Baseline Monitoring Document and As-Built Baseline Report
Upper Silver Creek Stream and Wetland Restoration Project

Burke County, North Carolina

DMS Project ID No. 94645

Catawba River Basin: 03050101-050050

Prepared for:
NC Department of Environmental Quality
Division of Mitigation Service (DMS)
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

Data Collection Period – April 2015

Draft Submission Date – August 2015

Final Submission Date – March 15, 2016

Baseline Monitoring Document and As-Built Baseline Report
Upper Silver Creek Stream and Wetland Restoration Project

Burke County, North Carolina

DMS Project ID No. 94645

Catawba River Basin: 03050101-050050

Prepared for:
NC Department of Environmental Quality
Division of Mitigation Service (DMS)
1652 Mail Service Center
Raleigh, NC 27699-1652

Prepared by:

Michael Baker
INTERNATIONAL

Michael Baker Engineering, Inc. NC Engineering License: F-1084

Data Collection Period – April 2015

Submission Date – August 2015

Final Submission Date – March 15, 2016

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF 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) in Burke County, NC resulting in the delivery of 4,980 Stream Mitigation Units (SMUs). In addition, Baker restored, enhanced or created approximately 9.14 acres of wetlands that have been previously disturbed resulting in the delivery of 6.85 Wetland Mitigation Units (WMUs). Wetland Mitigation Units result from a combination of 6.43 riparian WMUs and 0.42 non-riparian WMUs. The contracted units are 4,665 SMUs, 5.89 riparian WMUs, and 0.62 non-riparian WMUs (6.51 total WMUs). The reduction of contracted non-riparian WMUs is detailed in the approved mitigation plan addendum, accepted by the IRT in December of 2015. The nearest town, Morganton, is approximately twelve miles northeast of the Upper Silver Creek Mitigation Project site. The site lies in the Catawba River Basin within North Carolina Division of Water Resources (NCDWR) sub-basin 03-08-31 and local watershed unit 03050101-050050.

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

- Create geomorphically stable stream channels within the 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;
- 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;
- 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.

The project as-built condition closely mimics that proposed in the design. Differences are outlined below:

- In order to avoid creating a narrow area of soil between the mainstem channel and the channel of UT3 that could be easily eroded away, the confluence for UT3 was moved downstream to make this area more stable. This changed the confluence location on the mainstem from approximately station 4+75 to 5+60.

- Juncus sod mats, brush mattresses, transplants and floodplain debris piles were identified in the original plans to be used at various locations. During negotiations with the contractor it became apparent that the installation of these practices would be time consuming and thus, very expensive. In order to meet the budget for project construction most of these items were dropped. A few transplants were used but not to the degree, specified and increased plantings with livestakes and bare-root trees were used to replace transplants. Floodplain debris was placed in certain locations, but not to the extent and not necessarily in the locations shown.
- Toewood structures were substituted for many of the geolifts originally planned due to the season of construction, concerns that live vegetation would not survive if installed in the geolifts and the quantity of woody material available to construct toewood.
- Originally, twenty-five (25) species of woody vegetation were proposed for planting as bare-rooted trees or live stakes at this site. The planting contractor was only able to obtain eleven of these requested species. Nine other native species that had not been included on the original list were available and were substituted for those missing species. Twenty species were planted at the site (see Appendix C, Table 7 for the planted species).
- At the time of construction the lower end of the project was approximately 2 feet lower at the easement line where construction would be terminated than was shown on the plan. To ensure that there was not a steep drop at the end of the project, beginning at station 24+00 the channel slope was increased so that the ending elevation matched the natural channel. Additional grade control structures were added between 24+00 and 30+00 to increase channel stability given this slight increase in slope.

This report documents the completion of the project construction activities and presents baseline as-built monitoring data for the post-construction monitoring period. Baseline data is provided for long-term monitoring of channel geomorphology by examining the channel profile (total length of each restored stream) and channel cross-sections (16 total; 7 on Silver Creek, 2 on UT1, 2 on UT2 and 5 on UT3). Two crest gauges were installed to determine when greater than bankfull flows occur (one on UT3 and one on the mainstem). Survival and growth of vegetation at the site will be evaluated by examining vegetation (trees and herbaceous vegetation) within fourteen vegetation plots established at the site. Thirteen groundwater gauges were installed to monitor hydrology within the various wetland areas of the site. Monitoring data will be collected for 5 years to evaluate the success of restoration at this site. If success is not demonstrated at that point, some data may be collected for additional time until success is shown. Table 1 (Appendix A) summarizes site conditions before and after restoration, as well as the conditions predicted in the previously approved project Mitigation Plan.

2.0 PROJECT GOALS, BACKGROUND AND ATTRIBUTES

2.1 Project Location and Description

The Upper Silver Creek Stream and Wetland Restoration Project site is located approximately twelve miles southwest of Morganton, in Burke County, as shown in the Project Site Vicinity Map (Appendix A, Figure 1). The Upper Silver Creek Stream and Wetland Restoration Project area lies within cataloging unit 03050101050050 and DEQ sub-basin 03-08-31of the Catawba River Basin. The project site includes a segment of Silver Creek, 3 unnamed tributaries to Silver Creek and a series of wetlands that have been previously disturbed.

The Upper Silver Creek mitigation project streams drain a watershed that is predominantly forested with a considerable percentage of land in agriculture. Approximately 20% of the drainage is in some form of pastureland or hay production. A small number of residences are also located within the drainage area for the Upper Silver Creek project. Land use at the project site is characteristic of the greater watershed. Recent

land use of the site includes timber production, hay production and lands managed as pasture. Potential for land use change in the area adjacent to the conservation easement is low given the rural setting of the project.

Past intensive agricultural use of the property led to channel modification, dredging, riparian buffer removal, wetland conversion, ditching and the introduction of fill material in the floodplain. Stream channelization and dredging are evident on the project tributaries. Soil investigations identified buried A horizons in multiple locations, both in areas with hydric soils and without. Historic mining activity impacts are very likely, based on floodplain topography and widespread mining characteristics from known intensive gold mining sites. In addition to stream and floodplain modification, wetlands on site have been previously filled and the wetland hydrology altered by the installation of a series of swales and ditches. The resulting stream instability had resulted in significant erosion and sedimentation, as well as nutrient loading to tributaries, Silver Creek, and to the Catawba River downstream.

Silver Creek is shown as a "blue-line" stream on the USGS topographic quadrangle for the site, while UT1 and UT3 are shown as intermittent streams. Unnamed tributary 2 is not shown on the USGS topographic quadrangle. After referencing USGS topographic quadrangle maps to determine stream order, a field evaluation using the North Carolina Division of Water Resources (NCDWR) stream assessment protocol was conducted. Based on field data, Silver Creek and the three project tributaries are perennial stream channels.

2.2 Site Directions

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 is a channelized stream that enters Silver Creek upstream of the UT1 confluence and flows westward to Silver Creek from a forested area.

2.3 Project Goals and Objectives

The Upper Silver Creek Stream and Wetland Restoration Project was identified as an opportunity to improve water quality and ecological functions within a NC Division of Mitigation Services (NCDMS) Targeted Local Watershed (TLW).

The primary restoration goals of the project 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;
- Improve aquatic and terrestrial habitat.

To accomplish these goals, the following objectives were identified:

- Work within natural and manmade constraints to restore an active floodplain under bankfull flow conditions via a combination of floodplain excavation and raising the existing channel – this addresses all of the above goals;
- Introduce woody debris into the stream channel and on the floodplain – this addresses habitat goals and maximizes carbon availability to enhance bioremediation of nutrients and other pollutants;
- Establish wide buffers and floodplain diversity (using vegetation and topography) to address water quality and habitat enhancement goals;
- Establish natural riffle pool sequences, including recognition of the importance of other stream profile facets (runs and glides) to enhance channel stability by facilitating sediment transport continuity;
- Use the same method to pursue a diverse bedform with aforementioned profile characteristics and including also higher quality substrate in riffles, creating deeper and more diverse pools, developing areas that increase oxygenation, providing woody debris for habitat, and reducing bank erosion by creating vertical stability;
- Improve substrate and in-stream cover, addition of woody debris, reduction of water temperature, and restoration of terrestrial and wetland habitat;
- Connect tributaries to their floodplains via Priority I concepts for Restoration to enhance adjacent wetlands, reduce erosion sources from tributaries, and restore headwater habitat;
- Connect tributaries to the mainstem without creating aquatic passage issues (overcome the challenge of the mainstem being at a lower elevation through smaller grade drops spread over a longer distance and by reducing the slope of individual grade drops by incorporating cascading drops;
- Establish a stable cross-section that allows for natural recovery through sediment deposition on gently sloped banks to serve as an early-stage sediment sink and a long-term mechanism to allow for natural adaptation to watershed conditions – this addresses bank stability goals, habitat and water quality goals, and recognizes uncertainty in natural systems design through conservative design;
- Planting riparian areas with native vegetation at a density sufficient to achieve long-term density goals and with provisions to achieve short-term widespread coverage that will serve as habitat and erosion control;
- Establish a wide corridor protected by a permanent conservation easement to enhance storm water runoff filtering capacity, improve bank stability, provide shading to decrease water temperature and improve wildlife habitat, and increase rootmass and biomass for natural mulching and vegetative succession;
- Control invasive species and continue to monitor and treat if necessary over the project period; and
- Reduce the impact of the construction process and speed recovery through a number of methods. These methods include the minimization of the construction footprint and using livestakes and other bioengineering methods to jumpstart vegetation establishment.

The project goals directly addressed stressors identified in the Catawba River Basin Restoration Priority (RBRP) Plan such as inadequate riparian buffer cover, channel modification, and excess nutrient and sediment loading. The natural channel design approach resulted in a stable riparian headwater stream and wetland system that will reduce sediment and nutrient loading to the Silver Creek sub-watershed, while improving water quality conditions that support terrestrial and aquatic species within the Catawba River Basin.

3.0 PROJECT STRUCTURE, RESTORATION TYPE, AND APPROACH

3.1 Project Components

Within the project area, a segment of Silver Creek and three unnamed tributaries to Silver Creek were restored and one small reach on one of the unnamed tributaries was enhanced. A series of wetlands that had been disturbed were restored or enhanced depending on the level of impact and one area of wetland creation (where evidence of previous hydric conditions are present) was implemented. For design purposes, Silver Creek through the project site was divided into two reaches. The upstream was designated Reach 1 and the downstream reach, Reach 2. Each unnamed tributary was designated as a UT and named UT1, UT2 and UT3 moving from north to south (or downstream to upstream) at the project site. Both UT2 and UT3 had two reaches designated as Reach 1 and Reach 2. Wetlands were designated as JDW1 through JDW6 for those jurisdictional wetlands that were enhanced. Areas of wetland restoration were designated as R1 through R6 and the one creation area was designated C1. Figure 2 in Appendix A illustrates the locations of these streams and wetlands.

Restoration practices involved raising the existing streambed and reconnecting the stream to the historic floodplain and restoring overbank flow to abandoned wetland floodplains and hydric soils areas previously drained by ditching activities or incised, straightened channels. The restored channels were constructed as meandering channels at higher elevations. The existing ditches within the project area were filled to decrease surface and subsurface drainage and to raise the local water table. Native, riparian buffer vegetation was established and protected at least 30 feet from the top of bank along all project reaches. Lastly, restoration activities of the stream and wetland areas have utilized the majority of the parcels that the project occupies and the land has been protected with a conservation easement; therefore, no pasture area remains and the landowner who owns this property plans to maintain it only for wildlife benefits, quite enjoyment, and hunting.

3.2 Restoration Approach

Based on the post-construction as-built survey, the project consists of 4,843 LF of restoration on Silver Creek, UT1, UT2 and UT3-Reach2. One 342 LF reach (UT3-Reach1) was enhanced using an Enhancement Level II approach. In addition, the project restored a total of 4.67 acres of riparian wetlands, 0.21 acres of non-riparian wetlands, enhanced 2.85acres of riparian wetlands and 0.42 acres of non-riparian wetlands, and created 0.99 acres of riparian wetlands. A conservation easement has been established over 22.07 acres of land that includes the project site and will protect and preserve all stream reaches, wetland areas, and riparian buffers in perpetuity.

The revegetation plan for the overall riparian buffer system considered the combination of native vegetation species existing on-site and in the riparian communities identified by Schafale and Weakley (1990) that are included in the ecological community described as “Piedmont/Mountain Mixed Bottomland Hardwood Forest”. Planting areas were not designated by zones on the project plan sheets (Appendix D) to represent site conditions. Alternatively, observations were made of site wetness during planting and species that matched the observed wetness were planted in areas that provided the best conditions.

The restoration approach for the project allows stream flows larger than bankfull flows to spread onto the floodplain, dissipating flow energies, reducing stress on streambanks and hydrating wetland areas. In-stream structures were used to control streambed grade, reduce streambank stress, and promote bedform sequences and habitat diversity. The in-stream structures consist of root wads, log vanes, log weirs, cover logs, boulder cross-vanes, boulder vanes, constructed riffles, toewood bank revetment, and geolifts.

Streambanks were stabilized using a combination of erosion control matting, temporary and permanent seeding, and live stake planting. The site is planted with native vegetation (as shown in Table 7, Appendix

C) and is protected through a permanent conservation easement. Table 1 and Figure 2 (Appendix A) provide a summary of the project components.

3.2.1 Silver Creek Mainstem

Silver Creek Reach 1 (R1) begins at the upstream project limits, which is at the box culvert under US-64, and flows north for approximately 838 feet. At that point, it becomes Reach 2 (R2) and continues north for another 2,178 feet. R1 has a lower as-built slope allowing the channel to rise to a higher elevation relative to the old channel. Floodplain access along this reach, where it is too entrenched to access the valley floor at bankfull flow, was accomplished using a Priority Level II approach, lowering the floodplain to the needed elevation for overbank flooding. R2 was constructed using a Priority I approach, the channel top of bank was built at an elevation that utilized the existing valley floor as the floodplain and bankfull flows would access the valley floor (floodplain) and associated wetlands. At the lower end of R2 the channel increased in slope to transition back to the existing channel elevation and structures were used to provide grade control over this lower end.

3.2.2 UT1 Restoration

The UT1 project reach enters the site through a corrugated metal pipe (CMP) culvert under Goldmine Road. The pipe was perched above the channel eliminating aquatic species passage. This is the most northerly of the unnamed tributaries and has its confluence with the mainstem at station 25+75 on the mainstem, which is station 5+02 on UT1. UT1 has a drainage area of 0.28 sq. mi. and drains both forested and developed land. Part of this watershed is captured in a farm pond, with the overflow returning to this tributary. Prior to disturbance, this channel most likely functioned as an E type channel with thick vegetation providing bank stability. Disturbance of this channel was associated with pasture development and use, road construction and potentially gold mining. The channel was incised over the project reach, had floodplain access only on during large storm events, and had poor aquatic habitat consisting mostly of shallow riffles and runs, with a gravel bed. Restoration consisted of a Priority I approach that raised the channel to be continuous with the culvert invert to allow aquatic organism's potential passage. The new meandering channel was developed with a bank height ratio of 1.0 so that bankfull flows can access the floodplain. Meander bends had deeper pool habitat and some had this habitat improved by the installation of toe wood. To raise this tributary over most of its length required having a steeper slope over the lower 50 feet of channel as it dropped to the confluence with the mainstem. This steeper section of channel was protected by installing a series of boulder drop structures and log drop structures.

3.2.3 UT2 R1 & R2 Restoration

The UT2 project reach enters the project from an adjoining parcel to the east and has a confluence with the mainstem that is 575' upstream of the UT1 confluence. It has its confluence with the mainstem at station 21+01 on the mainstem, which is station 3+10 on UT2. Prior to restoration, the UT2 channel flowed just a few feet onto the project property before it fell across a significant head cut and then passed through a plastic pipe under an abandoned farm road. Stream flow dropped out of the pipe into a straight, excavated channel (ditch) that passed directly to the nearest point on the mainstem. The slope of this channel was approximately 0.037. Much of the drop expressed in this slope measurement was over the upstream reach as it dropped over the headcut and pipe to the excavated channel. The excavated channel had a very low slope. Material excavated from this channel was placed immediately adjacent to the channel creating a levy on the south side of the channel. This channel appears to have been degraded by farm road building and mining in its watershed, as there are numerous spoil piles on the adjoining property. Overall, this channel was restored

using a Priority I approach, raising the channel so that the top of bank is at the existing valley elevation and removing the old levy. There were two reaches designated based on the steepness of the planned channel. Reach 1 (R1) begins at the easement line and continues to station 1+03. R1 is steeper with a slope of 0.0295 and is constructed as a step-pool "B" type channel. Reach 2 (R2) begins at the end of R1 and continues to the confluence with the mainstem. R2 begins at a point where the channel has transitioned to the flatter floodplain and has a slope of 0.010. The channel pattern is meandering with shallow riffles and slightly deeper pools.

3.2.4 UT3 R1 Enhancement & R2 Restoration

The UT3 project reach enters the site through a CMP culvert under Goldmine Road but unlike UT1, this pipe was not perched above the stream, in fact, sediment had aggraded around the outfall of the pipe. This is the most southerly of the unnamed tributaries and has its confluence at station 5+60 on the mainstem, which is station 13+65 on UT3. The channel goes from having an aggraded channel at the pipe to being incised at the lower end of the reach (BHR of 2.4) near the mainstem. This channel condition resulted in poor habitat with little pool habitat and having primarily long shallow riffles. This incised condition also diminished effective ground water hydrology in the adjacent wetlands. There was a narrow buffer of young trees along UT3, which was preserved during construction. Within the project area, UT3 was divided into two reaches, UT3-1 and UT3-2. UT3-1 flows from the pipe at Goldmine Road to station 3+43 and UT3-2 flows from station 3+43 to the confluence at station 13+65. UT3-1 was enhanced using an Enhancement II approach consisting of alterations to dimension and profile to restore a properly sized channel that would move sediment through the aggrading areas. Structures were also added at specific locations along UT3-1 to protect eroding banks and to raise the channel slightly for restoration activities in the downstream reach. UT3-2 was restored using a Priority I approach in which the old channel was abandoned and filled and a new channel was constructed across the right bank floodplain of the old channel. The design of the constructed channel allowed the existing valley elevation to set the top of bank elevation for the new channel. This approach allows bankfull flows to access the floodplain, raises groundwater elevations to improve wetland hydrology and provides a meandering riffle/pool channel with much improved habitat.

3.2.5 Wetland Restoration

Wetlands at the project site have been degraded by having their hydrology, vegetation and soils impacted by anthropogenic alteration. Project streams have become incised due to alteration and drainage ditches have been constructed to move water off the land so that it can support agricultural endeavors. Incised channels have reduced floodplain activation so that the likelihood of overbank flooding is only provided on a 5 to 10 year, or greater, storm for all project channels. This depletes contributions of overbank flooding to wetland hydrology. Ditches that were common on the western bank of the mainstem Silver Creek further lowered supporting groundwater hydrology within historical and existing wetlands. Wetland soils have also been altered. Soil investigations indicated that pre-disturbance wetland areas were larger and that a wetland complex existed along much of the western floodplain. The findings of soil investigations are consistent with land disturbance from gold mining in the area, extreme flooding and channel/floodplain impacts due to watershed alterations (deforestation, mining, buffer removal, etc.), and erosional processes of natural and/or anthropogenic nature that moved soils from upslope of the project into the valley floor where the project is located. Wetland vegetation at the site was originally disturbed when the site was cleared to create a pasture. Vegetation was both burned and buried at the site. Buried burn piles were found during the site soil investigation. Since pasture conversion, the wetlands have been consistently

mowed to maintain the cleared conditions, limiting the development of woody vegetation but promoting herbaceous species growth.

Improvements of the wetlands at this site will include Restoration, Enhancement and Creation approaches. Restoration was undertaken in areas where vegetation alteration, minor filling (<12") and hydrologic alterations have resulted in non-jurisdictional areas that exhibit hydric soil signatures consistent with prior wetlands that have been disturbed. Enhancement was undertaken on existing wetlands where wetland characteristics associated with hydric soil, wetland hydrology or wetland vegetation were impaired. Enhancement involved replanting mowed wetlands and restoring hydrology to wetlands impacted by stream down-cutting and/or stream alteration. In some cases, minor fills (<6") were removed in discreet smaller areas and is considered an enhancement to soil and hydrologic conditions. Creation was undertaken in one area near where a lateral drainage ditch was located. This area had hydric soil signatures present but they were found at depths greater than a foot. Excavation of buried hydric soils in this area were conducted to restore wetland attributes and should result in near or full function of prior benefits.

3.3 Project History, Contacts, and Attribute Data

Baker implemented the project under a full delivery contract with NCDMS to provide stream and wetland mitigation credits in the Catawba River Basin. The chronology of the project is presented in Table 2. The contact information for all designers, contractors, and relevant suppliers is presented in Table 3. Relevant Project background information is presented in Table 4. Tables 2, 3, and 4 are located in Appendix A of this report. As-built stationing is outlined in the Construction Summary, below, and in Table 1 in Appendix A.

3.3.1 Construction Summary

The construction contractor was River Works, Inc. (River Works). A preconstruction meeting with River Works was conducted on May 14, 2014 and they began mobilizing to the site on May 20th. Construction began on Silver Creek in early June 2014. The Mainstem channel between 6+00 and 10+50 was completed during July 2014 and the channel between 13+00 and 15+00 was completed early in August 2014. During August, September and early October, River Works performed the grading that was associated with the various wetland areas and this soil was moved to the various stockpile areas. Construction on UT2 was completed during late September. Construction to the end of the mainstem was completed in November 2014.

UT3 was completed in December 2014 when structures in the enhancement reach were completed. UT1 was one of the last channels constructed and was completed during the end of November and first of December 2014.

As grading was completed on all the stream channels and on the designated wetland areas the bare ground was seeded with a native riparian seed mix and with millet or rye (depending on the season). The bare ground was then mulched with wheat straw. On the channels the sloping banks were covered with coir matting after seeding, which was pinned in place with wooden stakes. Live stakes were installed in the stream banks after the channel was constructed and at all sites by the end of December 2014. Bare rooted trees were planted across the site during the first week of March 2015.

As-built plan sheets/record drawings depict actual surveyed areas with the project area and depict any changes from the construction drawings to what was implemented on-site during construction. The as-built plan sheets/record drawings are located in Appendix D. The as-built results for the project, including restoration, enhancement, and creation areas, totaled

5,169 LF of stream and 9.14 AC of wetlands. The length and area for individual reaches and wetlands are summarized in Appendix A - Table 1.

Baker and River Works met on-site on December 2, 2014 and conducted a preliminary punch-list review of final items to be performed. A final site review with River Works was conducted on January 9, 2015. River Works demobilized in early January 2015 after the final walk through. The site was reviewed by the Division of Mitigation Services on January 13, 2015. Monitoring devices such as wetland ground water wells (except the one added), crest gauges, vegetation plots (except those added) and photo points for monitoring this site were installed and surveyed by mid-April 2015.

4.0 PERFORMANCE STANDARDS

The performance standards and success criteria for the project site will follow guidelines developed in the Stream Mitigation Guidelines (SMG) (USACE 2003) and as described in the approved mitigation plan for this project.

Post-restoration monitoring for stream related mitigation work will be conducted for five years post construction, based on a May 13, 2013 letter from NCDMS to the IRT regarding "EEP sites - seven year monitoring". As stated in the letter, "In the fourth year of monitoring, EEP will decide if the specific site may qualify to close out after five successful monitoring years. For those, EEP will submit to the IRT for early closure. For any … site that EEP does not think meets early closeout criteria, EEP will contract to complete the final two years" of monitoring (NCEEP (Now NCDMS), 2013).

Monitoring of project streams and wetlands will follow the recommendations in the 2003 SMG and the approved mitigation plan. Monitoring efforts will annually collect, evaluate, and report on stream, wetland, and vegetation success. Monitoring shall be consistent with the requirements described in the Federal Rule for compensatory mitigation sites in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.5 paragraphs (a) and (b), dated April 2008.

5.0 MONITORING PLAN AND SUCCESS CRITERIA

5.1 Stream Monitoring – Silver Creek, UT1, UT2 and UT3

Geomorphic monitoring of all the stream reaches will be conducted once a year for a minimum of five years following the completion of construction to evaluate the effectiveness of the restoration practices. Monitored stream parameters include stream dimension (cross-sections), pattern (planimetric survey), profile (longitudinal profile survey), and visual observation with photographic documentation. The methods used and related success criteria are described below for each parameter.

5.1.1 Bankfull Events and Flooding Functions

The occurrence of bankfull events within the monitoring period will be documented by the use of crest gauges and photographs. The crest gauge will record the highest watermark between site visits, and the gauge will be checked at each site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits.

Two bankfull flow events must be documented within a five-year monitoring period. The two, bankfull events must occur in separate years. Monitoring will continue during the five-year period to document

the second bankfull event. If a second event is not recorded at the end of the five-year period, the IRT will determine if further monitoring of this parameter is needed.

5.1.2 Cross-Sections

Per the USACE 2003 SMGs, permanent cross-sections were generally installed at a rate of one cross-section per twenty bankfull widths of restored stream, with approximately 50 percent of cross-sections located at riffles and 50 percent located at pools. Each cross-section is marked on both banks with permanent monuments to establish the exact transect used. A common benchmark will be used for cross-sections and consistently used to facilitate easy comparison of year-to-year data. Cross-section surveys will occur annually and will include measurements of Bank Height Ratio and Entrenchment Ratio. The monitoring survey will include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg, if the features are present. Riffle cross-sections will be classified using the Rosgen Stream Classification System (Rosgen 1994, 1996).

There should be little change in as-built cross-sections. If changes do occur, they will be documented in the survey data and evaluated to determine if they represent a movement toward a more unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross-sections will be classified using the Rosgen Stream Classification System, and all monitored cross-sections should fall within the quantitative parameters (i.e. BHR no more than 1.2 and ER no less than 2.2) defined for channels of the design stream type. Given the small channel size, sandy substrate, and large floodplain widths of the proposed steam, bank pins will not be installed unless required by the USACE.

5.1.3 Pattern

The plan view measurements such as sinuosity, radius of curvature, and meander width ratio will be taken on newly constructed meanders for the as-built baseline conditions. Subsequent visual monitoring will be conducted twice a year, at least five months apart, to document any changes or excessive lateral movement in the plan view of the restored channel.

5.1.4 Longitudinal Profile

A longitudinal profile was surveyed for the entire length of channel on Silver Creek, UT1, UT2 and UT3-R2 immediately after construction to document as-built baseline conditions. The survey was tied to a permanent benchmark and measurements included thalweg, water surface, bankfull, and top of low bank. Each of these measurements were taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth. The longitudinal profile should show that the bedform features installed are consistent with intended design stream type. The longitudinal profiles will be replicated each year.

5.1.5 Bed Material Analyses

Bed material analysis will consist of pebble counts taken in the as-built year and year 5 only unless site instability points towards a sediment transport issue. Sample sites will be selected to represent conditions on the mainstem and on the tributaries. These samples, combined with evidence provided by changes in cross-section and profile data will reveal changes in sediment transport and bed gradation that occur over time as the stream adjusts to upstream sediment loads and cross-sections evolve into a more permanent stable dimension.

5.1.6 Photo Reference Stations

Photographs will be used to document restoration success. Reference photo points will be photographed after construction and continued annually for at least five years. Photographs will be taken from a height of approximately five to six feet. Markers will be established at each photo point and reference

photographs carried into the field to ensure that the same locations (and view directions) of the site are duplicated in each monitoring period.

Lateral reference photos. Reference photo transects will be taken at each permanent cross-section. Photographs will be taken of both banks at each cross-section. The transect centerline will be centered in the photographs of each bank to the extent possible. The water line will be located in the lower edge of the frame, and as much of the bank as possible will be included in each photo. Photographers should make an effort to maintain consistent areas in each photo over time.

Structure photos. Photographs will be taken of grade control structures along the restored stream and will be limited to boulder and log steps. Photographers will make every effort to maintain consistent areas in each photo over time.

Photographs will be used to evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures subjectively. Lateral photos should not indicate excessive erosion or continuing degradation of the banks. A series of photos over time should indicate successive maturation of riparian vegetation.

5.2 Wetland Monitoring

5.2.1 Groundwater Data Collection

Groundwater monitoring wells were installed in the created, restored, and enhanced wetland areas in both the riparian and non-riparian wetlands in order to document the hydrologic conditions present post-construction. The monitoring wells will be used to evaluate the restoration of groundwater hydrology during each growing season for five years of hydrologic monitoring, or until success criteria have been met. Thirteen automated gauges were installed.. 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 (described below), which may then be compared to the hydrology of reference wetlands.

Installation and monitoring of the groundwater stations followed the USACE standard methods outlined in the technical note ERDC TN-WRAP-05-2 and NCDMS Guidance Topics for the Development of DMS Mitigation Plans (USACE, 2005 and Faber-Langendoen et. al. 2006). The location of each groundwater monitoring well was surveyed as part of the As-built survey data and is shown on the As-built Plan Set. Data from each of the wells will be downloaded on a quarterly basis.

Success criteria for wetland hydrology will be based on standards for atypical wetland areas (USACE, 2005). Criteria have been met when each wetland site is saturated within 12 inches of the soil surface for 12% of the growing season when rainfall amounts mimic normal conditions, or for “fourteen (14) or more consecutive days during the growing season during a period when antecedent precipitation has been…drier than normal…for a minimum frequency of 5 years in 10 or 50%” of the monitoring time frame (USACE, 1987 and 2005).

The average growing season for the project locale is 208 days, beginning on April 3 and ending October 29 (NRCS Burke County WETS Table , Morganton, NC: NC5838, 2002). Data was retrieved from http://www.wcc.nrcs.usda.gov/climate/wetlands.html for this station for the period of record from 1971-2000. Thus, 12% of the growing season for this project is 25 days.

In order to determine if the rainfall is normal for the given year, rainfall amounts will be tallied using data obtained from the Burke County Morganton WETS Station NC5838 (NRCS, Established 1971) and from the nearby automated weather station in Rutherford County at Casar, NC (311538) that has been in operation since 1956. Data from this station can be obtained from the Southeast Regional Climate Center (SERCC) website (http://www.sercc.com/cgi-bin/sercc/cliMAIN.pl?nc1538, 2011).

Additionally, large areas of ponded, standing water located in the central portion of the left bank of the restored wetland area have been observed for extended periods from the late autumn through spring. This restricted the location of groundwater wells in this area during the initial installation effort in March 2015. All observed inundation will be noted and documented during future annual monitoring. Overbank flooding from the adjacent channel will also be noted during annual monitoring.

Baker will evaluate wetland areas annually for restoration success and the results will be reported in the annual monitoring report. If the rainfall data for any given year during the monitoring period are abnormal, it may be possible that the desired hydrology for the site will not meet specific success criteria. However, reference wetland data will be assessed to determine if there is a positive correlation between the underperformance of the project site and the natural hydrology of the reference site(s).

5.2.2 Photo Reference Stations

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 seven years following construction. Photographs will be taken from a height of approximately five to six feet. Permanent markers were established to ensure that the same locations (and view directions) on the site are documented in each monitoring period.

5.3 Vegetation Monitoring

Successful restoration of the vegetation on a site is dependent upon hydrologic restoration, planting of preferred canopy species, and volunteer regeneration of the native plant community. In order to determine if successful restoration of vegetation is achieved, vegetation-monitoring quadrants have been installed and will be monitored across the restoration site in accordance with the CVS-NCDMS Protocol for Recording Vegetation, Version 4.1 (2007). Vegetation will be monitored using fourteen (14) plots established randomly within the planted riparian buffer and wetland utilizing the CVS Monitoring Levels 1 and 2. The size of individual quadrants are 100 square meters for woody tree species and 1 square meter for herbaceous vegetation. Originally, nine veg plots were established at this site, which was two plots more than was approved in the Mitigation Plan. However, it was determined after the baseline data was collected that the correct number of plots based on the CVS guidance using 2.5% of the planted area, is 14 plots. Five additional vegetation monitoring plots were added during year one monitoring efforts and the results for these plots will be reported in the first year monitoring report.

Vegetation monitoring will occur in the fall, prior to the loss of leaves. Individual quadrant data will be provided and will include species diameter, height, density, and coverage quantities. Relative values will be calculated, and importance values will be determined. Individual seedlings were marked such that they can be found in succeeding monitoring years. Mortality will be determined from the difference between the previous year's living, planted seedlings and the current year's living, planted seedlings.

At the end of the first full growing season between September 1st and November 30th, species composition, stem density, and survival will be evaluated. Vegetation plots shall be monitored for five years until the final success criteria are achieved. The restored site will be evaluated between September and November. The interim measure of vegetative success for the site will require the survival of at least 320, 3-year old, planted trees per acre at the end of year three of the monitoring period. The final vegetative success criteria at year 5 will be the survival of no less than 260, 5-year old, planted trees per acre.

While measuring species density and height is the current accepted methodology for evaluating vegetation success on mitigation projects, species density and height alone may be inadequate for assessing plant community health. For this reason, the vegetation monitoring plan will incorporate the evaluation of

additional plant community indices, native volunteer species, and the presence of invasive species vegetation to assess overall vegetative success.

6.0 AS-BUILT DATA DOCUMENTATION

Stream, wetland, and vegetation components will be monitored for five years post-construction to evaluate project success. The specific locations of vegetation plots, permanent cross-sections, crest gauges, and wetland gauges are shown on the as-built plan sheets. Photo reference stations were installed along all of the project channels. The location and photo direction of each photo reference point are also depicted on the as-built plan sheets in Appendix D.

6.1 Stream Data

For monitoring stream success criteria, sixteen (16) permanent cross-sections (7 on Silver Creek, 2 on UT1, 2 on UT2 and 5 on UT3) and two (2) crest gauges were installed on project streams. The permanent cross-sections will be used to monitor channel dimension and bank stability over time. The crest gauge will be used to document the occurrence of bankfull events. Twenty seven (27) photo reference points were installed throughout the project area (10 photo points on Silver Creek, 4 photo points on UT1, 3 photo points on UT2, and 10 photo points on UT3). The size of streambed material was accessed by doing five (5) 100-count pebble counts. Two at locations on the mainstem and at one site on each of the unnamed tributaries. The total number of cross-sections and crest gauges installed to monitor this project site was increased from the numbers proposed in the Upper Silver Creek Mitigation Plan, from a proposed ten cross-sections to the installed sixteen and from one crest gauge to two. Additionally, a longitudinal survey was completed for the restored stream channels to provide a baseline for evaluating changes in bed conditions over time. The as-built permanent cross-sections (with photos) and as-built longitudinal data as well as the quantitative pre-construction, reference reach, and design data used to determine restoration approach are provided in Appendix B. As-built data will be used for comparison to post-construction monitoring data. The locations of the permanent cross-sections, crest gauges and photo points are shown on the as-built plan sheets in Appendix D. Photographs from each photo point are provided in Appendix E.

6.2 Hydrology Data

A total of thirteen (13) groundwater monitoring gauges were installed throughout the project site. Wells were located in the approximate locations that were shown in the Upper Silver Creek Mitigation Plan. However, some locations were altered because additional wells were installed. Groundwater gauges will document water table hydrology throughout the five-year monitoring period and will be compared to pre-restoration and reference conditions. Locations of the groundwater gauges are depicted in the as-built plan sheets in Appendix D.

6.3 Vegetation Data

Bare-root trees and shrubs were planted within restoration and enhancement areas of the conservation easement. A minimum 30-foot buffer was established and protected along all stream reaches. Planting of bare-root trees and shrubs, as well as wetland and live stake planting was completed in March 2015. Twenty-five (25) species of woody vegetation were proposed for planting in the site mitigation plan and were requested from the contractor; however, only eleven (11) of the twenty were available. In addition, nine (9) other native, riparian woody species were commercially available at the needed time and were planted at the site for a total of 20 species being planted. Species planted at the Upper Silver Creek site are summarized in Table 7 of Appendix C.

The Mitigation Plan for the site specifies that the number of quadrants required shall be based on the CVS-NCDMS monitoring guidance (2007). The total number of quadrants was calculated using the CVS-NCDMS

Entry Tool Database version 2.2.7 (CVS-NCEEP, 2007). The sizes of individual quadrants are 100 square meters. Fourteen (14) vegetation plots were installed throughout the project site. Nine plots were established initially and the data from these plots is reported here; however, upon review it was determined that additional plots were required. Five vegetation plots were added at the Upper Silver Creek site and their location is shown on Figure 2 and on the plan sheets in Appendix D. The data for all 14 vegetation plots will be reported in the year one monitoring report. The initial planted density within each of the original nine vegetation monitoring plots is provided in Table 8 of Appendix C. The average density of planted bare root stems, based on the data from the nine vegetation monitoring plots, is 841 stems per acre. The locations of the nine vegetation plots (plot numbers 1-9) are shown on the as-built plan sheets in Appendix D. The added vegetation plots are shown on Figure 2.

6.4 Areas of Concern

No areas of concern for the time of this report.

7.0 MAINTENANCE AND CONTINGENCY PLANS

Maintenance requirements vary from site to site and are generally driven by the following conditions:

- Projects without established floodplain vegetation are more susceptible to erosion from floods than floodplains with mature herbaceous and woody vegetation.
- Projects with sandy, non-cohesive soils are more prone to bank erosion than cohesive soils or soils with high gravel and cobble content.
- Alluvial valley channels with access to their floodplain are less vulnerable to erosion than channels that have been disconnected from their floodplain.
- Wet weather during construction can make accurate channel and floodplain excavations difficult.
- Extreme and/or frequent flooding can cause floodplain and channel erosion.
- Extreme hot, cold, wet, or dry weather during and after construction can limit vegetation growth, particularly temporary and permanent seed.
- The presence and aggressiveness of invasive vegetation species can affect the extent to which a native species vegetation buffer can be established.
- The presence of beaver can affect vegetation survivability and stream function.

The site will be monitored on a regular basis, including a physical inspection of the site at least once a year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Maintenance issues and recommended remediation measures will be detailed and documented in the post-construction monitoring reports. Factors that may have caused any maintenance needs, including any of the conditions listed above, shall be discussed. Routine maintenance will be most likely in the first two years following site construction and may include the following components as described below.

7.1 Streams

Routine channel maintenance and repair activities may include modifying in-stream structures to prevent piping, securing loose coir matting, and supplemental installations of live stakes and other target vegetation along the project reaches. Areas of concentrated stormwater and floodplain flows that intercept the channel may also require maintenance to prevent bank failures and head-cutting until vegetation becomes established.

7.2 Wetland

Routine wetland maintenance and repair activities may include supplemental installations of target vegetation within the wetland or installation and maintenance of groundwater wells. Areas of concentrated stormwater and floodplain flows that intercept the wetland may also require maintenance to prevent scour.

7.3 Vegetation

Vegetation will be maintained to ensure the health and vigor of the targeted plant community. Baker will provide required remedial action on a case-by-case basis, such as: replanting more wet/drought tolerant species, conducting beaver management/dam removal, removing undesirable/invasive species vegetation and will continue to monitor vegetation performance until the corrective actions demonstrate that the site is trending towards or meeting the standard requirement. Existing mature woody vegetation will be visually monitored during annual site visits to document any mortality, due to construction activities or changes to the water table that may negatively affect existing forest cover or favorable buffer vegetation. Additionally, herbaceous vegetation, primarily native grasses, will be seeded/planted throughout the site as necessary. Exotic invasive plant species will be controlled by mechanical and/or chemical methods. Any invasive plant species control requiring herbicide application will be performed in accordance with NC Department of Agriculture and Consumer Services (NCDA&CS) rules and regulations.

7.4 Site Boundary

Site boundaries have been demarcated in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries can be identified by fence, marker, bollard, post, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.

8.0 REFERENCES

Carolina Vegetation Survey (CVS) and NC Ecosystem Enhancement Program (NCEEP). 2007. CVS-NCEEP Data Entry Tool v. 2.2.7. University of North Carolina, Raleigh, NC.

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

Faber-Langendoen, D., Rocchio, J., Schafale, M., Nordman, C., Pyne, M., Teague, J., Foti, T., Comer, P. (2006), *Ecological Integrity Assessment and Performance Measures for Wetland Mitigation*. NatureServe, Arlington, Virginia.

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.

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.

North Carolina Division of Mitigation Services. 2009. Guidance and Content Requirements for EEP Monitoring Reports Ver. 1.2.1. December 1, 2009.

____. Letter from NCDMS to the IRT regarding “DMS sites - seven year monitoring” 2013.

Rosgen, D. L. 1994. A classification of natural rivers. Catena 22:169-199.

___. 1996. Applied River Morphology. Wildland Hydrology Books, Pagosa Springs, Colo.

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.

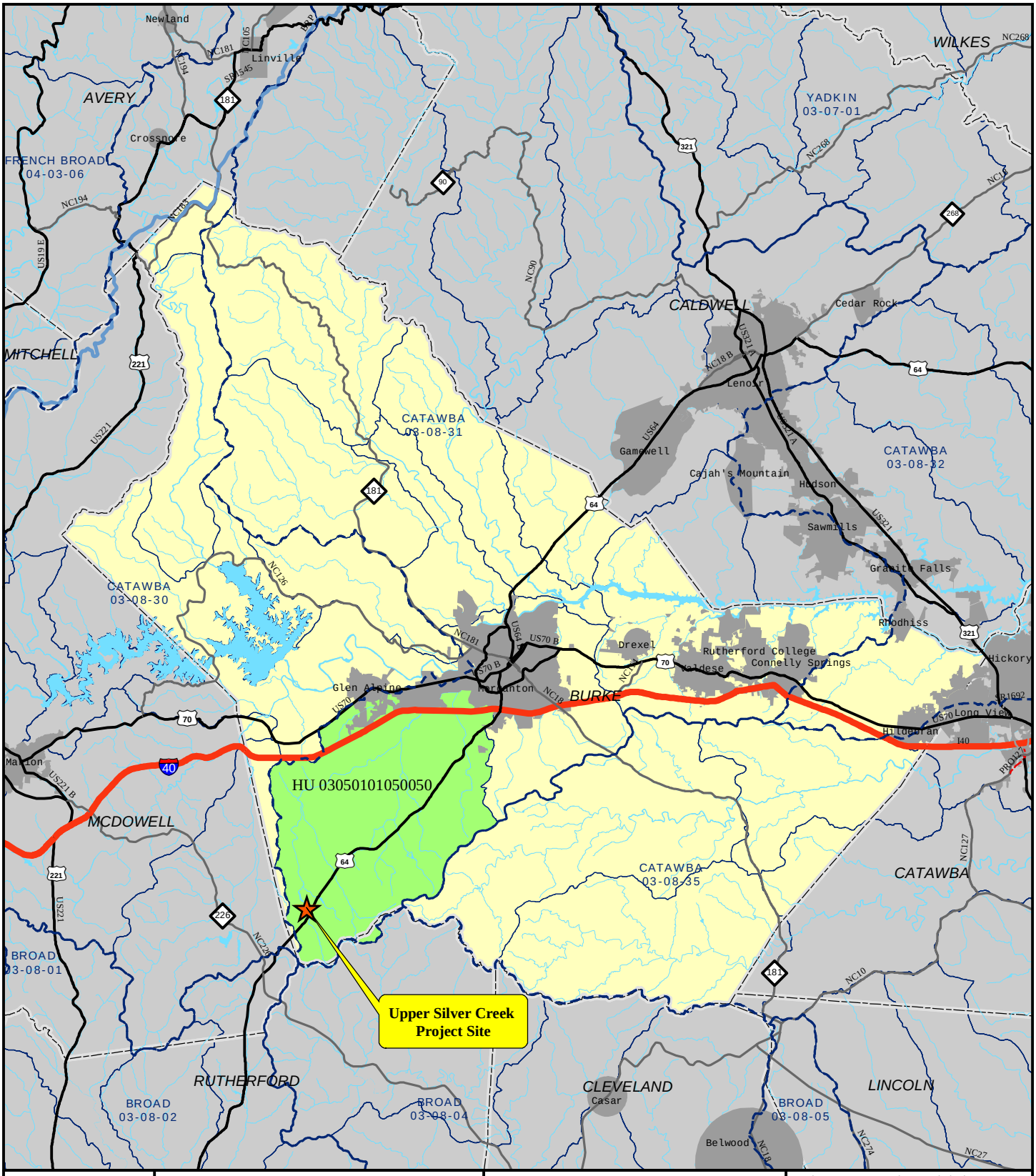
United States Army Corps of Engineers (USACE). 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. Environmental Laboratory. US Army Engineer Waterways Experiment Station. Vicksburg, MS.

____. 2003. Stream Mitigation Guidelines. April 2003, U.S. Army Corps of Engineers. Wilmington District. Prepared with cooperation from US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Quality. www.saw.usace.army.mil/wetlands/Mitigation/stream_mitigation.html

____. 2005. Technical standard for water-table monitoring of potential wetland sites. *ERDC TN-WRAP-05-2*, Vicksburg, MS. http://el.erdc.usace.army.mil/wrap/pdf/tnwrap05-2.pdf

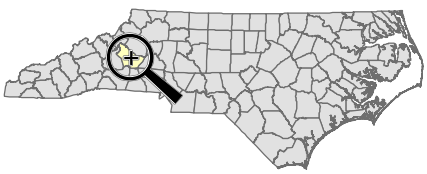
APPENDIX A

Figures 1 - 3, Tables 1 - 4



Division of Mitigation Services

Map Inset



Burke County, NC

LEGEND:

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

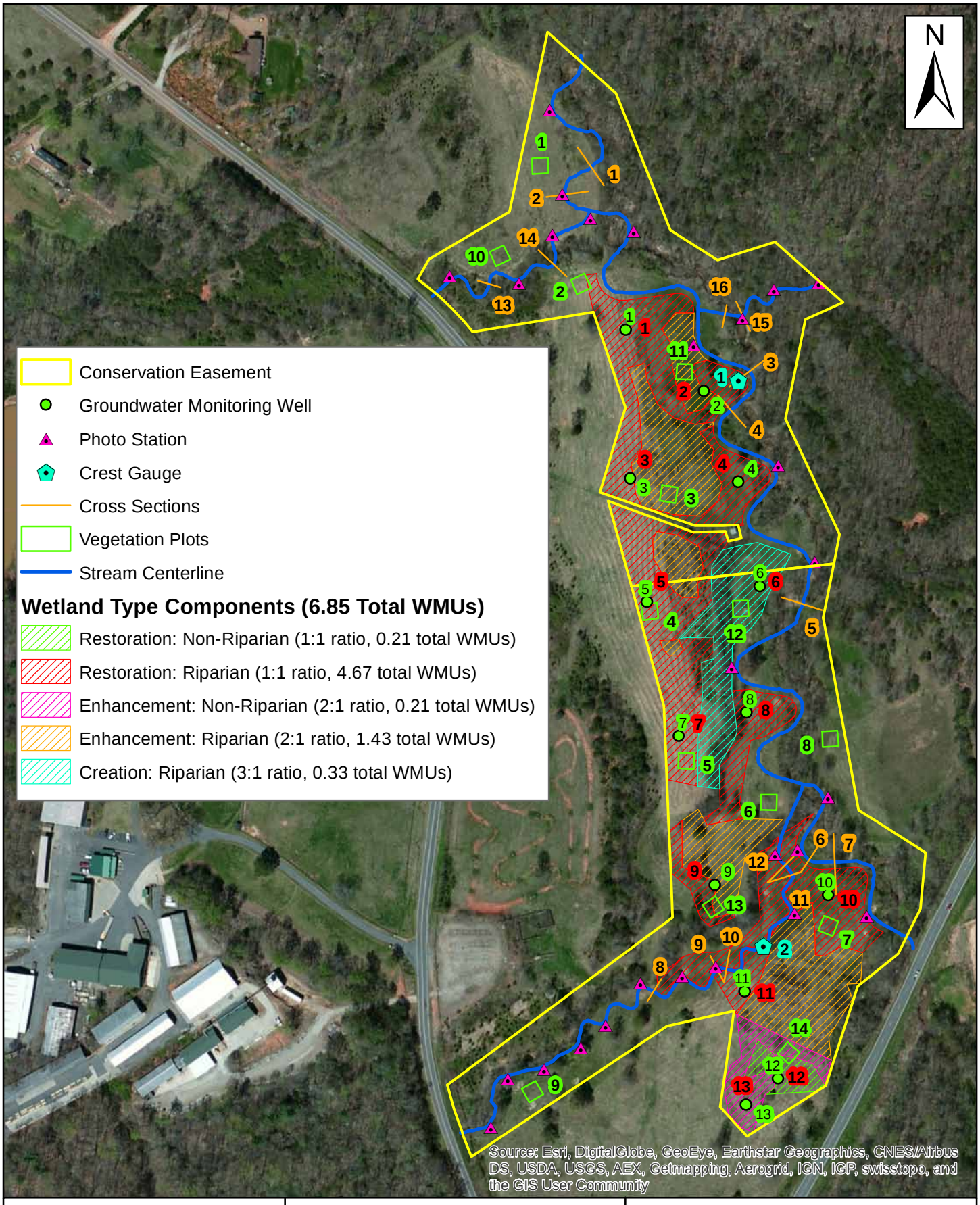
N

0 1 2 4 Miles

Figure 1. Project Vicinity Map

Upper Silver Creek
NCDMS Project #94645
Baseline Monitoring Report
Burke County, NC

Michael Baker INTERNATIONAL

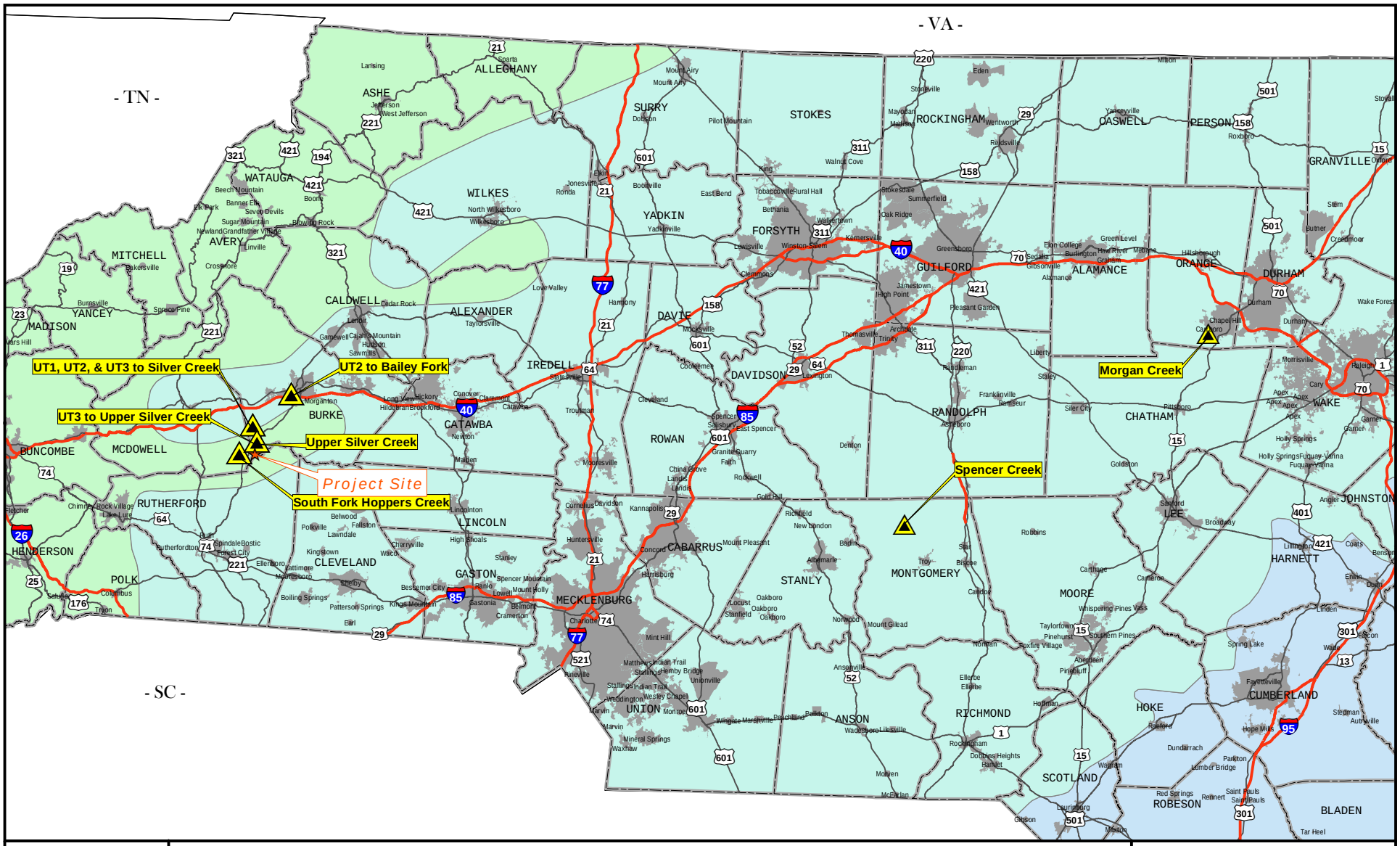


Michael Baker INTERNATIONAL

0 250 500 Feet

DMS Project # 94645

Figure 2
Restoration Summary Map and As-Built Monitoring Features
Upper Silver Creek Site



North Carolina Division of Mitigation Services

Figure 3 Reference Reach Location
Upper Silver Creek
NCDMS #94645
Mitigation Plan
Burke County, NC

Michael Baker INTERNATIONAL

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 - P1	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	342					
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

* All componenets reflect changes proposed in the Mitigation Plan Addendum for the Upper Silver Creek Restoration Project in Burke County, November 30, 2015 and accepted by the IRT in December, 2015.

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
Mitigation Plan Addendum	N/A	N/A	Dec-16
Year 1 Monitoring	Dec-15	N/A	Mar-16
Year 2 Monitoring	Dec-16	N/A	N/A
Year 3 Monitoring	Dec-17	N/A	N/A
Year 4 Monitoring	Dec-18	N/A	N/A
Year 5 Monitoring	Dec-19	N/A	N/A

Table 3. Project Contacts Table	
Upper Silver Creek Restoration Project: DMS Project ID No. 94645	
Designer	
Michael Baker Engineering, Inc.	797 Haywood Rd Suite 201 Asheville, NC 28806 Contact: Micky Clemmons, Tel. 828-412-6100
Construction Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Planting Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Seeding Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: 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 ArborGen Inc. (trees), 843-528-3204 Dykes and Son (trees), 931-668-8833
Monitoring Performers	
Michael Baker Engineering, Inc.	797 Haywood Rd Suite 201 Asheville, NC 28806
	Contact:
Stream 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		
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 have been disturbed to some degree; until recently, some were still periodically mowed. As a result, only remnants of native vegetative communities exist in the wetland areas.
3. Fescue was 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 B

Morphological Summary Data (Tables 5 and 6), Cross-section Plots, Profile Plots, Pebble Count Plots

Table 5. Baseline 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**						**Design**						**As-built**					
											Morgan Creek																	
Dimension and Substrate - Riffle		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
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
Floodprone Width (ft)	-	-	-	-	397.0	-	-	453.0	-	7	77.5	-	-	86.8	-	-	397	-	-	453.0	-	-	-	>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
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
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
Width/Depth Ratio	-	-	-	-	7.4	-	-	8.8	-	7	14.1	-	-	14.7	-	-	-	12	-	-	-	-	11.8	14.8	15.1	17.3	2.4	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
Bank Height Ratio	-	-	-	-	1.07	-	-	1.5	-	7	1.0	-	-	1.0	-	-	1	-	-	1.1	-	-	1.0	1.03	1.00	1.1	0.0	4
d50 (mm)	-	-	-	-	-	17.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pattern																												
Channel Beltwidth (ft)	-	-	-	-	45	-	-	106	-	-	-	-	-	-	-	-	104	-	-	208	-	-	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
Rc:Bankfull width (ft/ft)	-	-	-	-	1	-	-	3.1	-	-	-	-	-	-	-	-	1.8	-	-	2.8	-	-	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
Meander Width Ratio	-	-	-	-	2.3	-	-	5.4	-	-	-	-	-	-	-	-	7.0	-	-	12.0	-	-	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
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
Pool Length (ft)	-	-	-	-	15	-	-	135	-	-	-	-	-	-	-	-	78	-	-	137	-	-	50.4	97.1	94.0	136.6	20.4	16.0
Pool Spacing (ft)	-	-	-	-	40	-	-	162	-	-	46	-	-	277	-	-	104	-	-	182	-	-	113.7	145.8	140.1	210.4	29.6	15
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
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
Reach Shear Stress (competency) lb/f²	-	-	-	-	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	-	-
Impervious cover estimate (%)	-	-	-	-	-	<5%	-	-	-	-	-	-	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-
Rosgen Classification	-	-	-	-	-	E	-	-	-	-	-	C4	-	-	-	-	-	C	-	-	-	-	-	C	-	-	-	-
BF Velocity (fps)	-	-	-	-	2.8	-	-	4.9	-	7	-	7	-	-	-	-	-	4.20	-	-	-	-	-	4.27	-	-	-	-
BF Discharge (cfs)	-	232.0	196.0	213.2	180	-	-	240	-	-	-	524	-	-	-	-	-	230.0	-	-	-	-	-	212.2	-	-	-	-
Valley Length	-	-	-	-	-	1947	-	-	-	-	-	-	-	-	-	-	-	1947.0	-	-	-	-	-	1947.0	-	-	-	-
Channel length (ft^3)	-	-	-	-	-	3179	-	-	-	-	-	-	-	-	-	-	-	3068	-	-	-	-	-	3016	-	-	-	-
Sinuosity	-	-	-	-	-	1.63	-	-	-	-	-	-	-	-	-	-	-	1.58	-	-	-	-	-	1.55	-	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	0.0040	-	-	-	-	-	0.0070	-	-	-	-	0.003	-	-	0.004	-	-	-	0.0043	-	-	-	-
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.003	-	-	0.008	-	-	-	0.004	-	-	-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-	2.1	-	-	-	-	-	-	-	-	-	-	-	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.

3. Existing conditions survey data is compiled for the entire UT1 Reach within the project limits.

Table 5. Baseline Stream Summary

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

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**					
Dimension and Substrate - Riffle		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
BF Width (ft)	-	11.9	6.9	-	6.1	-	-	9.3	-	4	6.3	-	-	7.9	-	-	-	9.5	-	-	-	-	-	9.6	-	-	-	1
Floodprone Width (ft)	-	-	-	-	10.9	-	-	60.5	-	4	15	-	-	19	-	-	10.9	-	-	60.5	-	-	-	>150	-	-	-	1
BF Mean Depth (ft)	-	0.7	1.0	-	0.97	-	-	1.50	-	4	0.7	-	-	0.9	-	-	-	0.95	-	-	-	-	-	0.9	-	-	-	1
BF Max Depth (ft)	-	-	-	-	1.37	-	-	2.07	-	4	1.0	-	-	1.35	-	-	-	1.2	-	-	-	-	-	1.3	-	-	-	1
BF Cross-sectional Area (ft^2)	-	9.1	9.0	-	9	-	-	9.07	-	4	5.5	-	-	6.5	-	-	-	9.0	-	-	-	-	-	8.9	-	-	-	1
Width/Depth Ratio	-	-	-	-	4	-	-	9.6	-	4	7.3	-	-	11.7	-	-	-	10	-	-	-	-	-	10.3	-	-	-	1
Entrenchment Ratio	-	-	-	-	1.2	-	-	10	-	4	1.9	-	-	3.0	-	-	1.1	-	-	6.4	-	-	-	5.3	-	-	-	1
Bank Height Ratio	-	-	-	-	1.5	-	-	3.0	-	4	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	-	1.00	-	-	-	1
d50 (mm)	-	-	-	-	-	18.0	-	-	-	-	-	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pattern																											
Channel Beltwidth (ft)	-	-	-	-	30	-	-	60	-	-	-	-	-	-	-	-	33	-	-	76	-	-	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
Rc:Bankfull width (ft/ft)	-	-	-	-	1.2	-	-	2.7	-	-	-	-	-	-	-	-	1.8	-	-	2.8	-	-	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
Meander Width Ratio	-	-	-	-	12	-	-	18	-	-	1.2	-	-	1.2	-	-	7.0	-	-	12.0	-	-	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
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
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.1	33.8	35.1	41.7	6.6	5
Pool Spacing (ft)	-	-	-	-	15	-	-	50	-	-	39.9	-	-	62.3	-	-	38	-	-	67	-	-	23.4	46.0	51.6	60.1	13.3	7
Pool Max Depth (ft)	-	-	-	-	2	-	-	2.4	-		1.8	-	-	1.8	-	-	1.9	-	-	3.3	-	-	-	1.4	-	-	-	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					
Reach Shear Stress (competency) lb/ft^2	-	-	-	-	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	-	-
Impervious cover estimate (%)	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-
Rosgen Classification	-	-	-	-	-	E, Gc, Bc	-	-	-	-	-	E/Bc	-	-	-	-	-	E (high W/D)	-	-	-	-	-	C	-	-	-	-
BF Velocity (fps)	-	-	-	-	3.4	-	-	4.6	-		2.1	-	3.4	-	-	-	-	3.7	-	-	-	-	-	3.81	-	-	-	-
BF Discharge (cfs)	-	38.0	36.0	-	31	-	-	41	-	-	-	18	-	-	-	-	-	33.5	-	-	-	-	-	33.9	-	-	-	-
Valley Length	-	-	-	-	-	371	-	-	-	-	-	-	-	-	-	-	-	367.0	-	-	-	-	-	367.0	-	-	-	-
Channel length (ft)[3]	-	-	-	-	-	524	-	-	-	-	-	134.5	-	-	-	-	-	373	-	-	-	-	-	495	-	-	-	-
Sinuosity	-	-	-	-	-	1.41	-	-	-	-	-	1.05	-	-	-	-	-	1.35	-	-	-	-	-	1.36	-	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	0.0160	-	-	-		-	0.0189	-	-	-	-	-	0.0150	-	-	-	-		0.0162	-		-	-
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.011	-	-	-	-		0.0161	-		-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	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.

3. Existing conditions survey data is compiled for the entire UT1 Reach within the project limits.

Table 5. Baseline 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**						**Design**						**As-built**					
											Morgan Creek																	
Dimension and Substrate - Riffle		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
BF Width (ft)	-	6.0	3.1	-	3.1	-	-	3.4	-	2	6.3	-	-	7.9	-	-	-	6.0	-	-	-	-	-	6.6	-	-	-	1
Floodprone Width (ft)	-	-	-	-	5.1	-	-	6.4	-	2	15	-	-	19	-	-	60		-	120.0	-	-	-	>100	-	-	-	1
BF Mean Depth (ft)	-	0.4	0.6	-	0.84	-	-	0.90	-	2	0.7	-	-	0.9	-	-	-	0.5	-	-	-	-	-	0.4	-	-	-	1
BF Max Depth (ft)	-	-	-	-	1.1	-	-	1.4	-	2	1.0	-	-	1.35	-	-	-	0.6	-	-	-	-	-	0.9	-	-	-	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
Width/Depth Ratio	-	-	-	-	3.5	-	-	4.0	-	2	7.3	-	-	11.7	-	-	-	12.0	-	-	-	-	-	16.0	-	-	-	1
Entrenchment Ratio	-	-	-	-	1.6	-	-	1.9	-	2	1.9	-	-	3.0	-	-	10	-	-	20	-	-	-	7.0	-	-	-	1
Bank Height Ratio	-	-	-	-	2.2	-	-	2.4	-	2	-	-	-	-	-	-	-	1.1	-	-	-	-	-	1.2	-	-	-	1
d50 (mm)	-	-	-	-	-	18.00	-	-	-	-	-	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pattern																												
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	-	-	30	-	-	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
Rc:Bankfull width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	-	-	3.0	-	-	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
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	1.2	-	-	1.2	-	-	7.0	-	-	12.0	-	-	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
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
Pool Length (ft)	-	-	-	-	5.2	-	-	12.7	-	-	-	-	-	-	-	-	17.41	-	-	26.03	-	-	7.5	17.3	15.6	28.8	8.0	8
Pool Spacing (ft)	-	-	-	-	9.5	-	-	51	-	-	39.9	-	-	62.3	-	-	9	-	-	30	-	-	14.8	28.8	25.2	47.9	11.5	8
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	1.8	-	-	-	-	-	1.4	-	-	-	-	-	1.7	-	-	-	1
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					
Reach Shear Stress (competency) lb/f²	-	-	-	-	-	-	-	-	-	-	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	-	-
Impervious cover estimate (%)	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-
Rosgen Classification	-	-	-	-	-	G/B[3]	-	-	-	-	-	E/Bc	-	-	-	-	-	Cb, C	-	-	-	-	-	C	-	-	-	-
BF Velocity (fps)	-	-	-	-	3.2	-	-	3.9	-	-	2.1	-	3.4	-	-	-	-	3.50	-	-	-	-	-	2.98	-	-	-	-
BF Discharge (cfs)	-	-	9.5	-	9	-	-	11	-	-	-	18	-	-	-	-	-	10.0	-	-	-	-	-	8.0	-	-	-	-
Valley Length	-	-	-	-	-	194	-	-	-	-	-	-	-	-	-	-	-	248.0	-	-	-	-	-	248.0	-	-	-	-
Channel length (ft)	-	-	-	-	-	209	-	-	-	-	-	134.5	-	-	-	-	-	333	-	-	-	-	-	310	-	-	-	-
Sinuosity	-	-	-	-	-	1.08	-	-	-	-	-	1.05	-	-	-	-	-	1.34	-	-	-	-	-	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	-	-
BF slope (ft/ft)	-	-	-	-	-	0.024	-	-	-	-	-	-	-	-	-	-		0.02			-	-	0.0077	0.0175	-	0.0272	-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	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.

3. The evolution scenario is more likely a Cb starting point; however, the slope of the stream is such that a B-type stream with a lower entrenchment ratio could have been present before mining and other disturbance. The cross-sections classify in a strict sense as B-type channels, however the entrenchment ratio is within 0.2 units of the acceptable variation for classification as a G. The low width/depth ratio suggests that it is more appropriately classified as a G.

Table 5. Baseline Stream Summary

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

UT3																											
Parameter	**USGS Gauge**	**Regional Curve Interval [1,2]**			**Pre-Existing Condition[1]**						**Reference Reach Data Morgan Creek**						**Design**						**As-built**					
Dimension and Substrate - Riffle		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
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	0.9	3
Floodprone Width (ft)	-	-	-	-	7.7	-	-	48.0	-	-	15.0	-	-	19.0	-	-	-	-	-	-	-	-		>150				
BF Mean Depth (ft)	-	0.6	0.8	-	1.05	-	-	1.57	-	-	0.70	-	-	0.90	-	-	-	0.8	-	-	-	-	0.65	0.8	0.8	0.90	0.1	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	0.1	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	0.4320494	3
Width/Depth Ratio	-	-	-	-	2.4	-	-	5	-	-	7.3	-	-	11.7	-	-	-	8.9	-	-	-	-	9.12	11.6	10.3	15.46	2.7466828	3
Entrenchment Ratio	-	-	-	-	2.1	-	-	9.1	-	-	1.9	-	-	3	-	-	-	-	-	-	-	-	5.4	7.8	8.5	9.4	1.7133463	3
Bank Height Ratio	-	-	-	-	1.0	-	-	2.4	-	-	-	-	-	-	-	-	1.0	-	-	1.0	-	-	1.0	1.1	1.1	1.2	0.1	3
d50 (mm)	-	-	-	-	-	16.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pattern																												
Channel Beltwidth (ft)	-	-	-	-	44	-	-	94	-	-	-	-	-	-	-	-	25	-	-	56	-	-	36.4	47.014286	48.4	57.7	7.2092061	7
Radius of Curvature (ft)	-	-	-	-	11	-	-	30	-	-	-	-	-	-	-	-	13	-	-	21	-	-	14	18.842857	19.4	25.1	3.7201602	7
Rc:Bankfull width (ft/ft)	-	-	-	-	2.5	-	-	6.7	-	-	-	-	-	-	-	-	1.8	-	-	3	-	-	1.5909091	2.1412338	2.2045455	2.8522727	0.4227455	7
Meander Wavelength (ft)	-	-	-	-	49	-	-	72	-	-	45	-	-	75	-	-	49	-	-	84	-	-	63.5	74.857143	71.7	94.2	10.300743	7
Meander Width Ratio	-	-	-	-	10.9	-	-	12.8	-	-	6.4	-	-	10.5	-	-	7	-	-	12	-	-	7.2159091	8.5064935	8.1477273	10.704545	1.170539	7
Profile																												
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.1	21.1	20.6	28.2	4.5	11
Riffle Slope (ft/ft)	-	-	-	-	0.0052	-	-	0.0305	-	-	0.0130	-	-	0.054	-	-	0.0160	-	-	0.022	-	-	0.0036	0.0158	0.0172	0.0248	0.0072	11
Pool Length (ft)	-	-	-	-	25	-	-	65	-	-	17.4	-	-	26	-	-	20	-	-	40	-	-	18.4	26.4	25.8	33.5	5	11
Pool Spacing (ft)	-	-	-	-	40	-	-	140	-	-	39.9	-	-	62.3	-	-	18	-	-	42	-	-	36.3	49	47.7	60.7	7.3	15
Pool Max Depth (ft)	-	-	-	-	1.8	-	-	1.8	-		1.8	-	-	1.8	-	-	1.6	-	-	2.8	-	-	1.74	1.955	1.955	2.17	0.215	2
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					
Reach Shear Stress (competency) lb/f²	-	-	-	-	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	-	-
Impervious cover estimate (%)	-	-	-	-	-	<5%	-	-	-	-	-	-	-	-	-	-	-	<5%	-	-	-	-	-	-	-	-	-	-
Rosgen Classification	-	-	-	-	-	E	-	-	-	-	-	E/Bc	-	-	-	-	-	E	-	-	-	-	-	-	-	-	-	-
BF Velocity (fps)	-	-	-	-	3.9	-	-	4.9	-	-	2.1	-	3.4	-	-	-	-	3.3	-	-	-	-	-	3.43	-	-	-	-
BF Discharge (cfs)	-	26.0	24.0	-	20	-	-	25	-	-	-	15	-	-	-	-	-	21.7	-	-	-	-	-	23	-	-	-	-
Valley Length	-	-	-	-	-	1002	-	-	-	-	-	-	-	-	-	-	-	1015	-	-	-	-	-	1015	-	-	-	-
Channel length (ft)[3]	-	-	-	-	-	1210	-	-	-	-	-	135	-	-	-	-	-	1332	-	-	-	-	-	1348	-	-	-	-
Sinuosity	-	-	-	-	-	1.21	-	-	-	-	-	1.05	-	-	-	-	-	1.31	-	-	-	-	-	1.33	-	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	0.0150	-	-	-	-	-	0.0197	-	-	-	-	-	0.0130	-	-	-	-	-	0.0128	-	-	-	-
BF slope (ft/ft)	-	-	-	-	-	0.012	-	-	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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.
3. Existing conditions survey data is compiled for the entire UT1 Reach within the project limits.

Table 6. 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							35.7							43.5							23.8						
BF Mean Depth (ft)	1.7							1.6							1.7							2.0						
Width/Depth Ratio	17.2							21.8							25.2							11.8						
BF Cross-sectional Area (ft²)	49.2							58.3							74.9							48.0						
BF Max Depth (ft)	3.0							4.0							5.2							3.3						
Width of Floodprone Area (ft)	>300							>300							>300							>300						
Entrenchment Ratio	3.3							2.5							2.1							3.7						
Bank Height Ratio	1.1							1.0							0.7							1.0						
Wetted Perimeter (ft)	32.4							38.9							46.9							27.8						
Hydraulic Radius (ft)	15.6							21.8							36.0							11.8						
Fixed baseline bankfull elevation	1197.4							1198.2							1202.3							1203.0						
Based on current/developing bankfull feature																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Cross Sectional Area between end pins (ft²)	-							-																				
d50 (mm)	-							-														36.6						

	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							43.5							26.6													
BF Mean Depth (ft)	1.7							1.8							2.1													
Width/Depth Ratio	17.3							23.6							13.0													
BF Cross-sectional Area (ft²)	46.9							80.1							54.5													
BF Max Depth (ft)	2.9							5.3							3.3													
Width of Floodprone Area (ft)	>300							>300							>300													
Entrenchment Ratio	3.1							1.6							4.8													
Bank Height Ratio	1.0							1.0							1.0													
Wetted Perimeter (ft)	31.7							47.2							30.7													
Hydraulic Radius (ft)	1.5							1.7							1.8													
Fixed baseline bankfull elevation	1208.8							1208.1							1208.2													
Based on current/developing bankfull feature																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Cross Sectional Area between end pins (ft²)	-							-							-							-						
d50 (mm)	-							-							33.4							-						

Table 6. 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																			
BF Mean Depth (ft)	0.9							2.0																			
Width/Depth Ratio	10.3							4.7																			
BF Cross-sectional Area (ft²)	8.9							18.5																			
BF Max Depth (ft)	1.3							3.7																			
Width of Floodprone Area (ft)	>150							>150																			
Entrenchment Ratio	5.3							8.7																			
Bank Height Ratio	1.0							1.1																			
Wetted Perimeter (ft)	11.5							13.3																			
Hydraulic Radius (ft)	0.8							1.4																			
Fixed baseline bankfull elevation	1204.0							1201.6																			
Based on current/developing bankfull feature																											
BF Width (ft)																											
BF Mean Depth (ft)																											
Width/Depth Ratio																											
BF Cross-sectional Area (ft²)																											
BF Max Depth (ft)																											
Width of Floodprone Area (ft)																											
Entrenchment Ratio																											
Bank Height Ratio																											
Wetted Perimeter (ft)																											
Hydraulic Radius (ft)																											
Cross Sectional Area between end pins (ft²)	-							-																			
d50 (mm)	38.8							-																			

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							6.6																			
BF Mean Depth (ft)	0.8							0.4																			
Width/Depth Ratio	8.9							16.0																			
BF Cross-sectional Area (ft²)	6.1							2.7																			
BF Max Depth (ft)	1.7							0.9																			
Width of Floodprone Area (ft)	>100							>100																			
Entrenchment Ratio	9.2							7.0																			
Bank Height Ratio	1.1							1.2																			
Wetted Perimeter (ft)	9.0							7.4																			
Hydraulic Radius (ft)	0.7							0.4																			
Fixed baseline bankfull elevation	1201.9							1201.2																			
Based on current/developing bankfull feature																											
BF Width (ft)																											
BF Mean Depth (ft)																											
Width/Depth Ratio																											
BF Cross-sectional Area (ft²)																											
BF Max Depth (ft)																											
Width of Floodprone Area (ft)																											
Entrenchment Ratio																											
Bank Height Ratio																											
Wetted Perimeter (ft)																											
Hydraulic Radius (ft)																											
Cross Sectional Area between end pins (ft²)	-							-							-							-						
d50 (mm)	-							29.3							-							-						

Table 6. Morphology and Hydraulic Monitoring Summary

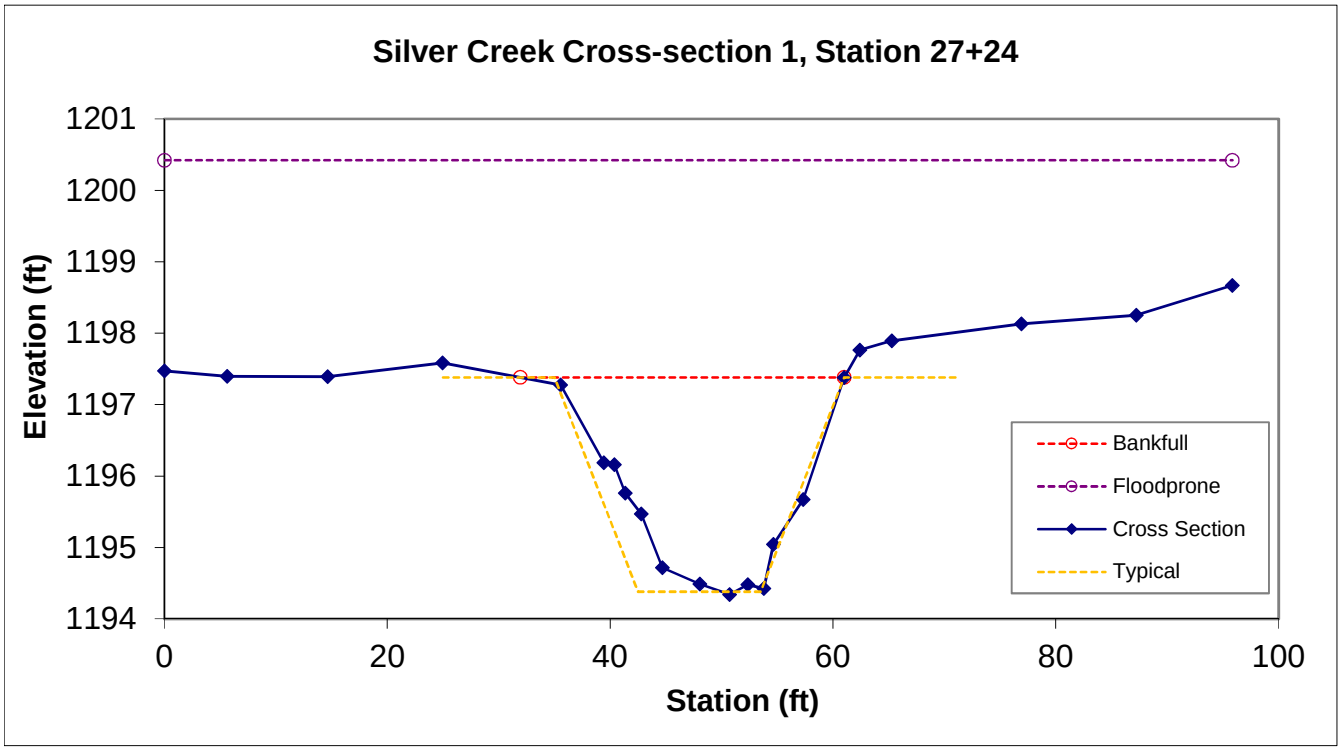
Upper Silver Creek Restoration Project: DMS Project ID No. 94645

UT3 (1,365 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							10.7							8.1							13.0						
BF Mean Depth (ft)	0.7							1.0							0.8							1.0						
Width/Depth Ratio	15.5							10.5							10.3							12.8						
BF Cross-sectional Area (ft²)	6.5							10.9							6.3							13.2						
BF Max Depth (ft)	1.1							1.7							1.1							2.2						
Width of Floodprone Area (ft)	>150							>150							>150							>150						
Entrenchment Ratio	5.4							5.8							8.5							>5.6						
Bank Height Ratio	1.0							1.0							1.1							1.0						
Wetted Perimeter (ft)	11.4							12.8							9.6							15.1						
Hydraulic Radius (ft)	0.6							0.9							0.7							0.9						
Fixed baseline bankfull elevation	1215.4							1212.8							1212.9							1209.3						
Based on current/developing bankfull feature																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Cross Sectional Area between end pins (ft²)	-							-																				
d50 (mm)	31.2							-																				

	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																											
BF Mean Depth (ft)	0.9																											
Width/Depth Ratio	9.1																											
BF Cross-sectional Area (ft²)	7.3																											
BF Max Depth (ft)	1.4																											
Width of Floodprone Area (ft)	>150																											
Entrenchment Ratio	9.4																											
Bank Height Ratio	1.2																											
Wetted Perimeter (ft)	10.0																											
Hydraulic Radius (ft)	0.7																											
Fixed baseline bankfull elevation	1208.8																											
Based on current/developing bankfull feature																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Cross Sectional Area between end pins (ft²)	-							-							-							-						
d50 (mm)	-							-							-							-						

Permanent Cross-section 1
(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	49.2	29.06	1.69	3.04	17.16	1.1	3.3	1197.38	1197.58



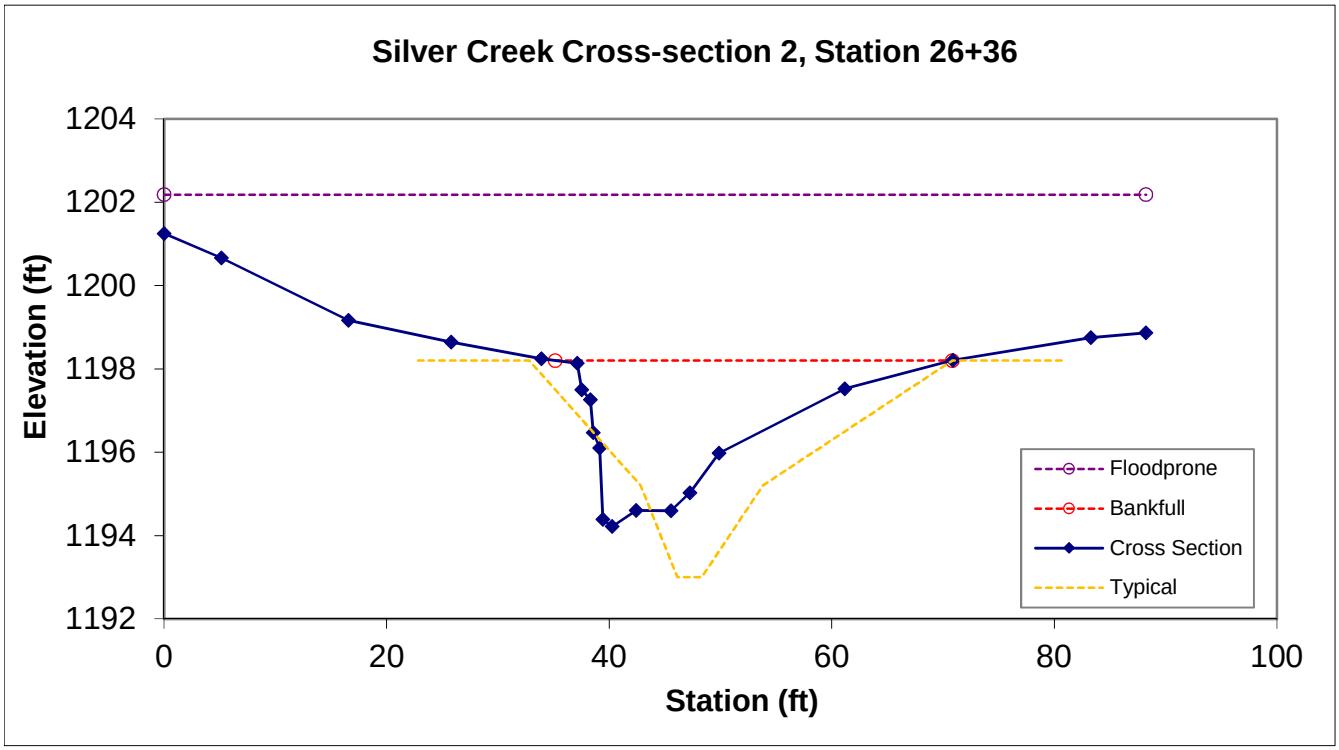
Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 2

(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	C	58.3	35.67	1.63	3.98	21.82	1	2.5	1198.2	1198.21



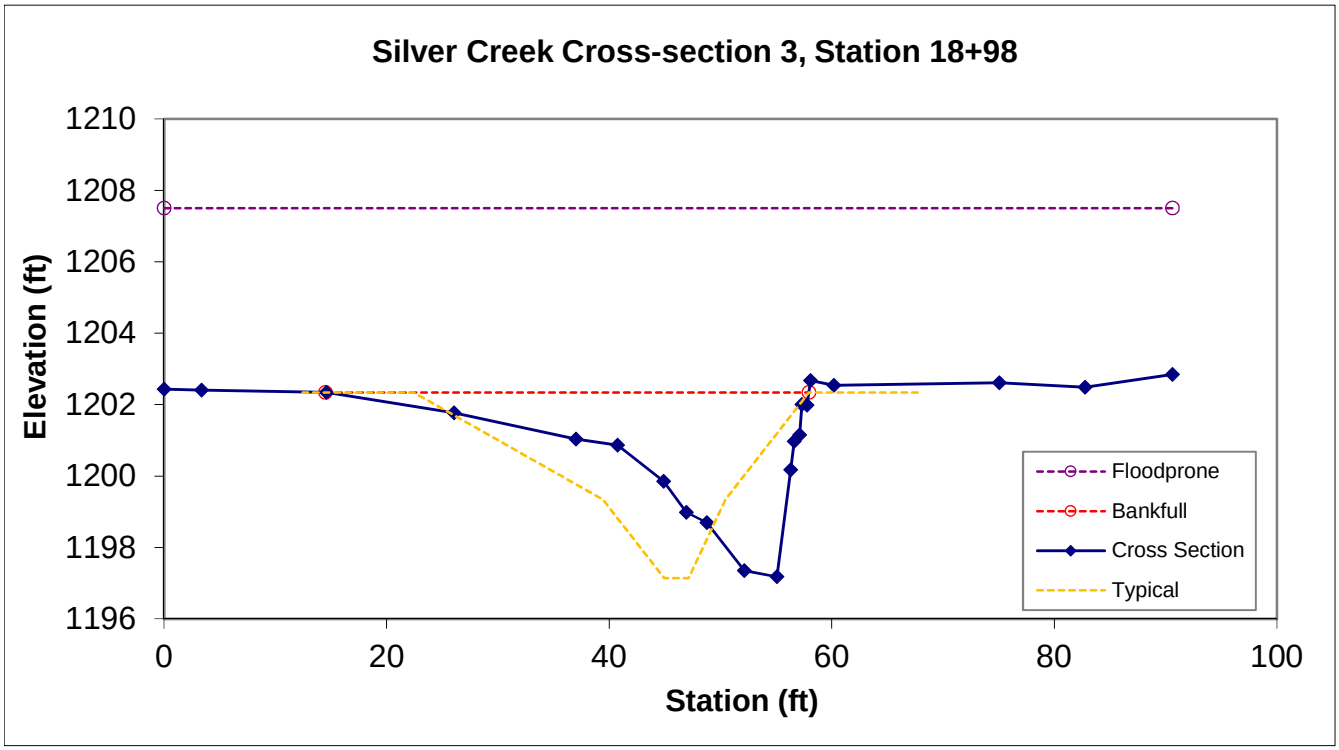
Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 3

(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	C	74.9	43.45	1.72	5.16	25.2	0.7	2.1	1202.34	1201.03



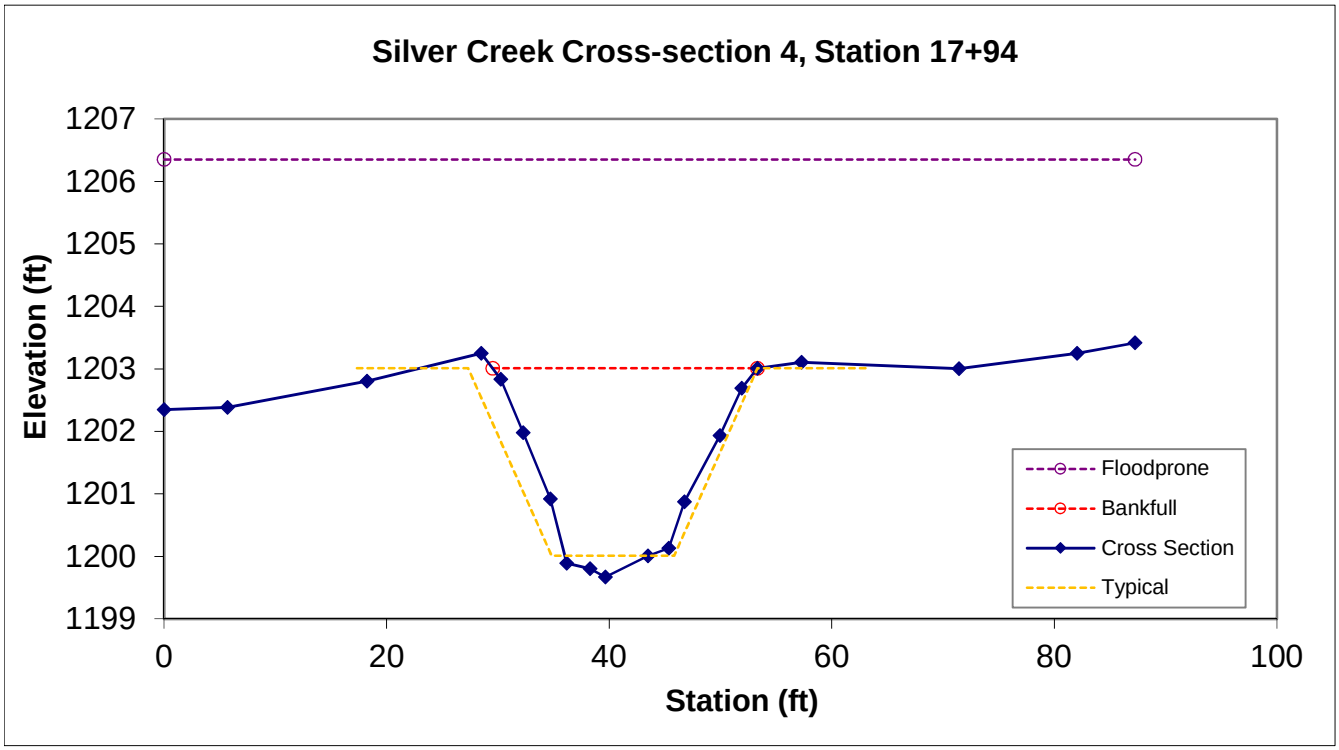
Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 4

(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	48	23.81	2.01	3.34	11.82	1	3.7	1203.01	1203.01



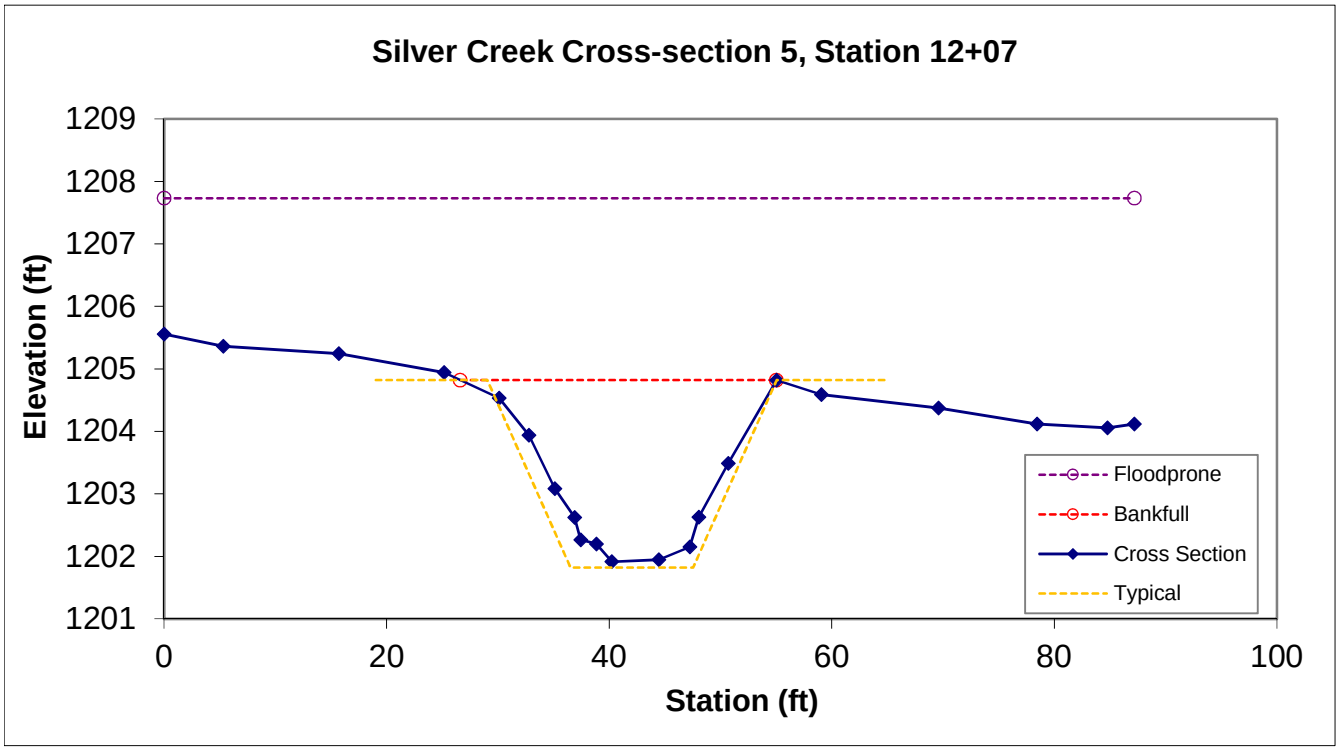
Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 5

(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	46.9	28.43	1.65	2.91	17.25	1	3.1	1204.82	1204.82



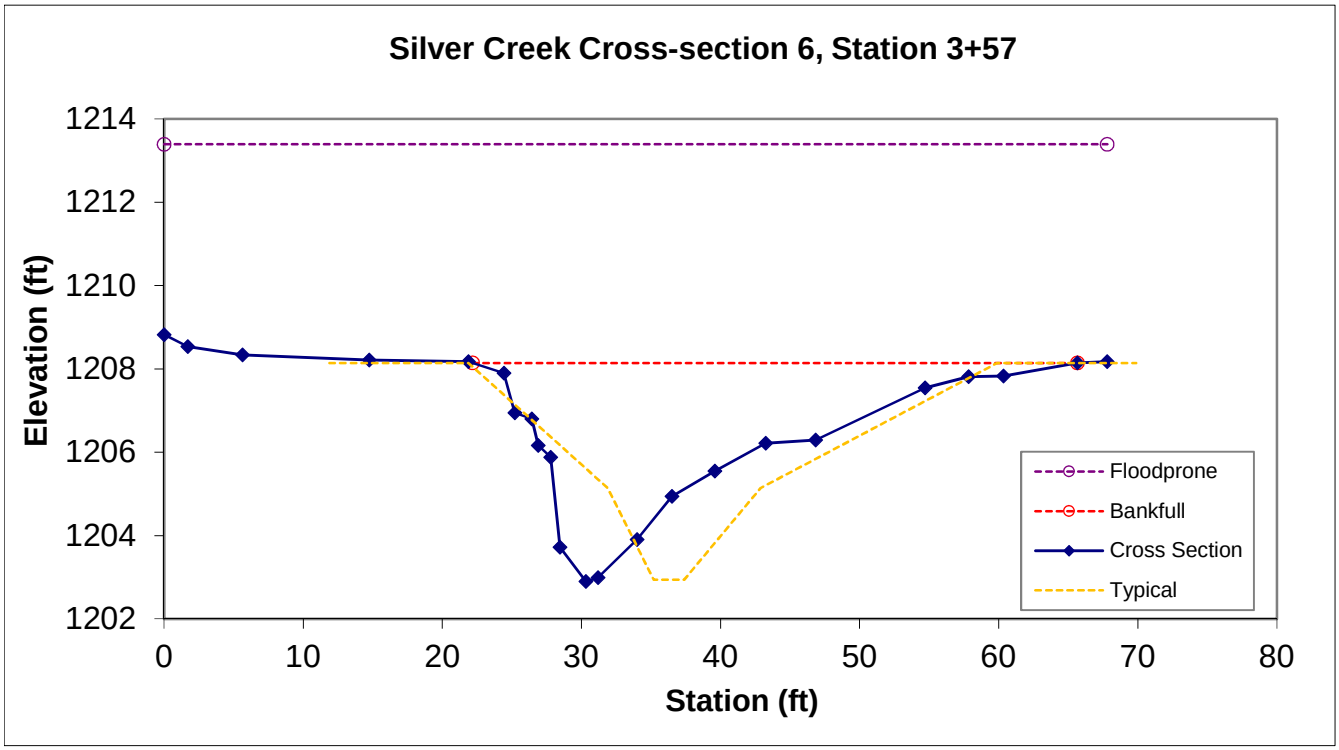
Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 6

(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	C	80.1	43.48	1.84	5.25	23.59	1	1.6	1208.14	1208.14



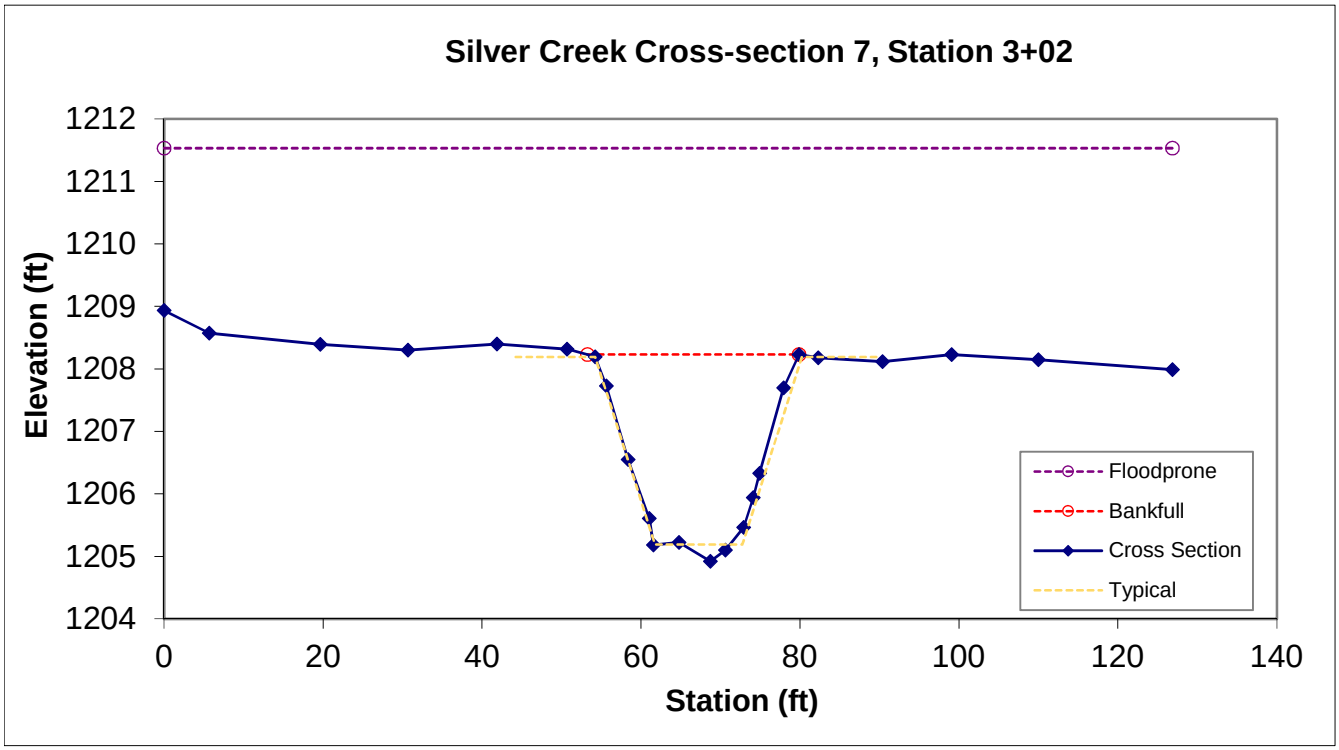
Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 7

(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	54.5	26.61	2.05	3.3	12.98	1	4.8	1208.23	1208.19

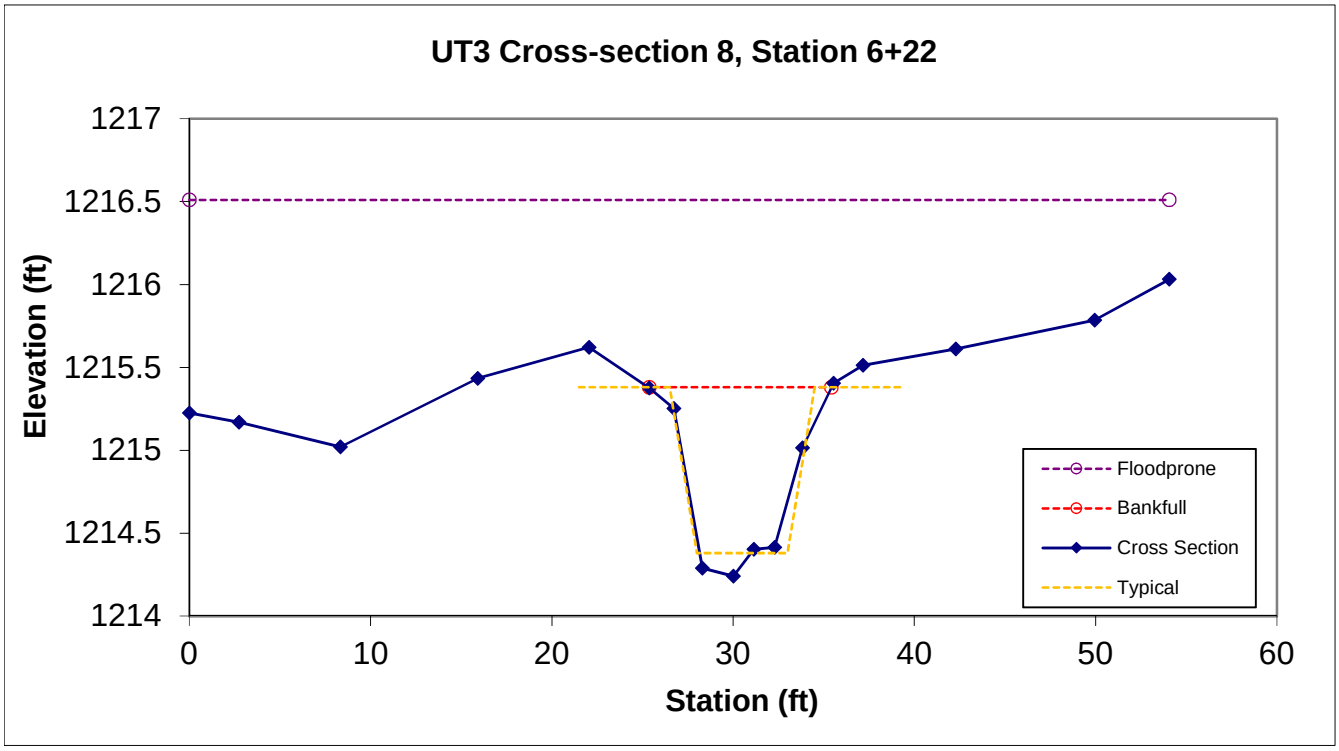


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 8
(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	6.5	10.05	0.65	1.13	15.46	1	5.4	1215.38	1215.41

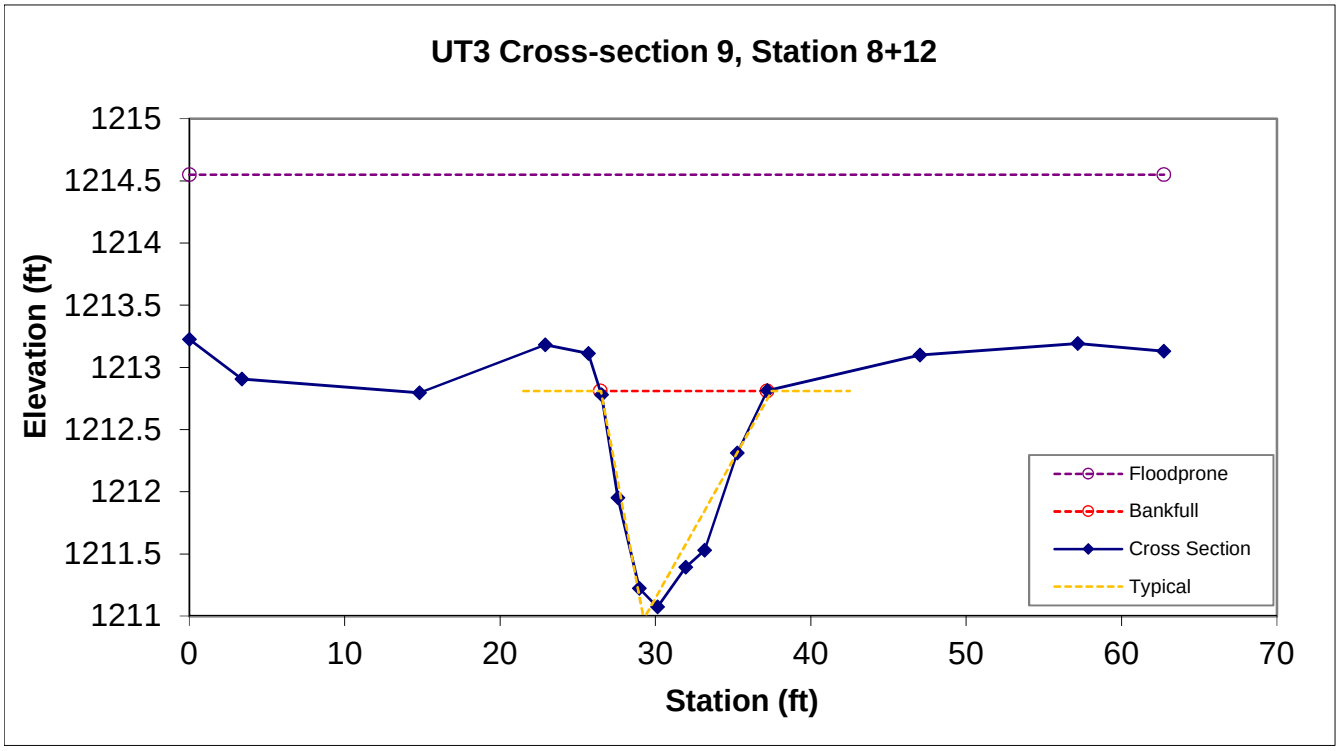


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 9
(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	E	10.9	10.73	1.02	1.74	10.53	1	5.8	1212.81	1212.81

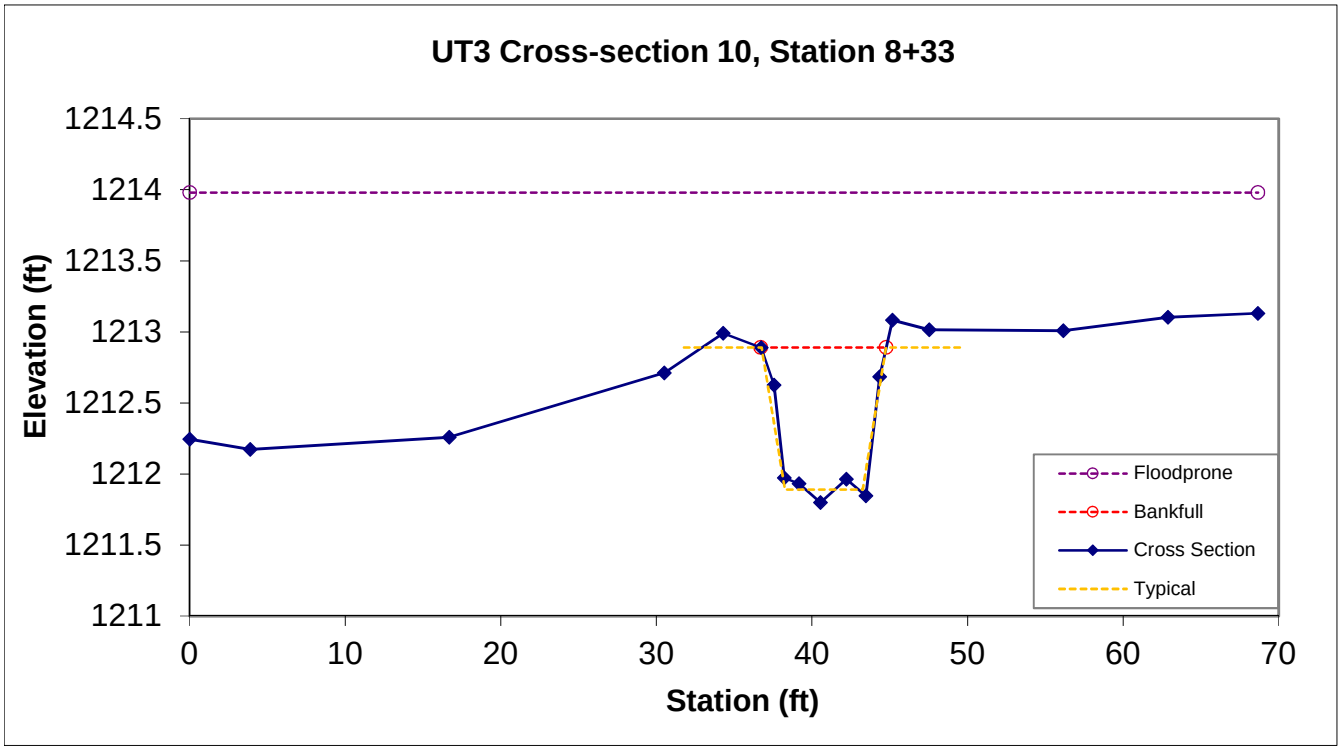


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 10
(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	6.3	8.07	0.78	1.09	10.34	1.1	8.5	1212.89	1212.99

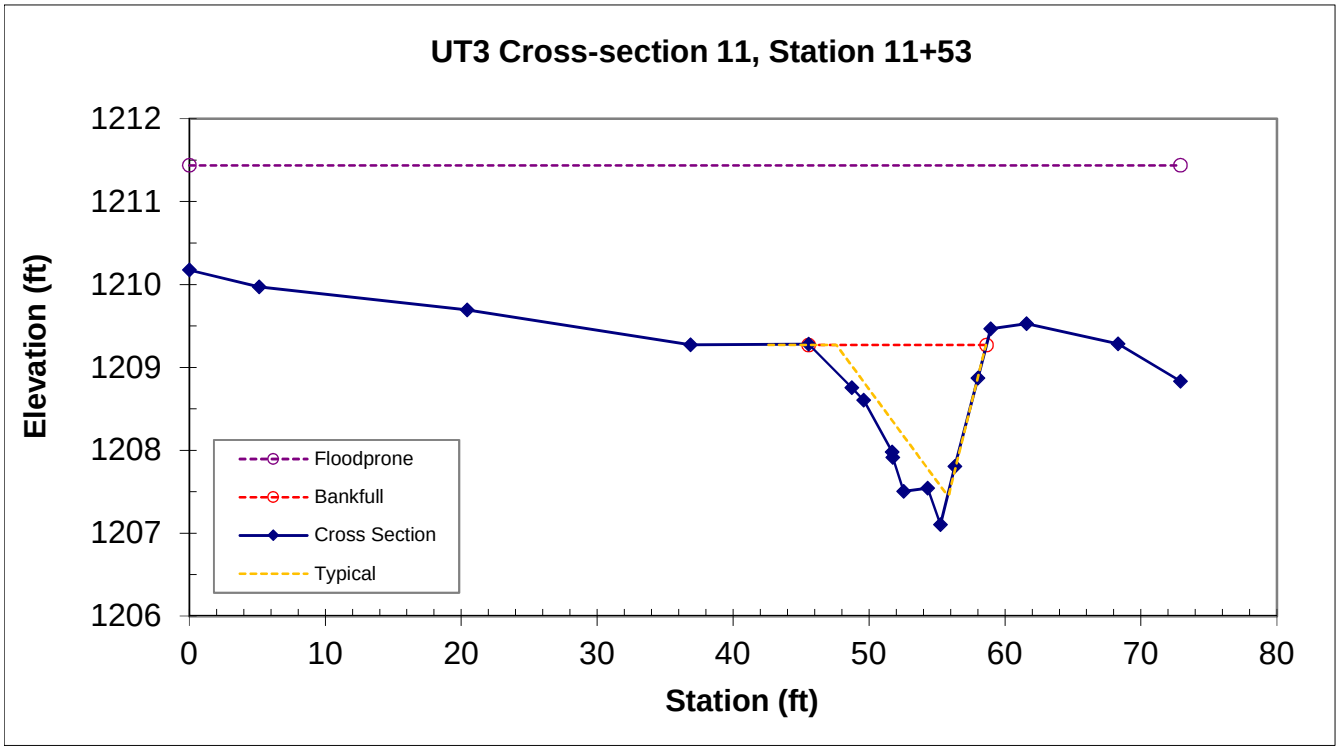


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 11
(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	C	13.22	13.03	1.01	2.17	12.8	1	>5.6	1209.27	1211.436

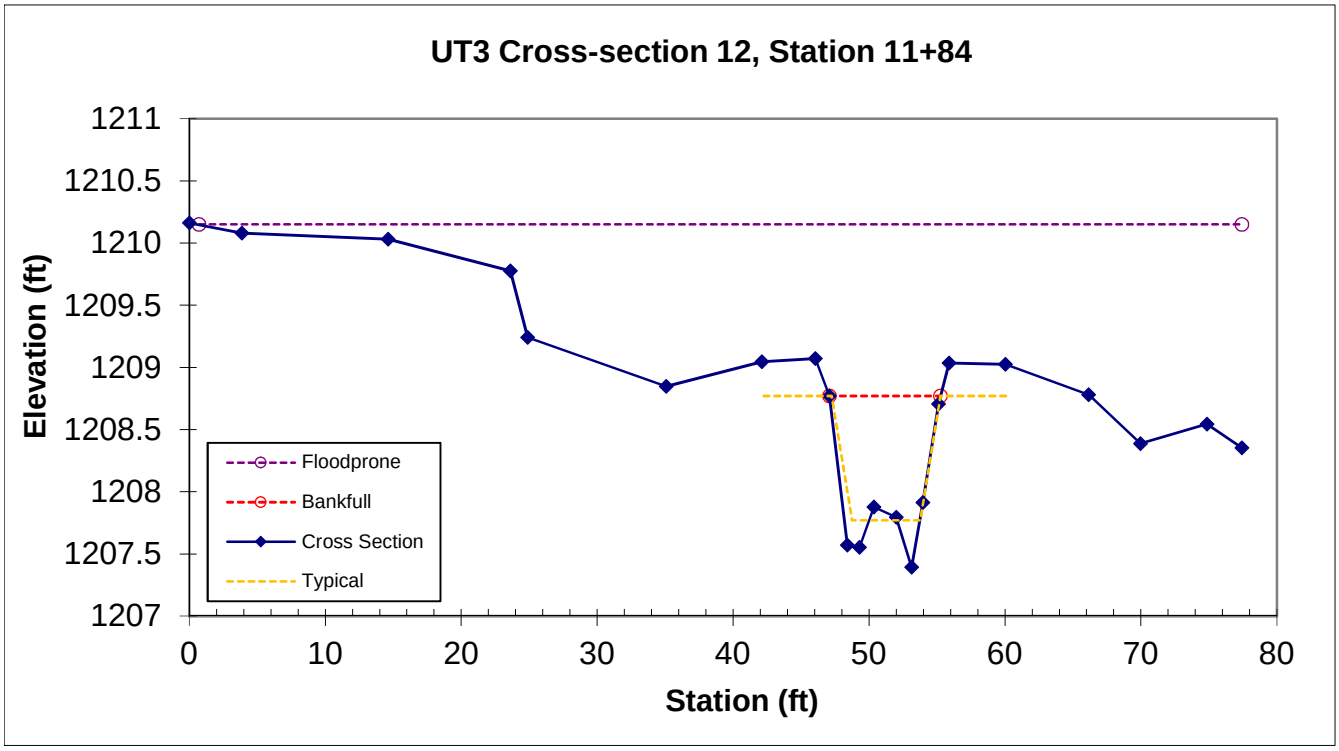


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 12
(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	7.3	8.17	0.9	1.38	9.12	1.2	9.4	1208.77	1209.04

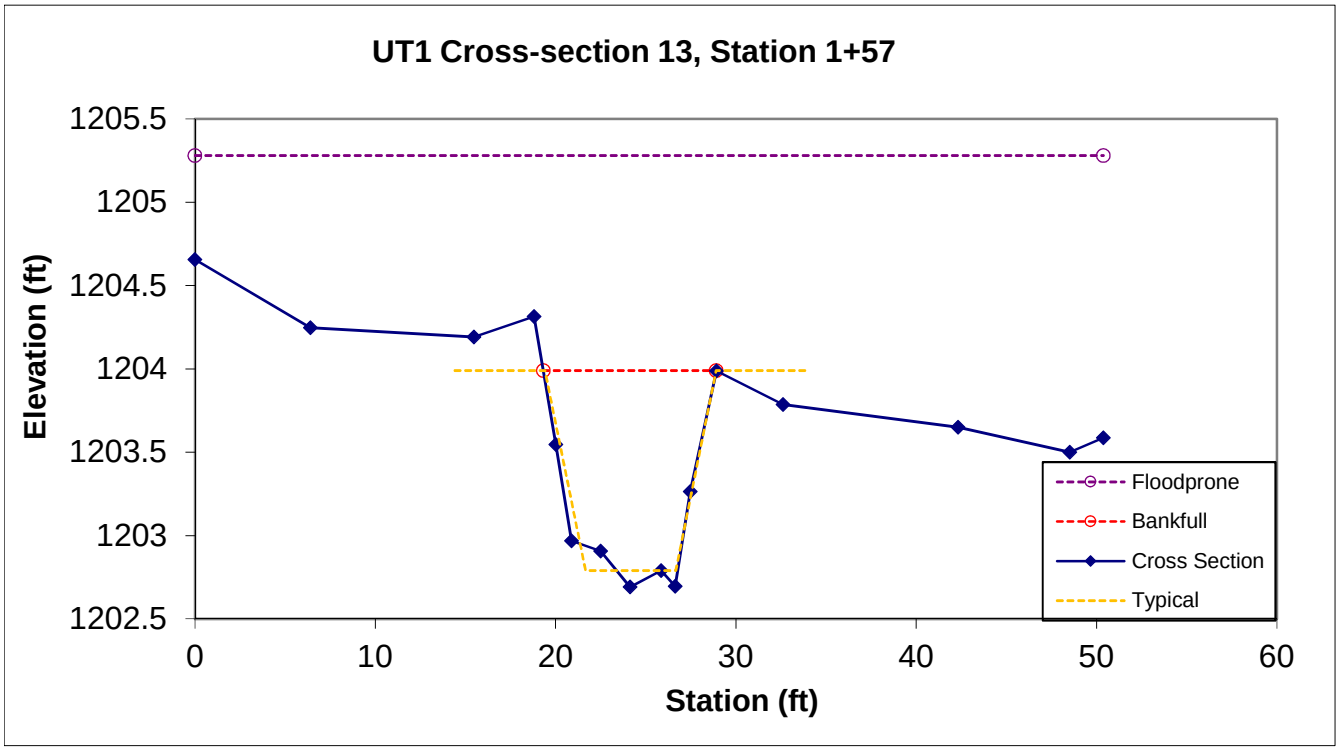


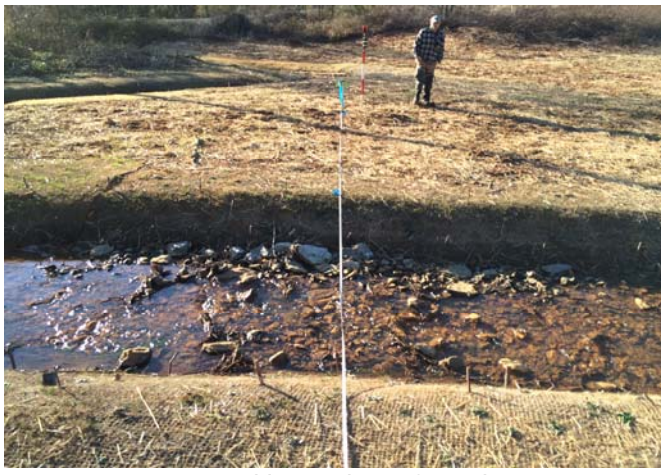
Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 13
(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	8.9	9.59	0.93	1.3	10.33	1	5.3	1203.99	1203.99



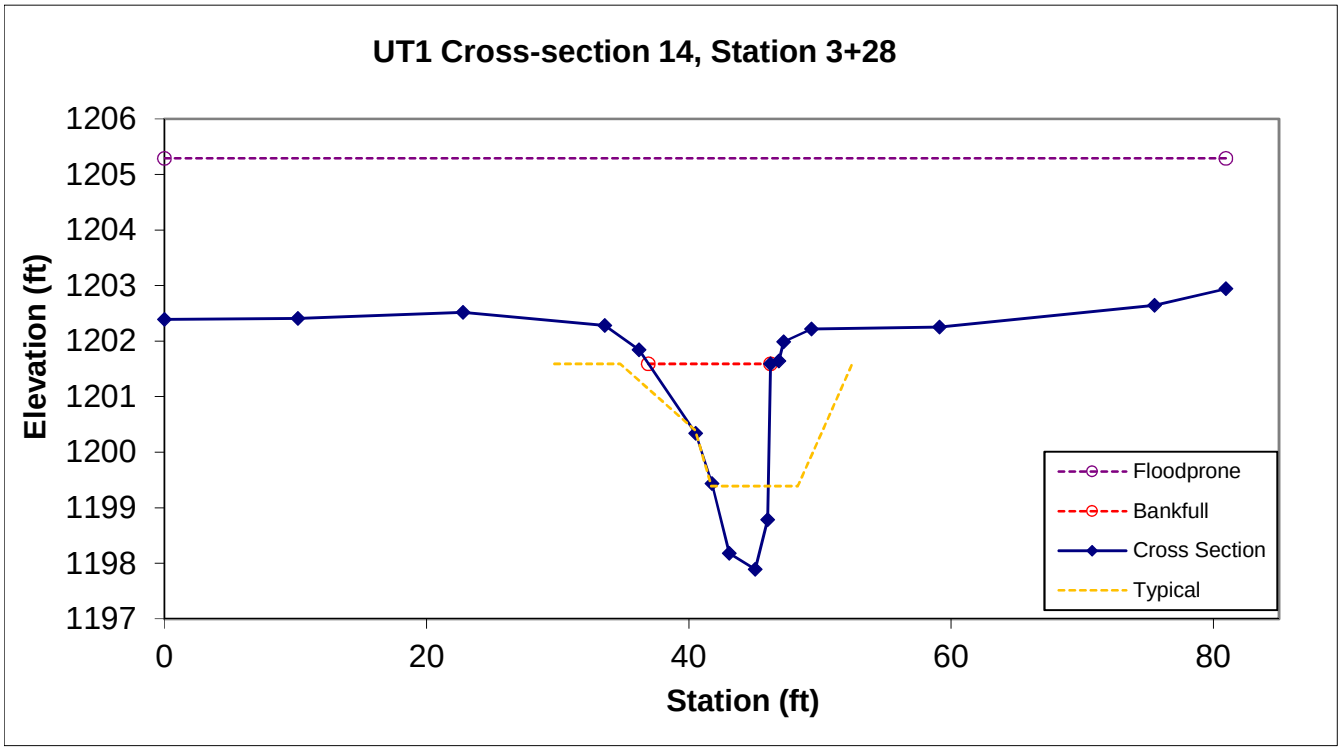


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 14
(As-Built Data - collected March, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	E	18.5	9.32	1.98	3.7	4.71	1.1	8.7	1201.59	1201.99

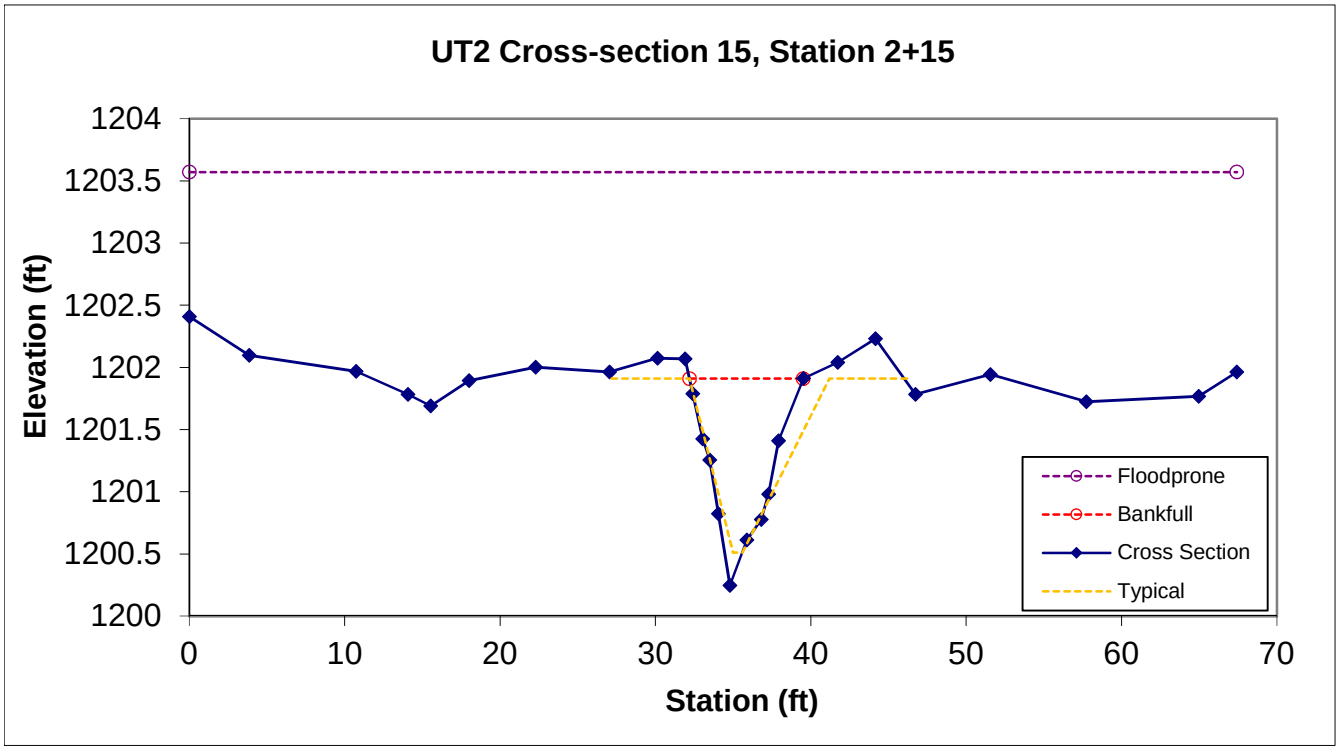


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 15
(As-Built Data - collected June, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	E	6.1	7.33	0.83	1.66	8.88	1.1	9.2	1201.91	1202.04

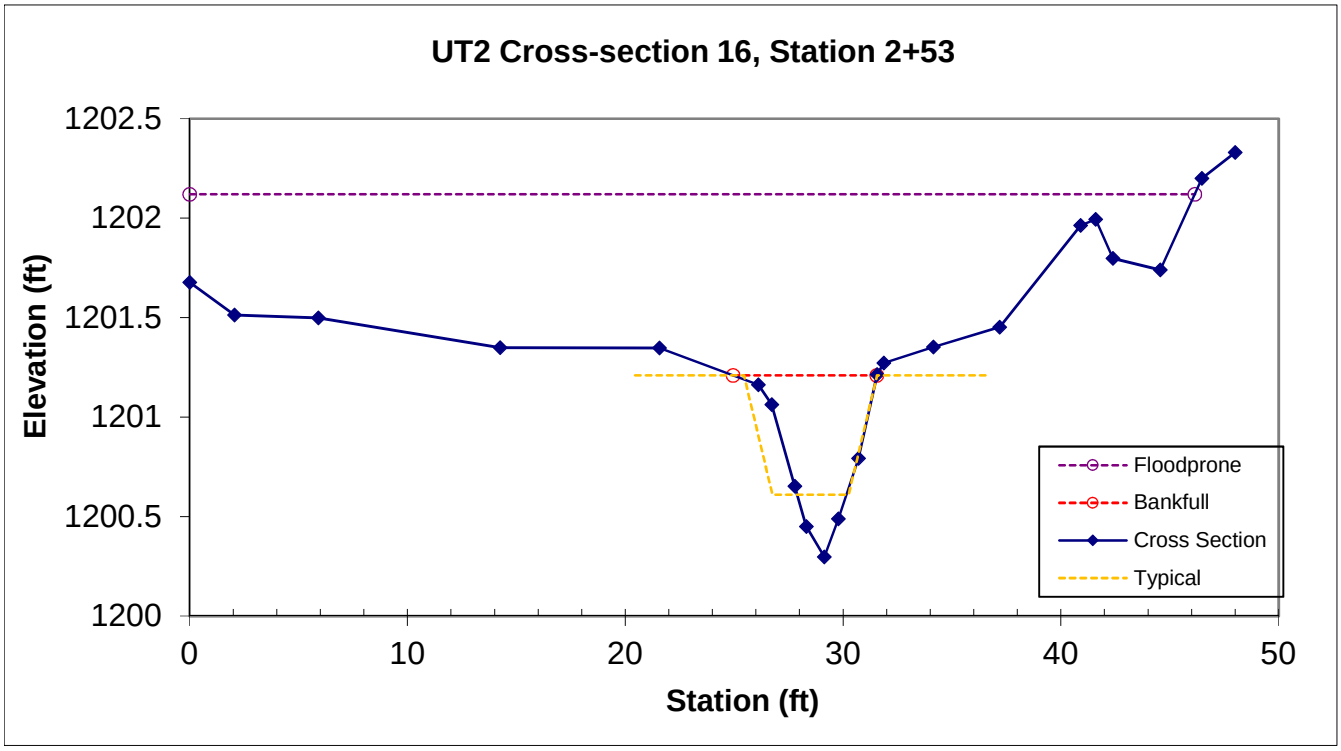


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 16
(As-Built Data - collected June, 2015)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	2.7	6.6	0.41	0.91	15.99	1.2	7	1201.21	1201.35

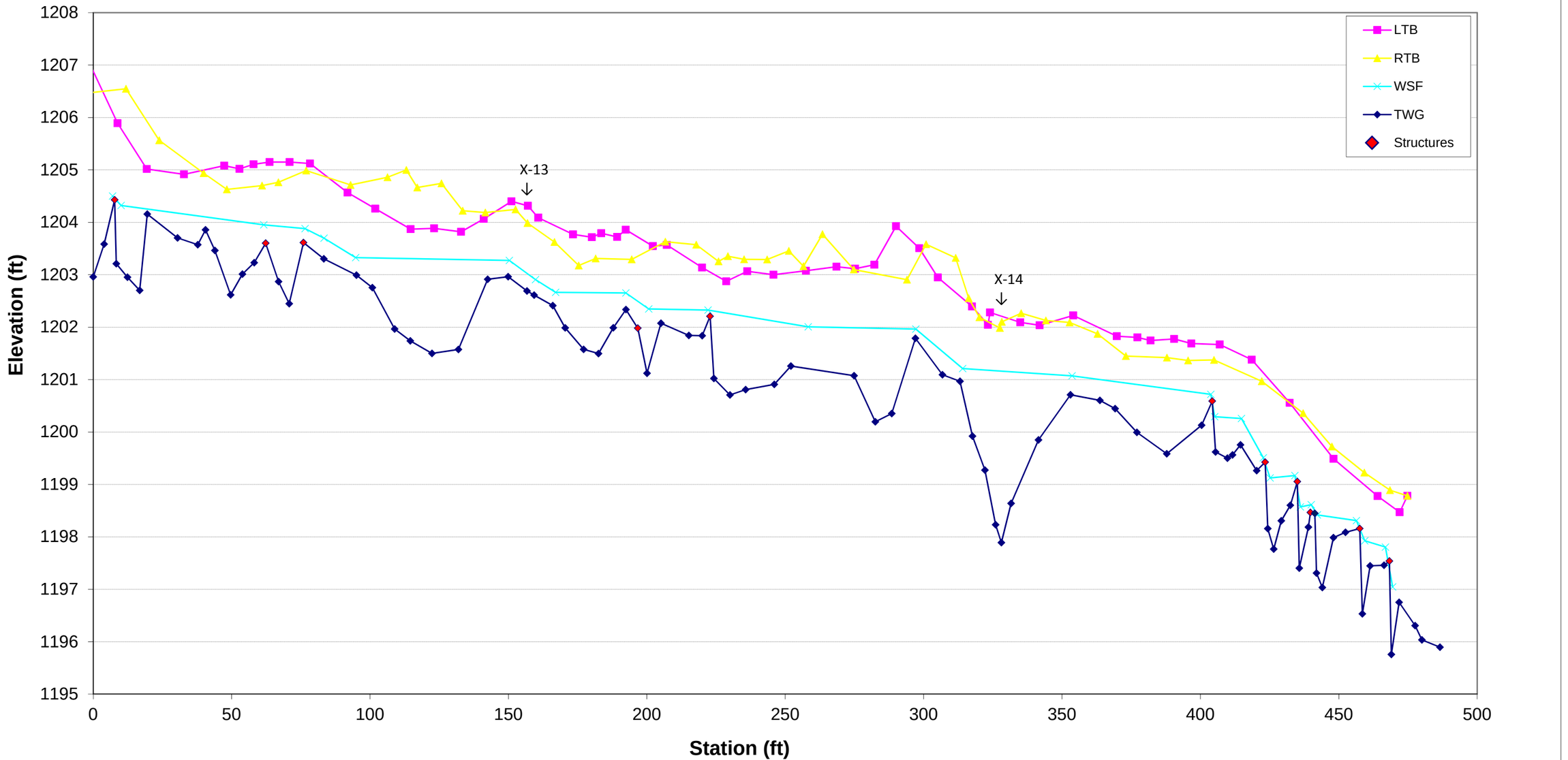


Looking at the Left Bank

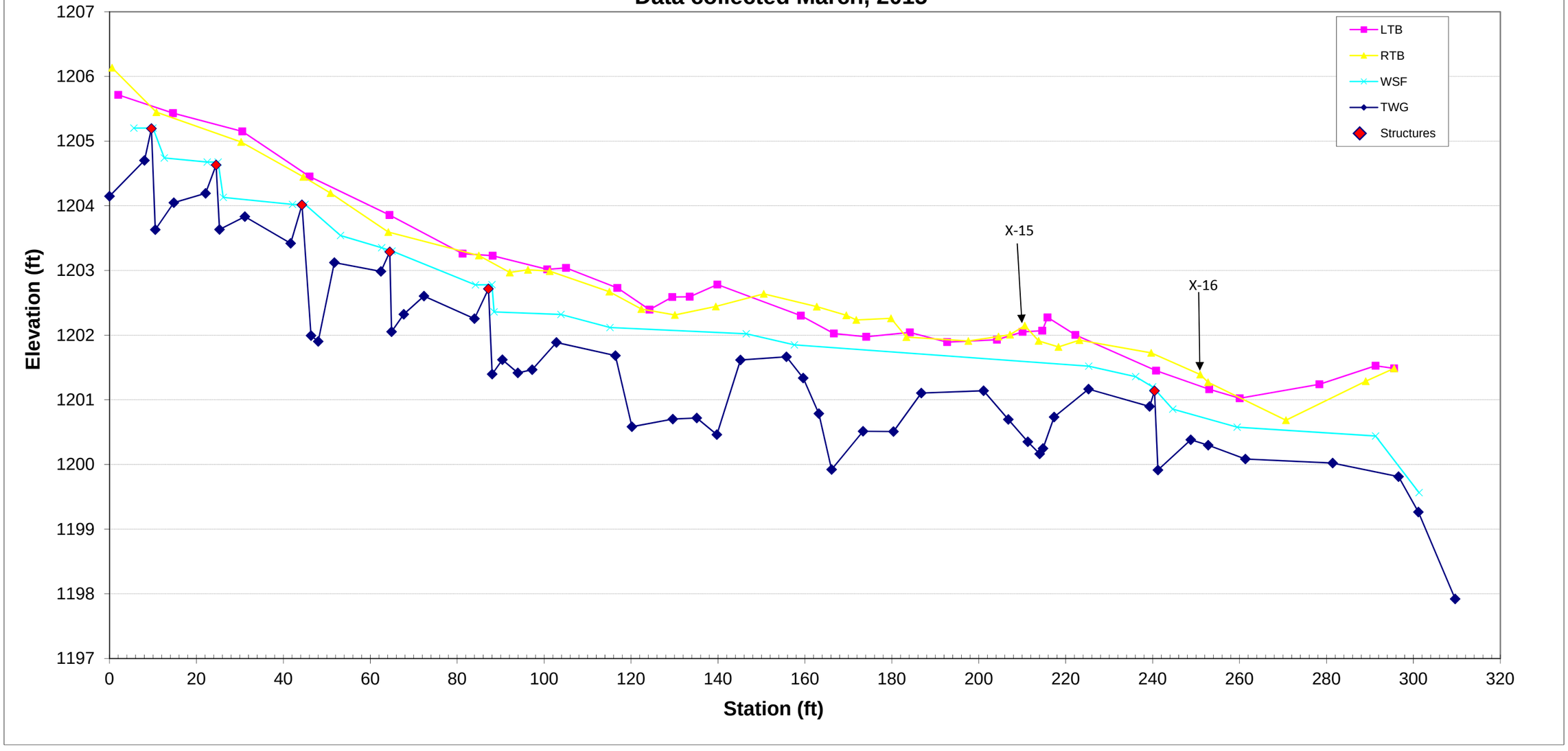
Looking at the Right Bank

As-built Profile of Silver Creek, Station 0+00 to 32+00
Data collected March, 2015

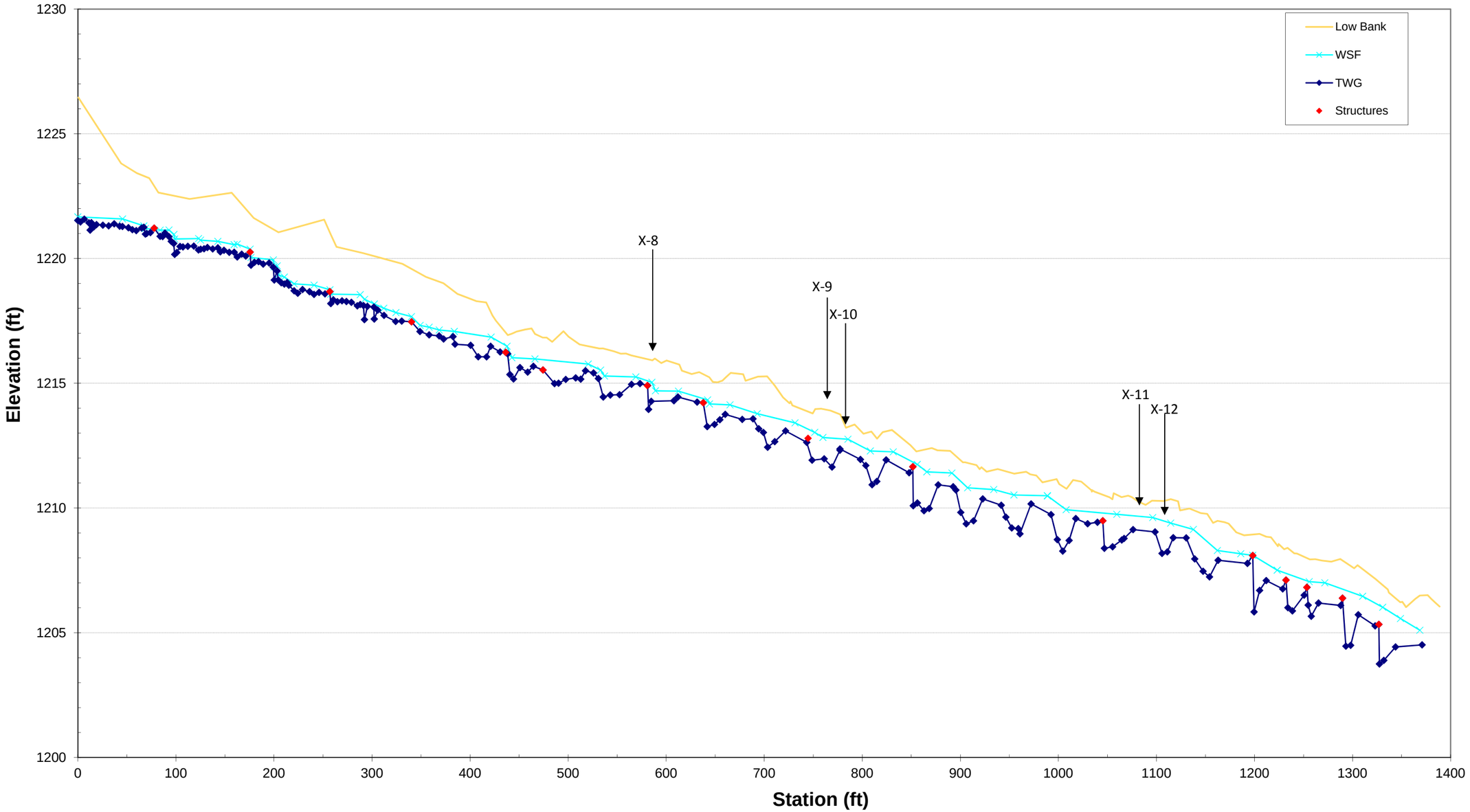
As-built Profile of UT1, Station 0+00 to 5+00
Data collected March, 2015



As-built Profile of UT2, Station 0+00 to 3+20
Data collected March, 2015



As-built Profile of UT3, Station 0+00 to 14+00
Data collected March, 2015

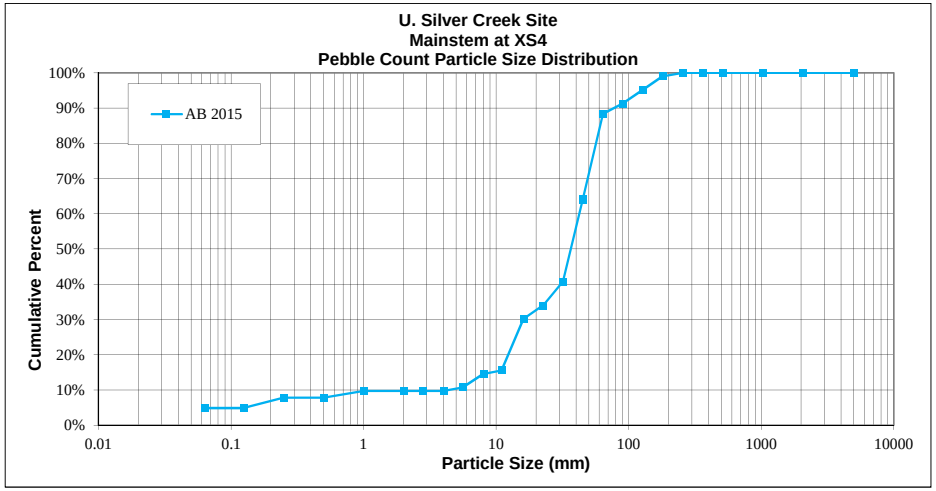


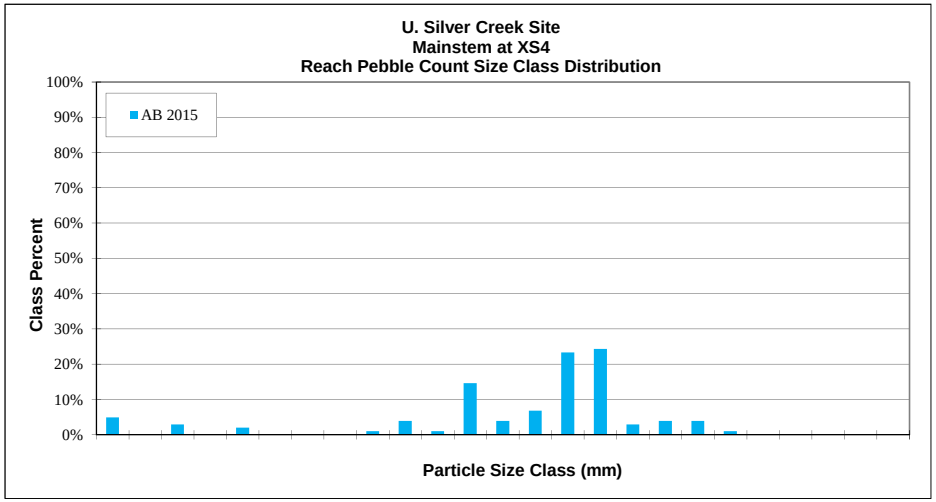
Cross-Section Pebble Count; As-built Survey
U. Silver Creek Mitigation Project, DMS# 94645

SITE OR PROJECT:	U. Silver Cr
REACH/LOCATION:	Riffle at XS4
FEATURE:	Riffle

			AB 2015			Distribution
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum	Plot Size (mm)
Silt/Clay	Silt / Clay	< .063	5	5%	5%	0.063
Sand	Very Fine	.063 - .125			5%	0.125
	Fine	.125 - .25	3	3%	8%	0.25
	Medium	.25 - .50			8%	0.50
	Coarse	.50 - 1.0	2	2%	10%	1.0
	Very Coarse	1.0 - 2.0			10%	2.0
Gravel	Very Fine	2.0 - 2.8			10%	2.8
	Very Fine	2.8 - 4.0			10%	4.0
	Fine	4.0 - 5.6	1	1%	11%	5.6
	Fine	5.6 - 8.0	4	4%	15%	8.0
	Medium	8.0 - 11.0	1	1%	16%	11.0
	Medium	11.0 - 16.0	15	15%	30%	16.0
	Coarse	16 - 22.6	4	4%	34%	22.6
	Coarse	22.6 - 32	7	7%	41%	32
	Very Coarse	32 - 45	24	23%	64%	45
	Very Coarse	45 - 64	25	24%	88%	64
Cobble	Small	64 - 90	3	3%	91%	90
	Small	90 - 128	4	4%	95%	128
	Large	128 - 180	4	4%	99%	18000%
	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			103	100%		

Summary Data			
Channel materials			
D16 =	11.1	D84 =	60.1
D35 =	23.8	D95 =	126.3
D50 =	36.6	D100 =	180 - 256



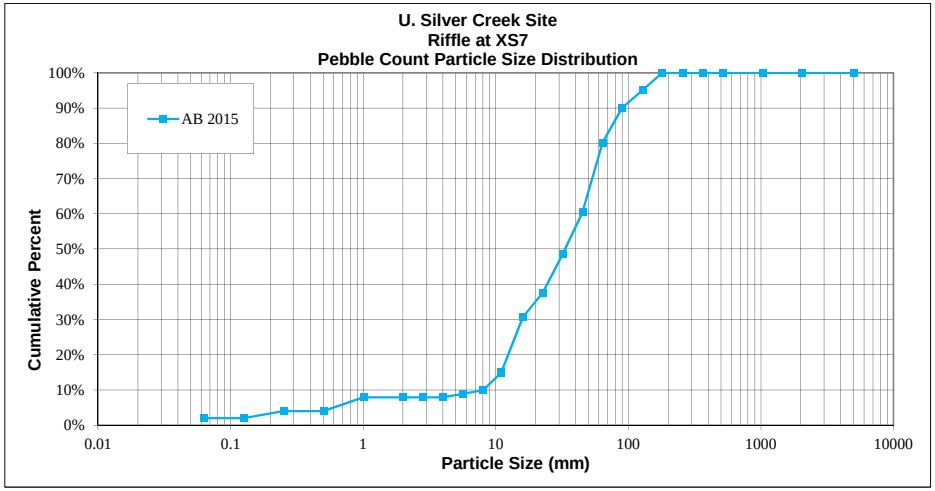


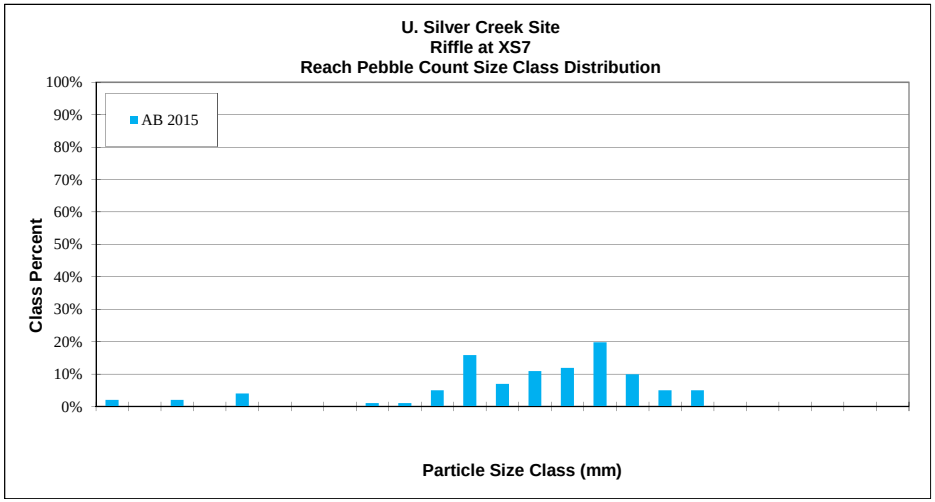
Cross-Section Pebble Count; As-built Survey
U. Silver Creek Mitigation Project, DMS# 94645

SITE OR PROJECT:	U. Silver Cr
REACH/LOCATION:	Riffle at XS7
FEATURE:	Riffle

			AB 2015			Distribution
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum	Plot Size (mm)
Silt/Clay	Silt / Clay	< .063	2	2%	2%	0.063
Sand	Very Fine	.063 - .125			2%	0.125
	Fine	.125 - .25	2	2%	4%	0.25
	Medium	.25 - .50			4%	0.50
	Coarse	.50 - 1.0	4	4%	8%	1.0
	Very Coarse	1.0 - 2.0			8%	2.0
Gravel	Very Fine	2.0 - 2.8			8%	2.8
	Very Fine	2.8 - 4.0			8%	4.0
	Fine	4.0 - 5.6	1	1%	9%	5.6
	Fine	5.6 - 8.0	1	1%	10%	8.0
	Medium	8.0 - 11.0	5	5%	15%	11.0
	Medium	11.0 - 16.0	16	16%	31%	16.0
	Coarse	16 - 22.6	7	7%	38%	22.6
	Coarse	22.6 - 32	11	11%	49%	32
	Very Coarse	32 - 45	12	12%	60%	45
	Very Coarse	45 - 64	20	20%	80%	64
Cobble	Small	64 - 90	10	10%	90%	90
	Small	90 - 128	5	5%	95%	128
	Large	128 - 180	5	5%	100%	18000%
	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			101	100%		

Summary Data			
Channel materials			
D16 =	11.3	D84 =	73.0
D35 =	19.8	D95 =	127.5
D50 =	33.4	D100 =	128 - 180



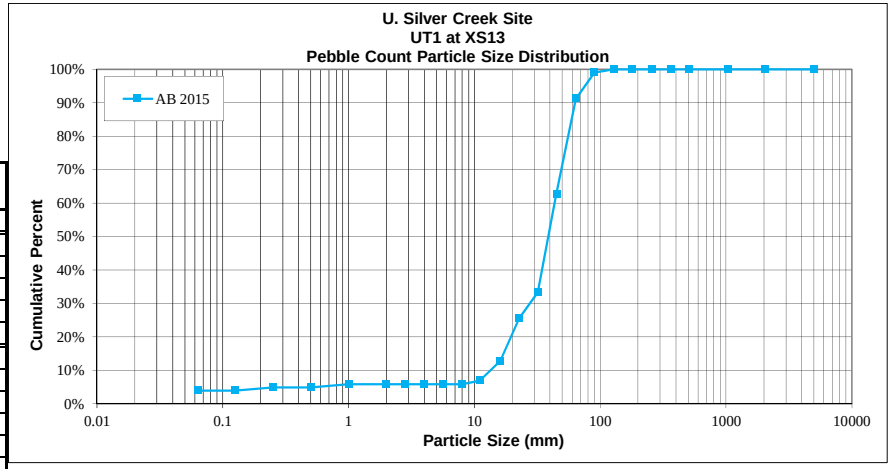


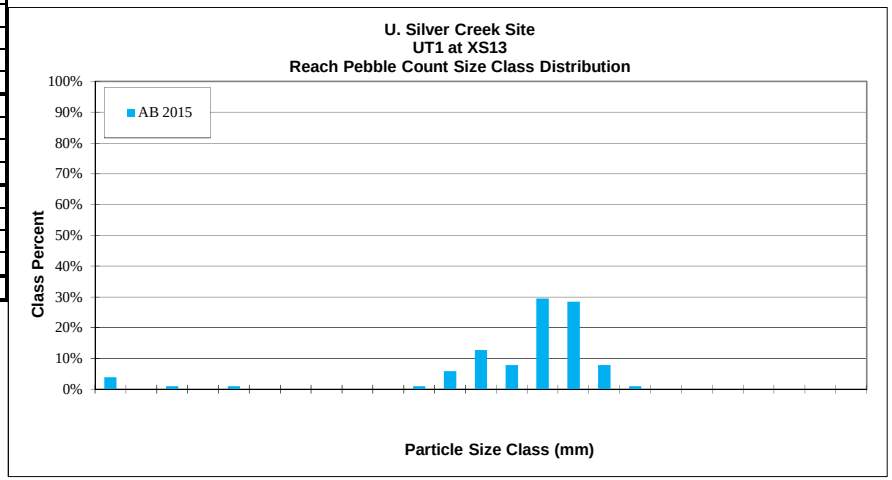
Cross-Section Pebble Count; As-built Survey
U. Silver Creek Mitigation Project, DMS# 94645

SITE OR PROJECT:	U. Silver Cr
REACH/LOCATION:	UT1 XS13
FEATURE:	Riffle

			AB 2015			Distribution
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum	Plot Size (mm)
Silt/Clay	Silt / Clay	< .063	4	4%	4%	0.063
Sand	Very Fine	.063 - .125			4%	0.125
	Fine	.125 - .25	1	1%	5%	0.25
	Medium	.25 - .50			5%	0.50
	Coarse	.50 - 1.0	1	1%	6%	1.0
	Very Coarse	1.0 - 2.0			6%	2.0
Gravel	Very Fine	2.0 - 2.8			6%	2.8
	Very Fine	2.8 - 4.0			6%	4.0
	Fine	4.0 - 5.6			6%	5.6
	Fine	5.6 - 8.0			6%	8.0
	Medium	8.0 - 11.0	1	1%	7%	11.0
	Medium	11.0 - 16.0	6	6%	13%	16.0
	Coarse	16 - 22.6	13	13%	25%	22.6
	Coarse	22.6 - 32	8	8%	33%	32
	Very Coarse	32 - 45	30	29%	63%	45
	Very Coarse	45 - 64	29	28%	91%	64
Cobble	Small	64 - 90	8	8%	99%	90
	Small	90 - 128	1	1%	100%	128
	Large	128 - 180			100%	18000%
	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			102	100%		

Summary Data			
Channel materials			
D16 =	17.5	D84 =	58.6
D35 =	32.6	D95 =	75.6
D50 =	38.8	D100 =	90 - 128



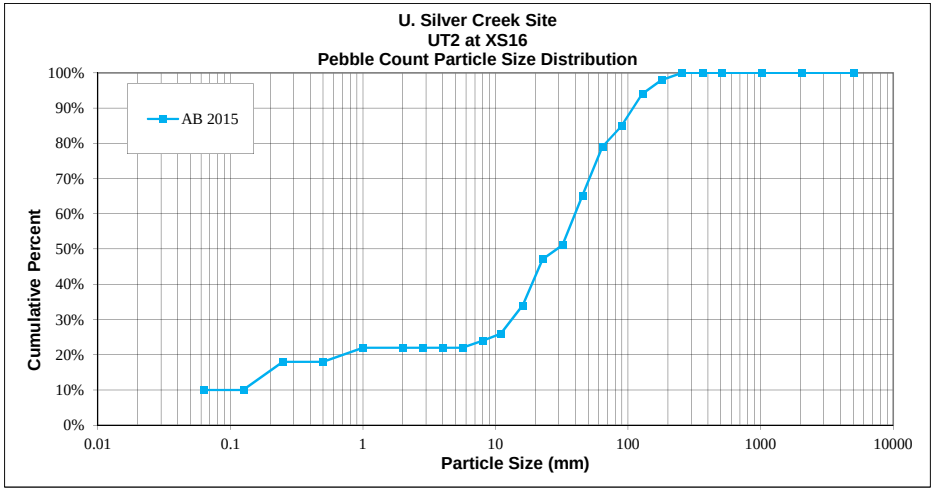


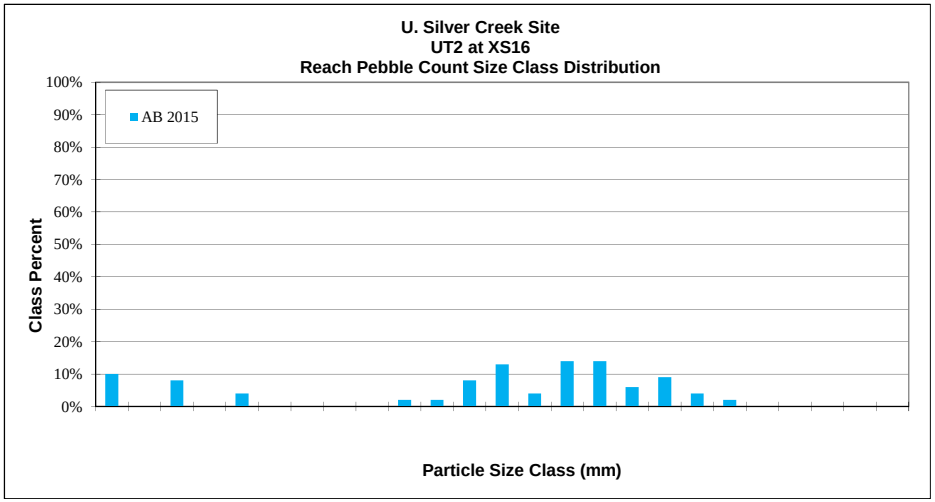
Cross-Section Pebble Count; As-built Survey
U. Silver Creek Mitigation Project, DMS# 94645

SITE OR PROJECT:	U. Silver Cr
REACH/LOCATION:	UT2 XS16
FEATURE:	Riffle

			AB 2015			Distribution
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum	Plot Size (mm)
Silt/Clay	Silt / Clay	< .063	10	10%	10%	0.063
Sand	Very Fine	.063 - .125			10%	0.125
	Fine	.125 - .25	8	8%	18%	0.25
	Medium	.25 - .50			18%	0.50
	Coarse	.50 - 1.0	4	4%	22%	1.0
	Very Coarse	1.0 - 2.0			22%	2.0
Gravel	Very Fine	2.0 - 2.8			22%	2.8
	Very Fine	2.8 - 4.0			22%	4.0
	Fine	4.0 - 5.6			22%	5.6
	Fine	5.6 - 8.0	2	2%	24%	8.0
	Medium	8.0 - 11.0	2	2%	26%	11.0
	Medium	11.0 - 16.0	8	8%	34%	16.0
	Coarse	16 - 22.6	13	13%	47%	22.6
	Coarse	22.6 - 32	4	4%	51%	32
	Very Coarse	32 - 45	14	14%	65%	45
	Very Coarse	45 - 64	14	14%	79%	64
Cobble	Small	64 - 90	6	6%	85%	90
	Small	90 - 128	9	9%	94%	128
	Large	128 - 180	4	4%	98%	18000%
	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			100	100%		

Summary Data			
Channel materials			
D16 =	0.2	D84 =	85.0
D35 =	16.4	D95 =	139.4
D50 =	29.3	D100 =	180 - 256



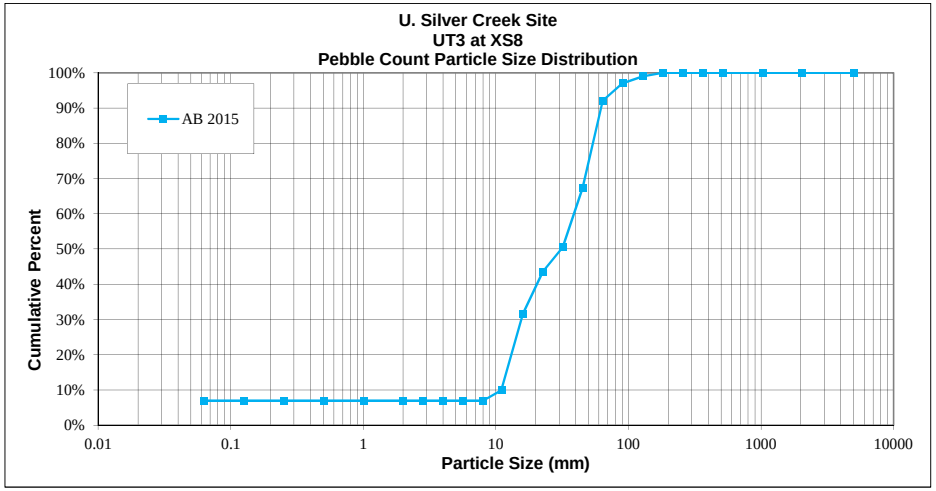


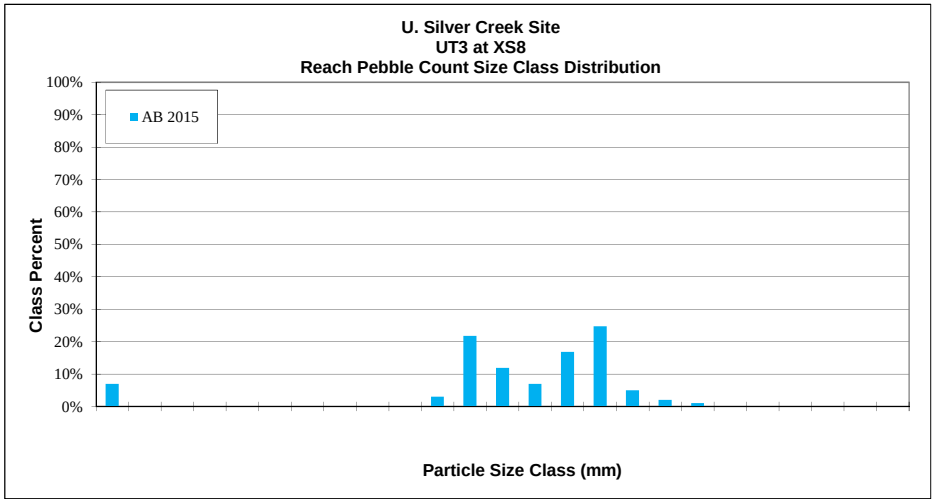
Cross-Section Pebble Count; As-built Survey
U. Silver Creek Mitigation Project, DMS# 94645

SITE OR PROJECT:	U. Silver Cr
REACH/LOCATION:	UT3 XS8
FEATURE:	Riffle

			AB 2015			Distribution
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum	Plot Size (mm)
Silt/Clay	Silt / Clay	< .063	7	7%	7%	0.063
Sand	Very Fine	.063 - .125			7%	0.125
	Fine	.125 - .25			7%	0.25
	Medium	.25 - .50			7%	0.50
	Coarse	.50 - 1.0			7%	1.0
	Very Coarse	1.0 - 2.0			7%	2.0
Gravel	Very Fine	2.0 - 2.8			7%	2.8
	Very Fine	2.8 - 4.0			7%	4.0
	Fine	4.0 - 5.6			7%	5.6
	Fine	5.6 - 8.0			7%	8.0
	Medium	8.0 - 11.0	3	3%	10%	11.0
	Medium	11.0 - 16.0	22	22%	32%	16.0
	Coarse	16 - 22.6	12	12%	44%	22.6
	Coarse	22.6 - 32	7	7%	50%	32
	Very Coarse	32 - 45	17	17%	67%	45
	Very Coarse	45 - 64	25	25%	92%	64
Cobble	Small	64 - 90	5	5%	97%	90
	Small	90 - 128	2	2%	99%	128
	Large	128 - 180	1	1%	100%	18000%
	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			101	100%		

Summary Data			
Channel materials			
D16 =	12.2	D84 =	57.0
D35 =	17.6	D95 =	78.3
D50 =	31.2	D100 =	128 - 180





APPENDIX C

Vegetation Data (Tables 7 and 8), Vegetation Plot Photo Log, Raw Vegetation Data

Table 7. Vegetation Species Planted Across the Restoration Site
Upper Silver Creek Restoration Project: EEP Project ID No. 94645

Botanical Name	Common Name	% Planted by Species	Total Number of Stems
Riparian Buffer Plantings 760 Stems/Acre			
Acer rubrum	Red Maple	8%	780
Asimina triloba	Pawpaw	26%	2,580
Carpinus carolinianum	Ironwood	10%	980
Diospyros virginica	Persimmon	12%	1,175
Liriodendron tulipfera	Tulip poplar	14%	1,375
Platanus occidentalis	Sycamore	8%	780
Quercus michauxii	Swamp Chestnut Oak	4%	390
Quercus phellos	Willow Oak	8%	780
Vaccineum corymbosum	Blueberry	8%	780
Viburnum dentatum	Arrowwood Viburnum	4%	390
		Total	10,010
Wetland Plantings 880 Stems/Acre			
Alnus serrulata	Tag Alder	3%	280
Betula nigra	River Birch	8%	765
Cornus amomum	Silky Digwood	6%	565
Corylus cornuta	Hazelnut	4%	380
Fraxinus pennsylvanica	Green Ash	8%	765
Platanus occidentalis	Sycamore	11%	1,135
Quercus michauxii	Swamp Chestnut Oak	33%	3,350
Quercus nigra	Water Oak	18%	1,765
Quercus phellos	Willow Oak	8%	765
Salix sericea	Silky willow	3%	280
		Total	10,050
Riparian Live Stake Plantings			
Cornus amomum	Silky Dogwood	35%	2,275
Physocarpus opulifolius	Ninebark	15%	975
Salix nigra	Black Willow	5%	325
Salix sericea	Silky Willow	25%	1,625
Sambucus canadensis	Elderberry	20%	1,300
		Total	6,500

Table 8. Stem Count Arranged by Plot
Project: Upper Silver Creek, EEP Project # 94645.

			Current Plot Data (MY0 2015)																				
			94645-01-0001			94645-01-0002			94645-01-0003			94645-01-0004			94645-01-0005			94645-01-0006			94645-01-0007		
Scientific Name	Common Name	Species Type	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T
Acer rubrum	red maple	Tree	1		1	6		6				2		2									
Alnus serrulata	hazel alder	Shrub							1		1												
Betula nigra	river birch	Tree							3		3	1		1				1		1	3		3
Carpinus caroliniana	American hornbeam	Tree	2		2	3		3				1		1	1		1				1		1
Cornus amomum	silky dogwood	Shrub							1		1	3		3	6		6	4		4	2		2
Corylus cornuta	beaked hazelnut	Shrub Tree																1		1			
Diospyros virginiana	common persimmon	Tree	1		1							1		1									
Fraxinus pennsylvanica	green ash	Tree							2		2				8		8	1		1	1		1
Liriodendron tulipifera	tuliptree	Tree	3		3	2		2				1		1									
Platanus occidentalis	American sycamore	Tree	12		12	4		4	6		6	7		7	4		4	3		3	3		3
Quercus michauxii	swamp chestnut oak	Tree				6		6	1		1	2		2	2		2	3		3	3		3
Quercus nigra	water oak	Tree							3		3										1		1
Quercus phellos	willow oak	Tree	2		2	3		3				3		3				3		3			
Unknown		Shrub or Tree				2		2															
Vaccinium corymbosum	highbush blueberry	Shrub				1		1															
Viburnum dentatum	southern arrowwood	Shrub	15		15	3		3															
		Stem count	36		36	30		30	17		17	21		21	21		21	16		16	14		14
		size (ares)	1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	7		7	9		9	7		7	9		9	5		5	7		7	7		7
		Stems per ACRE	1457		1457	1214		1214	688		688	850		850	850		850	647		647	567		567

P = Planted
V = Volunteer
T = Total

This color indicates that the number includes volunteer stems.
Indicates that the stems per Acre exceeds requirements by 10%
Indicates that the stems per Acre exceeds requirements, but by less than 10%

Table 8 Stem Count Arranged by Plot, continued.
Project: Upper Silver Creek, EEP Project # 94645.

			Current Plot Data (MY0 2015)						Annual Means																	
			94645-01-0008			94645-01-0009			MY0 (2015)			MY1 (2015)			MY2 (2016)			MY3 (2016)			MY4 (2016)			MY4 (2016)		
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
Acer rubrum	red maple	Tree	3		3				12		12															
Alnus serrulata	hazel alder	Shrub							1		1															
Betula nigra	river birch	Tree							8		8															
Carpinus caroliniana	American hornbeam	Tree				1		1	9		9															
Cornus amomum	silky dogwood	Shrub							16		16															
Corylus cornuta	beaked hazelnut	Shrub Tree							1		1															
Diospyros virginiana	common persimmon	Tree	1		1				3		3															
Fraxinus pennsylvanica	green ash	Tree							12		12															
Liriodendron tulipifera	tuliptree	Tree	2		2	2		2	10		10															
Platanus occidentalis	American sycamore	Tree	5		5	3		3	47		47															
Quercus michauxii	swamp chestnut oak	Tree	2		2				19		19															
Quercus nigra	water oak	Tree							4		4															
Quercus phellos	willow oak	Tree				6		6	17		17															
Unknown		Shrub or Tree	1		1	3		3	6		6															
Vaccinium corymbosum	highbush blueberry	Shrub							1		1															
Viburnum dentatum	southern arrowwood	Shrub	2		2	1		1	21		21															
		Stem count	16	0	16	16		16	187		187	0		0	0		0	0		0	0		0	0		0
		size (ares)	1			1			9			9			9			9			9			9		
		size (ACRES)	0.02			0.02			0.22			0.22			0.22			0.22			0.22			0.22		
		Species count	7		7	6		6	16		16	0		0	0		0	0		0	0		0	0		0
		Stems per ACRE	647		647	647		647	841		841	0		0	0		0	0		0	0		0	0		0

P = Planted
V = Volunteer
T = Total

This color indicates that the number includes volunteer stems.
Indicates that the stems per Acre exceeds requirements by 10%
Indicates that the stems per Acre exceeds requirements, but by less than 10%

Silver Creek Site Vegetation Plot Photos

Photo 1. Vegetation Plot 1 – Tree photo.

Photo 2. Vegetation Plot 1 – Herbaceous photo.

Photo 3. Vegetation Plot 2 – Tree photo.

Photo 4. Vegetation Plot 2 – Herbaceous photo.

Photo 5. Vegetation Plot 3 – Tree photo.

Photo 6. Vegetation Plot 3 – Herbaceous photo.

Photo 7. Vegetation Plot 4 – Tree photo.

Photo 8. Vegetation Plot 4 – Herbaceous photo.

Photo 9. Vegetation Plot 5 – Tree photo.

Photo Point 10, Vegetation Plot 5 – Herbaceous photo.

Photo 11. Vegetation Plot 6 – Tree photo.

Photo 12. Vegetation Plot 6 – Herbaceous photo.

Photo 13. Vegetation Plot 7 – Tree photo.

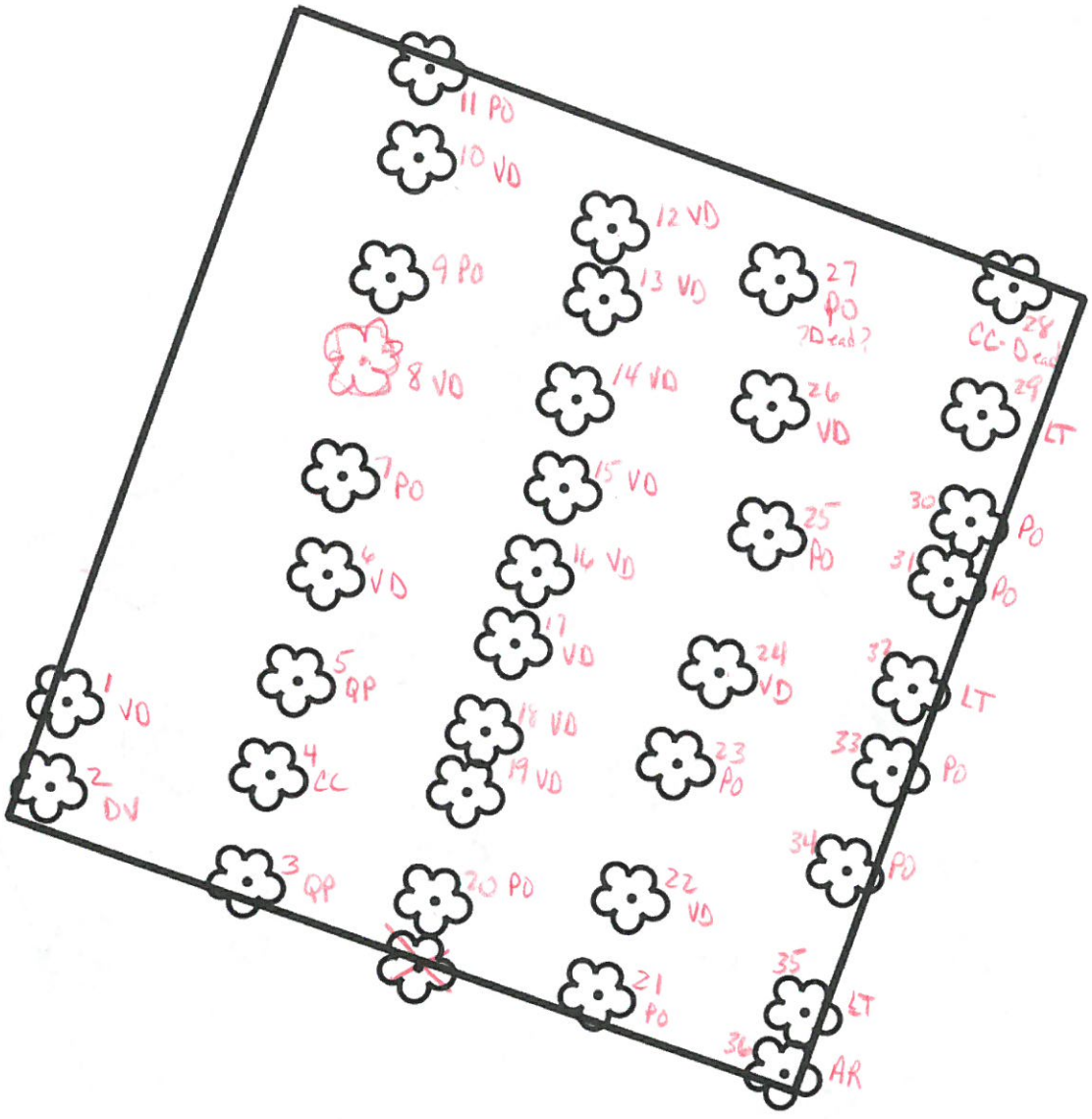
Photo 14. Vegetation Plot 7 – Herbaceous photo.

Photo 15. Vegetation Plot 8 – Tree photo.

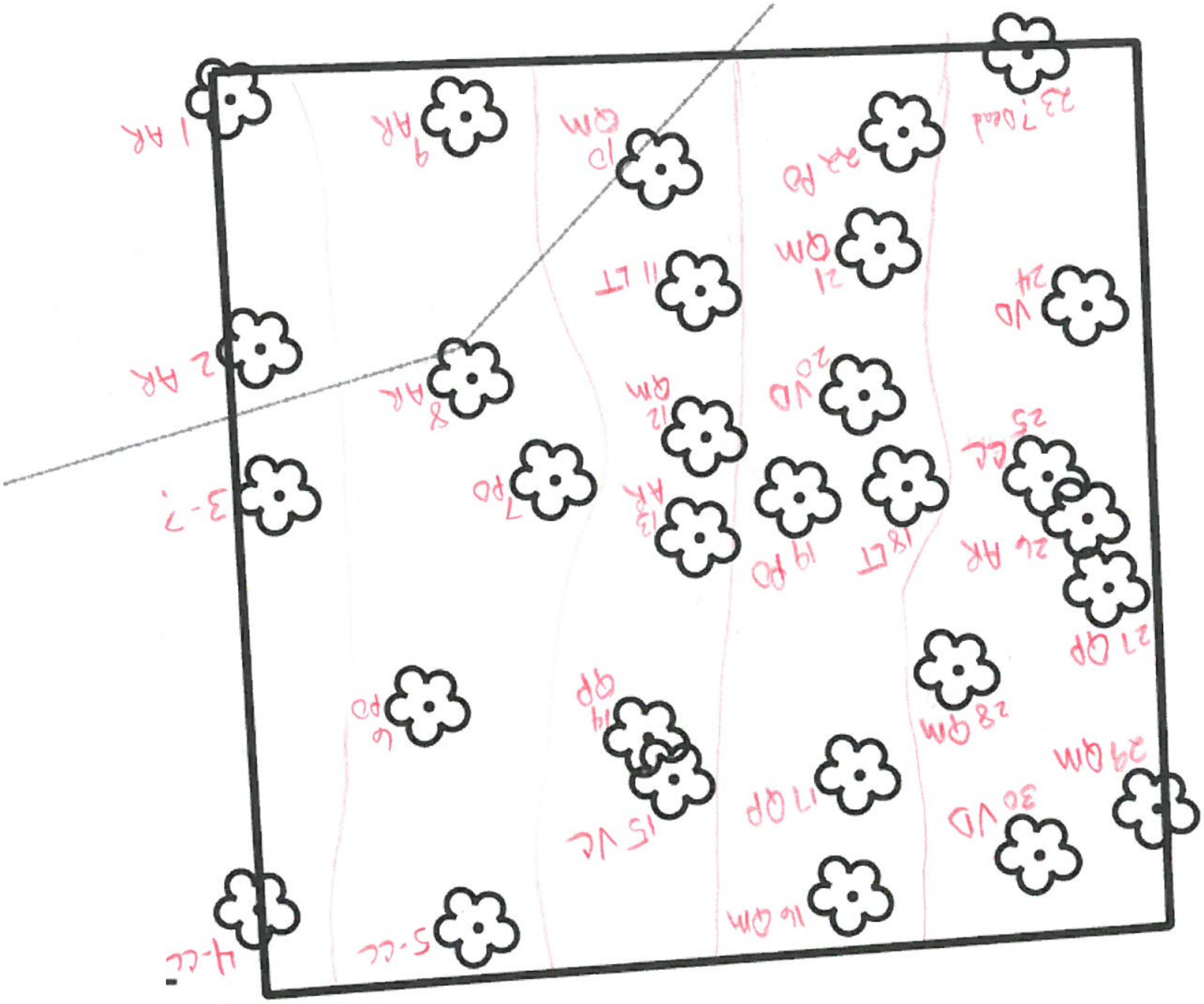
Photo 16. Vegetation Plot 8 – Herbaceous photo.

Photo 17. Vegetation Plot 9 – Tree photo.

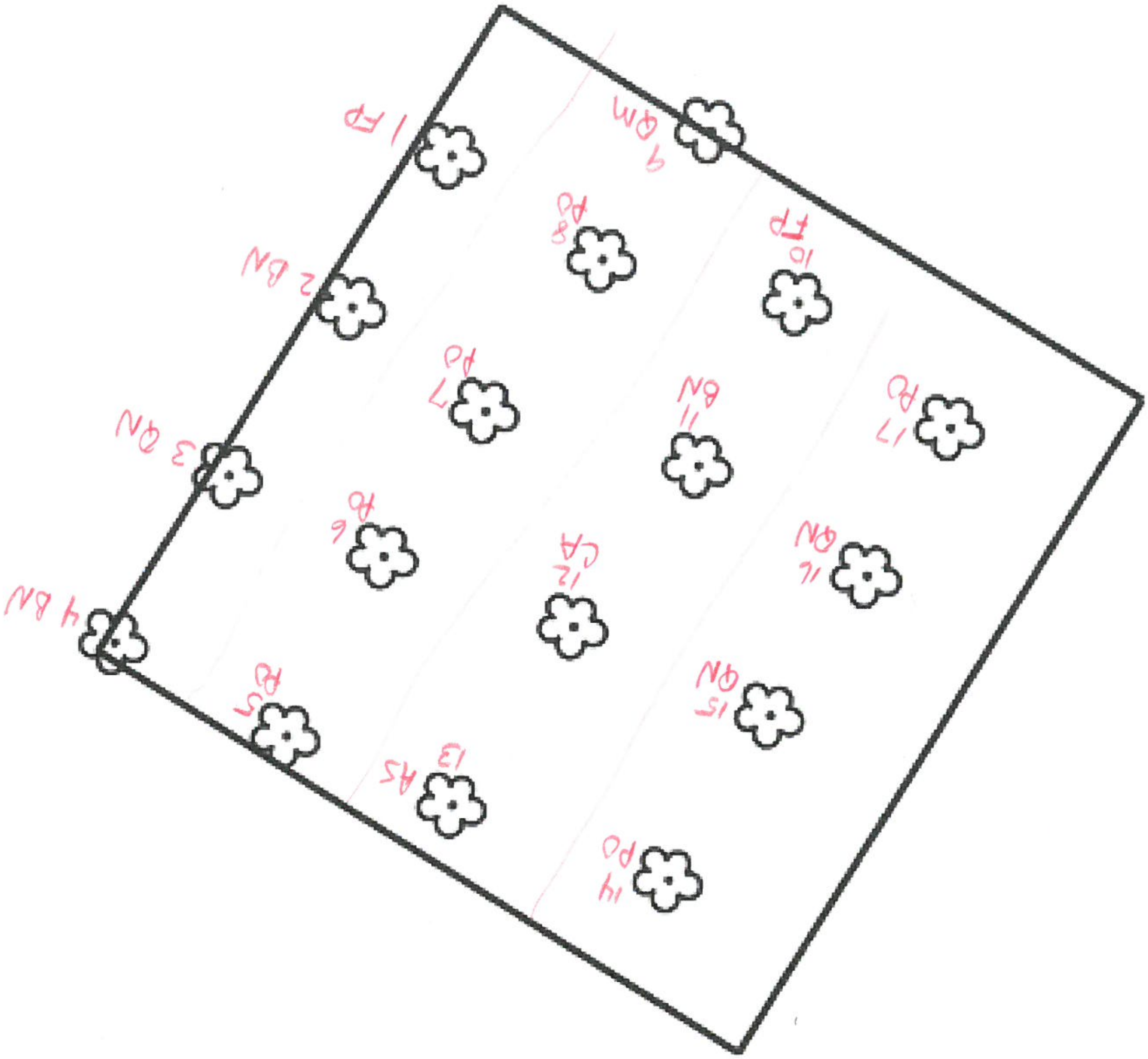
Photo 18. Vegetation Plot 9 – Herbaceous photo.


11 PO
10 VD
12 VD
9 PO
13 VD
27 PO
28 CC-O
8 VD
14 VD
26 VD
29 LT
7 PO
15 VD
25 PO
30 PO
6 VD
16 VD
31 PO
17 VD
24 VD
32 LT
1 VD
5 QP
18 VD
23 PO
33 PO
2 DV
4 CC
19 VD
34 PO
3 QP
20 PO
22 VD
35 LT
21 PO
36 AR

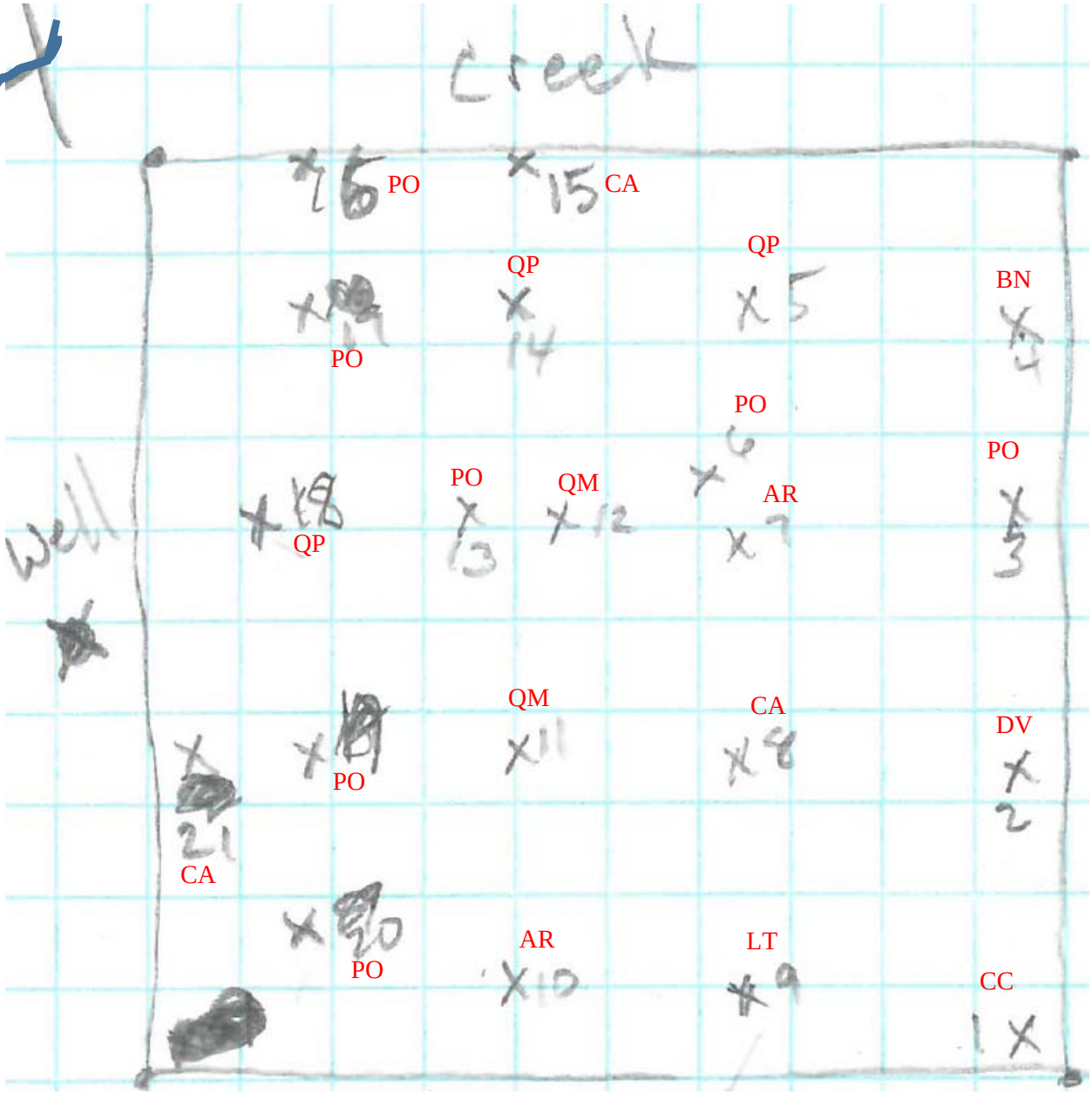
1

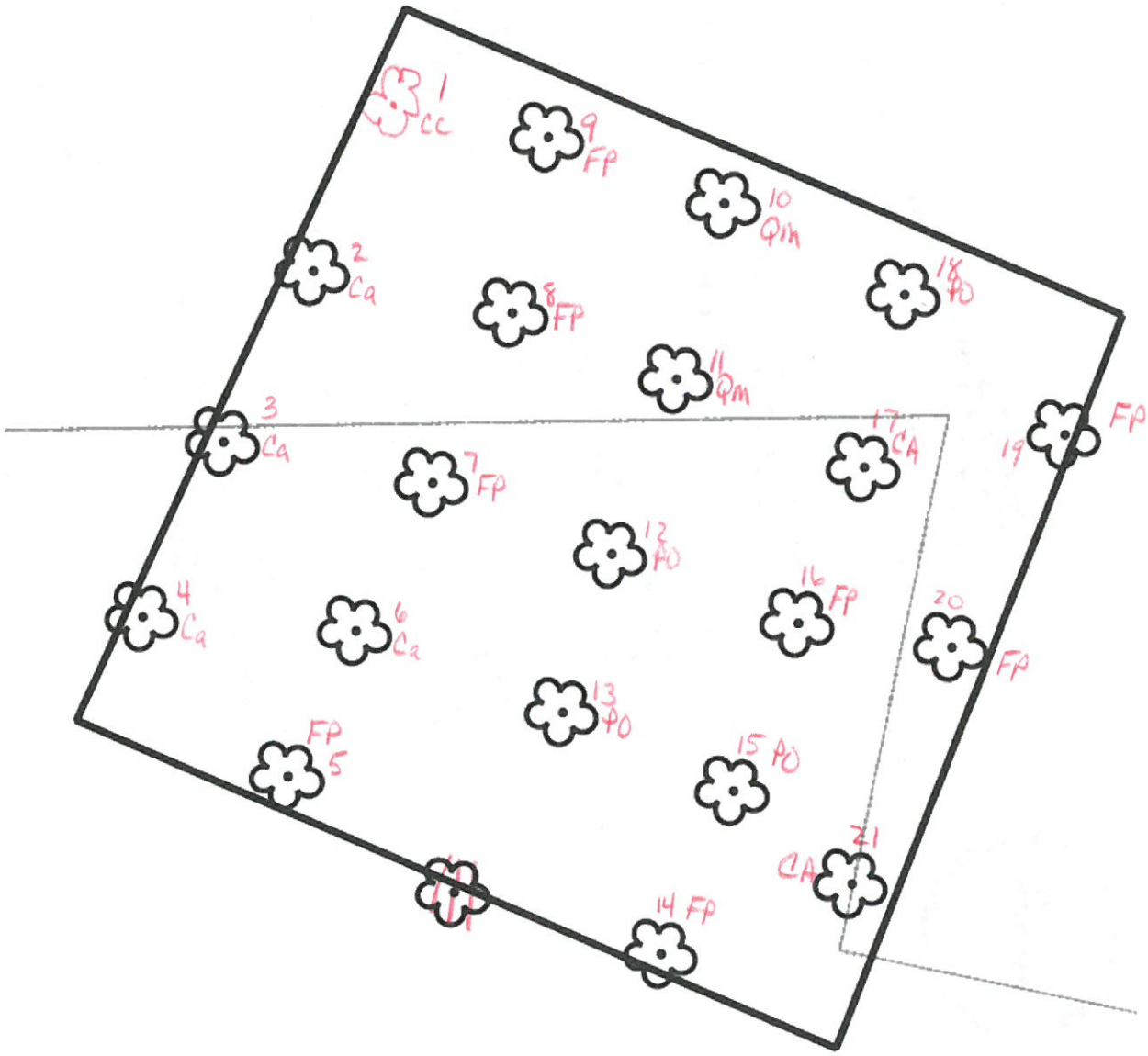

1 AR
2 AR
3-?
4-CC
5-CC
6 PO
7 PO
8 AR
9 AR
10 QM
11 LT
12 QM
13 AR
14 QP
15 VC
16 QM
17 QP
18 LT
19 PO
20 VD
21 QM
22 PO
23 Dead
24 VD
25 CC
26 AR
27 QP
28 QM
29 QM
30 VD

②

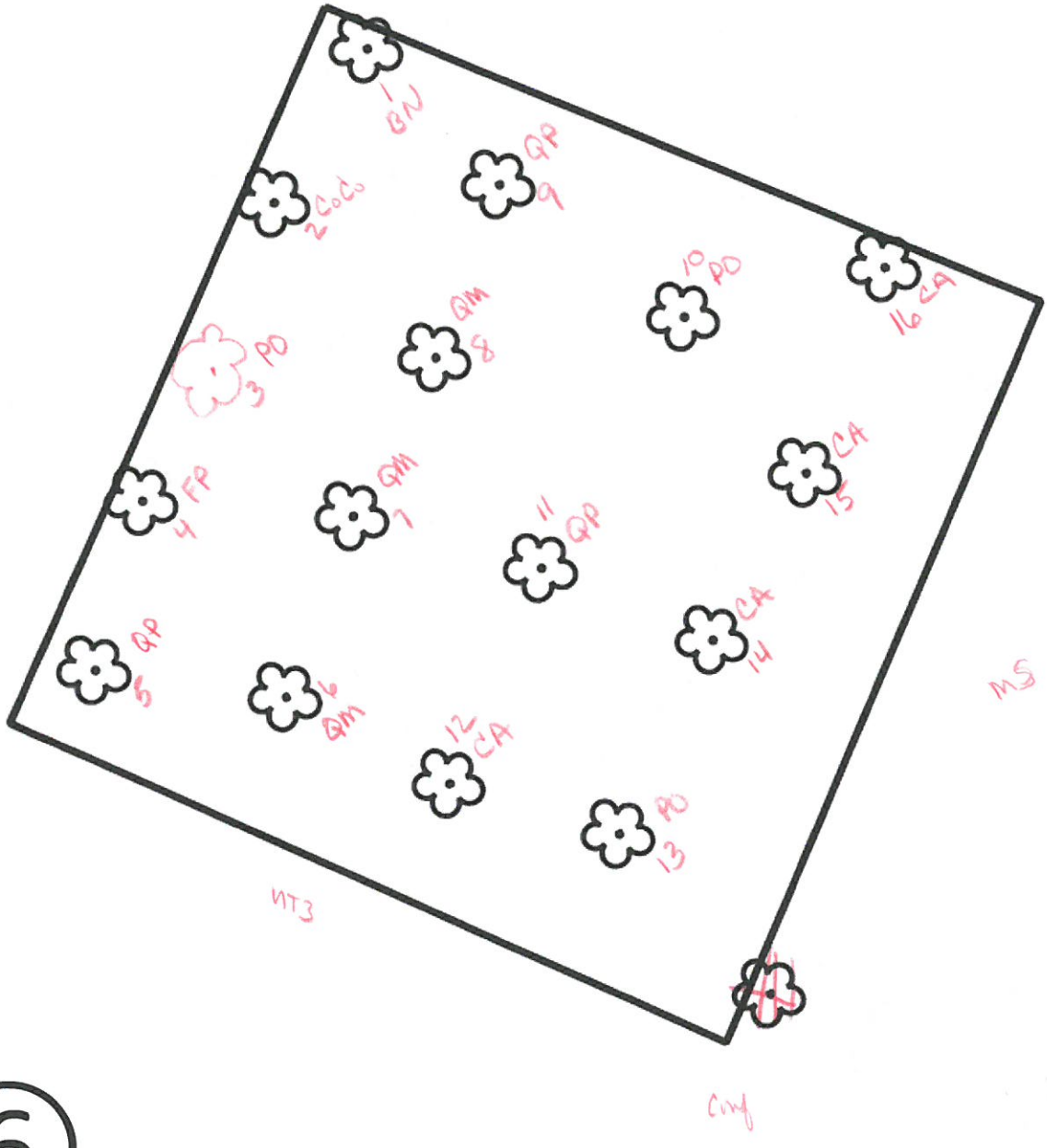


③

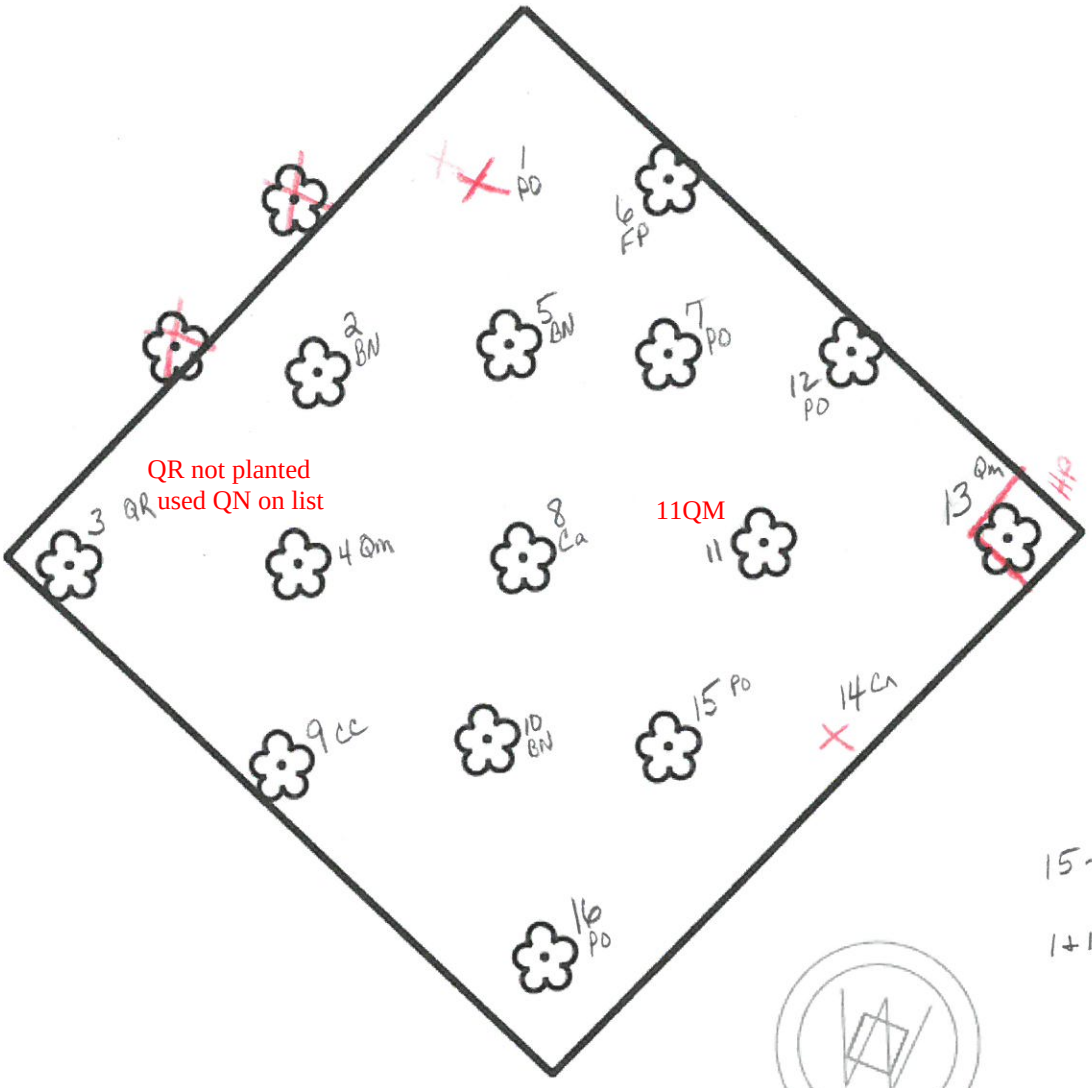

creek
PO
CA
QP
BN
PO
QP
PO
PO
QM
AR
QP
PO
QM
CA
DV
PO
CA
AR
LT
PO
CC


1 CC
9 FP
10 QM
2 Ca
8 FP
18 PO
11 QM
3 Ca
17 CA
19 FP
7 FP
12 PO
16 FP
4 Ca
6 Ca
20 FP
13 PO
FP 5
15 PO
21 CA
14 FP

5


1 BN
2 CoCo
GP 9
10 PD
16 CA
PD 3
GM 8
FP 4
GM 7
11 GP
CA 15
CA 14
GP 5
6 GM
12 CA
PD 13
MT3
MS
CM

6

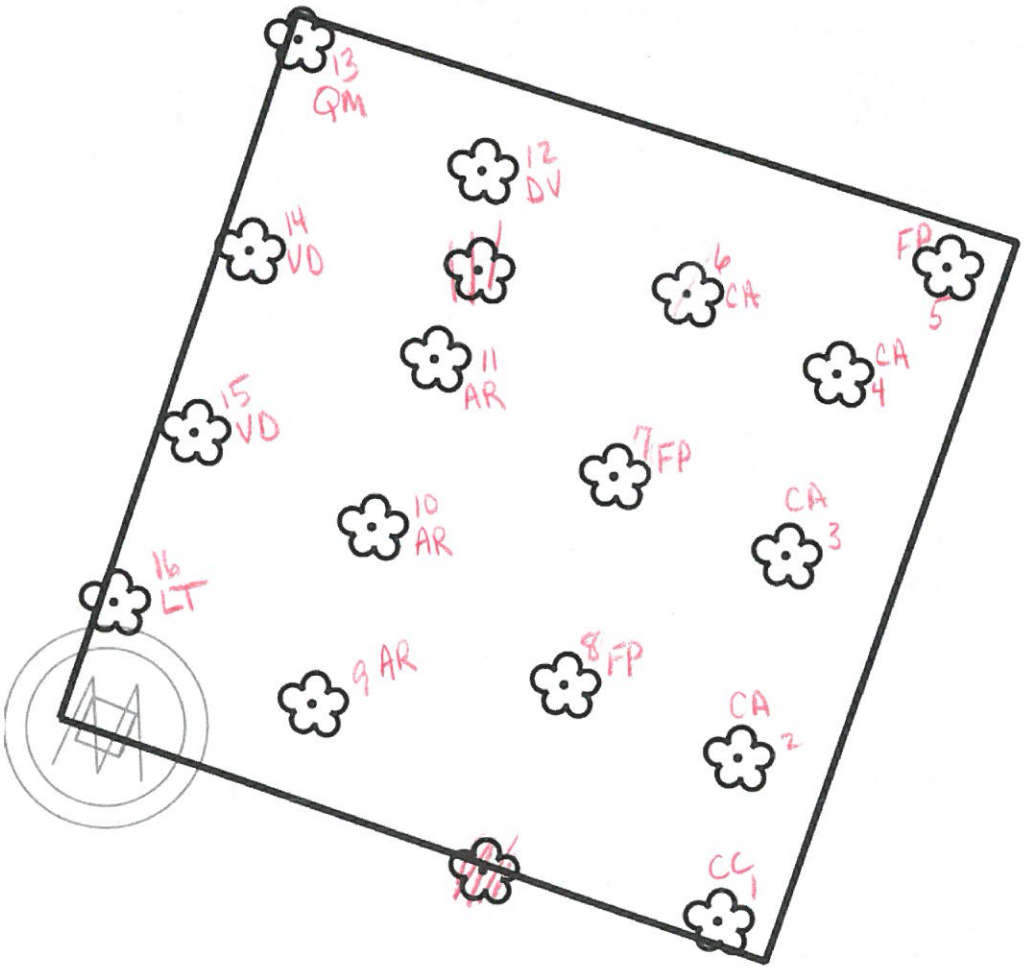


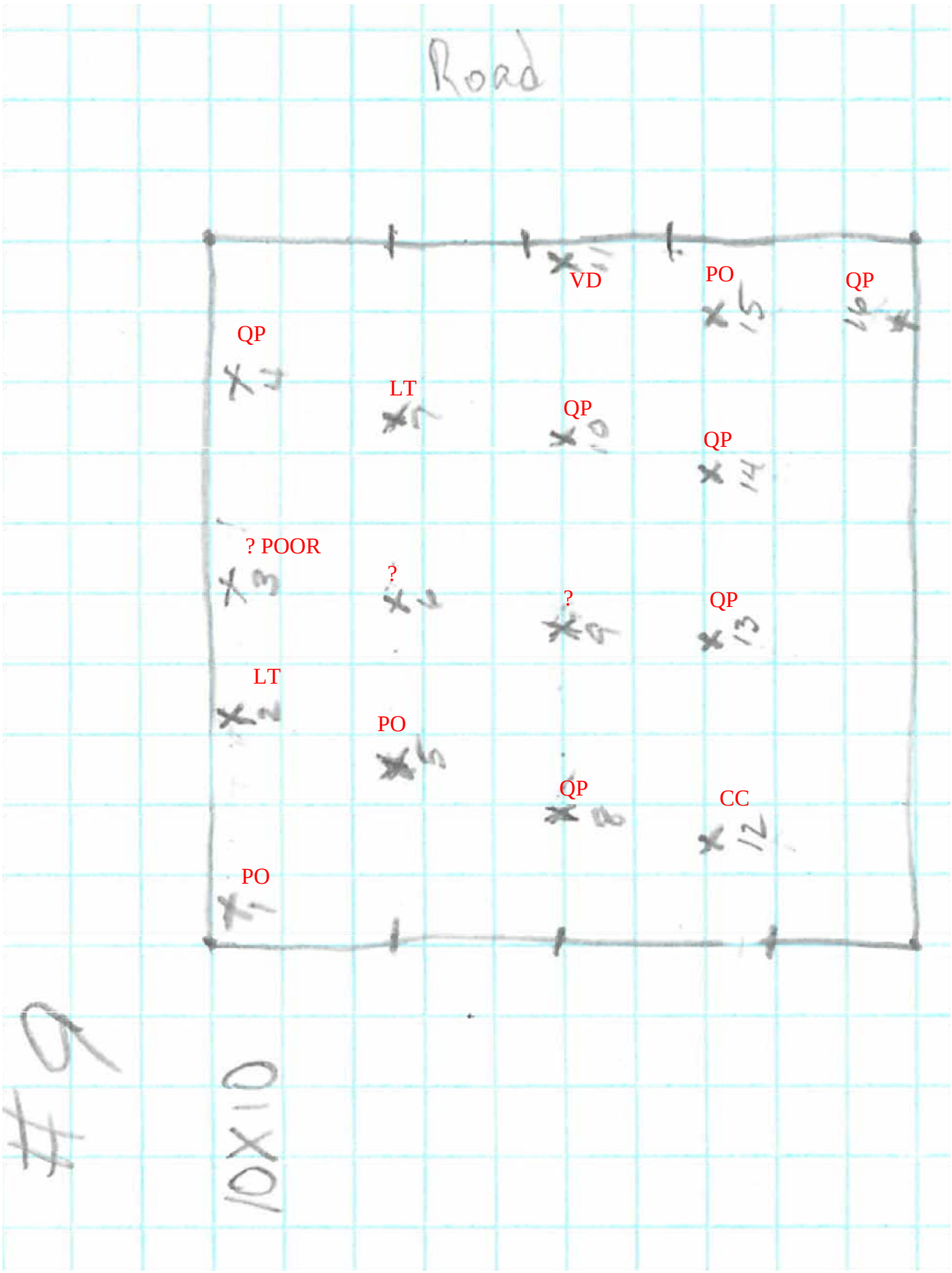
QR not planted
used QN on list

11QM

15 - Not counted and tagged
1 + 14 Not surveyed

7


13
QM
12
DV
14
VD
6
CA
FP
5
11
AR
CA
4
15
VD
7
FP
10
AR
CA
3
16
LT
9
AR
8
FP
CA
2
CC
1


Road
VD
PO
QP
QP
LT
QP
QP
? POOR
?
?
QP
LT
PO
QP
CC
PO
#9
10X10

APPENDIX D

As-Built Plan Sheets/Record Drawings

STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	120598	1	12
NCDMS PROJECT NO. 94645			

NC DIVISION OF MITIGATION SERVICES

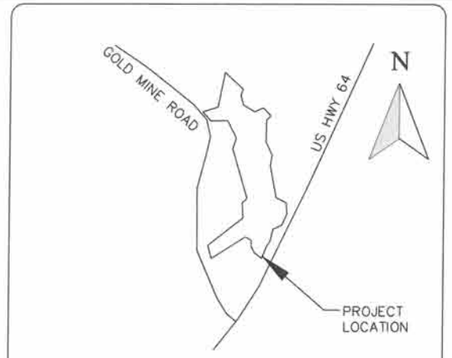
Upper Silver Creek Stream and Wetland Restoration Project, Option C

Burke County, North Carolina

Type of Work: AS - BUILT PLAN

Upper Silver Creek (Brackett Site)

NCDMS PROJECT NO. 94645



VICINITY MAP
NOT TO SCALE

NORTH CAROLINA PROFESSIONAL SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT

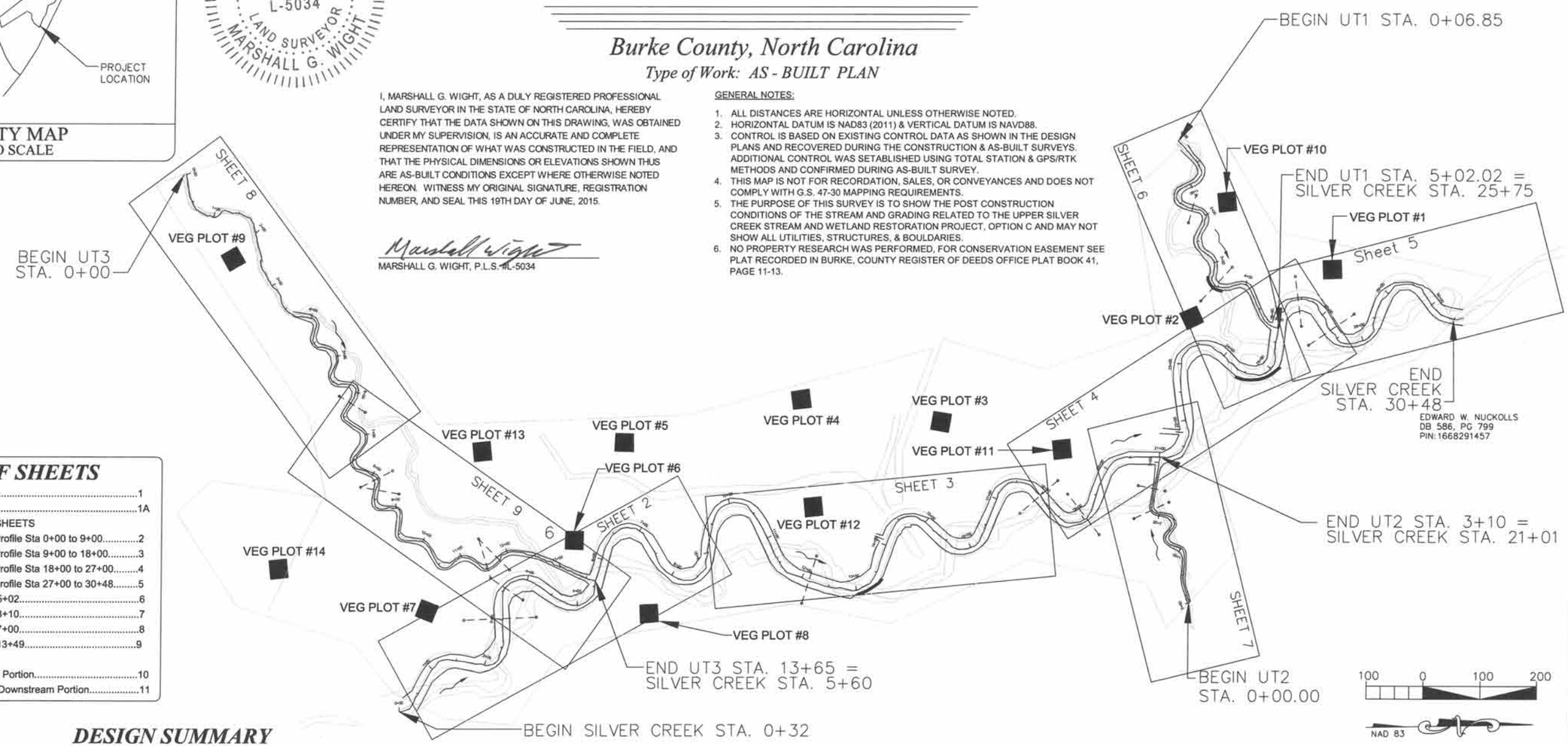
I, MARSHALL G. WIGHT, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 19TH DAY OF JUNE, 2015.

Marshall Wight

MARSHALL G. WIGHT, P.L.S. #L-5034

GENERAL NOTES:

1. ALL DISTANCES ARE HORIZONTAL UNLESS OTHERWISE NOTED.
2. HORIZONTAL DATUM IS NAD83 (2011) & VERTICAL DATUM IS NAVD88.
3. CONTROL IS BASED ON EXISTING CONTROL DATA AS SHOWN IN THE DESIGN PLANS AND RECOVERED DURING THE CONSTRUCTION & AS-BUILT SURVEYS. ADDITIONAL CONTROL WAS ESTABLISHED USING TOTAL STATION & GPS/RTK METHODS AND CONFIRMED DURING AS-BUILT SURVEY.
4. THIS MAP IS NOT FOR RECORDATION, SALES, OR CONVEYANCES AND DOES NOT COMPLY WITH G.S. 47-30 MAPPING REQUIREMENTS.
5. THE PURPOSE OF THIS SURVEY IS TO SHOW THE POST CONSTRUCTION CONDITIONS OF THE STREAM AND GRADING RELATED TO THE UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C AND MAY NOT SHOW ALL UTILITIES, STRUCTURES, & BOULDARIES.
6. NO PROPERTY RESEARCH WAS PERFORMED, FOR CONSERVATION EASEMENT SEE PLAT RECORDED IN BURKE, COUNTY REGISTER OF DEEDS OFFICE PLAT BOOK 41, PAGE 11-13.



INDEX OF SHEETS

DESIGN SUMMARY

STREAMS

Name:	Reach	Stations	Linear Ft	Type	Approach	SMU
SILVER CK	1 (SC1)	0+32 TO 8+70	838	Restoration	PII	838
SILVER CK	2 (SC2)	8+70 TO 30+48	2,178	Restoration	PI	2,178
UT1	1 (UT1-1)	0+07 TO 5+02	495	Restoration	PI	495
UT2	1 (UT2-1)	0+00 TO 1+03	103	Restoration	PI	103
UT2	2 (UT2-2)	1+03 TO 3+10	207	Restoration	PI	207
UT3	1 (UT3-1)	0+00 TO 3+43	343	Enhancement II	N/A	137
UT3	2 (UT3-2)	3+43 TO 13+65	1,022	Restoration	PI	1,022
					TOTAL:	4,980

WETLANDS	Acres	Type	WMU
Wetland Restoration	4.67	Riparian	4.67
Wetland Restoration	0.21	Non-Riparian	0.21
Wetland Enhancement	2.85	Riparian	1.43
Wetland Enhancement	0.42	Non-Riparian	0.21
Wetland Creation	0.99	Riparian	0.33
		TOTAL:	6.85

PREPARED FOR THE OFFICE OF:

NCDEQ
DIVISION OF MITIGATION SERVICES

1652 MAIL SERVICE CENTER
RALEIGH, N.C. 27699-1652

NCDMS PROJECT MGR.: Matthew Reid

NCDMS REVIEW COORDINATOR: Matthew Reid

PREPARED IN THE OFFICE OF:

Michael Baker INTERNATIONAL

Michael Baker Engineering Inc.
797 Haywood Road, Suite 201
Asheville, NORTH CAROLINA 28806
Phone: 828.350.1408
Fax: 828.350.1409
License #: F-1084

JACOB M. BYERS, PE
PROJECT ENGINEER

MICKY CLEMMONS
PROJECT MANAGER

MARCH 14 2016
DATE

Revisions

Date	Sheets

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 039201 3/27/16 ENGINEER JACOB M. BYERS

SIGNATURE: *P.E.*

LEGEND OF PLAN VIEW

- ROCK CROSS VANE
- ROCK DROP
- ROCK VANE
- CONSTRUCTED RIFFLE
- LOG CROSS VANE
- GRADE CONTROL LOG J-HOOK
- LOG VANE
- COVER LOG
- ROOT WAD
- GEOLIFT
- TOEWOOD
- VEG PLOT
- WETLAND RESTORATION
- WETLAND ENHANCEMENT TO EXISTING JURISDICTIONAL WETLANDS
- WETLAND CREATION
- (W) MONITORING WELL
- CREST GUAGE
- PHOTO POINT
- AS-BUILT SURVEYED CROSS SECTION
- EXISTING THALWEG
- EXISTING TOP OF BANK
- DESIGN THALWEG
- DESIGN TOP OF BANK
- AS-BUILT THALWEG
- AS-BUILT TOP OF BANK
- FLOW DIRECTION
- CE — CONSERVATION EASEMENT
- EXISTING CONTOURS
- 1200 — AS-BUILT MAJOR CONTOUR
- AS-BUILT MINOR CONTOUR

LEGEND OF PROFILE VIEW

- PROPOSED THALWEG
- PROPOSED LOW BANK
- AS-BUILT THALWEG
- AS-BUILT LOW BANK

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS 3/24/11

NCDMS Proj. No. 94645

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

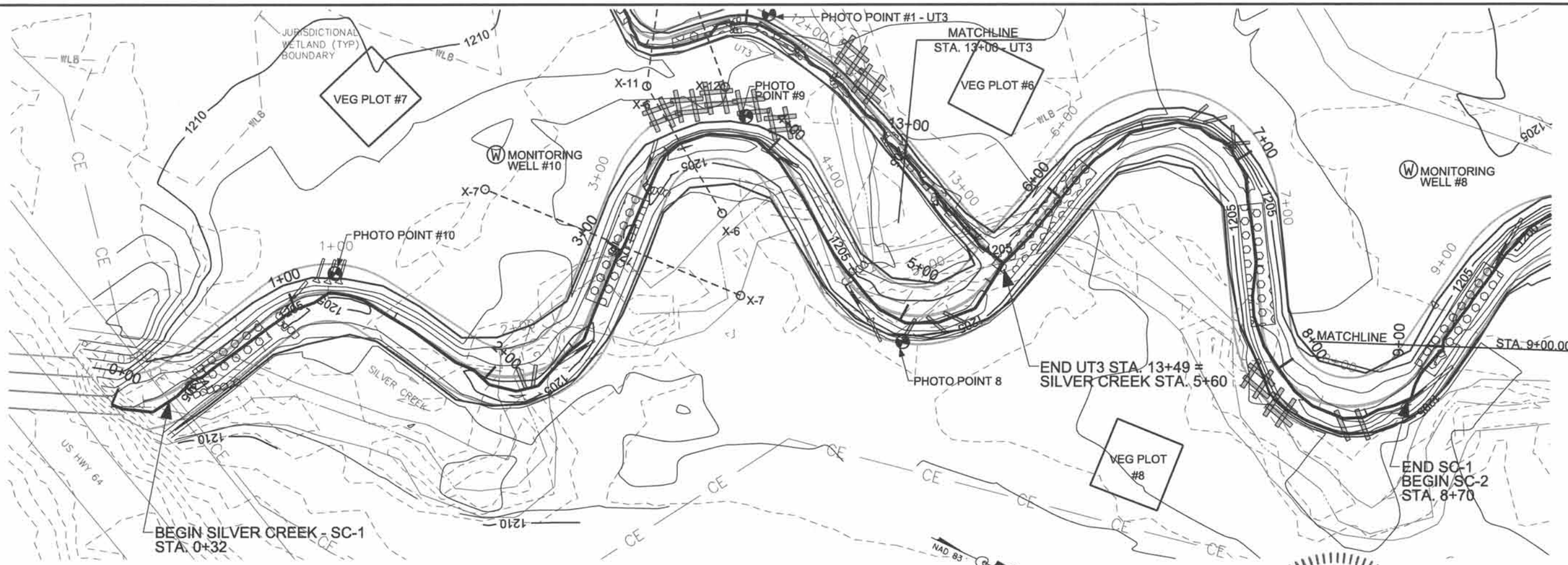
UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

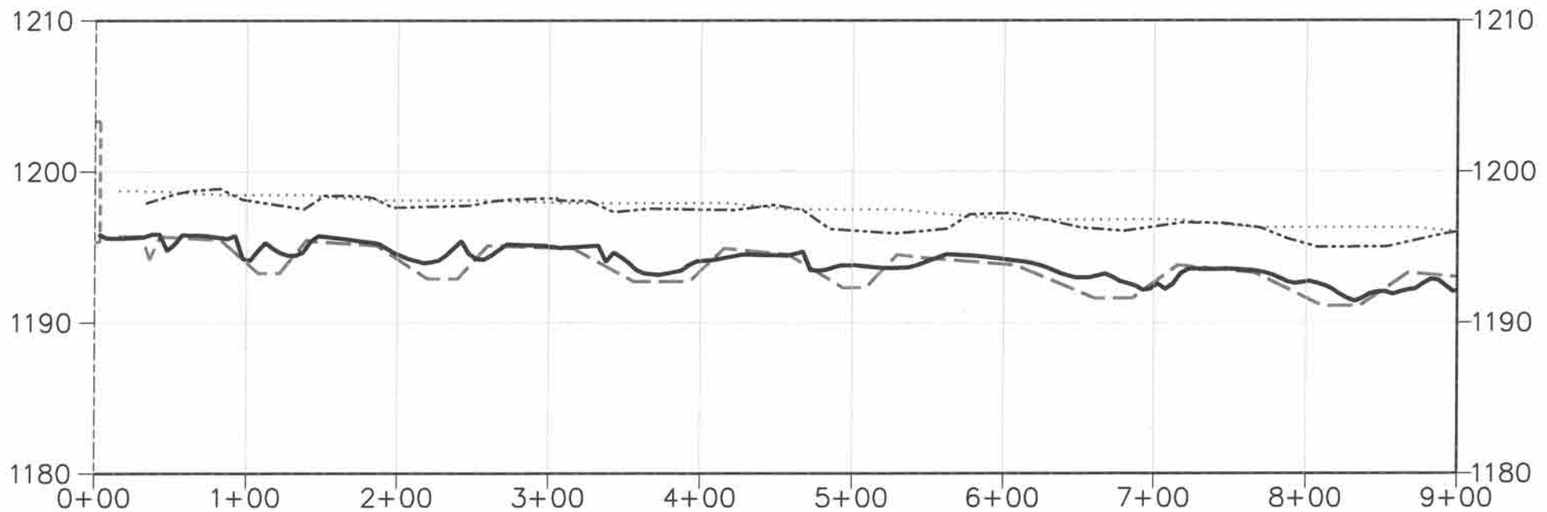
SILVER CREEK MAINSTEM
AS-BUILT PLAN

Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

Revisions
Date | Sheets

Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:
Sheet: 1A of 11





LEGEND OF PROFILES

PROPOSED THALWEG
PROPOSED LOW BANK
AS-BUILT THALWEG
AS-BUILT LOW BANK

PROFILE SCALE
HORIZONTAL: 1"=100'
VERTICAL: 1"=10'

I, MARSHALL G. WIGHT, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 19TH DAY OF JUNE, 2015.

Marshall Wight
MARSHALL G. WIGHT, P.L.S. #L-5034

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS 3/24/16

NORTH CAROLINA PROFESSIONAL SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

SILVER CREEK MAINSTEM AS-BUILT PLAN

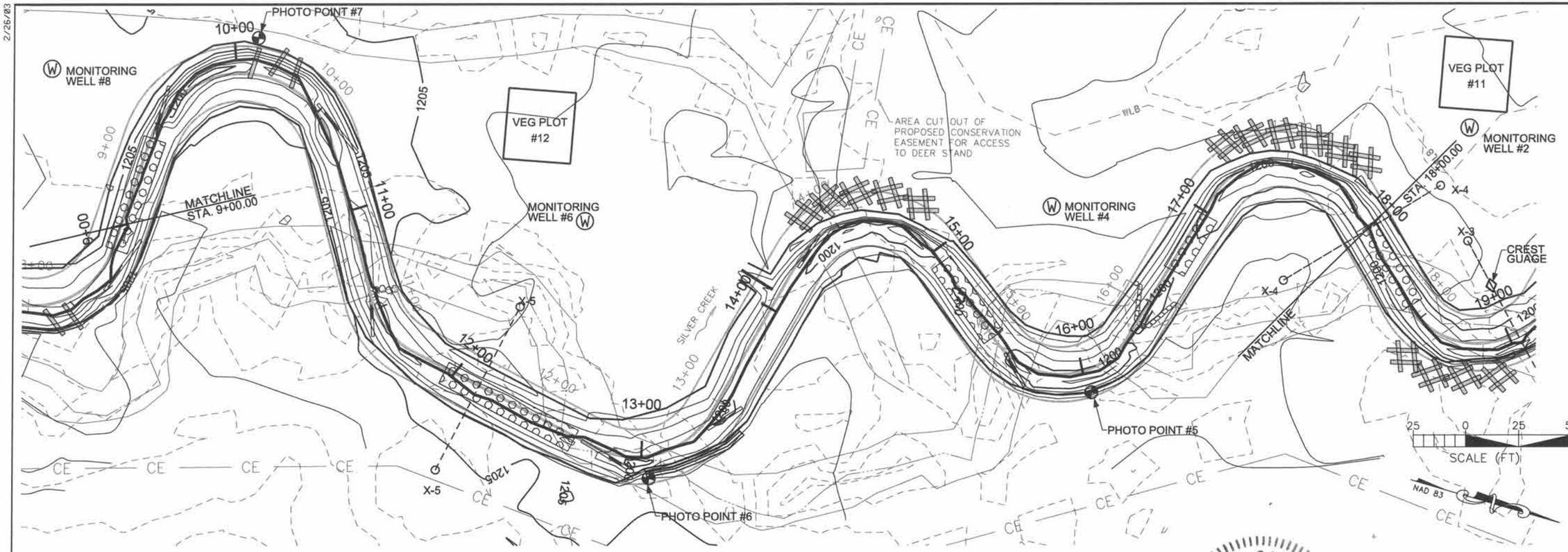
Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

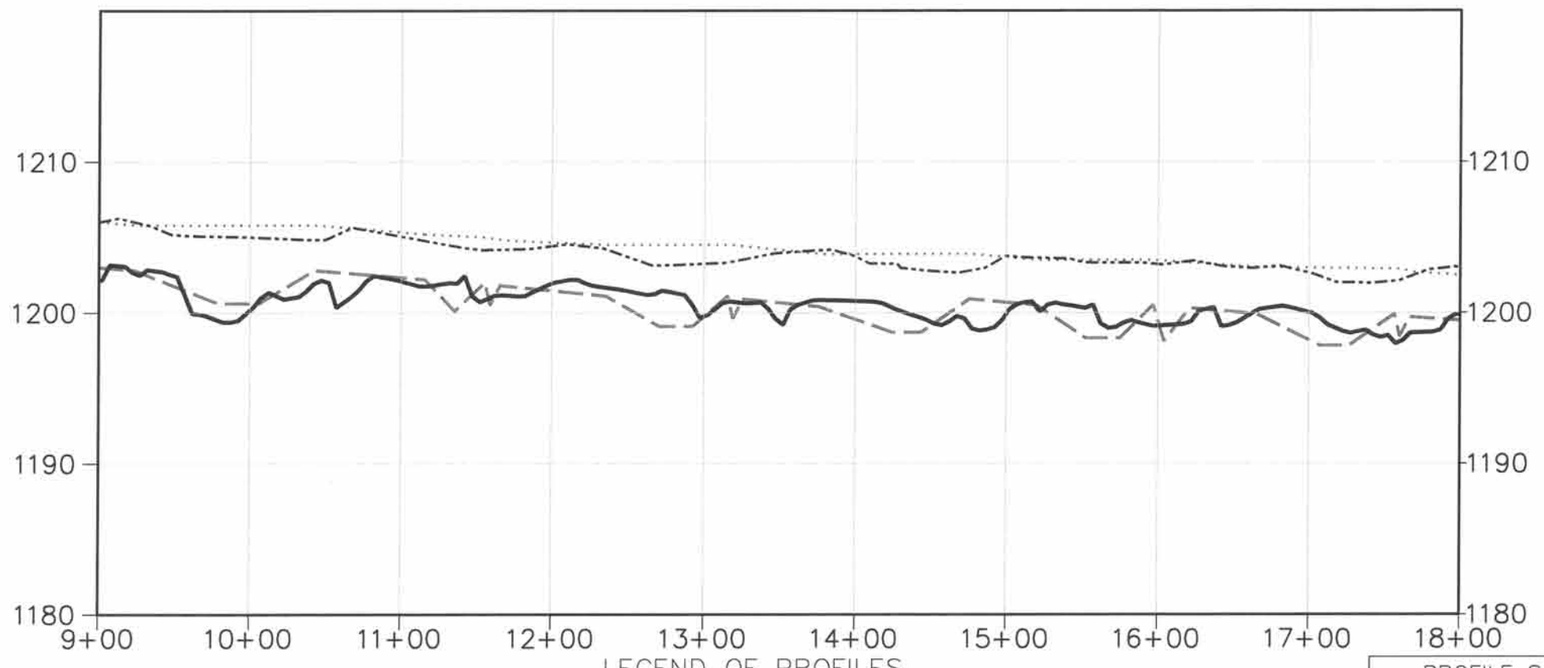
Revisions
Date | Sheets

Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:
Sheet: 2 of 11

NCDMS Proj. No. 94645

2/26/03
3/23/2016
R:\120598\AS_BUILT\PLANS\UprSilverCk_003270_As-Built-Plans.dgn
mcreu





PROFILE SCALE
HORIZONTAL: 1"=100'
VERTICAL: 1"=10'

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

I, MARSHALL G. WIGHT, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 19TH DAY OF JUNE, 2015.

Marshall Wight
MARSHALL G. WIGHT, P.L.S. #L-5034

NORTH CAROLINA PROFESSIONAL SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT

NCDMS Proj. No. 94645

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

SILVER CREEK MAINSTEM AS-BUILT PLAN

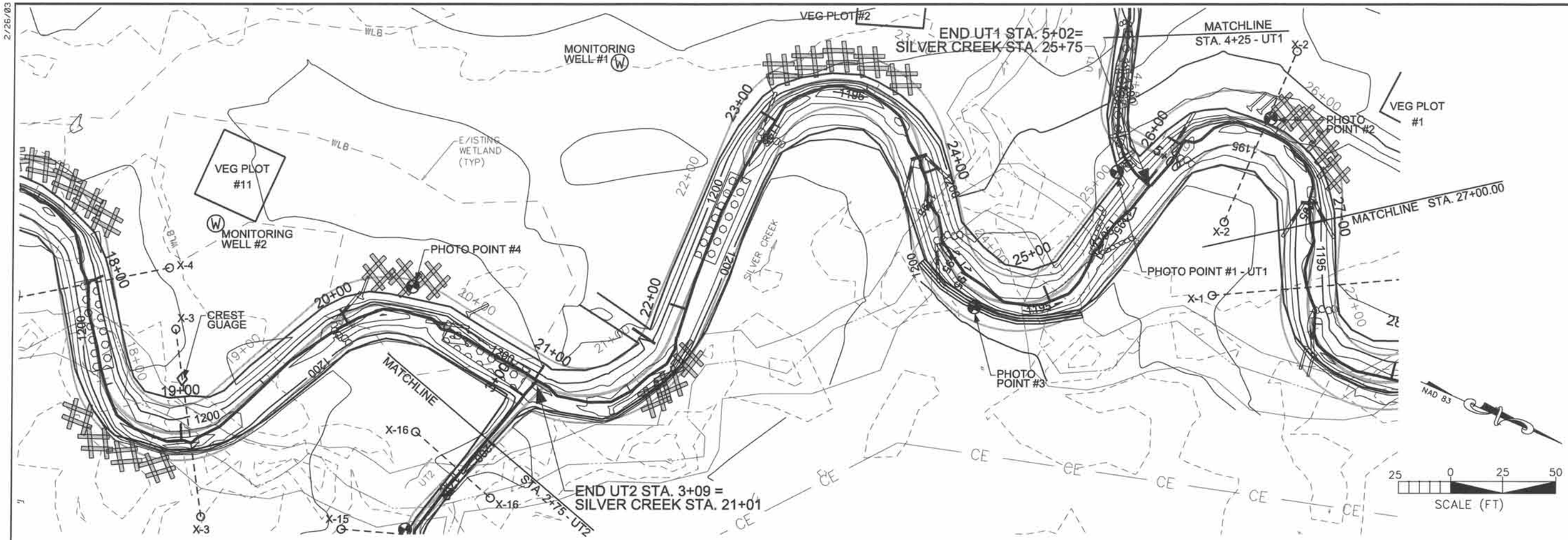
Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

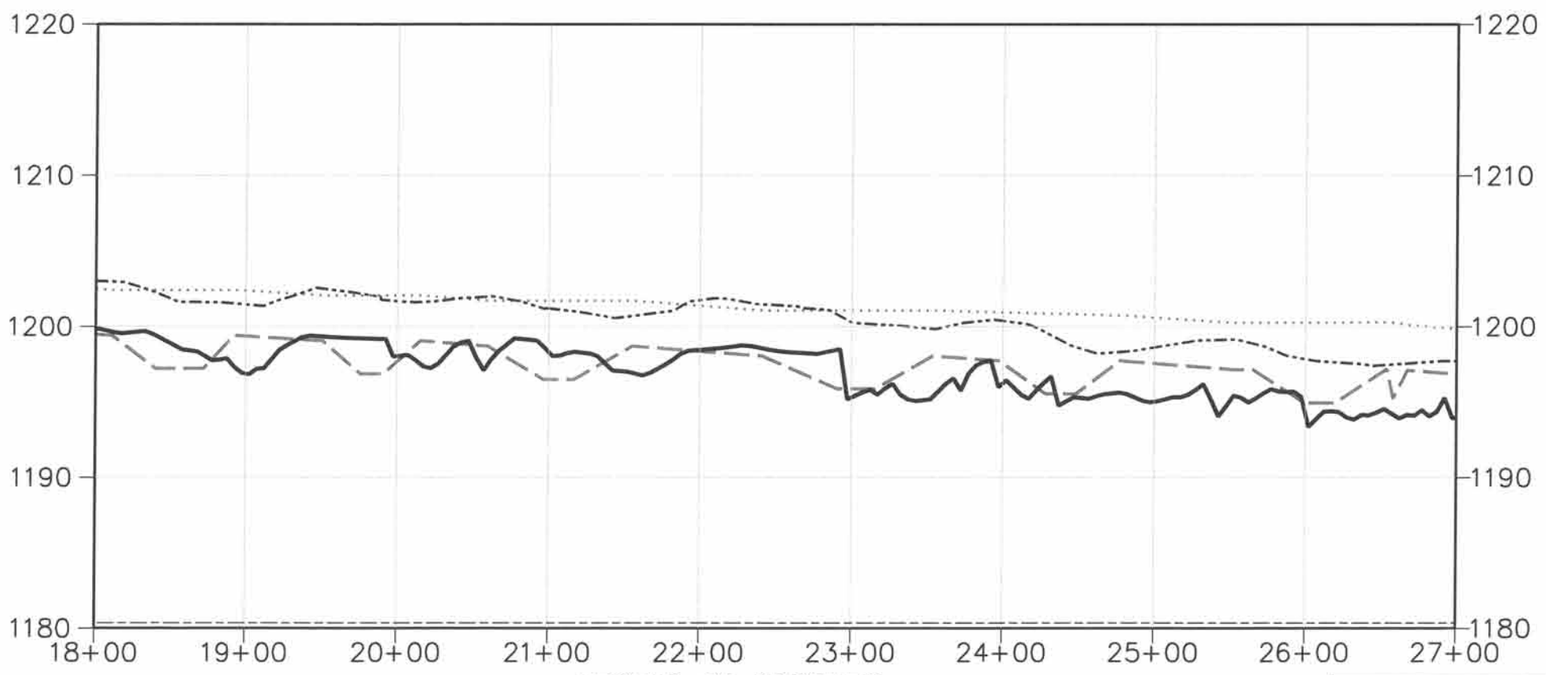
Revisions
Date | Sheets

Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:
Sheet: 3 of 11

2/26/03

3/23/2016
R:\120598\AS_BUILT\PLANS\UprSilverCk_003270_As-Built-Plans.dgn
mcarey





PROFILE SCALE
HORIZONTAL: 1"=100'
VERTICAL: 1"=10'

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS 3/22/16

I, MARSHALL G. WIGHT, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 19TH DAY OF JUNE, 2015.

Marshall Wight

MARSHALL G. WIGHT, P.L.S. #L-5034

NORTH CAROLINA PROFESSIONAL SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT

NCDMS Proj. No. 94645

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

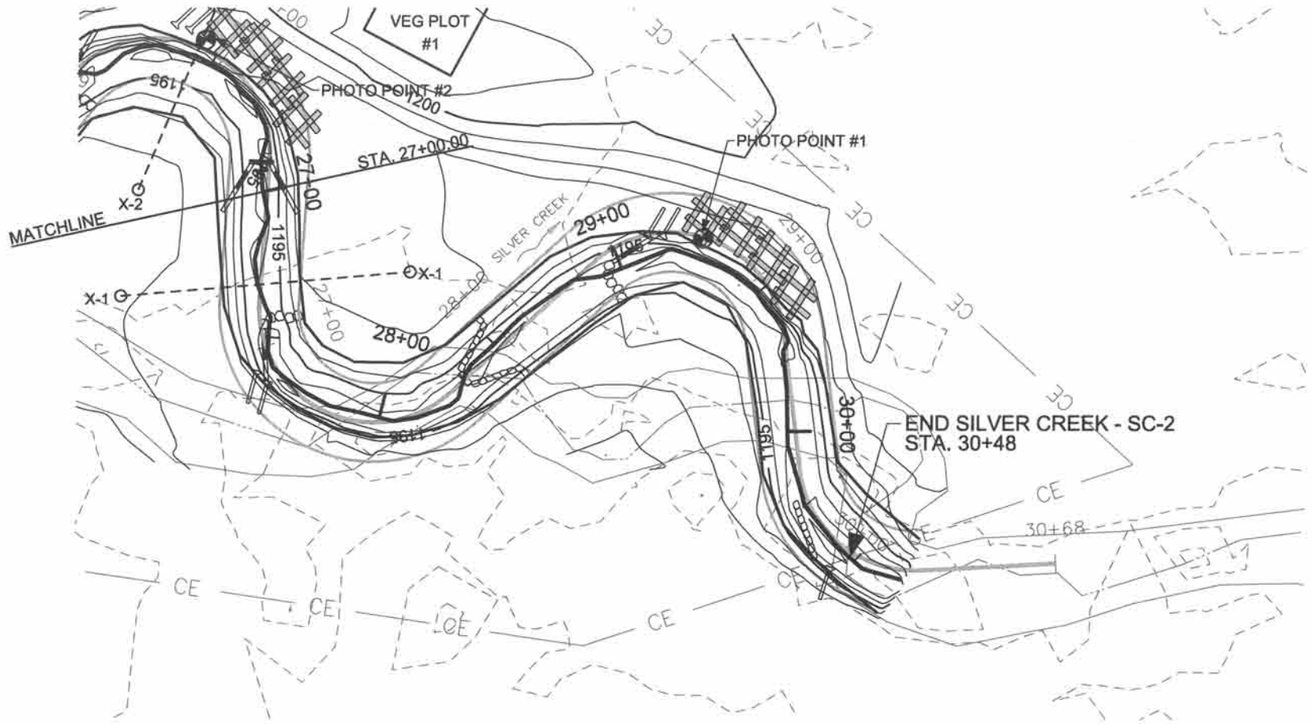
SILVER CREEK MAINSTEM AS-BUILT PLAN

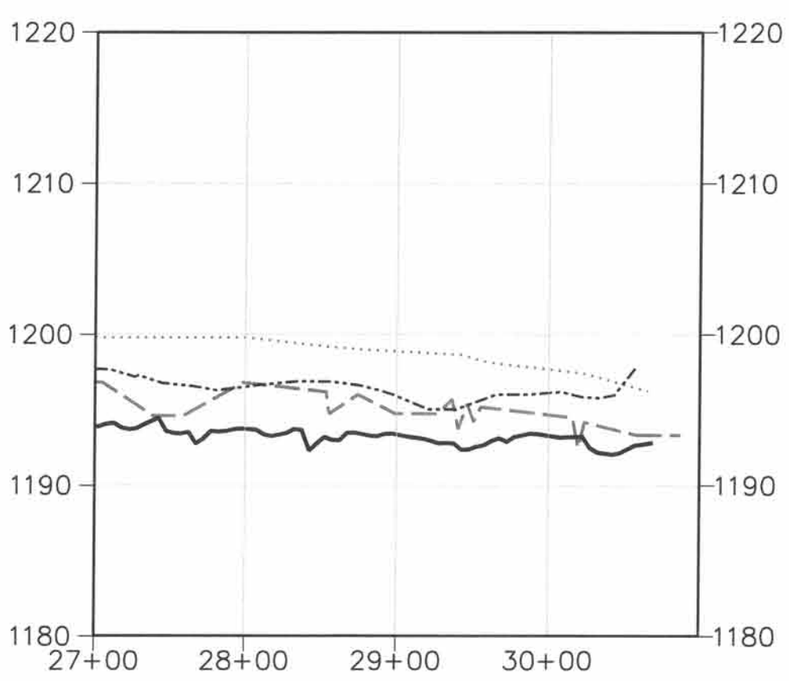
Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

Revisions
Date | Sheets

Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:
Sheet: 4 of 11

3/22/2016
R:\120598\AS-BUILT\PLANS\Upr-SilverCk_003270_As-Built-Plans.dgn
mcarey





PROFILE SCALE
HORIZONTAL: 1"=100'
VERTICAL: 1"=10'

LEGEND OF PROFILES

- PROPOSED THALWEG
- PROPOSED LOW BANK
- AS-BUILT THALWEG
- AS-BUILT LOW BANK

I, MARSHALL G. WIGHT, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 19TH DAY OF JUNE, 2015.

Marshall Wight
MARSHALL G. WIGHT, P.L.S. #L-5034

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

SILVER CREEK MAINSTEM AS-BUILT PLAN

Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

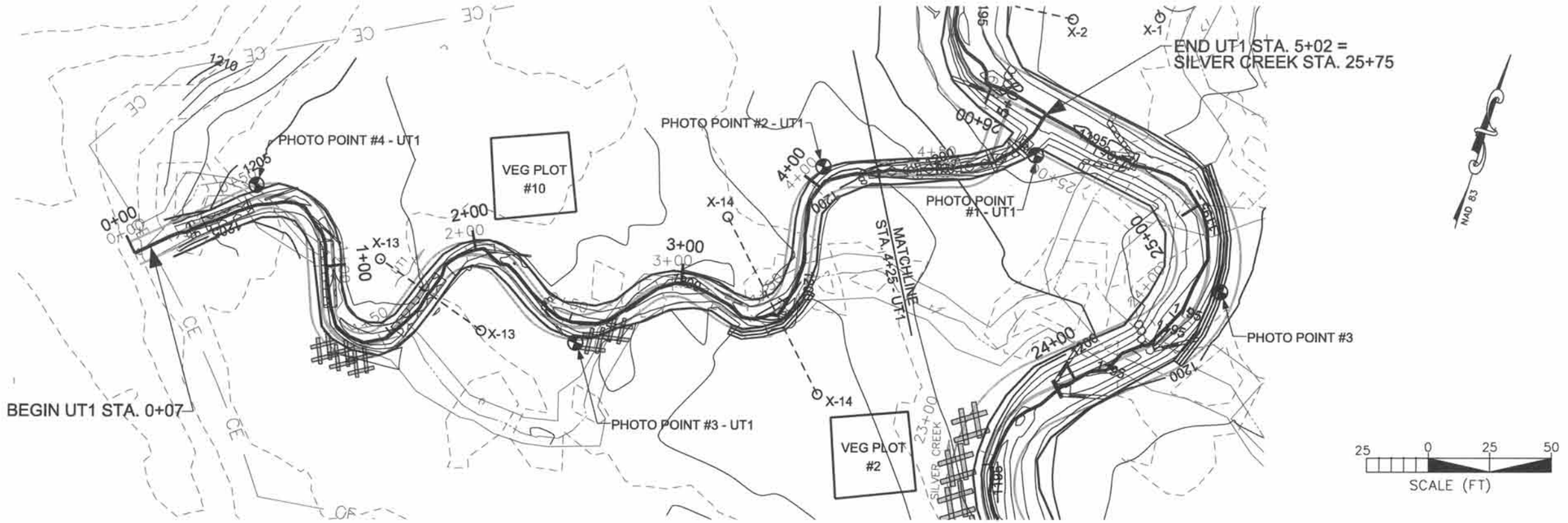
Revisions
Date | Sheets

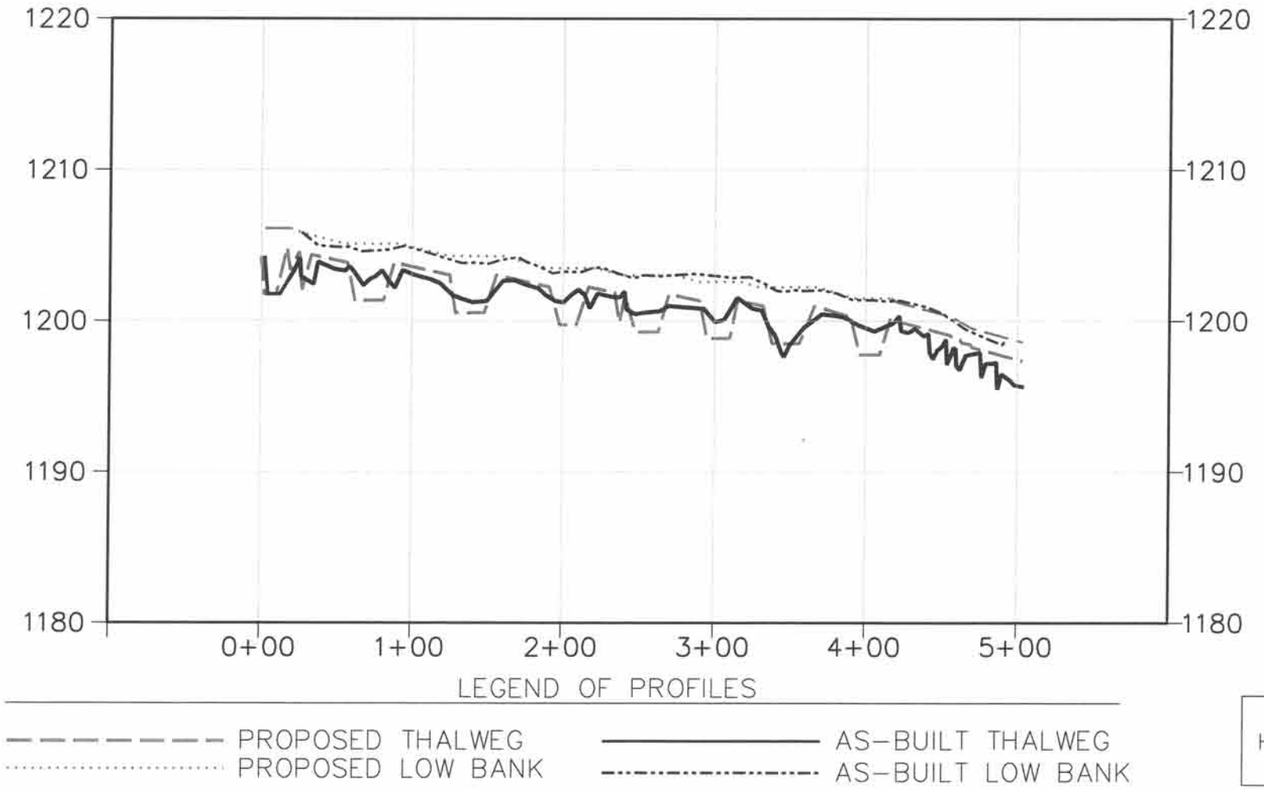
Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:
Sheet: 5 of 11

NCDMS Proj. No. 94645

2/26/03

3/23/2016
R:\120598\AS_BUILT\PLANS\UpprSilverCk_003270_As-Built-Plans.dgn
mcbrau





PROFILE SCALE
HORIZONTAL: 1"=100'
VERTICAL: 1"=10'

I, MARSHALL G. WIGHT, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 19TH DAY OF JUNE, 2015.

Marshall Wight

MARSHALL G. WIGHT, P.L.S. #L-5034

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS 3/24/16

NORTH CAROLINA PROFESSIONAL SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT

NCDMS Proj. No. 94645

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

SILVER CREEK UT 1
AS-BUILT PLAN

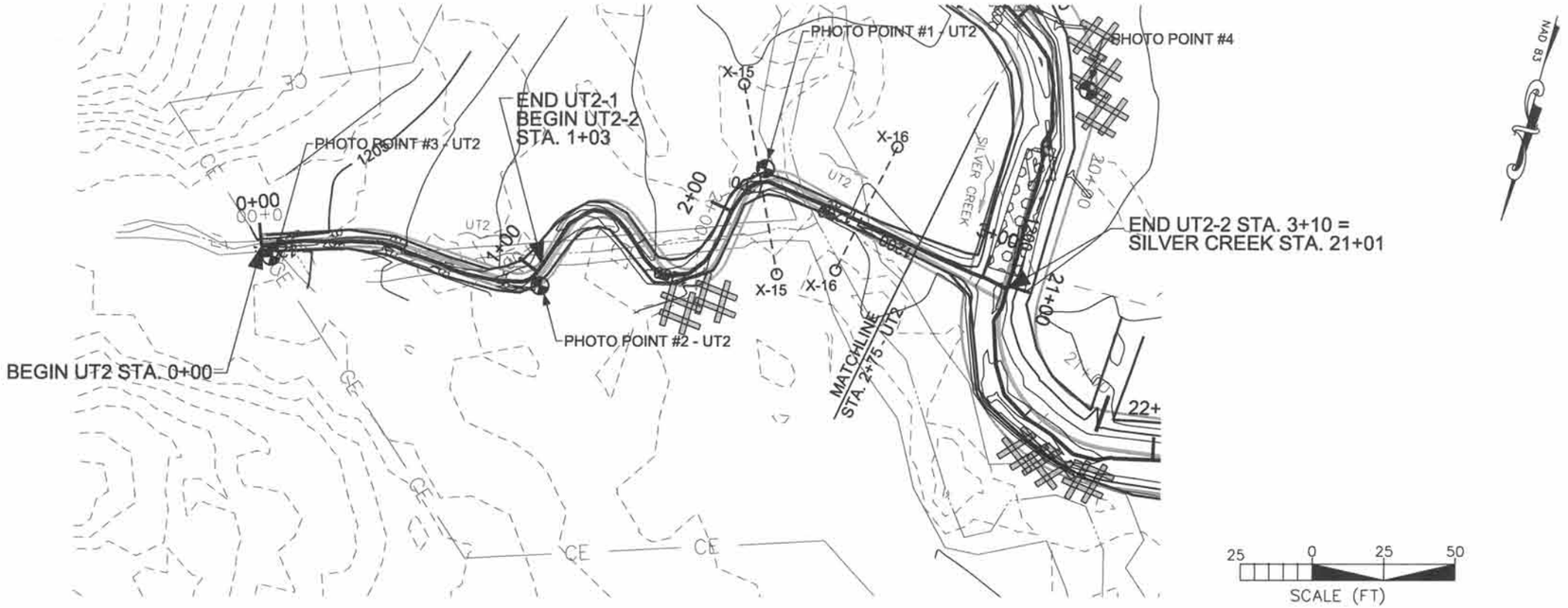
Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

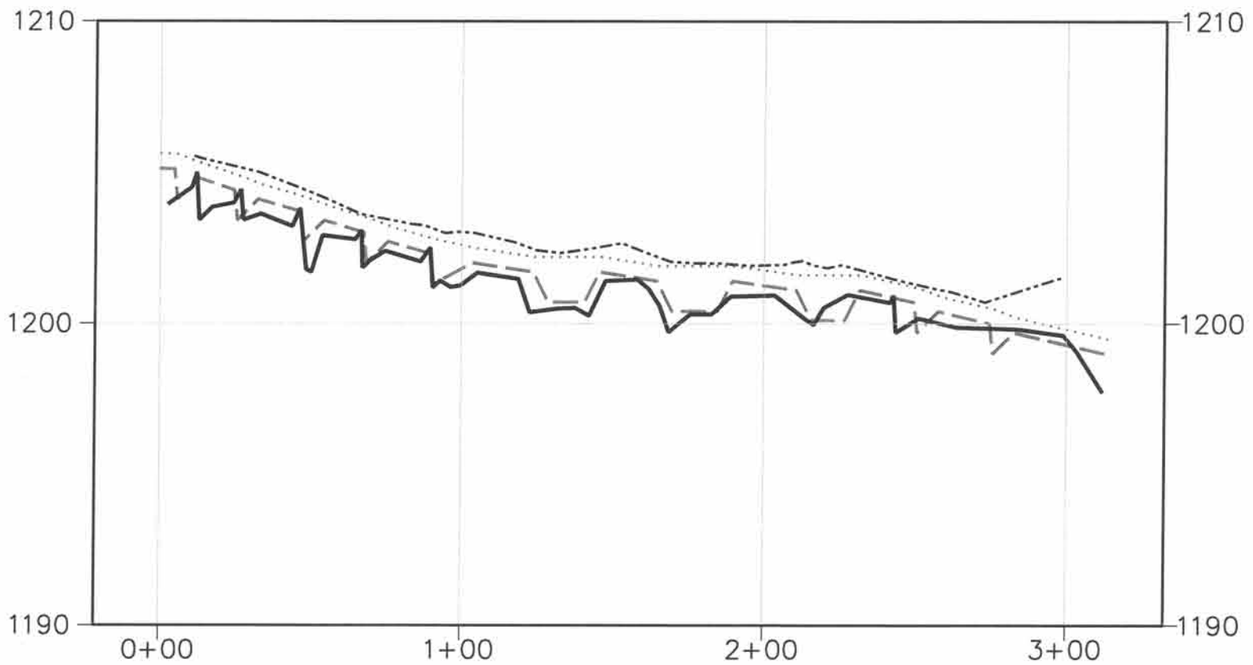
Revisions
Date | Sheets

Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:
Sheet: 6 of 11

2/26/03

3/23/2016
R:\120598\AS_BUILT\PLANS\UprSilverCk_003270_As-Built-Plans.dgn
mcarey





PROFILE SCALE
HORIZONTAL: 1"=100'
VERTICAL: 1"=10'

I, MARSHALL G. WIGHT, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 19TH DAY OF JUNE, 2015.

Marshall Wight

MARSHALL G. WIGHT, P.L.S. #L-5034

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS 3/24/11

NORTH CAROLINA PROFESSIONAL SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

SILVER CREEK UT2
AS-BUILT PLAN

Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

Revisions
Date | Sheets

Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:
Sheet: 7 of 11

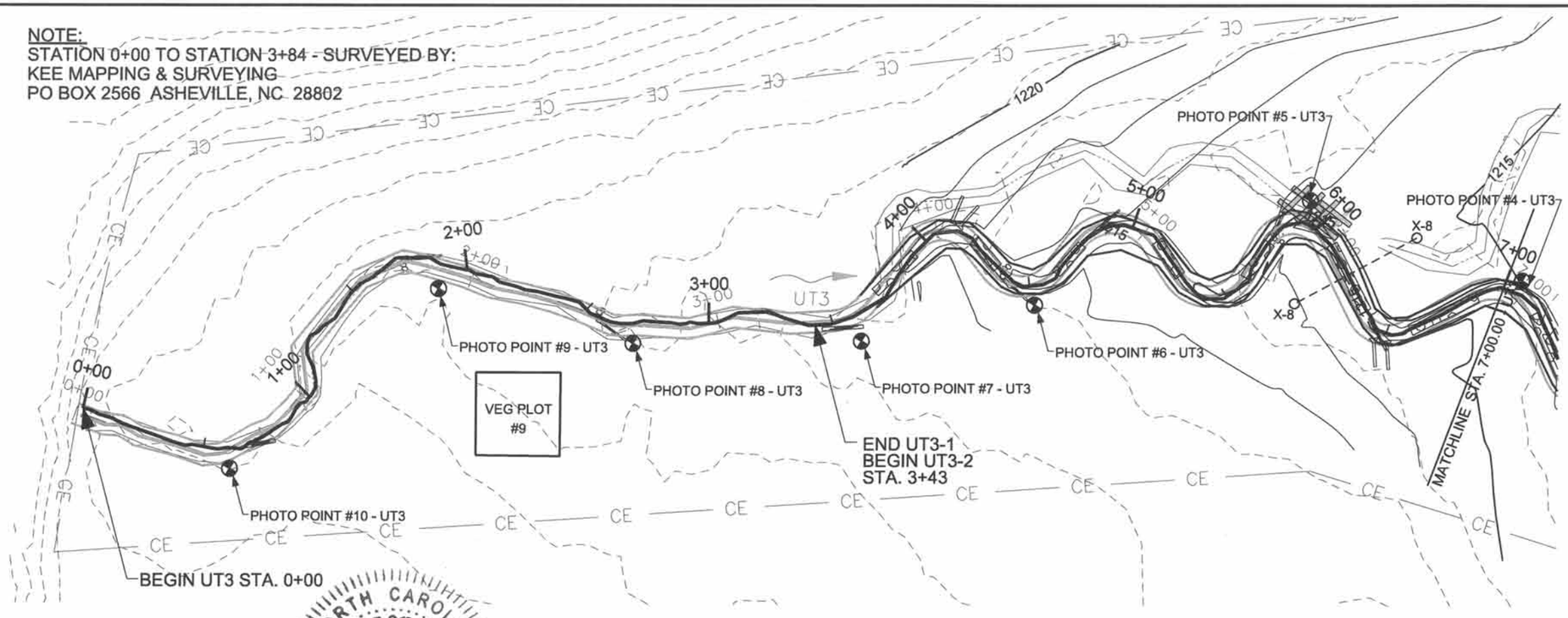
NCDMS Proj. No. 94645

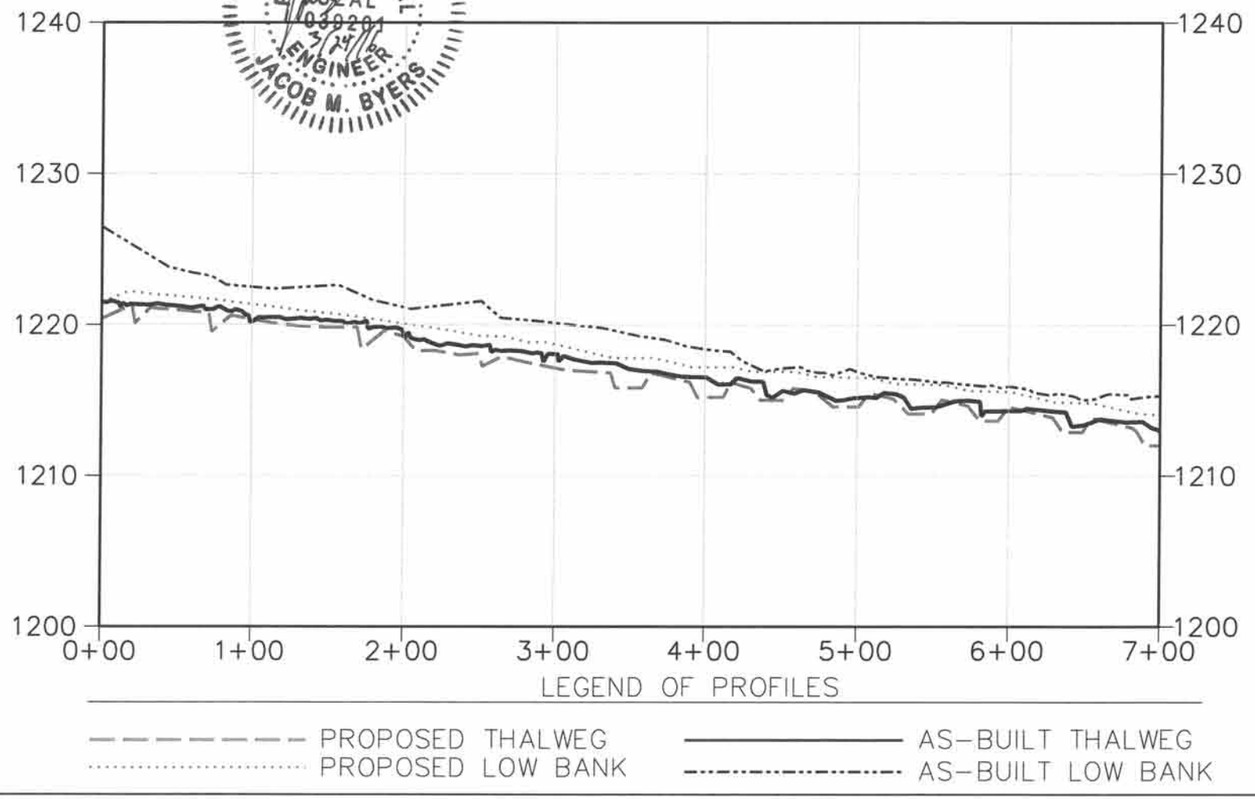
2/26/03

3/23/2015
R:\120598\AS.BUILT\PLANS\UprSilverCk_003270.As-Built-Plans.dgn
mcgarey

2/26/03

NOTE:
STATION 0+00 TO STATION 3+84 - SURVEYED BY:
KEE MAPPING & SURVEYING
PO BOX 2566 ASHEVILLE, NC 28802





NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

I, MARSHALL G. WIGHT, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 19TH DAY OF JUNE, 2015.

Marshall Wight

MARSHALL G. WIGHT, P.L.S. #L-5034

NORTH CAROLINA PROFESSIONAL SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT

I, PHILLIP B. KEE, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, BETWEEN STATIONS 0+00 TO 3+84 WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 14TH DAY OF MARCH, 2016.

Phillip B. Kee

PHILLIP B. KEE, P.L.S. #L-4647

NORTH CAROLINA PROFESSIONAL SEAL L-4647 LAND SURVEYOR PHILLIP B. KEE

PROFILE SCALE
HORIZONTAL: 1"=100'
VERTICAL: 1"=10'

NCDMS Proj. No. 94645

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

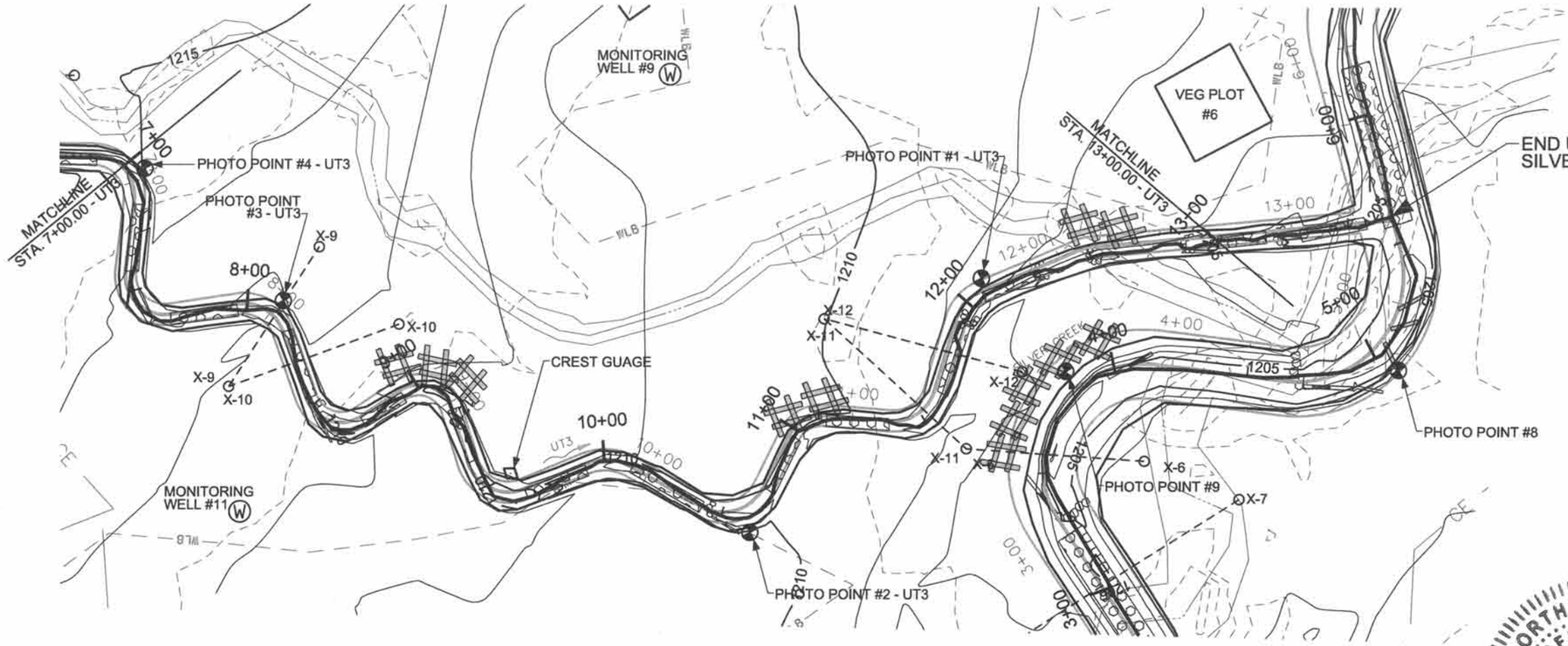
SILVER CREEK UT3
AS-BUILT PLAN

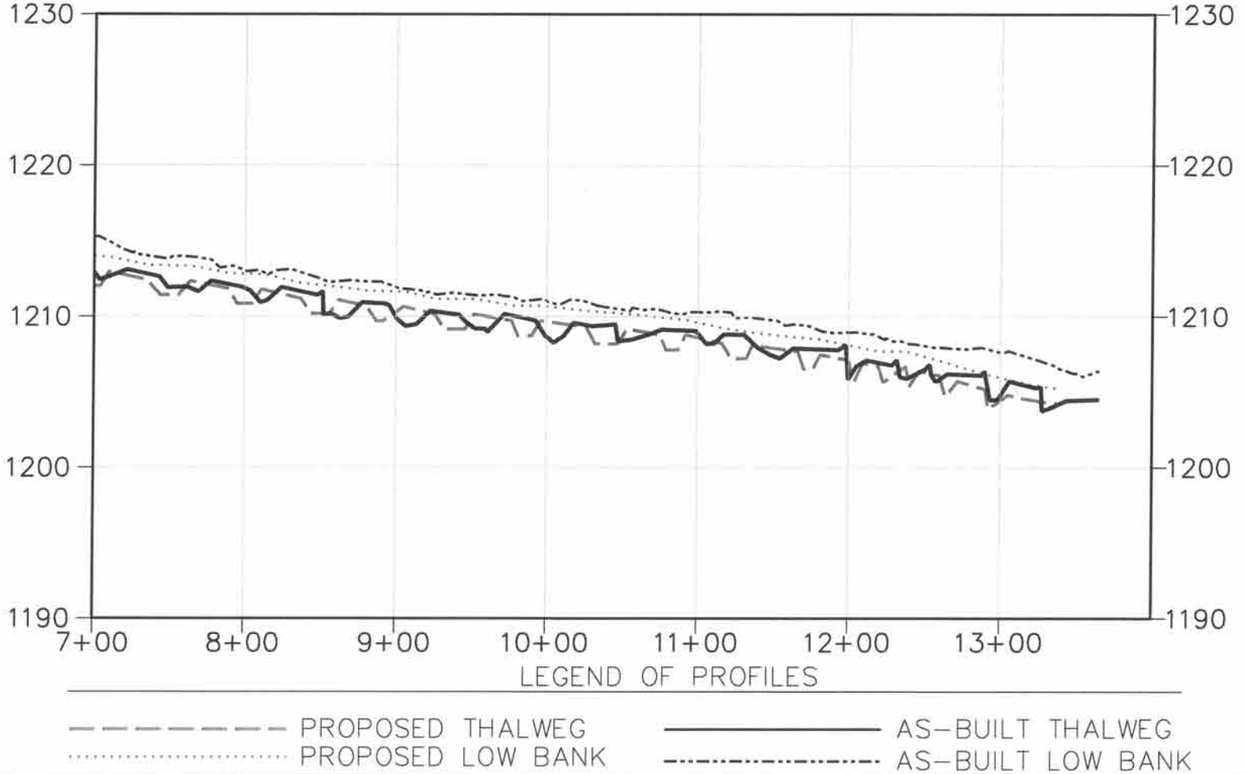
Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

Revisions
Date | Sheets

Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:
Sheet: 8 of 11

3/23/2016
R:\120598\AS_BUILT\PLANS\UprSilverCk_003270_As-Built-Plans.dgn
mcgreu





I, MARSHALL G. WIGHT, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 19TH DAY OF JUNE, 2015.

Marshall G. Wight

MARSHALL G. WIGHT, P.L.S. #L-5034

NORTH CAROLINA PROFESSIONAL SEAL L-5034 LAND SURVEYOR MARSHALL G. WIGHT

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS

PROFILE SCALE
HORIZONTAL: 1"=100'
VERTICAL: 1"=10'

NCDMS Proj. No. 94645

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

SILVER CREEK UT3
AS-BUILT PLAN

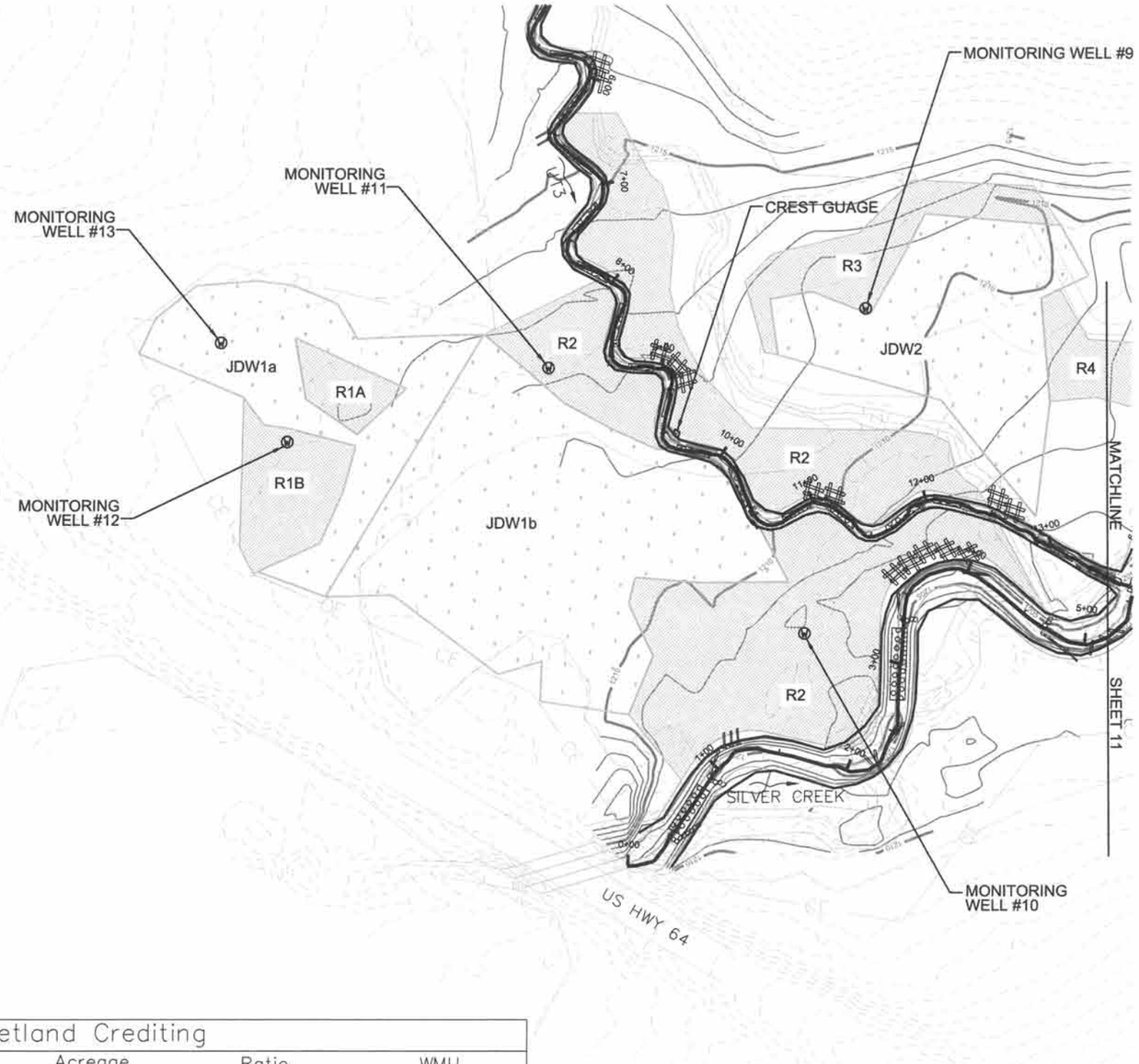
Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

Revisions
Date | Sheets

Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:
Sheet: 9 of 11

2/26/03

3/23/2016
R:\120598\AS_BUILT\PLANS\UprSilverCk_003278_As-Built-Plans.dgn
mcereu



Wetland Crediting				
Wetland Name	Credit Type	Acreage	Ratio	WMU
JDW1a	Enhancement	0.42	2:1	0.21
JDW1b	Enhancement	1.01	2:1	0.51
JDW2	Enhancement	0.51	2:1	0.25
R1a	Restoration	0.06	1:1	0.06
R1b	Restoration	0.15	1:1	0.15
R2	Restoration	1.22	1:1	1.22
R3	Restoration	0.18	1:1	0.18
R4	See Sht 11	–	–	–
			Sheet Subtotal	2.58

NAD 83

50 0 50 100

SCALE (FT)

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS 3/24/16

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

WETLANDS AS-BUILT PLAN

Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

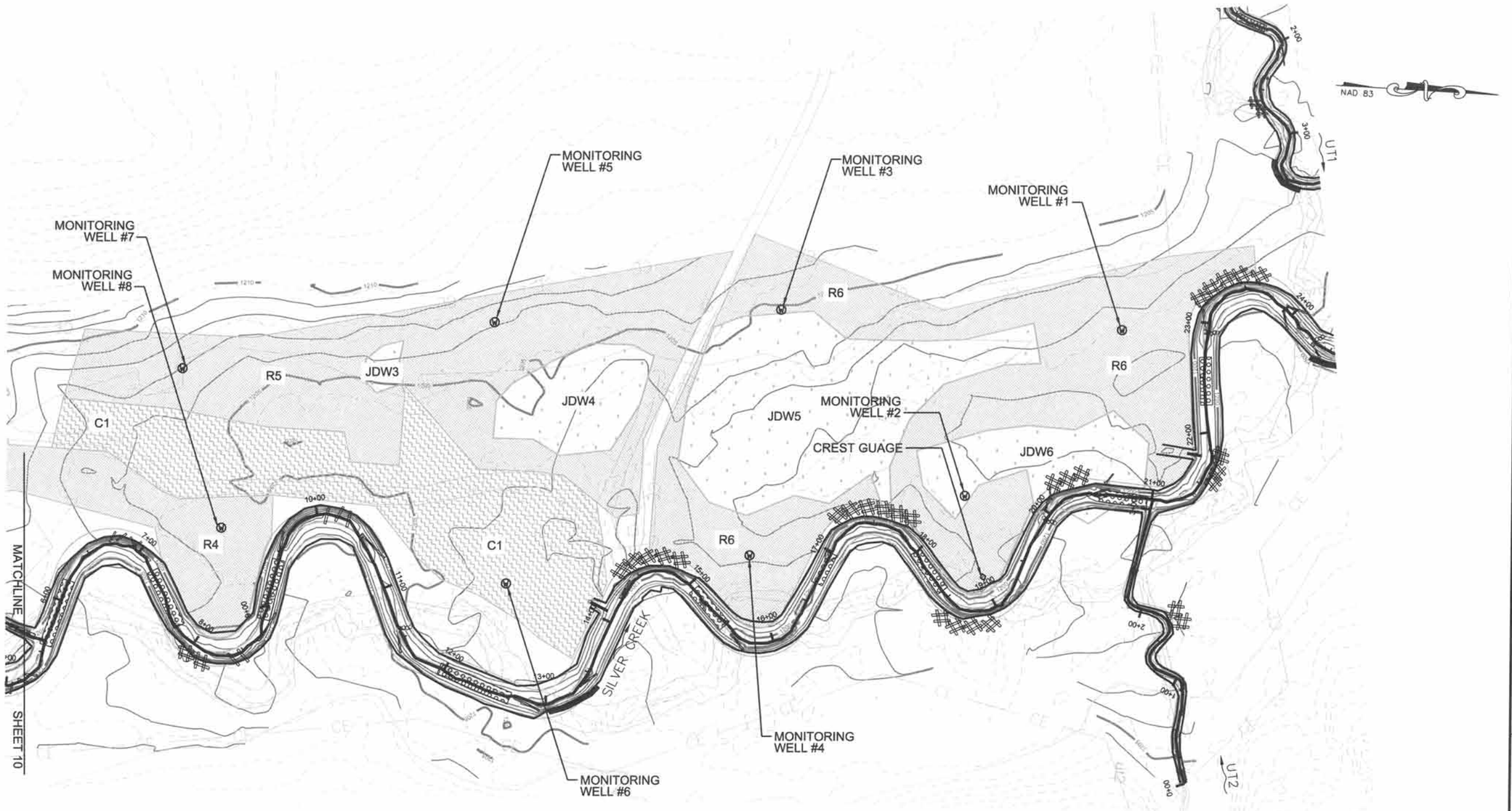
Revisions
Date Sheets

Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:
Sheet: 10 of 11

NCDMS Proj. No. 94645

2/26/03

3/22/2016
R:\120598\AS-BUILT\PLANS\UpperSilverCk_003270_As-Built-Plans.dgn
mcarey



Wetland Crediting				
Wetland Name	Credit Type	Acreage	Ratio	WMU
JDW3	Enhancement	0.03	2:1	0.02
JDW4	Enhancement	0.24	2:1	0.12
JDW5	Enhancement	0.81	2:1	0.40
JDW6	Enhancement	0.25	2:1	0.13
R4	Restoration	0.44	1:1	0.44
R5	Restoration	1.29	1:1	1.29
R6	Restoration	1.54	1:1	1.54
C1	Creation	0.99	3:1	0.33
			Sheet Subtotal	4.27
			Project Total	6.85

NORTH CAROLINA PROFESSIONAL SEAL 039201 ENGINEER JACOB M. BYERS 3/24/06

Michael Baker Engineering Inc.
NC Engineering License F-1084
797 Haywood Road, Suite 201
Asheville, North Carolina 28806
Phone: 828.350.1408
Fax: 828.350.1409

Michael Baker INTERNATIONAL

UPPER SILVER CREEK STREAM AND WETLAND RESTORATION PROJECT, OPTION C
BURKE COUNTY, NC

WETLANDS AS-BUILT PLAN

Prepared for:
NCDENR
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

Revisions
Date Sheets

Project No. 120598
Date:
DESIGNED:
DRAWN:
CHECKED:

NCDMS Proj. No. 94645
Sheet: 11 of 11

APPENDIX E

Photo Log of Photo Points on Upper Silver Creek, UT1, UT2, UT3 and Wetlands

Upper Silver Creek Mainstem Photos

Photo 1. Mainstem Photo Point 1 – Station 29+26 (April 17, 2015) downstream view from left bank.

Photo 2. Mainstem Photo Point 1 – Station 29+26 (April 17, 2015) upstream view from left bank.

Photo 3. Mainstem Photo Point 2 – Station 26+44 (April 17, 2015) downstream view from left bank.

Photo 4. Mainstem Photo Point 2 – Station 26+44 (April 17, 2015) upstream from left bank.

Photo 5. Mainstem Photo Point 3 – Station 24+70 (April 17, 2015) upstream from right bank.

Photo 6. Mainstem Photo Point 3 – Station 24+70 (April 17, 2015) downstream from right bank.

Photo 7. Mainstem Photo Point 4 (PP4) – Station 20+30 (April 17, 2015) downstream from left bank.

Photo 8. Mainstem Photo Point 4 (PP4) – Station 20+30 (April 17, 2015) upstream from left bank.

Photo 9. Mainstem Photo Point 5 – Station 16+03 (April 17, 2015) upstream from right bank.

Photo Point 10, Mainstem Photo Point 5 – Station 16+03 (April 17, 2015) downstream from right bank.

Photo 11. Mainstem Photo Point 6 – Station 13+03 (April 17, 2015) upstream from right bank.

Photo 12. Mainstem Photo Point 5 – Station 13+03 (April 17, 2015) downstream from right bank.

Photo 13. Mainstem Photo Point 7 – Station 10+11
(April 17, 2015) downstream from left bank.

Photo 14. Mainstem Photo Point 7 – Station 10+11
(April 17, 2015) upstream from left bank.

Photo 15. Mainstem Photo Point 8 – Station 5+06
(April 17, 2015) upstream from right bank.

Photo 16. Mainstem Photo Point 8 – Station 5+06
(April 17, 2015) downstream from right bank.

Photo 17. Mainstem Photo Point 9 – Station 3+87
(April 17, 2015) downstream from left bank.

Photo 18. Mainstem Photo Point 9 – Station 3+87
(April 17, 2015) upstream from left bank.

Photo 19. Mainstem Photo Point 10 – Stat. 1+22 (April 17, 2015) downstream from left bank.

Photo 20. Mainstem Photo Point 10 – Stat. 1+22 (April 17, 2015) upstream from left bank.

Unnamed Tributary 1 Photos

Photo 21. UT1 Photo Point 1 – Station 4+82 (April 17, 2015) upstream from left bank.

Intentionally Left Blank

Photo 22. UT1 Photo Point 2 – Station 4+07 (April 17, 2015) downstream from left bank.

Photo 23. UT1 Photo Point 2 – Station 4+07 (April 17, 2015) upstream from left bank.

Photo 24. UT1 Photo Point 3 – Station 2+55
(April 17, 2015) upstream from right bank.

Photo 25. UT1 Photo Point 3 – Station 2+55
(April 17, 2015) downstream from right bank.

Photo 26. UT1 Photo Point 4 – Station 0+55
(April 17, 2015) downstream from left bank.

Photo 27. UT1 Photo Point 4 – Station 0+55
(April 17, 2015) upstream from left bank.

Unnamed Tributary 2 Photos

Photo 28. UT2 Photo Point 1 – Station 2+15
(April 17, 2015) downstream from left bank.

Photo 29. UT2 Photo Point 1 – Station 2+15
(April 17, 2015) upstream from left bank.

Photo 30. UT2 Photo Point 2 – Station 0+96
(April 17, 2015) upstream from left bank.

Photo 31. UT2 Photo Point 2 – Station 0+96
(April 17, 2015) downstream from left bank.

Photo 32. UT2 Photo Point 3 – Station 0+02
(April 17, 2015) downstream from left bank.

Photo 33. UT2 Photo Point 3 – Station 0+02
(April 17, 2015) upstream from left bank.

Unnamed Tributary 3 Photos

Photo 34. UT3 Photo Point 1 – Station 11+91
(April 17, 2015) downstream from left bank.

Photo 35. UT3 Photo Point 1 – Station 11+91
(April 17, 2015) upstream from left bank.

Photo 36. UT3 Photo Point 2 – Station 10+47
(April 17, 2015) upstream from right bank.

Photo 37. UT3 Photo Point 2 – Station 10+47
(April 17, 2015) downstream from right bank.

Photo 38. UT3 Photo Point 3 – Station 8+02
(April 17, 2015) downstream from left bank.

Photo 39. UT3 Photo Point 3 – Station 8+02
(April 17, 2015) upstream from left bank.

Photo 40. UT3 Photo Point 4 – Station 6+95
(April 17, 2015) downstream from left bank.

Photo 41. UT3 Photo Point 4 – Station 6+95
(April 17, 2015) upstream from left bank.

Photo 42. UT3 Photo Point 5 – Station 5+87
(April 17, 2015) downstream from left bank.

Photo 43. UT3 Photo Point 5 – Station 5+87
(April 17, 2015) upstream from left bank.

Photo 44. UT3 Photo Point 6 – Station 4+55
(April 17, 2015) upstream from right bank.

Photo 45. UT3 Photo Point 6 – Station 4+55
(April 17, 2015) downstream from right bank.

Photo 46. UT3 Photo Point 7 – Station 3+47
(April 17, 2015) upstream to structure.

Photo 47. UT3 Photo Point 8 – Station 2+67
(April 17, 2015) upstream to structure.

Photo 48. UT3 Photo Point 9 – Station 1+89
(April 17, 2015) upstream to structure.

Photo 49. UT3 Photo Point 10 – Station 0+61
(April 17, 2015) downstream to structure.

Wetland Photos

Photo 50. As-built Wetland Photo Point – W1,
(April 1, 2015)

Photo 51. As-built Wetland Photo Point – W2,
(April 1, 2015)

Photo 52. As-built Wetland Photo Point – W3,
(April 1, 2015)

Photo 53. As-built Wetland Photo Point – W4,
(April 1, 2015)

Photo 54. As-built Wetland Photo Point – W5,
(April 1, 2015)

Photo 55. As-built Wetland Photo Point – W6,
(April 1, 2015)

Photo 56. As-built Wetland Photo Point – W7,
(April 1, 2015)

Photo 57. As-built Wetland Photo Point – W8,
(April 1, 2015)

Photo 58. As-built Wetland Photo Point – W9,
(April 1, 2015)

Photo 59. As-built Wetland Photo Point – W10,
(April 1, 2015)

Photo 60. As-built Wetland Photo Point – W11, (April 1, 2015)

Photo 61. As-built Wetland Photo Point – W12, (April 1, 2015)

Photo 62. As-built Wetland Photo Point – downstream of deer-stand.

Photo 63. As-built Wetland Photo Point – upstream of deer-stand.

Photo 64. As-built Wetland Photo Point – left bank cross-section 7 pin to veg plot 5.

Photo 65. As-built Wetland Photo Point – left bank cross-section 7 pin to veg plot 4.

Photo 66. As-built Wetland Photo Point – left bank cross-section 6 pin to veg plot 3.

Photo 67. As-built Wetland Photo Point – up valley from left bank at station 22+00.