	1.0							1.0																				
Wetted Perimeter (ft)	9.8							10.2																				
Hydraulic Radius (ft)	0.4							0.5																				
Cross Sectional Area between end pins (ft²)	-							-							-							-						
d50 (mm)	-							-							-							-						

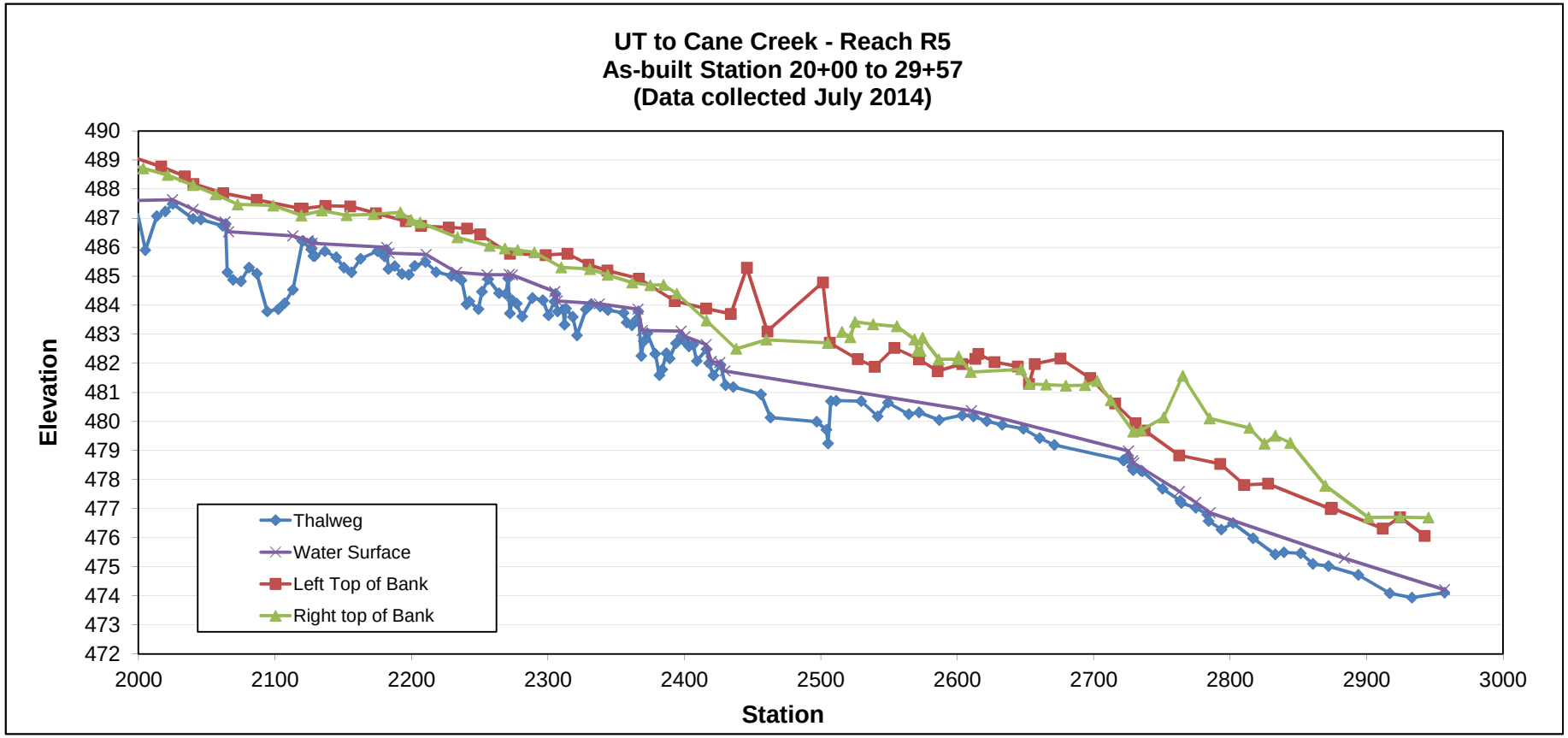
Table 6. Morphology and Hydraulic Monitoring Summary
UT to Cane Creek Restoration Project: EEP Project ID No. 95729

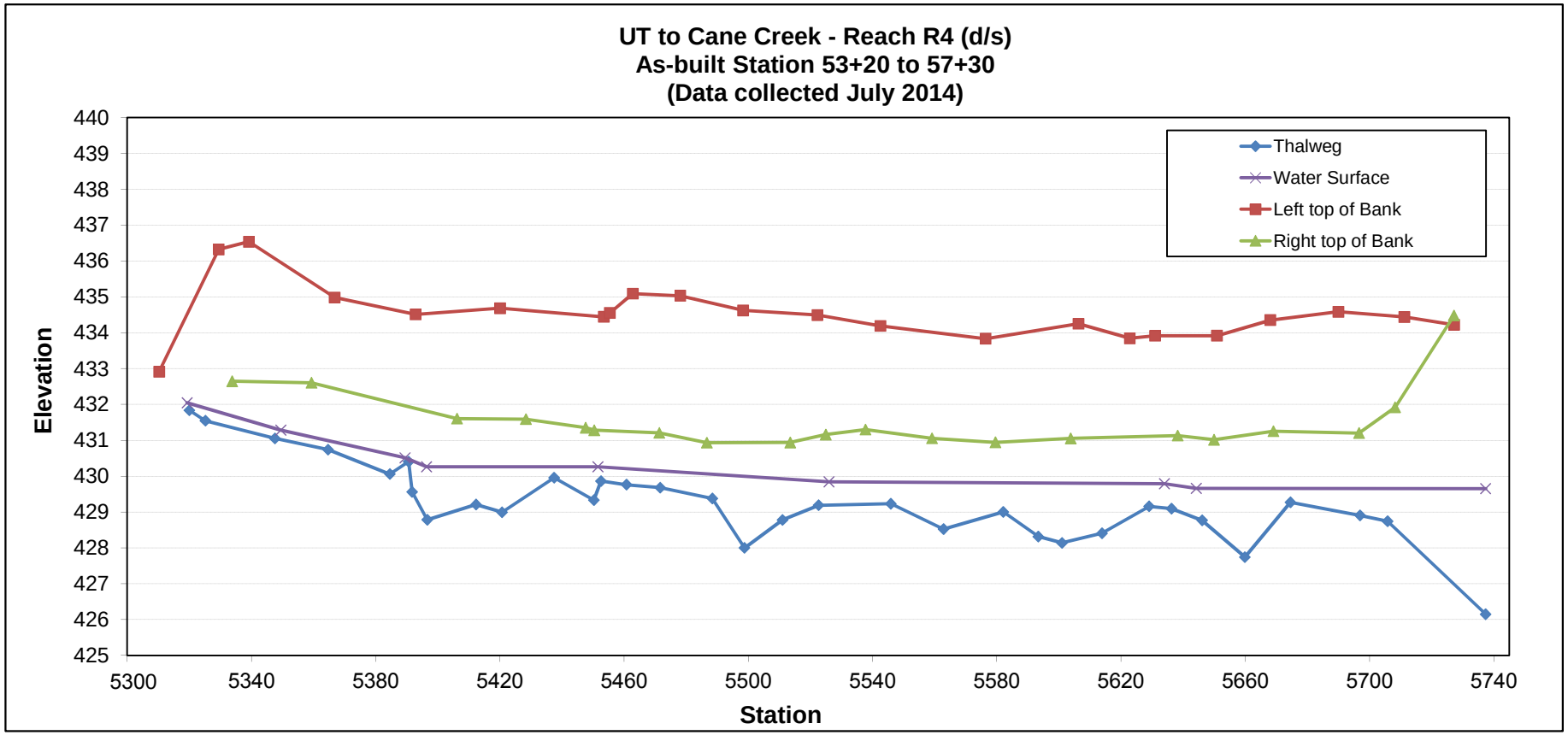
Reach 4 (2,333 LF)																									
	Cross-section X-7 (Riffle)							**Cross-section X-8 (Pool)**							**Cross-section X-9 (Riffle)**										
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Based on current/developing bankfull feature																												
BF Width (ft)	18.74							17.08							13.77													
BF Mean Depth (ft)	0.79							1.45							1.02													
Width/Depth Ratio	23.7							11.8							13.5													
BF Cross-sectional Area (ft²)	14.8							24.7							14.1													
BF Max Depth (ft)	1.24							3.41							1.85													
Width of Floodprone Area (ft)	56.1							72.5							33.9													
Entrenchment Ratio	3.0							4.2							2.5													
Bank Height Ratio	1.9							1.1							1.1													
Wetted Perimeter (ft)	20.3							20.0							15.8													
Hydraulic Radius (ft)	0.7							1.2							0.9													
Cross Sectional Area between end pins (ft²)	-							-																				
d50 (mm)	-							-																				
Reach 1 (1,045 LF)																												
	Cross-section X-10 (Pool)							**Cross-section X-11 (Riffle)**							**Cross-section X-12 (Riffle)**													
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Based on current/developing bankfull feature																												
BF Width (ft)	9.11							7.21							7.83													
BF Mean Depth (ft)	0.95							0.57							0.51													
Width/Depth Ratio	9.6							12.8							15.2													
BF Cross-sectional Area (ft²)	8.7							4.1							4.0													
BF Max Depth (ft)	1.90							0.89							0.73													
Width of Floodprone Area (ft)	65.6							65.9							84.4													
Entrenchment Ratio	6.9							9.1							10.8													
Bank Height Ratio	1.1							1.0							1.3													
Wetted Perimeter (ft)	11.0							8.4							8.9													
Hydraulic Radius (ft)	0.8							0.5							0.5													
Cross Sectional Area between end pins (ft²)	-							-							-							-						
d50 (mm)	-							-							-							-						


UT to Cane Creek - Reach R1
As-built Station 10+00 to 20+45
(Data collected July 2014)
Elevation
446
445
444
443
442
441
440
439
438
437
436
435
434
433
432
431
430
429
428
990
1090
1190
1290
1390
1490
1590
1690
1790
1890
1990
2090
Station
Thalweg
Left Top of Bank
Right Top of Bank
Water Surface


UT to Cane Creek - Reach R3
As-built Station 10+00 to 13+90
(Data collected July 2014)
Elevation
485
484
483
482
481
480
479
478
477
476
475
474
473
990
1030
1070
1110
1150
1190
1230
1270
1310
1350
1390
Station
Thalweg
Water Surface
Left Top of Bank
Right Top of Bank


UT to Cane Creek - Reach R5
As-built Station 10+00 to 20+00
(Data collected July 2014)
Elevation
503
502
501
500
499
498
497
496
495
494
493
492
491
490
489
488
487
486
485
990
1090
1190
1290
1390
1490
1590
1690
1790
1890
1990
Station
Thalweg
Water Surface
Left Top of Bank
Right top of Bank

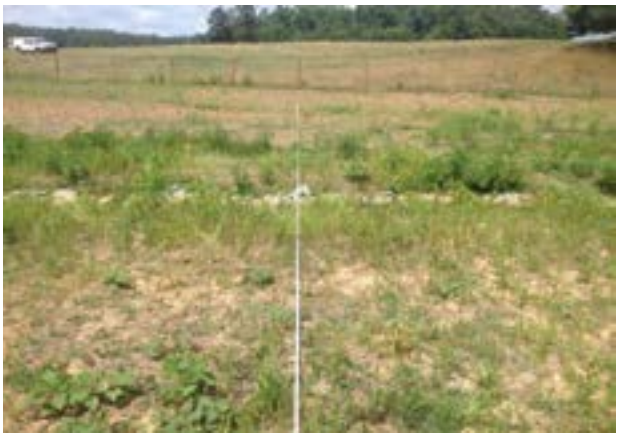

UT to Cane Creek - Reach R5
As-built Station 20+00 to 29+57
(Data collected July 2014)
Elevation
490
489
488
487
486
485
484
483
482
481
480
479
478
477
476
475
474
473
472
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
Station
Thalweg
Water Surface
Left Top of Bank
Right top of Bank


UT to Cane Creek - Reach R4 (d/s)
As-built Station 53+20 to 57+30
(Data collected July 2014)
Elevation
440
439
438
437
436
435
434
433
432
431
430
429
428
427
426
425
5300
5340
5380
5420
5460
5500
5540
5580
5620
5660
5700
5740
Station
Thalweg
Water Surface
Left top of Bank
Right top of Bank

Permanent Cross-section 1

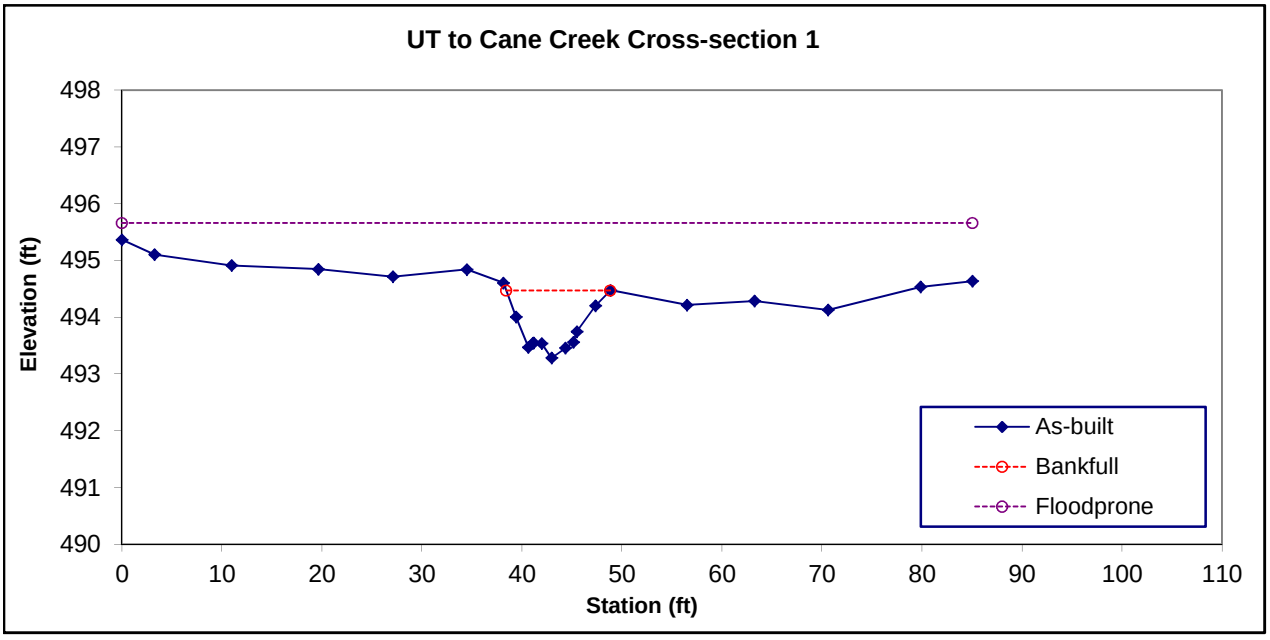
(As-built Data - Collected July 2014)

Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	7.1	10.41	0.68	1.19	15.2	1	8.2	494.47	494.48



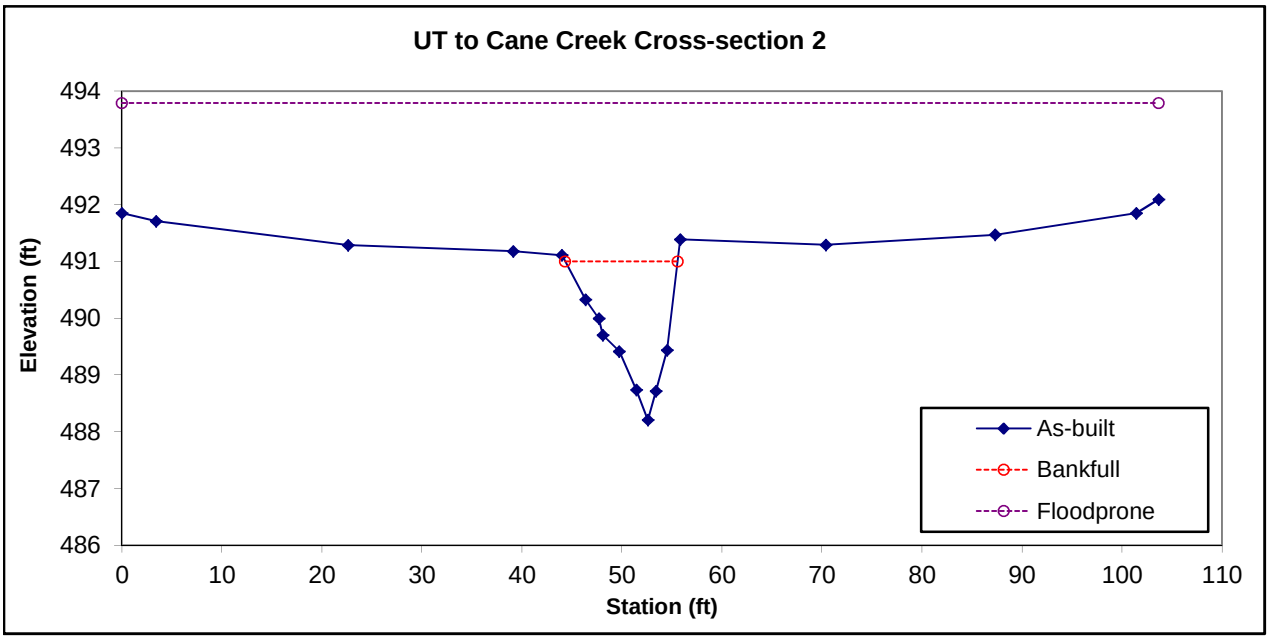
Permanent Cross-section 2

(As-built Data - Collected July 2014)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	-	15.8	11.24	1.41	2.79	8	1	9.2	491	491.11



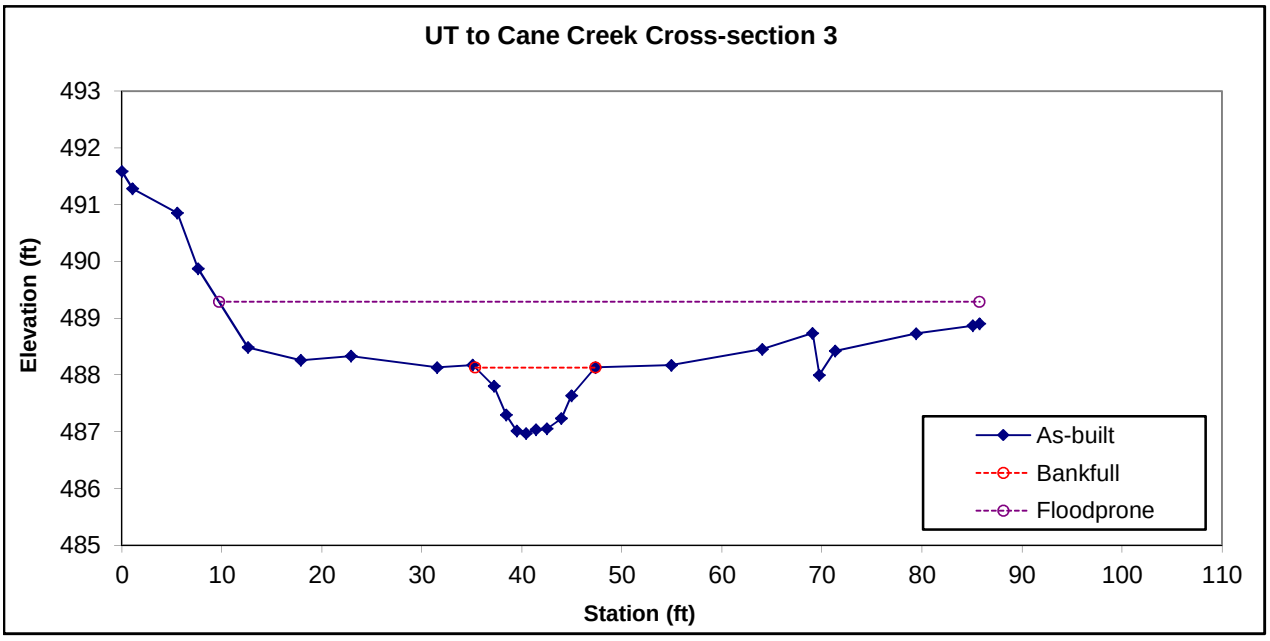
Permanent Cross-section 3

(As-Built Data - Collected July 2014)

Looking at the Left Bank

Looking at the Right Bank

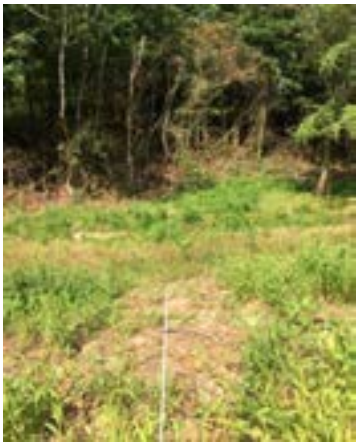
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	-	8.1	12	0.68	1.16	17.8	1	6.3	488.13	488.13



Permanent Cross-section 4

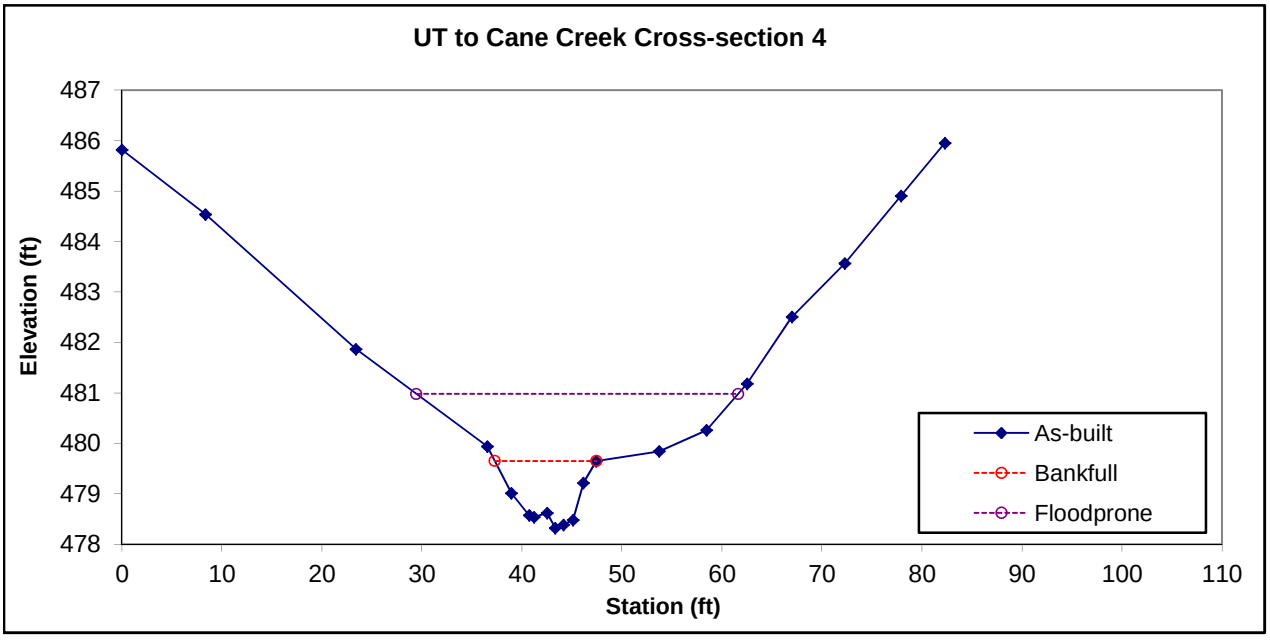
(As-Built Data - Collected July 2014)

Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	8.3	10.16	0.81	1.33	12.5	1.0	3.2	479.65	479.65



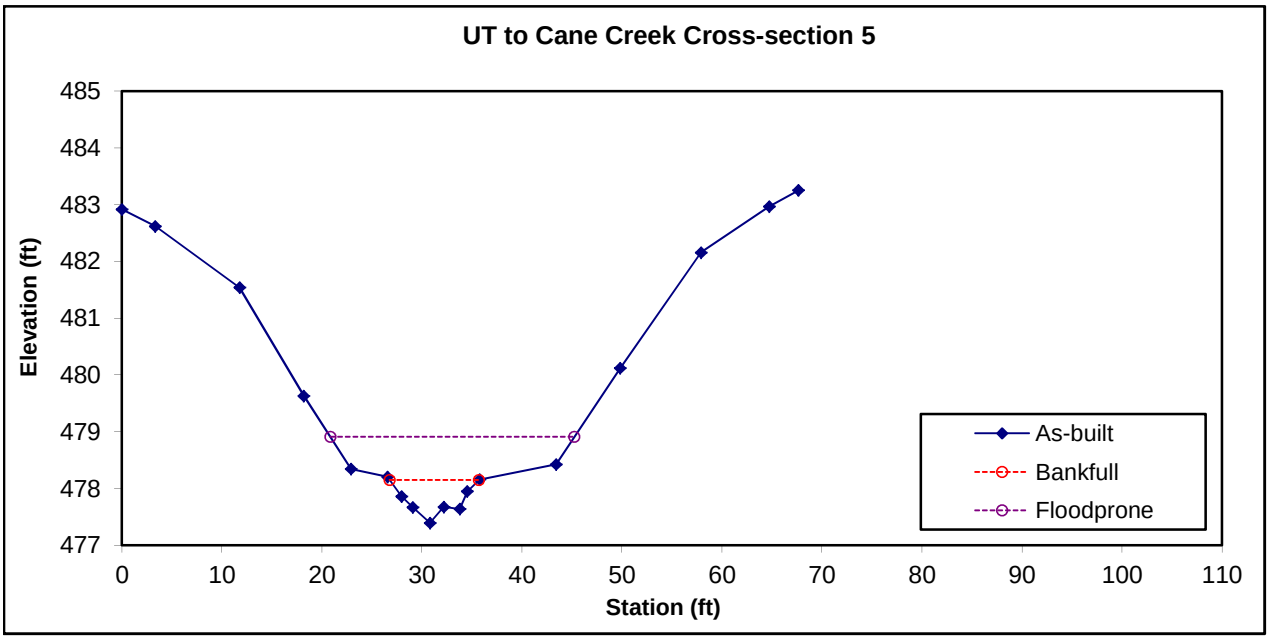
Permanent Cross-section 5

(As-built Data - Collected July 2014)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	3.7	8.94	0.41	0.76	21.7	1.0	2.7	478.15	478.16



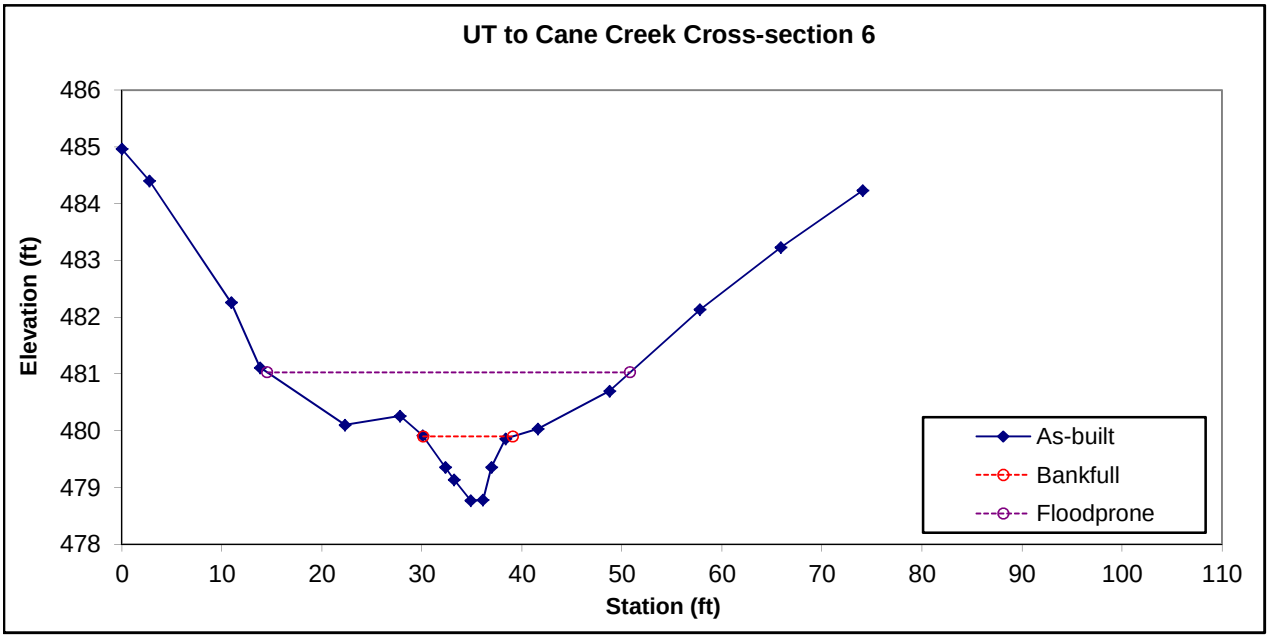
Permanent Cross-section 6

(As-built Data - Collected July 2014)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	-	5.3	8.98	0.59	1.13	15.3	1.0	4.0	479.9	479.86



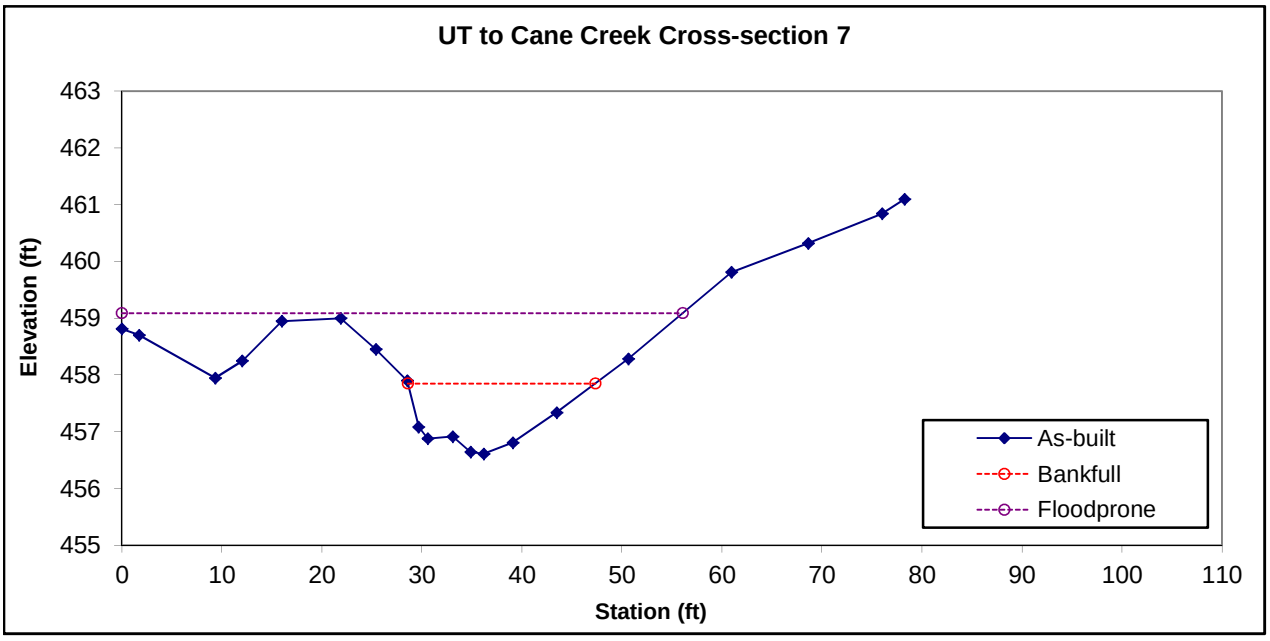
Permanent Cross-section 7

(As-built Data - Collected July 2014)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	14.8	18.74	0.79	1.24	23.7	1.9	3.0	457.85	459



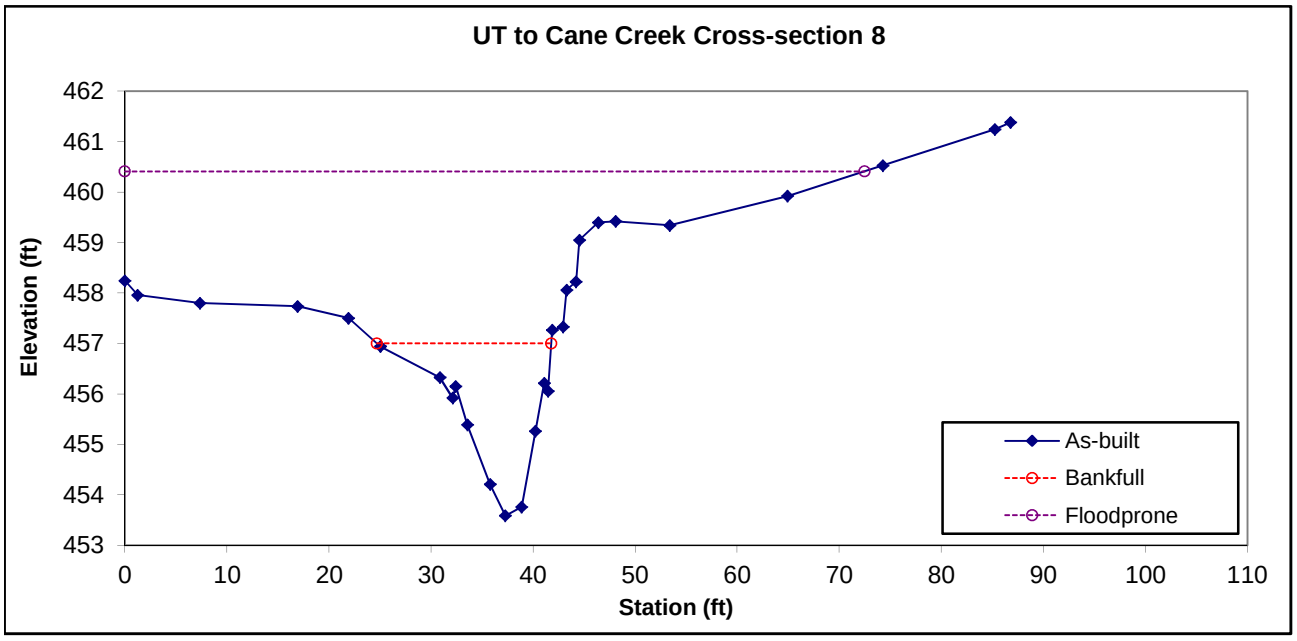
Permanent Cross-section 8

(As-built Data - Collected July 2014)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	-	24.7	17.08	1.45	3.41	11.8	1.1	4.2	457	457.5



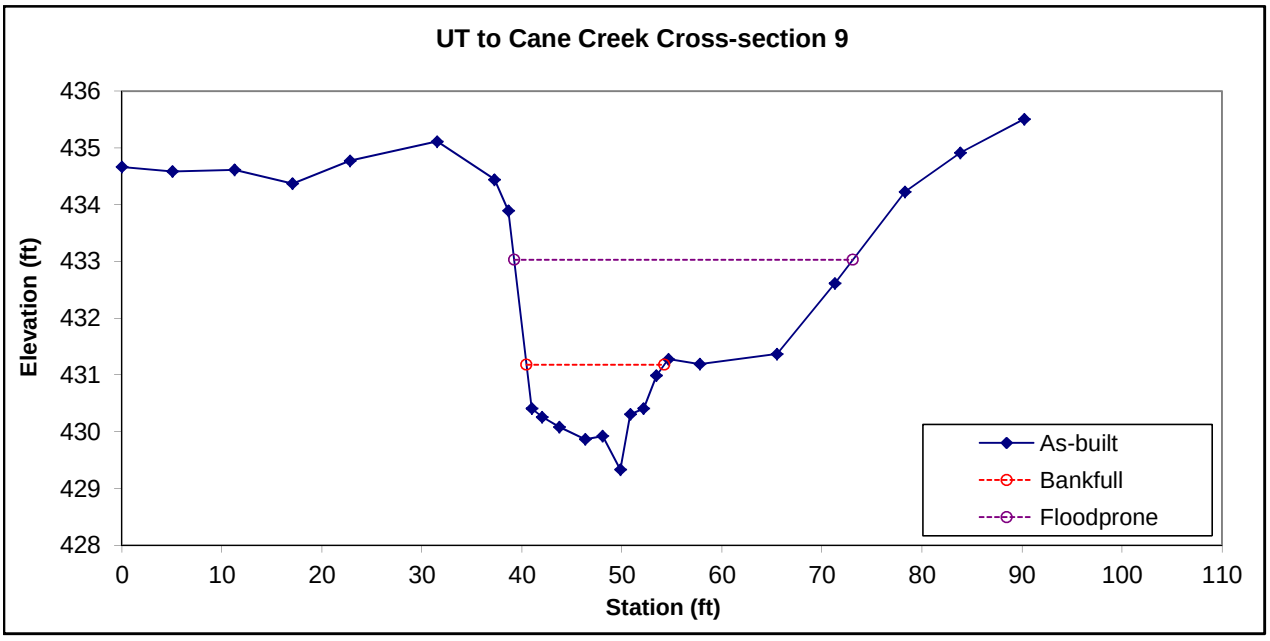
Permanent Cross-section 9

(As-built Data - Collected July 2014)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	14.05	13.77	1.02	1.85	13.5	1.1	2.5	431.18	431.28



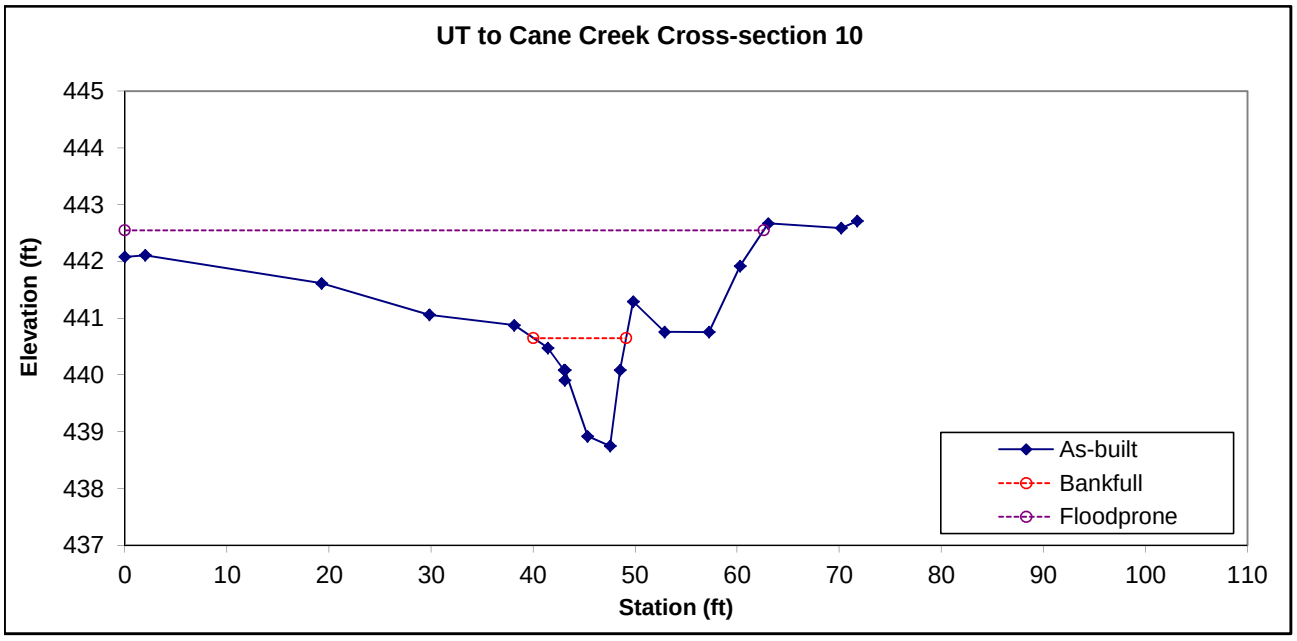
Permanent Cross-section 10

(As-built Data - Collected July 2014)

Looking at the Left Bank

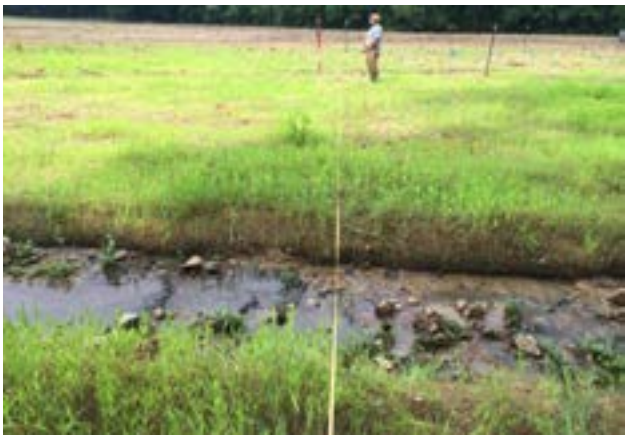
Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	-	8.7	9.11	0.95	1.9	9.55	1.1	6.9	440.65	440.88



Permanent Cross-section 11

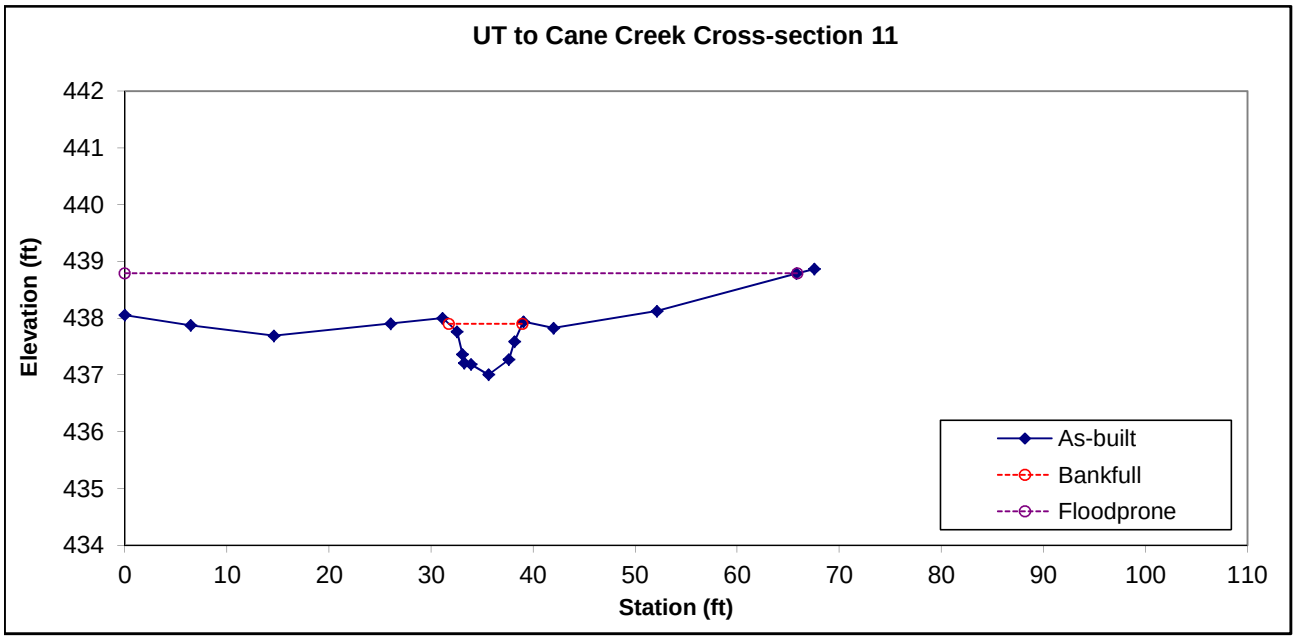
(As-built Data - Collected July 2014)



Looking at the Left Bank

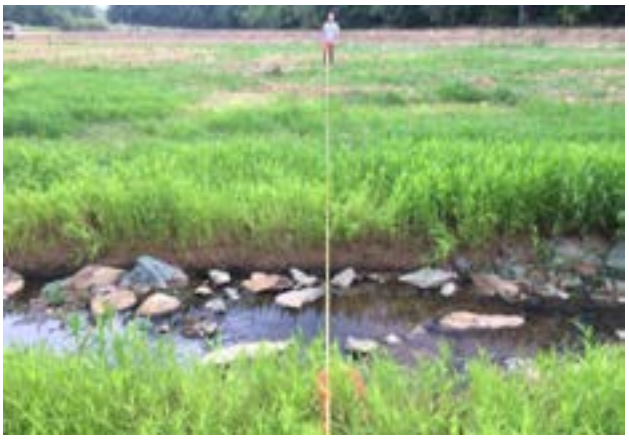
Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	4.1	7.21	0.57	0.89	12.8	1.0	9.1	437.9	437.94



Permanent Cross-section 12

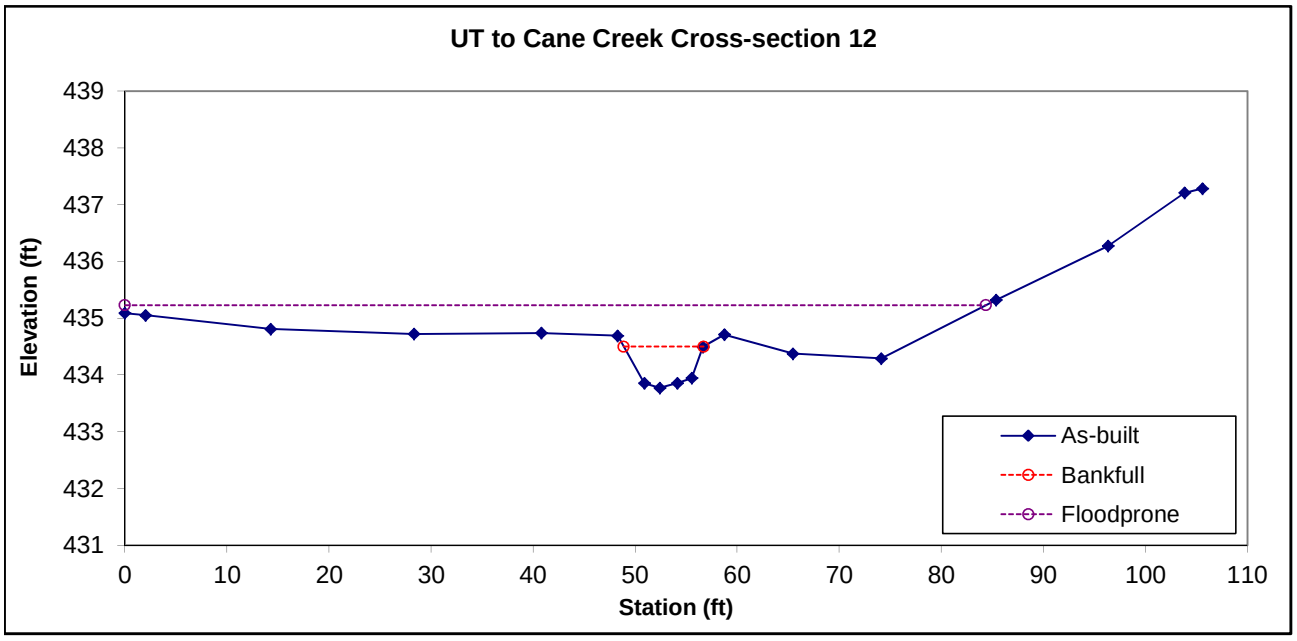
(As-built Data - Collected July 2014)



Looking at the Left Bank

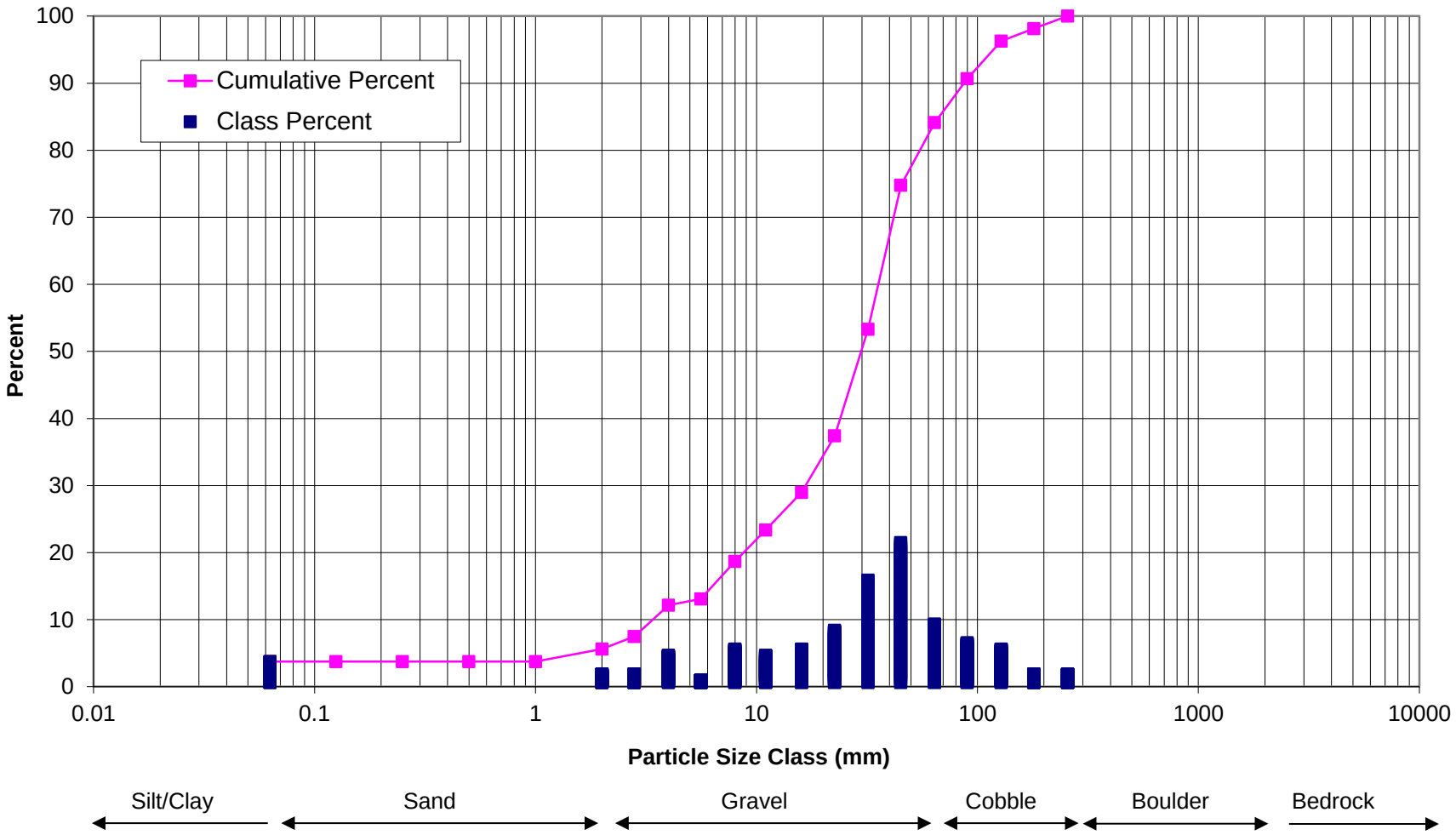
Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	4.0	7.83	0.51	0.73	15.2	1.3	10.8	434.5	434.69



Sediment Distribution - Active Bed Pebble Count

UT to Cane Creek - Reach 5, Riffle Cross-Section 3



PEBBLE COUNT DATA SHEET

SITE OR PROJECT:	UT to Cane Creek
REACH/LOCATION:	Reach 5 at Cross-Section 3
DATE COLLECTED:	7/28/2014
FIELD COLLECTION BY:	SEK
DATA ENTERED BY:	SEK

SEDIMENT ANALYSIS DATA SHEET

			PARTICLE CLASS			Reach Summary		Riffle Summary		Pool Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Pool	Total	Class %	% Cum	Class %	% Cum	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	4.00		4	3.74	3.74	3.74	3.74		#DIV/0!
S A N	Very Fine	.063 - .125					3.74		3.74		#DIV/0!
	Fine	.125 - .25					3.74		3.74		#DIV/0!
	Medium	.25 - .50					3.74		3.74		#DIV/0!
	Coarse	.50 - 1.0					3.74		3.74		#DIV/0!
	Very Coarse	1.0 - 2.0	2.00		2	1.87	5.61	1.87	5.61		#DIV/0!
GRAVEL	Very Fine	2.0 - 2.8	2.00		2	1.87	7.48	1.87	7.48		#DIV/0!
	Very Fine	2.8 - 4.0	5.00		5	4.67	12.15	4.67	12.15		#DIV/0!
	Fine	4.0 - 5.6	1.00		1	0.93	13.08	0.93	13.08		#DIV/0!
	Fine	5.6 - 8.0	6.00		6	5.61	18.69	5.61	18.69		#DIV/0!
	Medium	8.0 - 11.0	5.00		5	4.67	23.36	4.67	23.36		#DIV/0!
	Medium	11.0 - 16.0	6.00		6	5.61	28.97	5.61	28.97		#DIV/0!
	Coarse	16 - 22.6	9		9	8.41	37.38	8.41	37.38		#DIV/0!
	Coarse	22.6 - 32	17		17	15.89	53.27	15.89	53.27		#DIV/0!
	Very Coarse	32 - 45	23		23	21.50	74.77	21.50	74.77		#DIV/0!
	Very Coarse	45 - 64	10		10	9.35	84.11	9.35	84.11		#DIV/0!
COBBLE	Small	64 - 90	7		7	6.54	90.65	6.54	90.65		#DIV/0!
	Small	90 - 128	6		6	5.61	96.26	5.61	96.26		#DIV/0!
	Large	128 - 180	2		2	1.87	98.13	1.87	98.13		#DIV/0!
	Large	180 - 256	2		2	1.87	100.00	1.87	100.00		#DIV/0!
BOULDER	Small	256 - 362					100.00		100.00		#DIV/0!
	Small	362 - 512					100.00		100.00		#DIV/0!
	Medium	512 - 1024					100.00		100.00		#DIV/0!
	Large-Very Large	1024 - 2048					100.00		100.00		#DIV/0!
BEDROCK	Bedrock	> 2048					100.00		100.00		#DIV/0!
			107	0	107			100	100	0	#DIV/0!

Cummulative	
Channel materials	
D_{16} =	6.74
D_{35} =	20.49
D_{50} =	29.79
D_{84} =	63.73
D_{95} =	118.25
D_{100} =	180 - 256

Riffle	
Channel materials	
D_{16} =	6.74
D_{35} =	20.49
D_{50} =	29.79
D_{84} =	63.73
D_{95} =	118.25
D_{100} =	180 - 256

Pool	
Channel materials	
D_{16} =	#N/A
D_{35} =	#N/A
D_{50} =	#N/A
D_{84} =	#N/A
D_{95} =	#N/A
D_{100} =	#N/A

APPENDIX C

Vegetation Summary Data

(Tables 7 and 8)

Table 7. Vegetation Species Planted Across the Restoration Site
UT to Cane Creek Restoration Project: EEP Project ID No. 95729

Botanical Name	Common Name	% Planted by Species	Total Number of Stems
Riparian Buffer Plantings - Overstory			
Betula nigra	river birch	9.0	860
Carpinus caroliniana	ironwood	6.0	570
Fraxinus pennsylvanica	green ash	9.0	860
Liriodendron tulipfera	tulip poplar	6.0	570
Platanus occidentalis	American sycamore	9.0	860
Quercus alba	white oak	9.0	860
Quercus michauxii	swamp chestnut oak	6.0	570
Quercus nigra	water oak	6.0	570
Riparian Buffer Plantings - Understory			
Asimina triloba	paw paw	6.0	570
Diospyros virginiana	persimmon	6.0	570
Hamamelis virginiana	witch hazel	6.0	570
Itea virginica	Virginia sweetspire	8.0	760
Lindera benzoin	spicebush	8.0	760
Viburnum dentatum	arrowwood Viburnum	6.0	570
Riparian Live Stake Plantings			
Cornus amomum	silky dogwood	10%	NA
Salix nigra	black willow	10%	NA
Salix sericea	silky willow	40%	NA
Sambucus canadensis	elderberry	40%	NA

Table 8. Stem Count for Each Species Arranged by Plot
UT to Cane Creek Restoration Project: EEP Project ID No. 95729

Botanical Name	Common Name	Plots					
		1	2	3	4	5	6
Tree Species							
Betula nigra	river birch	4	1				2
Carpinus caroliniana	ironwood	2	1		1		3
Fraxinus pennsylvanica	green ash	1	8		2		4
Liriodendron tulipfera	tulip poplar						
Platanus occidentalis	American sycamore	4					
Quercus alba	white oak						
Quercus michauxii	swamp chestnut oak	1			2		3
Quercus nigra	water oak						
Quercus spp.	unknown oak	1					
Shrub Species							
Asimina triloba	paw paw	1					
Diospyros virginiana	persimmon	1					
Hamamelis virginiana	witch hazel						
Itea virginica	Virginia sweetspire						
Lindera benzoin	spicebush						
Viburnum dentatum	arrowwood viburnum						
Unknown	unknown	7	7	16	13	19	1
Stems/plot		22	17	16	17	19	13
Stems/acre		880	680	640	680	760	520
Total Stems/ Acre for Year 0 As-Built (Baseline Data)		**693**					

APPENDIX D

As-Built Plan Sheets/Record Drawings

STATE	EEP PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	132700	1	15
EEP ID No. 95729			

UT TO CANE CREEK

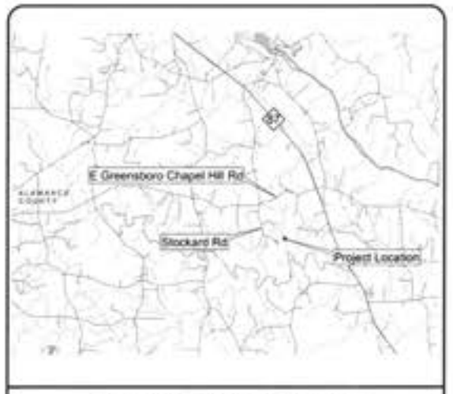
PROJECT: 132700

NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

ALAMANCE COUNTY

LOCATION: APPROXIMATELY 3 MILES SOUTH OF THE TOWN OF SAXAPAHAW

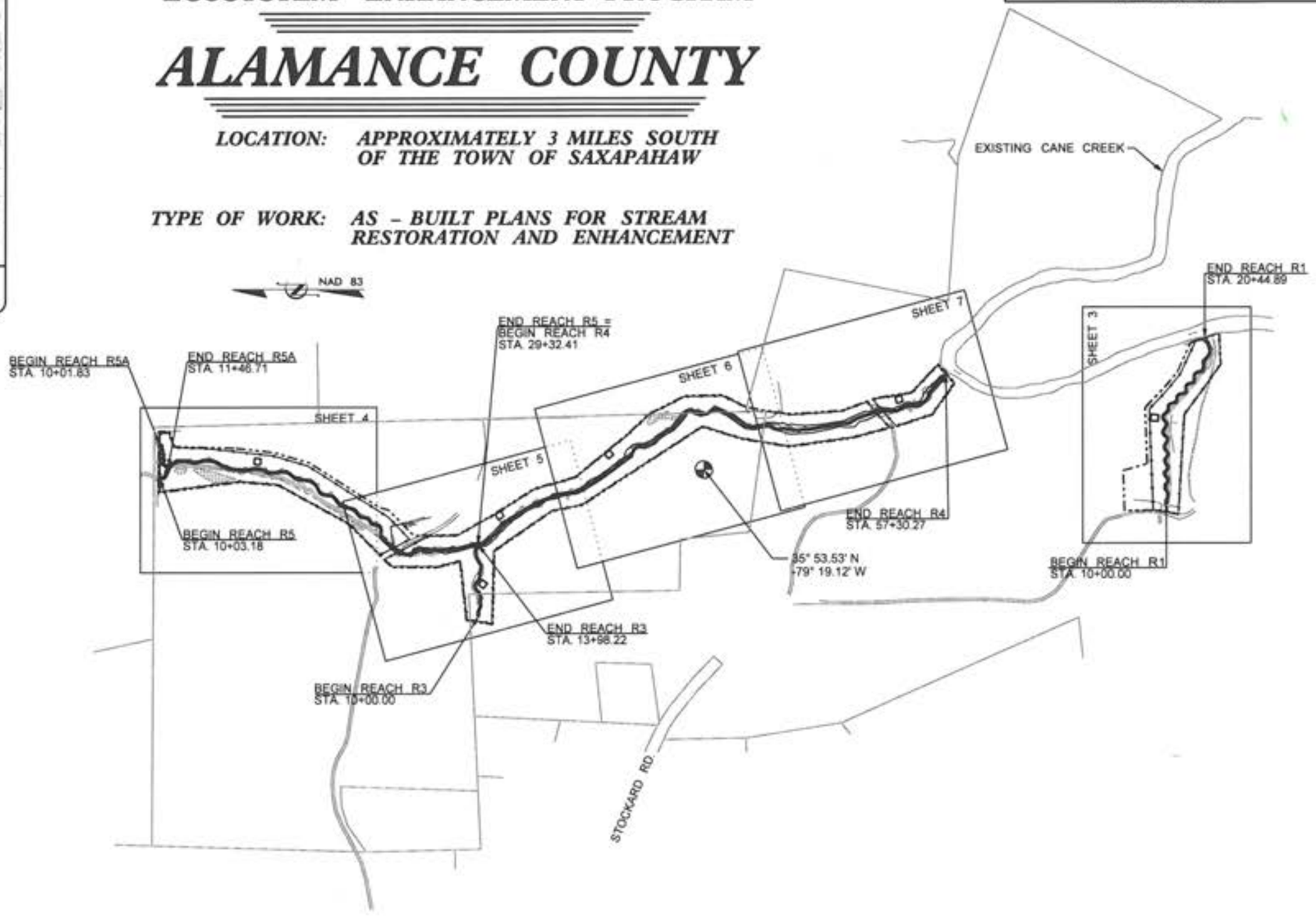
TYPE OF WORK: AS – BUILT PLANS FOR STREAM RESTORATION AND ENHANCEMENT



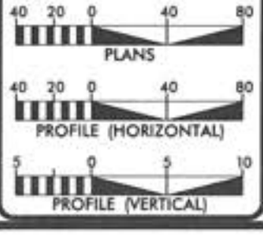
VICINITY MAP

INDEX OF SHEETS

DWR PROJECT #13-1177
USACE ACTION ID #2012-01907
APPROVAL DATE 02/19/14



GRAPHIC SCALES



PROJECT SUMMARY

AS-BUILT RESTORATION LENGTH REACH R1	=	1,045 FEET
AS-BUILT RESTORATION LENGTH REACH R3	=	398 FEET
AS-BUILT RESTORATION LENGTH REACH R4	=	410 FEET
AS-BUILT ENHANCEMENT LENGTH REACH R4	=	2,353 FEET
AS-BUILT RESTORATION LENGTH REACH R5	=	1,461 FEET
AS-BUILT ENHANCEMENT LENGTH REACH R5	=	433 FEET
AS-BUILT ENHANCEMENT LENGTH REACH R5A	=	145 FEET

PREPARED FOR THE OFFICE OF:

Ecosystem Enhancement Program

NCDENR
ECOSYSTEM ENHANCEMENT PROGRAM
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

NCEEP CONTACT: JEFF SCHAFFER, PROJECT MANAGER

PREPARED IN THE OFFICE OF:

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

JUNE 2014
COMPLETION DATE

WILLIAM SCOTT HUNT, III, PE
PROJECT ENGINEER

KAYNE VAN STELL
PROJECT MANAGER

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III

6.22.14

SIGNATURE P.E.

PROJECT REFERENCE NO.	SHEET NO.
132700	1-A

PROJECT ENGINEER

Baker

Michael Baker Engineering Inc.

EEP ID No. 95729

STREAM CONVENTIONAL SYMBOLS

SUPERCEDES SHEET 1-B

- ROCK J-HOOK
- ROOT WAD
- LOG J-HOOK
- LOG VANE
- LOG WEIR
- CONSTRUCTED RIFFLE
- BOULDER CLUSTER
- LOG STEP POOL
- PERMANENT STREAM CROSSING
- VEGETATION PLOT
- CONTROL POINT
- CREST GAUGE
- FIELD FENCE
- CONSERVATION EASEMENT
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- LIMITS OF DISTURBANCE
- PROPERTY LINE
- DITCH PLUG
- CHANNEL FILL
- BRUSH MATTRESS
- GEOLIFT WITH BRUSH TOE

GENERAL NOTES

1. CONSTRUCTION BEGAN IN MARCH 2014 AND WAS COMPLETED IN JUNE 2014.
2. VEGETATION PLANTING BEGAN IN APRIL 2014 AND WAS COMPLETED IN JUNE 2014.

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

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22967 WILLIAM SCOTT HUNT, III
10.22.14

VEGETATION SELECTION

The following table lists the bare root vegetation selection for the project site. Total planting area is approximately 14 acres. Species were planted at density of 680 stems per acre and a minimum of 50 feet from the stream banks to the revegetation limits. Exact placement of species were determined prior to site planting and based on apparent wetness of planting locations and per the vegetation specialist. Refer to the Revegetation Plan Sheets & Construction Specifications for vegetation planting locations and riparian buffer requirements.

Riparian Buffer - Overstory Trees (8'x8' spacing - 680 stems/acre)				
Scientific Name	**Common Name**	**% Planted By Species**	**Wetland Tolerance**	**Approx. Number of Stems**
Fraxinus pennsylvanica	Green Ash	9%	FACW	860
Betula nigra	River Birch	9%	FACW	860
Liriodendron tulipifera	Tulip Poplar	6%	FAC	570
Quercus michauxii	Swamp Chestnut Oak	6%	FACW-	570
Carpinus caroliniana	Ironwood	6%	FAC	570
Platanus occidentalis	American Sycamore	9%	FACW-	860
Quercus alba	White Oak	9%	FACU	860
Quercus nigra	White Oak	6%	FACU	570
	Sub-total	60%		**5,720**
Riparian Buffer - Understory (8'x8' spacing - 680 stems/acre)				
Scientific Name	**Common Name**			
Diospyros virginiana	Persimmon	6%	FAC	570
Lindera benzoin	Spicebush	8%	FACW	760
Hamamelis virginiana	Witch hazel	6%	FAC-	570
Viburnum dentatum	Arrowwood Viburnum	6%	FAC	570
Itea virginica	Virginia sweetspire	8%	FACW+	760
Asimina triloba	Paw paw	6%	FAC	570
	Sub-total	40%		**3,800**
	Total Bare-roots			**9,520**

Permanent herbaceous seed mixtures for the project site were planted throughout the floodplain and riparian buffer areas. Permanent seed mixtures were applied with temporary seed, as defined in the construction specifications.

Scientific Name	Common Name	% Planted By Species	Total lbs per Acre	Wetland Tolerance
Andropogon gerardii	Big blue stem	10%	1.50	FAC
Dichanthelium clandestinum	Deer Tongue	15%	1.50	FACW
Carex crinata	Fringed sedge	10%	2.25	FACW+
Chasmanthium latifolium	River oats	5%	1.50	FACU
Elymus virginicus	Virginia wild rye	15%	1.50	FAC
Juncus effusus	Soft rush	5%	2.25	FACW+
Panicum virgatum	Switchgrass	10%	1.50	FAC+
Polygonum pensylvanicum	Pennsylvania Smartweed	5%	0.75	FACW
Schizachyrium scoparium	Little blue stem	10%	0.75	FACU
Tripsacum dactyloides	Eastern gamagrass	5%	0.75	FAC+
Sorghastrum nutans	Indiangrass	10%	0.75	FACU
	Total	**100%**	**15.0**	

The following table lists temporary seed mix for the project site. All disturbed areas were stabilized using mulch and temporary seed as defined in the construction specifications.

Planting Dates	Species Name	Rate (lbs./acre)
September to March	Rye Grain (Cool Season)	130
April to August	Browntop Millet (Warm Season)	40

Live staking was applied to all restored streambanks following the details in this plan set and according to the construction specifications.

Scientific Name	Common Name	% Planted By Species	Wetland Tolerance
Cornus amomum	Silky Dogwood	10%	FACW+
Salix nigra	Black Willow	10%	OBL
Salix sericea	Silky Willow	40%	OBL
Sambucus canadensis	Elderberry	40%	FACW-

PROJECT REFERENCE NO.	SHEET NO.
13270O	1-B

EEP ID No. 95729

*S.U.E = SUBSURFACE UTILITY ENGINEER

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

CONVENTIONAL SYMBOLS

NORTH CAROLINA PROFESSIONAL SEAL 22867 ENGINEER WILLIAM SCOTT HUNT, III
10.22.14

BOUNDARIES AND PROPERTY:

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin
- Property Corner
- Property Monument
- Parcel/Sequence Number
- Existing Fence Line
- Proposed Woven Wire Fence
- Proposed Chain Link Fence
- Proposed Barbed Wire Fence
- Existing Wetland Boundary
- Proposed Wetland Boundary
- Existing Endangered Animal Boundary
- Existing Endangered Plant Boundary

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
- Buffer Zone 1
- Buffer Zone 2
- Flow Arrow
- Disappearing Stream
- Spring
- Wetland
- Proposed Lateral, Tail, Head Ditch
- False Sump

RAILROADS:

- Standard Gauge
- RR Signal Milepost
- 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
- Proposed Temporary Construction Easement
- Proposed Temporary Drainage Easement
- Proposed Permanent Drainage Easement
- Proposed Permanent Utility Easement
- Proposed Temporary Utility Easement
- Proposed Permanent Easement with Iron Pin and Cap Marker

ROADS AND RELATED FEATURES:

- Existing Edge of Pavement
- Existing Curb
- Proposed Slope Stakes Cut
- Proposed Slope Stakes Fill
- Proposed Wheel Chair Ramp
- 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

EXISTING STRUCTURES:

MAJOR:
- Bridge, Tunnel or Box Culvert
- Bridge Wing Wall, Head Wall and End Wall

MINOR:
- Head and End Wall
- Pipe Culvert
- Footbridge
- Drainage Box: Catch Basin, DI or JB
- Paved Ditch Gutter
- Storm Sewer Manhole
- Storm Sewer

UTILITIES:

POWER:
- Existing Power Pole
- Proposed Power Pole
- Existing Joint Use Pole
- Proposed Joint Use Pole
- Power Manhole
- Power Line Tower
- Power Transformer
- U/G Power Cable Hand Hole
- H-Frame Pole
- Recorded U/G Power Line
- Designated U/G Power Line (S.U.E.*)

TELEPHONE:
- Existing Telephone Pole
- Proposed Telephone Pole
- Telephone Manhole
- Telephone Booth
- Telephone Pedestal
- Telephone Cell Tower
- U/G Telephone Cable Hand Hole
- Recorded U/G Telephone Cable
- Designated U/G Telephone Cable (S.U.E.*)
- Recorded U/G Telephone Conduit
- Designated U/G Telephone Conduit (S.U.E.*)
- Recorded U/G Fiber Optics Cable
- Designated U/G Fiber Optics Cable (S.U.E.*)

WATER:
- Water Manhole
- Water Meter
- Water Valve
- Water Hydrant
- Recorded U/G Water Line
- Designated U/G Water Line (S.U.E.*)
- Above Ground Water Line

TV:
- TV Satellite Dish
- TV Pedestal
- TV Tower
- U/G TV Cable Hand Hole
- Recorded U/G TV Cable
- Designated U/G TV Cable (S.U.E.*)
- Recorded U/G Fiber Optic Cable
- Designated U/G Fiber Optic Cable (S.U.E.*)

GAS:
- Gas Valve
- Gas Meter
- Recorded U/G Gas Line
- Designated U/G Gas Line (S.U.E.*)
- Above Ground Gas Line

SANITARY SEWER:
- Sanitary Sewer Manhole
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line
- Above Ground Sanitary Sewer
- Recorded SS Forced Main Line
- Designated SS Forced Main Line (S.U.E.*)

MISCELLANEOUS:
- Utility Pole
- Utility Pole with Base
- Utility Located Object
- Utility Traffic Signal Box
- Utility Unknown U/G Line
- 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.

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	2

PROJECT ENGINEER

Baker

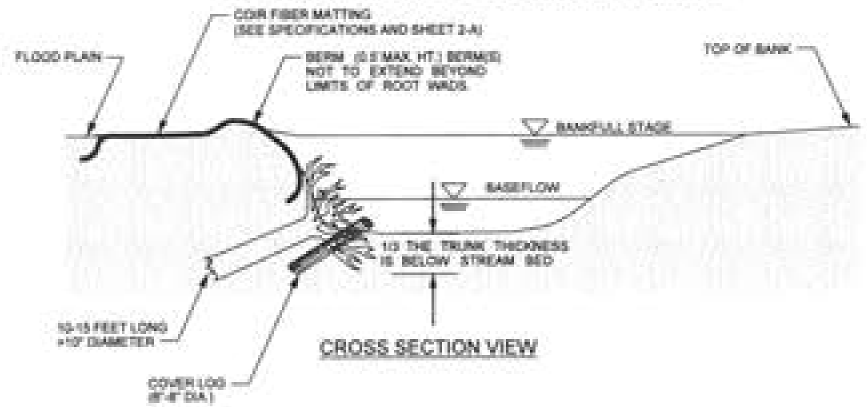
Michael Baker Engineering Inc.

EEP ID No. 95729

ROOT WADS

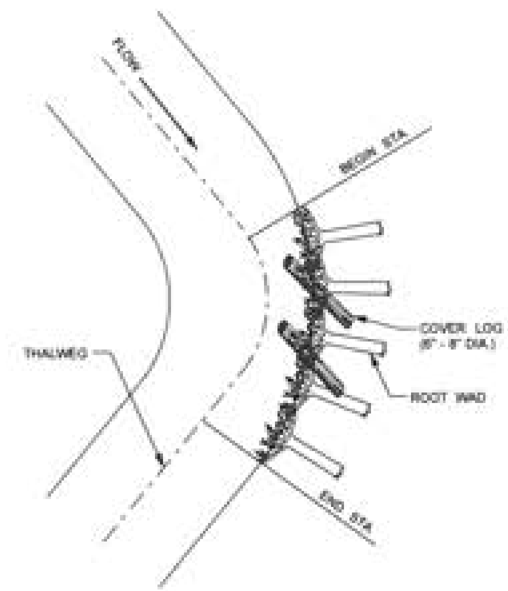
ROOT WADS WITHOUT TRANSPLANTS

USE IF TRANSPLANTS ARE NOT AVAILABLE ON-SITE



CROSS SECTION VIEW

PLAN VIEW



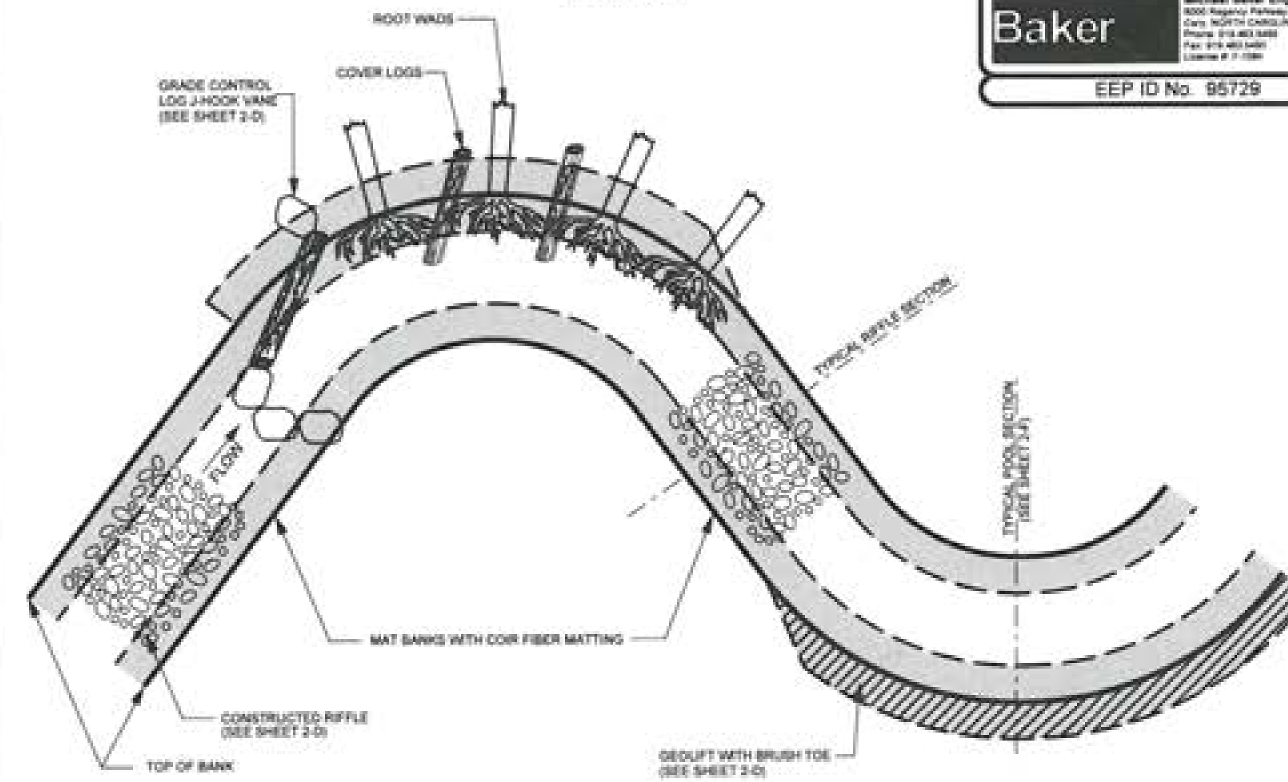
NOTES:

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.

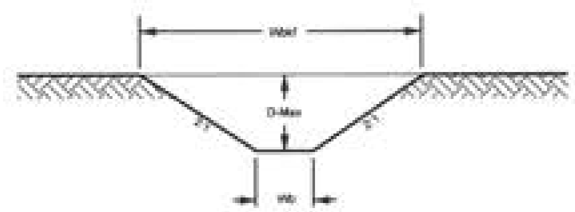
TYPICAL STRUCTURE PLACEMENT

STRUCTURE NOTES:

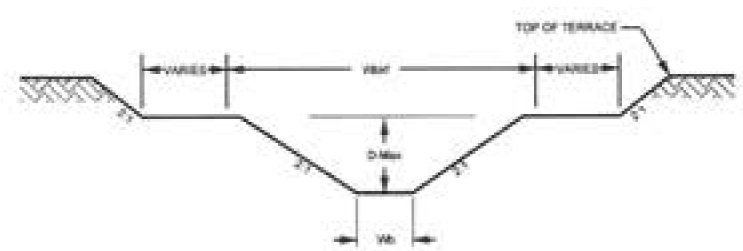
1. GENERALLY CONSTRUCTED RIFFLES, ROOT WADS, LOG VANES AND COIR FIBER MATTING WILL BE INSTALLED IN THE LOCATION AND SEQUENCE AS SHOWN.
2. ANY CHANGES TO NUMBER OR LOCATION OF STRUCTURES DURING CONSTRUCTION MUST BE APPROVED BY THE DESIGN ENGINEER.
3. COIR FIBER MATTING TO BE INSTALLED ON ALL RESTORED STREAMBANKS, FLOODPLAIN BENCHING, AND TERRACE SLOPES AS DESCRIBED IN THE TECHNICAL SPECIFICATIONS.



TYPICAL RIFFLE, POOL, AND BANKFULL BENCH CROSS-SECTIONS

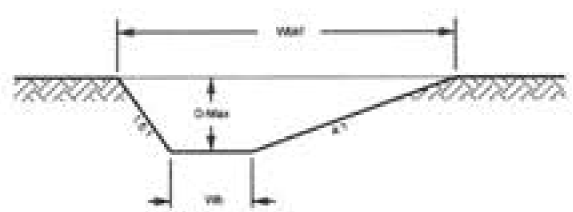


RIFFLE

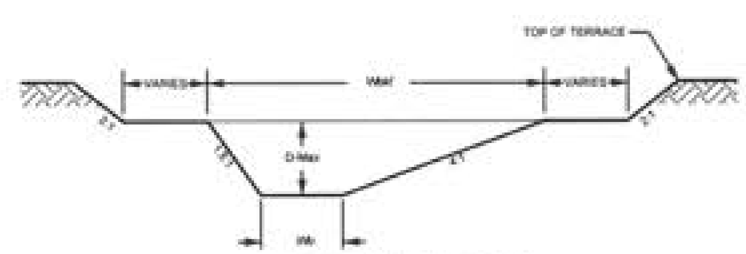


RIFFLE WITH BANKFULL BENCH

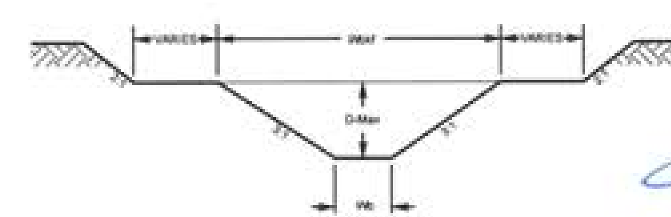
R1		R3		R4		R5		R5A		
RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	
8.8	9.0	7.2	9.2	14.0	17.0	10.8	13.0	3.3	5.0	WIDTH OF BANKFULL (Wbkf)
0.7	1.5	0.7	1.3	1.2	2.2	1.1	2.0	0.4	1.0	MAXIMUM DEPTH (D-Max)
13.0	11.1	13.0	12.3	14.0	12.8	13.0	12.1	12.0	10.0	WIDTH TO DEPTH RATIO (Wbkf / D)
3.7	7.3	4.0	8.9	14.0	22.9	9.0	14.0	0.9	2.5	BANKFULL AREA (Abkf)
4.3	0.8	4.5	1.4	9.2	3.8	6.2	1.0	1.3	0.1	BOTTOM WIDTH (Wb)



POOL



POOL WITH BANKFULL BENCH



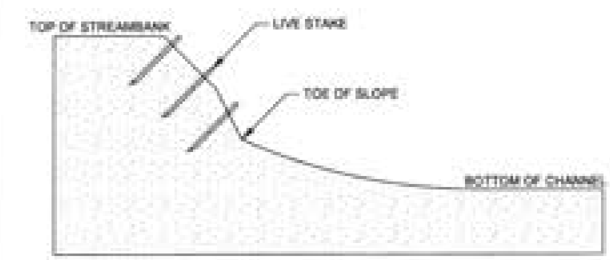
STEP - POOL

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22967 WILLIAM SCOTT HUNT, III 10.22.14

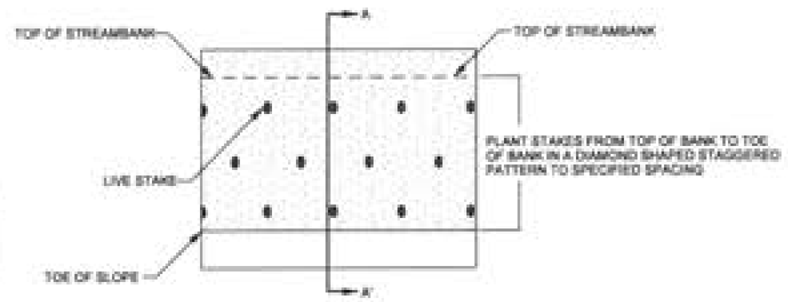
NOTES:

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.

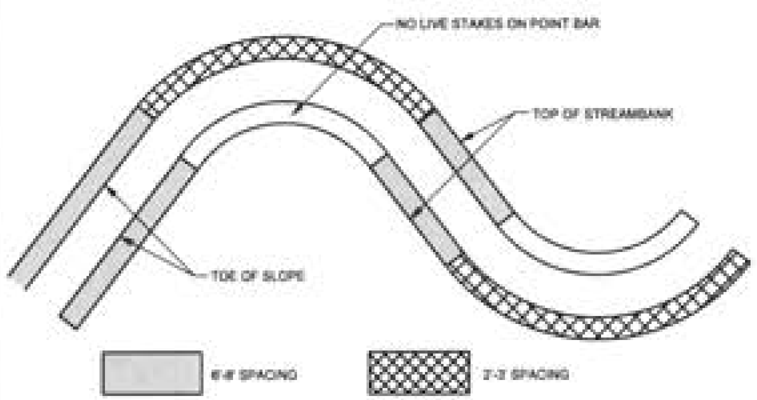
LIVE STAKING



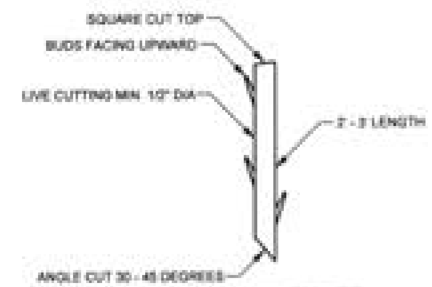
SECTION A - A'



PLAN VIEW



LIVE STAKE SPACING PLAN VIEW

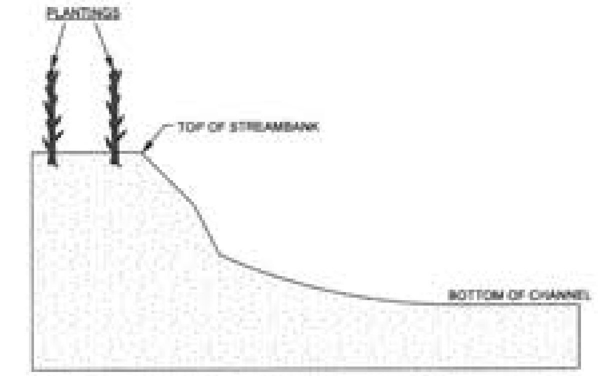


LIVE STAKE DETAIL

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.

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	2-A

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EEP ID No.: 95729

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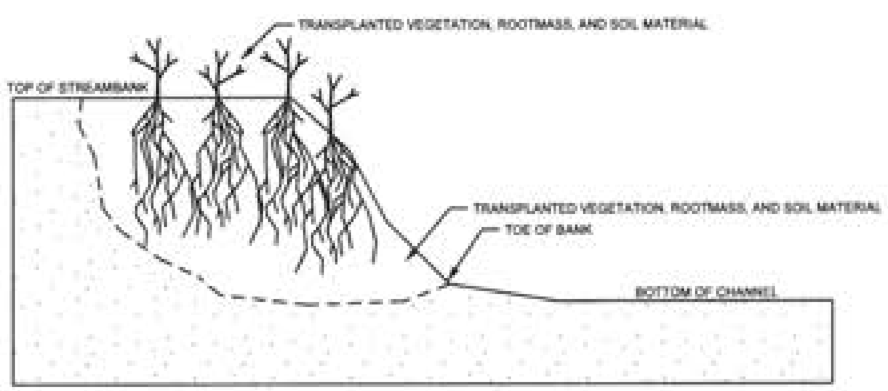
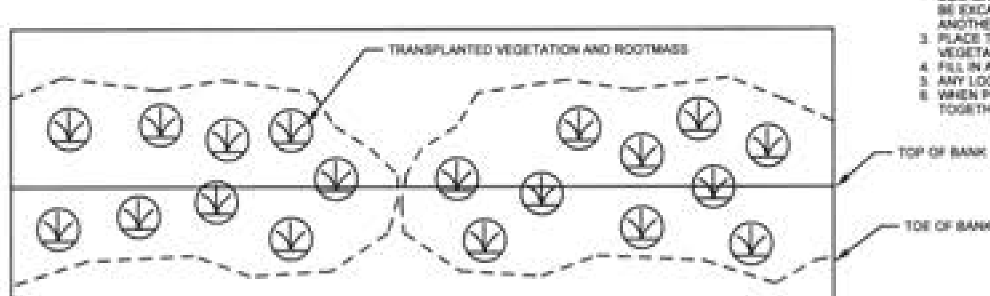
10.22.14

TRANSPLANTED VEGETATION



CROSS SECTION VIEW



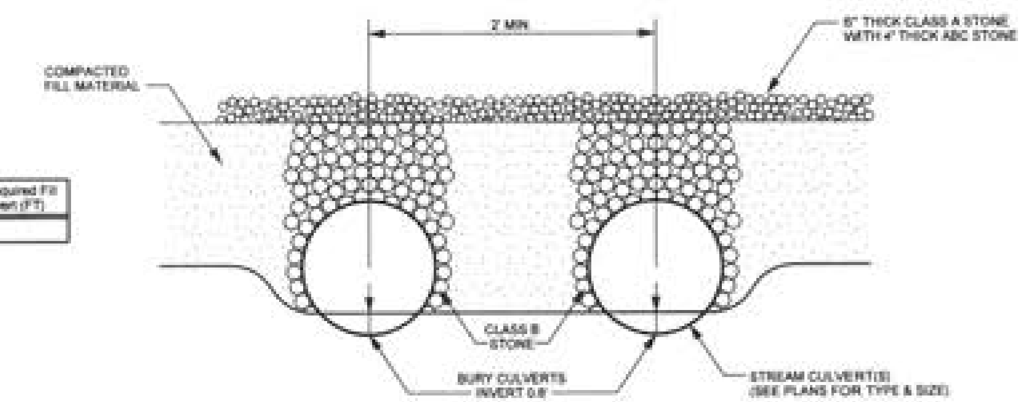
PLAN VIEW

NOTES:

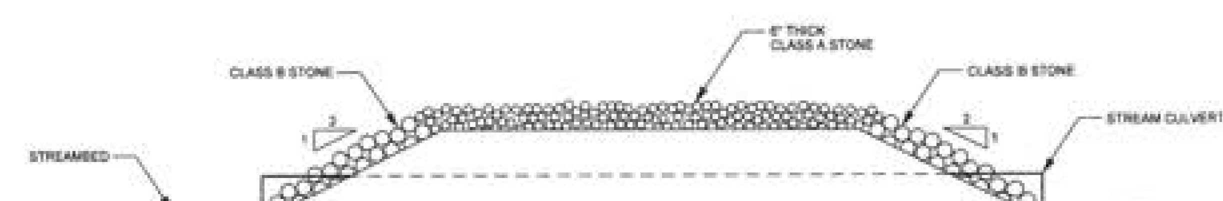
1. EXCAVATE A HOLE IN THE BANK TO BE STABILIZED THAT WILL ACCOMMODATE THE SIZE OF TRANSPLANT TO BE PLACED. BEGIN EXCAVATION AT THE TOE OF THE BANK.
2. EXCAVATE THE ENTIRE ROOT MASS AND AS MUCH ADDITIONAL SOIL MATERIAL AS POSSIBLE. IF ENTIRE ROOT MASS CAN NOT BE EXCAVATED AT ONCE, THE TRANSPLANT IS TOO 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.

PERMANENT ROAD CULVERT CROSSING

Culvert Type	Depth of Required Fill Over Culvert (FT)
STREAM	2.0



PROFILE VIEW ALONG ROAD



CROSS SECTION

NOTES:

1. APPLY SUFFICIENT FILL OVER CULVERTS TO PREVENT CULVERT COLLAPSE.
2. STABILIZE FILL AROUND CULVERTS WITH CLASS B STONE. STABILIZE REMAINING ROADSIDE SLOPES WITH EROSION MATTING ACCORDING TO SPECIFICATIONS.
3. CULVERT SPACING A MINIMUM OF 2' APART.

BAKER PROJECT REFERENCE NO.	SHEET NO.
132100	2-B

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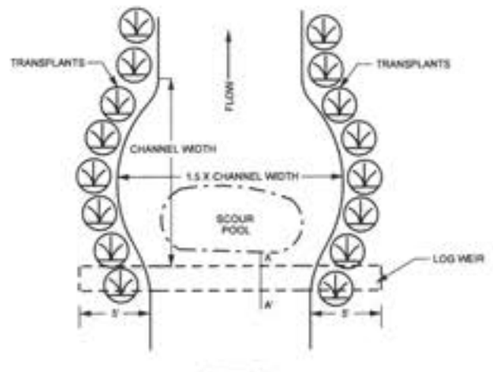
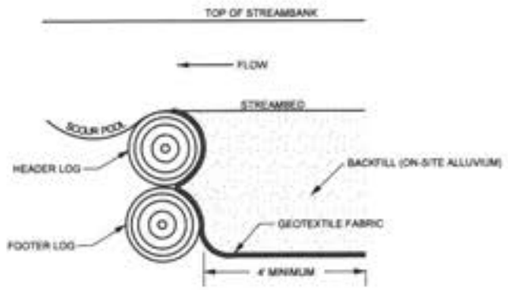
EEP ID No. 95729

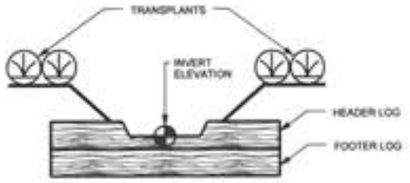
LOG WEIR



PLAN VIEW



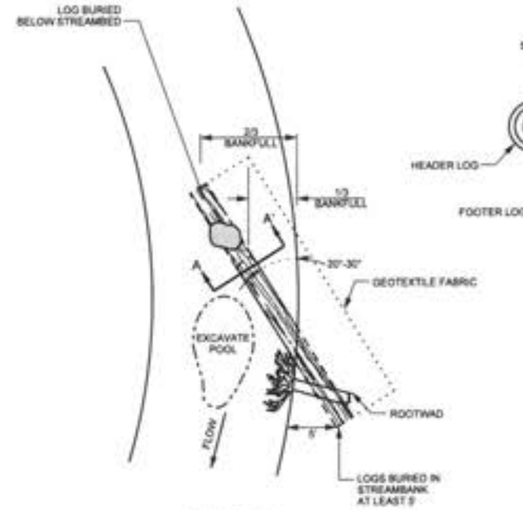
SECTION A-A'



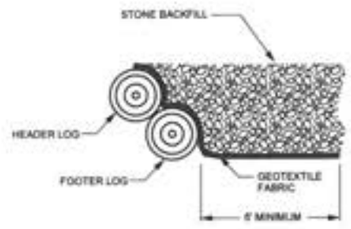
CROSS SECTION VIEW

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.

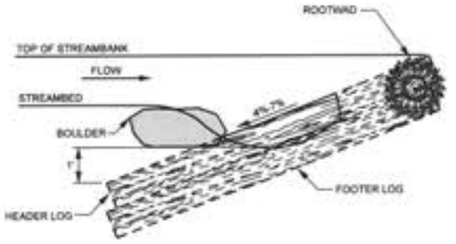
LOG VANE



PLAN VIEW



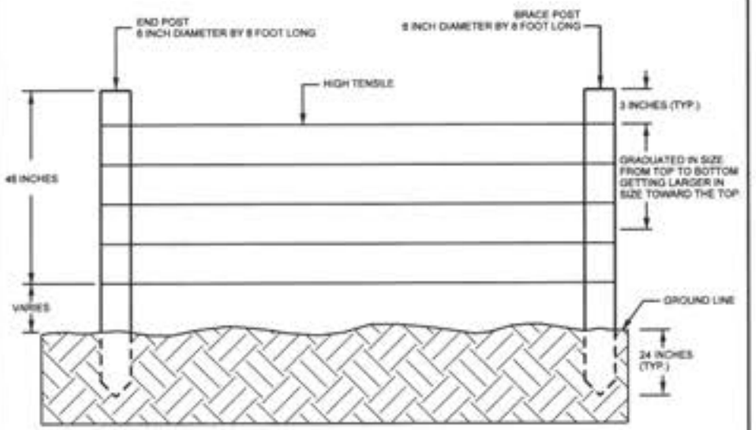
SECTION A - A'



PROFILE VIEW

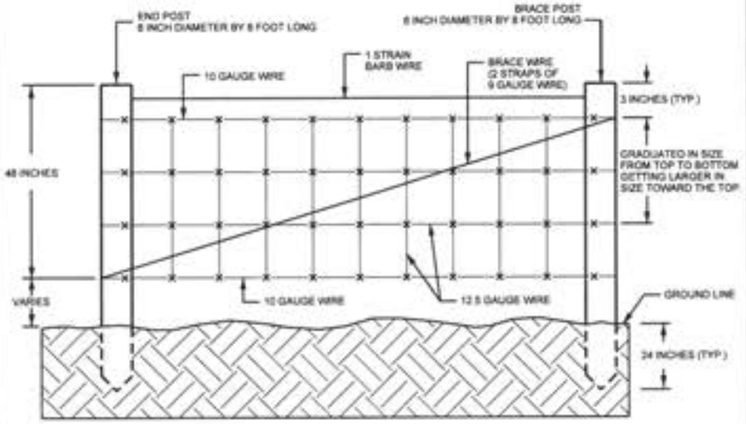
NOTES:
1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. BOULDERS MUST BE OF SUFFICIENT SIZE TO ANCHOR LOGS.
3. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOGS.
4. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS 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.

HIGH TENSILE FIELD FENCE



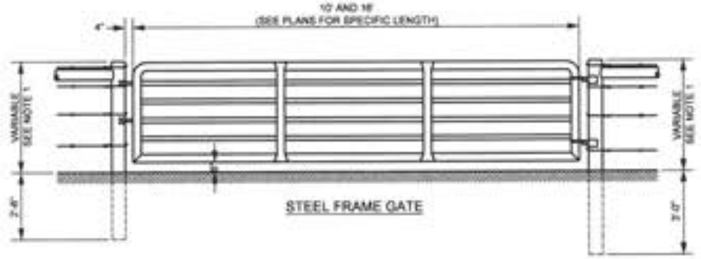
NOTE:
1. END POSTS SHALL BE INSTALLED AT A SPACING OF 10-15 FEET.

WOVEN FIELD FENCE



NOTE:
1. END POSTS SHALL BE INSTALLED AT A SPACING OF 10-15 FEET.

STEEL GATES



STEEL FRAME GATE

NOTES:
1. POST HEIGHT DIMENSION SHALL BE THE SAME AS REQUIRED FOR THE ADJACENT FENCE.
2. CONSTRUCT AN END OR STRESS PANEL, AS REQUIRED IN THE SPECIFICATION, ON EACH SIDE OF GATE.
3. HINGES AND LOCKS SHALL BE INSTALLED AS SPECIFIED BY GATE MANUFACTURER.

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
10.22.14

REVISIONS
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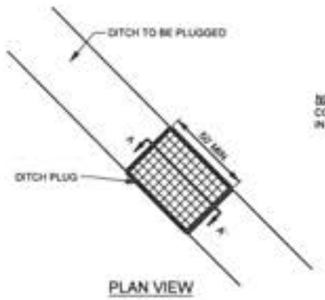
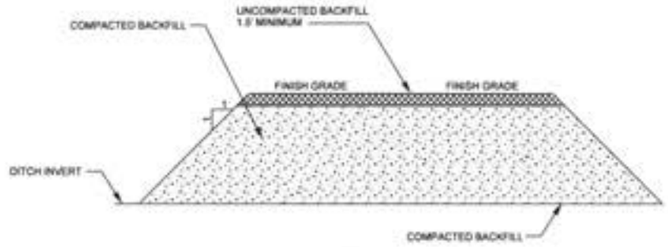
UTCANEOR, 95729, AB, BAKER, FINAL

DITCH PLUG



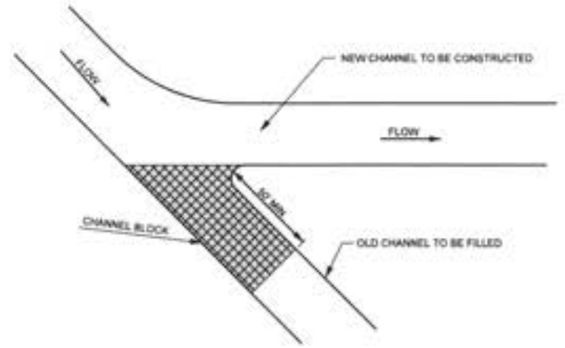
NOTE:
COMPACT BACKFILL USING ON-SITE HEAVY EQUIPMENT IN 10 INCH LIFTS

PLAN VIEW

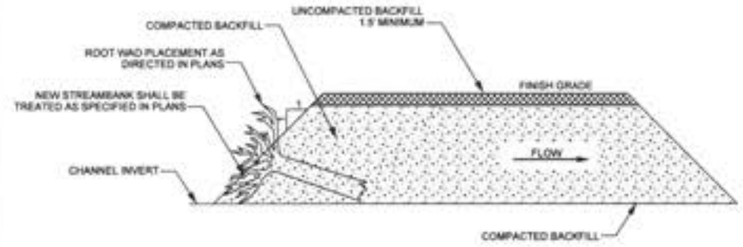


SECTION A - A'

CHANNEL BLOCK



PLAN VIEW



PROFILE VIEW

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	2C

PROJECT ENGINEER

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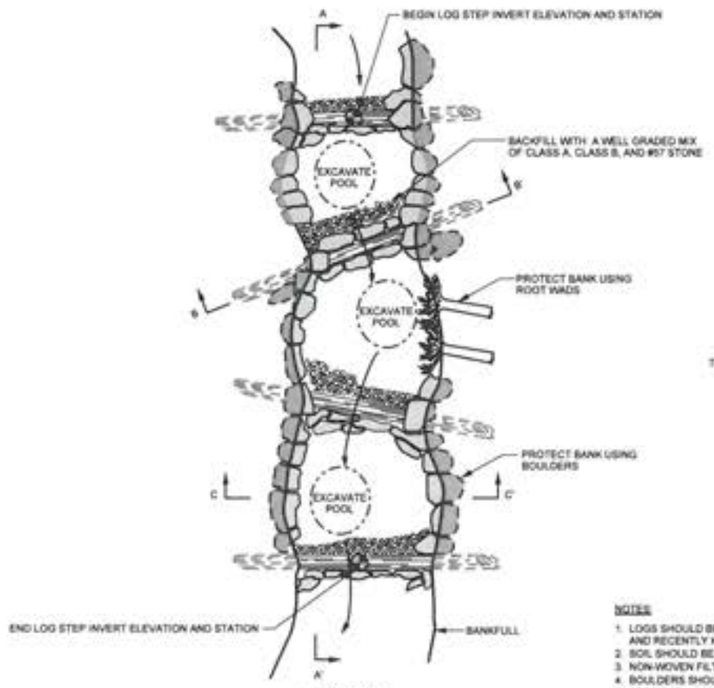
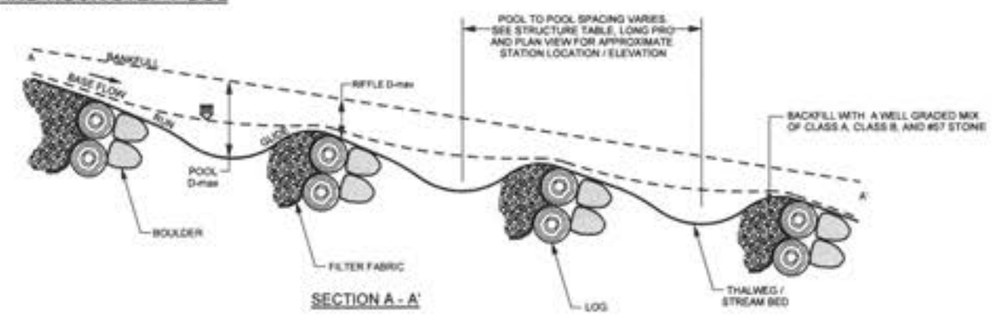
10.22.14

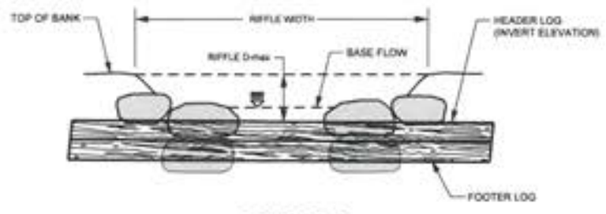
LOG AND ROCK STEP-POOL



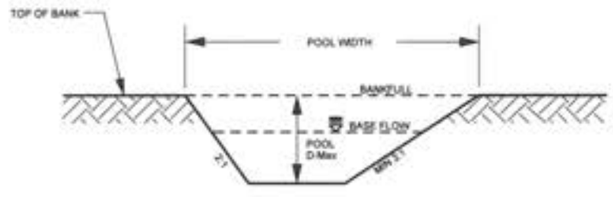
PLAN VIEW



SECTION A - A'



SECTION B - B'



SECTION C - C'

NOTES:

1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED AND EXTENDING INTO THE BANK 5' ON EACH SIDE.
2. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
3. NON-WOVEN FILTER FABRIC SHOULD BE NAILED/STAPLED TO THE LOG BELOW THE BACKFILL.
4. BOULDERS SHOULD BE 3' X 2' X 2' AND PLACED ON TOP OF HEADER LOG FOR ANCHORING.
5. LOGS SHOULD BE ANGLED 60° - 70° FROM THE STREAM BANK AND CROSS SLOPES SHOULD NOT EXCEED 2%.
6. STEP HEIGHTS/DROPS SHALL NOT EXCEED 0.4 FT AND POOL DEPTHS NOT TO EXCEED 1.6 FT.
7. THE NUMBER LOG STEPS MAY VARY BETWEEN BEGIN AND END STATIONING DEPENDING ON LOG DIAMETER SIZE. SEE LONGITUDINAL PROFILE AND STRUCTURE TABLE FOR STATION AND ELEVATION.

2/26/09

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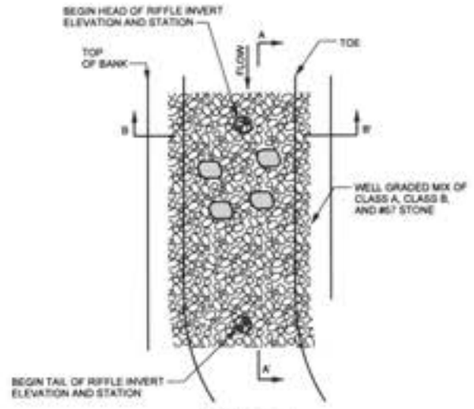
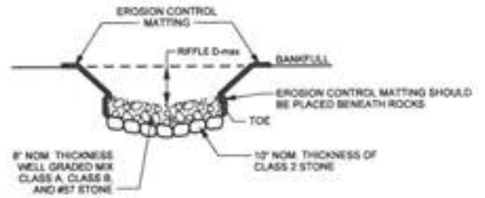
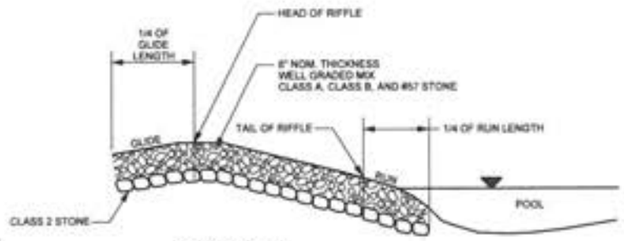
CONSTRUCTED RIFFLE



PLAN VIEW



SECTION B - B'

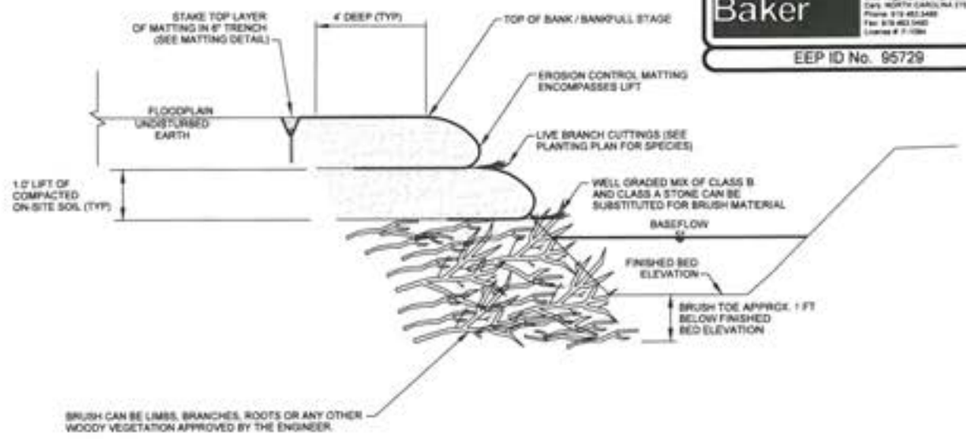


PROFILE A - A'

NOTES:
1. UNDERCUT CHANNEL BED ELEVATION 18 INCHES TO ALLOW FOR LAYERS OF STONE.
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 SUB LAYER OF CLASS 2 STONE.
4. INSTALL A WELL GRADED MIX OF SPECIFIED STONE, COMPACTED TO GRADE.
5. 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.
6. RIFFLE LENGTHS WILL VARY. SEE LONGITUDINAL PROFILE AND STRUCTURE TABLE FOR BEGINNING AND ENDING STATIONS AND ELEVATIONS.

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/ON ADJACENT TO HILL SLOPES.



NOTES:
1. WHEN GEOLIFTS ARE BUILT ABOVE ROOTWAD CLUSTER, USE LARGE STONE BACKFILL BEHIND ROOT MASS TO BUILT FOUNDATION

BAKER PROJECT REFERENCE NO. 132700 | SHEET NO. 2-D
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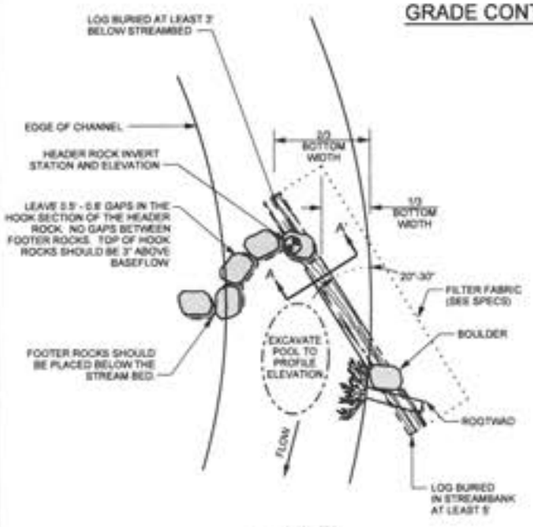
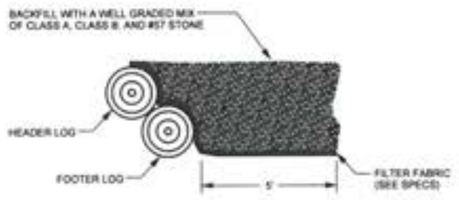
EEP ID No. 95729

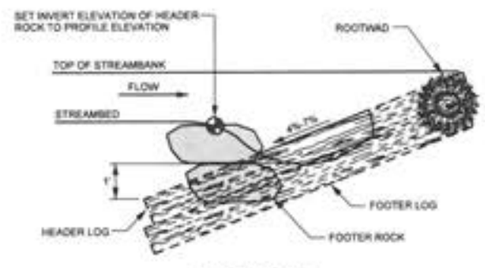
GRADE CONTROL LOG J-HOOK VANE



PLAN VIEW



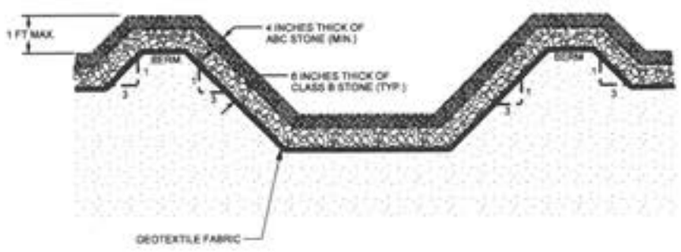
SECTION A - A'



PROFILE VIEW

NOTES:
1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. BOULDERS MUST BE 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 SECURES 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 0.8 FEET APART.
7. NON-WOVEN FILTER FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
8. FOOTERS SHALL BE INSTALLED SUCH THAT 1/4 TO 1/3 OF THE LENGTH IS DOWNSTREAM OF THE HEADER.

PERMANENT FORD STREAM CROSSING



NOTES:
1. CONSTRUCT STREAM CROSSING WHEN FLOW IS LOW.
2. HAVE ALL NECESSARY MATERIALS AND EQUIPMENT ON-SITE BEFORE WORK BEGINS.
3. MINIMIZE CLEARING AND EXCAVATION OF STREAMBANKS. DO NOT EXCAVATE CHANNEL BOTTOM. COMPLETE ONE SIDE BEFORE STARTING ON THE OTHER SIDE.
4. INSTALL STREAM CROSSING AT RIGHT ANGLE TO THE FLOW.
5. GRADE SLOPES TO A 3:1 SLOPE. TRANSPLANT SOD FROM ORIGINAL STREAMBANK ONTO SIDE SLOPES.
6. MAINTAIN CROSSING SO THAT RUNOFF IN THE CONSTRUCTION ROAD DOES NOT ENTER EXISTING CHANNEL.
7. A STABILIZED PAD OF STONE BACKFILL, 6 INCHES THICK, LINED WITH GEOTEXTILE FABRIC SHALL BE USED OVER THE BERM AND ACCESS SLOPES.
8. WIDTH OF THE CROSSING SHALL BE SUFFICIENT TO ACCOMMODATE THE LARGEST VEHICLE CROSSING THE CHANNEL.
9. CONTRACTOR SHALL DETERMINE AN APPROPRIATE RAMP ANGLE ACCORDING TO EQUIPMENT UTILIZED.

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
6.27.14

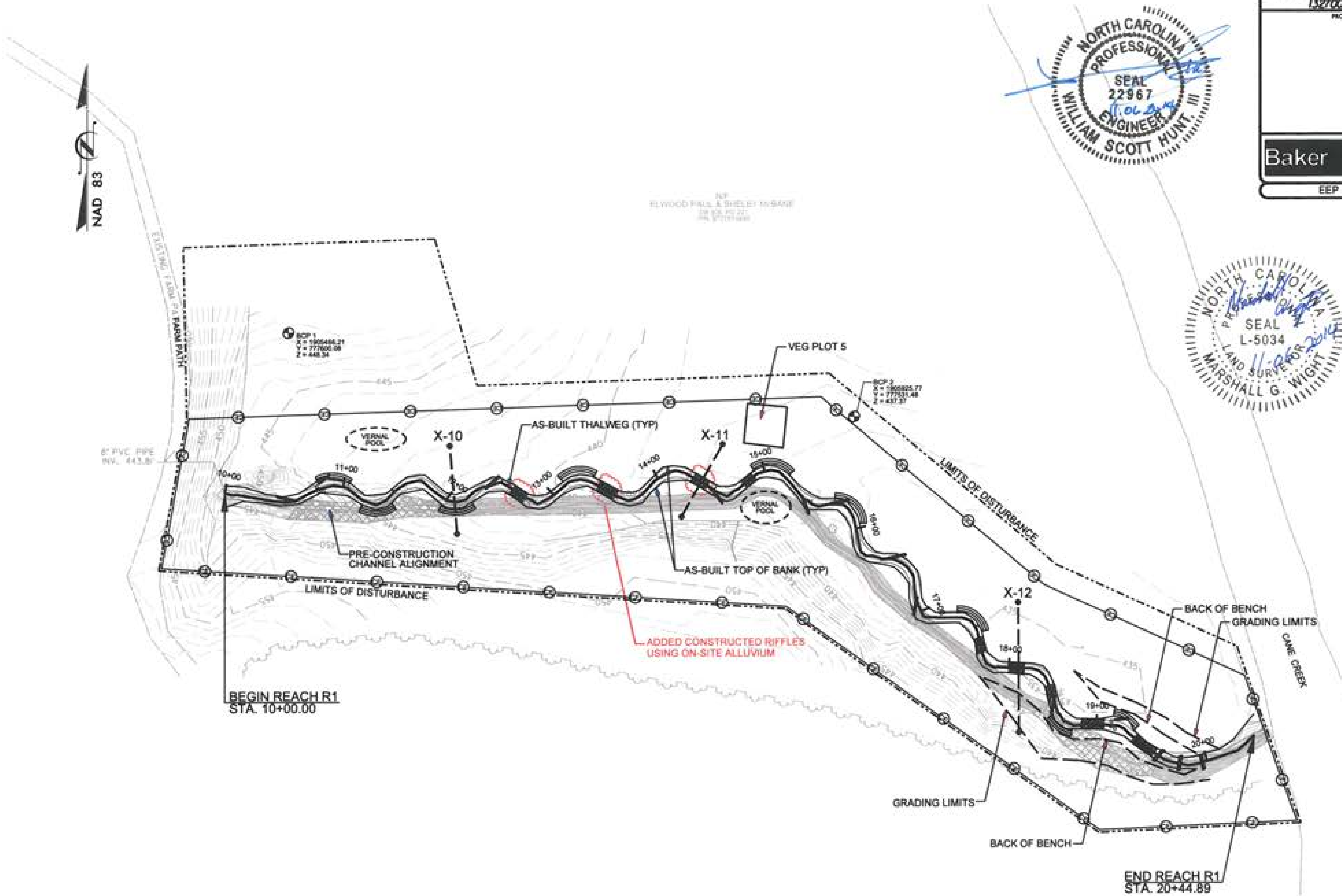
REVISIONS
NO. BY DATE
PROJECT MANAGER
UTICA/CR 95729 AB BAKER FINAL

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	3

PROJECT ENGINEER

Baker — Michael Baker Engineering Inc.

EEP ID No. 95729



FILL EXISTING CHANNEL

DITCH PLUG / CHANNEL BLOCK

NOTES:

1. CONTOURS SHOWN ARE PRE-RESTORATION.
2. FENCE LOCATIONS SHOWN ARE APPROXIMATE AND INSTALLED OUTSIDE OF THE CONSERVATION EASEMENT BOUNDARY.

UT TO CANE CREEK AS-BUILT PLAN

40 20 0 40 80

SCALE (FT)

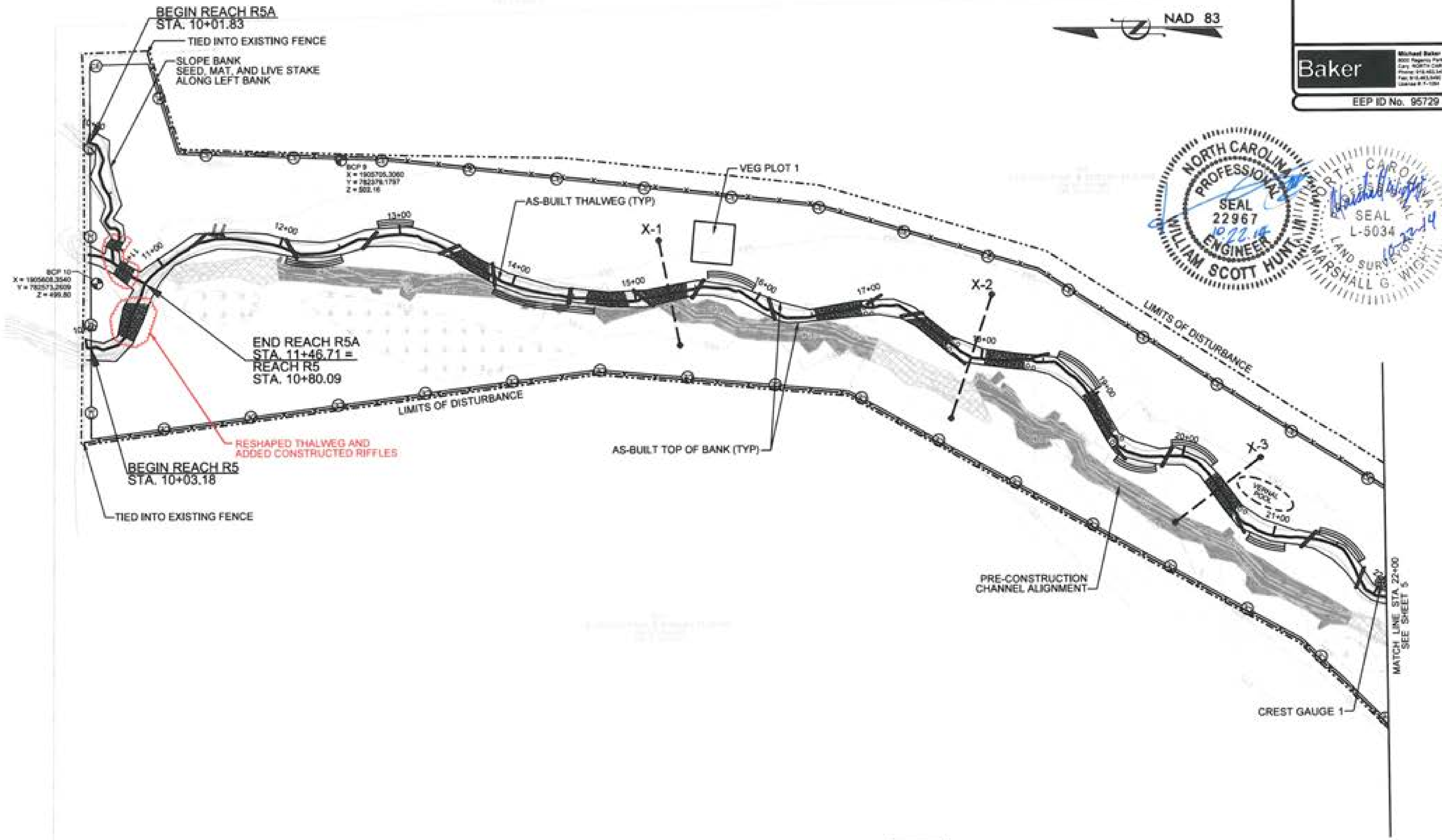
BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	4

PROJECT ENGINEER

Baker

Michael Baker Engineering Inc.

EEP ID No. 95729



NOTES:

1. CONTOURS SHOWN ARE PRE-RESTORATION.
2. FENCE LOCATIONS SHOWN ARE APPROXIMATE AND INSTALLED OUTSIDE OF THE CONSERVATION EASEMENT BOUNDARY.

FILL EXISTING CHANNEL

DITCH PLUG / CHANNEL BLOCK

UT TO CANE CREEK
AS-BUILT

40 20 0 40 80

SCALE (FT)

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	5

PROJECT ENGINEER

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: P-1084

EEP ID No. 95729

NAD 83

MATCH LINE STA. 23+00
SEE SHEET 4

INSTALLED (2) 48" DIA RCP
PERMANENT CULVERT CROSSING
INV. IN 480.01
INV. OUT 479.71

SLOPE BANK
SEED, MAT, AND LIVE STAKE

LIMITS OF DISTURBANCE

INSTALLED 10'
WORK GATE (TYP)

INSTALLED LARGE GATES AT
EASMENT CROSSING(TYP)

INSTALLED ROCK J-HOOK

X-4

X-5

X-6

AS-BUILT THALWEG (TYP)

LIMITS OF DISTURBANCE

BCP 14
X = 1904997.1060
Y = 783896.6697
Z = 485.3687

END REACH R5 =
BEGIN REACH R4
STA. 29+32.41

VEG PLOT 2

REMOVE INVASIVE SPECIES

RESHAPE THALWEG
SLOPE BANKS
SEED AND MAT

LIMITS OF DISTURBANCE

AS-BUILT TOP OF BANK (TYP)

END REACH R3
STA. 13+98.22

BACK OF BENCH

CREST GAUGE 2

VEG PLOT 6

GRADING LIMITS

BEGIN REACH R3
STA. 10+00.00

INSTALLED PERMANENT
FORD STREAM CROSSING

MATCH LINE STA. 34+50
SEE SHEET 6

FILL EXISTING CHANNEL

DITCH PLUG / CHANNEL BLOCK

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
10.22.14

NORTH CAROLINA PROFESSIONAL SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT
10-22-14

NOTES:
1. CONTOURS SHOWN ARE PRE-RESTORATION.
2. FENCE LOCATIONS SHOWN ARE APPROXIMATE AND INSTALLED OUTSIDE OF THE CONSERVATION EASEMENT BOUNDARY.

UT TO CANE CREEK
AS-BUILT PLAN

40 20 0 40 80
SCALE (FT)

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	6

PROJECT ENGINEER

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.481.5400
Fax: 919.481.5490
License #: P-1084

EEP ID No. 95729

NAD 83

INSTALLED CONSTRUCTED RIFFLES
REMOVE DEBRIS JAMS
SLOPE BANK
SEED, MAT AND LIVE STAKE

X-7
X-8

VEG PLOT 3

BCP 9
X = 1905729.8150
Y = 780202.7025
Z = 470.7399

BCP 10
X = 1905875.2660
Y = 779769.5570
Z = 458.6150

HEAVY INVASIVE SPECIES REMOVAL

LIMITS OF DISTURBANCE

34+00
35+00
36+00
37+00
38+00
39+00
40+00
41+00
42+00
43+00
44+00
45+00
46+00

MATCH LINE STA. 34+50
SEE SHEET 5

MATCH LINE STA. 46+50.00
SEE SHEET 7

AS-BUILT THALWEG (TYP)

REMOVE DEBRIS JAMS
SLOPE BANK
SEED, MAT AND LIVE STAKE

REMOVE WOODY DEBRIS
RESHAPE THALWEG
SLOPE BANK
SEED, MAT, AND LIVE STAKE

NORTH CAROLINA PROFESSIONAL SEAL 22867 ENGINEER WILLIAM SCOTT HUNT, III 10.22.14

NORTH CAROLINA SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT 10-22-14

NOTES:
1. CONTOURS SHOWN ARE PRE-RESTORATION.
2. FENCE LOCATIONS SHOWN ARE APPROXIMATE AND INSTALLED OUTSIDE OF THE CONSERVATION EASEMENT BOUNDARY.

UT TO CANE CREEK AS-BUILT PLAN

40 20 0 40 80
SCALE (FT)

2/26/03

R:\132700\Design\Plans\As-Built\132700_AB_PSH_B5.dgn
UTCANE/CR 95729 AB BAKER FINAL

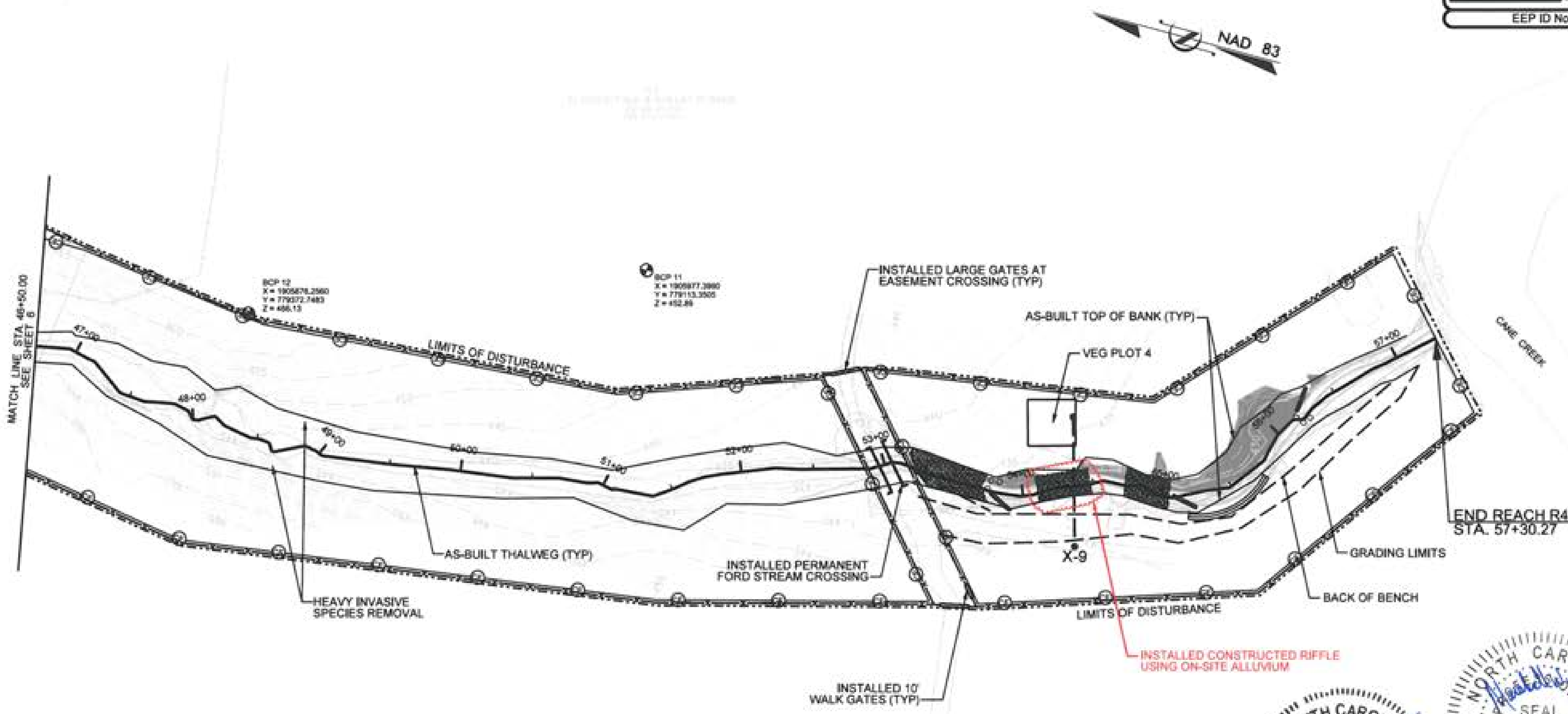
BAKER PROJECT REFERENCE NO. 132700 | SHEET NO. 7

PROJECT ENGINEER

Baker

Michael Baker Engineering Inc.

EEP ID No. 95729



NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22967 WILLIAM SCOTT HUNT, III 10.22.14

NORTH CAROLINA PROFESSIONAL LAND SURVEYOR SEAL L-5034 MARSHALL G. WIGHT 10-22-14

FILL EXISTING CHANNEL

NOTES:

1. CONTOURS SHOWN ARE PRE-RESTORATION.
2. FENCE LOCATIONS SHOWN ARE APPROXIMATE AND INSTALLED OUTSIDE OF THE CONSERVATION EASEMENT BOUNDARY.

UT TO CANE CREEK AS-BUILT PLAN

SCALE (FT) 40 20 0 40 80

UTCANECR_95729_AB_BAKER_FINAL

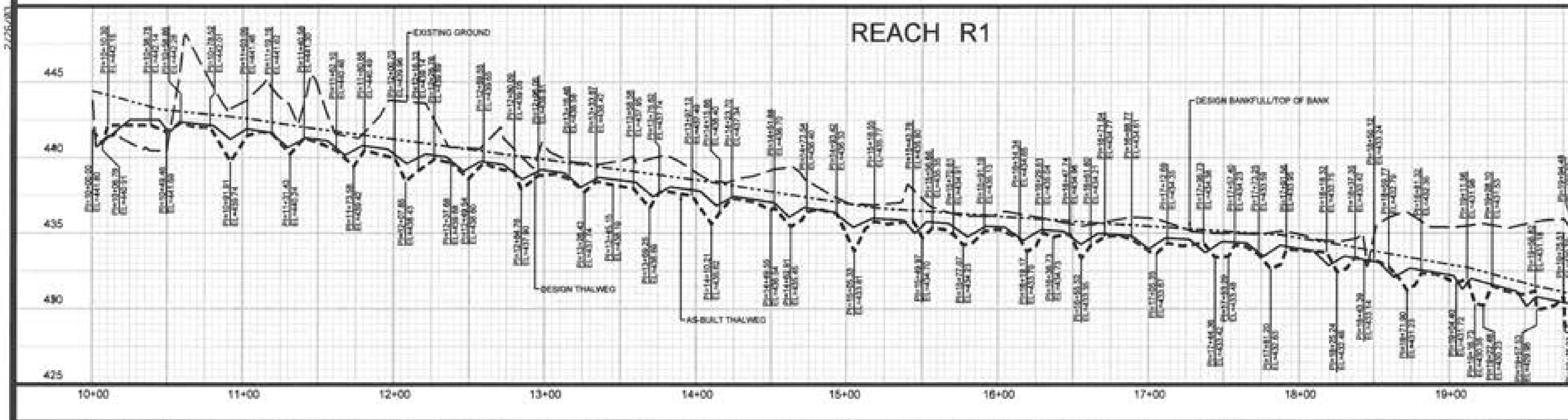
BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	8

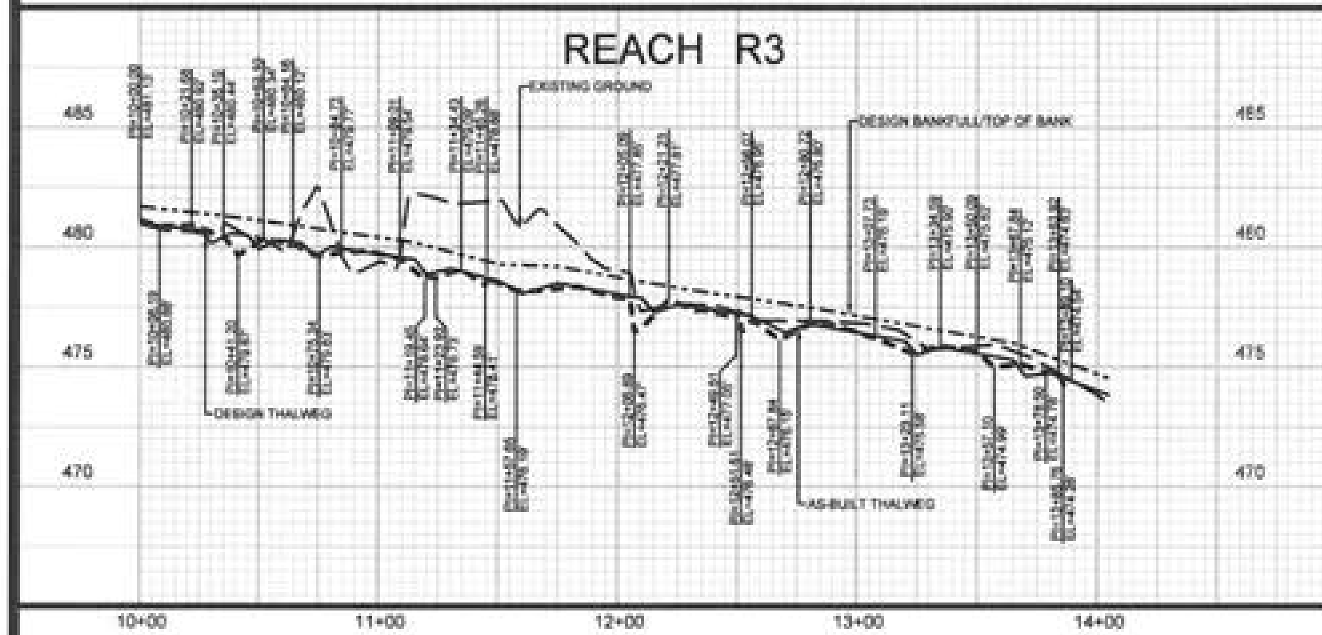
PROJECT ENGINEER

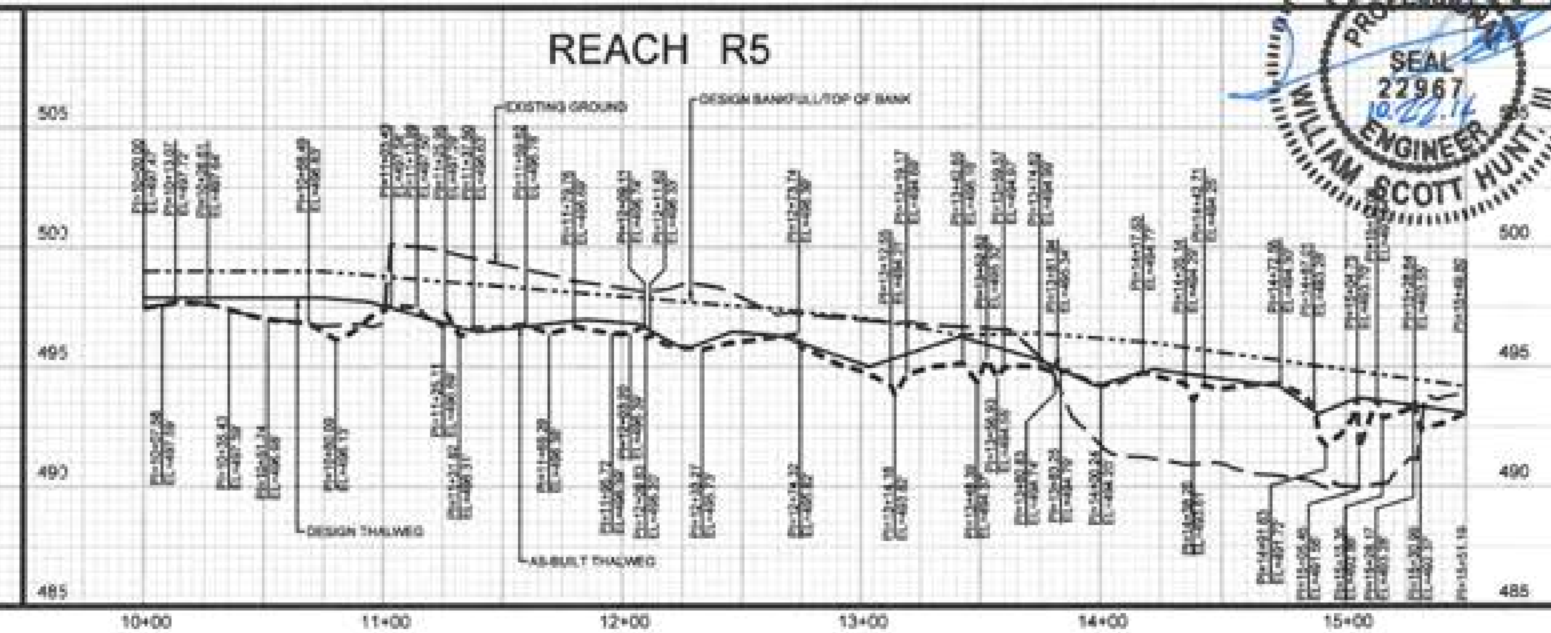
Baker

Michael Baker Engineering Inc.

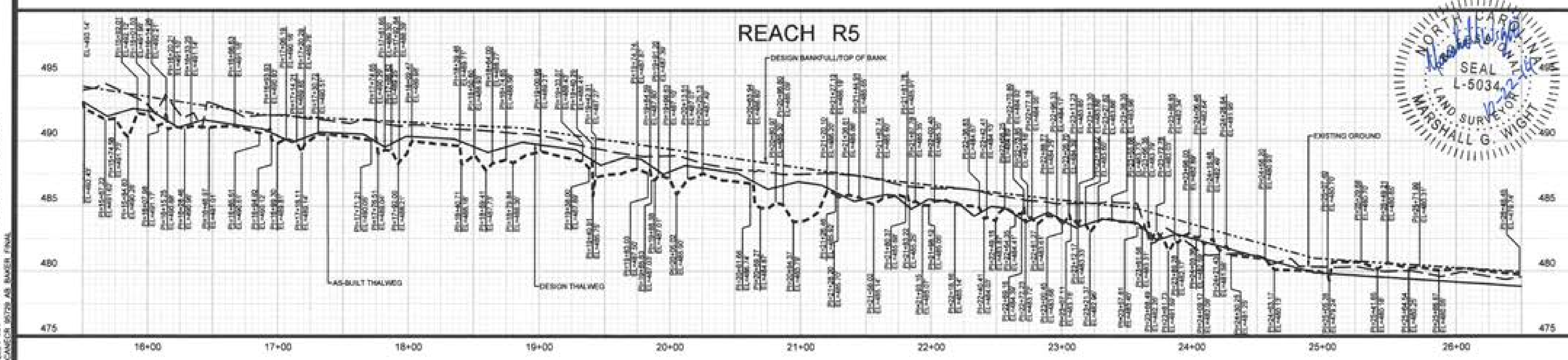
EEP ID No. 95729







NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22967 WILLIAM SCOTT HUNT, III 10.22.14



NORTH CAROLINA LAND SURVEYOR SEAL L-5034 MARSHALL G. WIGHT 10-22-14

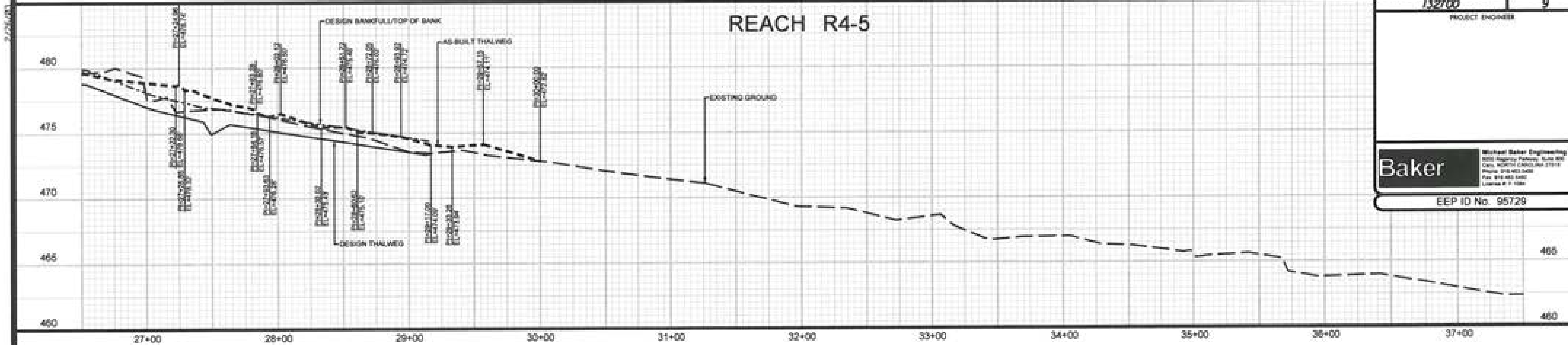
BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	9

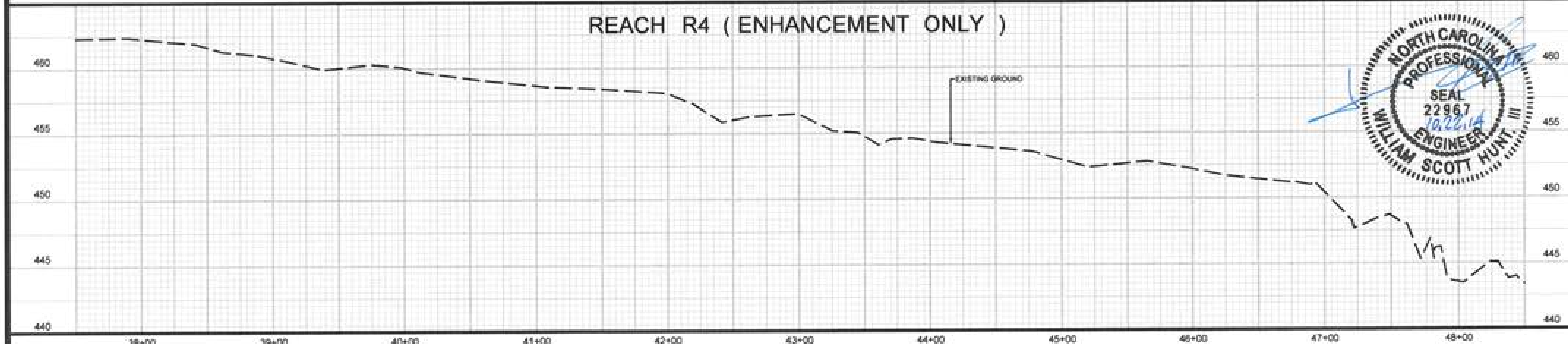
PROJECT ENGINEER

Baker

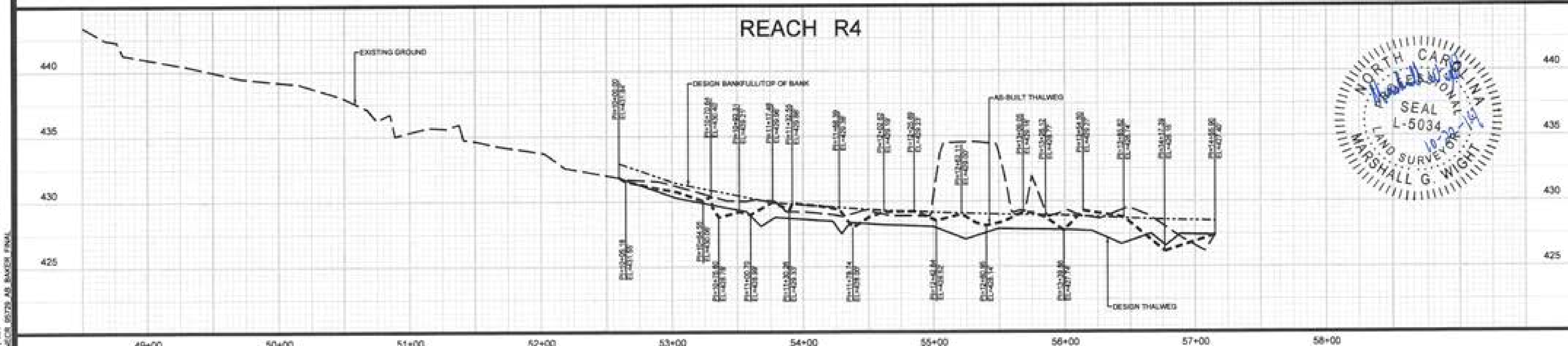
Michael Baker Engineering Inc.

EEP ID No. 95729





NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22967 WILLIAM SCOTT HUNT, III 10.22.14



NORTH CAROLINA SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT 10-22-14

APPENDIX E

Photo Log

Reach 1, view upstream towards dam at station 12+50
(June 12, 2014)

Reach 1, view downstream at station 12+50
(July 30, 2014)

Reach 3, view upstream at station 12+50 (June 5, 2014)

Reach 3, view downstream at station 10+90 (June 5, 2014)

Reach 4, view upstream at 55+00 (June 5, 2014)

Reach 4, rock J-Hook, view upstream at station 53+75
(June 5, 2014)

Reach 4, crossing at station 53+00 (June 5, 2014)

Reach 4, view upstream at station 34+00 (May 27, 2014)

Reach 4, crossing at station 33+00 (June 5, 2014)

Reach 4, view upstream at station 32+00 (June 5, 2014)

Reach 5, view downstream at station 28+00 (June 5, 2014)

Reach 5, view upstream at station 27+75 (June 5, 2014)

Reach 5, crossing at station 24+75 (June 12, 2014)

Reach 5, view downstream at station 24+00 (June 12, 2014)

Reach 5, view upstream at station 24+25 (June 12, 2014)

Reach 5, view downstream at station 17+75 (June 12, 2014)

Reach 5, view upstream at station 16+75 (June 12, 2014)

Reach 5, view upstream at station 11+50 (June 12, 2014)