Logan Creek Stream Restoration Project
Year 4 Monitoring Report - Final

Jackson County, North Carolina

NCDMS Project ID No. 92515; Contract No. D06046-A

Savannah River Basin: 03060101-010020

DWR # 20080879 Ver. 2, SAW ID: 2008-01711

Project Info:	Monitoring Year: 4 of 5 Year of Data Collection: 2018 Year of Completed Construction: May 2015 Submission Date: December 2018
Submitted To:	NCDEQ – Division of Mitigation Services 5 Ravenscroft Drive, Suite 102 Asheville, NC 28801 NCDEQ Contract ID No. D06046-A

Michael Baker
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December 31, 2018

NCDEQ - Division of Mitigation Services (DMS)
Attn: Mr. Paul Wiesner, Western Project Management Supervisor
5 Ravenscroft Drive, Suite 102
Asheville, NC 28801

Subject: Response to DMS comments on the Year 4 Monitoring Report Draft Review for the Logan Creek Stream Restoration Project; Savannah River Basin - CU# 03060101; Jackson County, North Carolina; NCDMS Project # 92515; Contract No. D06046-A

Dear Mr. Wiesner,

Please find enclosed the final Logan Creek Year 4 Monitoring Report. We have addressed the comments that you submitted on the draft report and our responses to your comments are the following:

- An Interagency Review Team (IRT) site visit meeting was held at the Logan Creek site on 3/28/18. The 2013 project mitigation plan proposed 4,249 SMUs and did not include UT 7 and UT8. The As-Built Baseline (MY0) report indicates 4,329 SMUs and the MY3 and MY4 reports indicate 4,327 SMUs. The project assets, additional UTs (7 & 8) and the walking trail/s located within the conservation easement were discussed at the March 2018 meeting. The MY4 report notes IRT discussion regarding the walking trail located in the conservation easement. In the revised MY4 report, please document all of the issues discussed during the 3/28/18 IRT site visit meeting.
  The footage and SMUs for the As-built-MY0 and MY1 report were the same based on the post construction survey when we determined the actual footage. In the MY2 report, we reduced these numbers slightly because the landowner installed a foot-bridge crossing that had been removed during construction, so MY2 to MY4 have consistently reported the same figures. A paragraph was added to the Executive Summary that summarized the IRT site visit, any concerns and how they were addressed.

- Executive Summary: In the executive summary, please note the proposed resolution to the mowing encroachment reported (EA-1).
  The following statement was added: "Because the vegetation plot meets success criteria we are not asking Lonesome Valley to move the nature trail in this area."

- Table 2: Please update the "Data Collection Complete" cells for the As- Built Baseline Report and MY1.
  Dates were added in the proper cells.

- Table 7: In the Annual Means; MY1 is shown as 2016. MY1 data was collected in 2015. Please update Table 7 accordingly to avoid confusion.
  This date was corrected, and a note added to explain the difference between MY0 & MY1.

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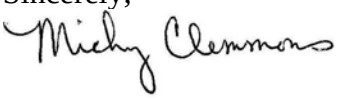
- BHRs for MY4 should be calculated based on the attached guidance. Please revise the report accordingly. Only MY4 (2018) data and future monitoring reports are applicable to the BHR guidance. It is not necessary to recalculate previous monitoring years.
  The BHR in the draft was calculated according to the guidance. We have added a second line to each cross-section called Abkf which returns the MY0 cross-sectional area, we have also added a note to each cross-section and to Table 11 explaining this.

- Please confirm that all bridges and crossings located within the conservation easement have been removed from the project assets.
  All bridges and crossings within the conservation easement have been removed from project assets. As explained in #1 above, this was done last in MY2 and assets have been consistent since that report.

If you have any questions or find any issues that need to be addressed, please contact me directly at (828) 412-6100. I am submitting an invoice for this task to Ms. Debby Davis in the Raleigh DMS Office and will be providing you an email copy.

Sincerely,



Micky Clemmons,
Project Manager
Michael Baker Engineering, Inc.

Logan Creek Stream Restoration Project
Year 4 Monitoring Report

Jackson County, North Carolina

NCDMS Project ID Number – 92515

Report Prepared and Submitted by Michael Baker Engineering, Inc.
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TABLE OF CONTENTS

APPENDICES

1.0 EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) restored, enhanced or preserved 5,110 linear feet (LF) of perennial stream channel along Logan Creek and eight unnamed tributaries (UT1, UT2, UT3, UT4, UT5, UT6, UT7 and UT8) in Jackson County, NC (Appendix A). The nearest town, Cashiers, is approximately five miles west of the Logan Creek Project site. The site lies in the Savannah River Basin within the Targeted Local Watershed 03060101-010020 (Horsepasture River) and within the North Carolina Division of Water Resources (NCDWR) sub-basin formerly known as 03-06-01-01 (Keowee River Subbasin). The Horsepasture River is a National Wild and Scenic River and a state-designated Natural and Scenic River. The project involved the restoration, enhancement, and preservation of a stable channel and a Montane Alluvial/Montane Oak-Hickory Forest system (NCWAM 2010, Schafale and Weakley 1990) from impairments within the project area due to past agricultural conversion including orchard development, trout hatchery development, mink farming and more recently single-family home development.

The project goals directly address stressors identified in the Savannah River Basin Restoration Priority Plan (RBRP) (DMS 2001 and updated 2008) such as habitat degradation, inadequate riparian buffer cover, channel modification, and excess nutrient and sediment loading. The primary restoration goals, as outlined in the approved mitigation plan, are described below:

- Create geomorphically stable stream channels within the Logan Creek project site.
- Protect stable areas as well as mature trees and other desirable vegetation.
- Improve water quality within the Logan Creek project area through reduction of bank erosion, improved nutrient and sediment removal, and stabilization of streambanks.
- Improve aquatic and terrestrial habitat.

To accomplish these goals, the following actions were taken:

- Restore the existing eroding or over-wide stream reaches by creating a stable channel that has access to its floodplain.
- Improve in-stream habitat by providing a more diverse bedform with riffles and pools, creating deeper pools, providing woody debris for habitat, moving sand deposits through the reach and reducing bank erosion.
- Establish native stream bank and floodplain vegetation to increase storm water runoff filtering capacity, improve bank stability, provide shading to decrease water temperature, provide cover, improve wildlife habitat and protect this area with a permanent conservation easement.
- Improve terrestrial habitat by increasing the density of tree species that root deeply, by thinning the thick stands of rhododendron within the easement area and planting a more diverse native plant community.

During Monitoring Year 4 (MY4), our monitoring activities indicated that the planted acreage was functioning well with most banks, benches and floodplain areas developing a diverse herbaceous community and having good growth of planted trees. There were no new Vegetative Problem Areas identified during 2018. The Encroachment Area (EA-1) that was noted in 2016 is still mowed as a part of the nature trail, although no new trees in Vegetation (Veg) Plot 3 have been affected since MY3. Despite the impacts to the trees in the plot, Veg Plot 3 still meets minimum success criteria for MY4. Because the plot meets the success criteria we are not asking Lonesome Valley to move the nature trail in this area.

The 11 channel problem areas (CPAs) noted in the MY3 report did not show further erosion or degradation during 2018, and no new CPAs were noted in MY4. Most of the previously listed sites exhibited further stabilization during MY4. Updated photos of all CPAs can be found in Appendix D.

As noted in the Baseline report, eight (8) vegetation monitoring plots were installed at this site after construction, with seven (7) being installed along the restoration reach (Logan Creek, Reach 1) and one (1) being installed along the enhancement reach (Logan Creek, Reach 2). The location of these vegetation monitoring plots can be seen on Figures 2A-C. The average density of total planted stems following the MY4 growing season is 668 stems per acre (SPA). The average density of volunteer trees across all 8 vegetation plots was 379 SPA. The total average density of all planted and volunteer stems in MY4 was 1,047 SPA.

Stream geomorphological stability and performance during MY4 was assessed by surveying thirteen (13) cross-sections (8 on Logan Creek, 2 on UT3, 2 on UT6 and 1 on UT8) and a profile of Logan Creek, UT3, UT6 and UT8, evaluating the bed particle size with 3 riffle pebble counts and by observation and replicating channel location photographs. An additional cross-section was added on UT8 during MY2 surveying so there are cross-sections on all restored tributaries. Cross-sections of all the channels indicated that there was very little change in the cross-sections during MY4. The average particle size observed in MY4 pebble counts increased slightly in two of the pebble counts and remained the same in the third. No observed changes indicate any instability. The Visual Morphological Stability Assessment indicates that the Site is stable and performing well. All structures but one (CPA 3-5) are functioning as designed during MY4. The structures that were piping in MY3 have filled in and are no longer piping. Overall, channel morphology is responding as designed and meeting project goals.

An Interagency Review Team (IRT) site visit to Logan Creek was held on March 28, 2018. Because this project began before the IRT was established and members had never visited the site, it was felt that other visits in the area offered a good opportunity for the IRT to see this site. The visit allowed IRT members to see UT7 (EII) and UT8 (R) which were added after the Mitigation Plan was produced, when the As-Built (MY0) report was prepared. They were also able to view the nature trail that is partially within the easement area. IRT members did not find any issues with the two unnamed tributaries. There was concern with how close the nature trail was in one location, near a meander that was less than 10 feet from the stream bank. Michael Baker contacted the Lonesome Valley development on July 17, 2018 and requested that the trail be moved away from the stream. Lonesome Valley responded the next day, saying that they would address the issue. The trail was moved away from the creek in the area of concern and in one additional location where it was close.

Summary information/data related to the Site 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 available on the NCDMS website. All raw data supporting the tables and figures in the appendices are available from NCDMS upon request.

2.0 METHODOLOGY

The monitoring plan for the Site includes criteria to evaluate the success of the stream and vegetation components of the project. The methodology and report template used to evaluate these components adheres to the NCDMS monitoring guidance document dated December 1, 2009 and other mitigation guidance (NCEEP 2009 and USACE 2003), which will continue to serve as the template for subsequent monitoring years. The specific locations of monitoring features: vegetation plots, permanent cross-sections and profiles, and the crest gauge location, are shown on the Current Conditions Plan View (CCPV) sheets found in Appendix A.

Vegetation monitoring plots, pebble counts, and site photo points were monitored in October 2018. Site surveys for channel cross-sections, photos and profiles were also conducted in October 2018.

2.1 Vegetation Assessment

To determine if success criteria are achieved, vegetation monitoring quadrants (veg plots) were installed and are monitored in accordance with the CVS-NCEEP Protocol for Recording Vegetation, Version 4.1 (CVS 2007 and Lee *et al* 2007). The vegetation monitoring plots are a minimum of two percent of the planted portion of the Site with eight plots established randomly within the planted riparian buffer, per CVS Monitoring Level 2. No veg plots were established within the undisturbed forested areas along the northern part of the project or within the undisturbed forested areas along Reach 2 of Logan Creek and UT5. A small area was disturbed within this enhancement reach so that structures and channel repairs could be made during construction in April of 2015. Veg Plot 1 is located in this area where bare root trees and herbaceous vegetation were planted. The sizes of individual quadrants are 100 square meters for woody species and 1 square meter for herbaceous vegetation. Herbaceous vegetation quadrants were established in one corner of the larger woody vegetation plots and monitored by comparative photographs taken each year.

Trees surviving within vegetation monitoring plots were visually accessed during MY4. All vegetation was found to be in good condition. All plots indicated that most trees were growing and in good to excellent condition and herbaceous vegetation was well established and growing well. The average density of total planted stems following the MY4 growing season is 668 stems per acre (SPA) with a range from 364 SPA to 931 SPA. The average density of volunteer trees was 379 SPA and the density ranged from 0 to 1,133 SPA. The overall average, including both planted and volunteer stems, was 1,047 SPA. With an average planted density of 668 stems per acre, the Site is on track to meet the final success criteria of 260 stems per acre by the end of MY5.

The invasive multiflora rose (rosa multiflora) that was noted in MY2 was treated in July 2017. As of MY4 monitoring (October 2018), the multiflora rose is largely under control and no new growth areas have been noted. Any new growth that is noted in the future will be treated as needed. No other areas of concern regarding the existing vegetation were noted along Logan Creek or any of the tributaries. Year 4 vegetation assessment information is provided in Appendix C.

Concerns about the walking trail that parallels the stream were raised by the Interagency Review Team (IRT) during a walkthrough in March 2018. The IRT pointed out one area where the trail was within approximately 10 feet of the stream in the outside of a meander bend near station 19+50. This issue was raised with the Lonesome Valley maintenance personnel, and during MY4 field work it was noted that the trail has been moved in this location to an acceptable distance from the stream (called out as Stream Relocation in Figure 2B of the CCPV). The abandoned trail area will not be maintained in the future. Trees and shrubs will be transplanted into this area in MY5 and the new trail will be flagged to ensure encroachment does not occur in the future. The maintenance staff also moved the trail crossing of UT4 upstream on UT4 and away from the Logan creek where it appeared to be closer than 10 feet. This area is also called out in Figure 2B.

2.2 Stream Assessment

The restoration approach for the Logan Creek Site included the restoration of channels to a stable morphology that allows for the transport of water and sediment through the Site and allows stream flows larger than bankfull flows to spread onto the floodplain. Stream monitoring efforts focus on visual observations, a crest gauge to document bankfull flooding events, surveying established stream cross-sections and channel profiles to assess channel stability and pebble counts to assess if proper sediment transport is taking place.

Stream survey data was collected to a minimum of Class C Vertical and Class A Horizontal Accuracy using Leica TS06 Total Station and was georeferenced to the NAD83 State Plane Coordinate System, FIPS3200 in US Survey Feet, which was derived from the As-built Survey.

2.2.1 Morphologic Parameters and Channel Stability

Cross-sections were classified using the Rosgen Stream Classification System (Rosgen 1994) and all cross-sections were evaluated to determine if they meet design expectations. Cross-sections were also compared to cross-section plots from previous monitoring years to evaluate changes in the cross sections. Morphological survey data is presented in Appendix D.

A longitudinal profile was surveyed for the entire length of Logan Creek, UT3 and UT6, and UT8 to document changes during MY4. The survey was tied to a permanent benchmark and measurements included thalweg, water surface, and top of low bank. Each of these measurements were taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth.

Stream geomorphological stability and performance during MY4 was assessed by surveying thirteen (13) cross-sections (8 on Logan Creek, 2 on UT3, 2 on UT6 and 1 on UT8) and a profile of these channels as described above. The bed particle size was evaluated with three riffle pebble counts and by observation and replicating channel location photographs. Cross-sections and profiles of all the channels indicated that there was very little change in the channel during MY4. The Visual Morphological Stability Assessment indicates that the Site is stable and performing at 89 to 100 percent for all parameters. One structure (on UT8) was still piping during MY4 (CPA 3-1, CPA 3-3, CPA 3-5). CPA 3-1 and CPA 3-3 that were noted in the MY3 report have filled in naturally and are no longer piping. (Table 14 in e-file data). Overall, channel morphology is responding as designed and meeting project goals.

Pebble count data for MY4 indicates an overall shift to larger particle sizes as compared to the MY0 data. The channel had a mean D50 of 16.5 mm during baseline sampling, 36.9 mm during MY1, 22.2 mm in MY2, 26.8 mm in MY3, and 34.0 mm in MY4. This represents a general coarsening of particle size since baseline sampling.

2.2.2 Hydrology

A crest gauge was installed on the floodplain at the bankfull elevation along the right top of bank on Logan Creek at approximate Station 30+00. There were two major bankfull events recorded on the crest gauge during MY4. The crest gauge indicated a water depth on the floodplain of 12.8 inches during the first event and 11.9 inches during the second event. There were also physical indications of this flooding, such as large debris and wrack lines that indicated a flooding level that extended well beyond the top of bank (see photos with Table 9). Crest gauge readings are presented in Appendix D.

2.2.3 Photographic Documentation

Reference transects were photographed at each permanent cross-section. A survey tape is normally centered in the photograph when the tape is used to identify the transect. The water line was located in the lower area of the frame, and as much of the bank as possible included in each photograph. Photographs were taken at specific photo points established along each channel during Year 4 monitoring. Photographs from these points are replicated each year and used to document changes along the channel. Points were selected to include grade control structures as well as other structural components installed during construction. Annual photographs from the established photo points are shown in Appendix D.

2.2.4 Project Problem Areas

Project problem areas fall into three types: Vegetation Problem Areas (VPA), Encroachment Areas (EA), and Channel Problem Areas (CPA). All observed problem areas are shown on the CCPV maps. There were no VPAs identified during MY4. Vegetation was well established across the entire project site.

One structure (CPA 3-5) that was experiencing piping in MY3 is still piping in MY4. The other structures that were noted in MY3 have filled in naturally and are no longer piping. Hand repairs will be made to CPA 3-5 during MY5.

No new erosion areas were noted in MY4. Some of the areas of erosion that were called out in MY3 (CPA 3-2, CPA 2-1, CPA 2-4, CPA 2-5, CPA 2-6) have stabilized and are fully vegetated. The remaining areas of erosion (CPA 3-4, CPA 2-3) have not completely stabilized but have not gotten worse in MY4 and are supporting vegetation. These areas will continue to be monitored in MY5.

The Encroachment Area (EA-1) that was first noted in 2016 is still regularly being mowed through Vegetation Plot 3 to maintain the nature trail, although no new trees in the plot have been affected since MY2. The mowed path through the plot is still approximately 10-12 feet wide. Despite the impacts to the trees in the plot, Veg Plot 3 still meets minimum success criteria for MY4.

All issues discussed above reference the CCPV mapping and the Stream Problem Area table included in Appendix D and the e-File data with associated photos.

3.0 REFERENCES

Carolina Vegetation Survey (CVS) and NC Ecosystem Enhancement Program (NCEEP). 2007. CVS-NCEEP Data Entry Tool v. 2.3.1. University of North Carolina, Raleigh, NC.

Lee, M., Peet R., Roberts, S., Wentworth, T. 2007. CVS-NCEEP Protocol for Recording Vegetation, Version 4.1.

Harman, W.A., D.E. Wise, M.A. Walker, R. Morris, M.A. Cantrell, M. Clemmons, G.D. Jennings, D.R. Clinton, J.M. Patterson. 2000. Bankfull Regional Curves for North Carolina Mountain Streams. In: AWRA Conference Proceedings, D.L. Kane, editor. American Water Resources Specialty Conference on Water Resources in Extreme Environments. Anchorage, Alaska.

North Carolina Ecosystem Enhancement Program (NCEEP). 2008. Savannah River Basin Restoration Priorities. December 2008. https://files.nc.gov/ncdeq/Mitigation%20Services/Watershed_Planning/Savannah_River_Basin/Savannah_RBRP_hcb_22dec08.pdf

North Carolina Ecosystem Enhancement Program (NCEEP). 2009. Guidance and Content Requirements for EEP Monitoring Reports Version 1.2.1. December 1, 2009.

NC Wetland Functional Assessment Team (WFAT). 2010. North Carolina Wetland Assessment Manual (NC WAM) User Manual, Version 4.1. Dated October 2010.

NC Wetlands Restoration Program (NCWRP). 2001. Watershed Restoration Plan for the Savannah River Basin.

Rosgen, D. L. 1994. A Classification of Natural Rivers. Catena 22:169-199.

Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. North Carolina Natural Heritage Program. Division of Parks and Recreation, NCDENR. Raleigh, NC.

United States Army Corps of Engineers (USACE). 2003. Stream Mitigation Guidelines, April 2003, U.S. Army Corps of Engineers. Wilmington District.

Appendix A

Project Vicinity Map and Background Tables

Includes:

Figure 1. Project Vicinity Map and Directions

Figure 2. Current Condition Plan View (CCPV) MY4, Overview Map

Figure 2A. CCPV MY4, North Area

Figure 2B. CCPV MY4, Middle Area

Figure 2C. CCPV MY4, South Area

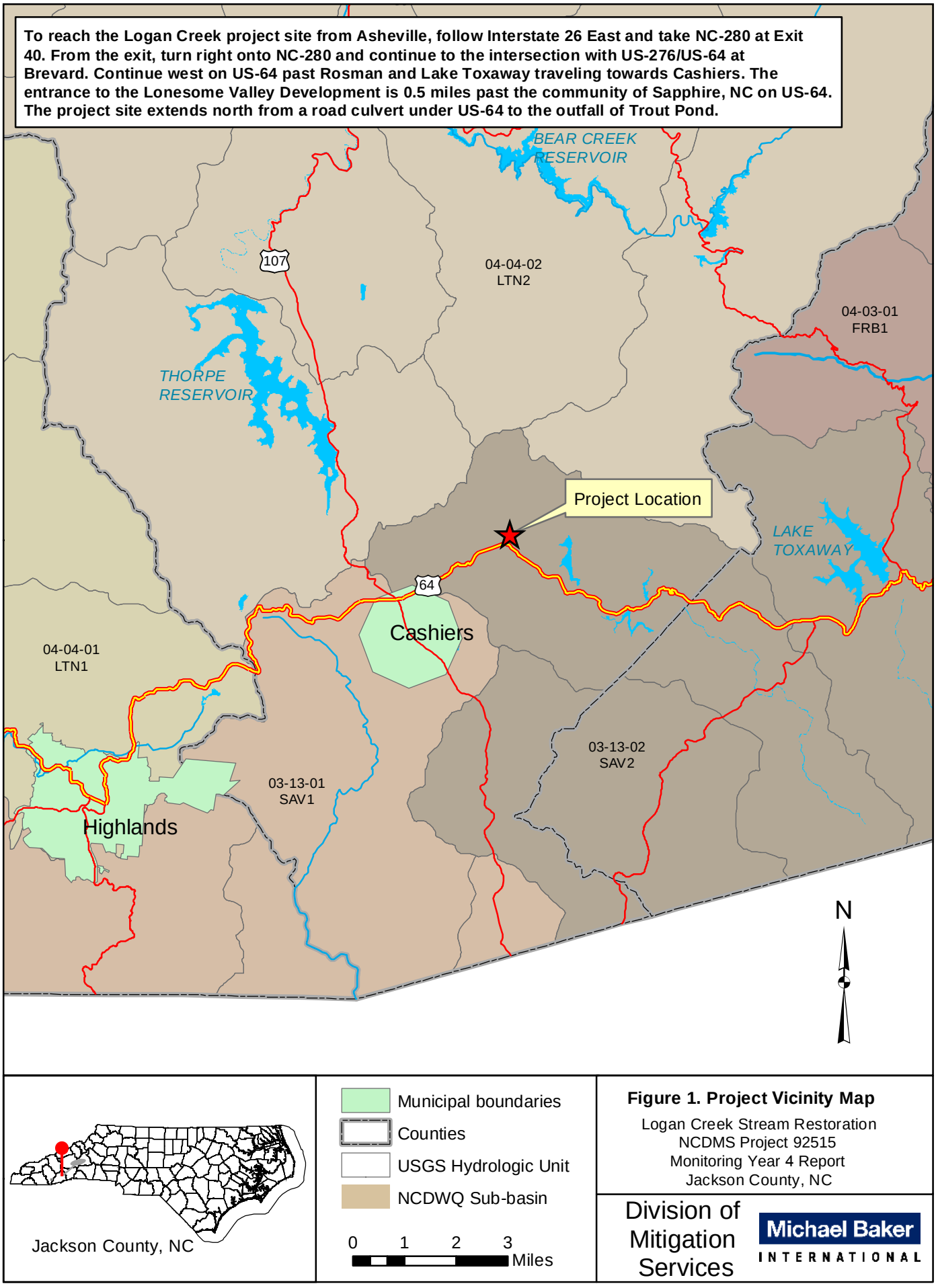

Figure 1. Project Vicinity Map

Logan Creek Stream Restoration
NCDMS Project 92515
Monitoring Year 4 Report
Jackson County, NC

Division of Mitigation Services

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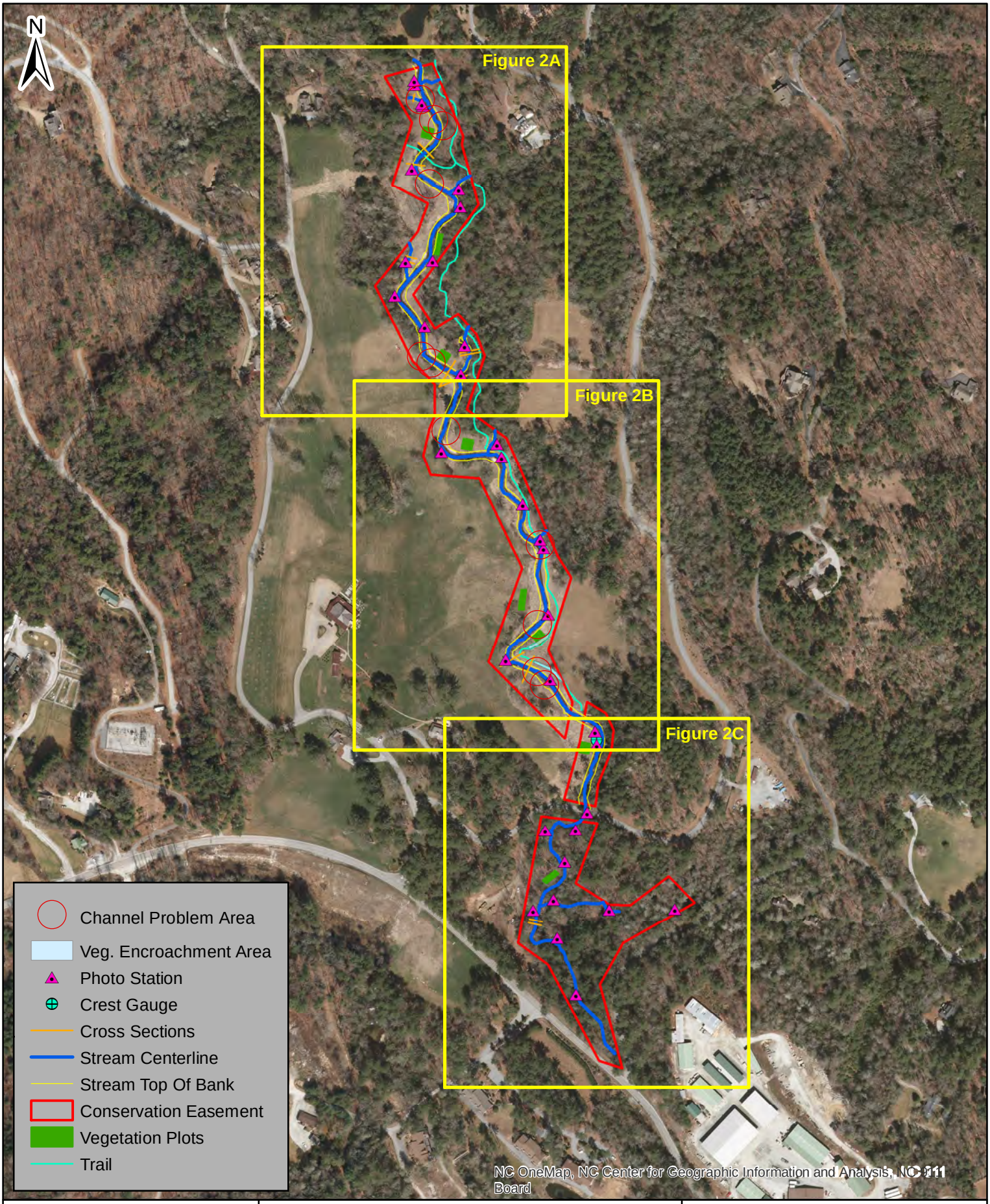

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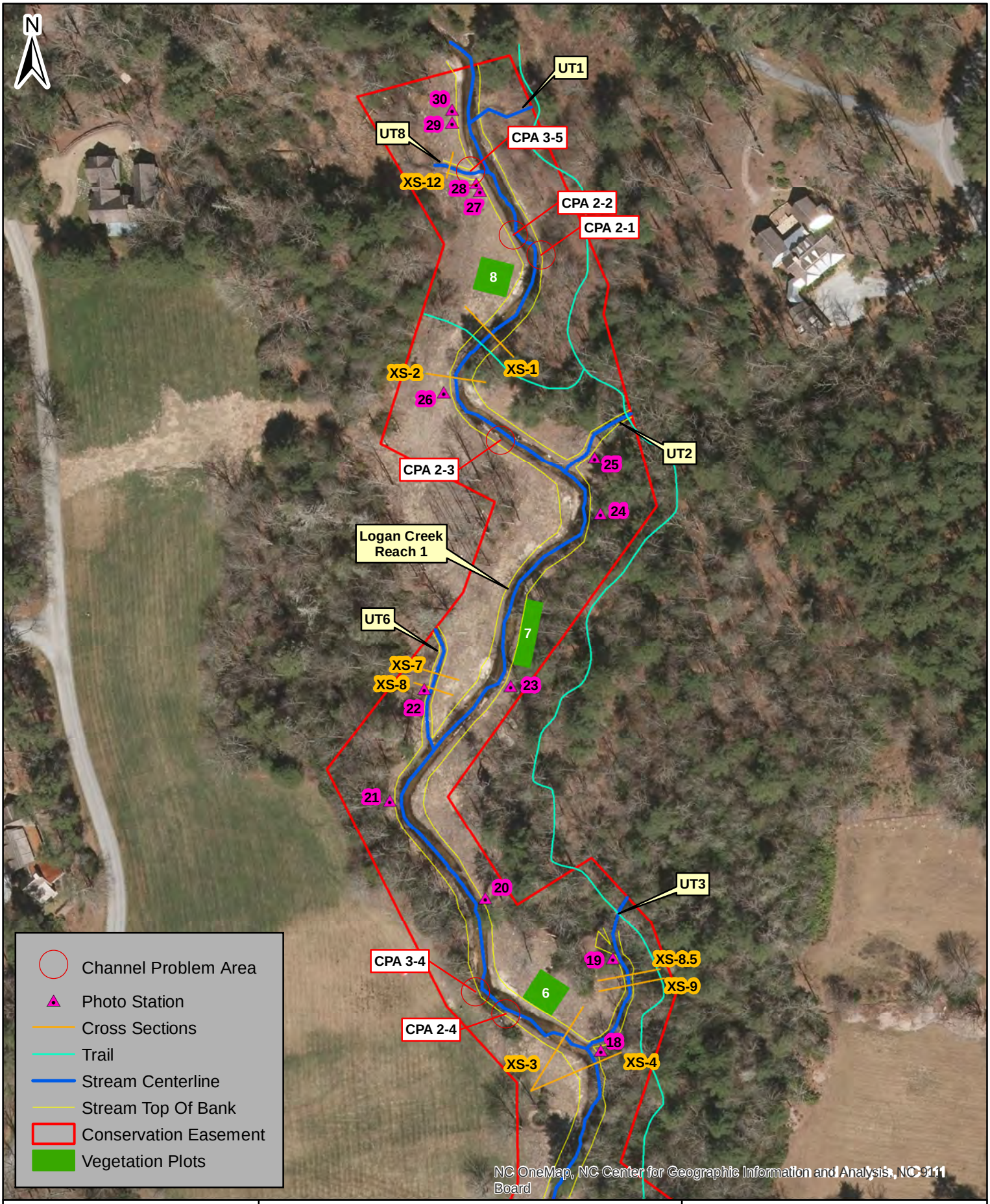
0 400 800 Feet

1 inch = 400 feet

DMS Project # 92515

Figure 2 - Overview
Current Conditions Plan View
Monitoring Year 4
Logan Creek Site



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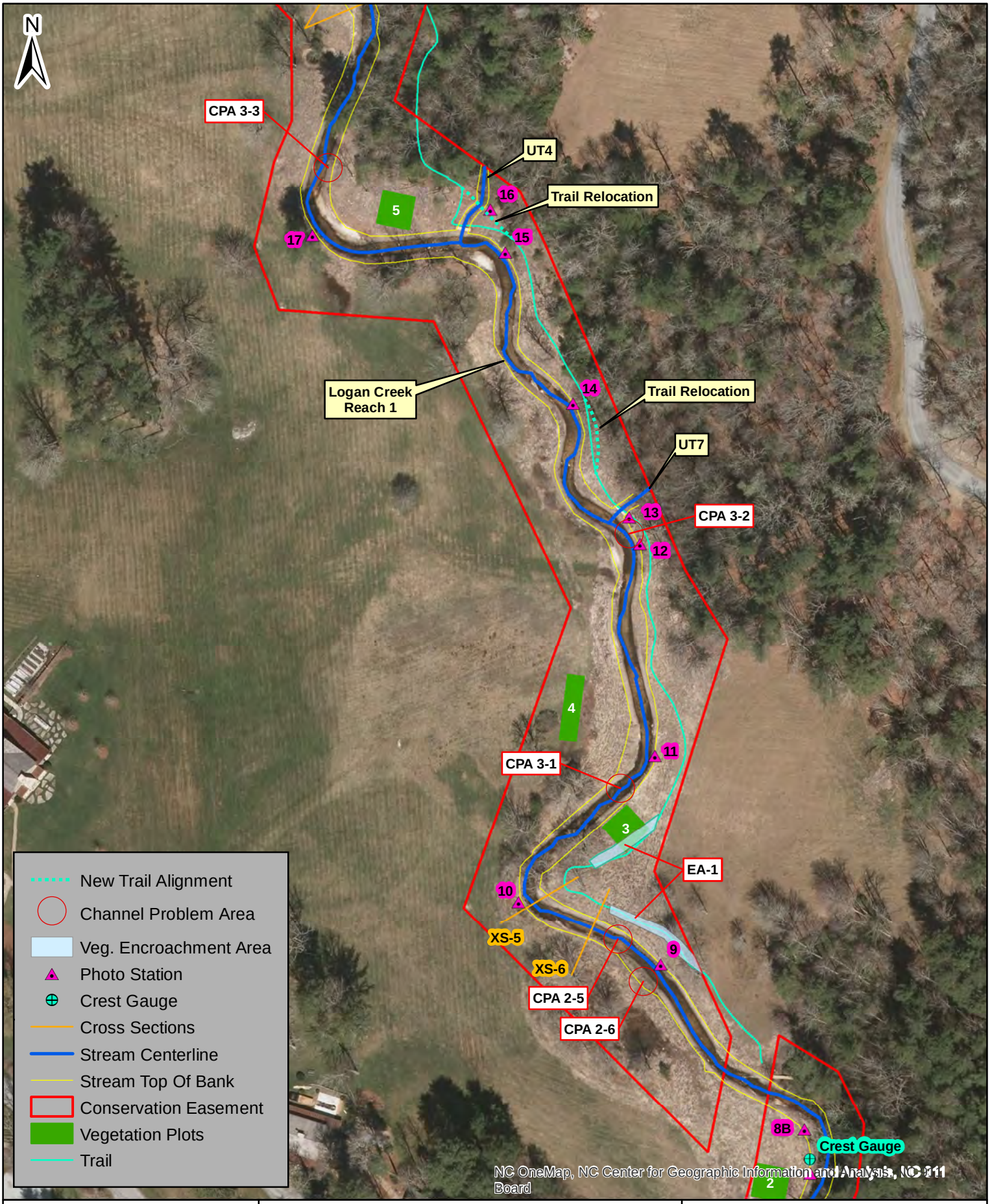
0 125 250 Feet

1 inch = 125 feet

DMS Project # 92515

Figure 2A - North Area
Current Conditions Plan View
Monitoring Year 4
Logan Creek Site



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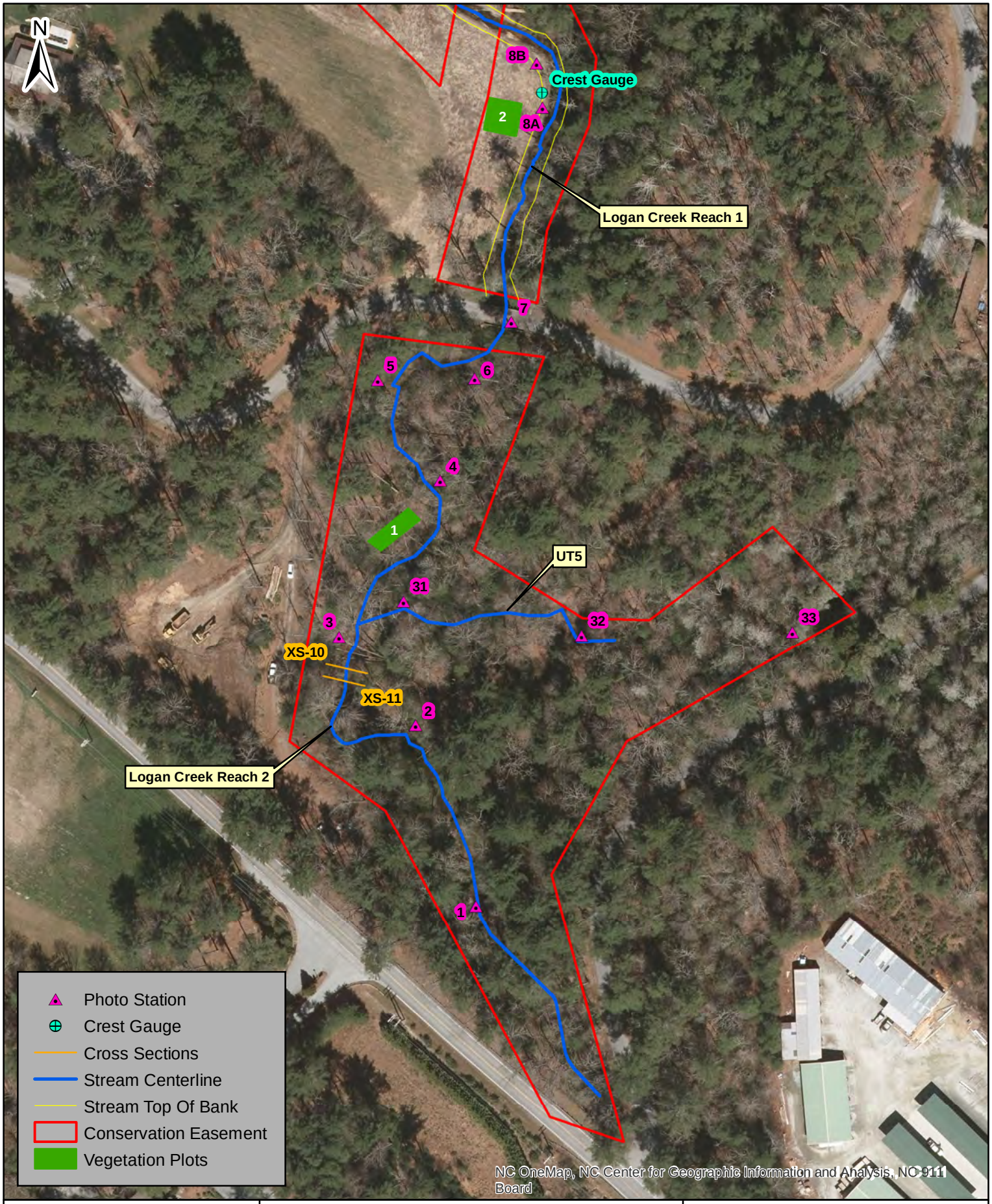
0 125 250 Feet

1 inch = 125 feet

DMS Project # 92515

Figure 2B - Middle Area
Current Conditions Plan View
Monitoring Year 4
Logan Creek Site



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0 125 250 Feet

1 inch = 125 feet

DMS Project # 92515

Figure 2C - South Area
Current Conditions Plan View
Monitoring Year 4
Logan Creek Site

Appendix B
General Project Tables

Includes:

Table 1. Project Components and Mitigation Credits
Figure 3. Project Asset Map
Table 2. Project Activity and Reporting History
Table 3. Project Contacts
Table 4. Project Attributes

Table 1. Project Components and Mitigation Credits

Logan Creek Restoration Project: DMS Project ID No. 92515

Mitigation Credits

	Stream				Riparian Wetland	Non-riparian Wetland	Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R	EI	EII	P					
Totals	3,441 SMU	692 SMU	136 SMU	58 SMU					

Project Components

Project Component or Reach ID	Stationing/ Location	Existing Footage/ Acreage	Approach	Restoration/ Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
STREAMS						
Logan Creek						
Reach 1	0+00 to 31+84	3134 LF	Restoration - PI	3,131 SMU	3,131 LF	1:1
Reach 2	32+43 to 42+81	1038 LF	Enhancement I	692 SMU	1,038 LF	1.5:1
UT1	0+00 to 0+71	71 LF	Enhancement II	28 SMU	71 LF	2.5:1
UT2	0+00 to 0+92	92 LF	Enhancement II	37 SMU	92 LF	2.5:1
UT3						
Reach 1	0+00 to 0+40	40 LF	Enhancement II	16 SMU	40 LF	2.5:1
Reach 2	0+40 to 1+78	138 LF	Restoration - PI	138 SMU	138 LF	1:1
UT4	0+00 to 0+84	84 LF	Enhancement II	34 SMU	84 LF	2.5:1
UT5	0+00 to 2+87	290 LF	Preservation	58 SMU	290 LF	5:1
UT6	0+00 to 1+27	127 LF	Restoration - PI	127 SMU	127 LF	1:1
UT7	0+00 to 0+54	54 LF	Enhancement II	21 SMU	54 LF	2.5:1
UT8	0+00 to 0+45	45 LF	Restoration - P1	45 SMU	45 LF	1:1

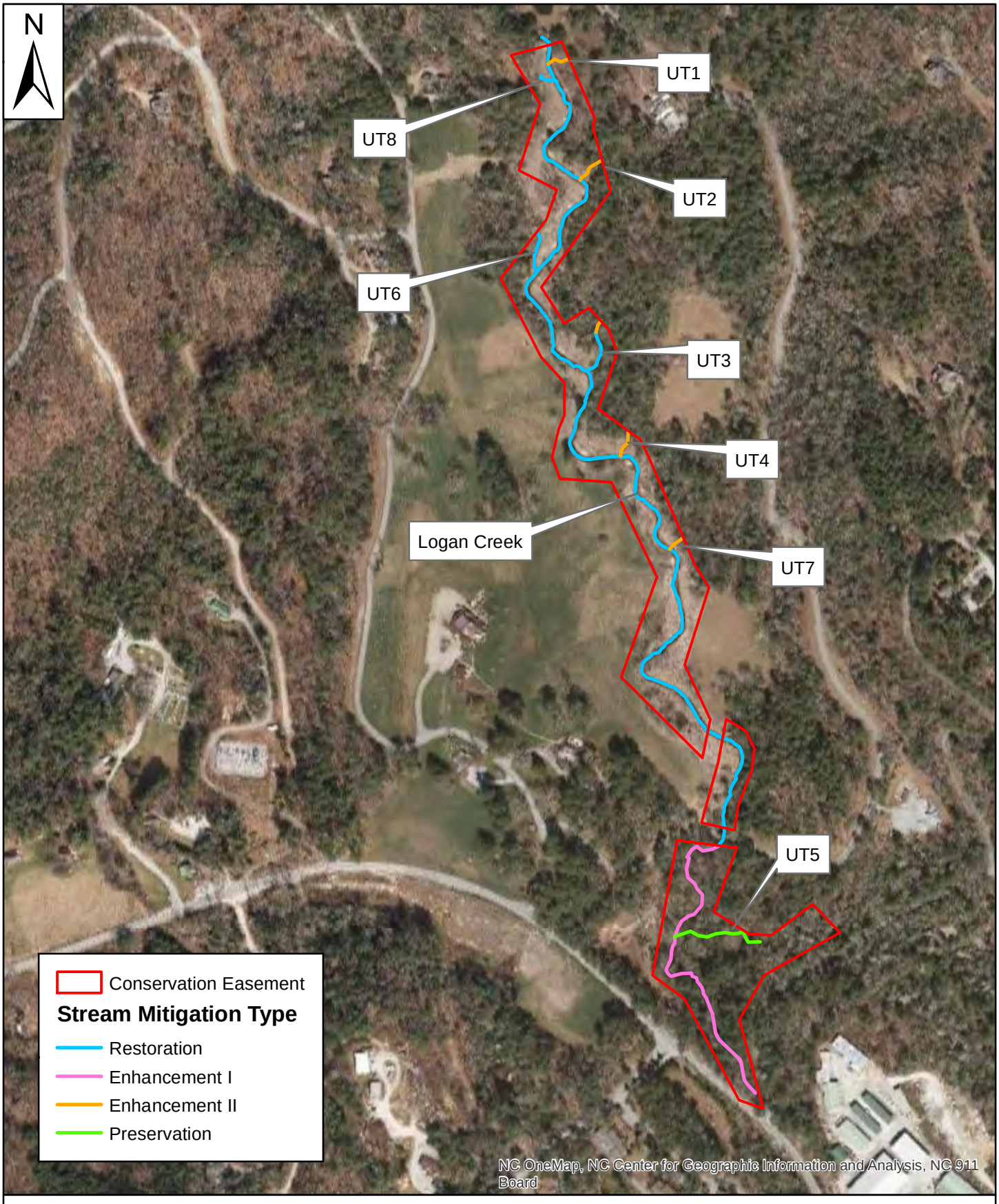
Component Summation

Restoration Level	Stream (LF)	Riparian Wetland (AC)		Non-riparian Wetland (AC)	Buffer (SF)	Upland (AC)
Restoration	3,441					
Enhancement I	1,038					
Enhancement II	341					
Creation						
Preservation	290					
High Quality Preservation						

BMP Elements

Element		Location	Purpose/Function	Notes

BMP Elements: BR= Bioretention Cell; SF= Sand Filter; SW= Stormwater Wetland; WDP= Wet Detention Pond; DDP= Dry Detention Pond; FS= Filter Strip; S= Grassed Swale; LS= Level Spreader; NI=Natural Infiltration Area



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0 200 400 600 800 1,000 Feet

DMS Project # 92515

Figure 3
Stream Asset Map
Monitoring Year 4
Logan Creek Site

Table 2. Project Activity and Reporting History
Logan Creek Restoration Project: DMS Project ID No. 92515

Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Mitigation Plan Prepared	Jun-07	06-07	Apr-08
Mitigation Plan Amended	Apr-13	N/A	May-13
Mitigation Plan Approved	N/A	N/A	Jun-13
Final Design – (at least 90% complete)	N/A	N/A	May-13
Construction Begins	N/A	N/A	Jun-14
Temporary S&E mix applied to entire project area	N/A	N/A	Jan-15*
Permanent seed mix applied to entire project area	N/A	N/A	Jan-15*
Planting of bare root trees and live stakes	N/A	N/A	Jan-15*
End of Construction	N/A	N/A	May-15**
Survey of As-built conditions (Year 0 Monitoring-baseline)	N/A	Mar-15	Aug-15
As-Built Baseline Report	N/A	Apr-15	Nov-15
Year 1 Monitoring	N/A	Mar-16	Apr-16
Year 2 Monitoring	Dec-16	Nov-16	Dec-16
Year 3 Monitoring	Dec-17	Oct-17	Dec-17
Year 4 Monitoring	Dec-18	Oct-18	Nov-18
Year 5 Monitoring	Dec-19	N/A	N/A

* Began seeding with the start of construction June, 2014 and site was seeded multiple times with a final entire area overseeding at the time the bare root trees were planted.

** Construction of the majority of the site was completed by November 1, 2014 after a 2 week extension of the trout moratorium. The Enhancement Reach was done after April 15, 2015 (when Trout Moratorium ends) and was completed by May 12, 2015.

Table 3. Project Contacts	
Logan Creek Restoration Project: DMS Project ID No. 92515	
Designer	
Michael Baker Engineering, Inc.	797 Haywood Rd Suite 201 Asheville, NC 28806 Contact: Micky Clemmons, Tel. 828-412-6100
Construction Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Bill Wright, Tel. 919-582-3575
Planting Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Bill Wright, Tel. 919-582-3575
Seeding Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Bill Wright, Tel. 919-582-3575
Seed Mix Sources	Green Resources (seed), Tel. 336-855-6363
Nursery Stock Suppliers	ArborGen Inc. (trees), 843-528-3204 Dykes and Son (trees), 931-668-8833
Monitoring Performers	
Michael Baker Engineering, Inc.	797 Haywood Rd Suite 201 Asheville, NC 28806 Contact:
Stream and Vegetation Monitoring	Micky Clemmons, Tel. 828-412-6100
Monitoring Surveyor	Kee Mapping and Surveying P.O. Box 2566 Asheville, NC 28802 Contact: Brad Kee, License #C-3039; Phone: 828-575-9021

Table 4. Project Attributes			
Logan Creek Restoration Project: DMS Project ID No. 92515			
Project Information			
Project Name	Logan Creek Mitigation Project		
County	Jackson		
Project Area (acres)	12.71		
Project Coordinates (latitude and longitude)	Latitude 35.132803° Longitude -83.061046°		
Watershed Summary Information			
Physiographic Province	Blue Ridge		
River Basin	Savannah River Basin		
USGS Hydrologic Unit 8-digit and 14-digit	03060101 / 03060101010020		
DWR Sub-basin	Keowee River: 0306010101		
Project Drainage Area (AC)	Mainstem 1353.5 at beginning to 1714 at end, UT1, UT4, UT6, UT7 & UT8 <13, UT2 = 26; UT3 = 32, UT5 = 128.		
Project Drainage Area Percentage of Impervious Area	<2%		
USGA Land Use Classification	Deciduous Forest (76%)		
	Evergreen Forest (8%)		
	Pasture Land (4.6%)		
NCDMS Land Use Classification for this Hydrologic Unit	Forest (91%)	Shrub (1%)	
	Developed (6%)	Other (.5%)	
	Agriculture (1.5%)		
Stream Reach Summary Information			
Parameters	**Mainstem - Reach 1**	**Mainstem - Reach 2**	**UT3**
			R1 **R2**
Length of Reach (LF)	3,134	1,038	40 138
Valley Classification (Rosgen)	VIII	VIII	II
Drainage Area (AC)	1,557	1,714	32
NCDWR Stream Identification Score	52.5	52.5	41.5
NCDWR Water Quality Classification	C; TR: +HQW	C; TR: +HQW	C; TR: +HQW
Morphological Description (Rosgen stream type)	C-E	C-E	B
Evolutionary Trend	C→E	C→E	B
Underlying Mapped Soils	NkA	SaC	NkA, SaC
Drainage Class	Poorly drained to very poorly drained soils	Very deep, well drained, mod permeable soils	Somewhat poorly to well drained
Soil Hydric Status	Non-Hydric	Non-Hydric	Site-specific
Average Channel Slope (ft/ft)	0.004	0.007	0.012
FEMA Classification	Zone AE	Zone AE	None
Native Vegetation Community	Mixed Forested/Rhododendron and grassland	Mixed Forested/Rhododendron and grassland	Mixed Forested/Rhododendron and grassland
Percent Composition of Exotic/Invasive Vegetation[2]	<1%	<1%	<1%
Parameters	**UT3**	**UT6**	**6 other small UTs in R1**
	R1 **R2**		
Length of Reach (LF)	40 138	127	45 - 127
Valley Classification (Rosgen)	II	II	II
Drainage Area (AC)	32	32	.02 to .04
NCDWR Stream Identification Score	41.5	41.5	40.5 - 32.5
NCDWR Water Quality Classification	C; TR: +HQW	C; TR: +HQW	C; TR: +HQW
Morphological Description (Rosgen stream type)	B	B	E - B
Evolutionary Trend	B	B	B→C→E
Underlying Mapped Soils	NkA, SaC	NkA, SaC	NkA, SaC
Drainage Class	Somewhat poorly to well drained	Somewhat poorly to well drained	Somewhat poorly to well drained
Soil Hydric Status	Site-specific	Site-specific	Site-specific
Average Channel Slope (ft/ft)	0.012	0.012	0.0134 (UT6)
FEMA Classification	None	None	None
Native Vegetation Community	Mixed Forested/Rhododendron and grassland	Mixed Forested/Rhododendron and grassland	Mixed Forested/Rhododendron and grassland
Percent Composition of Exotic/Invasive Vegetation[2]	<1%	<1%	<1%
Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Permit: Action ID #2008-01711
Waters of the United States – Section 401	Yes	Yes	Permit: WQC #3885
Endangered Species Act	No	Yes	Categorical Exclusion
Historic Preservation Act	No	Yes	Categorical Exclusion
Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	No-Rise	Certification, June 27, 2016
Essential Fisheries Habitat	No	N/A	N/A

Notes:
1. See Figure 2.5 of Mitigation Plan for key to soil series symbols.
3. USGS Land Use Data (2001) used rather than CGIA Land Use Classification data which is more dated (1996)

Appendix C

Vegetation Assessment Data

Includes:

Table 5 Vegetation Plot Mitigation Success Summary
Table 6 CVS Vegetation Metadata
Table 7 Stem Count Arranged by Plot and Species
Figure 4 Vegetation Monitoring Plot Photos
Figure 4.1 Trail Relocation Photos - MY4
Table 7.1 Vegetative Problem Areas (e-file)
Table 7.2 Vegetation Condition Assessment at Logan Creek (e-file)

Table 5. Vegetation Plot Mitigation				
Success Summary (2018, MY4)				
Plot #	**Stream/ Wetland Stems[1]**	**Volunteers[2]**	**Total[3]**	**Success Criteria Met?**
1	769	0	769	Yes
2	364	283	647	Yes
3	607	526	1133	Yes
4	607	121	728	Yes
5	850	971	1821	Yes
6	688	1133	1821	Yes
7	931	0	931	Yes
8	526	0	526	Yes
Project Avg	**668**	**379**	**1047**	**Yes**

Stem Class	**Characteristics**
[1]Stream/ Wetland Stems	Native planted woody stems. Includes shrubs, does NOT include live stakes. No vines
[2]Volunteers	Native woody stems. Not planted. No vines.
[3]Total	Planted + volunteer native woody stems. Includes live stakes. Excl. exotics. Excl. vines.

This color indicates that the number includes volunteer stems

Indicates that the stems per acre exceeds requirements by 10%

Indicates that the stems per acre exceeds requirements, but by less than 10%

Table 6. Vegetation Metadata

Logan Creek Stream and Restoration Project - Project #92515

Report Prepared By	Russell Myers
Date Prepared	10/22/2018 13:37
database name	92515_MY4_Logan_cvs-eep-entrytool-v2.3.1.mdb
database location	L:\projects\109243 - Logan Creek\Monitoring\YR4 Monitoring\2.0 - Monitoring Data\App C - Vegetation\Veg Data
computer name	ASHELRMYERS1
file size	46698496

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	92515
project Name	Logan Creek
Description	This Project will restore or enhance 4823 linear feet (LF) of stream along Logan Creek.
River Basin	Savannah
length(ft)	5110
stream-to-edge width (ft)	30
area (sq m)	28481.19
Required Plots (calculated)	8
Sampled Plots	8

Table 7. Stem Count Arranged by Plot
Project: Logan Creek, DMS Project 392515

			Current Plot Data (MY4 2018)																				
			92515-01-0001			92515-01-0002			92515-01-0003			92515-01-0004			92515-01-0005			92515-01-0006			92515-01-0007		
Scientific Name	**Common Name**	**Species Type**	**P**	**V**	**T**	**P**	**V**	**T**	**P**	**V**	**T**	**P**	**V**	**T**	**P**	**V**	**T**	**P**	**V**	**T**	**P**	**V**	**T**
Alnus serrulata	hazel alder	Shrub				3		3	6	10	16	2		2	7		7	3		3	6		6
Betula nigra	river birch	Tree							1		1	3		3	3		3	1		1	2		2
Diospyros virginiana	common persimmon	Tree				1		1	1		1	2		2	4		4	2		2	5		5
Fraxinus pennsylvanica	green ash	Tree				1		1	2		2	4		4	2		2	8		8	3		3
Hamamelis virginiana	American witchhazel	Tree	5		5																		
Leucothoe fontanesiana	highland doghobble	Shrub																					
Lindera benzoin	northern spicebush	Shrub	2		2																		
Liriodendron tulipifera	tuliptree	Tree	1		1	1	7	8		3	3	2	3	5		24	24	1	28	29	4		4
Nyssa sylvatica	blackgum	Tree							2		2				2		2				1		1
Oxydendrum arboreum	sourwood	Tree																					
Pinus strobus	eastern white pine	Tree																					
Quercus alba	white oak	Tree				3		3				1		1	2		2						
Quercus rubra	northern red oak	Tree							3		3	1		1	1		1	2		2	2		2
Robinia pseudoacacia	black locust	Tree																					
Sambucus canadensis	Common Elderberry	Shrub																					
Unknown		Shrub or Tree																					
Viburnum dentatum	southern arrowwood	Shrub	11		11																		
		Stem count	19	0	19	9	7	16	15	13	28	15	3	18	21	24	45	17	28	45	23	0	23
		size (ares)	1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	4	0	4	5	1	5	6	2	7	7	1	7	7	1	8	6	1	6	7	0	7
		Stems per ACRE	769	0	769	364	283	647	607	526	1133	607	121	728	850	971	1821	688	1133	1821	931	0	931

P = Planted — This color indicates that the number includes volunteer stems
V = Volunteer — Indicates that the stems per acre exceeds requirements by 10%
T = Total — Indicates that the stems per acre exceeds requirements, but by less than 10%

Table 7. Stem Count Arranged by Plot, continued
Project: Logan Creek, DMS Project 392515

			Current Plot Data (MY4 2018)			Annual Means														
			92515-01-0008			MY4 (2018)			MY3 (2017)			MY2 (2016)			MY1 (2015)*			MY0 (2015)*		
Scientific Name	**Common Name**	**Species Type**	**P**	**V**	**T**	**P**	**V**	**T**	**P**	**V**	**T**	**P**	**V**	**T**	**P**	**V**	**T**	**P**	**V**	**T**
Alnus serrulata	hazel alder	Shrub	5		5	32	10	42	32	25	57	32	30	62	32		32	33		33
Betula nigra	river birch	Tree	2		2	12		12	11		11	12		12	11		11	13		13
Diospyros virginiana	common persimmon	Tree	1		1	16		16	16		16	18		18	20		20	24		24
Fraxinus pennsylvanica	green ash	Tree	2		2	22		22	22		22	23		23	24		24	24		24
Hamamelis virginiana	American witchhazel	Tree				5		5	7		7	9		9	11		11			
Leucothoe fontanesiana	highland doghobble	Shrub							1		1	3		3	3		3	4		4
Lindera benzoin	northern spicebush	Shrub				2		2	2		2	2		2	2		2			
Liriodendron tulipifera	tuliptree	Tree	2		2	11	65	76	10	35	45	9	55	64	11		11	17		17
Nyssa sylvatica	blackgum	Tree	1		1	6		6	7		7	8		8	9		9	20		20
Oxydendrum arboreum	sourwood	Tree											2	2						
Pinus strobus	eastern white pine	Tree											14	14						
Quercus alba	white oak	Tree				6		6	7		7	7		7	6		6	6		6
Quercus rubra	northern red oak	Tree				9		9	9		9	10		10	12		12	13		13
Robinia pseudoacacia	black locust	Tree											1	1						
Sambucus canadensis	Common Elderberry	Shrub														1	1			
Unknown		Shrub or Tree																7		7
Viburnum dentatum	southern arrowwood	Shrub				11		11	11		11	11		11	11		11	9		9
		Stem count	13	0	13	132	75	207	135	60	195	144	102	246	152	1	153	170	0	170
		size (ares)	1			8			8			8			8			8		
		size (ACRES)	0.02			0.20			0.20			0.20			0.20			0.20		
		Species count	6	0	6	11	2	11	12	2	12	12	5	15	12	1	13	11	0	11
		Stems per ACRE	526	0	526	668	379	1047	683	304	986	728	516	1244	769	5	774	860	0	860

P = Planted — This color indicates that the number includes volunteer stems
V = Volunteer — Indicates that the stems per acre exceeds requirements by 10%
T = Total — Indicates that the stems per acre exceeds requirements, but by less than 10%

*MY0 was completed in spring 2015 after the trout moratorium, MY1 data was collected after the growing season in the winter 2015. This corrects an inaccurate date show on previous reports.

Figure 4. Vegetation Monitoring Plot Photos,
DMS Project #92515

Photo 1. Vegetation Plot 1 – Tree photo (October 12, 2018).

Photo 2. Vegetation Plot 1 – Herbaceous photo (October 12, 2018).

Photo 3. Vegetation Plot 2 – Tree photo (October 12, 2018).

Photo 4. Vegetation Plot 2 – Herbaceous photo (October 12, 2018).

Photo 5. Vegetation Plot 3 – Tree photo (October 12, 2018).

Photo 6. Vegetation Plot 3 – Herbaceous photo (October 12, 2018).

Logan Creek Site - Vegetation Plot Photos,
DMS Project #92515 - continued

Photo 7. Vegetation Plot 4 – Tree photo (October 12, 2018).

Photo 8. Vegetation Plot 4 – Herbaceous photo (October 12, 2018).

Photo 9. Vegetation Plot 5 – Tree photo (October 12, 2018).

Photo 10, Vegetation Plot 5 – Herbaceous photo (October 12, 2018).

Photo 11. Vegetation Plot 6 – Tree photo (October 12, 2018).

Photo 12. Vegetation Plot 6 – Herbaceous photo (October 12, 2018).

Logan Creek Site - Vegetation Plot Photos,
DMS Project #92515 - continued

Photo 13. Vegetation Plot 7 – Tree photo (October 12, 2018).

Photo 14. Vegetation Plot 7 – Herbaceous photo (October 12, 2018).

Photo 15. Vegetation Plot 8 – Tree photo (October 12, 2018).

Photo 16. Vegetation Plot 8 – Herbaceous photo (October 12, 2018).

Figure 4.1 Trail Relocation Photos – MY4

Photo 17. Trail Relocation 1 facing downstream – Trail was relocated away from the stream.

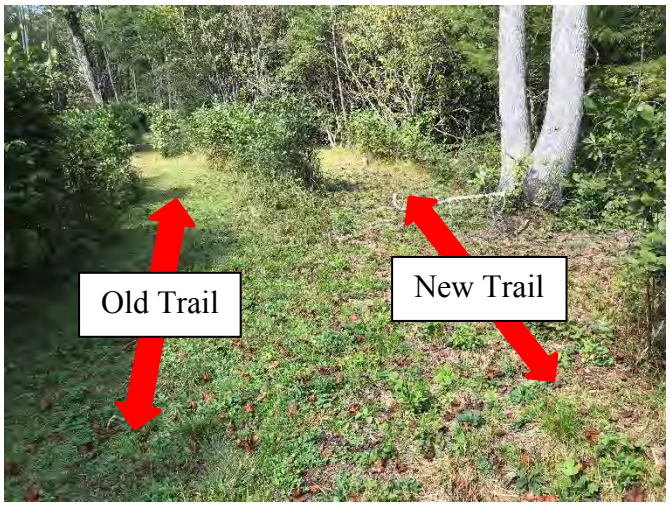


Photo 18. Trail Relocation 1 facing upstream– Trail was relocated away from stream.

Photo 19. Trail Relocation 2 facing downstream – Trail was relocated away from the stream, bridge will be moved.

Photo 20. Trail Relocation 2 facing downstream– Trail was relocated away from the stream, bridge will be moved.

e-file

Table 7.1 Vegetative Problem Areas MY4			
Feature Category	**Station #/Range**	**Probable Cause**	**Photo #**
Bare Bank	None		
Bare Bench	None		
Bare Flood Plain	None		
Invasive /Exotic Populations	None		

e-file

Table 7.2 Vegetation Condition Assessment

Planted Acreage[1]	7.49					
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Planted Acreage**
1. Bare Areas	None	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	None	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	None	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%
Easement Acreage[2]	**12.71**					
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Easement Acreage**
4. Invasive Areas of Concern[4]	None	1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas[3]	There was one Encroachment Area (EA-1) noted in 2016 along the nature trail, in the area of stations 23+00 to 28+00. A new maintenance staff person had the nature trail mowed; however, a wider area was mowed than we verbally agreed should be maintained. The width was 10-12 feet wide, while we had agreed to a width of 4-6 feet wide, which approximates the width of the previously existing nature trail. We discussed this with staff at Lonesome Valley and they agreed to address this issue with the trail maintenance staff, and to be sure they know the proper width for future maintenance. During MY3 monitoring, it was noted that the trail through Veg Plot 3 was still being mowed. This issue will be addressed with the trail maintenance staff again.	none	Light Blue	2	0.014	0.11%

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 EEP 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, particularly 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.

Appendix D

Stream Assessment Data

Includes:

Figure 5. Logan Creek Stream Restoration project
Photo Points - Monitoring Year 4, (Stationing is approximate)

Photo 1. Logan Creek Photo Point 1 – Station 40+45 (October 5, 2018) upstream view from right bank.

Photo 2. Logan Creek Photo Point 1 – Station 40+45 (October 5, 2018) downstream view from right bank.

Photo 3. Logan Creek Photo Point 2 – Station 38+60 (October 5, 2018) downstream view from left bank.

Photo 4. Logan Creek Photo Point 2 – Station 38+60 (October 5, 2018) upstream view from left bank.

Photo 5. Logan Creek Photo Point 3 – Station 36+75 (October 5, 2018) upstream view from right bank.

Photo 6. Logan Creek Photo Point 3 – Station 36+75 (October 5, 2018) downstream view from right bank.

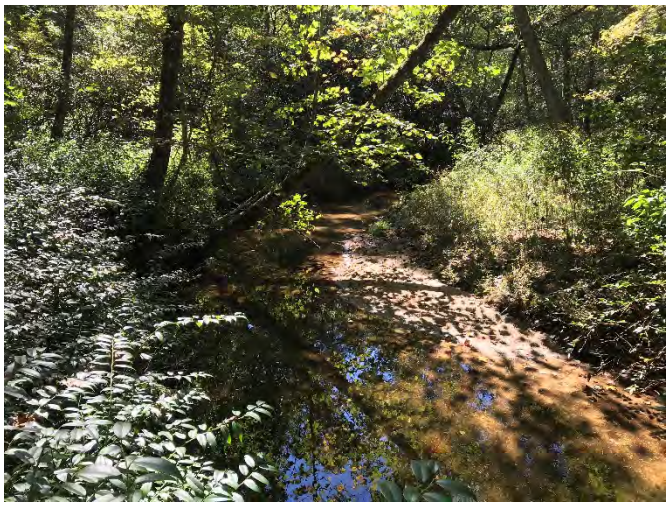


Photo 7. Logan Creek Photo Point 4 – Station 34+80 (October 5, 2018) downstream from left bank.

Photo 8. Logan Creek Photo Point 4 – Station 34+80 (October 5, 2018) upstream from left bank.

Photo 9. Logan Creek Photo Point 5 – Station 33+60 (October 5, 2018) upstream from right bank.

Photo 10. Logan Creek Photo Point 5 – Station 33+60 (October 5, 2018) downstream from right bank.

Photo 11. Logan Creek Photo Point 6 – Station 32+70 (October 5, 2018) downstream view from left bank.

Photo 12. Logan Creek Photo Point 6 – Station 32+70 (October 5, 2018) upstream view from left bank.

Photo 13. Logan Creek Photo Point 7 – Station 32+15 (October 5, 2018) downstream view from bridge.

Photo 14. Logan Creek Photo Point 7 – Station 32+00 (October 5, 2018) upstream view from bridge.

Photo 15. Logan Creek Photo Point 8a – Station 29+75 (October 5, 2018) downstream view from right bank.

Photo 16. Logan Creek Photo Point 8b – Station 29+25 (October 5, 2018) upstream view from right bank.

Photo 17. Logan Creek Photo Point 9 – Station 26+75 (October 5, 2018) downstream view from left bank.

Photo 18. Logan Creek Photo Point 9 – Station 26+75 (October 5, 2018) upstream view from left bank.

Photo 19. Logan Creek Photo Point 10 – Station 25+25 (October 5, 2018) upstream view from right bank.

Photo 20. Logan Creek Photo Point 10 – Station 25+25 (October 5, 2018) downstream view from right bank.

Photo 21. Logan Creek Photo Point 11 – Station 23+20 (October 5, 2018) downstream view from left bank.

Photo 22. Logan Creek Photo Point 11 – Station 23+20 (October 5, 2018) upstream view from left bank.

Photo 23. Logan Creek Photo Point 12 – Station 21+20 (October 5, 2018) downstream view from left bank.

Photo 24. Logan Creek Photo Point 12 – Station 21+20 (October 5, 2018) upstream view from left bank.

Photo 25. UT7 Photo Point 13 – (October 5, 2018) upstream view from left bank.

Photo 26. UT7 Photo Point 13 – (October 5, 2018) downstream view from left bank.

Photo 27. Logan Creek Photo Point 14 – Station 19+45 (October 5, 2018) downstream view from left bank.

Photo 28. Logan Creek Photo Point 14 – Station 19+45 (October 5, 2018) upstream view from left bank.

Photo 29. Logan Creek Photo Point 15 – Station 17+45 (October 5, 2018) downstream view from left bank.

Photo 30. Logan Creek Photo Point 15 – Station 17+45 (October 5, 2018) upstream view from left bank.

Photo 31. UT4 Photo Point 16 – Station 0+40 (October 5, 2018) downstream view from left bank.

Photo 32. UT4 Photo Point 16 – Station 0+40 (October 5, 2018) upstream view from left bank.

Photo 33. Logan Creek Photo Point 17 – Station 15+50 (October 5, 2018) upstream view from right bank.

Photo 34. Logan Creek Photo Point 17 – Station 15+50 (October 5, 2018) downstream view from right bank.

Photo 35. Logan Creek Photo Point 18 – Station 12+90 (October 5, 2018) downstream view from left bank.

Photo 36. Logan Creek Photo Point 18 – Station 12+90 (October 5, 2018) upstream view from left bank.

Photo 37. UT3 Photo Point 19 – Station 00+60 (October 5, 2018) upstream from left bank.

Photo 38. UT3 Photo Point 19 – Station 00+60 (October 5, 2018) downstream from left bank.

Photo 39. UT3 Photo Point 19 – Station 00+60 (October 5, 2018) upstream from left bank to vernal pool.

Intentionally left blank.

Photo 40. Logan Creek Photo Point 20 – Station 10+60 (October 5, 2018) downstream view from left bank.

Photo 41. Logan Creek Photo Point 20 – Station 10+60 (October 5, 2018) upstream view from left bank.

Photo 42. Logan Creek Photo Point 21 – Station 9+40 (October 5, 2018) upstream view from right bank.

Photo 43. Logan Creek Photo Point 21 – Station 9+40 (October 5, 2018) downstream view from right bank.

Photo 44. UT6 Photo Point 22 – Station 0+75 (October 5, 2018) upstream view from right bank.

Photo 45. UT6 Photo Point 22 – Station 0+75 (October 5, 2018) downstream view from right bank.

Photo 46. Logan Creek Photo Point 23 – Station 7+70 (October 5, 2018) downstream view from left bank.

Photo 47. Logan Creek Photo Point 23 – Station 7+70 (October 5, 2018) upstream view from left bank.

Photo 48. Logan Creek, Photo Point 24 – Station 5+70 (October 5, 2018) downstream view from left bank.

Photo 49. Logan Creek, Photo Point 24 – Station 5+70 (October 5, 2018) upstream view from left bank.

Photo 50. UT2, Photo Point 25 – Station 0+65 (October 5, 2018) upstream view from left bank.

Photo 51. UT2, Photo Point 25 – Station 0+65 (October 5, 2018) downstream view from left bank.

Photo 52. Logan Creek, Photo Point 26 – Station 3+80 (October 5, 2018) upstream view from right bank.

Photo 53. Logan Creek, Photo Point 26 – Station 3+80 (October 5, 2018) downstream view from right bank.

Photo 54. Logan Creek, Photo Point 27 – Station 1+12 (October 5, 2018) upstream view from right bank.

Photo 55. Logan Creek, Photo Point 27 – Station 1+12 (October 5, 2018) downstream view from right bank.

Photo 56. UT8, Photo Point 28 – Station 1+10 (October 5, 2018) upstream view from right bank and confluence.

Photo 57. UT1, Photo Point 29 – Station 0+50 (October 5, 2018) view upstream and confluence.

Photo 58. Logan Creek, Photo Point 30 – Station 0+50 (October 5, 2018) upstream view from right bank.

Photo 59. Logan Creek, Photo Point 30 – Station 0+50 (October 5, 2018) downstream view from right bank.

Photo 60. UT5 - Preservation, Photo Point 31 – Station 1+80 (October 5, 2018) downstream view from mid-channel to confluence.

Photo 61. UT5 - Preservation, Photo Point 31 – Station 1+80 (October 5, 2018) upstream view from mid-channel to confluence.

Photo 62. UT5 - Preservation, Photo Point 32 – (October 5, 2018) downstream view from right bank.

Photo 63. UT5 - Preservation, Photo Point 32 – (October 5, 2018) upstream view from right bank.

Table 8. Visual Morphological Stability Assessment
Logan Creek Stream Restoration Project: DMS Project ID No. 92515

Logan Creek, Reach 1 (3,184 LF), Restoration Reach

Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Perfomance Mean or Total
A. Riffles	1. Present?	18	18	0	100	
	2. Armor stable (e.g. no displacement)?	18	18	0	100	
	3. Facet grades appears stable?	18	18	0	100	
	4. Minimal evidence of embedding/fining?	18	18	0	100	
	5. Length appropriate?	18	18	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	35	35	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	35	35	0	100	
	3. Length appropriate?	35	35	0	100	**100%**
C. Thalweg	1. Upstream of pool (structure) centering? (%)	100	100	0	100	
	2. Downstream of pool (structure) centering? (%)	100	100	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	17	19	0	89	
	2. Of those eroding, # w/concomitant point bar formation?	19	19	0	100	
	3. Apparent Rc within spec?	19	19	0	100	
	4. Sufficient floodplain access and relief?	19	19	0	100	**97%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	3,184	3,184	0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	3,184	3,184	0	100	**100%**
F. Vanes, Rock/Log Drop Structures*	1. Free of back or arm scour?	24	24	0	100	
	2. Height appropriate?	24	24	0	100	
	3. Angle and geometry appear appropriate?	24	24	0	100	
	4. Free of piping or other structural failures?	24	24	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	24	24	0	100	
	2. Footing stable?	24	24	0	100	**100%**

Logan Creek, Reach 2 (1,038 LF), Enhancement Reach

Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Perfomance Mean or Total
A. Riffles	1. Present?	10	10	0	100	
	2. Armor stable (e.g. no displacement)?	10	10	0	100	
	3. Facet grades appears stable?	10	10	0	100	
	4. Minimal evidence of embedding/fining?	10	10	0	100	
	5. Length appropriate?	10	10	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	13	13	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	13	13	0	100	
	3. Length appropriate?	13	13	0	100	**100%**
C. Thalweg	1. Upstream of pool (structure) centering? (%)	100	100	0	100	
	2. Downstream of pool (structure) centering? (%)	100	100	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	5	5	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	5	5	0	100	
	3. Apparent Rc within spec?	5	5	0	100	
	4. Sufficient floodplain access and relief?	5	5	0	100	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	1,038	1,038	0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	1,038	1,038	0	100	**100%**
F. Vanes, Rock/Log Drop Structures*	1. Free of back or arm scour?	11	11	0	100	
	2. Height appropriate?	11	11	0	100	
	3. Angle and geometry appear appropriate?	11	11	0	100	
	4. Free of piping or other structural failures?	11	11	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	0	0	0		
	2. Footing stable?	0	0	0		

* Note: Due to very low water levels some piping is occurring, only one structure may need to be repaired to fix the issue. Most structures in Reach 2 were designed to have water go under them during low water, in order to move sand through the reach.

Table 8. Visual Morphological Stability Assessment - Continued
Logan Creek Stream Restoration Project: DMS Project ID No. 92515

UT3 (178 LF)						
Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Perfomance Mean or Total
A. Riffles	1. Present?	3	3	0	100	
	2. Armor stable (e.g. no displacement)?	3	3	0	100	
	3. Facet grades appears stable?	3	3	0	100	
	4. Minimal evidence of embedding/fining?	3	3	0	100	
	5. Length appropriate?	3	3	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	3	3	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	3	3	0	100	
	3. Length appropriate?	3	3	0	100	**100%**
C. Thalweg[1]	1. Upstream of pool (structure) centering? (%)	100	100	0	100	
	2. Downstream of pool (structure) centering? (%)	100	100	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	0	0			
	2. Of those eroding, # w/concomitant point bar formation?	0	0			
	3. Apparent Rc within spec?	0	0			
	4. Sufficient floodplain access and relief?	0	0			
E. Bed General	1. General channel bed aggradation areas (bar formation)	178	178	0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	178	178	0	100	**100%**
F. Vanes, Rock/Log Drop Structures	1. Free of back or arm scour?	4	4	0	100	
	2. Height appropriate?	4	4	0	100	
	3. Angle and geometry appear appropriate?	4	4	0	100	
	4. Free of piping or other structural failures?	4	4	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	0	0			
	2. Footing stable?	0	0			

UT6, (127 LF)						
Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Perfomance Mean or Total
A. Riffles	1. Present?	3	3	0	100	
	2. Armor stable (e.g. no displacement)?	3	3	0	100	
	3. Facet grades appears stable?	3	3	0	100	
	4. Minimal evidence of embedding/fining?	3	3	0	100	
	5. Length appropriate?	3	3	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	2	2	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	2	2	0	100	
	3. Length appropriate?	2	2	0	100	**100%**
C. Thalweg	1. Upstream of pool (structure) centering? (%)	100	100	0	100	
	2. Downstream of pool (structure) centering? (%)	100	100	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	N/A	N/A	N/A	100	
	2. Of those eroding, # w/concomitant point bar formation?	N/A	N/A	N/A	100	
	3. Apparent Rc within spec?	N/A	N/A	N/A	100	
	4. Sufficient floodplain access and relief?	N/A	N/A	N/A	100	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	127	127	0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	127	127	0	100	**100%**
F. Vanes, Rock/Log Drop Structures	1. Free of back or arm scour?	2	2	0	100	
	2. Height appropriate?	2	2	0	100	
	3. Angle and geometry appear appropriate?	2	2	0	100	
	4. Free of piping or other structural failures?	2	2	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	N/A	N/A	N/A	N/A	
	2. Footing stable?	N/A	N/A	N/A	N/A	**N/A**

Table 8. Visual Morphological Stability Assessment - Continued
Logan Creek Stream Restoration Project: DMS Project ID No. 92515

UT8, (45 LF)						
Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Perfomance Mean or Total
A. Riffles	1. Present?	1	1	0	100	
	2. Armor stable (e.g. no displacement)?	1	1	0	100	
	3. Facet grades appears stable?	1	1	0	100	
	4. Minimal evidence of embedding/fining?	1	1	0	100	
	5. Length appropriate?	1	1	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	0	0	0		
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	0	0	0		
	3. Length appropriate?	0	0	0		
C. Thalweg	1. Upstream of pool (structure) centering? (%)	100	100	0	100	
	2. Downstream of pool (structure) centering? (%)	100	100	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	N/A	N/A	N/A	100	
	2. Of those eroding, # w/concomitant point bar formation?	N/A	N/A	N/A	100	
	3. Apparent Rc within spec?	N/A	N/A	N/A	100	
	4. Sufficient floodplain access and relief?	N/A	N/A	N/A	100	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	45	45	0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	45	45	0	100	**100%**
F. Vanes, Rock/Log Drop Structures	1. Free of back or arm scour?	1	1	0	100	
	2. Height appropriate?	1	1	0	100	
	3. Angle and geometry appear appropriate?	1	1	0	100	
	4. Free of piping or other structural failures?	0	1	0	0	**75%**
G. Wads/ Boulders	1. Free of scour?	N/A	N/A	N/A	N/A	
	2. Footing stable?	N/A	N/A	N/A	N/A	**N/A**

Table 9. Verification of Bankfull or Greater than Bankfull Events
Logan Creek Stream Restoration Project: DMS Project ID No. 92515

Year	Date of Data Collection	Date of Event	Method of Data Collection	Gauge Watermark Height (inches)*
				Logan Creek Station 30+00
MY2	3/18/2016	2 events: 1 in Dec-15 and 1 in Jan-16.	Crest Gauge	25.75
	8/17/2016	undetermined	Crest Gauge	1.56
MY3	10/26/2017	Between 7/26/2017 and 10/26/2017	Crest Gauge, Photographs	26.04
	10/26/2017	10/23/2017	Crest Gauge, Photographs	17.4
MY4	3/16/2018	Between 10/26/2017 and 3/16/2018	Crest Gauge	12.84
	6/12/2018**	Between 3/16/2018 and 6/12/2018	Crest Gauge, Photographs	11.88

* height indicates the highest position of cork shavings on the dowel. ** No events recorded after 6/12/18.

Crest Gauge reading taken on 3/16/2018 shows a distinct high flow event at 12.84 inches on the crest gauge.

Crest Gauge reading taken on 6/12/2018 shows a distinct high flow event at 11.88 inches on the crest gauge.

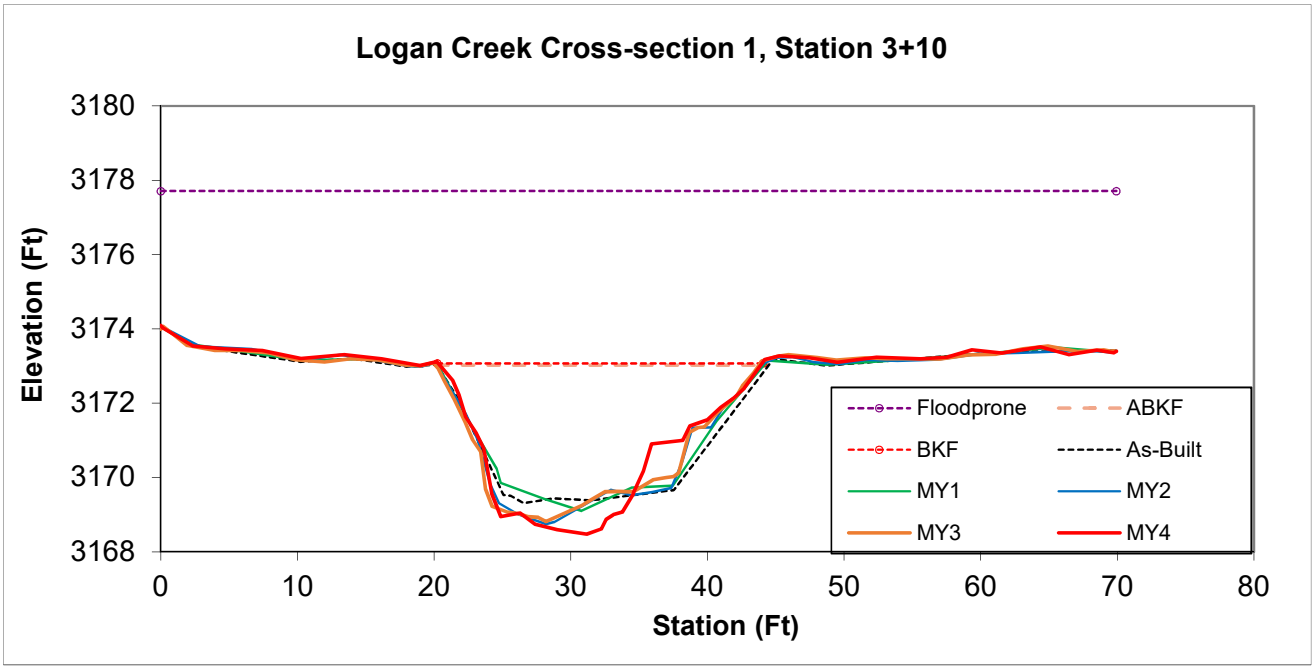
Wrack lines and debris above bankfull near station 29+00 (6/12/2018).

Debris piled up near the footbridge that crosses the stream at station 28+50 (6/12/2018).

Figure 6. Cross-Sections with Annual Overlays

Permanent Cross-Section 1
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Riffle	E	64.89	25.96	2.50	4.62	10.38	1.02	2.69	3173.07	3173.13	4.63



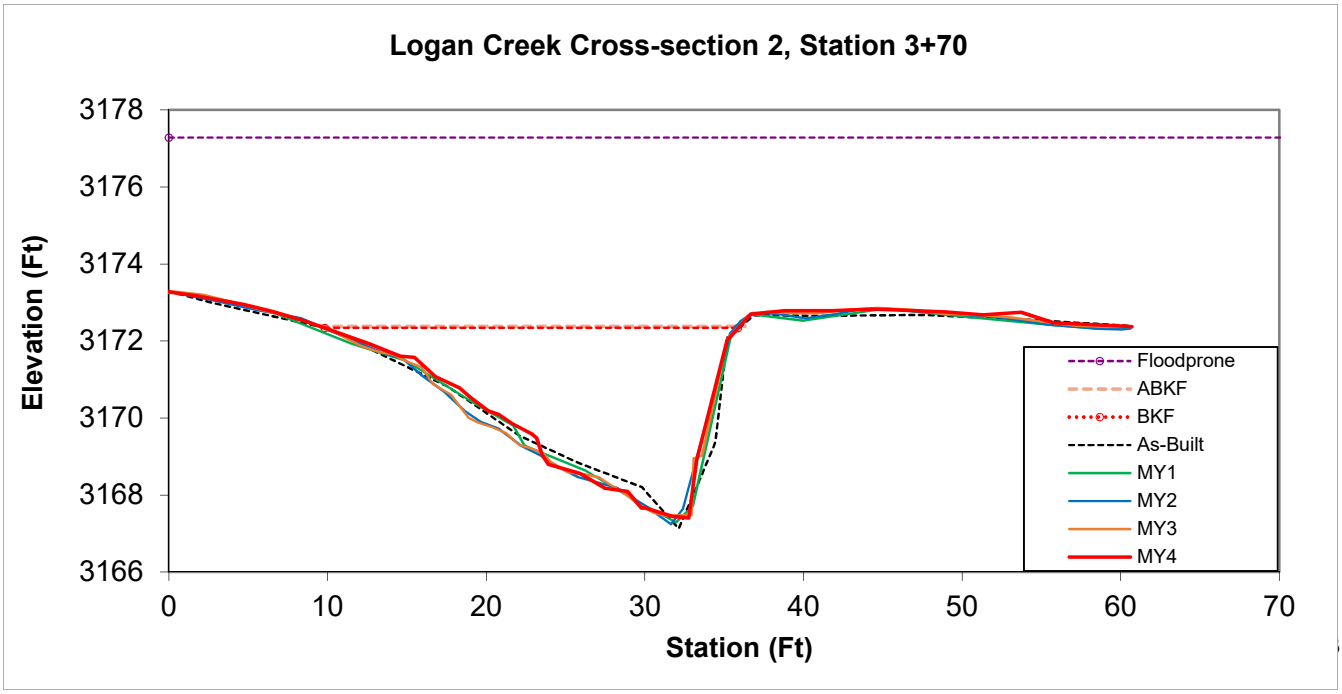
Looking at the Left Bank

Looking at the Right Bank

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-Section 2
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Pool	-	62.88	26.14	2.41	4.94	10.85	1.08	2.32	3172.34	3172.68	5.26



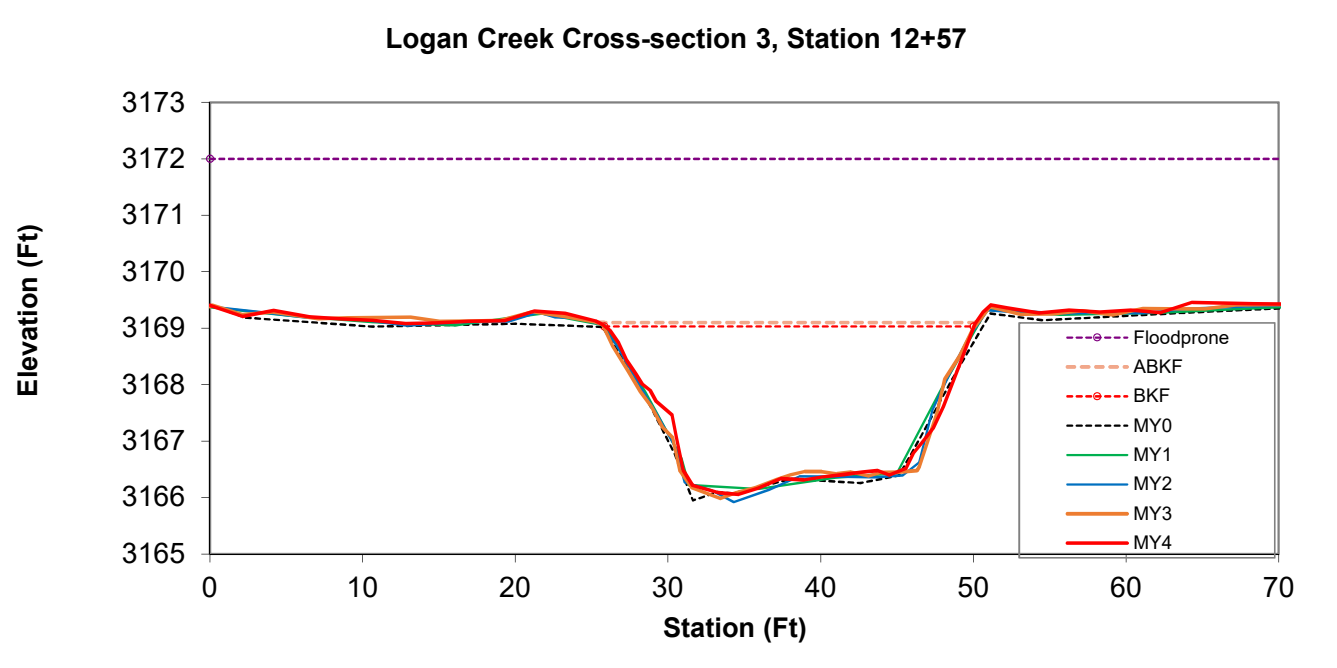
Looking at the Left Bank

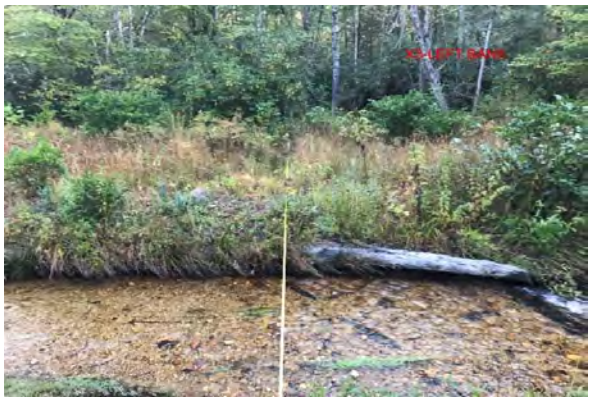
Looking at the Right Bank

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-Section 3
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Riffle	E	51.38	24.17	2.13	2.97	11.35	1.01	4.11	3169.03	3169.13	3.07





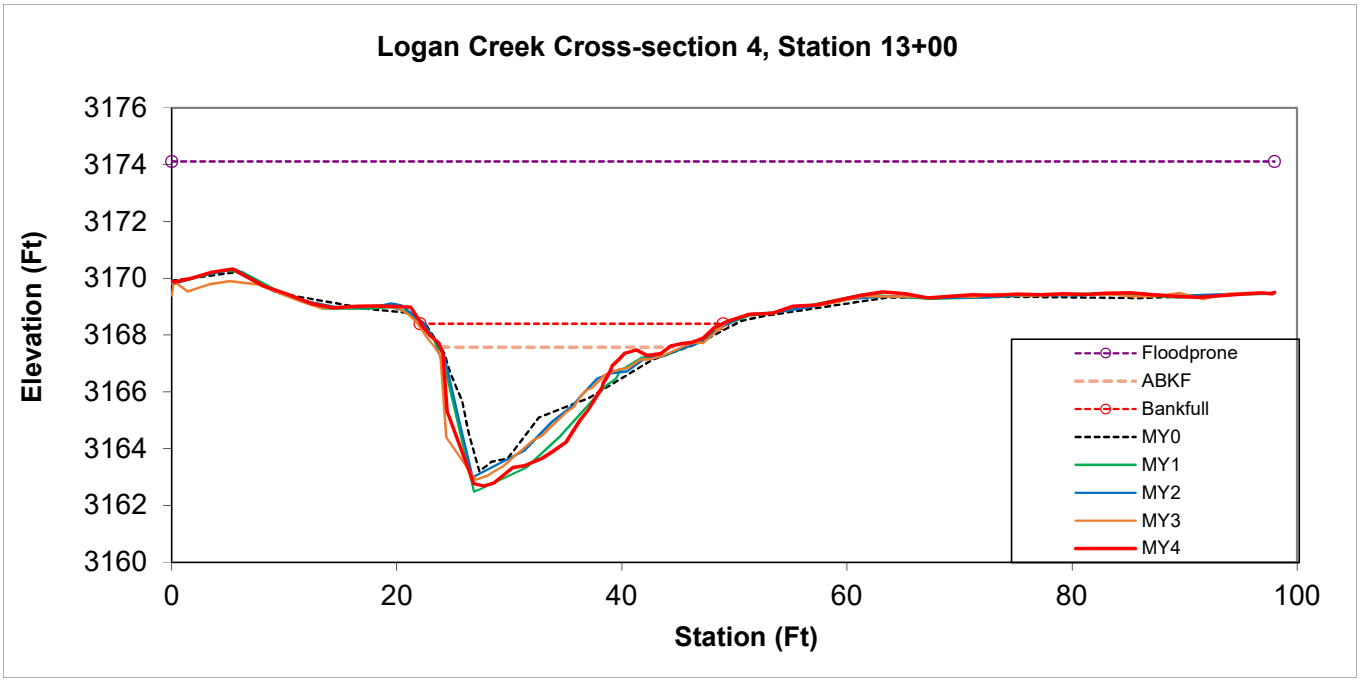
Looking at the Left Bank

Looking at the Right Bank

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-Section 4
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Pool	-	73.24	26.80	2.73	4.71	9.82	1.28	3.66	3168.40	3168.98	6.28



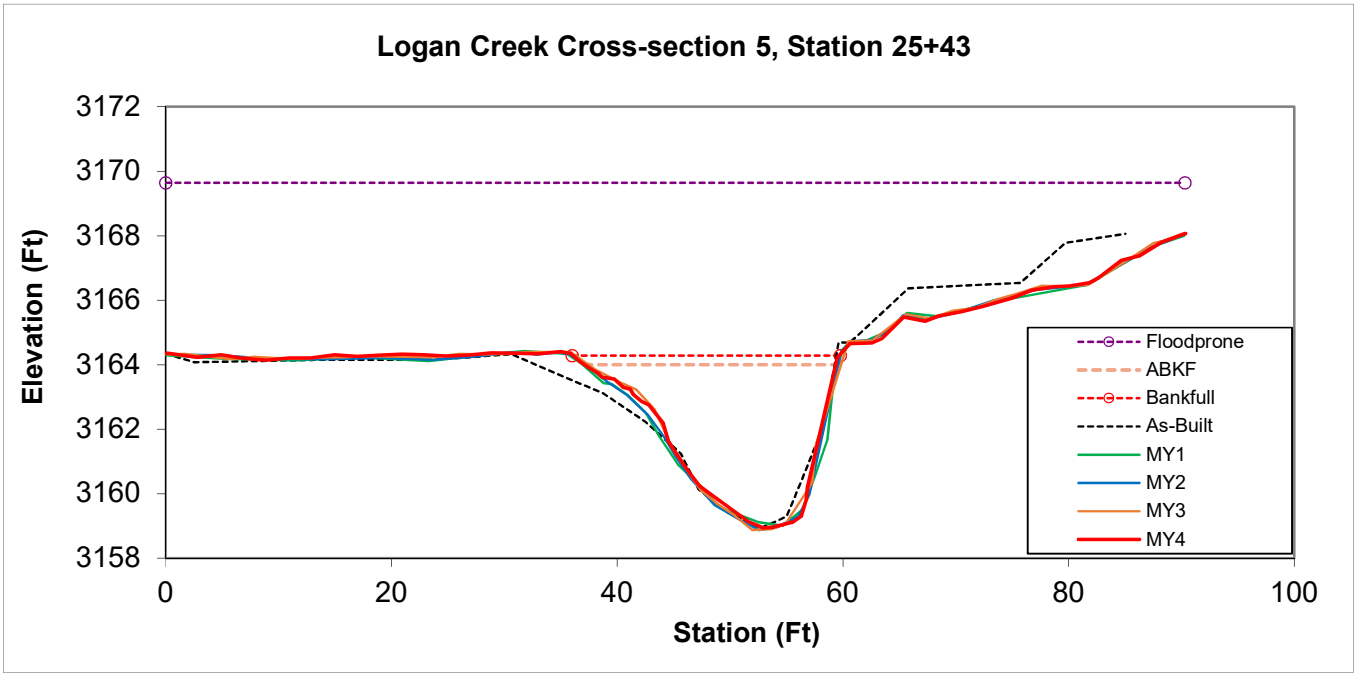
Looking at the Left Bank

Looking at the Right Bank

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-Section 5
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Pool	-	70.59	23.63	2.99	5.35	7.90	1.08	3.82	3164.28	3164.40	5.47



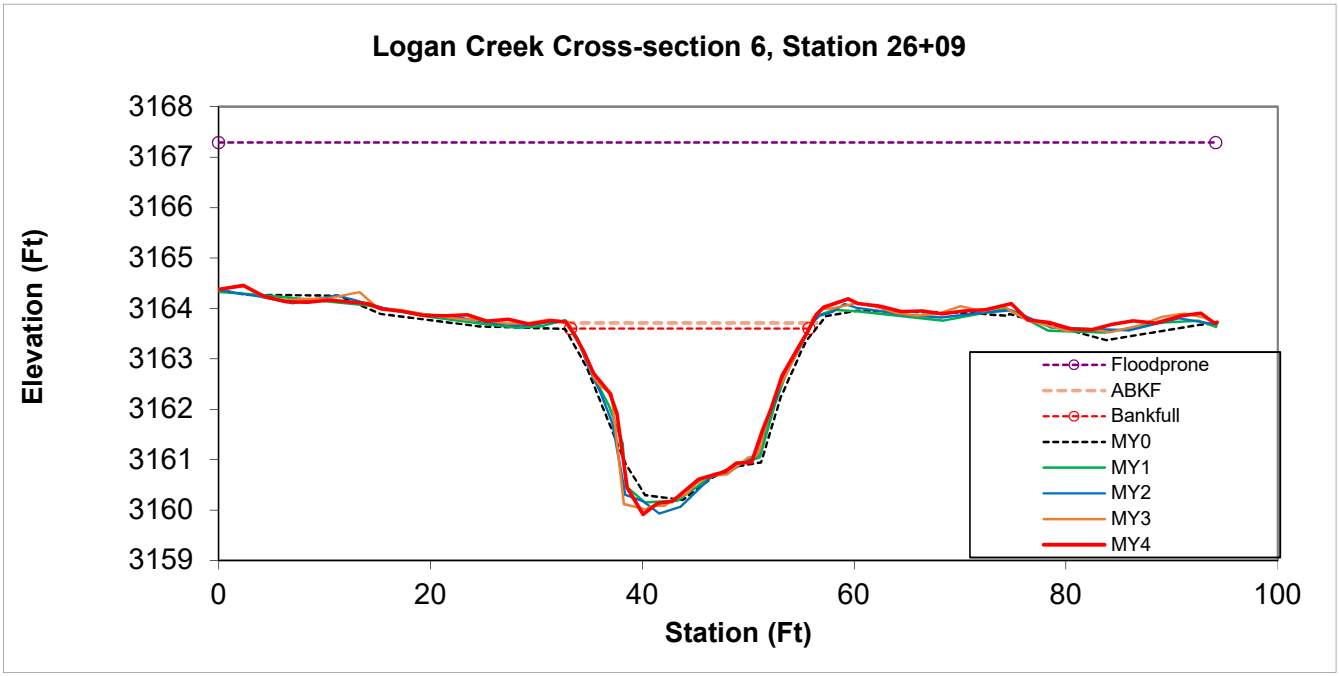
Looking at the Left Bank

Looking at the Right Bank

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-Section 6
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Riffle	E	49.12	22.58	2.18	3.69	10.33	1.01	4.19	3163.60	3163.73	3.82



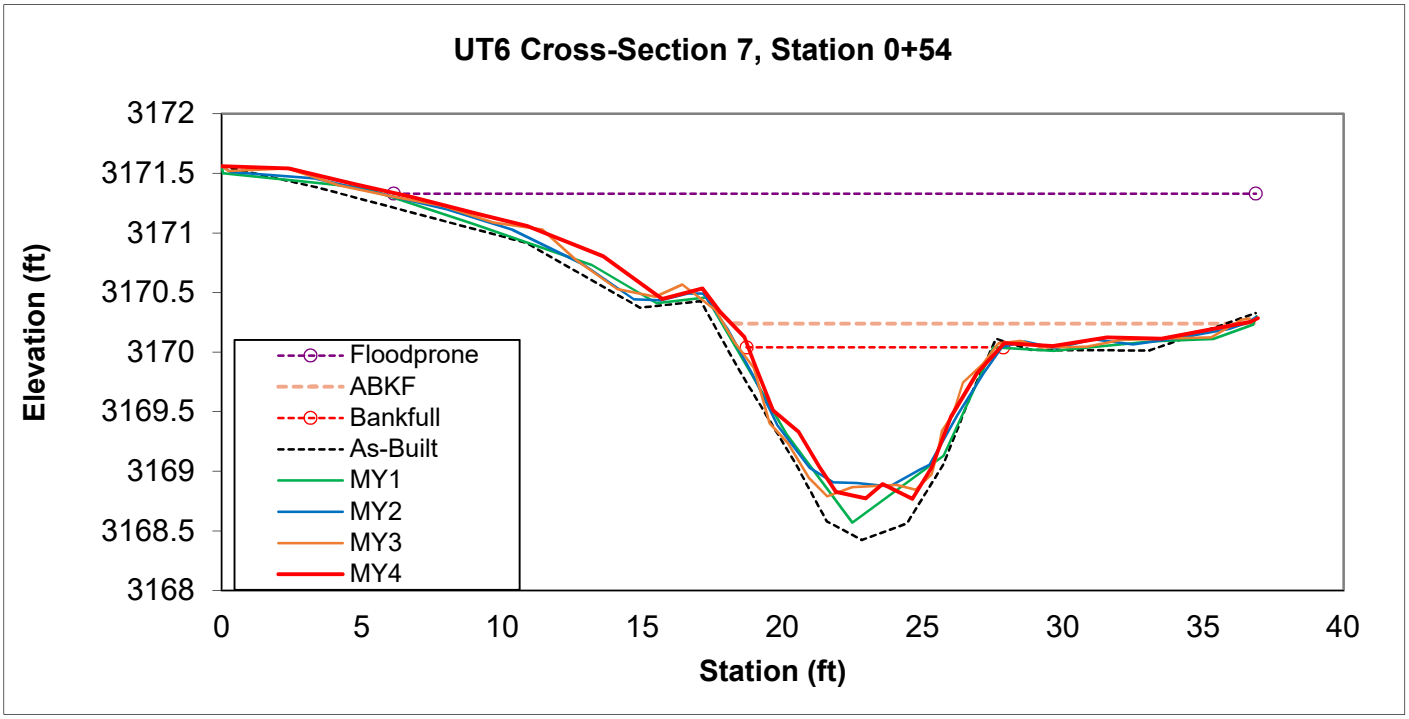
Looking at the Left Bank

Looking at the Right Bank

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-section 7
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Pool	-	7.29	9.05	0.81	1.28	11.17	0.89	3.4	3170.04	3170.07	1.32



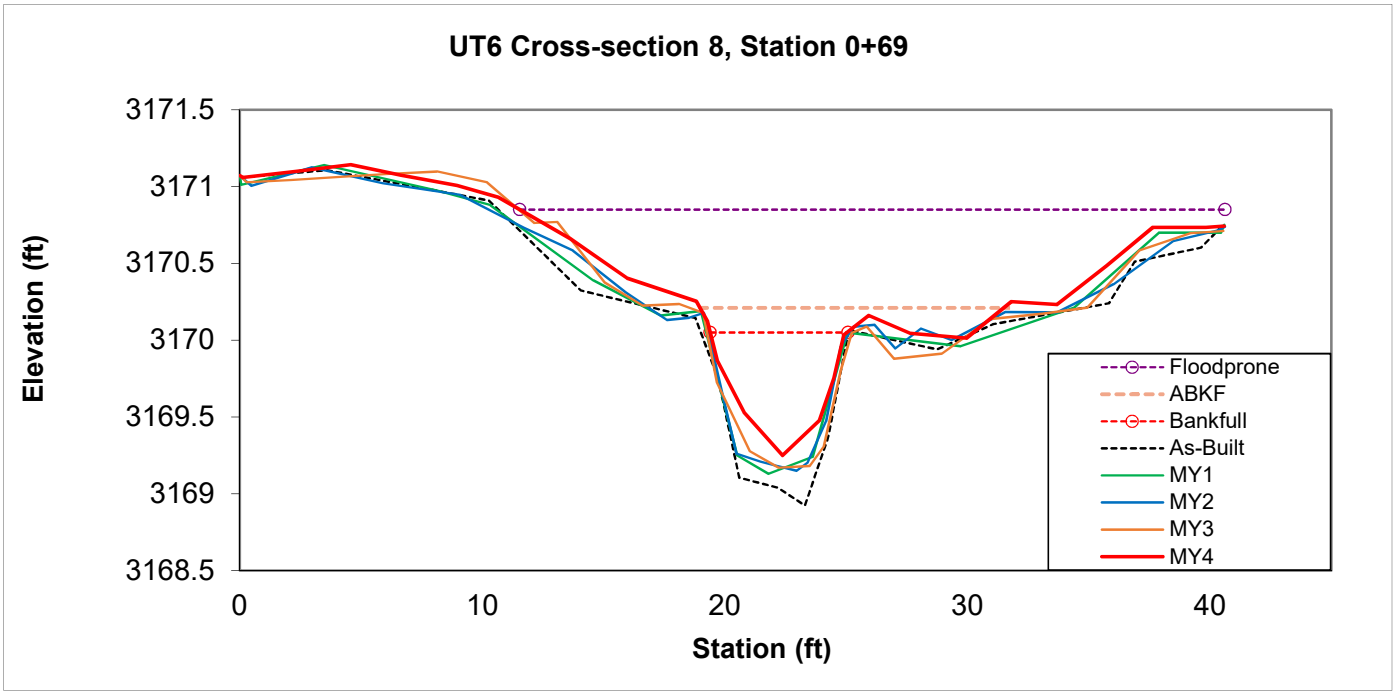
Looking at the Left Bank

Looking at the Right Bank

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-section 8
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Riffle	E	2.83	5.64	0.50	0.80	11.28	0.95	5.15	3170.05	3170.16	0.91



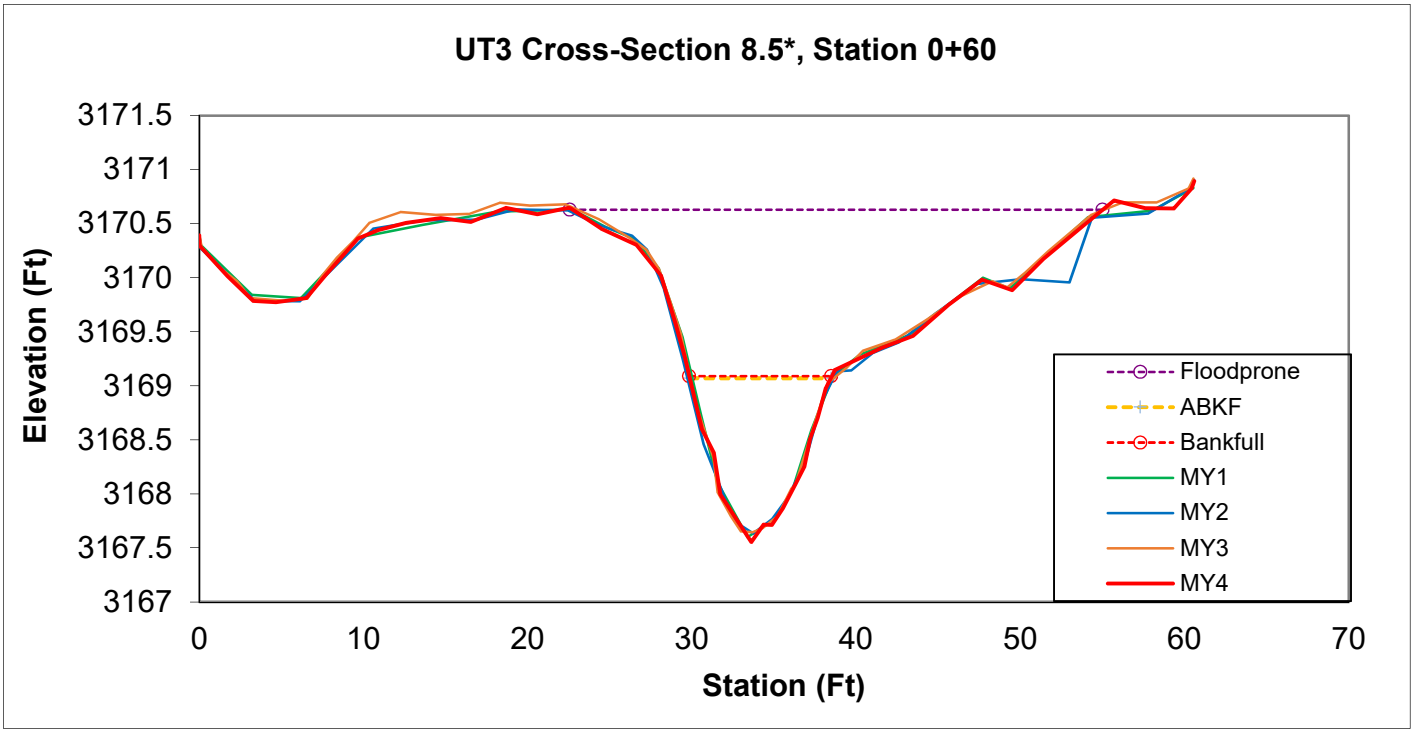
Looking at the Left Bank

Looking at the Right Bank

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-section 8.5
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Pool	-	8.09	8.67	0.93	1.54	9.32	1.06	6.13	3169.09	3169.17	1.61



Looking at the Left Bank

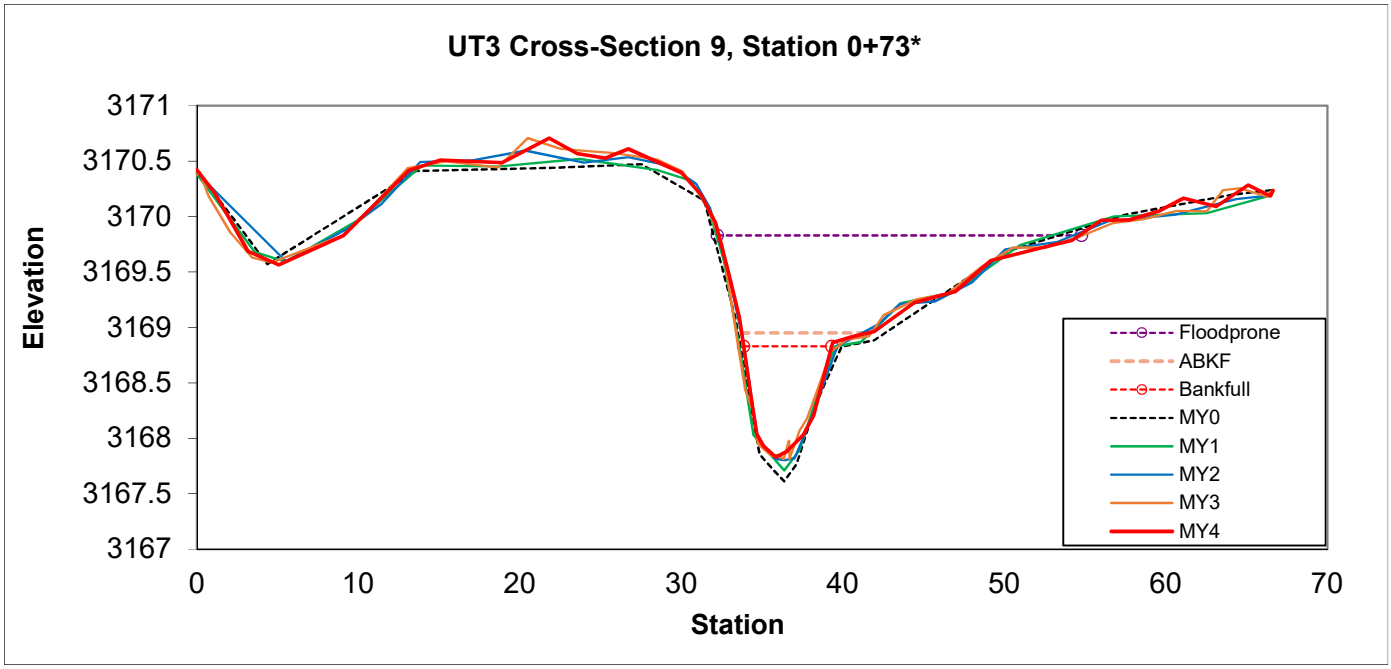
Looking at the Right Bank

* This Pool cross-section was not taken for the baseline but was added during MY1 survey and will be continued each year going forward.

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-section 9
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Riffle	E	3.76	5.45	0.69	1.00	7.90	0.96	5.29	3168.83	3168.87	1.08



Looking at the Left Bank

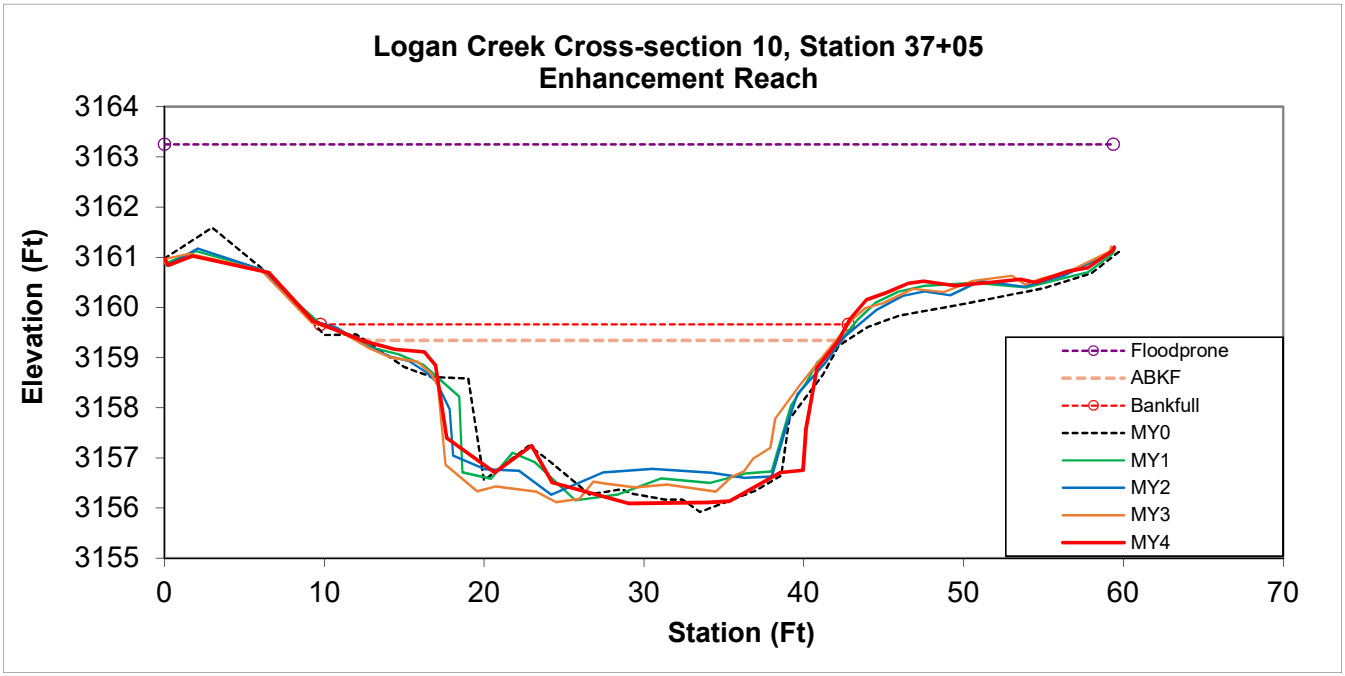
Looking at the Right Bank

* The stationing shown on this cross section plot has been changed to correct an error shown in the MY0 plots.

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-section 10
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Pool	-	77.11	32.98	2.34	3.58	14.09	1.25	1.80	3159.66	3160.16	4.04



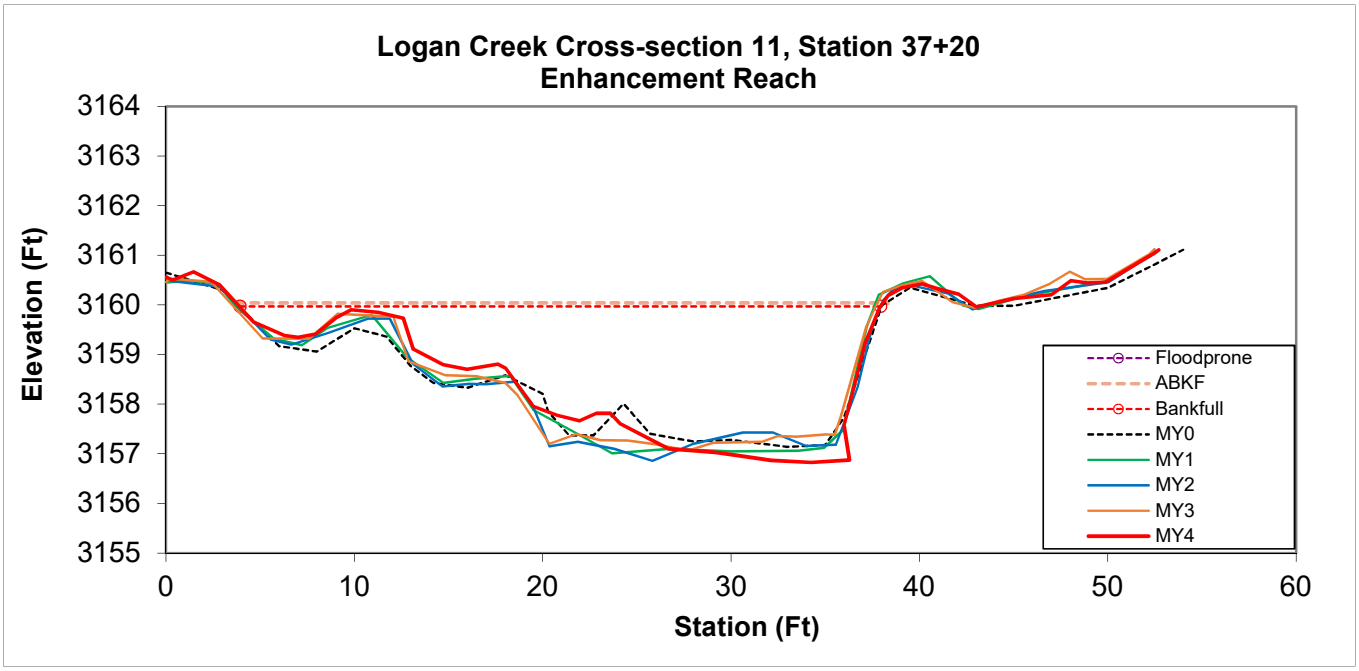
Looking at the Left Bank

Looking at the Right Bank

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-section 11
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Riffle	B	58.32	34.16	1.71	3.14	19.98	1.14	1.54	3159.97	3160.44	3.64



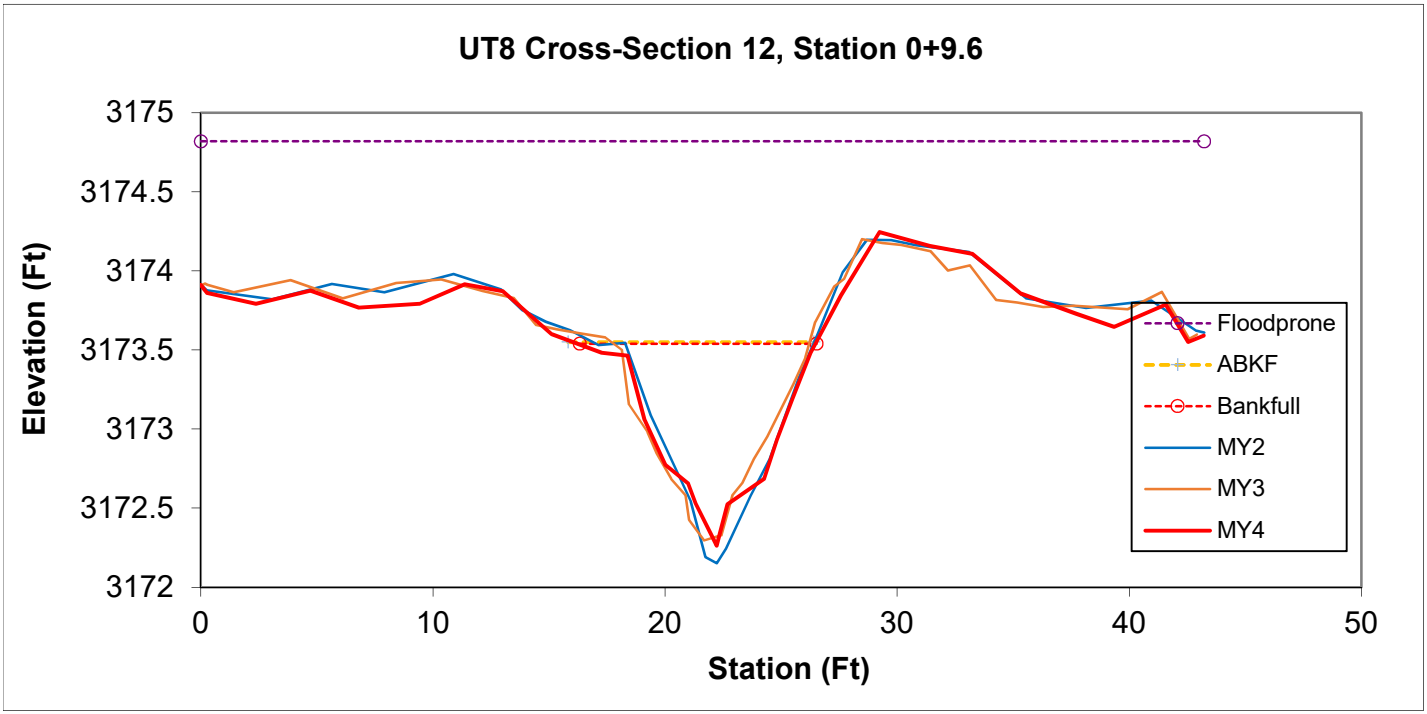
Looking at the Left Bank

Looking at the Right Bank

Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Permanent Cross-section 12
(MY4 Data - collected October, 2018)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev	Low TOB Depth
Riffle	C	5.92	10.25	0.58	1.28	17.67	0.93	4.22	3173.54	3173.46	1.20



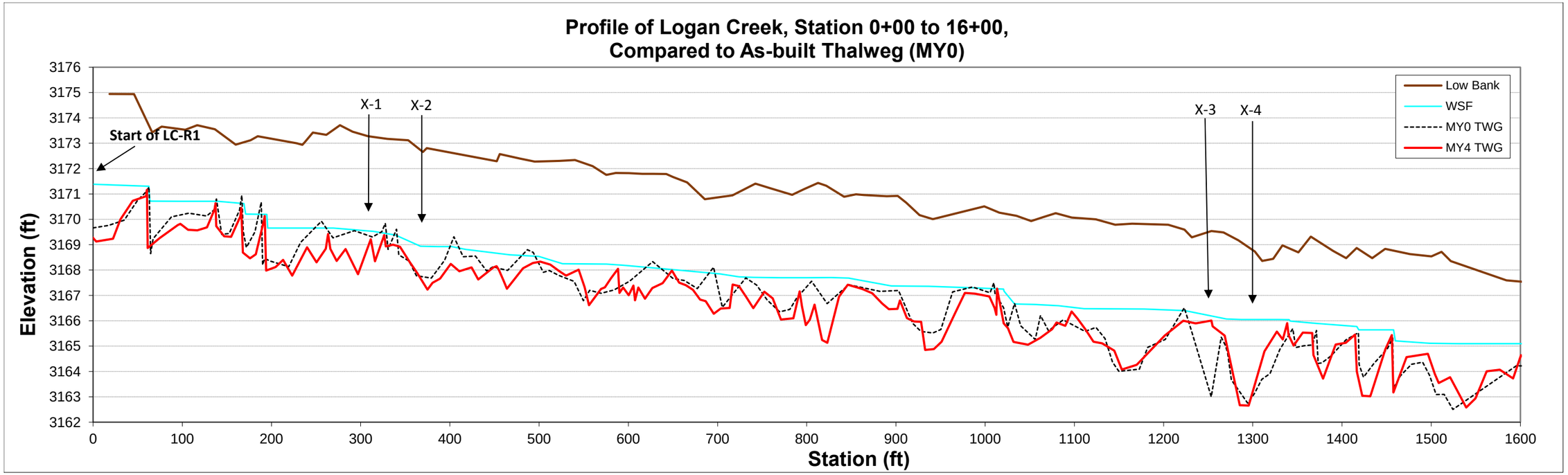
Looking at the Left Bank

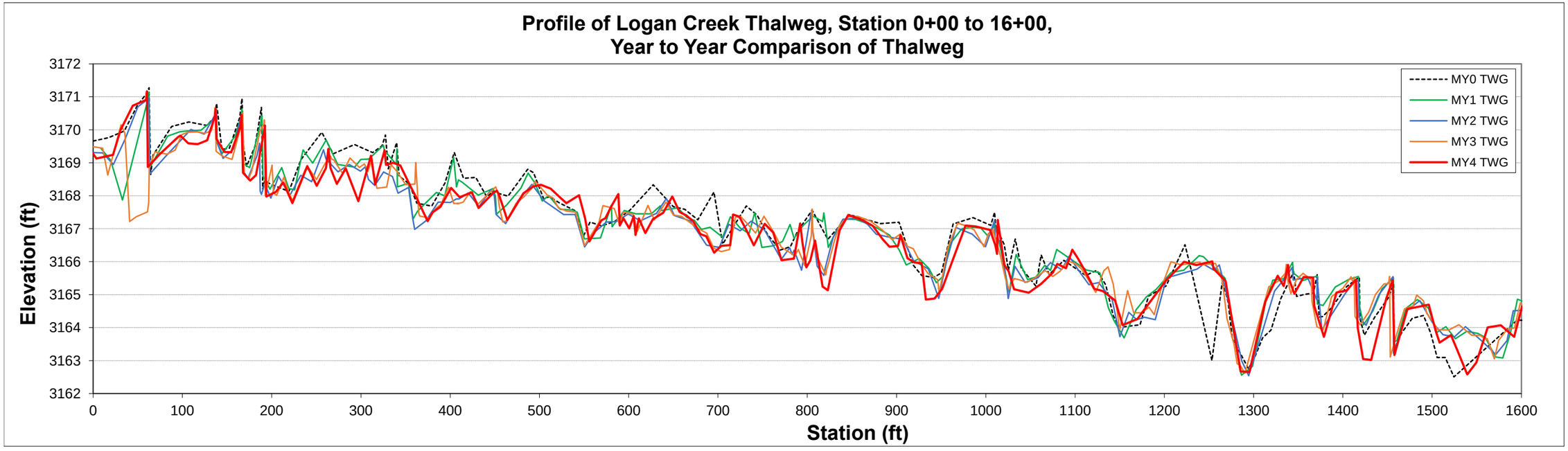
Looking at the Right Bank

*This Riffle cross-section was not taken during AB or MY1 surveys but was added in MY2 and will be continued each year going forward.

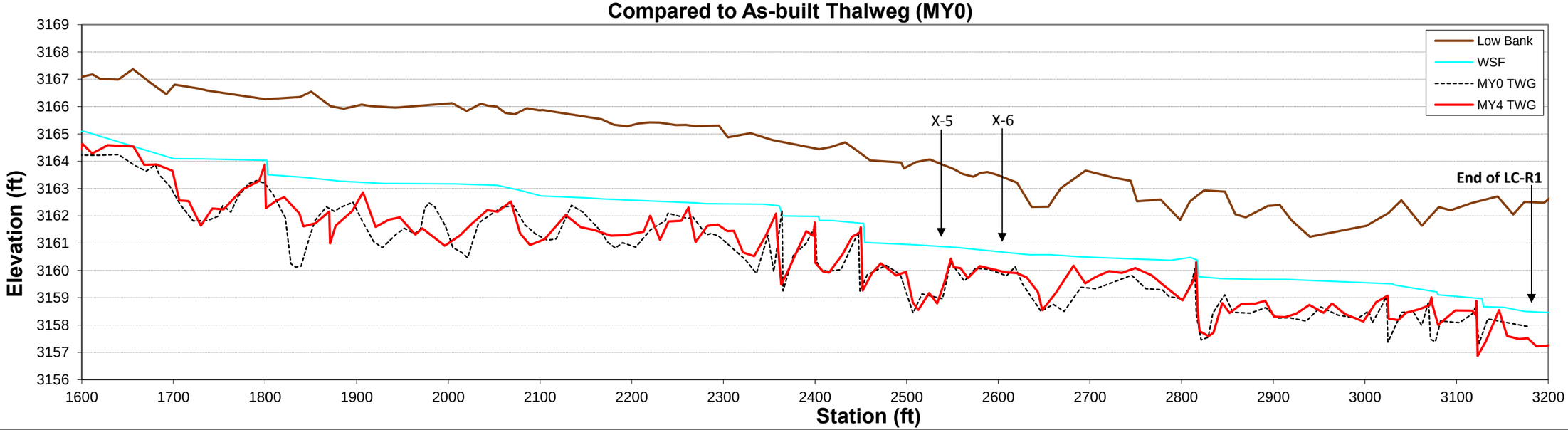
Note: ABKF stands for as-built bankfull which represents the bankfull line held at the as-built cross sectional area.

Figure 7. Longitudinal Profiles with Annual Overlays

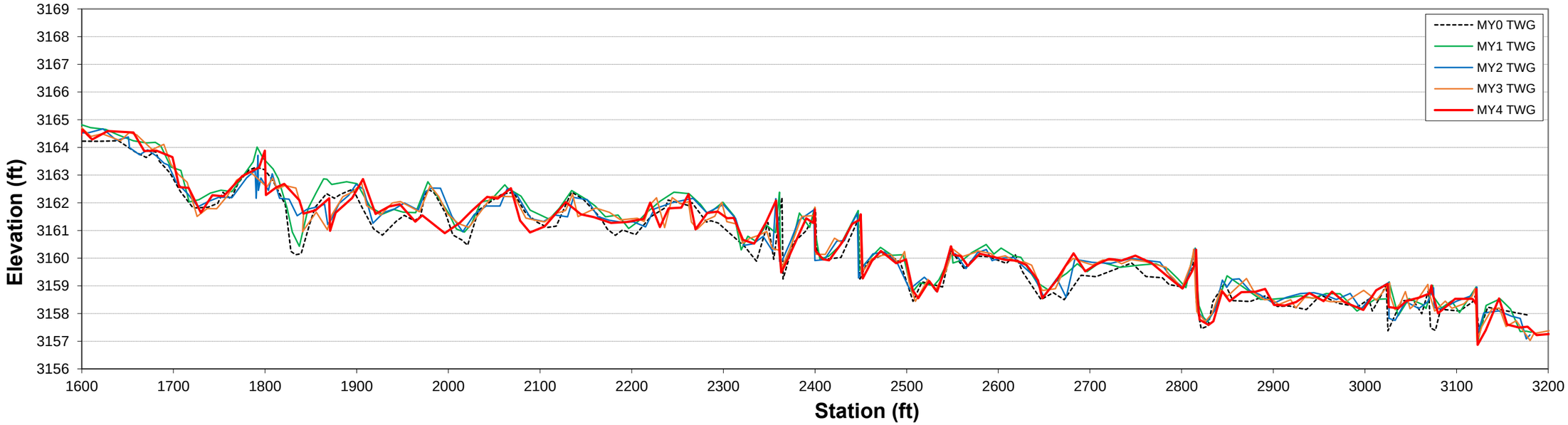


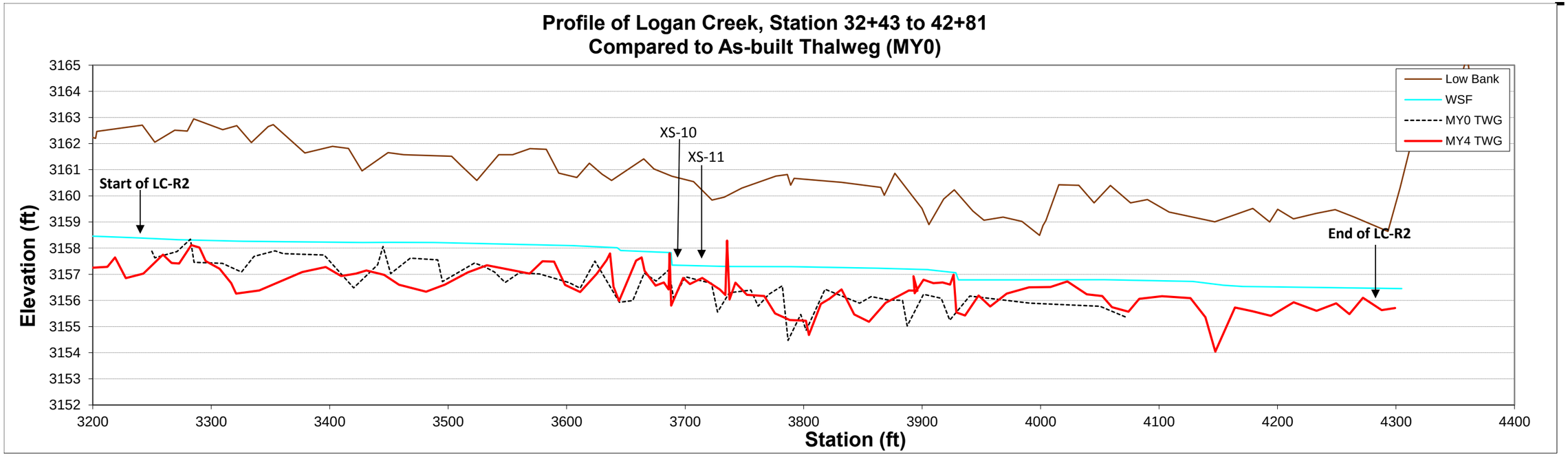


Profile of Logan Creek, Station 16+00 to 32+00
Compared to As-built Thalweg (MY0)

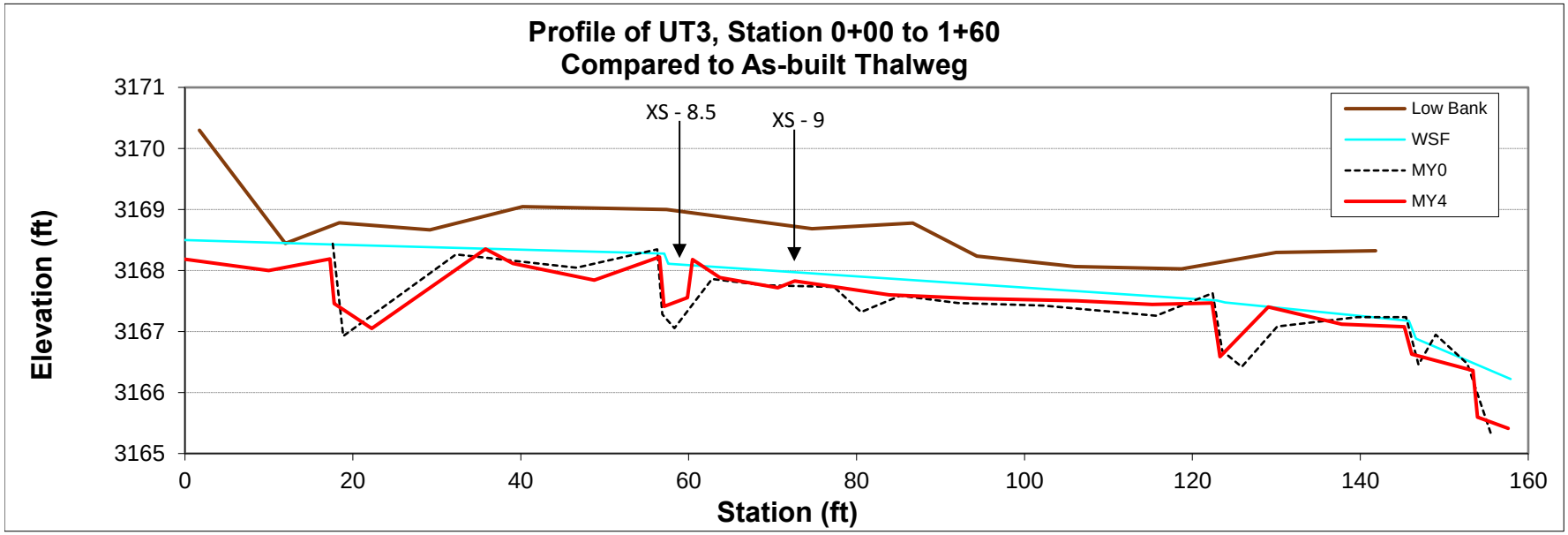


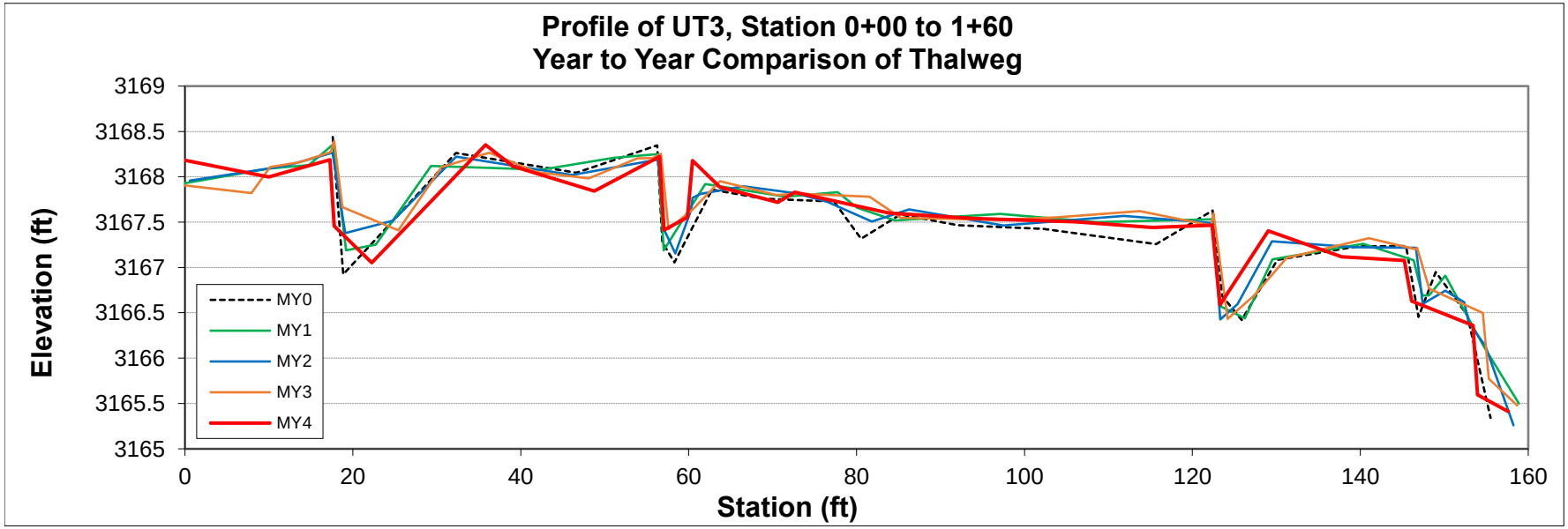
Profile of Logan Creek Thalweg, Station 16+00 to 32+00
Year to Year Comparison of Thalweg

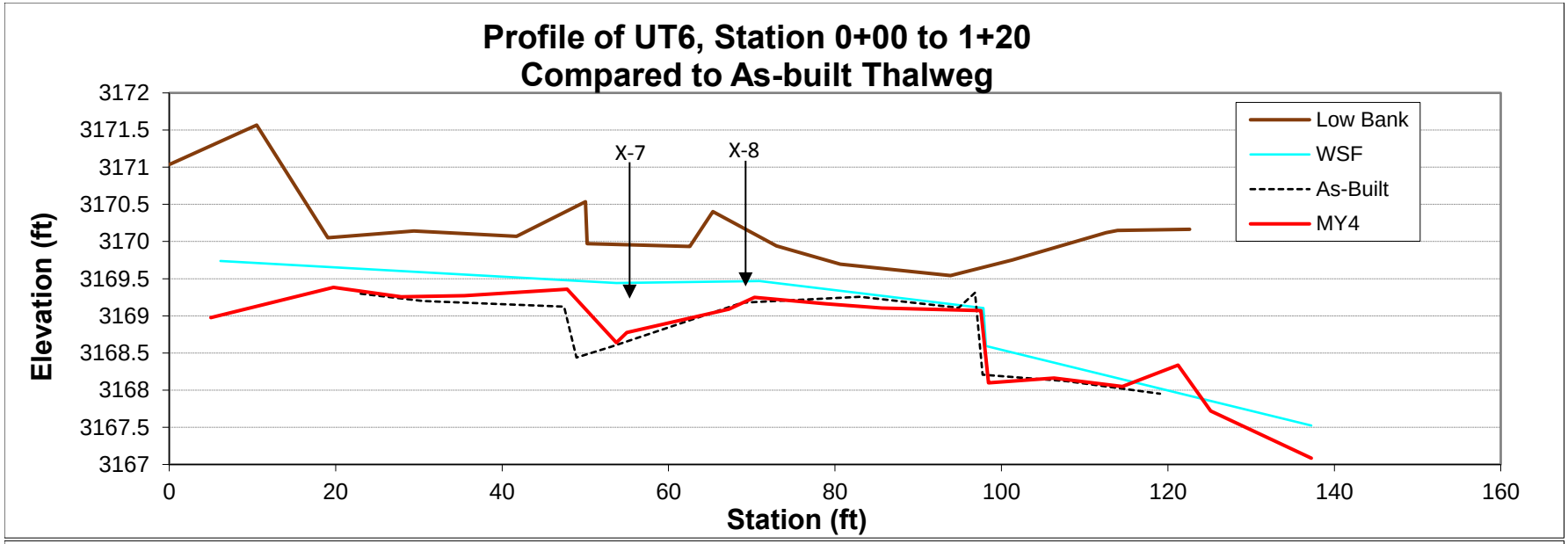


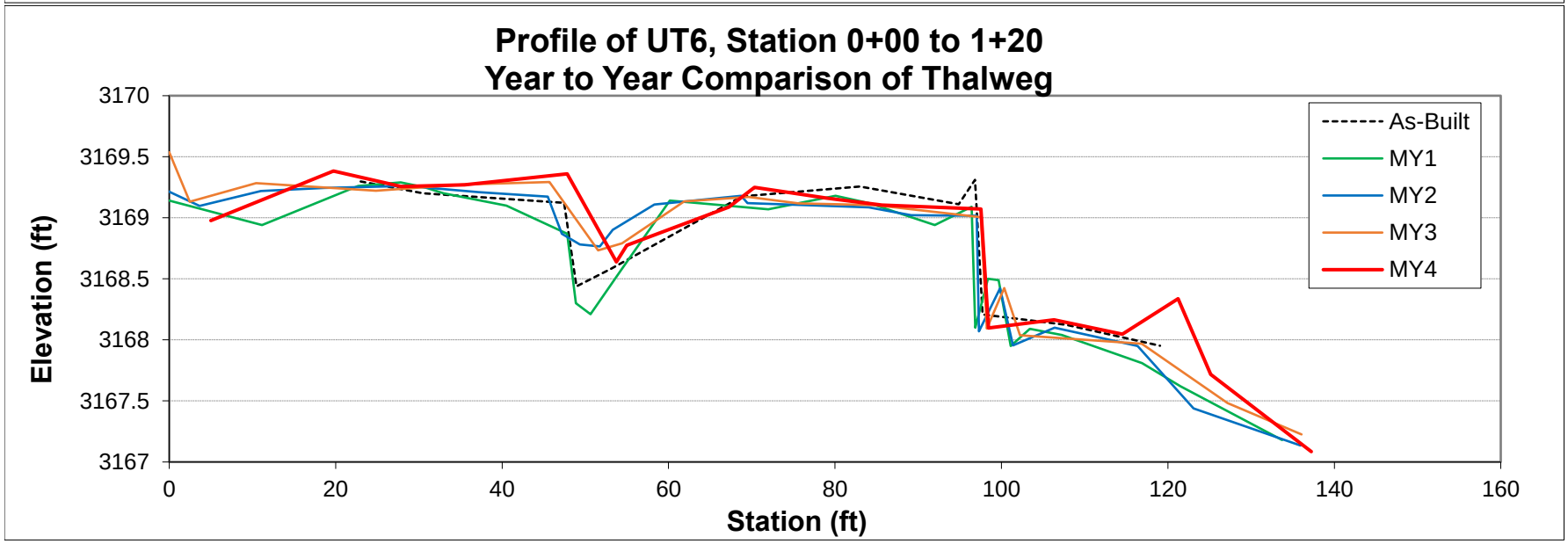

Profile of Logan Creek, Station 32+43 to 42+81
Compared to As-built Thalweg (MY0)
Elevation (ft)
Station (ft)
Start of LC-R2
XS-10
XS-11
End of LC-R2
Low Bank
WSF
MY0 TWG
MY4 TWG
3165
3164
3163
3162
3161
3160
3159
3158
3157
3156
3155
3154
3153
3152
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
4200
4300
4400

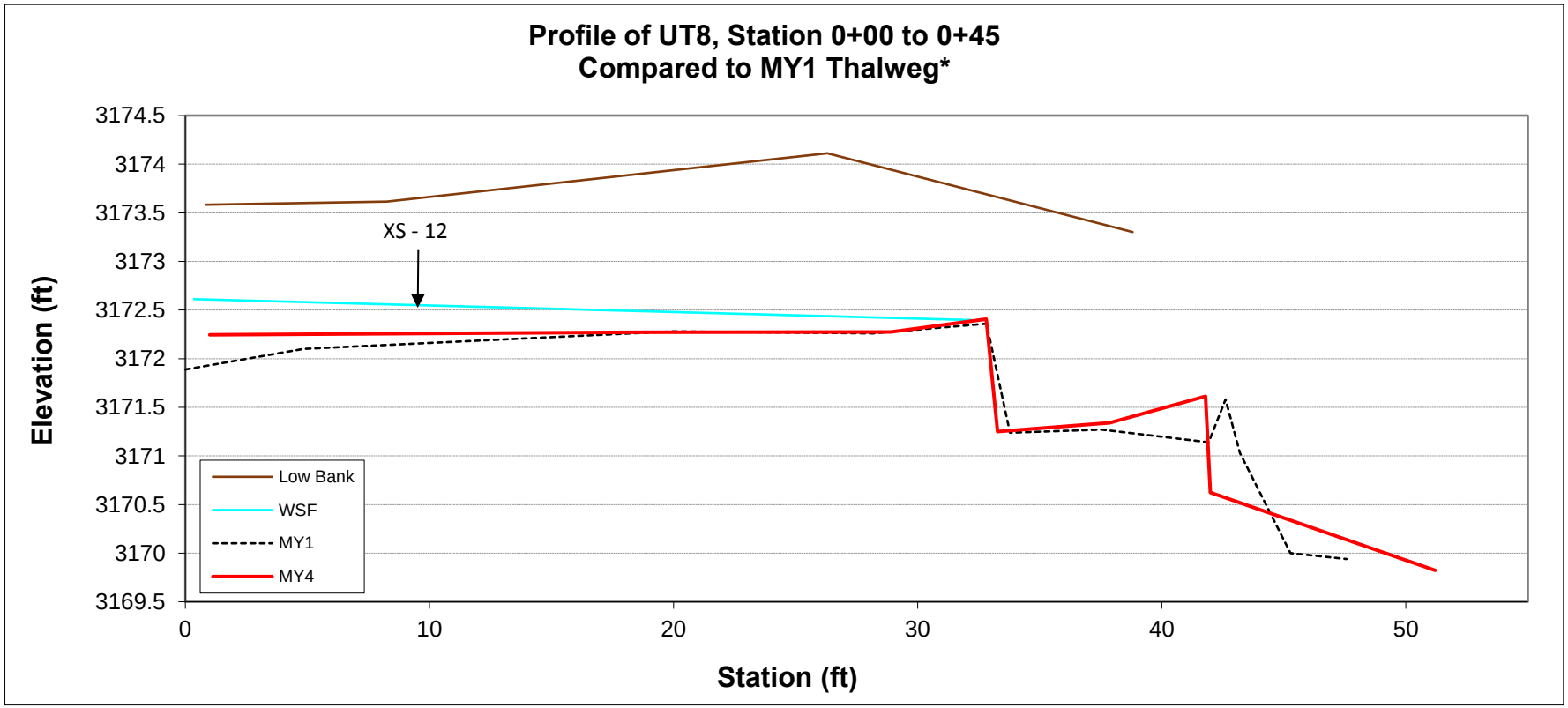
Profile of Logan Creek Thalweg, Station 32+43 to 42+81
Year to Year Comparison of Thalweg
Elevation (ft)
Station (ft)
MY0 TWG
MY1 TWG
MY2 TWG
MY3 TWG
MY4 TWG
3165
3164
3163
3162
3161
3160
3159
3158
3157
3156
3155
3154
3153
3152
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
4200
4300
4400


Profile of UT3, Station 0+00 to 1+60
Compared to As-built Thalweg
Elevation (ft)
Station (ft)
XS - 8.5
XS - 9
Low Bank
WSF
MY0
MY4
3171
3170
3169
3168
3167
3166
3165
0
20
40
60
80
100
120
140
160


Profile of UT3, Station 0+00 to 1+60
Year to Year Comparison of Thalweg
Elevation (ft)
Station (ft)
MY0
MY1
MY2
MY3
MY4
3169
3168.5
3168
3167.5
3167
3166.5
3166
3165.5
3165
0
20
40
60
80
100
120
140
160


Profile of UT6, Station 0+00 to 1+20
Compared to As-built Thalweg
Elevation (ft)
Station (ft)
X-7
X-8
Low Bank
WSF
As-Built
MY4
3172
3171.5
3171
3170.5
3170
3169.5
3169
3168.5
3168
3167.5
3167
0
20
40
60
80
100
120
140
160


Profile of UT6, Station 0+00 to 1+20
Year to Year Comparison of Thalweg
Elevation (ft)
Station (ft)
As-Built
MY1
MY2
MY3
MY4
3170
3169.5
3169
3168.5
3168
3167.5
3167
0
20
40
60
80
100
120
140
160



* Note: This profile was added in MY1 because restoration credit is being requested for this reach. However, the profile on this reach was not surveyed and included in the MY0 report.

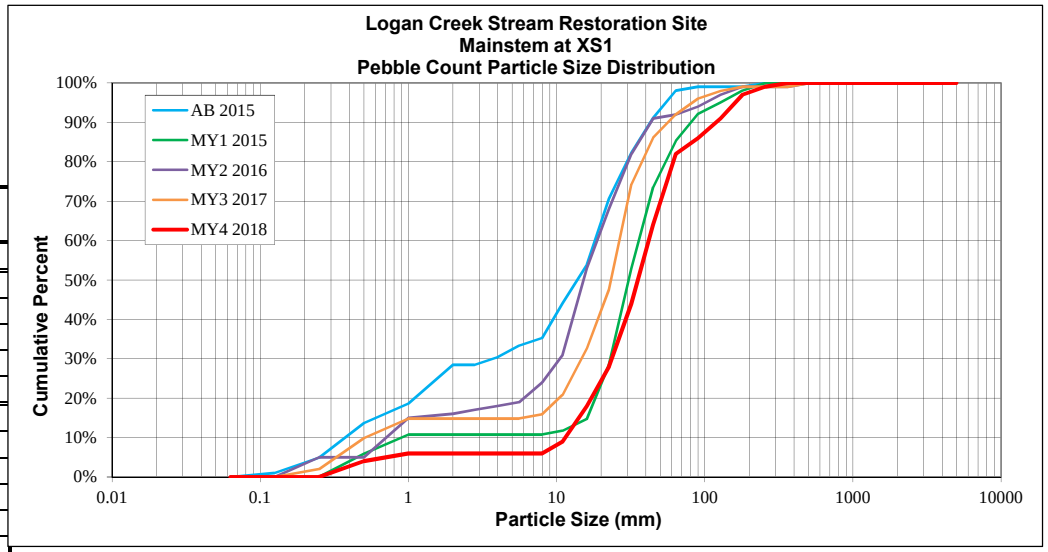
Figure 8 Pebble Count Plots with Annual Overlays.

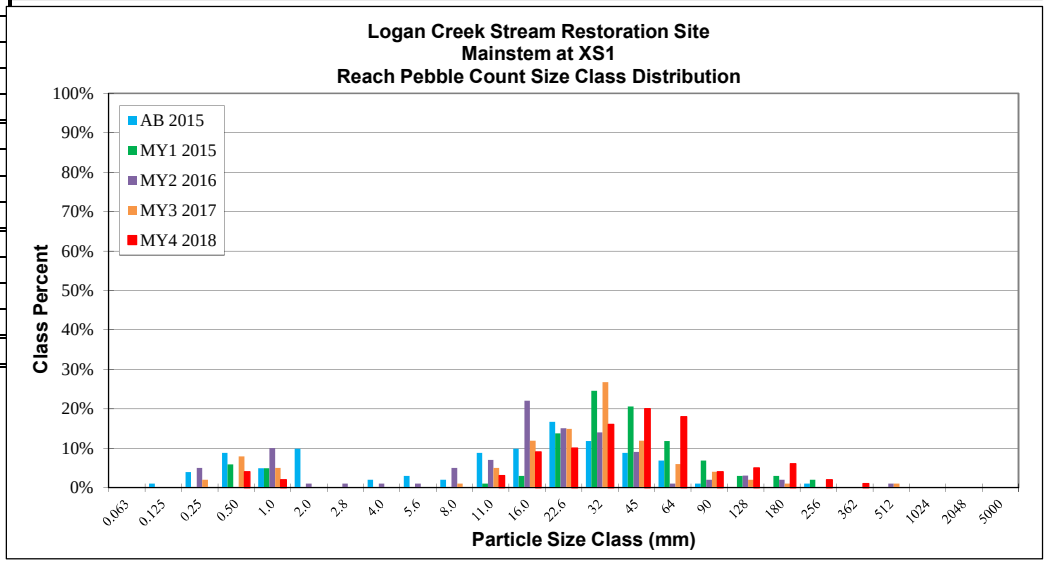
Cross-Section Pebble Count; Monitoring Year 4
Logan Creek Mitigation Project, DMS #92515

SITE OR PROJECT:	Logan Cr
REACH/LOCATION:	Riffle at XS1
FEATURE:	Riffle
DATE:	12-Oct-18

			MY4 2018			Distribution
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum	Plot Size (mm)
Silt/Clay	Silt / Clay	< .063			0%	0.063
Sand	Very Fine	.063 - .125			0%	0.125
	Fine	.125 - .25			0%	0.25
	Medium	.25 - .50	4	4%	4%	0.50
	Coarse	.50 - 1.0	2	2%	6%	1.0
	Very Coarse	1.0 - 2.0			6%	2.0
Gravel	Very Fine	2.0 - 2.8			6%	2.8
	Very Fine	2.8 - 4.0			6%	4.0
	Fine	4.0 - 5.6			6%	5.6
	Fine	5.6 - 8.0			6%	8.0
	Medium	8.0 - 11.0	3	3%	9%	11.0
	Medium	11.0 - 16.0	9	9%	18%	16.0
	Coarse	16 - 22.6	10	10%	28%	22.6
	Coarse	22.6 - 32	16	16%	44%	32
	Very Coarse	32 - 45	20	20%	64%	45
	Very Coarse	45 - 64	18	18%	82%	64
Cobble	Small	64 - 90	4	4%	86%	90
	Small	90 - 128	5	5%	91%	128
	Large	128 - 180	6	6%	97%	180
	Large	180 - 256	2	2%	99%	256
Boulder	Small	256 - 362	1	1%	100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
Bedrock	Bedrock	> 2048			100%	5000
Total % of whole count			100	100%		

Summary Data			
Channel materials			
D16 =	14.7	D84 =	75.9
D35 =	26.3	D95 =	160.7
D50 =	35.4	D100 =	256 - 362



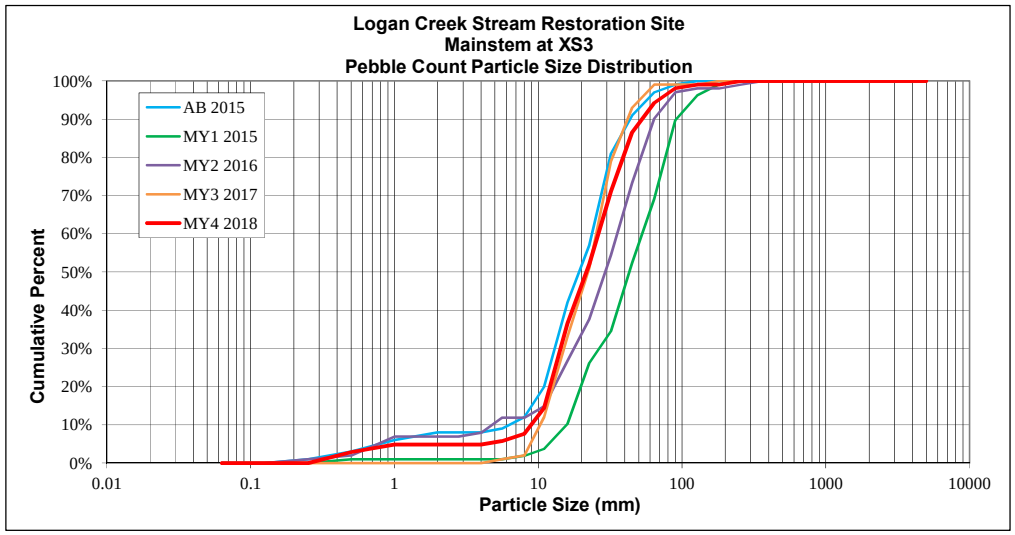


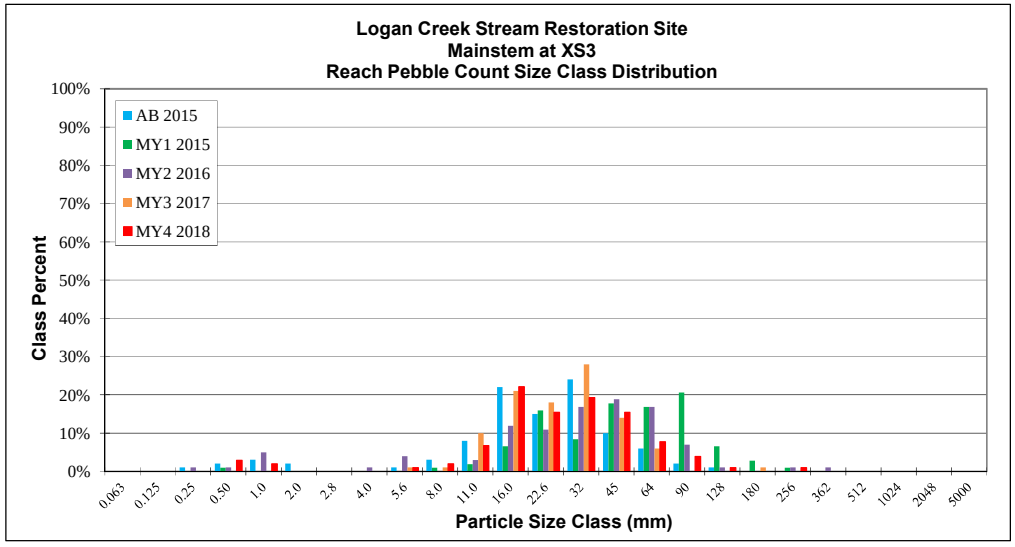
Cross-Section Pebble Count; Monitoring Year 4
Logan Creek Mitigation Project, DMS #92515

SITE OR PROJECT:	Logan Cr
REACH/LOCATION:	Riffle at XS3
FEATURE:	Riffle
DATE:	12-Oct-18

			MY4 2018			Distribution
MATERIAL	**PARTICLE**	**SIZE (mm)**	**Total**	**Class %**	**% Cum**	**Plot Size (mm)**
Silt/Clay	Silt / Clay	< .063			0%	0.063
Sand	Very Fine	.063 - .125			0%	0.125
	Fine	.125 - .25			0%	0.25
	Medium	.25 - .50	3	3%	3%	0.50
	Coarse	.50 - 1.0	2	2%	5%	1.0
	Very Coarse	1.0 - 2.0			5%	2.0
Gravel	Very Fine	2.0 - 2.8			5%	2.8
	Very Fine	2.8 - 4.0			5%	4.0
	Fine	4.0 - 5.6	1	1%	6%	5.6
	Fine	5.6 - 8.0	2	2%	8%	8.0
	Medium	8.0 - 11.0	7	7%	14%	11.0
	Medium	11.0 - 16.0	23	22%	37%	16.0
	Coarse	16 - 22.6	16	15%	52%	22.6
	Coarse	22.6 - 32	20	19%	71%	32
	Very Coarse	32 - 45	16	15%	87%	45
	Very Coarse	45 - 64	8	8%	94%	64
Cobble	Small	64 - 90	4	4%	98%	90
	Small	90 - 128	1	1%	99%	128
	Large	128 - 180			99%	180
	Large	180 - 256	1	1%	100%	256
Boulder	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
Bedrock	Bedrock	> 2048			100%	5000
Total % of whole count			104	100%		

Summary Data			
Channel materials			
D16 =	11.3	D84 =	42.5
D35 =	15.6	D95 =	68.5
D50 =	21.6	D100 =	180 - 256



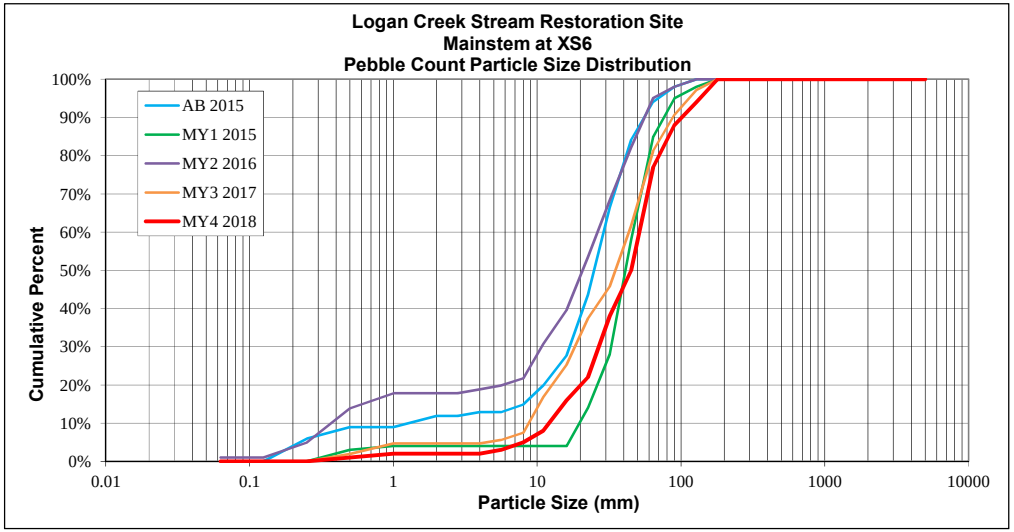


Cross-Section Pebble Count; Monitoring Year 4
Logan Creek Mitigation Project, DMS #92515

SITE OR PROJECT:	Logan Cr
REACH/LOCATION:	Riffle at XS6
FEATURE:	Riffle
DATE:	12-Oct-18

			MY4 2018			Distribution
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum	Plot Size (mm)
Silt/Clay	Silt / Clay	< .063			0%	0.063
Sand	Very Fine	.063 - .125			0%	0.125
	Fine	.125 - .25			0%	0.25
	Medium	.25 - .50	1	1%	1%	0.50
	Coarse	.50 - 1.0	1	1%	2%	1.0
	Very Coarse	1.0 - 2.0			2%	2.0
Gravel	Very Fine	2.0 - 2.8			2%	2.8
	Very Fine	2.8 - 4.0			2%	4.0
	Fine	4.0 - 5.6	1	1%	3%	5.6
	Fine	5.6 - 8.0	2	2%	5%	8.0
	Medium	8.0 - 11.0	3	3%	8%	11.0
	Medium	11.0 - 16.0	8	8%	16%	16.0
	Coarse	16 - 22.6	6	6%	22%	22.6
	Coarse	22.6 - 32	16	16%	38%	32
	Very Coarse	32 - 45	12	12%	50%	45
	Very Coarse	45 - 64	27	27%	77%	64
Cobble	Small	64 - 90	11	11%	88%	90
	Small	90 - 128	6	6%	94%	128
	Large	128 - 180	6	6%	100%	180
	Large	180 - 256			100%	256
Boulder	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
Bedrock	Bedrock	> 2048			100%	5000
Total % of whole count			100	100%		

Summary Data			
Channel materials			
D16 =	16.0	D84 =	79.5
D35 =	30.0	D95 =	135.5
D50 =	45.0	D100 =	128 - 180



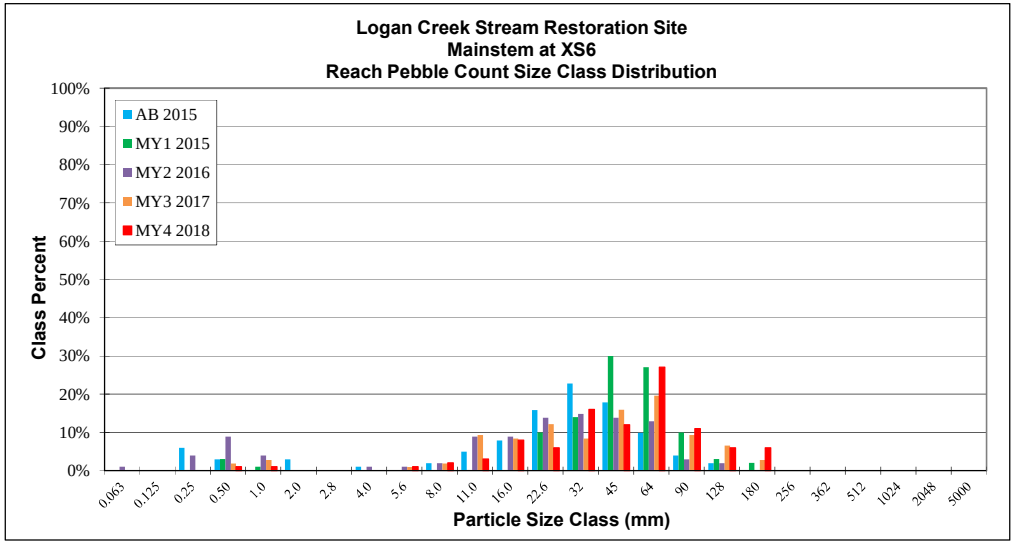


Table 10. Monitoring Year 4 Stream Summary
Logan Creek Restoration Project; DMS Project ID No. 94645

Logan Creek Mainstem

Parameter	USGS Gauge	Regional Curve Interval [1]			Pre-Existing Condition						Reference Reach Data – Right Prong Logan Creek						Design						As-built						MY1						MY2						MY3						MY4					
Dimension and Substrate - Riffl		NC Mtn.	Regional	Curve	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	-	26.4	28.3	-	22.9	27.3	23.8	38.7	6.6	4	-	16.7	-	-	-	-	-	26.0	-	-	-	-	23.6	24.3	24.1	25.2	0.67	3	22.6	23.7	24.0	24.3	0.77	3	22.5	26.2	24.3	33.9	4.50	4	22.4	26.2	24.1	34.1	4.62	4	22.6	26.7	25.1	34.2	4.46	4
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	35.0	-	-	-	-	-	150.00	-	-	-	-	-	>150	-	-	-	3	-	>150	-	-	-	3	>54	>80	-	>100	-	4	>54	>80	-	>100	-	4	>54	>80	-	>100	-	4
BF Mean Depth (ft)	-	1.4	1.5	-	1.50	2.2	2.4	2.60	0.4	4	-	1.06	-	-	-	-	-	2.3	-	-	-	-	2.1	2.3	2.2	2.6	0.21	3	1.8	2.2	2.2	2.7	0.32	4	1.7	2.2	2.2	2.7	0.34	4	1.7	2.1	2.2	2.5	0.28	4
BF Max Depth (ft)	-	-	-	-	3.4	3.6	3.5	3.8	0.2	4	-	1.54	-	-	-	-	-	4.0	-	-	-	-	3.1	3.4	3.4	3.7	0.24	3	2.9	3.4	3.5	4.0	0.45	3	3.0	3.5	3.4	4.3	0.53	4	2.9	3.5	3.3	4.3	0.53	4	3.0	3.6	3.4	4.6	0.64	4
BF Cross-sectional Area (ft²)	-	37.5	42.7	-	55.8	58.0	58.4	59.5	1.36	4	-	17.7	-	-	-	-	-	58.5	-	-	-	-	51.7	56.0	53.2	63.0	5.01	3	50.2	54.6	51.2	62.4	5.53	3	51.4	57.7	57.3	64.8	5.74	4	50.8	56.8	55.9	64.7	5.60	4	49.1	55.9	54.9	64.9	6.19	4
Width/Depth Ratio	-	-	-	-	8.9	13.6	9.8	25.7	7.01	4	-	15.8	-	-	-	-	-	12	-	-	-	-	9.2	10.7	10.8	12.0	1.12	3	9.3	10.3	10.1	11.6	0.96	3	8.9	12.2	10.6	18.6	3.81	4	8.9	12.4	10.6	19.6	4.24	4	10.3	13.0	10.9	20.0	4.04	4
Entrenchment Ratio	-	-	-	-	3.4	11.3	12.0	17.8	5.83	4	-	2.0	-	-	-	-	-	5.8	-	-	-	-	2.9	3.6	3.9	4.0	0.50	3	2.9	3.7	4.0	4.1	0.54	3	1.6	3.2	3.5	4.2	1.06	4	1.5	3.2	3.5	4.2	1.08	4	1.5	3.1	3.4	4.2	1.10	4
Bank Height Ratio	-	-	-	-	1	1.2	1.1	1.5	0.2	4	-	1.2	-	-	-	-	-	1.0	-	-	-	-	1.0	1.00	1.00	1.0	0.00	3	1.0	1.0	1.0	1.1	0.05	3	1.0	1.1	1.0	1.2	0.09	4	1.0	1.0	1.0	1.1	0.04	4	1.01	1.05	1.02	1.14	0.06	4
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.4	-	-	-	-	12.4	12.4	12.4	12.4	0.00	1	30.7	38.3	41.1	43.0	5.41	3	15.2	21.7	20.7	29.2	5.8	3	22.2	26.8	23.3	35.0	5.8	3	21.6	34.0	34.7	45.0	8.3	3
Pattern																																																		
Channel Beltwidth (ft)	-	-	-	-	194	216	217	252	18.13	7	-	80	-	-	-	-	65	-	-	140	-	-	130.0	193.2	190.0	258.0	41.45	6	130.0	193.2	190.0	258.0	41.5	6	130.0	193.2	190.0	258.0	41.5	6	130.0	193.2	190.0	258.0	41.5	6	130.0	193.2	190.0	258.0	41.5	6
Radius of Curvature (ft)	-	-	-	-	23	32	30	46	8.6	5	-	23	-	-	-	-	28	63.9	-	75	-	12	44.0	63.9	66.1	104.0	17.17	9	44.0	63.9	66.1	104.0	17.2	9	44.0	63.9	66.1	104.0	17.2	9	44.0	63.9	66.1	104.0	17.2	9	44.0	63.9	66.1	104.0	17.2	9
Rc:Bankfull width (ft/ft)	-	-	-	-	0.85	1.19	1.11	1.7	0.32	5	-	1.38	-	-	-	-	1.1	-	-	2.9	-	-	1.80	2.60	2.70	4.30	0.71	9	1.80	2.60	2.70	4.30	0.71	9	1.80	2.60	2.70	4.30	0.71	9	1.80	2.60	2.70	4.30	0.71	9	1.80	2.60	2.70	4.30	0.71	9
Meander Wavelength (ft)	-	-	-	-	120	177	197	239	46.75	5	-	150	-	-	-	-	118	-	-	236	-	-	145.0	236.7	244.5	321.0	48.10	12	145.0	236.7	244.5	321.0	48.1	12	145.0	236.7	244.5	321.0	48.1	12	145.0	236.7	244.5	321.0	48.1	12	145.0	236.7	244.5	321.0	48.1	12
Meander Width Ratio	-	-	-	-	4.44	6.56	7.3	8.85	1.73	5	-	4.8	-	-	-	-	2.5	-	-	5.4	-	-	6.0	9.7	10.1	13.2	1.98	12	6.0	9.7	10.1	13.2	2.0	12	6.0	9.7	10.1	13.2	2.0	12	6.0	9.7	10.1	13.2	2.0	12	6.0	9.7	10.1	13.2	2.0	12
Profile																																																		
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.7	68.1	65.3	149.8	31.6	16	18.6	90.5	93.5	162.3	47.4	9	40.6	105.7	90.6	238.8	61.8	9	27.5	103.3	80.6	220.2	65.3	9
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	0.003	-	-	0.007	-	-	-	-	-	-	-	-	0.0009	0.0079	0.0049	0.0218	0.0065	16	0.0025	0.0076	0.0075	0.0162	0.0042	9	0.0060	0.0046	0.0034	0.0118	0.0036	9	0.0031	0.0078	0.0064	0.0129	0.0033	9
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31.0	66.4	64.5	112.2	25.4	19	48.1	89.2	82.2	150.6	29.1	14	24.2	89.2	82.2	150.6	29.1	14	28.5	90.1	84.5	208.8	45.2	14
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	94	-	-	165	-	-	-	-	-	-	-	-	86.6	148.6	143.5	292.6	51.9	20	50	127.4	119.8	264	46.3	24	38	152.3	126.5	524	109.0	24	52.1	141.7	132.8	239.5	54.6	23
Pool Max Depth (ft)	-	2.5	-	-	2.9	3.8	4.0	4.5	0.64	3	-	2.28	-	-	-	-	-	6.00	-	-	-	-	5.2	5.3	5.2	5.4	0.1	3	5.1	5.4	5.3	5.9	0.36	3	5	5.3	5.4	5.4	0.15	3	3	3.3	3.3	3.9	0.40	4	2.0	2.5	2.5	3.0	0.4	4
Pool Volume (ft³)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Substrate and Transport Parameters																																																	
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SC% / Sa% / G% / B% / Be%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d16 / d35 / d50 / d84 / d95	-	-	-	-	-	0.8 / 5.8 / 12.4 / 35.4 / 169.6					-	-	-	-	-	-	-	-	-	-	-	-	-	mean 5.1 / 10.9 / 16.5 / 34.8 / 55.9						-	mean 17.3/ 28.6 / 36.9 / 71.8 / 123.1						-	mean 6.7/ 16.3 / 22.2 / 45.4 / 91.4						-	mean 10.2 / 18.2 / 26.8 / 49.7 / 82.2						-	mean 14.0 / 24.0 / 34.0 / 66.0 / 121.6					
Reach Shear Stress (competency) lb/ft²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stream Power (transport capacity) W/m²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Additional Reach Parameter																																																	
Drainage Area (SM)	-	2.1 to 2.67			2.1 at upper end of project to 2.67 towards end of project						-	0.83	-	-	-	-	2.1 at upper end of project to 2.67 towards end of project						2.1 at upper end of project to 2.67 towards end of project						2.1 at upper end of project to 2.67 towards end of project						2.1 at upper end of project to 2.67 towards end of project						2.1 at upper end of project to 2.67 towards end of project						2.1 at upper end of project to 2.67 towards end of project					
Impervious cover estimate (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.67	-	-	-	-	-	2.67	-	-	-	-	-	2.67	-	-	-	-	-	2.67	-	-	-	-	-	2.67	-	-	-	-	-	2.67	-	-	-	-
Rosgen Classification	-	-	-	-	-	C4 to E4					-	C4	-	-	-	-	-	C4	-	-	-	-	-	C4	-	-	-	-	-	C4	-	-	-	-	-	C4	-	-	-	-	-	C4	-	-	-	-	-	C4	-	-	-	-
BF Velocity (fps)	-	-	-	-	-	-	-	-	-	-	-	3.55	-	-	-	-	-	4.31	-	-	-	-	-	4.33	-	-	-	-	-	4.20	-	-	-	-	-	4.20	-	-	-	-	-	4.20	-	-	-	-	-	4.20	-	-	-	-
BF Discharge (cfs)	-	205.7	237.0		-	-	-	-	-	-	-	98	-	-	-	-	-	271.5	-	-	-	-	-	242.6	-	-	-	-	-	264.8	-	-	-	-	-	264.8	-	-	-	-	-	264.8	-	-	-	-	-	264.8	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel length (ft)	-	-	-	-	-	4,700	-	-	-	-	-	2,101	-	-	-	-	-	4,101	-	-	-	-	-	4,172	-	-	-	-	-	4,172	-	-	-	-	-	4,172	-	-	-	-	-	4,172	-	-	-	-	-	4,172	-	-	-	-
Sinuosity	-	-	-	-	-	-	-	-	-	-	-	2.01	-	-	-	-	-	1.3	-	-	-	-	-	1.31	-	-	-	-	-	1.34	-	-	-	-	-	1.34	-	-	-	-	-	1.34	-	-	-	-	-	1.34	-	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.0079	-	-	-	-	-	0.0035	-	-	-	-	-	0.0039	-	-	-	-	-	0.0033	-	-	-	-	-	0.0033	-	-	-	-	-	0.0033	-	-	-	-	-	0.0033	-	-	-	-
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.016	-	-	-	-	-	0.0047	-	-	-	-	-	0.0052	-	-	-	-	-	0.0044	-	-	-	-	-	0.0044	-	-	-	-	-	0.0044	-	-	-	-	-	0.0044	-	-	-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BEHI VL% / L% / M% / H% / VH% / E%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel Stability or Habitat Metric	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biological or Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Harman, W.A., D.E Wise, M.A. Walker, R. Morris, MA Cantrell, M. Clemmons, G.D. Jennings, D.R. Clinton, J.M. Patterson. 2000. Bankfull Regional Curves for North Carolina Mountain Streams. In: AWRA Conference Proceedings, D.L. Kane, editor. American Water Resources Specialty Conference on Water Resources in Extreme Environments. Anchorage, Alaska.

UT3

Parameter	USGS Gauge	Regional Curve Interval [1]			Pre-Existing Condition						Reference Reach Data – Morgan Creek						Design						As-built						MY1						MY2						MY3						MY4					
Dimension and Substrate - Riffl		NC Mtn./NC Pied.		Rural	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	-	5.3	4.1	-	-	-	-	-	-	-	-	16.7	-	-	-	-	-	6.0	-	-	-	-	6.1	6.2	6.2	6.3	0.06	2	-	5.9	-	-	-	1	-	5.8	-	-	-	1	-	6.2	-	-	-	1	-	5.5	-	-	-	1
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	35.0	-	-	-	-	-	>27	-	-	-	-	-	28.1	-	-	-	1	-	22.6	-	-	-	1	-	22.6	-	-	-	1	-	22.6	-	-	-	1	-	22.6	-	-	-	1
BF Mean Depth (ft)	-	0.4	0.5	-	-	-	-	-	-	-	-	1.06	-	-	-	-	0.7	-	-	-	-	-	0.70	0.70	0.70	0.80	0.02	2.00	-	0.70	-	-	-	1	-	0.70	-	-	-	1	-	0.60	-	-	-	1	-	0.69	-	-	-	1
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	1.54	-	-	-	-	-	-	-	-	-	-	1.1	1.2	1.2	1.2	0.0	2	-	1.1	-	-	-	1	-	1.0	-	-	-	1	-	1.0	-	-	-	1	-	1.0	-	-	-	1
BF Cross-sectional Area (ft²)	-	1.9	4.1	-	-	-	-	-	-	-	-	17.7	-	-	-	-	4.2	-	-	-	-	-	4.5	4.6	4.6	4.6	0.1	2	-	4.1	-	-	-	1	-	4.0	-	-	-	1	-	3.8	-	-	-	1	-	3.8	-	-	-	1
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	15.8	-	-	-	-	-	-	-	-	-	-	8.1	8.4	8.4	8.7	0.3	2	-	8.5	-	-	-	1	-	8.4	-	-	-	1	-	9.9	-	-	-	1	-	7.9	-	-	-	1
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	4.3	5.5	5.5	6.6	1.2	2	-	4.0	-	-	-	1	-	3.9	-	-	-	1	-	4.9	-	-	-	1	-	5.3	-	-	-	1
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	0.0	2	-	1.0	-	-	-	1	-	1.0	-	-	-	1	-	1.1	-	-	-	1	-	0.96	-	-	-	1
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pattern																																																		
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rc:Bankfull width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	1.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	4.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profile																																																		
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.0	31.8	19.0	77.0	26.3	4	14.3	18.7	14.9	30.5	6.9	4	27.1	43.8	43.8	60.5	16.7	2	24.1	42.8	39.3	64.9	16.8	3	15.3	31.5	20.3	58.7	19.4	3	20.7	35.6	24.4	61.8	18.6	3
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	0.0052	0.0107	0.0106	0.017	0.0041	4	0.0000	0.0078	0.0118	0.0140	0.0084	4	0.0000	0.0032	0.0032	0.0064	0.0032	2	0.0072	0.0092	0.0084	0.0121	0.0021	3	0.0049	0.0061	0.0065	0.0068	0.0008	3	0.0063	0.0202	0.0115	0.0427	0.0161	3
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.0	-	-	0	4	6.5	11.6	7.9	21.4	5.7	5	5.68	11.56	11.70	17.29	4.70	3	7.50	10.90	10.20	15.00	3.10	3	6.99	9.42	8.58	12.68	2.40	3	3.94	9.72	6.70	18.53	6.30	3
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	18.0	22.7	24.0	26.0	3.4	3	22.2	39.0	42.4	48.8	10.2	4	21.23	42.9	38.02	69.37	20	3	24.1	42.8	39.3	64.9	16.8	3	32.2	44.4	34.6	66.5	15.6	3	34.3	45.1	34.8	66.2	14.9	3
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	2.28	-	-	-	-	-	1.2	-	-	-	-	1.7	-	-	-	-	1	-	1.5	-	-	-	-	-	1.5	-	-	-	-	-	1.0	-	-	-	-	-	0.9	-	-	-	-
Pool Volume (ft³)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Substrate and Transport Parameters																																																		
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SC% / Sa% / G% / B% / Be%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d16 / d35 / d50 / d84 / d95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reach Shear Stress (competency) lb/ft²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stream Power (transport capacity) W/m²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Additional Reach Parameter																																																	
Drainage Area (SM)	-	0.05			0.05						-	0.83	-	-	-	-	-	-	-	-	-	-	-	0.05				-	0.05				-	0.05				-	0.05				-	0.05				-	0.05				-
Impervious cover estimate (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-
Rosgen Classification	-	-	-	-	-	-	-	-	-	-	-	C4	-	-	-	-	-	-	-	-	-	-	-	C	-	-	-	-	-	C	-	-	-	-	-	E	-	-	-	-	-	E	-	-	-	-	-	E	-	-	-	-
BF Velocity (fps)	-	-	-	-	-	-	-	-	-	7	-	3.55	-	-	-	-	-	4.27	-	-	-	-	-	4.81	-	-	-	-	-	4.81	-	-	-	-	-	4.81	-	-	-	-	-	4.81	-	-	-	-	-	4.81	-	-	-	-
BF Discharge (cfs)	-	7.8	18.3		-	-	-	-	-	-	-	98	-	-	-	-	-	271.5	-	-	-	-	-	212.2	-	-	-	-	-	22.1	-	-	-	-	-	22.1	-	-	-	-	-	22.1	-	-	-	-	-	22.1	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel length (ft)	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-	-	311.0	-	-	-	-	-	350	-	-	-	-	-	153	-	-	-	-	-	153	-	-	-	-	-	153	-	-	-	-	-	153	-	-	-	-
Sinuosity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	-	-	-	-	-	1.17	-	-	-	-	-	1.17	-	-	-	-	-	1.17	-	-	-	-	-	1.17	-	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.0079	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	0.0225	-	-	-	-	-	0.0225	-	-	-	-	-	0.0225	-	-	-	-	-	0.0225	-	-	-	-
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-	-	0.004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BEHI VL% / L% / M% / H% / VH% / E%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel Stability or Habitat Metric	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biological or Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Harman, W.A., D.E Wise, M.A. Walker, R. Morris, MA Cantrell, M. Clemmons, G.D. Jennings, D.R. Clinton, J.M. Patterson. 2000. Bankfull Regional Curves for North Carolina Mountain Streams. In: AWRA Conference Proceedings, D.L. Kane, editor. American Water Resources Specialty Conference on Water Resources in Extreme Environments. Anchorage, Alaska.

Table 10. Monitoring Year 4 Stream Summary
Logan Creek Restoration Project; DMS Project ID No. 94645

UT6

Parameter	USGS Gauge	Regional Curve Interval [1]			Pre-Existing Condition						Reference Reach Data – Morgan Creek						Design						As-built						MY1						MY2						MY3						MY4					
		NC Mtn.	NC Pied.	Rural	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffl																																																
BF Width (ft)	-	5.3	4.1	-	-	-	-	-	-	-	-	16.7	-	-	-	-	-	6.0	-	-	-	-	6.1	6.2	6.2	6.3	0.06	2	-	5.8	-	-	-	1	-	5.8	-	-	-	1	-	6.0	-	-	-	1	-	5.64	-	-	-	1
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	35.0	-	-	-	-	-	-	-	-	-	-	-	>27	-	-	-	1	-	32.4	-	-	-	1	-	>35	-	-	-	1	-	>35	-	-	-	1	-	>35	-	-	-	1
BF Mean Depth (ft)	-	0.4	0.5	-	-	-	-	-	-	-	-	1.06	-	-	-	-	-	0.7	-	-	-	-	0.70	0.70	0.70	0.80	0.02	2.00	-	0.70	-	-	-	1	-	0.60	-	-	-	1	-	0.60	-	-	-	1	-	0.5	-	-	-	1
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	1.54	-	-	-	-	-	-	-	-	-	-	1.1	1.2	1.2	1.2	0.0	2	-	0.9	-	-	-	1	-	0.9	-	-	-	1	-	0.9	-	-	-	1	-	0.8	-	-	-	1
BF Cross-sectional Area (ft^2)	-	1.9	4.1	-	-	-	-	-	-	-	-	17.7	-	-	-	-	-	4.2	-	-	-	-	4.5	4.6	4.6	4.6	0.1	2	-	3.8	-	-	-	1	-	3.7	-	-	-	1	-	3.8	-	-	-	1	-	2.83	-	-	-	1
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	15.8	-	-	-	-	-	-	-	-	-	-	8.1	8.4	8.4	8.7	0.3	2	-	9.0	-	-	-	1	-	9.1	-	-	-	1	-	9.5	-	-	-	1	-	11.28	-	-	-	1
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	4.3	5.5	5.5	6.6	1.2	2	-	5.6	-	-	-	1	-	5.4	-	-	-	1	-	4.9	-	-	-	1	-	5.15	-	-	-	1
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	0.0	2	-	1.0	-	-	-	1	-	1.0	-	-	-	1	-	1.1	-	-	-	1	-	0.95	-	-	-	1
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1
Pattern																																																
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rc:Bankfull width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	1.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	4.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profile																																																
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.0	31.8	19.0	77.0	26.3	4	14.3	18.7	14.9	30.5	6.9	4	17.8	27.0	27.0	36.3	9.2	2	27.5	31.0	31.0	34.5	3.5	2	35.2	35.4	35.4	35.6	0.2	2	27.2	27.7	27.7	28.1	0.4	2
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	0.0052	0.0107	0.0106	0.017	0.0041	4	0.0000	0.0078	0.0118	0.0140	0.0084	4	0.0014	0.0052	0.0052	0.0090	0.0038	2	0.0029	0.0033	0.0033	0.0036	0.0004	2	0.0014	0.0021	0.0021	0.0028	0.0007	2	0.0009	0.0037	0.0037	0.0066	0.0029	2
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.0	-	-	0	4	6.5	11.6	7.9	21.4	5.7	5	19.75	26.73	26.73	33.70	7.00	2	9.40	16.30	16.30	23.20	6.90	2	2.76	9.51	9.51	16.26	6.8	2	22.49	23.09	23.09	23.69	0.6	2
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	18.0	22.7	24.0	26.0	3.4	3	22.2	39.0	42.4	48.8	10.2	4	39.46	42.9	42.9	46.34	3.40	2	45.60	46.85	46.85	48.10	1.25	2	46.87	47.9	47.91	48.94	1.00	2	44.71	46.70	46.73	48.74	2	2
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	2.28	-	-	-	-	-	1.2	-	-	-	-	1.7	-	-	-	-	1	-	1.5	-	-	-	1	-	1.17	-	-	-	1	-	0.735	-	-	-	1	-	0.87	-	-	-	1
Pool Volume (ft^3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Substrate and Transport Parameter																																																
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SC% / Sa% / G% / B% / Be%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d16 / d35 / d50 / d84 / d95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reach Shear Stress (competency) lb/ft^2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stream Power (transport capacity) W/m^2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Additional Reach Parameter																																																
Drainage Area (SM)	-		0.02				0.02		-	-	-	0.83	-	-	-	-	-	-	-	-	-	-	-	0.02	-	-	-	-	0.02	-	-	-	-	0.02	-	-	-	-	0.02	-	-	-	-	0.02	-	-	-	-
Impervious cover estimate (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-
Rosgen Classification	-	-	-	-	-	-	-	-	-	-	-	C4	-	-	-	-	-	-	-	-	-	-	-	E	-	-	-	-	-	E	-	-	-	-	-	E	-	-	-	-	-	E	-	-	-	-
BF Velocity (fps)	-	-	-	-	-	-	-	-	-	7	-	3.55	-	-	-	-	-	-	-	-	-	-	-	4.27	-	-	-	-	-	3.32	-	-	-	-	-	3.32	-	-	-	-	-	3.32	-	-	-	-
BF Discharge (cfs)	-	7.8	18.3	-	-	-	-	-	-	-	-	98	-	-	-	-	-	-	-	-	-	-	-	212.2	-	-	-	-	-	15.2	-	-	-	-	-	15.2	-	-	-	-	-	15.2	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel length (ft)[2]	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-	-	311.0	-	-	-	-	-	350	-	-	-	-	-	104	-	-	-	-	-	104	-	-	-	-	-	104	-	-	-	-
Sinuosity	-	-	-	-	-	-	-	-	-	-	-	2.01	-	-	-	-	-	-	-	-	-	-	-	1.5	-	-	-	-	-	1.04	-	-	-	-	-	1.04	-	-	-	-	-	1.04	-	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.0079	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	0.0114	-	-	-	-	-	0.0114	-	-	-	-	-	0.0114	-	-	-	-
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-	-	0.004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BEHI VL% / L% / M% / H% / VH% / E%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel Stability or Habitat Metric	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biological or Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] Harman, W.A., D.E Wise, M.A. Walker, R. Morris, MA Cantrell, M. Clemmons, G.D. Jennings, D.R. Clinton, J.M. Patterson. 2000. Bankfull Regional Curves for North Carolina Mountain Streams. In: AWRA Conference Proceedings, D.L. Kane, editor. American Water Resources Specialty Conference on Water Resources in Extreme Environments. Anchorage, Alaska.

UT8

Parameter	USGS Gauge	Regional Curve Interval [1]			Pre-Existing Condition						Reference Reach Data – Morgan Creek						Design						As-built						MY1						MY2						MY3						MY4					
		NC Mtn.	NC Pied.	Rural	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffl																																																
BF Width (ft)	-	5.3	4.1	-	-	-	-	-	-	-	-	16.7	-	-	-	-	-	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	8.1	-	-	-	1	-	8.4	-	-	-	1	-	10.3	-	-	-	1
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	35.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	>50	-	-	-	1	-	>50	-	-	-	1	-	>50	-	-	-	1
BF Mean Depth (ft)	-	0.4	0.5	-	-	-	-	-	-	-	-	1.06	-	-	-	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	0.70	-	-	-	1	-	0.70	-	-	-	1	-	0.6	-	-	-	1
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	1.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1.4	-	-	-	1	-	1.2	-	-	-	1	-	1.3	-	-	-	1
BF Cross-sectional Area (ft^2)	-	1.9	4.1	-	-	-	-	-	-	-	-	17.7	-	-	-	-	-	4.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	6.0	-	-	-	1	-	5.8	-	-	-	1	-	5.9	-	-	-	1
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	15.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	11.0	-	-	-	1	-	12.2	-	-	-	1	-	17.7	-	-	-	1
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	5.3	-	-	-	1	-	5.1	-	-	-	1	-	4.2	-	-	-	1
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1.0	-	-	-	1	-	1.0	-	-	-	1	-	0.93	-	-	-	1
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pattern: reach is to short for this data																																																
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rc:Bankfull width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	1.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	4.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profile: reach is to short for this data																																																
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.0	31.8	19.0	77.0	26.3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	0.0052	0.0107	0.0106	0.017	0.0041	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.0	-	-	0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	18.0	22.7	24.0	26.0	3.4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	2.28	-	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Volume (ft^3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Substrate and Transport Parameter																																																
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SC% / Sa% / G% / B% / Be%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d16 / d35 / d50 / d84 / d95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reach Shear Stress (competency) lb/ft^2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stream Power (transport capacity) W/m^2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Additional Reach Parameter																																																
Drainage Area (SM)	-		0.02				0.02		-	-	-	0.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	-	-	-	0.02	-	-	-	-	0.02	-	-	-	-
Impervious cover estimate (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-
Rosgen Classification	-	-	-	-	-	-	-	-	-	-	-	C4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	E	-	-	-	-	-	E	-	-	-	-	-	C	-	-	-
BF Velocity (fps)	-	-	-	-	-	-	-	-	-	7	-	3.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.32	-	-	-	-	-	3.32	-	-	-	-	-	3.32	-	-	-
BF Discharge (cfs)	-	7.8	18.3	-	-	-	-	-	-	-	-	98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.2	-	-	-	-	-	15.2	-	-	-	-	-	15.2	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel length (ft)[2]	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-	-	311.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	104	-	-	-	-	-	104	-	-	-	-	-	104	-	-	-
Sinuosity	-	-	-	-	-	-	-	-	-	-	-	2.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.04	-	-	-	-	-	1.04	-	-	-	-	-	1.04	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.0079	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0114	-	-	-	-	-	0.0114	-	-	-	-	-	0.0114	-	-	-
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BEHI VL% / L% / M% / H% / VH% / E%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel Stability or Habitat Metric	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biological or Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] Harman, W.A., D.E Wise, M.A. Walker, R. Morris, MA Cantrell, M. Clemmons, G.D. Jennings, D.R. Clinton, J.M. Patterson. 2000. Bankfull Regional Curves for North Carolina Mountain Streams. In: AWRA Conference Proceedings, D.L. Kane, editor. American Water Resources Specialty Conference on Water Resources in Extreme Environments. Anchorage, Alaska.

Table 11. Morphology and Hydraulic Monitoring Summary
Logan Creek Restoration Project: DMS Project ID No. 92515

Logan Creek (4,172 LF)																											
	Cross-section X-1, Station 3+10 (Riffle), Restoration Reach							Cross-section X-2, Station 3+70 (Pool), Restoration Reach							Cross-section X-3, Station 12+57 (Riffle), Restoration Reach							Cross-section X-4, Station 13+00 (Pool)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																											
BF Width (ft)	24.1	24.0	24.1	24.0	26.0	-	-	25.9	26.8	26.0	26.0	26.1	-	-	25.2	24.3	24.46	24.3	24.2	-	-	27.6	27.1	27.1	27.4	26.8	-	-
BF Mean Depth (ft)	2.6	2.6	2.7	2.7	2.5	-	-	2.5	2.4	2.5	2.6	2.4	-	-	2.1	2.1	2.15	2.2	2.1	-	-	2.3	2.7	2.4	2.6	2.7	-	-
Width/Depth Ratio	9.2	9.3	8.9	8.9	10.4	-	-	10.5	11.0	10.3	10.2	10.9	-	-	12.0	11.6	11.36	11.3	11.4	-	-	12.1	10.0	11.2	10.7	9.8	-	-
BF Cross-sectional Area (ft²)	63.0	62.4	64.8	64.7	64.9	-	-	63.9	65.2	65.5	66.2	62.9	-	-	53.2	51.2	52.7	52.3	51.4	-	-	62.8	73.8	65.4	70.2	73.2	-	-
BF Max Depth (ft)	3.7	4.0	4.3	4.3	4.6	-	-	5.2	5.1	5.1	4.9	4.9	-	-	3.1	2.9	3.11	3.1	3.0	-	-	5.2	5.9	5.4	5.5	4.7	-	-
Width of Floodprone Area (ft)	>70	>70	>70	>70	>70	-	-	>60	>60	>60	>60	>60	-	-	>100	>100	>100	>100	>100	-	-	>100	>100	>100	>100	>100	-	-
Entrenchment Ratio	2.9	2.9	2.9	2.9	2.7	-	-	2.3	2.3	2.3	2.3	2.3	-	-	3.9	4.1	4.1	4.1	4.1	-	-	3.6	3.6	3.6	3.6	3.7	-	-
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	-	-	1.1	1.1	1.0	1.1	1.1	-	-	1.0	1.1	1.0	1.0	1.0	-	-	1.0	1.0	1.1	1.0	1.3	-	-
Wetted Perimeter (ft)	29.3	29.3	29.5	29.4	31.0	-	-	30.9	31.7	31.0	31.1	31.0	-	-	29.5	28.6	28.8	28.6	28.4	-	-	32.2	32.6	31.9	32.5	32.3	-	-
Hydraulic Radius (ft)	2.1	2.1	2.2	2.2	2.1	-	-	2.1	2.1	2.1	2.1	2.0	-	-	1.8	1.8	1.8	1.8	1.8	-	-	2.0	2.3	2.0	2.2	2.3	-	-
Based on current/developing bankfull feature																											
BF Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Cross-sectional Area (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Width of Floodprone Area (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wetted Perimeter (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydraulic Radius (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cross Sectional Area between end pins (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d50 (mm)	13.8	30.7	15.2	23.3	35.4	-	-	-	-	-	-	-	-	-	19.2	43	29.2	22.2	21.6	-	-	-	-	-	-	-	-	-

	Cross-section X-5, Station 25+43 (Pool), Restoration Reach							Cross-section X-6, Station 26+09 (Riffle), Restoration Reach							Cross-section 10, Station 37+05 (Pool), Enhancement Reach							Cross-section 11, Station 37+20 (Riffle), Enhancement Reach						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																												
BF Width (ft)	21.3	24.0	23.9	23.8	23.6	-	-	23.6	22.6	22.5	22.4	22.6	-	-	31.0	33.4	33.4	33.3	33.0	-	-	29.2	33.9	33.9	34.1	34.2	-	-
BF Mean Depth (ft)	3.0	3.1	3.1	3.0	3.0	-	-	2.2	2.2	2.3	2.3	2.2	-	-	2.1	2.1	2.1	2.3	2.3	-	-	2.1	1.8	1.8	1.7	1.7	-	-
Width/Depth Ratio	7.1	7.8	7.8	8.0	7.9	-	-	10.8	10.1	9.9	9.9	10.3	-	-	14.4	15.6	15.9	14.8	14.1	-	-	14.0	18.6	18.6	19.6	20.0	-	-
BF Cross-sectional Area (ft²)	63.9	74.3	73.3	71.0	70.6	-	-	51.7	50.2	51.4	50.8	49.1	-	-	66.6	71.2	70.3	74.7	77.1	-	-	60.7	61.8	61.8	59.4	58.3	-	-
BF Max Depth (ft)	5.4	5.3	5.4	5.4	5.4	-	-	3.4	3.5	3.7	3.6	3.7	-	-	3.5	3.5	3.4	3.5	3.6	-	-	2.9	3.0	3.0	2.9	3.1	-	-
Width of Floodprone Area (ft)	>80	>90	>90	>90	>90	-	-	>95	>95	>95	>95	>95	-	-	>60	>60	>60	>60	>60	-	-	>54	>54	>54	>54	>54	-	-
Entrenchment Ratio	4.4	4.4	3.8	3.8	3.8	-	-	4.0	4.0	4.2	4.2	4.2	-	-	4.2	1.8	1.8	1.8	1.8	-	-	4.5	1.6	1.6	1.5	1.5	-	-
Bank Height Ratio	1.0	1.0	1.0	1.0	1.1	-	-	1.0	1.0	1.0	1.0	1.0	-	-	1.0	1.1	1.0	1.0	1.3	-	-	1.1	1.2	1.2	1.1	1.1	-	-
Wetted Perimeter (ft)	27.3	30.2	30.0	29.8	29.6	-	-	28.0	27.0	27.1	26.9	26.9	-	-	35.2	37.6	37.6	37.8	37.7	-	-	33.4	37.6	37.6	37.6	37.6	-	-
Hydraulic Radius (ft)	2.3	2.5	2.4	2.4	2.4	-	-	1.8	1.9	1.9	1.9	1.8	-	-	1.9	1.9	1.9	2.0	2.0	-	-	1.8	1.6	1.6	1.6	1.6	-	-
Based on current/developing bankfull feature																												
BF Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Cross-sectional Area (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Width of Floodprone Area (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wetted Perimeter (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydraulic Radius (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cross Sectional Area between end pins (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d50 (mm)	-	-	-	-	-	-	-	24.9	41.1	20.7	35.0	45.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: Per DMS/IRT request, the bank height ratio for MY4 has been calculated using the as-built bankfull area. All other values were calculated using the as-built bankfull elevation, as was done for previous monitoring reports.

Table 11. Morphology and Hydraulic Monitoring Summary
Logan Creek Restoration Project: DMS Project ID No. 92515

UT3 (178 LF)

	Cross-section X-8.5, Station 0+60* (Pool)							Cross-section X-9, Station 0+73* (Riffle)																							
Dimension and substrate	Base*	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+			
Based on fixed baseline bankfull elevation																															
BF Width (ft)	-	8.6	8.2	8.9	8.7	-	-	6.3	5.9	5.8	6.2	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Mean Depth (ft)	-	0.9	0.9	0.9	0.9	-	-	0.7	0.7	0.7	0.6	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Width/Depth Ratio	-	9.4	9.9	9.9	9.3	-	-	8.7	8.5	8.4	9.9	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Cross-sectional Area (ft²)	-	7.9	8.2	8.1	8.1	-	-	4.5	4.1	4.0	3.8	3.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Max Depth (ft)	-	1.5	1.5	1.4	1.5	-	-	1.2	1.1	1.0	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Width of Floodprone Area (ft)	-	32.0	30.9	30.9	32.4	-	-	26.8	23.8	22.6	22.6	22.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Entrenchment Ratio	-	3.7	3.4	4.5	6.1	-	-	4.3	4.0	3.9	4.9	5.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Bank Height Ratio	-	1.1	1.0	1.1	1.1	-	-	1.0	1.0	1.0	1.1	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Wetted Perimeter (ft)	-	10.4	10.0	10.7	10.5	-	-	7.7	7.3	7.2	7.4	6.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Hydraulic Radius (ft)	-	0.8	0.8	0.8	0.8	-	-	0.6	0.6	0.6	0.5	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Based on current/developing bankfull feature																															
BF Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Cross-sectional Area (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Width of Floodprone Area (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Wetted Perimeter (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Hydraulic Radius (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Cross Sectional Area between end pins (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

*Stationing is corrected in this report.

UT6 (127 LF)

	Cross-section X-7, Station 0+54 (Pool)							Cross-section X-8, Station 0+69 (Riffle)																							
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+			
Based on fixed baseline bankfull elevation																															
BF Width (ft)	9.8	9.2	9.4	9.7	9.1	-	-	6.1	5.8	5.8	6.0	5.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Mean Depth (ft)	1.0	0.9	0.8	0.8	0.8	-	-	0.8	0.7	0.6	0.6	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Width/Depth Ratio	9.5	10.7	12.1	11.2	11.2	-	-	8.1	9.0	9.1	9.5	11.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Cross-sectional Area (ft²)	10.1	7.9	7.4	7.4	7.3	-	-	4.6	3.8	3.7	3.8	2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Max Depth (ft)	1.7	1.5	1.2	1.2	1.3	-	-	1.1	0.9	0.9	0.9	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Width of Floodprone Area (ft)	> 50	> 50	> 50	> 50	>50	-	-	> 35	> 35	> 35	> 35	>35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Entrenchment Ratio	3.8	4.0	3.1	3.3	3.4	-	-	6.6	5.6	5.4	4.9	5.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Bank Height Ratio	1.0	1.0	1.0	1.1	0.9	-	-	1.0	1.0	1.0	1.1	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Wetted Perimeter (ft)	11.8	10.9	11.0	11.3	10.7	-	-	7.7	7.1	7.1	7.3	6.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Hydraulic Radius (ft)	0.9	0.7	0.7	0.7	0.7	-	-	0.6	0.5	0.5	0.5	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Based on current/developing bankfull feature																															
BF Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Cross-sectional Area (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Width of Floodprone Area (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Wetted Perimeter (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Hydraulic Radius (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Cross Sectional Area between end pins (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

Note: Per DMS/IRT request, the bank height ratio for MY4 has been calculated using the as-built bankfull area. All other values were calculated using the as-built bankfull elevation, as was done for previous monitoring reports.

Table 11. Morphology and Hydraulic Monitoring Summary
Logan Creek Restoration Project: DMS Project ID No. 92515

UT8 (45 LF)																													
	Cross-section X-12, Station 0+9.6 (Riffle)																												
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																													
BF Width (ft)	-	-	8.1	8.4	10.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Mean Depth (ft)	-	-	0.7	0.7	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Width/Depth Ratio	-	-	11.0	12.2	17.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Cross-sectional Area (ft²)	-	-	6.0	5.8	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Max Depth (ft)	-	-	1.4	1.2	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Width of Floodprone Area (ft)	-	-	> 50	> 50	>50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Entrenchment Ratio	-	-	5.3	5.1	4.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank Height Ratio	-	-	1.0	1.0	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wetted Perimeter (ft)	-	-	9.6	9.8	11.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydraulic Radius (ft)	-	-	0.6	0.6	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Based on current/developing bankfull feature																													
BF Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Cross-sectional Area (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Width of Floodprone Area (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wetted Perimeter (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydraulic Radius (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cross Sectional Area between end pins (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Note: Per DMS/IRT request, the bank height ratio for MY4 has been calculated using the as-built bankfull area. All other values were calculated using the as-built bankfull elevation, as was done for previous monitoring reports.																													

e-file

Table 12 MY4 Stream Problem Areas and Photos Logan Creek Stream Restoration Project, Number #92515			
Feature Issue	**Station**	**Suspected Cause**	**Photo #**
Aggradation/Bar Formation	None	None	None
Bank Scour	Station 21+00	CPA 3-2. Bank slump (approx. 6 ft.) along left bank of main stem. Has stabilized and is no longer eroding.	21,22
	Station 11+50	CPA 3-4. Bank slump (approx. 8 ft.) along right bank of main stem. The slump area has not completely stabilized but has not worsened and is still vegetated in 2018.	25,26
	Station 2+10	CPA 2-1. Flooding during December and January caused a small area of bank scour at this location. Bank was repaired in 2017 and remained stable in 2018 (MY4).	1, 2, 3
	Station 4+60	CPA 2-3. Flooding during December and January 2017 caused a small area of bank scour at this location. The bank was repaired in 2017 and has vegetated in 2018 but is still eroding in places. This will be monitored in MY5.	7,8,9
	Station 11+70	CPA 2-4. Flooding during December and January 2017 caused a small area of bank scour at this location. Bank has revegetated and stabilized in 2018.	10,11,12
	Station 26+60	CPA 2-5. Flooding during December and January 2017 caused a small area of bank scour at this location. This scour area has revegetated and stabilized.	13,14,15
	Station 27+00	CPA 2-6. Flooding during December and January 2017 caused a small area of bank scour at this location. Scour area was repaired in 2017 and has revegetated and stabilized in 2018.	16,17,18
Engineered Structures	Station 23+75	CPA 3-1. Piping of log structure has stabilized and is no longer piping in MY4.	19,20
	Station 14+75	CPA 3-3. Piping of log structure after the fabric sealing this structure tore. Structure has stabilized and is no longer piping in 2018.	23,24
	UT8 Station 00+40	CPA 3-4. Piping of log structure on UT-8 near the confluence of UT-8 and Logan Creek. This log structure is still piping but has not worsened. Hand repairs will be made on the structure in MY5.	27
	2+00	CPA 2-2. Piping of log structure after the fabric sealing this structure tore during flooding of December and January. Structure was repaired in 2017 and was no longer piping in 2018.	4,5,6
Encroachments	Station (approximately) 23+00 to 28+00	EA-1. New maintenance workers mowed the nature trail (an allowance in the easement); however, they mowed a wider width than was agreed. We discussed this with staff at Lonesome Valley and they were going to discuss this with a new trails manager.	28,29

Logan Creek Stream Restoration Project – Monitoring Year 4 Problem Area Photos

CPA 2-1

Photo 1. CPA 2-1 – Station 2+10, small area of bank scour caused by flooding of December and January 2016.

Photo 2. CPA 2-1 – Station 2+10, same area as shown in photo 1 during October 2017 with vegetation stabilizing site. Bank was graded, matting was reinstalled, and live stakes were added during October 2017.

Photo 3. CPA 2-1 – Scour area has stabilized and is no longer eroding after repairs were made in 2017.

CPA 2-2

Photo 4. CPA 2-2 – Station 2+00, Piping of log structure after the fabric sealing this structure tore during flooding of December and January 2016.

Photo 5. CPA 2-2 – Station 2+00, Piping structure was repaired in May 2017. Fabric was replaced and substrate was replaced upstream of log structure.

Photo 6. CPA 2-2 – Log structure that was repaired in 2017 has remained stable and is no longer piping.

CPA 2-3

Photo 7. CPA 2-3 – Station 4+60, small area of bank scour caused by flooding of December and January 2016.

Photo 8. CPA 2-3 – Station 4+60, bank scour area was regraded, matting was reinstalled, and herbaceous vegetation was transplanted in May 2017. Livestakes were installed in October 2017.

Photo 9. CPA 2-3 – Station 4+60, bank scour area has vegetated but is still eroding. Will be monitored in MY5.

CPA 2-4

Photo 10. CPA 2-4 – Station 11+70, small area of bank scour caused by flooding of December and January 2016.

Photo 11. CPA 2-4 – Station 11+70, scour area noted in MY2 has stabilized for the most part. Livestakes were planted in the scour area as well as the bank downstream of the problem area in October 2017.

Photo 12. CPA 2-4 – Station 11+70, Bank has vegetated and stabilized in 2018.

CAP 2-5

Photo 13. CPA 2-5 – Station 26+60, small area of bank scour caused by flooding of December and January 2016.

Photo 14. CPA 2-5 – Station 26+60, bank scour area was regraded, matting was reinstalled, and herbaceous vegetation was transplanted in May 2017. Livestakes were installed in October 2017.

Photo 15. CPA 2-5 – Station 26+60, Scour area has revegetated and stabilized.

CPA 2-6

Photo 16. CPA 2-6 – Station 27+00, small area of bank scour caused by flooding of December and January 2016.

Photo 17. CPA 2-6 – Station 27+00, bank scour area was regraded, matting was reinstalled, and herbaceous vegetation was transplanted in May 2017. Livestakes were installed in October 2017.

Photo 18. CPA 2-6 – Station 27+00, scour area has revegetated and stabilized in 2018.

CPA 3-1

Photo 19. CPA 3-1 – Station 23+75, piping of log structure after the fabric sealing this structure tore in 2017.

Photo 20. CPA 3-1 – Log structure has stabilized and is no longer piping.

CPA 3-2

Photo 21. CPA 3-2 – Station 21+00, small bank slump area (approx. 6 ft.) along left bank of main stem.

Photo 22. CPA 3-2– Area has stabilized and is fully vegetated.

CPA 3-3

Photo 23. CPA 3-3 – Station 14+75, piping of log structure after the fabric sealing this structure tore in 2017.

Photo 24. CPA 3-3 – Station 14+75, piping log structure has stabilized and is no longer piping in 2018.

CPA 3-4

Photo 25. CPA 3-4 – Station 11+50, small bank slump (approx. 8 ft.) along right bank of main stem.

Photo 26. CPA 3-4 – Station 11+50, slump area has not stabilized but has not worsened in 2018. Will continue to monitor in MY5.

CPA 3-5

Photo 27. CPA 3-5 – Station UT8 00+40, piping of log structure on UT-8 near the confluence of UT-8 and Logan Creek. Hand repairs will be made to CPA 3-5 during MY5.

Trail Encroachments

Photo 28. EA 2-1 – Maintenance workers mowed the nature trail wider than the 4-6 feet that had been agreed to earlier, near stationing 23+00 to 28+00.

Photo 29. EA 2-1 – In July of 2017, the path was still being mowed wide through Veg Plot 3.