
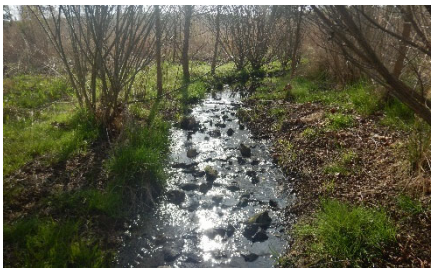


MONITORING YEAR 5 ANNUAL REPORT

Final

January 2023

BUCKWATER MITIGATION SITE

Orange County, NC
Neuse River Basin
HUC 03020201
DMS Project No. 97084
NCDEQ Contract No. 006829
USACE Action ID No. 2016-00873
DWR Project No. 2016-0406v2

Data Collection Dates: January-November 2023

PREPARED FOR:

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

January 29, 2024

Jeremiah Dow
Eastern Regional Supervisor
North Carolina DEQ Division of Mitigation Services
217 West Jones Street, Raleigh, NC 27603

RE: DMS Comments on the MY5 Report
Buckwater, Project ID #97084, DMS Contract 6829

Dear Mr. Dow:

We have reviewed the comments on the Monitoring Year 5 Report for the above referenced project dated December 11, 2023 and have revised the report based on these comments. The revised documents are submitted with this letter. Below are responses to each of your comments. For your convenience, the comments are reprinted with our response in italics.

Stream Report:

1. Table 2 – since veg plot data was collected in MY5, we recommend changing the "Cumulative Monitoring Results" column associated with vegetation success to something more quantitative, i.e., 15 of 19 plots met success.
   Response: Table 2 "Cumulative Monitoring Results" column associated with vegetation success has been updated to reflect a quantitative result.

2. Section 2.3 – contains possible conflicting statements that majority of streams are "functioning as designed" and then calls out XS 34 on T7A as a potential problem (pool filling), but then goes on to say T7A is functioning as designed. What streams or reaches are not functioning as designed? Also, pool XS 26 has lost about 60% of its cross-sectional area while XS 34 has lost about 38%. Why was XS 34 singled out and not XS 26 (is XS 26 a result of point bar formation vs. XS 34 simply losing pool depth)? Are the repair areas considered not functioning as intended for MY5?
   Response: Section 2.3 has been updated to remove any conflicting statements. XS 26 is now included in Section 2.3. It was not originally included because it developed a point bar and was not considered aggrading as seen in XS 34. The repairs are stable and are functioning as intended.

3. Figure 1b – a couple of the veg plots are not labeled, or the label is offset so it is difficult to see.
   Response: Figure 1b has been updated to clearly show the veg plot labels.

4. Table 4 – the visual stream assessment tables indicate that that 100% of all structures were functioning as intended. The structures that required repair in August should be included here, especially as they weren't identified for the MY4 report. In MY6, assuming the repairs were successful, they would no longer need to be reported.
   Response: Table 4 has been updated to reflect the structures that were repaired in August.

5. Table 5 – shows no invasive areas of concern, but a 1.72-acre polygon of privet treatment is shown on the CCPV. The privet treatment polygon was included in this Table in the riparian buffer report.

   <u>Response:</u> Table 5 has been updated to reflect the 1.72-acre polygon of privet treatment.

6. Due to the number of sweetgum volunteers recorded in VPs 13 and 15, is there any plan, or need, to expand sweetgum thinning efforts?

   <u>Response:</u> Currently there is no plan to expand the sweetgum thinning efforts. The planted trees height and density are on track to meet MY7 success criteria and do not seem to be outcompeted by the sweetgum volunteers. However, Wildlands will continue to monitor this area throughout the year and will thin if deemed necessary.

If you have any questions, please contact me by phone (919) 851-9986, or by email (jlorch@wildlandseng.com).
Sincerely,

Jason Lorch, *Monitoring Coordinator*

PREPARED BY:

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Phone: 919.851.9986

BUCKWATER MITIGATION SITE

Monitoring Year 5 Annual Report

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Section 1: PROJECT OVERVIEW

The Buckwater Mitigation Site (Site) is located in central Orange County, approximately 4.5 miles northeast of Hillsborough, NC. The Site lies in the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). Table 3 presents information related to the project attributes.

1.1 Project Quantities and Credits

The Site is located on eleven parcels under nine different landowners and a conservation easement was recorded on 51.84 acres. Mitigation work within the Site included restoration, enhancement I, and enhancement II of perennial and intermittent stream channels. Table 1 below shows stream credits by reach and the total amount of stream credits expected at closeout.

Table 1: Project Quantities and Credits

PROJECT MITIGATION QUANTITIES						
Reach ID	**Mitigation Plan Footage**	**As-Built Footage**	**Mitigation Category**	**Restoration Level**	**Mitigation Ratio (X:1)**	**Comments**
STREAMS						
Buckwater Reach 1	445	433	Warm	EII	2.5	Grade Control Structures, Bank Repair, Conservation Easement
Buckwater Reach 2	160	162	Warm	EI	1.5	Grade Control Structures, Bank Repair, Planted Buffer
Buckwater Reach 3	232	232	Warm	EI	1.5	Grade Control Structures, Bank Repair, Planted Buffer
Buckwater Reach 4	2,067	2,071	Warm	R	1.0	Full Channel Restoration, Planted Buffer, Invasive Control
	30	29	N/A	N/A	0.0	Utility Crossing
	206	209	Warm	R	1.0	Full Channel Restoration, Planted Buffer
	72	70	N/A	N/A	0.0	Road Crossing
	194	198	Warm	R	1.0	Full Channel Restoration, Planted Buffer
Buckwater Reach 5	486	485	Warm	R	1.0	Full Channel Restoration, Planted Buffer, Invasive Control
Buckwater Reach 6	379	363	Warm	R	1.0	Full Channel Restoration, Planted Buffer, Invasive Control
	118	30	N/A	N/A	0.0	Utility Crossing
Buckwater Reach 7	43	132	N/A	N/A	0.0	Utility Crossing
	891	885	Warm	EII	2.5	Grade Control Structures, Bank Repair, Enhancement Work Completed Beyond Limits of Conservation Easement
Buckwater Reach 8	188	185	Warm	EII	2.5	Bank Repair, Conservation Easement
T1 Reach 1	366	375	Warm	EI	1.5	Grade Control Structures, Planted Buffer
	119	0	N/A	N/A	0.0	Road Crossing
T1 Reach 2	123	244	N/A	N/A	0.0	Utility Crossing
	485	477	Warm	R	1.0	Full Channel Restoration, Planted Buffer
	25	43	N/A	N/A	0.0	Utility Crossing
T2	587	592	Warm	R	1.0	Full Channel Restoration, Planted Buffer

PROJECT MITIGATION QUANTITIES						
Reach ID	**Mitigation Plan Footage**	**As-Built Footage**	**Mitigation Category**	**Restoration Level**	**Mitigation Ratio (X:1)**	**Comments**
STREAMS						
T3 Reach 1	1,101	1,107	Warm	EII	2.5	Livestock Exclusion, Grade Control Structures, Planted Buffer
	30	29	N/A	N/A	0.0	Road Crossing
	166	167	Warm	EII	2.5	Livestock Exclusion, Grade Control Structures, Planted Buffer
T3 Reach 2	658	665	Warm	R	1.0	Full Channel Restoration, Planted Buffer, Livestock Exclusion
	63	93	N/A	N/A	0.0	Road Crossing
	193	197	Warm	R	1.0	Full Channel Restoration, Planted Buffer, Livestock Exclusion
T4	961	956	Warm	R	1.0	Full Channel Restoration, Planted Buffer
T4A Reach 1	311	327	Warm	R	1.0	Farm Pond Drained, Full Channel Restoration, Planted Buffer
T4A Reach 2	175	155	Warm	EII	2.5	Livestock Exclusion, Grade Control Structures, Conservation Easement
	72	75	N/A	N/A	0.0	Road Crossing
T4A Reach 3	201	208	Warm	R	1.0	Full Channel Restoration, Planted Buffer
	64	66	N/A	N/A	0.0	Road Crossing
T4B Reach 1	345	346	Warm	R	1.0	Full Channel Restoration, Livestock Exclusion
T5	548	554	Warm	R	1.0	Full Channel Restoration, Planted Buffer, Invasive Control
	167	0	N/A	N/A	0.0	Road Crossing
	711	722	Warm	R	1.0	Full Channel Restoration, Planted Buffer, Farm Pond Drained
T6 Reach 1	695	697	Warm	EII	2.5	Invasive Control, Bank Repair, Conservation Easement
T6 Reach 2	458	458	Warm	EII	2.5	Invasive Control, Bank Repair, Conservation Easement
	30	30	N/A	N/A	0.0	Road Crossing
T6 Reach 3	620	623	Warm	EI	1.5	Grade Control Structures, Planted Buffer, Invasive Control
T6A	311	313	Warm	EII	2.5	Grade Control Structures, Bank Repair, Conservation Easement
T6B	136	136	Warm	EII	2.5	Grade Control Structures, Bank Repair, Conservation Easement
T7 Reach 1	322	320	Warm	EI	1.5	Grade Control Structures, Planted Buffer
T7 Reach 2	363	367	Warm	R	1.0	Full Channel Restoration, Planted Buffer
T7 Reach 3	356	357	Warm	R	1.0	Full Channel Restoration, Planted Buffer
T7A	242	240	Warm	EI	1.5	Grade Control Structures, Planted Buffer
T8	631	621	Warm	EI	1.5	Grade Control Structures, Planted Buffer

PROJECT MITIGATION QUANTITIES						
Reach ID	**Mitigation Plan Footage**	**As-Built Footage**	**Mitigation Category**	**Restoration Level**	**Mitigation Ratio (X:1)**	**Comments**
STREAMS						
T9	73	73	Warm	EII	2.5	Grade Control Structures, Conservation Easement

Blue = **Restoration**	Yellow = **Enhancement I**	Orange = **Enhancement II**

Restoration Level	**Stream**		
	Warm	**Cool**	**Cold**
Restoration	9,051.000		
Enhancement I	1,715.334		
Enhancement II	1,855.600		
Preservation			
Totals	**12,621.934**		
Total Stream Credit	12,621.934		

1.2 Project Goals and Objectives

The project is intended to provide numerous ecological benefits. Table 2 below describes expected outcomes to water quality and ecological processes and provides project goals and objectives.

Table 2: Goals, Performance Criteria, and Functional Improvements

Goal	Objective/ Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Improve the stability of stream channels.	Construct stream channels that will maintain stable cross-sections, patterns, and profiles over time.	Significantly reduce sediment inputs from bank erosion. Reduce shear stress on channel boundary.	ER stays over 2.2 and BHR below 1.2 with visual assessments showing progression towards stability.	Cross-section monitoring and visual inspections.	Beaver dams were removed along Buckwater Creek Reach 6. Cross-section surveys show the channels are stable.
Improve in-stream habitat.	Install habitat features such as constructed riffles, cover/lunker logs, and brush toes into restored/enhanced streams. Add woody materials to channel beds. Construct pools of varying depth.	Increase and diversify available habitats for macroinvertebrates, fish, and amphibians leading to colonization and increase in biodiversity over time. Add complexity including LWD to streams.	There is no required performance standard for this metric.	N/A	Repairs to failing structures along T3 Reach 2, T4, T4B Reach 1, and T6 Reach 3 were made to improve quality of stream habitat and overall function.

Goal	Objective/ Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime.	Reconstruct stream channels for bankfull dimensions and depth relative to the existing floodplain.	Raise water table and hydrate riparian wetlands. Allow more frequent flood flows to disperse on the floodplain.	Two or more bankfull events in separate years and two geomorphically significant events throughout the monitoring period. 30 consecutive days of flow for intermittent channels.	Crest gauges and/or pressure transducers recording flow elevations.	Bankfull or gemorphically significant events were recorded on all streams with crest gauges. T4B, T6, T7 Reach 2, and T7A exceeded 30 days of consecutive flow during MY5.
Exclude cattle from project streams.	Install fencing around conservation easements adjacent to cattle pastures.	Reduce and control sediment inputs; reduce and manage nutrient inputs; reduce and manage fecal coliform inputs. Contribute to protection of or improvement to a Water Supply Waterbody. Support Falls Lake recovery plan.	Prevent cattle from accessing the stream.	Visually inspect the Site to ensure no cattle encroachment is occurring.	No cattle encroachments.
Restore and enhance native floodplain and streambank vegetation.	Plant native tree and understory species in riparian zone and plant appropriate species on streambank.	Reduce sediment inputs from bank erosion and runoff. Increase nutrient cycling and storage in floodplain. Provide riparian habitat. Add a source of LWD and organic material to stream.	Survival rate of 320 stems per acre at MY3, 260 stems per acre at MY5, and 210 stems per acre at MY7. Height requirement is 7 feet at MY5 and 10 feet at MY7.	One hundred square meter vegetation plots are placed on 2% of the planted area of the Site and monitored annually.	15 of 19 VPs met the MY5 success criteria. 3 of the 4 failing VPs are on track to meet the MY7 success criteria. Invasive vegetation was removed in March 2023. Repair LODs have been replanted.
Permanently protect the project Site from harmful uses.	Establish conservation easements on the Site.	Protect Site from encroachment on the riparian corridor and direct impact to streams and wetlands.	Prevent easement encroachment.	Visually inspect the perimeter of the Site to ensure no easement encroachment is occurring.	Mowing within the easement occurred along T6 where the conservation easement shares a boundary with a utility easement. Boundary signage will be checked, refreshed, and reposted in winter 2023.

1.3 Project Attributes

Prior to construction activities, the primary causes of Site degradation were stream channelization and livestock grazing, both of which originated prior to 1938. Agricultural activity remained intensive through the 1990s with several thousand beef cattle and three hog houses. Currently, approximately 100 cows graze on two properties and non-forested land is used for cultivating hay. Several ponds along Buckwater Creek, T3, and T5 were built between 1938 and 1955. According to 1955 aerial photography, the top 1,000 feet of Buckwater Creek on the Site were channelized. Landowners maintained lower Buckwater Creek below Walnut Hill Drive as a straightened channel until the 1990s. Table 3 below and Table 8 in Appendix C present additional information on pre-restoration conditions.

Table 3: Project Attributes

PROJECT INFORMATION					
Project Name	Buckwater Mitigation Site	County		Orange County	
Project Area (acres)	51.84	Project Coordinates		36.62349 N, 79.12911 W	
PROJECT WATERSHED SUMMARY INFORMATION					
Physiographic Province	Piedmont	River Basin		Neuse	
USGS HUC 8-digit	03020201	USGS HUC 14-digit		03020201030030	
DWR Sub-basin	03-04-01	Land Use Classification		63.9% Forested, 32.1% Cultivated, 3.9% Impervious	
Project Drainage Area (acres)	2,259	Percentage of Impervious Area		3.9%	
RESTORATION TRIBUTARY SUMMARY INFORMATION					
Parameters	**Buckwater Creek**	**T1**	**T2 & T3**	**T4, T4A, & T4B**	
Pre-project length (feet)	5,557	1,073	2,728	2,216	
Post-project (feet)	5,223	852	2,728	1,992	
Valley confinement	Moderately Confined to Unconfined	Unconfined	Unconfined to Confined	Moderately Confined to Unconfined	
Drainage area (acres)	2,259	1,216	218	77	
Perennial, Intermittent, Ephemeral	Perennial	Perennial	Perennial	Intermittent	
DWR Water Quality Classification	WS-IV				
Dominant Stream Classification (existing)	E4/G4c	E4/B4c	E4/G4c	G4	
Dominant Stream Classification (proposed)	C4/E4	E4	B4/C4	B4	
Dominant Evolutionary class (Simon) if applicable	Stage V		Stage IV		
Parameters	**T5 & T6**	**T7 & T7A**		**T8**	
Pre-project length (feet)	3,184	1,235		620	
Post-project (feet)	3,054	1,284		621	
Valley confinement	Moderately Confined	Moderately Confined to Confined		Moderately Confined	
Drainage area (acres)	109	28		21	
Perennial, Intermittent, Ephemeral	Intermittent	Intermittent		Intermittent	
DWR Water Quality Classification	WS-IV				
Dominant Stream Classification (existing)	E4/C4	E4/G4		E4	
Dominant Stream Classification (proposed)	B4/C4	B4/C4			
Dominant Evolutionary class (Simon) if applicable	Stage IV				

REGULATORY CONSIDERATIONS			
Parameters	**Applicable?**	**Resolved?**	**Supporting Documentation**
Water of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No. 27 and DWQ 401 Water Quality Certification No. 4134.
Water of the United States - Section 401	Yes	Yes	
Endangered Species Act	Yes	Yes	Categorical Exclusion in Mitigation Plan (Wildlands, 2017)
Historic Preservation Act	Yes	Yes	
Coastal Zone Management Act (CZMA or CAMA)	N/A	N/A	N/A
Essential Fisheries Habitat	N/A	N/A	N/A

Section 2: MONITORING YEAR 5 DATA ASSESSMENT

Annual monitoring and site visits were conducted during MY5 to assess the condition of the project. The vegetation and stream success criteria for the Site follow the approved success criteria presented in the Mitigation Plan (Wildlands, 2017). Performance criteria for vegetation, stream, and hydrologic assessment are located in Section 1.2 Table 2: Goals, Performance Criteria, and Functional Improvements. Methodology for annual monitoring is presented in the MY0 Annual Report (Wildlands, 2019).

2.1 Vegetative Assessment

The MY5 vegetative survey was completed in October 2023. Vegetation monitoring resulted in a planted stem density range of 162 to 647 stems per acre. Out of the 19 vegetation plots, 15 are meeting the interim requirement of 260 stems per acre required at MY5. Vegetation plots 6, 7, 8, and 18 do not meet the interim success criteria. However, vegetation plots 6 and 7 are only failing to meet requirements by less than 10% with 243 stems per acre each and are on track to meet the final success criteria of 210 stems per acre. Despite the mortality of planted stems in plot 18, when accounting for volunteer American elm this plot surpasses the final success criteria with the number of stems per acre totaling 243. Tulip poplar (*Liriodendron tulipifera*) and eastern red cedar (*Juniperus virginiana*) were approved by the NCIRT as desirable species and were counted toward the MY5 vegetation success criteria.

Herbaceous vegetation is abundant across the Site and includes native pollinator species, which is indicative of a healthy riparian habitat. The riparian habitat is helping to reduce nutrient runoff from the cattle fields outside the easement and stabilizing the stream banks. Refer to Appendix A for Vegetation Plot Photographs and the Vegetation Condition Assessment Table and Appendix B for Vegetation Plot Data.

2.2 Vegetation Areas of Concern and Management

A small area of dense sweetgum (*Liquidambar styraciflua*) saplings was noted along T6 Reach 1 (Appendix 2). The sweetgum population was thinned to approximately 50% density in February 2023. Wildlands will continue to monitor and manage this area for overgrowth of sweetgums.

Several small areas totaling 1.72 acres of Chinese privet (Ligustrum sinense) growth were noted along Buckwater Creek Reaches 6 and 7, T2, and T4. The invasive removal was completed along Buckwater Creek Reach 6, T2, and T4 in March 2023 (Appendix 2). Wildlands will continue to manage and remove the remaining populations of Chinese privet along Buckwater Creek Reach 7 through winter 2023-2024.

In April 2023, several constructed instream structures along T3 Reach 2, T4, T4B Reach 1, and T6 Reach 3 were observed to be performing poorly or failing (Appendix 2). In August 2023, mechanical repairs to these structures were made which required equipment access into the easement. The resulting limits of disturbance (LOD) for all four repair areas totaled approximately 0.20 acres. Replanting of the LODs was completed in November 2023. A total of 140 stems were planted across the four repair area LODs and livestakes will be added to the adjacent streambanks in winter 2023-2024.

Soil amendments and ring sprays were conducted in April 2023. Soil amendments were applied locally to trees with low heights across the site. Ring sprays were conducted in areas across the site with dense fescue to reduce competition with planted trees.

In September 2023, it was noted that the utility company that maintains the electrical distribution easement adjoining the easement boundary south of T6 mowed within the conservation easement. The entire mowed area is approximately 0.04 acres. The encroachment has been addressed with the utility

company and approximately one dozen containerized trees of species included in the approved planting list were planted in the mowed area in November 2023. Wildlands will check, refresh, and repost boundary signage throughout the site in winter 2023-2024.

2.3 Stream Assessment

Morphological surveys for MY5 were conducted in March 2023. All streams within the Site are stable. All but two of the 36 cross-sections show little to no change in the bankfull area and width-to-depth ratio, and bank height ratios are less than 1.2. Cross-section 26 on T5 developed a point bar after construction, before the floodplain soils became stabilized. The cross-section has remained stable since MY1, and the riffle (cross-section 27) shows no signs of filling in. T5 has been monitored closely since construction and is not a concern. Cross-section 34 on T7A shows some aggradation in the pool, but the riffle (cross-section 33) shows no aggradation. By multiple visual assessments, T7A is stable, and the sediment source is believed to be coming from outside the conservation easement. Pebble count data is no longer required per the September 29, 2021 Technical Work Group Meeting and is not included in this report. The IRT reserves the right to request pebble count data/particle distributions if deemed necessary during the monitoring period. Refer to Appendix A for the Visual Stream Morphology Stability Assessment Table and Stream Photographs and Appendix C for Stream Geomorphology Data. See Appendix A for stream photographs and visual assessment data.

2.4 Stream Areas of Concern and Management

Several small beaver dams were removed along Buckwater Creek Reaches 5 and 6 in February 2023 and two beavers were trapped by APHIS. Beaver returned to the stream later in 2023 and an additional beaver dam was removed along Buckwater Creek Reach 6 (Figure 1b) in November 2023 along with several smaller dams on Buckwater Creek Reaches 4 and 5. A total of nine beavers were trapped by APHIS. It is believed the beaver were displaced from further downstream outside of the conservation easement and moved upstream to the Site. The area where the beaver dam occurred experienced some herbaceous vegetation loss and sediment deposition. Some black willows (*Salix nigra*) along the top of bank were gnawed, but the majority of planted stems and mature trees further from the stream experienced little to no gnawing damage. The vegetation is expected to grow back over the next year. The sediment deposition occurred on the point bars and is not a concern.

Several piping rock and log sills and a failed log riffle were observed along T3 Reach 2, T4, T4B Reach 1, and T6 Reach 3, as well as a perched culvert below a crossing on T4. Mechanical repairs of these structures were completed in August 2023. The locations of all stream repair areas and associated LODs are shown on Figures 1c and 1d. Details of the failed structures and repairs completed are included in Appendix F. All stream repairs are stable and functioning as intended.

2.5 Hydrology Assessment

Bankfull or geomorphically significant events were recorded on Buckwater Creek Reach 6, T1 Reach 2, T2, T4, T5 (upstream and downstream of St. Mary's Road), and T7 Reach 3. All channels have met the hydrologic success criteria of two bankfull events in separate years and two geomorphically significant events throughout the monitoring period.

In addition, the presence of baseflow must be documented on intermittent reaches (T4A, T4B, T6, T7 Reach 2, T7A, and T8) for a minimum of 30 consecutive days during a normal precipitation year. All of the intermittent reaches met the criteria and maintained baseflow from 133 to 243 consecutive days. The T6 flow gauge malfunctioned at the beginning of November 2023 and data from the beginning of June 2023 to November was not available. Despite this, T6 still met baseflow requirements with the limited data available. The gauge was replaced in mid-November 2023.

The barotroll onsite malfunctioned in June 2023, but the faulty readings were not noticeable until the beginning of November. Data from a barotroll at a site approximately 1.5 miles away (Martin Dairy Mitigation Site) was used to replace the faulty readings from June to September 2023. The barotroll at the Martin Dairy Mitigation Site malfunctioned and started producing faulty data at the beginning of September 2023. Comparable barotroll data was not available for use between September 2023 and mid-November 2023 when the onsite barotroll could be replaced. Refer to Appendix D for hydrologic data.

2.6 Wetland Assessment

Three groundwater gauges were installed and monitored within the existing wetlands zones. All gauges were installed at locations requested by NCDWR and were downloaded and maintained quarterly. The purpose of these gauges is to assess potential effects to wetland hydrology from the construction of restored stream channels through these areas. The results of this monitoring are not tied to any success criteria. The measured hydroperiod ranged from 3.0% to 38.1% of the growing season, consecutively. Refer to Appendix D for wetland data.

Per the Mitigation Plan (Wildlands, 2017) wetlands were delineated in MY4 and results were compared to the delineation completed pre-construction in 2016. The results of the field investigation indicated that overall, wetland area increased by 4.93 acres within the easement. Most of the wetland area gained resulted from expansion of floodplain wetland boundaries, indicating that stream restoration has had an overall positive effect on wetlands within the Site. Despite groundwater data recorded at groundwater gauge one showing a shortened hydroperiod between MY1 and MY5, and groundwater gauge two having an average hydroperiod of 8 days (3.0%), all wetland areas where groundwater gauges were installed were determined to still be functioning as jurisdictional wetlands in MY4 according to the 1987 U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual and subsequent Eastern Mountains and Piedmont Regional Supplement (2012). All wetland areas had evidence of hydric soils and a hydroperiod within 12 inches for part or most of the year and vegetative communities dominated by hydrophytic species.

2.7 Monitoring Year 5 Summary

Visual assessment indicated that the vast majority of stream reaches within the Site are geomorphically stable and functioning as designed. This is especially true once mechanical repairs were completed. Beaver dams were removed in February 2023 and again in November 2023, and the impacted herbaceous and woody vegetation is expected to fill in over time. Vegetation has become well established along the streambanks providing shade, stability, and a source of organic material. Repairs were made to failing stream structures in August 2023 and replanting of the LODs was completed in November 2023. An invasive vegetation treatment will be scheduled for 2024 to address remaining scattered Chinese privet. All channels have met the hydrologic success criteria. Greater than 30 days of consecutive flow were recorded on all stream reaches with flow gauges. Stream crossings are stable and all fences are in good condition. Additional signage will be added where the utility company encroachment occurred; no other encroachments have occurred.

Summary information and data related to the performance of various project and monitoring elements can be found in the tables and figures in the report appendices. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

Section 3: REFERENCES

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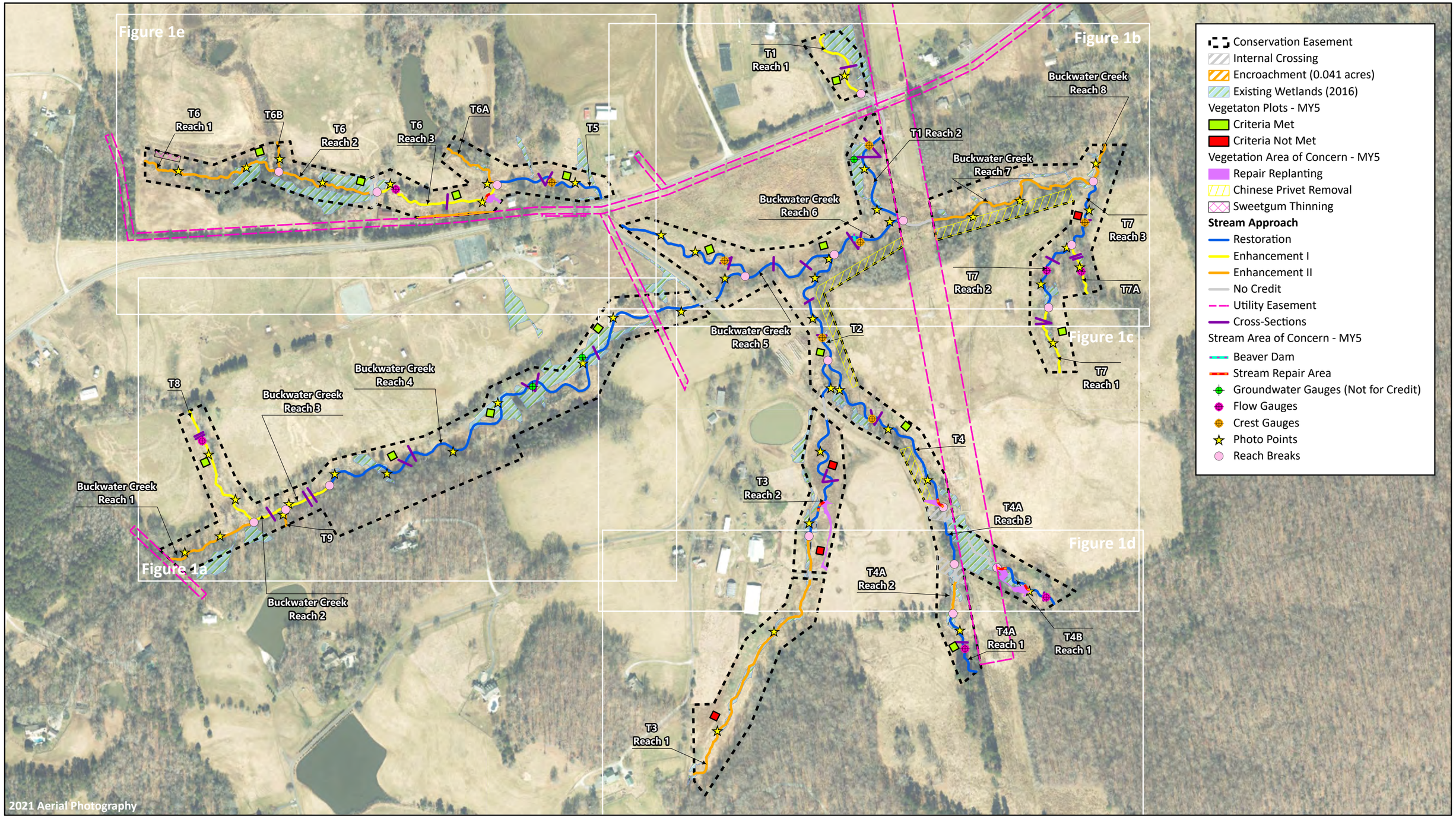

WILDLANDS ENGINEERING

0 400 800 Feet

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Figure 1. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Orange County, NC

Buckwater Creek Reach 4

Buckwater Creek Reach 3

Buckwater Creek Reach 1

Buckwater Creek Reach 2

T8

T9

PP 1

PP 2

PP 3

PP 4

PP 5

PP 6

PP 7

PP 8

PP 9

PP 47

PP 48

PP 49

XS 1

XS 2

XS 3

XS 4

XS 5

XS 6

XS 7

XS 8

XS 35

XS 36

GWG 1

GWG 2

100+00

105+00

110+00

115+00

120+00

125+00

130+00

800+00

805+00

1

2

3

19

Walnut Hill Dr

2021 Aerial Photography

Conservation Easement
Structures
Existing Wetlands (2016)
Vegetaton Plots - MY5
Criteria Met
Stream Approach
Restoration
Enhancement I
Enhancement II
As-Built Bankfull
Utility Easement
Cross-Sections
Groundwater Gauges (Not for Credit)
Flow Gauges
Photo Points
Reach Breaks

WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 1a. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Orange County, NC

Conservation Easement
Structures
Existing Wetlands (2016)
Vegetaton Plots - MY5
Criteria Met
Criteria Not Met
Stream Approach
Restoration
Enhancement I
Enhancement II
As-Built Bankfull
Utility Easement
Cross-Sections
Groundwater Gauges (Not for Credit)
Crest Gauges
Flow Gauges
Photo Points
Reach Breaks
Barotroll

T1 Reach 1
T1 Reach 2
T2
T7 Reach 2
T7 Reach 3
T7A
Buckwater Creek Reach 5
Buckwater Creek Reach 6
Buckwater Creek Reach 7
Buckwater Creek Reach 8
St Marys Rd
Stagg Rd
Walnut Hill Dr
4506
4414
4398
131
200+00
210+00
135+00
140+00
130+00
145+00
150+00
155+00
325+00
705+00
710+00
750+00
XS 13
XS 14
XS 15
XS 27
XS 28
XS 9
XS 10
XS 11
XS 12
XS 19
XS 30
XS 29
XS 31
XS 34
XS 33
XS 32
PP 17
PP 18
PP 19
PP 13
PP 14
PP 15
PP 16
PP 40
PP 41
PP 11
PP 12
PP 26
PP 25
PP 9
PP 10
PP 43
PP 44
PP 46
PP 45
GWG 3
5
16
4
3
18
2021 Aerial Photography

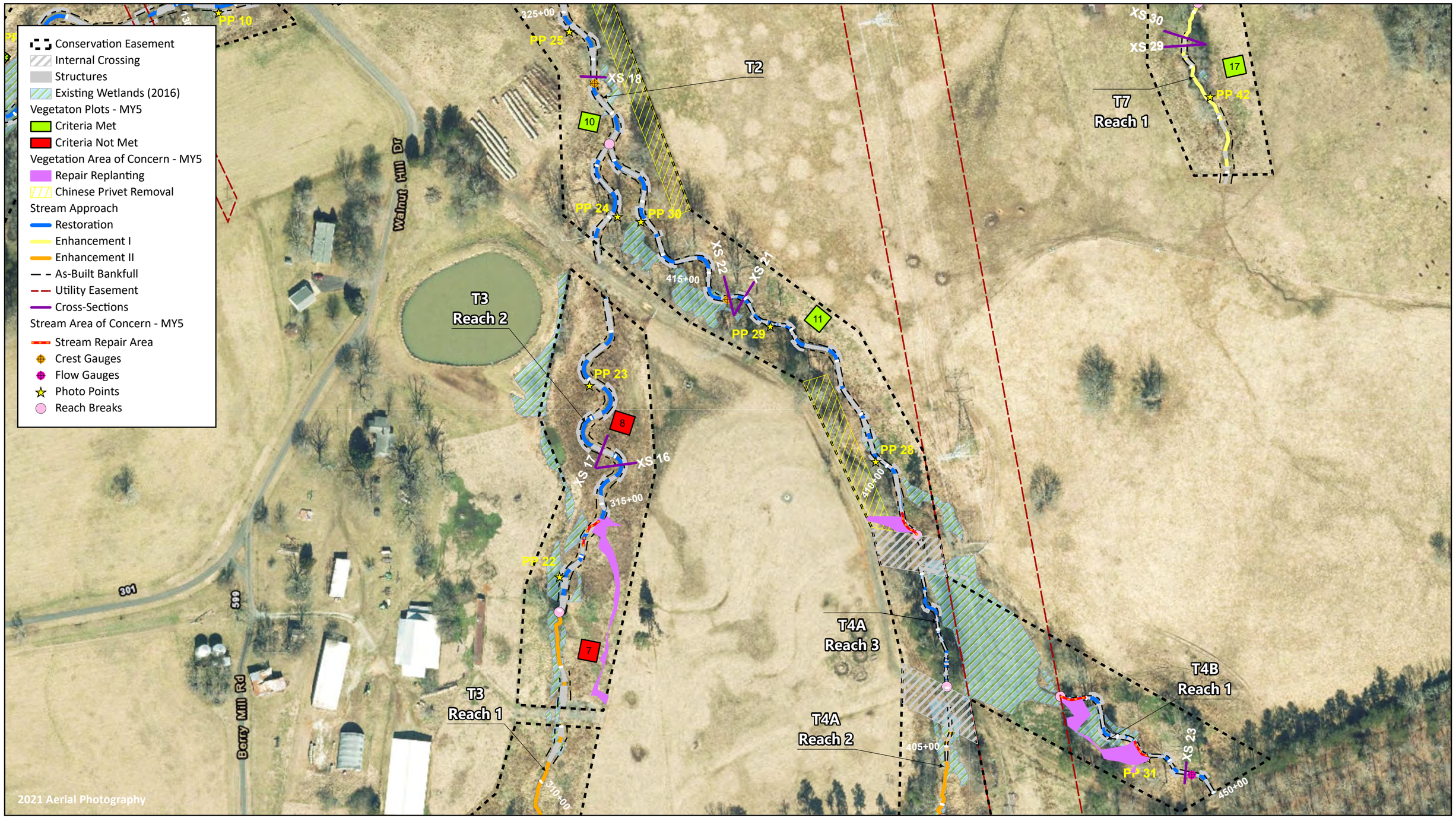
WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 1b. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Orange County, NC



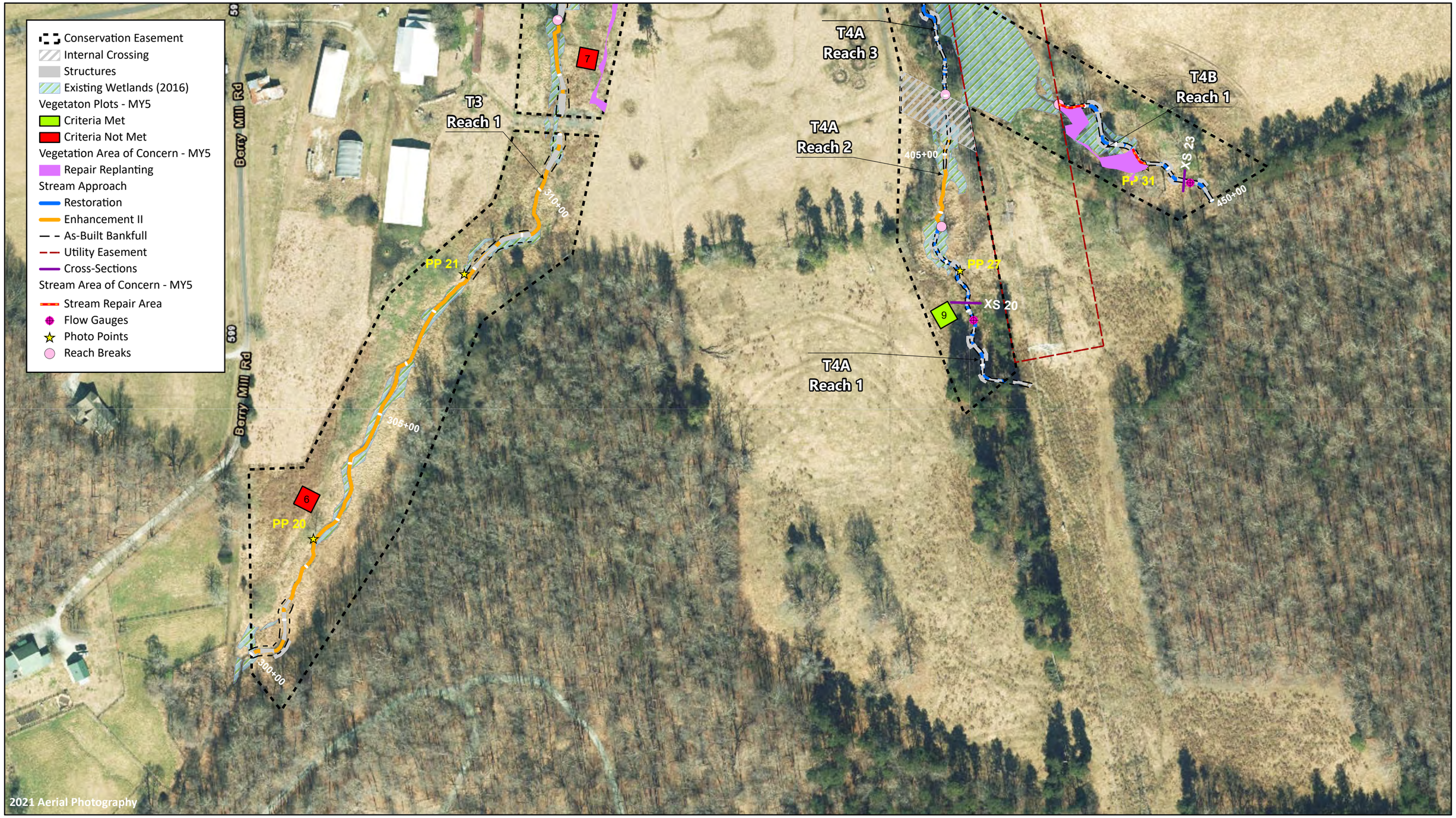
WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 1c. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Orange County, NC



WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 1d. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Orange County, NC

Conservation Easement
Internal Crossing
Structures
Encroachment (0.041 acres)
Existing Wetlands (2016)
Vegetaton Plots - MY5
Criteria Met
Vegetation Area of Concern - MY5
Repair Replanting
Sweetgum Thinning

Stream Approach
Restoration
Enhancement I
Enhancement II
As-Built Bankfull
Utility Easement
Cross-Sections
Stream Area of Concern - MY5
Stream Repair Area
Crest Gauges
Flow Gauges
Photo Points
Reach Breaks

T6 Reach 1
T6B
T6 Reach 2
T6 Reach 3
T6A
T5

PP 32
PP 33
PP 34
PP 35
PP 36
PP 37
PP 38
PP 39

505+00
510+00
516+00
520+00
650+00

XS 24
XS 25
XS 26

12
13
14
15

St Marys Rd
3984
4008
4198
St M
Walnut Hill Dr
161

2021 Aerial Photography

WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 1e. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Orange County, NC

APPENDIX A. Visual Assessment Data

Table 4. Visual Stream Morphology Stability Assessment Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Buckwater Creek Reach 2/3

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	394
					Assessed Bank Length	788
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.	25	25		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	58	58		100%

Visual assessment was completed on 11/1/2023.

Buckwater Reach 4

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	2,478
					Assessed Bank Length	4,956
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.	15	15		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	4	4		100%

Visual assessment was completed on 11/1/2023.

Table 4. Visual Stream Morphology Stability Assessment Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Buckwater Creek Reach 5/6

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	848
					Assessed Bank Length	1,696
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.	22	22		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	30	30		100%

Visual assessment was completed on 11/1/2023.

T1

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	1,444
					Assessed Bank Length	2,888
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.	14	14		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	7	7		100%

Visual assessment was completed on 11/1/2023.

Table 4. Visual Stream Morphology Stability Assessment Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

T2/T3

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
				Assessed Stream Length		2,136
				Assessed Bank Length		4,272
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.			40*	99%
				Totals:	**40**	**99%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	4	4		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	17	17		100%

Visual assessment was completed on 11/1/2023.

*Mechanical repairs were conducted August 2023.

T4/T4A

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
				Assessed Stream Length		1,646
				Assessed Bank Length		3,292
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.			78	98%
				Totals:	**78**	**98%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	13*	14		93%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	23	23		100%

Visual assessment was completed on 11/1/2023.

*Nine piping rock sills were counted as one step pool structure at As-Built. Mechanical repairs were conducted August 2023.

Table 4. Visual Stream Morphology Stability Assessment Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

T4B

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	346
					Assessed Bank Length	692
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.			50*	93%
				Totals:	**50**	**93%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	1*	2		50%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	5	5		100%

Visual assessment was completed on 11/1/2023.

*Six piping rock sills were counted as one step pool structure at As-Built. Mechanical repairs were conducted August 2023.

T5/T6

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	3,503
					Assessed Bank Length	7,006
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.			40*	99%
				Totals:	**40**	**99%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	0	0		N/A
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	13	13		100%

Visual assessment was completed on 11/1/2023.

*Mechanical repairs were conducted August 2023.

Table 4. Visual Stream Morphology Stability Assessment Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

T7

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	1,044
					Assessed Bank Length	2,088
Bank	**Surface Scour/ Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour.			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse.			0	100%
				Totals:	**0**	**100%**
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	5	5		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	20	20		100%

Visual assessment was completed on 11/1/2023.

T7A

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	240
					Assessed Bank Length	480
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.	0	0		N/A
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	2	2		100%

Visual assessment was completed on 11/1/2023.

Table 4. Visual Stream Morphology Stability Assessment Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

T8

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
				Assessed Stream Length		621
				Assessed Bank Length		1,242
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.	0	0		N/A
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	6	6		100%

Visual assessment was completed on 11/1/2023.

Table 5. Vegetation Condition Assessment Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Planted Acreage **23.60**

Vegetation Category	Definitions	Mapping Threshold (ac)	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.10	0	0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.10	0	0%
		Total	**0.00**	**0%**
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.25	0	0%
		Cumulative Total	**0.00**	**0%**

Easement Acreage **51.84**

Vegetation Category	Definitions	Mapping Threshold (ac)	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. Invasive species included in summation above should be identified in report summary.	0.10	1.72*	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	1 Encroachments Noted / 0.04 ac**	

*Chinese privet *(Ligustrum sinense)* was chemically treated along a 1.72-acre polygon in March 2023.
** Mowing occurred within the easement near T6 during maintenance of the adjacent utility easement.

STREAM PHOTOGRAPHS

	
PHOTO POINT 1 Buckwater R1 – upstream *(3/28/2023)*	**PHOTO POINT 1 Buckwater R1 – downstream *(3/28/2023)***
	
PHOTO POINT 2 Buckwater R1 – upstream *(3/28/2023)*	**PHOTO POINT 2 Buckwater R1 – downstream *(3/28/2023)***
	
PHOTO POINT 3 Buckwater R3 – upstream *(3/28/2023)*	**PHOTO POINT 3 Buckwater R3 – downstream *(3/28/2023)***

	
PHOTO POINT 4 Buckwater R4 – upstream *(3/28/2023)*	**PHOTO POINT 4 Buckwater R4 – downstream *(3/28/2023)***
	
PHOTO POINT 5 Buckwater R4 – upstream *(3/28/2023)*	**PHOTO POINT 5 Buckwater R4 – downstream *(3/28/2023)***
	
PHOTO POINT 6 Buckwater R4 – upstream *(3/28/2023)*	**PHOTO POINT 6 Buckwater R4 – downstream *(3/28/2023)***

	
PHOTO POINT 7 Buckwater R4 – upstream *(3/28/2023)*	**PHOTO POINT 7 Buckwater R4 – downstream *(3/28/2023)***
	
PHOTO POINT 8 Buckwater R4 – upstream *(3/28/2023)*	**PHOTO POINT 8 Buckwater R4 – downstream *(3/28/2023)***
	
PHOTO POINT 9 Buckwater R4 – upstream *(3/28/2023)*	**PHOTO POINT 9 Buckwater R4 – downstream *(3/28/2023)***

	
PHOTO POINT 10 Buckwater R4 – upstream *(3/28/2023)*	**PHOTO POINT 10 Buckwater R4 – downstream *(3/28/2023)***
	
PHOTO POINT 11 Buckwater R4 – upstream *(3/28/2023)*	**PHOTO POINT 11 Buckwater R4 – downstream *(3/28/2023)***
	
PHOTO POINT 12 Buckwater R5 – upstream *(3/28/2023)*	**PHOTO POINT 12 Buckwater R5 – downstream *(3/28/2023)***

	
PHOTO POINT 13 Buckwater R6 – upstream *(3/28/2023)*	**PHOTO POINT 13 Buckwater R6 – downstream *(3/28/2023)***
	
PHOTO POINT 14 Buckwater R7 – upstream *(3/28/2023)*	**PHOTO POINT 14 Buckwater R7 – downstream *(3/28/2023)***
	
PHOTO POINT 15 Buckwater R7 – upstream *(3/28/2023)*	**PHOTO POINT 15 Buckwater R7 – downstream *(3/28/2023)***

	
PHOTO POINT 16 Buckwater R8 – upstream *(3/28/2023)*	**PHOTO POINT 16 Buckwater R8 – downstream *(3/28/2023)***
	
PHOTO POINT 17 T1 Reach 1 – upstream *(3/28/2023)*	**PHOTO POINT 17 T1 Reach 1 – downstream *(3/28/2023)***
	
PHOTO POINT 18 T1 Reach 2 – upstream *(3/28/2023)*	**PHOTO POINT 18 T1 Reach 2 – downstream *(3/28/2023)***

	
PHOTO POINT 19 T1 Reach 2 – upstream *(3/28/2023)*	**PHOTO POINT 19 T1 Reach 2 – downstream *(3/28/2023)***
	
PHOTO POINT 20 T3 Reach 1 – upstream *(3/28/2023)*	**PHOTO POINT 20 T3 Reach 1 – downstream *(3/28/2023)***
	
PHOTO POINT 21 T3 Reach 1 – upstream *(3/28/2023)*	**PHOTO POINT 21 T3 Reach 1 – downstream *(3/28/2023)***

	
PHOTO POINT 22 T3 Reach 2 – upstream *(3/28/2023)*	**PHOTO POINT 22 T3 Reach 2 – downstream *(3/28/2023)***
	
PHOTO POINT 23 T3 Reach 2 – upstream *(3/28/2023)*	**PHOTO POINT 23 T3 Reach 2 – downstream *(3/28/2023)***
	
PHOTO POINT 24 T3 Reach 2 – upstream *(3/28/2023)*	**PHOTO POINT 24 T3 Reach 2 – downstream *(3/28/2023)***

	
PHOTO POINT 25 T2 – upstream *(3/28/2023)*	**PHOTO POINT 25 T2 – downstream *(3/28/2023)***
	
PHOTO POINT 26 T2 – upstream *(3/28/2023)*	**PHOTO POINT 26 T2 – downstream *(3/28/2023)***
	
PHOTO POINT 27 T4A Reach 1 – upstream *(3/28/2023)*	**PHOTO POINT 27 T4A Reach 1 – downstream *(3/28/2023)***

	
PHOTO POINT 28 T4 – upstream *(4/6/2023)*	**PHOTO POINT 28 T4 – downstream *(4/6/2023)***
	
PHOTO POINT 29 T4 – upstream *(3/28/2023)*	**PHOTO POINT 29 T4 – downstream *(3/28/2023)***
	
PHOTO POINT 30 T4 – upstream *(3/28/2023)*	**PHOTO POINT 30 T4 – downstream *(3/28/2023)***

	
PHOTO POINT 31 T4B Reach 1 – upstream *(3/28/2023)*	**PHOTO POINT 31 T4B Reach 1 – downstream *(3/28/2023)***
	
PHOTO POINT 32 T6 Reach 1 – upstream *(3/28/2023)*	**PHOTO POINT 32 T6 Reach 1 – downstream *(3/28/2023)***
	
PHOTO POINT 33 T6 Reach 1 – upstream *(3/28/2023)*	**PHOTO POINT 33 T6 Reach 1 – downstream *(3/28/2023)***

	
PHOTO POINT 34 T6 Reach 2 – upstream *(3/28/2023)*	**PHOTO POINT 34 T6 Reach 2 – downstream *(3/28/2023)***
	
PHOTO POINT 35 T6 Reach 3 – upstream *(3/28/2023)*	**PHOTO POINT 35 T6 Reach 3 – downstream *(3/28/2023)***
	
PHOTO POINT 36 T6 Reach 3 – upstream *(3/28/2023)*	**PHOTO POINT 36 T6 Reach 3 – downstream *(3/28/2023)***

	
PHOTO POINT 37 T6B – upstream *(3/28/2023)*	**PHOTO POINT 37 T6B – downstream *(3/28/2023)***
	
PHOTO POINT 38 T6A – upstream *(3/28/2023)*	**PHOTO POINT 38 T6A – downstream *(3/28/2023)***
	
PHOTO POINT 39 T5 – upstream *(3/28/2023)*	**PHOTO POINT 39 T5 – downstream *(3/28/2023)***

PHOTO POINT 40 T5 – upstream *(3/28/2023)*

PHOTO POINT 40 T5 – downstream *(3/28/2023)*

PHOTO POINT 41 T5 – upstream *(3/28/2023)*

PHOTO POINT 41 T5 – downstream *(3/28/2023)*

PHOTO POINT 42 T7 Reach 1 – upstream *(3/28/2023)*

PHOTO POINT 42 T7 Reach 1 – downstream *(3/28/2023)*

PHOTO POINT 43 T7 Reach 2 – upstream *(3/28/2023)*

PHOTO POINT 43 T7 Reach 2 – downstream *(3/28/2023)*

PHOTO POINT 44 T7 Reach 2 – upstream *(3/28/2023)*

PHOTO POINT 44 T7 Reach 2 – downstream *(3/28/2023)*

PHOTO POINT 45 T7 Reach 3 – upstream *(3/28/2023)*

PHOTO POINT 45 T7 Reach 3 – downstream *(3/28/2023)*

	
PHOTO POINT 46 T7A – upstream *(3/28/2023)*	**PHOTO POINT 46 T7A – downstream *(3/28/2023)***
	
PHOTO POINT 47 T8 – upstream *(3/28/2023)*	**PHOTO POINT 47 T8 – downstream *(3/28/2023)***
	
PHOTO POINT 48 T8 – upstream *(3/28/2023)*	**PHOTO POINT 48 T8 – downstream *(3/28/2023)***

	
PHOTO POINT 49 T9 – upstream *(3/28/2023)*	**PHOTO POINT 49 T9 – downstream *(3/28/2023)***

VEGETATION PLOT PHOTOGRAPHS

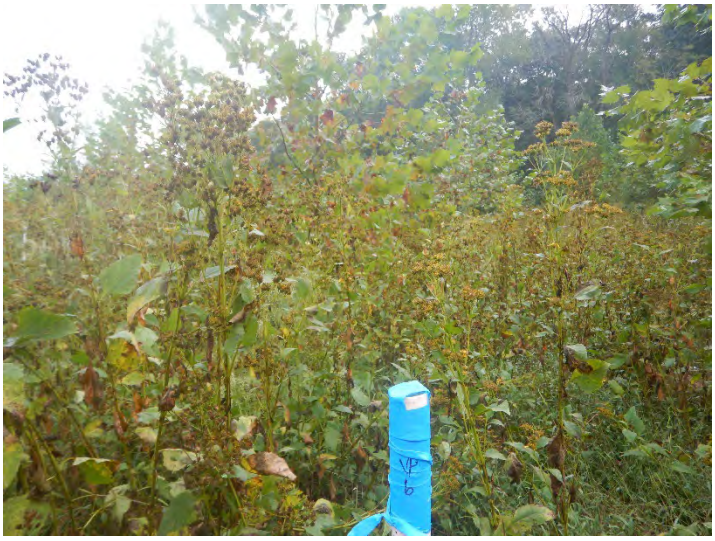
VEG PLOT 1 *(10/03/2023)*

VEG PLOT 2 *(10/03/2023)*

VEG PLOT 3 *(10/03/2023)*

VEG PLOT 4 *(10/03/2023)*

VEG PLOT 5 *(10/03/2023)*



VEG PLOT 6 *(10/03/2023)*

VEG PLOT 7 *(10/03/2023)*

VEG PLOT 8 *(10/03/2023)*

VEG PLOT 9 *(10/03/2023)*

VEG PLOT 10 *(10/03/2023)*

VEG PLOT 11 *(10/03/2023)*

VEG PLOT 12 *(10/03/2023)*

VEG PLOT 13 *(10/03/2023)*

VEG PLOT 14 *(10/03/2023)*

VEG PLOT 15 *(10/24/2023)*

VEG PLOT 16 *(10/03/2023)*

VEG PLOT 17 *(10/03/2023)*

VEG PLOT 18 *(10/03/2023)*

VEG PLOT 19 *(10/24/2023)*

APPENDIX B. Vegetation Plot Data

Table 6. Vegetation Plot Criteria Attainment Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Plot	Success Criteria Met *	Tract Mean
1	Yes	79%
2	Yes	
3	Yes	
4	Yes	
5	Yes	
6	No*	
7	No*	
8	No	
9	Yes	
10	Yes	
11	Yes	
12	Yes	
13	Yes	
14	Yes	
15	Yes	
16	Yes	
17	Yes	
18	No	
19	Yes	

*Vegetation Plots 6 and 7 only failed to meet criteria by less than 10%.

Table 7. Planted and Total Stem Counts
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

			Current Plot Data (MY5 2023)																				
			VP 1			VP 2			VP 3			VP 4			VP 5			VP 6			VP 7		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo	Box Elder	Tree																2	2	2			
Acer rubrum	Red Maple	Tree																					
Aesculus pavia	Red Buckeye	Shrub Tree																			1	1	1
Betula nigra	River Birch	Tree	1	1	1	2	2	2	3	3	3	2	2	2	1	1	1						
Carya	Hickory spp.	Tree																					
Celtis occidentalis	Hackberry	Shrub Tree																					
Diospyros virginiana	American Persimmon	Tree									1												
Fraxinus pennsylvanica	Green Ash	Tree	3	3	3	1	1	1	2	2	2	4	4	4	1	1	2						
Juglans nigra	Black Walnut	Tree			2						2												1
Juniperus virginiana	Eastern Red Cedar	Tree																					
Liquidambar styraciflua	Sweet Gum	Tree			2			1						1									
Liriodendron tulipifera	Tulip-poplar	Tree			1				1	1	1												
Nyssa biflora	Swamp Tupelo	Tree																					
Pinus taeda	Loblolly Pine	Tree															1						
Platanus occidentalis	Sycamore	Tree	1	1	1	5	5	5	4	4	4	2	2	2	4	4	4	4	4	4	1	1	1
Pyrus calleryana	Callery Pear	Exotic																					
Quercus alba	White Oak	Tree													2	2	2				2	2	2
Quercus lyrata	Overcup Oak	Tree										3	3	3	1	1	1						
Quercus michauxii	Swamp Chestnut Oak	Tree	1	1	1				1	1	1												
Quercus pagoda	Cherrybark Oak	Tree													1	1	1						
Quercus phellos	Willow Oak	Tree	1	1	1							3	3	3	1	1	1				1	1	1
Quercus shumardii	Shumard Oak	Shrub Tree				2	2	2	1	1	1				2	2	2				1	1	1
Salix nigra	Black Willow	Tree																					
Ulmus	Elm spp.	Tree																					
Ulmus alata	Winged Elm	Tree																					
Ulmus americana	American Elm	Tree																					
Viburnum dentatum	Arrow-wood	Shrub Tree																					
		Stem count	7	7	8	10	10	10	12	12	13	14	14	14	13	13	14	6	6	6	6	6	6
		size (ares)	1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	5	5	8	4	4	5	6	6	8	5	5	6	8	8	9	2	2	2	5	5	6
		Stems per ACRE	283	283	324	405	405	405	486	486	526	567	567	567	526	526	567	243	243	243	243	243	243

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes

P-all: All planted stems

T: Total stems

Table 7. Planted and Total Stem Counts
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

			Current Plot Data (MY5 2023)																				
			VP 8			VP 9			VP 10			VP 11			VP 12			VP 13			VP 14		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	Box Elder	Tree													1	1	1						
Acer rubrum	Red Maple	Tree															1			2			
Aesculus pavia	Red Buckeye	Shrub Tree																					
Betula nigra	River Birch	Tree													2	2	2	4	4	4	5	5	5
Carya	Hickory spp.	Tree																					
Celtis occidentalis	Hackberry	Shrub Tree				2	2	2															
Diospyros virginiana	American Persimmon	Tree															2			1			
Fraxinus pennsylvanica	Green Ash	Tree							4	4	4	1	1	1			1	3	3	3	3	3	3
Juglans nigra	Black Walnut	Tree																					
Juniperus virginiana	Eastern Red Cedar	Tree															1						
Liquidambar styraciflua	Sweet Gum	Tree			8												1			16			7
Liriodendron tulipifera	Tulip-poplar	Tree																			1	1	1
Nyssa biflora	Swamp Tupelo	Tree																					
Pinus taeda	Loblolly Pine	Tree																					
Platanus occidentalis	Sycamore	Tree	4	4	4	3	3	3	1	1	1				5	5	5	4	4	4	3	3	4
Pyrus calleryana	Callery Pear	Exotic																					
Quercus alba	White Oak	Tree				1	1	1				4	4	4	1	1	1						
Quercus lyrata	Overcup Oak	Tree				1	1	1	2	2	2												
Quercus michauxii	Swamp Chestnut Oak	Tree							1	1	1				3	3	3				2	2	2
Quercus pagoda	Cherrybark Oak	Tree										1	1	1									
Quercus phellos	Willow Oak	Tree													2	2	2				1	1	1
Quercus shumardii	Shumard Oak	Shrub Tree				1	1	1				1	1	1	1	1	1						
Salix nigra	Black Willow	Tree						1			6												
Ulmus	Elm spp.	Tree																		7			
Ulmus alata	Winged Elm	Tree																					
Ulmus americana	American Elm	Tree																					
Viburnum dentatum	Arrow-wood	Shrub Tree																			1	1	1
		Stem count	4	4	4	8	8	9	8	8	14	7	7	7	15	15	20	11	11	21	16	16	17
		size (ares)	1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	1	1	2	5	5	6	4	4	5	4	4	4	7	7	12	3	3	7	7	7	8
		Stems per ACRE	162	162	162	324	324	364	324	324	567	283	283	283	607	607	809	445	445	850	647	647	688

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes

P-all: All planted stems

T: Total stems

Table 7. Planted and Total Stem Counts
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

			Current Plot Data (MY5 2023)															
			VP 15			VP 16			VP 17			VP 18			VP 19			
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	
Acer negundo	Box Elder	Tree							3	3	3							
Acer rubrum	Red Maple	Tree																
Aesculus pavia	Red Buckeye	Shrub Tree																
Betula nigra	River Birch	Tree	3	3	5	4	4	4				1	1	1	3	3	3	
Carya	Hickory spp.	Tree																
Celtis occidentalis	Hackberry	Shrub Tree																
Diospyros virginiana	American Persimmon	Tree							2	2	2							
Fraxinus pennsylvanica	Green Ash	Tree	2	2	2	1	1	1	1	1	1	2	2	2	2	2	2	
Juglans nigra	Black Walnut	Tree									4			1				
Juniperus virginiana	Eastern Red Cedar	Tree																
Liquidambar styraciflua	Sweet Gum	Tree			25						4			5				
Liriodendron tulipifera	Tulip-poplar	Tree																
Nyssa biflora	Swamp Tupelo	Tree																
Pinus taeda	Loblolly Pine	Tree												1				
Platanus occidentalis	Sycamore	Tree	4	4	4	4	4	4	1	1	1	1	1	1	2	2	2	
Pyrus calleryana	Callery Pear	Exotic																
Quercus alba	White Oak	Tree																
Quercus lyrata	Overcup Oak	Tree										1	1	1				
Quercus michauxii	Swamp Chestnut Oak	Tree													1	1	1	
Quercus pagoda	Cherrybark Oak	Tree				1	1	1										
Quercus phellos	Willow Oak	Tree				2	2	2							1	1	1	
Quercus shumardii	Shumard Oak	Shrub Tree																
Salix nigra	Black Willow	Tree															7	
Ulmus	Elm spp.	Tree																
Ulmus alata	Winged Elm	Tree																
Ulmus americana	American Elm	Tree												1				
Viburnum dentatum	Arrow-wood	Shrub Tree	2	2	2	1	1	1	1	1	1							
		Stem count	11	11	13	13	13	13	8	8	8	5	5	6	9	9	16	
		size (ares)	1			1			1			1			1			
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			
		Species count	4	4	5	6	6	6	5	5	7	4	4	8	5	5	6	
		Stems per ACRE	445	445	526	526	526	526	324	324	324	202	202	243	364	364	647	

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes

P-all: All planted stems

T: Total stems

Table 7. Planted and Total Stem Counts
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

			Annual Means																	
			MY5 (2023)			MY4 (2022)			MY3 (2021)			MY2 (2020)			MY1 (2019)			MY0 (2019)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo	Box Elder	Tree	4	4	4	6	6	6	6	6	6									
Acer rubrum	Red Maple	Tree			3			5			6									
Aesculus pavia	Red Buckeye	Shrub Tree	1	1	1	1	1	1	2	2	2	1	1	1	9	9	9	10	10	10
Betula nigra	River Birch	Tree	30	30	32	30	30	32	33	33	33	22	22	24	34	34	35	41	41	41
Carya	Hickory spp.	Tree												1						
Celtis occidentalis	Hackberry	Shrub Tree	2	2	2	2	2	2	4	4	4									
Diospyros virginiana	American Persimmon	Tree	2	2	6	2	2	4	2	2	4			1						
Fraxinus pennsylvanica	Green Ash	Tree	30	30	32	29	29	30	32	32	38	33	33	33	34	34	34	34	34	34
Juglans nigra	Black Walnut	Tree			10			3			2			1			1			
Juniperus virginiana	Eastern Red Cedar	Tree			1			4			1									
Liquidambar styraciflua	Sweet Gum	Tree			70			49			27			5			3			
Liriodendron tulipifera	Tulip-poplar	Tree	2	2	3	1	1	1	2	2	2	2	2	2	22	22	22	32	32	32
Nyssa biflora	Swamp Tupelo	Tree												1						
Pinus taeda	Loblolly Pine	Tree			2			3			1									
Platanus occidentalis	Sycamore	Tree	51	51	52	51	51	57	53	53	58	47	47	49	56	56	56	62	62	62
Pyrus calleryana	Callery Pear	Exotic						1												
Quercus alba	White Oak	Tree	10	10	10	12	12	12	19	19	19	5	5	5	10	10	10	11	11	11
Quercus lyrata	Overcup Oak	Tree	8	8	8	10	10	11	12	12	12	13	13	13	25	25	25	22	22	22
Quercus michauxii	Swamp Chestnut Oak	Tree	7	7	7	11	11	11	16	16	16	10	10	10	13	13	13	13	13	13
Quercus pagoda	Cherrybark Oak	Tree	3	3	3	5	5	5	8	8	8									
Quercus phellos	Willow Oak	Tree	11	11	11	13	13	14	17	17	18	10	10	10	33	33	33	33	33	33
Quercus shumardii	Shumard Oak	Shrub Tree	9	9	9	12	12	12	12	12	12	5	5	5	8	8	8	9	9	9
Salix nigra	Black Willow	Tree			14			9			10			3						
Ulmus	Elm spp.	Tree			7						4									
Ulmus alata	Winged Elm	Tree							1	1	2									
Ulmus americana	American Elm	Tree			1			5												
Viburnum dentatum	Arrow-wood	Shrub Tree	5	5	5	7	7	7	7	7	7	9	9	9	13	13	13	15	15	15
		Stem count	175	175	211	192	192	231	226	226	264	157	157	168	257	257	259	282	282	282
		size (ares)	19			19			19			19			19			19		
		size (ACRES)	0.47			0.47			0.47			0.47			0.47			0.47		
		Species count	15	15	23	15	15	23	16	16	23	11	11	17	11	11	13	11	11	11
		Stems per ACRE	373	373	449	409	409	492	481	481	562	334	334	358	547	547	552	601	601	601

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes

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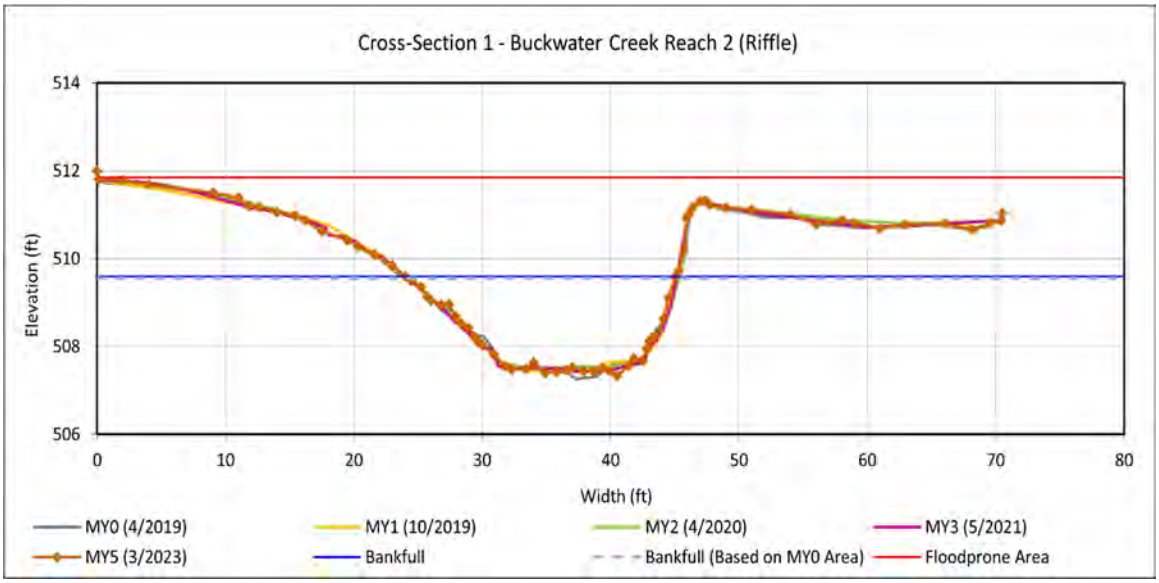
T: Total stems

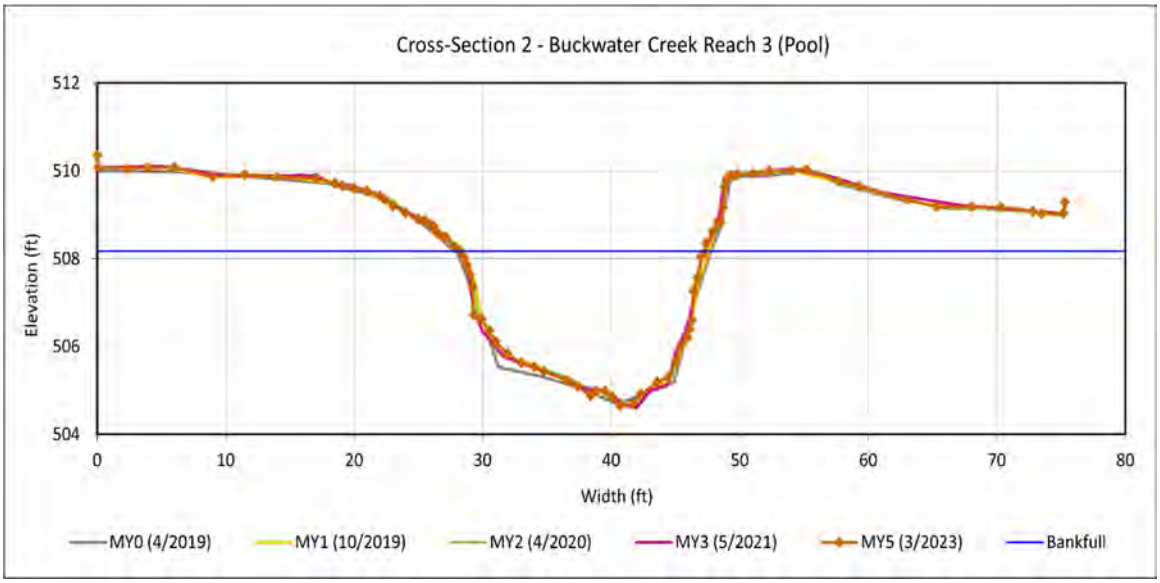
APPENDIX C. Stream Geomorphology Data

Cross-Section Plots



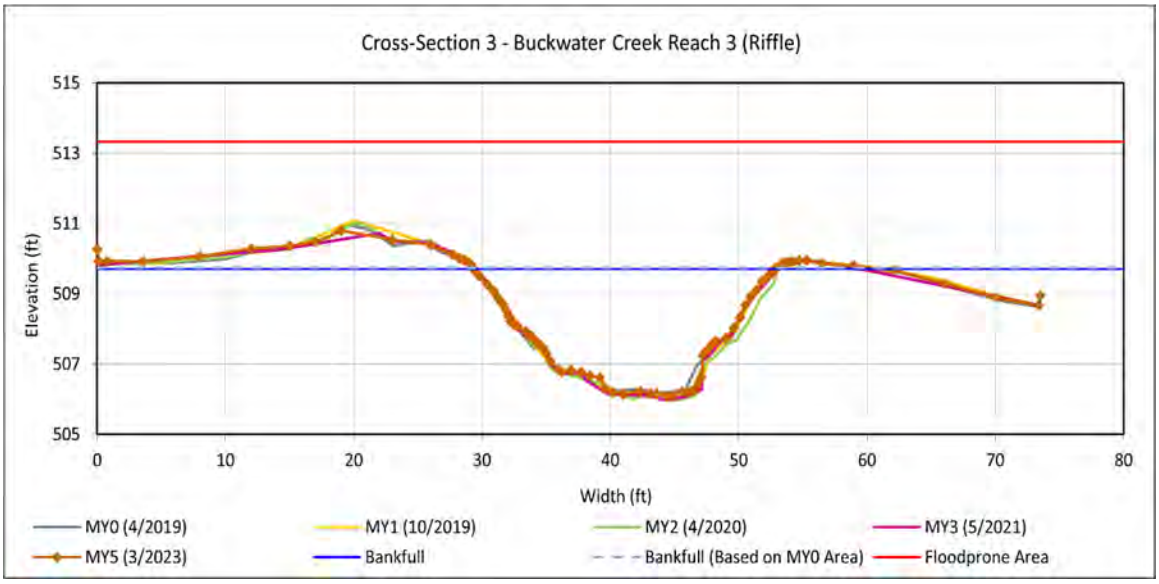
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	509.51	509.54	509.56	509.52	509.52	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.98	1.02	1.03	1.02	
Thalweg Elevation	507.26	507.43	507.49	507.42	507.33	
LTOB Elevation	509.51	509.51	509.61	509.59	509.59	
LTOB Max Depth	2.25	2.08	2.12	2.17	2.26	
LTOB Cross-Sectional Area	31.89	31.23	32.94	33.42	32.60	

Downstream *(3/21/2023)*



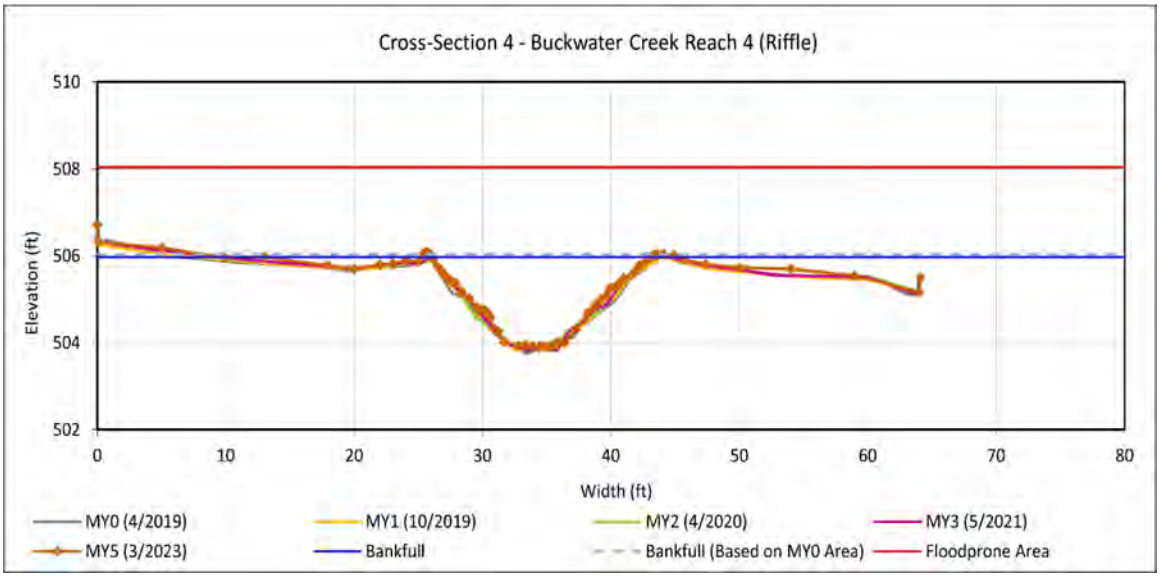
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	504.68	504.61	504.59	504.61	504.66	
LTOB Elevation	508.12	508.03	508.22	508.14	508.17	
LTOB Max Depth	3.44	3.42	3.63	3.53	3.51	
LTOB Cross-Sectional Area	49.15	45.28	48.58	47.46	47.63	

Downstream *(3/21/2023)*



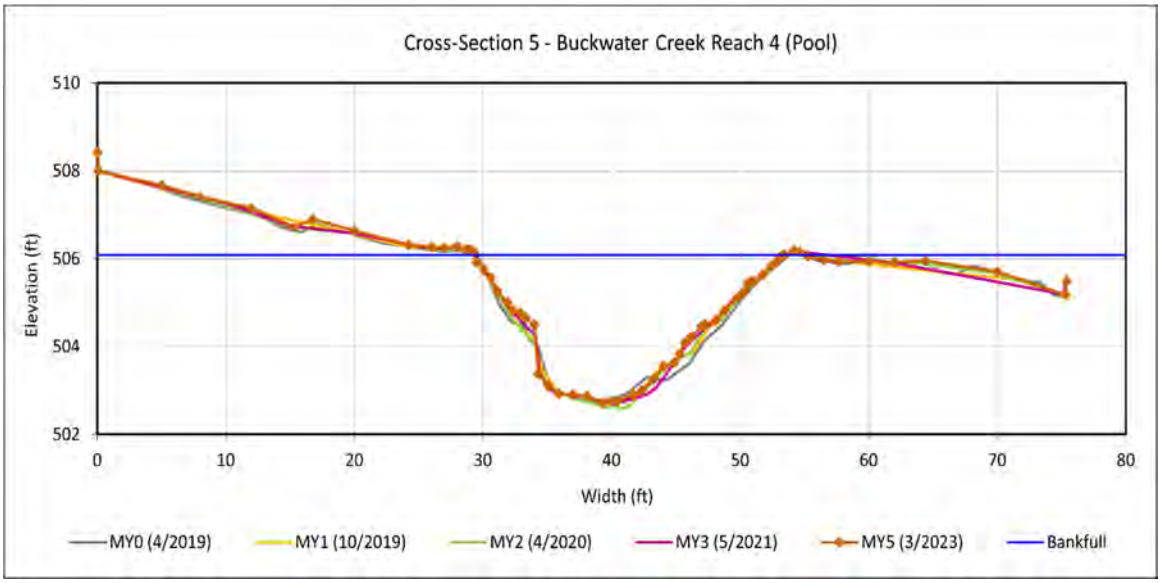
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	509.71	509.67	509.59	509.66	509.74	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.00	1.03	1.01	0.99	
Thalweg Elevation	506.17	505.95	505.98	505.97	506.08	
LTOB Elevation	509.71	509.65	509.85	509.70	509.70	
LTOB Max Depth	3.54	3.70	3.87	3.73	3.62	
LTOB Cross-Sectional Area	55.32	54.90	61.52	56.15	54.37	

Downstream *(3/21/2023)*



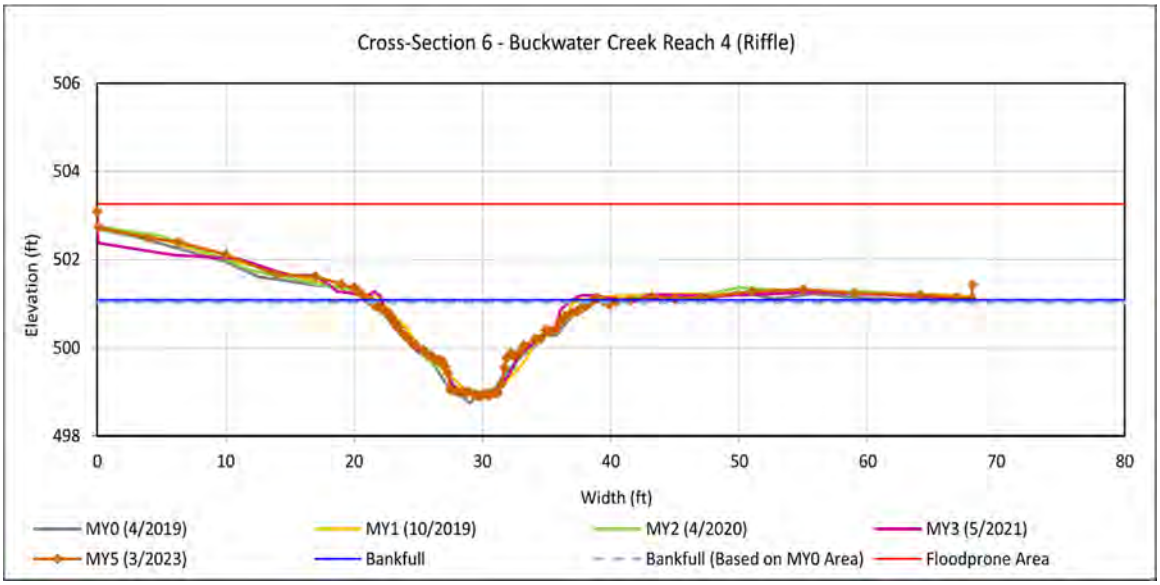
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	505.91	505.94	505.98	505.99	506.04	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.99	0.95	0.95	0.97	
Thalweg Elevation	503.75	503.83	503.80	503.83	503.90	
LTOB Elevation	505.91	505.93	505.88	505.89	505.97	
LTOB Max Depth	2.16	2.10	2.08	2.06	2.60	
LTOB Cross-Sectional Area	21.88	21.70	20.12	20.22	20.63	

Downstream *(3/21/2023)*



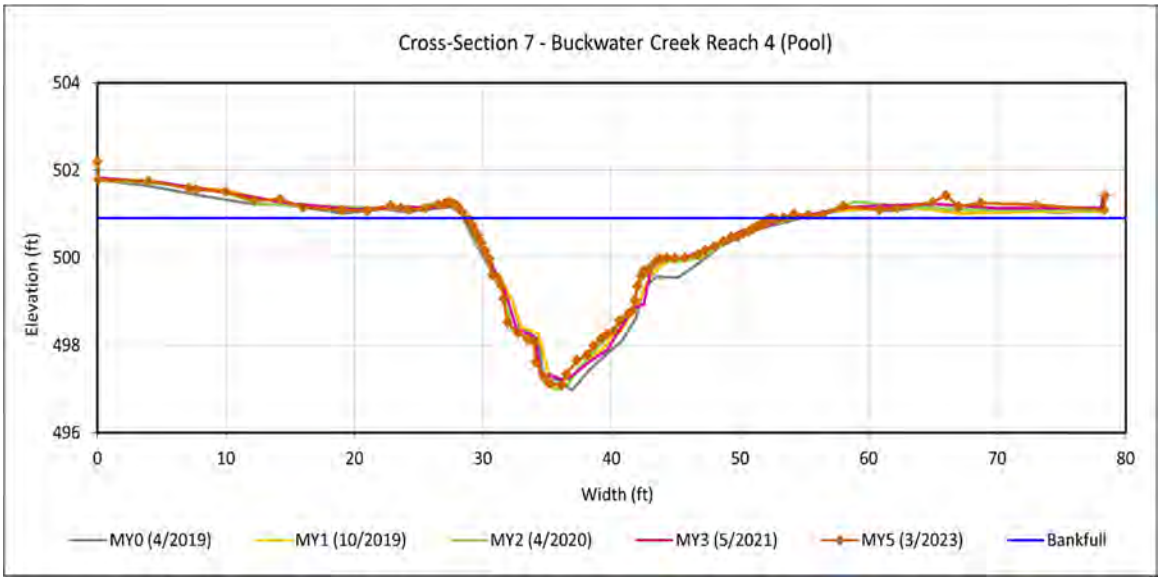
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	502.72	502.72	502.58	502.68	502.71	
LTOB Elevation	506.10	506.05	506.10	506.09	506.08	
LTOB Max Depth	3.38	3.33	3.52	3.41	3.37	
LTOB Cross-Sectional Area	50.42	47.80	49.84	48.40	47.11	

Downstream *(3/21/2023)*



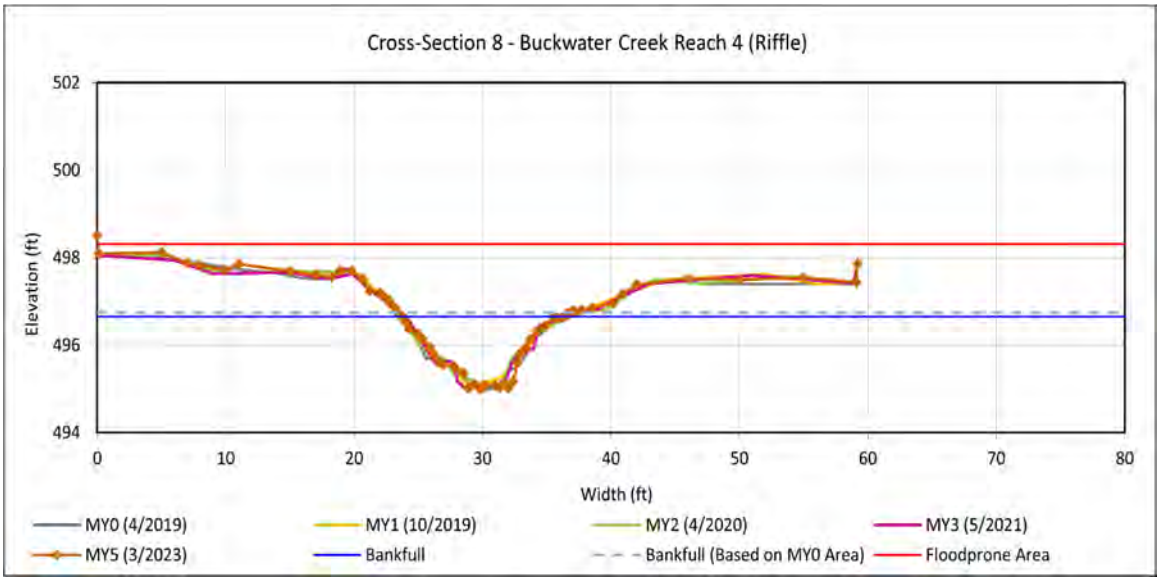
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	500.92	500.73	500.71	500.73	501.03	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.16	1.17	1.19	1.02	
Thalweg Elevation	499.75	498.96	498.97	498.92	498.89	
LTOB Elevation	500.92	501.01	501.00	501.07	501.07	
LTOB Max Depth	1.17	2.05	2.03	2.15	2.18	
LTOB Cross-Sectional Area	13.61	17.62	18.12	18.31	18.50	

Downstream *(3/21/2023)*



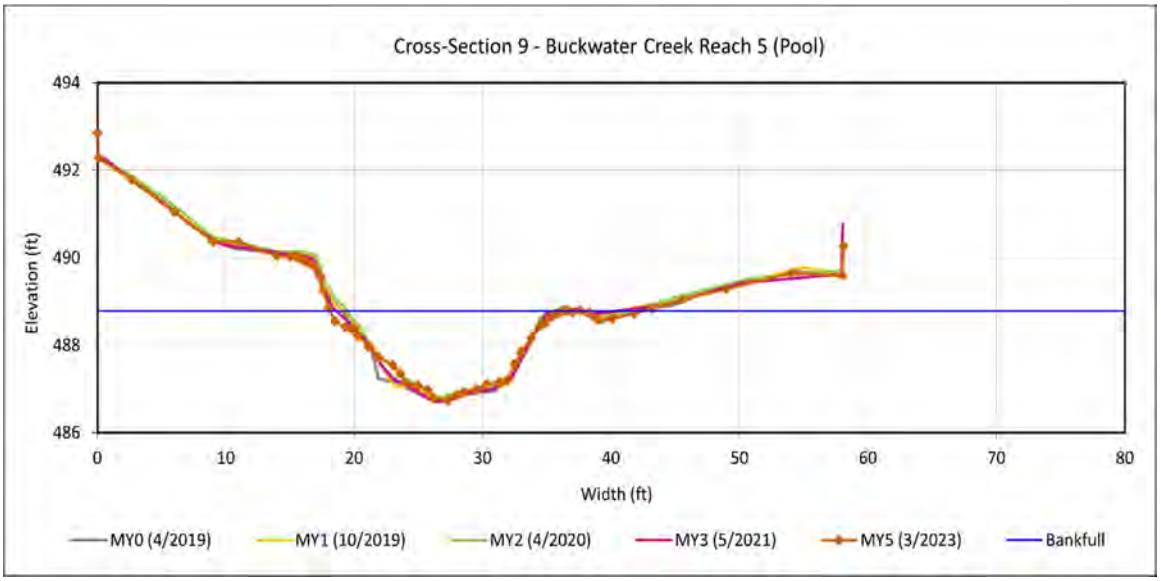
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	496.97	497.03	496.98	497.23	497.09	
LTOB Elevation	500.69	500.88	500.92	500.85	500.90	
LTOB Max Depth	3.72	3.85	3.94	3.62	3.81	
LTOB Cross-Sectional Area	38.82	39.83	41.79	39.42	39.68	

Downstream *(3/21/2023)*



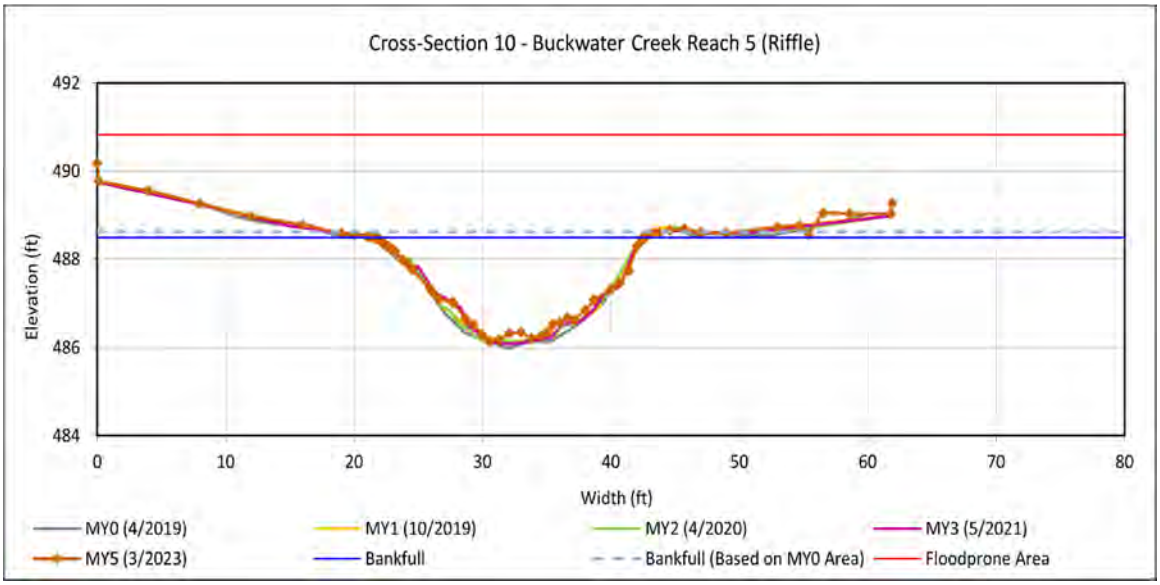
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	496.69	496.75	496.74	496.73	496.74	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.88	0.93	0.94	0.95	
Thalweg Elevation	494.96	495.03	495.06	495.01	494.99	
LTOB Elevation	496.69	496.55	496.63	496.62	496.65	
LTOB Max Depth	1.73	1.52	1.57	1.61	1.66	
LTOB Cross-Sectional Area	12.51	9.82	10.96	11.14	11.35	

Downstream *(3/21/2023)*



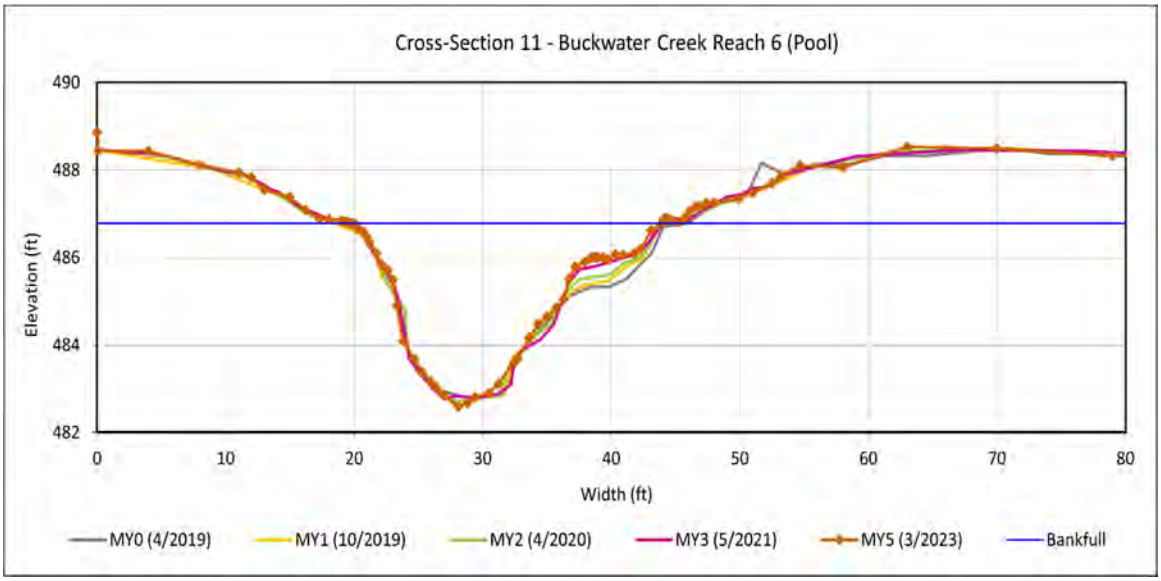
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	486.70	486.77	486.81	486.71	486.74	
LTOB Elevation	488.72	488.74	488.72	488.74	488.78	
LTOB Max Depth	2.02	1.97	1.91	2.03	2.04	
LTOB Cross-Sectional Area	21.71	21.23	20.04	21.57	21.46	

Downstream *(3/23/2023)*



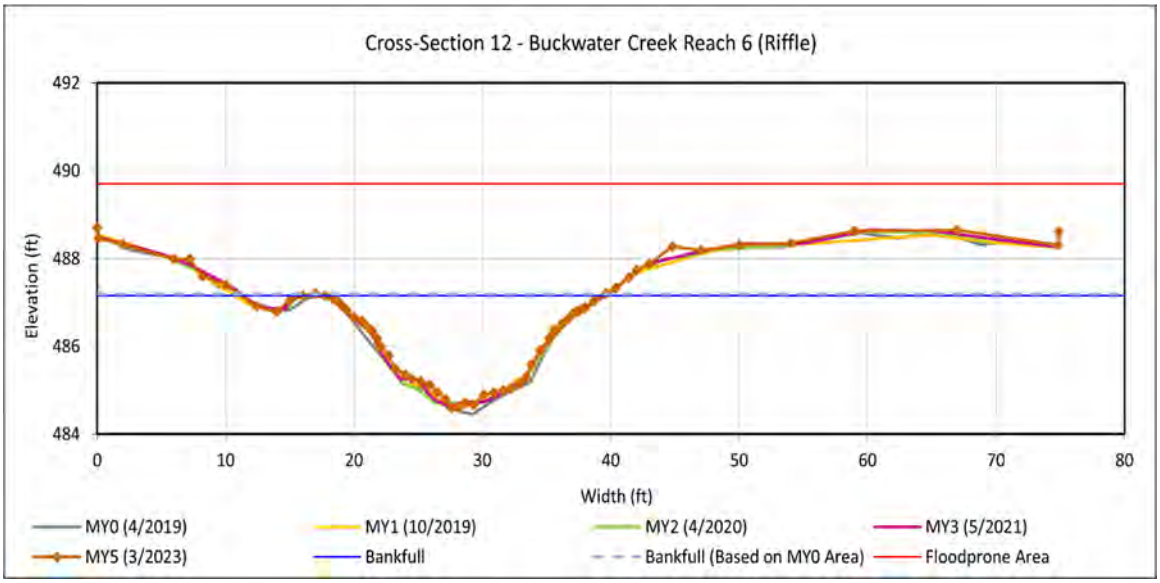
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	488.49	488.59	488.57	488.59	488.62	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94	0.99	0.97	0.95	
Thalweg Elevation	485.98	486.11	486.12	486.08	486.15	
LTOB Elevation	488.49	488.43	488.55	488.52	488.49	
LTOB Max Depth	2.51	2.32	2.43	2.44	2.34	
LTOB Cross-Sectional Area	33.27	30.04	32.87	31.76	30.21	

Downstream *(3/23/2023)*



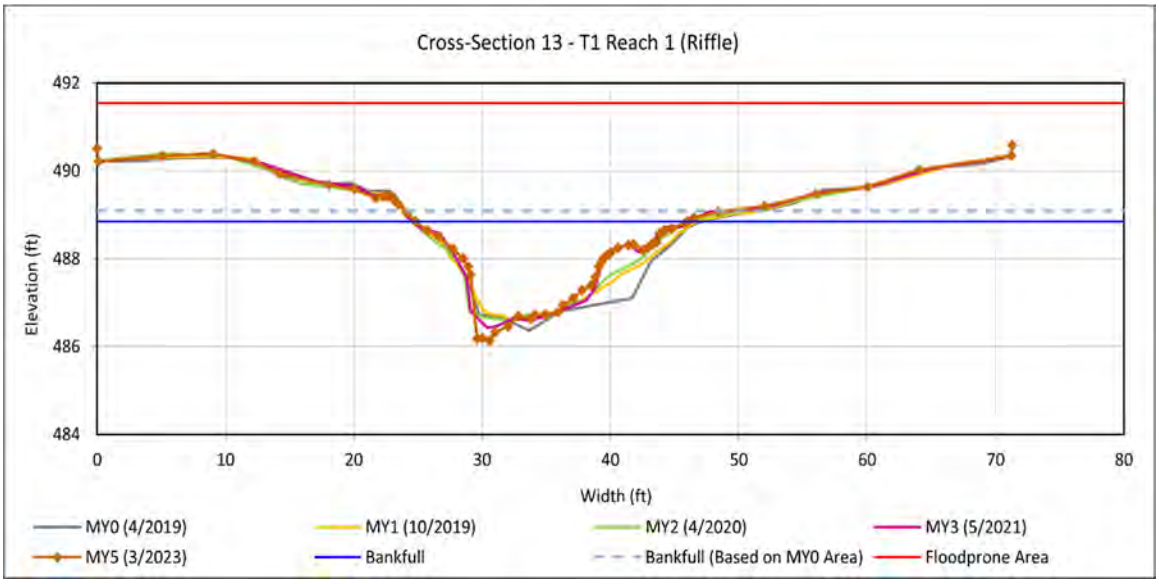
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	482.75	482.57	482.70	482.77	482.59	
LTOB Elevation	486.68	486.46	486.67	486.69	486.78	
LTOB Max Depth	3.93	3.89	3.97	3.92	4.19	
LTOB Cross-Sectional Area	52.40	45.99	50.03	49.81	49.93	

Downstream *(3/23/2023)*



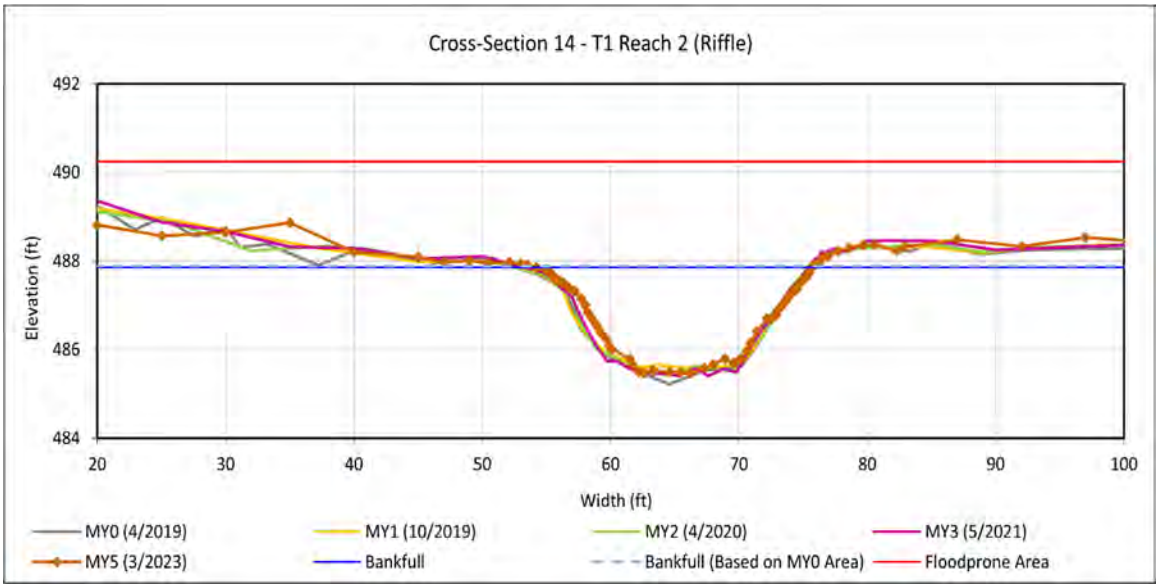
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	487.04	487.13	487.11	487.15	487.19	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.97	0.99	0.97	0.98	
Thalweg Elevation	484.46	484.68	484.67	484.63	484.60	
LTOB Elevation	487.04	487.06	487.08	487.06	487.15	
LTOB Max Depth	2.58	2.38	2.41	2.43	2.55	
LTOB Cross-Sectional Area	30.55	29.06	30.00	28.82	29.71	

Downstream *(3/23/2023)*



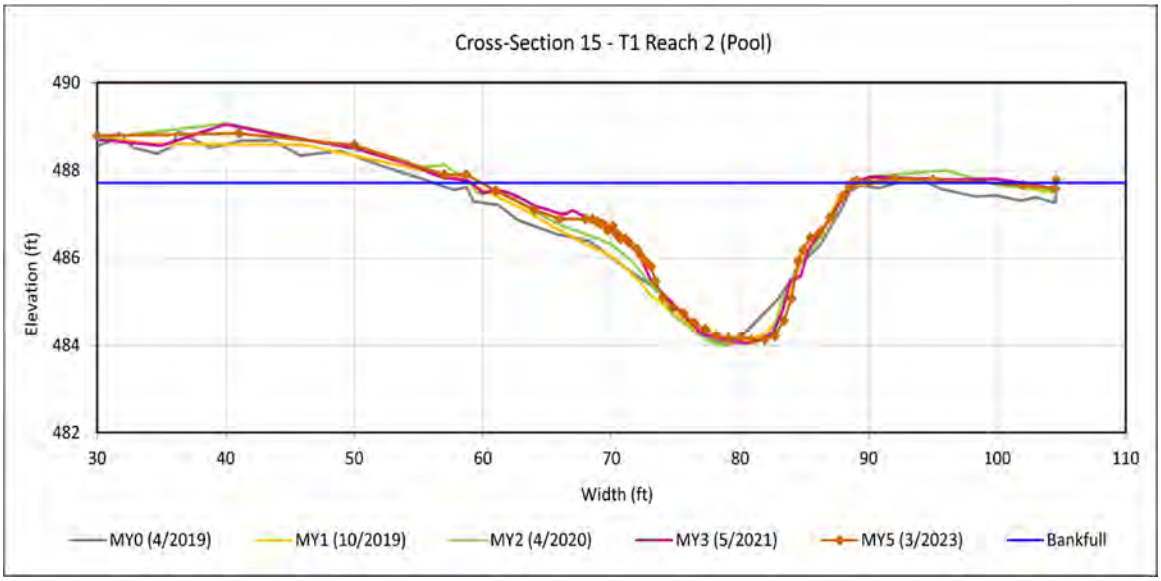
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	488.81	488.96	488.98	489.08	489.09	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94	0.91	0.93	0.92	
Thalweg Elevation	486.36	486.61	486.60	486.43	486.14	
LTOB Elevation	488.81	488.82	488.78	488.88	488.68	
LTOB Max Depth	2.45	2.21	2.18	2.45	2.70	
LTOB Cross-Sectional Area	31.45	28.29	27.01	27.28	25.91	

Downstream *(3/23/2023)*



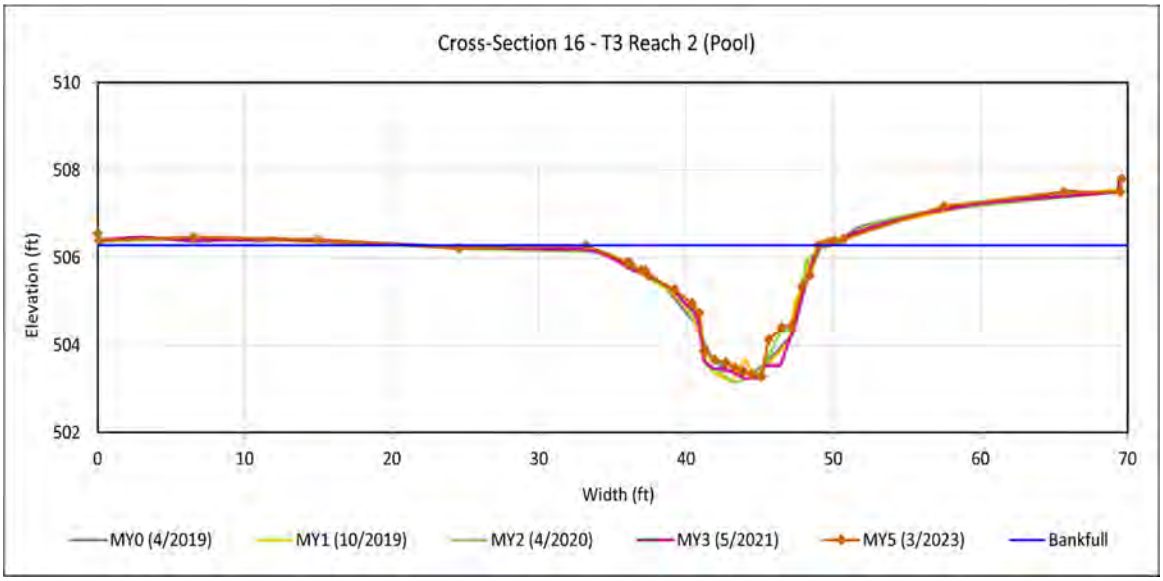
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	487.70	487.79	487.77	487.76	487.88	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.96	0.98	1.00	0.99	
Thalweg Elevation	485.22	485.58	485.43	485.41	485.46	
LTOB Elevation	487.70	487.70	487.73	487.76	487.85	
LTOB Max Depth	2.48	2.12	2.30	2.35	2.39	
LTOB Cross-Sectional Area	32.68	30.85	31.75	32.64	32.04	

Downstream *(3/23/2023)*



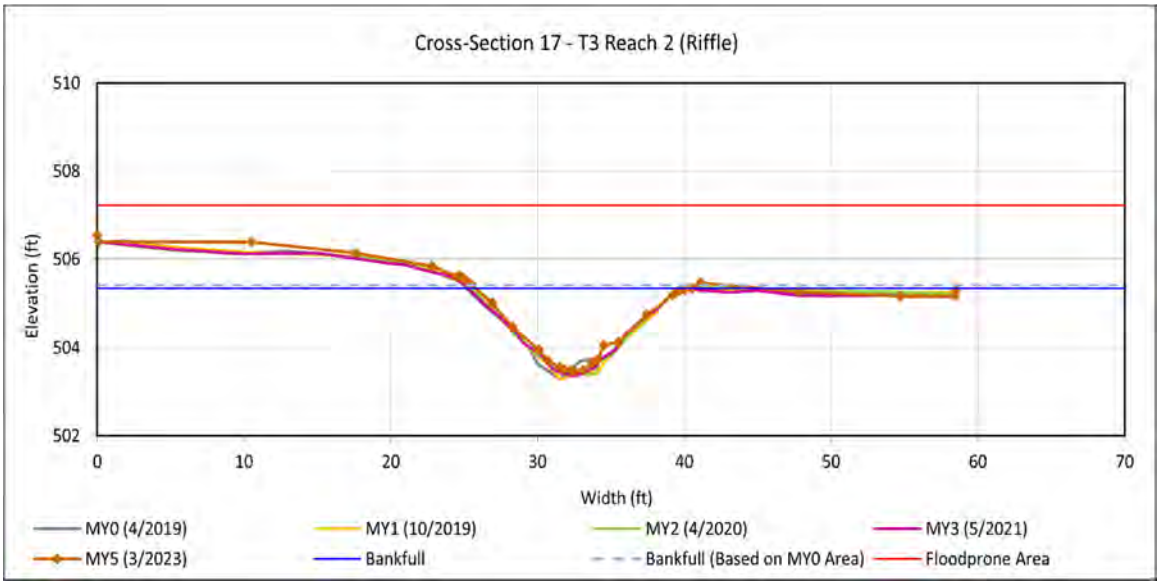
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	483.99	484.03	483.97	484.04	484.12	
LTOB Elevation	487.21	487.66	487.65	487.49	487.71	
LTOB Max Depth	3.22	3.63	3.68	3.45	3.59	
LTOB Cross-Sectional Area	42.23	55.47	52.77	44.48	50.72	

Downstream *(3/23/2023)*



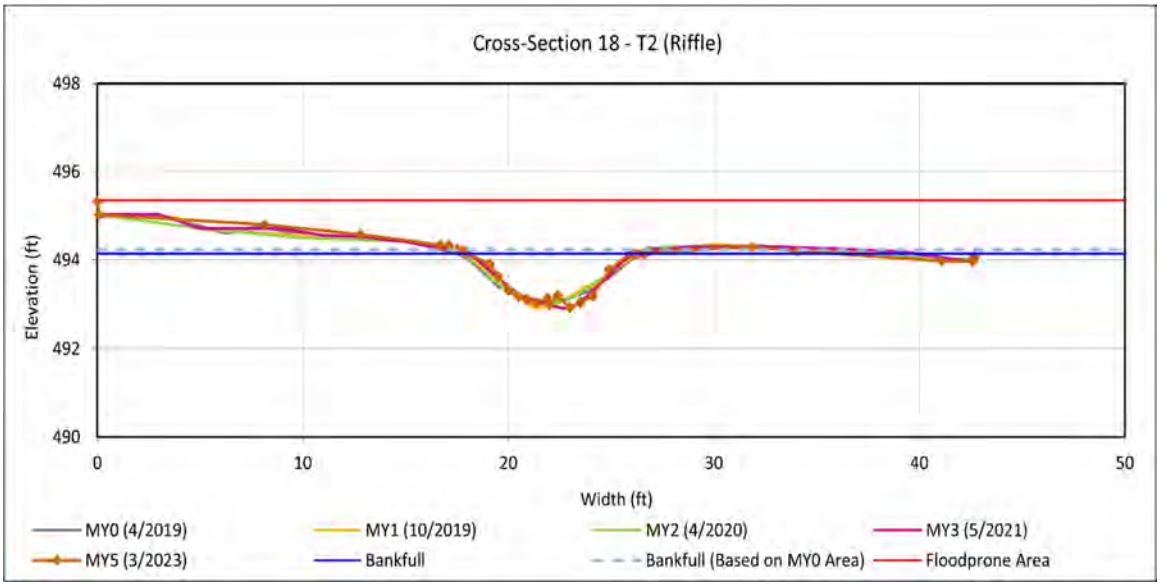
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	503.36	503.16	503.14	503.23	503.28	
LTOB Elevation	505.82	505.97	506.03	505.98	506.28	
LTOB Max Depth	2.46	2.81	2.89	2.75	3.00	
LTOB Cross-Sectional Area	17.64	19.53	19.92	20.15	22.25	

Downstream *(3/15/2023)*



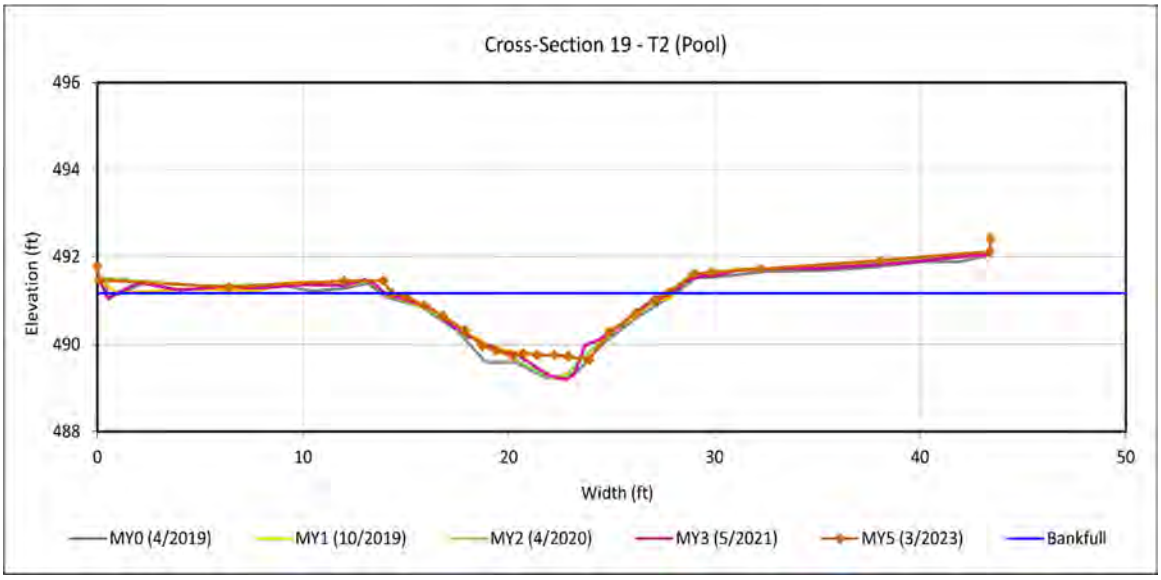
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	505.31	505.29	505.33	505.33	505.41	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.01	0.98	0.99	0.97	
Thalweg Elevation	503.29	503.28	503.39	503.36	503.46	
LTOB Elevation	505.31	505.32	505.28	505.31	505.34	
LTOB Max Depth	2.02	2.04	1.89	1.95	1.88	
LTOB Cross-Sectional Area	15.32	15.70	14.66	15.09	14.30	

Downstream *(3/15/2023)*



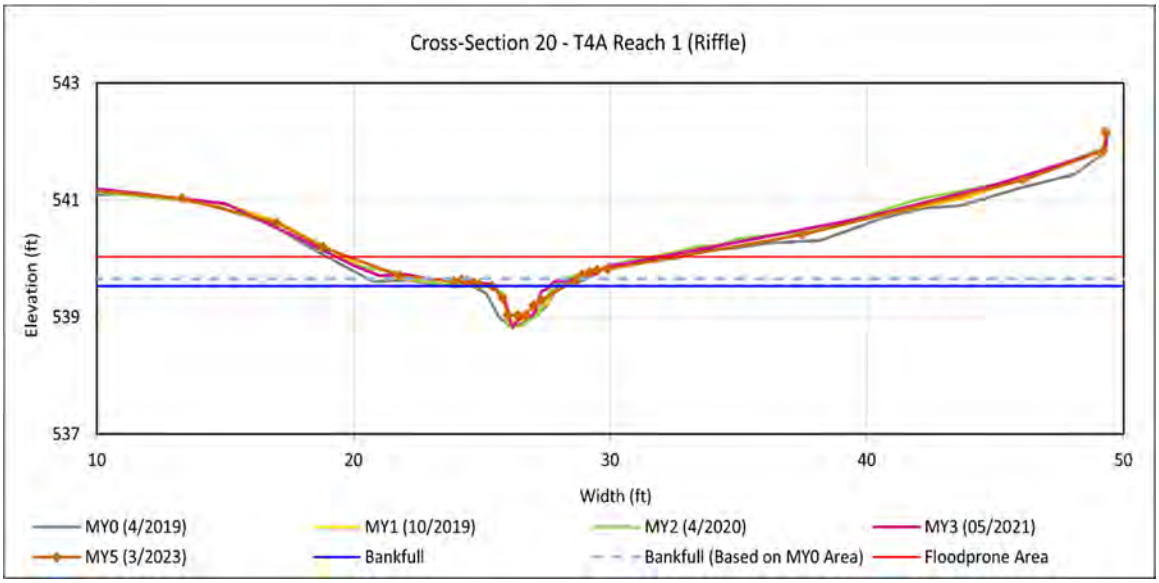
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	494.17	494.21	494.22	494.20	494.23	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.98	0.99	1.00	0.93	
Thalweg Elevation	493.00	492.92	492.99	492.91	492.93	
LTOB Elevation	494.17	494.19	494.21	494.21	494.14	
LTOB Max Depth	1.17	1.27	1.22	1.30	1.21	
LTOB Cross-Sectional Area	6.35	6.22	6.27	6.46	5.61	

Downstream *(3/15/2023)*



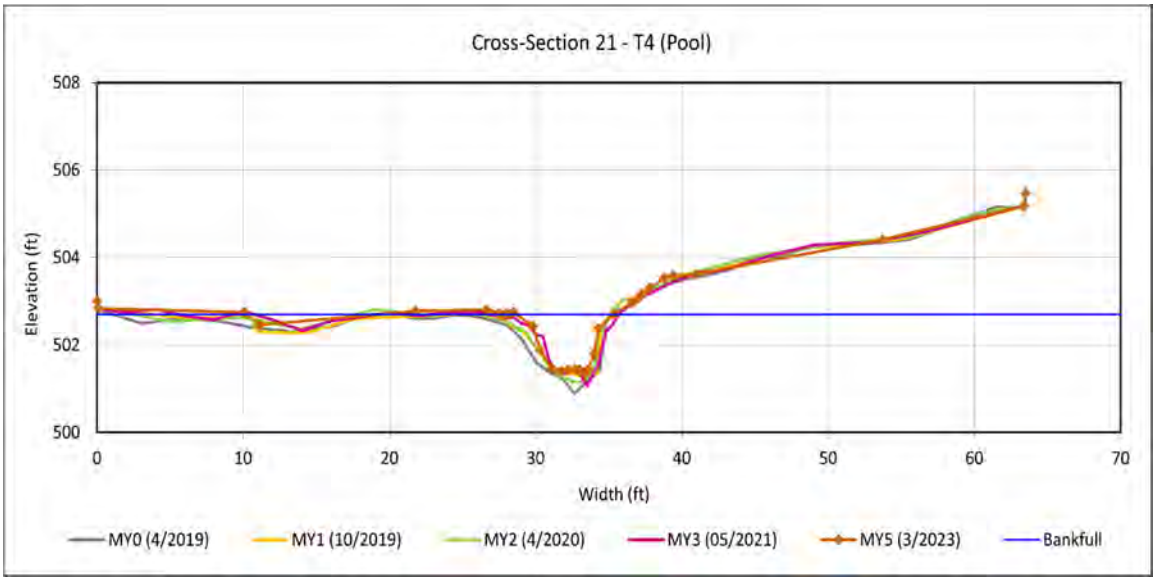
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	489.22	489.24	489.22	489.19	489.64	
LTOB Elevation	491.10	491.21	491.16	491.14	491.16	
LTOB Max Depth	1.88	1.97	1.94	1.95	1.52	
LTOB Cross-Sectional Area	13.58	13.41	13.08	12.29	11.69	

Downstream *(3/15/2023)*



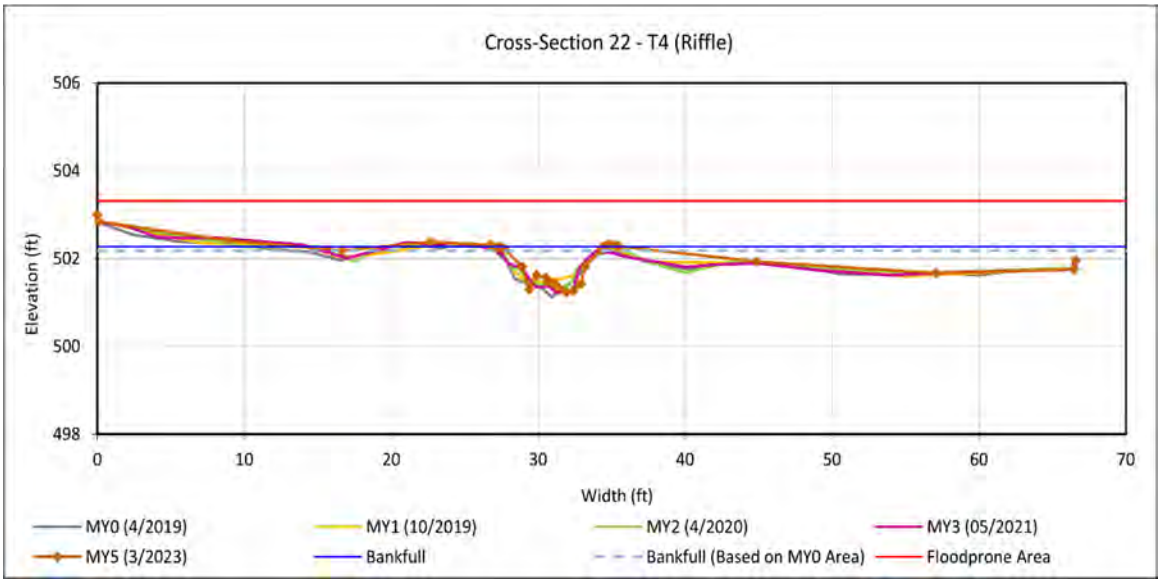
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	539.53	539.62	539.61	539.74	539.65	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.92	0.88	0.82	0.80	
Thalweg Elevation	538.83	538.89	538.83	538.82	539.03	
LTOB Elevation	539.53	539.56	539.52	539.57	539.53	
LTOB Max Depth	0.70	0.67	0.69	0.75	0.50	
LTOB Cross-Sectional Area	1.33	0.99	0.96	0.85	0.79	

Downstream *(3/15/2023)*



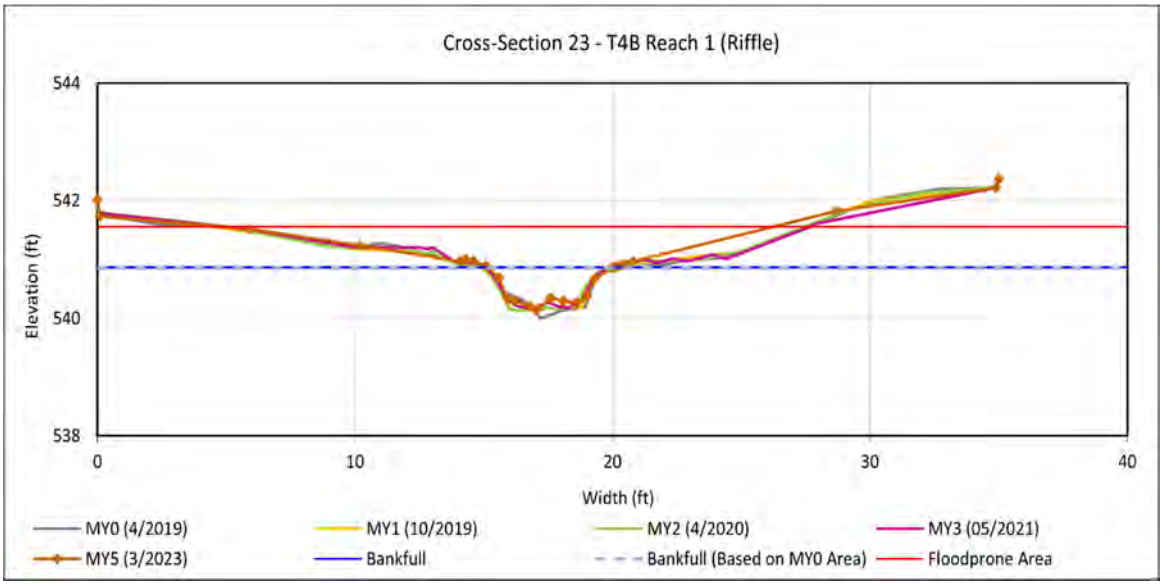
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	500.89	501.27	501.14	501.05	501.37	
LTOB Elevation	502.51	502.53	502.59	502.64	502.70	
LTOB Max Depth	1.62	1.26	1.45	1.59	1.33	
LTOB Cross-Sectional Area	6.66	5.33	5.75	5.63	5.20	

Downstream *(3/15/2023)*



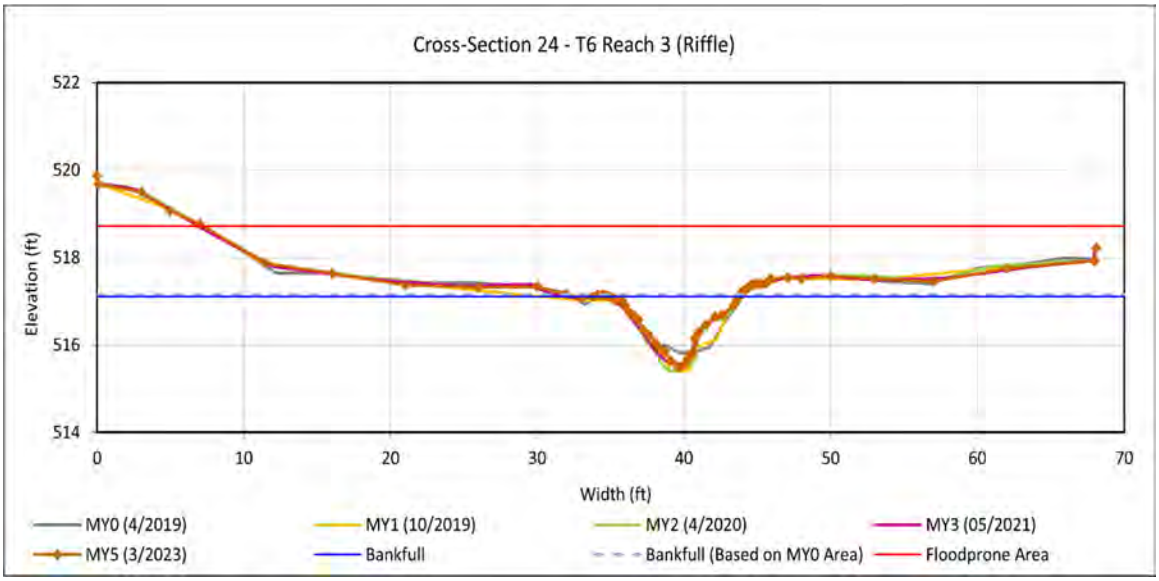
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	502.09	502.23	502.18	502.16	502.19	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.86	0.94	1.04	1.09	
Thalweg Elevation	501.12	501.44	501.20	501.22	501.23	
LTOB Elevation	502.09	502.12	502.12	502.19	502.27	
LTOB Max Depth	0.97	0.68	0.92	0.97	1.04	
LTOB Cross-Sectional Area	3.62	2.83	3.20	3.83	4.17	

Downstream *(3/15/2023)*



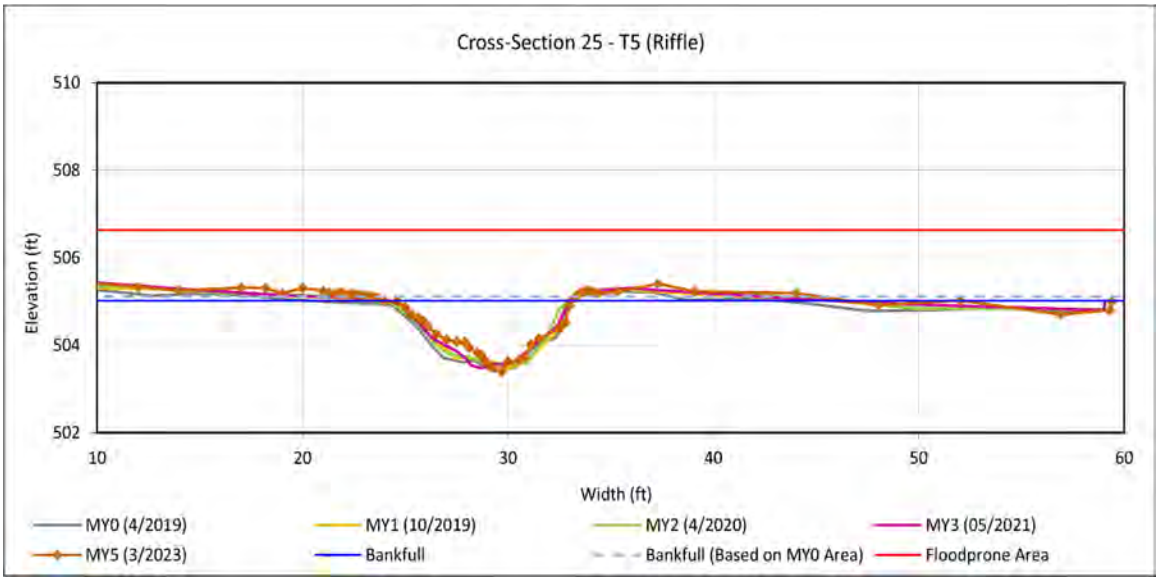
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	540.79	540.78	540.80	540.82	540.85	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.95	0.94	0.98	1.01	
Thalweg Elevation	540.00	540.12	540.13	540.16	540.20	
LTOB Elevation	540.79	540.75	540.76	540.81	540.86	
LTOB Max Depth	0.79	0.63	0.63	0.65	0.69	
LTOB Cross-Sectional Area	2.14	1.96	1.96	2.03	2.14	

Downstream *(3/15/2023)*



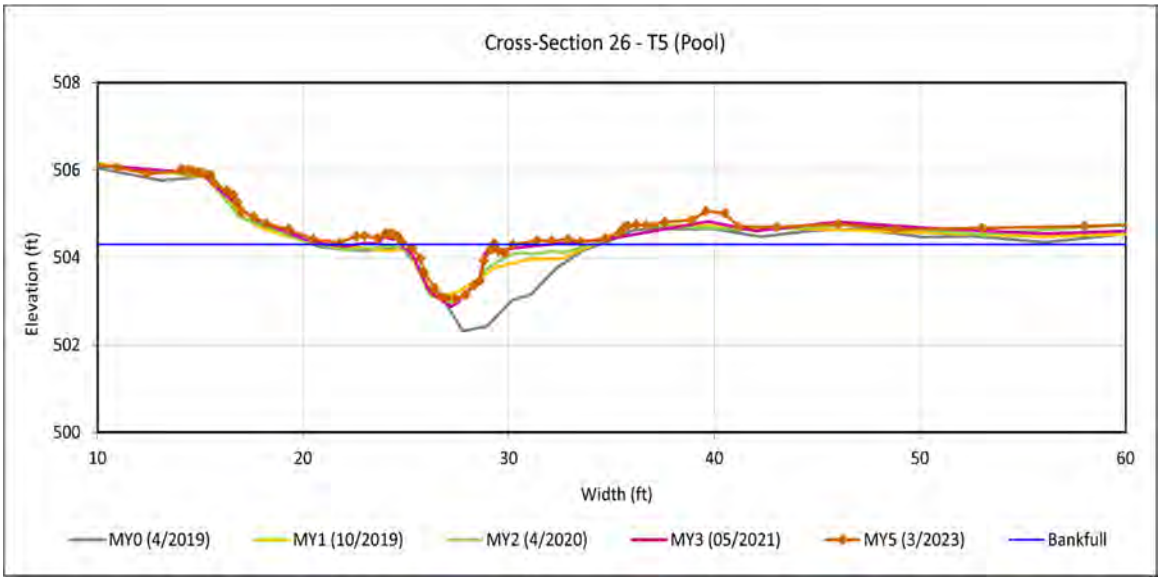
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	517.07	516.99	517.06	517.11	517.15	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.02	1.01	0.96	0.97	
Thalweg Elevation	515.82	515.39	515.40	515.54	515.49	
LTOB Elevation	517.07	517.02	517.07	517.05	517.10	
LTOB Max Depth	1.25	1.63	1.67	1.51	1.61	
LTOB Cross-Sectional Area	7.15	7.37	7.26	6.55	6.49	

Downstream *(3/23/2023)*



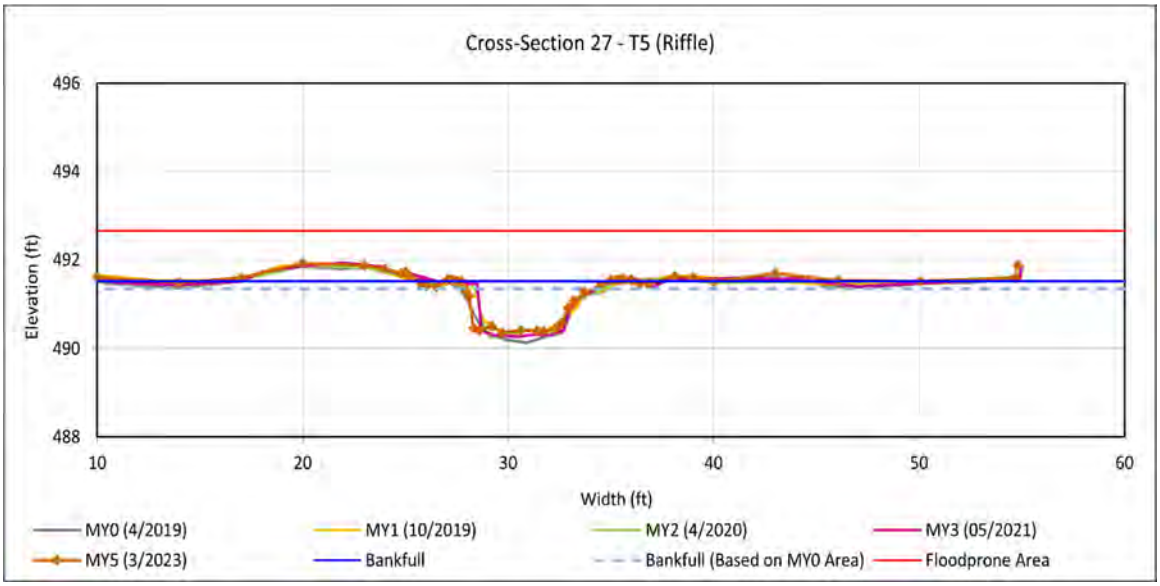
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	504.92	504.91	505.02	505.07	505.11	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.01	0.96	0.93	0.94	
Thalweg Elevation	503.40	503.47	503.56	503.48	503.39	
LTOB Elevation	504.92	504.93	504.97	504.96	505.01	
LTOB Max Depth	1.52	1.46	1.41	1.48	1.62	
LTOB Cross-Sectional Area	8.45	7.85	7.98	7.67	7.55	

Downstream *(3/23/2023)*



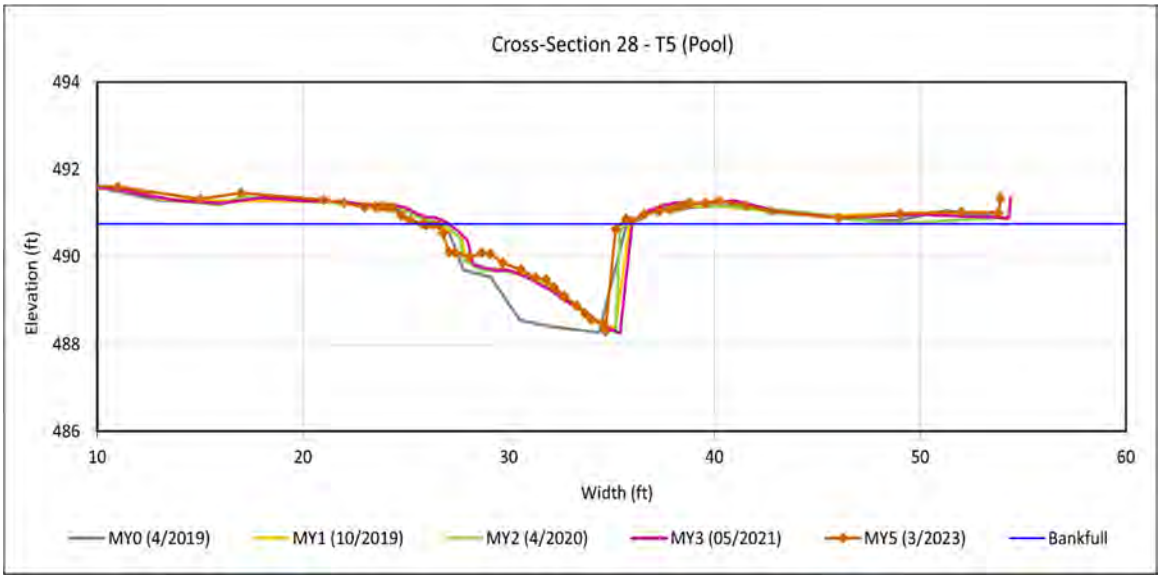
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	502.32	503.13	502.96	502.87	503.06	
LTOB Elevation	504.17	504.15	504.19	504.19	504.30	
LTOB Max Depth	1.85	1.02	1.23	1.32	1.24	
LTOB Cross-Sectional Area	8.48	3.84	3.81	3.21	3.39	

Downstream *(3/23/2023)*



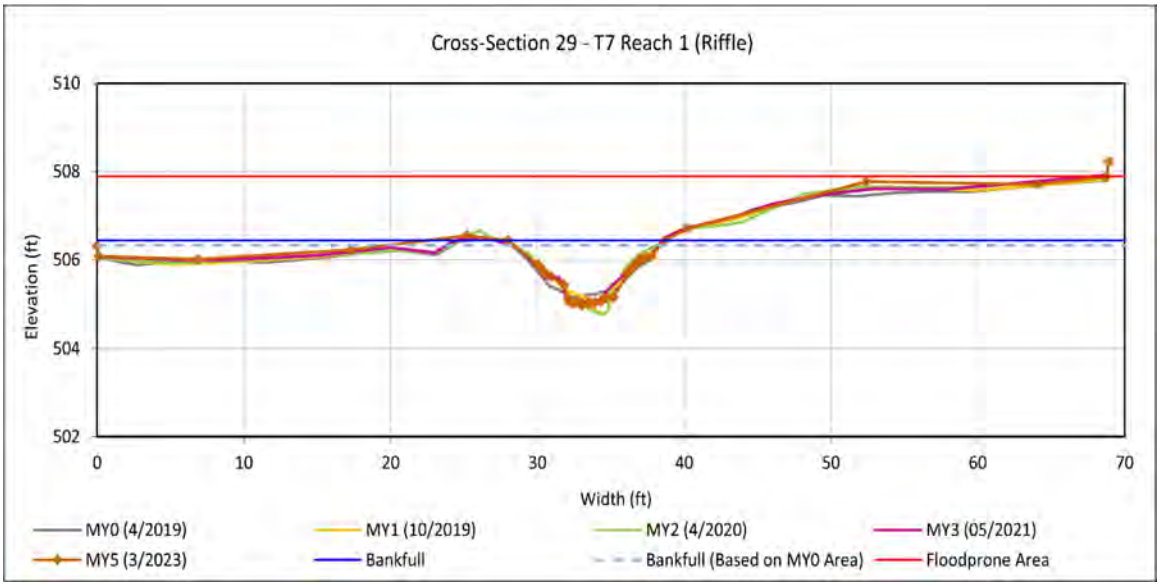
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	491.22	491.37	491.37	491.32	491.35	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.92	1.11	1.12	1.16	
Thalweg Elevation	490.13	490.33	490.25	490.27	490.39	
LTOB Elevation	491.22	491.29	491.49	491.45	491.51	
LTOB Max Depth	1.09	0.96	1.24	1.18	1.15	
LTOB Cross-Sectional Area	4.55	3.92	5.36	5.28	5.73	

Downstream *(3/21/2023)*



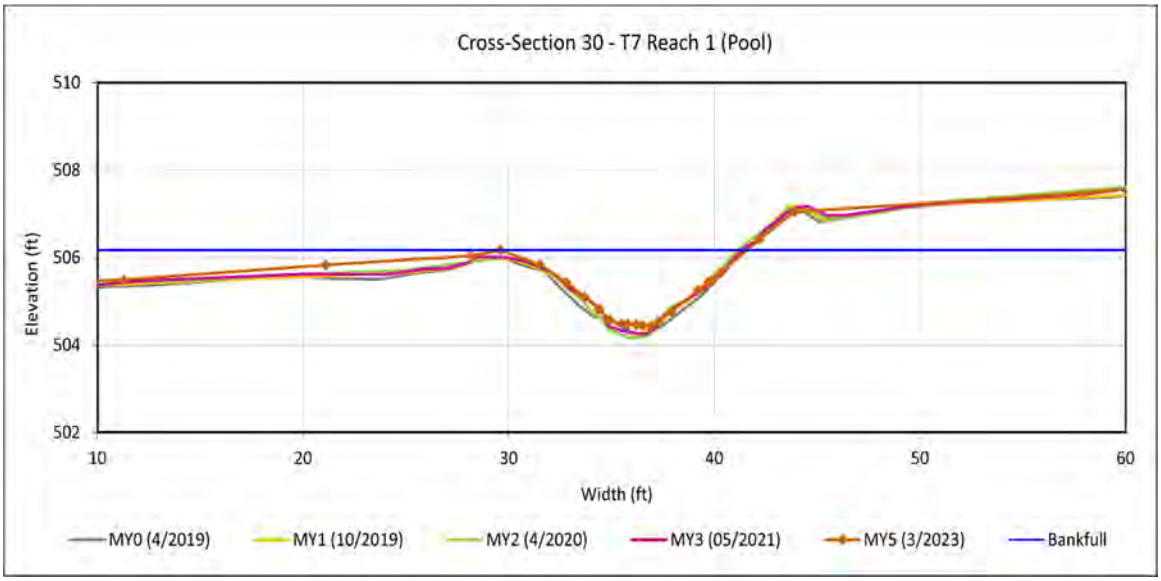
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	488.27	488.39	488.28	488.25	488.3	
LTOB Elevation	490.75	490.81	490.77	490.77	490.75	
LTOB Max Depth	2.48	2.39	2.49	2.52	2.45	
LTOB Cross-Sectional Area	15.16	12.25	11.84	12.46	10.39	

Downstream *(3/21/2023)*



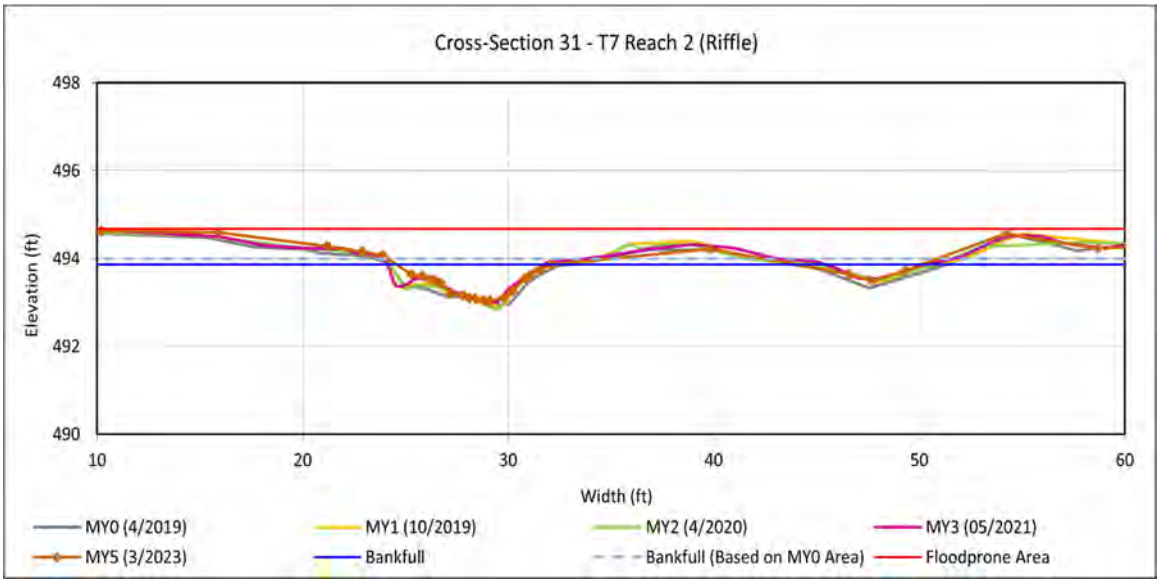
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	506.31	506.33	506.36	506.35	506.33	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.97	1.03	1.05	1.08	
Thalweg Elevation	505.13	504.78	504.77	504.97	504.99	
LTOB Elevation	506.31	506.29	506.41	506.41	506.44	
LTOB Max Depth	1.18	1.51	1.64	1.44	1.45	
LTOB Cross-Sectional Area	7.40	6.98	7.89	8.08	8.56	

Downstream *(3/15/2023)*



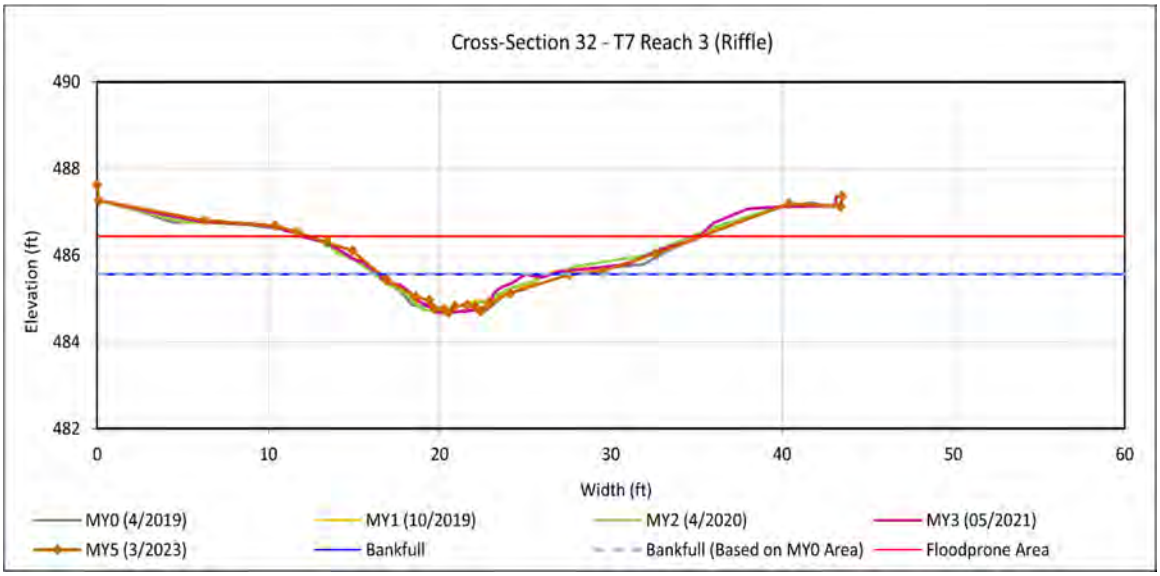
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	504.22	504.17	504.15	504.25	504.43	
LTOB Elevation	505.68	505.88	505.96	505.95	506.17	
LTOB Max Depth	1.46	1.71	1.81	1.70	1.74	
LTOB Cross-Sectional Area	7.53	8.87	9.55	9.19	11.04	

Downstream *(3/15/2023)*



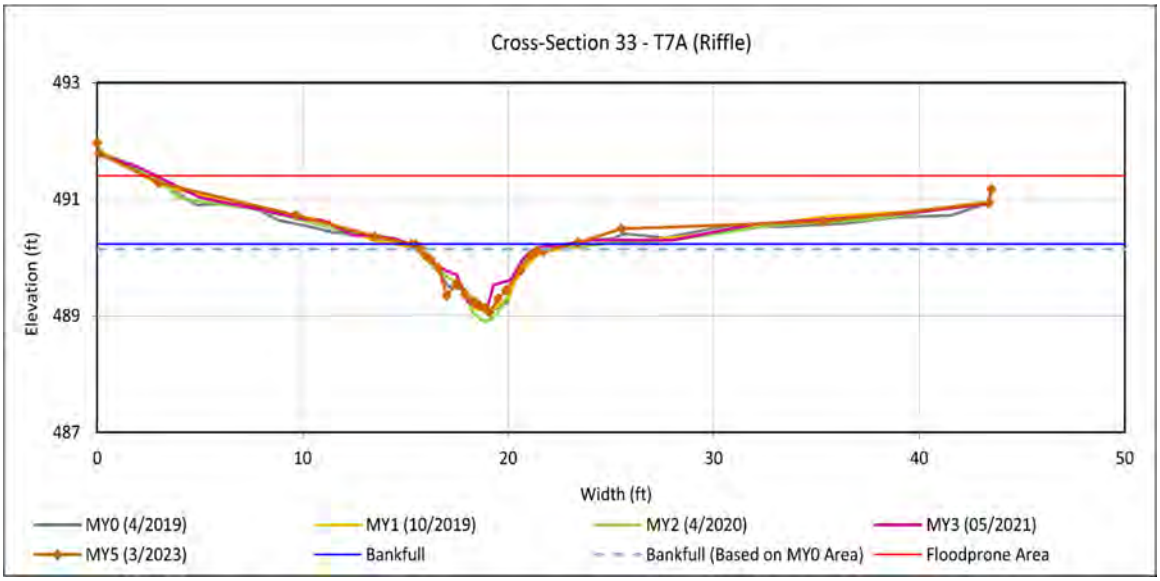
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	493.84	493.91	493.90	493.97	493.99	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94	0.97	0.96	0.87	
Thalweg Elevation	492.95	492.87	492.84	492.98	493.04	
LTOB Elevation	493.84	493.84	493.87	493.93	493.86	
LTOB Max Depth	0.89	0.97	1.03	0.95	0.82	
LTOB Cross-Sectional Area	4.56	4.03	4.31	4.29	3.44	

Downstream *(3/15/2023)*



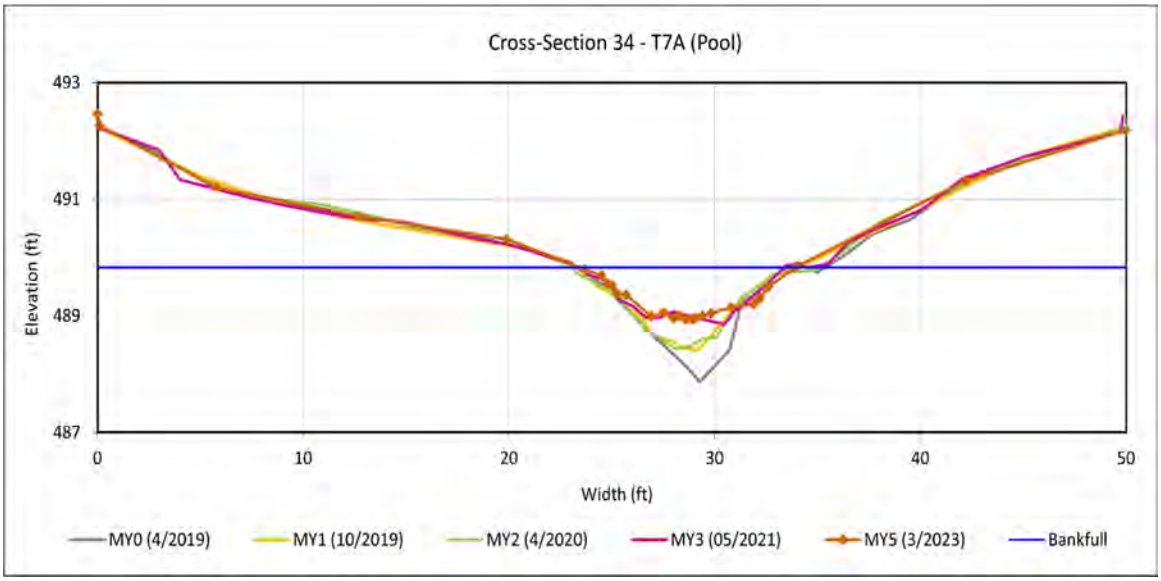
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	485.52	485.59	485.58	485.63	485.57	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.01	0.98	0.92	0.99	
Thalweg Elevation	484.65	484.69	484.68	484.67	484.71	
LTOB Elevation	485.52	485.60	485.56	485.56	485.56	
LTOB Max Depth	0.87	0.91	0.88	0.89	0.88	
LTOB Cross-Sectional Area	5.15	5.26	4.92	4.57	5.14	

Downstream *(3/15/2023)*



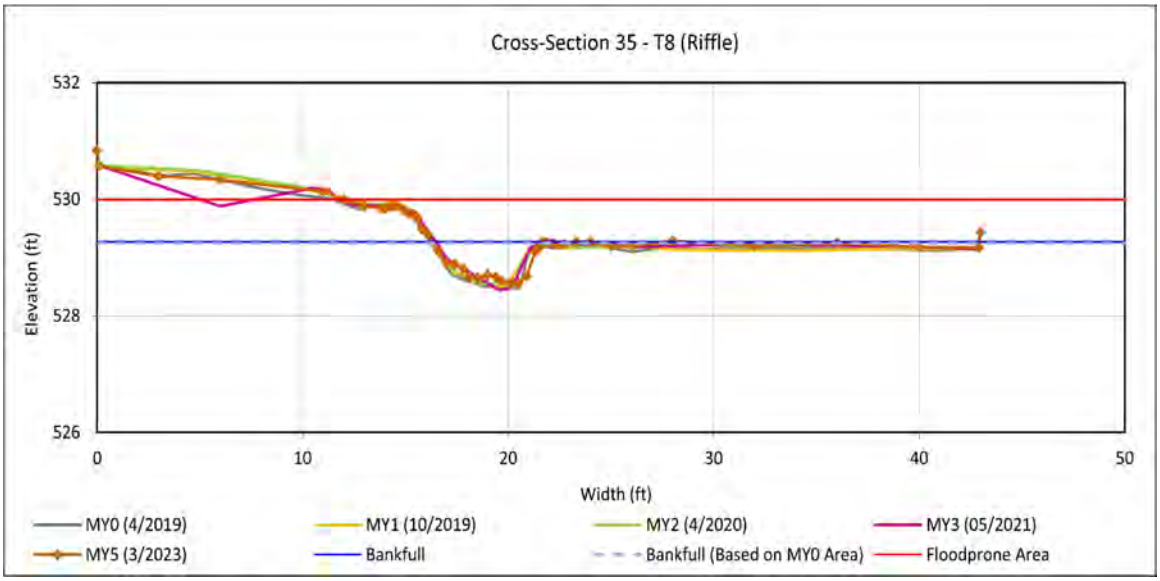
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	490.11	490.11	490.11	490.24	490.14	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.96	0.97	0.95	1.09	
Thalweg Elevation	489.10	489.07	488.90	489.14	489.06	
LTOB Elevation	490.11	490.07	490.07	490.18	490.23	
LTOB Max Depth	1.01	1.00	1.17	1.04	1.17	
LTOB Cross-Sectional Area	3.31	3.06	3.08	2.96	3.95	

Downstream *(3/15/2023)*



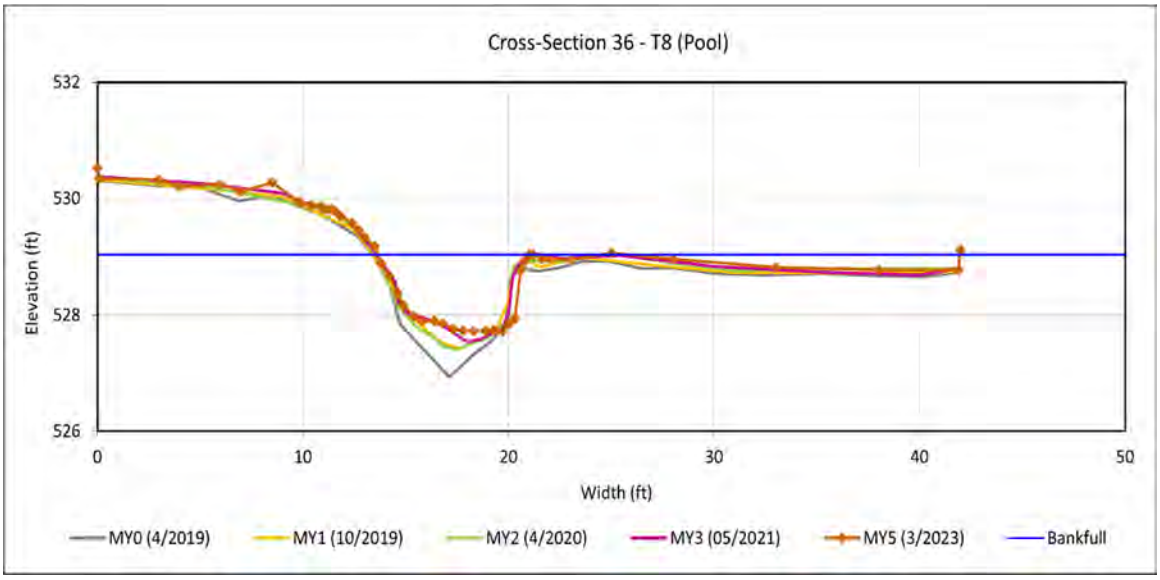
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	487.87	488.42	488.43	488.85	488.93	
LTOB Elevation	489.85	489.92	489.73	489.87	489.83	
LTOB Max Depth	1.98	1.50	1.30	1.02	0.90	
LTOB Cross-Sectional Area	9.43	8.51	6.60	6.42	5.76	

Downstream *(3/15/2023)*



	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	529.20	529.29	529.27	529.30	529.25	
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.92	0.96	0.99	1.03	
Thalweg Elevation	528.48	528.47	528.54	528.44	528.55	
LTOB Elevation	529.20	529.22	529.24	529.29	529.27	
LTOB Max Depth	0.72	0.75	0.70	0.85	0.72	
LTOB Cross-Sectional Area	2.61	2.24	2.46	2.54	2.84	

Downstream *(3/21/2023)*



	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	526.93	527.42	527.40	527.54	527.72	
LTOB Elevation	528.62	528.78	528.84	528.96	529.03	
LTOB Max Depth	1.69	1.36	1.44	1.42	1.31	
LTOB Cross-Sectional Area	6.71	5.98	6.75	6.69	7.31	

Downstream *(3/21/2023)*

Table 8. Baseline Stream Data Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**Buckwater Creek Reach 4**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	13		1	17.6		13.8	17.2	3
Floodprone Width (ft)	17	44	1	38	87	150	200	3
Bankfull Mean Depth (ft)	1.5	1.8	1	1.3		0.9	1.3	3
Bankfull Max Depth (ft)	2.1	2.2	1	1.2	1.5	1.7	2.2	3
Bankfull Cross Sectional Area (ft^2)	20.0	24.0	1	22.5		12.5	21.9	3
Width/Depth Ratio	7.3	8.6	1	14.0		13.5	15.3	3
Entrenchment Ratio	1.3	3.3	1	2.5	5.0	8.7	14.5	3
Bank Height Ratio	1.6	1.7	1	1.0		1.0		3
Max particle size (mm) mobilized at bankfull								
Rosgen Classification	E4/G4c			C4		C4		
Bankfull Discharge (cfs)	80		1	78.0		53.0		
Sinuosity	1.14			1.30		1.30		
Water Surface Slope (ft/ft)	0.0070		1	0.0070		0.0071		
Other	---			---		---		
Parameter	**Buckwater Creek Reach 5/6**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	15		1	19.0		20.5	21.5	2
Floodprone Width (ft)	20		1	40	91	200		2
Bankfull Mean Depth (ft)	1.8		1	1.6		1.5		2
Bankfull Max Depth (ft)	2.3		1	1.2	1.5	2.5	2.6	2
Bankfull Cross Sectional Area (ft^2)	28.0		1	29.7		30.6	33.6	2
Width/Depth Ratio	8.3		1	12.0		13.8	13.9	2
Entrenchment Ratio	1.3		1	2.2	5.0	9.3	9.8	2
Bank Height Ratio	2.0		1	1.0		1.0		2
Max particle size (mm) mobilized at bankfull								
Rosgen Classification	G4c			E4		E4		
Bankfull Discharge (cfs)	110		1	91.0	100.0	109.0		
Sinuosity	1.41			1.40		1.40		
Water Surface Slope (ft/ft)	0.0070		1	0.0040	0.0070	0.0060		
Other	---			---		---		
Parameter	**T2**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	8.8	11.0	1	10.6		9.1		1
Floodprone Width (ft)	14	49	1	23	53	100		1
Bankfull Mean Depth (ft)	0.9	1.4	1	0.8		0.7		1
Bankfull Max Depth (ft)	1.2	1.8	1	1.2	1.3	1.2		1
Bankfull Cross Sectional Area (ft^2)	8.3	15.0	1	8.9		6.4		1
Width/Depth Ratio	7.9	9.4	1	13.0		13.2		1
Entrenchment Ratio	1.3	>5.6	1	2.2	5.0	10.9		1
Bank Height Ratio	1.4	2.0	1	1.0		1.0		1
Max particle size (mm) mobilized at bankfull								
Rosgen Classification	E4/G4c			B4/C4		B4/C4		
Bankfull Discharge (cfs)	36		1	36.0		20		
Sinuosity	1.20			1.20		1.20		
Water Surface Slope (ft/ft)	0.0150		1	0.0120	0.0200	0.0170		
Other	---			---		---		

Table 8. Baseline Stream Data Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**T3**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	7.5	13	1	9.6		14.4		1
Floodprone Width (ft)	22	26	1	21	48	300		1
Bankfull Mean Depth (ft)	0.6	0.8	1	0.8		1.1		1
Bankfull Max Depth (ft)	1.1	1.3	1	0.9	1.1	2.0		1
Bankfull Cross Sectional Area (ft^2)	6.2	7.5	1	7.3		13.0		1
Width/Depth Ratio	9.2	23	1	13.0		13.6		1
Entrenchment Ratio	1.7	>3.4	1	2.2	5.0	20.8		1
Bank Height Ratio	1.2	1.7	1	1.0		1.0		1
Max particle size (mm) mobilized at bankfull								
Rosgen Classification	E4/Incised B4c			C4		C4		
Bankfull Discharge (cfs)	26		1	26.0		66.0		
Sinuosity	1.20		1	1.30		1.20		
Water Surface Slope (ft/ft)	0.0180		1	0.0100	0.0230	0.0159		
Other	---			---		---		
Parameter	**T4**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	7.2		1	7.6		6.7		3
Floodprone Width (ft)	9		1	11	17	150		3
Bankfull Mean Depth (ft)	0.6		1	0.6		0.5		3
Bankfull Max Depth (ft)	0.8		1	0.7	0.9	1.0		3
Bankfull Cross Sectional Area (ft^2)	4.8	5.1	1	4.3		3.6		3
Width/Depth Ratio	11		1	13.0		12.3		3
Entrenchment Ratio	1.3		1	1.4	2.2	22.3		3
Bank Height Ratio	1.6		1	1.0		1.0		3
Max particle size (mm) mobilized at bankfull								
Rosgen Classification	G4			B4/C4		B4		
Bankfull Discharge (cfs)	17		1	18.0		70.0		
Sinuosity	1.10		1	1.20		1.10		
Water Surface Slope (ft/ft)	0.0270		1	0.0240		0.0239		
Other	---			---		---		
Parameter	**T5**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	6.1	8.9	1	9.7		6.1	8.6	2
Floodprone Width (ft)	10	22	1	20	46	100	200	2
Bankfull Mean Depth (ft)	0.6		1	0.7		0.8	1.0	2
Bankfull Max Depth (ft)	0.9	1.4	1	0.8	1.0	1.1	1.5	2
Bankfull Cross Sectional Area (ft^2)	6.2	6.3	1	6.7		8.1	8.5	2
Width/Depth Ratio	9.7	13.0	1	14.0		4.5	8.7	2
Entrenchment Ratio	1.6	2.3	1	2.2	5.0	11.7	33.0	2
Bank Height Ratio	2.1	4.1	1	1.0		1.0		2
Max particle size (mm) mobilized at bankfull								
Rosgen Classification	Incised E4/C4			B4/C4		C4		
Bankfull Discharge (cfs)	21		1	22.0		12.0		
Sinuosity	1.10			1.30		1.30		
Water Surface Slope (ft/ft)	0.0150		1	0.0130		0.0138		
Other	---			---		---		

Table 9. Cross-Section Morphology Monitoring Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

	Buckwater Creek Reach 2						Buckwater Creek Reach 3											
	Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)						Cross-Section 3 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	509.51	509.54	509.56	509.52	509.56		N/A	N/A	N/A	N/A	N/A		509.71	509.67	509.59	509.66	509.74	
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	0.98	1.02	1.03	1.02		N/A	N/A	N/A	N/A	N/A		1.00	1.00	1.03	1.01	0.99	
Thalweg Elevation	507.26	507.43	507.49	507.42	507.33		504.68	504.61	504.59	504.61	504.66		506.17	505.95	505.98	505.97	506.08	
LTOB[2] Elevation	509.51	509.51	509.61	509.59	509.59		508.12	508.03	508.22	508.14	508.17		509.71	509.65	509.85	509.70	509.70	
LTOB[2] Max Depth (ft)	2.25	2.08	2.12	2.17	2.26		3.44	3.42	3.63	3.53	3.51		3.54	3.70	3.87	3.73	3.62	
LTOB[2] Cross Sectional Area (ft^2)	31.89	31.23	32.94	33.42	32.60		49.15	45.28	48.58	47.46	47.63		55.32	54.90	61.52	56.15	54.37	
	Buckwater Creek Reach 4																	
	Cross-Section 4 (Riffle)						Cross-Section 5 (Pool)						Cross-Section 6 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	505.91	505.94	505.98	505.99	506.04		N/A	N/A	N/A	N/A	N/A		500.92	500.73	500.71	500.73	501.03	
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	0.99	0.95	0.95	0.97		N/A	N/A	N/A	N/A	N/A		1.00	1.16	1.17	1.19	1.02	
Thalweg Elevation	503.75	503.83	503.80	503.83	503.90		502.72	502.72	502.58	502.68	502.71		499.75	498.96	498.97	498.92	498.89	
LTOB[2] Elevation	505.91	505.93	505.88	505.89	505.97		506.10	506.05	506.10	506.09	506.08		500.92	501.01	501.00	501.07	501.07	
LTOB[2] Max Depth (ft)	2.16	2.10	2.08	2.06	2.60		3.38	3.33	3.52	3.41	3.37		1.17	2.05	2.03	2.15	2.18	
LTOB[2] Cross Sectional Area (ft^2)	21.88	21.70	20.12	20.22	20.63		50.42	47.80	49.84	48.40	47.11		13.61	17.62	18.12	18.31	18.50	
	Buckwater Creek Reach 4						Buckwater Creek Reach 5											
	Cross-Section 7 (Pool)						Cross-Section 8 (Riffle)						Cross-Section 9 (Pool)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A	N/A	N/A	N/A		496.69	496.75	496.74	496.73	496.74		N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A	N/A	N/A	N/A		1.00	0.88	0.93	0.94	0.95		N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	496.97	497.03	496.98	497.23	497.09		494.96	495.03	495.06	495.01	494.99		486.70	486.77	486.81	486.71	486.74	
LTOB[2] Elevation	500.69	500.88	500.92	500.85	500.90		496.69	496.55	496.63	496.62	496.65		488.72	488.74	488.72	488.74	488.78	
LTOB[2] Max Depth (ft)	3.72	3.85	3.94	3.62	3.81		1.73	1.52	1.57	1.61	1.66		2.02	1.97	1.91	2.03	2.04	
LTOB[2] Cross Sectional Area (ft^2)	38.82	39.83	41.79	39.42	39.68		12.51	9.82	10.96	11.14	11.35		21.71	21.23	20.04	21.57	21.46	

[1]Bank Height Ratio (BHR) takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation.

[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.

Table 9. Cross-Section Morphology Monitoring Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

	Buckwater Creek Reach 5						Buckwater Creek Reach 6											
	Cross-Section 10 (Riffle)						Cross-Section 11 (Pool)						Cross-Section 12 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	488.49	488.59	488.57	488.59	488.62		N/A	N/A	N/A	N/A	N/A		487.04	487.13	487.11	487.15	487.19	
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	0.94	0.99	0.97	0.95		N/A	N/A	N/A	N/A	N/A		1.00	0.97	0.99	0.97	0.98	
Thalweg Elevation	485.98	486.11	486.12	486.08	486.15		482.75	482.57	482.70	482.77	482.59		484.46	484.68	484.67	484.63	484.60	
LTOB[2] Elevation	488.49	488.43	488.55	488.52	488.49		486.68	486.46	486.67	486.69	486.78		487.04	487.06	487.08	487.06	487.15	
LTOB[2] Max Depth (ft)	2.51	2.32	2.43	2.44	2.34		3.93	3.89	3.97	3.92	4.19		2.58	2.38	2.41	2.43	2.55	
LTOB[2] Cross Sectional Area (ft^2)	33.27	30.04	32.87	31.76	30.21		52.40	45.99	50.03	49.81	49.93		30.55	29.06	30.00	28.82	29.71	
	T1 Reach 1						T1 Reach 2											
	Cross-Section 13 (Riffle)						Cross-Section 14 (Riffle)						Cross-Section 15 (Pool)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	488.81	488.96	488.98	489.08	489.09		487.70	487.79	487.77	487.76	487.88		N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	0.94	0.91	0.93	0.92		1.00	0.96	0.98	1.00	0.99		N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	486.36	486.61	486.60	486.43	486.14		485.22	485.58	485.43	485.41	485.46		483.99	484.03	483.97	484.04	484.12	
LTOB[2] Elevation	488.81	488.82	488.78	488.88	488.68		487.70	487.70	487.73	487.76	487.85		487.21	487.66	487.65	487.49	487.71	
LTOB[2] Max Depth (ft)	2.45	2.21	2.18	2.45	2.70		2.48	2.12	2.30	2.35	2.39		3.22	3.63	3.68	3.45	3.59	
LTOB[2] Cross Sectional Area (ft^2)	31.45	28.29	27.01	27.28	25.91		32.68	30.85	31.75	32.64	32.04		42.23	55.47	52.77	44.48	50.72	
	T3 Reach 2												T2					
	Cross-Section 16 (Pool)						Cross-Section 17 (Riffle)						Cross-Section 18 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A	N/A	N/A	N/A		505.31	505.29	505.33	505.33	505.41		494.17	494.21	494.22	494.20	494.23	
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A	N/A	N/A	N/A		1.00	1.01	0.98	0.99	0.97		1.00	0.98	0.99	1.00	0.93	
Thalweg Elevation	503.36	503.16	503.14	503.23	503.28		503.29	503.28	503.39	503.36	503.46		493.00	492.92	492.99	492.91	492.93	
LTOB[2] Elevation	505.82	505.97	506.03	505.98	506.28		505.31	505.32	505.28	505.31	505.34		494.17	494.19	494.21	494.21	494.14	
LTOB[2] Max Depth (ft)	2.46	2.81	2.89	2.75	3.00		2.02	2.04	1.89	1.95	1.88		1.17	1.27	1.22	1.30	1.21	
LTOB[2] Cross Sectional Area (ft^2)	17.64	19.53	19.92	20.15	22.25		15.32	15.70	14.66	15.09	14.30		6.35	6.22	6.27	6.46	5.61	

[1]Bank Height Ratio (BHR) takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation.

[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.

Table 9. Cross-Section Morphology Monitoring Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

	T2						T4A Reach 1						T4					
	Cross-Section 19 (Pool)						Cross-Section 20 (Riffle)						Cross-Section 21 (Pool)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A	N/A	N/A	N/A		539.53	539.62	539.61	539.74	539.65		N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A	N/A	N/A	N/A		1.00	0.92	0.88	0.82	0.80		N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	489.22	489.24	489.22	489.19	489.64		538.83	538.89	538.83	538.82	539.03		500.89	501.27	501.14	501.05	501.37	
LTOB[2] Elevation	491.10	491.21	491.16	491.14	491.16		539.53	539.56	539.52	539.57	539.53		502.51	502.53	502.59	502.64	502.70	
LTOB[2] Max Depth (ft)	1.88	1.97	1.94	1.95	1.52		0.70	0.67	0.69	0.75	0.50		1.62	1.26	1.45	1.59	1.33	
LTOB[2] Cross Sectional Area (ft^2)	13.58	13.41	13.08	12.29	11.69		1.33	0.99	0.96	0.85	0.79		6.66	5.33	5.75	5.63	5.20	
	T4						T4B Reach 1						T6 Reach 3					
	Cross-Section 22 (Riffle)						Cross-Section 23 (Riffle)						Cross-Section 24 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	502.09	502.23	502.18	502.16	502.19		540.79	540.78	540.80	540.82	540.85		517.07	516.99	517.06	517.11	517.15	
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	0.86	0.94	1.04	1.09		1.00	0.95	0.94	0.98	1.01		1.00	1.02	1.01	0.96	0.97	
Thalweg Elevation	501.12	501.44	501.20	501.22	501.23		540.00	540.12	540.13	540.16	540.20		515.82	515.39	515.40	515.54	515.49	
LTOB[2] Elevation	502.09	502.12	502.12	502.19	502.27		540.79	540.75	540.76	540.81	540.86		517.07	517.02	517.07	517.05	517.10	
LTOB[2] Max Depth (ft)	0.97	0.68	0.92	0.97	1.04		0.79	0.63	0.63	0.65	0.69		1.25	1.63	1.67	1.51	1.61	
LTOB[2] Cross Sectional Area (ft^2)	3.62	2.83	3.20	3.83	4.17		2.14	1.96	1.96	2.03	2.14		7.15	7.37	7.26	6.55	6.49	
	T5																	
	Cross-Section 25 (Riffle)						Cross-Section 26 (Pool)						Cross-Section 27 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	504.92	504.91	505.02	505.07	505.11		N/A	N/A	N/A	N/A	N/A		491.22	491.37	491.37	491.32	491.35	
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	1.01	0.96	0.93	0.94		N/A	N/A	N/A	N/A	N/A		1.00	0.92	1.11	1.12	1.16	
Thalweg Elevation	503.40	503.47	503.56	503.48	503.39		502.32	503.13	502.96	502.87	503.06		490.13	490.33	490.25	490.27	490.39	
LTOB[2] Elevation	504.92	504.93	504.97	504.96	505.01		504.17	504.15	504.19	504.19	504.30		491.22	491.29	491.49	491.45	491.51	
LTOB[2] Max Depth (ft)	1.52	1.46	1.41	1.48	1.62		1.85	1.02	1.23	1.32	1.24		1.09	0.96	1.24	1.18	1.15	
LTOB[2] Cross Sectional Area (ft^2)	8.45	7.85	7.98	7.67	7.55		8.48	3.84	3.81	3.21	3.39		4.55	3.92	5.36	5.28	5.73	

[1]Bank Height Ratio (BHR) takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation.

[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.

Table 9. Cross-Section Morphology Monitoring Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

	T5						T7 Reach 1											
	Cross-Section 28 (Pool)						Cross-Section 29 (Riffle)						Cross-Section 30 (Pool)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A	N/A	N/A	N/A		506.31	506.33	506.36	506.35	506.33		N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A	N/A	N/A	N/A		1.00	0.97	1.03	1.05	1.08		N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	488.27	488.39	488.28	488.25	488.3		505.13	504.78	504.77	504.97	504.99		504.22	504.17	504.15	504.25	504.43	
LTOB[2] Elevation	490.75	490.81	490.77	490.77	490.75		506.31	506.29	506.41	506.41	506.44		505.68	505.88	505.96	505.95	506.17	
LTOB[2] Max Depth (ft)	2.48	2.39	2.49	2.52	2.45		1.18	1.51	1.64	1.44	1.45		1.46	1.71	1.81	1.70	1.74	
LTOB[2] Cross Sectional Area (ft^2)	15.16	12.25	11.84	12.46	10.39		7.40	6.98	7.89	8.08	8.56		7.53	8.87	9.55	9.19	11.04	
	T7 Reach 2						T7 Reach 3						T7A					
	Cross-Section 31 (Riffle)						Cross-Section 32 (Riffle)						Cross-Section 33 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	493.84	493.91	493.90	493.97	493.99		485.52	485.59	485.58	485.63	485.57		490.11	490.11	490.11	490.24	490.14	
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	0.94	0.97	0.96	0.87		1.00	1.01	0.98	0.92	0.99		1.00	0.96	0.97	0.95	1.09	
Thalweg Elevation	492.95	492.87	492.84	492.98	493.04		484.65	484.69	484.68	484.67	484.71		489.10	489.07	488.90	489.14	489.06	
LTOB[2] Elevation	493.84	493.84	493.87	493.93	493.86		485.52	485.60	485.56	485.56	485.56		490.11	490.07	490.07	490.18	490.23	
LTOB[2] Max Depth (ft)	0.89	0.97	1.03	0.95	0.82		0.87	0.91	0.88	0.89	0.88		1.01	1.00	1.17	1.04	1.17	
LTOB[2] Cross Sectional Area (ft^2)	4.56	4.03	4.31	4.29	3.44		5.15	5.26	4.92	4.57	5.14		3.31	3.06	3.08	2.96	3.95	
	T7A						T8											
	Cross-Section 34 (Pool)						Cross-Section 35 (Riffle)						Cross-Section 36 (Pool)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A	N/A	N/A	N/A		529.20	529.29	529.27	529.30	529.25		N/A	N/A	N/A	N/A	N/A	
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A	N/A	N/A	N/A		1.00	0.92	0.96	0.99	1.03		N/A	N/A	N/A	N/A	N/A	
Thalweg Elevation	487.87	488.42	488.43	488.85	488.93		528.48	528.47	528.54	528.44	528.55		526.93	527.42	527.40	527.54	527.72	
LTOB[2] Elevation	489.85	489.92	489.73	489.87	489.83		529.20	529.22	529.24	529.29	529.27		528.62	528.78	528.84	528.96	529.03	
LTOB[2] Max Depth (ft)	1.98	1.50	1.30	1.02	0.90		0.72	0.75	0.70	0.85	0.72		1.69	1.36	1.44	1.42	1.31	
LTOB[2] Cross Sectional Area (ft^2)	9.43	8.51	6.60	6.42	5.76		2.61	2.24	2.46	2.54	2.84		6.71	5.98	6.75	6.69	7.31	

[1]Bank Height Ratio (BHR) takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation.

[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. Hydrology Data

Table 10. Bankfull Events

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Reach	MY1 (2019)	MY2 (2020)	MY3 (2021)	MY4 (2022)	MY5 (2023)	MY6 (2024)	MY7 (2025)
Buckwater Creek Reach 6	6/18/2019	2/6/2020* 5/21/2020	1/3/2021* 4/9/2021*	4/6/2022[2]	3/28/2023[2]		
T1 Reach 2	4/13/2019	2/6/2020* 5/21/2020*	**	3/17/2022 5/23/2022* 12/15/2022*	4/7/2023		
T2	6/18/2019*	2/6/2020* 5/21/2020*	**	3/12/2022 3/17/2022* 12/15/2022	4/7/2023		
T4	4/14/2019* 6/18/2019	2/6/2020 5/21/2020	1/3/2021 3/31/2021*	3/12/2022*	9/1/2023 9/27/2023 10/23/2023		
T5: US of St. Mary's Rd	N/A	2/6/2020 5/21/2020	1/3/2021* 4/9/2021*	1/3/2022*	10/24/2023		
T5: DS of St. Mary's Rd	4/13/2019 6/18/2019	2/6/2020 5/21/2020	1/3/2021* 4/9/2021*	1/3/2022	9/3/2023* 10/24/2023		
T7 Reach 3	6/18/2019*	2/6/2020	1/3/2021[1] 4/9/2021*	1/3/2022 3/12/2022[1] 12/15/2022	9/1/2023 9/26/2023 10/23/2023		

*Only a geomorphically significant event. Not a bankfull event.
**No bankfull or geomorphically significant events discernible due to gauge freezing.
1. T7 Reach 3 recorded bankfull events on the flow gauge on T7 Reach 2.
2. Bankfull event recorded based on visual observations.

Table 11. Rainfall Summary

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

	MY1 (2019)	MY2 (2020)	MY3 (2021)	MY4 (2022)	MY5 (2023)	MY6 (2024)	MY7 (2025)
Annual Precip Total	43.35	61.38	47.80	50.16	48.05*		
WETS 30th Percentile	43.75	43.73	43.79	43.52	43.92		
WETS 70th Percentile	51.13	50.88	51.30	51.01	51.42		
Normal	Y	Y	Y	Y	*		

Annual Precipitation Source: **Durham 11 W** Station, Orange County, NC, State Climate Office (Approximately 10 miles south of the Site).
30 Year Avereage Precipitation Source: **Chapel Hill 2 W** Station, Orange County, NC, AgCIS (Approximately 12 miles south of the Site).
*Annual precipitation total was collected up until 11/14/2022. Data will be updated in MY6.

BANKFULL EVENTS
VISUAL OBSERVATIONS

	
Buckwater Creek Reach 4 *(3/28/2023)*	**Buckwater Creek Reach 5** *(3/28/2023)*

Table 12. Recorded In-Stream Flow Events Summary

Buckwater Mitigation Site

DMS Project No. 97084

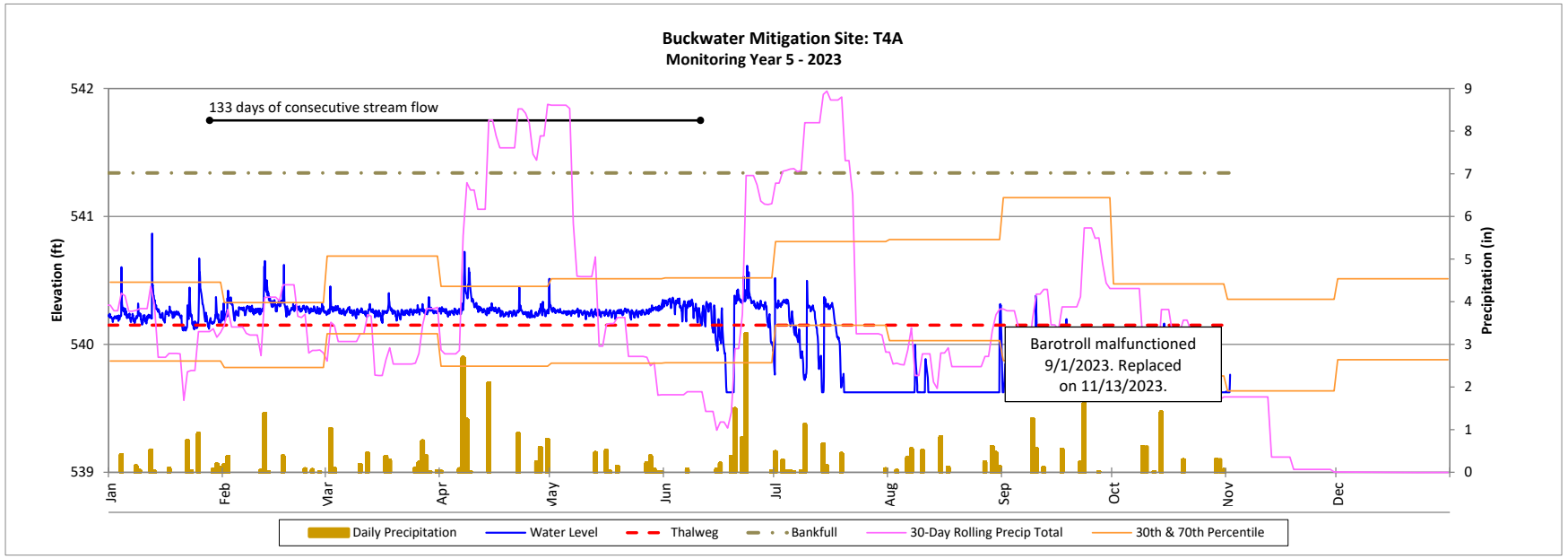
Monitoring Year 5 - 2023

Reach	Max Consecutive Days/ Total Days Meeting Success Criteria*						
	MY1 (2019)	MY2 (2020)	MY3 (2021)	MY4 (2022)	MY5 (2023)	MY6 (2024)	MY7 (2025)
T4A	96 Days/ 120 Days	70 Days/ 216 Days	52 Days/ 155 Days	63 Days/ 179 Days	133 Days/ 182 Days		
T4B	63 Days/ 91 Days	208 Days/ 290 Days	188 Days/ 263 Days	166 Days/ 252 Days	160 Days/ 193 Days		
T6	73 Days/ 103 Days	294 Days/ 294 Days	238 Days/ 280 Days	161 Days/ 317 Days	150 Days/ 150 Days**		
T7 Reach 2	**Not Installed**	194 Days/ 234 Days	146 Days/ 171 Days	137 Days/ 235 Days	156 Days/ 174 Days		
T7A	169 Days/ 233 Days	133 Days/ 281 Days	250 Days/ 338 Days	221 Days/ 317 Days	233 Days/ 226 Days		
T8	19 Days/ 21 Days**	207 Days/ 272 Days	101 Days/ 196 Days	57 Days/ 122 Days	243 Days/ 243 Days		

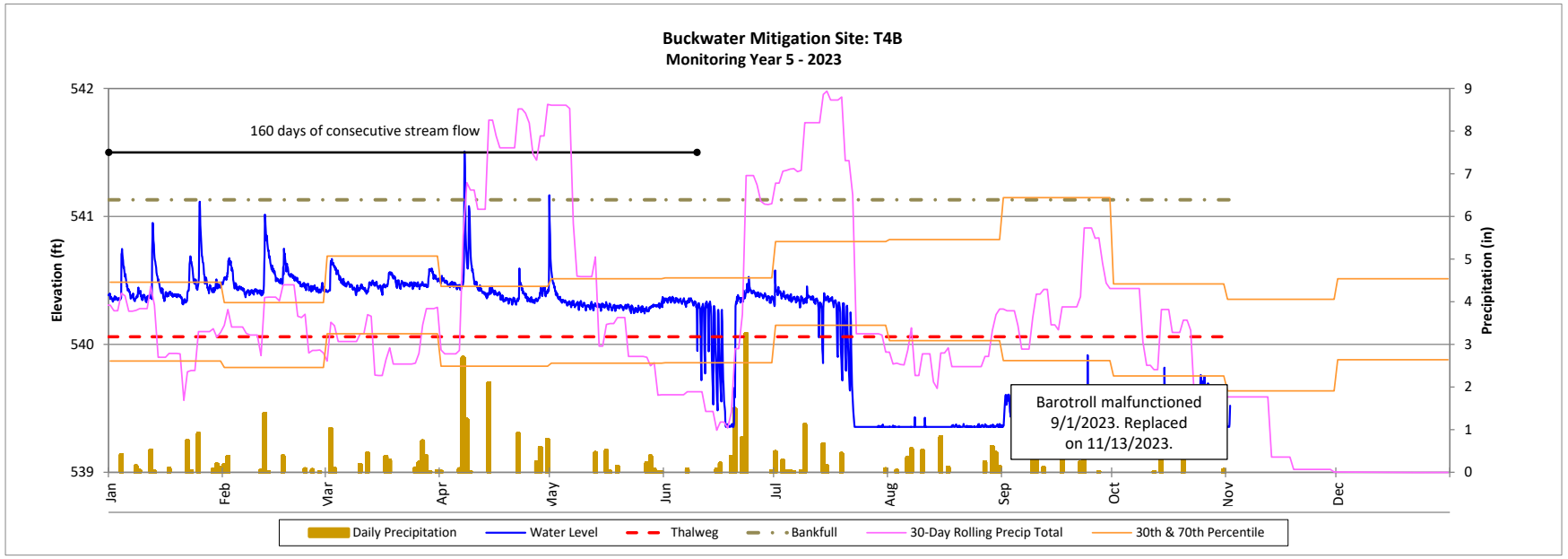
*Success criteria is 30 consecutive days of flow.

**Gauge malfunctioned.

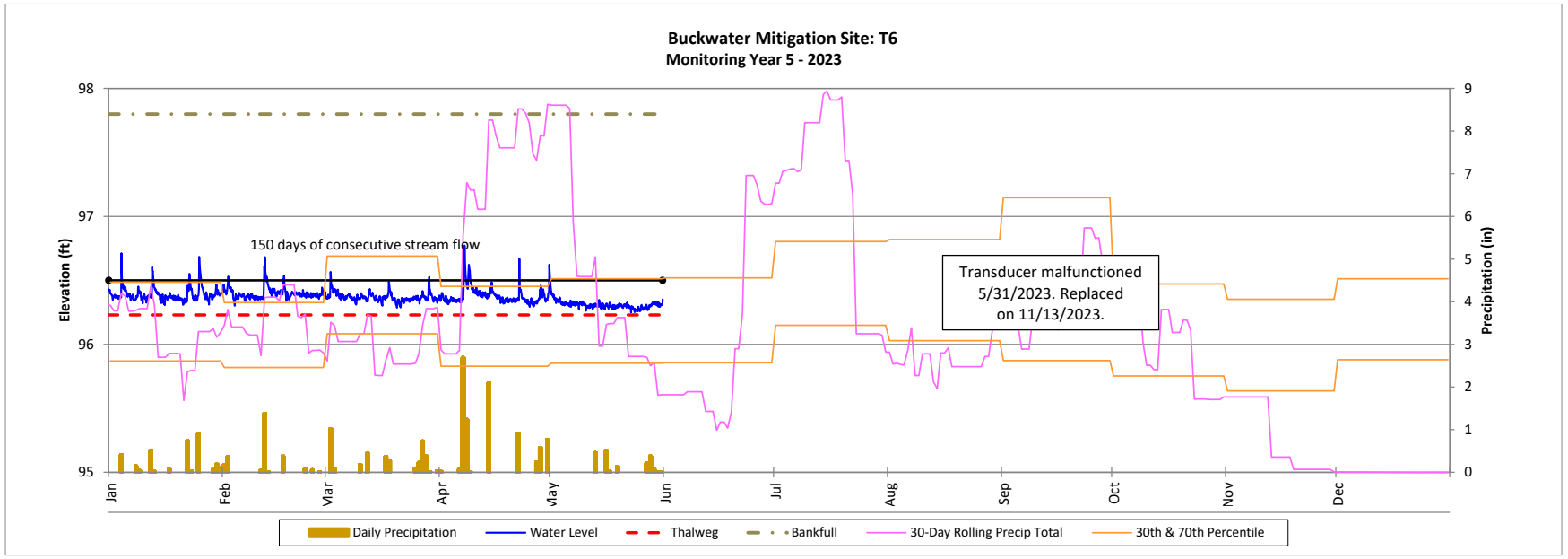
Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023



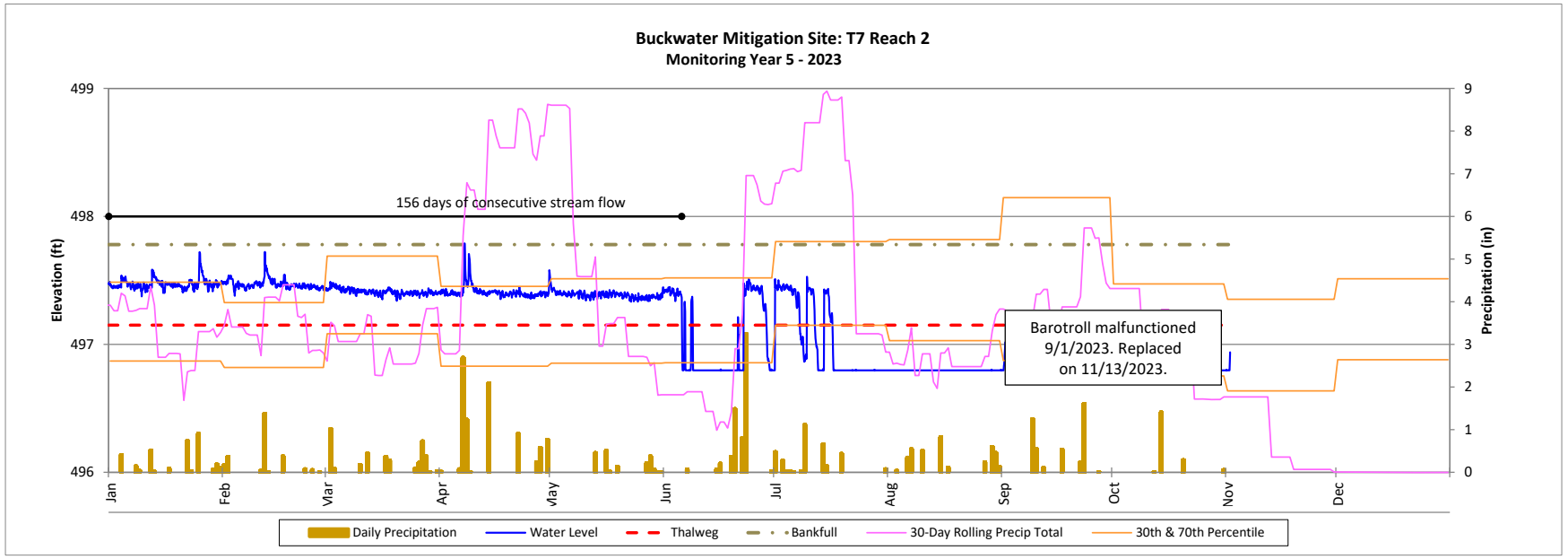
Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023



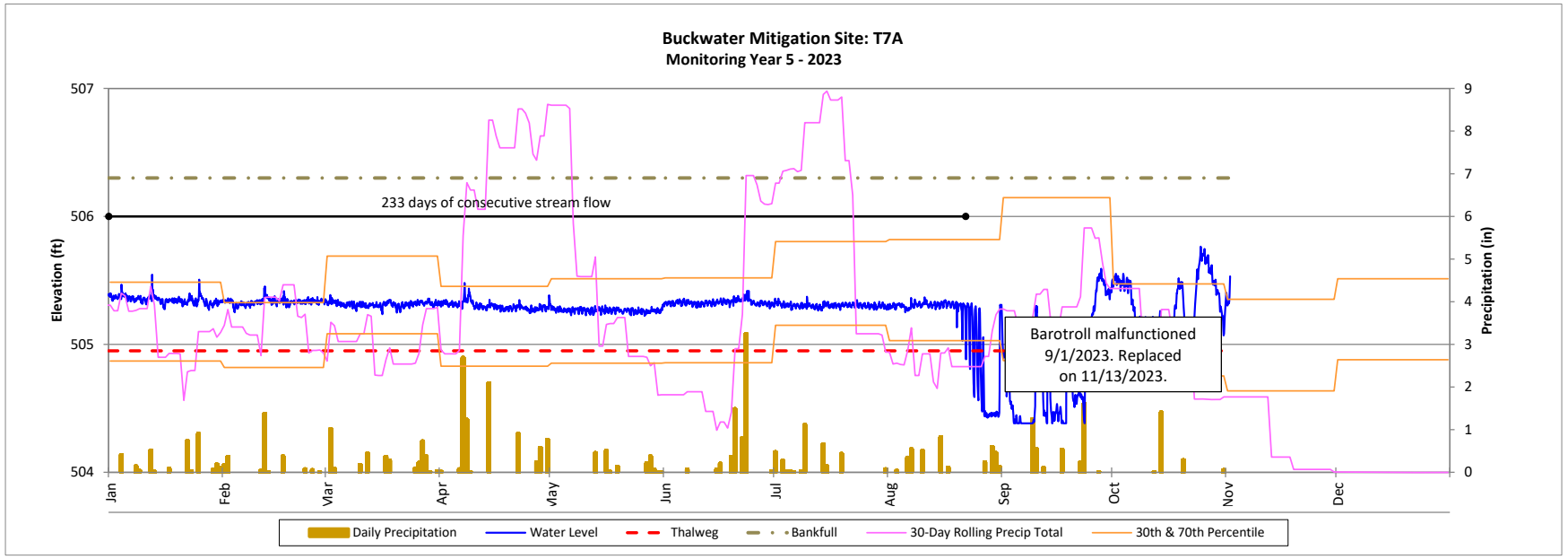
Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023



Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023



Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023



Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

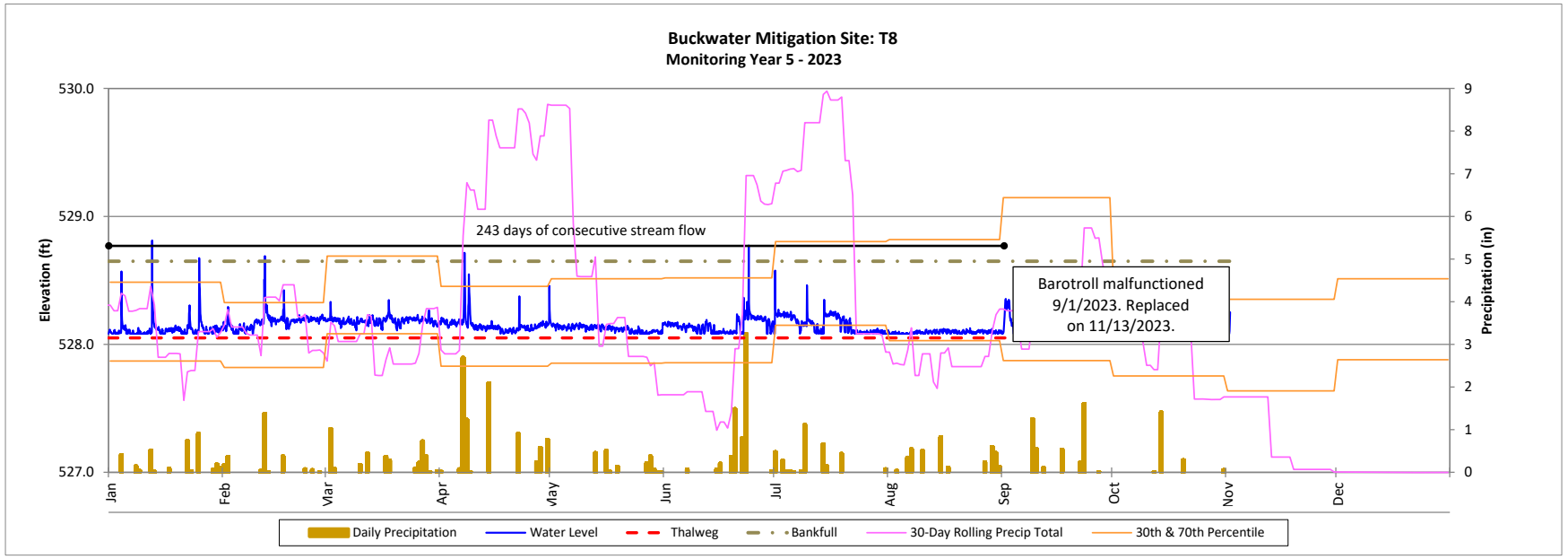


Table 13. Groundwater Gauge Summary

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Summary of Groundwater Gauge Results for Monitoring Years 1 through 7							
Gauge	Max Consecutive Days During Growing Season (Percentage)						
	MY1 (2019)	MY2 (2020)	MY3 (2021)	MY4 (2022)	MY5 (2023)*	MY6 (2024)	MY7 (2025)
1	**55 Days (20.7%)**	**34 Days (12.8%)**	**24 Days (9.4%)**	**28 Days (10.6%)**	**8 Days (3.0%)**		
2	**13 Days (4.9%)**	**6 Days (2.3%)**	**8 Days (3.1%)**	**6 Days (2.3%)**	**8 Days (3.0%)**		
3	**58 Days (21.8%)**	**135 Days (50.4%)**	**110 Days (43.0%)**	**105 Days (39.6%)**	**101 Days (38.1%)**		

Performance Standard: **None**

Daily Rainfall: **Durham 11 W** Station, Orange County, NC, State Climate Office

WETS Station (30th & 70th Percentile): **Chapel Hill 2 W** Station, Orange County, NC, AgCIS

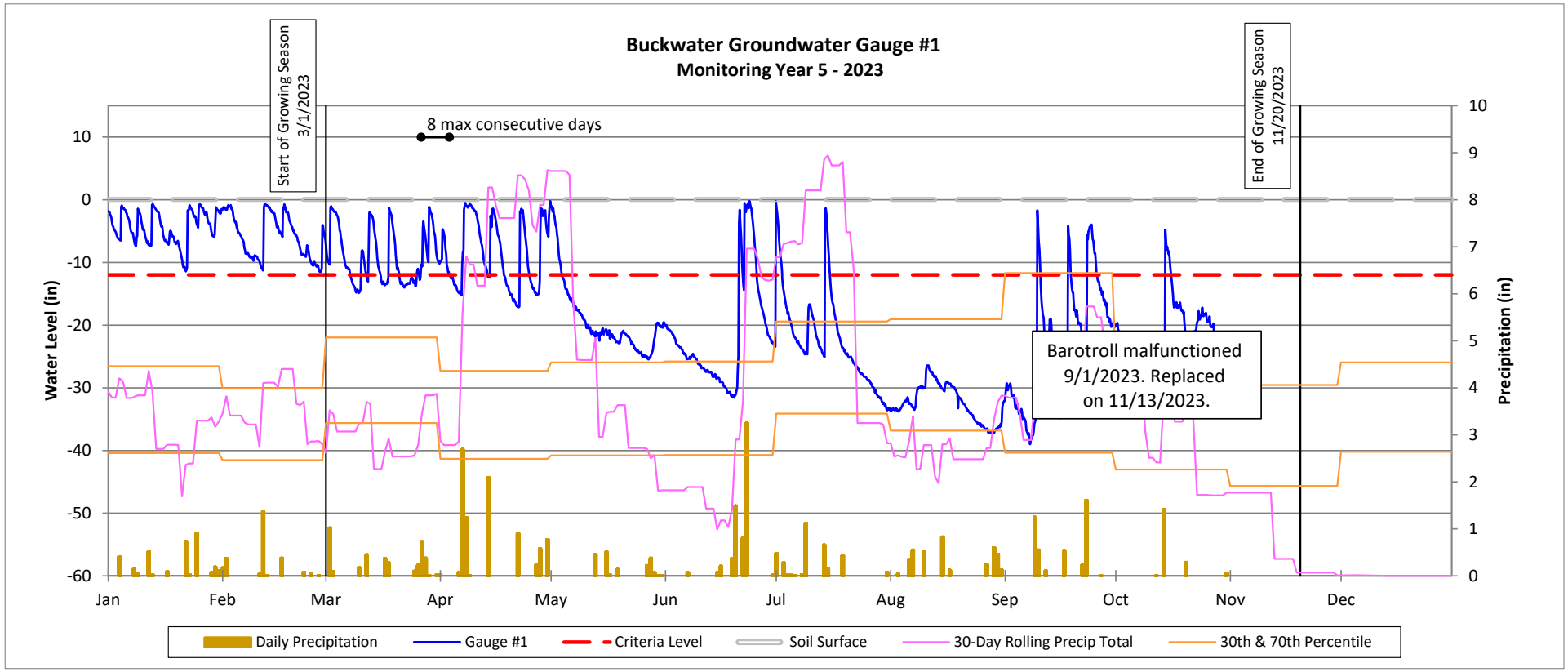
Growing Season: **3/1/2021 to 11/11/2021 (255 Days)**

Groundwater Gauge Plot

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

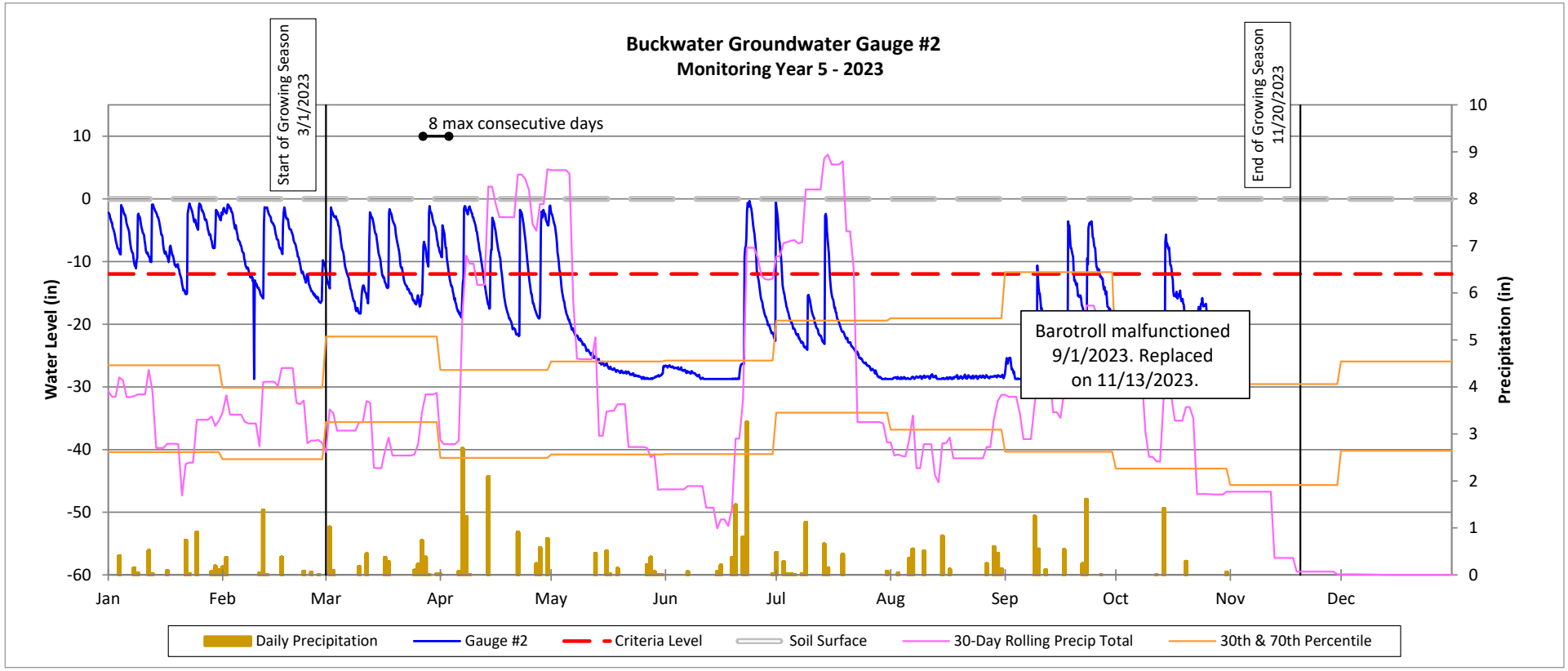


Groundwater Gauge Plot

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

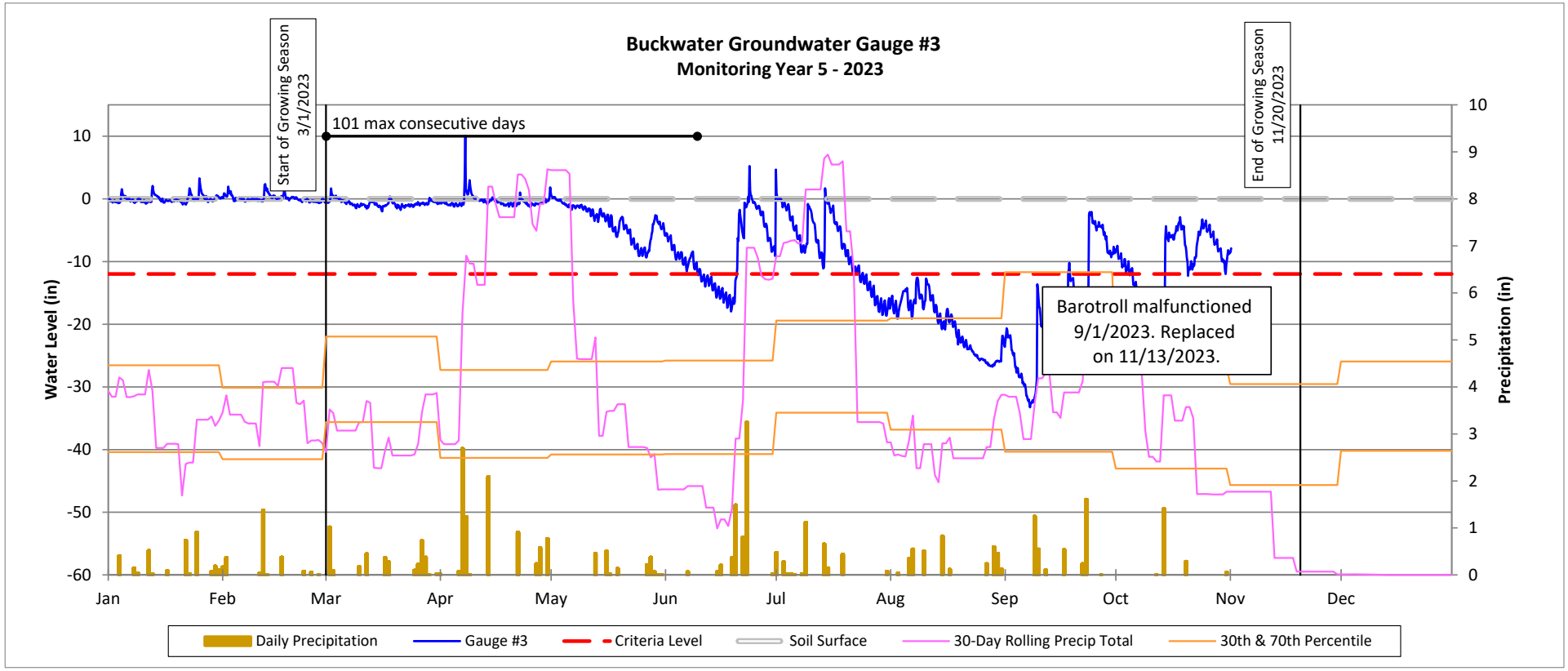


Groundwater Gauge Plot

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023



APPENDIX E. Project Timeline and Contact Info

Table 14. Project Activity and Reporting History
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Activity or Deliverable		Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted		NA	March 2016
Mitigation Plan Approved		December 2017	December 2017
Construction (Grading) Completed		April 2018-April 2019	April 2019
Planting Completed		April 2018-April 2019	April 2019
As-Built Survey Completed		May 2021	May 2021
Baseline Monitoring Document (Year 0)	Stream Survey	April 2019	July 2019
	Vegetation Survey	April 2019	
Year 1 Monitoring	Stream Survey	October 2019	December 2019
	Vegetation Survey	October 2019	
	In-stream repairs	August 2019	
	Invasive Treatment	October 2019	
Year 2 Monitoring	Stream Survey	April 2020	December 2020
	Vegetation Survey	September 2020	
	Stream Bank Repairs	April 2020	
	Soil Amendments	August 2020	
	In-stream Vegetation Treatment	August 2020	
Year 3 Monitoring	Stream Survey	May 2021	December 2021
	Vegetation Survey	October 2021	
	Replanting & Soil Amendments	February 2021	
	Ring Sprays	March 2021	
Year 4 Monitoring	Follow-Up Delineation	October 2022	December 2022
	Supplemental Planting	November 2022	
Year 5 Monitoring	Stream Survey	March 2023	December 2023
	Vegetation Survey	October 2023	
	Sweetgum Thinning	February 2023	
	Invasive Treatment	March 2023	
	Soil Amendments & Ring Sprays	April 2023	
	Stream Repairs	August 2023	
	Beaver Removal	February & November 2023	
	Repair Area & Encroachment Planting	November 2023	
Year 6 Monitoring			December 2024
Year 7 Monitoring	Stream Survey	2025	December 2025
	Vegetation Survey	2025	

Table 15. Project Contact Table
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Designer Nicole Macaluso Millns, PE	**Wildlands Engineering, Inc.** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Ecotone, Inc.** 2120 High Point Rd Forest Hill, MD 21050
Monitoring Performers Monitoring, POC	**Wildlands Engineering, Inc.** Jason Lorch 919.851.9986

APPENDIX F. Additional Documentation

WILDLANDS
ENGINEERING

MEMORANDUM

TO: 401 Permit Reviewer

FROM: Carolyn Lanza, Wildlands Engineering

DATE: July 7, 2023

RE: Project Repair Plan - Supporting Documentation
BUCKWATER MITIGATION SITE
Orange County, NC

On behalf of the North Carolina Department of Mitigation Services (NCDMS), Wildlands Engineering, Inc. (Wildlands) is requesting a new water quality certification for an existing stream mitigation project in Orange County, NC. The Buckwater Mitigation Site was originally permitted in March of 2018 under the NC Division of Water Resources (NCDWR) Water Quality General Certification Number 4134 and the US Army Corps of Engineers (USACE) Nationwide Permit Number 27. The project was constructed between April of 2018 and April of 2019.

Minor repairs are now needed for this mitigation site and the previous water quality certification for the project has expired. The repairs are relatively minor and will be permitted by the USACE under the Nationwide Permit Number 3. However, we have been informed by NCDWR that a new water quality certification will be needed. A repair plan for the project site is attached to this memo. Most of the repairs are simply replacing structures that were originally constructed but have become damaged and repairing bank erosion. In total, the repairs will be constructed on 238 linear feet of the project. The total length of the original project is 16,276 LF (MY0 Annual Report, September 2019).

We hope this water quality certification for the repair work can be processed in a timely manner. If you have additional questions or need more information about the repair plan to issue the new water quality certification, please do not hesitate to contact me at 313-969-7318 or at clanza@wildlandseng.com should you have any questions.

Sincerely,

Carolyn Lanza

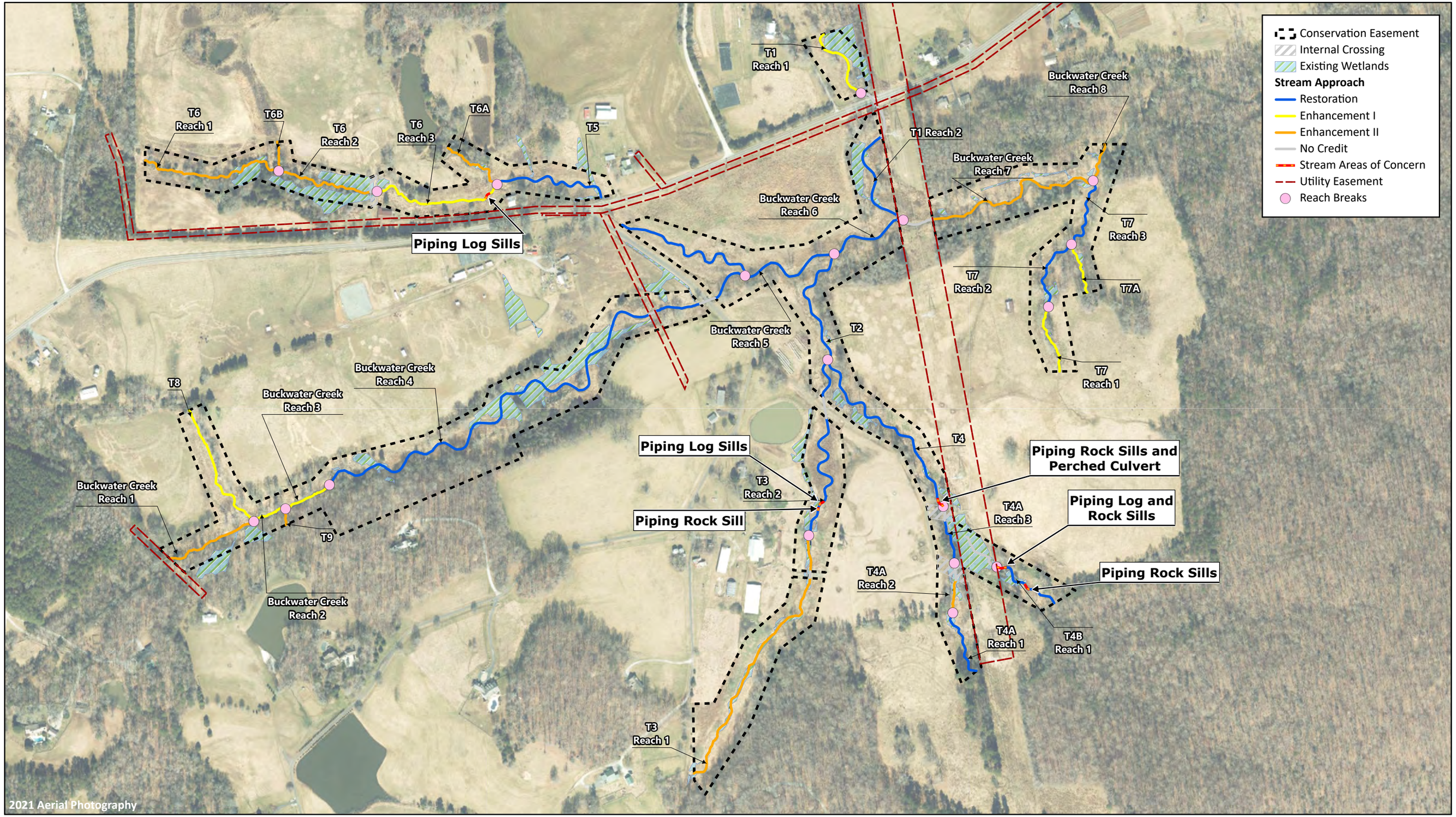
Carolyn Lanza
Environmental Scientist

Table 1. Areas of Concern and Management Actions

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Reach	Start Station	End Station	Length (LF)	Description	Planned 2023 Management Action
T3 Reach 2	314+20	314+30	10	Piping rock sill; souring left bank. Riffle upstream of piping sill is stable and providing grade control.	Remove rock sill and tamp down left bank.
	314+40	314+70	30	Piping angled log riffle due to log sills being improperly keyed in. Riffle material is providing grade control.	Remove angled log riffle, rebuild as native riffle.
T4	408+42		N/A	Perched culvert due to piping rock sills below.	Rebuild rock sill structures downstream to upstream and remove boulder toe along banks.
	408+42	409+20	78	Nine piping rock sills. Original construction of rock sills were built upstream to downstream preventing proper sealing of structures.	
T4B Reach 1	451+40	451+70	30	Six piping rock sills. Original construction of rock sills were built upstream to downstream preventing proper sealing of structures.	Rebuild rock sill structures downstream to upstream.
	453+00	453+50	50	Four piping log sills and two piping rock sills due to erosion around log sills.	Rebuild structures and remove boulder toe along banks.
T6 Reach 3	517+80	518+20	40	Four piping log sills due to erosion around log sill.	Remove log sills and replace with boulder sills.

Not applicable (N/A): Lengths not associated with instances (points)



WILDLANDS ENGINEERING

0 400 800 Feet

N

Figure 1. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Orange County, NC

Stream Area of Concern Photographs

	
T3 R2 STA 314+20 - 314+30 – Piping Rock Sill (3/24/2023)	**T3 R2 STA 314+40 - 314+70 – Piping Angled Log Riffle** (3/24/2023)
	
T3 R2 STA 314+40 - 314+70 – Piping Angled Log Riffle (3/24/2023)	**T3 R2 STA 314+40 - 314+70 – Piping Angled Log Riffle** (3/24/2023)

	
T4 STA 408+42 – Perched Culvert (3/24/2023)	**T4 STA 408+42 – 409+20 – Piping Rock Sills** (3/24/2023)
	
T4 STA 408+42 – 409+20 – Piping Rock Sills (3/24/2023)	**T4B R1 STA 451+40 – 451+70 – Piping Rock Sills** (3/24/2023)
	
T4B R1 STA 451+40 – 451+70 – Piping Rock Sills (3/24/2023)	**T4B R1 STA 451+40 – 451+70 – Piping Rock Sills** (3/24/2023)

T4B R1 STA 453+00 – 453+50 – Piping Log and Rock Sills (3/24/2023)

T4B R1 STA 453+00 – 453+50 – Piping Log and Rock Sills (3/24/2023)

T6 R3 STA 517+80 – 518+20 – Piping Log Sills (3/24/2023)

T6 R3 STA 517+80 – 518+20 – Piping Log Sills (3/24/2023)

T6 R3 STA 517+80 – 518+20 – Piping Log Sills (3/24/2023)

Stream Repair Area Photographs

T4 STA 408+42 – 409+20 – Repaired Reach (8/22/2023)

T4B R1 STA 453+00 – 453+50 – Repaired Area (8/22/2023)

T4B R1 STA 451+40 – 451+70 – Repaired Area (8/22/2023)

T3 R2 STA 314+20 – 314+30 – Repaired Area (8/22/2023)

T6 R3 STA 517+80 – 518+20 – Repaired Area (8/22/2023)

MEETING SUMMARY

MEETING: MY5 IRT Site Walk
Buckwater Mitigation Site
Neuse 03020201; Orange County, NC
DEQ Contract No. 006829
DMS Project No. 97084
USACE ID: 2016-0406

DATE: *On-Site Meeting*: Thursday, October 12, 2023
Meeting Notes Distributed: Wednesday, October 17, 2023

Attendees

Todd Tugwell, USACE
Casey Haywood, USACE
Jeremiah Dow, DMS
Danielle Mir, DMS
Chris Roessler, Wildlands
Jason Lorch, Wildlands
Neil Curtis, Wildlands

Meeting Notes

- **General Site Notes**
  - All repair areas were seen during the site walk. The IRT asked that photographs of the repair areas be included in future monitoring reports. Also, the IRT would like to see evidence of flow for the repair areas on T4 and T4B. This can be either flow gauge data or trail camera pictures, and site walk photos from throughout the year.
  - Add random vegetation plots to supplementally planted areas and priority 2 areas where cut was completed during construction.
- **Buckwater Creek**
  - Several small beaver dams were present on Buckwater Creek downstream of Walnut Hill Drive. The USDA has been contacted and will remove the beaver and their dams.
- **T4A**
  - A tree had fallen across the internal crossing on T4A. Wildlands will work with the tenant farmer to remove the tree and repair the fences that were damaged by the tree.
- **T6**
  - The internal ford crossing on T6 was discussed. Wildlands explained that the landowner would like to upgrade the crossing to access a future home that is being planned on the north side of T6. The landowner is planning on adding rock to the current ford crossing to improve access to the future home. It should be a mixture of different size stone and be close to the as-built elevations.

- The recent clearing encroachment along the power line easement was walked and Wildlands stated that they would add two extra conservation easement signs to shorten the gap in between the current signs and add approximately a dozen containerized trees to the impacted area. The IRT agreed with this approach.
- The repair area at the bottom of T6 was seen and there was a discussion about rock versus log sills on intermittent channels. The IRT prefers to see rock sills in intermittent channels for long-term stability purposes. There is concern about the long-term stability of log sills due to them rotting. Containerized trees will be added to the areas affected during the repairs.