
MY2 FINAL MONITORING REPORT
Hornpipe Branch Tributaries Mitigation Project
Lenoir County
Neuse River Basin
CU 03020202

DMS Project # 100076
DMS Contract # 7605
Contracted RFP # 16-007401
USACE Action ID Number: SAW-2018-01762
DWR Project # 2018-1155

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





November 30th, 2022

NC Department of Environmental Quality

Division of Mitigation Services

Attn: Lindsay Crocker

217 West Jones Street, Suite 3000-A

Raleigh, NC 27603

RE: WLS Responses to NCDEQ DMS Review Comments for Task 8 Draft Monitoring Report Year 2 for Hornpipe Branch Tributaries Mitigation Project, NCDEQ DMS Full-Delivery Project ID #100076, Contract #7605, Neuse River Basin, Cataloging Unit 03020202, Lenoir County, NC

Dear Ms. Crocker:

Water & Land Solutions, LLC (WLS) is pleased to present the Final Monitoring Year 2 Report for the Hornpipe 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:

General:

1. **DMS Comment: 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 and to describe riffles that reflect BHR changes greater than 10%.

2. **DMS Comment: Cross section graphs 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.
3. **DMS Comment: 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.
4. **DMS Comment: 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. **DMS Comment: There are six photo station points indicated by baseline monitoring feature submission and only two photo station photos submitted in year 3, please verify the number of required photo station points and submit missing photos if necessary.** WLS Response: WLS has confirmed that there are two required photo station points and only two were submitted at baseline. The MY0 shapefile is included in the e-data.
2. **DMS Comment: Please submit graphs for surface flow and groundwater gauge data.** WLS Response: Hydrology graphs are provided in the Hydro folder.
3. **DMS Comment: Please note that the stream visual assessment table is to be submitted on a per segment basis in the future.** WLS Response: WLS updated the stream visual assessment tables to include data by reach.

Please contact me if you have any questions or comments.

Sincerely,

Water & Land Solutions, LLC



Emily Dunnigan
Water & Land Solutions, LLC
7721 Six Forks Road, Suite 130
Raleigh, NC 27615
Office Phone: (919) 614-5111
Mobile Phone: (269) 908-6306
Email: emily@waterlandsolutions.com

Table of Contents

1	Project Summary.....	1
1.1	Project Location and Description.....	1
1.2	Project Quantities and Credits.....	1
1.3	Current Condition Plan View.....	3
2	Goals, Performance Criteria, and Functional Improvements	4
2.1	Project Goals and Objectives	4
2.2	Project Success Criteria.....	5
2.2.1	Single-Thread Streams	5
2.2.2	Headwater Streams	6
2.2.3	Vegetation.....	7
2.2.4	Visual Assessment.....	7
3	Project Attributes.....	7
3.1	Design Approach	7
3.1.1	Stream.....	7
3.2	Project Attributes.....	8
4	Monitoring Year 2 Assessment and Results.....	10
4.1	Morphological Assessment.....	10
4.1.1	Stream Horizontal Pattern & Longitudinal Profile	10
4.1.2	Stream Horizontal Dimension.....	10
4.2	Stream Hydrology	10
4.2.1	Stream Flow	10
4.2.2	Bankfull Events.....	11
4.2.3	Headwater Stream Channel Formation	11
4.2.4	Wetlands	11
4.2.5	Vegetation.....	11

LIST OF APPENDICES

Appendix A - Visual Assessment Data

Visual Stream Morphology Stability Assessment Table
Vegetation Condition Assessment Table
Cross-Section Photos
Stream Photo Points (Culvert Crossings)

Appendix B - Vegetation Plot Data

Vegetation Performance Standards Summary Table
Vegetation Plot Counts and Densities Table
Red-line Planting List
Vegetation Plot Photos

Appendix C - Stream Morphology Data

Cross-Sections with Annual Overlays
Baseline Stream Data Summary Tables
Cross-Section Morphology Data
Headwater Stream Channel Formation Table
Evidence of Headwater Channel Formation Photos

Appendix D - Hydrologic Data

Verification of Bankfull Events
Monthly Rainfall Summary Data
Water Level Hydrographs
Flow Gauge and Crest Gauge Installation Diagram
Wetland Hydrology Criteria Attainment Table and Graphs

Appendix E - Project Timeline and Contact Info

1 Project Summary

1.1 Project Location and Description

The Hornpipe Branch Tributaries Mitigation Project (“Project”) is a North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) full-delivery stream mitigation project contracted with Water & Land Solutions, LLC (WLS) in response to RFP 16-007401. The Project will provide stream mitigation credits in the Neuse River Basin (Cataloging Unit 03020202). The Project is in Lenoir County, North Carolina, in the Community of Deep Run at coordinates 35.134242° North and -77.655045° West. The project site is in the Targeted Local Watershed 003020202050010 (Warm Water Thermal Regime).

The Project involved the restoration of five stream reaches (MS1, MS2, MS3, UT1, and UT2) and their riparian buffers. Proposed stream lengths total 1,239 linear feet of headwater streams and 3,912 linear feet of single-thread streams. The mitigation plan provides a detailed project summary and Table 1 provides a summary of project assets. Figure 1 illustrates the project mitigation components and Figure 2 illustrates the reference site location in proximity to the project.

Monitoring Year 2 (MY2) activities occurred in July 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, streambed condition and stability, stream flow, and vegetation. Based on these results, the Project is on a trajectory to meet interim and final success criteria in Monitoring Year 3 (MY3). For more information on the chronology of the project history, activity, and contact information, refer to Appendix E.

1.2 Project Quantities and Credits

The Project mitigation components include Stream Restoration activities as summarized in Table 1 below.



Table 1. Hornpipe Branch Tributaries (ID-100076) 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							
MS1	1,440	1,468	Warm	R	1.00000	1,440.000	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
MS2	943	940	Warm	R	1.00000	943.000	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
MS3	1,529	1,521	Warm	R	1.00000	1,529.000	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
UT1	677	677	Warm	R	1.00000	677.000	Headwater Channel Restoration, Planted Buffer, Permanent Conservation Easement
UT2	562	562	Warm	R	1.00000	562.000	Headwater Channel Restoration, Planted Buffer, Permanent Conservation Easement
					Total:	5,151.000	
Wetland							
					Total:	0.000	
Project Credits							
	Stream			Riparian	Non-Rip	Coastal	
Restoration Level	Warm	Cool	Cold	Wetland	Wetland	Marsh	
Restoration	5,151.000	0.000	0.000	0.000	0.000	0.000	
Re-establishment				0.000	0.000	0.000	
Rehabilitation				0.000	0.000	0.000	
Enhancement				0.000	0.000	0.000	
Enhancement I	0.000	0.000	0.000				
Enhancement II	0.000	0.000	0.000				
Creation				0.000	0.000	0.000	
Preservation	0.000	0.000	0.000	0.000	0.000		
Totals	5,151.000	0.000	0.000	0.000	0.000	0.000	

Total Stream Credit	5,151.000
Total Wetland Credit	0.000

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



1.3 Current Condition Plan View

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



- Conservation Easement
- Mapping Index
- Stream Restoration
- Channel (No Credit)

Access
35.136677, -77.658286

Sandy Foundation Rd

Figure 1b

MS1

MS2

Figure 1c

MS3

UT2

UT1



0 250 500 Feet

NCGGIA, NC911 Board



**Hornpipe Branch Tributaries
Mitigation Project
Lenoir County, North Carolina**

USACE Action ID Number:
SAW-2018-01762
Data Collection Date: 9/30/2022
MY2

USACE
Current Conditions Plan View
Monitoring Year 2

NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

FIGURE
1a

- Conservation Easement
- Woodline
- Existing Wetland
- Top of Bank
- Pre-existing Channel
- Stream Restoration
- Channel (No Credit)
- Rain Gauge
- Crest Gauge
- Wetland Gauge
- Flow Gauge
- ▲ Constructed Log Riffle
- ▲ Geolift - Toewood
- ▲ Log Riffle
- ▲ Log Structure
- ▲ Rock Riffle
- ▲ Root Wad
- Photo Station (2)
- Cross Sections
- Vegetation Plot**
- Success Criteria Met
- Random 50m x 2m Vegetation Plot**
- Success Criteria Met
- Water Quality Improvement Features
- Culvert



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



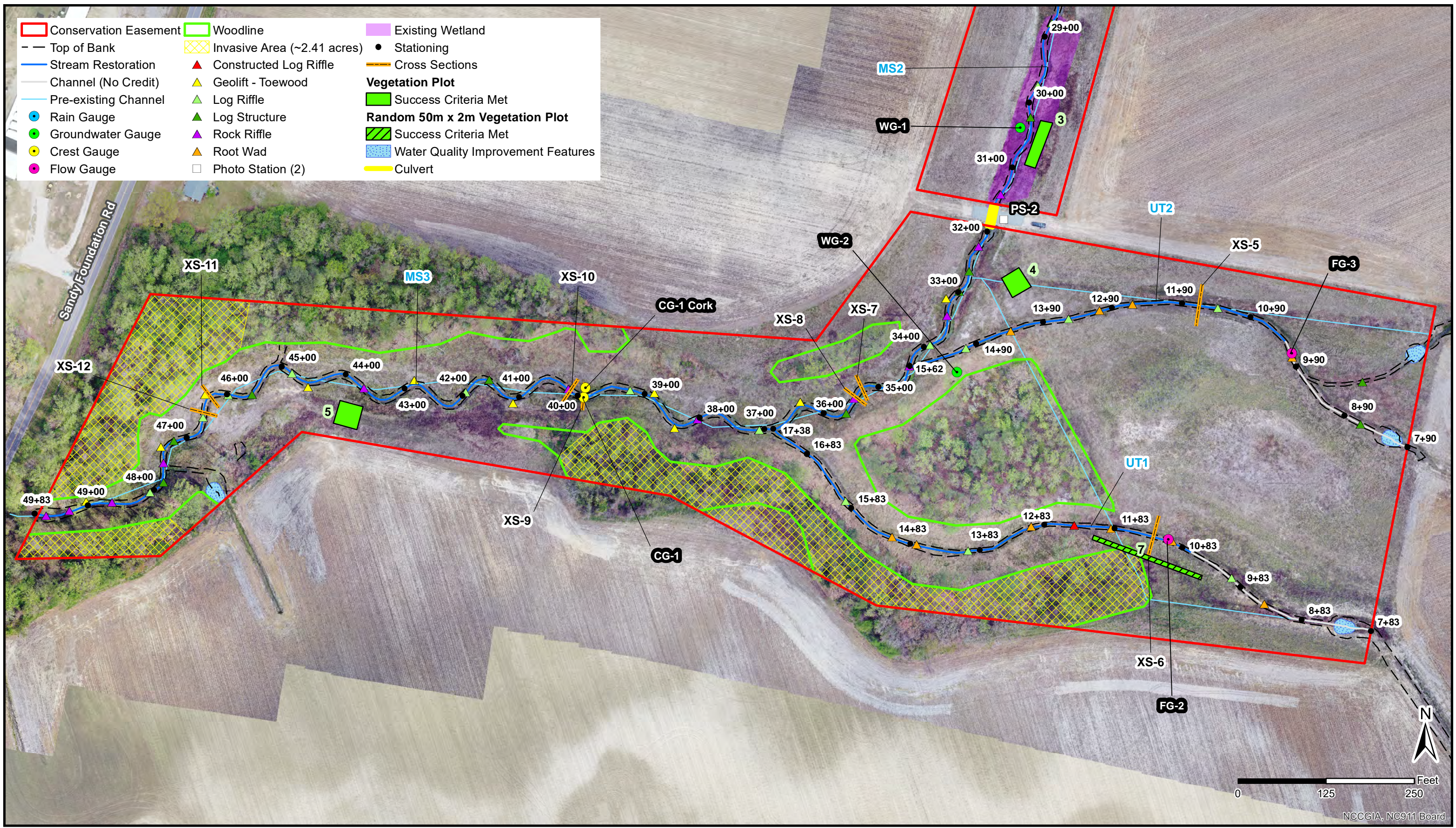
**Hornpipe Branch Tributaries
Mitigation Project
Lenoir County, North Carolina**

USACE Action ID Number:
SAW-2018-01762
Data Collection Date: 9/30/2022
MY2

USACE
Current Conditions Plan View
Monitoring Year 2

NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

FIGURE
1b



NCCGIA, NC911 Board



**Hornpipe Branch Tributaries
Mitigation Project
Lenoir County, North Carolina**

USACE Action ID Number:
SAW-2018-01762
Data Collection Date: 9/30/2022
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 Hornpipe Branch Tributaries Final Approved Mitigation Plan and will address general restoration goals and opportunities outlined in the 2010 (amended 2018) Neuse River Basin Watershed Restoration Priorities (RBRP). More specifically, the functional goals and objectives outlined in the RBRP will be met:

- Reducing sediment and nutrient inputs to the Southwest Creek Watershed.
- Restoring and protecting streams, wetlands, riparian buffers and aquatic habitat.
- Implementing agricultural BMPs and stream restoration in nutrient sensitive watersheds.

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	3 Flow gauges (MS1, UT1, UT2)	3/3 met requirements - 2022
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 data is supplementary and is not tied to project success criteria.	Minimum of four bankfull events in separate years. Wetland hydrology data is supplementary. Wetlands are not tied to project success criteria.	CG-1 : 9 recorded bankfull events, CG-2: 10 recorded bankfull events - 2022
Improve stability 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.	12 Cross section surveys	all cross sections BHR<1.2. - 2022
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 an average height of seven feet; and a minimum of 210 stems per acre and average ten foot tree heights must be present at year seven.	Tree data for 5 fixed veg plots and 2 random plots (species & height), visual assessment	7/7 veg plots met - 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 Single-Thread 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. 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 PIPS 3200). Morphological data will be collected at 12 cross-sections. Survey data will be imported into Microsoft Excel® and 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 is expected to have minimal changes 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 and/or ephemeral exhibit base 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 Headwater Streams

Continuous Surface Flow: Continuous surface water flow within the valley or crenulation must be documented to occur every year for at least 30 consecutive days during the prescribed monitoring period. Additional monitoring maybe required if surface water flow cannot be documented due to abnormally dry conditions.

Channel Formation: During monitoring years 1 through 4, the preponderance of evidence must demonstrate a concentration of flow indicative of channel formation within the topographic low-point of the valley or crenulation as documented by the following indicators:

- Scour (indicating sediment transport by flowing water)
- Sediment deposition (accumulations of sediment and/or formation ripples)
- Sediment sorting (sediment sorting indicated by grain-size distribution with the primary path of flow)
- Multiple observed flow events (must be documented by gauge data and/or photographs)
- Destruction of terrestrial vegetation
- Presence of litter and debris
- Wracking (deposits of drift material indicating surface water flow)
- Vegetation matted down, bent, or absent (herbaceous or otherwise)
- Leaf litter disturbed or washed away

During monitoring years 5 through 7, the stream must successfully meet the requirements above and the preponderance of evidence must demonstrate the development of stream bed and banks as documented by the following indicators:

- Bed and banks (may include the formation of stream bed and banks, development of channel pattern such as meander bends and/or braiding at natural topographic breaks, woody debris, or plant root systems)



- Natural line impressed on the bank (visible high-water mark)
- Shelving (shelving of sediment depositions indicating transport)
- Water staining (staining of rooted vegetation)
- Change in plant community (transition to species adapted for flow or inundation for a long duration, including hydrophytes)
- Changes in character of soil (texture and/or chroma changes when compared to the soils abutting the primary path of flow).

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 planted trees per acre at the end of Year 3 of the monitoring period; and at least 260, five-year-old, planted 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 planted stems per acre that must average ten feet in height in Year 7 of monitoring.

Vegetation success is being monitored at a total of five permanent vegetation plots and two random transects. 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 are processed using the NCDMS Shiny App. For each fixed plot the origin was marked with a PVC pole and the other three corners were marked with rebar. For each random transect the ends of the transect and each tree was marked with flagging tape. 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

3.1.1 Stream

The Project stream design approach included a combination of stream restoration activities. Priority Level I, II and III restoration approaches were incorporated with the design of a single-thread meandering channel and headwater stream valley, with parameters based on reference site comparisons, published empirical relationships, NC Coastal Plain Regional Curves, and hydrologic and hydraulic analyses. All non-vegetated areas within the conservation easement were planted with native vegetation and any areas of invasive species were removed and/or treated.

- **MS1** – Priority Level II/III Restoration



- **MS2** – Priority Level I/II Restoration
- **MS3** – Priority Level I Restoration
- **UT1 and UT2** – Headwater Restoration

3.2 Project Attributes

See Table 3 below for Project Attributes.



Table 3. Project Attribute Table					
Project Name	Hornpipe Branch Tributaries Mitigation Project				
County	Lenoir				
Project Area (acres)	23.43				
Project Coordinates (latitude and longitude decimal degrees)	35.134242°, -77.655045°				
Project Watershed Summary Information					
Physiographic Province	Coastal Plain				
River Basin	Neuse River				
USGS Hydrologic Unit 8-	3020202				
DWR Sub-basin	3/4/2005				
Project Drainage Area (acres)	331				
Project Drainage Area Percentage of Impervious Area	2.00%				
Land Use Classification	2.01.03, 2.01.01, 3.02 (78% cultivated crops, 16% evergreen/mixed forest)				
Reach Summary Information					
Parameters	Reach MS1	Reach MS2	Reach MS3	Reach UT1	Reach UT2
Pre-project length (feet)	1,493	774	1,548	498	644
Post-project (feet)	1,468	940	1,521	677	562
Valley confinement (Confined, moderately confined, unconfined)	unconfined	unconfined	unconfined	unconfined	unconfined
Drainage area (acres)	183	222	331	46	32
Perennial, Intermittent, Ephemeral	Intermittent	Perennial	Perennial	Intermittent	Ephemeral
NCDWR Water Quality Classification	C, NSW	C, NSW	C, NSW	C, NSW	C, NSW
Dominant Stream Classification (existing)	N/A (channelized ditch)	N/A (channelized ditch)	F5	N/A (channelized ditch)	N/A (channelized ditch)
Dominant Stream Classification (proposed)	DA/E5	C5/E5	C5/E5	DA	DA
Dominant Evolutionary class (Simon) if applicable	IV	IV	III/IV	IV	IV
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	Categorical Exclusion		



4 Monitoring Year 2 Assessment and Results

4.1 Morphological Assessment

Morphological data for MY2 was collected in July 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 stream channel pattern and longitudinal profiles closely match the design parameters. The MY2 plan form geometry or pattern fell within acceptable ranges of the design parameters for all restored reaches. 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. Two of the 12 cross-sections are located in headwater restoration reaches and the remaining 10 cross-sections are located in Priority I/II single-thread restoration channels. All ten of the PI/PII cross-sections show little change in the bankfull area and all bank height ratios are less than 1.2. Riffle cross-sections 8 and 12 had slight aggradation resulting in changes greater than ten percent in bank height ratio from MY0. All cross-sections are stable, and no remedial action is proposed at this time. It is expected that over time 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.

4.2 Stream Hydrology

4.2.1 Stream Flow

All three pressure transducers (flow gauges), installed in March 2021 on reaches MS1, UT1, and UT2, documented that the streams exhibited surface flow for a minimum of 30 consecutive days throughout the monitoring year (Appendix D). One additional flow gauge, FG-4, is located on a reference reach located 0.5 miles north of the project. During MY2, FG-4's pressure sensor malfunctioned resulting in inaccurate data from April 6th, 2022, to September 30th, 2022. The gauge will be replaced prior to MY3. Additionally, to determine if rainfall amounts are normal for the given year, precipitation data was obtained from an onsite rain gauge. Rainfall for MY2 was below normal for 4 months of the 2022 monitoring period (January – October).

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	MS1	229 days 1/1/2022 – 8/17/2022	247 days	25 days	13 days
FG-2	UT1	94 days 1/1/2022 – 4/4/2022	117 days	155 days	76 days
FG-3	UT2	118 days 1/1/2022 – 4/28/2022	154 days	118 days	36 days



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-4	Reference Reach	27 days* 2/4/2022 – 3/3/2022	65 days	29 days	6 days

*FG-4 sensor malfunction resulted in inaccurate data from 4/6/2022 – 9/30/2022.

4.2.2 Bankfull Events

During MY2, bankfull events were recorded on both pressure transducer crest gauges. CG-1 recorded 9 events with a maximum event of 1.48' above bankfull on January 16th, 2022. CG-2 was installed on MS-1 on December 12th, 2021. CG-2 recorded 9 events with a maximum event of 1.676' above bankfull on June 4th, 2022. Associated data and photographs are located in Appendix D.

4.2.3 Headwater Stream Channel Formation

During MY2, streams UT1 and UT2 exhibited evidence indicative of channel formation within the topographic low-point of the valley (see table and photographs in appendix C). UT1 had the following indicators: scour, multiple observed flow events, wracking, matted down, bent, or absent vegetation, and disturbed/absent leaf litter. UT2 had the following indicators: scour and multiple observed flow events.

4.2.4 Wetlands

Wetland mitigation credits are not contracted or proposed for this project. Two groundwater wells were installed in March 2021 in an existing jurisdictional wetland on MS-2 (GW-1) and adjacent to UT2 (GW-2) to monitor groundwater levels in the project. No performance standards for wetland hydrology success were proposed in the Mitigation Plan and therefore wetland mitigation monitoring is not included in the project. GW-1 had a consecutive hydroperiod of 27.56 percent and GW-2 had a consecutive hydroperiod of 8.44 percent of the growing season during MY2. Groundwater well locations are shown on the CCPVs, and the data is included in Appendix D.

4.2.5 Vegetation

Monitoring of the five 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 456 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. Each vegetation plot is meeting the interim measure requirements and has 364 - 526 stems per acre. Volunteer tulip poplar (*Liriodendron tulipifera*) was noted during MY2, but more species are expected to establish in upcoming years.

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

A significant population of privet (*Ligustrum sinense*) was located along MS3 and the wooded areas of UT1 and UT2 prior to construction. Construction activities included removing existing privet within the easement. Mechanical and herbicide treatments of privet along MS3 (~2.41 acres) were conducted during MY2 (see CCPV). Larger privet was cut and resprouts will be treated as needed. Smaller privet was foliar sprayed with 3% herbicide. Treatments are documented in the table below.



Invasive Species Treatment Table

Monitoring Year	Invasive Targeted	Invasive Treatment	Date Treatment Conducted	Herbicide Used
1	Privet	Foliar	5/5/2021	Rodeo (3%), Garlon 3A (3%)
	Privet	Foliar	5/19/2021	Rodeo (3%), Garlon 3A (3%)
	Privet	Foliar	6/1/2021	Garlon 3A (3%)
2	Privet	Cut	2/3/2022	N/A
	Privet	Cut	2/8/2022	N/A
	Privet	Cut	2/16/2022	N/A
	Privet	Cut	3/3/2022	N/A
	Privet	Foliar and cut-stump	4/19/2022	Rodeo (3%) and Garlon 3A (3%)
	Privet	Foliar	5/3/2022	Rodeo (3%)

These areas will be closely monitored, and re-sprouts will be treated as needed to prevent further establishment. Any future 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

Cross-Section Photos

Stream Photo Points (Culvert Crossings) Photos

Visual Stream Stability Assessment						
Reach	MS1					
Assessed Stream Length	1,468					
Assessed Bank Length	2,936.00					
Major Channel Category	Metric		Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	Surface Scour/Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	12	12		100%
	Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in DMS monitoring guidance document)	4	4		100%

Visual Stream Stability Assessment						
Reach	MS2					
Assessed Stream Length	940					
Assessed Bank Length	1,880.00					
Major Channel Category	Metric		Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	Surface Scour/Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	14	14		100%
	Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in DMS monitoring guidance document)	11	11		100%

Visual Stream Stability Assessment						
Reach	MS3					
Assessed Stream Length	1,521					
Assessed Bank Length	3,042.00					
Major Channel Category	Metric		Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	Surface Scour/Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	17	17		100%
	Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in DMS monitoring guidance document)	16	16		100%

Visual Stream Stability Assessment						
Reach	UT1					
Assessed Stream Length	677					
Assessed Bank Length	1,354.00					
Major Channel Category	Metric		Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	Surface Scour/Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8		100%
	Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in DMS monitoring guidance document)	4	4		100%

Visual Stream Stability Assessment						
Reach	UT2					
Assessed Stream Length	562					
Assessed Bank Length	1,124.00					
Major Channel Category	Metric		Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	Surface Scour/Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8		100%
	Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in DMS monitoring guidance document)	5	5		100%

Visual Vegetation Assessment				
Planted Acreage		17.7		
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.	0.10 acres	0.00	0.0%
Total			0.00	0.0%
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.10 acres	0.00	0.0%
Cumulative Total			0.00	0.0%
Easement Acreage		23.43		
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	2.41	10.3%
Easement Encroachment Areas	Encroachment may be point, line, or polygon. Encroachment to be mapped consists of any violation of restrictions specified in the conservation easement. Common encroachments are mowing, cattle access, vehicular access. Encroachment has no threshold value as will need to be addressed regardless of impact area.	none	0.00	



3/24/21, 9:27 AM
Lenoir

MS1, XS1, Upstream (MY-00)



7/11/22, 10:40 AM
Lenoir County

MS1, XS1, Upstream (MY-02)



3/24/21, 9:27 AM
Lenoir

MS1, XS1, Downstream (MY-00)



7/11/22, 10:36 AM
Lenoir County

MS1, XS1, Downstream (MY-02)



3/24/21, 9:26 AM
Lenoir

MS1, XS1, Left Bank (MY-00)



7/11/22, 10:37 AM
Lenoir County

MS1, XS1, Left Bank (MY-02)



3/24/21, 9:27 AM
Lenoir

MS1, XS1, Right Bank (MY-00)



7/11/22, 10:36 AM
Lenoir County

MS1, XS1, Right Bank (MY-02)



3/24/21, 9:37 AM
Lenoir

MS1, XS2, Upstream (MY-00)



7/11/22 10:33 AM
Lenoir County

MS1, XS2, Upstream (MY-02)



3/24/21, 9:37 AM
Lenoir

MS1, XS2, Downstream (MY-00)



7/11/22 10:33 AM
Lenoir County

MS1, XS2, Downstream (MY-02)



3/24/21, 9:36 AM
Lenoir

MS1, XS2, Left Bank (MY-00)



7/11/22 10:33 AM
Lenoir County

MS1, XS2, Left Bank (MY-02)



3/24/21, 9:37 AM
Lenoir

MS1, XS2, Right Bank (MY-00)



7/11/22 10:33 AM
Lenoir County

MS1, XS2, Right Bank (MY-02)



3/24/21, 9:48 AM
Lenoir

MS2, XS3, Upstream (MY-00)



7/11/22, 11:13 AM
Lenoir County

MS2, XS3, Upstream (MY-02)



3/24/21, 9:49 AM
Lenoir

MS2, XS3, Downstream (MY-00)



7/11/22, 11:13 AM
Lenoir County

MS2, XS3, Downstream (MY-02)



3/24/21, 9:48 AM
Lenoir

MS2, XS3, Left Bank (MY-00)



7/11/22, 11:12 AM
Lenoir County

MS2, XS3, Left Bank (MY-02)



3/24/21, 9:49 AM
Lenoir

MS2, XS3, Right Bank (MY-00)



7/11/22, 11:13 AM
Lenoir County

MS2, XS3, Right Bank (MY-02)



MS2, XS4, Upstream (MY-00)



MS2, XS4, Upstream (MY-02)



MS2, XS4, Downstream (MY-00)



MS2, XS4, Downstream (MY-02)



3/24/21, 9:50 AM
Lenoir

MS2, XS4, Left Bank (MY-00)



7/11/22, 11:18 AM
Lenoir County

MS2, XS4, Left Bank (MY-02)



3/24/21, 9:50 AM
Lenoir

MS2, XS4, Right Bank (MY-00)



7/11/22, 11:19 AM
Lenoir County

MS2, XS4, Right Bank (MY-02)



3/24/21, 10:10 AM
Lenoir

UT2, XS5, Upstream (MY-00)



7/11/22, 11:55 AM
Lenoir County

UT2, XS5, Upstream (MY-02)



3/24/21, 10:09 AM
Lenoir

UT2, XS5, Downstream (MY-00)



7/11/22, 11:54 AM
Lenoir County

UT2, XS5, Downstream (MY-02)



3/24/21, 10:09 AM
Lenoir

UT2, XS5, Left Bank (MY-00)



7/11/22, 11:54 AM
Lenoir County

UT2, XS5, Left Bank (MY-02)



3/24/21, 10:09 AM
Lenoir

UT2, XS5, Right Bank (MY-00)



7/11/22, 11:54 AM
Lenoir County

UT2, XS5, Right Bank (MY-02)



3/24/21, 10:19 AM
Lenoir

UT1, XS6, Upstream (MY-00)



7/11/22 11:52 AM
Lenoir County

UT1, XS6, Upstream (MY-02)



3/24/21, 10:19 AM
Lenoir

UT1, XS6, Downstream (MY-00)



7/11/22 11:53 AM

UT1, XS6, Downstream (MY-02)



3/24/21, 10:19 AM
Lenoir

UT1, XS6, Left Bank (MY-00)



7/11/22 11:53 AM

UT1, XS6, Left Bank (MY-02)



3/24/21, 10:20 AM
Lenoir

UT1, XS6, Right Bank (MY-00)



7/11/22 11:53 AM

UT1, XS6, Right Bank (MY-02)



3/24/21, 10:42 AM
Lenoir

MS3, XS7, Upstream (MY-00)



7/11/22, 1:31 PM
Lenoir County

MS3, XS7, Upstream (MY-02)



3/24/21, 10:41 AM
Lenoir

MS3, XS7, Downstream (MY-00)



7/11/22, 1:32 PM
Lenoir County

MS3, XS7, Downstream (MY-02)



MS3, XS7, Left Bank (MY-00)



MS3, XS7, Left Bank (MY-02)



MS3, XS7, Right Bank (MY-00)



MS3, XS7, Right Bank (MY-02)



3/24/21, 10:48 AM
Lenoir

MS3, XS8, Upstream (MY-00)



7/11/22, 1:33 PM
Lenoir County

MS3, XS8, Upstream (MY-02)



3/24/21, 10:47 AM
Lenoir

MS3, XS8, Downstream (MY-00)



7/11/22, 1:34 PM
Lenoir County

MS3, XS8, Downstream (MY-02)



MS3, XS8, Left Bank (MY-00)



MS3, XS8, Left Bank (MY-02)



MS3, XS8, Right Bank (MY-00)



MS3, XS8, Right Bank (MY-02)



3/24/21, 10:59 AM
Lenoir

MS3, XS9, Upstream (MY-00)



7/11/22, 1:59 PM
Lenoir County

MS3, XS9, Upstream (MY-02)



3/24/21, 10:58 AM
Lenoir

MS3, XS9, Downstream (MY-00)



7/11/22, 1:58 PM
Lenoir County

MS3, XS9, Downstream (MY-02)



MS3, XS9, Left Bank (MY-00)



MS3, XS9, Left Bank (MY-02)



MS3, XS9, Right Bank (MY-00)



MS3, XS9, Right Bank (MY-02)



3/24/21, 11:03 AM
Lenoir

MS3, XS10, Upstream (MY-00)



7/11/22, 2:02 PM
Lenoir County

MS3, XS10, Upstream (MY-02)



3/24/21, 11:02 AM
Lenoir

MS3, XS10, Downstream (MY-00)



7/11/22, 2:02 PM
Lenoir County

MS3, XS10, Downstream (MY-02)



3/24/21, 11:03 AM
Lenoir

MS3, XS10, Left Bank (MY-00)



7/11/22, 2:02 PM
Lenoir County

MS3, XS10, Left Bank (MY-02)



3/24/21, 11:03 AM
Lenoir

MS3, XS10, Right Bank (MY-00)



7/11/22, 2:02 PM
Lenoir County

MS3, XS10, Right Bank (MY-02)



MS3, XS11, Upstream (MY-00)



MS3, XS11, Upstream (MY-02)



MS3, XS11, Downstream (MY-00)



MS3, XS11, Downstream (MY-02)



3/24/21, 11:12 AM
Lenoir

MS3, XS11, Left Bank (MY-00)



7/11/22, 2:26 PM
Lenoir County

MS3, XS11, Left Bank (MY-02)



3/24/21, 11:12 AM
Lenoir

MS3, XS11, Right Bank (MY-00)



7/11/22, 2:25 PM
Lenoir County

MS3, XS11, Right Bank (MY-02)



3/24/21, 11:17 AM
Lenoir

MS3, XS12, Upstream (MY-00)



7/11/22, 2:29 PM
Lenoir County

MS3, XS12, Upstream (MY-02)



3/24/21, 11:17 AM
Lenoir

MS3, XS12, Downstream (MY-00)



7/11/22, 2:29 PM
Lenoir County

MS3, XS12, Downstream (MY-02)



3/24/21, 11:17 AM
Lenoir

MS3, XS12, Left Bank (MY-00)



7/11/22, 2:29 PM
Lenoir County

MS3, XS12, Left Bank (MY-02)



3/24/21, 11:18 AM
Lenoir

MS3, XS12, Right Bank (MY-00)



7/11/22, 2:29 PM
Lenoir County

MS3, XS12, Right Bank (MY-02)



4/6/21, 10:22 AM
Lenoir

PS-1 – MS1, Culvert Crossing, Upstream (MY-00)



4/5/22, 11:25 AM
Lenoir County

PS-1 – MS1, Culvert Crossing, Upstream (MY-02)



4/6/21, 10:21 AM
Lenoir

PS-1 – MS1, Culvert Crossing, Downstream (MY-00)



4/5/22, 11:26 AM
Lenoir County

PS-1 – MS1, Culvert Crossing, Downstream (MY-02)



4/6/21, 10:49 AM
Lenoir

PS-2 – MS2, Culvert Crossing, Upstream (MY-00)



4/5/22, 12:17 PM
Lenoir County

PS-2 – MS2, Culvert Crossing, Upstream (MY-02)



4/6/21, 10:48 AM
Lenoir

PS-2 – MS2, Culvert Crossing, Downstream (MY-00)



4/5/22, 11:13 AM
Lenoir County

PS-2 – MS2, Culvert Crossing, Downstream (MY-02)

Appendix B:

Vegetation Plot Data

Vegetation Performance Standards Summary Table
Vegetation Plot Counts and Densities Table
Red-line Planting List
Vegetation Plot Photos

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	445	3	5	0	486	3	5	0	445	3	4	0
Monitoring Year 1	364	2	5	0	405	2	5	0	445	2	4	0
Monitoring Year 0	526	1	5	0	607	1	7	0	769	1	7	0
	Veg Plot 4 F				Veg Plot 5 F				Veg Plot Group 6 R			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2	526	2	8	0	486	3	8	0	364	3	4	0
Monitoring Year 1	607	2	7	0	445	2	7	0	567	2	5	0
Monitoring Year 0	648	1	8	0	607	2	10	0	607	2	8	0
	Veg Plot Group 7 R											
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives								
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2	445	4	6	0								
Monitoring Year 1	324	2	6	0								
Monitoring Year 0	729	2	9	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	17.7
Date of Initial Plant	2021-03-31
Date(s) of Supplemental Plant(s)	NA
Date(s) Mowing	NA
Date of Current Survey	2022-09-29
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/S hrub	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 R		Veg Plot 7 R	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	<i>Betula nigra</i>	river birch	Tree	FACW	1	1	1	1	2	2			1	1	1	1	3	
	<i>Carpinus caroliniana</i>	American hornbeam	Tree	FAC			1	1			1	1					1	
	<i>Fraxinus pennsylvanica</i>	green ash	Tree	FACW			3	3					1	1	2			
	<i>Liriodendron tulipifera</i>	tuliptree	Tree	FACU			4	4	1	2			1	1				
	<i>Nyssa biflora</i>	swamp tupelo	Tree	OBL							1	1						
	<i>Persea palustris</i>	swamp bay	Shrub	FACW							2	2						
	<i>Platanus occidentalis</i>	American sycamore	Tree	FACW	3	3					3	3	3	3	3	3	3	3
	<i>Quercus alba</i>	white oak	Tree	FACU	1	1					1	1	1	1	1	1	1	1
	<i>Quercus bicolor</i>	swamp white oak	Tree	FACW	1	1			2	2	1	1	1	1	1	1		
	<i>Quercus michauxii</i>	swamp chestnut oak	Tree	FACW							3	3	1	1	1	1		1
<i>Quercus phellos</i>	willow oak	Tree	FACW	5	5	3	3	5	5	1	1	3	3	3	3	3	2	
Sum	Performance Standard				11	11	12	12	10	11	13	13	12	12	9	11		
Mitigation Plan Performance Standard	Current Year Stem Count				11		12			11		13		12	9	11		
	Stems/Acre				445		486			445		526		486	364	445		
	Species Count				5		5			4		8		8	4	6		
	Dominant Species Composition (%)				45		33			45		23		25	33	27		
	Average Plot Height (ft.)				3		3			3		2		3	3	4		
	% Invasives				0		0			0		0		0	0	0		
Post Mitigation Plan Performance Standard	Current Year Stem Count				11		12			11		13		12	9	11		
	Stems/Acre				445		486			445		526		486	364	445		
	Species Count				5		5			4		8		8	4	6		
	Dominant Species Composition (%)				45		33			45		23		25	33	27		
	Average Plot Height (ft.)				3		3			3		2		3	3	4		
	% Invasives				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.

Hornpipe Mitigation Project Red-line Planting List				
Species	Common Name	Stems	% Planted	Mitigation Plan %
<i>Fraxinus pennsylvanica</i>	Green Ash	700	5.56%	3%
<i>Betula nigra</i>	River birch	1800	14.29%	10%
<i>Quercus michauxii</i>	Swamp chestnut oak	700	5.56%	8%
<i>Quercus bicolor</i>	Swamp white oak	700	5.56%	8%
<i>Platanus occidentalis</i>	American sycamore	1700	13.49%	10%
<i>Quercus nigra</i>	Water Oak	1500	11.90%	8%
<i>Liriodendron tulipifera</i>	Tulip Poplar	1400	11.11%	10%
<i>Quercus phellos</i>	Willow Oak	1700	13.49%	8%
<i>Nyssa biflora</i>	Swamp black gum	700	5.56%	8%
<i>Quercus alba</i>	White Oak	600	4.76%	6%
<i>Clethra alnifolia</i>	Sweet pepperbush	0	0.00%	3%
<i>Carpinus caroliniana</i>	Ironwood	700	5.56%	3%
<i>Persea palustris</i>	Red bay	200	1.59%	3%
<i>Ilex verticillata</i>	Winterberry	200	1.59%	0%
<i>Eubotrys racemosus</i>	Swamp doghobble	0	0.00%	3%
<i>Magnolia virginiana</i>	Sweetbay magnolia	0	0.00%	3%
<i>Cyrilla racimiflora</i>	Titi	0	0.00%	3%
<i>Itea virginica</i>	Sweetspire	0	0.00%	3%
Total		12,600	100%	

* changes from mitigation plan in red

Riparian Buffer Live Stake Plantings – Streambanks (Proposed 2'- 3' Spacing @ Meander Bends and 6'- 8' Spacing @ Riffle Sections)			
Scientific Name	Common Name	% Planting by Species	Wetland Tolerance
<i>Cephalanthus occidentalis</i>	Buttonbush	20%	OBL
<i>Salix sericea</i>	Silky willow	30%	OBL
<i>Salix nigra</i>	Black willow	30%	OBL
<i>Sambucus canadensis</i>	Elderberry	20%	FACW-

Note: Final species selection may change due to refinement or availability at the time of planting. Species substitutions will be coordinated between WLS and planting contractor prior to the procurement of plant stock and documented in the as-built report.



4/6/21, 9:32 AM
Lenoir

Fixed Veg Plot 1 (MY-00)



9/29/22, 9:03 AM
Lenoir County

Fixed Veg Plot 1 (MY-02)



4/6/21, 10:09 AM
Lenoir

Fixed Veg Plot 2 (MY-00)



9/29/22, 9:24 AM
Lenoir County

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)



4/2/21, 11:08 AM
Lenoir

Fixed Veg Plot 5 (MY-00)



9/29/22, 10:59 AM
Lenoir County

Fixed Veg Plot 5 (MY-02)



9/29/22, 9:39 AM
Lenoir County

Random Veg Plot 6, Facing West (MY-02)



9/29/22, 9:43 AM
Lenoir County

Random Veg Plot 6, Facing East (MY-02)



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



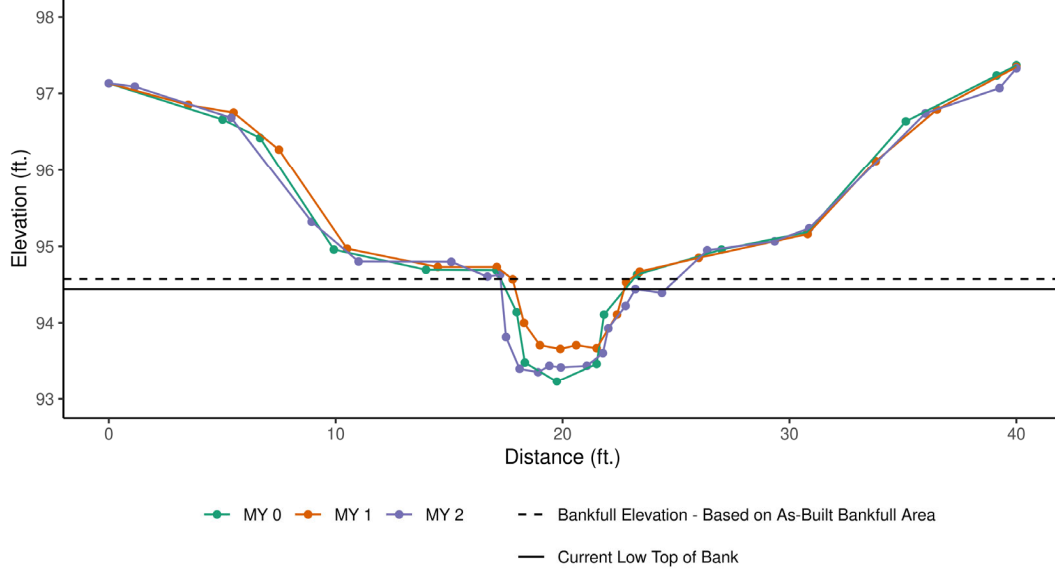
Random Veg Plot 7, Facing West (MY-02)

Appendix C:

Stream Geomorphology Data

Cross-Sections with Annual Overlays
Baseline Stream Data Summary Tables
Cross-Section Morphology Data
Headwater Stream Channel Formation Table
Evidence of Headwater Channel Formation Photos

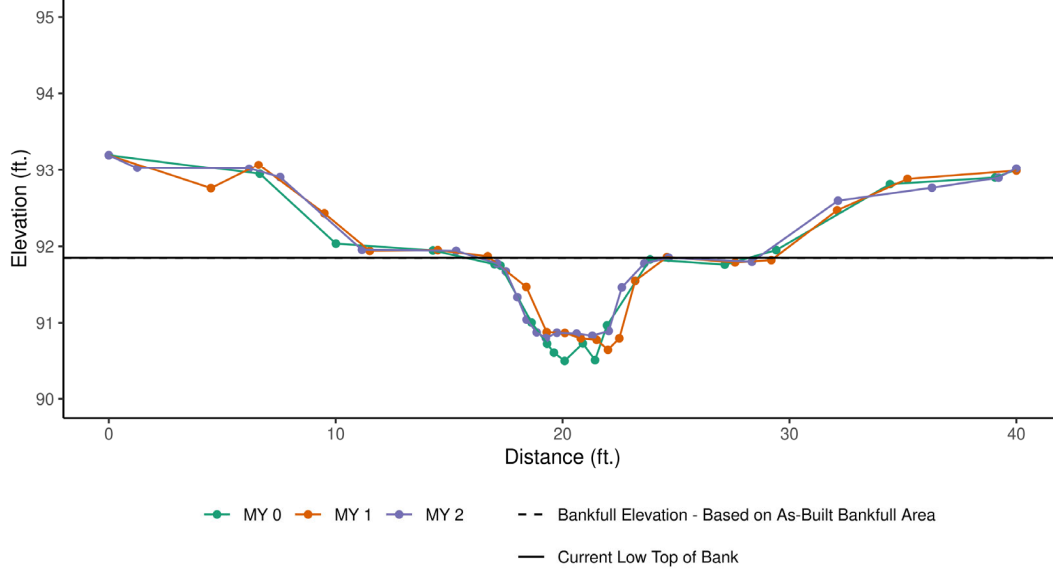
Cross-Section 1 (MS1 - Pool) MY2



Distance	Elevation	Features
0	97.13	TLP
1.14608246	97.087	
5.39782447	96.683	
8.94181531	95.32	
11.0089786	94.802	
15.0944438	94.798	
16.6883817	94.605	
17.2450445	94.631	TLB
17.5062392	93.816	
18.1052088	93.401	
18.9184536	93.356	
19.4156533	93.44	
19.9235762	93.419	THW
21.0673891	93.44	
21.7762805	93.606	
22.013874	93.929	
22.7764173	94.223	
23.2081718	94.442	TRB, BKF
24.3783916	94.393	
26.3734681	94.948	
29.3475975	95.065	
30.8726416	95.238	
35.9936664	96.742	
39.2557205	97.068	
40	97.323	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	94.63	94.85	94.57					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.85	0.89					
Thalweg Elevation	93.23	93.66	93.42					
LTOB Elevation	94.63	94.67	94.44					
LTOB Max Depth	1.401	1.01	1.023					
LTOB Cross Sectional Area	5.20	4.13	4.43					

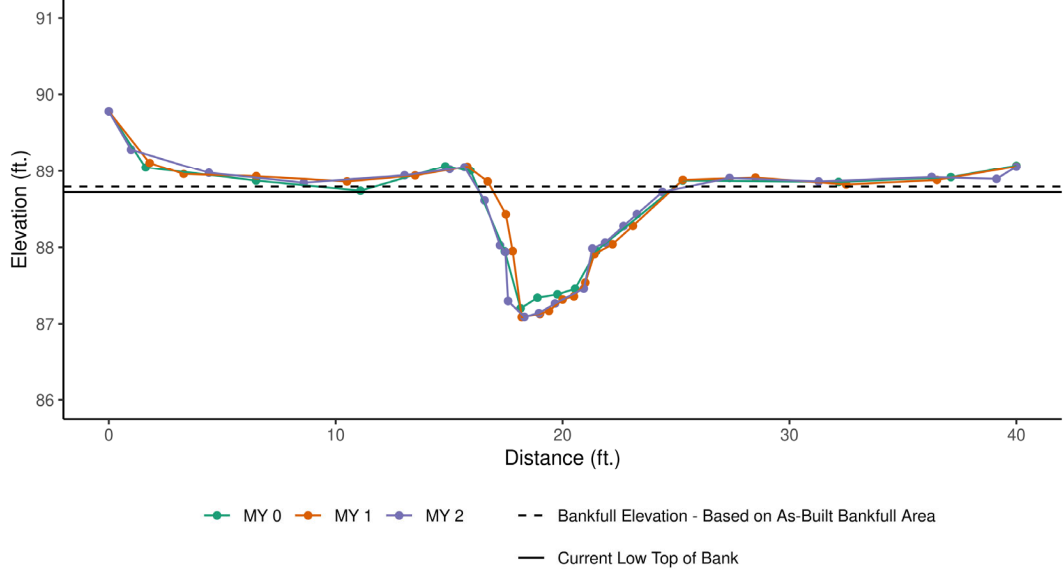
Cross-Section 2 (MS1 - Riffle) MY2



Distance	Elevation	Features
0	93.2	TLP
1.25516931	93.029	
6.18317596	93.022	
7.55258949	92.904	
11.1573053	91.955	
15.3081955	91.941	TLB
17.1127596	91.776	
17.4994157	91.673	
18.0055028	91.337	
18.4140217	91.043	
18.8572283	90.878	
19.2614731	90.803	THW
19.748924	90.873	
20.6173026	90.861	
21.3097068	90.833	
22.0335305	90.896	
22.6118842	91.464	
23.6018502	91.777	
24.6775237	91.851	TRB, BKF
28.3453192	91.799	
32.138586	92.596	
36.2791196	92.765	
39.2146081	92.896	
40	93.025	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	91.75	91.82	91.85					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.03	1.00					
Thalweg Elevation	90.51	90.65	90.80					
LTOB Elevation	91.75	91.86	91.85					
LTOB Max Depth	1.245	1.21	1.048					
LTOB Cross Sectional Area	4.72	5.03	4.74					

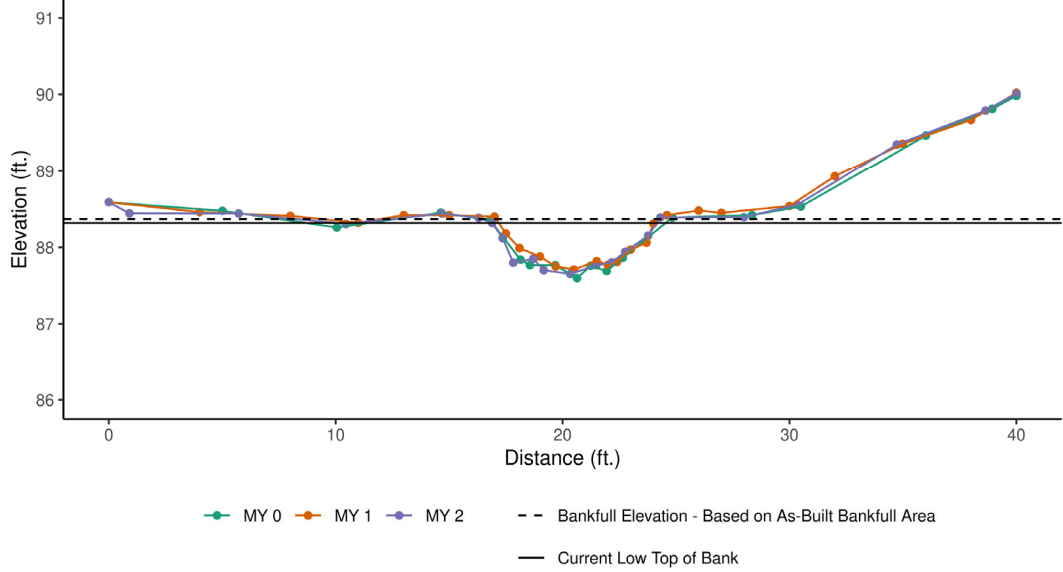
Cross-Section 3 (MS2 - Pool) MY2



Distance	Elevation	Features
0	89.78	TLP
0.98061205	89.285	
4.41266473	88.976	
8.59361914	88.844	
13.0347264	88.942	
15.0266362	89.027	
15.6734474	89.052	TLB
16.5587012	88.614	
17.2423062	88.027	
17.4767152	87.94	
17.5972166	87.3	
18.3136247	87.091	THW
18.9566492	87.14	
19.6662871	87.268	
20.9338966	87.462	
21.3123625	87.984	
21.871954	88.06	
22.6847903	88.278	
23.2754891	88.432	
24.399003	88.723	TRB, BKF
27.3567301	88.905	
31.2874444	88.859	
36.2643138	88.919	
39.1251755	88.894	
40	89.057	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	88.87	88.84	88.79					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.02	0.96					
Thalweg Elevation	87.34	87.09	87.09					
LTOB Elevation	88.87	88.88	88.72					
LTOB Max Depth	1.529	1.79	1.632					
LTOB Cross Sectional Area	7.68	8.01	7.12					

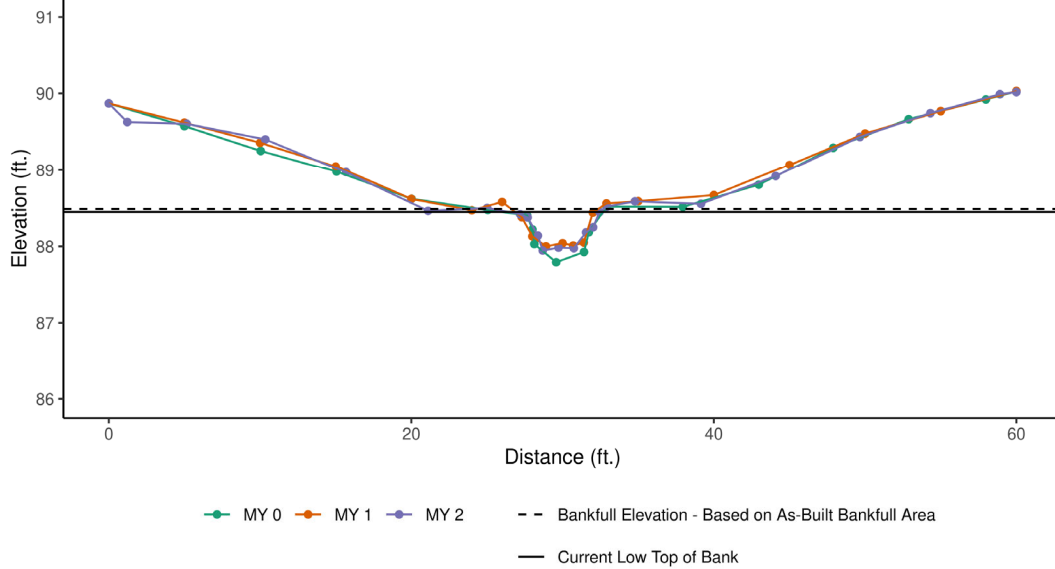
Cross-Section 4 (MS2 - Riffle) MY2



Distance	Elevation	Features
0	88.59	TLP
0.91211074	88.443	
5.72289437	88.441	
10.4523247	88.305	
14.6871325	88.44	
16.3032573	88.385	
16.8960576	88.317	TLB, BKF
17.3582282	88.12	
17.8254136	87.799	
18.7108408	87.851	
19.1661407	87.701	
20.3406665	87.652	THW
21.4857396	87.767	
22.1613234	87.802	
22.7599653	87.942	
23.7710258	88.152	
24.3082512	88.389	TRB
27.9913123	88.393	
30.3485073	88.556	
34.7301708	89.35	
38.6405666	89.79	
40	90.009	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	88.35	88.43	88.37					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.97	0.93					
Thalweg Elevation	87.60	87.71	87.65					
LTOB Elevation	88.35	88.40	88.32					
LTOB Max Depth	0.755	0.69	0.665					
LTOB Cross Sectional Area	3.64	3.45	3.27					

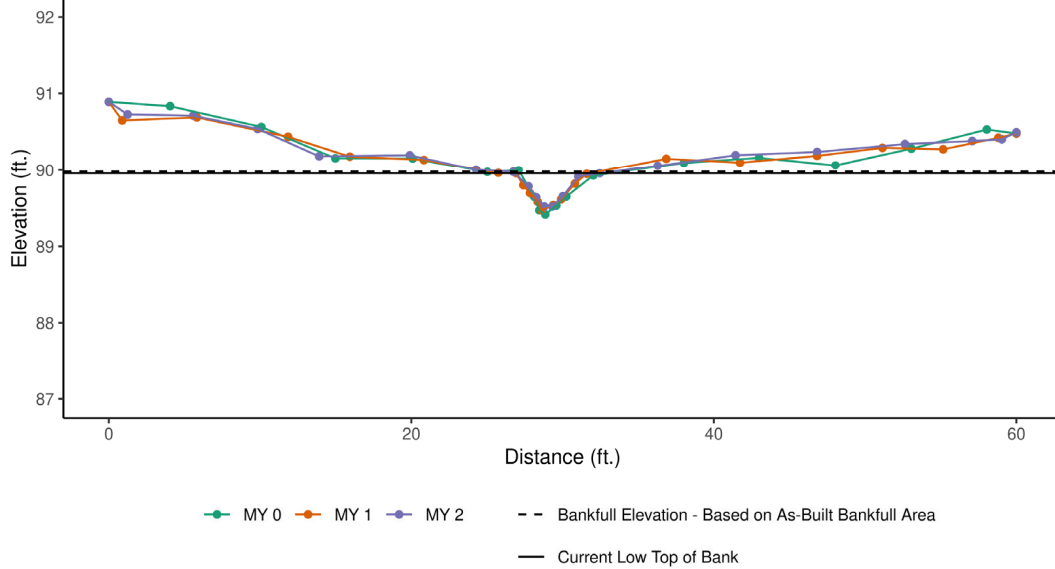
Cross-Section 5 (UT2 - Headwater) MY2



Distance	Elevation	Features
0	89.87	TLP
1.2202008	89.629	
5.15407295	89.605	
10.348167	89.403	
15.686133	88.972	
21.1070336	88.463	
25.0174623	88.501	TLB, BKF
27.1964579	88.419	
27.6895842	88.377	
28.367412	88.139	
28.6883263	87.945	THW
29.7305998	87.983	
30.7417205	87.976	
31.5512531	88.182	
32.0152725	88.248	
32.4445454	88.449	TRB
32.9465179	88.52	
34.7845773	88.588	
39.1475271	88.555	
44.0866153	88.92	
49.6558656	89.436	
54.3148279	89.744	
58.9092486	89.989	
60	90.017	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	88.40	88.50	88.49					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	1.12	0.93					
Thalweg Elevation	87.79	88.00	87.95					
LTOB Elevation	88.40	88.56	88.45					
LTOB Max Depth	0.609	0.56	0.504					
LTOB Cross Sectional Area	1.96	2.35	1.73					

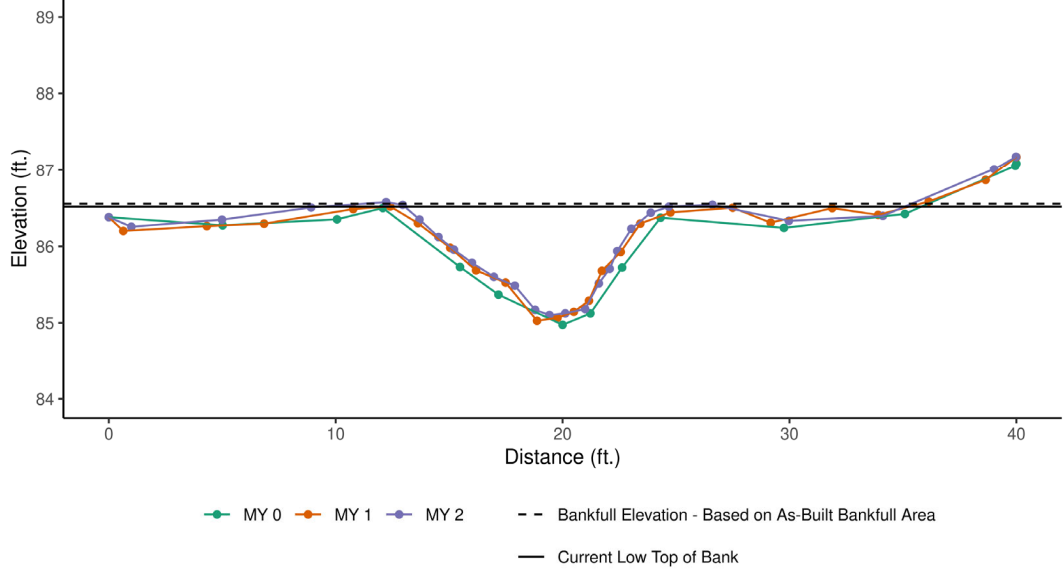
Cross-Section 6 (UT1 - Headwater) MY2



Distance	Elevation	Features
0	90.89	TLP
1.244	90.727	
5.58402767	90.711	
9.84026732	90.54	
13.9089054	90.184	
19.8977085	90.197	
24.280475	90.007	
26.7338415	89.977	TLB, BKF
27.7464647	89.784	
28.2568506	89.641	
28.7931873	89.521	
29.312587	89.52	THW
30.026215	89.657	
31.0381209	89.913	
32.4586626	89.957	TRB
36.2858681	90.058	
41.4331357	90.198	
46.8261975	90.241	
52.6332137	90.344	
57.0789127	90.383	
59.0397755	90.406	
60.141959	90.496	
59.0397755	90.406	
60	90.496	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	89.93	89.96	89.98					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.98	0.95					
Thalweg Elevation	89.42	89.47	89.52					
LTOB Elevation	89.93	89.95	89.96					
LTOB Max Depth	0.511	0.477	0.437					
LTOB Cross Sectional Area	1.23	1.19	1.10					

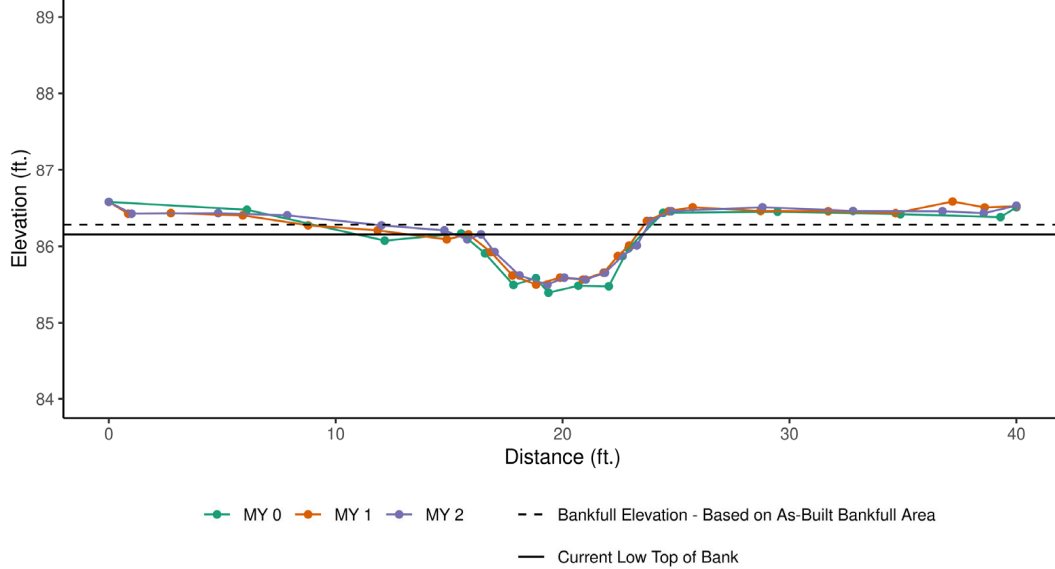
Cross-Section 7 (MS3 - Pool) MY2



Distance	Elevation	Features
0	86.38	TLP
0.99276684	86.255	
4.9890004	86.348	
8.9147678	86.507	
12.2224896	86.577	
12.9519027	86.541	TLB
13.6915494	86.35	
14.5284813	86.122	
15.2124912	85.956	
16.0042758	85.786	LEW
16.9704779	85.602	
17.8944608	85.487	
18.7891538	85.171	
19.4199086	85.103	THW
20.1189842	85.126	
20.9918444	85.182	
21.5984333	85.517	
22.0757697	85.707	REW
22.4091347	85.938	
23.0318946	86.229	
23.8862057	86.438	
24.6815798	86.517	TRB, BKF
26.6045984	86.543	
29.9720446	86.332	
34.1154236	86.397	
39.0208791	87.013	
39.9824559	87.178	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	86.37	86.51	86.56					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.95	0.97					
Thalweg Elevation	84.98	85.03	85.10					
LTOB Elevation	86.37	86.44	86.52					
LTOB Max Depth	1.398	1.413	1.414					
LTOB Cross Sectional Area	9.20	8.37	8.75					

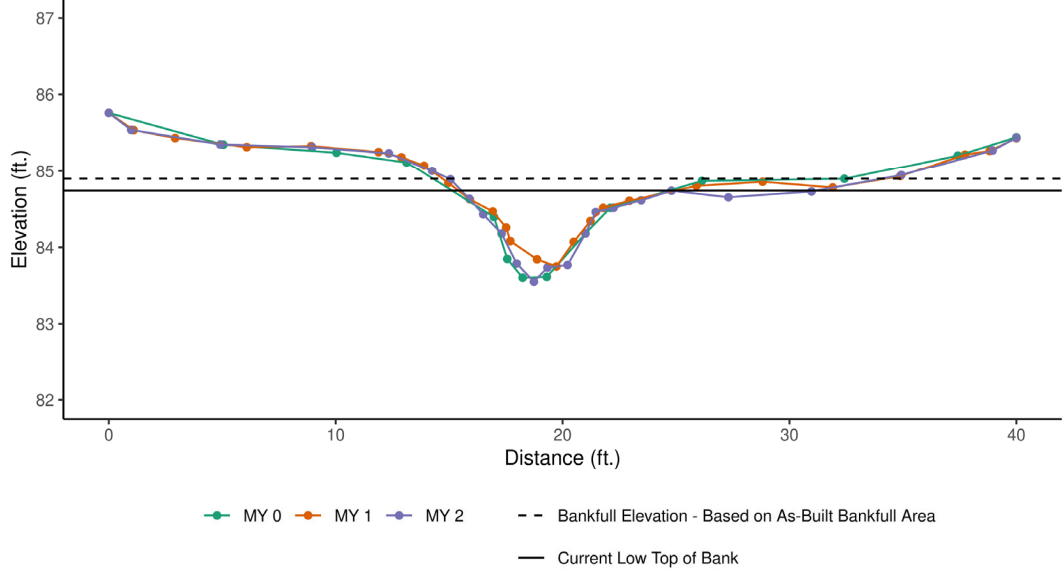
Cross-Section 8 (MS3 - Riffle) MY2



Distance	Elevation	Features
0	86.58	TLP
1.00400996	86.426	
4.81978526	86.433	
7.86251016	86.404	
12.0163869	86.274	
14.7895978	86.208	
15.8013155	86.09	
16.4040528	86.156	TLB, BKF
17.0006257	85.926	LEW
18.1023018	85.62	
19.3319542	85.501	THW
20.0747199	85.592	
21.0177738	85.566	
21.8665231	85.656	REW
22.6440499	85.873	
23.2724569	86.011	
23.8760004	86.33	TRB
24.7911955	86.459	
28.8084821	86.51	
32.8011631	86.461	
36.7433395	86.458	
38.5601585	86.432	
40	86.53	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	86.17	86.27	86.28					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.85	0.84					
Thalweg Elevation	85.40	85.50	85.50					
LTOB Elevation	86.17	86.16	86.16					
LTOB Max Depth	0.773	0.655	0.655					
LTOB Cross Sectional Area	4.04	3.20	3.14					

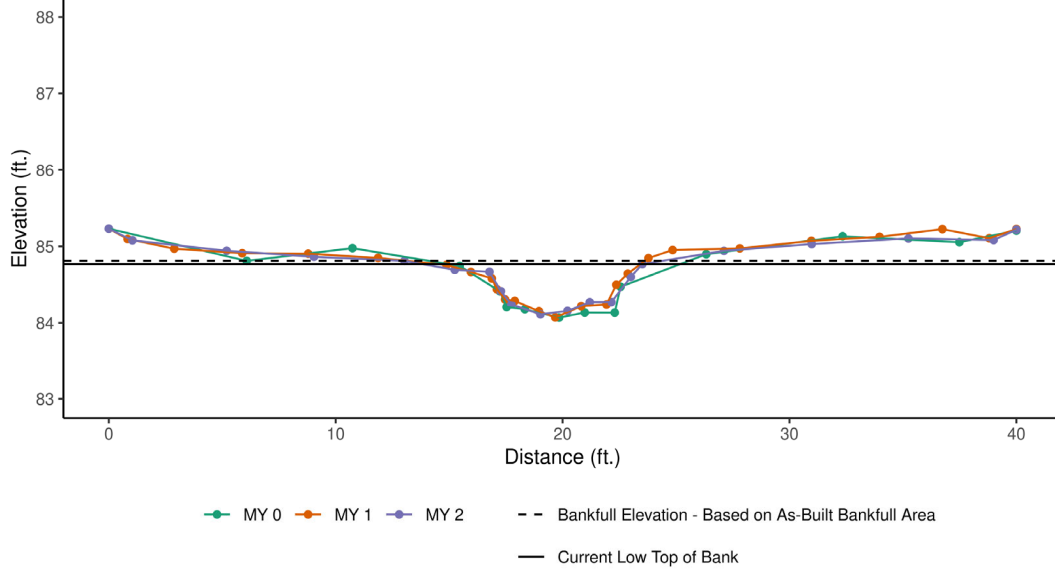
Cross-Section 9 (MS3 - Pool) MY2



Distance	Elevation	Features
0	85.76	TLP
0.98549987	85.541	
4.9147358	85.351	
8.96359325	85.315	
12.3426359	85.235	
14.2492961	85.002	
15.0587121	84.89	TLB
15.8883495	84.635	
16.5003497	84.431	
17.3121128	84.179	LEW
17.9769787	83.788	
18.7362159	83.552	THW
19.3326785	83.736	
20.2180846	83.769	
21.0083058	84.18	
21.4612824	84.461	
22.2454999	84.516	
23.4649486	84.614	
24.8010473	84.74	TRB, BKF
27.3082624	84.654	
30.971559	84.73	
34.9302509	84.946	
38.9509926	85.273	
40	85.437	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	84.87	84.93	84.90					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.94	0.88					
Thalweg Elevation	83.60	83.75	83.55					
LTOB Elevation	84.87	84.86	84.74					
LTOB Max Depth	1.265	1.107	1.188					
LTOB Cross Sectional Area	6.09	5.12	4.63					

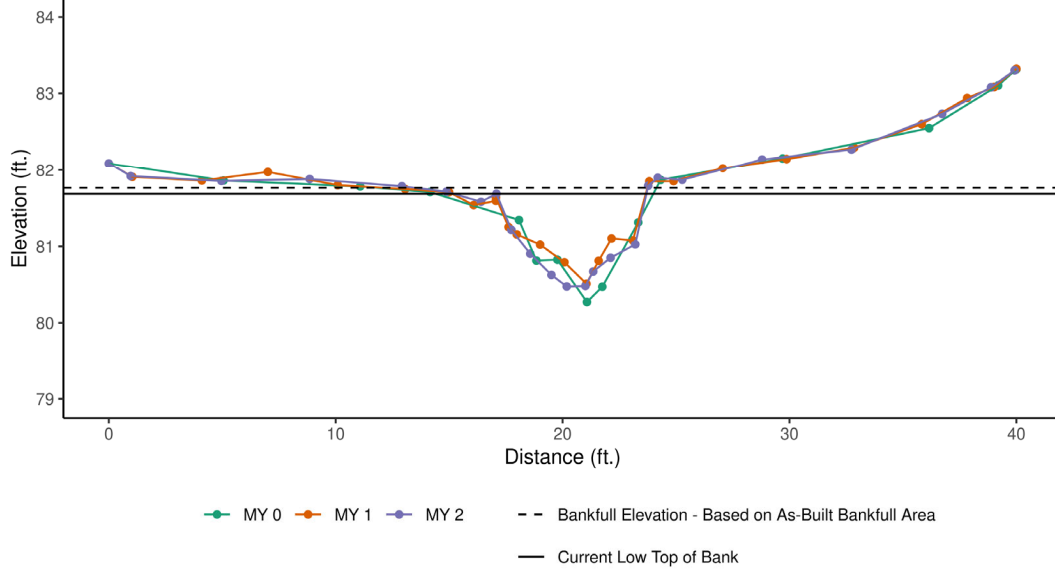
Cross-Section 10 (MS3 - Riffle) MY2



Distance	Elevation	Features
0	85.23	TLP
1.04011778	85.078	
5.1945456	84.942	
9.04218408	84.863	
13.0288605	84.81	TLB
15.2472618	84.693	
16.7785037	84.667	
17.2814084	84.414	
17.7430057	84.242	
19.0234438	84.113	THW
20.2157422	84.158	
21.1969412	84.27	
22.1499578	84.272	
23.0063562	84.601	
23.5157907	84.768	TRB, BKF
27.1124673	84.941	
30.9801142	85.03	
35.2430442	85.103	
38.9974633	85.082	
40	85.217	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	84.74	84.83	84.81					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.91	0.94					
Thalweg Elevation	84.07	84.07	84.11					
LTOB Elevation	84.74	84.76	84.77					
LTOB Max Depth	0.674	0.686	0.655					
LTOB Cross Sectional Area	3.77	3.18	3.36					

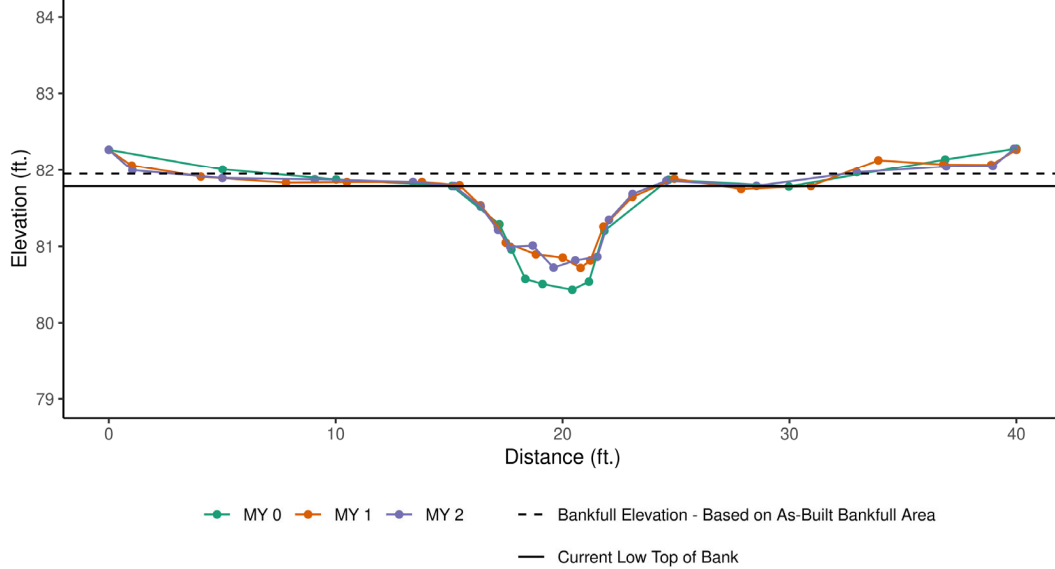
Cross-Section 11 (MS3 - Pool) MY2



Distance	Elevation	Features
0	82.09	TLP
0.96232479	81.919	
4.96568807	81.854	
8.8527651	81.88	
12.9167785	81.785	
14.8834368	81.714	
16.4049088	81.581	
17.0839669	81.687	TLB, BKF
17.742257	81.214	
18.5738312	80.904	
19.5066211	80.627	
20.1823288	80.476	THW
21.0045809	80.483	
21.3499411	80.672	
22.1154157	80.851	
23.2035545	81.026	REW
23.7741141	81.792	
24.1933417	81.896	TRB
25.2734765	81.87	
28.79389	82.142	
32.7316003	82.272	
36.728266	82.735	
38.8829909	83.079	
39.9213924	83.298	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	81.71	81.83	81.77					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.91	0.94					
Thalweg Elevation	80.27	80.51	80.48					
LTOB Elevation	81.71	81.71	81.69					
LTOB Max Depth	1.437	1.196	1.211					
LTOB Cross Sectional Area	5.88	4.84	5.37					

Cross-Section 12 (MS3 - Riffle) MY2



Distance	Elevation	Features
0	82.27	TLP
1.03927763	81.998	
5.00583999	81.893	
9.07827407	81.876	
13.4050779	81.84	
15.2197789	81.786	TLB, BKF
16.390963	81.518	
17.1580316	81.214	
17.6920744	80.993	LEW
18.6825184	81.01	
19.6026211	80.722	THW
20.558893	80.817	
21.5294055	80.863	REW
22.0443539	81.346	
23.0824226	81.683	
24.5747676	81.855	TRB
28.5448589	81.789	
32.9665875	81.97	
36.9100261	82.047	
38.9617692	82.051	
39.8987283	82.283	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	81.79	81.93	81.95					
Bank Height Ratio - Based on As-Built Bankfull Area	1.00	0.92	0.87					
Thalweg Elevation	80.43	80.72	80.72					
LTOB Elevation	81.79	81.84	81.79					
LTOB Max Depth	1.354	1.121	1.064					
LTOB Cross Sectional Area	6.47	5.46	5.04					

Table7a: Baseline Stream Data Summary Hornpipe, MS1											Hornpipe, MS2									Hornpipe, MS3													
Parameter	Pre-Existing Condition (3/14/2018)					Design		MY0 (3/24/2021)				Pre-Existing Condition (3/14/2018)					Design		MY0 (3/24/2021)				Pre-Existing Condition (3/14/2018)					Design		MY0 (3/24/2021)			
	Min	Mean	Med	Max	n	Min	Max	Min	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Max	n			
Riffle Only																																	
Bankfull Width (ft)	4.2				1		6.9		6.4	1		4.5			1		7.5		7.9	1		8.4			1		8.4		8.0	9.5	3		
Floodprone Width (ft)	9.0				1	15.0	30.0		34.5	1		8.7			1	29.0	47.0		33.9	1		8.8			1	19.0	30.0	40.0	40.0	3			
Bankfull Mean Depth (ft)	0.9				1		0.5		0.7	1		1.0			1		0.6		0.5	1		0.7			1		0.6	0.4	0.7	3			
Bankfull Max Depth (ft)	1.2				1		0.7		1.2	1		1.3			1		0.8		0.8	1		0.8			1		0.9	0.7	1.3	3			
Bankfull Cross Sectional Area (ft ²)	3.8				1		3.7		4.7	1		4.4			1		4.3		3.6	1		5.5			1		5.4	3.8	6.5	3			
Width/Depth Ratio	4.7				1		13.0		8.8	1		4.5			1		13.0		17.1	1		12.7			1		13.0	13.0	24.0	3			
Entrenchment Ratio	2.1				1	2.2	4.3		5.4	1		2.0			1	3.9	6.3		4.3	1		1.1			1	2.3	3.6	4.2	5.0	3			
Bank Height Ratio	2.6				1	1.0	1.1		1.0	1		2.2			1	1.0	1.1		1.0	1		4.8			1	1.0	1.1	1.0	1.0	3			
Max part size (mm) mobilized at Bankfull	14.0					10.0		12.0				13.0					8.0		6.0				10.0					9.0		8.0			
Rosgen Classification	Channelized					DA/E5		E5				Channelized					E5/C5		C5				F5					E5/C5		C5			
Bankfull Discharge (cfs)	4.0					4.0		4.0				4.5					4.5		4.5				6.6					6.6		6.6			
Sinuosity (ft)	1.01					1.02		1.02				1.01					1.11		1.10				1.02					1.18		1.16			
Water Surface Slope (Channel) (ft/ft)	0.005					0.0049		0.0044				0.0041					0.0037		0.0033				0.004					0.0044		0.0042			
Other																																	

Table7a: Baseline Stream Data Summary Hornpipe, UT1 (HW)											Hornpipe, UT2 (HW)														
Parameter	Pre-Existing Condition (3/14/2018)					Design		MY0 (3/24/2021)				Pre-Existing Condition (3/14/2018)					Design		MY0 (3/24/2021)						
	Min	Mean	Med	Max	n	Min	Max	Min	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Max	n					
Riffle Only																									
Bankfull Width (ft)	4.3				1		4.4		4.7	1		2.7			1		4.4		4.4	1		4.8			1
Floodprone Width (ft)	6.9				1	15.0	30.0		44.5	1		4.4			1	15.0	30.0		30.5	1					
Bankfull Mean Depth (ft)	0.4				1		0.3		0.3	1		0.4			1		0.3		0.4	1					
Bankfull Max Depth (ft)	1.0				1		0.3		0.5	1		0.6			1		0.3		0.6	1					
Bankfull Cross Sectional Area (ft ²)	1.6				1		1.2		1.2	1		1.1			1		1.2		2.0	1					
Width/Depth Ratio	11.5				1		16.0		18.2	1		6.8			1		16.0		11.9	1					
Entrenchment Ratio	1.6				1	3.4	6.8		9.4	1		1.6			1	3.4	6.8		6.3	1					
Bank Height Ratio	3.3				1	1.0	1.1		1.0	1		4.7			1	1.0	1.1		1.0	1					
Max part size (mm) mobilized at Bankfull	9.0					6.0		6.0				9.0					7.0		10.0						
Rosgen Classification	Channelized					DA		DA				Channelized					DA		DA						
Bankfull Discharge (cfs)	1.4					1.4		1.4				1.2					1.2		1.2						
Sinuosity (ft)	1.06					1.09		1.09				1.06					1.07		1.05						
Water Surface Slope (Channel) (ft/ft)	0.0065					0.0062		0.0063				0.0067					0.0065		0.0062						
Other																									

Monitoring Data - Cross-Section Morphology Monitoring Summary
Hornpipe Branch Tributaries/DMS:100076 Segment/Reach: MS1, MS2, MS3, UT1, UT2 (Data Collected 7/11/2022)

	Cross-Section 1 (Pool - MS1)							Cross-Section 2 (Riffle - MS1)							Cross-Section 3 (Pool - MS2)							Cross-Section 4 (Riffle - MS2)						
	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-Bankfull¹ Area	94.63	94.85	94.57					91.75	91.82	91.85					88.87	88.84	88.79					88.35	88.43	88.37				
Bank Height Ratio_Based on AB Bankfull¹ Area	N/A	N/A	N/A					1.00	1.03	1.00					N/A	N/A	N/A					1.00	0.97	0.93				
Thalweg Elevation	93.23	93.66	93.42					90.51	90.65	90.80					87.34	87.09	87.09					87.60	87.71	87.65				
LTOB² Elevation	94.63	94.67	94.44					91.75	91.86	91.85					88.87	88.88	88.72					88.35	88.40	88.32				
LTOB² Max Depth (ft)	1.40	1.01	1.02					1.25	1.21	1.05					1.53	1.79	1.63					0.75	0.69	0.67				
LTOB2 Cross-Sectional Area (ft2)	5.20	4.13	4.43					4.72	5.03	4.74					7.68	8.01	7.12					3.64	3.45	3.27				
	Cross-Section 5 (Headwater - UT2)							Cross-Section 6 (Headwater UT1)							Cross-Section 7 (Pool - MS3)							Cross-Section 8 (Riffle - MS3)						
	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-Bankfull¹ Area	88.40	88.50	88.49					89.93	89.96	98.98					86.37	86.51	86.56					86.17	86.27	86.28				
Bank Height Ratio_Based on AB Bankfull¹ Area	1.00	1.12	0.93					1.00	0.98	0.95					N/A	N/A	N/A					1.00	0.85	0.84				
Thalweg Elevation	87.79	88.00	87.95					89.42	89.47	98.52					84.98	85.03	85.10					85.40	85.50	85.50				
LTOB² Elevation	88.40	88.56	88.45					89.93	89.95	89.96					86.37	86.44	86.52					86.17	86.16	86.16				
LTOB² Max Depth (ft)	0.61	0.56	0.50					0.51	0.48	0.44					1.40	1.41	1.41					0.77	0.66	0.66				
LTOB2 Cross-Sectional Area (ft2)	1.96	2.35	1.73					1.23	1.19	1.10					9.20	8.37	8.75					4.04	3.20	3.14				
	Cross-Section 9 (Pool - MS3)							Cross-Section 10 (Riffle - MS3)							Cross-Section 11 (Pool - MS3)							Cross-Section 12 (Riffle - MS3)						
	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-Bankfull¹ Area	84.87	84.93	84.90					84.74	84.83	84.84					81.71	81.83	81.77					81.79	81.93	81.95				
Bank Height Ratio_Based on AB Bankfull¹ Area	N/A	N/A	N/A					1.00	0.91	0.94					N/A	N/A	N/A					1.00	0.92	0.87				
Thalweg Elevation	83.60	83.75	83.55					84.07	84.07	84.11					80.27	80.51	80.48					80.43	80.72	80.72				
LTOB² Elevation	84.87	84.86	84.74					84.74	84.76	84.77					81.71	81.71	81.69					81.79	81.84	81.79				
LTOB² Max Depth (ft)	1.27	1.11	1.19					0.67	0.69	0.66					1.44	1.20	1.21					1.35	1.12	1.06				
LTOB2 Cross-Sectional Area (ft2)	6.09	5.12	4.63					3.77	3.18	3.36					5.88	4.84	5.37					6.47	5.46	5.04				

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

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

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

**Headwater Stream Channel Formation Table
Hornpipe Branch Tributaries Mitigation Project**

Channel Forming Indicators - UT1	MY1	MY2	MY3	MY4
Scour (indicating sediment transport by flowing water)	Yes	Yes		
Sediment deposition (accumulations of sediment and/or formation of ripples)	No	No		
Sediment sorting (sediment sorting indicated by grain-size distribution within primary flow path)	No	No		
Multiple observed flow events (must be documented by gauge data and/or photographs)	Yes	Yes		
Destruction of terrestrial vegetation	No	No		
Presence of litter and debris	No	No		
Wracking (deposits of drift material indicating surface water flow)	Yes	Yes		
Vegetation matted down, bent, or absent (herbaceous or otherwise)	No	Yes		
Leaf litter disturbed or washed away	No	Yes		
Channel Forming Indicators - UT2	MY1	MY2	MY3	MY4
Scour (indicating sediment transport by flowing water)	Yes	Yes		
Sediment deposition (accumulations of sediment and/or formation of ripples)	No	No		
Sediment sorting (sediment sorting indicated by grain-size distribution within primary flow path)	No	No		
Multiple observed flow events (must be documented by gauge data and/or photographs)	Yes	Yes		
Destruction of terrestrial vegetation	No	No		
Presence of litter and debris	No	No		
Wracking (deposits of drift material indicating surface water flow)	Yes	No		
Vegetation matted down, bent, or absent (herbaceous or otherwise)	No	No		
Leaf litter disturbed or washed away	No	No		



4/5/22, 11:51 AM
Lenoir County

UT1, absent leaf litter in channel



4/5/22, 11:51 AM
Lenoir County

UT1, leaf litter outside of channel



4/5/22, 11:52 AM
Lenoir County

UT1, vegetation matted outside of channel



2/8/22, 9:29 AM
Lenoir County

UT1, wrack line

Appendix D:

Hydrologic Data

Verification of Bankfull Events
Monthly Rainfall Summary Data
Water Level Hydrographs
Flow Gauge and Crest Gauge Installation Diagrams
Wetland Hydrology Criteria Attainment Table and Graphs

**Hornpipe Branch Tributaries Mitigation Project: Overbank Events (MY2)
Crest Gauge CG-1 (MS3)**

	Date of Collection	Date of Occurrence	Method	Notes	Measurement Above Bankfull (feet)
MY1	4/7/2021	3/27/2021 - 3/28/2021	Pressure Transducer	Bankfull due to rainfall event	0.411
	4/7/2021	4/1/2021	Pressure Transducer	Bankfull due to rainfall event	0.488
	8/5/2021	unknown	Cork Gauge	Evidence of bankfull on traditional cork gauge	0.85
	10/19/2021	unknown	Cork Gauge	Evidence of bankfull on traditional cork gauge	0.45
MY2	4/5/2022	1/3/2022	Pressure Transducer	Bankfull due to rainfall event	1.058
	4/5/2022	1/10/2022	Pressure Transducer	Bankfull due to rainfall event	0.131
	4/5/2022	1/16/2022	Pressure Transducer	Bankfull due to rainfall event	1.48
	7/11/2022	4/6/2022	Pressure Transducer	Bankfull due to rainfall event	0.599
	7/11/2022	6/4/2022	Pressure Transducer	Bankfull due to rainfall event	1.165
	7/11/2022	7/9/2022	Pressure Transducer	Bankfull due to rainfall event	0.458
	9/29/2022	7/13/2022	Pressure Transducer	Bankfull due to rainfall event	0.309
	9/29/2022	7/31/2022	Pressure Transducer	Bankfull due to rainfall event	0.529
	9/29/2022	8/21/2022	Pressure Transducer	Bankfull due to rainfall event	0.623

*MY2 9 events with a maximum bankfull of 1.48

Hornpipe Branch Tributaries Mitigation Project: Overbank Events (MY2) Crest Gauge CG-2 (MS1)					
	Date of Collection	Date of Occurrence	Method	Notes	Measurement Above Bankfull (feet)
MY1	Not Installed in MY1				
MY2	4/5/2022	1/3/2022	Pressure Transducer	Bankfull due to rainfall event	1.28
	4/5/2022	1/10/2022	Pressure Transducer	Bankfull due to rainfall event	0.236
	4/5/2022	1/16/2022	Pressure Transducer	Bankfull due to rainfall event	1.654
	4/5/2022	Unknown	Visual	Observance of wrack lines, alluvial deposit in floodplain of MS1	NA
	4/5/2022	4/5/2022	Pressure Transducer	Bankfull due to rainfall event	0.911
	7/11/2022	6/4/2022	Pressure Transducer	Bankfull due to rainfall event	1.676
	7/11/2022	7/8/2022	Pressure Transducer	Bankfull due to rainfall event	0.344
	9/29/2022	7/14/2022	Pressure Transducer	Bankfull due to rainfall event	0.289
	9/29/2022	7/31/2022	Pressure Transducer	Bankfull due to rainfall event	0.465
	9/29/2022	8/21/2022	Pressure Transducer	Bankfull due to rainfall event	0.791

*MY2 10 events with maximum bankfull of 1.676

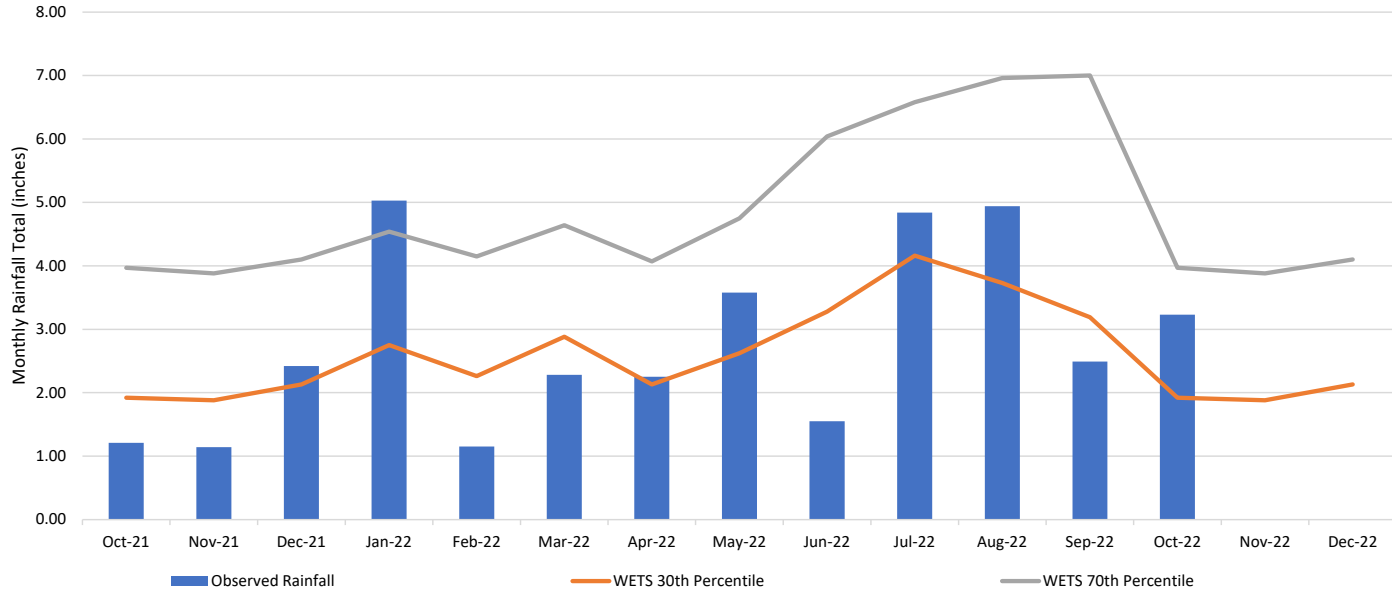


Alluvial Deposit



Wrack line

Hornpipe Branch Tributaries Mitigation Site MY2 2022



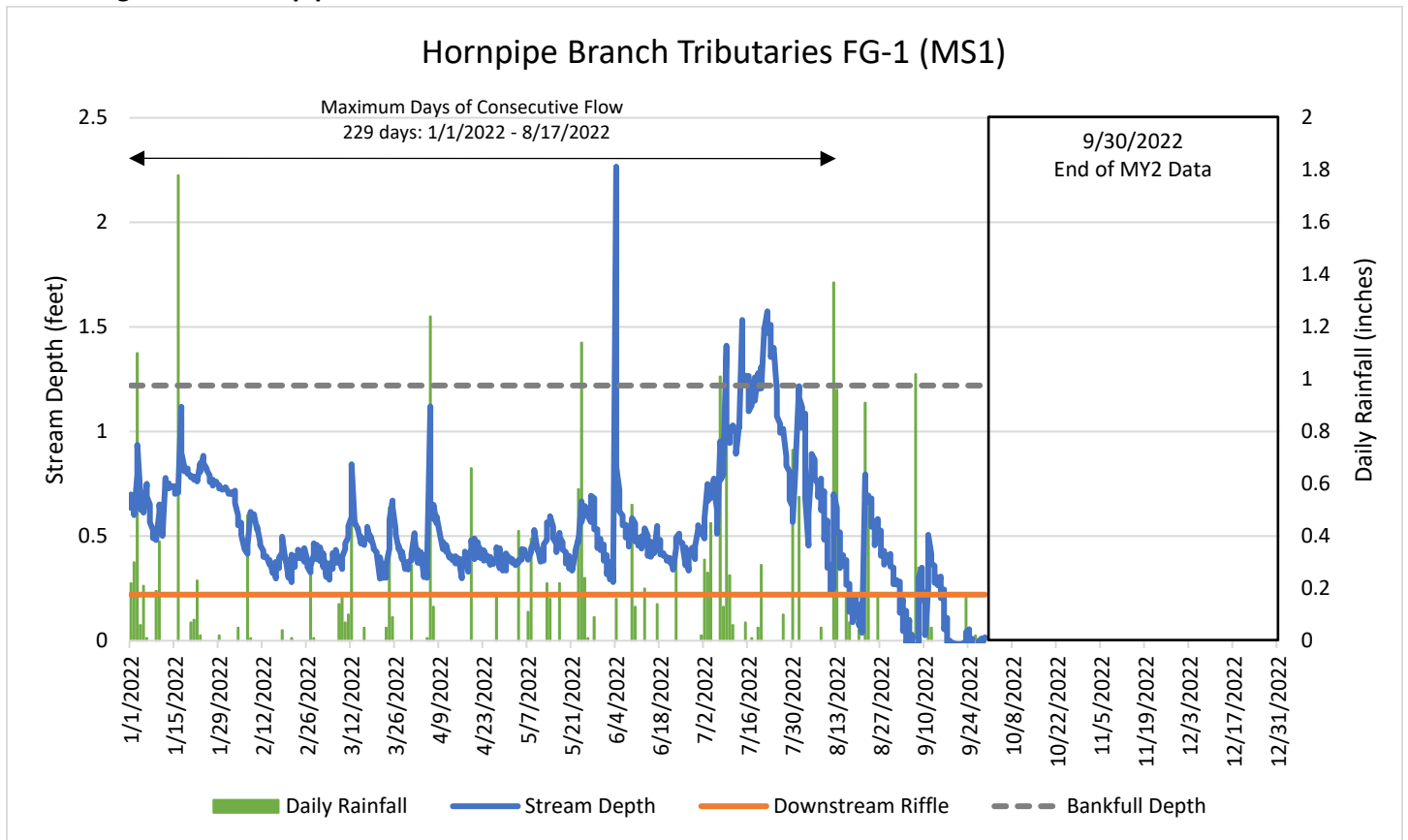
Hornpipe Branch Tributaries Mitigation Project Monthly Rainfall Summary

	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22
Observed Rainfall	1.21	1.14	2.42	5.03	1.15	2.28	2.25	3.58	1.55	4.84	4.94	2.49	3.23	**	**
WETS 30th Percentile	1.92	1.88	2.13	2.75	2.26	2.88	2.13	2.62	3.28	4.16	3.73	3.19	1.92	1.88	2.13
WETS 70th Percentile	3.97	3.88	4.10	4.54	4.15	4.64	4.07	4.75	6.04	6.58	6.96	7.00	3.97	3.88	4.10
Low/Normal/High	L	L	N	H	L	L	N	N	L	N	N	L	N	**	**

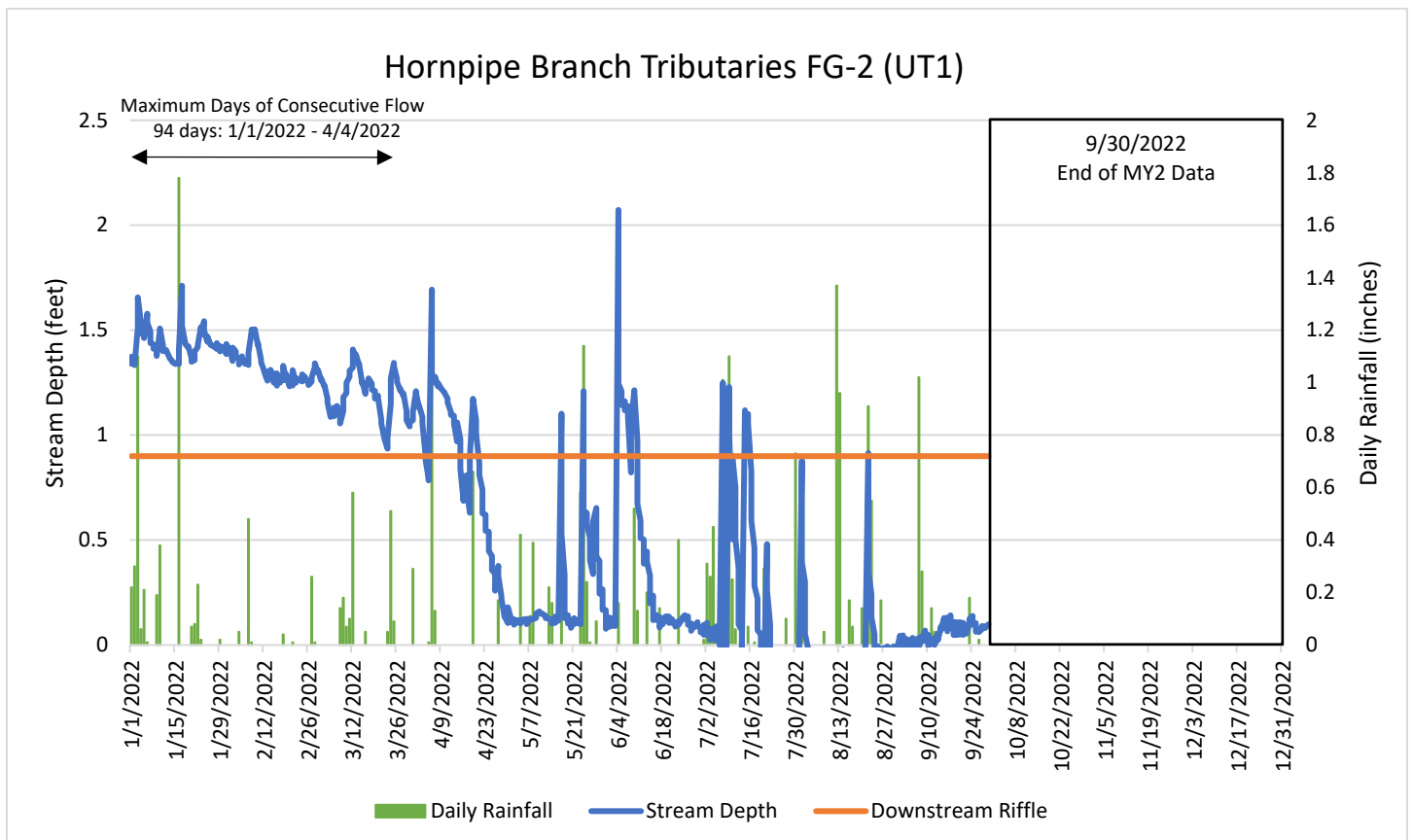
*30th and 70th Percentile data collected from data from WETS Station: KINSTON AG RESEARCH, NC

**Incomplete Month

Flow Gauge Data – Hornpipe Branch Tributaries MY2

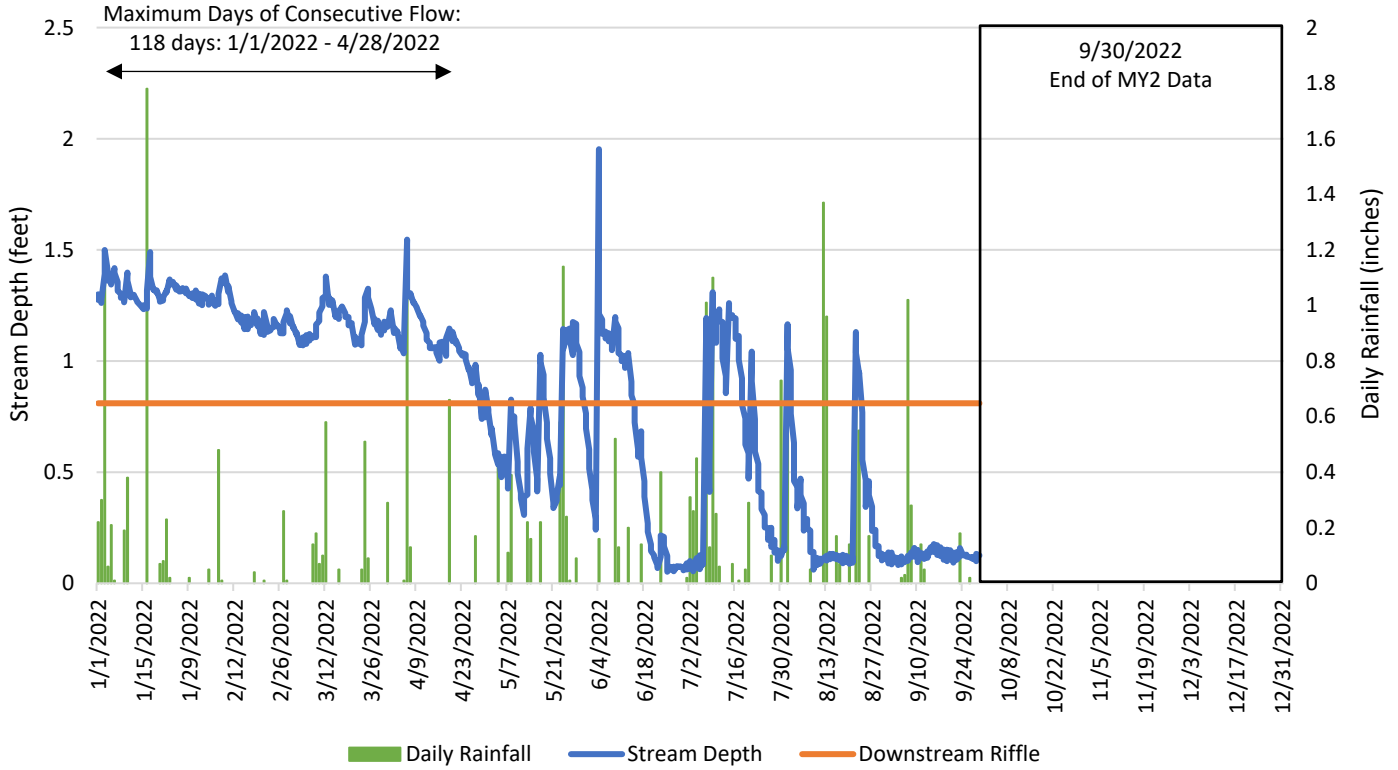


*247 days of cumulative flow in MY2, 25 days of cumulative no flow in MY2



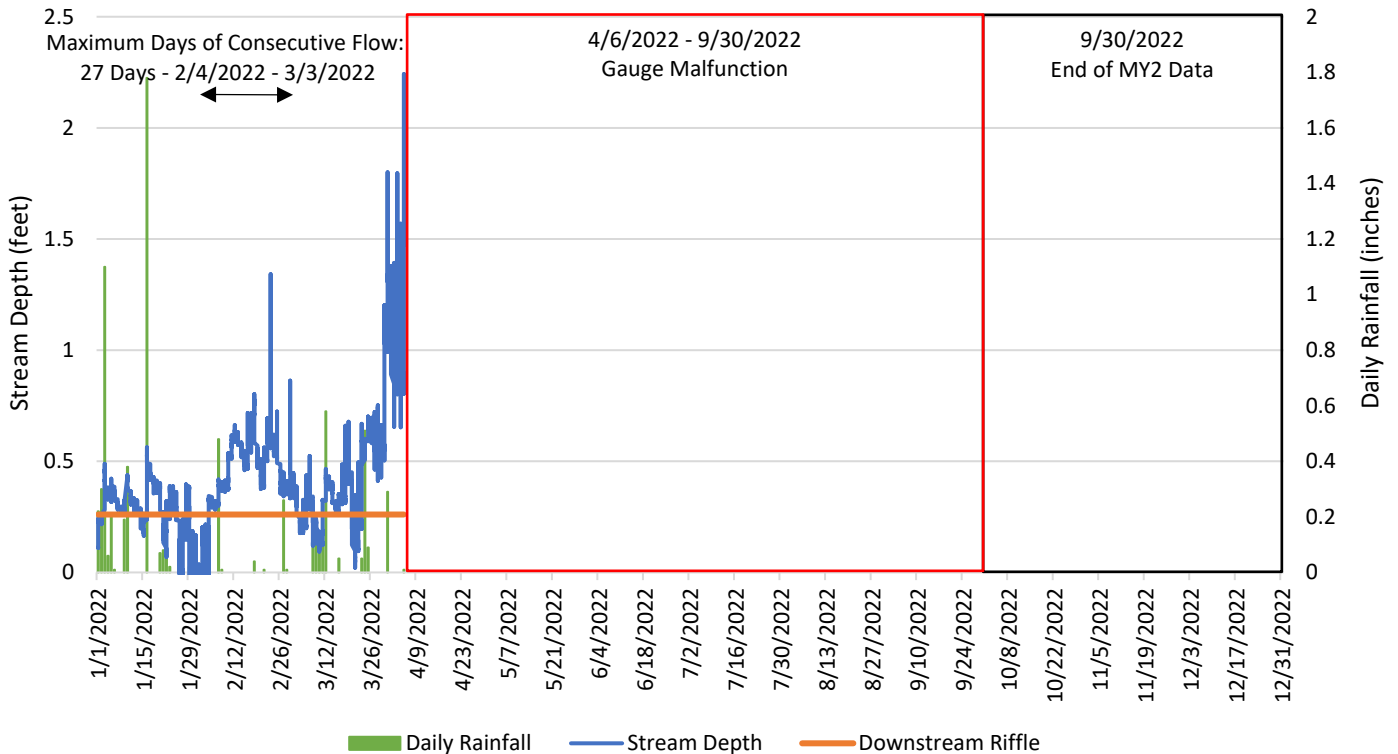
*117 days of cumulative flow in MY2, 155 days of cumulative no flow in MY2

Hornpipe Branch Tributaries FG-3 (UT2)



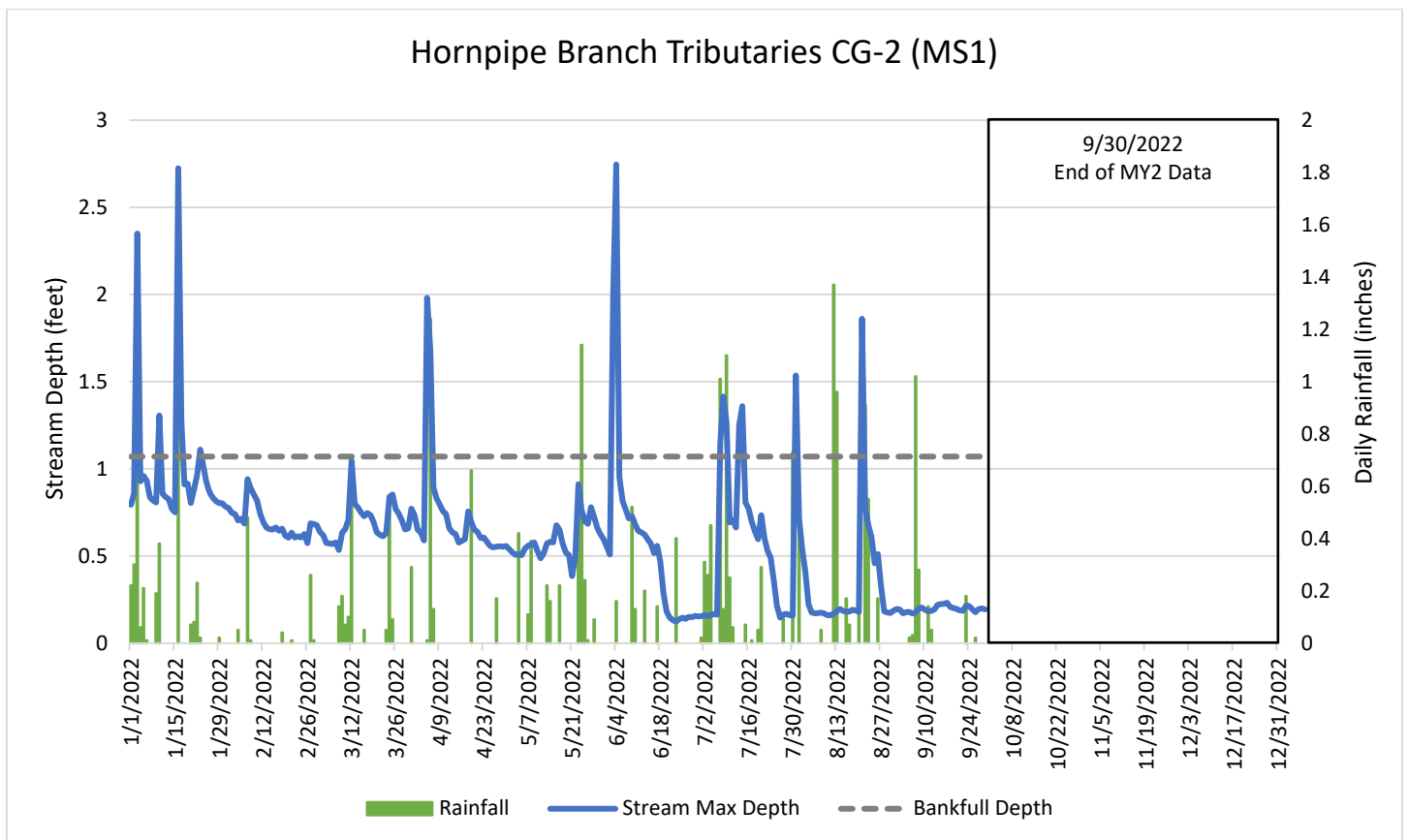
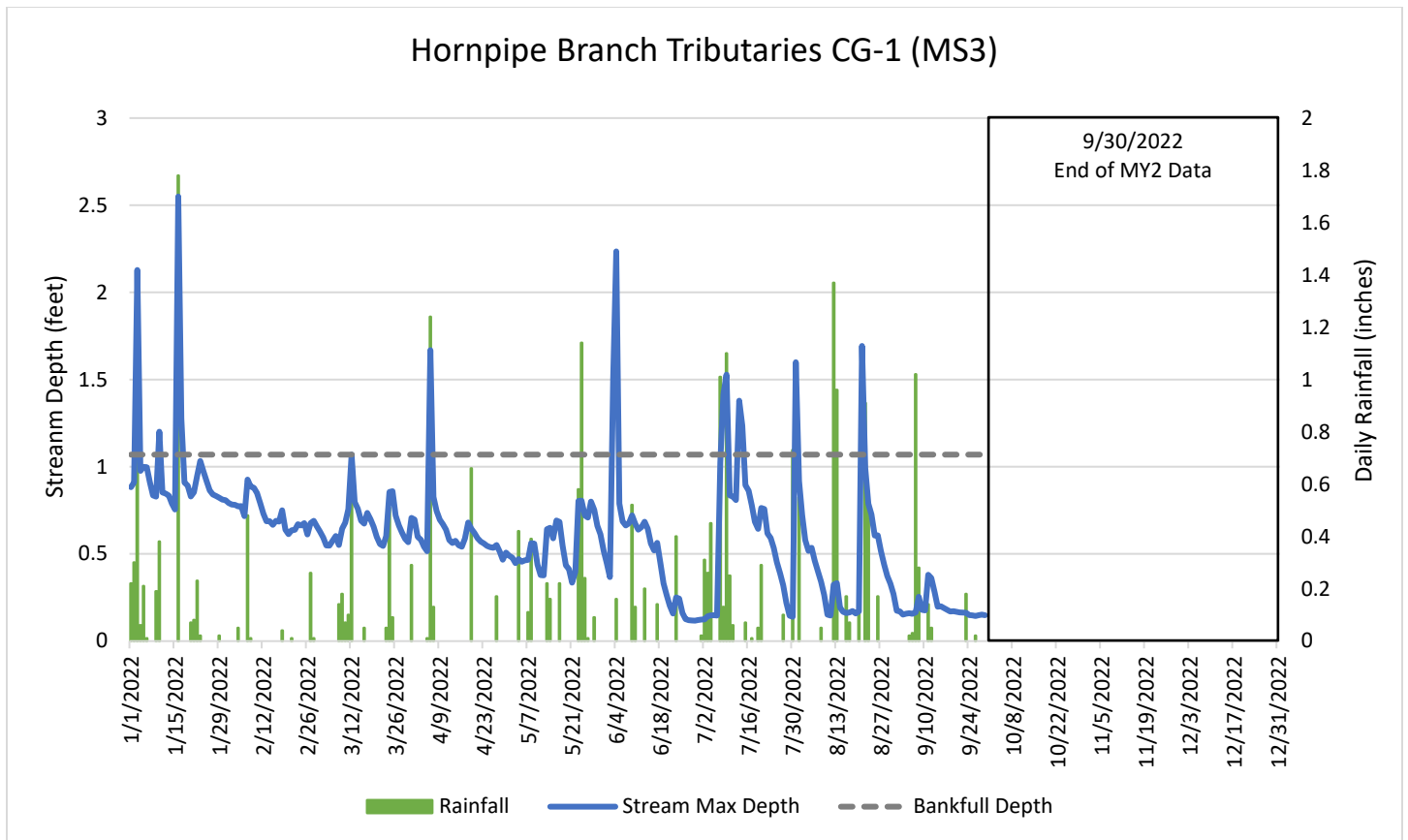
*154 days of cumulative flow in MY2, 118 days of cumulative no flow in MY2

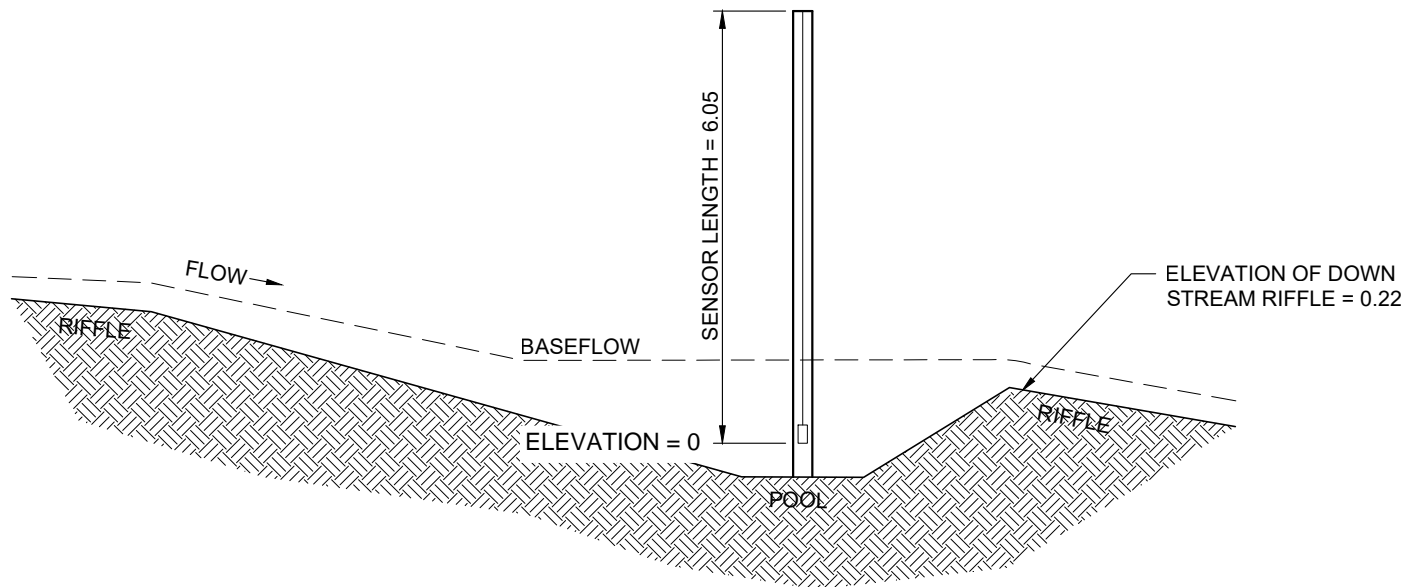
Hornpipe Branch Tributaries FG-4 (Reference Reach)



*65 days of cumulative flow in MY2, 29 days of cumulative no flow in MY2

Crest Gauge Data – Hornpipe Branch Tributaries MY2

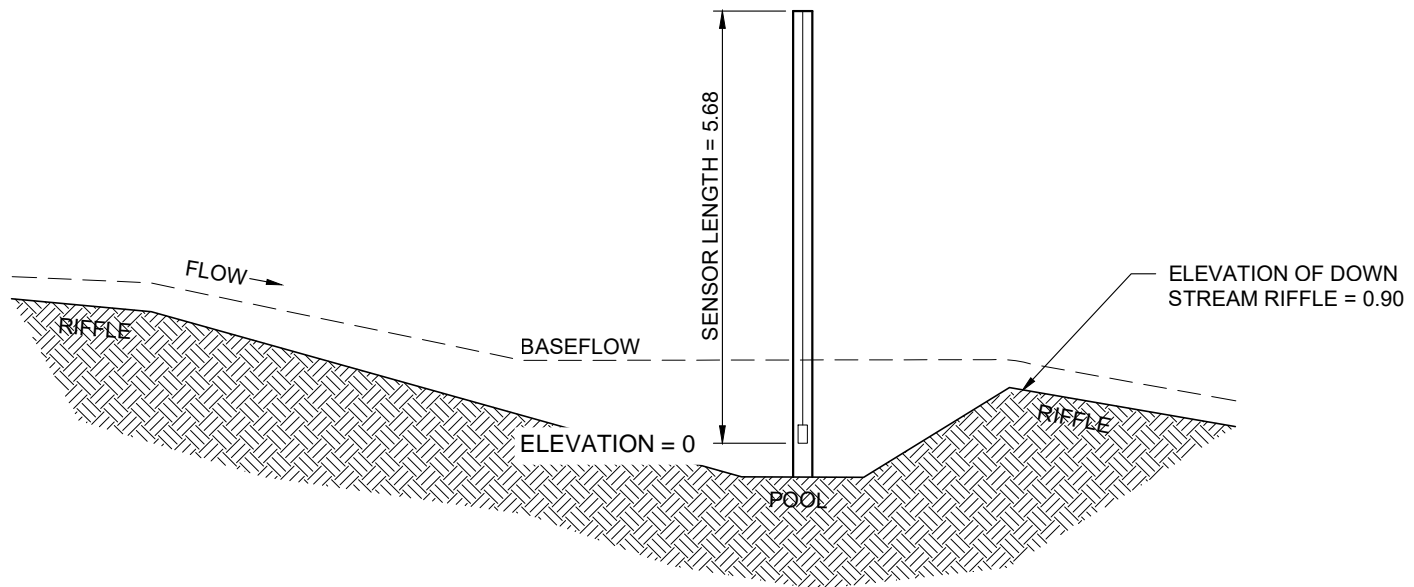




FLOW GAUGE #1 - MS1

Flow Depth = 0.22 feet

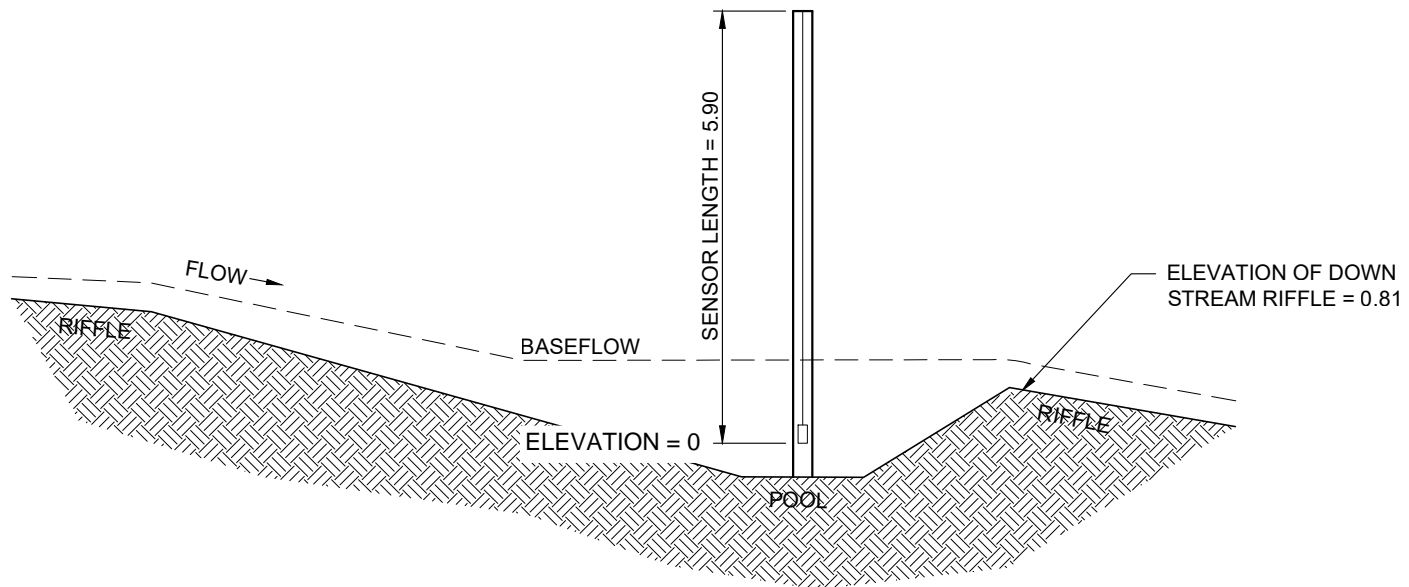
*All elevations relative to sensor depth



FLOW GAUGE #2 - UT1

Flow Depth = 0.90 feet

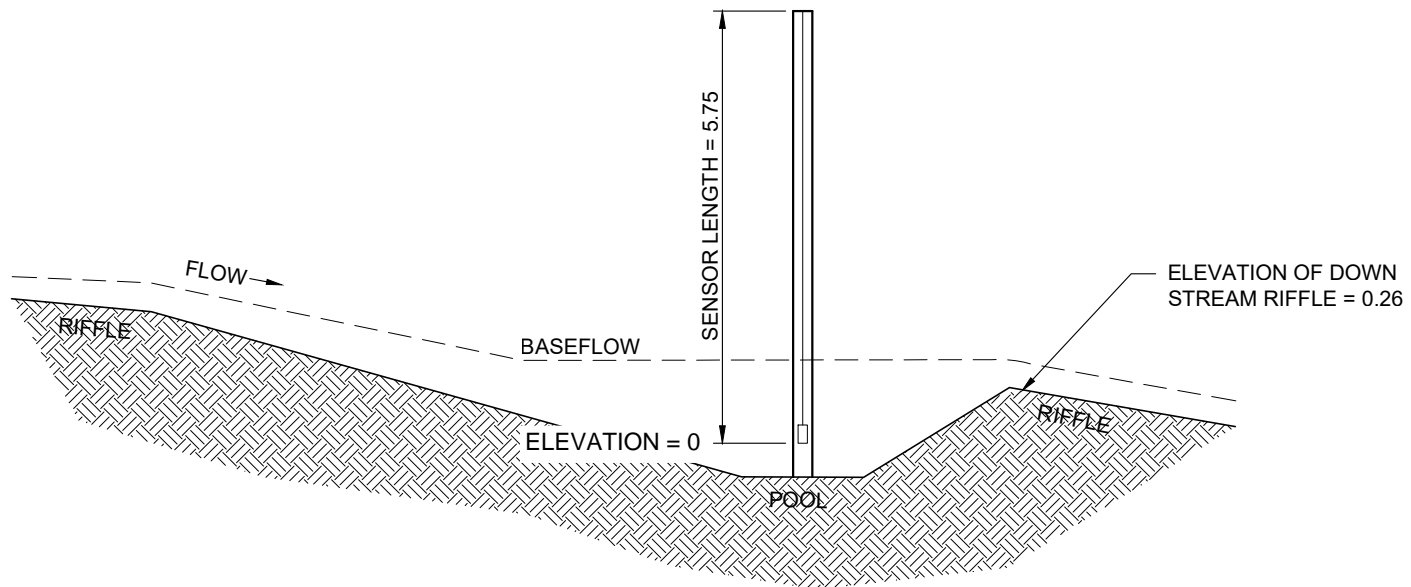
*All elevations relative to sensor depth



FLOW GAUGE #3 - UT2

Flow Depth = 0.81 feet

*All elevations relative to sensor depth

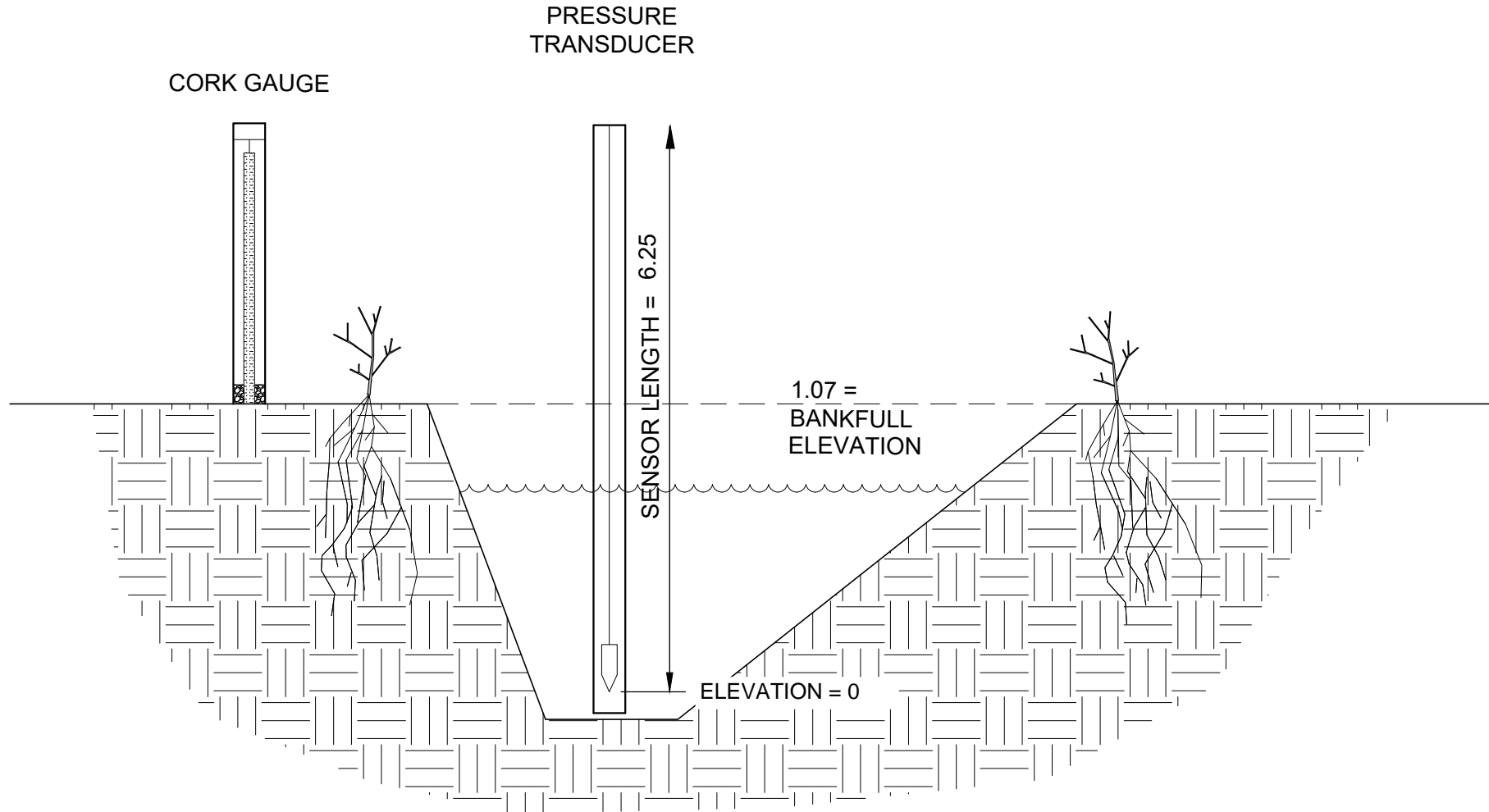


FLOW GAUGE #4 - Reference Reach

Flow Depth = 0.26 feet

*All elevations relative to sensor depth

CROSS SECTIONAL VIEW OF STREAM



Crest Gauge CG-1 (MS-3)

Bankfull Event Depth = 1.07 feet

*All elevations relative to sensor depth

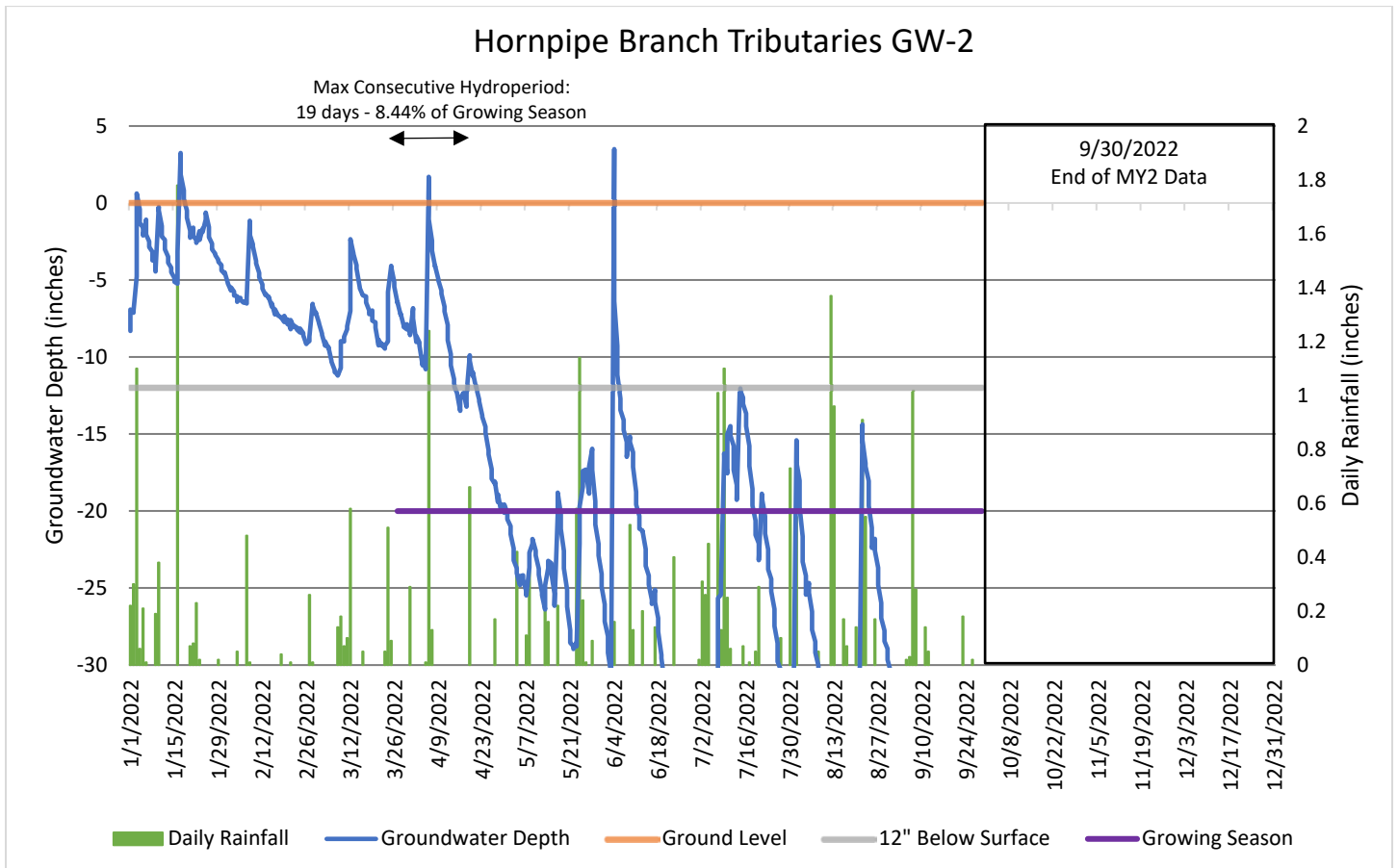
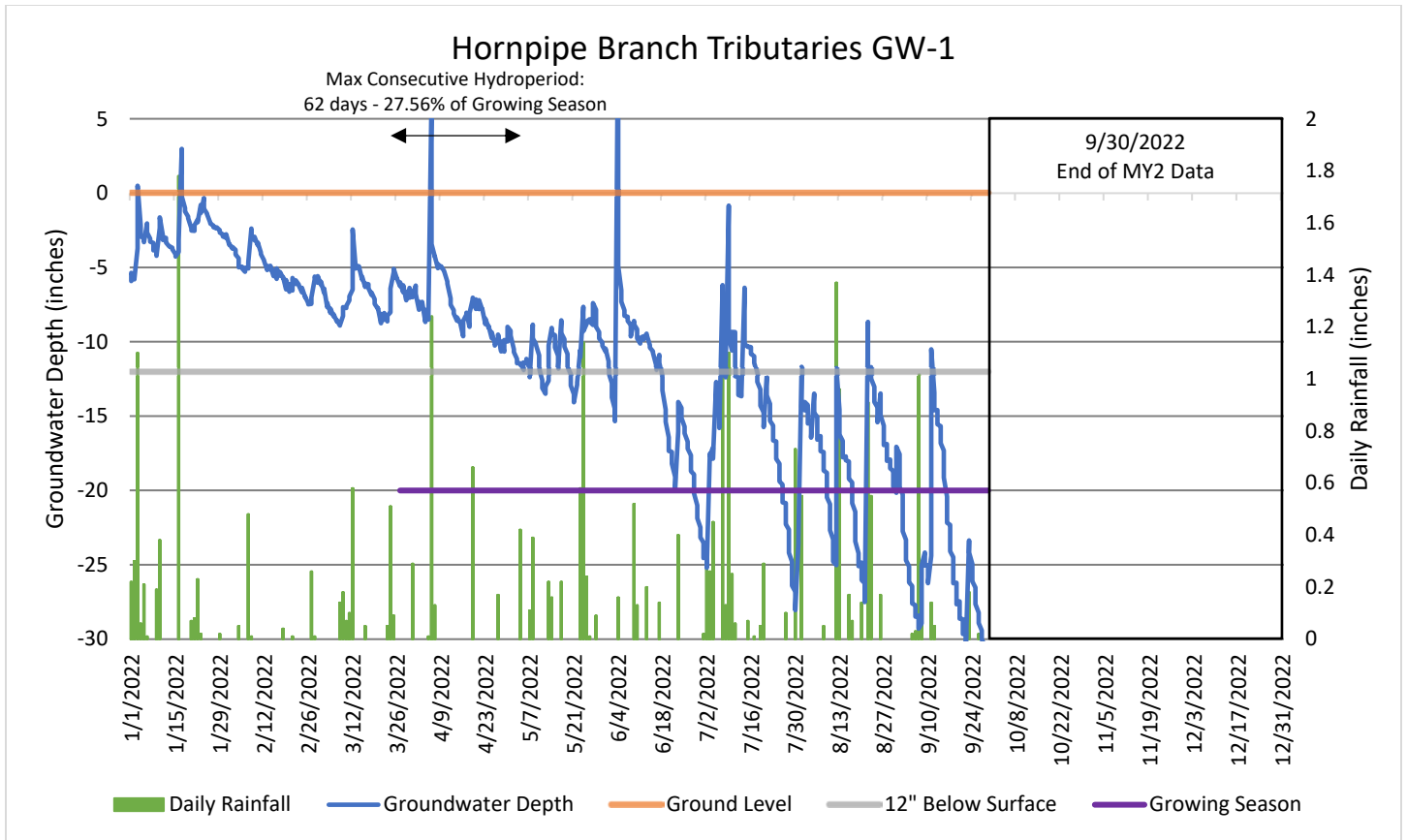
Hornpipe Branch Tributaries Wetland Hydrology Criteria Attainment Table

Performance Standard: N/A*
WETS Station: Kinston Ag Research, Inc
Growing Season: 3/26 to 11/7 (225 days)
Max. Consecutive Hydroperiod (%)

Monitoring Gauge	MY 1 2021	MY2 2022	MY 3 2023	MY 4 2024	MY 5 2025	MY 6 2026	MY 7 2027	MY 7+ 2028	Average
GW-1	12.00%	27.56%							19.78%
GW-2	11.56%	8.44%							10.00%

*No wetland mitigation credits were contracted or proposed for Hornpipe Branch Tributaries therefore no performance standards for wetland hydrology success are proposed.

Groundwater Gauge Data – Hornpipe Branch Tributaries MY2



Appendix E:
Project Timeline and Contact
Info

Project Timeline and Contacts		
Activity or Deliverable	Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted	NA	6/14/2018
Mitigation Plan Approved	NA	7/6/2020
Construction (Grading) Completed	NA	3/26/2021
Planting Completed	NA	4/3/2021
As-built Survey Completed	NA	5/14/2021
MY-0 Baseline Report	4/29/2021	6/18/2021
MY1 Monitoring Reports	10/19/2021	11/29/2021
MY2 Monitoring Reports	9/30/2022	11/30/2022
Remediation Items (e.g. beaver removal, supplements, repairs etc.)		
Encroachment		

Hornpipe Branch Tributaries	
Provider	7721 Six Forks Road, Suite 130
Water & Land Solutions, LLC	Raleigh, NC 27615
Mitigation Provider POC: Emily Dunnigan	(269) 908-6306
Designer	7721 Six Forks Road, Suite 130
Water & Land Solutions, LLC	Raleigh, NC 27615
Primary project design POC: Kayne Van Stell	(919) 818-8481
Construction Contractor	453 Silk Hope Liberty Road
Wright Contracting, LLC	Siler City, NC 27344
Primary contractor POC: Ben Johnson	(336) 402-8312