YEAR 5 MONITORING REPORT

ROSES CREEK STREAM MITIGATION SITE
Burke County, North Carolina
NC DMS Project # 96309

Prepared for:

NCDEQ Division of Mitigation Services (DMS)
217 West Jones St., Suite 3000A
Raleigh, North Carolina 27603

Construction Completed: May 2016
Morphology Data Collected: February 17, 2020
Vegetation Data Collected: August 10, 2020
Submitted: January 2021

Mitigation Project Name	**Roses Creek Stream Mitigation Site**	**USACE Action ID**	**2014-00517**
DMS ID	**96309**	**DWR Permit**	**2014-0194**
River Basin	**Catawba**	**Date Project Instituted**	**4/3/2020**
Cataloging Unit	**03050101**	**Date Prepared**	**4/21/2020**
County	**Burke**	**Stream/Wet. Service Area**	**Catawba 03050101**

Signature & Date of Official Approving Credit Release

1 - For NCDMS, no credits are released during the first milestone
2 - For NCDMS projects, the initial credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the IRT by posting it to the DMS portal, provided the following have been met:
1) Approved of Final Mitigation Plan
2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property.
3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan.
4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.
3 - A 10% reserve of credits is to be held back until the bankfull event performance standard has been met.

Credit Release Milestone	**Cold Stream Credits**						
Project Credits	**Scheduled Releases %**	**Proposed Releases %**	**Proposed Released #**	**Not Approved # Releases**	**Approved Credits**	**Anticipated Release Year**	**Actual Release Date**
1 - Site Establishment	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 - Year 0 / As-Built	30.00%	30.00%	1,502.880	0.000	1,502.880	2016	9/22/2016
3 - Year 1 Monitoring	10.00%	10.00%	500.960	0.000	500.960	2017	4/3/2017
4 - Year 2 Monitoring	10.00%	10.00%	500.960	0.000	500.960	2018	4/25/2018
5 - Year 3 Monitoring	10.00%	10.00%	500.960	0.000	500.960	2019	4/26/2019
6 - Year 4 Monitoring	5.00%	5.00%	250.480	0.000	250.480	2020	4/21/2020
7 - Year 5 Monitoring	10.00%					2021	
8 - Year 6 Monitoring	5.00%					2022	
9 - Year 7 Monitoring	10.00%					2023	
Stream Bankfull Standard	10.00%	10.00%	500.960	0.000	500.960	2019	4/26/2019
			Totals		3,757.200		

Total Gross Credits	5,009.600
Total Unrealized Credits to Date	0.000
Total Released Credits to Date	3,757.200
Total Percentage Released	75.00%
Remaining Unreleased Credits	1,252.400

Notes

Contingencies (if any)

Project Quantities

Mitigation Type	**Restoration Type**	**Physical Quantity**
Cold Stream	Restoration	4,738.000
Cold Stream	Enhancement II	679.000

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County	**Burke**	**Stream/Wet. Service Area**	**Catawba 03050101**

Debits

							Stream Restoration Credits
Beginning Balance (mitigation credits)							**5,009.600**
Released Credit							**3,757.200**
Unrealized Credits							**0.000**
Owning Program	**Req. Id**	**TIP #**	**Project Name**	**USACE Permit #**	**DWR Permit #**	**DCM Permit #**	
Statewide Stream & Wetland ILF Program	REQ-005319		Linville Dam ESSI Project	2008-02753	2008-0915		580.000
NCDOT Stream & Wetland ILF Program	REQ-005791		SR 1560 - Bridge 118 - Division 13	2013-00803			41.000
NCDOT Stream & Wetland ILF Program	REQ-005792		SR 1560 - Bridge 123 - Division 13	2013-00806			34.000
NCDOT Stream & Wetland ILF Program	REQ-005918		SR 1438 - Bridge 291 - Division 13	2013-01675			21.000
NCDOT Stream & Wetland ILF Program	REQ-006081		Bridge 152 on SR 1150 over White Pine Creek	2014-00641			68.000
NCDOT Stream & Wetland ILF Program	REQ-006159		SR 1365 Improvements - Division 11	2014-00119			255.000
NCDOT Stream & Wetland ILF Program	REQ-006274		SR 1515 Improvements - Division 11	2015-00240			130.000
NCDOT Stream & Wetland ILF Program	REQ-006511		SR 1560 - Bridge 580125 - Division 13	2016-00373			100.000
NCDOT Stream & Wetland ILF Program	REQ-006555		SR 1369 Improvements - Division 11	2015-02250			41.400
NCDOT Stream & Wetland ILF Program	REQ-006555		SR 1369 Improvements - Division 11	2015-02250			81.480
NCDOT Stream & Wetland ILF Program	REQ-006555		SR 1369 Improvements - Division 11	2015-02250			324.120
NCDOT Stream & Wetland ILF Program	REQ-006748		SR 1410 - Bridge 580284 - Division 13	2017-00910			67.680
NCDOT Stream & Wetland ILF Program	REQ-006748		SR 1410 - Bridge 580284 - Division 13	2017-00910			14.320
NCDOT Stream & Wetland ILF Program	REQ-006749		SR 1241 - Bridge 110320 - Division 13	2017-00893			82.000
NCDOT Stream & Wetland ILF Program	REQ-006754	B-4447	Bridge 160 on I-40	2017-00901			99.000
NCDOT Stream & Wetland ILF Program	REQ-006755		SR 1798 - Bridge 580011 - Division 13	2017-00896			38.000
NCDOT Stream & Wetland ILF Program	REQ-006863		SR 1258 - Bridge 110131 - Division 13	2017-00930			12.840
NCDOT Stream & Wetland ILF Program	REQ-006863		SR 1258 - Bridge 110131 - Division 13	2017-00930			23.160
NCDOT Stream & Wetland ILF Program	REQ-006871		SR 1560 - Bridge 580126 - Division 13	2017-00928			38.000
NCDOT Stream & Wetland ILF Program	REQ-007279	B-5138	Bridge 6 over Gunpowder Creek on US 321A	2013-01764			151.000
NCDOT Stream & Wetland ILF Program	REQ-007848		SR 1369 Improvements - Division 11	2015-02250			30.000
NCDOT Stream & Wetland ILF Program	REQ-008486		SR 1128 - Bridge 580245 - Division 13	2017-00897			165.000
Total Credits Debited							**2,397.000**
Remaining Available balance (Released credits)							**1,360.200**
Remaining Credits (Unreleased credits)							**1,252.400**

February 15, 2021

Harry Tsomides
Project Manager NCDEQ – Division of Mitigation Services

Re: Monitoring Year 5 Response to Comments
Roses Creek Stream Restoration Project
Burke County, North Carolina

Dear Mr. Tsomides,

We have reviewed and addressed your review comments dated January 29, 2021. For ease of review the responses are in italics.

1. Report cover indicates submittal in December 2020 however the report was not received until January 12, 2021. Please change submittal date to January 2021.
RE: Comply. The date on the report cover has been revised to January 2021.

2. Please continue to include the 8/27/2019 IRT meeting minutes and USACE and DWR comments, as an Appendix, and reference in the report.
RE: Comply. The IRT meeting minutes and USACE and DWR comments have been added to the report as Appendix F.

3. Fig 5.3 x-axis label has distance rather than time as a label. This was also an issue in the prior (MY4) annual report.
RE: Comply. Figure 5.3 x-axis has been revised to show time.

4. Vegetation Visual Assessment –Invasive treatment is mentioned in the text as having occurred in Feb and Aug 2020 however not captured in the project activities table. Please provide month-year of treatment in Table 2 (Project Activity and Reporting History). This was also a DMS comment in the prior (MY4) annual report, that had been addressed in the final version with addition of 2019 invasive and dam removal events however the 2019 invasive treatment events have disappeared in the MY5 report. Please include all maintenance activities throughout the life of the project in this table.
RE: Comply. Table 2 has been updated to reflect all maintenance activities for MY5.

5. CCPVs – Failing veg plots need to be differentiated from plots meeting criteria, using color coding, similar to MY3 report.
RE: Comply. Veg plots have been updated to reflect differentiations for plots meeting criteria and plots failing to meet based on planted stems.

6. The report states:
"*According to Performance Standards in the Mitigation Plan, vegetation monitoring can be ended after Year 5 if the site is meeting Year 5 survivability standards and planted stems are averaging 8+feet in height or greater. Given that all plots are exceeding vegetative success*

criteria of 260 stems/acre and average stem height is 6 feet across the Site, LMG recommends conducting only visual vegetative monitoring for the remainder of the monitoring period."

The project monitoring and performance standards vegetation monitoring commitment established in the IRT-approved mitigation plan is for CVS vegetation monitoring in years 1, 2, 3, 5, and 7. Until another arrangement is made and formalized with the IRT, HDR will be expected to monitor and provide all data per the approved mitigation plan.

RE: Understood. The paragraph mentioned in the comment has been removed from the report narrative.

7. Asset table - Please list quantities and credits to the appropriate decimal places to match the attached format needed.

   RE: Comply. The quantities and credits are now shown to the third decimal place.

8. Stream stability section – It is indicated that one area of mass wasting occurred between section 25+00 and 30+00. Can the locality/stationing be narrowed down more from a station range of 500 LF?

   RE: Comply. The area of mass wasting has now been specified in the report from STA 27+94 – 28+09.

9. It is indicated that:

   "Areas of erosion were observed on November 16, 2020 to assess potential storm damage; however, no areas of erosion worsened substantially, and no remedial action is necessary at this time."

   How was the determination made that these areas did not worsen? Over what time period have these been observed if the observation was made in November 2020? Please provide some more details and timeline on the areas of erosion and trending; give dates whenever possible.

   RE: The areas of mass wasting, and toe erosion were first observed and mapped in January of 2020. After a major storm event in October of 2020, LMG conducted another Site visit to assess any damage that may have resulted from the storm. During this Site visit LMG re-examined the areas and compared notes and photographs from January 2020 to November 2020 conditions and determined that both areas remained relatively unchanged throughout the year. Neither area expanded laterally into the bank due to soil loss and neither area appeared to have expanded upstream or downstream along the bank. At this time LMG does not recommend performing any remedial actions but does anticipate monitoring the area closely to determine if the areas will continue to stabilize naturally. This is now reflected in the report narrative.

10. Surface Water Level Meter Data – The tributary graphs provided do not summarize the information needed. At a minimum, rain data should be shown concurrently, with a callout showing where the most consecutive days/dates during which criteria were met.

    RE: Comply. Rain gauge data has been included in the updated report and call outs have been added.

11. Has the downed fencing been fixed yet? This is an area adjacent to cattle pasture.

    RE: The landowner has been made aware of the downed fence. LMG cannot confirm that the fence has been repaired at this time, but LMG is working with the landowner to address the damaged area.

Digital Comments

12. Please review cross section BHR calculations. Cross section 11 is reported to have a BHR of 1.16, but the BHR should be 1.4. This is being caused by an inaccurate MY0 bankfull cross sectional area (e.g. 2.19 vs. 1.4). This was verified using the Mecklenburg spreadsheet and the DMS cross section tool. The MY0 cross sectional area for XS7 also appears to be inaccurate (e.g. 2.3 vs. 1.9), so please review the MY0 cross sectional areas to determine how these affect MY5 BHR's. Additionally, for cross section 10, there is a greater than symbol. For other cross sections where the BHR is >1 the actual value is reported, so please do this for XS 10.
    RE: The geomorphology values in the Cross Section tables for Cross Section 11 has been updated in this resubmittal of the report to correspond to the cross section geometry presented in the graph.
    Respectfully, Land Management Group does not agree with the sentiment that the Baseline bankfull elevation should be adjusted. The bankfull geometry for XS 7 and XS 11 was submitted and approved as part of the Baseline Monitoring report. All geomorphology data for XS 7 and XS 11 over the last 4 monitoring years has been calculated based on the baseline bankfull elevation/ cross sectional area, therefore LMG does not see any reason to modify the baseline geometry in Year 5. With this in mind, LMG believes that the bank height ratios of <1 and 1.12 for XS 7 and XS 11 respectively, are correct based on DMS guidelines for BHR calculation.
    XS 10 has been updated to BHR <1. When calculated using the guidance DMS provided the bank height ratio equals 0.873. The direction of the greater than sign has been revised to "less than".

13. In MY4 there was rain gauge data included with the stream gauge figures, and these data were included in the submitted spreadsheet for UT3. Please include figures to represent these data in the report.
    RE: Comply. Rain gauge data has been included in the figures and the data spreadsheets.

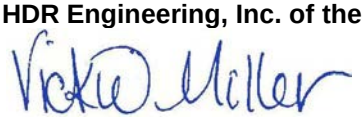
14. Please submit features for the flow meters and photo points, ensuring they are attributed with unique ID's.
    RE: Comply. Shapefiles depicting flow meter locations have been uploaded to the support files CCPV shapefile folder. Photo point shapefiles have also been uploaded to the shapefile folder and are labeled Cross Section Photo points and Veg Plot Photo Points.

15. Please resubmit the stream visual assessment features as lines rather than polygons (e.g. erosion, deposition, mass wasting).
    RE: Comply. Shapefiles have been updated to line features for erosion, deposition, and mast wasting areas and included as linear features in the support files.

16. Please ensure that visual assessment features reflect the number of segments or polygons reported in table 5 and 6. For example, Table 6 suggests that there are 2 invasive polygons, but 9 were submitted.
    RE: Comply. Visual assessment data has been updated based on length of linear features updated for previous comment.

If you have any questions or concerns, please call me at (919) 232-6637 or email to vickie.miller@hdrinc.com .

Sincerely,
HDR Engineering, Inc. of the Carolinas



Vickie Miller, AICP, PWS
Senior Environmental Scientist

Prepared by:

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Land Management Group

on behalf of:

HDR Engineering
555 Fayetteville Street, Suite 900
Raleigh, North Carolina 27601
919.232.6600
919.232.6642 (fax)

I HEREBY CERTIFY THAT THE DOCUMENT CONTAINED HEREIN, ROSES CREEK YEAR 5 MONITORING REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNED SEALED AND DATED THIS 9TH DAY OF FEBRUARY 2021.

NORTH CAROLINA PROFESSIONAL SEAL 050744 ENGINEER ALEX D DIGERONIMO

Alex D. DiGeronimo, PE

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1.0 PROJECT SUMMARY

The following report summarizes the vegetation establishment and stream stability for Year 5 monitoring for the Roses Creek Site (hereafter referred to as the "Site") in Burke County, North Carolina.

1.1 Goals and Objectives

Primary goals for the Site, as detailed in the Roses Creek Stream Mitigation Site Mitigation Plan (ICA Engineering 2015) include:

1. Reducing water quality stressors and providing/enhancing flood attenuation.
2. Restoring and enhancing aquatic, semi-aquatic and riparian habitat.
3. Restoring and enhancing habitat connectivity with adjacent natural habitats.

The following objectives accomplish the goals listed above:

1. Reducing water quality stressors and providing/enhancing flood attenuation through:
    a. Restoring the existing degraded, straightened and incised/entrenched streams as primarily a Priority 1 restoration where bankfull and larger flows can access the floodplain allowing nutrients, sedimentation, trash and debris from upstream runoff to settle from floodwaters to the extent practical. Restoring a stable dimension, pattern, and profile will ensure the channel will transport and attenuate watershed flows and sediment loads without aggrading or degrading.
    b. Restore channel banks by relocating the channel, excavating bankfull benches, placing in-stream structures to reduce shearing forces on outside meander bends, and planting native vegetative species to provide soil stability, thus reducing stream bank stressors.
    c. Reducing point source (i.e. cattle and equipment crossings) and non-point source (i.e. stormwater runoff through pastures) pollution associated with on-site agricultural operations (hay production and cattle) by exclusionary fencing from the stream and riparian buffer and by eliminating all stream crossings from the easement.
    d. Plant a vegetative buffer on stream banks and adjacent floodplains to treat nutrient enriched surface runoff from adjacent pastureland associated with on-site agricultural operations.
    e. Restoring riparian buffers adjacent to the streams that are currently maintained for hay production that will attenuate floodwaters, in turn reducing stressors from upstream impacts.
2. Restoring and enhancing aquatic, semi-aquatic and riparian habitat through:
    a. Restoration of a sinuous gravel bed channel that promotes a stable bed form and accommodates benthic macroinvertebrate and fish propagation. Additionally, woody materials such as log structures, overhanging planted vegetation and toe wood/brush toe in submerged water will provide a diversity of shading, bed form and foraging opportunities for aquatic organisms.
    b. Restoring native vegetation to the stream channel banks and the adjacent riparian corridor, that is currently grass dominated, will diversify flora and create a protected habitat corridor, which will provide an abundance of available foraging and cover habitat for a multitude of amphibians, reptiles, mammals and birds.
3. Restoring and enhancing habitat connectivity with adjacent natural habitats through:

a. Planting the riparian buffer with native vegetation.
b. Protection of the restored community will ensure a protected wildlife corridor between the Site and the upstream and downstream mature riparian buffers and upland habitats.
c. Converting approximately 15 acres from existing agricultural land to riparian buffer protected by permanent conservation easement.

1.2 Success Criteria

Monitoring of restoration efforts will be performed until success criteria are fulfilled. Monitoring includes stream channel/hydraulics and vegetation. In general, the restoration success criteria, and required remediation actions, are based on the Stream Mitigation Guidelines (USACE et al. 2003) and the Ecosystem Enhancement Program Monitoring Requirements and Performance Standards for stream and/or Wetland Mitigation (NCEEP 2011). Project success criteria are further detailed in the Baseline Monitoring Document & As-Built Baseline Report (HDR|ICA 2016).

1.3 Background Summary

The North Carolina Department of Environmental Quality Division of Mitigation Services (DMS) contracted HDR|ICA to restore 4,746 linear feet of Roses Creek and three of its unnamed tributaries within the Site to assist in fulfilling stream mitigation needs in the watershed. The Site is located approximately 12 miles northwest of downtown Morganton in Burke County, NC. The Site contains Roses Creek and three unnamed headwater tributaries of Roses Creek (UT 1, UT 2 and UT 3). The Site is located within the 03050101060030 14-digit Hydrologic Unit, which is also a DMS Targeted Hydrologic Unit for Cataloging Unit 03050101 of the Catawba River Basin. Roses Creek is classified as a Water Supply Watershed (WS-III), as it is part of the headwaters that feed Lake Rhodhiss. The Site is comprised of one property owned by Robert B. Sisk and Martha M. Sisk (PIN # 1767479652) (known as the Sisk Farm). Additional information concerning project history is presented in Table 2.

1.4 Vegetation

Planted stem performance across the entirety of the site is meeting or exceeding Year 5 criteria average of 260 stems per acre. When only taking planted stems into account, 11 of the 17 plots are meeting Year 5 criteria of 260 stems per acre. When considering natural recruits, all vegetation plots exceed Year 5 criteria. Average stem density across the site including natural recruits is 358 stems per acre. Stem density calculations including natural recruits were made based on the 2016 Monitoring Guidance which dictates no single species may account for over 50% of the required number of stems within any vegetation plot.

River birch has become the dominant species in the floodplain downstream of Station 28+00, as a natural recruit. However, planted stems are surviving and providing some diversity.

Chinese privet, Japanese honeysuckle and multiflora rose continue to be observed downstream of STA 14+75 along UT 1. In addition, privet and multiflora rose was observed downstream of STA 37+00 in the left floodplain of Roses Creek. Invasive species were chemically treated in April and August 2020. The Current Conditions Plan View depicts invasive species treatment areas (April and August, 2020).

1.5 Stream Stability

Roses Creek and its tributaries have remained in stable, functioning condition over the past monitoring year. The Site experienced multiple above bankfull flows in October 2020. Nearby rain gauge data indicates the Site received 3.5 inches of rain within a 24-hour period on October 11, 2020 and another 3 inches of rain from October 24, 2020 to October 28, 2020. It is estimated that flows overtopped the banks by approximately two feet as evidenced by wrack lines noted during a November Site visit (see Figures 3.26-3.27). One area of mass wasting (Roses Creek left bank STA 27+94 – 28+09) and one area of moderate toe erosion (Roses Creek left bank STA 33+26 – 33+66) were observed in January 2020. After the October storm event, the areas of toe erosion and mass wasting were re-observed and did not show any signs of additional soil loss or upstream/downstream migration. At this time LMG does not recommend any remedial action, however these areas will be monitored closely in the upcoming year. A small section of fence adjacent to the oxbow pond (Station 24+00, CCPV Sheet 3) was damaged during the October storm event. LMG has notified the property owner and is working with them closely to ensure it is being repaired. Bank pins were examined during morphological surveys and were not exposed.

Cross section geometry along Roses Creek has experienced minor fluctuations over the past two monitoring years. Cross Section 4 has increased in depth and bankfull area due to a beaver dam that was constructed immediately upstream of the cross section causing a scour hole to form through the cross section. The beaver dam was discovered in February 2020 and removed the following month. As sediment is transported through the system it is possible that this hole will fill in over time. Stream banks remain stable through this reach following removal of the beaver dam.

UT 1, 2 and 3 have continued to see deposition over the past two monitoring years. When reviewing the cross sections, it appears that UT 1, 2, and 3 have narrowed due to deposition along the stream banks; however, this is anticipated as vegetation establishes and causes sediment to deposit along the banks. Tributary cross sections continue to decrease in bankfull area; however, each tributary maintains a single thread channel throughout the Site.

Large amounts of detritus were deposited in the floodplain of Roses Creek near station 15+00 indicating that the site has experienced multiple above bankfull flows in 2020. All four crest gauges on Site have been damaged by insects, making the gauge measurements unreadable. It should be noted that the Site had met Success Criteria of two bankfull events by Year 3 of monitoring. Flow events will continue to be recorded via the tributary gauges and visually assessed by wrack lines along the channel and floodplain areas. Crest gauge records for Years 1 – 4 are provided in Appendix E.

Based on water level data obtained using Hobo U20 pressure transducers installed in the bottom of each tributary, UT2 and UT3 have indicated consistent flow throughout the past monitoring year. It is believed that UT1 also experienced consistent flow throughout the past monitoring year; however, due to equipment failure data was not recorded for the entire month of January and part of February. It is worth noting that each tributary has exhibited flow for a span of over 30 consecutive days at least once in the past year. Water level data is provided in Appendix E as well.

A pebble count was conducted on Roses Creek in January 2020. Results show that average particle size has decreased from a D50 of 61.45 mm to 50.54 mm.

2.0 METHODOLOGY

Year 5 monitoring surveys were completed using a Total Station. Each cross section was marked with a rebar monument at their beginning and ending points. The rebar has been located vertically and horizontally in NAD 83-State Plane. Surveying these monuments throughout the Site ensured proper orientation. The survey data was imported into MicroStation for verification. RIVERMorph was used to analyze cross section data. Tables and figures were created using Microsoft Excel. A pebble count was conducted and analyzed in RIVERMorph.

Vegetation monitoring was completed using CVS level II methods, for 17, 100 square meter vegetation plots (Lee et al. 2006). The taxonomic standard for vegetation used for this document was Flora of the Southern and Mid-Atlantic States (Weakley 2011).

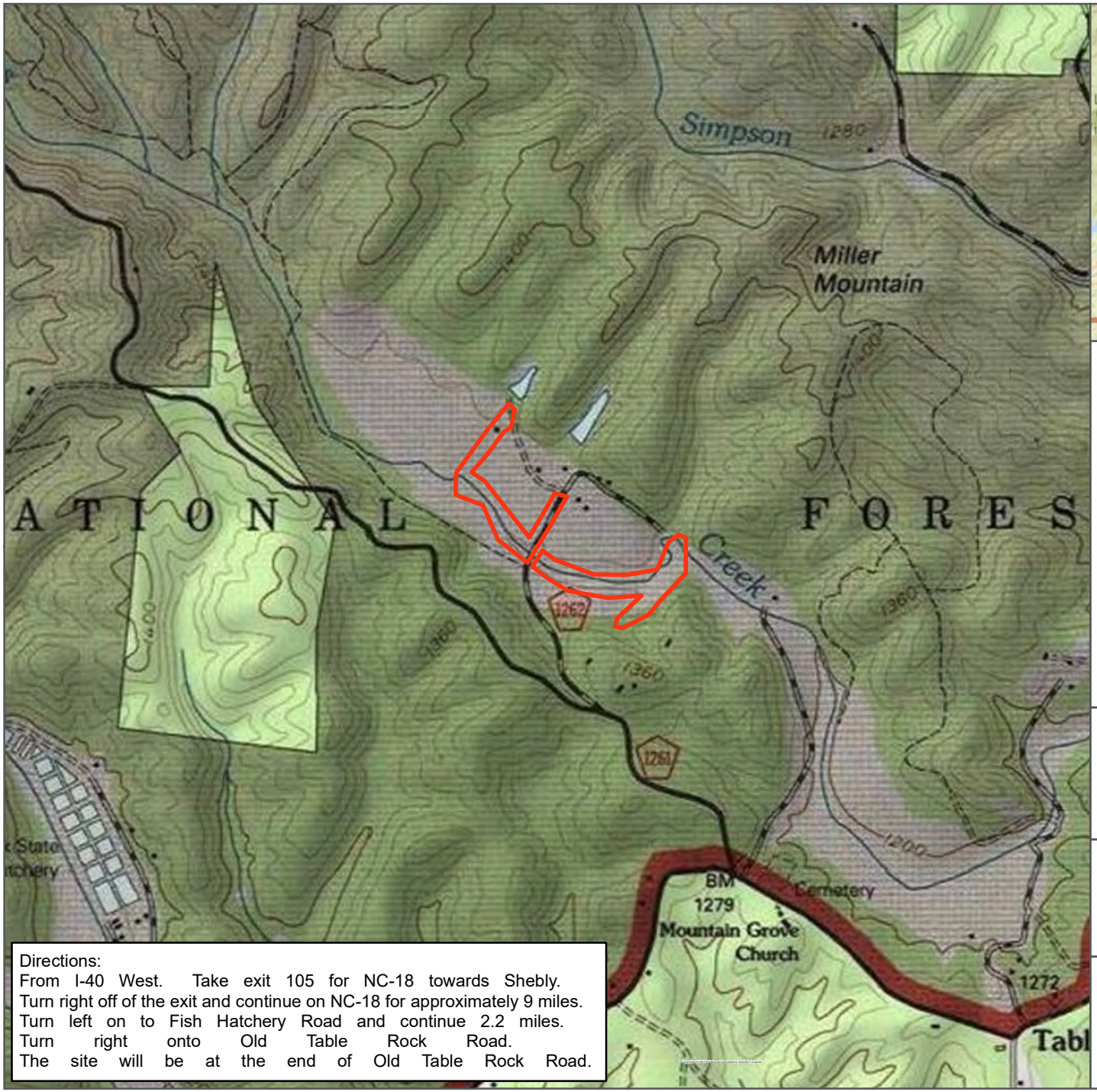
3.0 REFERENCES

Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (http://cvs.bio.unc.edu/methods.htm).

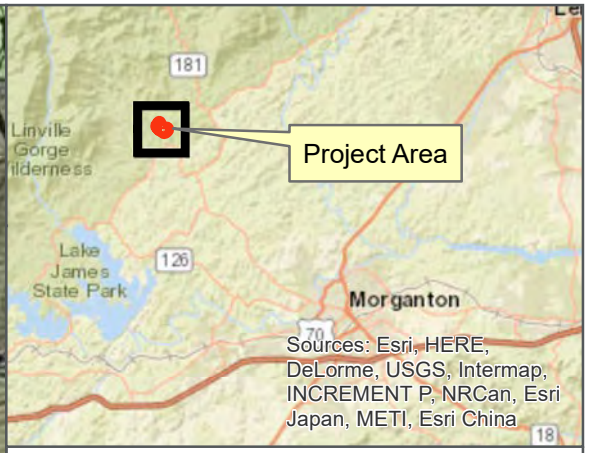
Weakley, Alan S. 2011. Flora of the Southern and Mid-Atlantic States (online). Available: http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2011-May-nav.pdf [May 15, 2011]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

APPENDICES

Appendix A. Project Vicinity Map and Background Tables



Directions:
From I-40 West. Take exit 105 for NC-18 towards Shebly.
Turn right off of the exit and continue on NC-18 for approximately 9 miles.
Turn left on to Fish Hatchery Road and continue 2.2 miles.
Turn right onto Old Table Rock Road.
The site will be at the end of Old Table Rock Road.



Legend

Project Easement

The subject project site is an environmental restoration site of the NCDEQ Divison of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, monitoring, and stewardship of the restoration site is permitted within the terms and timeframes of their defined, pre-approved roles. Any intended site visitation or activity by any person outside of these previously sanctioned activities/roles requires prior coordination with DMS.

ROSES CREEK STREAM MITIGATION SITE

VICINITY MAP
BURKE COUNTY, NC

N

0 1,000 2,000 4,000 Feet

FIGURE 1

PATH: Z:\ROSES_CREEK\5.0_PROJECT_DEVELOPMENT\5.2_WORK_IN_PROGRESS\DOCS\MONITORING\YEAR 1\APPENDIX A_VICINITY MAP AND BACKGROUND TABLES\VICINITY MAP.MXD - USER: ADIGERON - DATE: 11/13/2017

Map Produced 12/2/2016

Table 1. Project Components and Mitigation Credits

Roses Creek, Burke County DMS Project No. 96309									
Credit Summary									
	Stream SMU		Riparian Wetland WMU		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	5,009								
Project Components									
Project Component or Reach ID	Stationing/ Location		Existing Footage/ Acreage	Approach (PI, PII, etc.)	Restoration or Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio	SMU	
Roses Creek	10+00-41+81		3,643.000	PI	Restoration	3,181.000	1:1	3,121.000*	
Roses Creek	41+81-42+19		38.000	-	EII	38.000	2.5:1	15.200	
UT 1	10+00-12+54; 16+11-16+46		267.000	PI	Restoration	289.000	1:1	289.000	
UT 1	12+54-16+11; 16+46-19+30		641.000	-	EII	641.000	2.5:1	256.400	
UT 2	10+00-17+07		610.000	PI	Restoration	707.000	1:1	707.000	
UT 3	10+00-16+21		558.000	PI	Restoration	621.000	1:1	621.000	
Total	NA		5,757.000	PI	Restoration/ EII	5,477.000	1-2.5:1	5,009.600	

* Stream Mitigation Units decreased by 60 to account for break in easement at the stream crossing on Sisk Farm Road

Component Summation						
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	4,798					
Enhancement II	679					

Table 2. Project Activity and Reporting History

Activity or Report	Data Collection Complete	Completion or Delivery
Mitigation Plan	September 2015	September 2015
Final Design – Construction Plans	September 2015	March 2016
Construction	February 25, 2016	May 18, 2016
Temporary S&E Mix Applied to Entire Project Area	---	May 18, 2016
Permanent Seed Mix Applied to Entire Project Area	---	May 18, 2016
Bare Root, Containerized, and B&B plantings for Entire Project Area	---	May 27, 2016
Mitigation Plan/As-built (Year 0 Monitoring-Baseline)	May 2016	July 2016
Year 1 Monitoring	November 2016	January 2017
Stream Morphology	November 2016	--
Vegetation	August 2016	--
Supplemental Planting	---	February 2017
Year 2 Monitoring	August 2017	November 2017
Stream Morphology	June 2017	--
Vegetation	August 2017	--
Supplemental Planting	---	February 2018
Year 3 Monitoring	August 2018	November 2018
Stream Morphology	March 2018	--
Vegetation	August 2018	--
Structural Repairs	--	October 2018
Year 4 Monitoring	November 2019	December 2019
Stream Morphology	--	--
Vegetation	--	--
Dam Removal	--	September 2019
Invasive Species Management	January 2019	September 2019
Year 5 Monitoring		
Stream Morphology	February 2020	January 2021
Vegetation	August 2020	January 2021
Invasive Species Management		April and Aug. 2020
Dam Removal		March 2020
Year 6 Monitoring		
Stream Morphology		
Vegetation		
Year 7 Monitoring		
Stream Morphology		
Vegetation		

Table 3. Project Contacts Table

Designer Primary project design POC	ICA Engineering 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Vickie Miller (919) 232-6600
Construction Contractor Construction Contractor POC	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Lloyd Glover (919) 639-6132
Structural Repair Contractor Structural Repair Contractor POC	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Lloyd Glover (919) 639-6132
Planting Contractor Planting Contractor POC	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Lloyd Glover (919) 639-6132
Supplemental Planting Contractor Supplemental Planting Contractor POC	River Works, Inc. 114 W Main Street, Suite 106 Clayton, NC 27520 Bill Wright (919) 590-5193
Seeding Contractor Seeding Contractor POC	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27607 Lloyd Glover (919) 639-6132
Seed Mix Sources	Green Resources – Triangle Office
Nursery Stock Suppliers	1) Dykes and Son Nursery, McMinnville, TN 2) Foggy Mountain Nursery (live stakes)
Monitoring Performers	HDR|ICA Engineering Inc. 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Vickie Miller (919) 232-6600 Land Management Group, Inc 3101 Poplarwood Court, Suite 120 Raleigh, North Carolina 27604 Michael Foster (919) 645-4350
Stream Monitoring POC	Land Management Group, Inc 3101 Poplarwood Court, Suite 120 Raleigh, North Carolina 27604 Michael Foster (919) 645-4350
Vegetation Monitoring POC	Land Management Group, Inc 3101 Poplarwood Court, Suite 120 Raleigh, North Carolina 27604 Michael Foster (919) 645-4350

Table 4. Project Information

Project Information				
Project Name		Roses Creek Stream Mitigation Site		
County		Burke		
Project Area (acres)		17.3		
Project Coordinates (latitude and longitude)		35.850953, -81.819541		
Project Watershed Summary Information				
Physiographic Province		Piedmont / Mountain		
River Basin		Catawba		
USGS Hydrologic Unit 8-digit	03050101	USGS Hydrologic Unit 14-digit	03050101060030	
NCDWQ Sub-basin		03-08-31		
Project Drainage Area (acres)		Roses: 3,309, UT 1: 35, UT 2: 47, UT 3: 10		
Project Drainage Area Percentage of Impervious Area		<1%		
CGIA Land Use Classification		Agricultural/Pasture		
Ecoregion		Northern Inner Piedmont		
Geological Unit		Zabg: Alligator Back Formation; Gneiss		
Reach Summary Information				
Parameters	**Roses Creek**	**UT 1**	**UT 2**	**UT 3**
Length of reach (linear feet)	3,681 existing	900 existing	610 existing	558 existing
Valley Classification	VIII	VIII	VIII	VIII
Drainage Area (acres)	3,309	35	47	13
NCDWQ Stream Identification Score	56	30	33.5	34
NCDWQ Water Quality Classification	WS-III; Tr	WS-III; Tr	WS-III; Tr	WS-III; Tr
Morphological Description (stream type)	E4, B4, and F4	B5, F5	B5	B5, G5
Evolutionary Trend	Simon's Stages: Premodified » Constructed » Degradation and Widening	Could maintain a B type channel in majority of reach Or F » B	G » B/E	G » B

Regulatory Considerations (cont.)			
Coastal Zone Management (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	CLOMR/LOMR
Essential Fisheries Habitat	No	N/A	N/A

Appendix B. Visual Assessment Data

CONTRACT: ROSES CREEK DMS PROJECT #: 96309

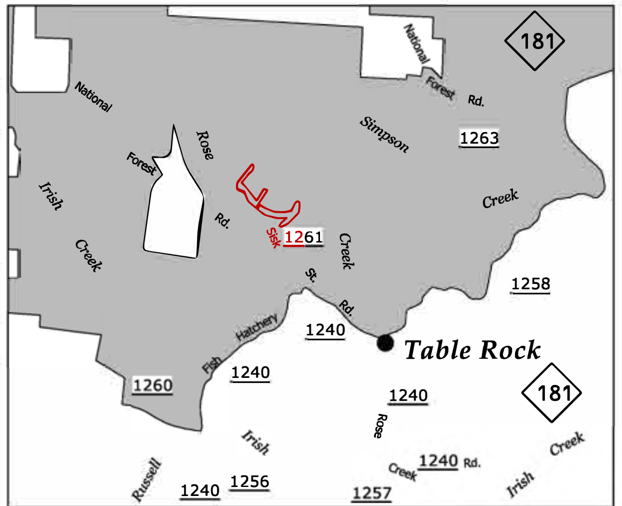
STATE	ROSES CREEK	SHEET NO.
N.C.		1

CURRENT CONDITIONS PLAN VIEW (CCPV)
ROSES CREEK

LOCATION: BURKE COUNTY, NORTH CAROLINA

LAT: 35°51' 01" N LONG: -81°49' 11" W

TYPE OF WORK: CCPV PLANS - YEAR 5



VICINITY MAP

YEAR 5 CONDITIONS

- FALLEN TREE
- CONSTRUCTED BERM

BANK/BED CONDITION

- MODERATE EROSION
- MINOR EROSION
- MASS WASTING
- SAND BAR
- DEPOSITION (SILT)
- WRACK LINES
- BEAVERDAM
- SCOUR HOLE/ GULLEY

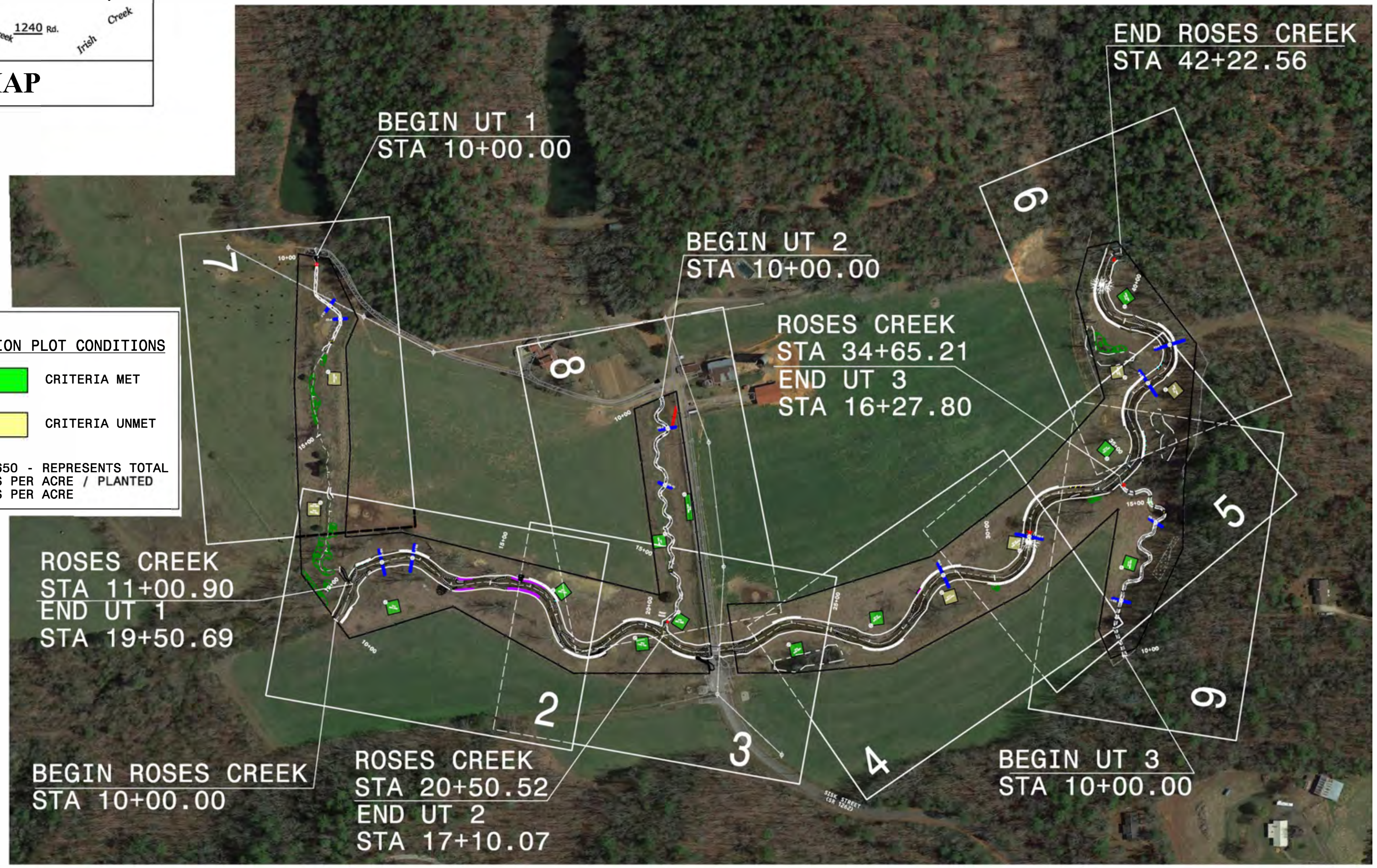
VEGETATION PROBLEM AREAS

- INVASIVE POPULATION
- VEGETATION IN STREAM

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

NOTE:
650/650 - REPRESENTS TOTAL STEMS PER ACRE / PLANTED STEMS PER ACRE



LEGEND

- ASBUILT ALIGNMENTS & STATIONING
- THALWEG
- BANKFULL
- EPHEMERAL POOL
- CONSERVATION EASEMENT
- POWERLINE
- FENCE
- CROSS-SECTION LOCATION
- FLOW METER
- CREST GAUGE
- PHOTO POINT & DIRECTION
- EXISTING WETLANDS
- 10 x 10 VEG PLOT
- 5 x 20 VEG PLOT
- BRUSH TOE
- ROCK L-VANE
- ROCK CROSS VANE
- ROCK STEP STRUCTURE w/ BOULDERS
- ROCK STEP STRUCTURE w/ CLASS B RIP RAP
- ROCK / LOG CROSS VANE
- FLOODPLAIN INTERCEPTOR

GRAPHIC SCALES

50 25 0 50 100 — PLANS

10 5 0 10 20 — PROFILE (HORIZONTAL)

20 10 0 20 40 — PROFILE (VERTICAL)

DESIGN DATA

ROSES CREEK

DESIGN STREAM TYPE	= C4
BANKFULL AREA (FT^2) CROSS-SECTIONED	= 66.4
BANKFULL WIDTH (FT)	= 30.5
MAX DEPTH (FT)	= 2.72
WIDTH / DEPTH RATIO	= 14.0
DRAINAGE AREA (MI^2)	= 5.17
BANKFULL SLOPE(FT/FT)	= 0.0062

UT 1

DESIGN STREAM TYPE	= C5
BANKFULL AREA (FT^2) CROSS-SECTIONED	= 2.1
BANKFULL WIDTH (FT)	= 5.0
MAX DEPTH (FT)	= 0.58
WIDTH / DEPTH RATIO	= 13.0
DRAINAGE AREA (MI^2)	= 0.06
BANKFULL SLOPE(FT/FT)	= 0.0021

UT 2

DESIGN STREAM TYPE	= C5
BANKFULL AREA (FT^2) CROSS-SECTIONED	= 2.1
BANKFULL WIDTH (FT)	= 5.0
MAX DEPTH (FT)	= 0.58
WIDTH / DEPTH RATIO	= 13.0
DRAINAGE AREA (MI^2)	= 0.07
BANKFULL SLOPE(FT/FT)	= 0.0021

UT 3

DESIGN STREAM TYPE	= C5
BANKFULL AREA (FT^2) CROSS-SECTIONED	= 2.6
BANKFULL WIDTH (FT)	= 5.5
MAX DEPTH (FT)	= 0.63
WIDTH / DEPTH RATIO	= 13.1
DRAINAGE AREA (MI^2)	= 0.02
BANKFULL SLOPE(FT/FT)	= 0.0021

PROJECT LENGTH

		PROPOSED DESIGN STREAM LENGTH	ASBUILT STREAM LENGTH
ROSES CREEK	=	3,219.20 FT	3,222.56 FT
UT 1	=	930.38 FT	950.69 FT
UT 2	=	707.59 FT	710.07 FT
UT 3	=	621.03 FT	627.80 FT

CHRISTOPHER L. SMITH
PROJECT MANAGER

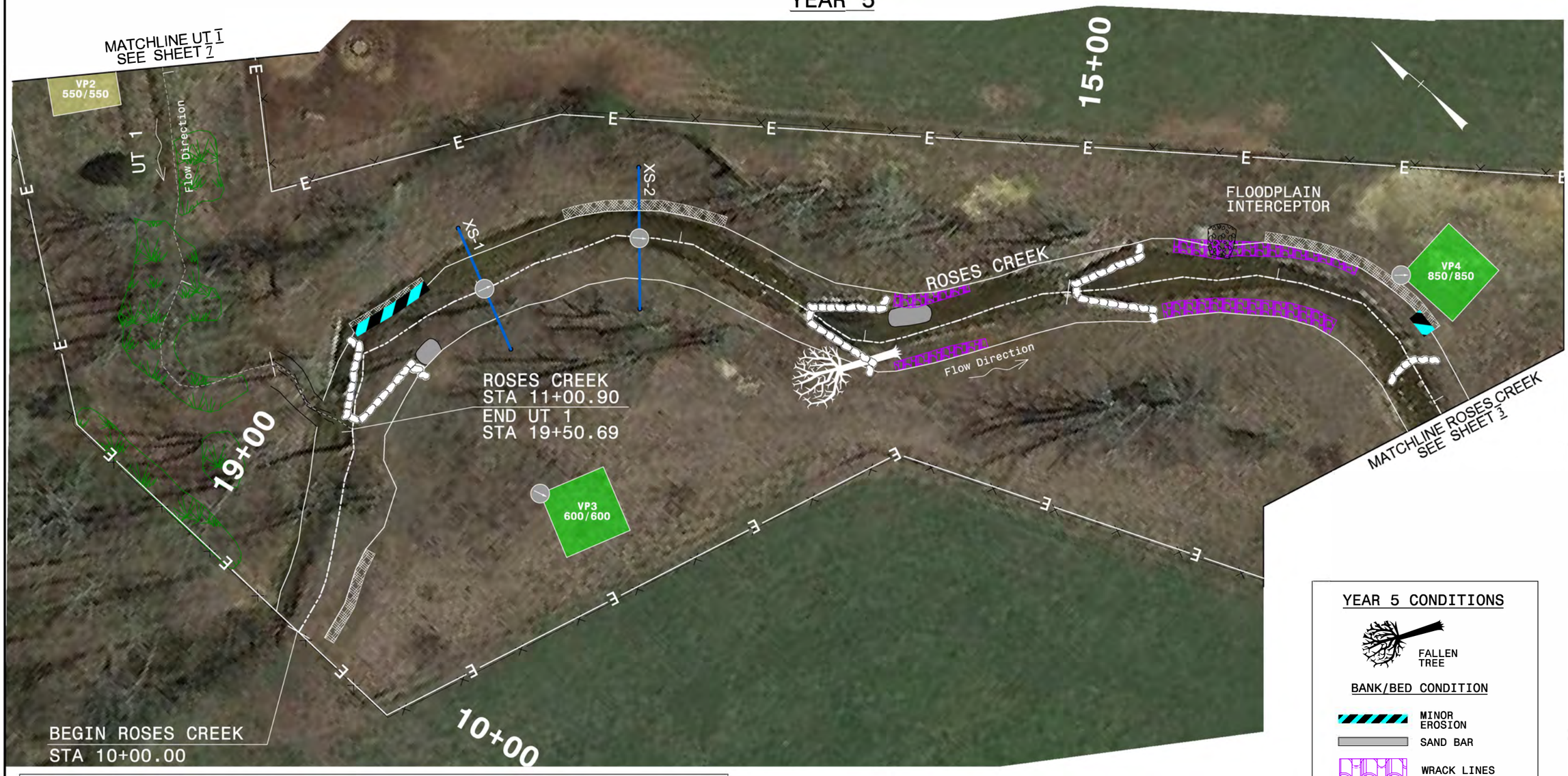
Prepared in the Office of:

HDR ICA

ICA Engineering, Inc.
555 Fayetteville Street,
Suite 900
Raleigh, NC 27601
NC License No: F-0258

$$$$$$SYSTIME$$$$$
$$$$$$$$$$$$$$$$$DGN$$$$$$$$$$$$$$$$$$$$$
$$$$USERNAME$$$$

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5



LEGEND

- 15+00
- ASBUILT ALIGNMENTS & STATIONING
- THALWEG
- BANKFULL
- EPHEMERAL POOL
- CONSERVATION EASEMENT
- FENCE
- PHOTO POINT & DIRECTION
- CROSS-SECTION LOCATION
- 10 x 10 VEG PLOT
- 5 x 20 VEG PLOT
- BRUSH TOE
- CREST GAUGE
- ROCK L-VANE
- ROCK CROSS VANE
- ROCK STEP STRUCTURE w/ BOULDERS
- ROCK STEP STRUCTURE w/ CLASS B RIP RAP
- FLOODPLAIN INTERCEPTOR

YEAR 5 CONDITIONS

- FALLEN TREE

BANK/BED CONDITION

- MINOR EROSION
- SAND BAR
- WRACK LINES

VEGETATION PROBLEM AREAS

- INVASIVE POPULATION

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

NOTE:
650/650 - REPRESENTS TOTAL STEMS PER ACRE / PLANTED STEMS PER ACRE

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Raleigh, NC 27601
NC License No: F-0258

ROSES CREEK RESTORATION PROJECT
STREAM
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE
50 25 0 25
PLANS

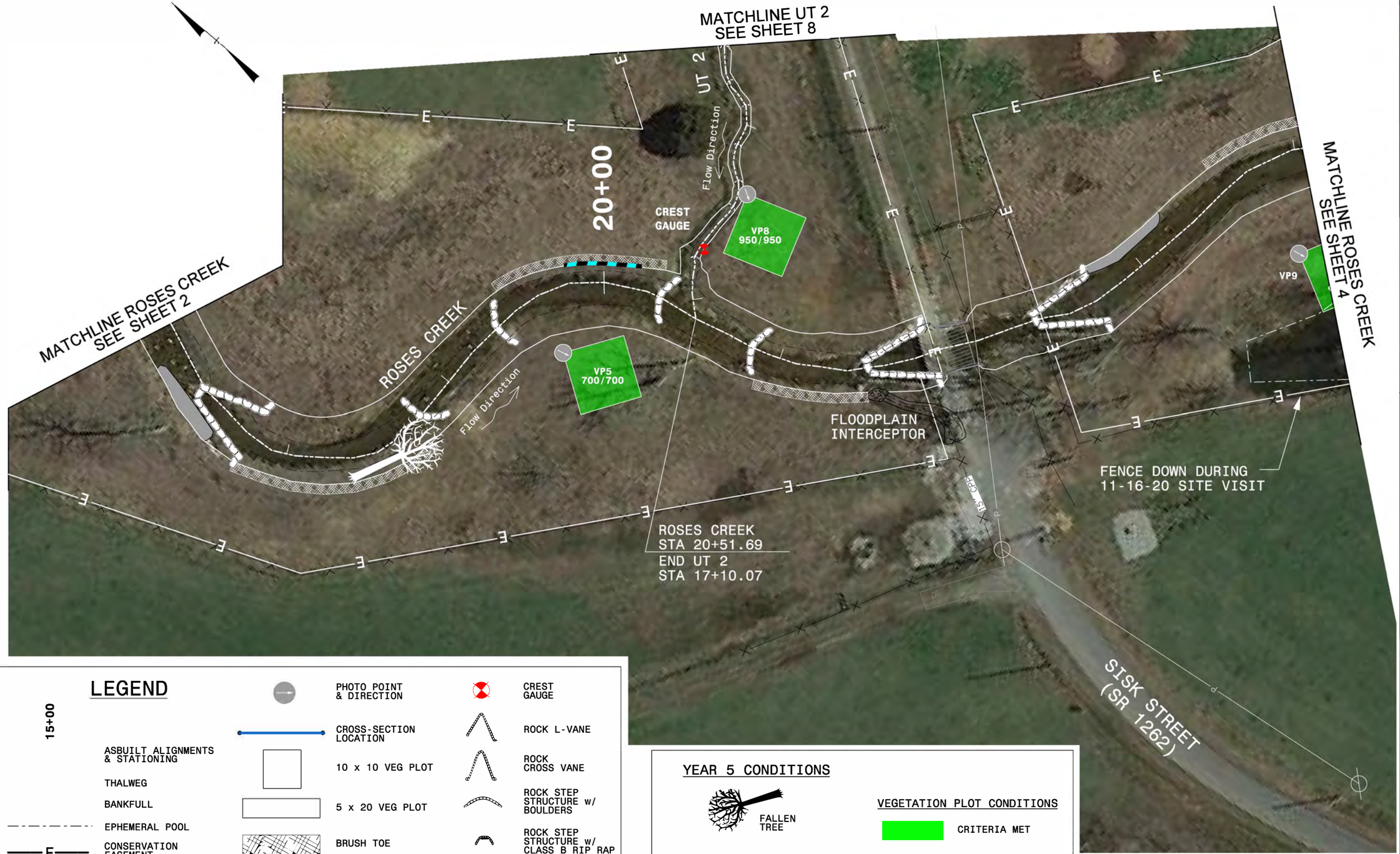
DATE: 09-21-2020

CCPV
YEAR 5

SHEET
2

EEP# 96309

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5



LEGEND

15+00 — ASBUILT ALIGNMENTS & STATIONING

THALWEG

BANKFULL

EPHEMERAL POOL

E — CONSERVATION EASEMENT

FENCE

PHOTO POINT & DIRECTION

CROSS-SECTION LOCATION

10 x 10 VEG PLOT

5 x 20 VEG PLOT

BRUSH TOE

P — POWER LINE

CREST GAUGE

ROCK L-VANE

ROCK CROSS VANE

ROCK STEP STRUCTURE w/ BOULDERS

ROCK STEP STRUCTURE w/ CLASS B RIP RAP

FLOODPLAIN INTERCEPTOR

YEAR 5 CONDITIONS

FALLEN TREE

BANK/BED CONDITION

MINOR EROSION

SAND BAR

VEGETATION PLOT CONDITIONS

CRITERIA MET

CRITERIA UNMET

NOTE:
650/650 - REPRESENTS TOTAL STEMS PER ACRE / PLANTED STEMS PER ACRE

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ROSES CREEK RESTORATION PROJECT
STREAM
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE 50 25 0 25 PLANS

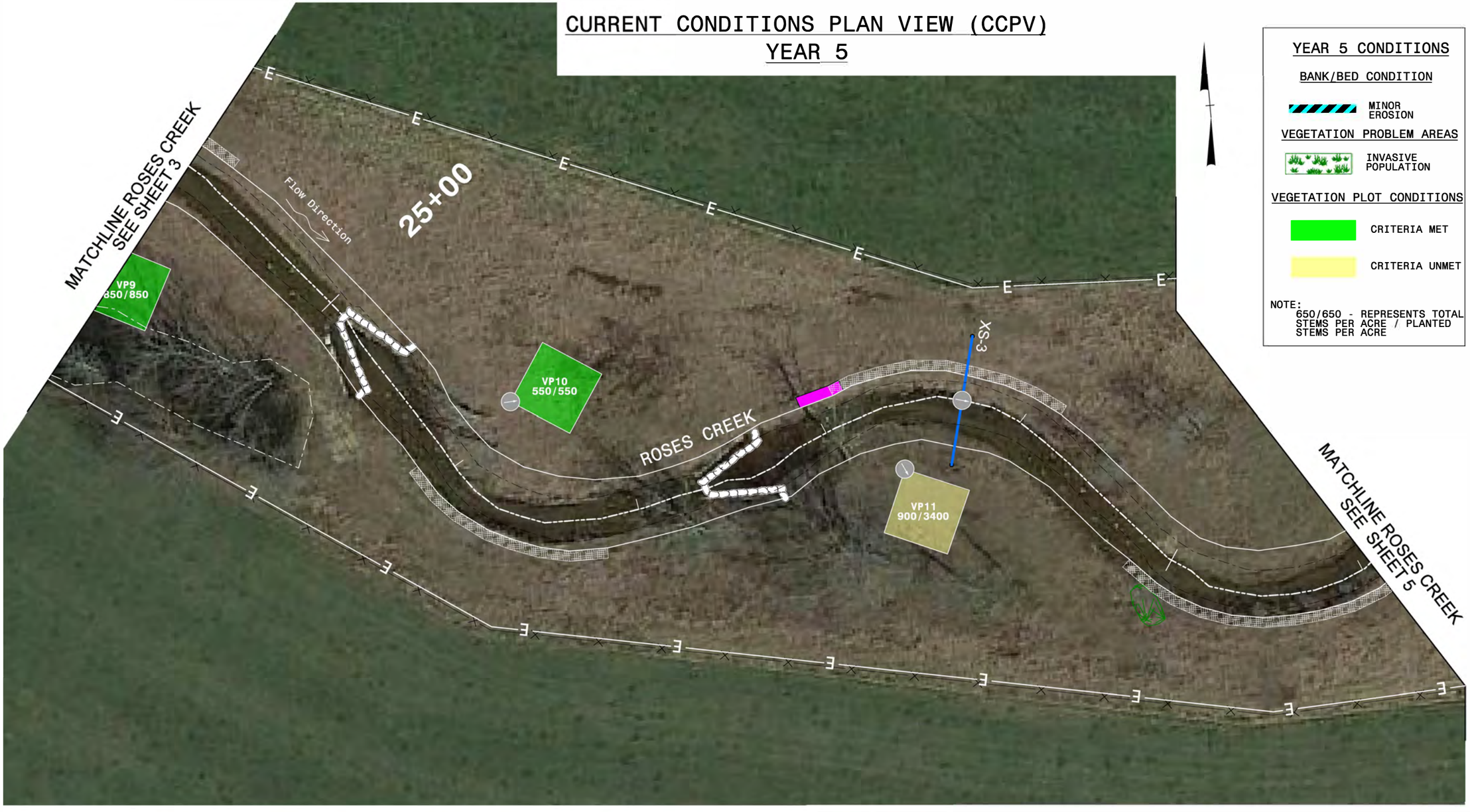
DATE: 09-21-2020

CCPV YEAR 5

SHEET 3

EEP# 96309

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5



YEAR 5 CONDITIONS

BANK/BED CONDITION

MINOR EROSION

VEGETATION PROBLEM AREAS

INVASIVE POPULATION

VEGETATION PLOT CONDITIONS

CRITERIA MET

CRITERIA UNMET

NOTE:
650/650 - REPRESENTS TOTAL STEMS PER ACRE / PLANTED STEMS PER ACRE

LEGEND

15+00

ASBUILT ALIGNMENTS & STATIONING

THALWEG

BANKFULL

EPHEMERAL POOL

CONSERVATION EASEMENT

FENCE

MASS WASTING

PHOTO POINT & DIRECTION

CROSS-SECTION LOCATION

10 x 10 VEG PLOT

5 x 20 VEG PLOT

BRUSH TOE

CREST GAUGE

ROCK L-VANE

ROCK CROSS VANE

ROCK STEP STRUCTURE w/ BOULDERS

ROCK STEP STRUCTURE w/ CLASS B RIP RAP

FLOODPLAIN INTERCEPTOR

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555 Fayetteville Street, Suite 900
Raleigh, NC 27601
NC License No: F-0258

ROSES CREEK RESTORATION PROJECT
STREAM
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE 50 25 0 25
PLANS

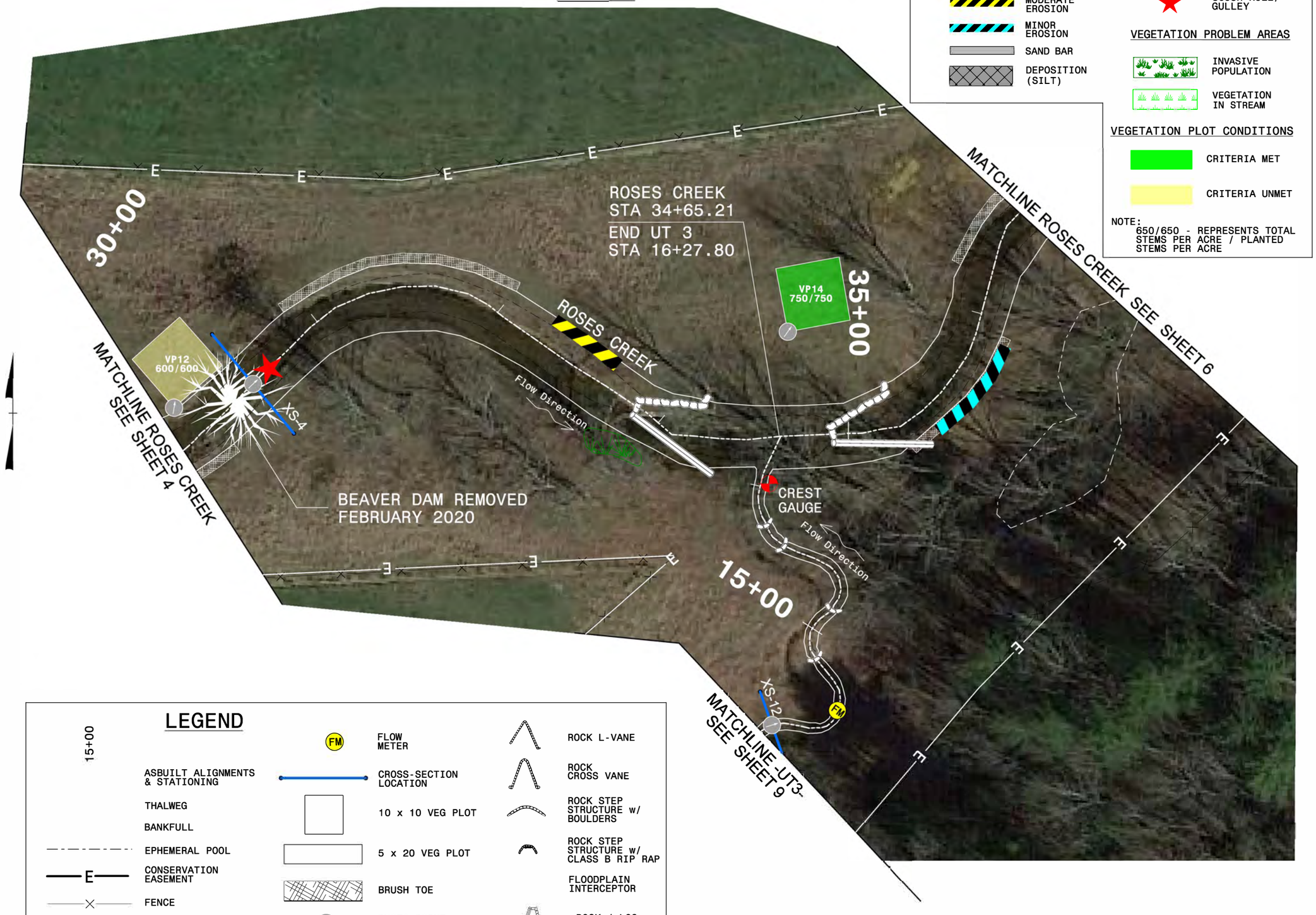
DATE: 09-21-2020

CCPV YEAR 5

SHEET 4

EEP# 96309

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5



YEAR 5 CONDITIONS

BANK/BED CONDITION

- MODERATE EROSION
- MINOR EROSION
- SAND BAR
- DEPOSITION (SILT)
- BEAVERDAM
- SCOUR HOLE/ GULLEY

VEGETATION PROBLEM AREAS

- INVASIVE POPULATION
- VEGETATION IN STREAM

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

NOTE:
650/650 - REPRESENTS TOTAL STEMS PER ACRE / PLANTED STEMS PER ACRE

LEGEND

15+00

- ASBUILT ALIGNMENTS & STATIONING
- THALWEG
- BANKFULL
- EPHEMERAL POOL
- CONSERVATION EASEMENT
- FENCE
- CREST GAUGE
- FLOW METER
- CROSS-SECTION LOCATION
- 10 x 10 VEG PLOT
- 5 x 20 VEG PLOT
- BRUSH TOE
- PHOTO POINT & DIRECTION
- ROCK L-VANE
- ROCK CROSS VANE
- ROCK STEP STRUCTURE w/ BOULDERS
- ROCK STEP STRUCTURE w/ CLASS B RIP RAP
- FLOODPLAIN INTERCEPTOR
- ROCK / LOG CROSS VANE

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NC License No: F-0258

ROSES CREEK
STREAM RESTORATION PROJECT
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE
50 25 0 25
PLANS

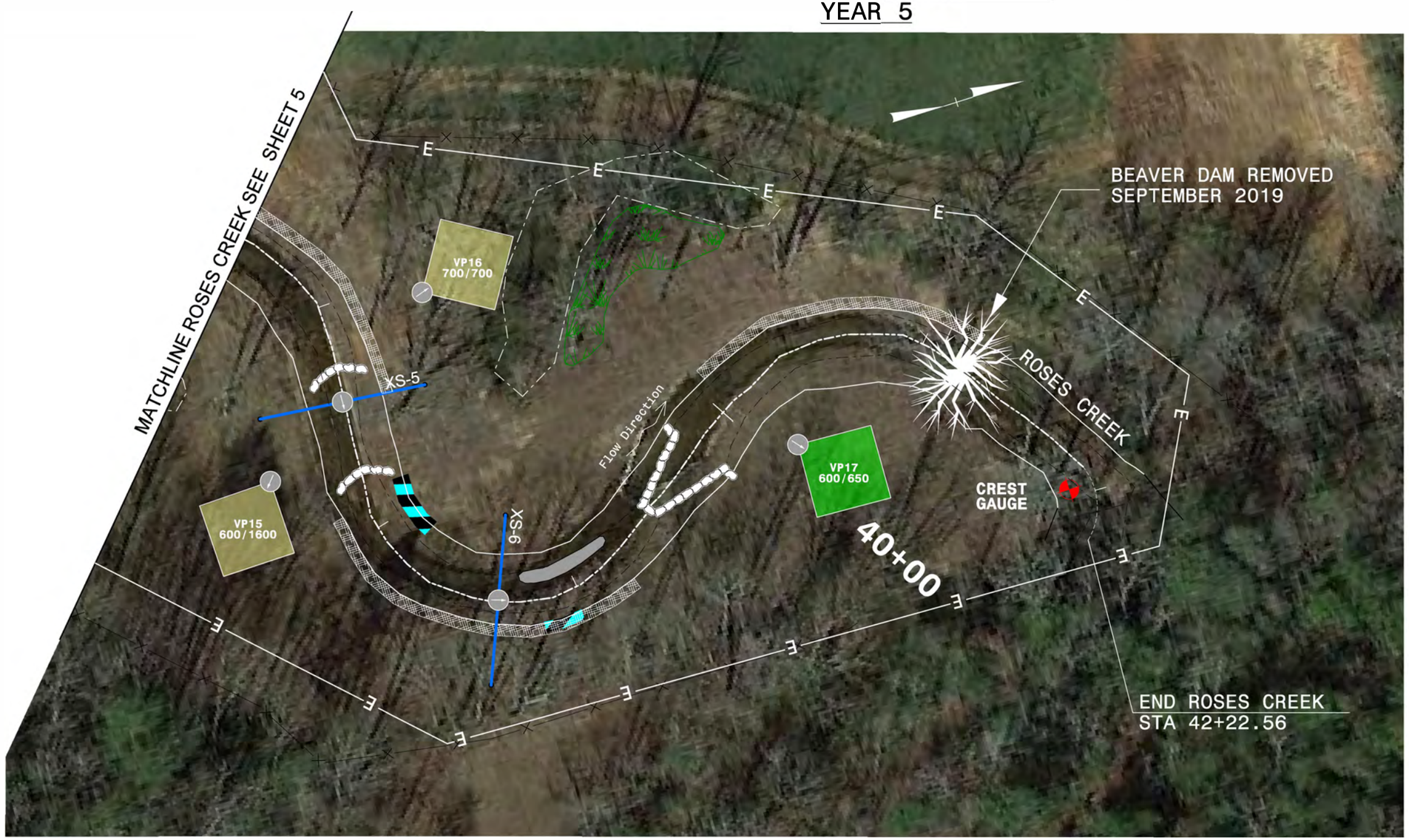
DATE: 09-21-2020

CCPV
YEAR 5

SHEET
5

EEP# 96309

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5



LEGEND

15+00

- ASBUILT ALIGNMENTS & STATIONING
- THALWEG
- BANKFULL
- EPHEMERAL POOL
- CONSERVATION EASEMENT
- FENCE
- CROSS-SECTION LOCATION
- 10 x 10 VEG PLOT
- 5 x 20 VEG PLOT
- BRUSH TOE
- PHOTO POINT & DIRECTION
- CREST GAUGE
- ROCK L-VANE
- ROCK CROSS VANE
- ROCK STEP STRUCTURE w/ BOULDERS
- ROCK STEP STRUCTURE w/ CLASS B RIP RAP
- FLOODPLAIN INTERCEPTOR

YEAR 5 CONDITIONS

BANK/BED CONDITION

- MODERATE EROSION
- MINOR EROSION
- SAND BAR
- BEAVERDAM

VEGETATION PROBLEM AREAS

- INVASIVE POPULATION

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

NOTE:
650/650 - REPRESENTS TOTAL STEMS PER ACRE / PLANTED STEMS PER ACRE

ICA Engineering, Inc.
555 Fayetteville Street, Suite 900
Raleigh, NC 27601
NC License No: F-0258

ROSES CREEK RESTORATION PROJECT
STREAM
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 09-21-2020

CCPV YEAR 5

SHEET
6

EEP# 96309

$$$$$SYSTIME$$$$$
$$$$$USERNAME$$$$$

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5

YEAR 5 CONDITIONS

VEGETATION PROBLEM AREAS

INVASIVE POPULATION

VEGETATION PLOT CONDITIONS

CRITERIA MET

CRITERIA UNMET

NOTE:
650/650 - REPRESENTS TOTAL STEMS PER ACRE / PLANTED STEMS PER ACRE

LEGEND

15+00

ASBUILT ALIGNMENTS & STATIONING

THALWEG

BANKFULL

EPHEMERAL POOL

CONSERVATION EASEMENT

FENCE

CROSS-SECTION LOCATION

10 x 10 VEG PLOT

FLOW METER

POWER LINE

PHOTO POINT & DIRECTION

CREST GAUGE

ROCK STEP STRUCTURE w/ CLASS B RIP RAP

FLOODPLAIN INTERCEPTOR

ICA Engineering, Inc.
555 Fayetteville Street, Suite 900
Raleigh, NC 27601
NC License No: F-0258

ROSES CREEK
STREAM RESTORATION PROJECT
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 09-21-2020

CCPV
YEAR 5

SHEET
7

EEP# 96309

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5

LEGEND

15+00

- ASBUILT ALIGNMENTS & STATIONING
- THALWEG
- BANKFULL
- EPHEMERAL POOL
- CONSERVATION EASEMENT
- FENCE
- CROSS-SECTION LOCATION
- 10 x 10 VEG PLOT
- 5 x 20 VEG PLOT
- FLOW METER
- PHOTO POINT & DIRECTION
- CREST GAUGE
- BRUSH TOE
- ROCK STEP STRUCTURE w/ CLASS B RIP RAP
- FLOODPLAIN INTERCEPTOR
- POWER LINE

YEAR 5 CONDITIONS

- CONSTRUCTED BERM

BANK/BED CONDITION

- DEPOSITION (SILT)

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

NOTE:
650/650 - REPRESENTS TOTAL STEMS PER ACRE / PLANTED STEMS PER ACRE

ICA Engineering, Inc.
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Raleigh, NC 27601
NC License No: F-0258

ROSES CREEK
STREAM RESTORATION PROJECT
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 09-21-2020

CCPV
YEAR 5

SHEET
8

EEP# 96309

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5

YEAR 5 CONDITIONS

BANK/BED CONDITION

DEPOSITION (SILT)

VEGETATION PLOT CONDITIONS

CRITERIA MET

CRITERIA UNMET

NOTE:
650/650 - REPRESENTS TOTAL STEMS PER ACRE / PLANTED STEMS PER ACRE

LEGEND

15+00

ASBUILT ALIGNMENTS & STATIONING

THALWEG

BANKFULL

EPHEMERAL POOL

CONSERVATION EASEMENT

FENCE

PHOTO POINT & DIRECTION

CROSS-SECTION LOCATION

10 x 10 VEG PLOT

EXISTING WETLANDS

ROCK STEP STRUCTURE w/ CLASS B RIP RAP

FLOODPLAIN INTERCEPTOR

ICA Engineering, Inc.
555 Fayetteville Street,
Suite 900
Raleigh, NC 27601
NC License No: F-0258

ROSES CREEK
STREAM RESTORATION PROJECT
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 09-21-020

CCPV
YEAR 5

SHEET
9

EEP# 96309

$$$$$$$SYSTIMES$$$$$$
$$$$$$$USERNAME$$$$$$
$$$$$$$DWGNAME$$$$$$
$$$$$$$$$$$$$$$$$$$$$$

Table 5: Visual Stream Morphology Stability Assessment
Reach ID: Roses Creek
Assessed Length: 3,121 FT

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	17	17			100%
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	18	18			100%
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	18	18			100%
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	17	17			100%
		2. Thalweg centering at downstream of meander (Glide)	17	17			100%
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			5	144	95%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			1	33	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			1	15	99%
				Totals	7	192	94%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	19	19			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	19	19			100%
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	19	19			100%
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	19	19			100%
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	19	19			100%

Table 5a: Visual Stream Morphology Stability Assessment
Reach ID: UT1
Assessed Length: 234 LF

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	0	0			100%
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	2	2			100%
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	2	2			100%
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	3	3			100%
		2. Thalweg centering at downstream of meander (Glide)	3	3			100%
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%
				Totals	0	0	100.0%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	12	12			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	12	12			100%
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	12	12			100%
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	12	12			100%
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	12	12			100%

Table 5b: Visual Stream Morphology Stability Assessment
Reach ID: UT2
Assessed Length: 707 LF

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			1	126	82%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	22	22			100%
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	21	21			100%
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	21	21			100%
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	22	22			100%
		2. Thalweg centering at downstream of meander (Glide)	22	22			100%
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%
				Totals	0	0	100.0%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	21	21			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	21	21			100%
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	21	21			100%
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	21	21			100%
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	21	21			100%

Table 5c: Visual Stream Morphology Stability Assessment
Reach ID: UT3
Assessed Length: 620 LF

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			1	282	55%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	13	13			100%
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	12	12			100%
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	13	13			100%
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	13	13			100%
		2. Thalweg centering at downstream of meander (Glide)	13	13			100%
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%
				Totals	0	0	100.0%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	14	14			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	14	14			100%
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	14	14			100%
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	14	14			100%
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	14	14			100%

Table 6. Vegetation Condition Assessment

Planted Acreage **15.81**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.05 Acres	Pink polygons filled with green x's	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 Acres	Blue cross hatch pattern	0	0.0	0.0%
			Total			
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.1 Acres	Pattern and color.	0	0	0%
			Cumulative Total			

Easement Acreage **17.33**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000 SF	Green grass pattern.	9	0.3	2%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	None	N/A	N/A	N/A	N/A

Figures 3.1 - 3.30. Vegetation Plot and Site Photos

3.1 Vegetation Plot 1

3.2 Vegetation Plot 2

3.3 Vegetation Plot 3

3.4 Vegetation Plot 4

3.5 Vegetation Plot 5

3.6 Vegetation Plot 6

3.7 Vegetation Plot 7

3.8 Vegetation Plot 8

3.9 Vegetation Plot 9

3.10 Vegetation Plot 10

3.11 Vegetation Plot 11

3.12 Vegetation Plot 12

3.13 Vegetation Plot 13

3.14 Vegetation Plot 14

3.15 Vegetation Plot 15

3.16 Vegetation Plot 16

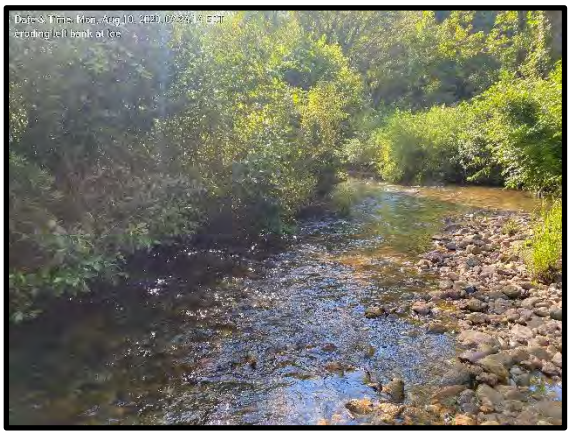
3.17 Vegetation Plot 17

3.18 Minor erosion at station 20+00

3.19 Beaver dam at station 30+00

3.20 Mass wasting at station 27+94 – 28+09

3.21 Moderate toe erosion at station 32 +32-32+70. Looking perpendicular.



3.22 Moderate toe erosion left bank station 32+32-32+70. Looking downstream.

3.23 Minor erosion at station 35+00.

3.24 Minor erosion at station 39+30.

3.25 Minor Erosion at station 40+00.

3.26 Wrack lines from October rain events above station 15+00.

3.27 Damage to fence from October rain events.

3.28 Wrack lines from October rain events below station 35+00.

3.29 UT 2 single thread channel.

3.30 UT 3 single thread channel.

Appendix C. Vegetation Plot Data

EEP Project Code 96309. Project Name: Roses Creek

Table 7a: Vegetation Plot Mitigation Success Summary

Scientific Name	Common Name	Species Type	Current Plot Data (MY5 2020)																														
			96309-WFW-0001			96309-WFW-0002			96309-WFW-0003			96309-WFW-0004			96309-WFW-0005			96309-WFW-0006			96309-WFW-0007			96309-WFW-0008			96309-WFW-0009			96309-WFW-0010			96309-WFW-0011		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Alnus incana	gray alder																																	
Alnus serrulata	hazel alder	Shrub																1	1	2				2	2	2			1					
Asimina triloba	pawpaw	Tree																																
Betula nigra	river birch	Tree			1	3	3	3	1	1	3				1	1	2			1			1	1	1	5	1	1	5			7	1	1	101
Carya	hickory	Tree																											1					
Carya glabra	pignut hickory	Tree																																
Cephalanthus occidentalis	common buttonbush	Shrub			1													1	1	2										1	1			
Cornus alternifolia	alternateleaf dogwood	Tree																																
Cornus amomum	silky dogwood	Shrub			4	1	1	4	1	1	1	1	1	1	1	1	1	3	3	6	1	1	2	4	4	4						1	1	1	1
Cornus florida	flowering dogwood	Tree																																
Diospyros virginiana	common persimmon	Tree			27																													
Fraxinus nigra	black ash	Tree																																
Fraxinus pennsylvanica	green ash	Tree				1	1	1	1	1	2	2	2	2	3	3	5	3	3	5	4	4	6	1	1	2	1	1	1	4	4	6	2	2	2
Lindera benzoin	northern spicebush	Shrub																																
Liquidambar styraciflua	sweetgum	Tree									4			3																				
Liriodendron tulipifera	tuliptree	Tree	1	1	2	1	1	1	5	5	5	1	1	1							1	1	1				2	2	2					
Nyssa sylvatica	blackgum	Tree																																
Platanus occidentalis	American sycamore	Tree	2	2	2			2	1	1	4	6	6	8	5	5	9				4	4	6	4	4	5	3	3	4	3	3	3	2	2	3
Populus heterophylla	swamp cottonwood	Tree																																
Prunus serotina	black cherry	Tree																																
Prunus serotina var. serotina	black cherry	Tree																					1											
Quercus michauxii	swamp chestnut oak	Tree																																
Quercus nigra	water oak	Tree	1	1	1																													
Quercus pagoda	cherrybark oak	Tree																			1	1	1											
Quercus phellos	willow oak	Tree																																
Quercus rubra	northern red oak	Tree							1	1	1	1	1	2																				
Rhus copallinum	flameleaf sumac	shrub			2																													
Robinia pseudoacacia	black locust	Tree															1																	
Rosa multiflora	multiflora rose	Exotic																								1								
Salix nigra	black willow	Tree																											1			1		
Ulmus americana	American elm	Tree																																
Ulmus rubra	slippery elm	Tree	2	2	2																													
Stem count			6	6	42	6	6	11	10	10	20	11	11	17	10	10	18	8	8	16	11	11	18	12	12	19	7	7	15	8	8	19	6	6	107
size (ares)			1			1			1			1			1			1			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			4	4	9	4	4	5	6	6	7	5	5	6	4	4	5	4	4	5	5	5	7	5	5	6	4	4	7	3	3	6	4	4	4
Stems per ACRE			243	243	1700	243	243	445	405	405	809	445	445	688	405	405	728	324	324	647	445	445	728	486	486	769	283	283	607	324	324	769	243	243	4330
Stems per ACRE (no single species exceeding 50% comp.			364			445			567			567			607			647			647			688			567			647			324		

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

EEP Project Code 96309. Project Name: Roses Creek

Table 7b: Vegetation Plot Mitigation Success Summary

Scientific Name	Common Name	Species Type	Current Plot Data (MY5 2020)																																
			96309-WFW-0012			96309-WFW-0013			96309-WFW-0014			96309-WFW-0015			96309-WFW-0016			96309-WFW-0017			MY5 (2020)			MY3 (2018)			MY2 (2017)			MY1 (2016)			MY0 (2016)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Alnus incana	gray alder																									1									
Alnus serrulata	hazel alder	Shrub															1				3	3	6	2	2	21	2	2	12						
Asimina triloba	pawpaw	Tree									1												1												
Betula nigra	river birch	Tree	1	1	101	2	2	5			100			100			100	1	1	51	12	12	586	13	13	384	8	8	151	19	19	19	26	26	26
Carya	hickory	Tree						2															3												
Carya glabra	pignut hickory	Tree																						1	1	3	2	2	2						
Cephalanthus occidentalis	common buttonbush	Shrub															1				2	2	5							4	4	4	5	5	5
Cornus alternifolia	alternateleaf dogwood	Tree																												1	1	1	2	2	2
Cornus amomum	silky dogwood	Shrub				2	2	2				1	1	2	1	1	2	2	2	2	19	19	33	28	28	38	26	26	26	35	35	35	54	54	54
Cornus florida	flowering dogwood	Tree																						1	1	1	1	1	1						
Diospyros virginiana	common persimmon	Tree																					27			20			22						
Fraxinus nigra	black ash	Tree																									2	2	2	9	9	9	9	9	9
Fraxinus pennsylvanica	green ash	Tree	3	3	4	5	5	7	1	1	1	2	2	2	1	1	1	2	2	3	36	36	50	40	40	52	35	35	38	56	56	56	74	74	74
Lindera benzoin	northern spicebush	Shrub																									1	1	2						
Liquidambar styraciflua	sweetgum	Tree			1									1									9			2			3						
Liriodendron tulipifera	tuliptree	Tree							1	1	1				1	1	1	1	1	4	14	14	18	15	15	17	6	6	11	11	11	11	12	12	12
Nyssa sylvatica	blackgum	Tree						1															1												
Platanus occidentalis	American sycamore	Tree	1	1	2	4	4	4	5	5	6							2	2	4	42	42	62	40	40	83	31	31	42	49	49	49	59	59	59
Populus heterophylla	swamp cottonwood	Tree																						3	3	3	3	3	3						
Prunus serotina	black cherry	Tree										1	1	1							1	1	1	1	1	1	1	1	1						
Prunus serotina var. serotina	black cherry	Tree																					1												
Quercus michauxii	swamp chestnut oak	Tree																												2	2	2	2	2	2
Quercus nigra	water oak	Tree																			1	1	1	1	1	1				1	1	1	1	1	1
Quercus pagoda	cherrybark oak	Tree																			1	1	1	1	1	1									
Quercus phellos	willow oak	Tree																												47	47	47	68	68	68
Quercus rubra	northern red oak	Tree																			2	2	3	2	2	3									
Rhus copallinum	flameleaf sumac	shrub																					2			1									
Robinia pseudoacacia	black locust	Tree																					1												
Rosa multiflora	multiflora rose	Exotic												1			1						3												
Salix nigra	black willow	Tree			1																		3	1	1	19	1	1	4	4	4	4	7	7	7
Ulmus americana	American elm	Tree																												4	4	4	7	7	7
Ulmus rubra	slippery elm	Tree																			2	2	2												
Stem count			5	5	109	13	13	21	7	7	109	4	4	107	3	3	107	8	8	64	135	135	819	149	149	651	119	119	320	242	242	242	326	326	326
size (ares)			1			1			1			1			1			1			17			17			17			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.42			0.42			0.42			0.02			0.02		
Species count			3	3	5	4	4	6	3	3	5	3	3	6	3	3	7	5	5	5	12	12	22	14	14	18	13	13	15	13	13	13	13	13	13
Stems per ACRE			202	202	4411	526	526	850	283	283	4411	162	162	4330	121	121	4330	324	324	2590	321	321	1950	355	355	1550	283	283	762	9793	9793	9793	13193	13193	13193
Stems per ACRE not exceeding 50% comp			283			567			364			283			283			324			451														

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

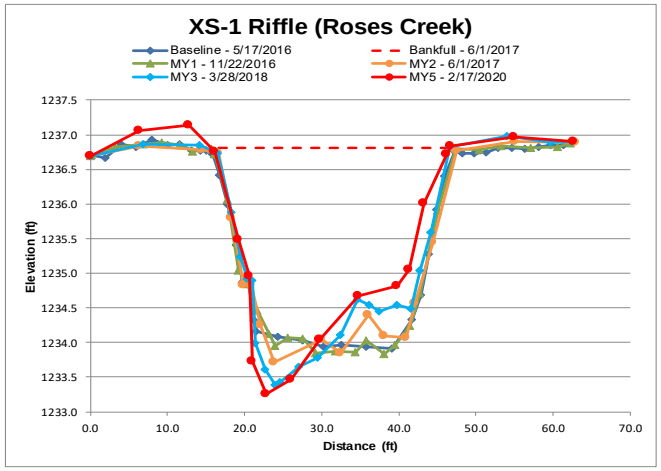
Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Appendix D. Stream Survey Data

Figure 4.1

River Basin	Catawba
Watershed	03050101060030
XS ID	XS 1 (Roses Creek)
Drainage Area (Acres)	3,309
Date	2/17/2020
Field Crew	AD, MF

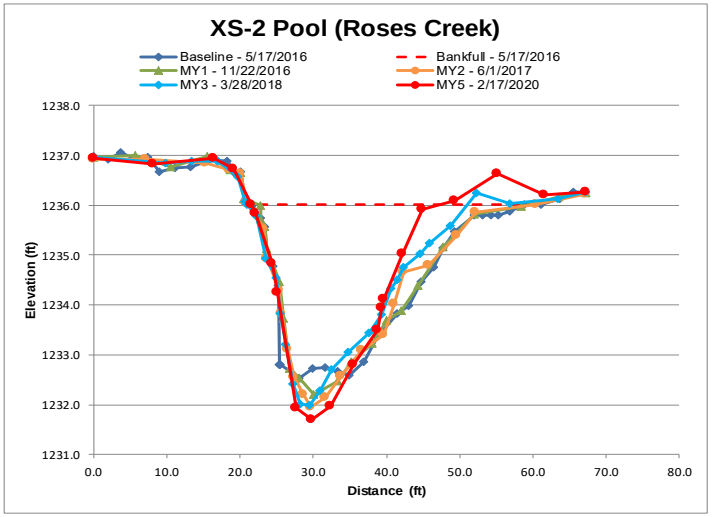


	Cross Section 1 (Riffle)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	33.80	31.10	30.73	29.98	29.94	
Floodprone Width (ft)	508.32	508.32	508.32	508.32	508.32	
Bankfull Mean Depth (ft)	2.00	2.20	2.19	2.18	2.02	
Bankfull Max Depth (ft)	2.81	2.89	3.01	3.35	3.47	
Bankfull Cross Sectional Area (ft^2)	67.70	68.28	67.22	65.27	60.43	
Bankfull Width/Depth Ratio	16.90	14.14	14.03	13.75	14.82	
Bankfull Entrenchment Ratio	15.04	16.35	16.54	16.96	16.98	
Low Bank Height (ft)	---	---	---	3.44	3.60	
Bank Height Ratio*	1.00	1.00	1.00	1.00	1.00	

* Base - MY2 calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

Figure 4.2

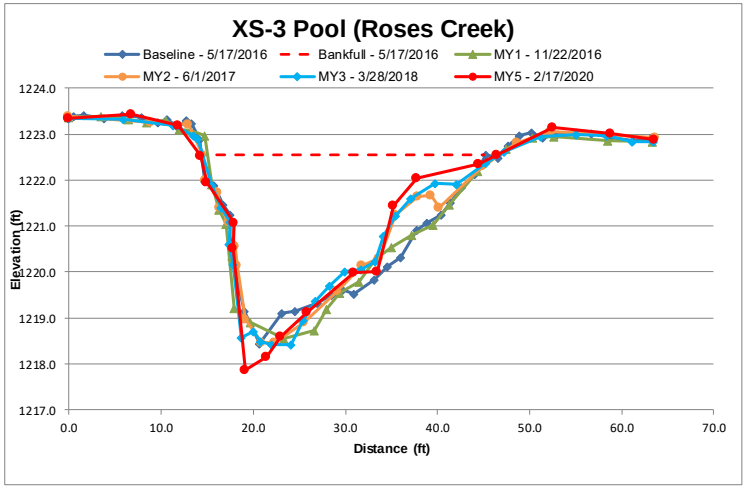
River Basin	Catawba
Watershed	03050101060030
XS ID	XS 2 (Roses Creek)
Drainage Area (Acres)	3,309
Date	2/17/2020
Field Crew	AD, MF



	Cross Section 2 (Pool)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	38.53	37.04	39.49	30.03	25.64	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.73	1.75	1.65	1.96	2.24	
Bankfull Max Depth (ft)	3.47	3.80	4.05	4.02	4.32	
Bankfull Cross Sectional Area (ft^2)	66.48	64.97	65.02	58.79	57.56	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bank Height Ratio						

Figure 4.3

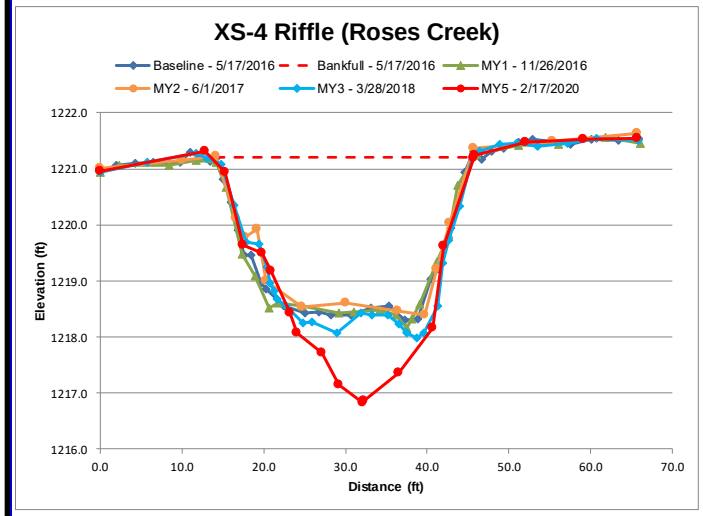
River Basin	Catawba
Watershed	03050101060030
XS ID	XS 3 (Roses Creek)
Drainage Area (Acres)	3,309
Date	2/17/2020
Field Crew	AD, MF



	Cross Section 3 (Pool)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	32.44	31.58	32.26	32.20	32.28	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	2.19	2.32	2.07	2.03	2.00	
Bankfull Max Depth (ft)	4.10	3.99	4.09	4.13	4.68	
Bankfull Cross Sectional Area (ft^2)	71.10	73.39	66.76	65.48	64.54	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bank Height Ratio						

Figure 4.4

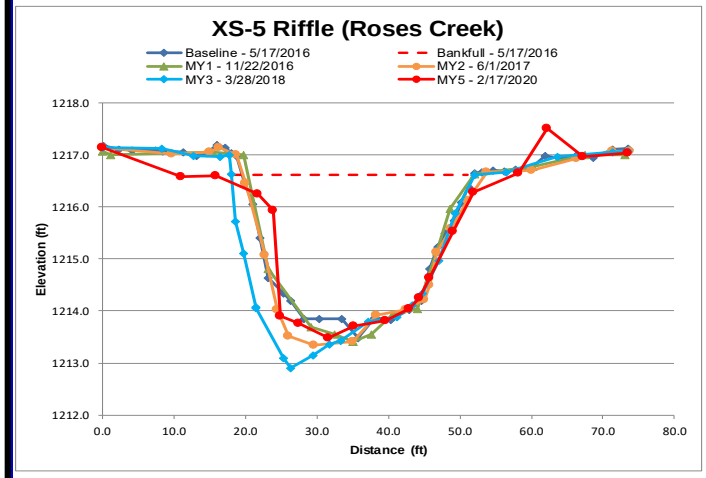
River Basin	Catawba
Watershed	03050101060030
XS ID	XS 4 (Roses Creek)
Drainage Area (Acres)	3,309
Date	2/17/2020
Field Crew	AD, MF



	Cross Section 4 (Riffle)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	31.11	31.66	31.03	32.35	32.12	
Floodprone Width (ft)	696.00	696.00	696.00	696.00	696.00	
Bankfull Mean Depth (ft)	2.19	2.16	2.08	2.12	2.63	
Bankfull Max Depth (ft)	2.89	3.03	2.80	3.20	4.37	
Bankfull Cross Sectional Area (ft^2)	68.21	68.41	64.61	71.47	84.41	
Bankfull Width/Depth Ratio	14.21	14.66	14.92	14.64	12.21	
Bankfull Entrenchment Ratio	22.37	21.98	22.43	21.51	21.67	
Low Bank Height (ft)	---	---	---	3.38	4.42	
Bank Height Ratio*	1.00	1.00	1.00	1.05	1.15	

Figure 4.5

River Basin	Catawba
Watershed	03050101060030
XS ID	XS 5 (Roses Creek)
Drainage Area (Acres)	3,309
Date	2/17/2020
Field Crew	AD, MF

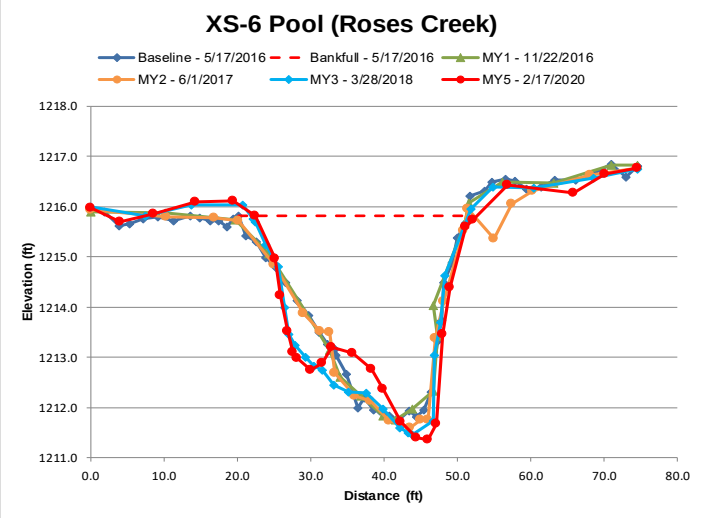


	Cross Section 5 (Riffle)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	32.56	32.99	34.06	36.04	30.66	
Floodprone Width (ft)	563.60	563.60	563.60	563.60	563.60	
Bankfull Mean Depth (ft)	2.13	2.25	2.22	2.37	1.90	
Bankfull Max Depth (ft)	3.16	3.23	3.29	3.73	2.80	
Bankfull Cross Sectional Area (ft^2)	69.41	74.12	75.52	85.30	58.11	
Bankfull Width/Depth Ratio	15.29	14.66	15.34	15.21	16.14	
Bankfull Entrenchment Ratio	17.31	17.08	16.55	15.64	18.38	
Low Bank Height (ft)	---	---	---	3.69	2.80	
Bank Height Ratio*	1.00	1.00	1.00	<1	<1	

* Base - MY2 calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

Figure 4.6

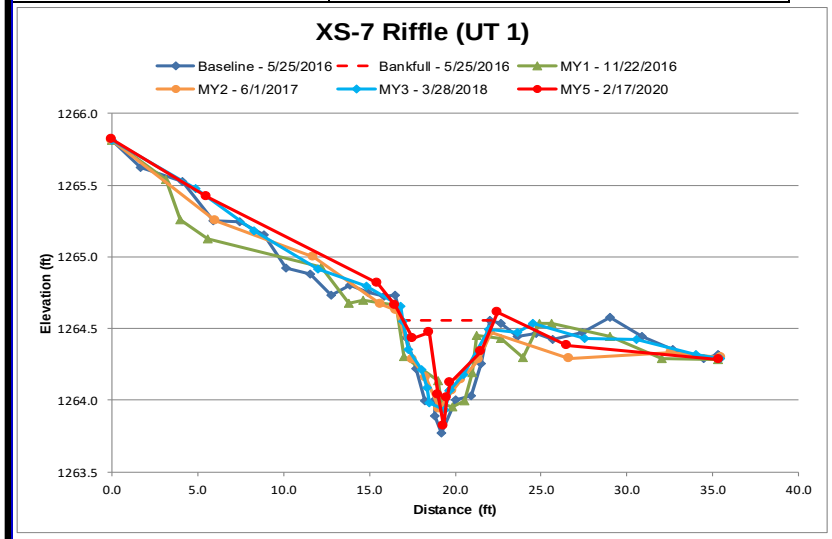
River Basin	Catawba
Watershed	03050101060030
XS ID	XS 6 (Roses Creek)
Drainage Area (Acres)	3,309
Date	2/17/2020
Field Crew	AD, MF



	Cross Section 6 (Pool)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	31.02	31.30	30.99	29.70	29.46	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	2.37	2.23	2.32	2.69	2.56	
Bankfull Max Depth (ft)	4.07	3.98	4.11	4.36	4.37	
Bankfull Cross Sectional Area (ft^2)	73.63	69.77	71.83	80.01	75.54	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bank Height Ratio						

Figure 4.7

River Basin	Catawba
Watershed	03050101060030
XS ID	XS 7 (UT 1)
Drainage Area (Acres)	38.40
Date	4/27/2020
Field Crew	AD, MF

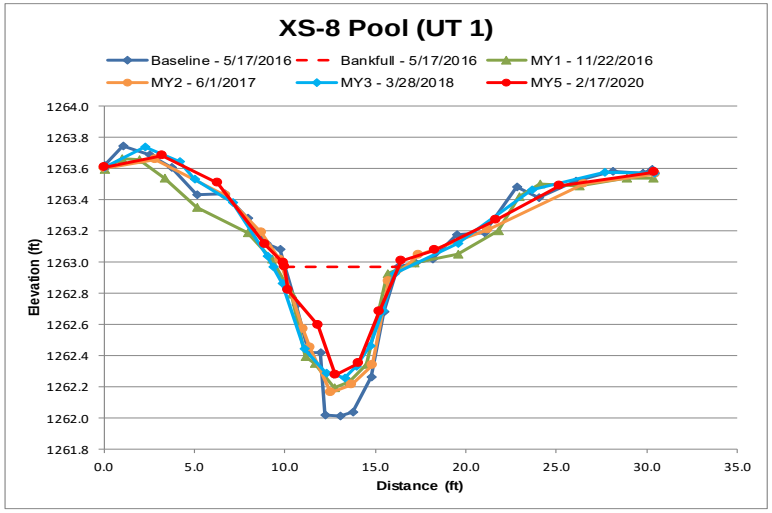


	Cross Section 7 (Riffle)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	5.12	4.46	5.31	5.01	5.38	
Floodprone Width (ft)	91.80	91.80	91.80	91.80	91.80	
Bankfull Mean Depth (ft)	0.45	0.41	0.35	0.36	0.26	
Bankfull Max Depth (ft)	0.78	0.59	0.61	0.62	0.74	
Bankfull Cross Sectional Area (ft^2)	2.30	1.82	1.86	1.78	1.40	
Bankfull Width/Depth Ratio	11.38	10.88	15.17	13.92	20.69	
Bankfull Entrenchment Ratio	17.93	20.58	17.29	18.32	17.05	
Low Bank Height (ft)	---	---	---	0.57	0.79	
Bank Height Ratio*	1.00	1.00	1.00	<1	<1	

* Base - MY2 calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

Figure 4.8

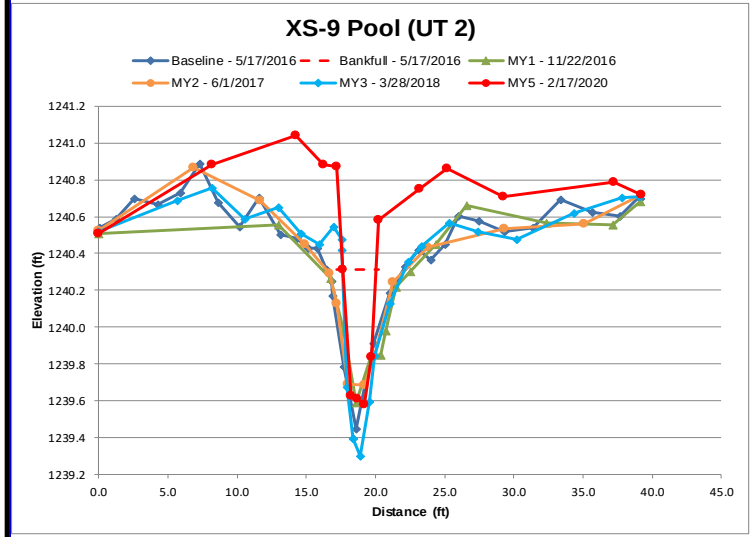
River Basin	Catawba
Watershed	03050101060030
XS ID	XS 8 (UT 1)
Drainage Area (Acres)	38.40
Date	2/17/2020
Field Crew	AD, MF



	Cross Section 8 (Pool)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	6.24	7.07	6.80	7.49	6.30	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	0.58	0.44	0.47	0.42	0.40	
Bankfull Max Depth (ft)	0.96	0.77	0.81	0.71	0.70	
Bankfull Cross Sectional Area (ft^2)	3.64	3.10	3.23	3.12	2.50	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bank Height Ratio						

Figure 4.9

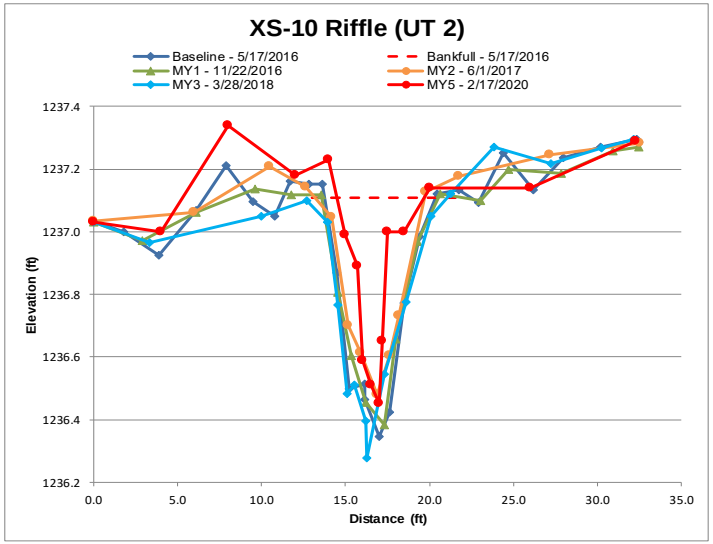
River Basin	Catawba
Watershed	03050101060030
XS ID	XS 9 (UT 2)
Drainage Area (Acres)	44.80
Date	4/27/2020
Field Crew	AD, MF



	Cross Section 9 (Pool)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	5.56	6.43	5.69	5.53	2.37	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	0.37	0.31	0.33	0.49	0.53	
Bankfull Max Depth (ft)	0.86	0.72	0.63	1.12	0.73	
Bankfull Cross Sectional Area (ft^2)	2.07	1.97	1.90	2.73	1.26	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bank Height Ratio						

Figure 4.10

River Basin	Catawba
Watershed	03050101060030
XS ID	XS 10 (UT 2)
Drainage Area (Acres)	44.80
Date	4/27/2020
Field Crew	AD, MF

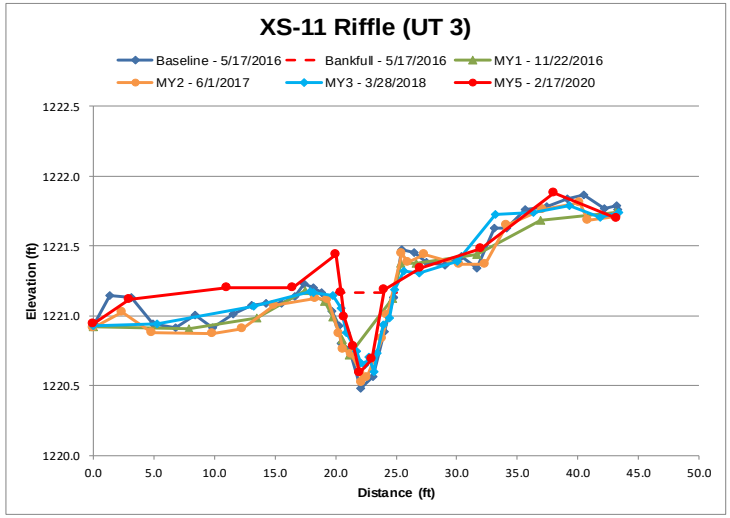


	Cross Section 10 (Riffle)					
Dimension and substrate*	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	6.70	7.10	6.79	7.38	5.18	
Floodprone Width (ft)	93.36	93.36	93.36	93.36	93.36	
Bankfull Mean Depth (ft)	0.42	0.38	0.32	0.39	0.24	
Bankfull Max Depth (ft)	0.77	0.74	0.64	0.84	0.66	
Bankfull Cross Sectional Area (ft^2)	2.79	2.69	2.17	2.88	1.23	
Bankfull Width/Depth Ratio	16.75	18.68	21.22	18.92	21.58	
Bankfull Entrenchment Ratio	13.93	13.14	13.75	12.65	18.03	
Low Bank Height (ft)	---	---	---	0.83	0.69	
Bank Height Ratio*	1.00	1.00	1.01	1.00	<1	

* Base - MY2 calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

Figure 4.11

River Basin	Catawba
Watershed	03050101060030
XS ID	XS 11 (UT 3)
Drainage Area (Acres)	12.80
Date	4/27/2020
Field Crew	AD, MF

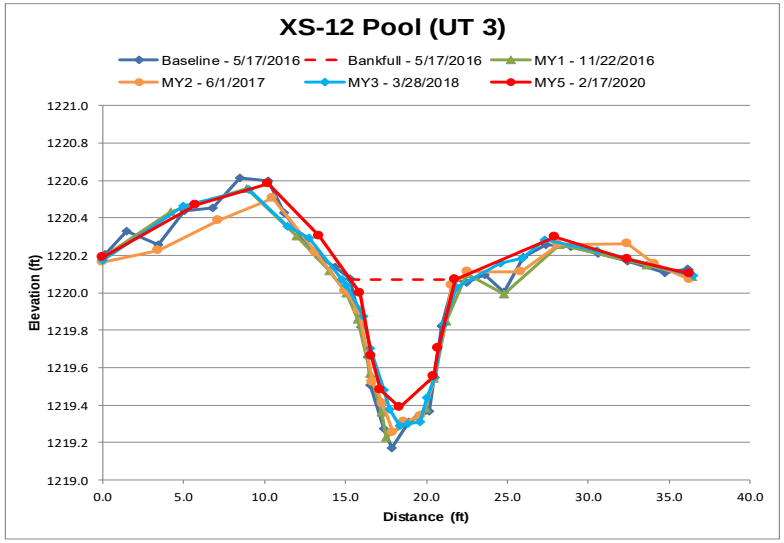


	Cross Section 11 (Riffle)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	6.00	7.28	5.38	6.73	7.22	
Floodprone Width (ft)	175.41	175.41	175.41	175.41	175.41	
Bankfull Mean Depth (ft)	0.36	0.21	0.37	0.24	0.30	
Bankfull Max Depth (ft)	0.69	0.46	0.65	0.57	0.76	
Bankfull Cross Sectional Area (ft^2)	2.19	1.51	2.01	1.62	2.18	
Bankfull Width/Depth Ratio	16.67	34.67	14.54	28.04	24.07	
Bankfull Entrenchment Ratio	29.24	24.09	32.60	26.06	24.3	
Low Bank Height (ft)	---	---	---	0.50	0.85	
Bank Height Ratio*	1.00	1.00	1.00	<1	1.12	

* Base - MY2 calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

Figure 4.12

River Basin	Catawba
Watershed	03050101060030
XS ID	XS 12 (UT 3)
Drainage Area (Acres)	12.80
Date	2/17/2020
Field Crew	AD, MF



	Cross Section 12 (Pool)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Width (ft)	6.39	7.93	7.52	7.99	6.50	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	0.56	0.46	0.45	0.40	0.43	
Bankfull Max Depth (ft)	0.90	0.84	0.82	0.78	0.68	
Bankfull Cross Sectional Area (ft^2)	3.55	3.61	3.40	3.23	2.78	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bank Height Ratio						

Table 8. Baseline Stream Data Summary
Roses Creek Mitigation Site
Roses Creek: 3,200 Lf.

Parameter	Regional Curve		Pre-Existing Condition	Reference - Roses Creek Upstream	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Eq. Mountains	Eq. Piedmont	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	35.00	26.20	41.10	30.50	30.50	31.02	31.98	31.11	33.80	1.58	3.00
Floodprone Width (ft)			78.90	250.00	480.00	394.24	524.76	508.32	671.72	139.47	3.00
Bankfull Mean Depth (ft)	1.80	2.60	1.67	1.88	2.18	2.00	2.19	2.19	2.37	0.19	3.00
Bankfull Max Depth (ft)			2.92	2.71	2.72	2.81	3.26	2.89	4.07	0.71	3.00
Bankfull Cross Sectional Area (ft^2)	66.00	66.10	68.83	57.40	66.40	67.70	69.85	68.21	73.63	3.29	3.00
Width/Depth Ratio			24.60	16.20	14.00	13.09	14.73	14.21	16.90	1.96	3.00
Entrenchment Ratio			1.92	8.20	15.70	12.67	16.45	15.04	21.65	4.65	3.00
Bank Height Ratio			1.80	1.00	1.00	1.00	1.00	1.00	1.00	0.00	3.00
d50 (mm)			61.30	61.30	61.30						
Profile											
Riffle Length (ft)						37.17	64.41	58.40	106.19	18.18	23.00
Riffle Slope (ft/ft)			0.01	0.02	0.03	0.01	0.02	0.02	0.05	0.01	23.00
Pool Length (ft)						17.36	53.01	54.24	93.29	20.18	26.00
Pool Max depth (ft)			4.13	4.70	4.36	3.31	4.50	4.43	6.20	0.80	26.00
Pool Spacing (ft)			37.00 - 171.00	76.9 - 227.9	2.0 - 7.5	86.78	130.47	130.18	210.45	35.20	25.00
Pool Cross Sectional Area (ft^2)											
Pattern											
Channel Beltwidth (ft)			73.00 - 152.00	30.0 - 195.0	61.0 - 195.2						
Radius of Curvature (ft)			28 - 168	30.0 - 178.0	61.0 - 91.5						
Rc: Bankfull Width (ft/ft)			0.7 - 4.1	1.0 - 5.8	2.0 - 3.0						
Meander Wavelength (ft)			200 - 375	60 - 344	61.0 - 344.0						
Meander Width Ratio			1.78 - 3.70	1.0 - 6.4	2.0 - 6.4						
Substrate, bed and transport parameters											
Ri% / P%						35% / 65%					
SC% / Sa% / G% / C% / B% / Be%											
d16 / d35 / d50 / d84 / d95/ d^p / di^{sp} (mm)											
Reach Shear Stress (competency) lb/ft^2											
Max part size (mm) mobilized at bankfull											
Unit Stream Power (transport capacity) lbs/ft.s			3.83		3.83	3.83					
Additional Reach Parameters											
Drainage Area (SM)			5.17	4.66	5.17						
Impervious cover estimate (%)											
Rosgen Classification			B4	C4	C4	C4					
Bankfull Velocity (fps)				5.10	4.80						
Bankfull Discharge (cfs)			300.00	295.00	300.00						
Valley length (ft)			2894.00		2894.00	2894.00					
Channel Thalweg length (ft)			3425.00		3219.00	3219.00					
Sinuosity (ft)			1.18	1.11	1.11	1.11					
Water Surface Slope (Channel) (ft/ft)			0.0099	0.0192	0.0062	0.0059					
BF slope (ft/ft)					0.0062	0.0059					
Bankfull Floodplain Area (acres)											
Proportion over wide (%)											
Entrenchment Class (ER Range)											
Incision Class (BHR Range)											
BEHI VL% / L% / M% / H% / VH% / E%											
Channel Stability or Habitat Metric											
Biological or Other											

Table 8a. Baseline Stream Data Summary
Roses Creek Mitigation Site
UT 1 to Roses Creek: 234 LF

Parameter	Regional Curve		Pre-Existing Condition	Reference - UT West Branch Rocky River	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Eq. Mountains	Eq. Piedmont	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	6.70	5.30	6.00	4.40	5.00	5.12	5.12	5.12	5.12	0.00	1.00
Floodprone Width (ft)			8.40	27.50	60.00	91.80	91.80	91.80	91.80	0.00	1.00
Bankfull Mean Depth (ft)	0.50	0.70	0.23	0.51	0.38	0.45	0.45	0.45	0.45	0.00	1.00
Bankfull Max Depth (ft)			0.36	1.00	0.58	0.78	0.78	0.78	0.78	0.00	1.00
Bankfull Cross Sectional Area (ft^2)	3.20	3.30	1.39	2.30	2.10	2.30	2.30	2.30	2.30	0.00	1.00
Width/Depth Ratio			26.20	12.80	13.00	11.38	11.38	11.38	11.38	0.00	1.00
Entrenchment Ratio			1.40	6.28	12.00	17.93	17.93	17.93	17.93	0.00	1.00
Bank Height Ratio			6.11	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
d50 (mm)											
Profile											
Riffle Length (ft)						7.20	10.60	9.60	17.00	2.91	12.00
Riffle Slope (ft/ft)			0.0260	0.0033 - 0.0284	0.0021 - 0.0029	0.0201	0.0265	0.0213	0.0799	0.0210	12.00
Pool Length (ft)						3.60	11.89	9.80	37.39	9.23	11.00
Pool Max depth (ft)			Channelized	1.98	0.77	0.49	0.73	0.77	0.96	0.19	11.00
Pool Spacing (ft)			Channelized	10.10 - 41.0	10.0 - 30.0	18.40	24.04	20.90	45.59	8.03	10.00
Pool Cross Sectional Area (ft^2)											
Pattern											
Channel Beltwidth (ft)			Channelized	12.00 - 18.00	10.00 - 30.00						
Radius of Curvature (ft)			Channelized	10.00 - 14.00	12.00 - 15.00						
Rc: Bankfull Width (ft/ft)			Channelized	2.30 - 3.20	2.40 - 3.00						
Meander Wavelength (ft)			Channelized	45.00 - 66.00	20.0 - 55.0						
Meander Width Ratio			Channelized	2.74 - 4.11	2.00 - 6.00						
Substrate, bed and transport parameters											
Ri% / P%						49% / 51%					
SC% / Sa% / G% / C% / B% / Be%											
d16 / d35 / d50 / d84 / d95/ di^p / di^{sp} (mm)											
Reach Shear Stress (competency) lb/ft^2											
Max part size (mm) mobilized at bankfull											
Unit Stream Power (transport capacity) lbs/ft.s			0.07		0.07	0.07					
Additional Reach Parameters											
Drainage Area (SM)			0.06	0.07	0.06						
Impervious cover estimate (%)											
Rosgen Classification			F5	C5	C5	C5					
Bankfull Velocity (fps)				1.30	1.10						
Bankfull Discharge (cfs)			2.4	3.00	2.40						
Valley length (ft)			199.00		199.00	199.00					
Channel Thalweg length (ft)			199.00		234.00	234.00					
Sinuosity (ft)			1.00	1.16	1.18	1.18					
Water Surface Slope (Channel) (ft/ft)			0.0260	0.0033 - 0.0284	0.0021	0.0027					
BF slope (ft/ft)					0.0021	0.0027					
Bankfull Floodplain Area (acres)											
Proportion over wide (%)											
Entrenchment Class (ER Range)											
Incision Class (BHR Range)											
BEHI VL% / L% / M% / H% / VH% / E%											
Channel Stability or Habitat Metric											
Biological or Other											

Table 8b. Baseline Stream Data Summary
Roses Creek Mitigation Site
UT 2 to Roses Creek: 707 LF

Parameter	Regional Curve		Pre-Existing Condition	Reference - UT West Branch Rocky River	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Mountains Eq.	Piedmont Eq.	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	7.10	5.60	4.40	4.40	5.00	6.70	6.70	6.70	6.70	0.00	1.00
Floodprone Width (ft)			8.10	27.50	60.00	32.45	32.45	32.45	32.45	0.00	1.00
Bankfull Mean Depth (ft)	0.50	0.80	0.95	0.51	0.38	0.42	0.42	0.42	0.42	0.00	1.00
Bankfull Max Depth (ft)			1.39	1.00	0.58	0.77	0.77	0.77	0.77	0.00	1.00
Bankfull Cross Sectional Area (ft^2)	3.50	3.70	4.16	2.30	2.10	2.79	2.79	2.79	2.79	0.00	1.00
Width/Depth Ratio			4.60	12.80	13.00	15.95	15.95	15.95	15.95	0.00	1.00
Entrenchment Ratio			1.84	6.28	12.00	4.84	4.84	4.84	4.84	0.00	1.00
Bank Height Ratio			1.70	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
d50 (mm)											
Profile											
Riffle Length (ft)						4.27	13.94	13.33	31.46	6.12	23.00
Riffle Slope (ft/ft)			0.0260	0.0033 - 0.0284	0.0021 - 0.0030	0.0020	0.0025	0.0025	0.0038	0.0006	23.00
Pool Length (ft)						3.73	10.18	8.00	27.19	5.71	24.00
Pool Max depth (ft)			Channelized	1.98	0.77	0.53	0.96	0.92	1.59	0.24	24.00
Pool Spacing (ft)			Channelized	10.10 - 41.00	10.0 - 30.00	7.46	25.57	22.39	57.59	11.77	23.00
Pool Cross Sectional Area (ft^2)											
Pattern											
Channel Beltwidth (ft)			Channelized	12.00 - 18.00	13.70 - 30.00						
Radius of Curvature (ft)			Channelized	10.00 - 14.00	12.00 - 16.00						
Rc: Bankfull Width (ft/ft)			Channelized	2.30 - 3.20	2.40 - 3.20						
Meander Wavelength (ft)			Channelized	45.00 - 66.00	20.00 - 75.50						
Meander Width Ratio			Channelized	2.74 - 4.11	2.70 - 6.00						
Substrate, bed and transport parameters											
Ri% / P%						58% / 42%					
SC% / Sa% / G% / C% / B% / Be%											
d16 / d35 / d50 / d84 / d95/ d^2 / di^{sp} (mm)											
Reach Shear Stress (competency) lb/ft^2											
Max part size (mm) mobilized at bankfull											
Unit Stream Power (transport capacity) lbs/ft.s			0.89		0.06	0.06					
Additional Reach Parameters											
Drainage Area (SM)			0.07	0.07	0.07						
Impervious cover estimate (%)											
Rosgen Classification			G5	C5	C5	C5					
Bankfull Velocity (fps)				1.30	1.10						
Bankfull Discharge (cfs)			2.40	3.00	2.40						
Valley length (ft)			575.00		575.00	575.00					
Channel Thalweg length (ft)			575.00		707.00	707.00					
Sinuosity (ft)			1.00	1.16	1.99	1.23					
Water Surface Slope (Channel) (ft/ft)			0.0260	0.0033 - 0.0284	0.0021	0.0023					
BF slope (ft/ft)					0.0021	0.0023					
Bankfull Floodplain Area (acres)											
Proportion over wide (%)											
Entrenchment Class (ER Range)											
Incision Class (BHR Range)											
BEHI VL% / L% / M% / H% / VH% / E%											
Channel Stability or Habitat Metric											
Biological or Other											

Table 8c. Baseline Stream Data Summary
Roses Creek Mitigation Site
UT 3 to Roses Creek: 620 LF

Parameter	Regional Curve		Pre-Existing Condition	Reference - UT West Branch Rocky River	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Mountains Eq.	Piedmont Eq.	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	4.50	3.50	5.00	4.40	5.50	6.00	6.00	6.00	6.00	0.00	1
Floodprone Width (ft)			44.13	27.50	70.00	175.41	175.41	175.41	175.41	0.00	1
Bankfull Mean Depth (ft)	0.30	0.30	0.26	0.51	0.42	0.36	0.36	0.36	0.36	0.00	1
Bankfull Max Depth (ft)			1.70	1.00	0.63	0.69	0.69	0.69	0.69	0.00	1
Bankfull Cross Sectional Area (ft^2)	1.50	1.60	2.40	2.30	2.60	2.19	2.19	2.19	2.19	0.00	1
Width/Depth Ratio			12.23	12.80	13.10	16.67	16.67	16.67	16.67	0.00	1
Entrenchment Ratio			9.52	6.28	12.70	29.24	29.24	29.24	29.24	0.00	1
Bank Height Ratio			3.33	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1
d50 (mm)											
Profile											
Riffle Length (ft)						4.0	13.7	11.1	46.1	9.2	20
Riffle Slope (ft/ft)			0.0295	0.0033 - 0.0284	0.0029 - 0.0045	0.0025	0.0030	0.0030	0.0035	0.0004	20
Pool Length (ft)						3.2	12.1	8.1	34.6	9.0	20
Pool Max depth (ft)			Channelized	1.98	0.84	0.76	1.49	1.29	2.61	0.61	20
Pool Spacing (ft)			Channelized	10.10 - 41.00	12.7 - 51.70	10.3	25.0	25.8	45.3	9.4	19
Pool Cross Sectional Area (ft^2)											
Pattern											
Channel Beltwidth (ft)			Channelized	12.00 - 18.00	15.10 - 49.50						
Radius of Curvature (ft)			Channelized	10.00 - 14.00	12.70 - 17.60						
Rc: Bankfull Width (ft/ft)			Channelized	2.30 - 3.20	2.30 - 3.20						
Meander Wavelength (ft)			Channelized	45.00 - 66.00	15.10 - 83.10						
Meander Width Ratio			Channelized	2.74 - 4.11	2.70 - 9.00						
Substrate, bed and transport parameters											
Ri% / P%						53% / 47%					
SC% / Sa% / G% / C% / B% / Be%											
d16 / d35 / d50 / d84 / d95/ d^2 / di^{sp} (mm)											
Reach Shear Stress (competency) lb/ft^2											
Max part size (mm) mobilized at bankfull											
Unit Stream Power (transport capacity) lbs/ft.s			0.09		0.08	0.08					
Additional Reach Parameters											
Drainage Area (SM)			0.02	0.07	0.02						
Impervious cover estimate (%)											
Rosgen Classification			B5	C5	C5	C5					
Bankfull Velocity (fps)				1.30	1.00						
Bankfull Discharge (cfs)			2.6	3.0	2.6						
Valley length (ft)			422		422	422					
Channel Thalweg length (ft)			422		620	620					
Sinuosity (ft)			1.00	1.16	1.47	1.47					
Water Surface Slope (Channel) (ft/ft)			0.0268	0.0033 - 0.0284	0.0025	0.0037					
BF slope (ft/ft)					0.0025	0.0037					
Bankfull Floodplain Area (acres)											
Proportion over wide (%)											
Entrenchment Class (ER Range)											
Incision Class (BHR Range)											
BEHI VL% / L% / M% / H% / VH% / E%											
Channel Stability or Habitat Metric											
Biological or Other											

Table 9. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)
Roses Creek Mitigation Site
Roses Creek: 3,200 LF

	Cross Section 1 (Riffle)								Cross Section 2 (Pool)							
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Based on fixed baseline bankfull elevation																
Bankfull Width (ft)	33.80	31.10	30.73	29.98		29.94			38.53	37.04	39.49	30.03		25.64		
Floodprone Width (ft)	508.32	508.32	508.32	508.32		508.32										
Bankfull Mean Depth (ft)	2.00	2.20	2.19	2.18		2.02			1.73	1.75	1.65	1.96		2.24		
Bankfull Max Depth (ft)	2.81	2.89	3.01	3.35		3.47			3.47	3.80	4.05	4.02		4.32		
Bankfull Cross Sectional Area (ft^2)	67.70	68.28	67.22	65.27		60.43			66.48	64.97	65.02	58.79		57.56		
Bankfull Width/Depth Ratio	16.90	14.14	14.03	13.75		14.82										
Bankfull Entrenchment Ratio	15.04	16.35	16.54	16.96		16.98										
Low Bank Height (ft)				3.44		3.60										
Bank Height Ratio*	1.00	1.00	1.00	1.00		1.00										
	Cross Section 3 (Pool)								**Cross Section 4 (Riffle)**							
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Based on fixed baseline bankfull elevation																
Bankfull Width (ft)	32.44	31.58	32.26	32.20		32.28			31.11	31.66	31.03	32.35		32.12		
Floodprone Width (ft)									696.00	696.00	696.00	696.00		696.00		
Bankfull Mean Depth (ft)	2.19	2.32	2.07	2.03		2.00			2.19	2.16	2.08	2.12		2.63		
Bankfull Max Depth (ft)	4.10	3.99	4.09	4.13		4.68			2.89	3.03	2.80	3.20		4.37		
Bankfull Cross Sectional Area (ft^2)	71.10	73.39	66.76	65.48		64.54			68.21	68.41	64.61	71.47		84.41		
Bankfull Width/Depth Ratio									14.21	14.66	14.92	14.64		12.21		
Bankfull Entrenchment Ratio									22.37	21.98	22.43	21.51		21.67		
Low Bank Height (ft)												3.38		4.42		
Bank Height Ratio*									1.00	1.00	1.00	1.06		1.15		
	Cross Section 5 (Riffle)								**Cross Section 6 (Pool)**							
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Based on fixed baseline bankfull elevation																
Bankfull Width (ft)	32.56	32.99	34.06	36.04		30.66			31.02	31.30	30.99	29.70		29.46		
Floodprone Width (ft)	563.60	563.60	563.60	563.60		563.60										
Bankfull Mean Depth (ft)	2.13	2.25	2.22	2.37		1.90			2.37	2.23	2.32	2.69		2.56		
Bankfull Max Depth (ft)	3.16	3.23	3.29	3.73		2.80			4.07	3.98	4.11	4.36		4.37		
Bankfull Cross Sectional Area (ft^2)	69.41	74.12	75.52	85.30		58.11			73.63	69.77	71.83	80.01		75.54		
Bankfull Width/Depth Ratio	15.29	14.66	15.34	15.21		16.14										
Bankfull Entrenchment Ratio	17.31	17.08	16.55	15.64		18.38										
Low Bank Height (ft)				3.69		2.80										
Bank Height Ratio*	1.00	1.00	1.00	<1		<1										

* Base - MY2 calculated by holding bankfull elevation constant. MY3 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

Table 9a. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)
Roses Creek Mitigation Site
UT 1 Roses Creek: 234 LF

	Cross Section 7 (Riffle)								Cross Section 8 (Pool)							
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Based on fixed baseline bankfull elevation																
Bankfull Width (ft)	5.12	4.46	5.31	5.01		5.38			6.24	7.07	6.80	7.49		6.30		
Floodprone Width (ft)	91.80	91.80	91.80	91.80		91.80										
Bankfull Mean Depth (ft)	0.45	0.41	0.35	0.36		0.26			0.58	0.44	0.47	0.42		0.40		
Bankfull Max Depth (ft)	0.78	0.59	0.61	0.62		0.74			0.96	0.77	0.81	0.71		0.70		
Bankfull Cross Sectional Area (ft^2)	2.30	1.82	1.86	1.78		1.4			3.64	3.10	3.23	3.12		2.50		
Bankfull Width/Depth Ratio	11.38	10.88	15.17	13.92		20.69										
Bankfull Entrenchment Ratio	17.93	20.58	17.29	18.32		17.05										
Low Bank Height (ft)				0.57		0.79										
Bank Height Ratio*	1.00	1.00	1.00	<1		<1										

* Base - MY2 calculated by holding bankfull elevation constant. MY3 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

Table 9b. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)
Roses Creek Mitigation Site
UT2 Roses Creek: 707 LF

	Cross Section 9 (Pool)								Cross Section 10 (Riffle)							
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Based on fixed baseline bankfull elevation																
Bankfull Width (ft)	5.56	6.43	5.69	5.53		2.37			6.70	7.10	6.79	7.38		5.18		
Floodprone Width (ft)									93.36	93.36	93.36	93.36		93.36		
Bankfull Mean Depth (ft)	0.37	0.31	0.33	0.49		0.53			0.42	0.38	0.32	0.39		0.24		
Bankfull Max Depth (ft)	0.86	0.72	0.63	1.12		0.73			0.77	0.74	0.64	0.84		0.66		
Bankfull Cross Sectional Area (ft^2)	2.07	1.97	1.90	2.73		1.26			2.79	2.69	2.17	2.88		1.23		
Bankfull Width/Depth Ratio									16.75	18.68	21.22	18.92		21.58		
Bankfull Entrenchment Ratio									13.93	13.14	13.75	12.65		18.03		
Low Bank Height (ft)												0.83		0.69		
Bank Height Ratio*									1.00	1.00	1.01	1.00		<1		

* Base - MY2 calculated by holding bankfull elevation constant. MY3 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

Table 9c. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)

Roses Creek Mitigation Site

UT3 Roses Creek: 620 LF

	Cross Section 11 (Riffle)								Cross Section 12 (Pool)							
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Based on fixed baseline bankfull elevation																
Bankfull Width (ft)	6.00	7.28	5.38	6.73		7.22			6.39	7.93	7.52	7.99		6.50		
Floodprone Width (ft)	175.41	175.41	175.41	175.41		175.41										
Bankfull Mean Depth (ft)	0.36	0.21	0.37	0.24		0.30			0.56	0.46	0.45	0.40		0.43		
Bankfull Max Depth (ft)	0.69	0.46	0.65	0.57		0.76			0.90	0.84	0.82	0.78		0.68		
Bankfull Cross Sectional Area (ft^2)	2.19	1.51	2.01	1.62		2.18			3.55	3.61	3.40	3.23		2.78		
Bankfull Width/Depth Ratio	16.67	34.67	14.54	28.04		24.07										
Bankfull Entrenchment Ratio	29.24	24.09	32.60	26.06		24.30										
Low Bank Height (ft)				0.5		0.85										
Bank Height Ratio*	1.00	1.00	1.00	<1		1.12										

* Base - MY2 calculated by holding bankfull elevation constant. MY3 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

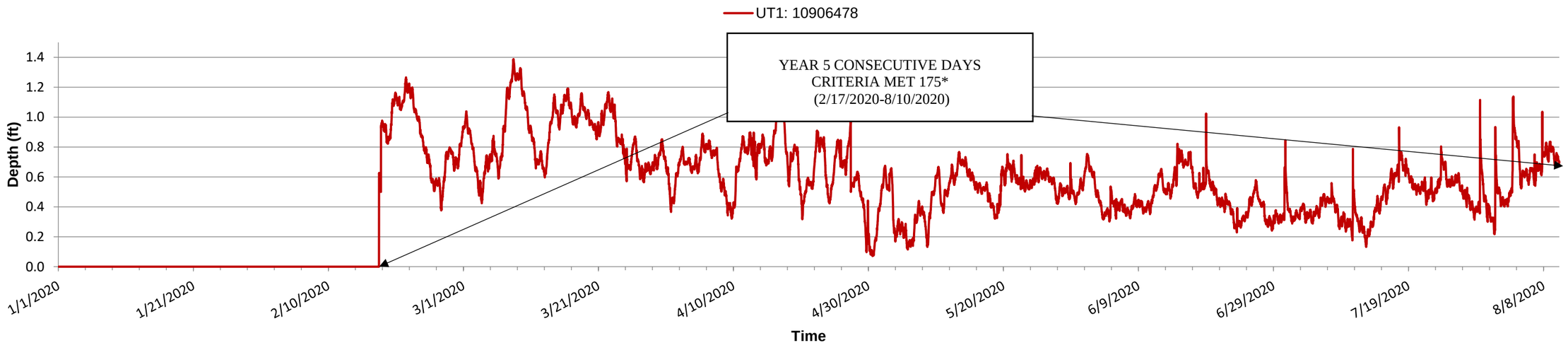
Appendix E. Hydrologic Data

Table 10. Verification of Bankfull Events

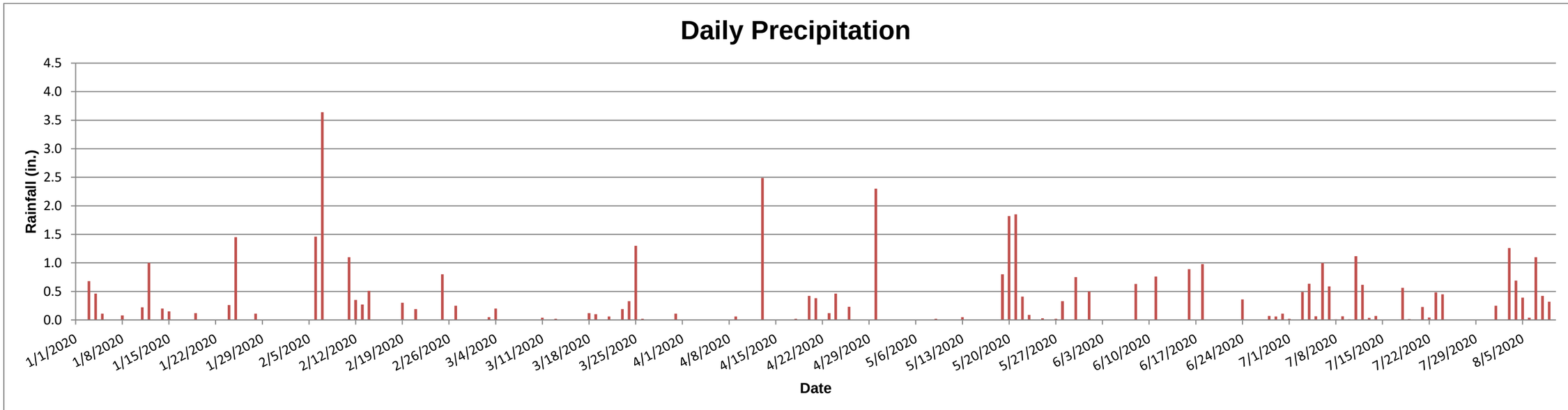
Date	Crest Gauge Info		Gauge Reading (ft)	Gauge Elevation (ft)	Crest Elevation (ft)	Bankfull Elevation (ft)	Height above Bankfull (ft)	Photo
	Site	Sta.						
10/5/2016	1	Roses Creek Lower	0.00	1212.11	N/A	1213.93	N/A	5.1
10/5/2016	2	UT 1	0.00	1267.45	N/A	1267.95	N/A	5.2
10/5/2016	3	UT 2	0.35	1227.81	1228.16	1228.19	N/A	5.3
10/5/2016	4	UT 3	0.25	1216.94	1217.19	1217.36	N/A	5.4
11/22/2016	1	Roses Creek Lower	0.00	1212.11	N/A	1213.93	N/A	5.5
11/22/2016	2	UT 1	0.00	1267.45	N/A	1267.95	N/A	5.6
11/22/2016	3	UT 2	0.00	1227.81	N/A	1228.19	N/A	5.7
11/22/2016	4	UT 3	0.35	1216.94	1217.29	1217.36	N/A	5.8
6/2/2017	1	Roses Creek Lower	1.89	1212.11	1214.00	1213.93	0.07	5.9
6/2/2017	2	UT 1	0.80	1267.45	1268.25	1267.95	0.30	5.10
6/2/2017	3	UT 2	1.50	1227.81	1229.31	1228.19	1.12	5.11
6/2/2017	4	UT 3	1.80	1216.94	1218.74	1217.36	1.38	5.12
8/15/2017	1	Roses Creek Lower	0.50	1212.11	1212.61	1213.93	N/A	5.13
8/15/2017	2	UT 1	0.38	1267.45	1267.83	1267.95	N/A	5.14
8/15/2017	3	UT 2	0.85	1227.81	1228.66	1228.19	0.47	5.15
8/15/2017	4	UT 3	1.64	1216.94	1218.58	1217.36	1.22	5.16
3/28/2018	1	Roses Creek Lower	2.83	1212.11	1214.94	1213.93	1.01	5.17
3/28/2018	2	UT 1	0.38	1267.45	1267.83	1267.95	N/A	5.18
3/28/2018	3	UT 2	2.50	1227.81	1230.31	1228.19	2.12	5.19
3/28/2018	4	UT 3	1.38	1216.94	1218.32	1217.36	0.96	5.20
8/6/2018	1	Roses Creek Lower	3.75	1212.11	1215.86	1213.93	1.93	5.21
8/6/2018	2	UT 1	1.13	1267.45	1268.58	1267.95	0.63	5.22
8/6/2018	3	UT 2	2.54	1227.81	1230.35	1228.19	2.16	5.23
8/6/2018	4	UT 3	2.92	1216.94	1219.86	1217.36	2.50	5.24
1/29/2019	1	Roses Creek Lower	2.68	1212.11	1214.79	1213.93	0.86	5.25
1/29/2019	2	UT 1	0.67	1267.45	1268.12	1267.95	0.17	5.26
1/29/2019	3	UT 2	3.83	1227.81	1231.64	1228.19	3.45	5.27
1/29/2019	4	UT 3	3.75	1216.94	1220.69	1217.36	3.33	5.28

Figure 5.1 – 5.3 Tributary Water Level Gauge Meter Data

Figure 5.1 UT 1 Water Level



Daily Precipitation



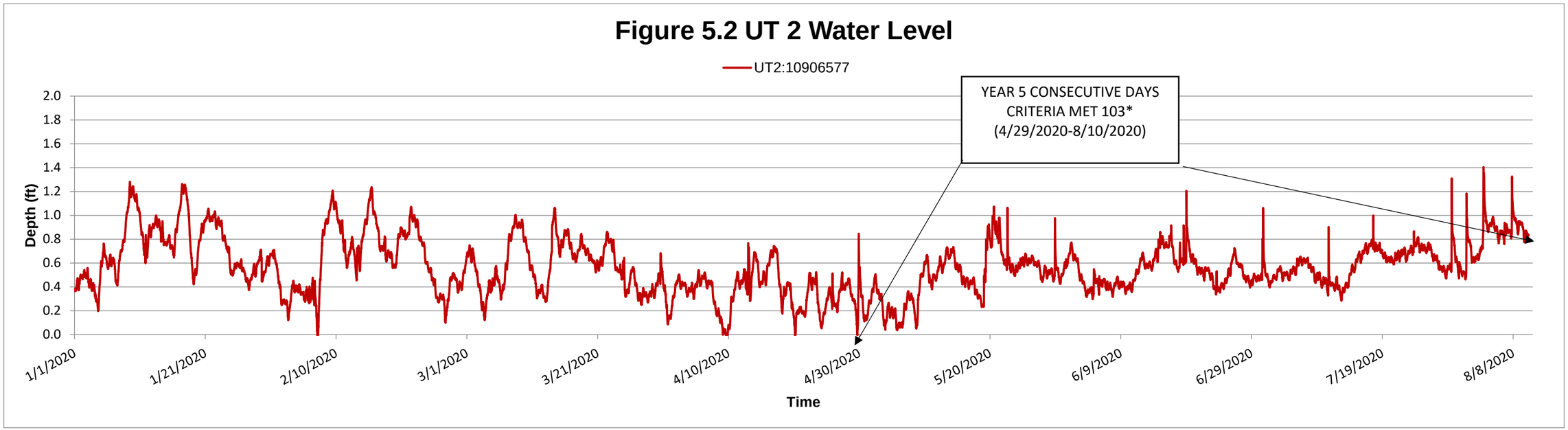


Figure 5.2 UT 2 Water Level
UT2:10906577
YEAR 5 CONSECUTIVE DAYS
CRITERIA MET 103*
(4/29/2020-8/10/2020)
Depth (ft)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/2020
1/21/2020
2/10/2020
3/1/2020
3/21/2020
4/10/2020
4/30/2020
5/20/2020
6/9/2020
6/29/2020
7/19/2020
8/8/2020
Time

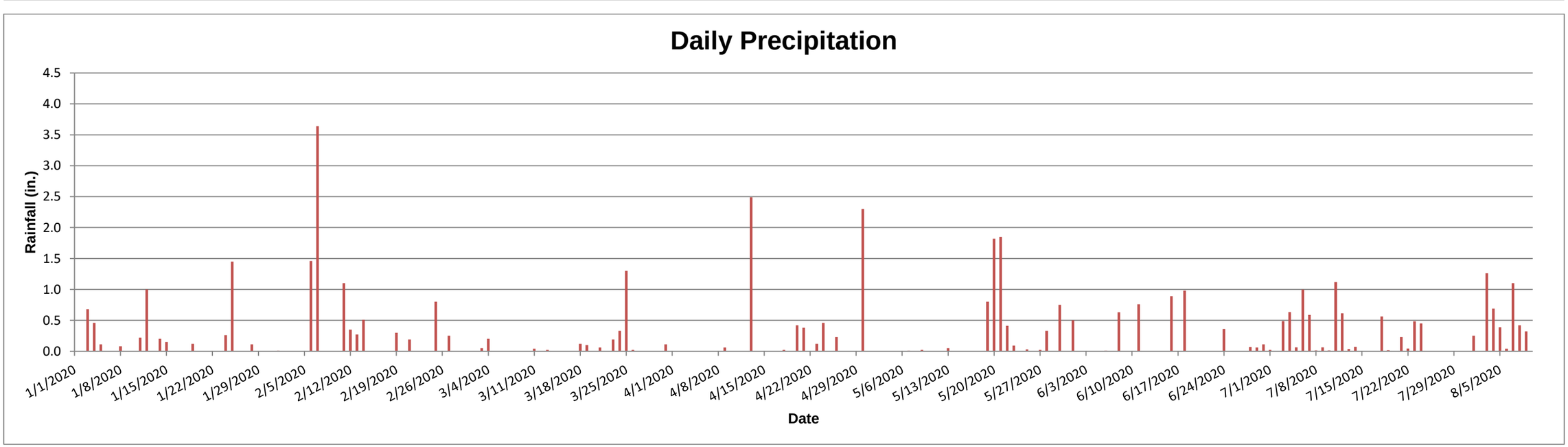
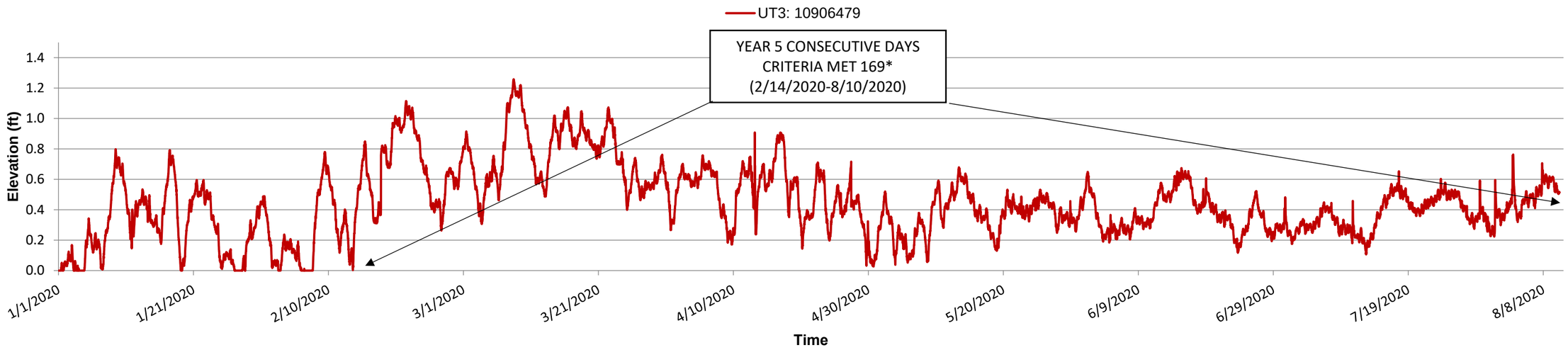

Daily Precipitation
Rainfall (in.)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/2020
1/8/2020
1/15/2020
1/22/2020
1/29/2020
2/5/2020
2/12/2020
2/19/2020
2/26/2020
3/4/2020
3/11/2020
3/18/2020
3/25/2020
4/1/2020
4/8/2020
4/15/2020
4/22/2020
4/29/2020
5/6/2020
5/13/2020
5/20/2020
5/27/2020
6/3/2020
6/10/2020
6/17/2020
6/24/2020
7/1/2020
7/8/2020
7/15/2020
7/22/2020
7/29/2020
8/5/2020
Date

Figure 5.3 UT 3 Water Level



Daily Precipitation

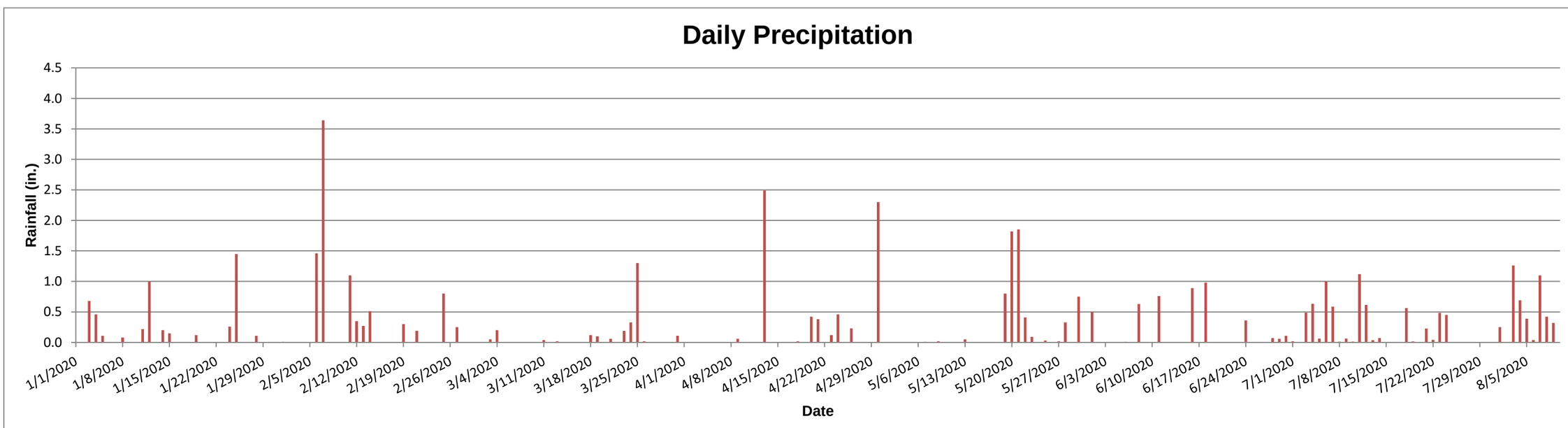


Table 11. Tributary Surface Water Summary

Tributary	Dates	Number of Consecutive Days with Flow
UT 1	6/25/2016 - 7/27/2016	32
UT 1	2/25/2017 - 5/6/2017	70
UT 1	6/1/2017 - 8/14/2017	74
UT 1	1/12/2018 – 3/1/2018	48
UT 1	5/15/2018 – 8/6/2018	83
UT 1	2/17/2020 – 4/26/2020	69
UT 1	4/27/2020 – 8/10/2020	105
UT 2	6/9/2016 - 1/22/2017	228
UT 2	1/23/2017 - 5/11/2017	108
UT 2	6/1/2017 – 7/26/2017	55
UT 2	8/30/2017 – 10/3/2017	34
UT 2	11/18/2017 – 3/20/2018	122
UT 2	4/19/2018 – 8/6/2018	109
UT 2	1/1/2020 – 2/7/2020	37
UT 2	2/7/2020 – 4/9/2020	62
UT2	4/29/2020-8/10/2020	103
UT 3	2/15/2017 – 5/11/2017	85
UT 3	6/1/2017 – 7/23/2017	52
UT 3	12/14/2017 – 3/1/2018	77
UT 3	4/27/2018 – 7/22/2018	86
UT 3	2/14/2020 – 8/10/2020	169

Appendix F. IRT Meeting Minutes (08/27/2019)

Meeting Minutes

Project:	Roses Creek Stream Mitigation Site (DMS # 96309)	
Subject:	IRT Credit Release Meeting	
Date:	Tuesday, August 27, 2019	
Location:	Burke County	
Attendees:	Todd Tugwell (USACE)	Kim Browning (USACE)
	Mac Haupt (DWR)	Erin Davis (DWR)
	Paul Wiesner (DMS)	Harry Tsomides (DMS)
	Tim Baumgartner (DMS)	Melonie Allen (DMS)
	Joe Famularo (DMS)	Ryan Smith (HDR)
	Chris Smith (HDR)	

The IRT Credit Release Meeting for the Roses Creek Stream Mitigation Site was held at 9:00 AM on Tuesday, August 27, 2019 at the project site in Burke County. The following represents highlights of discussions that occurred during the site visit:

1. Chris Smith provided a synopsis of the project site to begin the meeting.
2. The IRT expressed concern over the following items at this stage in monitoring (year 4):
    a. Vegetation.
        i. 2 vegetation plots along UT 1 are not currently meeting success criteria
            1. Supplemental planting occurred during 2018.
        ii. Invasive Plants: Privet has been treated along UT 1 multiple times this year but no measures were taken prior to 2019.
    b. Repair areas along Roses Creek.
    c. Tributary discharge and maintenance of single thread channel as opposed to wetland complex.

Site Walk

1. Discussion regarding the current condition of the tributaries. UT 2 and UT 3 are the tributaries of concern:
    a. HDR observed that the monitoring cross sections for the tributaries do not show aggradation or significant alteration in cross sectional dimension.

b. HDR observed that the flow gauge data indicates all the tributaries meet performance standard requirements.
c. There is flow through the restored channels, however, there is also water flowing in the floodplains of UT 2 and UT 3.
d. Dense, low growing vegetation (juncus/carex/salix/polygonum) is prevalent along several reaches of UT 2 and UT 3's channel side slopes and floodplain. The IRT expressed concern that vegetation is constricting channel flow and could in the future cause enough aggradation within the channels to the point that they function as a linear wetland rather than the channel functioning as a stream. HDR reiterated that monitoring cross-sectional data confirms that the channel is maintaining its dimension even though the vegetation is admittedly dense which restricts the ability to visually identify sections of existing bed and bank within some restored channel reaches.
e. Some sediment entered the upstream extent of UT 2 due to a soil access road that had not been stabilized immediately following construction completion. The road is now stabilized, however there is still sediment that is slowly being mobilized downstream.
f. The IRT indicated that stream reaches proposed for stream mitigation credit should function as streams and be considered jurisdictional streams by the regulatory agencies at project closeout. The IRT noted that stream channels that are determined to be non-jurisdictional will not be eligible to receive stream mitigation credit. The IRT suggested documenting stream conditions with photos and videos during winter when plants are dormant in an effort to more clearly identify the channel bed and bank. The IRT noted that there has been allowances for providers to maintain vegetation on channel banks through the first two monitoring years. They did not recommend this for this site during the visit, but noted it as a potential tool for future sites.
g. There was discussion during the site walk on if flow gauges should be moved further upstream compared with their current locations. At the end of the walk it was determined that the tributaries appear to display sufficient flow and that it may not be necessary to relocate flow gauges.

2. Continued treatment of invasives including but not limited to privet and multi-flora rose is necessary though project closeout.
3. Vegetation on UT 1 was a concern prior to the site walk due to low survival rates within monitoring plots as noted in the monitoring report. However, during the site walk woody vegetation was noted to be dense along UT 1, displaying healthy vigor and survivability. HDR will review monitoring plots to determine if monitored vegetation within the plots is accurate and/or if vegetation with the plots is representative of survivability along UT 1 and will detail the information in the MY4 (2019) report.
4. Beaver have entered the site near the downstream terminus of restoration on Roses Creek (have built one dam and began a second). The IRT noted that beaver management should begin and removal of the dam is necessary. Beaver inspection, management and dam removal should be completed until project closeout.
    a. *NOTE: As of September 11, 2019 the beaver dams have been removed and an eradication program has begun through a contract with the USDA APHIS.*
5. The IRT noted that overall the site is functioning well (both streams, repairs from storm events and vegetation). The IRT noted issues on both UT 2 and UT 3 that have potential credit

implications. The IRT was willing to release stream credits for MY3 (2018) as long as the remaining amount of unreleased credits exceeded the potential stream credits associated with both UT2 and UT3. The IRT indicated that they would review the MY4 report and any supplemental data provided and discuss the project and additional project credit release at the 2020 IRT credit release meeting.

6. The IRT noted that HDR should document any adaptive management measures and discuss measures during the credit release meeting in April 2020. Any significant adaptive management must be pre-approved by the IRT before implementation.

-----Original Message-----
From: Tugwell, Todd J CIV USARMY CESAW (US) [mailto:Todd.J.Tugwell@usace.army.mil]
Sent: Monday, September 23, 2019 10:07 AM
To: Wiesner, Paul <paul.wiesner@ncdenr.gov>
Cc: Davis, Erin B <erin.davis@ncdenr.gov>
Subject: [External] FW: Roses Creek_DMS# 96309: IRT Credit Release Site Visit (8-27-19) Meeting Minutes

CAUTION: External email. Do not click links or open attachments unless you verify. Send all suspicious email as an attachment to report.spam@nc.gov<mailto:report.spam@nc.gov>

Paul, see below.
Thanks,
Todd

-----Original Message-----
From: Tugwell, Todd J CIV USARMY CESAW (US)
Sent: Friday, September 20, 2019 1:07 PM
To: 'Davis, Erin B' <erin.davis@ncdenr.gov>; Haupt, Mac <mac.haupt@ncdenr.gov>; Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Subject: RE: Roses Creek_DMS# 96309: IRT Credit Release Site Visit (8-27-19) Meeting Minutes

Paul, just a couple comments:
1. under the site walk, 1.f., I would stress that we do not want vegetation manipulation along the channel on this project, not that is just not recommended.
2. I believe we noted some evidence of livestock within the buffer that should be noted in the minutes.
Thanks,
Todd

-----Original Message-----
From: Davis, Erin B [mailto:erin.davis@ncdenr.gov]
Sent: Thursday, September 19, 2019 8:59 AM
To: Tugwell, Todd J CIV USARMY CESAW (US) <Todd.J.Tugwell@usace.army.mil>; Haupt, Mac <mac.haupt@ncdenr.gov>; Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Subject: [Non-DoD Source] RE: Roses Creek_DMS# 96309: IRT Credit Release Site Visit (8-27-19) Meeting Minutes

These meeting minutes generally reflect my field notes with the noticeable omission of the evidence of cattle present along UT1. Also, I had noted that sections of the adjacent fencing connected to the easement area could use reinforcement (areas that were down and allowed us to cross) and it's recommended HDR notify the landowner.

Erin B. Davis, PWS

Stream & Wetland Mitigation Specialist

401 & Buffer Permitting Branch

Division of Water Resources

Department of Environmental Quality

919-707-3684 office

erin.davis@ncdenr.gov <mailto:erin.davis@ncdenr.gov>

From: Wiesner, Paul
Sent: Friday, September 13, 2019 10:48 AM
To: Tugwell, Todd J CIV USARMY CESAW (US) <Todd.J.Tugwell@usace.army.mil>; Haupt, Mac <mac.haupt@ncdenr.gov>; Davis, Erin B <erin.davis@ncdenr.gov>; Kim Browning <Kimberly.D.Browning@usace.army.mil>
Cc: Smith, Ryan <Ryan.V.Smith@hdrinc.com>; Smith, Christopher <Christopher.L.Smith@hdrinc.com>; Allen, Melonie <melonie.allen@ncdenr.gov>; Famularo, Joseph T <Joseph.Famularo@ncdenr.gov>; Baumgartner, Tim <tim.baumgartner@ncdenr.gov>; Tsomides, Harry <harry.tsomides@ncdenr.gov>
Subject: Roses Creek_DMS# 96309: IRT Credit Release Site Visit (8-27-19) Meeting Minutes

All:

The meeting minutes from the August 27, 2019 Roses Creek IRT credit release site visit are attached for your review.

Please let us know if you have any additional comments, questions or concerns.

Chris and Ryan,

Please include the final meeting minutes (including any additional IRT comments) in the MY4 report as an Appendix.

Thanks

Paul Wiesner

Western Regional Supervisor

North Carolina Department of Environmental Quality

Division of Mitigation Services

828-273-1673 Mobile

paul.wiesner@ncdenr.gov <mailto:paul.wiesner@ncdenr.gov>

Western DMS Field Office

5 Ravenscroft Drive

Suite 102

Asheville, N.C. 28801