

**UT to Little Hunting Creek (Johnson Site)
Stream Restoration Monitoring Report**

**EEP Project # 197
EEP Contract # D09078s
Monitoring Year 05**



Submitted to:



NCEEP, 1652 Mail Service Center, Raleigh, NC 27699-1652

Construction Completed: November 2007

Data Collection: September 2014

Submitted: December 2014

Design and Monitoring Firm



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1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The unnamed tributary to Little Hunting Creek (UTLHC) Stream Restoration Project (Site) is located west of Harmony Highway (NC 21) and north of Hunting Creek Road (SR 1111) in Iredell County, North Carolina (Appendix 1.1). The Site lies within the 197 acre parcel owned by Mr. Allen D. Johnson. UTLHC is a first order perennial stream located in the Northern Inner Piedmont ecoregion in the Yadkin River Basin (USGS HUC 03040102). The stream restoration plan was designed by KCI Associates of North Carolina. Project streams were restored primarily using a Priority III restoration approach. UTLHC's main channel was designed and constructed as a B4c type channel. The restoration reach was restored using native vegetation and in-stream structures, such as cross-vanes and rock sill grade controls. Riparian areas were planted with native bare root seedlings and herbaceous cover to enhance the riparian areas and stabilize stream banks. Construction of the restoration project was completed in the fall of 2007. Appendix A provides more detailed project activity, history, contact information, and watershed/site background information for this project.

Project Goals

- Restore a stable channel morphology and floodplain to the project stream that is capable of moving the flows and sediment provided by its watershed.
- Improve water quality by reducing bank erosion and bed degradation.
- Enhance aquatic and terrestrial habitat in the stream corridor.

Project Objectives

- Build an appropriate B4c type channel with stable dimensions.
- Plant a riparian buffer of native trees and shrubs throughout the site.
- Grade a floodplain adjacent to the stream.
- Exclude livestock from the riparian buffer.

The 2014 monitoring found UTLHC to generally be stable with little change from the previous monitoring year. The stream structures are in good condition and continue to maintain grade. Areas of in-stream vegetation noted in previous monitoring years have washed out completely with the exception of a few localized areas at the very top of the site. Areas of channel degradation at the bottom of the site reported on in previous monitoring years also appear to be the result of sediment deposition on the banks and bankfull bench due to backwater conditions when Little Hunting Creek rises. As a part of the stream success criterion, the stream must experience at least two bankfull events, each in separate monitoring years. The site has experienced multiple bankfull events since construction.

The vegetation monitoring success criterion for the planted stream riparian zone during fifth-year monitoring is a density of 260 stems/acre. The fifth-year vegetation monitoring was based on the Level 2 CVS-EEP vegetation monitoring protocol. Overall, the Site has an average density of 301 planted stems/acre, excluding live stakes. Of all the vegetation monitoring plots, Plots 1, 4, and 7 had planted stem densities below the five-year success criterion of 260 stems/acre. Including volunteers, the Site averaged 1,174 total stems/acre. While there are some isolated invasive species, including Chinese privet (*Ligustrum sinense*), tree of heaven (*Alnus altissima*), and Japanese honeysuckle (*Lonicera japonica*), none of these are especially prevalent or taking over any one particular area. Overall the site is well vegetated with a dense cover of herbaceous and woody species.

Summary information/data related to the occurrence of items such as beaver or encroachment 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 and in the Mitigation Plan documents available on the EEPs website. All raw data supporting the tables and figures in the appendices are available from EEP upon request.

2.0 METHODOLOGY

The survey data were collected with a Total Station instrument.

The stationing for the longitudinal profile is based on the thalweg stationing and has been adjusted to match grade control structures from previous longitudinal profiles. The stationing was adjusted by changing the stationing between grade control structures to match the stationing from previous surveys.

The CVS-EEP protocol, Level 2 (<http://cvs.bio.unc.edu/methods.htm>) was used to collect vegetation data from the site.

3.0 REFERENCES

- Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E., 2003. Stream Restoration A Natural Channel Design Handbook.
- Harrelson, Cheryl C; Rawlins, C.L.; Potyondy, John P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique*. Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.
- KCI Associates of NC. 2008. Johnson Site Stream Restoration Mitigation Plan and As-Built Report (2008). Raleigh, NC
- Lee, M.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>)
- Rosgen, D L. 1996. Applied River Morphology. Wildland Hydrology Books, Pagosa Springs, CO.
- Weakley, A.S. 2008. *Flora of the Carolinas, Virginia, Georgia, Northern Florida, and Surrounding Areas* (Draft April 2008). University of North Carolina at Chapel Hill: Chapel Hill, NC.
- USACE. 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

Appendix A

Project Vicinity Map and Background Tables

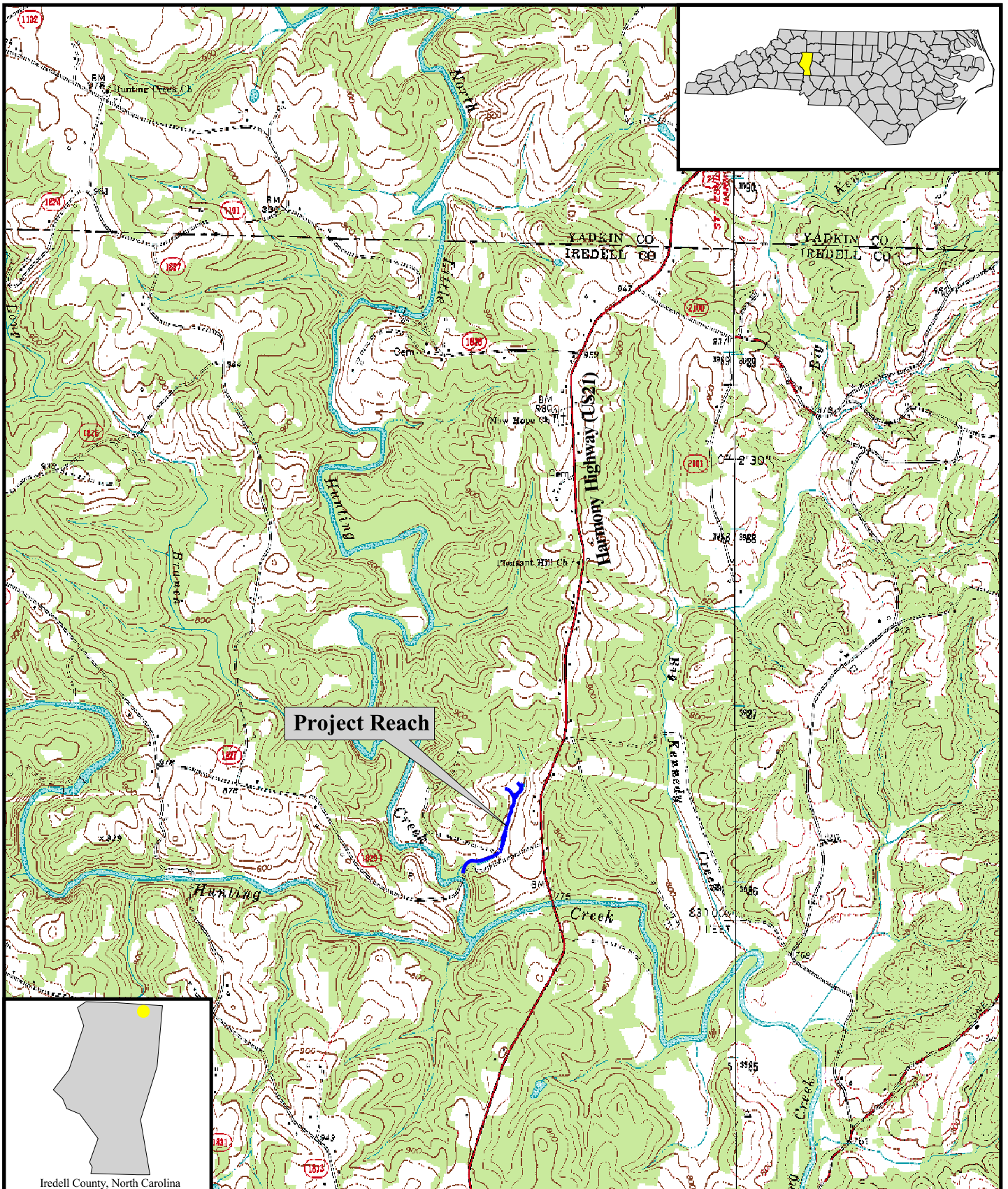


Figure 1. Vicinity Map

 Project Reach Location

Johnson Site



1000 0 1000 2000 Feet



Source: Brooks Crossroads and Lone Hickory USGS 7.5' Topographic Quadrangles

Table 1a. Project Components
UT to Little Hunting Creek (Johnson Site) / Project No. 197

Project Component or Reach ID	Existing Feet/Acres	Restoration Level	Approach	Linear Footage	Stationing	Mitigation Ratio	Mitigation Credits	BMP Elements
UTLHC	2,209 lf	R	P3	2,209	10+00 - 32+09	1:1	2,209	N/A
UT1	117 lf	E	E2	117.0		2.5:1	47.0	N/A
UT2	300 lf	E	E2	300		2.5:1	120	N/A

Table 1b. Component Summations
UT to Little Hunting Creek (Johnson Site) / Project No. 197

Restoration Level	Stream (lf)	Riparian Wetland (Ac)		Non-Ripar (Ac)	Upland (Ac)	Buffer (Ac)	BMP
		Riverine	Non-Riverine				
Restoration	2,209						
Enhancement II	417						
Totals (Feet/Acres)	2,626	0		0	0	0.00	0
MU Totals	2,376	0		0	0	0.00	0

Table 2. Project Activity & Reporting History
UT to Little Hunting Creek (Johnson Site) / Project No. 197

Elapsed Time Since Grading Complete: 5 yr 1 month		
Elapsed Time Since Planting Complete: 5 yr 1 month		
Number of Reporting Years: 5		
Activity or Report	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	Nov 2005	Feb 2006
Final Design - Construction Plans	Nov 2005	Feb 2006
Construction		Nov 2007
Planting		Nov 2007
Baseline Monitoring/Report	Dec 2007	June 2008
Year 1 Monitoring	Jan 2009	Feb 2009
Year 2 Monitoring	Jun 2009	Dec 2009
Year 3 Monitoring	Oct 2010	Jan 2011
Year 4 Monitoring	Jun 2012	Dec 2012
Year 5 Monitoring	Sep 2014	Dec 2014

Table 3. Project Contacts UT to Little Hunting Creek (Johnson Site) / Project No. 197	
Designer	KCI Associates of North Carolina 4601 Six Forks Road, Suite 220 Raleigh, NC 27609
Primary Project Design POC	Adam Spiller (919) 278-2514
Construction and Seeding Contractor	Quartermaster Environmental Inc. P.O. Drawer 400 Shelby, NC 28150
Planting Contractor	Carolina Wetland Services 550 E. Westinghouse Boulevard Charlotte, NC 28273
Monitoring Performers	
MY-01 - MY-04	Jordan, Jones and Goulding, Inc. 6801 Governors Lake Parkway Norcross, GA 30071
Monitoring POC	Alison Nichols (704)301-7563
MY-05	KCI Associates of North Carolina 4601 Six Forks Road, Suite 220 Raleigh, NC 27609
Monitoring POC	Adam Spiller (919) 278-2514

**Table 4. Project Attributes
UT to Little Hunting Creek (Johnson Site) / Project No. 197**

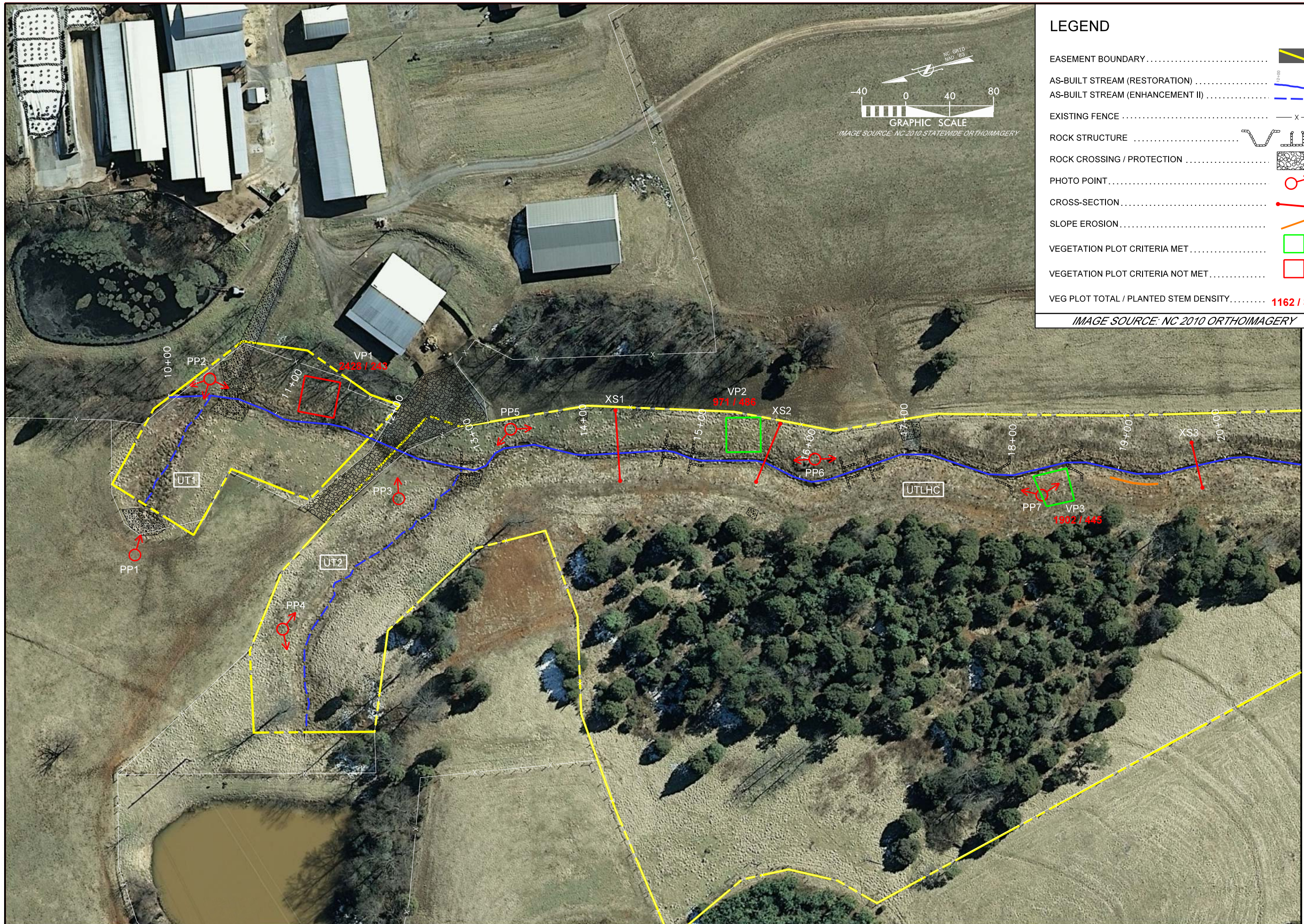
Project County	Iredell County, NC		
Project Area (acres)	10.1		
Project Coordinates	80d 45' 52.582" W, 36d 1' 19.619" N		
Project Watershed Summary Information			
Physiographic Region	Piedmont		
Project River Basin	Yadkin		
USGS HUC for Project (8 digit)	03040102		
NCDWQ Sub-basin for Project and Reference	03-07-06		
Project Drainage Area (acres)	108.8		
Project Drainage Area Percentage of Impervious Area	3		
CGIA Land Use Classification	-		
Reach Summary Information*			
Parameters			
Length of reach (linear feet)	2,626		
Valley classification	N/A		
Drainage area (acres)	57.6		
NCDWQ stream identification score	12-108-16-6 (Little Hunting Creek)		
NCDWQ Water Quality Classification	WS-III		
Morphological Description (stream type)	Perennial		
Evolutionary trend	F5/F6 to B4/5c		
Underlying mapped soils	Chewalca, Colfax Sandy Loam, Various Cecil Series		
Drainage Class	-		
Soil Hydric status	N/A		
Slope	2.2000		
FEMA classification	Zones A and C		
Native vegetation community	U		
Percent composition of exotic invasive vegetation	-		
Regulatory Considerations			
Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States - Section 404	Yes	Yes	N/A
Waters of the United States - Section 401	Yes	Yes	N/A
Endangered Species Act	No	N/A	N/A
Historic Preservation Act	No	N/A	N/A
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	No	N/A	N/A
Essential Fisheries Habitat	No	N/A	N/A

*This site is not within an EEP planning area but is in a Targeted Local Watershed

"N/A": items do not apply / "-" Items are not available / "U" Items are unknown

Appendix B

Visual Assessment Data



LEGEND

- EASEMENT BOUNDARY [Yellow dashed line symbol]
- AS-BUILT STREAM (RESTORATION) [Blue line symbol]
- AS-BUILT STREAM (ENHANCEMENT II) [Blue dashed line symbol]
- EXISTING FENCE [White 'X' symbol]
- ROCK STRUCTURE [Grey hatched area symbol]
- ROCK CROSSING / PROTECTION [Cross-hatched area symbol]
- PHOTO POINT [Red circle with arrow symbol]
- CROSS-SECTION [Red line with arrow symbol]
- SLOPE EROSION [Orange line symbol]
- VEGETATION PLOT CRITERIA MET [Green square symbol]
- VEGETATION PLOT CRITERIA NOT MET [Red square symbol]
- VEG PLOT TOTAL / PLANTED STEM DENSITY **1162 / 301**

IMAGE SOURCE: NC 2010 ORTHOIMAGERY

SYL	DESCRIPTION	DATE	APPROVED



KCI
ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4801 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

UT TO LITTLE HUNTING CREEK
(JOHNSON SITE)
PROJECT #197 - MONITORING YEAR 05
IREDELL COUNTY, NORTH CAROLINA

DATE: NOV 2014
SCALE: SEE GRAPHIC
CURRENT
CONDITION
PLAN VIEW
SHEET 1 OF 2

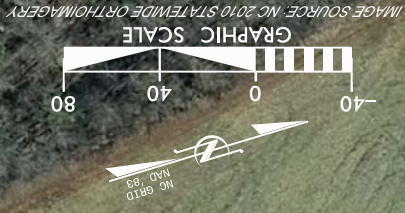
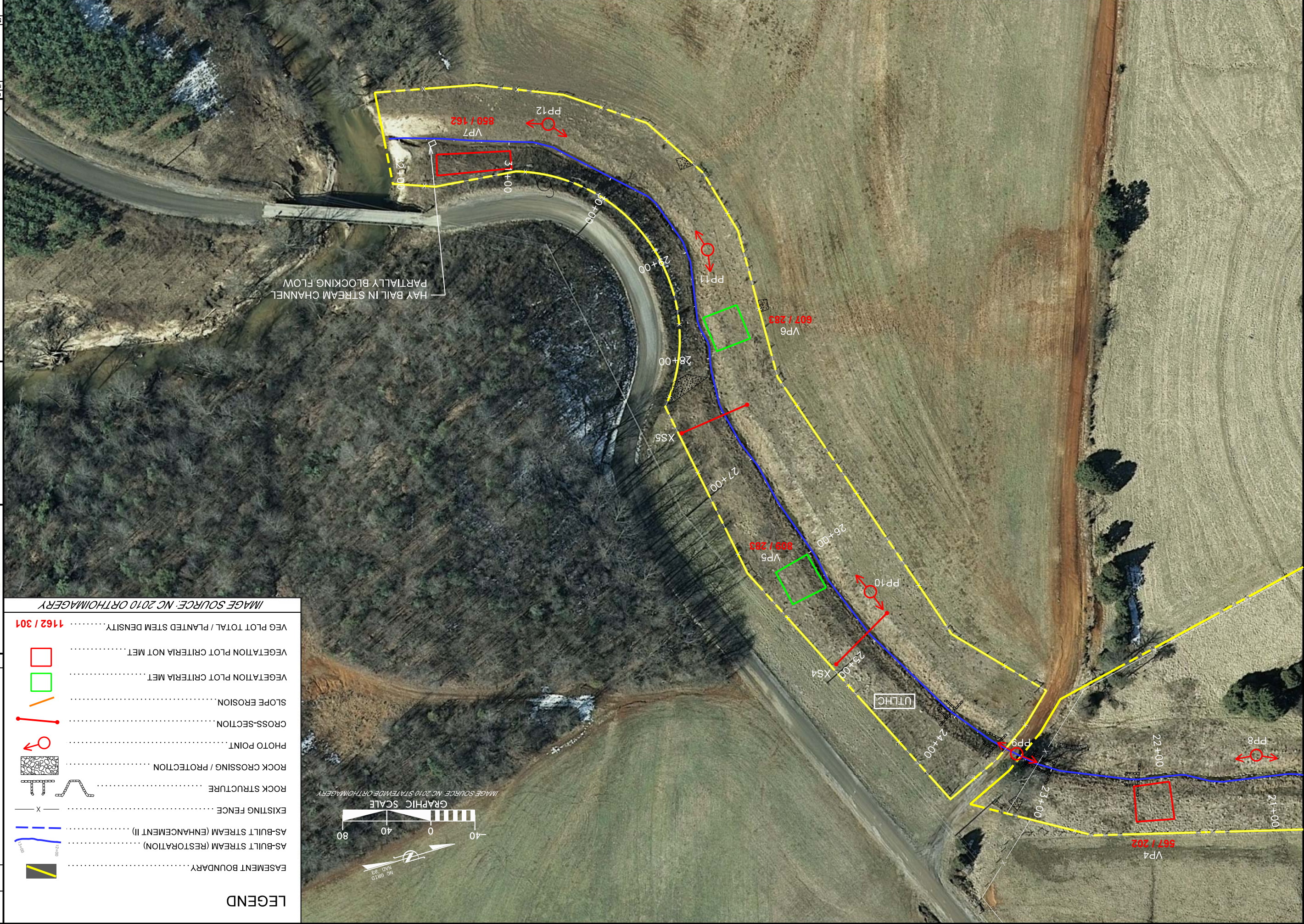


IMAGE SOURCE: NC 2010 STATEWIDE ORTHOMAGERY

HAY BAIL IN STREAM CHANNEL
PARTIALLY BLOCKING FLOW

LEGEND

- EASEMENT BOUNDARY
- AS-BUILT STREAM (RESTORATION)
- AS-BUILT STREAM (ENHANCEMENT II)
- EXISTING FENCE
- ROCK STRUCTURE
- ROCK CROSSING / PROTECTION
- PHOTO POINT
- CROSS-SECTION
- SLOPE EROSION
- VEGETATION PLOT CRITERIA MET
- VEGETATION PLOT CRITERIA NOT MET
- VEG PLOT TOTAL / PLANTED STEM DENSITY

IMAGE SOURCE: NC 2010 ORTHOMAGERY

SYMBOL	DESCRIPTION	DATE	APPROVED



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RALEIGH, NORTH CAROLINA 27609

UT TO LITTLE HUNTING CREEK
(JOHNSON SITE)
PROJECT #197 - MONITORING YEAR 05
IREDELL COUNTY, NORTH CAROLINA

DATE: NOV 2014
SCALE: SEE GRAPHIC
CURRENT
CONDITION
PLAN VIEW
SHEET 2 OF 2

Table 5. Visual Stream Morphology Stability Assessment							
Project Number and Name: 197 - UT to Little Hunting Creek (Johnson Site)							
Assessed Length 2,209				Main Channel			
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
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			0	0	100%
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	32	32			100%
		3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	22	22		
	4. Thalweg Position	2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	22	22			100%
		1. Thalweg centering at upstream of meander bend (Run)	22	22			100%
		2. Thalweg centering at downstream of meander (Glide)	22	22			100%
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%
Totals					0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	11	11			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	11	11			100%
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	11	11			100%
	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)	11	11			100%
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	11	11			100%

Table 6. Vegetation Condition Assessment						
Project Number and Name: 197 - UT to Little Hunting Creek (Johnson Site)						
Planted Acreage 9.8			Easement Acreage 10.1			
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acre	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acre	Pattern and Color	0	0.00	0.0%
Total				0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acre	Pattern and Color	0	0.00	0.0%
Cumulative Total				0	0.00	0.0%
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1,000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%

Stream Station Photos



Photo Point #1 – MY-01 January 2009



Photo Point #1 – MY-05 September 2014



Photo Point #2 – North – MY-01 January 2009



Photo Point #2 – North – MY-05 September 2014



Photo Point #2 – West – MY-01 January 2009



Photo Point #2 – West – MY-05 September 2014



Photo Point #2 –South – MY-01 January 2009



Photo Point #2 – South – MY-05 September 2014



Photo Point #3 – MY-01 January 2009



Photo Point #3 – MY-05 September 2014



Photo Point #4 – Downstream – MY-01 January 2009



Photo Point #4 – Downstream – MY-05 September 2014



Photo Point #4 – Upstream MY-01 January 2009



Photo Point #4 – Upstream MY-05 September 2014



Photo Point #5 – Downstream – MY-01 January 2009



Photo Point #5 – Downstream – MY-05 September 2014



Photo Point #5 – Upstream – MY-01 January 2009



Photo Point #5 – Upstream – MY-05 September 2014



Photo Point #6 – Downstream – MY-01 January 2009



Photo Point #6 – Downstream – MY-05 September 2014



Photo Point #6 – Upstream – MY-01 January 2009



Photo Point #6 – Upstream – MY-05 September 2014



Photo Point #7 – Downstream – MY-01 January 2009



Photo Point #7 – Downstream – MY-05 September 2014



Photo Point #7 – Upstream – MY-01 January 2009



Photo Point #7 – Upstream – MY-05 September 2014



Photo Point #8 – Downstream – MY-01 January 2009



Photo Point #8 – Downstream – MY-05 September 2014



Photo Point #8 – Upstream – MY-01 January 2009



Photo Point #8 – Upstream – MY-05 September 2014



Photo Point #9 – Downstream – MY-01 January 2009



Photo Point #9 – Downstream – MY-05 September 2014



Photo Point #9 – Upstream – MY-01 January 2009

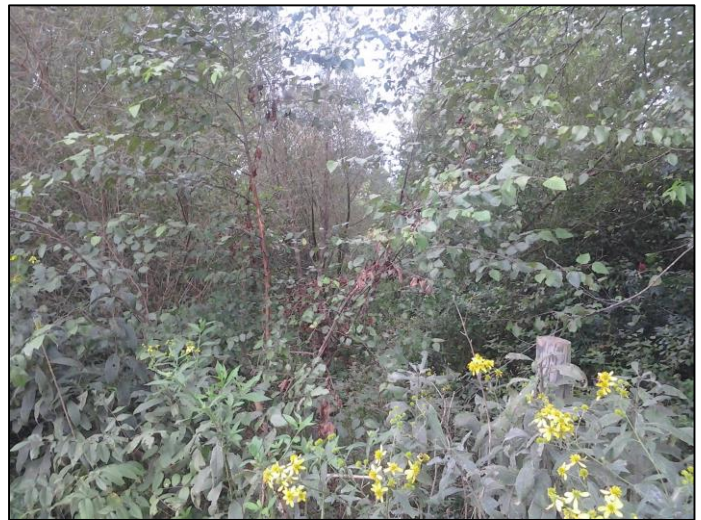


Photo Point #9 – Upstream – MY-05 September 2014



Photo Point #10 – Downstream – MY-01 January 2009

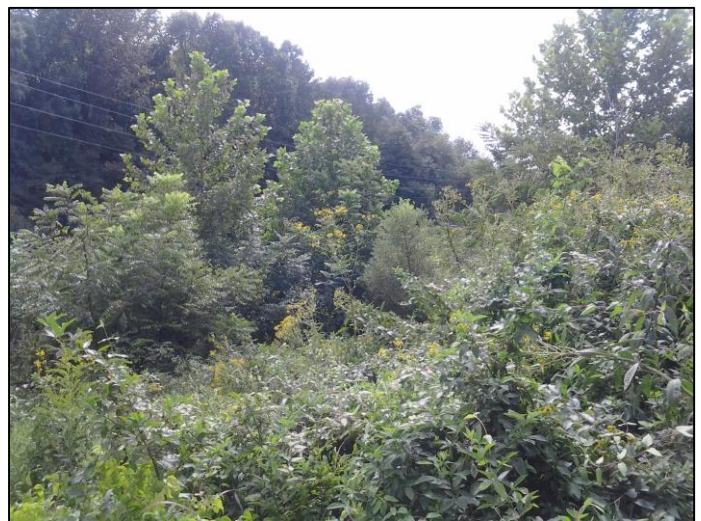


Photo Point #10 – Downstream – MY-05 September 2014



Photo Point #10 – Upstream – MY-01 January 2009



Photo Point #10 – Upstream – MY-05 September 2014



Photo Point #11 – Downstream – MY-01 January 2009



Photo Point #11 – Downstream – MY-05 September 2014



Photo Point #11 – Upstream – MY-01 January 2009

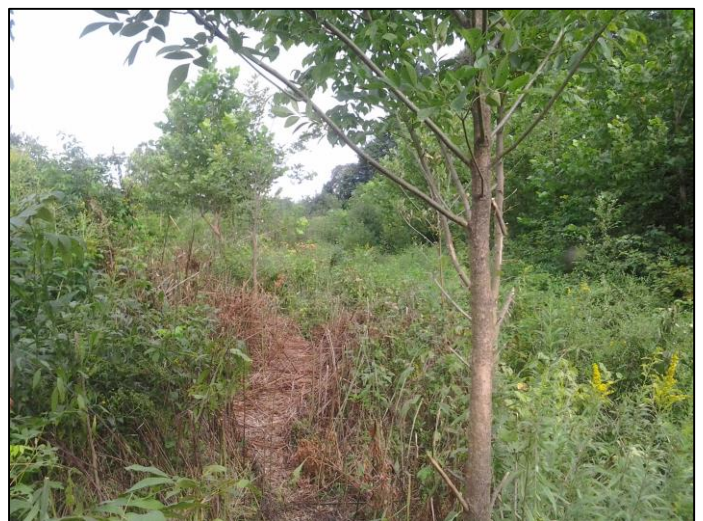


Photo Point #11 – Upstream – MY-05 September 2014



Photo Point #12 – Downstream – MY-01 January 2009



Photo Point #12 – Downstream – MY-05 September 2014



Photo Point #12 – Upstream – MY-01 January 2009



Photo Point #12 – Upstream – MY-05 September 2014

Problem Area Photos



Station 19+00 Right bank – MY-05 September 2014



Station 19+00 Right bank – MY-05 September 2014



Station 31+25 Hay bale in stream – MY-05 September 2014

Vegetation Plot Photos



Veg Plot #1 – MY-05 September 2014



Veg Plot #2 – MY-05 September 2014



Veg Plot #3 – MY-05 September 2014



Veg Plot #4 – MY-05 September 2014



Veg Plot #5 – MY-05 September 2014



Veg Plot #6 – MY-05 September 2014



Veg Plot #7 – MY-05 September 2014

Appendix C

Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment UT to Little Hunting Creek (Johnson Site) / Project No. 197				
Stream Vegetation Totals (per acre)				
Plot ID	¹Stream Stems	²Volunteers	³Total	Success Criteria Met?
1	243	2,185	2,428	No
2	486	526	971	Yes
3	445	1,497	1,902	Yes
4	202	364	567	No
5	283	526	809	Yes
6	283	324	607	Yes
7	162	688	850	No
Project Avg	301	873	1,162	Yes

¹Stream Stems Native planted woody stems. Includes shrubs, does NOT include live stakes.

²Volunteers Native woody stems. NOT planted.

³Total Planted + volunteer native woody stems. Includes live stakes.

Table 8. CVS Vegetation Plot Metadata UT to Little Hunting Creek (Johnson Site) / Project No. 197	
Report Prepared By	Dale Prihoda
Date Prepared	9/16/2014 12:45
database name	cvs-eep-Johnson.mdb
database location	M:\2014\16145025_Johnson Monitoring
computer name	12-3ZV4FP1
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.
PROJECT SUMMARY-----	
Project Code	197
project Name	Johnson Site
Description	Stream Restoration in Iredell County, North Carolina
River Basin	Yadkin-Pee Dee
length(ft)	2200
stream-to-edge width (ft)	50
area (sq m)	20436.6
Required Plots (calculated)	7
Sampled Plots	7

Table 9. CVS Stem Count Total and Planted by Plot and Species
UT to Little Hunting Creek (Johnson Site) / Project No. 197

			Current Plot Data (MY5 2014)																	
Scientific Name	Common Name	Species Type	E197-A-0001			E197-A-0002			E197-A-0003			E197-A-0004			E197-A-0005			E197-A-0006		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo</i>	boxelder	Tree			30			1								2			5	
<i>Acer rubrum</i>	red maple	Tree			17			2												
<i>Asimina triloba</i>	pawpaw	Tree						1										1	1	1
<i>Betula nigra</i>	river birch	Tree	1	1	1	1	1	1	1	1	1			1						
<i>Cornus amomum</i>	silky dogwood	Shrub				1	1	1	4	4	4	2	2	2				1	1	1
<i>Diospyros virginiana</i>	common persimmon	Tree				2	2	2			1			2	1	1	2	1	1	2
<i>Fraxinus pennsylvanica</i>	green ash	Tree	2	2	2	1	1	1				1	1	1				3	3	3
<i>Juglans nigra</i>	black walnut	Tree			3											6				1
<i>Juniperus virginiana</i>	eastern redcedar	Tree			3			7			16			1						
<i>Ligustrum sinense</i>	Chinese privet	Exotic						1			1									
<i>Liriodendron tulipifera</i>	tuliptree	Tree	2	2	3	1	1	2	1	1	1				1	1	3			
<i>Pinus echinata</i>	shortleaf pine	Tree									9									
<i>Platanus occidentalis</i>	American sycamore	Tree							3	3	4	1	1	6	3	3	4	1	1	1
<i>Prunus serotina</i>	black cherry	Tree	1	1	1															1
<i>Quercus falcata</i>	southern red oak	Tree				2	2	2	1	1	1									
<i>Quercus laurifolia</i>	laurel oak	Tree							1	1	1									
<i>Quercus nigra</i>	water oak	Tree				2	2	2												
<i>Quercus phellos</i>	willow oak	Tree				2	2	2				1	1	1	2	2	2			
<i>Rhus copallinum</i>	flameleaf sumac	shrub									9									
<i>Sambucus canadensis</i>	American elderberry	Shrub															1			
<i>Unknown</i>		Shrub or Tree																		
Stem count			6	6	60	12	12	25	11	11	48	5	5	14	7	7	20	7	7	15
size (ares)			1			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			4	4	8	8	8	13	6	6	11	4	4	7	4	4	7	5	5	8
Stems per ACRE			243	243	2,428	486	486	1,012	445	445	1,942	202	202	567	283	283	809	283	283	607

Table 9. CVS Stem Count Total and Planted by Plot and Species continued
 UT to Little Hunting Creek (Johnson Site) / Project No. 197

Scientific Name	Common Name	Species Type	EI97-A-0007			MY5 (2014)			MY4 (2012)			MY3 (2010)			MY2 (6/2009)			MY1 (1/2009)			MY0 (2008)			
			PnOLS	P-all	T	PnOLS	P-all	T	PnOLS	P-all	T	PnOLS	P-all	T	PnOLS	P-all	T	PnOLS	P-all	T	PnOLS	P-all	T	
<i>Acer negundo</i>	boxelder	Tree			16					54					12									
<i>Acer rubrum</i>	red maple	Tree								19					6									
<i>Asimina triloba</i>	pawpaw	Tree								1														
<i>Betula nigra</i>	river birch	Tree	1	1	1	4	4	5	1	4	4	4	2	2	2	4	4	6	7	7	7	7		
<i>Cornus amomum</i>	silky dogwood	Shrub				8	8	8	2	3	1	2	2	2	13	13	13	16	16	16	16	16		
<i>Diospyros virginiana</i>	common persimmon	Tree				4	4	9		1	1	1	1	1										
<i>Eastern baccharis</i>	eastern baccharis	Shrub																						
<i>Fraxinus pennsylvanica</i>	green ash	Tree	1	1	2	8	8	9	2	1	1	1	1	1	7	7	7	8	8	8	8	8		
<i>Juglans nigra</i>	black walnut	Tree						10																
<i>Juniperus virginiana</i>	eastern redcedar	Tree						27		3														
<i>Ligustrum sinense</i>	Chinese privet	Exotic						2																
<i>Liquidambar styraciflua</i>	sweetgum	Tree											2											
<i>Liriodendron tulipifera</i>	tuliptree	Tree				5	5	9		2														
<i>Pinus echinata</i>	shortleaf pine	Tree						9																
<i>Pinus taeda</i>	loblolly pine	Tree								1					2									
<i>Platanus occidentalis</i>	American sycamore	Tree				8	8	15		1	1	2	2	2	6	6	6	9	9	9	9	9		
<i>Prunus serotina</i>	black cherry	Tree				1	1	2																
<i>Quercus falcata</i>	southern red oak	Tree				3	3	3		1	1	1	2									14		
<i>Quercus laurifolia</i>	laurel oak	Tree				1	1	1																
<i>Quercus nigra</i>	water oak	Tree				2	2	2		1	1													
<i>Quercus phellos</i>	willow oak	Tree				5	5	5		1														
<i>Rhus copallinum</i>	flameleaf sumac	shrub						9																
<i>Salix nigra</i>	black willow	Tree																						
<i>Sambucus nigra</i>	European black elderberry	Shrub	2	2	2	2	2	3																
Unknown		Shrub or Tree																				13		
			Stem count	4	4	21	52	52	203	6	6	38	6	6	10	10	12	49	49	119	77	77		
			size (ares)	1			7			7			7			7			0.17			0.17		
			size (ACRES)	0.02			0.17			0.17			0.17			0.17			0.17			0.17		
			Species count	3	3	4	13	13	20	6	6	13	6	6	8	8	7	7	8	8	8	7	7	
			Stems per ACRE	161.9	161.9	849.8	301	301	1,174	254	254	1,550	256	256	911	911	486	486	688	688	445.2	445.2		

Appendix D

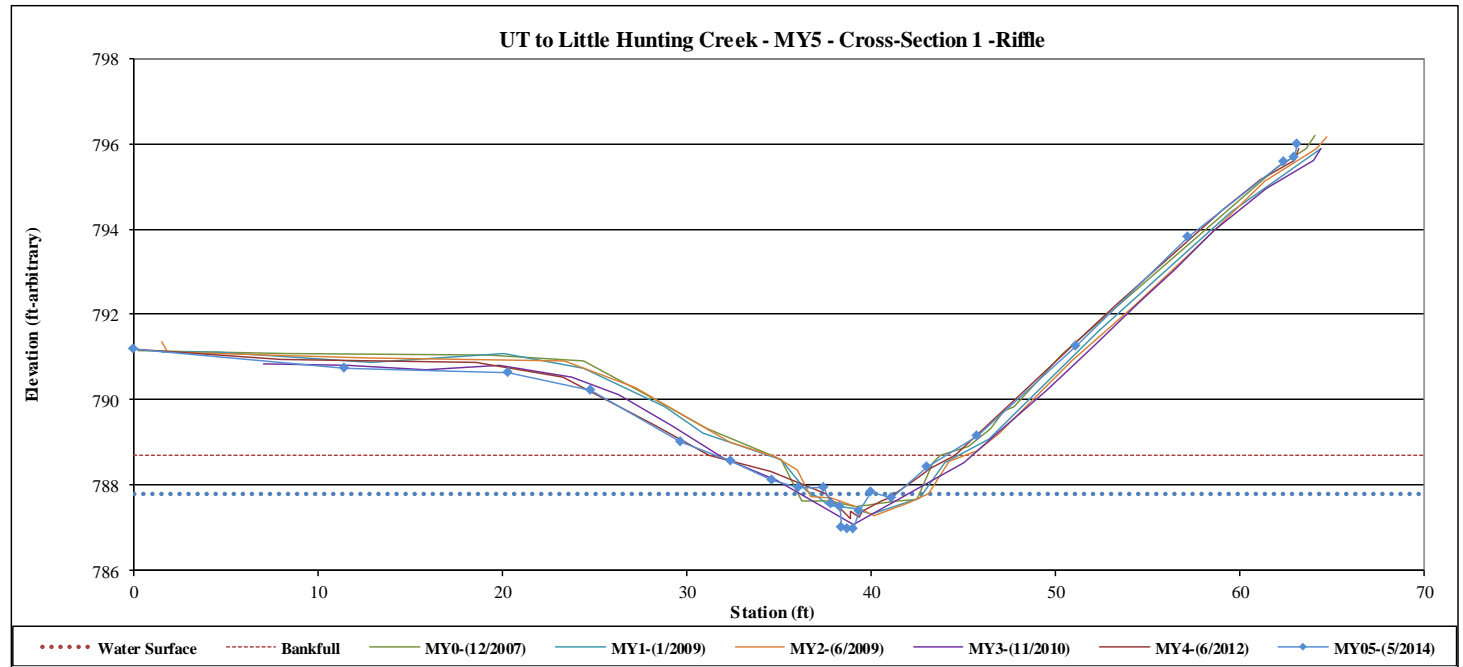
Stream Survey Data

Project Name	UT to Hunting Creek
EEP Project Number	197
Cross-Section ID	XS-1, Riffle, 3+92
Survey Date	5/2014

SUMMARY DATA	
Bankfull Elevation (ft)	788.70
Bankfull Cross-Sectional Area (ft ²)	8.60
Bankfull Width (ft)	12.50
Flood Prone Area Elevation (ft)	790.43
Flood Prone Width (ft)	63.10
Bankfull Mean Depth (ft)	0.70
Bankfull Max Depth (ft)	1.70
W/D Ratio	18.20
Entrenchment Ratio	5.00
Bank Height Ratio	0.49



Station	Elevation	Notes
0.00	791.17	xs-1-lbp
11.44	790.74	xs-1
20.33	790.63	xs-1
24.81	790.23	xs-1
29.63	789.01	xs-1
32.41	788.55	xs-1
34.66	788.11	xs-1
36.09	787.95	xs-1
37.44	787.95	xs-1-tob
37.81	787.56	xs-1
38.32	787.50	xs-1-ew
38.39	787.00	xs-1
38.69	786.97	xs-1-thw
39.03	786.97	xs-1
39.35	787.40	xs-1-ew
39.95	787.84	xs-1-tob
41.13	787.69	xs-1
43.00	788.42	xs-1
45.74	789.15	xs-1
51.13	791.26	xs-1
57.18	793.81	xs-1
62.35	795.58	xs-1
62.93	795.67	xs-1
63.12	796.00	xs-1-rbp

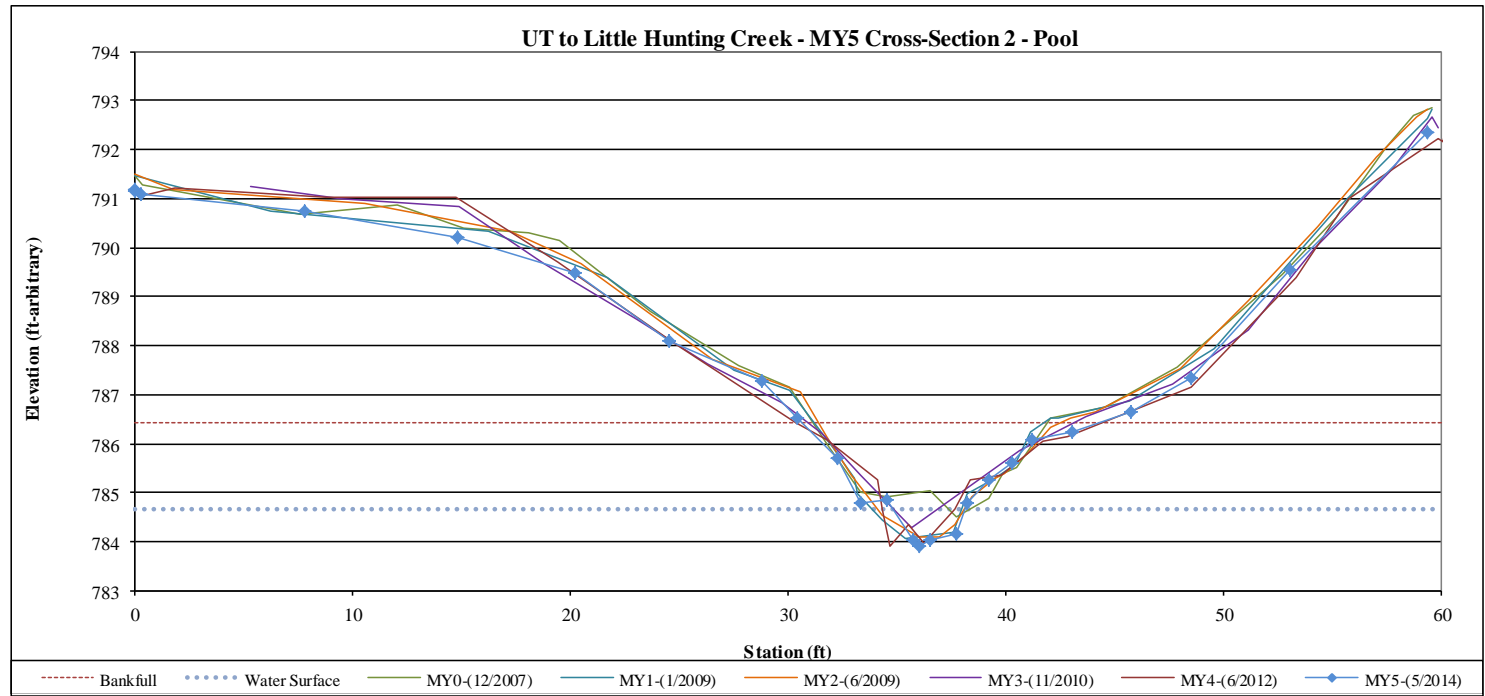


Project Name	UT to Little Hunting Creek
EEP Project Number	197
Cross-Section ID	XS-2, Pool, 5+25
Survey Date	5/2014

SUMMARY DATA	
Bankfull Elevation (ft)	786.42
Bankfull Cross-Sectional Area (ft ²)	14.40
Bankfull Width (ft)	10.80
Flood Prone Area Elevation (ft)	-
Flood Prone Width (ft)	-
Bankfull Mean Depth (ft)	1.30
Bankfull Max Depth (ft)	2.50
W/D Ratio	-
Entrenchment Ratio	-
Bank Height Ratio	-



Station	Elevation	Notes
0.00	791.17	xs-2-lbp
0.00	791.19	xs-2-lbp
0.25	791.10	xs-2
7.78	790.75	xs-2
14.84	790.22	xs-2
20.21	789.49	xs-2
24.56	788.11	xs-2
28.75	787.27	xs-2
30.45	786.53	xs-2-tob
32.27	785.69	xs-2
33.36	784.80	xs-2
34.56	784.84	xs-2-ew
35.71	784.05	xs-2
36.05	783.91	xs-2-thw
36.49	784.03	xs-2
37.76	784.15	xs-2
38.23	784.78	xs-2-ew
39.19	785.27	xs-2
40.31	785.62	xs-2
41.23	786.08	xs-2-tob
43.03	786.24	xs-2
45.73	786.65	xs-2
48.52	787.33	xs-2
53.03	789.56	xs-2
59.40	792.35	xs-2

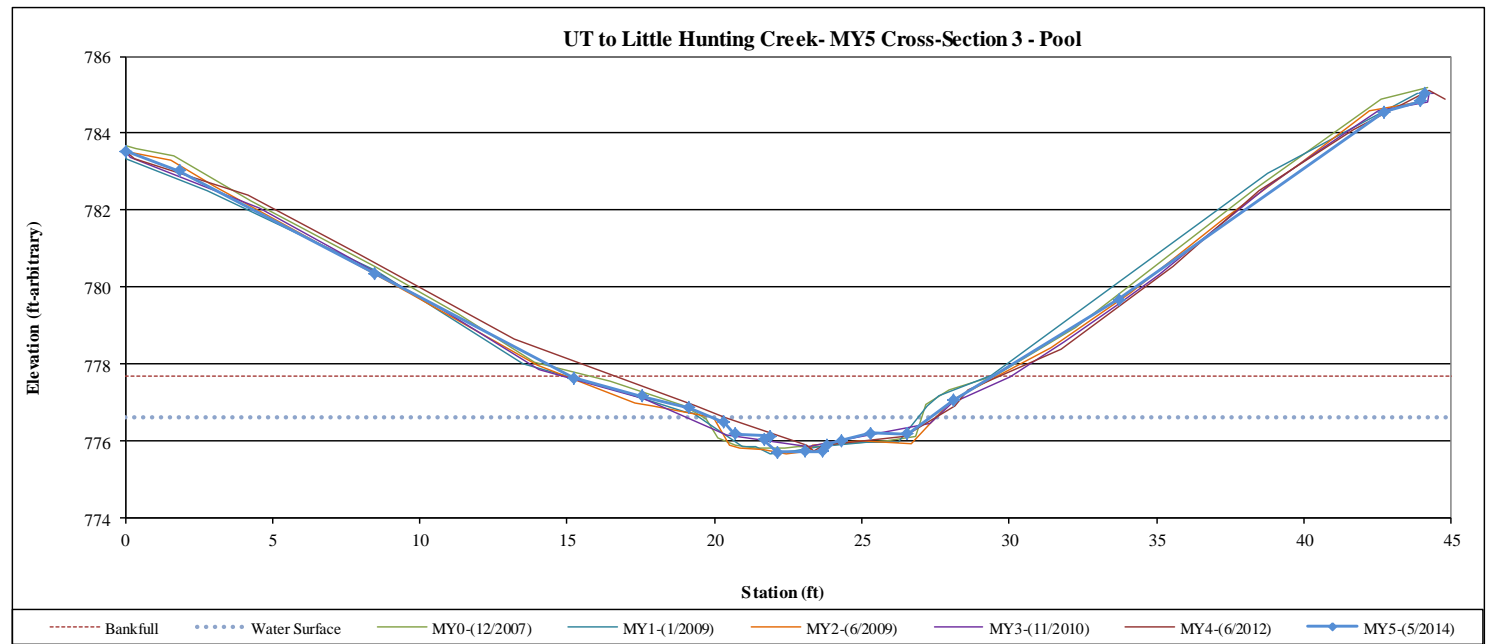


Project Name	UT to Little Hunting Creek
EEP Project Number	197
Cross-Section ID	XS-3, Pool, 9+41
Survey Date	5/2014

SUMMARY DATA	
Bankfull Elevation (ft)	777.69
Bankfull Cross-Sectional Area (ft ²)	15.40
Bankfull Width (ft)	14.30
Flood Prone Area Elevation (ft)	-
Flood Prone Width (ft)	-
Bankfull Mean Depth (ft)	1.10
Bankfull Max Depth (ft)	2.00
W/D Ratio	-
Entrenchment Ratio	-
Bank Height Ratio	-



Station	Elevation	Notes
0.00	783.53	xs 3-lbp
1.84	783.02	xs 3
8.45	780.36	xs 3
15.21	777.65	xs 3
17.52	777.16	xs 3
19.12	776.88	xs 3
20.32	776.49	xs 3-tob
20.70	776.18	xs 3
21.88	776.12	xs 3
21.68	776.03	xs 3-ew
22.12	775.71	xs 3
23.08	775.74	xs 3-thw
23.68	775.73	xs 3
23.80	775.90	xs 3-ew
24.33	776.03	xs 3
25.31	776.22	xs 3
26.53	776.19	xs 3
28.09	777.07	xs 3
33.72	779.69	xs 3
42.73	784.55	xs 3
43.97	784.83	xs 3
44.11	785.03	xs 3-rbp

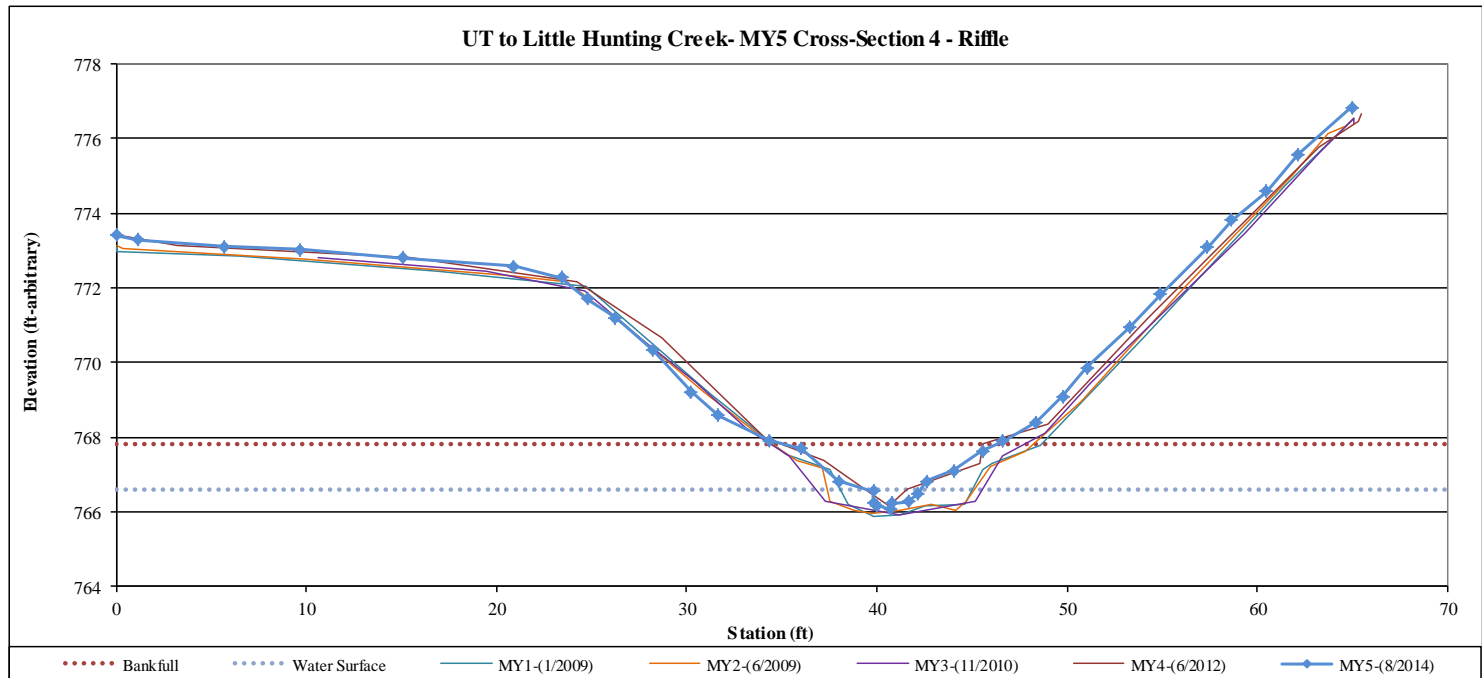


Project Name	UT to Little Hunting Creek
EEP Project Number	197
Cross-Section ID	XS-4, Riffle, 14+72
Survey Date	8/2014

SUMMARY DATA	
Bankfull Elevation (ft)	767.81
Bankfull Cross-Sectional Area (ft ²)	8.70
Bankfull Width (ft)	9.00
Flood Prone Area Elevation (ft)	769.60
Flood Prone Width (ft)	20.90
Bankfull Mean Depth (ft)	1.00
Bankfull Max Depth (ft)	1.70
W/D Ratio	9.30
Entrenchment Ratio	2.30
Bank Height Ratio	0.40



Station	Elevation	Notes
0.00	773.41	xs4-lbp
1.17	773.29	xs4
5.65	773.10	xs4
9.67	773.02	xs4
15.11	772.81	xs4
20.90	772.59	xs4
23.40	772.28	xs4
24.77	771.70	xs4
26.25	771.20	xs4
28.21	770.33	xs4
30.24	769.21	xs4
31.67	768.58	xs4
34.30	767.90	xs4
36.01	767.68	xs4
37.99	766.80	xs4-tob
39.81	766.55	xs4-ew
39.83	766.25	xs4
40.00	766.16	xs4
40.69	766.06	xs4-thw
40.81	766.22	xs4
41.67	766.27	xs4
42.18	766.49	xs4-ew
42.60	766.81	xs4
44.02	767.09	xs4-tob
45.56	767.62	xs4
46.64	767.90	xs4
48.38	768.39	xs4
49.77	769.09	xs4
51.06	769.85	xs4



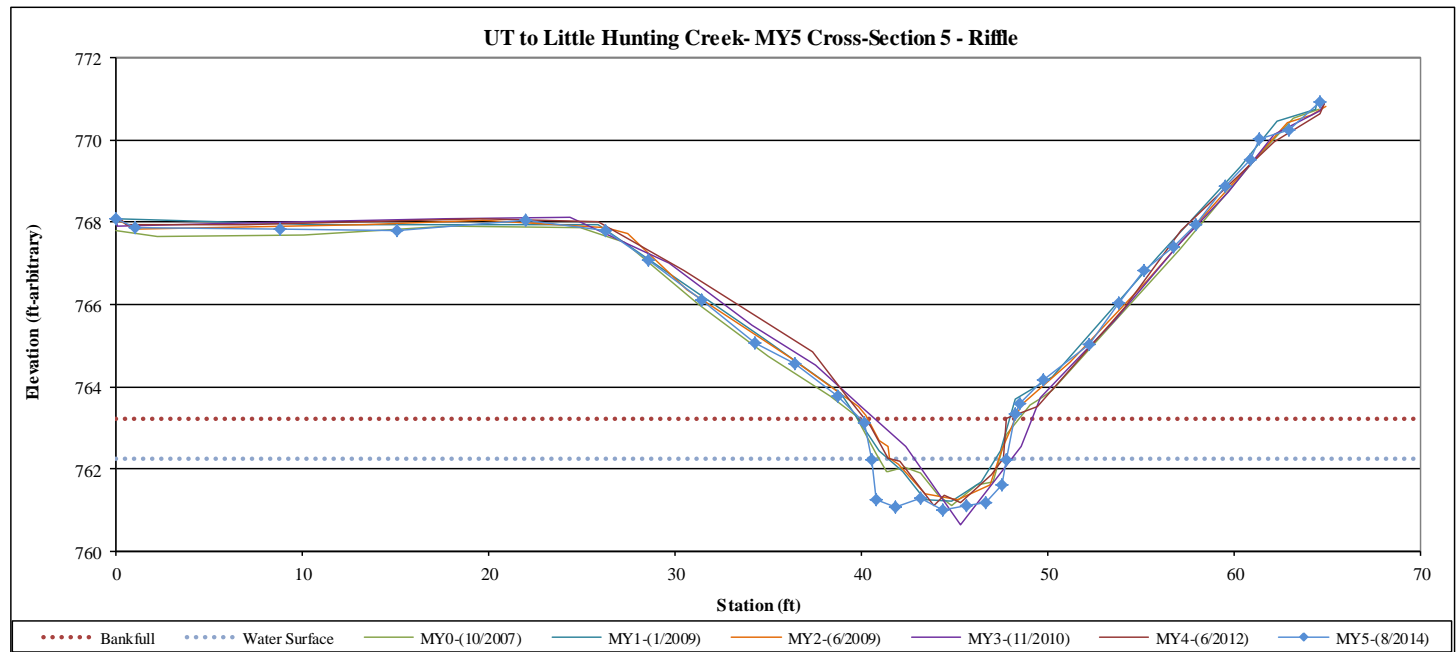
*some values excluded due to space limitations

Project Name	UT to Little Hunting Creek
EEP Project Number	197
Cross-Section ID	XS-5, Riffle, 17+10
Survey Date	8/2014

SUMMARY DATA	
Bankfull Elevation (ft)	763.22
Bankfull Cross-Sectional Area (ft ²)	14.90
Bankfull Width (ft)	8.20
Flood Prone Area Elevation (ft)	765.40
Flood Prone Width (ft)	19.60
Bankfull Mean Depth (ft)	1.80
Bankfull Max Depth (ft)	2.20
W/D Ratio	4.50
Entrenchment Ratio	2.10
Bank Height Ratio	1.00

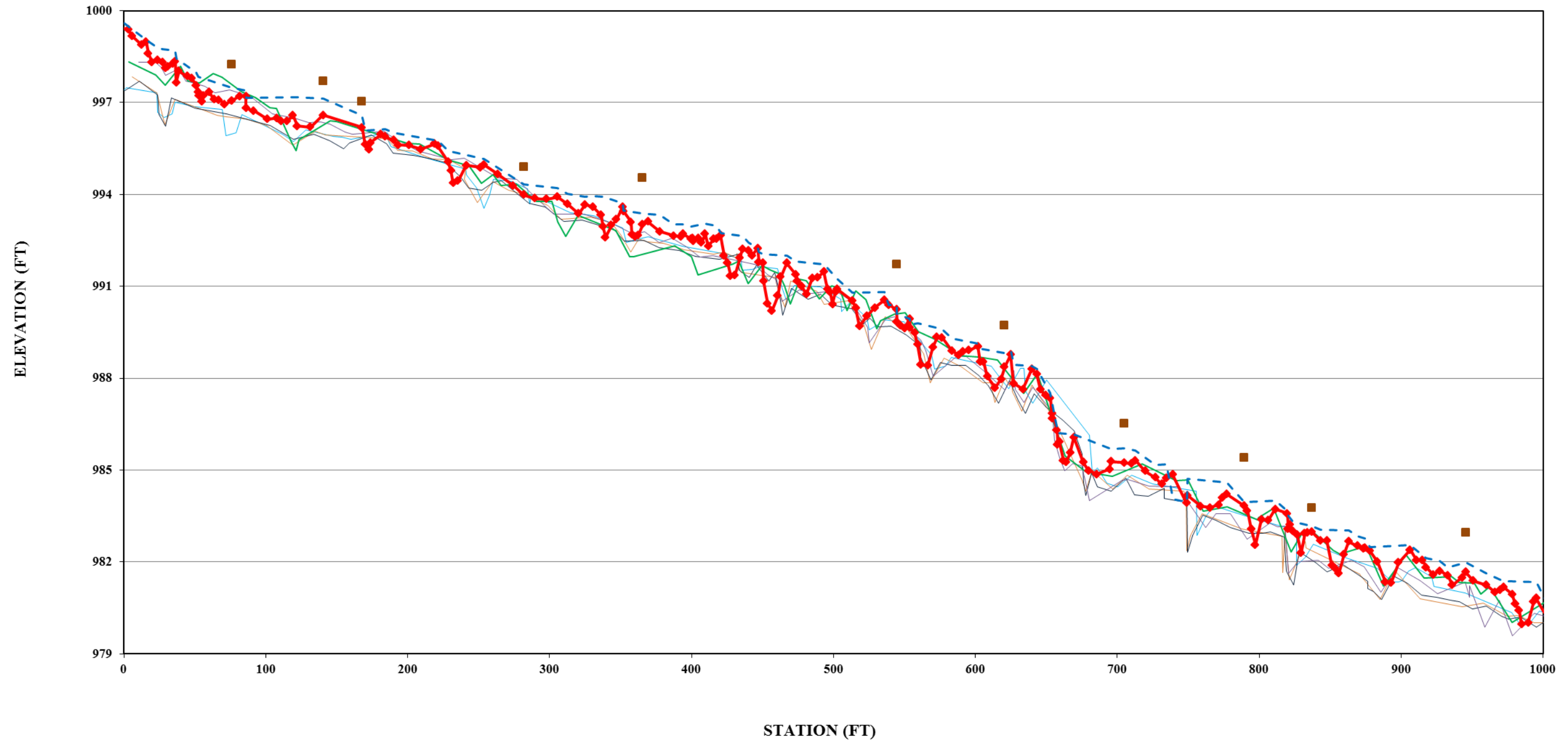


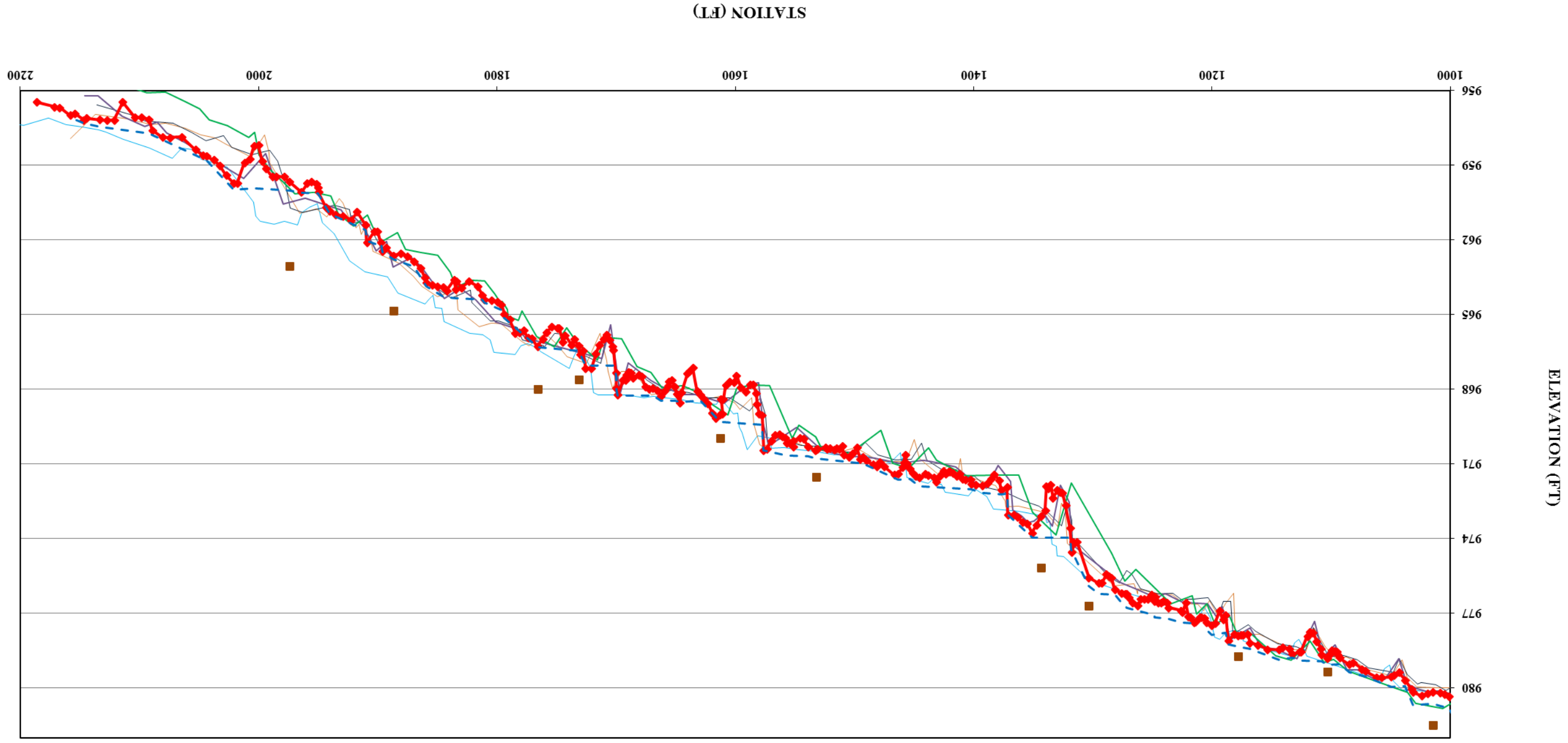
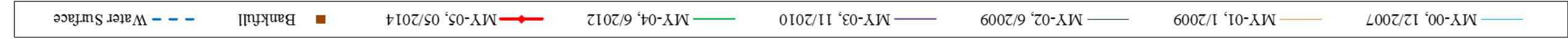
Station	Elevation	Notes
0.00	768.07	xs5-lbp
1.03	767.86	xs5
8.83	767.82	xs5
15.11	767.80	xs5
21.96	768.05	xs5
26.27	767.79	xs5
28.54	767.08	xs5
31.41	766.10	xs5
34.31	765.08	xs5
36.41	764.57	xs5
38.71	763.78	xs5
40.21	763.13	xs5-tob
40.58	762.21	xs5-ew
40.83	761.24	xs5
41.87	761.07	xs5
43.16	761.29	xs5
44.42	761.01	xs5-thw
45.67	761.12	xs5
46.69	761.17	xs5
47.52	761.61	xs5
47.81	762.24	xs5-ew
48.27	763.34	xs5
48.51	763.61	xs5-tob
49.80	764.15	xs5
52.21	765.02	xs5
53.85	766.04	xs5
55.18	766.82	xs5
56.74	767.39	xs5
57.92	767.95	xs5



*some values excluded due to space limitations

**Longitudinal Profile
UT to Little Hunting Creek
EEP Project Number 197- MY-05
Stations 0+00 - 10+00**

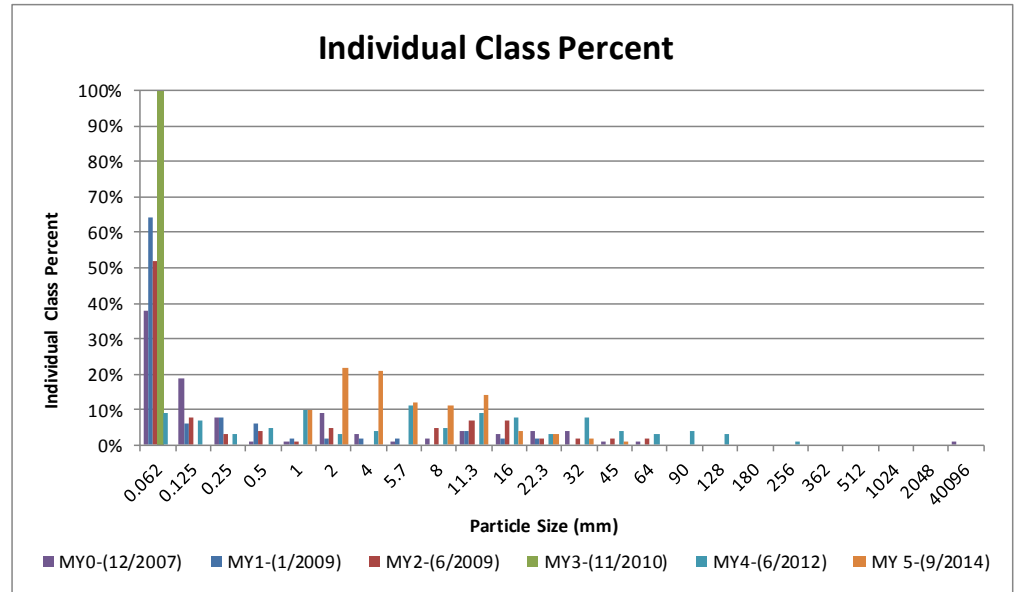
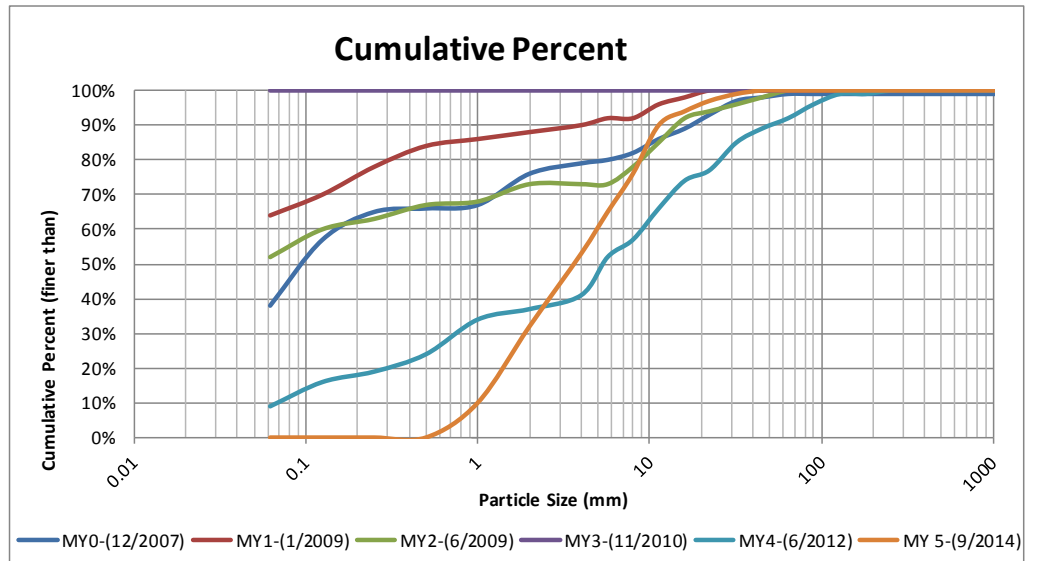




Longitudinal Profile
UT to Little Hunting Creek
EEP Project Number 197- MY-05
Stations 10+00 - 22+00

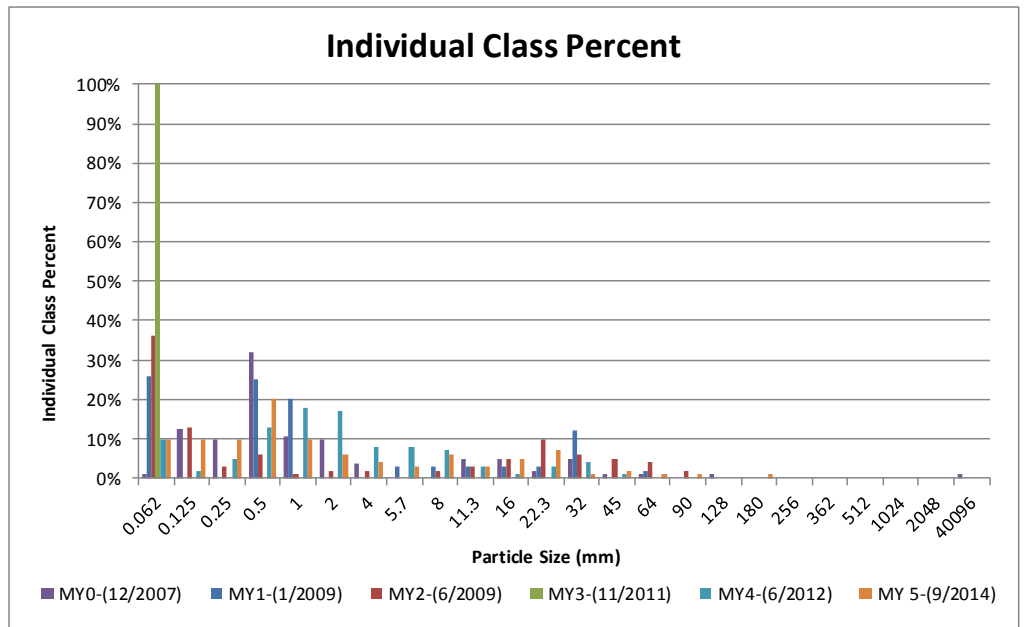
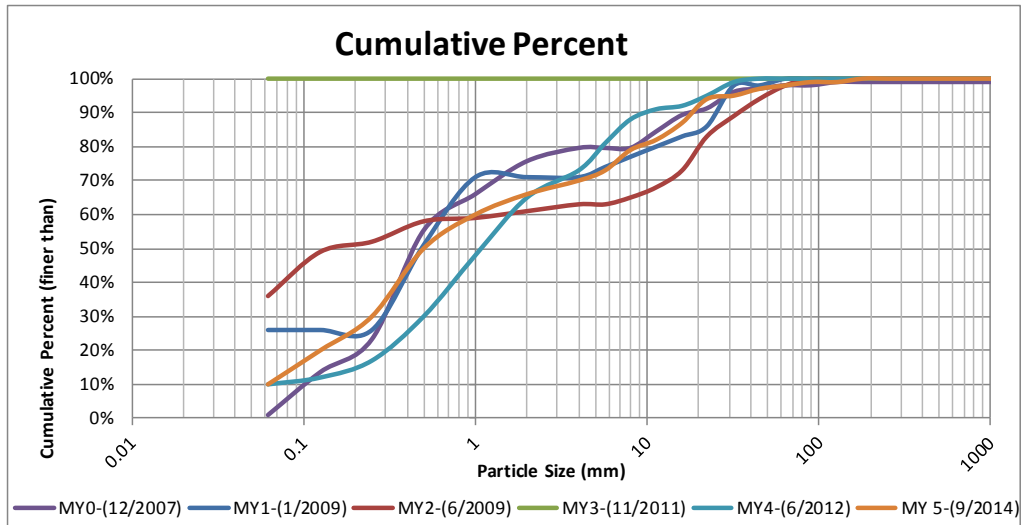
Project Name: UT to Little Hunting Creek (Johnson Site)					
Cross-Section: 1					
Feature: Riffle					
MY5-(9/2014)					
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	0	0%	0%
	coarse sand	1.00	10	10%	10%
	very coarse sand	2.0	22	22%	32%
Gravel	very fine gravel	4.0	21	21%	53%
	fine gravel	5.7	12	12%	65%
	fine gravel	8.0	11	11%	76%
	medium gravel	11.3	14	14%	90%
	medium gravel	16.0	4	4%	94%
	course gravel	22.3	3	3%	97%
	course gravel	32.0	2	2%	99%
	very coarse gravel	45	1	1%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	3.6
D84	9.6
D95	18.00



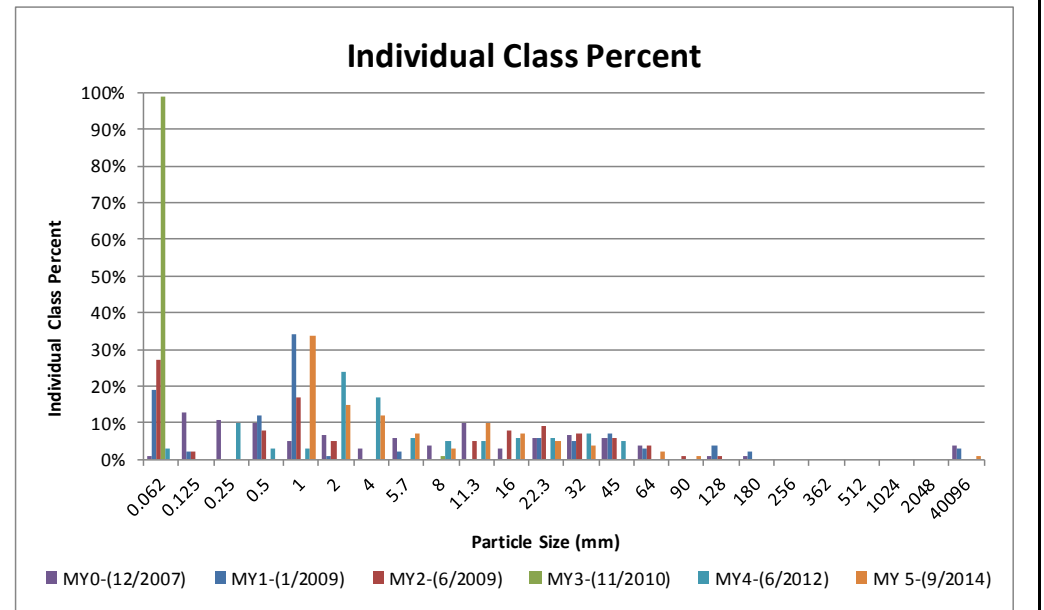
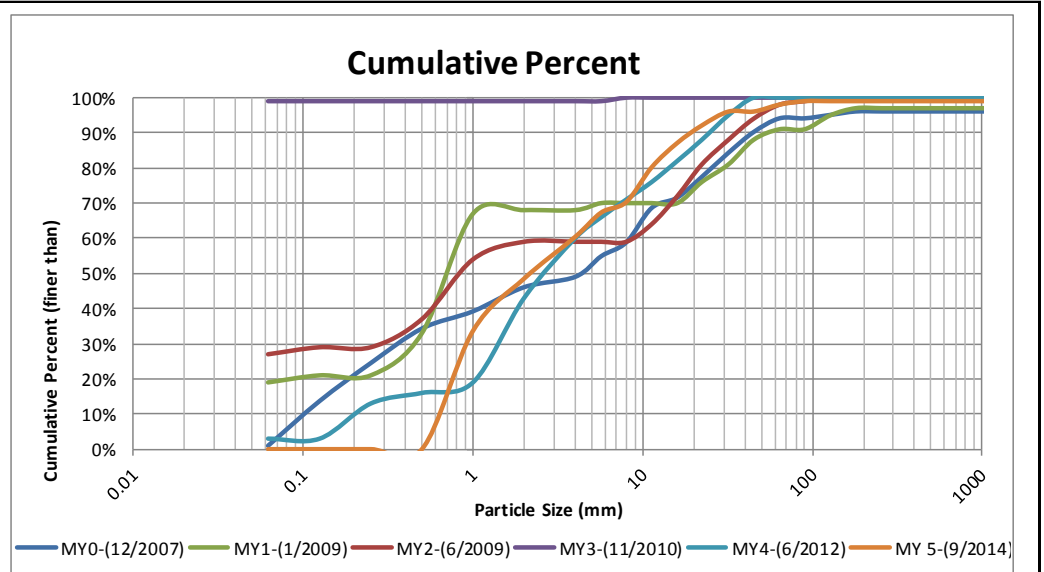
Project Name: UT to Little Hunting Creek (Johnson Site)					
Cross-Section: 2					
Feature: Pool					
MY5-(9/2014)					
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	10	10%	10%
Sand	very fine sand	0.125	10	10%	20%
	fine sand	0.250	10	10%	30%
	medium sand	0.50	20	20%	50%
	coarse sand	1.00	10	10%	60%
	very coarse sand	2.0	6	6%	66%
Gravel	very fine gravel	4.0	4	4%	70%
	fine gravel	5.7	3	3%	73%
	fine gravel	8.0	6	6%	79%
	medium gravel	11.3	3	3%	82%
	medium gravel	16.0	5	5%	87%
	course gravel	22.3	7	7%	94%
	course gravel	32.0	1	1%	95%
	very coarse gravel	45	2	2%	97%
	very coarse gravel	64	1	1%	98%
Cobble	small cobble	90	1	1%	99%
	medium cobble	128	0	0%	99%
	large cobble	180	1	1%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	0.35
D84	9.1
D95	22



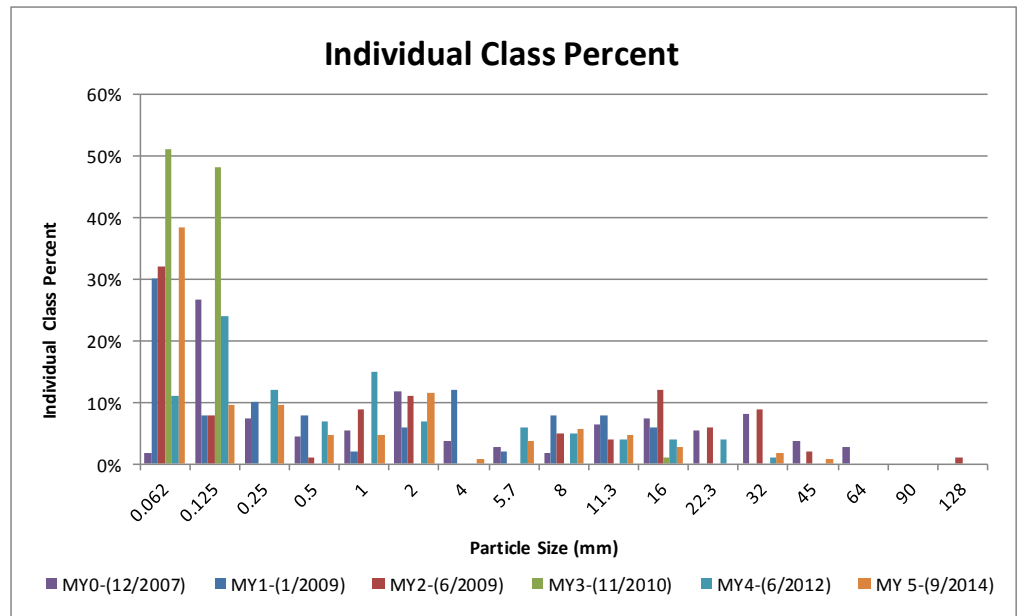
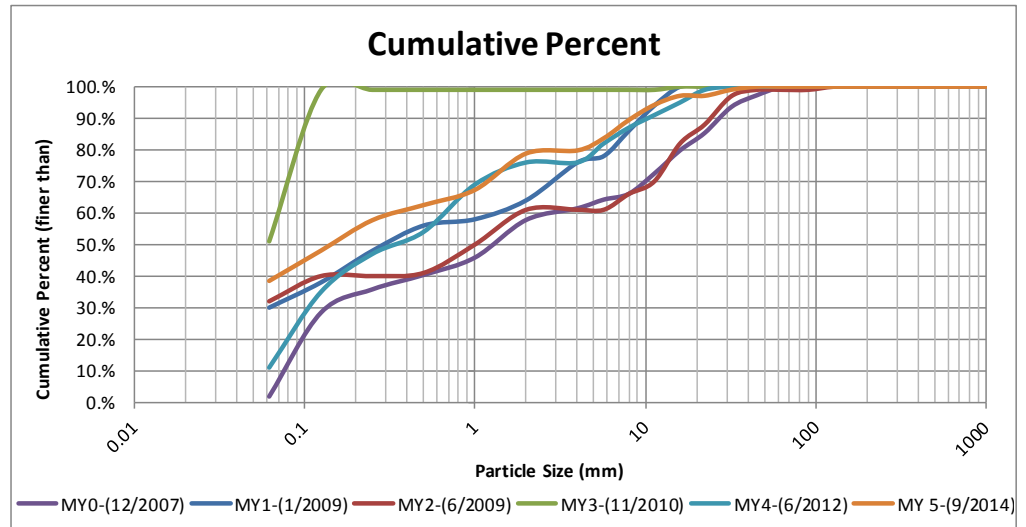
Project Name: UT to Little Hunting Creek (Johnson Site)					
Cross-Section: 3					
Feature: Pool					
MY5-(9/2014)					
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	0	0%	0%
	coarse sand	1.00	34	34%	34%
	very coarse sand	2.0	15	15%	49%
Gravel	very fine gravel	4.0	12	12%	60%
	fine gravel	5.7	7	7%	67%
	fine gravel	8.0	3	3%	70%
	medium gravel	11.3	10	10%	80%
	medium gravel	16.0	7	7%	87%
	course gravel	22.3	5	5%	92%
	course gravel	32.0	4	4%	96%
	very coarse gravel	45	0	0%	96%
	very coarse gravel	64	2	2%	98%
Cobble	small cobble	90	1	1%	99%
	medium cobble	128	0	0%	99%
	large cobble	180	0	0%	99%
	very large cobble	256	0	0%	99%
Boulder	small boulder	362	0	0%	99%
	small boulder	512	0	0%	99%
	medium boulder	1024	0	0%	99%
	large boulder	2048	0	0%	99%
Bedrock	bedrock	40096	1	1%	100%
TOTAL % of whole count			101	100%	100%

Summary Data	
D50	2.1
D84	13
D95	27



Project Name: UT to Little Hunting Creek (Johnson Site)					
Cross-Section: 4					
Feature: Riffle					
MY5-(9/2014)					
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	40	38%	38%
Sand	very fine sand	0.125	10	10%	48%
	fine sand	0.250	10	10%	58%
	medium sand	0.50	5	5%	63%
	coarse sand	1.00	5	5%	67%
	very coarse sand	2.0	12	12%	79%
Gravel	very fine gravel	4.0	1	1%	80%
	fine gravel	5.7	4	4%	84%
	fine gravel	8.0	6	6%	89%
	medium gravel	11.3	5	5%	94%
	medium gravel	16.0	3	3%	97%
	course gravel	22.3	0	0%	97%
	course gravel	32.0	2	2%	99%
	very coarse gravel	45	1	1%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			104	100%	100%

Summary Data	
D50	0.14
D84	6.1
D95	12.0



Project Name: UT to Little Hunting Creek (Johnson Site)					
Cross-Section: 5					
Feature: Riffle					
MY5-(9/2014)					
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	15	15%	15%
	coarse sand	1.00	5	5%	20%
	very coarse sand	2.0	20	20%	40%
Gravel	very fine gravel	4.0	23	23%	62%
	fine gravel	5.7	19	19%	81%
	fine gravel	8.0	10	10%	91%
	medium gravel	11.3	7	7%	98%
	medium gravel	16.0	0	0%	98%
	course gravel	22.3	0	0%	98%
	course gravel	32.0	1	1%	99%
	very coarse gravel	45	0	0%	99%
	very coarse gravel	64	0	0%	99%
Cobble	small cobble	90	0	0%	99%
	medium cobble	128	0	0%	99%
	large cobble	180	0	0%	99%
	very large cobble	256	0	0%	99%
Boulder	small boulder	362	0	0%	99%
	small boulder	512	0	0%	99%
	medium boulder	1024	0	0%	99%
	large boulder	2048	0	0%	99%
Bedrock	bedrock	40096	1	1%	100%
TOTAL % of whole count			101	100%	100%

Summary Data	
D50	2.7
D84	6.4
D95	9.20

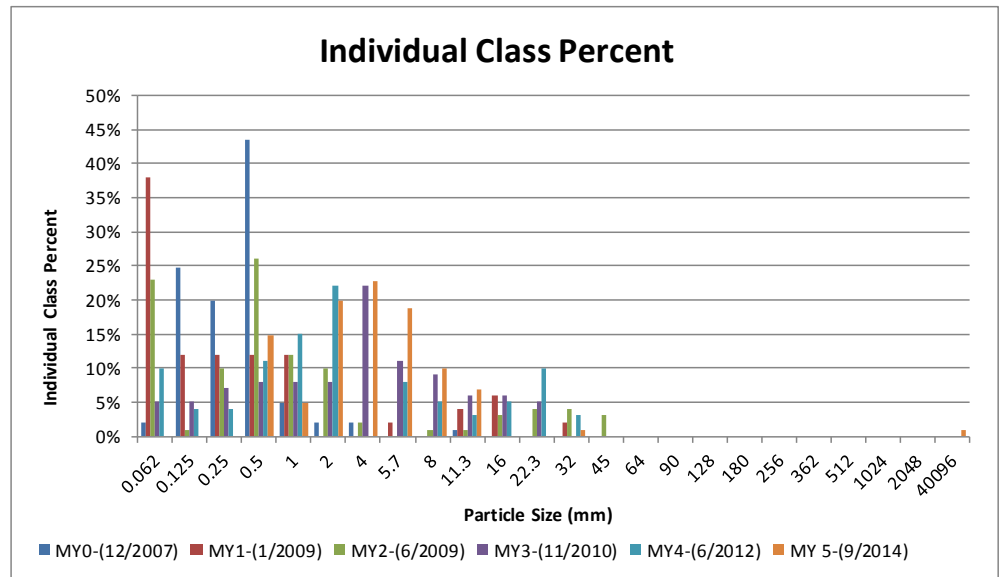
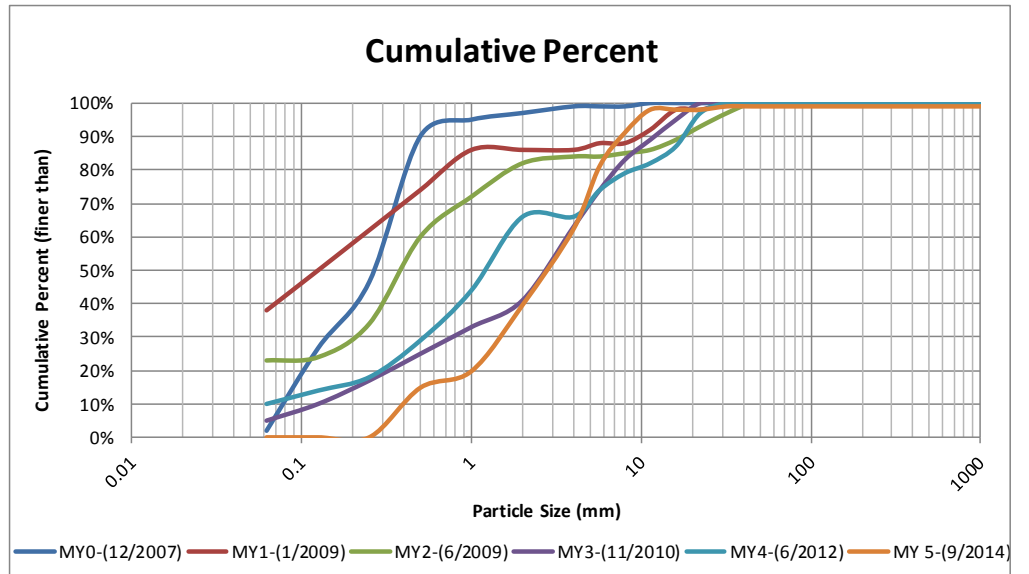


Table 10. Baseline Stream Data Summary: UT to Little Hunting Creek - 2,730 lf
UT to Little Hunting Creek (Johnson Site) / Project No. 197

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-built						
	LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n	
Dimension and Substrate - Riffle																									
Bankfull Width (ft)				4	9.4	8.4	15.0		6	9.0	9.5		10.0		2	8.4			8.2	8.5	8.7	8.7			3
Floodprone Width (ft)				7	13	12	21		6	13	17		21		2	10		11	15	17	19	18			3
Bankfull Mean Depth (ft)				0.5	0.8	0.8	1.0		6	1.1	1.2		1.2		2	0.8			0.9	1.0	0.9	1.1			3
Bankfull Max Depth (ft)				0.7	1.2	1.2	1.7		6	1.3	1.4		1.5		2	0.9		1.0	1.1	1.2	1.1	1.4			3
Bankfull Cross-Sectional Area (ft ²)				3.5	6.7	6.5	7.4		6	10.4	10.6		10.7		2	7.0			7.2	8.2	7.6	9.7			3
Width/Depth Ratio				4.2	14.3	10.7	30.1		6	8	10		12		2	10.0		2.3	7.7	9.0	9.4	10.0			3
Entrenchment Ratio				1.1	1.4	1.3	5.4		6	1.3	1.8		2.3		2	1.3			2.0	2.0	2.0	2.1			3
Bank Height Ratio				2.6	5.2	5.1	9.1		6	0.9	1.5		2.1		2	1.0		6.6	1.0	1.0	1.0	1.0			3
Pattern																									
Channel Beltwidth (ft)					30						45					38		42	16	26	23	39			9
Radius of Curvature (ft)				11			20			13			42			11		37	16	27	28	41			14
Rc:Bankfull width (ft/ft)				0.7			5			1.3			4.4			1.3		4.4	1.9	0.2	3.3	4.8			14
Meander Wavelength (ft)				40			140			93			136			76		126	47	69	70	97			10
Meander Width Ratio				2			705			4.5			5			4.5		5	1.9	3.1	2.7	4.6			9
Profile																									
Riffle Length (ft)																			16	44	43	83			32
Riffle Slope (ft/ft)				0.0070			0.0860			0.0130			0.0280			0.010		0.022	0.0025	0.0198	0.0170	0.0888			32
Pool Length (ft)				2			15			3			25			3		21	3	9	8	36			22
Pool Max Depth																									
Pool Spacing (ft)				15			132			30			59			28		59	18	102	68	364			22
Substrate, bed and transport parameters																									
Ri%/Ru%/P%/G%/S%																									
SC% / Sa% / G% / C% / B% / Be%					26%/39%/30%/2%/-/3%						.5%/18.5%/77%/4%/-/-									13.7%/46.3%/37.7%/0.7%/-/1.7%					
d16 / d35 / d50 / d84 / d95 / di ^P / di ^{SP} (mm)					<0.062 / 0.15 / 0.31 / 12.1 / 48 / - / -						1.6 / 4.0 / 6.7 / 34 / 60 / - / -								0.1 / 0.2 / 1.3 / 20 / 37 / - / -						
Reach Shear Stress (competency) lb/ft ²																0.95						1.01			
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m ²																									
Additional Reach Parameters																									
Drainage Area (SM)					7.8						4.8					7.8						7.8			
Impervious cover estimate					10%											10%						10%			
Rosgen Classification					f5/B5c/G5c						B4c					B4c						B4c			
Bankfull Velocity (fps)																						1.62			
Bankfull Discharge (cfs)					22						44					22						22			
Valley length (ft)																						1,939			
Channel thalweg length (ft)					2,260											2,156						2,158			
Sinuosity					1.10						1.2					1.10						1.11			
Water Surface Slope (Channel) (ft/ft)					0.0180						0.0130					0.0190						0.018			
BF slope (ft/ft)					0.0190						0.016					0.0190						0.019			
Bankfull Floodplain Area (acres)																									
Proportion over wide (%)																									
Entrenchment Class (ER Range)					100% < 1.5 (1.13)						100% > 10 (15.66)					100% > 10 (16.67)				5.0 < 100% < 9.9 (5.35,6.30)					
Incision Class (BHR Range)					(2.53) 100% > 2.0						1.2 = (1.2) 100% < 1.49					(1.0) 100% < 1.2				(1.0) 100% < 1.2					
BEHI VL% / L% / M% / H% / VH% / E%																									
Channel Stability or Habitat Metric																									
Biological or Other																									

**Table 1a. Monitoring - Cross-Section Morphology Data
 UT to Little Hunting Creek (Johnson Site) / Project No. 197**

Dimension and Substrate														
Cross-Section 1 (Riffle)					Cross-Section 2 (Pool)					Cross-Section 3 (Pool)				
MY1-2008	MY2-2009	MY3-2010	MY4-2012	MY5-2014	MY1-2008	MY2-2009	MY3-2010	MY4-2012	MY5-2014	MY1-2008	MY2-2009	MY3-2010	MY4-2012	MY5-2014
9.15	9.04	13.01	13.28	12.50	11.04	11.67	12.78	13.93	10.80	10.00	*	9.77	9.18	14.30
Bankfull Width (ft)														
19.36	19.23	22.73	23.41	63.10	28.58	28.27	29.65	30.39	29.80	17.09	*	16.73	22.67	23.50
Floodprone Width (ft)														
0.84	0.80	0.73	0.63	0.70	0.84	0.80	1.02	1.30	1.30	0.77	*	0.67	1.03	1.10
Bankfull Mean Depth (ft)														
1.26	0.80	1.51	1.48	1.70	2.44	2.40	2.24	2.50	2.50	1.23	*	1.04	1.71	2.00
Bankfull Max Depth (ft)														
7.72	7.27	9.50	8.45	8.60	15.67	14.16	13.44	14.40	14.40	7.66	*	6.54	9.43	15.40
Bankfull Cross-Sectional Area (ft ²)														
10.89	11.30	17.82	21.08	18.20	8.71	12.17	13.66	8.10	8.10	12.99	*	14.58	8.91	13.30
Bankfull Width/Depth Ratio														
2.11	2.13	1.75	1.76	5.00	2.59	2.32	2.80	2.80	2.80	1.71	*	1.71	2.47	1.60
Bankfull Entrenchment Ratio														
2.76	2.76	2.48	2.45	0.49	2.52	2.94	2.8	0.90	0.90	6.20	6.20	7.36	5.33	0.40
Bankfull Bank Height Ratio														
66.00	66.00	66.00	66.00	66.00	165.00	165.00	165.00	165.00	165.00	180.00	180.00	180.00	180.00	180.00
Cross-Sectional Area Between End Pins (ft ²)														
0.05	0.06	0.03	5.39	3.60	0.49	0.17	0.05	0.35	0.35	0.75	0.88	0.03	2.82	2.10
d50 (mm)														

Based on fixed baseline elevation														
Cross-Section 4 (Riffle)					Cross-Section 5 (Riffle)									
MY1-2008	MY2-2009	MY3-2010	MY4-2012	MY5-2014	MY1-2008	MY2-2009	MY3-2010	MY4-2012	MY5-2014					
8.23	8.78	9.92	10.62	9.00	8.32	8.12	7.97	7.62	8.20					
Bankfull Width (ft)														
16.73	16.25	16.39	20.04	20.90	18.40	18.82	21.58	17.32	19.60					
Floodprone Width (ft)														
0.93	0.95	0.75	0.84	1.00	1.37	1.37	1.27	1.38	1.80					
Bankfull Mean Depth (ft)														
1.27	1.19	1.21	1.67	1.70	2.08	2.06	2.67	2.11	2.20					
Bankfull Max Depth (ft)														
7.63	8.31	7.48	8.88	8.70	11.39	11.15	10.10	10.55	14.90					
Bankfull Cross-Sectional Area (ft ²)														
8.85	9.24	13.23	12.64	9.30	6.07	5.93	6.28	5.52	4.50					
Bankfull Width/Depth Ratio														
2.03	1.85	1.65	1.89	2.30	2.21	2.32	2.71	2.27	2.40					
Bankfull Entrenchment Ratio														
5.20	5.20	4.93	4.49	0.40	3.14	3.14	2.81	2.71	1.00					
Bankfull Bank Height Ratio														
128.00	128.00	128.00	128.00	128.00	108.00	108.00	108.00	108.00	108.00					
Cross-Sectional Area Between End Pins (ft ²)														
0.31	1.00	0.06	0.36	0.14	0.13	0.40	2.82	1.27	2.70					
d50 (mm)														

Table 11b. Monitoring - Stream Reach Morphology Data Table
UT to Little Hunting Creek (Johnson Site) Stream Restoration Project/EEP Project No. 197
UT to Little Hunting Creek (2,216 ft.)

Parameter	Baseline						MY 1 2008						MY 2 2009						MY 3 2010						MY 4 2012						MY 5 2014					
	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																																				
Bankfull Width (ft)	8.2	8.5	8.7	8.7	-	3	8.23	8.57	8.32	9.15	-	3	8.12	9.40	8.91	11.67	-	3	7.97	10.69	9.92	13.01	-	3	7.62	10.51	10.62	13.28	-	3	8.20	9.90	9.00	12.50	-	3
Floodprone Width (ft)	15.0	17.0	18.0	18.0	-	3	16.73	18.16	18.40	19.36	-	3	16.25	20.64	19.03	28.27	-	3	16.39	21.42	21.58	29.65	-	3	17.32	20.26	20.04	23.41	-	3	19.60	34.53	20.90	63.10	-	3
Bankfull Mean Depth (ft)	0.9	1.0	0.9	1.1	-	3	0.84	1.05	0.93	1.37	-	3	0.80	0.98	0.88	1.37	-	3	0.67	0.89	0.75	1.27	-	3	0.63	0.95	0.84	1.38	-	3	0.70	1.17	1.00	1.80	-	3
Bankfull Max Depth (ft)	1.1	1.2	1.1	1.4	-	3	1.26	1.54	1.27	2.08	-	3	0.80	1.61	1.63	2.40	-	3	1.04	1.73	1.51	2.67	-	3	1.48	1.75	1.67	2.11	-	3	1.70	1.87	1.70	2.20	-	3
Bankfull Cross Sectional Area (ft2)	7.2	8.2	7.6	9.7	-	3	7.63	8.91	7.72	11.39	-	3	7.27	10.59	9.73	15.63	-	3	6.54	9.41	9.50	13.44	-	3	8.45	9.29	8.88	10.55	-	3	8.60	10.73	8.70	14.90	-	3
Width/Depth Ratio	7.7	9.0	9.4	10.0	-	3	6.07	8.60	8.85	10.89	-	3	5.93	8.80	8.98	11.30	-	3	6.28	12.82	13.23	17.82	-	3	5.52	13.08	12.64	21.08	-	3	4.50	10.67	9.30	18.20	-	3
Entrenchment Ratio	2.0	2.0	2.0	2.1	-	3	2.03	2.12	2.11	2.21	-	3	1.86	2.18	2.23	2.42	-	3	1.65	2.03	1.75	2.71	-	3	1.76	1.97	1.89	2.27	-	3	2.30	3.23	2.40	5.00	-	3
Bank Height Ratio	1.0	1.0	1.0	1.0	-	3	2.76	3.70	3.14	5.20	-	3	2.52	3.96	3.14	6.20	-	3	2.48	4.10	2.94	7.36	-	3	2.45	3.22	2.71	4.49	-	3	0.40	0.63	0.49	1.00	-	3
Bankfull Velocity (fps)	0.09	1.62	0.5	4.22	-	3	0.10	0.63	0.17	1.61	-	3	0.79	2.40	2.45	3.96	-	3	0.01	0.59	0.03	1.74	-	3	1.49	3.95	2.63	7.74	-	3					-	3
PROFILE																																				
Riffle Length (ft)	16	44.0	43	86	-	32	6.97	-	22.44	74.22	-	32	4.26	-	12.07	58.23	-	32	12.50	-	35.54	67.54	-	32	11.97	-	37.87	67.25	-	32	1.40	9.91	7.00	44.80	-	59
Riffle Slope (ft/ft)	0.0025	0.0198	0.0170	0.0888*	-	32	0.0024	-	0.0226	0.0867	-	32	0.0084	-	0.0327	0.1544	-	32	0.0128	-	0.0321	0.0810	-	32	0.01504	-	0.0301	0.1152	-	32	0.002	0.251	0.037	0.251	-	55
Pool Length (ft)	3	9.0	8	36	-	22	9.06	-	16.71	33.77	-	22	6.43	-	12.11	31.25	-	22	13.01	-	23.49	42.37	-	22	24.45	-	38.43	58.52	-	22	1.00	11.00	9.00	35.00	-	46
Pool Max depth	N/A	N/A	N/A	N/A	-	-	N/A	-	N/A	N/A	-	-	N/A	-	N/A	N/A	-	-	0.39	-	1.43	2.71	-	22	0.66	-	1.31	2.92	-	22	0.248	1.02	0.93	2.18	-	46
Pool Spacing (ft)	18	102.0	68	364	-	22	19.99	-	73.45	156.17	-	22	22.79	-	83.18	224.51	-	22	20.63	-	76.93	205.69	-	22	42.75	-	122.09	233.19	-	22	2.40	36.63	25.10	146.30	-	46
PATTERN																																				
Channel Beltwidth (ft)	16	26.0	23	39	-	9	16	26.0	23	39	-	9	16	26.0	23	39	-	9	16	26.0	23	39	-	9	16	26.0	23	39	-	9	16	26.00	23	39	-	9
Radius of Curvature (ft)	16	27.0	28	41	-	14	16	27.0	28	41	-	14	16	27.0	28	41	-	14	16	27.0	28	41	-	14	16	27.0	28	41	-	14	16	27.00	28	41	-	14
Meander Wavelength (ft)	47	69.0	70	97	-	10	47	69.0	70	97	-	10	47	69.0	70	97	-	10	47	69.0	70	97	-	10	47	69.0	70	97	-	10	47	69.00	70	97	-	10
Meander Width Ratio	1.9	3.1	2.7	4.6	-	9	1.9	3.1	2.7	4.6	-	9	1.9	3.1	2.7	4.6	-	9	1.9	3.1	2.7	4.6	-	9	1.9	3.1	2.7	4.6	-	9	1.9	3.10	2.7	4.6	-	9
ADDITIONAL REACH PARAMETERS																																				
Rosgen Classification	B4c						B5c						B5c						B6c						B5c											
Channel Thalweg length (ft)	2,209						2,158						2,158						2,158						2,156						2,216					
Sinuosity (ft)	1.11						1.11						1.11						1.11						1.11											
Water Surface Slope (Channel) (ft/ft)	0.018						0.018						0.019						0.019						0.019						0.019					
BF slope (ft/ft)	0.019						0.018						0.019						0.019						0.020						0.020					
Ri%/Ru%/P%/G%/S%	27.00	27.00	18.00	18.00	7.00	117	27.00	27.00	18.00	18.00	7.00	117	27.00	27.00	18.00	18.00	7.00	117	27.00	27.00	18.00	18.00	7.00	117	27.00	27.00	18.00	18.00	7.00	117	27.00	27.00	18.00	18.00	7.00	117
SC%/Sa%/G%/C%/B%/Be%	13.7	46.30	37.70	0.7	-	1.7	35.4	40.00	22.80	6	-	3	34	33.20	31.80	1.66	-	-	71	28.30	30.00			-	8.6	48.80	41.00	8	-	-	10.0	44.0	45.0	-	-	1.0
d16 / d35 / d50 / d84 / d95	0.1	0.20	1.30	20	37	5	0.034	0.21	0.34	12.92	38.17	-	0.032	0.17	0.51	16.76	33.56	-	0.05	0.27	0.59	1.76	3.26	-	0.26	0.89	2.19	15.1	35.07	-	0.52	1.03	1.78	8.84	17.64	
% of reach with eroding banks	-						1.08						23						5.3						2.8											
Channel Stability or Habitat Metric	-						-						-						-						-											
Biological or Other	-						-						-						-						-											

Appendix E

Hydrology Data

**Table 12. Verification of Bankful Events
UT to Little Hunting Creek (Johnson Site) / Project No. 197**

Date of Rainfall	Amount (inches)	USGS Approved (A) or Provisional Data (P)
8/26/2008 – 8/27/2008	4.56	A
12/10/2008 – 12/11/2008	3.10	P
1/6/2009 – 1/7/2009	2.55	A
6/3/2009 – 6/5/2009	4.59	P
1/24/2010 /- 1/25/2010	2.56	P
2/5/2010 – 2/6/2010	2.33	P
5/16/2010 – 5/17/2010	5.41	P
9/26/2010 – 9/28/2010	4.41	P
10/27/2010 – 10/28/2010	5.69	P
5/14/2012 – 5/16/2012	5.1	P