FINAL

ANNUAL MONITORING REPORT
YEAR 5 (2016)
HAUSER CREEK STREAM RESTORATION SITE
DAVIE COUNTY, NORTH CAROLINA
(DMS Project No. 92471, Contract No. 004804)
Construction Completed August 2011

Submitted to:
North Carolina Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

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Prepared by:
Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, North Carolina 27603

Axiom Environmental, Inc.

November 2016

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1.0 EXECUTIVE SUMMARY

The North Carolina Department of Environmental Quality- Division of Mitigation Services (DMS, formerly NCEEP) has completed stream mitigation at the Hauser Creek Stream Restoration Site (hereafter referred to as the "Site") located on the property of Alethea Segal in Davie County, North Carolina to assist in fulfilling stream mitigation goals in the area. The Site is located in United States Geological Survey (USGS) Hydrologic Unit 03040101160010 (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-07-02) of the Yadkin Pee-Dee River Basin. The Site is not located in a Targeted Local Watershed. The Site drainage area is an approximately 2.64-square mile rural watershed at the Site outfall consisting primarily of forest and pasture land with low-density residential property. This report (compiled based on NCEEP's *Procedural Guidance and Content Requirements for EEP Monitoring Reports* Version 1.4 dated 11/7/11) summarizes data for year 5 (2016) monitoring.

Restoration goals outlined in the approved *Hauser Creek Restoration Plan* [NCEEP 2008] include the following.

- Improve water quality with the construction of stable stream banks, removal of cattle access, and the establishment of a protective buffer.
- Control transport of sediment recruited by stream flows from cleared adjacent floodplains with the establishment of a forested buffer.
- Improve the stream function and habitat with the connection of the channelized and incised stream back to its floodplain.
- Restore long-term stability with the restoration of channel pattern, profile, and dimension.
- Improve in-stream habitat with the installation of root wads, constructed riffles, cross-vanes, and single wing vanes to enhance pool depths.
- Improve buffer habitat by creating ephemeral pools within the old channel fill areas.

Project objectives outlined in the approved *Hauser Creek Restoration Plan* [NCEEP 2008] include the following.

- The restoration of 2525 linear feet of stream with Priority I Restoration in order to raise the stream elevation, reconnect the floodplain, restore pattern, and reestablish channel dimension.
- The enhancement of 93 linear feet of stream with Enhancement Level II activities, which involve buffer restoration and bank stabilization.
- The preservation of 108 linear feet of stream by placing a conservation easement along the downstream reach of channel.
- Establish a riparian buffer with an average distance of 50 feet beyond each stream bank.

Prior to construction, the Site contained a degraded stream channel located within maintained pasture and floodplain fields with wooded uplands. Site streams were characterized by a narrow buffer, channels widths approximately two times what they should be, steep to moderate bank slopes, incision, and elevated bank-height ratios. Project construction was completed in August 2011. The Site will be protected by a permanent conservation easement held by the State of North Carolina.

Seven vegetation monitoring plots were monitored during July 2016 for Year 5 (2016) monitoring. Vegetation success criteria dictate that an average density of 320 stems-per-acre must be surviving in the first three monitoring years. Subsequently, 288 stems-per-acre must be surviving in year 4 and 260 stems-per-acre in year 5. Stem counts will be based on an average of the evaluated vegetation plots. Based on the number of stems counted, average densities were measured at 497 planted stems-per-acre (excluding livestakes) surviving in Year 5 (2016). The dominant species identified at the Site were planted stems of sycamore (*Platanus occidentalis*) and green ash (*Fraxinus pennsylvanica*). All seven vegetation plots met success criteria based on planted stems alone.

Overall, vegetation at the Site is thriving. One small population of Japanese honeysuckle (*Lonicera japonica*) was observed during Year 3 (2014) near and in vegetation plot 1 (Figure 2A, Appendix B). This area is small and does not appear to have spread during Years 4 (2015) and 5 (2016).

Success criteria for stream restoration will be assessed using measurements of stream dimension, pattern, and profile; Site photographs; visual assessments; and vegetation sampling. Success is based on the stability of the stream.

Overall, the stream is functioning properly and as designed. Three areas of bank erosion were observed in past monitoring years, and they continued to erode during Year 5 (2016). This bank erosion has slowed as woody vegetation has established on the stream banks, and it is expected to continue to do so as roots continue to establish, but the erosion remains concerning. Additionally, several high flow rain events during Year 4 (2015) and Year 5 (2015) resulted in two areas of streambed degradation. All areas of concern are noted in Figures 2A-2B (Appendix B) and are listed in the table below.

Map Label*	Station	Notes
SAC-1	22+50	Moderate erosion and sloughing of approximately 25 feet along the right bank of an outer bend
SAC-2	18+75	Severe erosion and sloughing of approximately 35 feet along the left bank of an outer bend as well as approximately 10 feet of the inner bend
SAC-3	12+00	Moderate erosion and sloughing of approximately 15 feet along the right bank of an outer bend
SAC-4	20+30 to 22+45	Streambed degradation – riffle and pool scour and loss of bed material throughout reach due to high flow events on approximately 215 feet of stream
SAC-5	14+05 to 18+20	Streambed degradation – riffle and pool scour and loss of bed material throughout reach due to high flow events on approximately 415 feet of stream

*Map labels on Figures 2A-2B, Appendix B

Additionally, beaver activity has been an ongoing issue throughout the monitoring period. Two beaver dams were observed during an October 2016 Site visit (Figures 2A-2B, Appendix B).

Success criteria for stream restoration will include documentation of two bankfull channel events during the monitoring period. In the event that less than two bankfull events occur during the first five years, monitoring will continue until the second event is documented. In addition, bankfull events must occur during separate monitoring years. A crest gauge is located within the Site to assist with documentation of bankfull events (Figures 2 and 2A-2B, Appendix B). Five bankfull events were documented to date during the Year 5 (2016) monitoring season for a total of eighteen bankfull events.

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 tables and figures within this report's 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

2.1 Vegetation Assessment

Seven vegetation plots were established and marked after construction with metal t-posts demarking the four corners of the plot. The plots are 10 meters square and are located randomly within the Site. These plots were surveyed on July 2016 for the Year 5 (2016) monitoring season using the *CVS-EEP Protocol for*

Recording Vegetation, Version 4.2 (Lee et al. 2008) (http://cvs.bio.unc.edu/methods.htm); results are included in Appendix C. The taxonomic standard for vegetation used for this document was *Flora of the Southern and Mid-Atlantic States* (Weakley 2012).

2.2 Stream Assessment

Annual stream monitoring was conducted in March 2016 for the Year 5 (2016) monitoring season. Measurements were taken using a Topcon GTS 303 total station and Recon data collector. The raw total station file was processed using Carlson Survey Software into a Computer Aided Design (CAD) file. Coordinates were exported as a text/ASCII file to Microsoft Excel for processing and presentation of data. Pebble counts were completed using the modified Wolman method (Rosgen 1993). A crest gauge was installed in the lower portion of the Site to assist with documentation of overbank events.

Seven permanent cross-sections, five riffle and two pool, will be used to evaluate stream dimension; locations are depicted on Figures 2 and 2A-2B (Appendix B). Cross-sections are permanently monumented with metal t-posts at each end point. Cross-sections will be surveyed annually to provide a detailed measurement of the stream and banks including points on the adjacent floodplain, top of bank, bankfull, breaks in slope, edge of water, and thalweg. Data will be used to calculate width-depth ratios, entrenchment ratios, and bank height ratios for each cross-section. In addition, pebble counts were completed at cross-sections 3, 5, and 7, and photographs will be taken at each permanent cross-section annually.

One approximately 2500-linear foot monitoring reach (the entire Site stream reach) will be used to evaluate stream pattern and longitudinal profile (Figures 2 and 2A-2B, Appendix B). Measurement of channel pattern will include belt-width and meander length. Subsequently, data will be used to calculate meander-width ratios. Longitudinal profile measurements will include average water surface slopes, facet slopes, and pool-to-pool spacing. In addition, visual stream morphology stability assessments will be completed in each monitoring reach annually to assess the channel bed, banks, and in-stream structures.

3.0 REFERENCES

Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation, Version 4.2. (online). Available: http://cvs.bio.unc.edu/methods.htm.

North Carolina Ecosystem Enhancement Program (NCEEP). 2008. Hauser Creek Restoration Plan - Davie County, NC.

North Carolina Ecosystem Enhancement Program (NCEEP). Unpublished. Procedural Guidance and Content Requirements for EEP Monitoring Projects, Version 1.4, dated 11/07/11. NC Department of Environment and Natural Resources. Available online at http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=2288101&name=DLFE-39268.pdf.

Weakley, Alan S. 2012. Flora of the Southern and Mid-Atlantic States. Available online at: http://www.herbarium.unc.edu/WeakleysFlora.pdf [September 28, 2012]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

Weather Underground. 2016. Station at Winston Salem Airport, North Carolina. (online). Available: http://www.wunderground.com/history/airport/KINT/2016/10/19/DailyHistory.html?req_city=NA&req_state=NA&req_statename=NA [October 19, 2016]. Weather Underground.

APPENDIX A

PROJECT SITE LOCATION MAP AND BACKGROUND TABLES

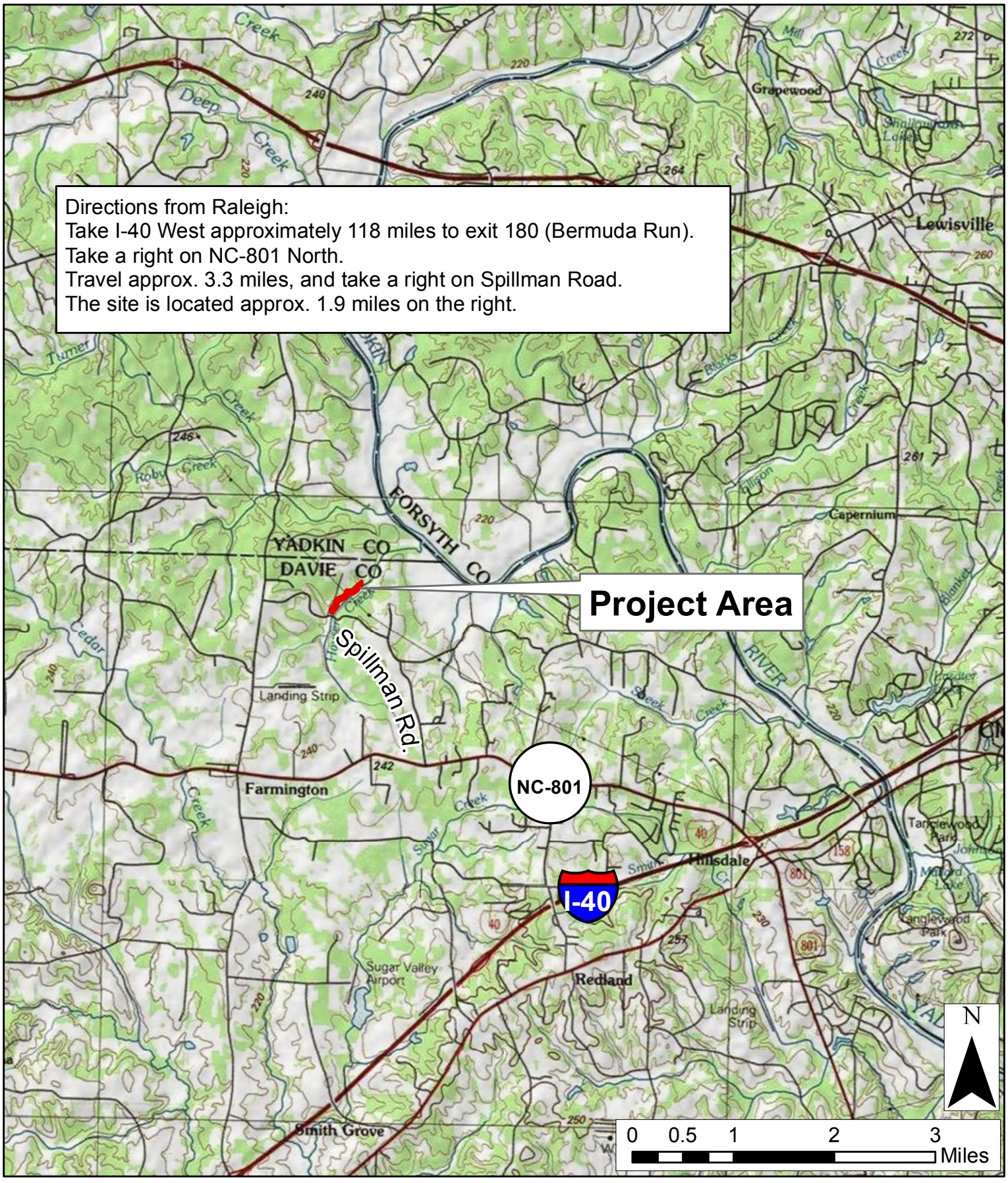
Figure 1. Site Location Map

Table 1. Project Components and Mitigation Credits

Table 2. Project Activity and Reporting History

Table 3. Project Contacts Table

Table 4. Project Baseline Information and Attributes



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SITE LOCATION MAP
HAUSER CREEK
DMS PROJECT NUMBER 92471
Davie County, North Carolina

Dwn. by. KRJ	FIGURE
Date: October 2015	1
Project: 12-004.11	

Table 1. Project Components and Mitigation Credits
Hauser Stream Restoration Site (DMS Project Number 92741)

Mitigation Credits							
	Stream		Riparian Wetland			Buffer	
Type	Restoration	Restoration Equivalent	Restoration	Restoration Equivalent			
Totals	2387	22	--	--		--	
Projects Components							
Project Component/ Reach ID	Station Range	Existing Linear Footage/ Acreage	Priority Approach	Restoration/ Restoration Equivalent	Restoration Linear Footage/ Acreage	Mitigation Ratio	Comment
Reach 1	00+72 – 16+40	--	P1	Restoration	1568	1:1	Priority 1 Restoration
Reach 2	16+40 – 19+90	--	P1	Restoration	350	2:1	Half Credit Due to Location Within a Utilities Easement
Reach 3	19+90 – 26+31	641	P1	Restoration	607	1:1	34 ft is Outside of Easement in a Piped Crossing
Reach 4	26+31–27+39	108	Pres	Preservation	108	5:1	Preservation
Reach 5	--	93	E2	Enhancement (Level II)	93	2.5:1	Level II Enhancement.

Component Summation			
Restoration Level	Stream (linear footage)	Riparian Wetland (acres)	Buffer (square footage)
Restoration	2525*	--	--
Enhancement (Level II)	93	--	--
Preservation	108	--	--
Totals	**2726**	--	--
Mitigation Units	**2409 SMUs**	**--**	**--**

*34 linear feet is located outside of the easement in a piped crossing and is therefore not counted for mitigation credit; in addition, 350 linear feet is located within a utilities easement and therefore only receives half credit (2:1 mitigation ratio)

Table 2. Project Activity and Reporting History
Hauser Stream Restoration Site (DMS Project Number 92471)

Elapsed Time Since Grading Complete: 5 years 2 months
Elapsed Time Since Planting Complete: 4 years 9 months
Number of Reporting Years: 5

Activity or Deliverable	Data Collection Complete	Completion or Delivery
ERTR		April 2008
Restoration Plan		May 2008
No-rise Flood Study Approval		December 2009
Construction Plans / Erosion Control Plan		June 2010
Land Quality Approval		May 2011
Construction and Grading Begins		April 2011
Temporary S&E Mix Applied		April-August 2011
Permanent Seed Mix Applied		April-August 2011
Construction and Grading Ends		August 2011
Containerized Planting for Entire Reach		January 2012
As-Built Construction Drawings		March 2012
SCO Final Report		March 2012
Year 1 Monitoring (2012)	October 2012	December 2012
Year 2 Monitoring (2013)	October 2013	November 2013
Year 3 Monitoring (2014)	September 2014	September 2014
Year 4 Monitoring (2015)	October 2015	December 2015
Year 5 Monitoring (2016)	October 2016	November 2016

Table 3. Project Contacts Table
Hauser Stream Restoration Site (DMS Project Number 92471)

Designer	Ward Consulting Engineers, P.C. 8368 Six Forks Road Suite 104 Raleigh, NC 27615-5083 Becky Ward 919-870-0526
Construction, Planting, and Seeding Contractor	Carolina Environmental Contracting, Inc. Mt. Airy, North Carolina 336-320-3849
Surveyor	Turner Land Surveying PLLC 3201 Glenridge Drive Raleigh, NC 27604 Elizabeth Turner 919-875-1378
Seed Mix Source	Unknown
Baseline Data Collection	Not Applicable
Annual Monitoring Performer	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693

Table 4. Project Baseline Information and Attributes
Hauser Stream Restoration Site (DMS Project Number 92471)

Project Information	
Project Name	Hauser Stream Restoration Site
Project County	Davie County, North Carolina
Project Area	9.11 acres
Project Coordinates	836,322.303◦N, 1,551,907.668◦E
Project Watershed Summary Information	
Physiographic Region	Piedmont
Ecoregion	Southern Outer Piedmont
Project River Basin	Yadkin Pee-dee
USGS 8-digit HUC	03040101
USGS 14-digit HUC	03040101160010
NCDWQ Subbasin	03-07-02
Project Drainage Area	2.64 square miles
Project Drainage Area Impervious Surface	0.6%
Watershed Type	Rural
Reach Summary Information	
Parameters	**Hauser Creek**
Restored/Enhanced Length	2726 linear feet
Drainage Area	2.64 square miles
NCDWQ Index Number	12-86
NCDWQ Classification	WS-IV
Valley Type/Morphological Description	VIII/C4
Dominant Soil Series	Wehadkee, Chewacla
Drainage Class	Poorly Drained, Somewhat poorly drained
Soil Hydric Status	Hydric, Nonhydric may contain hydric Wehadkee inclusions
Slope	0.0025
FEMA Classification	Regulated Stream
Native Vegetation Community	Piedmont/Low Mountain Alluvial Forest
Percent Composition of Exotic Invasives	<5%
Regulatory Considerations	
Regulation	**Applicable**
Waters of the U.S. –Sections 404 and 401	Yes-Received Appropriate Permits
Endangered Species Act	Yes-No Effect
Historic Preservation Act	No
CZMA/CAMA	No
FEMA Floodplain Compliance	Yes-Received a No Rise Certification
Essential Fisheries Habitat	No

APPENDIX B

VISUAL ASSESSMENT DATA

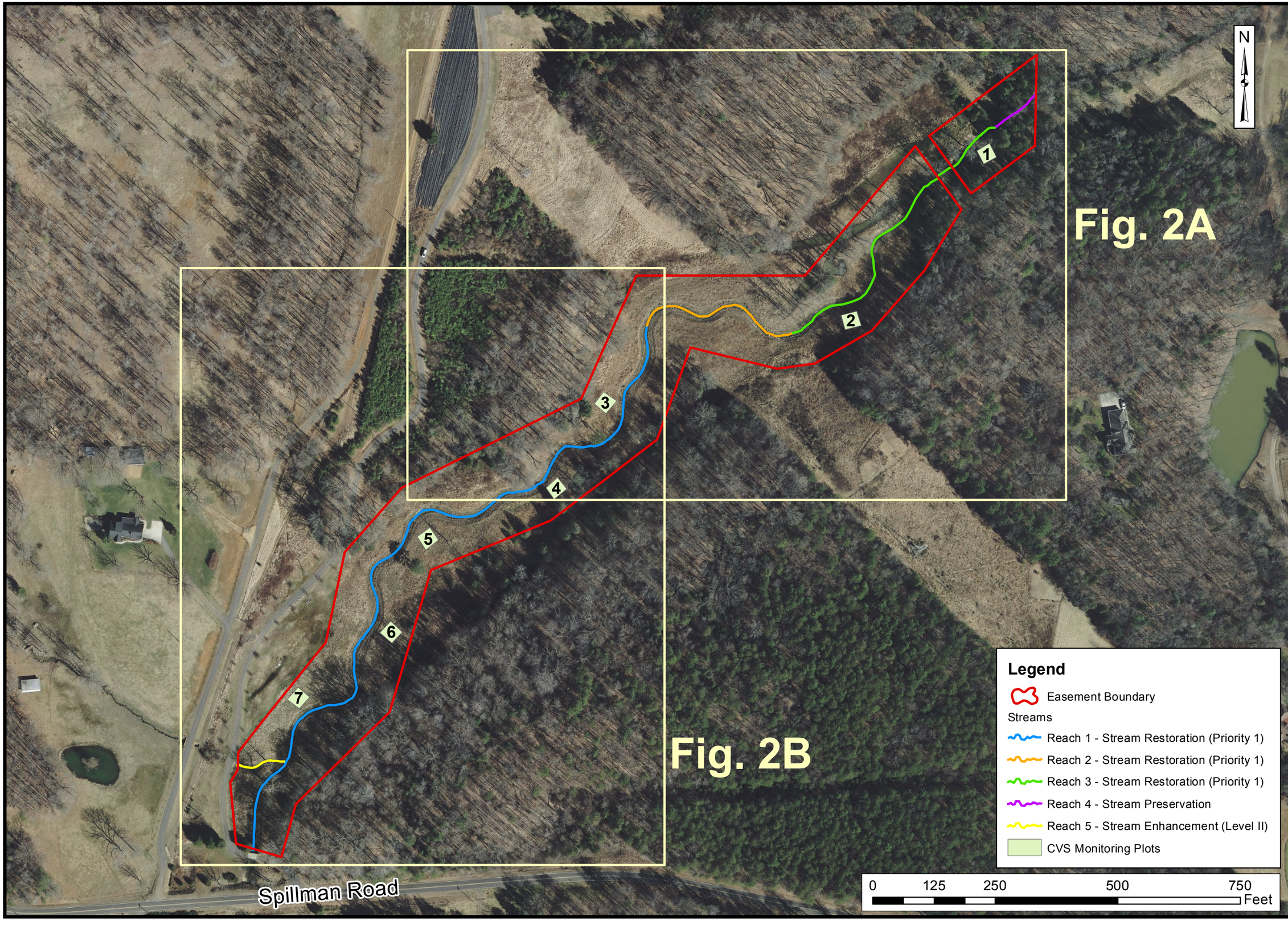
Figures 2 and 2A-2B. Current Conditions Plan View

Table 5. Visual Stream Morphology Stability Assessment

Table 6. Vegetation Condition Assessment

Stream Fixed Station Photographs

Vegetation Monitoring Photographs



Axiom Environmental, Inc.

Prepared for:

North Carolina Department of Environmental Quality

Division of Mitigation Services

Project:

HAUSER CREEK RESTORATION SITE

DMS Project Number 92471
Davie County, NC

Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by: KRJ/CLF

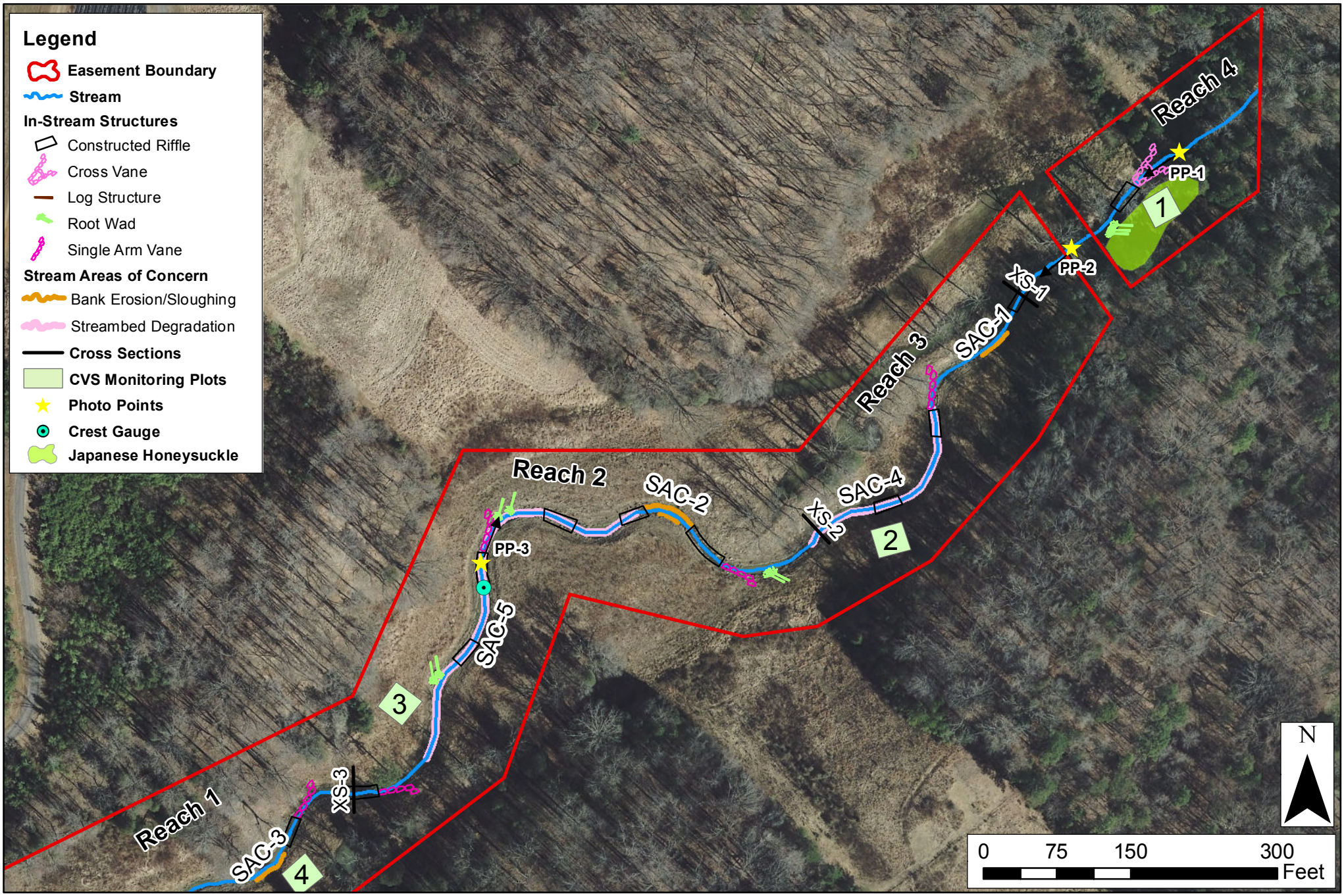
Date: Nov 2016

Scale: 1 in = 180 ft

Project No.: 12-004.11

FIGURE

2



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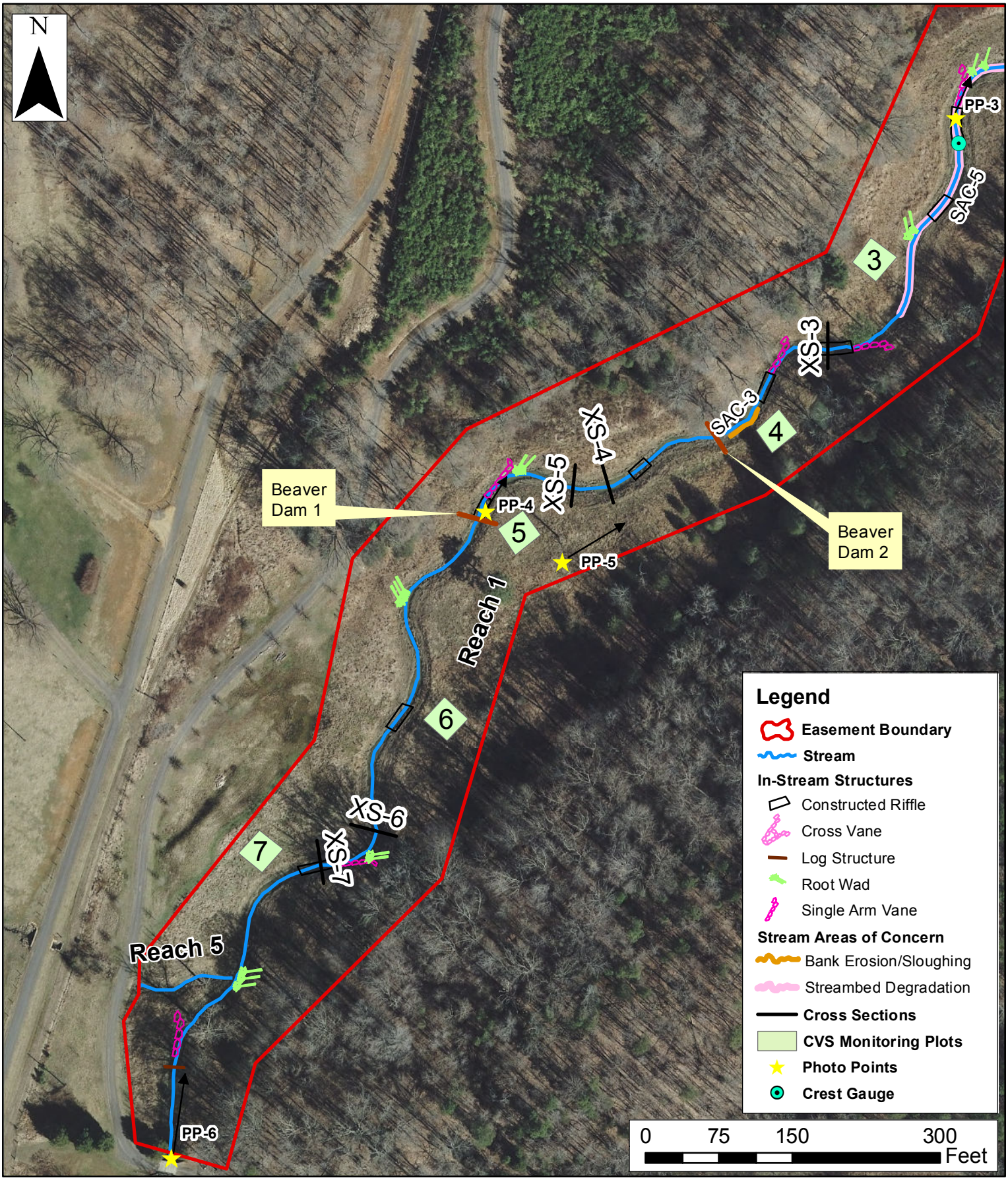
CURRENT CONDITIONS PLAN VIEW
HAUSER CREEK
DMS PROJECT NUMBER 92471
Davie County, North Carolina

Dwn. by.	KRJ/CLF
Date:	Oct 2016
Project:	12-004.11

FIGURE
2A



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CURRENT CONDITIONS PLAN VIEW
HAUSER CREEK
DMS PROJECT NUMBER 92471
Davie County, North Carolina

Dwn. by.
KRJ/CLF

Date:
Oct 2016

Project:
12-004.11

FIGURE
2B

Table 5 **Visual Stream Morphology Stability Assessment**
Reach ID **Hauser**
Assessed Length **2468**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			2	630	74%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	15	15			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	24	24			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	100	100			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	100	100			100%			
		2. Thalweg centering at downstream of meander (Glide)	100	100			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%			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%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			4	85	98%	4	20	99%
				Totals	4	85	98%	4	20	99%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	8	8			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			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)	8	8			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	8	8			100%			

HAUSER

Table 6 Vegetation Condition Assessment

Planted Acreage[1] **5.9**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	NA	0.1 acres	N/A	0	0.00	0.0%
2. Low Stem Density Areas	NA	0.1 acres	N/A	0	0.00	0.0%
			Total		0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	NA	0.25 acres	N/A	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage[2] **13.34**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern[4]	Japanese honeysuckle	1000 SF	Green Polygon	1	0.10	0.7%
5. Easement Encroachment Areas[3]	NA	none	N/A	0	0.00	0.0%

1 = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project effort.

2 = The acreage within the easement boundaries.

3 = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e., item 1,2 or 3) as well as a parallel tally in item 5.

4 = Invasives may occur in or out of planted areas, but still within the easement and will therefore be calculated against the overall easement acreage. Invasives of concern/interest are listed below. The list of high concern spcies are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by DMS such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likley trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly ealry in a projects monitoring history. However, areas of discreet, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolzing invasives polygons, particulalry for situations where the conditon for an area is somewhere between isolated specimens and dense, discreet patches. In any case, the point or polygon/area feature can be symbolized to describe things like high or low concern and species can be listed as a map inset, in legend items if the number of species are limited or in the narrative section of the executive summary.

Hauser Creek
Stream Fixed Station Photographs
Taken July 2016

Stream Photo 1

Stream Photo 2

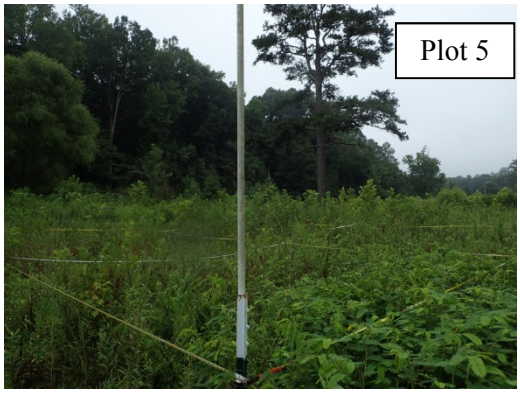
Stream Photo 3

Stream Photo 4

Stream Photo 5

Stream Photo 6

Hauser Creek
Vegetation Monitoring Photographs
Taken July 2016



APPENDIX C

VEGETATION PLOT DATA

Table 7. Vegetation Plot Criteria Attainment

Table 8. CVS Vegetation Plot Metadata

Table 9. Total and Planted Stems by Plot and Species

Table 7. Vegetation Plot Criteria Attainment
Hauser Restoration Site (DMS Project Number 92741)

Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	Yes	100%
2	Yes	
3	Yes	
4	Yes	
5	Yes	
6	Yes	
7	Yes	

Table 8. CVS Vegetation Plot Metadata
Hauser Restoration Site (DMS Project Number 92741)

Report Prepared By	Corri Faquin
Date Prepared	9/16/2016 16:04
database name	Axiom-hauser_EEP-2016-A-v2.3.1.mdb
database location	S:\Business\Projects\12\12-004 EEP Monitoring\12-004.11 Hauser Creek\2016\CVS
computer name	KEENAN-PC
file size	47579136
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	92471
project Name	UT to Hauser Creek
Description	Stream Restoration
River Basin	Yadkin-Pee Dee
length(ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	7

Table 9. Total and Planted Stems by Plot and Species
DMS Project Code 92471. Project Name: Hauser Creek

			Current Plot Data (MY5 2016)																					Annual Means														
			92471-01-0001			92471-01-0002			92471-01-0003			92471-01-0004			92471-01-0005			92471-01-0006			92471-01-0007			MY5 (2016)			MY4 (2015)			MY3 (2014)			MY2 (2013)			MY1 (2012)		
Scientific Name	Common Name	Species Type	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	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Abelia	abelia																																	2				
Acer negundo	boxelder	Tree									11												1			12			1			43			14			15
Acer rubrum	red maple	Tree																																				2
Alnus serrulata	hazel alder	Shrub	1	1	1	1	1	1										2	2	2				4	4	4	4	4	4	4	4	6	3	3	5	5	5	5
Betula nigra	river birch	Tree							2	2	2	1	1	4	2	2	2	1	1	1				6	6	9	6	6	6	7	7	7	7	7	11	6	6	6
Callicarpa americana	American beautyberry	Shrub							1	1	1													1	1	1	1	1	1	2	2	2	3	3	3	3	3	3
Carpinus caroliniana	American hornbeam	Tree			2																					2												
Cornus amomum	silky dogwood	Shrub	1	1	1	4	4	4							1	1	1	1	1	1	1	1	1	8	8	8	9	9	9	9	9	9	11	11	11	9	9	9
Diospyros virginiana	common persimmon	Tree	3	3	3	1	1	1				1	1	2				1	1	1	1	1	1	7	7	8	7	7	7	8	8	8	8	8	8	3	3	3
Fraxinus pennsylvanica	green ash	Tree	4	4	7	3	3	24	4	4	29	4	4	15	1	1	47	4	4	8				20	20	130	20	20	173	20	20	221	20	20	167	14	14	14
Juglans nigra	black walnut	Tree																														1			1			
Juniperus virginiana	eastern redcedar	Tree															6			2						8			7									
Liquidambar styraciflua	sweetgum	Tree			65			24			50			4			4			6			5			158			157			320			189			76
Liriodendron tulipifera	tuliptree	Tree	1	1	30						10			1				1	1	1	1	1	1	3	3	43	3	3	15	3	3	10	3	3	6	3	3	11
Nyssa	tupelo	Tree													2	2	2	2	2	2				4	4	4	4	4	4	4	4	4	2	2	2			
Nyssa sylvatica	blackgum	Tree							2	2	2													2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
Physocarpus opulifolius	common ninebark	Shrub	2	2	2				2	2	2										1	1	1	5	5	5	4	4	4	4	4	4	2	2	2	3	3	3
Pinus taeda	loblolly pine	Tree						2									4									6												
Platanus occidentalis	American sycamore	Tree	2	2	2	1	1	1	2	2	2	8	8	9	1	1	7				4	4	4	18	18	25	18	18	30	18	18	50	18	18	28	19	19	22
Pyrus calleryana	Callery pear	Exotic																														1						
Quercus michauxii	swamp chestnut oak	Tree	1	1	1				1	1	1							1	1	1	2	2	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Sambucus canadensis	Common Elderberry	Shrub																									1	1	2	1	1	1	2	2	2	2	2	2
Ulmus americana	American elm	Tree															3									3						1			1			
Unknown		Shrub or Tree																									1	1	1	1	1	2	1	1	1			
Viburnum dentatum	southern arrowwood	Shrub													3	3	3							3	3	3	3	3	3	3	3	3	4	4	4			
		Stem count	15	15	114	10	10	57	14	14	110	14	14	35	10	10	79	13	13	25	10	10	16	86	86	436	88	88	431	91	91	700	90	90	463	73	73	177
		size (ares)	1			1			1			1			1			1			1			7			7			7			7			7		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.17			0.17			0.17			0.17			0.17		
		Species count	8	8	10	5	5	7	7	7	10	4	4	6	6	6	10	8	8	10	6	6	8	13	13	19	15	15	18	15	15	20	15	15	20	12	12	15
		Stems per ACRE	607	607	4613	404.7	404.7	2307	566.6	566.6	4452	566.6	566.6	1416	404.7	404.7	3197	526.1	526.1	1012	404.7	404.7	647.5	497.2	497.2	2521	508.7	508.7	2492	526.1	526.1	4047	520.3	520.3	2677	422	422	1023

Color for Density
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes
P-all = Planting including livestakes
T = All planted and natural recruits including livestakes
T includes natural recruits

APPENDIX D

STREAM SURVEY DATA

Cross-section Plots

Longitudinal Profile Plots

Substrate Plots

Table 10. Baseline Stream Data Summary

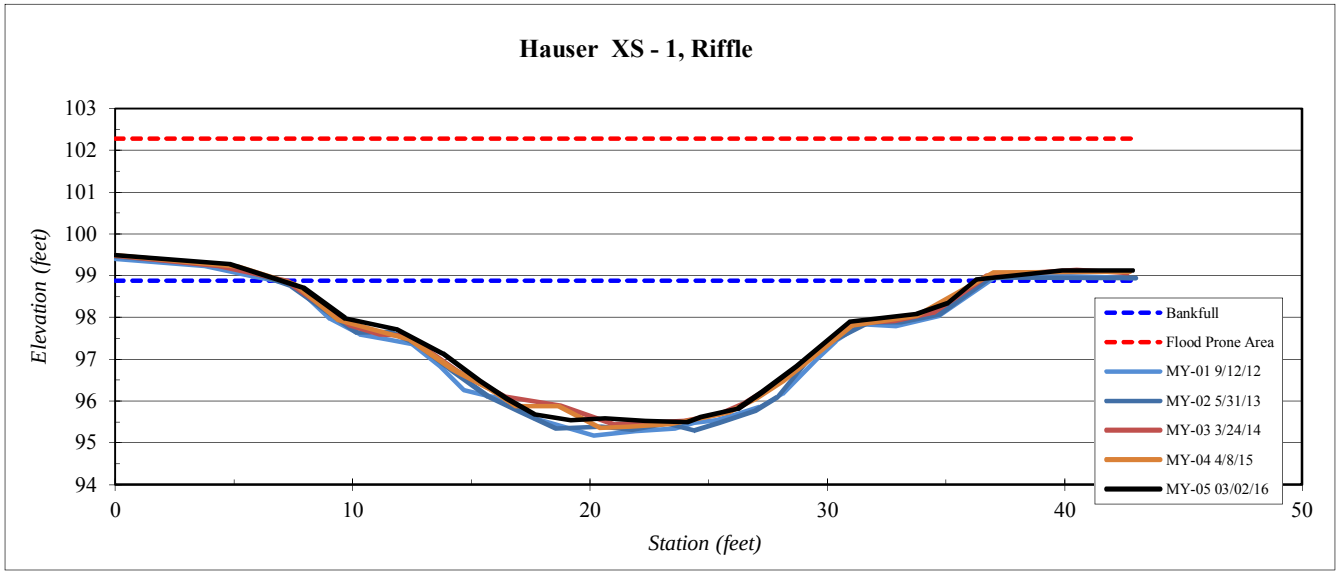
Tables 11a-b. Monitoring Data

Site	Hauser Creek
Watershed:	Yadkin Pee Dee
XS ID	XS - 1, Riffle
Feature	Riffle
Date:	3/1/2016
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	99.49
4.8	99.28
7.9	98.71
9.7	97.98
11.9	97.71
13.8	97.13
15.4	96.47
16.5	96.06
17.7	95.68
19.2	95.53
20.7	95.58
22.3	95.52
24.1	95.50
24.7	95.62
26.2	95.81
27.2	96.21
28.7	96.83
30.9	97.91
33.8	98.09
35.1	98.34
36.3	98.9
39.9	99.1
42.9	99.1

SUMMARY DATA	
Bankfull Elevation:	98.9
Bankfull Cross-Sectional Area:	57.5
Bankfull Width:	29.2
Flood Prone Area Elevation:	102.3
Flood Prone Width:	150.0
Max Depth at Bankfull:	3.4
Mean Depth at Bankfull:	2.0
W / D Ratio:	14.8
Entrenchment Ratio:	5.1
Bank Height Ratio:	1.0

Stream Type	C

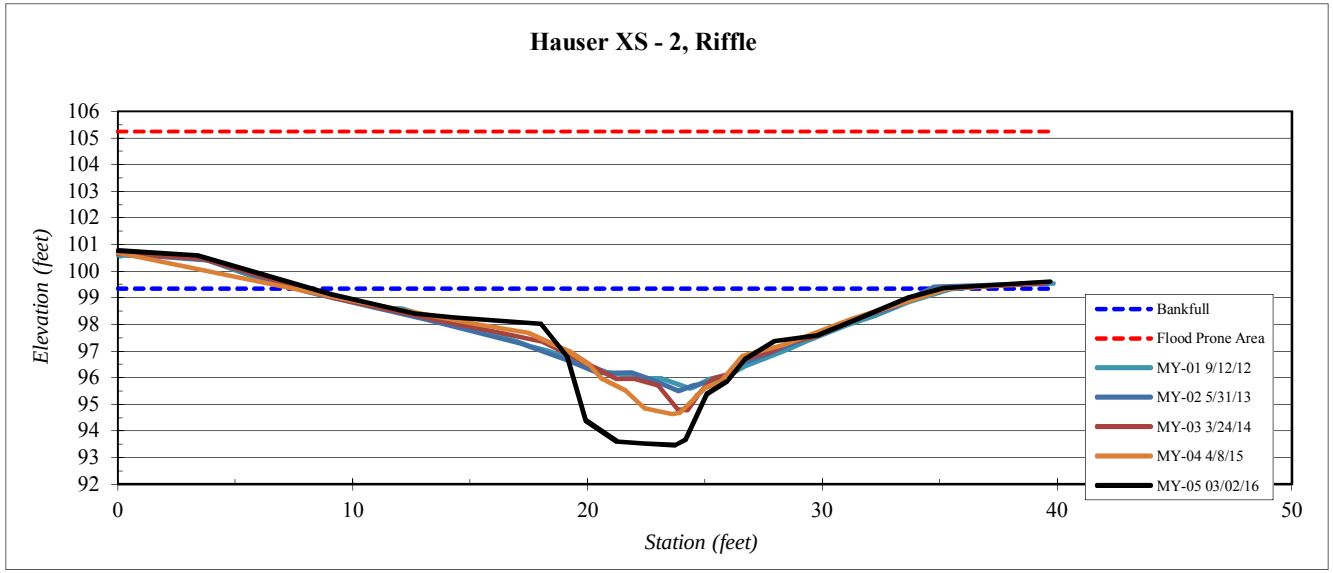


Site	Hauser Creek
Watershed:	Yadkin Pee Dee
XS ID	XS - 2, Riffle
Feature	Riffle
Date:	3/1/2016
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.00	100.77
3.39	100.59
9.11	99.12
12.66	98.41
14.31	98.25
18.01	98.02
19.14	96.80
19.93	94.41
21.27	93.61
22.40	93.53
23.73	93.47
24.16	93.67
25.07	95.39
25.96	95.87
26.72	96.70
28.0	97.36
29.8	97.60
31.4	98.17
33.7	99.02
35.2	99.37
39.7	99.60

SUMMARY DATA	
Bankfull Elevation:	99.3
Bankfull Cross-Sectional Area:	57.8
Bankfull Width:	26.8
Flood Prone Area Elevation:	105.2
Flood Prone Width:	150.0
Max Depth at Bankfull:	5.9
Mean Depth at Bankfull:	2.2
W / D Ratio:	12.4
Entrenchment Ratio:	5.6
Bank Height Ratio:	1.0

Stream Type	C

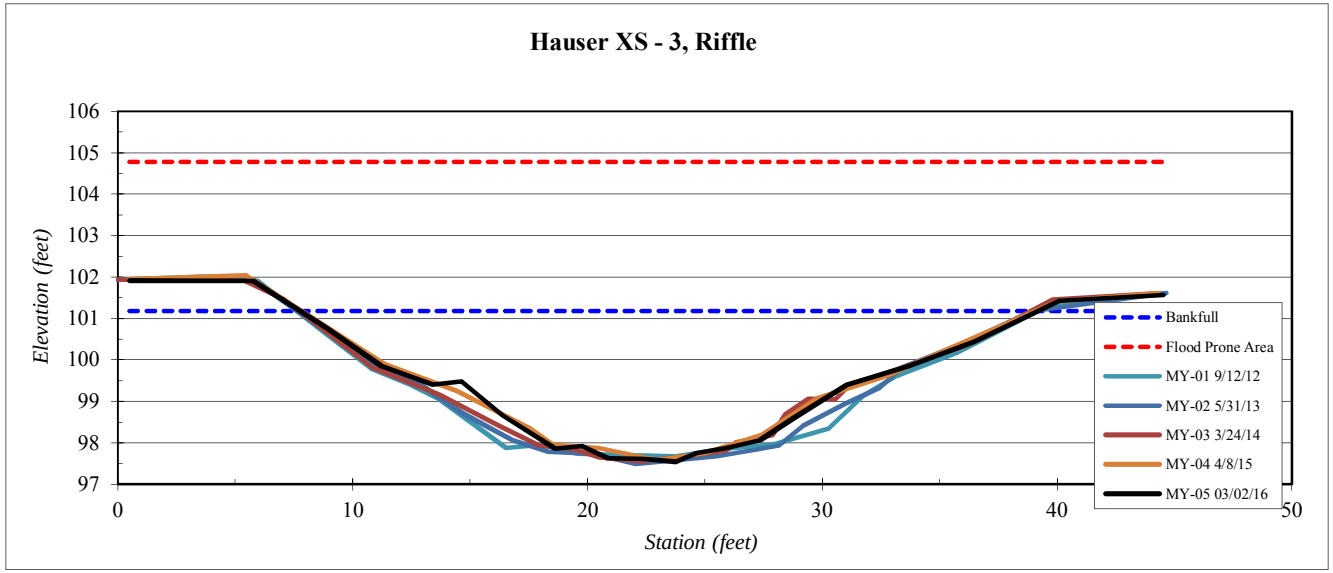


Site	Hauser Creek
Watershed:	Yadkin Pee Dee
XS ID	XS - 3, Riffle
Feature	Riffle
Date:	3/1/2016
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.50	101.91
5.77	101.90
8.90	100.77
11.24	99.85
13.41	99.40
14.64	99.48
16.37	98.66
18.64	97.86
19.76	97.92
20.89	97.63
22.39	97.61
23.73	97.54
24.64	97.75
25.91	97.88
27.34	98.06
28.8	98.61
31.1	99.40
33.7	99.86
36.5	100.43
40.1	101.42
44.5	101.57

SUMMARY DATA	
Bankfull Elevation:	101.2
Bankfull Cross-Sectional Area:	64.9
Bankfull Width:	31.4
Flood Prone Area Elevation:	104.8
Flood Prone Width:	150.0
Max Depth at Bankfull:	3.6
Mean Depth at Bankfull:	2.1
W / D Ratio:	15.2
Entrenchment Ratio:	4.8
Bank Height Ratio:	1.0

Stream Type	C

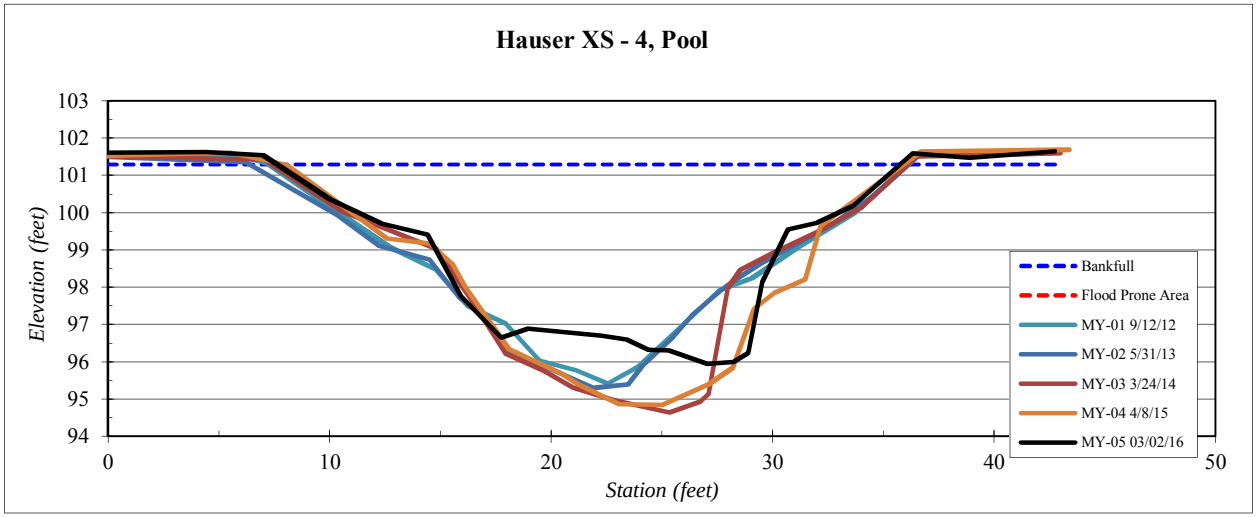


Site	Hauser Creek
Watershed:	Yadkin Pee Dee
XS ID	XS - 4, Pool
Feature	Pool
Date:	3/1/2016
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.0	101.6
4.5	101.6
7.0	101.5
10.0	100.4
12.4	99.7
14.4	99.4
15.9	97.8
17.8	96.6
19.0	96.9
22.3	96.7
23.4	96.6
24.4	96.3
25.3	96.3
27.0	95.9
28.2	96.0
28.9	96.2
29.5	98.1
30.7	99.6
32.0	99.7
33.6	100.2
36.3	101.6
38.9	101.5
42.7	101.6

SUMMARY DATA	
Bankfull Elevation:	101.3
Bankfull Cross-Sectional Area:	83.8
Bankfull Width:	28.1
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	5.3
Mean Depth at Bankfull:	3.0
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C/E

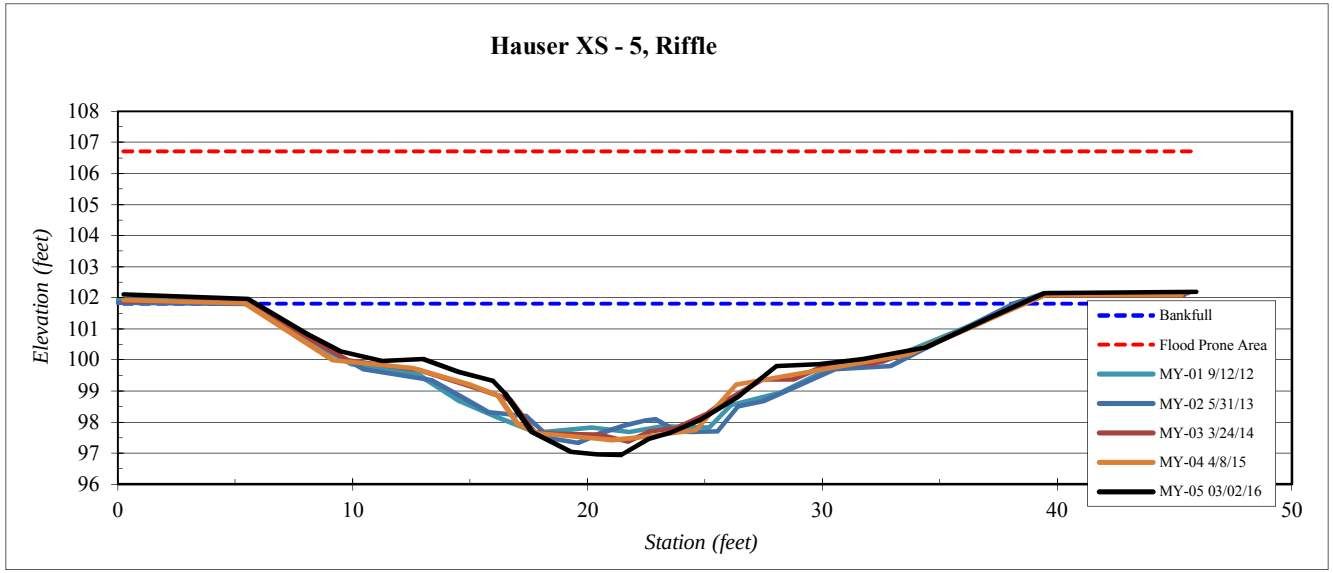


Site	Hauser Creek
Watershed:	Yadkin Pee Dee
XS ID	XS - 5, Riffle
Feature	Riffle
Date:	3/1/2016
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.25	102.12
5.53	101.97
8.07	100.83
9.48	100.28
11.25	99.97
13.01	100.02
14.49	99.61
15.98	99.34
16.50	98.92
17.63	97.68
19.29	97.05
20.41	96.96
21.46	96.95
22.59	97.46
23.56	97.66
24.8	98.07
26.4	98.82
28.0	99.80
29.9	99.86
31.7	100.03
34.4	100.40
37.1	101.34
39.5	102.16
45.9	102.19

SUMMARY DATA	
Bankfull Elevation:	101.8
Bankfull Cross-Sectional Area:	76.5
Bankfull Width:	32.6
Flood Prone Area Elevation:	106.7
Flood Prone Width:	150.0
Max Depth at Bankfull:	4.9
Mean Depth at Bankfull:	2.3
W / D Ratio:	13.9
Entrenchment Ratio:	4.6
Bank Height Ratio:	1.0

Stream Type	C

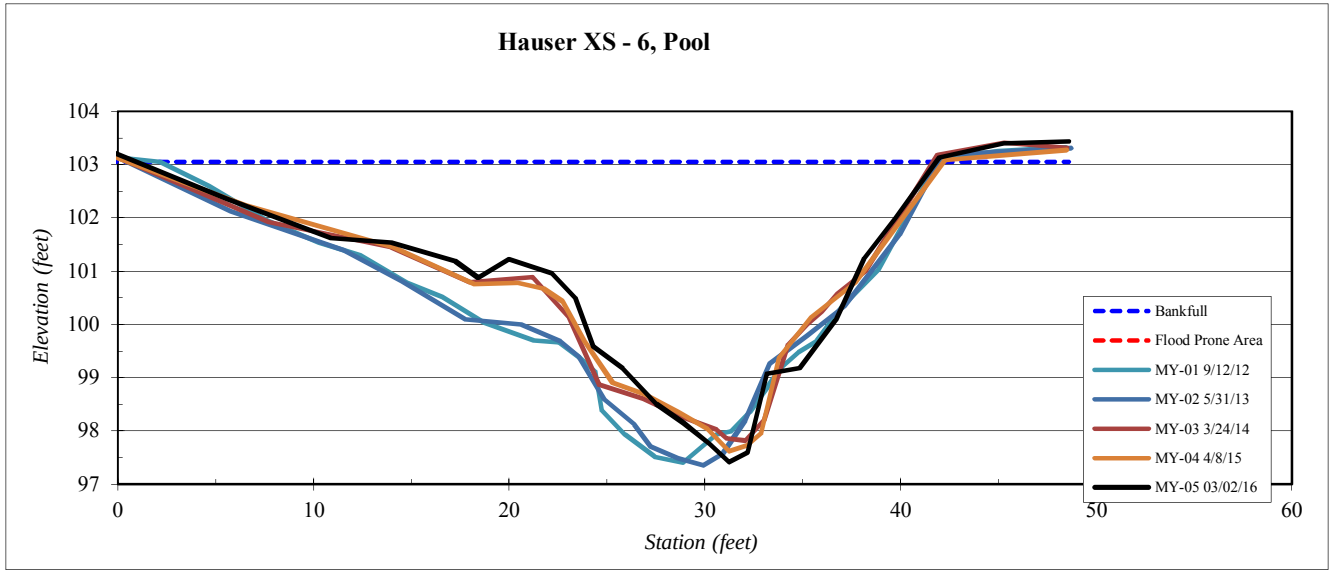


Site	Hauser Creek
Watershed:	Yadkin Pee Dee
XS ID	XS - 6, Pool
Feature	Pool
Date:	3/1/2016
Field Crew:	Perkinson, Gibbons

Station	Elevation
-0.50	103.26
5.58	102.35
10.89	101.62
13.97	101.54
17.23	101.19
18.43	100.87
20.00	101.22
22.18	100.96
23.38	100.49
24.31	99.58
25.81	99.17
27.52	98.51
28.93	98.15
30.25	97.75
31.23	97.42
32.18	97.59
33.18	99.07
34.87	99.18
36.71	100.08
38.14	101.24
39.70	101.98
42.00	103.13
45.27	103.40
48.61	103.43

SUMMARY DATA	
Bankfull Elevation:	103.1
Bankfull Cross-Sectional Area:	93.9
Bankfull Width:	40.9
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	5.6
Mean Depth at Bankfull:	2.3
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C

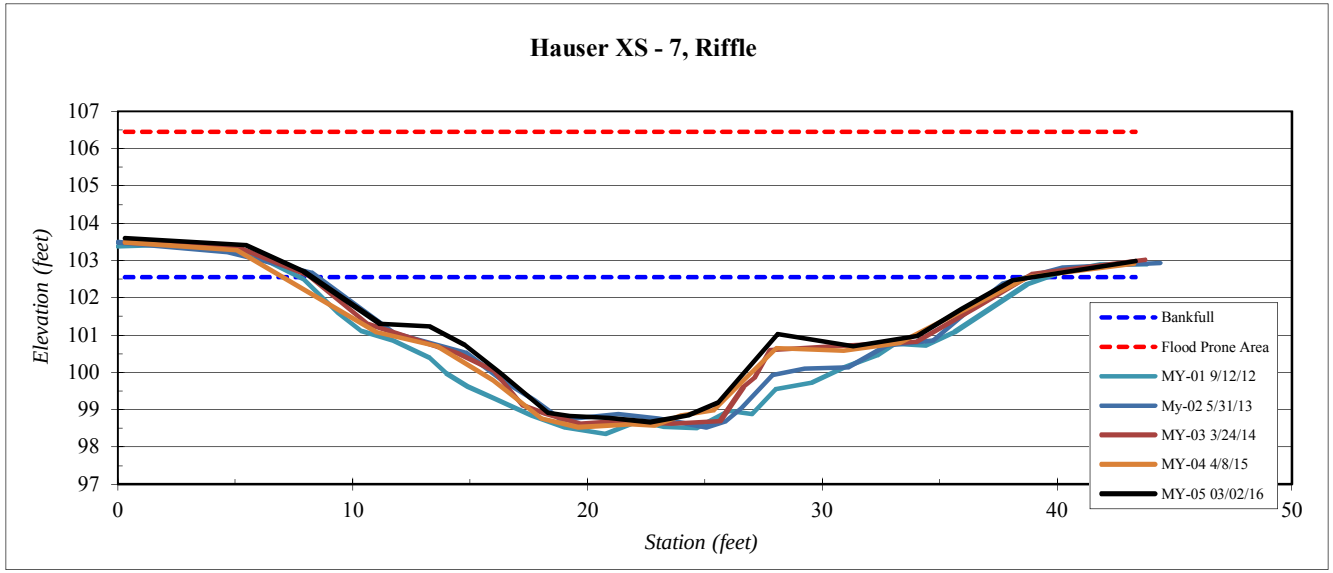


Site	Hauser Creek
Watershed:	Yadkin Pee Dee
XS ID	XS - 7, Riffle
Feature	Riffle
Date:	3/1/2016
Field Crew:	Perkinson, Gibbons

Station	Elevation
0.30	103.60
5.46	103.41
7.91	102.71
11.18	101.29
13.27	101.24
14.78	100.73
16.31	99.98
18.31	98.92
19.23	98.83
20.92	98.79
22.69	98.67
24.30	98.85
25.57	99.19
28.10	101.03
31.31	100.71
34.05	100.97
35.92	101.69
38.11	102.46
43.34	102.98

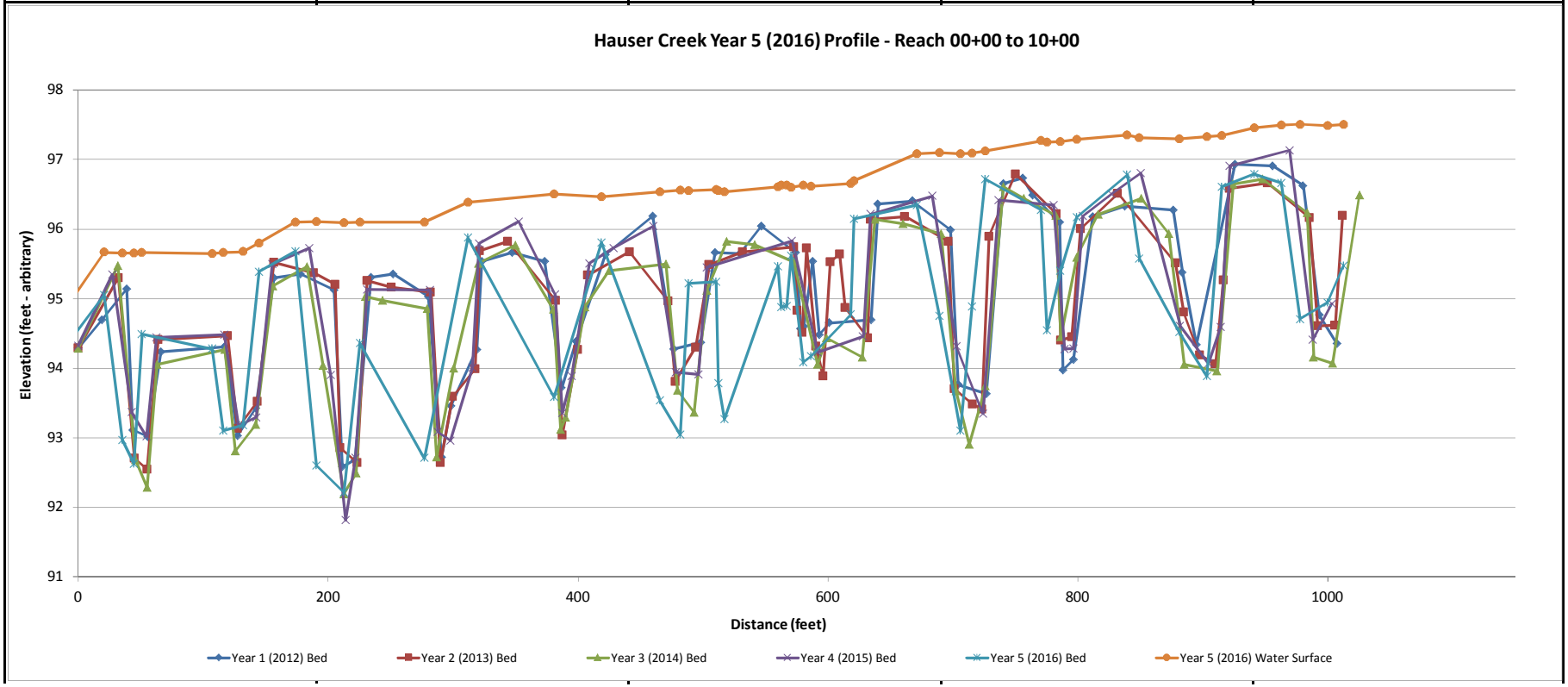
SUMMARY DATA	
Bankfull Elevation:	102.6
Bankfull Cross-Sectional Area:	63.1
Bankfull Width:	30.7
Flood Prone Area Elevation:	106.5
Flood Prone Width:	150.0
Max Depth at Bankfull:	3.9
Mean Depth at Bankfull:	2.1
W / D Ratio:	14.9
Entrenchment Ratio:	4.9
Bank Height Ratio:	1.0

Stream Type	C



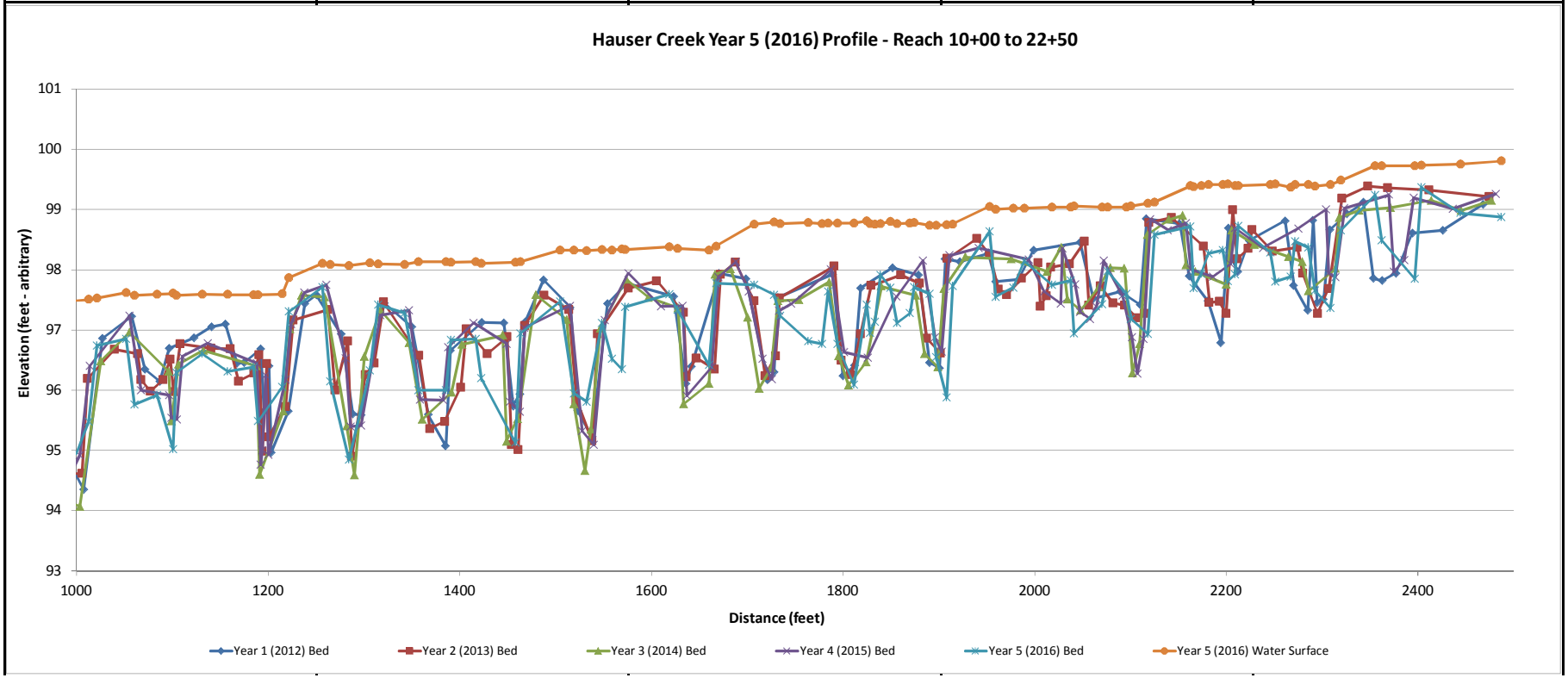
Project Name	Hauser Creek - Year 5 (2016) Profile		**2012**	**2013**	**2014**	**2015**	**2016**	
Reach	Main Reach (00+00 - 10+00)	**Avg. Water Surface Slope**	0.0022	0.0022	0.0022	0.0020	0.0020	
Feature	Profile	**Riffle Length**	48	56	51	52	39	
Date	3/2/16	**Avg. Riffle Slope**	0.0047	0.0039	0.0043	0.0055	0.0038	
Crew	Perkinson, Gibbons	**Pool Length**	16	18	21	17	24	
		Avg. Pool Slope	0.0005	0.0004	0.0008	0.0018	0.0005	

2012 Year 1 Monitoring \Survey			2013 Year 2 Monitoring \Survey			2014 Year 3 Monitoring \Survey			2015 Year 4 Monitoring \Survey			2016 Year 5 Monitoring \Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**



Project Name	Hauser Creek - Year 5 (2016) Profile		**2012**	**2013**	**2014**	**2015**	**2016**	
Reach	Main Reach (10+00 - 22+50)	**Avg. Water Surface Slope**	0.0022	0.0022	0.0022	0.0020	0.0020	
Feature	Profile	**Riffle Length**	48	56	51	52	39	
Date	3/2/16	**Avg. Riffle Slope**	0.0047	0.0039	0.0043	0.0055	0.0038	
Crew	Perkinson, Gibbons	**Pool Length**	16	18	21	17	24	
		Avg. Pool Slope	0.0005	0.0004	0.0008	0.0018	0.0005	

2012 Year 1 Monitoring \Survey			2013 Year 2 Monitoring \Survey			2014 Year 3 Monitoring \Survey			2015 Year 4 Monitoring \Survey			2016 Year 5 Monitoring \Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**

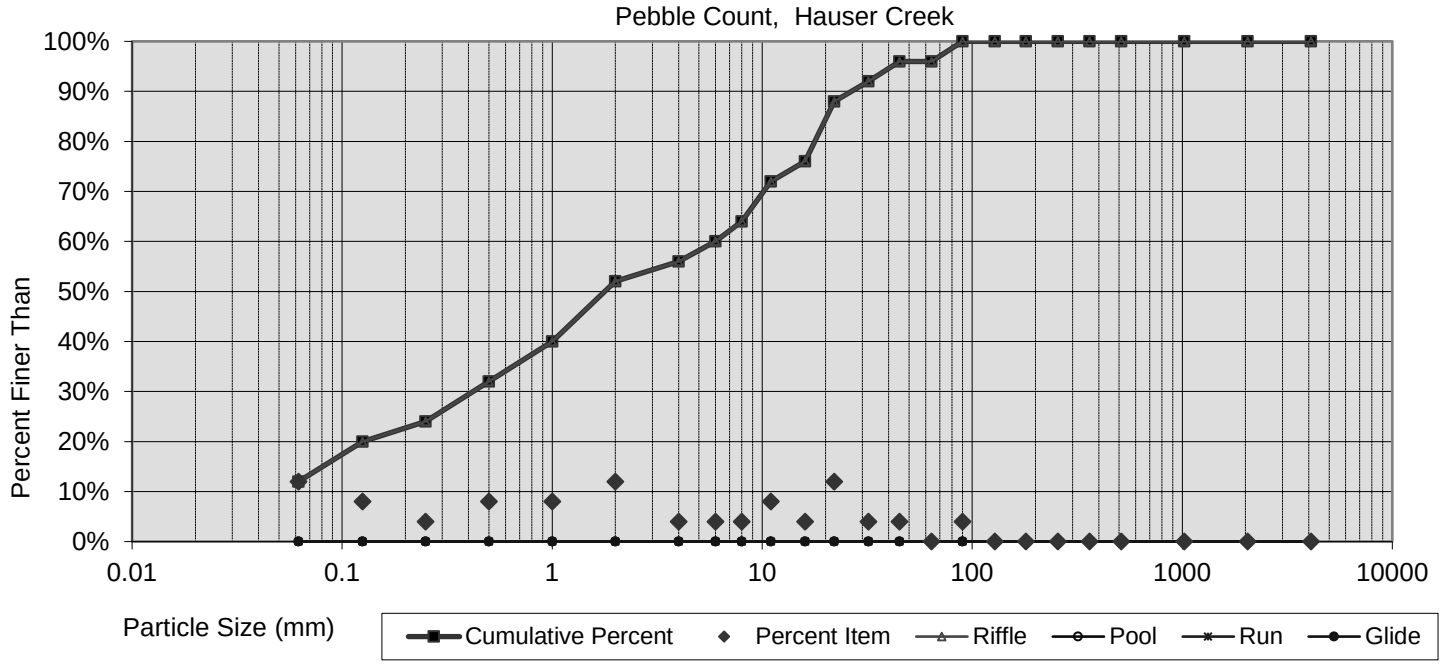


Pebble Count,

Hauser Creek

Yadkin Pee Dee

Note: **Cross Section 3**



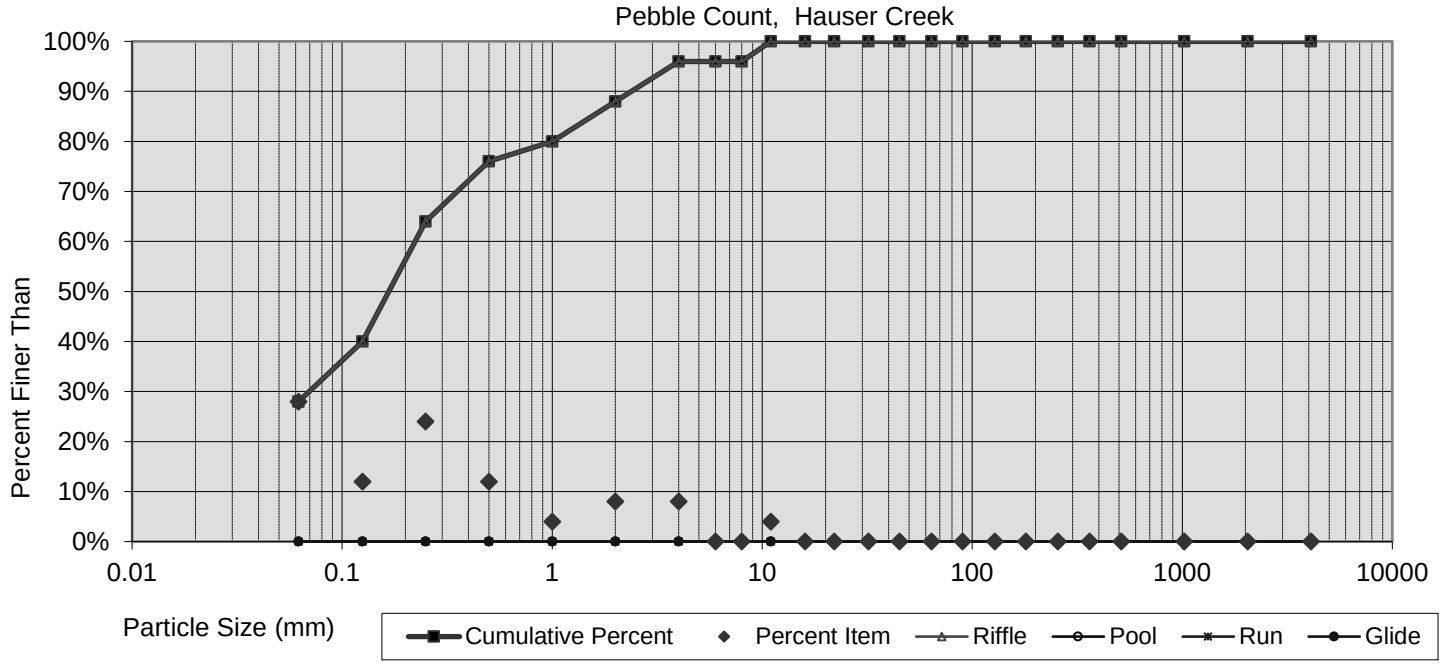
Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.088	0.65	1.8	20	41	12%	40%	44%	4%	0%	0%

Pebble Count,

Hauser Creek

Yadkin Pee Dee

Note: **Cross Section 5**



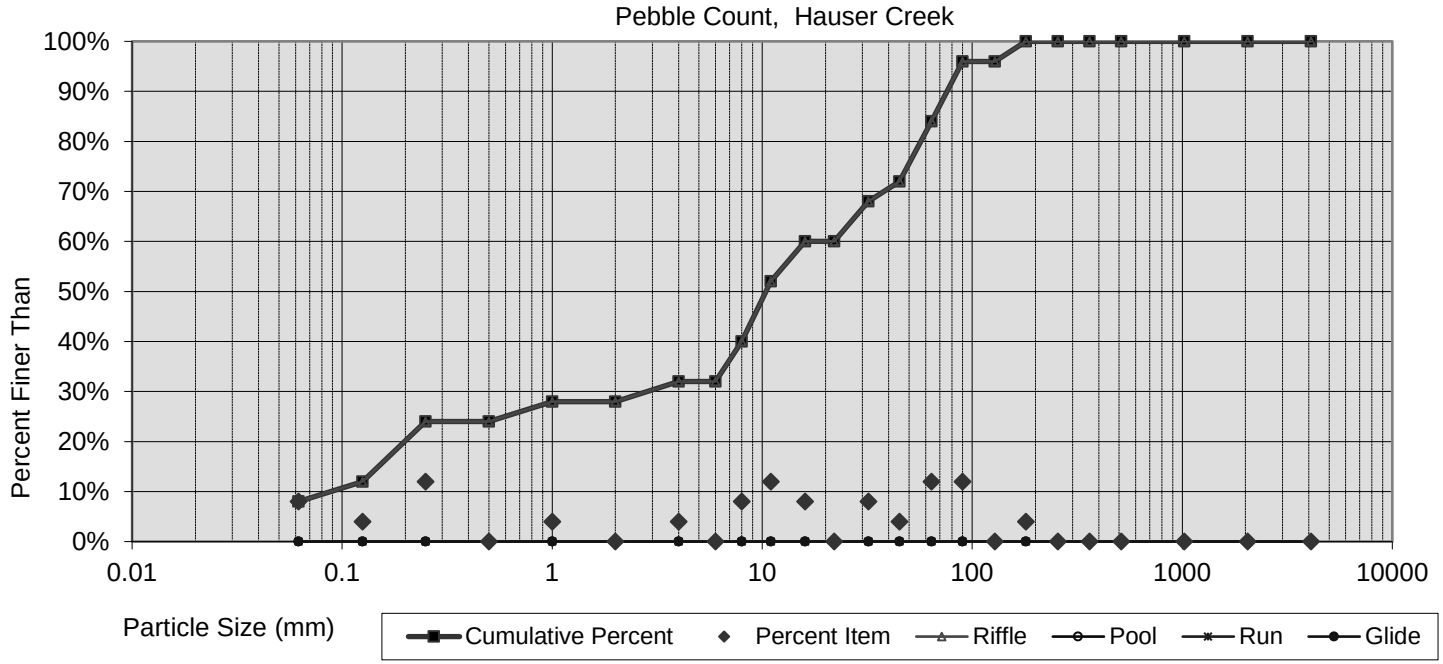
Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
#N/A	0.09	0.2	1	4	28%	60%	12%	0%	0%	0%

Pebble Count,

Hauser Creek

Yadkin Pee Dee

Note: **Cross Section 7**



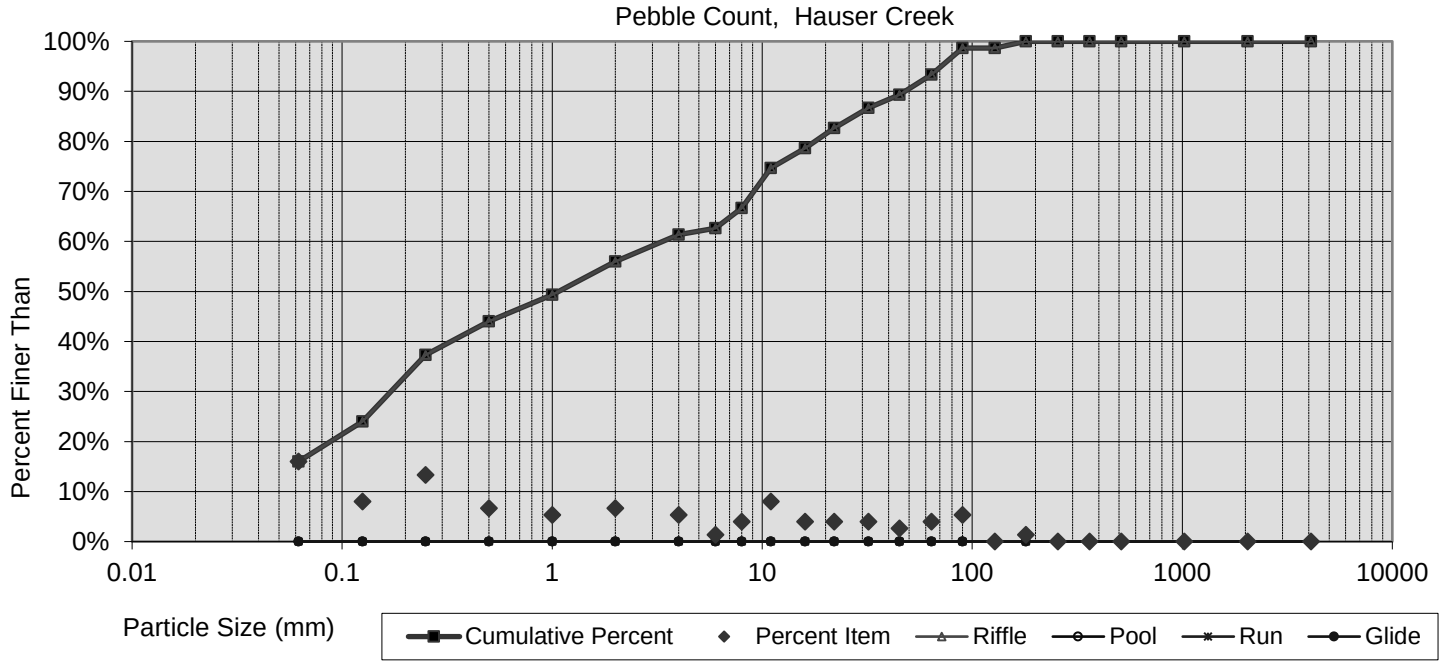
Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.157	6.68	10.4	64	87	8%	20%	56%	16%	0%	0%

Pebble Count,

Hauser Creek

Yadkin Pee Dee

Note: **Reach Total**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.062	0.22	1.1	25	71	16%	40%	37%	7%	0%	0%

Table 10. Baseline Stream Data Summary
Hauser Stream Restoration Site-Project No. 92471

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design		
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max
Bankfull Width (ft)	-	-	-	-	17.2		20.8	27.7			21.5		26.5	30.9				33	
Floodprone Width (ft)					176.8		275.2	333.4			306		415	530			210	268	330
Bankfull Mean Depth (ft)	-	-	-	-	2		2.6	3.1			1.6		2.2	3.4				2.5	
[1]Bankfull Max Depth (ft)	-				3.9		4.3	4.8			3.3		3.8	4.2			3.3	3.8	4.2
Bankfull Cross Sectional Area (ft^2)	-	-	-	-	38		54.7	71.2			43		60	80				83.2	
Width/Depth Ratio	-				5.5		8	10.8			7		12	19				13	
Entrenchment Ratio	-				10		13.5	19.3			8.3		16	22.4			6.4	8.1	10
[1]Bank Height Ratio	-				0.8		1.26	1.65			0.7		0.86	1.07			0.9	1	1.1
Profile																			
Riffle Length (ft)					----		----	----			----		----	----			----	----	----
Riffle Slope (ft/ft)					----		----	----			----		----	----			----	----	----
Pool Length (ft)					----		----	----			----		----	----			----	----	----
Pool Max depth (ft)					4.6		5.4	7.2			3.8		4.5	5.2			3.5	4	4.7
Pool Spacing (ft)					12.3		83.2	308			30		64	106			65	89	110
Pattern																			
Channel Beltwidth (ft)					35		46.6	56			26		30	36			43	61.5	107
Radius of Curvature (ft)					23		92.1	273			13		85	275			50	80	155
Rc:Bankfull width (ft/ft)					1.2		4.5	14.4			0.53		3.58	11.2			1.5	2.4	4.7
Meander Wavelength (ft)					55		118	245			60		90	160			128	164	194
Meander Width Ratio					2.9		5.8	12.9			1.1		1.3	1.6			1.3	1.9	3.3
Transport parameters																			
Reach Shear Stress (competency) lb/f^2					----												----		
Max part size (mm) mobilized at bankfull					----												----		
Stream Power (transport capacity) W/m^2					----												----		
Additional Reach Parameters																			
Rosgen Classification	----				C5/E5						C5/E5						C5		
Bankfull Velocity (fps)	----	----	----	----	5.24												5		
Bankfull Discharge (cfs)	----	----	----	----	416														
Valley length (ft)					2156						----								
Channel Thalweg length (ft)					2242						----						2463		
Sinuosity (ft)					1.04						1.1						1.17		
Water Surface Slope (Channel) (ft/ft)	-				0.0024						0.0028						0.0025		
BF slope (ft/ft)	-				----						----						----		
[3]Bankfull Floodplain Area (acres)					----						----						----		
[4]% 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 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing survey data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)

	Cross Section 1 (Riffle)						Cross Section 2 (Riffle)						Cross Section 3 (Riffle)						Cross Section 4 (Pool)					
Based on fixed baseline bankfull elevation[1]	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	98.8	98.8	98.9	99.0	98.9		99.3	99.3	99.3	99.3	99.3		101.3	101.2	101.2	101.2	101.2		101.3	101.4	101.4	101.3	101.3	
Bankfull Width (ft)	29.2	29.0	29.2	29.4	29.2		27.6	26.8	27.4	27.8	26.8		32.4	31.3	31.2	31.3	31.4		28.9	30.0	29.2	27.9	28.1	
Floodprone Width (ft)	150.0	150.0	150.0	150.0	150.0		150.0	150.0	150.0	150.0	150.0		150.0	150.0	150.0	150.0	150.0		NA	NA	NA	NA	NA	
Bankfull Mean Depth (ft)	2.1	2.0	2.0	2.0	2.0		1.8	1.9	1.8	1.8	2.2		2.4	2.2	2.1	2.0	2.1		3.1	3.0	3.4	3.5	3.0	
Bankfull Max Depth (ft)	3.6	3.5	3.4	3.5	3.4		3.7	3.8	4.6	4.7	5.9		3.6	3.7	3.6	3.6	3.6		5.9	6.1	6.8	6.4	5.3	
Bankfull Cross Sectional Area (ft^2)	61.8	59.2	58.2	59.1	57.5		49.5	49.6	50.2	50.6	57.8		76.3	70.2	67.0	63.9	64.9		88.3	91.3	98.1	97.8	83.8	
Bankfull Width/Depth Ratio	13.8	14.2	14.7	14.6	14.8		15.4	14.5	15.0	15.3	12.4		13.8	14.0	14.5	15.3	15.2		NA	NA	NA	NA	NA	
Bankfull Entrenchment Ratio	5.1	5.2	5.1	5.1	5.1		5.4	5.6	5.5	5.4	5.6		4.6	4.8	4.8	4.8	4.8		NA	NA	NA	NA	NA	
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Cross Sectional Area between end pins (ft^2)	----	----	----	----	----		----	----	----	----	----		----	----	----	----	----		----	----	----	----	----	
d50 (mm)	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA		23.1	18.8	18.8	4.9	1.8		NA	NA	NA	NA	NA	

	Cross Section 5 (Riffle)						Cross Section 6 (Pool)						Cross Section 7 (Riffle)					
Based on fixed baseline bankfull elevation[1]	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	101.9	101.8	101.9	101.8	101.8		103.1	103.1	103.1	103.1	103.1		102.7	102.7	102.7	102.6	102.6	
Bankfull Width (ft)	33.6	32.6	33.4	33.2	32.6		39.7	41.5	41.1	41.7	40.9		33.0	31.3	31.0	31.7	30.7	
Floodprone Width (ft)	150.0	150.0	150.0	150.0	150.0		NA	NA	NA	NA	NA		150.0	150.0	150.0	150.0	150.0	
Bankfull Mean Depth (ft)	2.6	2.5	2.4	2.4	2.3		2.8	2.7	2.4	2.3	2.3		2.6	2.4	2.3	2.2	2.1	
Bankfull Max Depth (ft)	4.3	4.5	4.5	4.4	4.9		5.6	5.7	5.2	5.4	5.6		4.4	4.2	4.0	4.0	3.9	
Bankfull Cross Sectional Area (ft^2)	85.8	82.5	80.8	79.2	76.5		109.9	110.6	96.8	95.8	93.9		85.5	74.8	72.1	69.9	63.1	
Bankfull Width/Depth Ratio	13.2	12.9	13.8	13.9	13.9		NA	NA	NA	NA	NA		12.7	13.1	13.3	14.4	14.9	
Bankfull Entrenchment Ratio	4.5	4.6	4.5	4.5	4.6		NA	NA	NA	NA	NA		4.5	4.8	4.8	4.7	4.9	
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Cross Sectional Area between end pins (ft^2)	----	----	----	----	----		----	----	----	----	----		----	----	----	----	----	
d50 (mm)	0.1	0.1	0.2	0.1	0.2		NA	NA	NA	NA	NA		22.0	11.0	10.0	10.6	10.4	

1 = Widths and depths for monitoring resurvey will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established. If the performer has inherited the project and cannot acquire the datum used for prior years this must be discussed with DMS. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: "It is uncertain if the monitoring datum has been consistent over the monitoring history, which may influence calculated values. Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary."

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Hauser Stream Restoration-Project No. 92471 (2463 feet)

Parameter	MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	27.6		32.4	33.6			26.8		31.3	32.6			27.4		31	33.4			27.8		31.3	33.2			26.8		30.7	32.6		
Floodprone Width (ft)			150						150						150						150						150			
Bankfull Mean Depth (ft)	1.8		2.4	2.6			1.9		2.2	2.5			1.8		2.1	2.4			1.8		2	2.4			2		2.1	2.4		
[1]Bankfull Max Depth (ft)	3.6		3.7	4.4			3.5		3.8	4.5			3.4		4	4.6			3.5		4	4.7			3.4		3.9	5.9		
Bankfull Cross Sectional Area (ft^2)	49.5		76.3	85.8			49.6		70.2	82.5			50.2		67	80.8			50.6		63.9	79.2			57.5		63.1	76.5		
Width/Depth Ratio	12.7		13.5	15.3			13		14.1	14.5			13.5		14.6	15.2			13.8		14.7	15.7			12.2		14.6	15		
Entrenchment Ratio	4.5		4.6	5.4			4.6		4.8	5.6			4.5		4.8	5.5			4.5		4.8	5.4			4.6		4.9	5.6		
[1]Bank Height Ratio			1						1						1						1						1			
Profile																														
Riffle Length (ft)	28	48	48	74	12.5	27	8	56	52	154	25	27	15	51	49	123	23	25	13	52	50	95	21	28	11	39	36	107	21	27
Riffle Slope (ft/ft)	0.0%	0.5%	0.3%	2.8%	0.6%	25	0.0%	0.4%	0.2%	3.4%	0.7%	26	0.0%	0.4%	0.1%	3.5%	0.7%	25	0.0%	0.5%	0.2%	3.1%	0.8%	28	0.0%	0.4%	0.2%	2.6%	0.6%	27
Pool Length (ft)	3	16	12	49	11	31	4	18	16	58	11	32	8	21	19	42	9	25	2	17	15	41	10	28	4	24	17	86	18	32
Pool Max depth (ft)	5.6		5.8	5.9			5.7		5.9	6.1			5.2		6	6.8			5.4		5.9	6.4			5.3		5.5	5.6		
Pool Spacing (ft)	8	77	85	118	27	31	8	75	86	154	35	33	39	93	93	174	26	25	26	86	88	131	26	28	11	75	74	176	39	32
Pattern																														
Channel Beltwidth (ft)																														
Radius of Curvature (ft)																														
Rc:Bankfull width (ft/ft)																														
Meander Wavelength (ft)																														
Meander Width Ratio																														

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Additional Reach Parameters																														
Rosgen Classification	C4						C4						C4						C4						C4					
Channel Thalweg length (ft)	2468						2468						2468						2468						2498					
Sinuosity (ft)	1.17						1.17						1.17						1.17						1.17					
Water Surface Slope (Channel) (ft/ft)	0.0022						0.0022						0.0022						0.002						0.002					
BF slope (ft/ft)	----						----						----						----						----					
[3]Ri% / Ru% / P% / G% / S%	52%	16%	20%	12%			29%	8%	11%	52%			55%	13%	22%	10%			59%	10%	19%	12%			42%	13%	33%	12%		
[3]SC% / Sa% / G% / C% / B% / Be%	19%	28%	32%	21%	0%	0%	17%	31%	38%	13%	1%	0%	16%	35%	39%	9%	1%	0%	23%	35%	31%	10%	0%	0%	16%	40%	37%	70%	0%	0%
[3]d16 / d35 / d50 / d84 / d95 /	NA	0.26	6.9	73	130		NA	0.34	4	44	108		0.062	0.44	1.8	38	104		NA	0.16	0.6	35	81		0.062	0.22	1.1	25	71	
[2]% of Reach with Eroding Banks	<5%						<5%						<5%						<5%						<5%					
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, disp = max subpave
4. = Of value/needed only if the n exceeds 3

APPENDIX E

HYDROLOGY DATA

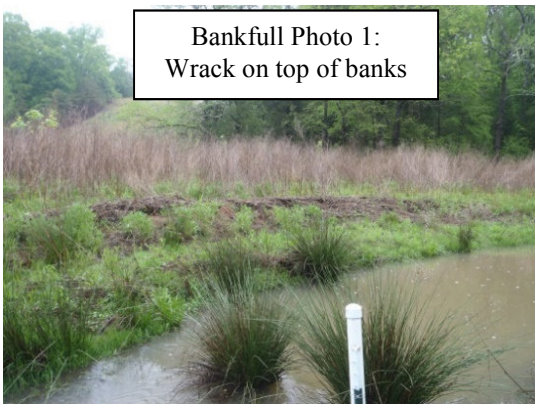
Table 12. Verification of Bankfull Events

Table 12. Verification of Bankfull Events

Hauser Creek Restoration Site (DMS Project Number 92741)

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
June 3, 2013	December 26, 2012	Approximately 1.16 inches of rain documented to occur after two 0.5-inch events within the previous week at a nearby rain station*.	--
April 29, 2013	January 17, 2013	Approximately 4.6 inches of rain documented to occur from January 13-17, 2013 at a nearby rain station*.	--
April 29, 2013/ June 3, 2013	April 28, 2013	Approximately 1.25 inches of rain documented at a nearby rain station*, in addition to crest gauge observations and visual signs of overbank including wrack and sediment deposition adjacent to the channel, and receding water.	1-3
November 25, 2013	June 7, 2013	Approximately 2.76 inches of rain documented to occur between June 5-7, 2013 at a nearby rain station*.	--
November 25, 2013	July 27, 2013	Approximately 1.89 inches of rain documented to occur on July 27, 2013 at a nearby rain station*.	--
November 25, 2013	August 12, 2013	Approximately 2.60 inches of rain documented to occur between August 10-13, 2013 at a nearby rain station*.	--
July 7, 2014	November 26, 2013	Approximately 2.42 inches of rain documented to occur between November 26-27, 2013 at a nearby rain station*.	--
July 7, 2014	December 22, 2013	Approximately 2.47 inches of rain documented to occur between December 22-23, 2013 at a nearby rain station*.	--
July 7, 2014	January 11, 2014	Approximately 1.96 inches of rain documented to occur between January 10-11, 2014 at a nearby rain station*.	--
July 7, 2014	April 15, 2014	Approximately 2.33 inches of rain documented to occur between April 14-15, 2014 and one week after a 1.56-inch rainfall event at a nearby rain station*.	--
July 8, 2015	April 19, 2015	Approximately 1.84 inches of rain documented to occur on April 19, 2015 at a nearby rain station*.	--
October 9, 2015	August 10, 2015	Approximately 1.69 inches of rain documented to occur on August 10, 2015 at a nearby rain station*.	--
October 14, 2015	October 3, 2015	Approximately 4.79 inches of rain documented to occur between September 24 and October 3, 2015 at a nearby rain station*.	4
March 1, 2016	December 24, 2016	Approximately 2.62 inches of rain documented to occur between December 22-24, 2016 at a nearby rain station*.	--
March 1, 2016	February 3, 2016	Approximately 1.61 inches of rain documented to occur on February 3, 2016 at a nearby rain station*.	5-6
May 3, 2016	May 3, 2016	Stream observed at bankfull after approximately 2.59 inches of rain documented to occur between April 30 and May 3, 2016 at a nearby rain station*.	7
August 9, 2016	August 5, 2016	Approximately 3.22 inches of rain documented to occur between July 31 and August 5, 2016 at a nearby rain station*.	--
October 17, 2016	October 8, 2016	Approximately 3.15 inches of rain documented to occur on October 8, 2016 at a nearby rain station*.	--

*Reported at the Winston Salem Airport (KINT) (Weatherunderground 2016)



Bankfull Photo 1:
Wrack on top of banks

Bankfull Photo 2:
Sediment deposition

Bankfull Photo 3:
Crest gauge

Bankfull Photo 4: Wrack in streamside vegetation and on top of bank

Bankfull Photo 5:
Wrack in floodplain

Bankfull Photo 6:
Wrack in floodplain

Bankfull Photo 7:
Stream at bankfull flow

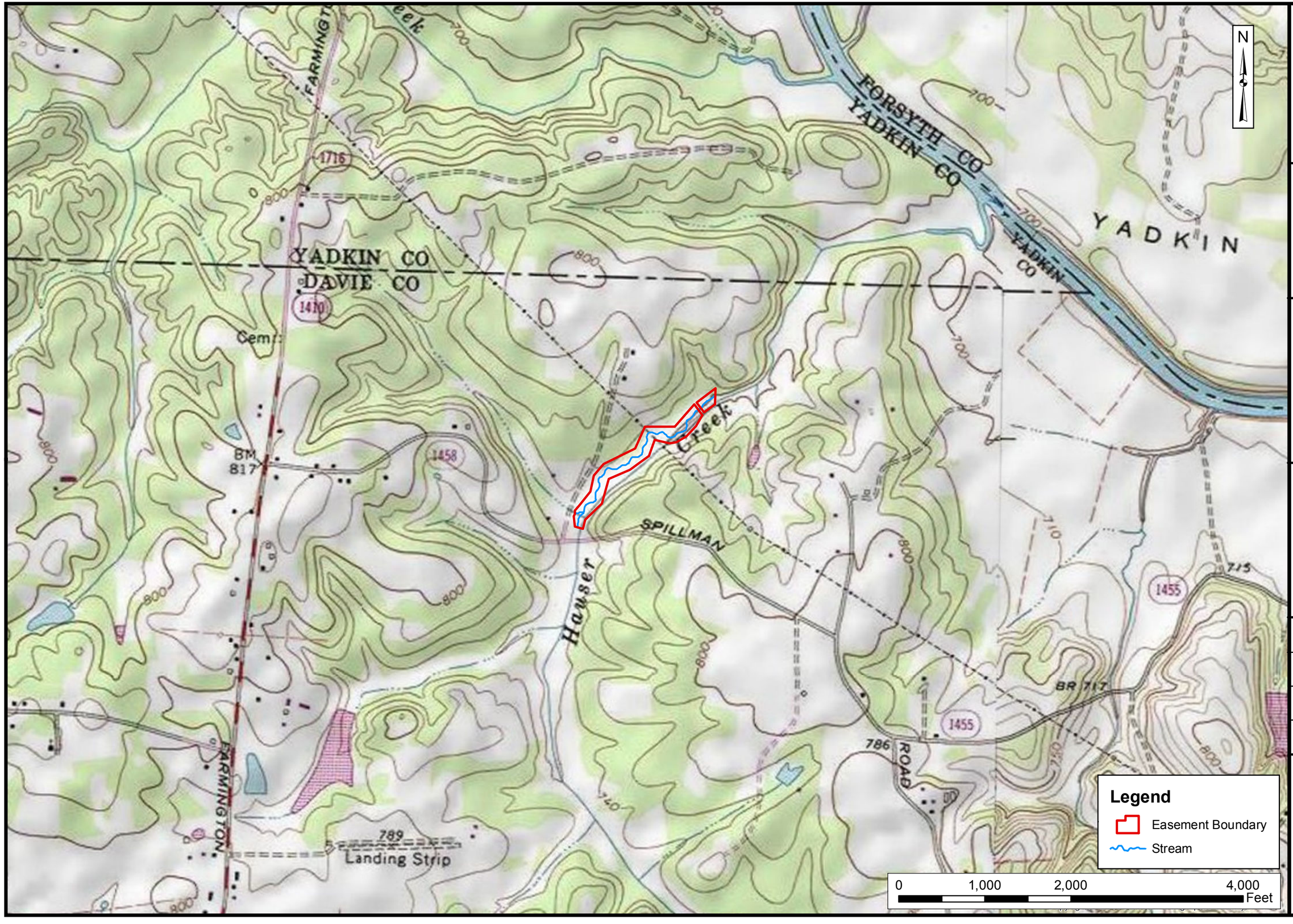
APPENDIX F

ADDITIONAL SITE DATA

Figure 3. USGS Topographic Map

Figure 4. NRCS Soils Map

Preconstruction Photographs



Axiom Environmental, Inc.

Prepared for:

North Carolina Department of Environmental Quality

Division of Mitigation Services

Project:

HAUSER CREEK RESTORATION SITE

DMS Project Number 92471
Davie County, NC

Title:

USGS TOPOGRAPHIC MAP

Farmington and Clemmons, NC 7.5 Minute Quads

Drawn by:	KRJ/CLF
Date:	Nov 2016
Scale:	1 in = 1,000 ft
Project No.:	12-004.11

FIGURE

3

Map Symbol	Soil Description
ChA	Chewacla loam; 0-2% slopes; frequently flooded
MsD	Mocksville sandy loam; 15-45% slopes

ToB2
TmD
ToC2
RaC
ToB2
ToC2
W
ChA
MsD
MsB
MsC
RaB
TmD
MsC
ToC2
ToB2
ToC2
ToC2
TmD

N

Legend

- Easement Boundary
- Stream
- NRCS Soil Boundaries

0 250 500 1,000 Feet

Axiom Environmental, Inc.

Prepared for:

North Carolina Department of Environmental Quality

Division of Mitigation Services

Project:

HAUSER CREEK RESTORATION SITE

DMS Project Number 92471
Davie County, NC

Title:

NRCS SOILS MAP

Drawn by: KRJ/CLF

Date: Sept 2016

Scale: 1 in = 210 ft

Project No.: 12-004.11

FIGURE

4

Preconstruction Photographs

Extracted from Restoration Plan (dated May 30, 2008)