MY1 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: 2021

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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December 17, 2021

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 7 Submittal, Draft Monitoring Year 1 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 1 Report (including record drawings) 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 1 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:

General:

- **Stream flow and wetland gages. For many gages, most of the monitoring year (5 months) is showing as data malfunctions. Although gages many met within the first month of monitoring, the entirety of the monitoring year is expected to be captured. Please check and download data more regularly in the future to avoid this issue. Be advised that in previous monitoring years the IRT considers malfunction the same as not meeting success.** Response: Gauges are downloaded during quarterly site visits. Lost data was due to a malfunctioning data shuttle and not a malfunction of the data logger. A malfunction in the data shuttle was an error we were not aware could occur. Now that we are aware of this potential malfunction, we will be more diligent in downloading gauge data in the future.

- **Provide a photo that shows the additional marking for the encroachment area on MS-R2 in the subdivisions. In MY2 monitoring report, please provide photos of re-planted area and conditions. Suggest using larger stock, aesthetically pleasing trees from the mitigation planting plan.** Response: Photos of the encroachment areas are included in e-data. These areas will be replanted with 1 gallon stock with species from the approved mitigation plan. Photos will be provided in future reports.

- **At the baseline site visit, it was observed in the field that there are some areas of overland flow into the easement from the High School BMP Pond around R3 (lower). Please describe condition of this area after MY1 in response or report narrative.** Response: Overland flow occurs near R3 (lower)/upper MS-1 during heavy rain events. Herbaceous vegetation is establishing well on the stream bank and left buffer area. There were no issues observed during MY1 of sediment entering the stream. Documentation and photos of this area will be included in future monitoring reports.

Electronic Comments:

- **Please submit a feature characterizing the invasive treatment areas.** Response: A shapefile of the invasive species area is included in the e-data.

Please contact me if you have any questions or comments.

Sincerely,

Water & Land Solutions, LLC

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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 1 (MY1) activities occurred during the second week of November 2021. This report presents the data for MY1. The Project meets the MY1 success criteria for stream hydrology, stream horizontal and vertical stability, streambed condition and stability, and vegetation. Stream flow success criteria was not documented at FG-1 on R4 due to a data download malfunction. Six 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

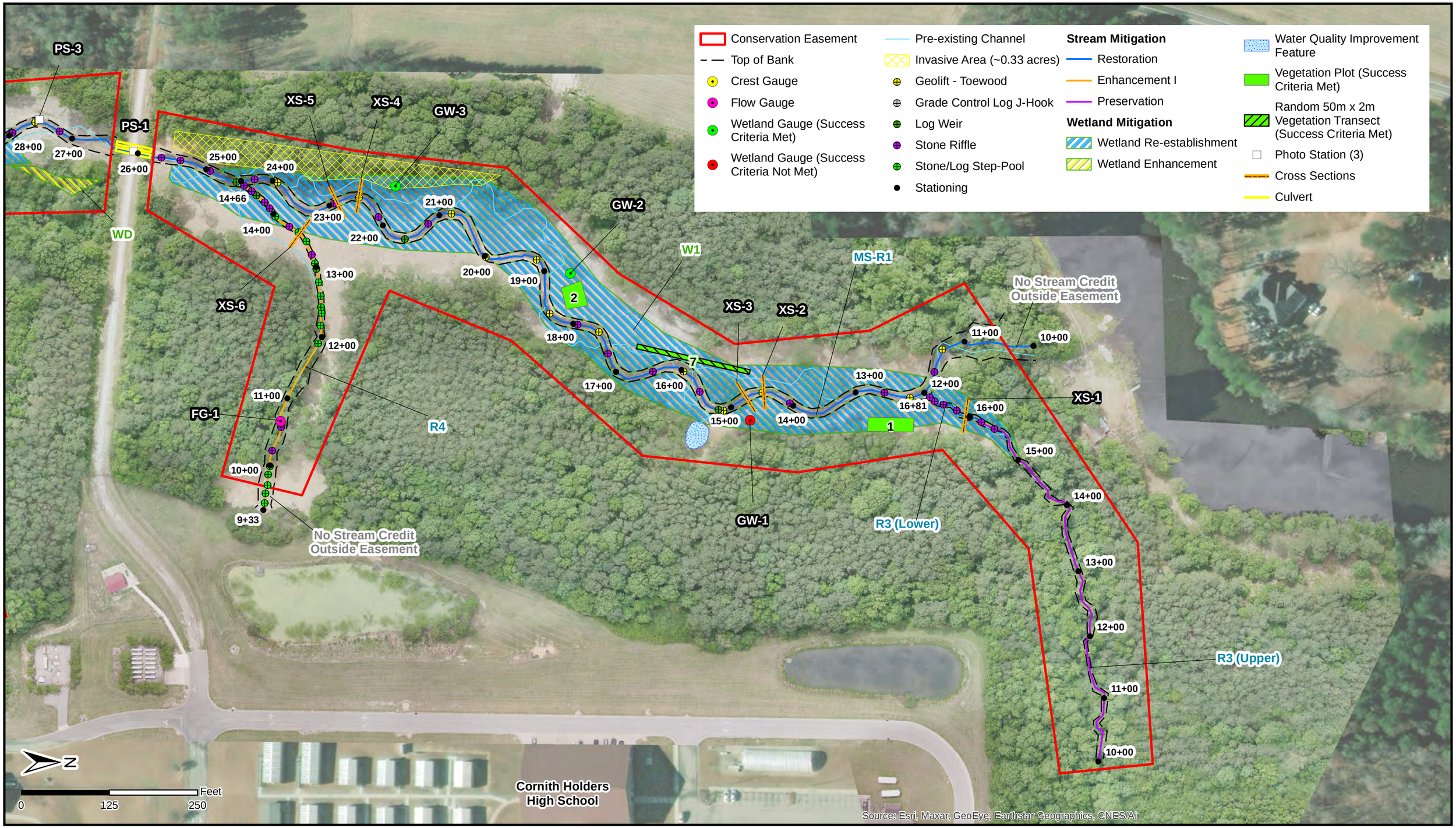
Buffalo Creek Tributaries Mitigation Project
Johnston County, North Carolina

USACE Action ID Number:
SAW-2018-00425
December 2021
MY1

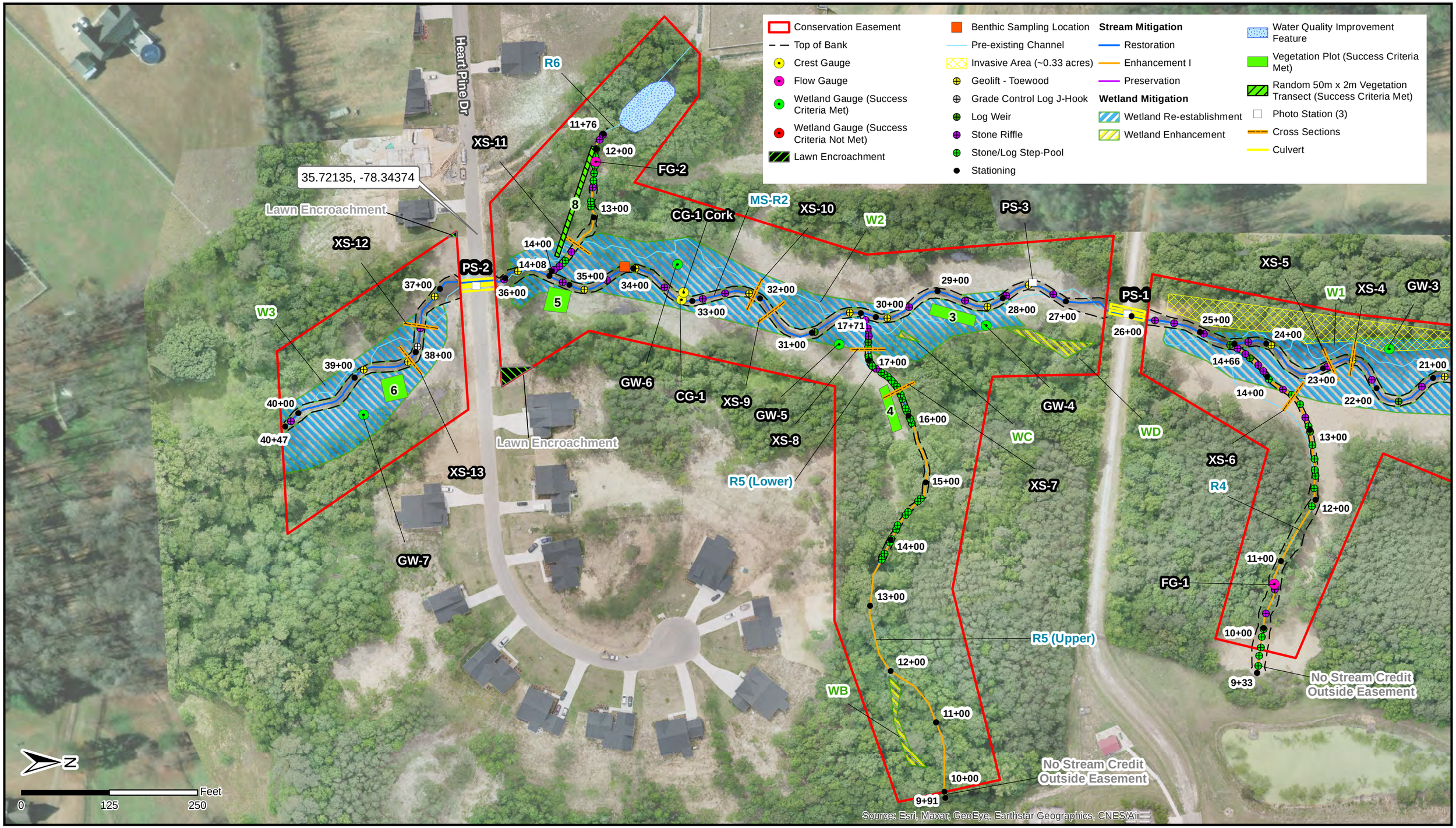
USACE
Current Conditions Plan View
Monitoring Year 1

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 December 2021 MY1	USACE Current Conditions Plan View Monitoring Year 1 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
December 2021
MY1

USACE
Current Conditions Plan View
Monitoring Year 1

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).	1/2 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. 6/7 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	8/8 met requirements - 2021

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 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 1 Assessment and Results

The dates of Year 1 monitoring activities are detailed in Appendix E. All year 1 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 the as-built profile was collected in November 2021. Refer to Appendices A and C for summary data tables, morphological plots, and stream photographs.

4.1.1 Stream Horizontal Pattern & Longitudinal Profile

The MY1 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 MY1 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. FG-2 (R6) exhibited a maximum consecutive flow of 45 days between March 3rd, 2021 and April 17th, 2021, with a cumulative total of 69 days of flow and 182 days of no flow during MY1 (Appendix D). FG-1 (R4) exhibited a maximum consecutive flow of 11 days between June 3rd, 2021 and June 14th, 2021, with a cumulative total of 20 days of flow and 28 days of no flow during MY1. FG-1 lost data from July 13th, 2021 to November 9th, 2021 due to a malfunctioning HOBO Onset Waterproof Shuttle Data Transporter. FG-1 will be monitored closely in MY2 and is expected to meet criteria when a full year of data is collected. 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.

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 validate flood status MS-R2. During MY1, bankfull events were recorded on the pressure transducer crest gauge. CG-1 recorded four events with a maximum event of 1.06 feet above bankfull on June 6th, 2021. Additionally, the cork crest gauge located adjacent to the pressure transducer confirmed at least one bankfull event.

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 MY1, six of the seven wetland groundwater wells met the twelve percent wetland hydrology criteria. GW-1 did not meet hydrology criteria and had a hydroperiod of 2.2 percent during MY1. GW-1 (W1), GW-2 (W1), and GW-3 (W1) lost data from July 13th, 2021 to November 9th, 2021 due to a malfunctioning HOBO Onset Waterproof Shuttle Data Transporter. GW-1 had no obvious or apparent reason to not meet success criteria, other than potential recharge in Year 1. GW-1 will be monitored closely in MY2 and is expected to meet hydrologic criteria when a full growing season worth of data is collected.

4.4 Vegetation

Monitoring of the six permanent vegetation plots and two random transects was completed during November 2021. Vegetation data and photos can be found in Appendix B. The MY1 average planted density is 510 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. All vegetation plots meet the interim measure requirements and have 364 - 648 stems per acre. Volunteer species were not noted at baseline monitoring but are expected to establish in the future.

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

Two encroachments (~0.014 acres) were noted near the southern most culvert crossing on MS-R2. Both are recently sodded/planted grassy areas adjacent to recent home construction. To prevent further encroachment, the homeowners were contacted, and the easement line was more clearly marked. Encroachment planting will occur in early MY2, and actions taken will be documented in the MY2 report.

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

Monitoring Year	Invasive Targeted	Invasive Treatment	Date Treatment Conducted	Herbicide Used
1	Privet	Foliar	6/2/2021	Garlon 3A (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)
Encroachment Area Photos

Visual Stream Stability Assessment						
Reach	MS-R1, MS-R2, R3 (upper), R3 (lower), R4, R5 (upper), R5 (lower), R6					
Assessed Stream Length	5,053					
Assessed Bank Length	9,200					
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.	131	131		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)	28	28		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	0.00	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.	Black with Green stripes	0.014	

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

R3 Lower, XS-1, Upstream (MY-01)

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

R3 Lower, XS-1, Downstream (MY-01)

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

R3 Lower, XS-1, Left Bank (MY-01)

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

R3 Lower, XS-1, Right Bank (MY-01)

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

MS-R1, XS-2, Upstream (MY-01)

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

MS-R1, XS-2, Downstream (MY-01)

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

MS-R1, XS-2, Left Bank (MY-01)

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

MS-R1, XS-2, Right Bank (MY-01)

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

MS-R1, XS-3, Upstream (MY-01)

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

MS-R1, XS-3, Downstream (MY-01)

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

MS-R1, XS-3, Left Bank (MY-01)

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

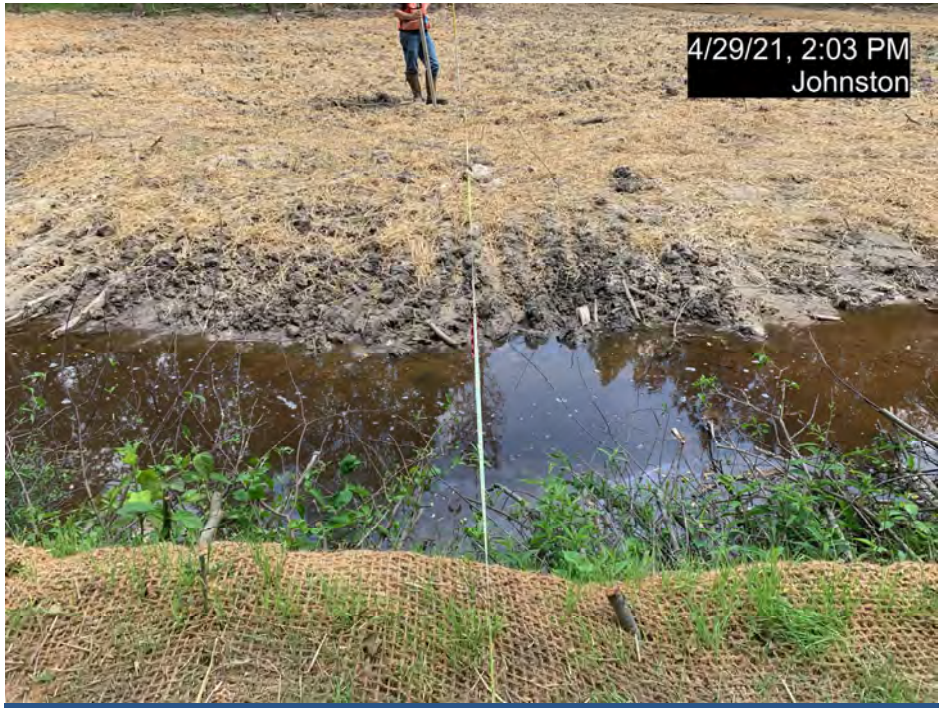
MS-R1, XS-3, Right Bank (MY-01)

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

MS-R1, XS-4, Upstream (MY-01)

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

MS-R1, XS-4, Downstream (MY-01)



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

MS-R1, XS-4, Left Bank (MY-01)

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

MS-R1, XS-4, Right Bank (MY-01)

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

MS-R1, XS-5, Upstream (MY-01)

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

MS-R1, XS-5, Downstream (MY-01)

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

MS-R1, XS-5, Left Bank (MY-01)

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

MS-R1, XS-5, Right Bank (MY-01)

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

R4, XS-6, Upstream (MY-01)

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

R4, XS-6, Downstream (MY-01)

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

R4, XS-6, Left Bank (MY-01)

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

R4, XS-6, Right Bank (MY-01)

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

R5 Lower, XS-7, Upstream (MY-01)

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

R5 Lower, XS-7, Downstream (MY-01)

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

R5 Lower, XS-7, Left Bank (MY-01)

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

R5 Lower, XS-7, Right Bank (MY-01)

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

R5 Lower, XS-8, Upstream (MY-01)

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

R5 Lower, XS-8, Downstream (MY-01)

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

R5 Lower, XS-8, Left Bank (MY-01)

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

R5 Lower, XS-8, Right Bank (MY-01)

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

MS-R2, XS-9, Upstream (MY-01)

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

MS-R2, XS-9, Downstream (MY-01)

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

MS-R2, XS-9, Left Bank (MY-01)

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

MS-R2, XS-9, Right Bank (MY-01)

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

MS-R2, XS-10, Upstream (MY-01)

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

MS-R2, XS-10, Downstream (MY-01)

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

MS-R2, XS-10, Left Bank (MY-01)

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

MS-R2, XS-10, Right Bank (MY-01)

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

R6, XS-11, Upstream (MY-01)

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

R6, XS-11, Downstream (MY-01)

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

R6, XS-11, Left Bank (MY-01)

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

R6, XS-11, Right Bank (MY-01)

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

MS-R2, XS-12, Upstream (MY-01)

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

MS-R2, XS-12, Downstream (MY-01)

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

MS-R2, XS-12, Left Bank (MY-01)

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

MS-R2, XS-12, Right Bank (MY-01)

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

MS-R2, XS-13, Upstream (MY-01)

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

MS-R2, XS-13, Downstream (MY-01)

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

MS-R2, XS-13, Left Bank (MY-01)

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

MS-R2, XS-13, Right Bank (MY-01)

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

PS-1 – MS-R1 Culvert Crossing, Upstream (MY-01)

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

PS-1 – MS-R1 Culvert Crossing, Downstream (MY-01)

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

PS-2 – MS-R2 Culvert Crossing, Upstream (MY-01)

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

PS-2 – MS-R2 Culvert Crossing, Downstream (MY-01)

PS-3 – MS-R2, Upstream (MY-01)

PS-3 – MS-R2, Downstream (MY-01)

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

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

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 Plot Counts and Densities Table	
Planted Acreage	6.34
Date of Initial Plant	2021-03-03
Date(s) of Supplemental Plant(s)	#N/A
Date(s) Mowing	#N/A
Date of Current Survey	2021-11-09
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	OBL	2	2							1	1				2
	Asimina triloba	pawpaw	Tree	FAC	1	1			1	1	1	1			2	2		1
	Betula nigra	river birch	Tree	FACW			2	2	1	1	1	1	1	1	1	1	1	1
	Carpinus caroliniana	American hornbeam	Tree	FAC	1	1	1	1			1	1	1	1	2	2		
	Corylus americana	American hazelnut	Shrub	FACU	1	1	2	2	1	1			1	1				
	Diospyros virginiana	common persimmon	Tree	FAC	3	3	1	1										
	Fraxinus pennsylvanica	green ash	Tree	FACW			1	1			3	3			1	1	1	1
	Hamamelis virginiana	American witchhazel	Tree	FACU					2	2			2	2				1
	Lindera benzoin	northern spicebush	Tree	FAC			1	1					1	1			1	
	Liriodendron tulipifera	tuliptree	Tree	FACU					1	1	2	2	2	2			2	1
	Nyssa sylvatica	blackgum	Tree	FAC	1	1							1	1			2	
	Platanus occidentalis	American sycamore	Tree	FACW					8	8	2	2	1	1	3	3		1
	Quercus alba	white oak	Tree	FACU	3	3	2	2	1	1	2	2	2	2	1	1	1	1
	Quercus rubra	northern red oak	Tree	FACU	3	3	2	2	1	1	1	1			3	3	1	
	Tilia americana	American basswood	Tree	FACU			1	1										
Sum	Performance Standard				15	15	13	13	16	16	13	13	13	13	13	13	9	9
Mitigation Plan Performance Standard	Current Year Stem Count					15		13		16		13		13		13	9	9
	Stems/Acre					607		526		648		526		526		526	364	364
	Species Count					8		9		8		8		10		7	7	8
	Dominant Species Composition (%)					20		15		50		23		15		23	22	22
	Average Plot Height					2		2		2		3		2		2	1	2
	% Invasives					0		0		0		0		0		0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					15		13		16		13		13		13	9	9
	Stems/Acre					607		526		648		526		526		526	364	364
	Species Count					8		9		8		8		10		7	7	8
	Dominant Species Composition (%)					20		15		50		23		15		23	22	22
	Average Plot Height					2		2		2		3		2		2	1	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.

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	607	2	8	0	526	2	9	0	648	2	8	0
Monitoring Year 0	688	2	8	0	607	1	11	0	688	2	8	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	526	3	8	0	526	2	10	0	526	2	7	0
Monitoring Year 0	607	2	10	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												
Monitoring Year 1	364	1	7	0	364	2	8	0				
Monitoring Year 0	648	2	12	0	729	2	11	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.

Fixed Veg Plot 1 (MY-00)

Fixed Veg Plot 1 (MY-01)

Fixed Veg Plot 2 (MY-00)

Fixed Veg Plot 2 (MY-01)

Fixed Veg Plot 3 (MY-00)

Fixed Veg Plot 3 (MY-01)

Fixed Veg Plot 4 (MY-00)

Fixed Veg Plot 4 (MY-01)

Fixed Veg Plot 5 (MY-00)

Fixed Veg Plot 5 (MY-01)

Fixed Veg Plot 6 (MY-00)

Fixed Veg Plot 6 (MY-01)

Random Veg Plot 7, Facing Northwest (MY-01)

Random Veg Plot 7, Facing Southeast (MY-01)

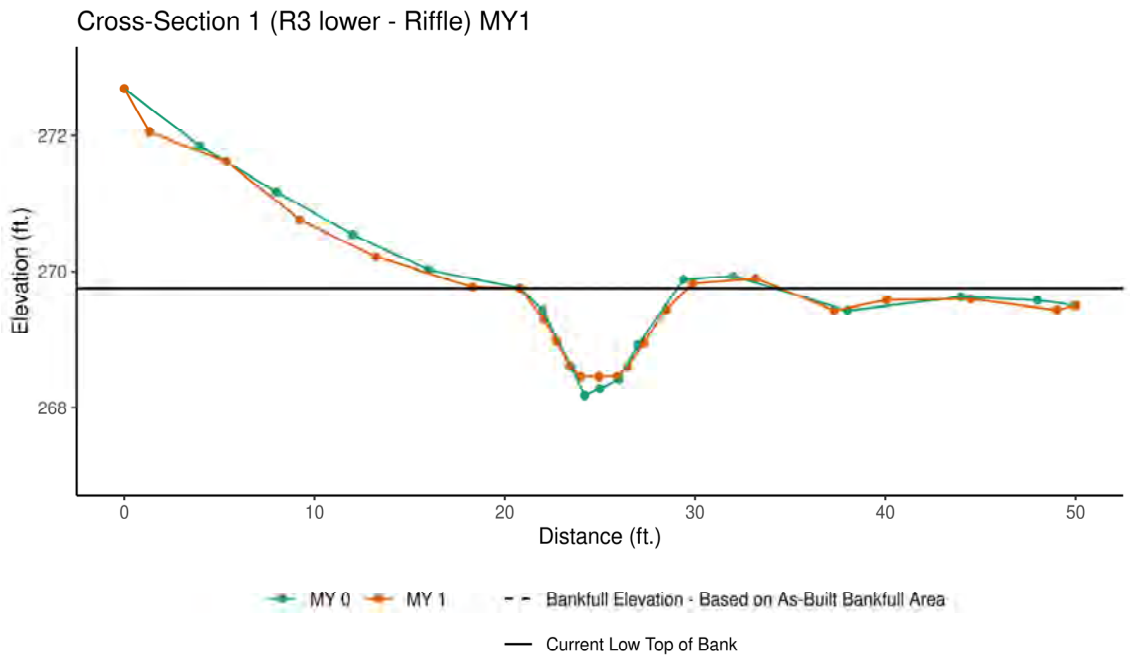
Random Veg Plot 8, Facing Northeast (MY-01)

Random Veg Plot 8, Facing Southwest (MY-01)

Appendix C:

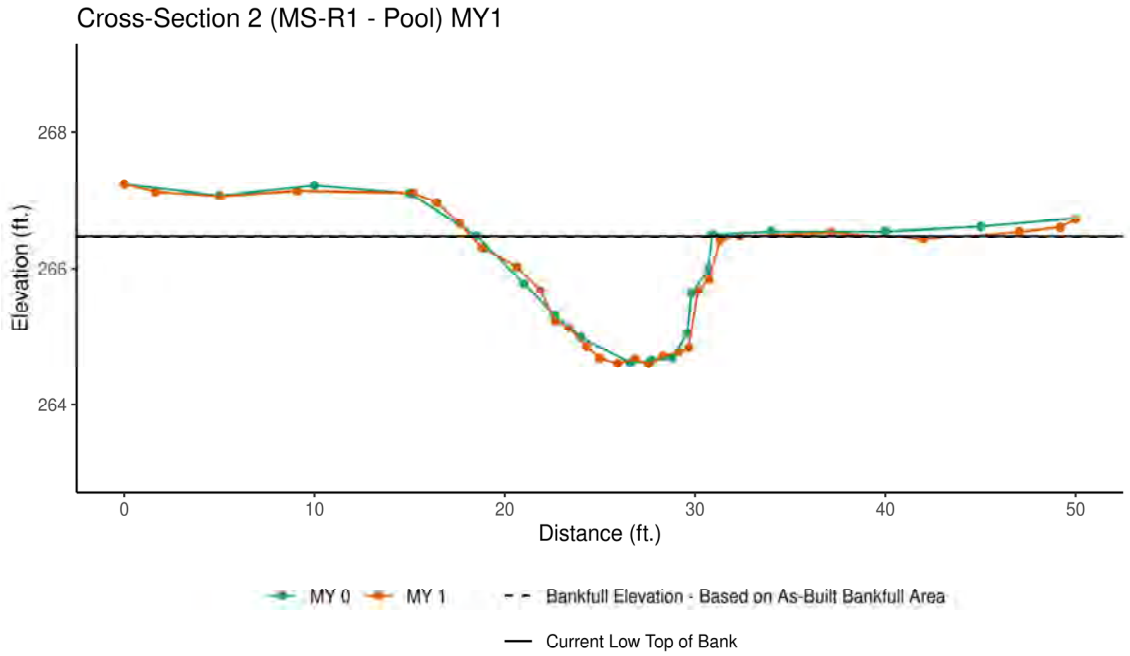
Stream Geomorphology Data

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



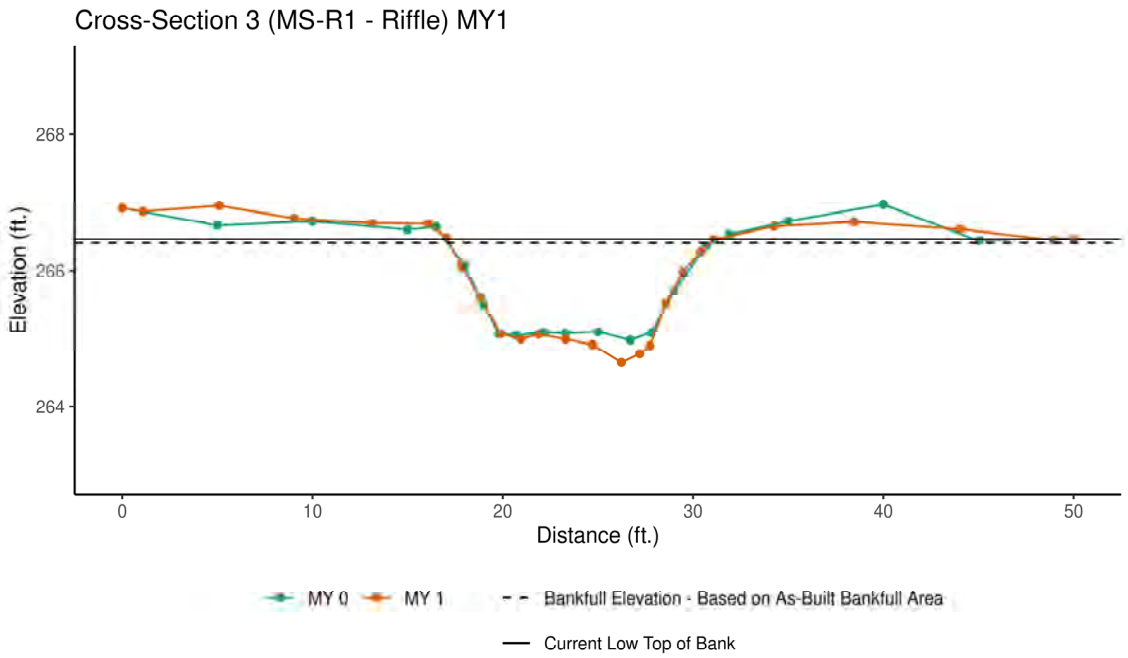
Distance	Elevation	Features
0	272.686	TLP
1.325	272.053	
5.35992211	271.617	
9.250104	270.758	
13.2430561	270.217	
18.2725992	269.773	
20.8121288	269.749	TLB, BKF
22.0677064	269.29	
22.713857	268.983	
23.4012148	268.61	
23.9860195	268.448	LEW
24.9560922	268.449	
25.9247883	268.448	THW
26.4445399	268.588	REW
27.3161063	268.956	
28.4885906	269.439	
29.8808746	269.826	TRB
33.2099595	269.898	
37.3173329	269.426	
40.0704662	269.582	
44.5161945	269.596	
49.0048753	269.434	
50	269.501	TRP

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



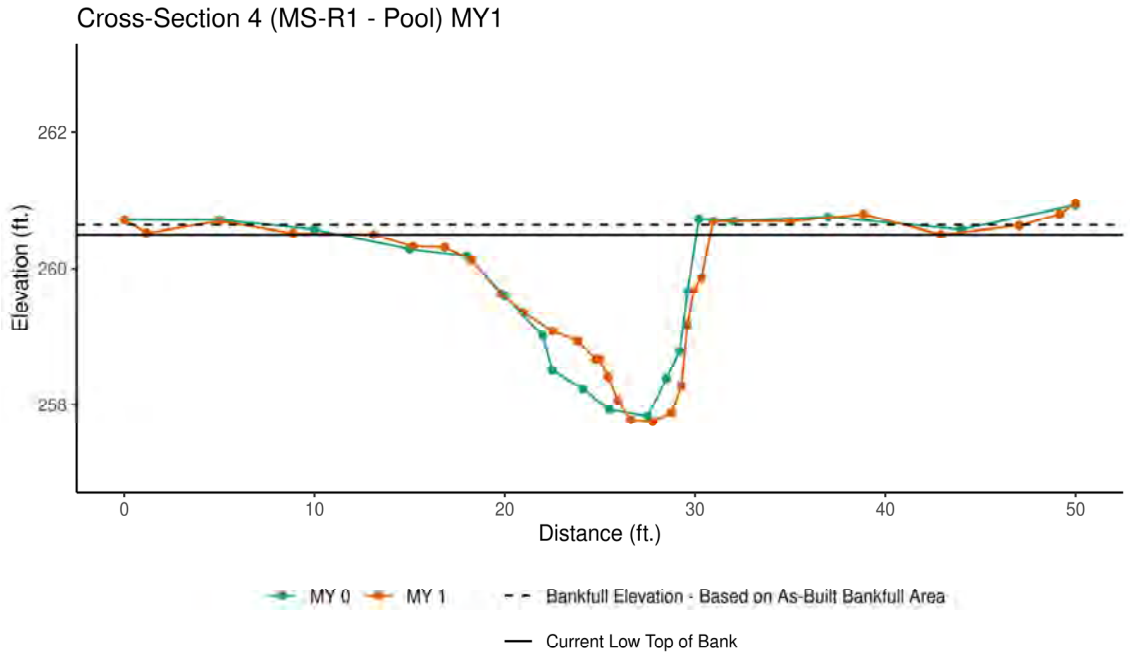
Distance	Elevation	Features
0	267.239	TLP
1.66029907	267.123	
5.06937471	267.058	
9.07713655	267.138	
15.1916834	267.104	
16.4318733	266.963	TLB
17.632575	266.663	
18.8054594	266.304	
20.6319822	266.022	
21.8784179	265.678	
22.6475504	265.232	LEW
23.3612647	265.129	
24.3094863	264.851	
24.9831079	264.679	
25.9343831	264.598	
26.842297	264.664	
27.5652059	264.593	THW
28.3272452	264.709	
29.1626732	264.774	
29.6616712	264.833	REW
30.1585415	265.679	
30.7324368	265.838	
31.3250826	266.422	
32.3819525	266.484	TRB, BKF
37.121151	266.533	
41.9843163	266.435	
47.0513903	266.545	
49.1955419	266.61	
50	266.726	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	266.51	266.46						
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.01						
Thalweg Elevation	264.61	264.59						
LTOB Elevation	266.51	266.48						
LTOB Max Depth	1.9	1.891						
LTOB Cross Sectional Area	15.14	15.47						



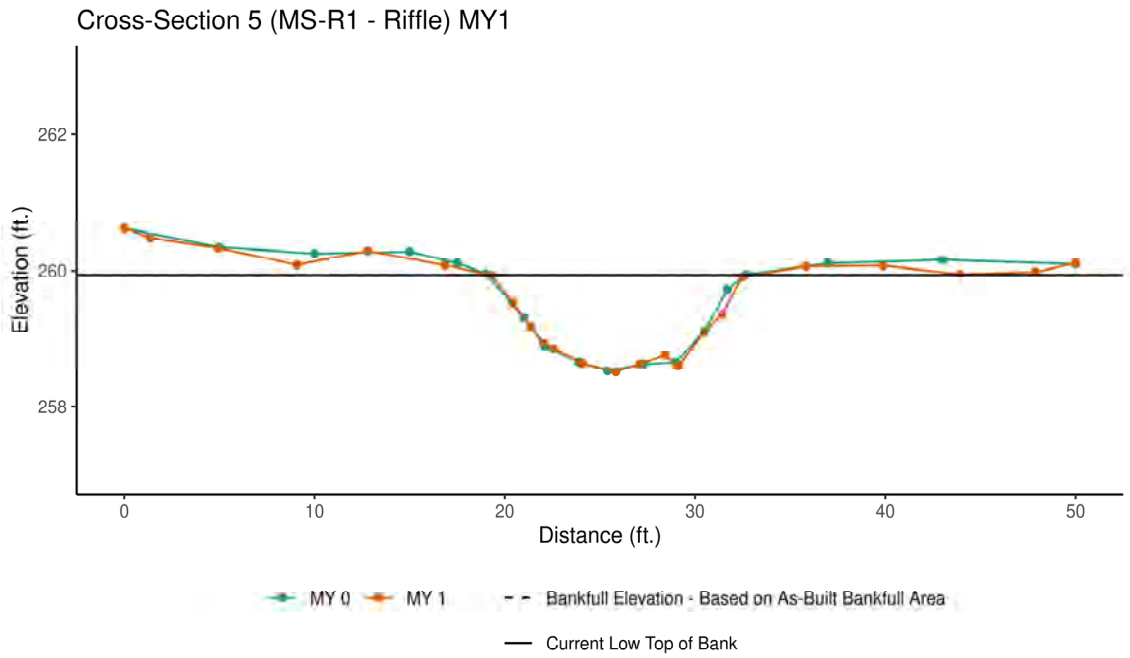
Distance	Elevation	Features
0	266.915	TLP
1.09450445	266.867	
5.08930614	266.948	
9.04461442	266.766	
13.1363505	266.697	
16.0912096	266.692	TLB
17.0471784	266.487	
17.8444568	266.062	
18.8251384	265.605	
19.8923312	265.067	
20.9470622	264.992	
21.8889471	265.061	LEW
23.3026785	264.988	
24.712495	264.907	
26.2349468	264.644	THW
27.1977814	264.772	
27.7339759	264.89	REW
28.5680642	265.511	
29.4613931	265.978	
30.4110304	266.279	
31.096981	266.464	TRB, BKF
34.2614123	266.652	
38.4567673	266.715	
44.0483059	266.61	
48.9261894	266.453	
50	266.472	TRP

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



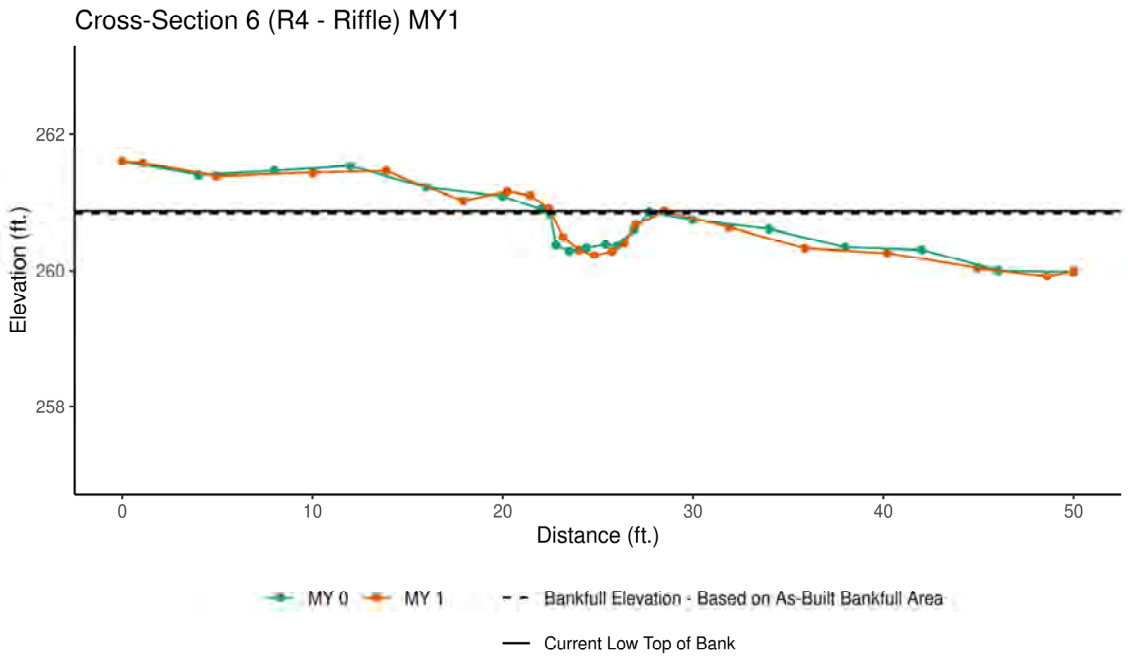
Distance	Elevation	Features
0	260.718	TLP
1.18189043	260.526	
5.00280811	260.698	
8.86648363	260.523	
13.0953587	260.504	TLB, BKF
15.1754963	260.328	
16.8498163	260.317	
18.2406897	260.125	
19.7998449	259.628	
21.005388	259.349	
22.5163032	259.077	
23.8318198	258.937	
24.9887233	258.659	LEW
24.7919499	258.661	
25.4380727	258.402	
25.9502596	258.06	
26.6279148	257.774	
27.7754755	257.746	THW
28.7590621	257.883	
29.288742	258.271	
29.597237	259.168	REW
29.9287238	259.673	
30.3429652	259.87	
30.942659	260.695	TRB
35.0170936	260.696	
38.8723928	260.794	
42.9398283	260.505	
47.0416013	260.635	
49.1736621	260.797	
50	260.951	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	260.58	260.64						
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.95						
Thalweg Elevation	257.83	257.75						
LTOB Elevation	260.58	260.50						
LTOB Max Depth	2.75	2.758						
LTOB Cross Sectional Area	23.68	21.25						



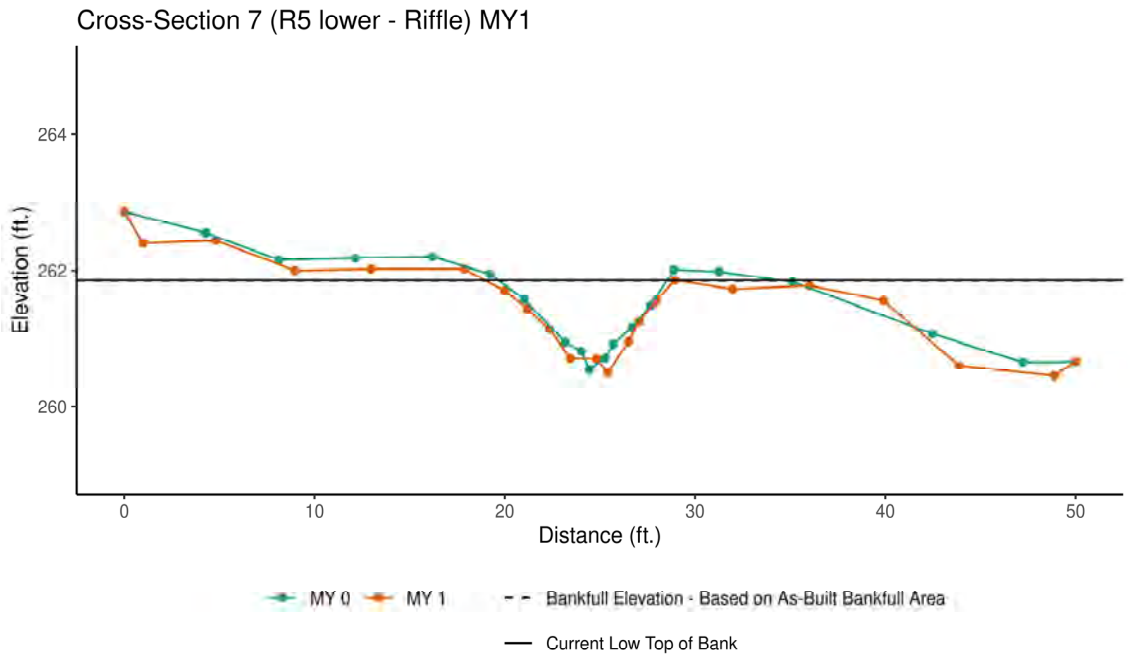
Distance	Elevation	Features
0	260.627	TLP
1.36720518	260.484	
4.9490098	260.33	
9.07314637	260.084	
12.7966094	260.288	
16.8604219	260.078	
19.2807294	259.937	TLB, BKF
20.4164466	259.529	
21.3685663	259.172	
22.0398887	258.924	
22.5333	258.85	LEW
24.1002391	258.626	
25.8377029	258.504	THW
27.0894532	258.615	
28.423525	258.753	REW
29.1347467	258.593	
29.0541826	258.592	
30.4775229	259.088	
31.4177478	259.354	
32.4857201	259.909	
35.8275025	260.063	TRB
39.8699424	260.075	
43.899666	259.948	
47.8879112	259.98	
50	260.109	TRP

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



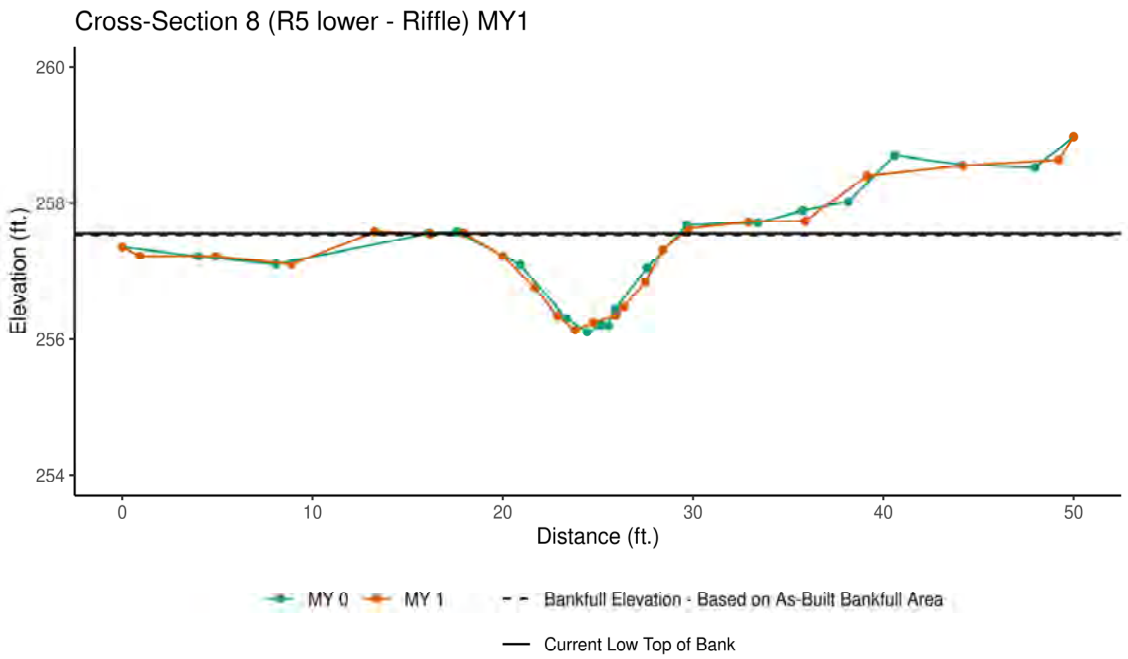
Distance	Elevation	Features
0	261.605	TLP
1.08301293	261.58	
4.96370688	261.389	
10.0433242	261.44	
13.8674419	261.462	
17.9335231	261.019	
20.2257812	261.161	
21.4460917	261.1	TLB
22.4334612	260.903	
23.1616288	260.498	LEW
24.0053156	260.303	
24.7978364	260.219	THW
25.7480548	260.281	
26.3680877	260.405	REW
26.9924924	260.67	
28.4992296	260.867	TRB, BKF
31.9376194	260.637	
35.882922	260.329	
40.2179737	260.255	
44.9481537	260.039	
48.6070186	259.921	
50	259.991	TRP

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



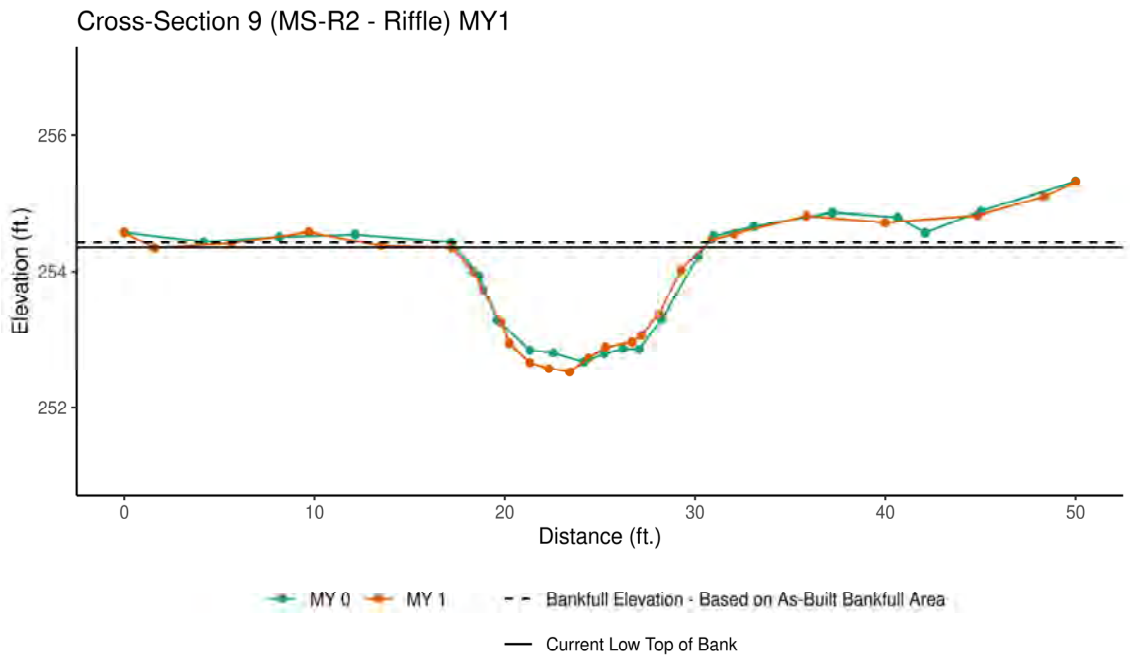
Distance	Elevation	Features
0	262.861	TLP
0.98800051	262.407	
4.80830334	262.448	
8.97281589	262	
12.9867873	262.024	
17.8704355	262.025	TLB
19.9876664	261.702	
21.1916684	261.431	
22.3549668	261.134	
23.4467943	260.703	LEW
24.8132101	260.698	
25.4170512	260.497	THW
26.5051964	260.952	REW
27.0545139	261.251	
27.9338986	261.544	
28.9377264	261.86	TRB, BKF
31.9748849	261.725	
36.0246994	261.778	
39.9147641	261.553	
43.8915735	260.593	
48.8851993	260.448	
50	260.657	TRP

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



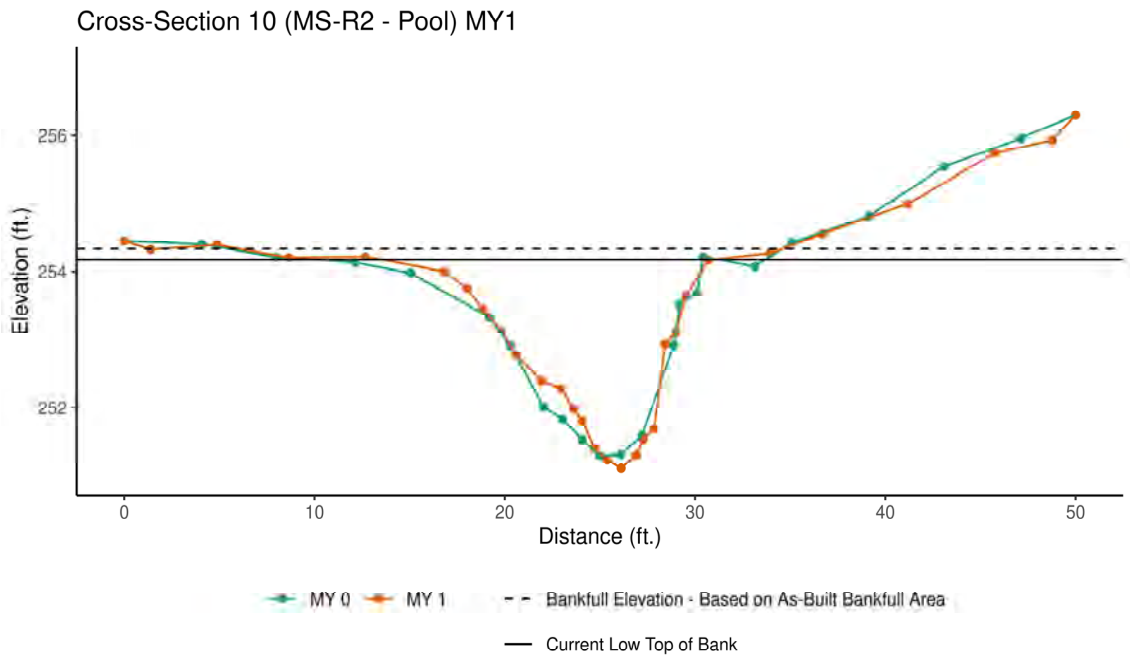
Distance	Elevation	Features
0	257.362	TLP
0.92907266	257.228	
4.92627445	257.223	
8.90200343	257.106	
13.2767421	257.588	
16.1933567	257.557	
17.9659338	257.564	TLB, BKF
19.9983027	257.227	
21.6850335	256.762	
22.8811756	256.343	LEW
23.8055595	256.136	THW
24.7497299	256.249	
25.9341857	256.35	
26.3726559	256.482	REW
27.4941407	256.846	
28.4073312	257.319	
29.7524929	257.635	TRB
32.912213	257.73	
35.890617	257.741	
39.1439305	258.402	
44.1922734	258.555	
49.2116578	258.64	
50	258.975	TRP

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



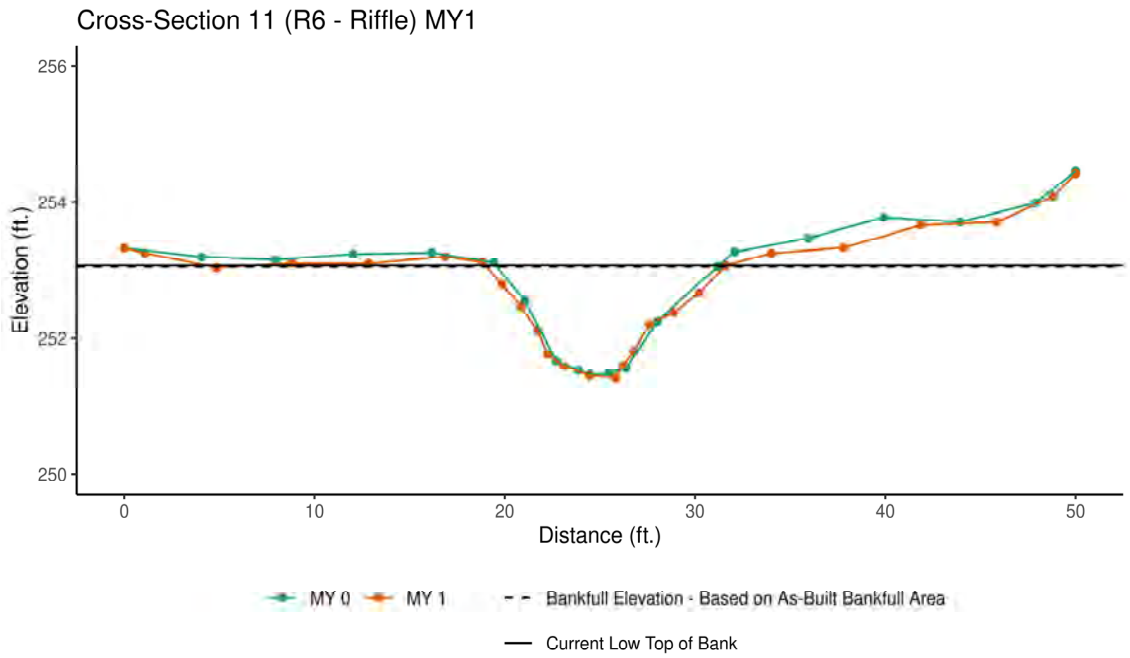
Distance	Elevation	Features
0	254.58	TLP
1.58507035	254.347	
5.61094823	254.422	
9.70787644	254.584	
13.5158398	254.381	
17.2102213	254.355	TLB, BKF
18.3459681	253.997	
18.8533301	253.727	
19.8126074	253.25	
20.2355576	252.945	
21.3091597	252.654	
22.3161529	252.565	
23.4088643	252.517	THW
24.4107776	252.726	
25.2921743	252.886	
26.698527	252.962	
27.1870483	253.057	REW
28.0908359	253.374	
29.2747272	254.026	
30.8796731	254.474	TRB
32.0417858	254.56	
35.8749924	254.814	
39.9901603	254.716	
44.845661	254.823	
48.3637342	255.098	
50	255.316	TRP

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



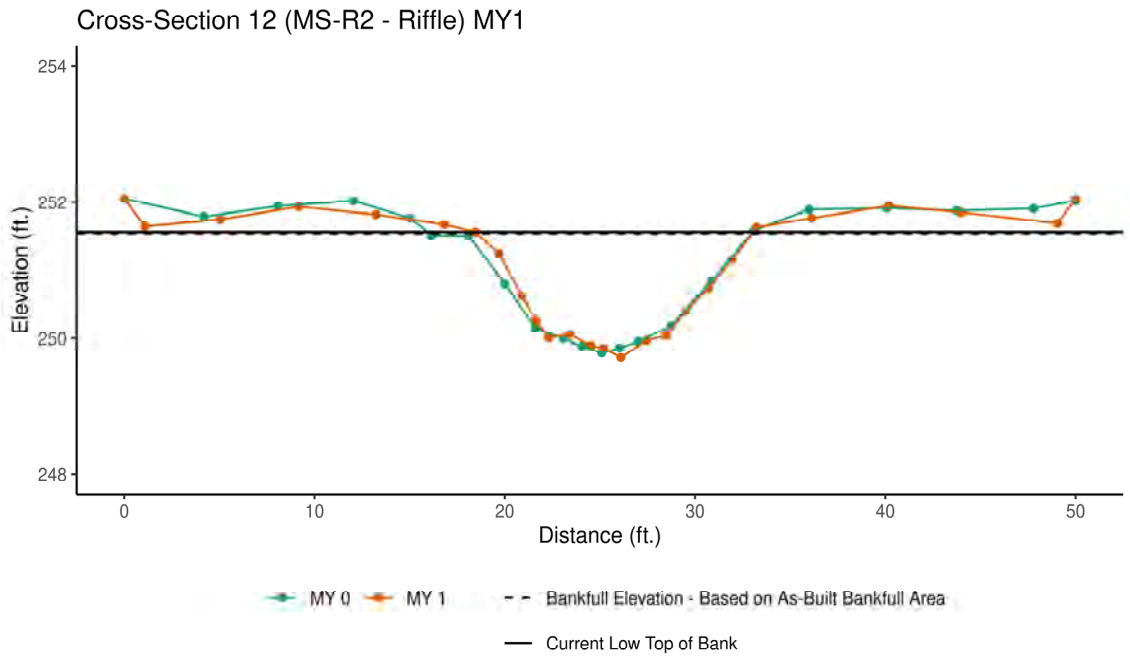
Distance	Elevation	Features
0	254.455	TLP
1.38691348	254.328	
4.87161616	254.397	
8.66896447	254.205	
12.6660351	254.221	TLB
16.8348298	253.998	
18.0215792	253.75	
18.8329017	253.442	
19.8142196	253.133	
20.5955995	252.762	LEW
21.9344823	252.391	
22.9701535	252.276	
23.6178506	251.983	
24.069435	251.8	
24.7307367	251.401	
25.3850128	251.222	
26.1158133	251.1	THW
26.8994636	251.298	
27.2738647	251.532	
27.8499593	251.685	REW
28.4216454	252.931	
28.9767961	253.098	
29.5193928	253.638	
30.70546	254.172	TRB, BKF
33.9386895	254.27	
36.695188	254.56	
41.1765352	254.987	
45.7403537	255.743	
48.7717218	255.933	
50	256.301	TRP

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



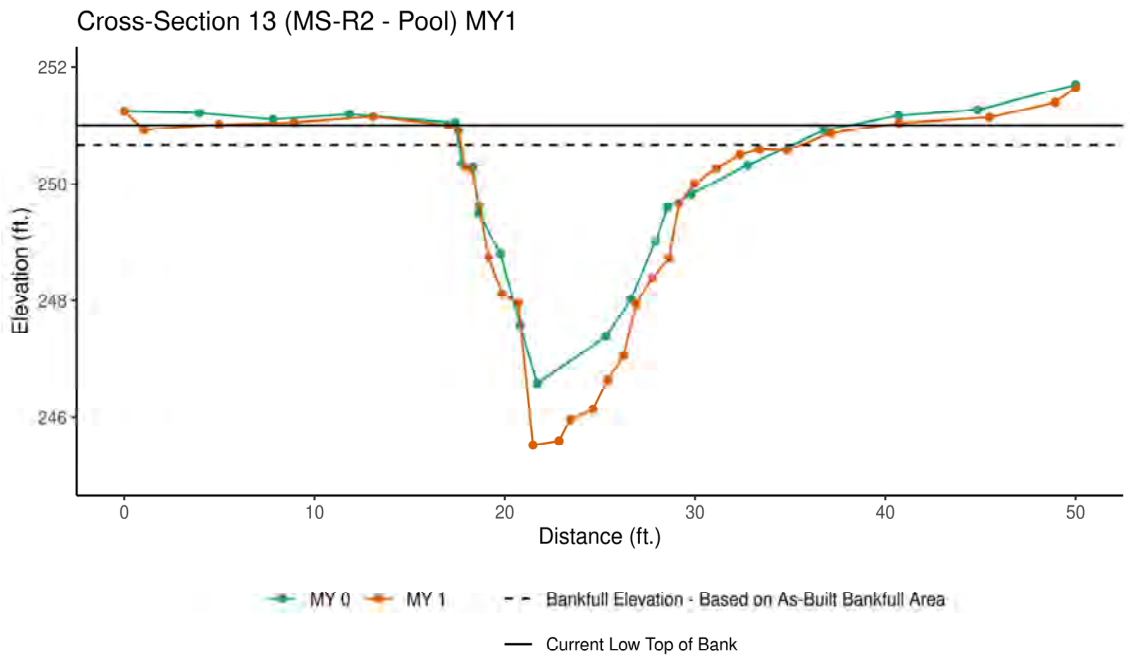
Distance	Elevation	Features
0	253.334	TLP
1.08220377	253.255	
4.84857464	253.043	
8.81132368	253.106	
12.8527896	253.102	
16.8709366	253.203	TLB
18.8158569	253.122	
19.85494	252.801	
20.8523718	252.469	
21.7405627	252.104	
22.2472111	251.768	LEW
23.1197362	251.586	
24.4416094	251.451	
25.8247163	251.418	THW
26.2209227	251.594	
26.7868961	251.808	REW
27.6025434	252.206	
28.8824803	252.385	
30.219162	252.67	
31.6128139	253.074	TRB, BKF
34.0217107	253.253	
37.8098062	253.341	
41.8827747	253.669	
45.8565159	253.711	
48.8379005	254.088	
50	254.423	TRP

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



Distance	Elevation	Features
0	252.051	TLP
1.0858697	251.651	
5.03945404	251.75	
9.15951838	251.935	
13.2363515	251.821	
16.8288468	251.676	
18.4587359	251.568	TLB, BKF
19.7098926	251.248	
20.899627	250.63	LEW
21.6397473	250.263	
22.3094335	250.009	
23.4175602	250.06	
24.5373222	249.89	
25.195684	249.858	
26.1005012	249.716	THW
27.4497065	249.972	
28.4844456	250.04	REW
28.4774547	250.038	
29.5166177	250.401	
30.6976732	250.737	
31.95394	251.156	
33.2442737	251.637	TRB
36.1307542	251.77	
40.1928006	251.949	
44.0151053	251.851	
49.0522599	251.694	
50	252.047	TRP

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



	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	251.18	250.68						
Bank Height Ratio - Based on As-Built Bankfull Area	0.96	1.06						
Thalweg Elevation	247.57	245.52						
LTOB Elevation	251.05	251.01						
LTOB Max Depth	3.48	5.49						
LTOB Cross Sectional Area	35.74	45.43						

Distance	Elevation	Features
0	251.258	TLP
1.02484975	250.929	
4.98061703	251.021	
8.93014496	251.06	
13.0837656	251.159	
17.0068218	251.01	TLB
17.5626069	250.91	
17.9385843	250.288	
18.2574086	250.259	
18.6530787	249.633	
19.1485819	248.739	LEW
19.8679378	248.119	
20.7127585	247.953	
21.4814722	245.52	THW
22.8503591	245.59	
23.4439829	245.957	
24.627839	246.138	
25.4158681	246.635	
26.2479985	247.052	
26.9005745	247.944	
27.7451706	248.39	
28.6212225	248.725	REW
29.1659031	249.674	
29.9679437	250.007	
31.132679	250.265	
32.3645156	250.507	
33.373492	250.594	
34.8455314	250.585	
37.1226716	250.871	
40.738109	251.046	TRB
45.4759864	251.149	
48.9306627	251.406	
50	251.654	TRP

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						266.51	266.46						266.54	266.41						260.58	260.64					
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.00						1.00	1.01						1.00	1.03						1.00	0.95					
Thalweg Elevation	268.18	268.45						264.61	264.59						265.08	264.64						257.83	257.75					
LTOB[2] Elevation	269.76	269.75						266.51	266.48						266.54	266.46						260.58	260.50					
LTOB[2] Max Depth (ft)	1.58	1.30						1.90	1.89						1.46	1.82						2.75	2.76					
LTOB[2] Cross Sectional Area (ft^2)	6.88	6.88						15.14	15.47						15.47	16.23						23.68	21.25					
	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						260.86	260.84						261.95	261.85						257.59	257.54					
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.00						1.00	1.05						1.00	1.01						1.00	1.02					
Thalweg Elevation	258.52	258.50						260.34	260.22						260.54	260.50						256.11	256.14					
LTOB[2] Elevation	259.95	259.94						260.86	260.87						261.95	261.86						257.59	257.56					
LTOB[2] Max Depth (ft)	1.43	1.43						0.52	0.65						1.41	1.36						1.48	1.43					
LTOB[2] Cross Sectional Area (ft^2)	12.96	12.95						2.10	2.26						6.62	6.70						8.35	8.61					
	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						254.21	254.34						253.11	253.05						251.51	251.55					
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.96						1.00	0.95						1.00	1.01						1.00	1.01					
Thalweg Elevation	252.66	252.52						251.29	251.10						251.46	251.42						249.79	249.72					
LTOB[2] Elevation	254.44	254.36						254.21	254.17						253.11	253.07						251.51	251.57					
LTOB[2] Max Depth (ft)	1.78	1.84						2.92	3.07						1.65	1.66						1.73	1.85					
LTOB[2] Cross Sectional Area (ft^2)	15.98	15.00						25.22	22.39						11.39	11.65						16.19	16.47					

	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					
Bank Height Ratio_Based on AB Bankfull[1] Area	0.96	1.06					
Thalweg Elevation	247.57	245.52					
LTOB[2] Elevation	251.05	251.01					
LTOB[2] Max Depth (ft)	3.48	5.49					
LTOB[2] Cross Sectional Area (ft^2)	35.74	45.43					

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.

Appendix D:
Hydrologic Data

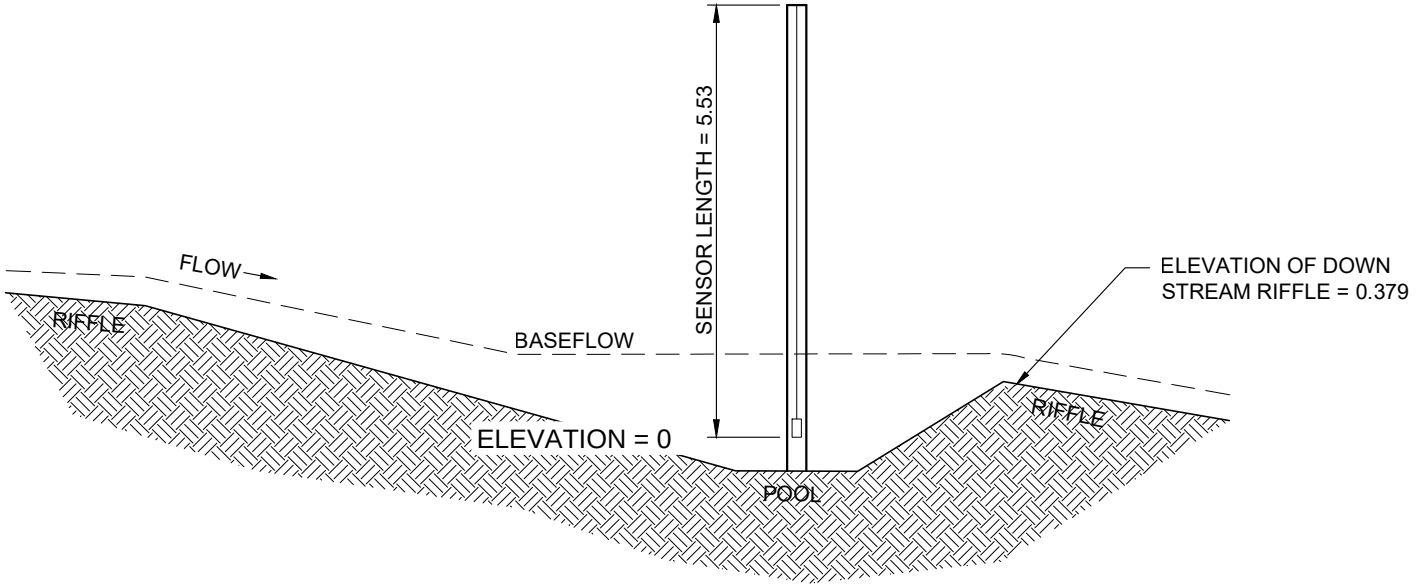
Verification of Bankfull Events
Flow Gauge and Crest Gauge Installation Diagrams
Flow Gauge and Crest Gauge Graphs
Wetland Hydrology Criteria and Hydrographs
Rainfall Data Table
Wetland Gauge Soil Notes MY0

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

7/13/2021

11/9/2021

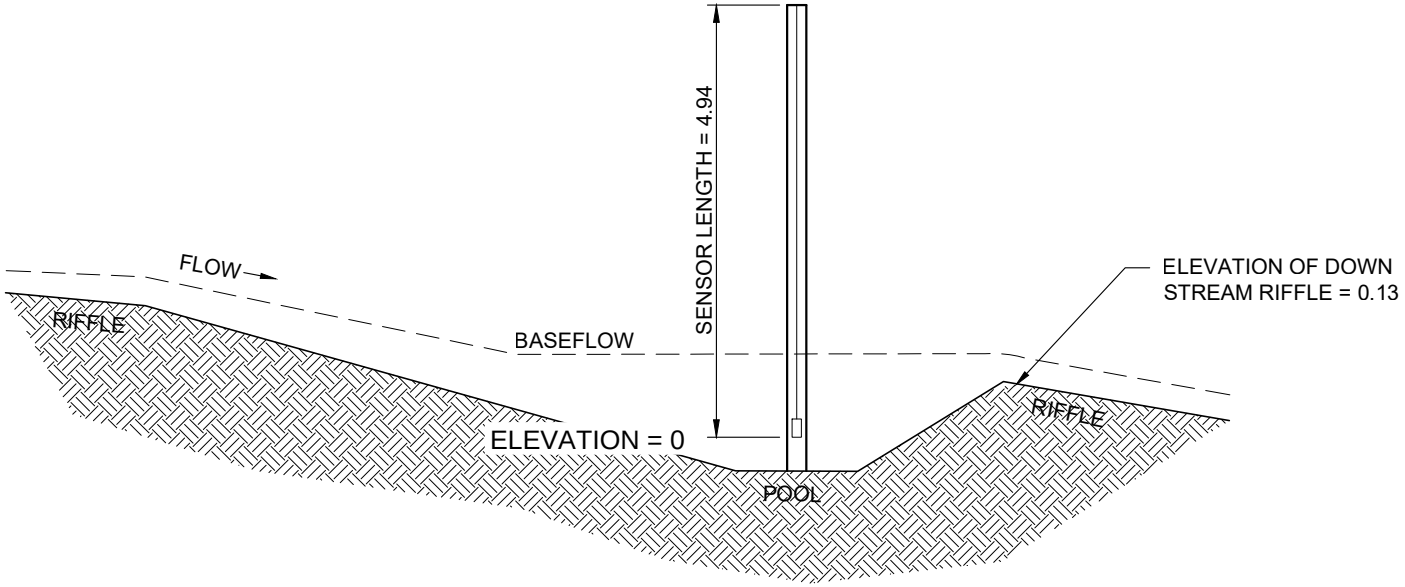
11/9/2021



FLOW GAUGE #1 - R4

Flow Depth = 0.379 feet

*All elevations relative to sensor depth

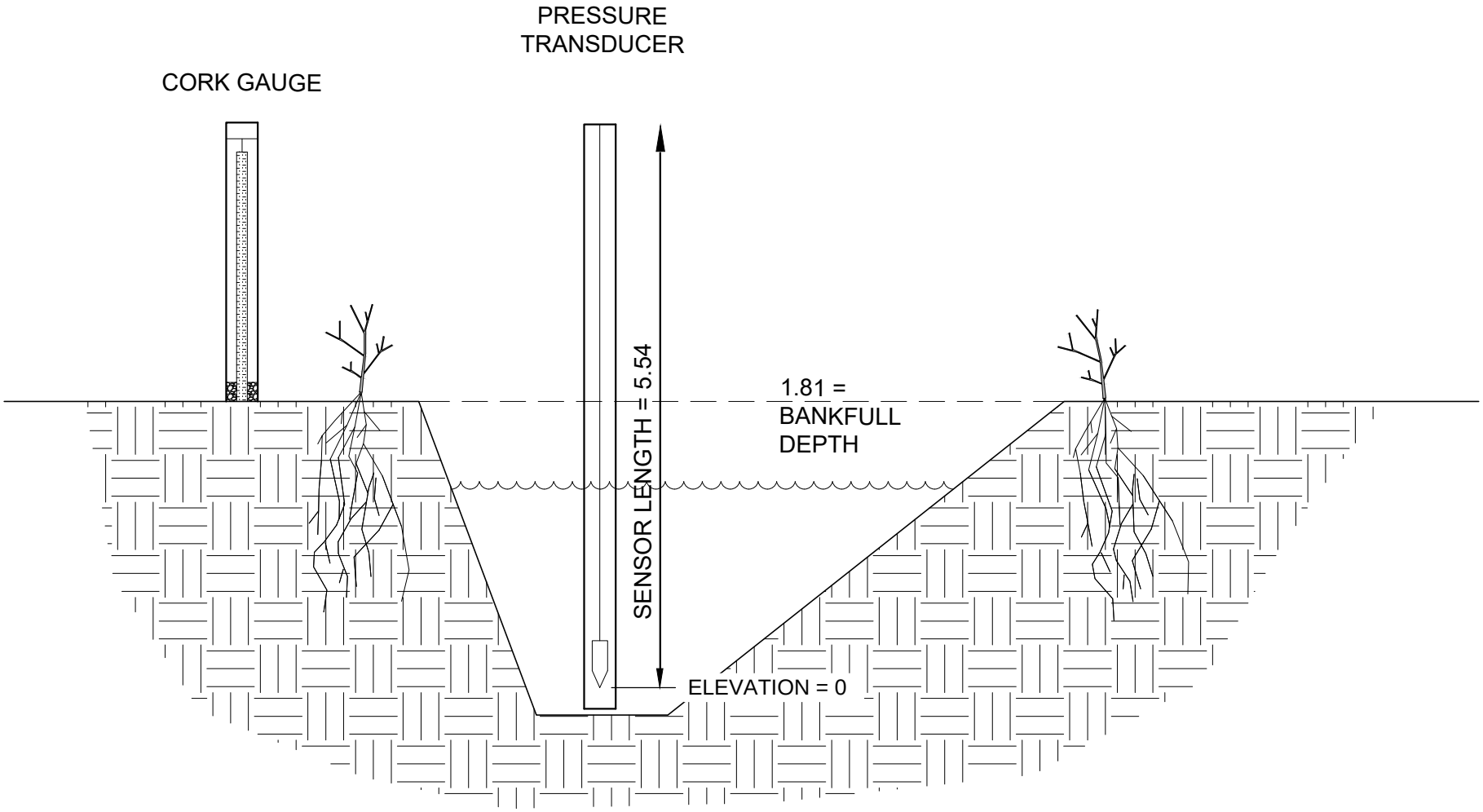


FLOW GAUGE #2 - R6

Flow Depth = 0.13 feet

*All elevations relative to sensor depth

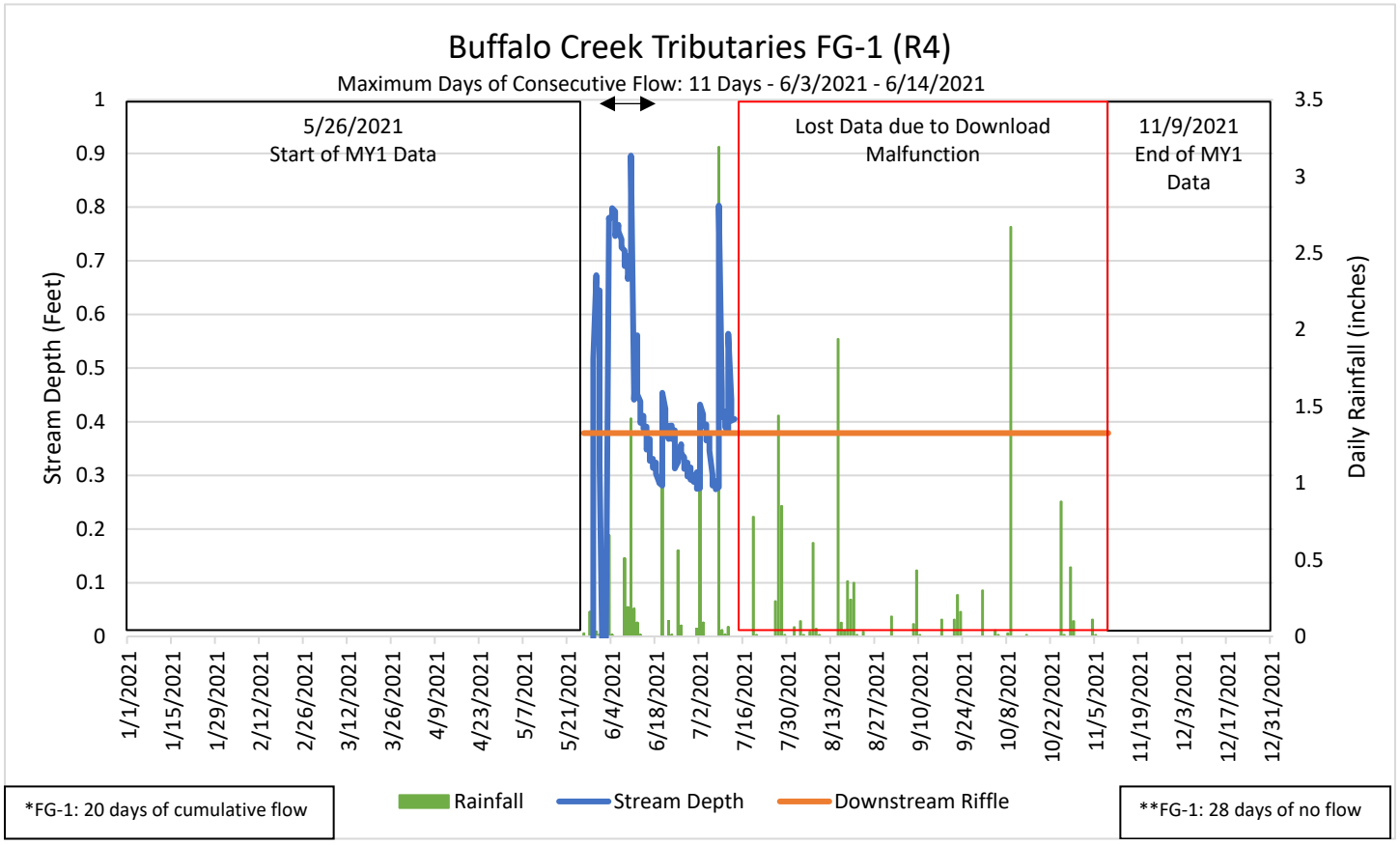
CROSS SECTIONAL VIEW OF STREAM

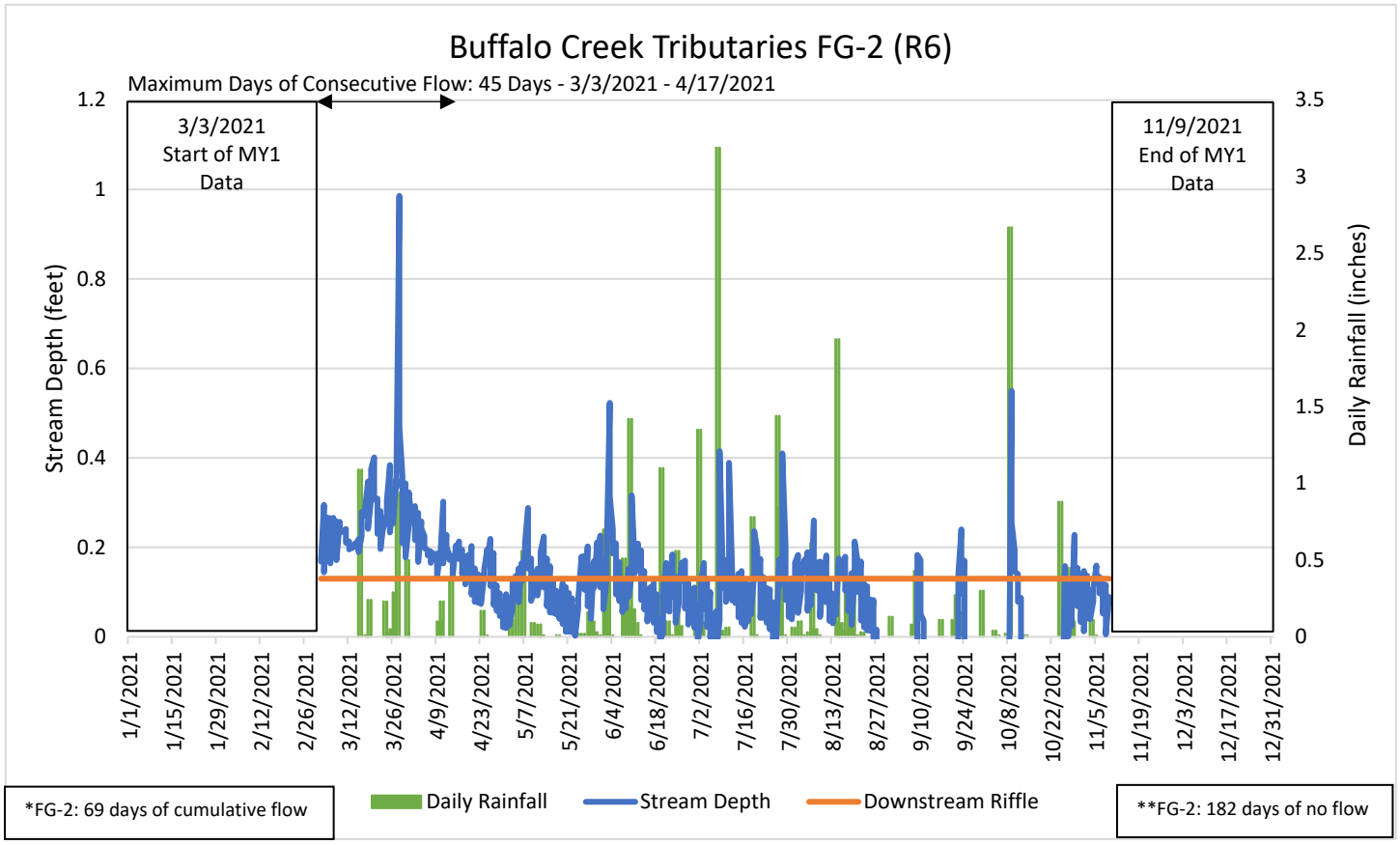


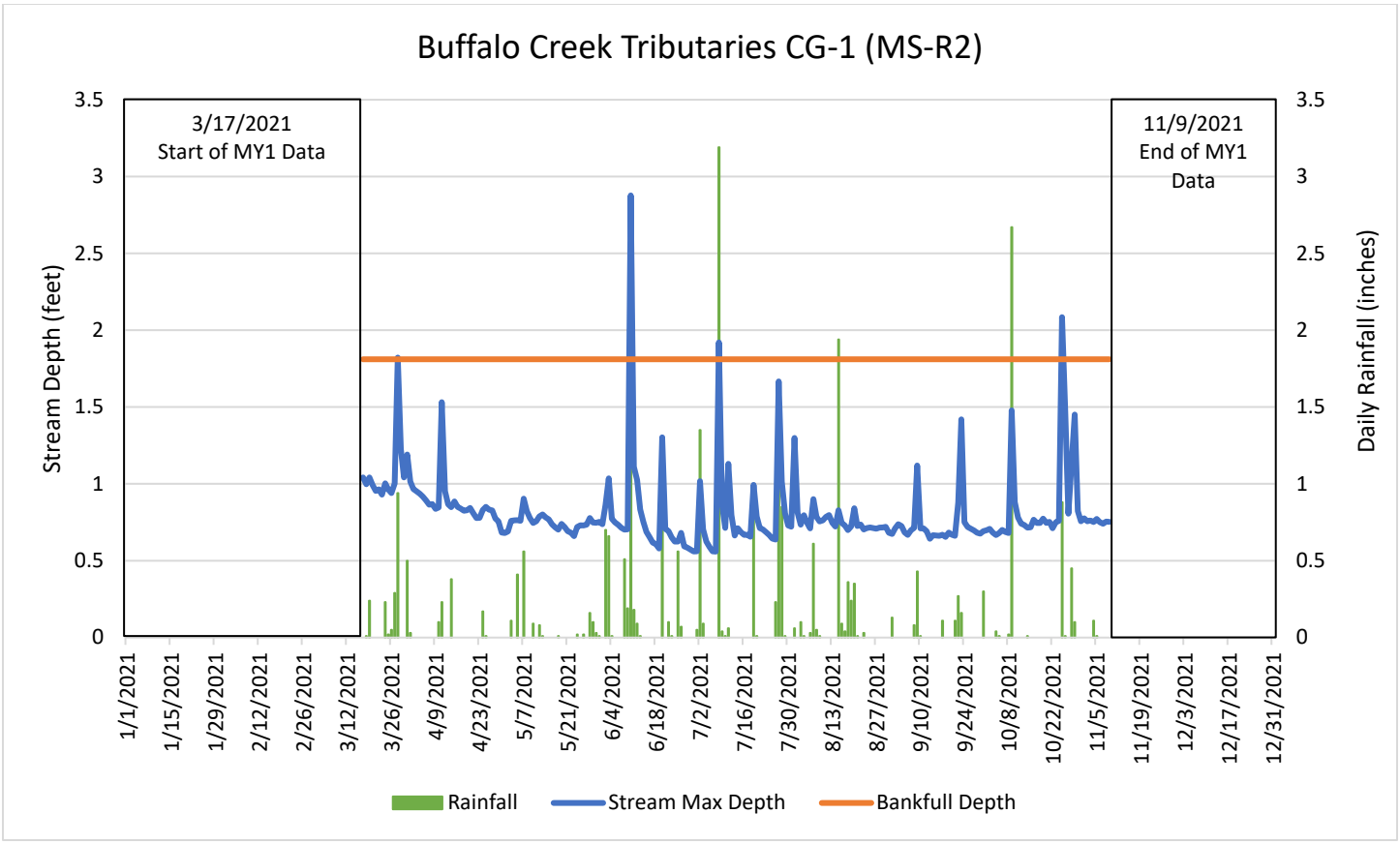
Crest Gauge CG-1 (MS-R2)

Bankfull Event Depth = 1.81

*All elevations relative to sensor depth

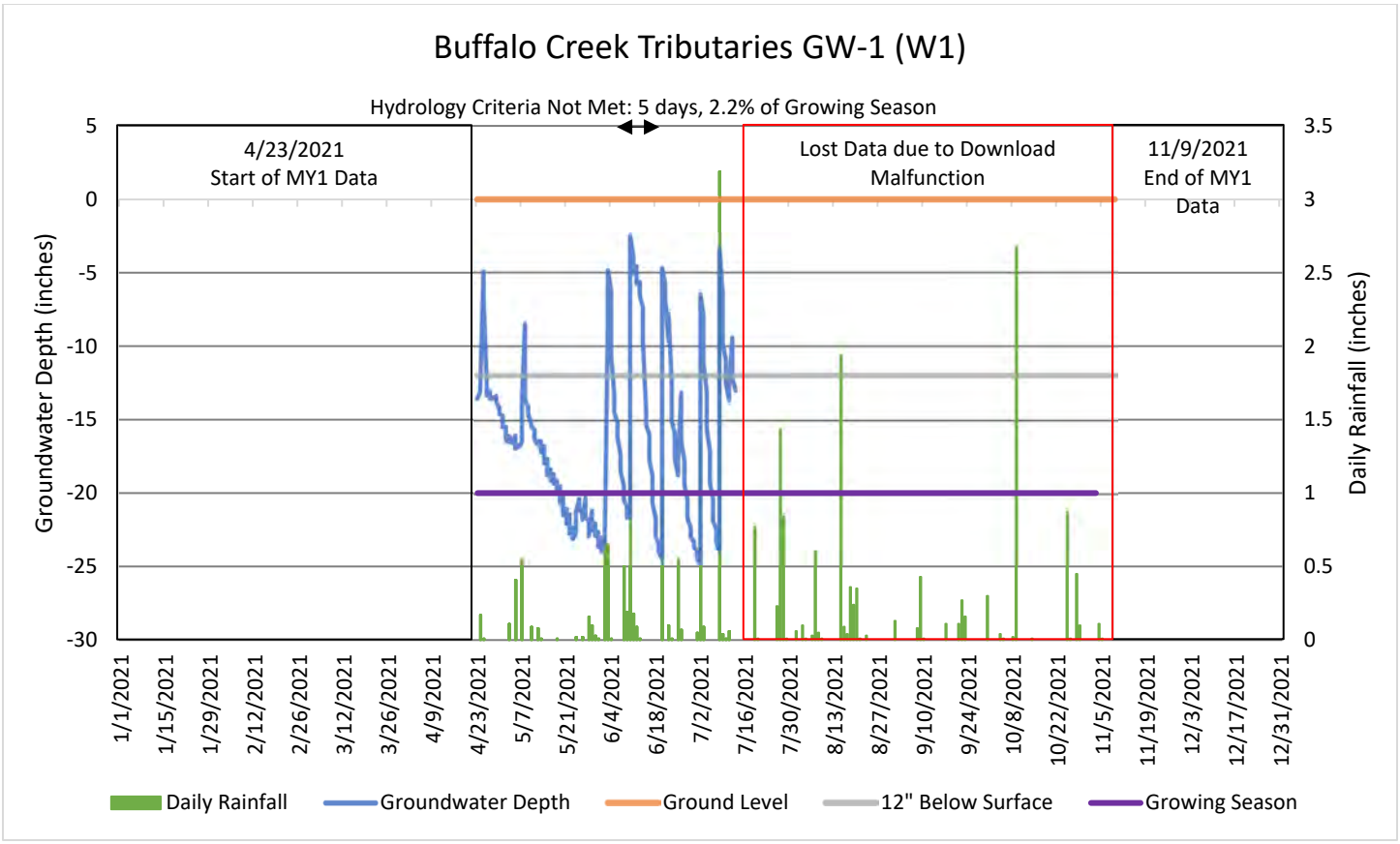

Buffalo Creek Tributaries FG-1 (R4)
Maximum Days of Consecutive Flow: 11 Days - 6/3/2021 - 6/14/2021
5/26/2021
Start of MY1 Data
Lost Data due to Download Malfunction
11/9/2021
End of MY1 Data
Stream Depth (Feet)
Daily Rainfall (inches)
*FG-1: 20 days of cumulative flow
Rainfall
Stream Depth
Downstream Riffle
**FG-1: 28 days of no flow

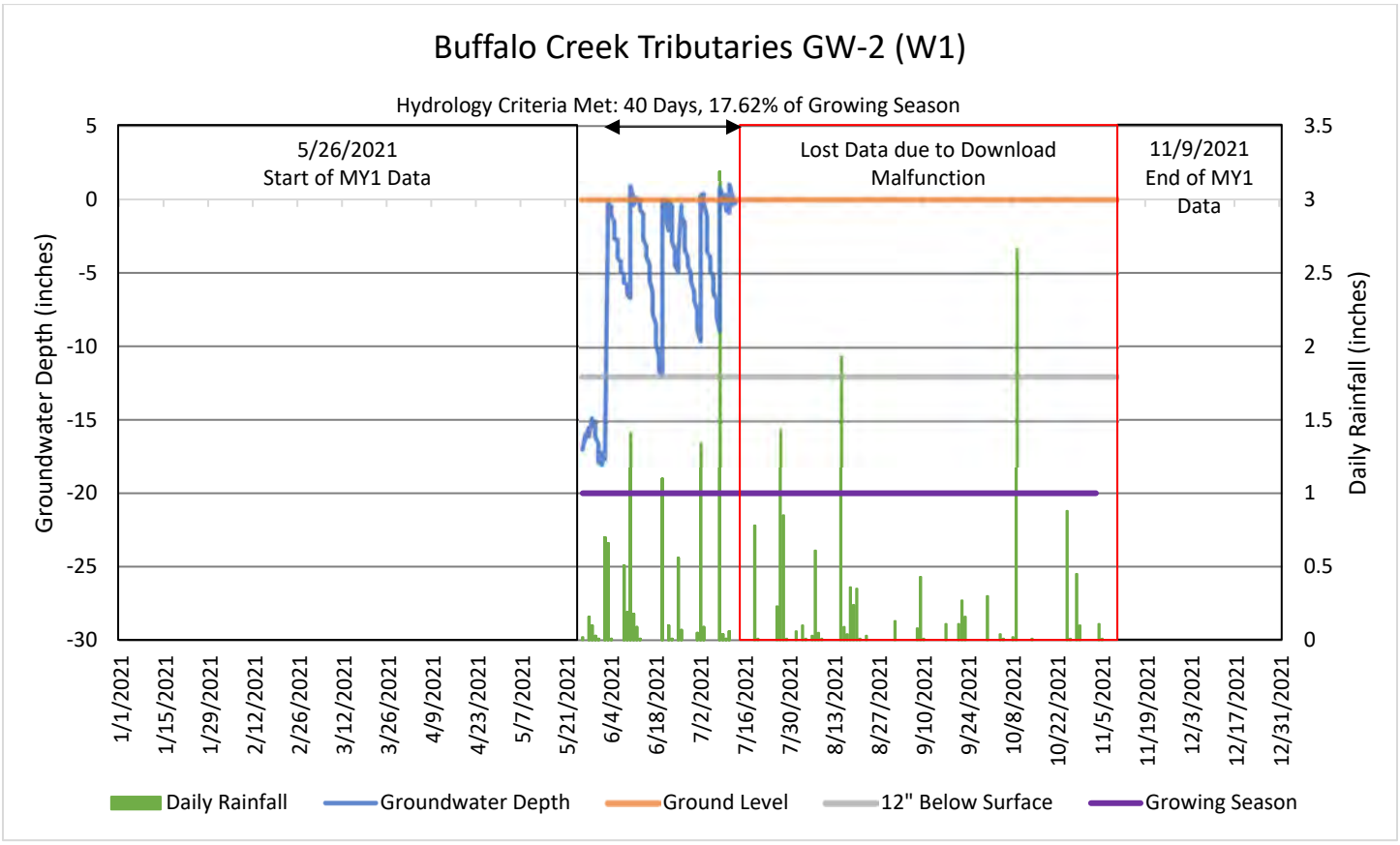

Buffalo Creek Tributaries FG-2 (R6)
Maximum Days of Consecutive Flow: 45 Days - 3/3/2021 - 4/17/2021
3/3/2021
Start of MY1 Data
11/9/2021
End of MY1 Data
Stream Depth (feet)
Daily Rainfall (inches)
*FG-2: 69 days of cumulative flow
Daily Rainfall
Stream Depth
Downstream Riffle
**FG-2: 182 days of no flow

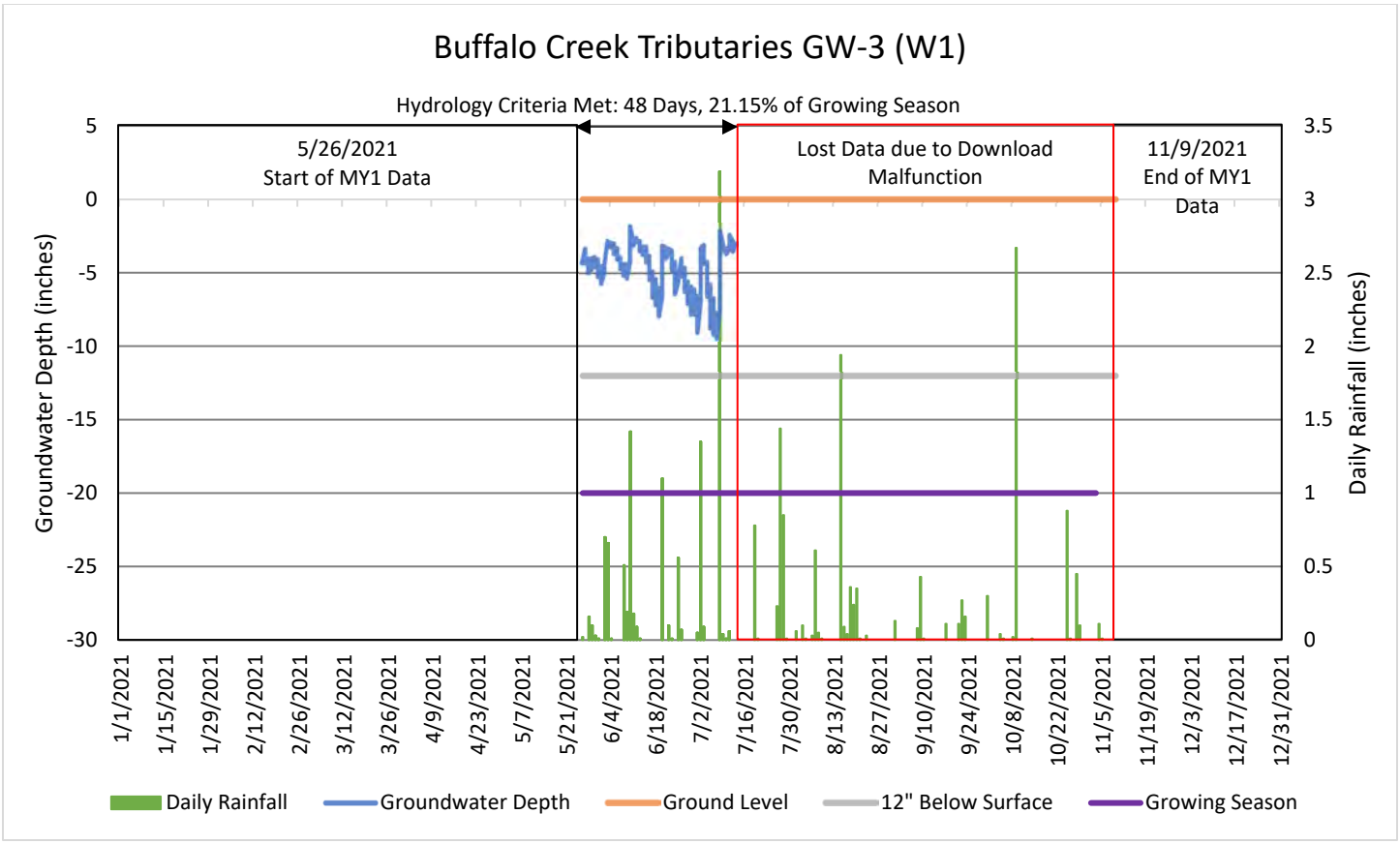

Buffalo Creek Tributaries CG-1 (MS-R2)
3/17/2021
Start of MY1 Data
11/9/2021
End of MY1
Data
Stream Depth (feet)
Daily Rainfall (inches)
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
9/10/2021
9/24/2021
10/8/2021
10/22/2021
11/5/2021
11/19/2021
12/3/2021
12/17/2021
12/31/2021
Rainfall
Stream Max Depth
Bankfull Depth

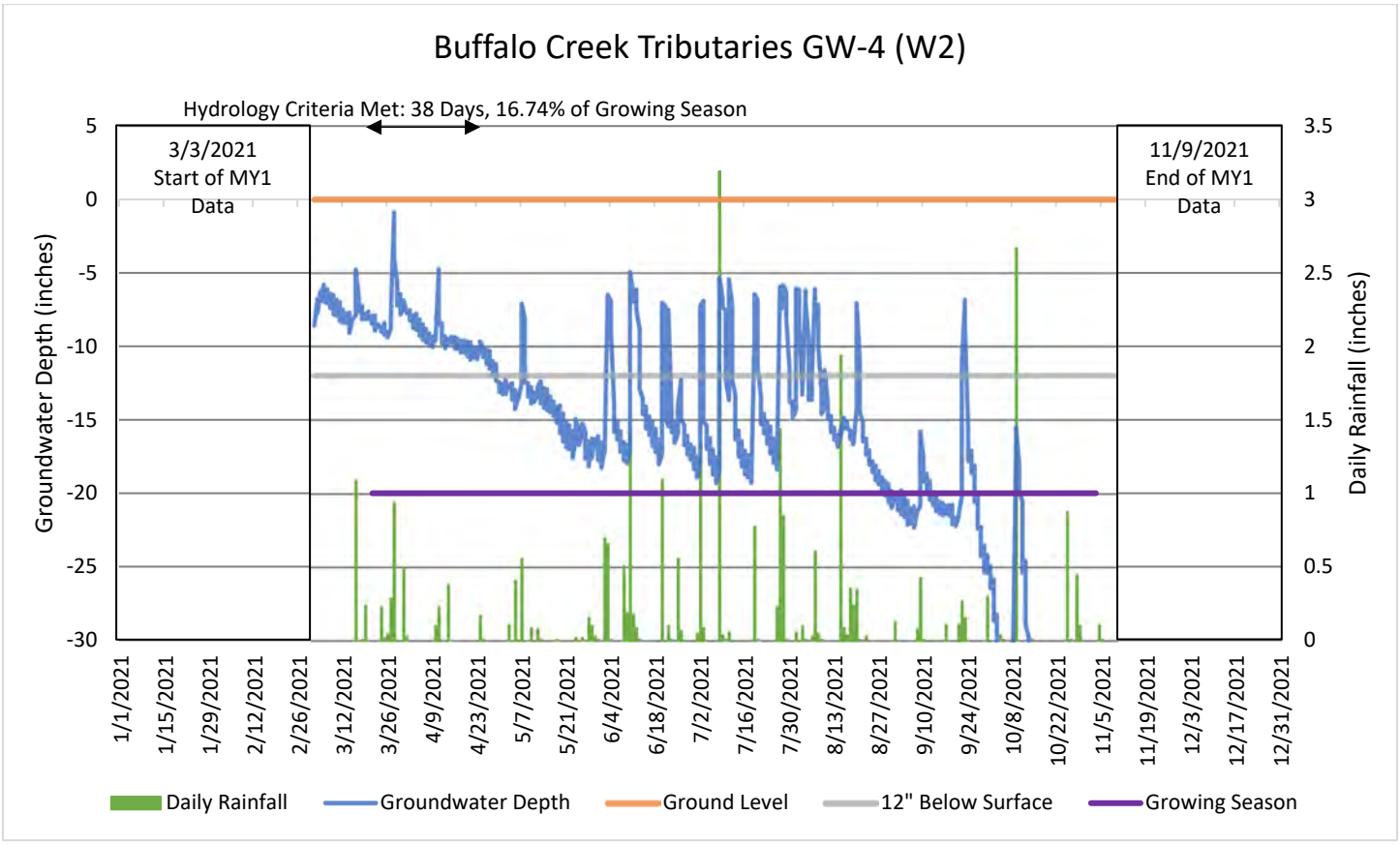
Max Consecutive Hydroperiod Saturation within 12 Inches of Soil Surface (Percent of Growing Season 3/21-11/3) CRONOS Station:Clayton (CLAY)								
Monitoring Gauge Name	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**Mean**
Groundwater Gauge 1 (W1)	2.20%							**2.20%**
Groundwater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

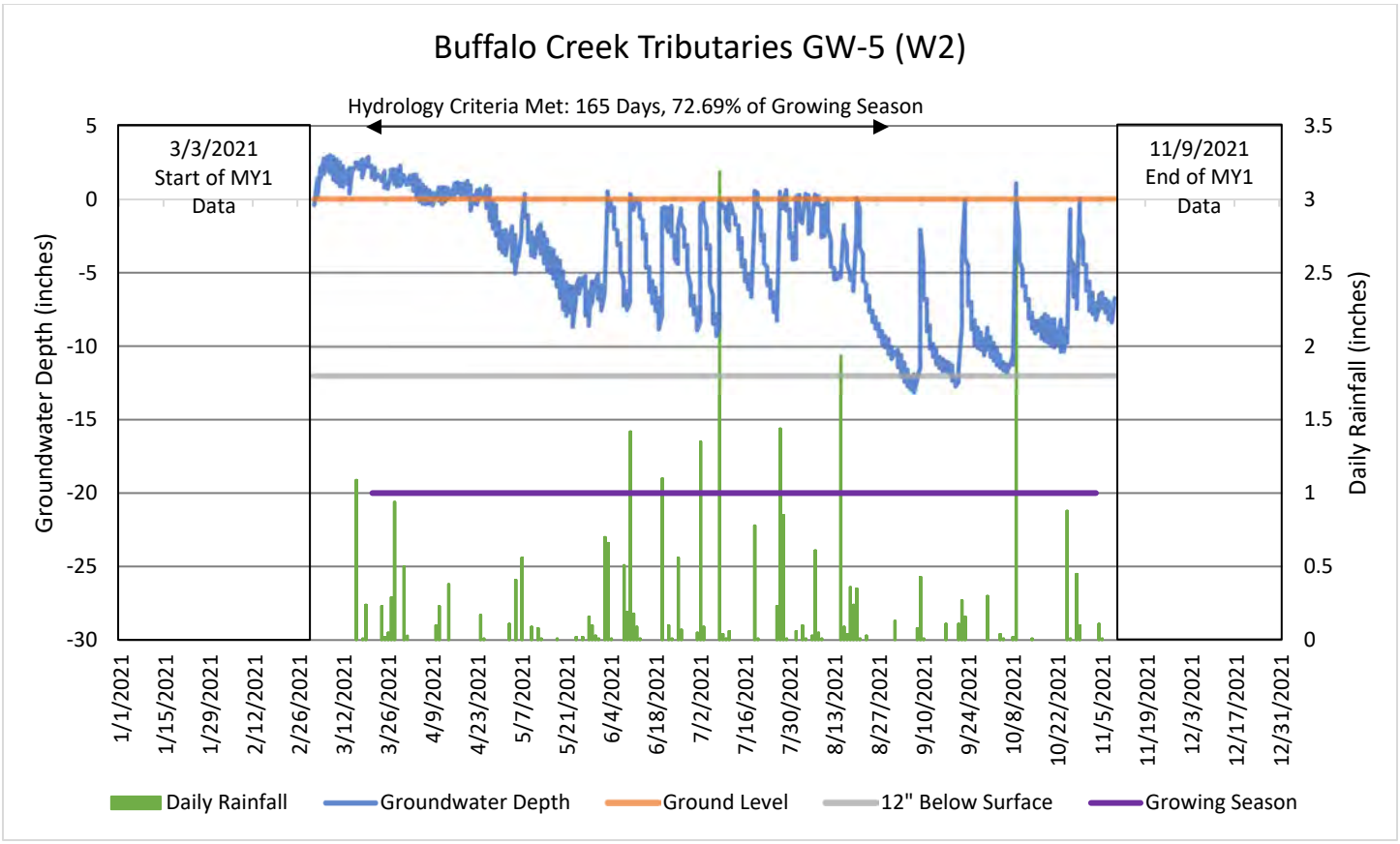
Groundwater Gauge Graphs

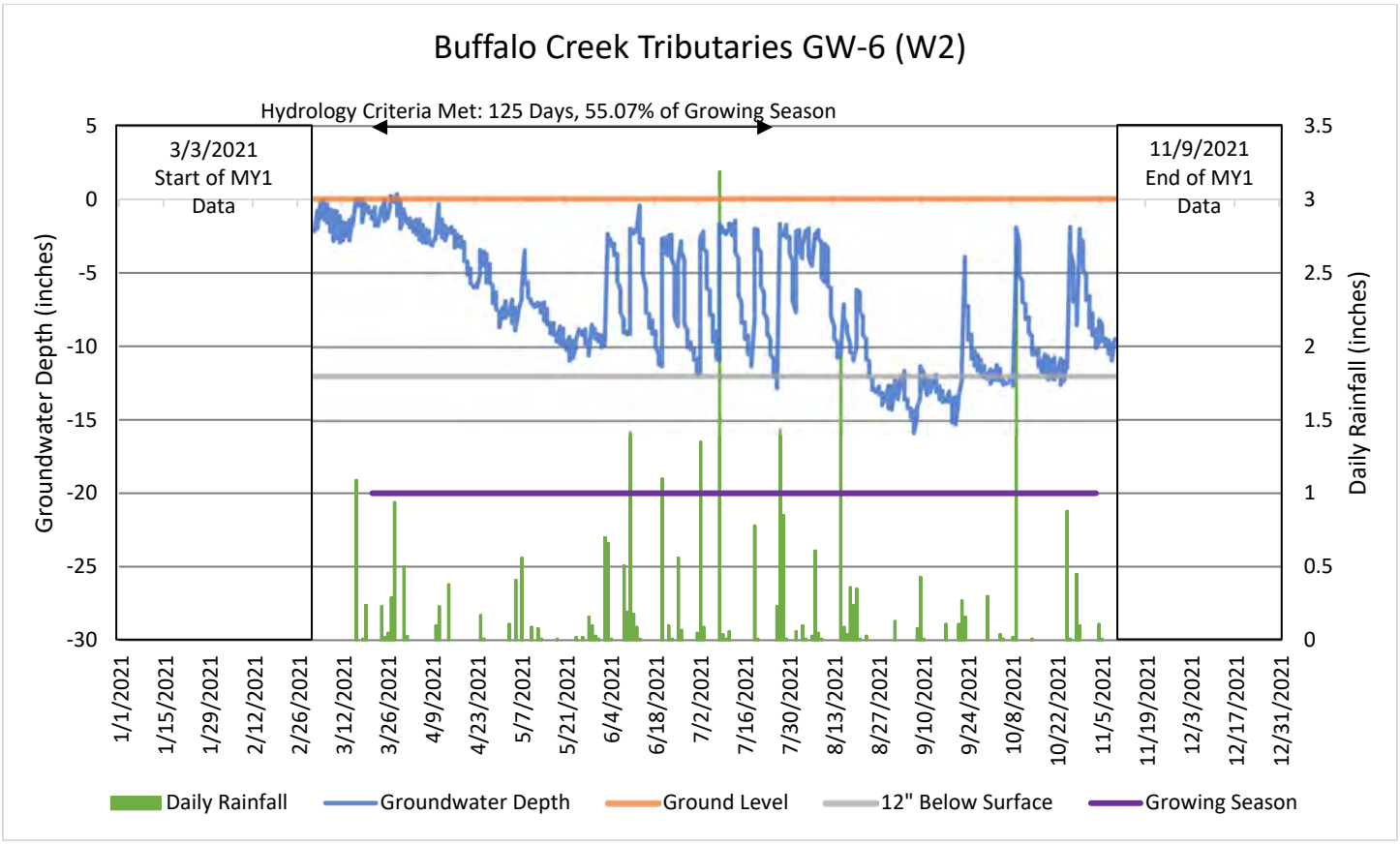


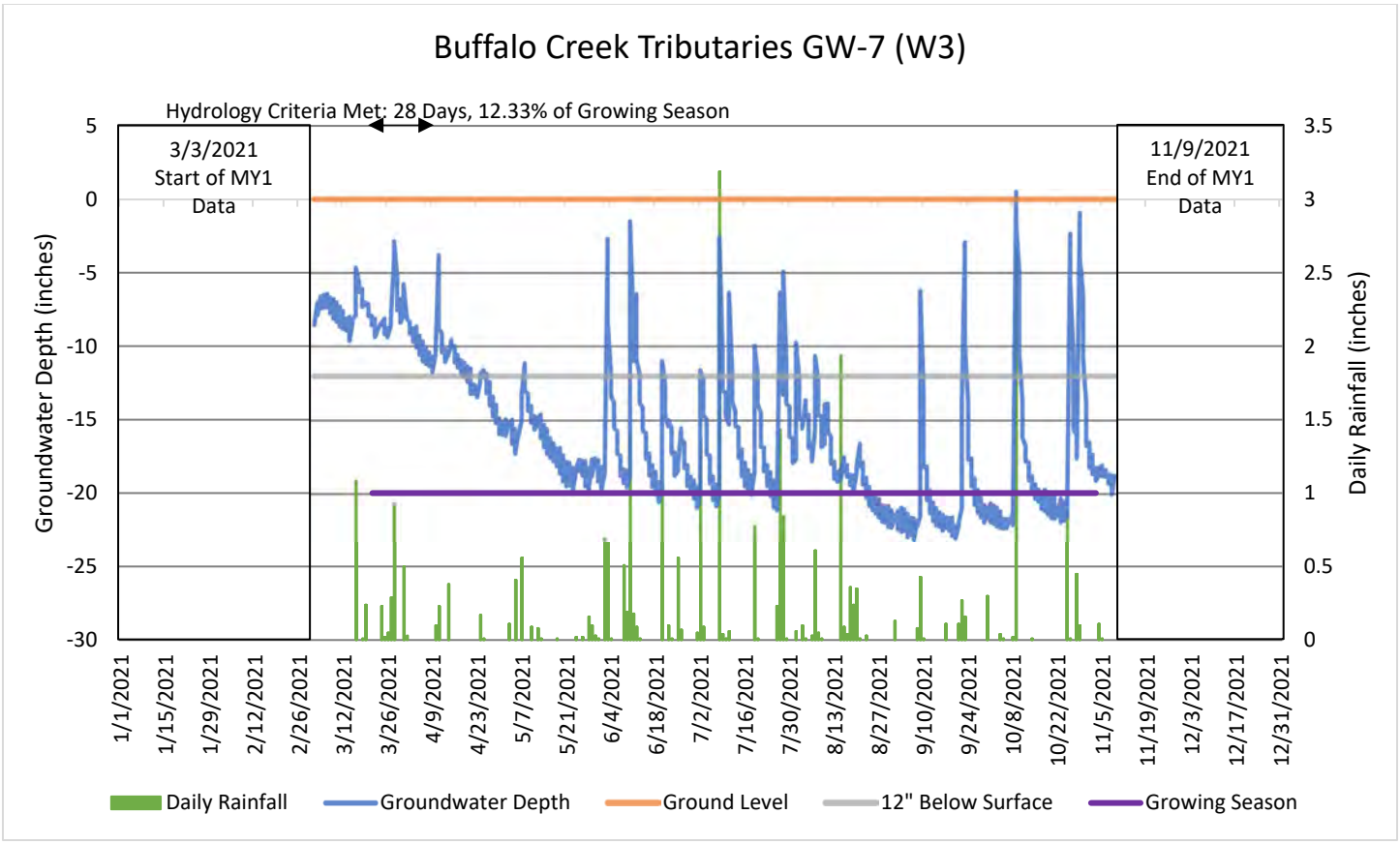



Buffalo Creek Tributaries GW-3 (W1)
Hydrology Criteria Met: 48 Days, 21.15% of Growing Season
5/26/2021
Start of MY1 Data
Lost Data due to Download Malfunction
11/9/2021
End of MY1 Data
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
9/10/2021
9/24/2021
10/8/2021
10/22/2021
11/5/2021
11/19/2021
12/3/2021
12/17/2021
12/31/2021
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface
Growing Season

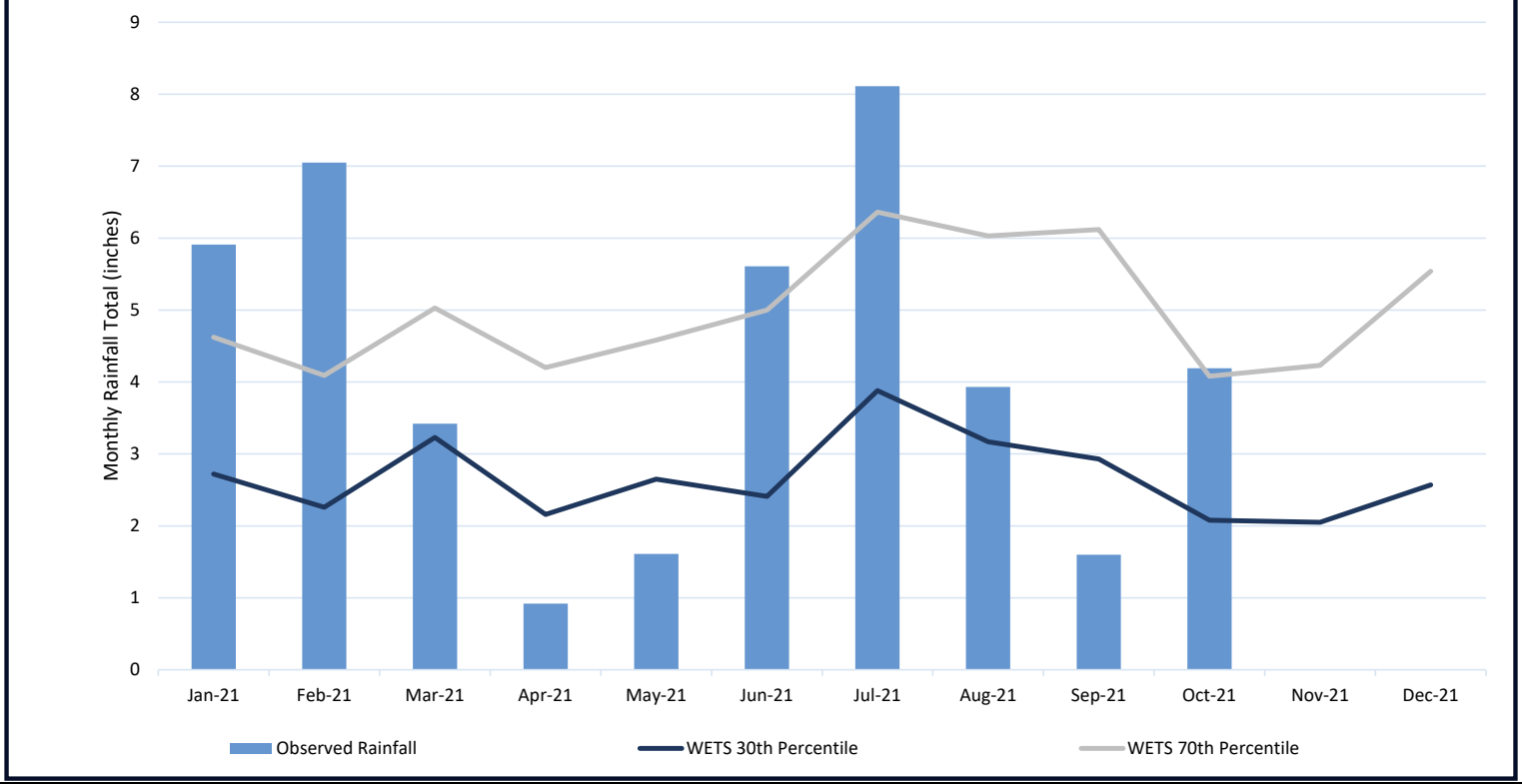

Buffalo Creek Tributaries GW-4 (W2)
Hydrology Criteria Met: 38 Days, 16.74% of Growing Season
3/3/2021
Start of MY1 Data
11/9/2021
End of MY1 Data
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
9/10/2021
9/24/2021
10/8/2021
10/22/2021
11/5/2021
11/19/2021
12/3/2021
12/17/2021
12/31/2021
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface
Growing Season


Buffalo Creek Tributaries GW-5 (W2)
Hydrology Criteria Met: 165 Days, 72.69% of Growing Season
3/3/2021
Start of MY1
Data
11/9/2021
End of MY1
Data
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
9/10/2021
9/24/2021
10/8/2021
10/22/2021
11/5/2021
11/19/2021
12/3/2021
12/17/2021
12/31/2021
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface
Growing Season


Buffalo Creek Tributaries GW-6 (W2)
Hydrology Criteria Met: 125 Days, 55.07% of Growing Season
3/3/2021
Start of MY1
Data
11/9/2021
End of MY1
Data
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
9/10/2021
9/24/2021
10/8/2021
10/22/2021
11/5/2021
11/19/2021
12/3/2021
12/17/2021
12/31/2021
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface
Growing Season


Buffalo Creek Tributaries GW-7 (W3)
Hydrology Criteria Met: 28 Days, 12.33% of Growing Season
3/3/2021
Start of MY1
Data
11/9/2021
End of MY1
Data
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
9/10/2021
9/24/2021
10/8/2021
10/22/2021
11/5/2021
11/19/2021
12/3/2021
12/17/2021
12/31/2021
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface
Growing Season

Buffalo Creek Mitigation Site
Rainfall Data



Rainfall Summary Table												
	Jan-2021	Feb-2021	Mar-2021	Apr-2021	May-2021	Jun-2021	Jul-2021	Aug-2021	Sep-2021	Oct-2021	Nov-2021	Dec-2021
Observed Rainfall	5.91	7.05	3.42	0.92	1.61	5.61	8.11	3.93	1.6	4.19	**	**
WETS 30th Percentile	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	4.62	4.09	5.03	4.2	4.58	5	6.36	6.03	6.12	4.08	4.23	5.54
Normal	H	H	N	L	L	H	H	N	L	H	**	**

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

Groundwater Gauge Installation Soil Notes						
	Depth (inches)	Matrix Color	%	Redox Color	%	Texture
GW-1	0-4	10 YR 2/1	100			Sandy Loam
	4-20	10 YR 3/1	80	10 YR 5/2	20	Sandy Loam
	20-30	10 YR 2/1	90	10 YR 6/8	10	Sandy Loam
	30-36	10 YR 4/1	80	10 YR 3/2	20	Sandy Loam
GW-2	0-24	10 YR 2/1	40	10 YR 4/2	40	Clay Loam
				10 YR 6/8	20	
	24-30	10 YR 2/1	100			Loam
GW-3	0-4	10 YR 2/1	100			Silty Loam
	4-16	10 YR 4/1	90	10 YR 4/6	10	Loam
	16-24	10 YR 2/2	100			Clay Loam
	24-36	10 YR 4/1	100			Clay
GW-4	0-18	2.5 YR 4/8	100			Clay
	18-36	2.5 YR 4/8	75	10 YR 3/1	25	Clay
	36-42	10 YR 5/2	100			Sand
GW-5	0-8	10 YR 4/3	100			Sandy Loam
	8-12	10 YR 4/2	100			Clay
	12-20	10 YR 3/1	75	10 YR 5/6	25	Clay
	20-28	10 YR 5/1	75	10 YR 5/6	25	Clay
	28-36	10 YR 5/1	100			Sandy Clay
GW-6	0-30	10 YR 3/2	100			Sandy Loam
	30-36	10 YR 5/2	100			Sand
	36-48	10 YR 6/3	100			Sand
GW-7	0-24	10 YR 3/2	100			Sandy Loam
	24-30	10 YR 4/2	100			Sand
	30-36	10 YR 5/2	100			Sand

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
MY1 Monitoring Report	11/09/21	12/17/2021
Remediation Items (e.g. beaver removal, supplements, repairs etc.)		
Encroachment		

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