# Upper Silver Creek Restoration Project
# Year 3 Monitoring Report

## Burke County, North Carolina

**NCDMS Project ID Number – 94645**

**Catawba River Basin: 03050101-050050**

**SAW ID: 2010-02157, DWR # 13-0595**

| | |
|---|---|
| Project Info: | Monitoring Year: 3 of 5<br>Year of Data Collection: 2017<br>Year of Completed Construction: 2015<br>Submission Date: November 2017 |
| Submitted To: | NCDEQ – Division of Mitigation Services<br>5 Ravenscroft Drive, Suite 102<br>Asheville, NC 28801<br>NCDEQ Contract ID No. 003270 |

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*Innovation Done Right...We Make a Difference*

November 30, 2017

NC Division of Mitigation Services (NCDMS)
Attn: Mr. Matthew Reid, Western Project Manager
5 Ravenscroft Drive, Suite 102
Asheville, NC 28801

Subject: Response to DMS comments on the Year 3 Monitoring Report Review for the Upper Silver Creek Stream and Wetland Restoration Project; Catawba River Basin - CU# 03050101; Burke County, North Carolina; NCEEP Project # 94645; Contract No. 003270

Dear Mr. Reid,

Please find enclosed the final Upper Silver Creek Year 3 Monitoring Report. I have addressed the comments that you submitted on the draft report. My responses to your comments are the following:

**General**

- Wetland success has improved since MY2 and appears to be trending toward success. As a result, Task 9 will be paid in full. Please be aware that future task payments may be reduced if wetland gauges do not show signs of trending toward success and associated credits are deemed at risk.
    - *Comment is noted. We will continue to monitor the wetland gauges throughout the winter and MY4 and record any changes in wetland performance.*

**Table 2**

- Please add June 2017 invasive treatment to table.
    - *Invasive treatment was added to Table 2.*
- Please add July 2017 beaver dam removal to table
    - *Beaver dam removal was added to Table 2.*

RBF CONSULTING jma THE LPA GROUP KASEMAN SALLYPORT MBAKERINTL.COM
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**CCPV or Figure 3**

- Modify either CCPV to show wetland components (R, E, Creation, riparian/non-riparian) or add *well* locations to Figure 3. The locations of the wells in relation to wetland component is valuable information for agency reviewers.
    - *Both the CCPV and Figure 3 were modified to show both the wetland components and well locations on the site. This will make it easier to draw comparisons between the two maps in the future.*

**Table 5**

- Draft hard copy was missing Table 5, but it was in the PDF. Please QA/QC finals hard copies before submittal for completeness.
    - *Table 5 was added to the hard copy of the report.*

**Vegetation Plot Photos**

- Currently labeled as Figure 3 in hard copy. Should be Figure 4 according to Table of Contents. It is correctly labeled in PDF.
    - *The Vegetation Plot Photos have been labeled Figure 4 in the report as well as the Table of Contents.*

**Cross-sections**

- Cross-section 7 does not have MY3 data overlaid on graph. Please update and verify morphology data is correct on graph and corresponding tables.
    - *MY3 data was added to Cross-section 7. Morphology data was correct on graph and corresponding tables.*

**Profile**

- The UT2 profile and sections of UT3 indicates significant aggradation. As Baker is aware, the USACE will be looking at defined bed/bank and often denies credit for channels that have become filled with sediment. I am aware of the large upstream sediment sources from past mining activities on UT2. Does Baker have any corrective action or adaptive management planned for these.
    - *No corrective actions are planned for the upcoming year. These sections of UT2 and UT3 will be monitored throughout the winter to see if high seasonal flows clear any of the deposited sediment from the channels and reevaluated in MY4.*

**Table 11**

- Consider increasing the significant digits on the Bank Height Ratio to two places. The BHR are shown this way on the cross-section plots (ex: XS1-1.06). This will help alleviate any problems with the IRT regarding calculating BHR and having "1.0" across the board. The IRT does not like to see 1.0 for BHR for every monitoring year. The IRT would like to see this number calculated for each monitoring year.
    - *The significant digits on all Bank Height Ratios has been increased to two places on Tables 10 and 11. These will be presented this way going forward.*

**Table 12a**

- Please double check the last column of data (Number of Instances where Water Table is 12 Inches from Ground Surface). I am unable to determine how the numbers shown are calculated when looking at the graphs. Consider removing this table from the report and just including in electronic deliverables. If you decide to remove from report, please update Table of Contents and Appendix E sheet.
    - *The data in this column was still linked to earlier versions of the spreadsheet and had not updated. This has been corrected and the numbers now reflect data from MY3. This table was removed from the hard copy of the report but included in the electronic deliverables. The Table of Contents has been updated.*

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

Micky Clemmons,
Project Manager
Michael Baker Engineering, Inc.

# Upper Silver Creek Restoration Project
# Year 3 Monitoring Report

## Burke County, North Carolina

### NCDMS Project ID Number – 94645

Report Prepared and Submitted by Michael Baker Engineering, Inc.
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NC Professional Engineering License # F-1084

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## APPENDICES

# 1.0 EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) restored or enhanced 5,186 linear feet (LF) of perennial stream channel along Silver Creek and three unnamed tributaries (UT1, UT2, and UT3); and additionally restored, enhanced or created approximately 9.14 acres of wetlands that had been previously disturbed in Burke County, NC, (Appendix A). The Upper Silver Creek Stream and Wetland Restoration Project (Site) is located southeast of Morganton, NC, approximately 11 miles southeast of the intersection of Highway 64 and I-40 and to the north of the intersection of Highway 64 and Goldmine Road. The Site is located in the NC Division of Water Resources (NCDWR) sub-basin 03-08-31 and the NCDEQ Division of Mitigation Services (NCDMS) Targeted Local Watershed (TLW) 03050101-050050 of the Catawba River Basin. The project involved the restoration and enhancement of a Piedmont/Mountain Mixed Bottomland Hardwood Forest system (NC WAM 2010, Schafale and Weakley 1990) from impairments within the project area due to past agricultural conversion, cattle grazing, gold mining and draining of floodplain wetlands by ditching activities.

The project goals directly addressed stressors identified in the Catawba River Basin Restoration Priority (RBRP) Plan such as degraded riparian conditions, channel modification, and excess sediment and nutrient inputs. The primary restoration goals, as outlined in the approved mitigation plan, are described below:

- Create geomorphically stable stream channels within the Upper Silver Creek project area including headwater tributaries in the Catawba River basin;
- Restore, enhance, and expand wetland functions across the Site;
- Improve and restore hydrologic connections between streams and degraded riparian wetland areas and overall ecosystem functionality;
- Improve water quality within the Upper Silver Creek project area through reduction of bank erosion, improved nutrient and sediment removal, and stabilization of streambanks; and
- Improve aquatic and terrestrial habitat.

To accomplish these goals, we recommended the following actions:

- Restore the existing incised, eroding, and channelized stream by creating a stable channel that has access to its floodplain;
- Improve water quality by establishing buffers for nutrient removal from runoff and by stabilizing stream banks to reduce bank erosion;
- Improve in-stream habitat by providing a more diverse bedform with riffles and pools, creating deeper pools, developing areas that increase oxygenation, providing woody debris for habitat, and reducing bank erosion; and
- Improve terrestrial habitat by planting riparian areas with native vegetation and protecting these areas with a permanent conservation easement. The riparian area will increase storm water runoff filtering capacity, improve bank stability, provide shading to decrease water temperature and improve habitat.

During early 2017, there was at least one high flow event that inundated the floodplain, depositing woody debris and other flotsam in wrack lines well away from the top of bank. This event does not appear to have significantly impacted the bank repairs that were made after the flood event in 2015, although one of the repaired areas is beginning to show erosion and undercutting (CPA-3). Year 3 (MY3) monitoring indicated

that the planted acreage was functioning well with no bank, bench or flood plain areas having bare areas of a significant size.

Invasive Chinese privet and multiflora rose were noted in the MY2 Monitoring Report as a problem, and were treated in June 2017. We will continue to treat invasive vegetation within this area with herbicide to minimize new growth. The areas of mowing encroachment noted in MY2 were marked with t-posts and flagged early in 2017, and there were no new mowing encroachments noted when MY3 monitoring was conducted. We have established and are monitoring fourteen (14) vegetation plots at this site. The average density of total planted stems following the MY3 growing season is 720 stems per acre, with an additional average of 64 volunteer stems per acre. Based on the average density of 720 planted stems per acre, the Site is on track to meet the established success criteria.

Stream geomorphological stability and performance during MY3 was assessed by surveying sixteen cross-sections, a profile of each channel, evaluating the bed particle size with five riffle pebble counts and by replicating channel location photographs. Channel cross-sections and profiles were similar to what was observed in the past with no major instability identified and the general morphology is responding as designed and meeting project goals. At least one significant flood event that was greater than bankfull occurred during MY3. This storm event caused valley wide flooding with wrack lines well away from the top of stream banks. Stream pebble data indicated that the shift to smaller particles on Silver Creek main stem had stabilized at sizes similar to what was seen in previous years. Pebble counts on UT2 and UT3 indicate that fine sediment has accumulated in the channels since MY2. This is likely due to several factors. Backwater from Silver Creek during high water events inundates the location of the pebble count along UT2. It is likely that suspended fine sediment drops out of the water column in this backwater. Also, low flows early in the year allowed herbaceous vegetation to encroach into the channel and impede flow. This prevented fine particulates that entered from upstream of the project from moving through the system and eventually filled sections of the streambed with a layer of fine silt and clay. Lastly, all three pebble counts on the unnamed tributaries were taken in constructed riffles which were designed to be immobile. The constructed riffle material is designed to be much coarser than the natural sediment load than the stream receives. The natural, finer sediment load, is often then deposited on top of the constructed riffles, which shifts the bed material to a finer grain size distribution as compared to the as-built condition. Overall, these data indicate a properly functioning system, as there were no mid-channel bars or other sediment transport issues.

Wetland monitoring during MY3 demonstrated that nine of the thirteen groundwater monitoring wells located on the Site met the wetland success criteria as stated in the Site Mitigation Plan (up from three of thirteen in MY2). The gauges that met success criteria (USAW1, USAW2, USAW5, USAW7, USAW8, USAW9, USAW10, USAW11, and USAW13) demonstrated consecutive hydroperiods of 12 percent or greater, ranging from 21.2 to 57.2 percent of the growing season. The gauges that did not meet success criteria demonstrated consecutive hydroperiods of 12 percent or less, with a range from 5.3 percent to 10.1 percent of the growing season. To rectify the wide range of rainfall data available from several nearby weather stations, a recording rain gauge was placed on-site and will be used in future monitoring years.

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, wetland 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 (NCDMS 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, monitoring wells, flow gauges, and the crest gauge, are shown on the CCPV sheets found in Appendix A.

The Year 3 monitoring data and site photographs were collected in October 2017.

## 2.1 Vegetation Assessment

In order to determine if vegetation success criteria are achieved, vegetation monitoring quadrants (veg plots) were installed and are monitored across the Site in accordance with the CVS-NCDMS Protocol for Recording Vegetation, Version 4.1 (CVS 2007 and Lee, Peet, Roberts and Wentworth 2007). The vegetation monitoring plots are a minimum of two percent of the planted portion of the Site with 14 plots established randomly within the planted riparian buffer and wetland area, per CVS Monitoring Level 2. No veg plots were established within the undisturbed wooded areas along the right bank of Silver Creek. The size of individual quadrants is 100 square meters for woody (tree) species and 1 square meter for herbaceous vegetation. Herbaceous quadrants were established in one corner of the larger woody plots and are monitored by comparing photographs taken year to year.

Year 3 monitoring found that all vegetation was in good condition. All vegetation monitoring quadrants indicated that vegetation was growing and in good to excellent condition. The average density of planted stems following the Year 3 growing season was 720 stems per acre. There was also an average of 64 volunteer stems per acre, composed of six different tree species. With an average density of 720 planted stems per acre, the Site has met the minimum interim success criteria of 320 stems per acre by the end of Year 3, and is on track to meet the final success criteria of 260 stems per acre by the end of Year 5.

The Vegetation Problem Area that was observed and noted in the MY2 monitoring report was addressed in Year 3. The Chinese privet found along the right floodplain of Silver Creek downstream of UT2 was treated during June 2017. All existing privet and new growth was treated with glyphosate in this area, and various other invasive vegetation was treated as necessary. Other target species included multiflora rose and Japanese honeysuckle. At the end of MY3, invasive vegetation growth is under control and will continue to be treated as necessary.

The four previously identified mowing encroachment areas from MY2 were marked using t-posts, PVC pipe and flagging in March 2017 before the landowner began mowing. The easement boundary is now easy to see and avoid encroachment. At the end of MY3 no areas of encroachment have been noted.

No other areas of concern regarding the vegetation were observed along Silver Creek or the tributaries. Year 3 vegetation assessment information is provided in Appendix C.

## 2.2 Stream Assessment

The Upper Silver Creek Site approach is for restoration of 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 the baseline cross-section plots to evaluate change between construction and the MY3 survey. Morphological survey data is presented in Appendix D.

A longitudinal profile was surveyed for the entire length of each channel to document changes from the as-built baseline conditions during the first year of monitoring. The survey was tied to a permanent benchmark and measurements included thalweg, water surface, and top of low bank. Each of these measurements was taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth.

Stream geomorphological stability and performance during MY3 was assessed by surveying sixteen (16) cross-sections (7 on Silver Creek, 2 on UT1, 2 on UT2 and 5 on UT3) and a profile of these channels as described above. The bed particle size was evaluated with five riffle pebble counts (2 on Silver Creek and 1 on each of the tributaries) and by observation and replicating channel location photographs. Cross-sections of all the channels were very similar to past years especially at riffle cross-sections. Most pool cross-sections showed some level of deposition. This was likely due to low levels of flow during dry periods of the year. There was little change from past profile surveys and profiles of each channel do not indicate any instability issues.

The Visual Morphological Stability Assessment indicates that the Site is stable with only minor CPAs identified. Two instances of piping were noted at two log vanes along the mainstem. These structures are called out in the CCPV as CPA-1 and CPA-2. There is also one instance of bank erosion and bank undercutting (CPA-3). The locations, descriptions and photos of this damage are included in the Stream Problem Areas Table in Appendix D and in the MY3 data electronic file. These sites will be monitored in the coming year and repaired if necessary. Overall, channel morphology is responding as designed and meeting project goals.

Pebble count data for MY3 indicates that the shift to smaller particles on Silver Creek mainstem has stabilized at sizes similar to what was seen in previous years. Pebble counts on UT2 and UT3 indicate that fine sediment has accumulated in the channels since MY2. This is likely due to several factors. Backwater from Silver Creek during high water events inundates the location of the pebble count along UT2. It is likely that suspended fine sediment drops out of the water column in this backwater. Also, low flows early in the year allowed herbaceous vegetation to encroach into the channel and impede flow. This prevented fine particulates that entered from upstream of the project from moving through the system and eventually filled sections of the streambed with a layer of fine silt and clay. Lastly, all three pebble counts on the unnamed tributaries were taken in constructed riffles which were designed to be immobile. The constructed riffle material is designed to be much coarser than the natural sediment load than the stream receives. The natural, finer sediment load is often then deposited on top of the constructed riffles, which shifts the bed material to a finer grain size distribution as compared to the as-built condition. We will monitor these reaches to determine whether this problem resolves itself as the herbaceous vegetation dies back and high winter flows begin to move through the system. Overall, these data indicate a properly functioning system, as there were no mid-channel bars or other sediment transport issues.

Two beaver dams were removed from the site during MY3 near the lower end of Reach 2 (Station 22+50 and Station 25+50). These dams backed up water in the stream, but do not appear to have

done permanent damage to streambanks or structure. Photos of the dams can be found in the Photolog.

### 2.2.2 Hydrology

Two crest gauges were installed on the floodplain at this site, at the bankfull elevation. One is located along the left top of bank on Silver Creek, at approximately Station 19+00, and the second is on the left top of bank of UT3, at approximately Station 9+50. Crest gauges on Silver Creek and on UT3 recorded water levels of approximately .45 feet and .25 feet above bankfull, respectively. Physical indicators of bankfull flows, such as wrack lines and debris on the bank, were also observed throughout the reach. The event that occurred on 4/24/2017 was the highest flow recorded in the area, and likely caused the high flow recorded on project site crest gauges and shown in Table 9, the bankfull verification information. There was also a high flow recorded on 10/23/2017-10/24/2017 that left debris piles and wrack lines above bankfull level throughout the site, but did not register on the crest gauge. Crest gauge readings are presented in Appendix D.

### 2.2.3 Photographic Documentation

Reference transects were photographed at each permanent cross-section. The survey tape was centered in the photograph of the bank. 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 also taken at specific photo points established along each channel during baseline reporting. Photographs from these points will be 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 and do not indicate any stability issues at the site and no failing structures.

## 2.3 Wetland Assessment

Thirteen automated groundwater-monitoring stations were installed in the wetland restoration area to document the hydrologic conditions during the monitoring period. The installations followed USACE protocols (USACE 1997). Groundwater data collected during Year 3 monitoring are located in Appendix E.

To meet the hydrologic success criteria, the monitoring gauge data must show that for each normal rainfall year within the monitoring period, the Site has been inundated or saturated for a certain hydroperiod. Criteria have been met when the wetland is saturated within 12 inches of the soil surface for 12 percent of the growing season when rainfall amounts approximate normal conditions. Alternatively, when dry conditions prevail, we may use the fourteen (14) or more consecutive days during the growing season when antecedent precipitation has been drier than normal for a minimum frequency of 5 years in 10 to 50 percent of the monitoring period (USACE, 1987 and 2005).

Visual monitoring of wetland areas will be conducted annually. Photographs will be used to visually document system performance and identify areas of low stem density, invasive species vegetation, beaver activity, or other areas of concern. Reference stations will be photographed each year for a minimum of five years following construction. Photographs will be taken from a height of approximately five to six feet. Permanent well markers were established and used to ensure that the same locations (and view directions) on the Site are documented in each monitoring period.

Wetland monitoring during MY3 demonstrated that nine of the thirteen groundwater monitoring wells located on the Site met the wetland success criteria as stated in the Site Mitigation Plan. Although four wells did not meet criteria, these data suggest a significant improvement in wetland performance since MY2. The gauges that met success criteria (USAW1, USAW2, USAW5,

USAW7, USAW8, USAW9, USAW10, USAW11, and USAW13) demonstrated consecutive hydroperiods of 12 percent or greater, these ranged from 21.2 to 57.2 percent of the growing season. The gauges that did not meet success criteria (USAW3, USAW4, USAW6, and USAW12) demonstrated consecutive hydroperiods of 12 percent or less, with a range from 5.3 percent to 10.1 percent of the growing season. The rain data for the region (Figure 9) shows that rainfall in the early months of 2017 was at or below average. The early months of the growing season are generally when wetland water tables are highest on mitigation sites. This lack of early year rainfall may have contributed to the four unsuccessful gauges. Baker will continue to monitor the groundwater hydrology of the Site during Monitoring Year 4.

An on-site recording rain gauge was installed at the site in August 2017. Data from this gauge will be used to measure local precipitation in the future to eliminate reliance on the nearby CRONOS stations. These stations often show a high level of variance across a small geographic area, which makes it difficult to determine the actual amount of rain the site receives. Having direct access to this data will allow accurate precipitation data to be collected and presented in future monitoring years.

# 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.

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

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). 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. Environmental Laboratory. US Army Engineer Waterways Experiment Station. Vicksburg, MS.

____. 1997. Corps of Engineers Wetlands Research Program. Technical Note VN-rs-4.1. Environmental Laboratory. U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

____. 2003. Stream Mitigation Guidelines, April 2003, U.S. Army Corps of Engineers. Wilmington District.

____. 2005. "Technical Standard for Water-Table Monitoring of Potential Wetland Sites," WRAP Technical Notes Collection (ERDC TN-WRAP-05-2), U.S. Army Engineer Research and Development Center. Vicksburg, MS.

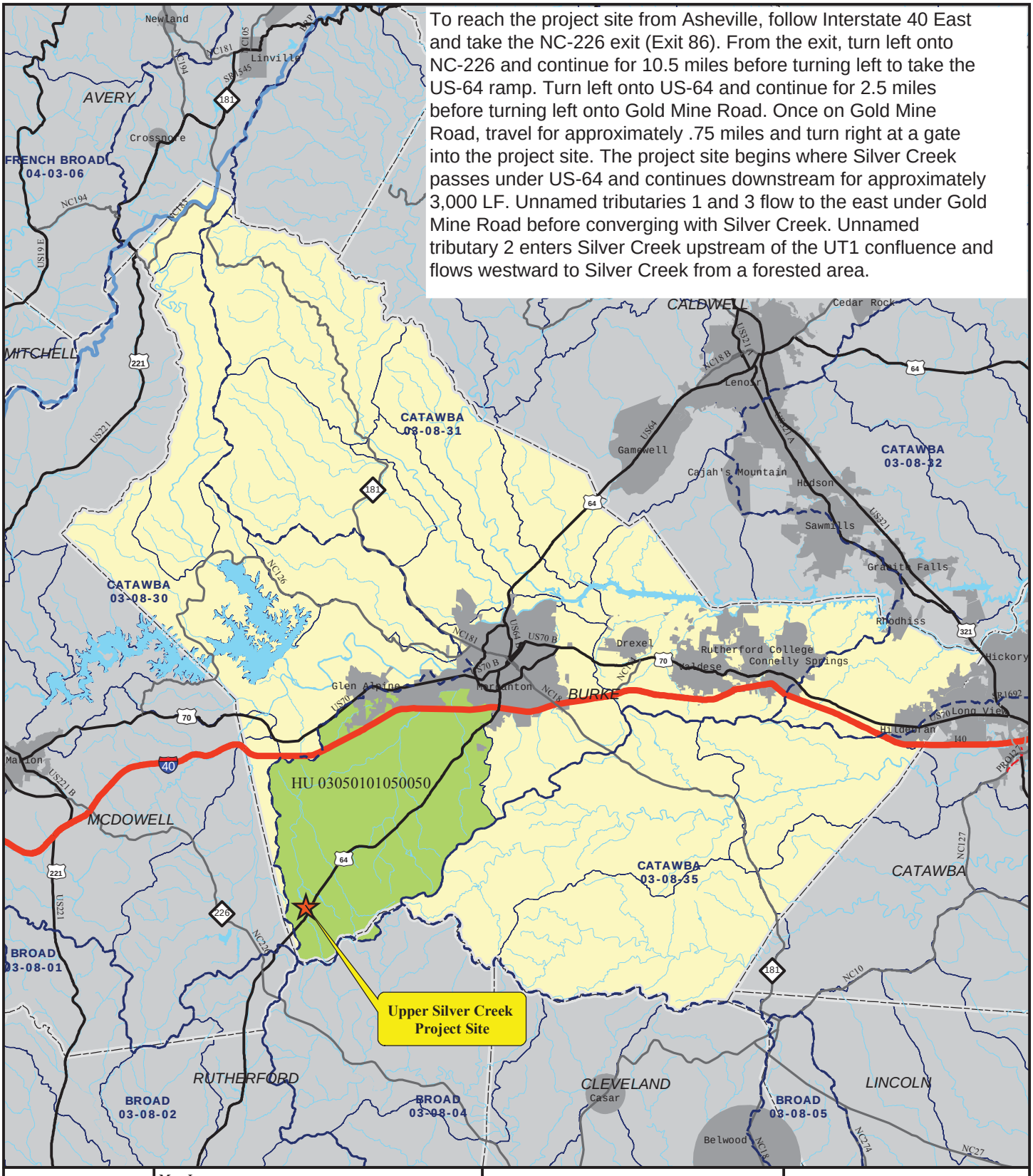
# Appendix A

## General Figures and Plan Views

Includes:

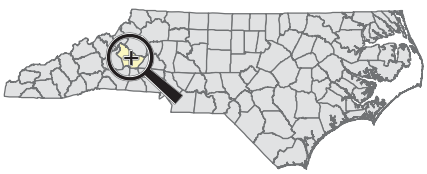
Figure 1. Project Vicinity Map and Directions
Figure 2. Current Condition Plan View (CCPV) – Overview Map
Figure 2A. CCPV North half of Project
Figure 2B. CCPV South half of Project

To reach the project site from Asheville, follow Interstate 40 East and take the NC-226 exit (Exit 86). From the exit, turn left onto NC-226 and continue for 10.5 miles before turning left to take the US-64 ramp. Turn left onto US-64 and continue for 2.5 miles before turning left onto Gold Mine Road. Once on Gold Mine Road, travel for approximately .75 miles and turn right at a gate into the project site. The project site begins where Silver Creek passes under US-64 and continues downstream for approximately 3,000 LF. Unnamed tributaries 1 and 3 flow to the east under Gold Mine Road before converging with Silver Creek. Unnamed tributary 2 enters Silver Creek upstream of the UT1 confluence and flows westward to Silver Creek from a forested area.




Division of Mitigation Services

Map Inset




**LEGEND:**

- NCDWQ Sub-basin
- Counties
- USGS Hydrologic Unit
- Project Hydrologic Unit
- Burke County

0 1 2 4 Miles

**Figure 1. Project Vicinity Map**

**Upper Silver Creek**
**NCDMWS Project #94645**
**Monitoring Year 3 Report**
**Burke County, NC**

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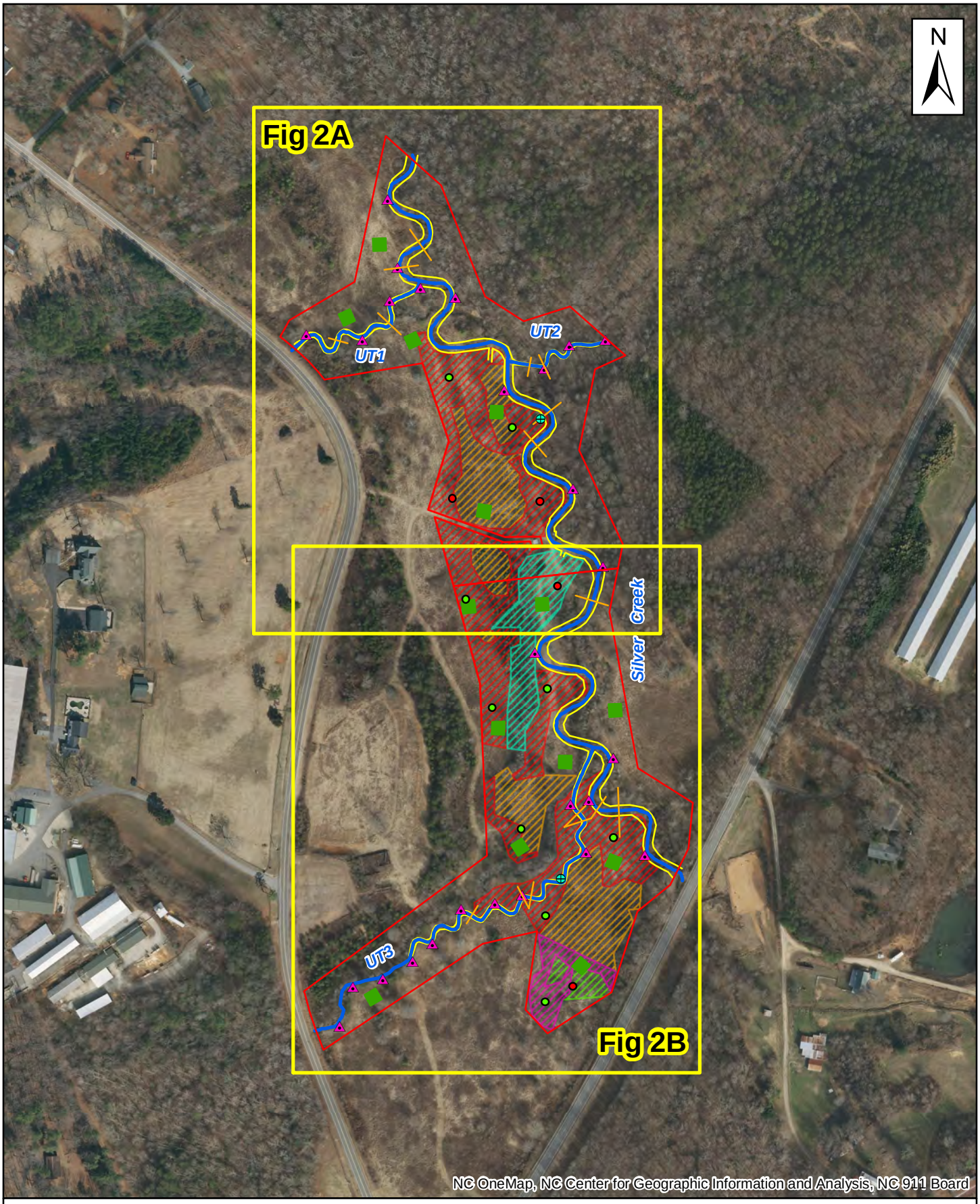


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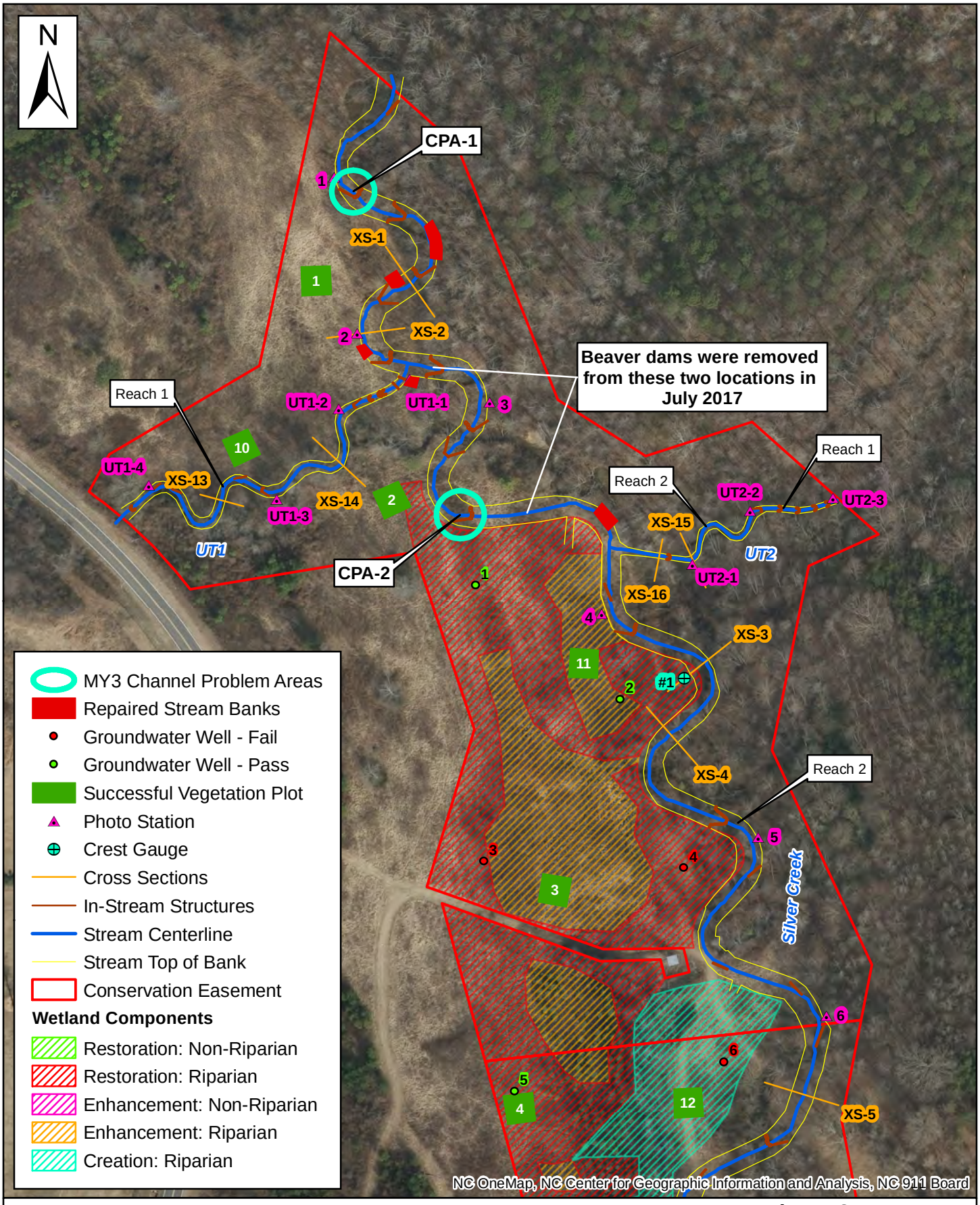
0 250 500 Feet

DMS Project # 94645

**Figure 2 - Overview**
**Current Conditions Plan View**
**Monitoring Year 3**
**Upper Silver Creek Site**

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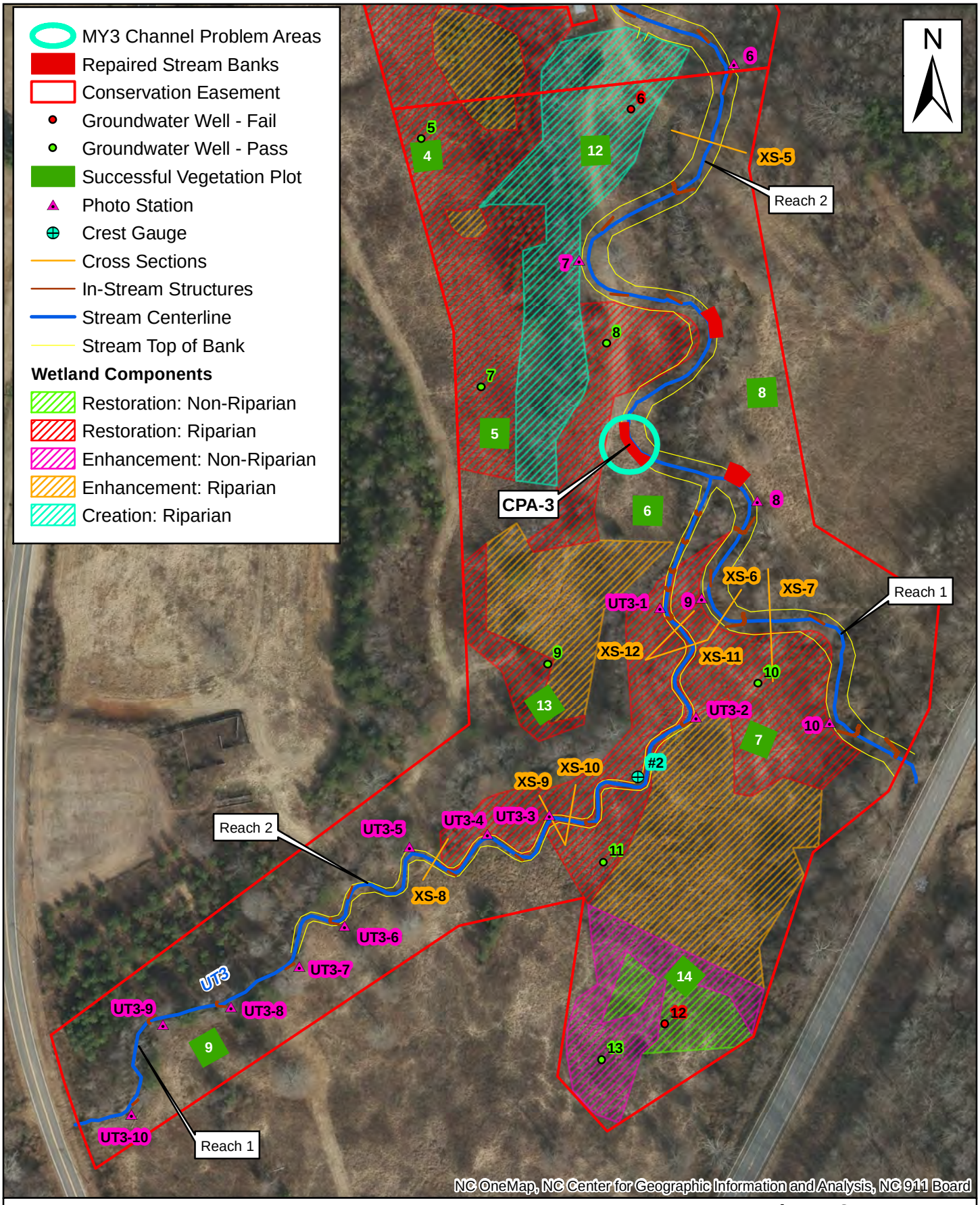
0 100 200 300 Feet

DMS Project # 94645

**Figure 2A**
**Current Conditions Plan View**
**Monitoring Year 3**
**Upper Silver Creek Site**

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0 100 200 300 Feet

**DMS Project # 94645**

**Figure 2B**
**Current Conditions Plan View**
**Monitoring Year 3**
**Upper Silver Creek Site**

# Appendix B
## General Project Tables

Includes:

Table 1. Project Components and Mitigation Credits
Figure 3. U. Silver Cr. 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**

**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

**Mitigation Credits**

| | Stream | | Riparian Wetland | | | Non-riparian Wetland | | | Buffer | Nitrogen Nutrient Offset | Phosphorus Nutrient Offset |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | R | EII | R | E | C | R | E | C | | | |
| Totals | 4,843 SMU | 137 SMU | 4.67 WMU | 1.43 WMU | 0.33 WMU | 0.21 WMU | 0.21 WMU | | | | |

**Project Components**

| Project Component or Reach ID | Stationing/ Location | Existing Footage/ Acreage | Approach | Restoration/ Restoration Equivalent | Restoration Footage or Acreage | Mitigation Ratio |
|---|---|---|---|---|---|---|
| **STREAMS** | | | | | | |
| Silver Creek | | 2643 LF | | | | |
| Reach 1 | 0+32 to 8+70 | | Restoration - PII | 838 SMU | 838 LF | 1:1 |
| Reach 2 | 8+70 to 30+48 | | Restoration - PI | 2,178 SMU | 2178 LF | 1:1 |
| UT1 | | 478 LF | | | | |
| Reach 1 | 0+07 to 5+02 | | Restoration - PI | 495 SMU | 495 LF | 1:1 |
| UT2 | | 187 LF | | | | |
| Reach 1 | 0+00 to 1+03 | | Restoration - PI | 103 SMU | 103 LF | 1:1 |
| Reach 2 | 1+03 to 3+10 | | Restoration - PI | 207 SMU | 207 LF | 1:1 |
| UT3 | | 1,162 LF | | | | |
| Reach 1 | 0+00 to 3+43 | | Enhancement I | 137 SMU | 343 LF | 2.5:1 |
| Reach 2 | 3+43 to 13+65 | | Restoration - PI | 1,022 SMU | 1,022 LF | 1:1 |
| | | | | | | |
| **WETLANDS** | See plan sheets | | | | | |
| JDW1a (NR) | | 0.42 AC | Enhancement | 0.21 WMU | 0.42 AC | 2:1 |
| JDW1b (Ri) | | 1.01 AC | Enhancement | 0.51 WMU | 1.01 AC | 2:1 |
| JDW2 (Ri) | | 0.51 AC | Enhancement | 0.25 WMU | 0.51 AC | 2:1 |
| JDW3 (Ri) | | 0.03 AC | Enhancement | 0.02 WMU | 0.03 AC | 2:1 |
| JDW4 (Ri) | | 0.24 AC | Enhancement | 0.12 WMU | 0.24 AC | 2:1 |
| JDW5 (Ri) | | 0.81 AC | Enhancement | 0.40 WMU | 0.81 AC | 2:1 |
| JDW6 (Ri) | | 0.25 AC | Enhancement | 0.13 WMU | 0.25 AC | 2:1 |
| R1A (NR) | | 0 | Restoration | 0.06 WMU | 0.06 AC | 1:1 |
| R1B (NR) | | 0 | Restoration | 0.15 WMU | 0.15 AC | 1:1 |
| R2 (Ri) | | 0 | Restoration | 1.22 WMU | 1.22 AC | 1:1 |
| R3 (Ri) | | 0 | Restoration | 0.18 WMU | 0.18 AC | 1:1 |
| R4 (Ri) | | 0 | Restoration | 0.44 WMU | 0.44 AC | 1:1 |
| R5 (Ri) | | 0 | Restoration | 1.29 WMU | 1.29 AC | 1:1 |
| R6 (Ri) | | 0 | Restoration | 1.54 WMU | 1.54 AC | 1:1 |
| C1 (Ri) | | 0 | Creation | 0.33 WMU | 0.99 AC | 3:1 |

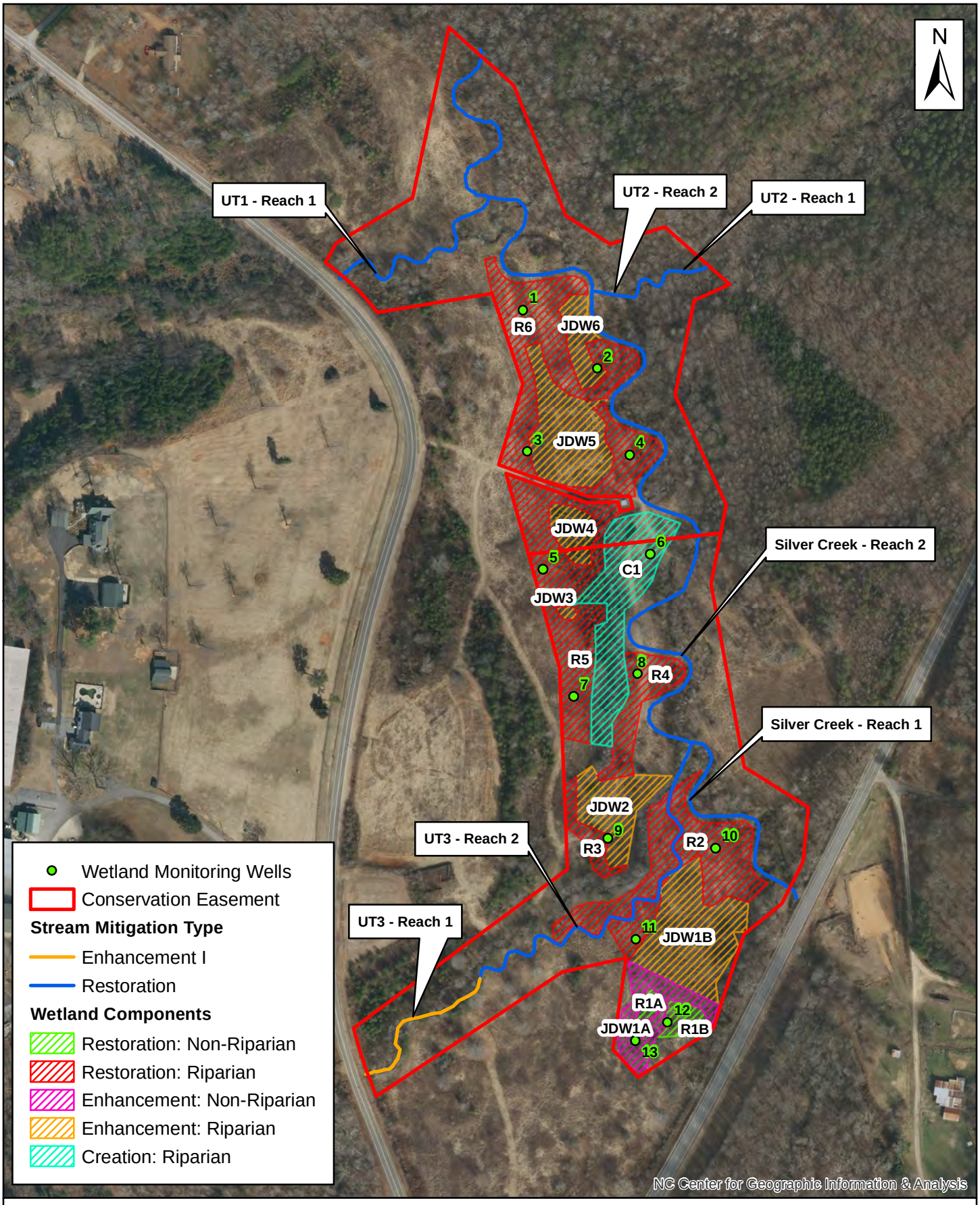
**Component Summation**

| Restoration Level | Stream (LF) | Riparian Wetland (AC) | | Non-riparian Wetland (AC) | Buffer (SF) | Upland (AC) |
|---|---|---|---|---|---|---|
| | | Riverine | Non-Riverine | | | |
| Restoration | 4,843 | 4.67 | | 0.21 | | |
| Enhancement I | | 2.85 | | 0.42 | | |
| Enhancement II | 343 | | | | | |
| Creation | | 0.99 | | | | |
| Preservation | | | | | | |
| 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




Michael Baker INTERNATIONAL

0 250 500 Feet

DMS Project # 94645

**Figure 3**
**U. Silver Cr. Project Asset Map**
**Upper Silver Creek Site**

**Table 2. Project Activity and Reporting History**
**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

| Activity or Report | Scheduled Completion | Data Collection Complete | Actual Completion or Delivery |
|---|---|---|---|
| Mitigation Plan Prepared | Jan-13 | N/A | Jan-13 |
| Mitigation Plan Amended | Sep-13 | N/A | Sep-13 |
| Mitigation Plan Approved | Oct-13 | N/A | Oct-13 |
| Final Design – (at least 90% complete) | N/A | N/A | May-14 |
| Construction Begins | N/A | N/A | May-14 |
| Temporary S&E mix applied to entire project area | N/A | N/A | Dec-14 |
| Permanent seed mix applied to entire project area | N/A | N/A | Dec-14 |
| Planting of live stakes | Winter 2015 | N/A | Feb-15 |
| Planting of bare root trees | N/A | N/A | Feb-15 |
| End of Construction | N/A | N/A | Dec-14 |
| Survey of As-built conditions (Year 0 Monitoring-baseline) | N/A | Mar-15 | Jul-15 |
| Repair of 3 piping structures | N/A | N/A | Aug-15 |
| Mitigation Plan Addendum | N/A | N/A | Dec-15 |
| Year 1 Monitoring | Dec-15 | Dec-15 | Apr-16 |
| Repair of channel problem areas resulting from flooding | N/A | N/A | Mar-16 |
| Year 2 Monitoring | Dec-16 | Nov-16 | Dec-16 |
| Invasive vegetation treatment | N/A | N/A | Jun-17 |
| Beaver dam removal | N/A | N/A | Jul-17 |
| Year 3 Monitoring | Dec-17 | Oct-17 | Dec-17 |
| Year 4 Monitoring | Dec-18 | N/A | N/A |
| Year 5 Monitoring | Dec-19 | N/A | N/A |

| Table 3. Project Contacts | |
|---|---|
| **Upper Silver Creek Restoration Project: DMS Project ID No. 94645** | |
| **Designer** | |
| Michael Baker Engineering, Inc. | 797 Haywood Rd Suite 201<br>Asheville, NC 28806<br>Contact:<br>Micky Clemmons, Tel. 828-412-6100 |
| **Construction Contractor** | |
| River Works, Inc. | 6105 Chapel Hill Road<br>Raleigh, NC 27607<br>Contact:<br>Phillip Todd, Tel. 919-582-3575 |
| **Planting Contractor** | |
| River Works, Inc. | 6105 Chapel Hill Road<br>Raleigh, NC 27607<br>Contact:<br>Phillip Todd, Tel. 919-582-3575 |
| **Seeding Contractor** | |
| River Works, Inc. | 6105 Chapel Hill Road<br>Raleigh, NC 27607<br>Contact:<br>Phillip Todd, Tel. 919-582-3575 |
| Seed Mix Sources | Green Resources (seed), Tel. 336-855-6363 |
| Nursery Stock Suppliers | Mellow Marsh Farm (trees), 919-742-1200<br>ArborGen Inc. (trees), 843-528-3204<br>Dykes and Son (trees), 931-668-8833 |
| **Monitoring Performers** | |
| Michael Baker Engineering, Inc. | 797 Haywood Rd Suite 201<br>Asheville, NC 28806 |
| | Contact: |
| Stream Monitoring Point of Contact | Micky Clemmons, Tel. 828-412-6100 |
| Vegetation Monitoring Point of Contact | Micky Clemmons, Tel. 828-412-6100 |
| Wetland Monitoring Point of Contact | Micky Clemmons, Tel. 828-412-6100 |

| Table 4. Project Attributes | | | |
|---|---|---|---|
| **Upper Silver Creek Restoration Project: DMS Project ID No. 94645** | | | |
| **Project Information** | | | |
| Project Name | Upper Silver Creek Mitigation Project | | |
| County | Burke | | |
| Project Area (acres) | 22.0 | | |
| Project Coordinates (latitude and longitude) | 35.6078 N, -81.81742 W | | |
| **Watershed Summary Information** | | | |
| Physiographic Province | Blue Ridge (borders Piedmont) | | |
| River Basin | Catawba | | |
| USGS Hydrologic Unit 8-digit and 14-digit | 03050101 / 03050101050050 | | |
| DWR Sub-basin | 03-08-31 | | |
| Project Drainage Area (AC) | Mainstem 2.7 - 3.3, UT1 0.28, UT2 0.05, UT3 0.17 | | |
| Project Drainage Area Percentage of Impervious Area | <2% | | |
| USGA Land Use Classification | Deciduous Forest (64%) | Woody Wetlands (1%) | |
| | Evergreen Forest (3%) | Developed, Open Space (5%) | |
| | Shrub/Scrub (5%) | Pasture/Hay (14%) | |
| | Grassland/Herbaceous (6%) | | |
| NCDMS Land Use Classification for Silver Creek Watershed | Forest (59%) | | |
| | Agriculture (23%) | | |
| | Impervious Cover (2.9%) | | |
| **Stream Reach Summary Information** | | | |
| **Parameters** | **Mainstem - Reach 1** | **Mainstem - Reach 2** | |
| Length of Reach (LF) | 838 | 2,178 | |
| Valley Classification (Rosgen) | VIII | VIII | |
| Drainage Area (AC) | 1,746 | 2,147 | |
| NCDWR Stream Identification Score | 49.5 | 49.5 | |
| NCDWR Water Quality Classification | C | C | |
| Morphological Description (Rosgen stream type) | E | E | |
| | Incised channel, little connection to floodplain | Incised channel, little connection to floodplain | |
| Evolutionary Trend | E→G, E→C/F | E→G, E→C/F | |
| Underlying Mapped Soils | AaA, FnA, UnB | AaA, FnA, UnB | |
| Drainage Class | Somewhat poorly to well drained | Somewhat poorly to well drained | |
| Soil Hydric Status | Site-specific | Site-specific | |
| Average Channel Slope (ft/ft) | 0.004 | 0.004 | |
| FEMA Classification | Zone AE | Zone AE | |
| Native Vegetation Community | Piedmont/Mtn. Mixed Bottomland Hardwoods | Piedmont/Mtn. Mixed Bottomland Hardwoods | |
| Percent Composition of Exotic/Invasive Vegetation | 10% | 5% | |
| **Parameters** | **UT1 - Reach 1** | **UT2 - Reach 1** | **UT2 - Reach 2** |
| Length of Reach (LF) | 495 | 103 | 207 |
| Valley Classification (Rosgen) | III | III | III |
| Drainage Area (AC) | 177 | 32 | 32 |
| NCDWR Stream Identification Score | 47.5 | 45 | 45 |
| NCDWR Water Quality Classification | C | C | C |
| Morphological Description (Rosgen stream type) | Gc | channelized B | channelized B |
| | Incised channel, little connection to floodplain | channelized/ditched channel | channelized/ditched channel |
| Evolutionary Trend | Gc→F | B→F→C | B→F→C |
| Underlying Mapped Soils | AaA, FnA | UnB | UnB, FnA |
| 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) | 0.016 | 0.037 | 0.037 |
| FEMA Classification | N/A | N/A | N/A |
| Native Vegetation Community | Piedmont Dry-Mesic Oak and Hardwoods to Mixed Bottomland Hardwoods | Piedmont/Mtn. Mixed Bottomland Hardwoods | Piedmont/Mtn. Mixed Bottomland Hardwoods |
| Percent Composition of Exotic/Invasive Vegetation | 5% | 2% | 2% |

| Parameters | UT3 - Reach 1 | UT3 - Reach 1 |
|---|---|---|
| Length of Reach (LF) | 342 | 1,006 |
| Valley Classification (Rosgen) | III | III |
| Drainage Area (AC) | 123 | 123 |
| NCDWR Stream Identification Score | 49.75 | 49.75 |
| NCDWR Water Quality Classification | C | C |
| Morphological Description (Rosgen stream type) | B/E | E |
| | Aggrading at upper end then stable to incising at lower end | Incised channel, little connection to floodplain |
| Evolutionary Trend | B/E→G | E→G |
| Underlying Mapped Soils | AaA | AaA, FnA |
| Drainage Class | Somewhat poorly to well drained | Somewhat poorly to well drained |
| Soil Hydric Status | Site-specific | Site-specific |
| Average Channel Slope (ft/ft) | 0.015 | 0.015 |
| FEMA Classification | N/A | N/A |
| Native Vegetation Community | Piedmont Dry-Mesic Oak and Hardwoods | Piedmont/Mtn. Mixed Bottomland Hardwoods |
| Percent Composition of Exotic/Invasive Vegetation | 2% | 2% |

**Wetland Summary Information**

| Parameters | JDW1 | JDW2 | JDW3 | JDW4 | JDW5 | JDW6 |
|---|---|---|---|---|---|---|
| Size of Wetland (AC) | 1.43 | 0.51 | 0.03 | 0.24 | 0.81 | 0.3 |
| Wetland Type | Riparian | Riparian | Riparian | Riparian | Riparian | Riparian |
| Mapped Soil Series | FnA | FnA | FnA | FnA | FnA | FnA |
| Drainage Class | Somewhat poorly to well drained | Somewhat poorly to well drained | Somewhat poorly to well drained | Somewhat poorly to well drained | Somewhat poorly to well drained | Somewhat poorly to well drained |
| Soil Hydric Status | Site-specific | Site-specific | Site-specific | Site-specific | Site-specific | Site-specific |
| Source of Hydrology | Hillslope seepage; Baseflow; Overbank Flooding | Hillslope seepage; Baseflow; Overbank Flooding | Hillslope seepage; Baseflow; Overbank Flooding | Hillslope seepage; Baseflow; Overbank Flooding | Hillslope seepage; Baseflow; Overbank Flooding | Hillslope seepage; Baseflow; Overbank Flooding |
| Hydrologic Impairment | Partially | Yes | No | Partially | Partially | Partially |
| Native Vegetation Community | Piedmont/Mountain Mixed Bottomland Hardwood Forest. Successional Deciduous Forest Land was once also present near Wetlands 2 & 5. | | | | | |
| Percent Composition of Exotic/Invasive Vegetation | ~30% | ~55% | ~10% | ~40% | ~55% | ~35% |

**Regulatory Considerations**

| Regulation | Applicable | Resolved | Supporting Documentation |
|---|---|---|---|
| Waters of the United States – Section 404 | Yes | Yes | Categorical Exclusion |
| Waters of the United States – Section 401 | Yes | Yes | Categorical Exclusion |
| Endangered Species Act | Yes | Yes | Categorical Exclusion |
| Historic Preservation Act | Yes | Yes | Categorical Exclusion |
| Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA) | No | N/A | N/A |
| FEMA Floodplain Compliance | Yes | Yes | Categorical Exclusion |
| Essential Fisheries Habitat | No | N/A | N/A |

Notes:
1. See Figure 2.3 of Mitigation Plan for key to soil series symbols.
2. All wetlands had been disturbed to some degree at the time the project was initiated. As a result, only remnants of native vegetative communities exist in the wetland areas.
3. Fescue is considered as invasive vegetation; it and other field grasses were the dominant nonnative wetland vegetation observed.
4. USGS Land Use Data (2001) used rather than CGIA Land Use Classification data which is more outdated (1996).
5. Source: Upper Catawba River Basin Restoration Priorities (NCEEP 2009) (https://deq.nc.gov/about/divisions/mitigation-services/dms-planning/watershed-planning-documents/catawba-river-basin)

# Appendix C

## Vegetation Assessment Data

Includes:

Table 5. Vegetation Plot Mitigation Success Summary

Table 6. CVS Vegetation Metadata Table

Table 7. Stem Count Arranged by Plot and Species

Figure 4. Vegetation Monitoring Plot Photos

| Table 5. Vegetation Plot Mitigation Success Summary (per acre) | | | | |
|---|---|---|---|---|
| **Plot #** | **Stream/ Wetland Stems[1]** | **Volunteers[2]** | **Total[3]** | **Success Criteria Met?** |
| **1** | 1174 | 121 | 1295 | Yes |
| **2** | 1133 | 40 | 1174 | Yes |
| **3** | 445 | 121 | 567 | Yes |
| **4** | 688 | 0 | 688 | Yes |
| **5** | 850 | 0 | 850 | Yes |
| **6** | 647 | 0 | 647 | Yes |
| **7** | 607 | 0 | 607 | Yes |
| **8** | 567 | 405 | 971 | Yes |
| **9** | 445 | 0 | 445 | Yes |
| **10** | 769 | 202 | 971 | Yes |
| **11** | 769 | 0 | 769 | Yes |
| **12** | 728 | 0 | 728 | Yes |
| **13** | 647 | 0 | 647 | Yes |
| **14** | 607 | 0 | 607 | Yes |
| **Project Avg** | **720** | **64** | **783** | |

| **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. |

Exceeds requirements by 10%

| Table 6. Vegetation Metadata<br>Upper Silver Creek Stream and Wetland Restoration - Project 94645 | |
|---|---|
| **Report Prepared By** | Russell Myers |
| **Date Prepared** | 10/19/2017 14:26 |
| | |
| **database name** | MY3_94645_UpperSilver_cvs-eep-entrytool-v2.3.1.mdb |
| **database location** | L:\projects\120598-Upr-Silver-FD\Monitoring\YR3 Monitoring\2.0 - Monitoring Data\App C - Vegetation Data |
| **computer name** | ASHELRMYERS |
| **file size** | 63311872 |
| | |
| **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** | 94645 |
| **project Name** | Upper Silver Creek |
| **Description** | Full Delivery stream and wetland restoration site |
| **River Basin** | Broad |
| **length(ft)** | 5,169' |
| **stream-to-edge width (ft)** | Minimum of 30 ft |
| **area (sq m)** | 62,321 sq. m. |
| **Required Plots (calculated)** | 14 |
| **Sampled Plots** | 14 |

**Table 7. Stem Count Arranged By Plot**
**Project: Upper Silver Creek, DMS Project #94645**

| | | | Current Plot Data (MY3 2017) | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 94645-01-0001 | | | 94645-01-0002 | | | 94645-01-0003 | | | 94645-01-0004 | | | 94645-01-0005 | | | 94645-01-0006 | | | 94645-01-0007 | | | 94645-01-0008 | | | 94645-01-0009 | | |
| 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 | P | V | T | P | V | T |
| Acer rubrum | red maple | Tree | 1 | | 1 | 6 | | 6 | | | | 1 | | 1 | | | | | | | | | | 3 | | 3 | | | |
| Alnus serrulata | hazel alder | Shrub | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Betula nigra | river birch | Tree | | | | | | | 2 | | 2 | | | | | | | 1 | | 1 | 3 | | 3 | | | | | | |
| Carpinus caroliniana | American hornbeam | Tree | 1 | | 1 | 3 | | 3 | | | | 2 | | 2 | 1 | | 1 | | | | 1 | | 1 | | | | 1 | | 1 |
| Cornus amomum | silky dogwood | Shrub | | | | | | | 1 | | 1 | 1 | | 1 | 6 | | 6 | 4 | | 4 | 2 | | 2 | | | | | | |
| Corylus cornuta | beaked hazelnut | Shrub Tree | | | | | | | | | | | | | | | | 1 | | 1 | | | | | | | | | |
| Diospyros virginiana | common persimmon | Tree | 1 | | 1 | | | | | | | 1 | | 1 | | | | | | | | | | 1 | | 1 | | | |
| Fraxinus pennsylvanica | green ash | Tree | | | | | | | 2 | | 2 | | | | 8 | | 8 | 1 | | 1 | 1 | | 1 | | | | | | |
| Liquidambar styraciflua | sweetgum | Tree | | | | | | | | 3 | 3 | | | | | | | | | | | | | | | | | | |
| Liriodendron tulipifera | tuliptree | Tree | | | | 1 | | 1 | | | | 1 | | 1 | | | | | | | | | | 2 | 5 | 7 | | | |
| Platanus occidentalis | American sycamore | Tree | 9 | 3 | 12 | 4 | 1 | 5 | 2 | | 2 | 6 | | 6 | 4 | | 4 | 3 | | 3 | 5 | | 5 | 4 | 5 | 9 | 2 | | 2 |
| Quercus | oak | Tree | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Quercus lyrata | overcup oak | Tree | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Quercus michauxii | swamp chestnut oak | Tree | 1 | | 1 | 6 | | 6 | 1 | | 1 | 2 | | 2 | 2 | | 2 | 3 | | 3 | 3 | | 3 | 2 | | 2 | | | |
| Quercus nigra | water oak | Tree | | | | | | | 3 | | 3 | | | | | | | | | | | | | | | | | | |
| Quercus pagoda | cherrybark oak | Tree | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Quercus phellos | willow oak | Tree | 2 | | 2 | 4 | | 4 | | | | 3 | | 3 | | | | 3 | | 3 | | | | | | | 5 | | 5 |
| Unknown | | Shrub or Tree | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | 2 |
| Vaccinium corymbosum | highbush blueberry | Shrub | | | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | |
| Viburnum dentatum | southern arrowwood | Shrub | 14 | | 14 | 3 | | 3 | | | | | | | | | | | | | | | | 2 | | 2 | 1 | | 1 |
| | | Stem count | 29 | 3 | 32 | 28 | 1 | 29 | 11 | 3 | 14 | 17 | 0 | 17 | 21 | 0 | 21 | 16 | 0 | 16 | 15 | 0 | 15 | 14 | 10 | 24 | 11 | 0 | 11 |
| | | size (ares) | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | |
| | | size (ACRES) | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | |
| | | Species count | 7 | 1 | 7 | 8 | 1 | 8 | 6 | 1 | 7 | 8 | 0 | 8 | 5 | 0 | 5 | 7 | 0 | 7 | 6 | 0 | 6 | 6 | 2 | 6 | 5 | 0 | 5 |
| | | Stems per ACRE | 1174 | 121 | 1295 | 1133 | 40 | 1174 | 445 | 121 | 567 | 688 | 0 | 688 | 850 | 0 | 850 | 647 | 0 | 647 | 607 | 0 | 607 | 567 | 405 | 971 | 445 | 0 | 445 |

**Table 7. Stem Count Arranged By Plot, Continued**
**Project: Upper Silver Creek, DMS Project #94645**

| | | | Current Plot Data (MY3 2017) | | | | | | | | | | | | | | | Annual Means | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 94645-01-0010 | | | 94645-01-0011 | | | 94645-01-0012 | | | 94645-01-0013 | | | 94645-01-0014 | | | 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 | P | V | T | P | V | T | P | V | T |
| Acer rubrum | red maple | Tree | | 1 | 1 | | | | 1 | | 1 | | | | | | | 12 | 1 | 13 | 13 | 1 | 14 | 14 | | 14 | 12 | | 12 |
| Alnus serrulata | hazel alder | Shrub | | | | 1 | | 1 | 1 | | 1 | | | | | | | 2 | | 2 | | 1 | 1 | 1 | | 1 | 1 | | 1 |
| Betula nigra | river birch | Tree | 1 | | 1 | 3 | | 3 | 6 | | 6 | 3 | | 3 | 1 | | 1 | 20 | | 20 | 19 | | 19 | 21 | | 21 | 8 | | 8 |
| Carpinus caroliniana | American hornbeam | Tree | | 1 | 1 | | | | 1 | | 1 | | | | | | | 10 | 1 | 11 | 11 | 1 | 12 | 11 | | 11 | 9 | | 9 |
| Cornus amomum | silky dogwood | Shrub | | | | 11 | | 11 | 3 | | 3 | 2 | | 2 | | | | 30 | | 30 | 32 | 5 | 37 | 32 | | 32 | 16 | | 16 |
| Corylus cornuta | beaked hazelnut | Shrub Tree | | | | | | | | | | | | | | | | 1 | | 1 | 1 | | 1 | 1 | | 1 | 1 | | 1 |
| Diospyros virginiana | common persimmon | Tree | | | | | | | | | | | | | | | | 3 | | 3 | 3 | | 3 | 3 | | 3 | 3 | | 3 |
| Fraxinus pennsylvanica | green ash | Tree | | | | | | | 2 | | 2 | | | | 4 | | 4 | 18 | | 18 | 18 | 1 | 19 | 19 | | 19 | 12 | | 12 |
| Liquidambar styraciflua | sweetgum | Tree | | | | | | | | | | | | | | | | | 3 | 3 | | 1 | 1 | | | | | | |
| Liriodendron tulipifera | tuliptree | Tree | 2 | 2 | 4 | | | | | | | | | | | | | 6 | 7 | 13 | 7 | 1 | 8 | 11 | | 11 | 10 | | 10 |
| Platanus occidentalis | American sycamore | Tree | 5 | | 5 | 1 | | 1 | 2 | | 2 | 3 | | 3 | 3 | | 3 | 53 | 9 | 62 | 54 | 5 | 59 | 60 | | 60 | 48 | | 48 |
| Quercus | oak | Tree | | | | | | | | | | | | | | | | | | | 1 | | 1 | 2 | | 2 | | | |
| Quercus lyrata | overcup oak | Tree | | | | | | | 1 | | 1 | | | | | | | 1 | | 1 | 1 | | 1 | 1 | | 1 | | | |
| Quercus michauxii | swamp chestnut oak | Tree | 1 | 1 | 2 | 1 | | 1 | | | | 8 | | 8 | 4 | | 4 | 34 | 1 | 35 | 32 | | 32 | 33 | | 33 | 20 | | 20 |
| Quercus nigra | water oak | Tree | | | | | | | | | | | | | | | | 3 | | 3 | 3 | | 3 | 4 | | 4 | 4 | | 4 |
| Quercus pagoda | cherrybark oak | Tree | | | | | | | | | | | | | 1 | | 1 | 1 | | 1 | | | | | | | | | |
| Quercus phellos | willow oak | Tree | 10 | | 10 | 2 | | 2 | 1 | | 1 | | | | 2 | | 2 | 32 | | 32 | 32 | | 32 | 32 | | 32 | 17 | | 17 |
| Unknown | | Shrub or Tree | | | | | | | | | | | | | | | | 2 | | 2 | 7 | | 7 | 10 | | 10 | 6 | | 6 |
| Vaccinium corymbosum | highbush blueberry | Shrub | | | | | | | | | | | | | | | | 1 | | 1 | 1 | | 1 | 1 | | 1 | 1 | | 1 |
| Viburnum dentatum | southern arrowwood | Shrub | | | | | | | | | | | | | | | | 20 | | 20 | 21 | | 21 | 21 | | 21 | 21 | | 21 |
| | | Stem count | 19 | 5 | 24 | 19 | 0 | 19 | 18 | 0 | 18 | 16 | 0 | 16 | 15 | 0 | 15 | 249 | 22 | 271 | 256 | 16 | 272 | 277 | 0 | 277 | 189 | 0 | 189 |
| | | size (ares) | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | | 14 | | | 14 | | | 14 | | | 9 | | |
| | | size (ACRES) | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.35 | | | 0.35 | | | 0.35 | | | 0.22 | | |
| | | Species count | 5 | 4 | 7 | 6 | 0 | 6 | 9 | 0 | 9 | 4 | 0 | 4 | 6 | 0 | 6 | 18 | 6 | 19 | 17 | 8 | 19 | 18 | 0 | 18 | 16 | 0 | 16 |
| | | Stems per ACRE | 769 | 202 | 971 | 769 | 0 | 769 | 728 | 0 | 728 | 647 | 0 | 647 | 607 | 0 | 607 | 720 | 64 | 783 | 740 | 46 | 786 | 801 | 0 | 801 | 850 | 0 | 850 |

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 included 9 vegetation plots. However, upon review, it was discovered that we needed to have 14 plots to meet guidelines. Five additional plots were added in the Fall of 2015 and the MY1 and later means include these additional plots

**Figure 4. Upper Silver Creek - Vegetation Plot Photos, DMS Project #94645**

Photo 1. Vegetation Plot 1 – Tree photo (October 17, 2017).

Photo 2. Vegetation Plot 1 – Herbaceous photo (October 17, 2017).

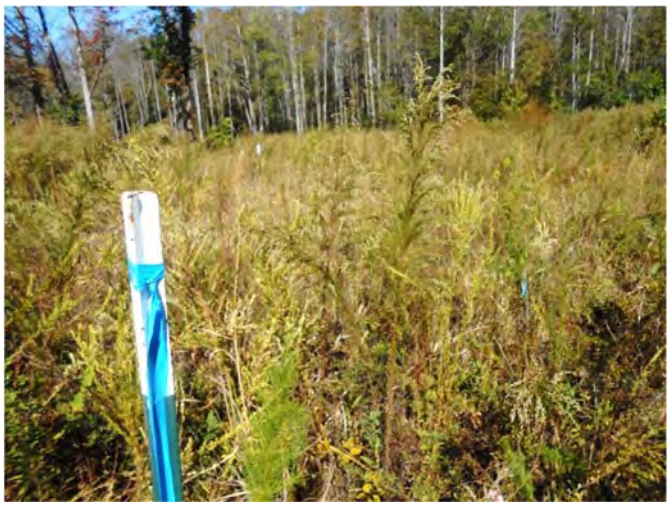


Photo 3. Vegetation Plot 2 – Tree photo (October 17, 2017).

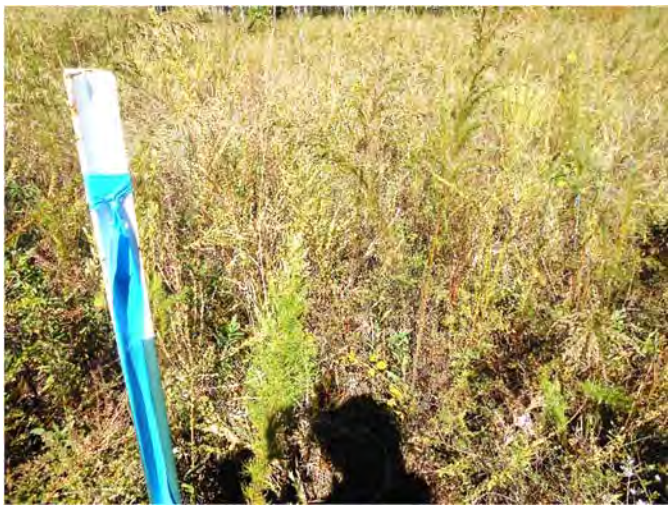


Photo 4. Vegetation Plot 2 – Herbaceous photo (October 17, 2017).

Photo 5. Vegetation Plot 3 – Tree photo (October 17, 2017).

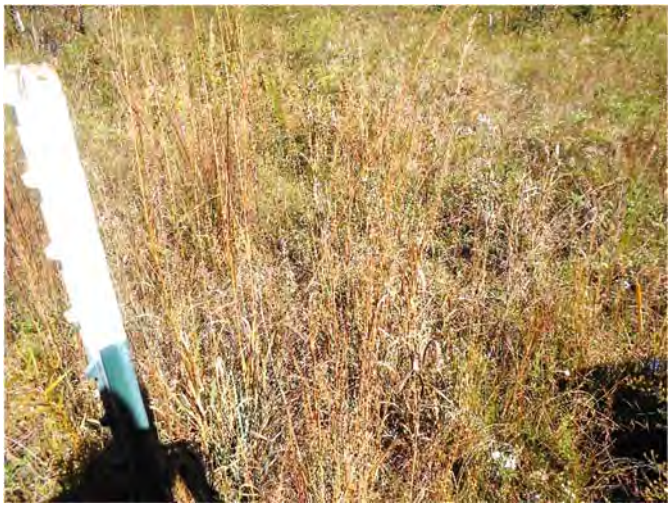


Photo 6. Vegetation Plot 3 – Herbaceous photo (October 17, 2017).

Photo 7. Vegetation Plot 4 – Tree photo (October 17, 2017).

Photo 8. Vegetation Plot 4 – Herbaceous photo (October 17, 2017).

Photo 9. Vegetation Plot 5 – Tree photo (October 17, 2017).

Photo Point 10, Vegetation Plot 5 – Herbaceous photo (October 17, 2017).

Photo 11. Vegetation Plot 6 – Tree photo (October 17, 2017).

Photo 12. Vegetation Plot 6 – Herbaceous photo (October 17, 2017).

Photo 13. Vegetation Plot 7 – Tree photo (October 17, 2017).

Photo 14. Vegetation Plot 7 – Herbaceous photo (October 17, 2017).

Photo 15. Vegetation Plot 8 – Tree photo (October 17, 2017).

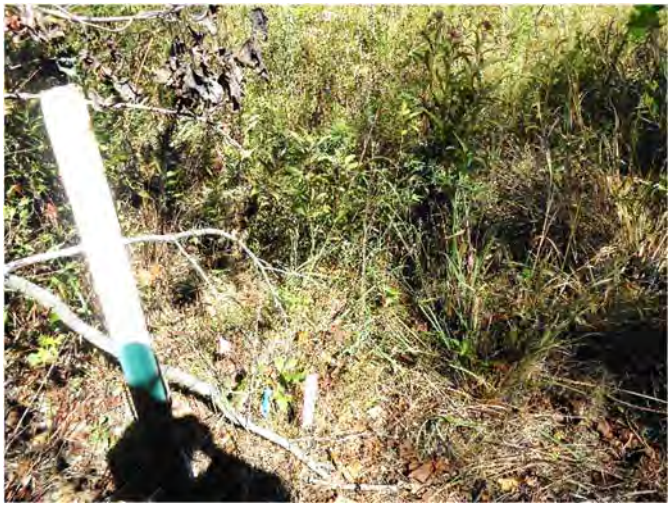


Photo 16. Vegetation Plot 8 – Herbaceous photo (October 17, 2017).

Photo 17. Vegetation Plot 9 – Tree photo (October 17, 2017).

Photo 18. Vegetation Plot 9 – Herbaceous photo (October 17, 2017).

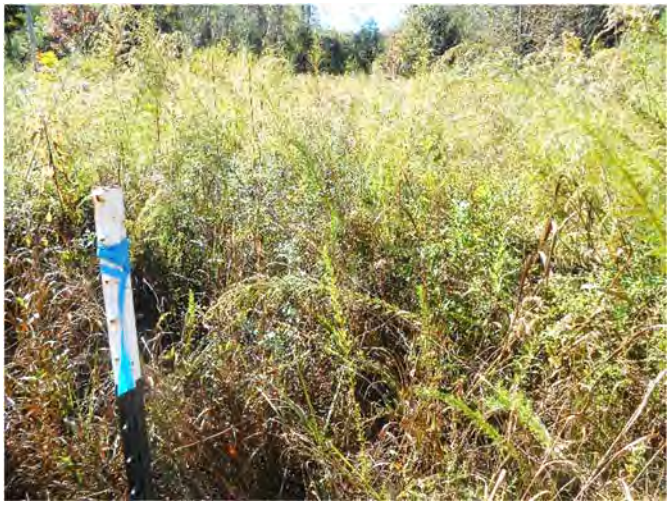


Photo 19. Vegetation Plot 10 – Tree photo (October 17, 2017).

Photo 20. Vegetation Plot 10 – Herbaceous photo (October 17, 2017).

Photo 21. Vegetation Plot 11 – Tree photo (October 17, 2017).

Photo 22. Vegetation Plot 11 – Herbaceous photo (October 17, 2017).

Photo 23. Vegetation Plot 12 – Tree photo (October 17, 2017).

Photo 24. Vegetation Plot 12 – Herbaceous photo (October 17, 2017).

Photo 25. Vegetation Plot 13 – Tree photo (October 17, 2017).

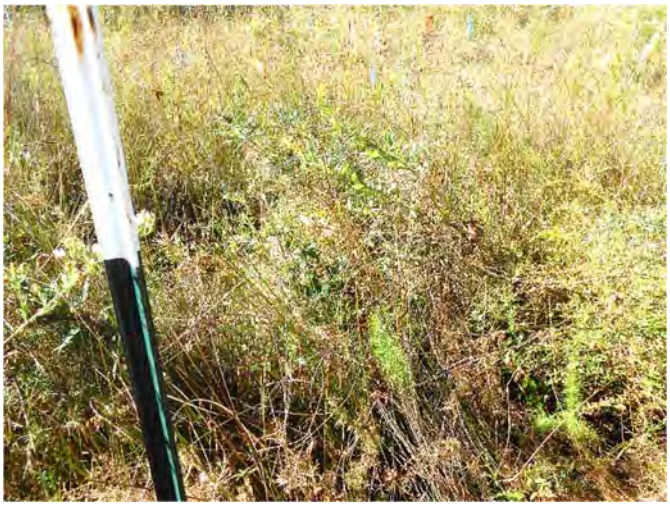


Photo 26. Vegetation Plot 13 – Herbaceous photo (October 17, 2017).

Photo 27. Vegetation Plot 14 – Tree photo (October 17, 2017).

Photo 28. Vegetation Plot 14 – Herbaceous photo (October 17, 2017).

# Appendix D

## Stream Assessment Data

Includes:

Figure 5. Stream Photos by Channel and Station

Table 8. Visual Morphological Stability Assessment

Table 9. Verification of Bankfull or Greater than Bankfull Events

Figure 6. Cross-Sections with Annual Overlays

Figure 7. Longitudinal Profiles with Annual Overlays

Figure 8. Pebble Count Plots with Annual Overlays

Table 10. Monitoring Year 3 Stream Summary

Table 11. Morphology and Hydraulic Monitoring Summary

**Figure 5. Upper Silver Creek Stream Photos by Channel and Station – MY3 (2017)**

Photo 1. Mainstem Photo Point 1 – Station 29+26
(October 18, 2017) downstream view from left bank.

Photo 2. Mainstem Photo Point 1 – Station 29+26
(October 18, 2017) upstream view from left bank.

Photo 3. Mainstem Photo Point 2 – Station 26+44
(October 18, 2017) downstream view from left bank.

Photo 4. Mainstem Photo Point 2 – Station 26+44
(October 18, 2017) upstream from left bank.

Photo 5. Mainstem Photo Point 3 – Station 24+70
(October 18, 2017) upstream from right bank.

Photo 6. Mainstem Photo Point 3 – Station 24+70
(October 18, 2017) downstream from right bank.

Photo 7. Mainstem Photo Point 4 (PP4) – Station 20+30 (October 18, 2017) downstream from left bank.

Photo 8. Mainstem Photo Point 4 (PP4) – Station 20+30 (October 18, 2017) upstream from left bank.

Photo 9. Mainstem Photo Point 5 – Station 16+03 (October 18, 2017) upstream from right bank.

Photo 10, Mainstem Photo Point 5 – Station 16+03 (October 18, 2017) downstream from right bank.

Photo 11. Mainstem Photo Point 6 – Station 13+03 (October 18, 2017) upstream from right bank.

Photo 12. Mainstem Photo Point 6 – Station 13+03 (October 18, 2017) downstream from right bank.

Photo 13. Mainstem Photo Point 7 – Station 10+11 (October 18, 2017) downstream from left bank.

Photo 14. Mainstem Photo Point 7 – Station 10+11 (October 18, 2017) upstream from left bank.

Photo 15. Mainstem Photo Point 8 – Station 5+06 (October 18, 2017) upstream from right bank.

Photo 16. Mainstem Photo Point 8 – Station 5+06 (October 18, 2017) downstream from right bank.

Photo 17. Mainstem Photo Point 9 – Station 3+87 (October 18, 2017) downstream from left bank.

Photo 18. Mainstem Photo Point 9 – Station 3+87 (October 18, 2017) upstream from left bank.

Photo 19. Mainstem Photo Point 10 – Stat. 1+22 (October 18, 2017) downstream from left bank.

Photo 20. Mainstem Photo Point 10 – Stat. 1+22 (October 18, 2017) upstream from left bank.

**Unnamed Tributary 1 - Monitoring Year 3 (2017)**

Photo 21. UT1 Photo Point 1 – Station 4+82 (October 18, 2017) upstream from left bank.

Intentionally Left Blank

Photo 22. UT1 Photo Point 2 – Station 4+07 (October 18, 2017) downstream from left bank.

Photo 23. UT1 Photo Point 2 – Station 4+07 (October 18, 2017) upstream from left bank.

Photo 24. UT1 Photo Point 3 – Station 2+55
(October 18, 2017) upstream from right bank.

Photo 25. UT1 Photo Point 3 – Station 2+55
(October 18, 2017) downstream from right bank.

Photo 26. UT1 Photo Point 4 – Station 0+55
(October 18, 2017) downstream from left bank.

Photo 27. UT1 Photo Point 4 – Station 0+55
(October 18, 2017) upstream from left bank.

**Unnamed Tributary 2 – Monitoring Year 3 (2017)**

Photo 28. UT2 Photo Point 1 – Station 2+15
(October 18, 2017) downstream from left bank.

Photo 29. UT2 Photo Point 1 – Station 2+15
(October 18, 2017) upstream from left bank.

Photo 30. UT2 Photo Point 2 – Station 0+96
(October 18, 2017) upstream from right bank.

Photo 31. UT2 Photo Point 2 – Station 0+96
(October 18, 2017) downstream from right bank.

Photo 32. UT2 Photo Point 3 – Station 0+02
(October 18, 2017) downstream from right bank.

Photo 33. UT2 Photo Point 3 – Station 0+02
(October 18, 2017) upstream from right bank.

**Unnamed Tributary 3 – Monitoring Year 3 (2017)**

Photo 34. UT3 Photo Point 1 – Station 12+10
(October 18, 2017) downstream from left bank.

Photo 35. UT3 Photo Point 1 – Station 12+10
(October 18, 2017) upstream from left bank.

Photo 36. UT3 Photo Point 2 – Station 10+66
(October 18, 2017) upstream from right bank.

Photo 37. UT3 Photo Point 2 – Station 10+66
(October 18, 2017) downstream from right bank.

Photo 38. UT3 Photo Point 3 – Station 8+10
(October 18, 2017) downstream from left bank.

Photo 39. UT3 Photo Point 3 – Station 8+10
(October 18, 2017) upstream from left bank.

Photo 40. UT3 Photo Point 4 – Station 7+05
(October 18, 2017) downstream from left bank.

Photo 41. UT3 Photo Point 4 – Station 7+05
(October 18, 2017) upstream from left bank.

Photo 42. UT3 Photo Point 5 – Station 5+95
(October 18, 2017) downstream from left bank.

Photo 43. UT3 Photo Point 5 – Station 5+95
(October 18, 2017) upstream from left bank.

Photo 44. UT3 Photo Point 6 – Station 4+55
(October 18, 2017) upstream from right bank.

Photo 45. UT3 Photo Point 6 – Station 4+55
(October 18, 2017) downstream from right bank.

Photo 46. UT3 Photo Point 7 – Station 3+60
(October 18, 2017) upstream to structure.

Photo 47. UT3 Photo Point 8 – Station 2+70
(October 18, 2017) upstream to structure.

Photo 48. UT3 Photo Point 9 – Station 1+90 (October 18, 2017) upstream to structure.

Photo 49. UT3 Photo Point 10 – Station 0+60 (October 18, 2017) downstream to structure.

Beaver dam located at Station 25+50 (6/28/2017)

Beaver dam located at Station 22+50 (6/28/2017)

**Table 8. Visual Morphological Stability Assessment**
**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

| Silver Creek, Reach 1 (838 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? | 4 | 4 | 0 | 100 | |
| | 2. Armor stable (e.g. no displacement)? | 4 | 4 | 0 | 100 | |
| | 3. Facet grades appears stable? | 4 | 4 | 0 | 100 | |
| | 4. Minimal evidence of embedding/fining? | 4 | 4 | 0 | 100 | |
| | 5. Length appropriate? | 4 | 4 | 0 | 100 | **100%** |
| | | | | | | |
| B. Pools | 1. Present? (e.g. not subject to severe aggradation or migration?) | 4 | 4 | 0 | 100 | |
| | 2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?) | 4 | 4 | 0 | 100 | |
| | 3. Length appropriate? | 4 | 4 | 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? | 3 | 4 | 0 | 75 | |
| | 2. Of those eroding, # w/concomitant point bar formation? | 4 | 4 | 0 | 100 | |
| | 3. Apparent Rc within spec? | 4 | 4 | 0 | 100 | |
| | 4. Sufficient floodplain access and relief? | 4 | 4 | 0 | 100 | **100%** |
| | | | | | | |
| E. Bed General | 1. General channel bed aggradation areas (bar formation) | 838 | 838 | 0 | 100 | |
| | 2. Channel bed degradation - areas of increasing down-cutting or head cutting? | 838 | 838 | 0 | 100 | **100%** |
| | | | | | | |
| F. Vanes, Rock/Log Drop Structures | 1. Free of back or arm scour? | 6 | 6 | 0 | 100 | |
| | 2. Height appropriate? | 6 | 6 | 0 | 100 | |
| | 3. Angle and geometry appear appropriate? | 6 | 6 | 0 | 100 | |
| | 4. Free of piping or other structural failures? | 6 | 6 | 0 | 100 | **100%** |
| | | | | | | |
| G. Wads/ Boulders | 1. Free of scour? | 4 | 4 | 0 | 100 | |
| | 2. Footing stable? | 4 | 4 | 0 | 100 | **100%** |

| Silver Creek, Reach 2 (2,178 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? | 17 | 17 | 0 | 100 | |
| | 2. Armor stable (e.g. no displacement)? | 17 | 17 | 0 | 100 | |
| | 3. Facet grades appears stable? | 17 | 17 | 0 | 100 | |
| | 4. Minimal evidence of embedding/fining? | 17 | 17 | 0 | 100 | |
| | 5. Length appropriate? | 17 | 17 | 0 | 100 | **100%** |
| | | | | | | |
| B. Pools | 1. Present? (e.g. not subject to severe aggradation or migration?) | 16 | 16 | 0 | 100 | |
| | 2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?) | 16 | 16 | 0 | 100 | |
| | 3. Length appropriate? | 16 | 16 | 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? | 16 | 16 | 0 | 100 | |
| | 2. Of those eroding, # w/concomitant point bar formation? | 16 | 16 | 0 | 100 | |
| | 3. Apparent Rc within spec? | 16 | 16 | 0 | 100 | |
| | 4. Sufficient floodplain access and relief? | 16 | 16 | 0 | 100 | **100%** |
| | | | | | | |
| E. Bed General | 1. General channel bed aggradation areas (bar formation) | 2,178 | 2,178 | 0 | 100 | |
| | 2. Channel bed degradation - areas of increasing down-cutting or head cutting? | 2,178 | 2,178 | 0 | 100 | **100%** |
| | | | | | | |
| F. Vanes, Rock/Log Drop Structures | 1. Free of back or arm scour? | 21 | 21 | 0 | 100 | |
| | 2. Height appropriate? | 21 | 21 | 0 | 100 | |
| | 3. Angle and geometry appear appropriate? | 21 | 21 | 0 | 100 | |
| | 4. Free of piping or other structural failures? | 19 | 21 | 3 | 90 | **98%** |
| | | | | | | |
| G. Wads/ Boulders | 1. Free of scour? | 14 | 14 | 0 | 100 | |
| | 2. Footing stable? | 14 | 14 | 0 | 100 | **100%** |

**Table 8. Visual Morphological Stability Assessment - Continued**
**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

**UT1 (502 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? | 7 | 7 | 0 | 100 | |
| | 2. Armor stable (e.g. no displacement)? | 7 | 7 | 0 | 100 | |
| | 3. Facet grades appears stable? | 7 | 7 | 0 | 100 | |
| | 4. Minimal evidence of embedding/fining? | 7 | 7 | 0 | 100 | |
| | 5. Length appropriate? | 7 | 7 | 0 | 100 | **100%** |
| | | | | | | |
| B. Pools | 1. Present? (e.g. not subject to severe aggradation or migration?) | 10 | 10 | 0 | 100 | |
| | 2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?) | 10 | 10 | 0 | 100 | |
| | 3. Length appropriate? | 10 | 10 | 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? | 7 | 7 | 0 | 100 | |
| | 2. Of those eroding, # w/concomitant point bar formation? | 7 | 7 | 0 | 100 | |
| | 3. Apparent Rc within spec? | 7 | 7 | 0 | 100 | |
| | 4. Sufficient floodplain access and relief? | 7 | 7 | 0 | 100 | **100%** |
| | | | | | | |
| E. Bed General | 1. General channel bed aggradation areas (bar formation) | 502 | 502 | 0 | 100 | |
| | 2. Channel bed degradation - areas of increasing down-cutting or head cutting? | 502 | 502 | 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? | N/A | N/A | N/A | N/A | |
| | 2. Footing stable? | N/A | N/A | N/A | N/A | **100%** |

**UT2, Reach 1 (103 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? | 4 | 4 | 0 | 100 | |
| | 2. Armor stable (e.g. no displacement)? | 4 | 4 | 0 | 100 | |
| | 3. Facet grades appears stable? | 4 | 4 | 0 | 100 | |
| | 4. Minimal evidence of embedding/fining? | 4 | 4 | 0 | 100 | |
| | 5. Length appropriate? | 4 | 4 | 0 | 100 | **100%** |
| | | | | | | |
| B. Pools | 1. Present? (e.g. not subject to severe aggradation or migration?) | 5 | 5 | 0 | 100 | |
| | 2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?) | 5 | 5 | 0 | 100 | |
| | 3. Length appropriate? | 5 | 5 | 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) | 103 | 103 | 0 | 100 | |
| | 2. Channel bed degradation - areas of increasing down-cutting or head cutting? | 103 | 103 | 0 | 100 | **100%** |
| | | | | | | |
| F. Vanes, Rock/Log Drop Structures | 1. Free of back or arm scour? | 5 | 5 | 0 | 100 | |
| | 2. Height appropriate? | 5 | 5 | 0 | 100 | |
| | 3. Angle and geometry appear appropriate? | 5 | 5 | 0 | 100 | |
| | 4. Free of piping or other structural failures? | 5 | 5 | 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**
**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

**UT2, Reach 2 (207 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? | 4 | 4 | 0 | 100 | |
| | 2. Armor stable (e.g. no displacement)? | 4 | 4 | 0 | 100 | |
| | 3. Facet grades appears stable? | 4 | 4 | 0 | 100 | |
| | 4. Minimal evidence of embedding/fining? | 4 | 4 | 0 | 100 | |
| | 5. Length appropriate? | 4 | 4 | 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. 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? | 3 | 3 | 0 | 100 | |
| | 2. Of those eroding, # w/concomitant point bar formation? | 3 | 3 | 0 | 100 | |
| | 3. Apparent Rc within spec? | 3 | 3 | 0 | 100 | |
| | 4. Sufficient floodplain access and relief? | 3 | 3 | 0 | 100 | **100%** |
| | | | | | | |
| E. Bed General | 1. General channel bed aggradation areas (bar formation) | 207 | 207 | 0 | 100 | |
| | 2. Channel bed degradation - areas of increasing down-cutting or head cutting? | 207 | 207 | 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? | 1 | 1 | 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
Upper Silver Creek Restoration Project: DMS Project ID No. 94645

**UT3 Reach 1 (343 LF) (Enhancement II 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? | N/A | N/A | N/A | N/A | |
| | 2. Armor stable (e.g. no displacement)? | N/A | N/A | N/A | N/A | |
| | 3. Facet grades appears stable? | N/A | N/A | N/A | N/A | |
| | 4. Minimal evidence of embedding/fining? | N/A | N/A | N/A | N/A | |
| | 5. Length appropriate? | N/A | N/A | N/A | N/A | **N/A** |
| | | | | | | |
| B. Pools | 1. Present? (e.g. not subject to severe aggradation or migration?) | N/A | N/A | N/A | N/A | |
| | 2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?) | N/A | N/A | N/A | N/A | |
| | 3. Length appropriate? | N/A | N/A | N/A | N/A | **N/A** |
| | | | | | | |
| C. Thalweg | 1. Upstream of pool (structure) centering? (%) | N/A | N/A | N/A | N/A | |
| | 2. Downstream of pool (structure) centering? (%) | N/A | N/A | N/A | N/A | **N/A** |
| | | | | | | |
| D. Meanders | 1. Outer bend in state of limited/controlled erosion? | N/A | N/A | N/A | N/A | |
| | 2. Of those eroding, # w/concomitant point bar formation? | N/A | N/A | N/A | N/A | |
| | 3. Apparent Rc within spec? | N/A | N/A | N/A | N/A | |
| | 4. Sufficient floodplain access and relief? | N/A | N/A | N/A | N/A | **N/A** |
| | | | | | | |
| E. Bed General | 1. General channel bed aggradation areas (bar formation) | 343 | 343 | 0 | 100 | |
| | 2. Channel bed degradation - areas of increasing down-cutting or head cutting? | 343 | 343 | 0 | 100 | **100%** |
| | | | | | | |
| F. Vanes, Rock/Log Drop Structures | 1. Free of back or arm scour? | 3 | 3 | 0 | 100 | |
| | 2. Height appropriate? | 3 | 3 | 0 | 100 | |
| | 3. Angle and geometry appear appropriate? | 3 | 3 | 0 | 100 | |
| | 4. Free of piping or other structural failures? | 3 | 3 | 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**
**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

| UT3 Reach 2 (1,022 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? | 22 | 22 | 0 | 100 | |
| | 2. Armor stable (e.g. no displacement)? | 22 | 22 | 0 | 100 | |
| | 3. Facet grades appears stable? | 22 | 22 | 0 | 100 | |
| | 4. Minimal evidence of embedding/fining? | 22 | 22 | 0 | 100 | |
| | 5. Length appropriate? | 22 | 22 | 0 | 100 | **100%** |
| | | | | | | |
| B. Pools | 1. Present? (e.g. not subject to severe aggradation or migration?) | 21 | 21 | 0 | 100 | |
| | 2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?) | 21 | 21 | 0 | 100 | |
| | 3. Length appropriate? | 21 | 21 | 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 | 17 | 0 | 100 | |
| | 2. Of those eroding, # w/concomitant point bar formation? | 17 | 17 | 0 | 100 | |
| | 3. Apparent Rc within spec? | 17 | 17 | 0 | 100 | |
| | 4. Sufficient floodplain access and relief? | 17 | 17 | 0 | 100 | **100%** |
| | | | | | | |
| E. Bed General | 1. General channel bed aggradation areas (bar formation) | 1,022 | 1,022 | 0 | 100 | |
| | 2. Channel bed degradation - areas of increasing down-cutting or head cutting? | 1,022 | 1,022 | 0 | 100 | **100%** |
| | | | | | | |
| F. Vanes, Rock/Log Drop Structures | 1. Free of back or arm scour? | 15 | 15 | 0 | 100 | |
| | 2. Height appropriate? | 15 | 15 | 0 | 100 | |
| | 3. Angle and geometry appear appropriate? | 15 | 15 | 0 | 100 | |
| | 4. Free of piping or other structural failures? | 15 | 15 | 0 | 100 | **100%** |
| | | | | | | |
| G. Wads/ Boulders | 1. Free of scour? | 4 | 4 | 0 | 100 | |
| | 2. Footing stable? | 4 | 4 | 0 | 100 | **100%** |

**Table 9. Verification of Bankfull or Greater than Bankfull Events**
Upper Silver Creek Restoration Project: DMS Project ID No. 94645

| Date of Data Collection | Date of Event | Method of Data Collection | Gauge Watermark Height (inches)* | |
|---|---|---|---|---|
| | | | Silver Creek Station 19+00 | UT3 Station 8+10 |
| 2/29/2016 | See table below | Crest gauge | 15.0 | 5.0 |
| 5/2/2017 | See table below | Crest Gauge | 5.4 | 3.0 |

* height indicates the highest position of cork shavings on the dowel and the height above bankfull, as 0" on the dowel is set at bankfull.

Photo 1. Silver Creek mainstem crest gauge staff showing cork deposition in red circle at 0.45' above the bottom of the staff, which is at the bankfull elevation. (5/2/2017)

Photo 2. UT3 crest gauge staff showing cork deposition in red circle at 0.25' above the bottom of the staff, which is at the bankfull elevation (5/2/2017).

Photo 3. Silver Creek stream bank showing accumulated debris of wrack line and bent over vegetation well above bankfull. Verifies crest gauge measurement. (11/1/2017)

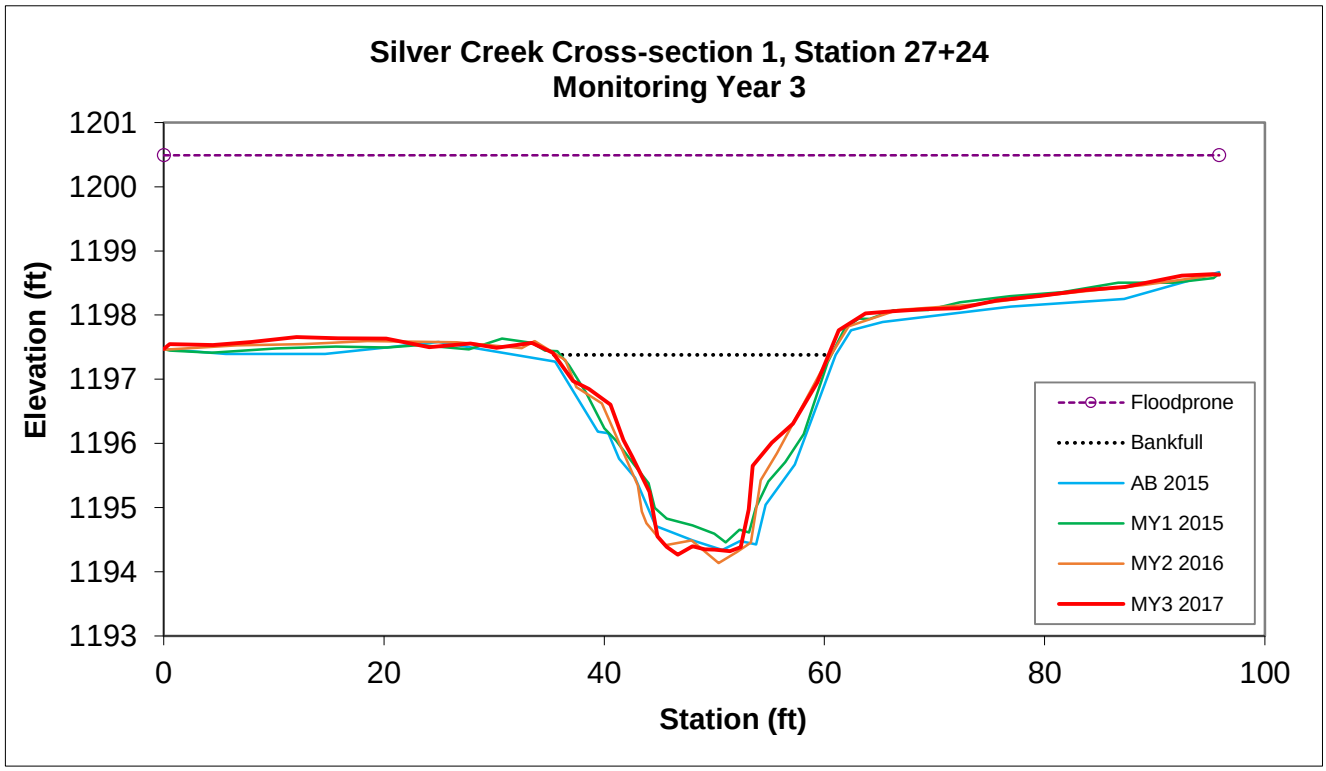
Photo 4. Silver Creek stream bank showing accumulated debris of wrack line and bent over vegetation well above bankfull. Verifies crest crest gauge measurements (11/1/2017).

**Figure 6. Cross-sections with Annual Overlays**

**Permanent Cross-section 1**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | C | 41.90 | 24.91 | 1.68 | 3.11 | 14.83 | 1.06 | 3.85 | 1197.38 | 1197.96 |





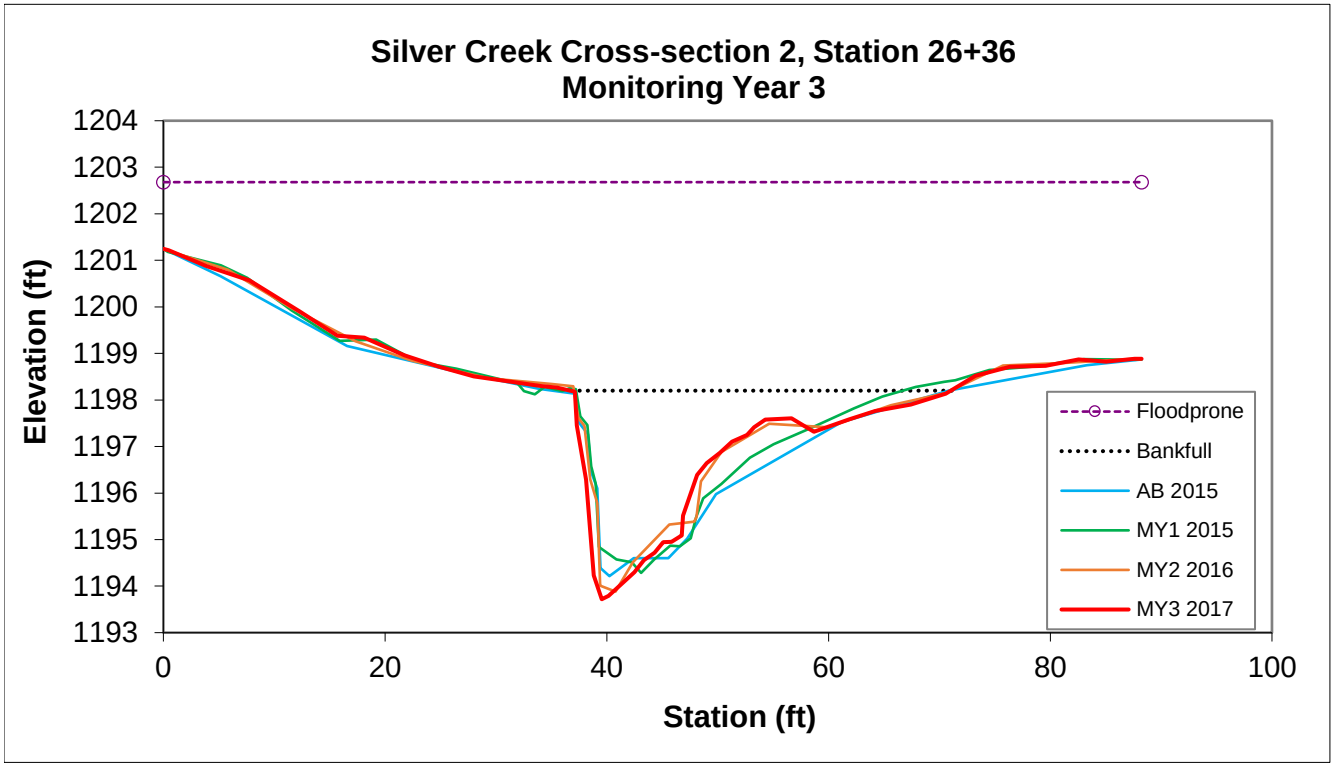
Looking at the Left Bank


Looking at the Right Bank

**Permanent Cross-section 2**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Pool | - | 52.03 | 34.54 | 1.51 | 4.48 | 22.87 | 1.00 | 2.55 | 1198.20 | 1198.21 |





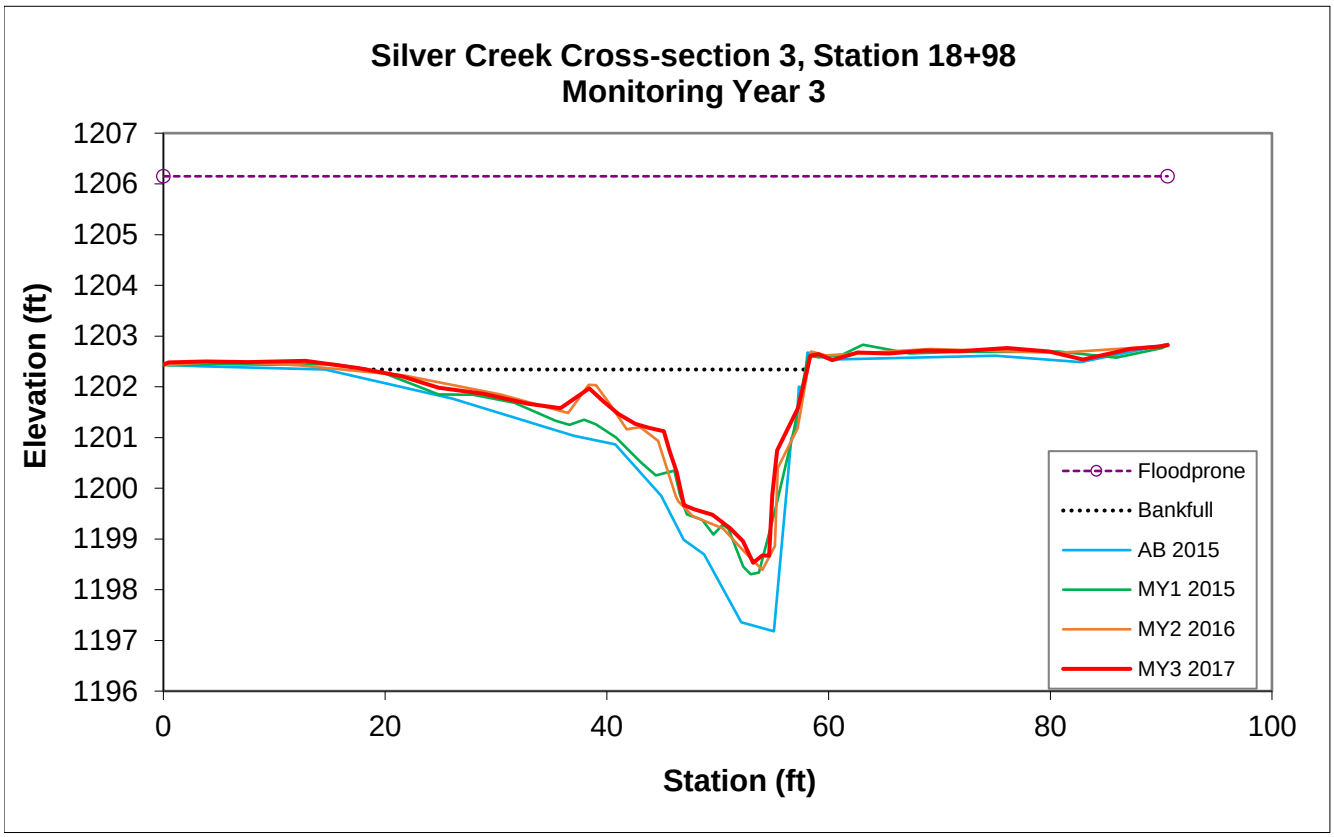
Looking at the Left Bank


Looking at the Right Bank

**Permanent Cross-section 3**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Pool | - | 46.81 | 39.84 | 1.17 | 3.81 | 34.05 | 1.07 | 2.27 | 1202.34 | 1202.51 |



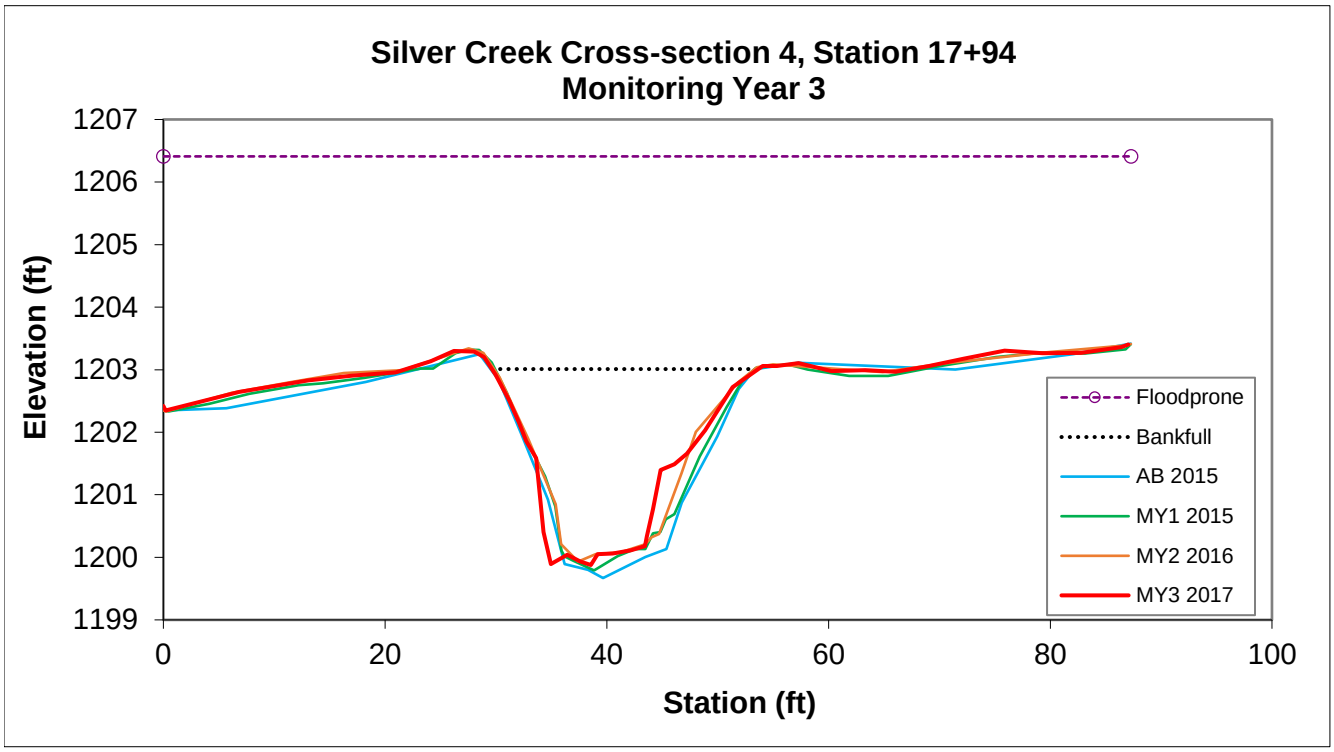

Looking at the Left Bank

Looking at the Right Bank

**Permanent Cross-section 4**
**(MY3 Data - collected Oct0ber, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | C | 41.90 | 24.00 | 1.75 | 3.13 | 13.71 | 1.02 | 3.63 | 1203.01 | 1203.07 |





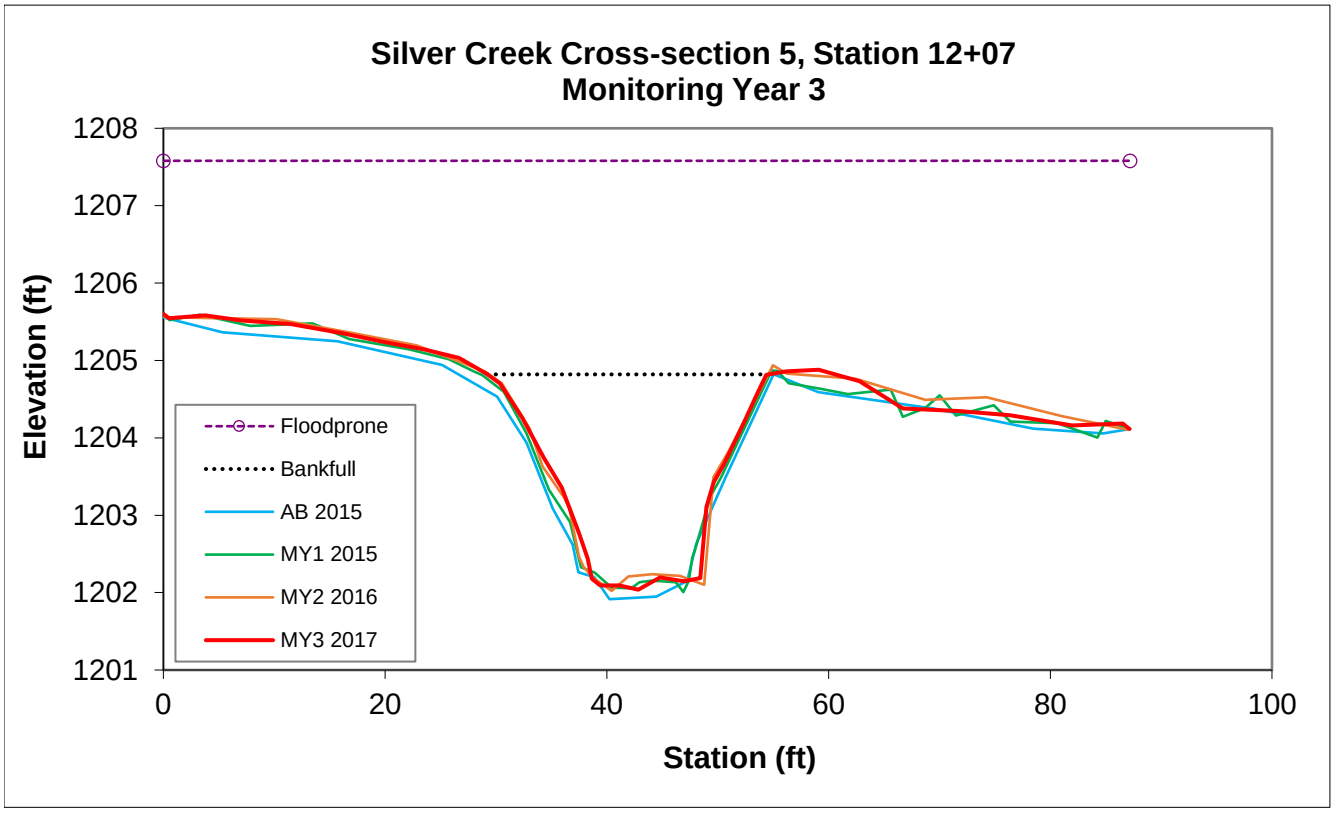
Looking at the Left Bank


Looking at the Right Bank

**Permanent Cross-section 5**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | C | 41.56 | 25.01 | 1.66 | 2.77 | 15.07 | 1.01 | 3.48 | 1204.82 | 1204.82 |





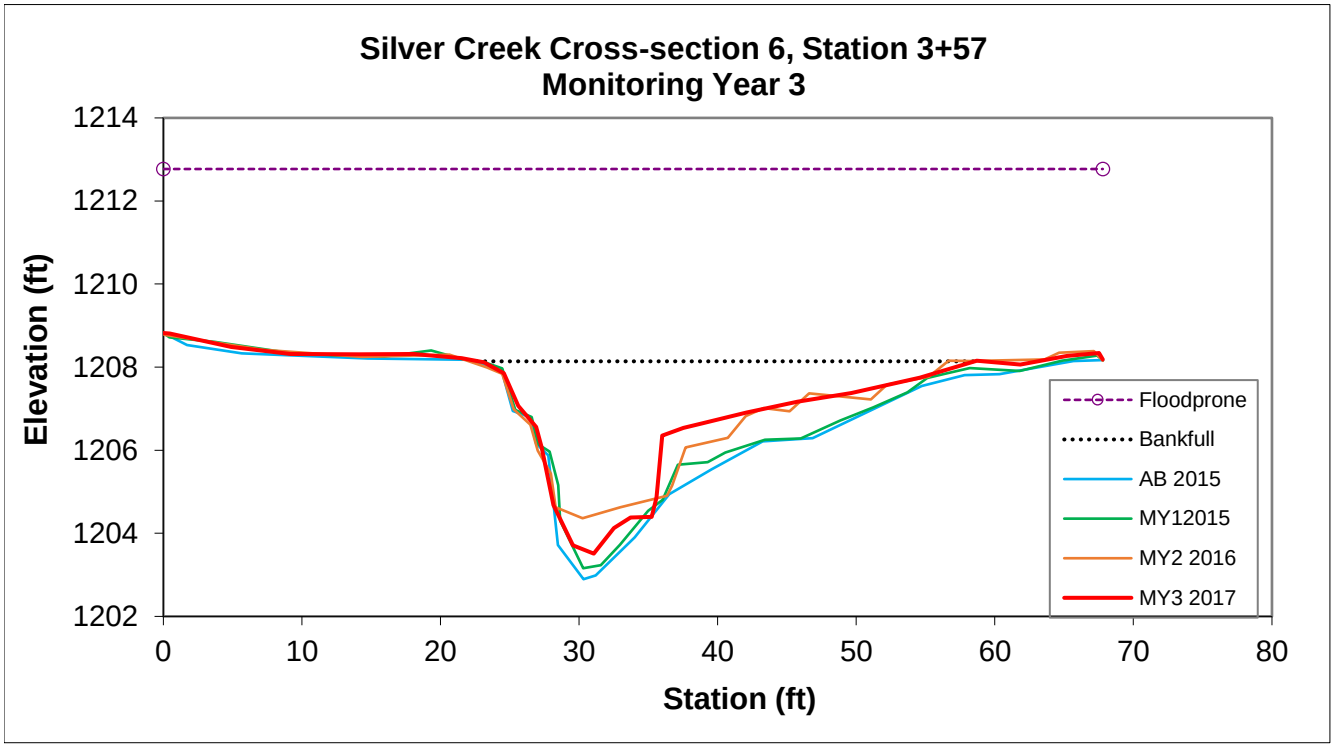
Looking at the Left Bank

Looking at the Right Bank

**Permanent Cross-section 6**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Pool | - | 57.16 | 35.96 | 1.59 | 4.63 | 22.62 | 1.01 | 1.89 | 1208.14 | 1208.14 |





Looking at the Left Bank

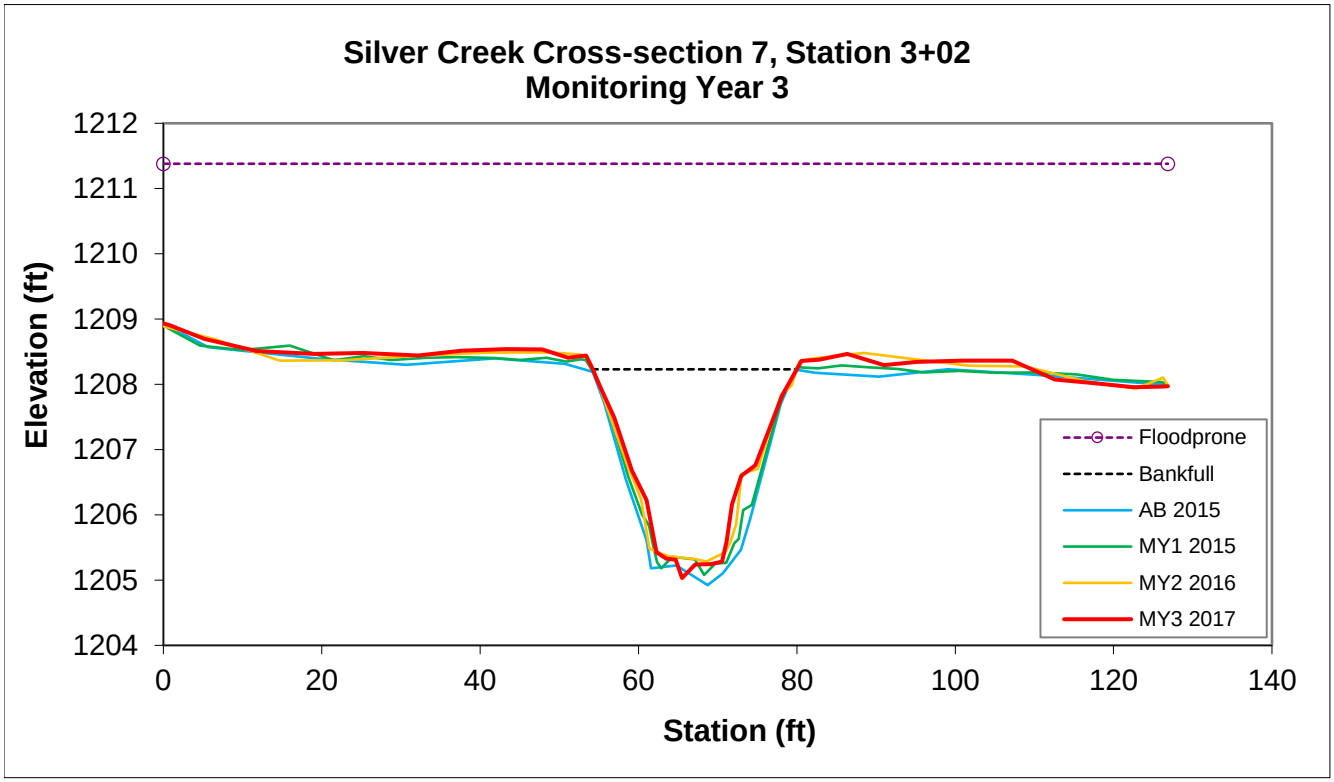

Looking at the Right Bank

**Permanent Cross-section 7**

**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | C | 46.23 | 25.75 | 1.80 | 3.20 | 14.31 | 1.04 | 4.93 | 1208.23 | 1208.36 |





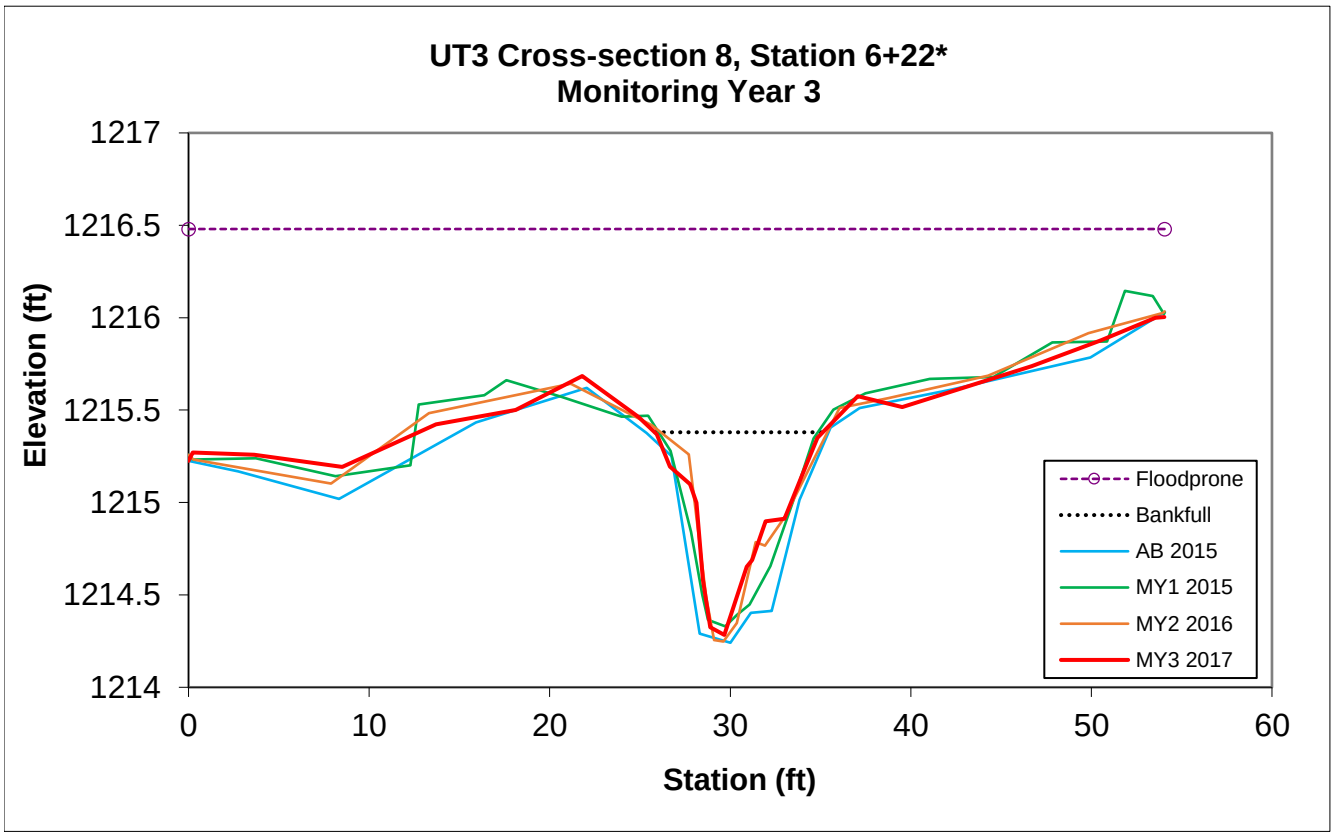
Looking at the Left Bank


Looking at the Right Bank

**Permanent Cross-section 8**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | C | 4.61 | 9.28 | 0.50 | 1.10 | 18.56 | 1.18 | 5.83 | 1215.38 | 1215.58 |





Looking at the Left Bank

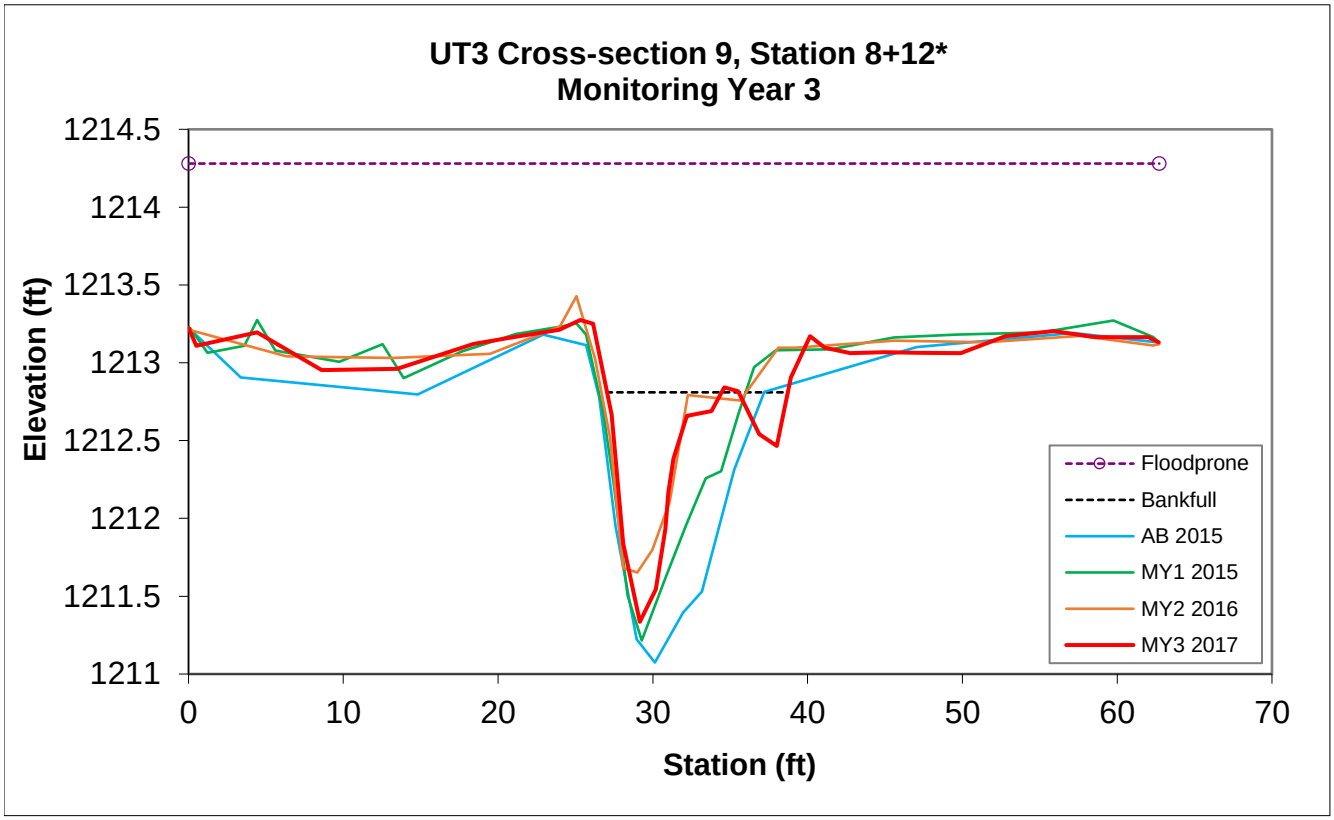

Looking at the Right Bank

* Note: Stationing for Cross-section 8 has been changed to 6+22; this was the surveyed location last year and this year and is changed from what is shown in the As-built survey and the MY1 report.

**Permanent Cross-section 9**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Pool | - | 5.30 | 10.57 | 0.50 | 1.47 | 21.14 | 1.24 | 5.93 | 1212.81 | 1213.17 |




Looking at the Left Bank

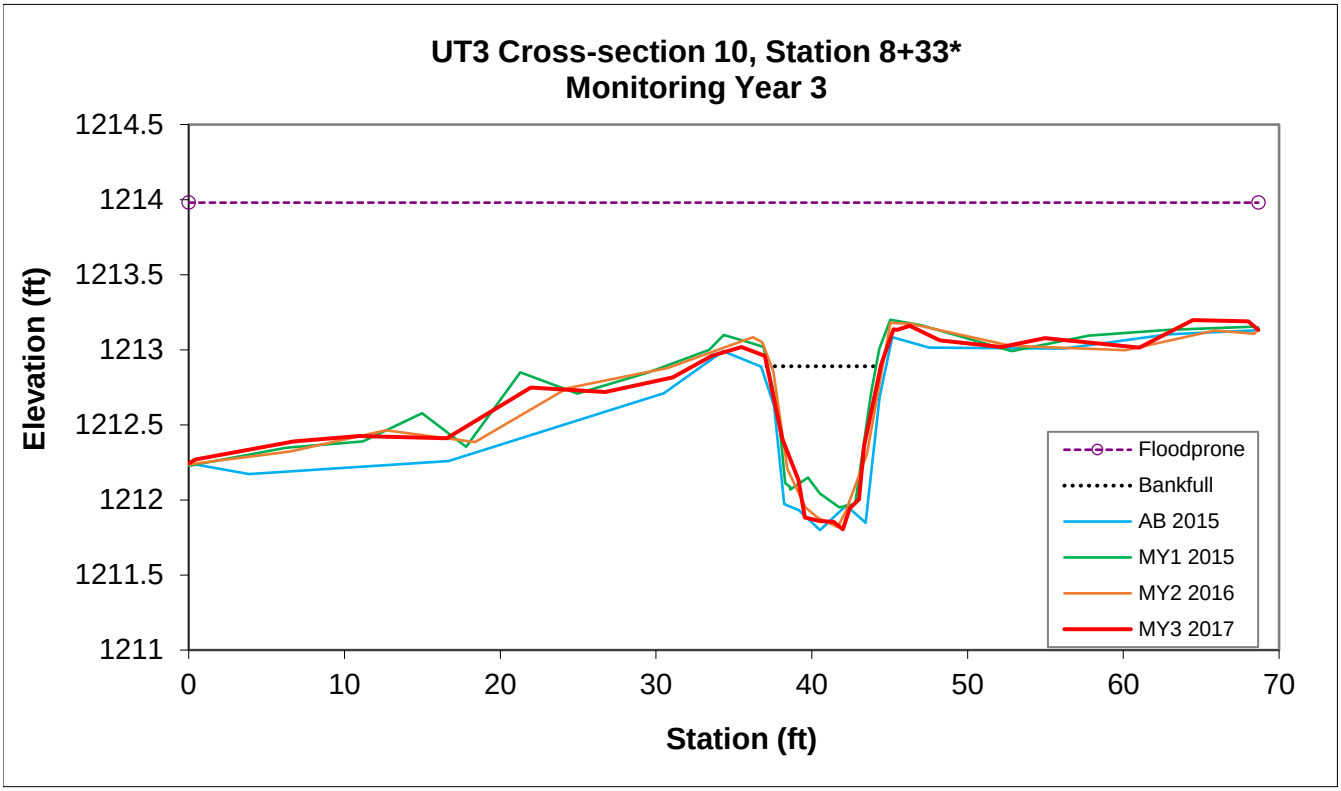

Looking at the Right Bank

* Note: Stationing for Cross-section 9 is being changed to 8+12 which is the surveyed location for the last two years and changes from what was indicated in the As-built survey and the MY1 report.

**Permanent Cross-section 10**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | E | 5.27 | 7.29 | 0.72 | 1.09 | 10.13 | 1.06 | 9.42 | 1212.89 | 1212.96 |




Looking at the Left Bank

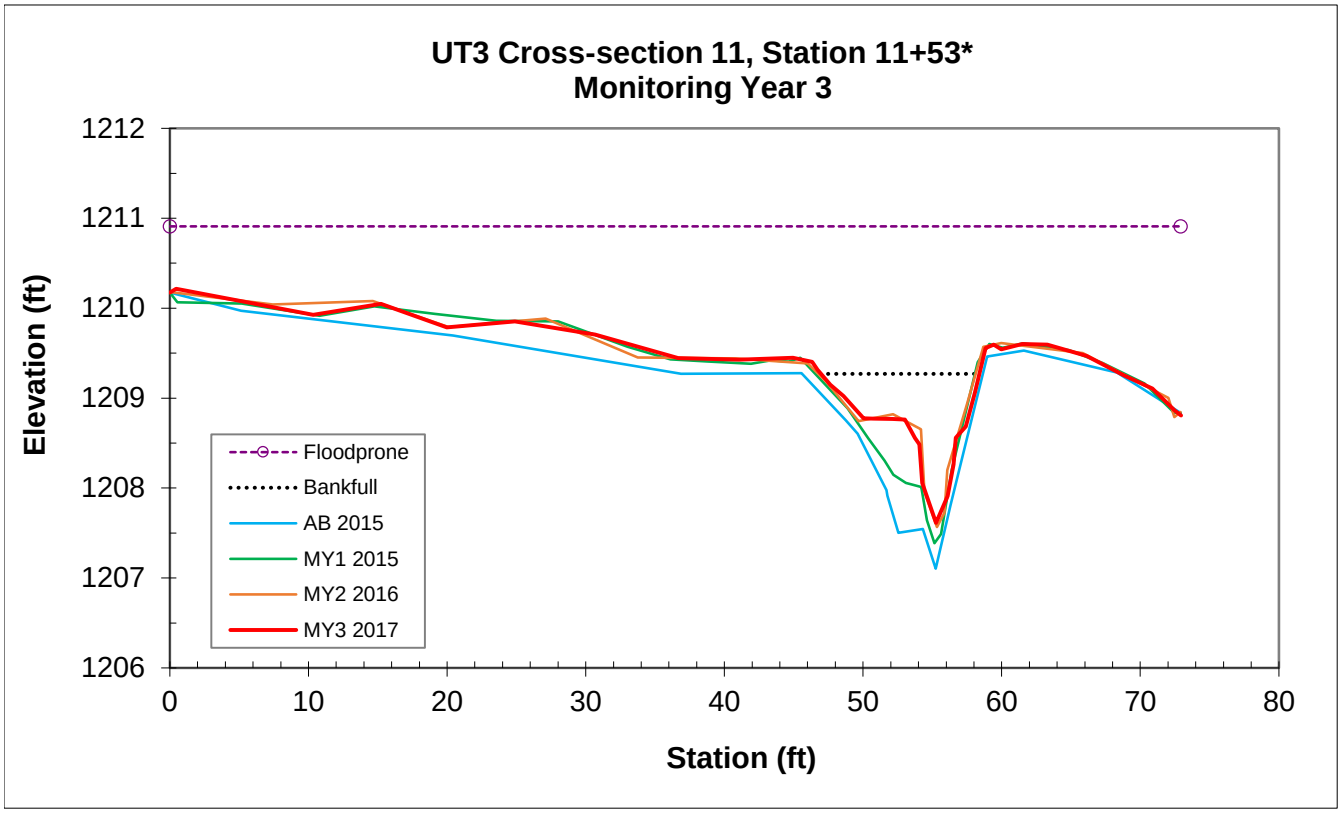

Looking at the Right Bank

* Note: Stationing for Cross-section 10 is being changed to 8+33 which is the surveyed location for the last two years and changes from what was indicated in the As-built survey and the MY1 report.

**Permanent Cross-section 11**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Pool | - | 7.12 | 11.35 | 0.63 | 1.65 | 18.02 | 1.10 | 6.43 | 1209.27 | 1209.40 |





Looking at the Left Bank

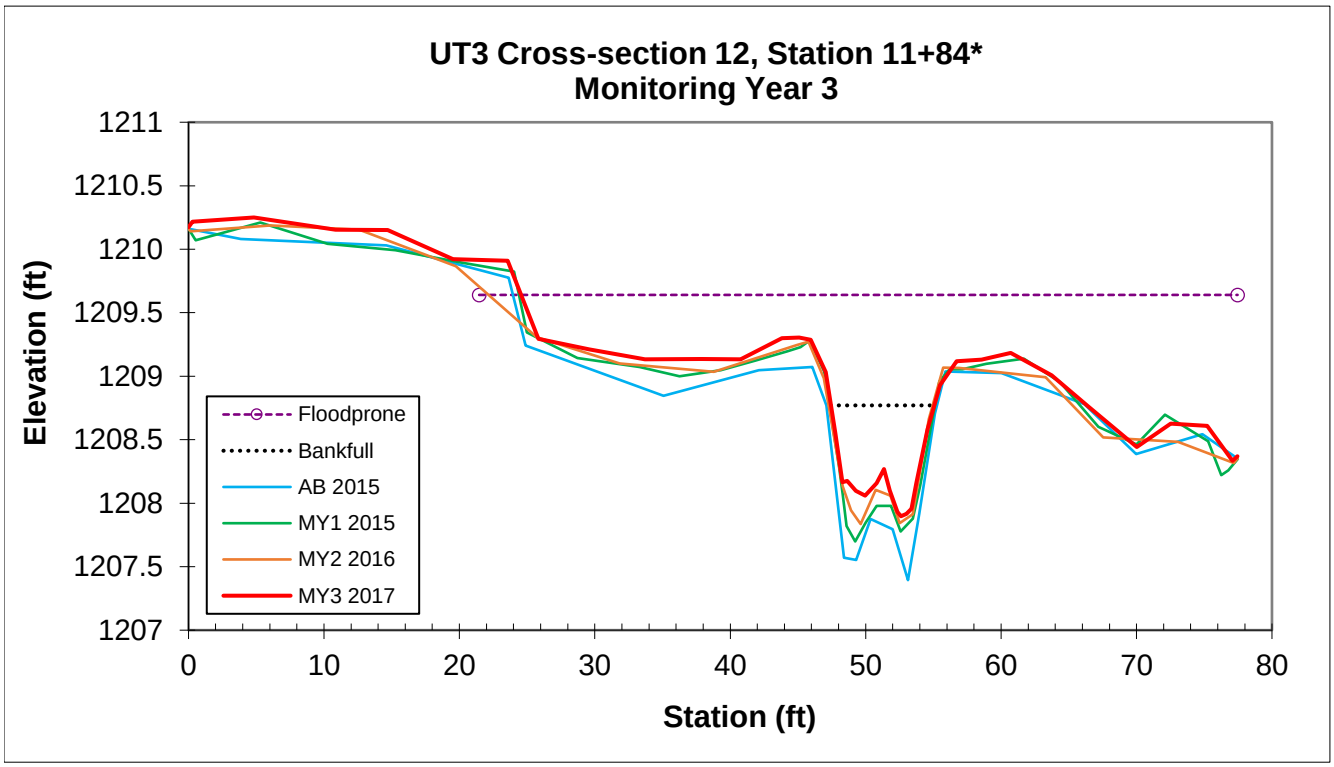
Looking at the Right Bank

* Note: Stationing for Cross-section 11 is being changed to 11+53 which is the surveyed location for the last two years and changes from what was indicated in the As-built survey and the MY1 report.

**Permanent Cross-section 12**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | C | 4.40 | 7.62 | 0.58 | 0.87 | 13.14 | 1.17 | 6.94 | 1208.77 | 1208.93 |





Looking at the Left Bank

Looking at the Right Bank

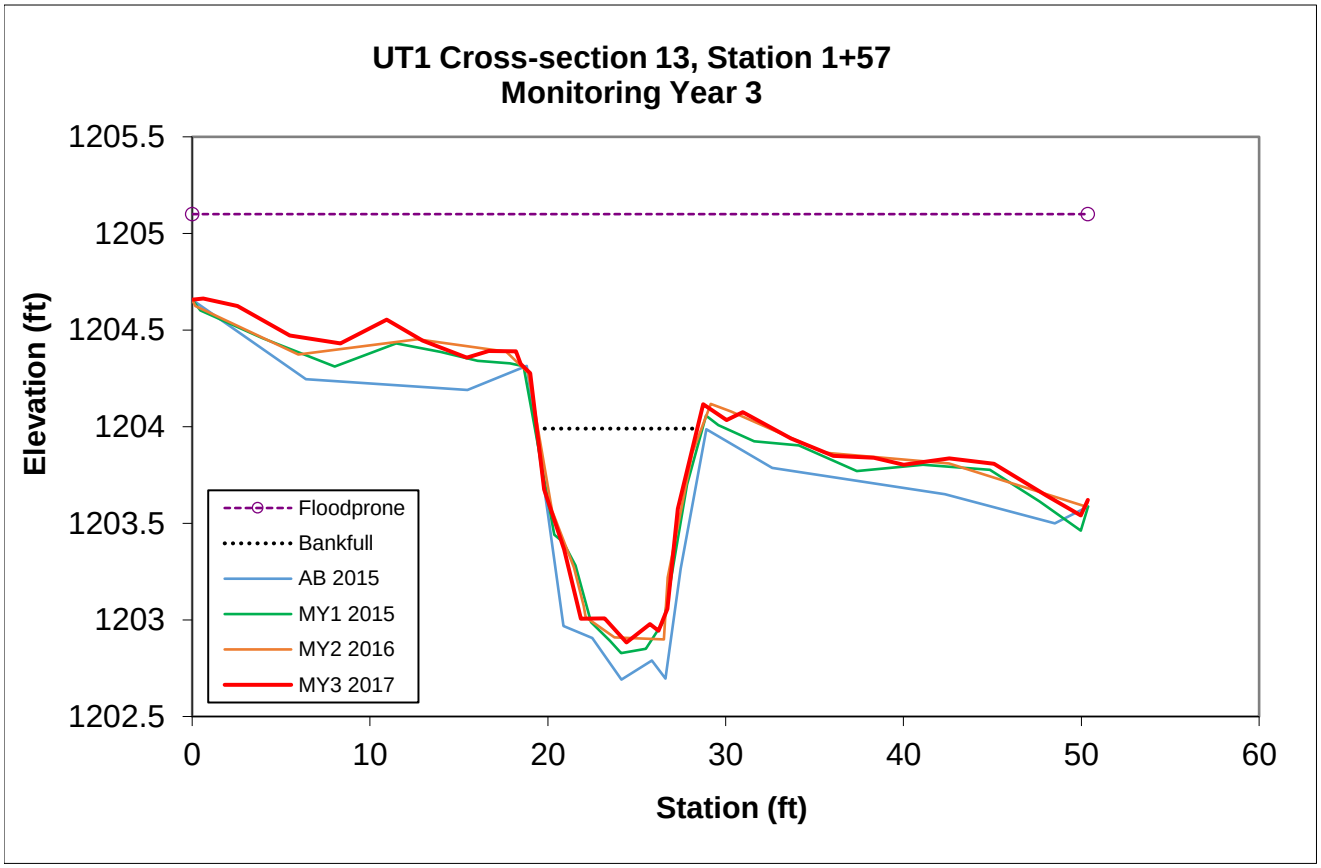
* Note: Stationing for Cross-section 11 is being changed to 11+53 which is the surveyed location for the last two years and changes from what was indicated in the As-built survey and the MY1 report.

**Permanent Cross-section 13**

**(MY3 Data - collected October, 2017)**

**Based on fixed baseline bankfull**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | E | 6.96 | 9.02 | 0.77 | 1.11 | 11.71 | 1.10 | 5.59 | 1203.99 | 1204.11 |





Looking at the Left Bank

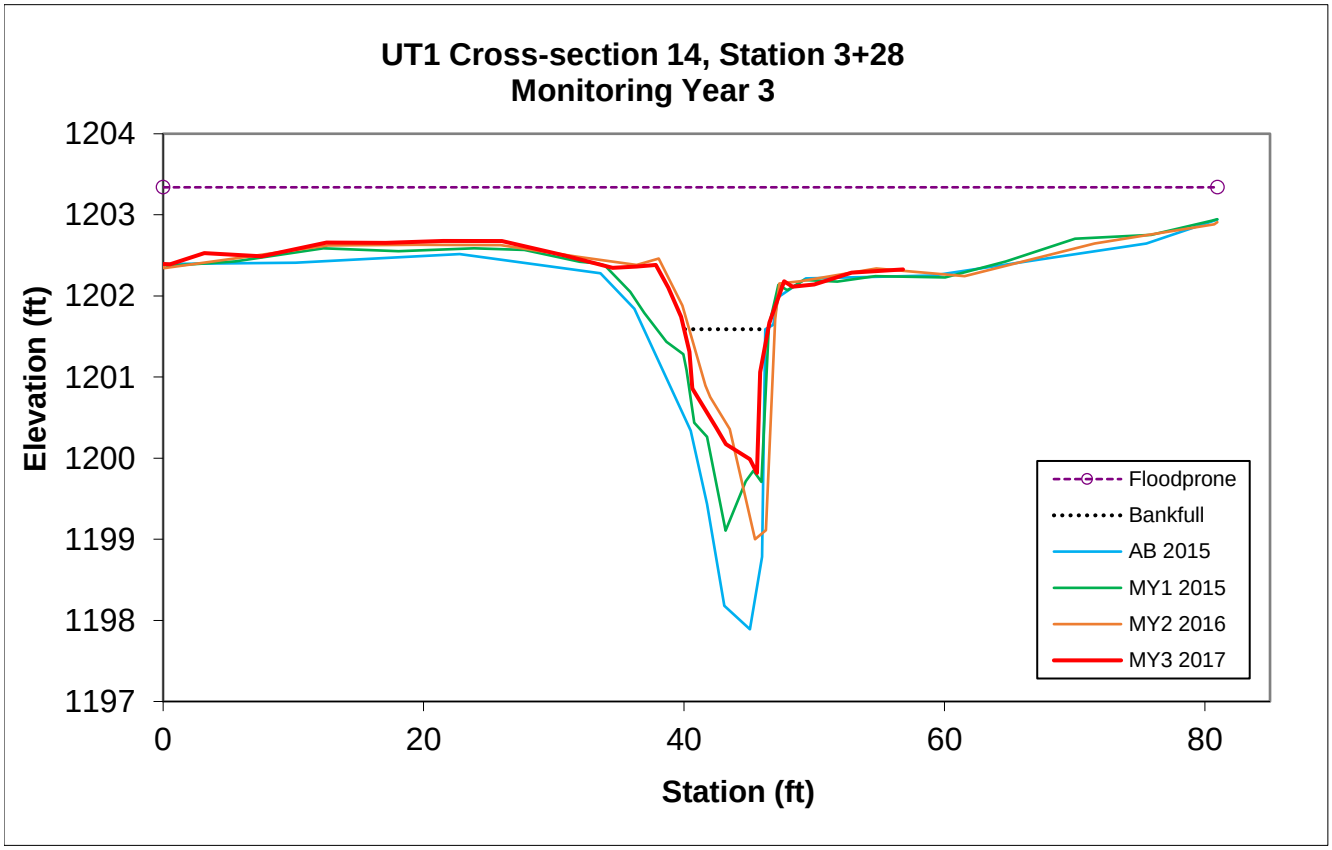

Looking at the Right Bank

**Permanent Cross-section 14**

**(MY3 Data - collected October, 2017)**

**Based on fixed baseline bankfull**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Pool | - | 7.01 | 6.43 | 1.09 | 1.76 | 5.90 | 1.34 | 12.59 | 1201.59 | 1202.19 |



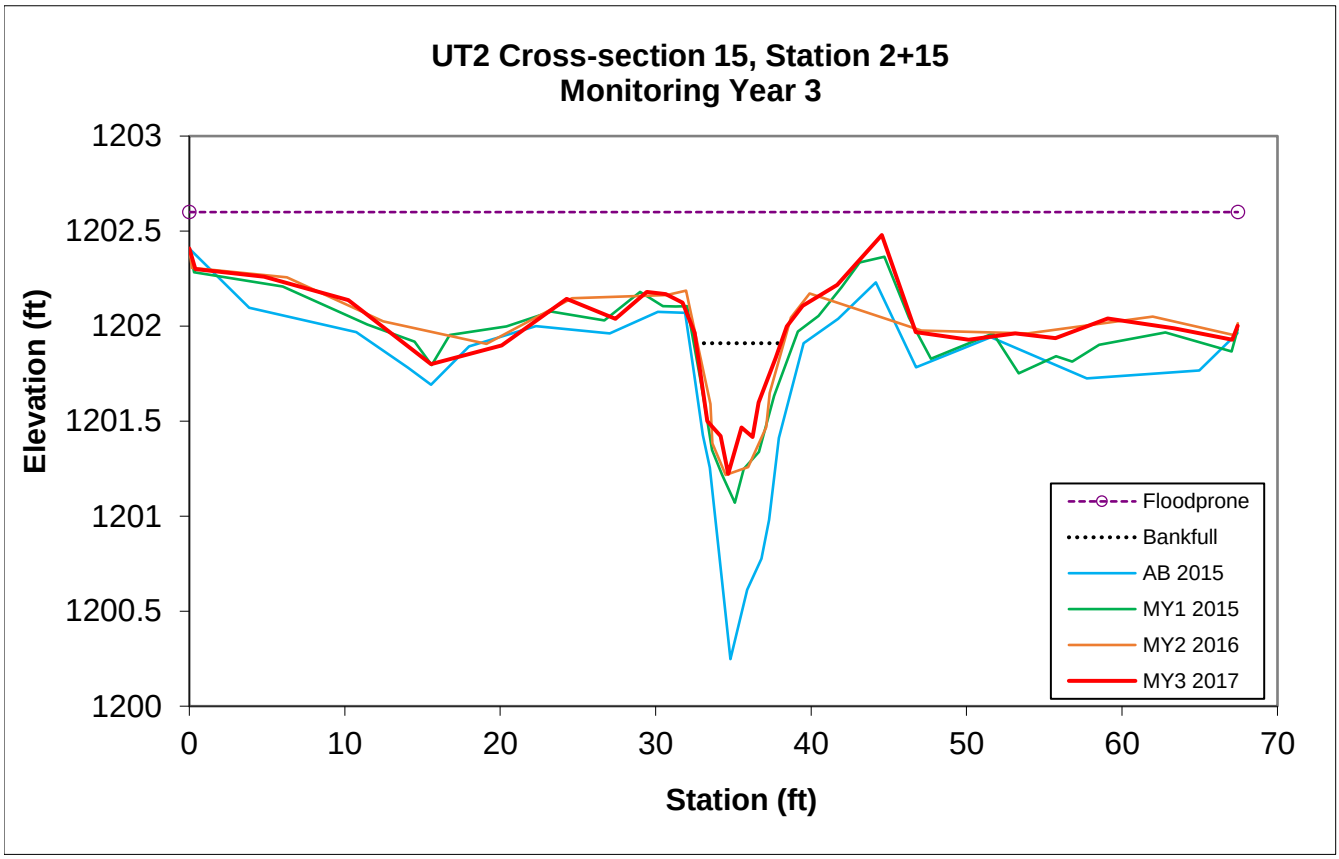

Looking at the Left Bank

Looking at the Right Bank

**Permanent Cross-section 15**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Pool | - | 2.02 | 5.46 | 0.37 | 0.69 | 14.76 | 1.30 | 12.34 | 1201.91 | 1202.12 |



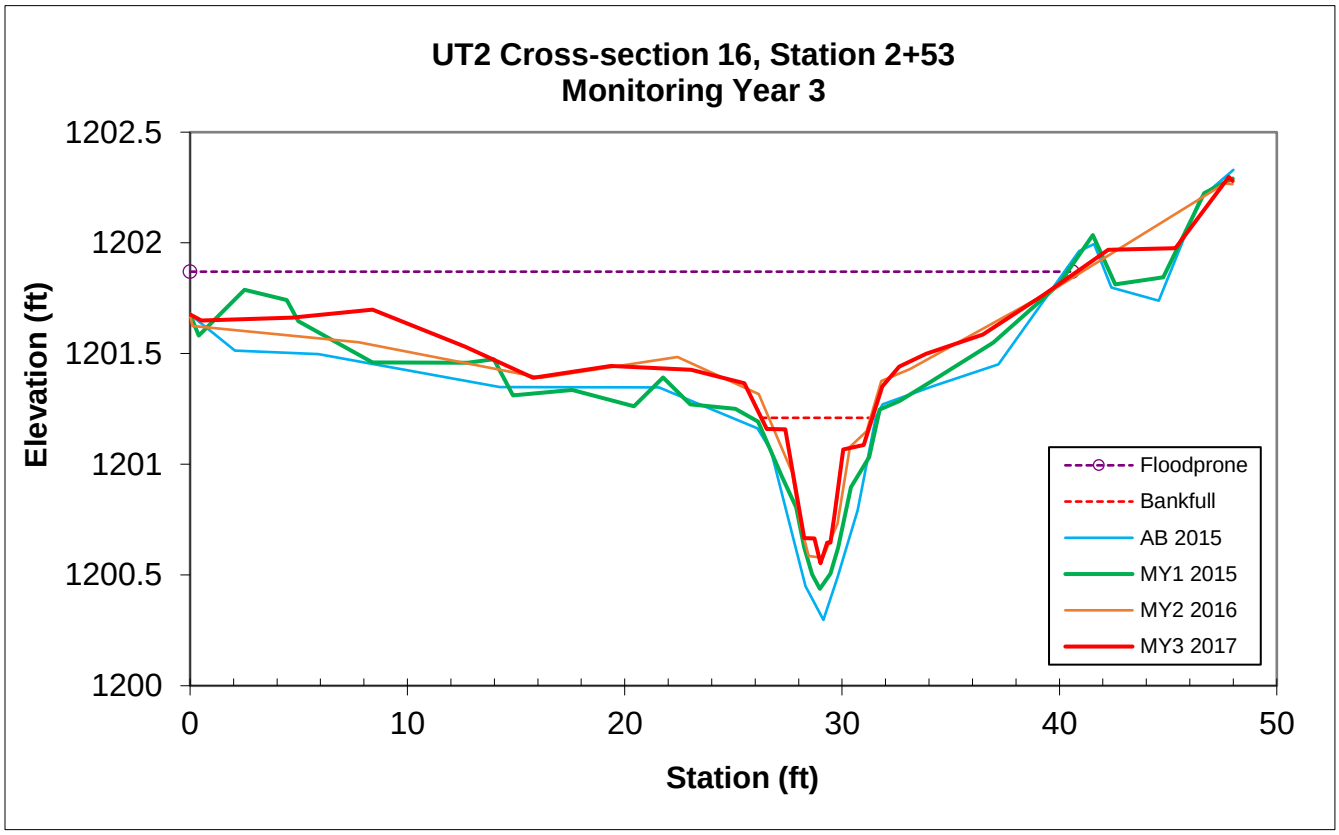

Looking at the Left Bank

Looking at the Right Bank

**Permanent Cross-section 16**
**(MY3 Data - collected October, 2017)**

**Based on fixed baseline BKF**

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | C | 1.37 | 5.11 | 0.27 | 0.66 | 18.93 | 1.23 | 7.97 | 1201.21 | 1201.36 |

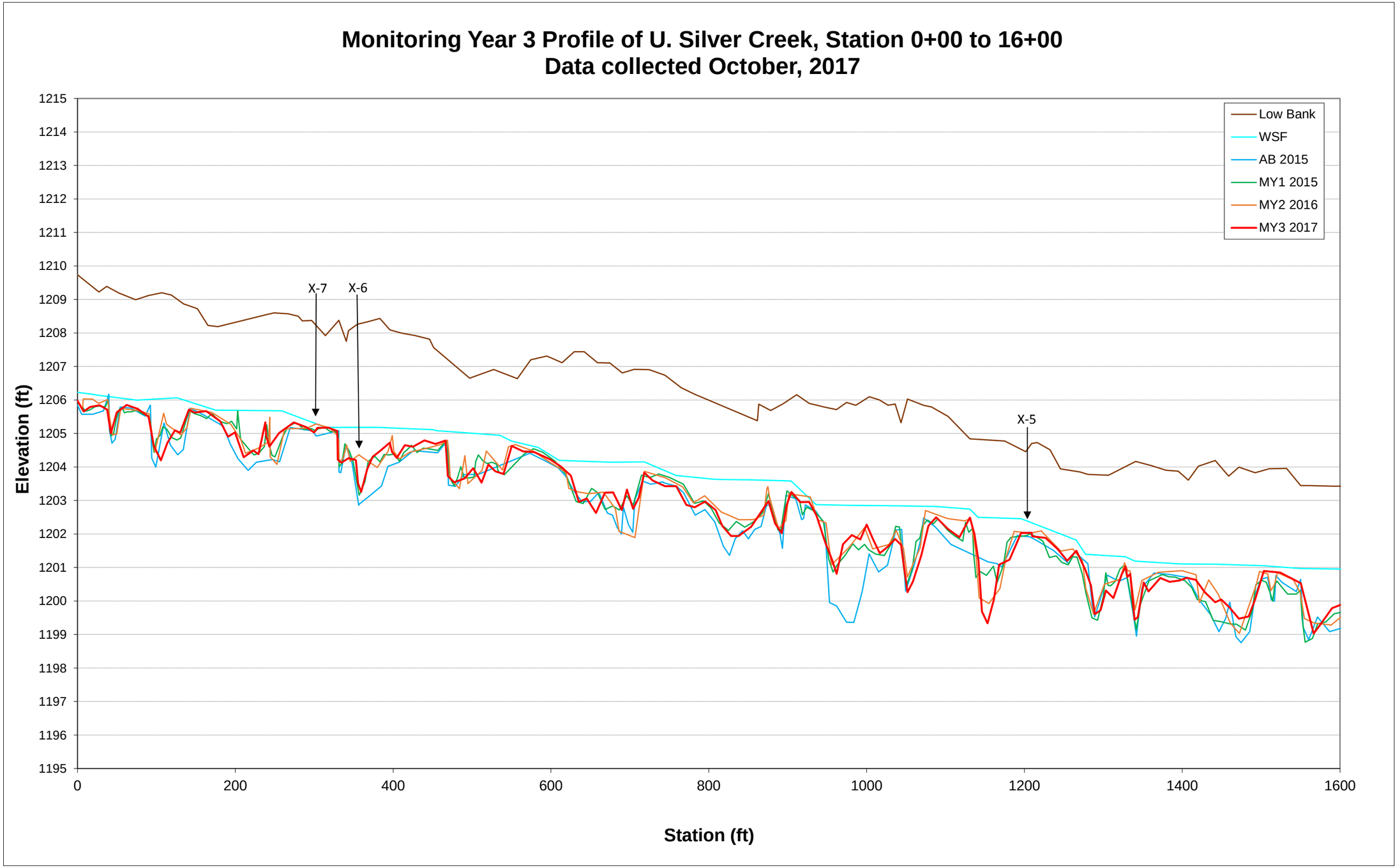




Looking at the Left Bank

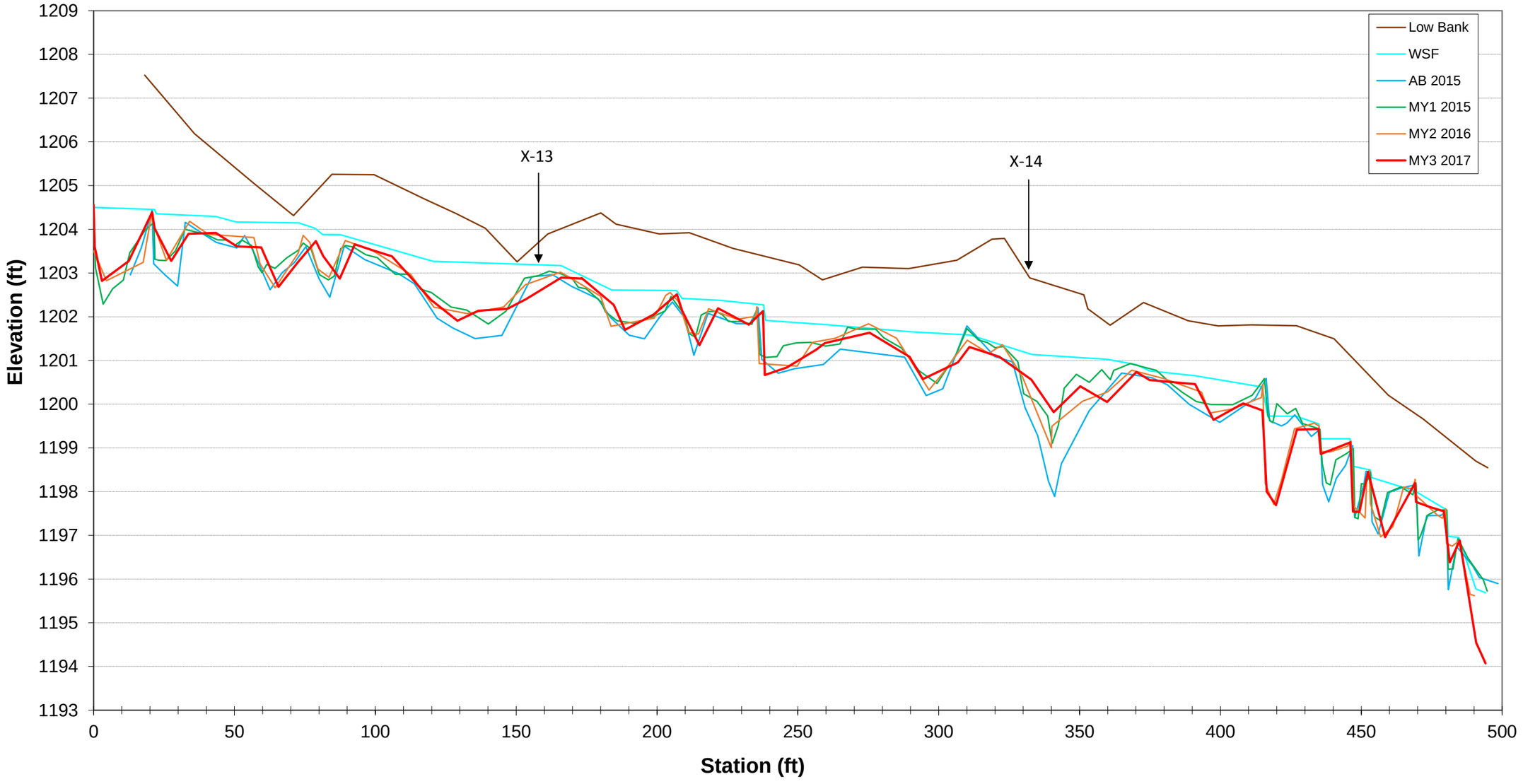
Looking at the Right Bank

**Figure 7. Longitudinal Profiles with Annual Overlay**

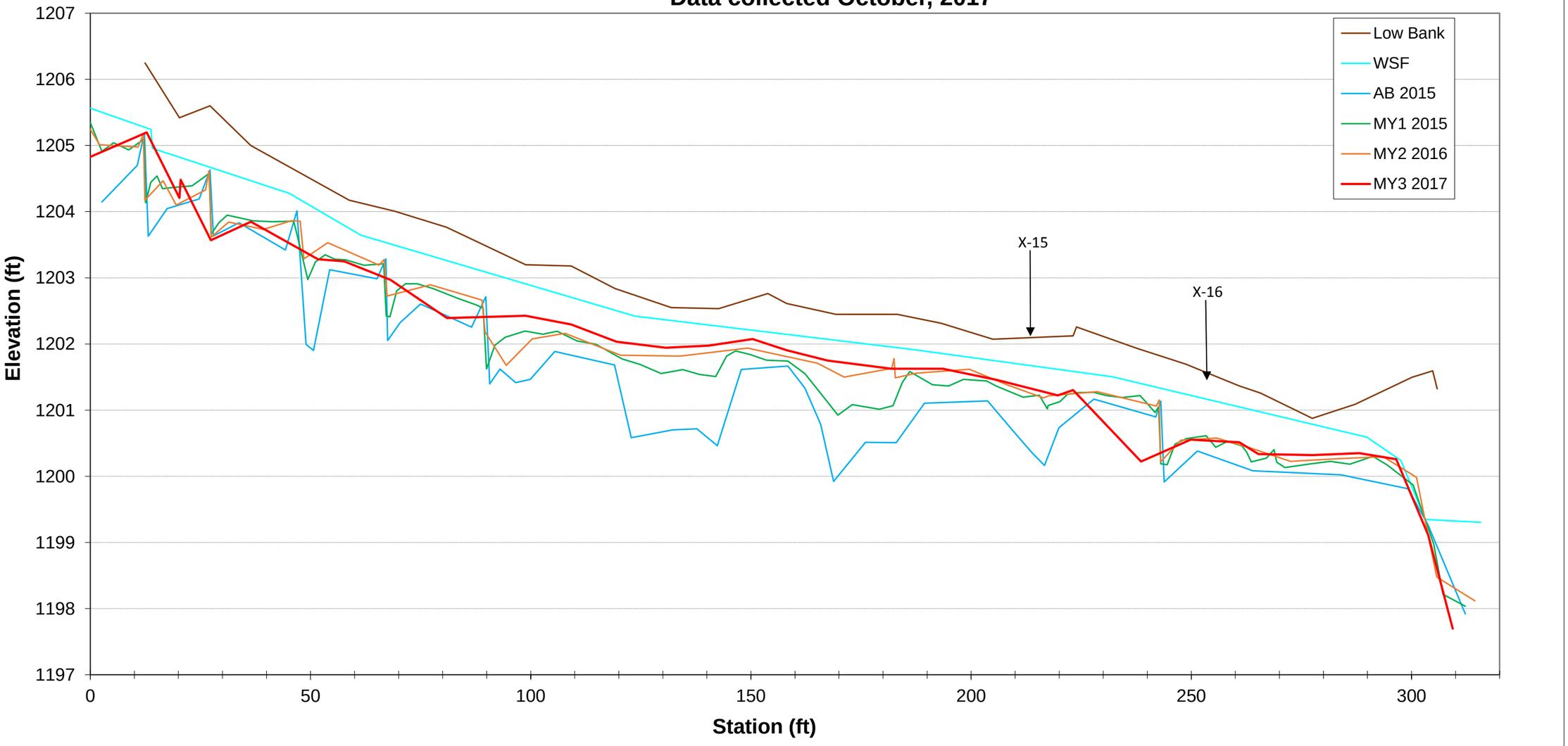


# Monitoring Year 3 Profile of U. Silver Creek, Station 16+00 to 32+00
## Data collected October, 2017

## Monitoring Year 3, Profile of UT1, Station 0+00 to 5+00
## Data collected October, 2017



## Monitoring Year 3 Profile of UT2, Station 0+00 to 3+20
## Data collected October, 2017



## Monitoring Year 3, Profile of UT3, Station 0+00 to 14+00
## Data collected October 2017

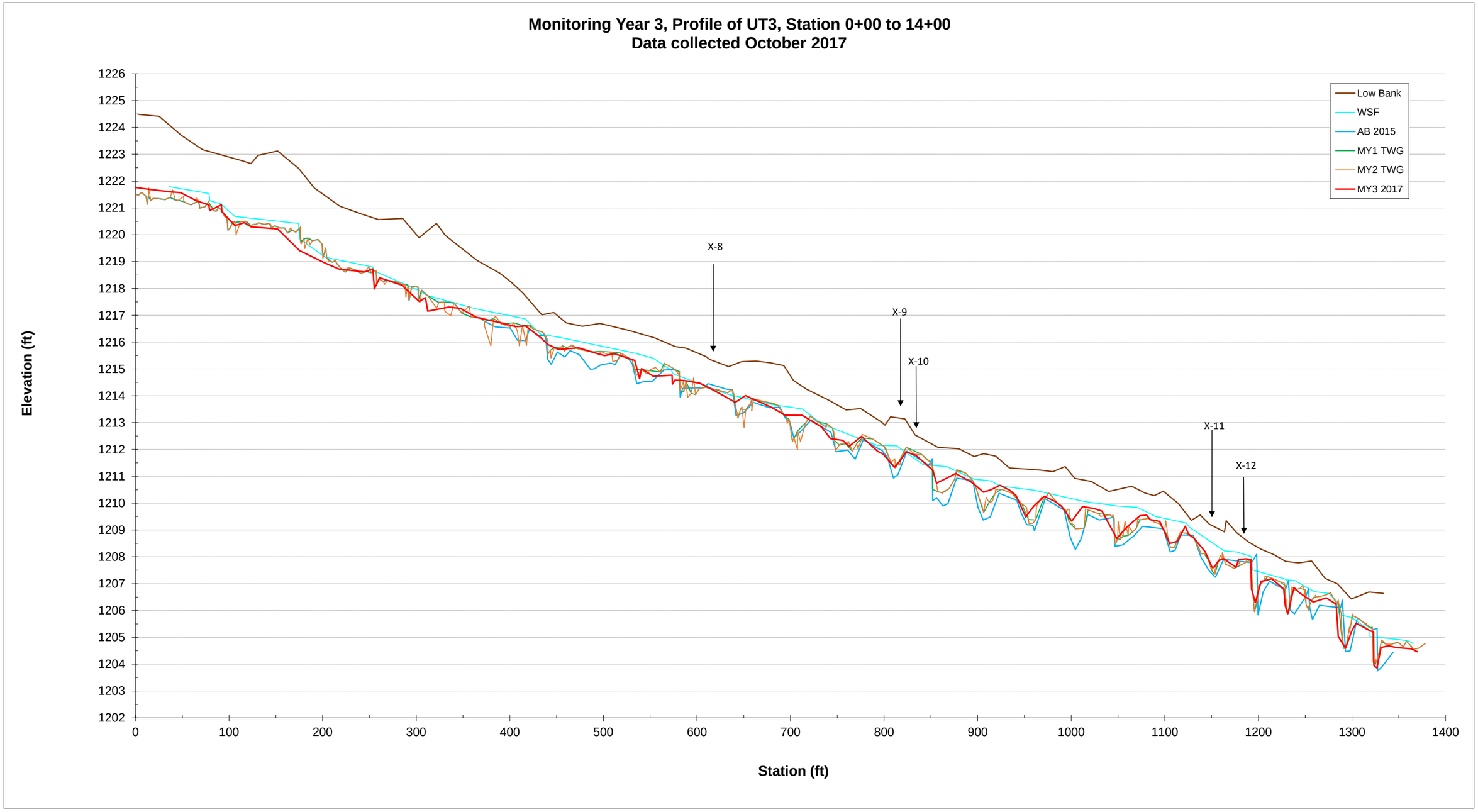


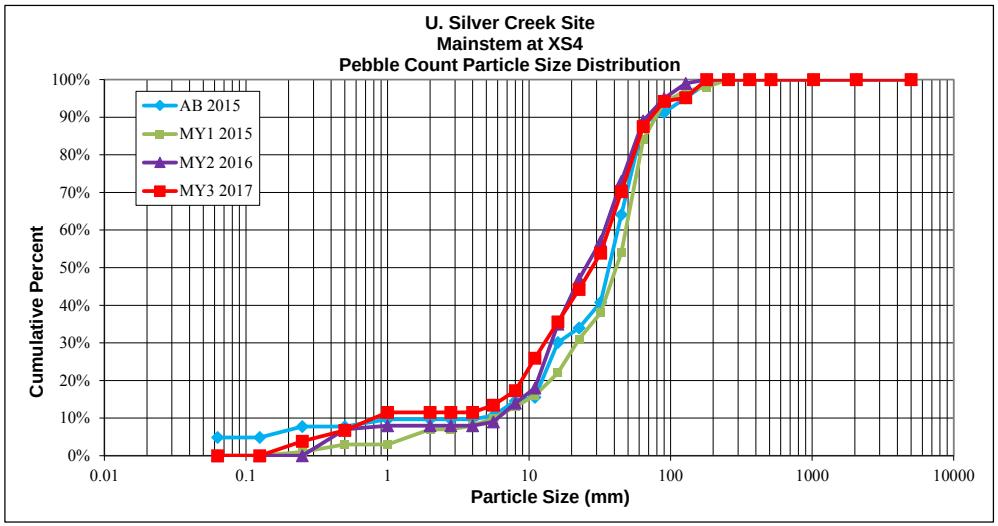
**Figure 8. Pebble Count Plots with Annual Overlays**

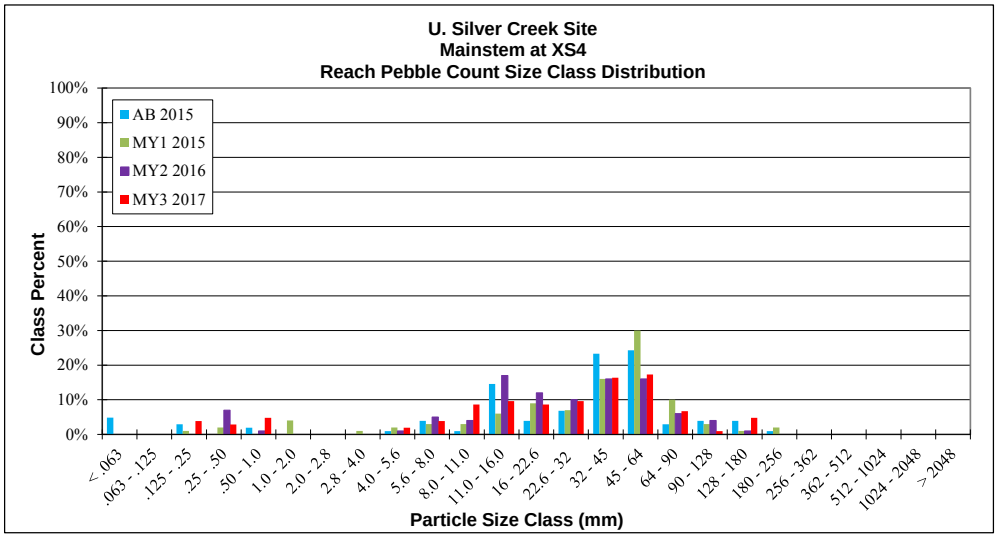
**Cross-Section Pebble Count; Monitoring Year 3**
**U. Silver Creek Mitigation Project, DMS# 94645**

| | |
|---|---|
| SITE OR PROJECT: | U. Silver Cr |
| REACH/LOCATION: | Riffle at XS4 |
| FEATURE: | Riffle |
| DATE: | 17-Oct-17 |

| | | | MY3 2017 | | | 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 | 4 | 4% | 4% | 0.25 |
| | Medium | .25 - .50 | 3 | 3% | 7% | 0.50 |
| | Coarse | .50 - 1.0 | 5 | 5% | 12% | 1.0 |
| | Very Coarse | 1.0 - 2.0 | | | 12% | 2.0 |
| Gravel | Very Fine | 2.0 - 2.8 | | | 12% | 2.8 |
| | Very Fine | 2.8 - 4.0 | | | 12% | 4.0 |
| | Fine | 4.0 - 5.6 | 2 | 2% | 13% | 5.6 |
| | Fine | 5.6 - 8.0 | 4 | 4% | 17% | 8.0 |
| | Medium | 8.0 - 11.0 | 9 | 9% | 26% | 11.0 |
| | Medium | 11.0 - 16.0 | 10 | 10% | 36% | 16.0 |
| | Coarse | 16 - 22.6 | 9 | 9% | 44% | 22.6 |
| | Coarse | 22.6 - 32 | 10 | 10% | 54% | 32 |
| | Very Coarse | 32 - 45 | 17 | 16% | 70% | 45 |
| | Very Coarse | 45 - 64 | 18 | 17% | 88% | 64 |
| Cobble | Small | 64 - 90 | 7 | 7% | 94% | 90 |
| | Small | 90 - 128 | 1 | 1% | 95% | 128 |
| | Large | 128 - 180 | 5 | 5% | 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 | | | 104 | 100% | | |
| Largest particle= | | 180 | | | | |

| Summary Data | | | |
|---|---|---|---|
| Channel materials | | | |
| D16 = | 7.1 | D84 = | 59.6 |
| D35 = | 15.6 | D95 = | 119.3 |
| D50 = | 27.8 | D100 = | 128 - 180 |



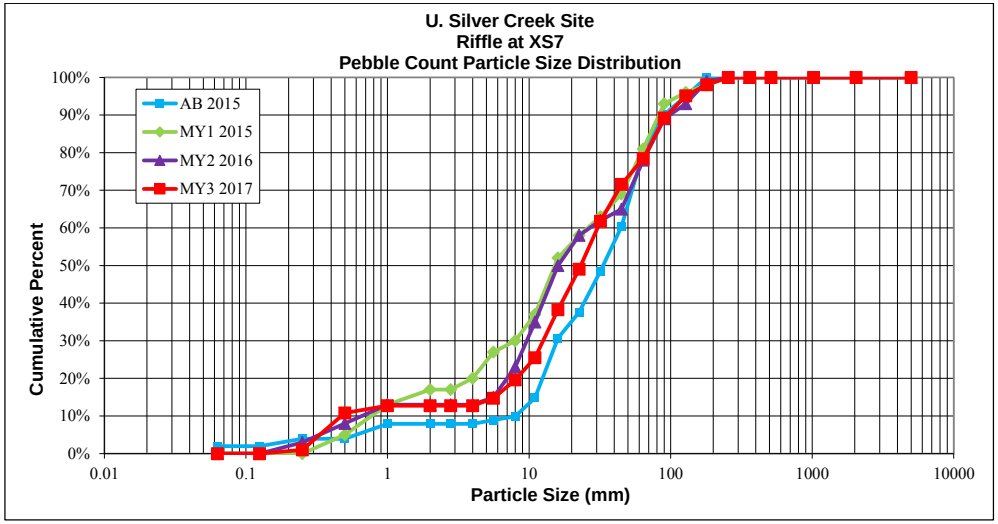
**Cross-Section Pebble Count; Monitoring Year 3**
**U. Silver Creek Mitigation Project, DMS# 94645**

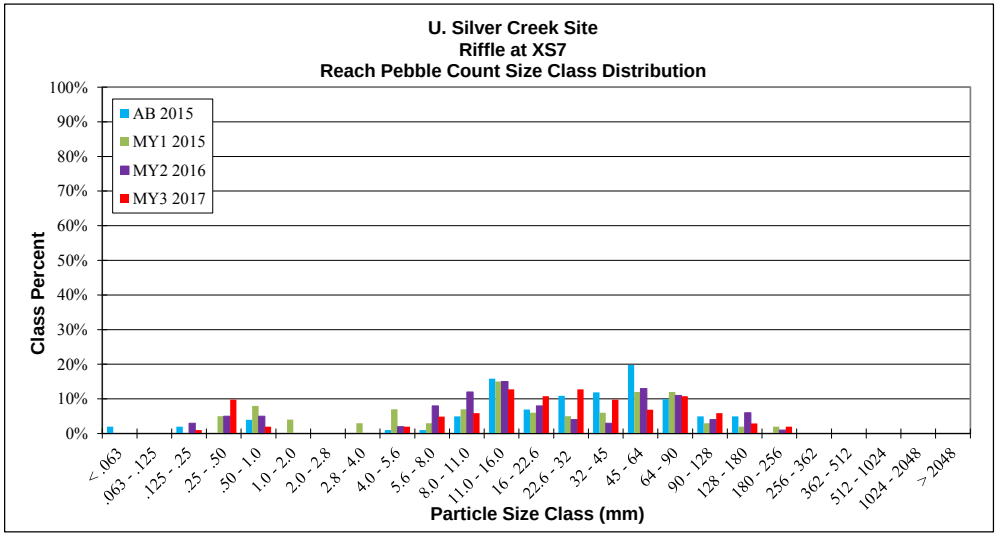
| | |
|---|---|
| SITE OR PROJECT: | U. Silver Cr |
| REACH/LOCATION: | Riffle at XS7 |
| FEATURE: | Riffle |
| DATE: | 17-Oct-17 |

| | | | MY3 2017 | | | 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 | 1 | 1% | 1% | 0.25 |
| | Medium | .25 - .50 | 10 | 10% | 11% | 0.50 |
| | Coarse | .50 - 1.0 | 2 | 2% | 13% | 1.0 |
| | Very Coarse | 1.0 - 2.0 | | | 13% | 2.0 |
| Gravel | Very Fine | 2.0 - 2.8 | | | 13% | 2.8 |
| | Very Fine | 2.8 - 4.0 | | | 13% | 4.0 |
| | Fine | 4.0 - 5.6 | 2 | 2% | 15% | 5.6 |
| | Fine | 5.6 - 8.0 | 5 | 5% | 20% | 8.0 |
| | Medium | 8.0 - 11.0 | 6 | 6% | 25% | 11.0 |
| | Medium | 11.0 - 16.0 | 13 | 13% | 38% | 16.0 |
| | Coarse | 16 - 22.6 | 11 | 11% | 49% | 22.6 |
| | Coarse | 22.6 - 32 | 13 | 13% | 62% | 32 |
| | Very Coarse | 32 - 45 | 10 | 10% | 72% | 45 |
| | Very Coarse | 45 - 64 | 7 | 7% | 78% | 64 |
| Cobble | Small | 64 - 90 | 11 | 11% | 89% | 90 |
| | Small | 90 - 128 | 6 | 6% | 95% | 128 |
| | Large | 128 - 180 | 3 | 3% | 98% | 180 |
| | Large | 180 - 256 | 2 | 2% | 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 | | | 102 | 100% | | |

Largest particle= 210

| Summary Data | | | |
|---|---|---|---|
| Channel materials | | | |
| D16 = | 6.2 | D84 = | 76.3 |
| D35 = | 14.5 | D95 = | 127.3 |
| D50 = | 23.2 | D100 = | 180 - 256 |



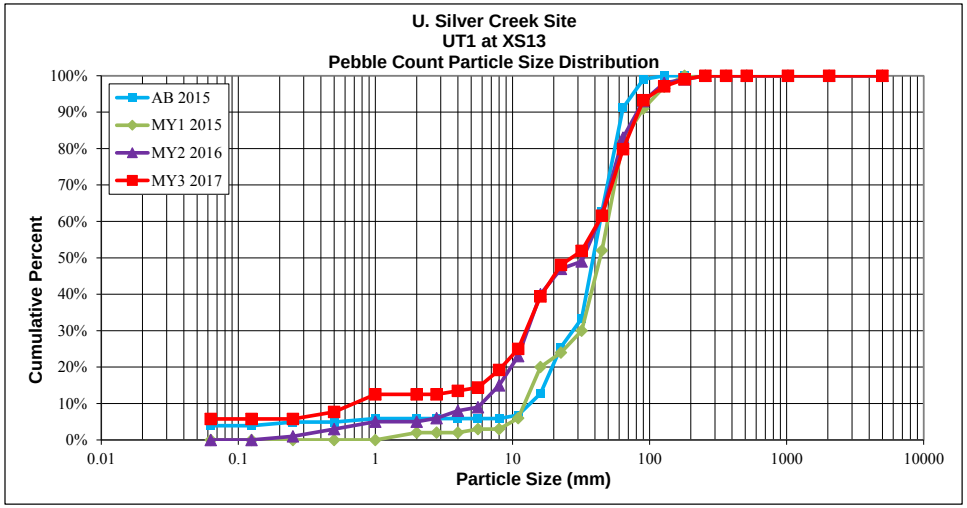
**Cross-Section Pebble Count; Monitoring Year 3**
**U. Silver Creek Mitigation Project, DMS# 94645**

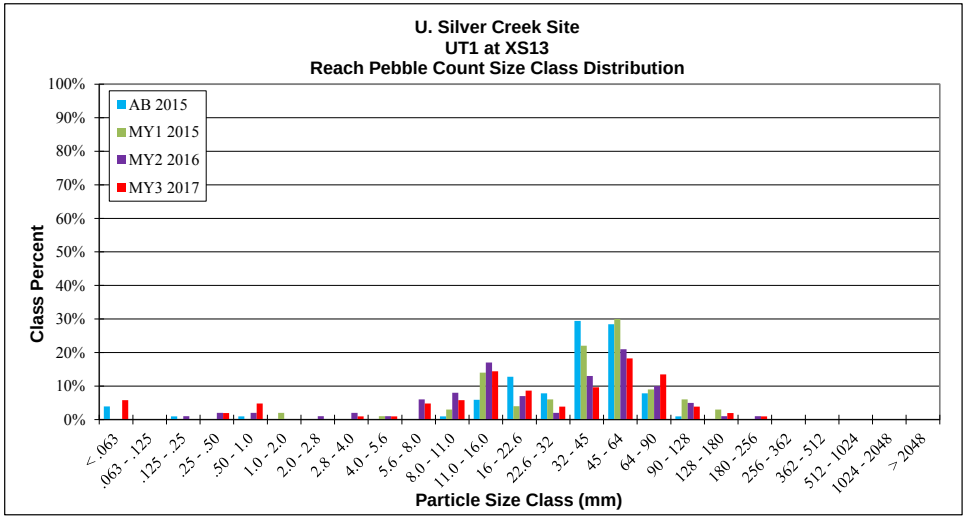
| | |
|---|---|
| SITE OR PROJECT: | U. Silver Cr |
| REACH/LOCATION: | UT1 XS13 |
| FEATURE: | Riffle |
| DATE: | 17-Oct-17 |

| | | | MY3 2017 | | | Distribution |
|---|---|---|---|---|---|---|
| **MATERIAL** | **PARTICLE** | **SIZE (mm)** | **Total** | **Class %** | **% Cum** | **Plot Size (mm)** |
| **Silt/Clay** | Silt / Clay | < .063 | 6 | 6% | 6% | 0.063 |
| **Sand** | Very Fine | .063 - .125 | | | 6% | 0.125 |
| | Fine | .125 - .25 | | | 6% | 0.25 |
| | Medium | .25 - .50 | 2 | 2% | 8% | 0.50 |
| | Coarse | .50 - 1.0 | 5 | 5% | 13% | 1.0 |
| | Very Coarse | 1.0 - 2.0 | | | 13% | 2.0 |
| **Gravel** | Very Fine | 2.0 - 2.8 | | | 13% | 2.8 |
| | Very Fine | 2.8 - 4.0 | 1 | 1% | 13% | 4.0 |
| | Fine | 4.0 - 5.6 | 1 | 1% | 14% | 5.6 |
| | Fine | 5.6 - 8.0 | 5 | 5% | 19% | 8.0 |
| | Medium | 8.0 - 11.0 | 6 | 6% | 25% | 11.0 |
| | Medium | 11.0 - 16.0 | 15 | 14% | 39% | 16.0 |
| | Coarse | 16 - 22.6 | 9 | 9% | 48% | 22.6 |
| | Coarse | 22.6 - 32 | 4 | 4% | 52% | 32 |
| | Very Coarse | 32 - 45 | 10 | 10% | 62% | 45 |
| | Very Coarse | 45 - 64 | 19 | 18% | 80% | 64 |
| **Cobble** | Small | 64 - 90 | 14 | 13% | 93% | 90 |
| | Small | 90 - 128 | 4 | 4% | 97% | 128 |
| | Large | 128 - 180 | 2 | 2% | 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% | | |

Largest particle= 220

| Summary Data | | | |
|---|---|---|---|
| Channel materials | | | |
| D16 = | 6.3 | D84 = | 71.2 |
| D35 = | 14.3 | D95 = | 105.5 |
| D50 = | 26.9 | D100 = | 180 - 256 |



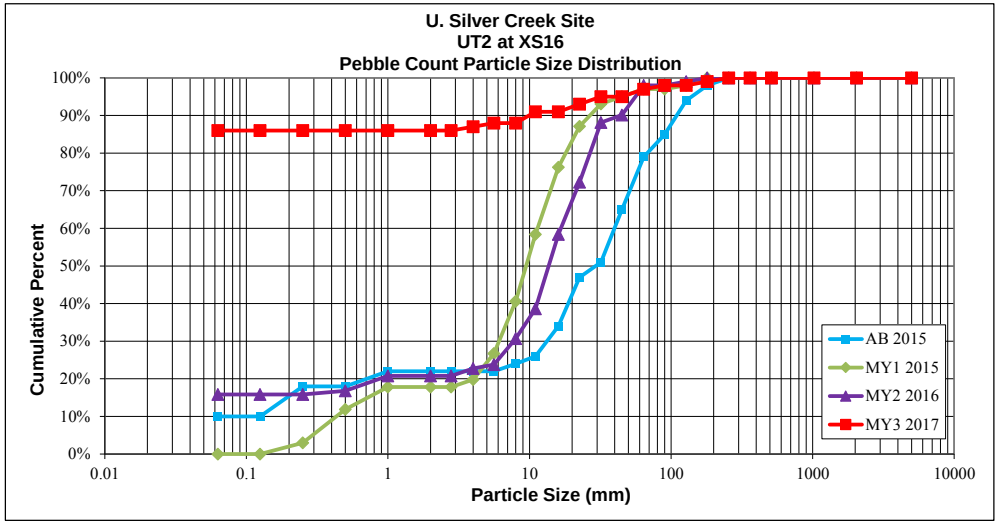
**Cross-Section Pebble Count; Monitoring Year 3**
**U. Silver Creek Mitigation Project, DMS# 94645**

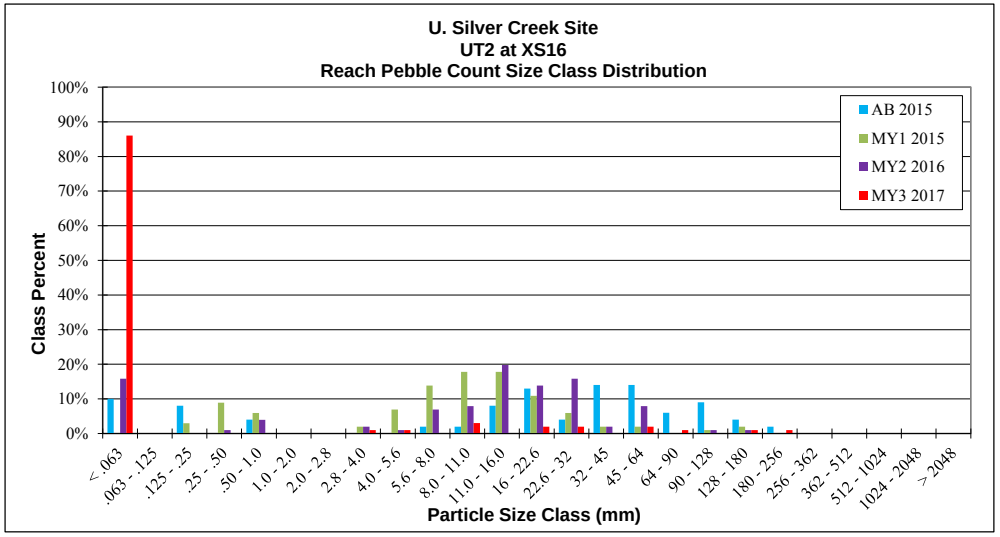
| | |
|---|---|
| SITE OR PROJECT: | U. Silver Cr |
| REACH/LOCATION: | UT2 XS16 |
| FEATURE: | Riffle |
| DATE: | 17-Oct-17 |

| | | | MY3 2017 | | | Distribution |
|---|---|---|---|---|---|---|
| MATERIAL | PARTICLE | SIZE (mm) | Total | Class % | % Cum | Plot Size (mm) |
| Silt/Clay | Silt / Clay | < .063 | 86 | 86% | 86% | 0.063 |
| Sand | Very Fine | .063 - .125 | | | 86% | 0.125 |
| | Fine | .125 - .25 | | | 86% | 0.25 |
| | Medium | .25 - .50 | | | 86% | 0.50 |
| | Coarse | .50 - 1.0 | | | 86% | 1.0 |
| | Very Coarse | 1.0 - 2.0 | | | 86% | 2.0 |
| Gravel | Very Fine | 2.0 - 2.8 | | | 86% | 2.8 |
| | Very Fine | 2.8 - 4.0 | 1 | 1% | 87% | 4.0 |
| | Fine | 4.0 - 5.6 | 1 | 1% | 88% | 5.6 |
| | Fine | 5.6 - 8.0 | | | 88% | 8.0 |
| | Medium | 8.0 - 11.0 | 3 | 3% | 91% | 11.0 |
| | Medium | 11.0 - 16.0 | | | 91% | 16.0 |
| | Coarse | 16 - 22.6 | 2 | 2% | 93% | 22.6 |
| | Coarse | 22.6 - 32 | 2 | 2% | 95% | 32 |
| | Very Coarse | 32 - 45 | | | 95% | 45 |
| | Very Coarse | 45 - 64 | 2 | 2% | 97% | 64 |
| Cobble | Small | 64 - 90 | 1 | 1% | 98% | 90 |
| | Small | 90 - 128 | | | 98% | 128 |
| | Large | 128 - 180 | 1 | 1% | 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 | | | 100 | 100% | | |

Largest particle= 190

| Summary Data | | | |
|---|---|---|---|
| Channel materials | | | |
| D16 = | | D84 = | |
| D35 = | | D95 = | 45.0 |
| D50 = | | D100 = | 180 - 256 |



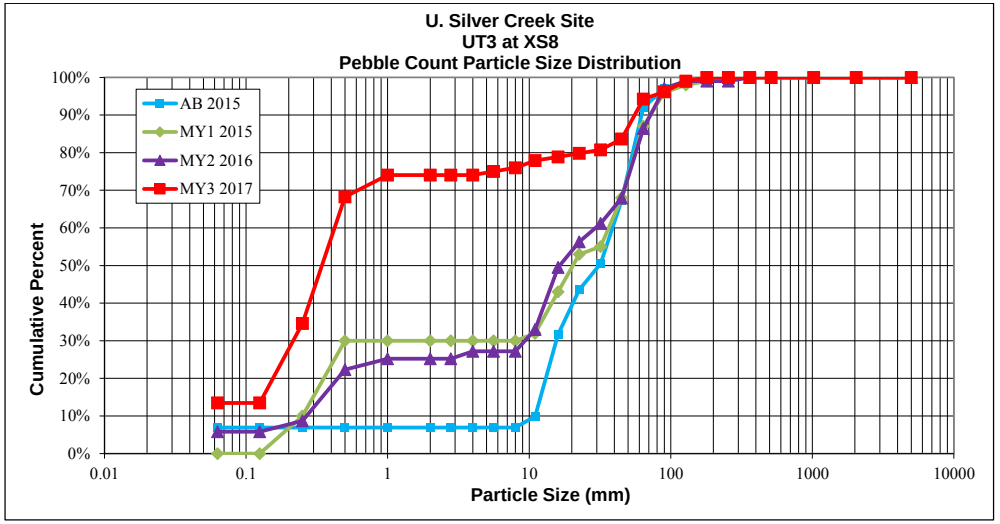
**Cross-Section Pebble Count; Monitoring Year 3**
**U. Silver Creek Mitigation Project, DMS# 94645**

| | |
|---|---|
| SITE OR PROJECT: | U. Silver Cr |
| REACH/LOCATION: | UT3 XS8 |
| FEATURE: | Riffle |
| DATE: | 17-Oct-17 |

| | | | MY3 2017 | | | Distribution |
|---|---|---|---|---|---|---|
| **MATERIAL** | **PARTICLE** | **SIZE (mm)** | **Total** | **Class %** | **% Cum** | **Plot Size (mm)** |
| **Silt/Clay** | Silt / Clay | < .063 | 14 | 13% | 13% | 0.063 |
| **Sand** | Very Fine | .063 - .125 | | | 13% | 0.125 |
| | Fine | .125 - .25 | 22 | 21% | 35% | 0.25 |
| | Medium | .25 - .50 | 35 | 34% | 68% | 0.50 |
| | Coarse | .50 - 1.0 | 6 | 6% | 74% | 1.0 |
| | Very Coarse | 1.0 - 2.0 | | | 74% | 2.0 |
| **Gravel** | Very Fine | 2.0 - 2.8 | | | 74% | 2.8 |
| | Very Fine | 2.8 - 4.0 | | | 74% | 4.0 |
| | Fine | 4.0 - 5.6 | 1 | 1% | 75% | 5.6 |
| | Fine | 5.6 - 8.0 | 1 | 1% | 76% | 8.0 |
| | Medium | 8.0 - 11.0 | 2 | 2% | 78% | 11.0 |
| | Medium | 11.0 - 16.0 | 1 | 1% | 79% | 16.0 |
| | Coarse | 16 - 22.6 | 1 | 1% | 80% | 22.6 |
| | Coarse | 22.6 - 32 | 1 | 1% | 81% | 32 |
| | Very Coarse | 32 - 45 | 3 | 3% | 84% | 45 |
| | Very Coarse | 45 - 64 | 11 | 11% | 94% | 64 |
| **Cobble** | Small | 64 - 90 | 2 | 2% | 96% | 90 |
| | Small | 90 - 128 | 3 | 3% | 99% | 128 |
| | Large | 128 - 180 | 1 | 1% | 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 | | | 104 | 100% | | |

Largest particle= 200

| Summary Data | | | |
|---|---|---|---|
| **Channel materials** | | | |
| D16 = | 0.14 | D84 = | 45.52 |
| D35 = | 0.25 | D95 = | 73.35 |
| D50 = | 0.34 | D100 = | 128 - 180 |



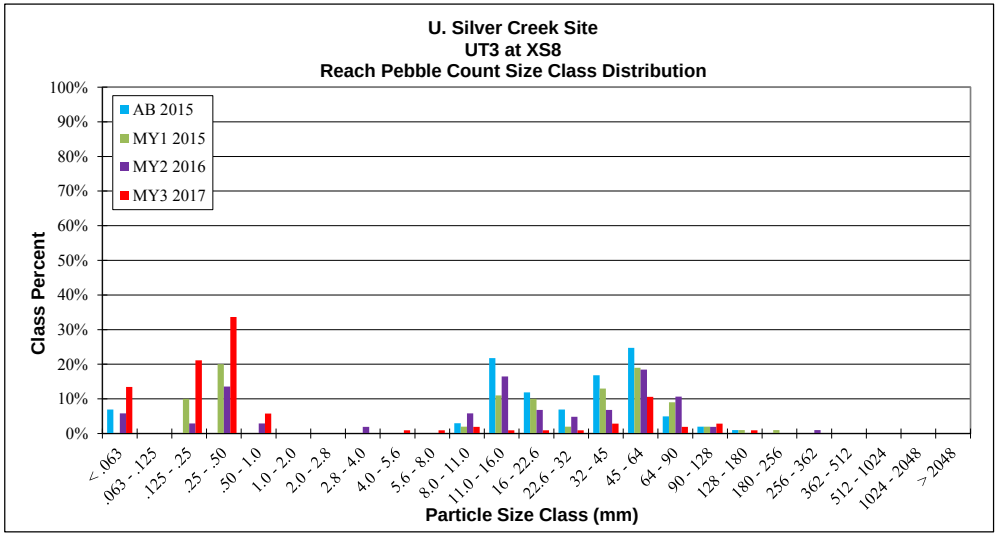



**Table 10. Monitoring Year 3 Stream Summary**

**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

**Silver Creek Mainstem**

| Parameter | USGS Gauge | Regional Curve Interval [1,2] | | | Pre-Existing Condition [1] | | | | | | Reference Reach Data: Morgan Creek | | | | | | Design | | | | | | As-built | | | | | | MY1 | | | | | | MY2 | | | | | | MY3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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 |
| **Dimension and Substrate - Riffle** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | - | 29.0 | 19.0 | - | 18.5 | - | - | 21.2 | - | 7 | 33.2 | - | - | 33.5 | - | - | - | 26.0 | - | - | - | - | 23.8 | 27.0 | 27.5 | 29.1 | 2.0 | 4 | 23.5 | 25.0 | 25.2 | 26.1 | 1.0 | 4 | 23.5 | 24.9 | 25.1 | 25.8 | 0.837 | 4 | 24.0 | 24.9 | 25.0 | 25.8 | 0.621 | 4 |
| Floodprone Width (ft) | - | - | - | - | 397.0 | - | - | 453.0 | - | 7 | 77.5 | - | - | 86.8 | - | - | 397 | - | - | 453.0 | - | - | - | >300 | - | - | - | - | - | >300 | - | - | - | - | >300 | - | - | - | - | - | >300 | - | - | - | - | - |
| BF Mean Depth (ft) | - | 1.6 | 2.1 | - | 2.29 | - | - | 2.93 | - | 7 | 2.3 | - | - | 2.4 | - | - | - | 2.2 | - | - | - | - | 1.7 | 1.9 | 1.9 | 2.1 | 0.18 | 4 | 1.7 | 1.8 | 1.8 | 2.0 | 0.11 | 4 | 1.7 | 1.8 | 1.8 | 1.8 | 0.061 | 4 | 1.7 | 1.7 | 1.7 | 1.8 | 0.056 | 4 |
| BF Max Depth (ft) | - | - | - | - | 3.3 | - | - | 3.9 | - | 7 | 2.8 | - | - | 2.9 | - | - | - | 3.0 | - | - | - | - | 2.9 | 3.1 | 3.2 | 3.3 | 0.2 | 4 | 2.8 | 3.0 | 3.0 | 3.2 | 0.2 | 4 | 2.8 | 3.0 | 3.0 | 3.2 | 0.162 | 4 | 2.8 | 3.1 | 3.1 | 3.2 | 0.166 | 4 |
| BF Cross-sectional Area ($ft^2$) | - | 46.0 | 45.0 | - | 46.3 | - | - | 55.2 | - | 7 | 75.1 | - | - | 79.8 | - | - | - | 56.0 | - | - | - | - | 46.9 | 49.7 | 48.6 | 54.5 | 2.9 | 4 | 43.4 | 45.4 | 43.8 | 50.6 | 3.0 | 4 | 41.1 | 44.0 | 43.7 | 47.6 | 2.513 | 4 | 41.6 | 42.9 | 41.9 | 46.2 | 1.929 | 4 |
| Width/Depth Ratio | - | - | - | - | 7.4 | - | - | 8.8 | - | 7 | 14.1 | - | - | 14.7 | - | - | - | 12 | - | - | - | - | 11.8 | 14.8 | 15.1 | 17.3 | 2.4 | 4 | 12.4 | 13.8 | 13.6 | 15.7 | 1.2 | 4 | 13.5 | 14.1 | 13.9 | 15.0 | 0.593 | 4 | 13.7 | 14.5 | 14.6 | 15.1 | 0.523 | 4 |
| Entrenchment Ratio | - | - | - | - | 19.6 | - | - | 24 | - | 7 | 2.3 | - | - | 2.6 | - | - | 15.3 | - | - | 17.4 | - | - | 3.1 | 3.7 | 3.5 | 4.8 | 0.7 | 4 | 3.3 | 4.0 | 3.8 | 4.9 | 0.6 | 4 | 3.5 | 4.0 | 3.8 | 4.9 | 0.545 | 4 | 3.5 | 4.0 | 3.7 | 4.9 | 0.568 | 4 |
| Bank Height Ratio | - | - | - | - | 1.07 | - | - | 1.5 | - | 7 | 1.0 | - | - | 1.0 | - | - | 1 | - | - | 1.1 | - | - | 1.00 | 1.03 | 1.00 | 1.10 | 0.04 | 4 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 4 | 1.00 | 1.00 | 1.00 | 1.00 | 0.43 | 4 | 1.01 | 1.03 | 1.03 | 1.06 | 0.019 | 4 |
| d50 (mm) | - | - | - | - | - | 17.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Pattern** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Channel Beltwidth (ft) | - | - | - | - | 45 | - | - | 106 | - | - | - | - | - | - | - | - | 104 | - | - | 208 | - | - | 99.0 | 133.3 | 137.7 | 157.9 | 19.24 | 13 | 99.0 | 133.3 | 137.7 | 157.9 | 19.24 | 13 | 99.0 | 133.3 | 137.7 | 157.9 | 19.24 | 13 | 99.0 | 133.3 | 137.7 | 157.9 | 19.24 | 13 |
| Radius of Curvature (ft) | - | - | - | - | 16 | - | - | 62 | - | - | - | - | - | - | - | - | 47 | - | - | 73 | - | - | 52.6 | 57.2 | 55.0 | 67.9 | 5.03 | 8 | 52.6 | 57.2 | 55.0 | 67.9 | 5.03 | 8 | 52.6 | 57.2 | 55.0 | 67.9 | 5.03 | 8 | 52.6 | 57.2 | 55.0 | 67.9 | 5.03 | 8 |
| Rc:Bankfull width (ft/ft) | - | - | - | - | 1 | - | - | 3.1 | - | - | - | - | - | - | - | - | 1.8 | - | - | 2.8 | - | - | 1.95 | 2.12 | 2.04 | 2.51 | 0.19 | 8 | 1.95 | 2.12 | 2.04 | 2.51 | 0.19 | 8 | 1.95 | 2.12 | 2.04 | 2.51 | 0.19 | 8 | 1.95 | 2.12 | 2.04 | 2.51 | 0.19 | 8 |
| Meander Wavelength (ft) | - | - | - | - | 59 | - | - | 139 | - | - | - | - | - | - | - | - | 182 | - | - | 312 | - | - | 172.0 | 225.4 | 201.7 | 310.0 | 49.3 | 8 | 172.0 | 225.4 | 201.7 | 310.0 | 49.3 | 8 | 172.0 | 225.4 | 201.7 | 310.0 | 49.3 | 8 | 172.0 | 225.4 | 201.7 | 310.0 | 49.3 | 8 |
| Meander Width Ratio | - | - | - | - | 2.3 | - | - | 5.4 | - | - | - | - | - | - | - | - | 7.0 | - | - | 12.0 | - | - | 6.4 | 8.3 | 7.5 | 11.5 | 1.8 | 8 | 6.4 | 8.3 | 7.5 | 11.5 | 1.8 | 8 | 6.4 | 8.3 | 7.5 | 11.5 | 1.8 | 8 | 6.4 | 8.3 | 7.5 | 11.5 | 1.8 | 8 |
| **Profile** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Riffle Length (ft) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 36.7 | 50.3 | 44.7 | 89.4 | 15.1 | 10.0 | 12.1 | 50.0 | 47.6 | 83.8 | 17.0 | 16 | 27.3 | 56.3 | 57.2 | 86.5 | 16.7 | 15 | 22.7 | 53.3 | 51.1 | 79.5 | 15.7 | 15 |
| Riffle Slope (ft/ft) | - | - | - | - | 0.001 | - | - | 0.108 | - | - | 0.014 | - | - | 0.024 | - | - | 0.005 | - | - | 0.008 | - | - | 0.0013 | 0.0078 | 0.0067 | 0.0152 | 0.0041 | 10.0 | 0.0000 | 0.0076 | 0.0055 | 0.0231 | 0.0073 | 16 | 0.0013 | 0.0058 | 0.0049 | 0.0130 | 0.0036 | 15 | 0.0001 | 0.0067 | 0.0082 | 0.0132 | 0.0045 | 15 |
| Pool Length (ft) | - | - | - | - | 15 | - | - | 135 | - | - | - | - | - | - | - | - | 78 | - | - | 137 | - | - | 50.4 | 97.1 | 94.0 | 136.6 | 20.4 | 16.0 | 42.7 | 80.3 | 87.7 | 116.8 | 22.6 | 14 | 16.7 | 80.0 | 83.7 | 126.0 | 26.7 | 19 | 11.9 | 81.5 | 84.2 | 160.7 | 34.4 | 19 |
| Pool Spacing (ft) | - | - | - | - | 40 | - | - | 162 | - | - | 46 | - | - | 277 | - | - | 104 | - | - | 182 | - | - | 113.7 | 145.8 | 140.1 | 210.4 | 29.6 | 15 | 42.8 | 115.2 | 120.5 | 191.4 | 36.6 | 19 | 48.1 | 113.6 | 116.6 | 202.2 | 42.0 | 20 | 50.5 | 118.9 | 111.9 | 193.5 | 39.1 | 20 |
| Pool Max Depth (ft) | - | - | - | - | 3.97 | - | - | 4.08 | - | - | 4.1 | - | - | 4.1 | - | - | 5.5 | - | - | 7.7 | - | - | 4.0 | 4.8 | 5.2 | 5.3 | 0.58 | 3 | 3.9 | 4.3 | 4.0 | 5.0 | 0.48 | 3 | 3.8 | 4.0 | 4.0 | 4.3 | 0.23 | 3 | 1.1 | 2.0 | 1.7 | 4.2 | 0.86 | 20 |
| Pool Volume ($ft^3$) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Substrate and Transport Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ri% / Ru% / P% / G% / S% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| SC% / Sa% / G% / B% / Be% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| d16 / d35 / d50 / d84 / d95 | - | - | - | - | 1.0 / 8.4 / 17 / 43 / 57 | | | | | | - / 1.2 / 3.0 / 77 / 800 | | | | | | - | | | | | | mean 11.2 / 21.8 / 35.0 / 66.6 /126.9 | | | | | 2 | mean 6.4 / 18.8 / 28.3 / 66.9 /107.5 | | | | | 2 | mean 7.7 / 13.5 / 20.6 / 67.2 /116.7 | | | | | 2 | mean 6.7 / 15.1 / 25.5 / 68.0 / 123 | | | | | 2 |
| Reach Shear Stress (competency) lb/F | - | - | - | - | 0.035 | - | - | 1.13 | - | - | - | - | - | - | - | - | - | 0.5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max part size (mm) mobilized at bankfull (Rosgen Curve) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Stream Power (transport capacity) W/$m^2$ | - | - | - | - | 34 | - | - | 40 | - | - | - | - | - | - | - | - | 29 | - | - | 35 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drainage Area (SM) | - | | 3.0 | | 2.73 | - | - | 3.35 | - | - | - | 8.4 | - | - | - | - | 2.73 | - | - | 3.35 | - | - | 2.73 | - | - | 3.35 | - | - | 2.73 | - | - | 3.35 | - | - | 2.73 | - | - | 3.35 | - | - | 2.73 | - | - | 3.35 | - | - |
| Impervious cover estimate (%) | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - |
| Rosgen Classification | - | - | - | - | - | E | - | - | - | - | - | C4 | - | - | - | - | - | C | - | - | - | - | - | C | - | - | - | - | - | C | - | - | - | - | - | C | - | - | - | - | - | C | - | - | - | - |
| BF Velocity (fps) | - | - | - | - | 2.8 | - | - | 4.9 | - | 7 | - | 7 | - | - | - | - | - | 4.20 | - | - | - | - | - | 4.27 | - | - | - | - | - | 4.21 | - | - | - | - | - | 4.21 | - | - | - | - | - | 4.21 | - | - | - | - |
| BF Discharge (cfs) | - | 232.0 | 196.0 | 213.2 | 180 | - | - | 240 | - | - | - | 524 | - | - | - | - | - | 230.0 | - | - | - | - | - | 212.2 | - | - | - | - | - | 229.3 | - | - | - | - | - | 229.3 | - | - | - | - | - | 229.3 | - | - | - | - |
| Valley Length | - | - | - | - | - | 1947 | - | - | - | - | - | - | - | - | - | - | - | 1947.0 | - | - | - | - | - | 1947.0 | - | - | - | - | - | 1947.0 | - | - | - | - | - | 1947.0 | - | - | - | - | - | 1947.0 | - | - | - | - |
| Channel length ($ft^2$ | - | - | - | - | - | 3179 | - | - | - | - | - | - | - | - | - | - | - | 3068 | - | - | - | - | - | 3016 | - | - | - | - | - | 3016 | - | - | - | - | - | 3016 | - | - | - | - | - | 3016 | - | - | - | - |
| Sinuosity | - | - | - | - | - | 1.63 | - | - | - | - | - | - | - | - | - | - | - | 1.58 | - | - | - | - | - | 1.55 | - | - | - | - | - | 1.55 | - | - | - | - | - | 1.55 | - | - | - | - | - | 1.55 | - | - | - | - |
| Water Surface Slope (Channel) (ft/ft) | - | - | - | - | - | 0.0040 | - | - | - | - | - | 0.0070 | - | - | - | - | 0.003 | - | - | 0.004 | - | - | - | 0.0043 | - | - | - | - | - | 0.0043 | - | - | - | - | - | 0.0043 | - | - | - | - | - | 0.0043 | - | - | - | - |
| BF slope (ft/ft) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.003 | - | - | 0.008 | - | - | - | 0.004 | - | - | - | - | - | 0.004 | - | - | - | - | - | 0.004 | - | - | - | - | - | 0.004 | - | - | - | - |
| Bankfull Floodplain Area (acres) | - | - | - | - | - | 2.1 | - | - | - | - | - | - | - | - | - | - | - | 5.2 | - | - | - | - | - | 5.2 | - | - | - | - | - | 5.2 | - | - | - | - | - | 5.2 | - | - | - | - | - | 5.2 | - | - | - | - |
| BEHI VL% / L% / M% / H% / VH% / E% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Channel Stability or Habitat Metric | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Biological or Other | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

1. Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. Wildland Hydrology. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.
2. 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.

**UT1**

| Parameter | USGS Gauge | Regional Curve Interval [1,2] | | | Pre-Existing Condition [1] | | | | | | Reference Reach Data: UT3 upstream of Gold Mine Road | | | | | | Design | | | | | | As-built | | | | | | MY1 | | | | | | MY2 | | | | | | MY3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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 |
| **Dimension and Substrate - Riffle** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | - | 11.9 | 6.9 | - | 6.1 | - | - | 9.3 | - | 4 | 6.3 | - | - | 7.9 | - | - | - | 9.5 | - | - | - | - | - | 9.6 | - | - | - | 1 | - | 9.3 | - | - | - | 1 | - | 9.2 | - | - | - | 1 | - | 9.0 | - | - | - | 1 |
| Floodprone Width (ft) | - | - | - | - | 10.9 | - | - | 60.5 | - | 4 | 15 | - | - | 19 | - | - | 10.9 | - | - | 60.5 | - | - | - | >150 | - | - | - | 1 | - | >150 | - | - | - | 1 | - | >150 | - | - | - | 1 | - | >150 | - | - | - | 1 |
| BF Mean Depth (ft) | - | 0.7 | 1.0 | - | 0.97 | - | - | 1.50 | - | 4 | 0.7 | - | - | 0.9 | - | - | - | 0.95 | - | - | - | - | - | 0.9 | - | - | - | 1 | - | 0.8 | - | - | - | 1 | - | 0.8 | - | - | - | 1 | - | 0.8 | - | - | - | 1 |
| BF Max Depth (ft) | - | - | - | - | 1.37 | - | - | 2.07 | - | 4 | 1.0 | - | - | 1.35 | - | - | - | 1.2 | - | - | - | - | - | 1.3 | - | - | - | 1 | - | 1.1 | - | - | - | 1 | - | 1.1 | - | - | - | 1 | - | 1.1 | - | - | - | 1 |
| BF Cross-sectional Area ($ft^2$) | - | 9.1 | 9.0 | - | 9 | - | - | 9.07 | - | 4 | 5.5 | - | - | 6.5 | - | - | - | 9.0 | - | - | - | - | - | 8.9 | - | - | - | 1 | - | 7.0 | - | - | - | 1 | - | 7.0 | - | - | - | 1 | - | 7.0 | - | - | - | 1 |
| Width/Depth Ratio | - | - | - | - | 4 | - | - | 9.6 | - | 4 | 7.3 | - | - | 11.7 | - | - | - | 10 | - | - | - | - | - | 10.3 | - | - | - | 1 | - | 12.3 | - | - | - | 1 | - | 12.2 | - | - | - | 1 | - | 11.7 | - | - | - | 1 |
| Entrenchment Ratio | - | - | - | - | 1.2 | - | - | 10 | - | 4 | 1.9 | - | - | 3.0 | - | - | 1.1 | - | - | 6.4 | - | - | - | 5.3 | - | - | - | 1 | - | 5.2 | - | - | - | 1 | - | 5.5 | - | - | - | 1 | - | 5.6 | - | - | - | 1 |
| Bank Height Ratio | - | - | - | - | 1.5 | - | - | 3.0 | - | 4 | 1.0 | - | - | 1.0 | - | - | 1.0 | - | - | 1.0 | - | - | - | 1.00 | - | - | - | 1 | - | 1.00 | - | - | - | 1 | - | 1.10 | - | - | - | 1 | - | 1.10 | - | - | - | 1 |
| d50 (mm) | - | - | - | - | - | 18.0 | - | - | - | - | - | 3.0 | - | - | - | - | - | - | - | - | - | - | - | 38.8 | - | - | - | 1 | - | 43.6 | - | - | - | 1 | - | 32.9 | - | - | - | 1 | - | 26.9 | - | - | - | 1 |
| **Pattern** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Channel Beltwidth (ft) | - | - | - | - | 30 | - | - | 60 | - | - | - | - | - | - | - | - | 33 | - | - | 76 | - | - | 33.3 | 49.6 | 44.6 | 70.1 | 13.08 | 5 | 33.3 | 49.6 | 44.6 | 70.1 | 13.08 | 5 | 33.3 | 49.6 | 44.6 | 70.1 | 13.08 | 5 | 33.3 | 49.6 | 44.6 | 70.1 | 13.08 | 5 |
| Radius of Curvature (ft) | - | - | - | - | 9 | - | - | 21 | - | - | - | - | - | - | - | - | 17 | - | - | 27 | - | - | 21.4 | 23.0 | 22.6 | 25.6 | 1.63 | 5 | 21.4 | 23.0 | 22.6 | 25.6 | 1.63 | 5 | 21.4 | 23.0 | 22.6 | 25.6 | 1.63 | 5 | 21.4 | 23.0 | 22.6 | 25.6 | 1.63 | 5 |
| Rc:Bankfull width (ft/ft) | - | - | - | - | 1.2 | - | - | 2.7 | - | - | - | - | - | - | - | - | 1.8 | - | - | 2.8 | - | - | 2.23 | 2.40 | 2.35 | 2.67 | 0.17 | 5 | 2.23 | 2.40 | 2.35 | 2.67 | 0.17 | 5 | 2.23 | 2.40 | 2.35 | 2.67 | 0.17 | 5 | 2.23 | 2.40 | 2.35 | 2.67 | 0.17 | 5 |
| Meander Wavelength (ft) | - | - | - | - | 92 | - | - | 138 | - | - | 45 | - | - | 75 | - | - | 67 | - | - | 114 | - | - | 69.60 | 74.40 | 72.00 | 81.60 | 5.18 | 3 | 69.60 | 74.40 | 72.00 | 81.60 | 5.18 | 3 | 69.60 | 74.40 | 72.00 | 81.60 | 5.18 | 3 | 69.60 | 74.40 | 72.00 | 81.60 | 5.18 | 3 |
| Meander Width Ratio | - | - | - | - | 12 | - | - | 18 | - | - | 1.2 | - | - | 1.2 | - | - | 7.0 | - | - | 12.0 | - | - | 7.3 | 7.8 | 7.5 | 8.5 | 0.5 | 3 | 7.3 | 7.8 | 7.5 | 8.5 | 0.5 | 3 | 7.3 | 7.8 | 7.5 | 8.5 | 0.5 | 3 | 7.3 | 7.8 | 7.5 | 8.5 | 0.5 | 3 |
| **Profile** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Riffle Length (ft) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 16.1 | 20.2 | 19.9 | 24.9 | 4.1 | 4 | 9.9 | 18.5 | 18.1 | 30.5 | 6.3 | 7 | 9.9 | 19.2 | 21.3 | 30.8 | 7.2 | 8 | 9.8 | 21.4 | 21.4 | 30.9 | 7.0 | 8 |
| Riffle Slope (ft/ft) | - | - | - | - | 0.018 | - | - | 0.039 | - | - | 0.013 | - | - | 0.054 | - | - | 0.0165 | - | - | 0.022 | - | - | 0.0185 | 0.0304 | 0.0267 | 0.0497 | 0.0122 | 4 | 0.0098 | 0.0207 | 0.0200 | 0.0387 | 0.0107 | 7 | 0.0097 | 0.0317 | 0.0302 | 0.0642 | 0.0162 | 8 | 0.0078 | 0.0195 | 0.0174 | 0.0325 | 0.0085 | 8 |
| Pool Length (ft) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 26.1 | 33.8 | 35.1 | 41.7 | 6.6 | 5 | 8.6 | 26.9 | 32.2 | 40.6 | 10.9 | 9 | 10.8 | 25.4 | 21.8 | 56.3 | 13.4 | 11 | 12.3 | 27.4 | 22.4 | 60.4 | 15.4 | 11 |
| Pool Spacing (ft) | - | - | - | - | 15 | - | - | 50 | - | - | 39.9 | - | - | 62.3 | - | - | 38 | - | - | 67 | - | - | 23.4 | 46.0 | 51.6 | 60.1 | 13.3 | 7 | 21.9 | 41.7 | 40.9 | 60.7 | 14.6 | 9 | 19.2 | 36.2 | 36.8 | 56.1 | 12.7 | 12 | 11.5 | 34.2 | 26.9 | 59.5 | 14.8 | 14 |
| Pool Max Depth (ft) | - | - | - | - | 2 | - | - | 2.4 | - | - | 1.8 | - | - | 1.8 | - | - | 1.9 | - | - | 3.3 | - | - | - | 1.4 | - | - | - | 1 | - | 2.5 | - | - | - | 1 | - | 2.6 | - | - | - | 1 | - | 1.2 | - | - | - | 1 |
| Pool Volume ($ft^3$) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Substrate and Transport Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ri% / Ru% / P% / G% / S% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| SC% / Sa% / G% / B% / Be% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| d16 / d35 / d50 / d84 / d95 | - | | | | | 4.0 / 12 / 18 / 49 / 85 | | | | | - | | | | | | - | | | | | | 17.5 / 32.6 / 38.8 / 58.6 / 75.6 | | | | | | - | | | | | | 8.3 / 14.3 / 32.9 / 66.2 / 103.6 | | | | | | 6.3/ 14.3 / 26.9 / 71.2 / 105.5 | | | | | |
| Reach Shear Stress (competency) lb/F | - | - | - | - | 0.1 | - | - | 1.0 | - | - | 0.2 | - | - | 0.6 | - | - | - | 0.5 - 0.6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max part size (mm) mobilized at bankfull (Rosgen Curve) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Stream Power (transport capacity) W/$m^2$ | - | - | - | - | - | 32 | - | - | - | - | 6.5 | - | - | 28.5 | - | - | - | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drainage Area (SM) | - | | 0.28 | | - | - | - | 0.28 | - | - | - | 0.12 | - | - | - | - | 0.28 | - | - | 0.28 | - | - | 2.73 | - | - | 3.35 | - | - | 2.73 | - | - | 3.35 | - | - | 2.73 | - | - | 3.35 | - | - | 2.73 | - | - | 3.35 | - | - |
| Impervious cover estimate (%) | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - |
| Rosgen Classification | - | - | - | - | - | E, Gc, Bc | - | - | - | - | - | E/Bc | - | - | - | - | - | E (high W/D) | - | - | - | - | - | C | - | - | - | - | - | C | - | - | - | - | - | C | - | - | - | - | - | C | - | - | - | - |
| BF Velocity (fps) | - | - | - | - | 3.4 | - | - | 4.6 | - | - | 2.1 | - | 3.4 | - | - | - | - | 3.7 | - | - | - | - | - | 3.81 | - | - | - | - | - | 3.48 | - | - | - | - | - | 3.48 | - | - | - | - | - | 3.48 | - | - | - | - |
| BF Discharge (cfs) | - | 38.0 | 36.0 | - | 31 | - | - | 41 | - | - | - | 18 | - | - | - | - | - | 33.5 | - | - | - | - | - | 33.9 | - | - | - | - | - | 24.4 | - | - | - | - | - | 24.4 | - | - | - | - | - | 24.4 | - | - | - | - |
| Valley Length | - | - | - | - | - | 371 | - | - | - | - | - | - | - | - | - | - | - | 367.0 | - | - | - | - | - | 367.0 | - | - | - | - | - | 367.0 | - | - | - | - | - | 367.0 | - | - | - | - | - | 367.0 | - | - | - | - |
| Channel length ($ft^2$ | - | - | - | - | - | 524 | - | - | - | - | - | 134.5 | - | - | - | - | - | 373 | - | - | - | - | - | 495 | - | - | - | - | - | 495 | - | - | - | - | - | 495 | - | - | - | - | - | 495 | - | - | - | - |
| Sinuosity | - | - | - | - | - | 1.41 | - | - | - | - | - | 1.05 | - | - | - | - | - | 1.35 | - | - | - | - | - | 1.36 | - | - | - | - | - | 1.36 | - | - | - | - | - | 1.36 | - | - | - | - | - | 1.36 | - | - | - | - |
| Water Surface Slope (Channel) (ft/ft) | - | - | - | - | - | 0.0160 | - | - | - | - | - | 0.0189 | - | - | - | - | - | 0.0150 | - | - | - | - | - | 0.0162 | - | - | - | - | - | 0.0162 | - | - | - | - | - | 0.0162 | - | - | - | - | - | 0.0162 | - | - | - | - |
| BF slope (ft/ft) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.011 | - | - | - | - | - | 0.0161 | - | - | - | - | - | 0.0161 | - | - | - | - | - | 0.0161 | - | - | - | - | - | 0.0161 | - | - | - | - |
| Bankfull Floodplain Area (acres) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5.2 | - | - | - | - | - | 5.2 | - | - | - | - | - | 5.2 | - | - | - | - | - | 5.2 | - | - | - | - |
| BEHI VL% / L% / M% / H% / VH% / E% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Channel Stability or Habitat Metric | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Biological or Other | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

1. Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. Wildland Hydrology. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.
2. 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 3 Stream Summary**
**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

**UT2**

| Parameter | USGS Gauge | Regional Curve Interval [1,2] | | | Pre-Existing Condition[1] | | | | | | Reference Reach Data – Morgan Creek | | | | | | Design | | | | | | As-built | | | | | | MY1 | | | | | | MY2 | | | | | | MY3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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 |
| **Dimension and Substrate - Riffle** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | - | 6.0 | 3.1 | - | 3.1 | - | - | 3.4 | - | 2 | 6.3 | - | - | 7.9 | - | - | - | 6.0 | - | - | - | - | - | 6.6 | - | - | - | 1 | - | 5.8 | - | - | - | 1 | - | 4.7 | - | - | - | 1 | - | 5.5 | - | - | - | 1 |
| Floodprone Width (ft) | - | - | - | - | 5.1 | - | - | 6.4 | - | 2 | 15 | - | - | 19 | - | - | 60 | | - | 120.0 | - | - | - | >100 | - | - | - | 1 | - | >100 | - | - | - | 1 | - | >100 | - | - | - | 1 | - | >100 | - | - | - | 1 |
| BF Mean Depth (ft) | - | 0.4 | 0.6 | - | 0.84 | - | - | 0.90 | - | 2 | 0.7 | - | - | 0.9 | - | - | - | 0.5 | - | - | - | - | - | 0.4 | - | - | - | 1 | - | 0.4 | - | - | - | 1 | - | 0.3 | - | - | - | 1 | - | 0.4 | - | - | - | 1 |
| BF Max Depth (ft) | - | - | - | - | 1.1 | - | - | 1.4 | - | 2 | 1.0 | - | - | 1.35 | - | - | - | 0.6 | - | - | - | - | - | 0.9 | - | - | - | 1 | - | 0.8 | - | - | - | 1 | - | 0.6 | - | - | - | 1 | - | 0.7 | - | - | - | 1 |
| BF Cross-sectional Area ($ft^2$) | - | 2.6 | 2.6 | - | 2.8 | - | - | 2.9 | - | 2 | 5.5 | - | - | 6.5 | - | - | - | 3.0 | - | - | - | - | - | 2.7 | - | - | - | 1 | - | 2.2 | - | - | - | 1 | - | 1.5 | - | - | - | 1 | - | 2.0 | - | - | - | 1 |
| Width/Depth Ratio | - | - | - | - | 3.5 | - | - | 4.0 | - | 2 | 7.3 | - | - | 11.7 | - | - | - | 12.0 | - | - | - | - | - | 16.0 | - | - | - | 1 | - | 15.7 | - | - | - | 1 | - | 14.5 | - | - | - | 1 | - | 14.8 | - | - | - | 1 |
| Entrenchment Ratio | - | - | - | - | 1.6 | - | - | 1.9 | - | 2 | 1.9 | - | - | 3.0 | - | - | 10 | - | - | 20 | - | - | - | 7.0 | - | - | - | 1 | - | 7.1 | - | - | - | 1 | - | 8.7 | - | - | - | 1 | - | 12.3 | - | - | - | 1 |
| Bank Height Ratio | - | - | - | - | 2.2 | - | - | 2.4 | - | 2 | - | - | - | - | - | - | - | 1.1 | - | - | - | - | - | 1.2 | - | - | - | 1 | - | 1.0 | - | - | - | 1 | - | 1.2 | - | - | - | 1 | - | 1.30 | - | - | - | 1 |
| d50 (mm) | - | - | - | - | - | 18.00 | - | - | - | - | - | 3.0 | - | - | - | - | - | - | - | - | - | - | - | 29.3 | - | - | - | - | - | 9.5 | - | - | - | 1 | - | 13.6 | - | - | - | 1 | - | - | - | - | - | 1 |
| **Pattern** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Channel Beltwidth (ft) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 22 | - | - | 30 | - | - | 30.4 | 32.6 | 32.2 | 35.3 | 2.02 | 3 | 30.4 | 32.6 | 32.2 | 35.3 | 2.02 | 3 | 30.4 | 32.6 | 32.2 | 35.3 | 2.02 | 3 | 30.4 | 32.6 | 32.2 | 35.3 | 2.02 | 3 |
| Radius of Curvature (ft) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 12 | - | - | 18 | - | - | 14.3 | 15.5 | 14.4 | 17.7 | 1.58 | 3 | 14.3 | 15.5 | 14.4 | 17.7 | 1.58 | 3 | 14.3 | 15.5 | 14.4 | 17.7 | 1.58 | 3 | 14.3 | 15.5 | 14.4 | 17.7 | 1.58 | 3 |
| Rc:Bankfull width (ft/ft) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.0 | - | - | 3.0 | - | - | 2.17 | 2.34 | 2.18 | 2.68 | 0.24 | 3 | 2.17 | 2.34 | 2.18 | 2.68 | 0.24 | 3 | 2.17 | 2.34 | 2.18 | 2.68 | 0.24 | 3 | 2.17 | 2.34 | 2.18 | 2.68 | 0.24 | 3 |
| Meander Wavelength (ft) | - | - | - | - | - | - | - | - | - | - | 45 | - | - | 75 | - | - | 42 | - | - | 72 | - | - | 52.1 | 54.9 | 54.9 | 57.6 | 2.8 | 2 | 52.1 | 54.9 | 54.9 | 57.6 | 2.8 | 2 | 52.1 | 54.9 | 54.9 | 57.6 | 2.8 | 2 | 52.1 | 54.9 | 54.9 | 57.6 | 2.8 | 2 |
| Meander Width Ratio | - | - | - | - | - | - | - | - | - | - | 1.2 | - | - | 1.2 | - | - | 7.0 | - | - | 12.0 | - | - | 7.9 | 8.3 | 8.3 | 8.7 | 0.4 | 2 | 7.9 | 8.3 | 8.3 | 8.7 | 0.4 | 2 | 7.9 | 8.3 | 8.3 | 8.7 | 0.4 | 2 | 7.9 | 8.3 | 8.3 | 8.7 | 0.4 | 2 |
| **Profile** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Riffle Length (ft) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 13.6 | 20.8 | 14.3 | 47.8 | 13.5 | 5 | 8.7 | 14.5 | 15.1 | 17.6 | 2.6 | 9 | 8.5 | 21.0 | 13.2 | 57.3 | 16.3 | 8 | 7.2 | 15.8 | 11.6 | 42.8 | 12.3 | 6 |
| Riffle Slope (ft/ft) | - | - | - | - | 0.014 | - | - | 0.057 | - | - | 0.013 | - | - | 0.054 | - | - | 0.014 | - | - | 0.033 | - | - | 0.0000 | 0.0131 | 0.0147 | 0.0214 | 0.0081 | 5 | 0.0000 | 0.0130 | 0.0129 | 0.0230 | 0.0072 | 9 | 0.0000 | 0.0132 | 0.0152 | 0.0235 | 0.0068 | 8 | 0.0013 | 0.0279 | 0.0120 | 0.1117 | 0.0381 | 6 |
| Pool Length (ft) | - | - | - | - | 5.2 | - | - | 12.7 | - | - | - | - | - | - | - | - | 17.41 | - | - | 26.03 | - | - | 7.5 | 17.3 | 15.6 | 28.8 | 8.0 | 8 | 2.9 | 11.9 | 9.5 | 25.7 | 8.1 | 9 | 4.5 | 11.0 | 11.0 | 20.5 | 5.5 | 8 | 7.2 | 22.5 | 23.0 | 38.7 | 8.5 | 8 |
| Pool Spacing (ft) | - | - | - | - | 9.5 | - | - | 51 | - | - | 39.9 | - | - | 62.3 | - | - | 9 | - | - | 30 | - | - | 14.8 | 28.8 | 25.2 | 47.9 | 11.5 | 8 | 14.8 | 32.9 | 22.8 | 73.4 | 18.9 | 7 | 11.7 | 25.6 | 26.0 | 50.7 | 10.9 | 9 | 7.7 | 34.4 | 29.5 | 72.6 | 18.9 | 9 |
| Pool Max Depth (ft) | - | - | - | - | - | - | - | - | - | - | - | 1.8 | - | - | - | - | - | 1.4 | - | - | - | - | - | 1.7 | - | - | - | 1 | - | 0.8 | - | - | - | 1 | - | 0.8 | - | - | - | 1 | - | 0.6 | - | - | - | 8 |
| Pool Volume ($ft^3$) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Substrate and Transport Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ri% / Ru% / P% / G% / S% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| SC% / Sa% / G% / B% / Be% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| d16 / d35 / d50 / d84 / d95 | - | - | - | - | 5.6 / 13 / 18 / 43 / 60 | | | | | | - | - | - | - | - | - | - | - | - | - | - | - | 0.2 / 16.4 / 29.3 / 85.0 / 139.4 | | | | | | 0.8 / 6.9 / 9.5 / 20.5 / 44.6 | | | | | | 0.3 / 9.5 / 13.6 / 29.2 / 56.0 | | | | | | - / - / - / - / 45 | | | | | |
| Reach Shear Stress (competency) lb/F | - | - | - | - | - | - | - | - | - | - | 0.2 | - | - | 0.6 | - | - | - | 0.3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max part size (mm) mobilized at bankfull (Rosgen Curve) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Stream Power (transport capacity) W/$m^2$ | - | - | - | - | 45 | - | - | 51 | - | - | 6.5 | - | - | 28.5 | - | - | - | 33 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drainage Area (SM) | - | | 0.05 | | - | 0.05 | - | - | - | - | - | 0.12 | - | - | - | - | 0.05 | - | - | 0.05 | - | - | 2.73 | - | - | 3.35 | - | - | 2.73 | - | - | 3.35 | - | - | 2.73 | - | - | 3.35 | - | - | 2.73 | - | - | 3.35 | - | - |
| Impervious cover estimate (%) | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - |
| Rosgen Classification | - | - | - | - | - | G/B[3] | - | - | - | - | - | E/Bc | - | - | - | - | - | Cb, C | - | - | - | - | - | C | - | - | - | - | - | C | - | - | - | - | - | C | - | - | - | - | - | C | - | - | - | - |
| BF Velocity (fps) | - | - | - | - | 3.2 | - | - | 3.9 | - | - | 2.1 | - | 3.4 | - | - | - | - | 3.50 | - | - | - | - | - | 2.98 | - | - | - | - | - | 2.92 | - | - | - | - | - | 2.92 | - | - | - | - | - | 2.92 | - | - | - | - |
| BF Discharge (cfs) | - | - | 9.5 | - | 9 | - | - | 11 | - | - | - | 18 | - | - | - | - | - | 10.0 | - | - | - | - | - | 8.0 | - | - | - | - | - | 6.4 | - | - | - | - | - | 6.4 | - | - | - | - | - | 6.4 | - | - | - | - |
| Valley Length | - | - | - | - | - | 194 | - | - | - | - | - | - | - | - | - | - | - | 248.0 | - | - | - | - | - | 248.0 | - | - | - | - | - | 248.0 | - | - | - | - | - | 248.0 | - | - | - | - | - | 248.0 | - | - | - | - |
| Channel length ($ft^2$) | - | - | - | - | - | 209 | - | - | - | - | - | 134.5 | - | - | - | - | - | 333 | - | - | - | - | - | 310 | - | - | - | - | - | 310 | - | - | - | - | - | 310 | - | - | - | - | - | 310 | - | - | - | - |
| Sinuosity | - | - | - | - | - | 1.08 | - | - | - | - | - | 1.05 | - | - | - | - | - | 1.34 | - | - | - | - | - | 1.2 | - | - | - | - | - | 1.2 | - | - | - | - | - | 1.2 | - | - | - | - | - | 1.2 | - | - | - | - |
| Water Surface Slope (Channel) (ft/ft) | - | - | - | - | 0.01 | - | - | 0.17 | - | - | - | 0.0197 | - | - | - | - | 0.0070 | 0.02 | - | 0.0310 | - | - | 0.0101 | 0.0198 | - | 0.0295 | - | - | - | 0.0241 | - | - | - | - | - | 0.0241 | - | - | - | - | - | 0.0241 | - | - | - | - |
| BF slope (ft/ft) | - | - | - | - | - | 0.024 | - | - | - | - | - | - | - | - | - | - | - | 0.02 | - | - | - | - | 0.0077 | 0.0175 | - | 0.0272 | - | - | - | 0.0203 | - | - | - | - | - | 0.0203 | - | - | - | - | - | 0.0203 | - | - | - | - |
| Bankfull Floodplain Area (acres) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5.2 | - | - | - | - | - | 5.2 | - | - | - | - | - | 5.2 | - | - | - | - | - | 5.2 | - | - | - | - |
| BEHI VL% / L% / M% / H% / VH% / E% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Channel Stability or Habitat Metric | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Biological or Other | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

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2. 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 [1,2] | | | Pre-Existing Condition[1] | | | | | | Reference Reach Data – Morgan Creek | | | | | | Design | | | | | | As-built | | | | | | MY1 | | | | | | MY2 | | | | | | MY3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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 |
| **Dimension and Substrate - Riffle** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | - | 9.8 | 5.5 | - | 3.7 | - | - | 5.3 | - | 2 | 0.1 | - | - | 0.1 | - | - | - | 8.0 | - | - | - | - | 8.1 | 8.8 | 8.2 | 10.1 | 0.91 | 3 | 7.0 | 7.9 | 7.8 | 8.8 | 0.76 | 3 | 7.2 | 8.1 | 7.8 | 9.2 | 0.85 | 3 | 7.3 | 8.1 | 7.6 | 9.3 | 0.87 | 3 |
| Floodprone Width (ft) | - | - | - | - | 7.7 | - | - | 48.0 | - | - | 15.0 | - | - | - | - | - | - | - | - | - | - | - | | >150 | - | - | - | - | - | >150 | - | - | - | - | - | >150 | - | - | - | 3 | - | >150 | - | - | - | 3 |
| BF Mean Depth (ft) | - | 0.6 | 0.8 | - | 1.05 | - | - | 1.57 | - | - | 0.70 | - | - | 0.90 | - | - | - | 0.8 | - | - | - | - | 0.7 | 0.8 | 0.8 | 0.9 | 0.10 | 3 | 0.6 | 0.7 | 0.7 | 0.7 | 0.05 | 3 | 0.5 | 0.7 | 0.7 | 0.7 | 0.11 | 3 | 0.5 | 0.6 | 0.6 | 0.7 | 0.09 | 3 |
| BF Max Depth (ft) | - | - | - | - | 1.7 | - | - | 2.0 | - | - | 1.0 | - | - | 1.4 | - | - | 1.0 | - | - | 1.1 | - | - | 1.1 | 1.2 | 1.1 | 1.4 | 0.13 | 3 | 0.9 | 1.0 | 1.1 | 1.1 | 0.06 | 3 | 1.1 | 1.1 | 1.1 | 1.1 | 0.03 | 3 | 0.9 | 1.0 | 1.1 | 1.1 | 0.11 | 3 |
| BF Cross-sectional Area ($ft^2$) | - | 6.4 | 6.3 | - | 5.56 | - | - | 5.93 | - | - | 5.5 | - | - | 6.5 | - | - | - | 6.0 | - | - | - | - | 6.3 | 6.7 | 6.5 | 7.3 | 0.43 | 3 | 4.8 | 5.3 | 5.3 | 5.8 | 0.41 | 3 | 4.7 | 5.3 | 5.3 | 5.8 | 0.45 | 3 | 4.4 | 4.8 | 4.6 | 5.3 | 0.37 | 3 |
| Width/Depth Ratio | - | - | - | - | 2.4 | - | - | 5 | - | - | 7.3 | - | - | 11.7 | - | - | - | 8.9 | - | - | - | - | 9.1 | 11.6 | 10.3 | 15.5 | 2.75 | 3 | 10.2 | 11.8 | 10.6 | 14.5 | 1.97 | 3 | 9.7 | 12.8 | 10.6 | 18.05 | 3.75 | 3 | 10.13 | 13.9 | 13.1 | 18.56 | 3.49 | 3 |
| Entrenchment Ratio | - | - | - | - | 2.1 | - | - | 9.1 | - | - | 1.9 | - | - | 3 | - | - | - | - | - | - | - | - | 5.4 | 7.8 | 8.5 | 9.4 | 1.71 | 3 | 6.1 | 7.7 | 7.0 | 9.9 | 1.62 | 3 | 5.9 | 7.5 | 7.0 | 9.6 | 1.55134 | 3 | 5.83 | 7.4 | 6.9 | 9.42 | 1.50076 | 3 |
| Bank Height Ratio | - | - | - | - | 1.0 | - | - | 2.4 | - | - | - | - | - | - | - | - | 1.0 | - | - | 1.0 | - | - | 1.00 | 1.10 | 1.10 | 1.20 | 0.08 | 3 | 1.10 | 1.20 | 1.20 | 1.30 | 0.08 | 3 | 1.00 | 1.13 | 1.10 | 1.30 | 0.12 | 3 | 1.06 | 1.14 | 1.17 | 1.18 | 0.05 | 3 |
| d50 (mm) | - | - | - | - | - | 16.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 31.2 | - | - | - | - | - | 20.4 | - | - | - | - | - | 16.4 | - | - | - | - | - | 0.3 | - | - | - | - |
| **Pattern** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Channel Beltwidth (ft) | - | - | - | - | 44 | - | - | 94 | - | - | - | - | - | - | - | - | 25 | - | - | 56 | - | - | 36.4 | 47.0 | 48.4 | 57.7 | 7.21 | 7 | 36.4 | 47.0 | 48.4 | 57.7 | 7.21 | 7 | 36.4 | 47.0 | 48.4 | 57.7 | 7.21 | 7 | 36.4 | 47.0 | 48.4 | 57.7 | 7.21 | 7 |
| Radius of Curvature (ft) | - | - | - | - | 11 | - | - | 30 | - | - | - | - | - | - | - | - | 13 | - | - | 21 | - | - | 14.0 | 18.8 | 19.4 | 25.1 | 3.72 | 7 | 14.0 | 18.8 | 19.4 | 25.1 | 3.72 | 7 | 14.0 | 18.8 | 19.4 | 25.1 | 3.72 | 7 | 14.0 | 18.8 | 19.4 | 25.1 | 3.72 | 7 |
| Rc:Bankfull width (ft/ft) | - | - | - | - | 2.5 | - | - | 6.7 | - | - | - | - | - | - | - | - | 1.8 | - | - | 3 | - | - | 1.6 | 2.1 | 2.2 | 2.9 | 0.42 | 7 | 1.6 | 2.1 | 2.2 | 2.9 | 0.42 | 7 | 1.6 | 2.1 | 2.2 | 2.9 | 0.42 | 7 | 1.6 | 2.1 | 2.2 | 2.9 | 0.42 | 7 |
| Meander Wavelength (ft) | - | - | - | - | 49 | - | - | 72 | - | - | 45 | - | - | 75 | - | - | 49 | - | - | 84 | - | - | 63.5 | 74.9 | 71.7 | 94.2 | 10.30 | 7 | 63.5 | 74.9 | 71.7 | 94.2 | 10.30 | 7 | 63.5 | 74.9 | 71.7 | 94.2 | 10.30 | 7 | 63.5 | 74.9 | 71.7 | 94.2 | 10.30 | 7 |
| Meander Width Ratio | - | - | - | - | 10.9 | - | - | 12.8 | - | - | 6.4 | - | - | 10.5 | - | - | 7 | - | - | 12 | - | - | 7.2 | 8.5 | 8.1 | 10.7 | 1.17 | 7 | 7.2 | 8.5 | 8.1 | 10.7 | 1.17 | 7 | 7.2 | 8.5 | 8.1 | 10.7 | 1.17 | 7 | 7.2 | 8.5 | 8.1 | 10.7 | 1.17 | 7 |
| **Profile** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Riffle Length (ft) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 13.1 | 21.1 | 20.6 | 28.2 | 4.50 | 11 | 10.8 | 24.3 | 21.0 | 65.2 | 12.20 | 15 | 11.4 | 27.2 | 26.7 | 64.5 | 11.8 | 18 | 10.3 | 25.9 | 21.6 | 58.5 | 11.6 | 17 |
| Riffle Slope (ft/ft) | - | - | - | - | 0.0052 | - | - | 0.0305 | - | - | 0.0130 | - | - | 0.054 | - | - | 0.0160 | - | - | 0.022 | - | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 11 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 15 | 0.0069 | 0.0212 | 0.0170 | 0.0702 | 0.0145 | 18 | 0.0000 | 0.0158 | 0.0133 | 0.0505 | 0.0135 | 17 |
| Pool Length (ft) | - | - | - | - | 25 | - | - | 65 | - | - | 17.4 | - | - | 26 | - | - | 20 | - | - | 40 | - | - | 18.4 | 26.4 | 25.8 | 33.5 | 5.00 | 11 | 15.0 | 25.6 | 26.1 | 39.9 | 7.30 | 17 | 13.5 | 22.8 | 23.5 | 34.4 | 6.2 | 17 | 7.6 | 28.5 | 28.8 | 60.5 | 13.9 | 17 |
| Pool Spacing (ft) | - | - | - | - | 40 | - | - | 140 | - | - | 39.9 | - | - | 62.3 | - | - | 18 | - | - | 42 | - | - | 36.3 | 49.0 | 47.7 | 60.7 | 7.30 | 15 | 32.7 | 52.2 | 48.6 | 94.5 | 13.60 | 17 | 22.6 | 50.0 | 48.5 | 94.5 | 15.0 | 17 | 33.6 | 50.3 | 48.1 | 86.2 | 13.2 | 17 |
| Pool Max Depth (ft) | - | - | - | - | 1.8 | - | - | 1.8 | - | - | 1.8 | - | - | 1.8 | - | - | 1.6 | - | - | 2.8 | - | - | 1.7 | 2.0 | 2.0 | 2.2 | 0.21 | 2 | 1.6 | 1.7 | 1.7 | 1.9 | 0.15 | 2.0 | 1.2 | 1.4 | 1.4 | 1.7 | 0.3 | 2 | 0.3 | 0.9 | 0.8 | 1.6 | 0.4 | 17 |
| Pool Volume ($ft^3$) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Substrate and Transport Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ri% / Ru% / P% / G% / S% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| SC% / Sa% / G% / B% / Be% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| d16 / d35 / d50 / d84 / d95 | - | - | - | - | 1.0 / 8.4 / 17 / 43 / 57 | | | | | | - / 1.2 / 3.0 / 77 / 800 | | | | | | - | | | | | | 12.2 / 17.6 / 31.2 / 57.0 / 78.3 | | | | | | 0.3 / 12.2 / 20.4 / 60.5 / 86.7 | | | | | | 0.4 / 11.5 / 16.4 / 61.1 / 84.2 | | | | | | 0.14 / .25 / .34 / 45.52 / 73.35 | | | | | |
| Reach Shear Stress (competency) lb/F | - | - | - | - | 0.55 | - | - | 0.8 | - | - | - | - | - | - | - | - | - | 0.6 | - | - | - | - | 0.2 | - | - | 0.6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max part size (mm) mobilized at bankfull (Rosgen Curve) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Stream Power (transport capacity) W/$m^2$ | - | - | - | - | 25 | - | - | 45 | - | - | 6.5 | - | - | 28.5 | - | - | - | 37 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Drainage Area (SM) | - | | 0.17 | | 0.14 | - | - | 0.17 | - | - | - | 0.1 | - | - | - | - | 0.14 | - | - | 0.17 | - | - | 0.14 | - | - | 0.17 | - | - | 0.14 | - | - | 0.17 | - | - | 0.14 | - | - | 0.17 | - | - | 0.14 | - | - | 0.17 | - | - |
| Impervious cover estimate (%) | - | - | - | - | - | <5% | - | - | - | - | - | - | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - | - | <5% | - | - | - | - |
| Rosgen Classification | - | - | - | - | - | E | - | - | - | - | - | E/Bc | - | - | - | - | - | E | - | - | - | - | - | E | - | - | - | - | - | E | - | - | - | - | - | E | - | - | - | - | - | E | - | - | - | - |
| BF Velocity (fps) | - | 26.0 | 24.0 | - | 3.9 | - | - | 4.9 | - | - | 2.1 | - | 3.4 | - | - | - | - | 3.3 | - | - | - | - | - | 3.43 | - | - | - | - | - | 3.17 | - | - | - | - | - | 3.17 | - | - | - | - | - | 3.17 | - | - | - | - |
| BF Discharge (cfs) | - | - | - | - | 20 | - | - | 25 | - | - | - | 15 | - | - | - | - | - | 21.7 | - | - | - | - | - | 23 | - | - | - | - | - | 16.8 | - | - | - | - | - | 16.8 | - | - | - | - | - | 16.8 | - | - | - | - |
| Valley Length | - | - | - | - | - | 1002 | - | - | - | - | - | - | - | - | - | - | - | 1015 | - | - | - | - | - | 1015 | - | - | - | - | - | 1015 | - | - | - | - | - | 1015 | - | - | - | - | - | 1015 | - | - | - | - |
| Channel length ($ft^2$) | - | - | - | - | - | 1210 | - | - | - | - | - | 135 | - | - | - | - | - | 1332 | - | - | - | - | - | 1348 | - | - | - | - | - | 1348 | - | - | - | - | - | 1348 | - | - | - | - | - | 1348 | - | - | - | - |
| Sinuosity | - | - | - | - | - | 1.21 | - | - | - | - | - | 1.05 | - | - | - | - | - | 1.31 | - | - | - | - | - | 1.33 | - | - | - | - | - | 1.33 | - | - | - | - | - | 1.33 | - | - | - | - | - | 1.33 | - | - | - | - |
| Water Surface Slope (Channel) (ft/ft) | - | - | - | - | - | 0.0150 | - | - | - | - | - | 0.0197 | - | - | - | - | - | 0.0130 | - | - | - | - | - | 0.0128 | - | - | - | - | - | 0.0128 | - | - | - | - | - | 0.0128 | - | - | - | - | - | 0.0128 | - | - | - | - |
| BF slope (ft/ft) | - | - | - | - | - | 0.012 | - | - | - | - | - | - | - | - | - | - | - | 0.013 | - | - | - | - | - | 0.013 | - | - | - | - | - | 0.013 | - | - | - | - | - | 0.013 | - | - | - | - | - | 0.013 | - | - | - | - |
| Bankfull Floodplain Area (acres) | - | - | - | - | - | 0.2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| BEHI VL% / L% / M% / H% / VH% / E% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Channel Stability or Habitat Metric | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Biological or Other | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

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2. 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**
**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

| **Silver Creek (3,016 LF)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cross-section X-1, Station 2724.3 (Riffle) | | | | | | | Cross-section X-2, Station 2636.7 (Pool) | | | | | | | Cross-section X-3, Station 1898.2 (Pool) | | | | | | | Cross-section X-4, Station 1793.8 (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) | 29.1 | 24.6 | 24.9 | 24.9 | | | | 35.7 | 29.5 | 34.0 | 34.5 | | | | 43.5 | 39.5 | 42.0 | 39.8 | | | | 23.8 | 23.5 | 23.5 | 24.0 | | | |
| BF Mean Depth (ft) | 1.7 | 1.8 | 1.8 | 1.7 | | | | 1.6 | 1.8 | 1.5 | 1.5 | | | | 1.7 | 1.5 | 1.2 | 1.2 | | | | 2.0 | 1.9 | 1.8 | 1.8 | | | |
| Width/Depth Ratio | 17.2 | 13.9 | 13.8 | 14.8 | | | | 21.8 | 16.8 | 23.3 | 22.9 | | | | 25.2 | 27.3 | 35.2 | 34.1 | | | | 11.8 | 12.4 | 13.5 | 13.7 | | | |
| BF Cross-sectional Area (ft²) | 49.2 | 43.4 | 45.0 | 41.9 | | | | 58.3 | 51.9 | 49.6 | 52.0 | | | | 74.9 | 57.3 | 50.2 | 46.8 | | | | 48.0 | 44.2 | 41.1 | 41.9 | | | |
| BF Max Depth (ft) | 3.0 | 2.9 | 3.2 | 3.1 | | | | 4.0 | 3.9 | 4.3 | 4.5 | | | | 5.2 | 4.0 | 4.0 | 3.8 | | | | 3.3 | 3.2 | 3.1 | 3.1 | | | |
| Width of Floodprone Area (ft) | >300 | >300 | >300 | >300 | | | | >300 | >300 | >300 | >300 | | | | >300 | >300 | >300 | >300 | | | | >300 | >300 | >300 | >300 | | | |
| Entrenchment Ratio | 3.3 | 3.9 | 3.8 | 3.9 | | | | 2.5 | 3.0 | 2.6 | 2.6 | | | | 2.1 | 2.3 | 2.2 | 2.3 | | | | 3.7 | 3.7 | 3.7 | 3.6 | | | |
| Bank Height Ratio | 1.10 | 1.00 | 1.10 | 1.06 | | | | 1.00 | 1.00 | 1.00 | 1.00 | | | | 0.70 | 0.70 | 0.90 | 1.07 | | | | 1.00 | 1.00 | 1.00 | 1.02 | | | |
| Wetted Perimeter (ft) | 32.4 | 28.1 | 28.5 | 28.3 | | | | 38.9 | 33.0 | 36.9 | 37.6 | | | | 46.9 | 42.4 | 44.4 | 42.2 | | | | 27.8 | 27.3 | 27.0 | 27.5 | | | |
| Hydraulic Radius (ft) | 1.5 | 1.5 | 1.6 | 1.5 | | | | 1.5 | 1.6 | 1.3 | 1.4 | | | | 1.6 | 1.4 | 1.1 | 1.1 | | | | 1.7 | 1.6 | 1.5 | 1.5 | | | |
| Fixed baseline bankfull elevation | 1197.4 | 1197.4 | 1197.4 | 1197.4 | | | | 1198.2 | 1198.2 | 1198.2 | 1198.2 | | | | 1202.3 | 1202.3 | 1202.3 | 1202.3 | | | | 1203.0 | 1203.0 | 1203.0 | 1203.0 | | | |
| **Based on current/developing bankfull feature** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | 29.1 | 26.2 | 26.2 | - | | | | 35.7 | 29.5 | 35.3 | - | | | | 43.5 | 42.6 | 42.0 | - | | | | 23.8 | 23.5 | 23.5 | - | | | |
| BF Mean Depth (ft) | 1.7 | 1.7 | 1.8 | - | | | | 1.6 | 1.8 | 1.5 | - | | | | 1.7 | 1.5 | 1.2 | - | | | | 2.0 | 1.9 | 1.8 | - | | | |
| Width/Depth Ratio | 17.2 | 15.2 | 14.4 | - | | | | 21.8 | 16.8 | 23.5 | - | | | | 25.2 | 29.3 | 35.2 | - | | | | 11.8 | 12.4 | 13.5 | - | | | |
| BF Cross-sectional Area (ft²) | 49.2 | 45.1 | 47.6 | - | | | | 58.3 | 51.9 | 53.1 | - | | | | 74.9 | 61.8 | 50.2 | - | | | | 48.0 | 44.2 | 41.1 | - | | | |
| BF Max Depth (ft) | 3.0 | 3.0 | 3.3 | - | | | | 4.0 | 3.9 | 4.4 | - | | | | 5.2 | 4.2 | 4.0 | - | | | | 3.3 | 3.2 | 3.1 | - | | | |
| Width of Floodprone Area (ft) | >300 | >300 | >300 | - | | | | >300 | >300 | >300 | - | | | | >300 | >300 | >300 | - | | | | >300 | 87.3 | >300 | - | | | |
| Entrenchment Ratio | 3.3 | 3.7 | >3.7 | - | | | | 2.5 | 3.0 | >2.5 | - | | | | 2.1 | 2.1 | 2.2 | - | | | | 3.7 | 3.7 | 3.7 | - | | | |
| Bank Height Ratio | 1.10 | 1.00 | 1.00 | - | | | | 1.00 | 1.00 | 1.00 | - | | | | 0.70 | 0.70 | 0.90 | - | | | | 1.00 | 1.00 | 1.00 | - | | | |
| Wetted Perimeter (ft) | 32.4 | 29.7 | 29.8 | - | | | | 38.9 | 33.0 | 38.3 | - | | | | 46.9 | 45.5 | 44.4 | - | | | | 27.8 | 27.3 | 27.0 | - | | | |
| Hydraulic Radius (ft) | 1.5 | 1.5 | 1.6 | - | | | | 1.5 | 1.6 | 1.4 | - | | | | 1.6 | 1.4 | 1.1 | - | | | | 1.7 | 1.6 | 1.5 | - | | | |
| Cross Sectional Area between end pins (ft²) | - | - | - | - | | | | - | - | - | - | | | | - | - | - | - | | | | - | - | - | - | | | |
| d50 (mm) | - | - | - | - | | | | - | - | - | - | | | | - | - | - | - | | | | 36.6 | 41.3 | 25.1 | - | | | |
| * Corrected from baseline report. | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Cross-section X-5, Station 1206.9 (Riffle) | | | | | | | Cross-section X-6, Station 357.2 (Pool) | | | | | | | Cross-section 7, Station 302.5 (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) | 28.4 | 26.1 | 25.2 | 25.0 | | | | 43.5 | 41.9 | 34.6 | 36.0 | | | | 26.6 | 25.9 | 25.8 | 25.8 | | | | | | | | | | |
| BF Mean Depth (ft) | 1.7 | 1.7 | 1.7 | 1.7 | | | | 1.8 | 1.8 | 1.7 | 1.6 | | | | 2.1 | 2.0 | 1.8 | 1.8 | | | | | | | | | | |
| Width/Depth Ratio | 17.3 | 15.7 | 15.0 | 15.1 | | | | 23.6 | 23.9 | 20.5 | 22.6 | | | | 13.0 | 13.3 | 14.0 | 14.3 | | | | | | | | | | |
| BF Cross-sectional Area (ft²) | 46.9 | 43.4 | 42.3 | 41.6 | | | | 80.1 | 73.5 | 58.3 | 57.2 | | | | 54.5 | 50.6 | 47.6 | 46.2 | | | | | | | | | | |
| BF Max Depth (ft) | 2.9 | 2.8 | 2.8 | 2.8 | | | | 5.3 | 5.0 | 3.8 | 4.6 | | | | 3.3 | 3.2 | 3.0 | 3.2 | | | | | | | | | | |
| Width of Floodprone Area (ft) | >300 | >300 | >300 | >300 | | | | >300 | >300 | >300 | >300 | | | | >300 | >300 | >300 | >300 | | | | | | | | | | |
| Entrenchment Ratio | 3.1 | 3.3 | 3.5 | 3.5 | | | | 1.6 | 1.6 | 2.0 | 1.9 | | | | 4.8 | 4.9 | 4.9 | 4.9 | | | | | | | | | | |
| Bank Height Ratio | 1.00 | 1.00 | 1.00 | 1.01 | | | | 1.00 | 0.90 | 1.00 | 1.01 | | | | 1.00 | 1.00 | 1.00 | 1.04 | | | | | | | | | | |
| Wetted Perimeter (ft) | 31.7 | 29.4 | 28.6 | 28.3 | | | | 47.2 | 45.4 | 38.0 | 39.1 | | | | 30.7 | 29.8 | 29.5 | 29.4 | | | | | | | | | | |
| Hydraulic Radius (ft) | 1.5 | 1.5 | 1.5 | 1.5 | | | | 1.7 | 1.7 | 1.5 | 1.5 | | | | 1.8 | 1.7 | 1.6 | 1.6 | | | | | | | | | | |
| Fixed baseline bankfull elevation | 1208.8 | 1208.8 | 1208.8 | 1208.8 | | | | 1208.1 | 1208.1 | 1208.1 | 1208.1 | | | | 1208.2 | 1208.2 | 1208.2 | 1208.2 | | | | | | | | | | |
| **Based on current/developing bankfull feature** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | 28.4 | 26.1 | 25.8 | - | | | | 43.5 | 41.9 | 34.6 | - | | | | 26.6 | 25.9 | 26.8 | - | | | | | | | | | | |
| BF Mean Depth (ft) | 1.7 | 1.7 | 1.7 | - | | | | 1.8 | 1.8 | 1.7 | - | | | | 2.1 | 2.0 | 1.8 | - | | | | | | | | | | |
| Width/Depth Ratio | 17.3 | 15.7 | 15.3 | - | | | | 23.6 | 23.9 | 20.5 | - | | | | 13.0 | 13.3 | 14.1 | - | | | | | | | | | | |
| BF Cross-sectional Area (ft²) | 46.9 | 43.4 | 43.3 | - | | | | 80.1 | 73.5 | 58.3 | - | | | | 54.5 | 50.6 | 51.0 | - | | | | | | | | | | |
| BF Max Depth (ft) | 2.9 | 2.8 | 2.8 | - | | | | 5.3 | 5.0 | 3.8 | - | | | | 3.3 | 3.2 | 3.1 | - | | | | | | | | | | |
| Width of Floodprone Area (ft) | >300 | >300 | >300 | - | | | | >300 | >300 | >300 | - | | | | >300 | >300 | >300 | - | | | | | | | | | | |
| Entrenchment Ratio | 3.1 | 3.3 | >3.4 | - | | | | 1.6 | 1.6 | 2.0 | - | | | | 4.8 | 4.9 | >4.7 | - | | | | | | | | | | |
| Bank Height Ratio | 1.00 | 1.00 | 1.00 | - | | | | 1.00 | 0.90 | 1.00 | - | | | | 1.00 | 1.00 | 1.00 | - | | | | | | | | | | |
| Wetted Perimeter (ft) | 31.7 | 29.4 | 29.1 | - | | | | 47.2 | 45.4 | 38.0 | - | | | | 30.7 | 29.8 | 30.5 | - | | | | | | | | | | |
| Hydraulic Radius (ft)* | 1.5 | 1.5 | 1.5 | - | | | | 1.7 | 1.7 | 1.5 | - | | | | 1.8 | 1.7 | 1.7 | - | | | | | | | | | | |
| Cross Sectional Area between end pins (ft²) | - | - | - | - | | | | - | - | - | - | | | | - | - | - | - | | | | | | | | | | |
| d50 (mm) | - | - | - | - | | | | - | - | - | - | | | | 33.4 | 15.2 | 16.0 | - | | | | | | | | | | |

**Table 11. Morphology and Hydraulic Monitoring Summary**
**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

| UT1 (495 LF) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cross-section X-13, Station 1+57 (Riffle) | | | | | | | Cross-section X-14, Station 3+28 (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) | 9.6 | 9.3 | 9.2 | 9.0 | | | | 9.3 | 8.6 | 6.6 | 6.4 | | | | | | | | | | | | | | | | |
| BF Mean Depth (ft) | 0.9 | 0.8 | 0.8 | 0.8 | | | | 2.0 | 1.3 | 1.4 | 1.1 | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 10.3 | 12.3 | 12.2 | 11.7 | | | | 4.7 | 6.8 | 4.8 | 5.9 | | | | | | | | | | | | | | | | |
| BF Cross-sectional Area (ft²) | 8.9 | 7.0 | 7.0 | 7.0 | | | | 18.5 | 10.9 | 9.0 | 7.0 | | | | | | | | | | | | | | | | |
| BF Max Depth (ft) | 1.3 | 1.1 | 1.1 | 1.1 | | | | 3.7 | 2.5 | 2.6 | 1.8 | | | | | | | | | | | | | | | | |
| Width of Floodprone Area (ft) | >150 | >150 | >150 | >150 | | | | >150 | >150 | >150 | >150 | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 5.3 | 5.4 | 5.5 | 5.6 | | | | 8.7 | 9.4 | 12.3 | 12.6 | | | | | | | | | | | | | | | | |
| Bank Height Ratio | 1.00 | 1.10 | 1.10 | 1.10 | | | | 1.10 | 1.20 | 1.20 | 1.34 | | | | | | | | | | | | | | | | |
| Wetted Perimeter (ft) | 11.5 | 10.8 | 10.7 | 10.6 | | | | 13.3 | 11.1 | 9.3 | 8.6 | | | | | | | | | | | | | | | | |
| Hydraulic Radius (ft) | 0.8 | 0.6 | 0.7 | 0.7 | | | | 1.4 | 1.0 | 1.0 | 0.8 | | | | | | | | | | | | | | | | |
| Fixed baseline bankfull elevation | 1204.0 | 1204.0 | 1204.0 | 1204.0 | | | | 1201.6 | 1201.6 | 1201.6 | 1201.6 | | | | | | | | | | | | | | | | |
| **Based on current/developing bankfull feature** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | 9.6 | 9.8 | 10.0 | - | | | | 9.3 | 11.0 | 8.3 | - | | | | | | | | | | | | | | | | |
| BF Mean Depth (ft) | 0.9 | 0.8 | 0.82 | - | | | | 2.0 | 1.4 | 1.6 | - | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 10.3 | 12.0 | 12.1 | - | | | | 4.7 | 8.0 | 5.3 | - | | | | | | | | | | | | | | | | |
| BF Cross-sectional Area (ft²) | 8.9 | 7.9 | 8.2 | - | | | | 18.5 | 15.0 | 13.1 | - | | | | | | | | | | | | | | | | |
| BF Max Depth (ft) | 1.3 | 1.2 | 1.2 | - | | | | 3.7 | 2.9 | 3.2 | - | | | | | | | | | | | | | | | | |
| Width of Floodprone Area (ft) | >150 | >150 | >150 | - | | | | >150 | >150 | >150 | - | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 5.3 | 5.2 | 5.1 | - | | | | 8.7 | 7.4 | 9.7 | - | | | | | | | | | | | | | | | | |
| Bank Height Ratio | 1.00 | 1.00 | 1.00 | - | | | | 1.10 | 1.00 | 1.00 | - | | | | | | | | | | | | | | | | |
| Wetted Perimeter (ft) | 11.5 | 11.4 | 11.6 | - | | | | 13.3 | 13.7 | 11.5 | - | | | | | | | | | | | | | | | | |
| Hydraulic Radius (ft) | 0.8 | 0.7 | 0.7 | - | | | | 1.4 | 1.1 | 1.1 | - | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cross Sectional Area between end pins (ft²) | - | - | - | - | | | | - | - | - | - | | | | | | | | | | | | | | | | |
| d50 (mm) | 38.8 | 43.6 | 32.9 | - | | | | - | - | - | - | | | | | | | | | | | | | | | | |

| UT2 (310 LF) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cross-section X-15, Station 2+15 (Pool) | | | | | | | Cross-section X-16, Station 2+53 (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) | 7.3 | 6.4 | 5.6 | 5.5 | | | | 6.6 | 5.8 | 4.7 | 5.1 | | | | | | | | | | | | | | | | |
| BF Mean Depth (ft) | 0.8 | 0.5 | 0.5 | 0.4 | | | | 0.4 | 0.4 | 0.3 | 0.3 | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 8.9 | 13.9 | 12.3 | 14.8 | | | | 16.0 | 15.7 | 14.5 | 18.9 | | | | | | | | | | | | | | | | |
| BF Cross-sectional Area (ft²) | 6.1 | 3.0 | 2.5 | 2.0 | | | | 2.7 | 2.2 | 1.5 | 1.4 | | | | | | | | | | | | | | | | |
| BF Max Depth (ft) | 1.7 | 0.8 | 0.7 | 0.7 | | | | 0.9 | 0.8 | 0.6 | 0.7 | | | | | | | | | | | | | | | | |
| Width of Floodprone Area (ft) | >100 | >100 | >100 | >100 | | | | >100 | >100 | >100 | >100 | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 9.2 | 10.5 | 12.1 | 12.3 | | | | 7.0 | 7.1 | 8.7 | 8.0 | | | | | | | | | | | | | | | | |
| Bank Height Ratio | 1.10 | 1.20 | 1.40 | 1.30 | | | | 1.20 | 1.00 | 1.20 | 1.23 | | | | | | | | | | | | | | | | |
| Wetted Perimeter (ft) | 9.0 | 7.3 | 6.5 | 6.2 | | | | 7.4 | 6.6 | 5.3 | 5.7 | | | | | | | | | | | | | | | | |
| Hydraulic Radius (ft) | 0.7 | 0.4 | 0.4 | 0.3 | | | | 0.4 | 0.3 | 0.3 | 0.2 | | | | | | | | | | | | | | | | |
| Fixed baseline bankfull elevation | 1201.9 | 1201.9 | 1201.9 | 1201.9 | | | | 1201.2 | 1201.2 | 1201.2 | 1201.2 | | | | | | | | | | | | | | | | |
| **Based on current/developing bankfull feature** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | 7.3 | 8.4 | 6.4 | - | | | | 6.6 | 5.8 | 5.5 | - | | | | | | | | | | | | | | | | |
| BF Mean Depth (ft) | 0.8 | 0.5 | 0.5 | - | | | | 0.4 | 0.4 | 0.4 | - | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 8.9 | 13.9 | 12.3 | - | | | | 16.0 | 15.7 | 14.5 | - | | | | | | | | | | | | | | | | |
| BF Cross-sectional Area (ft²) | 6.1 | 4 | 3.3 | - | | | | 2.7 | 2.2 | 2.1 | - | | | | | | | | | | | | | | | | |
| BF Max Depth (ft) | 1.7 | 1.0 | 0.8 | - | | | | 0.9 | 0.8 | 0.7 | - | | | | | | | | | | | | | | | | |
| Width of Floodprone Area (ft) | >100 | >100 | >100 | - | | | | >100 | >100 | >100 | - | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 9.2 | 8.1 | 10.5 | - | | | | 7.0 | 7.1 | 8.1 | - | | | | | | | | | | | | | | | | |
| Bank Height Ratio | 1.10 | 1.10 | 1.10 | - | | | | 1.20 | 1.00 | 1.10 | - | | | | | | | | | | | | | | | | |
| Wetted Perimeter (ft) | 9.0 | 9.3 | 7.5 | - | | | | 7.4 | 6.6 | 6.2 | - | | | | | | | | | | | | | | | | |
| Hydraulic Radius (ft) | 0.7 | 0.4 | 0.4 | - | | | | 0.4 | 0.3 | 0.3 | - | | | | | | | | | | | | | | | | |
| Cross Sectional Area between end pins (ft²) | - | - | - | - | | | | - | - | - | - | | | | - | | | | | | | - | | | | | | |
| d50 (mm) | - | - | - | - | | | | 29.3 | 9.5 | 13.6 | - | | | | - | | | | | | | - | | | | | | |

**Table 11. Morphology and Hydraulic Monitoring Summary**
**Upper Silver Creek Restoration Project: DMS Project ID No. 94645**

| UT3 (1,348 LF) | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cross-section X-8, Station 6+22 (Riffle) | | | | | | | Cross-section X-9, Station 8+12 (Pool) | | | | | | | Cross-section X-10, Station 8+33 (Riffle) | | | | | | | Cross-section X-11, Station 11+53 (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) | 10.1 | 8.8 | 9.2 | 9.3 | | | | 10.7 | 9.5 | 9.4 | 10.6 | | | | 8.1 | 7.0 | 7.2 | 7.3 | | | | 13.0 | 11.5 | 11.4 | 11.4 | | | |
| BF Mean Depth (ft) | 0.65 | 0.61 | 0.5 | 0.5 | | | | 1.0 | 0.8 | 0.5 | 0.5 | | | | 0.8 | 0.7 | 0.7 | 0.7 | | | | 1.0 | 0.9 | 0.6 | 0.6 | | | |
| Width/Depth Ratio | 15.5 | 14.5 | 18.1 | 18.6 | | | | 10.5 | 11.6 | 20.4 | 21.1 | | | | 10.3 | 10.2 | 9.7 | 10.1 | | | | 12.8 | 13.7 | 18.7 | 18.0 | | | |
| BF Cross-sectional Area ($ft^2$) | 6.5 | 5.3 | 4.7 | 4.6 | | | | 10.9 | 7.8 | 4.3 | 5.3 | | | | 6.3 | 4.8 | 5.3 | 5.3 | | | | 13.2 | 9.7 | 6.9 | 7.1 | | | |
| BF Max Depth (ft) | 1.1 | 1.1 | 1.1 | 1.1 | | | | 1.7 | 1.6 | 1.2 | 1.5 | | | | 1.1 | 0.9 | 1.1 | 1.1 | | | | 2.2 | 1.9 | 1.7 | 1.7 | | | |
| Width of Floodprone Area (ft) | >150 | >150 | >150 | >150 | | | | >150 | >150 | >150 | >150 | | | | >150 | >150 | >150 | >150 | | | | >150 | >150 | >150 | >150 | | | |
| Entrenchment Ratio | 5.4 | 6.1 | 5.9 | 5.8 | | | | 5.8 | 6.6 | 6.7 | 5.9 | | | | 8.5 | 9.9 | 9.6 | 9.4 | | | | 5.6 | 6.3 | 6.4 | 6.4 | | | |
| Bank Height Ratio | 1.00 | 1.10 | 1.00 | 1.18 | | | | 1.00 | 1.20 | 1.20 | 1.24 | | | | 1.10 | 1.20 | 1.10 | 1.06 | | | | 1.00 | 1.10 | 1.10 | 1.10 | | | |
| Wetted Perimeter (ft) | 11.4 | 10.0 | 10.2 | 10.3 | | | | 12.8 | 11.1 | 10.3 | 11.6 | | | | 9.6 | 8.3 | 8.7 | 8.7 | | | | 15.1 | 13.2 | 12.6 | 12.6 | | | |
| Hydraulic Radius (ft) | 0.6 | 0.5 | 0.5 | 0.4 | | | | 0.9 | 0.7 | 0.4 | 0.5 | | | | 0.7 | 0.6 | 0.6 | 0.6 | | | | 0.9 | 0.7 | 0.5 | 0.6 | | | |
| Fixed baseline bankfull elevation | 1215.4 | 1215.4 | 1215.4 | 1215.4 | | | | 1212.8 | 1212.8 | 1212.8 | 1212.8 | | | | 1212.9 | 1212.9 | 1212.9 | 1212.9 | | | | 1209.3 | 1209.3 | 1209.3 | 1209.3 | | | |
| **Based on current/developing bankfull feature** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | 10.1 | 11.7 | 12.2 | - | | | | 10.7 | 12.1 | 12.1 | - | | | | 8.1 | 7.5 | 8.0 | - | | | | 13 | 13.0 | 12.3 | - | | | |
| BF Mean Depth (ft) | 0.7 | 0.5 | 0.5 | - | | | | 1.0 | 0.9 | 0.6 | - | | | | 0.8 | 0.8 | 0.8 | - | | | | 1.0 | 0.9 | 0.7 | - | | | |
| Width/Depth Ratio | 15.5 | 22.0 | 24.5 | - | | | | 10.5 | 13.8 | 19.8 | - | | | | 10.3 | 9.8 | 9.9 | - | | | | 12.8 | 14.2 | 18.4 | - | | | |
| BF Cross-sectional Area ($ft^2$) | 6.5 | 6.2 | 6.1 | - | | | | 10.9 | 10.6 | 7.4 | - | | | | 6.3 | 5.7 | 6.4 | - | | | | 13.2 | 11.9 | 8.3 | - | | | |
| BF Max Depth (ft) | 1.1 | 1.1 | 1.3 | - | | | | 1.7 | 1.9 | 1.4 | - | | | | 1.1 | 1.1 | 1.2 | - | | | | 2.2 | 2.1 | 1.8 | - | | | |
| Width of Floodprone Area (ft) | >150 | >150 | >150 | - | | | | >150 | >150 | >150 | - | | | | >150 | >150 | >150 | - | | | | >150 | >150 | >150 | - | | | |
| Entrenchment Ratio | 5.4 | 4.6 | 4.4 | - | | | | 5.8 | 5.2 | 5.2 | - | | | | 8.5 | 9.2 | 8.6 | - | | | | 5.6 | 5.6 | 5.9 | - | | | |
| Bank Height Ratio | 1.00 | 1.00 | 1.00 | - | | | | 1.00 | 1.00 | 1.00 | - | | | | 1.10 | 1.10 | 1.00 | - | | | | 1.00 | 1.00 | 1.00 | - | | | |
| Wetted Perimeter (ft) | 11.4 | 12.7 | 13.2 | - | | | | 12.7 | 13.8 | 13.3 | - | | | | 9.7 | 9.0 | 9.6 | - | | | | 15.0 | 14.9 | 13.7 | - | | | |
| Hydraulic Radius (ft) | 0.6 | 0.5 | 0.5 | - | | | | 0.9 | 0.8 | 0.6 | - | | | | 0.7 | 0.6 | 0.7 | - | | | | 0.9 | 0.8 | 0.6 | - | | | |
| Cross Sectional Area between end pins ($ft^2$) | - | - | - | - | | | | - | - | - | - | | | | - | - | - | - | | | | - | - | - | - | | | |
| d50 (mm) | 31.2 | 20.4 | 16.4 | - | | | | - | - | - | - | | | | - | - | - | - | | | | - | - | - | - | | | |

| | Cross-section X-12, Station 11+84 (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) | 8.2 | 7.8 | 7.7 | 7.6 | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Mean Depth (ft) | 0.9 | 0.7 | 0.7 | 0.6 | | | | | | | | | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 9.1 | 10.6 | 11.7 | 13.1 | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Cross-sectional Area ($ft^2$) | 7.3 | 5.8 | 5.0 | 4.4 | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Max Depth (ft) | 1.4 | 1.1 | 0.9 | 0.9 | | | | | | | | | | | | | | | | | | | | | | | | |
| Width of Floodprone Area (ft) | >150 | >150 | >150 | >150 | | | | | | | | | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 9.4 | 7.0 | 7.3 | 6.9 | | | | | | | | | | | | | | | | | | | | | | | | |
| Bank Height Ratio | 1.20 | 1.30 | 1.30 | 1.17 | | | | | | | | | | | | | | | | | | | | | | | | |
| Wetted Perimeter (ft) | 10.0 | 9.3 | 9.0 | 8.8 | | | | | | | | | | | | | | | | | | | | | | | | |
| Hydraulic Radius (ft) | 0.7 | 0.6 | 0.6 | 0.5 | | | | | | | | | | | | | | | | | | | | | | | | |
| Fixed baseline bankfull elevation | 1208.8 | 1208.8 | 1208.8 | 1208.8 | | | | | | | | | | | | | | | | | | | | | | | | |
| **Based on current/developing bankfull feature** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | 8.2 | 9.1 | 9.2 | - | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Mean Depth (ft) | 0.9 | 0.9 | 0.8 | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 9.1 | 10.5 | 11.1 | - | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Cross-sectional Area ($ft^2$) | 7.3 | 8.0 | 7.5 | - | | | | | | | | | | | | | | | | | | | | | | | | |
| BF Max Depth (ft) | 1.4 | 1.3 | 1.2 | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Width of Floodprone Area (ft) | >150 | >150 | >150 | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 9.4 | 8.5 | 8.5 | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Bank Height Ratio | 1.20 | 1.00 | 1.00 | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Wetted Perimeter (ft) | 10.0 | 10.9 | 10.8 | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Hydraulic Radius (ft) | 0.7 | 0.7 | 0.7 | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Cross Sectional Area between end pins ($ft^2$) | - | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | |
| d50 (mm) | - | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | |

# Appendix E

## Wetland Assessment Data

Includes:

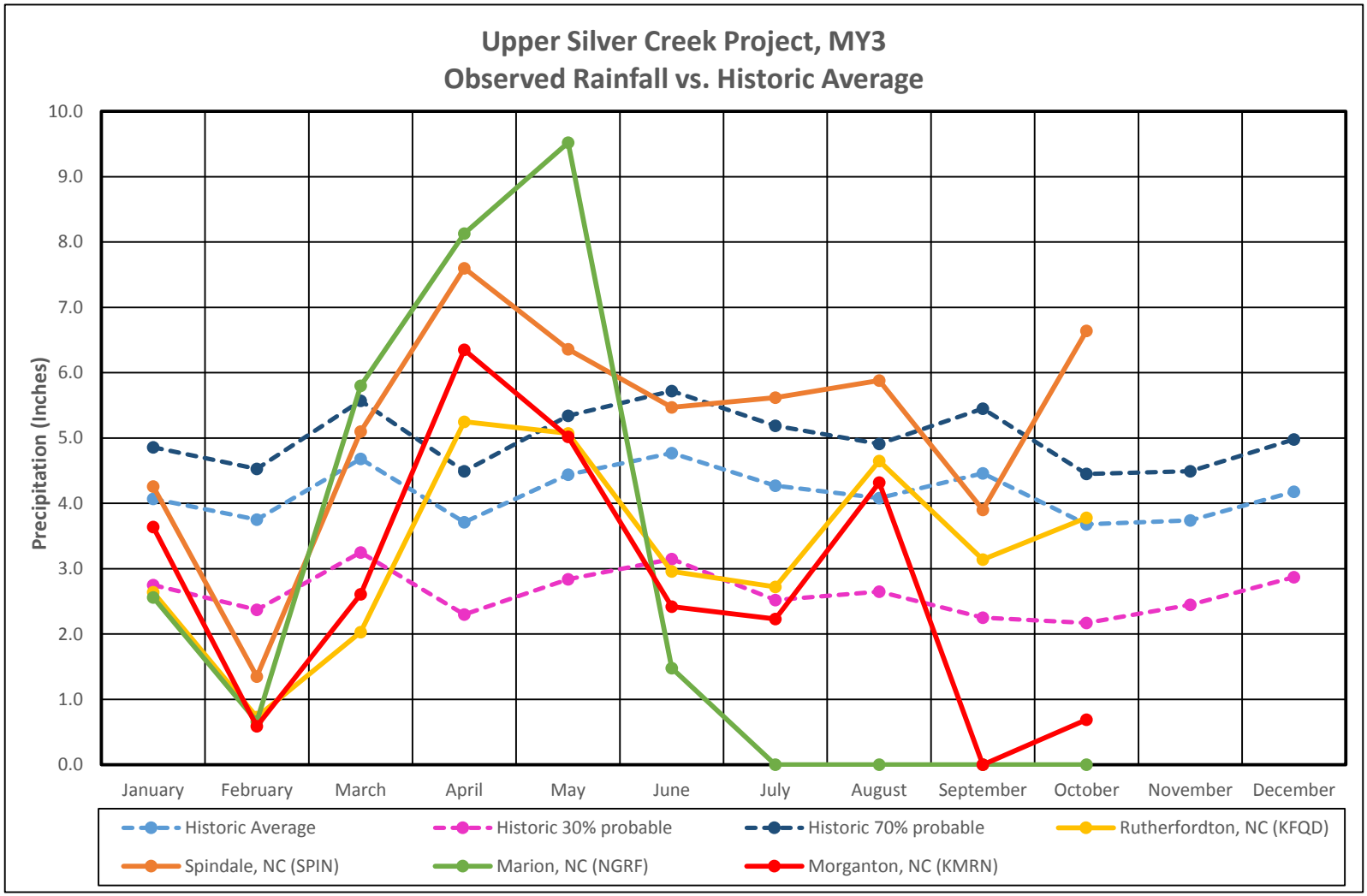
Figure 9. Observed Rainfall vs Historical Average

Figure 10. Wetland Gauge Graphs

Table 12. Wetland Gauge Attainment data

Figure 11. Wetland Photo Log

**Figure 9. Observed Rainfall vs. Historical Average**




Historic rainfall data from Burke County Soil Survey, NRCS, pg. 420
Rainfall data source for Rutherfordton, NC: http://climate.ncsu.edu/cronos?station=KFQD&temporal=hourly
Rainfall data source for Spindale, NC: http://climate.ncsu.edu/cronos?station=SPIN&temporal=hourly
Rainfall data source for Marion, NC: http://climate.ncsu.edu/cronos?station=NGRF&temporal=hourly
Rainfall data source for Morganton, NC: http://climate.ncsu.edu/cronos?station=KMRN&temporal=hourly
Rainfall data source for historic averages: Morganton, NC WETS Table (1971-2016)

**Figure 10. Wetland gauge graphs for each well, showing depth to groundwater and rainfall during MY3.**

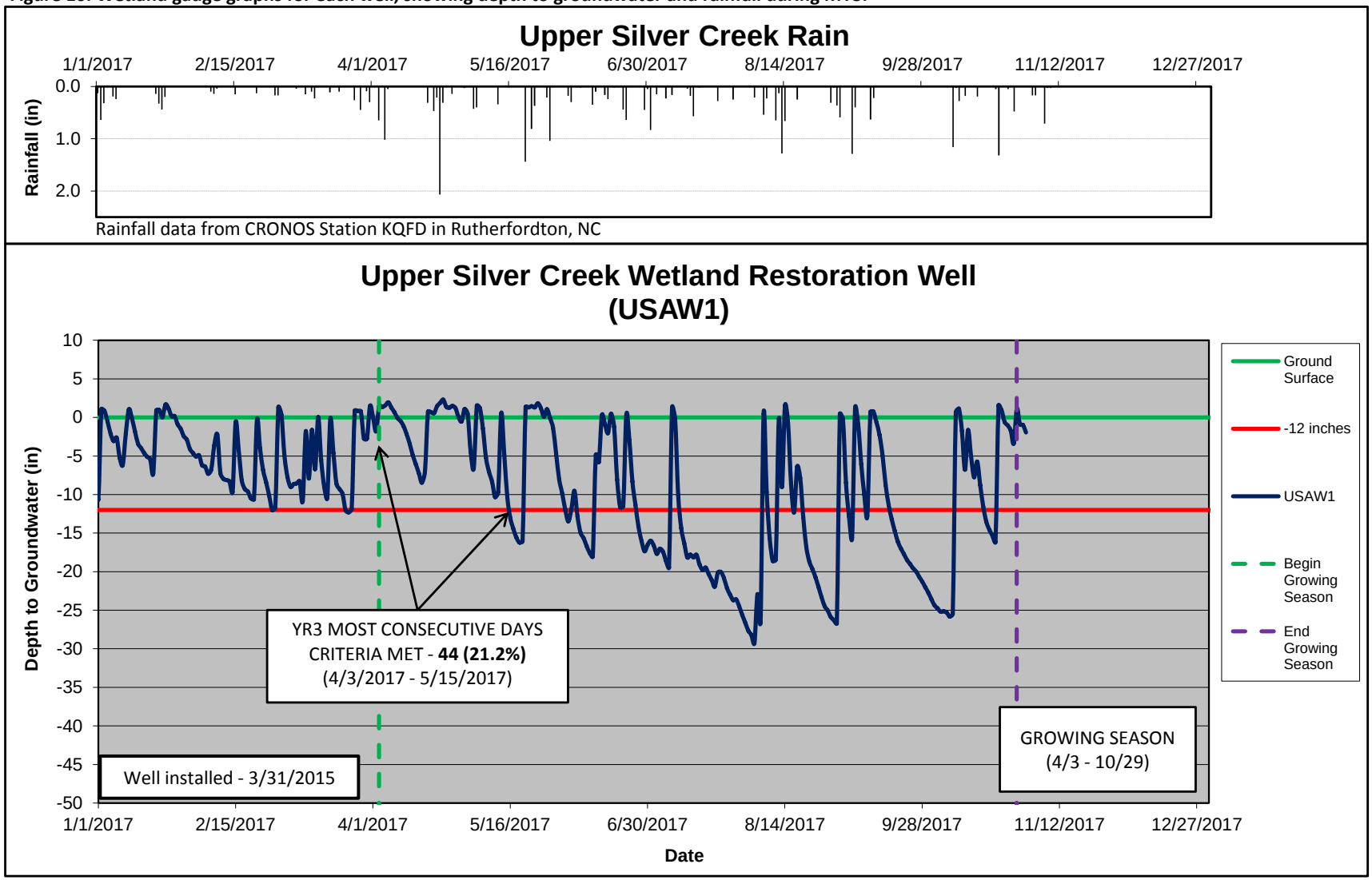


**Figure 10. Wetland gauge graphs (continued)**

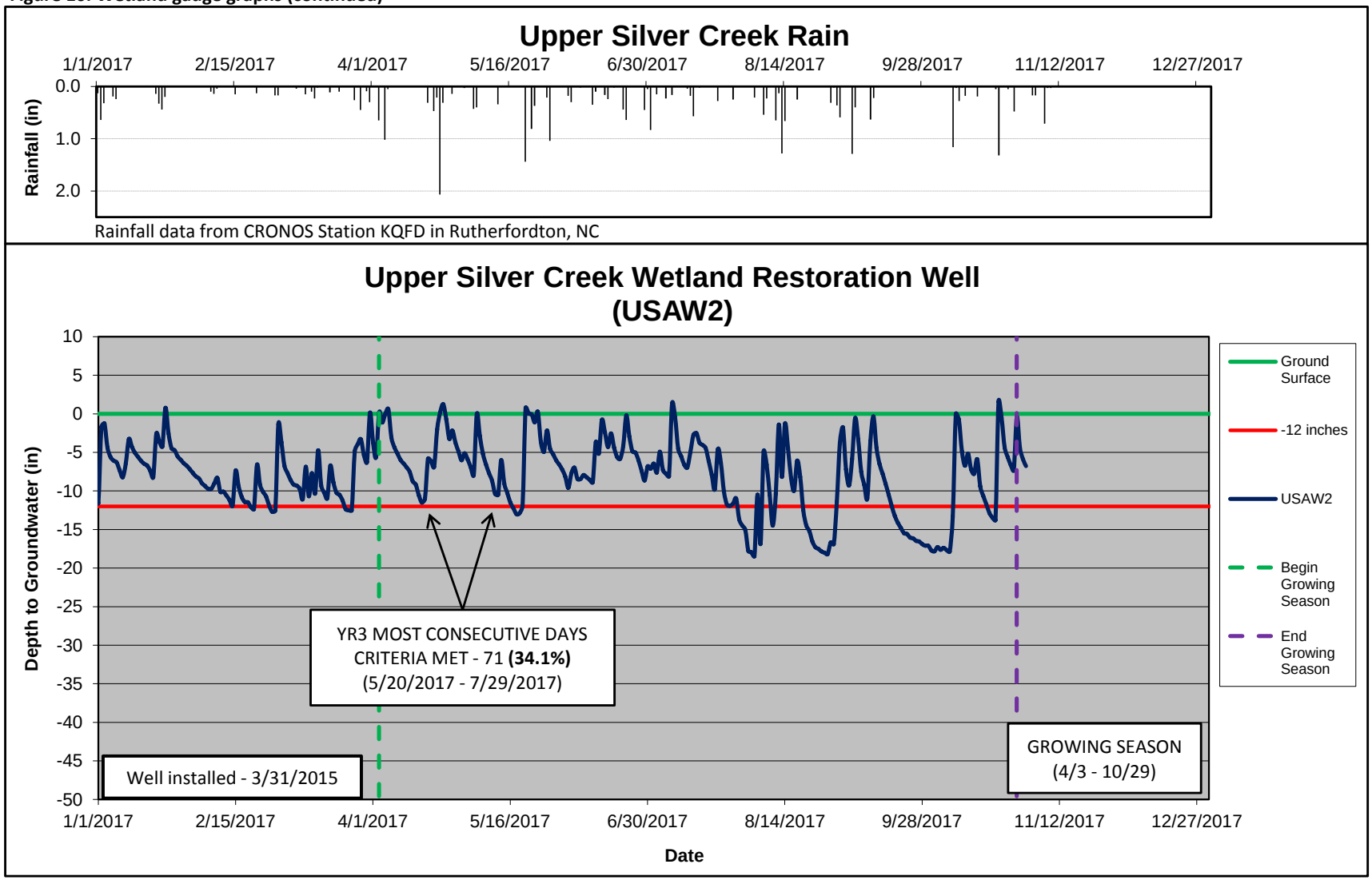


**Figure 10. Wetland gauge graphs (continued)**

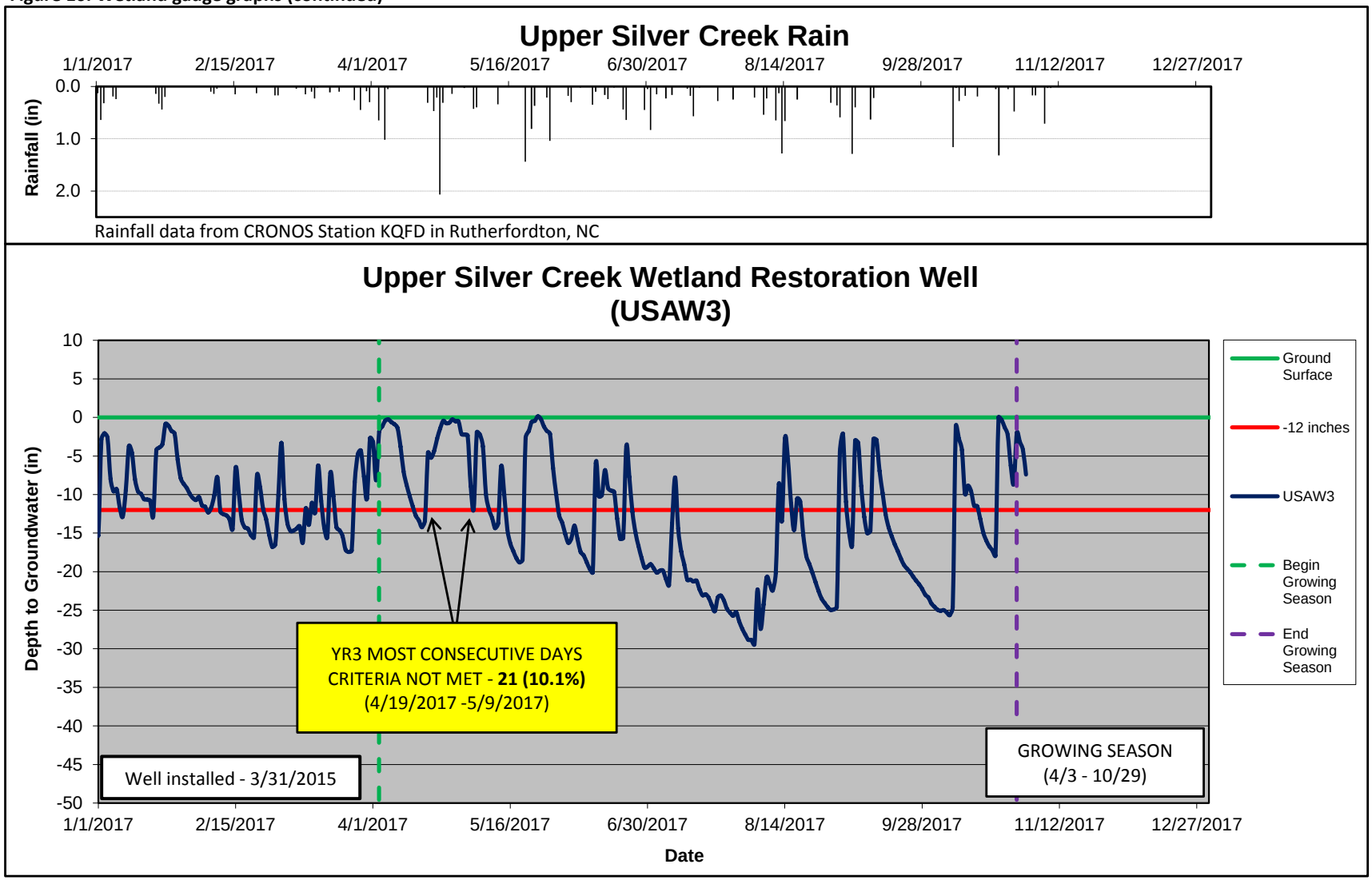


**Figure 10. Wetland gauge graphs (continued)**

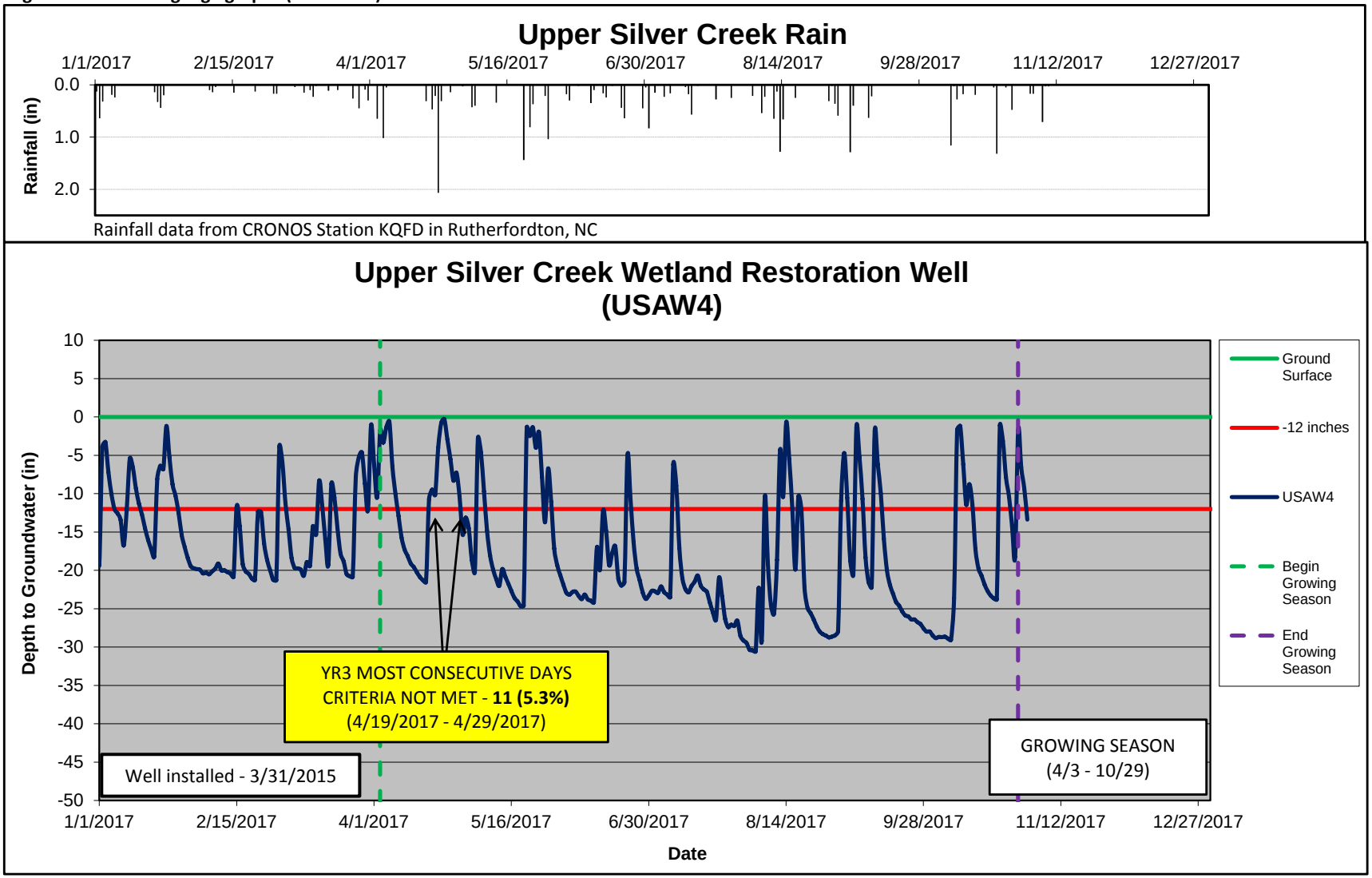


**Figure 10. Wetland gauge graphs (continued)**

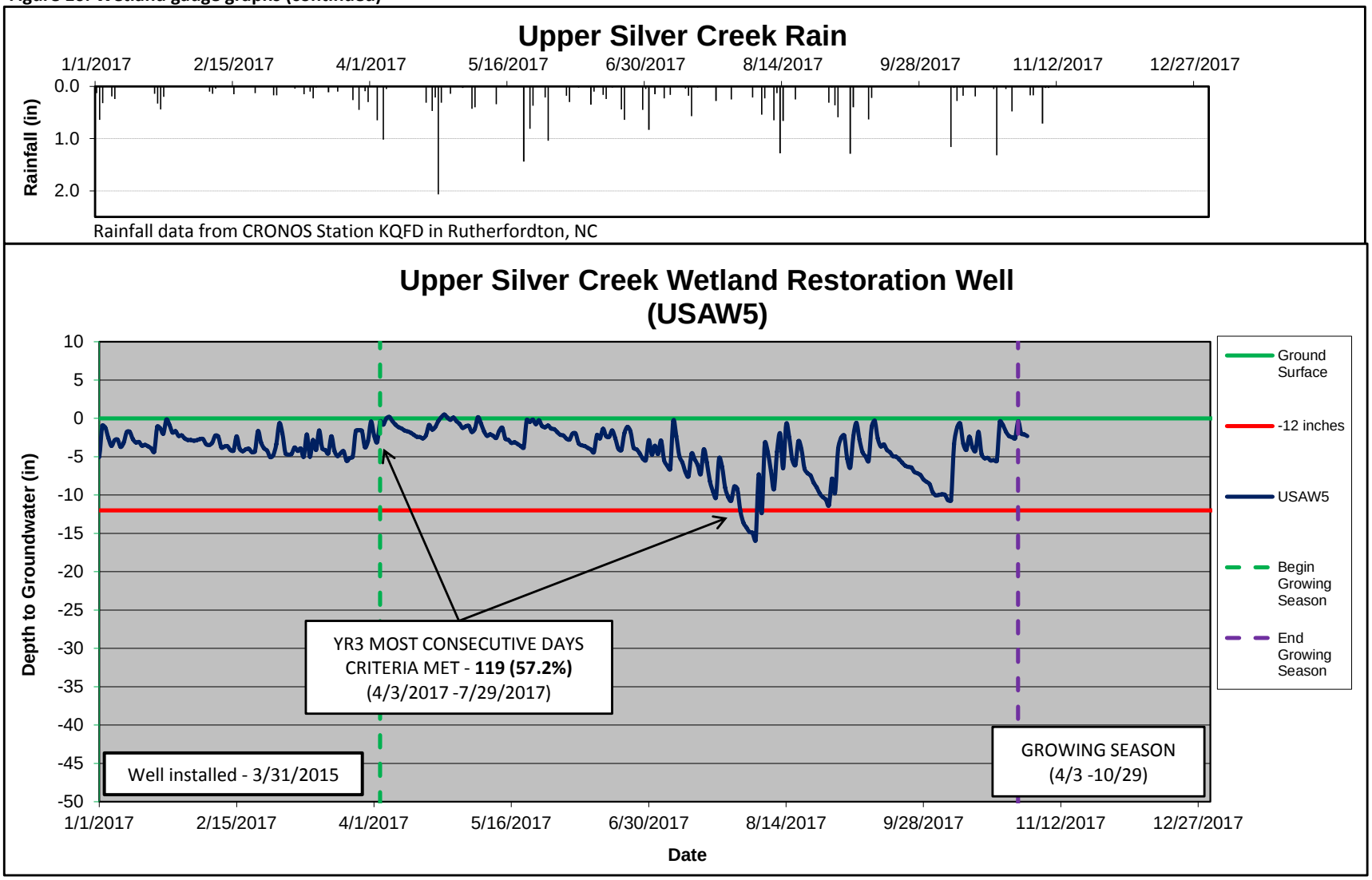


**Figure 10. Wetland gauge graphs (continued)**

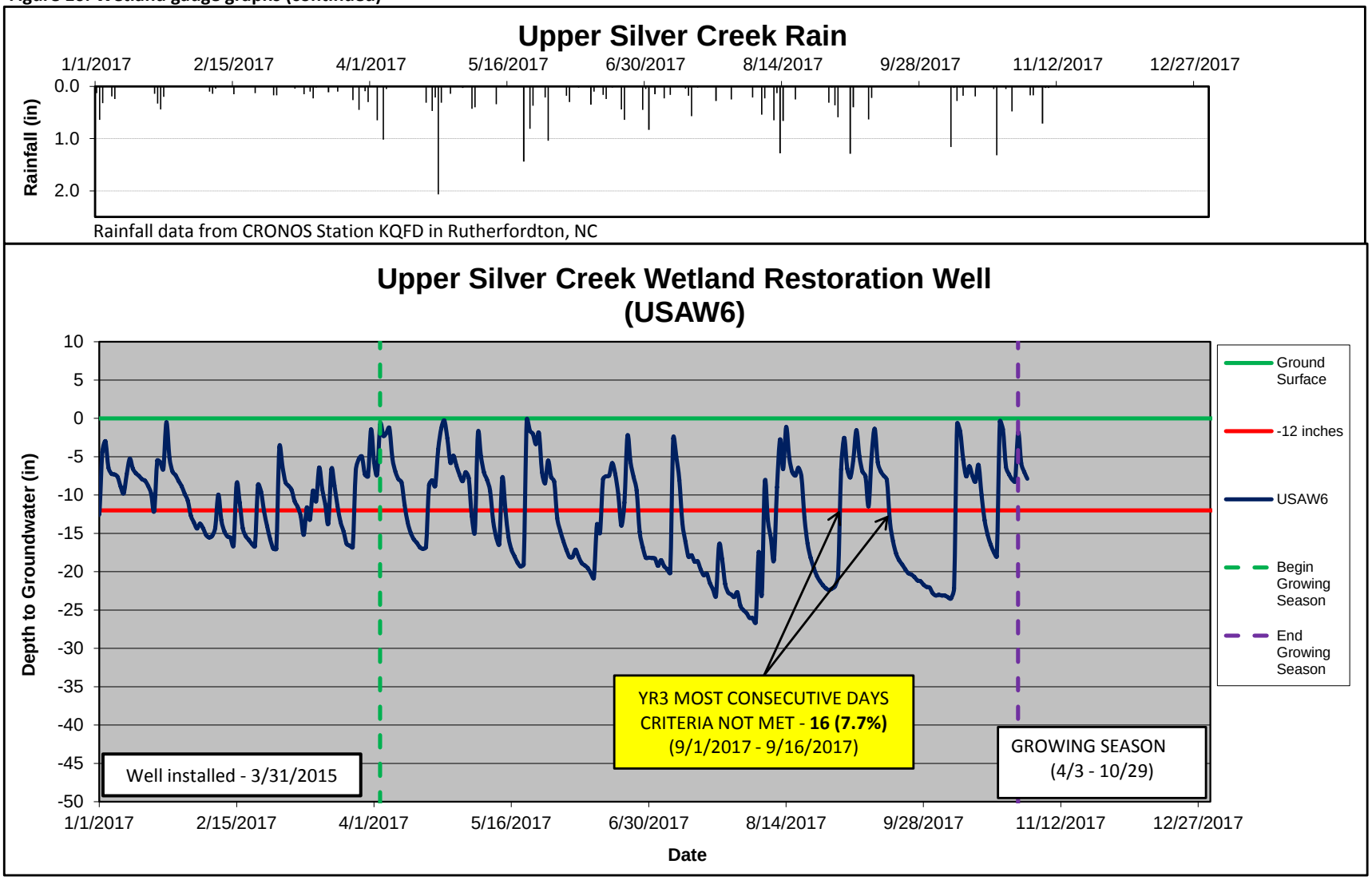


**Figure 10. Wetland gauge graphs (continued)**

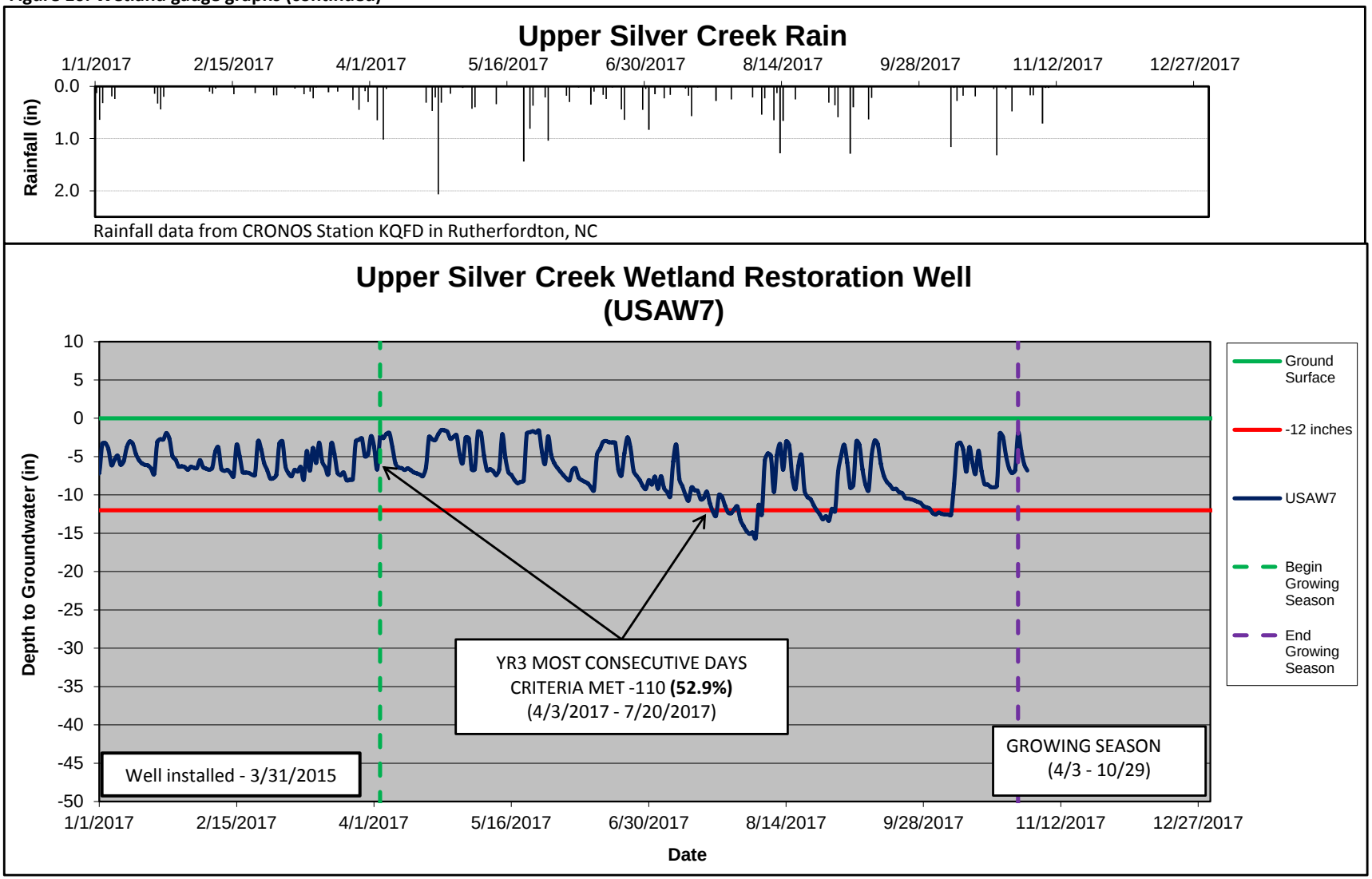


**Figure 10. Wetland gauge graphs (continued)**

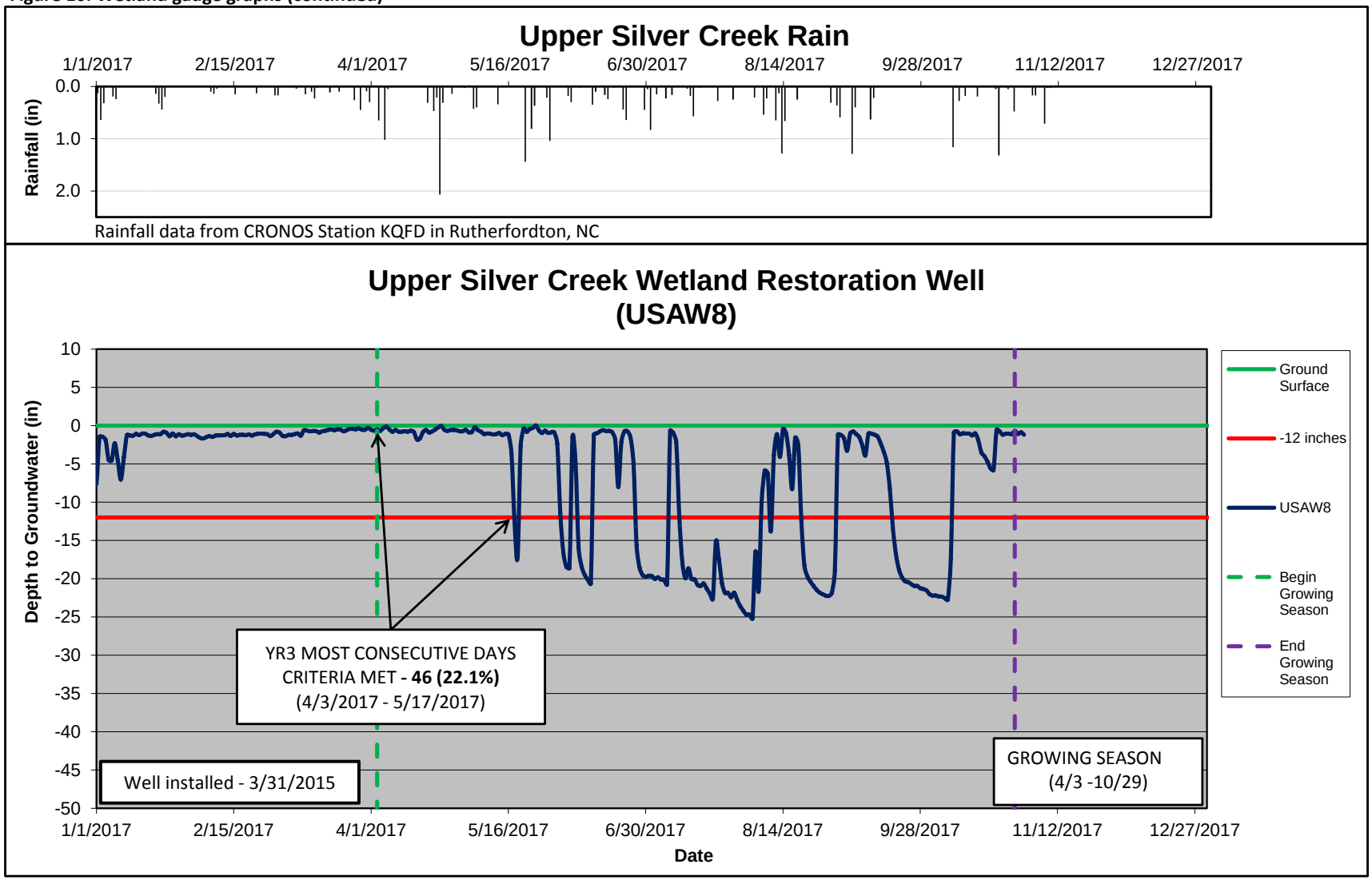


**Figure 10. Wetland gauge graphs (continued)**

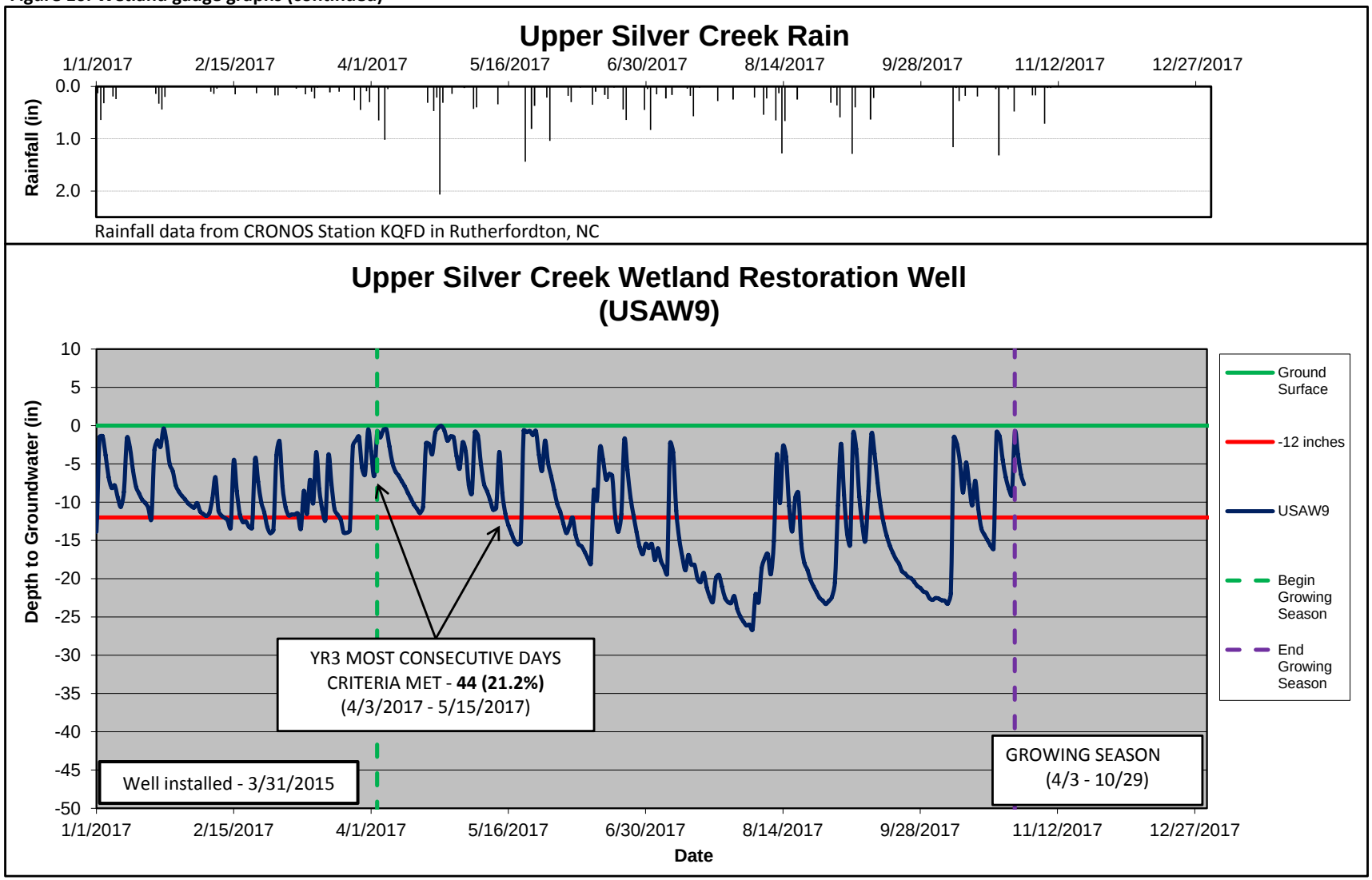


**Figure 10. Wetland gauge graphs (continued)**

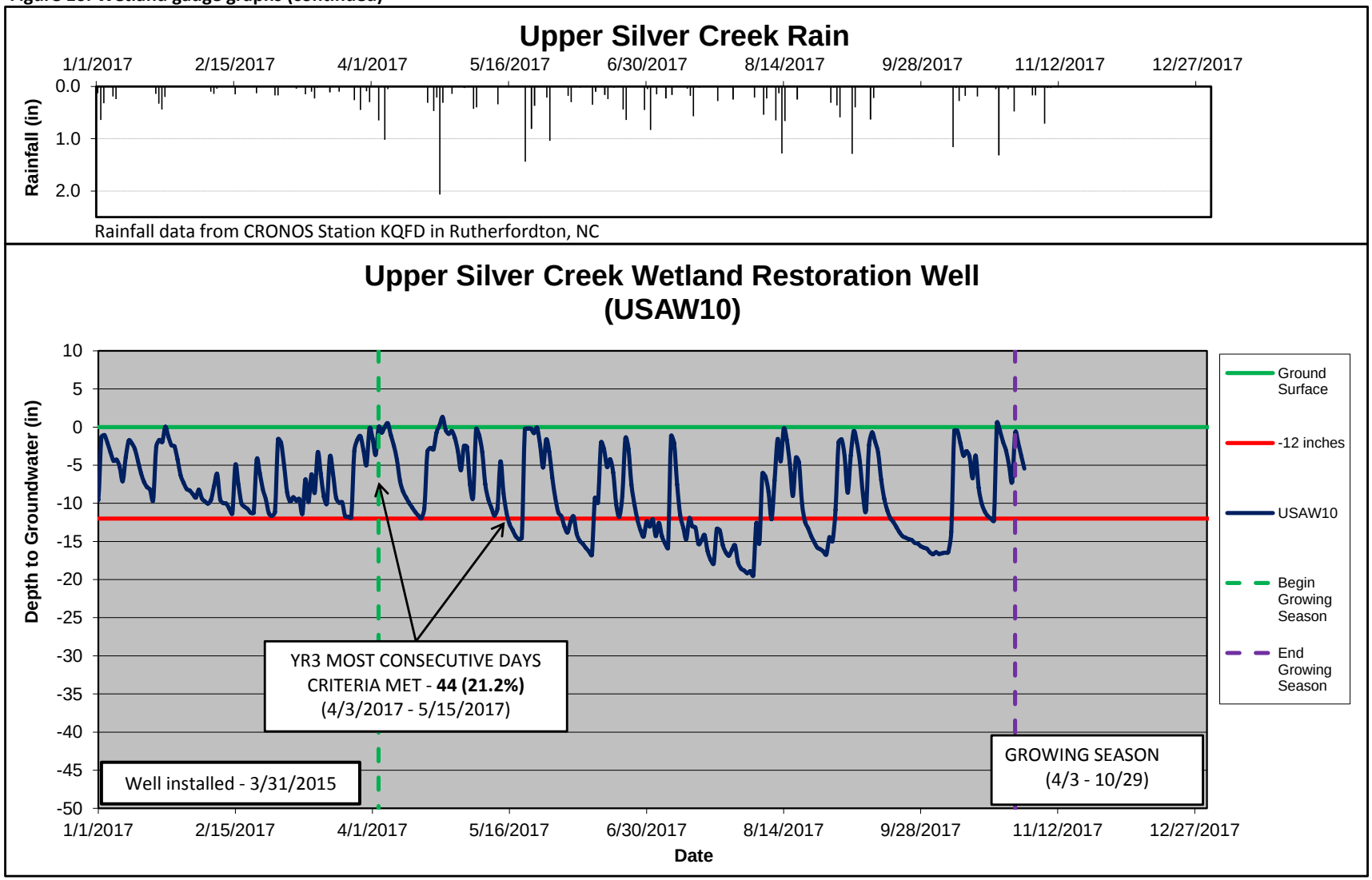


**Figure 10. Wetland gauge graphs (continued)**

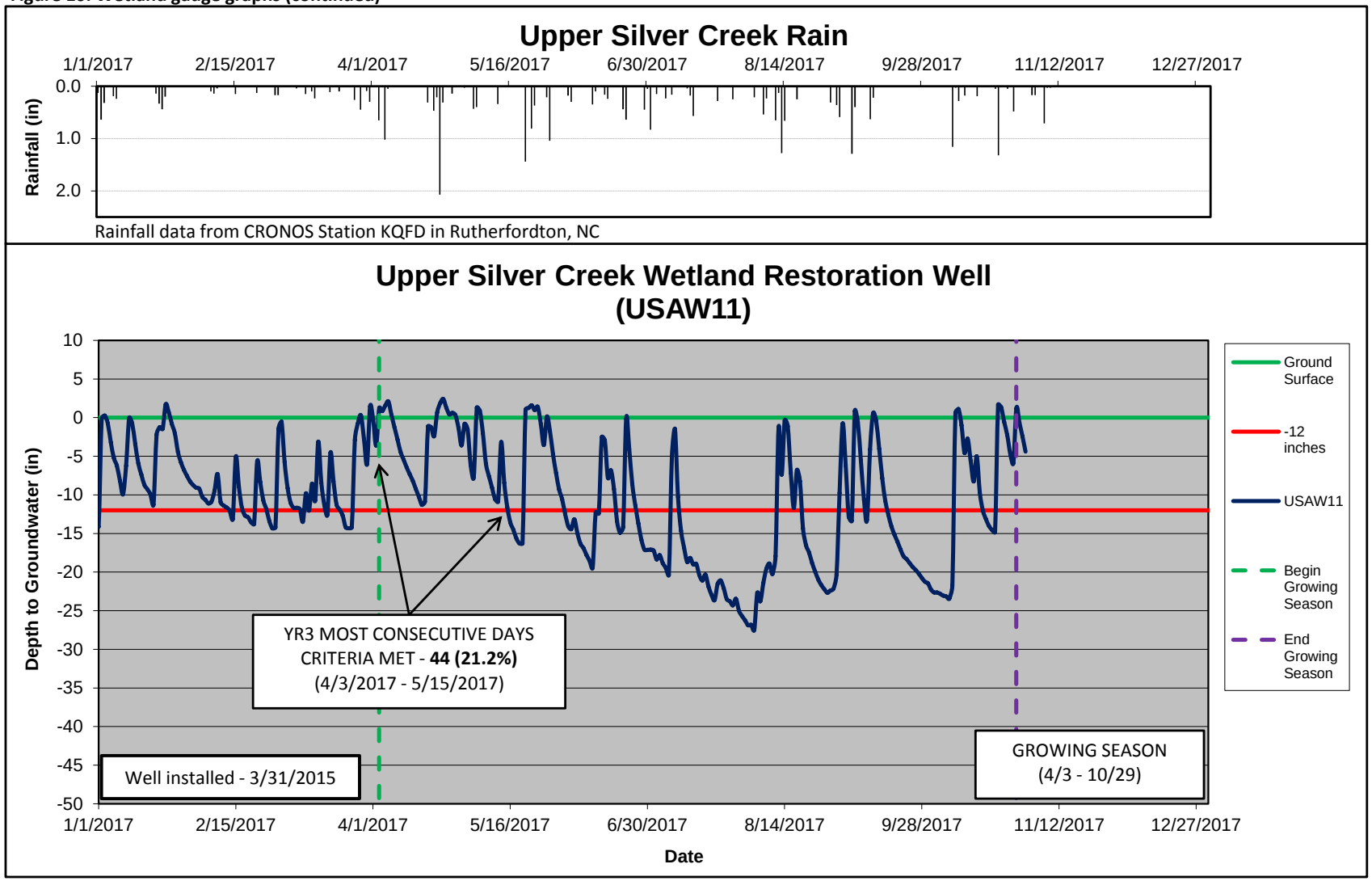


**Figure 10. Wetland gauge graphs (continued)**

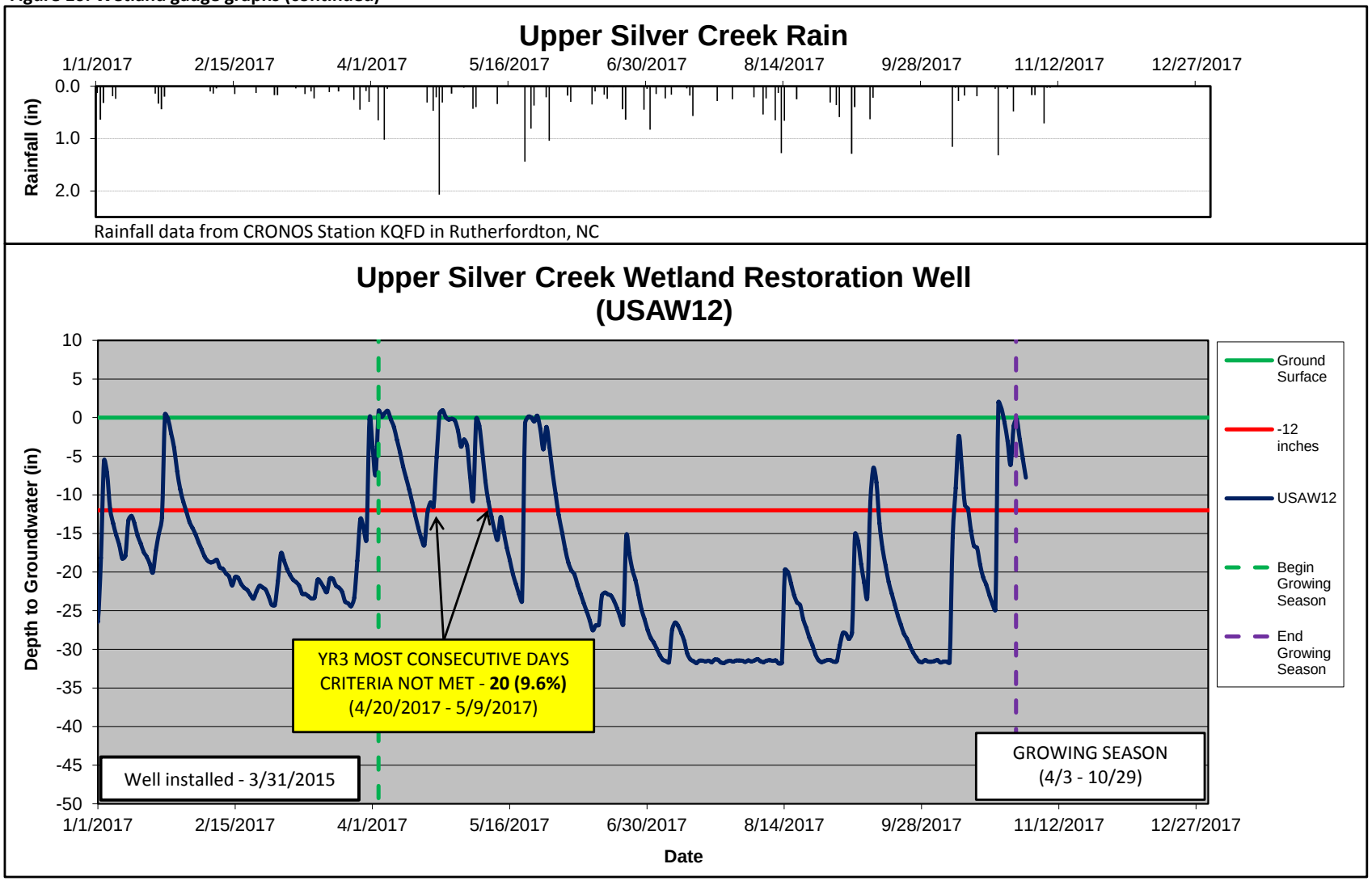


**Figure 10. Wetland gauge graphs (continued)**

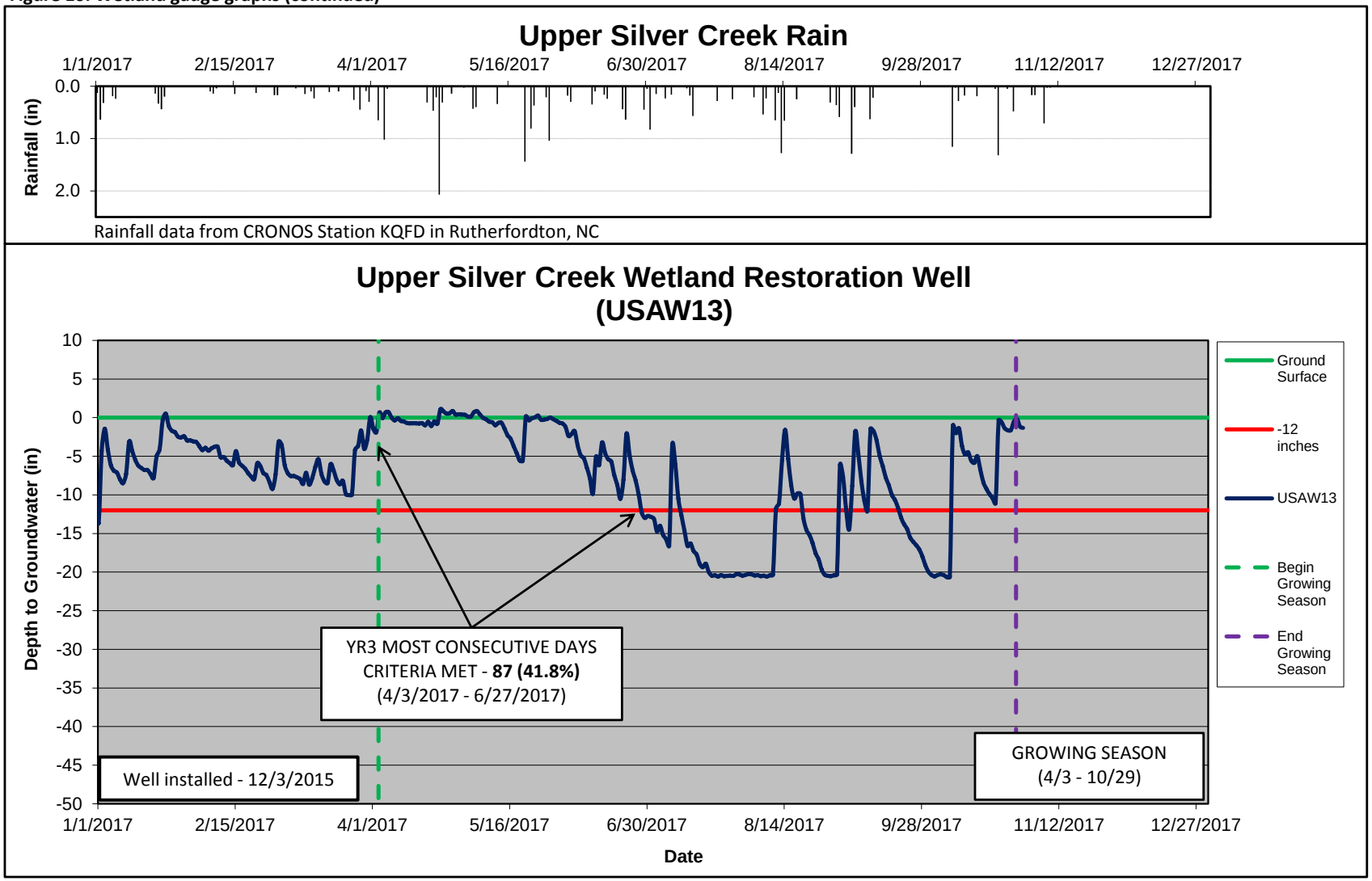


**Table 12. Wetland gauge attainment data, summary of groundwater gauge results for MY 1 through 5 at the U. Silver Creek Project Site, DMS Project #94645.**

| Gauge | Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage) | | | | |
|---|---|---|---|---|---|
| | Monitoring Year 1 (2015) | Monitoring Year 2 (2016) | Monitoring Year 3 (2017) | Monitoring Year 4 (2018) | Monitoring Year 5 (2019) |
| USAW1 | Yes/36.5 days (17.5 %) | No/9.5 days (4.6%) | Yes/44 days (21.2%) | | |
| USAW2 | No/21.8 days (10.5 %) | No/12.3 days (5.9%) | Yes/71 days (34.1%) | | |
| USAW3 | No/20.3 days (9.7 %) | No/7 days (3.4%) | No/21 days (10.1%) | | |
| USAW4 | No/5.5 days (2.6 %) | No/5 days (2.4%) | No/11 days (5.3%) | | |
| USAW5 | Yes/80.5 days (38.7 %) | Yes/77.5 days (37.3 %) | Yes/119 days (57.2%) | | |
| USAW6 | No/19.5 days (9.4 %) | No/7 days (3.4 %) | No/16 days (7.7 %) | | |
| USAW7 | Yes/74.5 days (35.8 %) | Yes/72.5 days (34.9 %) | Yes/110 days (52.9%) | | |
| USAW8 | No/2.5 days (1.2 %) | No/5.8 days (2.8 %) | Yes/46 days (22.1%) | | |
| USAW9 | Yes/35.5 days (17.1 %) | No/13.5 days (6.5 %) | Yes/44 days (21.2%) | | |
| USAW10 | No/19.8 days (9.5 %) | No/9.8 days (4.7 %) | Yes/44 days (21.2%) | | |
| USAW11 | No/18.5 days (8.9 %) | No/11.5 days (5.5 %) | Yes/44 days (21.2%) | | |
| USAW12 | No/17.5 days (8.4 %) | No/7.3 days (3.5 %) | No/20 days (9.6%) | | |
| USAW13 | | Yes/55.5 days (26.7 %) | Yes/87 days (41.8%) | | |

**Figure 11. U. Silver Creek Wetland Photo Log, MY3 (2017)**

Photo 1. Wetland Photo Point – W1, replicates photo 50 in Baseline Report (November 1, 2017).

Photo 2. Wetland Photo Point – W2, replicates photo 51 in Baseline Report (November 1, 2017).

Photo 3. Wetland Photo Point – W3 replicates photo 52 in Baseline Report (November 1, 2017).

Photo 4. Wetland Photo Point – W4, replicates photo 53 in Baseline Report (November 1, 2017).

Photo 5. Wetland Photo Point – W5, replicates photo 54 in Baseline Report (November 1, 2017).

Photo 6. Wetland Photo Point – W6, replicates photo 55 in Baseline Report (November 1, 2017).

Photo 7. Wetland Photo Point – W7, replicates photo 56 in Baseline Report (November 1, 2017).

Photo 8. Wetland Photo Point – W8, replicates photo 57 in Baseline Report (November 1, 2017).

Photo 9. Wetland Photo Point – W9, replicates photo 58 in Baseline Report (November 1, 2017).

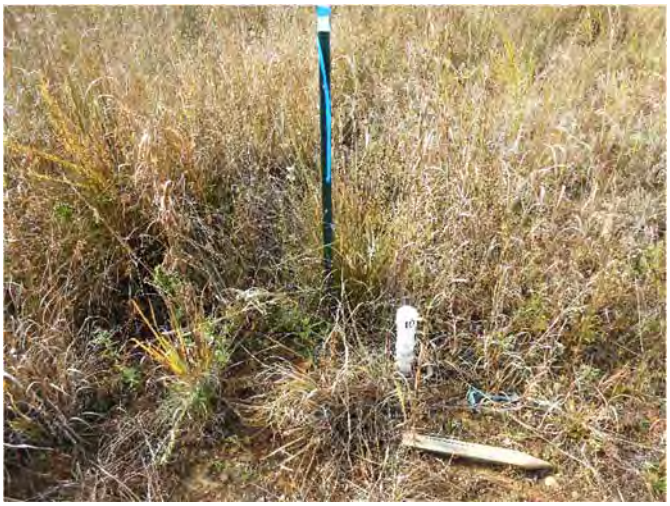


Photo 10. Wetland Photo Point – W10, replicates photo 59 in Baseline Report (November 1, 2017).

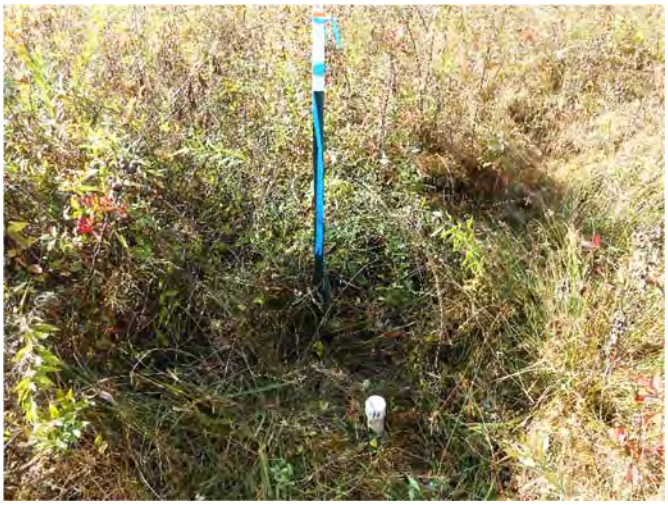


Photo 11. Wetland Photo Point – W11, replicates photo 60 in Baseline Report (November 1, 2017).

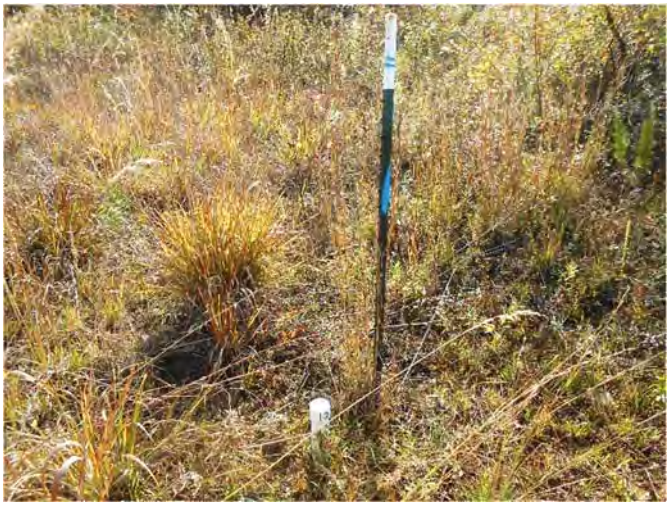


Photo 12. Wetland Photo Point – W12, replicates photo 61 in Baseline Report (November 1, 2017).

Photo 13. Wetland Photo Point – W13 added between time of baseline and MY1 survey, (April 1, 2015)