MY2 FINAL MONITORING REPORT
Buffalo Creek Tributaries Mitigation Project
Johnston County
Neuse River Basin
CU 03020201

DMS Project # 100042
DMS Contract # 7422
DMS RFP # 16-007279
USACE Action ID Number: SAW-2018-00425
DWR Project # 2018-0199 V2
Calendar Year of Data Collection: 2022

Prepared for:

North Carolina Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

Environmental Quality

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November 30, 2022

NC Department of Environmental Quality
Division of Mitigation Services
Attn: Lindsay Crocker, Project Manager
217 W. Jones Street, Suite 3000
Raleigh, NC 27609

RE: WLS Responses to NCDEQ DMS Review Comments for Task 8 Submittal, Draft Monitoring Year 2 Report for the Buffalo Creek Tributaries Mitigation Project, DMS Full-Delivery Project ID #100042, Contract #7422, Neuse River Basin, Cataloging Unit 03020201, Johnston County, NC

Dear Ms. Crocker:

Water & Land Solutions, LLC (WLS) is pleased to present the Final Monitoring Year 2 Report for the Buffalo Creek Tributaries Mitigation Project to the North Carolina Department of Environmental Quality (NCDEQ) Division of Mitigation Services (DMS). Per the DMS review comments, WLS has updated the Final Monitoring Year 2 Report and associated deliverables accordingly. We are providing the electronic deliverables via cloud link. The electronic deliverables are organized under the following folder structure as required under the digital submission requirements:

1. Report PDF
2. Support Files
    - 1_ Tables
    - 2_CCPV
    - 3_Veg
    - 4_Geomorph
    - 5_Hydro
    - 6_Photos

We are providing our written responses to DMS' review comments on the Draft As-Built Baseline Report below. Each of the DMS review comments is copied below in **bold** text, followed by the appropriate response from WLS in regular text:

1. **Suggest adding hydroperiod label to ccpv for wetland gages in future monitoring years.** WLS Response: The hydroperiod success criteria for wetland gauges has been added to CCPVs in the final monitoring report. WLS will continue to specify the hydroperiod on the CCPV figure in future monitoring years.

2. **Suggest checking seal on GW-7 sometime before MY3 growing season to ensure bentonite still intact.** WLS Response: WLS will check seal on GW-7 before the MY3 growing season to ensure bentonite is still intact.

3. **Cross-sections: The 2016 guidance establishes that BHR should not exceed 1.2 or 10% change per year at any measured riffles, but this does not apply to pool cross-sections. Suggest revising narrative to describe that riffles have not changed.** WLS Response: The narrative has been revised to reflect the 2016 guidance at riffles.

4. **Cross section graphs (starting at page 62 in PDF) are unclear. Confirm if this is from use of DMS tool or update with clearer visual if possible.** WLS Response: Graphics were generated using the DMS tool, but visuals became unclear when condensing into PDF. Appendices are updated with clearer visuals.

5. **Growing season for groundwater gages is through 11/3. Provide hydro data through that date if possible or explain if the entire length of growing season was used for calculations (i.e. did WLS assume worse case/no saturation from 9/14 on and use the total number of days for the denominator?).** WLS Response: The entire length of the growing season was used for calculations. WLS assumed no saturation from 9/14 through 11/3 to calculate the Hydroperiod, using the total number of days as the denominator to calculate percent of growing season.

6. **Update rain data (monthly totals) to include Oct/Nov/Dec 2021 to show antecedent moisture conditions if possible.** WLS Response: Rain data is updated to show monthly rainfall totals for Oct/Nov/Dec 2021.

Electronic Comments:

1. **The CCPV and shapefile submitted indicated .33 acres of invasives present on the site, however the vegetation visual assessment lists 0% invasives. Please rectify the data discrepancy or update report.** WLS Response: The vegetation visual assessment should have listed 0.33 acres of invasives present on the site. The final monitoring report has been updated to reflect this change.

2. **The stream and groundwater gauge graphs are missing from this submission.** WLS Response: The hydrology graphs are provided in the Hydro folder.

3. **Please note that the stream visual assessment table is to be filled out on a per segment basis for future submissions.** WLS Response: The stream visual assessment tables have been updated per segment.

Please contact me if you have any questions or comments.

Sincerely,

Water & Land Solutions, LLC

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Table of Contents

LIST OF APPENDICES

1 Project Summary

1.1 Project Location and Description

The Buffalo Creek Tributaries Mitigation Project ("Project") is a North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) full-delivery stream and wetland mitigation project contracted with Water & Land Solutions, LLC (WLS) in response to RFP 16-007279. The Project will provide stream and wetland mitigation credits in the Neuse River Basin (Cataloging Unit 03020201). The project site is in Johnston County, North Carolina, between the Town of Wendell and the Community of Archer Lodge. The Project is in the Lower Buffalo Creek Priority Sub-watershed 030202011504, study area for the Neuse 01 Regional Watershed Plan Phase II, Final Report (RWP), and in the Targeted Local Watershed 03020201180050, of the Neuse River Basin.

The Project involved the restoration, enhancement, and preservation of eight stream reaches (MS-R1, MS-R2, R3 (upper), R3 (lower), R4, R5 (upper), R5 (lower), and R6) with designed totals of approximately 5,029 linear feet of streams. The Project also includes riparian wetland restoration (re-establishment) and enhancement of approximately 3.495 acres. The Project provides significant ecological improvements and functional uplift through stream and wetland restoration and will decrease nutrient, and sediment loads within the watershed. See Section 2 for a detailed benefits summary and Table 1 for a summary of project assets. Figure 1a illustrates the project mitigation components.

Prior to construction, many of the existing streams were incised and degraded due to excess bank erosion and increased stormwater flows. Wetland hydrology was drained across the floodplain and areas mapped with hydric soils. The existing vegetation within the riparian corridor consists of mixed hardwood forest with some disturbed pine forest. Adjacent land use consists of agriculture, silviculture, and residential development.

Monitoring Year 2 (MY2) activities occurred during August and September 2022. This report presents the data for MY2. The Project meets the MY2 success criteria for stream hydrology, stream horizontal and vertical stability, and streambed condition and stability. Of the eight vegetation plots, one is not meeting interim success criteria. Four of the seven wetlands met success criteria for hydrology. Based on these results, the Project is on trajectory to meet interim and final success criteria. For more information on the chronology of the project history and activity, refer to Appendix E. Relevant project contact information is presented in Appendix E and project background information is presented in Table 3.

1.2 Project Quantities and Credits

The Project mitigation components include a combination of Stream Restoration, Enhancement and Preservation activities, as well as Riparian Wetland Re-establishment and Enhancement, as summarized in the table below.

Table 1. Buffalo Creek Tributaries Mitigation Project (DMS# 100042) Project Mitigation Quantities and Credits

Project Segment	Original Mitigation Plan Ft/Ac	As-Built Ft/Ac	Original Mitigation Category	Original Restoration Level	Original Mitigation Ratio (X:1)	Credits	Comments
Stream							
MS-R1	1543	1538	Warm	R (PI)	1.00000	1,543.000	Full channel restoration, planted buffer, permanent conservaiton easement
MS-R2	1351	1337	Warm	R (PI)	1.00000	1,351.000	Full channel restoration, planted buffer, permanent conservaiton easement
R3 (upper)	565	577	Warm	P	10.00000	56.500	Preservation of existing channel, permanent conservation easement
R3 (lower)	116	99	Warm	R (PI)	1.00000	116.000	Full channel restoration, planted buffer, permanent conservaiton easement
R4	459	499	Warm	EI	1.50000	306.000	Supplemental buffer planting, bank stabilization, permanent conservation easement
R5 (upper)	585	600	Warm	EI	1.50000	390.000	Supplemental buffer planting, bank stabilization, permanent conservation easement
R5 (lower)	158	171	Warm	R (PI)	1.00000	158.000	Full channel restoration, planted buffer, permanent conservaiton easement
R6	252	232	Warm	EI	1.50000	168.000	Supplemental buffer planting, bank stabilization, permanent conservation easement
Wetland							
W1	2.013	2.044	R	REE	1.00000	2.013	Planted buffer, hydrologic improvements, permanent conservation easement
W2	0.932	0.990	R	REE	1.00000	0.932	Planted buffer, hydrologic improvements, permanent conservation easement
W3	0.475	0.484	R	REE	1.00000	0.475	Planted buffer, hydrologic improvements, permanent conservation easement
WB	0.039	0.032	R	E	2.00000	0.020	Planted buffer, hydrologic improvements, permanent conservation easement
WC	0.004	0.004	R	E	2.00000	0.002	Planted buffer, hydrologic improvements, permanent conservation easement
WD	0.032	0.038	R	E	2.00000	0.016	Planted buffer, hydrologic improvements, permanent conservation easement

Project Credits

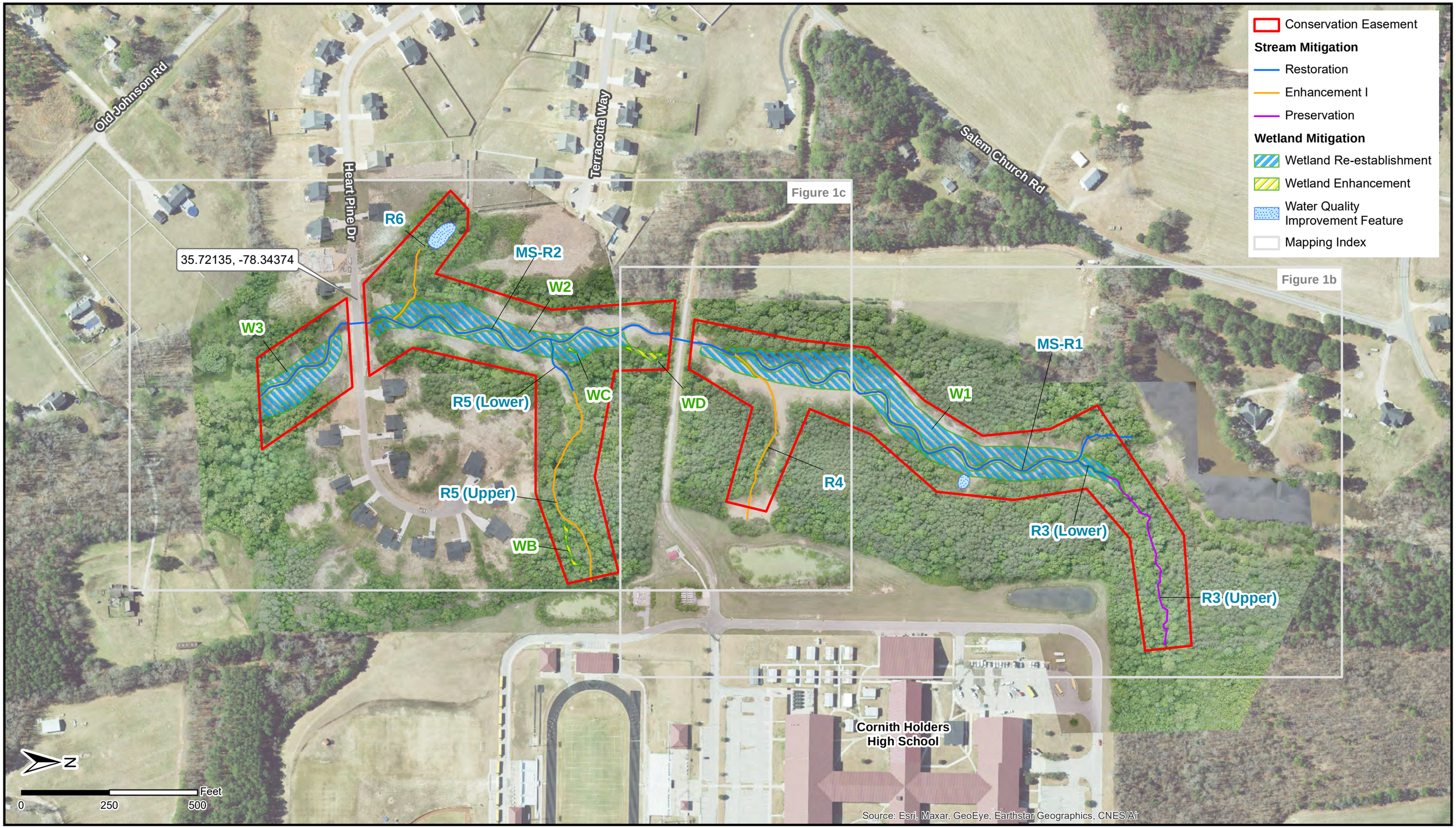
Restoration Level	Stream			Riparian Wetland	Non-Rip Wetland	Coastal Marsh
	Warm	Cool	Cold			
Restoration	3,168.000					
Re-establishment				3.420		
Rehabilitation						
Enhancement				0.038		
Enhancement I	864.000					
Enhancement II						
Creation						
Preservation	56.500					
Totals	**4,088.500**			**3.458**		

Total Stream Credit	**4,088.500**
Total Wetland Credit	**3.458**

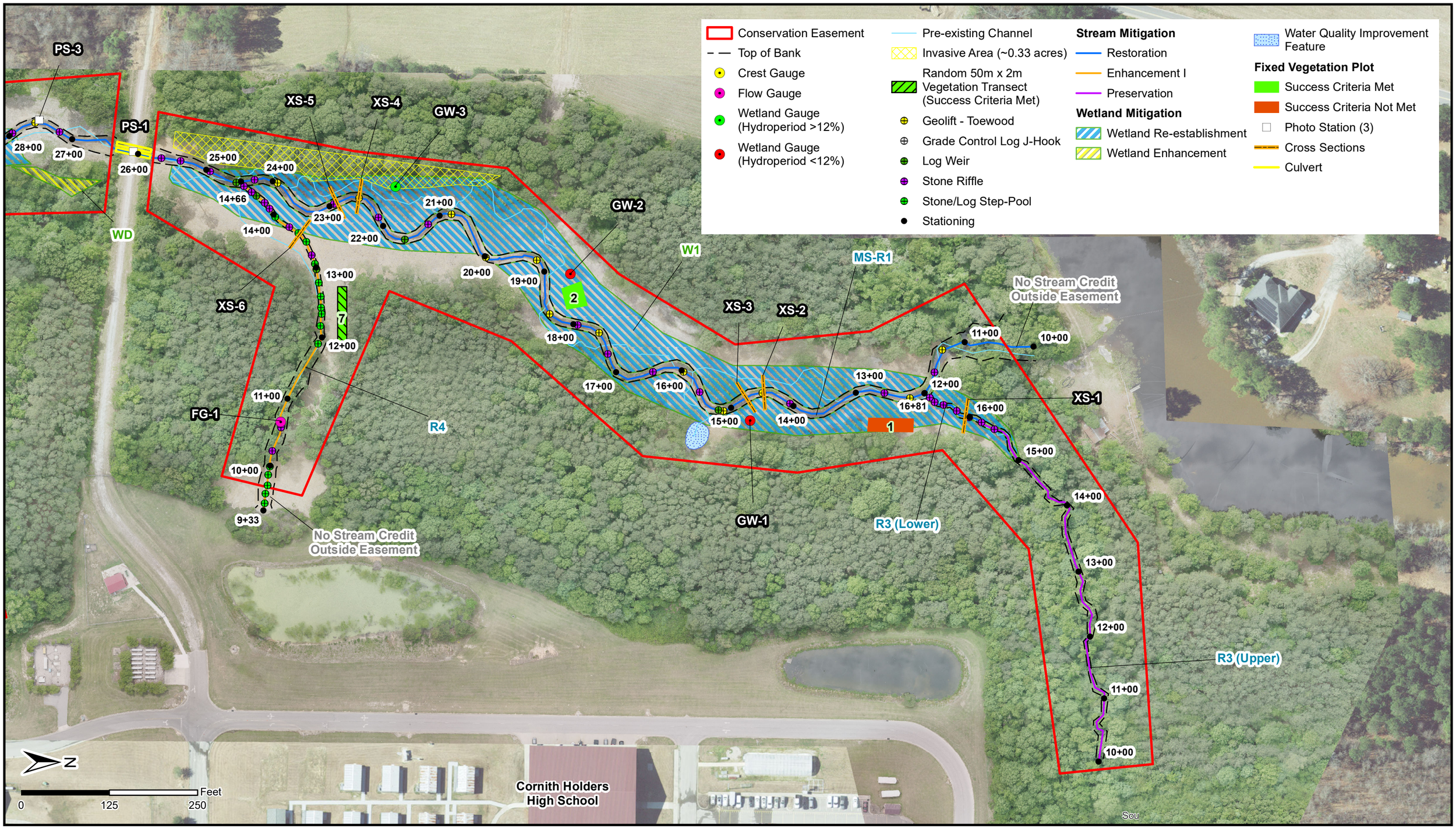
Wetland Mitigation Category			Restoration Level	
CM	Coastal Marsh		HQP	High Quality Preservation
R	Riparian		P	Preservation
NR	Non-Riparian		E	Wetland Enhancement - Veg and Hydro
			EII	Stream Enhancement II
			EI	Stream Enhancement I
			C	Wetland Creation
			RH	Wetland Rehabilitation - Veg and Hydro
			REE	Wetland Re-establishment Veg and Hydro
			R	Restoration

1.3 Current Condition Plan View

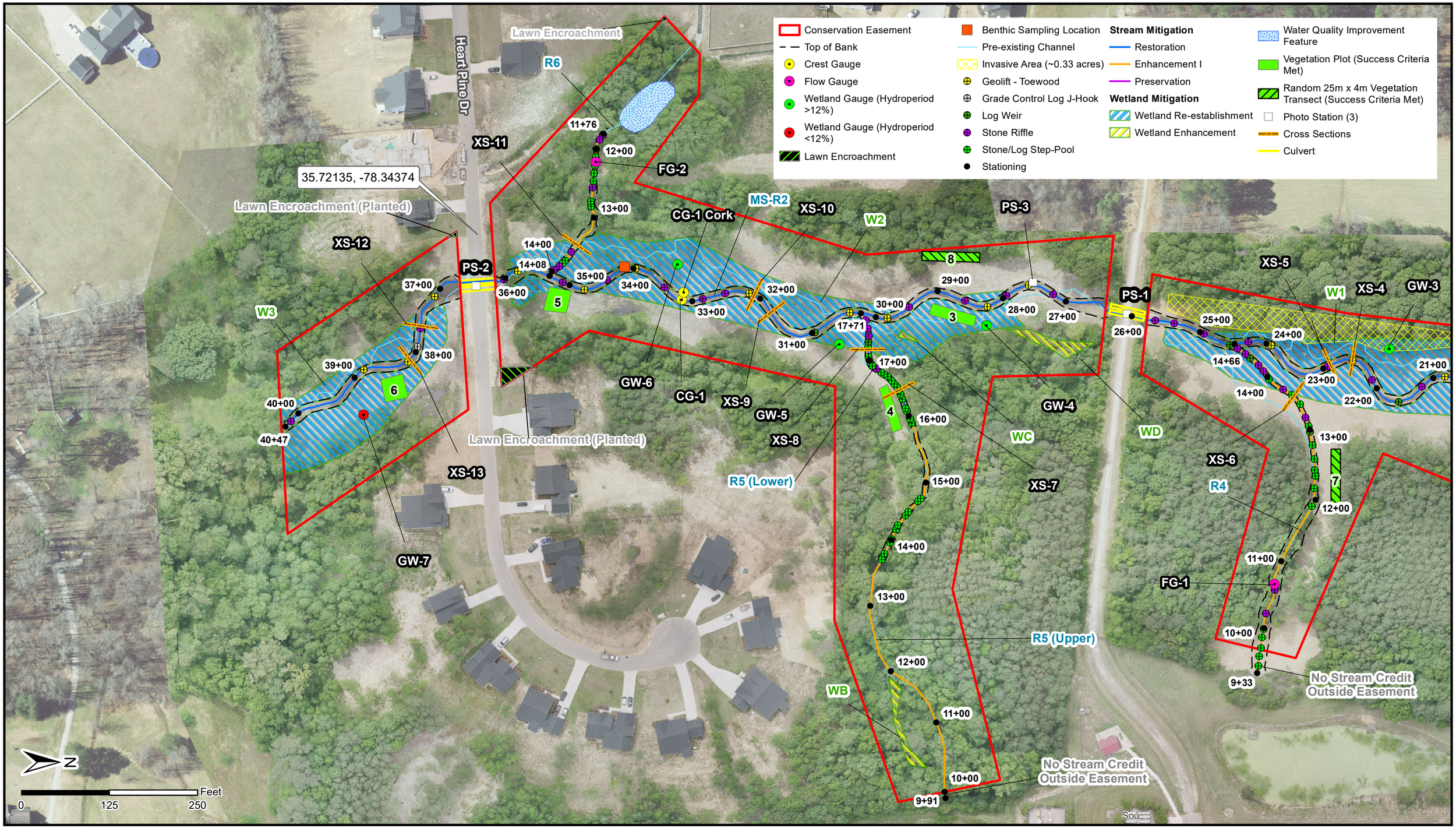
The following pages present the Current condition Plan View (CCPV).



WATER & LAND™ SOLUTIONS	NC Mitigation Services ENVIRONMENTAL QUALITY	**Buffalo Creek Tributaries Mitigation Project** **Johnston County, North Carolina**	USACE Action ID Number: SAW-2018-00425 November 2022 MY2	USACE Current Conditions Plan View Monitoring Year 2 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 1a



WATER & LAND™ SOLUTIONS	NC Mitigation Services ENVIRONMENTAL QUALITY	**Buffalo Creek Tributaries Mitigation Project** **Johnston County, North Carolina**	USACE Action ID Number: SAW-2018-00425 November 2022 MY2	USACE Current Conditions Plan View Monitoring Year 2 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE **1b**



WATER & LAND™ SOLUTIONS	NC Mitigation Services ENVIRONMENTAL QUALITY	**Buffalo Creek Tributaries Mitigation Project** **Johnston County, North Carolina**	USACE Action ID Number: SAW-2018-00425 November 2022 MY2	USACE Current Conditions Plan View Monitoring Year 2 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE **1c**

2 Goals, Performance Criteria, and Functional Improvements

2.1 Project Goals and Objectives

The Project will meet the goals and objectives described in the Buffalo Creek Tributaries Final Approved Mitigation Plan and will address general restoration goals and opportunities outlined in the DMS Neuse River Basin Watershed Restoration Priorities (RBRP). More specifically, three out of the four functional goals and objectives outlined in the Wake-Johnston Collaborative Local Watershed Plan (LWP) as well as the Neuse 01 RWP will be met by:

- Reducing sediment and nutrient inputs to the Buffalo Creek Watershed.
- Restoring, preserving, and protecting wetlands, streams, riparian buffers and aquatic habitat.
- Implementing stream restoration in rural catchments together as "project clusters."

To accomplish these project-specific goals, the following objectives will be measured to document overall project success:

- Restore stream and floodplain interaction and geomorphically stable conditions by reconnecting historic flow paths and promoting more natural flood processes;
- Improve and protect water quality by reducing streambank erosion, nutrient and sediment inputs;
- Restore and protect riparian buffer functions and habitat connectivity in perpetuity by recording a permanent conservation easement; and
- Incorporate water quality improvement features to reduce nonpoint source inputs to receiving waters.

Table 2: Summary: Goals, Performance, and Results					
Goal	**Objective/Treatment**	**Likely Functional Uplift**	**Performance Criteria**	**Measurement**	**Cumulative Monitoring Results**
Improve Stream Base Flow Duration	Improve and/or remove existing stream crossings and restore a more natural flow regime and aquatic passage.	Create a more natural and higher functioning headwater flow regime and provide aquatic passage; re-establish appropriate wetland hydroperiods and provide hydrologic storage	Maintain seasonal flow on intermittent stream for a minimum of 30 consecutive days during normal annual rainfall	2 Flow gauges (R4 and R6).	2/2 Flow gauges documented a minimum of 30 consecutive days of flow.
Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime.	Design BHRs to not exceed 1.2 and increase ERs no less than 2.2 for Rosgen 'C' and 'E' stream types and 1.4 for 'B' stream types.	Provide temporary water storage and reduce erosive forces (shear stress) in channel during larger flow events.	Minimum of four bankfull events in separate years. Wetland hydrology for 12% of growing season.	1 Crest gauge/pressure transducer (MS-R2), 7 wetland groundwater gauges (W1,W2, and W3).	1/1 Crest gauge documented bankfull events. 4/7 wetland gauges met 12% criteria.
Improve stabilty of stream channels	Construct stream channels that will maintain stable cross- sections, patterns, and profiles over time.	Reduction in sediment inputs from bank erosion, reduction of shear stress, and improved overall hydraulic function.	Bank height ratios remain below 1.2 over the monitoring period. Visual assessments showing progression towards stability.	13 Cross section surveys	13/13 cross sections BHR<1.2.
Establish Riparian Buffer Vegetation	Plant native species vegetation a minimum 50' wide from the top of the streambanks with a composition/density comparable to downstream reference condition.	Increase woody and herbaceous vegetation will provide channel stability and reduce streambank erosion, runoff rates and exotic species vegetation.	Within planted portions of the site, a minimum of 320 stems per acre must be present at year three; a minimum of 260 stems per acre must be present at year five with average height of seven feet; and a minimum of 210 stems per acre at year seven with an average height of ten feet.	Tree data for 6 permanent veg Plots and 2 Random veg transects (species & height), visual assessment	7/8 met requirements - 2022

2.2 Project Success Criteria

The success criteria for the Project will follow the approved performance standards and monitoring protocols from the final approved mitigation plan; which was developed in compliance with the USACE October 2016 Guidance, USACE Stream Mitigation Guidelines (April 2003 and October 2005), and 2008 Compensatory Mitigation Final Rule. Cross-section and vegetation plot data will be collected in Years 0, 1, 2, 3, 5, and 7. Stream hydrology data and visual monitoring will be reported annually. Specific success criteria components and evaluation methods are described below.

2.2.1 Streams

***Stream Hydrology*:** Four separate bankfull or over bank events must be documented within the seven-year monitoring period and the stream hydrology monitoring will continue until four bankfull events have been documented in separate years. Stream hydrology monitoring will be accomplished with pressure transducers installed in pools and correlating sensor depth to top of bank elevation (see appendix D for installation diagrams). Recorded water depth above the top of bank elevation will document a bankfull event. The devices will record water depth hourly and will be inspected quarterly.

The stage recorders include an automatic pressure transducer (HOBO Water Level (13 ft) Logger) set in PVC piping in the channel. The elevation of the bed and top of bank at each stage recorder location will

be recorded to be able to document presence of water in the channel and out of bank events. Visual observations (i.e. wrack or debris lines) and traditional cork crest gauges will also be used to document out of bank events.

Stream Profiles, Vertical Stability, and Floodplain Access: Stream profiles, as a measure of vertical stability and floodplain access will be evaluated by looking at Bank Height Ratios (BHR). In addition, observed bedforms should be consistent with those observed for channels of the design stream type(s). The BHR shall not exceed 1.2 along riffles within the restored Project stream reaches. This standard only applies to restored reaches of the channel where BHRs were corrected through design and construction. Vertical stability will be evaluated with visual assessment, cross-sections and, if directed by the IRT, longitudinal profile.

Stream Horizontal Stability: Cross-sections will be used to evaluate horizontal stream stability on restored streams. There should be little change expected in as-built restoration cross-sections. If measurable changes do occur, they should be evaluated to determine if the changes represent a movement toward a more unstable condition (e.g., downcutting, erosion) or a movement towards increased stability (e.g., settling, vegetation establishment, deposition along the streambanks, decrease in width/depth ratio). Cross-sections shall be classified using the Rosgen Stream Classification method and all monitored cross-sections should fall within the quantitative parameters defined for channels of the design stream type.

Stream cross-section monitoring will be conducted using a Topcon Total Station. Three-dimensional coordinates associated with cross-section data will be collected in the field (NAD83 State Plane feet FIPS 3200). Morphological data will be collected at 13 cross-sections. Survey data will be imported into Microsoft Excel® and the DMS Shiny App for data processing and analysis.

Reference photo transects will be taken at each permanent cross-section. Lateral photos should not indicate excessive erosion or continuing degradation of the streambanks. Photographs will be taken of both streambanks at each cross-section. A survey tape stretched between the permanent cross-section monuments/pins will be centered in each of the streambank photographs. The water elevation will be shown in the lower edge of the frame, and as much of the streambank as possible will be included in each photo. Photographers will attempt to consistently maintain the same area in each photo over time.

Streambed Material Condition and Stability: Streambed material should not significantly change over time and any significant changes (e.g., aggradation, degradation, embeddedness) will be noted after streambank vegetation becomes established and a minimum of two bankfull flows or greater have been documented. If significant changes are observed within stable riffles and pools, additional sediment transport analyses may be required.

Jurisdictional Stream Flow: Monitoring of stream flow will be conducted to demonstrate that the restored stream systems classified as intermittent exhibit surface flow for a minimum of 30 consecutive days throughout some portion of the year during a year with normal rainfall conditions. Stream flow monitoring will be accomplished with pressure transducers installed in pools and correlating sensor depth to the downstream top of riffle elevation (see appendix D for installation diagrams). If the pool water depth is at or above the top of riffle elevation, then the channel will be assumed to have surface flow. The devices will record water elevation twice per day and will be inspected quarterly to document surface hydrology and provide a basis for evaluating flow response to rainfall events.

2.2.2 Wetlands

Wetland Hydrology: The performance standard for wetland hydrology will be 12 percent based on the suggested wetland saturation thresholds for soils taxonomic subgroups. The proposed success criteria for wetland hydrology will be when the soils are saturated within 12 inches of the soil surface for 12 percent (27 days) of the 227-day growing season (March 21st through November 3rd) based on WETS data table for Johnston County, NC. The saturated conditions should occur during a period when antecedent precipitation has been normal or drier than normal for a minimum frequency of 5 years in 10 (USACE, 2005 and 2010b). Precipitation data will be obtained from an on-site rain gauge, installed at the Odell's House Mitigation Project, and the Clayton (CLAY) Research Weather Station, approximately nine miles southeast of the Project site. If a normal year of precipitation does not occur during the first seven years of monitoring, WLS will continue to monitor the Project hydrology until the Project site has been saturated for the appropriate hydroperiod. If rainfall amounts for any given year during the monitoring period are abnormally low, reference wetland hydrology data will be compared to determine if there is a correlation with the weather conditions and site variability.

Wetland hydrology will be monitored to document success in wetland restoration and enhancement areas where hydrology was affected. This will be accomplished with automatic pressure transducer gauges (located in groundwater wells) that record daily (twice per day) groundwater levels. The pressure transducer gauges are HOBO Water Level (13ft) Loggers made by Onset. Seven gauges will be installed within the wetland crediting areas. One automatic pressure transducer will be installed above ground for use as a barometric reference. One rain gauge will be installed at the adjacent Odell's House Mitigation Project site (0.3 miles southeast of the project) to document rainfall at the project. Gauges are downloaded quarterly and wetland hydroperiods are calculated during the growing season. Gauge installation will follow current regulatory guidance. Gauge data is downloaded using a HOBO Onset Waterproof Shuttle Data Transporter. Visual observations of primary and secondary wetland hydrology indicators will also be recorded during quarterly site visits.

2.2.3 Vegetation

Vegetation monitoring will occur in the fall each required monitoring year, prior to leaf drop. Plots will be monitored in years 1, 2, 3, 5, and 7. Vegetative success for the Project during the intermediate monitoring years will be based on the survival of at least 320, three-year-old trees per acre at the end of Year 3 of the monitoring period; and at least 260, five-year-old, trees per acre that must average seven feet in height at the end of Year 5 of the monitoring period. The final vegetative restoration success criteria will be achieving a density of no less than 210, seven-year-old stems per acre that must average ten feet in height in Year 7 of monitoring. Volunteer species on the approved planting list that meet success criteria standards will be counted towards success criteria.

Vegetation success is being monitored at a total of six permanent vegetation plots (10m x 10m or 20m x 5m) and two random vegetation transects (50m x 2m). Vegetation plot monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition and density of planted species. Data will be processed using the DMS ShinyApp. For each plot, the origin will be marked with a PVC pole and the other three corners marked with rebar. Tree species and height will be recorded for each planted stem and photos of each plot are to be taken from the origin each monitoring year.

2.2.4 Visual Assessment

WLS will conduct visual assessments in support of mitigation performance monitoring. Visual assessments of all stream reaches will be conducted twice per monitoring year with at least five months in between each site visit for each of the seven years of monitoring. Photographs will be used to visually document system performance and any areas of concern related to streambank and bed stability, condition of in-stream structures, channel migration, active headcuts, live stake mortality, invasive plant species or animal browsing, easement boundary encroachments, and general streambed conditions. Permanent photo points will be at the cross-sections and culvert crossings.

3 Project Attributes

3.1 Design Approach

The Project stream design approach included a combination of Stream Restoration, Enhancement Level I, and Preservation activities (Table 1). A Priority Level I restoration approach was incorporated with the design of both a single-thread meandering channel along the main stem (MS-R1 and MS-R2) and step-pool channels (R3, R4, R5 and R6). All non-vegetated or disturbed areas within the conservation easement were planted with native species vegetation and any areas of invasive species were removed and/or treated.

3.2 Project Attributes

See Table 3 below for Project attributes

Table 3. Project Attribute Table						
Project Name	Buffalo Creek Tributaries Mitigation Project					
County	Johnston					
Project Area (acres)	17.1					
Project Coordinates (latitude and longitude decimal degrees)	35.72275, -78.34285					
Project Watershed Summary Information						
Physiographic Province	Piedmont					
River Basin	Neuse					
USGS Hydrologic Unit 8-digit	3020201					
DWR Sub-basin	03-04-06					
Project Drainage Area (acres)	543 acres					
Project Drainage Area Percentage of Impervious Area	13%					
Land Use Classification	2.01.03, 2.01.01, 3.02 (20% cultivated crops, 9% grass/herbaceous, 48% mixed forest)					
Reach Summary Information						
Parameters	**MS-R1**	**MS-R2**	**R3 (upper and lower)**	**R4**	**R5 (upper and lower)**	**R6**
Pre-project length (feet)	1,803	1,475	701	469	766	208
Post-project (feet)	1,538	1,337	676	499	771	232
Valley confinement (Confined, moderately confined, unconfined)	moderately confined	moderately confined	unconfined	unconfined	unconfined	unconfined
Drainage area (acres)	442	543	24	30	19	25
Perennial, Intermittent, Ephemeral	Perennial	Perennial	Int/Perennial[1]	Ephemeral[2]	Perennial	Intermittent
NCDWR Water Quality Classification	C, NSW	C, NSW	C, NSW	C, NSW	C, NSW	C, NSW
Dominant Stream Classification (existing)	G4c	G4c/Incised E4	C5b (upper), G5 (lower)	G5c/C5	Incised E5 (upper), G5c (lower)	B5a
Dominant Stream Classification (proposed)	C4	C4	B4	B4	B4	B4
Dominant Evolutionary class (Simon) if applicable	III/IV	III	III	IV/V	I/III	I
Wetland Summary Information						
Parameters	**W1**	**W2**	**W3**	**WB**	**WC**	**WD**
Pre-project (acres)	N/A	N/A	N/A	0.039	0.004	0.032
Post-project (acres)	2.044	0.990	0.484	0.032	0.004	0.038
Wetland Type (non-riparian, riparian)	Riparian	Riparian	Riparian	Riparian	Riparian	Riparian
Mapped Soil Series	Wt: Wedhadkee loam	Wt: Wedhadkee loam	Wt: Wedhadkee loam	Ly: Lynchburg sandy loam	Wt: Wedhadkee loam	Wt: Wedhadkee loam
Soil Hydric Status	Hydric A	Hydric A	Hydric A	N/A	Hydric A	Hydric A

Regulatory Considerations			
Parameters	**Applicable?**	**Resolved?**	**Supporting Docs?**
Water of the United States - Section 404	Yes	Yes	404 Permit
Water of the United States - Section 401	Yes	Yes	401 Permit
Endangered Species Act	Yes	Yes	Categorical Exclusion
Historic Preservation Act	Yes	Yes	Categorical Exclusion
Coastal Zone Management Act (CZMA or CAMA)	No	N/A	N/A
Essential Fisheries Habitat	No	N/A	N/A

Note 1: Indicates that the lower section of the reach was classified as perennial and upper stream reach was classified as intermittent.
Note 2: Reach R4 is shown as a blue line stream on the USGS topographic map. The historic flow path has been piped from an existing stormwater BMP towards Reach R5 and diverted away from its natural stream valley.

4 Monitoring Year 2 Assessment and Results

The dates of Year 2 monitoring activities are detailed in Appendix E. All year 2 monitoring data is presented in this report and in the appendices. The Project is on track for meeting stream, wetland, and vegetation interim success criteria. All monitoring device locations are depicted on the CCPV (Figure 1a-c).

4.1 Morphological Assessment

Morphological data for MY2 was collected in August 2022. Refer to Appendices A and C for summary data tables, morphological plots, and stream photographs.

4.1.1 Stream Horizontal Pattern & Longitudinal Profile

The MY2 visual observations of stream horizontal pattern and longitudinal profiles closely match the design parameters and did not show any significant deviation from as-built conditions. The minor channel adjustments in riffle slopes, pool depths and pattern do not present a stability concern or indicate a need for remedial action and will be assessed visually during the annual assessments.

4.1.2 Stream Horizontal Dimension

The MY2 channel dimensions generally match the design parameters and are within acceptable and stable ranges of tolerance. Thirteen cross-sections are located in restoration and enhancement reaches across the project. Of the thirteen cross-sections, nine are located in riffles and four are located in pools. All thirteen cross-sections show little change in bankfull area, and all bank height ratios are less than 1.2. It is expected over time that some pools may accumulate fine sediment and organic matter, however, this is not an indicator of channel instability. Maximum riffle depths are also expected to fluctuate slightly throughout the monitoring period as the channels adjust to new flow regime.

4.2 Stream Hydrology

4.2.1 Stream Flow

Two pressure transducers (flow gauges) were installed in March and April 2021 on reaches R4 and R6 to document baseflow conditions. The flow gauge locations are within the upper one-third of the project reaches as shown on the CCPV. Both flow gauges exhibited flow for a minimum of 30 days in MY2. Additionally, to determine if rainfall amounts are normal for the given year, precipitation data was obtained from a rain gauge installed at Odell's House Mitigation Project (DMS #100041) less than a mile south of the Project site.

Flow Gauge Data

Flow Gauge Name	Flow Gauge Location	Longest Period of Consecutive Flow	Total Days of Cumulative Flow	Total Days of Cumulative No Flow	Longest Period of Consecutive No Flow
FG-1	R4	72 days 3/24/2022 – 6/3/2022	199 days	60 days	23 Days
FG-2	R6	156 days 1/1/2022 – 6/5/2022	164 days	95 days	27 Days

4.2.2 Bankfull Events

One crest gauge was installed in March 2021 to document bankfull events. WLS installed a conventional cork crest gauge, along with a pressure transducer to document flood status on MS-R2. During MY2, bankfull events were recorded on the pressure transducer crest gauge. CG-1 recorded five events with a maximum event of 0.945 feet above bankfull on August 12th, 2022.

4.3 Wetlands

Seven wetland groundwater wells were installed in March and April 2021 to monitor wetland hydrology. Wetland groundwater well locations are shown on the CCPV. During MY2, four of the seven wetland groundwater wells met the twelve percent wetland hydrology criteria. GW-1, GW-2, and GW-7 did not meet hydrology criteria and had hydroperiods of 10.13 percent, 10.57 percent, and 4.85 percent, respectively. GW-1 and GW-2 are close to meeting success criteria and no additional gauges are proposed at this time. An additional gauge will be installed in W3 to better capture hydrology during the winter of 2022. These areas are expected to continue to increase hydroperiod length in 2023 as groundwater continues to recharge.

4.4 Vegetation

Monitoring of the six permanent vegetation plots and two random transects was completed during September 2022. Vegetation data and photos can be found in Appendix B. The MY2 average planted density is 526 stems per acre, which exceeds the interim measure of vegetative success of at least 320 planted stems per acre at the end of the third monitoring year. Seven of the eight vegetation plots meet the interim success requirements, and the eight plots have a range of 283 - 810 stems per acre. Vegetation plot 1 is below success criteria by 1 stem, the low stem count is likely due to wetness and thick herbaceous cover. No remedial action is proposed at this time. Volunteer ironwood (*Carpinus caroliniana*), tulip poplar (*Liriodendron tulipifera*), and hazel alder (*Alnus serrulata*) were noted during monitoring year 2.

Visual assessment of vegetation outside of the monitoring plots indicates that the herbaceous vegetation is becoming well established throughout the project.

An area of concern was noted during a DMS site visit on July 2nd, 2021, of overland flow occurring along MS-R1 from an offsite BMP. This area is stable with dense herbaceous vegetation preventing soil erosion and there are no significant impacts to the floodplain or the stream (see photos in Appendix A). This area will continue to be monitored and any remedial actions will be documented in future reports.

During MY1 there were two encroachments (~0.014 acres) observed near the southernmost culvert crossing on MS-R2. Both were recently sodded/planted grassy areas adjacent to new home construction. To prevent further encroachment, the homeowners were contacted, and the easement line was more clearly marked. Encroachment planting occurred on January 6th, 2022, using one-gallon trees (see planting list below). During MY2, no further encroachments have occurred in these areas. A new encroachment (~0.0005 acres) was noted on August 18th, 2022. The landowner was contacted, and the easement was more clearly marked to prevent future mowing (see photos in Appendix A).

Supplemental Planting List

Species	Common Name	# Planted	% Planted
Quercus alba	White Oak	10	50.0%
Quercus rubra	Northern Red Oak	10	50.0%
	Total	**20**	**100.0%**

Small populations of Chinese privet (*Ligustrum sinense*) were noted within the easement during MY1 and MY2. Larger privet was cut mechanically with a brush cutter and smaller privet were treated with foliar spray. See table below for treatment information.

Invasive Species Herbicide Treatments

Monitoring Year	Invasive Targeted	Invasive Treatment	Date Treatment Conducted	Herbicide Used
1	Privet	Foliar	6/2/2021	Garlon 3A (3%)
2	Privet	Foliar	4/20/2022	Rodeo (3%)

The site will be monitored closely, and any invasive plant species will be treated as needed. Any further treatments will be documented and included in subsequent monitoring reports.

Appendix A:
Visual Assessment Data

Visual Stream Morphology Stability Assessment Table
Vegetation Condition Assessment Table
Photos: Cross-Section Photos
Photos: Stream Photo Points (Culvert Crossings, MS-R2)
Photos: Encroachment Areas and Additional Photos

Visual Stream Stability Assessment						
Reach	MS-R1					
Assessed Stream Length	1,538					
Assessed Bank Length	3,072					
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.	21	21		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)	15	15		100%

Visual Stream Stability Assessment						
Reach	MS-R2					
Assessed Stream Length	1,337					
Assessed Bank Length	2,674					
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.	19	19		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)	13	13		100%

Visual Stream Stability Assessment						
Reach	R3					
Assessed Stream Length		676				
Assessed Bank Length		1,352				
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.	10	10		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)	2	2		100%

Visual Stream Stability Assessment						
Reach	R4					
Assessed Stream Length		499				
Assessed Bank Length		998				
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.	36	36		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)	9	9		100%

Visual Stream Stability Assessment						
Reach	R5					
Assessed Stream Length		771				
Assessed Bank Length		1,542				
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.	31	31		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)	13	13		100%

Visual Stream Stability Assessment						
Reach	R6					
Assessed Stream Length	232					
Assessed Bank Length	464					
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.	27	27		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)	8	8		100%

Visual Vegetation Assessment				
Planted acreage	**6.3**			
Vegetation Category	**Definitions**	**Mapping Threshold**	**Combined Acreage**	**% of Planted Acreage**
Bare Areas	Very limited cover of both woody and herbaceous material.	0.10 acres	0.00	0.0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.10acres	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.	0.10 acres	0.00	0.0%
		Cumulative Total	0.00	0.0%
Easement Acreage	**17.1**			
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.	0.10 acres	0.33	1.9%
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.	Black with Green stripes	0.0145	

R3 Lower, XS-1, Upstream (MY-00)

R3 Lower, XS-1, Upstream (MY-02)

R3 Lower, XS-1, Downstream (MY-00)

R3 Lower, XS-1, Downstream (MY-02)

R3 Lower, XS-1, Left Bank (MY-00)

R3 Lower, XS-1, Left Bank (MY-02)

R3 Lower, XS-1, Right Bank (MY-00)

R3 Lower, XS-1, Right Bank (MY-02)

MS-R1, XS-2, Upstream (MY-00)

MS-R1, XS-2, Upstream (MY-02)

MS-R1, XS-2, Downstream (MY-00)

MS-R1, XS-2, Downstream (MY-02)

MS-R1, XS-2, Left Bank (MY-00)

MS-R1, XS-2, Left Bank (MY-02)

MS-R1, XS-2, Right Bank (MY-00)

MS-R1, XS-2, Right Bank (MY-02)

MS-R1, XS-3, Upstream (MY-00)

MS-R1, XS-3, Upstream (MY-02)

MS-R1, XS-3, Downstream (MY-00)

MS-R1, XS-3, Downstream (MY-02)

MS-R1, XS-3, Left Bank (MY-00)

MS-R1, XS-3, Left Bank (MY-02)

MS-R1, XS-3, Right Bank (MY-00)

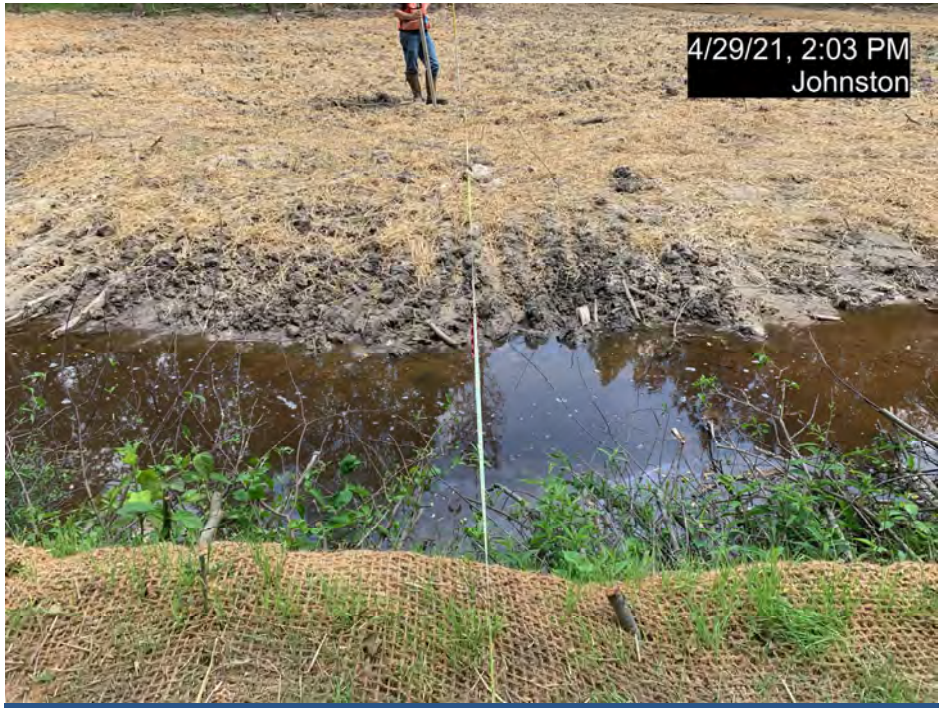
MS-R1, XS-3, Right Bank (MY-02)

MS-R1, XS-4, Upstream (MY-00)

MS-R1, XS-4, Upstream (MY-02)

MS-R1, XS-4, Downstream (MY-00)

MS-R1, XS-4, Downstream (MY-02)



MS-R1, XS-4, Left Bank (MY-00)

MS-R1, XS-4, Left Bank (MY-02)

MS-R1, XS-4, Right Bank (MY-00)

MS-R1, XS-4, Right Bank (MY-02)

MS-R1, XS-5, Upstream (MY-00)

MS-R1, XS-5, Upstream (MY-02)

MS-R1, XS-5, Downstream (MY-00)

MS-R1, XS-5, Downstream (MY-02)

MS-R1, XS-5, Left Bank (MY-00)

MS-R1, XS-5, Left Bank (MY-02)

MS-R1, XS-5, Right Bank (MY-00)

MS-R1, XS-5, Right Bank (MY-02)

R4, XS-6, Upstream (MY-00)

R4, XS-6, Upstream (MY-02)

R4, XS-6, Downstream (MY-00)

R4, XS-6, Downstream (MY-02)

R4, XS-6, Left Bank (MY-00)

R4, XS-6, Left Bank (MY-02)

R4, XS-6, Right Bank (MY-00)

R4, XS-6, Right Bank (MY-02)

R5 Lower, XS-7, Upstream (MY-00)

R5 Lower, XS-7, Upstream (MY-02)

R5 Lower, XS-7, Downstream (MY-00)

R5 Lower, XS-7, Downstream (MY-02)

R5 Lower, XS-7, Left Bank (MY-00)

R5 Lower, XS-7, Left Bank (MY-02)

R5 Lower, XS-7, Right Bank (MY-00)

R5 Lower, XS-7, Right Bank (MY-02)

R5 Lower, XS-8, Upstream (MY-00)

R5 Lower, XS-8, Upstream (MY-02)

R5 Lower, XS-8, Downstream (MY-00)

R5 Lower, XS-8, Downstream (MY-02)

R5 Lower, XS-8, Left Bank (MY-00)

R5 Lower, XS-8, Left Bank (MY-02)

R5 Lower, XS-8, Right Bank (MY-00)

R5 Lower, XS-8, Right Bank (MY-02)

MS-R2, XS-9, Upstream (MY-00)

MS-R2, XS-9, Upstream (MY-02)

MS-R2, XS-9, Downstream (MY-00)

MS-R2, XS-9, Downstream (MY-02)

MS-R2, XS-9, Left Bank (MY-00)

MS-R2, XS-9, Left Bank (MY-02)

MS-R2, XS-9, Right Bank (MY-00)

MS-R2, XS-9, Right Bank (MY-02)

MS-R2, XS-10, Upstream (MY-00)

MS-R2, XS-10, Upstream (MY-02)

MS-R2, XS-10, Downstream (MY-00)

MS-R2, XS-10, Downstream (MY-02)

MS-R2, XS-10, Left Bank (MY-00)

MS-R2, XS-10, Left Bank (MY-02)

MS-R2, XS-10, Right Bank (MY-00)

MS-R2, XS-10, Right Bank (MY-02)

R6, XS-11, Upstream (MY-00)

R6, XS-11, Upstream (MY-02)

R6, XS-11, Downstream (MY-00)

R6, XS-11, Downstream (MY-02)

R6, XS-11, Left Bank (MY-00)

R6, XS-11, Left Bank (MY-02)

R6, XS-11, Right Bank (MY-00)

R6, XS-11, Right Bank (MY-02)

MS-R2, XS-12, Upstream (MY-00)

MS-R2, XS-12, Upstream (MY-02)

MS-R2, XS-12, Downstream (MY-00)

MS-R2, XS-12, Downstream (MY-02)

MS-R2, XS-12, Left Bank (MY-00)

MS-R2, XS-12, Left Bank (MY-02)

MS-R2, XS-12, Right Bank (MY-00)

MS-R2, XS-12, Right Bank (MY-02)

MS-R2, XS-13, Upstream (MY-00)

MS-R2, XS-13, Upstream (MY-02)

MS-R2, XS-13, Downstream (MY-00)

MS-R2, XS-13, Downstream (MY-02)

MS-R2, XS-13, Left Bank (MY-00)

MS-R2, XS-13, Left Bank (MY-02)

MS-R2, XS-13, Right Bank (MY-00)

MS-R2, XS-13, Right Bank (MY-02)

PS-1 – MS-R1 Culvert Crossing, Upstream (MY-00)

PS-1 – MS-R1 Culvert Crossing, Upstream (MY-02)

PS-1 – MS-R1 Culvert Crossing, Downstream (MY-00)

PS-1 – MS-R1 Culvert Crossing, Downstream (MY-02)

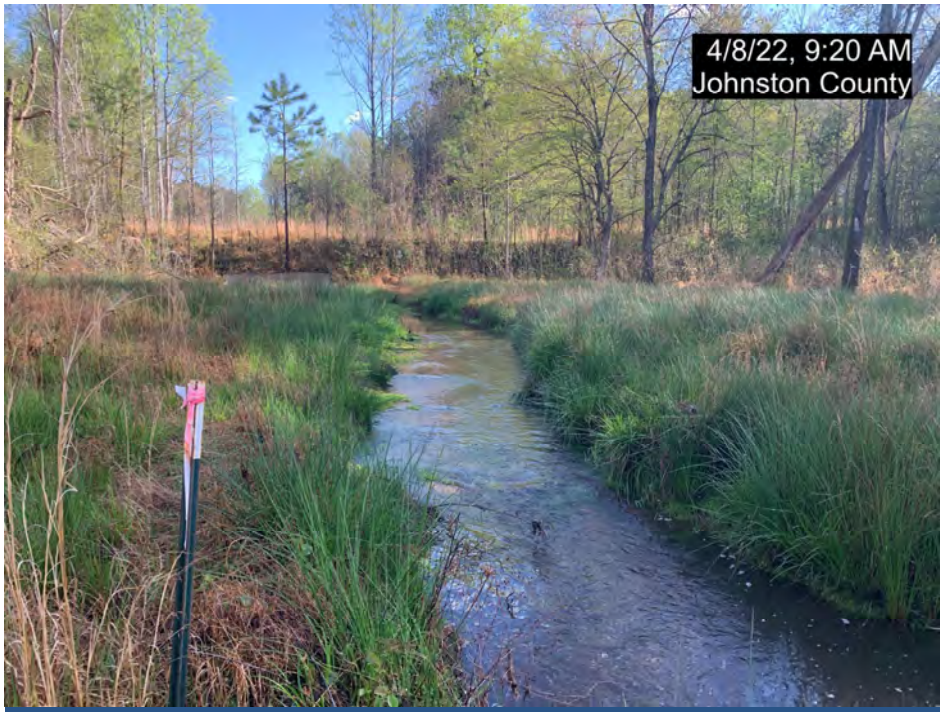
PS-2 – MS-R2 Culvert Crossing, Upstream (MY-00)

PS-2 – MS-R2 Culvert Crossing, Upstream (MY-02)

PS-2 – MS-R2 Culvert Crossing, Downstream (MY-00)

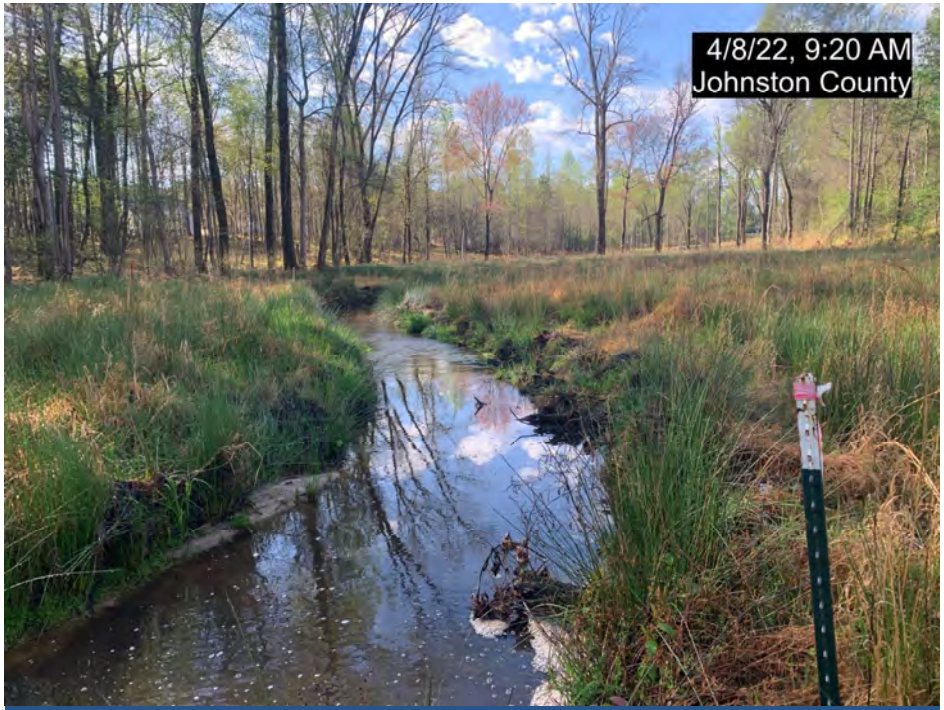
PS-2 – MS-R2 Culvert Crossing, Downstream (MY-02)

PS-3 – MS-R2, Upstream (MY-01)

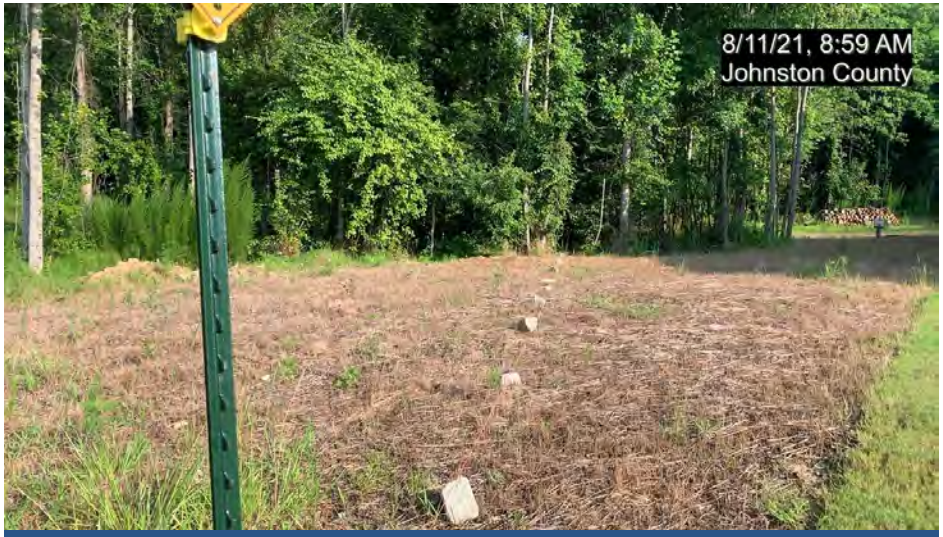


PS-3 – MS-R2, Upstream (MY-02)

PS-3 – MS-R2, Downstream (MY-01)



PS-3 – MS-R2, Downstream (MY-02)



Encroachment Area 1, MS-R2, Upstream of Culvert (MY-01)

Encroachment Area 1, MS-R2, Upstream of Culvert (MY-02)

Encroachment Area 2, MS-R2, Downstream of Culvert (MY-01)

Encroachment Area 2, MS-R2, Downstream of Culvert (MY-02)

Encroachment Area 3, R6, East of BMP (MY-02)

MS-R1, STA 15+00, BMP Overflow, Right Floodplain (MY-02)

MS-R1, STA 15+00, BMP Overflow, Right Floodplain (MY-02)

MS-R1, STA 15+00, BMP Overflow, Right Bank (MY-02)

Appendix B:
Vegetation Plot Data

Final Plant List
Vegetation Performance Standards Summary Table
Vegetation Plot Counts and Densities Table
Photos: Vegetation Plot Photos

Buffalo Creek Mitigation Project Final Planting List				
Species	**Common Name**	**Stems**	**% Planted**	**Mitigation Plan %**
Fraxinus pennsylvanica	Green Ash	132	3.00%	3%
Betula nigra	River birch	440	10.00%	10%
Tilia americana	Basswood	440	10.00%	10%
Quercus alba	White oak	440	10.00%	10%
Platanus occidentalis	American sycamore	440	10.00%	10%
Nyssa sylvatica	Black gum	440	10.00%	10%
Liriodendron tulipifera	Tulip Poplar	440	10.00%	10%
Quercus rubra	Northern red oak	440	10.00%	10%
Diospyros virginiana	Persimmon	176	4.00%	4%
Carpinus caroliniana	Ironwood	176	4.00%	4%
Hamemelis virginiana	Witch hazel	176	4.00%	4%
Asimina triloba	Pawpaw	176	4.00%	4%
Lindera benzoin	Spicebush	176	4.00%	4%
Alnus serulatta	Tag Alder	132	3.00%	3%
Corylus americana	Hazelnut	176	4.00%	4%
Total		**4,400**	**100%**	

* There were no changes of the Final Plant list from the Mitigation Plan

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	283	1	4	0	486	1	7	0	810	2	8	0
Monitoring Year 1	607	2	8	0	526	2	10	0	648	2	9	0
Monitoring Year 0	688	2	8	0	607	1	12	0	688	2	10	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	648	3	8	0	486	2	11	0	648	2	9	0
Monitoring Year 1	526	3	8	0	526	2	11	0	526	2	7	0
Monitoring Year 0	607	2	9	0	648	2	12	0	769	2	9	0
	Veg Plot Group 1 R				Veg Plot Group 2 R							
	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	324	2	3	0	526	2	4	0				
Monitoring Year 1	364	1	7	0	364	2	8	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.

Vegetation Plot Counts and Densities Table

Planted Acreage	11.17
Date of Initial Plant	2021-03-03
Date(s) of Supplemental Plant(s)	2022-01-06
Date(s) Mowing	N/A
Date of Current Survey	2022-09-16
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
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Total	Total
Species Included in Approved Mitigation Plan	Alnus serrulata	hazel alder	Tree	FACW	1	1							1	1		3		
	Asimina triloba	pawpaw	Tree	FAC					1	1	2	2			1	1		
	Betula nigra	river birch	Tree	FACW			1	1	1	1	1	1	1	1	1	1	1	
	Carpinus caroliniana	American hornbeam	Tree	FAC					1	6	1	1	1	1	2	2	8	
	Corylus americana	American hazelnut	Shrub	FACU			2	2	1	1			1	1				
	Diospyros virginiana	common persimmon	Tree	FAC	3	3	1	1					1	1				2
	Fraxinus pennsylvanica	green ash	Tree	FACW			1	1			3	3			1	1		
	Hamamelis virginiana	American witchhazel	Tree	FACU									2	2				1
	Lindera benzoin	northern spicebush	Tree	FACW			1	1					1	1				
	Liriodendron tulipifera	tuliptree	Tree	FACU			1	4			2	4	1	1		1		8
	Nyssa sylvatica	blackgum	Tree	FAC					2	2			1	1				
	Platanus occidentalis	American sycamore	Tree	FACW					7	7	2	2	1	1	3	3	2	3
	Quercus alba	white oak	Tree	FACU	1	1			1	1	1	1	1	1	1	1		
	Quercus rubra	northern red oak	Tree	FACU	2	2	2	2	1	1	2	2			3	3		
Sum	Performance Standard				7	7	9	12	15	20	14	16	12	12	12	16	11	14
Post Mitigation Plan Species	*Acer rubrum*	*red maple*	*Tree*	*FAC*				*2*				*3*						
	Liquidambar styraciflua	*sweetgum*	*Tree*	*FAC*						*3*								
	Rhus copallinum	*winged sumac*	*Tree*	*UPL*								*3*						
Sum	Proposed Standard				7	7	9	12	15	20	14	16	12	12	12	16	11	14
Mitigation Plan Performance Standard	Current Year Stem Count					7		12		20		16		12		16	11	14
	Stems/Acre					283		486		810		648		486		648	324	526
	Species Count					4		7		8		8		11		9	3	4
	Dominant Species Composition (%)					43		29		30		18		17		19	73	57
	Average Plot Height (ft.)					1		1		2		3		2		2	2	2
	% Invasives					0		0		0		0		0		0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					7		12		20		16		12		16	11	14
	Stems/Acre					283		486		810		648		486		648	324	526
	Species Count					4		7		8		8		11		9	3	4
	Dominant Species Composition (%)					43		29		30		18		17		19	73	57
	Average Plot Height (ft.)					1		1		2		3		2		2	2	2
	% Invasives					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.

Fixed Veg Plot 1 (MY-00)

Fixed Veg Plot 1 (MY-02)

Fixed Veg Plot 2 (MY-00)

Fixed Veg Plot 2 (MY-02)

Fixed Veg Plot 3 (MY-00)

Fixed Veg Plot 3 (MY-02)

Fixed Veg Plot 4 (MY-00)

Fixed Veg Plot 4 (MY-02)

Fixed Veg Plot 5 (MY-00)

Fixed Veg Plot 5 (MY-02)

Fixed Veg Plot 6 (MY-00)

Fixed Veg Plot 6 (MY-02)

Random Veg Plot 7, Facing East (MY-02)

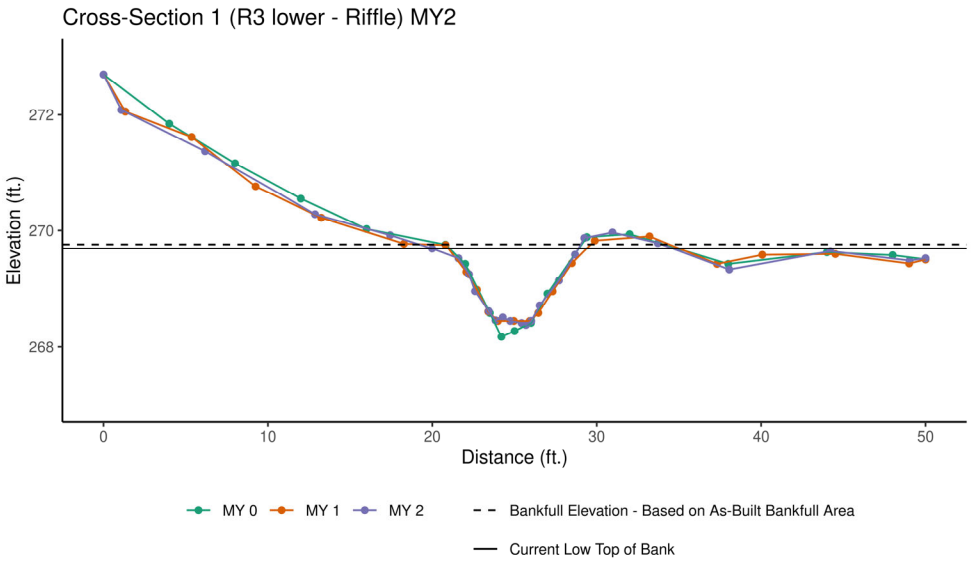
Random Veg Plot 7, Facing West (MY-02)

Random Veg Plot 8, Facing North (MY-02)

Random Veg Plot 8, Facing South (MY-02)

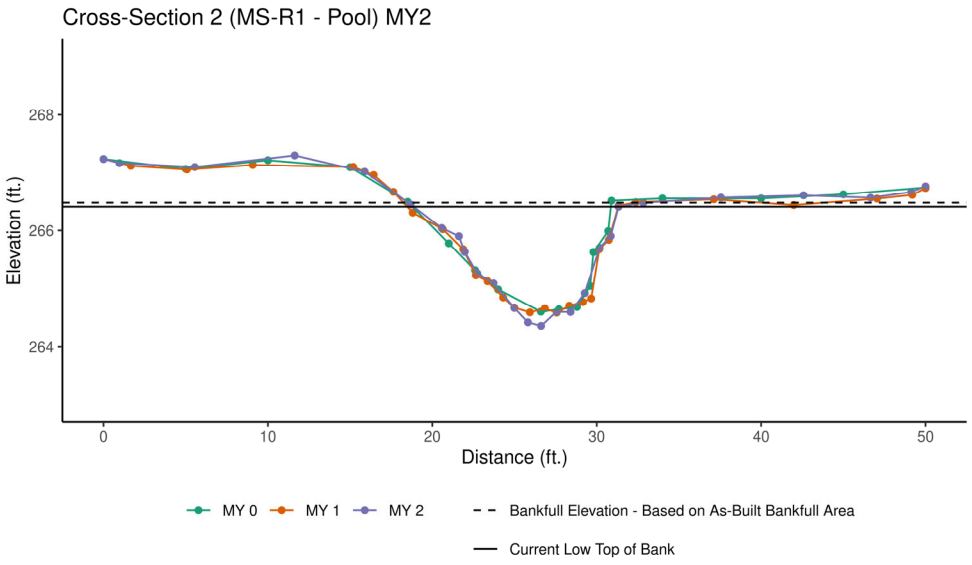
Appendix C:
Stream Geomorphology Data

MY2 Cross-Sections with Annual Overlays
Baseline Stream Data Summary Tables
Cross-Section Morphology Data



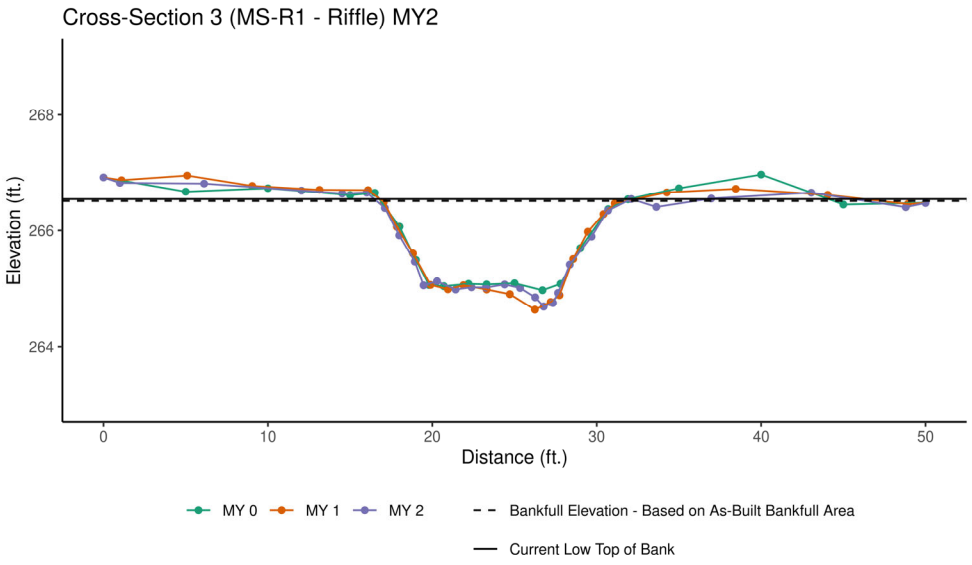
Distance	Elevation	Features
0	272.686	TLP
1.08187338	272.082	
6.175764	271.374	
12.8659063	270.276	
17.4322405	269.919	
19.9866325	269.689	TLB, BKF
21.5908811	269.522	
22.2306888	269.249	
22.5989635	268.959	
23.4283744	268.619	
23.8423183	268.46	
24.2866807	268.511	
24.7382824	268.449	
25.4332942	268.413	
25.6951086	268.381	THW
26.0158093	268.451	
26.5318912	268.714	
27.7009297	269.142	
28.680918	269.585	
29.2441478	269.87	TRB
30.9565865	269.966	
33.7165842	269.783	
38.0617289	269.331	
44.2129703	269.645	
49.0312526	269.485	
50	269.523	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	269.76	269.75	269.76					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.00	0.95					
Thalweg Elevation	268.18	268.45	268.38					
LTOB Elevation	269.76	269.75	269.69					
LTOB Max Depth	1.58	1.301	1.308					
LTOB Cross Sectional Area	6.88	6.88	6.26					



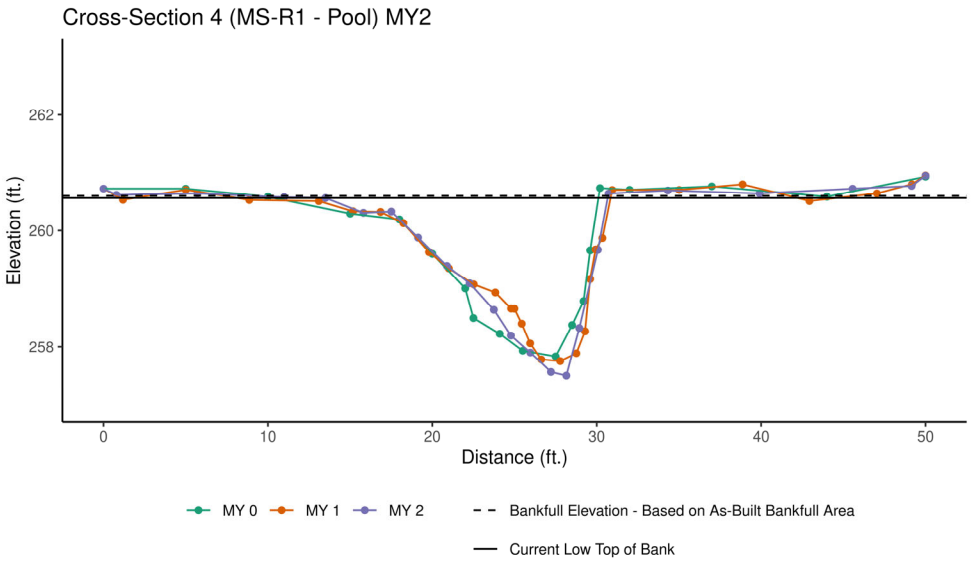
Distance	Elevation	Features
0	267.239	TLP
0.97003969	267.17	
5.55005306	267.102	
11.6275092	267.301	
15.8807711	267.022	
18.6793453	266.443	TLB
20.5703952	266.042	
21.6156051	265.901	
21.9723629	265.632	
22.7350709	265.264	
23.7210855	265.093	
24.9879354	264.672	
25.8163786	264.427	
26.6139759	264.366	THW
27.5532172	264.607	
28.4073915	264.604	
29.2674749	264.925	
30.1745705	265.702	
30.8523357	265.903	
31.3272138	266.406	TRB, BKF
32.8357361	266.473	
37.5529	266.563	
42.5808314	266.602	
46.6515827	266.561	
49.1242799	266.658	
50	266.761	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	266.51	266.46	266.47					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.01	0.97					
Thalweg Elevation	264.61	264.59	264.37					
LTOB Elevation	266.51	266.48	266.41					
LTOB Max Depth	1.9	1.891	2.04					
LTOB Cross Sectional Area	15.13	15.47	14.28					



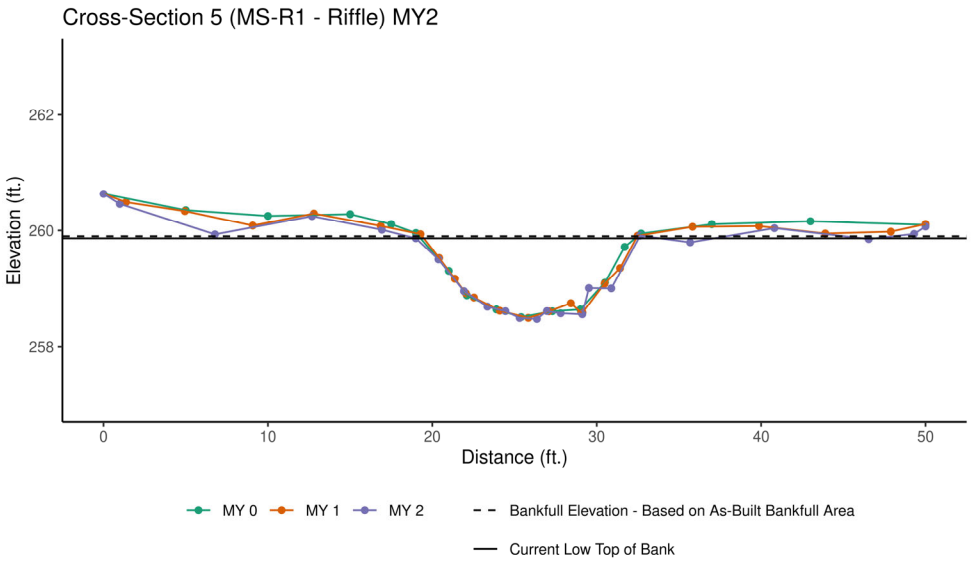
Distance	Elevation	Features
0	266.915	TLP
0.99446518	266.819	
6.11833155	266.807	
12.0397153	266.684	
14.5153819	266.633	
16.0085362	266.649	TLB
17.1117154	266.385	
17.9868171	265.916	
18.9359099	265.465	
19.4675436	265.06	
20.283028	265.129	
21.4160488	264.988	
22.3844147	265.026	
23.2481692	265.021	THW
24.39844	265.074	
25.3403011	265.013	
26.2518611	264.853	
26.7728819	264.697	
27.3365496	264.758	
27.6447193	264.928	
28.3601756	265.414	
29.6825854	265.895	
30.6801345	266.341	
32.100022	266.539	TRB, BKF
33.6258455	266.403	
36.9680985	266.548	
43.048909	266.648	
48.7982215	266.4	
50	266.471	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	266.54	266.41	266.50					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.03	1.02					
Thalweg Elevation	265.08	264.64	265.02					
LTOB Elevation	266.54	266.46	266.54					
LTOB Max Depth	1.46	1.82	1.518					
LTOB Cross Sectional Area	15.47	16.23	16.01					



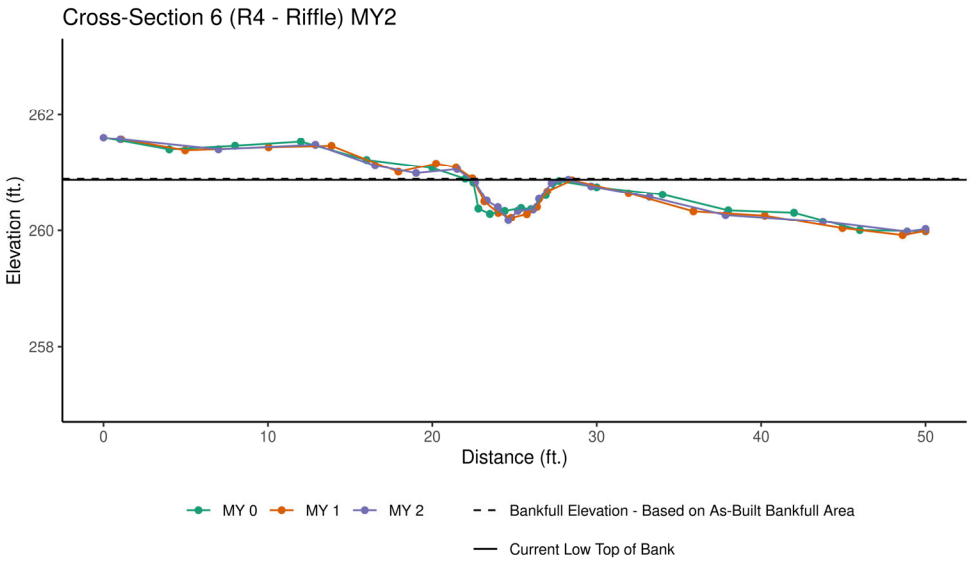
Distance	Elevation	Features
0	260.718	TLP
0.783801	260.609	
5.70971847	260.635	
10.9856907	260.57	
13.4992919	260.557	TLB, BKF
15.8097714	260.302	
17.5072181	260.323	
19.1326007	259.878	
20.8895458	259.39	
22.2659024	259.096	
23.7422932	258.64	
24.7826911	258.197	
25.9628207	257.895	
27.214127	257.56	
28.151643	257.497	THW
28.9413173	258.327	
30.0734895	259.668	
30.7153647	260.631	TRB
34.3281047	260.686	
39.9050028	260.634	
45.5634526	260.718	
49.1524453	260.765	
50	260.946	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	260.58	260.64	260.59					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.95	0.99					
Thalweg Elevation	257.83	257.75	257.50					
LTOB Elevation	260.58	260.50	260.56					
LTOB Max Depth	2.75	2.758	3.06					
LTOB Cross Sectional Area	23.69	21.24	23.06					



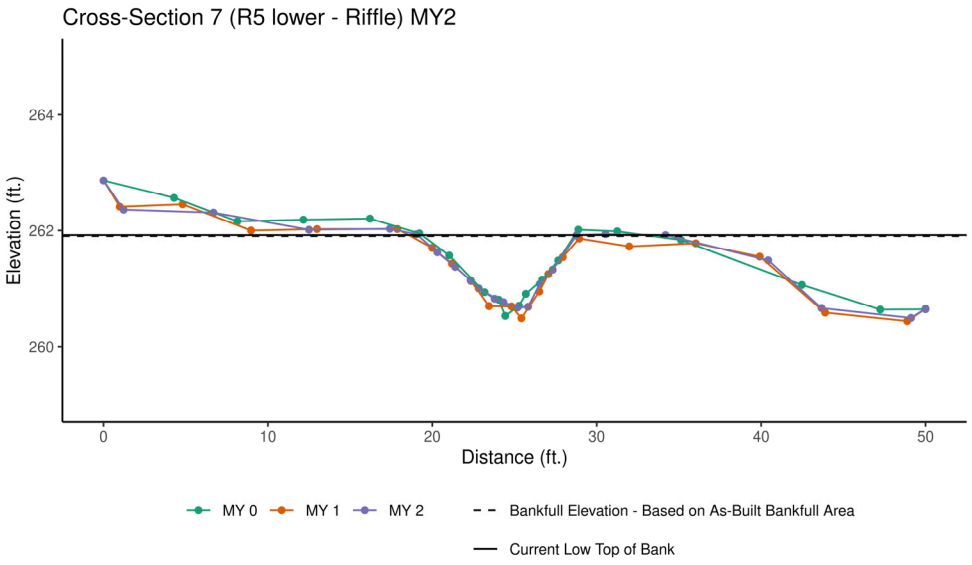
Distance	Elevation	Features
0	260.627	TLP
0.98984898	260.454	
6.77703571	259.934	
12.6815146	260.243	
16.931756	260.012	
18.9947888	259.865	TLB
20.3716333	259.505	
21.9223279	258.96	
23.3471172	258.695	
24.4446874	258.618	
25.3086079	258.502	
26.3599662	258.485	THW
26.9682048	258.619	
27.8062763	258.582	
29.1231331	258.565	
29.5247628	259.013	
30.8869363	259.008	
32.6458545	259.911	TRB, BKF
35.6819179	259.795	
40.8084458	260.04	
46.5430164	259.852	
49.3064037	259.941	
50	260.067	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	259.95	259.94	259.90					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.00	0.97					
Thalweg Elevation	258.52	258.50	258.49					
LTOB Elevation	259.95	259.94	259.87					
LTOB Max Depth	1.43	1.433	1.38					
LTOB Cross Sectional Area	12.96	12.95	12.47					



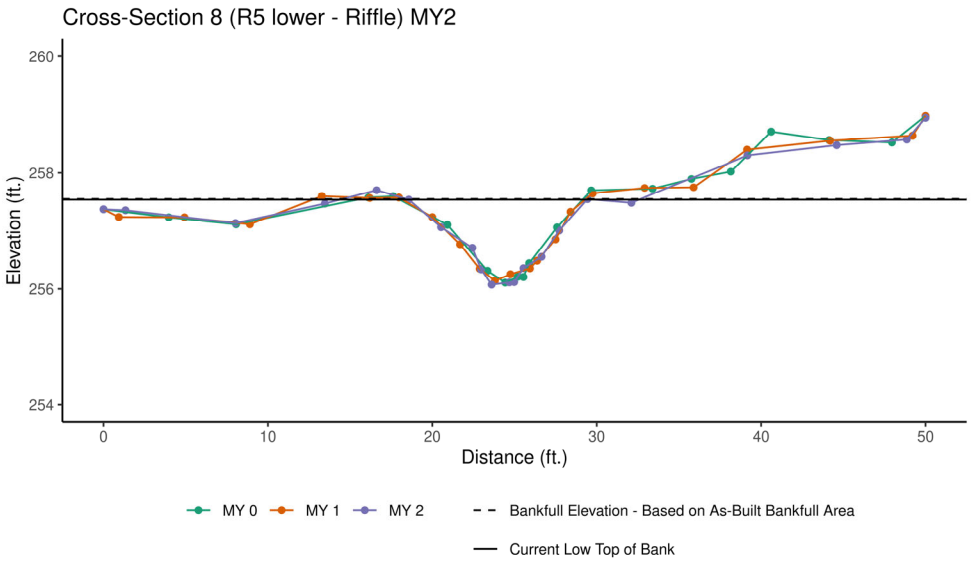
Distance	Elevation	Features
0	261.605	TLP
1.01030342	261.579	
6.99223805	261.406	
12.8869221	261.48	
16.5226381	261.128	
19.0116577	260.995	
21.5095244	261.064	TLB
22.5977023	260.828	
23.310946	260.509	
23.9872083	260.4	
24.6240475	260.175	THW
25.1963762	260.338	
26.1268823	260.36	
26.4923932	260.541	
27.2546327	260.817	
28.2736719	260.876	TRB, BKF
29.6605232	260.76	
33.2112138	260.575	
37.8346168	260.266	
43.7593029	260.152	
48.8801523	259.98	
50	260.023	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	260.86	260.84	260.89					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.05	0.97					
Thalweg Elevation	260.34	260.22	260.18					
LTOB Elevation	260.86	260.87	260.88					
LTOB Max Depth	0.52	0.648	0.701					
LTOB Cross Sectional Area	2.10	2.26	1.99					



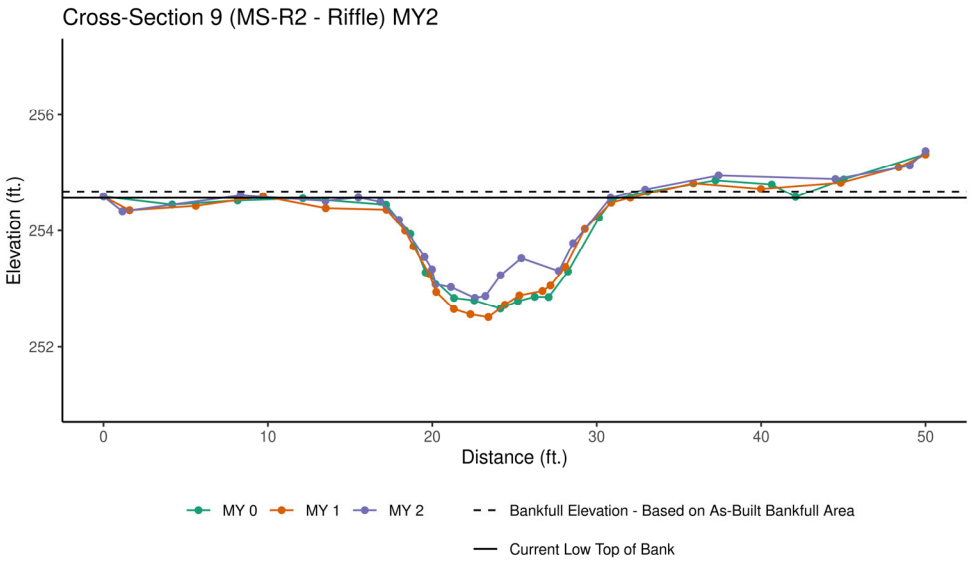
Distance	Elevation	Features
0	262.861	TLP
1.2212817	262.355	
6.68914733	262.305	
12.4993475	262.013	
17.4199013	262.029	
19.0327847	261.935	TLB
20.3059541	261.627	
21.3914093	261.375	
22.3264009	261.144	
22.8190764	261.008	
23.7880157	260.829	
24.3267248	260.77	
25.17704	260.678	THW
25.8237496	260.692	
26.5305708	261.082	
27.3225301	261.327	
28.7835766	261.921	TRB, BKF
30.5333607	261.937	
34.183153	261.92	
40.4287083	261.489	
43.6711546	260.67	
49.1181958	260.502	
50	260.659	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	261.95	261.85	261.90					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.01	1.01					
Thalweg Elevation	260.54	260.50	260.68					
LTOB Elevation	261.95	261.86	261.92					
LTOB Max Depth	1.413	1.363	1.243					
LTOB Cross Sectional Area	6.62	6.70	6.79					



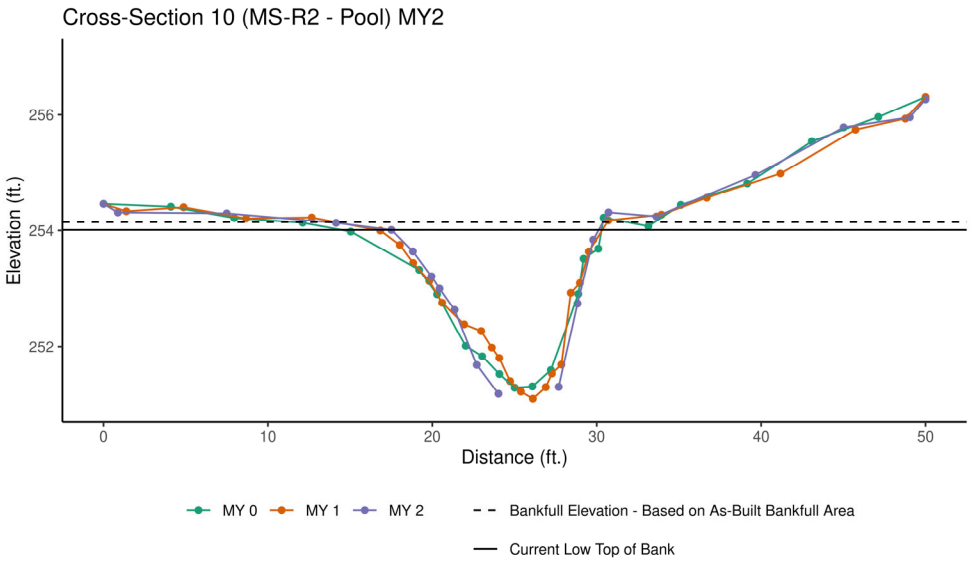
Distance	Elevation	Features
0	257.362	TLP
1.33422937	257.345	
8.02603813	257.125	
13.461125	257.46	
16.6106189	257.691	
18.5669903	257.528	TLB, BKF
20.5299562	257.056	
22.43641	256.701	
22.9661019	256.332	
23.605025	256.072	THW
24.6863316	256.111	
24.9786183	256.116	
25.546527	256.353	
26.6433764	256.55	
27.7182566	257.001	
29.4374083	257.537	TRB
32.1093139	257.474	
39.1628572	258.303	
44.5945878	258.479	
48.8602122	258.575	
50	258.944	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	257.59	257.54	257.54					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.02	0.99					
Thalweg Elevation	256.11	256.14	256.07					
LTOB Elevation	257.59	257.56	257.53					
LTOB Max Depth	1.479	1.428	1.456					
LTOB Cross Sectional Area	8.35	8.61	8.22					



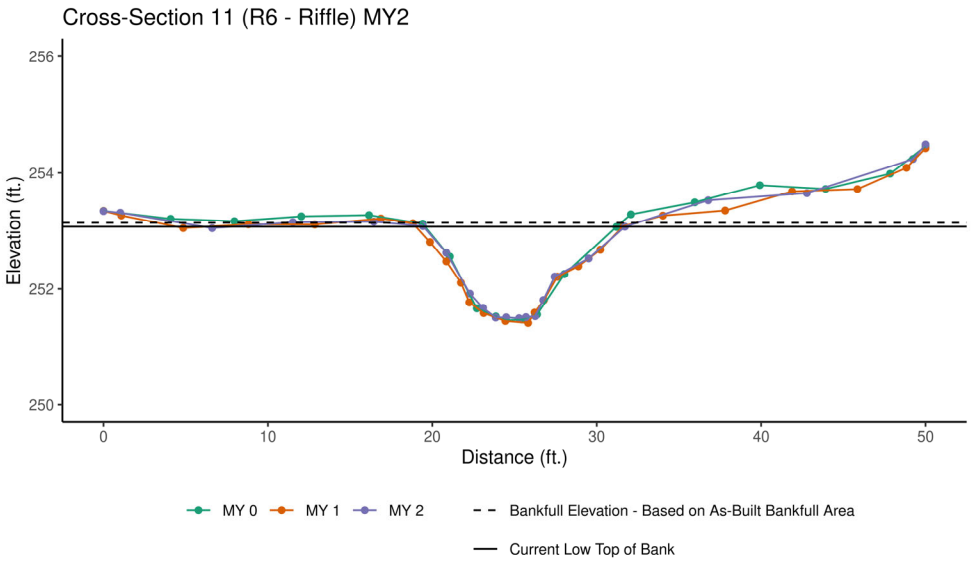
Distance	Elevation	Features
0	254.58	TLP
1.14996087	254.328	
8.33275573	254.599	
13.4992942	254.506	
15.4981818	254.563	TLB, BKF
16.8398079	254.489	
17.9735095	254.179	
19.5221286	253.546	
19.9810766	253.332	
20.194264	253.078	
21.1304504	253.031	
22.5865667	252.845	THW
23.2251188	252.877	
24.1486668	253.231	
25.415324	253.524	
27.6870666	253.304	
28.5633574	253.781	
30.8442314	254.558	TRB
32.9443746	254.705	
37.4103665	254.953	
44.5172714	254.89	
49.0451851	255.128	
50	255.373	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	254.44	254.43	254.67					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.96	0.94					
Thalweg Elevation	252.66	252.52	252.85					
LTOB Elevation	254.44	254.36	254.56					
LTOB Max Depth	1.776	1.838	1.713					
LTOB Cross Sectional Area	15.98	15.00	14.29					



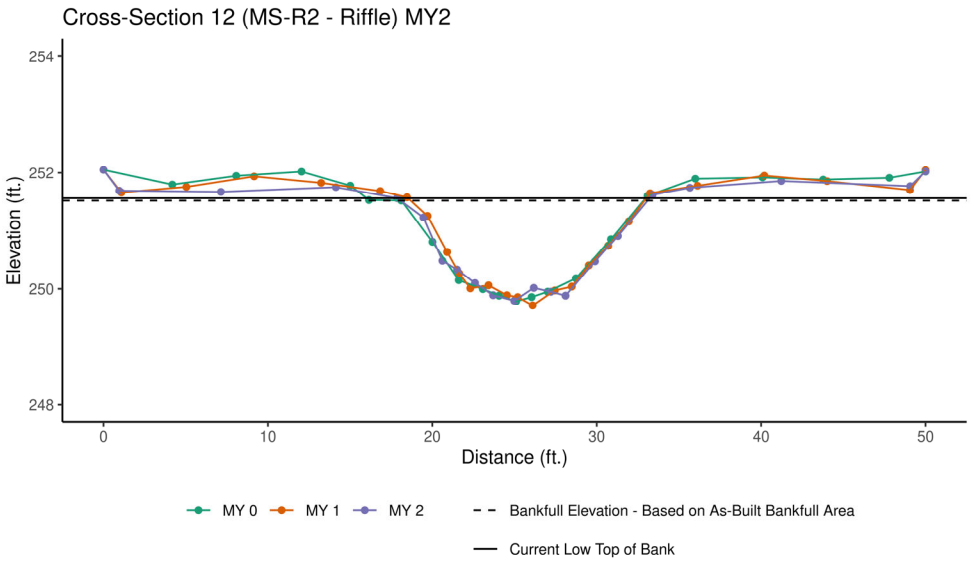
Distance	Elevation	Features
0	254.455	TLP
0.87177119	254.308	
7.4924787	254.292	
14.145009	254.13	
17.5117374	254.009	TLB. BKF
18.8150851	253.64	
19.9484233	253.212	
20.4387953	253.004	
21.354251	252.64	
22.7037267	251.679	
24.0229882	251.186	
24.9968411	250.678	
26.8822107	250.294	THW
27.6849054	251.303	
28.8317105	252.748	
29.7861351	253.839	
30.7148111	254.309	TRB
33.6351363	254.239	
39.65405	254.962	
45.0154746	255.782	
49.0427476	255.957	
50	256.261	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	254.21	254.34	254.14					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.95	0.96					
Thalweg Elevation	251.29	251.10	250.29					
LTOB Elevation	254.21	254.17	254.01					
LTOB Max Depth	2.923	3.072	3.715					
LTOB Cross Sectional Area	25.22	22.39	23.52					



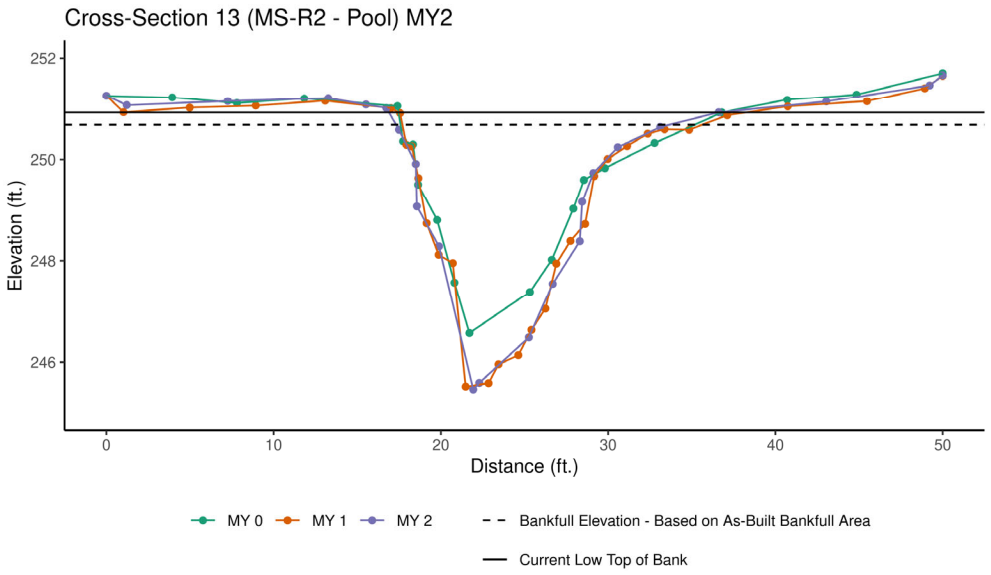
Distance	Elevation	Features
0	253.33	TLP
1.02101224	253.302	
6.60874428	253.042	
11.5197851	253.141	
16.4425224	253.15	
19.4268339	253.076	TLB, BKF
20.8520116	252.618	
22.286063	251.917	
23.0861639	251.672	
23.8531148	251.51	
24.4930711	251.513	
25.2762069	251.497	
25.6964396	251.516	
26.2557466	251.533	THW
26.7478197	251.806	
27.4428892	252.207	
29.507975	252.52	
31.7148476	253.066	TRB
36.7811727	253.517	
42.7832581	253.64	
49.2332864	254.239	
50	254.485	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	253.11	253.05	253.13					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.01	0.96					
Thalweg Elevation	251.46	251.42	251.53					
LTOB Elevation	253.11	253.07	253.07					
LTOB Max Depth	1.651	1.656	1.533					
LTOB Cross Sectional Area	11.39	11.65	10.59					



Distance	Elevation	Features
0	252.051	TLP
0.95451873	251.682	
7.1386865	251.662	
14.1328272	251.744	
17.8519293	251.554	TLB, BKF
19.4598085	251.222	
20.6132231	250.48	
21.5056584	250.328	
22.5945976	250.099	
23.6956898	249.891	
24.9851124	249.796	THW
26.1697199	250.016	
27.2073432	249.95	
28.1014764	249.883	
29.8931442	250.471	
31.2891864	250.905	
33.3937457	251.61	TRB
35.6623013	251.734	
41.2254793	251.853	
49.0678418	251.763	
50	252.024	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	251.51	251.55	251.51					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.01	1.02					
Thalweg Elevation	249.79	249.72	249.80					
LTOB Elevation	251.51	251.57	251.55					
LTOB Max Depth	1.729	1.852	1.758					
LTOB Cross Sectional Area	16.19	16.47	16.84					



Distance	Elevation	Features
0	251.258	TLP
1.21799918	251.069	
7.25465947	251.152	
13.2668662	251.211	
15.5203312	251.082	
16.736181	251.014	TLB, BKF
17.4929266	250.585	
18.5004433	249.91	
18.5631484	249.073	
19.8841091	248.286	
21.93364	245.467	THW
22.2935247	245.595	
25.2597641	246.489	
26.6866917	247.547	
28.3043654	248.384	
28.4445014	249.163	
29.1155631	249.732	
30.5779374	250.24	
33.1120723	250.637	
36.6048539	250.926	TRB
43.0408672	251.142	
49.2243942	251.466	
50	251.663	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	251.18	250.68	250.68					
Bank Height Ratio - Based on As-Built Bankfull Area	0.96	1.06	1.05					
Thalweg Elevation	247.57	245.52	245.47					
LTOB Elevation	251.05	251.01	250.93					
LTOB Max Depth	3.48	5.49	5.459					
LTOB Cross Sectional Area	35.73	45.44	43.28					

Baseline Stream Data Summary (Data Collected May 2021)
Buffalo Creek Tributaries Mitigation Project: MS-R1

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		10.6			1.0		14.0		15.1	2.0
Floodprone Width (ft)		12.5			1.0	65.0	80.0		80.0	2.0
Bankfull Mean Depth (ft)		1.6			1.0		1.2		1.1	2.0
Bankfull Max Depth (ft)		1.8			1.0		1.5		1.6	2.0
Bankfull Cross Sectional Area (ft^2)		17.2			1.0		16.5		16.2	2.0
Width/Depth Ratio		6.6			1.0		11.9		14.1	2.0
Entrenchment Ratio		1.2			1.0	4.6	5.7		3.3	2.0
Bank Height Ratio		2.6			1.0		1.0		1.0	2.0
Max part size (mm) mobilized at bankfull	84					79		87		
Rosgen Classification	G4c					C4		C4		
Bankfull Discharge (cfs)	70.0					70.0		70.0		
Sinuosity (ft)	1.36					1.22		1.19		
Water Surface Slope (Channel) (ft/ft)	0.0058					0.0065		0.0078		
Other										

Baseline Stream Data Summary
Buffalo Creek Tributaries Mitigation Project: R3 (lower)

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		7.1			1.0		5.5		8.3	1.0
Floodprone Width (ft)		22.0			1.0	20.0	25.0		43.0	1.0
Bankfull Mean Depth (ft)		0.5			1.0		0.4		0.8	1.0
Bankfull Max Depth (ft)		0.8			1.0		0.5		1.6	1.0
Bankfull Cross Sectional Area (ft^2)		3.7			1.0		2.1		6.9	1.0
Width/Depth Ratio		13.6			1.0		14.2		10.0	1.0
Entrenchment Ratio		3.1			1.0	3.6	4.6		5.2	1.0
Bank Height Ratio		1.0			1.0		1.0		1.0	1.0
Max part size (mm) mobilized at bankfull	156					125		168		
Rosgen Classification	G5					B4		B4		
Bankfull Discharge (cfs)	12.0					12.0		12.0		
Sinuosity (ft)	1.12					1.13		1.14		
Water Surface Slope (Channel) (ft/ft)	0.0362					0.0363		0.0289		
Other										

Baseline Stream Data Summary
Buffalo Creek Tributaries Mitigation Project: MS-R2

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		10.2			1.0		14.5		14.7	2.0
Floodprone Width (ft)		51.9			1.0	60.0	90.0		90.0	2.0
Bankfull Mean Depth (ft)		1.6			1.0		1.2		1.1	2.0
Bankfull Max Depth (ft)		2.3			1.0		1.6		1.7	2.0
Bankfull Cross Sectional Area (ft^2)		16.1			1.0		18.0		16.1	2.0
Width/Depth Ratio		6.4			1.0		11.7		13.4	2.0
Entrenchment Ratio		5.1			1.0	4.1	6.2		3.4	2.0
Bank Height Ratio		1.6			1.0		1.0		1.0	2.0
Max part size (mm) mobilized at bankfull	69					69		71		
Rosgen Classification	G4c/Incised E4					C4		C4		
Bankfull Discharge (cfs)	75.0					75.0		75.0		
Sinuosity (ft)	1.26					1.11		1.11		
Water Surface Slope (Channel) (ft/ft)	0.0045					0.0052		0.0059		
Other										

Baseline Stream Data Summary
Buffalo Creek Tributaries Mitigation Project: R4

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)					0.0		5.5		5.4	1.0
Floodprone Width (ft)					0.0	10.0	15.0		35.0	1.0
Bankfull Mean Depth (ft)					0.0		0.4		0.4	1.0
Bankfull Max Depth (ft)					0.0		0.6		0.9	1.0
Bankfull Cross Sectional Area (ft^2)					0.0		2.3		2.2	1.0
Width/Depth Ratio					0.0		12.9		13.6	1.0
Entrenchment Ratio					0.0	1.8	2.7		9.2	1.0
Bank Height Ratio					0.0		1.0		1.0	1.0
Max part size (mm) mobilized at bankfull						138		120		
Rosgen Classification	G5c/C5					B4		B4		
Bankfull Discharge (cfs)	10.0					10.0		10.0		
Sinuosity (ft)	1.07					1.05		1.09		
Water Surface Slope (Channel) (ft/ft)	0.0371					0.038		0.034		
Other										

Baseline Stream Data Summary Buffalo Creek Tributaries Mitigation Project: R5										
Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		2.8			1.0		5.0		9.5	2.0
Floodprone Width (ft)		26.2			1.0	10.0	25.0		25.0	2.0
Bankfull Mean Depth (ft)		0.8			1.0		0.3		0.7	2.0
Bankfull Max Depth (ft)		1.0			1.0		0.5		1.4	2.0
Bankfull Cross Sectional Area (ft^2)		2.1			1.0		1.7		6.6	2.0
Width/Depth Ratio		3.7			1.0		14.8		13.7	2.0
Entrenchment Ratio		9.3			1.0	2.0	5.0		5.3	2.0
Bank Height Ratio		1.8			1.0		1.0		1.0	2.0
Max part size (mm) mobilized at bankfull	134					96		195		
Rosgen Classification	E5b					B4		B4		
Bankfull Discharge (cfs)	7.0					7.0		7.0		
Sinuosity (ft)	1.14					1.10		1.07		
Water Surface Slope (Channel) (ft/ft)	0.0275					0.0287		0.0361		
Other										

Baseline Stream Data Summary Buffalo Creek Tributaries Mitigation Project: R6										
Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		4.2			1.0		6.0		12.0	1.0
Floodprone Width (ft)		7.9			1.0	25.0	30.0		50.0	1.0
Bankfull Mean Depth (ft)		0.5			1.0		0.4		0.9	1.0
Bankfull Max Depth (ft)		0.8			1.0		0.6		1.7	1.0
Bankfull Cross Sectional Area (ft^2)		2.1			1.0		2.2		11.4	1.0
Width/Depth Ratio		8.2			1.0		16.4		12.6	1.0
Entrenchment Ratio		1.9			1.0	4.2	5.0		4.2	1.0
Bank Height Ratio		1.3			1.0		1.0		1.0	1.0
Max part size (mm) mobilized at bankfull	199					171		262		
Rosgen Classification	B5a					B4		B4		
Bankfull Discharge (cfs)	12.0					12.0		12.0		
Sinuosity (ft)	1.13					1.11		1.10		
Water Surface Slope (Channel) (ft/ft)	0.0566					0.0574		0.042		
Other										

Monitoring Data - Cross Section Morphology Monitoring Summary

Buffalo Creek Tributaries Mitigation Project, DMS Project #100042

	Cross-Section 1 (Riffle - R3 lower)							Cross-Section 2 (Pool - MS-R1)							Cross-Section 3 (Riffle - MS-R1)							Cross-Section 4 (Pool - MS-R1)						
	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	269.76	269.75	269.76					266.51	266.46	266.47					266.54	266.41	266.50					260.58	260.64	260.59				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.00	0.95					N/A	N/A	N/A					1.00	1.03	1.02					N/A	N/A	N/A				
Thalweg Elevation	268.18	268.45	268.38					264.61	264.59	264.37					265.08	264.64	265.02					257.83	257.75	257.50				
LTOB[2] Elevation	269.76	269.75	269.69					266.51	266.48	266.41					266.54	266.46	266.54					260.58	260.50	260.56				
LTOB[2] Max Depth (ft)	1.58	1.30	1.31					1.90	1.89	2.04					1.46	1.82	1.52					2.75	2.76	3.06				
LTOB[2] Cross Sectional Area (ft^2)	6.88	6.88	6.26					15.14	15.47	14.28					15.47	16.23	16.01					23.68	21.25	23.06				

	Cross-Section 5 (Riffle - MS-R1)							Cross-Section 6 (Riffle - R4)							Cross-Section 7 (Riffle - R5 lower)							Cross-Section 8 (Riffle - R5 lower)						
	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	259.95	259.94	259.90					260.86	260.84	260.89					261.95	261.85	261.90					257.59	257.54	257.54				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.00	0.97					1.00	1.05	0.97					1.00	1.01	1.01					1.00	1.02	0.99				
Thalweg Elevation	258.52	258.50	258.49					260.34	260.22	260.18					260.54	260.50	260.68					256.11	256.14	256.07				
LTOB[2] Elevation	259.95	259.94	259.87					260.86	260.87	260.88					261.95	261.86	261.92					257.59	257.56	257.53				
LTOB[2] Max Depth (ft)	1.43	1.43	1.38					0.52	0.65	0.70					1.41	1.36	1.24					1.48	1.43	1.46				
LTOB[2] Cross Sectional Area (ft^2)	12.96	12.95	12.47					2.10	2.26	1.99					6.62	6.70	6.79					8.35	8.61	8.22				

	Cross-Section 9 (Riffle - MS-R2)							Cross-Section 10 (Pool - MS-R2)							Cross-Section 11 (Riffle - R6)							Cross-Section 12 (Riffle - MS-R2)						
	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	254.44	254.43	254.67					254.21	254.34	254.14					253.11	253.05	253.13					251.51	251.55	251.51				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.96	0.94					N/A	N/A	N/A					1.00	1.01	0.96					1.00	1.01	1.02				
Thalweg Elevation	252.66	252.52	252.85					251.29	251.10	250.29					251.46	251.42	251.53					249.79	249.72	249.80				
LTOB[2] Elevation	254.44	254.36	254.56					254.21	254.17	254.01					253.11	253.07	253.07					251.51	251.57	251.55				
LTOB[2] Max Depth (ft)	1.78	1.84	1.71					2.92	3.07	3.72					1.65	1.66	1.53					1.73	1.85	1.76				
LTOB[2] Cross Sectional Area (ft^2)	15.98	15.00	14.29					25.22	22.39	23.52					11.39	11.65	10.59					16.19	16.47	16.84				

	Cross-Section 13 (Pool - MS-R2)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	251.18	250.68	250.68				
Bank Height Ratio_Based on AB Bankfull[1] Area	N/A	N/A	N/A				
Thalweg Elevation	247.57	245.52	245.47				
LTOB[2] Elevation	251.05	251.01	250.93				
LTOB[2] Max Depth (ft)	3.48	5.49	5.46				
LTOB[2] Cross Sectional Area (ft^2)	35.74	45.43	43.28				

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.

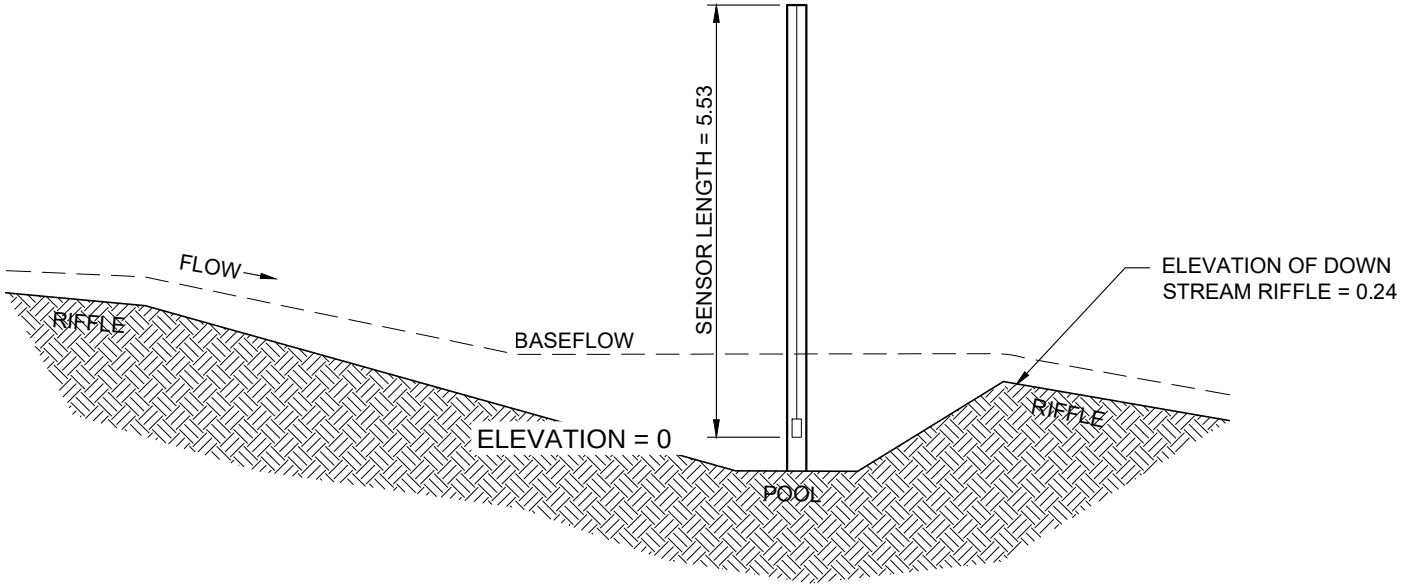
2 - **LTOB Area and Max depth -** These are based on the LTOB elevation for each years survey (The same elevation used for the LTOB in the BHR calculation). Area below the LTOB elevation will be used and tracked for each year as above. The difference between the LTOB elevation and the thalweg elevation (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

Verification of Bankfull Events
Flow Gauge and Crest Gauge Installation Diagrams
Flow Gauge and Crest Gauge Graphs
Wetland Hydrology Criteria and Hydrographs
Rainfall Data Table

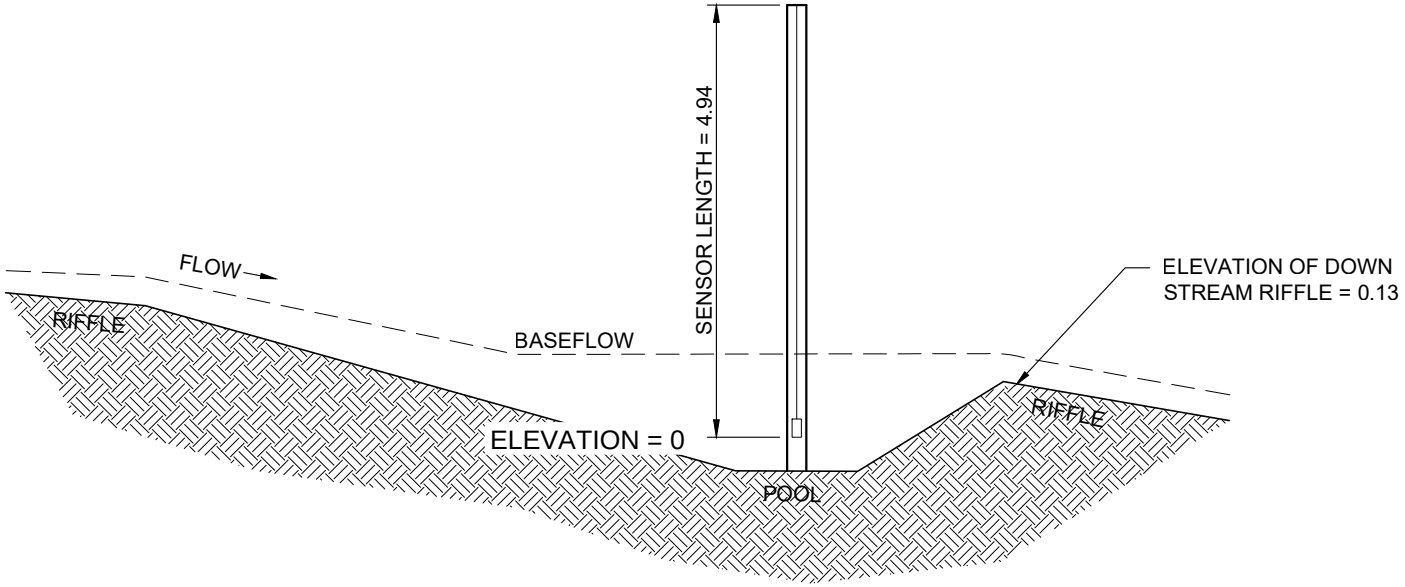
Verification of Bankfull Events - MS-R2 Buffalo Creek Tributaries Mitigation Project					
Monitoring Year	**Date of Collection**	**Date of Occurrence**	**Method**	**Photos**	**Measurement above bankfull (feet)**
MY1	5/26/2021	3/28/2021	Pressure Transducer	No	0.011
	7/13/2021	6/10/2021	Pressure Transducer	No	1.066
	7/13/2021	7/8/2021	Pressure Transducer	No	0.110
	7/13/2021	unknown	Visual Wrack Lines/Debris	Yes	N/A
	11/9/2021	10/25/2021	Pressure Transducer	No	0.27
	11/9/2021	unknown	Cork Crest Gauge	Yes	0.400
	11/9/2021	unknown	Sediment Floodplain Deposition	Yes	N/A
MY2	4/8/2022	1/3/2022	Pressure Transducer	No	0.31
	4/8/2022	1/16/2022	Pressure Transducer	No	0.245
	4/8/2022	3/24/2022	Pressure Transducer	No	0.855
	8/24/2022	7/9/2022	Pressure Transducer	No	0.726
	8/24/2022	8/12/2022	Pressure Transducer	No	0.945



FLOW GAUGE #1 - R4

Flow Depth = 0.24 feet

*All elevations relative to sensor depth

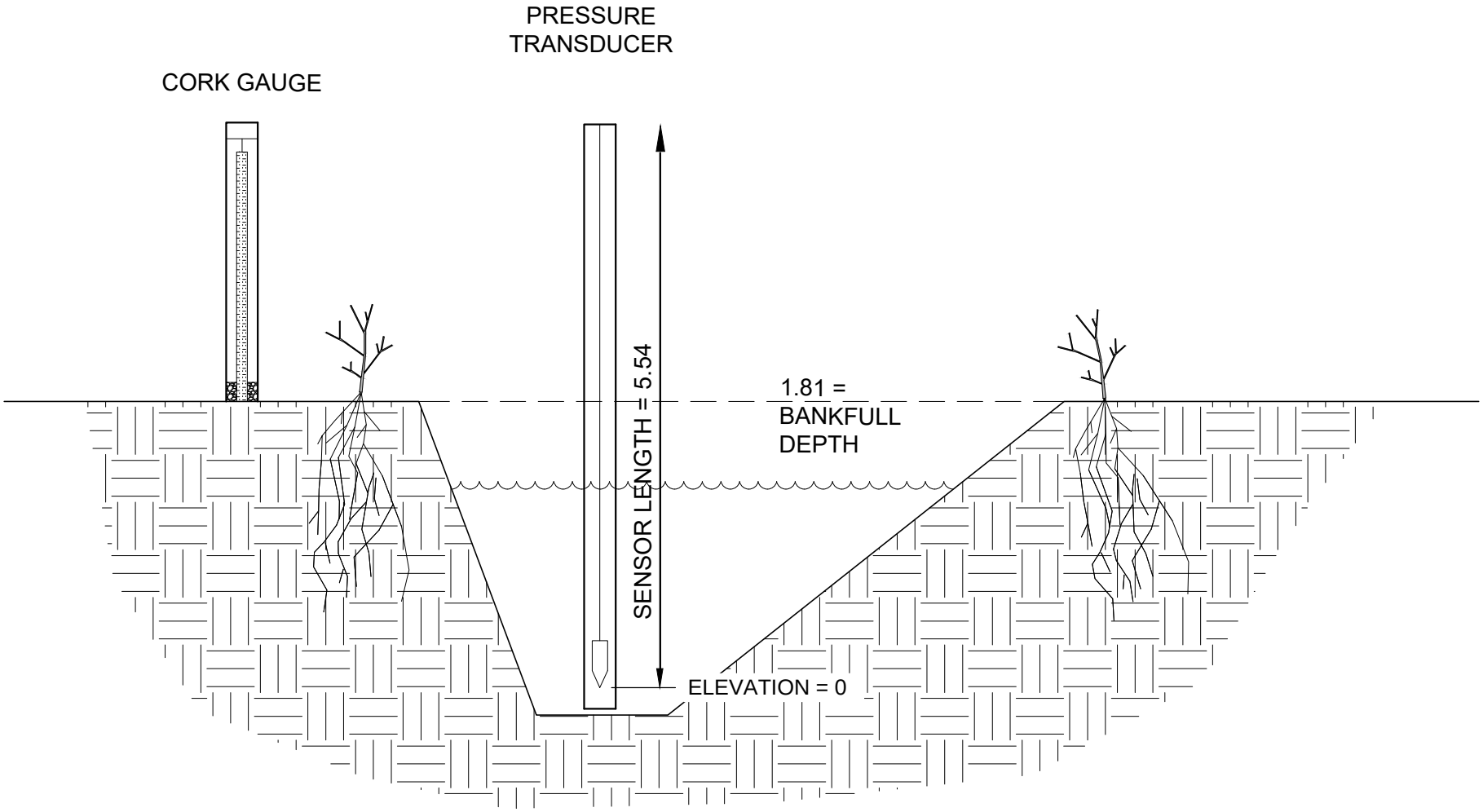


FLOW GAUGE #2 - R6

Flow Depth = 0.13 feet

*All elevations relative to sensor depth

CROSS SECTIONAL VIEW OF STREAM

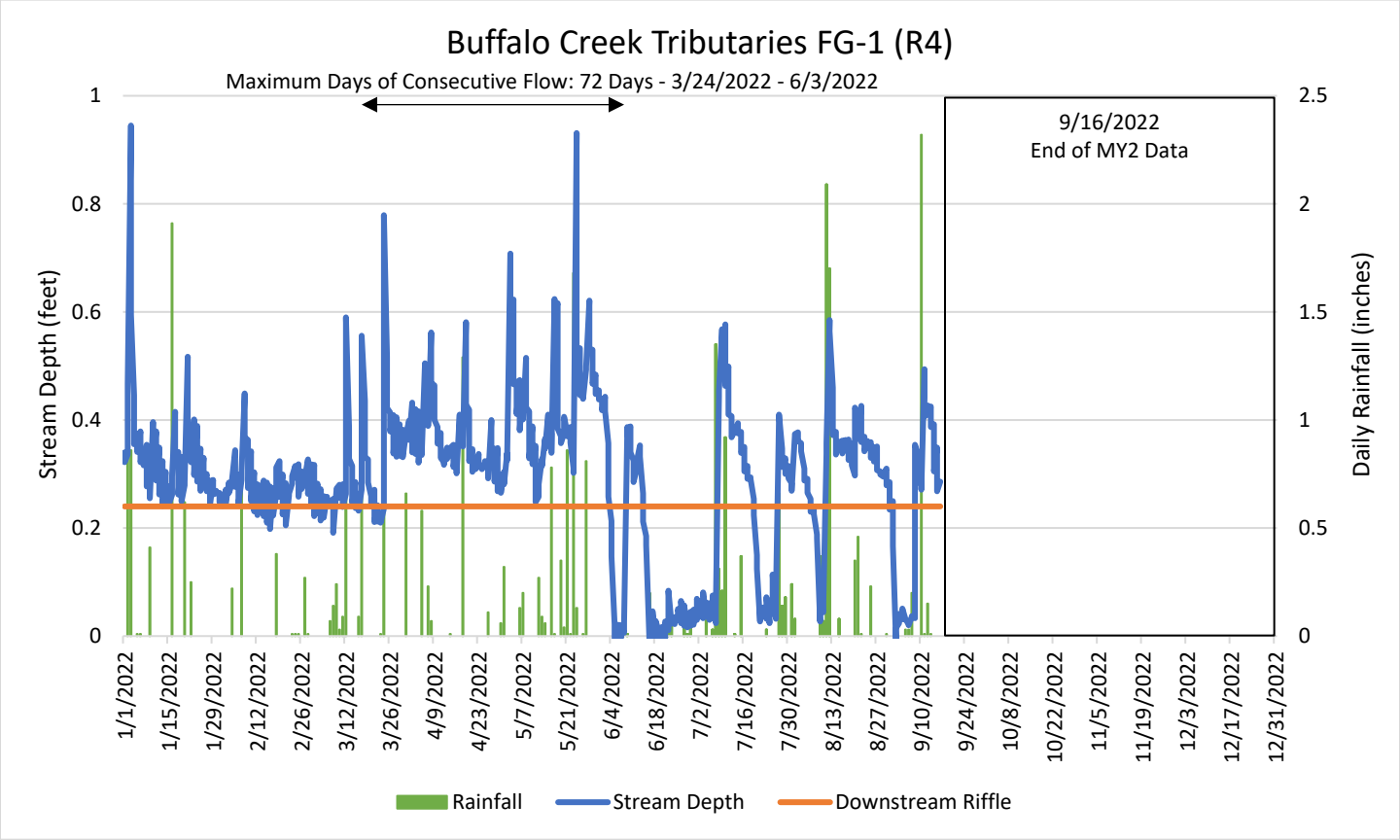


Crest Gauge CG-1 (MS-R2)

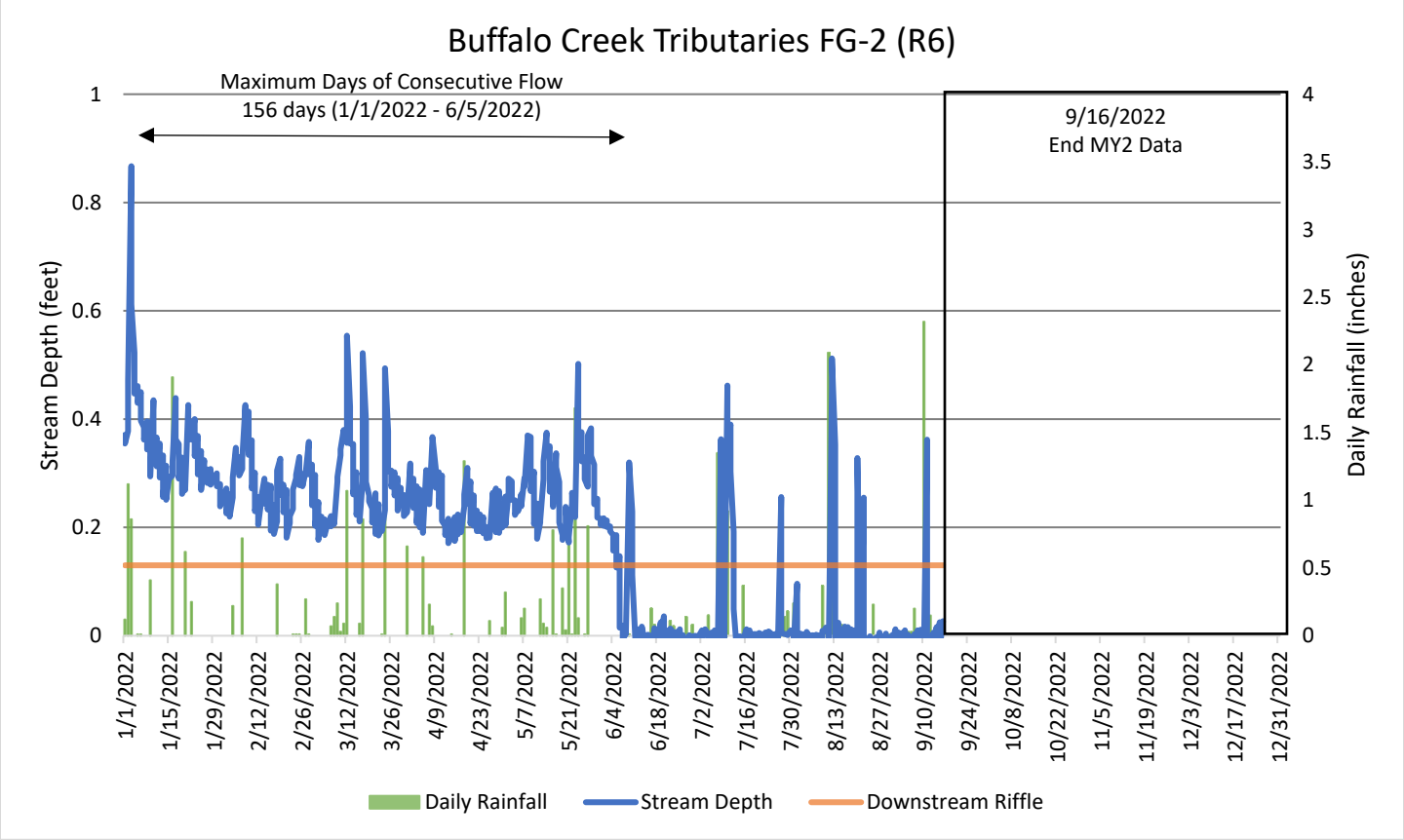
Bankfull Event Depth = 1.81

*All elevations relative to sensor depth

Flow Gauge Graphs

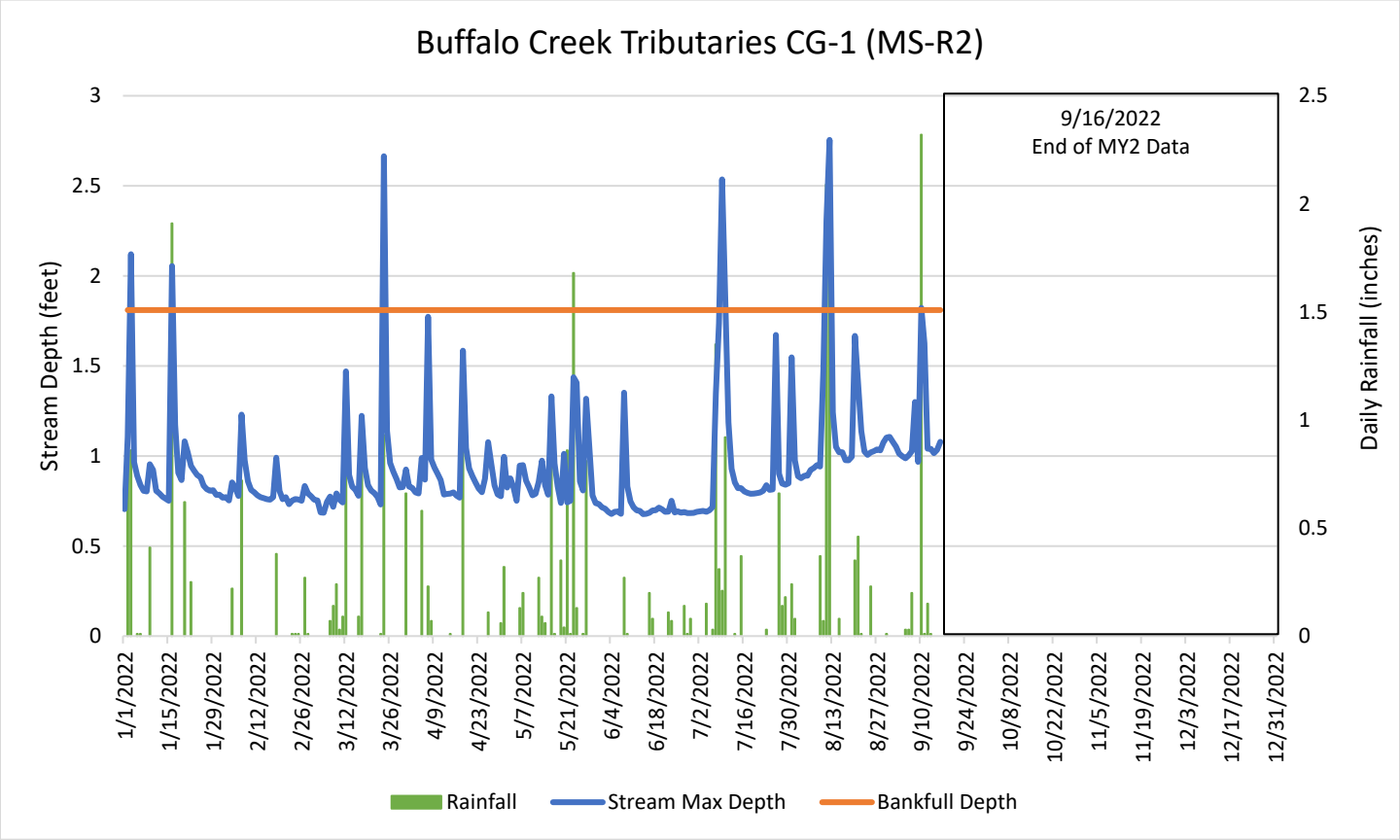


***FG-1:** 199 Cumulative days of flow, 60 days of no flow



***FG-2:** 164 Cumulative days of flow, 95 days of no flow

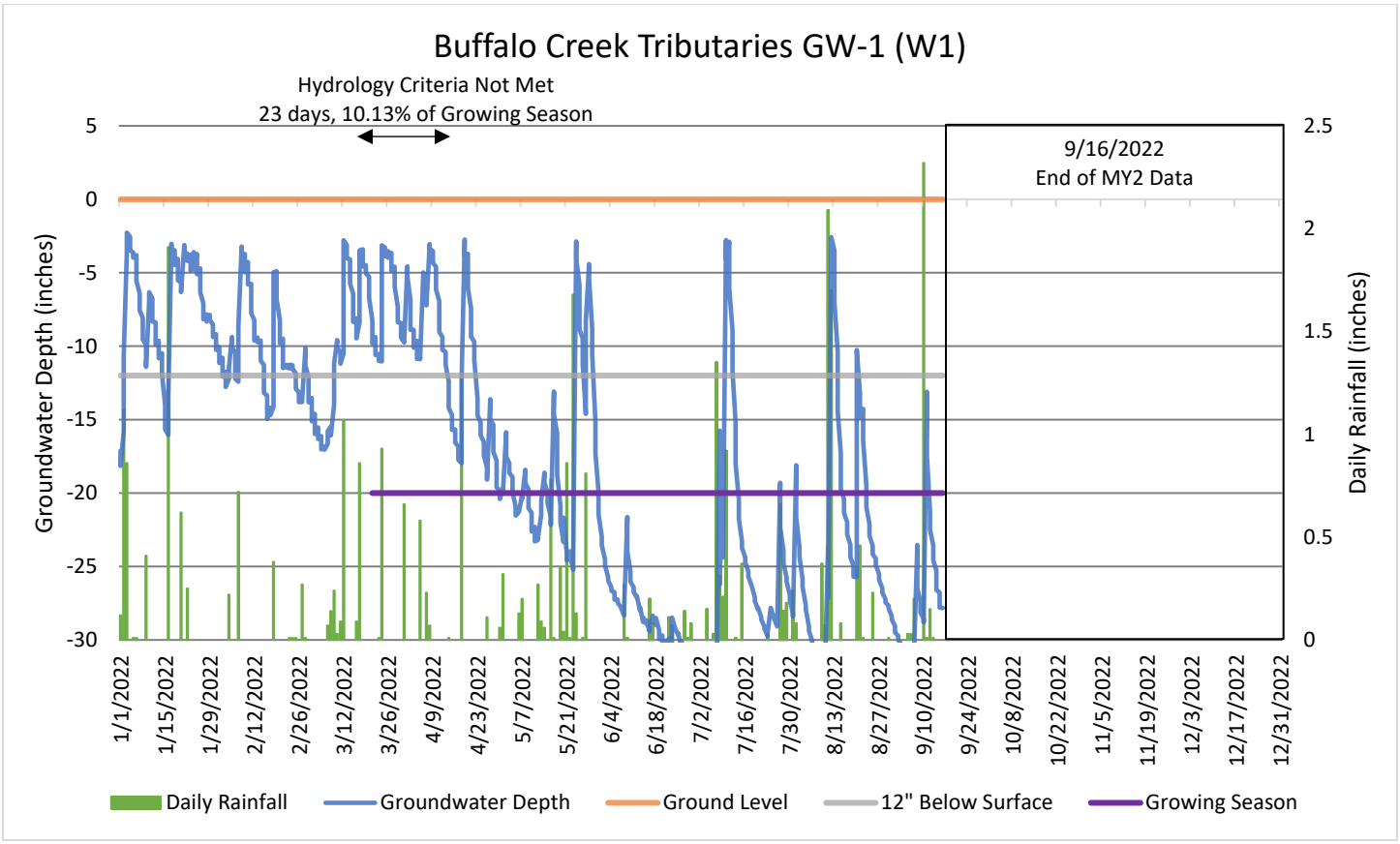
Crest Gauge Graph

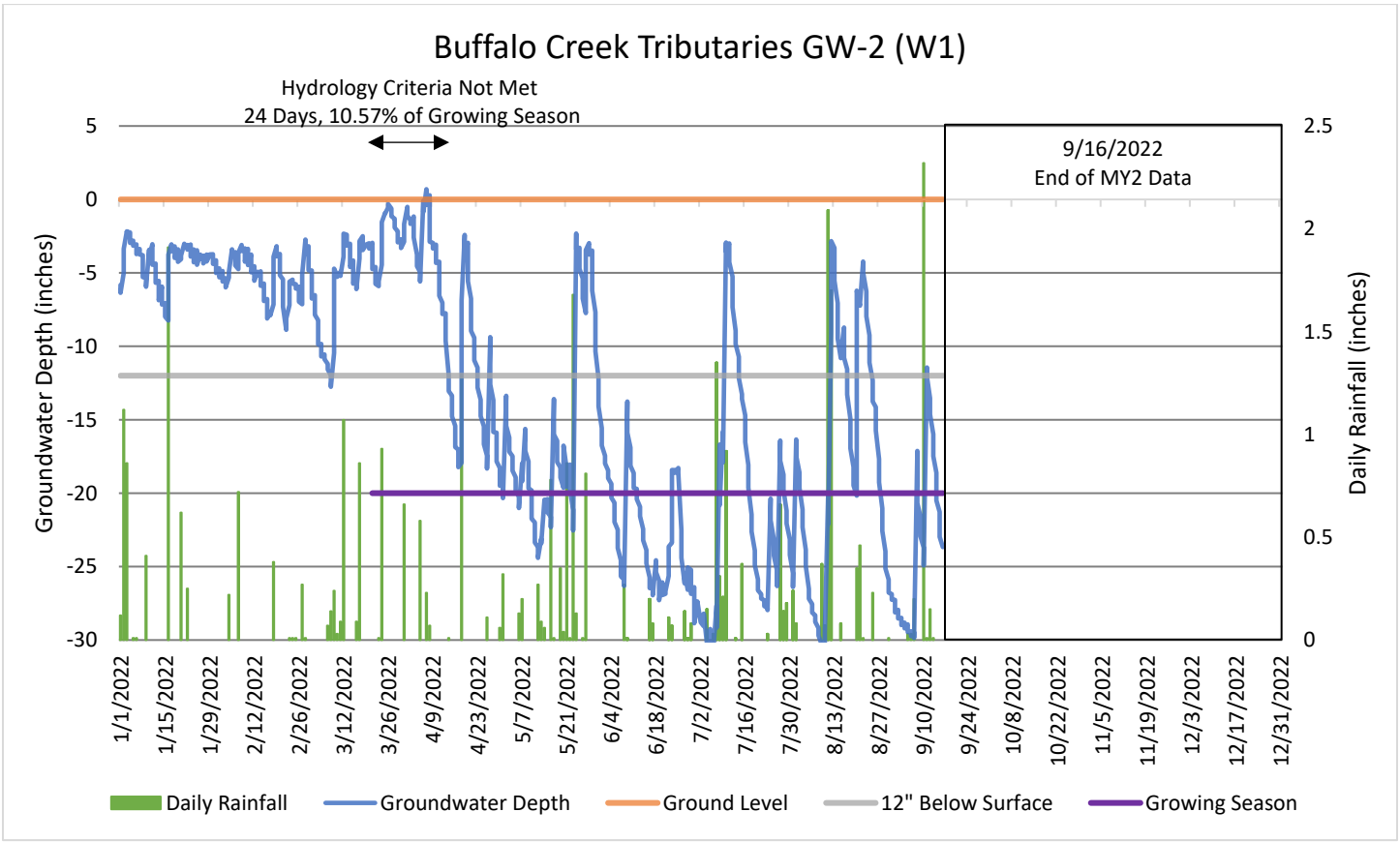


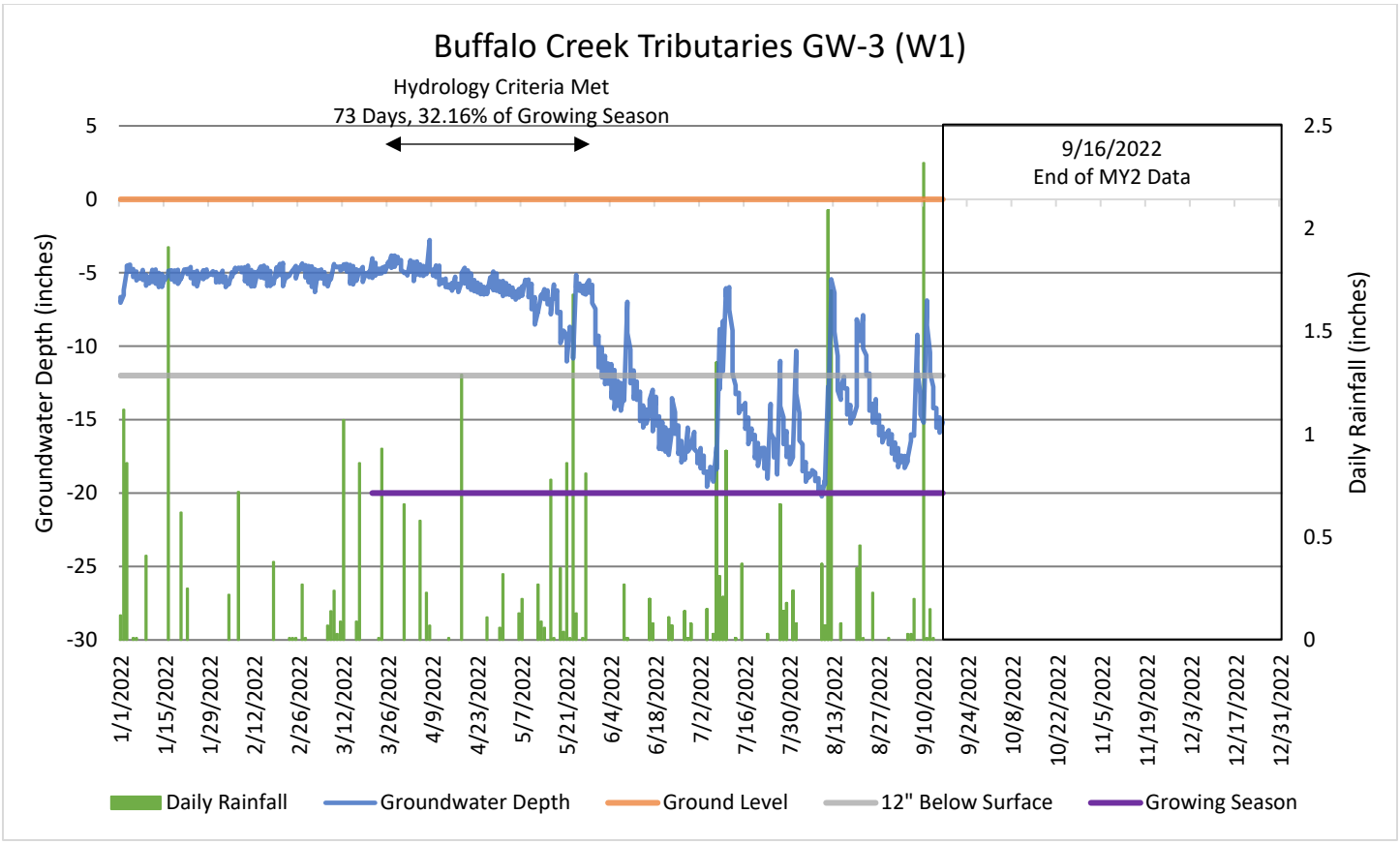
***CG-1:** 5 bankfull events in MY2 with a maximum of 0.945' above bankfull

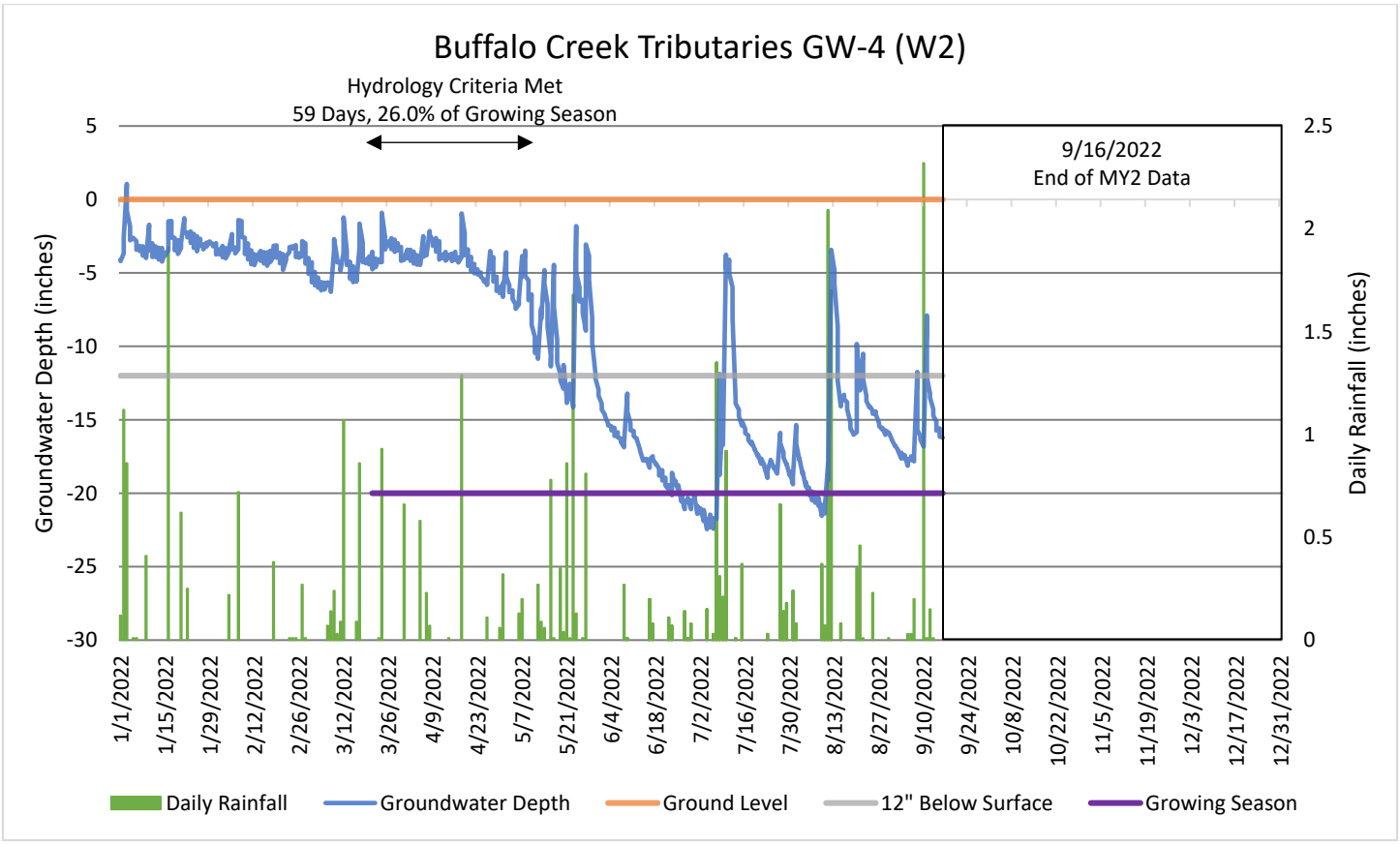
Max Consecutive Hydroperiod Saturation within 12 Inches of Soil Surface (Percent of Growing Season 3/21-11/3) CRONOS Station:Clayton (CLAY)								
Monitoring Gauge Name	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**Mean**
Groundwater Gauge 1 (W1)	**2.20%**	**10.13%**						**6.17%**
Groundwater Gauge 2 (W1)	**17.62%**	**10.57%**						**14.10%**
Groundwater Gauge 3 (W1)	**21.15%**	**32.16%**						**26.66%**
Groundwater Gauge 4 (W2)	**16.74%**	**26.00%**						**21.37%**
Groundwater Gauge 5 (W2)	**72.69%**	**37.44%**						**55.07%**
Groundwater Gauge 6 (W2)	**55.07%**	**22.47%**						**38.77%**
Groundwater Gauge 7 (W3)	**12.33%**	**4.85%**						**8.59%**

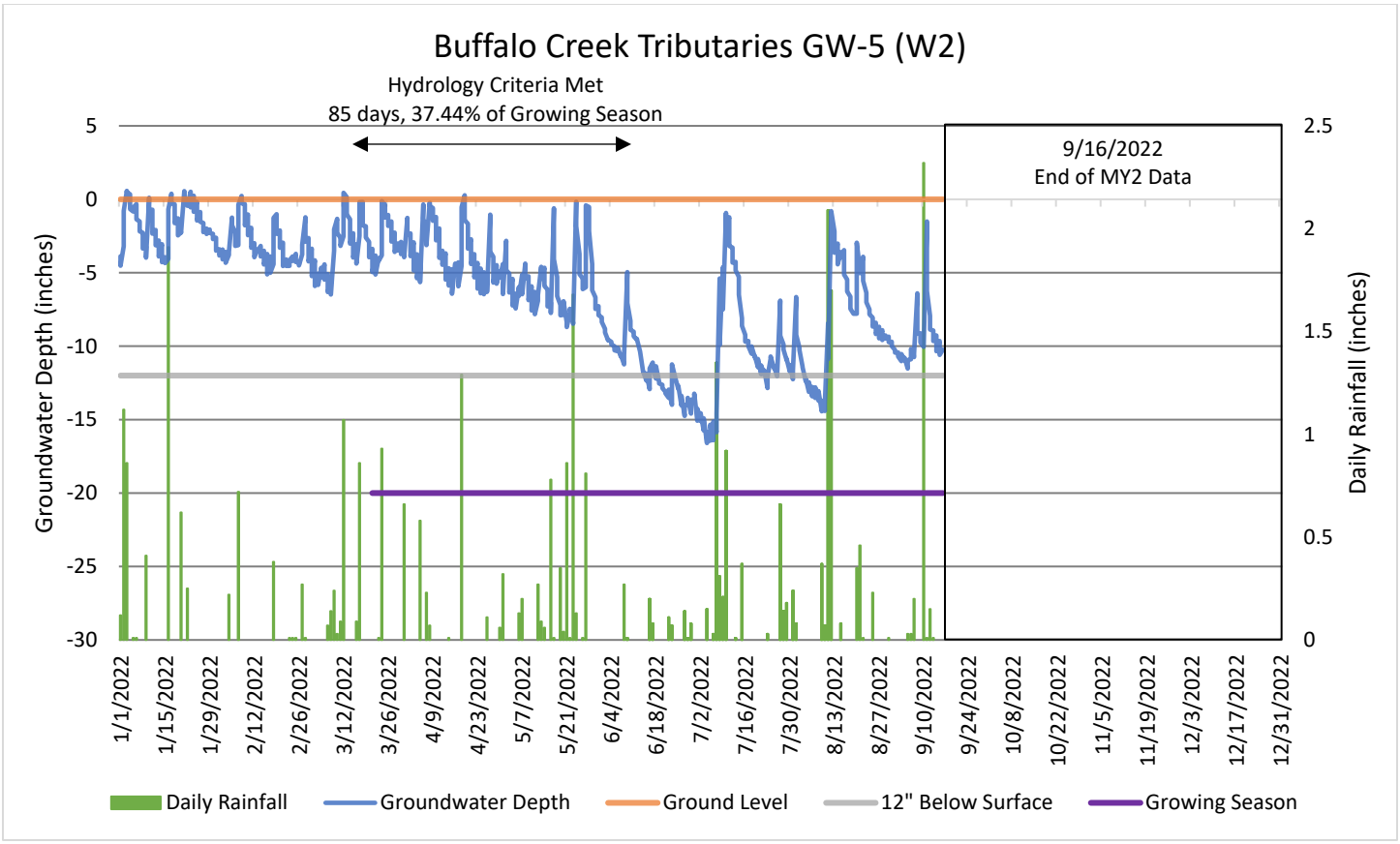
Groundwater Gauge Graphs

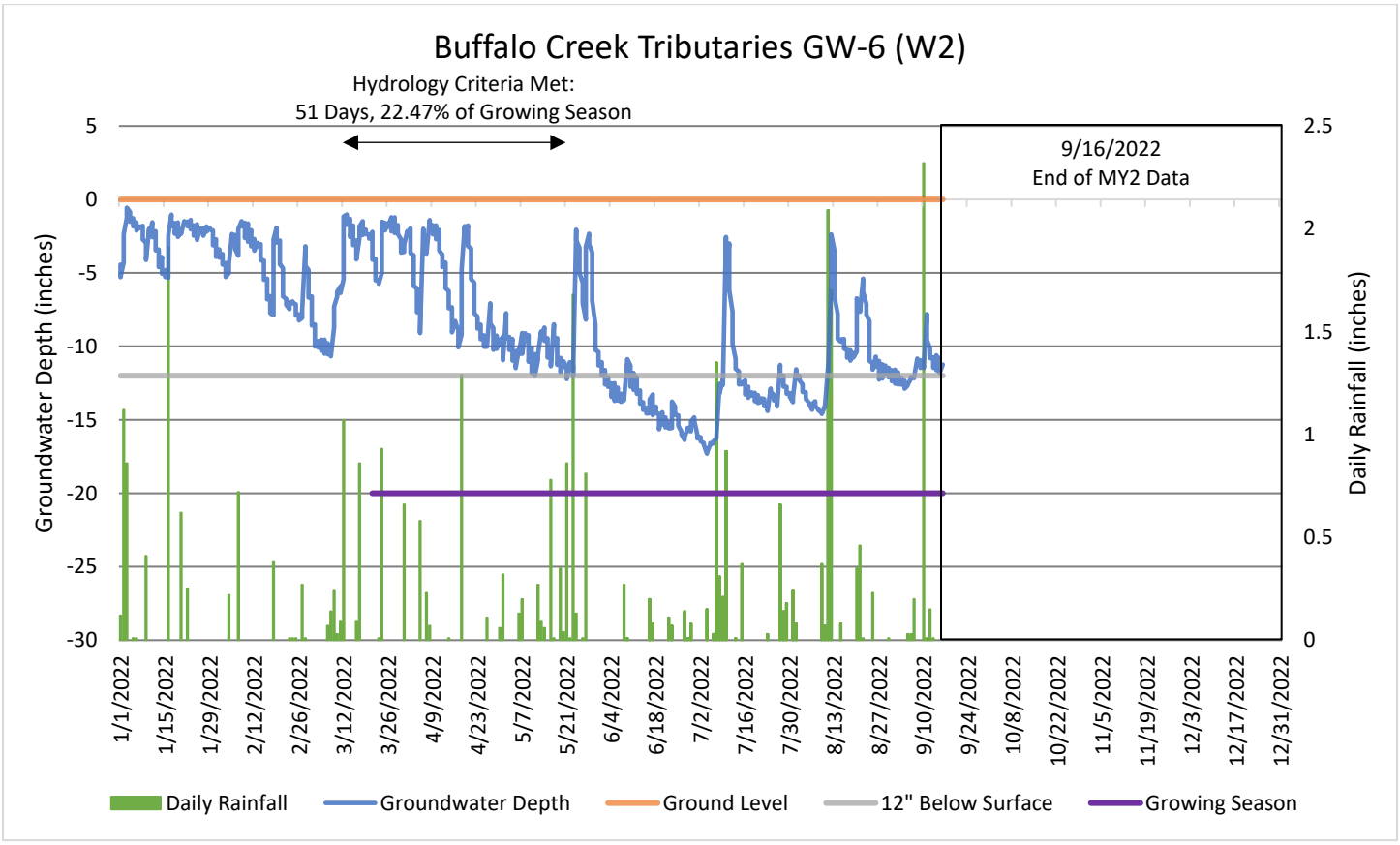


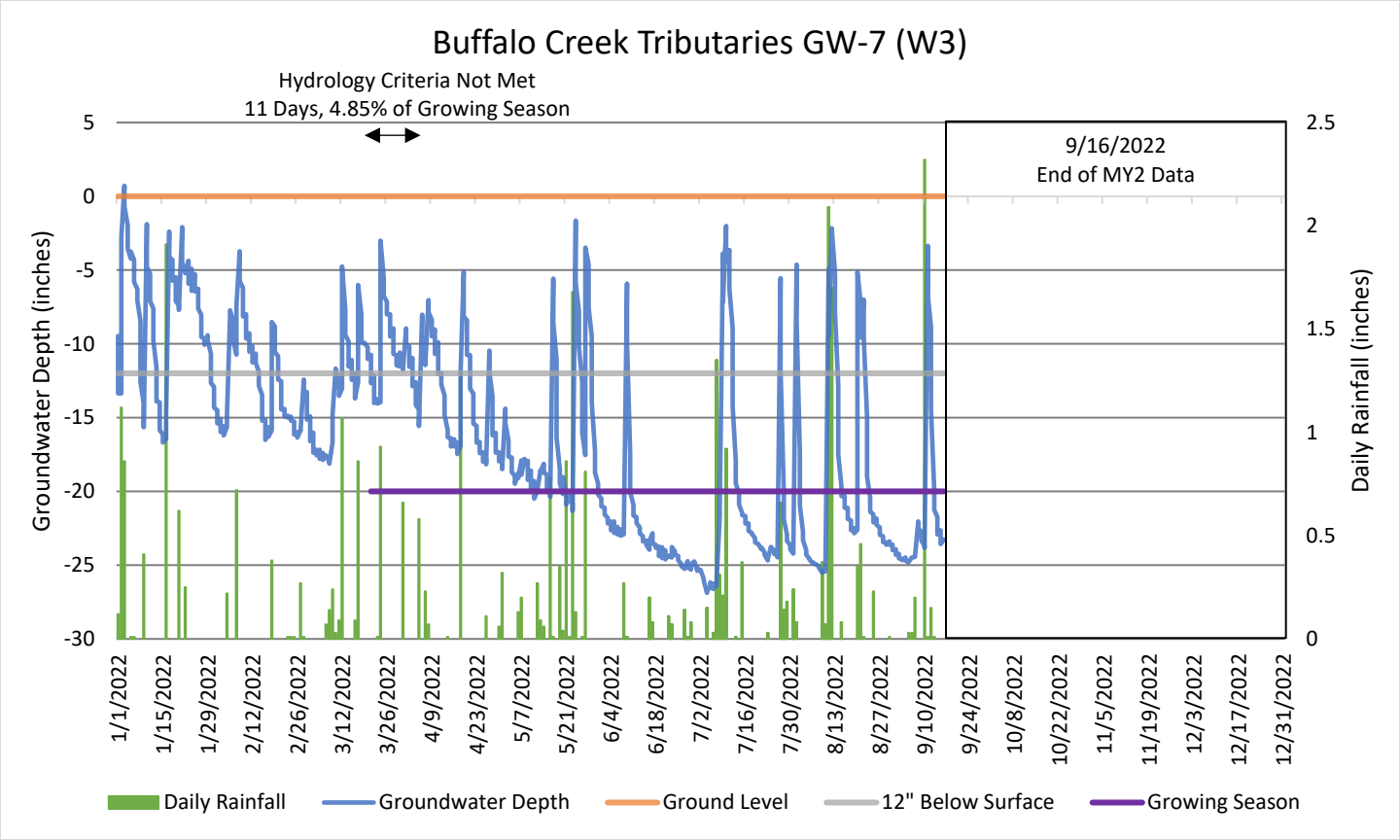


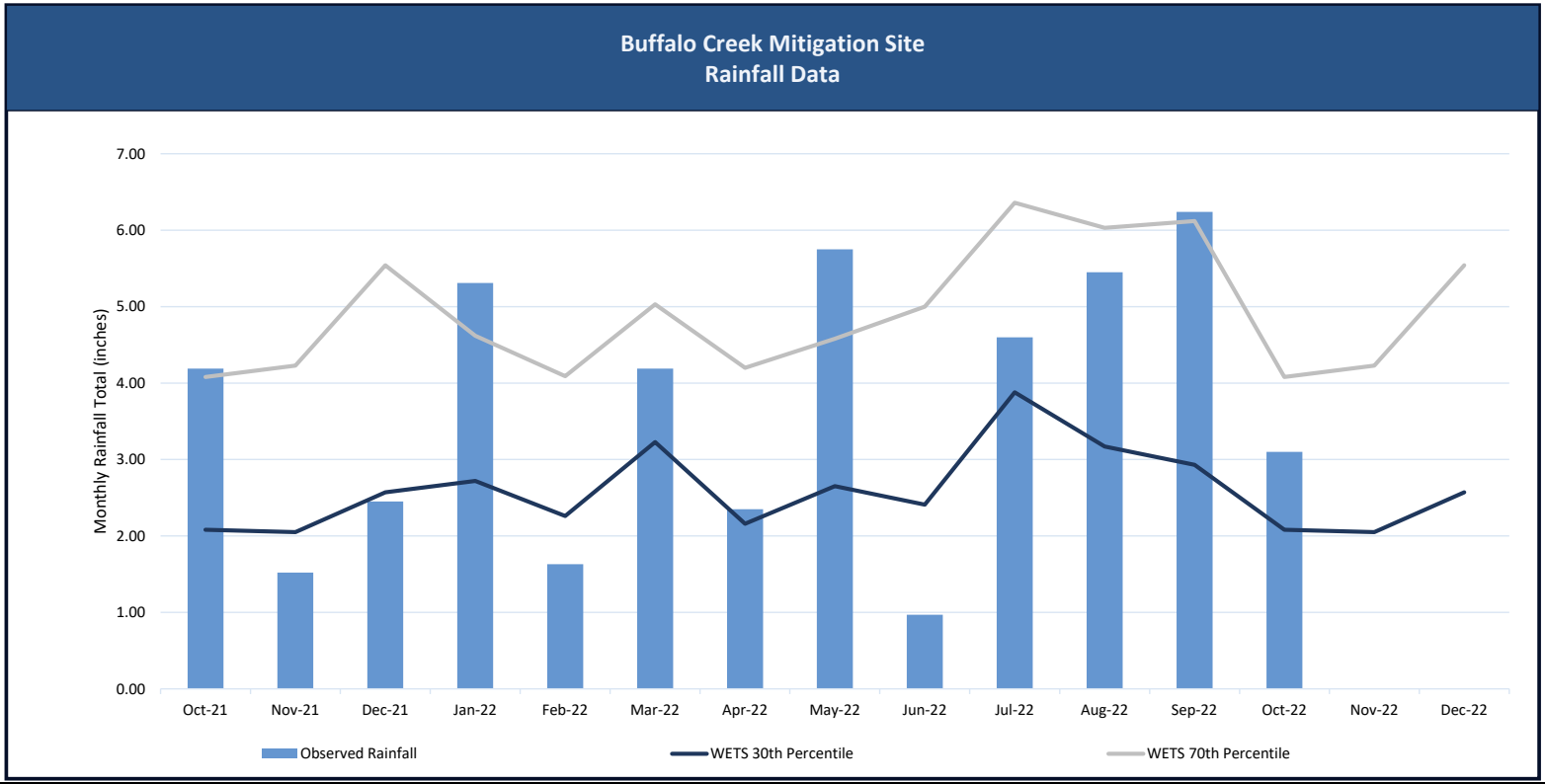

Buffalo Creek Tributaries GW-3 (W1)
Hydrology Criteria Met
73 Days, 32.16% of Growing Season
9/16/2022
End of MY2 Data
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
2.5
2
1.5
1
0.5
0
1/1/2022
1/15/2022
1/29/2022
2/12/2022
2/26/2022
3/12/2022
3/26/2022
4/9/2022
4/23/2022
5/7/2022
5/21/2022
6/4/2022
6/18/2022
7/2/2022
7/16/2022
7/30/2022
8/13/2022
8/27/2022
9/10/2022
9/24/2022
10/8/2022
10/22/2022
11/5/2022
11/19/2022
12/3/2022
12/17/2022
12/31/2022
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface
Growing Season


Buffalo Creek Tributaries GW-4 (W2)
Hydrology Criteria Met
59 Days, 26.0% of Growing Season
9/16/2022
End of MY2 Data
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
2.5
2
1.5
1
0.5
0
1/1/2022
1/15/2022
1/29/2022
2/12/2022
2/26/2022
3/12/2022
3/26/2022
4/9/2022
4/23/2022
5/7/2022
5/21/2022
6/4/2022
6/18/2022
7/2/2022
7/16/2022
7/30/2022
8/13/2022
8/27/2022
9/10/2022
9/24/2022
10/8/2022
10/22/2022
11/5/2022
11/19/2022
12/3/2022
12/17/2022
12/31/2022
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface
Growing Season


Buffalo Creek Tributaries GW-5 (W2)
Hydrology Criteria Met
85 days, 37.44% of Growing Season
9/16/2022
End of MY2 Data
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
2.5
2
1.5
1
0.5
0
1/1/2022
1/15/2022
1/29/2022
2/12/2022
2/26/2022
3/12/2022
3/26/2022
4/9/2022
4/23/2022
5/7/2022
5/21/2022
6/4/2022
6/18/2022
7/2/2022
7/16/2022
7/30/2022
8/13/2022
8/27/2022
9/10/2022
9/24/2022
10/8/2022
10/22/2022
11/5/2022
11/19/2022
12/3/2022
12/17/2022
12/31/2022
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface
Growing Season


Buffalo Creek Tributaries GW-6 (W2)
Hydrology Criteria Met:
51 Days, 22.47% of Growing Season
9/16/2022
End of MY2 Data
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
2.5
2
1.5
1
0.5
0
1/1/2022
1/15/2022
1/29/2022
2/12/2022
2/26/2022
3/12/2022
3/26/2022
4/9/2022
4/23/2022
5/7/2022
5/21/2022
6/4/2022
6/18/2022
7/2/2022
7/16/2022
7/30/2022
8/13/2022
8/27/2022
9/10/2022
9/24/2022
10/8/2022
10/22/2022
11/5/2022
11/19/2022
12/3/2022
12/17/2022
12/31/2022
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface
Growing Season


Buffalo Creek Tributaries GW-7 (W3)
Hydrology Criteria Not Met
11 Days, 4.85% of Growing Season
9/16/2022
End of MY2 Data
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
2.5
2
1.5
1
0.5
0
1/1/2022
1/15/2022
1/29/2022
2/12/2022
2/26/2022
3/12/2022
3/26/2022
4/9/2022
4/23/2022
5/7/2022
5/21/2022
6/4/2022
6/18/2022
7/2/2022
7/16/2022
7/30/2022
8/13/2022
8/27/2022
9/10/2022
9/24/2022
10/8/2022
10/22/2022
11/5/2022
11/19/2022
12/3/2022
12/17/2022
12/31/2022
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface
Growing Season



Rainfall Summary Table															
	Oct-2021	Nov-2021	Dec-2021	Jan-2022	Feb-2022	Mar-2022	Apr-2022	May-2022	Jun-2022	Jul-2022	Aug-2022	Sep-2022	Oct-2022	Nov-2022	Dec-2022
Observed Rainfall	4.19	1.52	2.45	5.31	1.63	4.19	2.35	5.75	0.97	4.60	5.45	6.24	3.10	**	**
WETS 30th Percentile	2.08	2.05	2.57	2.72	2.26	3.23	2.16	2.65	2.41	3.88	3.17	2.93	2.08	2.05	2.57
WETS 70th Percentile	4.08	4.23	5.54	4.62	4.09	5.03	4.20	4.58	5.00	6.36	6.03	6.12	4.08	4.23	5.54
Normal	H	L	L	H	L	N	N	H	L	H	N	H	N	**	**

*30th and 70th Percentile data collected from WETS Station : Johnston County

**Incomplete month of data

Appendix E:
Project Timeline and Contact Info

Activity or Deliverable	Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted	NA	1/2/2018
Mitigation Plan Approved	NA	6/29/2020
Construction (Grading) Completed	NA	4/22/2021
Planting Completed	NA	4/26/2021
As-built Survey Completed	NA	6/16/2021
MY-0 Baseline Report	05/04/21	6/17/2021
Encroachment 1 & 2 Documented	N/A	8/11/2021
MY1 Monitoring Report	11/09/21	11/24/2021
Encroachment 1 & 2 Planting	N/A	1/6/2022
Encroachment 3 Documented	N/A	8/18/2022
MY2 Monitoring Report	09/16/22	11/30/2022

Buffalo Creek Tributaries Mitigaiton Project: DMS #100042	
Provider	7721 Six Forks Road, Suite 130
Water & Land Solutions, LLC	Raleigh, NC 27615
Mitigation Provider POC: Emily Dunnigan	(571) 643-3165
Designer	7721 Six Forks Road, Suite 130
Water & Land Solutions, LLC	Raleigh, NC 27615
Primary project design POC: Christopher Tomsic	(828) 493-3287
Construction Contractor	114 W. Main Street
Providence Construction Services, LLC	Clayton, NC 27520
Primary Construction POC: Mike Rouse	(919) 805-6324