Year 1 Monitoring Report

FINAL

Greenbrier Stream Mitigation Project

Yadkin County, North Carolina

Monitoring Year 1

Data Collection Period:	**Submission Date:**
October 2020	November 2020

NCDEQ Contract No. 7616
DMS ID No. 100086
USACE Action ID No. SAW-2018-01755
NCDWR ID: 20181272
Yadkin River Basin
HUC 03040101

Prepared For:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27603

Prepared By:

Ecosystem Planning and Restoration
1150 SE Maynard Road, Suite 140
Cary, NC 27511

Mitigation Project Name	**Greenbrier Stream Restoration Site**	**USACE Action ID**	**2018-01755**
DMS ID	**100086**	**DWR Permit**	**2018-1272**
River Basin	**Yadkin**	**Date Project Instituted**	**6/27/2018**
Cataloging Unit	**03040101**	**Stream/Wet. Service Area**	**Yadkin 03040101**
County	**Yadkin**	**Date Printed**	**8/4/2020**

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Digitally signed by BROWNING.KIMBERLY.DANIELLE.1527683510
Date: 2020.09.10 10:13:47 -04'00'

Signature of Official Approving Credit Release

Credit Release Milestone	**Warm Stream Credits**						
Project Credits	**Scheduled Releases %**	**Estimated Scheduled Release #**	**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%	724.044	724.044	0.000	724.044	2020	8/4/2020
3 - Year 1 Monitoring	10.00%	241.348				2021	
4 - Year 2 Monitoring	10.00%	241.348				2022	
5 - Year 3 Monitoring	10.00%	241.348				2023	
6 - Year 4 Monitoring	5.00%	120.674				2024	
7 - Year 5 Monitoring	10.00%	241.348				2025	
8 - Year 6 Monitoring	5.00%	120.674				2026	
9 - Year 7 Monitoring	10.00%	241.348				2027	
Stream Bankfull Standard	10.00%	241.348					
			Totals		724.044		

Total Gross Credits	2,413.480
Total Unrealized Credits to Date	0.000
Total Released Credits to Date	724.044
Total Percentage Released	30.00%
Remaining Unreleased Credits	1,689.436

Notes

Contingencies (if any)

Project Quantities

Mitigation Type	**Restoration Type**	**Physical Quantity**
Warm Stream	Restoration	2,336.000
Warm Stream	Enhancement II	193.700

Mitigation Project Name	**Greenbrier Stream Restoration Site**	**USACE Action ID**	**2018-01755**
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Debits

							Warm Stream Restoration Credits
Beginning Balance (mitigation credits)							**2,413.480**
Released Credits							**724.044**
Unrealized Credits							**0.000**
Converted Credits							**0.000**
Owning Program	**Req. Id**	**TIP #**	**Project Name**	**USACE Permit #**	**DWR Permit #**	**DCM Permit #**	
Remaining Balance (Released credits)							**724.044**
Remaining Balance (Unreleased credits)							**1,689.436**
Total Remaining Balance (Released and Unreleased credits)							**2,413.480**

Ecosystem Planning and Restoration, LLC
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Mr. Paul Wiesner
NCDEQ – Division of Mitigation Services
5 Ravencroft Dr., Suite 102
Asheville, NC 28801

December 7, 2020

RE: Response to Draft MY1 Monitoring Report Comments dated December 2, 2020
Greenbrier Stream Mitigation Site
Yadkin River Basin – CU# 03040101 - Yadkin County, North Carolina
NCDMS Project # 100086, Contract # 7616

Dear Mr. Wiesner,

Ecosystem Planning and Restoration (EPR) has reviewed the comments on the Draft MY1 Monitoring Report provided December 2, 2020. The comments have been addressed as described below and the Final Baseline Report and electronic deliverables have been revised in response to this review.

- *Table 1. Project Mitigation Quantities and Credits & Table 3. Project Attribute Table: The thermal regime for the project streams is "warm". This was a typo/ mistake in the approved mitigation plan that DMS did not catch in the review. Please update the tables accordingly."*
  - **Tables 1 and 3 have been updated to reflect warm thermal regime.**

- *CCPV Maps: Since VP-4 is not meeting the MY3 interim success criteria of 320 stems/acre, it should be shown as "red" on the CCPV Maps. This should be updated in the MY2 report once the supplemental planting effort is completed and the plot meets the success criteria.*
  - **VP-4 and RVP-1 are now shown as red on the CCPV maps.**

- *Table 6 & Table 7: Recommend showing the VP-4 stems/ acre cells (162 stems/ acre) as orange/ red since it is not meeting the MY3 interim success criteria of 320 stems/acre.*
  - **The cells on Tables 6 and 7 showing the 162 stems/acre have been shaded red.**

Electronic Support File Comments:

- *Please provide the spatial feature used to display the vegetation problem area in Fig. 2B.*
  - **The spatial feature shapefile *Greenbrier_Veg_Problem_Areas* has been added to the digital submittal.**

- *In an effort to ensure that DMS has features that represent the creditable lengths or areas, the mitigation plan features were reviewed. In the mitigation plan design features, UT1B has a length of 232 ft, but is reported as 247.5 ft in the asset table. If possible, please resubmit the mitigation plan features ensuring that the feature lengths match reported lengths.*

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- **Based on a discussion with DMS, the shapefile will remain as originally provided.**

If you have any questions regarding the MY1 Monitoring Report, please contact me at 919-623-5411 or via email at ajames@eprusa.net.

Sincerely,

Amy James, PWS

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APPENDICES

1.0 PROJECT SUMMARY

Ecosystem Planning and Restoration, PLLC (EPR) implemented the Greenbrier Stream Mitigation Project (Project; Site) for the North Carolina Division of Mitigation Services (NCDMS) to provide 2,300 stream mitigation credits (SMCs) in the Yadkin River Basin, Hydrologic Unit Code (HUC) 03040101. The Project was instituted via NCDEQ-DMS RFP # 16-007406. The Project restored and enhanced 2,530 linear feet (LF) of one perennial (UT1) and three intermittent (UT1A, UT1A-1, and UT1B) unnamed tributaries (UT) to South Deep Creek within a 6.7-acre conservation easement. Mitigation assets are listed in Table 1.

The Site is located in DMS targeted local watershed 03040101130020. The Site was historically utilized for agricultural and cattle practices. As such, streams and existing wetlands in the project area were adversely impacted by direct cattle access, farming activities, and stream channelization. The Site is situated on once active pastureland in a WS-III watershed that is approximately 49% agricultural land, 42% forest, and 8% developed land, including open space and low intensity development. Prior to construction activities, project streams were incised, straightened, and suffered from significant cattle damage. The adjacent wetlands were small, but similarly trampled, and heavily grazed. Pre-construction, or pre-existing, site conditions are provided in Table 8 of Appendix C. Photos and a more detailed description of Site conditions before restoration are available in the Mitigation Plan (Final version submitted December 2019).

1.1 Goals and Objectives

The Project goals were established based on an assessment of site conditions and restoration potential with careful consideration of the stressors identified in the Upper Yadkin Pee-Dee River Basin Restoration Priorities (RBRP) report (NCEEP, 2009) and Yadkin Pee-Dee Basinwide Water Quality Plan (NCDWQ, 2008). These goals and objectives are presented in Table 2.

Site construction, planting, and baseline vegetation data collection were completed in April 2020 and the as-built survey was completed in May 2020. A detailed timeline of the Project activity and reporting history is provided in Appendix E.

1.2 Performance Criteria

Project success criteria were established in accordance with the *NCDMS Mitigation Plan Template* (ver. 06/2017), and *U.S. Army Corps of Engineers – Wilmington District Public Notice: Notification of Issuance of Guidance for Compensatory Stream and Wetland Mitigation Conducted for Wilmington District* (October 24, 2016). The monitoring plan for the site follows the guidance *NCDMS Annual Monitoring Report Format, Data, and Content Requirements* (October 2020). Table 2 details the United States Army Corps of Engineers (USACE) success criteria that evaluate whether project goals have been met throughout the monitoring period.

Table 1. Project Mitigation Quantities and Credits

Project Component (reach ID, etc.)	Original Mitigation Plan (ft/ac)	As-built (ft/ac)	Thermal Regime	Original Restoration Level	Original Mitigation Ratio (X:1)	Mitigation Credits	Notes/Comments
UT1 Reach 1	843.00	852.00	Warm	R	1.00000	843.00	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, and Permanent Conservation Easement.
UT1 Reach 2	40.00	40.00	Warm	E2	2.50000	16.00	Bank stabilization, Bioengineering, Planted Buffer, Exclusion of Livestock, and Permanent Conservation Easement
UT1 Reach 3	1097.00	1141.00	Warm	R	1.00000	1097.00	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, and Permanent Conservation Easement.
UT1A-1	153.70	145.00	Warm	E2	2.50000	61.48	Grade Control Structures, Bank Stabilization, Exclusion of Livestock, and Permanent Conservation Easement.
UT1A	148.50	153.00	Warm	R	1.00000	148.50	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, and Permanent Conservation Easement.
UT1B	247.50	228.00	Warm	R	1.00000	247.50	
					Total Assets Summary:		**2,413.48**

Length and Area Summations by Mitigation Category

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)
		Riverine	Non-Riverine	
Restoration	2,336			
Enhancement				
Enhancement I				
Enhancement II	193.7			
Rehabilitation				
Preservation				
High Quality Pres				

Overall Assets Summary

Asset Category	Overall Credits
Stream	**2,413.48**

Table 2. Summary: Goals, Performance and Results

Goal	Objective/Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Reduce sediment inputs and stream turbidity;	▪ Stabilize eroding stream banks. ▪ Install fencing to exclude livestock from project streams. ▪ Increase distance between active farming operations and receiving waters by re-establishing a riparian buffer permanently protected through a conservation easement.	▪ The exclusion of livestock will remove a direct source of nutrients, coliform, and sediment from the system, as well as a major contributor to channel instability. ▪ Restored riparian buffers will provide woody debris and detritus for aquatic organisms, reduced water temperatures, and increased dissolved oxygen concentrations, as well as shade and diverse aquatic and terrestrial habitats that are appropriate for the ecoregion and setting.	▪ Recordation and protection of a conservation easement meeting NCDMS guidelines ▪ Visual inspection of fence installed to exclude cattle from the stream and riparian buffer, demonstrating no encroachment. ▪ Vegetation success criteria of 320 native stems/acre in Year 3, 260 stems/acre in Year 5 and 210 native stems/acre in Year 7. ▪ Trees must average 7 feet in height at year 5, and 10 feet in height at year 7. ▪ Visual inspection of BMP's to ensure proper function during monitoring period. ▪ Geomorphic cross sections indicate stable sections over the monitoring period. ▪ Bank height ratio (BHR) cannot exceed 1.2 for all measured cross sections on a given reach. ▪ Entrenchment ratio (ER) must be 2.2 or above for all measured riffle cross-sections for C/E stream types and 1.4 or above for B stream types.	<u>Permanent Vegetation Plots</u> 4 permanent vegetation plots, 0.02 acre in size, surveyed during As-built, Years 1, 2, 3, 5, and 7 between July 1st and leaf drop. Data collection includes species, height, planted vs. volunteer, and age.	In Monitoring Year 1, Plot 4 indicated that the downstream riparian area of UT1 Reach 3 has a low stem count; therefore, that area will be replanted during the upcoming dormant season. However, the 4 permanent riparian vegetation plots had an overall average stem density of 415 stems/acre and have met the interim success criteria of 320 native stems/acre in Year 3.
Reduce nutrient inputs	▪ Install fencing to exclude livestock from project streams. ▪ Reduce the amount of land in active livestock pasture. ▪ Increase distance between active farming operations and receiving waters by re-establishing a riparian buffer permanently protected through a conservation easement. ▪ Restore riparian buffers to filter runoff.			<u>Annual Random Vegetation Plots</u> 2 randomly selected vegetation plots, 0.02 acre in size, surveyed during As-built, Years 1, 2, 3, 5, and 7 between July 1st and leaf drop. Data collection includes species and height.	The 2 randomly selected vegetation plots had an average stem density of 627 stems/acre and have met the interim success criteria of 320 native stems/acre in Year 3.
Reduce Fecal Coliform Inputs	▪ Install fencing to exclude livestock from project streams. ▪ Reduce the amount of land in active livestock pasture. ▪ Increase distance between active farming operations and receiving waters by re-establishing a riparian buffer permanently protected through a conservation easement.			<u>Cross Sections</u> Cross sections are surveyed during Years 1,2,3,5, and 7. 8 total cross sections, 6 on UT1 (3 riffle/3 pool), 1 on UT1A and 1 on UT1B.	The Year 1 monitoring cross-section survey indicates that the project streams are geomorphically stable and restored channel dimensions have not changed significantly during Monitoring Year 1.
Restore / Enhance Degraded Riparian Buffers	▪ Restore riparian buffer vegetation to filter runoff and provide organic matter and shade. ▪ Protect riparian buffers with a permanent conservation easement.				
Implement Agricultural BMPs in Agricultural Watersheds	▪ Install fencing to exclude livestock from project streams. ▪ Install alternative watering systems to keep livestock away from streams. ▪ Restore and protect riparian buffers. ▪ Install vegetated swales to slow and filter concentrated runoff before entering the streams.				

Table 2. Summary: Goals, Performance and Results

Goal	Objective/Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Protect High Resource Value Waters (including HQW, ORW, and WS classifications)	▪ Restore appropriate bed form diversity, headwater stream/wetland form, and in-stream structures to provide appropriate habitat. ▪ Restore minimum 50-foot riparian buffers along all project reaches. ▪ Protect riparian buffers with a permanent conservation easement.	▪ Functional uplift will occur by restoring project channels to their historic valley, raising the streambeds, and connecting them to adjacent wetlands at lower flows. ▪ The addition of in-stream structures hep to ensure channel stability and will provide greater bedform diversity, enhancing aquatic habitat for native species.	▪ Documentation of hydrophytic vegetation within vegetation monitoring plots. ▪ Documentation of four bankfull events in different years throughout the monitoring period. ▪ Documentation of 30 days of consecutive stream flow in all reaches each monitoring year	<u>Stream Profile</u> Full longitudinal survey on all restored and enhanced stream channels. Data was collected during As-built survey only.	A full longitudinal survey of the project streams was conducted during As-built monitoring. No signs of instability or degradation were noted during MY1 monitoring. Additional longitudinal profile surveys will not be conducted unless stability issues are identified in future monitoring years.
				<u>Visual Assessment</u> Conducted yearly on all restored stream channels and in-stream structures.	Stream photo points and visual assessment indicate that all restored channels and in-stream structures are performing as intended. No stream problem areas were observed.
				<u>Additional Cross Sections</u> Only surveyed if instability is documented during monitoring	No instability was documented during MY1 monitoring, so no additional cross sections were surveyed.
				<u>Stream Hydrology Monitoring</u> 3 pressure transducers (1 on UT1, UT1A, and UT1B each) and a rain gauge will record precipitation and streamflow data continuously through the monitoring period. Photos of high-water indicators will be taken yearly.	Flow gauge data from MY1 indicate that all three project streams met the established success criteria of 30 days or more of consecutive flow throughout the year. In addition, all 3 gauges recorded several bankfull events during 2020.

Table 3. Project Attribute Table

Project Background Information				
Project Name		Greenbrier Stream Restoration Project		
County		Yadkin		
Project Area (acres)		6.7		
Project Coordinates (latitude and longitude)		latitude 36 deg 8' 54" N, longitude 80 deg 49' 46" W		
Planted Acreage (Acres of Woody Stems Planted)		6.3		
Project Watershed Summary Information				
Physiographic Province		Piedmont		
River Basin		Yadkin Pee-Dee		
USGS Hydrologic Unit 8-digit	03040101	USGS Hydrologic Unit 14-digit	3040101130020	
Project Drainage Area (Acres and Sq. Mi.)		85 acres/ 0.13 Sq.Mi. (Total)		
Project Stream Thermal Regime		Warm		
Project Drainage Area Percentage of Impervious Area		<1%		
CGIA Land Use Classification		Agriculture/Pasture 49%, Forest 42%, 8% Residential/Developed		

Reach Summary Information				
Parameters	**UT1**	**UT1A-1**	**UT1A**	**UT1B**
Length of reach (linear feet)	1958	154	115	195
Valley confinement (Confined, moderately confined, unconfined)	Moderately confined	Unconfined	Unconfined	Unconfined
Drainage area (Acres and Square Miles)	0.13 Sq.Mi., 85 Ac	0.01 Sq.Mi., 8 Ac	0.01 Sq.Mi., 8 Ac	0.02 Sq.Mi., 10 Ac
Perennial, Intermittent, Ephemeral	Perennial	Intermittent	Intermittent	Intermittent
NCDWR Water Quality Classification	WS-III	WS-III	WS-III	WS-III
Stream Classification (existing)	B4c/B4	B4	F4	G4
Stream Classification (proposed)	B4/C4	B4	B4	B4
Evolutionary trend (Simon)	IV	III	IV	III
FEMA classification	X	X	X	X

Regulatory Considerations			
Parameters	**Applicable?**	**Resolved?**	**Supporting Docs?**
Water of the United States - Section 404	Yes	Yes	USACE NWP 27 - ID# SAW-2018-01755
Water of the United States - Section 401	Yes	Yes	DWR 401 WQC No. 4134 -- ID # 20181272
Division of Land Quality (Erosion and Sediment Control)	Yes	Yes	General Permit NCG010000 - ID # YADKI-2020-010
Endangered Species Act	No	Yes	Categorical Exclusion Document; Appendix 6 in Mitigation Plan
Historic Preservation Act	No	Yes	
Coastal Zone Management Act (CZMA or CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	No	N/A	N/A
Essential Fisheries Habitat	No	N/A	N/A

2.0 MONITORING DATA ASSESSMENT

Monitoring Year 1 (MY1) data was collected in September and October 2020. Current site conditions and monitoring data are described in the following sections to evaluate whether the project is meeting the success criteria established in the mitigation plan.

2.1 Stream Monitoring

Stream monitoring involves field data collection to assess the hydrologic and geomorphic functions of UT1, UT1A, and UT1B. Monitored parameters, methods, schedule/frequency, and extent are summarized in Table 2. These monitoring parameters follow USACE guidance but will also allow for monitoring of other parameters to document site performance related to the project goals listed in Table 2. The locations of the established monitoring cross sections and stream gauges are shown in Figure 2 Current Condition Plan View (CCPV).

2.1.1 Stream Profile

A full longitudinal profile was surveyed for the entire length of the restored streams in May 2020 to document as-built conditions. This survey was tied to a permanent benchmark and includes thalweg, right bank, and left bank features. Profile measurements were taken at the head and tail of each riffle, inverts of in-stream structures, and at the max depth of pools. The longitudinal profile will not be surveyed during annual monitoring unless vertical channel instability has been observed during monitoring and remedial actions or repairs are needed.

2.1.2 Stream Dimension

Eight (8) permanent cross sections were installed across the site; 6 on UT1 and 1 each on UT1A and UT1B. Five (5) cross sections were installed in riffles and three (3) were installed in pools. Each cross-section was marked using a length of rebar and steel t-posts on both streambanks. The location and elevation of each pin was recorded to facilitate data comparison from year to year. Cross-sections were surveyed using a Topcon RL-H5A Self Leveling Laser Level. Reported data includes measurements of bankfull elevation (based on the as-built bankfull area), bank height ratio (based on the as-built bankfull area), thalweg elevation, elevation of the low top of bank, maximum depth from the low top of bank, and low top of bank cross-sectional area (Appendix C). Stream dimension measurements were made using the NCDMS cross section tool (Version 1.0, 2020). Reference photos were taken of both streambanks to provide a visual assessment of any changes that may have occurred since the previous monitoring year.

The Year 1 monitoring cross-section survey indicates that the project streams are stable and restored channel dimensions have not changed significantly during Monitoring Year 1. The pool cross sections have deepened slightly since the as-built survey but do not appear to be degrading. The riffle cross-sections showed only minor fluctuations compared to the as-built condition and all restored streams meet the success criteria for restored stream channels as established in the mitigation plan and shown in Table A. The cross-section plots, photos, and data summary (Table 9) are included in Appendix C.

2.1.3 Channel Stability

Channel stability is assessed on a yearly basis using photographs to visually document the condition of the restored project streams. Photographs are taken from the same location in the same direction each year. Sixteen (16) photo points were established during baseline monitoring and are shown in the CCPV

(Figure 2). Visual assessments of channel stability and in-stream structure condition were also made regularly throughout Monitoring Year 1.

Stream photo points and visual assessments indicate that all restored channels and in-stream structures are in good condition and performing as intended. No significant stream problem areas were observed. The minor floodplain rilling along UT1 Reach 1 that was noted after construction has mostly stabilized and these areas are covered with dense herbaceous vegetation. Some sections of the restored channels also contain this herbaceous vegetation as well; however, it does not appear to be causing any significant problems. EPR believes this is a temporary issue and the material should wash through the channel during the dormant season.

2.1.4 Stream Hydrology

Three (3) pressure transducers were installed in UT1, UT1A, and UT1B to document stream flow and the occurrence of bankfull events within the monitoring period. The locations of these gauges are shown in the CCPV (Figure 2). All three gauges were installed in the downstream end of pools. The constructed bankfull elevation at each gauge was recorded, as well as the elevation of the downstream controlling grade. These elevations will be compared with the gauge readings to determine whether the stream is flowing and if a bankfull event has occurred. Photos will be taken of flood indicators such as debris lines and sediment deposition on the floodplain whenever it is apparent that a bankfull event has occurred.

This Project utilizes a tipping bucket rain gauge installed at another EPR-completed stream restoration approximately 0.75 miles to the southeast (Meadowbrook, DMS project no. 100024) to accurately document rainfall at the Site. The rainfall data can be compared to the flow gauge data to verify that high flows at the Site are correlated with rainfall events. The monitoring gauges were downloaded regularly throughout Monitoring Year 1 and rainfall data is presented in Figure 3. Monthly Rainfall Summary Data and the flow gauge plots are in Appendix D. When the rain gauge was downloaded during MY1 monitoring in October 2020, there were several spider webs built inside the tipping bucket that could have been impacting the mechanism that records rainfall. This could have altered the rainfall data presented in Appendix D, but it is difficult to determine with certainty. Measures will be taken to ensure this will not happen in future monitoring years.

Flow gauge data from MY1 indicate that all three project streams met the established success criteria of 30 days or more of consecutive flow throughout the year. According to the gauge for UT1 (SG-1), the stream had consistent flow throughout the year and the gauge documented 6 separate bankfull events. SG-2, located in UT1A, documented consistent flow throughout the year as well as 4 bankfull events. SG-3, which is installed in UT1B, documented 134 days of consecutive flow from June 16, 2020 to October 27, 2020 when the gauge was last downloaded. SG3 also recorded 10 separate bankfull events. These numerous events along UT1B are likely influenced by UT1B's proximity to a wetland area and strong ground water interaction. Additionally, these small headwater reaches have very low top of bank depths and flood flows can easily spill out onto the floodplain. This reach is performing as intended and the number of bankfull events is not concerning along this reach. Bankfull events were further documented by photographs of other flood indicators, which are provided in Appendix A. The date and timing of these bankfull events correlated with significant rainfall events recorded by the tipping bucket rain gauge.

2.2 Riparian Vegetation Monitoring

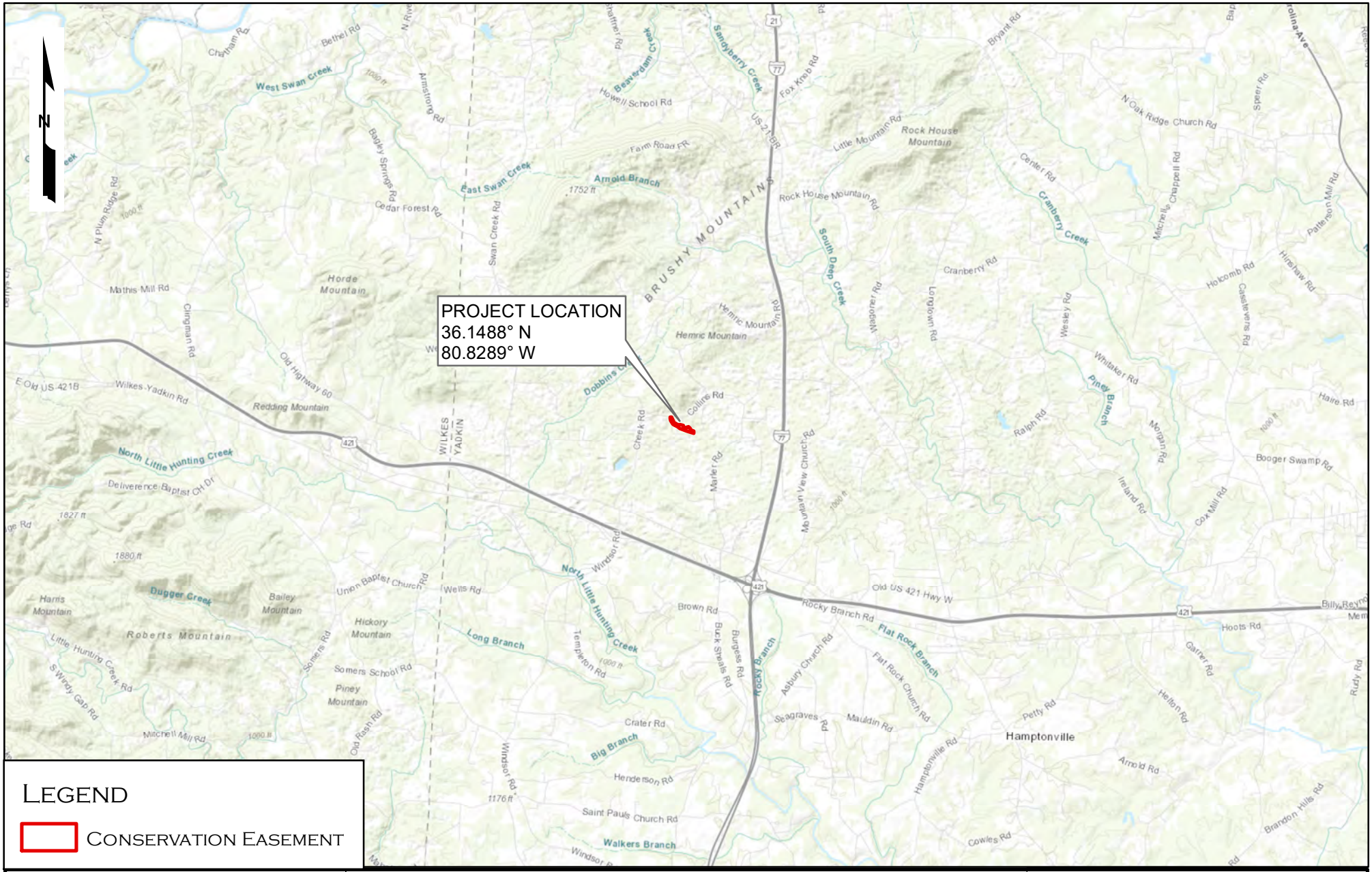
Riparian vegetation monitoring evaluates the growth and development of planted and volunteer vegetation across the site. Monitored parameters, methods, schedule/frequency, and extent are summarized in Table 2. These monitoring parameters follow USACE guidance but will also allow for monitoring of other parameters to document site performance related to the project goals listed in Table 2.

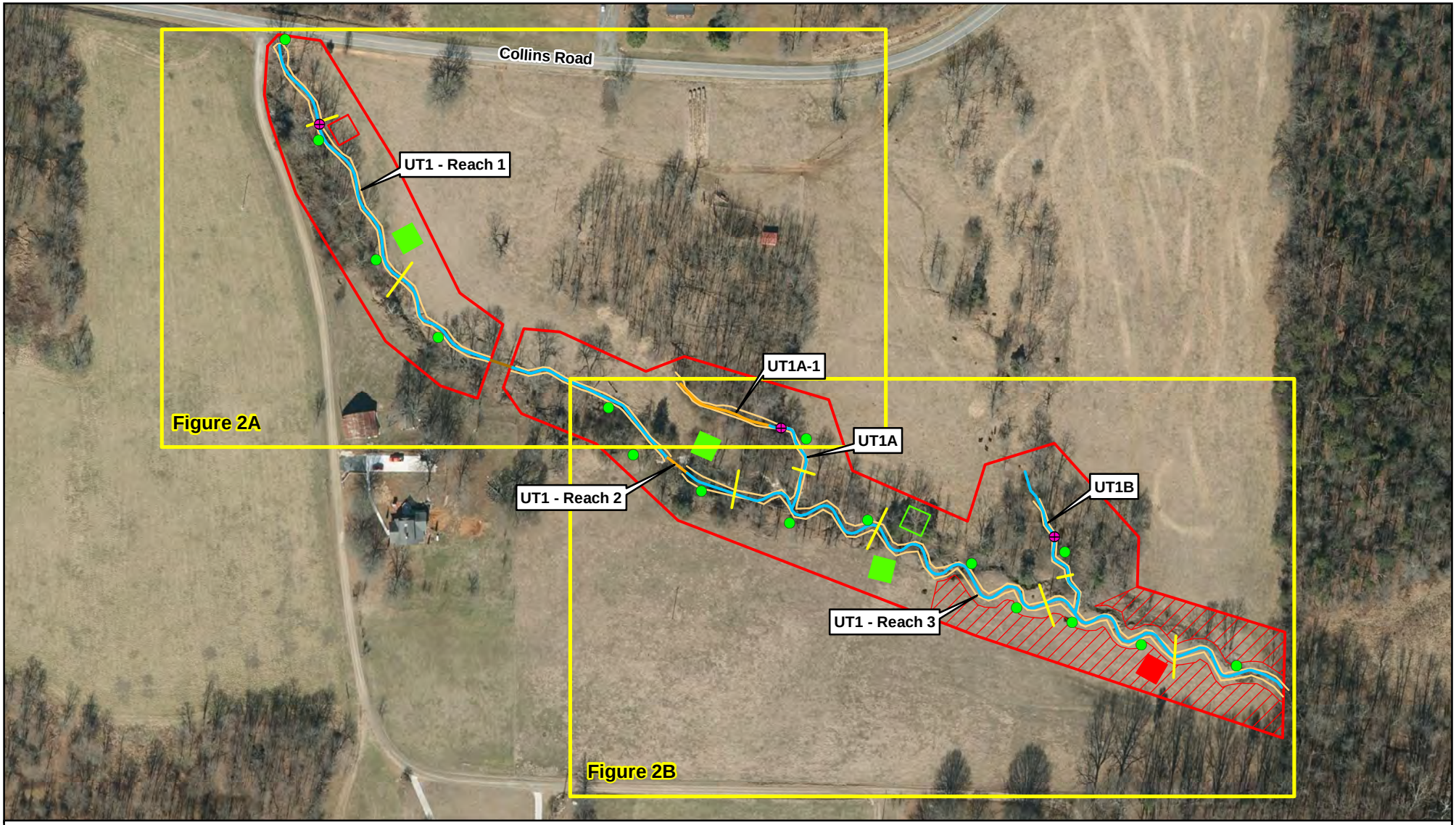
2.2.1 Vegetation Monitoring Data

Four permanent vegetation monitoring plots were monitored across the site. The corners of the permanent vegetation plots were marked using steel t-posts and the location of each plot was surveyed during the as-built survey. The individual trees within each permanent plot were flagged and identified to facilitate repeat monitoring each year. In addition to the 4 permanent plots, 2 randomly placed vegetation plots are established each year and the location of these plots is recorded using a GPS. All vegetation plots for MY1 are shown in the CCPV (Figure 2). Annual vegetation data was compiled and summarized using the DMS Vegetation Data Entry Tool.

Year 1 vegetation monitoring occurred in October 2020 before leaf drop and more than 180 days after planting. Stem counts for the vegetation plots (fixed and random) ranged from 4 trees per plot (162 trees per acre) in VP-4 F (Fixed) to 24 trees per plot (972 trees per acre) in VP-6 R (Random). The average density of stems from all 6 vegetation plots (fixed and random) was 12 trees per plot (486 trees per acre). Therefore, the vegetation plot data indicates that planted trees on the Site are meeting the interim success criteria of 320 stems/acre in Monitoring Year 3.

One vegetation problem area is noted in Figure 2. As indicated by the low stem count in VP-4 F (4 trees), the downstream riparian area of UT1 Reach 3 is covered in dense herbaceous vegetation that seems to have outcompeted the bare root trees that were planted in early 2020. This area covers around 1 acre and will be replanted in 2021. No other vegetation problem areas were noted in MY1. Riparian herbaceous and woody vegetation that was established after construction appears to be flourishing throughout the site. Additionally, no invasive species were noted within the conservation easement.


PROJECT LOCATION
36.1488° N
80.8289° W
N
BRUSHY MOUNTAINS
West Swan Creek
East Swan Creek
Arnold Branch
Rock House Mountain
Hemric Mountain
Horde Mountain
Redding Mountain
Roberts Mountain
Harris Mountain
Bailey Mountain
Hickory Mountain
Piney Mountain
North Little Hunting Creek
Dugger Creek
Long Branch
Big Branch
Rocky Branch
Flat Rock Branch
Cranberry Creek
South Deep Creek
Hamptonville
Old US 421 Hwy W
Rocky Branch Rd
Wilkes Yadkin Rd
Old Highway 60
Collins Rd
Union Baptist Church Rd
Somers School Rd
Crater Rd
Henderson Rd
Saint Pauls Church Rd
Walkers Branch
Deliverence Baptist Ch
Mathis Mill Rd
Cedar Forest Rd
Howell School Rd
Farm Road FR
Little Mountain Rd
Cranberry Rd
Brown Rd
Wells Rd
Windsor Rd
Mauldin Rd
Seagraves Rd
Asbury Church Rd
Fat Rock Church Rd
Hoots Rd
Booger Swamp Rd
Haire Rd
Ireland Rd
Cox Mill Rd
Arnold Rd
Brandon Hills Rd
Petty Rd
Helton Rd
Garner Rd
Rudy Rd
Ralph Rd
Morgan Rd
Piney Branch
Whitaker Rd
Wesley Rd
Holcomb Rd
Hinshaw Rd
Patterson Mill Rd
Center Rd
Mitchells Chapel Rd
N Oak Ridge Church Rd
Bryant Rd
Fox Knob Rd
Sandyberry Creek
Beaverdam Creek
Armstrong Rd
Bagley Springs Rd
Swan Creek Rd
N Plum Ridge Rd
Chatham Rd
Bethel Rd
Clingman Rd
Mahler Rd
Creek Rd
Mountain View Church Rd
Longtown Rd
Wagoner Rd
Hemric Mountain Rd
Buck Shoals Rd
Burgess Rd
Templeton Rd
Somers Rd
Old Rash Rd
Windsor Rd
Hampton Rd
Cowles Rd
S Windy Gap Rd
Little Hunting Creek Rd
Mitchell Mill Rd
1752 ft
1827 ft
1880 ft
1176 ft
1000 ft
421
21
77
LEGEND
Conservation Easement
0 1 2
Miles
GREENBRIER STREAM RESTORATION
VICINITY MAP
PREPARED FOR:
NCDEQ
Division of
Mitigation Services
Figure 1A
YADKIN COUNTY, NC
PREPARED BY:
Ecosystem
Planning &
Restoration
EPR



Streams - Restoration
Streams - Enhancement
No Credit
Conservation Easement
Fixed Veg Plot - Unsuccessful
Fixed Veg Plot - Successful
Random Veg Plot - Unsuccessful
Random Veg Plot - Successful
Top of Bank
Photo Points
Stream Gauges
Cross Sections
Vegetation Problem Areas

NC OneMap Orthoimagery (2018)

0 100 200 Feet

1 inch = 200 feet

N

GREENBRIER STREAM RESTORATION SITE

CURRENT CONDITION PLAN VIEW: OVERVIEW MAP

MY0: 2020

DMS PROJECT ID# 100086

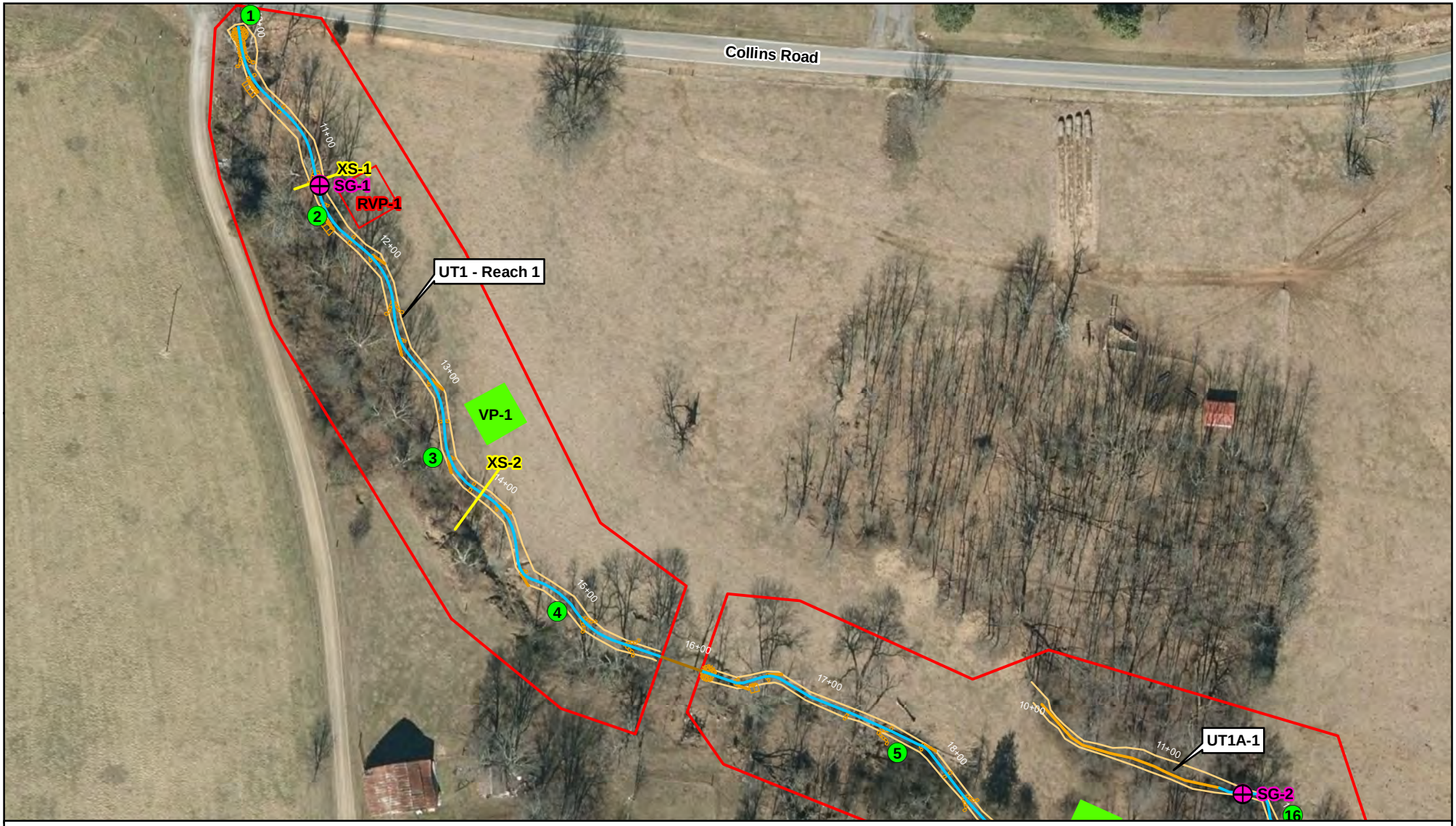
DEC 2020

FIGURE 2

YADKIN COUNTY, NC

Mitigation Services

ECOSYSTEM PLANNING & RESTORATION



Streams - Restoration
Streams - Enhancement
No Credit
Conservation Easement
Structures
Top of Bank
Photo Points
Stream Gauges
Cross Sections
Fixed Veg Plot - Unsuccessful
Fixed Veg Plot - Successful
Random Veg Plot - Unsuccessful
Random Veg Plot - Successful
Vegetation Problem Areas

NC OneMap Orthoimagery (2018)

0 100 Feet
1 inch = 100 feet

N

GREENBRIER STREAM RESTORATION SITE

CURRENT CONDITION PLAN VIEW: ASSET MAP

MY1: 2020

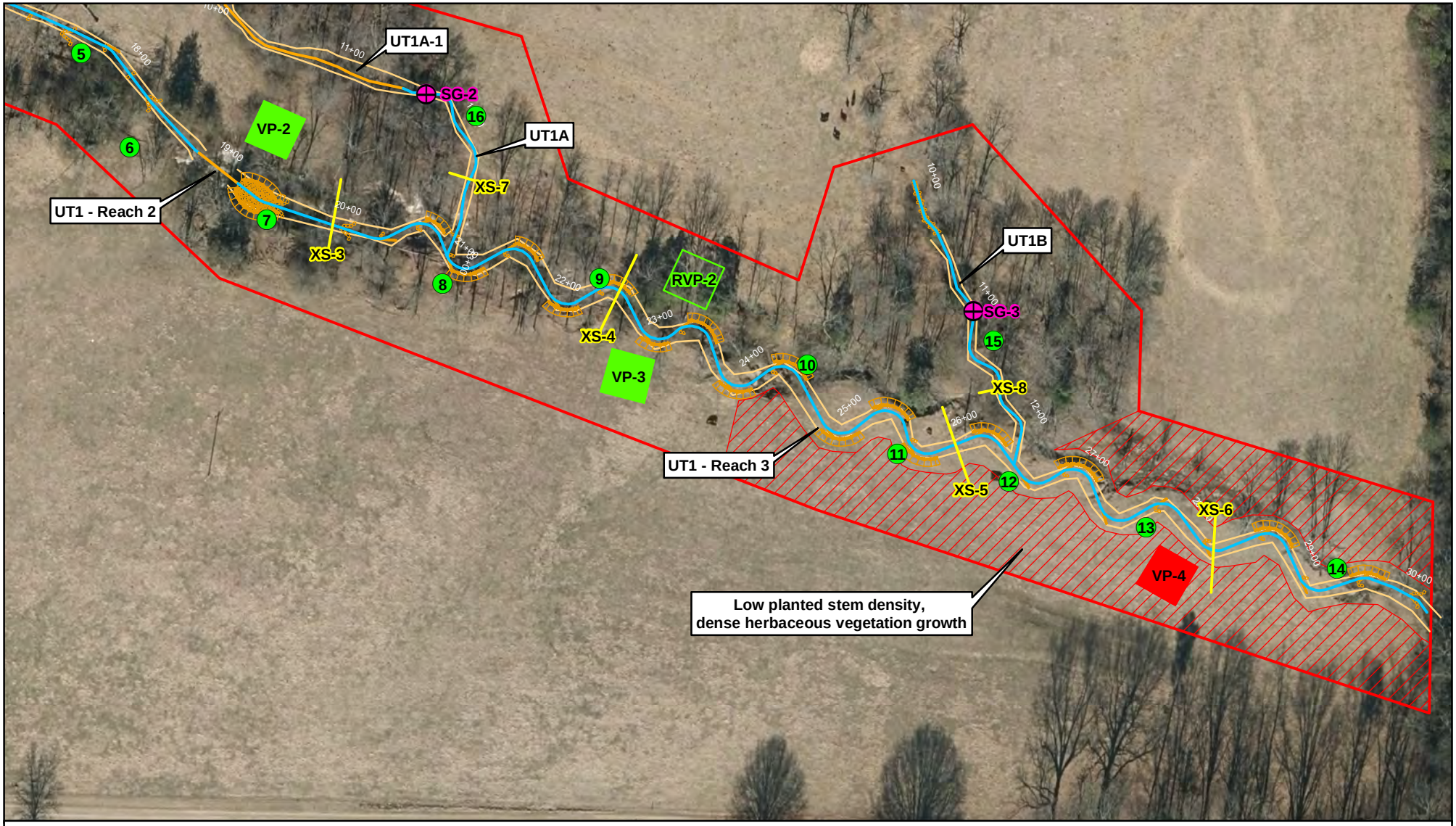
DMS PROJECT
ID# 100086
DEC 2020

FIGURE 2A

YADKIN COUNTY, NC

NC Mitigation Services
ENVIRONMENTAL QUALITY

EPR ECOSYSTEM PLANNING & RESTORATION



Streams - Restoration
Streams - Enhancement
No Credit
Conservation Easement
Structures
Top of Bank
Photo Points
Stream Gauges
Cross Sections
Fixed Veg Plot - Unsuccessful
Fixed Veg Plot - Successful
Random Veg Plot - Unsuccessful
Random Veg Plot - Successful
Vegetation Problem Areas

NC OneMap Orthoimagery (2018)

0 100 Feet
1 inch = 100 feet

N

GREENBRIER STREAM RESTORATION SITE

CURRENT CONDITION PLAN VIEW: ASSET MAP

MY1: 2020

DMS PROJECT
ID# 100086
DEC 2020

FIGURE 2B

YADKIN COUNTY, NC

Mitigation Services
Environmental Quality

Ecosystem Planning & Restoration

3.0 REFERENCES

North Carolina Department of Environmental Quality, Division of Mitigation Services (DMS). DMS Vegetation Data Entry Tool, October 2020. https://ncdms.shinyapps.io/Veg_Table_Tool/

North Carolina Department of Environmental Quality, Division of Mitigation Services (DMS). DMS Cross Section Tool V.1.0 2020. https://ncdms.shinyapps.io/XS_APP/

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North Carolina Ecosystem Enhancement Program. 2009. Upper Yadkin Pee-Dee River Basin Restoration Priorities.

North Carolina Division of Water Quality. 2008. Yadkin Pee-Dee Basinwide Water Quality Plan.

U.S. Army Corps of Engineers. October 2016. Wilmington District Public Notice: Notification of Issuance of Guidance for Compensatory Stream and Wetland Mitigation Conducted for Wilmington District.

Appendix A

Visual Assessment Data

Table 4. Visual Stream Morphology Stability Assessment Table

Table 5. Vegetation Condition Assessment Table

Vegetation Photo Log

Photo Log

Table 4a. Visual Stream Morphology Stability Assessment Table
Greenbrier Stream Mitigation Project (DMS No.100086)

Reach ID	**UT1 Reach 1**
Assessed Stream Length (ft)	**843**
Assessed Bank Length (ft)	**1686**

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	24	24		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	24	24		100%

Table 4b. Visual Stream Morphology Stability Assessment Table
Greenbrier Stream Mitigation Project (DMS No.100086)

Reach ID	**UT1 Reach 3**
Assessed Stream Length (ft)	**1097**
Assessed Bank Length (ft)	**2194**

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	15	15		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	24	24		100%

Table 4c. Visual Stream Morphology Stability Assessment Table
Greenbrier Stream Mitigation Project (DMS No.100086)

Reach ID UT1A
Assessed Stream Length (ft) 148.5
Assessed Bank Length (ft) 297

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	Surface Scour/Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	6	6		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	6	6		100%

Table 4d. Visual Stream Morphology Stability Assessment Table
Greenbrier Stream Mitigation Project (DMS No.100086)

Reach ID	**UT1B**
Assessed Stream Length (ft)	**247.5**
Assessed Bank Length (ft)	**495**

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	6	6		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	6	6		100%

Table 5. Vegetation Condition Assessment Table
Greenbrier Stream Mitigation Project (DMS No.100086)

Planted Acreage **6.34**

Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	0.00	0.0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.1 acres	1.00	15.8%
		Total	1.00	15.8%
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.25 acres	0.00	0.0%
		Cumulative Total	1.00	15.8%

Easement Acreage **6.7**

Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Invasives may occur outside of planted areas and within the easement and will therefore be calculated against the total easement acreage. Include species with the potential to directly outcompete native, young, woody stems in the short-term or community structure for existing communities. Species included in summation above should be identified in report summary.	0.1 acres	0.00	0.0%
Easement Encroachment Areas	Encroachment may be point, line, or polygon. Encroachment to be mapped consists of any violation of restrictions specified in the conservation easement. Common encroachments are mowing, cattle access, vehicular access. Encroachment has no threshold value as will need to be addressed regardless of impact area.	None	No Encroachments Noted	

Greenbrier Stream Mitigation Project
Monitoring Year 1 (November 2020) - Vegetation Photo Log

Veg Plot 1 F – NE Corner (10/27/2020)

Veg Plot 2 F – NW Corner (10/27/2020)

Veg Plot 3 F – NW Corner (10/27/2020)

Veg Plot 4 F – NW Corner (10/27/2020)

Veg Plot 5 R – NW Corner (10/27/2020)

Veg Plot 6 R– N Corner (10/27/2020)

Greenbrier Stream Mitigation Project
Monitoring Year 1 (November 2020) - Photo Log

Photo Point 1 – UT1 Reach 1, Sta. 10+00
Facing Downstream (10/27/2020)

Photo Point 2 – UT1 Reach 1, Sta. 11+50
Facing Upstream (10/27/2020)

Photo Point 3 – UT1 Reach 1, Sta. 13+55
Facing Downstream (10/27/2020)

Photo Point 4 – UT1 Reach 1, Sta. 15+00
Facing Downstream (10/27/2020)

Photo Point 5 – UT1 Reach 1, Sta. 17+60
Facing Upstream (10/27/2020)

Photo Point 6 – UT1 Reach 1, Sta. 18+50
Facing Downstream (10/27/2020)

Greenbrier Stream Mitigation Project
Monitoring Year 1 (November 2020) - Photo Log

Photo Point 7 – UT1 Reach 3, Sta. 19+60
Facing Upstream (10/27/2020)

Photo Point 8 – UT1 Reach 3, Sta. 21+00
Looking Upstream at UT1A From UT1 (10/27/2020)

Photo Point 9 – UT1 Reach 3, Sta. 22+40
Facing Downstream (10/27/2020)

Photo Point 10 – UT1 Reach 3, Sta. 24+30
Facing Upstream (10/27/2020)

Photo Point 11 – UT1 Reach 3, Sta. 25+55
Facing Downstream (10/27/2020)

Photo Point 12 – UT1 Reach 3, Sta. 26+45
Looking Upstream at UT1B From UT1 (10/27/2020)

Greenbrier Stream Mitigation Project
Monitoring Year 1 (November 2020) - Photo Log

Photo Point 13 – UT1 Reach 3, Sta. 27+55
Facing Upstream (10/27/2020)

Photo Point 14 – UT1 Reach 3, Sta. 29+45
Facing Downstream (10/27/2020)

Photo Point 15A – UT1B, Sta. 11+90
Facing Downstream (10/27/2020)

Photo Point 15B – UT1B, Sta. 11+90
Facing Upstream (10/27/2020)

Photo Point 16A – UT1A, Sta. 12+00
Facing Downstream (10/27/2020)

Photo Point 16B – UT1A, Sta. 12+00
Facing Upstream Towards UT1A-1 (10/27/2020)

Appendix B

Vegetation Plot Data

Table 6. Vegetation Plot Data

Table 7. Vegetation Performance Standards Summary Table

Table 6. Vegetation Plot Data
Greenbrier Stream Mitigation Project (NCDMS Project No. 100086)

Planted Acreage	6.34
Date of Initial Plant	2020-04-01
Date(s) of Supplemental Plant(s)	#N/A
Date(s) Mowing	#N/A
Date of Current Survey	2020-10-27
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 1 F		Veg Plot 2 F		Veg Plot 3 F		Veg Plot 4 F		Veg Plot 5 R	Veg Plot 6 R
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Total	Total
Species Included in Approved Mitigation Plan	Alnus serrulata	tag alder	shrub	OBL	1	1								
	Betula nigra	river birch	Tree	FACW	3	3	2	2	6	6			1	3
	Cornus amomum	silky dogwood	Shrub	FACW	1	1							2	
	Diospyros virginiana	common persimmon	Tree	FAC	1	1	3	3	1	1				
	Liriodendron tulipifera	tuliptree	Tree	FACU					2	2	1	1		
	Platanus occidentalis	American sycamore	Tree	FACW	1	1	3	3	2	2	2	2	1	
	Quercus nigra	water oak	Tree	FAC	1	1	1	1	1	1	1	1		
	Quercus phellos	willow oak	Tree	FAC	1	1			1	1			2	
	Salix nigra	black willow	Tree	OBL										21
	Ulmus americana	American elm	Tree	FACW	2	2			4	4			1	
Sum	Performance Standard				11	11	9	9	17	17	4	4	7	24
Mitigation Plan Performance Standard	Current Year Stem Count					11		9		17		4	7	24
	Stems/Acre					445		364		688		162	283	972
	Species Count					8		4		7		3	5	2
	Dominant Species Composition (%)					27		33		35		50	29	88
	Average Plot Height					2		2		1		2	2	15
	% Invasives					0		0		0		0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					11		9		17		4	7	24
	Stems/Acre					445		364		688		162	283	972
	Species Count					8		4		7		3	5	2
	Dominant Species Composition (%)					27		33		35		50	29	88
	Average Plot Height					2		2		1		2	2	15
	% Invasives					0		0		0		0	0	0

Meets Interim Success Criteria | **Does Not Meet Interim Success Criteria**

1). Bolded species are proposed for the current monitoring year, italicized species are not approved, and a regular font indicates that the species has been approved.
2). The "Species Included in Approved Mitigation Plan" section contains only those species that were included in the original approved mitigation plan. The "Post Mitigation Plan Species" section includes species that are being proposed through a mitigation plan addendum for the current monitoring year (bolded) , species that have been approved in prior monitoring years through a mitigation plan addendum (regular font), and species that are not approved (italicized).
3). The "Mitigation Plan Performance Standard" section is derived only from stems included in the original mitigation plan, whereas the "Post Mitigation Plan Performance Standard" includes data from mitigation plan approved, post mitigation plan approved, and proposed stems.

Table 7. Vegetation Performance Standards Summary Table
Greenbrier Stream Mitigation Project (NCDMS Project No. 100086)

Vegetation Performance Standards Summary Table												
	Veg Plot 1 F				Veg Plot 2 F				Veg Plot 3 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	445		8	0	364		4	0	688		7	0
Monitoring Year 0	729		9	0	607		5	0	769		7	0
	Veg Plot 4 F				Veg Plot Group 1 R				Veg Plot Group 2 R			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	162		3	0	283		5	0	972		2	0
Monitoring Year 0	688		4	0								
			Meets Interim Success Criteria				Does Not Meet Interim Success Criteria					

*Each monitoring year represents a different plot for the random vegetation plot "groups". Random plots are denoted with an R, and fixed plots with an F.

Appendix C

Stream Geomorphology Data

Cross-Sections With Annual Overlays

Table 8. Baseline Stream Data Summary

Table 9. Cross-Section Morphology Monitoring Summary

Cross Section Plot - MY1 - November 2020

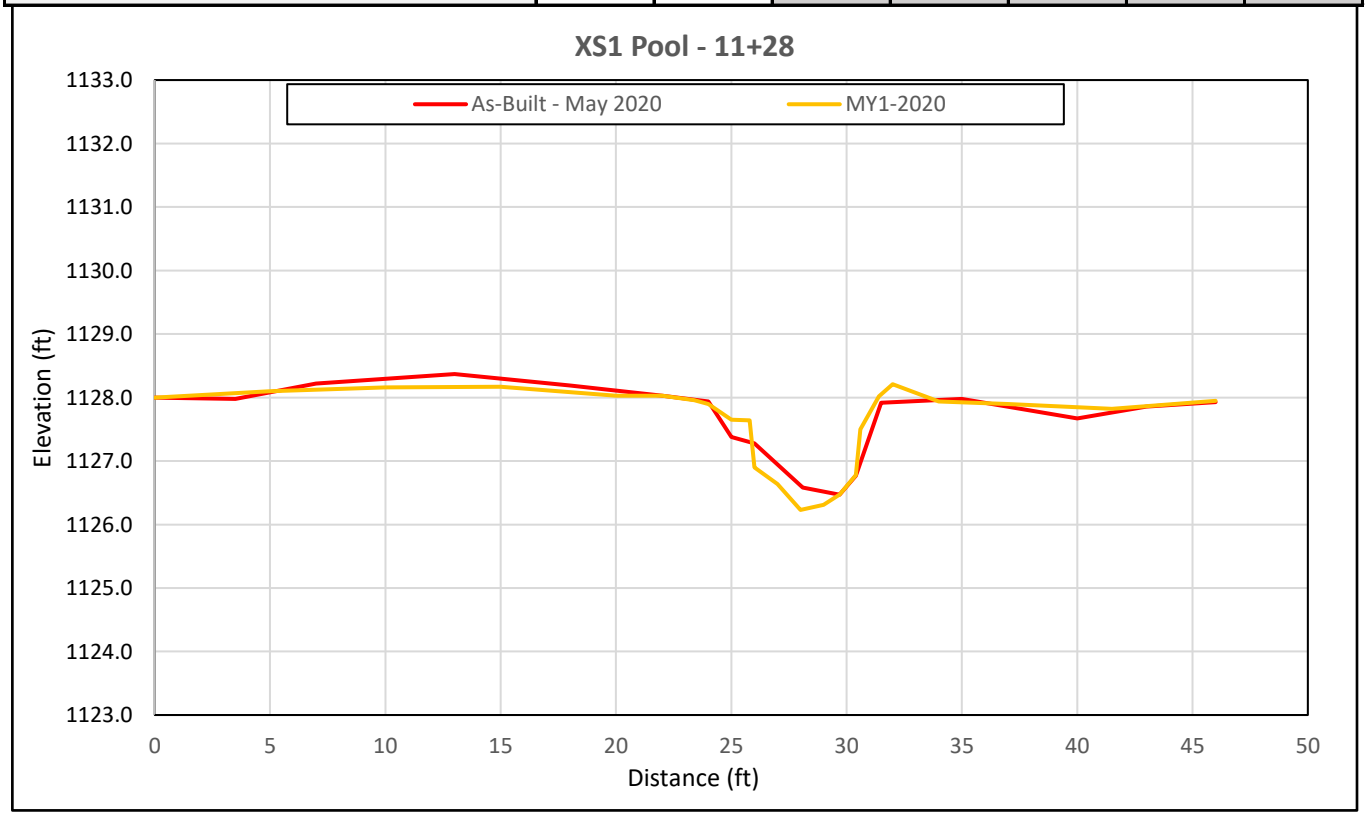
XS1 - UT1 Reach 1

Station 11+28 - Pool

XS1 looking upstream

XS1 facing right bank

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1127.92	1127.87					
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.09					
Thalweg Elevation	1126.47	1126.23					
LTOB Elevation	1127.92	1128.02					
LTOB Max Depth	1.45	1.79					
LTOB Cross Sectional Area	6.70	7.87					
Entrenchment Ratio	-	-					



Cross Section Plot - MY1 - November 2020

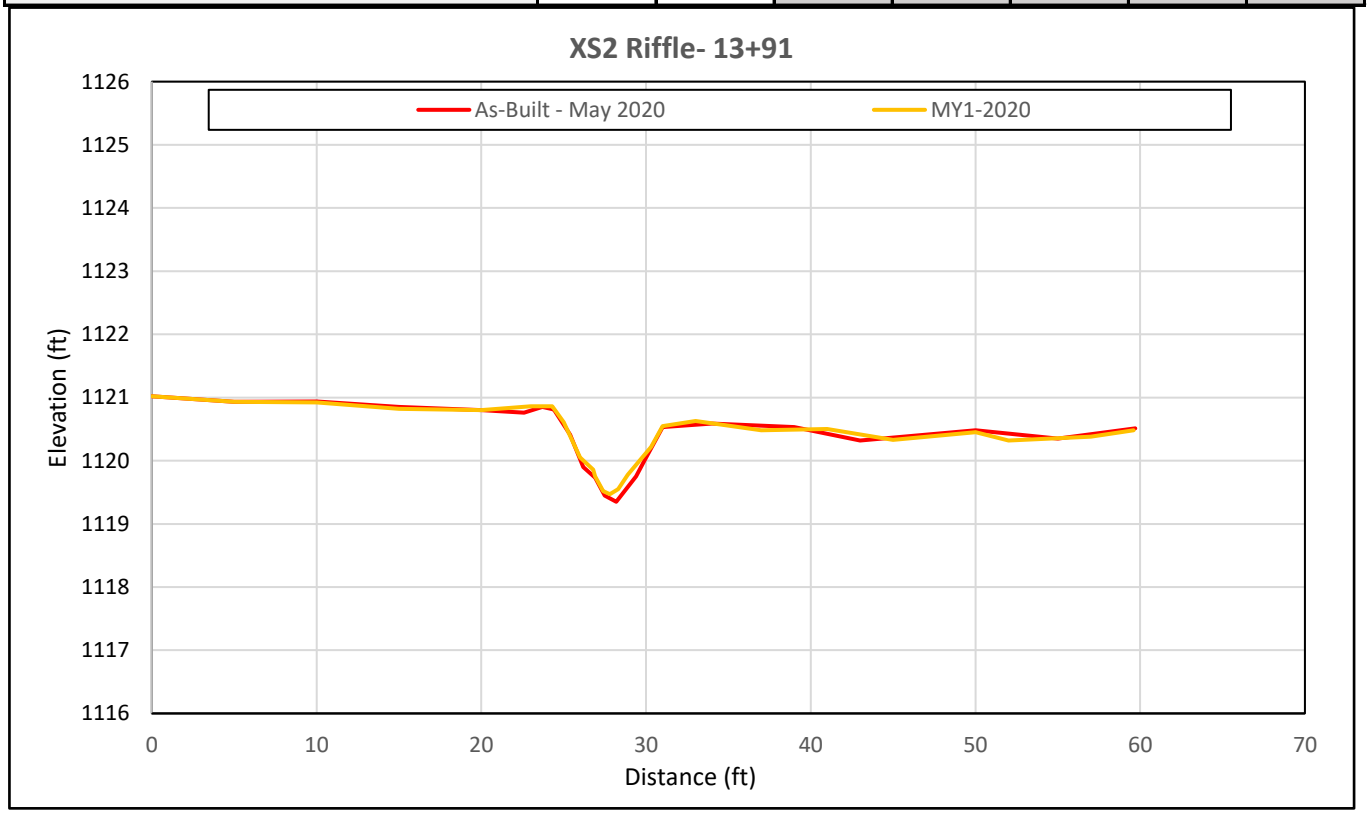
XS2 - UT1 Reach 1

Station 13+91 - Riffle

XS2 looking upstream

XS2 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1120.53	1120.61					
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94					
Thalweg Elevation	1119.35	1119.47					
LTOB Elevation	1120.53	1120.55					
LTOB Max Depth	1.18	1.08					
LTOB Cross Sectional Area	3.97	3.59					
Entrenchment Ratio	>10.12	>10.11					



Cross Section Plot - MY1 - November 2020

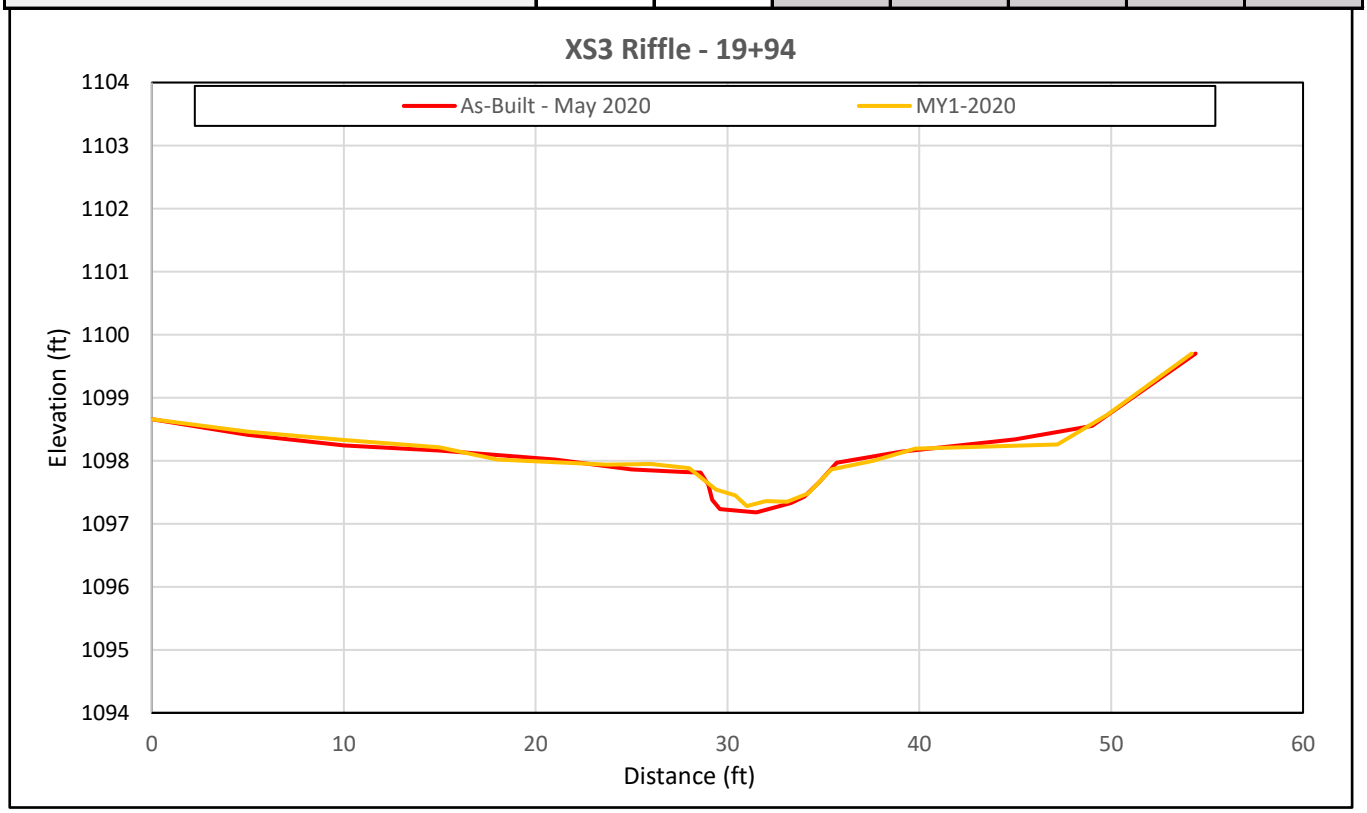
XS3 - UT1 Reach 3

Station 19+94 - Riffle

XS3 looking upstream

XS3 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1097.81	1097.90					
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.97					
Thalweg Elevation	1097.18	1097.28					
LTOB Elevation	1097.81	1097.88					
LTOB Max Depth	0.63	0.60					
LTOB Cross Sectional Area	2.99	2.84					
Entrenchment Ratio	6.39	5.80					



Cross Section Plot - MY1 - November 2020

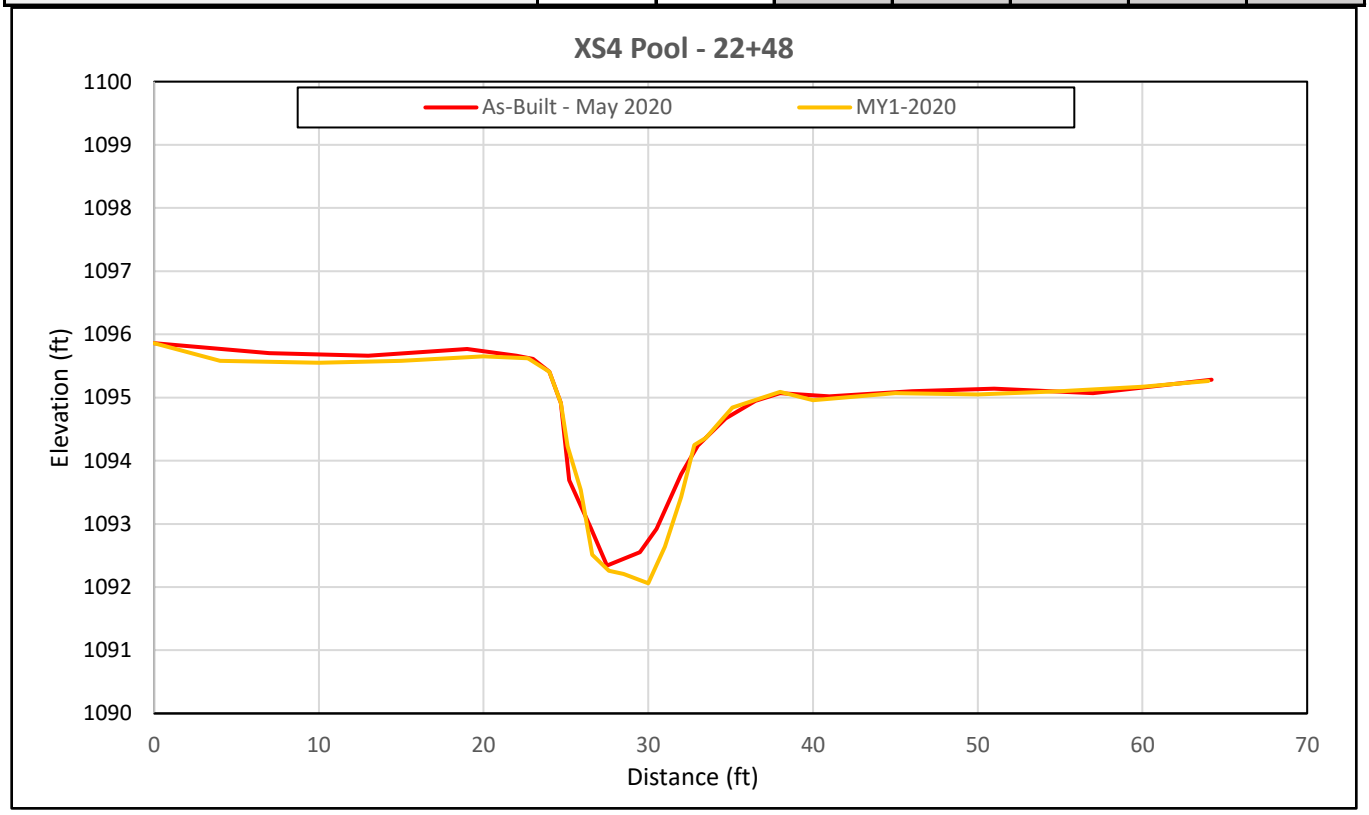
XS4 - UT1 Reach 3

Station 22+48 - Pool

XS4 looking upstream

XS4 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1094.95	1094.80					
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.01					
Thalweg Elevation	1092.34	1092.06					
LTOB Elevation	1094.95	1094.84					
LTOB Max Depth	2.61	2.78					
LTOB Cross Sectional Area	16.41	16.85					
Entrenchment Ratio	-	-					



Cross Section Plot - MY1 - November 2020

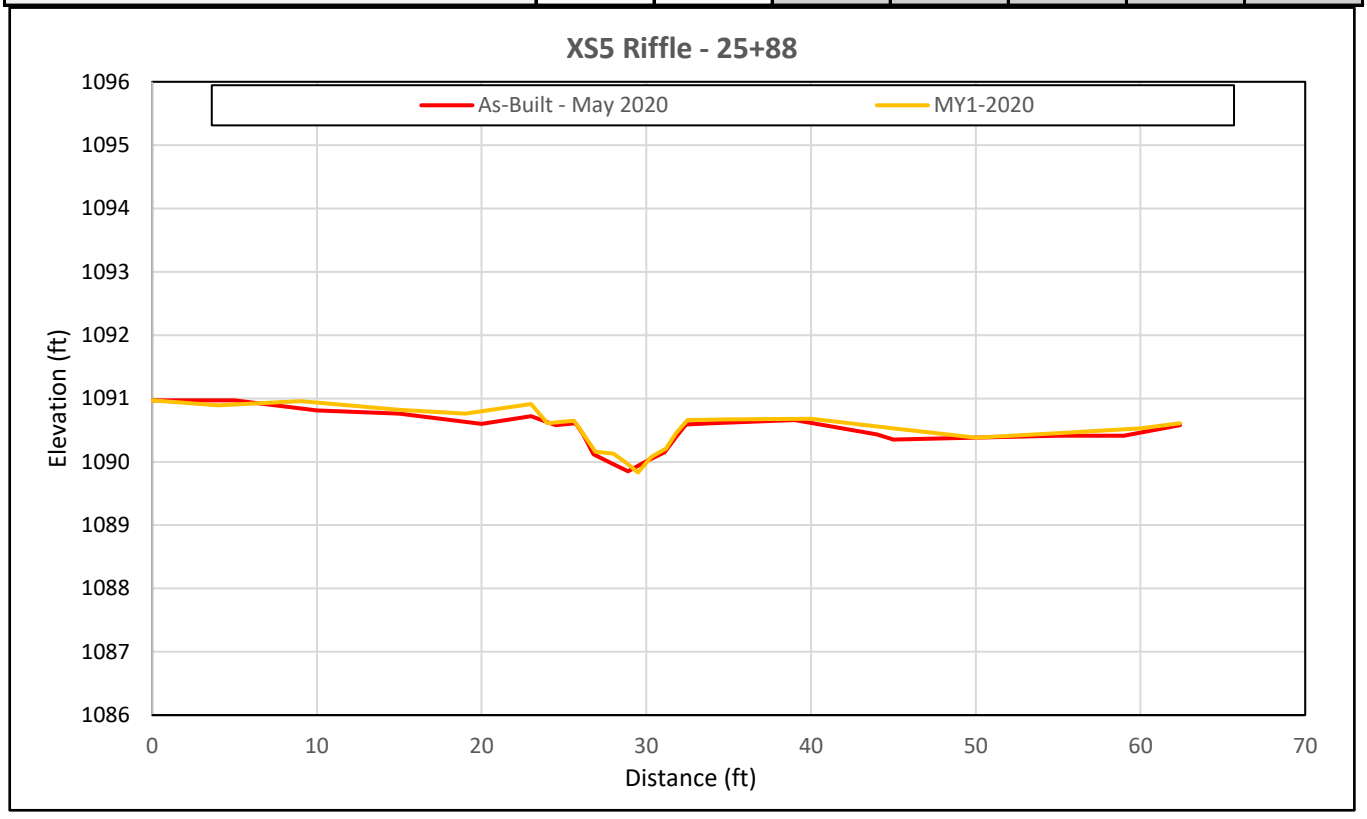
XS5 - UT1 Reach 3

Station 25+88 - Riffle

XS5 looking upstream

XS5 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1090.59	1090.64					
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.02					
Thalweg Elevation	1089.85	1089.83					
LTOB Elevation	1090.59	1090.66					
LTOB Max Depth	0.74	0.83					
LTOB Cross Sectional Area	3.08	3.26					
Entrenchment Ratio	>9.39	>9.1					



Cross Section Plot - MY1 - November 2020

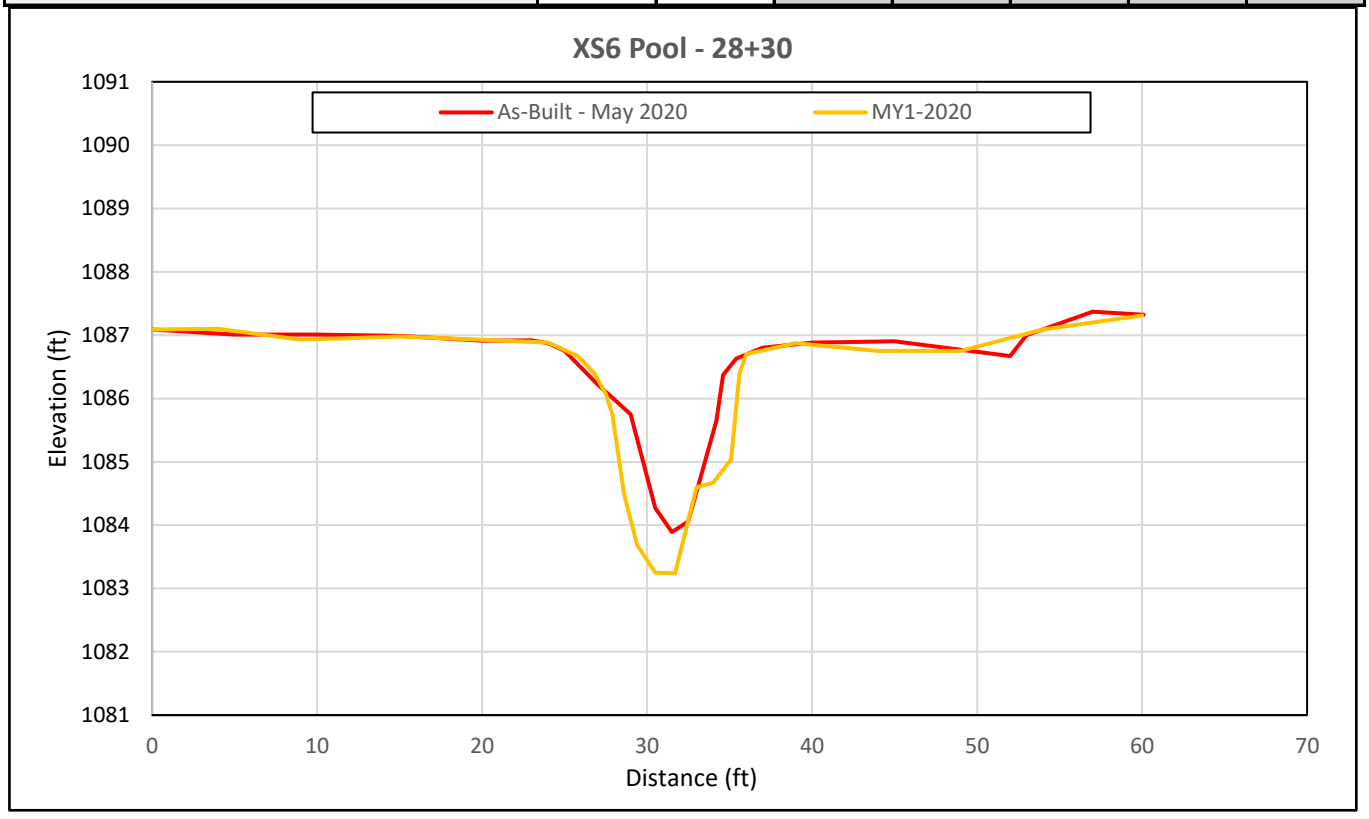
XS6 - UT1 Reach 3

Station 28+30 - Pool

XS6 looking upstream

XS6 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1086.63	1085.85					
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.32					
Thalweg Elevation	1083.89	1083.24					
LTOB Elevation	1086.63	1086.70					
LTOB Max Depth	2.74	3.46					
LTOB Cross Sectional Area	12.61	19.95					
Entrenchment Ratio	-	-					



Cross Section Plot - MY1 - November 2020

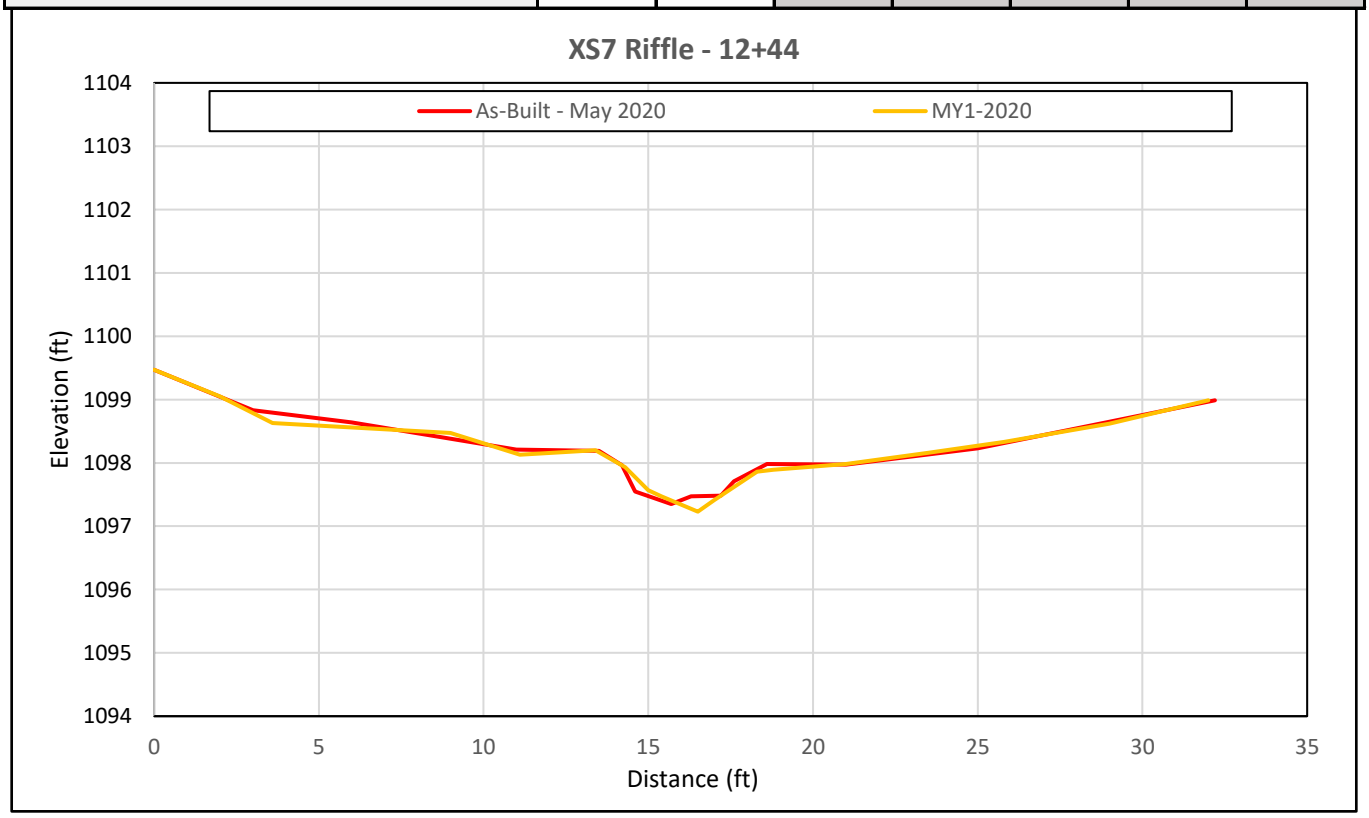
XS7 - UT1A

Station 12+44 - Riffle

XS7 looking upstream

XS7 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1097.98	1097.96					
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.91					
Thalweg Elevation	1097.35	1097.23					
LTOB Elevation	1097.98	1097.89					
LTOB Max Depth	0.63	0.66					
LTOB Cross Sectional Area	1.76	1.47					
Entrenchment Ratio	4.90	4.98					



Cross Section Plot - MY1 - November 2020

XS8 - UT1B

Station 11+71 - Riffle

XS8 looking upstream

XS8 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1089.94	1090.00					
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.76					
Thalweg Elevation	1089.59	1089.66					
LTOB Elevation	1089.94	1089.92					
LTOB Max Depth	0.35	0.26					
LTOB Cross Sectional Area	0.87	0.59					
Entrenchment Ratio	>5.26	>5.39					

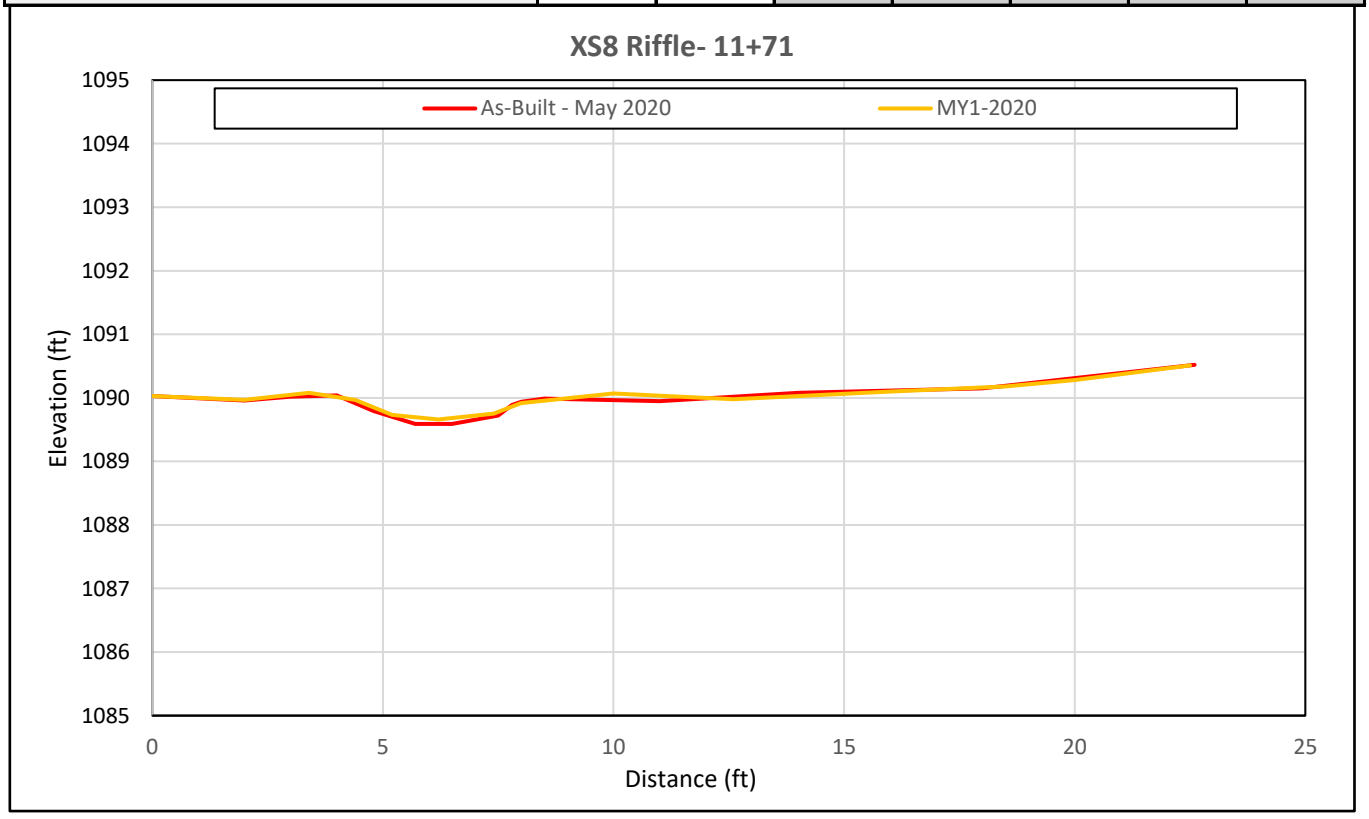


Table 8a. Baseline Stream Data Summary
Greenbrier Stream Mitigation Project (DMS No. 100086) - UT1 Reach 1 (843 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only	LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)	2.6	12	6.2	4.3	4.8	4.8	5.3	0.7	2	3.26	6.2	-	6.6	-	-	5.7	6.2	6.7	-	5.9	-	-	-	1
Floodprone Width (ft)				20.0	26.5	26.5	33.0	9.2	2	8.7	11.2	-	13.7	-	-	25.0	35.0	45.0	-	>59.7	-	-	-	1
Bankfull Mean Depth (ft)	0.4	1.4	0.5	0.5	0.6	0.6	0.8	0.2	2	0.5	0.6	-	0.6	-	-	0.4	0.5	0.6	-	0.7	-	-	-	1
[1]Bankfull Max Depth (ft)				0.7	0.9	0.9	1.1	0.2	2	0.7	0.7	-	0.8	-	-	0.5	0.6	0.7	-	1.2	-	-	-	1
Bankfull Cross Sectional Area (ft^2)	1.8	8	3.1	2.6	2.9	2.9	3.3	0.5	2	2.3	2.7	-	3.2	-	-	2.7	3.0	3.3	-	4.0	-	-	-	1
Width/Depth Ratio				5.6	8.4	8.4	11.1	3.9	2	12.0	15.0	-	18	-	-	11.0	13.0	15.0	-	8.8	-	-	-	1
Entrenchment Ratio				1.6	1.7	1.7	1.9	0.2	2	1.4	1.8	-	2.2	-	-	4.0	5.7	7.3	-	>10.1	-	-	-	1
[1]Bank Height Ratio				1.5	2.1	2.1	2.8	0.9	2	1.0	1.0	-	1.0	-	-	1.0	1.0	1.0	-	1.0	-	-	-	1
Profile																								
Riffle Length (ft)				N/A	N/A	N/A	N/A	N/A	N/A	Total riffle length 60-70% of reach length						7	17	33	16	26	24	39	8	14
Riffle Slope (ft/ft)				0.027	0.032	0.032	0.038	0.008	2	0.019	0.025	-	0.032	-	-	0.0385	0.051	0.063	0.018	0.0279	0.028	0.039	0.0049	14
Pool Length (ft)				N/A	N/A	N/A	N/A	N/A	N/A	Total pool length 30-40% of reach length						6	11	19	8	14	15	19	3	14
Pool Max depth (ft)				0.6	1.3	1.3	1.9	0.9	2	1.11	1.5	-	1.9	-	-	1.3	1.4	1.5	1.4	2.0	2.0	2.9	0.4	14
Pool Spacing (ft)				40.0	80.0	80.0	120.0	56.6	25	3.1	17.2	-	31.2	-	-	3	17	31	28	42	40	60	11	14
Pattern																								
Channel Beltwidth (ft)				6.0	19.0	20.0	38.0	11.4	8	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	17.2	20.4	20.5	23.8	2.0	8
Radius of Curvature (ft)				37.0	46.8	47.5	55.0	7.9	4	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	21.7	32.0	27.9	51.7	10.7	10
Rc:Bankfull width (ft/ft)				7.7	9.7	9.9	11.4	1.7	4	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	3.7	5.4	4.7	8.8	1.8	10
Meander Wavelength (ft)				66.0	111.7	86.0	224.0	57.8	11	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	50.0	93.1	99.0	113.0	19.1	9
Meander Width Ratio				1.2	4.0	4.2	7.9	2.4	8	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	2.9	3.5	3.5	4.0	0.3	8
Transport parameters																								
Reach Shear Stress (competency) lb/f^2				0.45												0.82			1.24					
Max part size (mm) mobilized at bankfull				84												142			160					
Stream Power (transport capacity) lb/s				23												36			34					
Additional Reach Parameters																								
Rosgen Classification				B4c						B4						B4			B4					
Bankfull Velocity (fps)	2.8	1.9	2.0	2.79												2.3			1.8					
Bankfull Discharge (cfs)	5	15	6.2	7												7								
Valley length (ft)				865						-						865								
Channel Thalweg length (ft)				926						-						919			852					
Sinuosity (ft)				1.07						1.1-1.2						1.03			1.02					
Water Surface Slope (Channel) (ft/ft)				0.018						-						0.035			0.032					
BF slope (ft/ft)				0.019						-						0.036			0.032					
[3]Bankfull Floodplain Area (acres)				0.5						-						0.7			0.95					
[4]% of Reach with Eroding Banks				-						-														
Channel Stability or Habitat Metric				-						-														
Biological or Other				-						-														

Table 8b. Baseline Stream Data Summary
Greenbrier Stream Mitigation Project (DMS No. 100086) - UT1 Reach 3 (1097 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only	LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)	2.7	12	8.0	7.1	9.3	9.3	11.5	3.1	2	3.3	4.8	-	6.2	-	-	7.1	7.6	8.1	6.6	6.6	6.6	6.7	0.0	2
Floodprone Width (ft)				11.4	15.3	15.3	19.1	5.5	2	7.6	7.8	-	8.1	-	-	20.0	54.0	88.0	42.3	52.3	52.3	>62.4	-	2
Bankfull Mean Depth (ft)	0.4	1.5	0.6	0.4	0.5	0.5	0.6	0.1	2	0.4	0.5	-	0.6	-	-	0.4	0.6	0.8	0.5	0.5	0.5	0.5	0.0	2
[1]Bankfull Max Depth (ft)				0.8	0.9	0.9	0.9	0.1	2	0.6	0.7	-	0.7	-	-	0.7	0.8	0.9	0.6	0.7	0.7	0.7	0.1	2
Bankfull Cross Sectional Area (ft^2)	2	10	4.8	4.1	4.3	4.3	4.6	0.4	2	1.3	2.4	-	3.6	-	-	4.1	4.5	5.0	3.0	3.0	3.0	3.1	0.1	2
Width/Depth Ratio				12.4	20.6	20.6	28.7	11.5	2	12	14	-	15	-	-	12.0	15.0	18.0	14.5	14.6	14.6	14.7	0.2	2
Entrenchment Ratio				1.6	1.7	1.7	1.7	0.1	2	1.6	1.7	-	1.7	-	-	4.0	5.7	7.3	6.4	7.9	7.9	>9.4	-	2
[1]Bank Height Ratio				2.2	2.9	2.9	3.5	0.9	2	1.0	1.0	-	1.0	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	2
Profile																								
Riffle Length (ft)				N/A	N/A	N/A	N/A	N/A	N/A	Total riffle length 60-70% of reach length						13	21	40	12	29	28	49	10	12
Riffle Slope (ft/ft)				0.016	0.031	0.031	0.046	0.021	2	0.018	0.020	-	0.023	-	-	0.014	0.019	0.023	0.010	0.0168	0.0165	0.025	0.0052	12
Pool Length (ft)				N/A	N/A	N/A	N/A	N/A	N/A	Total pool length 30-40% of reach length						9	21	30	23	28	26	42	6	12
Pool Max depth (ft)				0.9	1.0	1.0	1.1	0.1	2	0.7	1.2	-	1.7	-	-	1.4	1.5	1.7	1.8	2.2	2.2	2.9	0.3	12
Pool Spacing (ft)				N/A	N/A	N/A	N/A	N/A	N/A	17	25	-	33	-	-	26	40	53	30	47	47	62	8	12
Pattern																								
Channel Beltwidth (ft)				8.0	13.8	12.0	23.0	5.0	15.0	16.6	27.3	-	38.0	-	-	27.0	44.0	61.0	29.3	33.5	33.6	37.9	2.5	21
Radius of Curvature (ft)				14.0	28.1	26.0	44.0	11.6	7.0	9.5	11.9	-	14.3	-	-	15.0	19.0	23.0	17.5	22.5	22.4	26.2	2.7	20
Rc:Bankfull width (ft/ft)				1.5	3.0	2.8	4.7	1.2	7.0	2.0	2.5	-	3.0	-	-	2.0	2.5	3.0	2.6	3.4	3.4	3.9	0.4	20
Meander Wavelength (ft)				36.0	71.8	61.0	128.0	29.0	15.0	33.3	49.9	-	66.5	-	-	53.0	80.0	107.0	51.0	67.7	64.5	87.0	9.4	20
Meander Width Ratio				3.9	7.7	6.6	13.8	29.0	15.0	3.5	5.8	-	8.0	-	-	3.5	5.8	8.0	4.4	5.0	5.1	5.7	0.4	8
Transport parameters																								
Reach Shear Stress (competency) lb/f^2				0.79												0.54			0.38					
Max part size (mm) mobilized at bankfull				87.8												79.6			75.0					
Stream Power (transport capacity) lb/s				18												19			24					
Additional Reach Parameters																								
Rosgen Classification				B4						C4						C4			C4					
Bankfull Velocity (fps)	3.0	6.0	2.2	3.1												2.8			4.1					
Bankfull Discharge (cfs)	6	60	10.4	12.5												12.5								
Valley length (ft)				902						-						902								
Channel Thalweg length (ft)				991.6						-						1097			1141					
Sinuosity (ft)				1.09						1.2 to 1.4						1.22			1.26					
Water Surface Slope (Channel) (ft/ft)				0.015						-						0.013			0.014					
BF slope (ft/ft)				0.016						-						0.016			0.014					
[3]Bankfull Floodplain Area (acres)				0.3						-						1.1			1.6					
[4]% of Reach with Eroding Banks				-						-														
Channel Stability or Habitat Metric				-						-														
Biological or Other				-						-														

Table 8c. Baseline Stream Data Summary
Greenbrier Stream Mitigation Project (DMS No. 100086) - UT1A (148.5 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only	LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)	1	8	3.5	3.8	3.8	3.8	3.8	-	1	1.6	2.5	-	3.5	-	-	3.1	3.6	4.1	-	4.5	-	-	-	1
Floodprone Width (ft)				4.7	4.7	4.7	4.7	-	1	3.5	4.5	-	5.5	-	-	5.0	7.5	10.0	-	22.3	-	-	-	1
Bankfull Mean Depth (ft)	0.3	1	0.3	0.1	0.1	0.1	0.1	-	1	0.3	0.3	-	0.4	-	-	0.2	0.3	0.4	-	0.4	-	-	-	1
[1]Bankfull Max Depth (ft)				0.3	0.3	0.3	0.3	-	1	0.4	0.4	-	0.5	-	-	0.3	0.4	0.5	-	0.6	-	-	-	1
Bankfull Cross Sectional Area (ft^2)	1	6	1.1	0.5	0.5	0.5	0.5	-	1	0.7	0.9	-	1.1	-	-	0.9	1.0	1.1	-	1.8	-	-	-	1
Width/Depth Ratio				26.8	26.8	26.8	26.8	-	1	12.0	15.0	-	18	-	-	10.0	12.9	15.0	-	11.6	-	-	-	1
Entrenchment Ratio				1.3	1.3	1.3	1.3	-	1	1.4	1.8	-	2.2	-	-	1.4	2.1	2.8	-	4.9	-	-	-	1
[1]Bank Height Ratio				14.8	14.8	14.8	14.8	-	1	1.0	1.0	-	1.1	-	-	1.0	1.0	1.0	-	1.0	-	-	-	1
Profile																								
Riffle Length (ft)				N/A	N/A	N/A	N/A	N/A	N/A	Total riffle length 60-70% of reach length						4.0	8.0	11.0	9	14	15	19	4	5
Riffle Slope (ft/ft)				0.029	0.070	0.070	0.110	0.057	2	0.086	0.113	-	0.140	-	-	0.023	0.030	0.036	0.012	0.0292	0.032	0.047	0.0122	5
Pool Length (ft)				N/A	N/A	N/A	N/A	N/A	N/A	Total pool length 30-40% of reach length						3.0	5.0	12.0	5	12	12	20	5	5
Pool Max depth (ft)				N/A	N/A	N/A	N/A	N/A	N/A	0.7	0.9	-	1.2	-	-	0.6	0.7	0.8	0.5	0.8	0.9	0.9	0.2	5
Pool Spacing (ft)				N/A	N/A	N/A	N/A	N/A	N/A	1.3	6.9	-	12.5	-	-	2.0	10.0	18.0	18	23	22	32	5	4
Pattern																								
Channel Beltwidth (ft)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Radius of Curvature (ft)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rc:Bankfull width (ft/ft)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Meander Wavelength (ft)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Meander Width Ratio				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Transport parameters																								
Reach Shear Stress (competency) lb/f^2				0.68												0.35			0.40					
Max part size (mm) mobilized at bankfull				N/A												N/A			80					
Stream Power (transport capacity) lb/s				38												10			7					
Additional Reach Parameters																								
Rosgen Classification				F4						B4						B4			B4					
Bankfull Velocity (fps)	3.0	2.0	1.6	3.8												2			1.1					
Bankfull Discharge (cfs)	3	12	1.8	2.0												2.0								
Valley length (ft)				114						-						144								
Channel Thalweg length (ft)				115						-						148.5			153					
Sinuosity (ft)				1.01						1.1 to 1.2						1.03			1.06					
Water Surface Slope (Channel) (ft/ft)				0.078						-						0.020			0.018					
BF slope (ft/ft)				0.078						-						0.021			0.018					
[3]Bankfull Floodplain Area (acres)				0.01						-						0.02			0.13					
[4]% of Reach with Eroding Banks				-						-														
Channel Stability or Habitat Metric				-						-														
Biological or Other				-						-														

Table 8d. Baseline Stream Data Summary
Greenbrier Stream Mitigation Project (DMS No. 100086) - UT1B (247.50 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only	LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)	1	8	3.5	4.7	4.7	4.7	4.7	-	1	1.7	2.7	-	3.7	-	-	3.1	3.6	4.1	-	3.7	-	-	-	1
Floodprone Width (ft)				6.1	6.1	6.1	6.1	-	1	3.8	4.9	-	6.0	-	-	5.0	7.5	10.0	-	>19.34	-	-	-	1
Bankfull Mean Depth (ft)	0.3	1	0.3	0.5	0.5	0.5	0.5	-	1	0.3	0.4	-	0.4	-	-	0.2	0.3	0.4	-	0.2	-	-	-	1
[1]Bankfull Max Depth (ft)				0.8	0.8	0.8	0.8	-	1	0.4	0.5	-	0.5	-	-	0.3	0.4	0.5	-	0.4	-	-	-	1
Bankfull Cross Sectional Area (ft^2)	1	6	1.1	2.3	2.3	2.3	2.3	-	1	0.9	1.1	-	1.3	-	-	0.9	1.0	1.1	-	0.9	-	-	-	1
Width/Depth Ratio				9.9	9.9	9.9	9.9	-	1	12.0	15.0	-	18.0	-	-	10.0	12.9	15.0	-	15.3	-	-	-	1
Entrenchment Ratio				1.3	1.3	1.3	1.3	-	1	1.4	1.8	-	2.2	-	-	1.4	2.1	2.8	-	>5.26	-	-	-	1
[1]Bank Height Ratio				7.6	7.6	7.6	7.6	-	1	1.0	1.0	-	1.1	-	-	1.0	1.0	1.0	-	1.0	-	-	-	1
Profile																								
Riffle Length (ft)				N/A	N/A	N/A	N/A	N/A	N/A	Total riffle length 60-70% of reach length						8.0	10.0	15.0	15	18	19	20	2	3
Riffle Slope (ft/ft)				0.035	0.039	0.039	0.042	0.005	2	0.026	0.035	-	0.043	-	-	0.019	0.024	0.030	0.050	0.055	0.055	0.060	0.0041	3
Pool Length (ft)				N/A	N/A	N/A	N/A	N/A	N/A	Total pool length 30-40% of reach length						5.0	12.0	15.0	12	15	12	20	4	3
Pool Max depth (ft)				N/A	N/A	N/A	N/A	N/A	N/A	0.7	1.0	-	1.3	-	-	0.6	0.7	0.8	0.6	0.9	1.0	1.1	0.2	3
Pool Spacing (ft)				N/A	N/A	N/A	N/A	N/A	N/A	1.4	7.5	-	13.7	-	-	2.0	10.0	18.0	27	29	27	34	3	3
Pattern																								
Channel Beltwidth (ft)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Radius of Curvature (ft)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rc:Bankfull width (ft/ft)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Meander Wavelength (ft)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Meander Width Ratio				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Transport parameters																								
Reach Shear Stress (competency) lb/f^2				0.75												0.3			0.37					
Max part size (mm) mobilized at bankfull				N/A												N/A			75					
Stream Power (transport capacity) lb/s				11												10			15					
Additional Reach Parameters																								
Rosgen Classification				G4						B4						B4			B4					
Bankfull Velocity (fps)	3.0	2.0	1.6	1												2.3			2.6					
Bankfull Discharge (cfs)	3	12	1.8	2.3												2.3								
Valley length (ft)				181						-						215								
Channel Thalweg length (ft)				195						-						248			228					
Sinuosity (ft)				1.08						1.1 to 1.2						1.15			1.06					
Water Surface Slope (Channel) (ft/ft)				0.0239						-						0.017			0.026					
BF slope (ft/ft)				0.0239						-						0.02			0.026					
[3]Bankfull Floodplain Area (acres)				0.03						-						0.04			0.18					
[4]% of Reach with Eroding Banks				-						-														
Channel Stability or Habitat Metric				-						-														
Biological or Other				-						-														

Table 9. Monitoring Data - Cross-Section Morphology Data Table
Greenbrier Stream Mitigation Project (DMS No. 100086)

	UT1 Reach 1														UT1 Reach 3													
	Cross Section 1 (Pool)							Cross Section 2 (Riffle)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1127.92	1127.87						1120.53	1120.61						1097.81	1097.90						1094.95	1094.80					
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	1.09						1.00	0.94						1.00	0.97						1.00	1.01					
Thalweg Elevation	1126.47	1126.23						1119.35	1119.47						1097.18	1097.28						1092.34	1092.06					
LTOB[2] Elevation	1127.92	1128.02						1120.53	1120.55						1097.81	1097.88						1094.95	1094.84					
LTOB[2] Max Depth (ft)	1.45	1.79						1.18	1.08						0.63	0.60						2.61	2.78					
LTOB[2] Cross Sectional Area (ft^2)	6.70	7.87						3.97	3.59						2.99	2.84						16.41	16.85					
Entrenchment Ratio	-	-						>10.12	>10.11						6.39	5.80						-	-					

	UT1 Reach 3														UT1A							UT1B						
	Cross Section 5 (Riffle)							Cross Section 6 (Pool)							Cross Section 7 (Riffle)							Cross Section 8 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1090.59	1090.64						1086.63	1085.85						1097.98	1097.96						1089.94	1090.00					
Bank Height Ratio - Based on AB Bankfull[1] Area	1	1.02						1.00	1.32364						1	0.90659						1	0.76023					
Thalweg Elevation	1089.85	1089.83						1083.89	1083.24						1097.35	1097.23						1089.59	1089.66					
LTOB[2] Elevation	1090.59	1090.66						1086.63	1086.70						1097.98	1097.89						1089.94	1089.92					
LTOB[2] Max Depth (ft)	0.74	0.83						2.74	3.46						0.63	0.66						0.35	0.26					
LTOB[2] Cross Sectional Area (ft^2)	3.08	3.26						12.61	19.95						1.76	1.47						0.87	0.59					
Entrenchment Ratio	>9.39	>9.1						-	-						4.90	4.98						>5.26	>5.39					

The above morphology parameters reflect the 2018 guidance that arose from the mitigation technical workgroup consisting of DMS, the IRT and industry mitigation providers/practitioners. The outcome resulted in the focus on three primary morphological parameters of interest for the purposes of tracking channel change moving forward. They are the bank height ratio using a constant As-built bankfull area and the cross sectional area and max depth based on each years low top of bank. These are calculated as follows:

1 - Bank Height Ratio (BHR) takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation. For example if the As-built bankfull area was 10 ft2, then the MY1 bankfull elevation would be adjusted until the calculated bankfull area within the MY1 cross section survey = 10 ft2. The BHR would then be calculated with the difference between the low top of bank (LTOB) elevation for MY1 and the thalweg elevation for MY1 in the numerator with the difference between the MY1 bankfull elevation and the MY1 thalweg elevation in the denominator. This same process is then carried out in each successive year.
2 - LTOB Area and Max depth - These are based on the LTOB elevation for each years survey (The same elevation used for the LTOB in the BHR calculation). Area below the LTOB elevation will be used and tracked for each year as above. The difference between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

Note: The smaller the channel the closer the survey measurements are to their limit of reliable detection, therefore inter-annual variation in morphological measurement (as a percentage) is by default magnified as channel size decereases. Some of the variability above is the result of this factor and some is due to the large amount of depositional sediments observed.

Appendix D

Hydrologic Data

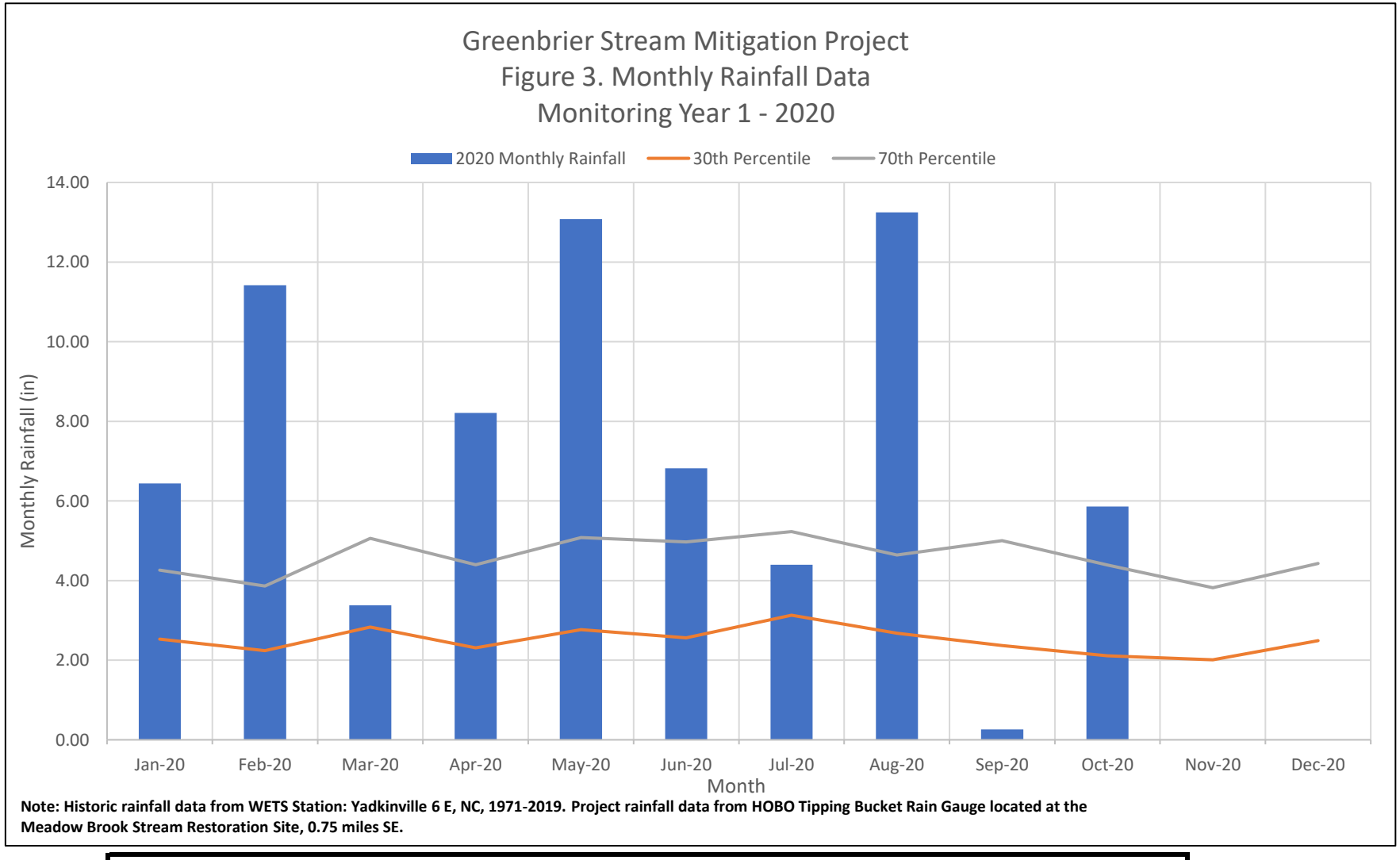
Table 10. Verification of Bankfull Events

Figure 3. Monthly Rainfall Summary Data

Precipitation and Water Level Hydrographs

Table 10. Bankfull Event Verification
Greenbrier Stream Mitigation Project (DMS No. 100086)

Overbank Events							
Gage ID	**MY1 (2020)**	**MY2 (2021)**	**MY3 (2022)**	**MY4 (2023)**	**MY5 (2025)**	**MY6 (2026)**	**MY7 (2027)**
UT1 Reach 1 - GBSG1	6 separate events: 5/27/2020 5/29/2020 8/9/2020-8/11/2020 8/21/2020 9/29/2020 10/11/2020	-	-	-	-	-	-
UT1A - GBSG2	4 separate events: 8/21/2020 9/29/2020 10/11/2020 10/25/2020	-	-	-	-	-	-
UT1B - GBSG3	10 separate events: 5/21/2020 5/24/2020 5/27/2020 5/29/2020 8/15/2020 8/17/2020 8/21/2020 9/29/2020 10/11/2020 10/25/2020	-	-	-	-	-	-

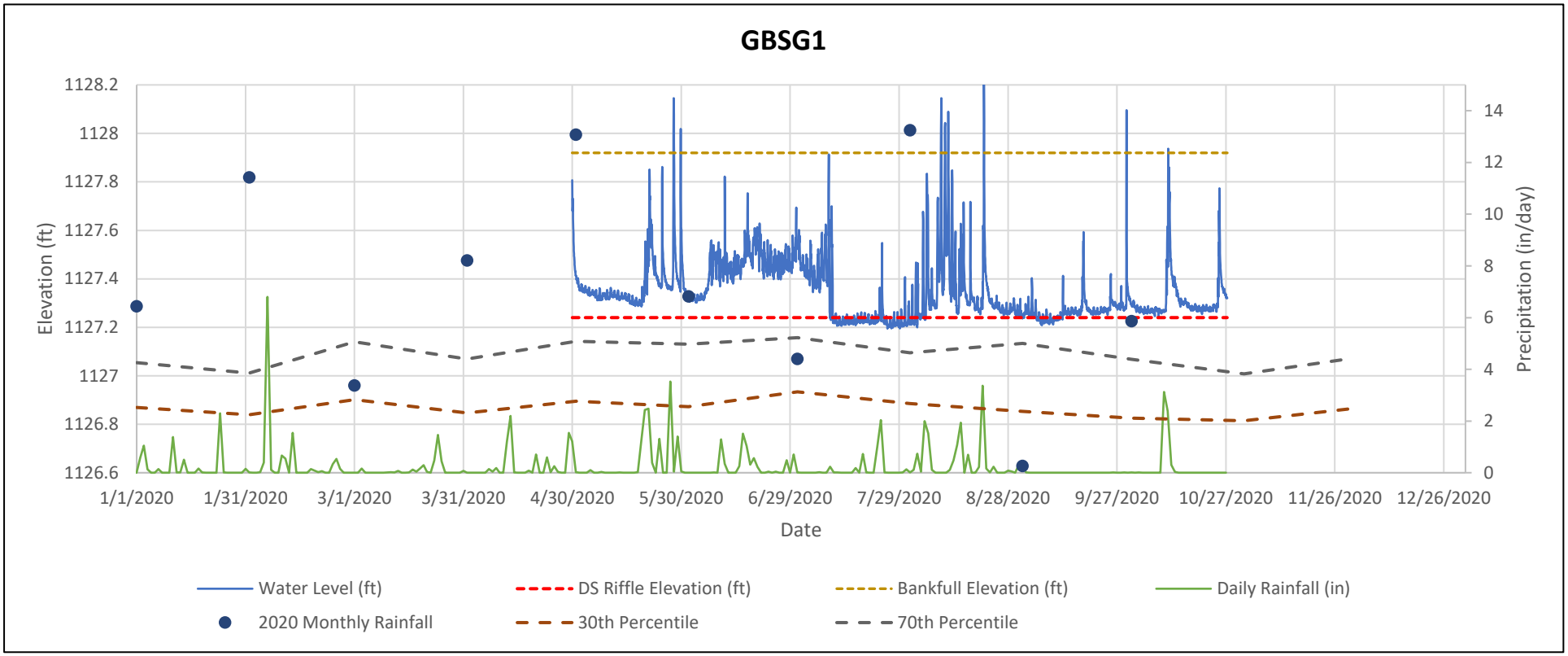


Note: Historic rainfall data from WETS Station: Yadkinville 6 E, NC, 1971-2019. Project rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

Rainfall Summary							
	2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Annual Precip Total	73.12	-	-	-	-	-	-
WETS 30th Percentile	41.65	-	-	-	-	-	-
WETS 70th Percentile	49.68	-	-	-	-	-	-
Normal	Y	-	-	-	-	-	-

*Note: 2020 rainfall data does not include data from November or December because the gauge was last downloaded in October during MY1 monitoring.

Greenbrier Stream Mitigation Project
Year 1 (2020) Streamflow Data

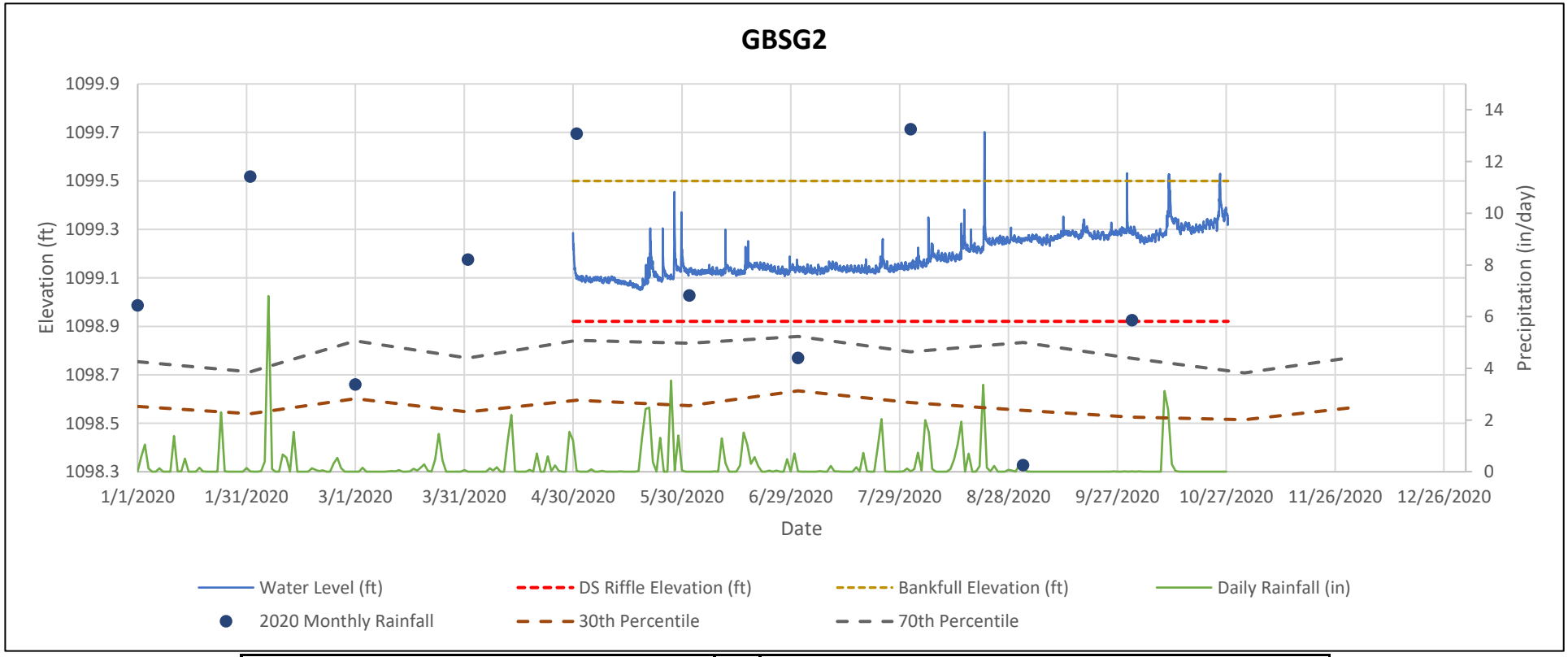


Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1 Reach 1
Date Installed	4/29/2020
Serial Number	20727108
Reach Type	Perennial

-Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.
- Historic rainfall data from WETS Station: Yadkinville 6 E, NC, 1971-2019

Year 1 (2020) Streamflow Data	
Gauge ID	GBSG1
Start Date	1/1/2020
End Date	12/31/2020
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1126.95
Controlling Grade Elevation (ft)	1127.24
Bankfull Elevation (ft)	1127.92
Most Consecutive Days of Flow	181
Total Days of Flow	181
Max High Water Level Above Bankfull (ft)	0.30
Bankfull Events	8
Meets Success Criteria	Yes

Greenbrier Stream Mitigation Project
Year 1 (2020) Streamflow Data

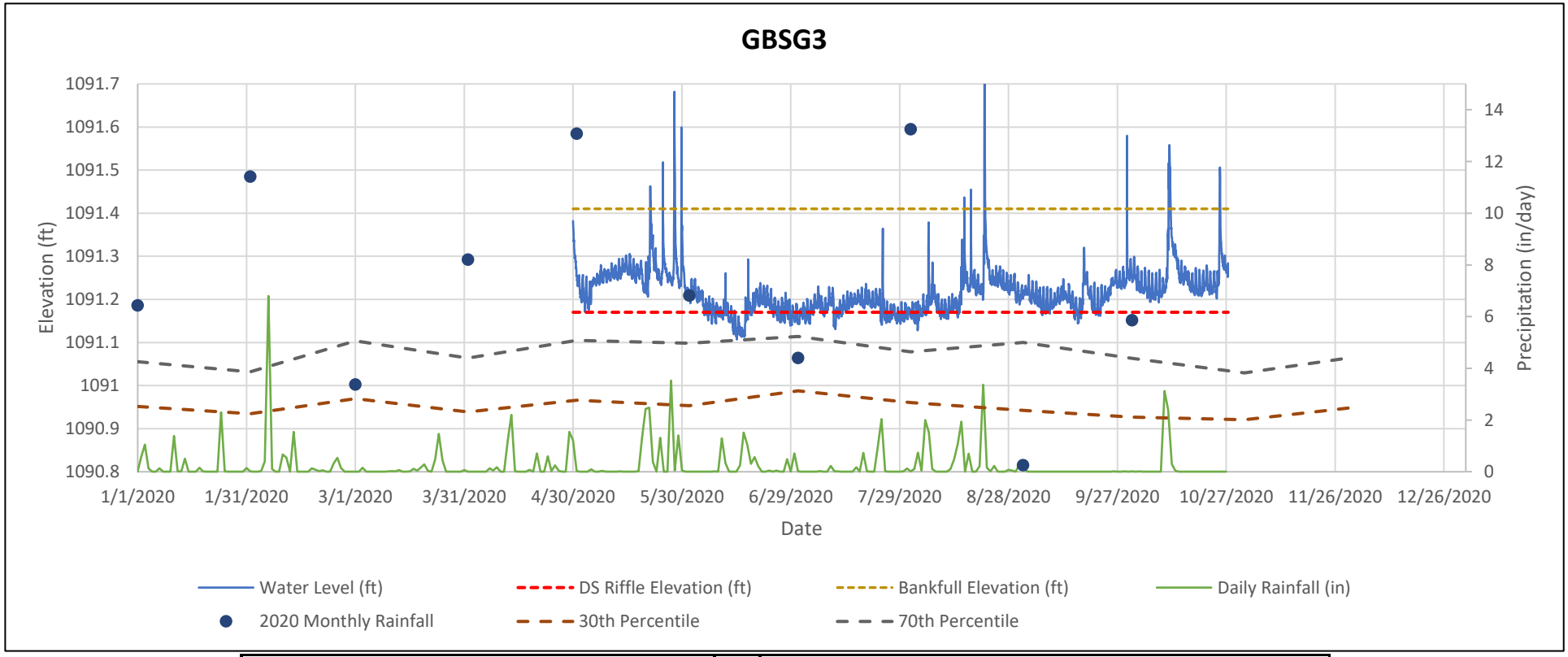


Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1A
Date Installed	4/29/2020
Serial Number	20727105
Reach Type	Perennial

-Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.
- Historic rainfall data from WETS Station: Yadkinville 6 E, NC, 1971-2019

Year 1 (2020) Streamflow Data	
Gauge ID	GBSG2
Start Date	1/1/2020
End Date	12/31/2020
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1098.79
Controlling Grade Elevation (ft)	1098.92
Bankfull Elevation (ft)	1099.5
Most Consecutive Days of Flow	181
Total Days of Flow	181
Max High Water Level Above Bankfull (ft)	0.20
Bankfull Events	6
Meets Success Criteria	Yes

Greenbrier Stream Mitigation Project
Year 1 (2020) Streamflow Data



Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1B
Date Installed	4/29/2020
Serial Number	20758210
Reach Type	Perennial

-Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.
- Historic rainfall data from WETS Station: Yadkinville 6 E, NC, 1971-2019.

Year 1 (2020) Streamflow Data	
Gauge ID	GBSG3
Start Date	1/1/2020
End Date	12/31/2020
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1091.05
Controlling Grade Elevation (ft)	1091.17
Bankfull Elevation (ft)	1091.41
Most Consecutive Days of Flow	134
Total Days of Flow	179
Max High Water Level Above Bankfull (ft)	0.39
Bankfull Events	11
Meets Success Criteria	Yes

Appendix E

Project Timeline and Contact Information

Table 11. Project Activity and Reporting History

Table 12. Project Contacts Table

Table 11. Project Activity and Reporting History
Greenbrier Stream Mitigation Project (NCDMS Project No. 100086)

Elapsed Time Since grading complete: **0 yrs 7 months**
Elapsed Time Since planting complete: **0 yrs 7 months**
Number of reporting Years[1]: **1**

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Institution Date	--	Jun-18
404 permit date	--	Feb-20
Final Mitigation Plan	2018 - 2019	Dec-19
Final Design – Construction Plans	--	Feb-20
Site Earthwork	March - April 2020	Apr-20
Bare-root plantings	--	Apr-20
As-built Survey	Jun-20	Jun-20
As-built Baseline Monitoring Report	May-20	Jul-20
Year 1 Monitoring	Nov-20	Nov-20
Year 2 Monitoring	2021	Nov-21
Year 3 Monitoring	2022	Nov-22
Year 4 Monitoring	2023	Nov-23
Year 5 Monitoring	2024	Nov-24
Year 6 Monitoring	2025	Nov-25
Year 7 Monitoring	2026	Nov-26

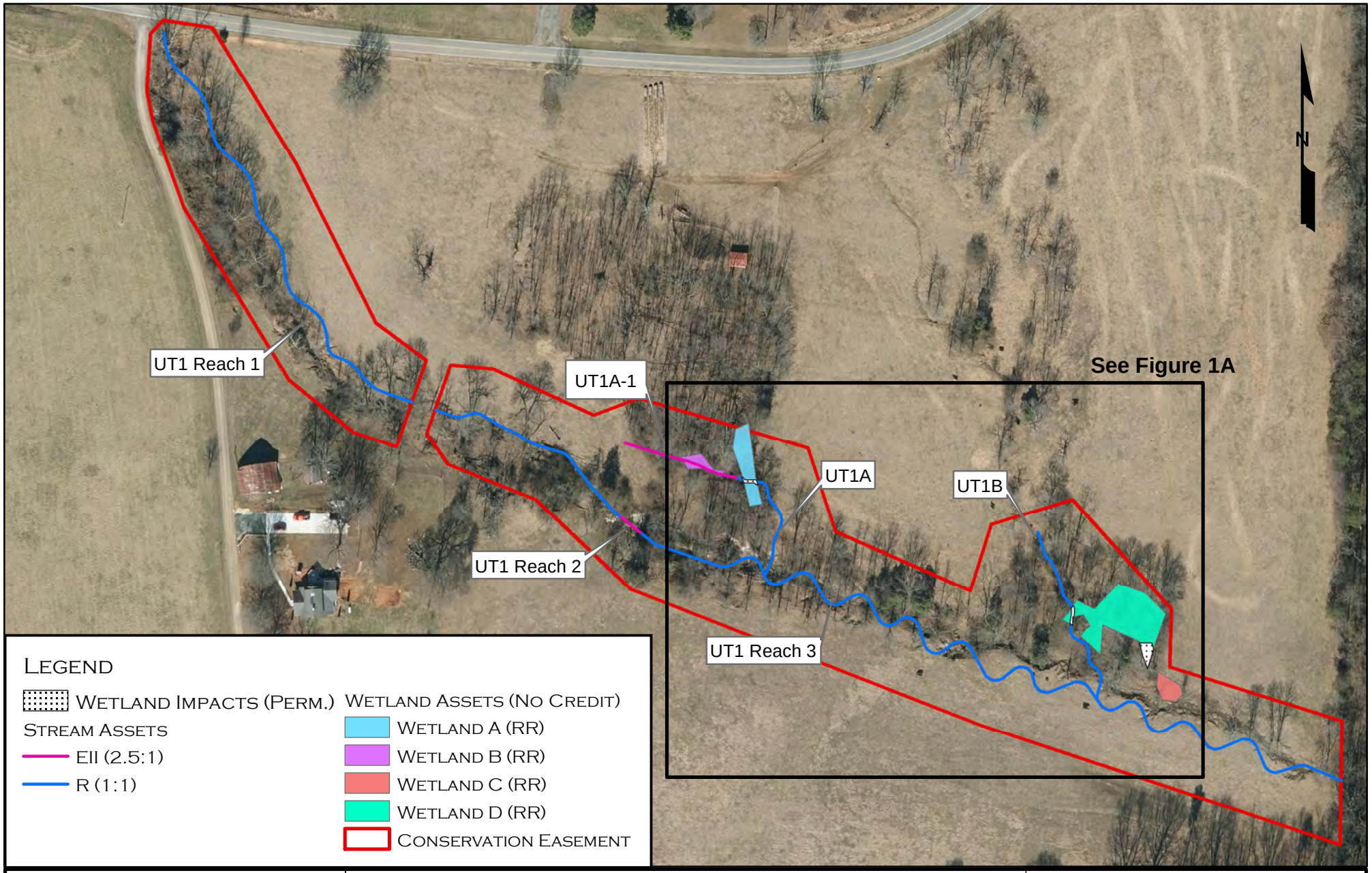
1 = The number of reports or data points produced excluding the baseline

Table 12. Project Contacts Table
Greenbrier Stream Mitigation Project (NCDMS Project No. 100086)

Designer Primary project design POC	Ecosystem Planning and Restoration, PLLC 1150 SE Maynard Road, Suite 140, Cary, NC 27511 Kevin Tweedy, PE (919) 388-0787
Construction Contractor Construction contractor POC	North State Environmental 2889 Lowery St, Winston-Salem, NC 27101 Darrell Westmoreland
Survey Contractor Survey contractor POC	Kinder Land Surveying 203 W. Lebanon St., Mount Airy, NC 27030 Frank Kinder (336) 783-4200
Planting Contractor Planting contractor POC	North State Environmental 2889 Lowery St, Winston-Salem, NC 27101 Darrell Westmoreland
Seeding Contractor Contractor POC	North State Environmental 2889 Lowery St, Winston-Salem, NC 27101 Darrell Westmoreland
Seed Mix Source	Green Resource, Colfax, NC 336-855-6363
Nursery Stock Supplier	Dykes and Son Nursery, McMinnville, TN 931-668-8833
Live Stake Supplier	Foggy Mountain Nursery, Lansing, NC 336-384-5323
Monitoring Performers	Ecosystem Planning and Restoration, PLLC
Stream Monitoring POC	Jake Byers, EPR (828) 348-8580
Vegetation Monitoring POC	Amy James, EPR (919) 388-0787

Appendix F

EPR Responses to IRT MY0 Comments



0 200 Feet	Greenbrier Stream Restoration Wetland Impacts Map – Overview	Prepared for: NCDEQ Division of Mitigation Services
PCN Figure 1	Yadkin County, NC	Prepared by: Ecosystem Planning & Restoration

From:	Jake Byers
To:	Kim Browning; Davis, Erin B
Cc:	Tugwell, Todd J CIV USARMY CESAW (US); Haywood, Casey M CIV (USA); Wilson, Travis W.; Munzer, Olivia; Merritt, Katie; Hamstead, Byron; Wiesner, Paul; Kevin Tweedy; Amy James; Russell Myers
Subject:	RE: [External] Notice of Initial Credit Release/ NCDMS Greenbrier Stream Restoration Site/ SAW-2018-01755/ Yadkin Co.
Date:	Friday, September 11, 2020 9:57:57 AM
Attachments:	Fig1_Wetland_Impacts_Overview.pdf

Hi Kim,

1. The alignment change was above Wetland B (see attached map included with the permit/PJD) and only shifted the upper approximately 40' of UT1A-1 slightly north.
2. We know the species planted on the site per the vegetation plans (species, densities, percentage of each species). When the sites are planted, hundreds of bare-root stems that essentially look like sticks are mixed by hand into sacks so that workers can grab a stem out of the sack, use a dibble bar to open a hole in the ground and plant a bare root, take a couple step and repeat. Identifying which species a tree/shrub is when they essentially look like sticks poking out of the ground can be very difficult and inaccurate which is why we decided to wait until MY1 to identify the species accurately.

Please let me know if you have any more questions.

Thanks,

-Jake

-----Original Message-----
From: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Sent: Friday, September 11, 2020 9:45 AM
To: Jake Byers <jbyers@eprusa.net>; Davis, Erin B <erin.davis@ncdenr.gov>
Cc: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Haywood, Casey M CIV (USA) <Casey.M.Haywood@usace.army.mil>; Travis Wilson (travis.wilson@ncwildlife.org) <travis.wilson@ncwildlife.org>; Munzer, Olivia <olivia.munzer@ncwildlife.org>; Merritt, Katie <katie.merritt@ncdenr.gov>; Hamstead, Byron <byron_hamstead@fws.gov>; Wiesner, Paul <paul.wiesner@ncdenr.gov>; Kevin Tweedy <ktweedy@eprusa.net>; Amy James <ajames@eprusa.net>; Russell Myers <RMyers@eprusa.net>
Subject: RE: [External] Notice of Initial Credit Release/ NCDMS Greenbrier Stream Restoration Site/ SAW-2018-01755/ Yadkin Co.

Thanks for the response, Jake. I do have two questions:
1. Will you please verify that the new alignment did not impact the existing wetlands that were around UT1A-1?
2. Since this is the as-built, shouldn't you know which species of trees are in each plot since they were just planted?

Thanks
Kim

Kim Browning
Mitigation Project Manager, Regulatory Division I U.S. Army Corps of Engineers

-----Original Message-----
From: Jake Byers <jbyers@eprusa.net>
Sent: Friday, September 11, 2020 9:17 AM
To: Davis, Erin B <erin.davis@ncdenr.gov>
Cc: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>; Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Haywood, Casey M CIV (USA) <Casey.M.Haywood@usace.army.mil>; Travis Wilson (travis.wilson@ncwildlife.org) <travis.wilson@ncwildlife.org>; Munzer, Olivia <olivia.munzer@ncwildlife.org>; Merritt, Katie <katie.merritt@ncdenr.gov>; Hamstead, Byron <byron_hamstead@fws.gov>; Wiesner, Paul <paul.wiesner@ncdenr.gov>; Kevin Tweedy <ktweedy@eprusa.net>; Amy James <ajames@eprusa.net>; Russell Myers <RMyers@eprusa.net>
Subject: [Non-DoD Source] RE: [External] Notice of Initial Credit Release/ NCDMS Greenbrier Stream Restoration Site/ SAW-2018-01755/ Yadkin Co.

Good morning,

Please see the responses below to Erin's questions. Please let me know if you need any additional information.

DWR Comments, Erin Davis:

Given the realignment change for UT1A-1, was the proposed vegetative swale feature also constructed in a new location?

The original proposed alignment was incorrect due to survey error. The original alignment did not connect to the low valley point and hydrology source. The realignment was needed to connect to the the existing swale and source of hydrology above UT1A-1. This existing swale impounds some water and is vegetated and buffered by woody vegetation. It was determined during construction that clearing the woody vegetation to grade and plant herbaceous vegetation would create less functional improvement than leaving this feature as is.

Since the vegetative survey was completed in May (growing season), why weren't the stem species identified in the veg plots table?
Very young bare-root tree species are quite difficult to identify, regardless if they are beginning to bud and leaf out. Making guesses of species of individual stems during MY0 when it is unclear, can create unnecessary work and confusion during subsequent monitoring reports by having to change and update tables and counts possibly leading to inaccuracies. All trees will be accurately identified by species during monitoring efforts this fall.

Thanks,

-Jake

Jake Byers, PE

Senior Water Resources Engineer

9 Old Weaver Farm Road

Weaverville, NC 28787

828-348-8580 (office)

828-989-5592 (cell)

919-388-0789 (fax)

From: Wiesner, Paul <paul.wiesner@ncdenr.gov>
Sent: Thursday, September 10, 2020 4:22 PM
To: Jake Byers <jbyers@eprusa.net>; Kevin Tweedy <ktweedy@eprusa.net>; Amy James <ajames@eprusa.net>
Subject: FW: [External] Notice of Initial Credit Release/ NCDMS Greenbrier Stream Restoration Site/ SAW-2018-01755/ Yadkin Co.

Jake, Erin and Kevin;

Can you all respond to Erin's questions from the review? Please CC all with your responses.

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

From: Browning, Kimberly D CIV USARMY CESAW (USA) [mailto:Kimberly.D.Browning@usace.army.mil]
Sent: Thursday, September 10, 2020 4:09 PM
To: Tugwell, Todd J CIV USARMY CESAW (US) <Todd.J.Tugwell@usace.army.mil <mailto:Todd.J.Tugwell@usace.army.mil> >; Davis, Erin B <erin.davis@ncdenr.gov <mailto:erin.davis@ncdenr.gov> >; Haywood, Casey M CIV (USA) <Casey.M.Haywood@usace.army.mil <mailto:Casey.M.Haywood@usace.army.mil> >; Wilson, Travis W. <travis.wilson@ncwildlife.org <mailto:travis.wilson@ncwildlife.org> >; Munzer, Olivia <olivia.munzer@ncwildlife.org <mailto:olivia.munzer@ncwildlife.org> >; Merritt, Katie <katie.merritt@ncdenr.gov <mailto:katie.merritt@ncdenr.gov> >; Byron Hamstead <byron_Hamstead@fws.gov <mailto:byron_Hamstead@fws.gov> >
Cc: Kevin Tweedy <ktweedy@eprusa.net <mailto:ktweedy@eprusa.net> >; Wiesner, Paul <paul.wiesner@ncdenr.gov <mailto:paul.wiesner@ncdenr.gov> >; Amy James <ajames@eprusa.net <mailto:ajames@eprusa.net> >
Subject: [External] Notice of Initial Credit Release/ NCDMS Greenbrier Stream Restoration Site/ SAW-2018-01755/ Yadkin Co.

Good afternoon,

The 15-Day Record Drawing review for the Greenbrier Stream Restoration Site (SAW-2018-01755) ended May 30, 2020. Per Section 332.8(o)(9) of the 2008 Mitigation Rule, this review followed the streamlined review process. All comments received from the NCIRT are incorporated in this email. Please address IRT concerns via email response. There were no objections to issuing the initial credit release. Please find attached the current signed ledger.

DWR Comments, Erin Davis:

Given the realignment change for UT1A-1, was the proposed vegetative swale feature also constructed in a new location?

Since the vegetative survey was completed in May (growing season), why weren't the stem species identified in the veg plots table?

Thanks much,

Kim

Kim Browning

Mitigation Project Manager, Regulatory Division I U.S. Army Corps of Engineers