

Beaver Creek Stream Restoration Monitoring Report

DMS Project # 028

Contract#: 6410

County: Surry

Monitoring Year: 2016

Years of Measurement/Monitoring: 5



Submitted to:

NCDEQ-DMS, 1652 Mail Service Center, Raleigh, NC 27699-1652

Data Collection: 2016
Construction Completed: Fall 2002
Submitted: November 2016

Monitoring Firm



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1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

In 2002, the North Carolina Ecosystem Enhancement Program (EEP) restored a 4,670 linear feet of Beaver Creek, a Tributary to Fisher River in Surry County, NC. The 5.9-mi² project watershed is located in US Geological Survey Hydrologic Unit 03040101 (NC Division of Water Resources Sub-basin 12-63-12) of the Yadkin River Basin. The site was first identified by the Surry County Soil and Water Conservation District as a potential restoration site after landowners complained about active erosion and flooding adjacent to the stream. The project is located entirely within undeveloped, agricultural land. The project objectives are listed below.

Project Objectives

- Restore 4,670 linear feet of Beaver Creek (as measured along the thalweg).
- Provide a stable stream channel that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport its watershed's water and sediment load.
- Improve water quality and reduce further property loss by stabilizing eroding stream banks.
- Reconnect the stream to its floodplain or establish a new floodplain at a lower elevation.
- Improve aquatic habitat with the use of natural material stabilization structures such as root wads, rock vanes, woody debris, and establish a riparian buffer.
- Provide aesthetic value, wildlife habitat, and bank stability through the creation or enhancement of a riparian zone.

Construction was completed at the site in the fall of 2002. Repair work was conducted at the site in the spring of 2004. The site was then monitored in 2004 by NC State University and in 2005 (Monitoring Year 2) by EcoLogic Associates. A second round of repair work was scheduled for 2005. The site was not monitored in 2006 or 2007, pending additional repairs and maintenance. Repairs were completed at the site in the summer of 2008. Additional planting and transplants took place in December 2008. URS performed the third year of monitoring in 2008. Another round of repairs was completed in December 2014, and fourth year monitoring was conducted in 2015 by KCI.

During the first year of monitoring (2004) four circular vegetation plots were established onsite. The following year (2005) fourteen new vegetation plots were established and permanently marked in the field. After repairs occurred in summer 2008, during which many of the plots were affected by construction, five plots were inventoried (VP11, VP10, VP12, VP4, and VP15) as part of the third year of monitoring in 2008. These five plots were monitored again in 2015 and 2016, the fourth and fifth years of monitoring. As a result of the repair work performed in 2014, Plots 10 and 15 were reinstalled during the fourth year monitoring their approximate original locations. The vegetation monitoring success criterion for the planted stream riparian zone is a density of 260 stems/acre at the end of five years of monitoring. The fifth-year vegetation monitoring was based on the Level 2 CVS-EEP vegetation monitoring protocol. The site's average density for this monitoring period was 324 planted stems/acre. Two of the five plots (Plots 4 and 15) had less than 260 planted stems/acre. Volunteer species are robust throughout the site and including volunteers, the site averaged 1,611 total stems/acre, with only Plot 15 not meeting the stem density criteria. Despite not meeting the success criteria, there are many mature trees in the area around Plot 15 and it is not indicative of a problem with the vegetation in this area of the site. Invasive species are present at the site, but are only scattered in isolated patches throughout the easement.

The project was originally surveyed for monitoring 2005 by EcoLogic. No longitudinal profile was surveyed at this time, but seven cross-sections were installed on the site. Because of the repair work that occurred in 2014, the right bank pins of cross-sections 3, and 4 were reinstalled in July 2015 during the fourth year monitoring. An effort was made to install these as close to the original cross-sections as possible, but there are alignment differences between the MY03 and MY04 cross-section data for these cross-sections. Cross-sections 1, 5, 6, and 7 show little change from the previous monitoring year. Cross-sections 2, 3, and 4 were all located within the 2014 repair areas and therefore show significant change from the

Monitoring Year 3 survey but do not show much change from last year's conditions. These repaired cross-sections are stable with the installed bioengineering creating well vegetated banks since planting in December 2014. As a part of the stream success criteria, the stream must experience at least two bankfull events, each in separate monitoring years. The site has experienced multiple bankfull events since construction, including in 2016.

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

2.0 METHODOLOGY

The survey data were collected with a total station instrument, using control coordinates supplied by URS. The MY05 stream survey was completed on November 18, 2016.

The CVS-EEP protocol, Level 2 (<http://cvs.bio.unc.edu/methods.htm>) was used to collect vegetation data from the site. The MY05 vegetation survey was conducted on July 1, 2016.

3.0 REFERENCES

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>).

USACE. 2003. Stream Mitigation Guidelines.
(<http://www.saw.usace.army.mil/wetlands/Mitigation/Documents/Stream/>).

Weakley, A. S. 2006. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas.
(http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2006-Jan.pdf).

Appendix A

Project Vicinity Map and Background Tables

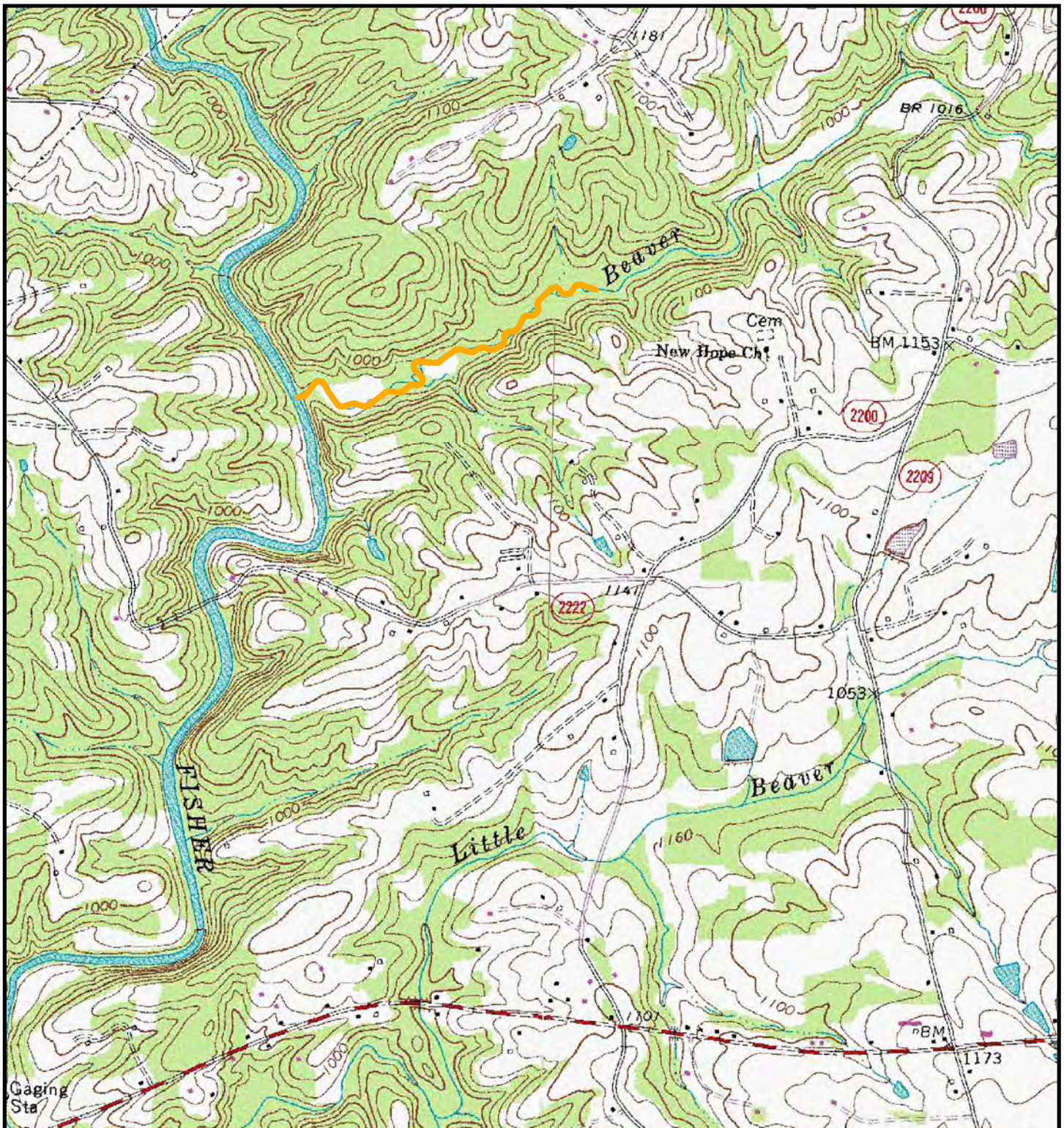
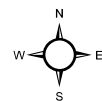


Figure 1. Vicinity Map
Beaver Creek Stream Restoration Site
DMS Project #028



— Project Reach



1:63,360
 1 inch equals 1 miles
 1 0.5 0 1 Miles

Table 1. Project Components and Mitigation Credits Beaver Creek, DMS Project #028									
Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Overall Credits	4,266								
Project Components									
Project Component -or- Reach ID	Stationing/ Location		Existing Footage/ Acreage		Approach (PI, PII etc.)		Restoration -or- Restoration Equivalent	Restoration Footage/Acreage	Mitigation Ratio
Beaver Creek	10+00 – 52+13		4,213*		PI		Restoration	4,266	1:1
Length and Area Summations									
Restoration Level	Stream (linear feet)		Riparian Wetlands (Acres)		Non-Riparian Wetlands (Acres)		Buffer (square feet)	Upland (Acres)	
Restoration	4,266								
Enhancement I									
Enhancement II									

*discrepancy between stationing and creditable footage is due to the as-built thalweg measurement's use for credit calculation

Table 2. Project Activity and Reporting History		
Project Number and Name: 028 – Beaver Creek		
Elapsed Time Since Grading Complete: 14 years		
Elapsed Time Since Planting Complete: 14 years		
Number of Reporting Years: 5		
Activity or Report	Data Collection Complete	Actual Completion or Delivery
Restoration Plan		2001
Mitigation Plan		2001
Construction		Fall 2002
Temporary S&E mix applied to project area		Fall 2002
As-built Report	Fall 2002	Feb. 2003
Permanent seed mix applied to reach		Fall 2002
Structural maintenance (bank and structure)		Spring 2004
Supplemental planting of bare root and containers		Spring 2004
Year 1 Monitoring	Fall 2004	Sep. 2004
Year 2 Monitoring	Fall 2005	Sep. 2005
Structural maintenance (bank and structure)		Summer 2008
Year 3 Monitoring	Sep. 2008	Oct. 2008
Supplemental planting of bare root and containers		Dec. 2008
Structural maintenance (bank and structure)		Dec. 2014
Year 4 Monitoring	July 2015	Dec. 2015
Year 5 Monitoring	Nov. 2016	Nov. 2016

Table 3. Project Contacts Table	
Project Number and Name: DMS #028, Beaver Creek	
Design Firm	Earth Tech of North Carolina 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607 Contact: Bill Jenkins Phone: (919) 854-6200
Construction Contractor	West Contracting PO Box 310 Marble, NC 28905 Contact: Maurice West Jr. Phone: (828)837-2280
Planting Contractor	Carolina Environmental PO Box 1905 Mount Airy, NC 27030 Contact: Joanne Cheatham Phone: (336)320-3849
2014 Repair Design Firm	KCI Associates of NC 4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514
2014 Repair Construction Contractor	Carolina Environmental Contracting, Inc. PO Box 1905 Mount Airy, NC 27030-6905 Contact: Ms. Joanne Cheatham Phone: (336) 320-3849
Monitoring Performers	
MY-01	Biological & Agricultural Engineering North Carolina State University Campus Box 7625 Raleigh, NC 27695 Contact: Dan Clinton Phone: (919)515-6771
MY-02	EcoLogic Associates, P.C. 4321-A South Elm-Eugene Street Greensboro, NC 27406 Contact: Kyle Hoover Phone: (336)355-1108
MY-03	URS Corporation – North Carolina 1600 Perimeter Park Drive, Suite 400 Morrisville, NC 27560 Contact: Kathleen McKeithan Phone: (919) 461-1597
MY-04-05	KCI Associates of NC 4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514

Table 4. Project Attribute Table	
Project Number and Name: 028 - Beaver Creek	
Project County	Surry County
Physiographic Region	Piedmont/Foothills
Ecoregion	Northern Inner Piedmont (45e)
Project River Basin	Yadkin
USGS HUC for Project (8 digit)	03040101
NCDWQ Sub-basin for Project	12-63-12
Within extent of EEP Watershed Plan?	No
WRC Class (Warm, Cool, Cold)	Cool
% of project easement demarcated	-
Beaver activity observed during design phase?	No
Restoration Component Attribute Table	
	Beaver Creek
Drainage Area	5.9 sq.mi.
Stream Order	Third
Restored length (feet)	4,266
Perennial or Intermittent	Perennial
Watershed Type (Rural, Urban, Developing, etc.)	Rural
Watershed LULC Distribution	
Urban	5%
Ag-Row Crop	0%
Ag-Livestock	50%
Forested	45%
Water/Wetlands	0%
Watershed impervious cover (%)	< 5%
NCDWQ AU/Index Number	27-5-(0.7)
NCDWQ Classification	C
303d listed?	No
Upstream of a 303d listed segment?	No
Reasons for 303d Listing or Stressor	N/A
Total acreage of easement	-
Total vegetated acreage within the easement	-
Total planted acreage as part of the restoration	9.4
Rosgen Classification of pre-existing	C4, G4, and F4
Rosgen Classification of As-built	E4
Valley Type	-
Valley Slope	0.006
Valley side slope range (e.g. 2-3%)	-
Valley toe slope range (e.g. 2-3%)	-
Trout waters designation	No
Species of concern, endangered etc.? (Y/N)	No
Dominant soil series and characteristics	
Series	Colvard and Suches
Drainage class	Well drained
Hydric status	Non-hydric
Slope	0-3%

Appendix B

Visual Assessment Data

LEGEND

VEG PLOT ABOVE 288 TOTAL PLANTED STEMS/ACRE 

VEG PLOT BELOW 288 TOTAL PLANTED STEMS/ACRE 

VEG PLOT TOTAL / PLANTED STEM DENSITY 1611 / 324

PHOTO POINT 

CROSS-SECTION 

GAUGE LOCATION 

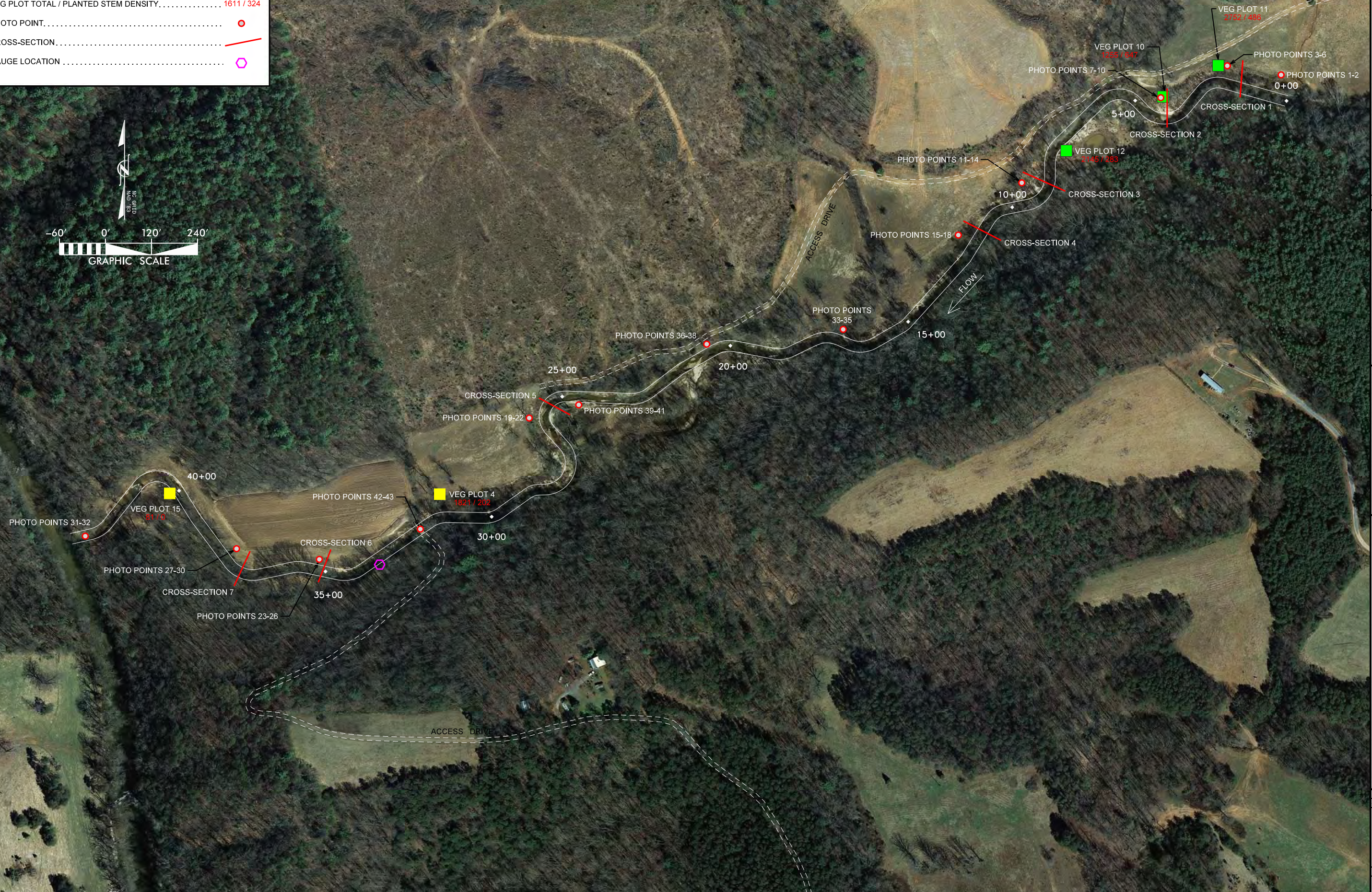
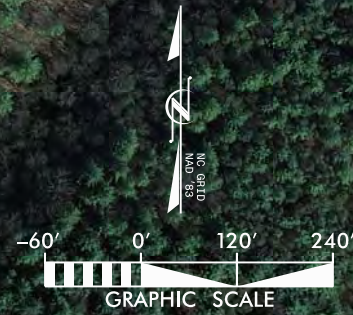
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Table 5. Visual Stream Morphology Stability Assessment										
Project Number and Name: 028 -Beaver Creek										
Assessed Length 4,266										
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	1. <u>Aggradation</u> - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. <u>Degradation</u> - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	20	20			100%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth $\geq$ 1.6)	40	40			100%			
		2. <u>Length</u> appropriate ($>30\%$ of centerline distance between tail of upstream riffle and head of downstrem riffle)	40	40			100%			
	4. Thalweg Position	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%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
Totals					0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	36	36			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	36	36			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	36	36			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	36	36			100%			
	4. Habitat	Pool forming structures maintaining $\sim$ Max Pool Depth : Mean Bankfull Depth ratio $\geq$ 1.6 Rootwads/logs providing some cover at base-flow.	36	36			100%			

Table 6. Vegetation Condition Assessment						
Project Number and Name: 028 - Beaver Creek						
Planted Acreage N/A			Easement Acreage N/A			
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 acres	Pattern and Color	0	0.00	N/A
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	N/A
Total				0	0.00	N/A
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 acres	Pattern and Color	0	0.00	N/A
Cumulative Total				0	0.00	N/A
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000 SF	Pattern and Color	0	0.00	N/A
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	N/A

Stream Station Photos



P1 facing upstream – 11/18/2016



P2 facing downstream – 11/18/2016



P3 facing upstream – 11/18/2016



P4 facing left bank



P5 facing downstream – 11/18/2016



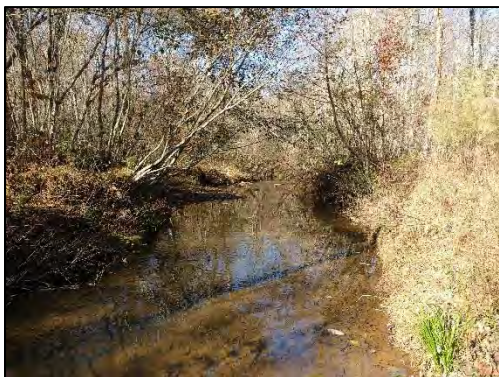
P6 facing right bank floodplain – 11/18/2016



P7 facing upstream – 11/18/2016



P8 facing left bank – 11/18/2016



P9 facing downstream – 11/18/2016



P10 facing right bank floodplain – 11/18/2016



P11 facing upstream – 11/18/2016



P12 facing left bank – 11/18/2016



P13 facing downstream – 11/18/2016



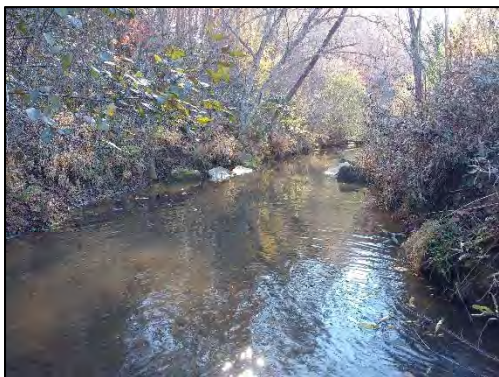
P14 facing right bank floodplain – 11/18/2016



P15 facing upstream – 11/18/2016



P16 facing left bank – 11/18/2016



P17 facing downstream – 11/18/2016



P18 facing right bank floodplain – 11/18/2016



P19 facing upstream – 11/18/2016



P20 facing left bank – 11/18/2016



P21 facing downstream – 11/18/2016



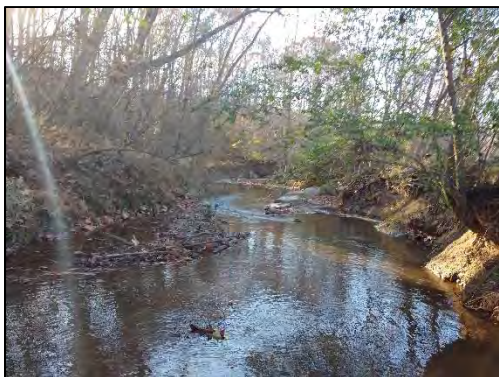
P22 facing right bank floodplain – 11/18/2016



P23 facing upstream – 11/18/2016



P24 facing left bank – 11/18/2016



P25 facing downstream – 11/18/2016



P26 facing right bank floodplain – 11/18/2016



P27 facing upstream – 11/18/2016



P28 facing left bank – 11/18/2016



P29 facing downstream – 11/18/2016



P30 facing right bank floodplain – 11/18/2016



P31 facing upstream – 11/18/2016



P32 facing downstream at Fisher River – 11/18/2016



P33 facing upstream – 11/18/2016



P34 facing left bank – 11/18/2016



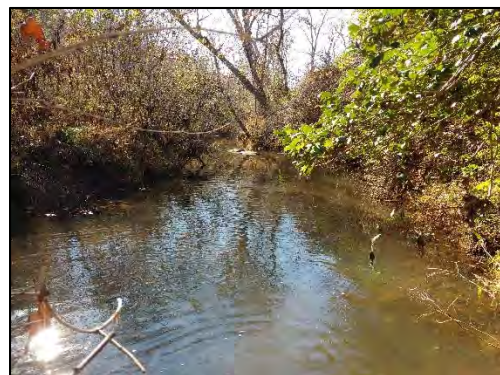
P35 facing downstream – 11/18/2016



P36 facing upstream – 11/18/2016



P37 facing left bank – 11/18/2016



P38 facing downstream – 11/18/2016



P39 facing upstream – 11/18/2016



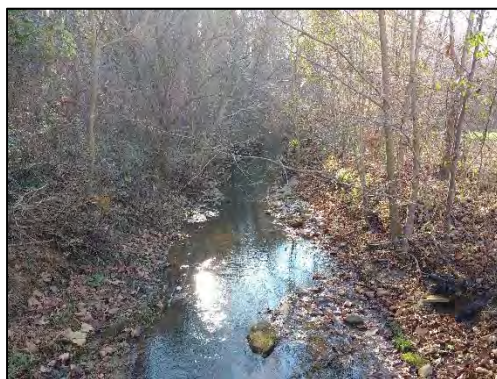
P40 facing right bank – 11/18/2016



P41 facing downstream – 11/18/2016



P42 facing upstream – 11/18/2016

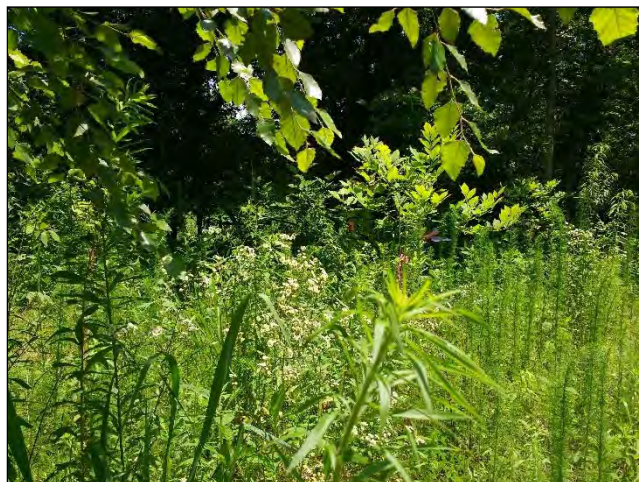


P43 facing downstream – 11/18/2016

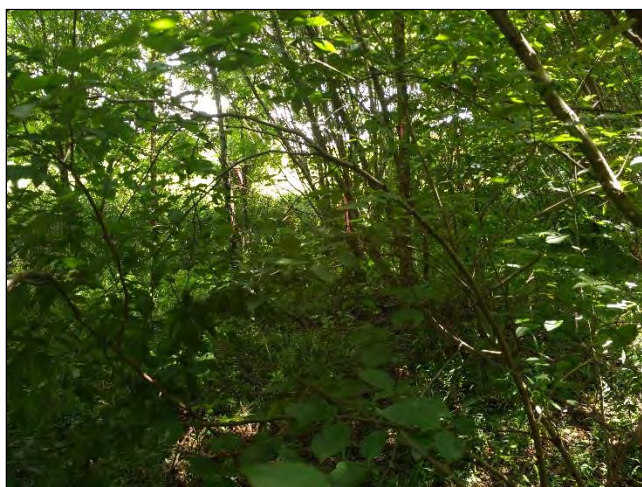
Vegetation Monitoring Plot Photos



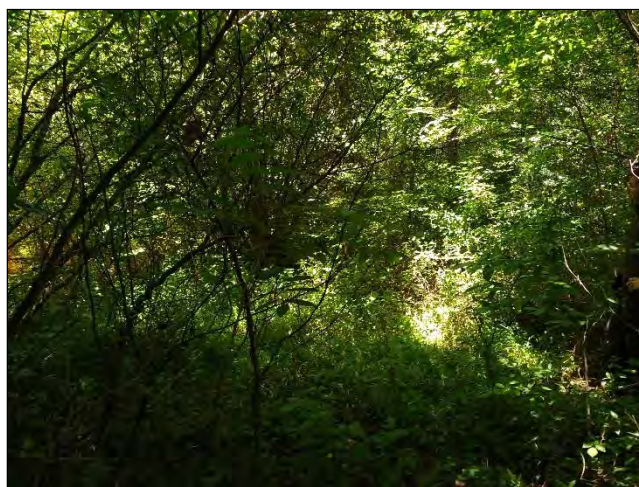
Plot 4 Photo. MY05 – 7/1/2016



Plot 10 Photo. MY05 – 7/1/2016



Plot 11 Photo. MY05 – 7/1/2016



Plot 12 Photo. MY05 – 7/1/2016



Plot 15 Photo. MY05 – 7/1/2016

Appendix C

Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment	
Project Number and Name: 028 - Beaver Creek	
Vegetation Plot ID	Vegetation Survival Threshold Met?
4	No
10	Yes
11	Yes
12	Yes
15	No

Table 8. CVS Vegetation Plot Metadata	
Report Prepared By	Randall Jones
Date Prepared	11/9/2016 16:33
database name	Beaver Creek 2008 cvs-eep-entrytool-v2.3.1.mdb
database location	M:\2015\16157992 Beaver Crk Monitoring\CVS Data Entry Tool
computer name	12-3ZV4FP1
file size	60035072
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	28
project Name	Beaver Creek
Description	Stream Restoration
River Basin	Yadkin-Pee Dee
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	5

Table 9. CVS Stem Count Total and Planted by Plot and Species DMS Project Code 28. Project Name: Beaver Creek			Current Plot Data (MY5 2016)															Annual Means								
Scientific Name	Common Name	Species Type	E28-01-0004			E28-01-0010			E28-01-0011			E28-01-0012			E28-01-0015			MY5 (2016)			MY4 (2015)			MY3 (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	PnoLS	P-all	T
Acer rubrum	red maple	Tree									6			6						12			10			
Alnus serrulata	hazel alder	Shrub						3		6	12			1					6	16		6	9		6	6
Betula nigra	river birch	Tree			16	4	4	4	1	1	8	1	1	25				6	6	53	6	6	35	14	14	14
Carpinus caroliniana	American hornbeam	Tree	2	2	11			4			16							2	2	31	2	2	14	2	2	2
Cercis canadensis	eastern redbud	Tree	1	1	1				1	1	1							2	2	2	2	2	3	4	4	4
Cornus amomum	silky dogwood	Shrub									2									2	1	1	3			
Cornus florida	flowering dogwood	Tree											2							2			1			
Corylus	hazelnut				1															1						
Diospyros virginiana	common persimmon	Tree				2	2	3										2	2	3	2	2	4			
Fraxinus pennsylvanica	green ash	Tree	1	1	2	5	5	5	4	4	6	1	1	3				11	11	16	10	10	14	8	8	8
Ilex	holly	Shrub or Tree											1							1						
Juglans nigra	black walnut	Tree						3	1	1	3							1	1	6			6	1	1	1
Juniperus virginiana	eastern redcedar	Tree									1									1			1			
Lindera benzoin	northern spicebush	Shrub			3						2									5			3			
Liriodendron tulipifera	tuliptree	Tree			1			3			2			2		1				9			5			
Nyssa sylvatica	blackgum	Tree							1	1	4							1	1	4	1	1	3	1	1	1
Oxydendrum arboreum	sourwood	Tree											7							7			10			
Pinus strobus	eastern white pine	Tree											1							1			1			
Platanus occidentalis	American sycamore	Tree			1	5	5	6								1		5	5	8	5	5	7			
Prunus serotina	black cherry	Tree			2															2			1	2	2	2
Quercus falcata	southern red oak	Tree							1	1	1							1	1	1	2	2	2	2	2	2
Quercus michauxii	swamp chestnut oak	Tree	1	1	1				2	2	3	4	4	4				7	7	8	7	7	8	10	10	10
Quercus phellos	willow oak	Tree							1	1	1	1	1	1				2	2	2	2	2	3	3	3	3
Quercus velutina	black oak	Tree																						2	2	2
Rhus glabra	smooth sumac	shrub																			1	1	1	7	7	7
Salix nigra	black willow	Tree		6	6														6	6		5	8		10	10
Sambucus canadensis	Common Elderberry	Shrub																					9			
Ulmus americana	American elm	Tree																					1			
Ulmus rubra	slippery elm	Tree																					32			
Stem count			5	11	45	16	16	31	12	18	68	7	7	53	0	0	2	40	52	199	41	52	194	56	72	72
size (ares)			1			1			1			1			1			5			5			5		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.12			0.12			0.12		
Species count			4	5	11	4	4	8	8	9	15	4	4	11	0	0	2	11	13	24	12	14	26	12	14	14
Stems per ACRE			202.3	445	1821	647.5	647	1255	485.6	728	2752	283.3	283	2145	0	0	80.9	323.7	421	1611	331.8	420.9	1570	453.2	583	583

Appendix D

Stream Survey Data

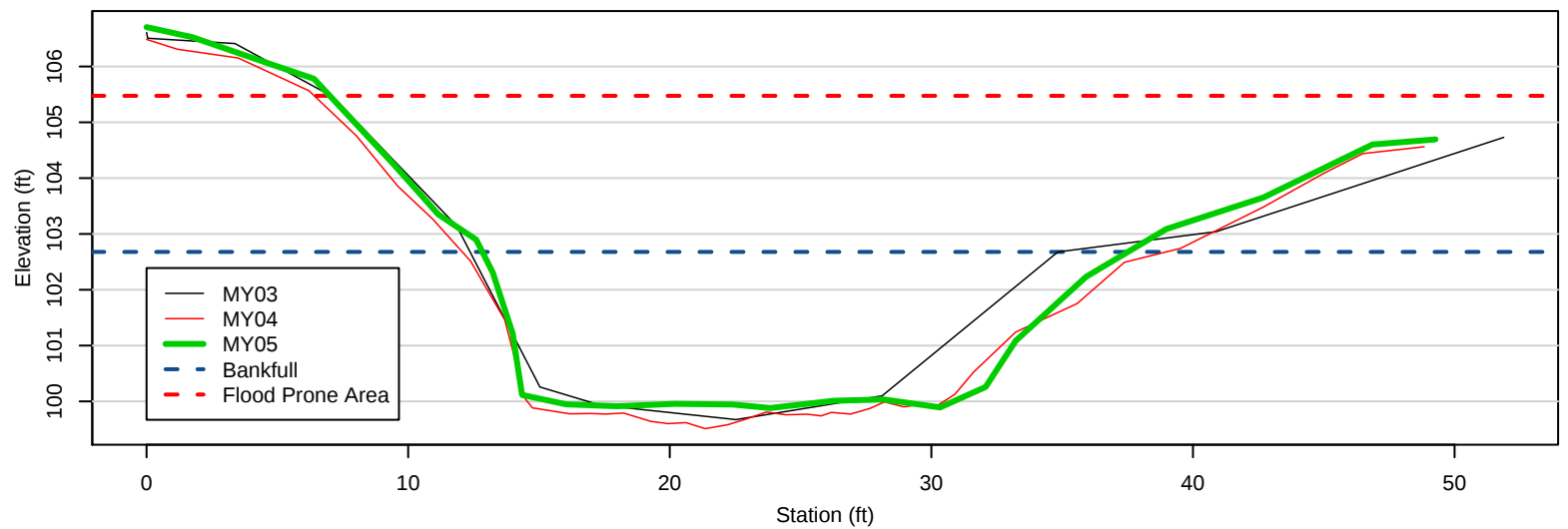
Station (ft)	Elevation (ft)
0.0	106.71
1.7	106.53
4.6	106.06
6.4	105.78
9.5	104.23
11.2	103.35
12.6	102.90
13.2	102.31
14.0	101.21
14.4	100.12
16.0	99.95
18.0	99.91
20.2	99.96
22.4	99.94
23.8	99.88
26.3	100.01
28.2	100.04
30.3	99.89
32.1	100.26
33.2	101.08
35.9	102.23
39.0	103.09
42.7	103.65
46.9	104.60
49.3	104.69

River Basin	Yadkin–Pee Dee
Watershed	Beaver Creek
XS ID	XS1
Drainage Area	5.9 sq. mi.
Date	11/18/2016
Field Crew	T. Seelinger, R. Jones

	Summary Data
Bankfull Elevation (ft)	102.7
Bankfull XS Area (sq ft)	54.8
Bankfull Width (ft)	24.2
Flood Prone Area Elevation (ft)	105.5
Flood Prone Width (ft)	> 42
Max Depth at Bankfull (ft)	2.8
Mean Depth at Bankfull (ft)	2.3
W / D Ratio	10.7
Entrenchment Ratio	> 1.7
Bank Height Ratio	1.0



Yadkin–Pee Dee River Basin, Beaver Creek, XS1, Riffle



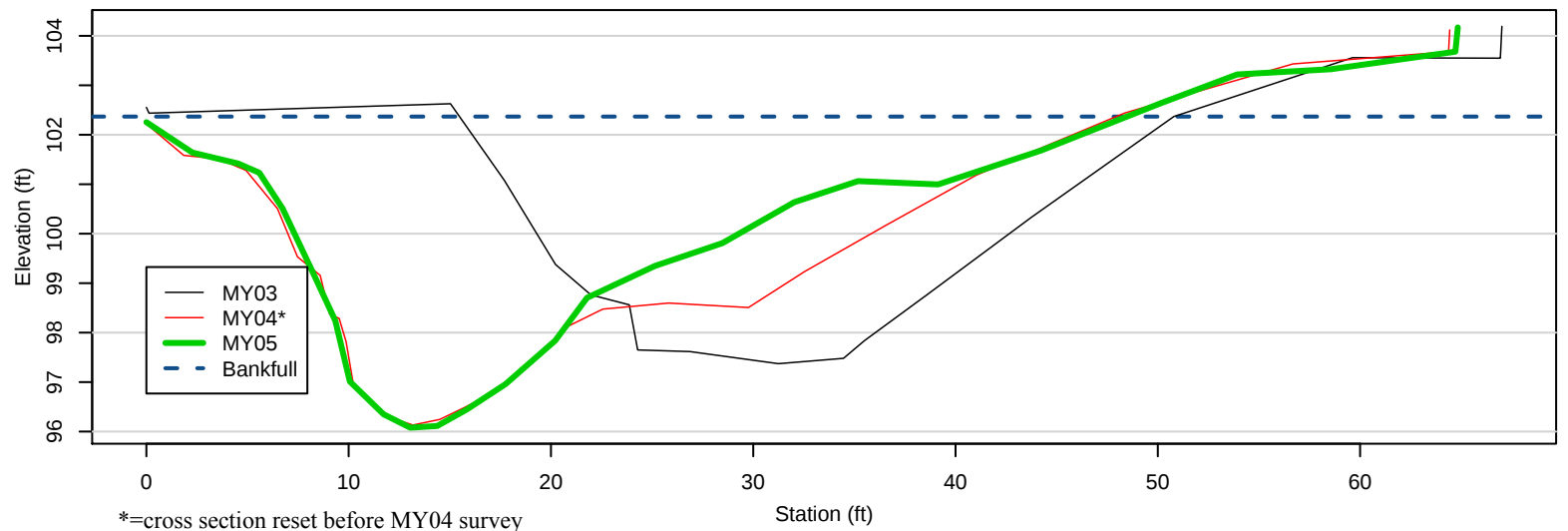
Station (ft)	Elevation (ft)
0.0	102.26
2.3	101.64
4.5	101.42
5.6	101.23
6.7	100.51
8.2	99.27
9.3	98.24
10.1	97.01
11.7	96.35
13.0	96.08
14.4	96.11
15.8	96.45
17.8	96.96
20.2	97.84
21.8	98.70
25.1	99.35
28.5	99.81
32.0	100.64
35.2	101.06
39.1	101.00
44.2	101.68
50.1	102.63
53.9	103.22
58.6	103.33
64.7	103.68
64.8	104.19

River Basin	Yadkin-Pee Dee
Watershed	Beaver Creek
XS ID	XS2
Drainage Area	5.9 sq. mi.
Date	11/18/2016
Field Crew	T. Seelinger, R. Jones

	Summary Data
Bankfull Elevation (ft)	102.4
Bankfull XS Area (sq ft)	126.1
Bankfull Width (ft)	47.9
Flood Prone Area Elevation (ft)	–
Flood Prone Width (ft)	–
Max Depth at Bankfull (ft)	6.3
Mean Depth at Bankfull (ft)	2.6
W / D Ratio	–
Entrenchment Ratio	–
Bank Height Ratio	1.0



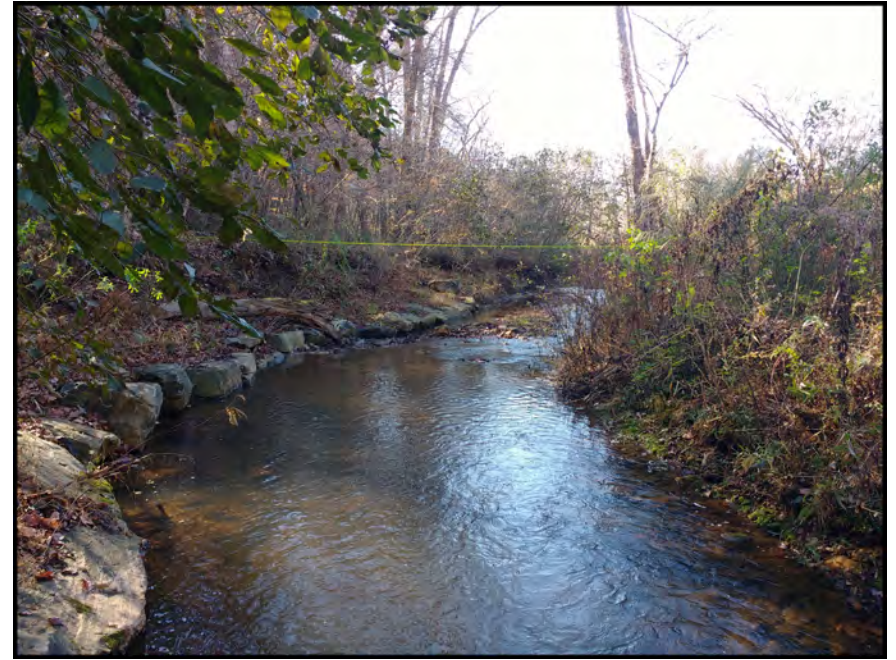
Yadkin-Pee Dee River Basin, Beaver Creek, XS2, Pool



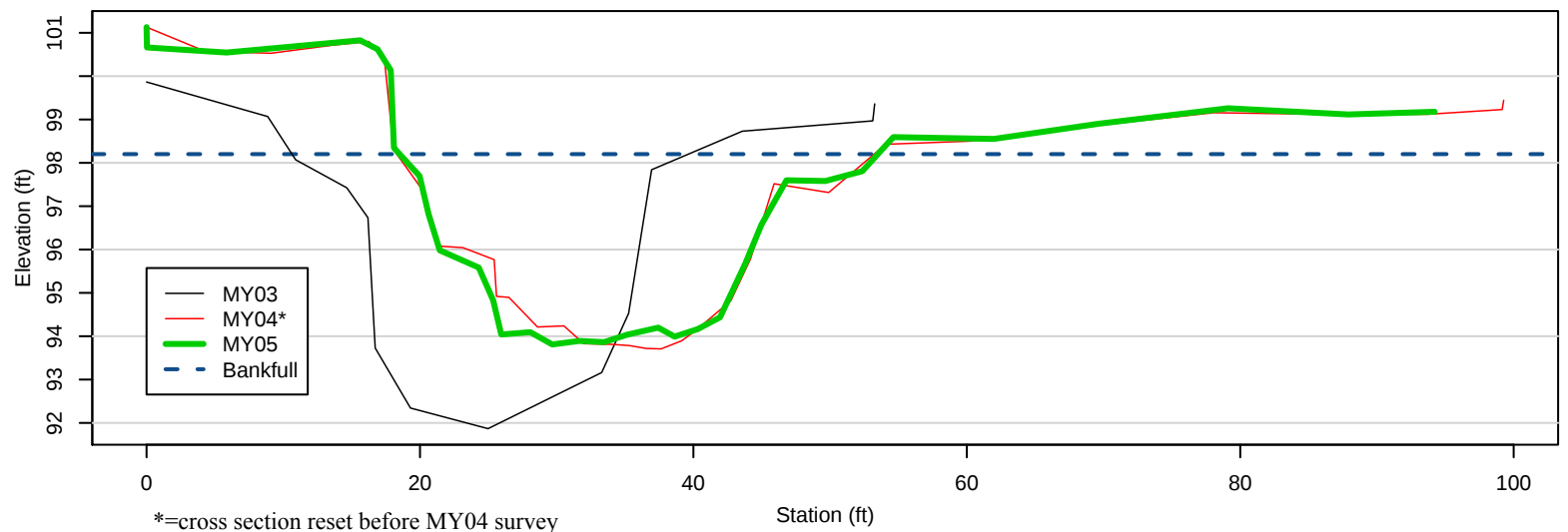
Station (ft)	Elevation (ft)
0.0	101.13
0.0	100.66
5.8	100.54
15.6	100.83
16.9	100.62
17.9	100.14
18.1	98.35
20.0	97.70
20.6	96.81
21.4	95.98
24.3	95.58
25.4	94.83
25.9	94.04
28.1	94.09
29.7	93.81
31.7	93.89
33.5	93.86
35.2	94.04
37.4	94.20
38.6	93.99
40.3	94.16
41.9	94.44
43.8	95.68
45.0	96.57
46.8	97.60
49.6	97.58
52.4	97.81
54.6	98.59
62.0	98.55
69.6	98.90
79.1	99.26
87.9	99.12
94.2	99.18

River Basin	Yadkin–Pee Dee
Watershed	Beaver Creek
XS ID	XS3
Drainage Area	5.9 sq. mi.
Date	11/18/2016
Field Crew	T. Seelinger, R. Jones

	Summary Data
Bankfull Elevation (ft)	98.2
Bankfull XS Area (sq ft)	95.1
Bankfull Width (ft)	34.4
Flood Prone Area Elevation (ft)	–
Flood Prone Width (ft)	–
Max Depth at Bankfull (ft)	4.4
Mean Depth at Bankfull (ft)	2.8
W / D Ratio	–
Entrenchment Ratio	–
Bank Height Ratio	1.0



Yadkin–Pee Dee River Basin, Beaver Creek, XS3, Pool



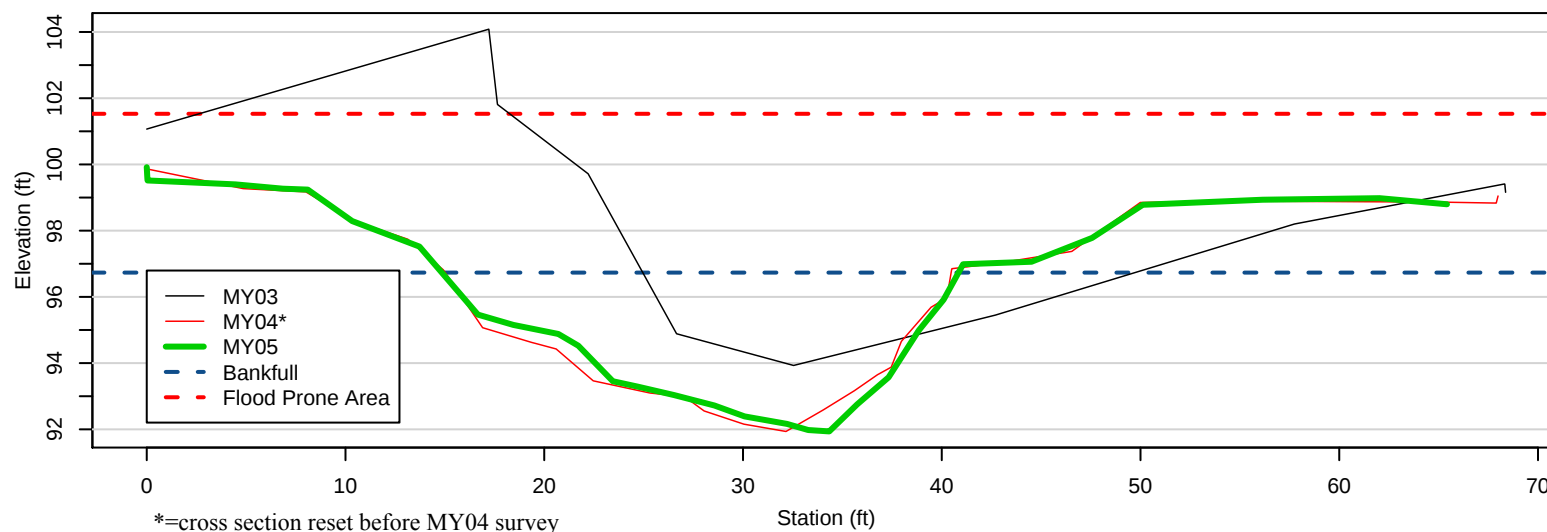
Station (ft)	Elevation (ft)
0.0	99.92
0.0	99.52
4.5	99.40
6.8	99.27
8.1	99.24
10.3	98.29
13.7	97.52
16.7	95.46
18.4	95.15
20.7	94.88
21.7	94.52
23.5	93.45
24.7	93.29
26.5	93.03
28.6	92.72
30.1	92.39
32.2	92.16
33.3	91.98
34.3	91.94
35.7	92.76
37.3	93.57
38.8	94.98
40.1	95.92
41.1	96.99
44.5	97.06
47.6	97.78
50.1	98.78
56.2	98.93
62.0	98.98
65.4	98.80

River Basin	Yadkin-Pee Dee
Watershed	Beaver Creek
XS ID	XS4
Drainage Area	5.9 sq. mi.
Date	11/18/2016
Field Crew	T. Seelinger, R. Jones

Summary Data	
Bankfull Elevation (ft)	96.7
Bankfull XS Area (sq ft)	76.3
Bankfull Width (ft)	25.8
Flood Prone Area Elevation (ft)	101.5
Flood Prone Width (ft)	> 65
Max Depth at Bankfull (ft)	4.8
Mean Depth at Bankfull (ft)	3.0
W / D Ratio	8.7
Entrenchment Ratio	> 2.5
Bank Height Ratio	1.0



Yadkin-Pee Dee River Basin, Beaver Creek, XS4, Riffle



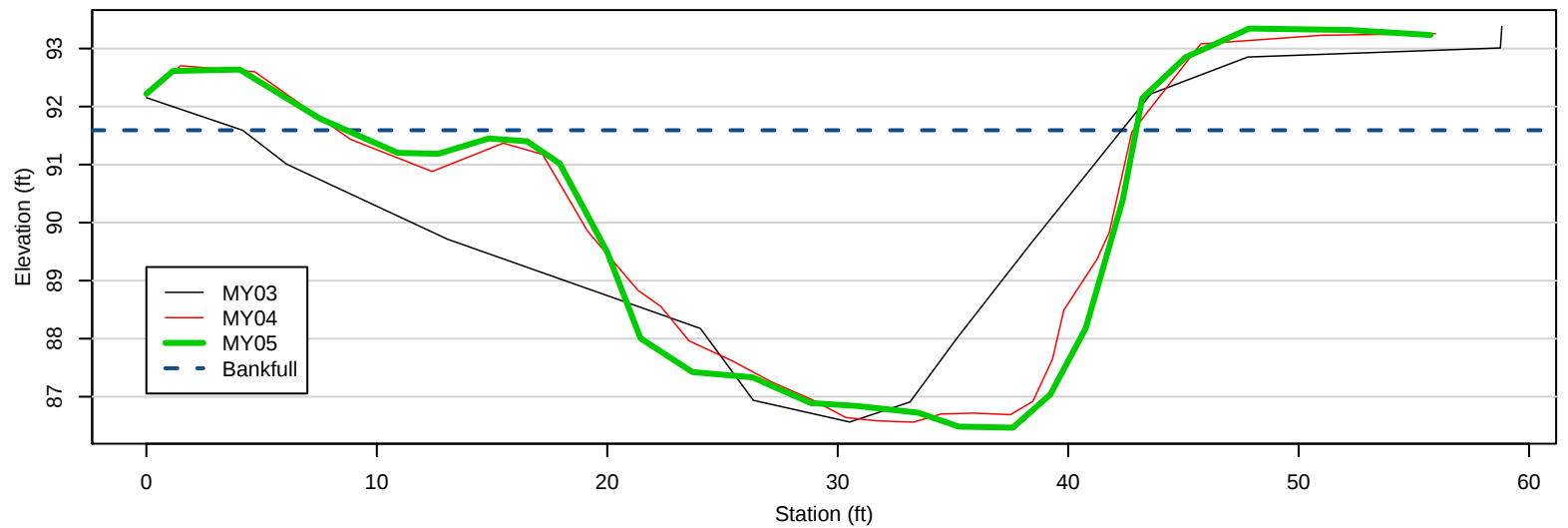
Station (ft)	Elevation (ft)
0.0	92.22
1.2	92.61
4.0	92.64
7.5	91.79
10.9	91.20
12.7	91.19
14.9	91.45
16.5	91.40
17.9	91.02
20.0	89.49
21.4	88.01
23.7	87.42
26.3	87.33
28.8	86.89
30.8	86.84
33.5	86.72
35.2	86.49
37.6	86.47
39.2	87.04
40.8	88.18
42.4	90.39
43.2	92.14
45.1	92.85
47.9	93.34
52.2	93.32
55.7	93.23

River Basin	Yadkin–Pee Dee
Watershed	Beaver Creek
XS ID	XS5
Drainage Area	5.9 sq. mi.
Date	11/18/2016
Field Crew	T. Seelinger, R. Jones

	Summary Data
Bankfull Elevation (ft)	91.6
Bankfull XS Area (sq ft)	101.5
Bankfull Width (ft)	33.6
Flood Prone Area Elevation (ft)	–
Flood Prone Width (ft)	–
Max Depth at Bankfull (ft)	5.1
Mean Depth at Bankfull (ft)	3.0
W / D Ratio	–
Entrenchment Ratio	–
Bank Height Ratio	1.0



Yadkin–Pee Dee River Basin, Beaver Creek, XS5, Pool



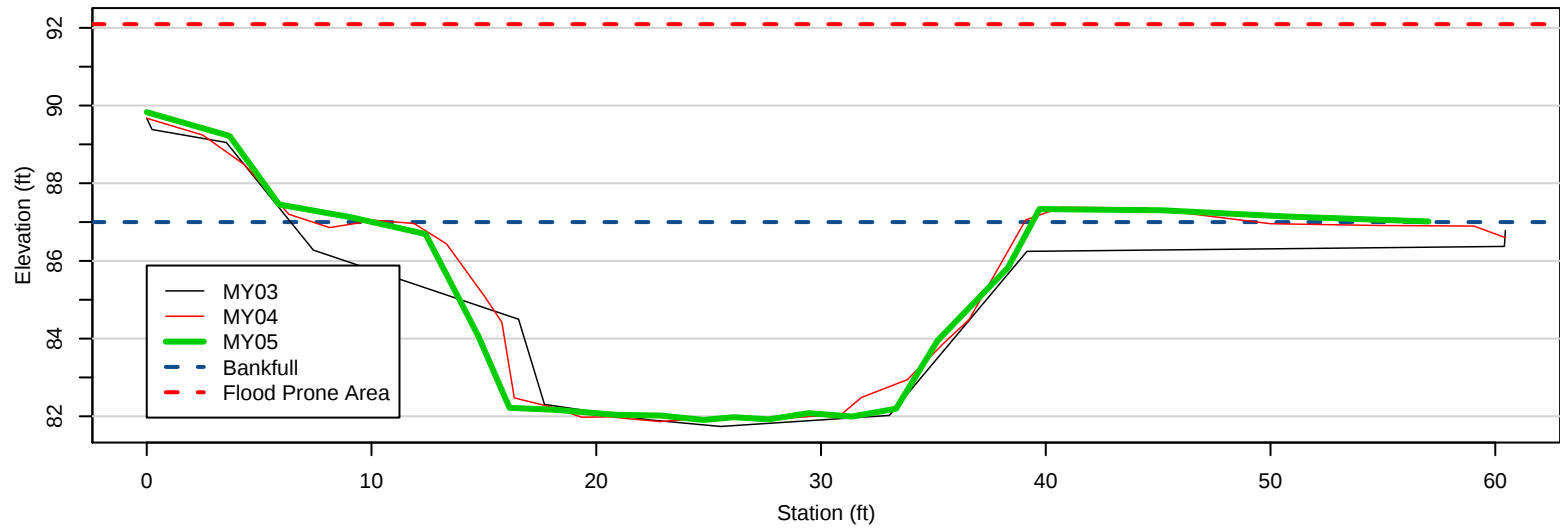
Station (ft)	Elevation (ft)
0.0	89.83
3.7	89.22
5.9	87.45
9.1	87.13
12.4	86.69
14.7	84.08
16.1	82.22
18.1	82.17
20.9	82.04
22.8	82.02
24.8	81.91
26.1	81.98
27.7	81.92
29.5	82.08
31.4	81.99
33.3	82.20
35.2	83.95
38.3	85.82
39.7	87.33
45.2	87.30
50.7	87.14
57.0	87.02

River Basin	Yadkin-Pee Dee
Watershed	Beaver Creek
XS ID	XS6
Drainage Area	5.9 sq. mi.
Date	11/18/2016
Field Crew	T. Seelinger, R. Jones

	Summary Data
Bankfull Elevation (ft)	87.0
Bankfull XS Area (sq ft)	109.2
Bankfull Width (ft)	28.5
Flood Prone Area Elevation (ft)	92.1
Flood Prone Width (ft)	> 57
Max Depth at Bankfull (ft)	5.1
Mean Depth at Bankfull (ft)	3.8
W / D Ratio	7.4
Entrenchment Ratio	> 2.0
Bank Height Ratio	1.0



Yadkin-Pee Dee River Basin, Beaver Creek, XS6, Riffle



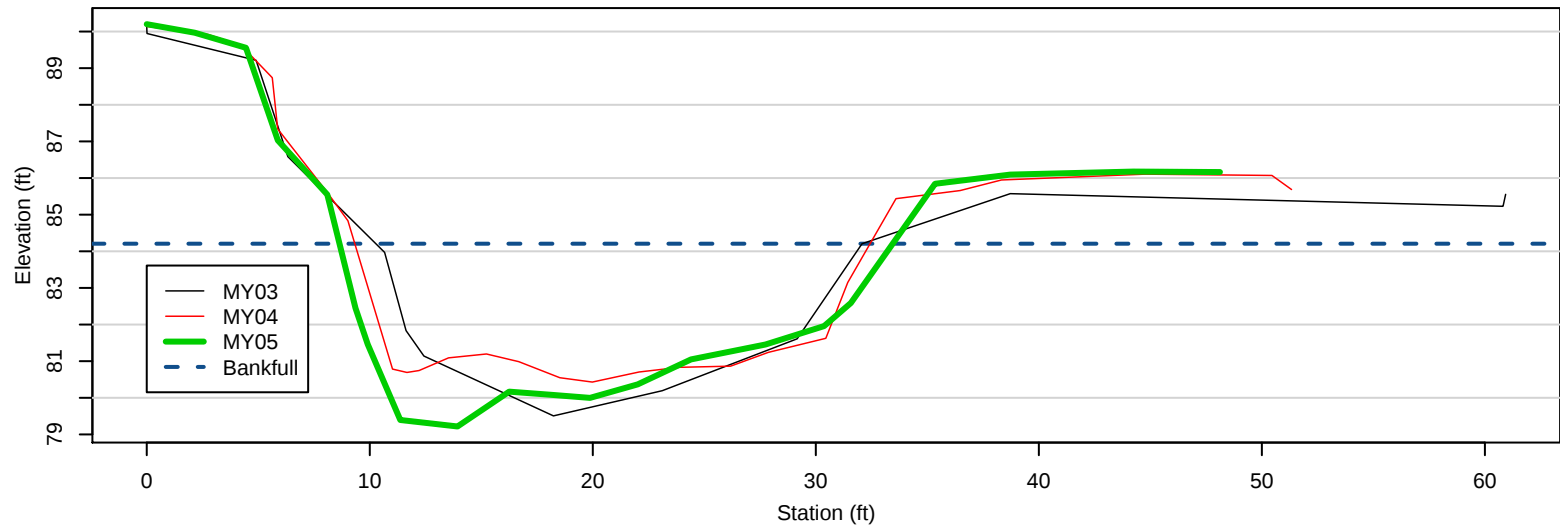
Station (ft)	Elevation (ft)
0.0	90.20
2.1	89.97
4.4	89.56
5.9	87.03
8.1	85.55
9.4	82.45
9.9	81.46
11.4	79.39
13.9	79.22
16.3	80.17
18.1	80.08
19.9	80.00
22.0	80.37
24.4	81.05
27.7	81.45
30.4	81.96
31.6	82.59
35.3	85.84
38.7	86.09
44.2	86.18
48.1	86.16

River Basin	Yadkin-Pee Dee
Watershed	Beaver Creek
XS ID	XS7
Drainage Area	5.9 sq. mi.
Date	11/18/2016
Field Crew	T. Seelinger, R. Jones

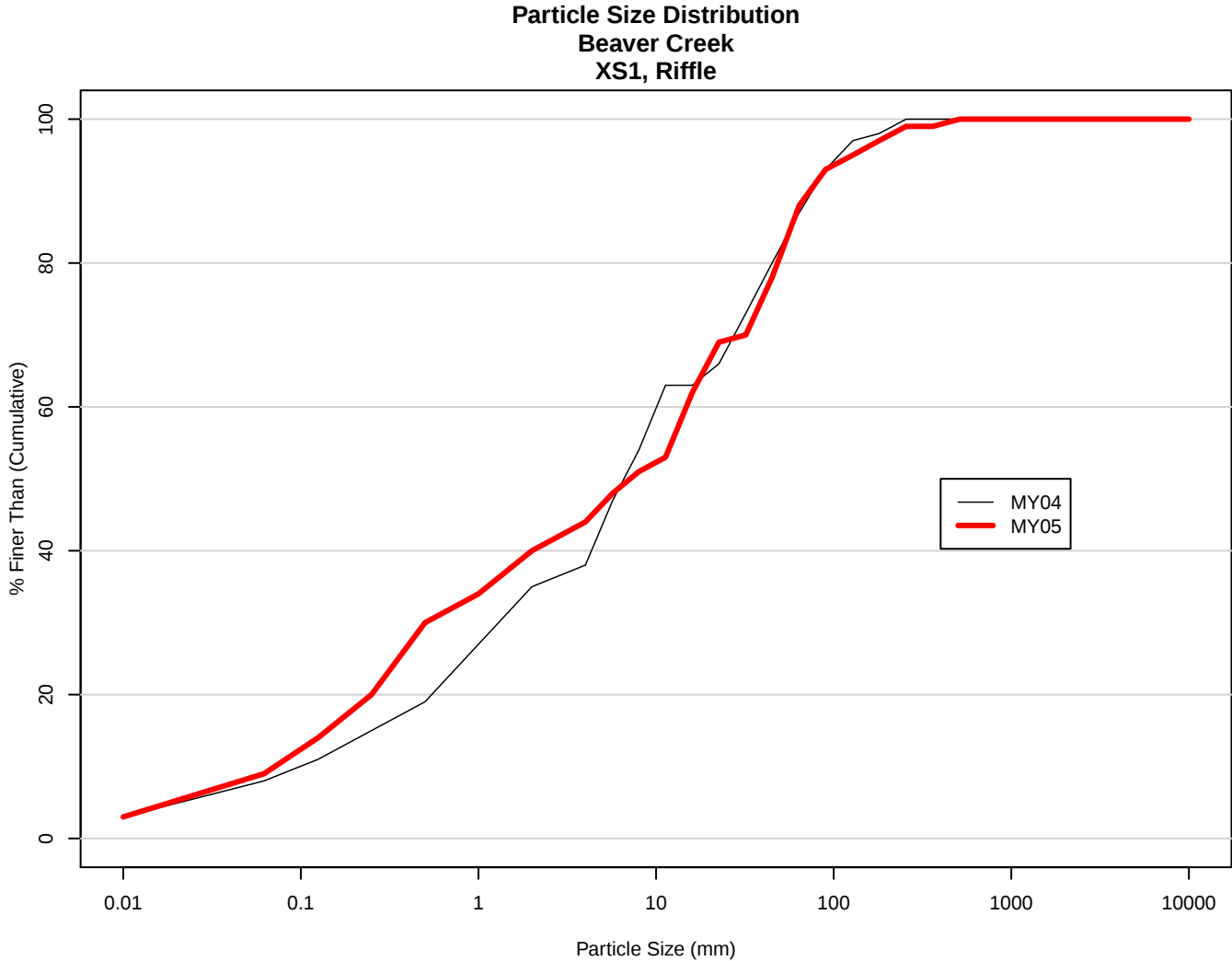
	Summary Data
Bankfull Elevation (ft)	84.2
Bankfull XS Area (sq ft)	82.6
Bankfull Width (ft)	24.7
Flood Prone Area Elevation (ft)	–
Flood Prone Width (ft)	–
Max Depth at Bankfull (ft)	5.0
Mean Depth at Bankfull (ft)	3.3
W / D Ratio	–
Entrenchment Ratio	–
Bank Height Ratio	1.0



Yadkin-Pee Dee River Basin, Beaver Creek, XS7, Pool



Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	3
Very Fine	.062 – .125	S	6
Fine	.125 – .25	A	5
Medium	.25 – .50	N	6
Coarse	.50 – 1	D	10
Very Coarse	1 – 2	S	4
Very Fine	2 – 4		6
Fine	4 – 5.7	G	4
Fine	5.7 – 8	R	4
Medium	8 – 11.3	A	3
Medium	11.3 – 16	V	2
Coarse	16 – 22.6	E	9
Coarse	22.6 – 32	L	7
Very Coarse	32 – 45	S	1
Very Coarse	45 – 64		8
Small	64 – 90	C	10
Small	90 – 128	O	5
Large	128 – 180	B	2
Large	180 – 256	L	2
Small	256 – 362	B	2
Small	362 – 512	L	
Medium	512 – 1024	D	1
Lrg– Very Lrg	1024 – 2048	R	
Bedrock	>2048	BDRK	
		Total	100



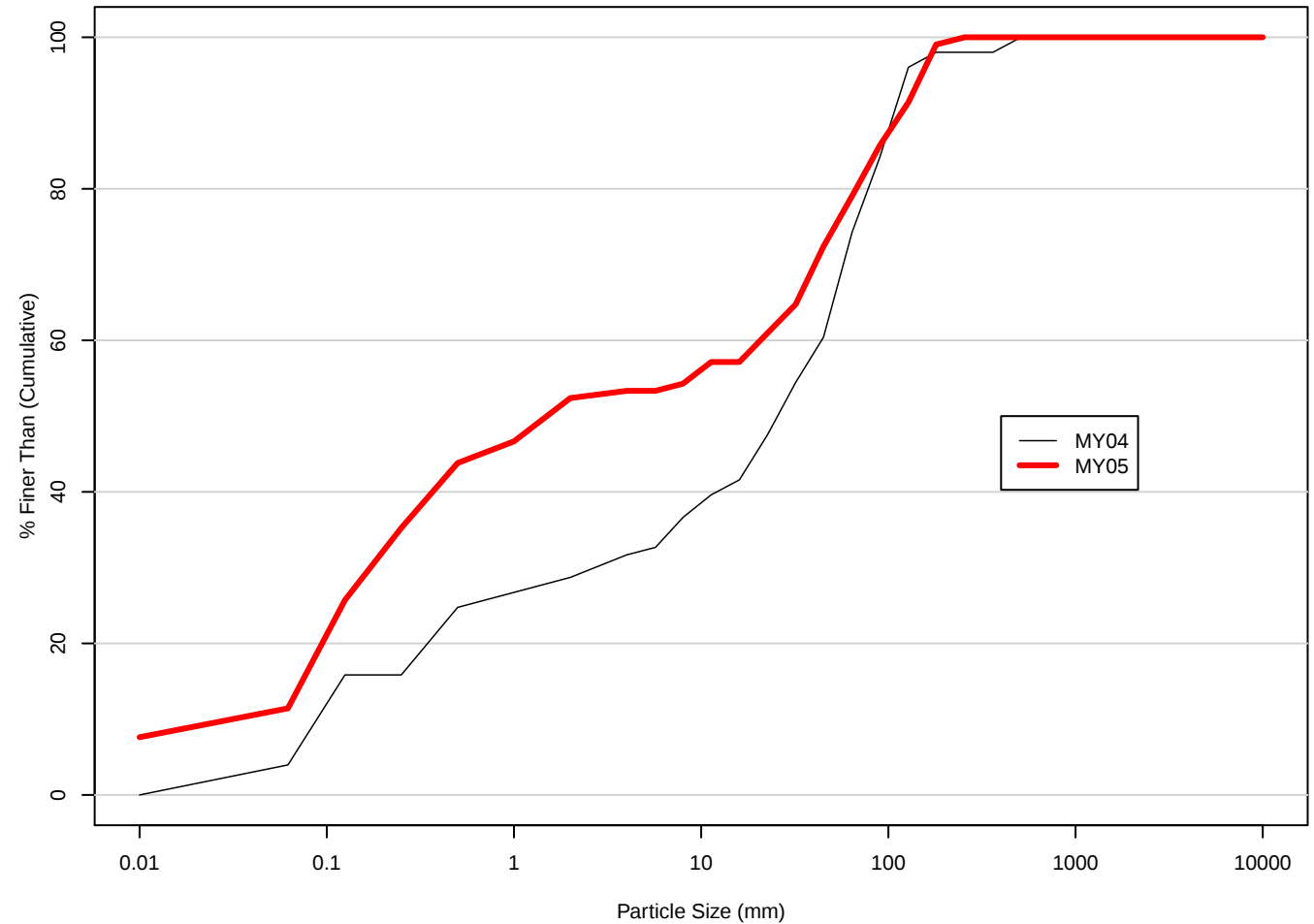
	Size (mm)
D16	0.16
D35	1.1
D50	7.1
D65	19
D84	56
D95	130

	Size Distribution
Mean (mm)	3
Dispersion	18.8
Skewness	-0.3

	Type
Silt/Clay	3%
Sand	31%
Gravel	44%
Cobble	19%
Boulder	3%
Bedrock	0%
Hardpan	0%
Wood/Det.	0%
Artificial	0%

Particle Size Distribution Beaver Creek XS2, Pool

Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	8
Very Fine	.062 – .125	S	4
Fine	.125 – .25	A	15
Medium	.25 – .50	N	10
Coarse	.50 – 1	D	9
Very Coarse	1 – 2	S	3
Very Fine	2 – 4		6
Fine	4 – 5.7	G	1
Fine	5.7 – 8	R	
Medium	8 – 11.3	A	1
Medium	11.3 – 16	V	3
Coarse	16 – 22.6	E	
Coarse	22.6 – 32	L	4
Very Coarse	32 – 45	S	4
Very Coarse	45 – 64		8
Small	64 – 90	C	7
Small	90 – 128	O	7
Large	128 – 180	B	6
Large	180 – 256	L	8
Small	256 – 362	B	1
Small	362 – 512	L	
Medium	512 – 1024	D	
Lrg– Very Lrg	1024 – 2048	R	
Bedrock	>2048	BDRK	
		Total	105



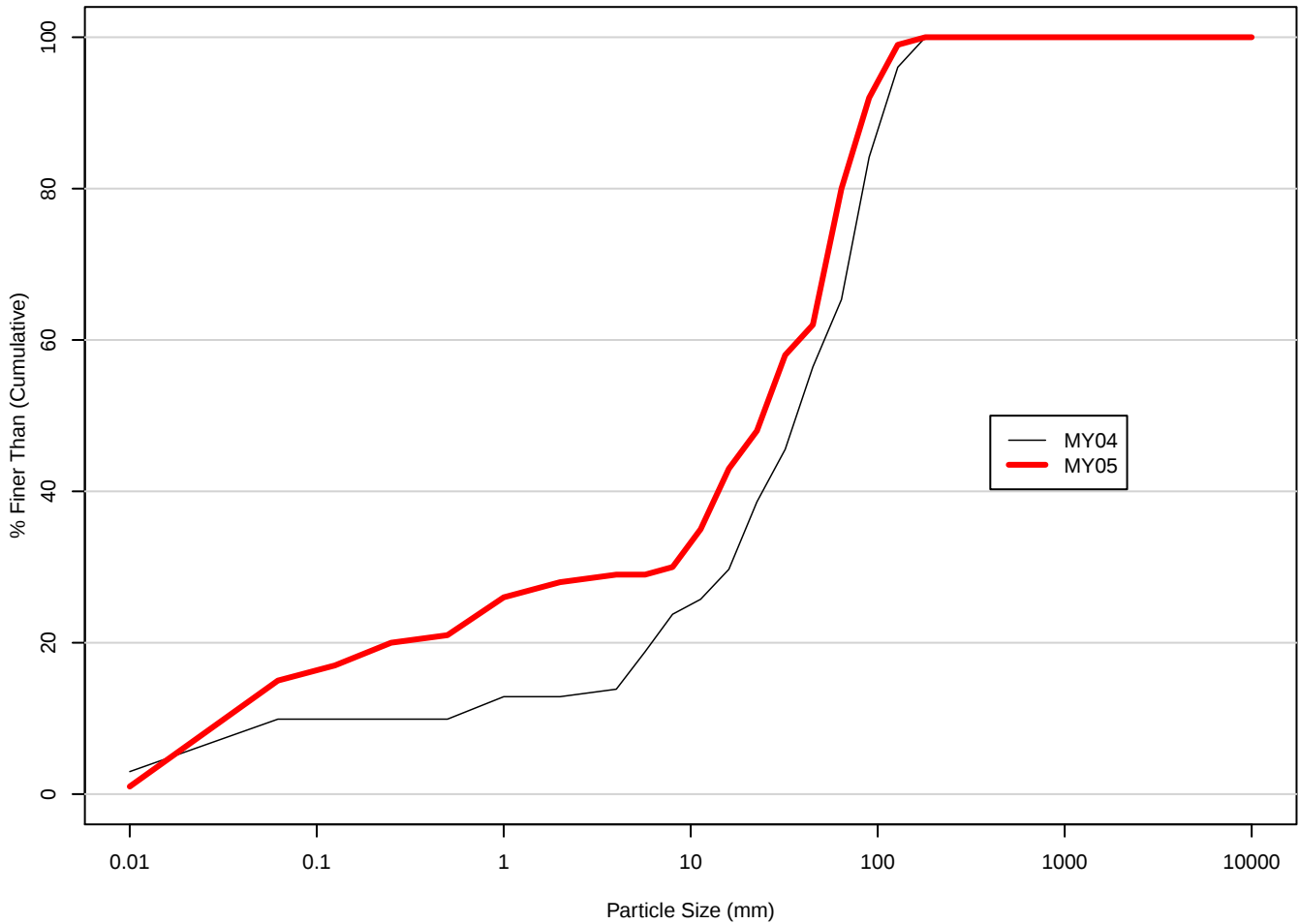
	<i>Size (mm)</i>
D16	0.078
D35	0.25
D50	1.5
D65	32
D84	82
D95	150

	<i>Size Distribution</i>
Mean (mm)	2.5
Dispersion	32.6
Skewness	0.2

	Type
Silt/Clay	8%
Sand	38%
Gravel	26%
Cobble	27%
Boulder	1%
Bedrock	0%
Hardpan	0%
Wood/Det.	0%
Artificial	0%

Particle Size Distribution
Beaver Creek
XS3, Pool

Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	1
Very Fine	.062 – .125	S	14
Fine	.125 – .25	A	2
Medium	.25 – .50	N	3
Coarse	.50 – 1	D	1
Very Coarse	1 – 2	S	5
Very Fine	2 – 4		2
Fine	4 – 5.7	G	1
Fine	5.7 – 8	R	
Medium	8 – 11.3	A	1
Medium	11.3 – 16	V	5
Coarse	16 – 22.6	E	8
Coarse	22.6 – 32	L	5
Very Coarse	32 – 45	S	10
Very Coarse	45 – 64		4
Small	64 – 90	C	18
Small	90 – 128	O	12
Large	128 – 180	B	7
Large	180 – 256	L	1
Small	256 – 362	B	
Small	362 – 512	L	
Medium	512 – 1024	D	
Lrg– Very Lrg	1024 – 2048	R	
Bedrock	>2048	BDRK	
		Total	100

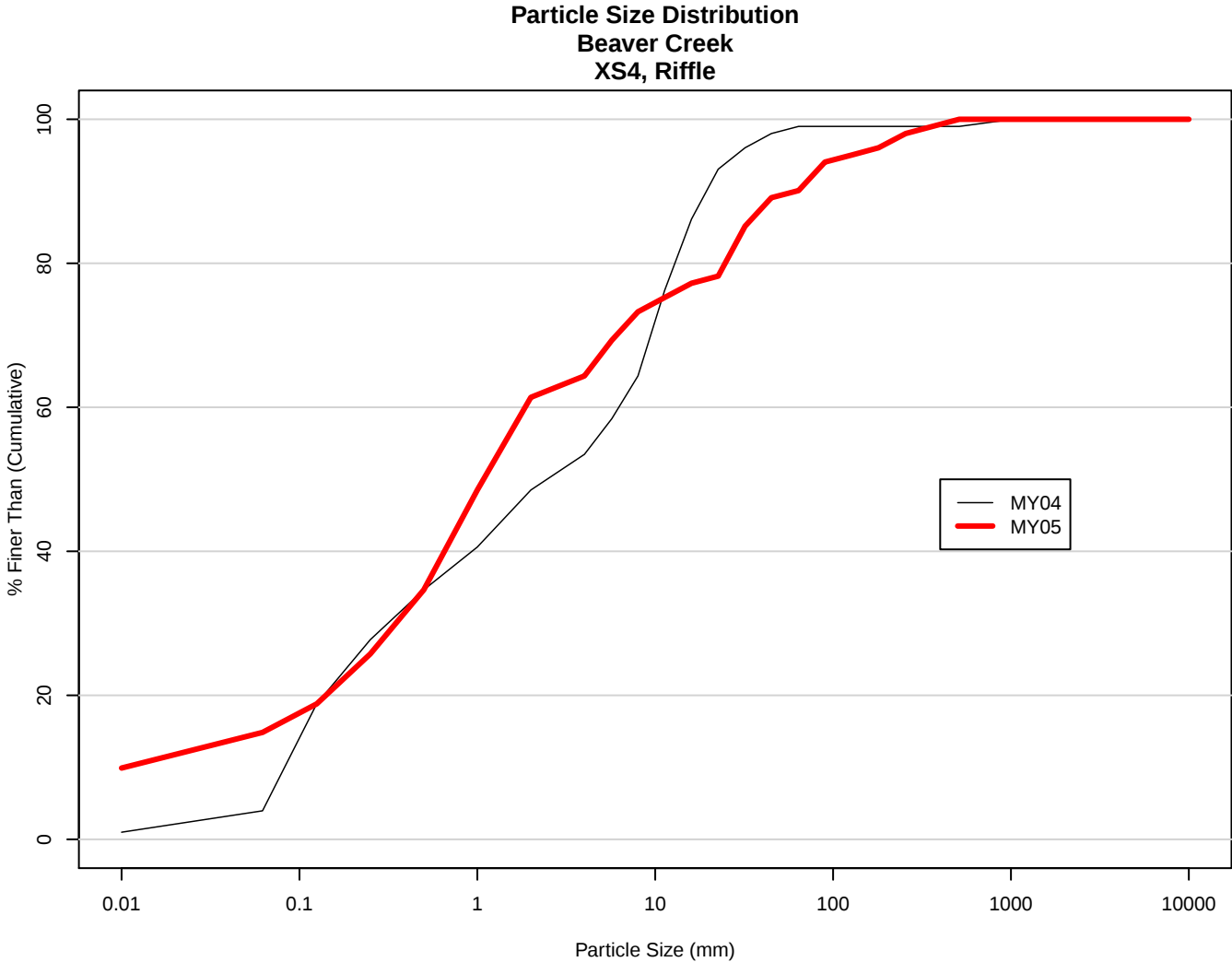


	Size (mm)
D16	0.088
D35	11
D50	24
D65	48
D84	72
D95	100

	Size Distribution
Mean (mm)	2.5
Dispersion	28.5
Skewness	-0.7

	Type
Silt/Clay	1%
Sand	25%
Gravel	36%
Cobble	38%
Boulder	0%
Bedrock	0%
Hardpan	0%
Wood/Det.	0%
Artificial	0%

Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	10
Very Fine	.062 – .125	S	5
Fine	.125 – .25	A	4
Medium	.25 – .50	N	7
Coarse	.50 – 1	D	9
Very Coarse	1 – 2	S	14
Very Fine	2 – 4		13
Fine	4 – 5.7	G	3
Fine	5.7 – 8	R	5
Medium	8 – 11.3	A	4
Medium	11.3 – 16	V	2
Coarse	16 – 22.6	E	2
Coarse	22.6 – 32	L	1
Very Coarse	32 – 45	S	7
Very Coarse	45 – 64		4
Small	64 – 90	C	1
Small	90 – 128	O	4
Large	128 – 180	B	1
Large	180 – 256	L	1
Small	256 – 362	B	2
Small	362 – 512	L	1
Medium	512 – 1024	D	1
Lrg– Very Lrg	1024 – 2048	R	
Bedrock	>2048	BDRK	
		Total	101

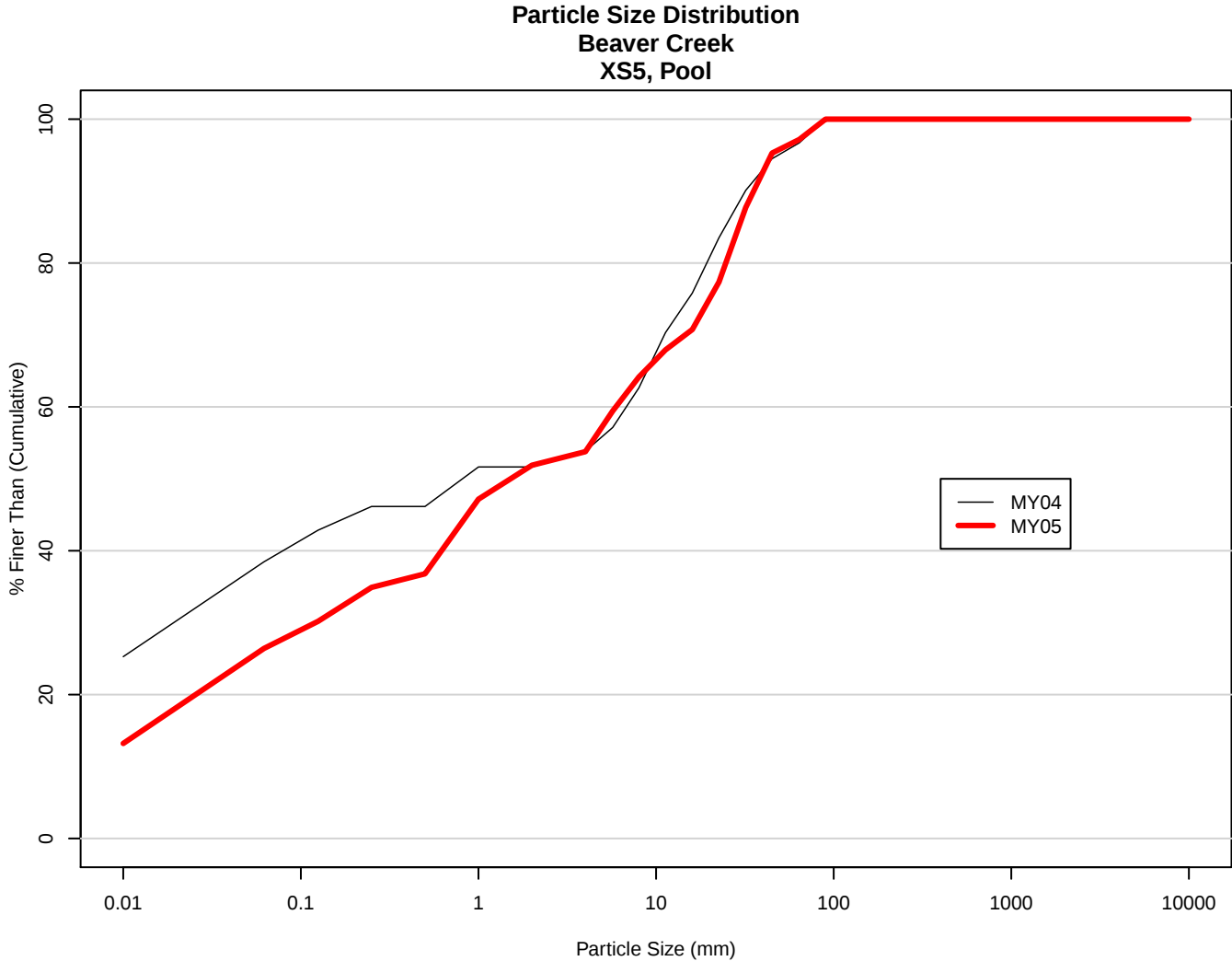


	Size (mm)
D16	0.076
D35	0.51
D50	1.1
D65	4.2
D84	30
D95	130

	Size Distribution
Mean (mm)	1.5
Dispersion	19.9
Skewness	0.1

	Type
Silt/Clay	10%
Sand	39%
Gravel	40%
Cobble	7%
Boulder	4%
Bedrock	0%
Hardpan	0%
Wood/Det.	0%
Artificial	0%

Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	14
Very Fine	.062 – .125	S	14
Fine	.125 – .25	A	4
Medium	.25 – .50	N	5
Coarse	.50 – 1	D	2
Very Coarse	1 – 2	S	11
Very Fine	2 – 4		5
Fine	4 – 5.7	G	2
Fine	5.7 – 8	R	6
Medium	8 – 11.3	A	5
Medium	11.3 – 16	V	4
Coarse	16 – 22.6	E	3
Coarse	22.6 – 32	L	7
Very Coarse	32 – 45	S	11
Very Coarse	45 – 64		8
Small	64 – 90	C	2
Small	90 – 128	O	3
Large	128 – 180	B	
Large	180 – 256	L	
Small	256 – 362	B	
Small	362 – 512	L	
Medium	512 – 1024	D	
Lrg– Very Lrg	1024 – 2048	R	
Bedrock	>2048	BDRK	
		Total	106

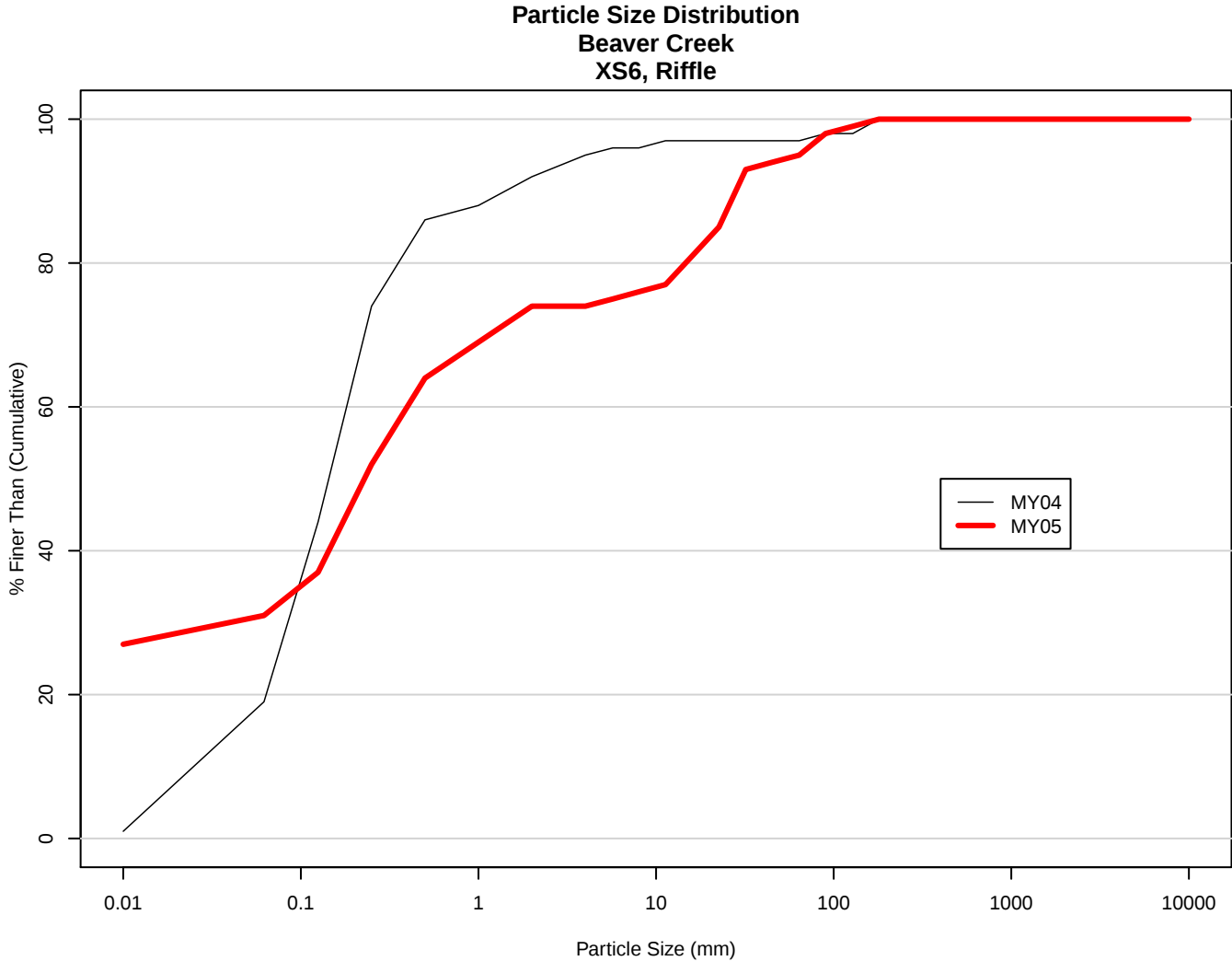


	Size (mm)
D16	0.015
D35	0.26
D50	1.5
D65	8.6
D84	28
D95	44

	Size Distribution
Mean (mm)	0.6
Dispersion	43.8
Skewness	−0.2

	Type
Silt/Clay	13%
Sand	34%
Gravel	48%
Cobble	5%
Boulder	0%
Bedrock	0%
Hardpan	0%
Wood/Det.	0%
Artificial	0%

Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	27
Very Fine	.062 – .125	S	4
Fine	.125 – .25	A	6
Medium	.25 – .50	N	15
Coarse	.50 – 1	D	12
Very Coarse	1 – 2	S	5
Very Fine	2 – 4		5
Fine	4 – 5.7	G	
Fine	5.7 – 8	R	1
Medium	8 – 11.3	A	1
Medium	11.3 – 16	V	1
Coarse	16 – 22.6	E	4
Coarse	22.6 – 32	L	4
Very Coarse	32 – 45	S	8
Very Coarse	45 – 64		1
Small	64 – 90	C	1
Small	90 – 128	O	3
Large	128 – 180	B	1
Large	180 – 256	L	1
Small	256 – 362	B	
Small	362 – 512	L	
Medium	512 – 1024	D	
Lrg– Very Lrg	1024 – 2048	R	
Bedrock	>2048	BDRK	
		Total	100



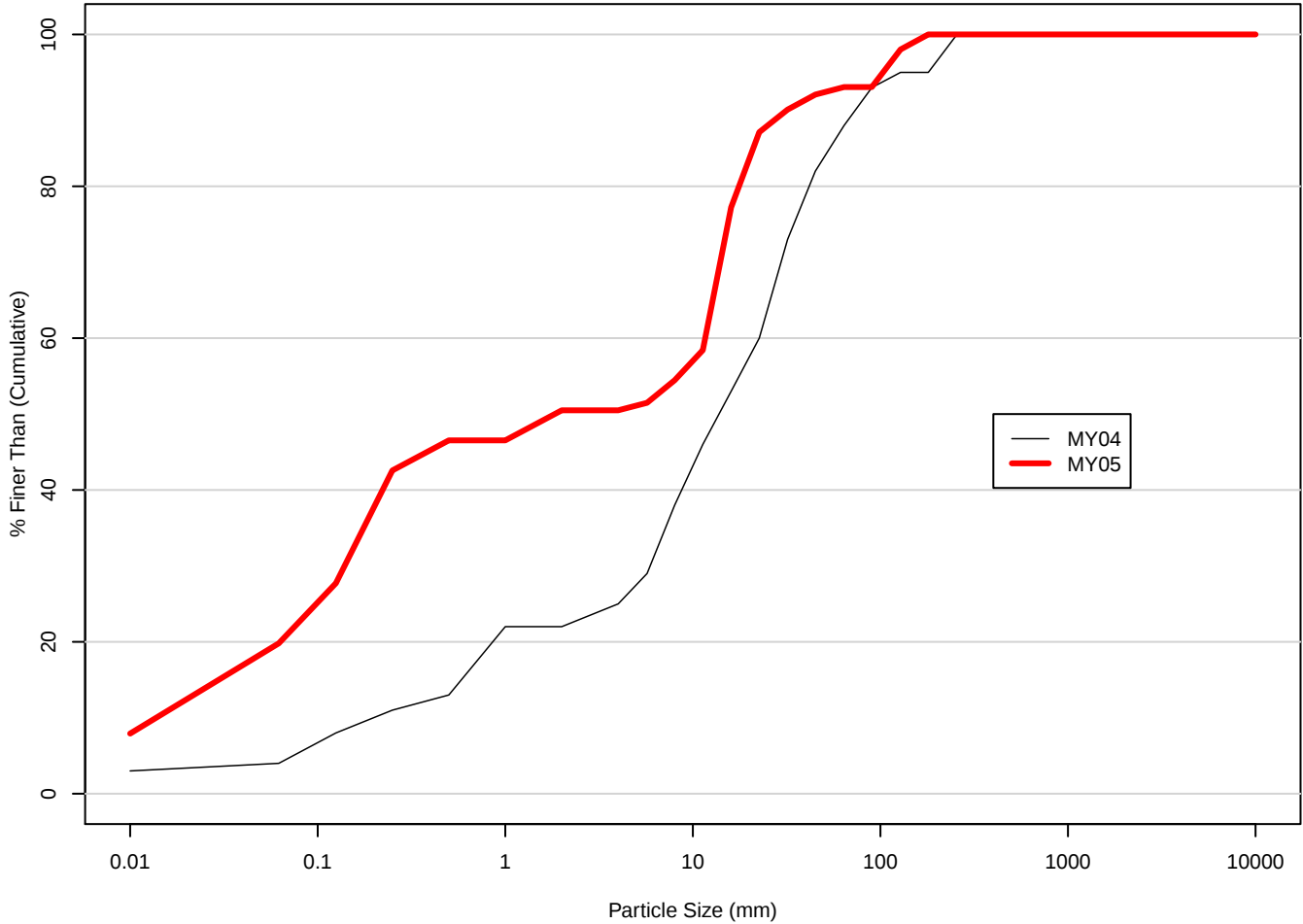
	Size (mm)
D16	0.062
D35	0.099
D50	0.23
D65	0.57
D84	21
D95	64

	Size Distribution
Mean (mm)	1.1
Dispersion	18.3
Skewness	0.6

	Type
Silt/Clay	27%
Sand	42%
Gravel	25%
Cobble	6%
Boulder	0%
Bedrock	0%
Hardpan	0%
Wood/Det.	0%
Artificial	0%

Particle Size Distribution
Beaver Creek
XS7, Pool

Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	8
Very Fine	.062 – .125	S	12
Fine	.125 – .25	A	8
Medium	.25 – .50	N	15
Coarse	.50 – 1	D	4
Very Coarse	1 – 2	S	
Very Fine	2 – 4		4
Fine	4 – 5.7	G	
Fine	5.7 – 8	R	1
Medium	8 – 11.3	A	3
Medium	11.3 – 16	V	4
Coarse	16 – 22.6	E	19
Coarse	22.6 – 32	L	10
Very Coarse	32 – 45	S	3
Very Coarse	45 – 64		2
Small	64 – 90	C	1
Small	90 – 128	O	
Large	128 – 180	B	5
Large	180 – 256	L	2
Small	256 – 362	B	
Small	362 – 512	L	
Medium	512 – 1024	D	
Lrg– Very Lrg	1024 – 2048	R	
Bedrock	>2048	BDRK	
		Total	101



	Size (mm)
D16	0.035
D35	0.18
D50	1.8
D65	13
D84	20
D95	100

	Size Distribution
Mean (mm)	0.8
Dispersion	24.2
Skewness	-0.2

	Type
Silt/Clay	8%
Sand	39%
Gravel	45%
Cobble	8%
Boulder	0%
Bedrock	0%
Hardpan	0%
Wood/Det.	0%
Artificial	0%

Table 10. Baseline Morphology and Hydraulic Summary																		
Beaver Creek - DMS Project Number 028																		
Parameter*	Regional Curve Interval			Pre-Existing Condition			Project Reference Stream (Big Branch)			Project Reference Stream (Basin Creek)			Design			As-built		
Dimension	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
BF Width (ft)	15	50	28	27	37.5	30.6	20	21.5	20.8	29.5	36.9	33.2	--	--	28	21.9	33.6	--
Floodprone Width (ft)	--	--	--	--	--	230	--	--	130	--	--	329	--	--	230	--	--	313
BF Cross Sectional Area (ft ²)	40	150	75	53.3	89.7	70.6	40.9	42.8	41.9	64.9	71.9	68.4	--	--	70	55.1	104.6	--
BF Mean Depth (ft)	1.7	4	2.8	1.8	2.8	2.3	--	--	2	1.9	2.2	2.1	--	--	2.5	2.6	3.1	--
BF MaxDepth (ft)	--	--	--	2.5	3.3	3.1	2.5	2.7	2.6	3	3.2	3.1	--	--	4.2	4.3	5.2	--
Width/Depth Ratio	--	--	--	9.5	16	13.6	9.8	10.8	10.3	13.4	19.4	16.4	--	--	11.2	9.8	10.8	--
Entrenchment Ratio	--	--	--	--	--	7.5	--	--	65	--	--	8.9	--	--	7.5	9.4	12	--
Bank Height Ratio	--	--	--	1.6	2.5	2	--	--	--	--	--	--	--	--	--	--	--	--
Wetted Perimeter (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydraulic radius (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pattem																		
Channel Beltwidth (ft)	--	--	--	34	256	107	31	44	37	59	75	64.7	43	208	99	43	208	87
Radius of Curvature (ft)	--	--	--	16	285	99	42	63	55	40.1	69.3	51.2	45	76	65.5	45	76	65
Meander Wavelength (ft)	--	--	--	116	802	338	185	260	222			350	192	485	305	192	485	275
Meander Width Ratio	--	--	--	1.1	8.4	3.5	1.5	2.1	1.8	1.7	2.3	1.9	1.5	7.4	3.5	--	--	--
* USGS gage data are unavailable for this project and are not included in the table.																		

Table 10. Baseline Morphology and Hydraulic Summary																		
Beaver Creek - DMS Project Number 028																		
Parameter*	Regional Curve Interval			Pre-Existing Condition			Project Reference Stream (Big Branch)			Project Reference Stream (Basin Creek)			Design			As-built		
Dimension	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Profile																		
Riffle Length (ft)	--	--	--	--	--	--	23.4	78	58.5	--	--	--	--	--	--	--	--	--
Riffle Slope (ft/ft)	--	--	--	--	--	--	0.015	0.019	0.017	0.018	0.02	0.021	0.004	0.032	0.01	--	--	--
Pool Length (ft)	--	--	--	--	--	--	23.6	32	26.9	--	--	--	--	--	--	--	--	--
Pool Spacing (ft)	--	--	--	80	440	215	98	180	139	271	334	305	94	321	159	--	--	--
Substrate																		
d50 (mm)	--	--	--	--	--	4.7	--	--	--	--	--	58	--	--	--	--	--	--
d84 (mm)	--	--	--	--	--	90	--	--	--	--	--	180	--	--	--	--	--	--
Additional Reach Parameters																		
Valley Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3314
Channel Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4220
Sinuosity	--	--	--	--	--	1.35	--	--	1.1	--	--		--	--	1.22	--	--	1.3
Water Surface Slope (ft/ft)	--	--	--	--	--	0.005	--	--	0.009	--	--	0.014	--	--	0.005	--	--	0.50%
BF Slope (ft/ft)	--	--	--	--	--	0.006	--	--	0.009	--	--		--	--	0.006	--	--	
Rosgen Classification	--	--	--	--	--	C4, G4, F4	--	--	E4	--	--	C4	--	--	E4	--	--	E5
* USGS gage data are unavailable for this project and are not included in the table.																		

Table 11a. Monitoring - Cross-Section Morphology Data Tables

Beaver Creek

DMS Project Number 028

Parameter	Cross Section 1					Cross Section 2					Cross Section 3					Cross Section 4				
	Riffle					Pool					Pool					Riffle				
Dimension	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4*	MY5	MY1	MY2	MY3	MY4*	MY5	MY1	MY2	MY3	MY4*	MY5
BF Width (ft)	29.1	19.3	22.5	26.9	24.2	29.1	25.6	35.3	49.0	47.9	24.6	21.2	34.1	34.9	34.4	32.9	19.1	20.2	25.5	25.8
Floodprone Width (ft)	>50	>50	>50	>50	>50	--	--	--	--	--	--	--	--	--	--	>60	>60	>60	>60	>65
BF Cross Sectional Area (ft²)	86.8	32.1	48.4	58.6	54.8	110.6	71.7	110.0	144.5	126.1	78.2	48.8	83.7	93.2	95.1	108.0	38.9	78.6	77.8	76.3
BF Mean Depth	2.7	1.67	2.2	2.2	2.3	3.8	2.8	3.1	2.9	2.6	3.2	2.3	2.5	2.7	2.8	3.3	2.0	3.9	3.1	3
BF Max Depth	4.5	2.2	3.0	3.2	2.8	5.8	4.8	5.0	6.2	6.3	5.2	3.3	4.3	4.5	4.4	6.7	2.8	4.9	4.8	4.8
Width/Depth Ratio	11.8	11.6	10.4	12.4	10.7	--	9.2	11.3	--	--	--	9.2	13.9	--	--	10.0	9.3	5.2	8.3	8.7
Entrenchment Ratio	10.8	1.7	>2.2	>1.9	>1.7	--	2.4	>2.0	--	--	--	1.9	>2.1	--	--	9.6	1.6	>3.0	>3.0	>2.5
Bank Height Ratio	--	--	1.0	1.0	1	--	--	1.0	--	--	--	--	1.0	--	--	--	--	1.0	1.0	1.0
Wetted Perimeter (ft)	--	20.6	23.9	--	--	--	28.9	37.6	--	--	--	23.2	36.0	--	--	--	20.8	25.0	--	--
Hydraulic radius (ft)	--	1.6	2	--	--	--	2.5	2.9	--	--	--	2.1	2.3	--	--	--	1.9	3.1	--	--
Substrate																				
d50 (mm)	1.1	3.2	40	9.2	7.1	0.4	0.7	6.4	36	1.5	0.4	1.6	1.5	52	24	0.6	2.0	0.1	4.5	1.1
d84 (mm)	45.3	32	120	78	56	27.9	1.0	39	130	82.0	21.7	16	6	130	72	22.0	52.6	9.1	21	30
Parameter					Cross Section 5					Cross Section 6					Cross Section 7					
Pool					Riffle					Pool					Cross Section 7					
Dimension	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5					
BF Width (ft)	48.0	34.0	38.1	34.6	33.6	34.6	33.2	31.6	27.2	28.5	38.2	20.8	21.8	23.1	24.7					
Floodprone Width (ft)	--	--	--	--	--	>60	>60	>60	>60	>60	--	--	--	--	--					
BF Cross Sectional Area (ft²)	125.8	88.8	101.6	98.1	101.5	93.6	78.2	90.2	103.9	109.2	95.2	47.0	71.1	84.2	82.6					
BF Mean Depth	2.6	2.6	2.7	2.8	3.0	2.7	2.4	2.9	3.8	3.8	2.5	2.3	3.3	3.0	3.3					
BF Max Depth	5.7	4.5	5.0	5.0	5.1	4.8	4.3	4.5	5.1	5.1	5.8	3.9	4.7	3.8	5.0					
Width/Depth Ratio	--	13.1	14.3	--	--	12.8	14.1	11.1	7.1	7.4	--	9.1	6.7	--	--					
Entrenchment Ratio	--	1.5	>1.6	--	--	9.1	1.3	>1.9	>1.6	>2.0	--	2.2	>2.8	--	--					
Bank Height Ratio	--	--	1.0	--	--	--	--	1.0	1.0	1.0	--	--	1.0	--	--					
Wetted Perimeter (ft)	--	35.7	39.9	--	--	--	36.0	34.4	--	--	--	22.6	24.9	--	--					
Hydraulic radius (ft)	--	2.5	2.5	--	--	2.2	2.2	2.6	--	--	--	2.1	2.8	--	--					
Substrate																				
d50 (mm)	5.3	1.4	0.1	1.6	1.5	0.4	11	1.1	0.3	0.2	0.4	0.6	0.9	19	1.8					
d84 (mm)	38.5	16	1.5	33	28	27.9	32	5.2	0.9	21	27.9	1.4	5.1	72	20					

*=Cross-sections 2, 3, and 4 reset in June 2015, before MY4 survey

Table 11b. Monitoring - Stream Reach Morphology Data Table															
Beaver Creek															
DMS Project Number 028															
Parameter	MY1			MY2			MY3			MY4*			MY5		
Pattern	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Channel Beltwidth (ft)	39	192	80	40	240	90	20	200	80						
Radius of Curvature (ft)	42	170	90	50	100	70	42	100	60						
Meander Wavelength (ft)	182	481	267	225	435	262	230	570	380						
Meander Width Ratio	--	--	--	11.6	22.5	13.5	9.8	29.7	17.8						
Profile															
Riffle Length (ft)	--	--	--	5.2	53.3	21.1	25	50.8	35.7						
Riffle Slope (ft/ft)	--	--	--	0.0053	0.069	0.029	0.0083	0.026	0.016						
Pool Length (ft)	--	--	--	33.9	195	89	57.8	187.8	95.1						
Pool Spacing (ft)	--	--	--	17.5	219	84	16.3	384.8	127.7						
Additional Reach Parameters															
Valley Length (ft)	--	3314	--	--	3314	--	--	3314	--						
Channel Length (ft)	--	4198	--	--	4360	--	--	4210	--						
Sinuosity	--	1.3	--	--	1.3	--	--	1.3	--						
Water Surface Slope (ft/ft)	--	0.55	--	--	0.005	--	--	0.005	--						
BF Slope (ft/ft)	--	0.54	--	--	0.005	--	--	0.005	--						
Rosgen Classification	--	E5	--	--	B5	--	--	B5	--						

*= profile data not collected in MY4 or MY5

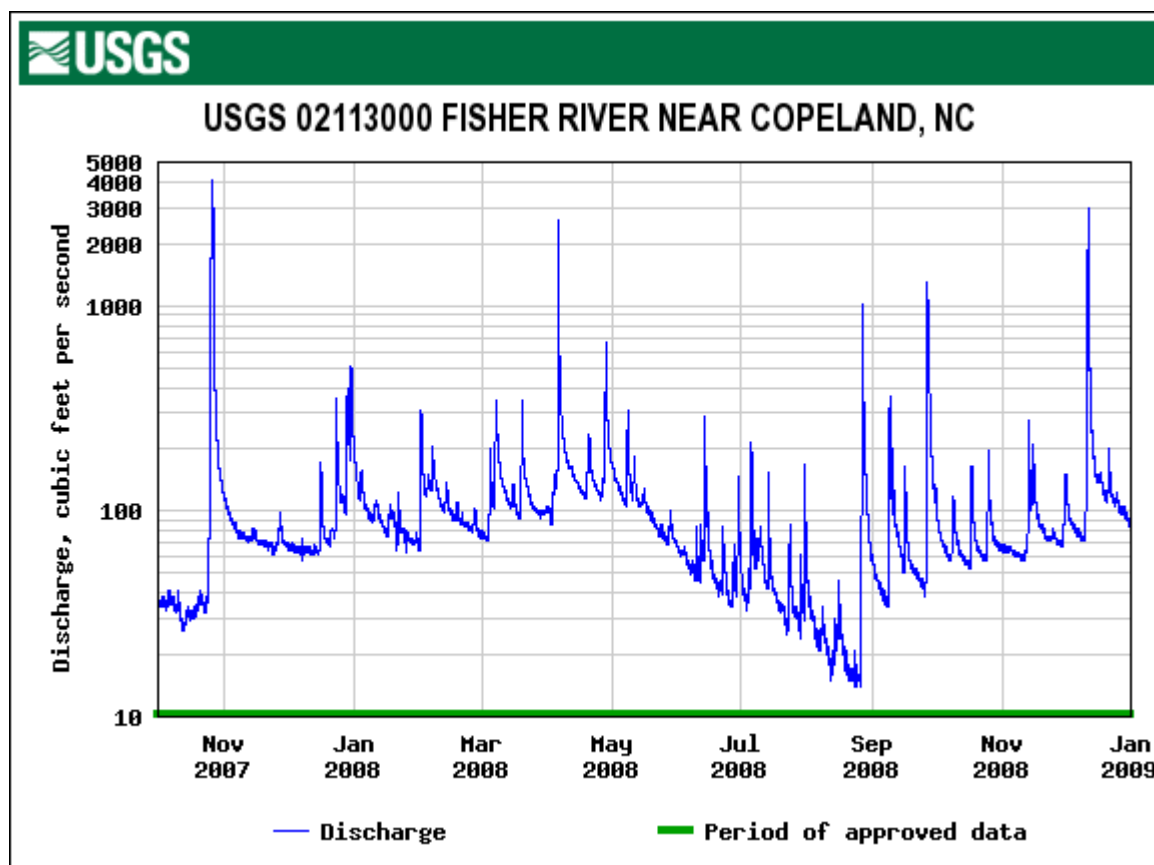
Appendix E

Hydrologic Data

Table 12. Verification of Bankfull Events

Project Number and Name: 028 - Beaver Creek

Date of Data Collection	Date of Occurrence	Method	Photo Number
9/19/2008	Oct. 2007	Proximal USGS Gage Resource	N/A
9/19/2008	March 2008	Proximal USGS Gage Resource	N/A
2/2/2016	Dec. 2008	Proximal USGS Gage Resource	N/A
2/2/2016	Jan. 2009	Proximal USGS Gage Resource	N/A
2/2/2016	June 2009	Proximal USGS Gage Resource	N/A
2/2/2016	Dec. 2009	Proximal USGS Gage Resource	N/A
2/2/2016	Jan. 2010	Proximal USGS Gage Resource	N/A
5/20/2016	Unknown	Photographs taken on-site, on-site crest gauge	1-2



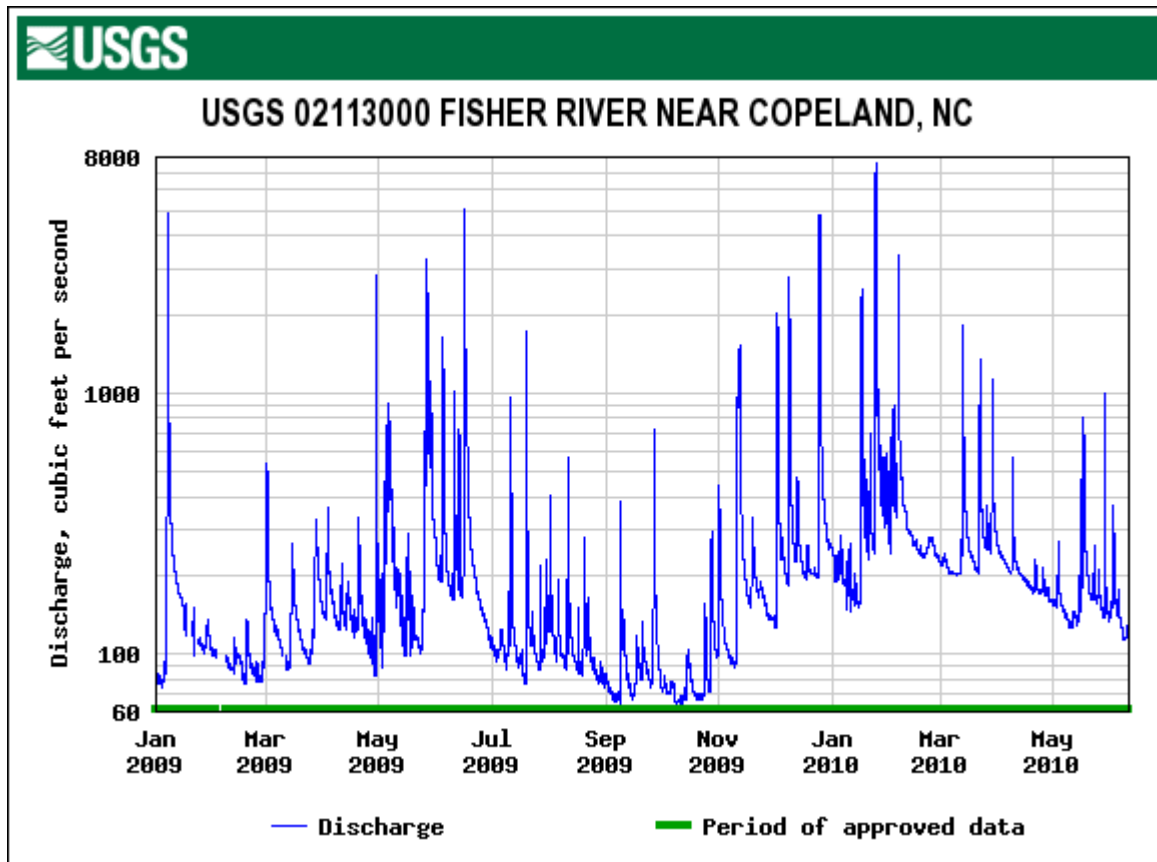


Photo 1. Wrack lines at bankfull



Photo 2. Crest gauge showing a bankfull event