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

December 21, 2021

RE:

Dear Mr. Tsomides,

Ecosystem Planning and Restoration (EPR) has reviewed the comments on the Draft MY2 Monitoring Report provided December 7, 2021. The comments have been addressed as described below and the Final MY2 Report and electronic deliverables have been revised in response to this review.

- *A vegetation plot success summary table would be helpful to add to the report (plot/criteria met(Y/N)/ Tract mean %)*
    - **Vegetation plot success is summarized in Table 7. Cells that are shaded orange are not meeting the interim performance criteria and cells that are green are meeting the interim performance criteria. In MY2, 100% of the vegetation plots are meeting the performance criteria.**

- *The Adaptive Management Plan was noted in the write up however it is not indicated whether or not the planting itself met the plan specifics (quantities, species, locations, etc). Please indicate accordingly and detail/explain any deviations if they occurred.*
    - **This has been clarified in the report document. The supplemental planting was conducted according to the submitted AMP and no deviations from the plan specifics (quantities, species, locations, etc.) were reported.**

- *Table 11 Activities – Completion/delivery dates should be blank if the milestone has not occurred yet.*
    - **Completion/delivery dates for milestones that have not been completed have been removed from Table 11.**

- *Thank you for EPR's wetland reporting, and providing wetland data despite the project being stream-only for credit. This will help determine the no net loss of wetland function as you note.*
    - **Noted. Groundwater data from MB GW1 will continue to be collected in MY3.**

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- **Note: Additional photos of the stream crossing located near Sta. 33+00 have been added to the photolog per the IRT comments and requests from 2021. An additional Photo Point will be added in MY3 to show this crossing.**

Digital Support Files

- *Please submit point features representing where beaver dams had existed.*
    - **A shapefile showing the locations of the two beaver dams that were removed in 2021 has been added to the electronic submittal. The points have been added to the CCPV.**

- *Please submit a feature depicting the 20ft of Toe Erosion along Meadow Brook Reach 1 and display this feature in the CCPV.*
    - **A shapefile showing the 20 ft. of to erosion along Meadow Brook Reach 1 has been added to the electronic submittal. The polyline feature has been added to the CCPV.**

- *Please include polygon features characterizing the MY2 random veg plots.*
    - **The polygon features for the MY2 random vegetation plots are included in the MB_ASB_VegMonitoringPlots shapefile along with the fixed plots.**

- *Please include all historic monitoring data in the veg tool input, including dead stems.*
    - **All historic vegetation monitoring data has been added to the vegetation tool input file, including dead stems. This information will be included in the input file moving forward.**

- *Please include the data for MB2 STR.*
    - **A spreadsheet containing the data for MB2 STR has been added to the electronic deliverable files.**

If you have any questions regarding the Final MY2 Monitoring Report, please contact me at 919-388-0787 or via email at cjones@eprusa.net.

Sincerely,

Cidney Jones, PE & CFM

Monitoring Year 2 Report

Final

Meadow Brook Stream Restoration Project

Yadkin County, North Carolina

Yadkin River Basin, Hydrologic Unit Code (HUC) 03040101

Data Collection Period:	**Submission Date:**
August 2021 – November 2021	December 2021

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
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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 Basinwide 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	218.000	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 2, the 6 permanent riparian vegetation plots had an average stem density of 958 native stems/acre and have met the success criteria of 320 native stems/acre in Year 3.
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.	The 6 randomly selected vegetation plots had an average stem density of 567 native stems/acre, which meets the success criteria for MY2.
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 MY2 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 2 monitoring cross section survey indicated that the project streams are geomorphically stable and functioning as intended. Some slight aggradation has occurred in isolated sections during MY2, mainly due to vegetation in the channel and on the stream banks.
				<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 MY2 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 MY2 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 4 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*

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 2 (MY2) data was collected in August, October, and November of 2021. 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 involved 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

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 were 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 were made by holding the bankfull area recorded in the Baseline As-built report constant and adjusting the bankfull elevation. All other geomorphic measurements were made by maintaining a constant benchmark bankfull elevation as recorded in the

Baseline As-built report. Reference photos were taken of both streambanks every year to provide a visual assessment of any changes that may occur.

The Year 2 monitoring cross-section survey indicates that the Project streams are geomorphologically stable. Due to continued herbaceous growth along the floodplain and streambanks, some cross sections appear to be aggrading slightly, but there is no concern of wide-spread channel instability. The channel vegetation that was noted in the MY1 report was not as prevalent in MY2, as shown in the cross-section photos provided in Appendix C. The channel vegetation is expected to become less of a problem in future monitoring years as the channels get more shade cover. Notes on specific cross-sections and actions to be taken in the next monitoring year are listed below.

- Cross section 11 shows signs of aggradation primarily due to herbaceous vegetation laying in the stream channel. As stream shading continues to improve EPR expects a decrease in the amount of vegetation in channels site wide.
- Cross sections 7 and 8 were impacted by downstream beaver dams where the water level had risen considerably. The beavers were trapped and both dams were removed in August 2021. At the time of the survey the water level had returned to normal, and the cross sections appeared stable.
- Cross section 1 showed signs of aggradation from Baseline to MY1 but stabilized from MY1 to MY2. The changes shown in the cross section from MY1 to MY2 show the channel adjusted to be slightly deeper and narrower, which indicates adjustments toward stability rather than instability.
- Cross sections 2, 8, and 13 showed minor geomorphological changes from Baseline to MY1 but stabilized from MY1 to MY2; while pool cross section 3 and 4 showed signs of adjustment from Baseline to MY1 the thalweg elevation remained consistent while the point bar continued to adjust from MY1 to MY2.

All restored streams meet the success criteria as established in the Mitigation Plan and shown in Table 2. The cross-section plots, photos, and data summary (Table 9) 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 2, 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. The location of the photo points are shown in the CCPV (Figure 2) and the photographs, which were taken on November 3, 2021, are provided in Appendix A.

There is a short reach of bank erosion noted in Table 4, Appendix A. The point bar has scoured and there is localized bank erosion. This area was first noticed after a storm event in April 2020 but appeared to be healing during MY1 monitoring. This area is visible in Photo Point 1 and will be observed during the next monitoring year. This area is shown in the CCPV.

With the exception of the area noted above, 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. Stream gauge, controlling grade, and bankfull elevations were re-surveyed in MY2 to address 2 concerns noted in MY1: a period of no flowing water in Meadow Brook (MB2 STR) and to document any adjustments experienced due to numerous bankfull events recorded in 2020. 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 2 and rainfall data is presented in the flow gauge plots in Appendix D.

Rain gauge data from September 2, 2021 to the time of data collection is unavailable because the batteries in the data logger had expired. The batteries were replaced in November 2021 and the instrument is fully functioning.

Flow gauge data from MY2 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 307 consecutive days) 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 307 consecutive days) and 4 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. 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 each year. In addition to the 6 permanent plots, 6 randomly placed vegetation plots are established each year and the location of these plots is recorded using GPS. All vegetation plots for MY2 are shown in the CCPV (Figure 2). 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.

Supplemental planting occurred March 2021 in response to low stem counts throughout much of the Meadow Brook Stream Restoration Site as observed during MY1. Supplemental planting procedures, locations, and species were detailed in the Adaptive Management Report submitted by EPR February 2021. The AMP is included in Appendix F. The supplemental planting was conducted according to the submitted AMP and no deviations from the plan specifics (quantities, species, locations, etc.) were reported.

Year 2 vegetation monitoring occurred in August 2021 before leaf drop. Annual vegetation data was compiled and summarized using the DMS Vegetation Data Entry Tool in Appendix B. Planted stem counts for each plot ranged from 9 trees per plot (364 trees per acre) in Random VP-8, to 34 trees per plot (1376 trees per acre) in Fixed VP-4. The average density of planted stems from all 12 vegetation plots (permanent and random) was 19 trees per plot (762 trees per acre). As indicated by the high stem counts found in many vegetation plots, supplemental planting has succeeded in bringing the site back into compliance, exceeding the interim performance criteria of 320 stems/acre in MY3.

Riparian herbaceous vegetation appears to be flourishing throughout the Site. In addition, no invasive vegetation was found.

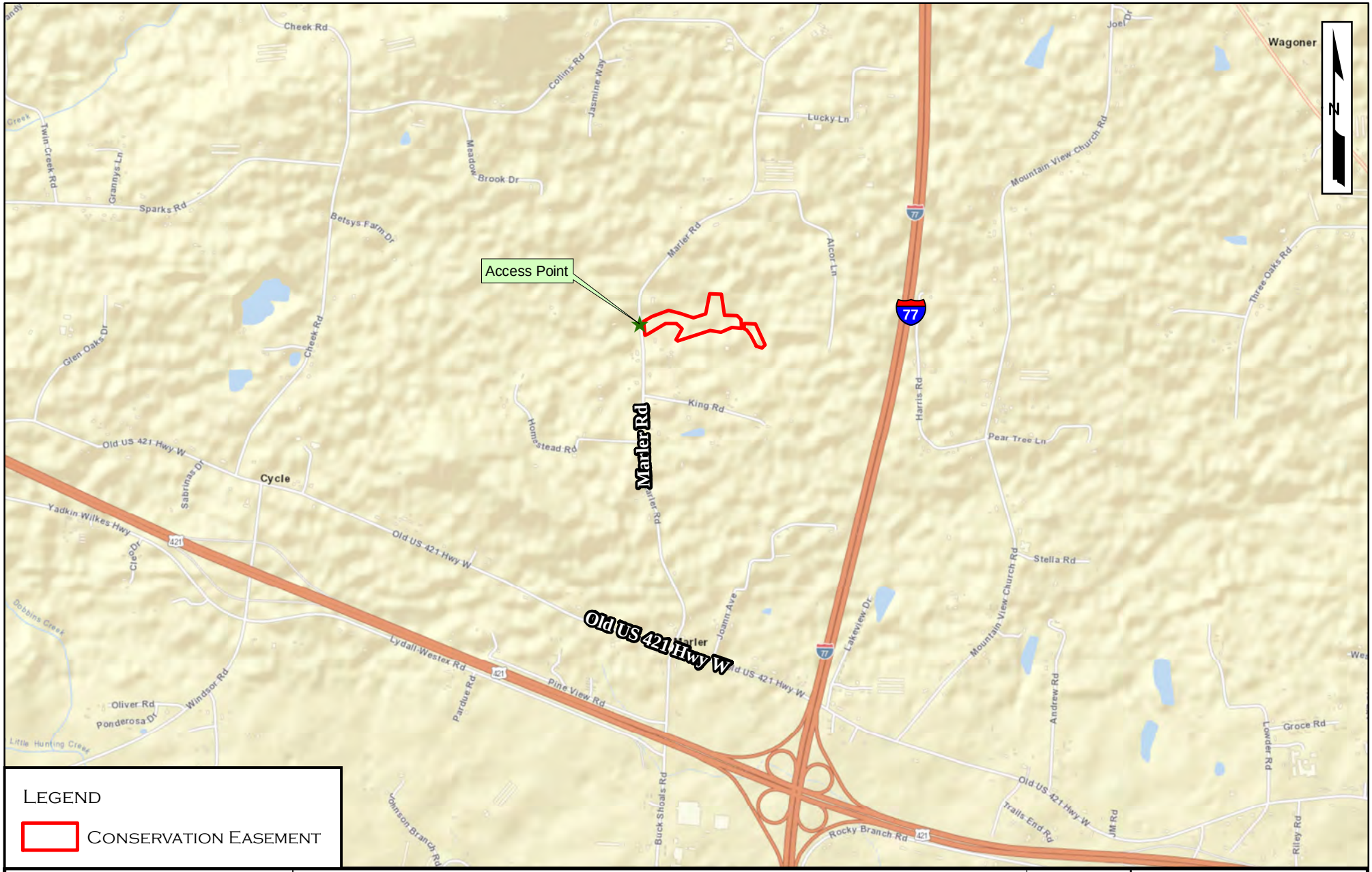
2.3 Wetland Hydrology

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 was 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, and Random VP-12 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 Random VP-8 are located within the wetland treatment cell and planted with hydrophytic herbaceous and woody vegetation.

Finally, as required by the 401/404 Permit, two groundwater gauges were installed in the existing wetlands at the Site. These data are provided in Appendix D but are not associated with success criteria for mitigation. The locations of the 2 wetland groundwater gauges are shown in the CCPV (Figure 2). The wetland gauges were downloaded regularly throughout the monitoring year. Groundwater Gauge 2 (MB GW2) was destroyed by high flows during a storm event and lacks data from January 21, 2021 through

the time of data collection. Per a conversation with USACE on March 9, 2021 (documented in Appendix F), there are no plans to reinstall MB GW2 at this time. The original purpose of the well was to demonstrate no net loss of wetland hydrology as a result of the stream restoration and the last two years of data have clearly shown that the riparian wetlands along Meadow Brook still have functioning wetland hydrology. MB GW1 will be left in place and the data from this well will continue to be included in annual monitoring reports.



LEGEND

Conservation Easement

0 1,000 2,000 Feet

MEADOW BROOK STREAM MITIGATION PROJECT

PROJECT LOCATION MAP

MY1 - 2020

NC Mitigation Services ENVIRONMENTAL QUALITY

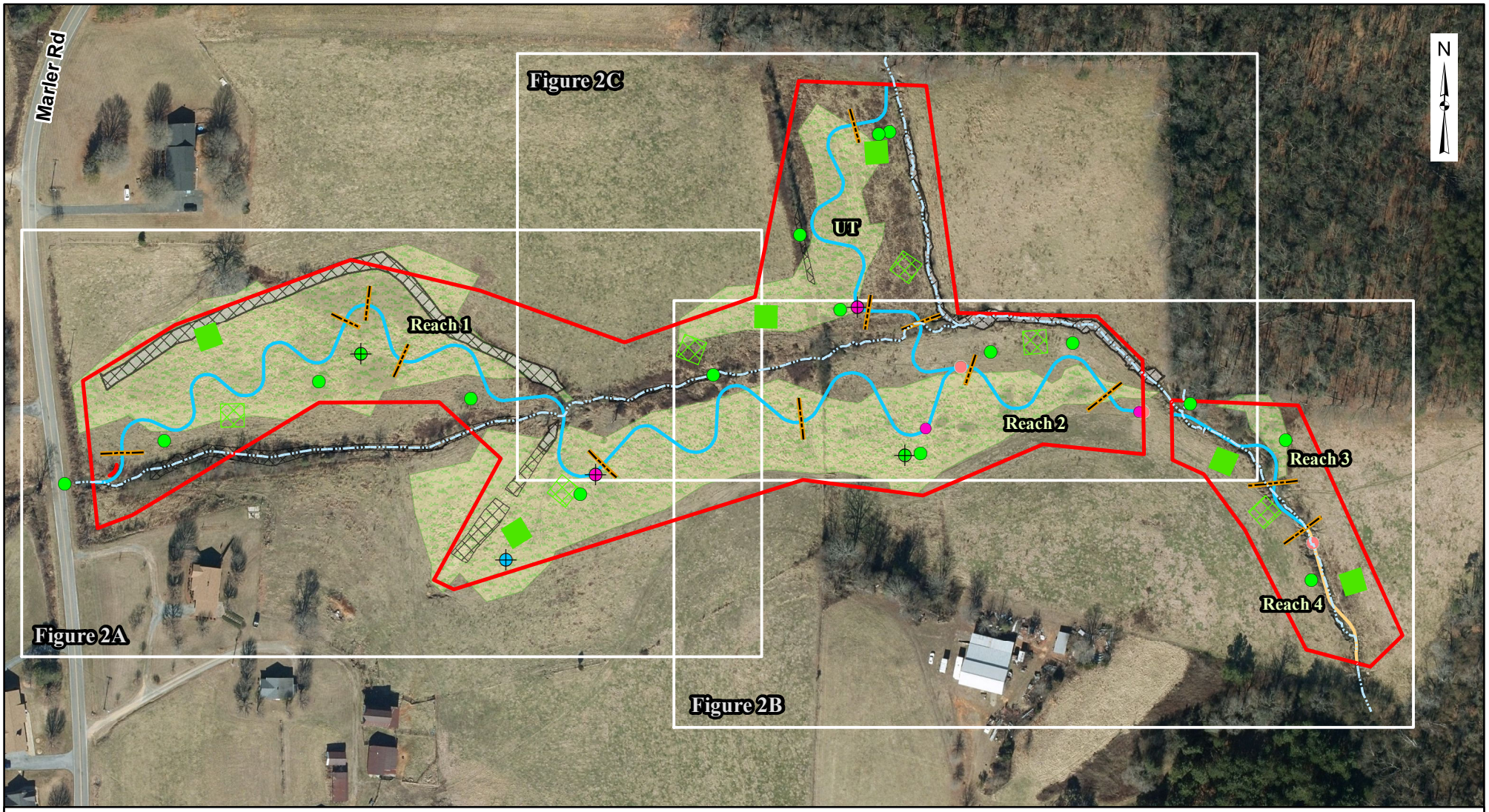
EPR ECOSYSTEM PLANNING & RESTORATION

FIGURE 1

DMS PROJECT #100024

YADKIN COUNTY, NC

DEC 2021



Legend

- Photo Points
- Pre-Existing Streams
- Existing Wetlands
- Conservation Easement
- Rain Gauge
- Stream Gauge
- Wetland Gauge
- Reach Breaks
- Stream Restoration
- Stream Enhancement
- Fixed Vegetation Plot
- Random Vegetation Plot
- Cross Sections
- Unfilled Ditches
- Filled Ditches
- MY2 Removed Beaver Dams
- MY2 Channel Problem Areas

NC OneMap Orthoimagery (2018)

0 200 Feet

1 inch = 200 feet

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Overview
MY2: 2021

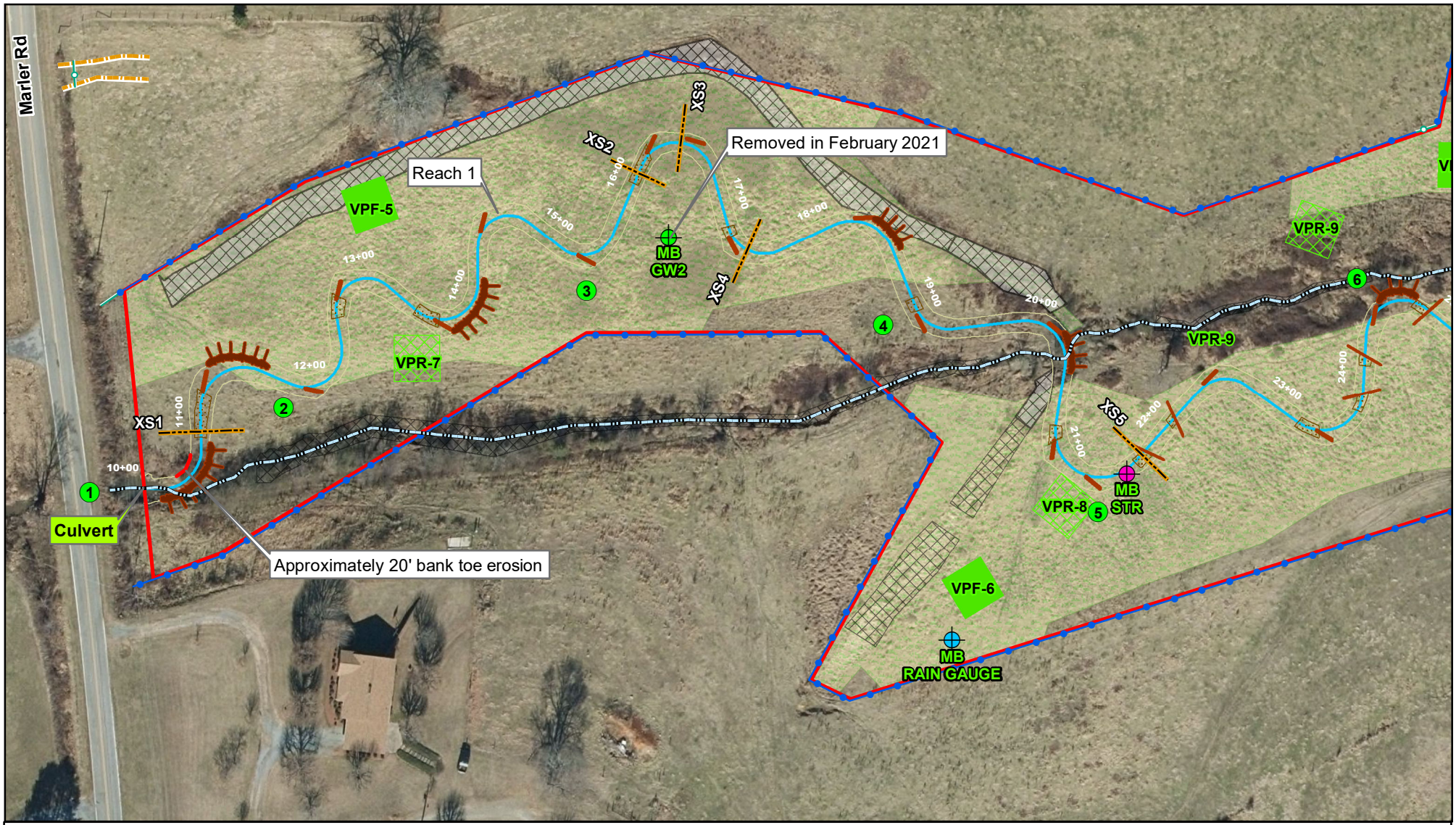
DMS Project ID# 100024
DEC 2021

FIGURE 2

Yadkin County, NC

Mitigation Services Environmental Quality

Ecosystem Planning & Restoration



Legend

- Top of Bank
- MY2 Channel Problem Areas
- Stream Centerline
- Pre-Existing Streams
- Existing Wetlands
- Conservation Easement
- Cross Sections
- Photo Points
- Fixed Vegetation Plot
- Random Vegetation Plot
- Unfilled Ditches
- Filled Ditches
- Rain Gauge
- Stream Gauge
- Wetland Gauge
- Farm Path
- Fencing
- Fence Gates
- Structures

NC OneMap Orthoimagery (2018)

0 100 Feet

1 inch = 100 feet

N

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Asset Map

MY2: 2021

DMS Project ID# 100024

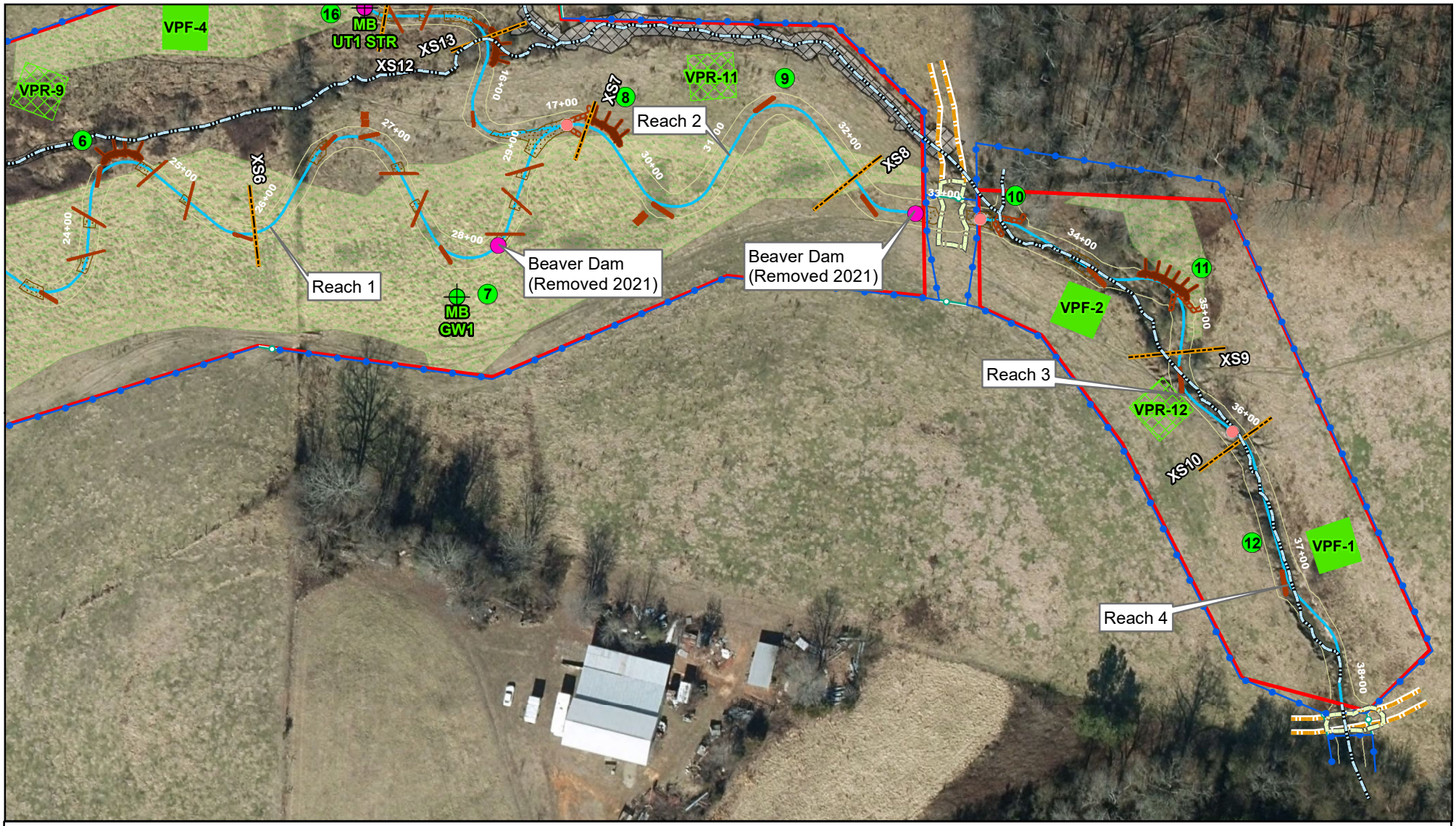
DEC 2021

FIGURE 2A

Yadkin County, NC

Mitigation Services

Ecosystem Planning & Restoration



Legend

- Reach Breaks
- Top of Bank
- Stream Centerline
- Pre-Existing Streams
- Existing Wetlands
- Conservation Easement
- Cross Sections
- Photo Points
- Fixed Vegetation Plot
- Random Vegetation Plot
- Unfilled Ditches
- Filled Ditches
- Stream Gauge
- Wetland Gauge
- Stream Crossing
- Farm Path
- Fencing
- Fence Gates
- Structures
- MY2 Removed Beaver Dams

NC OneMap Orthoimagery (2018)

0 100 Feet

1 inch = 100 feet

N

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Asset Map

MY2: 2021

DMS Project ID# 100024

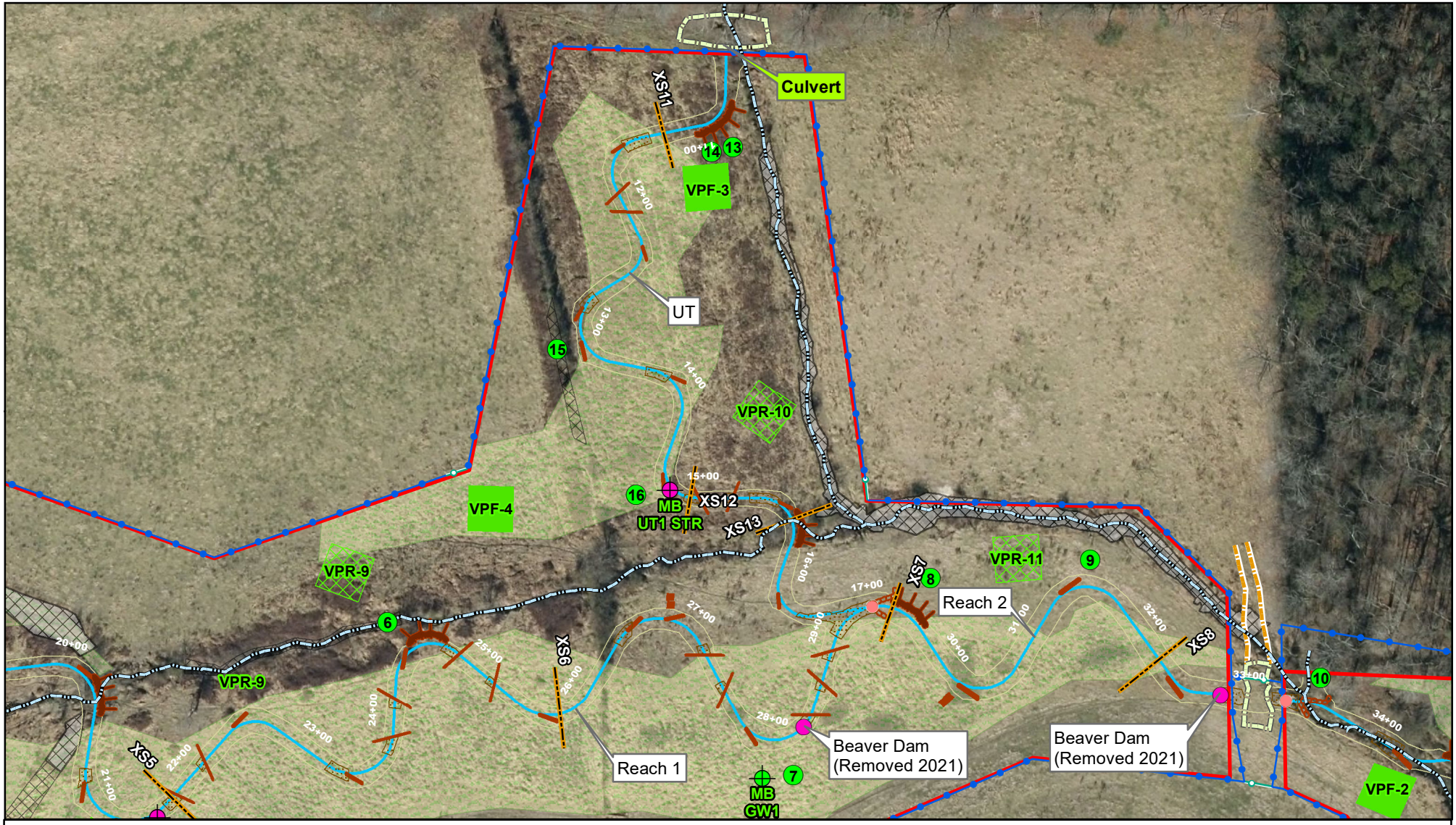
DEC 2021

FIGURE 2B

Yadkin County, NC

Mitigation Services Environmental Quality

Ecosystem Planning & Restoration



Legend

- Reach Breaks
- Top of Bank
- Stream Centerline
- Pre-Existing Streams
- Existing Wetlands
- Conservation Easement
- Cross Sections
- Photo Points
- Fixed Vegetation Plot
- Random Vegetation Plot
- Unfilled Ditches
- Filled Ditches
- Stream Gauge
- Wetland Gauge
- Stream Crossing
- Farm Path
- Fencing
- Fence Gates
- Structures
- MY2 Removed Beaver Dams

NC OneMap Orthoimagery (2018)

0 100 Feet

1 inch = 100 feet

N

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Asset Map

MY2: 2021

DMS Project ID# 100024

DEC 2021

FIGURE 2C

Yadkin County, NC

Mitigation Services Environmental Quality

Ecosystem Planning & Restoration

3.0 REFERENCES

Ecosystem Planning and Restoration (EPR). 2020. As-built Baseline Monitoring Report FINAL Meadow Brook Stream Restoration Project.

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

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

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

Appendix A

Visual Assessment Data

Table 4. Visual Stream Morphology Stability Assessment Table

Table 5. Vegetation Condition Assessment Table

Vegetation Plot Photo Log

Photo Log

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: 11/3/2021**

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.			20	99%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	20	99%
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: 11/3/2021**

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: 11/3/2021**

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: 11/3/2021**

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: 8/6/2021 & 8/23/2021**

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**

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 2 – Vegetation Plot Photo Log

Veg Plot 1 Fixed – SE Corner (08/23/2021)

Veg Plot 2 Fixed – SW Corner (08/23/2021)

Veg Plot 3 Fixed – SE Corner (08/06/2021)

Veg Plot 4 Fixed – NW Corner (08/06/2021)

Veg Plot 5 Fixed – NW Corner (08/06/2021)

Veg Plot 6 Fixed – N Corner (07/22/2021)

Random Veg Plot 7 R– (08/06/2021)

Random Veg Plot 8 R – (08/06/2021)

Random Veg Plot 9 R – (08/06/2021)

Random Veg Plot 10 R – (08/06/2021)

Random Veg Plot 11 R – (08/06/2021)

Random Veg Plot 12 R – NE Corner (08/23/2021)

Meadow Brook Stream Restoration Project
MY2 - Photo Log

Photo Point 1 – Reach 1, Sta. 0+00
Facing Downstream (11/3/2021)

Photo Point 2 – Reach 1, Sta. 11+90
Facing Downstream (11/3/2021)

Photo Point 3 – Reach 1, Sta. 15+35
Facing Downstream (11/3/2021)

Photo Point 4 – Reach 1, Sta. 19+10
Facing Downstream (11/3/2021)

Photo Point 5 – Reach 1, Sta. 21+50
Facing Downstream (11/3/2021)

Photo Point 6 – Reach 1, Sta. 24+50
Facing Downstream (11/3/2021)

Meadow Brook Stream Restoration Project
MY2 - Photo Log

Photo Point 7 – Reach 1, Sta. 28+20
Facing Downstream (11/3/2021)

Photo Point 8 – Reach 2, Sta. 29+70
Facing Upstream (11/3/2021)

Photo Point 9 – Reach 2, Sta. 31+60
Facing Downstream (11/3/2021)

Photo Point 10 – Reach 3, Sta. 33+55
Facing Upstream (10/21/2021)

Photo Point 11 – Reach 3, Sta. 34+80
Facing Downstream (10/21/2021)

Photo Point 12 – Reach 4, Sta. 36+90
Facing Downstream (10/21/2021)

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Meadow Brook Stream Restoration Project
MY2 - Photo Log

Photo Point 13 – UT, Sta. 10+90
Facing Upstream (11/3/2021)

Photo Point 14 – UT, Sta. 10+90
Facing Downstream (11/3/2021)

Photo Point 15 – UT, Sta. 13+20
Facing Downstream (11/3/2021)

Photo Point 16 – UT, Sta. 14+90
Facing Downstream (11/3/2021)

Stream crossing fence repairs near Sta. 38+00 facing downstream (3/11/2021)

Stream crossing fence repairs near Sta. 33+00 facing upstream (3/11/2021)

Stream crossing on Meadow Brook Reach 2, near Sta. 33+00 facing downstream (10/21/2021)

Stream crossing on Meadow Brook Reach 2, near Sta. 33+00 facing upstream (10/21/2021)

Site Overview
Facing West (October 2021)

Site Overview
Facing East (October 2021)

Appendix B

Vegetation Plot Data

Table 6. Vegetation Plot Data

Table 7. Vegetation Performance Standards Summary Table

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	2021-10-22
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	1	1	4	4	7	7	6	6			3			2
	Carya glabra	pignut hickory	Tree	FACU	2	2	2	2														
	Celtis laevigata	sugarberry	Tree	FACW	1	1					4	4										
	Cercis canadensis	eastern redbud	Tree	FACU			3	3	2	2												3
	Cornus amomum	silky dogwood	Shrub	FACW			5	5			4	4	6	6	9	9	8	5	2	2	5	1
	Diospyros virginiana	common persimmon	Tree	FAC			3	3	1	1	1	1	1	1	1	1						
	Fraxinus pennsylvanica	green ash	Tree	FACW	1	1	2	2			3	3					2		2			
	Liriodendron tulipifera	tuliptree	Tree	FACU	1	1	4	4													1	1
	other										4	4					1	2	1	2	4	
	Platanus occidentalis	American sycamore	Tree	FACW			1	1	2	2			2	2					2			1
	Quercus alba	white oak	Tree	FACU			1	1													2	
	Quercus nigra	water oak	Tree	FAC																		1
	Quercus phellos	willow oak	Tree	FAC							8	8										
	Quercus rubra	northern red oak	Tree	FACU	2	2	1	1			3	3	1	1								
	Salix nigra	black willow	Tree	OBL	5	5	1	1	5	5	2	2	4	4	6	6	2		3	5		2
	Salix sericea	silky willow	Shrub	OBL					2	2	1	1	1	1			1	2	2	4	8	
	Sambucus canadensis	American black elderberry	Tree				3	3	1	1					1	1						1
	Ulmus americana	American elm	Tree	FACW									3	3								
Sum	Performance Standard				13	13	29	29	14	14	34	34	25	25	23	23	14	9	15	13	20	12
Post Mitigation Plan Species	*Acer rubrum*	*red maple*	*Tree*	*FAC*						*2*								*1*				
	Alnus serrulata	hazel alder	Tree	OBL			3	3														1
	Carpinus caroliniana	American hornbeam	Tree	FAC											1	1						
Sum	Proposed Standard				13	13	32	32	14	14	34	34	25	25	24	24	14	9	15	13	20	13
Mitigation Plan Performance Standard	Current Year Stem Count					13		29		14		34		25		23	14	9	15	13	20	12
	Stems/Acre					526		1174		567		1376		1012		931	567	364	607	526	810	486
	Species Count					7		12		7		10		8		5	5	3	7	4	5	8
	Dominant Species Composition (%)					38		16		31		24		28		38	57	50	20	38	40	23
	Average Plot Height					4		2		4		2		3		3	4	4	4	5	4	2
	% Invasives					0		0		0		0		0		0	0	0	0	0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					13		32		14		34		25		24	14	9	15	13	20	13
	Stems/Acre					526		1295		567		1376		1012		972	567	364	607	526	810	526
	Species Count					7		13		7		10		8		6	5	3	7	4	5	9
	Dominant Species Composition (%)					38		16		31		24		28		38	57	50	20	38	40	23
	Average Plot Height					4		2		4		2		3		3	4	4	4	5	4	2
	% 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.

Does not Meet Interim Performance Criteria	Meets 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												
Monitoring Year 2	526	4	7	0	1174	2	12	0	567	4	7	0
Monitoring Year 1	324	3	5	0	850	1	9	0	202	1	4	0
Monitoring Year 0	810	2	7	0	1174	2	11	0	729	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												
Monitoring Year 2	1376	2	10	0	1012	3	8	0	931	3	5	0
Monitoring Year 1	364	2	7	0	526	3	6	0	121	3	2	0
Monitoring Year 0	648	2	7	0	729	2	8	0	688	2	4	0
	Veg Plot 7 R				Veg Plot 8 R				Veg Plot 9 R			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2	567	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 10 R				Veg Plot 11 R				Veg Plot 12 R			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2	526	5	4	0	810	4	5	0	486	2	8	0
Monitoring Year 1	121	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.

Meets interim Performance Criteria	Does not Meet Interim Performance Criteria

Appendix C

Stream Geomorphology Data

Cross-Sections With Annual Overlays

Table 8. Baseline Stream Data Summary

Table 9. Cross-Section Morphology Monitoring Summary

Cross Section Plots - MY2

XS1 - Reach 1

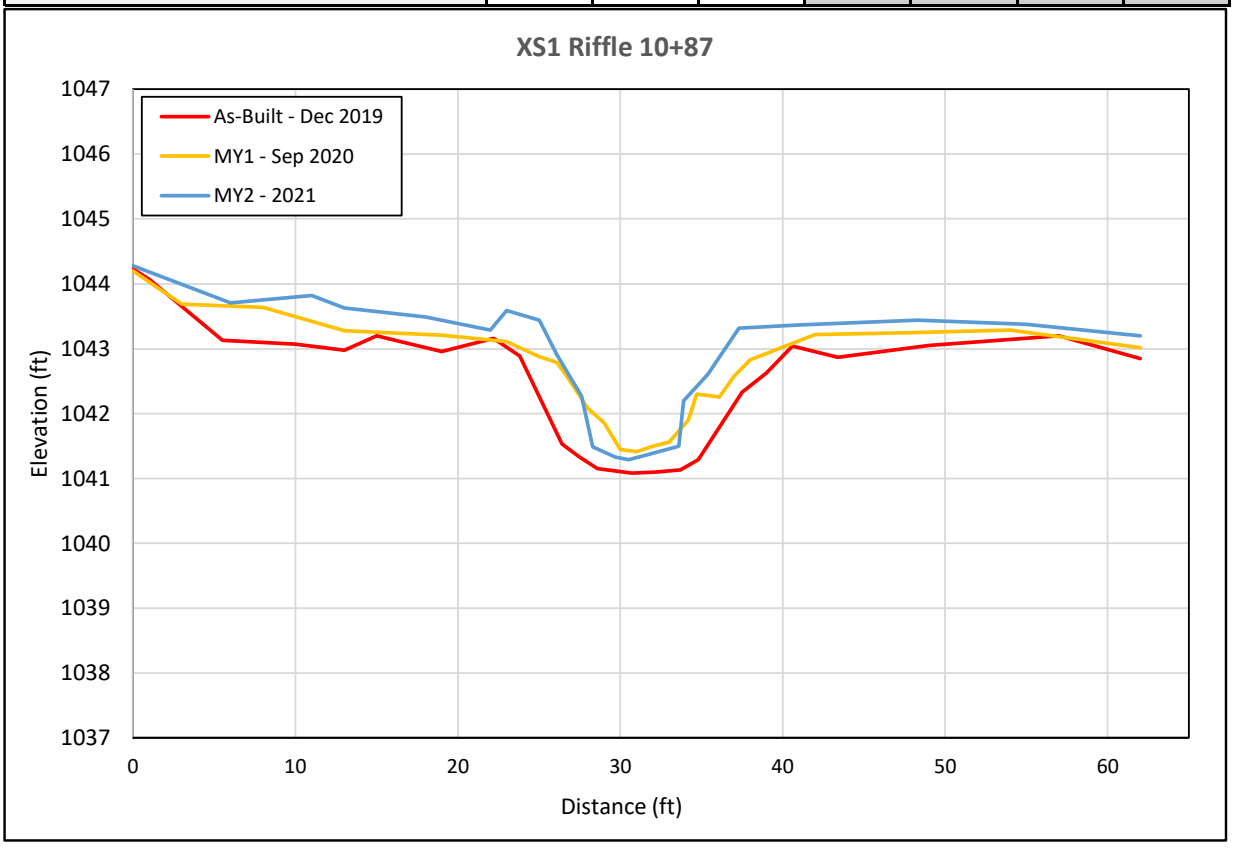
Rosgen Stream Type - C4

Station 10+87 - Riffle

XS2 looking upstream

XS2 looking downstream

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



Ecosystem Planning & Restoration

Cross Section Plot - MY2

XS2 - Reach 1

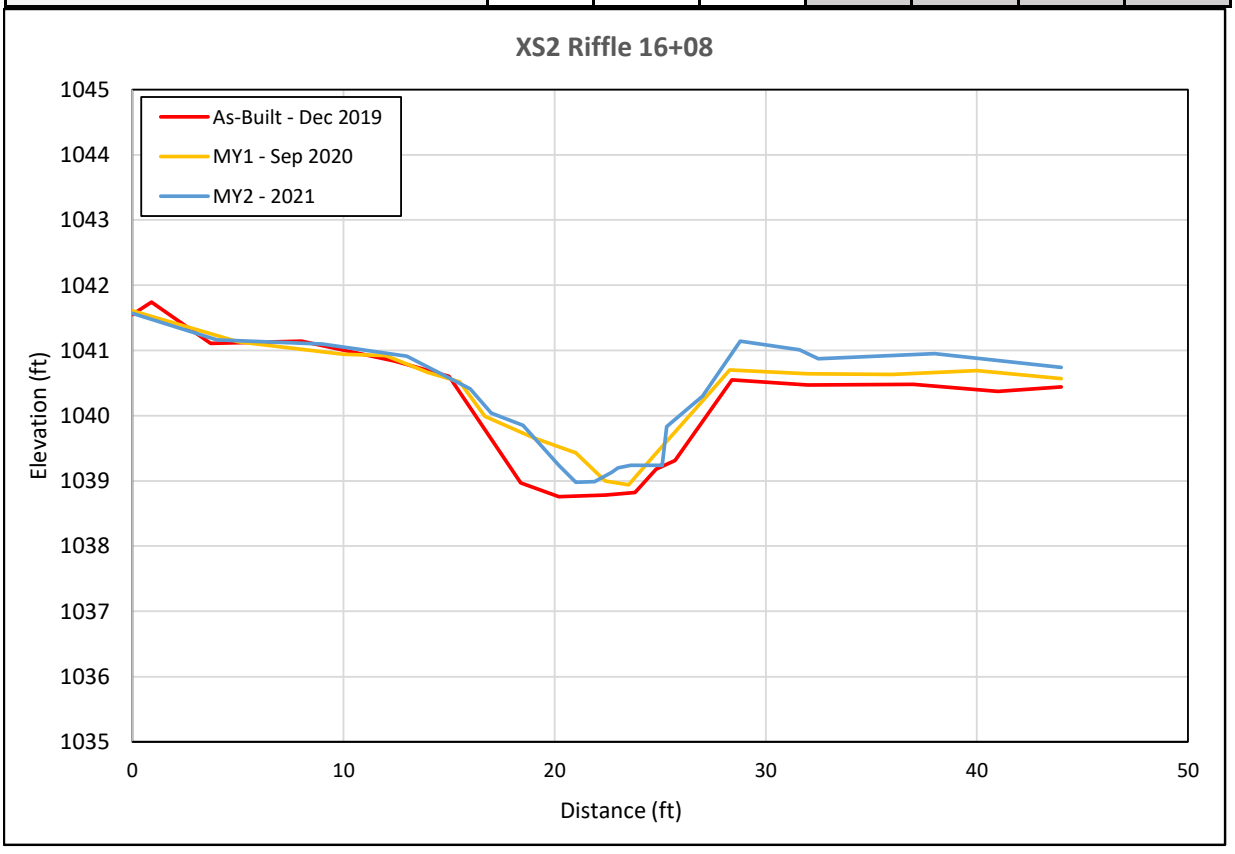
Rosgen Stream Type - C4

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.78	0.99				
Thalweg Elevation	1038.76	1038.94	1038.98				
LTOB Elevation	1040.55	1040.52	1040.91				
LTOB Max Depth	1.79	1.58	1.93				
LTOB Cross Sectional Area	16.40	10.80	16.01				
Entrenchment Ratio	>3.31	>3.46	>3.75				



ECOSYSTEM PLANNING & RESTORATION

Cross Section Plot - MY2

XS3 - Reach 1

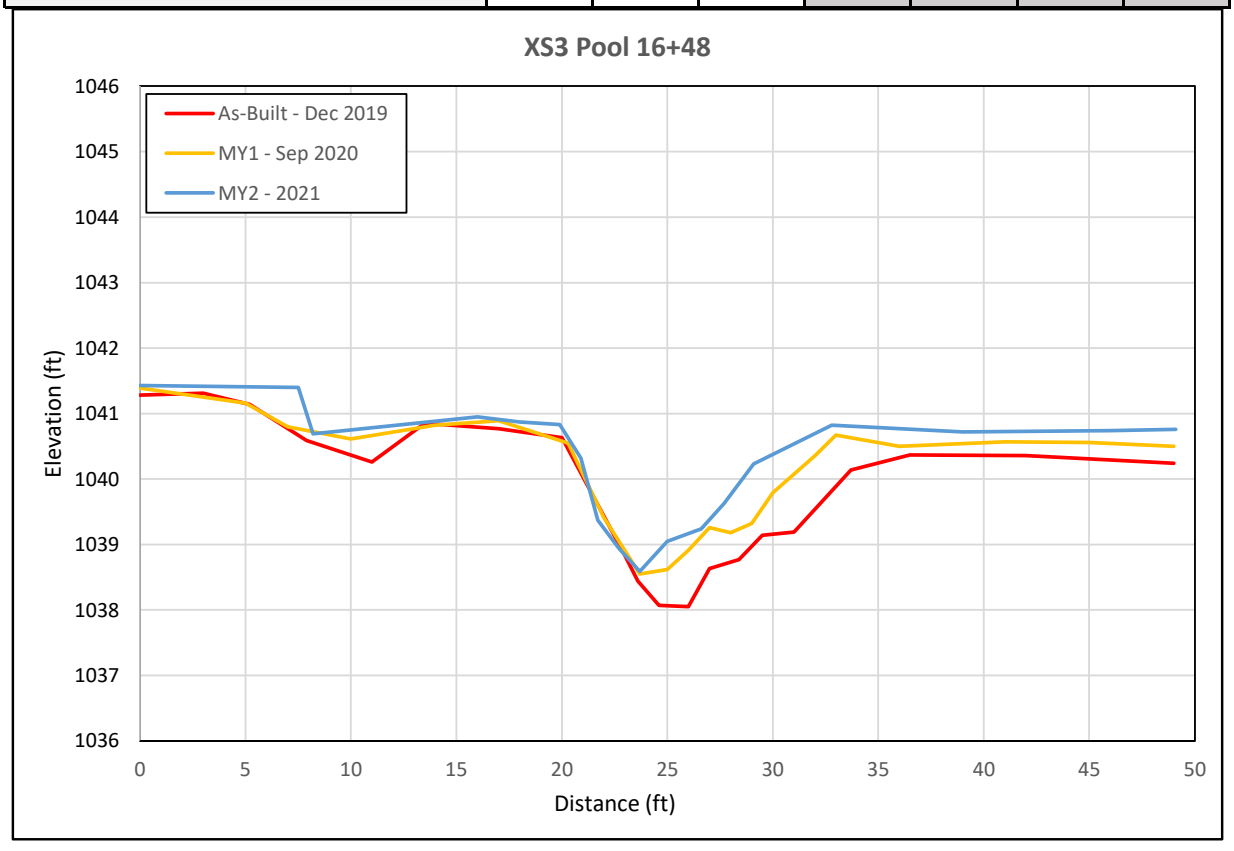
Rosgen Stream Type - C4

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.85	0.87				
Thalweg Elevation	1038.05	1038.55	1038.59				
LTOB Elevation	1040.37	1040.55	1040.82				
LTOB Max Depth	2.32	2.00	2.23				
LTOB Cross Sectional Area	18.32	14.08	13.89				
Entrenchment Ratio	-	-	-				



Cross Section Plot - MY2

XS4 - Reach 1

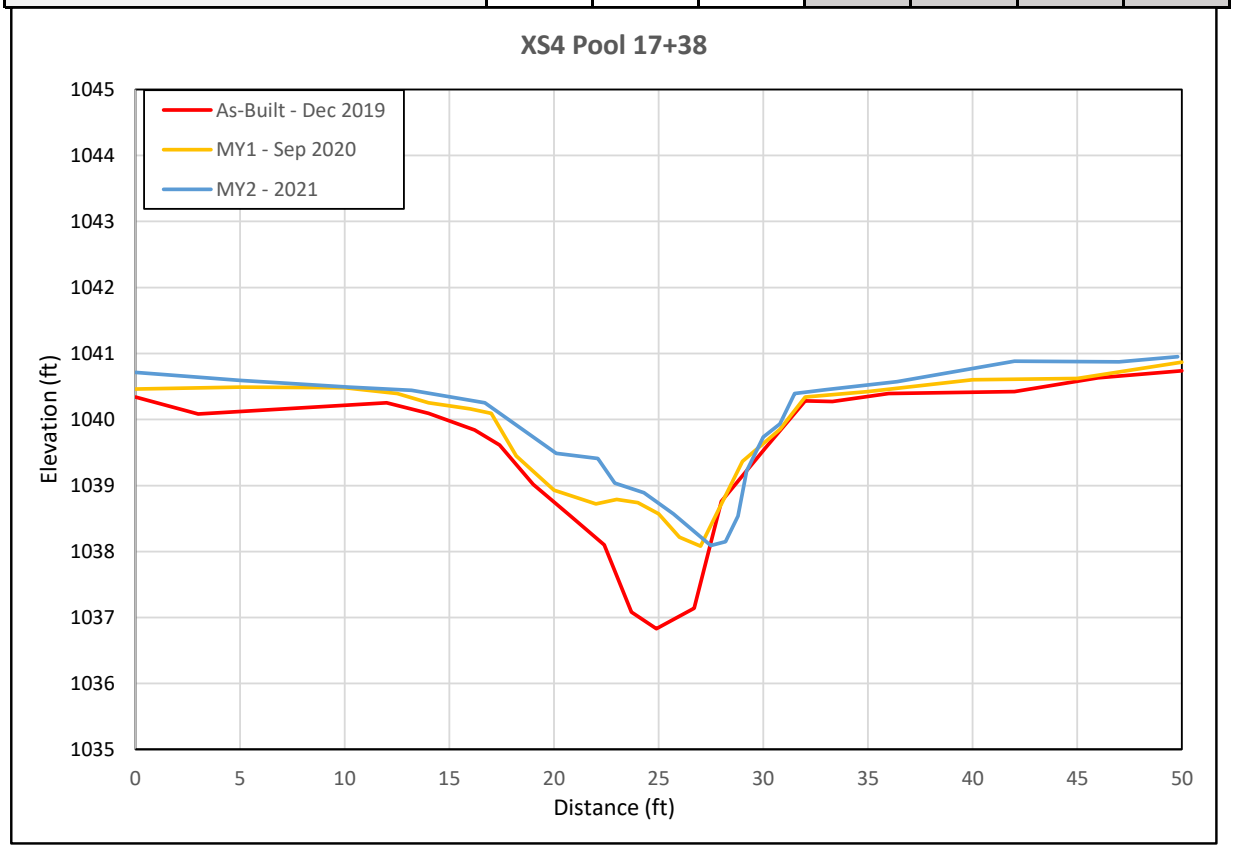
Rosgen Stream Type - C4

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.80	0.71				
Thalweg Elevation	1036.83	1038.08	1038.09				
LTOB Elevation	1040.25	1040.25	1040.25				
LTOB Max Depth	3.42	2.17	2.16				
LTOB Cross Sectional Area	27.86	18.48	15.31				
Entrenchment Ratio	-	-	-				



Ecosystem Planning & Restoration

Cross Section Plot - MY2

XS5 - Reach 1

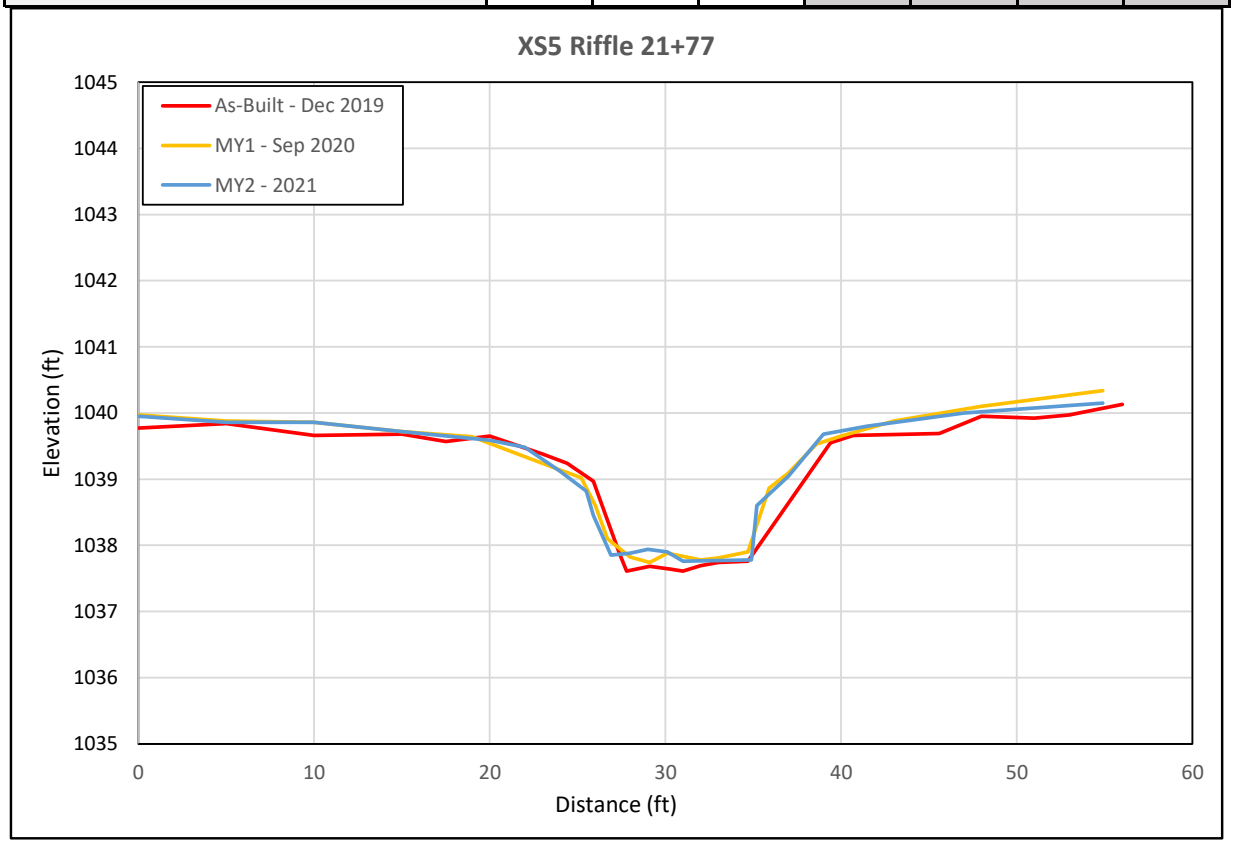
Rosgen Stream Type - C4

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94	1.02				
Thalweg Elevation	1037.61	1037.74	1037.76				
LTOB Elevation	1039.55	1039.53	1039.68				
LTOB Max Depth	1.94	1.79	1.92				
LTOB Cross Sectional Area	20.68	18.54	21.67				
Entrenchment Ratio	>3.06	>2.90	>2.93				



ECOSYSTEM PLANNING & RESTORATION

Cross Section Plot - MY2

XS6 - Reach 1

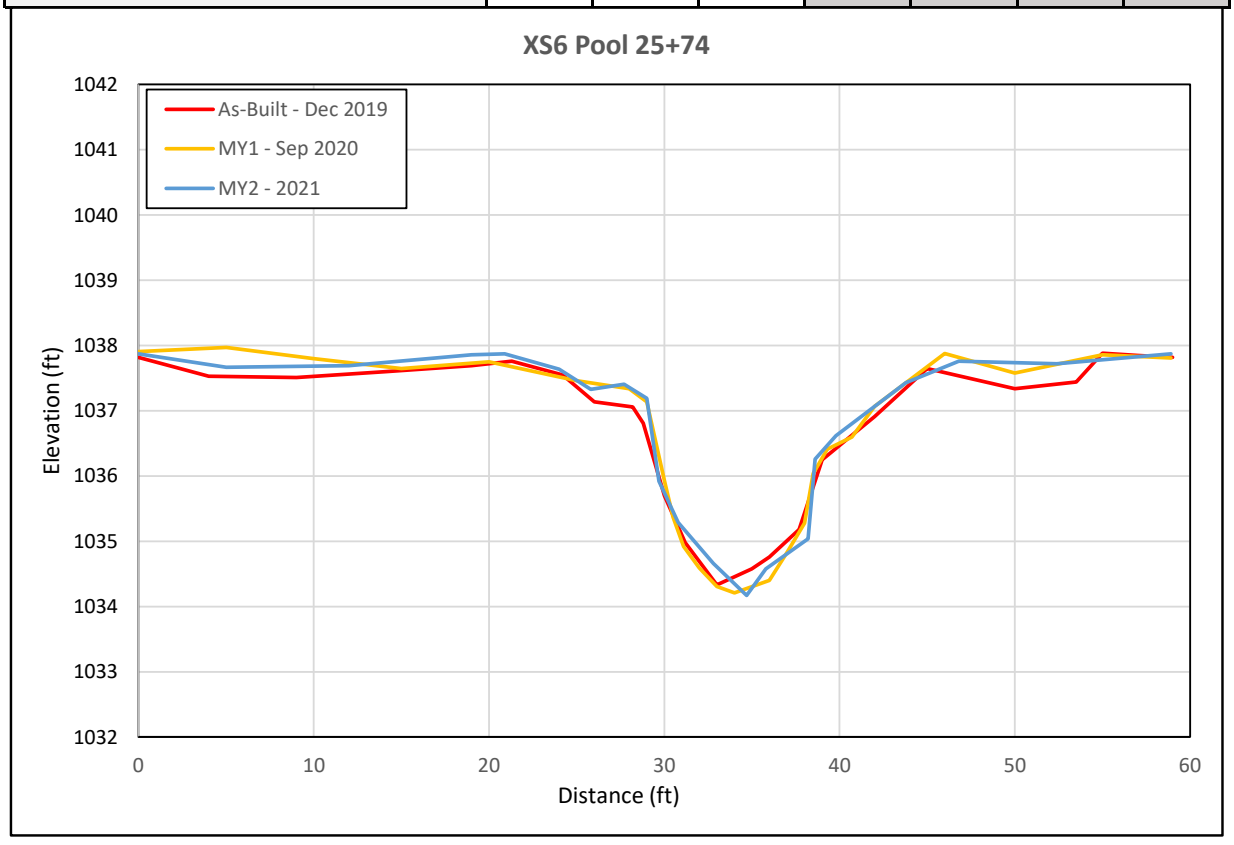
Rosgen Stream Type - C4

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.11	1.11				
Thalweg Elevation	1034.33	1034.21	1034.17				
LTOB Elevation	1037.06	1037.34	1037.41				
LTOB Max Depth	2.73	3.13	3.24				
LTOB Cross Sectional Area	21.82	26.18	26.27				
Entrenchment Ratio	-	-	-				



Cross Section Plot - MY2

XS7 - Reach 2

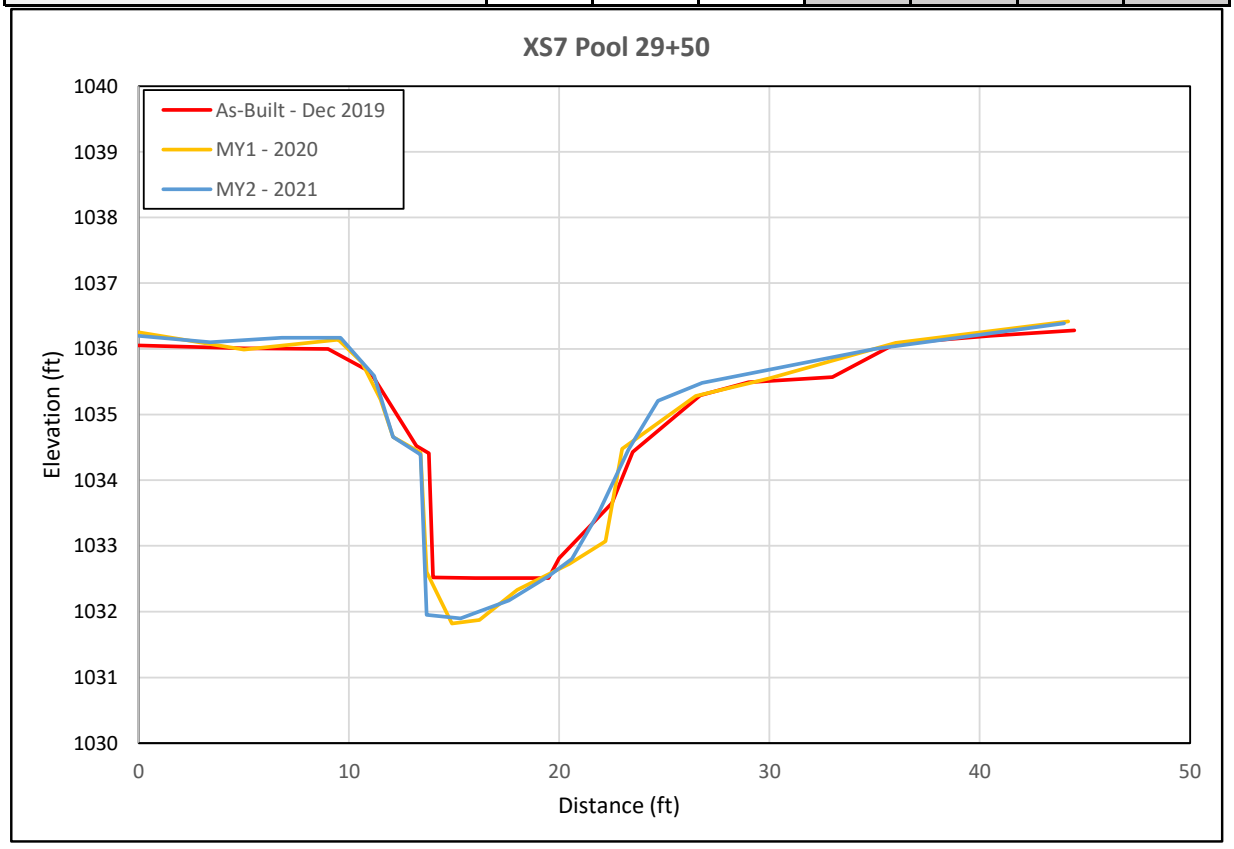
Rosgen Stream Type - C4

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.09	1.01				
Thalweg Elevation	1032.51	1031.82	1031.90				
LTOB Elevation	1035.65	1035.80	1035.59				
LTOB Max Depth	3.14	3.98	3.69				
LTOB Cross Sectional Area	32.43	38.84	32.98				
Entrenchment Ratio	-	-	-				



Ecosystem Planning & Restoration

Cross Section Plot - MY2

XS8 - Reach 2

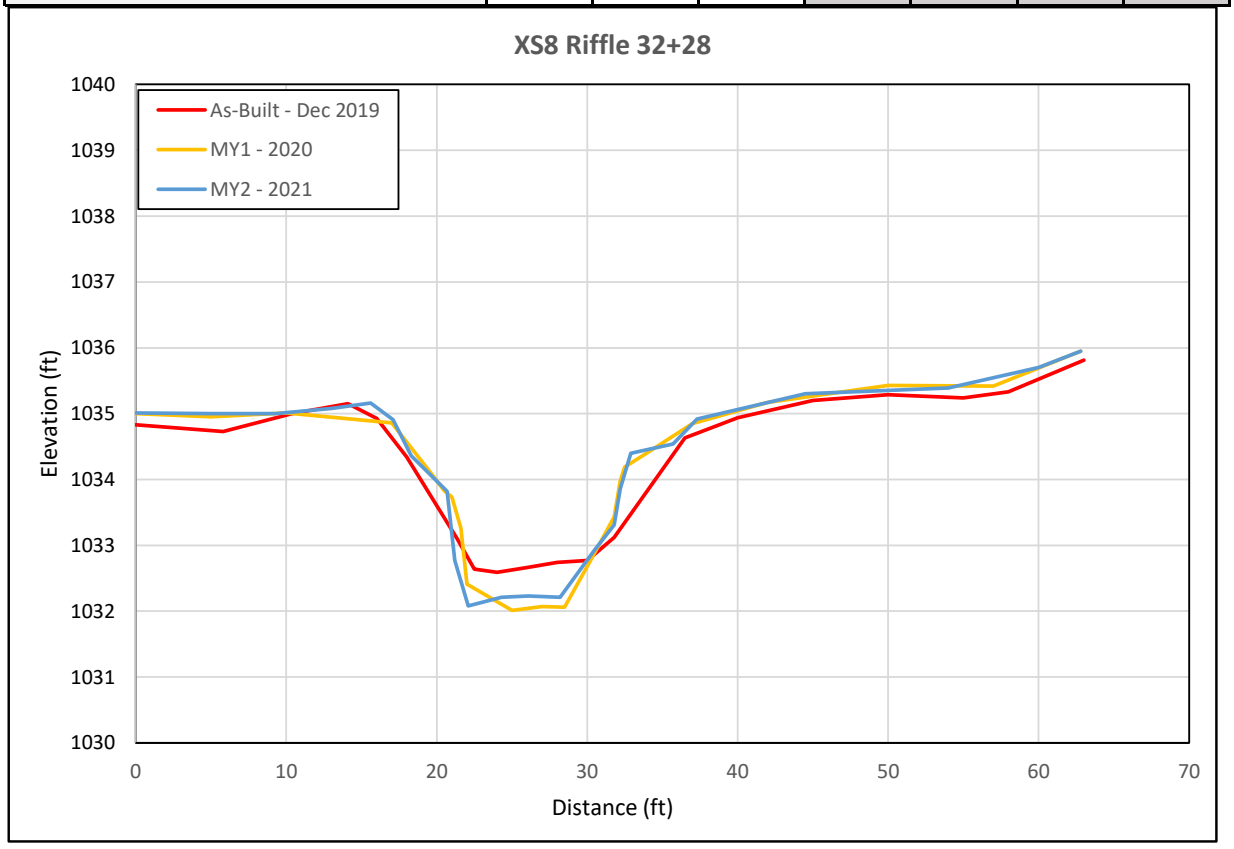
Rosgen Stream Type - C4

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.09	0.97				
Thalweg Elevation	1032.59	1032.01	1032.08				
LTOB Elevation	1034.63	1034.85	1034.54				
LTOB Max Depth	2.04	2.84	2.46				
LTOB Cross Sectional Area	26.44	30.76	25.20				
Entrenchment Ratio	>3.23	>3.55	>3.43				



Ecosystem Planning & Restoration

Cross Section Plot - MY2

XS9 - Reach 3

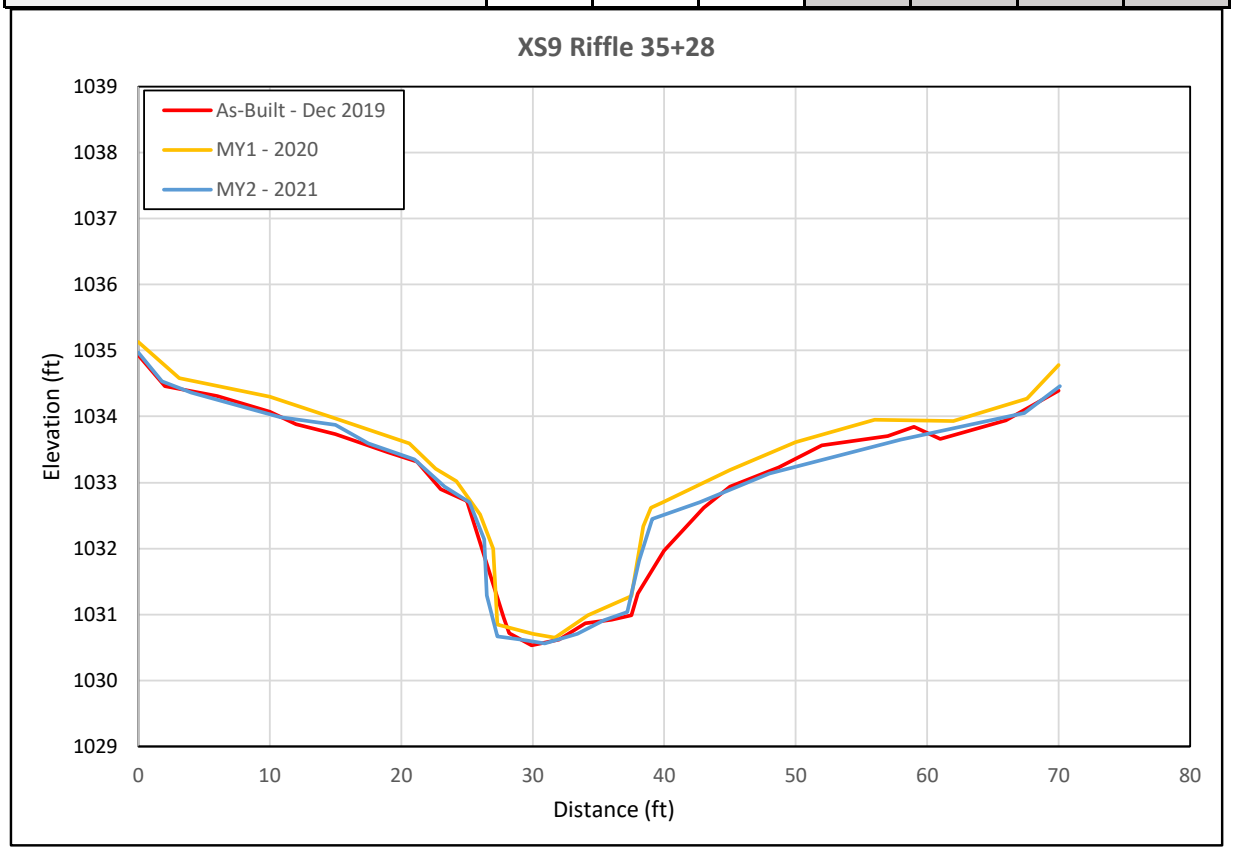
Rosgen Stream Type - B4c

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.85	0.99				
Thalweg Elevation	1030.53	1030.65	1030.56				
LTOB Elevation	1032.62	1032.62	1032.70				
LTOB Max Depth	2.09	1.97	2.14				
LTOB Cross Sectional Area	23.96	19.22	23.58				
Entrenchment Ratio	>3.87	>4.94	>4.22				



Ecosystem Planning & Restoration

Cross Section Plot - MY2

XS10 - Reach 3

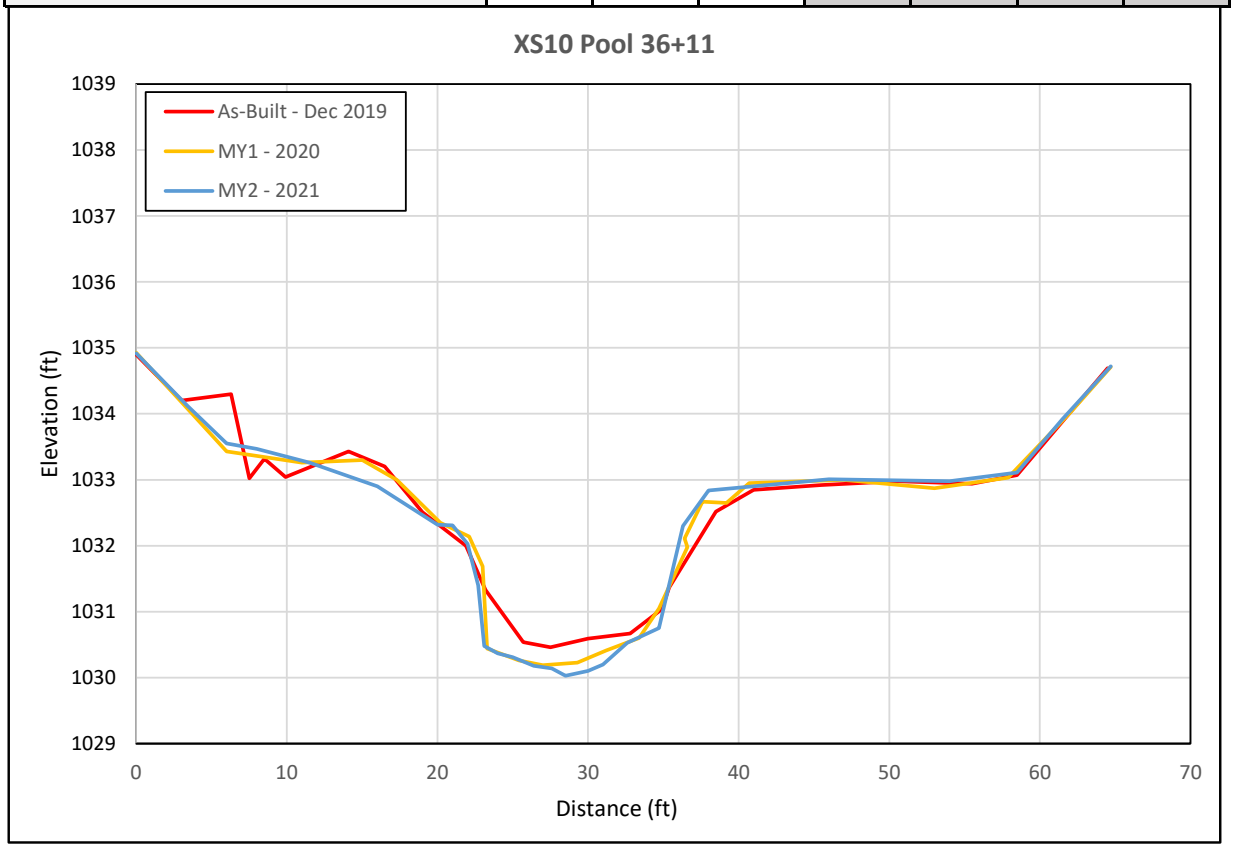
Rosgen Stream Type - B4c

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.07	1.05				
Thalweg Elevation	1030.46	1030.19	1030.03				
LTOB Elevation	1032.85	1032.95	1032.84				
LTOB Max Depth	2.39	2.76	2.81				
LTOB Cross Sectional Area	32.75	36.72	35.67				
Entrenchment Ratio	-	-	-				



Ecosystem Planning & Restoration

Cross Section Plot - MY2

XS11 - UT

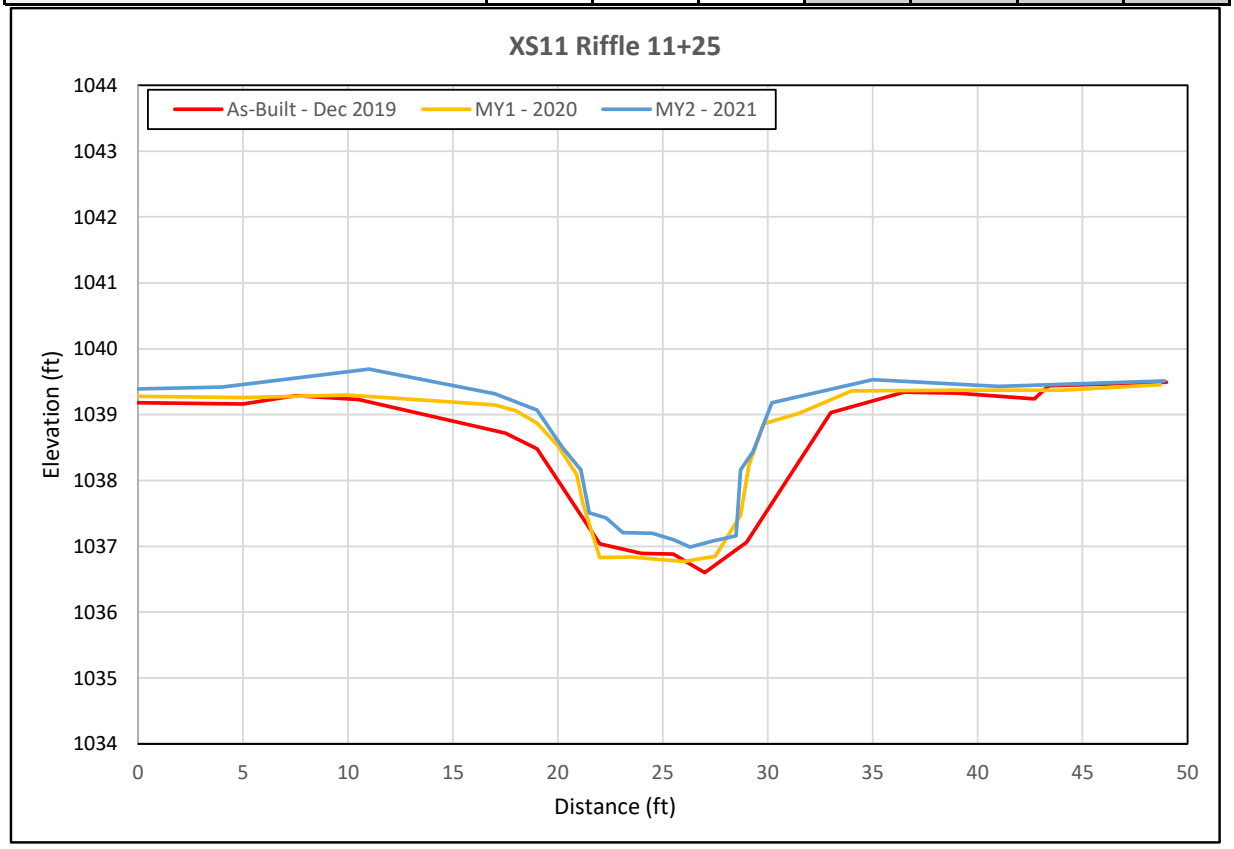
Rosgen Stream Type - C4

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.99	1.01				
Thalweg Elevation	1036.60	1036.84	1036.99				
LTOB Elevation	1038.48	1038.86	1039.07				
LTOB Max Depth	1.88	2.02	2.08				
LTOB Cross Sectional Area	15.54	15.40	15.69				
Entrenchment Ratio	>3.8	>5.23	>5.37				



ECOSYSTEM PLANNING & RESTORATION

Cross Section Plot - MY2

XS12 - UT

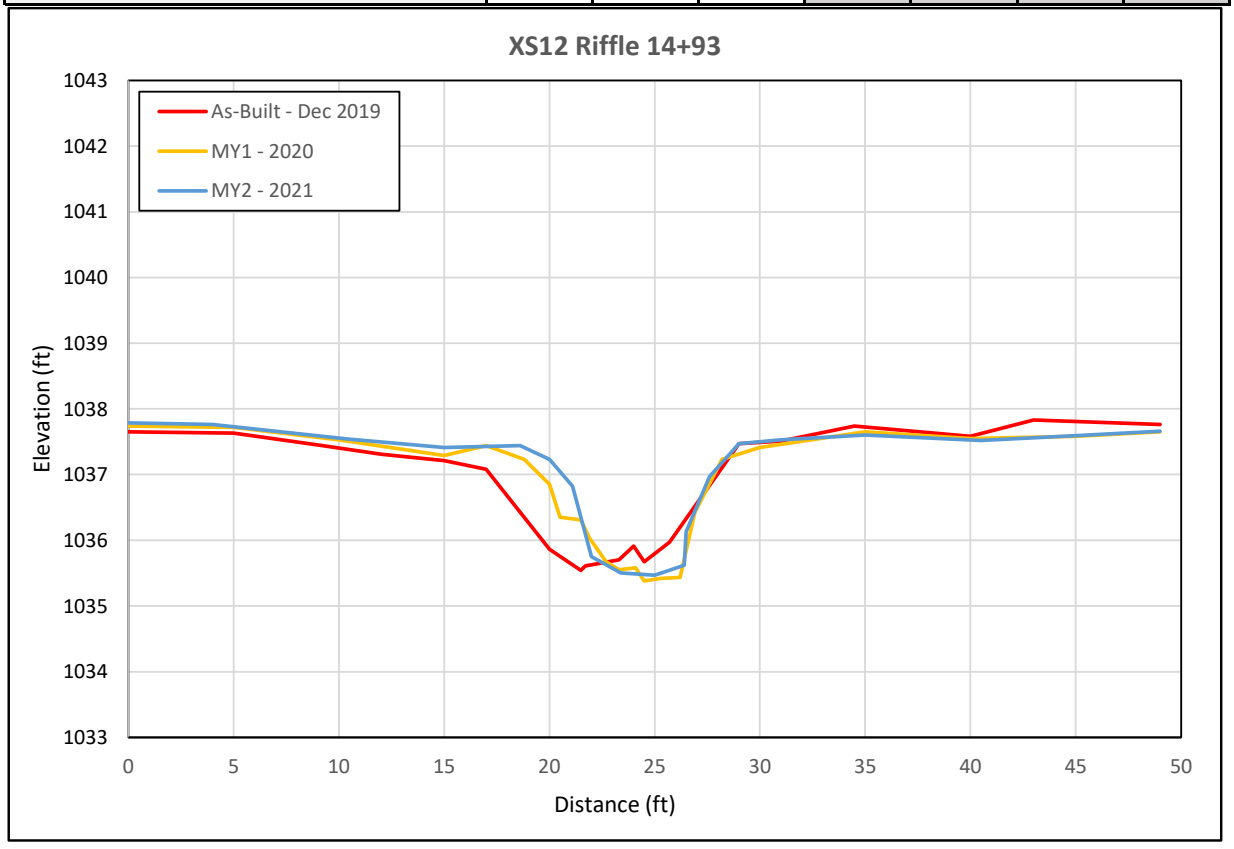
Rosgen Stream Type - C4

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.86	1.03				
Thalweg Elevation	1035.54	1035.67	1035.47				
LTOB Elevation	1037.08	1037.23	1037.44				
LTOB Max Depth	1.54	1.56	1.97				
LTOB Cross Sectional Area	10.89	8.47	11.41				
Entrenchment Ratio	>4.4	>5.64	>6.53				



Ecosystem Planning & Restoration

Cross Section Plot - MY2

XS13 - UT

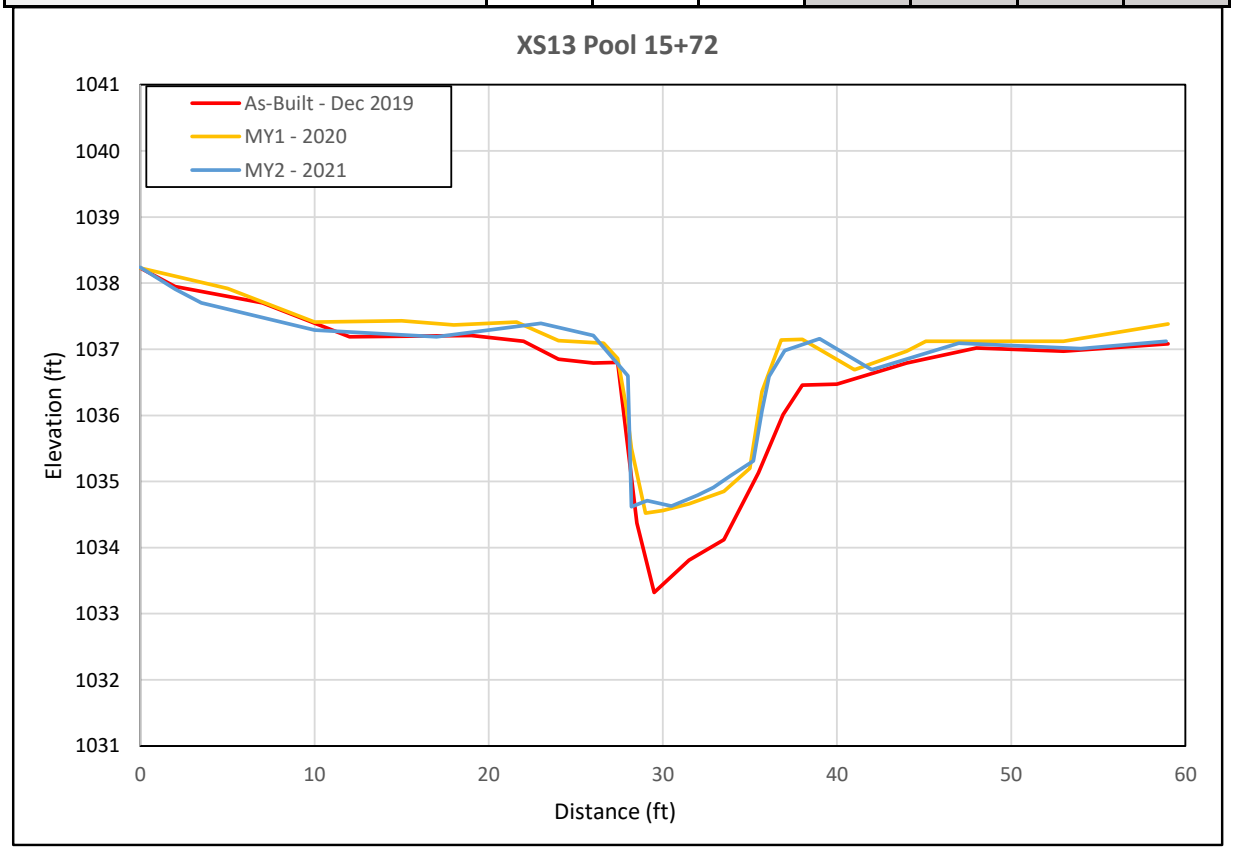
Rosgen Stream Type - C4

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				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94	1.04				
Thalweg Elevation	1033.32	1034.52	1034.62				
LTOB Elevation	1036.46	1037.09	1037.21				
LTOB Max Depth	3.14	2.57	2.59				
LTOB Cross Sectional Area	19.55	17.77	22.91				
Entrenchment Ratio	-	-	-				



Ecosystem Planning & Restoration

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					1040.55	1040.98	1040.94					1040.37	1040.90	1041.16					1040.25	1040.78	1041.111				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.84	0.84					1.00	0.78	0.99					1.00	0.85	0.87					1.00	0.80	0.71				
Thalweg Elevation	1041.08	1041.41	1041.29					1038.76	1038.94	1038.98					1038.05	1038.55	1038.59					1036.83	1038.08	1038.09				
LTOB[2] Elevation	1042.89	1043.11	1043.32					1040.55	1040.52	1040.91					1040.37	1040.55	1040.82					1040.25	1040.25	1040.25				
LTOB[2] Max Depth (ft)	1.81	1.70	2.03					1.79	1.58	1.93					2.32	2.00	2.23					3.42	2.17	2.16				
LTOB[2] Cross Sectional Area (ft^2)	19.79	14.06	15.02					16.40	10.80	16.01					18.32	14.08	13.89					27.86	18.48	15.31				
Entrenchment Ratio	>3.5	>4.52	>6.14					>3.31	>3.46	>3.75					-	-	-					-	-	-				

	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					1037.06	1037.03	1037.10					1035.65	1035.48	1035.56					1034.63	1034.62	1034.61				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.94	1.02					1.00	1.11	1.11					1.00	1.09	1.01					1.00	1.09	0.97				
Thalweg Elevation	1037.61	1037.74	1037.76					1034.33	1034.21	1034.17					1032.51	1031.82	1031.90					1032.59	1032.01	1032.08				
LTOB[2] Elevation	1039.55	1039.53	1039.68					1037.06	1037.34	1037.41					1035.65	1035.80	1035.59					1034.63	1034.85	1034.54				
LTOB[2] Max Depth (ft)	1.94	1.79	1.92					2.73	3.13	3.24					3.14	3.98	3.69					2.04	2.84	2.46				
LTOB[2] Cross Sectional Area (ft^2)	20.68	18.54	21.67					21.82	26.18	26.27					32.43	38.84	32.98					26.44	30.76	25.20				
Entrenchment Ratio	>3.06	>2.90	>2.93					-	-	-					-	-	-					>3.23	>3.55	>3.43				

	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					1032.85	1032.77	1032.70					1038.48	1038.87	1039.06					1037.08	1037.49	1037.39				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.85	0.99					1.00	1.07	1.05					1.00	0.99	1.01					1.00	0.86	1.03				
Thalweg Elevation	1030.53	1030.65	1030.56					1030.46	1030.19	1030.03					1036.60	1036.84	1036.99					1035.54	1035.67	1035.47				
LTOB[2] Elevation	1032.62	1032.62	1032.70					1032.85	1032.95	1032.84					1038.48	1038.86	1039.07					1037.08	1037.23	1037.44				
LTOB[2] Max Depth (ft)	2.09	1.97	2.14					2.39	2.76	2.81					1.88	2.02	2.08					1.54	1.56	1.97				
LTOB[2] Cross Sectional Area (ft^2)	23.96	19.22	23.58					32.75	36.72	35.67					15.54	15.40	15.69					10.89	8.47	11.41				
Entrenchment Ratio	>3.87	>4.94	>4.22					-	-	-					>3.8	>5.23	>5.37					>4.4	>5.64	>6.53				

	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																									
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.94	1.04																									
Thalweg Elevation	1033.32	1034.52	1034.62																									
LTOB[2] Elevation	1036.46	1037.09	1037.21																									
LTOB[2] Max Depth (ft)	3.14	2.57	2.59																									
LTOB[2] Cross Sectional Area (ft^2)	19.55	17.77	22.91																									
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

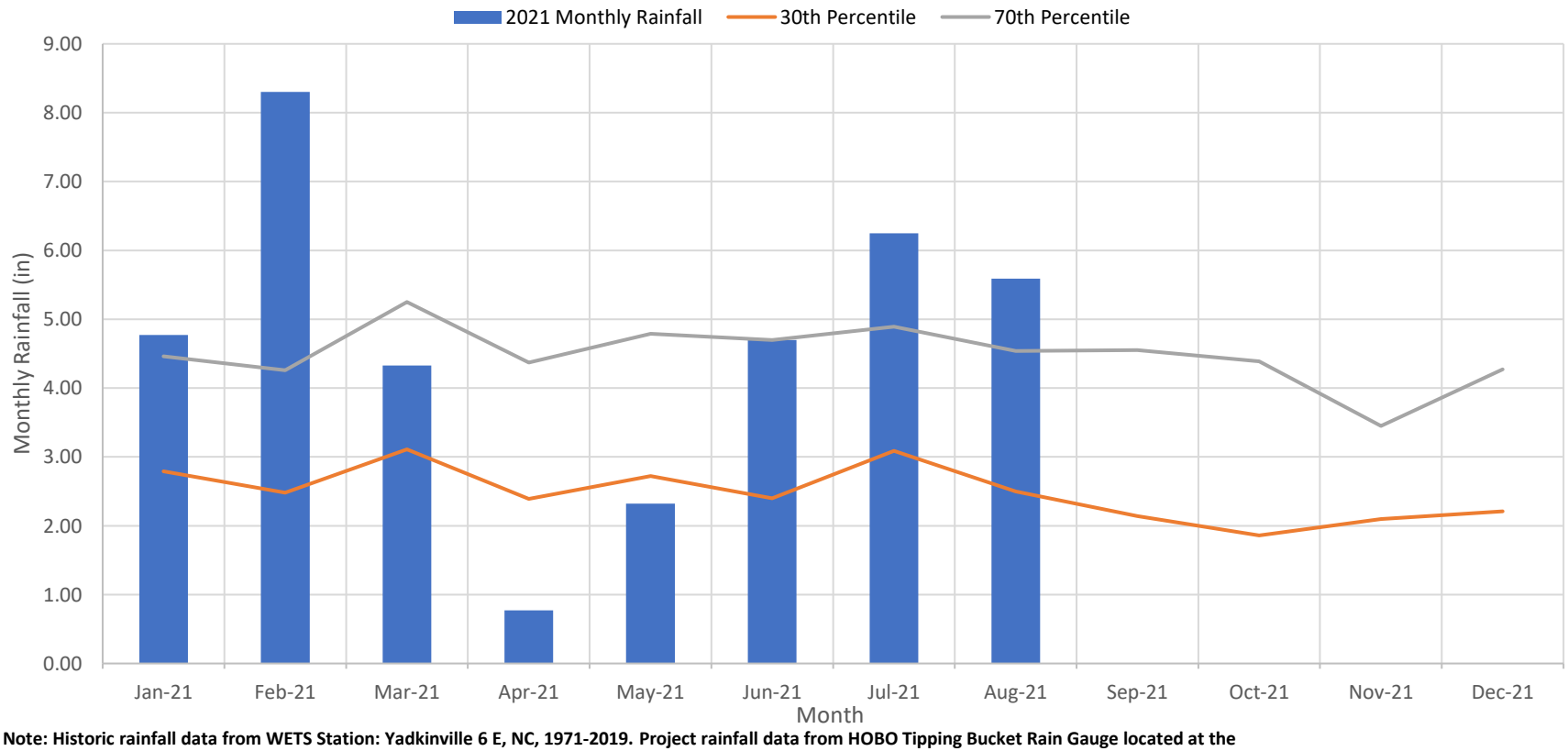
Figure 3. Monthly Rainfall Data

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	-	-	-	-	-
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	-	-	-	-	-

Meadow Brook Stream Restoration Project
Figure 3. Monthly Rainfall Data
Monitoring Year 2 - 2021

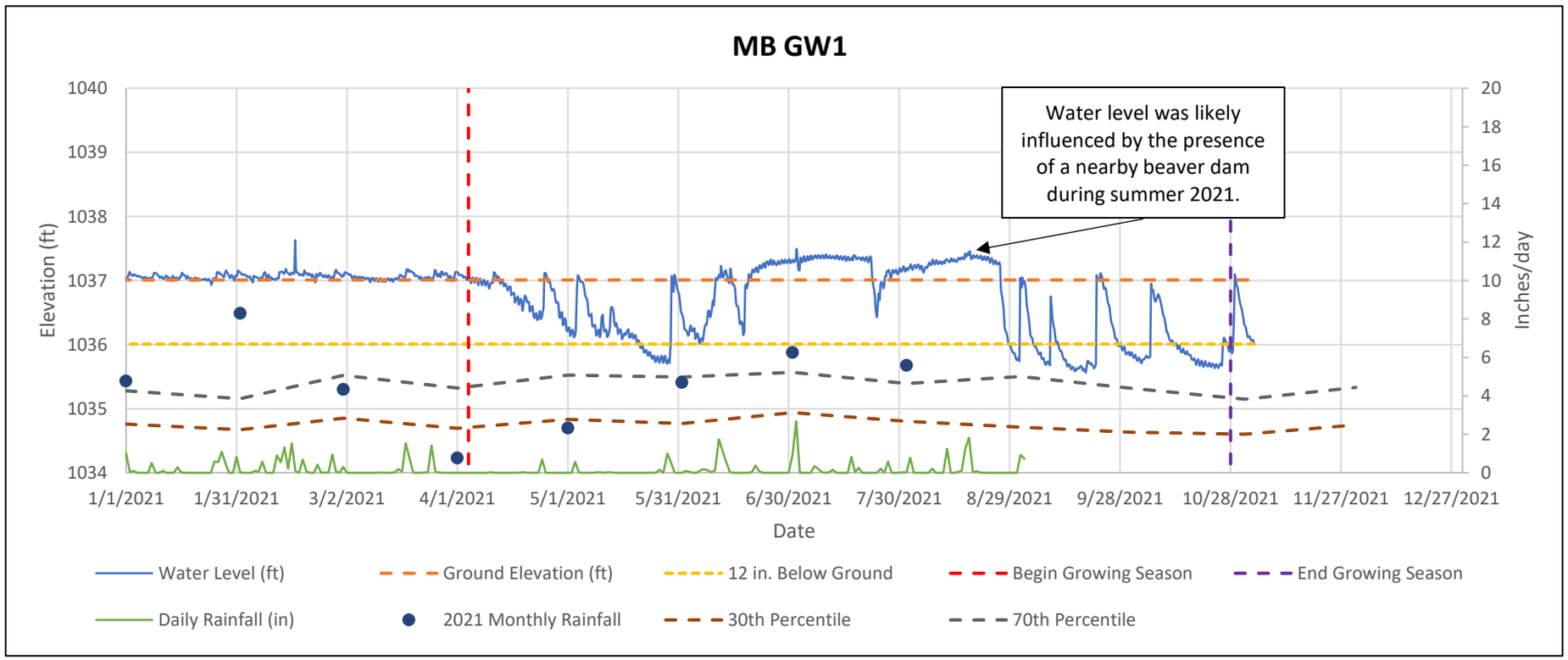


Note: Historic rainfall data from WETS Station: Yadkinville 6 E, NC, 1971-2019. Project rainfall data from HOBO Tipping Bucket Rain Gauge located at the

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

*Note: The batteries in the Meadow Brook tipping bucket rain gauge died on 9/2/21 so no rain data was collected from September to October.

Meadow Brook Stream Restoration Project
Year 2 (2021) Groundwater Data

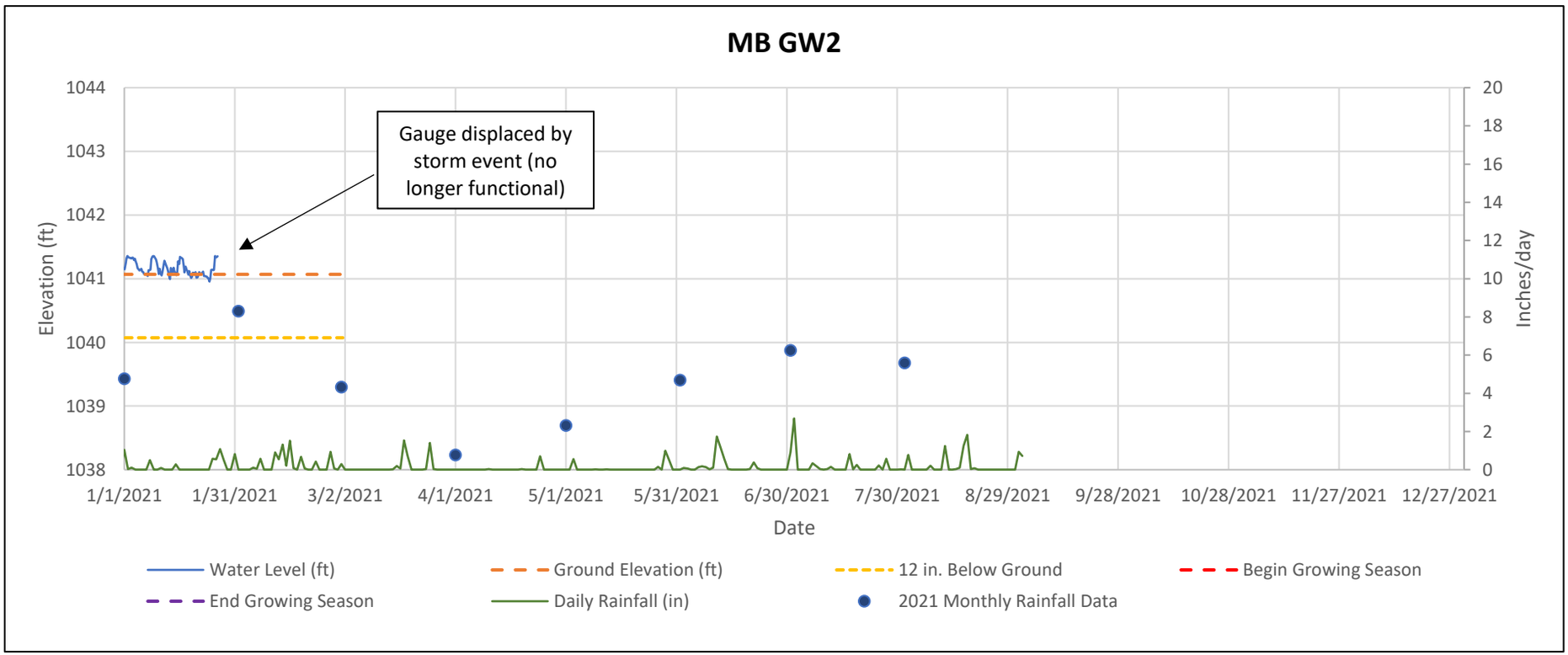


Site Info (Year 2)	
Site	Meadow Brook Stream Restoration Project
Begin Date	7/16/2019
End Date	11/3/2021
Total Days of Well Data	875

*Note: The batteries in the Meadow Brook tipping bucket rain gauge died on 9/2/21 so no rain data was collected from September to October.

Growing Season Information (Year 2 - 2021)		
Site		Meadow Brook Stream Restoration Project
Gauge ID		MB GW1
Serial #		20234983
Growing Season Start Date		4/4/2021
Growing Season End Date		10/28/2021
Total Growing Season Days		207
NRCS Soil Series		Dan River and Codorus
5.0%	Growing Season (Days)	10
12.5%	Growing Season (Days)	26
Most Consecutive Successful Days Within Growing Season		93
Percent of Growing Season with Consecutive Successful Days		44.9%
Average Water Level Elevation During Growing Season (ft)		1036.61
Total Cumulative Successful Days Within Growing Season		167

Meadow Brook Stream Restoration Project
Year 2 (2021) Groundwater Data

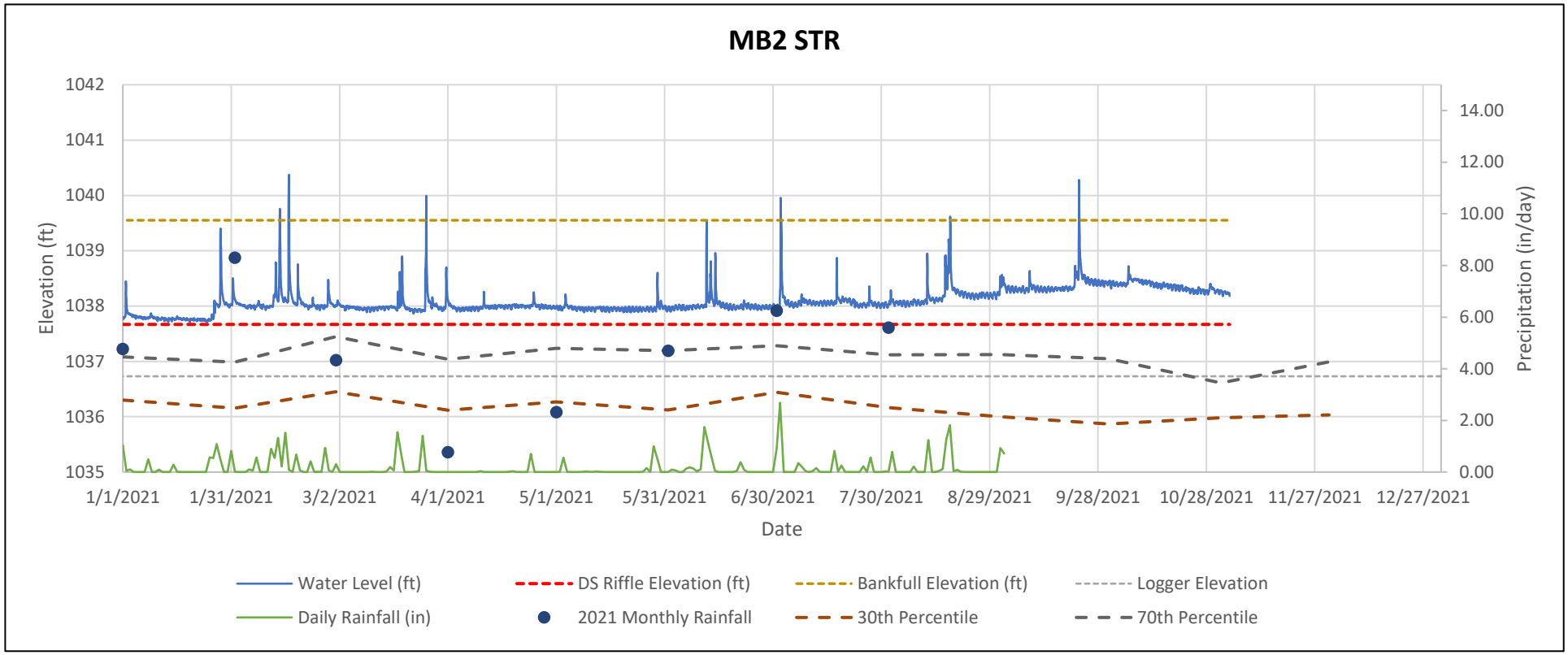


Site Info (Year 2)	
Site	Meadow Brook Stream Restoration Project
Begin Date	7/16/2019
End Date	1/26/2021
Total Days of Well Data	560

*Note: The batteries in the Meadow Brook tipping bucket rain gauge died on 9/2/21 so no rain data was collected from September to October.

Growing Season Information (Year 2 - 2021)		
Site		Meadow Brook Stream Restoration Project
Gauge ID		MB GW2
Serial #		20234986
Growing Season Start Date		4/4/2021
Growing Season End Date		10/28/2021
Total Growing Season Days		207
NRCS Soil Series		Dan River and Codorus
5.0%	Growing Season (Days)	10
12.5%	Growing Season (Days)	26
Most Consecutive Successful Days Within Growing Season		0
Percent of Growing Season with Consecutive Successful Days		0.0%
Average Water Level Elevation During Growing Season (ft)		N/A
Total Cumulative Successful Days Within Growing Season		0

Meadow Brook Stream Restoration Project
Year 2 (2021) Streamflow Data

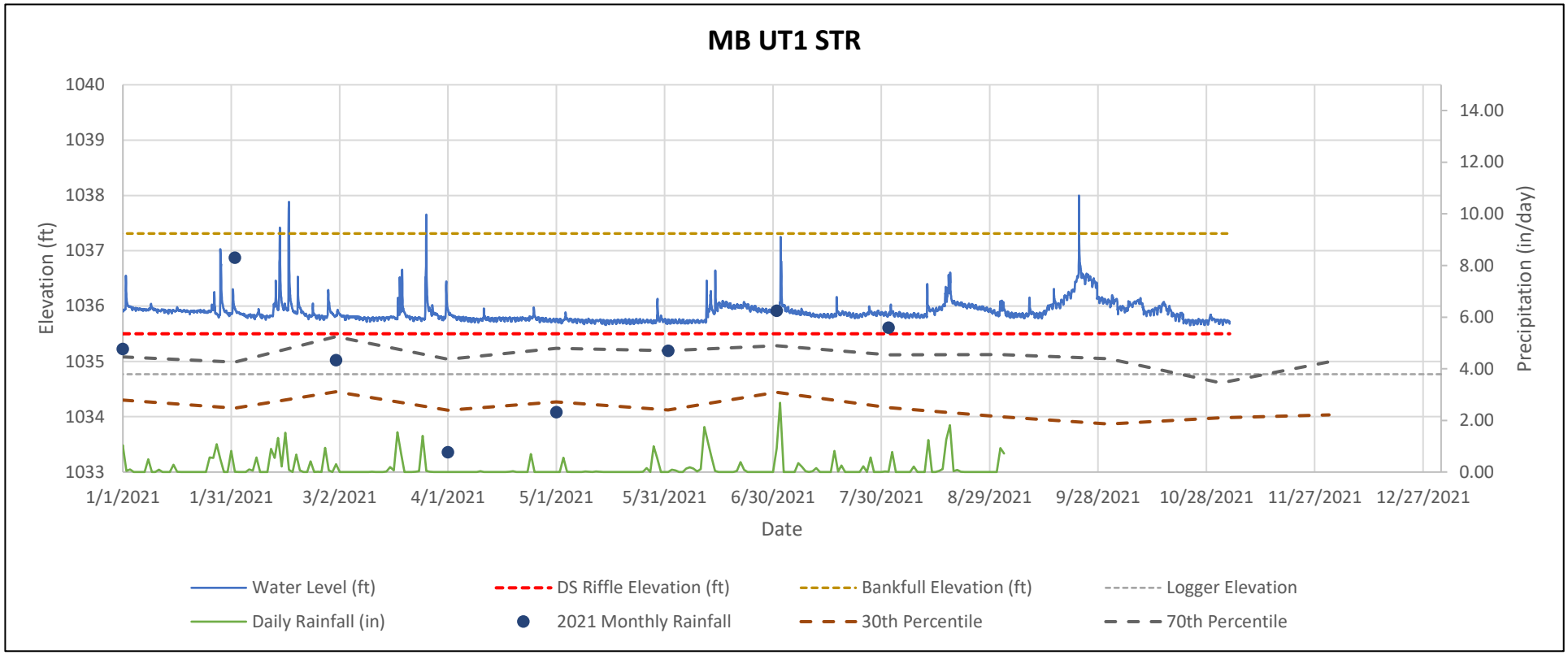


Site Info	
Stream	Meadow Brook Stream Restoration Project
Reach	Meadow Brook Reach 1
Date Installed	7/16/2019
Serial Number	20234985
Reach Type	Perennial

*Rainfall data from HOBO Tipping Bucket Rain Gauge located at the Meadow Brook Stream Restoration Site, 0.75 miles SE. Rain gauge data was not available for September and October 2021.

Year 2 (2021) Streamflow Data	
Gauge ID	MB2 STR
Start Date	1/1/2021
End Date	11/3/2021
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	307
Total Days of Flow	307
Max High Water Level Above Bankfull (ft)	0.82
Bankfull Events	6
Meets Success Criteria	Yes

Meadow Brook Stream Restoration Project
Year 2 (2021) 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. Rain gauge data was not available for September and October 2021.

Year 2 (2021) Streamflow Data	
Gauge ID	MB UT1 STR
Start Date	1/1/2021
End Date	11/3/2021
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	307
Total Days of Flow	307
Max High Water Level Above Bankfull (ft)	0.69
Bankfull Events	4
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: **2 yrs 5 months**
Elapsed time since planting complete: **1 yr 11 months**
Number of reporting years[1]: **2**

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
Year 3 Monitoring	-	-
Year 4 Monitoring	-	-
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

Meadow Brook Adaptive Management Plan February 2021

Email: MB GW#2, March 9, 2021

Ecosystem Planning and Restoration, LLC
1150 S.E. Maynard Road, Suite 140
Cary, NC 27511

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

February 16, 2021

Kim Browning
Mitigation Project Manager
Department of the Army
CORPS of Engineers
Wilmington District
69 Darlington Avenue
Wilmington, North Carolina 28403-1343

Subject: Response to NCDMS Meadow Brook Mitigation Site – NCIRT Comments during 15 – day Adaptive Management Plan Review

Dear Ms. Browning,

Ecosystem Planning and Restoration (EPR) has reviewed the comments on the Adaptive Management Plan for Meadow Brook Stream Restoration Project received on 2/12/2021. The comments have been addressed as described below to create the Final Adaptive Management Plan for Meadow Brook Stream Restoration Project.

USACE Comments, Kim Browning

1. *Based on submitted monitoring data, it appears that vegetation growth has been negatively affected by excessive site hydrology. The proposed adaptive management plan includes replanting portions of the site with additional species that are more adapted to the hydrologic conditions but does not include any modifications to address the underlying issue. Was the increased hydrology due solely to a few storm events? I agree that replanting the site should be included as part of the adaptive management plan. Further, given how extensive the planting is, about 80% of the site, vegetation monitoring should be extended an additional year, and the resulting data will be important in assessing the success of the performance of replanted vegetation. If the site appears to be demonstrating a trajectory for success later in monitoring (MY4 or MY5), we may eliminate the extra year of monitoring at that time. It would have been beneficial to include hydrology gauge data and rain gauge data to document the excessive inundation on site, and to include species mortality rates. Additionally, please indicate the percentage of each species to be planted. The Corps supports moving forward with the supplemental planting.*
    - **In the pre-construction site conditions, the site contained 6 acres of jurisdictional wetlands with several more acres of drained hydric soils. Restoration activities included raising the existing stream bed to connect to the historic floodplain, restoring a meandering riffle pool morphology, and filling existing drainage ditches. All these activities improved the site wetland hydrology. The improved site hydrology is also likely due to higher than average rainfall.**

Most of the riparian floodplain area is now functioning as a wetland, which is a positive ecological development.

- **EPR hopes to avoid additional vegetation monitoring since these efforts were initiated so early in the project's post-construction monitoring phase. However, if required, EPR can conduct vegetation monitoring surveys in MY8 if the previous year's data do not indicate a trend towards success. No additional monitoring efforts are proposed.**
- **Wetland and rain gauge data graphs from MY1 have been included in the Final AMP.**
- **The maximum percentage of each species that will be planted is included in the Revised Vegetation Selection table attached to the Final AMP.**

DWR Comments, Erin Davis

1. *DWR appreciates the additional adaptive management plan information provided, particularly the Revised Vegetation Selection. We are ok with the proposed additional species and percentages. DWR is glad to see that random plots were incorporated into the initial monitoring plan, however, we would still like to request 2-3 random transects to demonstrate survival and diversity in MY3.*
    - **Per a phone conversation with Erin Davis on 2/16/21, the 2-3 random transects may be omitted from MY3 efforts as the spatial distribution of fixed and changing random plots are sufficient.**

2. *DWR understands that it was a wetter than normal year. However, regarding the "very thick herbaceous vegetation competition", have you identified which species are competing most with the planted woody stems? Are the species part of your seed mix or volunteers? Is this a situation that will influence selection/percentages of seed mix species on future sites?*
    - **EPR has not identified any single species which competed the most with the woody planted stems and whether these species were planted or volunteer. It is clear that soft rush (juncus effusus), which was included in the original planting plan at 4%, has grown very thick in places. This species was already present on the site, however, and much of what is present on the site is likely volunteer growth.**

EPA Comments, Todd Bowers

*Note: These comments were addressed in the Revised AMP submitted on 2/11/2021

1. *I have reviewed the Adaptive Management Plan (AMP) for the proposed supplemental planting of the NCDMS Meadowbrook mitigation site to address the poor sitewide vegetation performance following the Monitoring Year 1 report of December 2020. In the MY1 Report, EPR was forthcoming in providing the data pertaining to unexpectedly high water table levels and vegetation mortality across much of the site following a year of higher than normal precipitation that produced an abnormally high number of bankfull events. I understand that sitewide supplemental planting needs to occur and that this*

needs to happen as soon as possible to take advantage of the rapidly closing window of plant dormancy.

With that in mind I offer the following suggestions to facilitate a better understanding of the corrective action to be undertaken. I recommend adding the wetland indicator status to the desired 8 species listed on page 2 of the AMP along with a clearer understanding of where these species will be planted. Since there are two distinct vegetation zones there should be some delineation between the two in species distribution. Poor performance was illustrated (vegetation problem area) for the upland areas too, so some consideration of wet condition tolerances needs to be considered for those areas as well. I also understand the urgency to address this problem, however the IRT should have been altered to this back in December so that we could have been a bit more proactive in addressing EPR's AMP and need to take immediate corrective action. I did not see the MY1 Report until the AMP was sent out for review so that may have caused some delay in turnaround for IRT approval. I understand that mortality was not just linked to wetter than expected conditions but rather that herbaceous vegetation competition was a contributing factor. If possible, I would like to know species mortality rates (diff between planted stems and those that survived) so that species with high mortality can be avoided or likewise those that have done well can be promoted.

- **Noted. These comments were addressed in the Revised AMP submitted on 2/11/2021.**

WRC Comments, Olivia Munzer

Comments on the additional species:

1. *- Witch hazel is a FACU species. Make sure this species isn't planted in the consistently wet area. They state that the upland areas did mostly well, so where will they plant this species, as well as those listed as FAC.*
    - **The upland planting areas account for only around 0.9 acres throughout the site. In general, these areas did perform better than the riparian wetland areas but they will still be supplementally planted using the revised upland planting mix presented in the attachments.**
2. *- I'd prefer to see something other than tulip poplar on the list since it was originally planted (10%) and it will volunteer.*
    - **Tulip poplar is a successful native species that will likely thrive in the difficult site conditions. It is preferred that Tulip poplar will remain as part of the AMP.**

Comments on the 2018 planting plan – I realize I am late to comment on this, but for next time and to note on other projects:

1. *- Remove cereal rye from temporary seeding. It is allelopathic.*
2. *- Add more pollinator species to the seed mix*
3. *- Riverbank wild-rye only occurs in mountains*
4. *- Switchgrass not commonly found in that part of the state (https://auth1.dpr.ncparks.gov/flora/species_account.php)*
5. *- Festuca ovina var. duriuscala – it is an introduced species*

6. *- Tall Fescue and Kentucky bluegrass as they can be invasive (https://www.invasive.org/species/grasses.cfm).*
7. *- Although persimmon can be found in a variety of habitats, it doesn't seem appropriate for riparian wetland. It is most commonly found in dry to mesic forests and edges.*
    - **Thank you for the comments on the 2018 planting plan. These will be taken into consideration on future projects. Note that there are several reasons that these species are included, and these can be discussed at a later date as needed.**

If you have any questions, please contact me at 925-337-1470 or via email at cjones@eprusa.net.

Sincerely,

Cidney Jones, PE & CFM

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

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

Adaptive Management Plan for Meadow Brook Stream Restoration Project

Revised February 16, 2021

The Meadow Brook Stream Restoration Project (Project, Site) is a DMS Full-Delivery located in Yadkin County, NC. The site is currently in MY2 (2021). Riparian herbaceous vegetation that was established after construction appears to be flourishing throughout the Site. Additionally, no invasive species were noted within the conservation easement. All restored streams meet the success criteria as established in the Final approved Mitigation Plan (2018). The site has withstood multiple storm events in MY1 and has held up extremely well. EPR is proposing to conduct supplemental planting across a portion of the site in early 2021 during dormant season.

Riparian vegetation monitoring evaluates the growth and development of planted and volunteer vegetation across the Site. Six (6) permanent vegetation monitoring plots were established across the Site. The individual trees within each permanent plot were flagged and identified to facilitate repeat monitoring each year. In addition to the 6 permanent plots, 6 randomly placed vegetation plots are established each year and the location of these plots is recorded using a GPS. All vegetation plot locations for MY1 are shown in the current conditions plan view (CCPV; Attached).

The vegetation performance criteria, as established in the Final approved Mitigation Plan (2018), are listed below:

- 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.

Data from MY1 is summarized in the table on the following page, Tables 6 and 7 from the MY1 Report are also provided in the attachments.

ECOSYSTEM PLANNING & RESTORATION

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Veg Plot ID	MY1 Stem Count	MY1 Stems/AC	Dominant Species Composition (%)
VPF-1	8	324	25
VPF-2	21	850	18
VPF-3	5	202	29
VPF-4	9	364	22
VPF-5	13	526	31
VPF-6	3	121	67
VPR-7	1	40	100
VPR-8	6	243	33
VPR-9	8	324	25
VPR-10	3	121	67
VPR-11	4	162	50
VPR-12	11	445	36

As indicated by the low planted stem count numbers found in many vegetation plots, much of the planted areas are not meeting the performance criteria. Six out of twelve of the riparian plots are already below the interim success criteria for density in year 3 and three more plots (shown in yellow) are not expected to meet the interim success criteria. Table 5 in Appendix A of the MY1 Report indicates that 8.80 acres of the 11.2-acre easement (78.6%) can be described as low stem density areas. The CCPV provided in the attachments shows the vegetation problem areas.

The high woody species mortality documented in the MY1 Report is likely due to 2 reasons:

1. Very thick herbaceous vegetation competition
2. Very wet conditions (refer to site groundwater monitoring attachment)

Supplemental planting efforts are currently being planned to re-plant certain areas of the site where mortality is high so that the site will meet the interim success criteria. This will include re-planting the available species included in the Final approved Mitigation Plan (2018) which were generally based on species suggested by Schafale and Weakly (1990) for Piedmont/Low Mountain Alluvial Forest and Schafale (2012) for Piedmont Alluvial Forest. The planting plan and planting zones from the plan set are provided in the attachments. Also, as part of these efforts, the planting contractor has suggested/requested using some additional native species that were not originally proposed in the Final approved Mitigation Plan (2018). The contractor is confident that these species will improve success. The additional species are listed in the table on the following page and revised vegetation plan tables are provided in the attachments.

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Cary, NC 27511

Phone: (919) 388-0787
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Cephalanthus occidentalis	OBL	Buttonbush
Physocarpus opulifolius	FACW	Nine Bark
Alnus serrulate	OBL	Tag Alder
Hamamelis virginiana	FACU	Witch hazel
Quercus michauxii	FACW	Swamp chestnut oak
Liriodendron tulipirera	FACU	Tulip poplar
Lindera benzoin	FAC	Spicebush
Carpinus caroliniana	FAC	American Hornbeam

Planting zones will loosely follow the zones shown in the Plans (Zone 1 along the streambanks, Zone 2 in the riparian wetlands, and Zone 3 in the Uplands). However within Zone 2, the FACW and OBL species listed in the table above will also be planted within areas of consistent standing water identified in the field. Also, approved species included in Zone 1 will be planted in these areas. The upland zone shown in the original planting plan generally did well and only accounts for 0.9 acres of planting. Individual species will be selected and planted per specific site conditions under the supervision of a qualified planting contractor. The maximum percent any species will encompass is provided in the revised vegetation plan in the Attachments. Green Ash will continue to be limited to 5% and the proposed diverse list will help ensure that no species is dominant.

EPR is making every effort to address the vegetation issues reported above in MY2 (2021) with more wet tolerant species. As it is very early in the monitoring, EPR does not believe that additional monitoring is warranted at this time.

Ecosystem Planning and Restoration, LLC
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Cary, NC 27511

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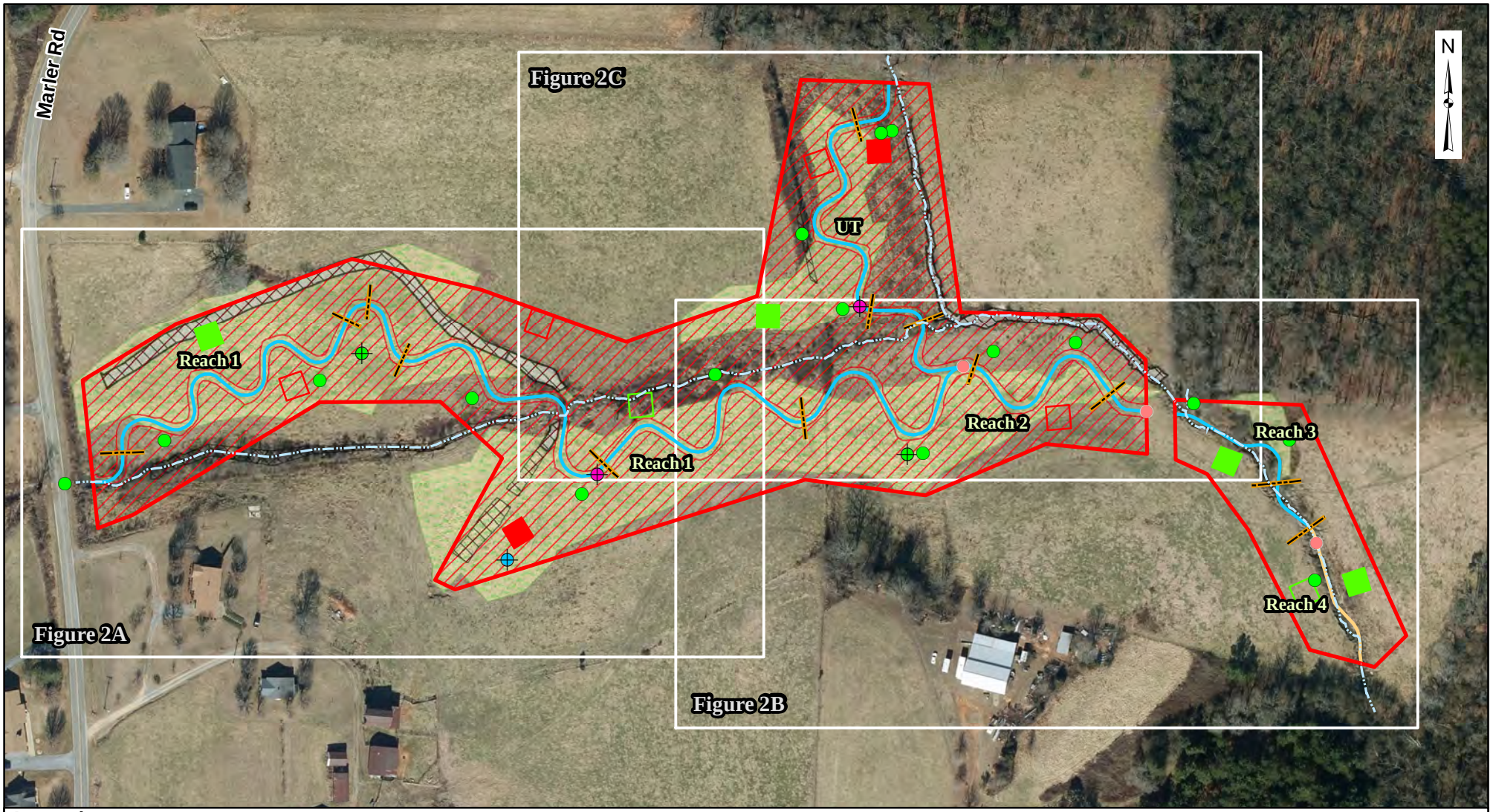
Attachments
for the
Adaptive Management Plan for Meadow Stream Restoration Project

1. Current Condition Plan View (CCPV) – Figures 2, 2A – 2C from Final Monitoring Year 1 Report (Dec 2020)
2. Vegetation Plot Data – Table 6 from Final Monitoring Year 1 Report (Dec 2020)
3. Vegetation Performance Standards Summary Table – Table 7 from Final Monitoring Year 1 Report (Dec 2020)
4. Groundwater and Rain Data from MY1 – from Final Monitoring Year 1 Report (Dec 2020)
5. Annual Rain Data Summary from MY1 – from Final Monitoring Year 1 Report (Dec 2020)
6. Revised Vegetation Plan – Created for this AMP
7. Vegetation Selection Plan Sheet – Sealed construction plan set, identical content to Appendix 9 from Final approved Mitigation Plan (2018)
8. Vegetation Plan Sheets – Sealed construction plan set, identical content to Appendix 9 from Final approved Mitigation Plan (2018)



Legend

- Photo Points
- Pre-Existing Streams
- Existing Wetlands
- Conservation Easement
- Rain Gauge
- Stream Gauge
- Wetland Gauge
- Reach Breaks
- Stream Restoration
- Stream Enhancement
- Fixed Veg Plot - Unsuccessful
- Fixed Veg Plot - Successful
- Random Veg Plot - Unsuccessful
- Random Veg Plot - Successful
- Cross Sections
- Unfilled Ditches
- Filled Ditches
- Vegetation Problem Area

NC OneMap Orthoimagery (2018)

0 200 Feet

1 inch = 200 feet

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Overview
MY1: 2020

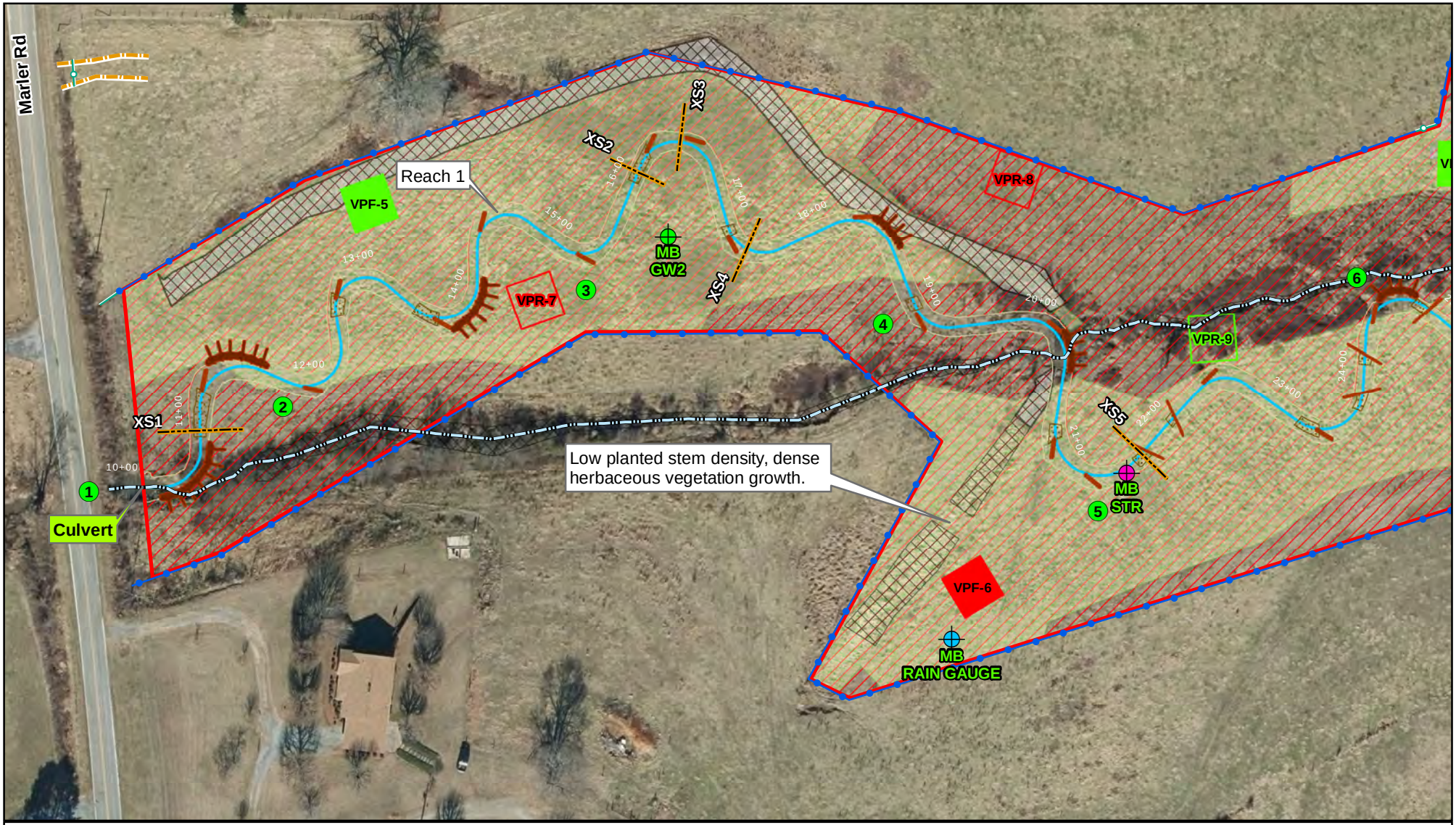
DMS Project ID# 100024
DEC 2020

FIGURE 2

Yadkin County, NC

Mitigation Services Environmental Quality

Ecosystem Planning & Restoration



Legend

- Top of Bank (ASB)
- Stream Centerline
- Pre-Existing Streams
- Structures
- Existing Wetlands
- Conservation Easement
- Cross Sections
- Photo Points
- Fixed Veg Plot - Unsuccessful
- Fixed Veg Plot - Successful
- Random Veg Plot - Unsuccessful
- Random Veg Plot - Successful
- Rain Gauge
- Stream Gauge
- Wetland Gauge
- Farm Path
- Fencing
- Fence Gates
- Vegetation Problem Area
- Unfilled Ditches
- Filled Ditches

NC OneMap Orthoimagery (2018)

0 100 Feet

1 inch = 100 feet

N

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Asset Map

MY1: 2020

DMS Project ID# 100024

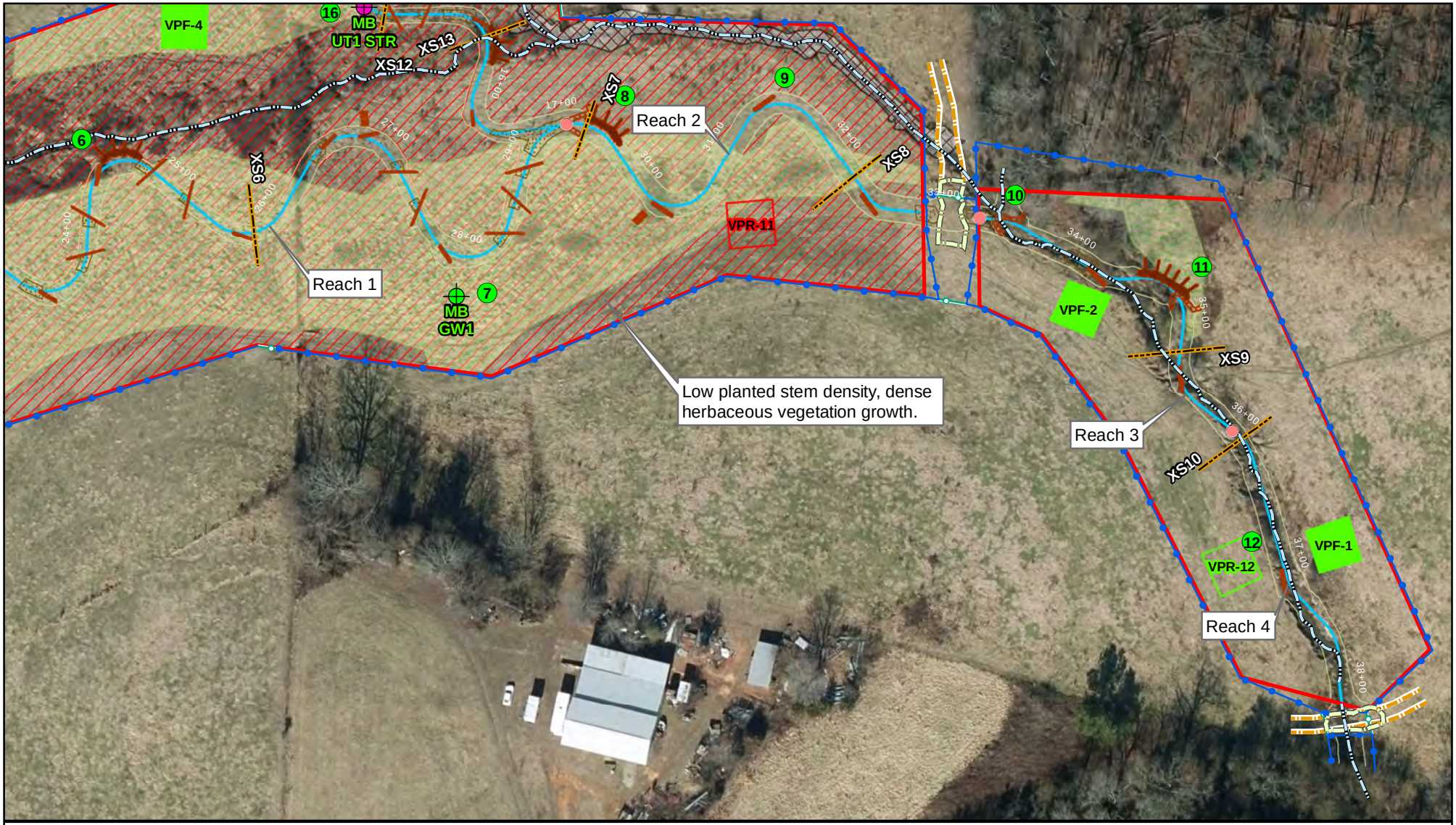
DEC 2020

FIGURE 2A

Yadkin County, NC

Mitigation Services

Ecosystem Planning & Restoration



Legend

- Top of Bank (ASB)
- Stream Centerline
- Pre-Existing Streams
- Structures
- Existing Wetlands
- Conservation Easement
- Cross Sections
- Photo Points
- Fixed Veg Plot - Successful
- Random Veg Plot - Unsuccessful
- Random Veg Plot - Successful
- Stream Gauge
- Wetland Gauge
- Reach Breaks
- Stream Crossing
- Farm Path
- Fencing
- Fence Gates
- Vegetation Problem Area
- Unfilled Ditches
- Filled Ditches

NC OneMap Orthoimagery (2018)

0 100 Feet

1 inch = 100 feet

N

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Asset Map

MY1: 2020

DMS Project ID# 100024

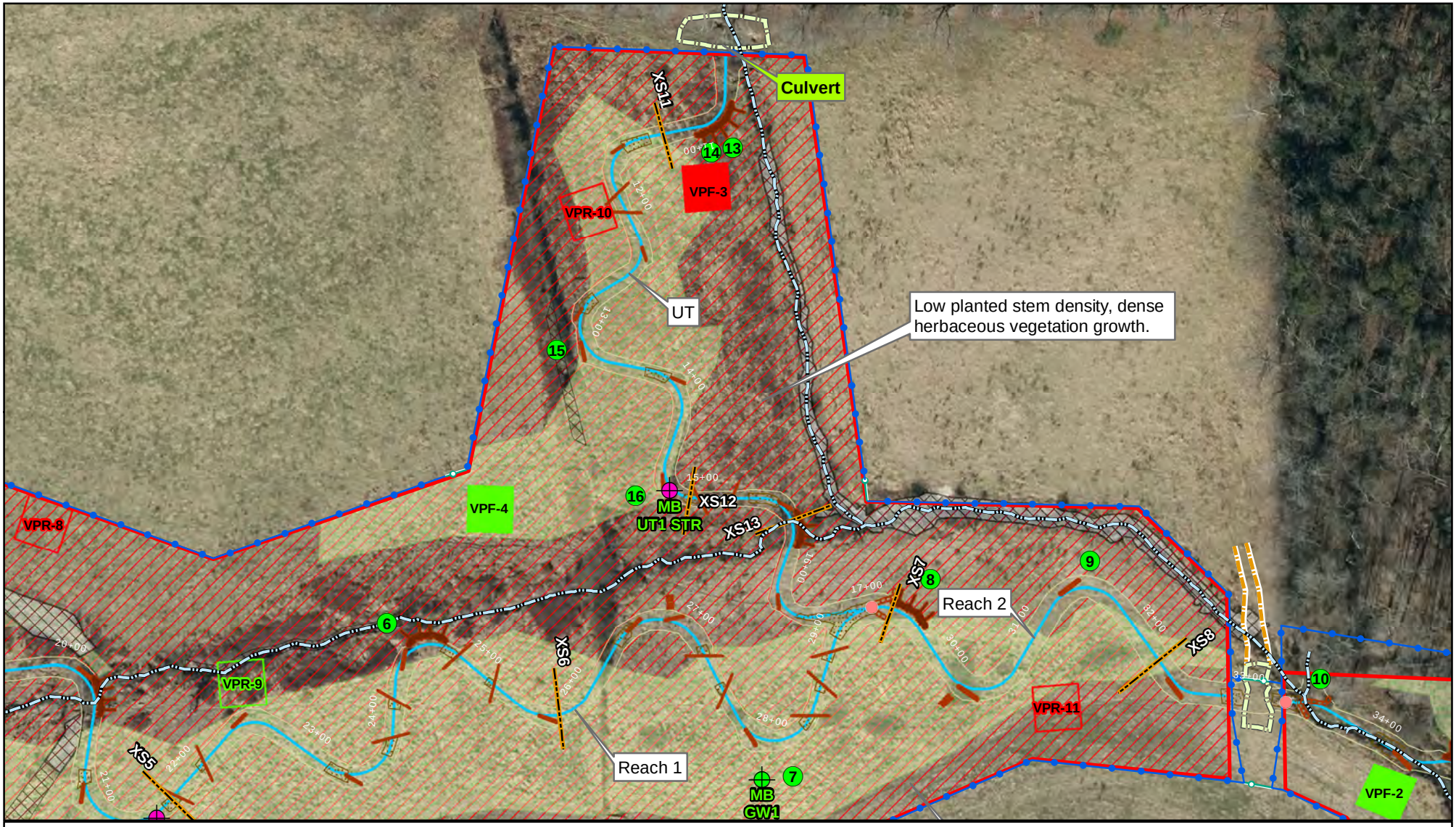
DEC 2020

FIGURE 2B

Yadkin County, NC

Mitigation Services Environmental Quality

Ecosystem Planning & Restoration



Legend

- Top of Bank (ASB)
- Stream Centerline
- Pre-Existing Streams
- Structures
- Existing Wetlands
- Conservation Easement
- Cross Sections
- Photo Points
- Fixed Veg Plot - Unsuccessful
- Fixed Veg Plot - Successful
- Random Veg Plot - Unsuccessful
- Random Veg Plot - Successful
- Stream Gauge
- Wetland Gauge
- Reach Breaks
- Stream Crossing
- Farm Path
- Fencing
- Fence Gates
- Vegetation Problem Area
- Unfilled Ditches
- Filled Ditches

NC OneMap Orthoimagery (2018)

0 100 Feet

1 inch = 100 feet

N

MEADOW BROOK STREAM MITIGATION PROJECT

Current Condition Plan View: Asset Map

MY1: 2020

DMS Project ID# 100024

DEC 2020

FIGURE 2C

Yadkin County, NC

Mitigation Services

Ecosystem Planning & Restoration

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)	#N/A
Date(s) Mowing	#N/A
Date of Current Survey	2020-10-27
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 1 F		Veg Plot 2 F		Veg Plot 3 F		Veg Plot 4 F		Veg Plot 5 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			2	2	2	2			3	3				2	1	1		1
	Celtis laevigata	sugarberry	Tree	FACW	1	1					1	1										
	Cercis canadensis	eastern redbud	Tree	FACU			3	3													1	
	Cornus amomum	silky dogwood	Shrub	FACW			4	4			1	1	4	4					1			4
	Diospyros virginiana	common persimmon	Tree	FAC			2	2	1	1	2	2	2	2	1	1			2		1	1
	Fraxinus pennsylvanica	green ash	Tree	FACW	2	2	3	3			2	2						1	1	2		2
	Liriodendron tulipifera	tuliptree	Tree	FACU	1	1	3	3														2
	Platanus occidentalis	American sycamore	Tree	FACW			3	3					1	1			1	1			2	
	Quercus alba	white oak	Tree	FACU							1	1										
	Quercus nigra	water oak	Tree	FAC														1	1			
	Quercus phellos	willow oak	Tree	FAC															2			
	Quercus rubra	northern red oak	Tree	FACU	2	2	1	1			1	1	1	1								
	Salix nigra	black willow	Tree	OBL	2	2			1	1	1	1	1	1	2	2						1
	Sambucus canadensis	American black elderberry	Tree						1	1												
	Ulmus americana	American elm	Tree	FACW									1	1				1				
Sum	Performance Standard				8	8	21	21	5	5	9	9	13	13	3	3	1	6	8	3	4	11
Post Mitigation Plan Species	*Acer rubrum*	*red maple*	*Tree*	*FAC*					*2*	*2*												
	Alnus serrulata	*tag alder*	*Tree*	*OBL*			*1*	*1*														
Sum	Proposed Standard				8	8	21	21	5	5	9	9	13	13	3	3	1	6	8	3	4	11
Mitigation Plan Performance Standard	Current Year Stem Count					8		21		5		9		13		3	1	6	8	3	4	11
	Stems/Acre					324		850		202		364		526		121	40	243	324	121	162	445
	Species Count					5		8		4		7		7		2	1	5	6	2	3	6
	Dominant Species Composition (%)					25		18		29		22		31		67	100	33	25	67	50	36
	Average Plot Height					3		1		1		2		3		6	2	2	3	3	3	2
	% 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.

Does not Meet Interim Performance Criteria	Meets interim Performance Criteria

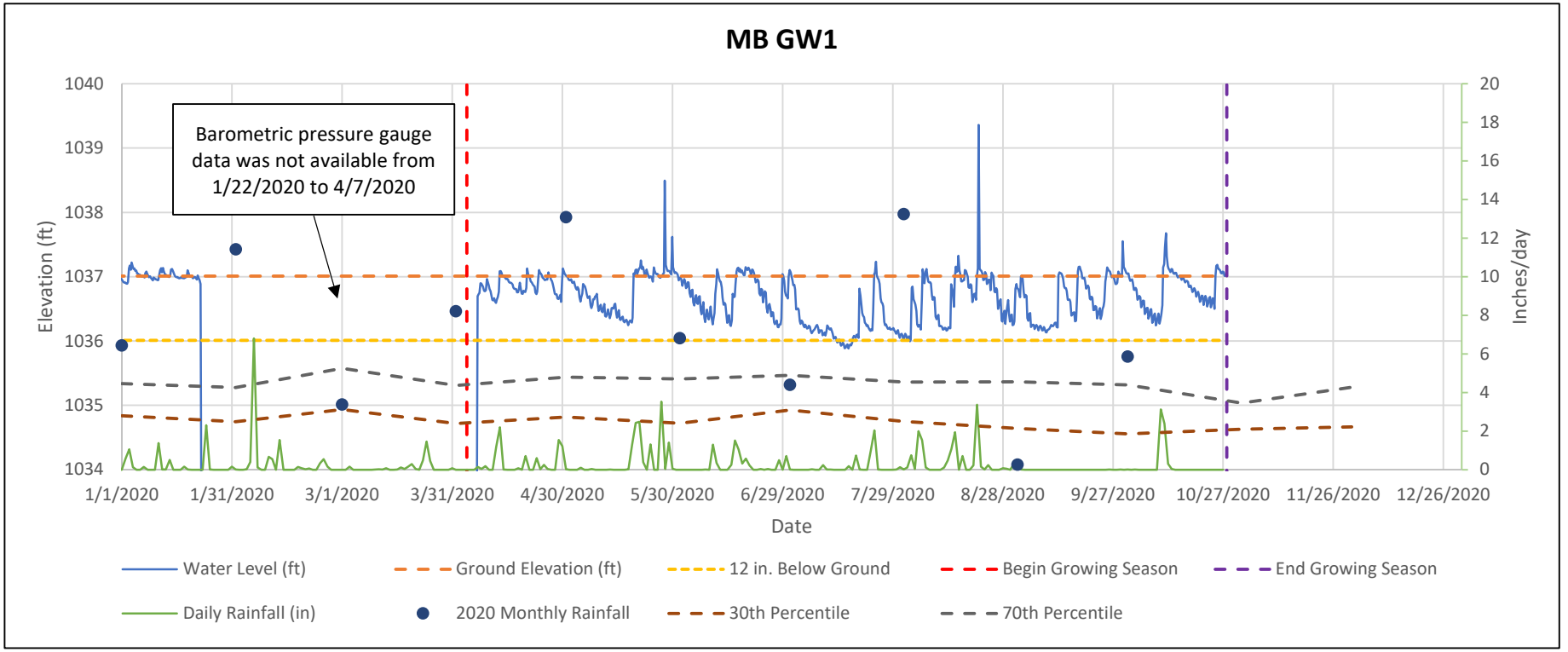
Table 7. Vegetation Performance Standards Summary Table
Meadow Brook Stream Restoration Project (NCDMS Project No. 100024)

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												
Monitoring Year 2												
Monitoring Year 1	324		5	0	850		9	0	202		5	0
Monitoring Year 0	809		6	0	1174		10	0	728		6	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												
Monitoring Year 2												
Monitoring Year 1	364		7	0	526		7	0	121		2	0
Monitoring Year 0	647		7	0	728		8	0	688		3	0
	Veg Plot 7 R				Veg Plot 8 R				Veg Plot 9 R			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	40		1	0	243		5	0	324		6	0
Monitoring Year 0												
	Veg Plot 10 R				Veg Plot 11 R				Veg Plot 12 R			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	121		2	0	162		3	0	445		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.

Meets interim Performance Criteria	Does not Meet Interim Performance Criteria

Meadow Brook Stream Restoration Project
Year 1 (2020) Groundwater Data

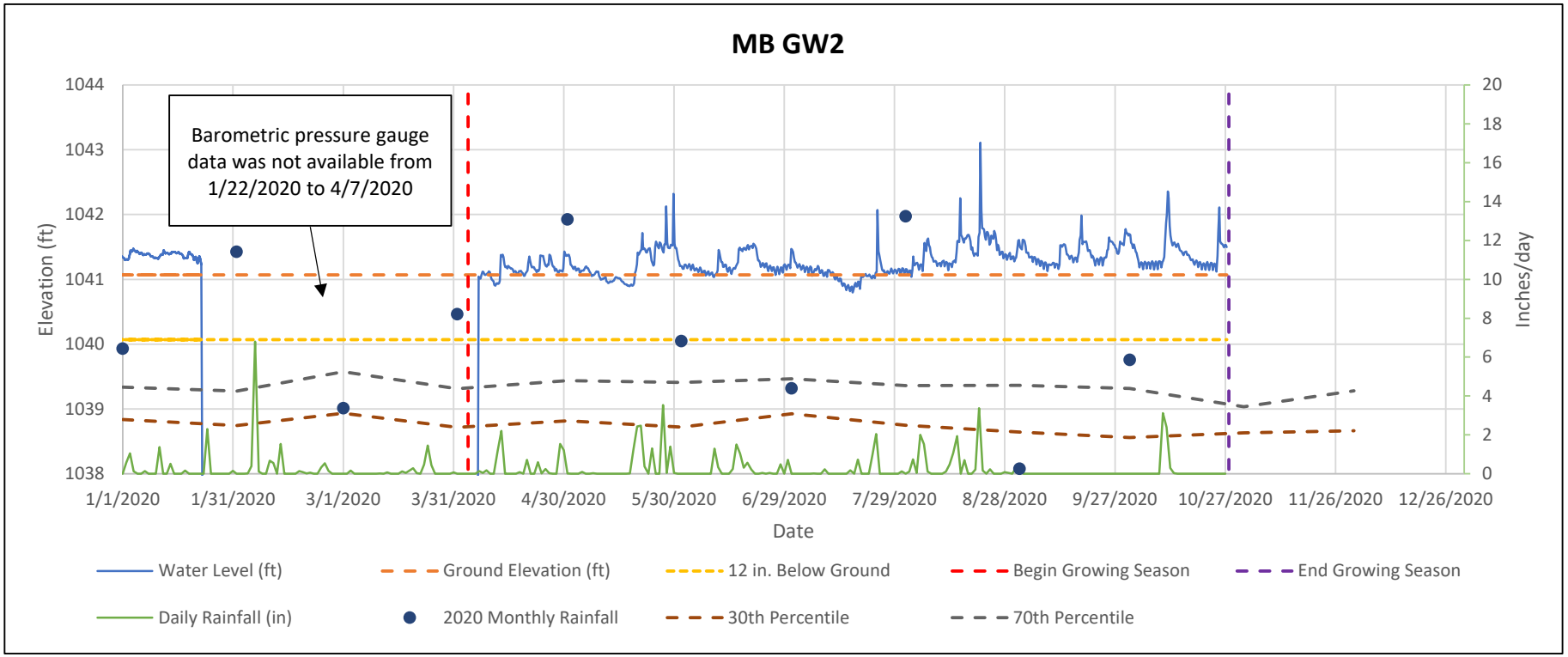


Site Info (Year 1)	
Site	Meadow Brook Stream Restoration Project
Begin Date	7/16/2019
End Date	10/28/2020
Total Days of Well Data	470

*Percentile lines in reference to WETS historic monthly rainfall data

Growing Season Information (Year 1 - 2020)		
Site		Meadow Brook Stream Restoration Project
Gauge ID		MB GW1
Serial #		20234983
Growing Season Start Date		4/4/2020
Growing Season End Date		10/28/2020
Total Growing Season Days		207
NRCS Soil Series		Dan River and Codorus
5.0%	Growing Season (Days)	10
12.5%	Growing Season (Days)	26
Most Consecutive Successful Days Within Growing Season		102
Percent of Growing Season with Consecutive Successful Days		49.3%
Average Water Level Elevation During Growing Season (ft)		1036.63
Total Cumulative Successful Days Within Growing Season		202

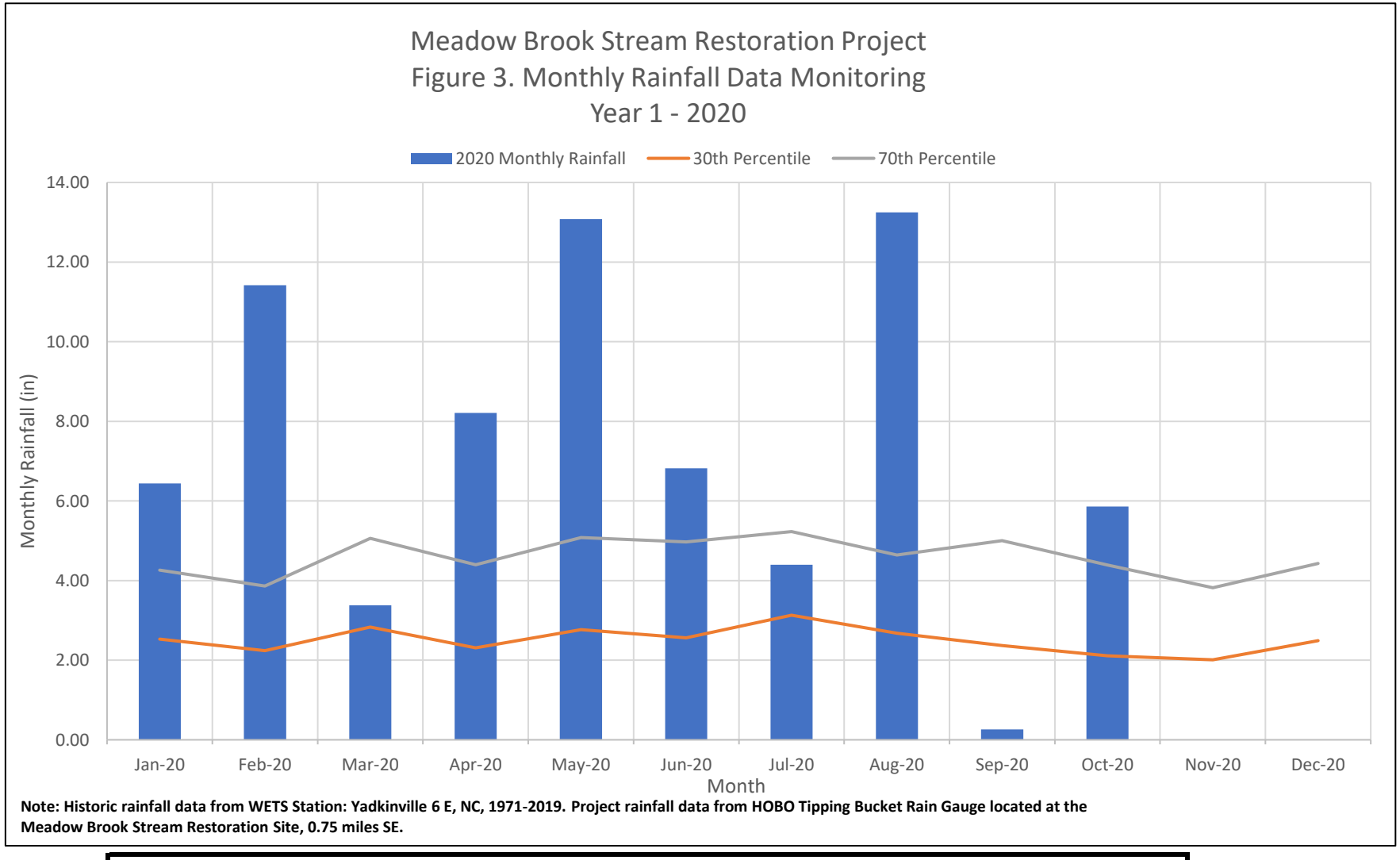
Meadow Brook Stream Restoration Site
Year 1 (2020) Groundwater Data



Site Info (Year 1)	
Site	Meadow Brook Stream Restoration Site
Begin Date	7/23/2019
End Date	10/28/2020
Total Days of Well Data	497

*Percentile lines in reference to WETS historic monthly rainfall data

Growing Season Information (Year 1 - 2020)		
Site		Meadow Brook Stream Restoration Site
Gauge ID		MB GW2
Serial #		20234986
Growing Season Start Date		4/4/2020
Growing Season End Date		10/28/2020
Total Growing Season Days		207
NRCS Soil Series		Dan River and Codorus
5.0%	Growing Season (Days)	10
12.5%	Growing Season (Days)	26
Most Consecutive Successful Days Within Growing Season		205
Percent of Growing Season with Consecutive Successful Days		99.0%
Average Water Level Elevation During Growing Season (ft)		1041.23
Total Cumulative Successful Days Within Growing Season		205



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

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

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

REVISED VEGETATION SELECTION
MEADOW BROOK ADAPTIVE MANAGEMENT PLAN, FEB 2021

Zone 2 - Riparian Wetlands Vegetation

-Riparian vegetation species shall be planted in the areas designated. The planting density will depend on availability of larger stock. If bare-root stock are used then supplemental planting will be performed to reach 680 stems/acre. If larger stock are available, high risk areas will be targeted and a lower density will be installed.
-All species will be planted according to the plans, details, and construction specifications. Not all of the species listed may be planted. A minimum of 6 species will be planted. Commercial availability may dictate which species and size are actually planted.

Scientific Name	Common Name	Maximum % by Species	Wetland Indicator Status
Alnus serrulata	Tag Alder	10%	OBL
Betula nigra	River Birch	10%	FACW
Carpinus caroliniana	American Hornbeam	10%	FAC
~~*Celtis laevigata*~~	~~Sugarberry~~	~~5%~~	~~FACW~~
Cephalanthus occidentalis	Buttonbush	10%	OBL
Diospryos virginiana	Persimmon	10%	FAC
Fraxinus pennsylvanica	Green Ash	5%	FACW
Physocarpus opulifolius	Ninebark	10%	FACW
Platanus occidentalis	Sycamore	10%	FACW
Quercus michauxii	Swamp Chestnut Oak	10%	FACW
Quercus nigra	Water Oak	5%	FAC
Quercus phellos	Willow Oak	5%	FAC
Ulmus americana	American Elm	5%	FACW
	Total	**100%**	

Zone 3 - Upland Vegetation

-Riparian vegetation species shall be planted in the areas designated. The planting density will depend on availability of larger stock. If bare-root stock are used then supplemental planting will be performed to reach 680 stems/acre. If larger stock are available, high risk areas will be targeted and a lower density will be installed.
-All species will be planted according to the plans, details, and construction specifications. Not all of the species listed may be planted. A minimum of 6 species will be planted. Commercial availability may dictate which species and size are actually planted.

Scientific Name	Common Name	Maximum	Wetland Indicator Status
Carya glabra	Pignut Hickory	10%	FACU
Carya tomentosa	Mockernut Hickory	10%	NI
~~*Cercis canadensis*~~	~~Redbud~~	~~5%~~	~~FACU~~
Cornus florida	Flowering Dogwood	15%	FACU
Diospyros virginiana	Persimmon	15%	FAC
Hamamelis virginiana	American Witch-Hazel	10%	FACU
~~*Ilex opaca*~~	~~American Holly~~	~~5%~~	~~FACU~~
~~*Juniperus virginiana*~~	~~Eastern Red Cedar~~	~~5%~~	~~FACU~~
Lindera benzoin	Spicebush	10%	FAC
Liriodendron tulipifera	Tulip Poplar	15%	FACU
~~*Oxydendrum arboreum*~~	~~Sourwood~~	~~5%~~	~~UPL~~
~~*Prunus serotina*~~	~~Black Cherry~~	~~5%~~	~~FACU~~
Quercus alba	White Oak	5%	FACU
Quercus falcata	Southern Red Oak	5%	FACU
Quercus rubra	Northern Red Oak	5%	FACU
NI = No indicator status	**Total**	**100%**	

VEGETATION SELECTION

PROJECT # 082 | SHEET NO. 3B

VEGETATION SELECTION

Temporary Seeding

Temporary herbaceous seed mixtures for the restoration site shall be planted in all disturbed areas. Temporary seed shall be applied according to the construction specifications and the information specified below.

Scientific Name	Common Name	Rate	Dates
Secale cereale	Cereal Rye Grain	130 lbs/acre	September to March (Cool Season)
Urochloa ramosa	Browntop Millet	30 lbs/acre	April to August (Warm Season)

Total Planting Area for Temporary Seeding 13.5 *acre(s)*

Zone 2 - Riparian Wetlands (Permanent Seeding)

This permanent seed mixture shall be planted in all disturbed areas as specified on the plans as **Zone 2**. This permanent seed mixture shall be applied with temporary seed, as defined in the construction specifications. Permanent seed shall be applied at a rate of **25 lbs/acre**.

Scientific Name	Common Name	% by Species	Wetland Indicator Status
Panicum virgatum	Switchgrass	23%	FAC
Elymus riparius	Riverbank Wildrye	20%	FACW
Panicum dichotomiflorum	Smooth Panicgrass	14%	FACW
Carex vulpinoidea	Fox sedge	12%	OBL
Panicum rigidulum	Redtop Panicgrass	8%	FACW
Dichanthelium clandestinum	Deer-tongue	8%	FAC
Bidens frondosa (or aristosa)	Beggars Tick	7%	FACW
Juncus effusus	Soft Rush	4%	FACW
Persicaria pensylvanica	Pennsylvania smartweed	2%	FACW
Sparganium americanum	American Bur Reed	2%	OBL
	Total	**100%**	

Total Planting Area for Permanent Seeding: 10.3 acre(s)

Zone 3 - Uplands (Permanent Seeding)

This permanent seed mixture shall be planted in all disturbed areas as specified on the plans as **Zone 3**. This permanent seed mixture shall be applied with temporary seed, as defined in the construction specifications. Permanent seed shall be applied at a rate of **25 lbs/acre**.

Scientific Name	Common Name	% by Species	Wetland Indicator Status
Elymus virginicus	Virginia wildrye	15%	FACW
Tripsacum dactyloides	Eastern Gamma Grass	13%	FACW
Agrostis scabra	Rough bentgrass	12%	FAC
Panicum virgatum	Switchgrass	12%	FAC
Carex vulpinoidea	Fox Sedge	10%	OBL
Tridens flavus	Purple Top	10%	FACU
Schizachyrium scoparium	Little Blue Stem	8%	FACU
Coreopsis lanceolata	Lance-Leaved Tick Seed	5%	FACU
Elymus hystrix	Bottlebrush Grass	5%	UPL
Sorghastrum nutans	Yellow Indian Grass	5%	FACU
Festuca ovina var. duriuscala	Hard Fescue	4%	UPL
Rudbeckia hirta	Black-Eyed Susan	1%	FACU
	Total	**100%**	

Total Planting Area for Permanent Seeding: 0.9 acre(s)

Zone 4 - Areas Outside of Easement (Permanent Seeding)

This permanent seed mixture shall be planted in all disturbed areas as specified on the plans as **Zone 4**. This permanent seed mixture shall be applied with temporary seed, as defined in the construction specifications. Permanent seed shall be applied at the rate shown below.

Scientific Name	Common Name	Rate	Dates
Poa pratensis	Kentucky Bluegrass	1 lb/1,000 sq.ft.	August - September (Cool Season)
Schedonorus arundinaceus	Tall Fescue	5 lb/1,000 sq.ft.	
	Total	6 lbs/1,000 sq.ft	

Total Planting Area for Permanent Seeding: 3.3 acre(s)

Zone 1 - Live Staking (Stream Banks)

Live stakes will be installed along all stabilized bank areas, as indicated on the planting plan sheets, details, and according to the construction specifications. Live stake all disturbed banks with a single row at a **1,742 live stakes per acre (5' x 5' spacing).** Not all of the species listed may be planted. Commercial availability may dictate which species are actually planted.

Scientific Name	Common Name	% by Species	Approx. Number of Stems	Wetland Indicator Status
Cornus amomum	Silky dogwood	40%	766	FACW
Salix sericea	Silky willow	30%	575	OBL
Salix nigra	Black willow	20%	383	OBL
Sambucus canadensis	Elderberry	10%	192	FAC
	Total	**100%**	1916	

Total Planting Area for Livestakes 1.1 **acre(s)**

Zone 2 - Riparian Wetlands Vegetation

Riparian vegetation species (bare-roots) shall be planted in the areas designated on the plans using the species mixture and percentages listed below. Riparian species shall be planted at an overall density of **680 stems per acre (8' x 8' spacing)**. All species will be planted according to the plans, details, and construction specifications. Not all of the species listed may be planted - a minimum of 6 species will be planted. Commercial availability may dictate which species are actually planted.

Scientific Name	Common Name	% by Species	Wetland Indicator Status
Betula nigra	River Birch	20%	FACW
Celtis laevigata	Sugarberry	5%	FACW
Diospryos virginiana	Persimmon	10%	FAC
Fraxinus pennsylvanica	Green Ash	10%	FACW
Platanus occidentalis	Sycamore	20%	FACW
Quercus nigra	Water Oak	10%	FAC
Quercus phellos	Willow Oak	15%	FAC
Ulmus americana	American Elm	10%	FACW
	Total	**100%**	

Total Planting Area for Riparian Vegetation 9.2 **acre(s)**

Zone 3 - Upland Vegetation

Upland vegetation species (bare-roots) shall be planted in the areas designated on the plans using the species mixture and percentages listed below. Species shall be planted at an overall density of **680 stems per acre (8' x 8' spacing)**. All species will be planted according to the plans, details, and construction specifications. Not all of the species listed may be planted - a minimum of 6 species will be planted. Commercial availability may dictate which species are actually planted.

Scientific Name	Common Name	% by Species	Wetland Indicator Status
Carya glabra	Pignut Hickory	10%	FACU
Carya tomentosa	Mockernut Hickory	10%	NI
Cercis canadensis	Redbud	5%	FACU
Cornus florida	Flowering Dogwood	5%	FACU
Diospyros virginiana	Persimmon	10%	FAC
Ilex opaca	American Holly	5%	FACU
Juniperus virginiana	Eastern Red Cedar	5%	FACU
Liriodendron tulipifera	Tulip Poplar	10%	FACU
Oxydendrum arboreum	Sourwood	5%	UPL
Prunus serotina	Black Cherry	5%	FACU
Quercus alba	White Oak	10%	FACU
Quercus falcata	Southern Red Oak	10%	FACU
Quercus rubra	Northern Red Oak	10%	FACU
NI = No indicator status	**Total**	**100%**	

Total Planting Area for Upland Vegetation 0.9 **acre(s)**

REVISIONS				
NO.	DESCRIPTION	ENGR.	APPROV.	DATE
1	DRAFT MITIGATION PLAN	CJ	KLT	3/2/18
2	FINAL MITIGATION PLAN	CJ	KLT	9/10/18
3	LAND QUALITY PERMITTING	CJ	KLT	10/24/18
4	CONSTRUCTION PLAN SET	CJ	KLT	12/7/18

PREPARED FOR:
NC Mitigation Services
NC DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

MEADOW BROOK
YADKIN COUNTY, NC

PREPARED IN THE OFFICE OF:
ECOSYSTEM PLANNING & RESTORATION
559 JONES FRANKLIN RD. SUITE 150
RALEIGH, NC 27606
LICENSE # P-1182

PROJECT ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 043187 ENGINEER
CIDNEY L. JONES
12-10-18

12/6/2018
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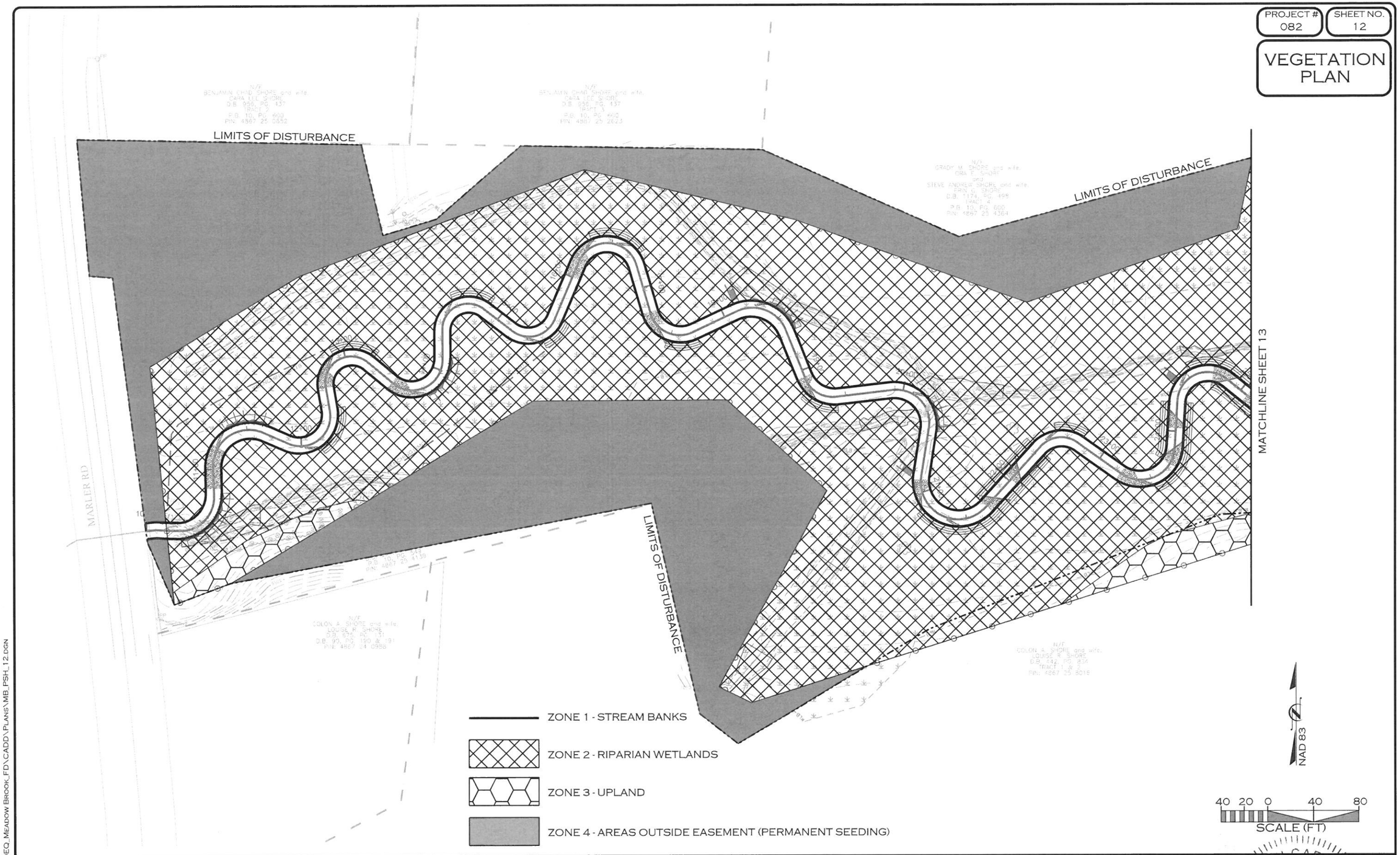
PROJECT # 082 | SHEET NO. 12

VEGETATION PLAN



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DIVISION OF MITIGATION SERVICES
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RALEIGH, NC 27699-1652

MEADOW BROOK
YADKIN COUNTY, NC

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LICENSE # P-1182

PROJECT ENGINEER
NORTH CAROLINA PROFESSIONAL SEAL 043187 ENGINEER CIDNEY J. JONES
12-10-18

12/6/2018
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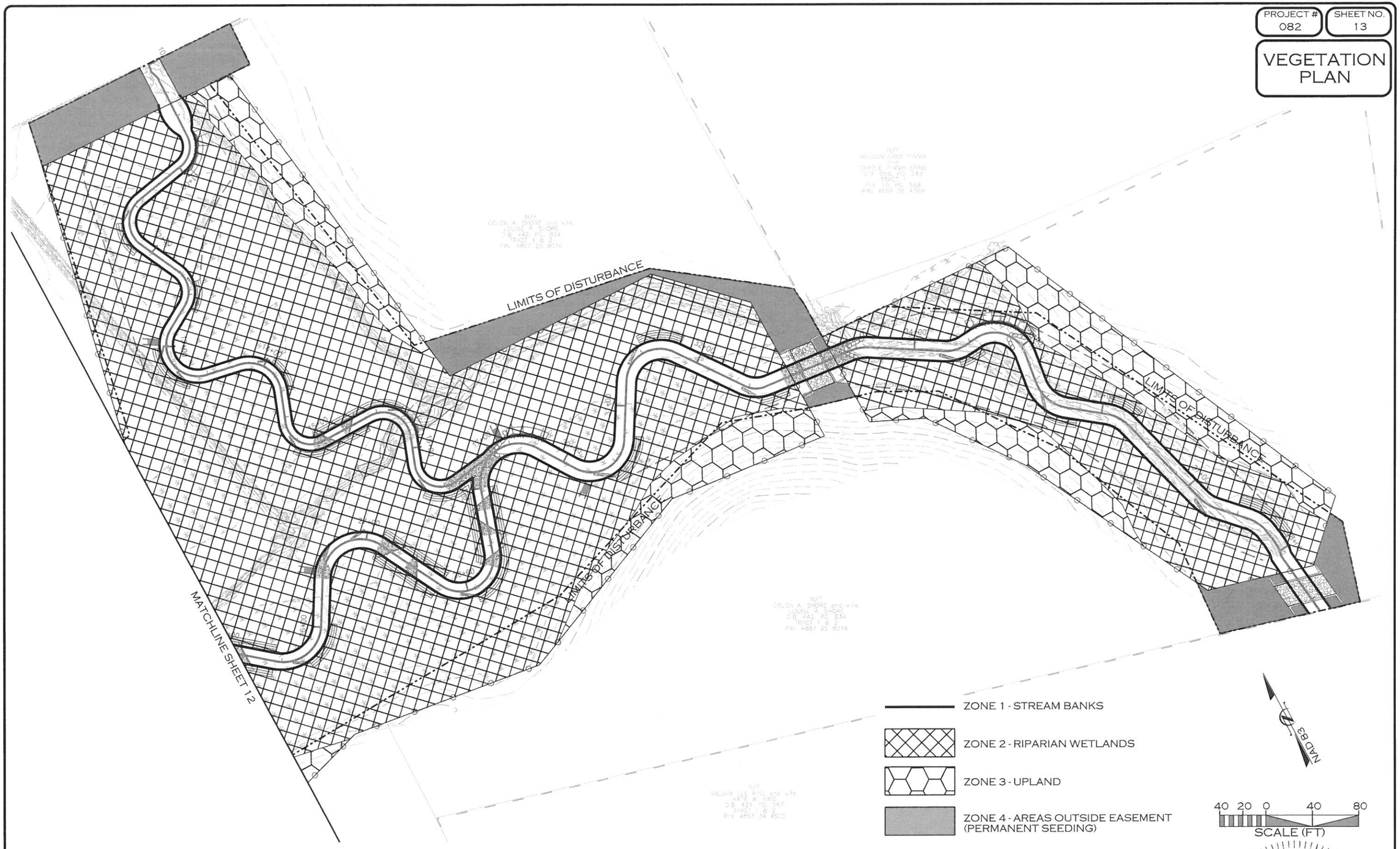
PROJECT # 082 | SHEET NO. 13

VEGETATION PLAN



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4	CONSTRUCTION PLAN SET	CJ	KLT	12/7/18

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12-10-18

12/6/2018
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From:	Jake Byers
To:	Browning, Kimberly D CIV USARMY CESAW (USA); Davis, Erin B
Cc:	Cidney Jones; Russell Myers; Tsomides, Harry; NCDENR NCEEP (Paul.wiesner@ncdenr.gov)
Subject:	Meadow Brook groundwater gage
Date:	Tuesday, March 9, 2021 11:38:55 AM

Hi Kim,

Good to speak with you this morning.

Per our conversation, this email documents that USACE approves of not re-installing the washed out groundwater gage (MB GW #2) at the Meadowbrook site since current data already shows groundwater at or near the surface during 100% of the growing season. In-lieu of re-installing the gage, EPR will re-delineate the wetland boundaries (as already provided for in the approved mitigation plan) at the end of the monitoring period to document no loss of wetlands. Please let me know if you have any questions.

Thanks,

-Jake

ECOSYSTEM PLANNING & RESTORATION

Jake Byers, PE
Senior Water Resources Engineer

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