
Monitoring Report – MY3
FINAL VERSION
Lake Wendell Mitigation Project
Calendar Year of Data Collection: 2020

NCDEQ DMS Project Identification # 97081
NCDEQ DMS Contract # 6826
Neuse River Basin (Cataloging Unit 03020201)
USACE Action ID Number: SAW-2016-00876
NCDEQ DWR Project # 2016-0385
Johnston County, NC
Contracted Under RFP # 16-006477
Data Collection Period: September-October 2020
Submission Date: December 11, 2020



Prepared for:



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

Prepared by:



WATER & LAND SOLUTIONS

7721 SIX FORKS ROAD, SUITE 130, RALEIGH, NC 27615
(919) 614 - 5111 | waterlandsolutions.com

Mitigation Project Name Lake Wendell Mitigation Project
DMS ID 97081
River Basin Neuse
Cataloging Unit 03020201
County Johnston

USACE Action ID 2016-00876
DWR Permit 2016-0385 v2
Date Project Instituted 3/18/2016
Date Prepared 1/10/2020
Stream/Wet. Service Area Neuse 03020201


Signature & Date of Official Approving Credit Release

- 1 - For NCDMS, no credits are released during the first milestone
2 - For NCDMS projects, the second credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the IRT by posting it to the DMS portal, provided the following have been met:
- 1) Approved of Final Mitigation Plan
 - 2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property.
 - 3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan.
 - 4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.
- 3 - A 10% reserve of credits is to be held back until the bankfull event performance standard has been met.

Credit Release Milestone	Warm Stream Credits						
	Scheduled Releases %	Proposed Releases %	Proposed Released #	Not Approved # Releases	Approved Credits	Anticipated Release Year	Actual Release Date
1 - Site Establishment	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 - Year 0 / As-Built	30.00%	30.00%	1,017.630	0.000	1,017.630	2019	3/26/2019
3 - Year 1 Monitoring	10.00%	10.00%	339.210	0.000	339.210	2019	8/19/2019
4 - Year 2 Monitoring	10.00%	10.00%	339.210	0.000	339.210	2020	4/21/2020
5 - Year 3 Monitoring	10.00%					2021	
6 - Year 4 Monitoring	5.00%					2022	
7 - Year 5 Monitoring	10.00%					2023	
8 - Year 6 Monitoring	5.00%					2024	
9 - Year 7 Monitoring	10.00%					2025	
Stream Bankfull Standard	10.00%	10.00%	339.210	0.000	339.210	2020	4/21/2020
			Totals	0.000	1,356.840		

Total Gross Credits	3,392.100
Total Unrealized Credits to Date	0.000
Total Released Credits to Date	2,035.260
Total Percentage Released	60.00%
Remaining Unreleased Credits	1,356.840

Notes

Contingencies (if any)

Project Quantities

Mitigation Type	Restoration Type	Physical Quantity
Warm Stream	Restoration	3,219.000
Warm Stream	Enhancement II	255.000
Warm Stream	Preservation	711.000

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Debits

							Stream Restoration Credits	Stream Restoration Equivalent Credits
Beginning Balance (mitigation credits)							3,321.000	71.100
Released Credit							1,992.600	42.600
Unrealized Credits							0.000	0.000
Owning Program	Req. Id	TIP #	Project Name	USACE Permit #	DWR Permit #	DCM Permit #		
NCDOT Stream & Wetland ILF Program	REQ-008290	R-2721A	R-2721A - NC 540 - West of NC 55 to East of SR	2009-02240	2018-1249	2018-1249	1,328.400	
NCDOT Stream & Wetland ILF Program	REQ-004844		SR 2516 - Division 5	2007-02814-292				15.000
NCDOT Stream & Wetland ILF Program	REQ-008187	I-5111 / I-4739	I-5111 / I-4739 - I-40 Widening (Wake & Johnston Counties)	2009-00556	2019-0593	2019-0593		13.440
Total Credits Debited							1,328.400	28.440
Remaining Available balance (Released credits)							664.200	14.220
Remaining balance (Unreleased credits)							1,328.400	28.440



December 11, 2020

NC Department of Environmental Quality

Division of Mitigation Services

Attn: Lindsay Crocker

217 West Jones Street, Suite 3000-A

Raleigh, NC 27603

RE: WLS Responses to NCDEQ DMS Review Comments for Task 9 Draft Monitoring Report Year 3 for the Lake Wendell Mitigation Project, NCDEQ DMS Full-Delivery Project ID #97081, Contract #6826, Neuse River Basin, Cataloging Unit 03020201, Johnston County, NC

Dear Ms. Crocker:

Water & Land Solutions, LLC (WLS) is pleased to present the Final Monitoring Report Year 3 for the Lake Wendell Mitigation Project to the North Carolina Department of Environmental Quality (NCDEQ) Division of Mitigation Services (DMS). The Final Monitoring Report Year 3 were developed by addressing NCDEQ DMS's review comments.

Under this cover, we are providing the Final Monitoring Report Year 3, and the required digital data for each (the .pdf copies of the entire updated reports and the updated digital data) via electronic delivery. We are providing our written responses to NCDEQ DMS's review comments on the Draft Monitoring Report Year 3 below. Each of the DMS review comments is copied below in **bold** text, followed by the appropriate response from WLS in regular text:

- 1. DMS Comment: The project states that all metrics met success, but one of the cross-sections and vegetation plots do not (in summary and monitoring results section). Revise to remove statement or add explanation for metrics not meeting. Also, this should not be shown as meeting on CCPV. It may be beneficial to point out that it is only missing one stem, and that the visual did not show any areas of concern. Additionally, it may be helpful to point out that due to the small starting size of the channel, the 20% change may not be relevant. It is also worth noting that there is a lower resolution of points taken in MY0 from other years which may be attributable to the differences.** WLS Response: WLS has updated section 5 of the report to clarify the metrics which are not meeting success criteria. Section 5.2 (Stream Horizontal & Vertical Stability) and section 5.5 (Vegetation) were updated with additional language and explanation of the one cross section and one vegetation plot that do not meet success criteria. The CCPV has been updated to show that Veg Plot 2 is not meeting success criteria.
- 2. DMS Comment: Update rain report for October and November if possible.** WLS Response: WLS updated Figure 5 with the October and November rain total.
- 3. DMS Comment: Confirm that the stream photos taken 3/2020 are still relevant for all streams in MY3.** WLS Response: All stream photos taken in March 2020 are still relevant for all locations in MY3. Photos were taken during the spring visual survey visit prior to the growing season.

Digital Deliverables:

- 1. DMS Comment: Please include the visual assessment photos as JPEGs rather than a single PDF.** WLS Response: JPEGs of all photos are now included in the e-data.

2. **DMS Comment: Assign unique ID's to the photo station spatial features and resubmit these features, ensuring that these ID's match the photo station ID's provided in the Monitoring Report.** WLS Response: The GIS shapefile containing the photo stations has been updated to include the unique ID in the attribute table. The unique ID is also shown in appendix B on each photo.
3. **DMS Comment: Include the shapefile for the kudzu area displayed in Fig. 1.** WLS Response: The kudzu shapefile is now included in the e-data.

Please contact me if you have any questions or comments.

Sincerely,

Water & Land Solutions, LLC



Catherine Manner
Water & Land Solutions, LLC
7721 Six Forks Road, Suite 130
Raleigh, NC 27615
Office Phone: (919) 614-5111
Mobile Phone: (571) 643-3165
Email: catherine@waterlandsolutions.com

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1 Project Summary

Water and Land Solutions, LLC (WLS) completed the construction and planting of the Lake Wendell Mitigation Project (Project) full-delivery project for the North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) in March 2018. The Project is located in Johnston County, North Carolina between the Community of Archer Lodge and the Town of Wendell at 35.73739°, -78.3538°. The Project site is located in the NCDEQ Sub-basin 03-04-06, in the Upper Buffalo Creek Sub-watershed 030202011502.

The Project involved the restoration, enhancement, preservation, and permanent protection of five stream reaches (R1, R2, R3, R4, and R5) and their riparian buffers, totaling 4,269 linear feet of streams and 490,477 square feet of riparian buffers (see buffer summary table below). WLS staff visited the site several times throughout 2020. Monitoring Year 3 (MY3) data collection occurred in September and October of 2020 (Table 2). This report presents the data for MY3. The Project meets the MY3 success criteria for stream hydrology, streambed condition and stability, and stream flow. For stream horizontal and vertical stability, one cross section is not meeting requirements. One vegetation plot is not meeting success requirements for vegetation. Based on these results, the Project is expected to meet the Monitoring Year 4 (MY4) success criteria in 2021.

RIPARIAN BUFFER (15A NCAC 02B.0295)											If Converted to Nutrient Offset							
Location	Jurisdictional Streams	Restoration Type	Reach ID/ Component	Buffer Width (ft)	Total Area (sf)	Creditable Area (sf)*	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits (BMU)	Convertible to Nutrient Offset (Yes or No)	Nutrient Offset: N (lbs)	Nutrient Offset: P (lbs)					
Rural or Urban	Subject or Nonsubject	Restoration	20-29				1	75%	1.33333		Yes	17,873.412	N/A					
			0-100	342,525	342,525	100%		1.00000	342,525.000									
			101-200			33%		3.03030										
			20-29			75%		2.66667										
			0-100	44,852	44,852	100%		2.00000	22,426.000									
		Enhancement	Enh & Cattle Ex. Enh	0-100	44,852	44,852	2	100%	2.00000	22,426.000	No							
			101-200			33%		6.06061										
			SUBTOTALS					387,377									364,951.000	17,873.412
			ELIGIBLE PRESERVATION AREA					129,126										
			TOTALS					491,480										
Rural or Urban	Subject or Nonsubject	Preservation	20-29			10	75%	13.33333		10,410.300								
			0-100	104,103	104,103		100%	10.00000										
			101-200				33%	30.30303										
			20-29				75%	6.66667										
			0-100				100%	5.00000										
			101-200				33%	15.15152										
			20-29				75%	4.00000										
			0-100				100%	3.00000										
			101-200				33%	9.09091										
			SUBTOTALS					104,103										10,410.300
TOTALS					491,480							375,361.300						

2 Project Background

2.1 Project Location, Setting, and Existing Conditions

The Project site is located in the Upper Buffalo Creek Sub-watershed 030202011502 study area of the Neuse 01 Regional Watershed Plan, in the Wake-Johnston Collaborative Local Watershed Plan, and in Targeted Local Watershed 03020201180050.

The project includes five stream reaches (R1, R2, R3, R4, and R5) which consisted of restoration, enhancement, preservation, and permanent protection of 4,269 linear feet of streams and 490,477 square feet of riparian buffers. The catchment area is 102 acres and has an impervious cover less than one percent. The dominant surrounding land uses are agriculture and mixed forest. Prior to construction, livestock had access to all Project streams, except R4, and the riparian buffers were less than 50 feet wide.



2.2 Mitigation Project Goals and Objectives

WLS established project mitigation goals and objectives based on the resource condition and functional capacity of the watershed to improve and protect diverse aquatic resources comparable to stable headwater stream systems within the Piedmont Physiographic Province. The proposed mitigation types and design approaches described in the final approved mitigation plan considered the general restoration and resource protection goals and strategies outlined in the 2010 Neuse River Basin Restoration Priority Plan (RBRP). The functional goals and objectives were further defined in the 2013 Wake-Johnston Collaborative Local Watershed Plan and 2015 Neuse 01 Regional Watershed Plan and include:

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

The following site-specific goals were developed to address the primary concerns outlined in the LWP and RWP and include:

Functional Category (Level)	Functional Goal / Parameter	Functional Design Objective
Hydrology (Level 1)	Improve Base Flow	Remove man-made pond dam and restore a more natural flow regime and aquatic passage.
Hydraulics (Level 2)	Reconnect Floodplain / Increase Floodprone Area Widths	Lower BHRs from >2.0 to 1.0-1.2 and maintain ERs at 2.2 or greater.
Geomorphology (Level 3)	Improve Bedform Diversity	Increase riffle/pool percentage to 70/30 and pool-to-pool spacing ratio 4-7X bankfull width.
	Increase Lateral Stability	Reduce BEHI/NBS streambank erosion rates comparable to downstream reference condition and stable cross-section values.
	Establish Riparian Buffer Vegetation	Plant native species vegetation a minimum 50' wide from the top of the streambanks with a composition/density comparable to downstream reference condition.
Physicochemical (Level 4)	Improve Water Quality	Remove cattle from riparian corridor and reduce fecal coliform bacteria levels.
Biology (Level 5)	Improve Macroinvertebrate Community and Aquatic Species Health	Incorporate native woody debris into channel and change DWR bioclassification rating from 'Poor' to a minimum 'Fair' by Monitoring Year 7.

To accomplish these site-specific goals, the following objectives will be measured and included with the performance standards to document overall project success:

- Provide a floodplain connection to incised stream with BHRs that range from 1.0 – 1.2 and ERs greater than 2.2 by removing a man-made pond, thereby promoting more natural flood flows,
- Improve bedform diversity by increasing scour pool spacing/depth variability every 4X-7X bankfull channel widths,
- Increase benthic macroinvertebrate habitat value by changing the DWR bioclassification rating from 'Poor' to 'Fair' after monitoring year 7,



- Reduce sediment loading from accelerated streambank erosion rates by decreasing BEHI/NBS values to 'Low' and constructing Radius of Curvature Ratios (Rc) to 2X-3X bankfull channel widths,
- Improve pre-restoration water quality parameters by increasing dissolved oxygen concentrations (DO), such that it meets a functioning level after monitoring year 7,
- Increase native species riparian buffer vegetation density/composition along streambank and floodplain areas that meet requirements of a minimum 50-foot-wide and 210 stems/acre after monitoring year 7,
- Improve aquatic habitat and fish movement through pond dam removal and the addition of in-stream cover and native woody debris by increasing the existing biotic index to a higher functioning level,
- Prevent cattle from accessing the conservation easement boundary by installing permanent fencing and reducing fecal coliform bacteria from the pre-restoration levels.

2.3 Project History, Contacts, and Timeframe

The chronology of the project history and activity is presented in Table 2. Relevant project contact information is presented in Table 3. Relevant project background information is presented in Table 4.

3 Project Mitigation Components

Refer to Figure 1 and Table 1 for the project components/asset information. A recorded conservation easement consisting of 11.97 acres protects and preserves all stream reaches, existing wetland areas, and riparian buffers in perpetuity.

3.1 Stream Mitigation Types and Approaches

Stream restoration practices involved raising the existing streambed and reconnecting the stream to the relic floodplain and constructing a channel through a drained farm pond (Reach R3). Some portions of the existing degraded channels that were abandoned within the restoration areas were filled to decrease surface and subsurface drainage and raise the local water table. The project also included restoring, enhancing, and protecting riparian buffers and riparian wetlands within the conservation easement. The permanent fencing system consisting of woven wire fencing was installed to NRCS technical standards in the pasture areas along and outside of the northern conservation easement boundaries of Reaches R1, R2, and R3. The vegetative components of this project included stream bank, floodplain, and transitional upland zones planting. The Site was planted with native species riparian buffer vegetation and now protected through a permanent conservation easement. Table 1 and Figure 1 (Appendix A) provide a summary of the project components.

3.1.1 R1 Restoration

Due to the past manipulation and degraded nature of R1, a combination of Priority Level I/II Restoration approaches were implemented along entire reach. A buried concrete pipe system was removed, and the stream channel was daylighted for approximately 200 feet to restore a more natural flow path and hydrologic function. Downstream of a culvert crossing installation, a new meandering channel was constructed, and remnant spoil piles were removed from the floodplain. In-stream structures, including log vanes, log and rock riffles, log steps and log weirs, were installed to provide control grade as well as dissipate flow energy, protect streambanks, and eliminate potential for future incision.



3.1.2 R2 Restoration

Restoration work along R2 involved a Priority Level I Restoration approach by raising the bed elevation and reconnecting the stream with its abandoned floodplain. This approach promoted the restoration of a stable channel form with appropriate bedform diversity, as well as improved biological functions through increased aquatic and terrestrial habitats. Proposed in-stream structures included constructed wood and stone riffles for grade control and habitat, log j-hook vanes, and log weirs/jams for encouraging step-pool formation energy dissipation, bank stability, and bedform diversity. A few mature trees were protected during construction and incorporated into the design. Bioengineering techniques such as vegetated geolifts, brush layers, and live stakes were used to protect streambanks and establish woody vegetation growth.

3.1.3 R3 Restoration

R3 restoration activities began immediately downstream from R2. In this area, a man-made farm pond was drained to reconnect the new stream channel with its geomorphic floodplain. Channel and floodplain excavation in this reach segment included the removal of shallow legacy sediments (approx. 12" depth) to accommodate a new bankfull channel and in-stream structures, as well as a more natural step-pool morphology using grade control structures in the steeper transitional areas. Shallow floodplain depressions and vernal pools were created in the floodplain to provide habitat diversity, nutrient cycling, and improved treatment of overland flows. The existing drain-pipe under the dam was removed and a new culverted pipe crossing was installed at a lower elevation to allow for aquatic passage while blending with the natural valley topography.

3.1.4 R4 Preservation and Enhancement

R4 began immediately downstream from the new culverted crossing at R3. Preservation was proposed along much of this reach since the existing stream and wetland system is mostly stable with a mature riparian buffer due to minimal historic impacts. This approach will extend the wildlife corridor from the boundary of Lake Wendell throughout the entire riparian valley, while providing a hydrologic connection and critical habitat linkage within the catchment area. Enhancement Level II work was conducted along a short portion of this reach to address the bank erosion and lateral instability that occurred during Hurricane Matthew (October 10, 2016). Construction activities consisted of mechanized removal of the downed trees and resetting the remaining live root balls along the streambank, and re-grading the stream bank back to a stable dimension, installing erosion control matting, and supplemental riparian buffer planting and live stakes.

3.1.5 R5 Restoration and Enhancement

A Priority Level I/II Restoration approach was for the upstream portion of the reach to improve stream functions and water quality. The existing concrete pipe system was completely removed to allow for the complete daylighting and raising of the stream bed elevation to reconnect the stream with its active floodplain. The reach was restored using appropriate riffle-pool and step-pool morphology with limited meander geometry. In-stream structures, including log weirs and woody and stone riffles will be used to control grade, as well as dissipate flow energy, protect streambanks, and eliminate potential for future incision. Restored streambanks will be graded to stable side slopes and the floodplain will be reconnected to further promote stability and hydrological function. Work along the downstream portion of R5 involved Enhancement Level II practices to improve the current channel condition and aquatic function.



4 Performance Standards

The applied success criteria for the Project will follow necessary performance standards and monitoring protocols presented in final approved mitigation plan. Annual monitoring and semi-annual site visits will be conducted to assess the condition of the project throughout the monitoring period. Monitoring activities will be conducted for a period of seven years with the final duration dependent upon performance trends toward achieving project goals and objectives. Specific success criteria components and evaluation methods are described in the table below.

Functional Category (Level)	Project Goal / Parameter	Measurement Method	Performance Standard	Potential Functional Uplift
Hydrology (Level 1)	Improve Base Flow Duration and Overbank Flows (i.e. channel forming discharge)	Pressure transducer, regional curve, regression equations, catchment assessment	Maintain seasonal flow for a minimum of 30 consecutive days during normal annual rainfall.	Create a more natural and higher functioning headwater flow regime and provide aquatic passage.
Hydraulics (Level 2)	Reconnect Floodplain / Increase Floodprone Area Widths	Bank Height Ratio, Entrenchment Ratio, crest gauge	Maintain average BHRs at 1.2 and ERs at 2.2 or greater and document out of bank and/or geomorphically significant flow events.	Provide temporary water storage and reduce erosive forces (shear stress) in channel during larger flow events.
Geomorphology (Level 3)	Improve Bedform Diversity	Pool to Pool spacing, riffle-pool sequence, pool max depth ratio, Longitudinal Profile	Increase riffle/pool percentage and pool-to-pool spacing ratios compared to reference reach conditions.	Provide a more natural stream morphology, energy dissipation and aquatic habitat/refugia.
	Increase Vertical and Lateral Stability	BEHI / NBS, Cross-sections and Longitudinal Profile Surveys, visual assessment	Decrease streambank erosion rates comparable to reference condition cross-section, pattern and vertical profile values.	Reduce sedimentation, excessive aggradation, and embeddedness to allow for interstitial flow habitat.
	Establish Riparian Buffer Vegetation	CVS Level I & II Protocol Tree Veg Plots (Strata Composition and Density), visual assessment	Within planted portions of the site, a minimum of 320 stems per acre must be present at year three; a minimum of 260 stems per acre must be present at year five; and a minimum of 210 stems per acre must be present at year seven.	Increase woody and herbaceous vegetation will provide channel stability and reduce streambank erosion, runoff rates and exotic species vegetation.
Physicochemical (Level 4)	Improve Water Quality	N/A	N/A	Removal of excess nutrients, FC bacteria, and organic pollutants will increase the hyporheic exchange and dissolved oxygen (DO) levels.
Biology (Level 5)	Improve Benthic Macroinvertebrate Communities and Aquatic Health	DWR Small Stream/Qual v4 sampling, IBI (MY3, MY5, MY7)	N/A	Increase leaf litter and organic matter critical to provide in-stream cover/shade, wood recruitment, and carbon sourcing.

Note: Level 4 and 5 project parameters and monitoring activities will not be tied to performance standards nor required to demonstrate success for credit release.



4.1 Streams

4.1.1 Stream Hydrology

Two separate bankfull events must be documented within the seven-year monitoring period. These two bankfull events must occur in separate years. Otherwise, the stream monitoring will continue until two bankfull events have been documented in separate years. In addition to the two bankfull flow events, two geomorphically significant flow events ($Q_{gs}=0.66Q_2$) must also be documented during the monitoring period. There are no temporal requirements regarding the distribution of the geomorphically significant flows.

4.1.2 Stream Profiles, Vertical Stability, and Floodplain Access

Stream profiles, as a measure of vertical stability will be evaluated by looking at Bank Height Ratios (BHR). The BHR shall not exceed 1.2 along the restored project reaches. This standard only applies to the restored project reaches where BHRs were corrected through design and construction. In addition, observed bedforms should be consistent with those observed for channels of the design stream type(s).

4.1.3 Stream Horizontal Stability

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

4.1.4 Streambed Material Condition and Stability

After construction, there should be minimal change in the particle size distribution of the streambed materials, over time, given the current watershed conditions and future sediment supply regime. Since the streams are predominantly sand-bed systems with minimal fine/coarse gravel, some coarsening is anticipated after restoration activities, however significant changes in particle size distribution are not expected. Streambed material condition is supplementary and is not part of success criteria.

4.1.5 Jurisdictional Stream Flow

The restored stream systems must be classified as at least intermittent, and therefore must exhibit base flow with at least 30 days of continuous flow during a year with normal rainfall conditions as described in the approved mitigation plan.

4.2 Vegetation

Vegetative restoration success for the project during the intermediate monitoring years will be based on the survival of at least 320, three-year-old planted trees per acre at the end of Year 3 of the monitoring period and at least 260, five-year-old, planted trees per acre at the end of Year 5 of the monitoring period. The final vegetative restoration success criteria will be achieving a density of not less than 210, seven-year-old planted stems per acre in Year 7 of monitoring. Planted vegetation (for projects in coastal plain and piedmont counties) must average seven feet in height at Year 5 of monitoring and 10 feet in height at Year 7 of monitoring. Volunteer species will be counted toward success if they are at least 12" tall, surviving for at least two years, and if they are species found on the approved planting list. For all of the



monitoring years (Year 1 through Year 7), the number of Red maple (*Acer rubrum*) stems cannot exceed 20 percent of the total stems in any of the vegetation monitoring plots.

5 Monitoring Year 3 Assessment and Results

Annual monitoring was conducted during MY3 in accordance with the monitoring plan as described in the approved mitigation plan to document the site conditions. All monitoring device locations are depicted on the CCPV (Figure 1). MY3 results are provided in the appendices. The Project meets the MY3 success criteria for stream hydrology and jurisdictional stream flow. For stream horizontal and vertical stability, all cross sections except XS-1 meet criteria. All vegetation plots except plot 2 meet the required success criteria.

5.1 Stream Hydrology

Monitoring to document the occurrence of the bankfull events (overbank flows) and geomorphically significant flow events ($Q_{gs}=0.66Q_2$) within the monitoring period, along with floodplain access by flood flows, is being conducted using a crest gauge installed near the downstream end of Reach R2 (Figure 1), to record the watermark associated with the highest flood stage between monitoring site visits. Photographs are also being used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits. Two recorded bankfull events occurred during MY3. These events were documented using the described crest gauge and photography (Table 8). Documented flow events in MY1 and MY2 satisfied the requirement of the occurrence of two bankfull events in separate years. See the table below for a summary of bankfull events documented in all monitoring years.

Monitoring Year	Documented Bankfull Events	Requirement Met
1	2	No
2	2	Yes
3	2	Yes

5.2 Stream Horizontal & Vertical Stability

Visual assessment was utilized for assessment of MY3 horizontal and vertical stream stability. The visual assessments for each stream reach concluded that the MY3 stream channel pattern and longitudinal profiles, in-stream structure location/function, still closely match the profile design parameters and MY0/baseline conditions (Appendix D). The MY3 plan form geometry and dimensions fall within acceptable ranges of the design parameters for all restored reaches. Minor channel adjustments in riffle slopes, pool depths and pattern were observed based on natural sediment migration and stream bank vegetation establishment but did not present a stability concern or indicate a need for remedial action. One cross section, XS-1 (riffle) located at station 15+00, exhibited a 20% change in bank height ratio when compared to MY1 data. Based on visual observations and cross section survey, this area is stable and modifications to BHR are due to the small size of the channel and transient sediment deposition. Minor piping is occurring at two instream structures near approximate stations 26+00 and 26+50 which will require minimal hand repair in MY4. These areas will continue to be monitored closely and remedial action will be described in the MY4 report.



5.3 Streambed Material Condition and Stability

A representative sediment sample was collected in R3 at a constructed riffle to assess streambed material condition and stability. The dominant substrate for the project was verified as coarse sand (Figure 3). The post-construction riffle substrate sampling indicated no significant change in streambed material condition or stability during MY3.

5.4 Jurisdictional Stream Flow Documentation

Jurisdictional stream flow documentation and monitoring of restored intermittent reaches is achieved by the installation of a flow gauge (continuous-read pressure transducer) within the thalweg of the channel towards the middle portion of the Reach R5 (Figure 1). Additionally, to determine if rainfall amounts are normal for the given year, precipitation data was obtained from CLAY Central Crops Research Station in Johnston County, approximately nine miles southwest of the site. The monitoring gauge documented that the stream exhibited surface flow for a minimum of 30 consecutive days throughout some portion of the year during a year with normal rainfall conditions (See Figure 4).

5.5 Vegetation

Vegetation monitoring for MY3 was conducted utilizing seven vegetation monitoring Plots, with monitoring conducted in accordance with the CVS-EEP Level I & II Monitoring Protocol (CVS, 2008) and DMS Stream and Wetland Monitoring Guidelines (DMS, 2017). See Figure 1 in Appendix B for the vegetation monitoring plot locations. Summary data and photographs of each Plot can be found in Appendix 3.

Plot 2 had an average stem density of 283.3 stems per acre which does not meet the year 3 minimum of 320 stems per acre. Plot 2 contains seven stems total, one stem below the requirement to meet success criteria. Loss in stem density from MY2 to MY3 is due to poor soil conditions. During MY4, Plot 2 will be monitored closely, and WLS will assess the need for supplemental planting in MY4. All other vegetation plots met MY3 interim success criteria.

The MY3 vegetation monitoring was also conducted utilizing visual assessment throughout the easement. The results of the visual assessment did not indicate any negative changes to the existing vegetation community. An area of encroachment approximately 0.008 acres was found along R1, see Figure 1. This area has been mowed by the adjacent homeowner and is currently vegetated with fescue. Management of this area has already begun and includes additional signage and a physical barrier (horse tape) to delineate the easement boundary and discourage further mowing. During MY4 additional trees will be planted in this area to ensure tree cover is achieved. Trees planted will be from the approved list in the mitigation plan. A previous area of concern is located along R1 buffer as shown on the CCPV (noted first in MY1). This area was utilized as a temporary staging area during construction and contains invasive vegetation (kudzu) along the right buffer. The area was treated twice during the 2020 year, once in March and once in October (see table below for treatments). Following these treatments, the percent cover of kudzu was reduced to approximately 5%. This area will continue to be treated during MY4 and documented in future reports.



Monitoring Year	Invasive Treatment	Date Treatment Conducted
2	Kudzu foliar spray and cut	August 15, 2019
	Kudzu foliar spray	September 24, 2019
3	Kudzu crown removal	March 18, 2020
	Kudzu foliar spray	October 7, 2020

5.6 Wetlands

Wetland mitigation credits are not contracted or proposed for this project. One groundwater monitoring well (pressure transducer) was installed during the baseline monitoring within an existing wetland area along Reach R4. The well was installed as a reference to document groundwater levels within the preservation area (Figure 4). No performance standards for wetland hydrology success was proposed in the Mitigation Plan and therefore wetland mitigation monitoring is not included for this project. The wetland gauge data is located in the appendices.



References

- Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E. 2003. Stream Restoration A Natural Channel Design Handbook.
- Harrelson, Cheryl C; Rawlins, C.L.; Potyondy, John P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique*. Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.
- KCI Associates of NC, DMS. 2010. Using Pressure Transducers for Stream Restoration Design and Monitoring.
- Lee, M., Peet R., Roberts, S., Wentworth, T. CVS-NCEEP Protocol for Recording Vegetation, Version 4.1, 2007.
- North Carolina Department of Environmental Quality, Division of Mitigation Services, Wildlands Engineering, Inc. 2015. Neuse 01 Regional Watershed Plan Phase II. Raleigh, NC.
- North Carolina Department of Environmental Quality, Division of Mitigation Services, 2017. Annual Report Format, Data Requirements, and Content Guidance. Raleigh, NC.
- Rosgen, D. L., 1994. A Classification of Natural Rivers. *Catena* 22: 169-199.
- Rosgen, D.L., 1996. Applied River Morphology. Wildland Hydrology Books, Pagosa Springs, CO.
- Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. North Carolina Natural Heritage Program. NCDENR Division of Parks and Recreation. Raleigh, NC.
- United States Army Corps of Engineers. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. Environmental Laboratory. US Army Engineer Waterways Experiment Station. Vicksburg, MS.
- _____. 1997. Corps of Engineers Wetlands Research Program. Technical Note VN-RS-4.1. Environmental Laboratory. U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.
- _____. 2003. Stream Mitigation Guidelines, April 2003, U.S. Army Corps of Engineers. Wilmington District.
- Water and Land Solutions, LLC (2017). Lake Wendell Stream and Riparian Buffer Mitigation Plan. NCDMS, Raleigh, NC.



Appendices



Appendix A – Background Tables and Figures

Table 1. Mitigation Assets and Components
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)

Project Component (reach ID, etc.) ¹	Wetland Position and HydroType ²	Existing Footage or Acreage	Stationing	Mitigation Plan Footage or Acreage	As-Built Footage or Acreage	Restoration Level	Approach Priority Level	Mitigation Ratio (X:1)	Mitigation Credits*	Notes/Comments
R1		839	10+00 -18+39	806	839	R	PI/PII	1	806	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
R2		995	18+39 - 28+00	995	992	R	PI	1	995	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.
R3		1208	28+00 - 40+77	1208	1268	R	PI	1	1208	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.
R4		711	40+77 - 49+11	711	702	P	-	10	71	Livestock Exclusion, Invasive Control, Permanent Conservation Easement.
R4 (middle)		111	46+26 - 47+37	111	111	EII	EII	2.5	44	Bank Stabilization, Floodplain Debris Clearing, Invasive Control, Permanent Conservation Easement.
R5 (upper)		210	10+00 - 12+10	210	210	R	PI/PII	1	210	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.
R5 (lower)		144	12+10 - 13+58	144	147	EII	EII	2.5	58	Enhancement, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.

Length and Area Summations by Mitigation Category

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)
		Riverine	Non-Riverine	
Restoration	3219			
Enhancement				
Enhancement I				
Enhancement II	255			
Creation				
Preservation	711			
High Quality Pres				

Overall Assets Summary

Asset Category	Overall Credits*
Stream	3,392
RP Wetland	
NR Wetland	

* Mitigation Credits are from the final approved mitigation plan, as verified by the as-built survey

**Table 2. Project Activity and Reporting History
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)**

Elapsed Time Since grading complete: 2 yrs 7 months
Elapsed Time Since planting complete: 2 yrs 7 months
Number of reporting Years⁰: 3

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Project Contract Execution	N/A	3/18/2016
Final Mitigation Plan Submittal	N/A	8/25/2017
Section 404 General (Regional and Nationwide) Permit Verification	N/A	10/5/2017
Begin Construction	N/A	11/13/2017
Mitigation Site Earthwork Completed	N/A	3/13/2018
Mitigation Site Planting Completed	N/A	3/30/2018
Installation of Monitoring Devices Completed	N/A	4/19/2018
Installation of Survey Monumentation and Boundary Marking	N/A	6/7/2018
As-built/Baseline (Year 0) Monitoring Report Submittal	6/23/2018	12/3/2018
Year 1 Monitoring Report Submittal	11/24/2018	12/4/2019
Year 2 Monitoring Report Submittal	10/29/2019	11/15/2019
Year 3 Monitoring Report Submittal	10/15/2020	12/11/2020
Year 4 Monitoring Report Submittal	N/A	N/A
Year 5 Monitoring Report Submittal	N/A	N/A
Year 6 Monitoring Report Submittal	N/A	N/A
Year 7 Monitoring Report Submittal	N/A	N/A

Table 3. Project Contacts
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)

Mitigation Provider	Water & Land Solutions, LLC 7721 Six Forks Road, Suite 130 Raleigh, NC 27615
Primary Project POC	Catherine Manner Phone: 571-643-3165
Construction Contractor	RiverWorks Construction 114 W. Main Street, Suite 106, Clayton, NC 27520
Primary Project POC	Bill Wright Phone: 919-590-5193
Survey Contractor (Existing Condition Surveys)	WithersRavenel 115 MacKenan Drive, Cary, NC 27511
Primary Project POC	Marshall Wight, PLS Phone: 919-469-3340
Survey Contractor (Conservation Easement, Construction and As-Builts Surveys)	True Line Surveying, PC 205 West Main Street, Clayton, NC 27520
Primary Project POC	Curk T. Lane, PLS 919-359-0427
Planting Contractor	RiverWorks Construction 114 W. Main Street, Suite 106, Clayton, NC 27520
Primary Project POC	Bill Wright Phone: 919-590-5193
Seeding Contractor	RiverWorks Construction 114 W. Main Street, Suite 106, Clayton, NC 27520
Primary Project POC	Bill Wright Phone: 919-590-5193
Seed Mix Sources	Green Resource 5204 Highgreen Ct., Colfax, NC 27235
	Rodney Montgomery Phone: 336-215-3458
Nursery Stock Suppliers	Foggy Mountain Nursery (Live Stakes) 797 Helton Creek Rd, Lansing, NC 28643
	Glenn Sullivan Phone: 336-977-2958
	Dykes & Son Nursery (Bare Root Stock) 825 Maude Etter Rd, Mcminnville, Tn 37110
	Jeff Dykes Phone: 931-668-8833
Monitoring Performers	Water & Land Solutions, LLC 7721 Six Forks Road, Suite 130 Raleigh, NC 27615
Stream Monitoring POC	Emily Dunnigan Phone: 269-908-6306
Vegetation Monitoring POC	Emily Dunnigan Phone: 269-908-6306

Table 4. Project Information and Attributes

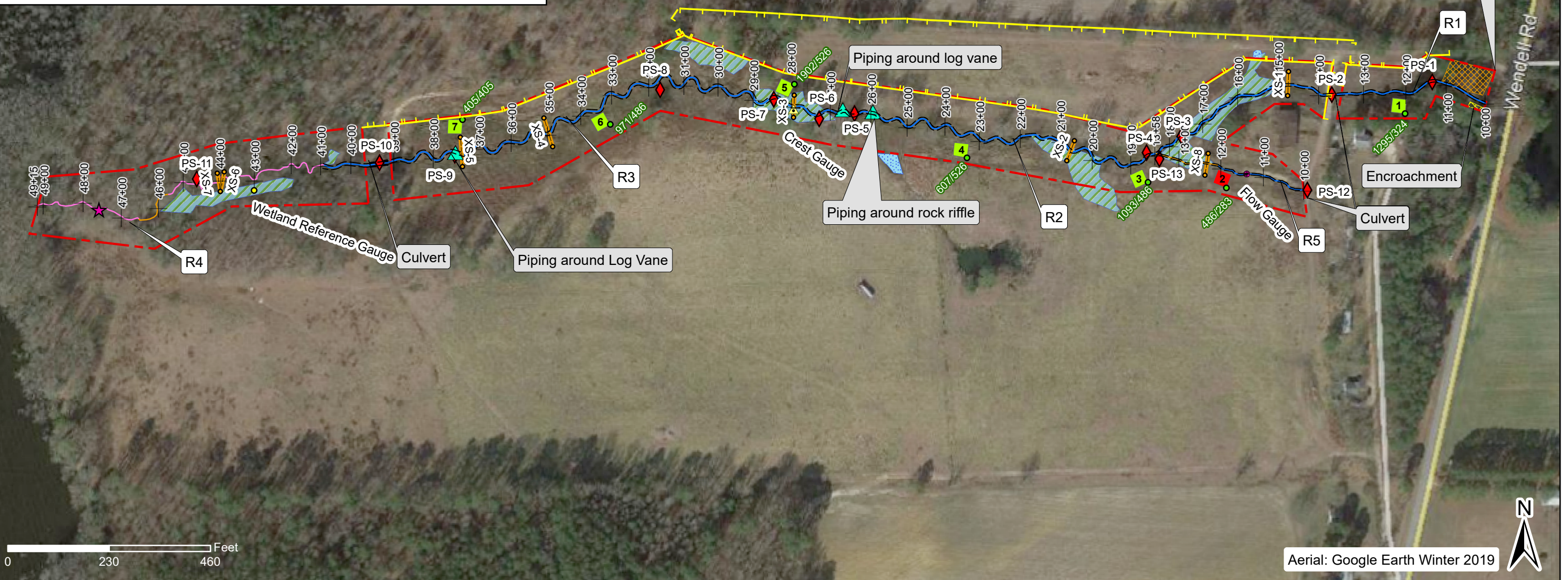
Project Name	Lake Wendell Mitigation Project				
County	Johnston				
Project Area (acres)	11.97				
Project Coordinates (latitude and longitude)	35.7373910 N, -78.3538050 W				
Planted Acreage (Acres of Woody Stems Planted)	8.9				
Project Watershed Summary Information					
Physiographic Province	Piedmont				
River Basin	Neuse				
USGS Hydrologic Unit 8-digit	03020201				
DWR Sub-basin	30406				
Project Drainage Area (Acres and Square Miles)	102 acres, 0.16 sq mi				
Project Drainage Area Percentage of Impervious Area	<1%				
CGIA Land Use Classification	2.01.03, 413, 4.99 (61% pasture, 31% mixed forest, 1% open water)				
Reach Summary Information					
Parameters	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5
Length of reach (linear feet)	850	952	1121	955	354
Valley confinement (Confined, moderately confined, unconfined)	unconfined	unconfined	unconfined	unconfined	unconfined
Drainage area (Acres and Square Miles)	33 acres, 0.05 sq mi	64 acres, 0.1 sq mi	83 acres, 0.13 sq mi	102 acres, 0.16 sq mi	10 acres, 0.02 sq mi
Perennial, Intermittent, Ephemeral	Perennial	Perennial	Perennial	Perennial	Intermittent
NCDWR Water Quality Classification	C; NSW	C; NSW	C;NSW	C; NSW	C; NSW
Stream Classification (existing)	G5c	E5/F5	N/A pond	E5	G5
Stream Classification (proposed)	C5b	C5	C5	E5	C5b
Evolutionary trend (Simon)	II	II (upper), III/IV (lower)	N/A pond	I	II (lower), III (upper)
FEMA classification	N/A	N/A	N/A	Zone AE	N/A
Wetland Summary Information					
Parameters	Wetland 1	Wetland 2	Wetland 3		
Size of Wetland (acres)	N/A	N/A	N/A		
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)					
Mapped Soil Series					
Drainage class					
Soil Hydric Status					
Source of Hydrology					
Restoration or enhancement method (hydrologic, vegetative etc.)					
Regulatory Considerations					
Parameters	Applicable?	Resolved?	Supporting Docs?		
Water of the United States - Section 404	Yes	Yes	Categorical Exclusion		
Water of the United States - Section 401	Yes	Yes	Categorical Exclusion		
Endangered Species Act	No	Yes	Categorical Exclusion		
Historic Preservation Act	No	N/A	Categorical Exclusion		
Coastal Zone Management Act (CZMA or CAMA)	No	N/A	Categorical Exclusion		
FEMA Floodplain Compliance	Yes	Yes	Categorical Exclusion		
Essential Fisheries Habitat	No	N/A	Categorical Exclusion		



Appendix B – Visual Assessment Data

Legend

- Conservation Easement
- Fence Line
- ▲ Crest Gauge
- Flow Gauge
- Wetland Gauge
- ★ Stream Reference Site Location
- Cross Section Pins
- Cross Sections
- ◆ Photo Points
- CVS Plot Origin
- Success Criteria Met
- Success Criteria Not Met
- Water Quality Features
- Top of Streambank
- Culvert Pipes
- Pre-Construction Wetlands (1.16 acres)
- ▲ Stream Structural Issue
- Kudzu Area (0.13 acres)
- Encroachment (0.008 acres)
- Stream Mitigation Type**
- Restoration
- Enhancement II
- Preservation



**Lake Wendell Mitigation Project
Johnston County, North Carolina**

NCDMS Contract No. 6826
NCDMS Project No. 97081
October 2020
MY3

Current Conditions
Plan View
Monitoring Year 3
NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

FIGURE
1

Table 5.
Project
Reach ID
Assessed Length

Visual Stream Morphology Stability Assessment
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)
R1, R2, R3, R4, R5
4221

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
Totals					0	0	100%	0	0	100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	68	68			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	41	41			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	22	25			88%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	16	16			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	16	16			100%			

Table 5a. Vegetation Condition Assessment
Project Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)
Planted Acreage¹ 8.9

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	1 acre	Solid light blue	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
Total				0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
Cumulative Total				0	0.00	0.0%

Easement Acreage² 12

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern ⁴	Areas or points (if too small to render as polygons at map scale).	1000 SF	orange hatched	1	0.13	1.1%
5. Easement Encroachment Areas ³	Areas or points (if too small to render as polygons at map scale).	none	yellow hatched	1	0.01	0.1%



PS-1, R1, facing upstream, Sta 11+50, June 11, 2018 (MY-00)



PS-1, R1, facing upstream, Sta 11+50, March 10, 2020 (MY-03)



PS-1, R1, facing downstream, Sta 11+50, June 11, 2018 (MY-00)



PS-1, R1, facing downstream, Sta 11+50, March 10, 2020 (MY-03)



PS-2, R1, facing upstream, Sta 13+50, April 27, 2018 (MY-00)



PS-2, R1, facing upstream, Sta 13+50, March 10, 2020 (MY-03)



PS-2, R1, facing downstream, Sta 13+50, April 27, 2018 (MY-00)



PS-2, R1, facing downstream, Sta 13+50, March 10, 2020 (MY-03)



PS-3, R1, facing downstream, Sta 17+50, April 27, 2018 (MY-00)



PS-3, R1, facing downstream, Sta 17+50, March 10, 2020 (MY-03)



PS-3, R1, facing upstream, Sta 17+50, April 27, 2018 (MY-00)



PS-3, R1, facing upstream, Sta 17+50, March 10, 2020 (MY-03)



PS-4, R2, facing downstream, Sta 18+50, April 30, 2018 (MY-00)



PS-4, R2, facing downstream, Sta 18+50, March 10, 2020 (MY-03)



PS-5, R2, facing upstream, Sta 26+50, April 27, 2018 (MY-00)



PS-5, R2, facing upstream, Sta 26+50, March 10, 2020 (MY-03)



PS-6, R2, facing downstream, Sta 27+50, April 27, 2018 (MY-00)



PS-6, R2, facing downstream, Sta 27+50, March 10, 2020 (MY-03)



PS-7, R2, facing upstream, Sta 28+25, April 27, 2018 (MY-00)



PS-7, R2, facing upstream, Sta 28+25, March 10, 2020 (MY-03)



PS-8, R3, facing downstream, Sta 32+00, April 27, 2018 (MY-00)



PS-8, R3, facing downstream, Sta 32+00, March 10, 2020 (MY-03)



PS-9, R3, facing downstream, Sta 37+50, April 27, 2018 (MY-00)



PS-9, R2, facing downstream, Sta 37+50, March 10, 2020 (MY-03)



PS-10, R3, facing upstream, Sta 39+50, March 20, 2018 (MY-00)



PS-10, R3, facing upstream, Sta 39+50, March 10, 2020 (MY-03)



PS-10, R4, facing downstream, Sta 40+00, March 20, 2018 (MY-00)



PS-10, R4, facing downstream, Sta 40+00, March 10, 2020 (MY-03)



PS-11, R4, facing downstream, Sta 44+50, August 21, 2015 (MY-00)



PS-11, R4, facing downstream, Sta 44+50, March 10, 2020 (MY-03)



PS-12, R5, facing downstream, Sta 10+00, April 27, 2018 (MY-00)



PS-12, R5, facing downstream, Sta 10+00, March 10, 2020 (MY-03)



PS-13, R5, facing upstream, old crest gauge, Sta 13+50, Apr 27, 2018 (MY-00)



PS-13, R5, facing upstream, Sta 13+50, March 10, 2020 (MY-03)



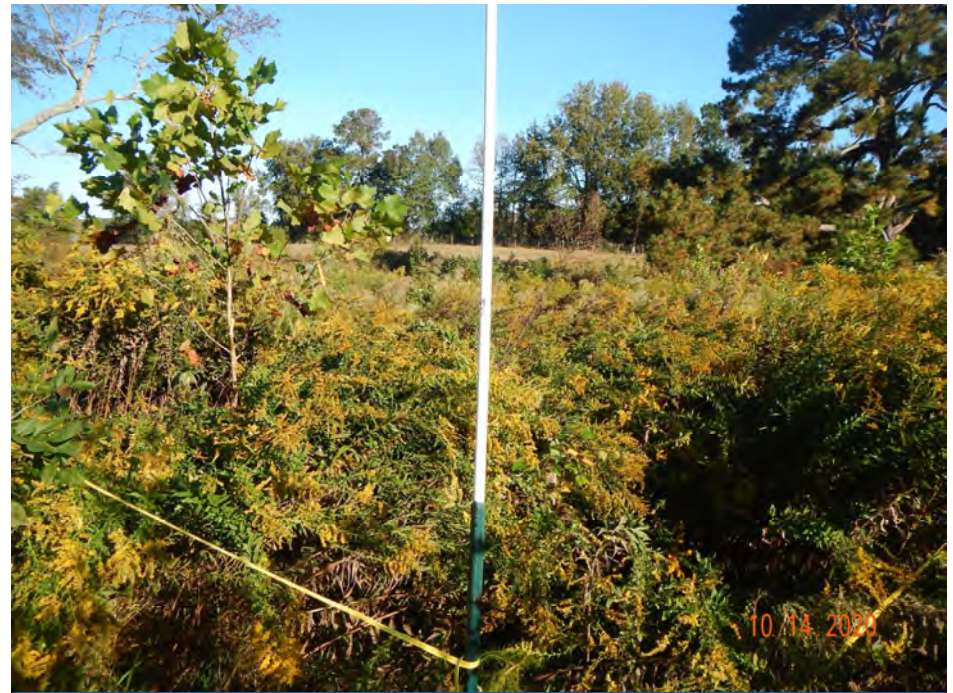
Veg Plot 1, November 5, 2018 (MY-01)



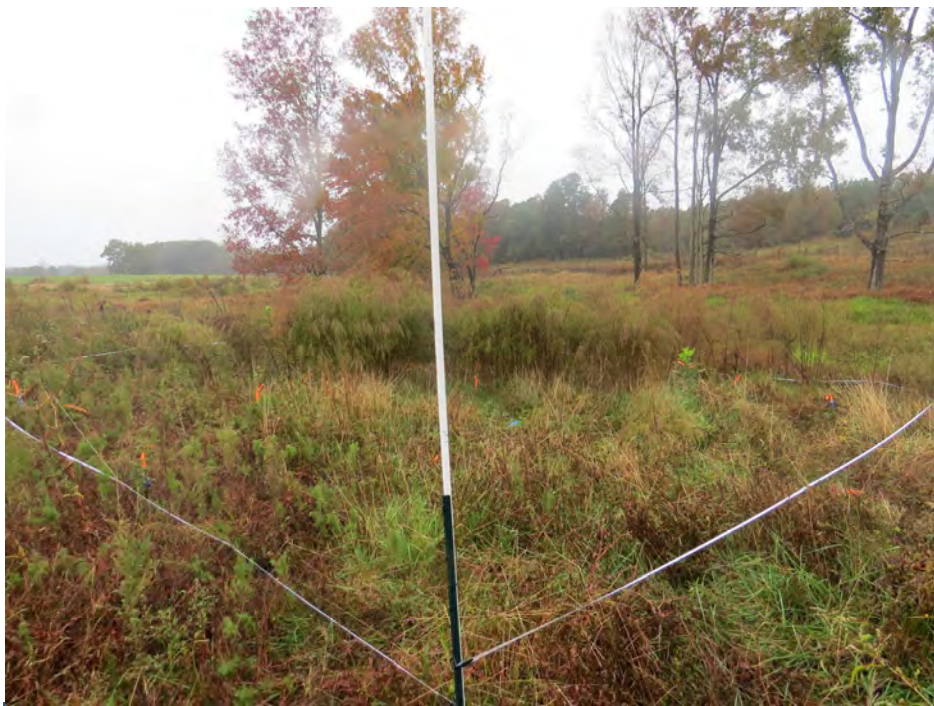
Veg Plot 1, October 14, 2020 (MY-03)



Veg Plot 2, April 27, 2018 (MY-00)



Veg Plot 2, October 14, 2020 (MY-03)



Veg Plot 3, November 5, 2018 (MY-01)



Veg Plot 3, October 14, 2020 (MY-03)



Veg Plot 4, April 13, 2018 (MY-00)



Veg Plot 4, October 14, 2020 (MY-03)



Veg Plot 5, April 13, 2018 (MY-00)



Veg Plot 5, October 14, 2020 (MY-03)



Veg Plot 6, April 13, 2018 (MY-00)



Veg Plot 6, October 14, 2020 (MY-03)



Veg Plot 7, April 13, 2018 (MY-00)



Veg Plot 7, October 14, 2020 (MY-03)



Appendix C – Vegetation Plot Data



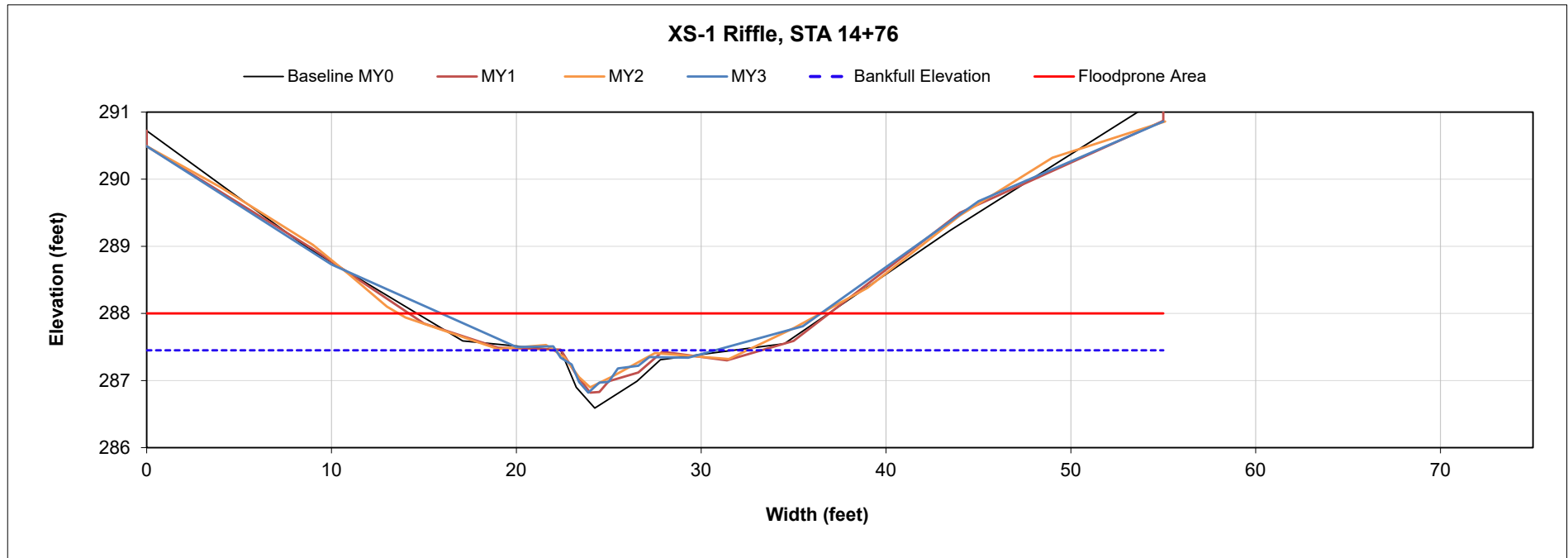
Appendix D – Stream Measurement and Geomorphology Data

Project Name	Lake Wendell Mitigation Project
Project ID	97081
Reach ID	R1
Cross Section ID	XS-1
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY3 2020	
Bankfull Elevation (ft)	287.5
Low Bank Height Elevation (ft)	287.4
Bankfull Max Depth (ft)	0.6
Low Bank Height (ft)	0.5
Bank Height Ratio	< 1.0
Bankfull X-section Area (ft ²)	2.0
% Change Bank Height Ratio	20.0%



Looking Downstream



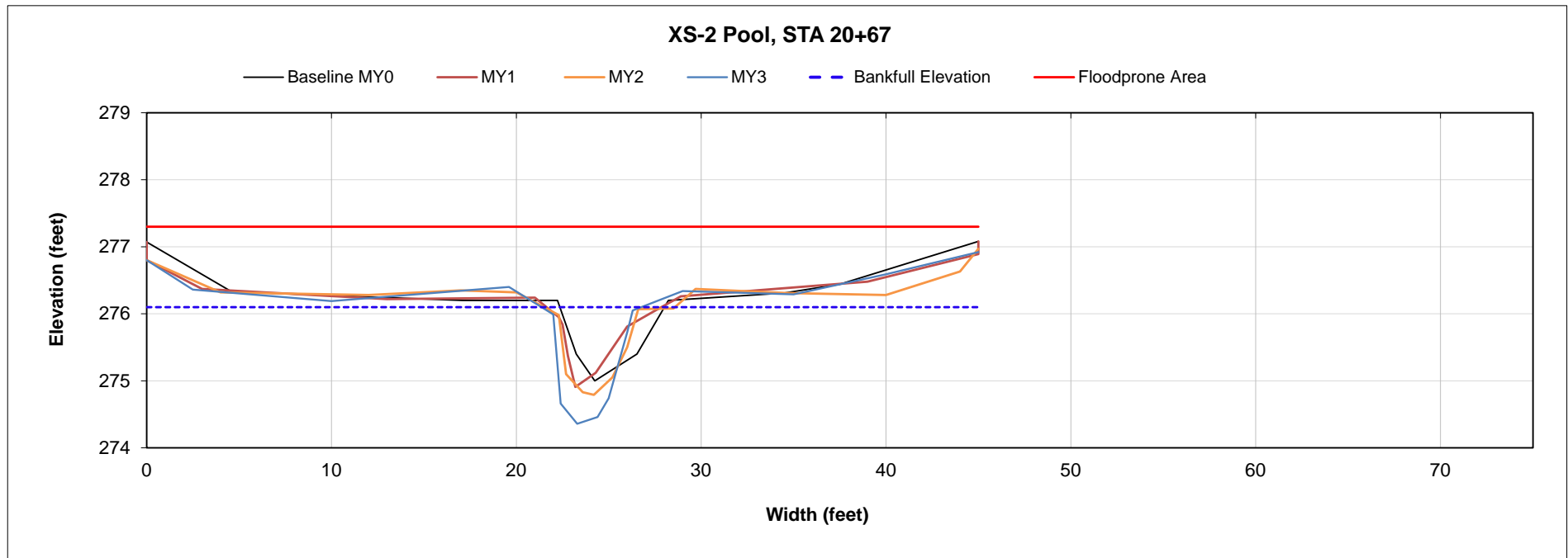
* Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull dimensions are calculated based on the current year's low bank height.
 ** MY1 used in place of as-built (MY0) due to issues with the as-built survey standards identified during MY1.

Project Name	Lake Wendell Mitigation Project
Project ID	97081
Reach ID	R2
Cross Section ID	XS-2
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY3 2020	
Bankfull Elevation (ft)	275.8
Low Bank Height Elevation (ft)	276.0
Bankfull Max Depth (ft)	1.4
Low Bank Height (ft)	1.6
Bank Height Ratio	1.1
Bankfull X-section Area (ft ²)	4.1
% Change Bank Height Ratio	10.0%



Looking Downstream



* Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull dimensions are calculated based on the current year's low bank height.

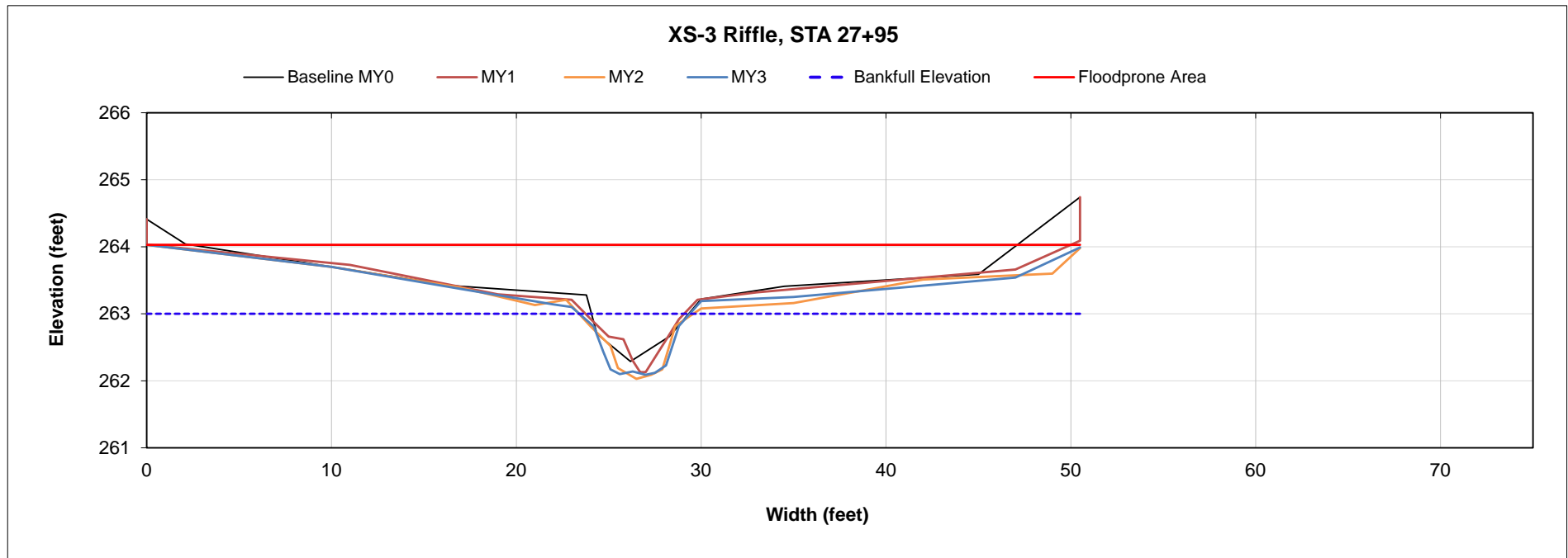
** MY1 used in place of as-built (MY0) due to issues with the as-built survey standards identified during MY1.

Project Name	Lake Wendell Mitigation Project
Project ID	97081
Reach ID	R2
Cross Section ID	XS-3
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY3 2020	
Bankfull Elevation (ft)	263.0
Low Bank Height Elevation (ft)	263.1
Bankfull Max Depth (ft)	0.9
Low Bank Height (ft)	1.0
Bank Height Ratio	1.1
Bankfull X-section Area (ft ²)	3.5
% Change Bank Height Ratio	10.0%



Looking Downstream



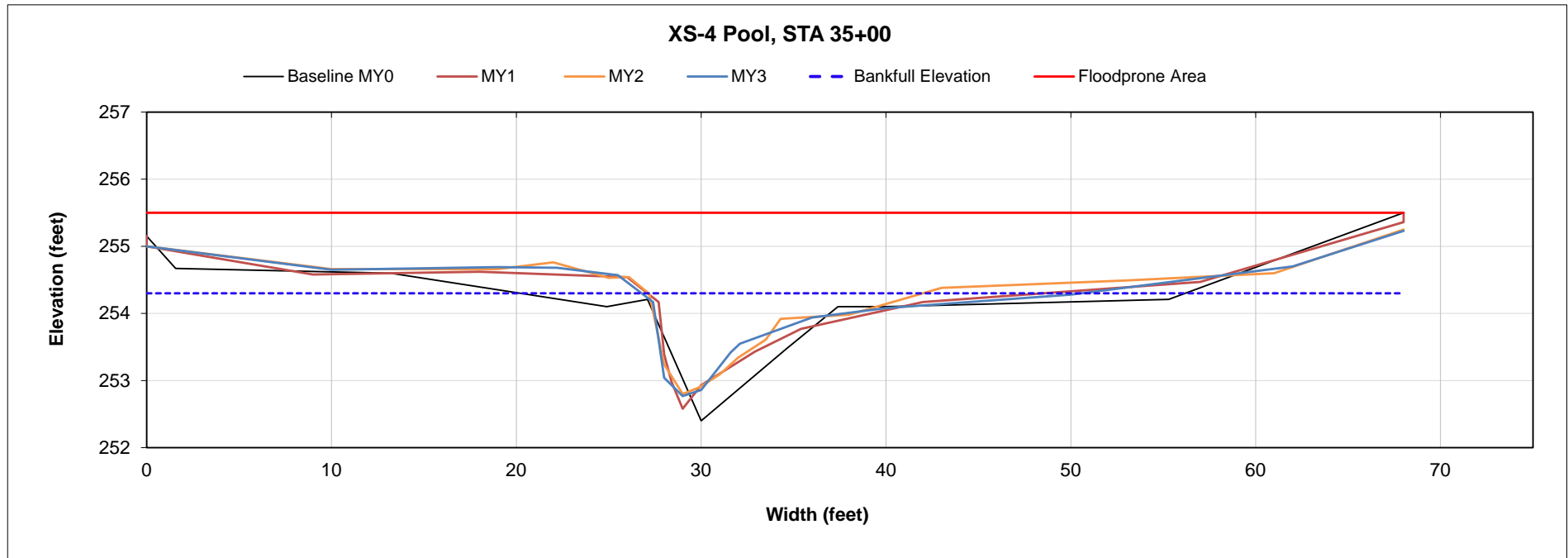
* Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull dimensions are calculated based on the current year's low bank height.
 ** MY1 used in place of as-built (MY0) due to issues with the as-built survey standards identified during MY1.

Project Name	Lake Wendell Mitigation Project
Project ID	97081
Reach ID	R3
Cross Section ID	XS-4
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY3 2020	
Bankfull Elevation (ft)	254.2
Low Bank Height Elevation (ft)	254.1
Bankfull Max Depth (ft)	1.5
Low Bank Height (ft)	1.3
Bank Height Ratio	< 1.0
Bankfull X-section Area (ft ²)	8.5
% Change Bank Height Ratio	10.0%



Looking Downstream



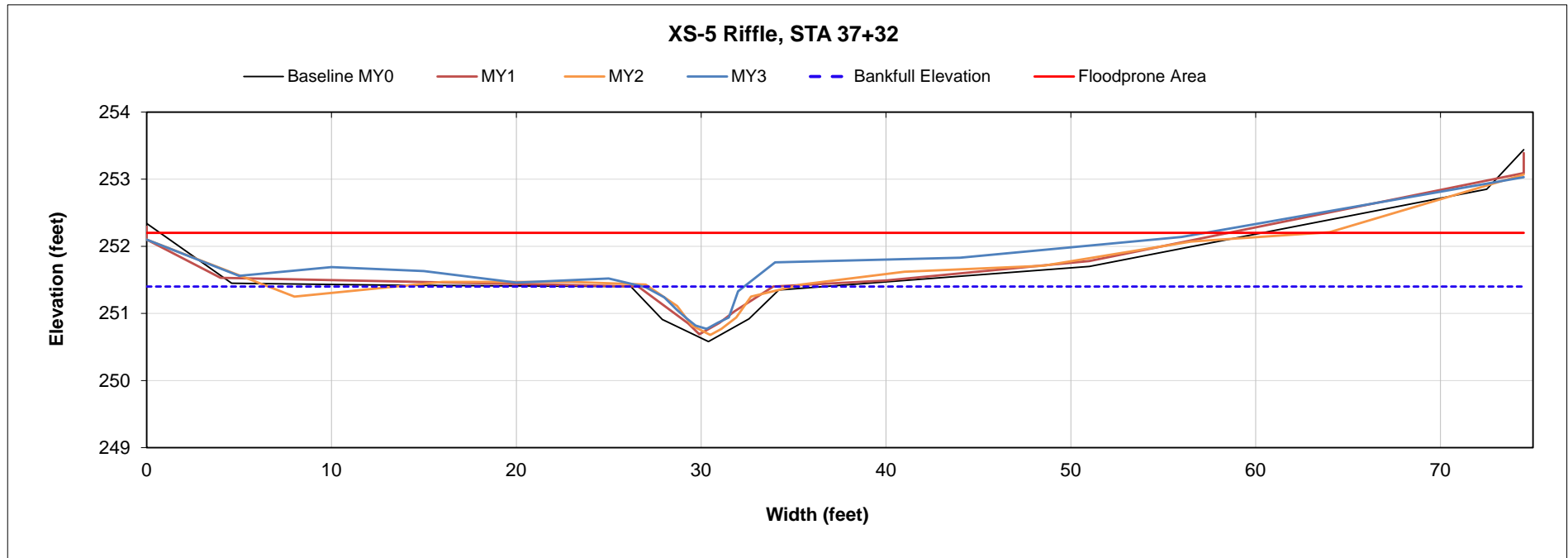
* Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull dimensions are calculated based on the current year's low bank height.
 ** MY1 used in place of as-built (MY0) due to issues with the as-built survey standards identified during MY1.

Project Name	Lake Wendell Mitigation Project
Project ID	97081
Reach ID	R3
Cross Section ID	XS-5
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY3 2020	
Bankfull Elevation (ft)	251.5
Low Bank Height Elevation (ft)	251.5
Bankfull Max Depth (ft)	0.8
Low Bank Height (ft)	0.8
Bank Height Ratio	1.0
Bankfull X-section Area (ft ²)	2.7
% Change Bank Height Ratio	0.0%



Looking Downstream



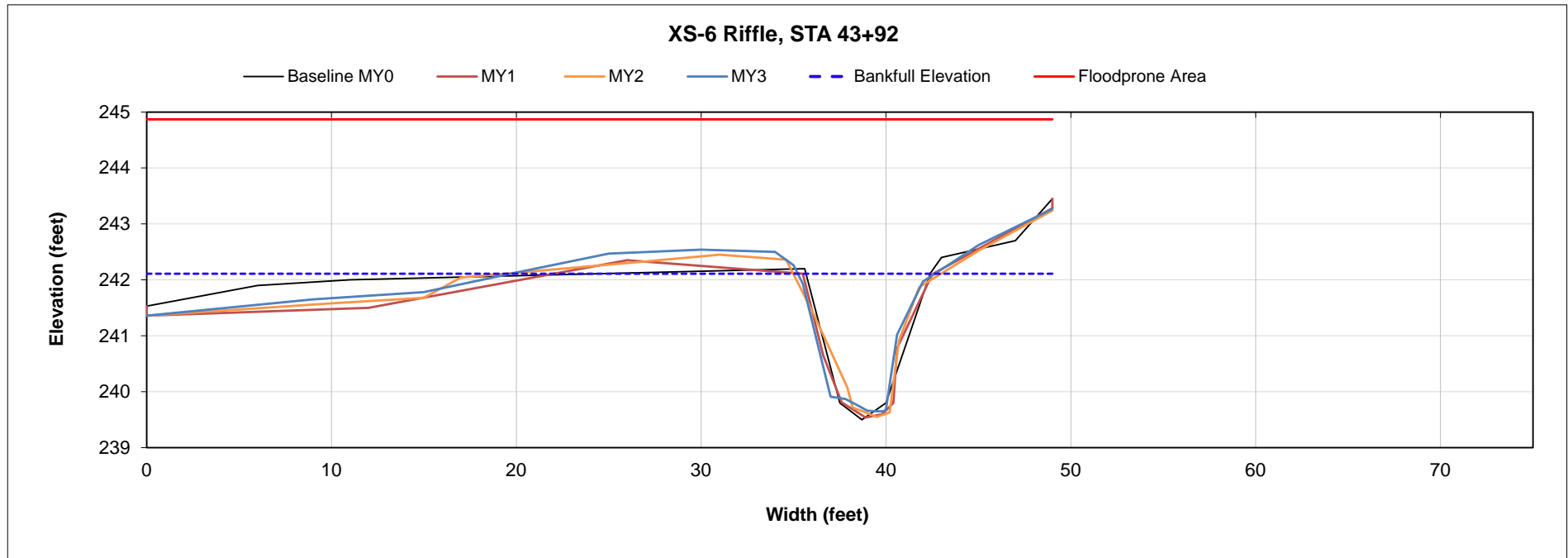
* Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull dimensions are calculated based on the current year's low bank height.
 ** MY1 used in place of as-built (MY0) due to issues with the as-built survey standards identified during MY1.

Project Name	Lake Wendell Mitigation Project
Project ID	97081
Reach ID	R4 (Preservation)
Cross Section ID	XS-6
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY3 2020	
Bankfull Elevation (ft)	242.2
Low Bank Height Elevation (ft)	242.3
Bankfull Max Depth (ft)	2.5
Low Bank Height (ft)	2.6
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	11.2
% Change Bank Height Ratio	0.0%



Looking Downstream



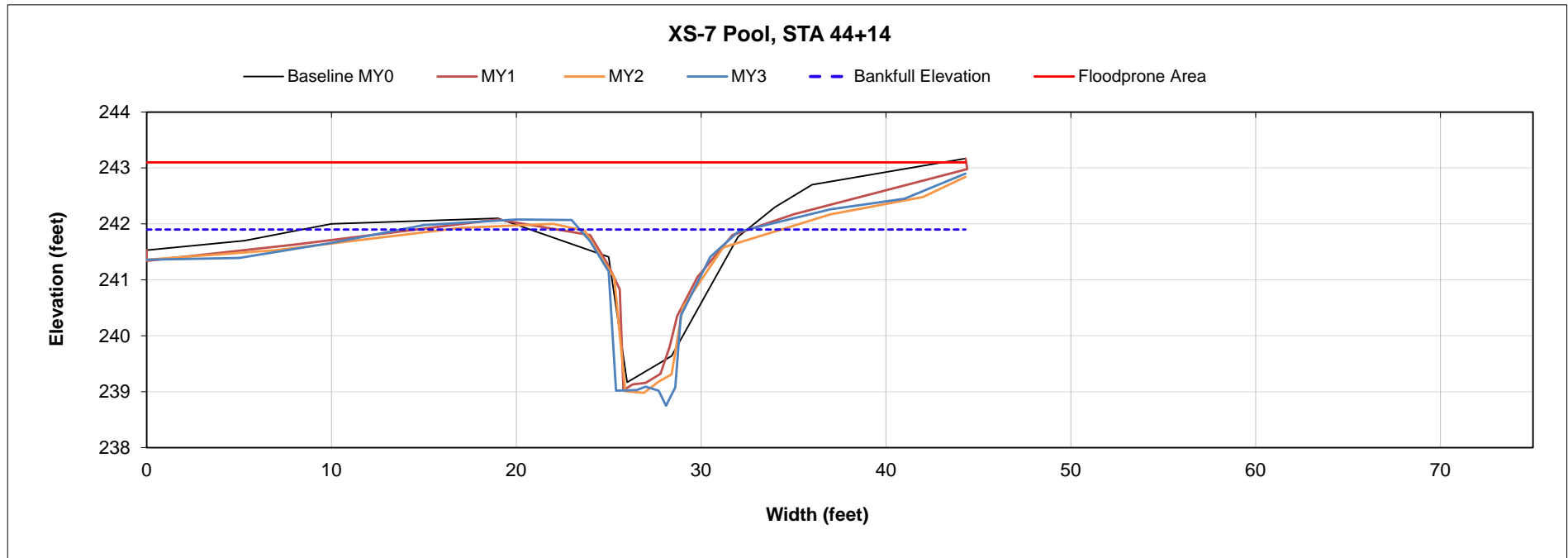
* Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull dimensions are calculated based on the current year's low bank height.
 ** MY1 used in place of as-built (MY0) due to issues with the as-built survey standards identified during MY1.

Project Name	Lake Wendell Mitigation Project
Project ID	97081
Reach ID	R4 (Preservation)
Cross Section ID	XS-7
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY3 2020	
Bankfull Elevation (ft)	241.8
Low Bank Height Elevation (ft)	241.9
Bankfull Max Depth (ft)	3.0
Low Bank Height (ft)	3.1
Bank Height Ratio	1.0
Bankfull X-section Area (ft ²)	12.3
% Change Bank Height Ratio	0.0%



Looking Downstream



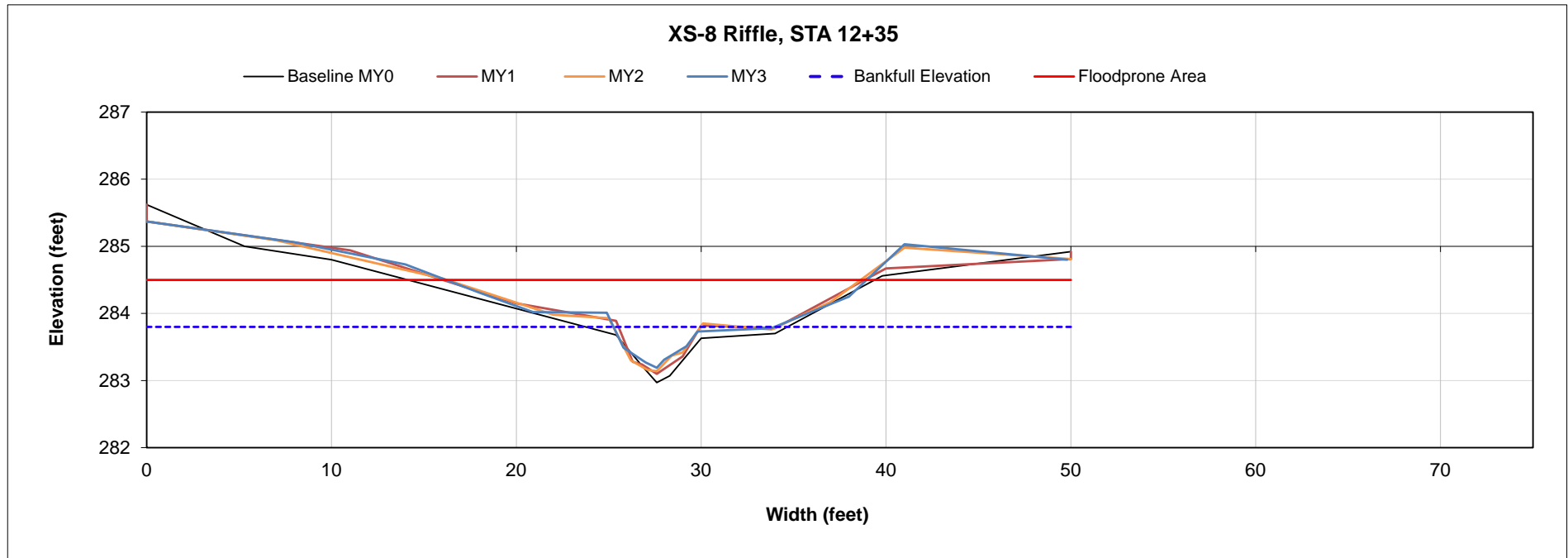
* Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull dimensions are calculated based on the current year's low bank height.
 ** MY1 used in place of as-built (MY0) due to issues with the as-built survey standards identified during MY1.

Project Name	Lake Wendell Mitigation Project
Project ID	97081
Reach ID	R5
Cross Section ID	XS-8
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY3 2020	
Bankfull Elevation (ft)	283.8
Low Bank Height Elevation (ft)	283.7
Bankfull Max Depth (ft)	0.6
Low Bank Height (ft)	0.5
Bank Height Ratio	< 1.0
Bankfull X-section Area (ft ²)	2.1
% Change Bank Height Ratio	10.0%



Looking Downstream



* Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull dimensions are calculated based on the current year's low bank height.
** MY1 used in place of as-built (MY0) due to issues with the as-built survey standards identified during MY1.

Lake Wendell
Figure 3: Pebble Count

Date Collected: 9/21/2018 10/18/2019 9/30/2020

MATERIAL	PARTICLE	SIZE (mm)	MY 1 Total #	MY2 Total #	MY3 Total #	MY4 Total #	MY5 Total #	MY6 Total #	MY7 Total #
SILT/CLAY	Silt / Clay	< .063	6	10	3				
	Very Fine	.063 - .125	12	4	7				
SAND	Fine	.125 - .25	9	3	19				
	Medium	.25 - .50	13	5					
	Coarse	.50 - 1.0	18	4	46				
	Very Coarse	1.0 - 2.0	17	12					
	Very Fine	2.0 - 2.8	11	1	1				
GRAVEL	Very Fine	2.8 - 4.0		1					
	Fine	4.0 - 5.6	4	2	2				
	Fine	5.6 - 8.0	4	4	7				
	Medium	8.0 - 11.0	2	5	4				
	Medium	11.0 - 16.0	1	11	6				
	Coarse	16 - 22.6	1	6	5				
	Coarse	22.6 - 32	1	8					
	Very Coarse	32 - 45		10					
	Very Coarse	45 - 64	1	5					
	COBBLE	Small	64 - 90		5				
Small		90 - 128		3					
Large		128 - 180		1					
Large		180 - 256							
BOULDER	Small	256 - 362							
	Small	362 - 512							
	Medium	512 - 1024							
	Large-Very Large	1024 - 2048							
BEDROCK	Bedrock	> 2048							
Total			100	100	100				

Cumulative	D16	0.11	0.2	0.16			
	D35	0.38	1.7	0.55			
	D50	0.73	15	0.69			
	D65	1.3	27	0.86			
	D84	3.5	60	7.7			
	D95	9.4	120	16			

MY3

Riffle		Pool	
Channel materials		Channel materials	
D16 =	0.53	D16 =	0.089
D35 =	0.68	D35 =	0.15
D50 =	0.82	D50 =	0.2
D65 =	2.4	D65 =	0.55
D84 =	11	D84 =	0.81
D95 =	18	D95 =	8.7

Weighted pebble count by bed features Lake Wendell Mitigation Project

65% riffle 35% pool

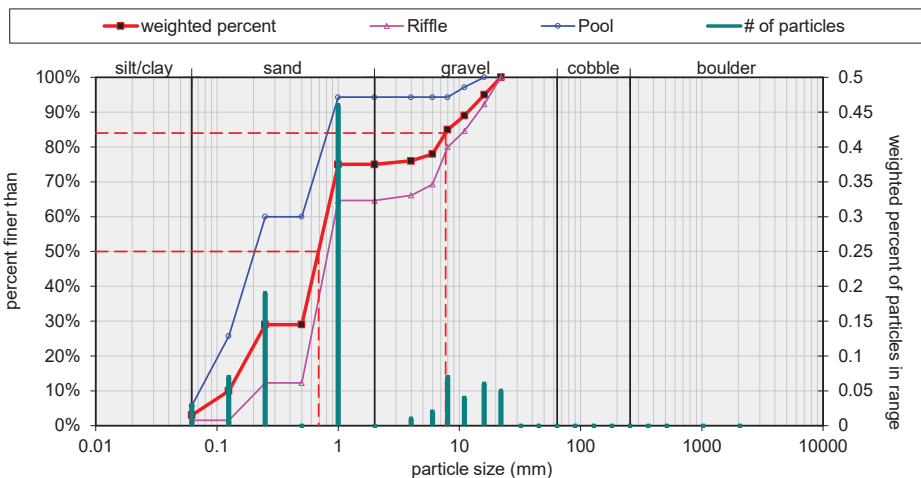


Table 7a. Baseline Stream Data Summary
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
Reach ID: R1								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	5.0	7.0	4.5	8.3	5.9	5.9	6.0	
Floodprone Width (ft)	6.1	18.7	10.0	20.0	14.0	30.0	25.3	
Bankfull Mean Depth (ft)	0.5	0.7	0.8	1.6	0.5	0.5	0.5	
Bankfull Max Depth (ft)	0.8	1.5	0.9	1.3	0.6	0.6	0.7	
Bankfull Cross Sectional Area (ft ²)	2.5	2.8	3.0	5.0	2.7	2.7	2.7	
Width/Depth Ratio	5.3	17.7	6.2	14.2	13.0	13.0	12.3	
Entrenchment Ratio	1.2	9.9	7.1	8.4	2.4	5.1	4.2	
Bank Height Ratio	1.1	2.3	0.9	1.1	1.0	1.0	1.0	
Profile								
Riffle Length (ft)	6.2	38.2	9.5	22.7	10.0	30.0	11.3	31.2
Riffle Slope (ft/ft)	0.016	0.037	0.009	0.015	0.020	0.035	0.017	0.036
Pool Length (ft)	4.1	7.9	6.1	8.7	7.0	10.0	5.5	12.5
Pool Max Depth (ft)	1.1	2.3	1.8	2.4	1.1	1.6	1.2	1.7
Pool Spacing (ft)	26.4	83.9	14.4	22.3	11.8	35.5	7.7	33.3
Pattern								
Channel Beltwidth (ft)	11.0	32.0	23.4	29.0	30.0	45.0	25.0	51.0
Radius of Curvature (ft)	8.0	50.0	11.2	17.5	15.0	25.0	11.0	36.0
Rc:Bankfull Width (ft/ft)	1.6	10.0	1.6	2.5	2.0	3.0	2.1	4.2
Meander Wavelength (ft)	20.0	100.0	43.4	65.1	30.0	44.8	23.0	56.0
Meander Width Ratio	2.2	6.4	3.9	4.5	5.1	7.6	4.1	7.4
Transport Parameters								
Boundary Shear Stress (lb/ft ²)	---		---		0.67		---	
Max part size (mm) mobilized at bankfull	---		---		2.00		---	
Stream Power (W/m ²)	---		---		42.00		---	
Additional Reach Parameters								
Rosgen Classification	G5c		E5/C5		B5c		B5c	
Bankfull Velocity (fps)	3.7		4.5		4.0		4.0	
Bankfull Discharge (cfs)	10.0		---		10.0		10.0	
Sinuosity	1.05		1.1 - 1.3		1.10		1.10	
Water Surface Slope (Channel) (ft/ft)	0.025		0.020		0.025		0.026	
Bankfull Slope (ft/ft)	0.027		0.020		0.025		0.027	

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
	Min	Max	Min	Max	Min	Max	Min	Max
Reach ID: R2								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	5.9	9.5	4.5	8.3	6.8	6.8	6.1	
Floodprone Width (ft)	13.7	14.1	10.0	20.0	15.0	30.0	46.0	
Bankfull Mean Depth (ft)	0.6	0.7	0.8	1.6	0.5	0.5	0.6	
Bankfull Max Depth (ft)	0.9	1.0	0.9	1.3	0.7	0.7	0.9	
Bankfull Cross Sectional Area (ft ²)	4.2	5.9	3.0	5.0	3.6	3.6	3.5	
Width/Depth Ratio	8.2	15.2	6.2	14.2	13.0	13.0	10.8	
Entrenchment Ratio	1.4	2.2	7.1	8.4	2.2	4.4	7.5	
Bank Height Ratio	1.8	1.9	0.9	1.1	1.0	1.0	1.0	
Profile								
Riffle Length (ft)	5.9	27.7	9.5	22.7	10.0	30.0	9.9	33.3
Riffle Slope (ft/ft)	0.015	0.029	0.009	0.015	0.015	0.020	0.016	0.033
Pool Length (ft)	3.9	7.8	6.1	8.7	7.9	9.8	5.4	13.6
Pool Max Depth (ft)	2.0	3.8	1.8	2.4	1.1	1.6	1.2	1.9
Pool Spacing (ft)	17.0	51.0	14.4	22.3	22.0	48.0	13.0	37.1
Pattern								
Channel Beltwidth (ft)	13.0	37.0	23.4	29.0	30.0	45.0	25.0	47.0
Radius of Curvature (ft)	7.0	29.0	11.2	17.5	15.0	25.0	9.8	30.3
Rc:Bankfull Width (ft/ft)	1.2	4.9	1.6	2.5	2.0	3.0	2.5	4.2
Meander Wavelength (ft)	42.0	121.0	43.4	65.1	30.0	44.8	29.0	17.0
Meander Width Ratio	2.3	6.3	3.9	4.5	5.1	7.6	4.4	7.9
Transport Parameters								
Boundary Shear Stress (lb/ft ²)	-		-		0.51		-	
Max part size (mm) mobilized at bankfull	-		-		2.00		-	
Stream Power (W/m ²)	-		-		29.10		-	
Additional Reach Parameters								
Rosgen Classification	E5/F5		E5/C5		C5		C5	
Bankfull Velocity (fps)	4.1		4.5		4.7		4.0	
Bankfull Discharge (cfs)	16.9		-		16.9		16.9	
Sinuosity	1.14		1.1 - 1.3		1.17		1.15	
Water Surface Slope (Channel) (ft/ft)	0.016		0.020		0.018		0.019	
Bankfull Slope (ft/ft)	0.017		0.020		0.017		0.019	

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
Reach ID: R3 (Pond)								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	9.5	-	4.5	8.3	7.8	7.8	7.9	
Floodprone Width (ft)	13.7	-	10.0	35.0	17.0	35.0	59.0	
Bankfull Mean Depth (ft)	0.6	-	0.8	1.6	0.6	0.6	0.5	
Bankfull Max Depth (ft)	0.9	-	0.9	1.3	0.7	0.8	0.8	
Bankfull Cross Sectional Area (ft ²)	5.9	-	3.0	5.0	4.4	4.4	3.7	
Width/Depth Ratio	15.2	-	6.2	14.2	14.0	14.0	16.8	
Entrenchment Ratio	1.4	-	7.1	8.4	2.2	4.5	7.4	
Bank Height Ratio	1.8	-	0.9	1.1	1.0	1.0	1.0	
Profile								
Riffle Length (ft)	-	-	9.5	22.7	12.0	33.0	10.0	30.0
Riffle Slope (ft/ft)	-	-	0.009	0.015	0.015	0.022	0.020	0.035
Pool Length (ft)	-	-	6.1	8.7	8.0	10.5	7.0	10.0
Pool Max Depth (ft)	-	-	1.8	2.4	1.4	2.0	1.1	1.6
Pool Spacing (ft)	-	-	14.4	22.3	25.0	55.0	11.8	35.5
Pattern								
Channel Beltwidth (ft)	-	-	23.4	29.0	25.0	45.0	30.0	46.0
Radius of Curvature (ft)	-	-	11.2	17.5	16.0	23.0	15.0	27.0
Rc:Bankfull Width (ft/ft)	-	-	1.6	2.5	2.0	3.0	2.5	4.2
Meander Wavelength (ft)	-	-	43.4	65.1	30.0	44.8	21.0	49.0
Meander Width Ratio	-	-	3.9	4.5	3.3	5.7	5.1	7.6
Transport Parameters								
Boundary Shear Stress (lb/ft ²)	-		-		0.52		-	
Max part size (mm) mobilized at bankfull	-		-		2.00		-	
Stream Power (W/m ²)	-		-		29.80		-	
Additional Reach Parameters								
Rosgen Classification	N/A (Pond)		E5/C5		C5		C5	
Bankfull Velocity (fps)	2.7		4.5		4.4		4.0	
Bankfull Discharge (cfs)	16.9		-		16.9		16.9	
Sinuosity	-		1.1 - 1.3		1.18		1.17	
Water Surface Slope (Channel) (ft/ft)	0.016		0.020		0.017		0.015	
Bankfull Slope (ft/ft)	-		0.020		0.018		0.016	

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
	Min	Max	Min	Max	Min	Max	Min	Max
Reach ID: R4								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	6.2	-	4.5	8.3	6.2	8.5	6.2	
Floodprone Width (ft)	44.1	-	10.0	35.0	17.0	35.0	17.0	
Bankfull Mean Depth (ft)	1.0	-	0.8	1.6	0.7	0.9	0.7	
Bankfull Max Depth (ft)	1.8	-	0.9	1.3	0.8	0.9	0.8	
Bankfull Cross Sectional Area (ft ²)	6.2	-	3.0	5.0	6.2	6.2	6.2	
Width/Depth Ratio	6.3	-	6.2	14.2	12.0	12.0	12.0	
Entrenchment Ratio	7.1	-	7.1	8.4	1.8	5.3	1.8	
Bank Height Ratio	1.0	-	0.9	1.1	1.0	1.1	1.0	
Profile								
Riffle Length (ft)	9.5	21.9	9.5	22.7	12.0	33.0	9.5	21.9
Riffle Slope (ft/ft)	0.013	0.022	0.009	0.015	0.013	0.022	0.013	0.022
Pool Length (ft)	6.1	8.5	6.1	8.7	8.0	10.5	6.1	8.5
Pool Max Depth (ft)	2.0	2.2	1.8	2.4	1.4	2.0	2.0	2.2
Pool Spacing (ft)	18.0	44.0	14.4	22.3	25.0	55.0	18.0	44.0
Pattern								
Channel Beltwidth (ft)	29.0	53.0	23.4	29.0	25.0	45.0	29.0	53.0
Radius of Curvature (ft)	12.0	20.0	11.2	17.5	16.0	23.0	12.0	20.0
Rc:Bankfull Width (ft/ft)	1.9	3.2	1.6	2.5	2.0	3.0	1.9	3.2
Meander Wavelength (ft)	52.0	77.0	43.4	65.1	30.0	44.8	52.0	77.0
Meander Width Ratio	4.7	8.5	3.9	4.5	3.3	5.7	4.7	8.5
Transport Parameters								
Boundary Shear Stress (lb/ft ²)	-		-		0.49		-	
Max part size (mm) mobilized at bankfull	-		-		2.00		-	
Stream Power (W/m ²)	-		-		29.00		-	
Additional Reach Parameters								
Rosgen Classification	E5		E5/C5		E5		E5	
Bankfull Velocity (fps)	3.2		4.0		3.2		3.2	
Bankfull Discharge (cfs)	23.7		-		23.7		23.7	
Sinuosity	1.25		1.1 - 1.3		1.25		1.25	
Water Surface Slope (Channel) (ft/ft)	0.014		0.020		0.014		0.014	
Bankfull Slope (ft/ft)	0.015		0.020		0.015		0.015	

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
Reach ID: R5								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	2.3	-	4.5	8.3	4.4	4.4	4.3	
Floodprone Width (ft)	3.3	-	10.0	35.0	15.0	30.0	24.0	
Bankfull Mean Depth (ft)	0.6	-	0.8	1.6	0.4	0.4	0.4	
Bankfull Max Depth (ft)	0.8	-	0.9	1.3	0.5	0.5	0.7	
Bankfull Cross Sectional Area (ft ²)	1.4	-	3.0	5.0	1.5	1.5	1.6	
Width/Depth Ratio	3.5	-	10.3	14.2	13.0	13.0	12.1	
Entrenchment Ratio	1.5	-	2.0	5.0	3.4	6.8	5.5	
Bank Height Ratio	3.3	-	0.9	1.1	1.0	1.0	1.0	
Profile								
Riffle Length (ft)	15.7	37.1	5.1	13.9	13.0	31.0	10.3	37.0
Riffle Slope (ft/ft)	0.019	0.027	0.017	0.026	0.015	0.027	0.017	0.027
Pool Length (ft)	3.1	11.0	4.5	7.0	6.8	9.4	4.7	8.5
Pool Max Depth (ft)	2.1	2.3	1.1	1.7	1.1	1.6	1.1	1.5
Pool Spacing (ft)	11.0	36.0	10.0	30.0	22.0	44.0	8.7	33.3
Pattern								
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-
Rc:Bankfull Width (ft/ft)	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-
Transport Parameters								
Boundary Shear Stress (lb/ft ²)	-		-		0.48		-	
Max part size (mm) mobilized at bankfull	-		-		2.00		-	
Stream Power (W/m ²)	-		-		24.30		-	
Additional Reach Parameters								
Rosgen Classification	G5		B5		B5		B5	
Bankfull Velocity (fps)	4.7		4.0		4.5		4.5	
Bankfull Discharge (cfs)	4.5		-		4.5		4.5	
Sinuosity	1.03		1.1 - 1.2		1.25		1.06	
Water Surface Slope (Channel) (ft/ft)	0.026		0.025		0.027		0.025	
Bankfull Slope (ft/ft)	0.025		0.025		0.027		0.024	

Parameter	Baseline		MY1		MY2		MY3		MY4		MY5	
Reach ID: R2												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	9.9	33.3										
Riffle Slope (ft/ft)	0.016	0.033										
Pool Length (ft)	5.4	13.6										
Pool Max depth (ft)	1.2	1.9										
Pool Spacing (ft)	13	37.1										
Pattern												
Channel Beltwidth (ft)	25	47										
Radius of Curvature (ft)	9.8	30.3										
Rc:Bankfull width (ft/ft)	2.5	4.2										
Meander Wavelength (ft)	29	17										
Meander Width Ratio	4.4	7.9										
Additional Reach Parameters												
Rosgen Classification	C5											
Sinuosity (ft)	1.15											
Water Surface Slope (Channel) (ft/ft)	0.019											
BF slope (ft/ft)	0.019											
³ Ri% / Ru% / P% / G% / S%												
³ SC% / Sa% / G% / C% / B% / Be%												
³ d16 / d35 / d50 / d84 / d95 /												
² % of Reach with Eroding Banks												
Channel Stability or Habitat Metric												
Biological or Other												

Pattern and Profile data will not typically be collected unless visual data, dimensional data or profile data indicate significant deviations from baseline conditions

Parameter	Baseline		MY1		MY2		MY3		MY4		MY5	
Reach ID: R3												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	10	30										
Riffle Slope (ft/ft)	0.02	0.035										
Pool Length (ft)	7	10										
Pool Max depth (ft)	1.1	1.6										
Pool Spacing (ft)	11.8	35.5										
Pattern												
Channel Beltwidth (ft)	30	46										
Radius of Curvature (ft)	15	27										
Rc:Bankfull width (ft/ft)	2.5	4.2										
Meander Wavelength (ft)	21	49										
Meander Width Ratio	5.1	7.6										
Additional Reach Parameters												
Rosgen Classification	C5											
Sinuosity (ft)	1.17											
Water Surface Slope (Channel) (ft/ft)	0.0153											
BF slope (ft/ft)	0.016											
³ Ri% / Ru% / P% / G% / S%												
³ SC% / Sa% / G% / C% / B% / Be%												
³ d16 / d35 / d50 / d84 / d95 /												
² % of Reach with Eroding Banks												
Channel Stability or Habitat Metric												
Biological or Other												

Pattern and Profile data will not typically be collected unless visual data, dimensional data or profile data indicate significant deviations from baseline conditions



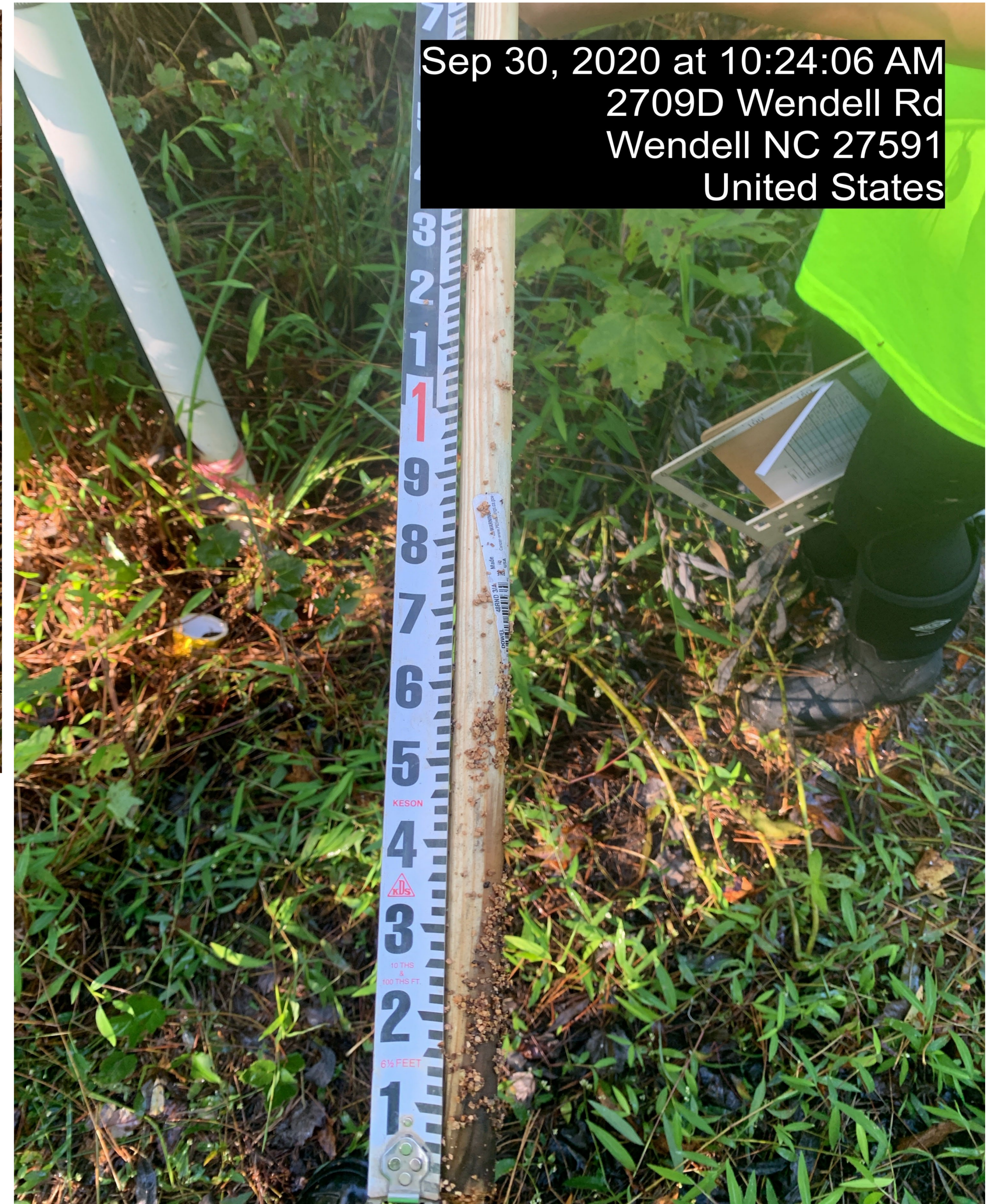
Appendix E – Hydrologic Data

Table 8. Verification of Flow Events

Date of Data Collection	Date of Occurrence	Method	Greater than Bankfull (Bkf) or Qgs (Q2*0.66 = 21.73 CFS) Stage?	Photo/ Notes	Height above bankfull	Requirement Met
8/16/2018	8/3/2018	Crest Gauge	Bkf, 3" above FP elevation	Photos		No
9/17/2018	9/16-9/17/2018	Observed visual indicators (wrack lines) of stage after storm	Bkf	Photos		No
11/21/2018	9/16-9/17/2018	Crest Gauge	Bkf	Photos		No
7/26/2019	7/24/2019	Crest Gauge	Bkf	Photos	.325 ft	No
8/20/2019	unknown	Crest Gauge	Bkf & Qgs	Photos	.45 ft	Yes
2/7/2020	unknown	Crest Gauge	Bkf & Qgs	Photos	.6 ft	Yes
9/30/2020	unknown	Crest Gauge	Bkf & Qgs	Photos	1.2 ft	Yes



2/7/2020



9/30/2020

Figure 4a: Gauge Graphs (pressure transducers)

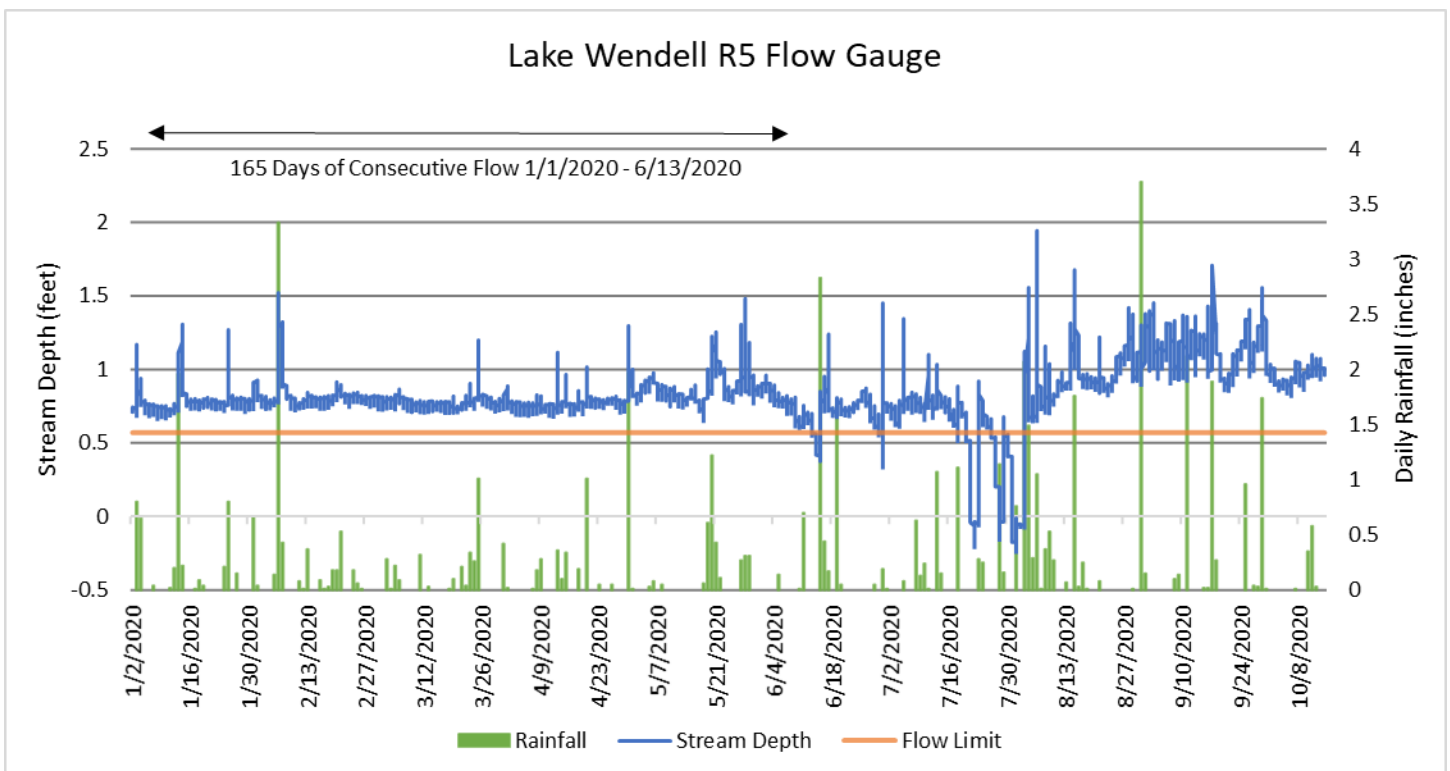
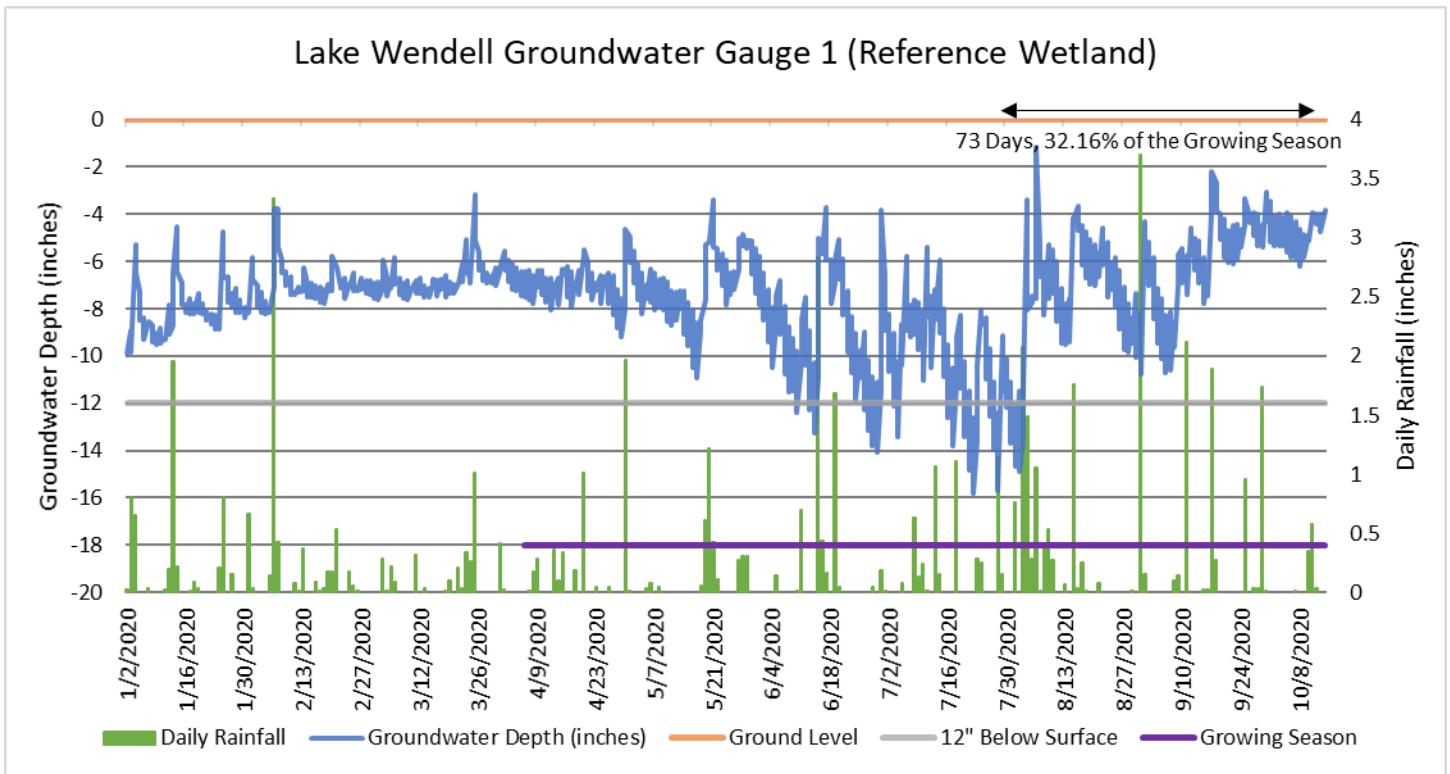


Figure 4b: Groundwater Gauge Data
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)
MY3 2020

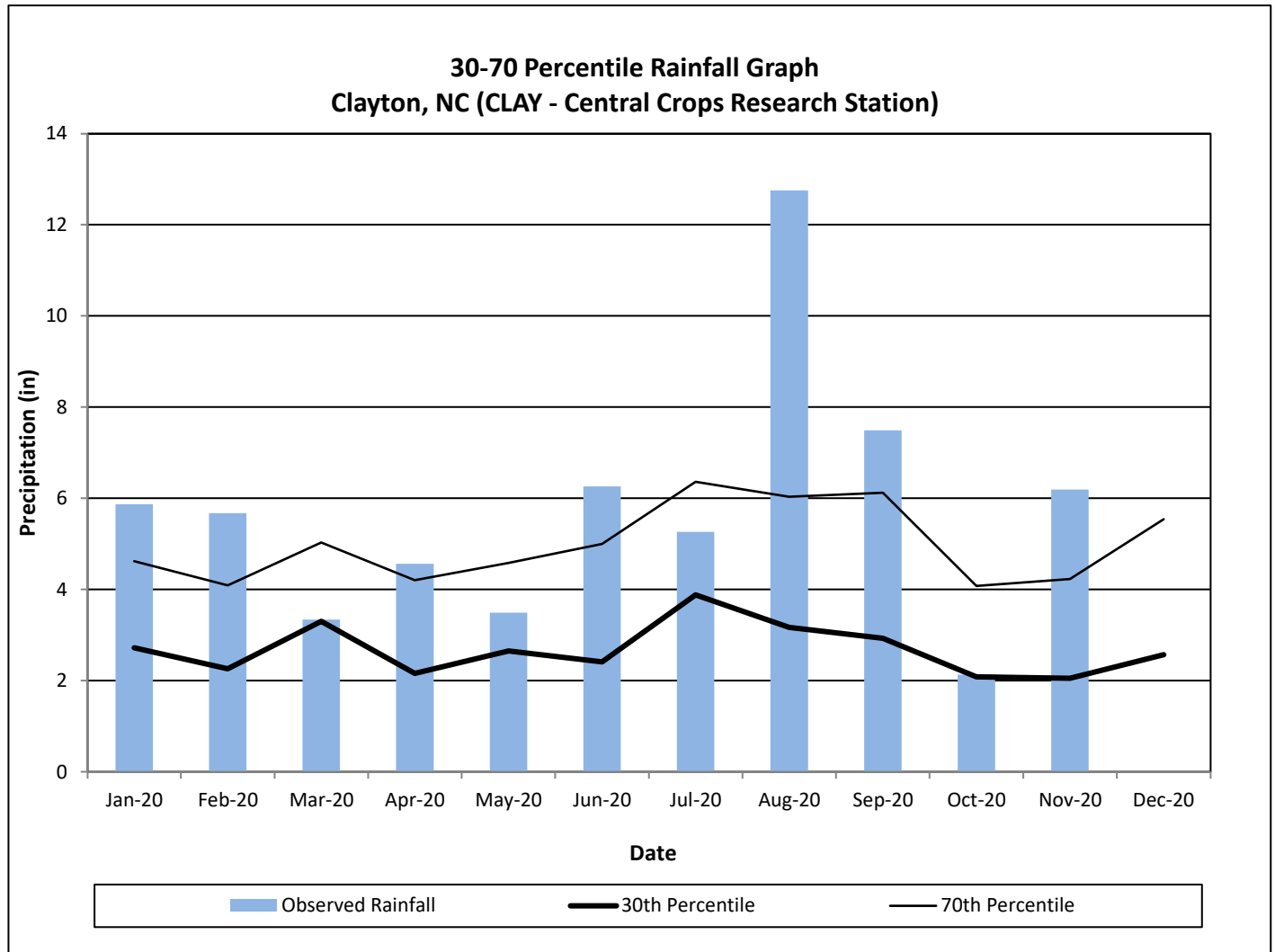
Monitoring Gauge Name	Max Consecutive Hydroperiod: Saturation within 12 Inches of Soil Surface (Percent of Growing Season) WETS Station: 317994 - Smithfield Growing Season: 4/6-11/4 (227 days)							
	2018	2019	2020	2021	2022	2023	2024	Mean
Lake Wendell Reference Wetland	95.20%	53.52%	32.16%					

Annual Precip Total NA
WETS 30th Percentile 42.7
WETS 70th Percentile 51.8
Normal Y

- Impoundment
- X% above or below success criteria
- N/A Not available - Gage pulled or yet to be installed by this phase
- M Malfunction, Data Overwritten or Unretrievable

*January-November

Figure 5: Monthly Rainfall Data
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)
MY3 2020



*30th and 70th percentile rainfall data collected from weather station CLAY - Central Crops Research Station in Clayton, NC.

**Incomplete Month

Month	30%	70%	Observed
Jan-20	2.72	4.62	5.87
Feb-20	2.26	4.09	5.67
Mar-20	3.30	5.03	3.34
Apr-20	2.16	4.20	4.56
May-20	2.65	4.58	3.49
Jun-20	2.41	5.00	6.26
Jul-20	3.88	6.36	5.26
Aug-20	3.17	6.03	12.75
Sep-20	2.93	6.12	7.49
Oct-20	2.08	4.08	2.13
Nov-20	2.05	4.23	6.19
Dec-20	2.57	5.54	**

Monitoring Report – Year 3
FINAL VERSION
Lake Wendell Mitigation Project (Riparian Buffer Mitigation)
Calendar Year of Data Collection: 2020

NCDEQ DMS Project Identification # 97081
NCDEQ DMS Contract # 6826
Neuse River Basin (Cataloging Unit 03020201)
USACE Action ID Number: SAW-2016-00876
NCDEQ DWR Project # 2016-0385
Johnston County, NC
Contracted Under RFP # 16-006477
Data Collection Period: September to October 2020
Submission Date: December 11, 2020



Prepared for:



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

Prepared by:



WATER & LAND SOLUTIONS

7721 SIX FORKS ROAD, SUITE 130, RALEIGH, NC 27615
(919) 614 - 5111 | waterlandsolutions.com

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Appendix D NC DWR Correspondence and Approvals



1 Project Summary

Water and Land Solutions, LLC (WLS) completed the construction and planting of the Lake Wendell Mitigation Project (Project) full-delivery project for the North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) in March 2018. The Project is located in Johnston County, North Carolina between the Community of Archer Lodge and the Town of Wendell at 35.73739°, -78.3538°. The Project site is located in the NCDEQ Sub-basin 03-04-06, in the Upper Buffalo Creek Sub-watershed 030202011502.

The Project involved the restoration, enhancement, preservation, and permanent protection of five stream reaches (R1, R2, R3, R4, and R5) and their riparian buffers, totaling 4,269 linear feet of streams and 490,477 square feet of riparian buffers. Monitoring Year 3 (MY3) monitoring activities occurred between September and October 2020 (Table 2). This report presents the data for the third year of monitoring (MY3). The Project meets the MY3 success criteria for vegetation. Based on these results, the Project is expected to meet the Monitoring Year 4 (MY4) success criteria in 2021.

2 Project Background

2.1 Project Location, Setting, and Existing Conditions

The Project site is located in the Upper Buffalo Creek Sub-watershed 030202011502 study area of the Neuse 01 Regional Watershed Plan, in the Wake-Johnston Collaborative Local Watershed Plan, and in Targeted Local Watershed 03020201180050.

The catchment area is 102 acres and has an impervious cover less than one percent. The dominant surrounding land uses are agriculture and mixed forest. Prior to construction, livestock had access to all Project streams, except R4, and the riparian buffers were less than 50 feet wide.

2.2 Mitigation Project Goals and Objectives

The following riparian buffer mitigation site-specific goals were developed:

- Restore and protect riparian buffer functions and habitat connectivity in perpetuity by recording a permanent conservation easement,
- Implement agricultural BMPs to reduce nonpoint source inputs to receiving waters.

To accomplish these site-specific goals, the following objectives will be measured and included with the performance standards to document overall project success:

- Increase native species riparian buffer vegetation density/composition along streambank and floodplain areas that meet requirements of a minimum 50-foot-wide and 260 stems/acre after monitoring year 5.
- Prevent cattle from accessing the conservation easement boundary by installing permanent fencing and reducing fecal coliform bacteria from the pre-restoration levels.



2.3 Project History, Contacts, and Timeframe

The Project will provide riparian buffer mitigation credits in accordance with North Carolina Administrative Code (NCAC), “Consolidated Buffer Mitigation Rule”, Rule 15A NCAC 02B .0295, effective November 1, 2015. Riparian buffer mitigation site viability was confirmed by DWRs April 28, 2016 letter entitled “Site Viability for Buffer Mitigation & Nutrient Offset – Lake Wendell Located Near 2869 Wendell Road, Wendell, NC, Johnston County”. The referenced site viability letter included a determination by DWR that Project Reaches R1, R2, R3 and R4 were either intermittent or perennial. A separate request for Stream Origin/Buffer Applicability Determination for Potential Mitigation for Project Reach R5 was submitted to DWR on May 18, 2017, as required under the referenced site viability letter. On June 1, 2017 DWR performed the requested determination and Reach R5 was determined to be intermittent, as communicated in the DWR June 8, 2017 letter entitled “On-Site Stream Determination for Applicability to the Neuse Riparian Buffer Rules and Water Quality Standards (15A NCAC 02B.0233)”, therefore confirming Reach R5’s eligibility for riparian buffer mitigation. See Appendix D for DWR correspondence and approval letters.

The final mitigation plan and PCN were submitted to DMS August 25, 2017 for submission to DWR and the NCIRT. The Section 404 General (Regional and Nationwide) Permit Verification was issued October 5, 2017. Project construction started on November 13, 2017 and mitigation site earthwork was completed on March 13, 2018, by RiverWorks Construction. Mitigation site planting was completed on March 30, 2018, by RiverWorks Construction. Trueline Surveying, PC completed the as-built survey in June 2018. WLS completed the installation of baseline monitoring devices on April 19, 2018 and the installation of survey monumentation and conservation easement boundary marking on June 7, 2018. MY1 was completed on November 24th, 2019 and submitted December 4th, 2019. Monitoring Year 2 data collection was completed from June until October 29th, 2019. Monitoring Year 3 data collection was completed from September – October 15th, 2020.

The project background and attribute summary are presented in Table 1. Refer to Figure 1 and Table 2 for the project areas and buffer asset information. Relevant project contact information is presented in Table 3.

3 Project Mitigation Components

3.1 Riparian Buffer Mitigation Types and Approaches

Riparian buffer mitigation included restoring, enhancing, and preserving the riparian buffer functions and corridor habitat. The project included planting to re-establish a native species vegetation riparian buffer corridor, which extended a minimum of 50 feet from the top of the streambanks along each of the project reaches, as well as permanently protecting those buffers with a conservation easement. Many areas of the conservation easement had riparian buffer widths greater than 50 feet established along one or both streambanks to provide additional functional uplift. The only exception is at the upstream end of Reach R1, where the width of the proposed left riparian buffer varies between 20 feet and 29 feet from the left top of bank. This narrow area of proposed riparian buffer is due to the site constraint caused by an existing residential structure. For project reaches proposed for restoration and enhancement, the riparian buffers were restored through reforestation of the entire conservation easement with native species riparian buffer vegetation (Table 5). For project reach sections proposed for preservation, the existing riparian



buffers are permanently protected via the recorded conservation easement. Additionally, permanent fencing was installed along with alternative watering systems to exclude livestock from the restored riparian buffer and conservation easement areas. The permanent fencing system consisting of woven wire fencing was installed to NRCS technical standards in the pasture areas along and outside of the northern conservation easement boundaries of Reaches R1, R2, and R3. Table 1 (Appendix A) provides a summary of the project components.

3.1.1 Tree and Shrub Planting Approaches

The riparian buffer planting zones for the project included the streambanks, floodplain, riparian wetland, and upland transitional areas. Plantings were conducted using native species bare-root trees and shrubs, live stakes, and seedlings that were generally planted at a total target density of 680 stems per acre. WLS implemented a riparian buffer planting strategy that includes a combination of overstory, or canopy, and understory species. The site planting strategy also included early successional, as well as climax species. The vegetation selections were mixed throughout the project planting areas so that the early successional species will give way to climax species as they mature over time.

3.1.2 Temporary and Permanent Seeding Approaches

Permanent seed mixtures of native species herbaceous vegetation and temporary herbaceous vegetation seed mixtures were applied to all disturbed areas of the project site. Temporary and permanent seeding were conducted simultaneously at all disturbed areas of the site during construction utilizing mechanical broadcast spreaders. The as-built re-vegetation plan lists the utilized species, mixtures, and application rates for permanent seeding.

3.1.3 Invasive Species Vegetation Treatment

During the project construction, invasive species exotic vegetation was either mechanically removed or chemically treated both to control its presence and reduce its spread within the conservation easement areas. During MY3 an area of concern was observed along R1 buffer as shown on the Figure 1. This area was utilized as a temporary staging area during construction and contains invasive species vegetation (kudzu) along the right buffer. This area was managed twice during MY3, with kudzu crown removal happening during the summer and foliar spray of the limited remaining stems in October using a 3 percent solution of Garlon 3A (see table below for treatments). Following these treatments, the percent cover of kudzu was reduced to approximately 5%. WLS will continue to monitor and treat the kudzu during MY4.

Monitoring Year	Invasive Treatment	Date Treatment Conducted
2	Kudzu foliar spray and cut	August 15, 2019
	Kudzu foliar spray	September 24, 2019
3	Kudzu crown removal (hand-digging)	March 18, 2020
	Kudzu foliar spray	October 7, 2020

4 Performance Standards

The applied success criteria for the Project will follow necessary performance standards and monitoring protocols presented in final approved mitigation plan. Annual monitoring and semi-annual site visits will be conducted to assess the condition of the project throughout the monitoring period. Monitoring



activities will be conducted for a period of five years. Specific success criteria components and evaluation methods are described below.

4.1 Vegetation

Measurements of the final vegetative restoration success for the project will be achieving a density of not less than 260, five-year-old planted stems per acre in Year 5 of monitoring. This final performance criteria shall include a minimum of four native hardwood tree species or four native hardwood tree and native shrub species, where no one species is greater than 50 percent of the stems. Native hardwood tree and native shrub volunteer species will be included to meet the final performance criteria of 260 stems per acre. Volunteer species will only be counted toward success if they were included in the approved planting plan and if they are surviving for at least two years. In addition, diffuse flow of runoff shall be maintained in the riparian buffer areas.

5 Monitoring Year 3 Assessment and Results

Annual monitoring was conducted during MY3 in accordance with the monitoring plan as described in the approved mitigation plan and was intended to document the site improvements based on restoration potential, catchment health, ecological stressors, and overall constraints. All the monitoring device locations are depicted on CCPV (Figure 1) and MY3 monitoring data results are listed in the appendices. The Project meets the MY3 success criteria for vegetation.

5.1 Vegetation

Vegetation monitoring for MY3 was conducted utilizing the seven vegetation monitoring plots, with monitoring conducted in accordance with the CVS-EEP Level I & II Monitoring Protocol (CVS, 2008) and DMS Stream and Wetland Monitoring Guidelines (DMS, 2017). See Figure 1 in Appendix B for the vegetation monitoring plot locations. The surviving planted stems include a minimum of four native hardwood tree species or four native hardwood tree and native shrub species, where no one species is greater than 50 percent of the stems. Summary data and photographs of each plot can be found in Appendix 3.

The MY3 vegetation monitoring was also conducted utilizing visual assessment along all the Project stream reaches. The overall results of the visual assessment did not indicate any negative changes to the existing vegetation community. An area of encroachment approximately 0.008 acres was found along R1, see Figure 1. This area has been mowed by the adjacent homeowner and is currently vegetated with fescue. Management of this area has already begun and includes additional signage and a physical barrier (horse tape) to delineate the easement boundary and discourage further mowing. During MY4 trees will be planted in this area to ensure tree cover is achieved. Trees planted will be from the approved list in the mitigation plan. Additionally, the visual monitoring confirmed that diffuse flow of runoff is being maintained in the riparian buffer areas.



6 References

- Lee, M., Peet R., Roberts, S., Wentworth, T. CVS-NCEEP Protocol for Recording Vegetation, Version 4.1, 2007.
- North Carolina Department of Environmental Quality, Division of Mitigation Services, Wildlands Engineering, Inc. 2015. Neuse 01 Regional Watershed Plan Phase II. Raleigh, NC.
- North Carolina Department of Environmental Quality, Division of Mitigation Services, 2017. Annual Report Format, Data Requirements, and Content Guidance. Raleigh, NC.
- Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. North Carolina Natural Heritage Program. NCDENR Division of Parks and Recreation. Raleigh, NC.
- United States Army Corps of Engineers. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. Environmental Laboratory. US Army Engineer Waterways Experiment Station. Vicksburg, MS.
- _____. 1997. Corps of Engineers Wetlands Research Program. Technical Note VN-RS-4.1. Environmental Laboratory. U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.
- _____. 2003. Stream Mitigation Guidelines, April 2003, U.S. Army Corps of Engineers. Wilmington District.
- Water and Land Solutions, LLC (2017). Lake Wendell Stream and Riparian Buffer Mitigation Plan. NCDMS, Raleigh, NC.



Appendices



Appendix A – Background Tables

Table 1. Buffer Project Attributes

Project Name	Lake Wendell Mitigation Project
Hydrologic Unit Code	03020201
River Basin	Neuse
Geographic Location (Lat, Long)	35.7373910 N, -78.3538050 W
Site Protection Instrument (DB, PG)	85, 148
Total Credits (BMU)	354,404.00
Types of Credits	Riparian Buffer
Mitigation Plan Date	Aug-18
Initial Planting Date	Mar-18
Baseline Report Date	Nov-18
MY1 Report Date	Dec-18
MY2 Report Date	Nov-19
MY3 Report Date	Dec-20
MY4 Report Date	
MY5 Report Date	

Table 2. Buffer Project Areas and Assets: Lake Wendell

RIPARIAN BUFFER (15A NCAC 02B.0295)											If Converted to Nutrient Offset		
Location	Jurisdictional Streams	Restoration Type	Reach ID/ Component	Buffer Width (ft)	Total Area (sf)	Creditable Area (sf)*	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits (BMU)	Convertible to Nutrient Offset (Yes or No)	Nutrient Offset: N (lbs)	Nutrient Offset: P (lbs)
Rural or Urban	Subject or Nonsubject	Restoration		20-29			1	75%	1.33333	-	Yes	-	-
			Restoration	0-100	342,525	342,525		100%	1.00000	342,525.000		17,873.412	N/A
				101-200				33%	3.03030	-		-	
		Enhancement		20-29			2	75%	2.66667	-	No	-	-
			Enh & Cattle Ex. Enh	0-100	44,852	44,852		100%	2.00000	22,426.000		-	-
				101-200				33%	6.06061	-		-	
SUBTOTALS						387,377				364,951.000		17,873.412	-

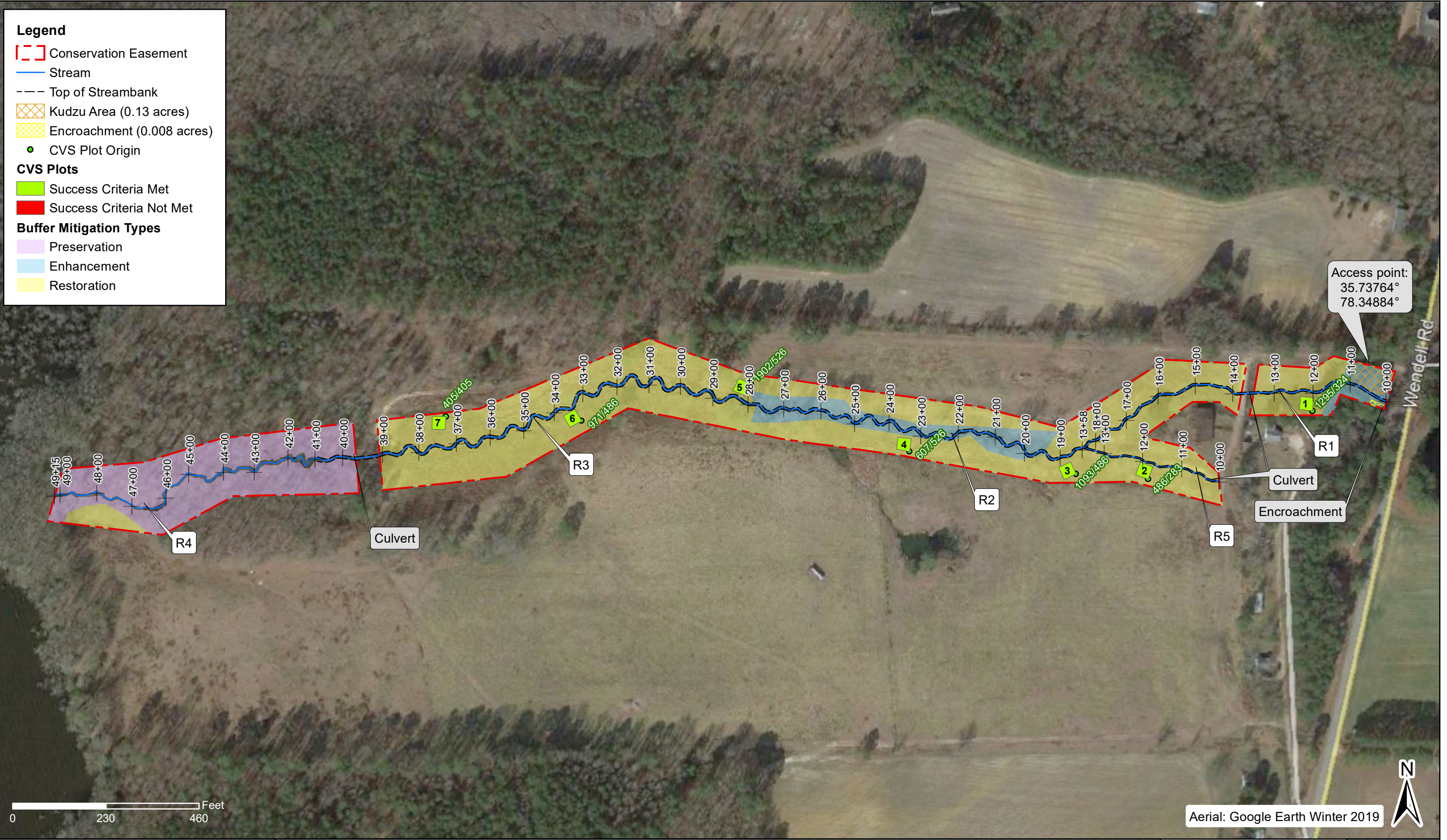
ELIGIBLE PRESERVATION AREA						129,126							
Location	Jurisdictional Streams	Restoration Type	Reach ID/ Component	Buffer Width (ft)	Total Area (sf)	Creditable Area (sf)*	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits (BMU)			
Rural	Subject	Preservation		20-29			10	75%	13.33333	-			
			Preservation	0-100	104,103	104,103		100%	10.00000	10,410.300			
				101-200				33%	30.30303	-			
	Nonsubject			20-29			5	75%	6.66667	-			
				0-100				100%	5.00000	-			
				101-200				33%	15.15152	-			
Urban	Subject or Nonsubject		20-29			3	75%	4.00000	-				
			0-100				100%	3.00000	-				
			101-200				33%	9.09091	-				
SUBTOTALS						104,103				10,410.300			
TOTALS						491,480				375,361.300			

Table 3. Project Contacts
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)

Mitigation Provider	Water & Land Solutions, LLC 7721 Six Forks Road, Suite 130 Raleigh, NC 27615
Primary Project POC	Catherine Manner Phone: 571-643-3165
Construction Contractor	RiverWorks Construction 114 W. Main Street, Suite 106, Clayton, NC 27520
Primary Project POC	Bill Wright Phone: 919-590-5193
Survey Contractor (Existing Condition Surveys)	WithersRavenel 115 MacKenan Drive, Cary, NC 27511
Primary Project POC	Marshall Wight, PLS Phone: 919-469-3340
Survey Contractor (Conservation Easement, Construction and As-Builts Surveys)	True Line Surveying, PC 205 West Main Street, Clayton, NC 27520
Primary Project POC	Curk T. Lane, PLS 919-359-0427
Planting Contractor	RiverWorks Construction 114 W. Main Street, Suite 106, Clayton, NC 27520
Primary Project POC	Bill Wright Phone: 919-590-5193
Seeding Contractor	RiverWorks Construction 114 W. Main Street, Suite 106, Clayton, NC 27520
Primary Project POC	Bill Wright Phone: 919-590-5193
Seed Mix Sources	Green Resource 5204 Highgreen Ct., Colfax, NC 27235
	Rodney Montgomery Phone: 336-215-3458
Nursery Stock Suppliers	Foggy Mountain Nursery (Live Stakes) 797 Helton Creek Rd, Lansing, NC 28643
	Glenn Sullivan Phone: 336-977-2958
	Dykes & Son Nursery (Bare Root Stock) 825 Maude Etter Rd, McMinnville, Tn 37110
	Jeff Dykes Phone: 931-668-8833
Monitoring Performers	Water & Land Solutions, LLC 7721 Six Forks Road, Suite 130 Raleigh, NC 27615
Stream Monitoring POC	Emily Dunnigan Phone: 269-908-6306
Vegetation Monitoring POC	Emily Dunnigan Phone: 269-908-6306



Appendix B – Visual Assessment Data



Legend

- Conservation Easement
- Stream
- Top of Streambank
- Kudzu Area (0.13 acres)
- Encroachment (0.008 acres)
- CVS Plot Origin

CVS Plots

- Success Criteria Met
- Success Criteria Not Met

Buffer Mitigation Types

- Preservation
- Enhancement
- Restoration

Table 4. Project Planted Acreage¹		Vegetation Condition Assessment Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081) 8.9				
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	1 acre	Solid light blue	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
Total				0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
Cumulative Total				0	0.00	0.0%

Easement Acreage²		12				
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern⁴	Areas or points (if too small to render as polygons at map scale).	1000 SF	orange hatched	1	0.13	1.1%
5. Easement Encroachment Areas³	Areas or points (if too small to render as polygons at map scale).	none	yellow hatched	1	0.01	0.1%



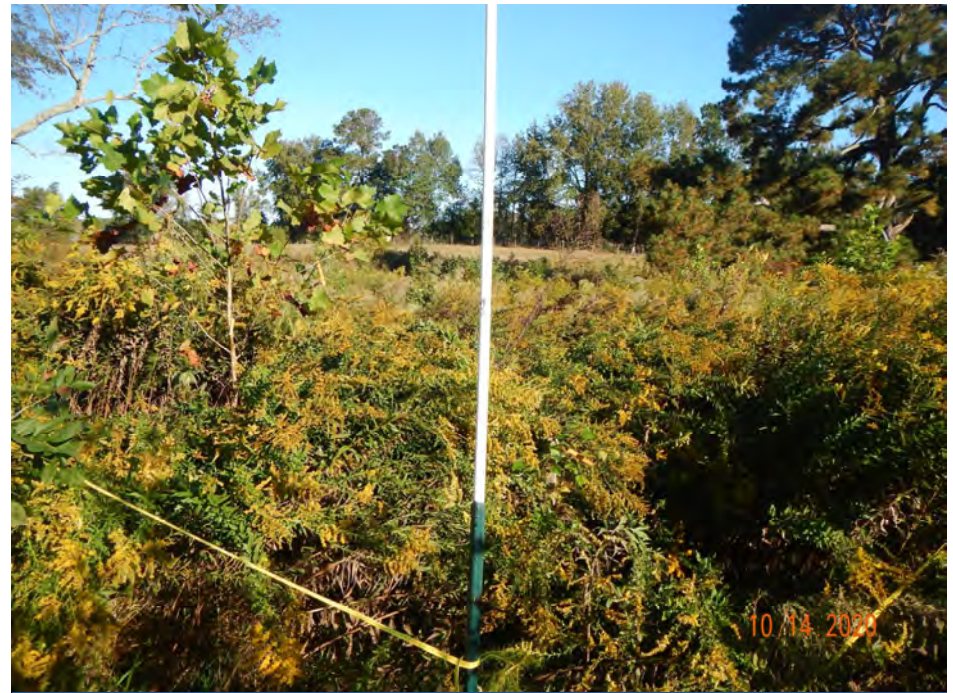
Veg Plot 1, November 5, 2018 (MY-01)



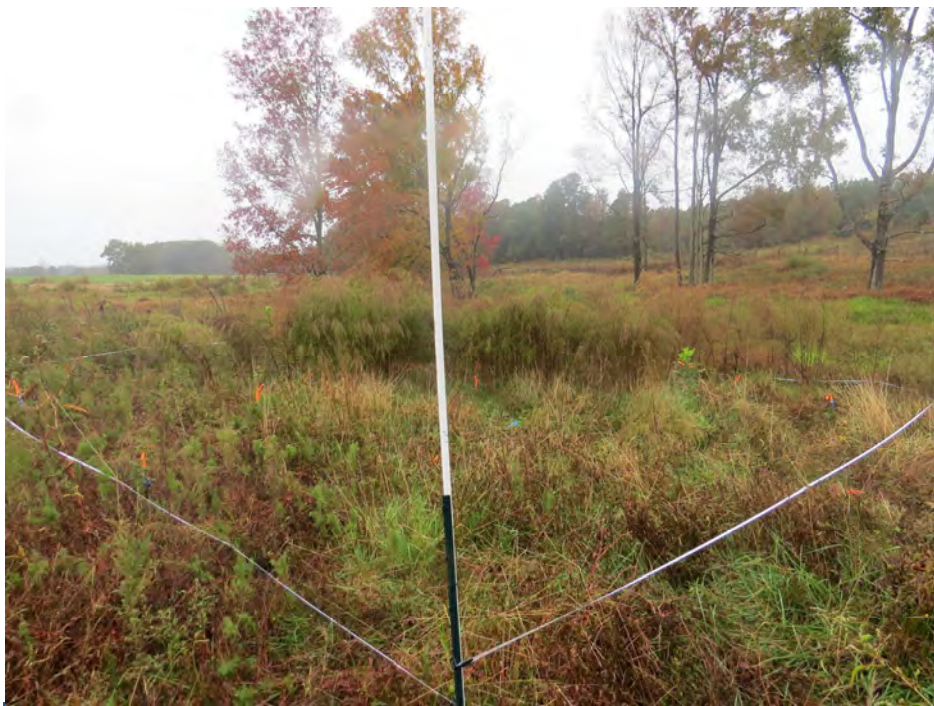
Veg Plot 1, October 14, 2020 (MY-03)



Veg Plot 2, April 27, 2018 (MY-00)



Veg Plot 2, October 14, 2020 (MY-03)



Veg Plot 3, November 5, 2018 (MY-01)



Veg Plot 3, October 14, 2020 (MY-03)



Veg Plot 4, April 13, 2018 (MY-00)



Veg Plot 4, October 14, 2020 (MY-03)



Veg Plot 5, April 13, 2018 (MY-00)



Veg Plot 5, October 14, 2020 (MY-03)



Veg Plot 6, April 13, 2018 (MY-00)



Veg Plot 6, October 14, 2020 (MY-03)



Veg Plot 7, April 13, 2018 (MY-00)



Veg Plot 7, October 14, 2020 (MY-03)



Kudzu Problem Area, October 22, 2020 (MY-03)



Kudzu Problem Area, October 22, 2020 (MY-03)



Encroachment Area, October 7, 2020 (MY-03)



Encroachment Area, October 7, 2020 (MY-03)



Appendix C – Vegetation Plot Data



Appendix D – DWR Correspondence and Approval



Water Resources
ENVIRONMENTAL QUALITY

PAT MCCRORY

Governor

DONALD R. VAN DER VAART

Secretary

S. JAY ZIMMERMAN

Director

April 28, 2016

DWR Project #: 2016-0385

Scott Hunt
Water & Land Solutions, LLC
11030 Raven Ridge Rd, Suite 119
Raleigh, NC 27614
(via electronic mail)

Re: Site Viability for Buffer Mitigation & Nutrient Offset – Lake Wendell
Located near 2869 Wendell Rd, Wendell, NC
Johnston County

Dear Mr. Hunt,

On April 8, 2016, Katie Merritt, with the Division of Water Resources (DWR), assisted you and others from Water & Land Solutions, LLC at the proposed Lake Wendell Mitigation Site (Site) in Wendell, NC. The Site is located in the Neuse River Basin within the 8-digit Hydrologic Unit Code 03020201. The Site is being proposed as part of a full-delivery stream restoration project for the Division of Mitigation Services (RFP #16-006477). The Interagency Review Team (IRT) was also present onsite. At your request, Ms. Merritt performed a site assessment of features onsite to determine suitability for buffer and nutrient offset mitigation. Features are more accurately shown in the attached maps signed by Ms. Merritt on April 20, 2016. If approved, mitigating this site could provide stream mitigation credits, riparian buffer credits and/or nutrient offset credits.

Ms. Merritt’s evaluation of features from Top of Bank (TOB) out to 200’ for buffer and nutrient offset mitigation pursuant to Rule 15A NCAC 02B .0295 (effective November 1, 2015) and Rule 15A NCAC 02B .0240 is provided in the table below:

<u>Feature</u>	<u>Classification</u>	<u>¹Subject to Buffer Rule</u>	<u>Adjacent Landuses</u>	<u>Buffer Credit Viable</u>	<u>²Nutrient Offset Viable at 2,273 lbs/acre</u>	<u>Mitigation Type/Comments</u>
R1 (above pipe)	Modified Natural Stream	Yes	narrow buffer of Mixed native hardwood & pine forest	Yes ³	No	Enhancement per 15A NCAC 02B .0295 (b)(4) in entire 50’ from TOB
R1 (piped portion – fence line)	Piped stream	Yes ³	managed lawn	Yes ³	No	Restoration
R1 (below fence line – R5 confluence)	Modified natural stream	Yes	pasture actively grazed by cattle	Yes	Yes	Restoration

R2	Stream	Yes	Pasture actively grazed by cattle and narrow closed canopy of native hardwoods	Yes	Yes (<i>outside of forested area</i>)	Narrow closed canopy = Enhancement per 15A NCAC 02B .0295 (o)(6); Outside of forested areas = Restoration
R3	Ag Pond (<i>to be drained</i>)	Yes	Pasture actively grazed by cattle	Yes ³	Yes	Restoration (<i>if pond is drained, a stream channel has to develop to be viable for any credit</i>)
R4	Stream	Yes	Native hardwood forest, closed canopy	Yes	No	Preservation per 15A NCAC 02B .0295 (o)(5)
R5	Undetermined conveyance	Not on maps	Pasture actively grazed by cattle	n/a	Yes	Need stream determination by DWR; if feature is a stream, feature is viable for buffer restoration per 15A NCAC 02B .0295 (o)(3)

¹Subjectivity calls were determined using the 1:24,000 scale quadrangle topographic map prepared by USGS and the most recent printed version of the soil survey map prepared by the NRCS

²For nutrient offset viability to be determined, the landowner must provide proof in writing that the land is being used for agriculture or has been used for agriculture previously (prior to rule baseline). Dates, supported by photos or other written records, must be included to confirm that the uses of the open fields onsite are/were for hay crop cultivation/row crop/cattle.

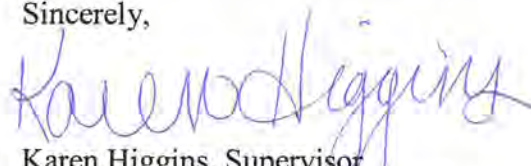
³Feature has been piped or is a pond, but has potential for buffer mitigation if feature is restored into a stream.

Maps showing the project site and the features are provided and signed by Ms. Merritt on April 20, 2016. This letter should be provided in all future mitigation plans for this Site. In addition, all vegetative plantings, performance criteria and other mitigation requirements for riparian restoration, enhancement and preservation must follow the requirements in 15A NCAC 02B .0295 to be eligible for buffer and nutrient offset credits. Where buffer and nutrient offset credits are viable in the same area, only one credit type is allowed to be generated for credit, not both.

For any areas depicted as not being viable for nutrient offset credit, one could propose a different measure other than riparian restoration/enhancement, along with supporting calculations and sufficient detail to support estimates of load reduction, for review by the DWR to determine viability for nutrient offset according to 15A NCAC 02B .0240.

Please contact Katie Merritt at (919)-807-6371 if you have any questions regarding this correspondence.

Sincerely,



Karen Higgins, Supervisor
401 and Buffer Permitting Branch

KAH/km

Attachments: Site Aerial Map, USGS Topographic Map, NRCS Soil Survey

cc:File Copy (Katie Merritt)

DMS – Jeff Schaffer (via electronic mail)

Legend

- Sediment Sample
- Cross Section
- Conservation
- Easement
- Existing Stream
- R1
- R2
- R3
- R4
- R5

Channel Incision and Stream Bank Erosion

Reach ID	Existing Stream Length (ft)	Not Incised (BHR ~1.0)	Slightly Incised (BHR = 1.1-1.3)	Severely Incised (BHR >1.5)	BHR @ Cross-section	Bank Scour %	Mass Wasting %
R1	848	N/A	N/A	N/A	1.1	30-40%	20-30%
R2	920	0%	0%	100%	1.9	40-50%	30-40%
R3	930	N/A	N/A	N/A	2.0	0-10%	0%
R4	853	90%	10%	0%	1.0	0-10%	0%
R5	350	50%	10%	40%	3.3	40-50%	50-60%

Notes: Approx. 350' along R1 is piped and/or severely manipulated/degraded, therefore channel incision and bank erosion were not estimated along the entire reach. The R3 cross-section survey was taken upstream of pond/backwater conditions.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aergrid, IGN, IGP, swisstopo, and the GIS User Community



Lake Wendell
Mitigation Project

Rym
4/20/10

Channel Stability &
Monitoring Features

NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

FIGURE
8

Kym 4/20/16

#2016-0385

Lake Wendell Site

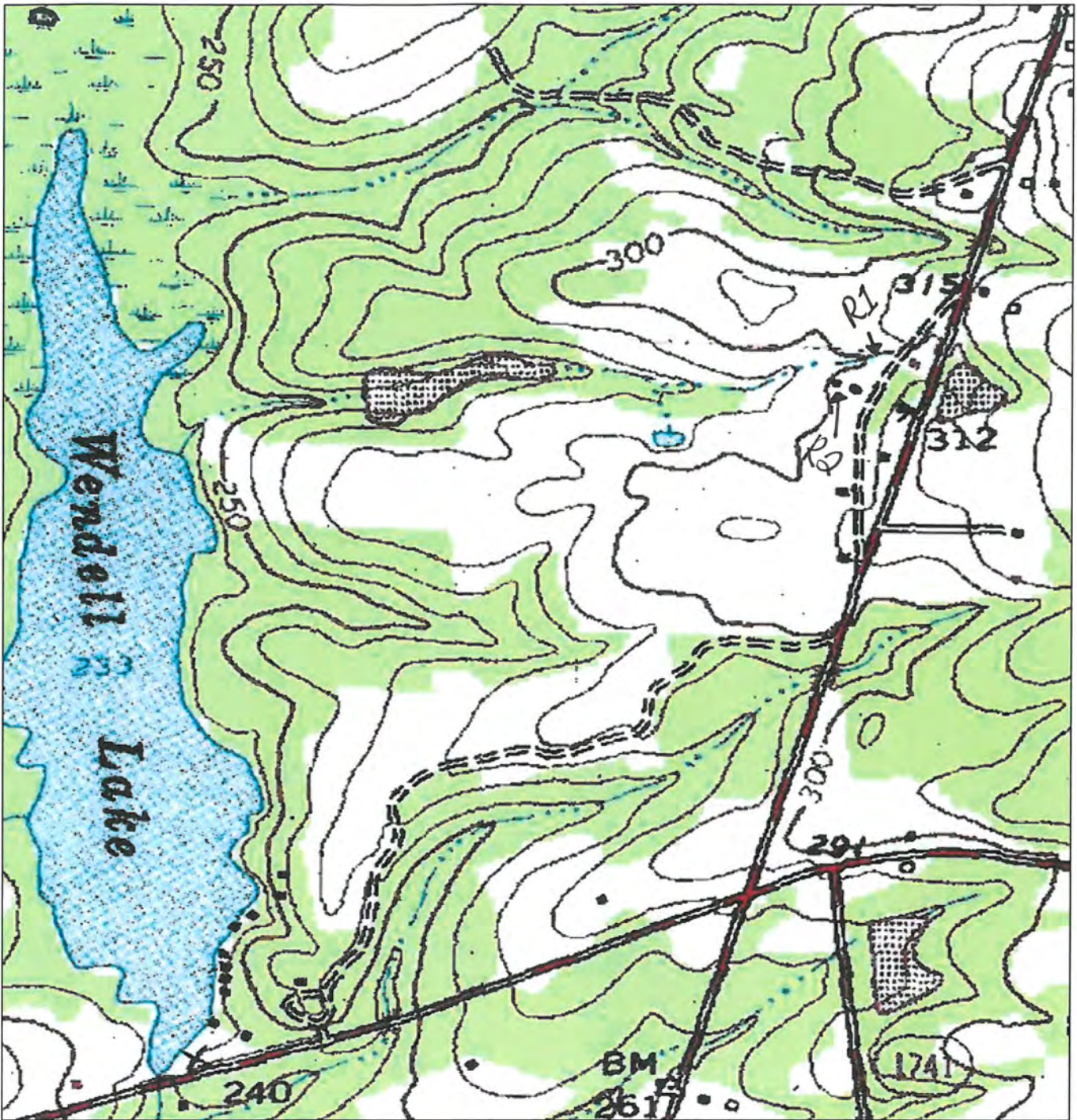


This map was prepared by the U.S. Department of Agriculture, Soil Conservation Service, and is based on the best available data. It is not intended for use as a legal document. The U.S. Department of Agriculture, Soil Conservation Service, is not responsible for any errors or omissions on this map.



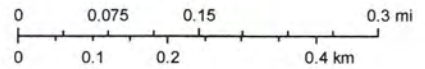
JOHNSON COUNTY, NORTH CAROLINA 2

NC USGS Topo & Parcels Map



April 20, 2016

1:6,528



Kym 4/20/16
2016-0385
Lake Wendell Site