

**FINAL**  
**BASELINE MONITORING DOCUMENT AND**  
**AS-BUILT BASELINE REPORT**

**ABBEY LAMM**  
**STREAM AND WETLAND MITIGATION SITE**

Alamance County, North Carolina  
Full Delivery Contract No. 5790

Data Collection: April and May 2015  
Submission: July 2015

Cape Fear River Basin  
Cataloging Unit 03030002



**PREPARED FOR:**

**N.C. DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES**  
**DIVISION OF MITIGATION SERVICES**  
**1601 MAIL SERVICE CENTER**  
**RALEIGH, NORTH CAROLINA 27699-1601**



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**PREPARED BY:**

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**JULY 2015**

## EXECUTIVE SUMMARY

Restoration Systems, LLC has established the Abbey Lamm Stream and Wetland Mitigation Site (Site) located approximately 2.0 miles east of Snow Camp in southern Alamance County and within the 14-digit Cataloging Unit and Targeted Local Watershed 03030002050050 of the Cape Fear River Basin.

The Site encompasses approximately 17.3 acres of agricultural land previously used for livestock grazing and hay production. The Site is situated along unnamed tributaries to Reedy Branch, a tributary to Cane Creek. Prior to construction, Site streams had been cleared of vegetation, dredged of cobble substrate, trampled by livestock, eroded vertically and laterally, and received extensive sediment and nutrient inputs from livestock. A 3.5-acre farm pond was located at the downstream extent of the Site. Approximately 86 percent of the stream channel had been degraded contributing to sediment export from the Site resulting from mechanical processes and from livestock hoof shear. In addition, streamside wetlands had been drained by channel incision, and soils had been compacted, cleared of forest vegetation, and altered by existing land uses. The Site was identified to assist the North Carolina Ecosystem Enhancement Program (NCEEP) in meeting its stream and wetland restoration goals.

The following table summarizes the project goals/objectives and proposed functional uplift based on proposed Site restoration activities and observations of two reference areas located in the vicinity of the Site.

### Project Goals and Objectives

Project Goal/Objective	How Goal/Objective will be Accomplished
<b>Improve Hydrology</b>	
Restore Floodplain Access	Building a new channel at the historic floodplain elevation to restore overbank flows
Restore Wooded Riparian Buffer	Planting a woody riparian buffer
Improve Microtopography	Scarifying soils to reduce compaction and hoof shear due to cattle
Restore Stream Stability	Building a new channel, planting a woody riparian buffer, and removing cattle
Increase Sediment Transport	
Improve Stream Geomorphology	
Increase Surface Storage and Retention	Building a new channel at the historic floodplain elevation restoring overbank flows, removing cattle, scarifying compacted soils, and planting woody vegetation
Restore Appropriate Inundation/Duration	
Increase Subsurface Storage and Retention	Raising the stream bed elevation
<b>Improve Water Quality</b>	
Increase Upland Pollutant Filtration	Planting a native, woody riparian buffer and installing 8 marsh treatment areas
Increase Thermoregulation	Planting a native, woody riparian buffer
Reduce Stressors and Sources of Pollution	Removing cattle and installing 8 marsh treatment areas
Increase Removal and Retention of Pathogens, Particulates (Sediments), Dissolved Materials (Nutrients), and Toxins from the Water Column	Raising the stream bed elevation, restoring overbank flows, planting with woody vegetation, removing cattle, increasing surface storage and retention, restoring appropriate inundation/duration, and installing 8 marsh treatment areas
Increase Energy Dissipation of Overbank/Overland Flows/Stormwater Runoff	Raising the stream bed elevation, restoring overbank flows, planting with woody vegetation, and installing 8 marsh treatment areas
<b>Restore Habitat</b>	
Restore In-stream Habitat	Building a stable channel with a cobble/gravel bed and planting a woody riparian buffer
Restore Stream-side Habitat	Planting a woody riparian buffer
Improve Vegetation Composition and Structure	

Positive aspects supporting mitigation activities at the Site include the following.

- Streams have a Best Usage Classification of **WS-V, NSW** (Nutrient Sensitive Waters)
- Located in a Targeted Local Watershed (TLW)
- According to the *Cape Fear River Basin Restoration Priorities 2009*, benthic ratings in the TLW vary from “Fair” to “Good-Fair” indicating a need for improvement of aquatic conditions in the watershed (NCEEP 2009)
- A Significant Natural Heritage Area is located immediately east of the Site

Project construction and planting was completed between January and April 2015. Site activities include the restoration of perennial and intermittent stream channels, enhancement (level II) of perennial and intermittent stream channels, and restoration of riparian wetlands. A total of **4731 Stream Mitigation Units (SMUs) and 1.0 Riparian Wetland Mitigation Units (WMUs)** are being offered as depicted in the following tables.

Stream Mitigation Type	Perennial Stream Counting Towards Mitigation Credits (linear feet)	Intermittent Stream Counting Towards Mitigation Credits (linear feet)	Ratio	Stream Mitigation Units
Restoration	2629	1771	1:1	4400
Enhancement (Level II)	403	426	2.5:1	331
<b>Totals</b>	<b>3032</b>	<b>2197</b>		<b>4731</b>
Wetland Mitigation Type	Acreage	Ratio	Riparian Wetland Mitigation Units	
Riparian Restoration	1.0	1:1	1.0	
Riparian Enhancement*	0.4	--	--	
<b>Totals</b>	<b>1.4</b>		<b>1.0</b>	

\*Wetland enhancement acreage is not included in mitigation credit calculations as per RFP 16-005568 requirements.

## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	i
1.0 PROJECT GOALS, BACKGROUND, AND ATTRIBUTES .....	1
1.1 Location and Setting .....	1
1.2 Project Goals and Objectives .....	1
1.3 Project Structure, Restoration Type, and Approach.....	2
1.3.1 Project Structure.....	2
1.3.2 Restoration Type and Approach .....	2
2.0 SUCCESS CRITERIA.....	3
2.1 Streams.....	3
2.2 Vegetation.....	4
2.3 Wetland Hydrology.....	5
3.0 MONITORING PLAN .....	6
3.1 Streams.....	6
3.2 Vegetation.....	7
3.3 Wetland Hydrology.....	7
3.4 Biotic Community Changes.....	7
4.0 MAINTENANCE AND CONTINGENCY .....	7
5.0 REFERENCES .....	9

## APPENDICES

### Appendix A. General Tables and Figures

Table 1. Project Components and Mitigation Units

Table 2. Project Activity and Reporting History

Table 3. Project Contacts Table

Table 4. Project Attributes Table

Figure 1. Site Location

Figure 2. Current Conditions Plan View

### Appendix B. Morphological Summary Data and Plots

Tables 5A-5E. Baseline Morphology and Hydraulic Summary

Tables 6A-6L. Morphology and Hydraulic Monitoring Summary

Substrate Plots

Fixed Station Photo Points

### Appendix C. Vegetation Data

Table 7. Planted Bare Root Woody Vegetation

Table 8. Total Planted Stems by Plot and Species

Vegetation Plot Photographs

### Appendix D. As-built Plan Sheets (Preliminary)

As-built Survey

Longitudinal Profile Plots

Cross-section Plots

### Appendix E. Preconstruction Benthic Data

Figure E1. Preconstruction Benthic Station Locations

Preconstruction Benthic Sample Results

Habitat Assessment Field Datasheets

## 1.0 PROJECT GOALS, BACKGROUND, AND ATTRIBUTES

### 1.1 Location and Setting

Restoration Systems, LLC has established the Abbey Lamm Stream and Wetland Mitigation Site (Site) located approximately 2.0 miles east of Snow Camp in southern Alamance County and within the 14-digit Cataloging Unit and Targeted Local Watershed 03030002050050 of the Cape Fear River Basin. The Site encompasses approximately 17.3 acres of agricultural land previously used for livestock grazing and hay production. The Site is situated along unnamed tributaries to Reedy Branch, a tributary to Cane Creek. Prior to construction, Site streams had been cleared of vegetation, dredged of cobble substrate, trampled by livestock, eroded vertically and laterally, and received extensive sediment and nutrient inputs from livestock. A 3.5-acre farm pond was located at the downstream extent of the Site. Approximately 86 percent of the stream channel had been degraded contributing to sediment export from the Site resulting from mechanical processes and from livestock hoof shear. In addition, streamside wetlands had been drained by channel incision, and soils had been compacted, cleared of forest vegetation, and altered by existing land uses.

Directions to the Site from Interstate 40 in Chapel Hill/Durham, North Carolina.

- Travel west on NC 54 for 7 miles,
- Exit onto Jones Ferry Road and turn left,
- Travel west for 1 mile,
- Turn right onto Old Greensboro Road (SR 1005) and travel 16 miles,  
(The road name changes to Greensboro-Chapel Hill Road at the Haw River)
- Turn left onto Holman Mill Road (SR 2356) and travel 1.5 miles,
- Turn left onto Major Hill Road (SR 2348) and the Site is on the left.
  - Site Latitude, Longitude  
35.885584°N, -79.394638°W (NAD83/WGS84)

### 1.2 Project Goals and Objectives

Based on the *Cape Fear River Basin Restoration Priorities Report 2009* (NCEEP 2009), Targeted Local Watershed 03030002050050 is characterized by benthic ratings varying between “Fair” and “Good-Fair” indicating a need for improvement to aquatic conditions. The Site is not included in a Local Watershed Plan; however, this project will meet overall goals of the Local Watershed Plans including 1) reduce sediment loading, 2) reduce nutrient loading, 3) manage stormwater runoff, 4) reduce toxic inputs, 5) provide and improve instream habitat, 6) provide and improve terrestrial habitat, 7) improve stream stability, and 8) improve hydrologic function.

Site activities include the restoration of perennial and intermittent stream channels, enhancement (level II) of perennial and intermittent stream channels, and restoration of riparian wetlands. The following table summarizes the project goals/objectives and proposed functional uplift based on proposed Site restoration activities and observations of two reference areas located in the vicinity of the Site.

<b>Project Goal/Objective</b>	<b>How Goal/Objective will be Accomplished</b>
<b>Improve Hydrology</b>	
Restore Floodplain Access	Building a new channel at the historic floodplain elevation, restoring overbank flows
Restore Wooded Riparian Buffer	Planting a woody riparian buffer
Improve Microtopography	Scarifying soils to reduce compaction and hoof shear due to cattle
Restore Stream Stability	Building a new channel, planting a woody riparian buffer, and removing cattle
Increase Sediment Transport	
Improve Stream Geomorphology	
Increase Surface Storage and Retention	Building a new channel at the historic floodplain elevation restoring overbank flows, removing cattle, scarifying compacted soils, and planting woody vegetation
Restore Appropriate Inundation/Duration	
Increase Subsurface Storage and Retention	Raising the stream bed elevation
<b>Improve Water Quality</b>	
Increase Upland Pollutant Filtration	Planting a native, woody riparian buffer and installing 8 marsh treatment areas
Increase Thermoregulation	Planting a native, woody riparian buffer
Reduce Stressors and Sources of Pollution	Removing cattle and installing 8 marsh treatment areas
Increase Removal and Retention of Pathogens, Particulates (Sediments), Dissolved Materials (Nutrients), and Toxins from the Water Column	Raising the stream bed elevation restoring overbank flows, planting with woody vegetation, removing cattle, increasing surface storage and retention, restoring appropriate inundation/duration, and installing 8 marsh treatment areas
Increase Energy Dissipation of Overbank/Overland Flows/Stormwater Runoff	Raising the stream bed elevation and restoring overbank flows, planting with woody vegetation, and installing 8 marsh treatment areas
<b>Restore Habitat</b>	
Restore In-stream Habitat	Building a stable channel with a cobble/gravel bed and planting a woody riparian buffer
Restore Stream-side Habitat	Planting a woody riparian buffer
Improve Vegetation Composition and Structure	

### **1.3 Project Structure, Restoration Type, and Approach**

#### **1.3.1 Project Structure**

Prior to construction, streams were cleared, dredged of cobble substrate, straightened, trampled by livestock, eroded vertically and laterally, and had received extensive sediment and nutrient inputs from livestock. Approximately 86 percent of the previously existing stream channel was degraded contributing to sediment export from the Site resulting from mechanical processes from livestock hoof shear. In addition, streamside wetlands were cleared and drained by channel downcutting and land uses. Previous Site conditions resulted in degraded water quality, a loss of aquatic habitat, reduced nutrient and sediment retention, and unstable channel characteristics (loss of horizontal flow vectors that maintain pools and an increase in erosive forces to channel bed and banks). Site restoration activities will restore riffle-pool morphology, aid in energy dissipation, increase aquatic habitat, stabilize channel banks, and greatly reduce sediment loss from channel banks.

#### **1.3.2 Restoration Type and Approach**

Restoration and protection of aquatic resources with a conservation easement will result in net gains in hydrology, water quality, and habitat functions at the Site. Site construction was completed on April 3, 2015 and Site planting was completed on April 7, 2015. A Terra Cell structure was not needed for this

project due to the presence of bedrock that allowed for a natural stream grade control. A summary of mitigation activities includes the following.

- Providing a minimum of 4731 SMUs, as calculated in accordance with the requirements stipulated in RFP #16-005568.
  - Restoring approximately 2629 linear feet of perennial stream channel through construction of stable stream channels in the historic floodplain location and elevation.
  - Restoring approximately 1771 linear feet of intermittent channel through construction of a stable channel at the historic floodplain elevation in order to restore downstream perennial channels at historic floodplain elevations and rehydrate adjacent hydric soils thereby restoring jurisdictional riparian wetlands.
  - Enhancing (Level II) approximately 403 linear feet of perennial stream channel and 426 linear feet of intermittent stream channel by ceasing current land use practices, removing invasive species, and planting with native forest vegetation.
- Providing a minimum of 1.0 riparian WMUs, as calculated in accordance with the requirements stipulated in RFP #16-005568.
  - Restoring 1.0 acre of riparian wetland by removing livestock, restoring compacted soils, raising stream channels to historic elevations, and rehydrating floodplain soils.
  - Enhancing an additional 0.4 acre of riparian wetland.
- Installing 8 marsh treatment areas to treat stormwater runoff prior to entering the Site.
- Removing cattle from the Site and fencing the entire conservation easement.
- Reincorporating stream bed substrate previously stockpiled by the landowner and by sifting through existing Site materials to isolate stream bed substrate.
- Revegetating wetlands, floodplains, and slopes adjacent to restored streams.
- Protecting the Site in perpetuity with a conservation easement.

Completed project activities, reporting history, completion dates, project contacts, and project attributes are summarized in Tables 1-4 (Appendix A).

## **2.0 SUCCESS CRITERIA**

### **2.1 Streams**

Monitoring and success criteria for stream restoration should relate to project goals and objectives. From a mitigation perspective, several of the goals and objectives are assumed to be functionally elevated by restoration activities without direct measurement. Other goals and objectives will be considered successful upon achieving vegetation success criteria. The following summarizes stream success criteria related to goals and objectives.



<b>Project Goal/Objective</b>	<b>Stream Success Criteria</b>
<b>Improve Hydrology</b>	
Restore Floodplain Access	Two overbank events will be documented, in separate years, during the monitoring period.
Restore Wooded Riparian Buffer	Attaining Vegetation Success Criteria.
Improve Microtopography	Removal of cattle and scarification of soils during construction.
Restore Stream Stability	Cross-sections, monitored annually, will be compared to as-built measurements to determine channel stability and maintenance of channel geomorphology.
Improve Stream Geomorphology	
Increase Surface Storage and Retention	Removal of cattle, installation of 8 marsh treatment areas, scarification of soils during construction, documentation of two overbank events in separate monitoring years, and attaining Wetland and Vegetation Success Criteria.
Restore Appropriate Inundation/Duration	
Increase Subsurface Storage and Retention	Two overbank events will be documented, in separate years, during the monitoring period and attaining Wetland Success Criteria.
Increase Sediment Transport	Pebble counts documenting coarsening of bed material from pre-existing conditions.
<b>Improve Water Quality</b>	
Increase Upland Pollutant Filtration	Installation of 8 marsh treatment areas and attaining Wetland and Vegetation Success Criteria
Increase Thermoregulation	Attaining Vegetation Success Criteria
Reduce Stressors and Sources of Pollution	Removal of cattle and installation of 8 marsh treatment areas
Increase Removal and Retention of Pathogens, Particulates (Sediments), Dissolved Materials (Nutrients), and Toxins from the Water Column	Removal of cattle, installation of 8 marsh treatment areas, documentation of two overbank events in separate monitoring years, and attaining Vegetation Success Criteria
Increase Energy Dissipation of Overbank/Overland Flows/Stormwater Runoff	Installation of 8 marsh treatment areas, documentation of two overbank events in separate monitoring years, and attaining Vegetation Success Criteria
<b>Restore Habitat</b>	
Restore In-stream Habitat	Reincorporating natural substrate removed from existing Site streams and stockpiled onsite into proposed stream beds, pebble counts documenting coarsening of bed material from pre-existing conditions, and attaining Vegetation Success Criteria (Section 8.3.1)
Restore Stream-side Habitat	Attaining Vegetation Success Criteria
Improve Vegetation Composition and Structure	Attaining Vegetation Success Criteria

Intermittent channels (UT 1 and UT 3) were scrutinized by IRT members with respect to jurisdictional status. Success criteria in these reaches require surface water flow within the stream channels during years with normal climactic conditions for at least 30 consecutive days. Furthermore, IRT members require these systems to have a discernible ordinary high water mark, which will be evaluated and considered towards project success. Iron-oxidizing bacteria and hydric soils within these reaches will be documented by photograph throughout the monitoring period, and will be considered signs of intermittent channels by IRT members.

## **2.2 Vegetation**

An average density of 320 planted stems per acre must be surviving in the first three monitoring years. Subsequently, 290 planted stems per acre must be surviving in year 4, 260 planted stems per acre in year 5, and 210 planted stems per acre in year 7. In addition, planted vegetation must average 10 feet in height in each plot at year 7 since this Site is located in the Piedmont. Volunteer stems may be considered on a

case-by-case basis in determining overall vegetation success; however, volunteer stems should be counted separately from planted stems.

### 2.3 Wetland Hydrology

Monitoring and success criteria for wetland restoration should relate to project goals and objectives. From a mitigation perspective, several of the goals and objectives are assumed to be functionally elevated by restoration activities without direct measurement. Other goals and objectives will be considered successful upon achieving vegetation success criteria. The following summarizes wetland success criteria related to goals and objectives.

Project Goal/Objective	Wetland Success Criteria
<b>Improve Hydrology</b>	
Restore Wooded Riparian Buffer	Attaining Vegetation Success Criteria.
Improve Microtopography	Removal of cattle and scarification of soils during construction.
Increase Surface Storage and Retention	Removal of cattle, scarification of soils during construction, documentation of two overbank events in separate monitoring years, attaining Vegetation Success Criteria, and documentation of an elevated groundwater table (within 12 inches of the soil surface) for greater than 10 percent of the growing season during average climatic conditions.
Restore Appropriate Inundation/Duration	
Increase Subsurface Storage and Retention	
<b>Improve Water Quality</b>	
Increase Upland Pollutant Filtration	Installation of 8 marsh treatment areas and attaining Wetland and Vegetation Success Criteria.
Reduce Stressors and Sources of Pollution	Removal of cattle and installation of 8 marsh treatment areas.
Increase Removal and Retention of Pathogens, Particulates (Sediments), Dissolved Materials (Nutrients), and Toxins from the Water Column	Removal of cattle, installation of 8 marsh treatment areas, documentation of two overbank events in separate monitoring years, and attaining Vegetation Success Criteria.
Increase Energy Dissipation of Overbank/Overland Flows/Stormwater Runoff	Installation of 8 marsh treatment areas, documentation of two overbank events in separate monitoring years, and attaining Vegetation Success Criteria.
<b>Restore Habitat</b>	
Restore Stream-side Habitat	Attaining Vegetation Success Criteria.
Improve Vegetation Composition and Structure	

According to the *Soil Survey of Alamance County*, the growing season for Alamance County is from April 17 – October 22 (USDA 1960). However, the start date for the growing season is not typical for the Piedmont region; therefore, for purposes of this project gauge hydrologic success will be determined using data from February 1 - October 22 to more accurately represent the period of biological activity. Based on growing season information outlined in the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Environmental Laboratory 2012), this will be confirmed annually by soil temperatures exceeding 41 degrees Fahrenheit at 12 inches depth and/or bud burst.

Target hydrological characteristics include saturation or inundation for 10 percent of the monitored period (February 1-October 22), during average climatic conditions. During years with atypical climatic conditions, groundwater gauges in reference wetlands may dictate threshold hydrology success criteria (75 percent of reference). These areas are expected to support hydrophytic vegetation. If wetland parameters are marginal as indicated by vegetation and/or hydrology monitoring, a jurisdictional determination will be performed. The jurisdictional determination will not supersede monitoring data, or

overturn a failure in meeting success criteria; however, this information may be used by the IRT, at the discretion of the IRT, to make a final determination on Site wetland re-establishment success.

### **3.0 MONITORING PLAN**

Monitoring requirements and success criteria outlined in the latest guidance by NCEEP dated November 7, 2011 (*Monitoring Requirements and Reporting Standards for Stream and/or Wetland Mitigation*) will be followed and are briefly outlined below. Monitoring data collected at the Site should include reference photos, plant survival analysis, channel stability analysis, and biological data, if specifically required by permit conditions.

Wetland hydrology is proposed to be monitored for a period of seven years (years 1-7). Riparian vegetation and stream morphology is proposed to be monitored for a period of seven years with measurements completed in years 1-3, year 5, and year 7. If monitoring demonstrates the Site is successful by year 5 and no concerns have been identified, Restoration Systems may propose to terminate monitoring at the Site and forego monitoring requirements for years 6 and 7. Early closure will only be provided through written approval from the USACE in consultation with the Interagency Review Team. Monitoring will be conducted by Axiom Environmental, Inc. Annual monitoring reports of the data collected will be submitted to the NCEEP by Restoration Systems no later than December 31 of each monitoring year data is collected.

#### **3.1 Streams**

Annual monitoring will include development of channel cross-sections and substrate on riffles and pools. Data to be presented in graphic and tabular format will include 1) cross-sectional area, 2) bankfull width, 3) average depth, 4) maximum depth, and 5) width-to-depth ratio. Post construction, permanently-monumented cross sections were installed throughout the Site, at approximately 50 foot intervals. Sixty monitoring cross sections will be measured annually. Cross section locations are depicted on Figure 2 (Appendix A) and Asbuilt Plan Sheets (Appendix D). Longitudinal profiles will not be measured routinely unless monitoring demonstrates channel bank or bed instability, in which case, longitudinal profiles may be required by the USACE along reaches of concern to track changes and demonstrate stability.

Visual assessment of in-stream structures will be conducted to determine if failure has occurred. Failure of a structure may be indicated by collapse of the structure, undermining of the structure, abandonment of the channel around the structure, and/or stream flow beneath the structure. In addition, visual assessments of the entire channel will be conducted in each of the seven years of monitoring as outlined in NCEEP *Monitoring Requirements and Reporting Standards for Stream and/or Wetland Mitigation*. Areas of concern will be depicted on a plan view figure identifying the location of concern along with a written assessment and photograph of the area.

Intermittent stream reaches, including UT 1 and UT 3, will receive priority 1 stream restoration to restore adjacent wetlands and elevate stream function. Priority 1 stream restoration along intermittent stream reaches was discussed by IRT members with regard to adequate base flow once stream restoration is complete. Therefore, stream flow gauges were installed in the upper and lower reaches of UT 1 and UT 3 to catalog flow of 30 consecutive days. The approximate location of stream flow gauges are depicted on Figure 2 (Appendix A) and Asbuilt Plan Sheets (Appendix D).

### **3.2 Vegetation**

After planting was completed in April 2015, an initial evaluation was performed to verify planting methods and to determine initial species composition and density. Supplemental planting and additional Site modifications will be implemented, if necessary.

During quantitative vegetation sampling, 14 sample plots (10-meter by 10-meter) were installed within the Site as per guidelines established in *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008). In each sample plot, vegetation parameters to be monitored include species composition and species density. Visual observations of the percent cover of shrub and herbaceous species will also be documented by photograph. Baseline vegetation plot information can be found in Appendix C. Initial stem count measurements indicate an average of 593 planted stems per acre across the Site. In addition, each vegetation plot exceeded the 320 stems per acre minimum criteria for success.

### **3.3 Wetland Hydrology**

Six groundwater monitoring gauges were installed to take measurements after hydrological modifications were performed at the Site. Groundwater gauges were installed in larger wetland sections along UT 1, UT 2, and the main stem channel. Gauges were installed at various elevations within the floodplain to accurately determine hydrology of wetland re-establishment areas. Approximate locations of wetland groundwater monitoring gauges are depicted on Figure 2 (Appendix A) and Asbuilt Plan Sheets (Appendix D). Hydrological sampling will continue throughout the growing season at intervals necessary to satisfy jurisdictional hydrology success criteria (USEPA 1990). In addition, an on-site rain gauge will document rainfall data for comparison of groundwater conditions with extended drought conditions and floodplain crest gauges will confirm overbank flooding events.

### **3.4 Biotic Community Changes**

Changes in the biotic community are anticipated from a shift in habitat opportunities as tributaries are restored. In-stream, biological monitoring is proposed to track the changes during the monitoring period. The benthic macroinvertebrate community will be sampled using NCDWQ protocols found in the Standard Operating Procedures for Benthic Macroinvertebrates (NCDWQ 2006) and Benthic Macroinvertebrate Protocols for Compensatory Stream Restoration Projects (NCDWQ 2001). Biological sampling of benthic macroinvertebrates will be used to compare preconstruction baseline data with postconstruction restored conditions.

Two benthic macroinvertebrate monitoring locations will be established within restoration reaches. Postrestoration collections will occur in the approximate location of the prerestoration sampling. Benthic macroinvertebrate samples will be collected from individual reaches using the Qual-4 collection method. Sampling techniques of the Qual-4 collection method consist of kick nets, sweep nets, leaf packs, and visual searches. Preproject biological sampling occurred on June 26, 2014 (data are included in Appendix E); postproject monitoring will occur in June of each monitoring year.

Identification of collected organisms will be performed by personnel with North Carolina Division of Water Resources (NCDWR) or by a NCDWR certified laboratory. Other data collected will include D50 values/NCDWR habitat assessment forms.

## **4.0 MAINTENANCE AND CONTINGENCY**

In the event that success criteria are not fulfilled, a mechanism for contingency will be implemented.

### **Stream**

In the event that stream success criteria are not fulfilled, a mechanism for contingency will be implemented. Stream contingency may include, but may not be limited to 1) structure repair and/or installation; 2) repair of dimension, pattern, and/or profile variables; and 3) bank stabilization. The method of contingency is expected to be dependent upon stream variables that are not in compliance with success criteria. Primary concerns, which may jeopardize stream success, include 1) structure failure, 2) headcut migration through the Site, and/or 3) bank erosion.

### **Structure Failure**

In the event that structures are compromised the affected structure will be repaired, maintained, or replaced. Once the structure is repaired or replaced, it must function to stabilize adjacent stream banks and/or maintain grade control within the channel. Structures which remain intact, but exhibit flow around, beneath, or through the header/footer will be repaired by excavating a trench on the upstream side of the structure and reinstalling filter fabric in front of the pilings. Structures which have been compromised, resulting in shifting or collapse of header/footer, will be removed and replaced with a structure suitable for Site flows.

### **Headcut Migration Through the Site**

In the event that a headcut occurs within the Site (identified visually or through measurements [i.e. bank-height ratios exceeding 1.4]), provisions for impeding headcut migration and repairing damage caused by the headcut will be implemented. Headcut migration may be impeded through the installation of in-stream grade control structures (rip-rap sill and/or log cross-vane weir) and/or restoring stream geometry variables until channel stability is achieved. Channel repairs to stream geometry may include channel backfill with coarse material and stabilizing the material with erosion control matting, vegetative transplants, and/or willow stakes.

### **Bank Erosion**

In the event that severe bank erosion occurs within the Site, resulting in elevated width-to-depth ratios, contingency measures to reduce bank erosion and width-to-depth ratio will be implemented. Bank erosion contingency measures may include the installation of log-vane weirs and/or other bank stabilization measures. If the resultant bank erosion induces shoot cutoffs or channel abandonment, a channel may be excavated which will reduce shear stress to stable values.

### **Vegetation**

Hydrological contingency will require consultation with hydrologists and regulatory agencies if wetland hydrology enhancement is not achieved. Floodplain surface modifications, including construction of ephemeral pools, represent a likely mechanism to increase the floodplain area in support of jurisdictional wetlands. Recommendations for contingency to establish wetland hydrology will be implemented and monitored until Hydrology Success Criteria are achieved.

### **Hydrology**

Hydrological contingency will require consultation with hydrologists and regulatory agencies if wetland hydrology enhancement is not achieved. Floodplain surface modifications, including construction of ephemeral pools, represent a likely mechanism to increase the floodplain area in support of jurisdictional wetlands. Recommendations for contingency to establish wetland hydrology will be implemented and monitored until Hydrology Success Criteria are achieved.

## 5.0 REFERENCES

- Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. United States Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.
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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, North Carolina Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.
- United States Department of Agriculture (USDA). 1960. Soil Survey of Alamance County, North Carolina. Soil Conservation Service.
- United States Environmental Protection Agency (USEPA). 1990. Mitigation Site Type Classification (MiST). EPA Workshop, August 13-15, 1989. EPA Region IV and Hardwood Research Cooperative, NCSU, Raleigh, North Carolina.

**Appendix A.**  
**General Tables and Figures**

Table 1. Project Components and Mitigation Credits

Table 2. Project Activity and Reporting History

Table 3. Project Contacts Table

Table 4. Project Attributes Table

Figure 1. Site Location

Figure 2. Current Conditions Plan View

**Table 1. Project Components and Mitigation Credits  
Abbey Lamm Restoration Site**

Mitigation Credits							
Stream	Stream	Riparian Wetland			Nonriparian Wetland		
Restoration	Enhancement	Restoration			Restoration		
4400	331	1.0			--		
Projects Components							
Station Range	Existing Linear Footage/Acreage	Priority Approach	Restoration/Restoration Equivalent	Restoration Linear Footage/Acreage	Mitigation Ratio	Mitigation Credits	Comment
UT 1 Station 00+21 to 05+62	531	PI	Restoration	541	1:1	541	
UT 1a Station 00+00 to 01+54	154	PI	Restoration	154-8=146	1:1	146	8 lf of UT1a located outside of easement is not credit generating
UT 2 Station 00+22 to 04+77	502	PI	Restoration	455	1:1	455	
UT 3a Station 00+00 to 00+93	93		EII	93	2.5:1	37	
UT 3b Station 00+00 to 01+43	143		EII	143	2.5:1	57	
UT 3c Station 00+00 to 01+90	190		EII	190	2.5:1	76	
UT 3 Station 00+93 to 11+77	1021	PI	Restoration	1084	1:1	1084	
Mainstem Channel Station 04+77 to 16+31	1098	PI	Restoration	1154-61-63=1030	1:1	1030	61 lf and 63 lf of Mainstem located outside of easement at two crossings are not credit generating
Mainstem Channel Station 16+31 to 20+59	428		EII	428-25=403	2.5:1	161	25 lf of Mainstem located outside of easement are not credit generating
Mainstem Channel Station 20+59 to 32+58	NA	PI	Restoration	1199-55=1144	1:1	1144	55 lf of Mainstem located outside of easement are not credit generating
Component Summation							
Restoration Level	Stream (linear footage)	Riparian Wetland (acreage)			Nonriparian Wetland (acreage)		
Restoration	4400*	1.0			--		
Enhancement (Level I)	--	--			--		
Enhancement (Level II)	829**	--			--		
Enhancement	--	0.4***			--		
<b>Totals</b>	<b>5229</b>	<b>--</b>			<b>--</b>		
<b>Mitigation Units</b>	<b>4731 SMUs</b>	<b>1.0 Riparian WMUs</b>			<b>0.00 Nonriparian WMUs</b>		

\*An additional 187 linear feet of stream restoration is proposed outside of the easement and is therefore not included in this total or in mitigation credit calculations.

\*\*An additional 25 linear feet of stream enhancement (level II) is proposed outside of the easement and is therefore not included in this total or in mitigation credit calculations.

\*\*\*Wetland enhancement acreage is not included in mitigation credit calculations as per RFP 16-005568 requirements.



**Table 2. Project Activity and Reporting History  
Abbey Lamm Restoration Site**

<b>Activity or Deliverable</b>	<b>Data Collection Complete</b>	<b>Completion or Delivery</b>
Technical Proposal (RFP No. 16-005568)	--	October 2013
EEP Contract No. 5790	--	February 2014
Mitigation Plan	--	September 2014
Construction Plans	--	September 2014
Construction Earthwork	--	April 3, 2015
Planting	--	April 7, 2015
As-Built Documentation	May 2015	May 2015

**Table 3. Project Contacts Table  
Abbey Lamm Restoration Site**

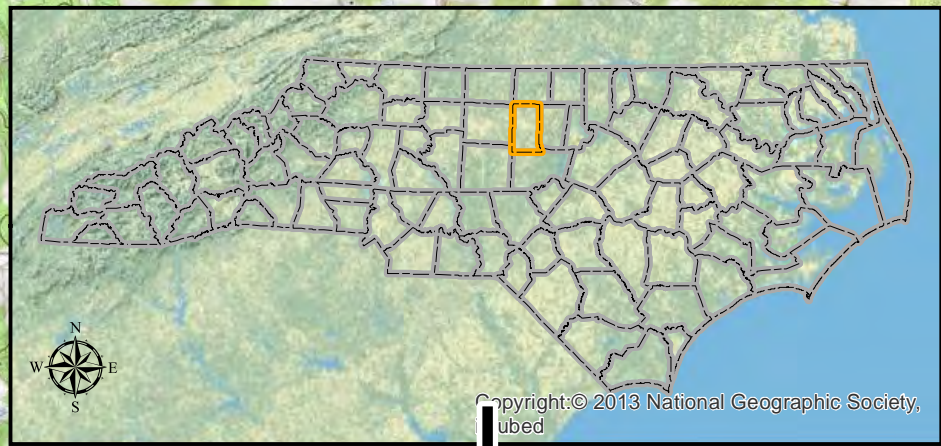
<b>Full Delivery Provider</b>	Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 Worth Creech 919-755-9490
<b>Designer</b>	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693
<b>Construction Plans and Sediment and Erosion Control Plans</b>	Sungate Design Group, PA 915 Jones Franklin Road Raleigh, NC 27606 Joshua G. Dalton, PE 919-859-2243
<b>Construction Contractor</b>	Land Mechanic Designs 780 Landmark Road Willow Spring, NC 27592 Lloyd Glover 919-639-6132
<b>Planting Contractor</b>	Carolina Silvics, Inc. 908 Indian Trail Road Edenton, NC 27932 Mary-Margaret McKinney 252-482-8491
<b>As-built Surveyor</b>	K2 Design Group 5688 US Highway 70 East Goldsboro, NC 27534 John Rudolph 919-751-0075
<b>Baseline Data Collection</b>	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693

**Table 4. Project Attribute Table  
Abbey Lamm Restoration Site**

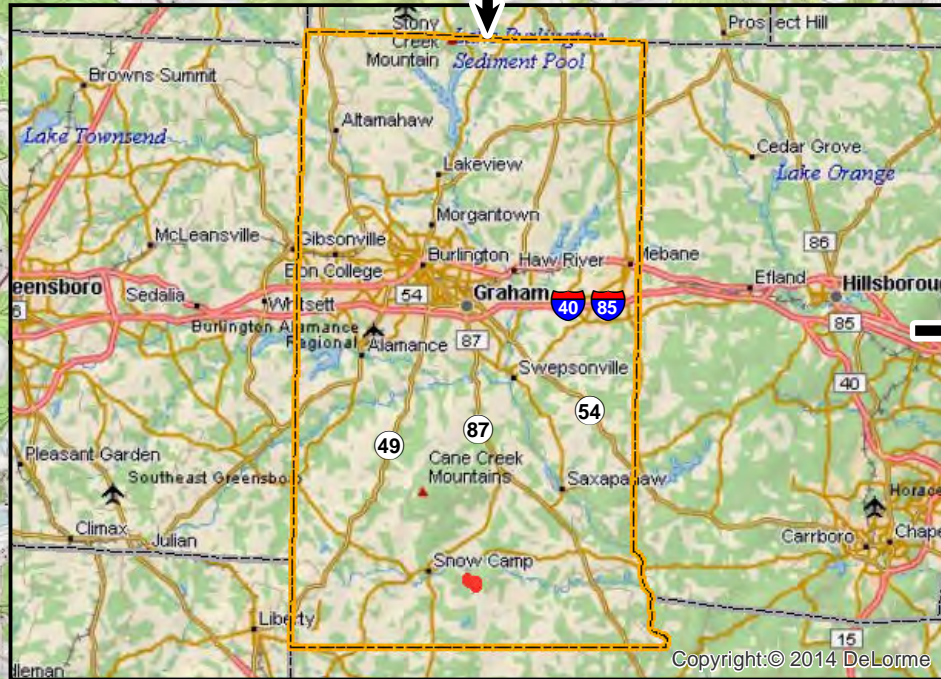
<b>Project Information</b>				
Project Name	Abbey Lamm Restoration Site			
Project County	Alamance County, North Carolina			
Project Area (acres)	17.3			
Project Coordinates (latitude & longitude)	35.885584°N, 79.394638°W			
<b>Project Watershed Summary Information</b>				
Physiographic Province	Piedmont			
Project River Basin	Cape Fear			
USGS HUC for Project (14-digit)	03030002050050			
NCDWR Sub-basin for Project	03-06-04			
Project Drainage Area (acres)	257			
Percentage of Project Drainage Area that is Impervious	<2%			
<b>Reach Summary Information</b>				
<b>Parameters</b>	<b>Main</b>	<b>UT 1</b>	<b>UT 2</b>	<b>UT 3</b>
Length of reach (linear feet)	3258	695	455	1510
Valley Classification	alluvial			
Drainage Area (acres)	257	49	56	32
NCDWR Stream ID Score	--	29	35.25	28
NCDWR Water Quality Classification	WS-V, NSW			
Existing Morphological Description (Rosgen 1996)	Eg5/Fc5	E/G 5	C/G 5	Eg5
Existing Evolutionary Stage (Simon and Hupp 1986)	III/IV	II/III	IV/III	III
Underlying Mapped Soils	Efland silt loam, Goldston slaty silt loam, Herndon silt loam, Moderately gullied land, Orange silt loam			
Drainage Class	Well-drained, well-drained, well-drained, poorly to well-drained, moderately well-drained			
Hydric Soil Status	Nonhydric			
Slope	0.0179	0.0256-0.0362		
FEMA Classification	NA			
Native Vegetation Community	Piedmont Alluvial Forest/Dry-Mesic Oak-Hickory Forest			
Watershed Land Use/Land Cover (Site)	40% forest, 58% agricultural land, <2% low density residential/impervious surface			
Watershed Land Use/Land Cover (Cedarock Reference Channel)	65% forest, 30% agricultural land, <5% low density residential/impervious surface			
Percent Composition of Exotic Invasive Vegetation	<5%			

**Table 4. Project Attribute Table  
Abbey Lamm Restoration Site (continued)**

<b>Wetland Summary Information</b>			
<b>Parameters</b>	<b>Wetlands</b>		
Wetland acreage	1.4		
Wetland Type	Riparian		
Mapped Soil Series	Worsham		
Drainage Class	Poorly drained		
Hydric Soil Status	Hydric		
Source of Hydrology	Groundwater, stream overbank		
Hydrologic Impairment	Incised streams, compacted soils, livestock		
Native Vegetation Community	Piedmont/Low Mountain Alluvial Forest		
% Composition of Exotic Invasive Vegetation	<5%		
<b>Regulatory Considerations</b>			
<b>Regulation</b>	<b>Applicable?</b>	<b>Resolved?</b>	<b>Supporting Documentation</b>
Waters of the United States-Section 401	Yes	In progress	JD Package (App D)
Waters of the United States-Section 404	Yes	In progress	JD Package (App D)
Endangered Species Act	No	--	CE Document (App E)
Historic Preservation Act	No	--	CE Document (App E)
Coastal Zone Management Act	No	--	NA
FEMA Floodplain Compliance	No	--	Appendix F
Essential Fisheries Habitat	No	--	NA



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Directions to the Site from Interstate 40 in Chapel Hill/Durham, NC:

- Travel west on NC 54 for 7 miles,
- Exit onto Jones Ferry Road and turn left,
- Travel west for 1 mile,
- Turn right onto Old Greensboro Road (SR 1005) and travel 16 miles, (The road name changes to Greensboro-Chapel Hill Road at the Haw River)
- Turn left onto Holman Mill Road (SR 2356) and travel 1.5 miles,
- Turn left onto Major Hill Road (SR 2348) and the Site is on the left.



Prepared for:



Project:

**ABBEY LAMM  
STREAM AND  
WETLAND  
MITIGATION  
SITE**

Alamance County, NC

Title:

**Site  
Location**

Notes:

Background Imagery sources (provided by ESRI Data and Maps):

1. Physical Map of the United States (2009) created by the U.S. Park Service (upper inset).
2. Delorme World Basemap digital mapping (2010, lower inset).
3. Snow Camp, NC (1978), Crutchfield Crossroads, NC (1974), Saxapahaw, NC (1977), and Silk Hope, NC (1974) 7.5-minute topographic quadrangles provided by the U.S. Geological Survey.

Drawn by: KRJ

Date: MAY 2015

Scale: 1:42000

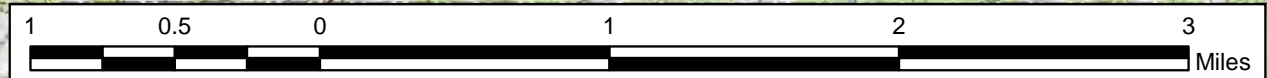
Project No.: 14-005

**FIGURE**

**1**

**Legend**

- Abbey Lamm Stream and Wetland Restoration Site
- County lines (inset)



Abbey Lamm Stream and Wetland Mitigation Site  
35.885584 N, -79.394638 W

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





Prepared for:



Project:

### ABBEY LAMM STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

### Current Conditions Plan View

Notes:

Background Imagery source:  
2014 aerial photography  
provided by the NC OneMap  
program (online, provided by  
the NC Geographic Information  
Coordination Council)

Drawn by: KRJ

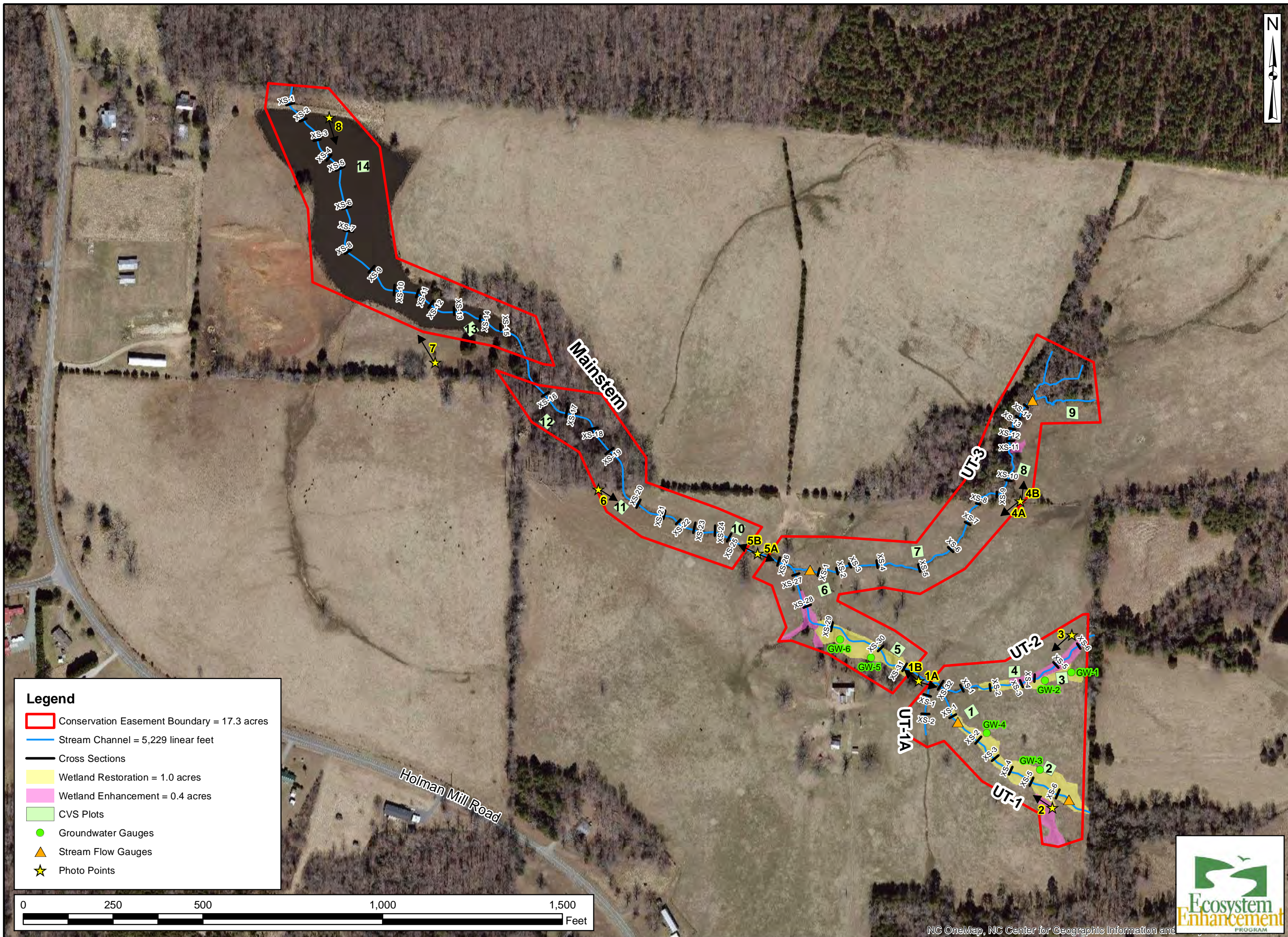
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Scale: 1:3000

Project No.: 14-005

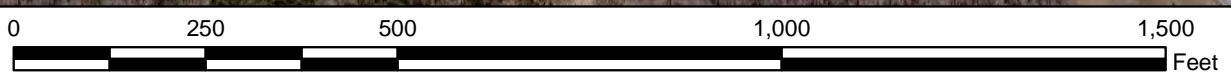
FIGURE

2



#### Legend

- Conservation Easement Boundary = 17.3 acres
- Stream Channel = 5,229 linear feet
- Cross Sections
- Wetland Restoration = 1.0 acres
- Wetland Enhancement = 0.4 acres
- CVS Plots
- Groundwater Gauges
- ▲ Stream Flow Gauges
- ★ Photo Points



**Appendix B**  
**Morphological Summary Data and Plots**

Tables 5A-5E. Baseline Stream Data Summary  
Tables 6A-6L. Monitoring Data-Dimensional Data Summary  
Substrate Plots  
Fixed Station Photo Points

**Table 5A. Baseline Morphology and Hydraulic Summary  
Lamm UT 1**

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Cedarrock Park			Project Reference Causey Farm			Design			As-built		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)	USGS gage data is unavailable for this project			4	12	6.5	8	12.1	8.1	10.7	11.3	11	6.5	7.5	7	6	9.1	8.6
Floodprone Width (ft)				6	27	17	15	25	18	122	140	131	30	90	50			50
BF Cross Sectional Area (ft <sup>2</sup> )						3.5			8			14.7			3.5	3.6	6.7	4.0
BF Mean Depth (ft)				0.3	0.9	0.6	0.8	1	0.8	1.3	1.4	1.4	0.46	0.55	0.5	0.5	0.7	0.6
BF Max Depth (ft)				0.7	1.3	1	1.1	1.4	1.4	1.9	2	2	0.6	0.8	0.7	0.7	1.2	0.9
Width/Depth Ratio				4.4	40	13.8	8	15.1	10.1	8	9	9	12	16	14	10	19	13
Entrenchment Ratio				1	6.8	2.9	1.9	2.2	2.1	11	13	12	4.3	12.9	7.1	6	8	5.8
Bank Height Ratio				1.3	2.6	1.7	1	1.8	1			1.4	1	1.3	1			1
Wetted Perimeter(ft)						===			===			===			===	6.3	9.6	8.9
Hydraulic radius (ft)						===			===			===			===	0.4	0.7	0.6
Pattern																		
Channel Beltwidth (ft)				No pattern of riffles and pools due to straightening activities			20	38	22.8	17	36	29.8	21	42	28	21	42	28
Radius of Curvature (ft)							11	27	16.5	9	113	30.6	14	70	21	14	70	21
Meander Wavelength (ft)							44	116	68.4	10	91	62.9	42	84	60	42	84	60
Meander Width ratio							2.4	4.7	2.8	1.5	3.5	2.7	3	6	4	3	6	4
Profile																		
Riffle length (ft)				No pattern of riffles and pools due to straightening activities					===			===			===	5	44	15
Riffle slope (ft/ft)							1.00%	5.76%	3.16%	0.20%	1.20%	0.98%	3.71%	7.73%	4.94%	1.10%	9.83%	2.98%
Pool length (ft)									===			===			===	5	12	8
Pool spacing (ft)							25	69	37.2	2	7.4	4	21	56	28	21	56	28
Substrate																		
d50 (mm)						===			===			===			===			===
d84 (mm)						===			===			===			===			===
Additional Reach Parameters																		
Valley Length (ft)						===			===			===			===			466
Channel Length (ft)						===			===			===			===			559
Sinuosity						1.02			1.2			1.46			1.2			1.2
Water Surface Slope (ft/ft)						2.84%			2.58%			0.53%			2.56% - 3.62%			2.56%
BF slope (ft/ft)						===			===			===			===			===
Rosgen Classification						E/G 5			E 4/5			E 4/5			E/C 3/4			E/C 3/4

**Table 5B. Baseline Morphology and Hydraulic Summary  
Lamm UT 2**

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Cedarrock Park			Project Reference Causey Farm			Design			As-built^		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension	USGS gage data is unavailable for this project	BF Width (ft)	7.1	15.6	9.7	8	12.1	8.1	10.7	11.3	11	6.5	7.5	7	5.9	9.7	7.6	
Floodprone Width (ft)		15	40	27	15	25	18	122	140	131	30	90	50			50		
BF Cross Sectional Area (ft <sup>2</sup> )				3.8			8			14.7			3.5	2.3	5.5	3.2		
BF Mean Depth (ft)		0.2	0.5	0.4	0.8	1	0.8	1.3	1.4	1.4	0.46	0.55	0.5	0.4	0.6	0.4		
BF Max Depth (ft)		0.5	1.3	0.8	1.1	1.4	1.4	1.9	2	2	0.6	0.8	0.7	0.5	1	0.7		
Width/Depth Ratio		14.2	78	28.8	8	15.1	10.1	8	9	9	12	16	14	15	21	17		
Entrenchment Ratio		1	5.6	3	1.9	2.2	2.1	11	13	12	4.3	12.9	7.1	5	9	6.6		
Bank Height Ratio		1	3	1.6	1	1.8	1			1.4	1	1.3	1			1		
Wetted Perimeter(ft)				===			===			===			===	6.1	10.1	7.7		
Hydraulic radius (ft)				===			===			===			===	0.3	0.5	0.4		
<b>Pattern</b>																		
Channel Beltwidth (ft)	No pattern of riffles and pools due to straightening activities			20	38	22.8	17	36	29.8	21	42	28	21	42	28			
Radius of Curvature (ft)				11	27	16.5	9	113	30.6	14	70	21	14	70	21			
Meander Wavelength (ft)				44	116	68.4	10	91	62.9	42	84	60	42	84	60			
Meander Width ratio				2.4	4.7	2.8	1.5	3.5	2.7	3	6	4	3	8	4			
<b>Profile</b>																		
Riffle length (ft)	No pattern of riffles and pools due to straightening activities					===			===			===	5	26	12			
Riffle slope (ft/ft)				1.00%	5.76%	3.16%	0.20%	1.20%	0.98%	3.71%	7.73%	4.94%	0.84%	4.64%	2.94%			
Pool length (ft)						===			===			===	4	14	8			
Pool spacing (ft)				25	69	37.2	2	7.4	4	21	56	28	21	56	28			
<b>Substrate</b>																		
d50 (mm)			===			===			===			===			===			
d84 (mm)			===			===			===			===			===			
<b>Additional Reach Parameters</b>																		
Valley Length (ft)			===			===			===			===			387			
Channel Length (ft)			===			===			===			===			464			
Sinuosity			1.03			1.2			1.46			1.2			1.2			
Water Surface Slope (ft/ft)			3.07% - 4.31%			2.58%			0.53%			2.56% - 3.62%			3.01%			
BF slope (ft/ft)			===			===			===			===			===			
Rosgen Classification			C/G 5			E 4/5			E 4/5			E/C 3/4			E/C 3/4			

^Measured as-built numbers do not include D-type reach.



**Table 5C. Baseline Morphology and Hydraulic Summary  
Lamm UT 3**

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Cedarrock Park			Project Reference Causey Farm			Design			As-built					
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med			
Dimension																					
BF Width (ft)	USGS gage data is unavailable for this project			3.4	12.3	7.2	8	12.1	8.1	10.7	11.3	11	6.5	7.5	7	6.3	8.6	7.3			
Floodprone Width (ft)				18	40	26	15	25	18	122	140	131	30	90	50					250	
BF Cross Sectional Area (ft <sup>2</sup> )						2.6					8			14.7				3.5	2	3.1	2.5
BF Mean Depth (ft)				0.2	0.8	0.4	0.8	1	0.8	1.3	1.4	1.4	0.46	0.55	0.5	0.3	0.5	0.3			
BF Max Depth (ft)				0.5	1.3	0.8	1.1	1.4	1.4	1.9	2	2	0.6	0.8	0.7	0.4	0.8	0.6			
Width/Depth Ratio				4.3	61.5	24	8	15.1	10.1	8	9	9	12	16	14	15	27	23			
Entrenchment Ratio				2.4	7	4.1	1.9	2.2	2.1	11	13	12	4.3	12.9	7.1	6	8	6.8			
Bank Height Ratio				1	2	1.4	1	1.8	1			1.4	1	1.3	1			1			
Wetted Perimeter(ft)						===			===			===			===			6.4	8.8	7.4	
Hydraulic radius (ft)						===			===			===			===			0.3	0.4	0.3	
<b>Pattern</b>																					
Channel Beltwidth (ft)	No pattern of riffles and pools due to straightening activities			20	38	22.8	17	36	29.8	21	42	28	21	42	28						
Radius of Curvature (ft)				11	27	16.5	9	113	30.6	14	70	21	14	70	21						
Meander Wavelength (ft)				44	116	68.4	10	91	62.9	42	84	60	42	84	60						
Meander Width ratio				2.4	4.7	2.8	1.5	3.5	2.7	3	6	4	3	8	4						
<b>Profile</b>																					
Riffle length (ft)	No pattern of riffles and pools due to straightening activities					===			===			===			6	66	21				
Riffle slope (ft/ft)				1.00%	5.76%	3.16%	0.20%	1.20%	0.98%	3.71%	7.73%	4.94%	0.82%	6.50%	3.13%						
Pool length (ft)						===			===			===			===		4	14	7		
Pool spacing (ft)				25	69	37.2	2	7.4	4	21	56	28	21	56	28						
<b>Substrate</b>																					
d50 (mm)			===			===			===			===						===			
d84 (mm)			===			===			===			===						===			
<b>Additional Reach Parameters</b>																					
Valley Length (ft)			===			===			===			===						846			
Channel Length (ft)			===			===			===			===						1015			
Sinuosity			1.05			1.2			1.46			1.2						1.2			
Water Surface Slope (ft/ft)			3.34%			2.58%			0.53%			2.56% 3.62%						3.19%			
BF slope (ft/ft)			===			===			===			===						===			
Rosgen Classification			Fc 5/6			Eg 5			E 4/5			E/C 3/4						C 3/4			

**Table 5D. Baseline Morphology and Hydraulic Summary  
Lamm Main Upstream**

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Cedarrock Park			Project Reference Causey Farm			Design			As-built				
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med		
Dimension																				
BF Width (ft)	USGS gage data is unavailable for this project			11.7	26.5	18.5	8	12.1	8.1	10.7	11.3	11	11.2	12.9	12.1	12.3	13.3	12.7		
Floodprone Width (ft)				29	75	56	15	25	18	122	140	131	20	90	40					250
BF Cross Sectional Area (ft <sup>2</sup> )						10.4			8			14.7			10.4	8.8	12.5	10.4		
BF Mean Depth (ft)				0.4	0.9	0.6	0.8	1	0.8	1.3	1.4	1.4	0.8	0.9	0.9	0.7	1	0.85		
BF Max Depth (ft)				1.1	1.7	1.3	1.1	1.4	1.4	1.9	2	2	1.1	1.4	1.3	1	12.6	1.3		
Width/Depth Ratio				11.7	66.3	31.5	8	15.1	10.1	8	9	9	12	16	14	13	17	15		
Entrenchment Ratio				1.9	24	6.2	1.9	2.2	2.1	11	13	12	1.7	7.4	3.3	7	7	7.05		
Bank Height Ratio				1	1.9	1.2	1	1.8	1			1.4	1	1.3	1			1		
Wetted Perimeter(ft)						===			===			===			===			13	13.9	13.2
Hydraulic radius (ft)						===			===			===			===			0.7	0.9	0.8
Pattern																				
Channel Beltwidth (ft)				No pattern of riffles and pools due to straightening activities			20	38	22.8	17	36	29.8	36	73	48	36	73	48		
Radius of Curvature (ft)							11	27	16.5	9	113	30.6	24	121	36	24	121	36		
Meander Wavelength (ft)							44	116	68.4	10	91	62.9	73	145	103	73	145	103		
Meander Width ratio							2.4	4.7	2.8	1.5	3.5	2.7	3	6	4	3	6	4		
Profile																				
Riffle length (ft)				No pattern of riffles and pools due to straightening activities					===			===			===	9	66	26		
Riffle slope (ft/ft)							1.00%	5.76%	3.16%	0.20%	1.20%	0.98%	2.15%	4.48%	2.86%	0.00%	3.87%	1.86%		
Pool length (ft)									===			===			===	5	34	12		
Pool spacing (ft)							25	69	37.2	2	7.4	4	36	97	48	36	97	48		
Substrate																				
d50 (mm)						===			===			===			===			===		
d84 (mm)						===			===			===			===			===		
Additional Reach Parameters																				
Valley Length (ft)						===			===			===			===			949		
Channel Length (ft)						===			===			===			===			1139		
Sinuosity						1.05			1.2			1.46			1.2			1.2		
Water Surface Slope (ft/ft)						1.76%			2.58%			0.53%			1.79%			1.57%		
BF slope (ft/ft)						===			===			===			===			===		
Rosgen Classification						Eg5/Fc			E 4/5			E 4/5			E/C 3/4			E/C 3/4		

**Table 5E. Baseline Morphology and Hydraulic Summary  
Lamm Main Downstream**

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Cedarrock Park			Project Reference Causey Farm			Design			As-built		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension	USGS gage data is unavailable for this project			8.7	17	13	8	12.1	8.1	10.7	11.3	11	11.2	12.9	12.1	12.8	13.4	13.0
BF Width (ft)				17	24	22	15	25	18	122	140	131	20	90	40			250
Floodprone Width (ft)						10.4			8			14.7			10.4	9.7	11.8	11.3
BF Cross Sectional Area (ft2)				0.6	1.2	0.9	0.8	1	0.8	1.3	1.4	1.4	0.8	0.9	0.9	0.8	0.9	0.8
BF Mean Depth (ft)				0.9	1.9	1.4	1.1	1.4	1.4	1.9	2	2	1.1	1.4	1.3	1.1	1.3	1.3
BF Max Depth (ft)				7.3	28.3	17.4	8	15.1	10.1	8	9	9	12	16	14	15	17	16
Width/Depth Ratio				1.2	2.6	1.8	1.9	2.2	2.1	11	13	12	1.7	7.4	3.3	7	7	6.9
Entrenchment Ratio				1.3	2.7	2	1	1.8	1			1.4	1	1.3	1			1
Bank Height Ratio						===			===			===			===	13.2	14.1	13.6
Wetted Perimeter(ft)						===			===			===			===	0.7	0.9	0.8
Hydraulic radius (ft)																		
Pattern																		
Channel Beltwidth (ft)				No pattern of riffles and pools due to straightening activities			20	38	22.8	17	36	29.8	36	73	48	36	73	48
Radius of Curvature (ft)							11	27	16.5	9	113	30.6	24	121	36	24	121	36
Meander Wavelength (ft)							44	116	68.4	10	91	62.9	73	145	103	73	145	103
Meander Width ratio							2.4	4.7	2.8	1.5	3.5	2.7	3	6	4	3	6	4
Profile																		
Riffle length (ft)				No pattern of riffles and pools due to straightening activities					===			===			===	15	142	59
Riffle slope (ft/ft)							1.00%	5.76%	3.16%	0.20%	1.20%	0.98%	2.15%	4.48%	2.86%	0.71%	3.22%	1.93%
Pool length (ft)									===			===			===	7	40	18
Pool spacing (ft)							25	69	37.2	2	7.4	4	36	97	48	36	97	48
Substrate																		
d50 (mm)						===			===			===			===			===
d84 (mm)						===			===			===			===			===
Additional Reach Parameters																		
Valley Length (ft)						===			===			===			===			961
Channel Length (ft)						===			===			===			===			1153
Sinuosity						NA		1.2			1.46			1.2				1.2
Water Surface Slope (ft/ft)						NA		2.58%			0.53%			1.79%				1.72%
BF slope (ft/ft)						===		===			===			===				===
Rosgen Classification						Eg5/Fc		E 4/5			E 4/5			E/C 3/4				E/C 3/4

**Table 6A. Morphology and Hydraulic Monitoring Summary**  
**Lamm UT-Main (Downstream) - Stream and Wetland Restoration Site**

Parameter	XS 1 Pool (Main Down)						XS 2 Riffle (Main Down)						XS 3 Riffle (Main Down)						XS 4 Riffle (Main Down)						XS 5 Pool (Main Down)					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																														
BF Width (ft)	13						12.8						13.1						13						14.1					
Floodprone Width (ft)	---						90						90						90						---					
BF Cross Sectional Area (ft2)	11.2						9.7						11.8						11.3						11.8					
BF Mean Depth (ft)	0.9						0.8						0.9						0.9						0.8					
BF Max Depth (ft)	1.7						1.1						1.3						1.3						1.7					
Width/Depth Ratio	---						16.9						14.5						15						---					
Entrenchment Ratio	---						7.03						6.9						6.92						---					
Bank Height Ratio	---						1						1						1						---					
Wetted Perimeter (ft)	13.6						13.2						13.7						13.6						15					
Hydraulic Radius (ft)	0.8						0.7						0.9						0.8						0.8					
Substrate																														
d50 (mm)	---						---						---						---						---					
d84 (mm)	---						---						---						---						---					

Parameter	XS 6 Riffle (Main Down)						XS 7 Riffle (Main Down)						XS 8 Riffle (Main Down)						XS 9 Riffle (Main Down)						XS 10 Riffle (Main Down)					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																														
BF Width (ft)	13.4						12.8						13.6						12.3						16.1					
Floodprone Width (ft)	90						90						90						90						90					
BF Cross Sectional Area (ft2)	11.3						8.7						11.6						9.8						12.4					
BF Mean Depth (ft)	0.8						0.7						0.9						0.8						0.8					
BF Max Depth (ft)	1.3						1.2						1.5						1.2						1.3					
Width/Depth Ratio	15.9						18.8						15.9						15.4						20.9					
Entrenchment Ratio	6.7						7.0						6.6						7.3						5.6					
Bank Height Ratio	1						1						1						1						1					
Wetted Perimeter (ft)	14.1						13.2						14.3						12.9						16.6					
Hydraulic Radius (ft)	0.8						0.7						0.8						0.8						0.7					
Substrate																														
d50 (mm)	---						---						---						---						---					
d84 (mm)	---						---						---						---						---					



**Table 6C. Morphology and Hydraulic Monitoring Summary**  
**Lamm UT-Main (Downstream) - Stream and Wetland Restoration Site**

Parameter	XS 11 Pool (Main Down)						XS 12 Riffle (Main Down)						XS 13 Riffle (Main Down)						XS 14 Riffle (Main Down)						XS 15 Pool (Main Down)					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																														
BF Width (ft)	13.4						11.9						15.4						13						16.1					
Floodprone Width (ft)	----						90						90						90						----					
BF Cross Sectional Area (ft2)	9.8						7.2						8.6						12.9						12.7					
BF Mean Depth (ft)	0.7						0.6						0.6						1.0						0.8					
BF Max Depth (ft)	1.4						1						0.9						1.4						1.8					
Width/Depth Ratio	----						19.67						27.58						13.1						----					
Entrenchment Ratio	----						7.563						5.8						6.923						----					
Bank Height Ratio	----						1						1						1						----					
Wetted Perimeter (ft)	13.9						12.2						15.6						13.6						16.7					
Hydraulic Radius (ft)	0.7						0.6						0.6						1						0.8					
<b>Substrate</b>																														
d50 (mm)	----						----						----						----						----					
d84 (mm)	----						----						----						----						----					

Parameter	XS 16 Riffle (Main Down)*						XS 17 Riffle (Main Down)*						XS 18 Riffle (Main Down)*						XS 19 Pool (Main Down)*					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																								
BF Width (ft)	16.2						14.3						13.2						12					
Floodprone Width (ft)	20						19						31						----					
BF Cross Sectional Area (ft2)	10.1						11.2						10.1						13.1					
BF Mean Depth (ft)	0.6						0.8						0.8						1.1					
BF Max Depth (ft)	0.8						1.3						1.2						1.4					
Width/Depth Ratio	25.984						18.26						17.25						----					
Entrenchment Ratio	1.2346						1.329						2.3						----					
Bank Height Ratio	2.375						1.615						1.583						----					
Wetted Perimeter (ft)	16.4						15.3						14						12.9					
Hydraulic Radius (ft)	0.6						0.7						0.7						1					
<b>Substrate</b>																								
d50 (mm)	----						----						----						----					
d84 (mm)	----						----						----						----					

\* Enhancement (Level II) Reach



**Table 6E. Morphology and Hydraulic Monitoring Summary  
Lamm Main (Upstream) - Stream and Wetland Restoration Site**

Parameter	XS 20 Pool (Main Up)						XS 21 Riffle (Main Up)					XS 22 Riffle (Main Up)					XS 23 Riffle (Main Up)					XS 24 Pool (Main Up)								
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																														
BF Width (ft)	7.1					13.3						12.6						12.3						12.8						
Floodprone Width (ft)	----					90						90						90						----						
BF Cross Sectional Area (ft <sup>2</sup> )	6.7					12.5						12.5						8.8						13.1						
BF Mean Depth (ft)	0.9					0.9						1.0						0.7						1.0						
BF Max Depth (ft)	1.3					1.4						1.4						1						1.8						
Width/Depth Ratio	----					14.2						12.7						17.2						----						
Entrenchment Ratio	----					6.77						7.1						7.32						----						
Bank Height Ratio	----					1						1						1						----						
Wetted Perimeter (ft)	8.4					13.9						13.3						13						13.6						
Hydraulic Radius (ft)	0.8					0.9						0.9						0.7						1						
Substrate																														
d50 (mm)	----					----						----						----						----						
d84 (mm)	----					----						----						----						----						

Parameter	XS 25 Riffle (Main Up)					XS 26 Pool (Main Up)					XS 27 Riffle (Main Up)					XS 28 Pool (Main Up)					XS 29 Riffle (Main Up)									
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																														
BF Width (ft)	13					13.3						12						11.4						12.8						
Floodprone Width (ft)	90					----						90						----						90						
BF Cross Sectional Area (ft <sup>2</sup> )	11.3					12.1						9.5						8.4						12.1						
BF Mean Depth (ft)	0.9					0.9						0.8						0.7						0.9						
BF Max Depth (ft)	1.4					1.8						1.2						1.3						1.4						
Width/Depth Ratio	14.956					----						15.2						----						13.5						
Entrenchment Ratio	6.9231					----						7.5						----						7.03						
Bank Height Ratio	1					----						1						----						1						
Wetted Perimeter (ft)	13.5					14						12.4						11.8						13.5						
Hydraulic Radius (ft)	0.8					0.9						0.8						0.7						0.9						
Substrate																														
d50 (mm)	----					----						----						----						----						
d84 (mm)	----					----						----						----						----						

Parameter	XS 30 Pool (Main Up)					XS 31 Riffle (Main Up)					XS 32 Riffle (Main Up)							
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																		
BF Width (ft)	12.3					11.6						12.7						
Floodprone Width (ft)	----					90						25						
BF Cross Sectional Area (ft <sup>2</sup> )	11.5					8.6						9						
BF Mean Depth (ft)	0.9					0.7						0.7						
BF Max Depth (ft)	1.7					1						1						
Width/Depth Ratio	----					15.6						17.9						
Entrenchment Ratio	----					7.76						2.0						
Bank Height Ratio	----					1						1						
Wetted Perimeter (ft)	12.9					12						13						
Hydraulic Radius (ft)	0.9					0.7						0.7						
Substrate																		
d50 (mm)	----					----						----						
d84 (mm)	----					----						----						





**Table 6G. Morphology and Hydraulic Monitoring Summary**  
**Lamm UT-1 - Stream and Wetland Restoration Site**

Parameter	XS 1 Pool (UT 1)						XS 2 Riffle (UT 1)						XS 3 Riffle (UT 1)						XS 4 Riffle (UT 1)						XS 5 Riffle (UT 1)						
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	
BF Width (ft)	8.1					8						9.1						6							8.7						
Floodprone Width (ft)	---					50						50						50							50						
BF Cross Sectional Area (ft <sup>2</sup> )	6.4					5						6.7						3.6							4						
BF Mean Depth (ft)	0.8					0.6						0.7						0.6							0.5						
BF Max Depth (ft)	1.3					1						1.2						0.9							0.9						
Width/Depth Ratio	---					12.8						12.4						10							18.9						
Entrenchment Ratio	---					6.25						5.5						8.33							5.75						
Bank Height Ratio	---					1						1						1							1						
Wetted Perimeter (ft)	8.6					8.4						9.6						6.3							9						
Hydraulic Radius (ft)	0.7					0.6						0.7						0.6							0.4						
<b>Substrate</b>																															
d50 (mm)	---					---						---						---							---						
d84 (mm)	---					---						---						---							---						

Parameter	XS 6 Pool (UT 1)						XS 1 Riffle (UT 1-a)						XS 2 Riffle (UT 1-a)					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	8.6					7.4						7.8						
Floodprone Width (ft)	---					50						50						
BF Cross Sectional Area (ft <sup>2</sup> )	4					2.5						3.4						
BF Mean Depth (ft)	0.5					0.3						0.4						
BF Max Depth (ft)	0.7					0.5						0.6						
Width/Depth Ratio	---					21.3						17.6						
Entrenchment Ratio	---					6.8						6.4						
Bank Height Ratio	---					1						1						
Wetted Perimeter (ft)	8.9					7.5						8						
Hydraulic Radius (ft)	0.4					0.3						0.4						
<b>Substrate</b>																		
d50 (mm)	---					---						---						
d84 (mm)	---					---						---						



**Table 6I. Morphology and Hydraulic Monitoring Summary  
Lamm UT-2 - Stream and Wetland Restoration Site**

Parameter	XS 1 Riffle (UT 2)						XS 2 Riffle (UT 2)						XS 3 Pool (UT 2)						XS 4 Riffle (UT 2)						XS 5 Riffle (UT 2)					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																														
BF Width (ft)	7.4						7.6						7.5						7.6						9.7					
Floodprone Width (ft)	50						50						---						50						50					
BF Cross Sectional Area (ft2)	3.2						2.7						7.2						3.6						5.5					
BF Mean Depth (ft)	0.4						0.4						1.0						0.5						0.6					
BF Max Depth (ft)	0.7						0.5						1.4						0.7						1					
Width/Depth Ratio	17.11						21.4						---						16						17.1					
Entrenchment Ratio	6.757						6.58						---						6.58						5.15					
Bank Height Ratio	1						1						---						1						1					
Wetted Perimeter (ft)	7.6						7.7						8.3						7.9						10.1					
Hydraulic Radius (ft)	0.4						0.3						0.9						0.4						0.5					
<b>Substrate</b>																														
d50 (mm)	---						---						---						---						---					
d84 (mm)	---						---						---						---						---					

Parameter	XS 6 Riffle (UT 2)					
	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension						
BF Width (ft)	5.9					
Floodprone Width (ft)	50					
BF Cross Sectional Area (ft2)	2.3					
BF Mean Depth (ft)	0.4					
BF Max Depth (ft)	0.6					
Width/Depth Ratio	15.13					
Entrenchment Ratio	8.475					
Bank Height Ratio	1					
Wetted Perimeter (ft)	6.1					
Hydraulic Radius (ft)	0.4					
<b>Substrate</b>						
d50 (mm)	---					
d84 (mm)	---					



**Table 6K. Morphology and Hydraulic Monitoring Summary  
Lamm UT-3 - Stream and Wetland Restoration Site**

Parameter	XS 1 Riffle (UT 3)						XS 2 Pool (UT 3)						XS 3 Riffle (UT 3)						XS 4 Pool (UT 3)						XS 5 Riffle (UT 3)					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
<b>Dimension</b>																														
BF Width (ft)	7.3						9.7						7.6						10.4						6.9					
Floodprone Width (ft)	50						----						50						----						50					
BF Cross Sectional Area (ft2)	2.4						5.9						2.5						7.5						3.1					
BF Mean Depth (ft)	0.3						0.6						0.3						0.7						0.4					
BF Max Depth (ft)	0.5						1						0.5						1.2						0.8					
Width/Depth Ratio	22.2						----						23.1						----						15.4					
Entrenchment Ratio	6.849						----						6.6						----						7.25					
Bank Height Ratio	1						----						1						----						1					
Wetted Perimeter (ft)	7.4						10						7.7						10.8						7.1					
Hydraulic Radius (ft)	0.3						0.6						0.3						0.7						0.4					
<b>Substrate</b>																														
d50 (mm)	----						----						----						----						----					
d84 (mm)	----						----						----						----						----					

Parameter	XS 6 Riffle (UT 3)						XS 7 Pool (UT 3)						XS 8 Riffle (UT 3)						XS 9 Riffle (UT 3)						XS 10 Pool (UT 3)					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
<b>Dimension</b>																														
BF Width (ft)	6.9						6.8						6.3						7.9						7.8					
Floodprone Width (ft)	50						----						50						50						----					
BF Cross Sectional Area (ft2)	2.8						7.1						2						2.5						5					
BF Mean Depth (ft)	0.4						1.0						0.3						0.3						0.6					
BF Max Depth (ft)	0.6						1.7						0.4						0.5						1					
Width/Depth Ratio	17						----						19.8						25						----					
Entrenchment Ratio	7.246						----						7.9						6.33						----					
Bank Height Ratio	1						----						1						1						----					
Wetted Perimeter (ft)	7.2						7.8						6.4						8.1						8.3					
Hydraulic Radius (ft)	0.4						0.9						0.3						0.3						0.6					
<b>Substrate</b>																														
d50 (mm)	----						----						----						----						----					
d84 (mm)	----						----						----						----						----					

Parameter	XS 11 Riffle (UT 3)						XS 12 Riffle (UT 3)						XS 13 Pool (UT 3)						XS 14 Riffle (UT 3)					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
<b>Dimension</b>																								
BF Width (ft)	6.3						7.9						7						8.6					
Floodprone Width (ft)	50						50						----						50					
BF Cross Sectional Area (ft2)	2.5						2.6						4.1						2.8					
BF Mean Depth (ft)	0.4						0.3						0.6						0.3					
BF Max Depth (ft)	0.6						0.6						1.2						0.7					
Width/Depth Ratio	15.88						24						----						26.4					
Entrenchment Ratio	7.937						6.33						----						5.81					
Bank Height Ratio	1						1						----						1					
Wetted Perimeter (ft)	6.5						8.1						8.2						8.8					
Hydraulic Radius (ft)	0.4						0.3						0.5						0.3					
<b>Substrate</b>																								
d50 (mm)	----						----						----						----					
d84 (mm)	----						----						----						----					



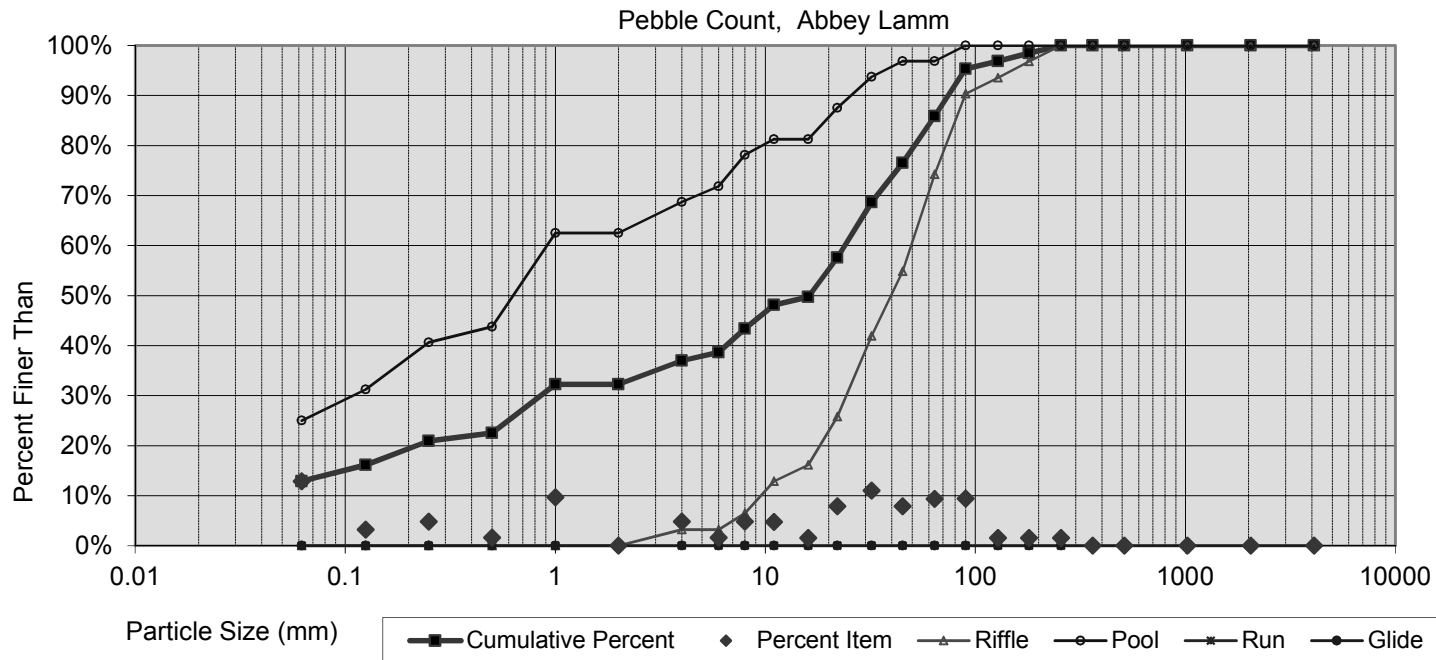
Pebble Count,

Abbey Lamm

Cape Fear

---

Note: **Mainstem - Reach-wide**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.122	2.99	16.2	60	89	13%	19%	52%	14%	0%	3%



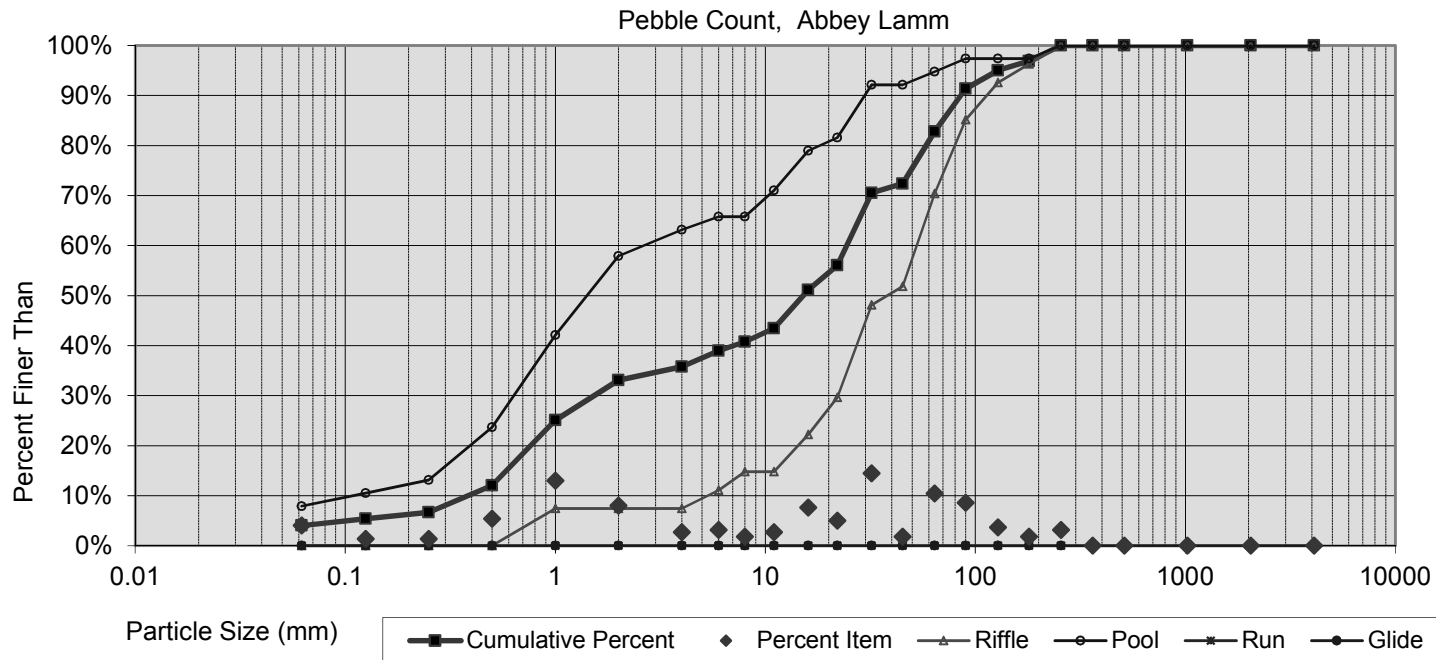
Pebble Count,

Abbey Lamm

Cape Fear

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Note: **UT-1 - Reach-wide**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.617	3.26	15.2	67	128	4%	29%	49%	17%	0%	2%

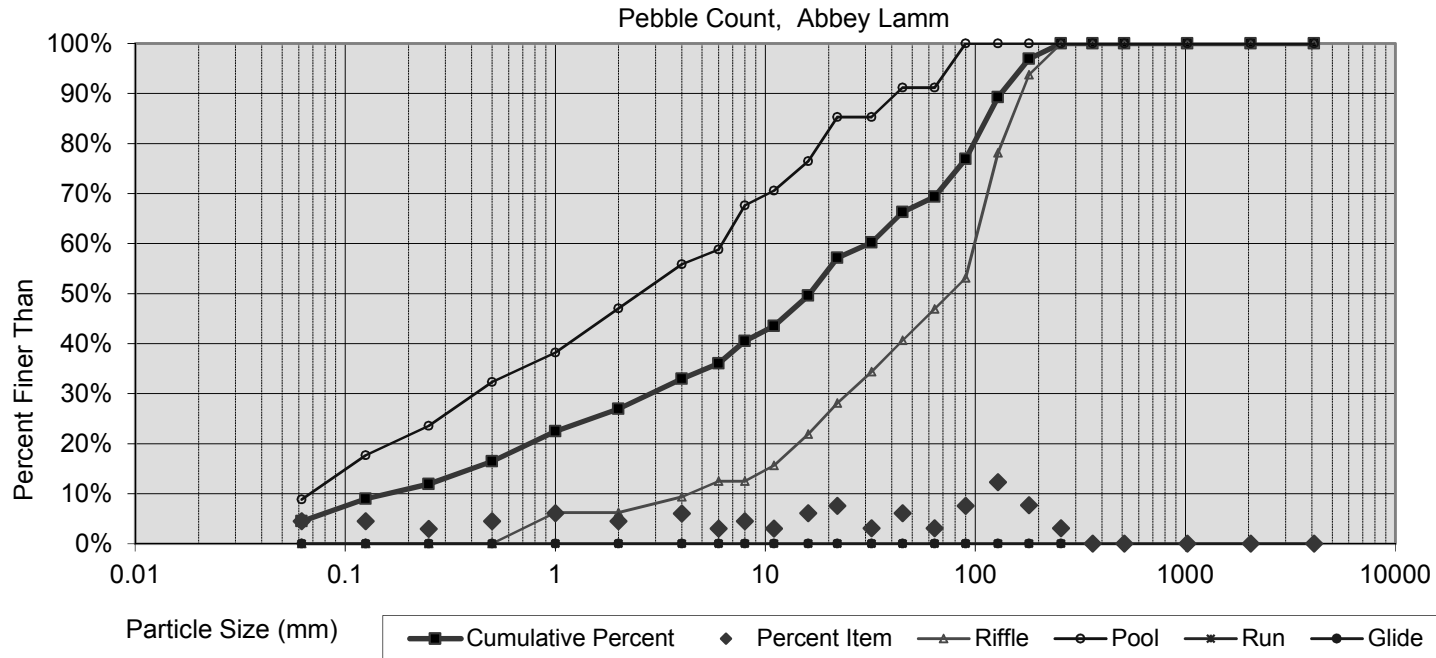
Pebble Count,

Abbey Lamm

Cape Fear

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Note: **UT-2 - Reach-wide**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.468	5.24	16.3	110	165	4%	22%	42%	30%	0%	2%

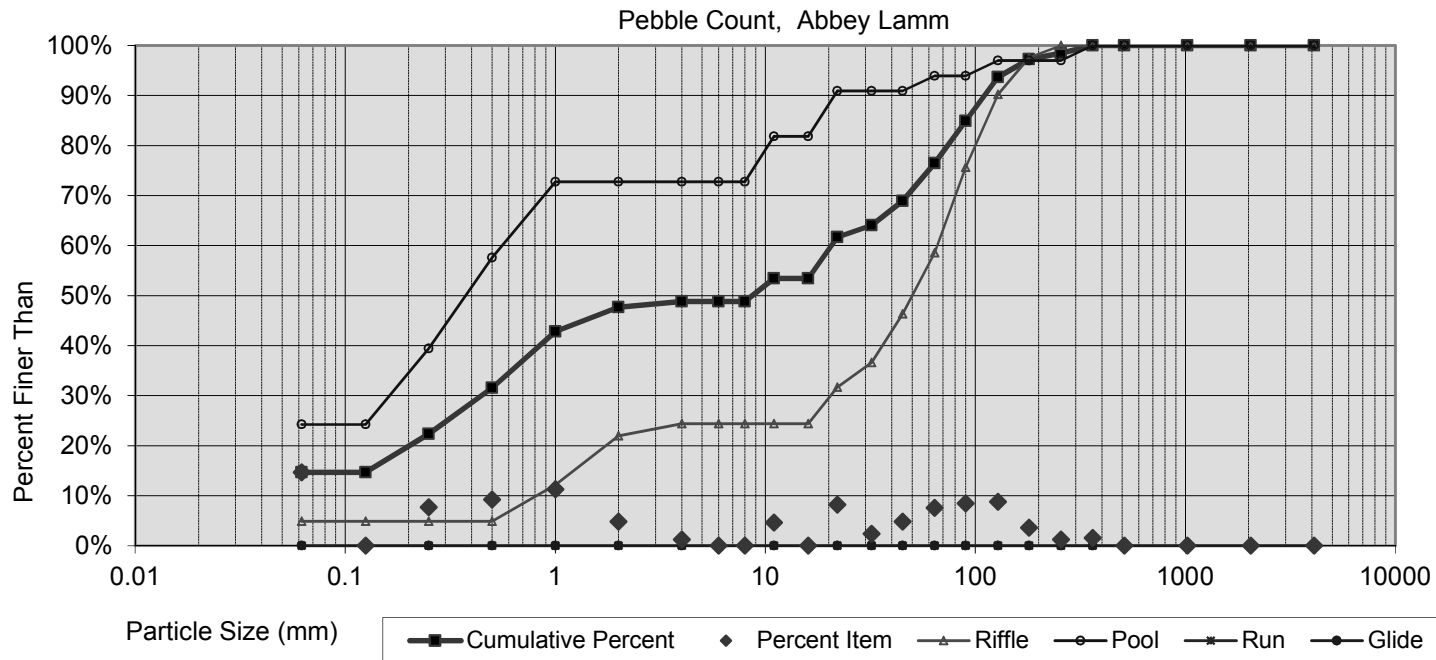
Pebble Count,

Abbey Lamm

Cape Fear

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Note: **UT-3 - Reach-wide**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.141	0.62	8.7	87	145	15%	33%	28%	22%	2%	1%

**Abbey Lamm  
Baseline Fixed Station Photographs  
Taken April 2015**

Photo Point 1A



Photo Point 1B



Photo Point 2



Photo Point 3



Photo Point 4A



Photo Point 4B



**Abbey Lamm  
Baseline Fixed Station Photographs (continued)  
Taken April 2015**



**Appendix C.  
Vegetation Data**

Table 7. Planted Woody Vegetation

Table 8. Total Planted Stems by Plot and Species  
Vegetation Plot Photographs

**Table 7. Planted Bare Root Woody Vegetation**

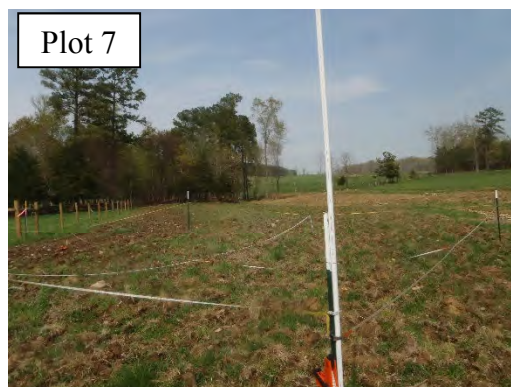
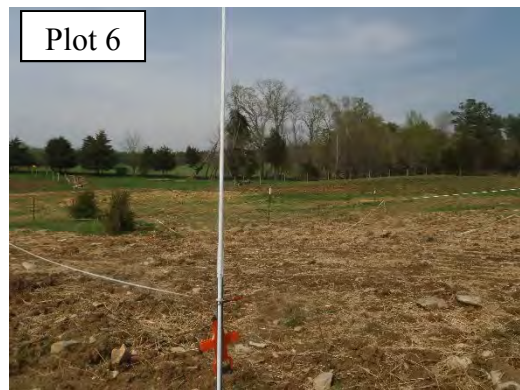
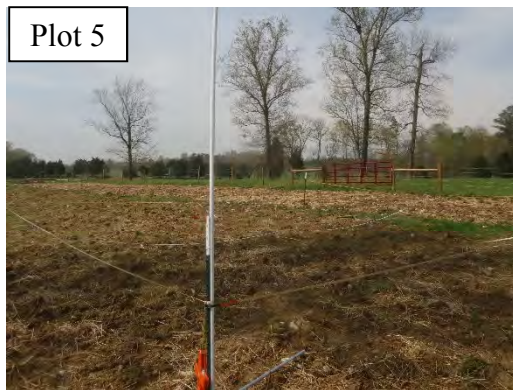
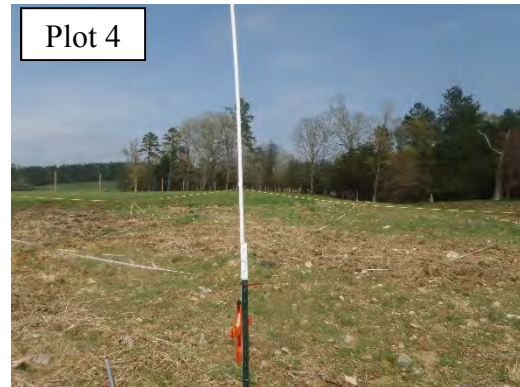
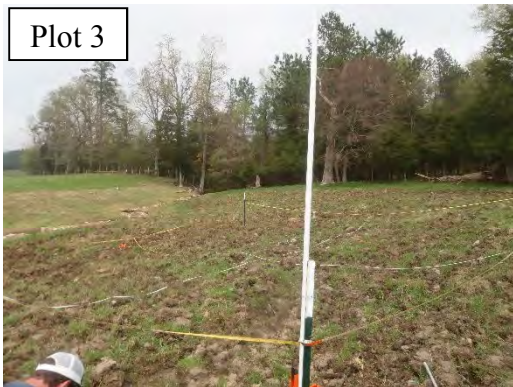
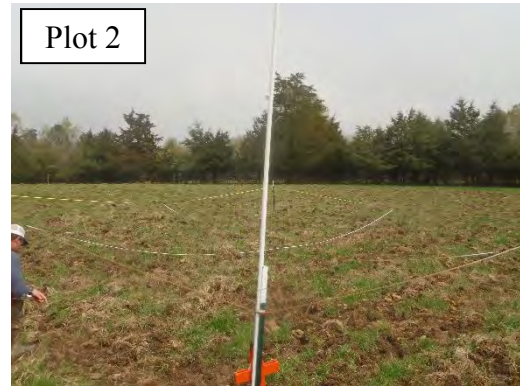
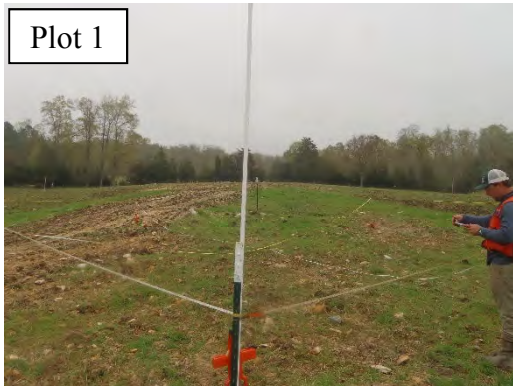
Species	Quantity
River birch ( <i>Betula nigra</i> )	600
Ironwood ( <i>Carpinus caroliniana</i> )	300
Sugarberry ( <i>Celtis laevigata</i> )	100
Buttonbush ( <i>Cephalanthus occidentalis</i> )	300
Silky dogwood ( <i>Cornus amomum</i> )	2800
Persimmon ( <i>Diospyros virginiana</i> )	500
Green ash ( <i>Fraxinus pennsylvanica</i> )	2400
Tulip poplar ( <i>Liriodendron tulipifera</i> )	3450
Swamp Black gum ( <i>Nyssa biflora</i> )	200
Sycamore ( <i>Platanus occidentalis</i> )	200
Black gum ( <i>Nyssa sylvatica</i> )	3150
White oak ( <i>Quercus alba</i> )	1600
Cherrybark oak ( <i>Quercus pagoda</i> )	200
Northern red oak ( <i>Quercus ruba</i> )	1100
Elderberry ( <i>Sambucus canadensis</i> )	300
<b>TOTAL</b>	<b>17,200</b>

**Table 8. Planted Stems by Plot and Species**

Species	CommonName	Total Planted Stems*	# plots	avg# stems	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Betula nigra	river birch	14	6	2.33	5		2		2		2	2			1			
Carpinus caroliniana	American hornbeam	5	3	1.67	1			1		3								
Celtis laevigata	sugarberry	7	5	1.4				1	2		1		2					1
Cephalanthus occidentalis	common buttonbush	7	3	2.33					1	2	4							
Cornus amomum	silky dogwood	28	8	3.5		1	6		4			8	2	2	3		2	
Diospyros virginiana	common persimmon	20	10	2	5	3		3	2	2	1		1	1	1	1		
Fraxinus pennsylvanica	green ash	24	7	3.43	1	5	4		2			6		3	3			
Liriodendron tulipifera	tuliptree	44	12	3.67	2	10		4	3	3	3		4	6	3	2	3	1
Nyssa	tupelo	9	5	1.8	3		1	1		2						2		
Nyssa aquatica	water tupelo	1	1	1	1													
Platanus occidentalis	American sycamore	1	1	1												1		
Quercus	oak	27	7	3.86				3		4				2	5	5	4	4
Quercus alba	white oak	3	2	1.5													1	2
Quercus rubra	northern red oak	6	5	1.2	1			1						1	1			2
Unknown		9	7	1.29		1	2	1		2	1		1			1		
<b>15</b>	<b>14</b>	<b>205</b>	<b>15</b>		<b>19</b>	<b>20</b>	<b>15</b>	<b>15</b>	<b>16</b>	<b>18</b>	<b>12</b>	<b>16</b>	<b>10</b>	<b>15</b>	<b>17</b>	<b>12</b>	<b>10</b>	<b>10</b>
<b>Stems per Acre</b>					<b>769</b>	<b>809</b>	<b>607</b>	<b>607</b>	<b>647</b>	<b>728</b>	<b>486</b>	<b>647</b>	<b>405</b>	<b>607</b>	<b>687</b>	<b>486</b>	<b>405</b>	<b>405</b>
<b>Total Stems per Acre</b>					<b>593</b>													

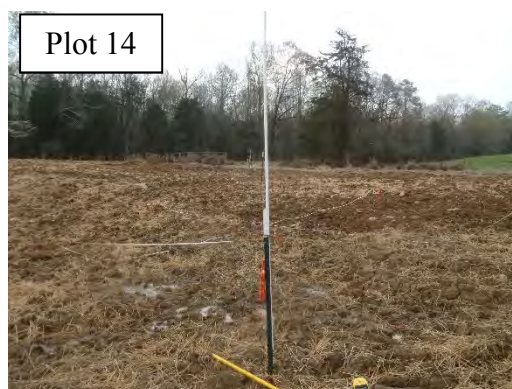
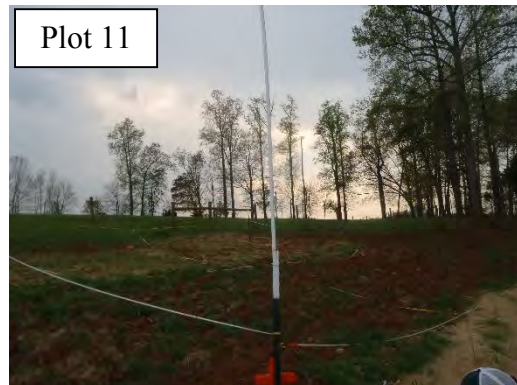
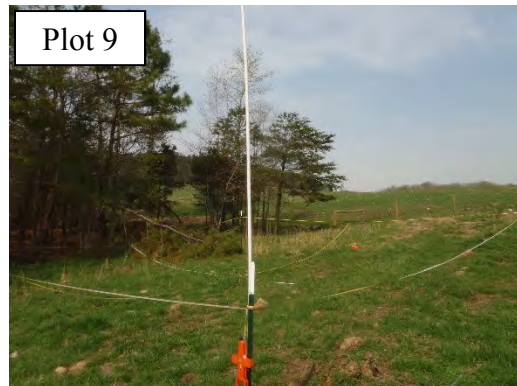
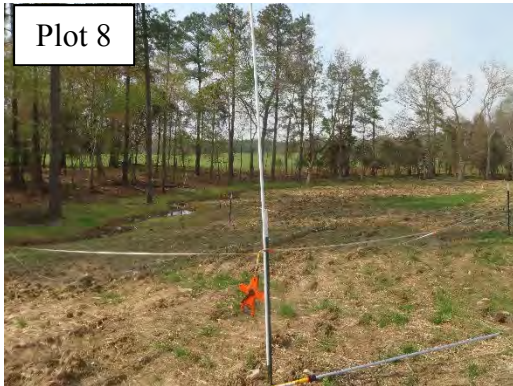
\* All stems reported are planted bare root stems, no livestakes occur within the plots.

**Abbey Lamm  
Baseline Vegetation Monitoring Photographs  
Taken April 2015**





Abbey Lamm  
Baseline Vegetation Monitoring Photographs  
Taken April 2015  
(continued)

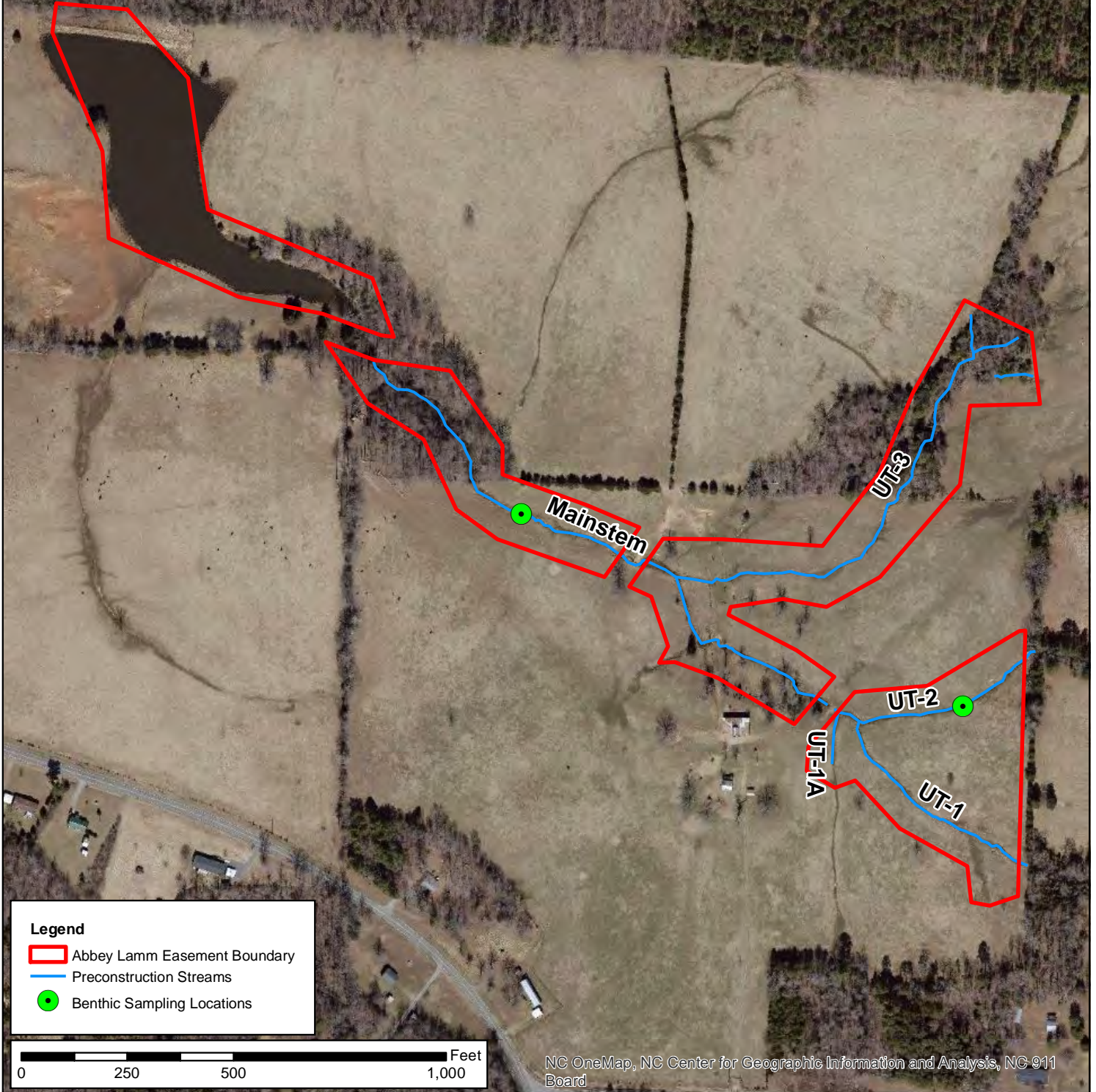


**Appendix D.**  
**As-built Plan Sheets (Preliminary)**

As-built Survey  
Longitudinal Profile Plots  
Cross Section Plots

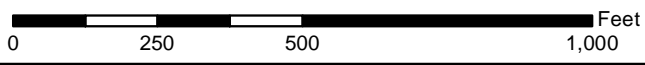
**Appendix E.**  
**Preconstruction Benthic Data**

Figure E1. Preconstruction Benthic Station Locations  
Preconstruction Benthic Sample Results  
Habitat Assessment Field Datasheets





**Legend**

- ▭ Abbey Lamm Easement Boundary
- Preconstruction Streams
- Benthic Sampling Locations



NC OneMap, NC Center for Geographic Information and Analysis, NC-911 Board

Prepared by:  Axiom Environmental, Inc.	Prepared for:  RESTORATION SYSTEMS LLC	Project: <b>ABBEY LAMM          STREAM AND WETLAND          MITIGATION SITE</b> Alamance County, NC	Title: <b>BENTHIC SAMPLING          LOCATIONS</b>	Dwn. by. KRJ	FIGURE <b>E1</b>
				Date: May 2015	
				Project: 14-005	

SPECIES	Tolerance Values	Functional Feeding Groups	UT-2	MAINSTEM
<b>MOLLUSCA</b>				
<b>Bivalvia</b>				
<b>Veneroida</b>				
Sphaeriidae		FC		
<b>Gastropoda</b>				
<b>Basommatophora</b>				
Physidae				
<i>Physella sp.</i>	8.7	CG	4	
<b>ANNELIDA</b>				
<b>Clitellata</b>				
<b>Oligochaeta</b>		CG		
<b>Tubificida</b>				
Naididae		CG		
<i>Nais communis</i>	8.7	CG		
<i>Pristina proboscidea</i>	7.7	CG	2	
Tubificinae w.h.c.		CG		1
Tubificinae w.o.h.c.		CG		1
<b>Hirudinea</b>		P		
<b>Rhynchobdellida</b>				
Glossiphoniidae		P		
<i>Placobdella sp.</i>		P		2
<b>ARTHROPODA</b>				
<b>Crustacea</b>				
<b>Ostracoda</b>			1	
<b>Amphipoda</b>		CG		
Crangonyctidae				
<i>Crangonyx sp.</i>	7.2	CG		
<b>Decapoda</b>				
Cambaridae				
<i>Procambarus sp.</i>	9.3	SH	1	
<b>Insecta</b>				
<b>Ephemeroptera</b>				
Baetidae		CG		
<i>Callibaetis sp.</i>	9.2	CG	3	
<i>Centroptilum sp.</i>	3.8	CG	3	
Caenidae		CG		
<i>Caenis sp.</i>	6.8	CG	2	
<b>Odonata</b>				
Aeshnidae		P		
<i>Aeshna sp.</i>		P	7	
Coenagrionidae		P	1	
<i>Ischnura sp.</i>	9.5		2	1

SPECIES	Tolerance Values	Functional Feeding Groups	UT-2	MAINSTEM
Libellulidae		P		
<i>Libellula sp.</i>	9.4	P	14	
<i>Plathemis lydia</i>	9.8			4
<i>Somatochlora sp.</i>	8.9	P	1	
<b>Hemiptera</b>				
Corixidae		PI		11
<i>Trichocorixa sp.</i>		-	2	
Notonectidae				
<i>Notonecta sp.</i>		P	1	
<b>Megaloptera</b>				
Corydalidae		P		
<i>Chauliodes rastricornis</i>		P		
Sialidae		P		
<i>Sialis sp.</i>	7	P	1	2
<b>Trichoptera</b>				
Hydropsychidae		FC		
<i>Diplectrona modesta</i>	2.3	FC		
Uenoidae				
<i>Neophylax sp.</i>	1.6	SC		
<b>Coleoptera</b>				
Dytiscidae		P		
<i>Laccophilus sp.</i>	9.8	P	4	
<i>Neoporus sp.</i>	5		1	
Halipidae				
<i>Peltodytes sp.</i>	8.4	SH		1
Hydrophilidae		P		
<i>Helochaeres maculicollis</i>		P	1	
<i>Tropisternus sp.</i>	9.3	P	2	
Scirtidae		SC		
<i>Cyphon sp.</i>				1
Staphylinidae		P	1	
<b>Diptera</b>				
Ceratopogonidae		P		2
Chironomidae				
<i>Chironomus sp.</i>	9.3	CG		5
<i>Clinotanypus sp.</i>	7.8	P		2
<i>Conchapelopia sp.</i>	8.4	P		
<i>Glyptotendipes sp.</i>	8.6	FC		1
<i>Natarsia sp.</i>	9.6	P	1	
<i>Parametriocnemus sp.</i>	3.9	CG		
<i>Paratendipes albimanus/duplicatus</i>	5.6		5	
<i>Phaenopsectra punctipes gp.</i>	7.1			

SPECIES	Tolerance Values	Functional Feeding Groups	UT-2	MAINSTEM
<i>Polypedilum flavum</i>	5.7	SH		
<i>Procladius sp.</i>	8.8	P	2	
<i>Psectrotanypus dyari</i>	10	P	7	
<i>Tanypodinae</i>				
<i>Tanytus sp.</i>		P		2
<i>Tanytarsus sp.</i>	6.6	FC	1	1
<i>Tribelos jucundum</i>	5.7		1	
Culicidae		FC		
<i>Anopheles sp.</i>	8.6	FC	1	
Dixidae		CG		
<i>Dixella sp.</i>		CG		
Ptychopteridae				
<i>Ptychoptera sp.</i>				
Tabanidae		PI		1
Tipulidae		SH		
<i>Tipula sp.</i>	7.5	SH		
<b>TOTAL NO. OR ORGANISMS</b>			<b>72</b>	<b>38</b>
<b>TOTAL NO. OF TAXA</b>			<b>27</b>	<b>16</b>
<b>EPT</b>			<b>3</b>	<b>0</b>
<b>Biotic Index Assigned Values</b>			<b>8.25</b>	<b>8.77</b>

Lemon  
Mainstem Upstream

Habitat Assessment Field Data Sheet  
Mountain/ Piedmont Streams

TOTAL SCORE 60

Biological Assessment Unit, DWQ

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream UT in Reedy Branch Location/road: Off Major Hill Rd (Road Name \_\_\_\_\_) County Atlanrce

Date 6/26/14 CC# 03030002 Basin Cape Fear Subbasin 03-06-04

Observer(s) Terrina/Parkinson Type of Study:  Fish  Benthos  Basinwide  Special Study (Describe) \_\_\_\_\_

Latitude 35.984683 Longitude -79.392336 Ecoregion:  MT  P  Slate Belt  Triassic Basin

Water Quality: Temperature \_\_\_\_\_ °C DO \_\_\_\_\_ mg/l Conductivity (corr.) \_\_\_\_\_ μS/cm pH \_\_\_\_\_

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: \_\_\_\_\_ %Forest \_\_\_\_\_ %Residential 100 %Active Pasture \_\_\_\_\_ % Active Crops  
\_\_\_\_\_ %Fallow Fields \_\_\_\_\_ % Commercial \_\_\_\_\_ %Industrial \_\_\_\_\_ %Other - Describe: \_\_\_\_\_

Watershed land use:  Forest  Agriculture  Urban  Animal operations upstream

Width: (meters) Stream 1 Channel (at top of bank) 1.5 Stream Depth: (m) Avg 0.1 Max 0.3  
 Width variable  Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 0.7

Bank Angle: 90 ° or  NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

- Channelized Ditch
  - Deeply incised-steep, straight banks  Both banks undercut at bend  Channel filled in with sediment
  - Recent overbank deposits  Bar development  Buried structures  Exposed bedrock
  - Excessive periphyton growth  Heavy filamentous algae growth  Green tinge  Sewage smell
- Manmade Stabilization:  N  Y;  Rip-rap, cement, gabions  Sediment/grade-control structure  Berm/levee

Flow conditions:  High  Normal  Low  
Turbidity:  Clear  Slightly Turbid  Turbid  Tannic  Milky  Colored (from dyes)  
Good potential for Wetlands Restoration Project??  YES  NO Details \_\_\_\_\_

- Channel Flow Status
- Useful especially under abnormal or low flow conditions.
- A. Water reaches base of both lower banks, minimal channel substrate exposed .....
  - B. Water fills >75% of available channel, or <25% of channel substrate is exposed.....
  - C. Water fills 25-75% of available channel, many logs/snags exposed.....
  - D. Root mats out of water.....
  - E. Very little water in channel, mostly present as standing pools.....

Weather Conditions: Hot, Sunny Photos:  N  Y  Digital  35mm

Remarks: \_\_\_\_\_



**I. Channel Modification**

- A. channel natural, frequent bends..... 5
- B. channel natural, infrequent bends (channelization could be old)..... 4
- C. some channelization present..... 3
- D. more extensive channelization, >40% of stream disrupted..... 2
- E. no bends, completely channelized or rip rapped or gabioned, etc..... 0

Evidence of dredging  Evidence of desnagging=no large woody debris in stream  Banks of uniform shape/height

Remarks \_\_\_\_\_ Subtotal 3

**II. Instream Habitat:** Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

C Rocks C Macrophytes R Sticks and leafpacks R Snags and logs C Undercut banks or root mats

**AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER**

	>70%	40-70%	20-40%	<20%
	Score	Score	Score	Score
4 or 5 types present.....	20	16	12	8
3 types present.....	19	<u>15</u>	11	7
2 types present.....	18	<u>14</u>	10	6
1 type present.....	17	13	9	5
No types present.....	0			

No woody vegetation in riparian zone Remarks \_\_\_\_\_ Subtotal 14

**III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder)** Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

**A. substrate with good mix of gravel, cobble and boulders** **Score**

- 1. embeddedness <20% (very little sand, usually only behind large boulders)..... 15
- 2. embeddedness 20-40%..... 12
- 3. embeddedness 40-80%..... 8
- 4. embeddedness >80%..... 3

**B. substrate gravel and cobble**

- 1. embeddedness <20%..... 14
- 2. embeddedness 20-40%..... 11
- 3. embeddedness 40-80%..... 6
- 4. embeddedness >80%..... 2

**C. substrate mostly gravel**

- 1. embeddedness <50%..... 8
- 2. embeddedness >50%..... 4

**D. substrate homogeneous**

- 1. substrate nearly all bedrock..... 3
- 2. substrate nearly all sand..... 3
- 3. substrate nearly all detritus..... 2
- 4. substrate nearly all silt/ clay..... 1

Remarks \_\_\_\_\_ Subtotal 8

**IV. Pool Variety** Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

**A. Pools present** **Score**

- 1. Pools Frequent (>30% of 200m area surveyed)
  - a. variety of pool sizes..... 10
  - b. pools about the same size (indicates pools filling in)..... 8
- 2. Pools Infrequent (<30% of the 200m area surveyed)
  - a. variety of pool sizes..... 6
  - b. pools about the same size..... 4

**B. Pools absent** 0

Subtotal 6

Pool bottom boulder-cobble=hard  Bottom sandy-sink as you walk  Silt bottom  Some pools over wader depth

Remarks \_\_\_\_\_ Page Total 31

**V. Riffle Habitats**

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area

	Riffles <b>Frequent</b> Score	Riffles <b>Infrequent</b> Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream.....	16	12
B. riffle as wide as stream but riffle length is not 2X stream width.....	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width.....	10	3
D. riffles absent.....	0	
Channel Slope: <input type="checkbox"/> Typical for area <input type="checkbox"/> Steep=fast flow <input type="checkbox"/> Low=like a coastal stream		Subtotal <u>14</u>

**VI. Bank Stability and Vegetation**

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
<b>A. Banks stable</b>		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	7	7
<b>B. Erosion areas present</b>		
1. diverse <b>trees</b> , shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and <b>shrubs</b> ; vegetation appears generally healthy.....	5	5
3. sparse <b>mixed</b> vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly <b>grasses</b> , few if any trees and shrubs, high erosion and failure potential at high flow.....	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0
		Total <u>5</u>

Remarks \_\_\_\_\_

**VII. Light Penetration** Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with <b>good</b> canopy with some breaks for light penetration.....	10
B. Stream with <b>full canopy</b> - breaks for light penetration absent.....	8
C. Stream with <b>partial</b> canopy - sunlight and shading are essentially equal.....	7
D. Stream with <b>minimal</b> canopy - full sun in all but a few areas.....	2
E. <b>No canopy</b> and no shading.....	0
	Subtotal <u>0</u>

Remarks \_\_\_\_\_

**VIII. Riparian Vegetative Zone Width**

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation: <input type="checkbox"/> Trees <input type="checkbox"/> Shrubs <input type="checkbox"/> Grasses <input type="checkbox"/> Weeds/old field <input type="checkbox"/> Exotics (kudzu, etc)	Lft. Bank Score	Rt. Bank Score
<b>A. Riparian zone intact (no breaks)</b>		
1. width > 18 meters.....	5	5
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
<b>B. Riparian zone not intact (breaks)</b>		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0
		Total <u>10</u>

Remarks \_\_\_\_\_

Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 29

Lumen  
Mainstem Downstream

Habitat Assessment Field Data Sheet  
Mountain/ Piedmont Streams

TOTAL SCORE 28

Biological Assessment Unit, DWQ

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream UT to Rocky Branch Location/road: Off Major Hill Rd (Road Name \_\_\_\_\_) County Alamance

Date 6/26/14 CC# 03050002 Basin Cape Fear Subbasin 03-06-04

Observer(s) Jessica + Perisvan Type of Study:  Fish  Benthos  Basinwide  Special Study (Describe) \_\_\_\_\_

Latitude 35.815875 Longitude -79.315705 Ecoregion:  MT  P  Slate Belt  Triassic Basin

Water Quality: Temperature \_\_\_\_\_ °C DO \_\_\_\_\_ mg/l Conductivity (corr.) \_\_\_\_\_ μS/cm pH \_\_\_\_\_

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: 20 %Forest \_\_\_\_\_ %Residential 80 %Active Pasture \_\_\_\_\_ % Active Crops  
\_\_\_\_\_ %Fallow Fields \_\_\_\_\_ % Commercial \_\_\_\_\_ %Industrial \_\_\_\_\_ %Other - Describe: \_\_\_\_\_

Watershed land use:  Forest  Agriculture  Urban  Animal operations upstream

Width: (meters) Stream 1.5 Channel (at top of bank) 3 Stream Depth: (m) Avg 0.3 Max 0.6  
 Width variable  Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 1.5

Bank Angle: 90 ° or  NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

- Channelized Ditch
  - Deeply incised-step, straight banks  Both banks undercut at bend  Channel filled in with sediment
  - Recent overbank deposits  Bar development  Buried structures  Exposed bedrock
  - Excessive periphyton growth  Heavy filamentous algae growth  Green tinge  Sewage smell
- Manmade Stabilization:  N  Y:  Rip-rap, cement, gabions  Sediment/grade-control structure  Berm/levee

Flow conditions:  High  Normal  Low

Turbidity:  Clear  Slightly Turbid  Turbid  Tannic  Milky  Colored (from dyes)

Good potential for Wetlands Restoration Project??  YES  NO Details \_\_\_\_\_

- Channel Flow Status
- Useful especially under abnormal or low flow conditions.
- A. Water reaches base of both lower banks, minimal channel substrate exposed .....
  - B. Water fills >75% of available channel, or <25% of channel substrate is exposed.....
  - C. Water fills 25-75% of available channel, many logs/snags exposed.....
  - D. Root mats out of water.....
  - E. Very little water in channel, mostly present as standing pools.....

Weather Conditions: \_\_\_\_\_ Photos:  N  Y  Digital  35mm P-3

Remarks: \_\_\_\_\_

**I. Channel Modification**

- A. channel natural, frequent bends..... 5
- B. channel natural, infrequent bends (channelization could be old)..... 4
- C. some channelization present..... 3
- D. more extensive channelization, >40% of stream disrupted..... 2
- E. no bends, completely channelized or rip rapped or gabioned, etc..... 0

Evidence of dredging  Evidence of desnagging=no large woody debris in stream  Banks of uniform shape/height

Remarks \_\_\_\_\_ Subtotal 3

**II. Instream Habitat:** Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

C Rocks R Macrophytes R Sticks and leafpacks R Snags and logs R Undercut banks or root mats

**AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER**

	>70%	40-70%	20-40%	<20%
	Score	Score	Score	Score
4 or 5 types present.....	20	16	12	8
3 types present.....	19	15	11	7
2 types present.....	18	14	10	6
1 type present.....	17	13	<u>9</u>	5
No types present.....	0			

No woody vegetation in riparian zone      Remarks \_\_\_\_\_      Subtotal 9

**III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder)** Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

- A. substrate with good mix of gravel, cobble and boulders**
  - 1. embeddedness <20% (very little sand, usually only behind large boulders)..... 15
  - 2. embeddedness 20-40%..... 12
  - 3. embeddedness 40-80%..... 8
  - 4. embeddedness >80%..... 3
- B. substrate gravel and cobble**
  - 1. embeddedness <20%..... 14
  - 2. embeddedness 20-40%..... 11
  - 3. embeddedness 40-80%..... 6
  - 4. embeddedness >80%..... 2
- C. substrate mostly gravel**
  - 1. embeddedness <50%..... 8
  - 2. embeddedness >50%..... 4
- D. substrate homogeneous**
  - 1. substrate nearly all bedrock..... 3
  - 2. substrate nearly all sand..... 3
  - 3. substrate nearly all detritus..... 2
  - 4. substrate nearly all silt/ clay..... 1

Remarks \_\_\_\_\_ Subtotal 1

**IV. Pool Variety** Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

- A. Pools present**
  - 1. Pools Frequent (>30% of 200m area surveyed)
    - a. variety of pool sizes..... 10
    - b. pools about the same size (indicates pools filling in)..... 8
  - 2. Pools Infrequent (<30% of the 200m area surveyed)
    - a. variety of pool sizes..... 6
    - b. pools about the same size..... 4
- B. Pools absent**..... 0

Subtotal 6

Pool bottom boulder-cobble=hard  Bottom sandy-sink as you walk  Silt bottom  Some pools over wader depth

Remarks \_\_\_\_\_ Page Total 19

**V. Riffle Habitats**

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles <b>Frequent</b> Score	Riffles <b>Infrequent</b> Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream.....	16	12
B. riffle as wide as stream but riffle length is not 2X stream width.....	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width.....	10	3
D. riffles absent.....	0	
Channel Slope: <input type="checkbox"/> Typical for area <input type="checkbox"/> Steep=fast flow <input type="checkbox"/> Low=like a coastal stream		Subtotal <u>7</u>

**VI. Bank Stability and Vegetation**

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
<b>A. Banks stable</b>		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	7	7
<b>B. Erosion areas present</b>		
1. diverse <b>trees</b> , shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and <b>shrubs</b> ; vegetation appears generally healthy.....	5	5
3. sparse <b>mixed</b> vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly <b>grasses</b> , few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0
		Total <u>4</u>

Remarks \_\_\_\_\_

**VII. Light Penetration** Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with <b>good</b> canopy with some breaks for light penetration.....	10
B. Stream with <b>full canopy</b> - breaks for light penetration absent.....	8
C. Stream with <b>partial</b> canopy - sunlight and shading are essentially equal.....	7
D. Stream with <b>minimal</b> canopy - full sun in all but a few areas.....	2
E. <b>No canopy</b> and no shading.....	0
	Subtotal <u>0</u>

Remarks \_\_\_\_\_

**VIII. Riparian Vegetative Zone Width**

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, other slides, etc.

FACE UPSTREAM

Dominant vegetation:  Trees  Shrubs  Grasses  Weeds/old field  Exotics (kudzu, etc)

	Lft. Bank Score	Rt. Bank Score
<b>A. Riparian zone intact (no breaks)</b>		
1. width > 18 meters.....	5	5
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
<b>B. Riparian zone not intact (breaks)</b>		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0
		Total <u>8</u>

Remarks \_\_\_\_\_

Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream.

Page Total 19  
TOTAL SCORE 58

Limm  
UT-2

### Habitat Assessment Field Data Sheet Mountain/ Piedmont Streams

**TOTAL SCORE** 91

#### Biological Assessment Unit, DWQ

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream UT to Rocky Branch Location/road: Off Major Hill Rd (Road Name \_\_\_\_\_) County Alamance

Date 6/26/14 CC# 03030002 Basin Cape Fear Subbasin 03-06-04

Observer(s) Perkins + Terriport Type of Study:  Fish  Benthos  Basinwide  Special Study (Describe) \_\_\_\_\_

Latitude 35.986621 Longitude -79.388883 Ecoregion:  MT  P  Slate Belt  Triassic Basin

Water Quality: Temperature \_\_\_\_\_ °C DO \_\_\_\_\_ mg/l Conductivity (corr.) \_\_\_\_\_ μS/cm pH \_\_\_\_\_

**Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.**

Visible Land Use: 30 %Forest \_\_\_\_\_ %Residential 30 %Active Pasture \_\_\_\_\_ % Active Crops  
40 %Fallow Fields \_\_\_\_\_ % Commercial \_\_\_\_\_ %Industrial \_\_\_\_\_ %Other - Describe: \_\_\_\_\_

Watershed land use:  Forest  Agriculture  Urban  Animal operations upstream

Width: (meters) Stream 1 Channel (at top of bank) 2 Stream Depth: (m) Avg 0.2 Max 0.5  
 Width variable  Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 0.5

Bank Angle: 70 ° or  NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

- Channelized Ditch
  - Deeply incised-steep, straight banks  Both banks undercut at bend  Channel filled in with sediment
  - Recent overbank deposits  Bar development  Buried structures  Exposed bedrock
  - Excessive periphyton growth  Heavy filamentous algae growth  Green tinge  Sewage smell
- Manmade Stabilization:  N  Y:  Rip-rap, cement, gabions  Sediment/grade-control structure  Berm/levee

Flow conditions:  High  Normal  Low  
Turbidity:  Clear  Slightly Turbid  Turbid  Tannic  Milky  Colored (from dyes)

Good potential for Wetlands Restoration Project??  YES  NO Details \_\_\_\_\_

#### Channel Flow Status

- Useful especially under abnormal or low flow conditions.
- A. Water reaches base of both lower banks, minimal channel substrate exposed .....
  - B. Water fills >75% of available channel, or <25% of channel substrate is exposed.....
  - C. Water fills 25-75% of available channel, many logs/snags exposed.....
  - D. Root mats out of water.....
  - E. Very little water in channel, mostly present as standing pools.....

Weather Conditions: \_\_\_\_\_ Photos:  N  Y  Digital  35mm P-1

Remarks: \_\_\_\_\_

**I. Channel Modification**

	<u>Score</u>
A. channel natural, frequent bends.....	5
B. channel natural, infrequent bends (channelization could be old).....	4
C. some channelization present.....	3
D. more extensive channelization, >40% of stream disrupted.....	2
E. no bends, completely channelized or rip rapped or gabioned, etc.....	0
<input type="checkbox"/> Evidence of dredging <input type="checkbox"/> Evidence of desnagging=no large woody debris in stream <input type="checkbox"/> Banks of uniform shape/height	
Remarks _____	Subtotal <u>5</u>

**II. Instream Habitat:** Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

C Rocks   C Macrophytes   R Sticks and leafpacks   C Snags and logs   R Undercut banks or root mats

**AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER**

	>70%	40-70%	20-40%	<20%
	Score	Score	Score	Score
4 or 5 types present.....	20	16	12	8
3 types present.....	19	15	11	7
2 types present.....	18	14	10	6
1 type present.....	17	13	9	5
No types present.....	0			

No woody vegetation in riparian zone   Remarks \_\_\_\_\_   Subtotal 15

**III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder)** Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

<b>A. substrate with good mix of gravel, cobble and boulders</b>	<u>Score</u>
1. embeddedness <20% (very little sand, usually only behind large boulders).....	15
2. embeddedness 20-40%.....	12
3. embeddedness 40-80%.....	8
4. embeddedness >80%.....	3
<b>B. substrate gravel and cobble</b>	
1. embeddedness <20%.....	14
2. embeddedness 20-40%.....	11
3. embeddedness 40-80%.....	6
4. embeddedness >80%.....	2
<b>C. substrate mostly gravel</b>	
1. embeddedness <50%.....	8
2. embeddedness >50%.....	4
<b>D. substrate homogeneous</b>	
1. substrate nearly all bedrock.....	3
2. substrate nearly all sand.....	3
3. substrate nearly all detritus.....	2
4. substrate nearly all silt/ clay.....	1

Remarks \_\_\_\_\_   Subtotal 11

**IV. Pool Variety** Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

<b>A. Pools present</b>	<u>Score</u>
1. Pools Frequent (>30% of 200m area surveyed)	
a. variety of pool sizes.....	10
b. pools about the same size (indicates pools filling in).....	8
2. Pools Infrequent (<30% of the 200m area surveyed)	
a. variety of pool sizes.....	6
b. pools about the same size.....	4
<b>B. Pools absent.....</b>	0

Subtotal 10

Pool bottom boulder-cobble=hard    Bottom sandy-sink as you walk    Silt bottom    Some pools over wader depth

Remarks \_\_\_\_\_   Page Total 41

**V. Riffle Habitats**

Definition: Riffle is area of reeration-can be debris dam, or narrow channel area.

	Riffles Frequent Score	Riffles Infrequent Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream...	16	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent	0	
Channel Slope: <input type="checkbox"/> Typical for area <input type="checkbox"/> Steep=fast flow <input type="checkbox"/> Low=like a coastal stream		Subtotal 16

**VI. Bank Stability and Vegetation**

FACE UPSTREAM

	Left Bank Score	Rt. Bank Score
<b>A. Banks stable</b>		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion	7	7
<b>B. Erosion areas present</b>		
1. diverse trees, shrubs, grass; plants healthy with good root systems	6	6
2. few trees or small trees and shrubs; vegetation appears generally healthy	5	5
3. sparse mixed vegetation; plant types and conditions suggest poorer soil binding	3	3
4. mostly grasses, few if any trees and shrubs, high erosion and failure potential at high flow	2	2
5. little or no bank vegetation, mass erosion and bank failure evident	0	0
		Total 14

Remarks \_\_\_\_\_

**VII. Light Penetration** Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with good canopy with some breaks for light penetration	10
B. Stream with full canopy - breaks for light penetration absent	8
C. Stream with partial canopy - sunlight and shading are essentially equal	7
D. Stream with minimal canopy - full sun in all but a few areas	2
E. No canopy and no shading	0

Remarks \_\_\_\_\_

Subtotal 10

**VIII. Riparian Vegetative Zone Width**

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition. A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation:  Trees  Shrubs  Grasses  Weeds/old field  Exotics (kudzu, etc)

	Lft. Bank Score	Rt. Bank Score
<b>A. Riparian zone intact (no breaks)</b>		
1. width > 18 meters	5	5
2. width 12-18 meters	4	4
3. width 6-12 meters	3	3
4. width < 6 meters	2	2
<b>B. Riparian zone not intact (breaks)</b>		
1. breaks rare		
a. width > 18 meters	4	4
b. width 12-18 meters	3	3
c. width 6-12 meters	2	2
d. width < 6 meters	1	1
2. breaks common		
a. width > 18 meters	3	3
b. width 12-18 meters	2	2
c. width 6-12 meters	1	1
d. width < 6 meters	0	0
		Total 10

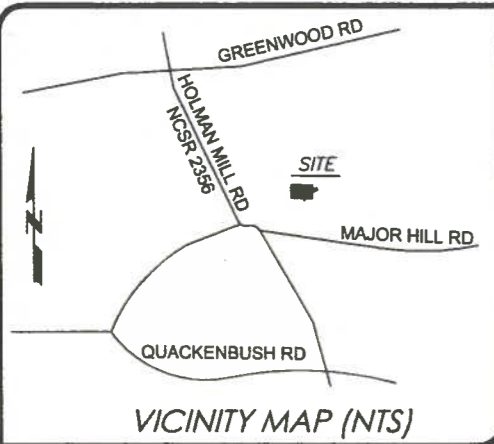
Remarks \_\_\_\_\_

Page Total 50

Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream.

TOTAL SCORE 91





**DEED REFERENCE(S) FOR NEW CONSERVATION EASEMENT:**  
D.B. 3275, PG(S). 988-992

**MAP REFERENCE(S) FOR NEW CONSERVATION EASEMENT:**  
BK. 76, PAGES 373  
BK. 76, PAGES 374

**MAP REFERENCE(S):**  
BK. 52, PG. 180  
BK. 57, PG. 183  
BK. 73, PG. 219  
BK. 76, PAGES 373-374

**CVS PLOTS COORDINATE TABLE (COORDINATE AT THE PLOT ORIGIN ▲)**

CVS PLOT #	NORTHING	EASTING
1	777054.89	1883587.92
2	776886.79	1883804.10
3	777126.36	1883848.31
4	777145.13	1883714.62
5	777200.35	1883408.59
6	777368.29	1883191.34
7	777476.86	1883446.57
8	777702.69	1883766.69
9	777867.04	1883874.43
10	777537.33	1882968.39
11	777619.76	1882659.87
12	777864.59	1882455.68
13	778091.92	1882212.69
14	778550.12	1881902.08

**CONSERVATION EASEMENT ACREAGE DATA:**

SECTION "A"	4.23 ACRES±
SECTION "B"	5.77 ACRES±
SECTION "C"	2.64 ACRES±
SECTION "D"	4.66 ACRES±
TOTAL CONSERVATION EASEMENT IS 17.30 ACRES± EXCLUDING ALL EASEMENTS AND RIGHT-OF-WAYS BY COORDINATE COMPUTATION	

**CROSS-SECTIONS COORDINATE TABLE (RIGHT SIDE OF X-SECTIONS FACING UP-STREAM)**

X-SECTION #	NORTHING	EASTING
XS1	778722.85	1881711.36
XS2	778691.37	1881746.74
XS3	778644.06	1881782.65
XS4	778583.30	1881821.69
XS5	778564.07	1881843.58
XS6R	778447.24	1881863.90
XS7R	778388.61	1881866.01
XS8R	778319.10	1881874.48
XS9R	778272.82	1881935.20
XS10R	778210.22	1882002.45
XS11P	778205.23	1882065.04
XS12R	778176.12	1882101.00
XS13R	778153.84	1882171.69
XS14R	778135.35	1882240.87
XS15P	778104.90	1882286.90
XS16R	777921.72	1882421.91
XS17R	777870.44	1882484.53
XS18R	777831.25	1882551.71
XS19P	777765.26	1882598.25
XS20P	777622.97	1882679.11
XS21R	777588.39	1882753.12
XS22R	777572.35	1882789.89
XS23R	777547.36	1882835.99
XS24P	777543.02	1882897.48
XS25R	777525.65	1882933.38
XS26P	777460.18	1883071.76
XS27R	777429.32	1883114.20
XS28P	777341.45	1883148.53
XS29R	777278.42	1883221.00
XS30P	777221.99	1883351.43
XS31R	777166.53	1883419.41
XS32	777113.84	1883518.31
UT1A XS1	777098.54	1883479.80
UT1A XS2R	777043.90	1883474.46
UT1 XS1	777034.53	1883550.46
UT1 XS2R	776962.65	1883622.89
UT1 XS3R	776913.37	1883668.39
UT1 XS4R	776878.48	1883716.77
UT1 XS5R	776848.94	1883772.98
UT1 XS6R	776814.03	1883848.06
UT2 XS1R	777108.43	1883587.86
UT2 XS2R	777112.44	1883662.08
UT2 XS3P	777122.68	1883749.94
UT2 XS4R	777137.29	1883785.48
UT2 XS5R	777174.68	1883848.96
UT2 XS6R	777228.19	1883912.16
UT3 XS1R	777432.94	1883183.67
UT3 XS2P	777436.02	1883242.60
UT3 XS3R	777452.74	1883347.86
UT3 XS4P	777441.60	1883465.66
UT3 XS5R	777496.55	1883557.02
UT3 XS6R	777569.11	1883608.99
UT3 XS7P	777622.22	1883632.15
UT3 XS8R	777652.64	1883677.37
UT3 XS9R	777688.24	1883718.10
UT3 XS10P	777762.82	1883733.70
UT3 XS11R	777773.60	1883730.75
UT3 XS12R	777830.55	1883729.36
UT3 XS13P	777861.89	1883742.28
UT3 XS14R	777895.03	1883765.35

**GENERAL NOTES:**

- NOTE: NO ABSTRACT TITLE, NOR TITLE COMMITMENT, NOR RESULTS OF TITLE SEARCH WERE FURNISHED TO THE SURVEYOR. ALL DOCUMENTS OF RECORD REVIEWED ARE NOTED HEREON (SEE REFERENCES). THERE MAY EXIST OTHER DOCUMENTS OF RECORD THAT MAY AFFECT THIS SURVEYED PARCEL.
- NO HORIZONTAL CONTROL EXISTS WITHIN 2000 FT. ALL DISTANCES ARE GROUND HORIZONTAL DISTANCES AND ALL CROSS-SECTIONS HAVE ASSUMED ELEVATIONS.
- ONLY CONTROL POINT 110 HAS TRUE NORTH CAROLINA STATE PLANE COORDINATES. ALL OTHER COORDINATES ARE GROUND COORDINATES (NAD 83(2011))
- LAST OF CONSTRUCTION WAS APRIL 3, 2015 AND PLANTING WAS DONE ON APRIL 7, 2015. THIS INFORMATION WAS PROVIDED BY RESTORATION SYSTEMS, LLC.
- THE OPUS SOLUTION ON CONTROL POINT 110 WAS VERIFIED ON TWO SEPARATE DATES WITH A MINIMUM OBSERVATION TIME OF 120 MINUTES. THE NCSPC SHOWN ON CONTROL POINT 110 WAS OBTAINED FROM AN NGS OPUS SOLUTION. THIS OBSERVATION WAS STARTED ON 04/08/2014 14:18:00 AND ENDED ON 04/08/2014 17:40:00 USING A TOPCON HYPERLITE PLUS GPS UNIT. THE COMBINED FACTOR IS 0.99990949. THE DATUM IS NAD '83(2011). THE FOLLOWING BASE STATIONS WERE USED IN THE OPUS SOLUTION:

PID	DESIGNATION	LATITUDE (m)	LONGITUDE (m)
AM7024	SNFD SANFORD CORS ARP	N352824.677	W0790928.984
DL3891	NCJL JORDAN LAKE CORS ARP	N354652.496	W0790203.927
DG9328	DURH DURHAM COOP CORS ARP	N355946.129	W0785358.036

Vegetation Association	Piedmont Alluvial Forest		Dry-Mesic Oak-Hickory Forest		Marsh Treatment Wetland	
Area (acres)	2.00		14.4		0.5	
Species	# planted*	% of total	# planted*	% of total	# planted*	# planted*
River birch (Betula nigra)	100	7.14%	--	--	--	--
Ironwood (Carpinus caroliniana)	--	--	300	3.06%	--	--
Sugarberry (Celtis laevigata)	100	7.14%	--	--	--	--
Buttonbush (Cephalanthus occidentalis)	--	--	--	--	300	21.43%
Silky dogwood (Cornus amomum)	100	7.14%	--	--	800	57.14%
Persimmon (Diospyros virginiana)	--	--	500	5.10%	--	--
Green ash (Fraxinus pennsylvanica)	200	14.29%	--	--	--	--
Tulip poplar (Liriodendron tulipifera)	300	21.43%	3150	32.14%	--	--
Swamp Black gum (Nyssa biflora)	200	14.29%	--	--	--	--
Sycamore (Platanus occidentalis)	200	14.29%	--	--	--	--
Black gum (Nyssa sylvatica)	--	--	3150	32.14%	--	--
White oak (Quercus alba)	--	--	1600	16.33%	--	--
Cherrybark oak (Quercus pagoda)	200	14.29%	--	--	--	--
Northern red oak (Quercus rubra)	--	--	1100	11.22%	--	--
Elberry (Sambucus canadensis)	--	--	--	--	300	21.43%
<b>TOTAL:</b>	<b>1,400</b>	<b>100.00%</b>	<b>9,800</b>	<b>100.00%</b>	<b>1,400</b>	<b>100.00%</b>

(VEGETATION TABLE PROVIDED BY RESTORATION SYSTEMS, LLC)

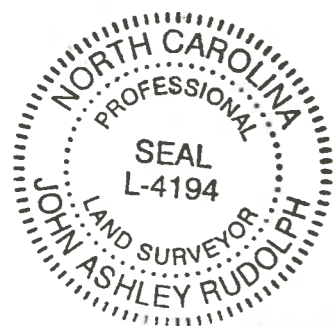
**SURVEYORS CERTIFICATION(S)**

Surveyor's disclaimer: No attempt was made to locate any cemeteries, wetlands, hazardous material sites, underground or aboveground utilities or any other features above, or below ground other than those shown.

I certify that the survey is of another category (as-built survey), such as the recombination of existing parcels, a court-ordered survey, or other exception to the definition of subdivision.

I certify that this plat does not meet G.S. 47-30 as amended.

I, John A. Rudolph, certify that this project was completed under my direct and responsible charge from an actual survey made under my supervision; that this As-built survey was performed at the 95 percent confidence level to meet Federal Geographic Data Committee Standards; that this survey was performed to meet the requirements for a topographic/planimetric survey to the accuracy of Class B and vertical accuracy when applicable to the Class B standard, and that the original data was obtained on March & April, 2015; that the survey was completed on April 20, 2015; and all coordinates are based on NC Grid 'NAD '83(2011) and all elevations are assumed elevations.



*John A. Rudolph*  
Surveyor L-4194



Axiom Environmental  
218 Snow Avenue  
Raleigh, NC 27603  
919-215-1693

**RESTORATION SYSTEMS, LLC**  
1101 HAYNES STREET  
SUITE 211  
RALEIGH, NC 27604

**SHEET 1**  
AS-BUILT SURVEY  
FOR  
**THE STATE OF NORTH CAROLINA,**  
**DIVISION OF MITIGATION SERVICES**  
**DMS PROJECT ID# 96311**  
**SPO FILE # 01-U**  
**NC DMS CONTRACT# 5790**  
**RFP# 16-005568**  
ABBEY LAMM STREAM  
AND WETLAND RESTORATION SITE  
NEWLIN TOWNSHIP ALAMANCE COUNTY NORTH CAROLINA

GRAPHIC SCALE 1" = 100'

DRAWN BY: FGR  
DATE: 7/7/15  
DWG. NO.: RSS104AB15  
SURVEYED BY: J.A.R.



5888 U.S. Hwy. 70 East  
Goldsboro, NC 27534  
Tel.: (919) 751-0075  
k2design@suddenlink.net

**LEGEND:**

- ISS - IRON STAKE SET
- ECM - EXISTING CONCRETE MARKER
- EIP - EXISTING IRON PIPE
- EN - EXISTING NAIL
- MNS - MAG NAIL SET
- EIS - EXISTING IRON STAKE
- EPP - EXISTING PUMP PIPE
- PPS - PUMP PIPE SET
- PTI - PINCHED TOP IRON PIPE
- NMC - NON-MONUMENTED CORNER
- R/W - RIGHT OF WAY
- EOP - EDGE OF PAVEMENT
- CPP - CORRUGATED PLASTIC PIPE
- CL - CENTERLINE
- UP - UTILITY POLE
- BK - BOOK
- D.B. - DEED BOOK
- PG. - PAGE

- No. 5 REBAR FLUSH WITH GRADE WITH AN ALUMINUM 3/4" CAP INSCRIBED: "STATE OF NORTH CAROLINA CONSERVATION EASEMENT"
- ▲ "FIXE" 3/8" BOLT SET IN ROCK OUTCROP

- CONSERVATION EASEMENT LINE
- - - TIE DOWN LINE
- - - RIGHT OF WAY LINE OR ADJOINER LINE

ACCESS EASEMENTS

- MONITORING REACH
- MODIFIED REACH
- LOG CROSS VANE
- LOG VANE
- ADDED LOG CROSS VANE
- ADDED LOG VANE
- CROSS-SECTION

- CVS PLOTS
- ORIGIN POINT ON CVS PLOTS
- NOT CONSTRUCTED
- MARSH TREATMENT
- GROUNDWATER GAUGE
- STREAM GAUGE
- PERMANENT STREAM CROSSING

- PHOTO TAKEN ON 4/17/15
- WETLAND ENHANCEMENT AREA
- WETLAND RESTORATION AREA

LINE DATA ALONG SECTION "A"		
LINE	BEARING	DISTANCE
L11	S01°35'21"W	504.26'
L12	S01°30'55"W	121.18'
L13	S71°13'51"W	69.28'
L14	N79°41'21"W	45.40'
L15	N06°17'19"W	85.35'
L16	N60°41'58"W	181.71'
L17	N43°11'17"W	154.17'
L18	S70°35'57"W	50.04'
L19	N59°35'19"W	76.73'
L20	N03°36'20"E	57.09'
L21	N40°08'34"E	169.46'
L22	N85°04'59"E	171.28'
L23	N59°19'50"E	251.26'
L24	N83°39'24"E	14.66'

LINE DATA ALONG SECTION "C"		
LINE	BEARING	DISTANCE
L49	N70°32'42"W	267.91'
L50	N54°06'19"W	119.87'
L51	N24°53'03"W	181.07'
L52	N57°19'47"W	156.89'
L53	N34°37'35"W	175.24'
L54	S70°14'26"E	123.82'
L55	S81°58'03"E	178.94'
L56	S34°59'34"E	215.35'
L57	S00°00'47"W	67.70'
L58	S69°57'50"E	213.03'
L59	S66°58'34"E	133.04'
L60	S35°10'43"W	142.72'

METADATA CORNER DESCRIPTIONS FOR CONSERVATION EASEMENT	
CORNER #	DESCRIPTION
(11) THRU (24)	No. 5 REBAR FLUSH WITH GRADE WITH AN ALUMINUM 3/4" CAP INSCRIBED: "STATE OF NORTH CAROLINA CONSERVATION EASEMENT"
(25)	"FIXE" 3/8" BOLT SET IN ROCK OUTCROP
(26) THRU (72)	No. 5 REBAR FLUSH WITH GRADE WITH AN ALUMINUM 3/4" CAP INSCRIBED: "STATE OF NORTH CAROLINA CONSERVATION EASEMENT"

METADATA CORNER DESCRIPTIONS FOR PROPERTY LINES & TIE DOWNS	
CORNER #	DESCRIPTION
(110)	No. 5 REBAR FLUSH WITH GRADE WITH PLASTIC CAP
(111)	1.0" O.D. IRON PIPE BENT FLUSH WITH GRADE
(112)	3/4" O.D. IRON PIPE FLUSH WITH GRADE
(113)	1.0" O.D. IRON PIPE BENT 0.3' ABOVE GRADE
(114)	1.0" O.D. IRON PIPE 0.2' ABOVE GRADE
(115)	1.0" O.D. IRON PIPE 0.1' ABOVE GRADE
(116)	3/4" O.D. IRON PIPE 1.0' ABOVE GRADE
(117)	ROCK, APPROXIMATELY 4" x 6"
(118)	1.0" O.D. IRON PIPE 0.6' ABOVE GRADE
(119)	3/4" O.D. IRON PIPE FLUSH WITH GRADE WITNESSED BY 36" OAK
(120) AND (121)	1.0" O.D. IRON PIPE 0.5' ABOVE GRADE
(122)	10" x 5" ROCK WITH "FIXE" BOLT
(124)	1.0" O.D. PINCHED TOP IRON PIPE 0.1' ABOVE GRADE
(125)	No. 5 REBAR FLUSH WITH GRADE
(126)	1.0" O.D. IRON PIPE 1.0' ABOVE GRADE
(127)	No. 5 REBAR FLUSH WITH GRADE

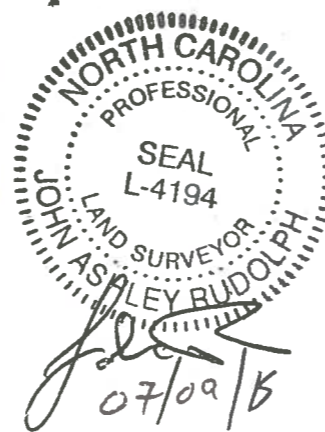
LINE DATA ALONG SECTION "B"		
LINE	BEARING	DISTANCE
L25	N58°53'57"W	209.94'
L26	N69°54'53"W	107.75'
L27	S87°59'21"W	37.01'
L28	N28°56'11"E	43.64'
L29	N18°59'00"W	122.99'
L30	N65°01'58"W	57.33'
L31	N35°10'43"E	137.99'
L32	S89°27'15"E	140.30'
L33	S86°17'48"E	235.39'
L34	N37°59'42"E	217.88'
L35	N22°35'49"E	203.07'
L36	N29°17'36"E	251.02'
L37	S63°55'16"E	175.40'
L38	S06°38'18"E	168.46'
L39	S88°50'47"W	164.02'
L40	S07°21'38"W	187.87'
L41	S40°57'51"W	287.95'
L42	S60°56'46"W	143.34'
L43	N80°21'27"W	103.21'
L44	S81°29'38"W	125.06'
L45	S15°04'01"W	18.90'
L46	S62°29'09"E	180.23'
L47	S55°10'48"E	108.23'
L48	S40°08'34"W	145.93'

LINE DATA ALONG SECTION "D"		
LINE	BEARING	DISTANCE
L61	N65°48'12"W	336.68'
L62	N03°44'59"W	204.67'
L63	N22°55'24"W	303.98'
L64	N07°38'26"E	69.38'
L65	S85°01'56"E	167.75'
L66	S41°17'34"E	216.62'
L67	S08°33'04"E	312.26'
L68	S67°18'21"E	419.22'
L69	S20°33'56"E	147.06'
L70	N81°58'03"W	30.92'
L71	N70°14'26"W	146.31'
L72	N78°21'50"W	200.86'

CONSERVATION EASEMENT ACREAGE DATA:	
SECTION "A"	4.23 ACRES±
SECTION "B"	5.77 ACRES±
SECTION "C"	2.64 ACRES±
SECTION "D"	4.66 ACRES±
TOTAL CONSERVATION EASEMENT IS 17.30 ACRES± EXCLUDING ALL EASEMENTS AND RIGHT-OF-WAYS BY COORDINATE COMPUTATION	

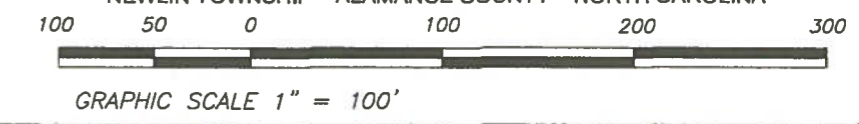
GROUND WATER GAUGES COORDINATE TABLE (APPROXIMATE CENTER ●)		
GW #	NORTHING	EASTING
1	776991.76	1883653.29
2	776887.90	1883800.68
3	777160.14	1883888.19
4	777136.69	1883816.26
5	777199.96	1883330.88
6	777250.40	1883245.92

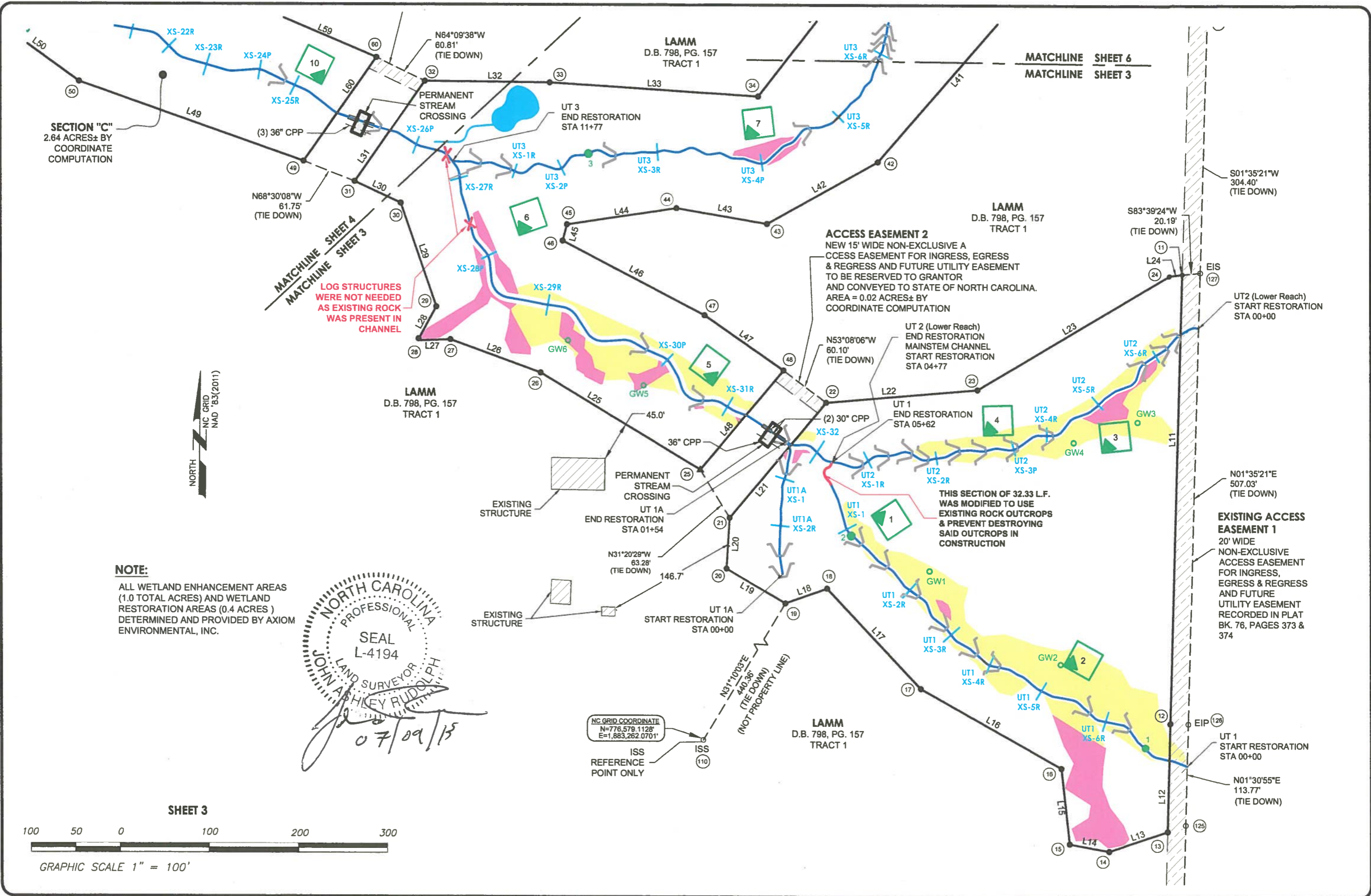
STREAM GAUGES COORDINATE TABLE (APPROXIMATE CENTER ●)		
CVS PLOT #	NORTHING	EASTING
1	776794.47	1883896.16
2	777031.80	1883564.71
3	777460.07	1883269.33



**FEMA FLOOD STATEMENT:**  
 THE AREA REPRESENTED BY THIS PLAT IS NOT LOCATED IN A FLOOD HAZARD BOUNDARY ACCORDING TO FEMA MAP NUMBER(S) 3710878700J, ZONE(S): X DATED: SEPTEMBER 6, 2006.

SHEET 2  
 AS-BUILT SURVEY  
 FOR  
**THE STATE OF NORTH CAROLINA,**  
**DIVISION OF MITIGATION SERVICES**  
 DMS PROJECT ID# 96311  
 SPO FILE # 01-U  
 NC DMS CONTRACT# 5790  
 RFP# 16-005568  
 ABBEY LAMM STREAM  
 AND WETLAND RESTORATION SITE  
 NEWLIN TOWNSHIP ALAMANCE COUNTY NORTH CAROLINA

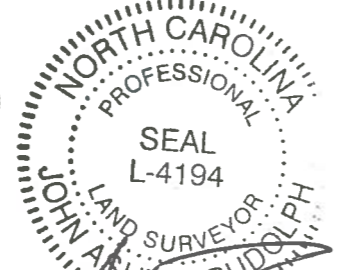




SECTION "C"  
2.64 ACRES± BY  
COORDINATE  
COMPUTATION

MATCHLINE SHEET 4  
MATCHLINE SHEET 3  
LOG STRUCTURES  
WERE NOT NEEDED  
AS EXISTING ROCK  
WAS PRESENT IN  
CHANNEL

**NOTE:**  
ALL WETLAND ENHANCEMENT AREAS  
(1.0 TOTAL ACRES) AND WETLAND  
RESTORATION AREAS (0.4 ACRES)  
DETERMINED AND PROVIDED BY AXIOM  
ENVIRONMENTAL, INC.



NC GRID COORDINATE  
N=776,579.1128'  
E=1,883,262.0701'  
ISS  
REFERENCE  
POINT ONLY

SHEET 3



GRAPHIC SCALE 1" = 100'

MATCHLINE SHEET 6  
MATCHLINE SHEET 3

S01°35'21"W  
304.40'  
(TIE DOWN)

S83°39'24"W  
20.19'  
(TIE DOWN)

**ACCESS EASEMENT 2**  
NEW 15' WIDE NON-EXCLUSIVE A  
CESS EASEMENT FOR INGRESS, EGRESS  
& REGRESS AND FUTURE UTILITY EASEMENT  
TO BE RESERVED TO GRANTOR  
AND CONVEYED TO STATE OF NORTH CAROLINA.  
AREA = 0.02 ACRES± BY  
COORDINATE COMPUTATION

UT 2 (Lower Reach)  
END RESTORATION  
MAINSTEM CHANNEL  
START RESTORATION  
STA 04+77

UT 1 END RESTORATION  
STA 05+62

THIS SECTION OF 32.33 L.F.  
WAS MODIFIED TO USE  
EXISTING ROCK OUTCROPS  
& PREVENT DESTROYING  
SAID OUTCROPS IN  
CONSTRUCTION

N01°35'21"E  
507.03'  
(TIE DOWN)

**EXISTING ACCESS  
EASEMENT 1**  
20' WIDE  
NON-EXCLUSIVE  
ACCESS EASEMENT  
FOR INGRESS,  
EGRESS & REGRESS  
AND FUTURE  
UTILITY EASEMENT  
RECORDED IN PLAT  
BK. 76, PAGES 373 &  
374

UT 1  
START RESTORATION  
STA 00+00

N01°30'55"E  
113.77'  
(TIE DOWN)

MATCHLINE SHEET 5  
MATCHLINE SHEET 4

N62°19'41"W  
229.69'  
(TIE DOWN)

**ACCESS EASEMENT 4**  
NEW 15' WIDE NON-EXCLUSIVE ACCESS EASEMENT FOR INGRESS, EGRESS & REGRESS AND FUTURE UTILITY EASEMENT TO BE RESERVED TO GRANTOR AND CONVEYED TO STATE OF NORTH CAROLINA. AREA = 0.05 ACRES± BY COORDINATE COMPUTATION

LAMM  
D.B. 864, PG. 246  
TRACT 1



20  
BK. 52, PG. 180  
LAMM  
D.B. 864, PG. 246

PHOTO 1  
(TAKEN ON 4-17-15)



MAIN CHANNEL  
END RESTORATION  
START ENHANCEMENT II  
STA 16+31

SECTION "C"  
2.64 ACRES± BY  
COORDINATE  
COMPUTATION

PHOTO 2  
(TAKEN ON 4-17-15)



**ACCESS EASEMENT 3**  
NEW 15' WIDE NON-EXCLUSIVE ACCESS EASEMENT FOR INGRESS, EGRESS & REGRESS AND FUTURE UTILITY EASEMENT TO BE RESERVED TO GRANTOR AND CONVEYED TO STATE OF NORTH CAROLINA. AREA = 0.02 ACRES± BY COORDINATE COMPUTATION

N64°09'38"W  
60.81'  
(TIE DOWN)

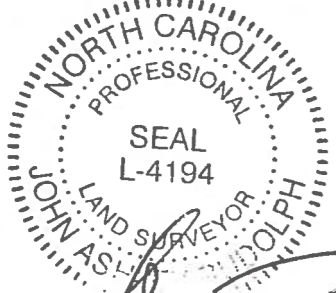
PERMANENT  
STREAM  
CROSSING

UT 3  
END RESTORATION  
STA 11+77

MATCHLINE SHEET 4  
MATCHLINE SHEET 3

LOG STRUCTURES  
WERE NOT NEEDED  
AS EXISTING ROCK  
WAS PRESENT IN  
CHANNEL

LAMM  
D.B. 798, PG. 157  
TRACT 1

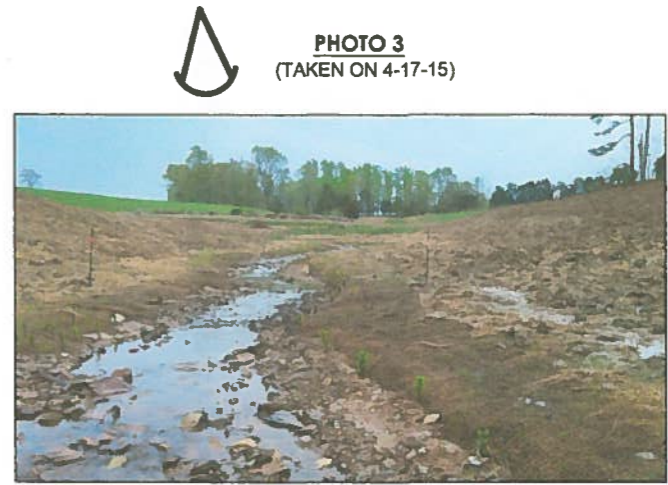
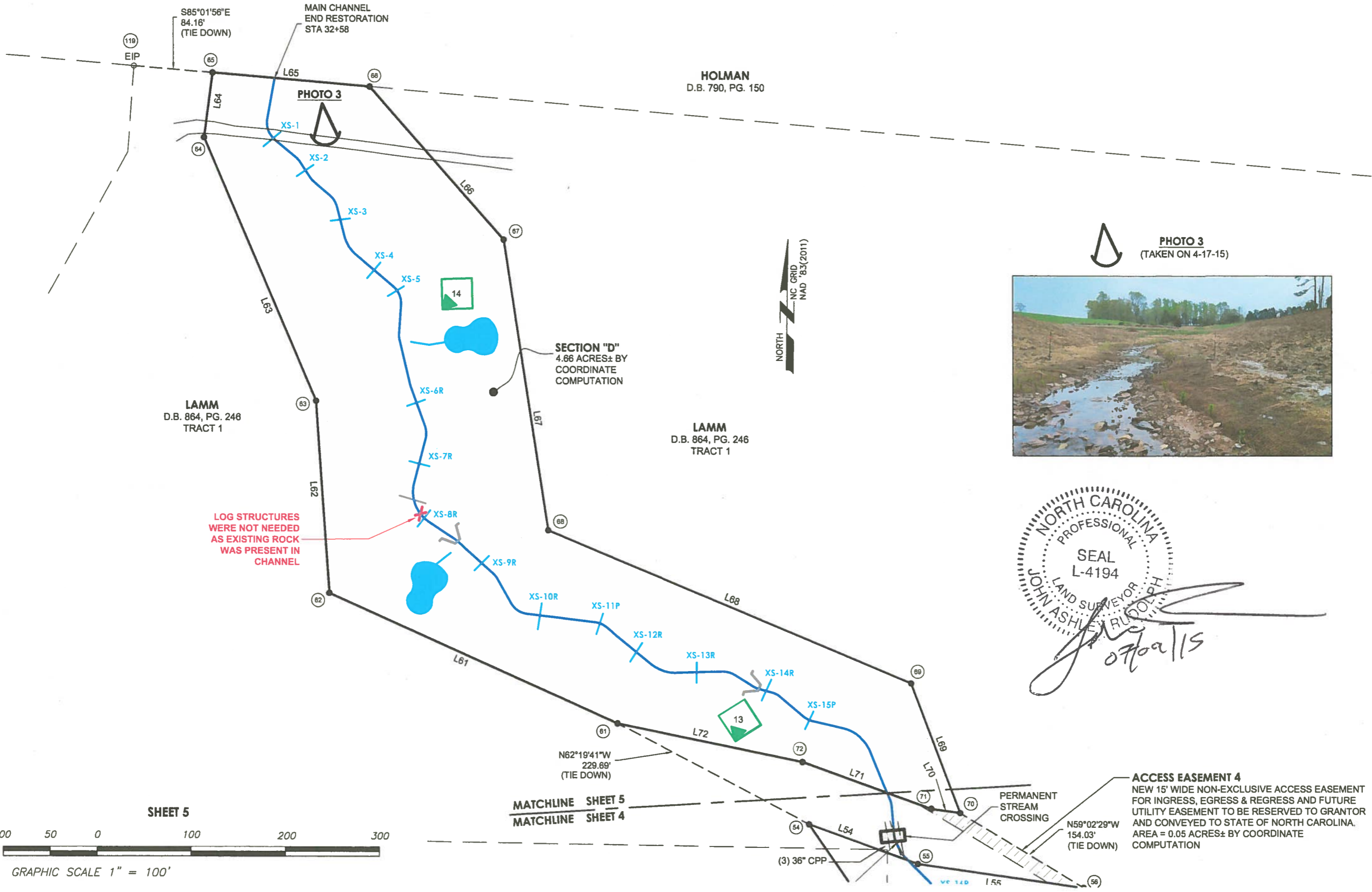


*John Aspinwall*  
07/09/15

SHEET 4

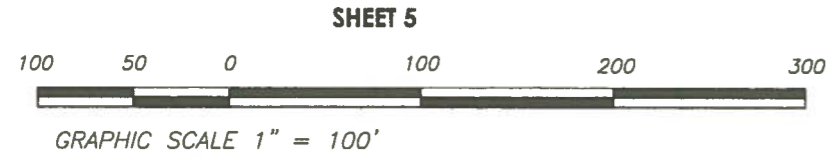


GRAPHIC SCALE 1" = 100'



NORTH CAROLINA  
 PROFESSIONAL  
 SEAL  
 L-4194  
 LAND SURVEYOR  
 JOHN ASHLEY RUDOLPH

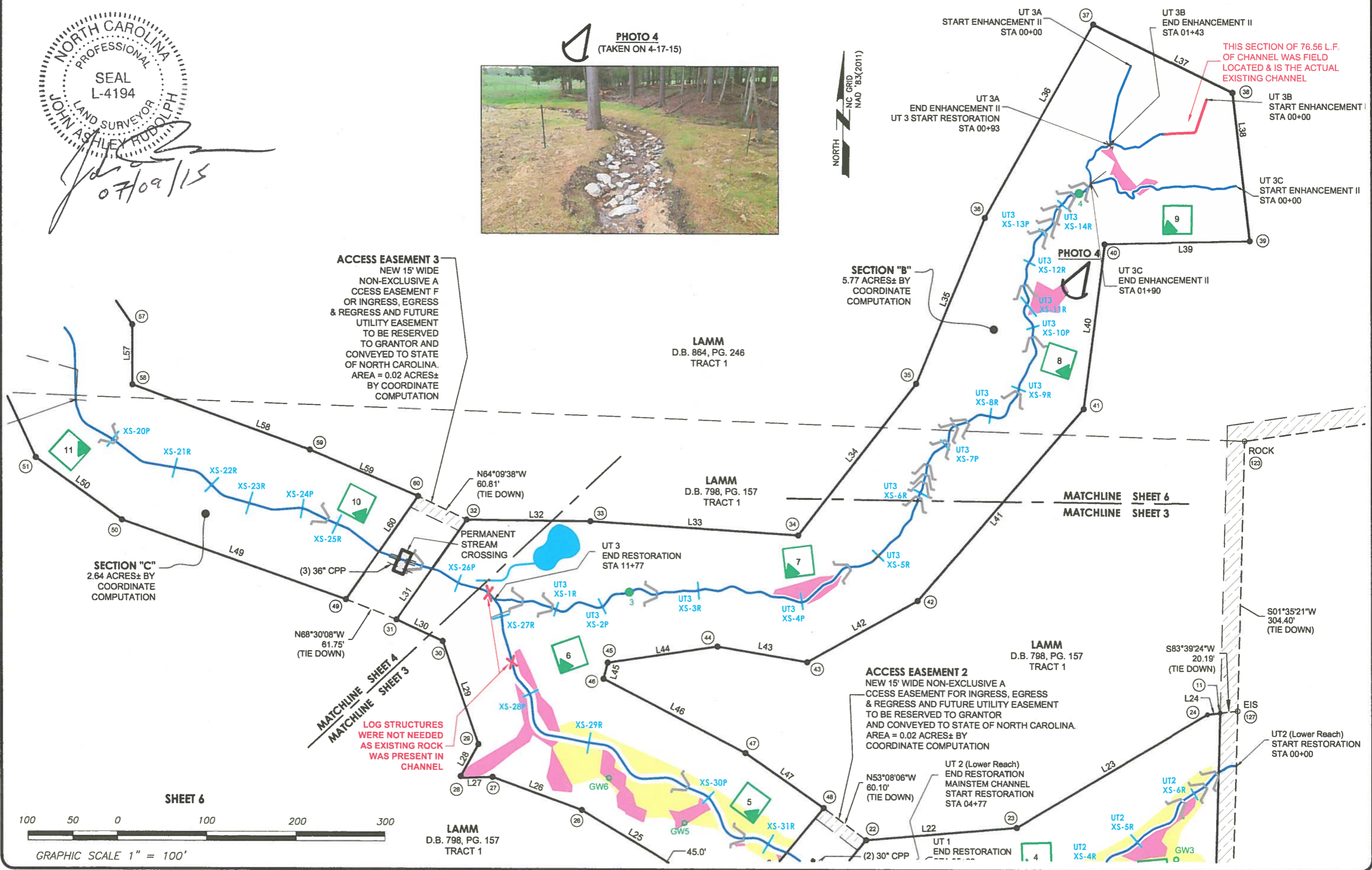
*[Signature]*  
 07/09/15





*07/09/15*

**PHOTO 4**  
(TAKEN ON 4-17-15)



**ACCESS EASEMENT 3**  
NEW 15' WIDE  
NON-EXCLUSIVE ACCESS EASEMENT FOR INGRESS, EGRESS & REGRESS AND FUTURE UTILITY EASEMENT TO BE RESERVED TO GRANTOR AND CONVEYED TO STATE OF NORTH CAROLINA.  
AREA = 0.02 ACRES± BY COORDINATE COMPUTATION

**SECTION "B"**  
5.77 ACRES± BY COORDINATE COMPUTATION

**SECTION "C"**  
2.64 ACRES± BY COORDINATE COMPUTATION

**LOG STRUCTURES**  
WERE NOT NEEDED  
AS EXISTING ROCK  
WAS PRESENT IN  
CHANNEL

**THIS SECTION OF 76.56 L.F.**  
**OF CHANNEL WAS FIELD**  
**LOCATED & IS THE ACTUAL**  
**EXISTING CHANNEL**

**MATCHLINE SHEET 6**  
**MATCHLINE SHEET 3**

**ACCESS EASEMENT 2**  
NEW 15' WIDE NON-EXCLUSIVE ACCESS EASEMENT FOR INGRESS, EGRESS & REGRESS AND FUTURE UTILITY EASEMENT TO BE RESERVED TO GRANTOR AND CONVEYED TO STATE OF NORTH CAROLINA.  
AREA = 0.02 ACRES± BY COORDINATE COMPUTATION

**SHEET 6**



GRAPHIC SCALE 1" = 100'

**LAMM**  
D.B. 798, PG. 157  
TRACT 1

**LAMM**  
D.B. 864, PG. 246  
TRACT 1

**LAMM**  
D.B. 798, PG. 157  
TRACT 1

**LAMM**  
D.B. 798, PG. 157  
TRACT 1

**UT 2 (Lower Reach)**  
END RESTORATION  
MAINSTEM CHANNEL  
START RESTORATION  
STA 04+77

**UT 1**  
END RESTORATION

**S01°35'21"W**  
**304.40'**  
**(TIE DOWN)**

**S83°39'24"W**  
**20.19'**  
**(TIE DOWN)**

**UT2 (Lower Reach)**  
START RESTORATION  
STA 00+00

**UT 3A**  
START ENHANCEMENT II  
STA 00+00

**UT 3A**  
END ENHANCEMENT II  
UT 3 START RESTORATION  
STA 00+93

**UT 3B**  
END ENHANCEMENT II  
STA 01+43

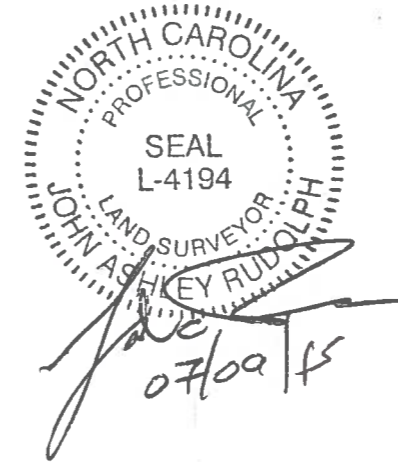
**UT 3B**  
START ENHANCEMENT II  
STA 00+00

**UT 3C**  
START ENHANCEMENT II  
STA 00+00

**UT 3C**  
END ENHANCEMENT II  
STA 01+90

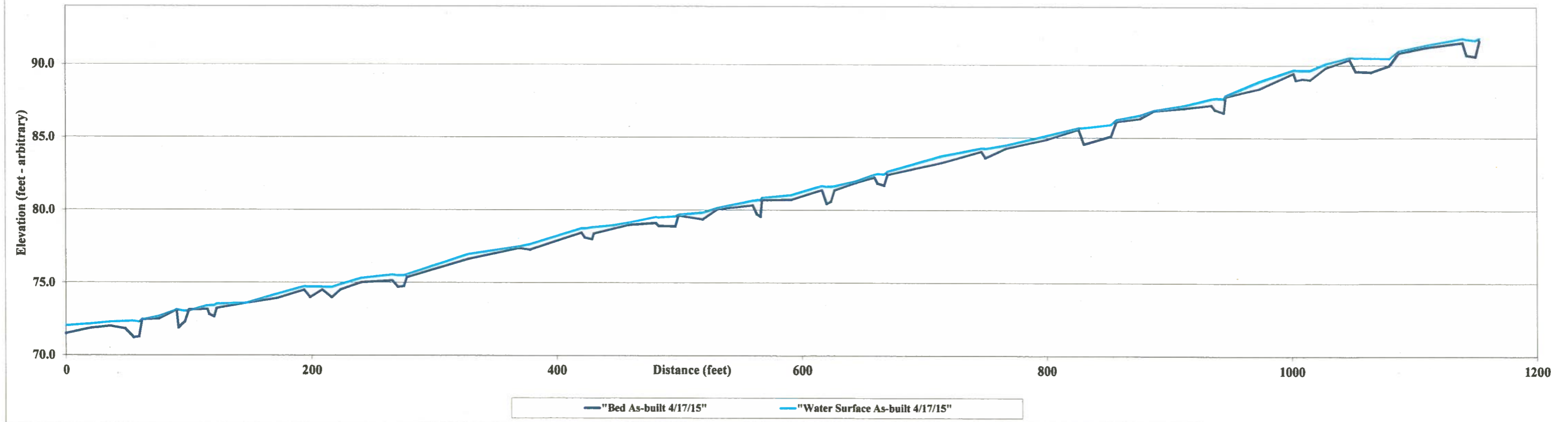
**PHOTO 4**

Project Name Lamm - As-built (2015) Profile											
Reach Main Lower											
Feature Profile											
Date 4/17/15											
Crew Perkinson, Gibbons											
2015 As-built Survey			2015 As-built Survey			2015 As-built Survey			2015 As-built Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	71.5	72.0	277.6	75.4	75.6	661.7	81.8	82.5	1064.7	89.5	90.5
20.0	71.9	72.1	327.9	76.6	77.0	667.2	81.7	82.5	1079.7	90.0	90.5
36.4	72.0	72.3	369.1	77.4	77.5	670.0	82.4	82.7	1087.4	90.9	91.0
48.2	71.8	72.3	377.7	77.3	77.6	713.7	83.3	83.7	1110.0	91.3	91.4
55.3	71.2	72.3	420.1	78.4	78.7	746.8	84.0	84.3	1139.5	91.6	91.9
59.7	71.3	72.3	422.9	78.1	78.7	750.0	83.6	84.2	1142.5	90.7	91.8
62.1	72.4	72.4	428.8	78.0	78.8	767.0	84.3	84.5	1150.0	90.6	91.7
75.8	72.5	72.7	430.1	78.4	78.8	800.2	84.9	85.1	1153.1	91.7	91.9
90.2	73.1	73.1	446.9	78.7	79.0	825.9	85.6	85.7			
91.8	71.9	73.1	458.6	79.0	79.1	830.4	84.6	85.7			
96.8	72.3	73.0	480.9	79.1	79.5	852.7	85.1	85.9			
100.3	73.1	73.1	483.2	78.9	79.5	857.1	86.1	86.2			
115.2	73.2	73.4	496.7	78.9	79.5	876.3	86.3	86.5			
116.6	72.8	73.4	499.4	79.6	79.7	887.8	86.8	86.9			
120.6	72.7	73.4	519.2	79.4	79.8	912.8	87.0	87.2			
122.5	73.2	73.5	531.2	80.1	80.1	934.5	87.3	87.7			
146.3	73.6	73.6	559.7	80.3	80.7	937.5	86.9	87.7			
171.9	73.9	74.2	563.0	79.7	80.7	944.6	86.7	87.7			
193.7	74.5	74.7	566.0	79.5	80.7	946.1	87.8	87.9			
198.7	74.0	74.7	567.2	80.7	80.8	973.8	88.4	88.9			
208.5	74.5	74.7	591.2	80.7	81.0	1001.4	89.5	89.7			
216.4	74.0	74.7	616.3	81.4	81.7	1003.5	89.0	89.7			
223.5	74.5	74.9	620.1	80.4	81.6	1008.6	89.1	89.6			
240.6	75.0	75.3	623.6	80.6	81.6	1015.1	89.0	89.7			
266.1	75.1	75.5	626.5	81.4	81.6	1027.6	89.8	90.1			
270.5	74.7	75.5	644.0	81.9	82.0	1047.1	90.4	90.5			
275.4	74.8	75.5	659.3	82.3	82.4	1052.3	89.6	90.5			

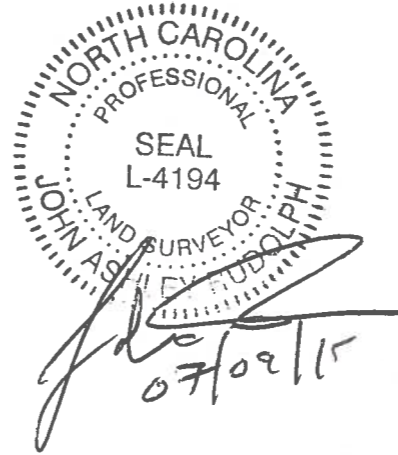


	As-built	As needed		
Avg. Water Surface Slope	0.0172			
Rifle Length	59			
Avg. Rifle Slope	0.0193			
Pool Length	18			

Lamm (Main Lower Reach) As-built Profile 2015

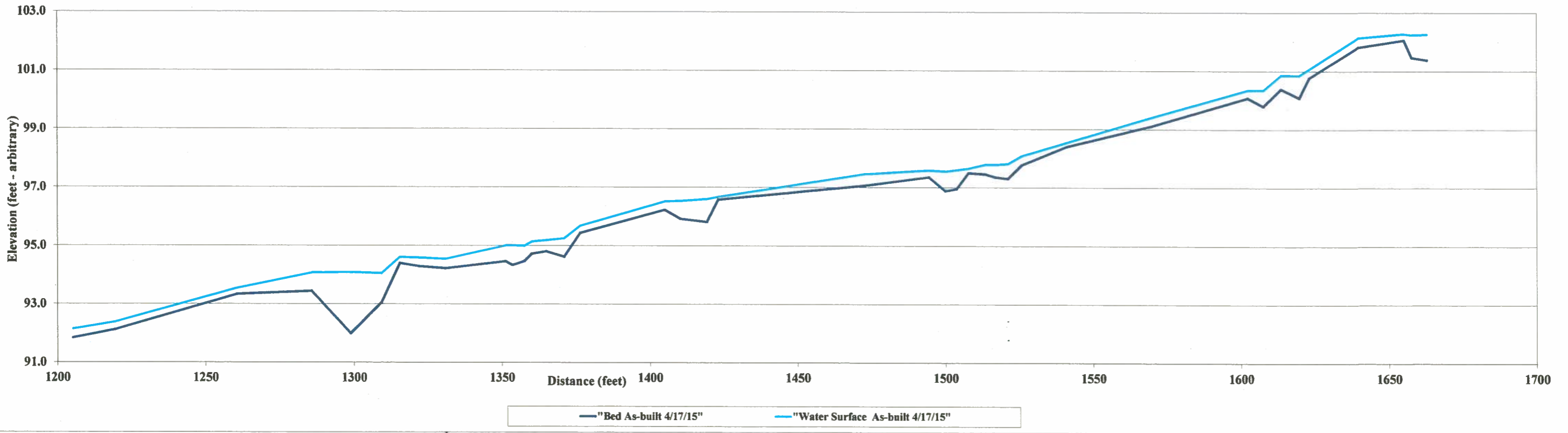


Project Name		Lamm - As-built (2015) Profile									
Reach		Main Lower (Woods)									
Feature		Profile									
Date		4/17/15									
Crew		Perkinson, Gibbons									
2015 As-built Survey			2015 As-built Survey			As needed			As needed		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
1205.2	91.8	92.1	1521.2	97.3	97.8						
1219.4	92.1	92.4	1525.9	97.8	98.1						
1260.5	93.3	93.5	1540.9	98.4	98.5						
1285.7	93.4	94.1	1569.7	99.1	99.4						
1298.8	92.0	94.1	1602.4	100.1	100.4						
1309.3	93.1	94.0	1607.6	99.8	100.4						
1315.5	94.4	94.6	1613.6	100.4	100.9						
1322.0	94.3	94.6	1619.7	100.1	100.8						
1330.9	94.2	94.5	1623.1	100.8	101.1						
1351.2	94.5	95.0	1639.6	101.8	102.1						
1353.5	94.3	95.0	1654.9	102.1	102.3						
1357.5	94.5	95.0	1657.7	101.5	102.2						
1360.1	94.7	95.1	1662.8	101.4	102.3						
1365.0	94.8	95.2									
1371.0	94.6	95.2									
1376.4	95.4	95.7									
1405.0	96.2	96.5									
1410.4	95.9	96.5									
1419.3	95.8	96.6									
1423.2	96.6	96.7									
1472.5	97.1	97.5									
1494.3	97.4	97.6									
1500.0	96.9	97.6									
1503.7	97.0	97.6									
1507.8	97.5	97.7									
1513.5	97.5	97.8									
1516.9	97.4	97.8									



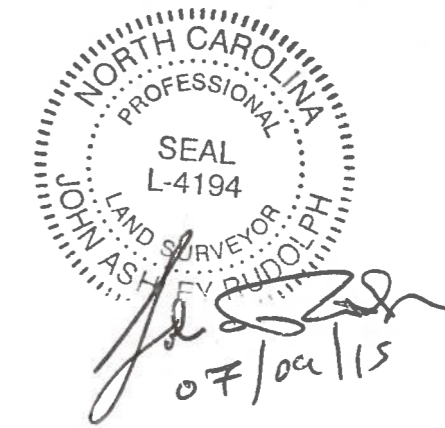
	As-built	As needed		
Avg. Water Surface Slope	0.0172			
Riffle Length	42			
Avg. Riffle Slope	0.0241			
Pool Length	14			

Lamm (Main Lower Reach Woods) As-built Profile 2015



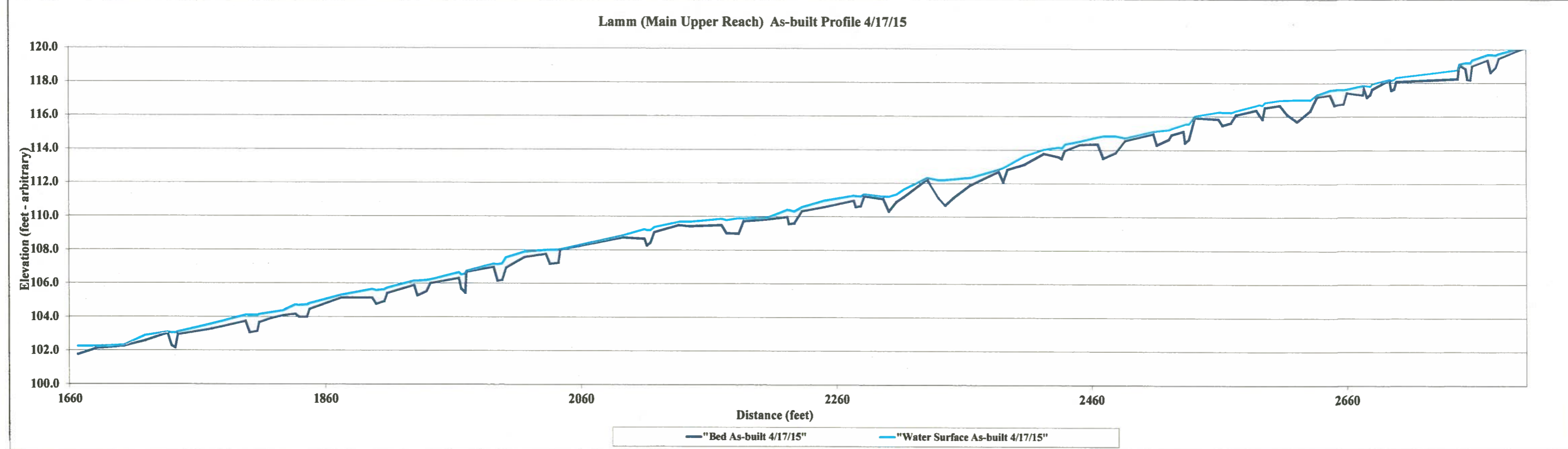


**Project Name** Lamm - As-built (2015) Profile  
**Reach** Main Upper Reach  
**Feature** Profile  
**Date** 4/17/15  
**Crew** Perkinson, Gibbons

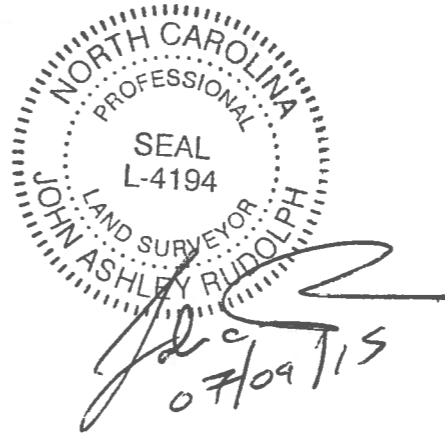


2015 As-built Survey			2015 As-built Survey			2015 As-built Survey			2015 As-built Survey			2015 As-built Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
1666.8	101.8	102.2	1942.2	106.0	106.2	2226.9	109.6	110.3	2486.5	114.6	114.7	2675.9	117.1	117.8
1681.3	102.1	102.2	1964.4	106.3	106.7	2233.0	110.3	110.6	2508.7	115.0	115.1	2678.5	117.3	117.8
1696.3	102.2	102.3	1966.2	105.7	106.5	2250.0	110.6	110.9	2511.4	114.3	115.1	2680.0	117.6	117.9
1703.0	102.3	102.3	1969.5	105.4	106.6	2273.5	111.0	111.3	2520.9	114.6	115.2	2693.6	118.2	118.2
1719.5	102.6	102.9	1970.4	106.7	106.7	2275.1	110.6	111.2	2523.0	114.9	115.3	2695.0	117.5	118.1
1737.2	103.0	103.1	1991.6	107.0	107.2	2279.1	110.6	111.2	2532.5	115.1	115.5	2697.3	117.6	118.2
1740.2	102.3	103.0	1994.6	106.2	107.1	2281.8	111.2	111.3	2533.6	114.4	115.5	2698.9	118.1	118.3
1743.1	102.1	103.0	1998.3	106.2	107.2	2296.7	111.1	111.2	2536.7	114.6	115.6	2746.8	118.2	118.8
1745.1	102.9	103.1	2001.4	106.9	107.5	2301.0	110.3	111.2	2541.2	115.9	116.0	2748.1	119.1	119.1
1771.1	103.3	103.6	2015.7	107.6	107.9	2307.0	110.9	111.3	2559.7	115.8	116.3	2752.9	118.8	119.2
1797.6	103.7	104.1	2032.5	107.8	108.0	2312.7	111.2	111.6	2562.8	115.5	116.2	2754.3	118.2	119.2
1800.9	103.1	104.1	2035.7	107.2	108.0	2331.1	112.2	112.3	2569.6	115.6	116.2	2756.8	118.2	119.2
1806.8	103.1	104.1	2042.2	107.2	108.0	2340.1	111.1	112.2	2573.4	116.1	116.3	2758.2	119.0	119.4
1808.2	103.7	104.1	2043.7	108.0	108.0	2345.2	110.7	112.2	2589.3	116.4	116.7	2770.2	119.4	119.7
1817.3	103.9	104.3	2092.7	108.7	108.9	2351.9	111.1	112.2	2591.5	116.1	116.7	2772.6	118.6	119.7
1826.8	104.1	104.4	2109.9	108.7	109.2	2365.0	111.9	112.3	2594.2	115.8	116.7	2776.6	118.9	119.7
1836.4	104.2	104.7	2111.7	108.3	109.2	2387.3	112.7	112.8	2596.0	116.5	116.8	2779.1	119.5	119.7
1839.6	104.0	104.7	2114.5	108.4	109.2	2390.9	112.1	112.9	2607.6	116.7	117.0	2793.7	119.9	120.0
1845.5	104.0	104.7	2117.6	109.1	109.4	2394.2	112.8	113.1	2613.5	116.1	117.0	2806.3	120.3	120.5
1847.5	104.5	104.8	2136.7	109.5	109.7	2407.4	113.1	113.6	2621.1	115.7	117.0			
1872.1	105.1	105.3	2145.5	109.4	109.7	2422.9	113.8	114.0	2631.5	116.3	117.0			
1896.5	105.1	105.7	2170.1	109.5	109.9	2434.2	113.6	114.2	2636.7	117.2	117.3			
1899.9	104.8	105.6	2173.9	109.0	109.8	2436.9	113.5	114.1	2646.8	117.3	117.6			
1906.3	104.9	105.6	2183.4	109.0	109.9	2439.3	114.0	114.3	2650.4	116.7	117.6			
1908.6	105.4	105.7	2187.2	109.7	109.9	2450.8	114.3	114.5	2657.4	116.7	117.6			
1929.5	105.9	106.2	2205.5	109.8	109.9	2464.9	114.3	114.8	2659.9	117.4	117.6			
1932.1	105.3	106.1	2221.5	110.0	110.4	2469.3	113.5	114.8	2672.6	117.3	117.8			
1939.1	105.5	106.2	2222.7	109.6	110.4	2478.9	113.8	114.8	2673.4	117.7	117.8			

	As-built	As needed		
Avg. Water Surface Slope	0.0157			
Riffle Length	26			
Avg. Riffle Slope	0.0186			
Pool Length	12			

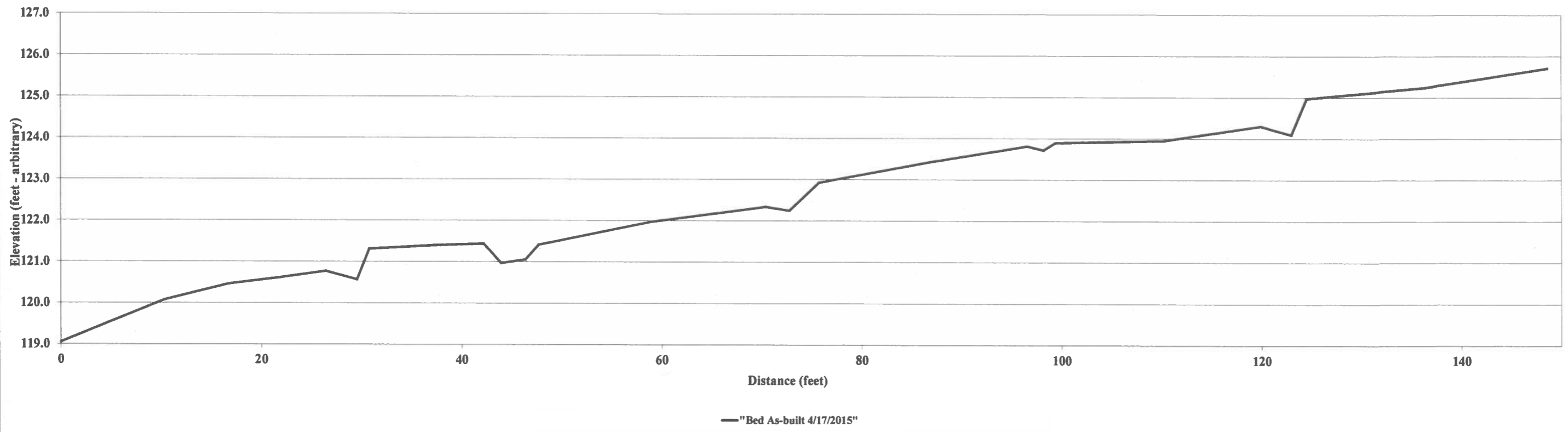


Project Name Lamm - As-built (2015) Profile											
Reach Tributary 1a											
Feature Profile											
Date 4/17/15											
Crew Perkinson, Gibbons											
2015 As-built Survey			As needed			As needed			As needed		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	119.1										
10.3	120.1										
16.7	120.5										
21.8	120.6										
26.4	120.8										
29.5	120.6										
30.8	121.3										
37.4	121.4										
42.2	121.4										
43.9	121.0										
46.4	121.1										
47.7	121.4										
58.9	122.0										
70.4	122.3										
72.7	122.2										
75.7	122.9										
86.8	123.4										
96.6	123.8										
98.2	123.7										
99.4	123.9										
110.2	123.9										
119.9	124.3										
123.0	124.1										
124.5	125.0										
136.4	125.2										
148.6	125.7										



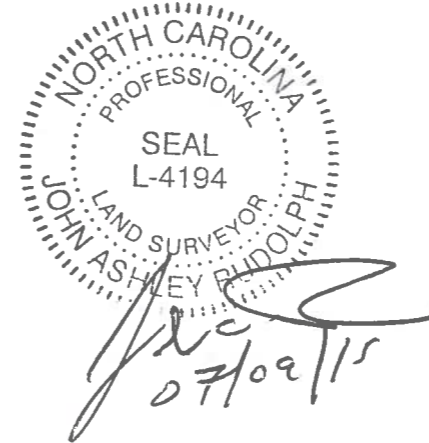
	As-built	As needed		
Avg. Water Surface Slope	NA			
Riffle Length	21			
Avg. Riffle Slope	NA			
Pool Length	5			

Lamm (UT 1a) As-built Profile 2015



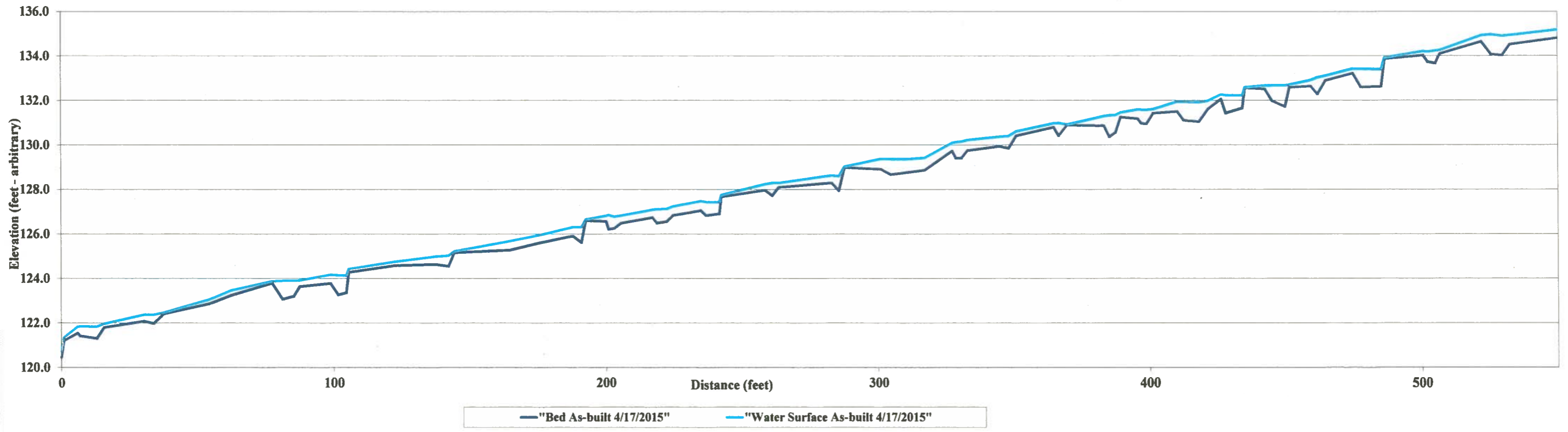
**Project Name** Lamm - As-built (2015) Profile  
**Reach** Tributary 1  
**Feature** Profile  
**Date** 4/17/15  
**Crew** Perkinson, Gibbons

2015 As-built Survey			2015 As-built Survey			2015 As-built Survey			2015 As-built Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	120.5	120.7	192.5	126.6	126.7	344.7	129.9	130.4	461.8	132.3	133.0
0.9	121.2	121.3	200.1	126.6	126.8	348.1	129.8	130.4	464.7	132.9	133.1
5.9	121.5	121.8	201.0	126.2	126.8	350.9	130.4	130.6	474.7	133.2	133.4
6.9	121.4	121.9	203.0	126.3	126.8	364.7	130.8	131.0	477.7	132.6	133.4
13.0	121.3	121.8	205.5	126.5	126.8	366.6	130.4	131.0	485.1	132.6	133.4
15.7	121.8	122.0	217.1	126.7	127.1	369.7	130.9	130.9	486.3	133.9	133.9
30.4	122.1	122.4	218.8	126.5	127.1	383.3	130.9	131.3	500.6	134.0	134.2
33.9	122.0	122.4	222.3	126.6	127.1	385.2	130.4	131.3	502.3	133.7	134.2
37.7	122.4	122.5	224.7	126.8	127.2	387.5	130.6	131.3	505.2	133.7	134.2
54.3	122.9	123.1	235.0	127.1	127.5	389.3	131.3	131.5	506.8	134.1	134.3
62.5	123.2	123.5	236.9	126.8	127.4	395.6	131.2	131.6	522.1	134.6	134.9
77.3	123.8	123.9	241.8	126.9	127.4	396.9	131.0	131.6	525.6	134.1	135.0
81.1	123.1	123.9	242.5	127.7	127.8	398.9	130.9	131.6	529.7	134.0	134.9
85.3	123.2	123.9	258.4	128.0	128.2	401.3	131.4	131.6	532.5	134.5	134.9
87.5	123.6	123.9	261.1	127.7	128.3	410.1	131.5	131.9	558.9	135.0	135.3
98.8	123.8	124.2	263.4	128.1	128.3	412.5	131.1	131.9			
101.6	123.3	124.1	283.0	128.3	128.6	418.1	131.0	131.9			
104.6	123.4	124.1	285.7	127.9	128.6	421.6	131.6	132.0			
105.5	124.3	124.4	287.7	129.0	129.0	426.3	132.1	132.3			
122.6	124.6	124.8	301.1	128.9	129.4	428.0	131.4	132.2			
137.3	124.6	125.0	304.8	128.7	129.4	434.1	131.7	132.2			
142.2	124.5	125.0	310.3	128.8	129.4	435.0	132.6	132.6			
144.3	125.2	125.2	317.3	128.9	129.4	442.4	132.5	132.7			
164.8	125.3	125.7	327.4	129.7	130.1	445.1	132.0	132.7			
176.0	125.6	126.0	328.7	129.4	130.1	449.9	131.7	132.7			
187.8	125.9	126.3	330.8	129.4	130.2	451.5	132.6	132.7			
191.0	125.6	126.3	333.0	129.7	130.2	459.2	132.6	132.9			

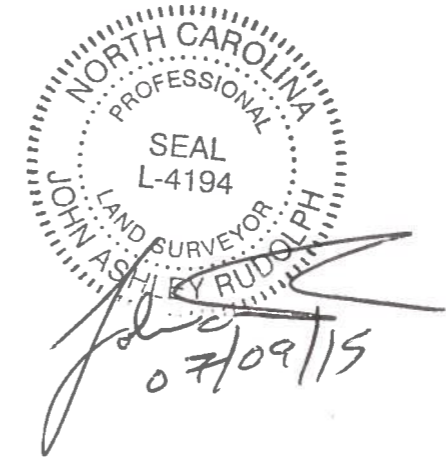


	As-built	As needed	
Avg. Water Surface Slope	0.0256		
Riffle Length	15		
Avg. Riffle Slope	0.0298		
Pool Length	7		

Lamm (UT 1) As-built Profile 2015

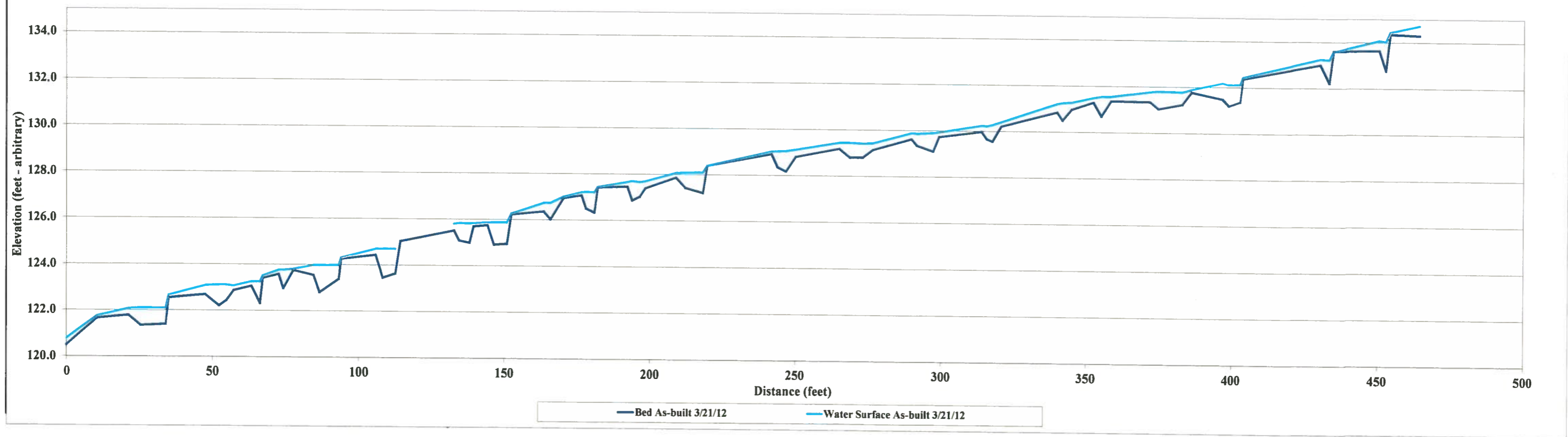


Project Name Lamm - As-built (2015) Profile											
Reach Tributary 2											
Feature Profile											
Date 4/17/15											
Crew Perkinson, Gibbons											
2015 As-built Survey			2015 As-built Survey			2015 As-built Survey			2015 As-built Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	120.5	120.8	139.5	125.7	125.8	276.6	129.1	129.4	452.6	132.8	134.0
10.5	121.6	121.7	144.3	125.7	125.9	289.8	129.6	129.9	454.0	134.3	134.4
21.2	121.8	122.1	146.5	124.9	125.9	291.7	129.3	129.9	464.1	134.3	134.7
25.4	121.3	122.1	151.0	125.0	125.9	297.3	129.1	129.9			
33.9	121.4	122.1	152.5	126.2	126.3	299.3	129.7	129.9			
35.0	122.5	122.7	163.6	126.4	126.7	314.0	130.0	130.2			
47.5	122.7	123.1	165.9	126.0	126.7	315.8	129.7	130.2			
52.3	122.2	123.1	170.4	127.0	127.0	317.7	129.6	130.3			
54.8	122.4	123.1	176.5	127.1	127.2	320.7	130.2	130.4			
57.4	122.9	123.1	178.0	126.5	127.2	339.9	130.8	131.2			
63.4	123.1	123.3	180.9	126.3	127.2	341.7	130.5	131.3			
66.3	122.3	123.2	182.2	127.4	127.4	344.8	131.0	131.3			
67.3	123.4	123.5	192.2	127.5	127.7	352.4	131.3	131.5			
72.7	123.6	123.8	193.8	126.9	127.7	355.1	130.7	131.5			
74.3	123.0	123.8	196.5	127.0	127.7	358.4	131.4	131.5			
77.7	123.8	123.8	198.4	127.4	127.7	371.8	131.3	131.8			
84.6	123.5	124.0	209.0	127.9	128.1	374.7	131.0	131.8			
86.6	122.8	124.0	212.2	127.4	128.1	382.8	131.2	131.8			
93.2	123.4	124.0	218.3	127.2	128.1	386.0	131.8	131.9			
94.0	124.3	124.3	219.8	128.4	128.4	396.6	131.5	132.2			
105.8	124.4	124.7	241.8	128.9	129.0	398.8	131.2	132.1			
108.3	123.4	124.7	243.8	128.4	129.0	402.8	131.4	132.1			
112.7	123.6	124.7	246.8	128.2	129.1	403.7	132.4	132.4			
114.4	125.0		250.1	128.8	129.1	430.2	133.0	133.3			
132.8	125.5	125.8	265.0	129.2	129.4	433.2	132.2	133.2			
134.6	125.1	125.8	268.7	128.8	129.4	434.6	133.6	133.6			
138.1	125.0	125.8	273.0	128.8	129.4	450.3	133.6	134.1			



	As-built	As needed		
Avg. Water Surface Slope	0.0301			
Riffle Length	12			
Avg. Riffle Slope	0.0294			
Pool Length	7.79			

Lamm (UT2) As-built Profile 2015

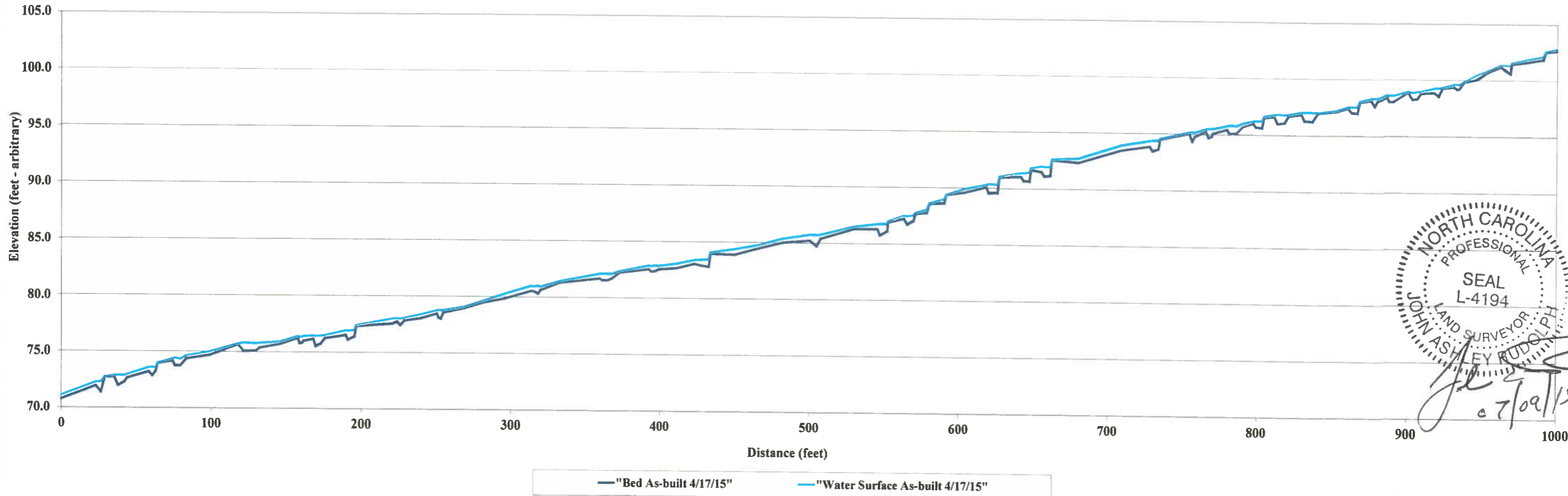


**Project Name** Lamm - As-built (2015) Profile  
**Reach** UT 3  
**Feature** Profile  
**Date** 4/17/15  
**Crew** Perkinson, Gibbons

2015 As-built Survey			2015 As-built Survey			2015 As-built Survey			2015 As-built Survey			2015 As-built Survey			2015 As-built Survey			2015 As-built Survey					
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation			
0.0	70.8	71.1	129.9	75.1	75.7	240.0	78.1	78.4	392.5	82.6	82.9	552.3	86.1	86.7	680.1	92.4	92.7	818.1	96.1	96.8	890.6	98.0	98.6
23.0	71.9	72.2	132.4	75.4	75.8	250.6	78.5	78.7	394.3	82.4	82.8	552.8	86.9	87.0	708.5	93.5	93.9	820.9	96.7	96.8	900.5	98.9	98.9
26.4	71.4	72.3	145.6	75.7	75.9	250.9	78.5	78.8	396.9	82.4	82.9	563.4	87.2	87.5	727.7	93.9	94.4	829.4	96.8	97.0	903.5	98.2	98.9
28.9	72.7	72.7	157.7	76.2	76.4	251.9	78.1	78.8	399.3	82.5	82.9	565.5	86.7	87.5	729.7	93.5	94.4	831.4	96.3	97.0	906.6	98.3	98.9
35.5	72.7	72.9	159.0	75.8	76.3	253.6	78.0	78.8	410.8	82.7	83.1	569.8	87.1	87.5	733.5	93.6	94.4	836.7	96.2	97.0	909.2	98.8	98.9
37.9	72.0	72.8	160.6	75.8	76.3	255.4	78.6	78.8	423.3	83.1	83.4	571.2	87.7	87.7	734.6	94.5	94.6	840.5	97.0	97.0	918.1	98.8	99.2
42.0	72.3	72.8	161.7	76.0	76.4	269.1	79.0	79.1	427.6	82.9	83.4	578.7	87.8	88.0	754.3	95.1	95.1	852.5	97.1	97.2	921.0	98.5	99.2
43.9	72.6	72.9	168.2	76.2	76.4	281.5	79.5	79.6	432.9	82.8	83.4	580.4	88.6	88.6	756.3	94.4	95.2	860.3	97.4	97.5	923.6	99.2	99.3
58.4	73.2	73.6	169.6	75.5	76.4	296.1	79.9	80.3	434.1	84.0	84.1	590.6	88.6	89.0	758.0	94.8	95.1	863.1	97.0	97.5	931.2	99.4	99.6
60.8	72.8	73.6	172.8	75.7	76.4	313.8	80.6	81.0	450.0	83.9	84.4	591.9	89.4	89.4	765.3	95.3	95.4	866.8	97.0	97.5	933.4	99.2	99.6
63.1	73.3	73.5	175.9	76.2	76.5	315.6	80.5	80.9	465.9	84.5	84.8	604.1	89.6	89.9	767.1	94.7	95.5	868.4	98.0	98.0	934.9	99.2	99.6
64.4	74.0	74.0	189.7	76.5	76.9	318.3	80.3	81.0	482.1	85.0	85.4	618.6	90.1	90.3	769.3	94.8	95.5	875.8	98.1	98.3	937.8	99.8	99.8
74.4	74.2	74.3	191.2	76.1	76.9	320.1	80.6	80.9	500.4	85.2	85.7	620.0	89.6	90.4	770.2	95.1	95.5	878.2	97.6	98.3	946.2	100.0	100.5
76.0	73.7	74.4	195.6	76.4	76.9	332.8	81.3	81.4	502.0	85.0	85.7	626.2	89.6	90.3	779.6	95.5	95.7	880.2	98.1	98.3	953.7	100.7	100.9
79.7	73.7	74.3	196.7	77.3	77.4	359.6	81.7	82.1	504.9	84.7	85.7	641.7	91.1	91.4	781.4	95.1	95.8	886.5	98.4	98.6	962.4	101.2	101.4
83.7	74.4	74.6	220.8	77.6	78.0	361.4	81.5	82.1	507.6	85.4	85.7	643.5	90.7	91.4	785.9	95.1	95.8	887.9	98.0	98.6	963.3	100.9	101.4
98.9	74.7	75.0	224.2	77.7	78.0	365.0	81.5	82.1	530.0	86.3	86.5	647.4	90.7	91.4	799.0	95.7	96.2	887.9	98.0	98.6	968.9	100.6	101.3
118.0	75.6	75.7	226.3	77.4	78.0	367.7	81.7	82.1	545.7	86.3	86.7	648.4	91.7	91.8	799.0	95.7	96.2	887.9	98.0	98.6	969.8	101.5	101.6
121.6	75.1	75.8	229.2	77.8	78.1	373.2	82.2	82.3	547.1	85.7	86.7	655.5	91.5	92.0	803.1	95.6	96.2	887.9	98.0	98.6	978.5	101.6	101.8
												657.4	91.1	91.9	804.3	96.5	96.6	887.9	98.0	98.6	990.7	101.9	102.2
												661.4	91.2	91.9	811.3	96.6	96.8	887.9	98.0	98.6	992.3	102.6	102.6
												662.4	92.6	92.6	813.5	96.0	96.8	887.9	98.0	98.6	992.3	102.6	102.6

Avg. Water Surface Slope	0.0319	As-built	1010.5	102.8	103.1
Riffle Length	20.7		1011.7	102.5	103.2
Avg. Riffle Slope	0.0313		1014.3	102.3	103.2
Pool Length	7.4		1015.3	103.4	103.5

Lamm (UT3) As-built Profile 2015



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 LAND SURVEYOR  
 JOHN ASHLEY RUDOLPH  
 4/27/15

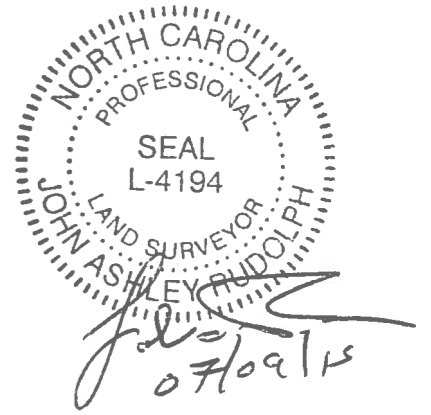
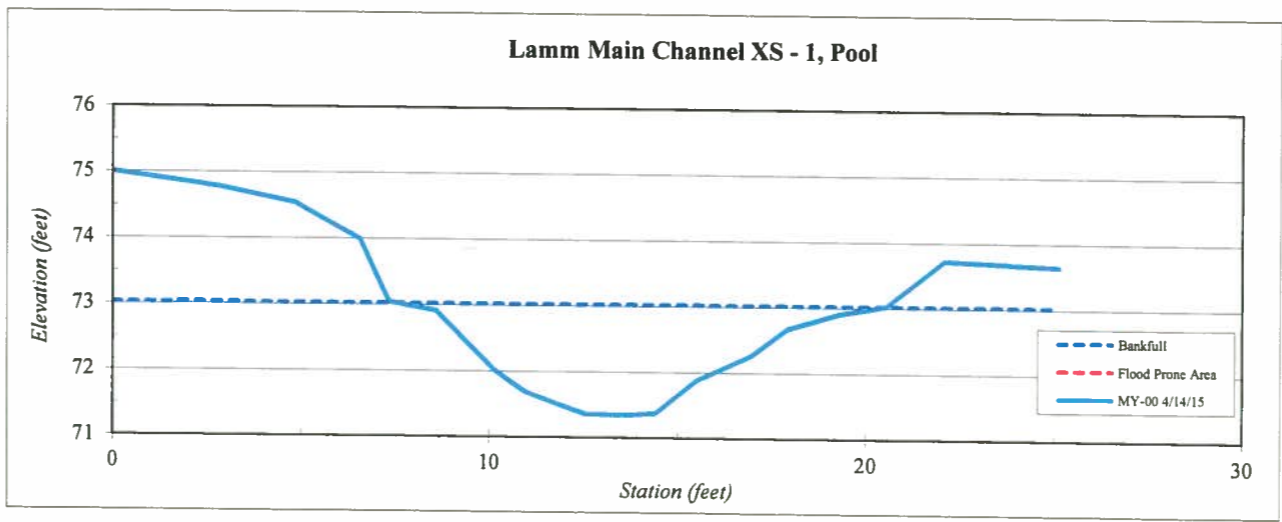
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 1, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	75.0
2.8	74.8
4.8	74.5
6.6	74.0
7.3	73.0
8.6	72.9
10.1	72.0
11.0	71.7
11.8	71.5
12.5	71.4
13.7	71.3
14.4	71.4
15.5	71.9
17.0	72.3
17.9	72.7
19.3	72.9
20.5	73.0
22.1	73.7
25.1	73.6

SUMMARY DATA	
Bankfull Elevation:	73.0
Bankfull Cross-Sectional Area:	11.2
Bankfull Width:	13.0
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	0.9
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type C/E



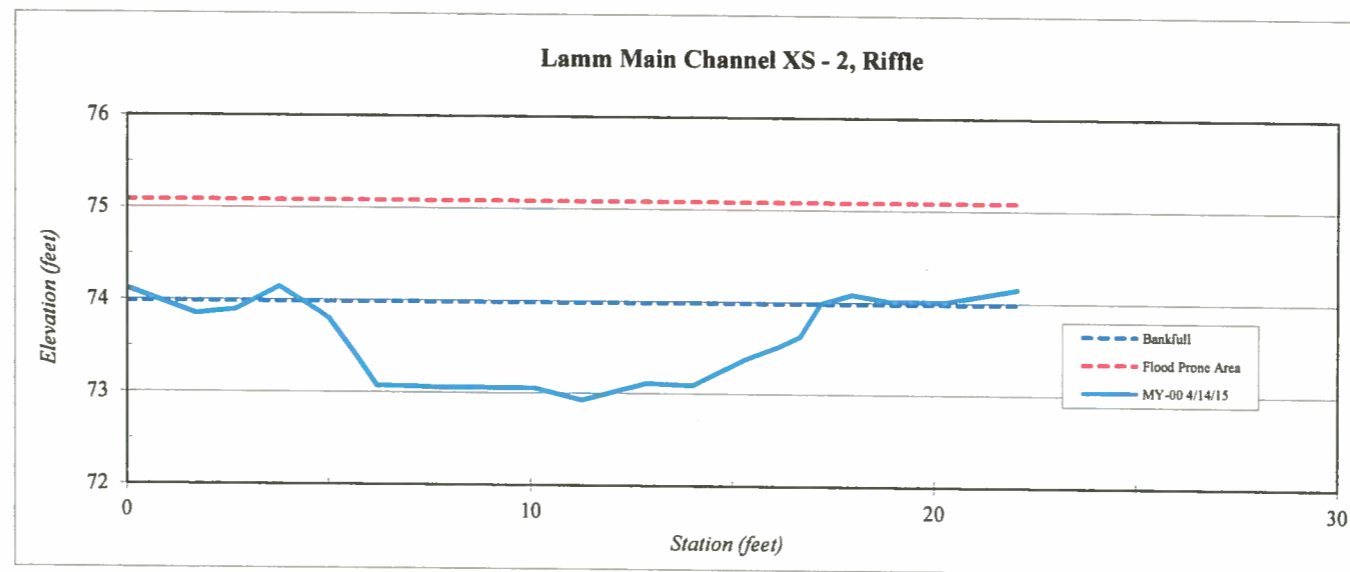
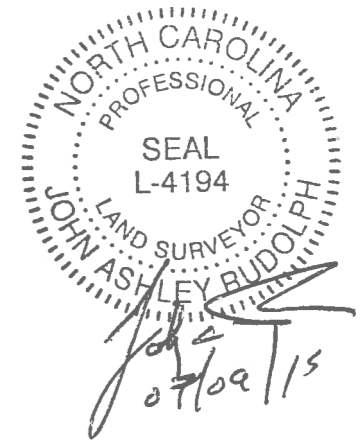
<b>Site</b>	Abbey Lamm
<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	Main Channel XS - 2, Riffle
<b>Feature</b>	Riffle
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons



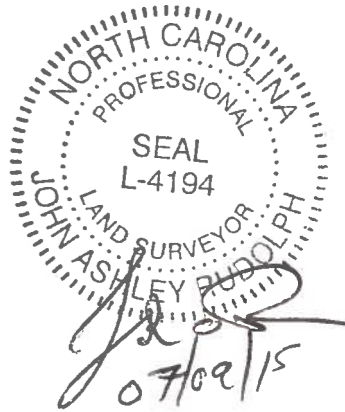
Station	Elevation
0.0	74.12
1.7	73.85
2.7	73.89
3.8	74.14
5.0	73.80
5.7	73.36
6.2	73.07
7.5	73.06
8.9	73.05
10.1	73.05
11.3	72.92
12.9	73.11
14.0	73.09
15.3	73.37
16.2	73.51
16.7	73.62
17.2	73.98
18.0	74.08
18.9	74.01
20.2	74.01
22.0	74.1

SUMMARY DATA	
Bankfull Elevation:	74.0
Bankfull Cross-Sectional Area:	9.7
Bankfull Width:	12.8
Flood Prone Area Elevation:	75.1
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.8
W / D Ratio:	16.9
Entrenchment Ratio:	7.0
Bank Height Ratio:	1.0

Stream Type C/E



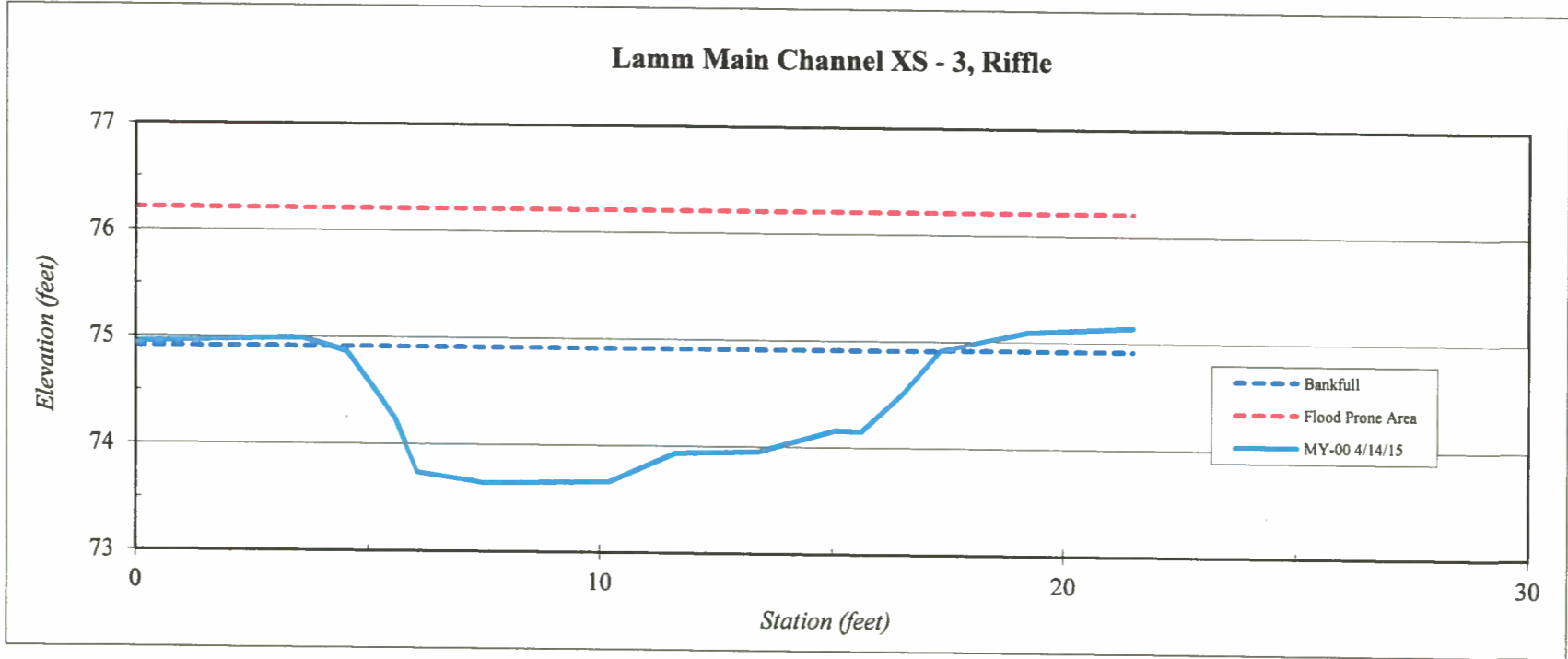
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 3, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	74.95
2.2	74.98
3.6	74.99
4.5	74.87
5.6	74.24
6.1	73.74
7.5	73.64
10.2	73.66
11.6	73.93
13.4	73.96
15.1	74.16
15.6	74.15
16.5	74.51
17.3	74.91
19.2	75.09
21.5	75.14

SUMMARY DATA	
Bankfull Elevation:	74.9
Bankfull Cross-Sectional Area:	11.8
Bankfull Width:	13.1
Flood Prone Area Elevation:	76.2
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.9
W / D Ratio:	14.5
Entrenchment Ratio:	6.9
Bank Height Ratio:	1.0

Stream Type: C/E





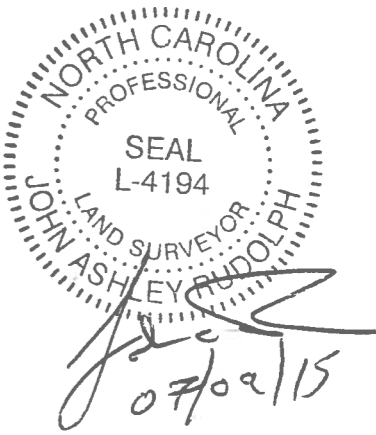
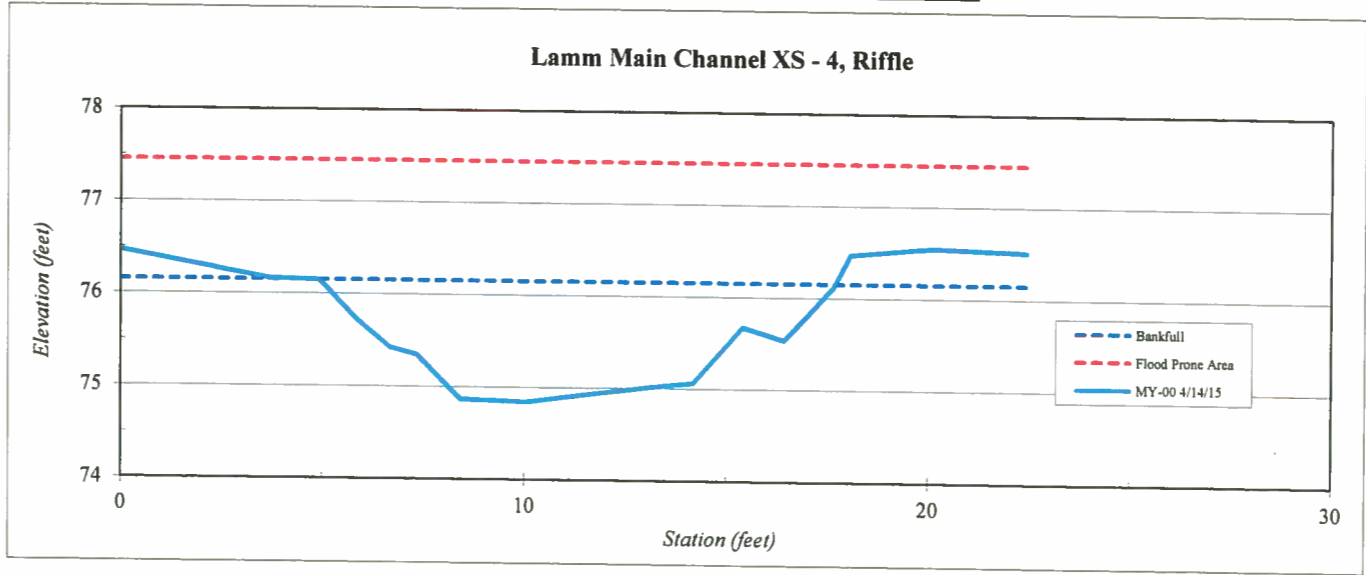
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<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	Main Channel XS - 4, Riffle
<b>Feature</b>	Riffle
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons

Station	Elevation
0.0	76.47
3.7	76.16
4.9	76.15
5.8	75.74
6.7	75.42
7.4	75.34
8.4	74.86
10.0	74.84
11.5	74.93
13.1	75.01
14.2	75.06
15.4	75.67
16.4	75.54
17.7	76.11
18.1	76.47
20.1	76.55
22.5	76.51

SUMMARY DATA	
<b>Bankfull Elevation:</b>	76.2
<b>Bankfull Cross-Sectional Area:</b>	11.3
<b>Bankfull Width:</b>	13.0
<b>Flood Prone Area Elevation:</b>	77.5
<b>Flood Prone Width:</b>	90.0
<b>Max Depth at Bankfull:</b>	1.3
<b>Mean Depth at Bankfull:</b>	0.9
<b>W / D Ratio:</b>	15.0
<b>Entrenchment Ratio:</b>	6.9
<b>Bank Height Ratio:</b>	1.0



Stream Type: C/E



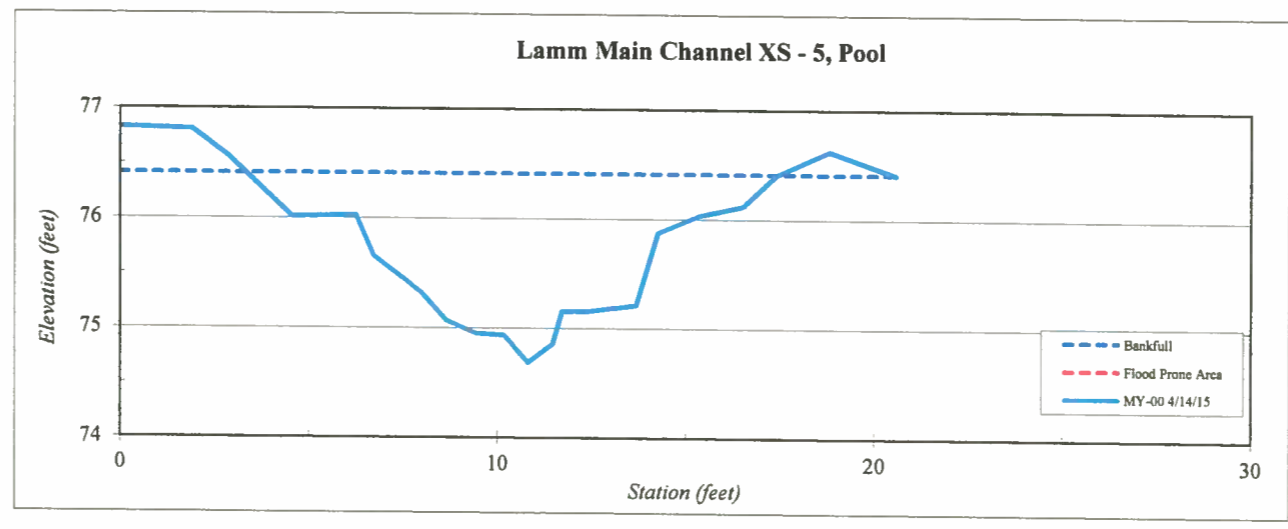
<b>Site</b>	Abbey Lamm
<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	Main Channel XS - 5, Pool
<b>Feature</b>	Pool
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons

Station	Elevation
0.0	76.8
1.9	76.8
2.9	76.6
4.5	76.0
6.2	76.0
6.7	75.7
8.0	75.3
8.6	75.1
9.4	74.9
10.2	74.9
10.8	74.7
11.5	74.9
11.7	75.2
12.4	75.2
13.7	75.2
14.3	75.9
15.3	76.0
16.5	76.1
17.4	76.4
18.8	76.6
20.6	76.41

SUMMARY DATA	
<b>Bankfull Elevation:</b>	76.4
<b>Bankfull Cross-Sectional Area:</b>	11.8
<b>Bankfull Width:</b>	14.1
<b>Flood Prone Area Elevation:</b>	NA
<b>Flood Prone Width:</b>	NA
<b>Max Depth at Bankfull:</b>	1.7
<b>Mean Depth at Bankfull:</b>	0.8
<b>W / D Ratio:</b>	NA
<b>Entrenchment Ratio:</b>	NA
<b>Bank Height Ratio:</b>	1.0



Stream Type: C/E



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LAND SURVEYOR  
JOHN ASHLEY RUDOLPH  
07/09/15

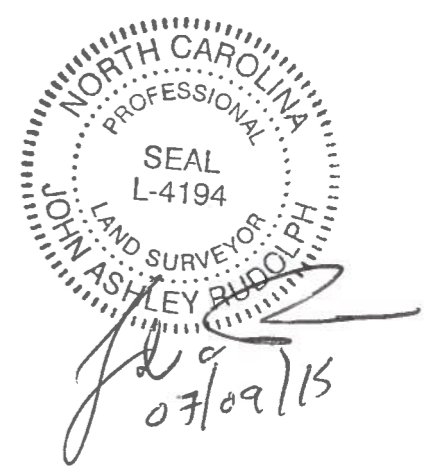
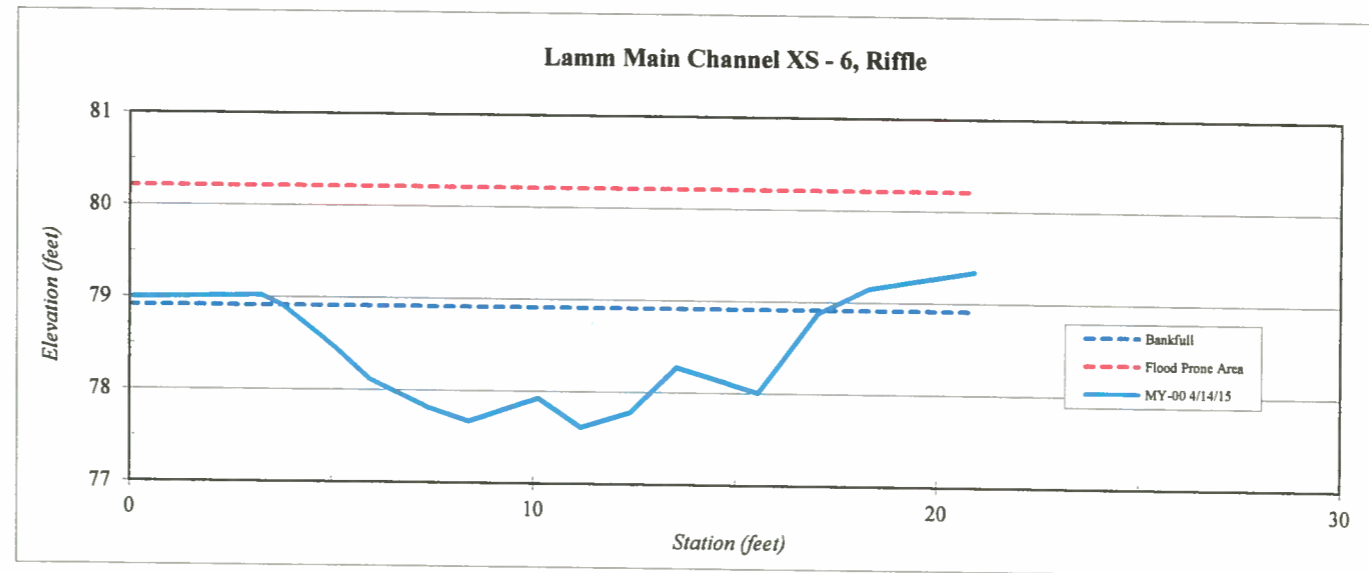
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 6, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Stream Type

Station	Elevation
0.0	78.99
2.0	79.01
3.2	79.02
3.8	78.91
5.1	78.46
6.0	78.11
7.3	77.82
8.4	77.66
10.1	77.92
11.2	77.61
12.4	77.78
13.5	78.27
15.6	78.01
17.0	78.87
18.3	79.15
20.9	79.34

SUMMARY DATA	
Bankfull Elevation:	78.9
Bankfull Cross-Sectional Area:	11.3
Bankfull Width:	13.4
Flood Prone Area Elevation:	80.2
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.8
W / D Ratio:	15.9
Entrenchment Ratio:	6.7
Bank Height Ratio:	1.0



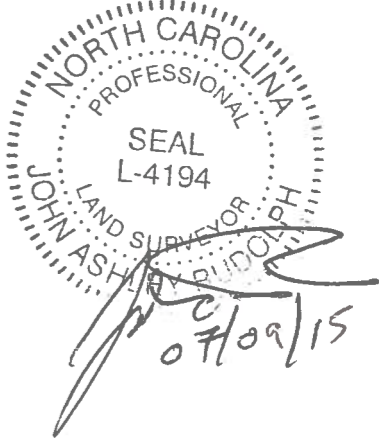
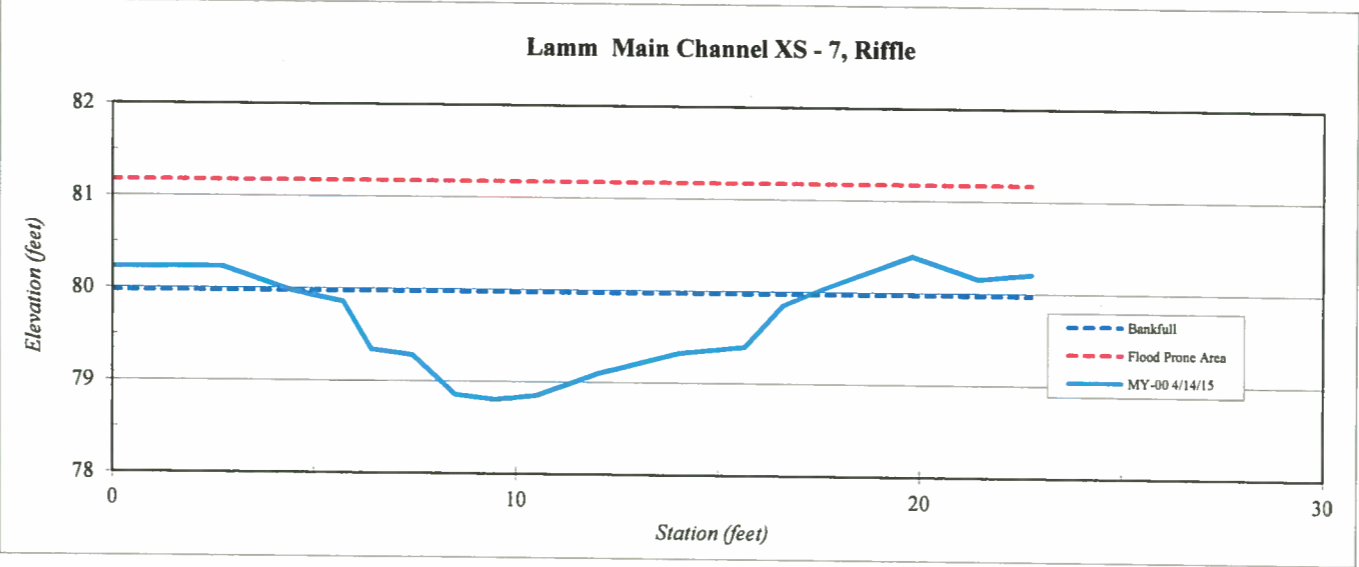
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 7, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	80.22
2.7	80.23
4.4	79.97
5.7	79.86
6.4	79.34
7.4	79.28
8.5	78.86
9.5	78.80
10.5	78.85
12.0	79.09
14.0	79.32
15.7	79.39
16.6	79.85
17.6	80.03
19.8	80.40
21.5	80.15
22.8	80.21

SUMMARY DATA		
Bankfull Elevation:		80.0
Bankfull Cross-Sectional Area:		8.7
Bankfull Width:		12.8
Flood Prone Area Elevation:		81.2
Flood Prone Width:		90.0
Max Depth at Bankfull:		1.2
Mean Depth at Bankfull:		0.7
W / D Ratio:		18.8
Entrenchment Ratio:		7.0
Bank Height Ratio:		1.0

Stream Type C/E



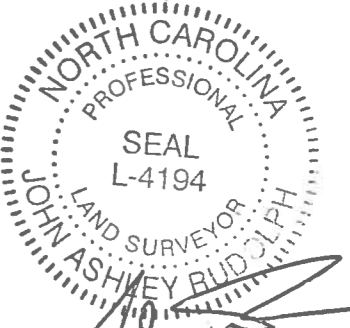
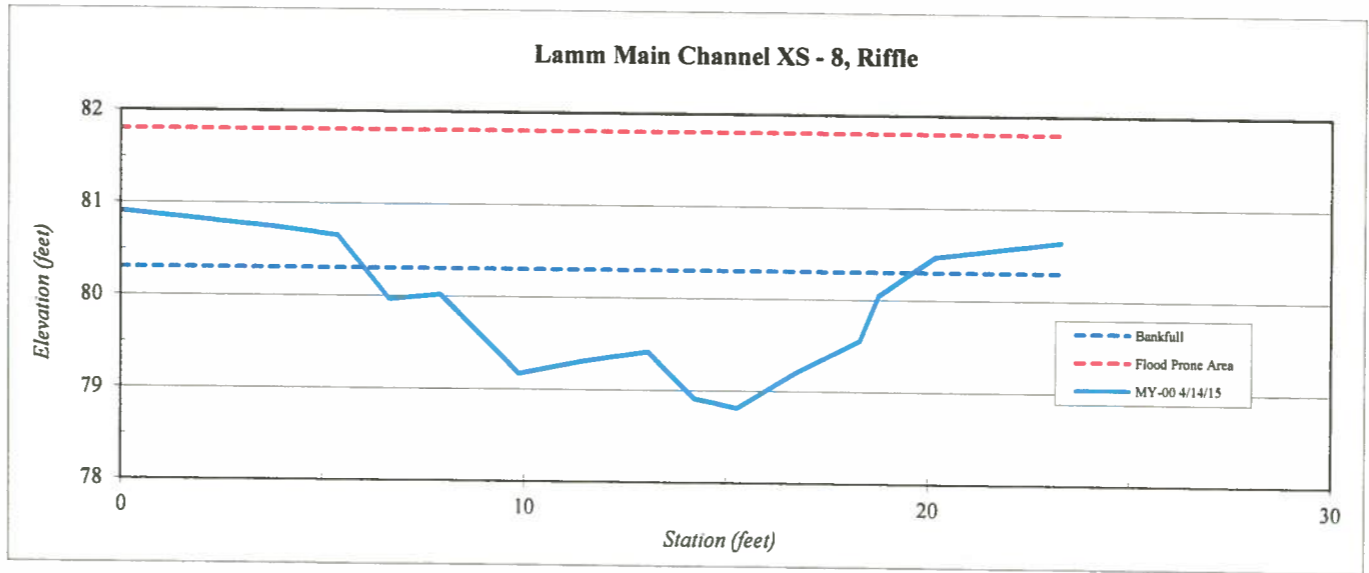
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 8, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	80.91
3.8	80.74
5.4	80.65
6.7	79.96
7.9	80.02
9.9	79.17
11.4	79.31
13.1	79.41
14.2	78.91
15.3	78.81
16.7	79.20
18.3	79.55
18.8	80.05
20.2	80.47
23.3	80.63

SUMMARY DATA	
Bankfull Elevation:	80.3
Bankfull Cross-Sectional Area:	11.6
Bankfull Width:	13.6
Flood Prone Area Elevation:	81.8
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.5
Mean Depth at Bankfull:	0.9
W / D Ratio:	15.9
Entrenchment Ratio:	6.6
Bank Height Ratio:	1.0



Stream Type



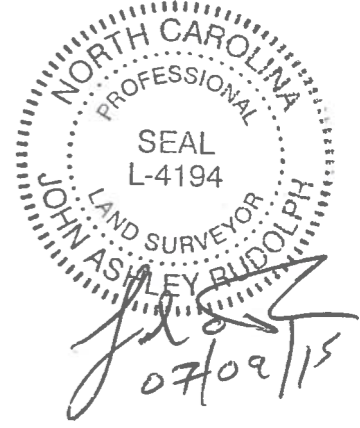
*John Ashley Rudolph*  
07/09/15

<b>Site</b>	Abbey Lamm
<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	Main Channel XS - 9, Riffle
<b>Feature</b>	Riffle
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons

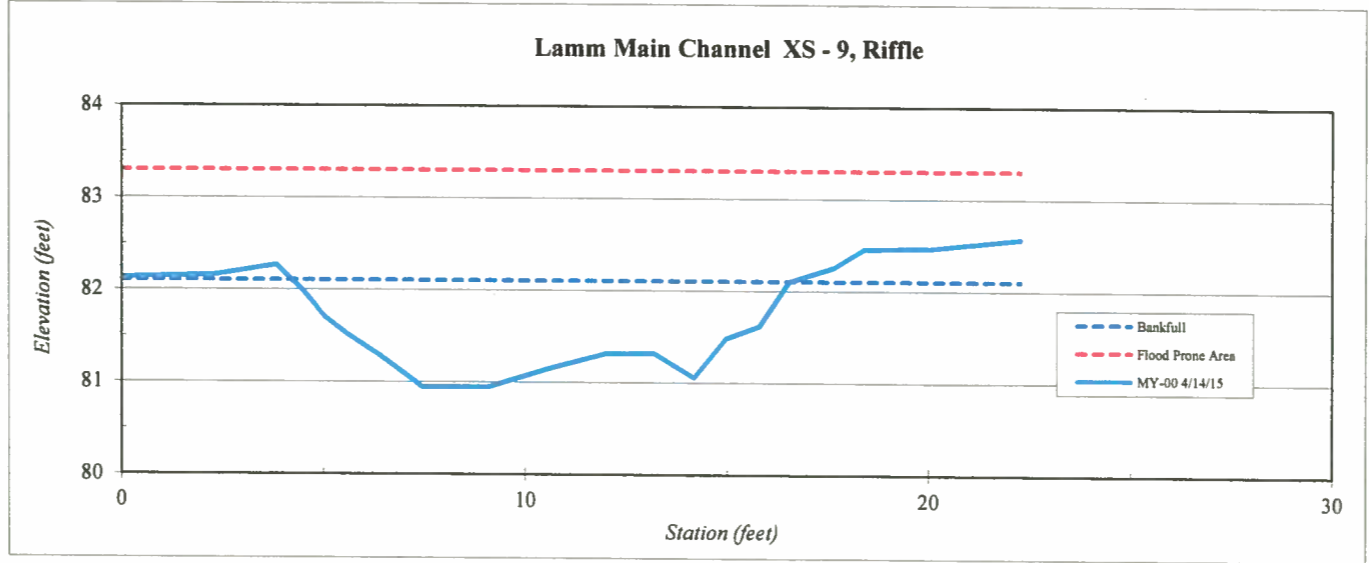


Station	Elevation
0.0	82.13
2.3	82.15
3.8	82.27
4.5	81.99
5.0	81.70
5.6	81.51
6.4	81.29
7.4	80.95
9.1	80.95
10.6	81.15
12.0	81.31
13.2	81.32
14.2	81.05
15.0	81.48
15.8	81.61
16.5	82.10
17.7	82.26
18.4	82.45
20.1	82.47
22.3	82.57

SUMMARY DATA	
<b>Bankfull Elevation:</b>	82.1
<b>Bankfull Cross-Sectional Area:</b>	9.8
<b>Bankfull Width:</b>	12.3
<b>Flood Prone Area Elevation:</b>	83.3
<b>Flood Prone Width:</b>	90.0
<b>Max Depth at Bankfull:</b>	1.2
<b>Mean Depth at Bankfull:</b>	0.8
<b>W / D Ratio:</b>	15.4
<b>Entrenchment Ratio:</b>	7.3
<b>Bank Height Ratio:</b>	1.0



Stream Type C/E



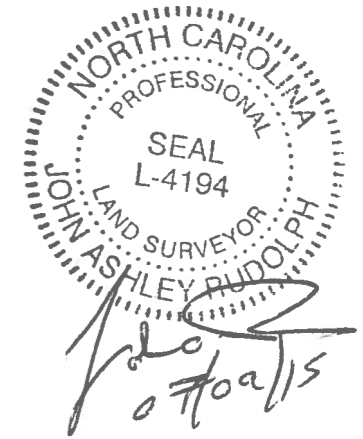
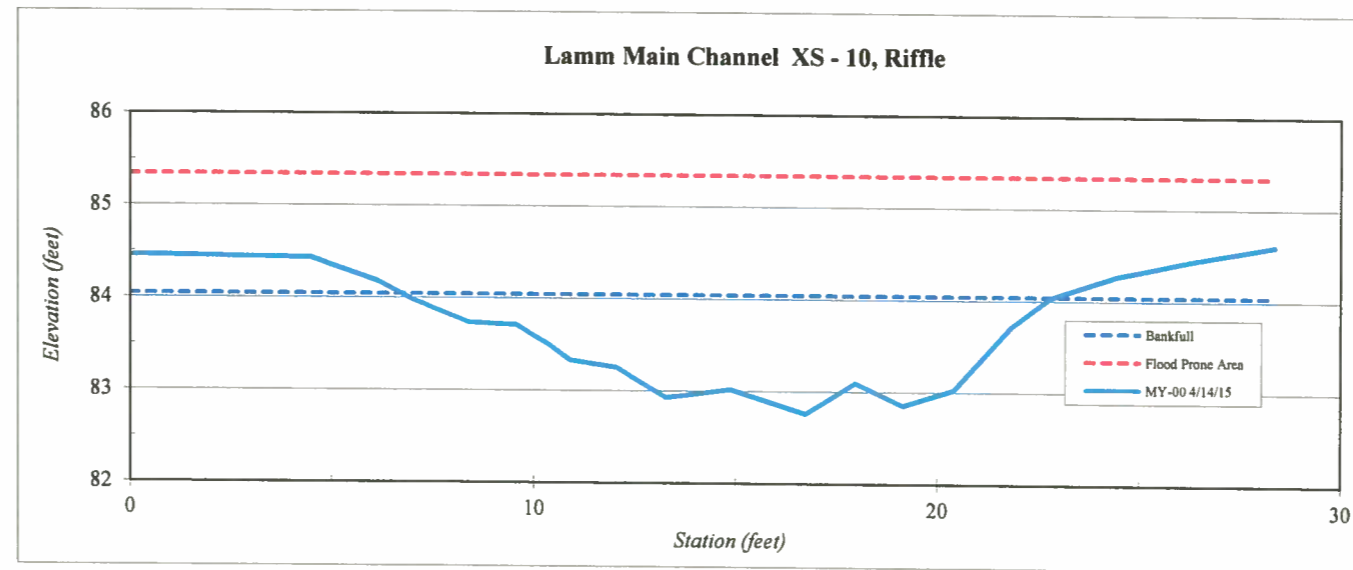
<b>Site</b>	Abbey Lamm
<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	Main Channel XS - 10, Riffle
<b>Feature</b>	Riffle
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons

Station	Elevation
0.0	84.46
4.5	84.43
6.1	84.18
7.0	83.97
8.4	83.73
9.6	83.71
10.3	83.50
10.9	83.33
12.0	83.25
13.3	82.93
14.9	83.02
16.7	82.76
18.0	83.09
19.2	82.85
20.4	83.03
21.8	83.71
22.8	84.04
24.4	84.26
26.2	84.43
28.4	84.60

SUMMARY DATA	
<b>Bankfull Elevation:</b>	84.0
<b>Bankfull Cross-Sectional Area:</b>	12.4
<b>Bankfull Width:</b>	16.1
<b>Flood Prone Area Elevation:</b>	85.3
<b>Flood Prone Width:</b>	90.0
<b>Max Depth at Bankfull:</b>	1.3
<b>Mean Depth at Bankfull:</b>	0.8
<b>W / D Ratio:</b>	20.9
<b>Entrenchment Ratio:</b>	5.6
<b>Bank Height Ratio:</b>	1.0



**Stream Type**      C/E



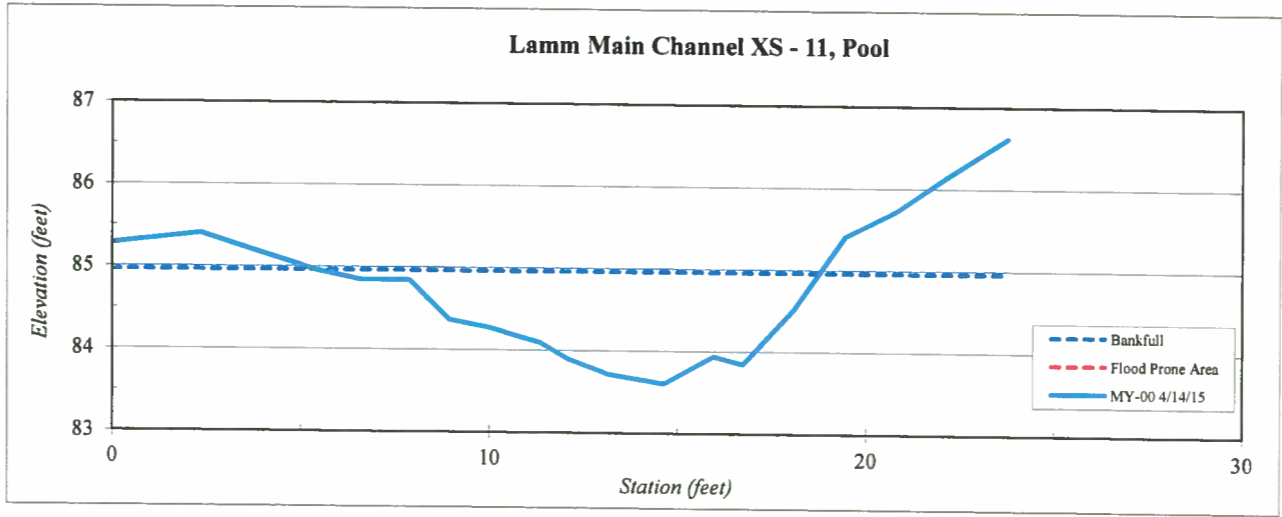
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 11, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	85.3
2.4	85.4
3.7	85.2
5.4	85.0
6.6	84.8
7.9	84.8
8.9	84.4
10.0	84.3
11.4	84.1
12.1	83.9
13.1	83.7
14.6	83.6
16.0	83.9
16.7	83.8
18.1	84.5
19.4	85.4
20.8	85.7
22.2	86.2
23.8	86.6

SUMMARY DATA	
Bankfull Elevation:	85.0
Bankfull Cross-Sectional Area:	9.8
Bankfull Width:	13.4
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.7
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type C/E



NORTH CAROLINA  
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L-4194  
LAND SURVEYOR  
JOHN ASHLEY RUDOLPH  
07/09/15



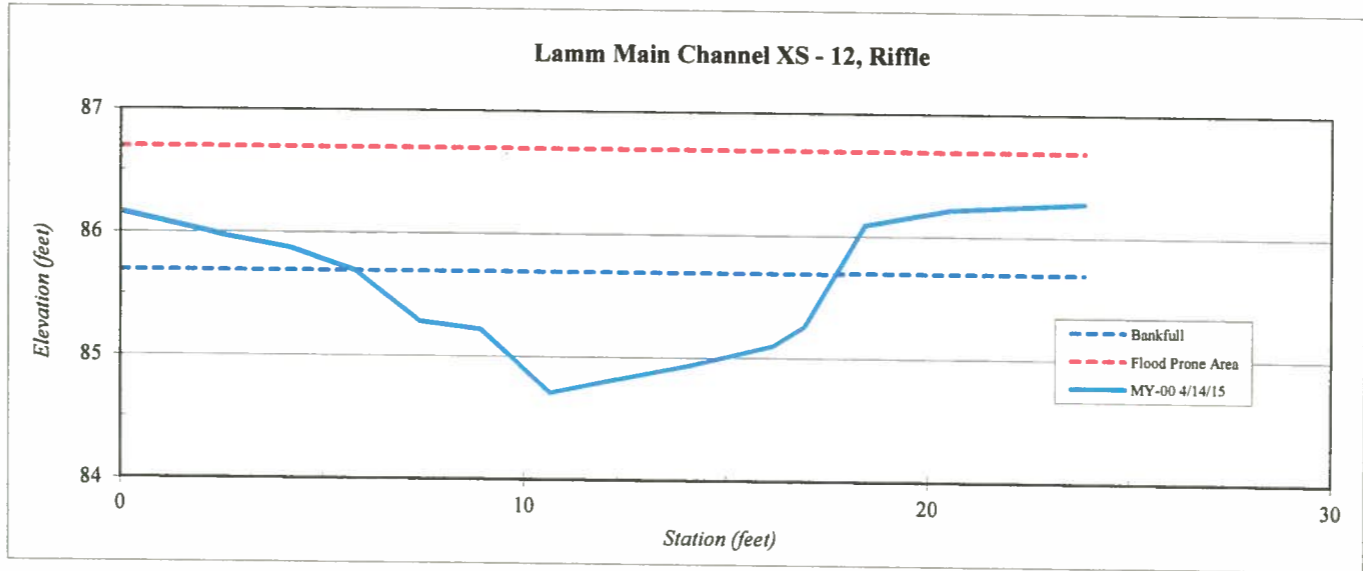
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 12, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	86.16
2.5	85.97
4.2	85.87
5.8	85.69
7.4	85.28
8.9	85.22
10.7	84.71
12.4	84.82
14.1	84.94
16.2	85.10
16.9	85.26
18.4	86.09
20.6	86.22
23.9	86.27

SUMMARY DATA	
Bankfull Elevation:	85.7
Bankfull Cross-Sectional Area:	7.2
Bankfull Width:	11.9
Flood Prone Area Elevation:	86.7
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.6
W / D Ratio:	19.7
Entrenchment Ratio:	7.6
Bank Height Ratio:	1.0



Stream Type



NORTH CAROLINA  
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 SEAL  
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 LAND SURVEYOR  
 JOHN ASHLEY BUNOLPH  
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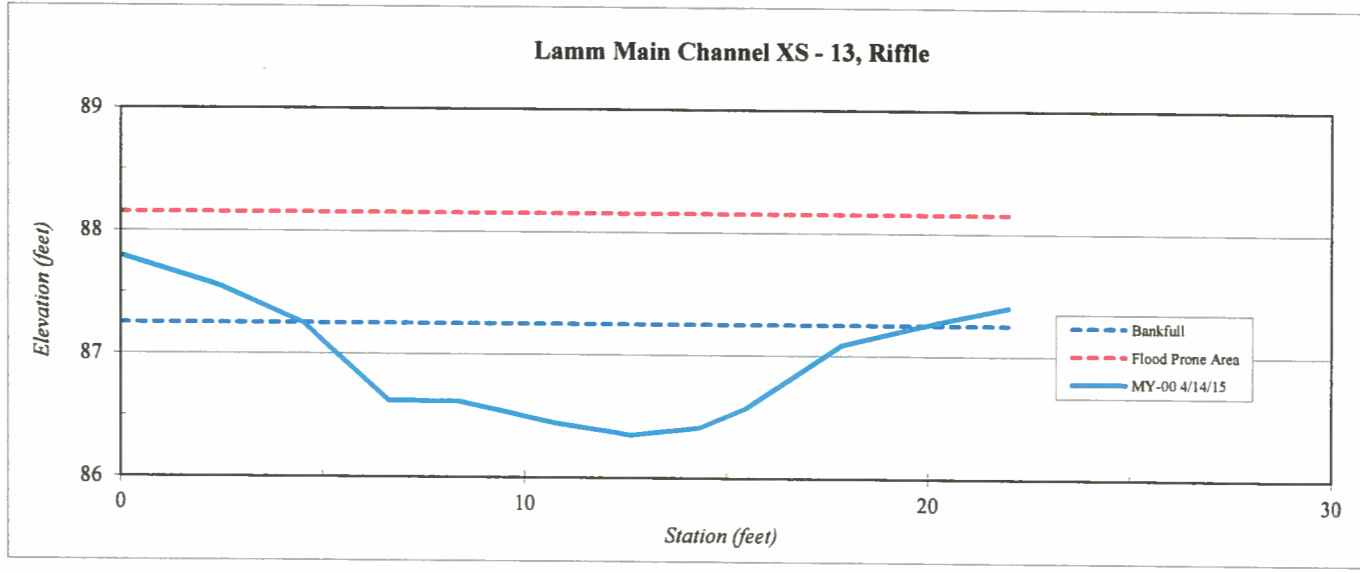
<b>Site</b>	Abbey Lamm
<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	Main Channel XS - 13, Riffle
<b>Feature</b>	Riffle
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons

Station	Elevation
0.0	87.80
2.5	87.54
4.5	87.25
6.6	86.62
8.4	86.62
10.8	86.44
12.6	86.35
14.3	86.41
15.5	86.57
17.9	87.09
20.2	87.27
22.0	87.40

SUMMARY DATA	
<b>Bankfull Elevation:</b>	87.3
<b>Bankfull Cross-Sectional Area:</b>	8.6
<b>Bankfull Width:</b>	15.4
<b>Flood Prone Area Elevation:</b>	88.2
<b>Flood Prone Width:</b>	90.0
<b>Max Depth at Bankfull:</b>	0.9
<b>Mean Depth at Bankfull:</b>	0.6
<b>W / D Ratio:</b>	27.6
<b>Entrenchment Ratio:</b>	5.8
<b>Bank Height Ratio:</b>	1.0



Stream Type | C



NORTH CAROLINA  
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LAND SURVEYOR  
JOHN ASHLEY RUDOLPH

*[Handwritten Signature]*  
07/04/15

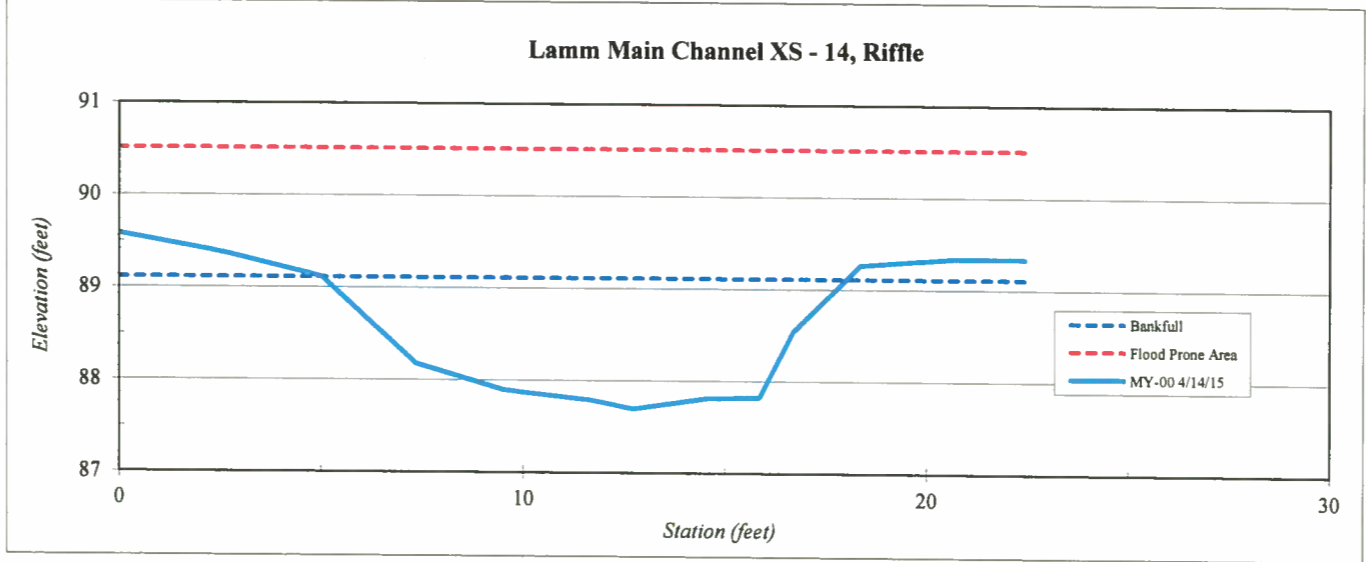
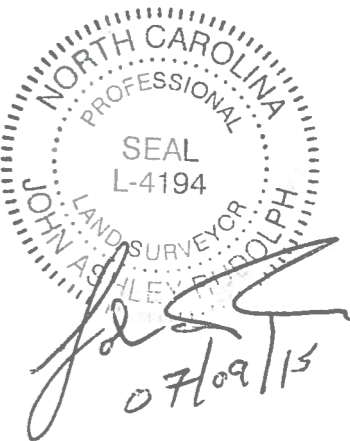
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 14, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	89.58
2.7	89.37
5.0	89.11
7.3	88.18
9.5	87.89
11.6	87.79
12.7	87.69
14.6	87.81
15.9	87.82
16.7	88.54
18.4	89.26
20.6	89.33
22.4	89.33

SUMMARY DATA	
Bankfull Elevation:	89.1
Bankfull Cross-Sectional Area:	12.9
Bankfull Width:	13.0
Flood Prone Area Elevation:	90.5
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	1.0
W / D Ratio:	13.1
Entrenchment Ratio:	6.9
Bank Height Ratio:	1.0



Stream Type C/E



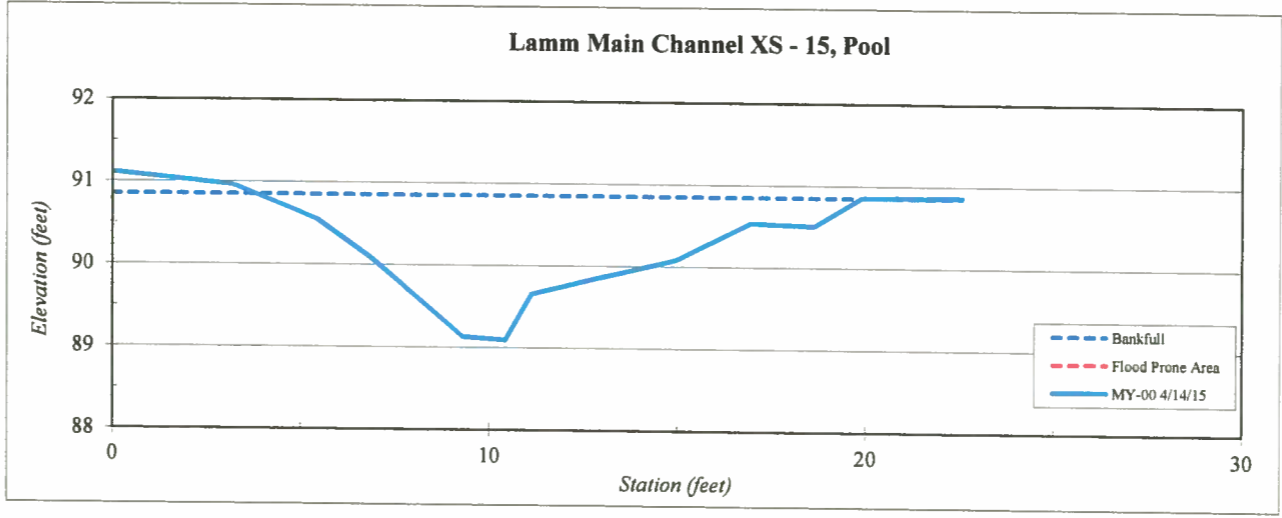
<b>Site</b>	Abbey Lamm
<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	Main Channel XS - 15, Pool
<b>Feature</b>	Pool
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons

Station	Elevation
0.0	91.1
3.2	91.0
5.4	90.5
6.8	90.1
8.2	89.6
9.3	89.1
10.4	89.1
11.1	89.7
13.2	89.9
15.0	90.1
17.0	90.5
18.6	90.5
19.9	90.9
22.6	90.9

SUMMARY DATA	
<b>Bankfull Elevation:</b>	90.9
<b>Bankfull Cross-Sectional Area:</b>	12.7
<b>Bankfull Width:</b>	16.1
<b>Flood Prone Area Elevation:</b>	NA
<b>Flood Prone Width:</b>	NA
<b>Max Depth at Bankfull:</b>	1.8
<b>Mean Depth at Bankfull:</b>	0.8
<b>W / D Ratio:</b>	NA
<b>Entrenchment Ratio:</b>	NA
<b>Bank Height Ratio:</b>	1.0



Stream Type: C/E



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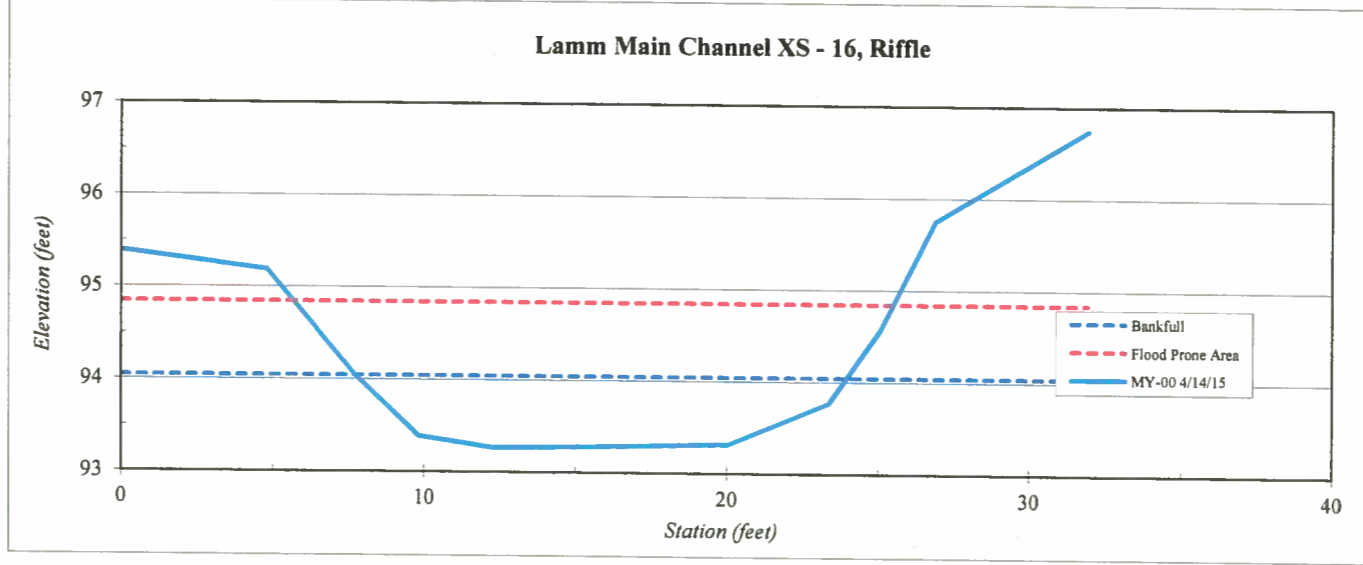
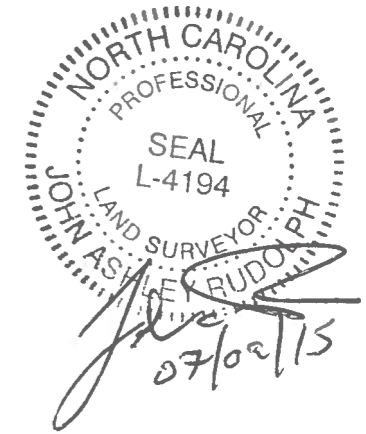
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 16, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	95.39
4.8	95.19
7.7	94.04
9.8	93.39
12.3	93.26
15.7	93.28
20.1	93.31
23.4	93.77
25.1	94.56
26.9	95.75
29.5	96.27
31.9	96.74

SUMMARY DATA	
Bankfull Elevation:	94.0
Bankfull Cross-Sectional Area:	10.1
Bankfull Width:	16.2
Flood Prone Area Elevation:	94.8
Flood Prone Width:	20.0
Max Depth at Bankfull:	0.8
Mean Depth at Bankfull:	0.6
W / D Ratio:	26.0
Entrenchment Ratio:	1.2
Bank Height Ratio:	1.0

Stream Type C



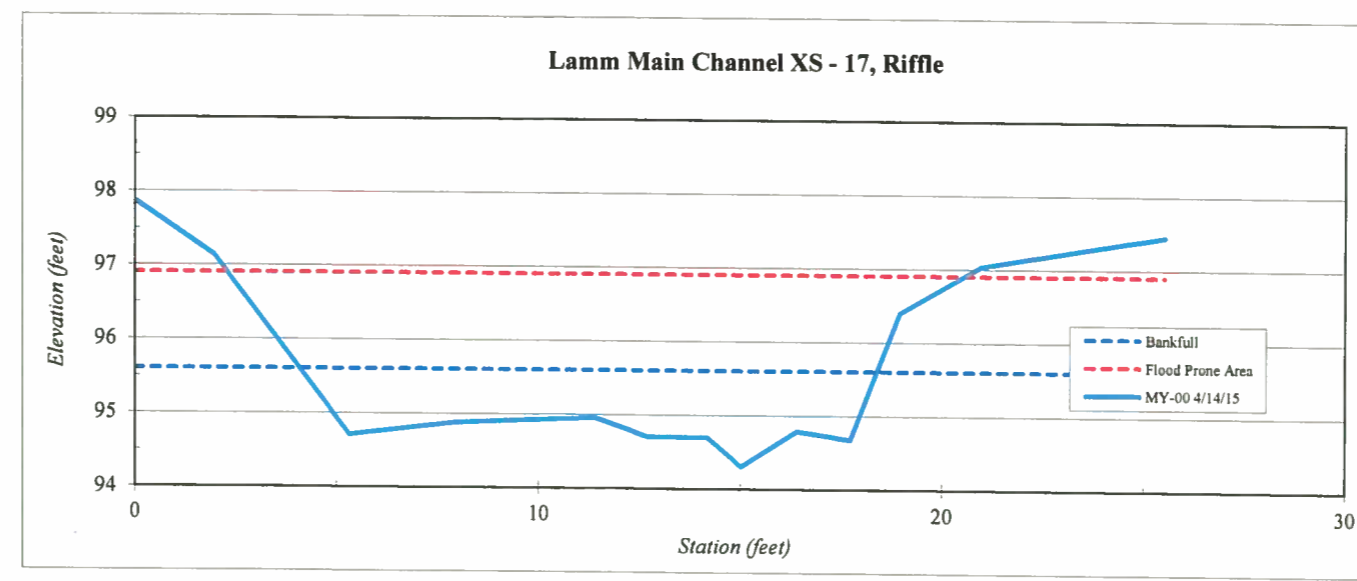
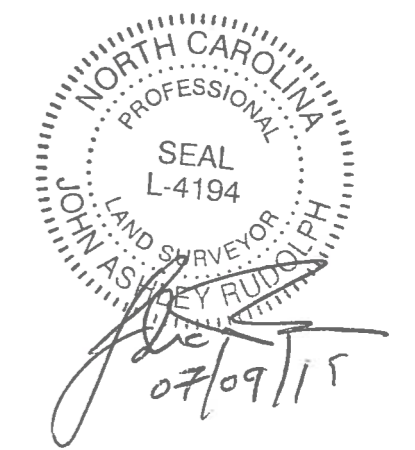
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 17, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	97.87
2.0	97.13
5.3	94.71
7.9	94.88
11.4	94.96
12.7	94.70
14.2	94.70
15.0	94.30
16.4	94.79
17.7	94.67
19.0	96.40
21.0	97.03
23.4	97.25
25.5	97.45

SUMMARY DATA	
Bankfull Elevation:	95.6
Bankfull Cross-Sectional Area:	11.2
Bankfull Width:	14.3
Flood Prone Area Elevation:	96.9
Flood Prone Width:	19.0
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.8
W / D Ratio:	18.3
Entrenchment Ratio:	1.3
Bank Height Ratio:	1.0

Stream Type



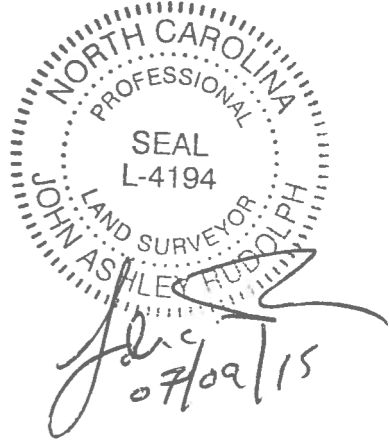
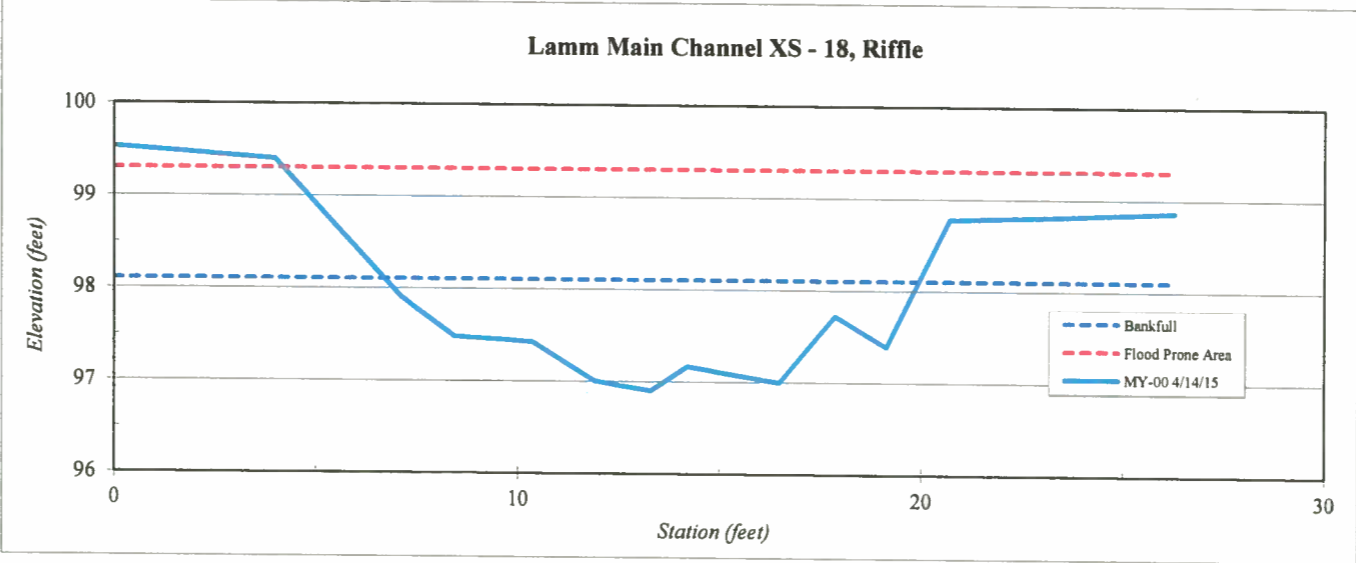
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 18, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	99.53
4.0	99.40
7.1	97.91
8.4	97.48
10.4	97.43
11.9	97.00
13.3	96.90
14.2	97.16
16.5	96.99
17.9	97.72
19.1	97.39
20.7	98.77
23.5	98.81
26.3	98.86

SUMMARY DATA	
Bankfull Elevation:	98.1
Bankfull Cross-Sectional Area:	10.1
Bankfull Width:	13.2
Flood Prone Area Elevation:	99.3
Flood Prone Width:	31.0
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.8
W / D Ratio:	17.3
Entrenchment Ratio:	2.3
Bank Height Ratio:	1.0

Stream Type: C/E



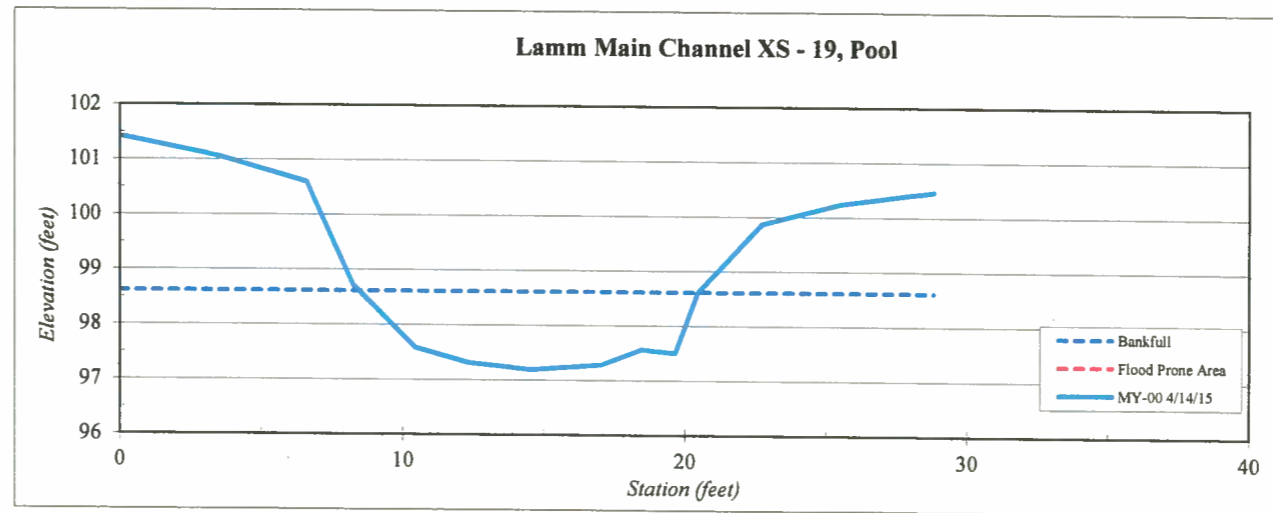
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 19, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	101.4
3.5	101.1
6.6	100.6
8.3	98.7
10.4	97.6
12.3	97.3
14.6	97.2
17.1	97.3
18.5	97.6
19.7	97.5
20.5	98.6
22.7	99.9
25.5	100.2
28.8	100.5

SUMMARY DATA	
Bankfull Elevation:	98.6
Bankfull Cross-Sectional Area:	13.1
Bankfull Width:	12.0
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	1.1
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type C/E



NORTH CAROLINA  
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JOHN ASALE RUDOLPH  
*[Signature]*  
07/09/15



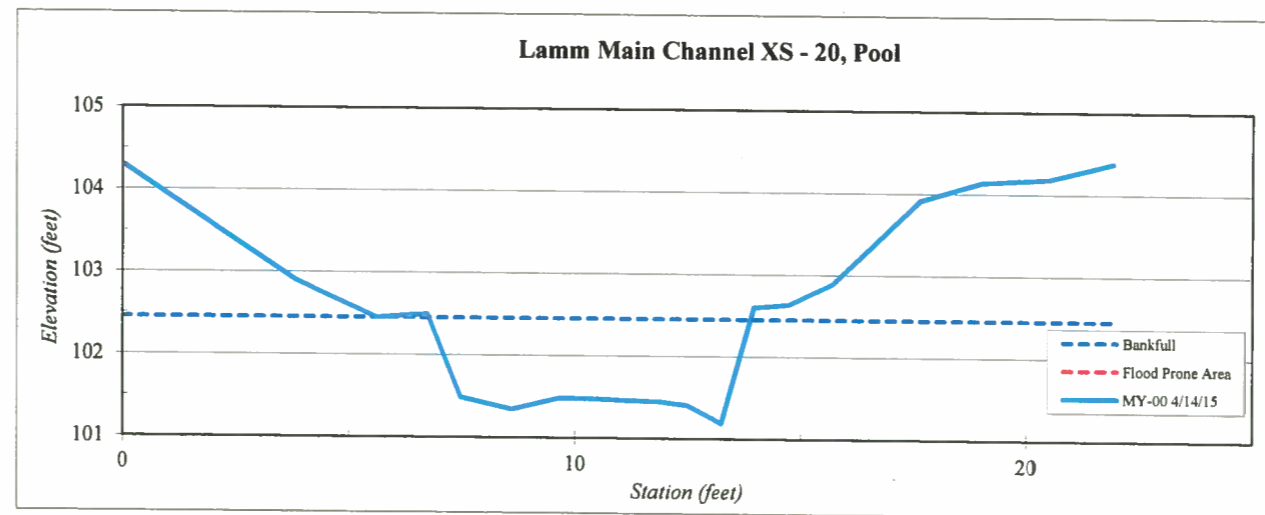
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 20, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	104.3
3.8	102.9
5.6	102.5
6.7	102.5
7.5	101.5
8.6	101.3
9.7	101.5
10.3	101.5
11.9	101.4
12.5	101.4
13.2	101.2
14.0	102.6
14.7	102.6
15.7	102.9
16.8	103.5
17.6	103.9
19.0	104.1
20.5	104.2
21.9	104.4

SUMMARY DATA	
Bankfull Elevation:	102.5
Bankfull Cross-Sectional Area:	6.7
Bankfull Width:	7.1
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.9
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type C/E



NORTH CAROLINA  
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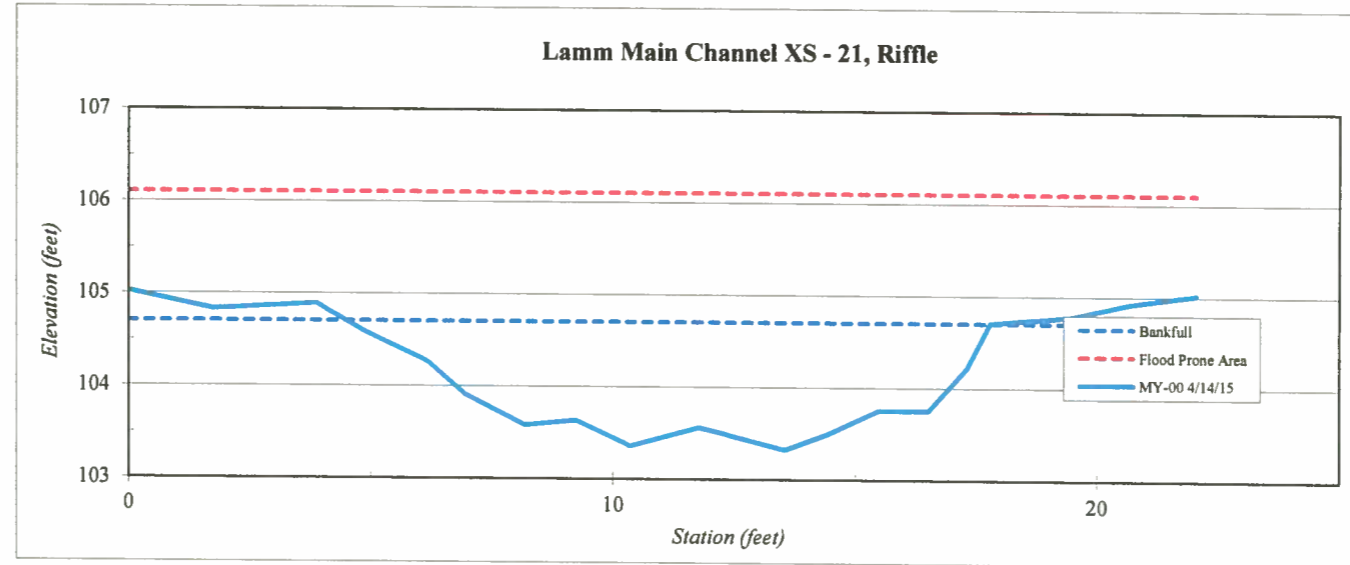
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 21, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	105.02
1.7	104.83
3.9	104.89
4.9	104.58
6.2	104.26
6.9	103.91
8.2	103.58
9.2	103.63
10.4	103.36
11.8	103.56
12.3	103.49
13.5	103.32
14.4	103.49
15.5	103.75
16.5	103.75
17.3	104.21
17.8	104.70
19.5	104.78
20.7	104.92
22.1	105.02

SUMMARY DATA	
Bankfull Elevation:	104.7
Bankfull Cross-Sectional Area:	12.5
Bankfull Width:	13.3
Flood Prone Area Elevation:	106.1
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.9
W / D Ratio:	16.9
Entrenchment Ratio:	7.0
Bank Height Ratio:	1.0



Stream Type: C/E



NORTH CAROLINA  
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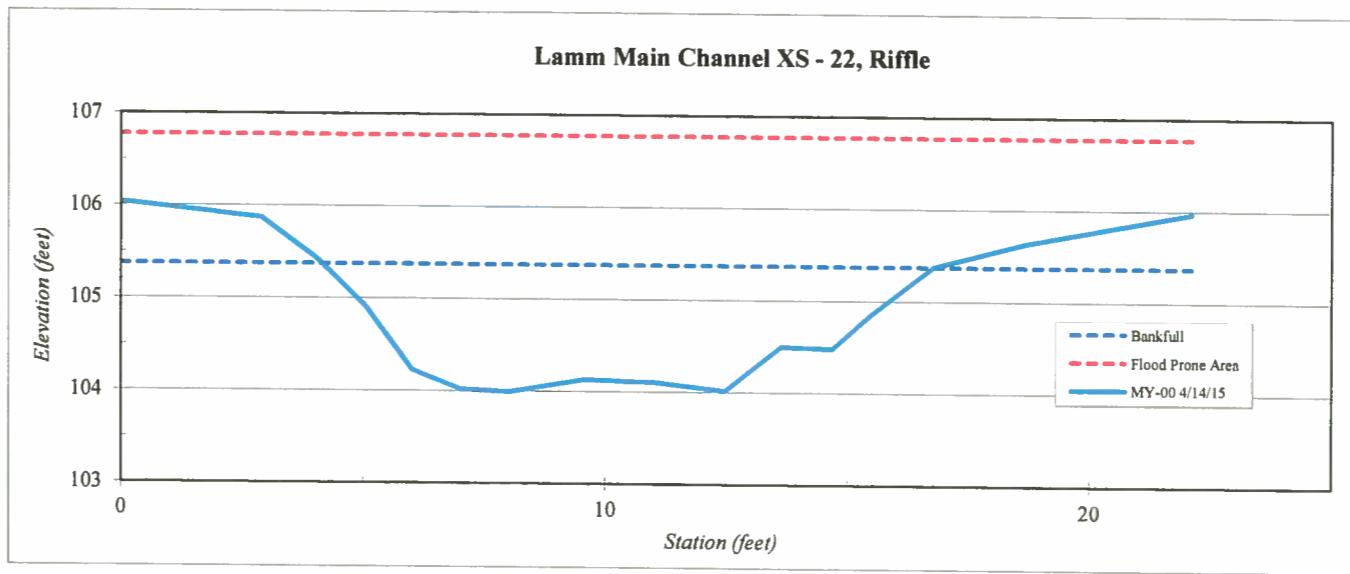
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 22, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	106.03
2.9	105.87
4.1	105.40
5.0	104.91
6.0	104.22
7.0	104.02
8.0	103.99
9.6	104.13
11.0	104.10
12.5	104.01
13.6	104.50
14.7	104.48
15.5	104.86
16.8	105.37
18.7	105.64
22.1	105.96

SUMMARY DATA	
Bankfull Elevation:	105.4
Bankfull Cross-Sectional Area:	12.5
Bankfull Width:	12.6
Flood Prone Area Elevation:	106.8
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	1.0
W / D Ratio:	12.7
Entrenchment Ratio:	7.1
Bank Height Ratio:	1.0



Stream Type: C/E



NORTH CAROLINA  
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JOHN ASHLEY BIRDOLPH

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07/09/15

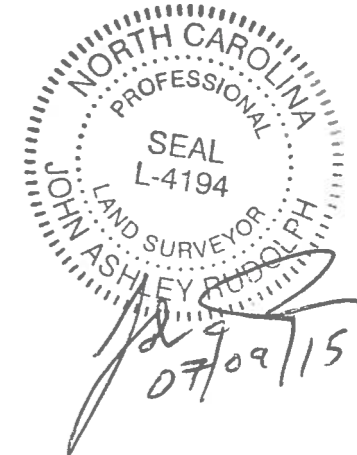
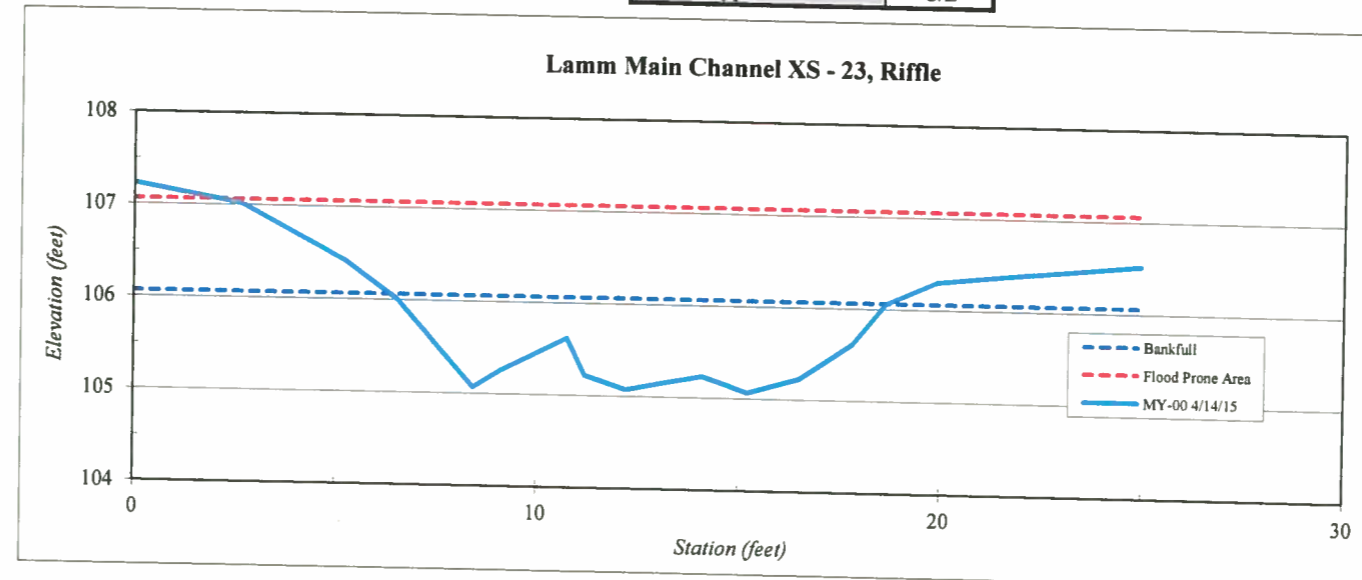
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 23, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	107.23
2.6	107.02
5.2	106.41
6.5	106.01
8.4	105.07
9.1	105.26
10.7	105.62
11.2	105.22
12.2	105.07
13.2	105.16
14.1	105.23
15.2	105.06
16.5	105.22
17.8	105.61
18.6	106.06
19.9	106.30
21.6	106.37
25.0	106.52

SUMMARY DATA	
Bankfull Elevation:	106.1
Bankfull Cross-Sectional Area:	8.8
Bankfull Width:	12.3
Flood Prone Area Elevation:	107.1
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.7
W/D Ratio:	17.2
Entrenchment Ratio:	7.3
Bank Height Ratio:	1.0



Stream Type      C/E



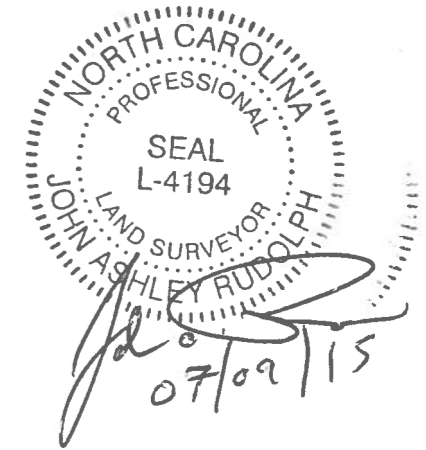
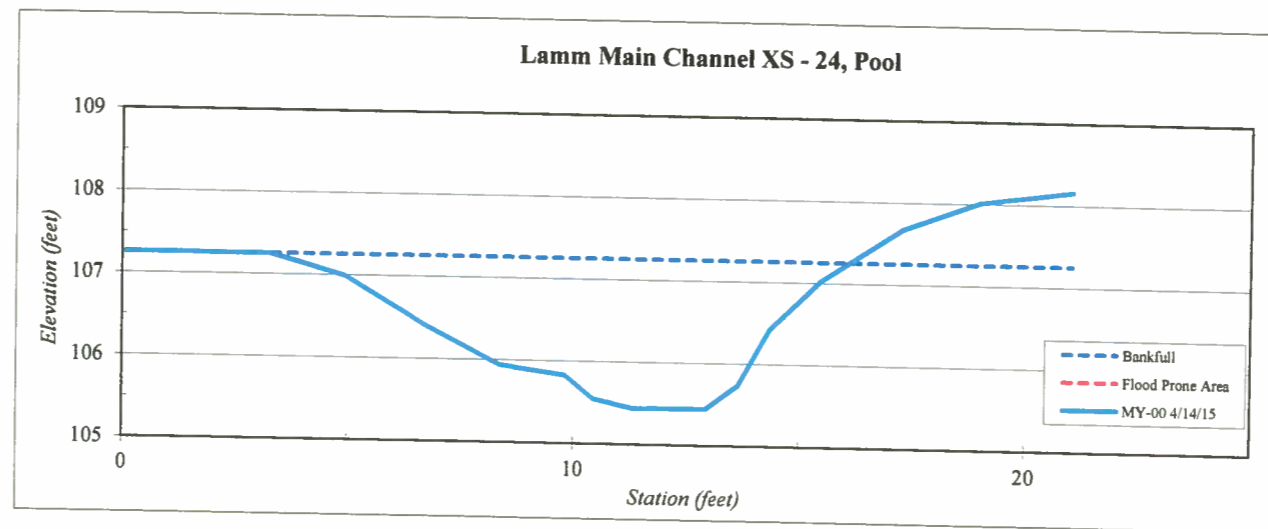
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 24, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	107.3
3.3	107.2
4.9	107.0
6.7	106.4
8.4	105.9
9.8	105.8
10.4	105.5
11.4	105.4
12.0	105.4
12.9	105.4
13.7	105.7
14.4	106.4
15.5	107.0
17.3	107.7
19.0	108.0
21.0	108.2

SUMMARY DATA	
Bankfull Elevation:	107.3
Bankfull Cross-Sectional Area:	13.1
Bankfull Width:	12.8
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	1.0
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type



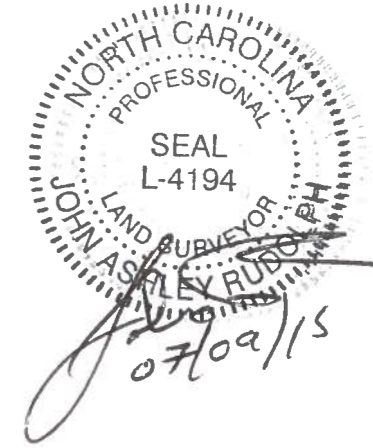
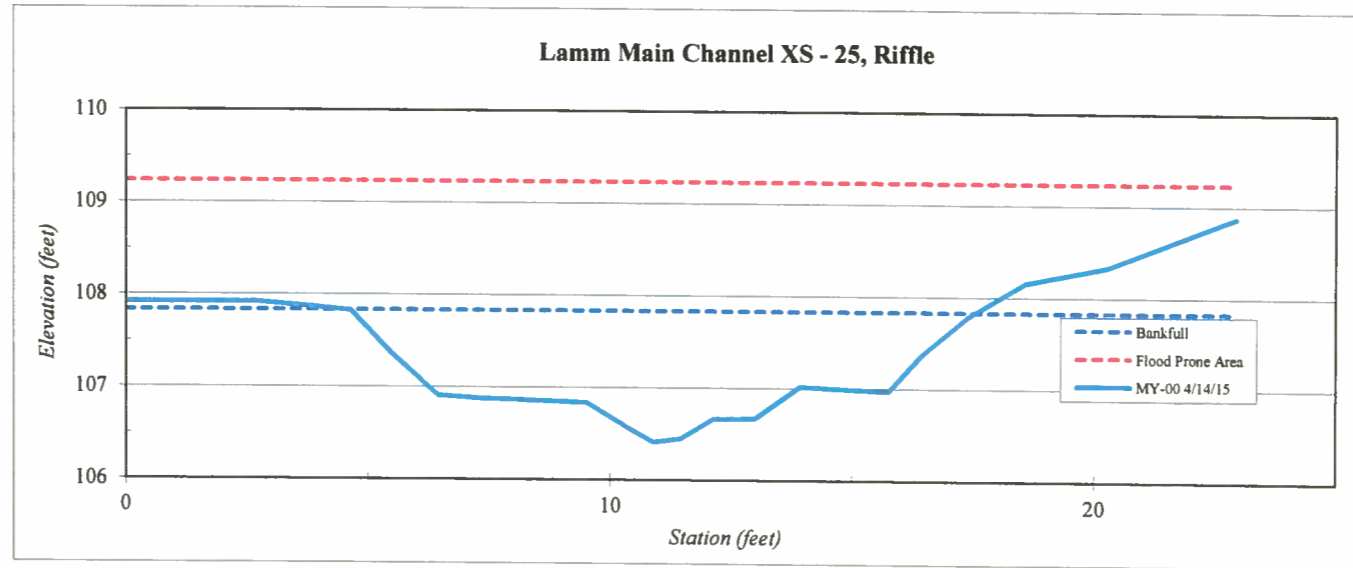
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 25, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	107.91
2.8	107.91
4.6	107.83
5.5	107.36
6.5	106.91
7.3	106.87
7.9	106.86
9.5	106.83
10.1	106.64
10.9	106.41
11.5	106.45
12.1	106.66
13.0	106.67
13.9	107.01
15.8	106.97
16.4	107.37
17.4	107.79
18.6	108.15
20.3	108.33
22.9	108.87

SUMMARY DATA	
Bankfull Elevation:	107.8
Bankfull Cross-Sectional Area:	11.3
Bankfull Width:	13.0
Flood Prone Area Elevation:	109.2
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.9
W / D Ratio:	15.0
Entrenchment Ratio:	6.9
Bank Height Ratio:	1.0



Stream Type: C/E



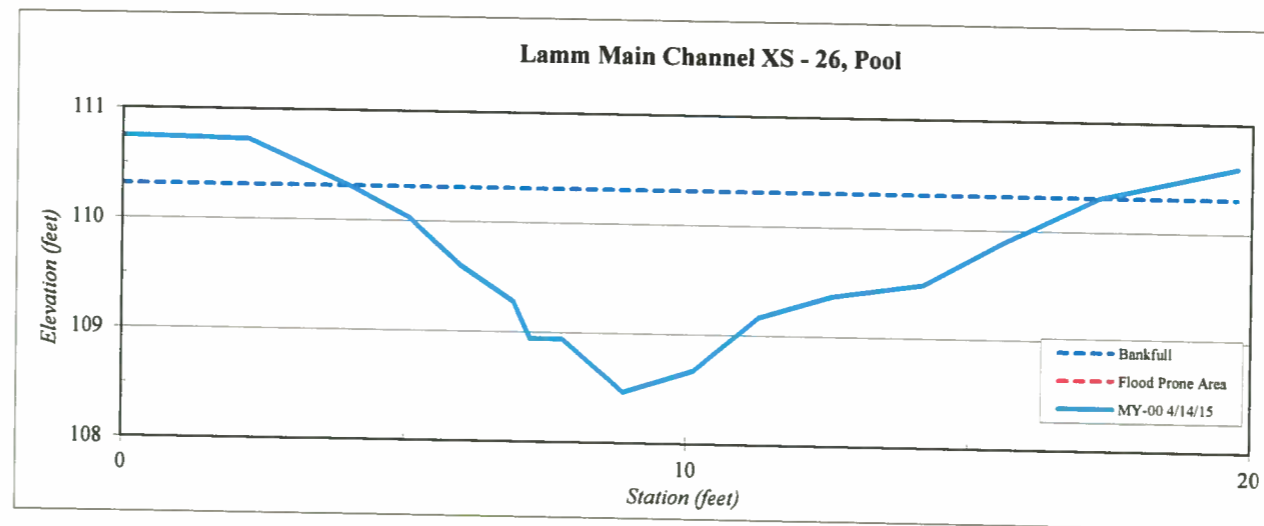
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 26, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	110.7
2.2	110.7
4.1	110.3
5.1	110.0
6.0	109.6
6.9	109.3
7.2	108.9
7.8	108.9
8.9	108.5
10.1	108.7
11.3	109.2
12.6	109.4
14.2	109.5
15.6	109.9
17.3	110.3
19.7	110.6

SUMMARY DATA	
Bankfull Elevation:	110.3
Bankfull Cross-Sectional Area:	12.1
Bankfull Width:	13.3
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	0.9
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type C/E



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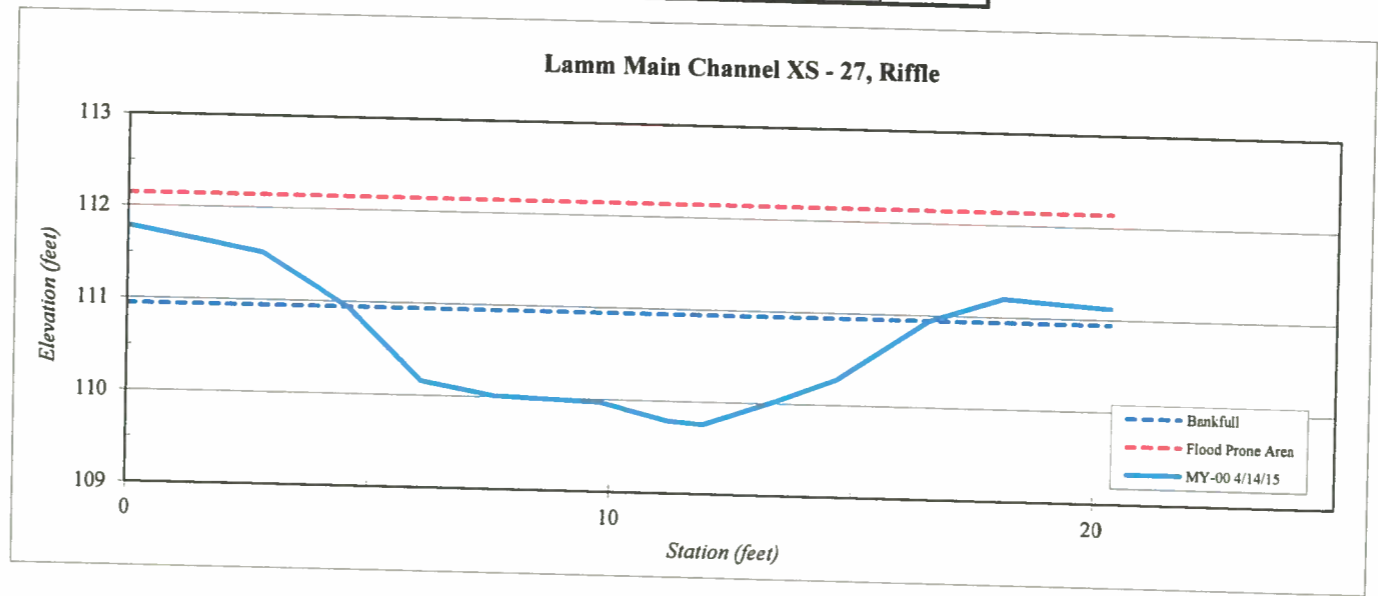
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 27, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	111.78
2.8	111.51
4.6	110.94
6.1	110.16
7.6	110.01
9.8	109.97
11.2	109.78
11.9	109.75
13.5	110.03
14.7	110.27
16.6	110.94
18.1	111.20
20.3	111.12

SUMMARY DATA	
Bankfull Elevation:	110.9
Bankfull Cross-Sectional Area:	9.5
Bankfull Width:	12.0
Flood Prone Area Elevation:	112.1
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.8
W / D Ratio:	15.2
Entrenchment Ratio:	7.5
Bank Height Ratio:	1.0

Stream Type C/E



NORTH CAROLINA  
PROFESSIONAL  
SEAL  
L-4194  
LAND SURVEYOR  
JOHN ASHLEY RUDOLPH

*John Ashley Rudolph*  
07/09/15



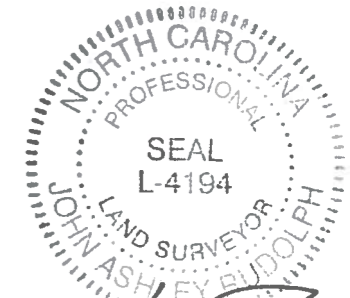
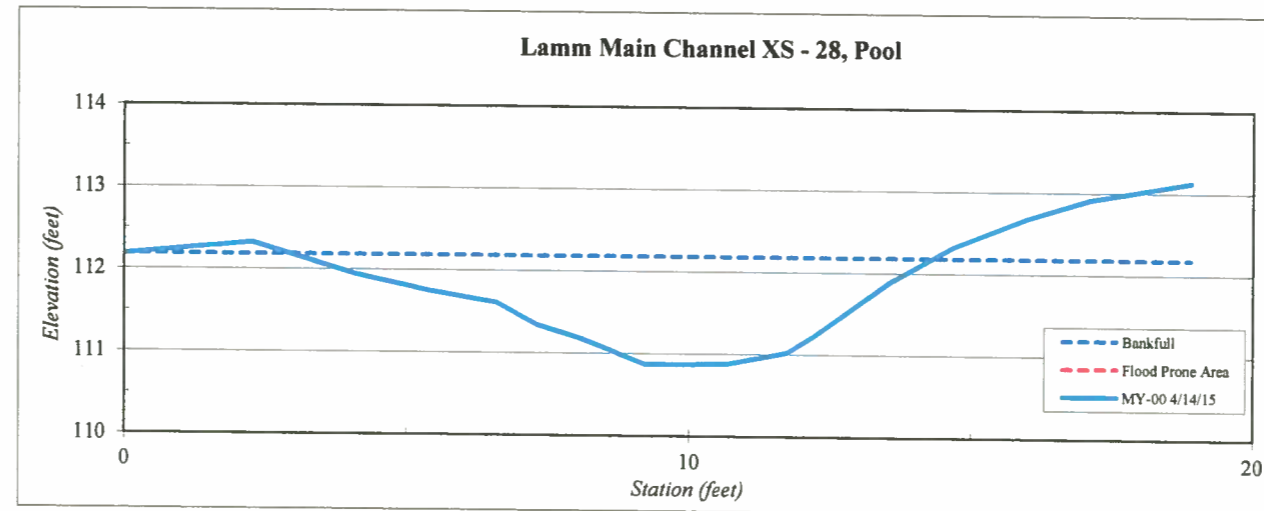
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 28, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	112.2
2.3	112.3
4.1	111.9
5.4	111.7
6.6	111.6
7.3	111.3
8.1	111.2
9.2	110.9
9.9	110.9
10.7	110.9
11.7	111.0
12.2	111.2
13.6	111.9
14.7	112.3
16.0	112.7
17.1	112.9
18.9	113.1

SUMMARY DATA	
Bankfull Elevation:	112.2
Bankfull Cross-Sectional Area:	8.4
Bankfull Width:	11.4
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.7
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type



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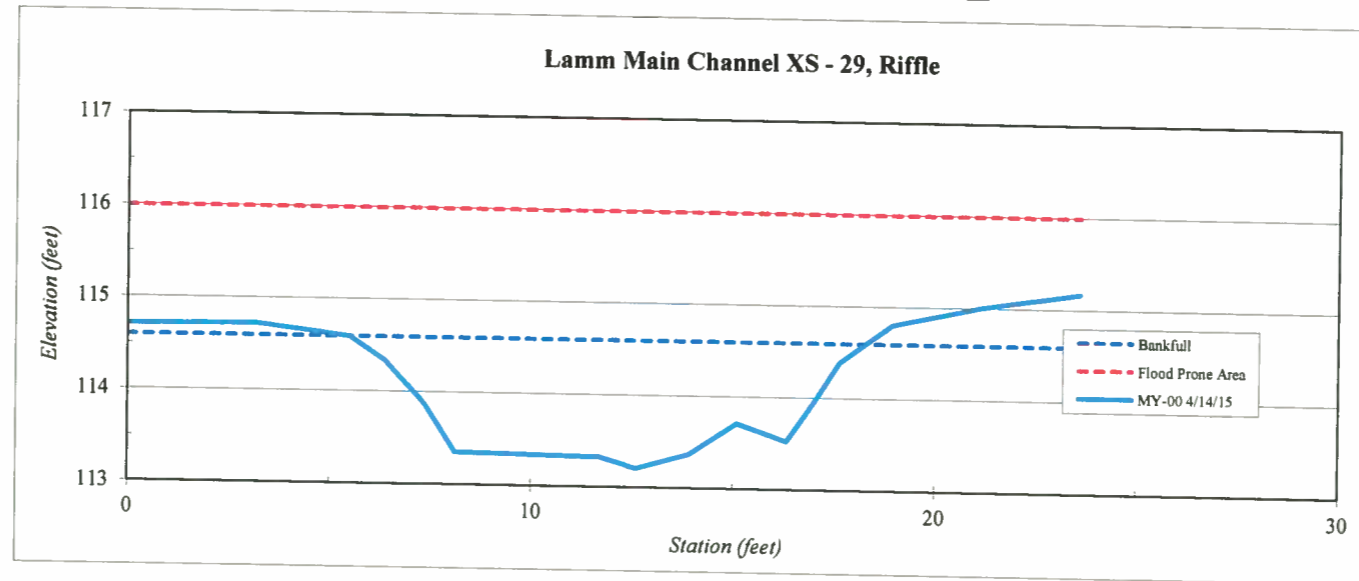
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 29, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	114.71
3.2	114.72
5.5	114.59
6.4	114.34
7.4	113.86
8.1	113.35
9.9	113.34
11.7	113.32
12.6	113.20
13.9	113.36
15.1	113.71
16.3	113.52
17.0	113.97
17.6	114.38
18.9	114.80
21.1	115.00
23.6	115.16

SUMMARY DATA	
Bankfull Elevation:	114.6
Bankfull Cross-Sectional Area:	12.1
Bankfull Width:	12.8
Flood Prone Area Elevation:	116.0
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.9
W / D Ratio:	13.5
Entrenchment Ratio:	7.0
Bank Height Ratio:	1.0

Stream Type: C/E



NORTH CAROLINA  
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SEAL  
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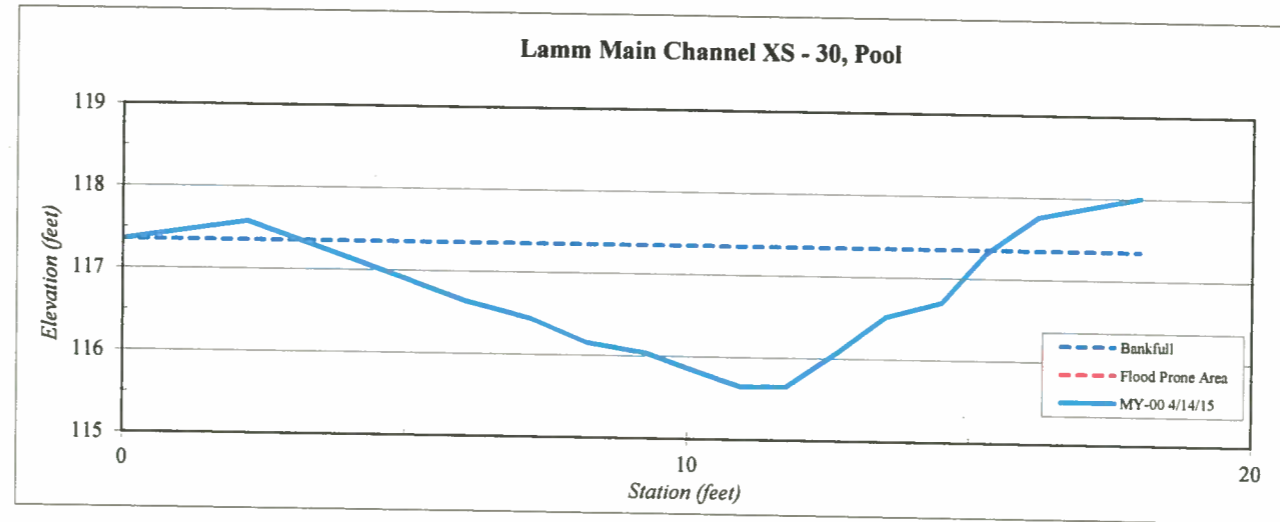
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 30, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	117.3
2.2	117.6
4.1	117.1
6.1	116.6
7.2	116.4
8.2	116.2
9.3	116.0
10.3	115.8
11.0	115.6
11.8	115.6
12.7	116.1
13.5	116.5
14.5	116.7
15.3	117.3
16.2	117.8
18.0	118.0

SUMMARY DATA	
Bankfull Elevation:	117.4
Bankfull Cross-Sectional Area:	11.5
Bankfull Width:	12.3
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	0.9
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type C/E



NORTH CAROLINA  
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 LAND SURVEYOR  
 JOHN ASHLEY RUDOLPH  
*John Ashley Rudolph*

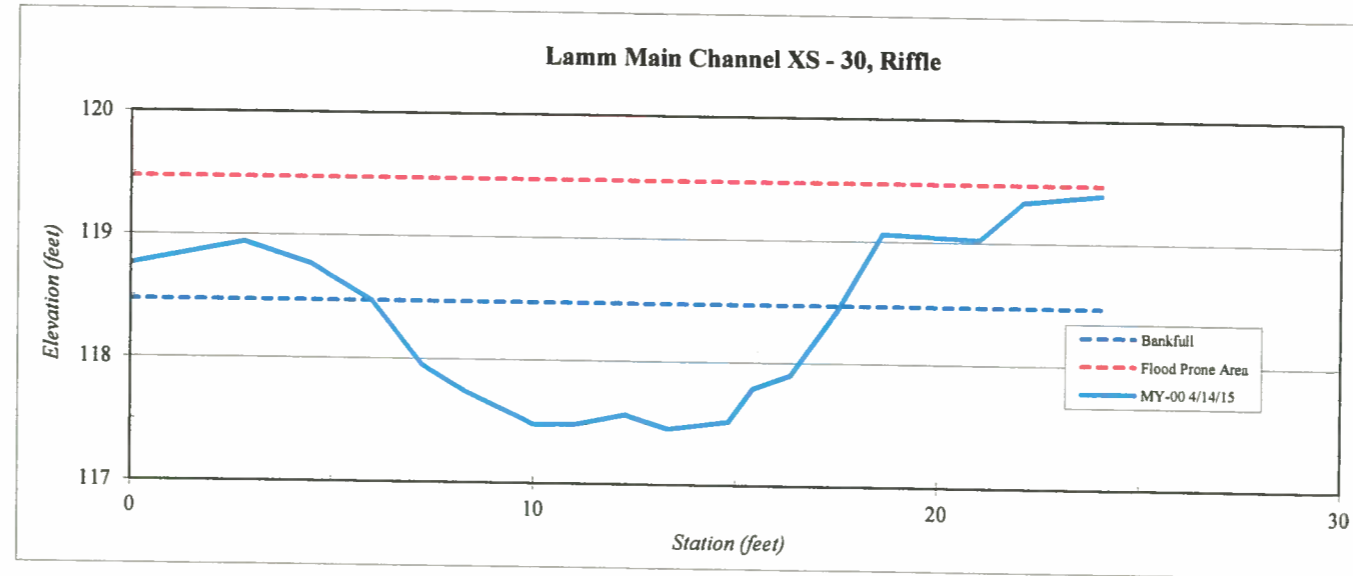
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	Main Channel XS - 30, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	118.76
2.8	118.94
4.5	118.77
6.0	118.47
7.2	117.95
8.3	117.74
10.0	117.48
11.0	117.48
12.3	117.56
13.3	117.45
14.8	117.51
15.4	117.79
16.4	117.90
17.5	118.44
18.6	119.06
21.0	119.02
22.1	119.33
24.0	119.39

SUMMARY DATA	
Bankfull Elevation:	118.5
Bankfull Cross-Sectional Area:	8.6
Bankfull Width:	11.6
Flood Prone Area Elevation:	119.5
Flood Prone Width:	90.0
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.7
W / D Ratio:	15.6
Entrenchment Ratio:	7.8
Bank Height Ratio:	1.0

Stream Type C/E



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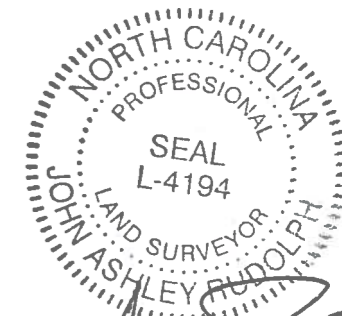
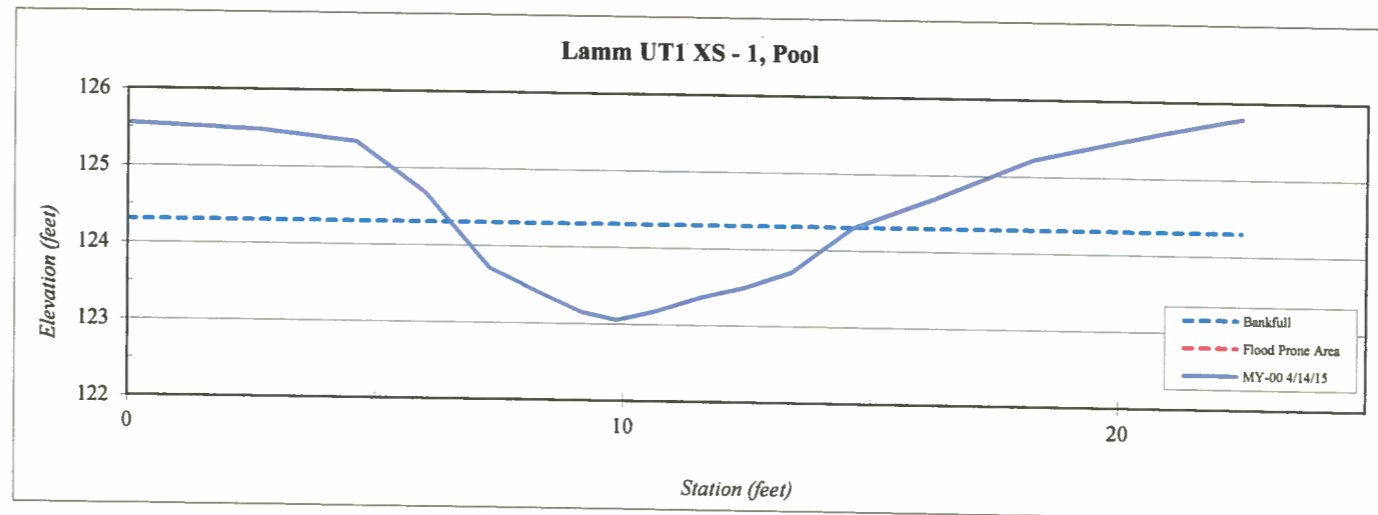
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	UT 1 XS - 1, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	125.6
2.7	125.5
4.6	125.3
6.0	124.7
7.3	123.7
8.4	123.4
9.2	123.1
9.9	123.0
10.7	123.2
11.5	123.4
12.4	123.5
13.4	123.7
14.6	124.3
16.3	124.7
18.3	125.2
20.8	125.6
22.5	125.8

SUMMARY DATA	
Bankfull Elevation:	124.3
Bankfull Cross-Sectional Area:	6.4
Bankfull Width:	8.1
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.8
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type: C/E



*John A. Rudolph*  
07/09/15

<b>Site</b>	Abbey Lamm
<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	UT 1 XS - 2, Riffle
<b>Feature</b>	Riffle
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons

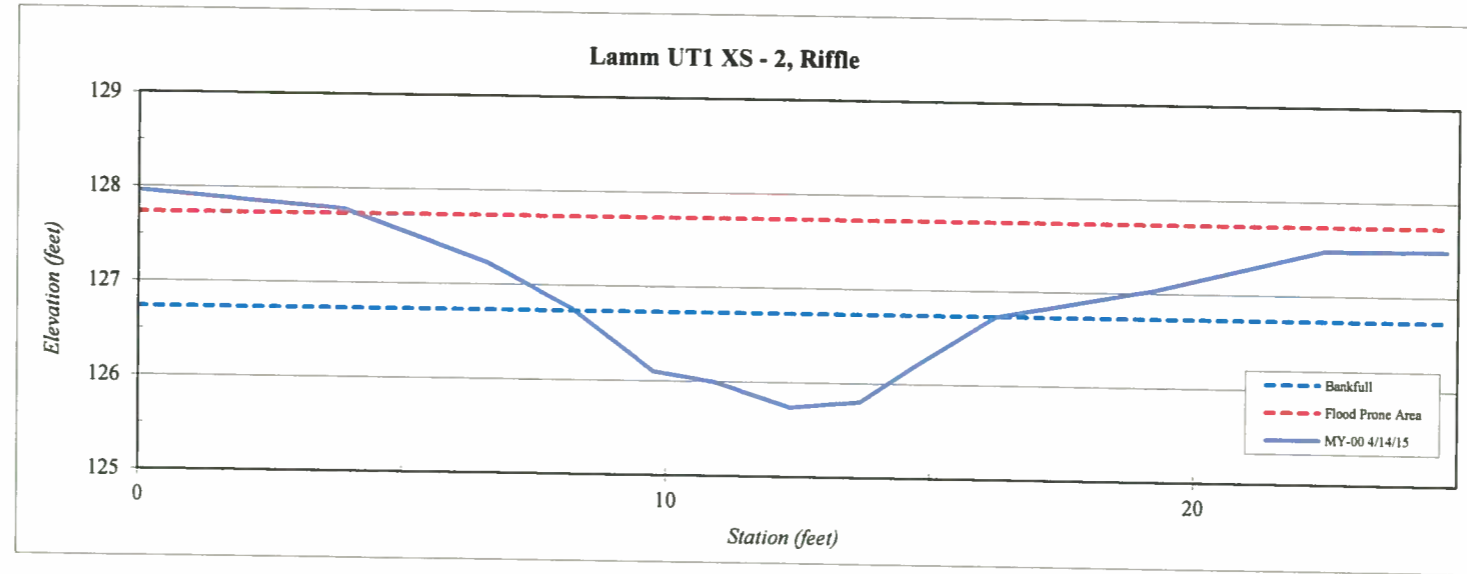
Station	Elevation
0.0	127.96
3.9	127.78
6.6	127.22
8.2	126.76
9.8	126.10
10.9	125.99
12.4	125.73
13.7	125.80
14.7	126.20
16.2	126.72
19.3	127.04
22.5	127.47
24.8	127.49

SUMMARY DATA	
<b>Bankfull Elevation:</b>	126.7
<b>Bankfull Cross-Sectional Area:</b>	5.0
<b>Bankfull Width:</b>	8.0
<b>Flood Prone Area Elevation:</b>	127.7
<b>Flood Prone Width:</b>	50.0
<b>Max Depth at Bankfull:</b>	1.0
<b>Mean Depth at Bankfull:</b>	0.6
<b>W / D Ratio:</b>	13.0
<b>Entrenchment Ratio:</b>	6.2
<b>Bank Height Ratio:</b>	1.0



Stream Type C/E

NORTH CAROLINA  
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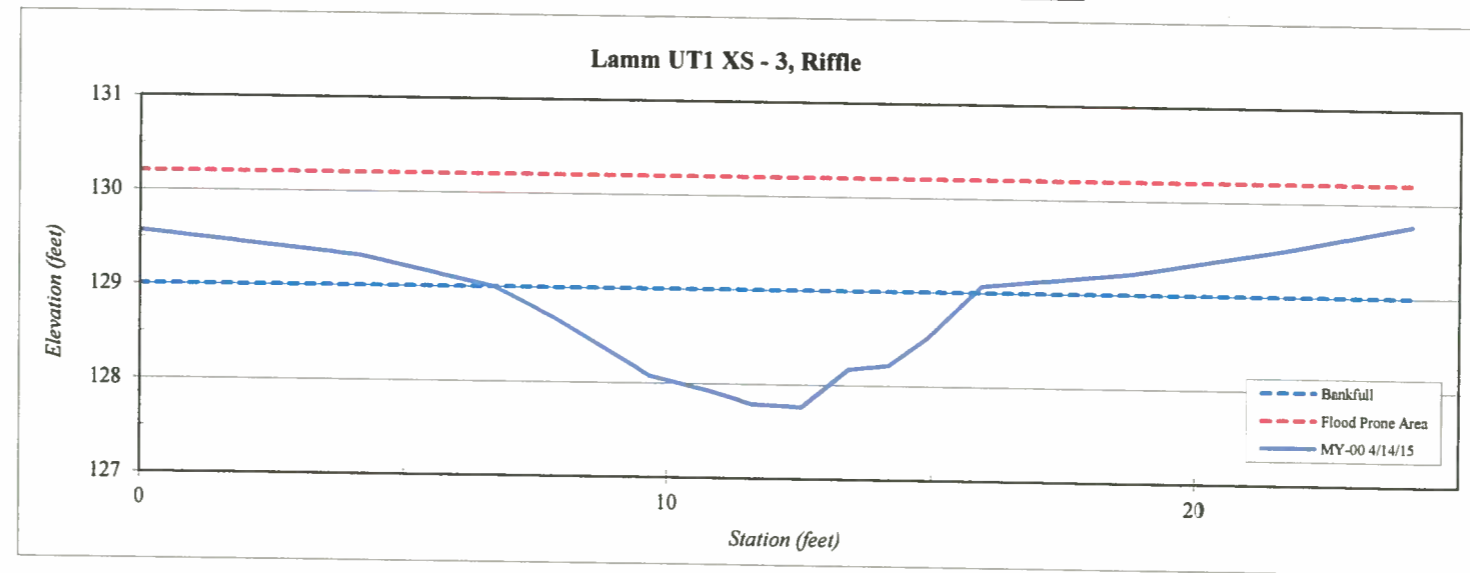
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	UT 1 XS - 3, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Stream Type C/E

Station	Elevation
0.0	129.57
4.2	129.32
6.7	129.00
7.8	128.68
9.7	128.07
10.8	127.92
11.6	127.79
12.5	127.76
13.4	128.17
14.2	128.21
14.9	128.51
15.9	129.07
18.8	129.22
21.8	129.50
24.1	129.76

SUMMARY DATA	
Bankfull Elevation:	129.0
Bankfull Cross-Sectional Area:	6.7
Bankfull Width:	9.1
Flood Prone Area Elevation:	130.2
Flood Prone Width:	50.0
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.7
W / D Ratio:	12.4
Entrenchment Ratio:	5.5
Bank Height Ratio:	1.0



*John Ashley Rudolph*  
07/09/15



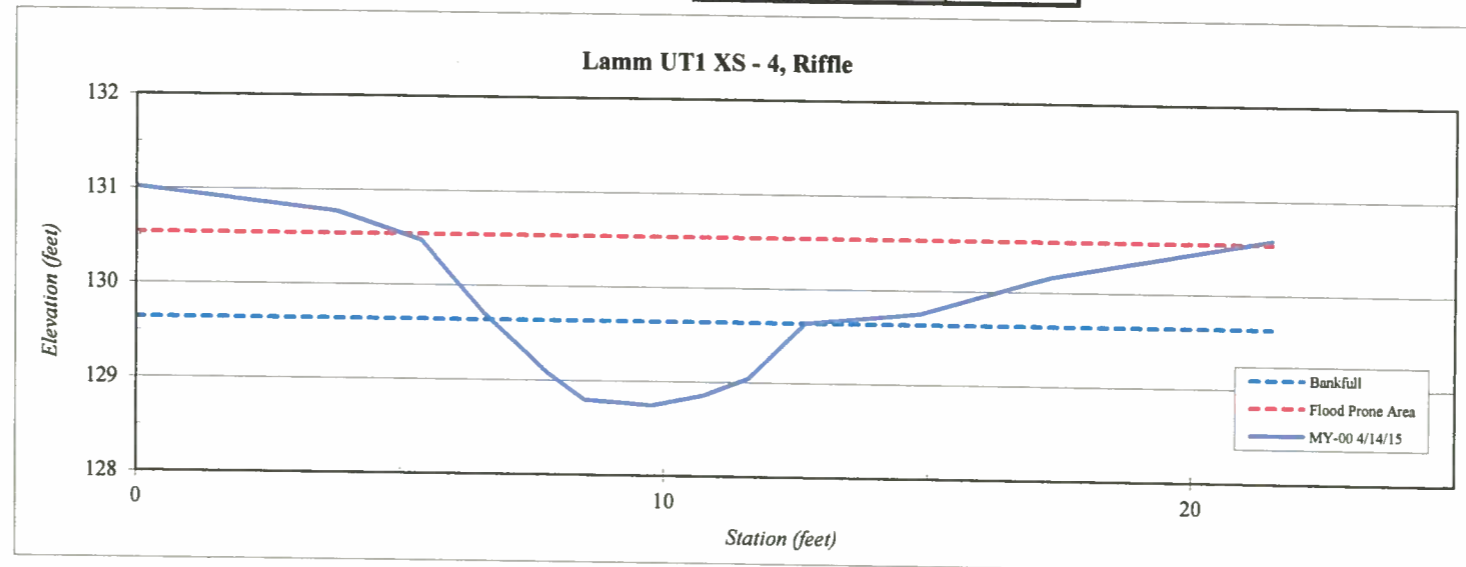
<b>Site</b>	Abbey Lamm
<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	UT 1 XS - 4, Riffle
<b>Feature</b>	Riffle
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons



Station	Elevation
0.0	131.02
3.8	130.77
5.4	130.47
6.6	129.71
7.8	129.07
8.5	128.80
9.8	128.74
10.8	128.86
11.6	129.04
12.7	129.63
14.9	129.75
17.3	130.16
21.5	130.57

SUMMARY DATA	
<b>Bankfull Elevation:</b>	129.6
<b>Bankfull Cross-Sectional Area:</b>	3.6
<b>Bankfull Width:</b>	6.0
<b>Flood Prone Area Elevation:</b>	130.5
<b>Flood Prone Width:</b>	50.0
<b>Max Depth at Bankfull:</b>	0.9
<b>Mean Depth at Bankfull:</b>	0.6
<b>W/D Ratio:</b>	10.0
<b>Entrenchment Ratio:</b>	8.3
<b>Bank Height Ratio:</b>	1.0

Stream Type



NORTH CAROLINA  
PROFESSIONAL  
SEAL  
L-4194  
LAND SURVEYOR  
JOHN ASHLEY RUDOLPH  
*John Ash*  
07/09/15

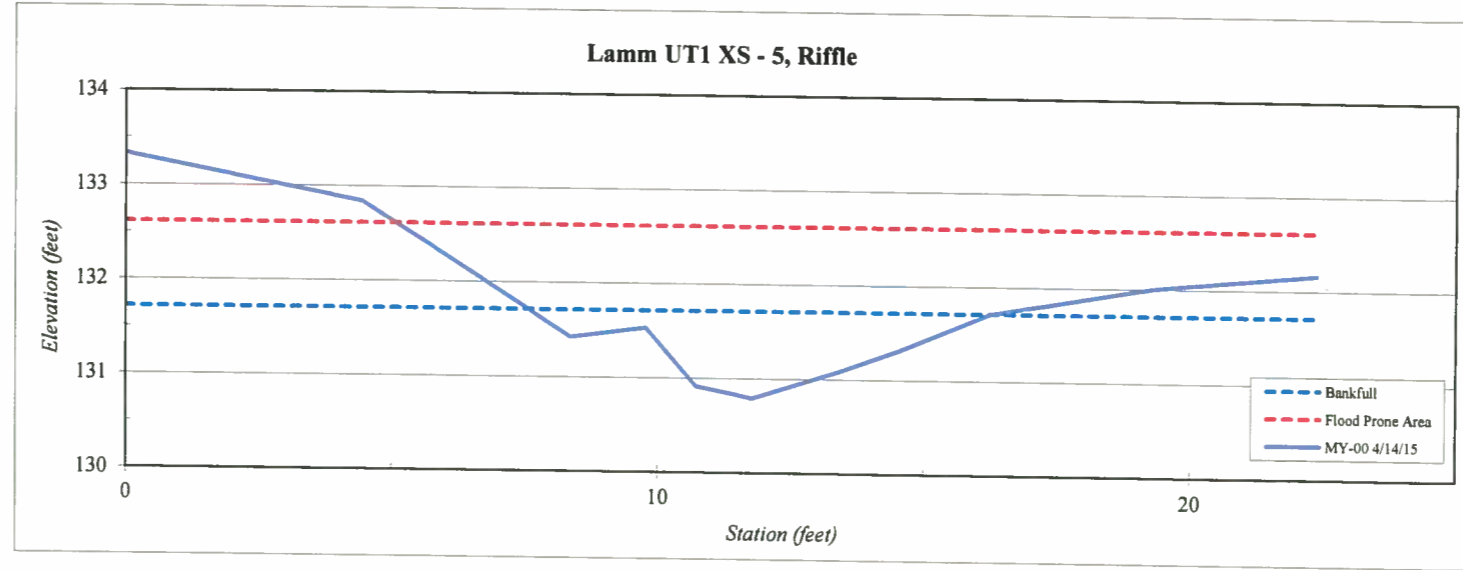
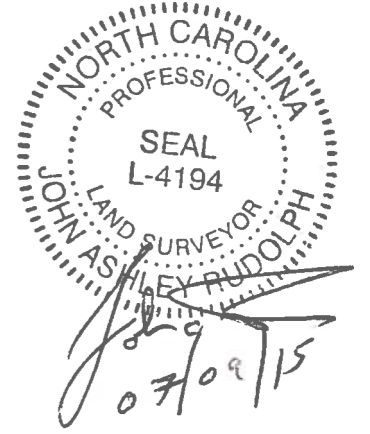
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	UT 1 XS - 5, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	133.33
4.4	132.84
6.2	132.22
8.4	131.42
9.8	131.53
10.7	130.91
11.8	130.79
13.3	131.07
14.5	131.31
16.3	131.71
19.3	132.00
22.4	132.16

SUMMARY DATA	
Bankfull Elevation:	131.7
Bankfull Cross-Sectional Area:	4.0
Bankfull Width:	8.7
Flood Prone Area Elevation:	132.6
Flood Prone Width:	50.0
Max Depth at Bankfull:	0.9
Mean Depth at Bankfull:	0.5
W / D Ratio:	18.9
Entrenchment Ratio:	5.7
Bank Height Ratio:	1.0

Stream Type C/E







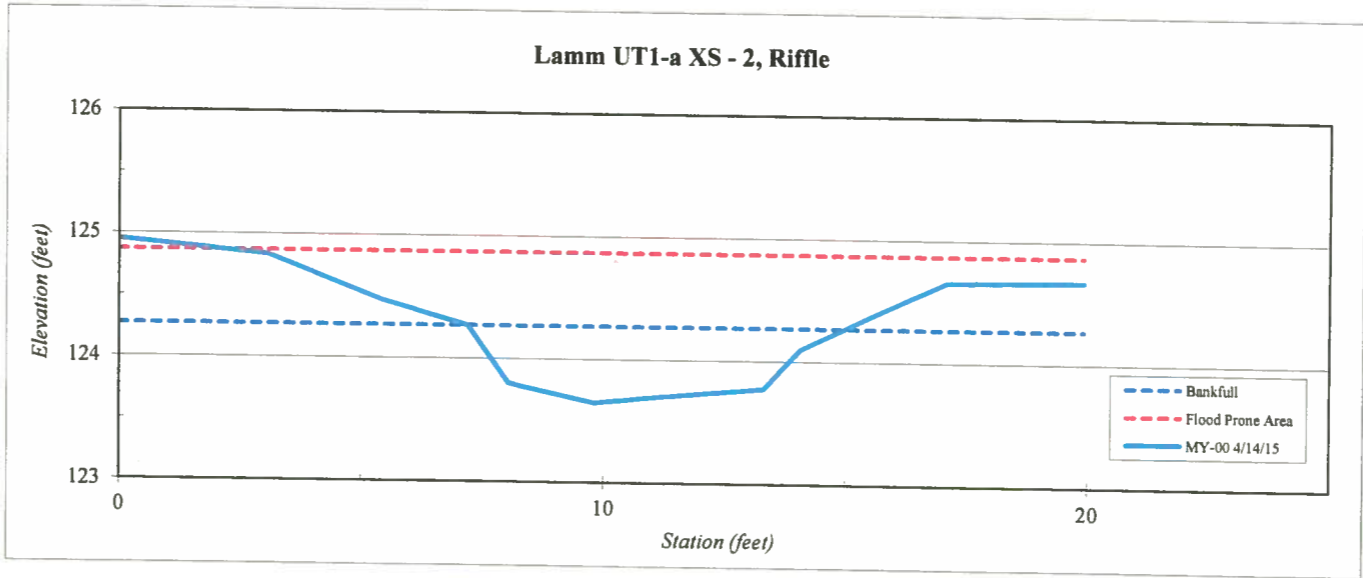
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	UT 1a XS - 2, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	124.95
3.1	124.83
5.4	124.47
7.2	124.27
8.0	123.80
9.8	123.65
10.9	123.69
13.3	123.77
14.1	124.10
15.7	124.40
17.1	124.66
19.9	124.67

SUMMARY DATA	
Bankfull Elevation:	124.3
Bankfull Cross-Sectional Area:	3.4
Bankfull Width:	7.8
Flood Prone Area Elevation:	124.9
Flood Prone Width:	50.0
Max Depth at Bankfull:	0.6
Mean Depth at Bankfull:	0.4
W / D Ratio:	17.6
Entrenchment Ratio:	6.4
Bank Height Ratio:	1.0

Stream Type: C/E



Professional Seal: NORTH CAROLINA PROFESSIONAL LAND SURVEYOR SEAL L-4194 JOHN ASHLEY BUBBOLPH  
*John Ashley Bubbolph*  
 07/09/15





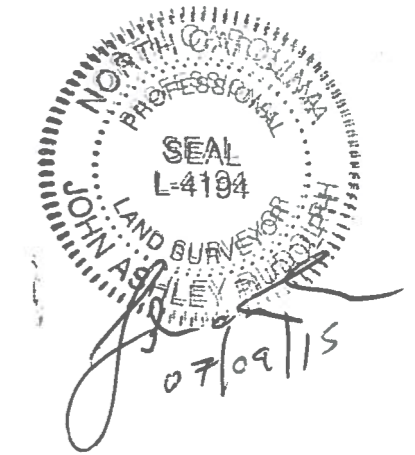
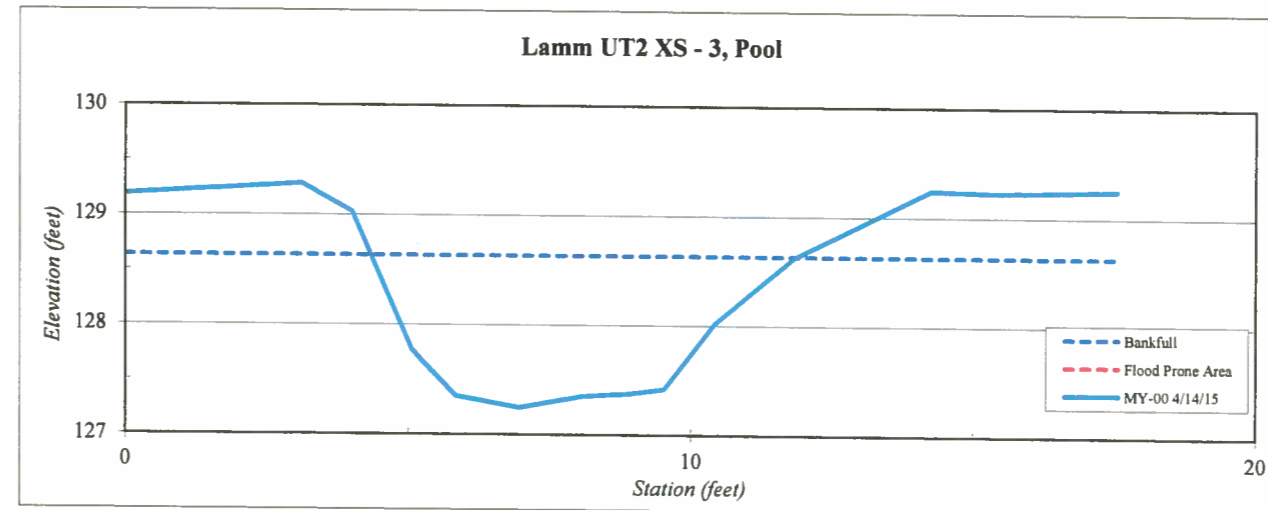
<b>Site</b>	Abbey Lamm
<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	UT 2 XS - 3, Pool
<b>Feature</b>	Pool
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons

Station	Elevation
0.0	129.2
3.1	129.3
4.0	129.0
5.1	127.8
5.8	127.4
7.0	127.2
8.1	127.4
8.9	127.4
9.5	127.4
10.4	128.0
11.8	128.6
13.3	129.0
14.3	129.2
15.5	129.2
17.5	129.2

SUMMARY DATA	
<b>Bankfull Elevation:</b>	128.6
<b>Bankfull Cross-Sectional Area:</b>	7.2
<b>Bankfull Width:</b>	7.5
<b>Flood Prone Area Elevation:</b>	NA
<b>Flood Prone Width:</b>	NA
<b>Max Depth at Bankfull:</b>	1.4
<b>Mean Depth at Bankfull:</b>	1.0
<b>W / D Ratio:</b>	NA
<b>Entrenchment Ratio:</b>	NA
<b>Bank Height Ratio:</b>	1.0



Stream Type C/E





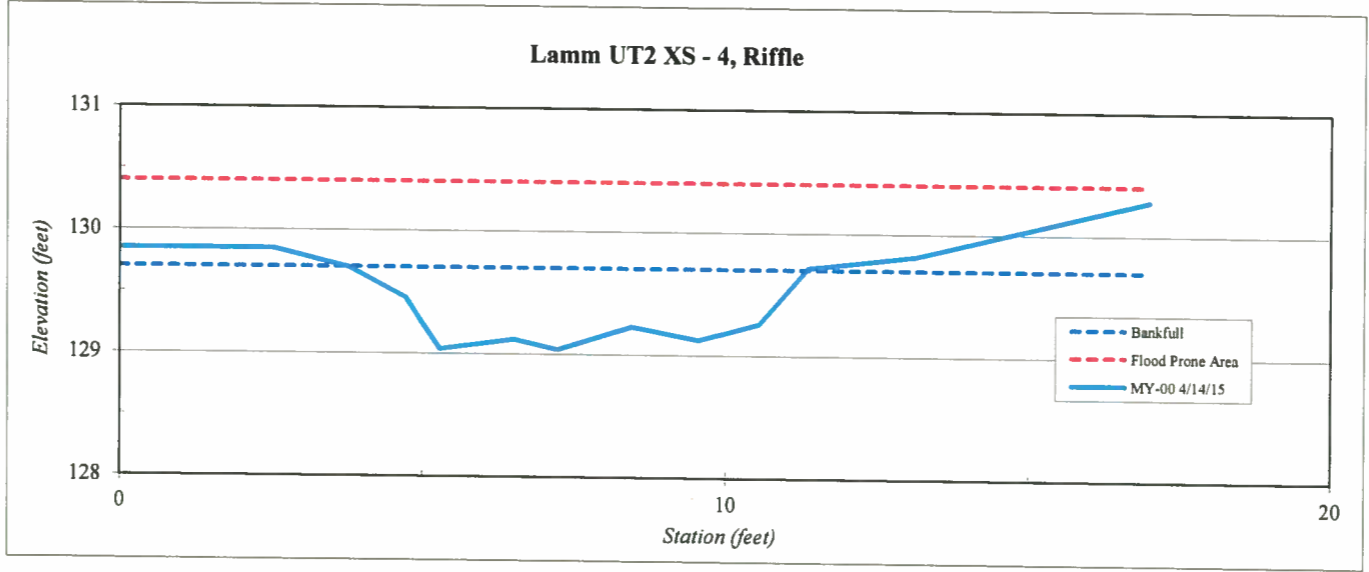
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	UT 2 XS - 4, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	129.85
2.5	129.85
3.8	129.70
4.7	129.45
5.3	129.04
6.5	129.12
7.2	129.04
8.5	129.23
9.6	129.12
10.6	129.26
11.4	129.71
13.1	129.81
17.0	130.28

SUMMARY DATA	
Bankfull Elevation:	129.7
Bankfull Cross-Sectional Area:	3.6
Bankfull Width:	7.6
Flood Prone Area Elevation:	130.4
Flood Prone Width:	50.0
Max Depth at Bankfull:	0.7
Mean Depth at Bankfull:	0.5
W / D Ratio:	16.0
Entrenchment Ratio:	6.6
Bank Height Ratio:	1.0



Stream Type C/E



SEAL L-4194  
 JOHN ASHLEY RUDOLPH  
*ASR*  
 07/09/15







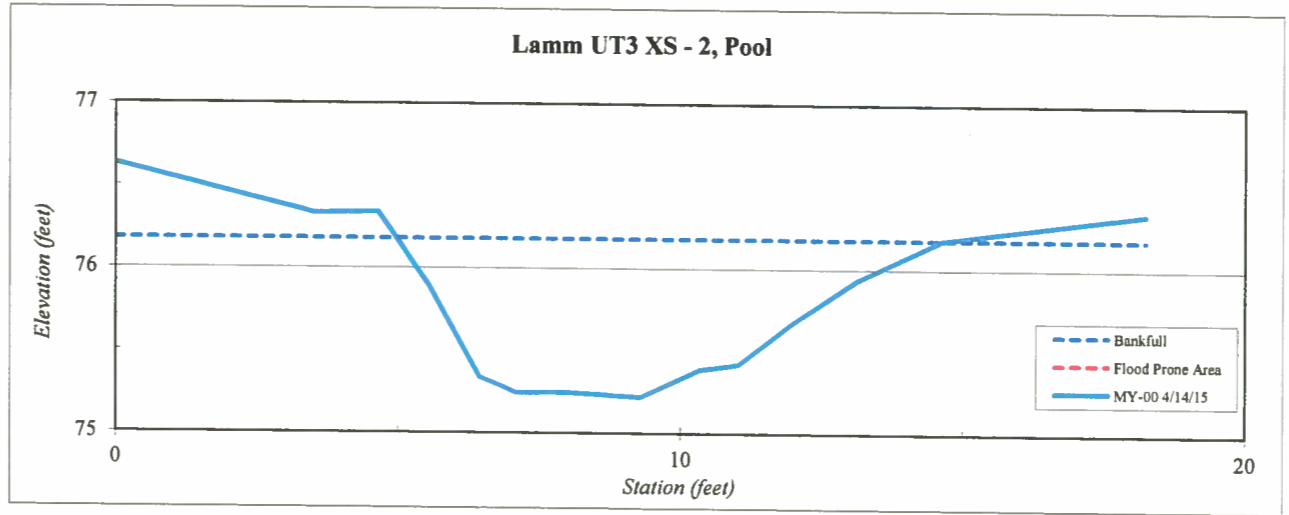
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	UT 3 XS - 2, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	76.6
3.5	76.3
4.7	76.3
5.5	75.9
6.4	75.3
7.1	75.2
7.9	75.2
9.3	75.2
10.3	75.4
11.0	75.4
12.0	75.7
13.1	75.9
14.6	76.2
18.2	76.3

SUMMARY DATA	
Bankfull Elevation:	76.2
Bankfull Cross-Sectional Area:	5.9
Bankfull Width:	9.7
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.6
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type C/E



*John Ashley Rudolph*  
07/09/15



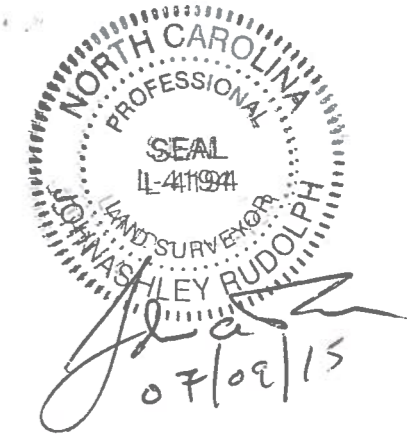
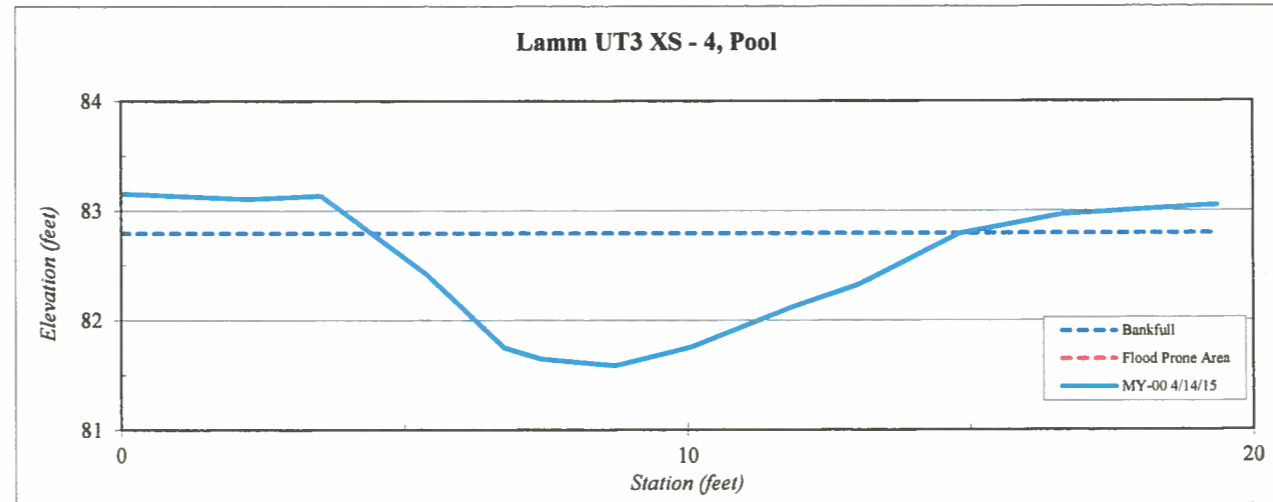
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	UT 3 XS - 4, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	83.2
2.2	83.1
3.5	83.1
5.4	82.4
6.8	81.7
7.4	81.6
8.7	81.6
9.5	81.7
10.1	81.8
11.9	82.1
13.0	82.3
14.8	82.8
16.7	83.0
19.4	83.0

SUMMARY DATA	
Bankfull Elevation:	82.8
Bankfull Cross-Sectional Area:	7.5
Bankfull Width:	10.4
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.7
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type C/E



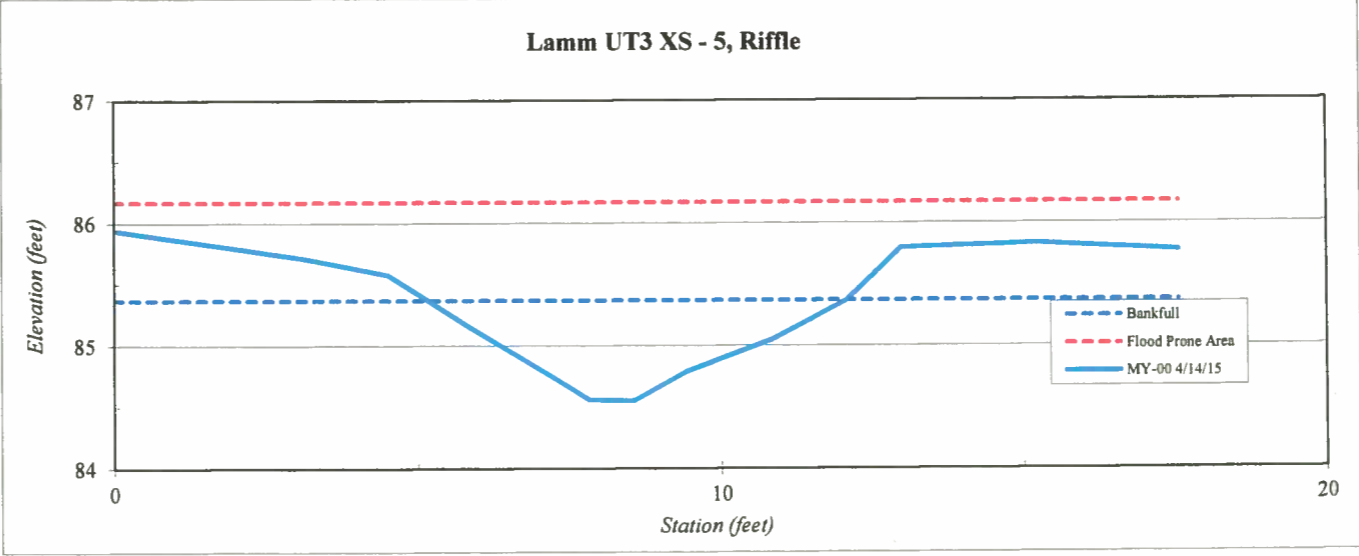
<b>Site</b>	Abbey Lamm
<b>Watershed:</b>	Cape Fear, 0303002
<b>XS ID</b>	UT 3 XS - 5, Riffle
<b>Feature</b>	Riffle
<b>Date:</b>	4/14/2015
<b>Field Crew:</b>	Perkinson, Gibbons

Station	Elevation
0.0	85.94
3.1	85.72
4.5	85.58
5.8	85.17
7.5	84.66
7.8	84.56
8.6	84.55
9.4	84.79
10.8	85.05
12.1	85.37
13.0	85.79
15.2	85.83
17.6	85.77

SUMMARY DATA	
<b>Bankfull Elevation:</b>	85.4
<b>Bankfull Cross-Sectional Area:</b>	3.1
<b>Bankfull Width:</b>	6.9
<b>Flood Prone Area Elevation:</b>	86.2
<b>Flood Prone Width:</b>	50.0
<b>Max Depth at Bankfull:</b>	0.8
<b>Mean Depth at Bankfull:</b>	0.4
<b>W / D Ratio:</b>	15.4
<b>Entrenchment Ratio:</b>	7.2
<b>Bank Height Ratio:</b>	1.0



Stream Type: C/E



*John A. Rudolph*  
07/09/15











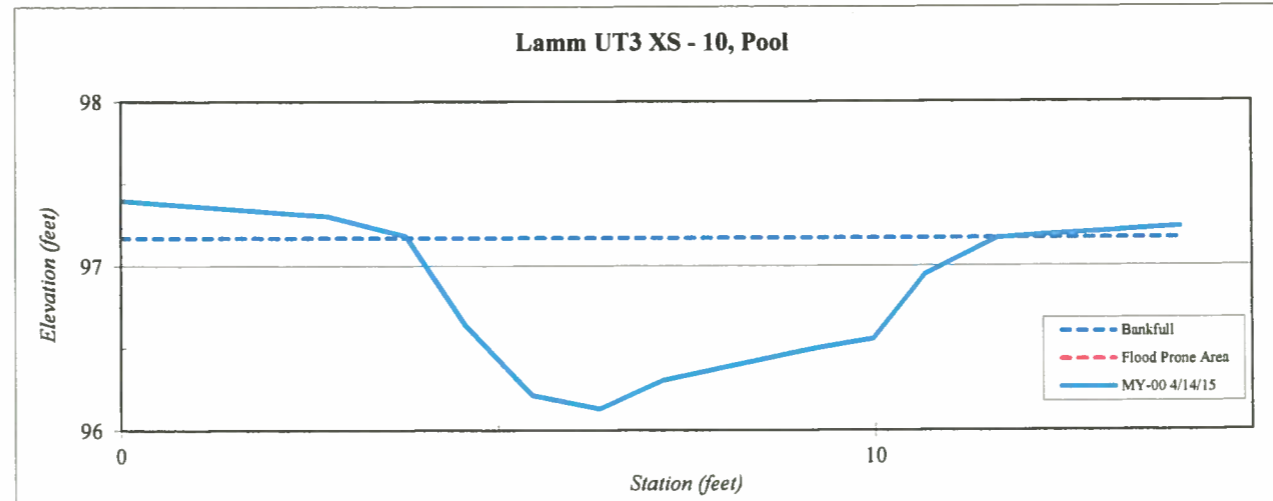
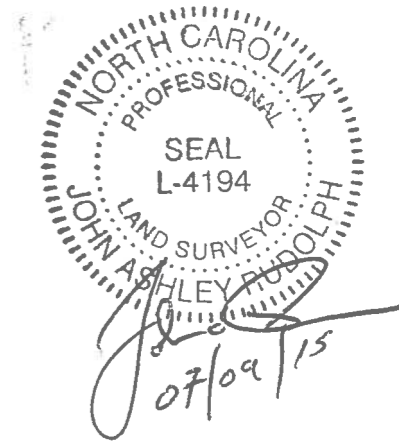
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	UT 3 XS - 10, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	97.4
2.7	97.3
3.8	97.2
4.6	96.6
5.4	96.2
6.3	96.1
7.2	96.3
8.2	96.4
9.1	96.5
10.0	96.6
10.7	96.9
11.6	97.2
14.1	97.2

SUMMARY DATA	
Bankfull Elevation:	97.2
Bankfull Cross-Sectional Area:	5.0
Bankfull Width:	7.8
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.6
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type C/E



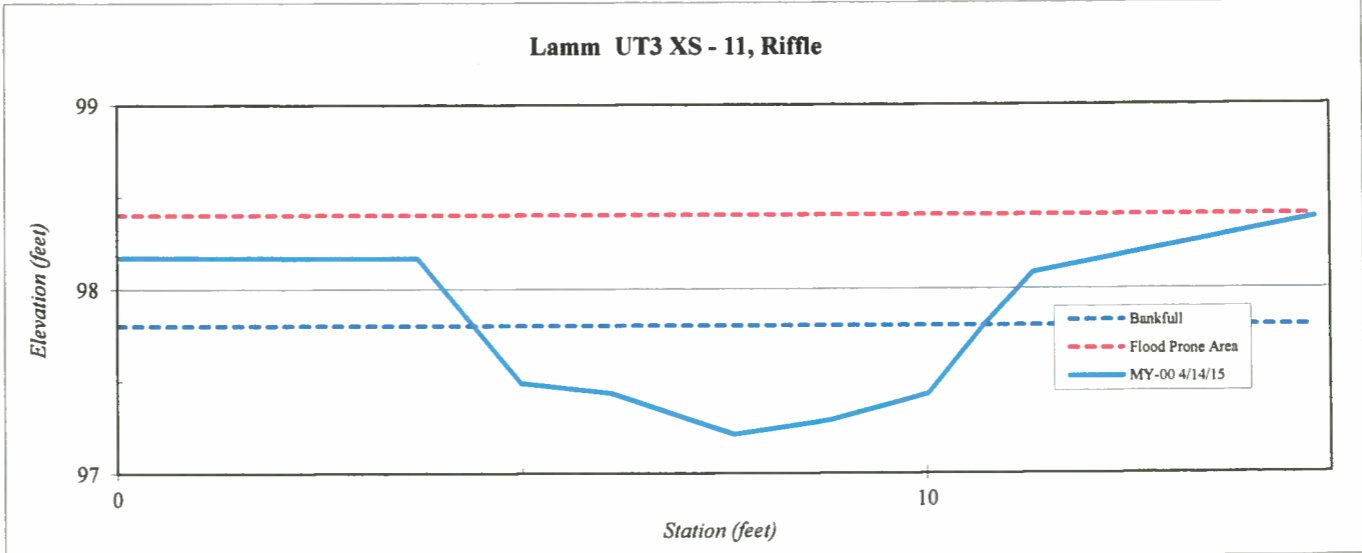
Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	UT 3 XS - 11, Riffle
Feature	Riffle
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons



Station	Elevation
0.0	98.17
3.0	98.17
3.7	98.17
5.0	97.49
6.1	97.43
7.6	97.21
8.8	97.29
10.0	97.43
10.7	97.80
11.3	98.09
14.8	98.38

SUMMARY DATA	
Bankfull Elevation:	97.8
Bankfull Cross-Sectional Area:	2.5
Bankfull Width:	6.3
Flood Prone Area Elevation:	98.4
Flood Prone Width:	50.0
Max Depth at Bankfull:	0.6
Mean Depth at Bankfull:	0.4
W / D Ratio:	15.9
Entrenchment Ratio:	7.9
Bank Height Ratio:	1.0

Stream Type: C/E



NORTH CAROLINA  
 PROFESSIONAL  
 SEAL  
 L-4194  
 LAND SURVEYOR  
 JOHN ASHLEY RUDOLPH  
*[Signature]*  
 07/09/15



Site	Abbey Lamm
Watershed:	Cape Fear, 0303002
XS ID	UT 3 XS - 13, Pool
Feature	Pool
Date:	4/14/2015
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	100.5
1.9	100.1
3.6	100.0
4.2	98.9
4.8	99.3
5.5	99.4
6.2	99.3
6.8	99.2
7.4	99.1
7.8	99.2
8.2	99.3
8.9	100.1
10.2	100.3
11.4	100.5
13.2	100.8

SUMMARY DATA	
Bankfull Elevation:	100.1
Bankfull Cross-Sectional Area:	4.1
Bankfull Width:	7.0
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.6
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type: C/E

