

Year 4 Monitoring Report
Final
Greenbrier Stream Mitigation Project
Yadkin County, North Carolina
Monitoring Year 4

Data Collection Period:
April, September – October 2023

Submission Date:
December 2023



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
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Prepared By:

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Mr. Paul Wiesner
NCDEQ – Division of Mitigation Services
DEQ Asheville Regional Office
2090 U.S. 70 Highway
Swannanoa, N.C. 28778-8211

December 21, 2023

**RE: Response to Draft MY4 Monitoring Report Comments dated December 13, 2023
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 MY4 Monitoring Report provided December 13, 2023. The comments have been addressed as described below and the Final Baseline Report and electronic deliverables have been revised in response to this review.

Section 2.1.3 Channel Stability: *“To expedite stream shading and stabilization, EPR planted additional live stakes along both UT1A and UT1B in January 2023.”* Please include the species of live stakes installed in MY4 (2023).

- **The supplemental planting list and location map for MY4 (2023) is attached in appendix B in this report.**

Section 2.1.3 Channel Stability: In the report text, please briefly reference MY3 CPA-3 as shown on the CCPV map/s. The report text addresses the lower extent of UT1B but the MY3 CPA-3 callout should be referenced in the text.

- **MY3 CPA-3 is briefly referenced in section 2.1.3 Channel Stability, paragraph four.**

Section 2.2.1 Vegetation Monitoring Data: In the report text, please confirm that EPR conducted a full project site boundary inspection at the end of the MY4 (2023) growing season. Please report the results of the boundary inspection and confirm that no current easement encroachments were observed. Please also report the integrity of the boundary marking and confirm that it currently meets the required DMS specifications.

- **A full boundary walk was performed on October 31, 2023, and is referenced in section 2.2.1 Vegetation Monitoring Data, paragraph two.**

General / Appendix B: In the revised report, please include a supplemental planting list/ table for the January 2023 (MY4) planting effort. The list/ table should be similar to the provided Greenbrier 2021 Supplemental Planting Species List and should include a wetness tolerance column.

- **A supplemental planting species list and wetness tolerance column is attached in appendix B.**

Digital Support File Comments:

- None

If you have any questions regarding the MY4 Monitoring Report, please contact me at 304-661-9974 or via email at rmyers@eprusa.net.

Sincerely,



Russell Myers

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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 damage from cattle. 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)	As-built (ft)	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)	Overall Assets Summary				
		Riverine	Non-Riverine						
Restoration	2,336							Asset Category	Overall Credits
Enhancement				Stream					
Enhancement I									
Enhancement II	193.7								
Rehabilitation									
Preservation									
High Quality Pres									



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;	<ul style="list-style-type: none"> 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. 		<ul style="list-style-type: none"> 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. 	<p><u>Permanent Vegetation Plots</u></p> <p>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.</p>	<p>In MY3, all permanent vegetation plots exceeded the performance standard as indicated for stem density in Year 3 with an average of 556 stems/acre.</p> <p>Vegetation plots were not required to be sampled in MY4 (2023). Vegetation monitoring will resume in MY5 (2024)</p>
Reduce nutrient inputs	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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. 	<p><u>Annual Random Vegetation Plots</u></p> <p>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.</p>	<p>In MY3, the 2 randomly selected vegetation plots exceeded the performance standard as indicated for stem density in Year 3 with an average of 667 stems/acre.</p> <p>Vegetation plots were not required to be sampled in MY4 (2023). Vegetation monitoring will resume in MY5 (2024)</p>
Reduce Fecal Coliform Inputs	<ul style="list-style-type: none"> 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. 		<ul style="list-style-type: none"> Geomorphologic cross sections indicate stable sections over the monitoring period. 		<p>The MY3 monitoring cross-section survey indicated that the project streams are geomorphically stable and restored channel dimensions have not changed significantly as of MY3. Some cross sections showed some fluctuation in depth but all were within the expected range. Overall, the cross sections indicated that all project streams are stable and functioning as intended.</p>
Restore / Enhance Degraded Riparian Buffers	<ul style="list-style-type: none"> Restore riparian buffer vegetation to filter runoff and provide organic matter and shade. Protect riparian buffers with a permanent conservation easement. 		<ul style="list-style-type: none"> 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. 	<p><u>Cross Sections</u></p> <p>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.</p>	
Implement Agricultural BMPs in Agricultural Watersheds	<ul style="list-style-type: none"> 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. 				<p>Cross sections were not required to be sampled in MY4 (2023). Cross section monitoring will resume in MY5 (2024)</p>



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)	<ul style="list-style-type: none"> ▪ 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. 	<ul style="list-style-type: none"> ▪ 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 help to ensure channel stability and will provide greater bedform diversity, enhancing aquatic habitat for native species. 	<ul style="list-style-type: none"> ▪ 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 	<p style="text-align: center;"><u>Stream Profile</u></p> 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 MY4 monitoring. Additional longitudinal profile surveys will not be conducted unless stability issues are identified in future monitoring years.
				<p style="text-align: center;"><u>Visual Assessment</u></p> 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.
				<p style="text-align: center;"><u>Additional Cross Sections</u></p> Only surveyed if instability is documented during monitoring	No channel instability was documented during MY4 monitoring, so no additional cross sections were surveyed.
				<p style="text-align: center;"><u>Stream Hydrology Monitoring</u></p> 3 pressure transducers (1 on UT1, UT1A, and UT1B) 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 MY4 indicate that all three stream gauges met the established success criteria of 30 days or more of consecutive flow throughout the year. In addition, SG-1 (UT1) recorded 2 bankfull events, SG-2 (UT1A) recorded 5 bankfull events, and SG-3 (UT1B) recorded 10 bankfull events in 2023.



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 36.1488 N, longitude 80.8289 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 4 (MY4) data were collected in April 2023, and September through October 2023. 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 are 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 are made using the most recent version of the NCDMS cross section tool. Reference photos are taken of both streambanks to provide a visual assessment of any changes that may have occurred since the previous monitoring year.

Cross sections were not surveyed in MY4 per the approved mitigation plan. The MY3 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 Appendix A. Three more points have been established since baseline monitoring, for a total of nineteen (19) photo points. The locations of each permanent photo point are shown in the CCPV (Figure 2). Visual assessments of channel stability and in-stream structure condition were also made regularly throughout MY4.



MY4 photo points were taken in April 2023 and supplemental photographs and game camera photographs were taken throughout the year. The photo points from MY4 can be found in Appendix A.

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. Some sections of the restored channels that once contained thick herbaceous vegetation (addressed in MY3 monitoring report) have mostly cleared as a result of shading from willows and riparian vegetation. To expedite stream shading and stabilization, EPR staff cut and installed black willow, silky dogwood, and dogwood live stakes and whips on-site along both UT1A and UT1B in January 2023. No live stakes were brought from off-site.

During the IRT Credit Release Site Visit in November 2022, the IRT noted two small, vegetated overbank side channels, one along the left bank of UT1 Reach 1 below the culvert crossing and one along the left bank of UT1B. These two areas are included in the MY4 CCPV as MY3 CPA-1 and MY3 CPA-3. These side channels have been continuously inspected during MY4 site visits. The side channels are stable and have not continued to degrade in MY4. Live stakes planted around the overbank side channels are thriving and helping to stabilize these riparian areas. These side channels are not listed as channel problem areas in MY4 and will not be included as channel problem areas in future monitoring reports.

During the 2022 site visit, the IRT also expressed concern over the lower extent of UT1B being at risk of turning into a braided stream/wetland system. This section includes 128 linear feet of channel with 128 credits being at risk. Visual assessments during MY4 monitoring indicate that UT1b has been largely shaded by riparian vegetation and remains a stable single thread channel clear of herbaceous vegetation. EPR will continue to monitor UT1B in MY5. This section of UT1B is not shown as a channel problem area in MY4. This area is included in the MY4 CCPV as MY3 CPA-2.

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 are compared with the gauge readings to determine whether the stream is flowing and if 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 MY4. Rainfall data is presented in Figure 3. Monthly Rainfall Summary Data and the precipitation and water level hydrographs are included in Appendix D.

In addition to the stream gauges, a game camera was placed on UT1a to provide further data on consecutive days of flow. The camera is oriented facing upstream and takes one photograph of the channel daily. All photographs from the game camera that include the stream channel indicate that the channel has consistent flow, but the camera was blocked by thick herbaceous vegetation during summer 2023. Selected game camera photographs taken over the course of MY4 can be found in Appendix A.



Flow gauge data from MY4 indicates 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 in UT1 (SG-1), the stream had 304 days of consecutive flow and 2 bankfull events during Monitoring Year 4. Data from SG-2, located in UT1A, indicates that the tributary had at least 196 days of consecutive flow and 5 bankfull events. The previous gauge that was installed in UT1a was malfunctioning and a new gauge was installed on 4/19/2023. Before that date, the stream flow data recorded was erroneous and does not appear in the MY4 hydrograph because the recorded elevations were so high. The gauge that was installed in April showed consistent streamflow that is corroborated by the game camera photos. SG-3, which is installed in UT1B, documented at least 141 days of consecutive flow and recorded 10 bankfull events.

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 (4) permanent vegetation monitoring plots are 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 vegetation monitoring year, and the location of these plots is recorded using GPS. Vegetation plots were not sampled in MY4, but vegetation plots for MY3 are shown in the CCPV (Figure 2). Annual vegetation data were compiled and summarized using the most recently updated version of the DMS Vegetation Data Entry Tool for MY3.

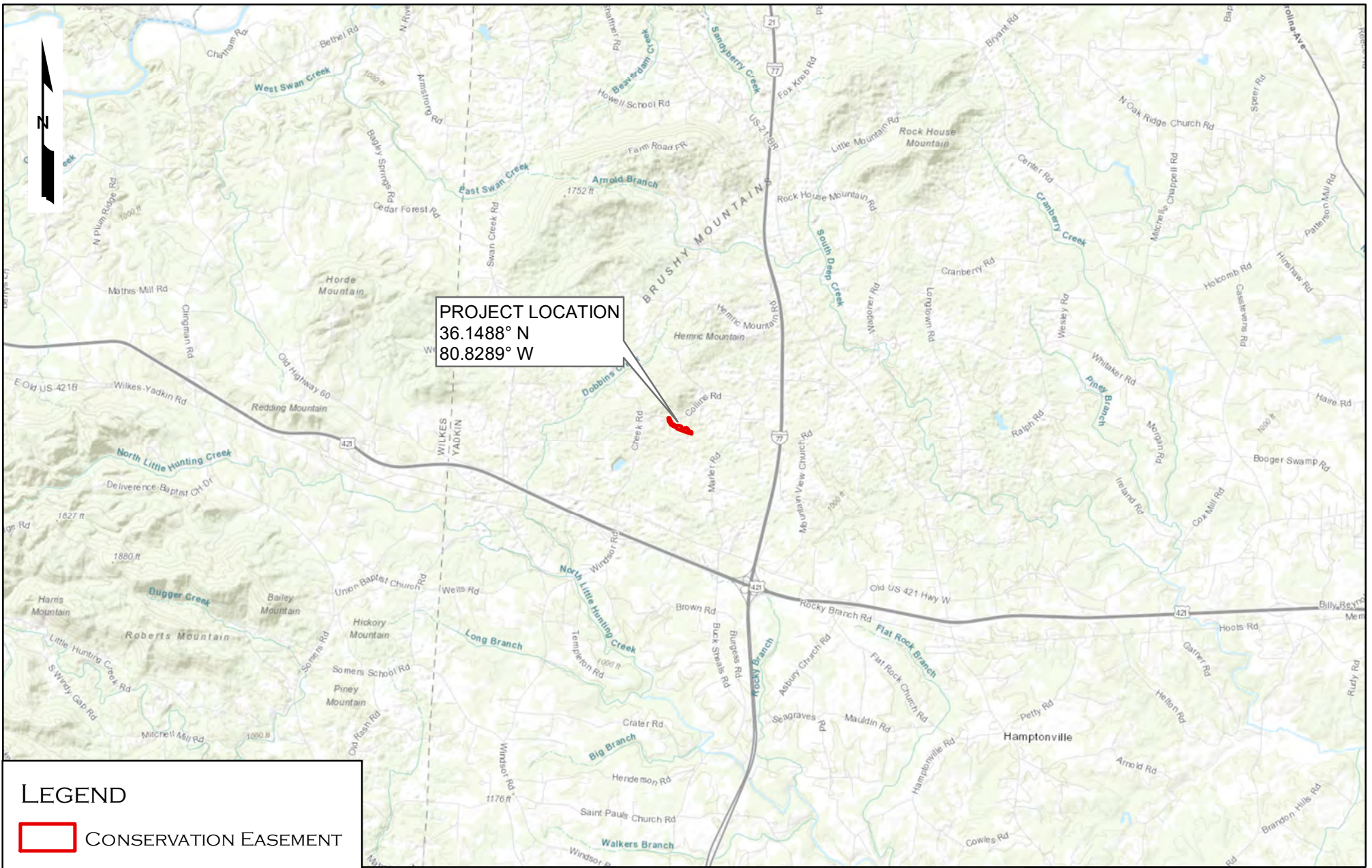
In January 2023, approximately 1.08 acres were supplementally planted using trees that were on the originally approved planting list. This planting addressed small areas of low stem density that were noted during the November 2022 IRT site visit. The supplementally planted areas are shown in the CCPV (Figure 2). A supplemental planting species list and location map from 2021 (MY2) and 2023 (MY4) is provided in Appendix B. EPR staff performed a full boundary walk on October 31, 2023. A few dead small trees were removed from the fence, but no other encroachments or damage were noted. The easement signs were all intact and in place.

No vegetation plots were required to be sampled in MY4 per the Mitigation Plan.

Small amounts of Chinese privet (*Ligustrum sinense*), Bradford pear (*Pyrus calleryana*), and multi-flora rose (*Rosa multiflora*) were spot treated in April and October 2023. No other areas of concern regarding invasive species were noted during subsequent MY4 site visits. Any dispersed invasive species will continue to be treated in MY5.

It was noted during a DMS property boundary assessment on 11/8/2022 that mowing had been occurring within the conservation easement along Meadow Brook Road. The landowner was informed of this encroachment and additional signage and horse tape was installed along the easement boundary in January 2023. Additionally, loose conservation easement signs along the fence were refastened.

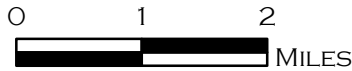




PROJECT LOCATION
 36.1488° N
 80.8289° W

LEGEND

 CONSERVATION EASEMENT



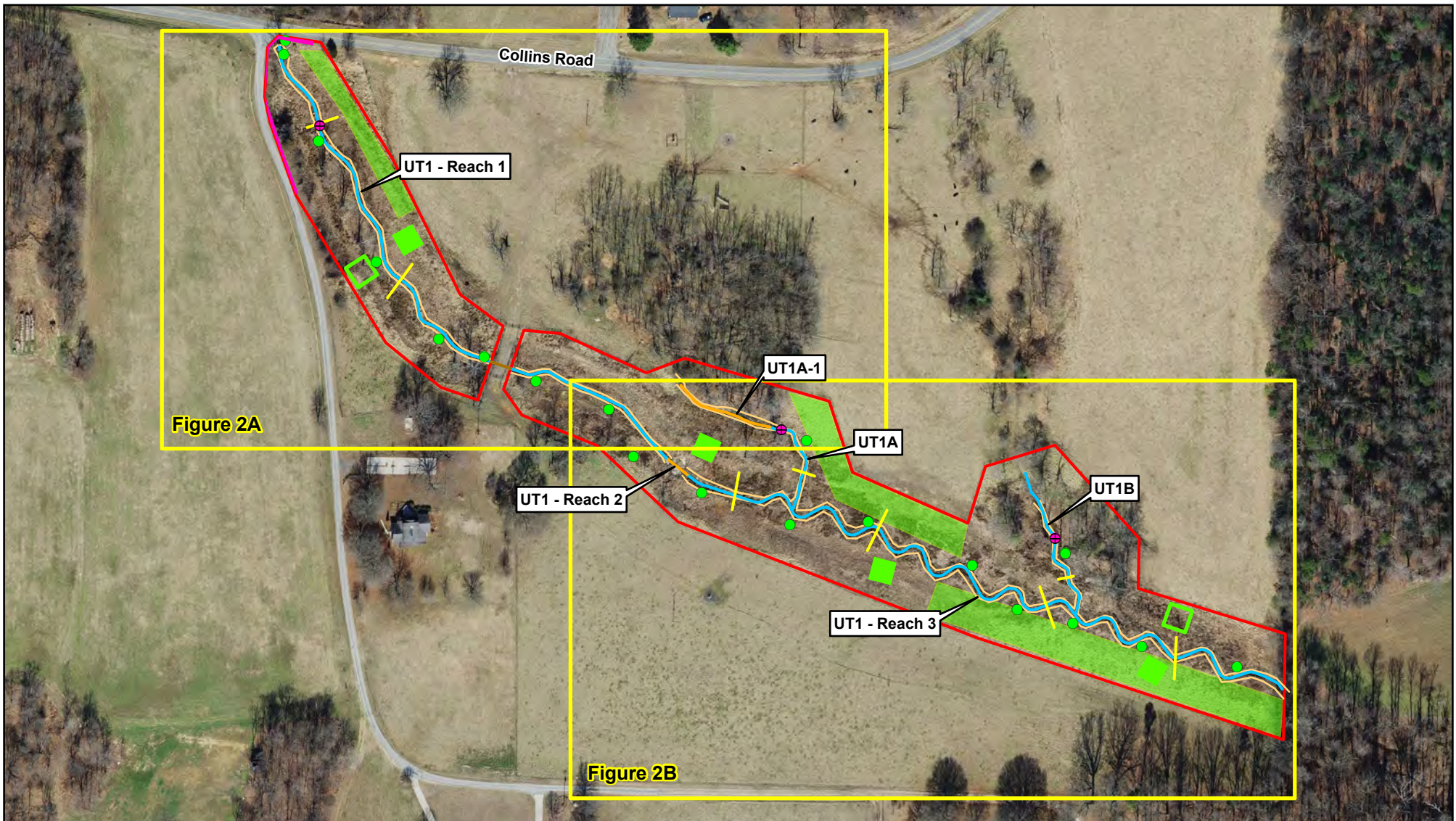
**GREENBRIER STREAM RESTORATION
 VICINITY MAP**

PREPARED FOR:
 NCDEQ
 DIVISION OF
 MITIGATION SERVICES

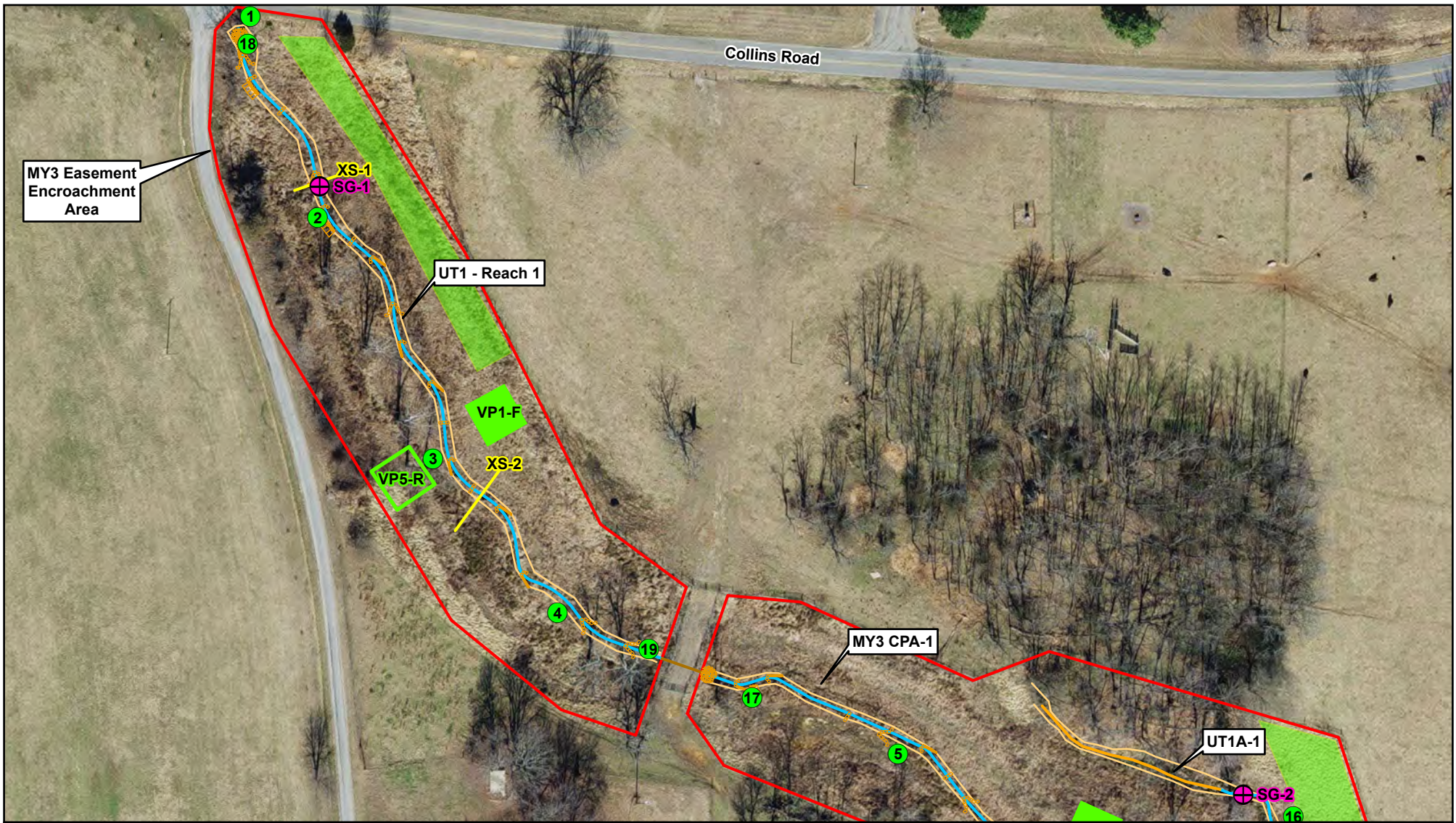
FIGURE 1A

YADKIN COUNTY, NC



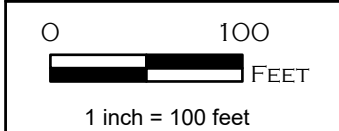


<ul style="list-style-type: none"> — Streams - Restoration — Streams - Enhancement II — No Credit Conservation Easement 	<ul style="list-style-type: none"> — Top of Bank ● Photo Points ⊕ Stream Gauges — Cross Sections 	<ul style="list-style-type: none"> Fixed Veg Plot - Successful in MY3 Random Veg Plot - Successful in MY3 Easement Encroachment January 2023 Supplemental Planting 	
<p>0 100 200 Feet 1 inch = 200 feet</p>	<p>N</p>	<p>GREENBRIER STREAM RESTORATION SITE CURRENT CONDITION PLAN VIEW: OVERVIEW MAP MY4: 2023</p> <p>YADKIN COUNTY, NC</p>	<p style="text-align: right;">NC OneMap Orthoimagery (2018)</p> <div style="display: flex; justify-content: space-between; align-items: center;"> <div> </div> <div> <p>DMS PROJECT ID# 100086 NOV 2023</p> </div> </div> <div style="display: flex; justify-content: space-between; align-items: center; margin-top: 10px;"> <div> </div> <div> <p>ECOSYSTEM PLANNING & RESTORATION</p> </div> </div>
<p>FIGURE 2</p>			



- | | | |
|--------------------------|---------------|-------------------------------------|
| Streams - Restoration | Structures | Cross Sections |
| Streams - Enhancement II | Top of Bank | Fixed Veg Plot - Successful in MY3 |
| No Credit | Photo Points | Random Veg Plot - Successful in MY3 |
| Conservation Easement | Stream Gauges | January 2023 Supplemental Planting |

NC OneMap Orthoimagery (2018)



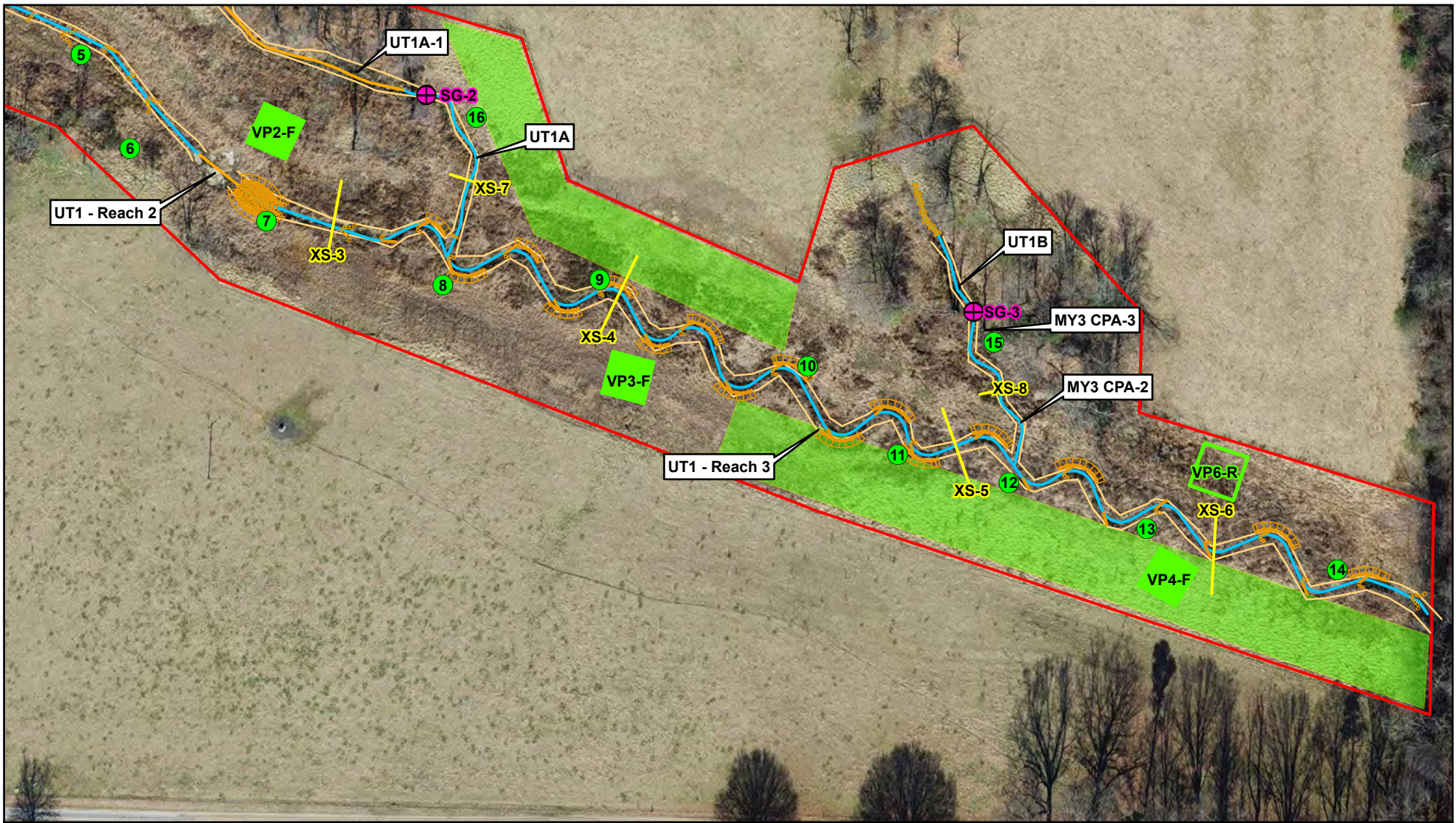
GREENBRIER STREAM RESTORATION SITE
CURRENT CONDITION PLAN VIEW: ASSET MAP
MY4: 2023

 <small>North Carolina Department of Environment & Natural Resources</small>	<p>DMS PROJECT ID# 100086 NOV 2023</p>
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FIGURE 2A

YADKIN COUNTY, NC

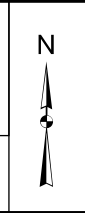
 <small>ECOSYSTEM PLANNING & RESTORATION</small>



Streams - Restoration	Structures	Cross Sections
Streams - Enhancement II	Top of Bank	Fixed Veg Plot - Successful in MY3
No Credit	Photo Points	Random Veg Plot - Successful in MY3
Conservation Easement	Stream Gauges	January 2023 Supplemental Planting

NC OneMap Orthoimagery (2018)

0 100
 FEET
 1 inch = 100 feet



GREENBRIER STREAM RESTORATION SITE
 CURRENT CONDITION PLAN VIEW: ASSET MAP
 MY4: 2023



DMS PROJECT
 ID# 100086
 NOV 2023

FIGURE 2B

YADKIN COUNTY, NC



3.0 REFERENCES

- North Carolina Department of Environmental Quality, Division of Mitigation Services (DMS). DMS Vegetation Data Entry Tool, March 2022. 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/
- North Carolina Department of Environmental Quality, Division of Mitigation Services (DMS). Annual Monitoring Report Format, Data, and Content Requirements, October 2020.
- 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

MY3 Vegetation Photo Log

MY4 Stream 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
 Assessment Date 10/31/2023

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 <u>NOT</u> 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
 Assessment Date 10/31/2023

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 <u>NOT</u> 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
 Assessment Date 10/31/2023

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 <u>NOT</u> 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
 Assessment Date 10/31/2023

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 <u>NOT</u> 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**
Assessment Date **10/31/2023**

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	0.00	0.0%
Total			0.00	0.0%
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			0.00	0.0%

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		

Note: Vegetation plot photos were not taken in 2023 (MY4). Photos will be taken in 2024 (MY5).

Greenbrier Stream Mitigation Project Monitoring Year 3 - Vegetation Photo Log



Veg Plot 1 – NE Corner (07/26/2022)



Veg Plot 2 – NW Corner (07/26/2022)



Veg Plot 3 – NW Corner (07/26/2022)



Veg Plot 4 – NW Corner (07/26/2022)



Veg Plot 5 R – S Corner (07/26/2022)



Veg Plot 6 R – S Corner (07/26/2022)

Greenbrier Stream Mitigation Project Monitoring Year 4 – Stream Photo Log



Photo Point 1 – UT1 Reach 1, Sta. 10+00
Facing Downstream (04/11/2023)



Photo Point 2 – UT1 Reach 1, Sta. 11+50
Facing Upstream (04/11/2023)



Photo Point 3 – UT1 Reach 1, Sta. 13+55
Facing Downstream (04/11/2023)



Photo Point 4 – UT1 Reach 1, Sta. 15+00
Facing Downstream (04/11/2023)



Photo Point 5 – UT1 Reach 1, Sta. 17+60
Facing Upstream (04/11/2023)



Photo Point 6 – UT1 Reach 1, Sta. 18+50
Facing Downstream (04/11/2023)

Greenbrier Stream Mitigation Project Monitoring Year 4 - Stream Photo Log



Photo Point 7 – UT1 Reach 3, Sta. 19+60
Facing Upstream (04/11/2023)



Photo Point 8 – UT1 Reach 3, Sta. 21+00
Looking Upstream at UT1A From UT1 (04/11/2023)



Photo Point 9 – UT1 Reach 3, Sta. 22+40
Facing Downstream (04/11/2023)



Photo Point 10 – UT1 Reach 3, Sta. 24+30
Facing Upstream (04/11/2023)

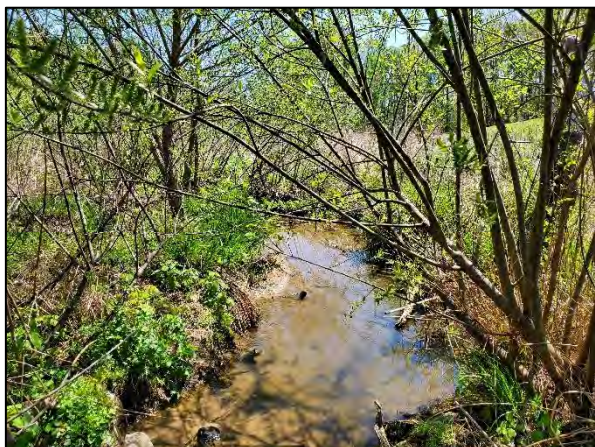


Photo Point 11 – UT1 Reach 3, Sta. 25+55
Facing Downstream (04/11/2023)



Photo Point 12 – UT1 Reach 3, Sta. 26+45
Looking Upstream at UT1B From UT1 (04/11/2023)

Greenbrier Stream Mitigation Project Monitoring Year 4 - Stream Photo Log



Photo Point 13 – UT1 Reach 3, Sta. 27+55
Facing Upstream (04/11/2023)



Photo Point 14 – UT1 Reach 3, Sta. 29+45
Facing Downstream (04/11/2023)



Photo Point 15A – UT1B, Sta. 11+90
Facing Downstream (04/11/2023)



Photo Point 15B – UT1B, Sta. 11+90
Facing Upstream (04/11/2023)

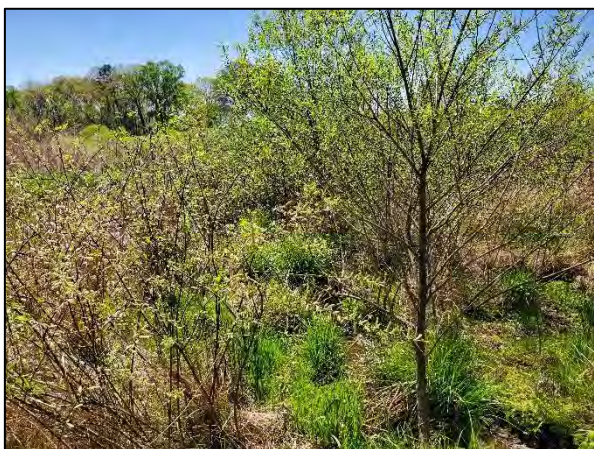


Photo Point 16A – UT1A, Sta. 12+00
Facing Downstream (04/11/2023)



Photo Point 16B – UT1A, Sta. 12+00
Facing Upstream Towards UT1A-1 (04/11/2023)

Greenbrier Stream Mitigation Project Monitoring Year 4 - Stream Photo Log



Photo Point 17 – UT1 Reach 1, Sta. 16+50
Facing Upstream (04/11/2023)



Photo Point 18 – UT1 Reach 1, Sta. 10+30
Facing Upstream (4/11/2023)



Photo Point 19 – UT1 Reach 1, Sta. 15+50
Facing Downstream (04/11/2023)

**Greenbrier Stream Mitigation Project
Monitoring Year 4 – Supplemental Photos**



Game Cam UT1a – 12/22/2023



Game Cam UT1a – 1/24/2023



Game Cam UT1a – 2/21/2023



Game Cam UT1a – 3/15/2023



Game Cam UT1a – 4/11/2023



Game Cam UT1a – 9/14/2023

****Note: vegetation blocked game camera view of the stream from 4/21/23-9/13/2023.***

Greenbrier Stream Mitigation Project Monitoring Year 4 – Supplemental Photos



Game Cam UT1a – 9/23/2023



Game Cam UT1a – 10/14/2023



Game Cam UT1a – 10/30/2023



Game Cam installed on UT1a – 10/31/2023



Constructed riffle facing downstream, UT1– 10/31/2023



Lateral scour pool, UT1 – 10/31/2023



Site Overview
Facing Northeast (4/14/2023)

Appendix B

Vegetation Plot Data

Table 6. MY3 Vegetation Plot Data

Table 7. MY3 Vegetation Performance Standards Summary

2021 (MY2) Supplemental Planting Species List

2021 (MY2) Supplemental Planting Location Map

2023 (MY4) Supplemental Planting list and Location Map

NOTE: NO VEGETATION PLOT DATA WERE COLLECTED IN 2023 (MY4)

VEGETATION MONITORING WILL RESUME IN 2024 (MY5)

NOTE: NO VEGETATION PLOT DATA WERE COLLECTED IN 2023 (MY4). VEGETATION MONITORING WILL RESUME IN 2024 (MY5)

**Table 6. MY3 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)	2021-03-03
Date(s) Mowing	N/A
Date of Current Survey	2022-10-08
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	<i>Alnus serrulata</i>	hazel alder	Tree	FACW							1	1		
	<i>Betula nigra</i>	river birch	Tree	FACW	5	5			4	4	1	1	1	2
	<i>Cercis canadensis</i>	eastern redbud	Tree	UPL			1	1			1	1		
	<i>Cornus amomum</i>	silky dogwood	Shrub	FACW	1	1								1
	<i>Diospyros virginiana</i>	common persimmon	Tree	FAC	2	2	7	7	1	1	1	1		1
	<i>Liriodendron tulipifera</i>	tuliptree	Tree	FACU					2	2	1	1		
	other										1	1		
	<i>Platanus occidentalis</i>	American sycamore	Tree	FACW	6	6	3	3	1	1	2	2	5	8
	<i>Quercus nigra</i>	water oak	Tree	FAC					1	1	1	1		
	<i>Quercus phellos</i>	willow oak	Tree	FACW	1	1			1	1	1	1		
<i>Salix nigra</i>	black willow	Tree	OBL	1	1							12		
<i>Sambucus canadensis</i>	American black elderberry	Tree												2
<i>Ulmus americana</i>	American elm	Tree	FAC	5	5			3	3					1
Sum	Performance Standard				21	21	11	11	13	13	10	10	18	15
Post Mitigation Plan Species	<i>Acer rubrum</i>	red maple	Tree	FAC										1
	<i>Hamamelis virginiana</i>	American witchhazel	Tree	FACU							1			
Sum	Proposed Standard				21	21	11	11	13	13	10	10	18	15
Mitigation Plan Performance Standard	Current Year Stem Count					21		11		13		10	18	15
	Stems/Acre					850		445		526		405	728	607
	Species Count					7		3		7		9	3	6
	Dominant Species Composition (%)					29		64		31		18	67	50
	Average Plot Height (ft.)					2		5		1		2	7	3
% Invasives					0		0		0		0	0	0	
Post Mitigation Plan Performance Standard	Current Year Stem Count					21		11		13		10	18	15
	Stems/Acre					850		445		526		405	728	607
	Species Count					7		3		7		9	3	6
	Dominant Species Composition (%)					29		64		31		18	67	50
	Average Plot Height (ft.)					2		5		1		2	7	3
% Invasives					0		0		0		0	0	0	

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.

Meets Interim Success Criteria	Does Not Meet Interim Success Criteria
--------------------------------	--

NOTE: NO VEGETATION PLOT DATA WERE COLLECTED IN 2023 (MY4). VEGETATION MONITORING WILL RESUME IN 2024 (MY5)

**Table 7. MY3 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	850	2	7	0	445	5	3	0	526	1	7	0
Monitoring Year 2	769	2	7	0	486	3	5	0	769	1	7	0
Monitoring Year 1	445	2	8	0	364	2	4	0	688	1	7	0
Monitoring Year 0	729	2	9	0	607	1	5	0	769	1	7	0
	Veg Plot 4 F				Veg Plot 5 R				Veg Plot 6 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	405	2	9	0	728	7	3	0	607	3	6	0
Monitoring Year 2	405	2	7	0	526	2	6	0	810	2	7	0
Monitoring Year 1	162	2	3	0	283	2	5	0	972	3	2	0
Monitoring Year 0	486	1	4	0								

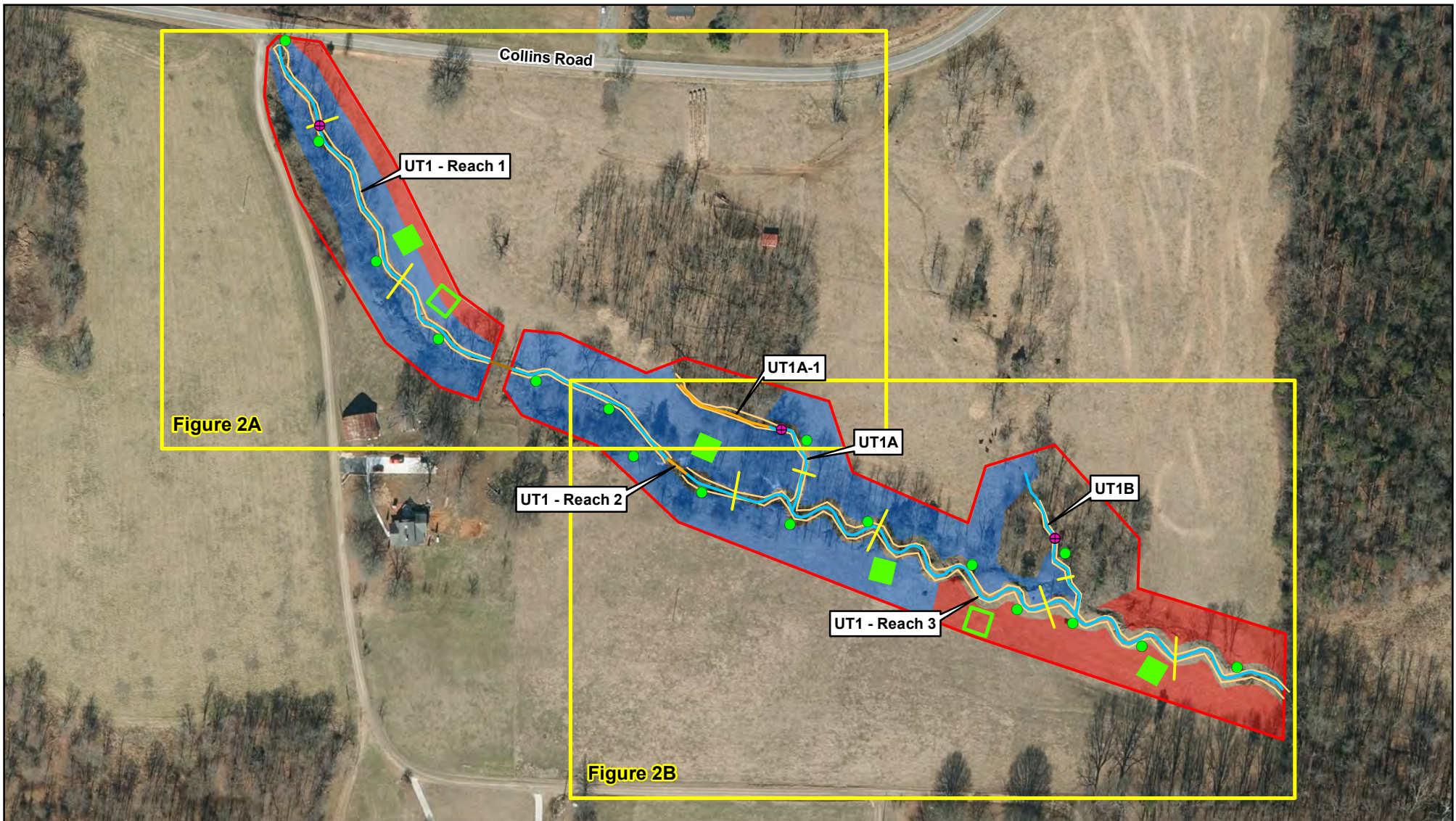
*Each monitoring year represents a different plot for the random vegetation plot "groups". Random plots are denoted with an R, and fixed plots with an F.

Note: DMS Vegetation Tool is not correctly calculating previous monitoring years stem counts due to an error in program. MY3 stem counts are accurate.

Meets Interim Success Criteria	Does Not Meet Interim Success Criteria
--------------------------------	--

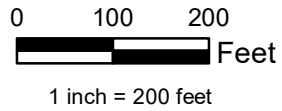
Greenbrier 2021 Supplemental Planting Species List

Trees and Shrubs			
<p>The following table lists bare-root vegetation selection for the 2021 replanting effort.</p> <p>-Trees were planted in replanting areas at a total density of 500 stems per acre. Total replanting area was approximately 1.28 acres.</p> <p>-Trees were planted in supplemental planting areas at a total density of 200 stems per acre. Total replanting area was approximately 3.19 acres.</p>			
Common Name	Scientific Name	Percent Planted by Species	Wetness Tolerance
Trees (75%) Planted 9' X 9' Spacing – 538 Trees/ Acre			
River Birch	<i>Betula nigra</i>	20%	FACW
Sycamore	<i>Platanus occidentalis</i>	20%	FACW
Water Oak	<i>Quercus nigra</i>	10%	FAC
American Elm	<i>Ulmus americana</i>	10%	FACW
Persimmon	<i>Diospyros virginiana</i>	10%	FAC
Willow Oak	<i>Quercus phellos</i>	10%	FAC
Tulip Poplar	<i>Liriodendron tulipifera</i>	20%	FAC
	Tree Total	100%	
Shrubs (25%) Planted 16' X 16' Spacing - 164 Shrubs/ Acre			
Tag Alder	<i>Alnus serrulata</i>	20%	FACW
Spicebush	<i>Lindera benzoin</i>	25%	FACW
Redbud	<i>Cercis canadensis</i>	20%	FACU
Elderberry	<i>Sambucus canadensis</i>	15%	FAC
Silky Dogwood	<i>Cornus amomum</i>	20%	FACW
	Shrub Total	100%	



- Streams - Restoration
- Streams - Enhancement
- No Credit
- Conservation Easement
- Top of Bank
- Photo Points
- ⊕ Stream Gauges
- Cross Sections
- Fixed Veg Plot - Successful
- Random Veg Plot - Successful
- 2021 Replanting
- 2021 Supplemental Planting

NC OneMap Orthoimagery (2018)



GREENBRIER STREAM RESTORATION SITE
 SUPPLEMENTAL PLANTING LOCATION MAP
 IN 2021 (MY2)

YADKIN COUNTY, NC



DMS PROJECT
 ID# 100086
 DEC 2021



Greenbrier 2023 Supplemental Planting Species List

2023 Supplemental Planting			
Date(s) Planted:	1/19/2023	Planter(s):	TB, AD, RM, JB, JC
Acre(s) Planted:	1.08	Trees per Acre:	436
Tree Condition:	24-30" tall, bare root,		
Site Conditions:	45 degrees, 20+ mph winds		
Planting Locations:	See attached pdf		

Tree Species used for Supplemental Planting			
--	--	--	--

Common Name	Percent Planted by Species	Calculated Trees	Actual Tree Order
River Birch	20%	94	100
Sycamore	20%	94	100
Water Oak	10%	47	50
American Elm	10%	47	50
Persimmon	10%	47	50
Willow Oak	10%	47	50
Tulip Poplar	20%	94	100
	100%	471	500

Notes:

Original Planting List in Mitigation Plan			
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Common Name	Scientific Name	Percent Planted by Species	Wetness Tolerance
Trees (75%) Planted 9' X 9' Spacing – 538 Trees/ Acre			
River Birch	<i>Betula nigra</i>	20%	FACW
Sycamore	<i>Platanus occidentalis</i>	20%	FACW
Water Oak	<i>Quercus nigra</i>	10%	FAC
American Elm	<i>Ulmus americana</i>	10%	FACW
Persimmon	<i>Diospyros virginiana</i>	10%	FAC
Willow Oak	<i>Quercus phellos</i>	10%	FAC
Tulip Poplar	<i>Liriodendron tulipifera</i>	20%	FAC
	Tree Total	100%	
Shrubs (25%) Planted 16' X 16' Spacing - 164 Shrubs/ Acre			
Tag Alder	<i>Alnus serrulata</i>	20%	FACW
Spicebush	<i>Lindera benzoin</i>	25%	FACW
Redbud	<i>Cercis canadensis</i>	20%	FACU
Elderberry	<i>Sambucus canadensis</i>	15%	FAC
Silky Dogwood	<i>Cornus amomum</i>	20%	FACW
	Shrub Total	100%	

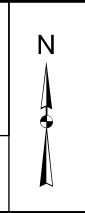


Streams - Restoration	Structures	Cross Sections
Streams - Enhancement	Top of Bank	Fixed Veg Plot - Successful
No Credit	Photo Points	Random Veg Plot - Successful
Conservation Easement	Stream Gauges	2023 - Supplemental Planting

NC OneMap Orthoimagery (2018)

0 100
 FEET
 1 inch = 100 feet

2023 SUPPLEMENTAL PLANTING



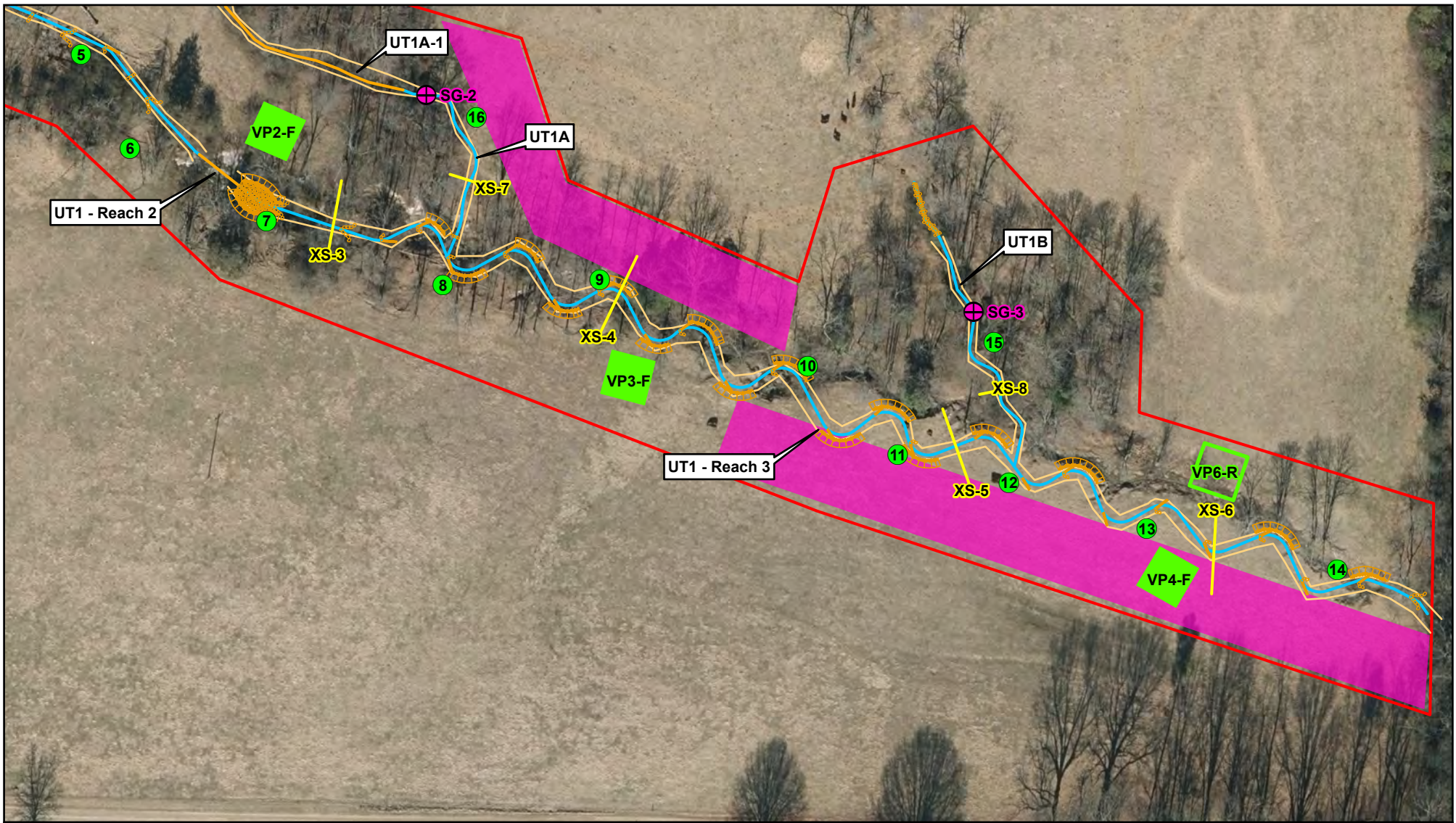
GREENBRIER STREAM RESTORATION SITE
 CURRENT CONDITION PLAN VIEW: ASSET MAP
 MY4: 2023

YADKIN COUNTY, NC



DMS PROJECT
 ID# 100086
 DEC 2023

ECOSYSTEM PLANNING & RESTORATION

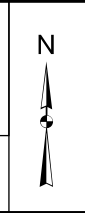


Streams - Restoration	Structures	Cross Sections
Streams - Enhancement	Top of Bank	Fixed Veg Plot - Successful
No Credit	Photo Points	Random Veg Plot - Successful
Conservation Easement	Stream Gauges	2023 - Supplemental Planting

NC OneMap Orthoimagery (2018)

0 100
 FEET
 1 inch = 100 feet

2023 SUPPLEMENTAL PLANTING



GREENBRIER STREAM RESTORATION SITE
 CURRENT CONDITION PLAN VIEW: ASSET MAP
 MY4: 2023

YADKIN COUNTY, NC



DMS PROJECT
 ID# 100086
 DEC 2023

ECOSYSTEM PLANNING & RESTORATION

Appendix C

Stream Geomorphology Data

MY3 Cross-Sections With Annual Overlays

Table 8. MY3 Baseline Stream Data Summary

Table 9. MY3 Cross-Section Morphology Data Table

NOTE: NO CROSS SECTION DATA COLLECTED IN 2023 (MY4)

CROSS SECTION DATA COLLECTION WILL RESUME IN 2024 (MY5)

**NOTE: NO CROSS SECTION DATA WERE COLLECTED IN 2023 (MY4)
CROSS SECTION DATA COLLECTION WILL RESUME IN 2024 (MY5)**

Cross Section Plot - MY3 - October 2022

XS1 - UT1 Reach 1

Rosgen Stream Type - B4

Station 11+28 - Pool

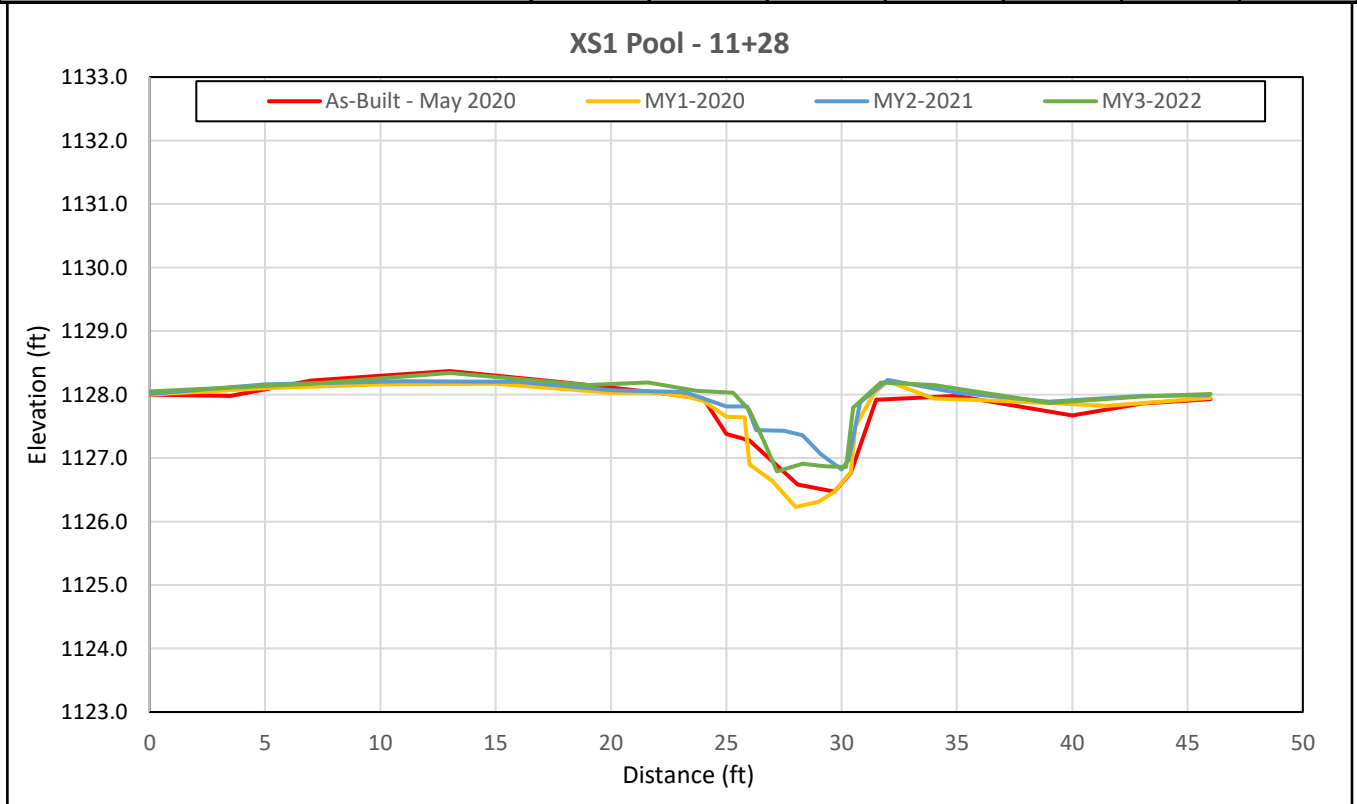


XS1 looking upstream



XS1 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1127.92	1127.87	1128.35	1128.35			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.09	0.8	0.79			
Thalweg Elevation	1126.47	1126.23	1126.82	1126.79			
LTOB Elevation	1127.92	1128.02	1128.04	1128.03			
LTOB Max Depth	1.45	1.79	1.22	1.24			
LTOB Cross Sectional Area	6.70	7.87	4.17	4.78			
Entrenchment Ratio	-	-	-	-			



Cross Section Plot - MY3 - October 2022

XS2 - UT1 Reach 1

Rosgen Stream Type - B4

Station 13+91 - Riffle

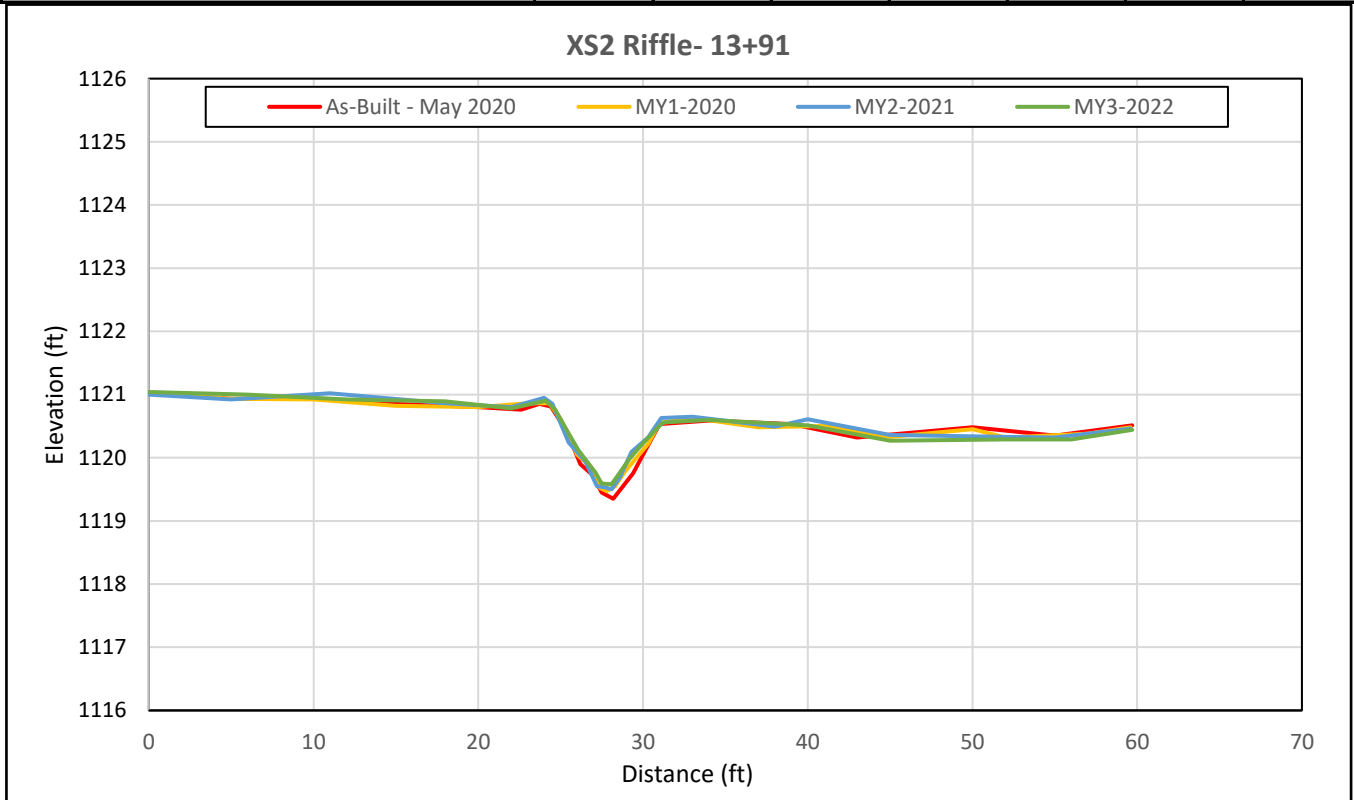


XS2 looking upstream



XS2 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1120.53	1120.61	1120.65	1120.69			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94	0.98	0.88			
Thalweg Elevation	1119.35	1119.47	1119.50	1119.58			
LTOB Elevation	1120.53	1120.55	1120.63	1120.56			
LTOB Max Depth	1.18	1.08	1.13	0.98			
LTOB Cross Sectional Area	3.97	3.59	3.86	3.19			
Entrenchment Ratio	>10.12	>10.11	>10.17	>10.09			



Cross Section Plot - MY3 - October 2022

XS3 - UT1 Reach 3

Rosgen Stream Type - C4

Station 19+94 - Riffle

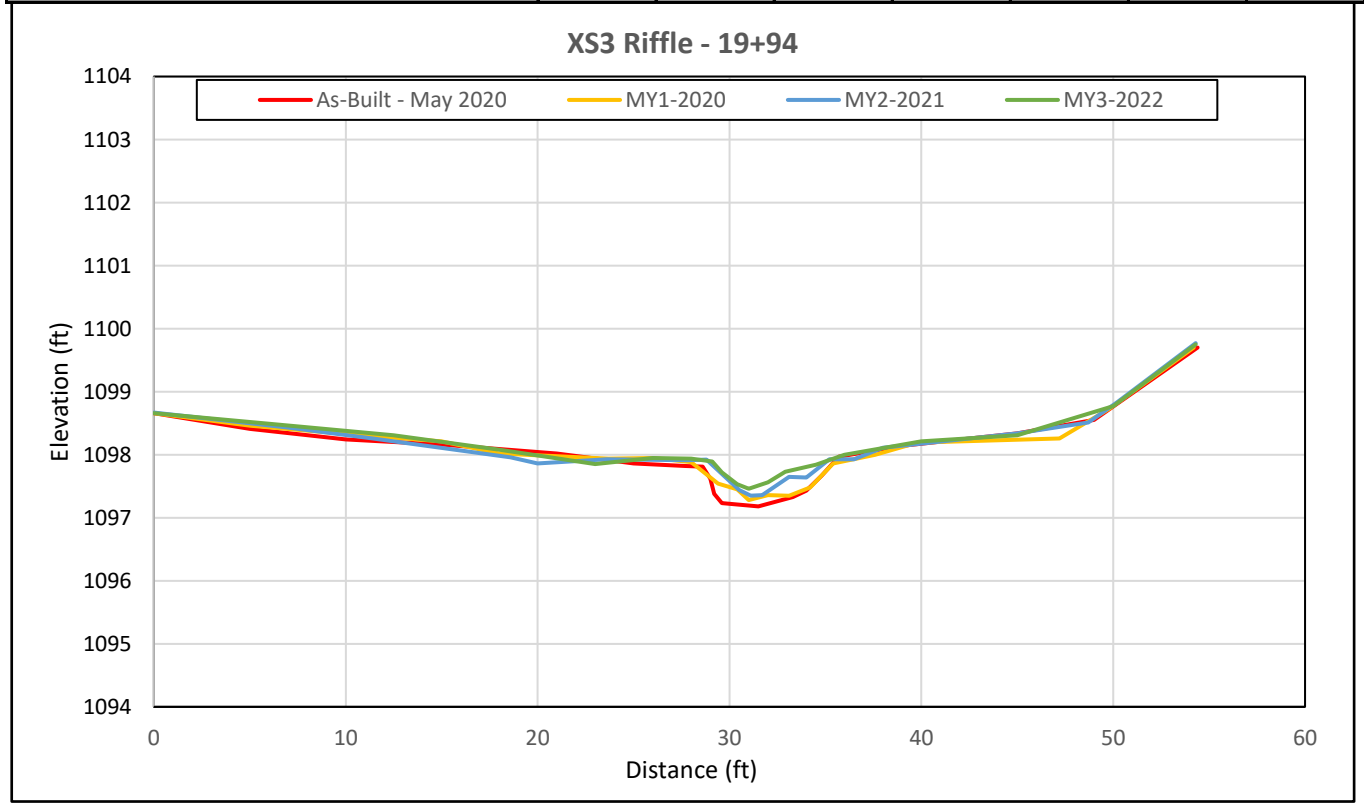


XS3 looking upstream



XS3 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1097.81	1097.90	1098.07	1098.13			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.97	0.79	0.72			
Thalweg Elevation	1097.18	1097.28	1097.35	1097.46			
LTOB Elevation	1097.81	1097.88	1097.92	1097.94			
LTOB Max Depth	0.63	0.60	0.57	0.48			
LTOB Cross Sectional Area	2.99	2.84	2.05	1.60			
Entrenchment Ratio	6.39	5.80	5.75	4.86			



Cross Section Plot - MY3 - October 2022

XS4 - UT1 Reach 3

Rosgen Stream Type - C4

Station 22+48 - Pool

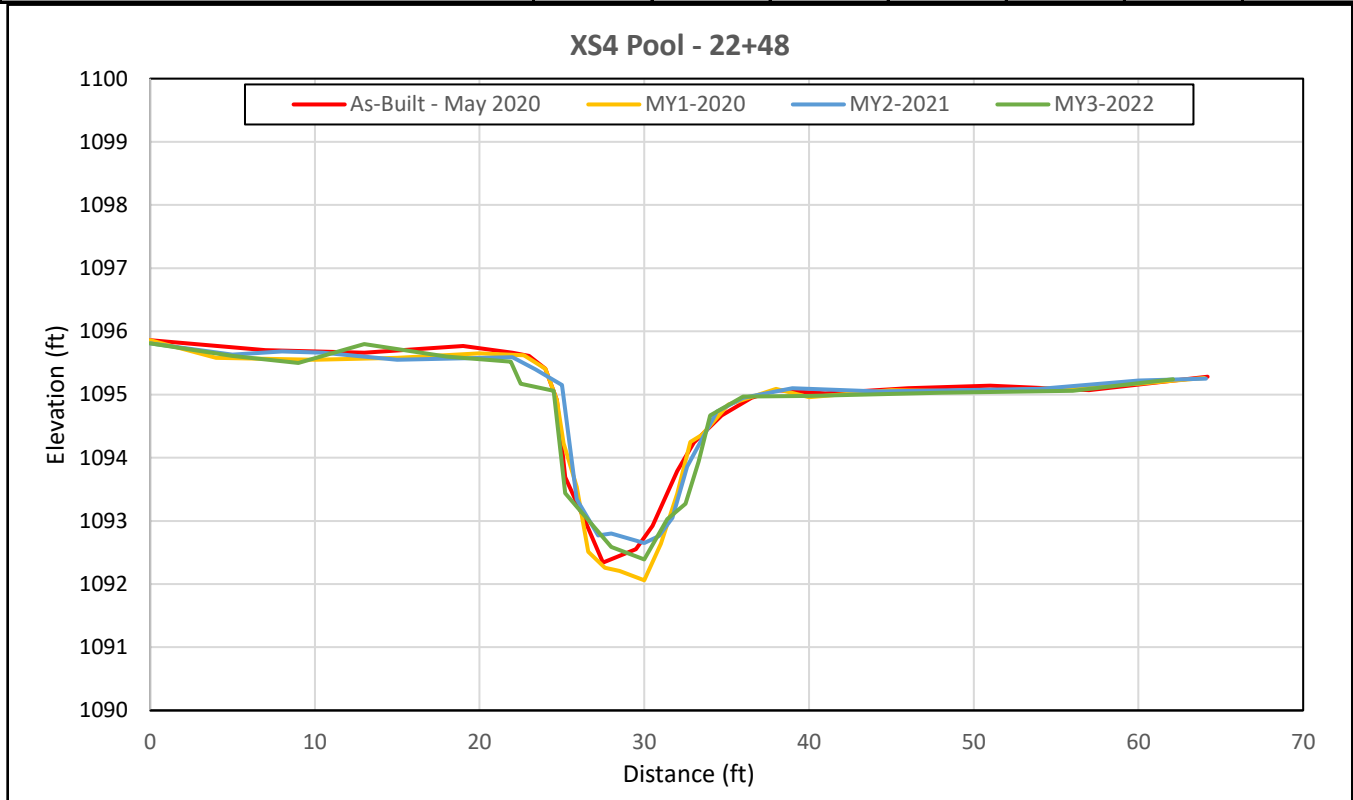


XS4 looking upstream



XS4 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1094.95	1094.80	1095.02	1094.83			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.01	1.04	1.06			
Thalweg Elevation	1092.34	1092.06	1092.65	1092.39			
LTOB Elevation	1094.95	1094.84	1095.10	1094.97			
LTOB Max Depth	2.61	2.78	2.45	2.58			
LTOB Cross Sectional Area	16.41	16.85	17.51	17.96			
Entrenchment Ratio	-	-	-	-			



Cross Section Plot - MY3 - October 2022

XS5 - UT1 Reach 3

Rosgen Stream Type - C4

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	1090.74	1090.61			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.02	0.88	1.03			
Thalweg Elevation	1089.85	1089.83	1090.07	1089.85			
LTOB Elevation	1090.59	1090.66	1090.66	1090.63			
LTOB Max Depth	0.74	0.83	0.59	0.78			
LTOB Cross Sectional Area	3.08	3.26	2.46	3.23			
Entrenchment Ratio	>9.39	>9.1	>9.84	>10.06			



Cross Section Plot - MY3 - October 2022

XS6 - UT1 Reach 3

Rosgen Stream Type - C4

Station 28+30 - Pool



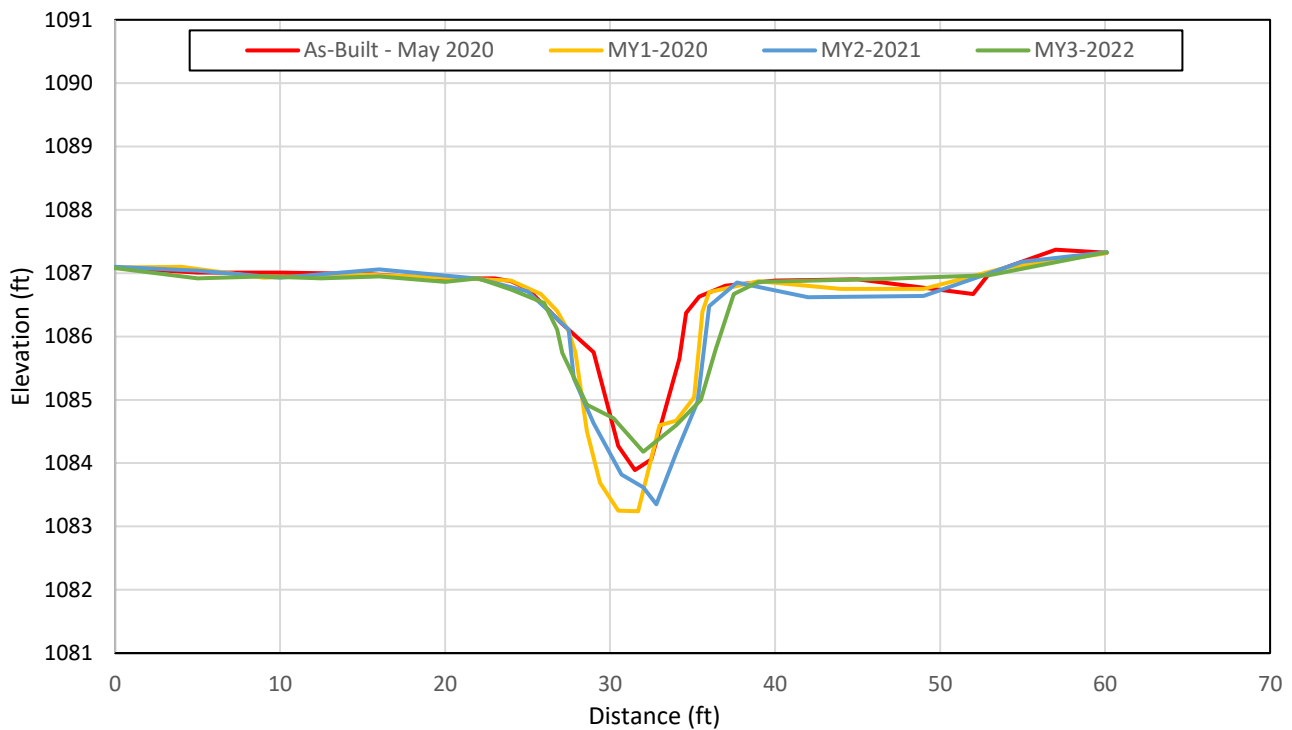
XS6 looking upstream



XS6 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1086.63	1085.85	1085.82	1086.13			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.32	1.42	1.37			
Thalweg Elevation	1083.89	1083.24	1083.35	1084.18			
LTOB Elevation	1086.63	1086.70	1086.85	1086.86			
LTOB Max Depth	2.74	3.46	3.50	2.68			
LTOB Cross Sectional Area	12.61	19.95	22.83	21.36			
Entrenchment Ratio	-	-	-	-			

XS6 Pool - 28+30



Cross Section Plot - MY3 - October 2022

XS7 - UT1A

Rosgen Stream Type - B4

Station 12+44 - Riffle



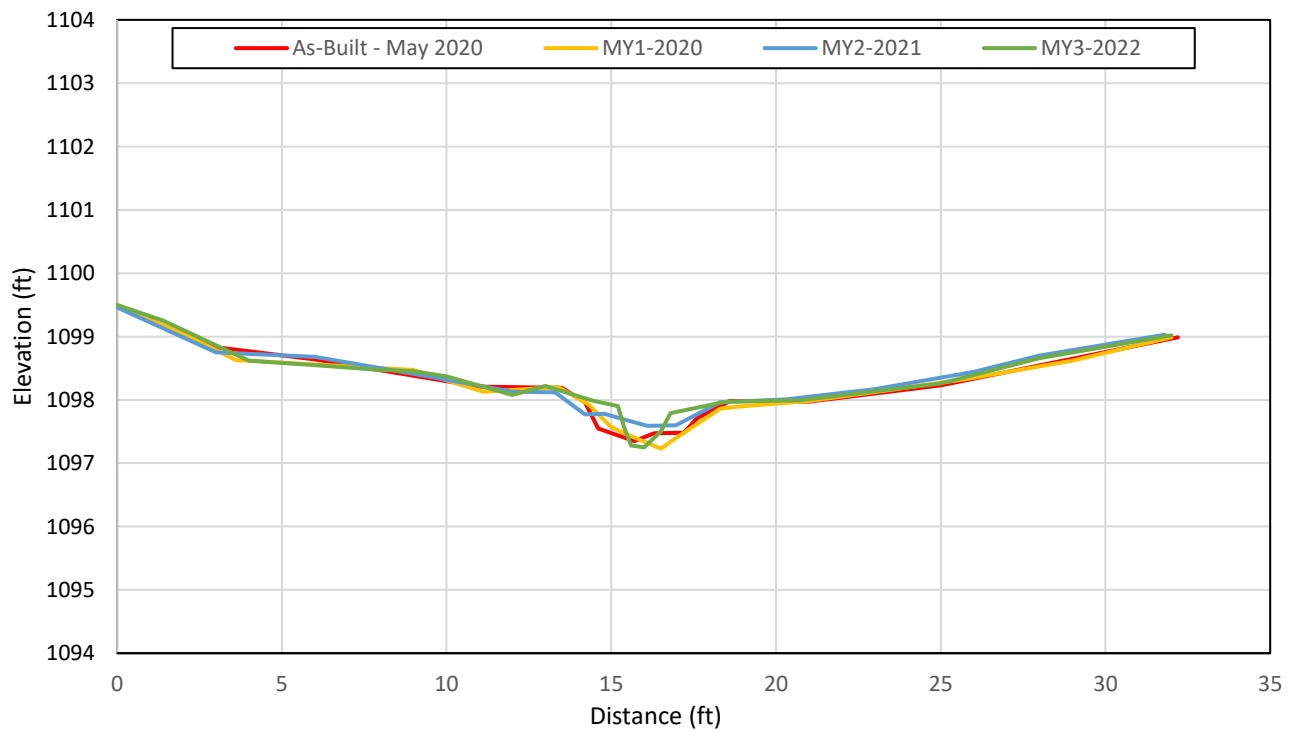
XS7 looking upstream



XS7 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1097.98	1097.96	1098.11	1098.16			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.91	0.71	0.79			
Thalweg Elevation	1097.35	1097.23	1097.59	1097.25			
LTOB Elevation	1097.98	1097.89	1097.96	1097.97			
LTOB Max Depth	0.63	0.66	0.37	0.72			
LTOB Cross Sectional Area	1.76	1.47	1.07	1.01			
Entrenchment Ratio	4.90	4.98	3.25	4.88			

XS7 Riffle - 12+44



Cross Section Plot - MY3 - October 2022

XS8 - UT1B

Rosgen Stream Type - B4

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	1090.17	1090.07			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.76	0.47	0.95			
Thalweg Elevation	1089.59	1089.66	1089.72	1089.60			
LTOB Elevation	1089.94	1089.92	1089.93	1090.05			
LTOB Max Depth	0.35	0.26	0.21	0.45			
LTOB Cross Sectional Area	0.87	0.59	0.19	0.79			
Entrenchment Ratio	>5.26	>5.39	>5.69	>7.26			

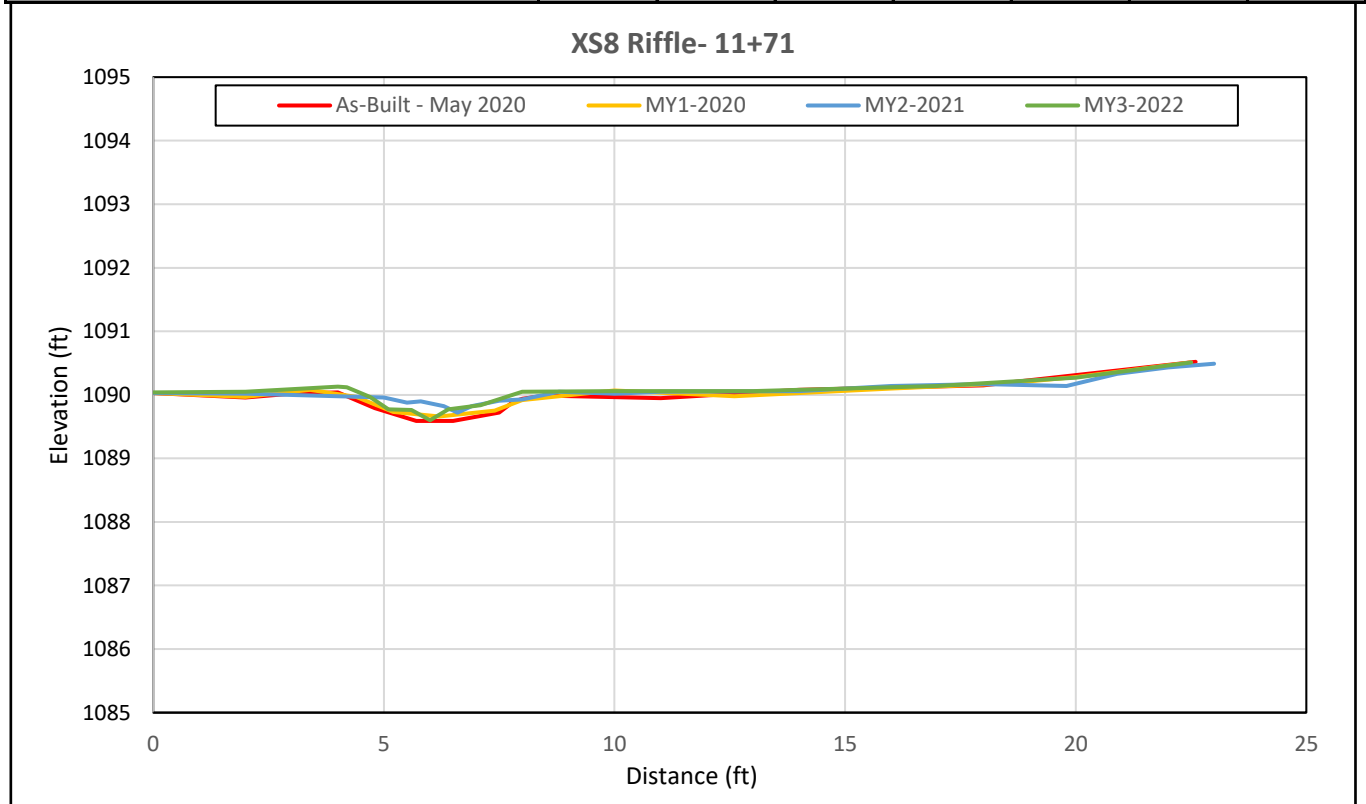


Table 8a. Baseline Stream Data Summary
Greenbrier Stream Mitigation Project (DMS No. 100086) - UT1 Reach 1 (843 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline						
	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	
Dimension and Substrate - Riffle Only																									
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/ft 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						
	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	
Dimension and Substrate - Riffle Only																									
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/ft 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						
	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	
Dimension and Substrate - Riffle Only																									
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/ft 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						
	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	
Dimension and Substrate - Riffle Only																									
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/ft 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			
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 (Rosgen Stream Type - B4)														UT1 Reach 3 (Rosgen Stream Type - C4)													
	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	1128.35	1128.35				1120.53	1120.61	1120.65	1120.69				1097.81	1097.90	1098.07	1098.13				1094.95	1094.80	1095.02	1094.83			
Bank Height Ratio - Based on AB Bankfull ¹ Area	1.00	1.09	0.80	0.79				1.00	0.94	0.98	0.88				1.00	0.97	0.79	0.72				1.00	1.01	1.04	1.06			
Thalweg Elevation	1126.47	1126.23	1126.82	1126.79				1119.35	1119.47	1119.50	1119.58				1097.18	1097.28	1097.35	1097.46				1092.34	1092.06	1092.65	1092.39			
LTOB ² Elevation	1127.92	1128.02	1128.04	1128.03				1120.53	1120.55	1120.63	1120.56				1097.81	1097.88	1097.92	1097.94				1094.95	1094.84	1095.10	1094.97			
LTOB ² Max Depth (ft)	1.45	1.79	1.22	1.24				1.18	1.08	1.13	0.98				0.63	0.60	0.57	0.48				2.61	2.78	2.45	2.58			
LTOB ² Cross Sectional Area (ft ²)	6.70	7.87	4.17	4.78				3.97	3.59	3.86	3.19				2.99	2.84	2.05	1.60				16.41	16.85	17.51	17.96			
Entrenchment Ratio	-	-	-	-				>10.12	>10.11	>10.17	>10.09				6.39	5.80	5.75	4.86				-	-	-	-			
	UT1 Reach 3 (Rosgen Stream Type - C4)														UT1A (Rosgen Stream Type - B4)						UT1B (Rosgen Stream Type - B4)							
	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	1090.74	1090.61				1086.63	1085.85	1085.82	1086.13				1097.98	1097.96	1098.11	1098.16				1089.94	1090.00	1090.17	1090.07			
Bank Height Ratio - Based on AB Bankfull ¹ Area	1.00	1.02	0.88	1.14				1.00	1.32	1.42	1.37				1.00	0.91	0.71	0.79				1.00	0.76	0.47	0.95			
Thalweg Elevation	1089.85	1089.83	1090.07	1089.85				1083.89	1083.24	1083.35	1084.18				1097.35	1097.23	1097.59	1097.25				1089.59	1089.66	1089.72	1089.60			
LTOB ² Elevation	1090.59	1090.66	1090.06	1090.71				1086.63	1086.70	1086.85	1086.86				1097.98	1097.89	1097.96	1097.97				1089.94	1089.92	1089.93	1090.05			
LTOB ² Max Depth (ft)	0.74	0.83	0.59	0.86				2.74	3.46	3.50	2.68				0.63	0.66	0.37	0.72				0.35	0.26	0.21	0.45			
LTOB ² Cross Sectional Area (ft ²)	3.08	3.26	2.46	3.94				12.61	19.95	22.83	21.36				1.76	1.47	1.07	1.01				0.87	0.59	0.19	0.79			
Entrenchment Ratio	>9.39	>9.1	>9.84	>10.06				-	-	-	-				4.90	4.98	3.25	4.88				>5.26	>5.39	>5.69	>7.26			

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 bankfull 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 recorded 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 decreases. Some of the variability above is the result of this factor and some is due to the large amount of depositional sediments observed.

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

	UT1 Reach 1 (Rosgen Stream Type - B4)														UT1 Reach 3 (Rosgen Stream Type - C4)													
	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	1128.35	1128.35				1120.53	1120.61	1120.65	1120.69				1097.81	1097.90	1098.07	1098.13				1094.95	1094.80	1095.02	1094.83			
Bank Height Ratio - Based on AB Bankfull ¹ Area	1.00	1.09	0.80	0.79				1.00	0.94	0.98	0.88				1.00	0.97	0.79	0.72				1.00	1.01	1.04	1.06			
Thalweg Elevation	1126.47	1126.23	1126.82	1126.79				1119.35	1119.47	1119.50	1119.58				1097.18	1097.28	1097.35	1097.46				1092.34	1092.06	1092.65	1092.39			
LTOB ² Elevation	1127.92	1128.02	1128.04	1128.03				1120.53	1120.55	1120.63	1120.56				1097.81	1097.88	1097.92	1097.94				1094.95	1094.84	1095.10	1094.97			
LTOB ² Max Depth (ft)	1.45	1.79	1.22	1.24				1.18	1.08	1.13	0.98				0.63	0.60	0.57	0.48				2.61	2.78	2.45	2.58			
LTOB ² Cross Sectional Area (ft ²)	6.70	7.87	4.17	4.78				3.97	3.59	3.86	3.19				2.99	2.84	2.05	1.60				16.41	16.85	17.51	17.96			
Entrenchment Ratio	-	-	-	-				>10.12	>10.11	>10.17	>10.09				6.39	5.80	5.75	4.86				-	-	-	-			
	UT1 Reach 3 (Rosgen Stream Type - C4)														UT1A (Rosgen Stream Type - B4)							UT1B (Rosgen Stream Type - B4)						
	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	1090.74	1090.61				1086.63	1085.85	1085.82	1086.13				1097.98	1097.96	1098.11	1098.16				1089.94	1090.00	1090.17	1090.07			
Bank Height Ratio - Based on AB Bankfull ¹ Area	1.00	1.02	0.88	1.03				1.00	1.32	1.42	1.37				1.00	0.91	0.71	0.79				1.00	0.76	0.47	0.95			
Thalweg Elevation	1089.85	1089.83	1090.07	1089.85				1083.89	1083.24	1083.35	1084.18				1097.35	1097.23	1097.59	1097.25				1089.59	1089.66	1089.72	1089.60			
LTOB ² Elevation	1090.59	1090.66	1090.06	1090.63				1086.63	1086.70	1086.85	1086.86				1097.98	1097.89	1097.96	1097.97				1089.94	1089.92	1089.93	1090.05			
LTOB ² Max Depth (ft)	0.74	0.83	0.59	0.78				2.74	3.46	3.50	2.68				0.63	0.66	0.37	0.72				0.35	0.26	0.21	0.45			
LTOB ² Cross Sectional Area (ft ²)	3.08	3.26	2.46	3.23				12.61	19.95	22.83	21.36				1.76	1.47	1.07	1.01				0.87	0.59	0.19	0.79			
Entrenchment Ratio	>9.39	>9.1	>9.84	>10.06				-	-	-	-				4.90	4.98	3.25	4.88				>5.26	>5.39	>5.69	>7.26			

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 bankfull 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 recorded 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 decreases. 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. Bankfull Event Verification

Figure 3. Monthly Rainfall Summary Data

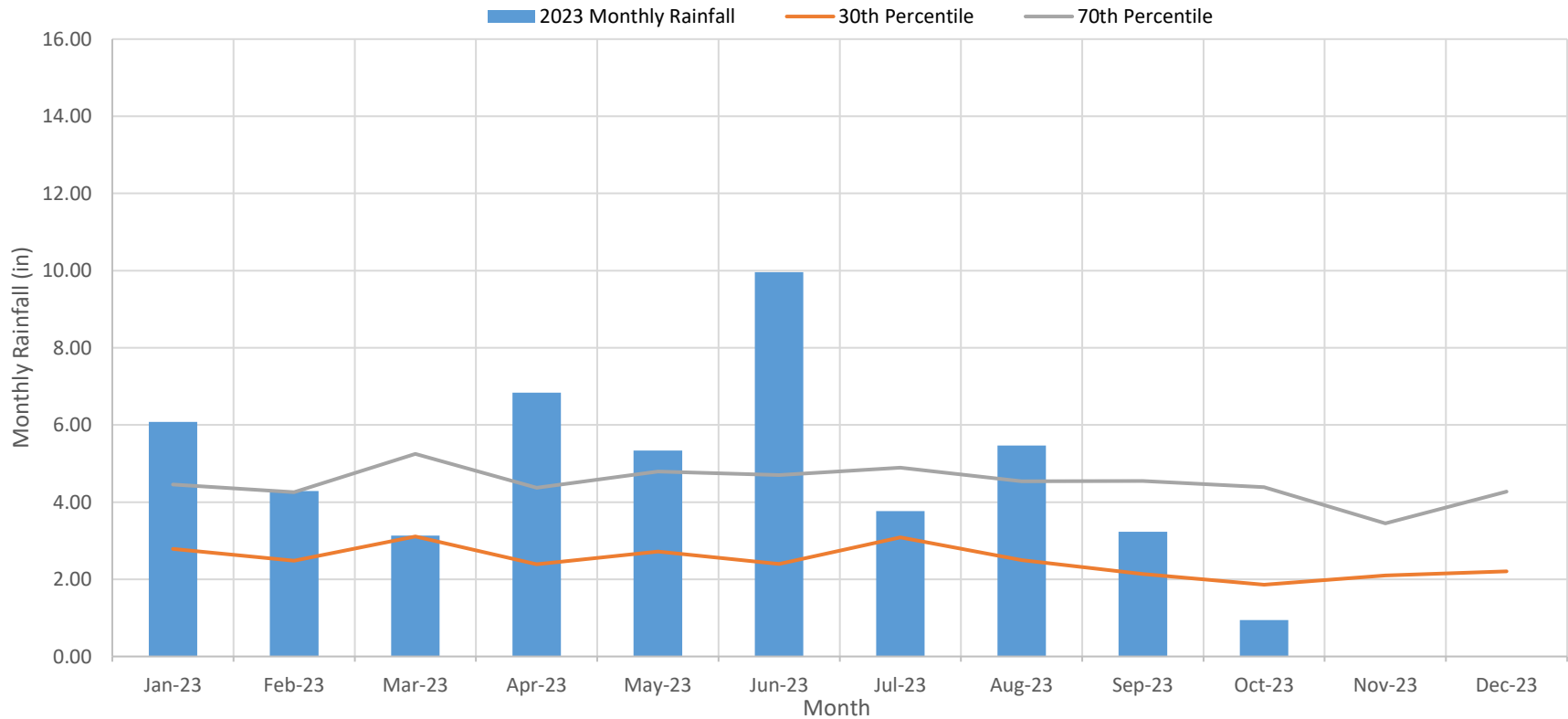
Precipitation and Water Level Hydrographs

**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	1 event: 9/22/2021	3 events: 7/6/2022 7/23/2022 8/6/2022	2 events: 6/19/2023 9/09/2023	-	-	-
UT1A - GBSG2*	4 separate events: 8/21/2020 9/29/2020 10/11/2020 10/25/2020	0 events	0 events	5 events: 6/19/2023 6/20/2023 6/26/2023 7/9/2023 9/9/2023	-	-	-
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	0 events	5 events: 5/26/2022 7/6/2022 7/23/2022 7/31/2022 8/6/2022	10 events: 1/4/2023 1/12/2023 1/25/2023 2/12/2023 2/17/2023 3/3/2023 4/28/2023 6/19/2023 6/26/2023 9/9/2023	-	-	-

*GBSG2 was malfunctioning in early 2023 and was replaced on 4/19/2023

**Greenbrier Stream Restoration Project
Figure 3. Monthly Rainfall Data
Monitoring Year 4 - 2023**



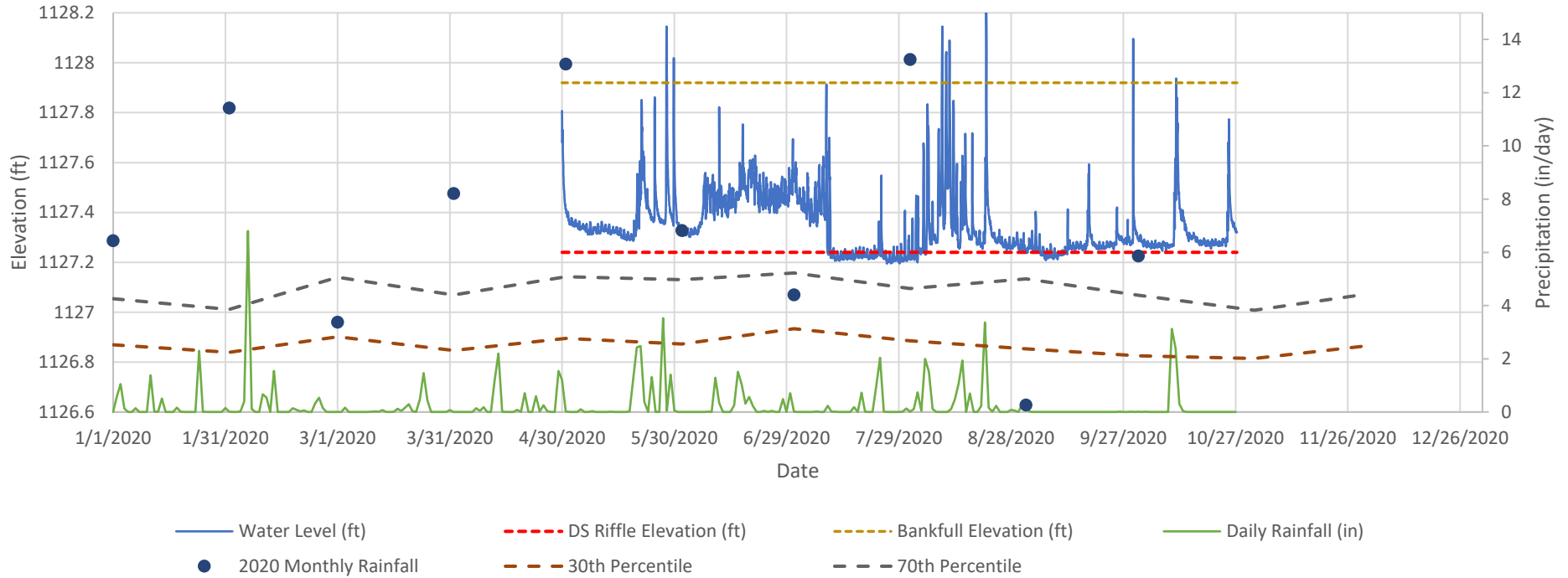
Note: Historic rainfall data from WETS Station: Yadkinville 6 E, NC, 1971-2019. Project rainfall data from HOBO Tipping Bucket Rain Gauge located at the

Rainfall Summary							
	2020	2021	2022	2023	2024	2025	2026
Annual Precip Total	87.91	37.03	83.93	*49.05	-	-	-
WETS 30th Percentile	29.79	29.79	29.79	29.79	-	-	-
WETS 70th Percentile	53.92	53.92	53.92	53.92	-	-	-
Normal	Y	Y	Y	Y	-	-	-

*Rain Gauge was not operational 3/1/2023-4/13/2023 due to a low battery. Rainfall data was supplemented for these dates from AgACIS station YADKINVILLE 0.2 E, NC

Greenbrier Stream Mitigation Project Year 1 (2020) Streamflow Data

GBSG1



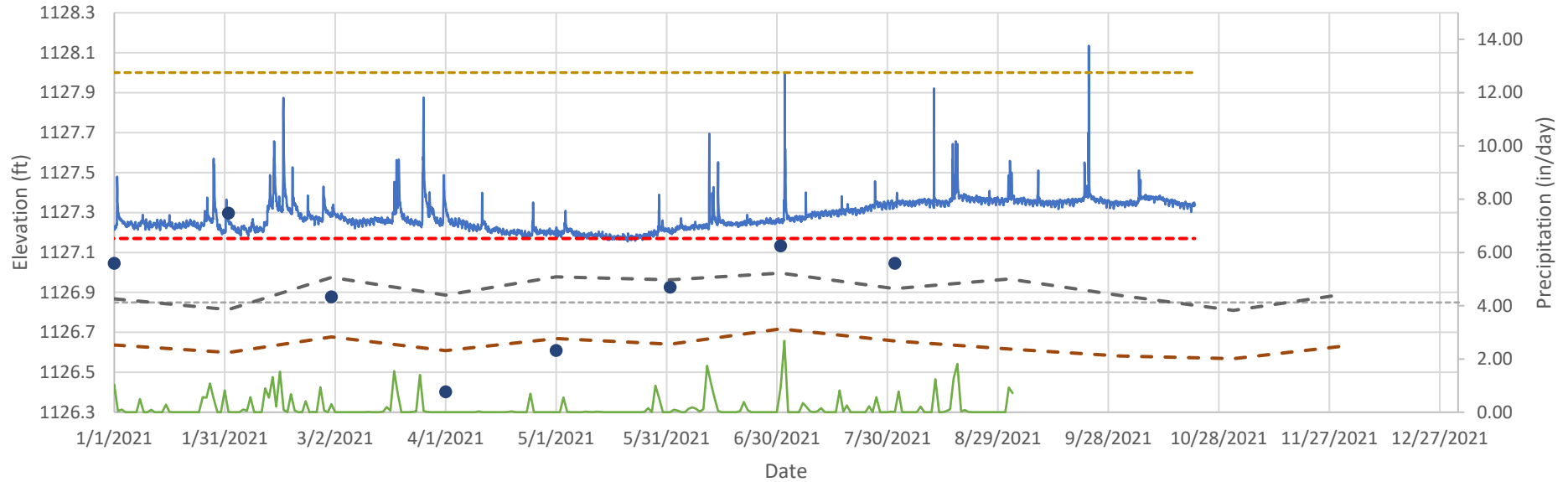
Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1 Reach 1
Date Installed	4/29/2020
Serial Number	20727108
Reach Type	Perennial

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

-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

Greenbrier Stream Mitigation Project Year 2 (2021) Streamflow Data

GBSG1



— Water Level (ft)
 - - - DS Riffle Elevation (ft)
 - - - Bankfull Elevation (ft)
 - - - Logger Elevation
— Daily Rainfall (in)
 ● 2021 Monthly Rainfall
- - - 30th Percentile
- - - 70th Percentile

Note: The Meadowbrook rain gauge batteries died on 9/2/21 so no rain data was collected for September and October.

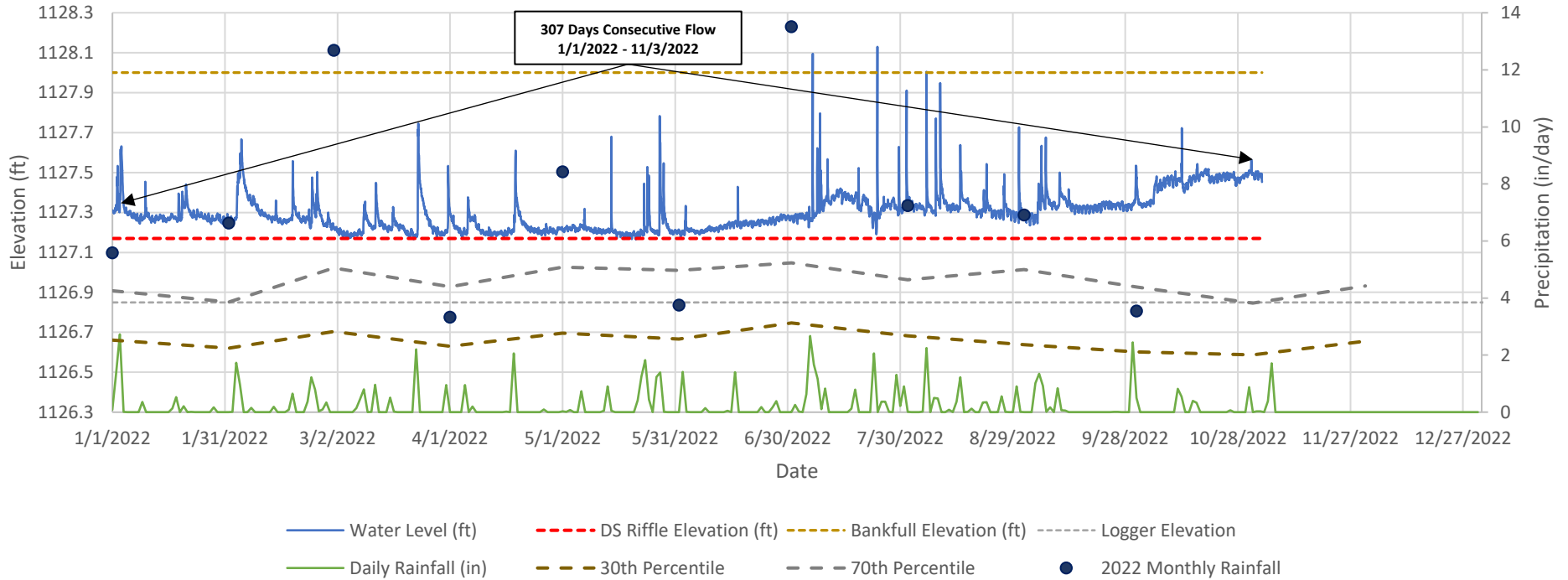
Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1 Reach 1
Date Installed	4/29/2020
Serial Number	20727108
Reach Type	Perennial

Year 2 (2021) Streamflow Data	
Gauge ID	GBSG1
Start Date	1/1/2021
End Date	12/31/2021
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1126.91
Controlling Grade Elevation (ft)	1127.17
Bankfull Elevation (ft)	1128
Most Consecutive Days of Flow	294
Total Days of Flow	294
Max High Water Level Above Bankfull (ft)	0.13
Bankfull Events	1
Meets Success Criteria	Yes

*Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

Greenbrier Stream Mitigation Project Year 3 (2022) Streamflow Data

GBSG1



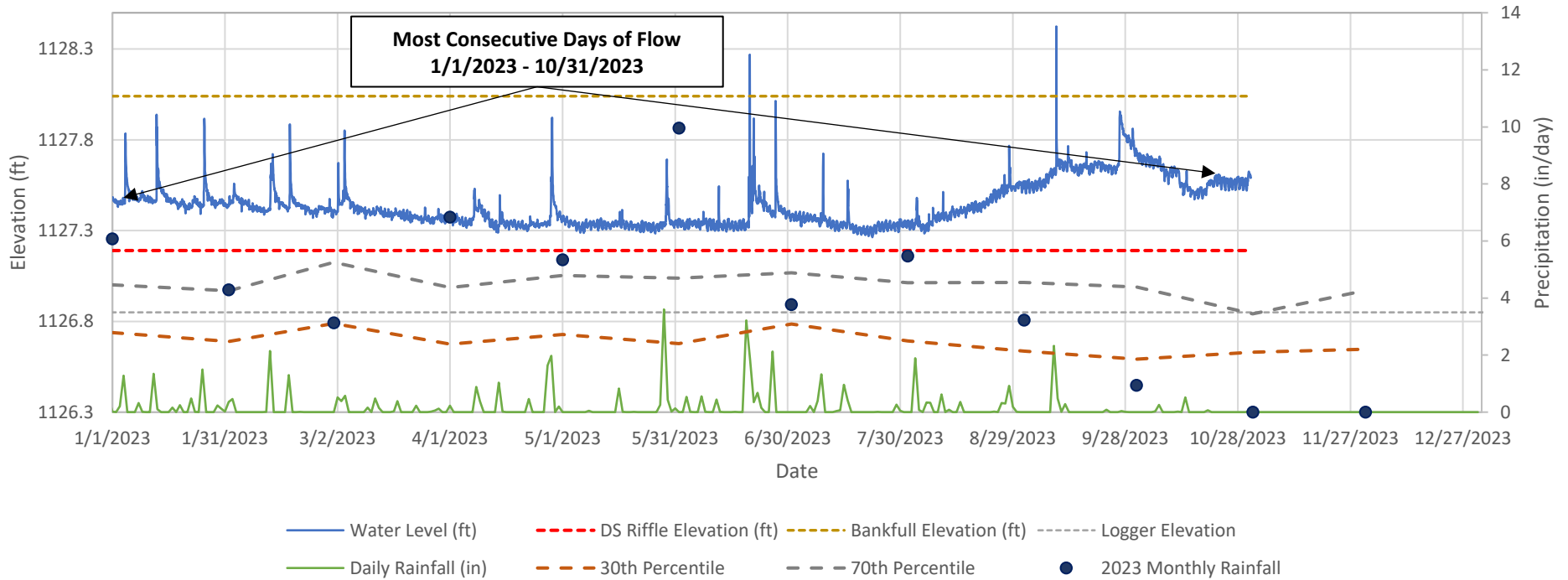
Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1 Reach 1
Date Installed	4/29/2020
Serial Number	20727108
Reach Type	Perennial

Year 3 (2022) Streamflow Data	
Gauge ID	GBSG1
Start Date	1/1/2022
End Date	11/3/2022
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1126.91
Controlling Grade Elevation (ft)	1127.17
Bankfull Elevation (ft)	1128
Most Consecutive Days of Flow	307
Total Days of Flow	307
Max High Water Level Above Bankfull (ft)	0.13
Bankfull Events	3
Meets Success Criteria	Yes

*Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

Greenbrier Stream Mitigation Project Year 4 (2023) Streamflow Data

GBSG1



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

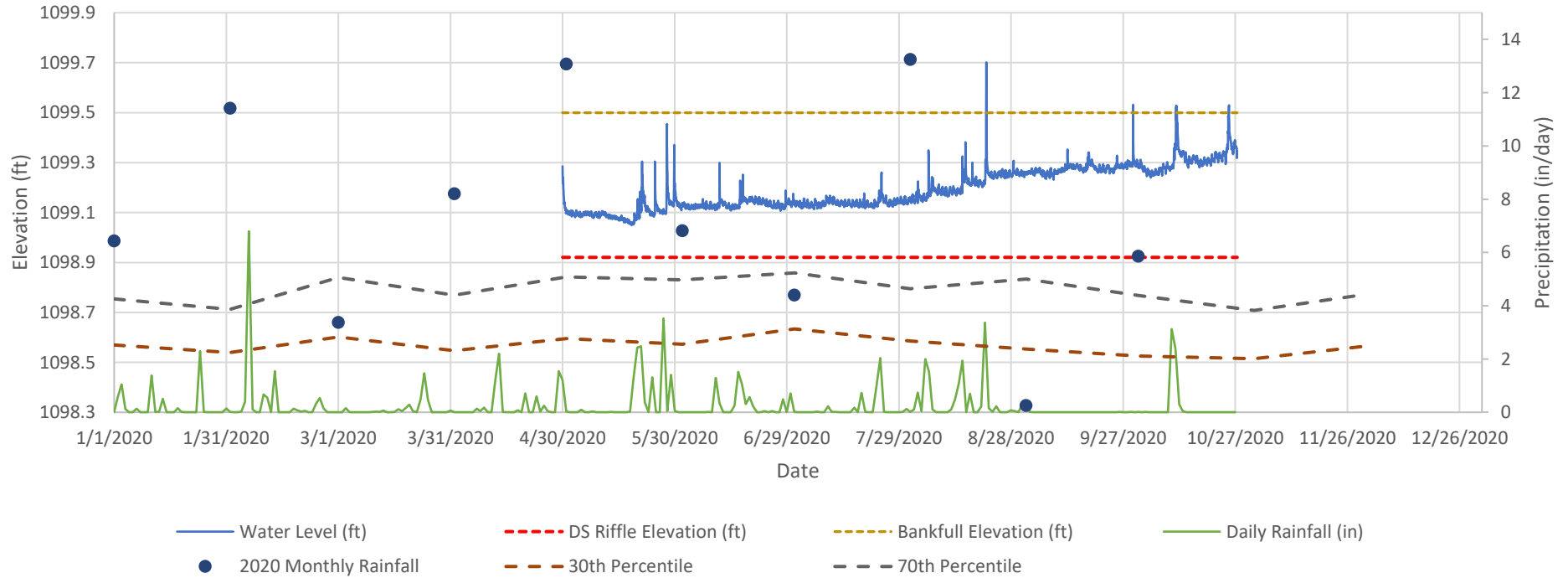
NOTE: Rain Gauge was not operational 3/1/2023-4/13/2023 due to a low battery. Rainfall data was supplemented these dates from AgACIS station YADKINVILLE 0.2 E, NC

*Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

Year 4 (2023) Streamflow Data	
Gauge ID	GBSG1
Start Date	1/1/2023
End Date	10/31/2023
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1126.91
Controlling Grade Elevation (ft)	1127.19
Bankfull Elevation (ft)	1128.04
Most Consecutive Days of Flow	304
Total Days of Flow	304
Max High Water Level Above Bankfull (ft)	0.39
Bankfull Events	2
Meets Success Criteria	Yes

Greenbrier Stream Mitigation Project Year 1 (2020) Streamflow Data

GBSG2



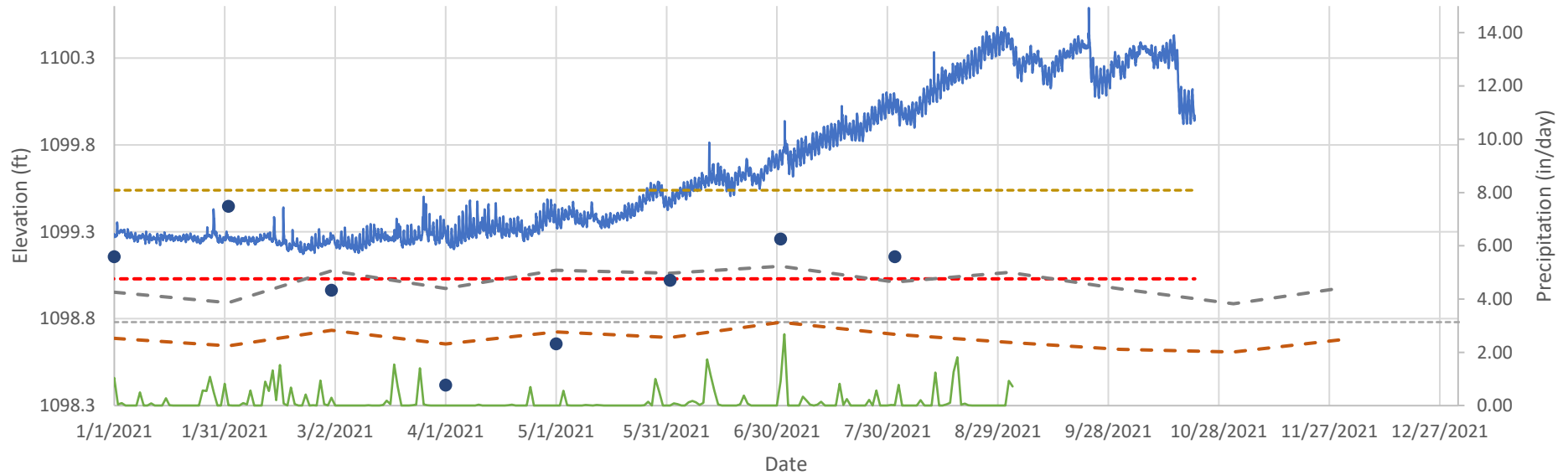
Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1A
Date Installed	4/29/2020
Serial Number	20727105
Reach Type	Perennial

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

-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

Greenbrier Stream Mitigation Project Year 2 (2021) Streamflow Data

GBSG2



— Water Level (ft)
 - - - DS Riffle Elevation (ft)
 - - - - Bankfull Elevation (ft)
 - - - - Logger Elevation
— Daily Rainfall (in)
 ● 2021 Monthly Rainfall
- - - - 30th Percentile
- - - 70th Percentile

Note: The Meadowbrook rain gauge batteries died on 9/2/21 so no rain data was collected for September and October. GBSG2 became buried in sediment in June 2021 so the water level elevation data from June - October is not accurate.

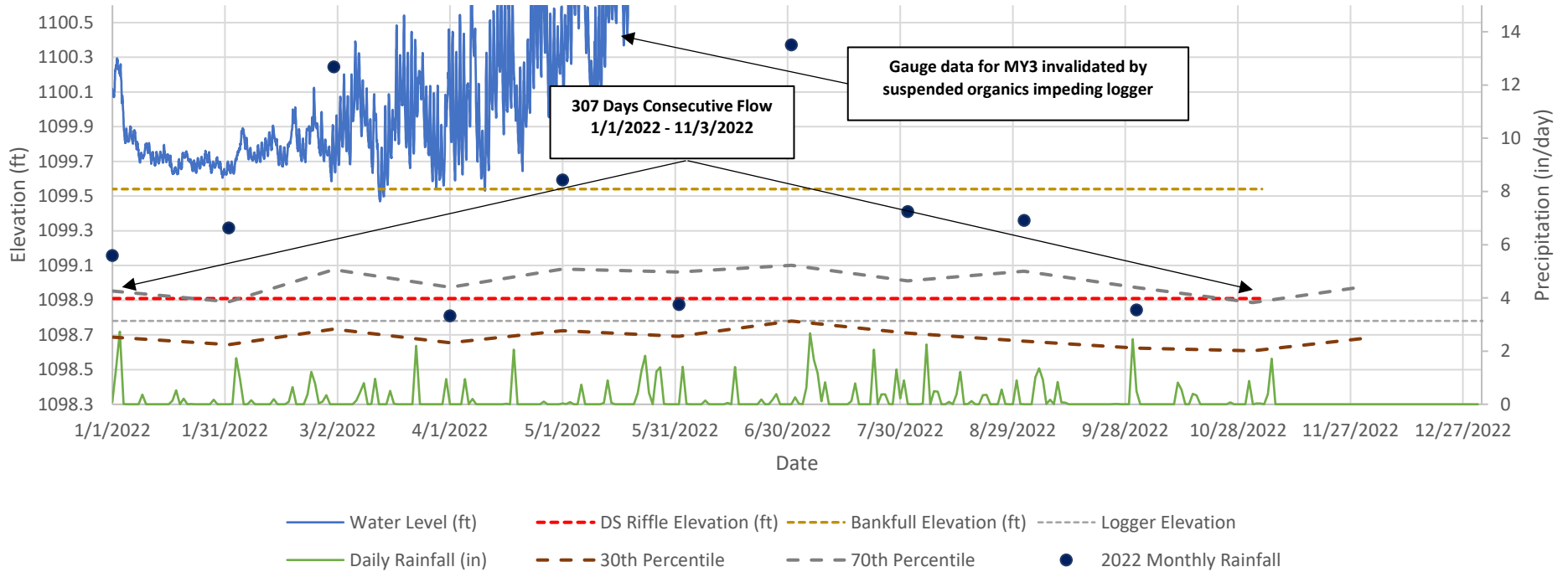
Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1A
Date Installed	4/29/2020
Serial Number	20727105
Reach Type	Intermittent

Year 2 (2021) Streamflow Data	
Gauge ID	GBSG2
Start Date	1/1/2021
End Date	12/31/2021
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1098.78
Controlling Grade Elevation (ft)	1099.03
Bankfull Elevation (ft)	1099.54
Most Consecutive Days of Flow	294
Total Days of Flow	294
Max High Water Level Above Bankfull (ft)	-
Bankfull Events	-
Meets Success Criteria	Yes

*Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

Greenbrier Stream Mitigation Project Year 3 (2022) Streamflow Data

GBSG2



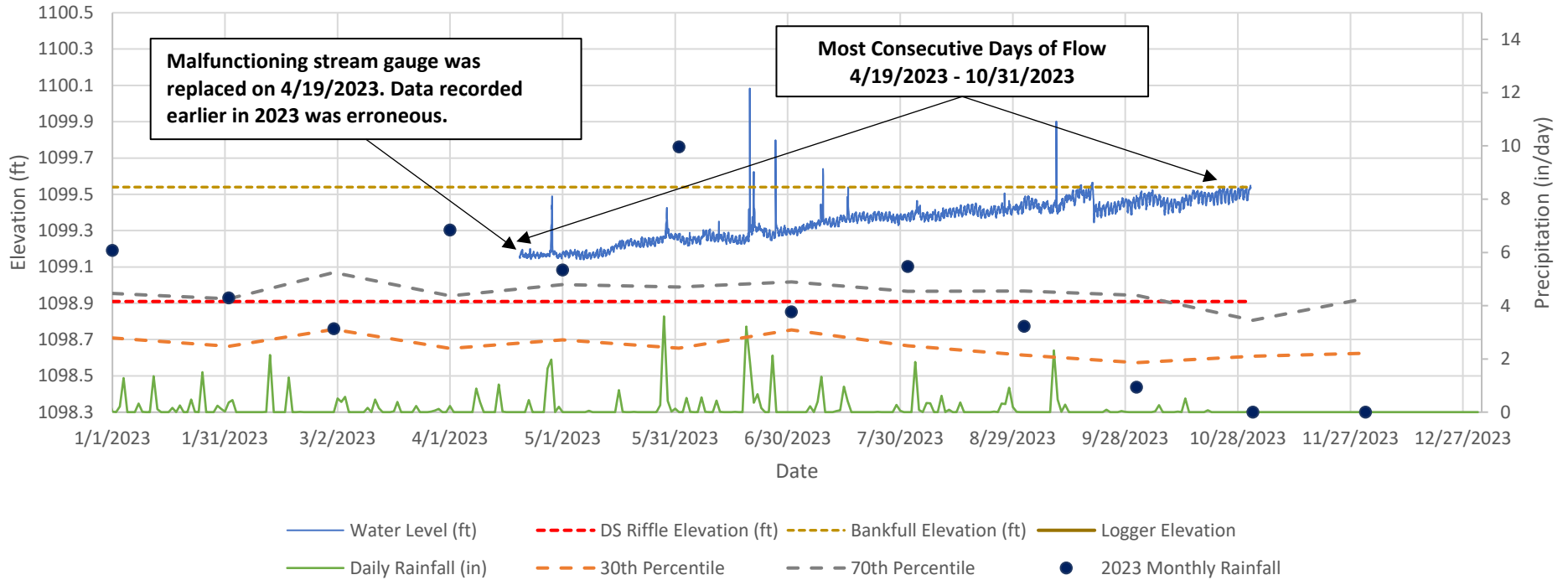
Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1A
Date Installed	4/29/2020
Serial Number	20727105
Reach Type	Intermittent

*Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

Year 3 (2022) Streamflow Data	
Gauge ID	GBSG2
Start Date	1/1/2022
End Date	11/3/2022
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1098.83
Controlling Grade Elevation (ft)	1098.91
Bankfull Elevation (ft)	1099.54
Most Consecutive Days of Flow	307
Total Days of Flow	307
Max High Water Level Above Bankfull (ft)	6.27
Bankfull Events	-
Meets Success Criteria	Yes

Greenbrier Stream Mitigation Project Year 4 (2023) Streamflow Data

GBSG2



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

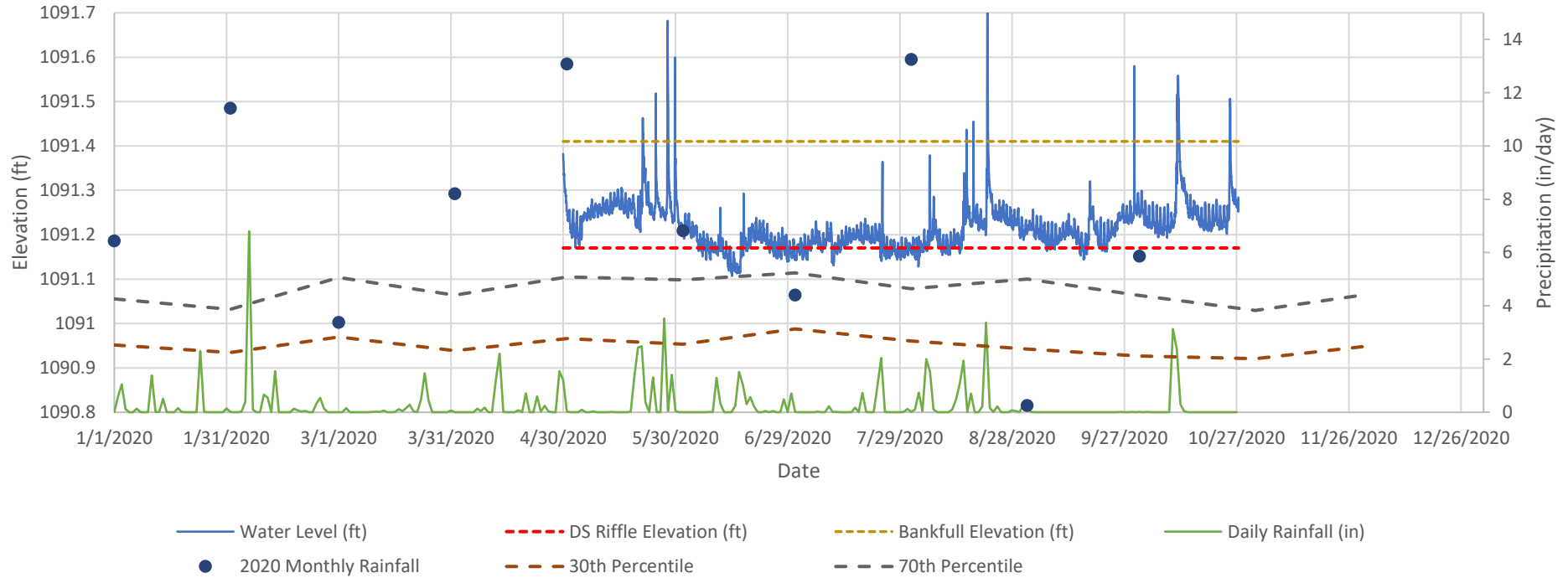
NOTE: Rain Gauge was not operational 3/1/2023-4/13/2023 due to a low battery. Rainfall data was supplemented these dates from AcAGIS station YADKINVILLE 0.2 E, NC
This gauge was faulty from 1/1/2023-4/11/2023

*Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

Year 4 (2023) Streamflow Data	
Gauge ID	GBSG2
Start Date	1/1/2023
End Date	10/31/2023
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1098.83
Controlling Grade Elevation (ft)	1098.91
Bankfull Elevation (ft)	1099.54
Most Consecutive Days of Flow	196
Total Days of Flow	297
Max High Water Level Above Bankfull (ft)	0.54
Bankfull Events	5
Meets Success Criteria	Yes

Greenbrier Stream Mitigation Project Year 1 (2020) Streamflow Data

GBSG3



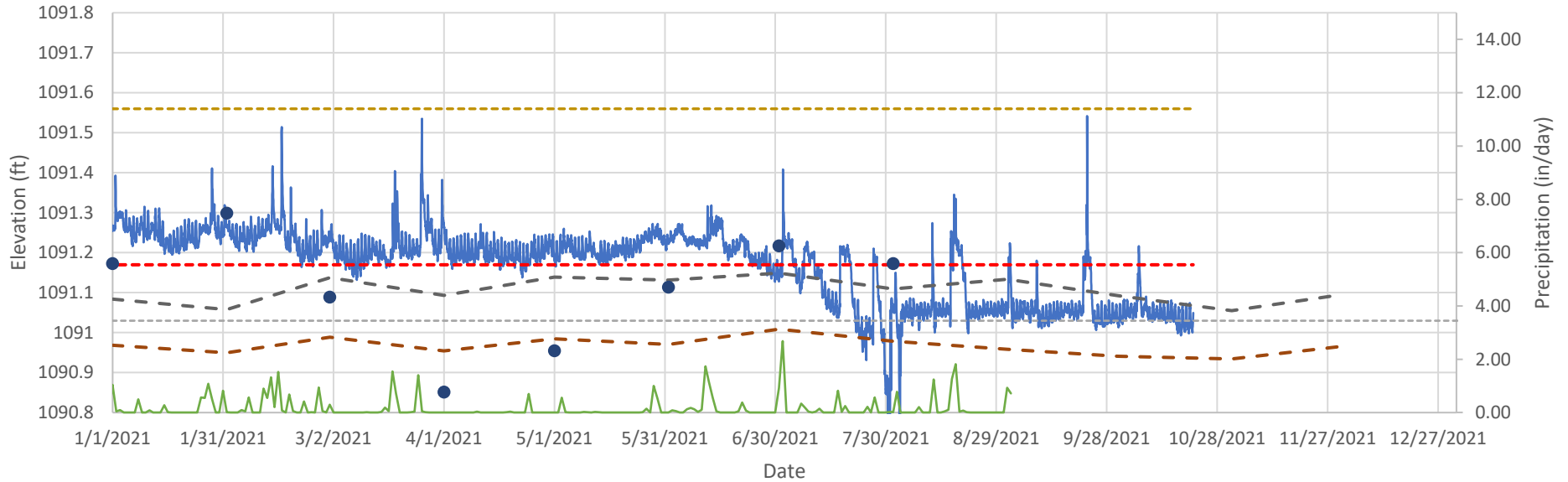
Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1B
Date Installed	4/29/2020
Serial Number	20758210
Reach Type	Perennial

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

-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.

Greenbrier Stream Mitigation Project Year 2 (2021) Streamflow Data

GBSG3



- Water Level (ft)
- Daily Rainfall (in)
- - - DS Riffle Elevation (ft)
- 2021 Monthly Rainfall
- - - Bankfull Elevation (ft)
- - - 30th Percentile
- - - Logger Elevation
- - - 70th Percentile

Note: The Meadowbrook rain gauge batteries died on 9/2/21 so no rain data was collected for September and October.

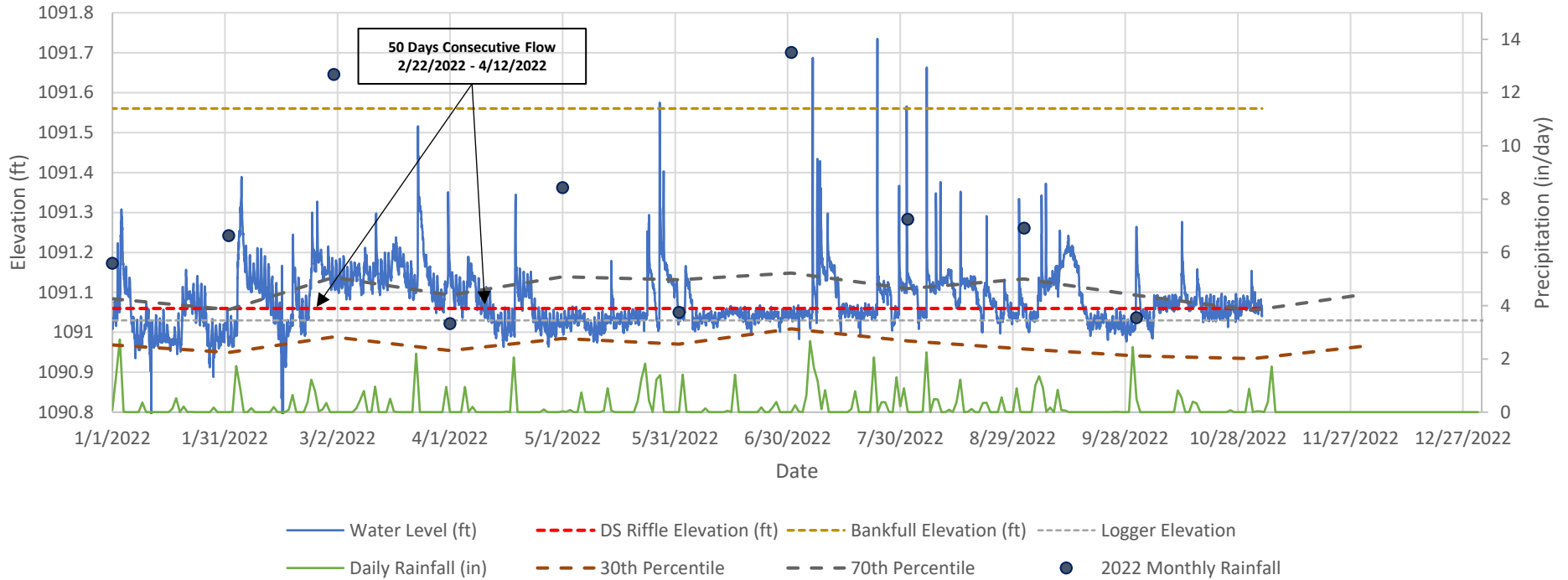
Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1B
Date Installed	4/29/2020
Serial Number	20758210
Reach Type	Intermittent

Year 2 (2021) Streamflow Data	
Gauge ID	GBSG3
Start Date	1/1/2021
End Date	12/31/2021
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1091.03
Controlling Grade Elevation (ft)	1091.17
Bankfull Elevation (ft)	1091.56
Most Consecutive Days of Flow	186
Total Days of Flow	208
Max High Water Level Above Bankfull (ft)	-
Bankfull Events	0
Meets Success Criteria	Yes

*Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

Greenbrier Stream Mitigation Project Year 3 (2022) Streamflow Data

GBSG3



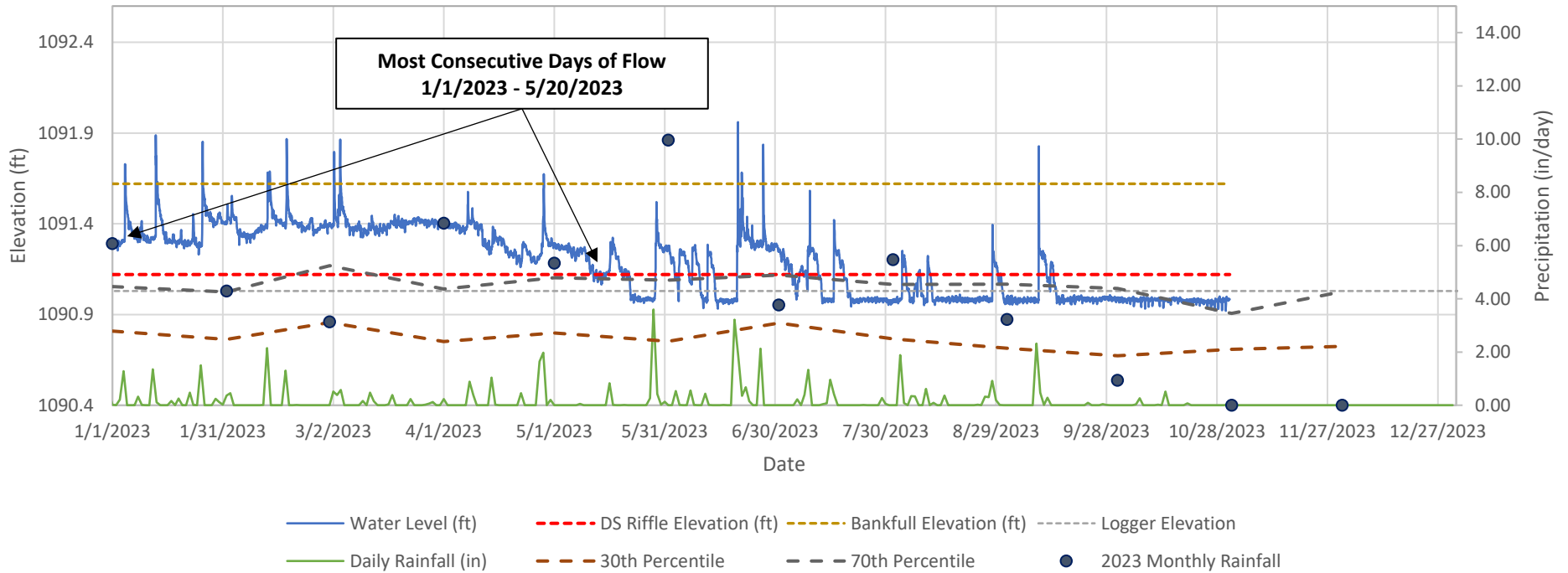
Site Info	
Stream	Greenbrier Stream Mitigation Project
Reach	UT1B
Date Installed	4/29/2020
Serial Number	20758210
Reach Type	Intermittent

Year 3 (2022) Streamflow Data	
Gauge ID	GBSG3
Start Date	1/1/2022
End Date	11/3/2022
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1091.03
Controlling Grade Elevation (ft)	1091.06
Bankfull Elevation (ft)	1091.56
Most Consecutive Days of Flow	50
Total Days of Flow	226
Max High Water Level Above Bankfull (ft)	0.17
Bankfull Events	5
Meets Success Criteria	Yes

*Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

Greenbrier Stream Mitigation Project Year 4 (2023) Streamflow Data

GBSG3



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

NOTE: Rain Gauge was not operational 3/1/2023-4/13/2023 due to a low battery. Rainfall data was supplemented these dates from AcAGIS station YADKINVILLE 0.2 E, NC

*Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

Year 4 (2023) Streamflow Data	
Gauge ID	GBSG3
Start Date	1/1/2023
End Date	10/31/2023
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1090.93
Controlling Grade Elevation (ft)	1091.12
Bankfull Elevation (ft)	1091.62
Most Consecutive Days of Flow	141
Total Days of Flow	197
Max High Water Level Above Bankfull (ft)	0.34
Bankfull Events	10
Meets Success Criteria	Yes

Appendix E

Project Timeline and Contact Info

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: 3 yrs 7 months
 Elapsed Time Since planting complete: 3 yrs 7 months
 Number of reporting Years¹: 4

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	May-20	May-20
As-built Baseline Monitoring Report	May-20	Jul-20
Year 1 Monitoring	Nov-20	Nov-20
Supplemental Bare-root plantings	--	Mar-21
Year 2 Monitoring	Oct-21	Nov-21
Year 3 Monitoring	Oct-22	Nov-22
Supplemental Bare-root plantings	--	Jan-23
Year 4 Monitoring	Oct-23	Nov-23
Year 5 Monitoring	-	-
Year 6 Monitoring	-	-
Year 7 Monitoring	-	-

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	Ecosystem Planning and Restoration, PLLC 1150 SE Maynard Road, Suite 140, Cary, NC 27511
Primary project design POC	Kevin Tweedy, PE (919) 388-0787
Construction Contractor	North State Environmental 2889 Lowery St, Winston-Salem, NC 27101
Construction contractor POC	Darrell Westmoreland
Survey Contractor	Kinder Land Surveying 203 W. Lebanon St., Mount Airy, NC 27030
Survey contractor POC	Frank Kinder (336) 783-4200
Planting Contractor	North State Environmental 2889 Lowery St, Winston-Salem, NC 27101
Planting contractor POC	Darrell Westmoreland
Seeding Contractor	North State Environmental 2889 Lowery St, Winston-Salem, NC 27101
Contractor POC	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