

YEAR 4 MONITORING REPORT

UT ROCKY RIVER – HARRIS ROAD MIDDLE

Cabarrus County, North Carolina

DMS IMS No. 92383, Contract No. 004346



Prepared for:

NCDEQ Division of Mitigation Services (DMS)

217 West Jones St., Suite 3000A

Raleigh, North Carolina 27603

Construction Completed: August, 2010

Morphology Data Collected: March 25, 2015

Vegetation Data Collected: September 21, 2015

Submitted: November, 2015

Prepared by:



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919.851.6846 (fax)

I HEREBY CERTIFY THAT THE DOCUMENT CONTAINED HEREIN, UT ROCKY RIVER-HARRIS ROAD MIDDLE YEAR 4 MONITORING REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNED SEALED, AND DATED THIS 19TH DAY OF NOVEMBER 2015.

A handwritten signature in blue ink, appearing to read 'Chris L. Smith', written over a horizontal line.

Chris L. Smith, PE



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1.0 EXECUTIVE SUMMARY

The following report summarizes the vegetation establishment and stream stability for Year 4 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 NCDEQ Division of Mitigation Services (DMS), formerly 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 035° 25' 34.52" N and 080° 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 plantings are surviving well across the site. Vegetation plots are averaging 338 planted stems per acre, exceeding Year 4 monitoring success criteria of 290 stems per acre or greater. Individually, 8 of the 14 plots are exceeding the Year 4 target when counting planted stems alone. When including natural recruits all of the plots exceed Year 4 target criteria.

Blackberry (*Rubus argutus*) continues to be a problem throughout the floodplain at the downstream end of the Site. However, additional planting is not recommended due to continued development of natural recruit tree species. The cluster of lespedeza (*Lespedeza cuneata*) continues to expand in coverage at the upstream end of the Site. Invasive plant species should be watched closely in the coming years; however, no action is necessary at this time as natural recruits continue to establish and improve the density and diversity of vegetation at the Site.

1.4 Stream Stability

UT Rocky River appears to be stable and functioning as designed. Minor scour is occurring along the channel bed between stations 18+52 and 19+02 and between stations 28+93 and 30+21. The scour just downstream of station 28+90 is the result of a beaver dam. Channel bed deposition is occurring between stations 27+17 and 27+94 and between stations 24+62 and 25+09. Natural aggregation and degradation of the channel bed is expected in a sand bed system such as UT Rocky River; however, beaver activity also contributes to fluctuations in the channel bed. The riffle to pool ratio has remained relatively consistent, indicating that the system as a whole has remained stable over the previous monitoring year.

Overall cross section data exhibits stable stream characteristics. Cross section 5 has reduced in area over the previous monitoring year by about 30%. This cross section is just upstream of a beaver dam found in the channel. It is likely that deposition has occurred in this area due to water backed up by the dam. All other cross sections are maintaining geometry.

The site has a history of beaver activity. Beaver dams were removed in winter 2015, however, other dams were discovered in March 2015 and July 2015 at approximately stations 28+90 and 32+90, respectively. DMS has contracted with the USDA Animal and Plant Health Inspection Service (APHIS) to control beaver activity on the site. The site has been under APHIS monitoring since October 2012. Since that time, APHIS has trapped 5 beaver and removed 12

dams. Beaver activity has been an ongoing issue at UT Rocky River. The site will continue to be monitored for beaver activity.

Vegetative cover is dense along the stream banks throughout the Site resulting in overall bank stability of 96 percent. Bank scour has increased slightly over the monitoring year, however, due to the strong presence of willows and other stabilizing vegetation the erosion will likely subside over the coming years.

The log cross vane below station 35+00 failed before Year 2 Monitoring. The structure could not be surveyed during Year 3 or 4 monitoring due to back water from Rocky River. If the failed structure compromises overall channel stability in upcoming monitoring years repairs may be necessary.

The site has experienced several bankfull flows throughout the monitoring period. Crest gauges installed on-site were inspected on March 24, 2015 and September 21, 2015. The crest gauges revealed that a bankfull event occurred at least twice during Year 4 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 plating native species. All vegetation plots located within wetland areas are exceeding success criteria when including natural recruits. Section 1.3 provides more details concerning vegetation at the site.

1.6 Note

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 DMS's website. All raw data supporting the tables and figures in the appendices is available from DMS upon request.

2.0 METHODOLOGY

Year 1, 2, 3 and 4 monitoring surveys were completed using a Total Station. Each cross section was marked with 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>)

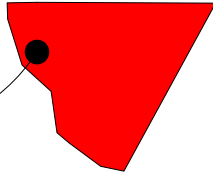
Weakley, Alan S. 2011. Flora of the Southern and Mid-Atlantic States (online). Available: http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2011-May-nav.pdf [May 15, 2011]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North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

APPENDICES

Appendix A. Project Vicinity Map and Background Tables

Cabarrus County North Carolina

PROJECT
AREA



Vicinity Map

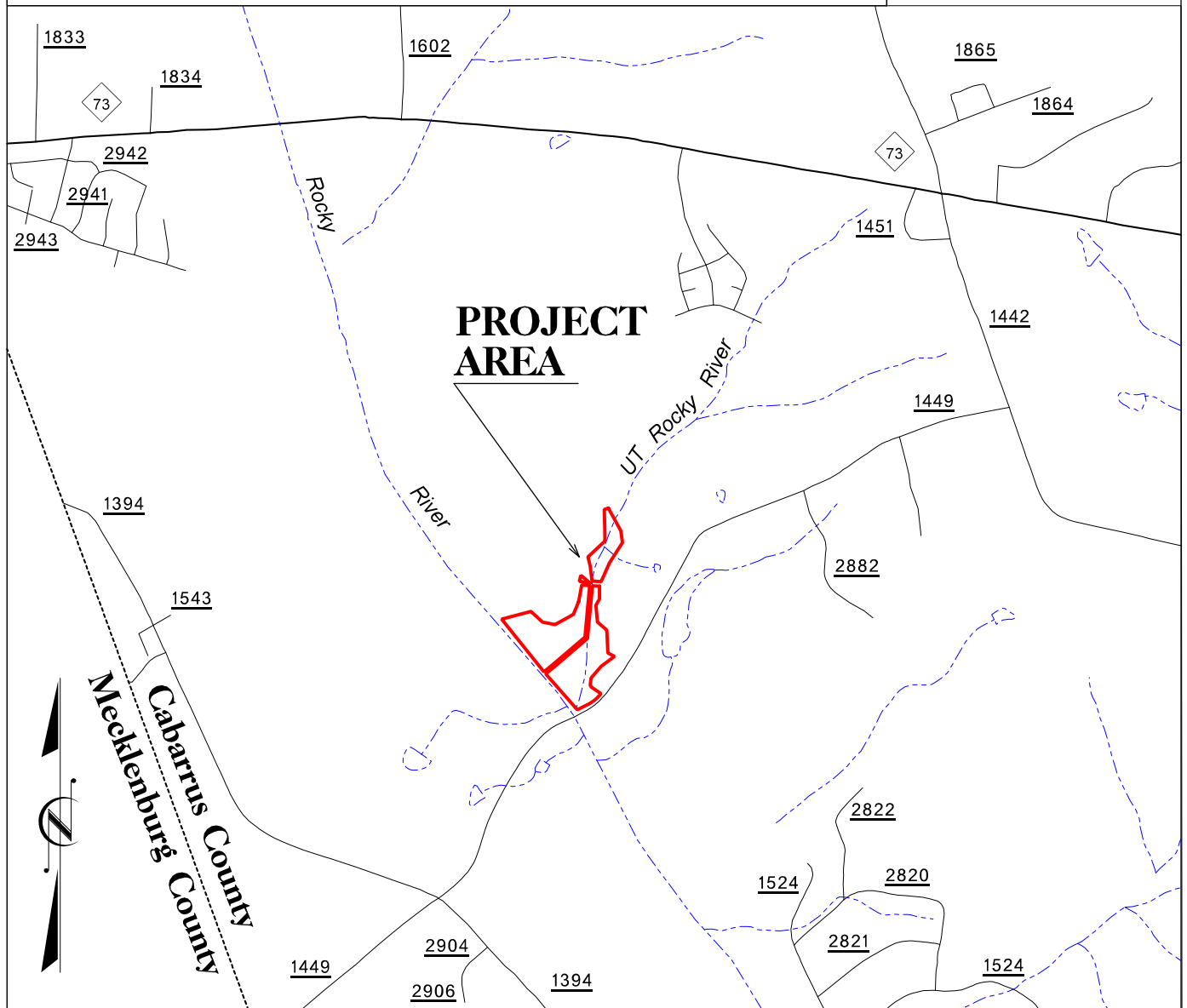
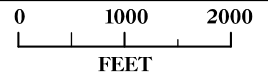
UT Rocky River – Harris Road Middle
Year 4 Monitoring
Cabarrus County, North Carolina



5121 Kingdom Way,
Suite 100
Raleigh, NC 27607
NC License No: F-0258

Date: 11/10/15

Figure: 1



Cabarrus County
Mecklenburg County

"The subject project site is an environmental restoration site of the NCDEQ Department 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 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 DMS."

Table 1. Project Components and Mitigation Credits

UT Rocky River – Harris Road Middle (DMS 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 (DMS 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
Beaver/Dam Removal		October 2012
Year 1 Monitoring	October 4, 2012	January 3, 2013
Beaver/Dam Removal		February 2013
Beaver/Dam Removal		March 2013
Beaver/Dam Removal		July 2013
Year 2 Monitoring	September 24, 2013	November 6, 2013
Live Stake Supplemental Planting		January/February 2014
Beaver/Dam Removal		April 2014
Year 3 Monitoring	September 23, 2014	November 2014
Beaver/Dam Removal		January 2015
Beaver/Dam Removal		August 2015
Year 4 Monitoring	September 21, 2015	November 2015

Table 3. Project Contacts Table

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

Designer Primary project design POC	HDR ICA Engineering 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	HDR ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066
Stream Monitoring POC	HDR ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066
Vegetation Monitoring POC	HDR ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066

Table 4. Project Information

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

Project Information	
Project Name	UT Rocky River – Harris Road Middle
Project County	Cabarrus
Project Area (acres)	20
Project Coordinates	35° 25' 34.52" N, 80° 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	7.1%
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 Hydrology	Groundwater and Floodwater
Hydrologic Impairment	No
Native Vegetation Community	Piedmont Alluvial Forest
Percent Composition of Exotic Invasive Veg.	6.2%

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

CONTRACT: UT ROCKY RIVER - HARRIS ROAD MIDDLE SCO# 070708001

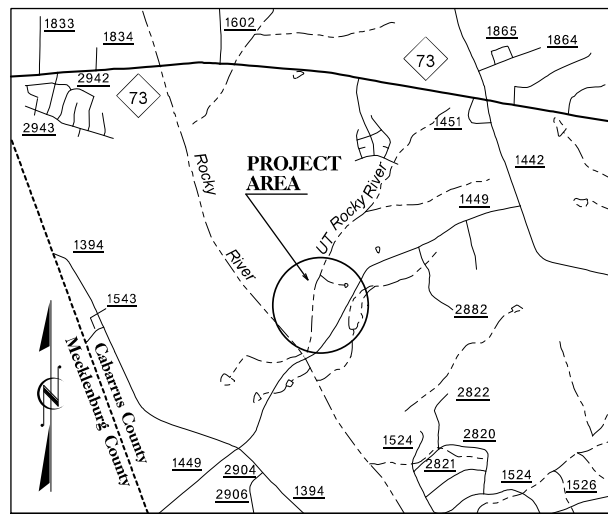
CURRENT CONDITIONS PLAN VIEW (CCPV) UT ROCKY RIVER - HARRIS ROAD MIDDLE

LOCATION: CABARRUS COUNTY, NORTH CAROLINA

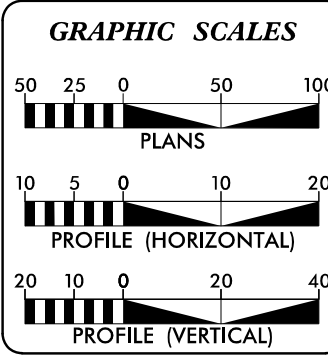
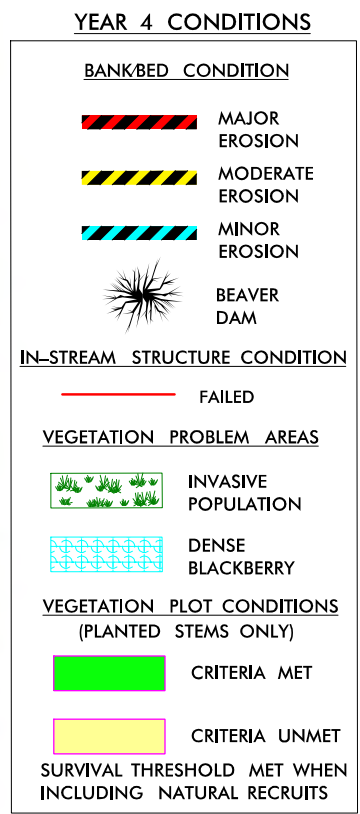
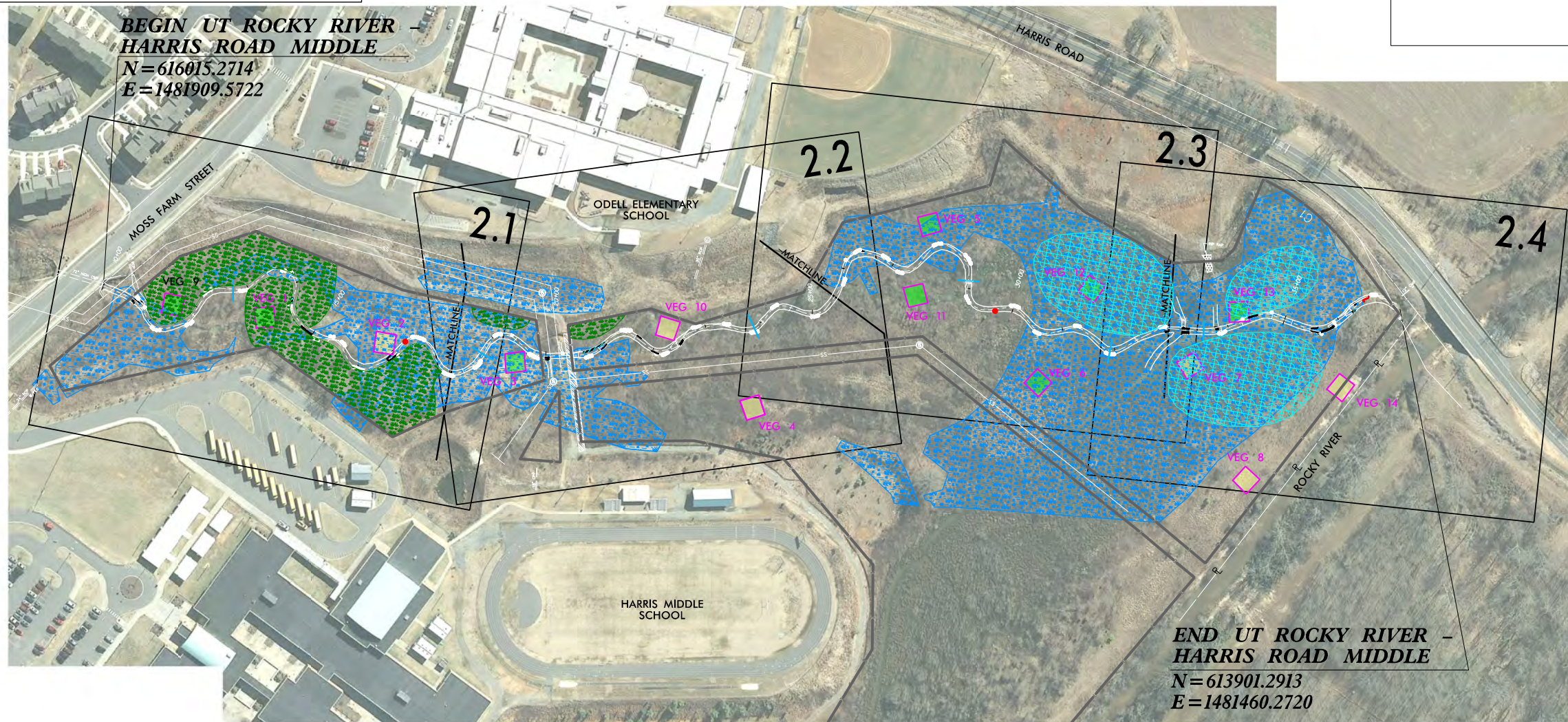
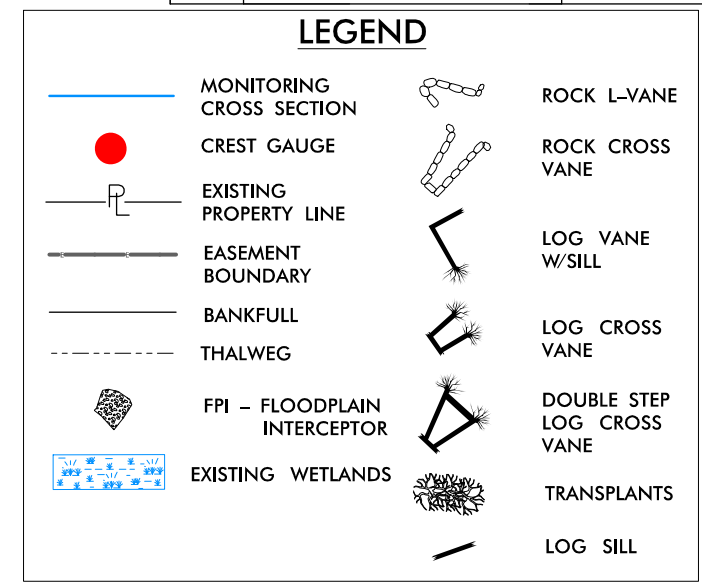
LAT: 35°25'34.52" N

LONG: 80°44'25.53" W

TYPE OF WORK: CURRENT CONDITIONS PLAN VIEW - CCPV (YR4)



VICINITY MAP



DESIGN DATA	
DESIGN STREAM TYPE	= C5/E5
BANKFULL AREA (FT ²)	= 9.0
CROSS-SECTIONED	
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.

INDEX OF SHEETS	
TITLE SITE OVERVIEW FIGURE.....	2.0
CCPV PLAN FIGURES.....	2.1 - 2.4

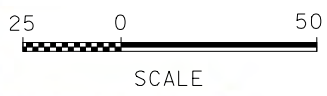
OWNER CONTACT:	
PAUL WIESNER	EPP PROJECT MANAGER
LIN XU	REVIEW COORDINATOR

Prepared In the Office of:

5121 Kingdom Way,
Suite 100
Raleigh, NC 27607
NC License No: F-0258

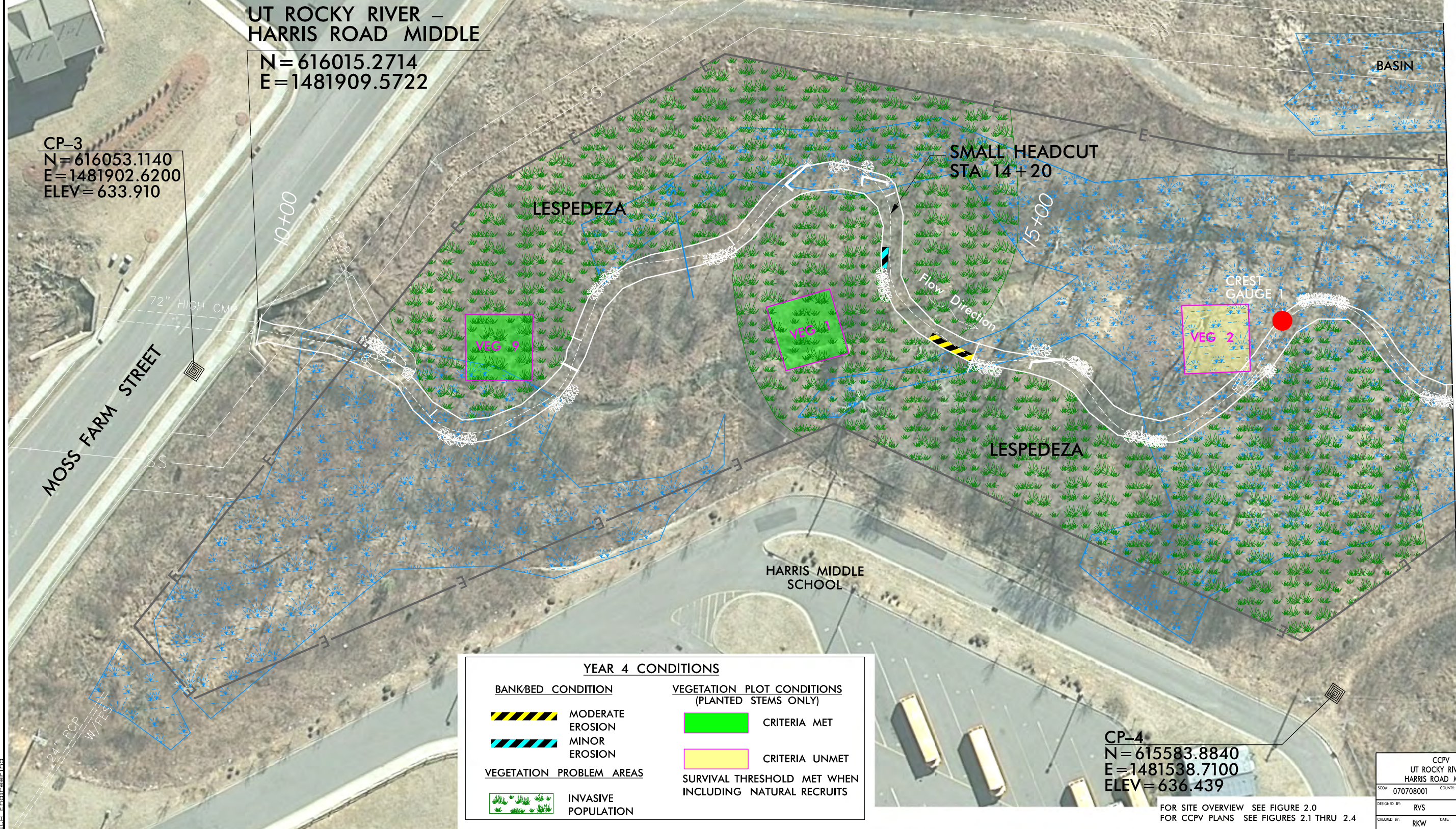
R. KEVIN WILLIAMS
PROJECT ENGINEER

RYAN V. SMITH
PROJECT DESIGNER



CURRENT CONDITIONS PLAN VIEW (CCPV)

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



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

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

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

YEAR 4 CONDITIONS			
	MODERATE EROSION		CRITERIA MET
	MINOR EROSION		CRITERIA UNMET
	INVASIVE POPULATION		SURVIVAL THRESHOLD MET WHEN INCLUDING NATURAL RECRUITS

-MATCHLINE- SEE FIGURE 2.2

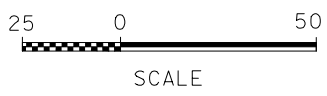
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FOR SITE OVERVIEW SEE FIGURE 2.0
 FOR CCPV PLANS SEE FIGURES 2.1 THRU 2.4

CCPV UT ROCKY RIVER - HARRIS ROAD MIDDLE	
SCOP: 070708001	COUNTY: CABARRUS
DESIGNED BY: RVS	
CHECKED BY: RKW	DATE: 11/15

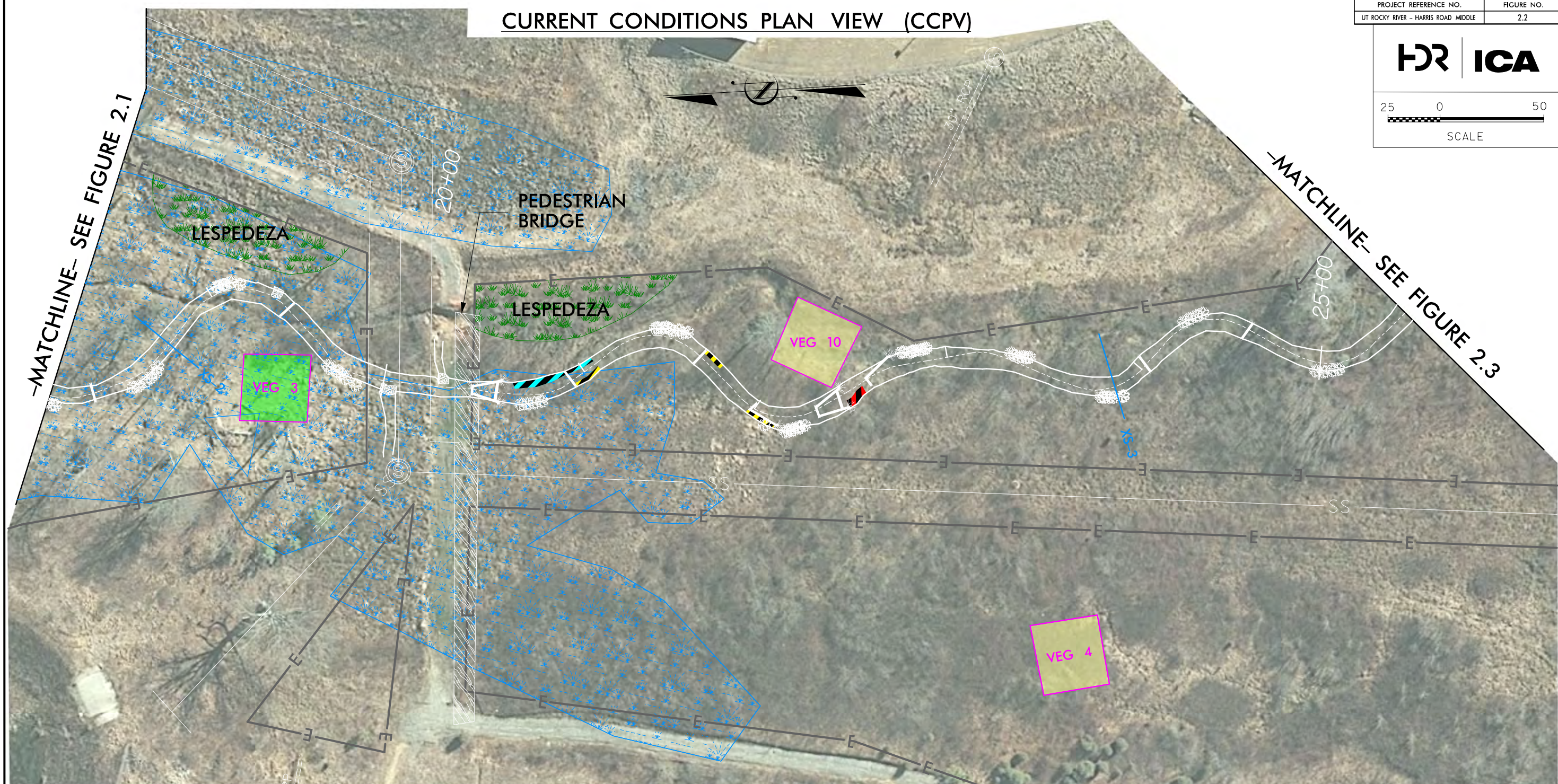
CURRENT CONDITIONS PLAN VIEW (CCPV)

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



-MATCHLINE- SEE FIGURE 2.1

-MATCHLINE- SEE FIGURE 2.3



LEGEND

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

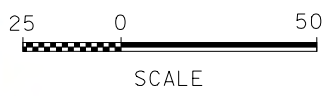
YEAR 4 CONDITIONS

- | | | | |
|--------------------------------------|---------------------|--|----------------|
| BANK/BED CONDITION | | VEGETATION PLOT CONDITIONS (PLANTED STEMS ONLY) | |
| | MAJOR EROSION | | CRITERIA MET |
| | MODERATE EROSION | | CRITERIA UNMET |
| | MINOR EROSION | SURVIVAL THRESHOLD MET WHEN INCLUDING NATURAL RECRUITS | |
| VEGETATION PROBLEM AREAS | | | |
| | INVASIVE POPULATION | | |
| IN-STREAM STRUCTURE CONDITION | | | |
| | FAILED | | |

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

CCPV UT ROCKY RIVER - HARRIS ROAD MIDDLE	
SCDF: 070708001	COUNTY: CABARRUS
DESIGNED BY: RVS	
CHECKED BY: RKW	DATE: 11/15



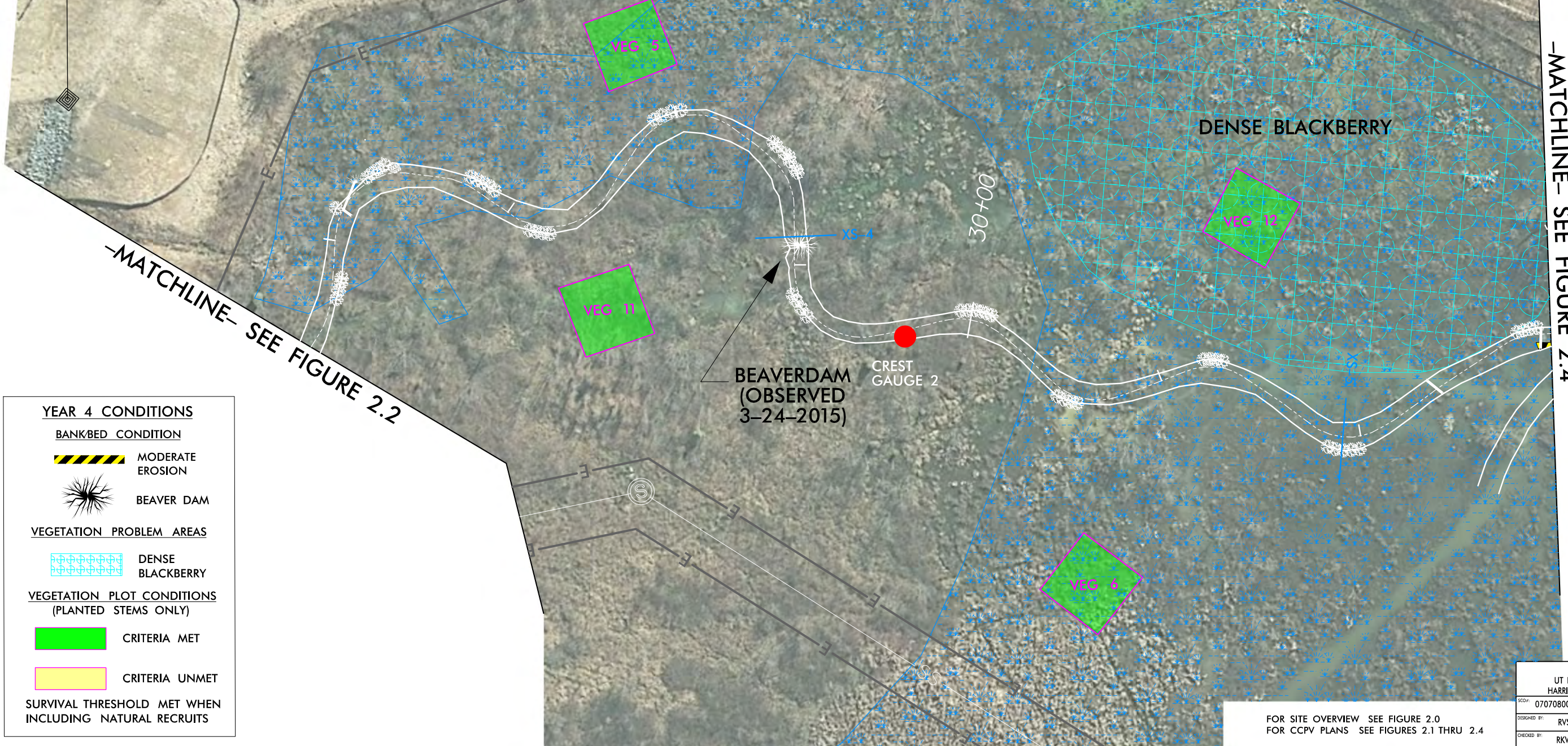
CURRENT CONDITIONS PLAN VIEW (CCPV)

LEGEND

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

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

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



YEAR 4 CONDITIONS

BANKBED CONDITION

	MODERATE EROSION
	BEAVER DAM

VEGETATION PROBLEM AREAS

	DENSE BLACKBERRY
--	------------------

VEGETATION PLOT CONDITIONS (PLANTED STEMS ONLY)

	CRITERIA MET
	CRITERIA UNMET

SURVIVAL THRESHOLD MET WHEN INCLUDING NATURAL RECRUITS

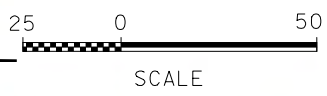
-MATCHLINE- SEE FIGURE 2.4

-MATCHLINE- SEE FIGURE 2.2

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

CCPV UT ROCKY RIVER - HARRIS ROAD MIDDLE	
SCOP: 070708001	COUNTY: CABARRUS
DESIGNED BY: RVS	
CHECKED BY: RKW	DATE: 11/15

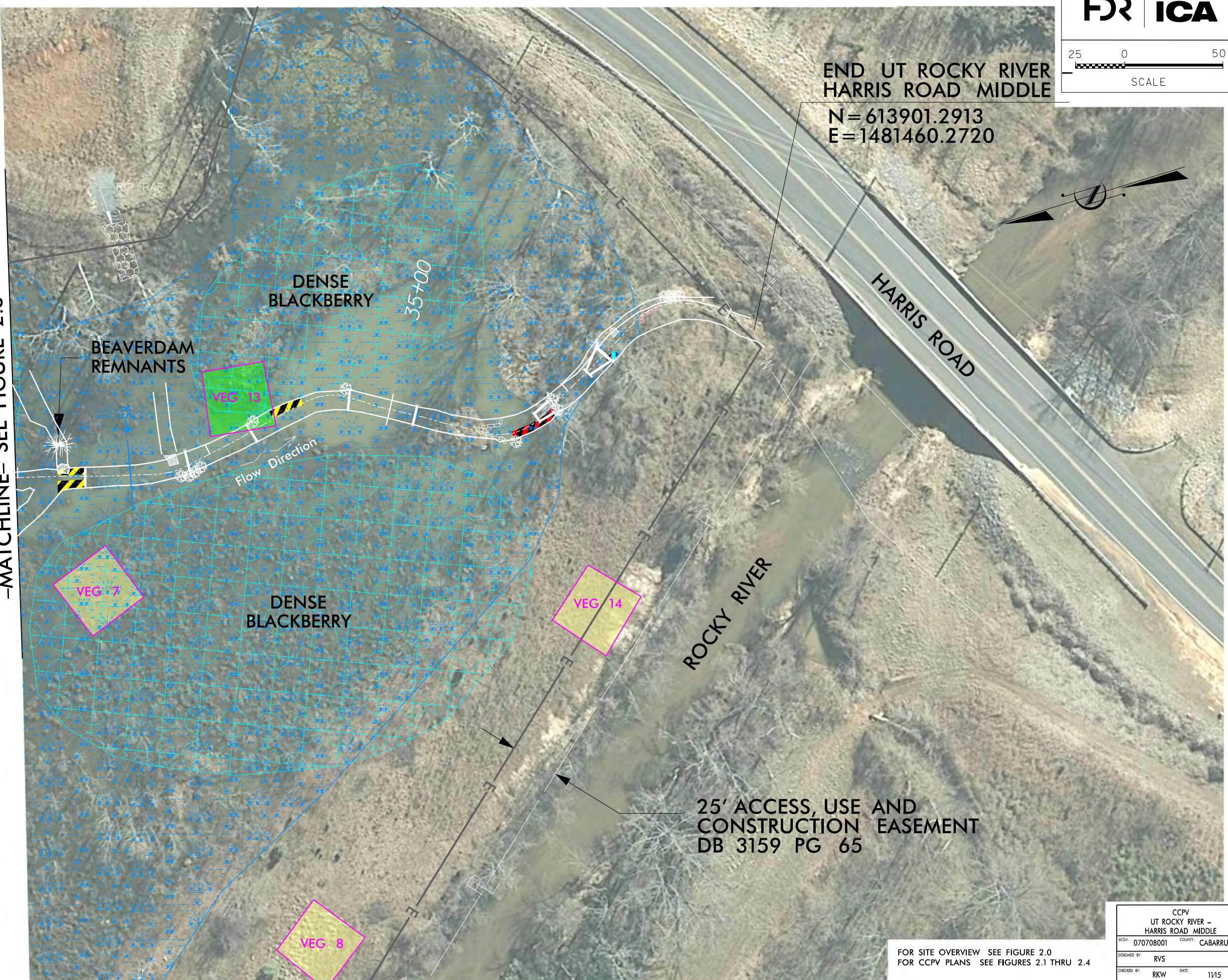


CURRENT CONDITIONS PLAN VIEW (CCPV)

- LEGEND**
- MONITORING CROSS SECTION
 - CREST GAUGE
 - EXISTING PROPERTY LINE
 - EASEMENT BOUNDARY
 - BANKFULL
 - THALWEG
 - 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 4 CONDITIONS**
- BANKBED CONDITION**
- MAJOR EROSION
 - MODERATE EROSION
 - MINOR EROSION
 - BEAVER DAM
- VEGETATION PROBLEM AREAS**
- DENSE BLACKBERRY
- IN-STREAM STRUCTURE CONDITION**
- FAILED
- VEGETATION PLOT CONDITIONS (PLANTED STEMS ONLY)**
- CRITERIA MET
 - CRITERIA UNMET
- SURVIVAL THRESHOLD MET WHEN INCLUDING NATURAL RECRUITS**

-MATCHLINE- SEE FIGURE 2.3



CCPV UT ROCKY RIVER - HARRIS ROAD MIDDLE	
SCDF: 070708001	COUNTY: CABARRUS
DESIGNED BY: RVS	
CHECKED BY: RKW	DATE: 11/15

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. <u>Aggradation</u> - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. <u>Degradation</u> - Evidence of downcutting			3	214	92%			
	2. Riffle Condition*	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	N/A	N/A			100%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient	36	36			100%			
		2. <u>Length</u> 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			12	199			
2. Undercut		Banks undercut/overhanging to the extent that mass wasting appears likely. Does <u>NOT</u> include 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 collapses			0	0	100%	N/A	N/A	N/A
Totals					12	199	96%	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.	26	27			96%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	26	27			96%			
	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).	N/A	N/A	0	0	0.00%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	All plots meet success when including natural recruits	N/A	0.00	0.00	0.00%
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 = 20.2						
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
4. Invasive Areas of Concern	Only areas dominated by Lespedeza are included in this table (areas of dense blackberry are shown on CCPV but not considered invasive)	All populations were mapped	See legend on CCPV	4	1.42	9.47%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	N/A	N/A	0	0	0.00%

Figures 3.1 - 3.20. Vegetation Plot Photos and Problem Areas



3.1 Vegetation Plot 1



3.2 Vegetation Plot 2



3.4 Vegetation Plot 4

PHOTO NOT AVAILABLE

3.3 Vegetation Plot 3



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

Appendix C. Vegetation Plot Data

Table 7. Vegetation Plot Mitigation Success Summary

UT Rocky River – Harris Road Middle (DMS 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	10	404	Yes
2	Piedmont Alluvial Forest (supplemental planting)	II	6	242	No*
3	Piedmont Alluvial Forest (riverine wetland area)	II	10	404	Yes
4	Piedmont Alluvial Forest (non-wetland area)	II	6	242	No*
5	Piedmont Alluvial Forest (riverine wetland area)	II	8	323	Yes
6	Piedmont Alluvial Forest (riverine wetland area)	II	12	485	Yes
7	Piedmont Alluvial Forest (riverine wetland area)	II	6	242	No*
8	Piedmont Alluvial Forest (non-wetland area)	II	6	242	No*
9	Piedmont Alluvial Forest (riverine wetland area & non-wetland area)	II	9	364	Yes
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	12	485	Yes
14	Piedmont Alluvial Forest (non-wetland area)	II	5	202	No*
Average Stems Per Acre				338	

*Survival threshold met when including natural recruits

Table 8. CVS Vegetation Metadata

Report Prepared By	Ben Furr
Date Prepared	10/26/2015 13:47
database name	cvs-eep-entrytool-v2.2.7.mdb
database location	S:\ UT_Rocky_River\Docs\Monitoring\CVS Data
computer name	NC12194
file size	55574528
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 4 Monitoring 2015)

Scientific Name	Common Name	Type	Plot 1		Plot 2		Plot 3		Plot 4	
			P	T	P	T	P	T	P	T
Acer negundo	Boxelder	Tree								
Acer rubrum	Red maple	Tree								
Alnus serrulata	Tag alder	Shrub								
Asimina triloba	Paw-paw	Shrub							1	1
Baccharis	baccharis	Shrub				4				
Baccharis halimifolia	Eastern baccharis	Shrub								1
Betula nigra	River birch	Tree								
Carya sp.	Hickory	Tree								
Carya ovata	Shagbark hickory	Tree							1	1
Celtis laevigata	Hackberry	Tree								
Cinnamomum	Cinnamomum	Tree								
Cornus amomum	Silky dogwood	Shrub					4	4		
Cornus florida	Flowering dogwood	Tree	2	2						
Diospyros virginiana	Common persimmon	Tree								6
Fraxinus pennsylvanica	Green ash	Tree	4	4	3	3			4	5
Liquidambar styraciflua	Sweetgum	Tree				1				
Liriodendron tulipifera	Yellow poplar	Tree								
Morella cerifera	Wax Myrtle	Shrub								
Platanus occidentalis	Sycamore	Tree					5	5		
Quercus sp.	Oak	Tree	1	1						
Quercus falcata	Southern red oak	Tree	3	3						
Quercus michauxii	Swamp chesnut oak	Tree								
Quercus phellos	Willow oak	Tree			2	3				
Rosa multiflora	Multiflora rose	Shrub								
Salix nigra	Black willow	Tree						2		
Sambucus canadensis	Common elderberry	Shrub								
Ulmus sp.	Elm	Tree								
Ulmus alata	Winged elm	Tree								
Ulmus americana	American elm	Tree			1	1	1	1		
Ulmus rubra	Slippery elm	Tree								
Plot Area (acres)			0.0247		0.0247		0.0247		0.0247	
Species Count			4	4	3	5	3	4	3	5
Stem Count			10	10	6	12	10	12	6	14
Stems per Acre			404.86	404.86	242.91	485.83	404.86	485.83	242.91	566.80

Table 9. Planted and Total Stem Counts (Species by Plot with Annual Means)
 UT Rocky River – Harris Road Middle (EEP IMS No. 92383) (Year 4 Monitoring 2015)

Scientific Name	Common Name	Type	Plot 5		Plot 6		Plot 7		Plot 8	
			P	T	P	T	P	T	P	T
Acer negundo	Boxelder	Tree								
Acer rubrum	Red maple	Tree								
Alnus serrulata	Tag alder	Shrub								
Asimina triloba	Paw-paw	Shrub								
Baccharis	baccharis	Shrub								
Baccharis halimifolia	Eastern baccharis	Shrub								
Betula nigra	River birch	Tree			1	1				
Carya sp.	Hickory	Tree								
Carya ovata	Shagbark hickory	Tree						2	2	
Celtis laevigata	Hackberry	Tree								
Cinnamomum	Cinnamomum	Tree								
Cornus amomum	Silky dogwood	Shrub		4		1	2	4		1
Cornus florida	Flowering dogwood	Tree								
Diospyros virginiana	Common persimmon	Tree								
Fraxinus pennsylvanica	Green ash	Tree	7	7			1	1		1
Liquidambar styraciflua	Sweetgum	Tree		1				2		
Liriodendron tulipifera	Yellow poplar	Tree								
Morella cerifera	Wax Myrtle	Shrub								
Platanus occidentalis	Sycamore	Tree	1	2					4	5
Quercus sp.	Oak	Tree								
Quercus falcata	Southern red oak	Tree								
Quercus michauxii	Swamp chesnut oak	Tree			3	3				
Quercus phellos	Willow oak	Tree			4	6	3	3		
Rosa multiflora	Multiflora rose	Shrub								
Salix nigra	Black willow	Tree		1				1		
Sambucus canadensis	Common elderberry	Shrub								
Ulmus sp.	Elm	Tree								
Ulmus alata	Winged elm	Tree								
Ulmus americana	American elm	Tree			4	5				
Ulmus rubra	Slippery elm	Tree								
Plot Area (acres)			0.0247		0.0247		0.0247		0.0247	
Species Count			2	5	4	5	3	5	2	4
Stem Count			8	15	12	16	6	11	6	9
Stems per Acre			323.89	607.29	485.83	647.77	242.91	445.34	242.91	364.37

Table 9. Planted and Total Stem Counts (Species by Plot with Annual Means)
 UT Rocky River – Harris Road Middle (EEP IMS No. 92383) (Year 4 Monitoring 2015)

Scientific Name	Common Name	Type	Plot 9		Plot 10		Plot 11		Plot 12	
			P	T	P	T	P	T	P	T
Acer negundo	Boxelder	Tree								
Acer rubrum	Red maple	Tree		1						
Alnus serrulata	Tag alder	Shrub			1	1				
Asimina triloba	Paw-paw	Shrub			1	1				
Baccharis	baccharis	Shrub								
Baccharis halimifolia	Eastern baccharis	Shrub								
Betula nigra	River birch	Tree								
Carya sp.	Hickory	Tree								
Carya ovata	Shagbark hickory	Tree								
Celtis laevigata	Hackberry	Tree								
Cinnamomum	Cinnamomum	Tree								
Cornus amomum	Silky dogwood	Shrub					6		20	
Cornus florida	Flowering dogwood	Tree		1						
Diospyros virginiana	Common persimmon	Tree				1				
Fraxinus pennsylvanica	Green ash	Tree	1	2			5	5	1	1
Liquidambar styraciflua	Sweetgum	Tree				10				8
Liriodendron tulipifera	Yellow poplar	Tree								
Morella cerifera	Wax Myrtle	Shrub								
Platanus occidentalis	Sycamore	Tree	5	7	3	5	6	7		
Quercus sp.	Oak	Tree								
Quercus falcata	Southern red oak	Tree	3	3	1	1	1	1		
Quercus michauxii	Swamp chesnut oak	Tree							3	3
Quercus phellos	Willow oak	Tree							5	5
Rosa multiflora	Multiflora rose	Shrub								
Salix nigra	Black willow	Tree		3						
Sambucus canadensis	Common elderberry	Shrub								
Ulmus sp.	Elm	Tree								
Ulmus alata	Winged elm	Tree								
Ulmus americana	American elm	Tree								
Ulmus rubra	Slippery elm	Tree								
Plot Area (acres)			0.0247		0.0247		0.0247		0.0247	
Species Count			3	6	4	6	3	4	3	5
Stem Count			9	17	6	19	12	19	9	37
Stems per Acre			364.37	688.26	242.91	769.23	485.83	769.23	364.37	1497.98

Table 9. Planted and Total Stem Counts (Species by Plot with Annual Means)
 UT Rocky River – Harris Road Middle (EEP IMS No. 92383) (Year 4 Monitoring 2015)

Scientific Name	Common Name	Type	Plot 13		Plot 14	
			P	T	P	T
Acer negundo	Boxelder	Tree				
Acer rubrum	Red maple	Tree				
Alnus serrulata	Tag alder	Shrub				
Asimina triloba	Paw-paw	Shrub				
Baccharis	baccharis	Shrub				
Baccharis halimifolia	Eastern baccharis	Shrub				
Betula nigra	River birch	Tree	2	2		
Carya sp.	Hickory	Tree				
Carya ovata	Shagbark hickory	Tree				
Celtis laevigata	Hackberry	Tree	2	2		
Cinnamomum	Cinnamomum	Tree				
Cornus amomum	Silky dogwood	Shrub				2
Cornus florida	Flowering dogwood	Tree				
Diospyros virginiana	Common persimmon	Tree				
Fraxinus pennsylvanica	Green ash	Tree	4	4	1	1
Liquidambar styraciflua	Sweetgum	Tree				4
Liriodendron tulipifera	Yellow poplar	Tree				
Morella cerifera	Wax Myrtle	Shrub				
Platanus occidentalis	Sycamore	Tree	1	1	1	1
Quercus sp.	Oak	Tree				
Quercus falcata	Southern red oak	Tree				7
Quercus michauxii	Swamp chesnut oak	Tree	3	3	3	3
Quercus phellos	Willow oak	Tree				
Rosa multiflora	Multiflora rose	Shrub				
Salix nigra	Black willow	Tree				
Sambucus canadensis	Common elderberry	Shrub				
Ulmus sp.	Elm	Tree				3
Ulmus alata	Winged elm	Tree				
Ulmus americana	American elm	Tree				
Ulmus rubra	Slippery elm	Tree				
Plot Area (acres)			0.0247		0.0247	
Species Count			5	5	3	7
Stem Count			12	12	5	21
Stems per Acre			485.83	486	202.4291	850

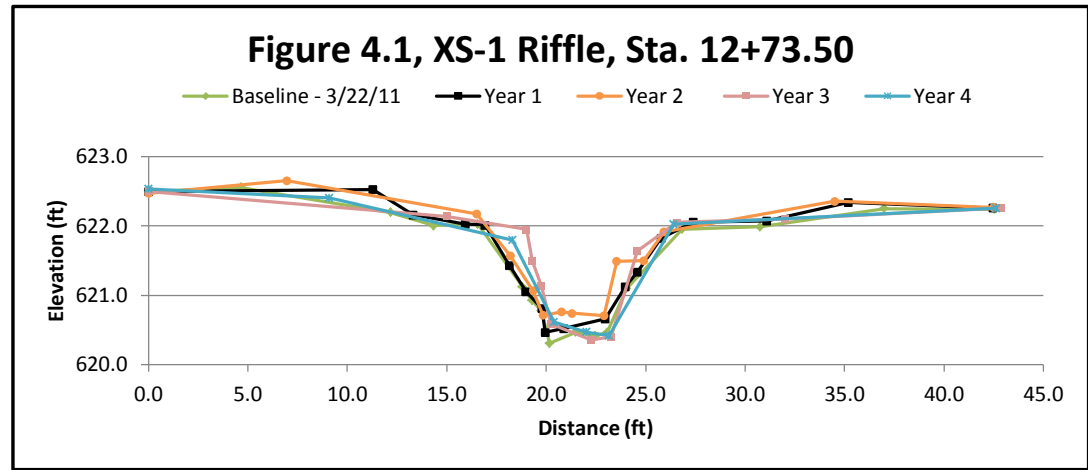
Table 9. Planted and Total Stem Counts (Species by Plot with Annual Means)
 UT Rocky River – Harris Road Middle (EEP IMS No. 92383) (Year 4 Monitoring 2015)

Scientific Name	Common Name	Type	YR4 (2015)		YR3 (2014)		YR2 (2013)		YR1(2012)	
			P	T	P	T	P	T	P	T
Acer negundo	Boxelder	Tree	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
Acer rubrum	Red maple	Tree	0.0	1.0	0.0	5.0	0.0	3.5	0.0	11.0
Alnus serrulata	Tag alder	Shrub	0.5	0.0	1.0	1.0	1.0	3.0	1.0	1.0
Asimina triloba	Paw-paw	Shrub	0.7	0.0	1.5	1.0	1.0	1.0	1.7	1.7
Baccharis	baccharis	Shrub	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
Baccharis halimifolia	Eastern baccharis	Shrub	0.0	1.0	0.0	2.3	0.0	2.0	0.0	4.0
Betula nigra	River birch	Tree	1.0	0.0	1.5	2.0	1.5	1.5	1.5	1.5
Carya sp.	Hickory	Tree	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
Carya ovata	Shagbark hickory	Tree	1.0	0.0	1.5	1.5	1.5	1.5	1.5	1.5
Celtis laevigata	Hackberry	Tree	1.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0
Cinnamomum	Cinnamomum	Tree	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0
Cornus amomum	Silky dogwood	Shrub	2.0	5.3	3.0	4.0	3.0	3.8	2.7	4.7
Cornus florida	Flowering dogwood	Tree	1.0	1.5	2.0	4.1	1.0	1.0	2.0	2.0
Diospyros virginiana	Common persimmon	Tree	0.0	3.5	0.0	2.7	0.0	3.3	0.0	3.3
Fraxinus pennsylvanica	Green ash	Tree	2.8	3.1	3.2	4.3	3.6	3.6	3.5	3.3
Liquidambar styraciflua	Sweetgum	Tree	0.0	4.3	5.0	7.3	0.0	9.3	0.0	9.8
Liriodendron tulipifera	Yellow poplar	Tree	0.0	0.0	0.0	1.7	1.0	1.0	1.0	1.0
Morella cerifera	Wax Myrtle	Shrub	0.0	0.0	0.0	7.0	0.0	1.0	0.0	0.0
Platanus occidentalis	Sycamore	Tree	2.9	4.1	3.1	3.0	3.4	3.3	3.4	3.4
Quercus sp.	Oak	Tree	0.5	0.0	1.0	1.5	1.0	1.0	1.5	1.5
Quercus falcata	Southern red oak	Tree	1.6	3.0	3.0	4.5	2.6	2.6	3.4	3.4
Quercus michauxii	Swamp chesnut oak	Tree	2.4	0.0	2.3	2.5	2.5	2.3	2.8	2.8
Quercus phellos	Willow oak	Tree	2.8	4.3	3.5	4.0	3.8	3.8	3.8	3.8
Rosa multiflora	Multiflora rose	Shrub	0.0	0.0	0.0	1.0	0.0	1.8	0.0	1.5
Salix nigra	Black willow	Tree	0.0	1.8	0.0	1.0	0.0	1.0	0.0	3.5
Sambucus canadensis	Common elderberry	Shrub	0.0	0.0	0.0	2.0	0.0	4.5	0.0	5.7
Ulmus sp.	Elm	Tree	0.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0
Ulmus alata	Winged elm	Tree	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
Ulmus americana	American elm	Tree	1.5	2.3	2.0	2.5	2.0	3.0	2.0	5.5
Ulmus rubra	Slippery elm	Tree	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0
Plot Area (acres)										
Species Count			3.2	5.0	3.4	6.1	3.4	6.0	3.6	6.2
Stem Count			8.4	16.0	9.2	21.7	9.1	19.0	10.1	24.6
Stems per Acre			338	648	373	879.1	367	769.2308	410.642	994.7947

Appendix D. Stream Survey Data

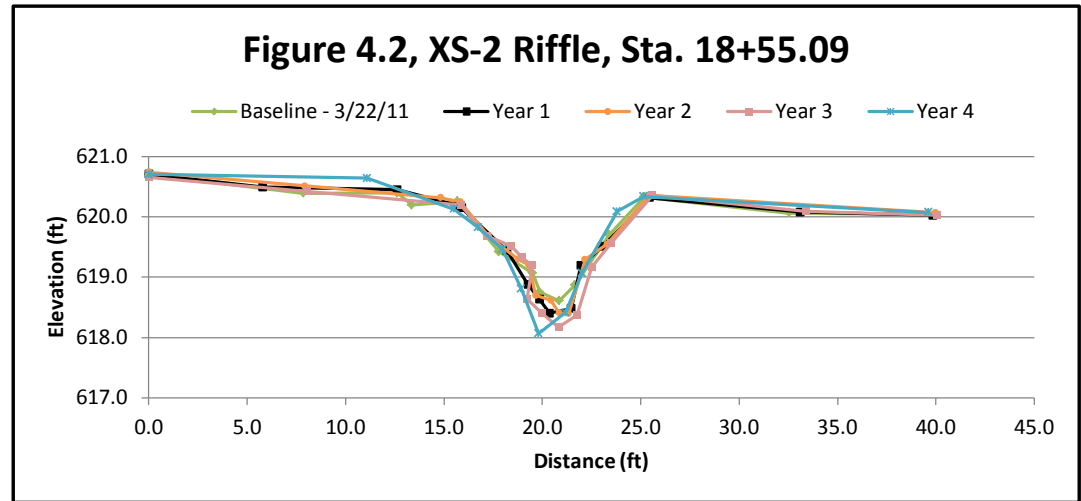
XS-1 Riffle, Sta. 12+73.50

Baseline		MY1		MY2		MY3	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	622.50	0.00	622.49	0.00	622.47	0.00	622.50
4.66	622.55	11.29	622.52	6.96	622.65	15.00	622.14
12.17	622.19	13.30	622.16	16.51	622.17	19.00	621.95
14.34	622.00	15.92	622.02	18.21	621.57	19.30	621.49
16.56	622.02	16.91	622.01	19.34	621.07	19.75	621.14
18.81	621.12	18.13	621.43	19.85	620.71	20.25	620.59
19.28	620.93	18.97	621.05	20.76	620.76	22.25	620.36
19.76	620.78	19.79	620.81	21.29	620.74	23.25	620.40
20.16	620.31	19.94	620.47	22.90	620.70	24.58	621.64
21.49	620.47	20.89	620.52	23.54	621.49	26.58	622.05
22.46	620.41	22.97	620.66	24.90	621.50	32.00	622.10
23.07	620.47	23.97	621.12	25.92	621.92	42.83	622.26
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				
MY4							
Sta.	Elev.						
0.00	622.53						
9.09	622.40						
18.31	621.79						
20.39	620.61						
22.04	620.47						
23.15	620.42						
26.41	622.02						
42.62	622.25						



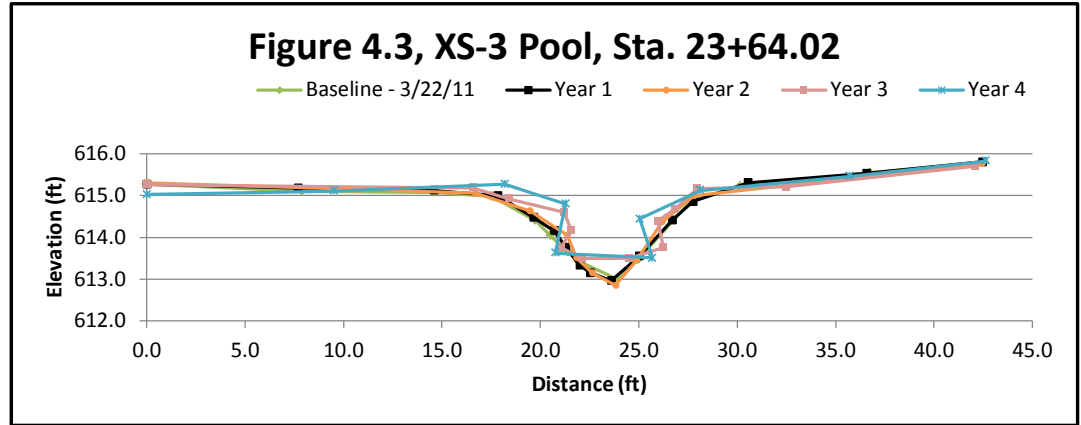
XS-2 Riffle, Sta. 18+55.09

Baseline		MY1		MY2		MY3	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	620.70	0.00	620.71	0.00	620.74	0.00	620.65
7.86	620.39	5.80	620.49	7.92	620.51	8.06	620.41
12.63	620.39	12.62	620.45	14.84	620.31	15.84	620.19
13.37	620.19	15.74	620.18	15.82	620.25	17.21	619.68
15.68	620.25	15.90	620.15	17.27	619.67	18.40	619.51
17.78	619.42	18.20	619.43	18.77	619.29	18.96	619.33
19.50	619.06	19.27	618.88	19.31	619.20	19.49	619.19
19.86	618.75	19.85	618.63	19.66	618.70	19.21	618.64
20.85	618.60	20.36	618.40	20.43	618.62	20.01	618.40
21.67	618.87	21.46	618.47	20.86	618.40	20.82	618.17
23.40	619.70	21.97	619.19	21.34	618.40	21.77	618.37
25.18	620.33	23.05	619.51	22.17	619.29	22.51	619.17
32.54	620.06	25.46	620.31	23.28	619.54	23.48	619.56
39.94	620.04	33.11	620.07	25.45	620.36	25.59	620.36
		39.86	620.02	40.00	620.06	33.38	620.09
						40.06	620.03
MY4							
Sta.	Elev.						
0.00	620.70						
11.10	620.64						
15.51	620.12						
16.73	619.82						
17.99	619.46						
18.92	618.81						
19.80	618.07						
21.18	618.41						
22.02	619.07						
23.80	620.09						
25.15	620.33						
39.63	620.07						



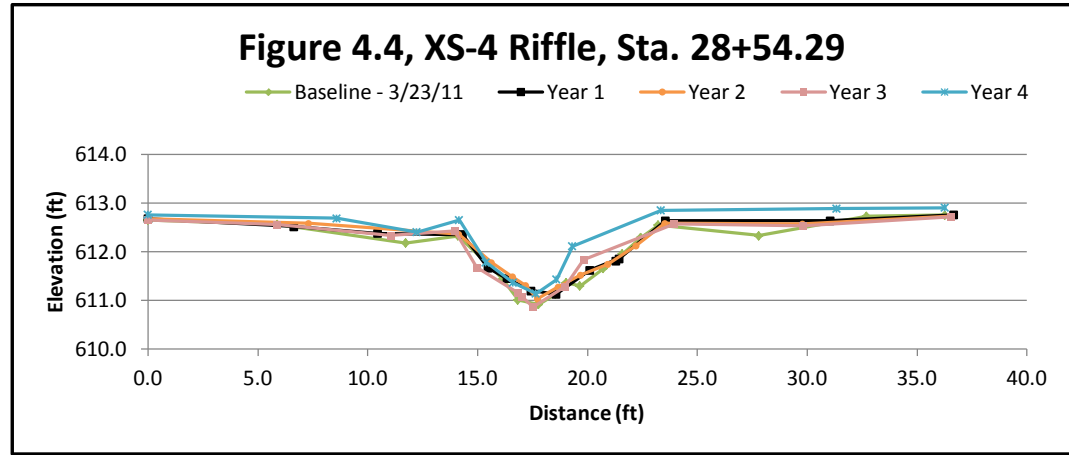
XS-3 Pool, Sta. 23+64.02

Baseline		MY1		MY2		MY3	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	615.27	0.0	615.28	0.0	615.31	0.0	615.27
7.90	615.10	7.7	615.18	10.7	615.15	16.6	615.19
14.63	615.08	14.6	615.12	16.7	615.05	18.4	614.93
17.53	614.99	17.8	615.00	19.5	614.64	21.2	614.59
19.75	614.41	19.7	614.47	21.4	614.04	21.6	614.17
20.53	614.04	20.7	614.16	21.8	613.52	21.1	613.75
21.39	613.65	21.3	613.76	22.6	613.15	22.1	613.49
21.92	613.43	22.0	613.33	23.8	612.85	24.5	613.50
23.93	612.99	22.5	613.15	24.9	613.44	26.2	613.76
25.03	613.49	23.6	612.96	26.2	614.37	26.0	614.40
27.66	614.87	25.0	613.54	27.8	615.00	26.8	614.68
30.14	615.22	26.7	614.41	42.4	615.77	28.0	615.16
36.75	615.54	27.8	614.86			32.5	615.21
42.56	615.79	30.5	615.31			42.1	615.70
		36.6	615.53				
		42.5	615.81				
MY4							
Sta.	Elev.						
0.00	615.03						
9.51	615.11						
18.19	615.28						
21.29	614.80						
20.77	613.62						
25.70	613.50						
25.06	614.44						
28.13	615.12						
35.73	615.46						
42.64	615.83						



XS-4 Riffle, Sta. 28+54.29

Baseline		MY1		MY2		MY3	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	612.65	0.00	612.68	0.00	612.68	0.00	612.65
5.91	612.56	6.65	612.52	7.32	612.59	5.87	612.55
11.74	612.18	10.45	612.38	14.15	612.36	11.04	612.33
14.13	612.33	14.31	612.35	15.63	611.78	13.98	612.42
15.57	611.70	15.49	611.66	16.59	611.49	14.96	611.68
16.14	611.43	16.36	611.45	17.18	611.31	16.85	611.16
16.84	611.00	17.43	611.20	17.74	611.03	17.02	611.07
17.79	610.91	18.58	611.12	18.68	611.28	17.51	610.86
18.55	611.13	20.12	611.62	19.68	611.52	18.97	611.28
19.04	611.36	21.46	611.86	20.93	611.74	19.83	611.83
19.67	611.30	21.31	611.81	22.22	612.12	23.95	612.57
20.73	611.65	23.56	612.64	23.53	612.58	29.81	612.53
21.59	611.95	31.05	612.63	29.80	612.57	36.54	612.71
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						
MY4							
Sta.	Elev.						
0.00	612.76						
8.59	612.69						
12.25	612.40						
14.16	612.65						
15.39	611.78						
16.62	611.36						
17.67	611.14						
18.60	611.43						
19.33	612.11						
23.36	612.85						
31.36	612.89						
36.27	612.91						



XS-5 Pool, Sta. 31+53.85

Baseline		MY1		MY2		MY3	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	611.81	0.00	611.79	0.00	611.81	0.00	611.80
4.96	611.92	5.69	611.95	9.05	611.82	7.57	611.95
8.92	611.81	8.84	611.79	12.54	611.11	10.72	611.61
12.17	611.25	11.17	611.40	15.05	610.64	11.49	611.46
13.60	611.02	13.18	610.97	16.46	609.90	12.62	611.18
14.48	610.90	14.92	610.50	17.20	609.42	13.90	610.86
15.40	610.33	16.43	610.07	17.87	609.42	14.95	610.74
16.19	610.05	17.35	609.43	18.74	609.49	15.56	610.11
18.00	609.75	18.40	609.43	19.03	609.82	15.86	609.36
18.81	610.06	18.57	609.50	20.17	611.08	16.84	609.10
19.50	610.68	20.05	610.88	22.46	611.71	18.01	609.34
21.19	611.56	21.30	611.54	31.76	611.53	19.45	609.77
22.79	611.94	22.87	611.97	39.10	611.45	19.93	611.12
26.94	611.65	31.64	611.47			21.37	611.48
33.80	611.56	39.11	611.49			22.20	611.91
38.93	611.51					31.95	611.6
MY4						38.96	611.5
Sta.	Elev.						
0.00	611.82						
9.46	611.83						
14.65	611.10						
17.48	610.01						
19.09	609.63						
19.05	609.83						
20.63	611.41						
26.21	611.74						
39.69	611.50						

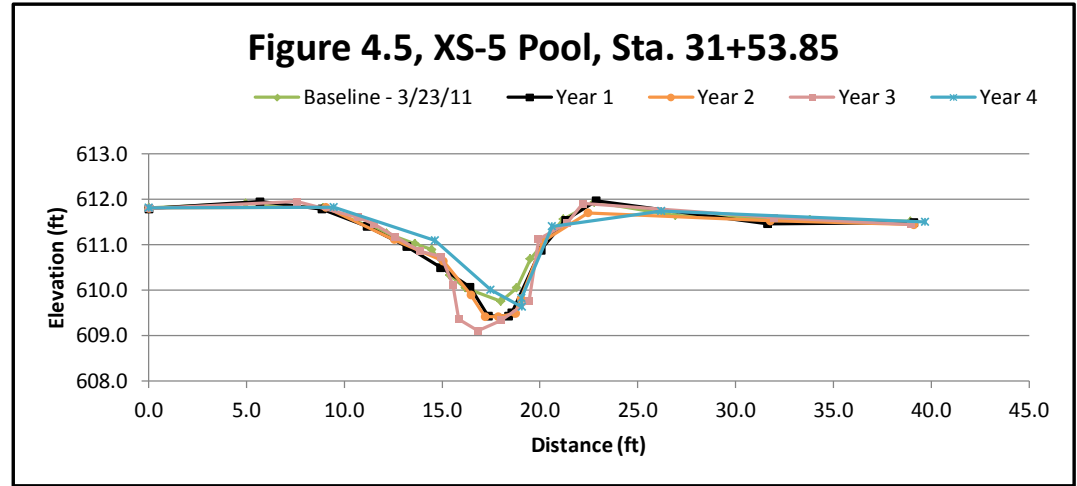


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XS-6 Pool (formerly Riffle), Sta. 33+18.49

Baseline		MY1		MY2		MY3	
Sta.	Elev.	Sta.	Elev.	Sta.	Elev.	Sta.	Elev.
0.00	611.00	0.00	610.98	0.00	611.00	0.00	610.97
7.89	610.75	6.68	610.74	6.68	610.96	8.60	610.65
11.38	610.58	11.23	610.66	11.19	610.64	11.76	610.71
14.26	609.95	15.51	609.59	14.29	609.95	13.25	610.05
16.03	609.43	16.26	609.03	15.91	609.59	14.81	609.88
16.60	609.08	17.51	607.99	16.65	608.59	16.06	609.47
16.95	608.81	18.07	607.99	17.93	607.45	16.49	608.60
18.13	608.72	18.85	608.36	19.38	607.46	17.62	607.22
19.09	609.00	19.25	608.85	20.78	609.67	20.24	607.13
20.26	609.47	20.05	609.05	22.71	610.56	21.16	609.68
22.68	610.61	22.66	610.56	29.46	610.67	22.90	610.54
28.83	610.59	28.59	610.56	35.85	611.08	24.47	610.65
33.03	610.92	35.81	611.16			29.94	610.72
35.68	611.18					35.98	611.16
MY4							
Sta.	Elev.						
0.00	611.00						
11.89	610.54						
15.47	609.81						
17.14	608.65						
18.25	607.29						
19.13	607.16						
19.60	609.49						
20.10	610.09						
27.83	610.67						
36.47	611.11						

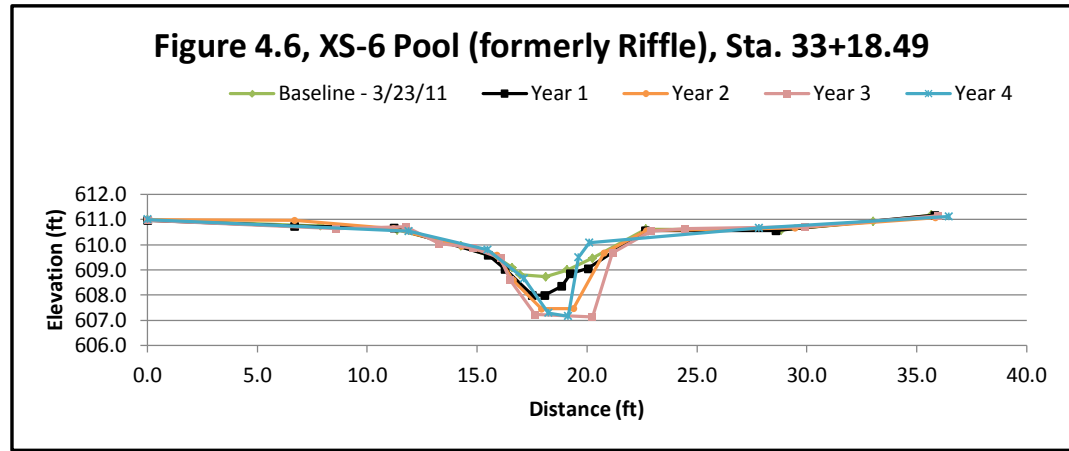


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Figure 5.1 UT Rocky River - Longitudinal Profile

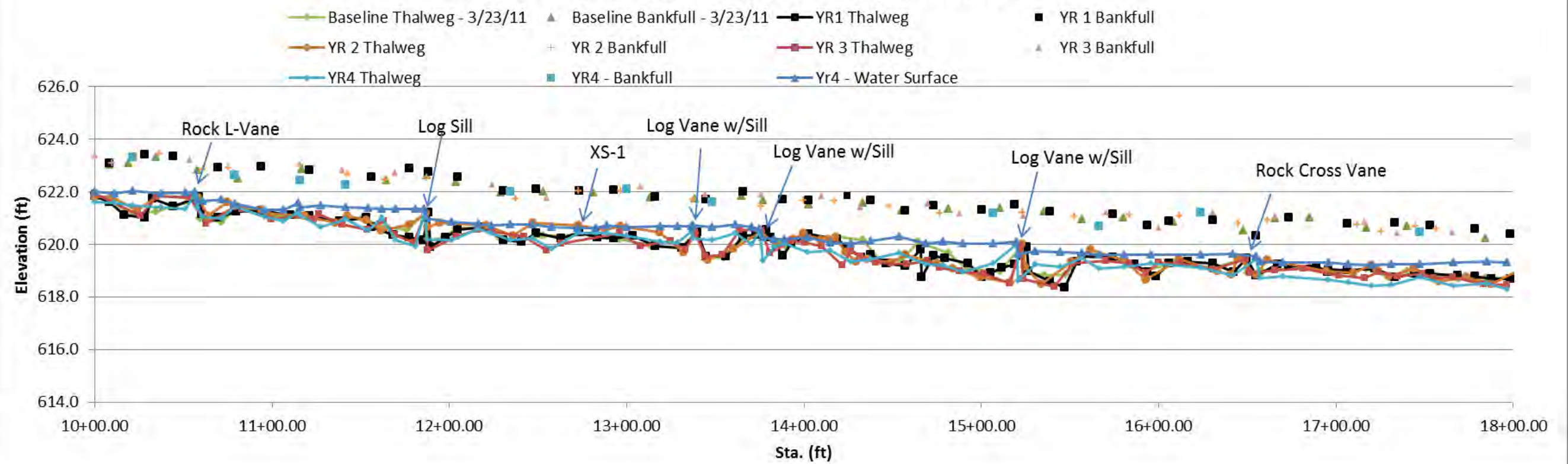


Figure 5.2 UT Rocky River - Longitudinal Profile

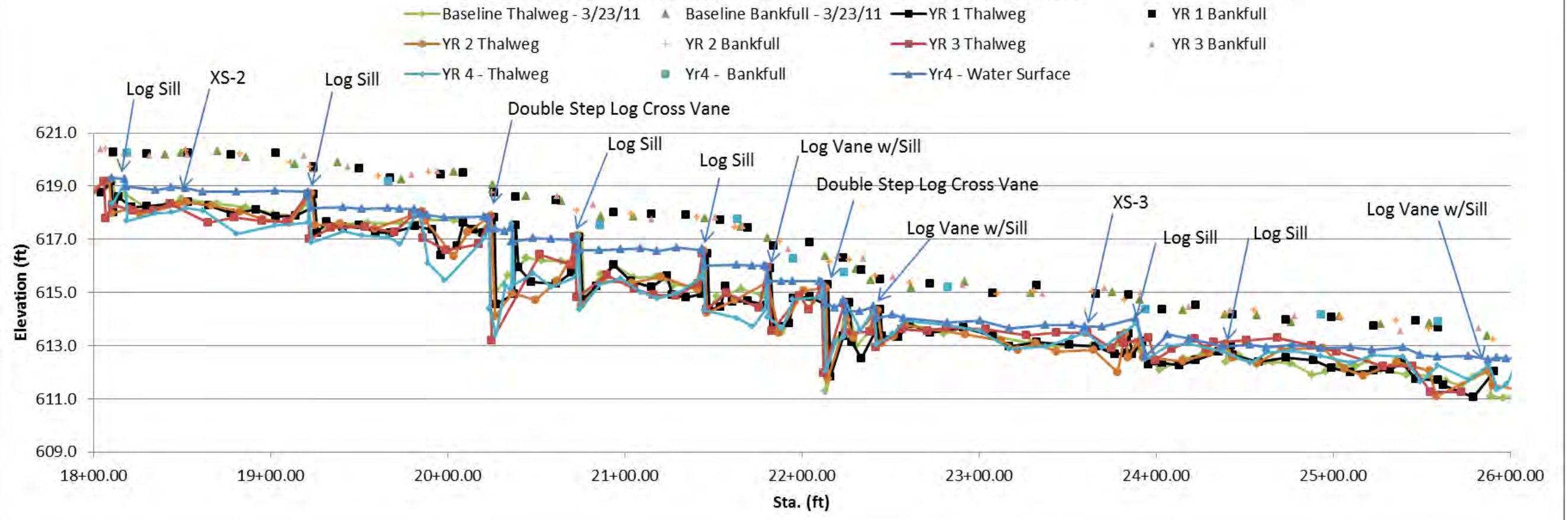


Figure 5.3 UT Rocky River - Longitudinal Profile

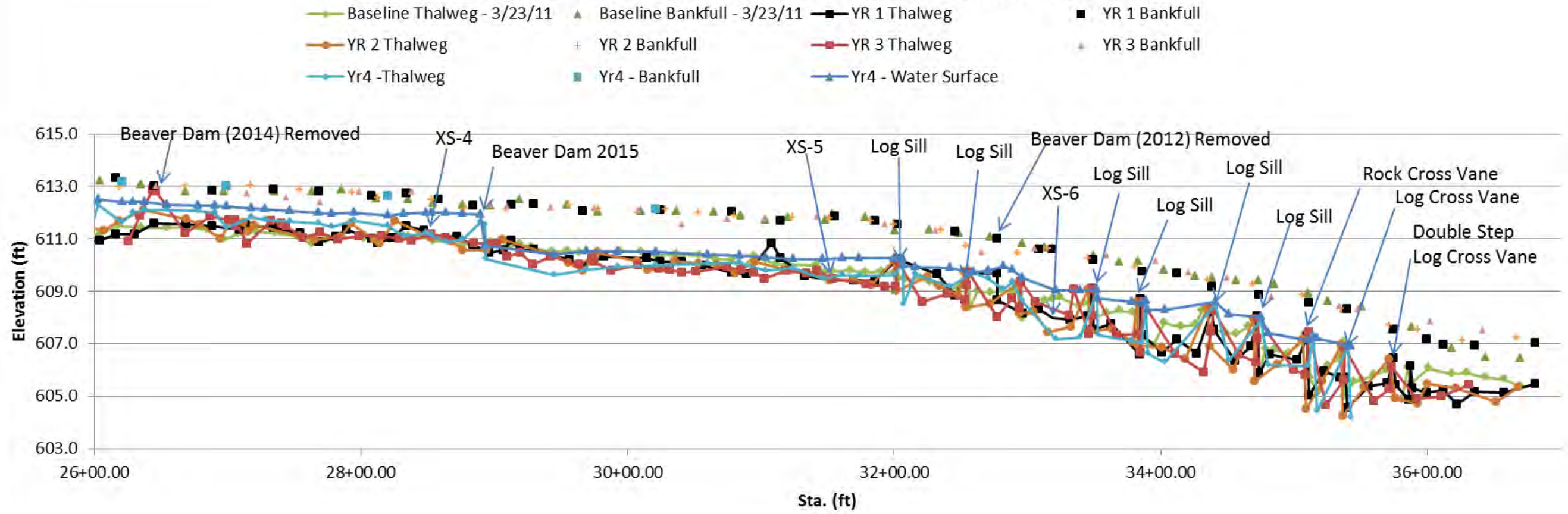


Table 10. Baseline Stream Data Summary
UT Rocky River - Harris Road Middle, DMS IMS No. 92383
UT Rocky River: 2,715 lf

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					
								Min	Mean	Med	Max	SD	n
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/ di ^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						
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 (DMS 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	8.70	7.09	7.63			9.30	10.06	9.34	8.91	9.23		
Floodprone Width (ft)	185.00	185.00	185.00	185.00	185.00			175.00	175.00	175.00	175.00	175.00		
Bankfull Mean Depth (ft)	0.90	0.87	0.73	0.97	0.88			0.90	0.83	0.88	0.51	0.83		
Bankfull Max Depth (ft)	1.60	1.56	1.21	1.59	1.37			1.65	1.83	1.85	2.02	2.02		
Bankfull Cross Sectional Area (ft ²)	9.20	8.93	6.31	6.89	6.70			8.00	8.33	8.18	9.73	7.67		
Bankfull Width/Depth Ratio	11.10	11.85	11.99	7.31	8.69			10.80	12.12	10.67	17.47	11.12		
Bankfull Entrenchment Ratio	18.30	17.94	21.26	26.09	24.24			18.80	17.40	18.74	19.64	19.95		
Bankfull Bank Height Ratio	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00	1.00	1.00		
	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	11.16	10.00			8.50	8.88	8.75	9.10	8.05		
Floodprone Width (ft)	132.00	132.00	132.00	132.00	132.00			292.00	292.00	292.00	292.00	292.00		
Bankfull Mean Depth (ft)	0.97	0.96	0.92	0.87	0.82			0.80	0.85	0.69	0.51	0.74		
Bankfull Max Depth (ft)	2.00	1.97	2.15	1.67	1.66			1.40	1.38	1.33	1.56	1.50		
Bankfull Cross Sectional Area (ft ²)	10.68	9.75	9.84	9.75	8.22			6.70	7.50	6.01	7.09	5.98		
Bankfull Width/Depth Ratio	11.36	10.55	11.71	12.83	12.24			10.70	10.45	12.73	17.84	10.88		
Bankfull Entrenchment Ratio	12.00	13.03	12.30	11.83	13.2			34.30	32.88	33.38	32.09	36.27		
Bankfull Bank Height Ratio	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00	1.00	1.00		
	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	10.80	13.00			11.60	11.24	11.17	10.80	11.50		
Floodprone Width (ft)	300.00	300.00	300.00	300.00	300.00			250.00	250.00	250.00	250.00	250.00		
Bankfull Mean Depth (ft)	0.90	1.09	0.99	1.13	0.66			0.90	1.18	1.31	1.61	0.88		
Bankfull Max Depth (ft)	2.05	2.45	2.29	2.50	1.98			1.90	2.62	3.11	3.41	3.23		
Bankfull Cross Sectional Area (ft ²)	12.30	14.95	12.72	12.28	8.65			10.70	13.27	14.64	17.41	10.11		
Bankfull Width/Depth Ratio	14.50	12.58	12.95	9.56	19.76			12.60	9.53	8.52	6.71	13.08		
Bankfull Entrenchment Ratio	22.60	21.88	23.37	27.78	23.07			21.60	22.24	22.38	23.15	21.73		
Bankfull Bank Height Ratio	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00	1.00	1.00		

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 (DMS IMS No. 92383)

UT Rocky River - 2.715 lf

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5							
	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		
Dimension and substrate - Riffle only																																						
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	7.09	8.37	8.91	9.10	1.11	3	7.63	8.30	8.05	9.23	0.83	3								
Floodprone Width (ft)	175	226	218	292	55	4	175	226	218	292	55	4	175	217	185	292	65	3	175	217	185	292	65	3	175.00	217.33	185.00	292.00	64.86	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	0.51	0.66	0.51	0.97	0.27	3	0.74	0.82	0.83	0.88	0.07	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	1.56	1.72	1.59	2.02	0.26	3	1.37	1.63	1.50	2.02	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	6.89	7.90	7.09	9.73	1.59	3	5.98	6.78	6.70	7.67	0.85	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	7.31	14.21	17.47	17.84	5.98	3	8.69	10.23	10.88	11.12	1.34	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	19.64	25.94	26.09	32.09	6.22	3	19.95	26.82	24.24	36.27	8.46	3								
¹ Bank Height Ratio	1	1	1	1	0	4	1	1	1	1	0	4	1	1	1	1	0	3	1	1	1	1	0	3	1.00	1.00	1.00	1.00	0.00	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	9.91	25.56	19.82	79.29	15.44	48	9.92	58.39	51.88	131.49	35.05	14								
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	0.0053	0.025	0.025	0.048	0.009	48	0.0006	0.004	0.002	0.015	0.005	14								
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	11.89	30.48	29.73	69.38	12.37	46	8.28	29.83	27.32	68.64	17.43	30								
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	1.39	2.44	2.30	5.62	0.78	46	1.56	2.28	2.01	4.03	0.79	16								
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	6.47	52.19	48.56	176.41	29.41	45	13.25	46.48	40.47	105.57	24.20	30								
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						C5						C5													
Channel Thalweg length (ft)	2715						2715						2715						2715						2715													
Sinuosity (ft)	1.25						1.25						1.25						1.25						1.25													
Water Surface Slope (Channel) (ft/ft)	0.006						0.006						0.006						0.0053						0.0060													
BF slope (ft/ft)	0.006						0.006						0.006						0.006						0.0059													
² R% / P%	43% / 57%						38% / 62%						28% / 72%						45% / 55%						48% / 52%													
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 parameters can include information from both the 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, dsp = 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
9/23/2014	1	16+85	1.66	620.65	622.31	621.05	1.26	6.5
9/23/2014	2	29+70	1.83	611.80	613.65	612.33	1.32	6.6
3/24/2015	2	29+70	1.29	611.80	613.09	612.33	0.76	6.7
9/21/2015	1	16+85	1.46	620.65	622.11	621.05	1.06	6.8

Figures 6.1 - 6.6 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)



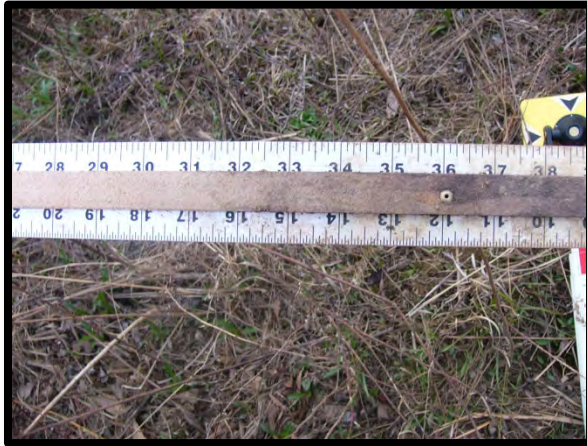
6.4 Crest Gauge 2 (9/24/2013)



6.5 Crest Gauge 1 (9/23/2014)



6.6 Crest Gauge 2 (9/23/2014)



6.7 Crest Gauge 2 (3/24/2015)



6.8 Crest Gauge 1 (9/21/2015)