
Monitoring Report
FINAL VERSION
Pen Dell Mitigation Project
Monitoring Year 1
Calendar Year of Data Collection: 2018

NCDEQ DMS Project Identification # 97079
NCDEQ DMS Contract # 6824
Neuse River Basin (Cataloging Unit 03020201)
USACE Action ID Number: SAW-2016-00885
NCDEQ DWR Project # 2016-0403
Johnston County, NC
Contracted Under RFP # 16-006477
Data Collection Period: March-May 2018, Submission Date: March 2019



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1 Project Summary

Water and Land Solutions, LLC (WLS) completed the construction and planting of the Pen Dell Mitigation Project (Project) full-delivery project for the North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) in April 2018. The Project is located in Johnston County, North Carolina between the Community of Archer Lodge and the Town of Wendell at 35° 43' 52.51" North and 78° 21' 10.12" West. The Project site is located in the NCDEQ Sub-basin 03-04-06, in the Lower Buffalo Creek Priority Sub-watershed 030202011504 study area for the Neuse 01 Regional Watershed Plan (RWP), and in the Targeted Local Watershed 03020201180050, all of the Neuse River Basin.

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 approximately 5,064 linear feet of existing streams, approximately 633,803 square feet of riparian buffers. The Project construction and planting were completed in April 2018 and MY1 monitoring activities occurred between April and November 2018 (Table 2). This report documents the completion of and presents the data for the first year of monitoring (MY1). The Project meets the MY1 success criteria for stream hydrology, stream horizontal and vertical stability, streambed material condition and stability, jurisdictional stream flow, and vegetation. Based on these results, the Project is expected to meet the Year 2 Monitoring success criteria in 2019.

2 Project Background

2.1 Project Location, Setting, and Existing Conditions

The Pen Dell Mitigation Project (Project) site is located in the Upper Buffalo Creek Sub-watershed 030202011502 study area for the Neuse 01 Regional Watershed Plan (RWP), in the Wake-Johnston Collaborative Local Watershed Plan, and in the Targeted Local Watershed 03020201180050, all of the Neuse River Basin. The Project site is situated in the lower piedmont where potential for future development associated with the I-540 corridor and rapidly growing Johnston County area is imminent, as described in the Regional Watershed Plan (RWP) for the Upper Neuse River Basin within Hydrologic Unit (HU) 03020201.

The RWP identified and prioritized potential mitigation strategies to offset aquatic resource impacts from development and provided mitigation project implementation recommendations to improve ecological uplift within the Neuse 01 subbasin, which included traditional stream and wetland mitigation, buffer restoration, nutrient offsets, non-traditional mitigation projects such as stormwater and agricultural BMPs, and rare, threatened, or endangered (RTE) species habitat preservation or enhancement.

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 approximately 5,064 linear feet of existing streams, approximately 633,803 square feet of riparian buffers permanently protected by a conservation easement. The catchment area is 156 acres and has an impervious cover of approximately one percent. The dominant land uses are agriculture and mixed forest. Prior to Project construction, livestock had access to R3 and R4, and the riparian buffers were less than 50 feet wide on all reaches except R5.



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 (LWP) and 2015 Neuse 01 Regional Watershed Plan (RWP) 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:

- Restore stream and floodplain interaction and geomorphically stable conditions by reconnecting historic flow paths and promoting more natural flood processes,
- Improve and protect water quality by reducing streambank erosion, nutrient and sediment inputs,
- Restore and protect riparian buffer functions and habitat connectivity in perpetuity by recording a permanent conservation easement,
- Implement agricultural BMPs to reduce nonpoint source inputs to receiving waters.
- To accomplish these site-specific goals, the following function-based objectives will be measured and included with the performance standards to document overall project success as described in the table below:

Functional Category (Level)	Functional Goal / Parameter	Functional Design Objective
Hydrology (Level 1)	Improve Base Flow	Improve and/or remove existing stream crossings 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 <1.2 and increase ERs at 2.2 or greater.
Geomorphology (Level 3)	Improve Bedform Diversity	Increase riffle/pool percentage and pool-to-pool spacing ratios.
	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
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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. The final mitigation plan and PCN were submitted to DMS September 29, 2017 for submission to the NCIRT. The Section 404 General (Regional and Nationwide) Permit Verification was issued January 12, 2018. Project construction started on January 29, 2018 and mitigation site earthwork was completed on April 1, 2018, and mitigation site planting was completed on April 6, 2018, both 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.

Refer to Figure 1 and Table 1 for the project components/asset information. A recorded conservation easement consisting of 15.95 acres protects and preserves all stream reaches, existing wetland areas, and riparian buffers in perpetuity.

3 Project Mitigation Components

3.1 Stream Mitigation Types and Approaches

Stream restoration practices involved raising the existing streambed and reconnecting the stream to the relic floodplain. 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. Permanent cattle exclusion fencing was provided around all restored reaches and riparian buffers, particularly along R3 and R4. 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 is 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 Enhancement Level II

Work along the R1 involved Enhancement Level II practices to improve the current channel condition and aquatic function. This area has been historically disturbed through agricultural practices and the channel exhibits limited morphology. Prior to construction, the existing channel has minimal bank erosion and channel incision throughout most of its length. WLS planted native woody species vegetation and restored the riparian buffer in excess of 50 feet within the conservation easement. Additionally, a 20-foot long culverted pipe crossing and the associated embankment was removed and a water quality treatment feature was installed outside of the conservation easement to reduce direct sediment and nutrient inputs.

3.1.2 R2 Enhancement Level I

Work along R2 involved Enhancement Level I activities by slightly raising the bed elevation and excavating floodplain benches. In-stream structures were installed to dissipate flow energies and protect streambanks. In-stream structures included constructed riffles for grade control and aquatic habitat, and log weirs/jams for encouraging step-pool formation, bank stability, and bedform diversity. Bioengineering



techniques such as geolifts and live stakes were also to protect streambanks and promote woody vegetation growth along the streambanks. A water quality treatment feature was installed outside the permanent conservation easement along the pond periphery to provide habitat diversity and capture fine sediment and nutrients coming from the active agricultural field areas across Wendell Road. Riparian buffers in excess of 50 feet were restored and protected along all of R2. Additionally, permanent fencing will be installed to permanently exclude livestock and reduce sediment and nutrient inputs.

3.1.3 R3 Enhancement Level I

Enhancement activities along R3 involved a Priority Level II restoration approach by slightly raising the bed elevation along the upper section and providing an active floodplain area within the valley. In-stream structures, such as log vanes, log steps, and log jam riffles were used to dissipate flow energy, protect streambanks, and eliminate potential for future incision. Channel banks were graded to stable side slopes and bioengineering techniques such as geolifts and live stakes were also be used to protect streambanks and promote woody vegetation growth. Healthy mature trees or significant native vegetation were protected and incorporated into the design and riparian buffers of at least 50 feet wide were established along the entire reach. Additionally, permanent fencing was installed along with alternative watering systems to exclude livestock and reduce direct sediment and nutrient inputs. The existing perched pipe culverts were removed and a new culverted stream crossing was installed at a lower elevation to help improve flow flows and aquatic passage.

3.1.4 R4 Restoration

Work along R4 involved relocating the existing degraded channel towards the center of the valley and implementing a Priority Level I Restoration approach by raising the bed elevation and reconnecting the stream with its abandoned floodplain. This approach promotes more frequent over bank flooding in areas with hydric soils, thereby creating favorable conditions for wetland enhancement. The reach was restored as a Rosgen 'C5' stream type using appropriate riffle-pool morphology with a conservative meander planform geometry that accommodates the natural valley slope and width. This approach allowed restoration of a stable channel form with appropriate bedform diversity, as well as improved biological functions through increased aquatic and terrestrial habitats. In-stream structures were incorporated to control grade, dissipate flow energies, protect streambanks, and eliminate the potential for channel incision. In-stream structures included constructed wood 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. Riparian buffers greater than 50 feet were restored and protected along the entire length of R4. Mature trees and significant native vegetation were protected and incorporated into the design. Additionally, shallow floodplain depressions were created to provide habitat diversity, temporary sediment storage and improved treatment of overland flows.

3.1.5 R5 Preservation

Preservation was implemented along this reach since the existing stream and wetland system is mostly stable with a mature riparian buffer due to minimal historic impacts. The preservation area is protected in perpetuity through a permanent conservation easement. This approach will extend the wildlife corridor from the project boundary throughout the entire riparian valley, while providing a hydrologic connection and critical habitat linkage within the catchment area.



3.2 Wetlands Mitigation Types and Approaches

Wetland mitigation credits are not contracted or proposed for this project.

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 (7) years with the final duration dependent upon performance trends toward achieving project goals and objectives. The following Proposed Monitoring Plan Summary from the approved final mitigation plan summarizes the measurement methods and performance standards. Specific success criteria components and evaluation methods follow.

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)	Well device (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	DWR Small Stream/Qual v4 sampling, IBI	N/A	Increase leaf litter and organic matter critical to provide in-stream



	Communities and Aquatic Health		cover/shade, wood recruitment, and carbon sourcing.
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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). Vertical stability and floodplain access will both be evaluated by looking at Entrenchment Ratios (ER). The ER shall be no less than 2.2 (>1.5 for “B” stream types) along the restored project stream reaches. This standard only applies to restored reaches of the channel where ERs were corrected through design and construction.

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.

4.1.5 Jurisdictional Stream Flow

The restored stream systems must be classified as at least intermittent, and therefore must exhibit base flow for some portion of the year 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 (7) feet in height at Year 5 of monitoring and ten (10) feet in height at Year 7 of monitoring. For all of the monitoring years (Year 1 through Year 7), the number of Red maple (*Acer rubrum*) stems cannot exceed 20% of the total stems in any of the vegetation monitoring plots.

4.3 Wetlands

Wetland mitigation credits are not contracted or proposed for this project. Wetland mitigation performance standards are therefore not included in this section.

5 Monitoring Year 1 Assessment and Results

Annual monitoring was conducted during MY1 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 of the monitoring device locations are depicted on the CCPV (Figure 1). MY1 monitoring results are provided in the appendices. The Project meets the MY1 success criteria for stream hydrology, stream horizontal and vertical stability, streambed material, jurisdictional stream flow and vegetation.

5.1 Stream Hydrology

Monitoring to document the occurrence of the two required bankfull events (overbank flows) and the two required “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 gage installed near the middle of Reach R3 (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. At least two bankfull events occurred during MY1. These events were documented using the described crest gage and photography (Table 8). The documented occurrence of these two flow events satisfies the requirement of the occurrence of the two bankfull events (overbank flows) and the two “geomorphically significant” flow events ($Q_{gs}=0.66Q_2$) within the monitoring period, along with floodplain access by flood flows.

5.2 Stream Horizontal & Vertical Stability

Visual assessment was utilized for assessment of MY1 horizontal and vertical stream stability. The visual assessments for each stream reach concluded that the MY1 stream channel pattern and longitudinal profiles, instream structure locations, still closely match the profile design parameters and MY0/baseline conditions. The MY1 plan form geometry or pattern still appears to fall within acceptable ranges of the design parameters for all restored reaches. Only minor channel adjustments in riffle slopes, pool depths and pattern were observed and therefore did not present a stability concern or indicate a need for remedial action.



5.3 Streambed Material Condition and Stability

A representative sediment sample was collected to assess streambed material condition and stability. The dominant substrate for the project was verified as coarse sand. The post-construction riffle substrate sampling indicated no significant change (e.g. aggradation, degradation, embeddedness) in streambed material condition or stability were observed during MY1.

5.4 Jurisdictional Stream Flow Documentation

Jurisdictional stream flow documentation and monitoring of restored intermittent reaches includes a combination of photographic documentation and the installation of a monitoring gauge (flow gage) (continuous-read pressure transducers) within the thalweg (bottom) of the channel towards the middle portion of enhanced Reach R1 (Figure 1). Additionally, to determine if rainfall amounts are normal for the given year, precipitation data was obtained from the Johnston County weather station (COOP 317994), approximately twenty miles south of the site. The monitoring gage 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 MY1 was conducted utilizing the seven (7) 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 MY1 average surviving planted stem density is 578 stems per acre, which exceeds the interim measure of vegetative success of at least 320 planted stems per acre at the end of the third monitoring year. Summary data and photographs of each plot can be found in Appendix 3. The MY1 vegetation monitoring was also conducted utilizing visual assessment along all of the Project stream reaches. The results of the visual assessment did not indicate any negative changes to the existing vegetation community.

5.6 Wetlands

Wetland mitigation credits are not contracted or proposed for this project. One groundwater monitoring well was installed during the baseline monitoring within an existing wetland area along Reach R4. Two additional groundwater monitoring wells, including an additional one along Reach R4 and an additional one along Reach R5 (preservation), were installed after the first year of monitoring, scheduled for March 2019. The wells were installed to document groundwater levels within the stream and wetland restoration and for reference and comparison to the preservation areas, at the request of the NCIRT (DWR). No performance standards for wetland hydrology success was proposed in the Mitigation Plan and therefore wetland mitigation monitoring is not included for this project.



6 References

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Appendices



Appendix A – Background Tables and Figures

**Table 2. Project Activity and Reporting History
Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)**

**Elapsed Time Since grading complete: 0 yrs 8 months
Elapsed Time Since planting complete: 0 yrs 8 months
Number of reporting Years⁰: 0**

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Project Contract Execution	N/A	3/18/2016
Final Mitigation Plan Submittal	N/A	9/29/2017
Section 404 General (Regional and Nationwide) Permit Verification	N/A	1/12/2018
Begin Construction	N/A	1/29/2018
Mitigation Site Earthwork Completed	N/A	4/1/2018
Mitigation Site Planting Completed	N/A	4/6/2018
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	N/A	N/A
Year 3 Monitoring Report Submittal	N/A	N/A
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 1. Mitigation Assets and Components
Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)**

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	--	1017	10+00 -20+17	1017	1017	EII	EII	2.5	407	Constructed Riffle Above Road Crossing, Planted Buffer, Permanent Conservation Easement
R2	--	546	20+77 - 26+25	526	546	EI	EI	1.5	351	Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.
R3	--	617	30+93 - 37+00	617	601	EI	EI	1.5	411	Channel Enhancement, Floodplain Grading, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.
R4	--	1846	37+00 - 54+87	1779**	1724	R	R	1	1744	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.
R5	--	1176	56+26 - 68+02	1176	1176	P	P	10	118	Invasive Control, 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	1779**			
Enhancement				
Enhancement I	1143			
Enhancement II	1017			
Creation				
Preservation	1176			
High Quality Pres				

Overall Assets Summary

Asset Category	Overall Credits*
Stream	3,031
RP Wetland	
NR Wetland	

* Mitigation Credits are from approved Mitigation Plan, as verified by the as-built survey.

**Credits on R4 reduced by 35' for powerline ROW realized at As-Built

**Table 3. Project Contacts
Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)**

Mitigation Provider	Water & Land Solutions, LLC 11030 Raven Ridge Road, Suite 200, Raleigh, NC 27614
Primary Project POC	William Scott Hunt, III, PE Phone: 919-270-4646
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 11030 Raven Ridge Road, Suite 200, Raleigh, NC 27614
Stream Monitoring POC	William Scott Hunt, III, PE Phone: 919-270-4646
Vegetation Monitoring POC	William Scott Hunt, III, PE Phone: 919-270-4646
Wetland Monitoring POC	William Scott Hunt, III, PE Phone: 919-270-4646

Table 4. Project Information and Attributes

Table 4. Project Information and Attributes					
Project Name	Pen Dell Mitigation Project				
County	Johnston				
Project Area (acres)	16.1				
Project Coordinates (latitude and longitude)	35.7303778 N, -78.3557472 W				
Planted Acreage (Acres of Woody Stems Planted)	8.74				
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)	156 acres, 0.24 sq mi				
Project Drainage Area Percentage of Impervious Area	<1%				
CGIA Land Use Classification	2.01.03, 2.99.05, 413, 4.98 (39% crops/hay, 31% pasture, 24% mixed forest, 2% open water/pond)				
Reach Summary Information					
Parameters	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5
Length of reach (linear feet)	1017	546	617	1846	1176
Valley confinement (Confined, moderately confined, unconfined)	unconfined	mod. confined	unconfined	unconfined	unconfined
Drainage area (Acres and Square Miles)	63 acres, 0.1 sq mi	73 acres, 0.11 sq mi	105 acres, 0.16 sq mi	134 acres, 0.21 sq mi	156 acres, 0.24 sq mi
Perennial, Intermittent, Ephemeral	Intermittent	Perennial/Intermittent	Perennial	Perennial	Perennial
NCDWR Water Quality Classification	C; NSW	C; NSW	C;NSW	C; NSW	C; NSW
Stream Classification (existing)	G5c	E5(incised)	E5(incised)	E5(incised), F5	E5
Stream Classification (proposed)	C5b	C5	C5	C5	E5
Evolutionary trend (Simon)	I	II	III/IV	III/IV	I
FEMA classification	N/A	N/A	N/A	N/A	Zone AE
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

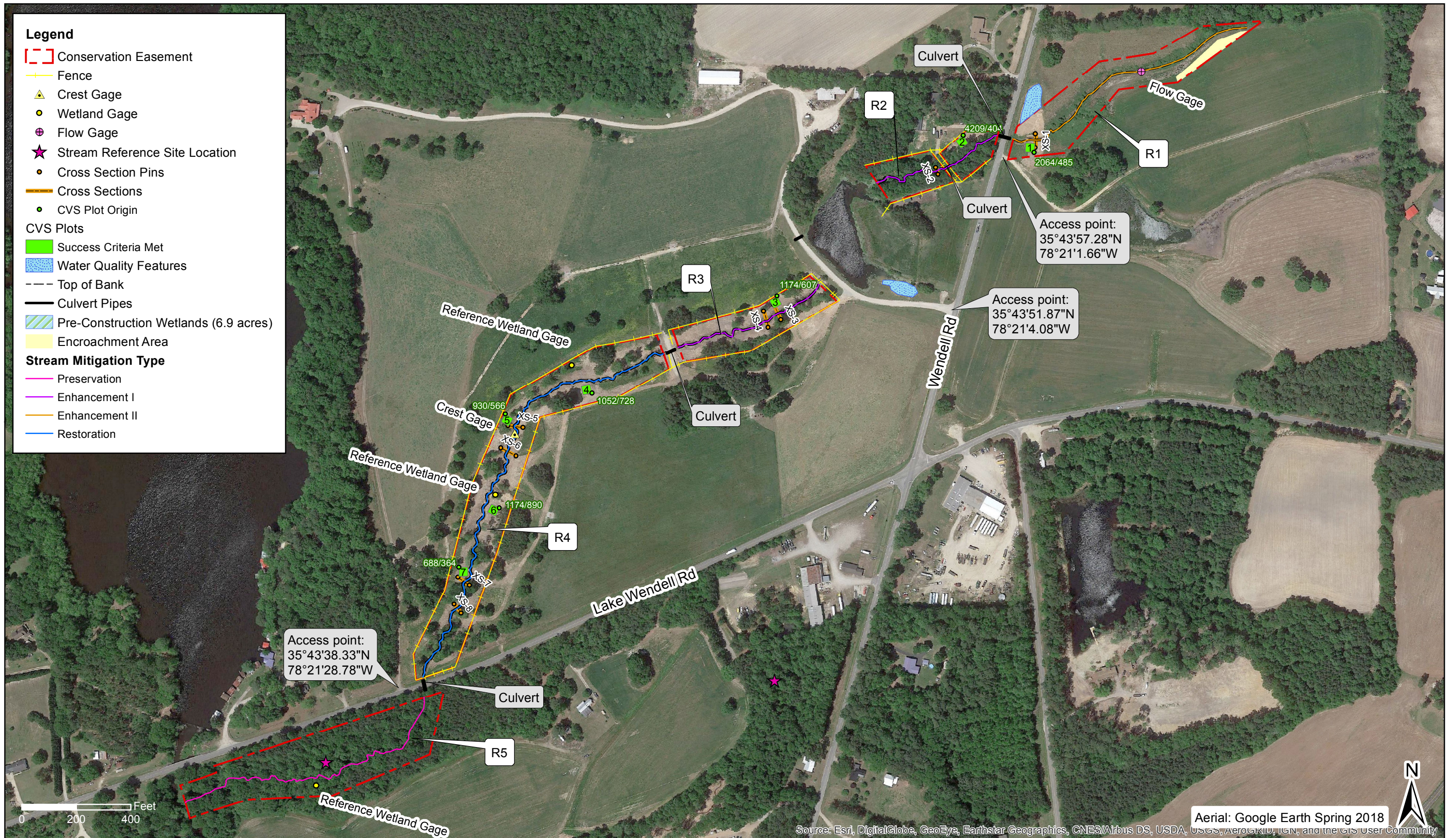


Table 5.
Project
Reach ID
Assessed Length

Visual Stream Morphology Stability Assessment
Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)
R1, R2, R3, R4, R5
5126

Major Channel Category	Channel Category	Sub-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.	37	37			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	32	32			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	13	13			100%			
	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)	9	9			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	35	37			95%			

* Please make Note that the calculation for bank footage uses the total bank footage in the reach not the linear footage of channel.

Therefore the denominator is 2 times the channel length in the calculation.

For the above example this would be 430 divided by 5000 feet of bank =

91%

Formulas exist in the cells above

Table 5a.	Vegetation Condition Assessment					
Project	Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)					
Planted Acreage¹	10.1					

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	Pattern and Color	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	15.95
-------------------------------------	--------------

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	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas ³	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%



R1, facing upstream, Sta 20+00, March 29, 2018 (MY-00)



R1, facing upstream, Sta 20+00, Dec 6, 2018 (MY-01)



R2, facing downstream, Sta 21+50, April 27, 2018 (MY-00)



R2, facing downstream, Sta 21+50, Dec 6, 2018 (MY-01)



R2, facing upstream at crossing, Sta 23+00, April 27, 2018 (MY-00)



R2, facing upstream at crossing, Sta 23+00, Sept 17, 2018 (MY-01)



R3, facing downstream, Sta 31+00, April 27, 2018 (MY-00)



R3, facing downstream, Sta 31+00, Dec 6, 2018 (MY-01)



R3, facing upstream, Sta 33+00, April 27, 2018 (MY-00)



R3, facing downstream, Sta 33+00, Sept 17, 2018 (MY-01)



R4, facing upstream, Sta 43+50, April 27, 2018 (MY-00)



R4, facing upstream, Sta 43+50, Dec 18, 2018 (MY-01)



R4, facing upstream, Sta 44+50, April 27, 2018 (MY-00)



R4, facing upstream, Sta 44+50, Dec 18, 2018 (MY-01)



R4, facing upstream, Sta 52+00, April 27, 2018 (MY-00)



R4, facing upstream, Sta 52+00, Dec 18, 2018 (MY-01)



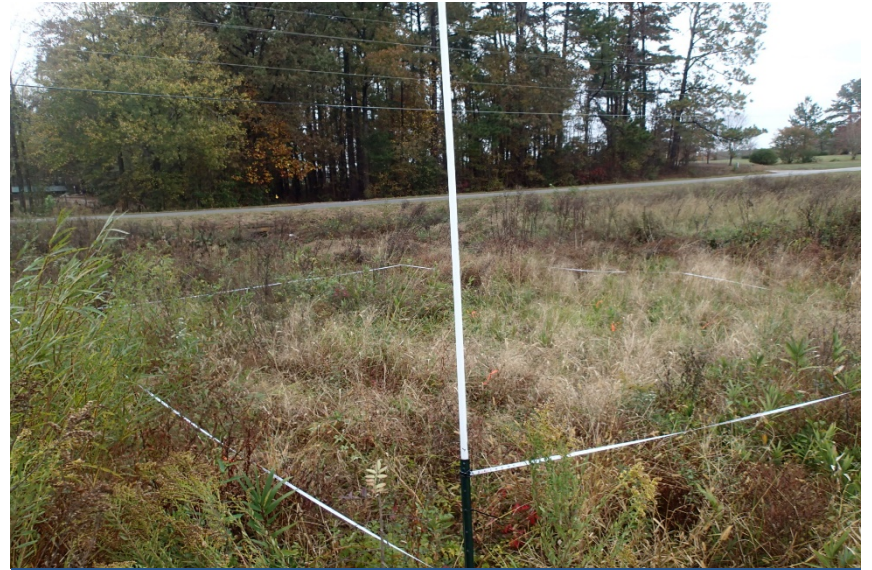
R5, facing upstream, near Sta 62+00, Sept 1, 2015, 2018 (MY-00)



R5, facing upstream, Sta 62+00, Dec 12, 2018 (MY-01)



Veg Plot 1 April 12, 2018 (MY-00)



Veg Plot 1 November 6, 2018 (MY-01)



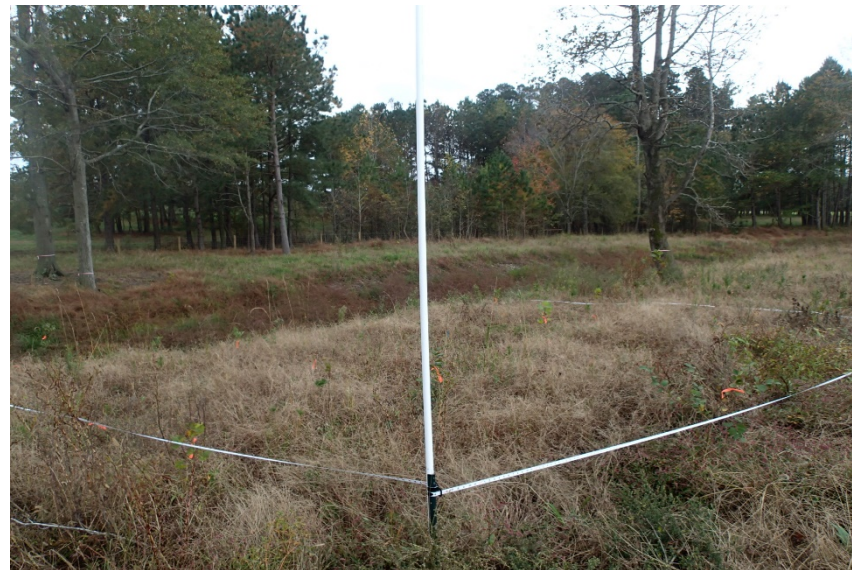
Veg Plot 2 April 12, 2018 (MY-00)



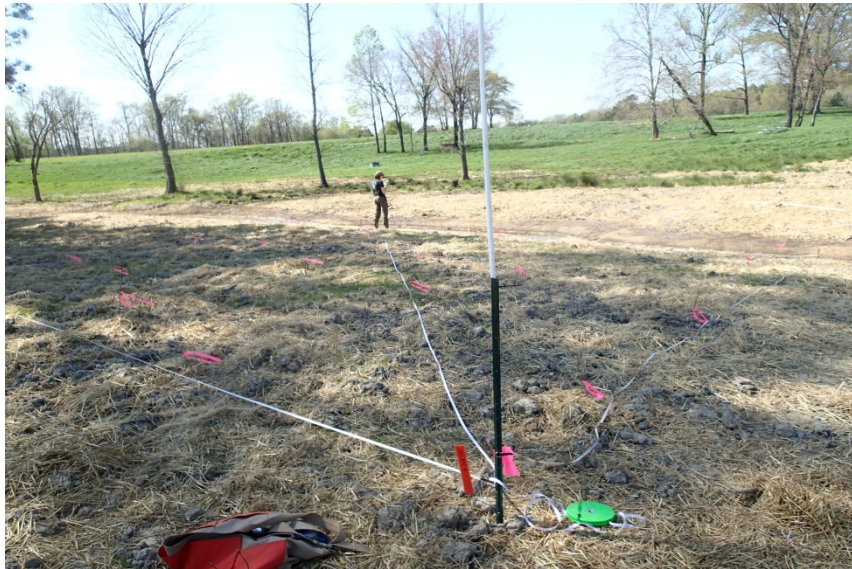
Veg Plot 2 November 6, 2018 (MY-01)



Veg Plot 3 April 12, 2018 (MY-00)



Veg Plot 3 November 6, 2018 (MY-01)



Veg Plot 4 April 12, 2018 (MY-00)



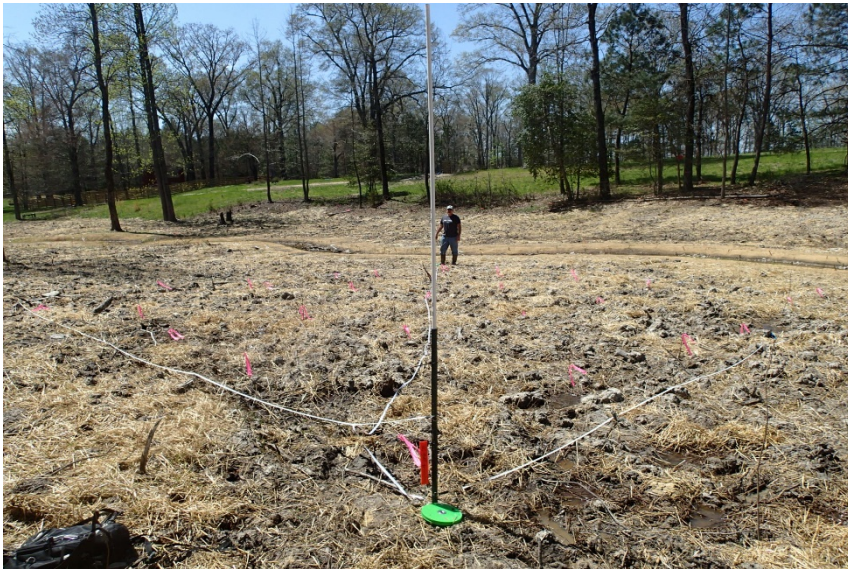
Veg Plot 4 November 6, 2018 (MY-01)



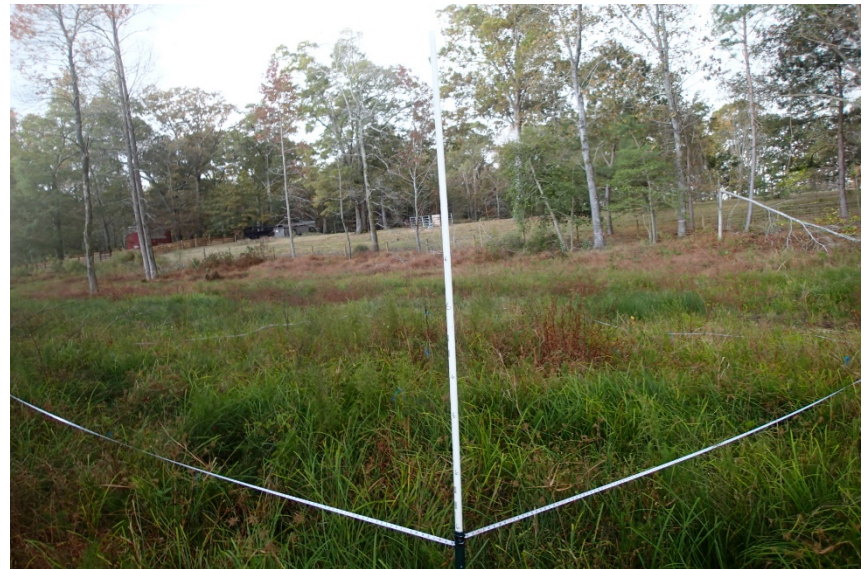
Veg Plot 5 April 12, 2018 (MY-00)



Veg Plot 5 November 6, 2018 (MY-01)



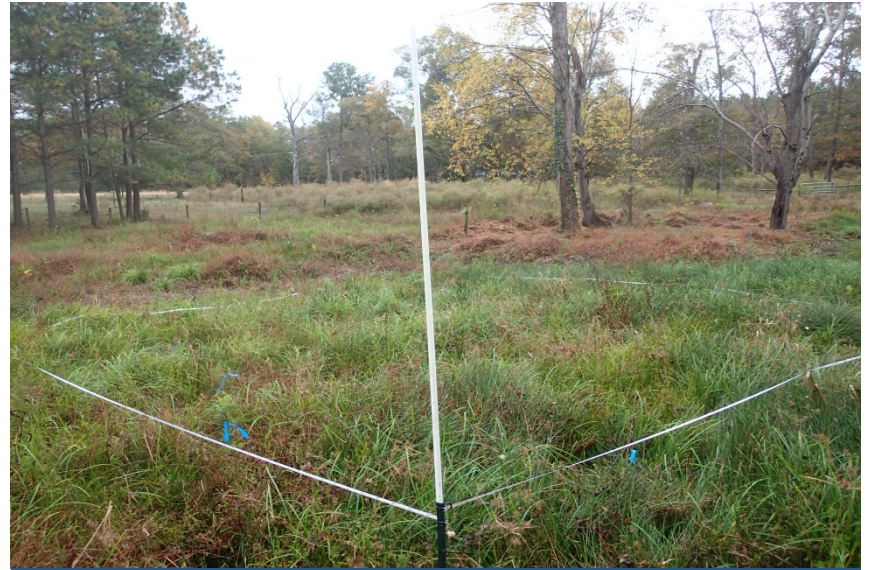
Veg Plot 6 April 12, 2018 (MY-00)



Veg Plot 6 November 6, 2018 (MY-01)



Veg Plot 7 April 12, 2018 (MY-00)



Veg Plot 7 November 6, 2018 (MY-01)



Appendix C – Vegetation Plot Data

Table 6. MY1 Stem Counts

Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)

Scientific Name	Common Name	Species Type	Current Plot Data (MY0-2018)																					Annual Means								
			002-01-0001			002-01-0002			002-01-0003			002-01-0004			002-01-0005			002-01-0006			002-01-0007			MY0 (2018)			MY1 (2018)					
			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 rubrum	Red Maple	Tree			4			90			14	1	1	5	2	2	5	1	1	1			3				3	3	3	4	4	122
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
Betula nigra	River Birch, Red Birch	Tree	3	3	3				1	1	1	2	2	2	2	2	2	3	3	3							14	14	14	11	11	11
Carpinus caroliniana	Ironwood	Shrub Tree						1	2	2	2				2	2	2	4	4	4	1	1	1				10	10	10	9	9	10
Carya	Hickory	Tree						1																								1
Cornus amomum	Silky Dogwood	Shrub Tree	1	1	1				3	3	3							1	1	1	1	1	1				6	6	6	6	6	6
Diospyros virginiana	American Persimmon, Possumwood	Tree										1	1	1				1	1	1							2	2	2	2	2	2
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	1	1	1				1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	10	10	10	10	10	10
Ilex verticillata	Winterberry	Shrub Tree				3	3	3																			3	3	3	3	3	3
Lindera benzoin	Northern Spicebush	Shrub Tree				3	3	3																			13	13	13	3	3	3
Liquidambar styraciflua	Sweet Gum, Red Gum	Tree			1												2															3
Liriodendron tulipifera	Tulip Tree	Tree	2	2	2	1	1	1				2	2	2				1	1	1	2	2	2				13	13	13	5	5	5
Magnolia virginiana	Sweetbay Magnolia	Shrub Tree				1	1	1	2	2	2	2	2	2													14	14	14	8	8	8
Platanus occidentalis	Sycamore, Plane-tree	Tree							2	2	2	2	2	2	5	5	5	4	4	4	1	1	1				14	14	14	14	14	14
Populus deltoides	Eastern Cottonwood	Tree															1															1
Quercus michauxii	Basket Oak, Swamp Chestnut Oak	Tree	1	1	1				3	3	3	2	2	2	1	1	1	3	3	3	1	1	1				9	9	9	11	11	11
Quercus nigra	Water Oak, Paddle Oak	Tree	1	1	1							2	2	2													9	9	9	3	3	3
Quercus phellos	Willow Oak	Tree	2	2	2	2	2	2				2	2	2				1	1	1	1	1	1				8	8	8	8	8	8
Rhus copallinum	Winged Elm	Shrub Tree			3																											3
Rosa palustris	Swamp Rose	Shrub Vine			26									3			3			7												39
Salix nigra	Black Willow	Tree			2																		5									7
Sambucus canadensis	Common Elderberry	Shrub Tree			3																											3
Ulmus rubra	Slippery Elm, Red Elm	Tree						2						1																		3
Viburnum nudum	Southern Wild Raisin, Possumhaw	Shrub Tree																									1	1	1			
		Stem count	12	12	51	10	10	104	15	15	29	18	18	26	14	14	23	22	22	29	9	9	17	132	132	132	100	100	279			
		size (ares)	1			1			1			1			1			1			1			7			7					
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.17			0.17					
		Species count	8	8	14	5	5	9	8	8	9	10	10	12	6	6	9	11	11	12	7	7	9	16	16	16	15	15	23			
		Stems per ACRE	485.6	485.623	2064	404.7	404.69	4209	607.0	607.03	1174	728.4	728.43	1052	566.6	566.56	930.8	890.3	890.31	1174	364.2	364.22	688	763.1	763.1	763.1	578.1	578.1	1613			

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%



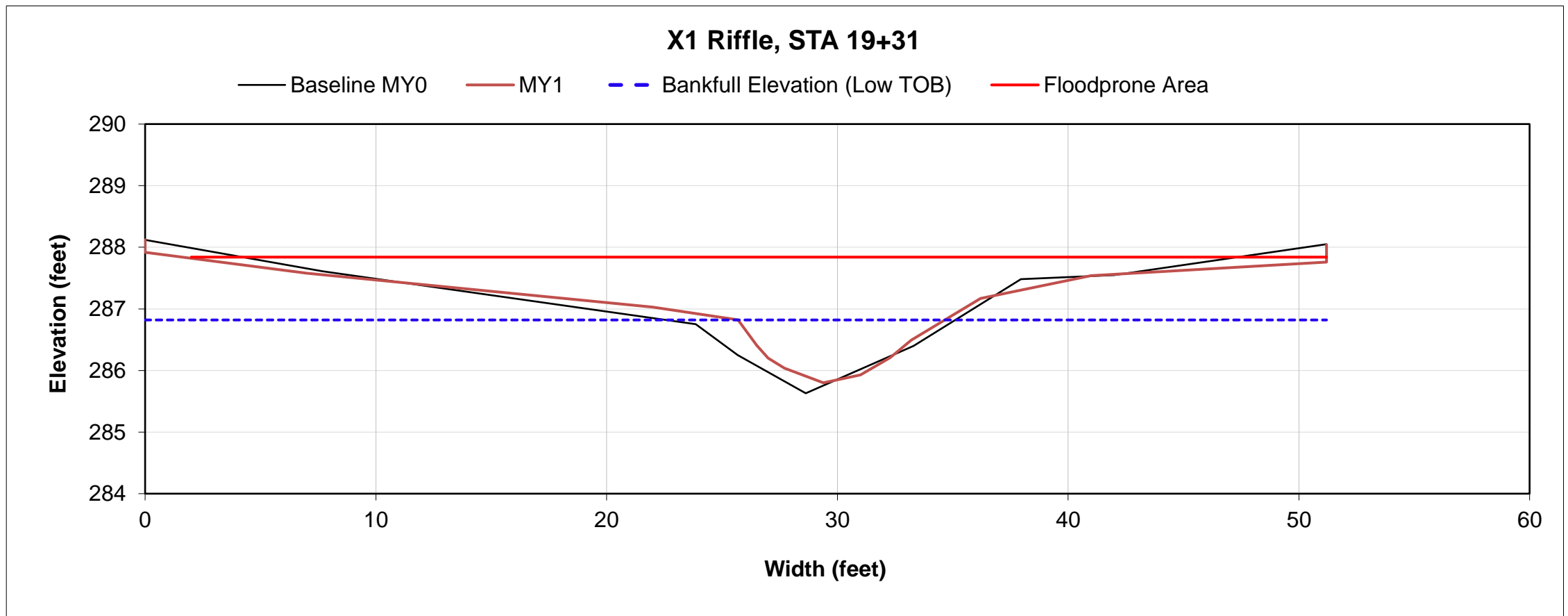
Appendix D – Stream Measurement and Geomorphology Data

Project Name	Pen Dell Mitigation Project
Project ID	97079
Reach ID	R1
Cross Section ID	X1
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	286.8
Bankfull Cross Sectional Area (ft²)	5.3
XS Area Change from As-built (%)	-1.0%
Bankfull Width (ft)	10.5
Max Depth (ft)	1.0
Mean Depth (ft)	0.5
Width/Depth Ratio	20.7
Flood Prone Area Width (ft)	49.2
Entrenchment Ratio	4.7
Bank Height Ratio	1.0



Looking Downstream

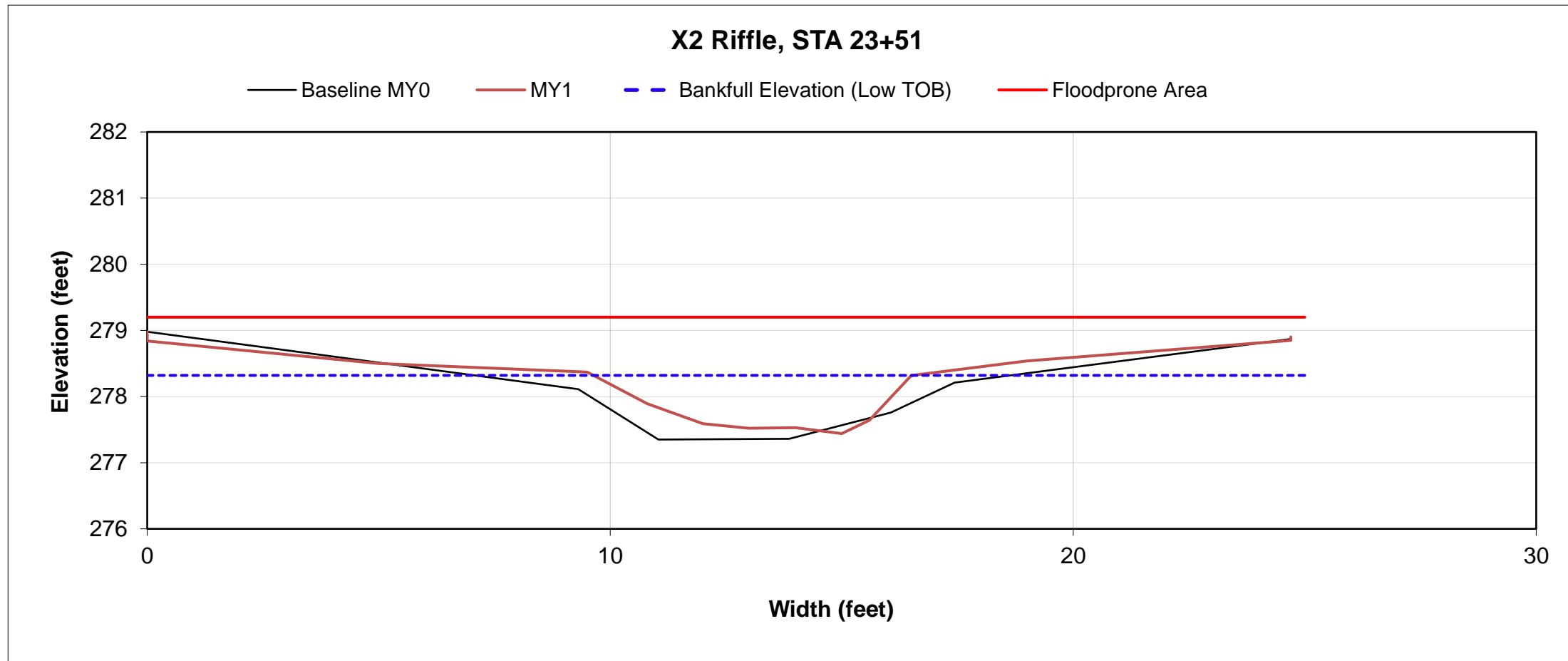


Project Name	Pen Dell Mitigation Project
Project ID	97079
Reach ID	R2
Cross Section ID	X2
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	278.3
Bankfull Cross Sectional Area (ft ²)	4.3
XS Area Change from As-built (%)	3.4%
Bankfull Width (ft)	7.0
Max Depth (ft)	0.9
Mean Depth (ft)	0.6
Width/Depth Ratio	11.4
Flood Prone Area Width (ft)	25.0
Entrenchment Ratio	3.6
Bank Height Ratio	1.0



Looking Downstream

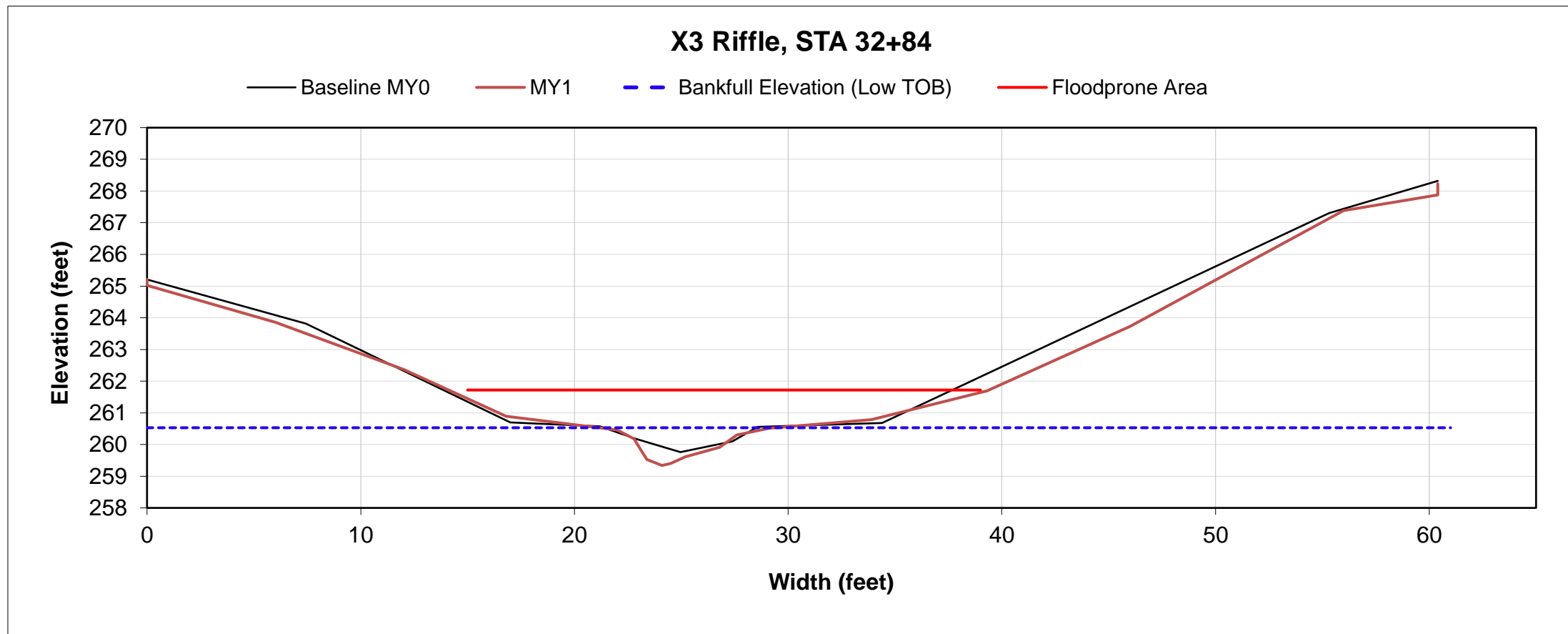


Project Name	Pen Dell Mitigation Project
Project ID	97079
Reach ID	R3
Cross Section ID	X3
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	260.5
Bankfull Cross Sectional Area (ft²)	3.8
XS Area Change from As-built (%)	10.9%
Bankfull Width (ft)	7.1
Max Depth (ft)	1.2
Mean Depth (ft)	0.5
Width/Depth Ratio	13.3
Flood Prone Area Width (ft)	24.0
Entrenchment Ratio	3.4
Bank Height Ratio	0.9



Looking Downstream

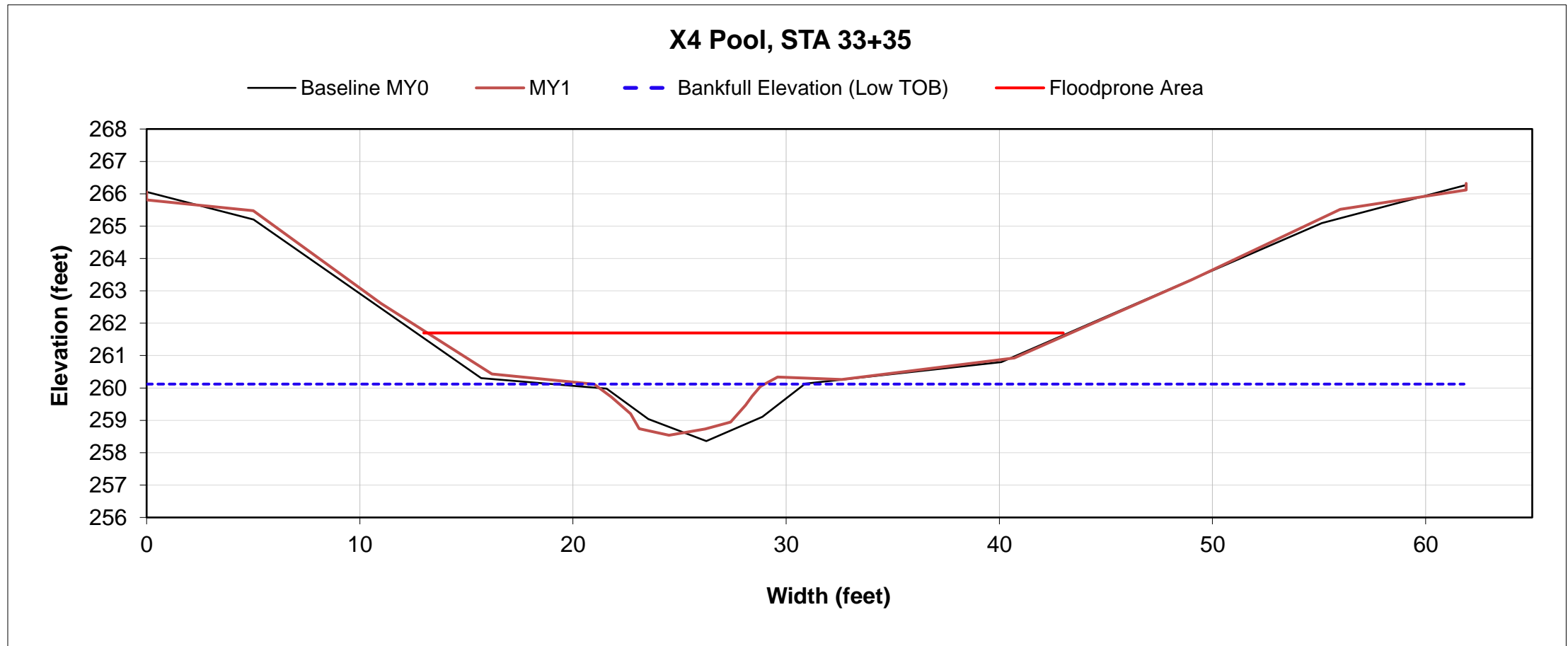


Project Name	Pen Dell Mitigation Project
Project ID	97079
Reach ID	R3
Cross Section ID	X4
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	260.1
Bankfull Cross Sectional Area (ft ²)	8.2
XS Area Change from As-built (%)	-2.7%
Bankfull Width (ft)	8.6
Max Depth (ft)	1.6
Mean Depth (ft)	0.9
Width/Depth Ratio	9.1
Flood Prone Area Width (ft)	30.0
Entrenchment Ratio	3.5
Bank Height Ratio	1.0



Looking Downstream

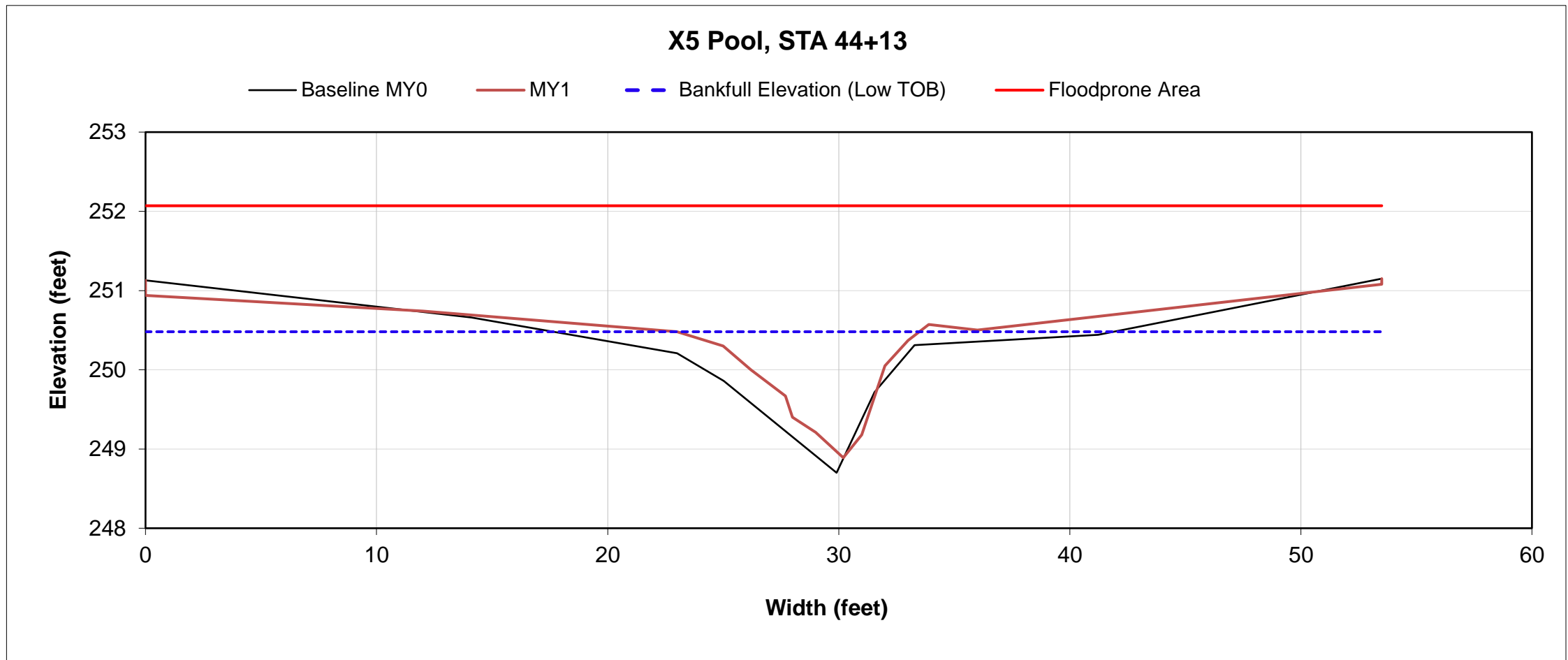


Project Name	Pen Dell Mitigation Project
Project ID	97079
Reach ID	R4
Cross Section ID	X5
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	250.5
Bankfull Cross Sectional Area (ft ²)	6.7
XS Area Change from As-built (%)	-2.3%
Bankfull Width (ft)	10.9
Max Depth (ft)	1.6
Mean Depth (ft)	0.6
Width/Depth Ratio	17.7
Flood Prone Area Width (ft)	53.5
Entrenchment Ratio	4.9
Bank Height Ratio	1.0

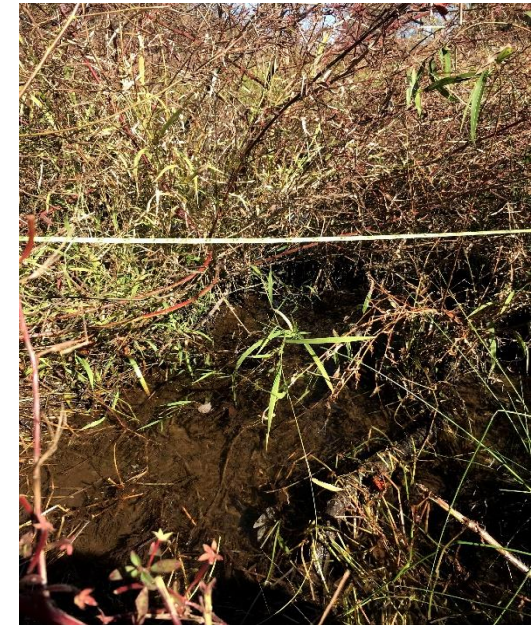


Looking Downstream

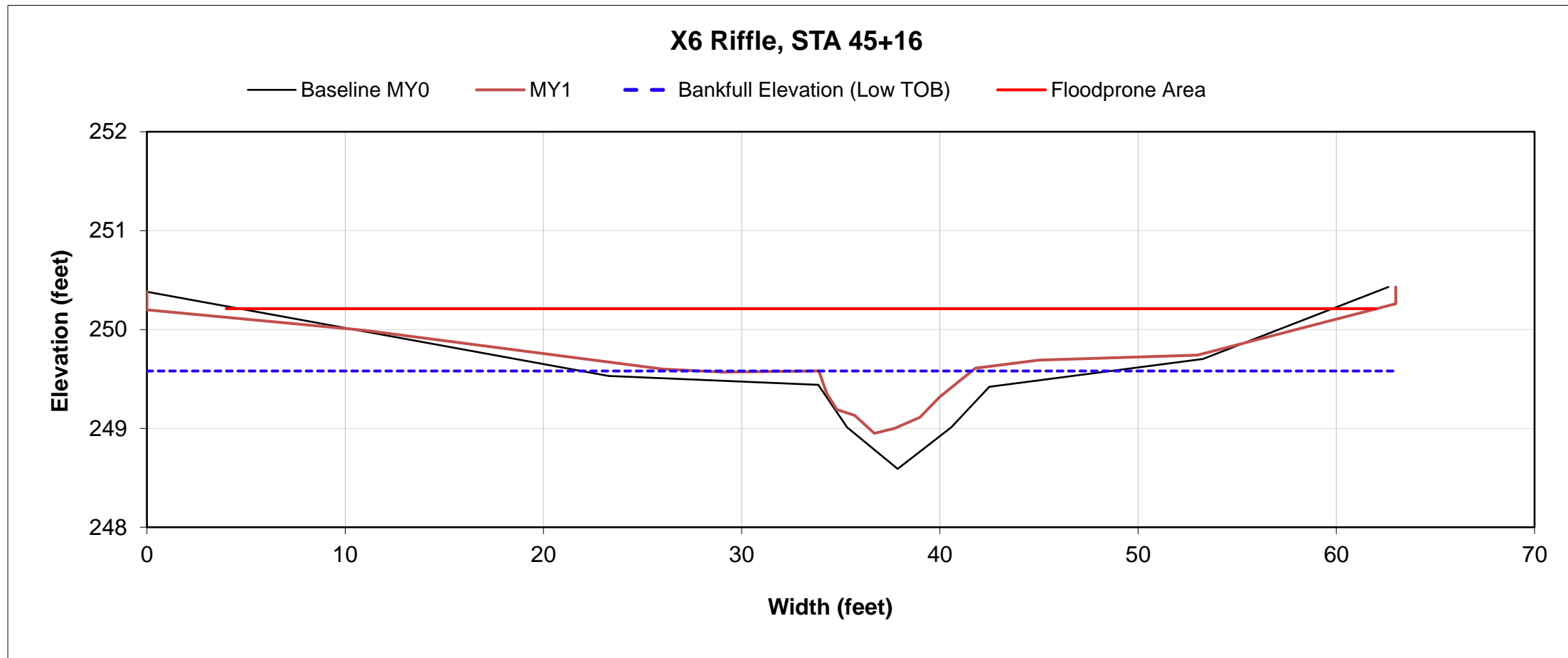


Project Name	Pen Dell Mitigation Project
Project ID	97079
Reach ID	R4
Cross Section ID	X6
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	249.6
Bankfull Cross Sectional Area (ft ²)	3.0
XS Area Change from As-built (%)	-27.5%
Bankfull Width (ft)	7.9
Max Depth (ft)	0.6
Mean Depth (ft)	0.4
Width/Depth Ratio	21.0
Flood Prone Area Width (ft)	58.0
Entrenchment Ratio	7.3
Bank Height Ratio	1.0



Looking Downstream

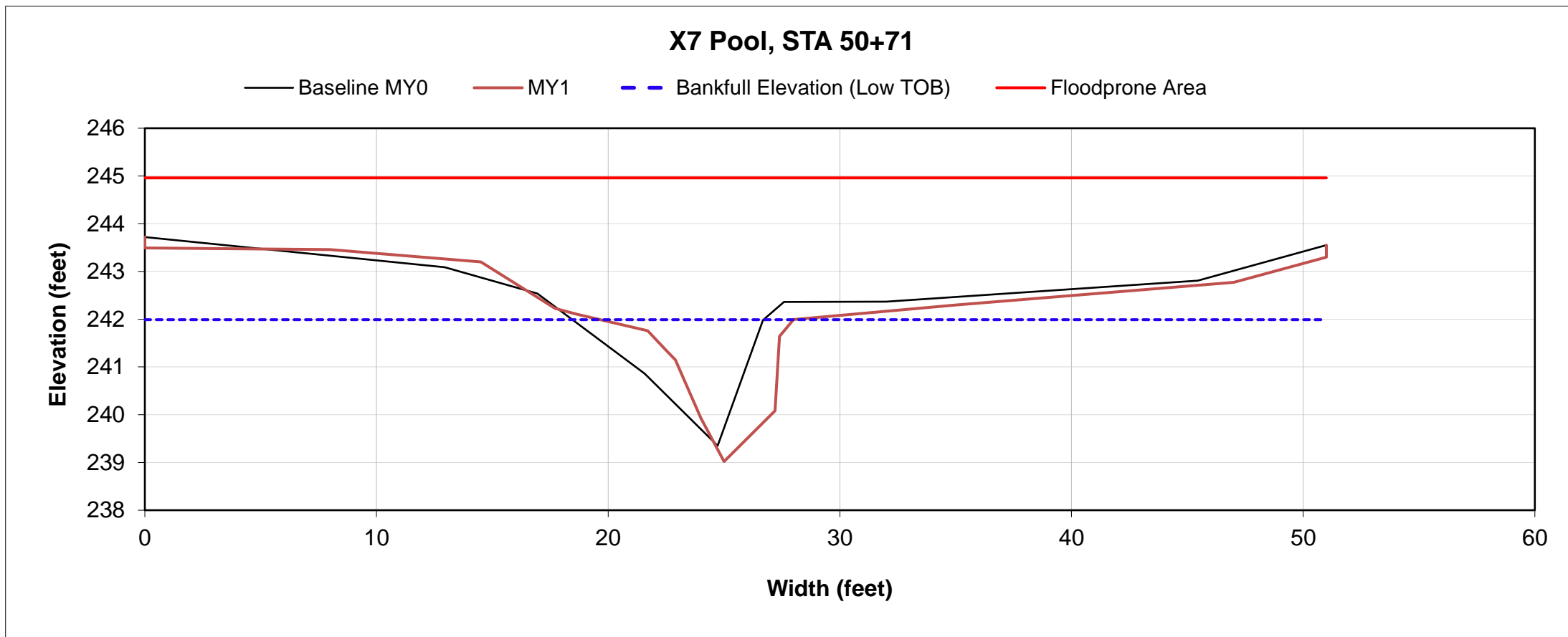


Project Name	Pen Dell Mitigation Project
Project ID	97079
Reach ID	R4
Cross Section ID	X7
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	242.0
Bankfull Cross Sectional Area (ft²)	12.9
XS Area Change from As-built (%)	-17.0%
Bankfull Width (ft)	10.3
Max Depth (ft)	3.0
Mean Depth (ft)	1.3
Width/Depth Ratio	8.2
Flood Prone Area Width (ft)	52.2
Entrenchment Ratio	5.1
Bank Height Ratio	1.0



Looking Downstream

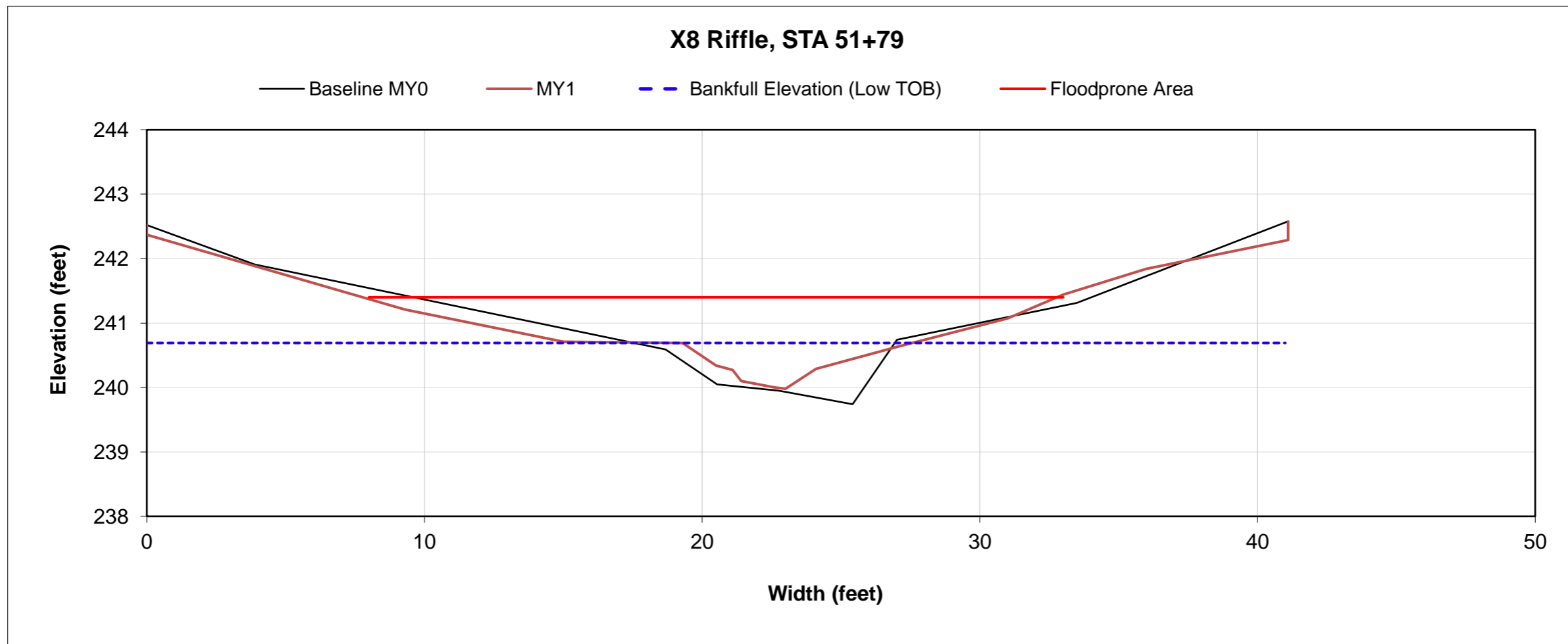


Project Name	Pen Dell Mitigation Project
Project ID	97079
Reach ID	R4
Cross Section ID	X8
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	240.7
Bankfull Cross Sectional Area (ft ²)	3.0
XS Area Change from As-built (%)	-31.0%
Bankfull Width (ft)	7.7
Max Depth (ft)	0.7
Mean Depth (ft)	0.4
Width/Depth Ratio	19.8
Flood Prone Area Width (ft)	25.0
Entrenchment Ratio	3.2
Bank Height Ratio	1.0

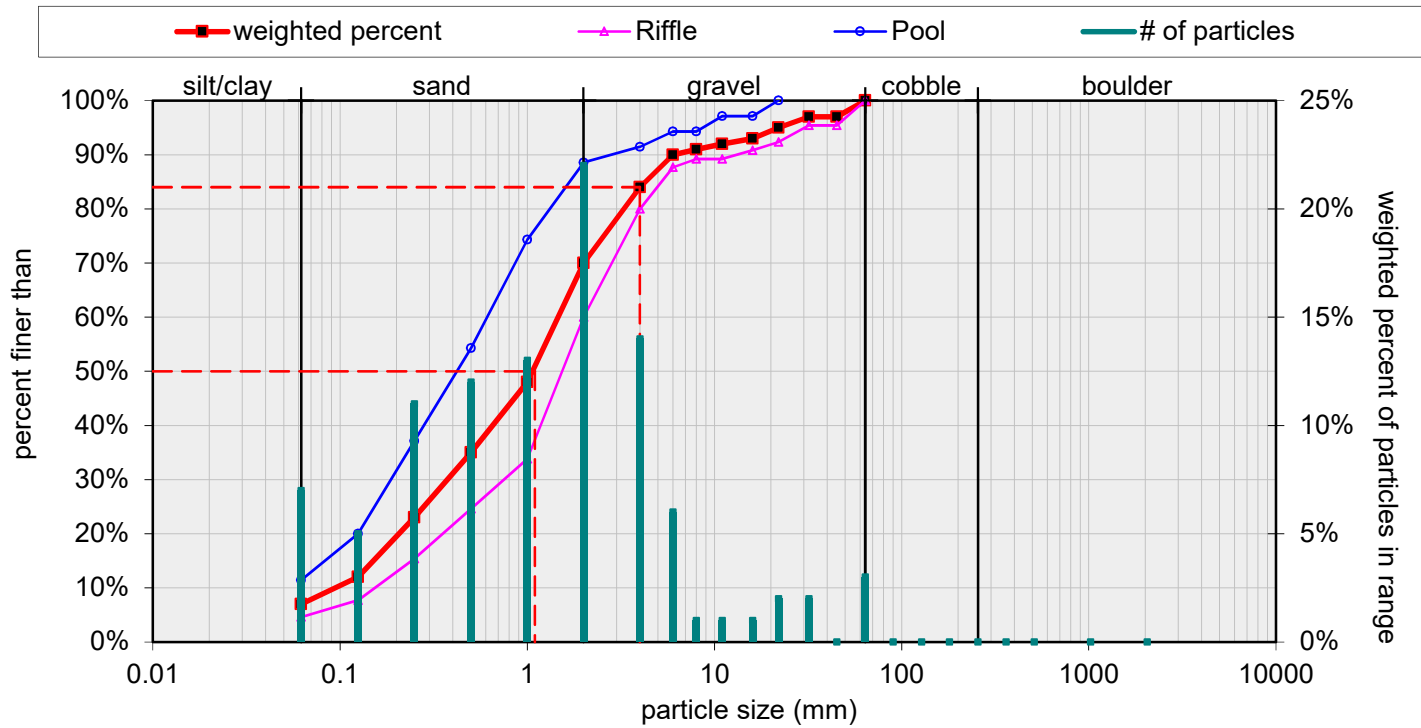


Looking Downstream



MY1 - Pen Dell Mitigation Project, Sediment Sample

65% riffle 35% pool



Size (mm)	Size Distribution	Type
D16 0.16	mean 0.8	silt/clay 7%
D35 0.5	dispersion 5.3	sand 63%
D50 1.1	skewness -0.12	gravel 30%
D65 1.7		cobble 0%
D84 4		boulder 0%
D95 22		

**Table 7a. Baseline Stream Data Summary
Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)**

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
Reach ID: R1 (EII)								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	4.4	6.6	4.5	8.3	5.7		11.1	-
Floodprone Width (ft)	15.9	42.0	10.0	20.0	15.0	30.0	49.0	-
Bankfull Mean Depth (ft)	0.4	0.8	0.8	1.6	0.5		0.6	-
Bankfull Max Depth (ft)	0.5	0.9	0.9	1.3	0.6		1.2	-
Bankfull Cross Sectional Area (ft ²)	1.9	4.2	3.0	5.0	2.7		7.0	-
Width/Depth Ratio	8.2	15.2	6.2	14.2	12.0		17.7	-
Entrenchment Ratio	1.4	2.2	7.1	8.4	2.6	5.3	4.4	-
Bank Height Ratio	0.7	1.5	0.9	1.1	1.0		1.0	-
Profile								
Riffle Length (ft)	6.2	38.2	9.5	22.7	-	-	-	-
Riffle Slope (ft/ft)	0.016	0.037	0.009	0.015	-	-	-	-
Pool Length (ft)	4.1	7.9	6.1	8.7	-	-	-	-
Pool Max Depth (ft)	1.1	2.3	1.8	2.4	-	-	-	-
Pool Spacing (ft)	26.4	83.9	14.4	22.3	-	-	-	-
Pattern								
Channel Beltwidth (ft)	11.0	32.0	23.4	29.0	-	-	-	-
Radius of Curvature (ft)	8.0	50.0	11.2	17.5	-	-	-	-
Rc:Bankfull Width (ft/ft)	1.6	10.0	1.6	2.5	-	-	-	-
Meander Wavelength (ft)	20.0	100.0	43.4	65.1	-	-	-	-
Meander Width Ratio	2.2	6.4	3.9	4.5	-	-	-	-
Transport Parameters								
Boundary Shear Stress (lb/ft ²)	-	-	-	-	0.50		-	-
Max part size (mm) mobilized at bankfull	-	-	-	-	2.00		-	-
Stream Power (W/m ²)	-	-	-	-	36.90		-	-
Additional Reach Parameters								
Rosgen Classification	G5c		E5/C5		C5		C5	
Bankfull Velocity (fps)	2.7		4.5		3.7		3.7	
Bankfull Discharge (cfs)	13.0		-		13.0		13.0	
Sinuosity	1.03		1.1 - 1.3		1.10		1.05	
Water Surface Slope (Channel) (ft/ft)	0.017		0.020		0.017		0.017	
Bankfull Slope (ft/ft)	0.017		0.020		0.017		0.017	

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
	Min	Max	Min	Max	Min	Max	Min	Max
Reach ID: R2 (EI)								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	9.5	-	4.5	8.3	6.8	6.8	7.8	9.5
Floodprone Width (ft)	13.7	-	10.0	20.0	15.0	30.0	23.0	13.7
Bankfull Mean Depth (ft)	0.9	-	0.8	1.6	0.5	0.5	0.5	0.9
Bankfull Max Depth (ft)	0.9	-	0.9	1.3	0.7	0.7	0.8	0.9
Bankfull Cross Sectional Area (ft ²)	5.9	-	3.0	5.0	3.6	3.6	4.2	5.9
Width/Depth Ratio	15.2	-	6.2	14.2	13.0	13.0	14.6	15.2
Entrenchment Ratio	1.4	-	7.1	8.4	2.2	4.4	2.9	1.4
Bank Height Ratio	1.9	-	0.9	1.1	1.0	1.0	1.0	1.9
Profile								
Riffle Length (ft)	5.9	27.7	9.5	22.7	-	-	-	-
Riffle Slope (ft/ft)	0.015	0.029	0.009	0.015	-	-	-	-
Pool Length (ft)	3.9	7.8	6.1	8.7	-	-	-	-
Pool Max Depth (ft)	2.0	3.8	1.8	2.4	-	-	-	-
Pool Spacing (ft)	17.0	51.0	14.4	22.3	-	-	-	-
Pattern								
Channel Beltwidth (ft)	13.0	37.0	23.4	29.0	-	-	-	-
Radius of Curvature (ft)	7.0	29.0	11.2	17.5	-	-	-	-
Rc:Bankfull Width (ft/ft)	1.2	4.9	1.6	2.5	-	-	-	-
Meander Wavelength (ft)	42.0	121.0	43.4	65.1	-	-	-	-
Meander Width Ratio	2.3	6.3	3.9	4.5	-	-	-	-
Transport Parameters								
Boundary Shear Stress (lb/ft ²)	-		-		0.51		-	
Max part size (mm) mobilized at bankfull	-		-		2.00		-	
Stream Power (W/m ²)	-		-		36.10		-	
Additional Reach Parameters								
Rosgen Classification	E5		E5/C5		E5/C5		E5/C5	
Bankfull Velocity (fps)	2.7		4.5		4.1		4.1	
Bankfull Discharge (cfs)	16.0		-		16.0		16.0	
Sinuosity	1.07		1.1 - 1.3		1.07		1.07	
Water Surface Slope (Channel) (ft/ft)	0.016		0.020		0.016		0.016	
Bankfull Slope (ft/ft)	0.017		0.020		0.017		0.017	

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
Reach ID: R3								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	7.4	-	4.5	8.3	7.8	7.8	7.1	
Floodprone Width (ft)	10.4	39.4	10.0	35.0	17.0	35.0	19.8	
Bankfull Mean Depth (ft)	0.8	-	0.8	1.6	0.6	0.6	0.4	
Bankfull Max Depth (ft)	1.6	-	0.9	1.3	0.7	0.8	0.8	
Bankfull Cross Sectional Area (ft ²)	5.0	-	3.0	5.0	4.4	4.4	3.1	
Width/Depth Ratio	11.0	-	6.2	14.2	14.0	14.0	16.3	
Entrenchment Ratio	1.4	-	7.1	8.4	2.2	4.5	2.8	
Bank Height Ratio	1.2	2.0	0.9	1.1	1.0	1.0	1.0	
Profile								
Riffle Length (ft)	11.0	41.0	9.5	22.7	12.0	33.0	12.0	30.0
Riffle Slope (ft/ft)	0.012	0.012	0.009	0.015	0.015	0.022	0.013	0.029
Pool Length (ft)	3.5	7.9	6.1	8.7	8.0	10.5	7.0	9.8
Pool Max Depth (ft)	2.8	-	1.8	2.4	1.4	2.0	1.1	2.0
Pool Spacing (ft)	3.5	9.6	14.4	22.3	25.0	55.0	13.0	48.0
Pattern								
Channel Beltwidth (ft)	29.0	53.0	23.4	29.0	25.0	45.0	25.0	45.0
Radius of Curvature (ft)	9.0	40.0	11.2	17.5	16.0	23.0	15.0	25.0
Rc:Bankfull Width (ft/ft)	1.2	5.4	1.6	2.5	2.0	3.0	1.5	3.0
Meander Wavelength (ft)	52.0	77.0	43.4	65.1	30.0	44.8	30.0	44.8
Meander Width Ratio	3.9	7.2	3.9	4.5	3.3	5.7	3.5	7.1
Transport Parameters								
Boundary Shear Stress (lb/ft ²)	-		-		0.52		-	
Max part size (mm) mobilized at bankfull	-		-		2.00		-	
Stream Power (W/m ²)	-		-		30.40		-	
Additional Reach Parameters								
Rosgen Classification	E5 incised (Pond)		E5/C5		E5/C5		E5/C5	
Bankfull Velocity (fps)	2.7		4.5		4.4		4.4	
Bankfull Discharge (cfs)	19.0		-		19.0		19.0	
Sinuosity	1.05		1.1 - 1.3		1.12		1.12	
Water Surface Slope (Channel) (ft/ft)	0.012		0.015		0.015		0.015	
Bankfull Slope (ft/ft)	0.013		0.015		0.015		0.015	

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)	6.0	-	4.5	8.3	7.8		8.6	8.3
Floodprone Width (ft)	35.0	-	10.0	35.0	17.0	45.0	56.0	25.0
Bankfull Mean Depth (ft)	1.3	-	0.8	1.6	0.6		0.5	0.6
Bankfull Max Depth (ft)	1.8	-	0.9	1.3	0.8		0.9	0.9
Bankfull Cross Sectional Area (ft ²)	12.3	-	3.0	5.0	4.7		4.1	5.2
Width/Depth Ratio	4.4	-	6.2	14.2	13.0		18.1	13.1
Entrenchment Ratio	6.1	-	7.1	8.4	2.2	5.8	6.5	3.0
Bank Height Ratio	1.5	-	0.9	1.1	1.0		1.0	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)	13.0	41.0	23.4	29.0	35.0	50.0	28.0	59.0
Radius of Curvature (ft)	7.9	28.9	11.2	17.5	16.0	25.0	12.0	23.0
Rc:Bankfull Width (ft/ft)	1.3	4.8	1.6	2.5	2.0	3.0	1.9	3.3
Meander Wavelength (ft)	36.0	101.0	43.4	65.1	55.0	80.0	52.0	77.0
Meander Width Ratio	2.2	6.8	3.9	4.5	4.5	6.4	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)	-	-	-	-	32.00	-	-	-
Additional Reach Parameters								
Rosgen Classification	E5/F5		E5/C5		C5		C5	
Bankfull Velocity (fps)	1.9		4.0		4.9		4.9	
Bankfull Discharge (cfs)	23.0		-		23.0		23.0	
Sinuosity	1.14		1.1 - 1.3		1.18		1.18	
Water Surface Slope (Channel) (ft/ft)	0.013		0.015		0.012		0.012	
Bankfull Slope (ft/ft)	0.012		0.015		0.012		0.013	

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

Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)

Parameters	Cross Section 1 (Riffle)							Cross Section 2 (Riffle)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)							Cross Section 5 (Pool)						
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	11.1	10.5						7.8	7						7.1	7.1						9.2	8.6						10.2	10.9					
Floodprone Width (ft)	49	49.2						23	25						19.8	24						29.6	30						53	53.5					
Bankfull Mean Depth (ft)	0.6	0.5						0.5	0.6						0.4	0.5						1	0.9						0.7	0.6					
Bankfull Max Depth (ft)	1.2	1						0.8	0.9						0.8	1.2						1.7	1.6						1.6	1.6					
Bankfull Cross Sectional Area (ft ²)	7	5.3						4.2	4.3						3.1	3.8						9.2	8.2						7.5	6.7					
Bankfull Width/Depth Ratio	17.7	20.7						14.6	11.4						16.3	13.3						9.2	9.1						13.8	17.7					
Bankfull Entrenchment Ratio	4.4	4.7						2.9	3.6						2.8	3.4						3.2	3.5						5.2	4.9					
Bankfull Bank Height Ratio	1	1						1	1						1	0.9						1	1						1	1					
d50 (mm)	N/a	N/a						N/a	N/a						N/a	N/a						N/a	N/a						N/a	N/a					
Parameters	Cross Section 6 (Riffle)							Cross Section 7 (Pool)							Cross Section 8 (Riffle)																				
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	8.6	7.9						10	10.3						8.3	7.7																			
Floodprone Width (ft)	56	58						38	52.2						25	25																			
Bankfull Mean Depth (ft)	0.5	0.4						1.3	1.3						0.6	0.4																			
Bankfull Max Depth (ft)	0.9	0.6						3	3						0.9	0.7																			
Bankfull Cross Sectional Area (ft ²)	4.1	3						13.4	12.9						5.2	3																			
Bankfull Width/Depth Ratio	18.1	21						7.5	8.2						13.1	19.8																			
Bankfull Entrenchment Ratio	6.5	7.3						3.8	5.1						3	3.2																			
Bankfull Bank Height Ratio	1	1						1	1						1	1																			
d50 (mm)	N/a	N/a						N/a	N/a						N/a	N/a																			

**Table 7c. Monitoring Data - Stream Reach Summary
Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)**

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)	-	-										
Riffle Slope (ft/ft)	-	-										
Pool Length (ft)	-	-										
Pool Max depth (ft)	-	-										
Pool Spacing (ft)	-	-										
Pattern												
Channel Beltwidth (ft)	-	-										
Radius of Curvature (ft)	-	-										
Rc:Bankfull width (ft/ft)	-	-										
Meander Wavelength (ft)	-	-										
Meander Width Ratio	-	-										
Additional Reach Parameters												
Rosgen Classification	C5											
Sinuosity (ft)	1.03											
Water Surface Slope (Channel) (ft/ft)	0.017											
BF slope (ft/ft)	0.017											
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

Table 8. Verification of Flow Events
Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)

Date of Data Collection	Date of Occurrence	Method	Greater than Bankfull (Bkf) or Qgs ($Q2^{0.66}$) Stage?	Photo/ Notes
9/17/2018	9/16-9/17/2018	Observed indicators of stage (wrack lines) after storm event	Bkf	Photos
11/21/2018	9/16-9/17/2018	Crest Gauge, >6" above FP elevation	Bkf	Photos



9/17/2018



9/17/2018



9/17/2018



9/17/2018



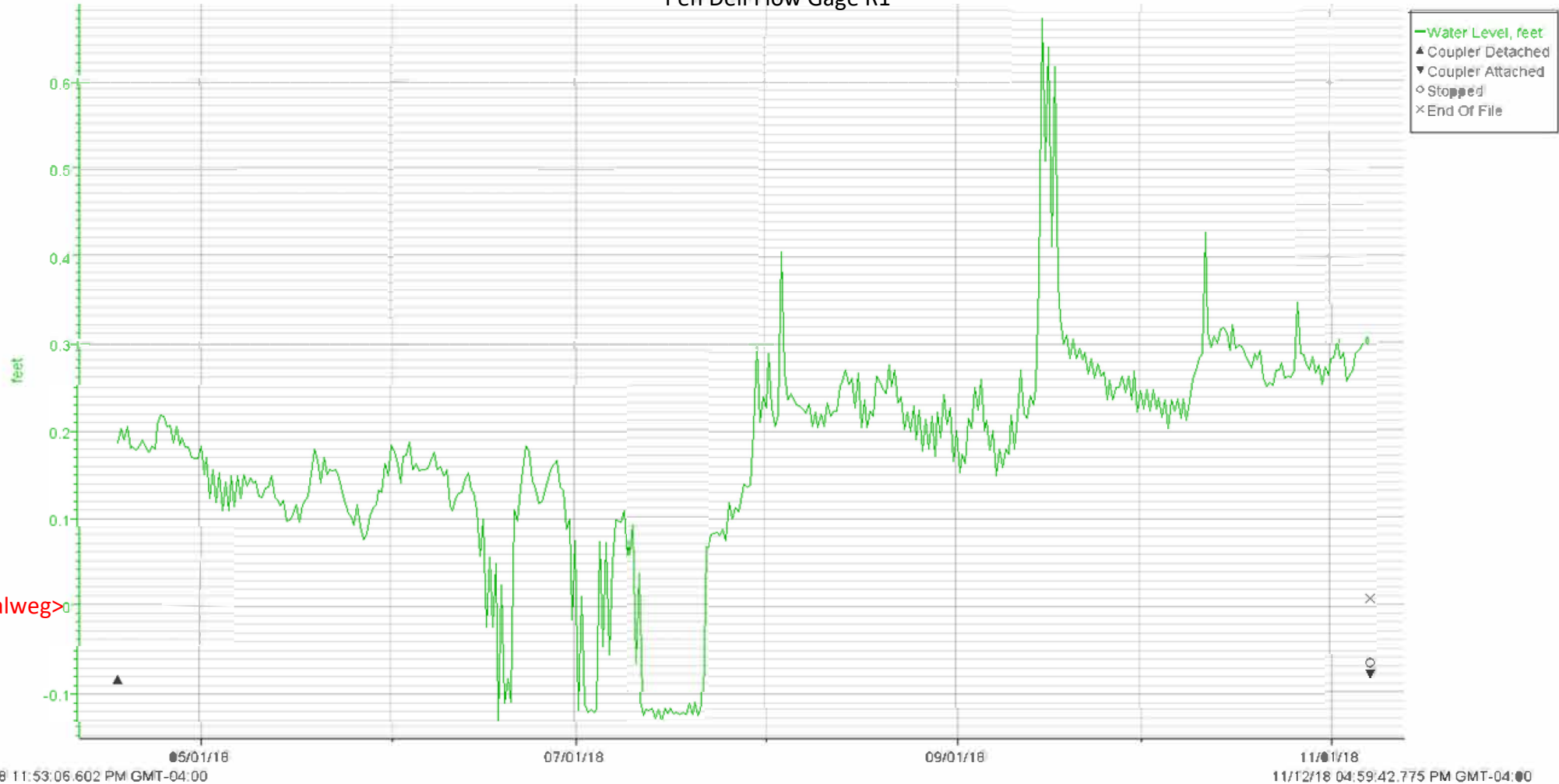
9/17/2018



11/21/2018

Figure 4

Pen Dell Flow Gage R1



0=Thalweg

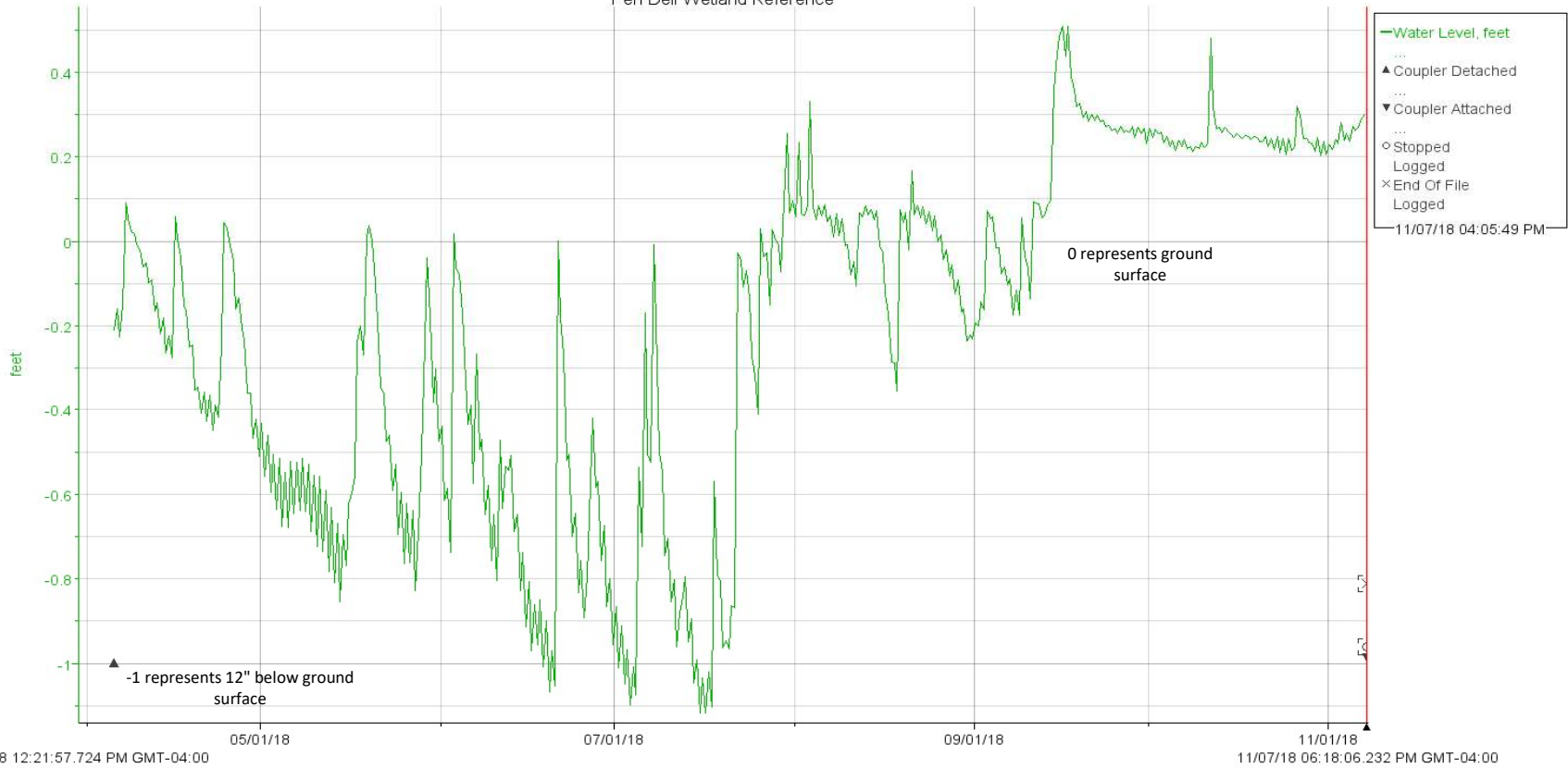
Flow Subsurface

Growing Season 4/5/2018-11/4/2018, 227 Days

Percent of Growing Season with Flow: 92%

Longest Consecutive Days of Flow: 105 Days (7/22/2018-11/4/2018)

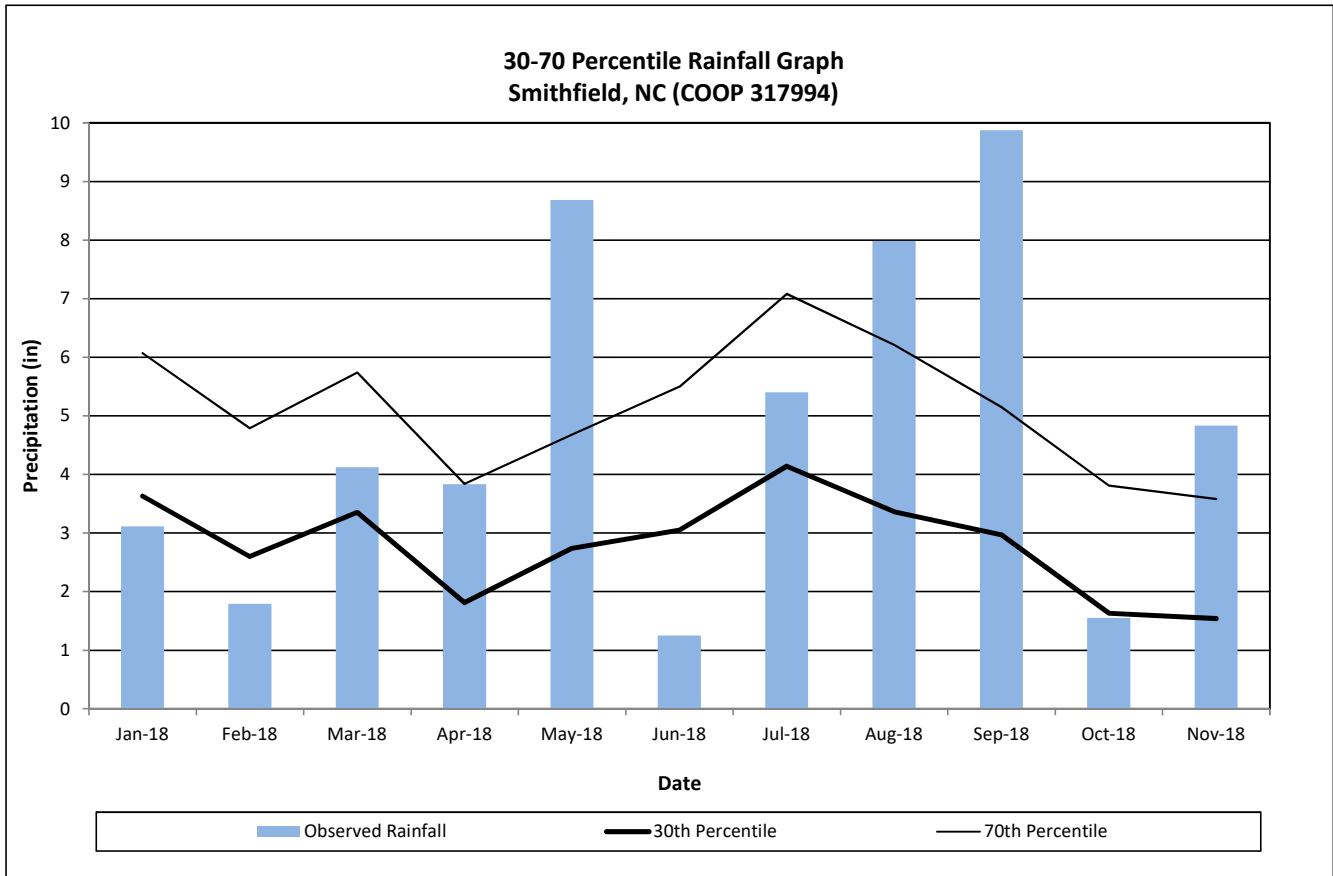
Pen Dell Wetland Reference



03/30/18 12:21:57.724 PM GMT-04:00

11/07/18 06:18:06.232 PM GMT-04:00

Monthly Rainfall Data
 Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)
 MY1 2018



*30th and 70th percentile rainfall data collected from weather station (COOP 317994) in Smithfield, NC.
 **Incomplete Month

Month	30%	70%	Observed
Jan-18	3.63	6.07	3.11
Feb-18	2.60	4.79	1.79
Mar-18	3.35	5.74	4.12
Apr-18	1.81	3.84	3.83
May-18	2.74	4.68	8.68
Jun-18	3.05	5.50	1.25
Jul-18	4.14	7.08	5.4
Aug-18	3.36	6.21	7.98
Sep-18	2.97	5.15	9.87
Oct-18	1.63	3.81	1.55
Nov-18	1.54	3.58	4.83
Dec-18	**	**	**



March 01, 2019

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 6 Draft Baseline Monitoring Report and Task 7 Draft Monitoring Report Year 1 for the Pen Dell Mitigation Project, NCDEQ DMS Full-Delivery Project ID #97079, Contract #6824, Neuse River Basin, Cataloging Unit 03020201, Johnston County, NC

Dear Ms. Crocker:

Water & Land Solutions, LLC (WLS) is pleased to present the Final Baseline Monitoring Report and Final Monitoring Report Year 1 for the Pen Dell Mitigation Project to the North Carolina Department of Environmental Quality (NCDEQ) Division of Mitigation Services (DMS). The Final Baseline Monitoring Report and the Final Monitoring Report Year 1 were developed by addressing NCDEQ DMS's review comments.

Under this cover, we are providing the required three (3) hard copies of the Final Baseline Monitoring Report and the Final Monitoring Report Year 1, and the required digital data for each (the .pdf copies of the entire updated reports and the updated digital data) via CDs. We are providing our written responses to NCDEQ DMS's review comments on the Draft Baseline Monitoring Report and Draft Monitoring Report Year 1 below. Each of the DMS review comments is copied below in **bold** text, followed by the appropriate response from WLS in regular text:

Field Notes:

- **DMS Comment: Update posts and/or signage up to specifications in the upper section northeast of Wendell Road.** WLS Response: All conservation easement boundary marking has been re-installed and/or corrected to meet or exceed the specifications as set forth in the NCDEQ DMS "Survey Requirements for Full Delivery Projects", Version 08/13/13, with the installation including the following:
 - Posts:
 - Type: Steel U-channel.
 - Length: 8 foot total length, with posts drive-installed approximately 2 feet deep to provide an installed height of approximately 6 feet above the ground.
 - Weight: 2 lbs/ft.
 - Coating: Factory coated with dark green enamel and at least 6 inches of the top of the post painted bright yellow.
 - Signs:
 - Type: Standard NCDEQ DMS aluminum conservation easement signs supplied by Voss Signs.
 - Spacing: Signs installed at each conservation easement corner, approximately 1 foot outside of each conservation easement corner marker. Signs installed as necessary along conservation easement boundary lines, between conservation easement corners, such that the maximum sign spacing interval is 200 feet.
 - Post attachment: 3/8" aluminum drive rivets.
- **DMS Comment: Ensure the location of the fenced horses north of the pond is not inside easement.** WLS Response: WLS is coordinating with the landowner to resolve this minor encroachment (referenced pasture fence extends approximately 3 feet into the conservation easement boundary at one location).
- **DMS Comment: Review location of the powerline on the north of Lake Wendell Road to ensure it is outside easement.** WLS Response: WLS has contacted Duke Energy to resolve. The existing power pole locations have been surveyed and WLS will verify private/public utility easement type and widths. Hypothetically, a 30-foot wide utility easement off the power poles has been assumed, which would be a ~35 stream credit reduction. This reduction in credits will be reflected in the asset tables.

Electronic Deliverables:

- **DMS Comment: All GIS files should be projected in NAD 83 State Plane coordinate system. These are all in GCS. Update and resubmit (for all projects please).** WLS Response: WLS has updated GIS shapefiles to the correct projections.
- **DMS Comment: DMS does not need Adobe files of any tables or graphs because they are available in the report in that format. Remove from deliverable submittals. Raw files are required.** WLS Response: WLS will removed Adobe pdf files from future deliverable submittals as requested.
- **DMS Comment: It appears that the digital files were submitted for the MY0 only, please also provide files for MY1 (excel and photos, not shapefiles).** WLS Response: The referenced MY1 digital files have been added as requested. Please use the re-submitted version of the referenced files.
- **DMS Comment: Shapefiles: it appears that the fence is inside the easement in the GIS layers provided. Can you check and respond? This is not showing as an issue on the red line as-built.** WLS Response: WLS has field verified the fence is outside the easement boundary and updated the GIS layers for clarification.
- **DMS Comment: Provide existing wetlands shapefile (request, not required).** WLS Response: WLS has provided existing wetlands shapefile as requested.
- **DMS Comment: Provide a shapefile of the stream asset that matches the asset table (from Mitigation Plan shapes). This asset file should match the linear feet of credit in the original asset table and be broken out and attributed (in the attribute table) by stream reach just like the Table 1.** WLS Response: WLS has provided the correct shapefiles that match those reported in the mitigation plan stream asset table.
- **DMS Comment: Although the As-built center line does match the as-built table (Table 1) it appears to have some lengths outside of the easement. Update shapefile to cut out any asset outside the easement and attribute each feature to match Table 1 in the attribute table or work with DMS to figure out what is going on here.** WLS Response: WLS has corrected the shapefile and verified the stream lengths match those reported in the stream asset table.
- **DMS Comment: Provide a shapefile for the riparian buffer asset that contains each are broken out by section on matches the table.** WLS Response: WLS has provided the correct shapefile that matches the riparian buffer asset table.
- **DMS Comment: As a note, once DMS receives and approves GIS data for asset and monitoring features, the only shapes that will be required in future submissions are vegetative areas of concern.** WLS Response: WLS appreciates the clarification and WLS will make sure to provide the correct GIS data as required for the future submissions.

As-Built Report:

1. **DMS Comment: Add the DWR number on the cover page (DWR 2016-0403). This should be true for all report cover pages.** WLS Response: The NCDEQ DWR Project Number (NCDEQ DWR Project # 2016-0403) has been added as requested to the cover page for each of the As-built Baseline Monitoring Reports and Monitoring Reports Year 1 where previously missing.
2. **DMS Comment: Page 1 and 2, WLS lists 5,126 linear feet of stream, but the numbers in the tables don't add up to that (existing showing 5,202). Where is that number from? Please correct and update.** WLS Response: The total existing stream length (5,202 linear feet, pre-restoration) included lengths outside the conservation easement boundary. WLS has verified the mitigation plan (5,115 linear feet) lengths match those reported in the stream asset table.
3. **DMS Comment: Page 1 and 2, the LWP goals and site-specific goals are duplicated on these pages. Remove the sets in the Project Objective and just keep in the Mitigation Objective section.** WLS Response: The referenced language regarding LWP goals and site specific goals have been removed from Section 1 Project Summary as requested.
4. **DMS Comment: Page 3, I don't see the objectives and performance standards listed in this bullet list in the Mitigation Plan. Is this a new addition or possibly from earlier revisions to the Mitigation Plan? See Table 12 in the Mitigation Plan. You can use these same tables from Mitigation Plan in all your future reports to avoid confusion if desired. Decision to leave this section as-is or revise should be consistent on all three project reports.** WLS Response: Sub-section 2.2 Mitigation Project Goals and Objectives and Section 4 Performance Standards have been revised as requested to match those in the approved final mitigation plan, including the addition of the relevant tables from the approved final mitigation plan.
5. **DMS Comment: Page 2, 2.3 this first paragraph contains dates that don't match the dates on the Table 2. Update table and/or section to reflect accurate dates that match.** WLS Response: All references to dates in each of the As-built Baseline Monitoring Reports and Monitoring Reports Year 1 and in Table 2, have been checked and edited/corrected as necessary for consistency, as requested.
6. **DMS Comment: Page 2, 2.3, paragraph 2, please remove first two sentences and reference to WLS contract as this is not relevant to report and does not match asset table in Mitigation Plan or As-built, nor does it reflect project assets.** WLS Response: The referenced sentences have been removed from the Sub-section 2.3 Project History, Contacts, and Timeframe as requested.
7. **DMS Comment: Page 8 references "crest gauges" but only one was installed.** WLS Response: All of the references to crest "gauges" (plural) in the As-built Baseline Monitoring Report and Monitoring Reports Year 1 have been modified

to crest “gage” (singular) to reflect that only one crest gage is being used for stream hydrologic monitoring. Please also note that all references to “gauge” have be change to “gage” for consistency.

8. **DMS Comment: Page 11, Wetlands. The installation and monitoring of three groundwater monitoring devices was agreed to by WLS and DWR (R4 @ 45+50, 50+50, and 64+50), although DMS advised WLS that they were not contractually required. Can WLS provide email or correspondence from DWR / IRT showing that a lesser number of gauges were accepted for inclusion in the MY0 and/or MY1 report and how do you plan on handling this?** WLS Response: WLS has revised the referenced Wetlands Subsection of the As-built Baseline Monitoring Report and Monitoring Report Year 1 to explain that the three requested and agreed upon groundwater monitoring wells have been installed, as follows: “One groundwater monitoring well was installed during the baseline monitoring within an existing wetland area along Reach R4. Two additional groundwater monitoring wells, including an additional one along Reach R4 and an additional one along Reach R5 (preservation), are being installed after the first year of monitoring, scheduled for March 2019. The wells were installed to document groundwater levels within the stream and wetland restoration and for reference and comparison to the preservation areas, at the request of the NCIRT (DWR).”
9. **DMS Comment: Page 11, 6.1, the dates in this first paragraph don’t match the dates on Table 2. Update table and/or section to reflect accurate dates that match.** WLS Response: All references to dates in each of the As-built Baseline Monitoring Reports and Monitoring Reports Year 1 and in Table 2, have been checked and edited/corrected as necessary for consistency, as requested.
10. **DMS Comment: Table 1. Mitigation Plan footage should be 526 for R2.** WLS Response: WLS has corrected and verified that the stream lengths match the mitigation plan footages reported in the assets table.
11. **DMS Comment: Add a footnote below Table 1 indicating that you will use Mitigation Plan numbers for project assets.** WLS Response: The following footnote has been added to Table 1 as suggested: “Mitigation Credits are from the final approved mitigation plan, as verified by the as-built survey.”
12. **DMS Comment: Page 12, Vegetation section and Revegetation Plan in As-Built drawings: Please indicate the area that was planted (how much area planted and where on map) and if there were any changes from the planting plan. This should be where you show any substitutions. For instance, ‘winterberry’ was not on planting plan but in Table 6 as planted, and the vegetation plots are only showing 9 of the proposed 19 plants proposed. Use a red line if they were not all used and add any substitutions. This will be helpful with volunteers (of the same planted species) if you need to meet success with them in the future. Can add as a table if this would be helpful (this number and species of stems is AB requirement).** WLS Response: WLS Response: The Revegetation Plan Sheets in the as-built plan set depict the as-built planted areas correctly, as depicted with the planting zone hatching, as shown in the planting zone legend on each sheet. The planting schedule on the Revegetation Plans has been “redlined”, as requested, to reflect the referenced plant substitutions (a total of 1 species deletion and 3 species substitutions).
13. **DMS Comment: Table 6. Missing a lot of common names, and there are multiple common names listed. Is this something going on with CVS? Check and fix please.** WLS Response: The referenced omissions and multiple common names are the result of the mechanics/functions of the CVS tool. WLS has manually edited the referenced table as needed for clarification.
14. **DMS Comment: Morphological tables R2 (E1), R3, R4 it appears you may have some of the max and min of the dimensions parameters switched (max showing min and vis versa) on some portions. Double check this is correct.** WLS Response: WLS has corrected the stream dimensions min/max in the morphological tables.

MY1 Report:

1. **DMS Comment: See comments 1-7, 9-10, and 13 from MY0 report above and update MY1 with same.** WLS Response: The referenced DMS comments listed and addressed herein, along with the corresponding edits, corrections, and additions made to the As-built Baseline Monitoring Reports, have also been addressed and made, respectively, as appropriate, to the Monitoring Reports Year 1 Reports as requested.
2. **DMS Comment: Photos-there are some spots that say ‘photo not available’ but they are showing in the MY0 report. Update.** WLS Response: The As-built Baseline Monitoring Report and Monitoring Report Year 1 photo logs have been revised and updated to address the referenced concern. This includes ensuring that each provided photo was selected such that the same/similar station, location, and perspective was repeated between the As-built Baseline Monitoring (Monitoring Year 0) photos and Monitoring Reports Year 1 photos, and that each vegetation plot and project stream reach was represented, all as applicable and feasible.
3. **DMS Comment: Page 1, Last paragraph: First paragraph contains dates that don’t match the dates on the Table 2. Update table and/or section to reflect accurate dates that match.** WLS Response: All references to dates in each of the As-built Baseline Monitoring Reports and Monitoring Reports Year 1 and in Table 2, have been checked and edited/corrected as necessary for consistency, as requested.
4. **DMS Comment: Page 7, Bankfull events, I don’t see a Table 8 documenting any bankfull events nor are there any pictures. WLS can’t claim any bankfull events in MY1 without this evidence. Update text to not state bankfull events and appendix if there is no Table 8.** WLS Response: WLS is not sure what the issue is with the Table 8 “worksheet” in the version of the ‘PenDell_97079_MY1_Annual_Rep_Tables.xls’ file DMS received, as the original WLS file has both the crest gage verification and photographic verification of 2 separate bankfull events (09/17/2019 and 11/21/2019) presented. Please use re-submitted version of the referenced file.

5. **DMS Comment: Page 7, Surface flow data. I don't see this data or Figure 4. Without evidence and monitoring, WLS can't claim flow performance.** WLS Response: This was an unintentional omission by WLS. The flow data and corresponding graph has been added to the 'Hydro Folder' as requested.
6. **DMS Comment: Page 8, wetland gauge: See comment #8 above.** WLS Response: WLS has revised the referenced Wetlands Subsection of the As-built Baseline Monitoring Report and Monitoring Report Year 1 to explain that the three requested and agreed upon groundwater monitoring wells have been installed, as follows: "One groundwater monitoring well was installed during the baseline monitoring within an existing wetland area along Reach R4. Two additional groundwater monitoring wells, including an additional one along Reach R4 and an additional one along Reach R5 (preservation), were installed after the first year of monitoring, scheduled for March 2019. The wells were installed to document groundwater levels within the stream and wetland restoration and for reference and comparison to the preservation areas, at the request of the NCIRT (DWR)."
7. **DMS Comment: Geomorph data: XS-6 (riffle) and XS-7 (pool) look like they have changed a bit from MY0. Do you have any concerns about these? Shouldn't the BHR have updated based on this change with the new method?** WLS Response: WLS is not concerned about the adjustments to the referenced cross sections, as it appears to be a minor channel adjustment towards the expected and desired stream dimension and stability. WLS used the new method for calculating adjusted BHRs. The adjusted bankfull elevation using the comparable as-built cross-sectional is approximately one tenth and therefore the BHR would be ~0.9 (<1). The morph table parameters have been updated to reflect this change.
8. **DMS Comment: Tables after 7c. are not filled out with MY1 data. Update report.** WLS Response: WLS is not sure what the issue is with the "worksheets" following Table 7C in the version of the PenDell_97079_MY1_Annual_Rep_Tables.xls file DMS received, as the original WLS file has all of the appropriate data filled in and presented on the referenced "worksheets". Please use re-submitted version of the referenced file.

Riparian Buffer MY0 & MY1 Report:

- **DMS Comment: Page 3. Check dates in the text with Table 2 to match.** WLS Response: All references to dates in each of the As-built Baseline Monitoring Reports and Monitoring Reports Year 1 and in Table 2, have been checked and edited/corrected as necessary for consistency, as requested.
- **DMS Comment: Page 3, last paragraph, first sentence. Remove contracting information as it is N/A.** WLS Response: The referenced sentences have been removed from the Sub-section 2.3 Project History, Contacts, and Timeframe as requested.
- **DMS Comment: Page 3, last paragraph shows 336,432 sf of riparian buffer credit, but the table shows 336,432. Update.** WLS Response: WLS has verified the riparian buffer credits match those reported in the assets table and removed from the last paragraph for consistency.
- **DMS Comment: Page 7, 6.1 check dates with table.** WLS Response: All references to dates in each of the As-built Baseline Monitoring Reports and Monitoring Reports Year 1 and in Table 2, have been checked and edited/corrected as necessary for consistency, as requested.
- **DMS Comment: Table 6. See comments above (#13 in AB section).** WLS Response: WLS Response: The referenced omissions and multiple common names are the result of the mechanics/functions of the CVS tool. WLS has manually edited the referenced table as needed for clarification.
- **DMS Comment: Table 5a is repeated in two places.** WLS Response: WLS was unable to locate the repeated Table 5a. Please use re-submitted version of the referenced file.
- **DMS Comment: Table 2. Update to show sf to the foot. That should be corrected on our template table. Apologies if it is not.** WLS Response: WLS has corrected the referenced table formatting as requested.
- **DMS Comment: Appendix D. Add the DWR Stream Determination letter for R1.** WLS Response: WLS has added the ""Subject: Buffer Determination Letter, NBRO #16-180 Johnston County"" DWR package to the As-built Baseline Monitoring Report Appendices as requested.
- **DMS Comment: Appendix D is printed twice. Ensure this is not repeated on the final.** WLS Response: WLS has insured that only one copy of Appendix D is included in this submittal. Please use the re-submitted version of the referenced file.
- **DMS Comment: See comment #12. For AB. Table of planted species and number is required.** WLS Response: WLS Response: The Revegetation Plan Sheets in the as-built plan set depict the as-built planted areas correctly, as depicted with the planting zone hatching, as shown in the planting zone legend on each sheet. The planting schedule on the Revegetation Plans has been "redlined", as requested, to reflect the referenced plant substitutions (a total of 1 species deletion and 3 species substitutions).
- **DMS Comment: Restoration credit in the R2 section is legitimate because this area was bare and planted but it was not described in the DWR eligibility letter. Add footnote to plan somewhere explaining why this was assigned restoration (instead of preservation) and this will require Katie Merritt reviewing and agreeing with call (indicate which pictures show this to help).** WLS Response: WLS has added the following text to the referenced subsection of the As-built Baseline Monitoring Report and Monitoring Report Year 1, as requested, for clarification: "A significant area of the existing northern riparian buffer for Reach R2 was incorrectly described as "Native hardwood forest, closed canopy" in the referenced site viability letter, as this area of the buffer was a fescue lawn. WLS proposed this area for riparian buffer restoration in the approved mitigation plan (Figure 11 Riparian Buffer Mitigation)."

Please contact me if you have any further questions or comments.

Sincerely,

Water & Land Solutions, LLC

A handwritten signature in blue ink, appearing to read 'W. Hunt, III', with a large, sweeping flourish extending to the right.

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Monitoring Report
FINAL VERSION
Pen Dell Mitigation Project (Riparian Buffer Mitigation)
Monitoring Year 1
Calendar Year of Data Collection: 2018

NCDEQ DMS Project Identification # 97079
NCDEQ DMS Contract # 6824
Neuse River Basin (Cataloging Unit 03020201)
USACE Action ID Number: SAW-2016-00885
NCDEQ DWR Project # 2016-0403
Johnston County, NC
Contracted Under RFP # 16-006477
Data Collection Period: April-November 2018, Submission Date: March 2019



Prepared for:



North Carolina Department of Environmental Quality
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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 Pen Dell Mitigation Project (Project) full-delivery project for the North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) in April 2018. The Project is located in Johnston County, North Carolina between the Community of Archer Lodge and the Town of Wendell at 35° 43' 52.51" North and 78° 21' 10.12" West. The Project site is located in the NCDEQ Sub-basin 03-04-06, in the Lower Buffalo Creek Priority Sub-watershed 030202011504 study area for the Neuse 01 Regional Watershed Plan (RWP), and in the Targeted Local Watershed 03020201180050, all of the Neuse River Basin.

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 approximately 5,064 linear feet of existing streams, approximately 633,803 square feet of riparian buffers. The Project construction and planting were completed in April 2018 and MY1 monitoring activities occurred between April and November 2018 (Table 2). This report documents the completion of and presents the data for the first year of monitoring (MY1). The Project meets the MY1 success criteria for vegetation. Based on these results, the Project is expected to meet the Year 2 Monitoring success criteria in 2019.

2 Project Background

2.1 Project Location, Setting, and Existing Conditions

The Pen Dell Mitigation Project (Project) site is located in the Upper Buffalo Creek Sub-watershed 030202011502 study area for the Neuse 01 Regional Watershed Plan (RWP), in the Wake-Johnston Collaborative Local Watershed Plan, and in the Targeted Local Watershed 03020201180050, all of the Neuse River Basin. The Project site is situated in the lower piedmont where potential for future development associated with the I-540 corridor and rapidly growing Johnston County area is imminent, as described in the Regional Watershed Plan (RWP) for the Upper Neuse River Basin within Hydrologic Unit (HU) 03020201.

The RWP identified and prioritized potential mitigation strategies to offset aquatic resource impacts from development and provided mitigation project implementation recommendations to improve ecological uplift within the Neuse 01 Sub-basin, which included traditional stream and wetland mitigation, buffer restoration, nutrient offsets, non-traditional mitigation projects such as stormwater and agricultural BMPs, and rare, threatened, or endangered (RTE) species habitat preservation or enhancement.

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 approximately 5,064 linear feet of existing streams, approximately 633,803 square feet of riparian buffers permanently protected by a recorded conservation easement (15.95 acres). The catchment area is 156 acres and has an impervious cover of approximately one percent. The dominant land uses are agriculture and mixed forest. Prior to Project construction, livestock had access to Reaches R3 and R4, and the riparian buffers were less than 50 feet wide on all reaches except R5.

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 (LWP) and 2015 Neuse 01 Regional Watershed Plan (RWP) 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”.

With regards to riparian buffer mitigation, the following site specific goals were developed to address the primary concerns outlined in the LWP and RWP and include:

- 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 – Pen Dell Located Near 2505 Wendell Rd, Wendell, NC, Johnston County”. The referenced viability letter specified for Reach R1 that riparian buffer credits being only being allowed outside of 25 feet off the top of stream banks. The described site viability confirmation included a determination by DWR that Project Reaches R2, R3 (Includes Project Reach R4) and R5 were either intermittent or perennial. A request for Stream Origin/Buffer Applicability Determination for Project Reach R1, as required in the referenced viability letter, was submitted to DWR on June 10, 2016. On June 20, 2016 and June 21, 2016 DWR performed the requested determination and Reach R1 was determined to be intermittent, as communicated in the DWR June 22, 2016 letter entitled “Subject: Buffer Determination Letter, NBRO #16-180 Johnston County”, therefore confirming Reach R1’s eligibility for riparian buffer mitigation. See Appendix D for DWR correspondence and approval letters.

In addition to DWR correspondence and approval, WLS investigated on-site jurisdictional waters of the US (WOTUS) using the US Army Corps of Engineers (USACE) Routine On-Site Determination Method. This method is defined in the 1987 Corps of Engineers Wetlands Delineation Manual and subsequent Eastern Mountain and Piedmont Regional Supplement. Determination methods included stream classification



utilizing the NCDWQ Stream Identification Form and the USACE Stream Quality Assessment Worksheet. The results of the on-site field investigation indicated that Project Reaches R1, R2, R3, R4, and R5 were determined to be jurisdictional stream channels. Project Reaches R2, R3, R4, and R5 were determined to be perennial while Project Reach R1 was determined to be intermittent. USACE representative Samantha Dailey verified Jurisdictional Determinations during a field visit on December 20, 2016.

The final mitigation plan and PCN were submitted to DMS September 29, 2017 for submission to DWR and the NCIRT. The Section 404 General (Regional and Nationwide) Permit Verification was issued January 12, 2018. Project construction started on January 29, 2018 and mitigation site earthwork was completed on April 1, 2018, and mitigation site planting was completed on April 6, 2018, both 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.

The project background and attribute summary is 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 R2, where the width of the proposed left riparian buffer varies between 20 feet and 29 feet from the right top of bank. This narrow area of proposed riparian buffer is due to the site constraint caused by an existing residential driveway. 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. For project reach sections proposed for preservation, the existing riparian buffers will be permanently protected via the conservation easement. A significant area of the existing northern riparian buffer for Reach R2 was incorrectly described as “Native hardwood forest, closed canopy” in the referenced site viability letter, as this area of the buffer was a fescue lawn. WLS proposed this area for riparian buffer restoration in the approved mitigation plan (Figure 11 Riparian Buffer Mitigation). Additionally, permanent fencing was installed along with alternative watering systems to exclude livestock from the restored riparian buffer and conservation easement areas. Table 1 and Figure 1 (Appendix A) provide 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. The as-built planting boundaries are shown on the as-built vegetation plans in Appendix E and Figure 1. Proposed plantings were conducted using native species bare-root trees and shrubs, live stakes, and seedlings. Proposed plantings predominantly consisted of bare-root vegetation and 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 MY1 vegetation assessment, no areas of concern was observed within the conservation easement boundary. Any areas identified during MY2 monitoring will be treated and documented in the subsequent annual report.

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 (5) 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 (4) native hardwood tree species or four (4) native hardwood tree and native shrub species, where no one species is greater than fifty (50) percent of the stems. Native hardwood tree and native shrub volunteer species may be included to meet the final performance criteria of 260 stems per acre. In addition, diffuse flow of runoff shall be maintained in the riparian buffer areas.

5 Monitoring Year 1 Assessment and Results

Annual monitoring was conducted during MY1 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 of the monitoring device locations are depicted on CCPV (Figure 1) and MY1 monitoring data results are listed in the appendices. The Project meets the MY1 success criteria for vegetation.

5.1 Vegetation

Vegetation monitoring for MY1 was conducted utilizing the seven (7) 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 MY1 average surviving planted stem density is 578 stems per acre, which exceeds the interim measure of vegetative success of at least 260 planted stems per acre at the end of the fifth monitoring year. The surviving planted stems also include a minimum of four (4) native hardwood tree species or four (4) native hardwood tree and native shrub species, where no one species is greater than fifty (50) percent of the stems. Summary data and photographs of each plot can be found in Appendix 3.

The MY1 vegetation monitoring was also conducted utilizing visual assessment along all of the Project stream reaches. The results of the visual assessment did not indicate any negative changes to the existing vegetation community. 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 Monitoring Report Format, Data and Content Requirement. 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). Pen Dell Stream and Riparian Buffer Mitigation Plan. NCDMS, Raleigh, NC.



Appendices



Appendix A – Background Tables

Table 1. Buffer Project Attributes

Project Name	Pen Dell Mitigation Project
Hydrologic Unit Code	03020201
River Basin	Neuse
Geographic Location (Lat, Long)	35°43' 52.51'' N 78°21' 10.12'' W
Site Protection Instrument (DB, PG)	85, 148
Total Credits (BMU)	371,215
Types of Credits	Riparian Buffer
Mitigation Plan Date	Nov-18
Initial Planting Date	Mar-18
Baseline Report Date	Nov-18
MY1 Report Date	Dec-18
MY2 Report Date	
MY3 Report Date	
MY4 Report Date	
MY5 Report Date	

Table 2. Buffer Project Areas and Assets

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	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	0.000		-	0.000
Rural or Urban	Subject or Nonsubject	Restoration	Restoration	0-100	286,888	286,888	1	100%	1.00000	286,888.000	Yes	14,970.199	--
Rural or Urban	Subject or Nonsubject	Restoration		101-200			1	33%	3.03030	0.000		-	0.000
Rural or Urban	Subject or Nonsubject	Enhancement		20-29			2	75%	2.66667	0.000		-	0.000
Rural or Urban	Subject or Nonsubject	Enhancement	Cattle Exc. Enh	0-100	124,088	124,088	2	100%	2.00000	62,044.000	No	-	0.000
Rural or Urban	Subject or Nonsubject	Enhancement		101-200			2	33%	6.06061	0.000		-	0.000
SUBTOTALS						410,976				348,932.000		14,970.199	0.000
ELIGIBLE PRESERVATION AREA						136,992							
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			
Rural	Subject	Preservation		20-29			10	75%	13.33333	0.000			
Rural	Subject	Preservation	Preservation	0-100	222,827	136,992	10	100%	10.00000	13,699.200			
Rural	Subject	Preservation		101-200			10	33%	30.30303	0.000			
Rural	Nonsubject	Preservation		20-29			5	75%	6.66667	0.000			
Rural	Nonsubject	Preservation		0-100			5	100%	5.00000	0.000			
Rural	Nonsubject	Preservation		101-200			5	33%	15.15152	0.000			
Urban	Subject or Nonsubject	Preservation		20-29			3	75%	4.00000	0.000			
Urban	Subject or Nonsubject	Preservation		0-100			3	100%	3.00000	0.000			
Urban	Subject or Nonsubject	Preservation		101-200			3	33%	9.09091	0.000			
SUBTOTALS						136,992				13,699.200			
TOTALS						547,968				362,631.200			

*Area eligible for preservation may be no more than 25% of total area, where total area is back-calculated with the equation R+E/0.75.

*Buffers must be at minimum 20' wide for riparian buffer credit, buffers must be 50' wide for nutrient offset credit

*When preservation areas exceed the total eligible preservation area, select the areas with the best credit ratios as the creditable areas.

Regulatory direction for Riparian Buffer in this table follows NCAC rule 15A NCAC 02B .0295, effective November 1, 2015.

Regulatory direction for Nutrient Offset in this table follows Nutrient Offsets Payments Rule 15A NCAC 02B. 0240, amended effective September 1, 2010 and DWR – 1998. Methodology and Calculations for determining Nutrient Reductions associated with Riparian Buffer Establishment.

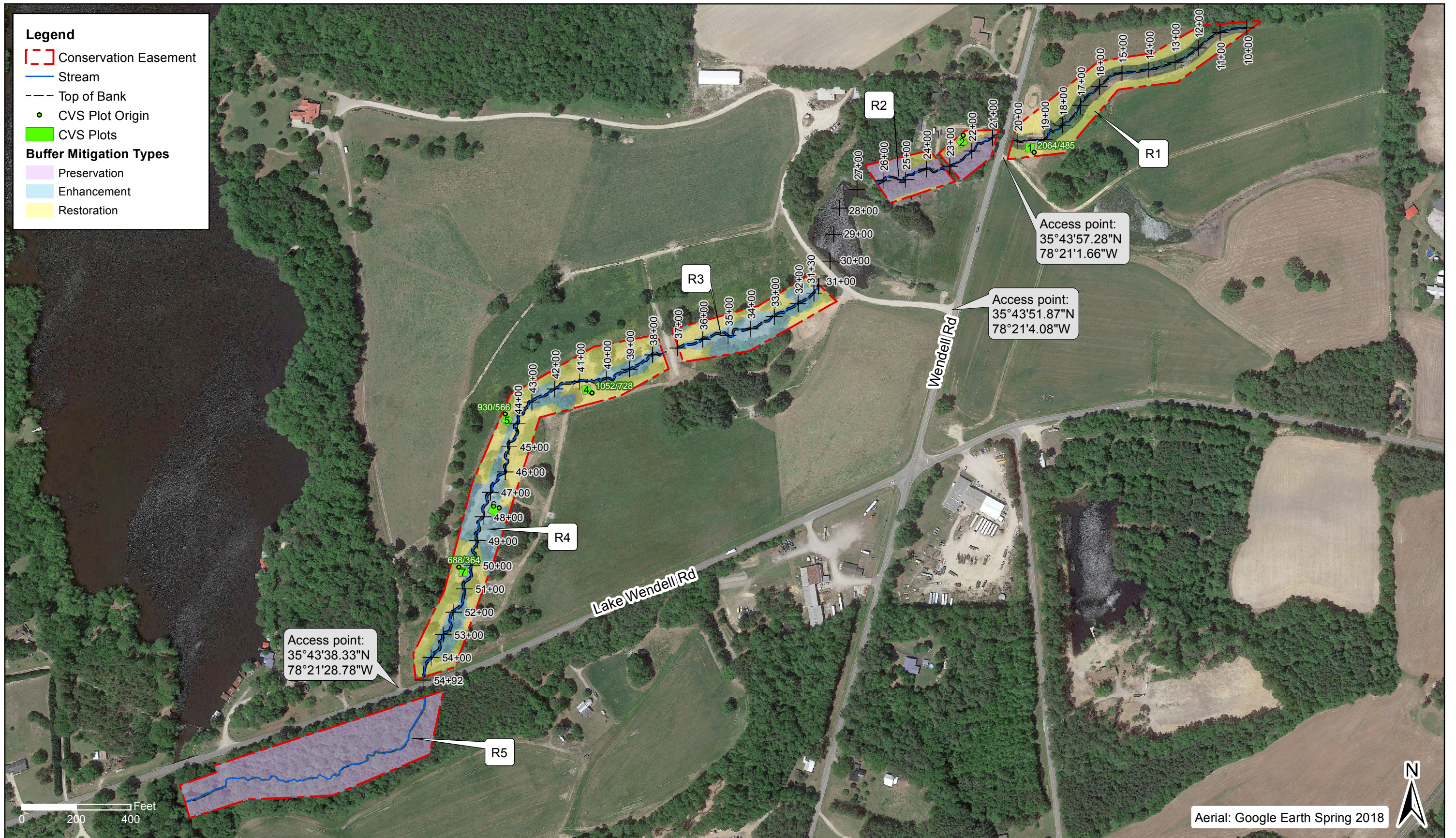
N.O. calculation based on effectiveness in 30 years, with DWR's 146.40 lb/ac P; and 2,273.02 lb/ac N. The N credit ratio used is 19.16394 sf per pound. The P credit ratio used is 297.54097 sf per pound.

Table 3. Project Contacts
Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)

Mitigation Provider	Water & Land Solutions, LLC 11030 Raven Ridge Road, Suite 200, Raleigh, NC 27614
Primary Project POC	William Scott Hunt, III, PE Phone: 919-270-4646
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 11030 Raven Ridge Road, Suite 200, Raleigh, NC 27614
Stream Monitoring POC	William Scott Hunt, III, PE Phone: 919-270-4646
Vegetation Monitoring POC	William Scott Hunt, III, PE Phone: 919-270-4646
Wetland Monitoring POC	William Scott Hunt, III, PE Phone: 919-270-4646



Appendix B – Visual Assessment Data



Legend

- Conservation Easement
- Stream
- Top of Bank
- CVS Plot Origin
- CVS Plots

Buffer Mitigation Types

- Preservation
- Enhancement
- Restoration

0 200 400 Feet

Aerial: Google Earth Spring 2018



**Pen Dell Mitigation Project
Johnston County, North Carolina**

NCDMS Contract No. 6824
NCDMS Project No. 97079
November 2018
MY1

Riparian Buffer &
Nutrient Offset Buffer
Mitigation Plan View

NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

**FIGURE
1**

Table 5a. Vegetation Condition Assessment
Project Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)
Planted Acreage¹ 10.1

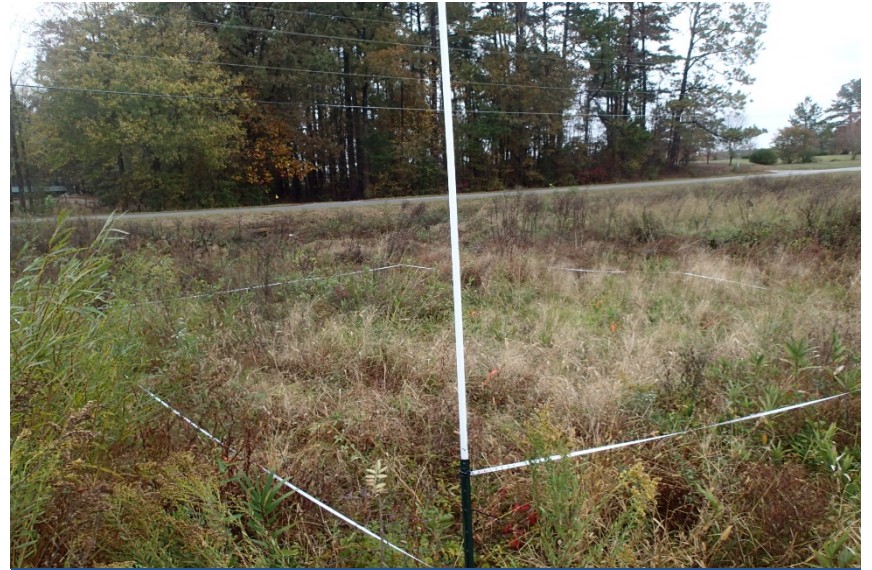
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	1 acre	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels 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 15.95

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	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas ³	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%



Veg Plot 1 April 12, 2018 (MY-00)



Veg Plot 1 November 6, 2018 (MY-01)



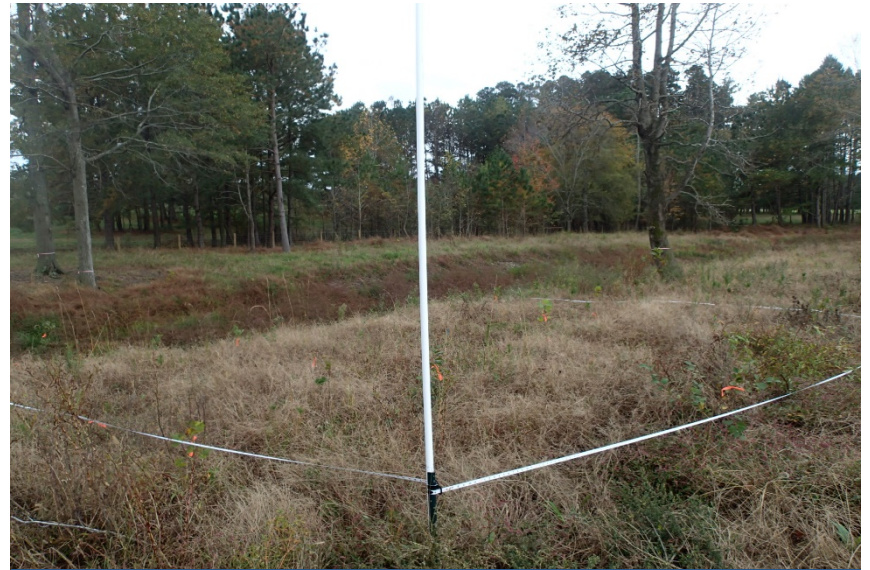
Veg Plot 2 April 12, 2018 (MY-00)



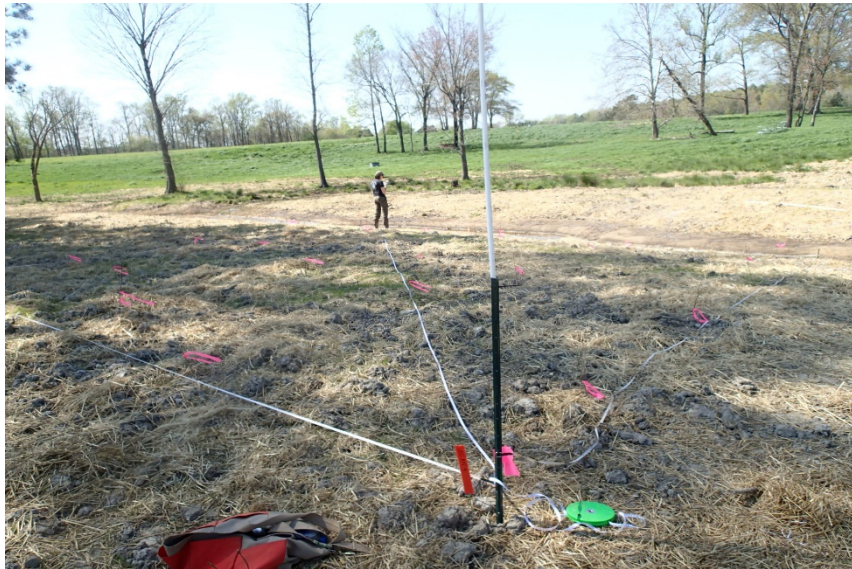
Veg Plot 2 November 6, 2018 (MY-01)



Veg Plot 3 April 12, 2018 (MY-00)



Veg Plot 3 November 6, 2018 (MY-01)



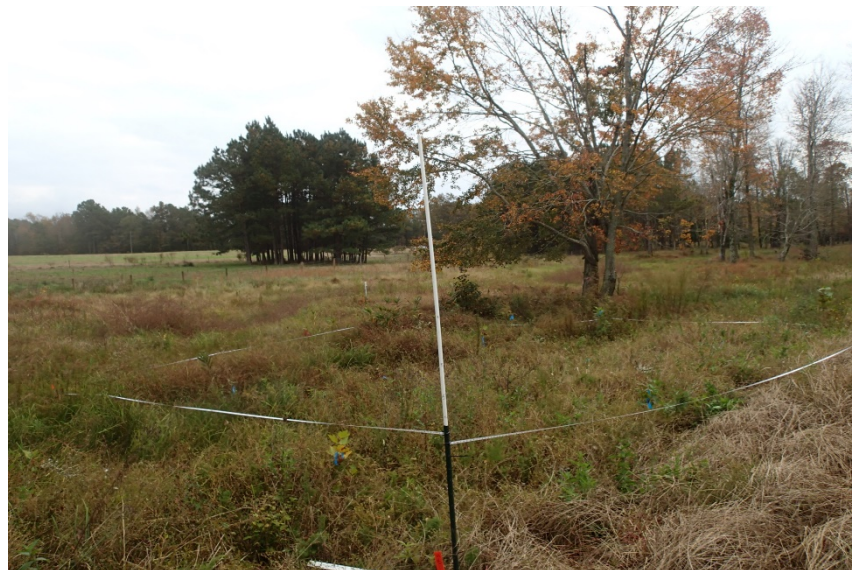
Veg Plot 4 April 12, 2018 (MY-00)



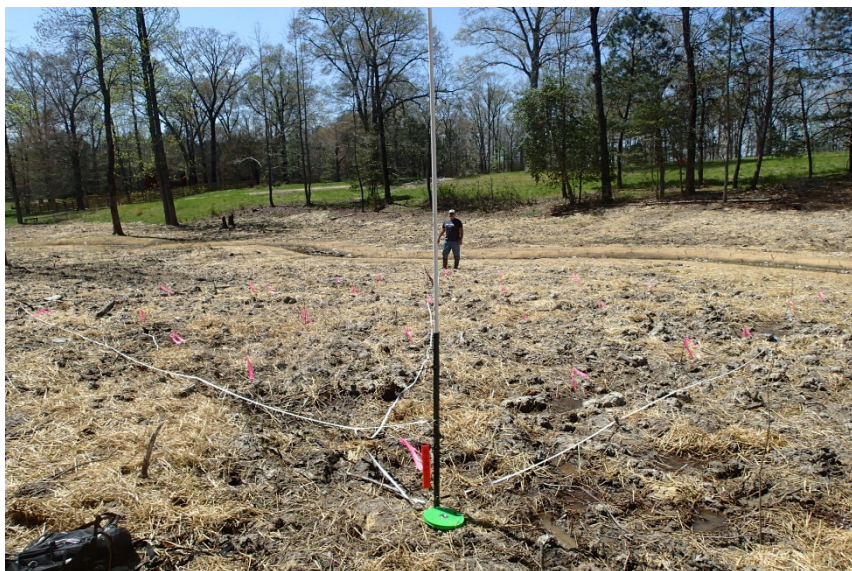
Veg Plot 4 November 6, 2018 (MY-01)



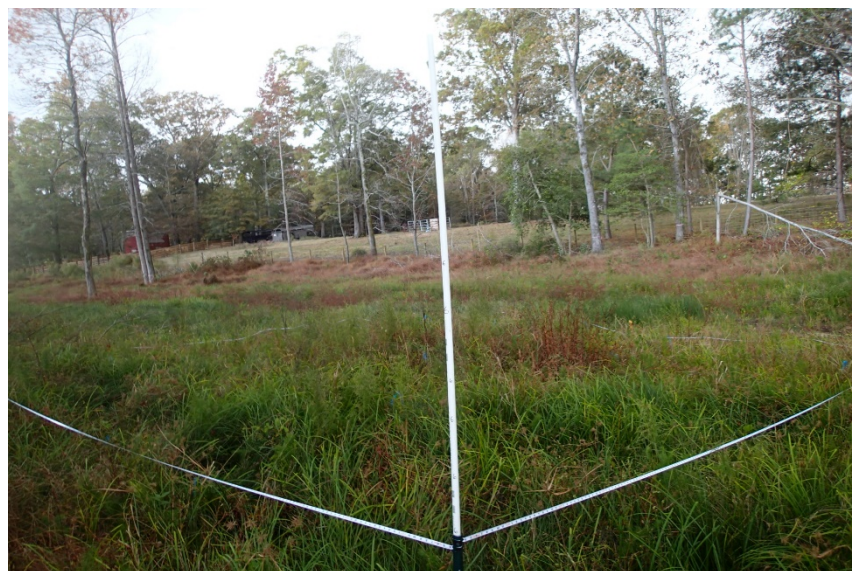
Veg Plot 5 April 12, 2018 (MY-00)



Veg Plot 5 November 6, 2018 (MY-01)



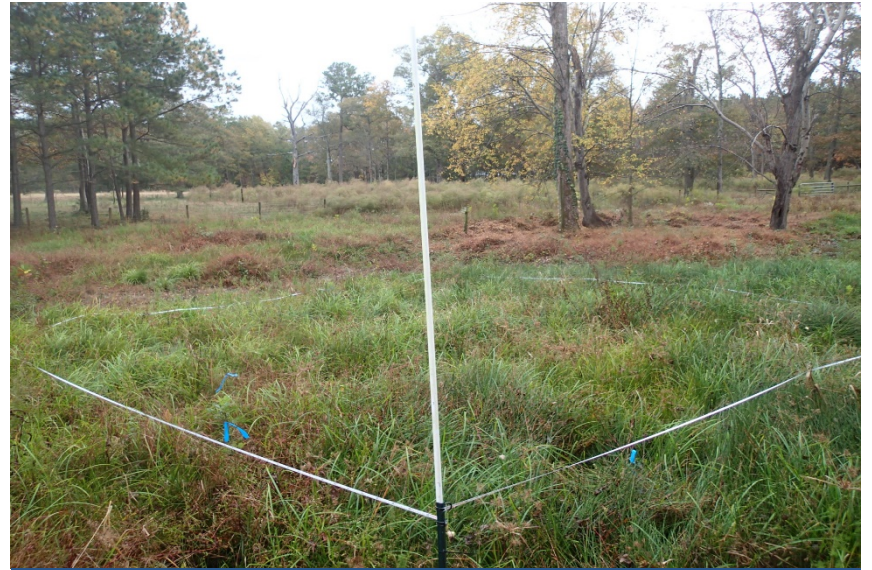
Veg Plot 6 April 12, 2018 (MY-00)



Veg Plot 6 November 6, 2018 (MY-01)



Veg Plot 7 April 12, 2018 (MY-00)



Veg Plot 7 November 6, 2018 (MY-01)



Appendix C – Vegetation Plot Data

Table 6. MY1 Stem Counts

Pen Dell Mitigation Project (NCDEQ DMS Project ID# 97079)

Scientific Name	Common Name	Species Type	Current Plot Data (MY0-2018)																					Annual Means								
			002-01-0001			002-01-0002			002-01-0003			002-01-0004			002-01-0005			002-01-0006			002-01-0007			MY0 (2018)			MY1 (2018)					
			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 rubrum	Red Maple	Tree			4			90			14	1	1	5	2	2	5	1	1	1			3				3	3	3	4	4	122
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
Betula nigra	River Birch, Red Birch	Tree	3	3	3				1	1	1	2	2	2	2	2	2	3	3	3							14	14	14	11	11	11
Carpinus caroliniana	Ironwood	Shrub Tree						1	2	2	2				2	2	2	4	4	4	1	1	1				10	10	10	9	9	10
Carya	Hickory	Tree						1																								1
Cornus amomum	Silky Dogwood	Shrub Tree	1	1	1				3	3	3							1	1	1	1	1	1				6	6	6	6	6	6
Diospyros virginiana	American Persimmon, Possumwood	Tree										1	1	1				1	1	1							2	2	2	2	2	2
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	1	1	1				1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	10	10	10	10	10	10
Ilex verticillata	Winterberry	Shrub Tree				3	3	3																			3	3	3	3	3	3
Lindera benzoin	Northern Spicebush	Shrub Tree				3	3	3																			13	13	13	3	3	3
Liquidambar styraciflua	Sweet Gum, Red Gum	Tree			1												2															3
Liriodendron tulipifera	Tulip Tree	Tree	2	2	2	1	1	1				2	2	2				1	1	1	2	2	2				13	13	13	5	5	5
Magnolia virginiana	Sweetbay Magnolia	Shrub Tree				1	1	1	2	2	2	2	2	2				1	1	1				2	2	2	14	14	14	8	8	8
Platanus occidentalis	Sycamore, Plane-tree	Tree							2	2	2	2	2	2	5	5	5	4	4	4	1	1	1				14	14	14	14	14	14
Populus deltoides	Eastern Cottonwood	Tree															1															1
Quercus michauxii	Basket Oak, Swamp Chestnut Oak	Tree	1	1	1				3	3	3	2	2	2	1	1	1	3	3	3	1	1	1				9	9	9	11	11	11
Quercus nigra	Water Oak, Paddle Oak	Tree	1	1	1							2	2	2													9	9	9	3	3	3
Quercus phellos	Willow Oak	Tree	2	2	2	2	2	2				2	2	2				1	1	1	1	1	1				8	8	8	8	8	8
Rhus copallinum	Winged Elm	Shrub Tree			3																											3
Rosa palustris	Swamp Rose	Shrub Vine			26									3			3			7												39
Salix nigra	Black Willow	Tree			2																		5									7
Sambucus canadensis	Common Elderberry	Shrub Tree			3																											3
Ulmus rubra	Slippery Elm, Red Elm	Tree						2						1																		3
Viburnum nudum	Southern Wild Raisin, Possumhaw	Shrub Tree																									1	1	1			
		Stem count	12	12	51	10	10	104	15	15	29	18	18	26	14	14	23	22	22	29	9	9	17	132	132	132	100	100	279			
		size (ares)	1			1			1			1			1			1			1			7			7					
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.17			0.17					
		Species count	8	8	14	5	5	9	8	8	9	10	10	12	6	6	9	11	11	12	7	7	9	16	16	16	15	15	23			
		Stems per ACRE	485.6	485.623	2064	404.7	404.69	4209	607.0	607.03	1174	728.4	728.43	1052	566.6	566.56	930.8	890.3	890.31	1174	364.2	364.22	688	763.1	763.1	763.1	578.1	578.1	1613			

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%



Appendix D – NC DWR Correspondence and Approvals



PAT MCCRORY

Governor

DONALD R. VAN DER VAART

Secretary

S. JAY ZIMMERMAN

Director

April 28, 2016

DWR Project #: 2016-0403

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 – Pen Dell
 Located near 2505 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 Pen Dell 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 25, 2016. If approved, mitigating this site could provide stream mitigation credits, riparian buffer credits and/or nutrient offset credits.

Ms. Merritt’s evaluation of the 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 Land uses</u>	<u>Buffer Credit Viable</u>	<u>²Nutrient Offset Viable at 2,273 lbs/acre</u>	<u>Mitigation Type/Comments</u>
R1 (wood line to road)	Undetermined conveyance	n/a	Active and pre-existing row crop; Land use along the conveyance consisted of a +/- 25’ narrow forested fringe w/ canopy from 1999-2010	n/a	Yes	Restoration for nutrient offset outside of 25’ on both sides of conveyance w/ plantings and easement starting at TOB back max 200’; Need stream determination by DWR if pursuing buffer credit; if feature is a stream, feature is viable for buffer restoration per 15A NCAC 02B .0295 (o)(3) outside of 25’ on both sides of conveyance.

R2 (Wendell Rd to below pond)	stream	Yes	Native hardwood forest, closed canopy	Yes	No	Preservation per 15A NCAC 02B .0295 (o)(5)
R3 (dirt path crossing to Lake Wendell Rd)	stream	Yes	All pasture actively grazed by cattle with mix of Native hardwood forest canopy	Yes	Yes	entire 50' from TOB and within all clusters of closed canopy hardwoods= Enhancement per 15A NCAC 02B .0295 (6); outside of forested areas (<i>pine tree clustered areas are not viable for credit</i>) =Restoration
R5	Stream	Yes	Native hardwood forest, closed canopy	Yes	No	Preservation per 15A NCAC 02B .0295 (o)(5)

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.

Maps showing the project site and the features are provided and are signed by Ms. Merritt on April 25, 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/or 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,

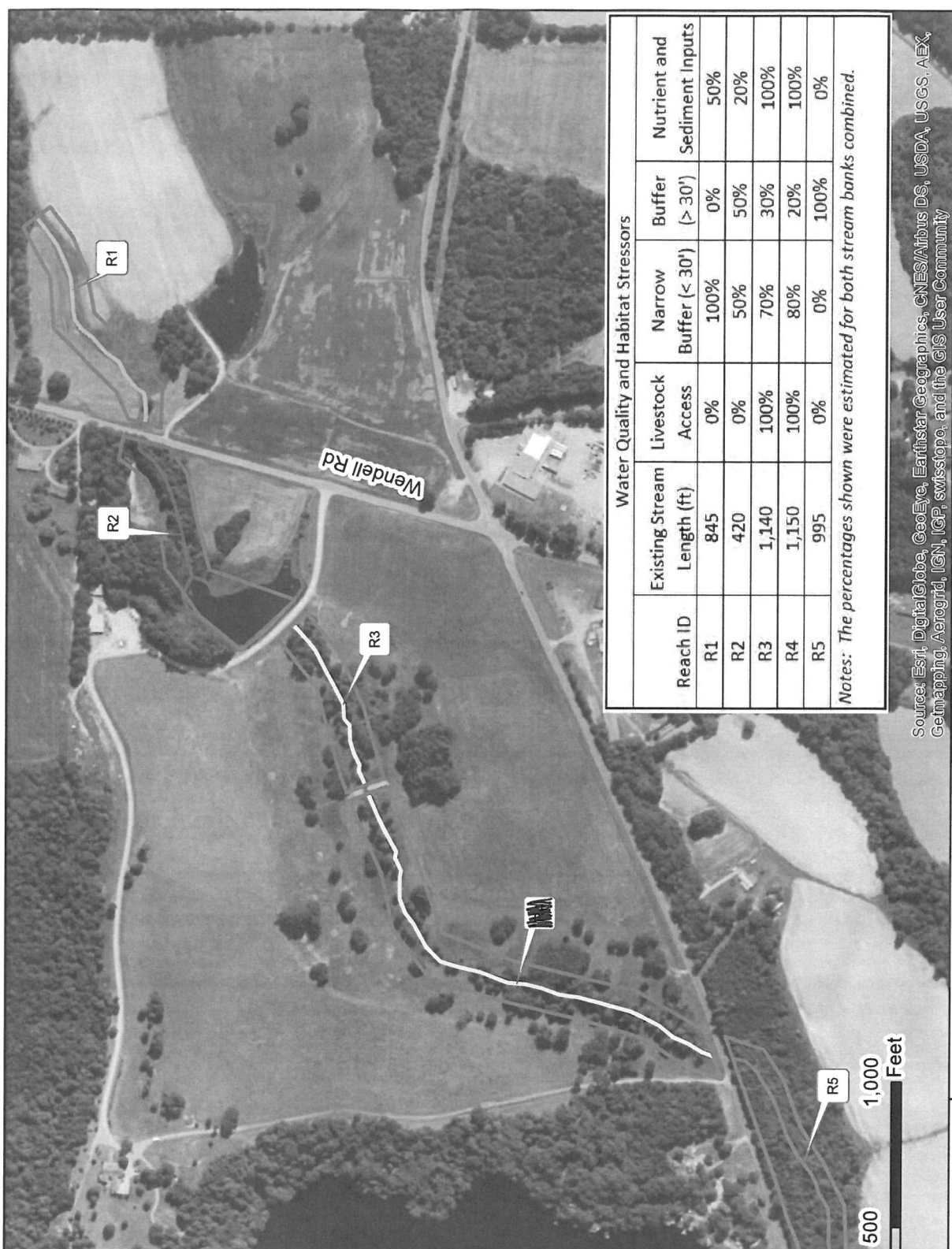
Karen Higgins, Supervisor
 401 and Buffer Permitting Branch

KAH/km

Attachments: Site Aerial Map, USGS Topographic Map, 1999 Aerial Photo, 2010 Aerial Photo

cc:File Copy (Katie Merritt)
 DMS – Jeff Schaffer (via electronic mail)

- Legend**
- Conservation Easement
 - Water Quality Stressors
 - Buffer (>30 ft)
 - Narrow Buffer
 - Narrow Buffer & Cattle Access
 - Nutrient and Sediment Inputs



Reach ID	Water Quality and Habitat Stressors					Nutrient and Sediment Inputs
	Existing Stream Length (ft)	Livestock Access	Narrow Buffer (< 30')	Buffer (> 30')		
R1	845	0%	100%	0%	50%	
R2	420	0%	50%	50%	20%	
R3	1,140	100%	70%	30%	100%	
R4	1,150	100%	80%	20%	100%	
R5	995	0%	0%	100%	0%	

Notes: The percentages shown were estimated for both stream banks combined.

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

Site Aerial (Current) *Kym 4/25/14* Water Quality Pen Dell Stressors
 Mitigation Project DNR # *2011-040B*

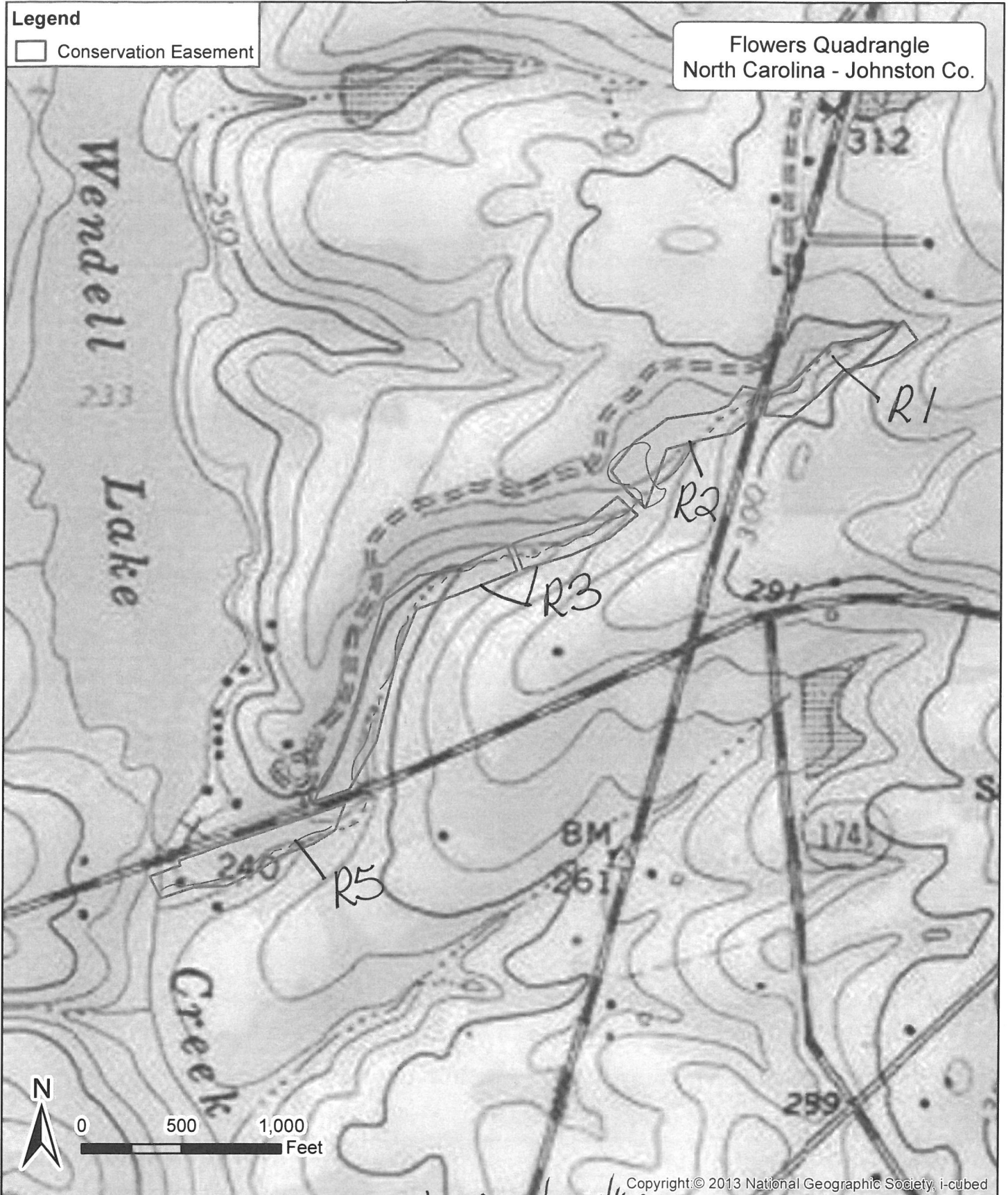


FIGURE 9

NAD 1983 2011 State Plane
 North Carolina FIPS 3200 FT US

Legend
□ Conservation Easement

Flowers Quadrangle
North Carolina - Johnston Co.



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Jym 4/25/14
Pen Dell
Mitigation Project
DNR # 2010-0403

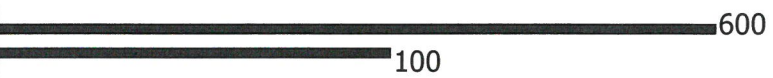
USGS
Topographic
Map
NAD 1983 2011 State Plane

FIGURE
2



Google earth

feet
meters



Aerial dated 12/2005
DWR# 2016-0403 (Pen Dell)
Kym 4/25/14



Google earth



Aerial dated 7/2010

DWR# 2014-0403 (Pen Dell)
Kym 4/25/14