YEAR 2 MONITORING REPORT

UT ROCKY RIVER – HARRIS ROAD MIDDLE

Cabarrus County, North Carolina
EEP IMS No. 92383, Contract No. 004346

Submitted to:

NCDENR-Ecosystem Enhancement Program
217 West Jones Street, Suite 3000A
Raleigh, North Carolina 27603

Construction Completed: August 2010
Morphology Data Collected: March 21, 2013
Vegetation Data Collected: September 24, 2013
Submitted: November 6, 2013

Prepared by:

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I HEREBY CERTIFY THAT THE DOCUMENTS CONTAINED HEREIN, UT ROCKY RIVER-HARRIS ROAD MIDDLE YEAR 2 MONITORING REPORT WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNED SEALED, AND DATED THIS _____ DAY OF _____ 2013.

_____

Chris L. Smith, PE

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1.0 EXECUTIVE SUMMARY

The following report summarizes the vegetation establishment and stream stability for Year 2 monitoring for the UT Rocky River–Harris Road Middle Site (hereafter referred to as the "Site") in Cabarrus County, North Carolina.

1.1 Goals and Objectives

The primary goals of the UT Rocky River stream restoration project focus on:

- Improving water quality
- Enhancing aquatic and terrestrial habitat within the Site watershed
- Establishing wildlife corridors within the Site boundaries
- Enhancing riparian wetlands adjacent to UT Rocky River
- Providing educational opportunities for students at grade schools adjacent to the Site

These goals will be achieved through the following objectives:

- Stabilizing UT Rocky River by restoring a more natural pattern, profile, and dimension that transports its sediment and flow without aggrading (as seen in areas affected by beavers and erosion control devices), or degrading (as seen in gully reaches on-site).
- Establishing a natural vegetative buffer adjacent to the UT Rocky River that filters runoff from adjacent development.
- Enhancing semi-aquatic habitat by enhancing existing wetlands with native tree and shrub plantings.
- Enhancing stream bed variability, providing shading/cover areas within the stream channel, and introducing woody debris in the form of rootwads, log vanes, and log sills.
- Removing existing invasive vegetative species and planting the buffer (floodplain) with native trees, shrubs, herbs and grasses.
- Create a wildlife corridor through the Site that connects habitat areas along the Rocky River with habitat areas at the upstream end of the Site. The corridors provide connectivity to a diversity of habitats including mature forest, early successional forest, stream-side forest, riparian wetlands, and uplands.
- Providing an educational benefit to children who can utilize the planned pedestrian footpath crossing the floodplain, and can view the stream channel from adjacent terraces where schools are located.

1.2 Background Summary

The North Carolina Ecosystem Enhancement Program (EEP) has completed restoration of 2,715 linear feet of stream and enhanced 8.7 acres of riparian wetland at the Site to assist in fulfilling stream and wetland mitigation goals in the area. The Site is located in northwest Cabarrus County approximately 6 miles southwest of the town of Kannapolis (Figure 1). The Site has a latitude and longitude of 035º 25' 34.52" N and 080º 44' 25.53'' W. The Site is situated in the northeast quadrant of the intersection of Harris Road and the Rocky River, between Harris Middle School and Odell Elementary School, approximately 1.5 miles south of Highway 73.

The Site is located within United States Geological Survey (USGS) Hydrologic Unit (HU) and Targeted Local Watershed 03040105010010 (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-07-11) of the Yadkin-Pee Dee River Basin, and will service the USGS 8-digit Cataloging Unit (CU) 03040105. The Site is currently owned by Cabarrus County and the State of North Carolina holds the conservation easement on the property.

1.3 Vegetation

Bare root and live stake plantings are surviving well across the Site with an average of 364 planted stems per acre surviving after Year 2. Plots 1, 2, 3, 5, 6, 11, 12, 13 and 14 of 14 vegetation plots are exceeding success criteria of at least 320 stems per acre. All of the plots contain 242 or greater stems per acre surviving after Year 2. Plot 4, 9 and 10 have greater than 360 stems per acre when including natural recruits. Plot 7 was affected by a beaver dam that was located immediately adjacent to the plot during Year 1 monitoring; however, the dam has been removed. APHIS was previously contracted to conduct monthly inspections at the Site to ensure beaver are controlled throughout the monitoring phase of the project. Due to lack of recent activity and cost, APHIS site inspections for beaver activity are now quarterly.

Plot 8 is located on a terrace slope along the southern boundary of the Site. This area appears to be drier than other areas at the Site, which may be contributing to the poor survival of planted stems in Plot 8. Approximately half of Plot 10 is also located along a terrace side slope and appears somewhat drier than other areas. Encroachment has occurred within Plot 10. It appears mowers have entered the easement/plot and taken out a vegetation plot stake. Additional plantings are not recommended at this time because natural recruitment of character tree species is anticipated over the course of the monitoring period and the areas exhibiting poor survivability are relatively small.

A small cluster of Sericea lespedeza (*Lespedeza cuneata*) was observed within Plot 9. Plot 9 is located near Moss Farm Street and a sewer easement that crosses UT Rocky River at the beginning of the project making this area susceptible to encroachment of invasive species. Plot 9 is currently not exceeding success criteria goals with 283 planted stems per acre surviving after Year 2; however, the stem count is 567 with natural recruits. EEP does not typically treat lespedeza during invasive species treatments; however, if the population continues to have a detrimental effect on the plot and surrounding area in monitoring Year 3, EEP will reassess.

1.4 Stream Stability

UT Rocky River appears to be stable and functioning as designed. The area formerly affected by the beaver dam is recovering. There is no evidence of trends toward significant change in channel dimension or pattern. Approximately 140 feet of the profile (Station 11+78 – 13+18) around Cross Section 1 show evidence of minor deposition most likely due to a slightly lower slope. Cross-sectional data indicates that the channel has experienced little change in dimension, with the exception of Cross Section 6. Cross Section 6 has continued to deepen in comparison with baseline and Year 1 conditions, resulting in a larger cross sectional area and smaller width to depth ratio. Scour at Cross Section 6 is likely a result of increased shear stress caused by the

beaver dam formerly located approximately 50 feet upstream. The beaver dam raised the water surface elevation above bankfull and increased the average water surface slope through this section. Profile data also depicts scour in the channel bed downstream of the beaver dam. Cross Section 6 appears to currently function as a pool in the system and will likely continue to function as a pool in the future.

Profile plots depict minimal shifting and deepening of pools throughout the reach. Some shifting is expected in sand bed channels, where the bed form is in constant flux and pools adjust their depths during most storm events. Sediment deposited immediately upstream of the beaver dam is flushing out now that the beaver dam has been removed. The percentage of riffles and pools throughout the reach has continued to change slightly from baseline conditions. Year 2 data depicts riffles to account for 28 percent (compared to 38 and 43 percent at Year 1 and baseline respectively) and pools to account for 72 percent (compared to 62 and 57 percent at Year 1 and baseline respectively). The backwater effect upstream of the beaver dam and the scour downstream of the beaver dam are the primary reasons for the change in riffle/pool percentages in Year 1. The channel is beginning to show some signs of reforming a riffle and pool sequence upstream of the old beaver dam; however, the Year 2 survey was taken within a month from the beaver dam removal and more time is needed to allow the channel to recover. The riffle sections affected by backwater from the beaver dam are expected to regain function once the stream has had time to recover from the beaver dam. The section downstream of the beaver dam is designed to function as a step-pool system to step the invert of UT Rocky River down to the invert of Rocky River. During Year 1 and 2, the pools between the log steps have enlarged, but the stream remains stable and is performing as intended. All structures are stable and maintaining grade control except the structure at station 35+80 which is showing erosion along the right arm.

Table 5, Visual Stream Morphology Stability Assessment, details 97 percent of the stream bed as stable, performing as intended for Year 2 Monitoring. One minor headcut was noted at station 14+20 (Figure 3.16). Nine areas along the bank are experiencing erosion and are depicted on the Current Conditions Plan View (CCPV) located in Appendix B. Photos of each problem area are also included in Appendix B.

Approximately 40 feet of the right bank near station 14+50 has stabilized since the vertical bank was observed during Year 1 Monitoring. The right bank at station 14+90 has little to no vegetation (Figure 3.17).

Approximately 20 feet of the left bank near station 20+90 has scoured allowing higher flows to migrate into the floodplain (Figure 3.18). The erosion occurs just upstream of a log sill, but the stream has not fully migrated around the log sill at this time. Woody and herbaceous vegetation in the floodplain is slowing the progression of erosion. This area will be watched closely and if the stream continues to migrate around the log sill corrective actions will be recommended to repair the area. The log sill at 20+90 appears to be piping at low flow but is still holding grade. Immediately downstream of the log sill near station 20+90, the right bank has scoured for approximately 15 feet (Figure 3.19). A rootwad was placed in this bank to stabilize the log sill

and it appears that the erosion has occurred along the trunk of the rootwad. Due to the relatively small size of this eroded area and the stability of the bank behind the rootwad, corrective actions are not recommended at this time.

The double step log cross vane at 22+30 has eroded on the right bank of the structure and is piping around the side of the header log (Figure 3.20). Corrective actions are not recommended at this time.

The beaver dam observed near station 33+30 during Year 1 monitoring was removed during January and February of 2013. Backwater from the beaver dam was observed as far upstream as station 30+00. The beaver dam has not had a significant impact on the stability of the stream (Figure 3.21). EEP had previously contracted APHIS to conduct monthly inspections to prevent re-colonization through the monitoring period. Due to the lack of recent activity and cost, APHIS site inspections for beaver activity are now quarterly on the site.

Minor bank erosion has occurred at station 34+25 near vegetation plot 13 (Figure 3.22). Major bank erosion has been noted around the meander bend at station 35+80 upstream of the log cross vane's right arm (Figure 3.24). This area will be watched closely. EEP plans to plant additional live stakes in these areas during the upcoming dormant season.

The site has experienced several bankfull flows throughout the first and second monitoring years. Crest gauges installed on-site were inspected on March 8, 2012; October 4, 2012; March 20, 2013 and September 24, 2013. The crest gauges revealed that a bankfull event occurred at least four times during Year 1 and 2 monitoring. (Table 13). Additional overbank evidence includes debris lines and vegetation bent in the downstream direction. Evidence of bankfull events can be found in Appendix E.

1.5 Wetlands

Existing wetlands at the Site were enhanced by removing exotic vegetation and planting native species. All vegetation plots located within wetland areas are exceeding success criteria, with the exception of Plot 7 which was affected by the beaver dam during Year 1 monitoring and Plot 9 which is affected by the dominance of lespedeza in the upland portion of the plot. Section 1.3 provides more details concerning vegetation at the Site.

1.6 Note

A vehicular path was noted within the easement break around station 20+00 during vegetation monitoring field work in August, 2013. EEP was immediately notified of the field observation.

Summary information/data related to the occurrence of items and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the

Mitigation Plan (formerly the Restoration Plan) documents available on EEP's website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

2.0 METHODOLOGY

The Year 1 and 2 monitoring surveys were completed using a Total Station. Each cross section was marked with two rebar monuments at their beginning and ending points. The rebar has been located vertically and horizontally in NAD 83-State Plane. Surveying these monuments throughout the Site ensured proper orientation. The survey data was imported into MicroStation for verification. The longitudinal stationing was developed from total station data and compared with previous years' data to ensure consistent beginning and ending points. RIVERMorph and the Ohio Department of Natural Resources' "The Reference Reach Spreadsheet Version 4.3L" were used to analyze the profile and cross section data (Mecklenburg 2006). Tables and figures were created using Microsoft Excel.

The channel is entirely a sand bed system; therefore, a pebble count was not conducted.

Vegetation monitoring was completed using CVS level II methods, for 14, 100 square meter vegetation plots (Lee et al. 2006). The taxonomic standard for vegetation used for this document was Flora of the Southern and Mid-Atlantic States (Weakley 2011).

3.0 REFERENCES

Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (http://cvs.bio.unc.edu/methods.htm).

Mecklenburg, Dan. 2006. The Reference Reach Spreadsheet Version 4.3L. 2006. Ohio Department of Natural Resources. Division of Soil and Water. (http://www.dnr.state.oh.us/tabid/9188/default.aspx)

Weakley, Alan S. 2011. Flora of the Southern and Mid-Atlantic States (online). Available: http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2011-May-nav.pdf [May 15, 2011]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

APPENDICES

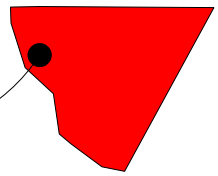
Appendix A. Project Vicinity Map and Background Tables

Vicinity Map

UT Rocky River –Harris Road Middle Baseline Monitoring Document
Cabarrus County, North Carolina

Cabarrus County
North Carolina

PROJECT AREA



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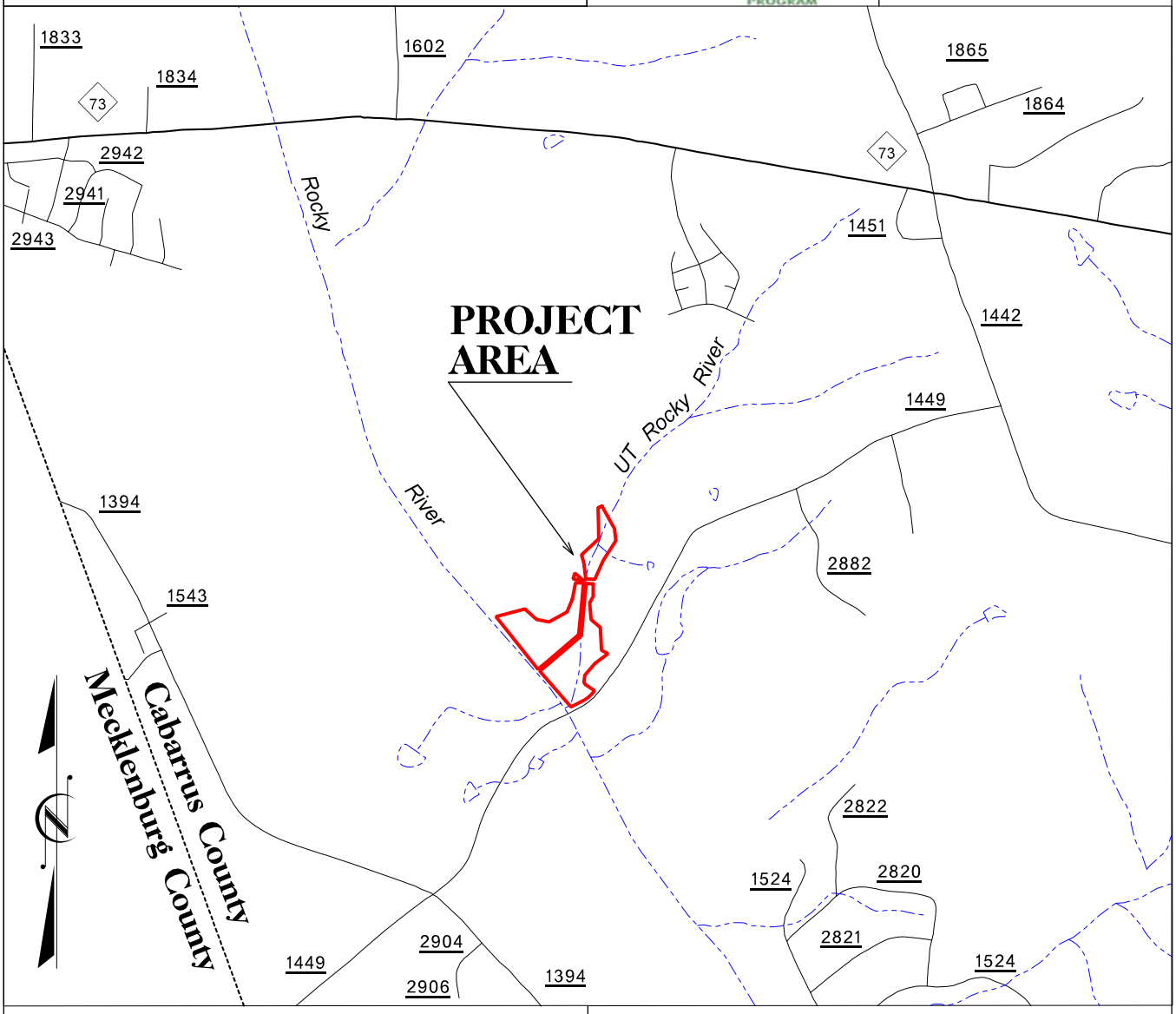
Ecosystem Enhancement Program

Date: 10/03/13

Figure: 1

0 1000 2000
FEET



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

Table 1. Project Components and Mitigation Credits

UT Rocky River – Harris Road Middle (EEP IMS No. 92383)

Mitigation Credits		
	Stream*	**Riparian Wetland****
Type	R	R
Total	2,615	4.1

Project Components						
Restoration Segment/ Reach ID	**Station Range**	**Existing LF/AC**	**Approach**	**Restoration or Restoration Equivalent**	**Restored LF/AC**	**Mitigation Ratio**
UT to Rocky River	10+00 – 34+50	2,020	PI	R	2,450	1:1
UT to Rocky River	34+50 – 37+15	330	PII	R	265	1:1
Wetland	-	8.7	Invasive Removal & Planting	R	8.2	2:1

Component Summation		
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)
		Riverine
Restoration	2,715	
Enhancement		8.2

*Stream credits are less than the linear feet restored because 100 feet of the restored stream flows through sewer line easements and was not included as part of the stream credit calculations.
**Wetlands located within the sewer line easements were not planted during the construction phase of this project and are not included as part of the enhanced wetland acreage or Wetland Mitigation Credits

Table 2. Project Activity and Reporting History

UT Rocky River – Harris Road Middle (EEP IMS No. 92383)

Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	April 2008	September 2008
Final Design – Construction Plans	September 2008	October 2008
Construction	June 11, 2010	March 23, 2011
Temporary S&E Mix Applied to Entire Project Area	August 30, 2010	March 23, 2011
Permanent Seed Mix Applied to Entire Project Area	August 30, 2010	March 23, 2011
Bare Root, Containerized, and B&B plantings for Entire Project Area	February 14, 2011	February 15, 2011
Mitigation Plan/As-built (Year 0 Monitoring-Baseline)	April 11, 2012	June 27, 2012
Year 1 Monitoring	October 4, 2012	January 3, 2013
Beaver removal	January/February 2013	January/February 2013
Year 2 Monitoring	September 24, 2013	November 6, 2013
Structural maintenance (bench expansion, vane, etc.)		
Year 3 Monitoring		
Supplemental planting of containerized material		
Year 4 Monitoring		

Table 3. Project Contacts Table

UT Rocky River – Harris Road Middle (EEP IMS No. 92383)

Designer Primary project design POC	Florence & Hutcheson 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Kevin Williams (919) 851-6066
Construction Contractor Construction Contractor POC	Vaughn Contracting, Inc. Tommy Vaughn P.O. Box 796 Wadesboro, NC 28170 (704) 694-6450
Planting Contractor Planting Contractor POC	Bruton Natural Systems Charlie Bruton PO Box 1197 Fremont, NC 27830 (919) 242-6555
Seeding Contractor Seeding Contractor POC	Vaughn Contracting, Inc. Tommy Vaughn P.O. Box 796 Wadesboro, NC 28170 (704) 694-6450
Seed Mix Sources	Green Resources – Triad Office
Nursery Stock Suppliers	1) ArborGen - South Carolina SuperTree Nursery 2) Dykes & Son Nursery 3) NC Division of Forest Resources 4) Carolina Wetland Services
Monitoring Performers	ICA Engineering f/k/a Florence & Hutcheson 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066
Stream Monitoring POC	ICA Engineering f/k/a Florence & Hutcheson 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066
Vegetation Monitoring POC	ICA Engineering f/k/a Florence & Hutcheson 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066

Table 4. Project Information

UT Rocky River – Harris Road Middle (EEP IMS No. 92383)

Project Information	
Project Name	UT Rocky River – Harris Road Middle
Project County	Cabarrus
Project Area (acres)	20
Project Coordinates	35º 25’ 34.52” N, 80º 44’ 25.53’’ W
Project Watershed Summary Information	
Physiographic Region	Southern Piedmont
Ecoregion	Southern Outer Piedmont
Project River Basin	Yadkin-Pee Dee
USGS 8-digit HUC	03040105
USGS 14-digit HUC	03040105010010
NCDWQ Subbasin	03-07-11
Project Drainage Area	0.77 sq. mi (at end of restoration reach)
Watershed Land Use	Forested = 15% Residential/Commerical = 85%
Reach Summary Information	
Parameters	**UT Rocky River**
Restored length	2,715
Drainage Area	0.77 sq. mi.
NCDWQ Index Number	14-(7)
NCDWQ Classification	C
Valley Type/Morphological Description	VIII/C5
Dominant Soil Series	Chewacla
Drainage Class	Somewhat poorly drained
Soil Hydric Status	Hydric
Slope	0.0060
FEMA Classification	AE & X
Native Vegetation Community	Piedmont Alluvial Forest
Percent Composition of Exotic Invasives	0.1%
Wetland Summary Information	
Parameters	**Wetland 1**
Size of Wetland (acres)	8.2
Wetland Type	Riparian Riverine
Mapped Soil Series	Chewacla
Drainage Class	Somewhat poorly drained
Soil Hydric Status	Hydric
Source of Hyrdrology	Groundwater and Floodwater
Hydrologic Impairment	No
Native Vegetation Community	Piedmont Alluvial Forest
Percent Composition of Exotic Invasive Veg.	0%

Table 4. Project Information (continued)

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the U.S. –Sections 404 and 401	Yes	Yes	Restoration Plan
Endangered Species Act	Yes	Yes	Restoration Plan
Historic Preservation Act	Yes	Yes	Restoration Plan
CZMA/CAMA	No	--	--
FEMA Floodplain Compliance	Yes	Yes	Restoration Plan
Essential Fisheries Habitat	No	--	--

Appendix B. Visual Assessment Data

09/08/99

CONTRACT: UT ROCKY RIVER – HARRIS ROAD MIDDLE SCO# 07070800I

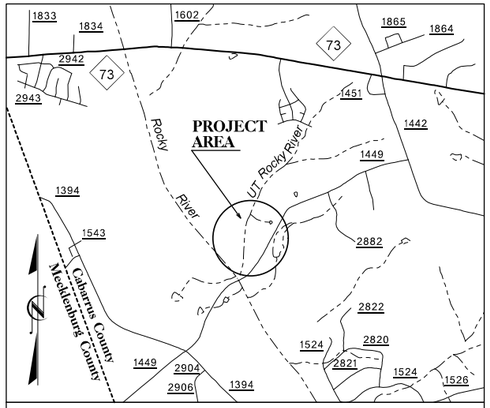
STATE		FIGURE NO.
N.C.	UT ROCKY RIVER – HARRIS ROAD MIDDLE	2.0

CURRENT CONDITIONS PLAN VIEW (CCPV)
UT ROCKY RIVER – HARRIS ROAD MIDDLE

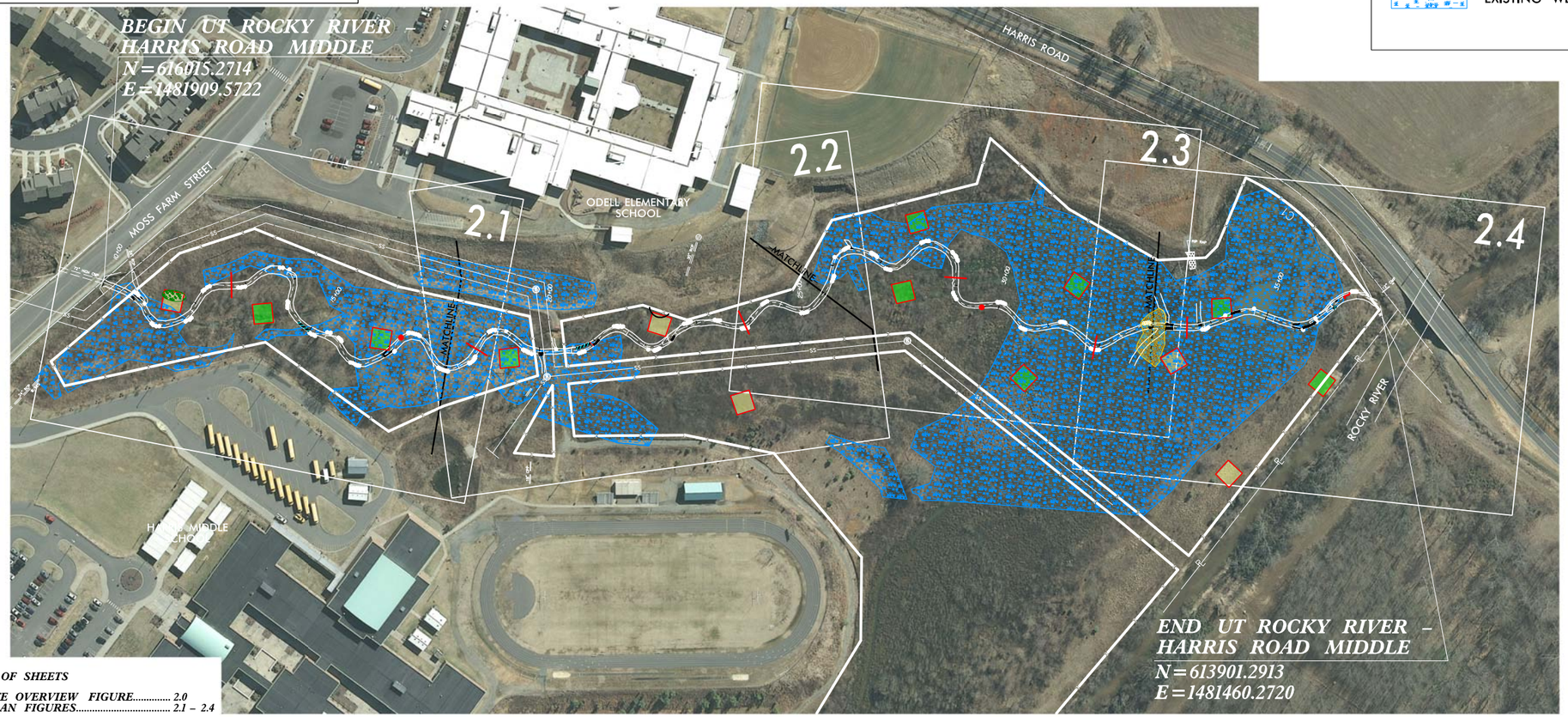
LOCATION: CABARRUS COUNTY, NORTH CAROLINA

LAT: 35°25'34.52" N LONG: 80°44'25.53" W

TYPE OF WORK: CURRENT CONDITIONS PLAN VIEW



VICINITY MAP



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TITLE/SITE OVERVIEW FIGURE..... 2.0
CCPV PLAN FIGURES..... 2.1 – 2.4

LEGEND

- MONITORING CROSS SECTION
- CREST GAUGE
- EXISTING PROPERTY LINE
- EASEMENT BOUNDARY
- BANKFULL
- THALWEG
- TOE OF SLOPE
- FPI – FLOODPLAIN INTERCEPTOR
- EXISTING WETLANDS
- ROCK L-VANE
- ROCK CROSS VANE
- LOG VANE W/SILL
- LOG CROSS VANE
- DOUBLE STEP LOG CROSS VANE
- TRANSPLANTS
- LOG SILL

YEAR 2 CONDITIONS

BANK/BED CONDITION

- MAJOR EROSION
- MODERATE EROSION
- MINOR EROSION

IN-STREAM STRUCTURE CONDITION

- FAILED

VEGETATION PROBLEM AREAS

- INVASIVE POPULATION
- THIN GRASS

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

GRAPHIC SCALES

50 25 0 50 100
PLANS

10 5 0 10 20
PROFILE (HORIZONTAL)

20 10 0 20 40
PROFILE (VERTICAL)

DESIGN DATA

DESIGN STREAM TYPE	=	C5/E5
BANKFULL AREA (FT^2) CROSS-SECTIONED	=	9.0
BANKFULL WIDTH (FT)	=	9.5
MAX DEPTH (FT)	=	1.4
WIDTH /DEPTH RATIO	=	10
DRAINAGE AREA (MI^2)	=	0.8
BANKFULL SLOPE(FT/FT)	=	0.002

PROJECT LENGTH

EXISTING STREAM LENGTH	=	2,350 FT
PROPOSED DESIGN STREAM LENGTH	=	2,715 FT
WETLAND ENHANCEMENT AREA	=	8.20 AC.

Ecosystem Enhancement Program

OWNER CONTACT:

PAUL WIESNER
EEP PROJECT MANAGER

LIN XU
REVIEW COORDINATOR

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R. KEVIN WILLIAMS
PROJECT ENGINEER

RYAN V. SMITH
PROJECT DESIGNER

10/22/2013
R:\Stream\Proj\CCPV_Plans\RockyRiver_CCPV_psh_2.dgn
Florence & Hutcheson, Inc.

PROJECT REFERENCE NO.	FIGURE NO.
UT ROCKY RIVER – HARRIS ROAD MIDDLE	2.1

CURRENT CONDITIONS PLAN VIEW (CCPV)

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25 0 50
SCALE

LEGEND

- MONITORING CROSS SECTION
- CREST GAUGE
- EXISTING PROPERTY LINE
- EASEMENT BOUNDARY
- BANKFULL
- THALWEG
- TOE OF SLOPE
- EXISTING WETLANDS
- ROCK L-VANE
- ROCK CROSS VANE
- LOG VANE W/SILL
- LOG CROSS VANE
- DOUBLE STEP LOG CROSS VANE
- TRANSPLANTS
- LOG SILL
- FPI – FLOODPLAIN INTERCEPTOR

UT ROCKY RIVER – HARRIS ROAD MIDDLE
N = 616015.2714
E = 1481909.5722

CP–3
N = 616053.1140
E = 1481902.6200
ELEV = 633.910

10+00

15+00

24" RCP

72" HIGH CMP

MOSS FARM STREET

SMALL HEADCUT
STA 14+20

BASIN

CREST GAUGE 1

VEG 1

VEG 2

VEG 9

Flow Direction

HARRIS MIDDLE SCHOOL

–MATCHLINE– SEE FIGURE 2.2

YEAR 2 CONDITIONS

BANK/BED CONDITION
- MINOR EROSION

VEGETATION PROBLEM AREAS
- INVASIVE POPULATION

VEGETATION PLOT CONDITIONS
- CRITERIA MET
- CRITERIA UNMET

CP–4
N = 615583.8840
E = 1481538.7100
ELEV = 636.439

FOR SITE OVERVIEW SEE FIGURE 2.0
FOR CCPV PLANS SEE FIGURES 2.1 THRU 2.4

CCPV UT ROCKY RIVER – HARRIS ROAD MIDDLE	
SCO#: 070708001	COUNTY: CABARRUS
DESIGNED BY: RVS	
CHECKED BY: RKW	DATE: 0513

10/22/2013
P:\(22_Projects)\CCPV_Plans\RockyRiver_CCPV_psh_2.1.dgn
Florence & Hutcheson, Inc.

CURRENT CONDITIONS PLAN VIEW (CCPV)

PROJECT REFERENCE NO.	FIGURE NO.
UT ROCKY RIVER – HARRIS ROAD MIDDLE	2.2

ICA Engineering
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25 0 50
SCALE

–MATCHLINE– SEE FIGURE 2.1

–MATCHLINE– SEE FIGURE 2.3

APPROXIMATE LOCATION OF VEHICULAR CROSSING

PLOT CORNER STAKE IS MISSING ENCROACHMENT (MOWING)

20+00

25+00

30" RCP

VEG 3

VEG 10

VEG 4

XS-2

XS-1

LEGEND

- MONITORING CROSS SECTION
- CREST GAUGE
- EXISTING PROPERTY LINE
- EASEMENT BOUNDARY
- BANKFULL
- THALWEG
- TOE OF SLOPE
- FPI – FLOODPLAIN INTERCEPTOR
- EXISTING WETLANDS
- ROCK L–VANE
- ROCK CROSS VANE
- LOG VANE W/SILL
- LOG CROSS VANE
- DOUBLE STEP LOG CROSS VANE
- TRANSPLANTS
- LOG SILL

YEAR 2 CONDITIONS

BANK/BED CONDITION
- MAJOR EROSION
- MODERATE EROSION
- MINOR EROSION

IN–STREAM STRUCTURE CONDITION
- FAILED

VEGETATION PLOT CONDITIONS (PLANTED STEMS ONLY)
- CRITERIA MET
- CRITERIA UNMET

FOR SITE OVERVIEW SEE FIGURE 2.0
FOR CCPV PLANS SEE FIGURES 2.1 THRU 2.4

CCPV
UT ROCKY RIVER – HARRIS ROAD MIDDLE

SCO#: 070708001	COUNTY: CABARRUS
DESIGNED BY: RVS	
CHECKED BY: RKW	DATE: 05/13

10/22/2013
R:\Stream\Pro\CCPV_Plans\RockyRiver_CCPV_psh_2.2.dgn
Florence & Hutcheson, Inc.

CURRENT CONDITIONS PLAN VIEW (CCPV)

PROJECT REFERENCE NO.	FIGURE NO.
UT ROCKY RIVER – HARRIS ROAD MIDDLE	2.3

ICA Engineering
f/k/a Florence & Hutcheson, Inc.
5121 Kingdom Way, Suite 100
Raleigh, NC 27607
NC License No: F-0258

25 0 50
SCALE

LEGEND

- MONITORING CROSS SECTION
- CREST GAUGE
- EXISTING PROPERTY LINE
- EASEMENT BOUNDARY
- BANKFULL
- THALWEG
- TOE OF SLOPE
- FPI – FLOODPLAIN INTERCEPTOR
- EXISTING WETLANDS
- ROCK L-VANE
- ROCK CROSS VANE
- LOG VANE W/SILL
- LOG CROSS VANE
- DOUBLE STEP LOG CROSS VANE
- TRANSPLANTS
- LOG SILL

CP-5
N = 614891.8620
E = 1481797.3510
ELEV = 635.892

CP-6
N = 614257.9240
E = 1481738.0020
ELEV = 635.892

VEG 5
VEG 11
VEG 12
VEG 6
XS-4
CREST GAUGE 2
30+00
45+00

–MATCHLINE– SEE FIGURE 2.2

–MATCHLINE– SEE FIGURE 2.4

YEAR 2 CONDITIONS

BANK/BED CONDITION

- MODERATE EROSION

VEGETATION PROBLEM AREAS

- THIN GRASS

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

FOR SITE OVERVIEW SEE FIGURE 2.0
FOR CCPV PLANS SEE FIGURES 2.1 THRU 2.4

CCPV
UT ROCKY RIVER – HARRIS ROAD MIDDLE

SCO#:	070708001	COUNTY:	CABARRUS
DESIGNED BY:	RVS		
CHECKED BY:	RKW	DATE:	05/13

10/22/2013
H:\Projects\Proj\CCPV_Plans\RockyRiver_CCPV_psh_2.3.dgn
Florence & Hutcheson, Inc.

CURRENT CONDITIONS PLAN VIEW (CCPV)

PROJECT REFERENCE NO.	FIGURE NO.
UT ROCKY RIVER – HARRIS ROAD MIDDLE	2.4

ICA Engineering
f/k/a Florence & Hutcheson, Inc.
5121 Kingdom Way, Suite 100
Raleigh, NC 27607
NC License No: F-0258

25 0 50
SCALE

LEGEND

- MONITORING CROSS SECTION
- CREST GAUGE
- EXISTING PROPERTY LINE
- EASEMENT BOUNDARY
- BANKFULL
- THALWEG
- TOE OF SLOPE
- EXISTING WETLANDS
- FPI – FLOODPLAIN INTERCEPTOR
- ROCK L–VANE
- ROCK CROSS VANE
- LOG VANE W/SILL
- LOG CROSS VANE
- DOUBLE STEP LOG CROSS VANE
- TRANSPLANTS
- LOG SILL

YEAR 2 CONDITIONS

BANK/BED CONDITION

- MAJOR EROSION
- MODERATE EROSION
- MINOR EROSION

IN–STREAM STRUCTURE CONDITION

- FAILED

VEGETATION PROBLEM AREAS

- THIN GRASS

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

–MATCHLINE– SEE FIGURE 2.3

RIP RAP

35+00

VEG 13

VEG 7

VEG 14

VEG 8

Flow Direction

HARRIS ROAD

12" CMP

END UT ROCKY RIVER – HARRIS ROAD MIDDLE
N=613901.2913
E=1481460.2720

25' ACCESS, USE AND CONSTRUCTION EASEMENT
DB 3159 PG 65

FOR SITE OVERVIEW SEE FIGURE 2.0
FOR CCPV PLANS SEE FIGURES 2.1 THRU 2.4

CCPV UT ROCKY RIVER – HARRIS ROAD MIDDLE			
SCO#:	070708001	COUNTY:	CABARRUS
DESIGNED BY:	RVS		
CHECKED BY:	RKW	DATE:	0513

10/22/2013

Table 5 Visual Stream Morphology Stability Assessment
UT Rocky River - Harris Road Middle Stream Restoration Project, 92383
UT Rocky River - 2,715 feet assessed

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			1	27	99%			
	2. Riffle Condition*	1. Texture/Substrate - Riffle maintains coarser substrate	N/A	N/A			100%			
	3. Meander Pool Condition	1. Depth Sufficient	36	36			100%			
		2. Length appropriate	36	36			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	32	32			100%			
		2. Thalweg centering at downstream of meander (Glide)	32	32			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			9	148	97%	0	N/A	N/A
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT included undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	N/A	N/A	N/A
	3. Mass Wasting	Bank slumping, calving, or collaps			1	15	99.7%	N/A	N/A	N/A
				Totals	10	163	97%	N/A	N/A	N/A
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs	27	27			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	27	27			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	25	27			93%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	25	27			93%			
	4. Habitat	Pool forming structures maintaing ~ Max Pool Depth : Mean Bankfull Depth ratio > 1.6 Rootwads/logs providing some cover at base-flow.	27	27			100%			

*Stream is a sand bed system, riffles are not expected to coarsen

Table 6. Vegetation Condition Assessment
UT Rocky River-Harris Road Middle, 92383
UT Rocky River: 2,715 feet

Planted Acreage = 15.0

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited ground cover (grass).	All populations were mapped	Thin grass	1	0.08	0.53%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	Vegetation Plots	VEG 4, 7, 8, 9, 10	5.00	0.12	0.82%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	None	N/A	N/A	N/A	N/A

Easement Acreage = 67.85

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	All populations were mapped	See legend on CCPV	1	0.01	0.09%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	Noted on map	See note on CCPV	1	0.006	0.04%

Figures 3.1 - 3.23. Vegetation Plot Photos and Problem Areas

3.1 Vegetation Plot 1

3.2 Vegetation Plot 2

3.3 Vegetation Plot 3

3.4 Vegetation Plot 4

3.5 Vegetation Plot 5

3.6 Vegetation Plot 6

3.7 Vegetation Plot 7

3.8 Vegetation Plot 8

3.9 Vegetation Plot 9

3.10 Vegetation Plot 10

3.11 Vegetation Plot 11

3.12 Vegetation Plot 12

3.13 Vegetation Plot 13

3.14 Vegetation Plot 14

3.15 Lespedeza population near Vegetation Plot 9

3.16 Small headcut at Station 14+20 facing downstream

3.17 Minor bank erosion at Station 15+00 facing downstream

3.18 Minor bank erosion at Station 20+90 facing left bank

3.19 Erosion and piping at Station 20+90 facing downstream

3.20 Piping of structure at Station 22+30 facing downstream

3.21 Beaver damage Station 33+30 facing upstream

3.22 Moderate bank erosion at Station 34+25 facing downstream

3.23 Eroded bank Station 35+80 facing downstream

Appendix C. Vegetation Plot Data

Table 7. Vegetation Plot Mitigation Success Summary

UT Rocky River – Harris Road Middle (EEP IMS No. 92383)					
Plot ID	**Community Type**	**CVS Level**	**Planted Stems**	**Stems Per Acre**	**Survival Threshold Met?**
1	Piedmont Alluvial Forest (non-wetland area)	II	9	364	Yes
2	Piedmont Alluvial Forest (supplemental planting)	II	8	323	Yes
3	Piedmont Alluvial Forest (riverine wetland area)	II	11	445	Yes
4	Piedmont Alluvial Forest (non-wetland area)	II	7	283	No
5	Piedmont Alluvial Forest (riverine wetland area)	II	10	405	Yes
6	Piedmont Alluvial Forest (riverine wetland area)	II	11	445	Yes
7	Piedmont Alluvial Forest (riverine wetland area)	II	6	242	No
8	Piedmont Alluvial Forest (non-wetland area)	II	7	283	No
9	Piedmont Alluvial Forest (riverine wetland area & non-wetland area)	II	7	283	No
10	Piedmont Alluvial Forest (non-wetland area)	II	6	242	No
11	Piedmont Alluvial Forest (non-wetland area)	II	12	485	Yes
12	Piedmont Alluvial Forest (riverine wetland area)	II	9	364	Yes
13	Piedmont Alluvial Forest (riverine wetland area)	II	13	526	Yes
14	Piedmont Alluvial Forest (non-wetland area)	II	11	445	Yes
Average Stems Per Acre				364	

Table 8. CVS Vegetation Metadata

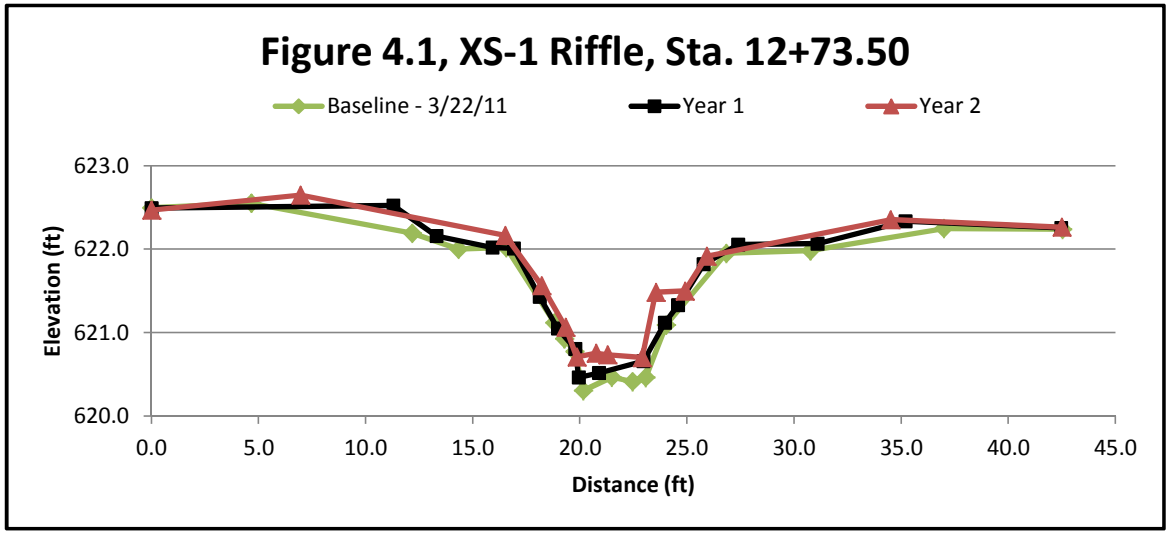
Report Prepared By	Ben Furr
Date Prepared	10/7/2013 15:27
database name	cvs-eep-entrytool-v2.2.7.mdb
database location	S:\ UT_Rocky_River\Docs\Monitoring\CVS Data
computer name	NC10465
file size	49401856
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	RR
project Name	UT Rocky River
Description	Stream and Wetland Restoration Project
River Basin	Yadkin-Pee Dee
length(ft)	2715
stream-to-edge width (ft)	50
area (sq m)	25220.62
Required Plots (calculated)	14
Sampled Plots	14

Table 9. Planted and Total Stem Counts (Species by Plot with Annual Means)																																			
UT Rocky River – Harris Road Middle (EEP IMS No. 92383) (Year 2 Monitoring 2013)																																Annual Means			
			Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Plot 8		Plot 9		Plot 10		Plot 11		Plot 12		Plot 13		Plot 14		YR2 (2013)		YR1 (2012)		AB (2011/2012	
Scientific Name	Common Name	Type	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T
Acer negundo	Boxelder	Tree		2																											0.0	2.0	0.0	0.0	0.0	0.0
Acer rubrum	Red maple	Tree		6																1											0.0	3.5	0.0	11.0	0.0	21.9
Alnus serrulata	Tag alder	Shrub																			1	3									1.0	3.0	1.0	1.0	1.0	1.0
Asimina triloba	Paw-paw	Shrub							1	1											1	1									1.0	1.0	1.7	1.7	2.0	2.0
Baccharis halimifolia	Eastern baccharis	Shrub				3														2		1									0.0	2.0	0.0	4.0	0.0	3.5
Betula nigra	River birch	Tree											1	1													2	2			1.5	1.5	1.5	1.5	1.5	1.5
Carya sp.	Hickory	Tree																													0.0	0.0	0.0	0.0	0.0	1.0
Carya ovata	Shagbark hickory	Tree							1	1							2	2													1.5	1.5	1.5	1.5	2.5	2.5
Celtis laevigata	Hackberry	Tree																									2	2			2.0	2.0	2.0	2.0	1.0	1.0
Cinnamomum	Cinnamomum	Tree		9																											0.0	9.0	0.0	0.0	0.0	0.0
Cornus amomum	Silky dogwood	Shrub				1	4	4				9		1	2	2				1		1				14		1			3.0	3.8	2.7	4.7	2.3	2.8
Cornus florida	Flowering dogwood	Tree	1	1																											1.0	1.0	2.0	2.0	2.0	2.0
Diospyros virginiana	Common persimmon	Tree		6						2														2							0.0	3.3	0.0	3.3	0.0	1.0
Fraxinus pennsylvanica	Green ash	Tree	4	4	3	3			5	5	7	7			1	1			1	1			5	5	1	1	5	5			3.6	3.6	3.5	3.3	3.6	4.5
Liquidambar styraciflua	Sweetgum	Tree				11																21				1		4			0.0	9.3	0.0	9.8	0.0	10.0
Liriodendron tulipifera	Yellow poplar	Tree					1	1																							1.0	1.0	1.0	1.0	1.0	1.0
Morella cerifera	Wax Myrtle	Shrub		1																		1									0.0	1.0	0.0	0.0	0.0	0.0
Platanus occidentalis	Sycamore	Tree					5	5			1	1					5	5	5	6	3	4	6	6		1	1	1	1	1	3.4	3.3	3.4	3.4	4.3	4.1
Quercus sp.	Oak	Tree	1	1	1	1																									1.0	1.0	1.5	1.5	1.5	1.5
Quercus falcata	Southern red oak	Tree	3	3															1	1	1	1	1	1					7	7	2.6	2.6	3.4	3.4	3.5	3.5
Quercus michauxii	Swamp chesnut oak	Tree									2	1	2	2											3	3	3	3			2.5	2.3	2.8	2.8	3.0	3.0
Quercus phellos	Willow oak	Tree			3	3							4	4	3	3									5	5					3.8	3.8	3.8	3.8	3.8	3.8
Rosa multiflora	Multiflora rose	Shrub				1						3										1						2			0.0	1.8	0.0	1.5	0.0	0.0
Salix nigra	Black willow	Tree										1																			0.0	1.0	0.0	3.5	0.0	3.0
Sambucus canadensis	Common elderberry	Shrub				2						6								1						9					0.0	4.5	0.0	5.7	0.0	0.0
Ulmus sp.	Elm	Tree																											3	3	3.0	3.0	3.0	3.0	2.5	5.3
Ulmus alata	Winged elm	Tree																													0.0	0.0	0.0	1.5	0.0	0.0
Ulmus americana	American elm	Tree		3	1	1	1	1					4	7																	2.0	3.0	2.0	5.5	2.0	2.0
Ulmus rubra	Slippery elm	Tree				1														1											1.0	1.0	0.0	0.0	0.0	0.0
Plot Area (acres)			0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247							
Species Count			4	10	4	10	4	4	3	4	3	7	4	5	3	3	2	2	3	8	4	9	3	4	3	7	5	8	3	3	3.4	6.0	3.6	6.2	4.1	6.1
Stem Count			9	36	8	27	11	11	7	9	10	28	11	15	6	6	7	7	7	14	6	34	12	14	9	34	13	20	11	11	9.1	19.0	10.1	24.6	11.4	30.5
Stems per Acre			364	1457	324	1093	445	445	283	364	405	1134	445	607	243	243	283	283	283	567	243	1377	486	567	364	1377	526	810	445	445	367	769	411	995	463	1235

Appendix D. Stream Survey Data

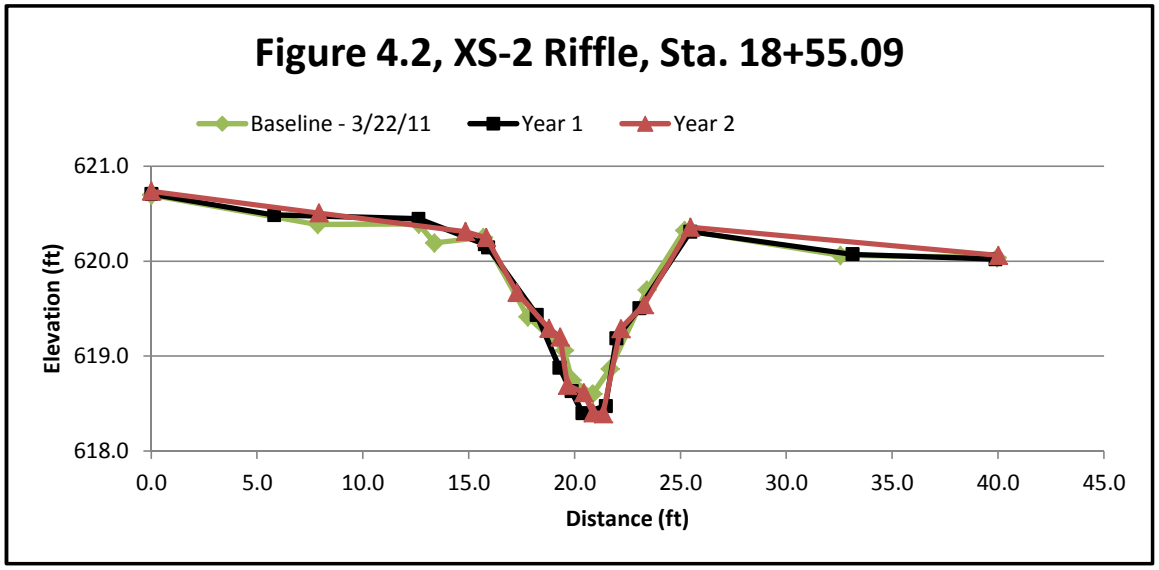
XS-1 Riffle, Sta. 12+73.50

Baseline		MY1		MY2	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	622.50	0.00	622.49	0.00	622.47
4.66	622.55	11.29	622.52	6.96	622.65
12.17	622.19	13.30	622.16	16.51	622.17
14.34	622.00	15.92	622.02	18.21	621.57
16.56	622.02	16.91	622.01	19.34	621.07
18.81	621.12	18.13	621.43	19.85	620.71
19.28	620.93	18.97	621.05	20.76	620.76
19.76	620.78	19.79	620.81	21.29	620.74
20.16	620.31	19.94	620.47	22.90	620.70
21.49	620.47	20.89	620.52	23.54	621.49
22.46	620.41	22.97	620.66	24.90	621.50
23.07	620.47	23.97	621.12	25.92	621.92
24.02	621.09	24.58	621.33	34.51	622.35
26.83	621.95	25.77	621.82	42.49	622.26
30.75	621.98	27.38	622.05		
36.99	622.25	31.09	622.07		
42.53	622.24	35.19	622.34		
		42.46	622.25		



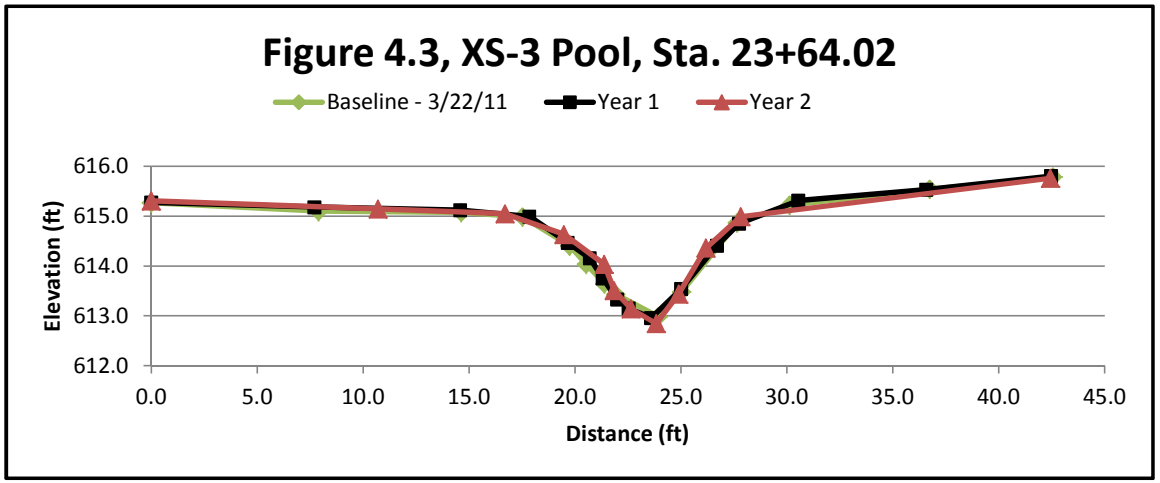
XS-2 Riffle, Sta. 18+55.09

Baseline		MY1		MY2	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	620.70	0.00	620.71	0.00	620.74
7.86	620.39	5.80	620.49	7.92	620.51
12.63	620.39	12.62	620.45	14.84	620.31
13.37	620.19	15.74	620.18	15.82	620.25
15.68	620.25	15.90	620.15	17.27	619.67
17.78	619.42	18.20	619.43	18.77	619.29
19.50	619.06	19.27	618.88	19.31	619.20
19.86	618.75	19.85	618.63	19.66	618.70
20.85	618.60	20.36	618.40	20.43	618.62
21.67	618.87	21.46	618.47	20.86	618.40
23.40	619.70	21.97	619.19	21.34	618.40
25.18	620.33	23.05	619.51	22.17	619.29
32.54	620.06	25.46	620.31	23.28	619.54
39.94	620.04	33.11	620.07	25.45	620.36
		39.86	620.02	40.00	620.06



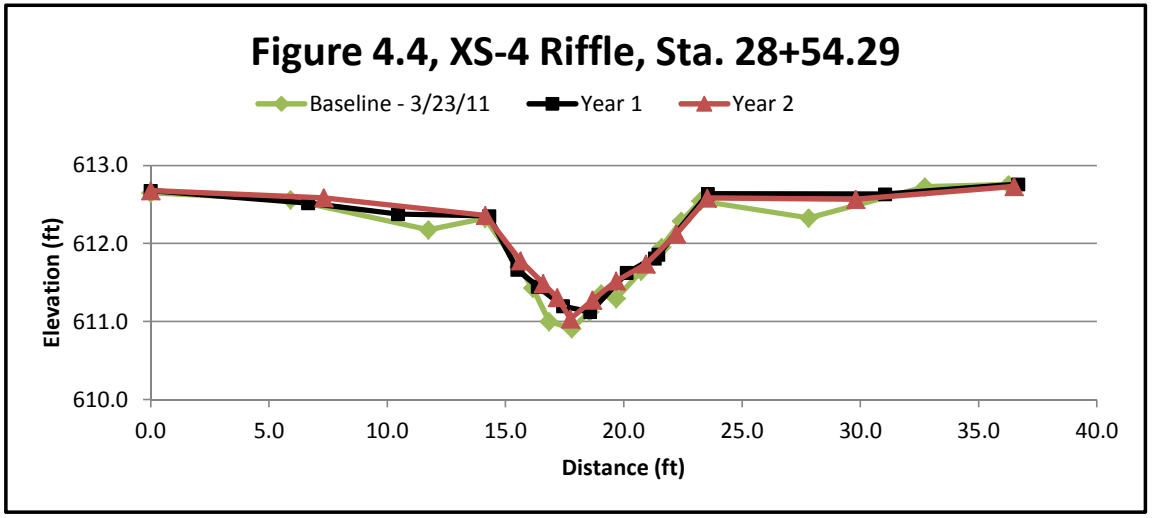
XS-3 Pool, Sta. 23+64.02

Baseline		MY1		MY2	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	615.27	0.0	615.28	0.0	615.31
7.90	615.10	7.7	615.18	10.7	615.15
14.63	615.08	14.6	615.12	16.7	615.05
17.53	614.99	17.8	615.00	19.5	614.64
19.75	614.41	19.7	614.47	21.4	614.04
20.53	614.04	20.7	614.16	21.8	613.52
21.39	613.65	21.3	613.76	22.6	613.15
21.92	613.43	22.0	613.33	23.8	612.85
23.93	612.99	22.5	613.15	24.9	613.44
25.03	613.49	23.6	612.96	26.2	614.37
27.66	614.87	25.0	613.54	27.8	615.00
30.14	615.22	26.7	614.41	42.4	615.77
36.75	615.54	27.8	614.86		
42.56	615.79	30.5	615.31		
		36.6	615.53		
		42.5	615.81		



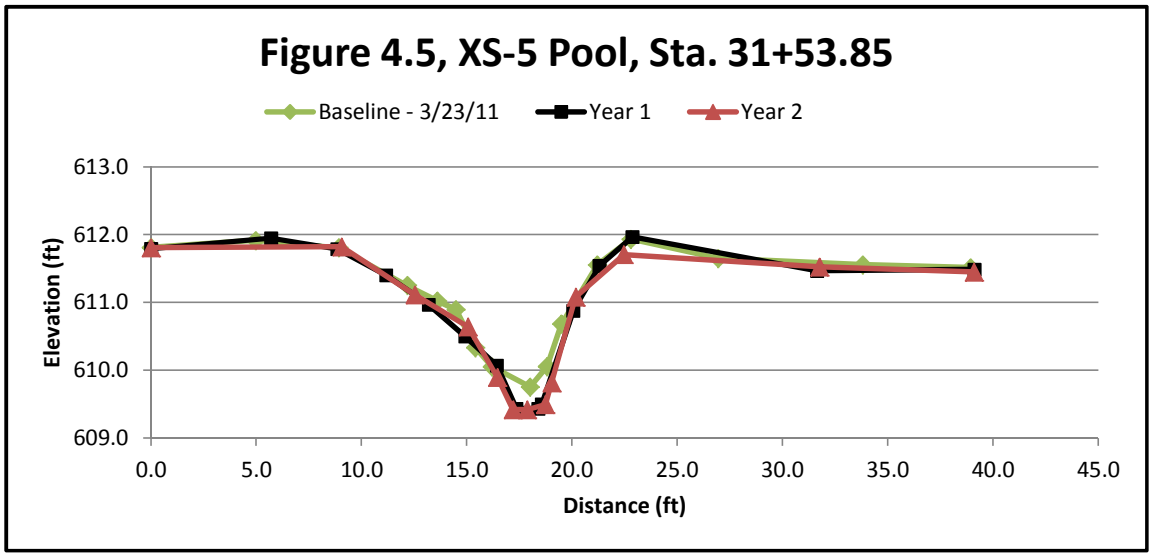
XS-4 Riffle, Sta. 28+54.29

Baseline		MY1		MY2	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	612.65	0.00	612.68	0.00	612.68
5.91	612.56	6.65	612.52	7.32	612.59
11.74	612.18	10.45	612.38	14.15	612.36
14.13	612.33	14.31	612.35	15.63	611.78
15.57	611.70	15.49	611.66	16.59	611.49
16.14	611.43	16.36	611.45	17.18	611.31
16.84	611.00	17.43	611.20	17.74	611.03
17.79	610.91	18.58	611.12	18.68	611.28
18.55	611.13	20.12	611.62	19.68	611.52
19.04	611.36	21.46	611.86	20.93	611.74
19.67	611.30	21.31	611.81	22.22	612.12
20.73	611.65	23.56	612.64	23.53	612.58
21.59	611.95	31.05	612.63	29.80	612.57
22.43	612.29	36.67	612.76	36.49	612.73
23.24	612.55				
27.82	612.33				
32.72	612.73				
36.27	612.75				



XS-5 Pool, Sta. 31+53.85

Baseline		MY1		MY2	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	611.81	0.00	611.79	0.00	611.81
4.96	611.92	5.69	611.95	9.05	611.82
8.92	611.81	8.84	611.79	12.54	611.11
12.17	611.25	11.17	611.40	15.05	610.64
13.60	611.02	13.18	610.97	16.46	609.90
14.48	610.90	14.92	610.50	17.20	609.42
15.40	610.33	16.43	610.07	17.87	609.42
16.19	610.05	17.35	609.43	18.74	609.49
18.00	609.75	18.40	609.43	19.03	609.82
18.81	610.06	18.57	609.50	20.17	611.08
19.50	610.68	20.05	610.88	22.46	611.71
21.19	611.56	21.30	611.54	31.76	611.53
22.79	611.94	22.87	611.97	39.10	611.45
26.94	611.65	31.64	611.47		
33.80	611.56	39.11	611.49		
38.93	611.51				



XS-6 Riffle, Sta. 33+18.49	Baseline		MY1		MY2	
	Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
	0.00	611.00	0.00	610.98	0.00	611.00
	7.89	610.75	6.68	610.74	6.68	610.96
	11.38	610.58	11.23	610.66	11.19	610.64
	14.26	609.95	15.51	609.59	14.29	609.95
	16.03	609.43	16.26	609.03	15.91	609.59
	16.60	609.08	17.51	607.99	16.65	608.59
	16.95	608.81	18.07	607.99	17.93	607.45
	18.13	608.72	18.85	608.36	19.38	607.46
	19.09	609.00	19.25	608.85	20.78	609.67
	20.26	609.47	20.05	609.05	22.71	610.56
	22.68	610.61	22.66	610.56	29.46	610.67
	28.83	610.59	28.59	610.56	35.85	611.08
	33.03	610.92	35.81	611.16		
	35.68	611.18				

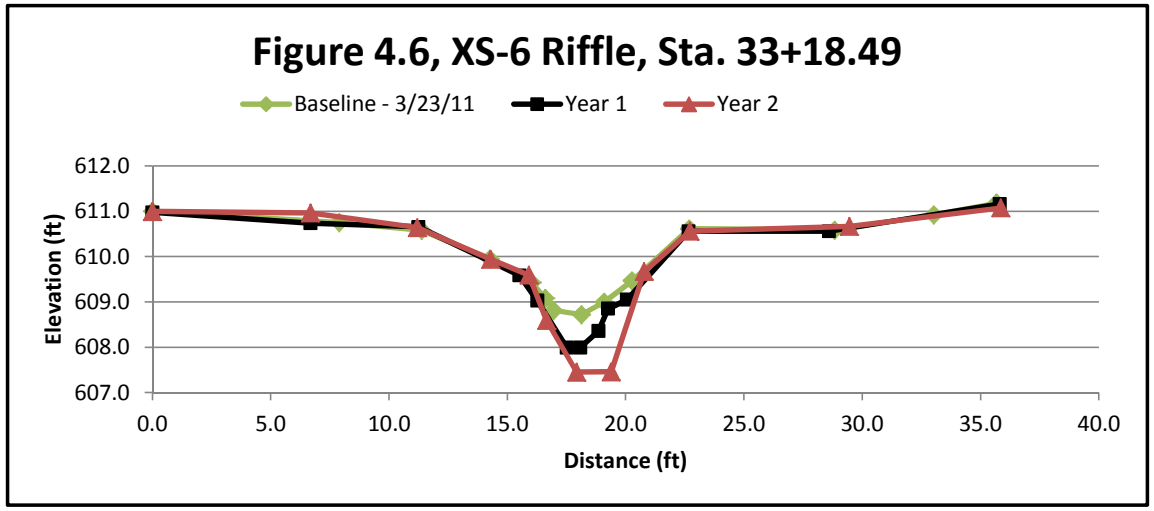


Figure 5.1 UT Rocky River - Longitudinal Profile

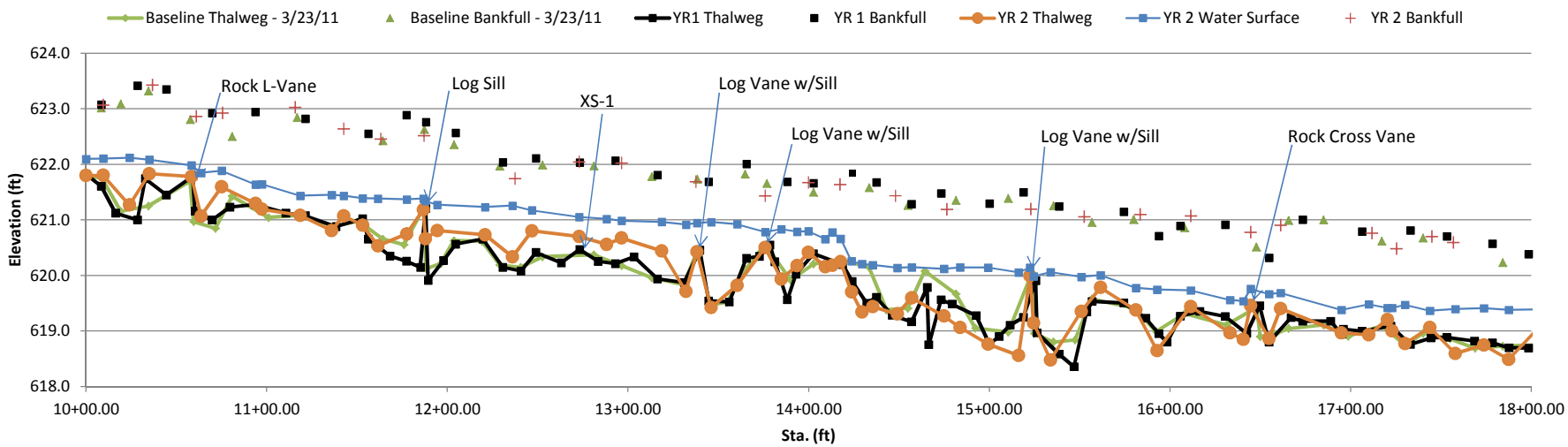


Figure 5.2 UT Rocky River - Longitudinal Profile

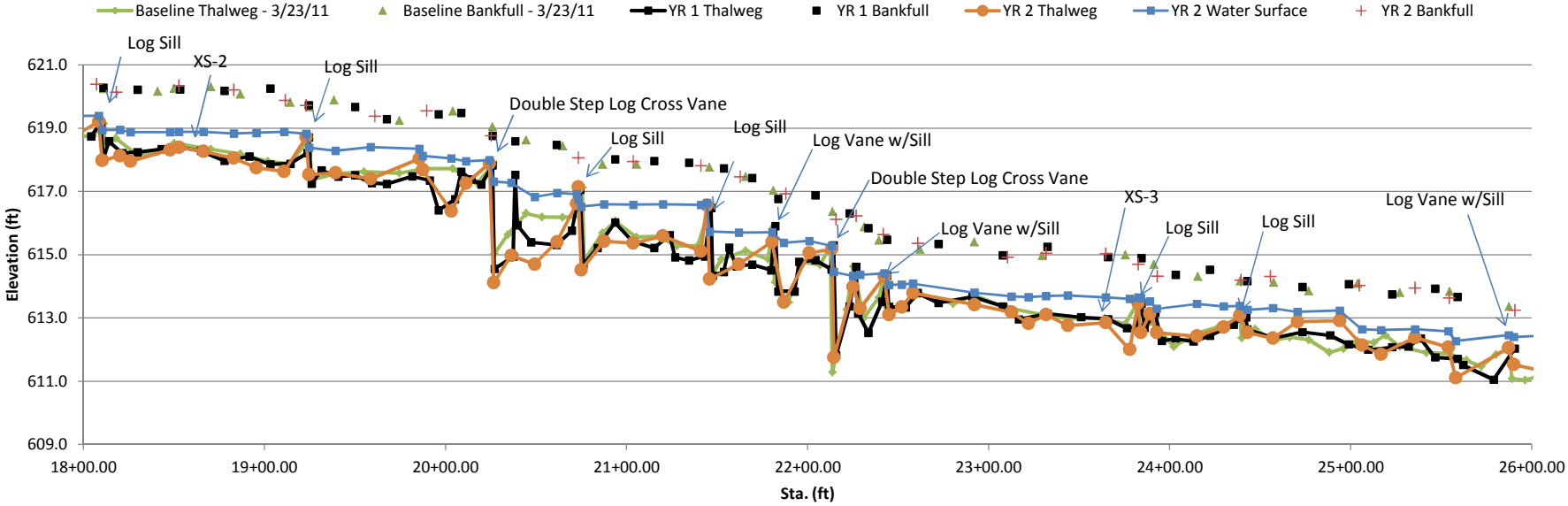


Figure 5.3 UT Rocky River - Longitudinal Profile

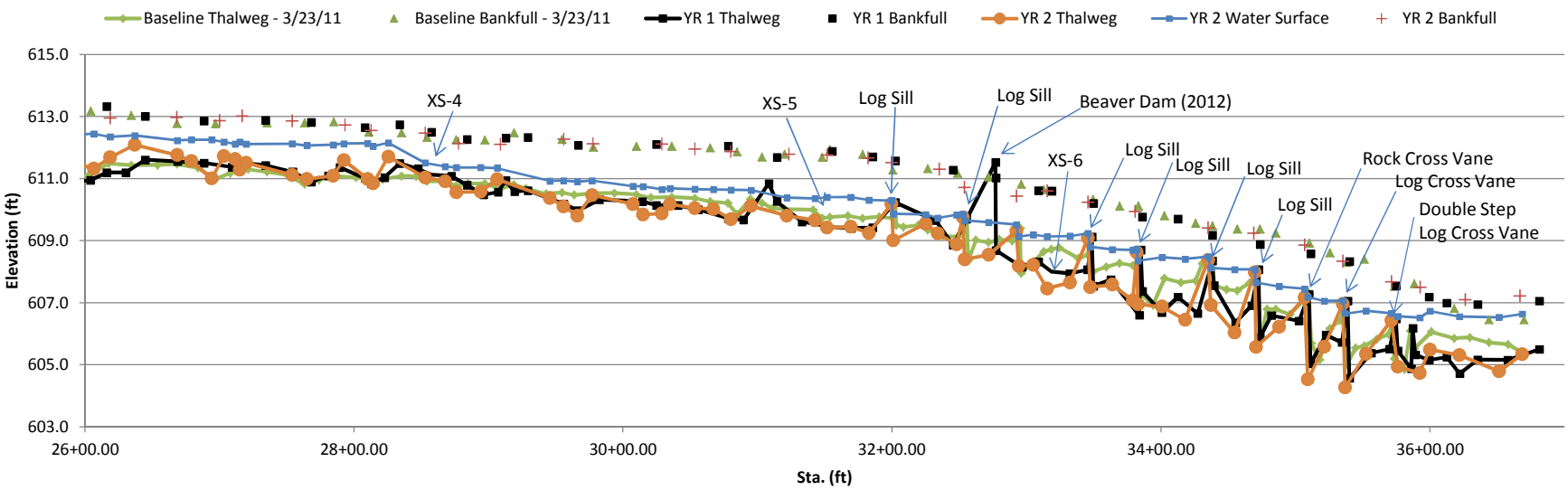


Table 10. Baseline Stream Data Summary
UT Rocky River - Harris Road Middle, EEP IMS No. 92383
UT Rocky River: 2,715 lf

Parameter	Regional Curve			Pre-Existing Condition (Beaver Influence Reach)	Pre-Existing Condition (Gully Reach)	Reference - UT Ledge Creek	Reference Reach - UT Wildcat Branch	Reference Reach - Mill Creek	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Eq.			Mean	Mean	Mean	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	9.10			5.10	4.70	14.70	8.20	11.3	9.50	8.50	9.88	9.70	11.60	1.32	4
Floodprone Width (ft)				270.00	9.70	63.00	130.00	300	300.00	175.00	225.50	217.50	292.00	55.42	4
Bankfull Mean Depth (ft)	1.16			0.20	0.89	1.25	1.03	1.85	0.95	0.80	0.88	0.90	0.90	0.05	4
Bankfull Max Depth (ft)				0.40	1.06	1.75	1.57	2.58	1.43	1.40	1.64	1.63	1.90	0.21	4
Bankfull Cross Sectional Area (ft^2)	10.68			0.90	4.20	18.30	8.50	21	9.00	6.70	8.65	8.60	10.70	1.71	4
Width/Depth Ratio				29.80	5.30	11.70	8.00	6.1	10.00	10.70	11.30	10.95	12.60	0.88	4
Entrenchment Ratio				53.30	2.00	4.30	15.90	26.5	31.60	18.30	23.25	20.20	34.30	7.51	4
Bank Height Ratio				1.00	2.12	1.54	1.09	1.09	1.00	1.00	1.00	1.00	1.00	0.00	4
d50 (mm)				sand	sand	sand	sand	sand	sand						
Profile															
Riffle Length (ft)										9.05	45.88	46.41	88.46	24.23	32
Riffle Slope (ft/ft)				0.0184	0.0553	0.0010	0.0022	0.0037	0.0033	0.0006	0.0038	0.0033	0.0126	0.0023	32
Pool Length (ft)										3.94	15.98	14.75	32.84	7.40	46
Pool Max depth (ft)				1.38	2.32	2.67	1.75	3.12	1.90	1.48	2.23	2.07	4.85	0.56	46
Pool Spacing (ft)				7.16-42.49	11.43-54.09	12.0-72.0	14.0-16.6	11.4-61.0	9.5-57.0	13.31	45.43	37.86	98.34	24.40	45
Pool Cross Sectional Area (ft^2)										10.68	11.49	11.49	12.30	1.15	2
Pattern															
Channel Beltwidth (ft)				41.00	41.00	48.0-55.0	13.8-19.4	15.1-27.0	19.0-57.0						
Radius of Curvature (ft)				6.0-15.0	6.0-15.0	14.9-22.2	10.9-15.3	9.7-29.8	28.5-38.0						
Rc: Bankfull Width (ft/ft)				1.2-2.9	1.3-3.1	1.0-1.5	1.3-1.9	0.9-2.6	3.0-4.0						
Meander Wavelength (ft)				83.00	83.00	134-140	22.5-29.0	37.7-72.6	57.0-133.0						
Meander Width Ratio				8.09	8.70	3.3-3.8	1.7-2.4	1.3-2.4	2.0-6.0						
Substrate, bed and transport parameters															
Ri% / Ru% / P% / G% / S%															
SC% / Sa% / G% / C% / B% / Be%															
d16 / d35 / d50 / d84 / d95/ df^p / di^{sp} (mm)															
Reach Shear Stress (competency) lb/ft^2				0.164	2.499	0.033	0.122	0.230	0.126						
Max part size (mm) mobilized at bankfull															
Stream Power (transport capacity) W/m^2					21.416	0.700	1.300	5.000	2.450						
Additional Reach Parameters															
Drainage Area (SM)				0.64	0.64	3.77	0.44	1.92	0.77						
Impervious cover estimate (%)															
Rosgen Classification				C5/D5	G5	C5	E5	E5	C5/E5	C5					
Bankfull Velocity (fps)					3.80	1.20	1.00	1.50	1.90	2.08					
Bankfull Discharge (cfs)					15.70	22.30	8.50	30.60	18.00	18.00					
Valley length (ft)				2238	2238				2180.00	2180.00					
Channel Thalweg length (ft)				2350	2350				2703.00	2715.00					
Sinuosity (ft)				1.05	1.05	1.26	1.15	1.18	1.24	1.25					
Water Surface Slope (Channel) (ft/ft)				0.0066	0.0219	0.0005	0.0024	0.0026	0.0022	0.0060					
BF slope (ft/ft)									0.0022	0.0060					
Bankfull Floodplain Area (acres)															
Proportion over wide (%)															
Entrenchment Class (ER Range)															
Incision Class (BHR Range)															
BEHI VL% / L% / M% / H% / VH% / E%															
Channel Stability or Habitat Metric															
Biological or Other															

Table 11. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Section)
UT Rocky River - Harris Road Middle (EEP IMS No. 92383)
UT Rocky River: 2,715 lf

	Cross Section 1 (Riffle)							Cross Section 2 (Riffle)						
Dimension and substrate[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	10.10	10.30	8.7					9.30	10.06	9.34				
Floodprone Width (ft)	185	185	185					175	175	175				
Bankfull Mean Depth (ft)	0.90	0.87	0.73					0.90	0.83	0.88				
Bankfull Max Depth (ft)	1.60	1.56	1.21					1.65	1.83	1.85				
Bankfull Cross Sectional Area (ft^2)	9.20	8.93	6.31					8.00	8.33	8.18				
Bankfull Width/Depth Ratio	11.10	11.85	11.99					10.80	12.12	10.67				
Bankfull Entrenchment Ratio	18.30	17.94	21.26					18.80	17.40	18.74				
Bankfull Bank Height Ratio	1	1	1					1	1	1				
	Cross Section 3 (Pool)							**Cross Section 4 (Riffle)**						
Dimension and substrate[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	11.02	10.13	10.73					8.50	8.88	8.75				
Floodprone Width (ft)	132	132	132					292	292	292				
Bankfull Mean Depth (ft)	0.97	0.96	0.92					0.80	0.85	0.69				
Bankfull Max Depth (ft)	2.00	1.97	2.15					1.40	1.38	1.33				
Bankfull Cross Sectional Area (ft^2)	10.68	9.75	9.84					6.70	7.50	6.01				
Bankfull Width/Depth Ratio	11.36	10.55	11.71					10.70	10.45	12.73				
Bankfull Entrenchment Ratio	12.00	13.03	12.30					34.30	32.88	33.38				
Bankfull Bank Height Ratio	1	1	1					1	1	1				
	Cross Section 5 (Pool)							**Cross Section 6 (Pool/formerly Riffle)[2]**						
Dimension and substrate[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	13.30	13.71	12.84					11.60	11.24	11.17				
Floodprone Width (ft)	300	300	300					250	250	250				
Bankfull Mean Depth (ft)	0.90	1.09	0.99					0.90	1.18	1.31				
Bankfull Max Depth (ft)	2.05	2.45	2.29					1.90	2.62	3.11				
Bankfull Cross Sectional Area (ft^2)	12.30	14.95	12.72					10.70	13.27	14.64				
Bankfull Width/Depth Ratio	14.50	12.58	12.95					12.60	9.53	8.52				
Bankfull Entrenchment Ratio	22.60	21.88	23.37					21.60	22.24	22.38				
Bankfull Bank Height Ratio	1	1	1					1	1	1				

1 = Based on current bankfull elevation, determined by field indicators of bankfull.
2 = Cross Section 6 is no longer included in the Table 12 dimension and substrate averages.

Table 12. Monitoring Data - Stream Reach Data Summary

UT Rocky River - Harris Road Middle (EEP IMS No. 92383)

UT Rocky River - 2,715 lf

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
Dimension and substrate - Riffle only	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	8.50	9.88	9.70	11.60	1.32	4	8.88	10.12	10.18	11.24	0.97	4	8.70	8.93	8.75	9.34	0.36	3																		
Floodprone Width (ft)	175	226	218	292	55	4	175	226	218	292	55	4	175	217	185	292	65	3																		
Bankfull Mean Depth (ft)	0.80	0.88	0.90	0.90	0.05	4	0.83	0.93	0.86	1.18	0.17	4	0.69	0.77	0.73	0.88	0.10	3																		
[1]Bankfull Max Depth (ft)	1.40	1.64	1.63	1.90	0.21	4	1.38	1.85	1.70	2.62	0.55	4	1.21	1.46	1.33	1.85	0.34	3																		
Bankfull Cross Sectional Area (ft^2)	6.70	8.65	8.60	10.70	1.71	4	7.50	9.51	8.63	13.27	2.58	4	6.01	6.83	6.31	8.18	1.18	3																		
Width/Depth Ratio	10.70	11.30	10.95	12.60	0.88	4	9.53	10.99	11.15	12.12	1.22	4	10.67	11.80	11.99	12.73	1.04	3																		
Entrenchment Ratio	18.30	23.25	20.20	34.30	7.51	4	17.40	22.62	20.09	32.88	7.18	4	18.74	24.46	21.26	33.38	7.83	3																		
[1]Bank Height Ratio	1	1	1	1	0	4	1	1	1	1	0	4	1	1	1	1	0	3																		
Profile																																				
Riffle Length (ft)	9.05	45.88	46.41	88.46	24.23	32	2.68	27.52	25.65	73.53	17.11	35	9.56	33.75	28.36	106.43	22.56	20																		
Riffle Slope (ft/ft)	0.001	0.004	0.003	0.013	0.002	32	0.000	0.005	0.002	0.048	0.011	35	0.001	0.006	0.004	0.018	0.452	15																		
Pool Length (ft)	3.94	15.98	14.75	32.84	7.40	46	1.72	23.68	23.17	69.48	12.65	65	1.10	30.99	28.52	67.70	15.22	56																		
Pool Max Depth (ft)	1.48	2.23	2.07	4.85	0.56	46	0.84	2.18	2.11	3.76	0.62	65	0.85	2.38	2.36	4.74	0.84	57																		
Pool Spacing (ft)	13.31	45.43	37.86	98.34	24.40	45	7.52	40.69	35.43	99.43	22.98	64	6.47	46.65	40.30	122.14	22.64	56																		
Pattern																																				
Channel Beltwidth (ft)																																				
Radius of Curvature (ft)																																				
Rc:Bankfull Width (ft/ft)																																				
Meander Wavelength (ft)																																				
Meander Width Ratio																																				
Additional Reach Parameters																																				
Rosgen Classification	C5						C5						C5																							
Channel Thalweg length (ft)	2715						2715						2715																							
Sinuosity (ft)	1.25						1.25						1.25																							
Water Surface Slope (Channel) (ft/ft)	0.006						0.006						0.006																							
BF slope (ft/ft)	0.006						0.006						0.006																							
[3]Ri% / P%	43% / 57%						38% / 62%						28% / 72%																							
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95																																				
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these paramenters can include information from both thte cross-section surveys and the longitudinal profile.

2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table

3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

Appendix E. Hydrologic Data

Table 13. Verification of Bankfull Events

Date	Crest Gauge Info		Gauge Reading (ft)	Gauge Elevation (ft)	Crest Elevation (ft)	Bankfull Elevation (ft)	Height above Bankfull (ft)	Photo
	Site	Sta.						
3/8/2012	1	16+85	0.75	620.65	621.40	621.05	0.35	6.1
10/4/2012	1	16+85	1.13	620.65	621.78	621.05	0.73	6.2
3/20/2013	1	16+85	1.75	620.65	622.40	621.05	1.35	6.3
9/24/2013	2	29+70	1.30	611.80	613.10	612.33	0.77	6.4

Figures 6.1 - 6.4 Crest Gauge Photos

6.1 Crest Gauge 1 (3/8/2012)

6.2 Crest Gauge 1 (10/4/2012)

6.3 Crest Gauge 1 (3/12/2013)

6.4 Crest Gauge 2 (9/24/2013)