Monitoring Year 4 Report

Final

Meadow Brook Stream Restoration Project

Yadkin County, North Carolina

Yadkin River Basin, Hydrologic Unit Code (HUC) 03040101

Data Collection Period:	**Submission Date:**
April, September – October 2023	December 2023

NCDEQ Contract No. 7184
DMS ID No. 100024
RFP No. 16-006993
USACE Action ID No. SAW-2017-01509
NCDWR ID: 2018-0919

Prepared For:

NC Department of Environmental Quality
Division of Mitigation Services
217 West Jones Street; 3rd Floor
Raleigh, NC 27603

Prepared By:

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

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

Phone: (919) 388-0787
www.eprusa.net

Mr. Harry Tsomides
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 the Draft Monitoring Year 4 Report for the Meadow Brook Site**
Yadkin River Basin – CU 03040101– Yadkin County
DMS Project # 100024
Contract # 007184

Dear Mr. Tsomides,

Ecosystem Planning and Restoration (EPR) has received the confirmation that you reviewed the Year 4 Monitoring Report Draft provided November 30, 2023. Since no comments were made on the draft, no changes were made to the final MY4 Report and the electronic deliverables.

Year 4 Monitoring Report Draft

- None

Digital Support Files

- None

If you have any questions regarding the Final 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 Meadow Brook Stream Restoration Project (Project; Site) for the North Carolina Department of Environmental Quality (NCDEQ) Division of Mitigation Services (DMS) to provide 3,409 stream mitigation credits (SMCs) in the Yadkin River Basin, Hydrologic Unit Code (HUC) 03040101. The Project restored and enhanced 3,437 linear feet (LF) of two perennial unnamed tributaries (UT) to South Deep Creek within a 11.2-acre conservation easement. Mitigation assets are listed in Table 1.

The Site is located in DMS Targeted Local Watershed 03040101130020. Project location is shown in Figure 1. The Site was historically utilized for agricultural use. 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 57% agricultural land, 33% forest, 6% developed open space, and 3% herbaceous land. Prior to construction activities, both Project streams were incised, straightened, and suffered from significant cattle damage. The adjacent wetlands were similarly trampled, heavily grazed, routinely mowed, and drained by multiple ditches and the channelization of the Project streams. Pre-construction, or pre-existing, Site conditions are provided in Table 3 and the Baseline Stream Data Summary Tables in Appendix C. Photos and a more detailed description of Site conditions before restoration are available in the Mitigation Plan (Final version submitted September 2018).

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 Basin wide Water Quality Plan (NCDWQ, 2008). These goals and objectives are presented in Table 2.

Site construction was completed in June 2019, and the as-built survey was completed in August 2019. Planting and baseline vegetation data collection was completed in January 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 *NCDEQ DMS Mitigation Plan Template* (ver. 06/2017), and *US 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 will follow the same guidance as the *NCDEQ DMS Annual Monitoring Report Format, Data, and Content Requirement* (October 2020). Table 2 details the success criteria that evaluate whether Project goals have been met throughout the monitoring period. For more detailed success criteria refer to the Final Mitigation Plan or the As-built Baseline Monitoring Report.

Table 1. Project Mitigation Quantities and Credits

Project Component (reach ID, etc.)	Original Mitigation Plan (ft/ac)	As-built (ft/ac)	Original Mitigation Thermal Regime Category	Original Restoration Level	Priority Level	Original Mitigation Ratio (X:1)	Mitigation Credits	Notes/Comments
Meadow Brook Reach 1	1304	1917	Warm	R	I	1.00000	1,917.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, and Permanent Conservation Easement.
Meadow Brook Reach 2	327	353	Warm	R	II	1.00000	353.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, and Permanent Conservation Easement.
Meadow Brook Reach 3	289	273	Warm	R	II	1.00000	273.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, and Permanent Conservation Easement.
Meadow Brook Reach 4	283	218	Warm	EI	-	1.50000	145.333	Habitat Structures, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
UT to Meadow Brook	396	676	Warm	R	I	1.00000	676.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, and Permanent Conservation Easement.
Wetland A*	2.930	2.630	RR	N/A		0.00000	0.00000	Planted, excluded livestock, plugged ditches, and encompasses section of Priority Level II Restoration reach.
Wetland B*	2.230	2.000	RR	N/A		0.00000	0.00000	Planted, excluded livestock, plugged ditches, and encompasses section of Priority Level II Restoration reach.
Wetland C*	0.820	0.740	RR	N/A		0.00000	0.00000	Planted, excluded livestock, plugged ditches, and encompasses section of Priority Level II Restoration reach.
Wetland D*	0.100	0.090	RR	N/A		0.00000	0.00000	Planted, excluded livestock, and encompasses section of Priority Level II Restoration reach.

*Note: Wetlands are not currently part of the Project assets and are not generating mitigation credits

Table 1. Project Mitigation Quantities and Credits (continued)

Length and Area Summations by Mitigation Category							
Restoration Level	**Stream**			**Riparian Wetland**		**Non-Rip Wetland**	**Coastal Marsh**
	Warm	Cool	Cold	Riverine	Non-Riverine		
Restoration	3219.000						
Re-establishment							
Enhancement							
Enhancement I	145.333						
Enhancement II							
Rehabilitation							
Preservation							
Creation							
Totals	3364.333						

Total Base SMCs	3364.333
Credit Loss in Required Buffer	-142.600
Credit Gain for Additional Buffer	187.600
Net Change in Credit from Buffers	45.000
Total Adjusted SMCs*	3409.333

*Credit adjustment for Non-standard Buffer Width calculation using Wilmington District Stream Buffer Credit Calculator (Updated 1/19/2019)

Table 2. Goals, Performance and Results

Goal	Objective/Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Reduce sediment inputs and stream turbidity	▪ Stabilize eroding stream banks. ▪ Install fencing to exclude livestock from project streams. ▪ Reconnect streams to the floodplain at lower flows. ▪ Restore woody riparian buffer vegetation.	▪ The exclusion of livestock has removed a direct source of nutrients, coliform, and sediment from the system, as well as a major contributor to channel instability. ▪ Restored riparian buffers will provide woody debris and detritus for aquatic organisms, reduced water temperatures and increased dissolved oxygen concentrations, as well as shade and diverse aquatic and terrestrial habitats that are appropriate for the ecoregion and setting.	▪ Recordation and protection of a conservation easement meeting NCDMS guidelines. ▪ Visual inspection of fence installed to exclude cattle from the stream and riparian buffer, demonstrating no encroachment. ▪ Vegetation success criteria of 320 native stems/acre in Year 3, 260 native stems/acre in Year 4 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. ▪ Any single species can only account for 50% of the required stems per monitoring plot. ▪ Visual documentation of installed watering system and regular checks on its operation during annual monitoring. ▪ Visual inspection of BMPs to ensure proper function during monitoring period.	<u>Permanent Vegetation Plots</u> 6 permanent vegetation plots, 0.02 acre in size (minimum), 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.	At the end of Monitoring Year 3, the 6 permanent riparian vegetation plots had an average stem density of 729 native stems/acre and met the success criteria of 320 native stems/acre in Year 3. Vegetation plots were not required to be sampled in MY4. Vegetation sampling will resume in MY5.
Reduce nutrient inputs	▪ Decrease drainage of riparian wetlands. ▪ Install wetland treatment cell. ▪ Reconnect streams to the floodplain at lower flows. ▪ Restore woody riparian buffer vegetation. ▪ Stabilize eroding stream banks.				
Reduce Fecal Coliform Inputs	▪ Install fencing to exclude livestock from project streams. ▪ Restore woody riparian buffer vegetation. ▪ Reconnect streams to the floodplain at lower flows. ▪ Install a wetland treatment cell.			<u>Annual Random Vegetation Plots</u> 6 randomly selected vegetation plots, 0.02 acre in size (minimum), surveyed during As-built, Years 1, 2, 3, 5, and 7 between July 1st and leaf drop. Data collection includes species and height.	In MY3, the 6 randomly selected vegetation plots had an average stem density of 418 native stems/acre, which met the success criteria for MY3. Vegetation plots were not required to be sampled in MY4. Vegetation sampling will resume in MY5.
Restore / Enhance Degraded Riparian Buffers	▪ Restore woody riparian buffer vegetation. ▪ Protect min. 50-foot riparian buffers with a permanent conservation easement. ▪ Decrease drainage of riparian wetlands. ▪ Reconnect streams to the floodplain at lower flows. ▪ Install fencing to exclude livestock from conservation easement.				
Implement Agricultural BMPs in Agricultural Watersheds	▪ Restore woody riparian buffer vegetation. ▪ Protect min. 50-foot riparian buffers with a permanent conservation easement. ▪ Install fencing to exclude livestock from project streams. ▪ Install alternative watering system for livestock. ▪ Install a wetland treatment cell.				

Table 2. Goals, Performance and Results

Goal	Objective/Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Protect High Resource Value Waters (including HQW, ORW, and WS classifications)	▪ Restore bed form diversity to improve habitat for native species. ▪ Restore woody riparian buffer vegetation. ▪ Protect min. 50-foot riparian buffers with a permanent conservation easement. ▪ Reconnect streams to the floodplain at lower flows. ▪ Install a wetland treatment cell.	▪ Wetland hydrology and in-channel hydraulics have been improved 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 helps to ensure channel stability and will provide greater bedform diversity, enhancing aquatic habitat for native species.	▪ Geomorphic cross sections indicate stable sections over the monitoring period. ▪ Bank height ratio (BHR) cannot exceed 1.2 for all measured cross sections on a given reach. ▪ Entrenchment ratio (ER) must be 2.2 or above for all measured riffle cross-sections for C/E stream types and 1.4 or above for B stream types. ▪ Documentation of hydrophytic vegetation within vegetation monitoring plots. ▪ Documentation of four bankfull events in different years throughout the monitoring period. ▪ Documentation of 30 days of consecutive stream flow in all reaches each monitoring year	<u>Stream Profile</u> Full longitudinal survey on all restored and enhanced stream channels. Data was collected during As-built survey only (unless otherwise required).	A full longitudinal survey of the project stream was conducted during As-built monitoring. No signs of major instability or degradation were noted during MY4 monitoring so a new profile was not surveyed.
				<u>Cross Sections</u> Cross sections are surveyed during Years 1,2,3,5, and 7. 13 total cross sections, 10 on Meadow Brook (5 riffle/5 pool), 3 on UT to Meadow Brook (2 riffle/1 pool).	The Year 3 monitoring cross section survey indicated that the project streams were geomorphically stable and functioning as intended. Cross Sections were not required to be surveyed in MY4. Cross section monitoring will resume in MY5.
				<u>Visual Assessment</u> Conducted yearly on all restored stream channels.	Stream photo points and visual assessment indicate that all restored streams are in good condition and performing as intended.
				<u>Additional Cross Sections</u> Only surveyed if instability is documented during monitoring.	No instability was documented during MY4 monitoring, so no additional cross sections were surveyed.
				<u>Stream Hydrology Monitoring</u> 2 pressure transducers (1 on Meadow Brook and UT to Meadow Brook each) and a rain gauge will record precipitation and streamflow data continuously through the monitoring period. Photos of high-water indicators will be taken yearly.	Flow gauge data from MY4 indicates that all project streams met the established success criteria of 30 days or more of consecutive flow throughout the year. In addition, 6 bankfull events were recorded for Meadow Brook and 8 bankfull events were recorded for UT to Meadow Brook.

Table 3. Project Attributes Table

Project Background Information				
Project Name		Meadow Brook Stream Restoration Project		
County		Yadkin		
Project Area (acres)		11.2		
Project Coordinates (latitude and longitude)		36.14139 / 80.81889		
Planted Acreage (Acres of Woody Stems Planted)		11.2		
Project Watershed Summary Information				
Physiographic Province		Northern Inner Piedmont		
River Basin		Yadkin Pee-Dee		
USGS Hydrologic Unit 8-digit	03040101	USGS Hydrologic Unit 14-digit	3040101130020	
DWR Sub-basin		03-07-02		
Project Drainage Area (Acres and Sq. Mi.)		1088 acres / 1.7 Sq. Mi.		
Project Drainage Area Percentage of Impervious Area		<1%		
CGIA Land Use Classification		Pasture (57%) and Deciduous Forest (26%)		

Reach Summary Information					
Parameters	**Meadow Brook**				**UT to Meadow Brook**
	Reach 1	**Reach 2**	**Reach 3**	**Reach 4**	
Length of reach (linear feet)	1304	327	289	283	396
Valley confinement (Confined, moderately confined, unconfined)	Unconfined	Unconfined	Confined	Confined	Unconfined
Drainage area (Acres and Square Miles)	.93 sq mi / 595 ac	1.51 sq mi / 966 ac	1.73 sq mi. / 1107 ac	1.73 sq mi / 1107 ac	.56 sq mi / 358 ac
Perennial, Intermittent, Ephemeral	Perennial				
NCDWR Water Quality Classification	WS-III				
Stream Classification (existing)	Incised E4	E4	E4	E4	E4
Stream Classification (proposed)	C4	C4	B4c	B4c	C4
Evolutionary trend (Simon)	IV				
FEMA classification	AE				

Wetland Summary Information				
Parameters	**Wetland A**	**Wetland B**	**Wetland C**	**Wetland D**
Size of Wetland (acres)	2.93	2.23	0.82	0.10
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian Riverine	Riparian Riverine	Riparian Riverine	Riparian Riverine
Mapped Soil Series	Dan River Sandy Loam	Dan River Sandy Loam	Dan River Sandy Loam / Clifford sandy clay loam	Dan River Sandy Loam
Drainage Class	Well-drained	Well-drained	Well-drained	Well-drained
Soil Hydric Status	Non-Hydric+	Non-Hydric+	Non-Hydric+	Non-Hydric+
Source of Hydrology	Groundwater, precipitation, runoff, overbank flooding	Groundwater, precipitation, runoff, overbank flooding	Groundwater, precipitation, runoff, overbank flooding	Groundwater, precipitation, runoff, overbank flooding
Restoration or enhancement method (hydrologic, vegetative etc.)	Vegetative*	Vegetative*	Vegetative*	Vegetative*

Table 3. Project Attributes Table (continued)

Regulatory Considerations			
Parameters	**Applicable?**	**Resolved?**	**Supporting Docs?**
Water of the United States - Section 404	Yes	Yes	USACE NWP 27 - ID# SAW-2017-01509
Water of the United States - Section 401	Yes	Yes	DWR 401 WQC No. 4134 -- ID # 2180919
Division of Land Quality (Erosion and Sediment Control)	Yes	Yes	General Permit NCG010000 - ID # YADKI-2019-004
Endangered Species Act	Yes	Yes	Categorical Exclusion Document; Appendix 7 in Mitigation Plan
Historic Preservation Act	Yes	Yes	
Coastal Zone Management Act (CZMA or CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	Yadkin County Floodplain Development Permit – ID # 2018-1
Essential Fisheries Habitat	No	N/A	N/A

*Wetlands are not being restored or enhanced for mitigation credit, but functional uplift is expected and there will be no net loss of wetland functions

+Jurisdictional wetlands were identified on soils mapped as non-hydric

2.0 MONITORING DATA ASSESSMENT

Monitoring Year 4 (MY4) data was collected in April, September, and October of 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. The monitoring plan for the Site will follow this guidance and the *NCDEQ DMS Annual Monitoring Report Format, Data, and Content Requirements* (October 2020).

2.1 Stream Monitoring

Stream monitoring involves field data collection to assess the hydrologic, hydraulic, and geomorphic functions of Meadow Brook and the UT. 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 are shown in Figure 2 Current Condition Plan View (CCPV).

2.1.1 Stream Dimension

No cross sections were required to be surveyed in MY4 per the Mitigation Plan.

Permanent cross sections were installed to monitor stream stability through dimension change. 13 permanent cross sections were installed across the Site; 10 on Meadow Brook and 3 on UT to Meadow Brook. 7 cross sections were installed in riffles and 6 were installed in pools. Each cross-section was monumented using a length of rebar and PVC pipe on both streambanks. The location and elevation of each pin was located and 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 (consistent with the Baseline As-Built Report), Bank Height Ratio (BHR), Low Top of Bank (LTOB) elevation, Thalweg Elevation, LTOB Max Depth, LTOB Cross Sectional Area, and Entrenchment Ratio (ER). BHR measurements are made by holding the bankfull area recorded in the

Baseline As-built report constant and adjusting the bankfull elevation. Reference photos are taken of both streambanks at the time of survey to provide a visual assessment of any changes that may occur.

No Cross Sections were required to be surveyed in MY4 per the Mitigation Plan. However, the cross-section data from MY3 are included in Appendix C.

2.1.2 Stream Profile

A full longitudinal profile was surveyed for the entire length of the restored streams in August 2019 to document as-built conditions (EPR, 2020). This survey was tied to a permanent benchmark and includes thalweg, right bank, and left bank features. Profile measurements were taken at the head of each feature (e.g. riffle, pool) and at the max depth of pools and data are provided in the Baseline Stream Data Summary tables in Appendix C. As noted in the baseline report, there were some pools that had filled with some sediment that are expected to scour and flush throughout the monitoring period.

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.

2.1.3 Channel Stability

Channel stability is assessed on a yearly basis using photographs to visually document the condition of the restored Project streams. Visual assessments of channel stability and in-stream structure condition were made throughout Monitoring Year 4, primarily after storm events. Visual assessments of bank stability and in-stream structures for each reach are provided in Appendix A. 16 photo points were established during baseline monitoring at which photographs are taken from the same location in the same direction each year. Four additional photo points have been added over the course of monitoring. This year, photos were taken during the spring to show the project with less vegetation obstructing the views. The location of the photo points are shown in the CCPV (Figure 2) and the photographs, which were taken on April 5, 2023 are provided in Appendix A.

The three beaver dams that were found over the course of MY3 have not been rebuilt in MY4. The streambanks upstream of these dams have become revegetated and have remained stable. The Project will continue to be monitored for beaver activity throughout the rest of the monitoring periods to ensure no new dams are constructed.

Stream photo points and visual assessment indicate that all restored channels and in-stream structures are in good condition and performing as intended. No significant stream problem areas were observed. No channel manipulation, including vegetation or sediment removal, has been performed in this monitoring year.

2.1.4 Stream Hydrology

Two (2) pressure transducers were installed, 1 each in Meadow Brook and the UT to Meadow Brook, 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). Both gauges were installed in the downstream end of pools. The constructed bankfull elevation at each gauge was located and recorded, as well as the elevation of the downstream controlling grade. Each year, 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 to accurately document rainfall at the

Site. The rainfall data can be compared to the flow gauge data to verify that high flows at the Site are correlated with rainfall events. The monitoring gauges were downloaded regularly throughout Monitoring Year 4 and rainfall data is presented in the flow gauge plots in Appendix D.

The batteries in the onsite rain gauge died in March, so rain gauge data from 3/1/2023 through 4/13/2023 was not available. Data for this time period have been supplemented with rain gauge data from AgACIS station Yadkinville 0.2 E, NC. These data are included in Appendix D. The battery was replaced on 4/13/2023 and the rain gauge is functioning normally.

Flow gauge data from MY4 indicates that both Project streams met the established success criteria of 30 days or more of consecutive flow throughout the year. According to the gauge for Meadow Brook (MB2 STR), the stream had constant flow throughout the year (at least 304 consecutive days in 2023 as of the most recent download) and the gauge documented 6 separate bankfull events. Gauge MB UT1 STR, located in the UT to Meadow Brook, documented constant flow throughout the year (at least 304 consecutive days in 2023 as of the most recent download) and 7 separate bankfull events. The date and timing of these bankfull events generally correlated with significant rainfall events recorded by the tipping bucket rain gauge.

2.2 Riparian Vegetation Monitoring

Riparian vegetation monitoring evaluates the growth and development of planted and volunteer vegetation across the Site. Monitored parameters, methods, schedule/frequency, and extent are summarized in Table 2. These monitoring parameters follow USACE guidance but will also allow for monitoring of other parameters to document Site performance related to the Project goals listed in Section 1.

2.2.1 Vegetation Monitoring Data

Six (6) permanent vegetation monitoring plots were established across the Site during as-built monitoring. 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 tagged and identified to facilitate repeat monitoring. In addition to the 6 permanent plots, 6 randomly placed vegetation plots are established each year that vegetation monitoring occurs and the location of these plots is recorded using GPS. All vegetation plots for MY3 are shown in the CCPV (Figure 2).

No vegetation plots were sampled MY4 per the monitoring requirements found in the Mitigation Plan. Vegetation monitoring will resume in MY5. Vegetation plot data for MY3 is included in Appendix B.

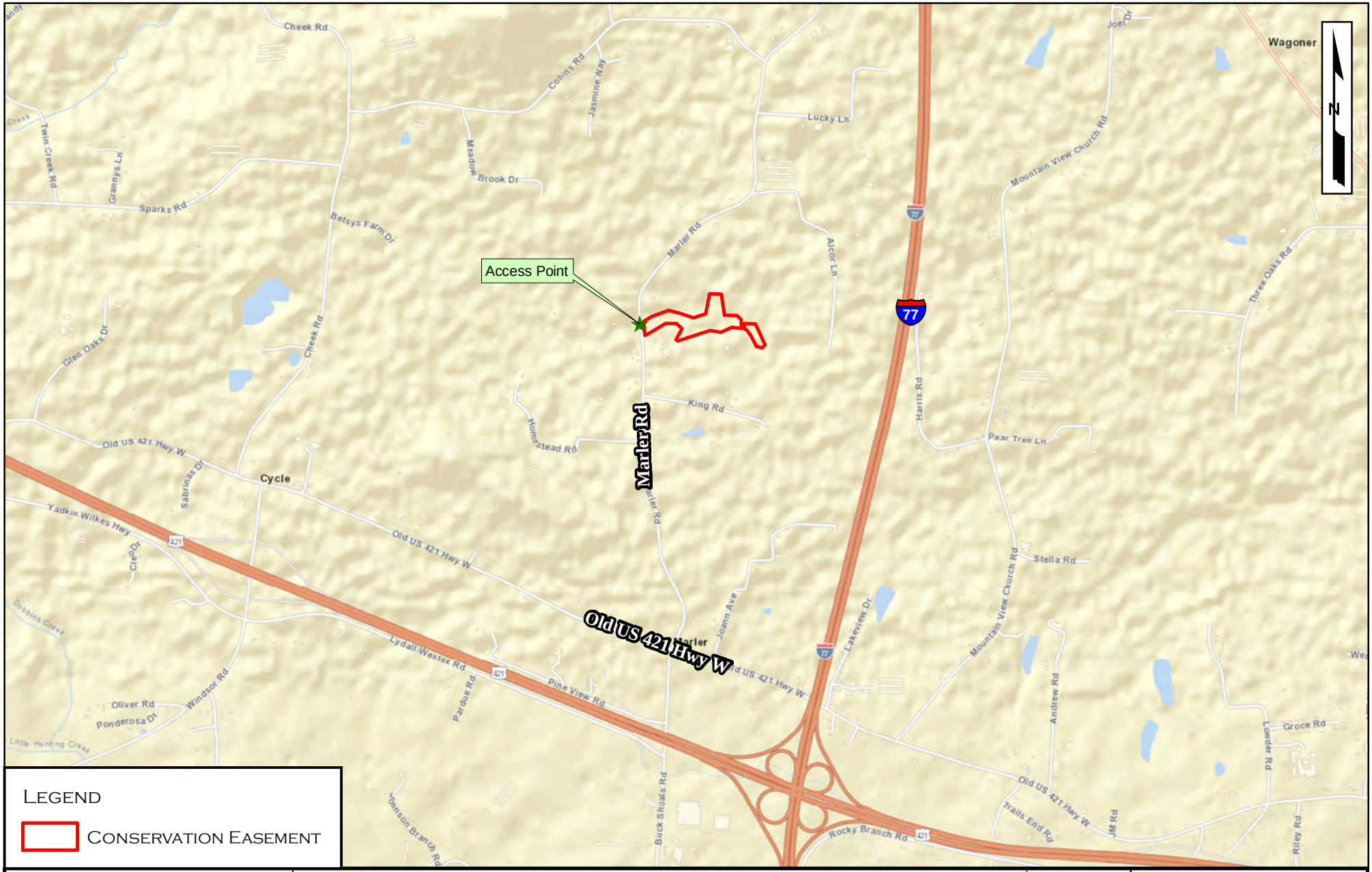
Table 5 in Appendix A summarizes the results of a visual review of the conservation easement, mapping any bare areas, areas of low stem density, invasive species, or easement encroachments. Riparian herbaceous vegetation appears to be flourishing throughout the Site. In addition, minimal invasive vegetation was found. Multiflora rose was found in small patches within the easement. The total amount of rose that was found and treated around the site was less than 0.1 acre. All rose was cut and spot-sprayed in April 2023. EPR will continue to treat all invasives found within the easement in future monitoring years. No easement encroachments were noted in MY4.

2.3 Wetland Hydrology

While no wetland mitigation credit was proposed as a part of this Project, efforts were taken to ensure that there was no net loss of existing riparian wetland function after construction. A preliminary jurisdictional wetland determination (PJD) and NCWAM assessment was completed prior to completion of construction to document the extent and functionality of the existing wetlands at the Site. The same assessments will be made after the monitoring period ends to document that there is no net loss of wetland functionality over the life of the Project.

In addition, hydrophytic vegetation has been documented within vegetation plots that are located in planting Zone 2 (Riparian Wetlands). Fixed VP-1, Fixed VP-2 are split between riparian planting and upland planting, but the rest of the permanent and random vegetation plots are within the riparian wetland planting zone (Zone 2). Fixed VP-6 and is located within the wetland treatment cell and planted with hydrophytic herbaceous and woody vegetation. No vegetation plots were sampled in MY4 per the monitoring requirements found in the Mitigation Plan. Vegetation monitoring will resume in MY5.

Finally, as required by the 401/404 Permit, two groundwater gauges were installed in the existing wetlands at the Site. These data are not associated with success criteria for mitigation. One of the wetland gauges (GW2) was destroyed by flooding and was not reinstalled. The location of the remaining groundwater gauge (GW1) is shown in the CCPV (Figure 2). As of MY3, EPR is no longer required to provide wetland gauge data in monitoring reports.



MEADOW BROOK STREAM MITIGATION PROJECT

PROJECT LOCATION MAP
MY4 - 2023

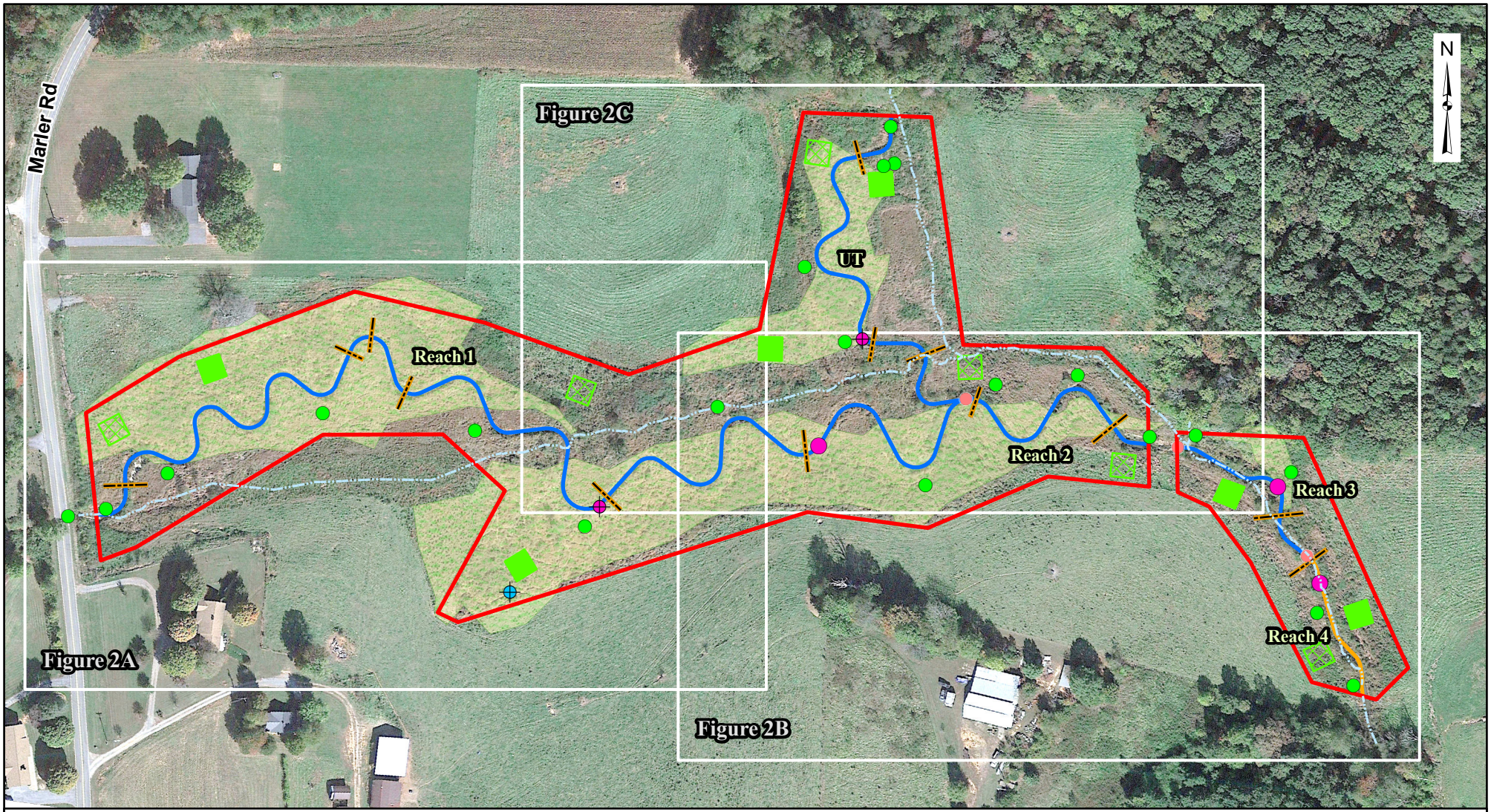
FIGURE 1

DMS PROJECT #100024
YADKIN COUNTY, NC

NOV 2023

NC Mitigation Services
ENVIRONMENTAL QUALITY

EPR ECOSYSTEM PLANNING & RESTORATION



Legend

- Pre-Existing Streams
- Conservation Easement
- Reach Breaks
- Stream Enhancement
- Stream Restoration
- Cross Sections
- Successful Fixed Vegetation Plot
- Successful Random Vegetation Plot
- MY3 Removed Beaver Dams
- Photo Points
- Rain Gauge
- Stream Gauge

NC OneMap Orthoimagery (2018)

0 200 Feet

1 inch = 200 feet

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Overview
MY4: 2023

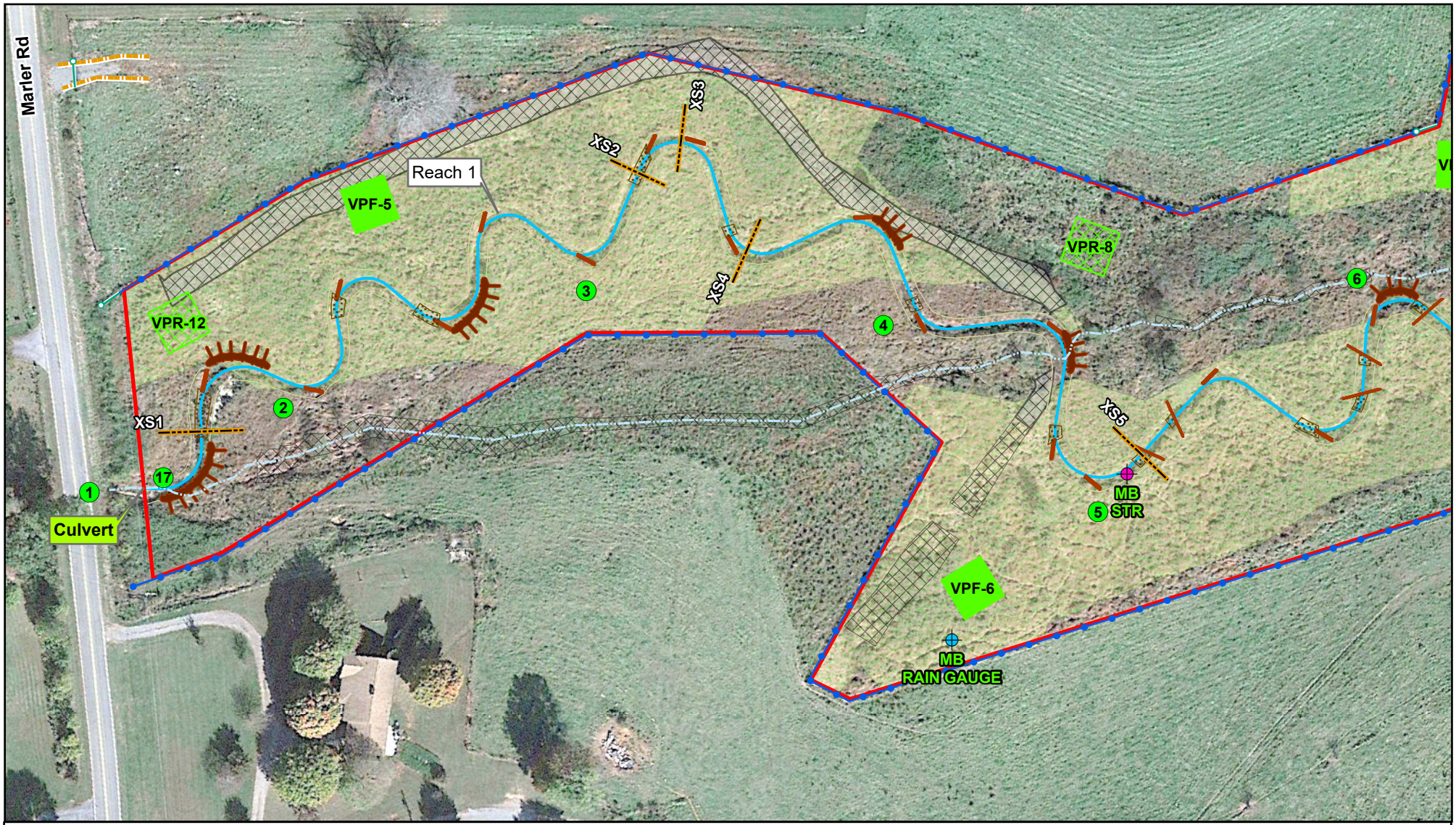
DMS Project ID# 100024
NOV 2023

FIGURE 2

Yadkin County, NC

Ecosystem Planning & Restoration

Note: Veg Plot Success Shown Here is From MY3 Data



Legend

- Successful Fixed Vegetation Plot
- Successful Random Vegetation Plot
- Photo Points
- Stream Centerline
- Unfilled Ditches
- Filled Ditches
- Pre-Existing Streams
- Top of Bank
- Stream Crossing
- Farm Path
- Fencing
- Fence Gates
- Existing Wetlands
- Rain Gauge
- Stream Gauge
- Cross Sections
- Conservation Easement
- Reach Breaks
- Structures

Aerial Imagery: Google Earth (2022)

0 100 Feet

1 inch = 100 feet

N

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Asset Map

MY4: 2023

DMS Project ID# 100024

NOV 2023

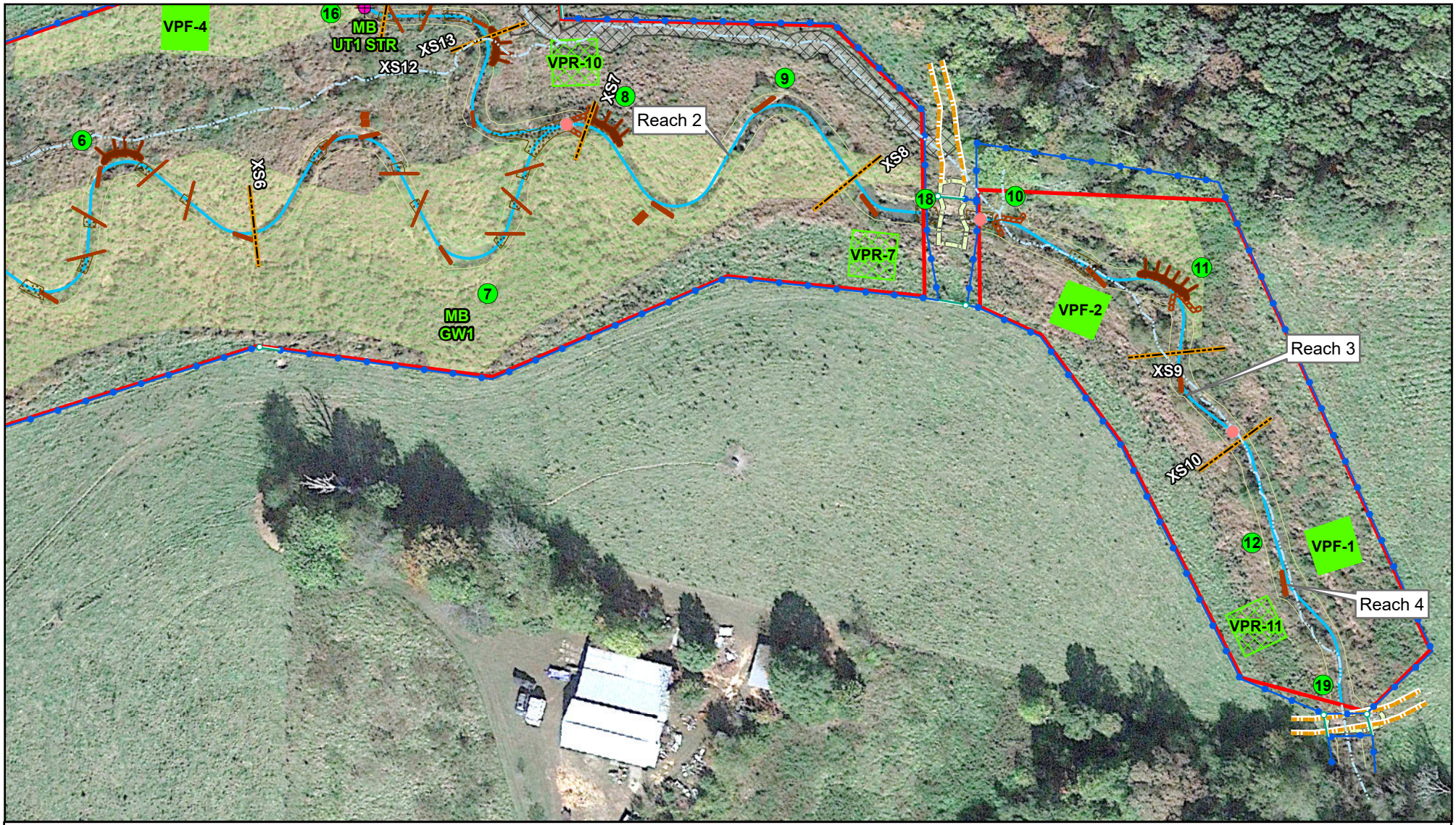
FIGURE 2A

Yadkin County, NC

Mitigation Services

Ecosystem Planning & Restoration

Note: Veg Plot Success Shown Here is From MY3 Data



Legend

- Successful Fixed Vegetation Plot
- Successful Random Vegetation Plot
- Photo Points
- Stream Centerline
- Unfilled Ditches
- Filled Ditches
- Pre-Existing Streams
- Top of Bank
- Stream Crossing
- Farm Path
- Fencing
- Fence Gates
- Existing Wetlands
- Rain Gauge
- Stream Gauge
- Cross Sections
- Conservation Easement
- Reach Breaks
- Structures

Aerial Imagery: Google Earth (2022)

0 100 Feet

1 inch = 100 feet

N

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Asset Map

MY4: 2023

DMS Project ID# 100024

NOV 2023

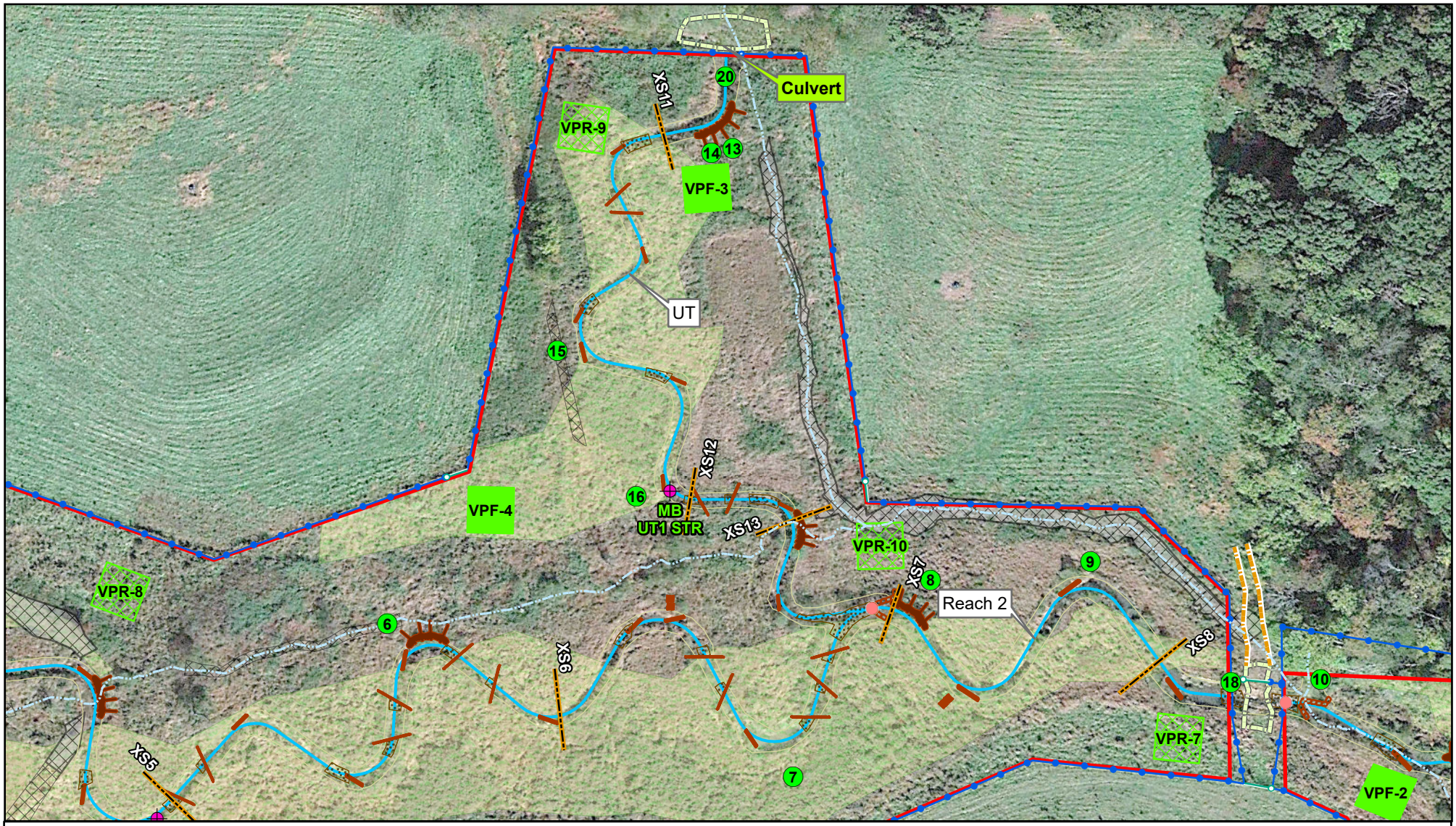
FIGURE 2B

Yadkin County, NC

Mitigation Services Environmental Quality

Ecosystem Planning & Restoration

Note: Veg Plot Success Shown Here is From MY3 Data



Legend

- Successful Fixed Vegetation Plot
- Successful Random Vegetation Plot
- Photo Points
- Stream Centerline
- Unfilled Ditches
- Filled Ditches
- Pre-Existing Streams
- Top of Bank
- Stream Crossing
- Farm Path
- Fencing
- Fence Gates
- Existing Wetlands
- Rain Gauge
- Stream Gauge
- Cross Sections
- Conservation Easement
- Reach Breaks
- Structures

Aerial Imagery: Google Earth (2022)

0 100 Feet

1 inch = 100 feet

N

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Asset Map

MY4: 2023

DMS Project ID# 100024

NOV 2023

FIGURE 2C

Yadkin County, NC

Mitigation Services Environmental Quality

Ecosystem Planning & Restoration

Note: Veg Plot Success Shown Here is From MY3 Data

3.0 REFERENCES

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Appendix A

Visual Assessment Data

Table 4. Visual Stream Morphology Stability Assessment Table

Table 5. Vegetation Condition Assessment Table

MY3 Vegetation Plot Photo Log

MY4 Stream Photo Log

Note: No vegetation data was collected in MY4

(2023) Vegetation monitoring will resume in MY5

(2024).

Table 4a. Visual Stream Morphology Stability Assessment Table
Meadow Brook Stream Restoration Project (DMS No.100024)

Reach ID: Meadow Brook Reach 1
Assessed Stream Length (ft): 1936
Assessed Bank Length (ft): 3872
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 NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	16	16		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)	45	45		100%

Table 4b. Visual Stream Morphology Stability Assessment Table
Meadow Brook Stream Restoration Project (DMS No.100024)

Reach ID: Meadow Brook Reach 2
Assessed Stream Length (ft): 393
Assessed Bank Length (ft): 786
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 NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	1	1		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)	7	7		100%

Table 4c. Visual Stream Morphology Stability Assessment Table
Meadow Brook Stream Restoration Project (DMS No.100024)

Reach ID: Meadow Brook Reach 3 (273 ft) Meadow Brook Reach 4 (218 ft)
Assessed Stream Length (ft): 491
Assessed Bank Length (ft): 982
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 NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5		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)	7	7		100%

Table 4d. Visual Stream Morphology Stability Assessment Table
Meadow Brook Stream Restoration Project (DMS No.100024)

Reach ID: UT to Meadow Brook
Assessed Stream Length (ft): 703
Assessed Bank Length (ft): 1406
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 NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8		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)	17	17		100%

Table 5. Vegetation Condition Assessment Table
Meadow Brook Restoration Project (DMS No.100024)

Planted Acreage: **11.2**
Assessment Dates: **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 **11.2**
Assessment Dates: **10/31/2023**

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	None	

Meadow Brook Stream Restoration Project
Monitoring Year 3 – Vegetation Plot Photo Log

Veg Plot 1 Fixed – SE Corner (09/07/2022)

Veg Plot 2 Fixed – SW Corner (09/07/2022)

Veg Plot 3 Fixed – SE Corner (09/28/2022)

Veg Plot 4 Fixed – NW Corner (09/07/2022)

Veg Plot 5 Fixed – NW Corner (09/07/2022)

Veg Plot 6 Fixed – N Corner (09/07/2022)

Random Veg Plot 7 R– (09/07/2022)

Random Veg Plot 8 R – (09/07/2022)

Random Veg Plot 9 R – (09/28/2022)

Random Veg Plot 10 R – (09/28/2022)

Random Veg Plot 11 R – (09/28/2022)

Random Veg Plot 12 R – NE Corner (09/28/2022)

Meadow Brook Stream Restoration Project
MY4 – Stream Photo Log

Photo Point 1 – Reach 1, Sta. 0+00
Facing Downstream (04/05/2023)

Photo Point 2 – Reach 1, Sta. 11+90
Facing Downstream (04/05/2023)

Photo Point 3 – Reach 1, Sta. 15+35
Facing Downstream (04/05/2023)

Photo Point 4 – Reach 1, Sta. 19+10
Facing Downstream (04/05/2023)

Photo Point 5 – Reach 1, Sta. 21+50
Facing Downstream (04/05/2023)

Photo Point 6 – Reach 1, Sta. 24+50
Facing Downstream (04/05/2023)

Photo Point 7 – Reach 1, Sta. 28+20
Facing Downstream (04/05/2023)

Photo Point 8 – Reach 2, Sta. 29+70
Facing Upstream (04/05/2023)

Photo Point 9 – Reach 2, Sta. 31+60
Facing Downstream (04/05/2023)

Photo Point 10 – Reach 3, Sta. 33+55
Facing Upstream (04/05/2023)

Photo Point 11 – Reach 3, Sta. 34+80
Facing Downstream (04/05/2023)

Photo Point 12 – Reach 4, Sta. 36+90
Facing Downstream (04/05/2023)

Photo Point 13 – UT, Sta. 10+90
Facing Upstream (04/05/2023)

Photo Point 14 – UT, Sta. 10+90
Facing Downstream (04/05/2023)

Photo Point 15 – UT, Sta. 13+20
Facing Downstream (04/05/2023)

Photo Point 16 – UT, Sta. 14+90
Facing Downstream (04/05/2023)

Photo Point 17 – Reach 1, Sta. 10+50
Facing Upstream (04/05/2023)

Photo Point 18 – Reach 2, Sta. 32+80
Facing Upstream (04/05/2023)

Photo Point 19 – Reach 3, Sta. 38+00
Facing Downstream (04/05/2023)

Photo Point 20 – UT, Sta 10+20
Facing Upstream (04/05/2023)

Representative Photo, Reach 4
Facing Upstream (10/31/2023)

Representative Photo, Reach UT1
Facing Upstream (10/31/2023)

Representative Photo, Reach 1
Offset rock vane, facing Upstream (10/31/2023)

Site Overview
Facing East (4/14/2023)

Appendix B

Vegetation Plot Data

Table 6. MY3 Vegetation Plot Data

Table 7. MY3 Vegetation Performance Standards Summary Table

Note: No vegetation data was collected in MY4 (2023)

Vegetation monitoring will resume in MY5 (2024)

Table 6. Vegetation Plot Data
Meadow Brook Stream Restoration Project (NCDMS Project No. 100024)

Planted Acreage	11.2
Date of Initial Plant	2020-01-20
Date(s) of Supplemental Plant(s)	2021-03-15
Date(s) Mowing	#N/A
Date of Current Survey	10/22/2022
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 F		Veg Plot 6 F		Veg Plot 7 R	Veg Plot 8 R	Veg Plot 9 R	Veg Plot 10 R	Veg Plot 11 R	Veg Plot 12 R
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Total	Total	Total	Total	Total	Total
Species Included in Approved Mitigation Plan	Betula nigra	river birch	Tree	FACW	1	1	3	3			2	2	6	6	4	4	4	4		1		3
	Carya glabra	pignut hickory	Tree	FACU	2	2	2	2										1				
	Celtis laevigata	sugarberry	Tree	FACW	1	1																
	Cercis canadensis	eastern redbud	Tree	FACU			1	1	2	2							4				1	
	Cornus amomum	silky dogwood	Shrub	FACW			4	4			1	1	6	6	8	8		1				
	Diospyros virginiana	common persimmon	Tree	FAC	1	1	3	3	1	1			1	1				1		2		1
	Fraxinus pennsylvanica	green ash	Tree	FACW	1	1	1	1			4	4						2			1	1
	Hamamelis virginiana	American witchhazel	Tree	FACU																	1	
	Liriodendron tulipifera	tuliptree	Tree	FACU	1	1	4	4										1		1		
	Platanus occidentalis	American sycamore	Tree	FACW			1	1	1	1			1	1			2	1	4	3		1
	Quercus alba	white oak	Tree	FACU			1	1			1	1										
	Quercus falcata	southern red oak	Tree	FACU																	2	
	Quercus phellos	willow oak	Tree	FAC							6	6										
	Quercus rubra	northern red oak	Tree	FACU	2	2	1	1			1	1					3					
	Salix nigra	black willow	Tree	OBL	5	5	2	2	3	3	1	1	4	4	6	6			2	2	3	3
	Salix sericea	silky willow	Shrub	OBL					2	2	1	1	1	1								
	Sambucus canadensis	American black elderberry	Tree				1	1	1	1	1	1			1	1			3			
	Sambucus nigra	black elderberry	Tree	FAC							1	1										
	Ulmus americana	American elm	Tree	FACW									3	3								3
Sum	Performance Standard				14	14	24	24	10	10	19	19	22	22	19	19	13	11	9	9	8	12
Post Mitigation Plan Species	*Acer rubrum*	*red maple*	*Tree*	*FAC*						*3*					*1*	*1*			*2*			
	Alnus serrulata	hazel alder	Tree	OBL			2	2														
	Carpinus caroliniana	American hornbeam	Tree	FAC											1	1						
	Cephalanthus occidentalis	common buttonbush	Shrub	OBL							4	4			1	1		2				
	Physocarpus opulifolius	*common ninebark*	*Shrub*	*FACW*						*1*												
	Quercus michauxii	swamp chestnut oak	Tree	FACW							1	1										
Sum	Proposed Standard				14	14	26	26	10	10	24	24	22	22	21	21	13	13	9	9	8	12
Mitigation Plan Performance Standard	Current Year Stem Count					14		24		10		19		22		19	13	11	9	9	8	12
	Stems/Acre					567		972		405		769		891		769	526	445	364	364	324	486
	Species Count					8		12		6		10		7		4	4	7	3	5	5	6
	Dominant Species Composition (%)					36		15		21		25		27		36	31	31	36	33	38	25
	Average Plot Height (ft.)					5		3		5		4		4		4	5	4	6	5	6	7
	% Invasives					0		0		0		0		0		0	0	0	0	0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					14		26		10		24		22		21	13	13	9	9	8	12
	Stems/Acre					567		1052		405		972		891		850	526	526	364	364	324	486
	Species Count					8		13		6		12		7		6	4	8	3	5	5	6
	Dominant Species Composition (%)					36		15		21		25		27		36	31	31	36	33	38	25
	Average Plot Height (ft.)					5		3		5		4		4		4	5	4	6	5	6	7
	% Invasives					0		0		0		0		0		0	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 Performance Criteria	Does not Meet Interim Performance Criteria

Table 7. Vegetation Performance Standards Summary Table
Meadow Brook Stream Restoration Project (NCDMS Project No. 100024)

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	567	5	8	0	972	3	12	0	405	5	6	0
Monitoring Year 2	526	4	7	0	1174	2	12	0	567	4	7	0
Monitoring Year 1	324	3	5	0	850	1	10	0	202	1	4	0
Monitoring Year 0	769	2	7	0	1174	2	11	0	688	2	7	0
	Veg Plot 4 F				Veg Plot 5 F				Veg Plot 6 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	769	4	9	0	891	4	7	0	769	4	4	0
Monitoring Year 2	1133	2	9	0	1012	3	8	0	931	3	5	0
Monitoring Year 1	364	2	7	0	526	3	6	0	81	3	2	0
Monitoring Year 0	648	2	7	0	729	2	8	0	445	2	4	0
	Veg Plot Group 1 R				Veg Plot Group 2 R				Veg Plot Group 3 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	526	5	4	0	445	4	7	0	364	6	3	0
Monitoring Year 2	526	4	5	0	364	4	3	0	607	4	7	0
Monitoring Year 1	40	2	1	0	243	2	5	0	324	3	6	0
Monitoring Year 0												
	Veg Plot Group 4 R				Veg Plot Group 5 R				Veg Plot Group 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	364	5	5	0	324	6	5	0	486	7	6	0
Monitoring Year 2	526	5	4	0	810	4	5	0	486	2	8	0
Monitoring Year 1	81	3	2	0	162	3	3	0	445	2	6	0
Monitoring Year 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 a bug in program. MY3 stem counts are correct**

Meets interim Performance Criteria	Does not Meet Interim Performance Criteria

Appendix C

Stream Geomorphology Data

MY3 Cross-Sections With Annual Overlays

Table 8. Baseline Stream Data Summary

Table 9. MY3 Cross-Section Morphology Monitoring Summary

Note:No cross-section data was collected in MY4 (2023)

Cross-section Monitoring will resume in MY5 (2024)

Cross Section Plots - MY3

XS1 - Reach 1

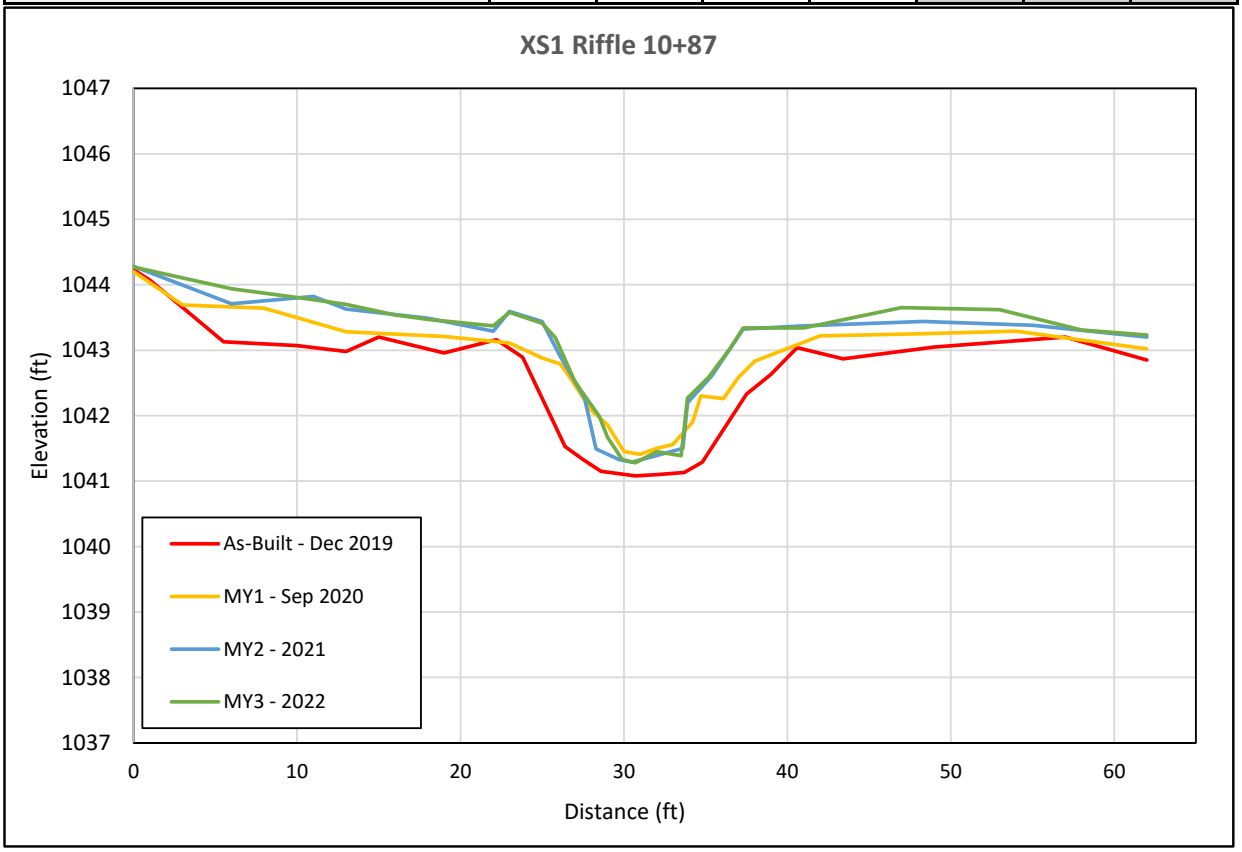
Rosgen Stream Type - C4

Station 10+87 - Riffle

XS1 looking upstream

XS1 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1042.89	1043.43	1043.72	1043.79			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.84	0.84	0.82			
Thalweg Elevation	1041.08	1041.41	1041.29	1041.28			
LTOB Elevation	1042.89	1043.11	1043.32	1043.34			
LTOB Max Depth	1.81	1.70	2.03	2.06			
LTOB Cross Sectional Area	19.79	14.06	15.02	14.33			
Entrenchment Ratio	>3.5	>4.52	>6.14	>6.36			



Cross Section Plot - MY3

XS2 - Reach 1

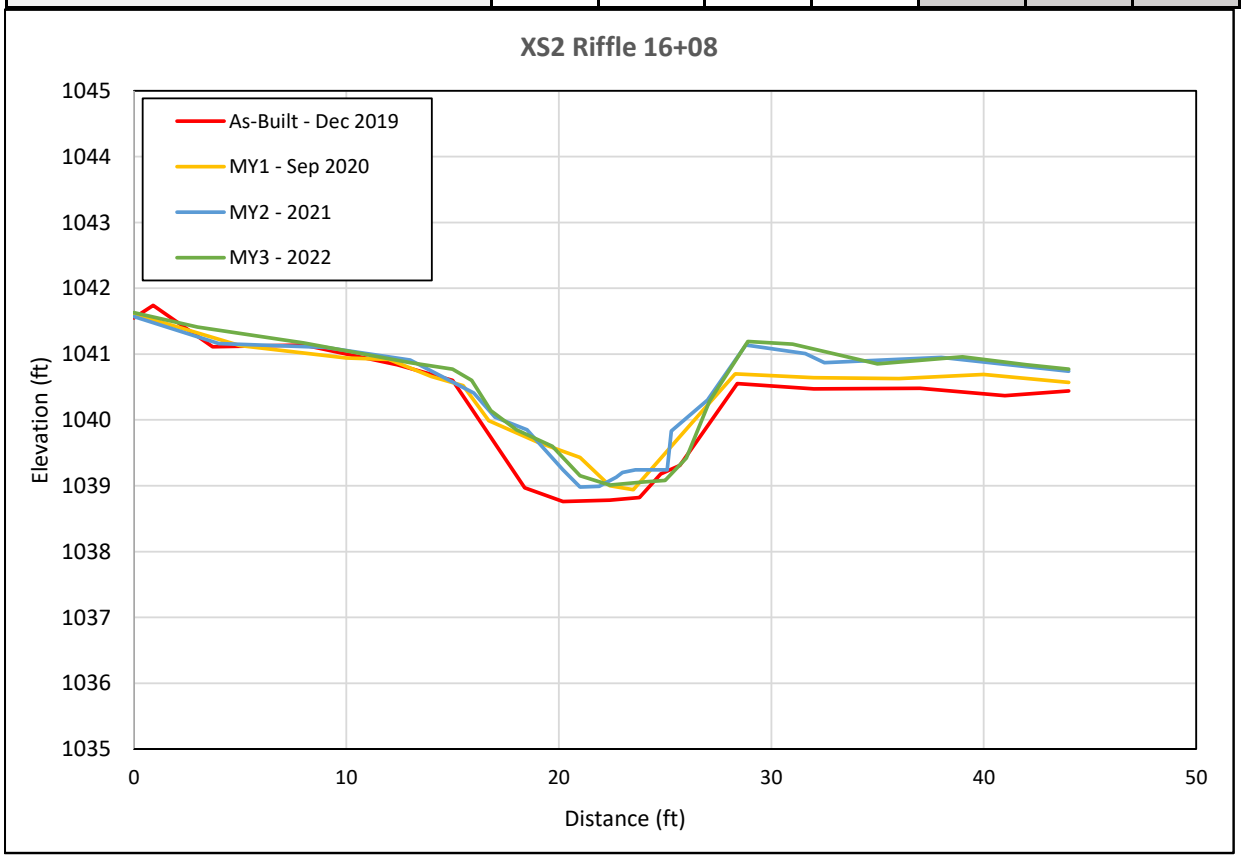
Rosgen Stream Type - C4

Station 16+08- Riffle

XS2 looking upstream

XS2 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1040.55	1040.98	1040.94	1040.90			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.78	0.99	0.98			
Thalweg Elevation	1038.76	1038.94	1038.98	1039.01			
LTOB Elevation	1040.55	1040.52	1040.91	1040.87			
LTOB Max Depth	1.79	1.58	1.93	1.86			
LTOB Cross Sectional Area	16.40	10.80	16.01	15.97			
Entrenchment Ratio	>3.31	>3.46	>3.75	>3.79			



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Cross Section Plot - MY3

XS3 - Reach 1

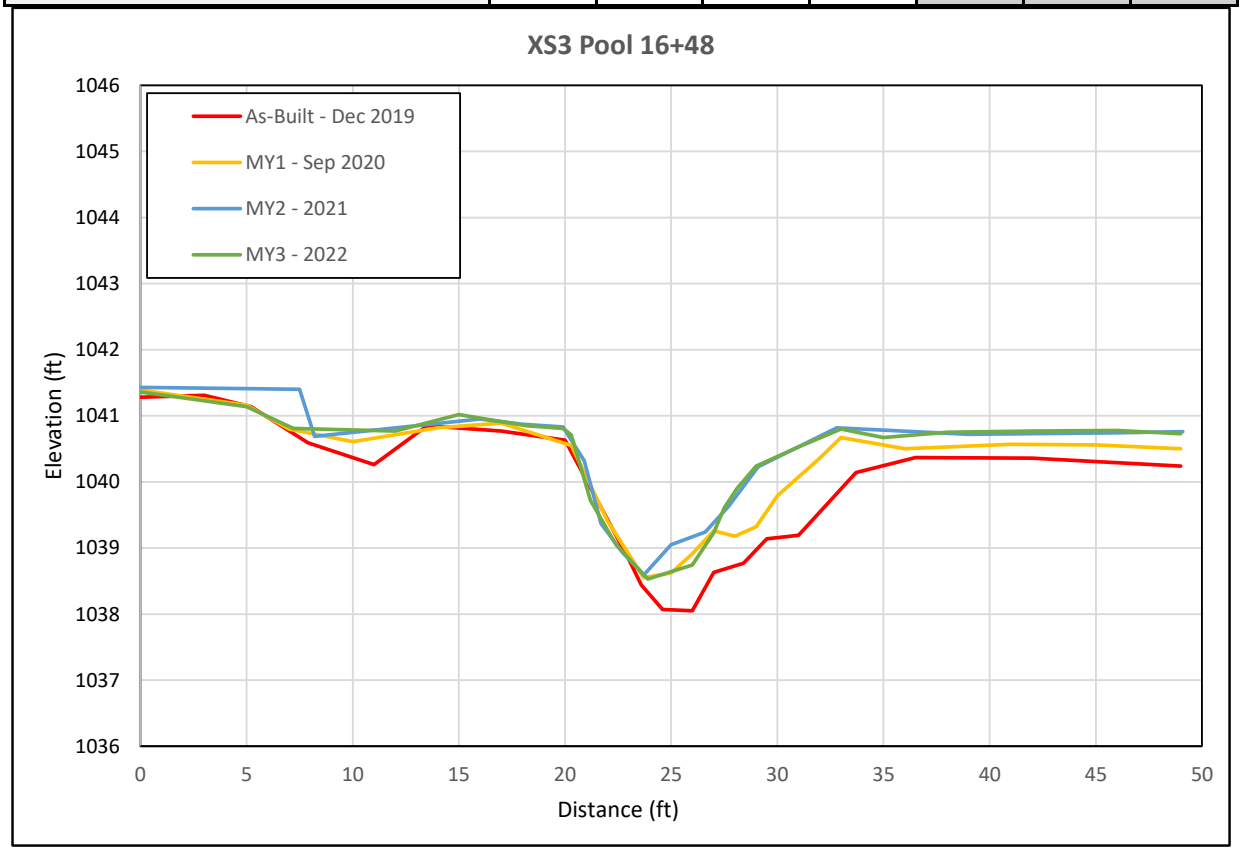
Rosgen Stream Type - C4

Station 16+48- Pool

XS3 looking upstream

XS3 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1040.37	1040.90	1041.16	1041.08			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.85	0.87	0.89			
Thalweg Elevation	1038.05	1038.55	1038.59	1038.53			
LTOB Elevation	1040.37	1040.55	1040.82	1040.80			
LTOB Max Depth	2.32	2.00	2.23	2.27			
LTOB Cross Sectional Area	18.32	14.08	13.89	14.69			
Entrenchment Ratio	-	-	-	-			



Cross Section Plot - MY3

XS4 - Reach 1

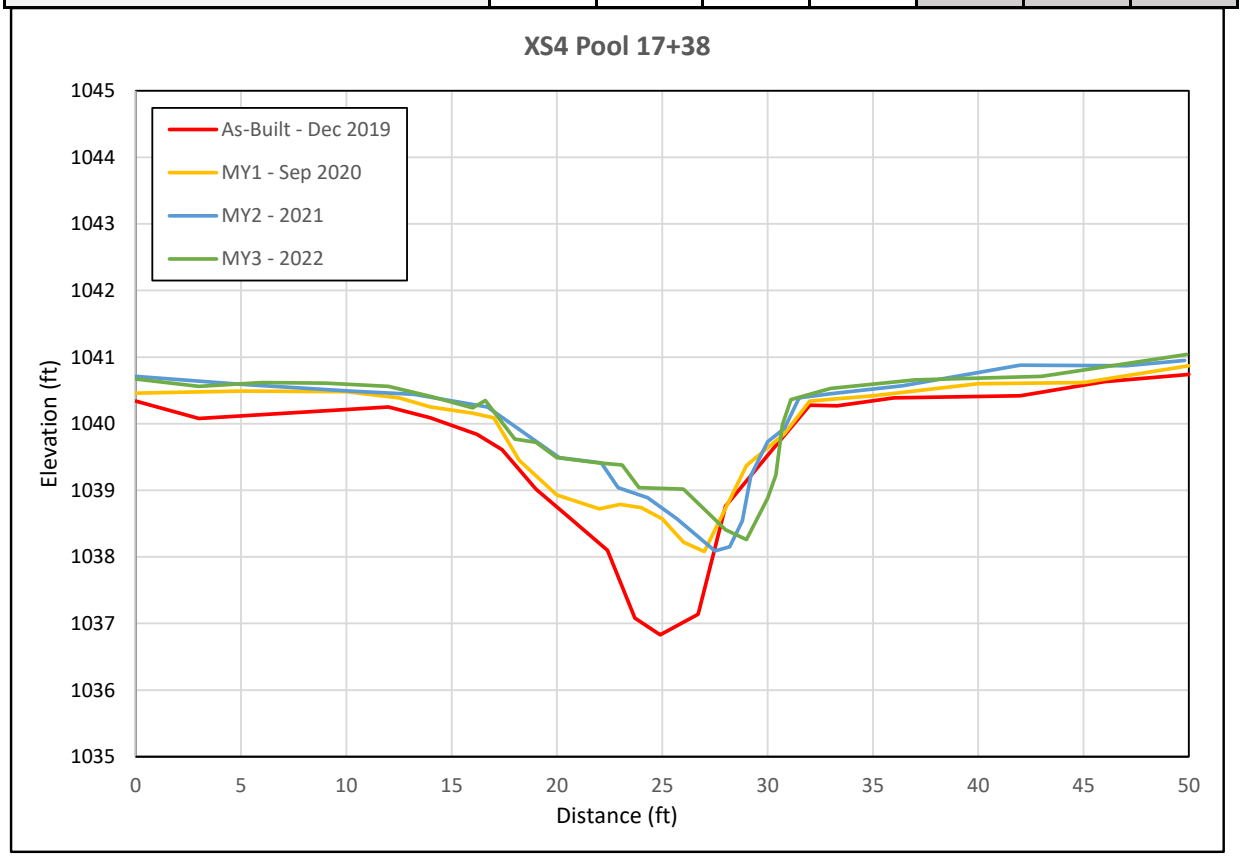
Rosgen Stream Type - C4

Station 17+38- Pool

XS4 looking upstream

XS4 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1040.25	1040.78	1041.11	1041.16			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.80	0.71	0.72			
Thalweg Elevation	1036.83	1038.08	1038.09	1038.26			
LTOB Elevation	1040.25	1040.25	1040.25	1040.35			
LTOB Max Depth	3.42	2.17	2.16	2.09			
LTOB Cross Sectional Area	27.86	18.48	15.31	16.17			
Entrenchment Ratio	-	-	-	-			



Cross Section Plot - MY3

XS5 - Reach 1

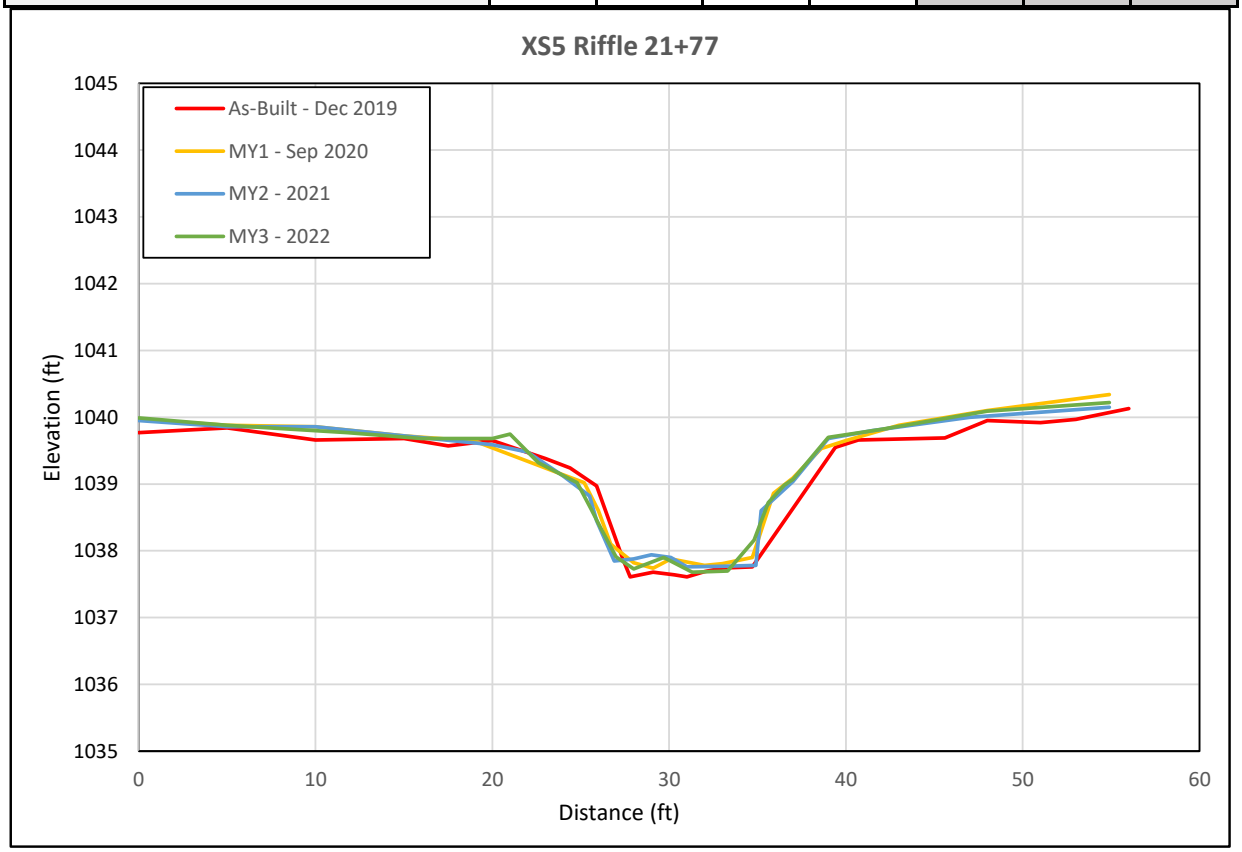
Rosgen Stream Type - C4

Station 21+77 - Riffle

XS5 looking upstream

XS5 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1039.55	1039.65	1039.63	1039.64			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94	1.02	1.03			
Thalweg Elevation	1037.61	1037.74	1037.76	1037.68			
LTOB Elevation	1039.55	1039.53	1039.68	1039.70			
LTOB Max Depth	1.94	1.79	1.92	2.02			
LTOB Cross Sectional Area	20.68	18.54	21.67	21.71			
Entrenchment Ratio	>3.06	>2.90	>2.93	>3.27			



Cross Section Plot - MY3

XS6 - Reach 1

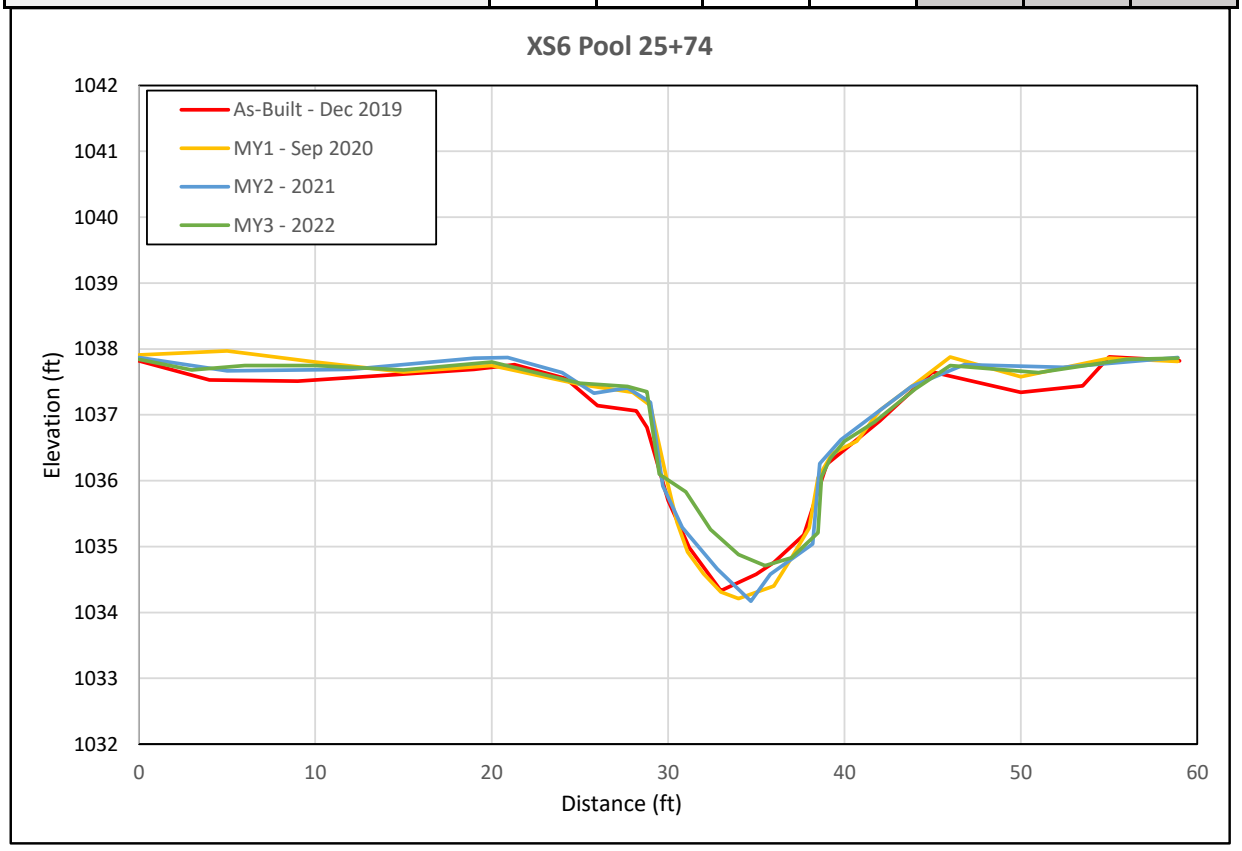
Rosgen Stream Type - C4

Station 25+74 - Pool

XS6 looking upstream

XS6 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1037.06	1037.03	1037.10	1037.33			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.11	1.11	1.04			
Thalweg Elevation	1034.33	1034.21	1034.17	1034.88			
LTOB Elevation	1037.06	1037.34	1037.41	1037.43			
LTOB Max Depth	2.73	3.13	3.24	2.55			
LTOB Cross Sectional Area	21.82	26.18	26.27	23.45			
Entrenchment Ratio	-	-	-	-			



Cross Section Plot - MY3

XS7 - Reach 2

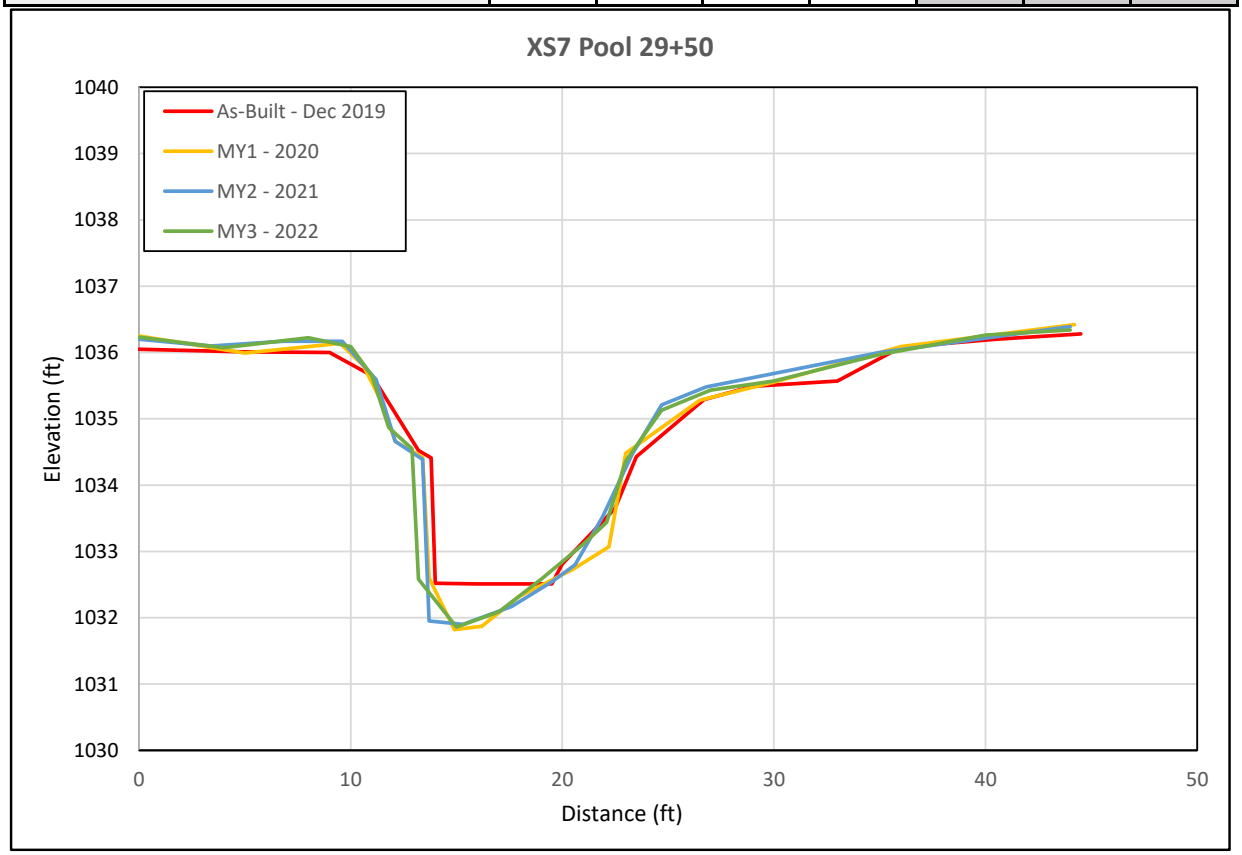
Rosgen Stream Type - C4

Station 29+50 - Pool

XS7 looking upstream

XS7 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1035.65	1035.48	1035.56	1035.53			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.09	1.01	1.03			
Thalweg Elevation	1032.51	1031.82	1031.90	1031.86			
LTOB Elevation	1035.65	1035.80	1035.59	1035.65			
LTOB Max Depth	3.14	3.98	3.69	3.79			
LTOB Cross Sectional Area	32.43	38.84	32.98	34.82			
Entrenchment Ratio	-	-	-	-			



Cross Section Plot - MY3

XS8 - Reach 2

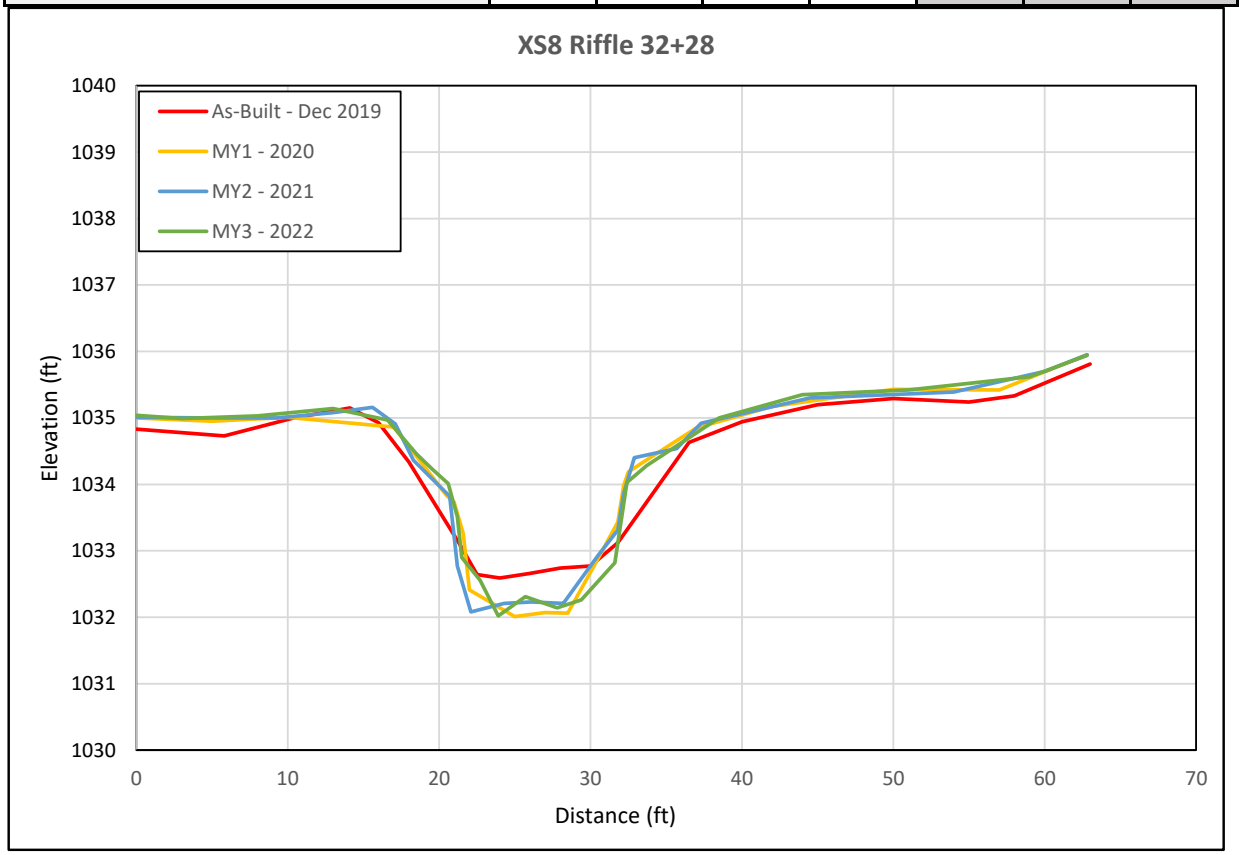
Rosgen Stream Type - C4

Station 32+28 - Riffle

XS8 looking upstream

XS8 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1034.63	1034.62	1034.61	1034.61			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.09	0.97	0.94			
Thalweg Elevation	1032.59	1032.01	1032.08	1032.02			
LTOB Elevation	1034.63	1034.85	1034.54	1034.46			
LTOB Max Depth	2.04	2.84	2.46	2.44			
LTOB Cross Sectional Area	26.44	30.76	25.20	23.95			
Entrenchment Ratio	>3.23	>3.55	>3.43	>3.46			



Cross Section Plot - MY3

XS9 - Reach 3

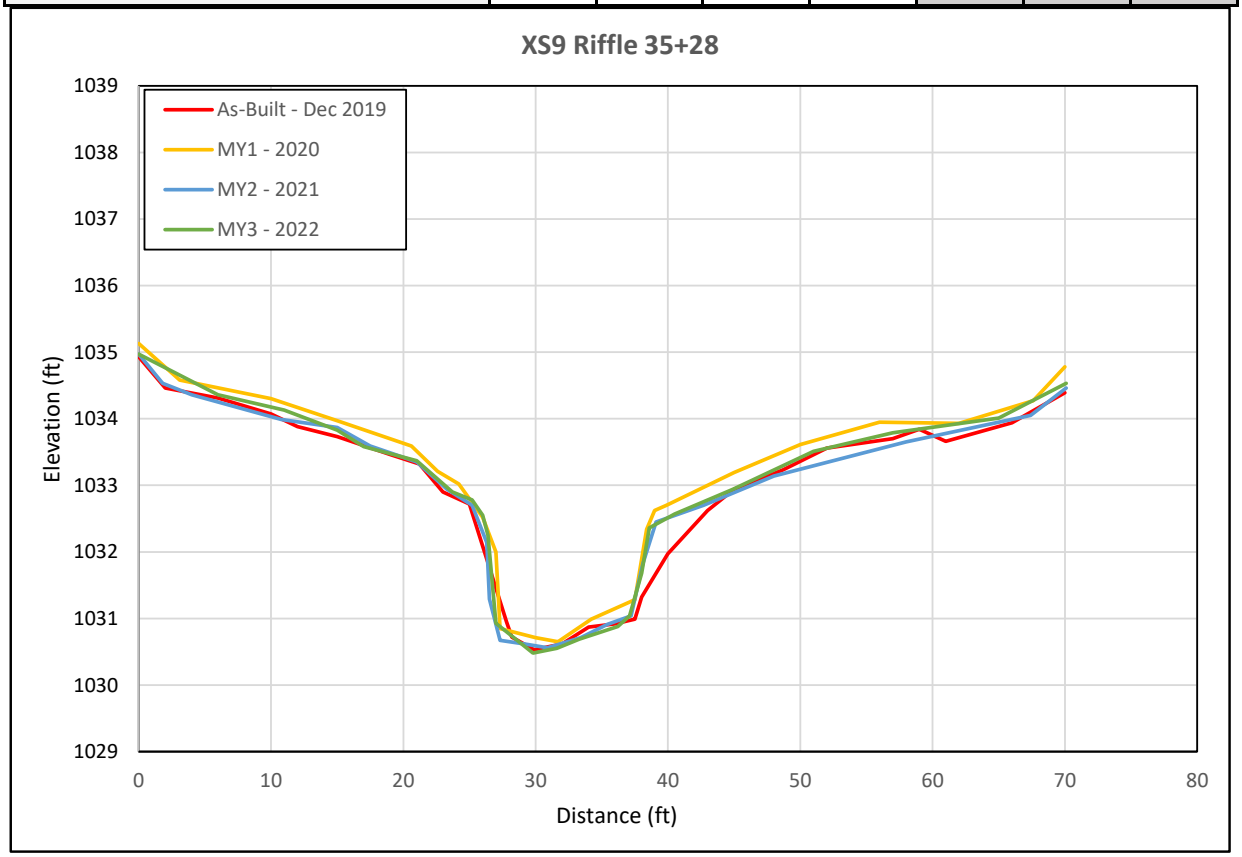
Rosgen Stream Type - B4c

Station 35+28 - Riffle

XS9 looking upstream

XS9 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1032.62	1032.98	1032.72	1032.76			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.85	0.99	0.92			
Thalweg Elevation	1030.53	1030.65	1030.56	1030.48			
LTOB Elevation	1032.62	1032.62	1032.70	1032.57			
LTOB Max Depth	2.09	1.97	2.14	2.09			
LTOB Cross Sectional Area	23.96	19.22	23.58	21.14			
Entrenchment Ratio	>3.87	>4.94	>4.22	>4.44			



Cross Section Plot - MY3

XS10 - Reach 3

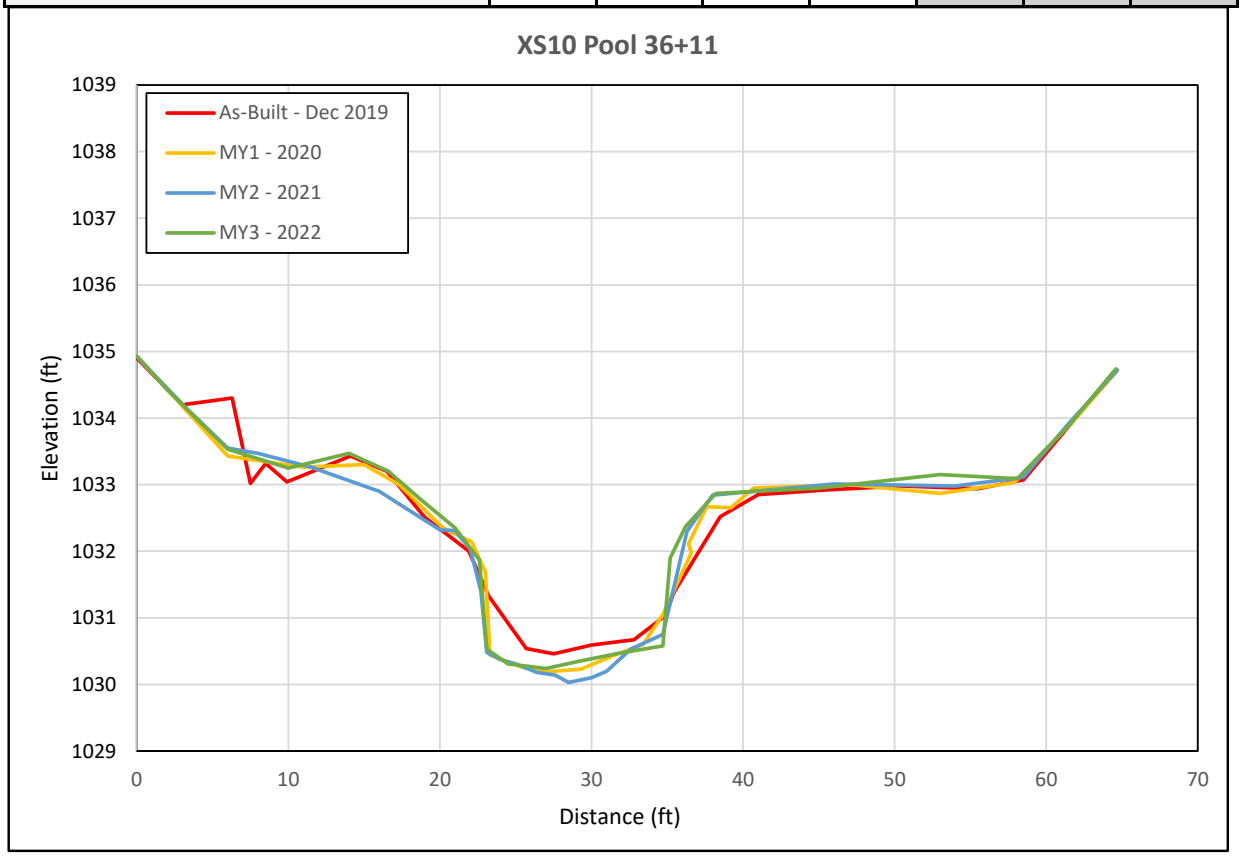
Rosgen Stream Type - B4c

Station 36+11- Pool

XS10 looking upstream

XS10 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1032.85	1032.77	1032.70	1032.83			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.07	1.05	1.02			
Thalweg Elevation	1030.46	1030.19	1030.03	1030.24			
LTOB Elevation	1032.85	1032.95	1032.84	1032.87			
LTOB Max Depth	2.39	2.76	2.81	2.63			
LTOB Cross Sectional Area	32.75	36.72	35.67	33.60			
Entrenchment Ratio	-	-	-	-			



Cross Section Plot - MY3

XS11 - UT

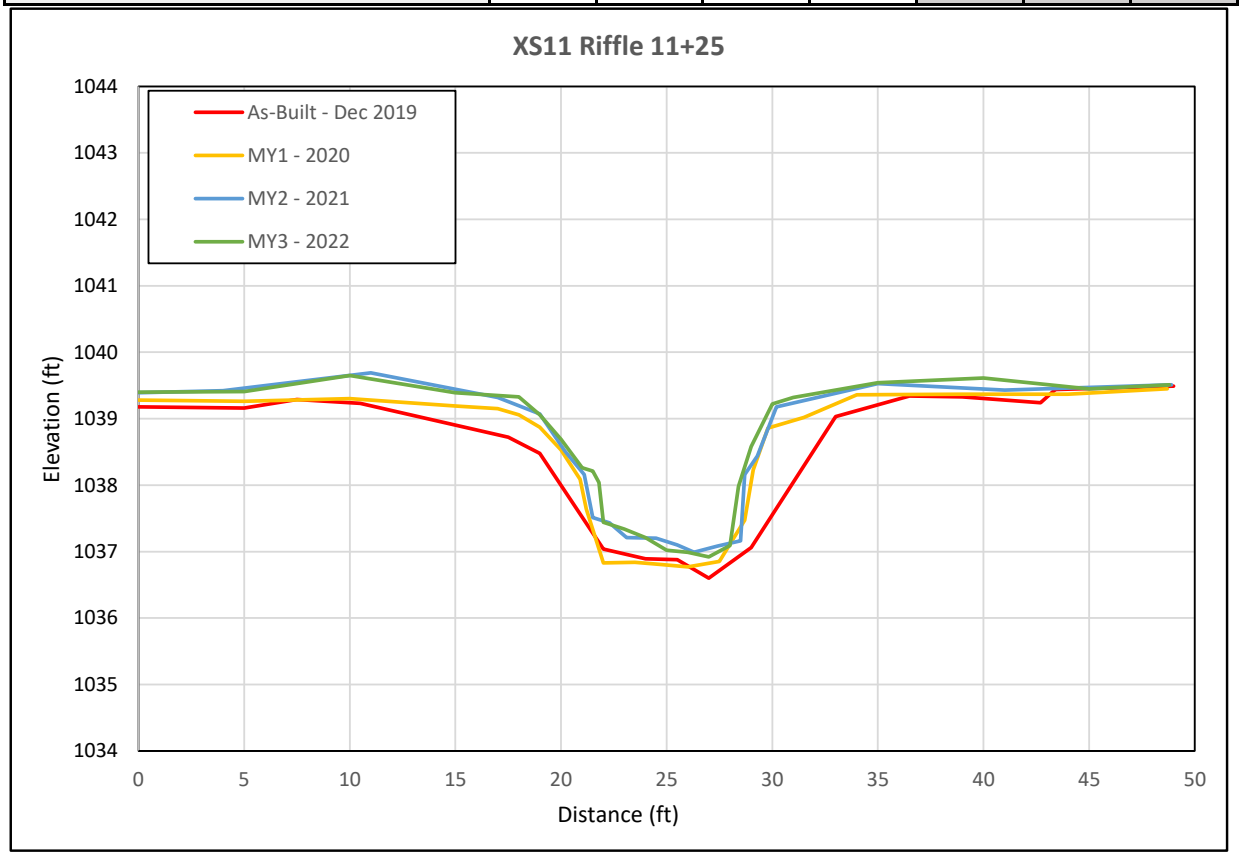
Rosgen Stream Type - C4

Station 11+25 - Riffle

XS11 looking upstream

XS11 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1038.48	1038.87	1039.06	1039.15			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.99	1.01	0.96			
Thalweg Elevation	1036.60	1036.84	1036.99	1036.92			
LTOB Elevation	1038.48	1038.86	1039.07	1039.06			
LTOB Max Depth	1.88	2.02	2.08	2.14			
LTOB Cross Sectional Area	15.54	15.40	15.69	14.60			
Entrenchment Ratio	>3.8	>5.23	>5.37	>5.8			



Cross Section Plot - MY3

XS12 - UT

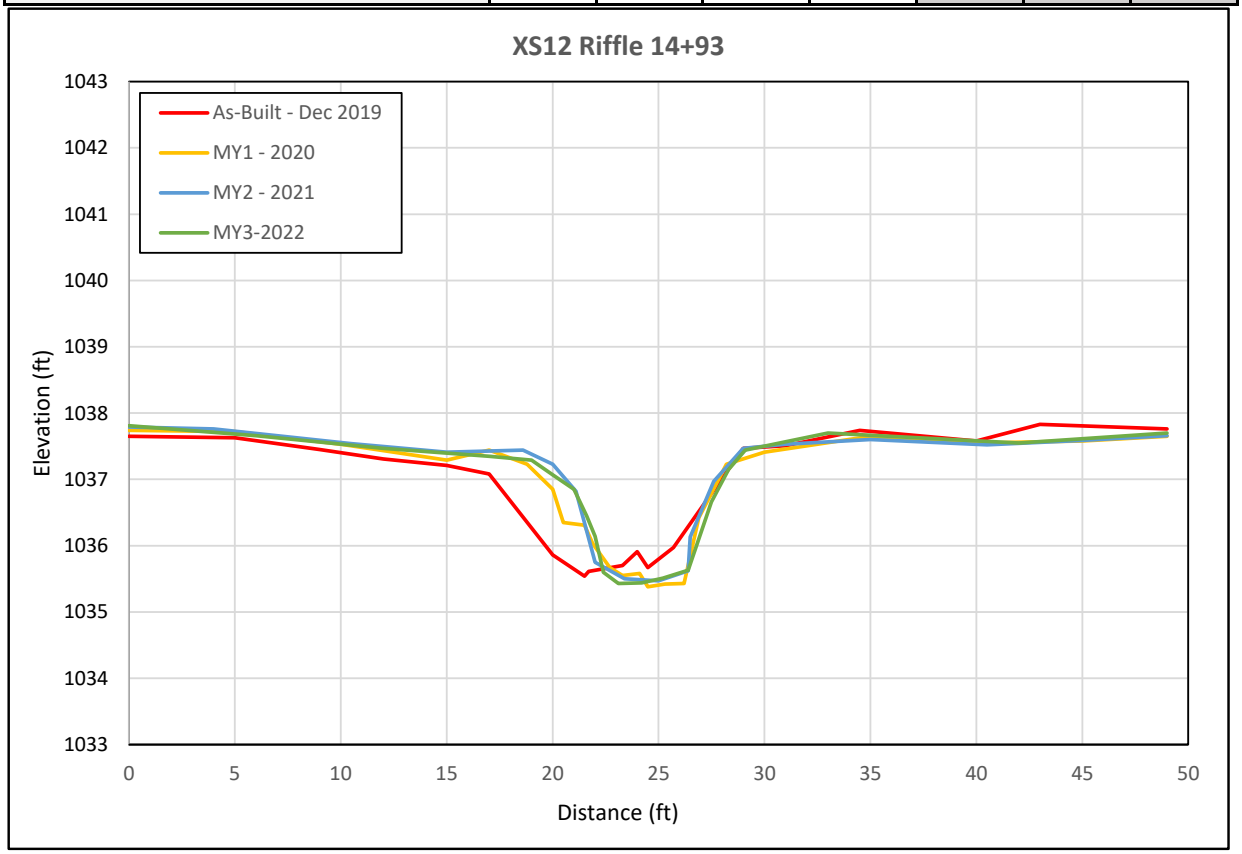
Rosgen Stream Type - C4

Station 14+93 - Riffle

XS12 looking upstream

XS12 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1037.08	1037.49	1037.39	1037.32			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.86	1.03	0.98			
Thalweg Elevation	1035.54	1035.67	1035.47	1035.43			
LTOB Elevation	1037.08	1037.23	1037.44	1037.29			
LTOB Max Depth	1.54	1.56	1.97	1.86			
LTOB Cross Sectional Area	10.89	8.47	11.41	10.55			
Entrenchment Ratio	>4.4	>5.64	>6.53	>5.95			



Cross Section Plot - MY3

XS13 - UT

Rosgen Stream Type - C4

Station 15+72 - Pool

XS13 looking upstream

XS13 looking downstream

	MY0	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation - Based on AB Bankfull Area	1036.46	1037.27	1037.10	1037.17			
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94	1.04	0.95			
Thalweg Elevation	1033.32	1034.52	1034.62	1034.26			
LTOB Elevation	1036.46	1037.09	1037.21	1037.02			
LTOB Max Depth	3.14	2.57	2.59	2.76			
LTOB Cross Sectional Area	19.55	17.77	22.91	18.04			
Entrenchment Ratio	-	-	-	-			

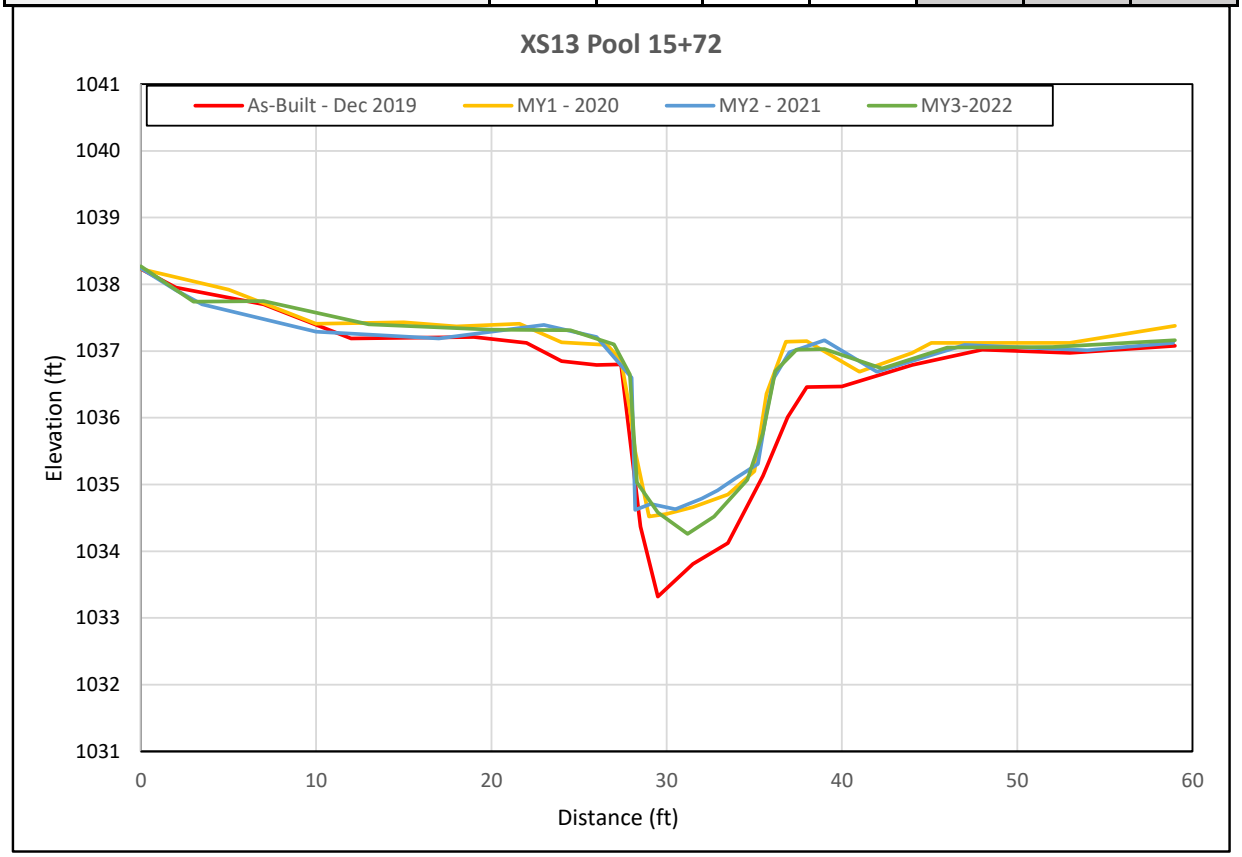


Table 8a. Baseline Stream Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - Meadow Brook Reach 1 (1936 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only	LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)	7	25	11.5	7.2	12.5	11.6	19.6	5.4	4	13.8	15.4	-	16.9	-	N/A	13.8	14.5	15.7	13.3	16.0	16.4	18.3	2.1	3
Floodprone Width (ft)				56.0	192.8	209.0	297.0	102.6	4	30.8	291.0	-	552	-	N/A	180.0	215.0	250.0	>44	>54	>56	>62	-	3
Bankfull Mean Depth (ft)	0.9	2.3	1.5	0.8	1.5	1.4	2.2	0.6	4	0.8	1.3	-	1.7	-	N/A	1.1	1.3	1.6	1.1	1.2	1.2	1.2	0.0	3
[1]Bankfull Max Depth (ft)				2.0	2.3	2.2	2.8	0.4	4	1.1	1.8	-	2.4	-	N/A	1.3	1.8	2.2	1.8	1.8	1.8	1.9	0.1	3
Bankfull Cross Sectional Area (ft^2)	9	40	15.1	15.1	15.7	15.4	16.9	0.9	4	11.0	19.9	-	28.7	-	N/A	15.2	19.0	25.1	16.4	18.9	19.5	20.7	1.8	3
Width/Depth Ratio				3.3	11.4	8.4	25.4	9.8	4	10.0	12.5	-	15	-	N/A	10.0	11.0	13.0	10.8	13.6	13.8	16.2	2.2	3
Entrenchment Ratio				5.7	17.5	15.7	33.0	12.5	4	2.2	3.1	-	40.0	-	N/A	12.2	22.6	33.0	>3.1	>3.1	>3.1	>3.1	-	3
[1]Bank Height Ratio				1.0	1.2	1.2	1.5	0.2	5	1.0	1.1	-	1.1	-	N/A	1.0	1.0	1.0	1	1	1	1	-	3
Profile																								
Riffle Length (ft)				11.0	48.7	20.0	216.0	74.2	7	Total riffle length 60-70% of reach length						31.0	52.0	72.0	32.2	55.7	60.1	72.0	14.2	12
Riffle Slope (ft/ft)				0.003	0.00757	0.004	0.022	0.0067	7	0.002	0.0045	-	0.007	-	-	0.0034	0.0045	0.006	0.003	0.004	0.004	0.006	0.001	12
Pool Length (ft)				9.0	43.9	39.0	98.0	36.8	8	Total pool length 30-40% of reach length						20.0	26.3	38.0	20.4	27.9	26.6	36.7	5.1	17
Pool Max depth (ft)				2.1	2.5	2.5	2.8	0.2	8	1.6	3.8	-	5.0	-	-	2.1	3.2	4.7	0.7	1.5	1.3	3.1	0.7	19
Pool Spacing (ft)				30.0	88.0	73.0	177.0	55.0	8	61.4	84.4	-	140	-	-	40.5	86.0	120.0	50.0	95.0	99.6	119.4	20.9	16
Pattern																								
Channel Beltwidth (ft)				11.0	27.1	24.0	44.0	12.1	10	53.7	88.3	-	122.8	-	-	54.8	75.5	106.8	55.0	76.3	69.1	106.6	15.0	18
Radius of Curvature (ft)				12.0	62.2	31.0	150.0	49.7	11	30.7	42.2	-	53.7	-	-	30.4	36.3	41.4	30.4	32.6	31.5	40.8	2.7	18
Rc:Bankfull width (ft/ft)				1.1	5.7	2.8	13.6	4.5	11	2.0	2.8	-	3.5	-	-	2.1	2.5	2.8	1.9	2.0	2.0	2.5	0.2	18
Meander Wavelength (ft)				65.0	176.4	120.0	450.0	143.9	7	107.5	145.8	-	184.2	-	-	103	138.1	189	108.0	135.0	136.4	166.0	18.0	17
Meander Width Ratio				1.0	2.5	2.2	4.0	1.1	10	3.5	5.8	-	8.0	-	-	3.7	5.1	7.2	3.4	4.7	4.3	6.6	0.8	17
Transport parameters																								
Reach Shear Stress (competency) lb/f^2				1												0.3			0.22					
Max part size (mm) mobilized at bankfull				243												68			50					
Stream Power (transport capacity) W/m^2				4.6												10			14.5					
Additional Reach Parameters																								
Rosgen Classification				E4						C4						C4			C4					
Bankfull Velocity (fps)	0.8	25.6	5.6	4.8												3.8			3.9					
Bankfull Discharge (cfs)	30	230	84.5	73												73			73					
Valley length (ft)				1249						-						1358*			1358					
Channel Thalweg length (ft)				1304						-						1936			1965					
Sinuosity (ft)				1.0						1.2 to 1.6						1.4			1.4					
Water Surface Slope (Channel) (ft/ft)				0.00498						-						0.0034			0.0035					
BF slope (ft/ft)				0.00498						-						0.0034			0.0035					
[3]Bankfull Floodplain Area (acres)				5.5						-						6.7			5.5					
[4]% of Reach with Eroding Banks				61%						-														
Channel Stability or Habitat Metric				37%						-														
Biological or Other				-						-														

Shaded cells indicate that these will typically not be filled in.

1. The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4. Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

* Note that the valley length has increased in the proposed alignment.

Table 8b. Baseline Stream Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - Meadow Brook Reach 2 (393 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only	LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)	8.5	30	14.2	14.5	14.5	14.5	14.5	-	1	15.2	16.9	-	18.6	-	-	16.1	16.6	18.4	19.5	19.5	19.5	19.5	-	1
Floodprone Width (ft)				48.0	48.0	48.0	48.0	-	1	37.2	323.0	-	608	-	-	180.0	197.5	215.0	>63	>63	>63	>63	-	1
Bankfull Mean Depth (ft)	1.1	3	1.7	1.7	1.7	1.7	1.7	-	1	1	1.5	-	1.9	-	-	1.2	1.4	1.8	1.4	1.4	1.4	1.4	-	1
[1]Bankfull Max Depth (ft)				2.5	2.5	2.5	2.5	-	1	1.2	1.9	-	2.6	-	-	1.5	1.9	2.6	2.0	2.0	2.0	2.0	-	1
Bankfull Cross Sectional Area (ft^2)	13	53	21.6	24.0	24.0	24.0	24.0	-	1	15.2	25.3	-	35.3	-	-	19.3	23.0	33.1	26.4	26.4	26.4	26.4	-	1
Width/Depth Ratio				8.7	8.7	8.7	8.7	-	1	10.0	12.5	-	15	-	-	10.0	12.0	13.0	14.3	14.3	14.3	14.3	-	1
Entrenchment Ratio				3.3	3.3	3.3	3.3	-	1	2.2	3.1	-	40.0	-	-	11.1	12.2	13.2	>3.2	>3.2	>3.2	>3.2	-	1
[1]Bank Height Ratio				1.0	1.0	1.0	1.0	-	1	1.0	1.1	-	1.1	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	1
Profile																								
Riffle Length (ft)				20.0	55.0	55.0	90.0	-	2	Total riffle length 60-70% of reach length						37.0	49.0	53.0	66.6	77.8	80.6	86.3	8.3	3
Riffle Slope (ft/ft)				0.002	0.031	0.031	0.06	-	2	0.002	0.0045	-	0.007	-	-	0.0038	0.0045	0.006	0.001	0.003	0.002	0.005	0.001	3
Pool Length (ft)				72.0	134.0	134.0	196.0	-	2	Total pool length 30-40% of reach length						32.0	34.0	39.0	16.8	24.7	23.7	34.5	6.5	4
Pool Max depth (ft)				3.1	3.4	3.4	3.7	-	2	2	4.3	-	6.7	-	-	2.8	3.2	4.9	1.0	1.8	1.7	2.9	0.7	4
Pool Spacing (ft)				135.0	213.0	213.0	290.0	-	2	67.6	93.0	-	118.3	-	-	95.0	108.0	111.0	89.8	115.9	112.1	149.5	21.9	4
Pattern																								
Channel Beltwidth (ft)				25.0	25.0	25.0	25.0	-	1	59.2	97.2	-	135.2	-	-	49.3	84.8	92.3	81.2	87.7	89.9	92.1	4.7	3
Radius of Curvature (ft)				25.0	25.0	25.0	25.0	-	1	33.8	46.5	-	59.2	-	-	37.1	38.1	42.1	37.3	38.5	38.7	39.2	0.7	4
Rc:Bankfull width (ft/ft)				2.3	2.3	2.3	2.3	-	1	2.0	2.8	-	3.5	-	-	2.3	2.3	2.6	1.9	2.0	2.0	2.0	0.0	4
Meander Wavelength (ft)				295.0	295.0	295.0	295.0	-	1	118.3	160.6	-	202.8	-	-	144.0	154.0	187.0	149.2	154.3	155.5	156.8	3.0	4
Meander Width Ratio				2.3	2.3	2.3	2.3	-	1	3.5	5.8	-	8.0	-	-	3.0	5.2	5.7	4.2	4.5	4.6	4.7	0.2	3
Transport parameters																								
Reach Shear Stress (competency) lb/f^2				0.7												0.3			0.3					
Max part size (mm) mobilized at bankfull				186												81			60					
Stream Power (transport capacity) W/m^2				43												15			18					
Additional Reach Parameters																								
Rosgen Classification				E4						C4						C4			C4					
Bankfull Velocity (fps)	3.3	6.6	5.6	4.4												2.8			3.8					
Bankfull Discharge (cfs)	43	350	120.0	100												100			100					
Valley length (ft)				322						-						322			322					
Channel Thalweg length (ft)				350						-						393			390					
Sinuosity (ft)				1.1						1.2 to 1.6						1.2			1.2					
Water Surface Slope (Channel) (ft/ft)				0.00685						-						0.0038			0.0039					
BF slope (ft/ft)				0.00685						-						0.0038			0.0039					
[3]Bankfull Floodplain Area (acres)				0.4						-						1.5			0.9					
[4]% of Reach with Eroding Banks				33%						-														
Channel Stability or Habitat Metric				-						-														
Biological or Other				-						-														

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 8c. Baseline Stream Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - Meadow Brook Reach 3 (273 feet) and Meadow Brook Reach 4 (218 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only	LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)	8.8	32	14.9	21	21	21	21	-	1	17.7	19.7	-	21.6	-	-	17.7	17.7	18.4	17.8	17.8	17.8	17.8	-	1
Floodprone Width (ft)				38	38	38	38	-	1	27.5	736.0	-	708	-	-	35.0	52.5	70.0	>70	>70	>70	>70	-	1
Bankfull Mean Depth (ft)	1.1	3	1.8	1.4	1.4	1.4	1.4	-	1	1.0	1.4	-	1.8	-	-	1.4	1.5	1.5	1.3	1.3	1.3	1.3	-	1
[1]Bankfull Max Depth (ft)				2.9	2.9	2.9	2.9	-	1	1.1	1.7	-	2.3	-	-	1.5	1.9	2.0	2.1	2.1	2.1	2.1	-	1
Bankfull Cross Sectional Area (ft^2)	15	62	23.6	30	30	30	30	-	1	17.7	28.3	-	38.88	-	-	24.8	26.0	27.6	24.0	24.0	24.0	24.0	-	1
Width/Depth Ratio				15	15	15	15	-	1	12.0	15.0	-	18	-	-	12.0	12.0	13.0	13.3	13.3	13.3	13.3	-	1
Entrenchment Ratio				2	2	2	2	-	1	1.4	1.8	-	40	-	-	1.9	2.9	3.9	>3.9	>3.9	>3.9	>3.9	-	1
[1]Bank Height Ratio				1.0	1.0	1.0	1.0	-	1	1.0	1.1	-	1.1	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	1
Profile																								
Riffle Length (ft)				7	12	12	18	-	2	Total riffle length 60-70% of reach length						16.0	23.5	30.0	38.2	73.5	62.2	131.4	36.9	4
Riffle Slope (ft/ft)				0.080	0.068	0.068	0.056	-	2	0.002	0.007	-	0.015	-	-	0.007	0.008	0.01	0.002	0.006	0.007	0.010	0.003	4
Pool Length (ft)				50	142	152	225	88	3	Total pool length 30-40% of reach length						21.0	27.5	64.0	17.7	36.2	34.0	59.3	13.4	5
Pool Max depth (ft)				2.7	3.1	3.1	3.4	0.4	3	2.0	4.2	-	6.3	-	-	3.0	2.7	5.3	1.2	1.4	1.4	1.9	0.2	5
Pool Spacing (ft)				60	152	152	243	-	2	29.5	63.9	-	98.3	-	-	22.0	61.0	104.0	29.9	94.0	103.4	168.9	47.2	5
Pattern																								
Channel Beltwidth (ft)				28	35	35	41	-	2	-	-	-	-	-	-	27.1	35.6	50.1	-	-	-	-	-	-
Radius of Curvature (ft)				25	50	50	74	-	2	-	-	-	-	-	-	38.0	43.0	49.0	39.2	40.8	40.8	42.4	1.6	2
Rc:Bankfull width (ft/ft)				2.3	4.5	4.5	6.7	-	2	-	-	-	-	-	-	2.1	2.4	2.7	2.2	2.3	2.3	2.4	0.1	2
Meander Wavelength (ft)				295	295	295	295	-	1	-	-	-	-	-	-	92.0	130.0	172.0	-	-	-	-	-	-
Meander Width Ratio				2.5	3.1	3.1	3.7	-	2	-	-	-	-	-	-	1.5	2.0	2.8	-	-	-	-	-	-
Transport parameters																								
Reach Shear Stress (competency) lb/f^2				0.6												0.6			0.53					
Max part size (mm) mobilized at bankfull				158												148			98					
Stream Power (transport capacity) W/m^2				58												41			43					
Additional Reach Parameters																								
Rosgen Classification				E4						B4c						B4c			B4c					
Bankfull Velocity (fps)	3.3	6.5	5.6	3.9												3.8			4.8					
Bankfull Discharge (cfs)	50	400	131.0	116												99			116					
Valley length (ft)				508						-									508					
Channel Thalweg length (ft)				523						-						533			532					
Sinuosity (ft)				1.03						1.1 to 1.2						1.05			1.05					
Water Surface Slope (Channel) (ft/ft)				0.00369						-						0.0066			0.007					
BF slope (ft/ft)				0.00369						-						0.0066			0.007					
[3]Bankfull Floodplain Area (acres)				0.4						-						0.6			0.4					
[4]% of Reach with Eroding Banks				18%						-														
Channel Stability or Habitat Metric				-						-														
Biological or Other				-						-														

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 8d. Baseline Stream Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - UT to Meadow Brook (703 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only	LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)	6	21	9.3	8	8	8	8	-	1	11.8	13.2	-	14.5	-	-	11.8	12.4	13.4	11.1	12.0	12.0	12.9	0.9	3
Floodprone Width (ft)				195	195	195	195	-	1	28.9	250.0	-	472	-	-	188	188	188	>49	>49	>49	>49	-	3
Bankfull Mean Depth (ft)	0.8	2.1	1.2	1.5	1.5	1.5	1.5	-	1	0.8	1.2	-	1.5	-	-	0.9	1.1	1.4	1.0	1.1	1.1	1.2	0.1	3
[1]Bankfull Max Depth (ft)				2.2	2.2	2.2	2.2	-	1	0.9	1.5	-	2	-	-	1.1	1.6	1.9	1.5	1.7	1.7	1.9	0.2	3
Bankfull Cross Sectional Area (ft^2)	7	30	10.3	11	11	11	11	-	1	9.4	15.6	-	21.8	-	-	11	14	19	10.9	13.2	13.2	15.5	2.3	3
Width/Depth Ratio				5	5	5	5	-	1	10	12.5	-	15	-	-	10	11	13	10.6	11.0	11.0	11.4	0.4	3
Entrenchment Ratio				26	26	26	26	-	1	2.2	3.1	-	40	-	-	15	15.0	15.0	>3.8	>4.1	>4.1	>4.4	-	3
[1]Bank Height Ratio				1.2	1.2	1.2	1.2	-	1	1	1.1	-	1.1	-	-	1	1	1	1	1	1	1	0.0	3
Profile																								
Riffle Length (ft)				8	85	118	129	67	3	Total riffle length 60-70% of reach length						27	37	53.6	33.5	43.4	44.4	51.2	7.6	4
Riffle Slope (ft/ft)				0.0066	0.02153	0.008	0.050	0.025	3	0.002	0.0045	-	0.007	-	-	0.005	0.006	0.008	0.001	0.008	0.010	0.013	0.005	5
Pool Length (ft)				29	39	31	56	15	3	Total pool length 30-40% of reach length						17	23	52	21.9	29.1	26.0	39.5	6.8	5
Pool Max depth (ft)				3.1	3.3	3.1	3.6	0.3	3	1.6	3.4	-	5.3	-	-	2.2	2.6	3.85	0.9	1.3	1.4	1.8	0.4	5
Pool Spacing (ft)				65	160	160	254	-	2	52.6	72.3	-	92.05	-	-	10	56	92	49.8	70.6	68.9	95.0	16.6	4
Pattern																								
Channel Beltwidth (ft)				16	16	16	16	0	3	46.0	75.6	-	105.2	-	-	44.7	61.7	68.7	45.4	56.8	56.7	67.8	7.7	6
Radius of Curvature (ft)				81	81	81	81	-	1	26.3	36.2	-	46.0	-	-	28.3	29.8	34.3	26.4	30.0	29.7	33.9	2.8	7
Rc:Bankfull width (ft/ft)				7.4	7.4	7.4	7.4	-	1	2.0	2.8	-	3.5	-	-	2.2	2.4	2.7	2.2	2.5	2.5	2.8	0.2	7
Meander Wavelength (ft)				-	-	-	-	-	-	92.1	124.9	-	157.8	-	-	97.0	119.0	128.0	113.9	117.9	116.0	126.0	4.1	6
Meander Width Ratio				1.5	1.5	1.5	1.5	0.0	3	3.5	5.8	-	8.0	-	-	3.5	4.9	5.4	3.8	4.7	4.7	5.6	0.6	6
Transport parameters																								
Reach Shear Stress (competency) lb/f^2				1.8												0.3			0.3					
Max part size (mm) mobilized at bankfull				459												81			60					
Stream Power (transport capacity) W/m^2				97												11			29					
Additional Reach Parameters																								
Rosgen Classification				E4						C4						C4			C4					
Bankfull Velocity (fps)	2.9	6.7	5.7	6.8												2.7			5.8					
Bankfull Discharge (cfs)	20	200	59.0	77												37			77					
Valley length (ft)				381						-						514*			524					
Channel Thalweg length (ft)				396						-						703			694					
Sinuosity (ft)				1.04						1.2 to 1.6						1.37			1.32					
Water Surface Slope (Channel) (ft/ft)				0.00828						-						0.0047			0.005					
BF slope (ft/ft)				0.00828						-						0.0047			0.005					
[3]Bankfull Floodplain Area (acres)				1.7						-						2.2			1.5					
[4]% of Reach with Eroding Banks				80%						-														
Channel Stability or Habitat Metric				-						-														
Biological or Other				-						-														

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

* Note that the valley length has increased in the proposed alignment.

Table 9. Monitoring Data - Cross-Section Morphology Data Table
Meadow Brook Stream Restoration Project (DMS No. 100024)

	Main Stem - Reach 1 (1,936 feet) - Rosgen Stream Type - C4																									
	Cross Section 1 (Riffle)							Cross Section 2 (Riffle)							Cross Section 3 (Pool)							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	1042.89	1043.43	1043.72	1043.79				1040.55	1040.98	1040.94	1040.90				1040.37	1040.90	1041.16	1041.08				1040.25	1040.78	1041.111	1041.44			
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.84	0.84	0.82				1.00	0.78	0.99	0.98				1.00	0.85	0.87	0.89				1.00	0.80	0.71	0.72			
Thalweg Elevation	1041.08	1041.41	1041.29	1041.28				1038.76	1038.94	1038.98	1039.01				1038.05	1038.55	1038.59	1038.53				1036.83	1038.08	1038.09	1038.54			
LTOB[2] Elevation	1042.89	1043.11	1043.32	1043.34				1040.55	1040.52	1040.91	1040.87				1040.37	1040.55	1040.82	1040.80				1040.25	1040.25	1040.25	1040.63			
LTOB[2] Max Depth (ft)	1.81	1.70	2.03	2.06				1.79	1.58	1.93	1.86				2.32	2.00	2.23	2.27				3.42	2.17	2.16	2.09			
LTOB[2] Cross Sectional Area (ft[2])	19.79	14.06	15.02	14.33				16.40	10.80	16.01	15.97				18.32	14.08	13.89	14.69				27.86	18.48	15.31	16.17			
Entrenchment Ratio	>3.5	>4.52	>6.14	>6.36				>3.31	>3.46	>3.75	>3.79				-	-	-	-				-	-	-	-			

	Main Stem - Reach 1 (1,936 feet) - Rosgen Stream Type - C4														Main Stem - Reach 2 (393 feet) - Rosgen Stream Type - C4													
	Cross Section 5 (Riffle)							Cross Section 6 (Pool)							Cross Section 7 (Pool)							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	1039.55	1039.65	1039.63	1039.64				1037.06	1037.03	1037.10	1037.33				1035.65	1035.48	1035.56	1035.53				1034.63	1034.62	1034.61	1034.61			
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.94	1.02	1.03				1.00	1.11	1.11	1.04				1.00	1.09	1.01	1.03				1.00	1.09	0.97	0.94			
Thalweg Elevation	1037.61	1037.74	1037.76	1037.68				1034.33	1034.21	1034.17	1034.88				1032.51	1031.82	1031.90	1031.86				1032.59	1032.01	1032.08	1032.02			
LTOB[2] Elevation	1039.55	1039.53	1039.68	1039.70				1037.06	1037.34	1037.41	1037.43				1035.65	1035.80	1035.59	1035.65				1034.63	1034.85	1034.54	1034.46			
LTOB[2] Max Depth (ft)	1.94	1.79	1.92	2.02				2.73	3.13	3.24	2.55				3.14	3.98	3.69	3.79				2.04	2.84	2.46	2.44			
LTOB[2] Cross Sectional Area (ft[2])	20.68	18.54	21.67	21.71				21.82	26.18	26.27	23.45				32.43	38.84	32.98	34.82				26.44	30.76	25.20	23.95			
Entrenchment Ratio	>3.06	>2.90	>2.93	>3.27				-	-	-	-				-	-	-	-				>3.23	>3.55	>3.43	>3.46			

	Main Stem - Reach 3 (273 feet) - Rosgen Stream Type - B4c														UT (703 feet) - Rosgen Stream Type - C4													
	Cross Section 9 (Riffle)							Cross Section 10 (Pool)							Cross Section 11 (Riffle)							Cross Section 12 (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	1032.62	1032.98	1032.72	1032.76				1032.85	1032.77	1032.70	1032.83				1038.48	1038.87	1039.06	1039.15				1037.08	1037.49	1037.39	1037.32			
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.85	0.99	0.92				1.00	1.07	1.05	1.02				1.00	0.99	1.01	0.96				1.00	0.86	1.03	0.98			
Thalweg Elevation	1030.53	1030.65	1030.56	1030.48				1030.46	1030.19	1030.03	1030.24				1036.60	1036.84	1036.99	1036.92				1035.54	1035.67	1035.47	1035.43			
LTOB[2] Elevation	1032.62	1032.62	1032.70	1032.57				1032.85	1032.95	1032.84	1032.87				1038.48	1038.86	1039.07	1039.06				1037.08	1037.23	1037.44	1037.29			
LTOB[2] Max Depth (ft)	2.09	1.97	2.14	2.09				2.39	2.76	2.81	2.63				1.88	2.02	2.08	2.14				1.54	1.56	1.97	1.86			
LTOB[2] Cross Sectional Area (ft[2])	23.96	19.22	23.58	21.14				32.75	36.72	35.67	33.60				15.54	15.40	15.69	14.60				10.89	8.47	11.41	10.55			
Entrenchment Ratio	>3.87	>4.94	>4.22	>4.44				-	-	-	-				>3.8	>5.23	>5.37	>5.8				>4.4	>5.64	>6.53	>5.95			

	UT (703 feet) - Rosgen Stream Type - C4																									
	Cross Section 13 (Pool)																									
	MY0	MY1	MY2	MY3	MY5	MY7	MY+																			
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1036.46	1037.27	1037.10	1037.17																						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.94	1.04	0.95																						
Thalweg Elevation	1033.32	1034.52	1034.62	1034.26																						
LTOB[2] Elevation	1036.46	1037.09	1037.21	1037.02																						
LTOB[2] Max Depth (ft)	3.14	2.57	2.59	2.76																						
LTOB[2] Cross Sectional Area (ft[2])	19.55	17.77	22.91	18.04																						
Entrenchment Ratio	-	-	-	-																						

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

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

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

Appendix D

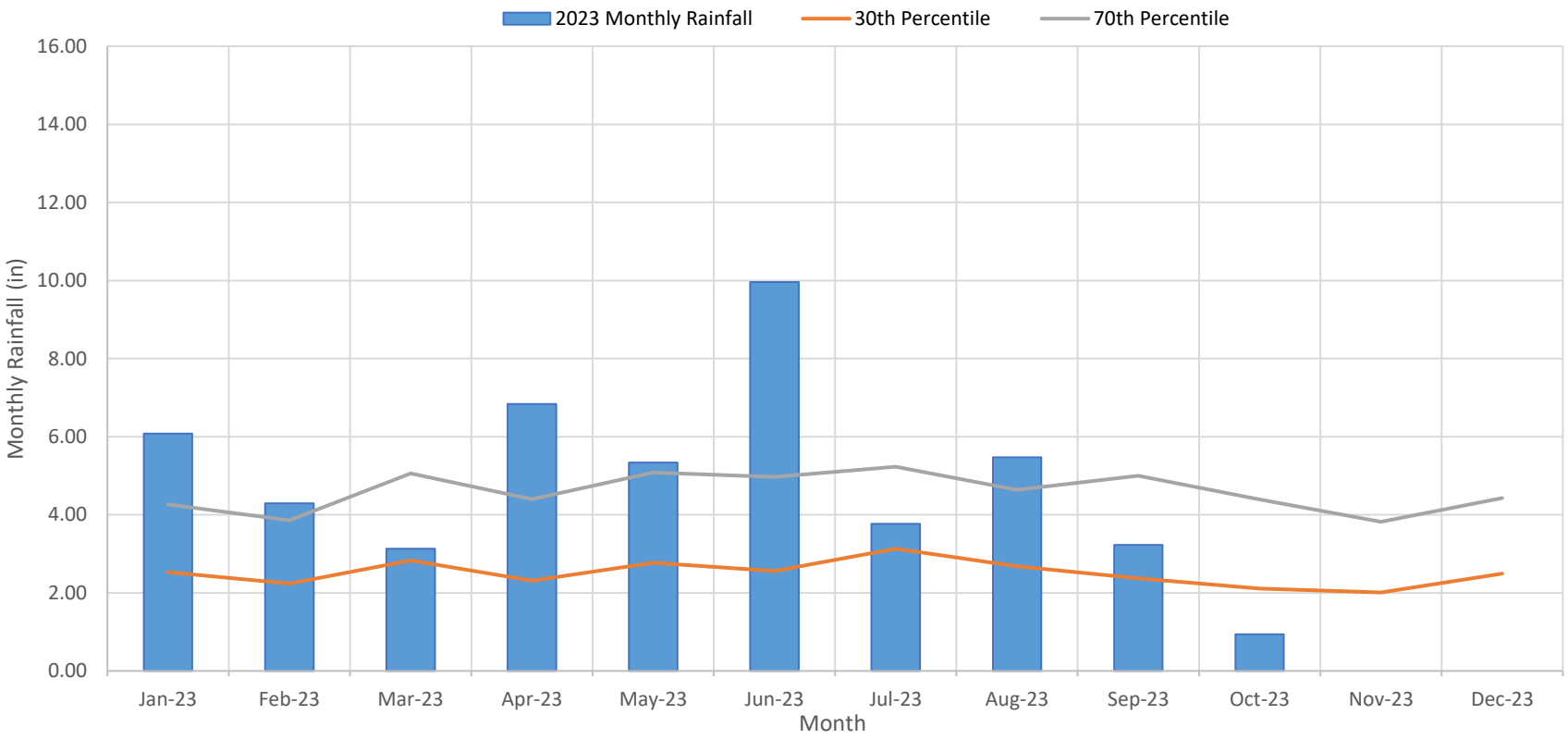
Hydrologic Data

Table 10. Bankfull Event Verification
Figure 3. Monthly Rainfall Data
Precipitation and Water Level Hydrographs

Table 10. Bankfull Event Verification
Meadow Brook Stream Restoration Project (DMS No. 100024)

Overbank Events							
Gage ID	**MY1 (2020)**	**MY2 (2021)**	**MY3 (2022)**	**MY4 (2023)**	**MY5 (2025)**	**MY6 (2026)**	**MY7 (2027)**
Meadow Brook - MB2 STR	11 separate events: 4/13/2020 5/21/2020 5/24/2020 5/27/2020 5/29/2020 8/6/2020 8/15/2020 8/21/2020 9/29/2020 10/11/2020 10/25/2020	6 separate events: 2/13/2021 2/16/2021 3/26/2021 7/2/2021 8/18/2021 9/22/2021	9 separate events: 7/6/2022 7/8/2022 7/24/2022 7/31/2022 8/6/2022 8/8/2022 9/5/2022 9/6/2022 11/6/2022	6 separate events: 1/25/2023 3/3/2023 4/28/2023 6/19/2023 6/26/223 9/9/2023	-	-	-
UT1 - MB1 STR UT1	14 separate events: 1/12/2020 4/13/2020 4/30/2020 5/27/2020 5/28/2020 7/24/2020 8/5/2020 8/15/2020 8/17/2020 8/21/2020 9/17/2020 9/29/2020 10/11/2020 10/25/2020	4 separate events: 2/13/2021 2/16/2021 3/26/2021 9/22/2021	6 separate events: 7/6/2022 7/7/2022 7/23/2022 8/6/2022 9/6/2022 11/6/2022	7 separate events: 1/4/2023 1/12/2023 1/25/2023 3/3/2023 4/28/2023 6/19/2023 6/26/223 9/9/2023	-	-	-

Meadow Brook Stream Restoration Project
Figure 3. Monthly Rainfall Data
Monitoring Year 4 - 2023

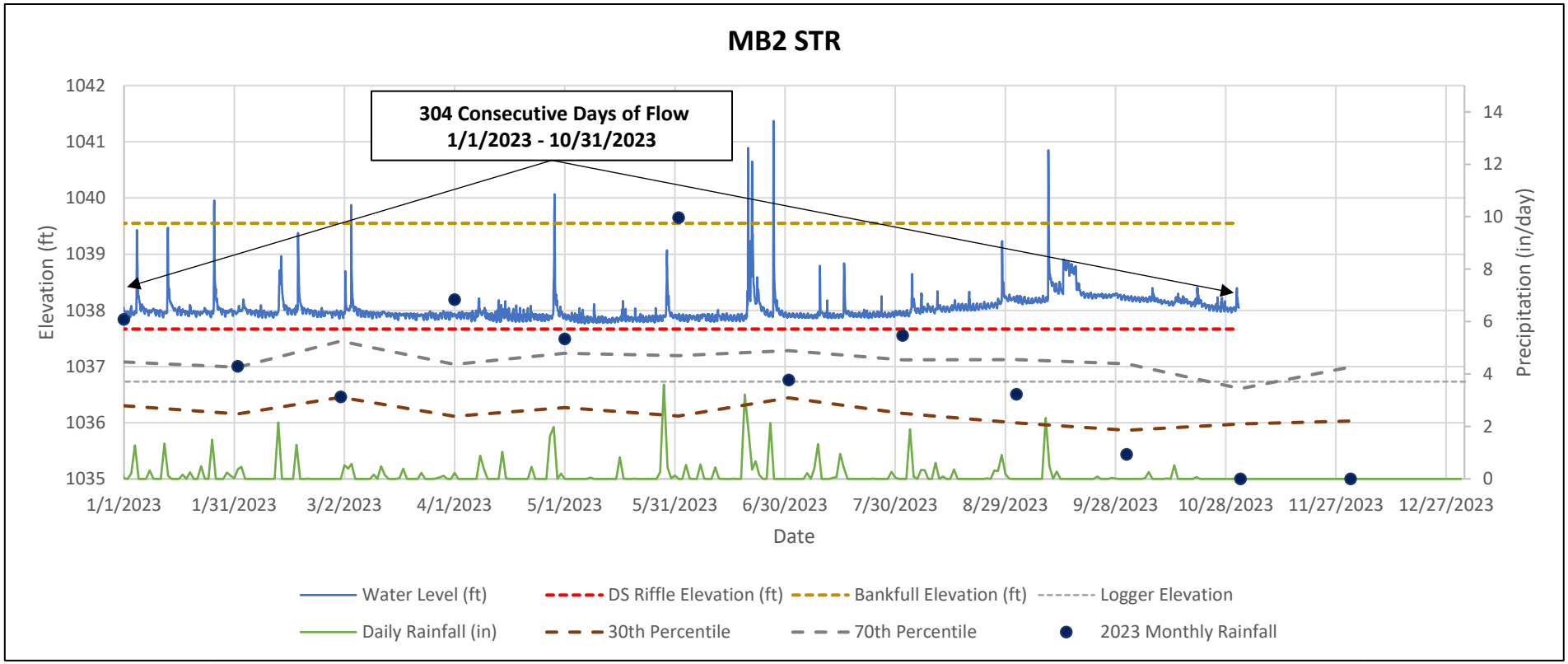


Note: Historic rainfall data from WETS Station: Yadkinville 6 E, NC, 1971-2019. Project rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE.

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 these dates from AcAGIS station YADKINVILLE 0.2 E, NC**

Meadow Brook Stream Restoration Project
Year 4 (2023) Streamflow Data



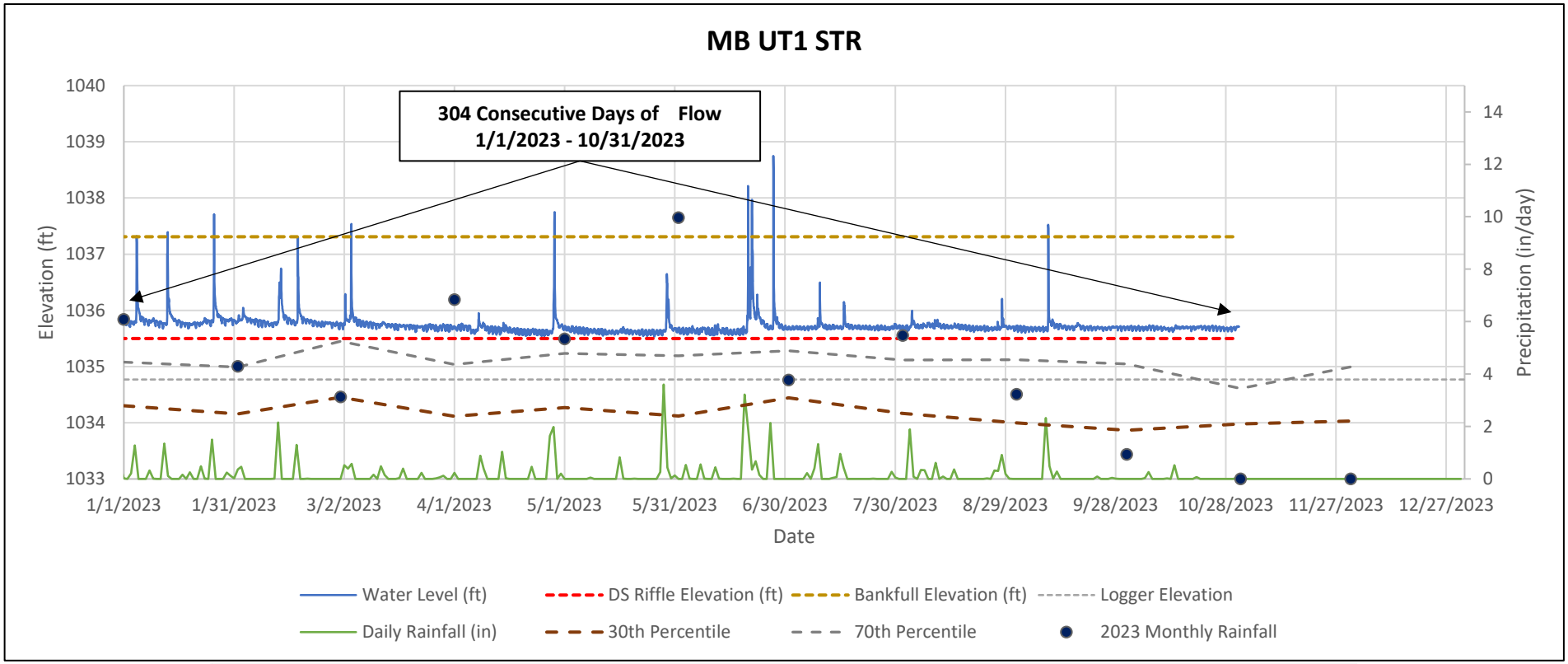
Site Info	
Stream	Meadow Brook Stream Restoration Project
Reach	Meadow Brook Reach 1
Date Installed	7/16/2019
Serial Number	20234985
Reach Type	Perennial

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

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

Year 4 (2023) Streamflow Data	
Gauge ID	MB2 STR
Start Date	1/1/2023
End Date	10/31/2023
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1036.73
Controlling Grade Elevation (ft)	1037.67
Bankfull Elevation (ft)	1039.55
Most Consecutive Days of Flow	304
Total Days of Flow	304
Max High Water Level Above Bankfull (ft)	1.82
Bankfull Events	6
Meets Success Criteria	Yes

Meadow Brook Stream Restoration Project
Year 4 (2023) Streamflow Data



Site Info	
Stream	Meadow Brook Stream Restoration Project
Reach	UT
Date Installed	7/16/2019
Serial Number	20234990
Reach Type	Perennial

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

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

Year 4 (2023) Streamflow Data	
Gauge ID	MB UT1 STR
Start Date	1/1/2023
End Date	10/31/2023
Flow Criteria (Days)	30
Recordings Per Day	24
Logger Elevation (ft)	1034.77
Controlling Grade Elevation (ft)	1035.50
Bankfull Elevation (ft)	1037.31
Most Consecutive Days of Flow	304
Total Days of Flow	304
Max High Water Level Above Bankfull (ft)	1.44
Bankfull Events	8
Meets Success Criteria	Yes

Appendix E

Project Timeline and Contact Information

Table 11. Project Activity and Reporting History

Table 12. Project Contacts Table

Table 11. Project Activity and Reporting History
Meadow Brook Stream Restoration Project - DMS ID 100024

Elapsed time since grading complete: **4 yrs 5 months**
Elapsed time since planting complete: **3 yr 11 months**
Number of reporting years[1]: **4**

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Institution Date	-	Aug-17
404 permit date	-	Oct-18
Final Mitigation Plan	2017 to 2018	Sep-18
Final Design – Construction Plans	-	Dec-18
Site Earthwork	Jan to June 2019	Jun-19
As-Built Survey Performed	Aug-19	Aug-19
Bare root plantings	-	Jan-20
As-built Baseline Monitoring Report (Monitoring Year 0)	2019	Feb-20
Year 1 Monitoring	Nov-20	Dec-20
Vegetation Replanting	Mar-21	Mar-21
Beaver trapping and dam removal	Aug-21	Aug-21
Year 2 Monitoring	Oct-21	Dec-21
Beaver trapping and dam removal	Aug-22	Aug-22
Year 3 Monitoring	Nov-22	Dec-22
Year 4 Monitoring	Oct-23	Dec-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
Meadow Brook Stream Restoration Project - DMS ID 100024

Designer	Ecosystem Planning and Restoration, PLLC 1150 SE Maynard Rd. Ste 140 Cary, NC 27511
Primary project design POC	Kevin Tweedy, PE (919) 388-0787
Construction Contractor	Yadkin Valley Construction, Inc 2961 Old 60 Hwy Ronda, NC 28670
Construction contractor POC	Brad Benton
Survey Contractor	Turner Land Surveying, PLLC PO Box 148, Swannanoa, NC 28778
Survey contractor POC	Lissa Turner (919) 827-0745
Planting Contractor	Foggy Mountain Nursery 797 Helton Creek Road Lansing, NC 28643
Planting contractor POC	Glenn Sullivan
Seeding Contractor	Yadkin Valley Construction, Inc
Contractor point of contact	
Seed Mix Sources	Green Resource (Sourced through Swan Creek Farm Supply) 5204 Highgreen Court Colfax, NC 27235
Nursery Stock Suppliers	Foggy Mountain Nursery
Monitoring Performers	Ecosystem Planning and Restoration, PLLC
Stream Monitoring POC	Russell Myers, EPR (828) 419-9752
Vegetation Monitoring POC	Russell Myers, EPR (828) 419-9752

Appendix F

IRT Correspondence

IRT Credit Release Meeting Notes 04/17/2023

DAY 1 Notes: 4/17/2023

RAP = Release As Proposed

Meadow Brook Site
100024
2022 – MY3
EPR
PM: Tsomides
2023 Notes: Minor pool aggregation reported in MY3(2022) was discussed. Cross Section 4 was noted as a concern. EPR believes that the pools will fluctuate but will eventually flush out. EPR noted that beaver have been a project issue in the past. The IRT asked about the fords and crossings on the site (photo point 19). EPR reported that cattle do not have continuous access to the project ford crossings and gates are kept closed when livestock are not crossing. RAP

Paul Wiesner
Western Regional Supervisor
North Carolina Department of Environmental Quality
Division of Mitigation Services
Cell: (828) 273-1673
paul.wiesner@ncdenr.gov

Asheville Regional Office
2090 U.S. 70 Highway
Swannanoa, NC 28778-8211