FINAL REPORT

Dupont State Forest Lake Julia Outfall Stream Restoration

Submitted by:

Biological and Agricultural Engineering Department
North Carolina State University
Raleigh, North Carolina

Submitted to:

North Carolina Department of Environment and Natural Resources
Division of Forest Resources
Raleigh, North Carolina

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Introduction

Faculty, staff, and students associated with the North Carolina State University (NCSU) Department of Biological and Agricultural Engineering worked with the North Carolina Division of Forest Resources (DFR) to complete a stream restoration demonstration and education project on Reasonover Creek at Dupont State Forest in Transylvania County, North Carolina. Approximately 600 linear feet of unstable stream was restored, immediately downstream of Lake Julia. Project work included: engineering design; permitting; construction; construction administration and observation; and education and training. Primary benefits of this project include improved water quality, stabilization of a slumping embankment adjacent to the stream, and aquatic habitat enhancement in a designated trout stream.

Background

Natural stream functions in many areas of North Carolina are threatened by historical and ongoing alterations in watershed hydrology and land use, resulting in unstable streams with poor habitat and water quality. Causes of degradation include channelization, sediment inundation, stormwater runoff, road crossings, and loss of riparian vegetation. These degraded functions are made worse from the results of severe floods that have occurred in western North Carolina over the previous decade. Prior to becoming part of Dupont State Forest, the Little River watershed, including Reasonover Creek, experienced impacts from floods, logging, agriculture, impoundments, and road construction. Reasonover Creek immediately downstream of Lake Julia was unstable with severe bank erosion and excessive in-stream sediment, resulting in poor habitat for fish and aquatic invertebrates (Figure 1). Based on a field evaluation of bank erodibility, it was estimated that the streambanks in this area are contributing 600 to 1000 tons of sediment per year directly to the stream.

Figure 1. Reasonover Creek prior to restoration.

Stream restoration can be defined as the application of engineering, geologic, and biological principles to improve hydrological and biological functions of the stream corridor. Components of a successful stream restoration project may include:

1. adjusting the stream channel size and shape;
2. establishing a hydrological connection between the channel and floodplain;
3. adding in-stream structures for stability and habitat enhancement;
4. stabilizing streambanks by regrading and/or establishing native vegetation; and
5. establishing a forested riparian corridor.

The natural channel design approach makes use of reference stream morphology and biology information to devise a comprehensive project aimed at restoring and maintaining natural stream functions over the long term. The purpose of this project was to design and implement a natural channel design project to achieve the highest water quality and habitat potential for Reasonover Creek, while providing opportunities for ongoing education, training, and research.

Project Summary

Approximately 600 linear feet of degraded stream in Reasonover Creek were restored using natural stream channel design and construction techniques, including channel realignment, floodplain grading, in-stream boulder and log structures, and planting native riparian vegetation. Project design and permitting occurred in 2009 and 2010, with construction by North State Environmental, Inc. during April and May 2011. The results of an as-built survey, conducted in August 2011, are attached. Specific project components included:

Channel relocation

Approximately 300 feet of channel was relocated away from an eroding hillslope. A new channel was constructed in the dry, gravel and cobble bed material was transferred from the old channel, then flow was turned into the new channel (Figure 2).

Figure 2. Relocated stream channel.

Floodplain grading and planting

A wide floodplain was constructed through the project, approximately three feet above the streambed. Seed, straw, and matting were applied to the streambanks and floodplain. Live stakes and transplants were installed immediately after construction. Planting of native riparian trees will be conducted by DFR during the next dormant season.

Boulder cross vanes

Two boulder cross vanes were constructed in the channel to provide grade control, direct flow into the new channel alignment, and enhance habitat (Figure 3).

Figure 3. Boulder cross-vanes.

Log j-hook vanes

Three log j-hook vanes were installed in the stream channel. These vanes help to turn flow while providing grade control and maintaining scour pools (Figure 4).

Figure 4. Log j-hook vanes.

Constructed riffles

Several riffles were constructed throughout the project. Construction of these riffles involved over-excavating the streambed by approximately two feet, then backfilling with mixed gravels, cobbles, boulders, and wood.

Brush toes

Brush toes were installed in the streambank at several locations, particularly at scour pools downstream of boulder and log structures (Figure 5). These involved layers of logs and brush under the water surface and live cuttings above the water surface. The top of the brush toe was seeded, matted, and covered with transplants.

Figure 5. Brush toes.

These restoration techniques have been demonstrated using workshops and "hands-on" education and training. During construction, a workshop was held at the site for 30 engineers, contractors, and regulators. Since project completion, three tours have been conducted for 80 resource management professionals. Additional site tours and the placement of interpretive signs for recreational visitors are both anticipated. The site now serves as a demonstration, education, and research project to demonstrate best management practices (BMPs) for restoring natural stream functions in watersheds that suffer from excessive nonpoint source pollution, especially sedimentation.

Project Deliverables

NCSU has completed the following deliverables associated with this project:

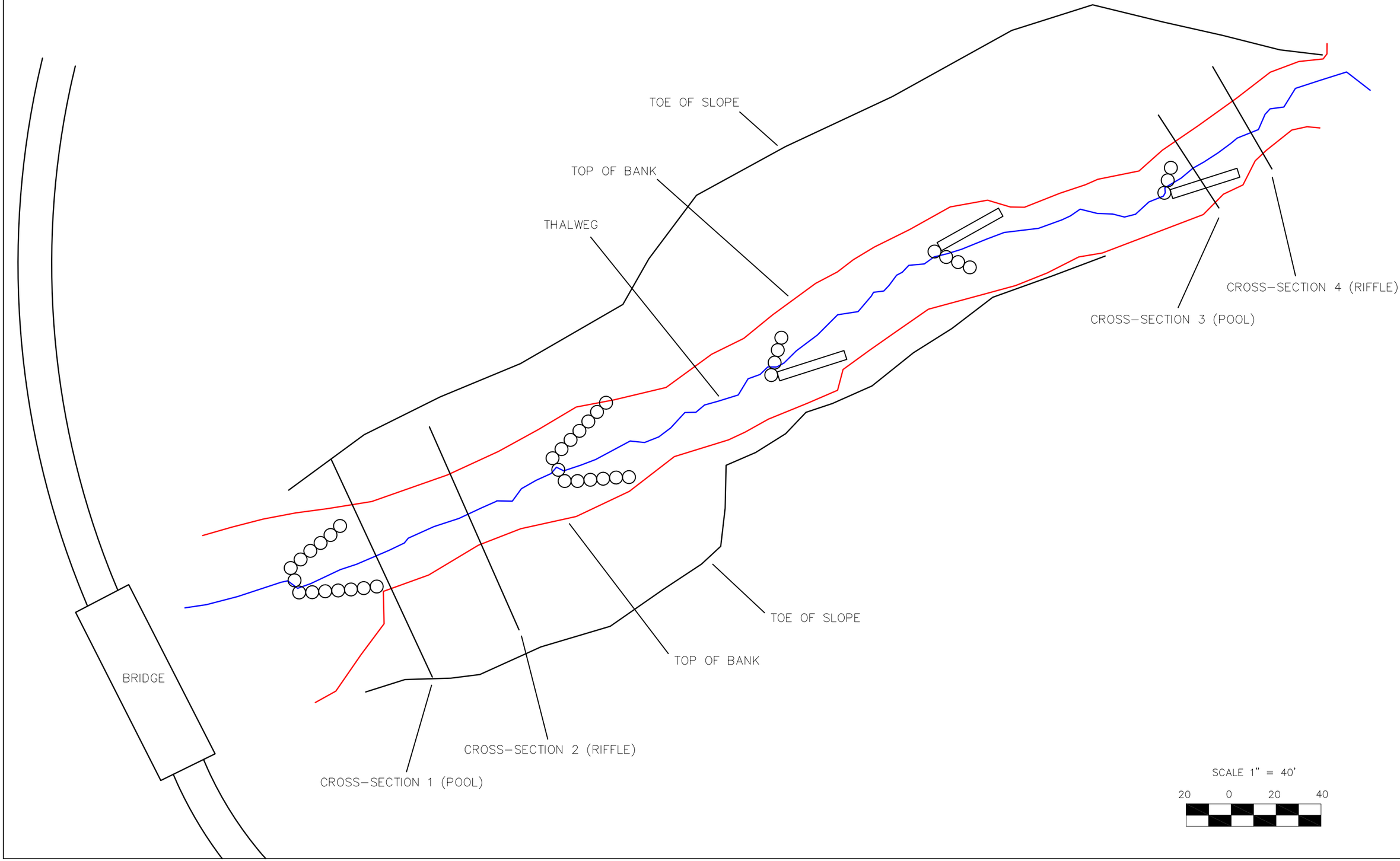
1. NCSU produced engineering plans and assisted in the preparation of permitting documents for restoring approximately 600 linear feet of degraded stream using natural channel design techniques.

2. NCSU implemented and conducted stream restoration, including oversight of site grading, channel/floodplain construction, in-stream structure installation, and riparian vegetation planting. This included necessary restoration-related follow-up repair or improvement work as identified by DFR or NCSU staff.

3. NCSU conducted at least two education/training programs to demonstrate stream restoration techniques, including a workshop during project implementation for teaching best stream construction technologies to environmental professionals and contractors.

4. NCSU submitted quarterly reports and invoices, and a final report with invoice documenting results of this project.

5. NCSU completed the above deliverables consistent with the terms and conditions identified in the funding contract including, but not limited to, abiding by all applicable regulatory (permitting, recordkeeping, reporting, and compliance specific conditions) requirements.



SCALE 1" = 40'

20 0 20 40

NO	DESCRIPTION	DRN	CHK	DATE
1	AS-BUILT	JMZ		08/17/11

REVISIONS

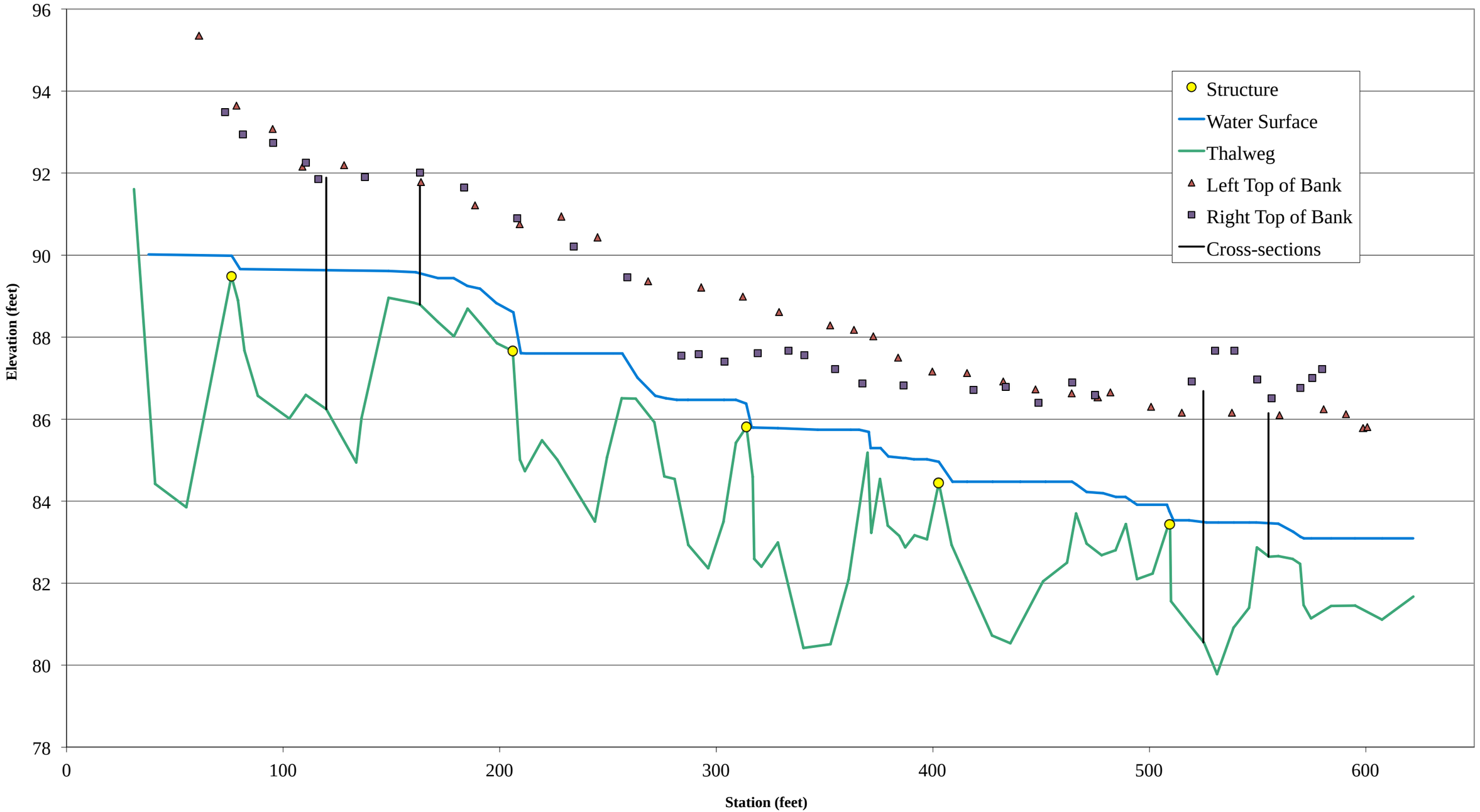
BIOLOGICAL & AGRICULTURAL ENGINEERING
Weaver Labs Campus Box 7625
North Carolina State University
Raleigh, NC 27695

OUTFALL TO LAKE JULIA STREAM RESTORATION
DUPONT STATE FOREST
TRANSYLVANIA COUNTY, N.C.

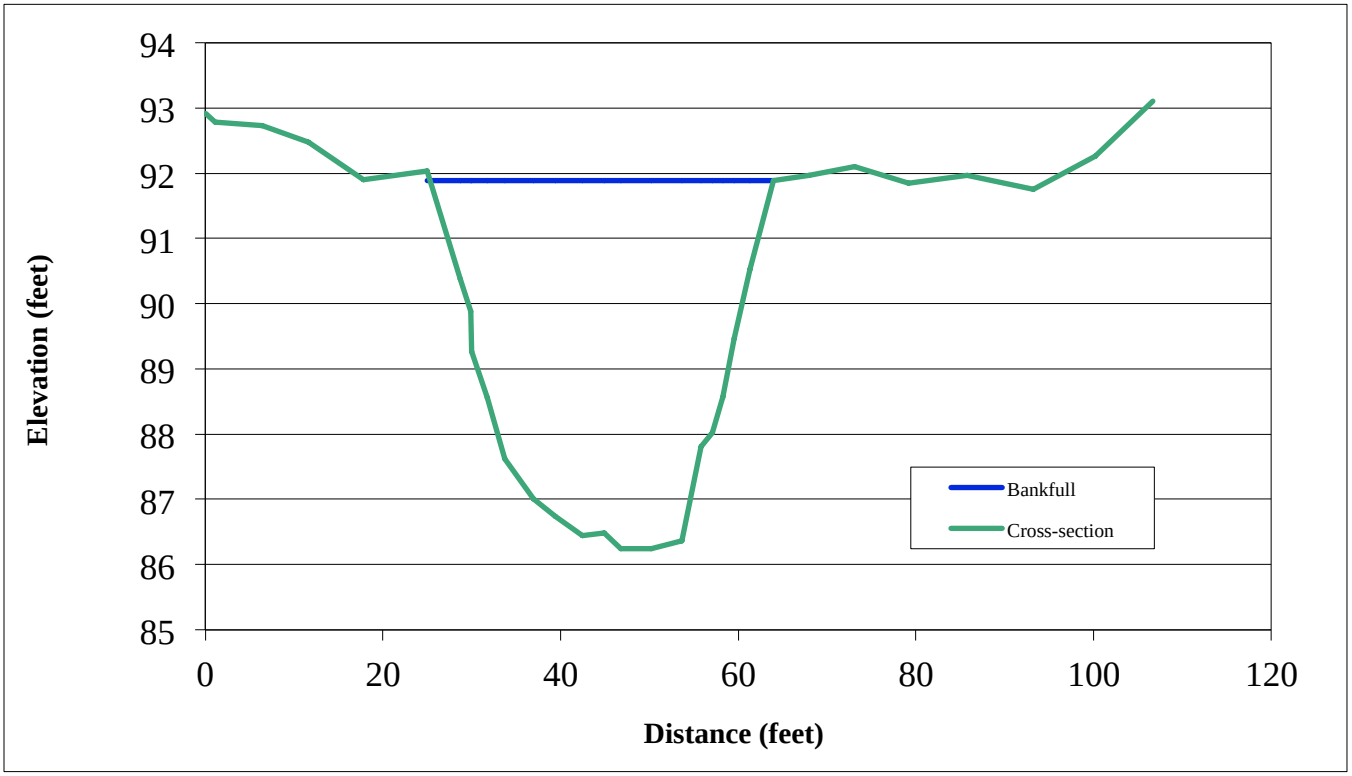
AS-BUILT CONDITIONS PLAN SHEET

DATE 08/17/2011
PROJECT NO.
FILENAME DUPONT.DWG
SHEET NO. PL - 1
DRAWING NO.

Outfall to Lake Julia Stream Restoration
As-built Conditions
Longitudinal Profile



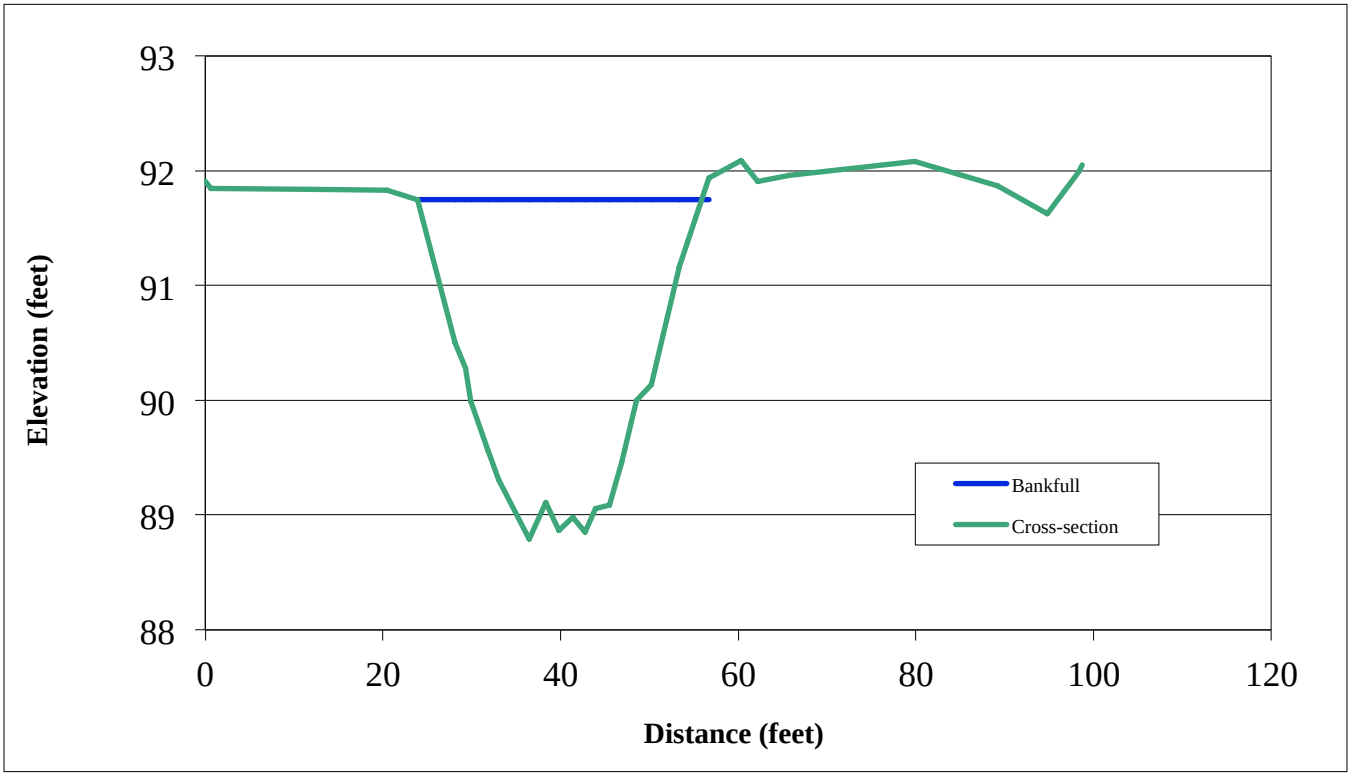
Outfall to Lake Julia Stream Restoration
As-built Conditions
Cross-section 1 (Pool; STA 1+20)



Cross-section Dimensions

	2011	
Area =	151.7	square feet
Width =	38.7	feet
Mean depth =	3.9	feet
Max depth =	5.7	feet

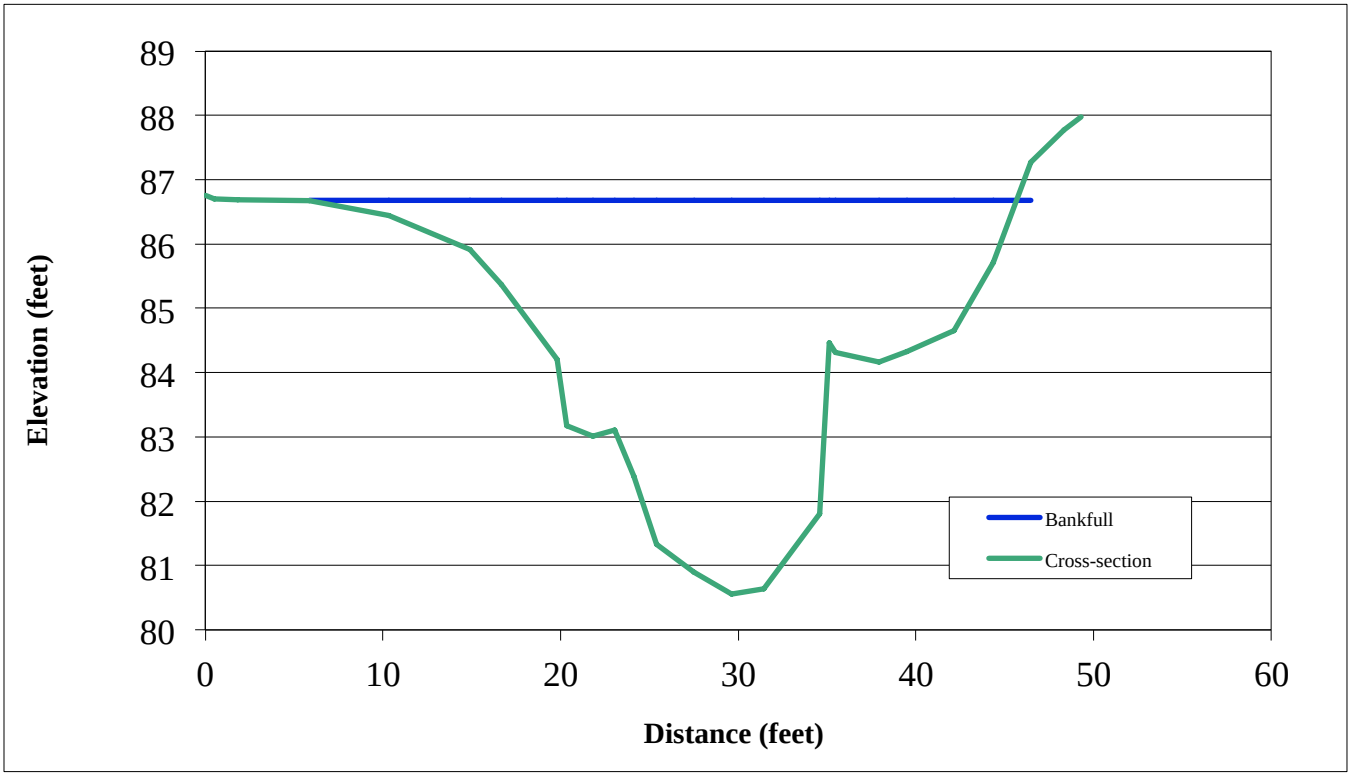
Outfall to Lake Julia Stream Restoration
As-built Conditions
Cross-section 2 (Riffle; STA 1+63)



Cross-section Dimensions

	2011	
Area =	60.0	square feet
Width =	32.0	feet
Mean depth =	1.9	feet
Max depth =	3.0	feet
W/D ratio =	17.1	

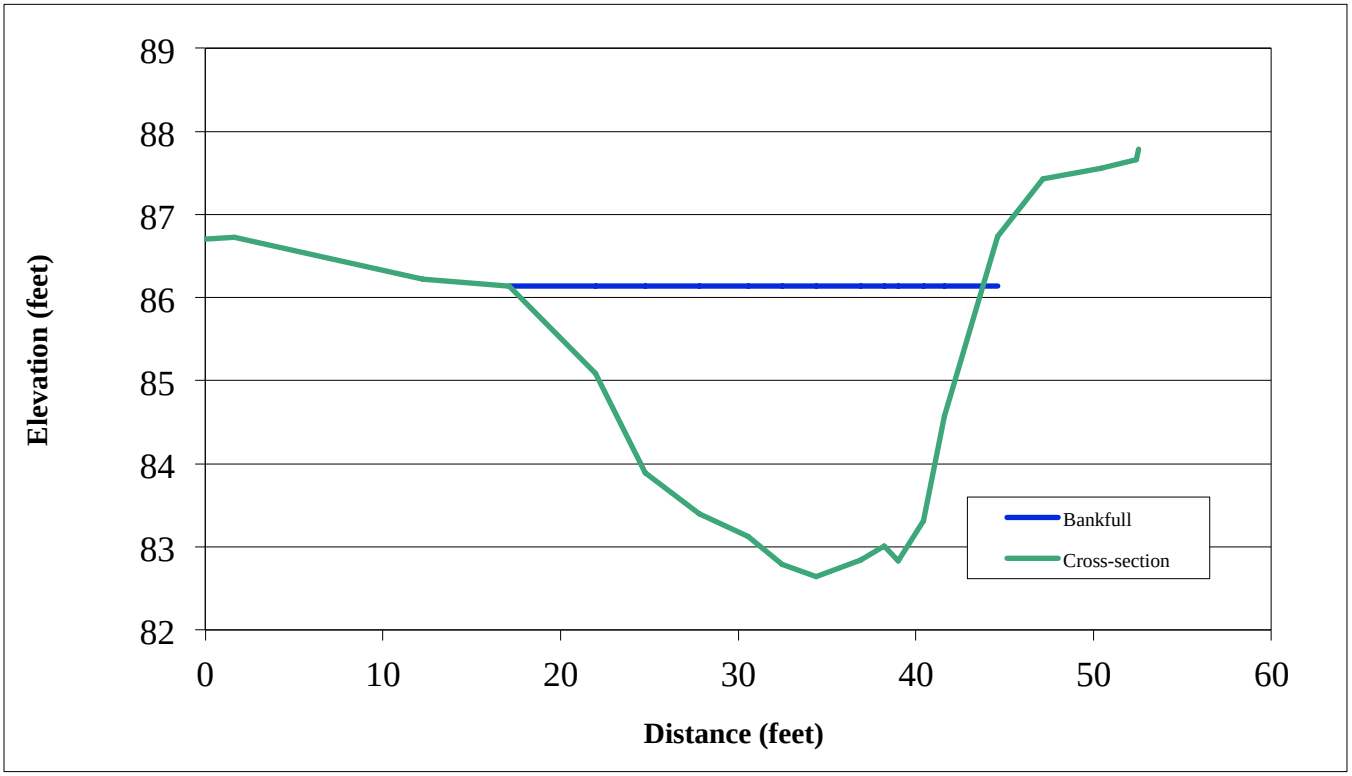
Outfall to Lake Julia Stream Restoration
As-built Conditions
Cross-section 3 (Pool; STA 5+25)



Cross-section Dimensions

	2011	
Area =	107.1	square feet
Width =	39.8	feet
Mean depth =	2.7	feet
Max depth =	6.1	feet

Outfall to Lake Julia Stream Restoration
As-built Conditions
Cross-section 4 (Riffle; STA 5+55)



Cross-section Dimensions

	2011	
Area =	59.3	square feet
Width =	26.7	feet
Mean depth =	2.2	feet
Max depth =	3.5	feet
W/D ratio =	12.0	