Monitoring Report – MY4
FINAL VERSION
Lake Wendell Mitigation Project
Calendar Year of Data Collection: 2021

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 V2
Johnston County, NC
Contracted Under RFP # 16-006477
Data Collection Period: September 2021
Submission Date: October 20th, 2021

Prepared for:

Environmental Quality

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October 20th, 2021

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 10 Draft Monitoring Report Year 4 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 4 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 4 were developed by addressing NCDEQ DMS's review comments.

Under this cover, we are providing the Final Monitoring Report Year 4, 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 4 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: Please add V2 to the end of the DWR project number on the title page (2016-0385 V2).** WLS Response: V2 was added to the DWR project number.

2. **DMS Comment: Riparian buffer report table 5a and Stream report table 6a: please remove the column with volunteers/acre and total stems/acre or populate these columns with correct data. Please note that volunteers on this table for success should not include pines, sweetgums, or invasives.** WLS Response: Volunteers/acre and total stems/acre columns were removed from the table. The data in the tables was correct, there were no volunteer species that could be counted toward success in any of the plots.

3. **DMS Comment: Clarify in the text where the substrate samples were taken (which reach).** WLS Response: Language was added to include approximate station location (38+00) on R3.

4. **DMS Comment: Update rain report for additional months if possible.** WLS Response: September rainfall data was added to Figure 5.

Digital Deliverables:

1. **DMS Comment: Please submit the features used to depict the kudzu area and encroachment area in the CCPV.** WLS Response: The shapefiles for the kudzu area and the encroachment area are included in the CCPV shapefile folder of E-Data.

2. **DMS Comment: The CVS entry tool that was submitted produces a Table 7 report with different values for plots 2 and 5 when compared to Table 6 in the monitoring report and Table 5 in the buffer report.**

Please review the CVS file, ensure the data are up to date and resubmit. WLS Response: The CVS entry tool that was submitted was from MY3, we have updated the CVS tool with the MY4 file.

Please contact me if you have any questions or comments.

Sincerely,

Water & Land Solutions, LLC

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LIST OF APPENDICES

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 2021. Monitoring Year 4 (MY4) data collection occurred in September of 2021 (Table 2). This report presents the data for MY4. The Project meets the MY4 success criteria for stream hydrology, streambed condition and stability, and stream flow. One vegetation plot is not meeting success requirements for vegetation. Based on these results, the Project is expected to meet the Monitoring Year 5 (MY5) success criteria in 2022.

Table 2. Buffer Project Areas and Assets: Lake Wendell

RIPARIAN BUFFER (15A NCAC 02B.0295)

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)	If Converted to Nutrient Offset: Convertible to Nutrient Offset (Yes or No)	If Converted to Nutrient Offset: Nutrient Offset: N (lbs)	If Converted to Nutrient Offset: Nutrient Offset: P (lbs)
Rural or Urban	Subject or Nonsubject	Restoration		20-29				75%	1.33333	-		-	-
			Restoration	0-100	342,525	342,525	1	100%	1.00000	342,525.000	Yes	17,873.412	N/A
				101-200				33%	3.03030	-		-	-
	Subject or	Enhancement		20-29				75%	2.66667	-		-	-
			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							
Location	Jurisdictional Streams	Restoration Type	Reach ID/ Component	Buffer Width (ft)		Creditable Area (sf)*	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits (BMU)			
Rural	Subject	Preservation		20-29				75%	13.33333	-			
			Preservation	0-100	104,103	104,103	10	100%	10.00000	10,410.300			
				101-200				33%	30.30303	-			
	Nonsubject			20-29				75%	6.66667	-			
				0-100			5	100%	5.00000	-			
				101-200				33%	15.15152	-			
Urban	Subject or Nonsubject			20-29				75%	4.00000	-			
				0-100			3	100%	3.00000	-			
				101-200				33%	9.09091	-			
				SUBTOTALS		104,103				10,410.300			
				TOTALS		491,480				375,361.300			

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 4 Assessment and Results

Annual monitoring was conducted during MY4 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). MY4 results are provided in the appendices. The Project meets the MY4 success criteria for stream hydrology and jurisdictional stream flow. Visual surveys indicate that the stream horizontal and vertical stability are meeting requirements. 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. One recorded bankfull event occurred during MY4. This event was 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
4	1	Yes

5.2 Stream Horizontal & Vertical Stability

Visual assessment was utilized for assessment of MY4 horizontal and vertical stream stability. The visual assessments for each stream reach concluded that the MY4 stream channel pattern and longitudinal profiles, in-stream structure location/function, still closely match the profile design parameters and MY0/baseline conditions (Appendix D). Cross-section data collection is not required for MY4 per the mitigation plan, data will be collected in MY5.

Minor piping was noted in MY3 at two instream structures near approximate stations 26+00 (SPA1) and 26+50 (SPA2). During MY4 these areas were live staked to prevent further erosion and provide bank stability. Both structures are failing, but there is not a systemic problem upstream or downstream and no immediate remedial action is proposed at this time. Monitoring of these areas will continue in MY5.

5.3 Streambed Material and Condition

A representative sediment sample was collected in R3, near station 38+00, at a constructed riffle and pool 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 MY4.

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 the stream exhibited surface flow for 119 consecutive days from January 1st to April 29th, 2021 (see Figure 4). A gauge malfunction resulted in the loss of data from July 14th, 2021, to September 14th, 2021. The malfunctioning gauge was repaired on September 14th, 2021.

5.5 Vegetation

Vegetation monitoring for MY4 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 242 stems per acre which does not meet the year 5 minimum of 260 stems per acre. Plot 2 contains six stems total, one stem below the requirement to meet success criteria. Loss in stem density from MY3 to MY4 is due to thick herbaceous vegetation. To determine if there is a larger issue with vegetation in this area, two random veg plots were surveyed (10m x 10m). Both plots met success criteria (see table below). During MY5, Plot 2 will be monitored closely, and WLS will assess the need for supplemental planting in at that time. All other vegetation plots met MY4 interim success criteria.

Random Veg Plot Data Table

Random Veg Plot	Number of Planted Stems	Trees/Acre	Tree Species	Requirement Met (260 stems/acre)
1	7	283	Water oak, green ash, swamp chestnut oak, sycamore, silky dogwood	Yes
2	8	323	Tag alder, tulip poplar, green ash, river birch, sycamore, red maple, sweetbay magnolia	Yes

The MY4 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 in MY3, see Figure 1 (VPA2). This area had been mowed by the adjacent homeowner and was vegetated with fescue. Management of this area in MY4 included additional signage and a physical barrier (horse tape) to

delineate the easement boundary and discourage further mowing. During MY4, additional trees were planted in this area to ensure tree cover is achieved (February 1st, 2021). Trees planted were from the approved list in the mitigation plan (see plant list below). A previous area of concern (VPA1) located along R1 buffer as shown on the CCPV (noted first in MY1) was utilized as a temporary staging area during construction and contains invasive vegetation (kudzu) along the right buffer. The area was treated once during the 2021 year in July (see table below for treatments). Following these treatments, the percent cover of kudzu was reduced to approximately 1%. The VPA1 area was planted with trees from the approved list in the mitigation plan on February 1st, 2021 (see plant list below). This area will continue to be treated during MY5 and documented in future reports.

Planting List Table

Common Name	Scientific Name	# Planted
Tulip Poplar	*Liriodendron tulipifera*	10
Sycamore	*Platanus occidentalis*	10
River Birch	*Betula nigra*	5
	TOTAL	25

Kudzu Treatment Table

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
4	Kudzu foliar spray	July 1, 2021

5.3 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. A gauge malfunction resulted in the loss of data from July 14th, 2021, to September 14th, 2021. The malfunctioning gauge was repaired on September 14th, 2021.

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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:	**3 yrs 6 months**
Elapsed Time Since planting complete:	**3 yrs 6 months**
Number of reporting Years[0]:	**4**

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 Verfication	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 MonitoringReport Submittal	10/29/2019	11/15/2019
Year 3 Monitoring Report Submittal	10/15/2020	12/11/2020
Year 4 Monitoring Report Submittal	9/14/2021	10/20/2021
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

CVS Vegetation Plots

- Success Criteria Met
- Success Criteria Not Met
- Random Veg Plots
- Water Quality Features
- Top of Streambank
- Culvert Pipes
- Pre-Construction Wetlands (1.16 acres)
- Stream Structural Issues
- Kudzu Area (0.13 acres)
- Encroachment (0.008 acres)

Stream Mitigation Type

- Restoration
- Enhancement II
- Preservation

Access point: 35.73764° 78.34884°

VPA1 - Kudzu

VPA2 - Encroachment

SPA1

SPA2

R1

R2

R3

R4

R5

Culvert

Crest Gauge

Wetland Reference Gauge

Flow Gauge

Wendell Road

PS-1 PS-2 PS-3 PS-4 PS-5 PS-6 PS-7 PS-8 PS-9 PS-10 PS-11 PS-12 PS-13

XS-1 XS-2 XS-3 XS-4 XS-5 XS-6 XS-7 XS-8

1174/323 323/242 809/485 607/526 1376/485 1052/485 404/404

Feet 0 230 460

N

Aerial: Google Earth March 2021

WATER & LAND™ SOLUTIONS

Lake Wendell Mitigation Project
Johnston County, North Carolina

NCDMS Contract No. 6826
NCDMS Project No. 97081
September 2021
MY4

Current Conditions
Plan View
Monitoring Year 4

NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

FIGURE
1

Table 5.	Visual Stream Morphology Stability Assessment
Project	Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)
Reach ID	R1, R2, R3, R4, R5
Assessed Length	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.	23	25			92%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not 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 Acreage[1]	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 Acreage[2]	**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 17, 2021 (MY-04)

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

PS-1, R1, facing downstream, Sta 11+50, March 17, 2021 (MY-04)

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

PS-2, R1, facing upstream, Sta 13+50, March 17, 2021 (MY-04)

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

PS-2, R1, facing downstream, Sta 13+50, March 17, 2021 (MY-04)

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

PS-3, R1, facing downstream, Sta 17+50, March 17, 2021 (MY-04)

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

PS-3, R1, facing upstream, Sta 17+50, March 17, 2021 (MY-04)

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

PS-4, R2, facing downstream, Sta 18+50, March 17, 2021 (MY-04)

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

PS-5, R2, facing upstream, Sta 26+50, March 17, 2021 (MY-04)

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

PS-6, R2, facing downstream, Sta 27+50, March 17, 2021 (MY-04)

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

PS-7, R2, facing upstream, Sta 28+25, March 17, 2021 (MY-04)

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

PS-8, R3, facing downstream, Sta 32+00, March 17, 2021 (MY-04)

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

PS-9, R2, facing downstream, Sta 37+50, March 17, 2021 (MY-04)

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

PS-10, R3, facing upstream, Sta 39+50, March 17, 2021 (MY-04)

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

PS-10, R4, facing downstream, Sta 40+00, March 17, 2021 (MY-04)

PS-11, R4, facing downstream, Sta 44+50, August 21, 2018 (MY-00)

PS-11, R4, facing downstream, Sta 44+50, March 17, 2021 (MY-04)

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

PS-12, R5, facing downstream, Sta 10+00, March 17, 2021 (MY-04)

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

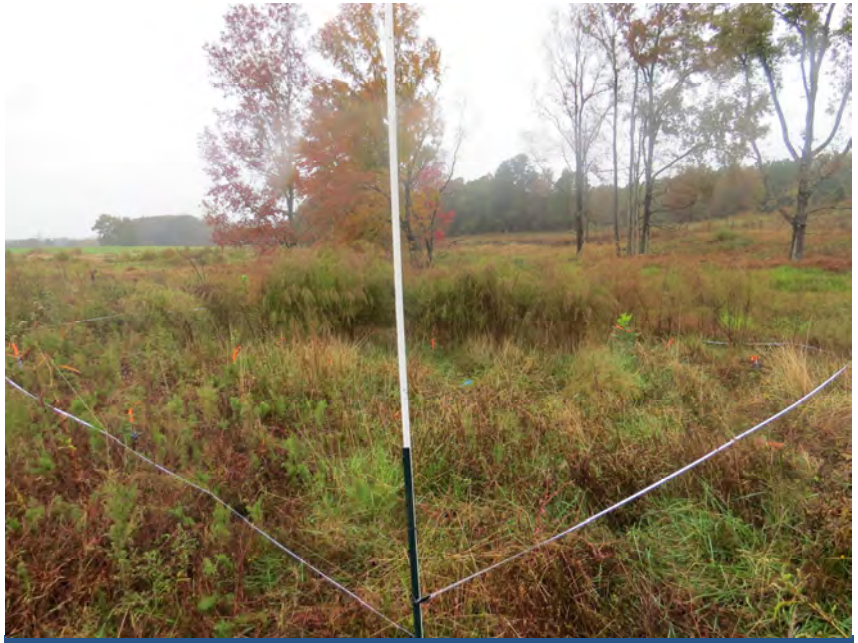
PS-13, R5, facing upstream, Sta 13+50, March 17, 2021 (MY-04)

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

Veg Plot 1, September 14, 2021 (MY-04)

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

Veg Plot 2, September 14, 2021 (MY-04)



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

Veg Plot 3, September 14, 2021 (MY-04)

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

Veg Plot 4, September 14, 2021 (MY-04)

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

Veg Plot 5, September 14, 2021 (MY-04)

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

Veg Plot 6, September 14, 2021 (MY-04)

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

Veg Plot 7, September 14, 2021 (MY-04)

Random Veg Plot 1, September 22, 2021 (MY-04)

Random Veg Plot 2, September 22, 2021 (MY-04)

SPA1, October 14, 2020 (MY-03)

SPA1, September 14, 2021 (MY-04)

SPA2, October 14, 2020 (MY-03)

SPA2, September 14, 2021 (MY-04)

Kudzu Problem Area (VPA1), October 22, 2020 (MY-03)

Kudzu Problem Area (VPA1), September 22, 2021 (MY-04)

Kudzu Problem Area (VPA1), October 22, 2020 (MY-03)

Kudzu Problem Area (VPA1), September 22, 2021 (MY-04)

Encroachment Area (VPA2), October 7, 2020 (MY-03)

Encroachment Area (VPA2), September 14, 2021 (MY-04)

Encroachment Area (VPA2), October 7, 2020 (MY-03)

Encroachment Area (VPA2), September 14, 2021 (MY-04)

Appendix C – Vegetation Plot Data

Lake Wendell

Table 6: Planted and Total Stem Counts

			Current Plot Data (MY4 2021)																					Annual Means														
			001-01-0001			001-01-0002			001-01-0003			001-01-0004			001-01-0005			001-01-0006			001-01-0007			MY4 (2021)			MY3 (2020)			MY2 (2019)			MY1 (2018)			MY0 (2018)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo		Tree																														1					
Acer rubrum		Tree			10							2	2	2			20	2	2	7	2	2	2	6	6	41	6	6	68	6	6	25	6	6	62	7	7	7
Alnus serrulata	Tag Alder, Smooth Alder, Hazel Alder	Shrub Tree							1	1	1							1	1	1	1	1	1	3	3	3	3	3	3	3	3	3	2	2	2	3	3	3
Betula nigra	River Birch, Red Birch	Tree	1	1	1	1	1	1	2	2	2	2	2	2				2	2	2				8	8	8	8	8	8	11	11	11	9	9	9	12	12	12
Carpinus caroliniana		Shrub Tree	1	1	1										2	2	2							3	3	3	3	3	3	3	3	3	4	4	4	5	5	5
Cornus amomum	Silky Dogwood	Shrub Tree	1	1	1	1	1	1																2	2	2	2	2	2	2	2	2	2	2	2	3	3	3
Diospyros virginiana	American Persimmon, Possumwood	Tree										2	2	2										2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	1	1	1	1	1	1	1	1	1				1	1	1							4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Ilex verticillata	Winterberry	Shrub Tree																																	1	1	1
Lindera benzoin	Northern Spicebush	Shrub Tree																																	8	8	8
Liquidambar styraciflua	Sweet Gum, Red Gum	Tree			9						8			1			1			2					21			16			8			9			
Liriodendron tulipifera		Tree	1	1	1				2	2	2				1	1	1	1	1	1	2	2	2	7	7	7	7	7	8	8	8	8	13	13	13	27	27	27
Magnolia virginiana		Shrub Tree				1	1	1	1	1	1	2	2	2				1	1	1	1	1	1	6	6	6	7	7	7	7	7	7	8	8	8	8	8	8
Pinus taeda	Loblolly Pine, Old Field	Tree			2			2									1			4						9			12									
Platanus occidentalis	Sycamore, Plane-tree	Tree	1	1	1	1	1	1	1	1	1				4	4	4	1	1	1	3	3	3	11	11	11	11	11	11	11	11	11	12	12	12	18	18	18
Prunus serotina		Shrub Tree												1												1			1			2						
Quercus michauxii	Basket Oak, Swamp Chestnut Oak	Tree	2	2	2							4	4	4	1	1	1	1	1	1				8	8	8	8	8	8	7	7	7	7	7	7	7	7	7
Quercus nigra	Water Oak, Paddle Oak	Tree				1	1	1				1	1	1										2	2	2	3	3	3	4	4	4	4	4	4	9	9	9
Quercus phellos	Willow Oak	Tree							4	4	4				3	3	3	3	3	3	1	1	1	11	11	11	11	11	11	9	9	9	10	10	10	11	11	11
Rhus copallinum		Shrub Tree																		2						2												
Rosa palustris	Swamp Rose	Shrub Vine																																1				
Salix nigra	Black Willow	Tree																																1				
Ulmus alata	Winged Elm	Tree																		1						1												
		Stem count	8	8	29	6	6	8	12	12	20	13	13	15	12	12	34	12	12	26	10	10	10	73	73	142	75	75	167	77	77	107	83	83	150	125	125	125
		size (ares)	1			1			1			1			1			1			1			7			7			7			7			7		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.17			0.17			0.17			0.17			0.17		
		Species count	7	7	10	6	6	7	7	7	8	6	6	8	6	6	9	8	8	12	6	6	6	13	13	18	13	13	16	13	13	16	13	13	16	15	15	15
		Stems per ACRE	323.7	323.7	1174	242.8	242.8	323.7	485.6	485.6	809.4	526.1	526.1	607	485.6	485.6	1376	485.6	485.6	1052	404.7	404.7	404.7	422	422	820.9	433.6	433.6	965.5	445.2	445.2	618.6	479.8	479.8	867.2	722.7	722.7	722.7

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Table 6a: Vegetation Plot Mitigation Success Summary Table			
Plot #	Planted Stems/Acre	Success Criteria Met	Average Stem Height (ft)
1	323	Yes	6.6
2	242	No	5.6
3	485	Yes	7.7
4	526	Yes	7
5	485	Yes	10
6	485	Yes	5.7
7	404	Yes	17
Project Average	421	Yes	8.5

Appendix D – Stream Measurement and Geomorphology Data

Lake Wendell
Figure 3: Pebble Count

		Date Collected:	9/21/2018	10/18/2019	9/30/2020	9/14/2021			
			MY 1	MY2	MY3	MY4	MY5	MY6	MY7
MATERIAL	PARTICLE	SIZE (mm)	Total #	Total #	Total #	Total #	Total #	Total #	Total #
SILT/CLAY	Silt / Clay	< .063	6	10	3	7			
SAN	Very Fine	.063 - .125	12	4	7				
	Fine	.125 - .25	9	3	19	14			
	Medium	.25 - .50	13	5					
	Coarse	.50 - 1.0	18	4	46	29			
	Very Coarse	1.0 - 2.0	17	12		1			
GRAVEL	Very Fine	2.0 - 2.8	11	1	1				
	Very Fine	2.8 - 4.0		1					
	Fine	4.0 - 5.6	4	2	2				
	Fine	5.6 - 8.0	4	4	7	1			
	Medium	8.0 - 11.0	2	5	4				
	Medium	11.0 - 16.0	1	11	6	4			
	Coarse	16 - 22.6	1	6	5	11			
	Coarse	22.6 - 32	1	8		14			
	Very Coarse	32 - 45		10		8			
	Very Coarse	45 - 64	1	5		7			
COBBLE	Small	64 - 90		5		1			
	Small	90 - 128		3		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	100			

Cumulative	D16	0.11	0.2	0.16	0.2			
	D35	0.38	1.7	0.55	0.7			
	D50	0.73	15	0.69	1			
	D65	1.3	27	0.86	21			
	D84	3.5	60	7.7	36			
	D95	9.4	120	16	61			

MY4	Riffle			Pool	
	Channel materials			Channel materials	
	D16 =	0.51		D16 =	0.16
	D35 =	7.4		D35 =	0.53
	D50 =	21		D50 =	0.65
	D65 =	28		D65 =	0.81
	D84 =	44		D84 =	13
	D95 =	83		D95 =	24

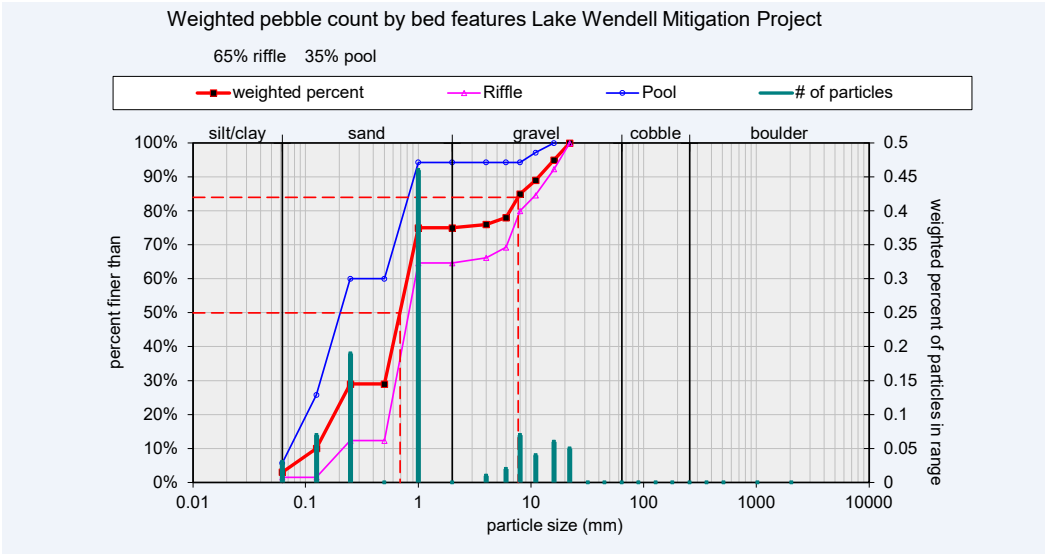


Table 7a. Baseline Stream Data Summary
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)

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	-	5.8	-
Floodprone Width (ft)	6.1	18.7	10.0	20.0	14.0	30.0	23.1	-
Bankfull Mean Depth (ft)	0.5	0.7	0.8	1.6	0.5	-	0.4	-
Bankfull Max Depth (ft)	0.8	1.5	0.9	1.3	0.6	-	0.7	-
Bankfull Cross Sectional Area (ft^2)	2.5	2.8	3.0	5.0	2.7	-	2.3	-
Width/Depth Ratio	5.3	17.7	6.2	14.2	13.0	-	14.6	-
Entrenchment Ratio	1.2	9.9	7.1	8.4	2.4	5.1	4.3	-
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	
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	-	6.6	-
Floodprone Width (ft)	13.7	14.1	10.0	20.0	15.0	30.0	45.0	-
Bankfull Mean Depth (ft)	0.6	0.7	0.8	1.6	0.5	-	0.5	-
Bankfull Max Depth (ft)	0.9	1.0	0.9	1.3	0.7	-	1.1	-
Bankfull Cross Sectional Area (ft^2)	4.2	5.9	3.0	5.0	3.6	-	3.6	-
Width/Depth Ratio	8.2	15.2	6.2	14.2	13.0	13.0	12.8	-
Entrenchment Ratio	1.4	2.2	7.1	8.4	2.2	4.4	7.4	-
Bank Height Ratio	1.8	1.9	0.9	1.1	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	-	7.3	-
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	-	0.5	-
Bankfull Max Depth (ft)	0.9	-	0.9	1.3	0.7	-	0.8	-
Bankfull Cross Sectional Area (ft^2)	5.9	-	3.0	5.0	4.4	-	3.5	-
Width/Depth Ratio	15.2	-	6.2	14.2	14.0	-	15.1	-
Entrenchment Ratio	1.4	-	7.1	8.4	2.2	4.5	8.0	-
Bank Height Ratio	1.8	-	0.9	1.1	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	
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	8.5
Floodprone Width (ft)	44.1	-	10.0	35.0	17.0	35.0	17.0	35.0
Bankfull Mean Depth (ft)	1.0	-	0.8	1.6	0.7	0.9	0.7	0.9
Bankfull Max Depth (ft)	1.8	-	0.9	1.3	0.8	0.9	0.8	0.9
Bankfull Cross Sectional Area (ft^2)	6.2	-	3.0	5.0	6.2	6.2	6.2	6.2
Width/Depth Ratio	6.3	-	6.2	14.2	12.0	12.0	12.0	12.0
Entrenchment Ratio	7.1	-	7.1	8.4	1.8	5.3	1.8	1.8
Bank Height Ratio	1.0	-	0.9	1.1	1.0	1.1	1.0	1.1
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	-	4.3	
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	
Bankfull Max Depth (ft)	0.8	-	0.9	1.3	0.5	-	0.7	
Bankfull Cross Sectional Area (ft^2)	1.4	-	3.0	5.0	1.5	-	1.6	
Width/Depth Ratio	3.5	-	10.3	14.2	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	
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	

Table 7b. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)							Cross Section 3 (Riffle)						
Parameters	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	5.8	5.5	10.4	8.6	N/A			6.1	7.9	7.0	4.0	N/A			6.6	6.8	6.4	6.0	N/A		
Floodprone Width (ft)	23.1	23.0	21.7	21.6	N/A			45.0	45.0	49.0	49.0	N/A			46.0	45.0	50.0	46.2	N/A		
Bankfull Mean Depth (ft)	0.4	0.4	0.2	0.2	N/A			0.8	0.6	0.6	1.0	N/A			0.5	0.5	0.5	0.6	N/A		
Bankfull Max Depth (ft)	0.7	0.6	0.6	0.6	N/A			1.2	1.3	1.3	1.4	N/A			1.1	1.1	1.0	0.9	N/A		
Bankfull Cross Sectional Area (ft^2)	2.3	2.0	2.0	2.0	N/A			4.6	4.1	4.1	4.1	N/A			3.5	3.5	3.5	3.5	N/A		
Bankfull Width/Depth Ratio	14.6	13.2	55.2	38.0	N/A			8.0	14.2	12.0	3.9	N/A			12.7	13.0	11.9	10.1	N/A		
Bankfull Entrenchment Ratio	4.3	4.2	2.1	2.5	N/A			7.5	5.7	7.0	12.2	N/A			7.5	6.8	7.8	7.7	N/A		
Bankfull Bank Height Ratio	1.0	1.0	<1	<1	N/A			1.0	1.0	1.0	1.1	N/A			1.0	1.0	1.1	1.1	N/A		
d50 (mm)	N/a	0.80	21.00	0.82	21.00			N/a	0.64	1.35	0.20	0.65			N/a	0.80	21.00	0.82	21.00		
	Cross Section 4 (Pool)							**Cross Section 5 (Riffle)**							**Cross Section 6 (Riffle)**						
Parameters	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	14.2	14.3	14.2	19.8	N/A			7.9	7.3	8.4	7.9	N/A			6.7	7.0	8.6	7.7	N/A		
Floodprone Width (ft)	68.0	68.0	68.0	68.0	N/A			59.0	59.0	49.0	59.1	N/A			49.0	49.0	49.0	49.0	N/A		
Bankfull Mean Depth (ft)	0.6	0.6	0.6	0.4	N/A			0.5	0.5	0.3	0.3	N/A			1.6	1.6	1.3	1.4	N/A		
Bankfull Max Depth (ft)	1.6	1.6	1.5	1.5	N/A			0.8	0.8	0.8	0.8	N/A			2.5	2.6	2.7	2.5	N/A		
Bankfull Cross Sectional Area (ft^2)	8.5	8.5	8.5	8.5	N/A			3.7	2.7	2.7	2.7	N/A			10.8	11.2	11.2	11.2	N/A		
Bankfull Width/Depth Ratio	23.8	24.4	23.8	46.5	N/A			16.8	15.1	25.2	23.1	N/A			4.2	4.4	6.7	5.3	N/A		
Bankfull Entrenchment Ratio	4.8	4.8	4.8	3.4	N/A			7.4	8.0	5.8	7.5	N/A			7.3	7.0	5.7	6.3	N/A		
Bankfull Bank Height Ratio	1.0	1.0	1.1	<1	N/A			1.0	<1	1.0	1.0	N/A			1.0	1.0	1.0	1.0	N/A		
d50 (mm)	N/a	0.64	1.35	0.20	0.65			N/a	0.80	21.00	0.82	21.00			N/a	0.80	21.00	0.82	21.00		
	Cross Section 7 (Pool)							**Cross Section 8 (Riffle)**													
Parameters	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+							
Bankfull Width (ft)	13.1	12.7	10.7	8.0	N/A			4.3	4.6	4.9	8.6	N/A									
Floodprone Width (ft)	44.0	44.0	44.0	44.0	N/A			24.0	20.0	23.0	23.0	N/A									
Bankfull Mean Depth (ft)	1.2	1.3	1.2	1.5	N/A			0.4	0.5	0.4	0.2	N/A									
Bankfull Max Depth (ft)	2.9	2.8	2.9	3.0	N/A			0.7	0.6	0.7	0.6	N/A									
Bankfull Cross Sectional Area (ft^2)	15.4	12.3	12.3	12.3	N/A			1.6	2.1	2.1	2.1	N/A									
Bankfull Width/Depth Ratio	10.9	9.6	9.3	5.2	N/A			12.1	10.1	11.3	35.4	N/A									
Bankfull Entrenchment Ratio	3.4	3.5	4.1	5.5	N/A			5.5	4.3	4.7	2.7	N/A									
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0	N/A			1.0	1.2	1.0	<1	N/A									
d50 (mm)	N/a	0.64	1.35	0.20	0.65			N/a	0.80	21.00	0.82	21.00									

Table 7c. Monitoring Data - Stream Reach Summary
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)

Parameter	Baseline		MY1		MY2		MY3		MY4		MY5	
Reach ID: R1												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	11.3	31.2										
Riffle Slope (ft/ft)	0.017	0.036										
Pool Length (ft)	5.5	12.5										
Pool Max depth (ft)	1.2	1.7										
Pool Spacing (ft)	7.7	33.3										
Pattern												
Channel Beltwidth (ft)	25	51										
Radius of Curvature (ft)	11	36										
Rc:Bankfull width (ft/ft)	2.1	4.2										
Meander Wavelength (ft)	23	56										
Meander Width Ratio	4.1	7.4										
Additional Reach Parameters												
Rosgen Classification	G5c											
Sinuosity (ft)	1.05											
Water Surface Slope (Channel) (ft/ft)	0.026											
BF slope (ft/ft)	0.0265											
[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: 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

Parameter	Baseline		MY1		MY2		MY3		MY4		MY5	
Reach ID: R4												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	9.5	21.9										
Riffle Slope (ft/ft)	0.013	0.022										
Pool Length (ft)	6.1	8.5										
Pool Max depth (ft)	2	2.2										
Pool Spacing (ft)	18	44										
Pattern												
Channel Beltwidth (ft)	29	53										
Radius of Curvature (ft)	12	20										
Rc:Bankfull width (ft/ft)	1.9	3.2										
Meander Wavelength (ft)	52	77										
Meander Width Ratio	4.7	8.5										
Additional Reach Parameters												
Rosgen Classification	E5											
Sinuosity (ft)	1.25											
Water Surface Slope (Channel) (ft/ft)	0.014											
BF slope (ft/ft)	0.015											
[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: R5												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	10.3	37										
Riffle Slope (ft/ft)	0.017	0.027										
Pool Length (ft)	4.7	8.5										
Pool Max depth (ft)	1.1	1.5										
Pool Spacing (ft)	8.7	33.3										
Pattern												
Channel Beltwidth (ft)	-	-										
Radius of Curvature (ft)	-	-										
Rc:Bankfull width (ft/ft)	-	-										
Meander Wavelength (ft)	-	-										
Meander Width Ratio	-	-										
Additional Reach Parameters												
Rosgen Classification	B5											
Sinuosity (ft)	1.06											
Water Surface Slope (Channel) (ft/ft)	0.025											
BF slope (ft/ft)	0.024											
[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												

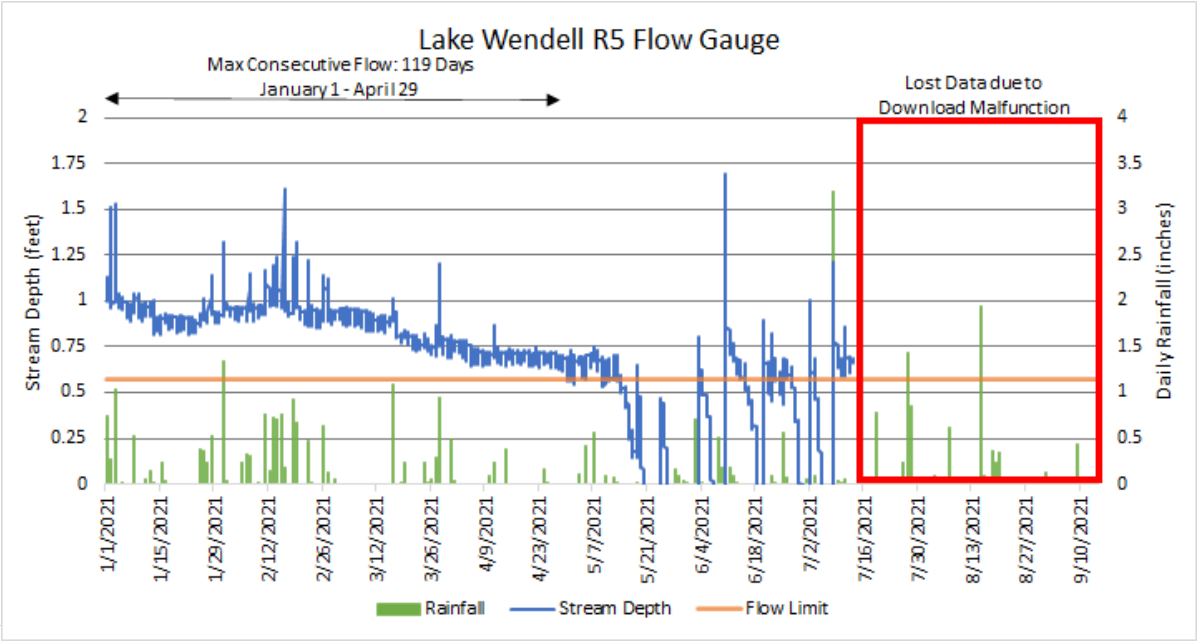
Pattern and Profile data will not typically be collected unless visual data, dimensional data or profile data indicate significant deviations from baseline conditions

Appendix E – Hydrologic Data

Table 8. Verification of Flow Events						
Monitoring Year	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
MY1	8/16/2018	8/3/2018	Crest Gauge	Bkf, 3" above FP elevation	Photos	
	9/17/2018	9/16-9/17/2018	Oberserved visual indicators (wrack lines) of stage after storm	Bkf	Photos	
	11/21/2018	9/16-9/17/2018	Crest Gauge	Bkf	Photos	
MY2	7/26/2019	7/24/2019	Crest Gauge	Bkf	Photos	.325 ft
	8/20/2019	uknown	Crest Gauge	Bkf & Qgs	Photos	.45 ft
MY3	2/7/2020	uknown	Crest Gauge	Bkf & Qgs	Photos	.6 ft
	9/30/2020	uknown	Crest Gauge	Bkf & Qgs	Photos	1.2 ft
MY4	1/13/2021	unknown	Crest Gauge	Bkf	Photos	0.5 ft

1/13/2021

Figure 4a: Hydrograph Data (pressure transducer)



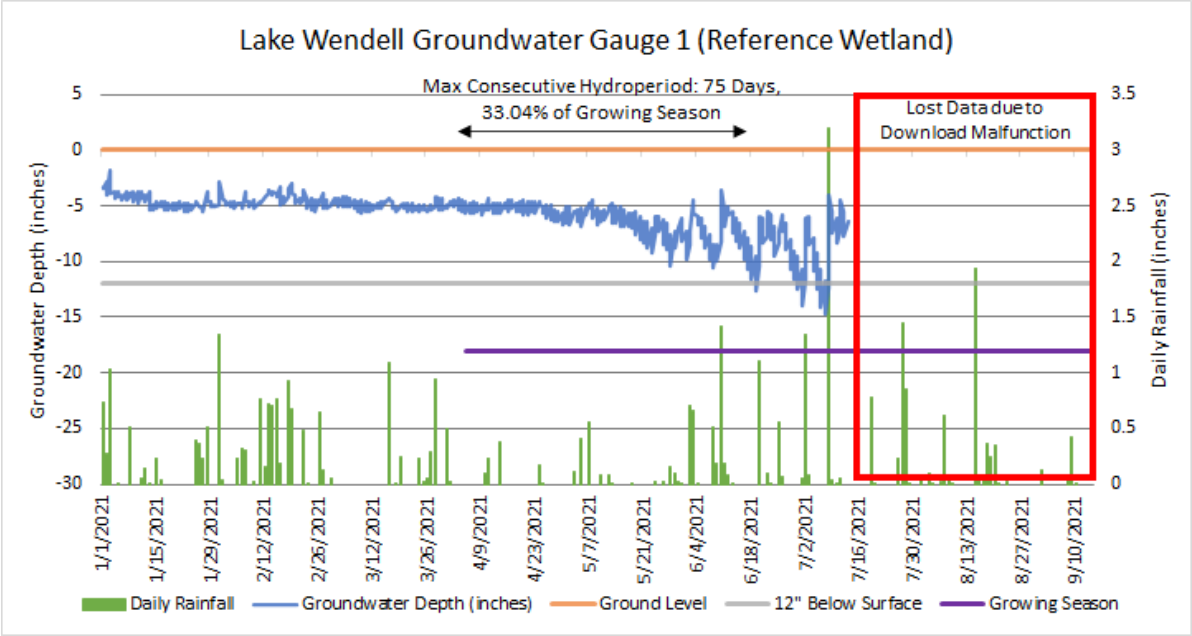
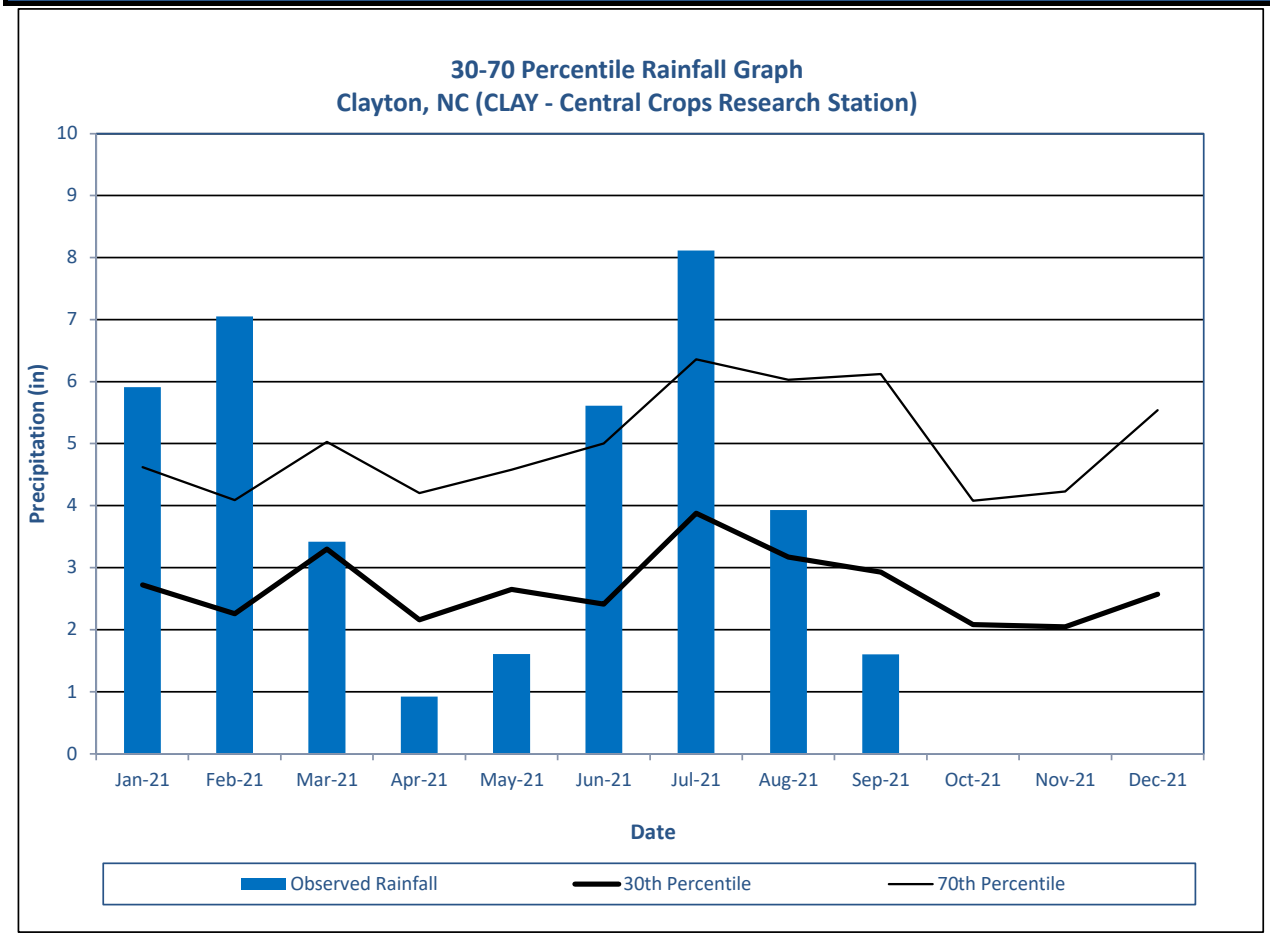


Figure 4b: Groundwater Gauge Data Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081) MY4 2021								
Monitoring Gauge Name	Max Consecutive Hydroperiod: Saturation within 12 Inches of Soil Surface (Percent of Growing Season) WETS Station: 317994 - Smithfield Growing Season: 4/6-11/4 (227 days)							
	2018	2019	2020	2021	2022	2023	2024	Mean
Lake Wendell Reference Wetland	95.20%	53.52%	32.16%	33.04%				

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

Figure 5: Monthly Rainfall Data
Lake Wendell Mitigation Project (NCDEQ DMS Project ID# 97081)
MY4 2021



*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-21	2.72	4.62	5.91
Feb-21	2.26	4.09	7.05
Mar-21	3.30	5.03	3.42
Apr-21	2.16	4.20	0.92
May-21	2.65	4.58	1.61
Jun-21	2.41	5.00	5.61
Jul-21	3.88	6.36	8.11
Aug-21	3.17	6.03	3.93
Sep-21	2.93	6.12	1.60
Oct-21	2.08	4.08	**
Nov-21	2.05	4.23	**
Dec-21	2.57	5.54	**