Monitoring Report
FINAL VERSION
Edwards-Johnson Mitigation Project
Monitoring Year 1
Calendar Year of Data Collection: 2018

NCDEQ DMS Project Identification # 97080
NCDEQ DMS Contract # 6825
Neuse River Basin (Cataloging Unit 03020201)
USACE Action ID Number: SAW-2016-00883
NCDEQ DWR Project # 2016-0404
Johnston County, NC
Contracted Under RFP # 16-006477
Data Collection Period: April-June 2018, Submission Date: March 2019

Prepared for:

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

Prepared by:

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

Table of Contents

LIST OF APPENDICES

1 Project Summary

Water and Land Solutions, LLC (WLS) completed the construction and planting of the Edwards-Johnson Mitigation Project (Project) full-delivery project for the North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) in March 2018. The Project is located in Johnston County, North Carolina between the Community of Archer Lodge and the Town of Wendell at 35˚ 43' 30.36'' North and 78˚ 21' 22.90'' 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, preservation and permanent protection of four stream reaches (R1, R2, R3, and R4) and their riparian buffers, totaling approximately 3,729 linear feet of existing streams. The Project construction and planting were completed in May 2018 and MY1 monitoring activities occurred between May 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, 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 Edwards-Johnson Mitigation Project (Project) site is located in the Lower Buffalo Creek Priority Sub-watershed 030202011504 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 included four stream reaches (R1, R2, R3, and R4) which involved the restoration, preservation and permanent protection of approximately3,729 linear feet of streams permanently protected by a conservation easement. The catchment area is 223 acres and has an impervious cover less than one percent. The dominant land uses are agriculture and mixed forest. Prior to Project construction, some of the riparian buffers were less than 50 feet wide.

2.2 Mitigation Project Goals and Objectives

WLS established project mitigation goals and objectives based on the resource condition and functional capacity of the watershed to improve and protect diverse aquatic resources comparable to stable

headwater stream systems within the Piedmont Physiographic Province. The proposed mitigation types and design approaches described in the final approved mitigation plan considered the general restoration and resource protection goals and strategies outlined in the 2010 Neuse River Basin Restoration Priority Plan (RBRP). The functional goals and objectives were further defined in the 2013 Wake-Johnston Collaborative Local Watershed Plan (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	Remove man-made pond dam and restore a more natural flow regime and aquatic passage.
Hydraulics (Level 2)	Reconnect Floodplain / Increase Floodprone Area Widths	Lower BHRs from >2.0 to 1.0-1.2 and maintain ERs at 2.2 or greater.
Geomorphology (Level 3)	Improve Bedform Diversity	Increase riffle/pool percentage to 70/30 and pool-to-pool spacing ratio 4-7X bankfull width.
	Increase Lateral Stability	Reduce BEHI/NBS streambank erosion rates comparable to downstream reference condition and stable cross-section values.
	Enhance Riparian Buffer Vegetation	Plant or protect native species vegetation a minimum 50' wide from the top of the streambanks with a composition/density comparable to reference condition.
Physicochemical (Level 4)	Improve Water Quality	Install water quality treatment basins along the riparian corridor and reduce sediment and nutrient levels.
Biology (Level 5)	Improve Macroinvertebrate Community and Aquatic Species Health	Incorporate native woody debris and bedform diversity into channel and change DWR bioclassification rating from 'Poor' to a minimum 'Fair' by Monitoring Year 7.

-

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 March 23, 2018 and mitigation site earthwork and mitigation site planting were completed on May 5, 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 May 14, 2018 and the installation of survey monumentation and conservation easement boundary marking on August 13, 2018.

Refer to Figure 1 and Table 1 for the project components/asset information. A recorded conservation easement consisting of 10.96 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. 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 (Appendix C) and now protected through a permanent conservation easement. Table 1 and Figure 1 (Appendix A) provide a summary of the project components.

3.1.1 R1 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 being protected in perpetuity through a permanent conservation easement. This approach will extend the wildlife corridor from the Buffalo Creek floodplain boundary throughout a majority of the riparian valley, while providing a hydrologic connection and critical habitat linkage within the catchment area.

3.1.2 R2 Restoration

Work along R2 involved a Priority Level I Restoration approach by raising the bed elevation and reconnecting the stream with its abandoned floodplain. This approach will promote more frequent over bank flooding in areas with hydric soils, thereby creating favorable conditions for wetland re-establishment. The reach was restored using appropriate riffle-pool morphology with a conservative meander planform geometry that accommodates the 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. Proposed 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 enhanced and will be protected along the entire length of R2. Mature trees and significant native vegetation were protected and incorporated into the design.

Bioengineering techniques such as vegetated geolifts and live stakes were also used to protect streambanks and promote woody vegetation growth along the streambanks. The existing unstable channel was filled to an elevation sufficient to connect the new bankfull channel to its active floodplain using suitable fill material excavated from the newly restored channels and remnant spoil piles. Additionally, water quality treatment basins were installed to reduce direct sediment and nutrient inputs.

3.1.3 R3 (Upper Reach) Restoration

A Priority Level I Restoration approach was implemented for the upstream portion to improve stream functions and water quality. Prior to restoration activities, the reach exhibited both lateral and vertical instability, as shown by active headcuts and moderate bank erosion. A new single-thread meandering channel was constructed offline in this area before reconnecting with multiple relic channel features and the existing channel alignment farther downstream. In-stream structures, including log riffles, log weirs and log vanes were used to dissipate flow energy, protect streambanks, and eliminate potential for future incision. Shallow floodplain depressions and vernal pools were created or preserved in the floodplain to provide habitat diversity, nutrient cycling, and improved treatment of overland flows. Restored streambanks were graded to stable side slopes and the floodplain was reconnected to further promote stability and hydrological function.

3.1.4 R3 (Lower Reach) 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 is being protected in perpetuity through a permanent conservation easement. This approach will extend the wildlife corridor from the Buffalo Creek floodplain boundary throughout a majority of the riparian valley, while providing a hydrologic connection and critical habitat linkage within the catchment area.

3.1.5 R4 Restoration

The restoration of R4 involved raising the existing bed elevation gradually to reconnect the stream with its active floodplain. Prior to restoration activities, the existing channel began experiencing backwater conditions and sediment aggradation from a man-made pond. The failing dam and remnant spoil piles were removed and the pond was drained to reconnect the new stream channel with its geomorphic floodplain. Channel and floodplain excavation in this reach segment included the removal of shallow legacy sediments (approx. 12” depth) to accommodate a new bankfull channel and in-stream structures, as well as a more natural step-pool morphology using grade control structures in the steeper transitional areas. Shallow floodplain depressions were created to provide habitat diversity, nutrient cycling, and improved treatment of overland flows. Riparian buffers greater than 50 feet were restored and protected along all R4.

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)	Remove man-made pond, 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 increase ERs at 2.2 or greater and document bankfull/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	Reduction of excess nutrients and organic pollutants will increase the hyporheic exchange and dissolved oxygen (DO) levels.
Biology (Level 5)	Improve Benthic Macroinvertebrate Communities and Aquatic Health	DWR Small Stream/ Qual v4 sampling, IBI	N/A	Increase leaf litter and organic matter critical to provide in-stream cover/shade, wood recruitment, and carbon sourcing.

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

4.1 Streams

4.1.1 Stream Hydrology

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

4.1.2 Stream Profiles, Vertical Stability, and Floodplain Access

Stream profiles, as a measure of vertical stability will be evaluated by looking at Bank Height Ratios (BHR). The BHR shall not exceed 1.2 along the restored project reaches. This standard only applies to the restored project reaches where BHRs were corrected through design and construction. In addition, observed bedforms should be consistent with those observed for channels of the design stream type(s). 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, and streambed material. All vegetation plots meet interim success criteria except veg plot 3 which appears to be experiencing prolonged wet conditions

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 (Qgs=0.66Q2) within the monitoring period, along with floodplain access by flood flows, is being conducted using a crest gauge, installed on December 12, 2018, on the floodplain of and across the dimension of the restored channel at the left top of bank of Reach R2, immediately upstream of the confluence of Reach R2 and R4 (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. Because the crest gage was installed after the submission of the Draft As-built Baseline Monitoring Reports and Draft Monitoring Reports Year 1, only the described photographic measures will be used for Year 1 stream hydrologic monitoring. At least one bankfull events occurred during MY1. This event was documented using the described photography (Table 8). The documented occurrence of this flow event satisfies the requirement of the occurrence of one of the two bankfull events (overbank flows) and the one of the two "geomorphically significant" flow events (Qgs=0.66Q2) 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 gage (flow gage) (continuous-read pressure transducers) within the thalweg (bottom) of the channel towards the middle portion of the Reach R4 (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 data for MY1 is incomplete and will be reconciled for MY2. The monitoring gage intended to document 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. WLS did observe stream flow along Reach R4, as well as along all of other project reaches, during each pre- and post-construction site visit in 2018, with WLS staff visiting the site on a monthly basis. These observations correspond do the monitoring flow gage documentation results at the nearby Lake Wendell and Pen Dell Mitigation Project Sites.

5.5 Vegetation

Vegetation monitoring for MY1 was conducted utilizing the four (4) 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 496 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 significant negative changes to the existing vegetation community.

An area of concern was observed along R3 buffer near veg plot 3 as shown on the CCPV. This area was utilized as a partial haul road during construction and experienced prolonged wetness during planting activities. Veg plot 3 stem density was approximately 283 stems per acre which is below the interim success criteria. In addition, low stem density was observed along R4 near veg plot 4. These areas will be watched closely during MY2 monitoring and any remedial actions, if necessary, will be documented in the subsequent MY2 report. In addition, a slight buffer encroachment was observed along the R2 as shown on the CCPV. The conservation easement is marked in this area and the landowner has been notified. This area will be replanted in Winter 2019 and documented in the MY2 report.

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 R3. The well data was unrecoverable and therefore an additional groundwater monitoring well was installed along Reach R3 (preservation) after the first year of monitoring, in early January 2019. The wells were installed to document groundwater levels within the stream and wetland restoration 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

Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E. 2003. Stream Restoration A Natural Channel Design Handbook.

Harrelson, Cheryl C; Rawlins, C.L.; Potyondy, John P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

KCI Associates of NC, DMS. 2010. Using Pressure Transducers for Stream Restoration Design and Monitoring.

Lee, M., Peet R., Roberts, S., Wentworth, T. CVS-NCEEP Protocol for Recording Vegetation, Version 4.1, 2007.

North Carolina Department of Environmental Quality, Division of Mitigation Services, Wildlands Engineering, Inc. 2015. Neuse 01 Regional Watershed Plan Phase II. Raleigh, NC.

North Carolina Department of Environmental Quality, Division of Mitigation Services, 2017. Annual Monitoring Report Format, Data and Content Requirement. Raleigh, NC.

Rosgen, D. L., 1994. A Classification of Natural Rivers. Catena 22: 169-199.

Rosgen, D.L., 1996. Applied River Morphology. Wildland Hydrology Books, Pagosa Springs, CO.

Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. North Carolina Natural Heritage Program. NCDENR Division of Parks and Recreation. Raleigh, NC.

United States Army Corps of Engineers. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. Environmental Laboratory. US Army Engineer Waterways Experiment Station. Vicksburg, MS.

___. 1997. Corps of Engineers Wetlands Research Program. Technical Note VN-RS-4.1. Environmental Laboratory. U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

___. 2003. Stream Mitigation Guidelines, April 2003, U.S. Army Corps of Engineers. Wilmington District.

Water and Land Solutions, LLC (2017). Edwards-Johnson Mitigation Project Final Mitigation Plan. NCDMS, Raleigh, NC.

Appendices

Appendix A – Background Tables and Figures

Table 1. Mitigation Assets and Components
Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)

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		611	10+00 -16+11	611	611	P	-	10	61	Invasive Control, Permanent Conservation Easement.
R2		1007	16+11 - 27+94	1183	1180	R	PI	1	1183	Full Channel Restoration, Invasive Control, Permanent Conservation Easement.
R3 (upper		629	27+94 - 36+09	815	853	R	PI	1	815	Full Channel Restoration, Invasive Control, Permanent Conservation Easement.
R3 (lower)		240	36+09 - 37+39	130	149	P	-	10	13	Invasive Control, Permanent Conservation Easement.
R4		815	10+00 - 19+36	951	936	R	PI/PII	1	951	Full Channel Restoration, Pond Removal, 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	2949			
Enhancement				
Enhancement I				
Enhancement II				
Creation				
Preservation	741			
High Quality Pres				

Overall Assets Summary

Asset Category	Overall Credits*
Stream	**3,023**
RP Wetland	
NR Wetland	

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

Table 2. Project Activity and Reporting History
Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)

Elapsed Time Since grading complete: **0 yrs 7 months**
Elapsed Time Since planting complete: **0 yrs 7 months**
Number of reporting Years[0]: **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 Verfication	N/A	1/12/2018
Begin Construction	N/A	3/23/2018
Mitigation Site Earthwork Completed	N/A	5/5/2018
Mitigation Site Planting Completed	N/A	5/5/2018
Installation of Monitoring Devices Completed	N/A	5/14/2018
Installation of Survey Monumentation and Boundary Marking	N/A	8/13/2018
As-built/Baseline (Year 0) Monitoring Report Submittal	6/23/2018	12/3/2018
Year 1 Monitoring Report Submittal	11/24/2018	12/4/2018
Year 2 MonitoringReport 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

Bolded items are examples of those items that are not standard, but may come up and should be included
Non-bolded items represent events that are standard components over the course of a typical project, but the one listed may not be all inclusive.
The above are obviously **not** the extent of potential relevant project activities, but are just provided as example as part of this exhibit.

Table 3. Project Contacts Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)	
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					
Project Name	Edwards-Johnson Mitigation Project				
County	Johnston				
Project Area (acres)	11.0				
Project Coordinates (latitude and longitude)	35.7245361 N, -78.3570806 W				
Planted Acreage (Acres of Woody Stems Planted)	3.69				
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)	223 acres, 0.35 sq mi				
Project Drainage Area Percentage of Impervious Area	2.30%				
CGIA Land Use Classification	2.01.03, 2.99.05, 413, 4.98 (33% crops/hay, 16% pasture, 51% mixed forest)				
Reach Summary Information					
Parameters	**Reach 1**	**Reach 2**	**Reach 3 (upper)**	**Reach 3 (lower)**	**Reach 4**
Length of reach (linear feet)	611	1173	770	130	1176
Valley confinement (Confined, moderately confined, unconfined)	unconfined	unconfined	unconfined	unconfined	unconfined
Drainage area (Acres and Square Miles)	96 acres, 0.15 sq mi	120 acres, 0.19 sq mi	211 acres, 0.33 sq mi	223 acres, 0.35 sq mi	55 acres, 0.09 sq mi
Perennial, Intermittent, Ephemeral	Intermittent	Perennial	Perennial	Perennial	Intermittent
NCDWR Water Quality Classification	C; NSW	C; NSW	C;NSW	C; NSW	C; NSW
Stream Classification (existing)	C5	G5c	E5(incised)	E5(incised)	G5c/Pond
Stream Classification (proposed)	C5	C5	C5	C5, D5	C5
Evolutionary trend (Simon)	I	III/IV	IV	V	III/IV
FEMA classification	N/A	N/A	N/A	Zone AE	N/A
Wetland Summary Information					
Parameters	**Wetland 1**	**Wetland 2**	**Wetland 3**		
Size of Wetland (acres)	N/A	N/A	N/A		
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)					
Mapped Soil Series					
Drainage class					
Soil Hydric Status					
Source of Hydrology					
Restoration or enhancement method (hydrologic, vegetative etc.)					
Regulatory Considerations					
Parameters	**Applicable?**	**Resolved?**	**Supporting Docs?**		
Water of the United States - Section 404	Yes	Yes	Categorical Exclusion		
Water of the United States - Section 401	Yes	Yes	Categorical Exclusion		
Endangered Species Act	No	Yes	Categorical Exclusion		
Historic Preservation Act	No	N/A	Categorical Exclusion		
Coastal Zone Management Act (CZMA or CAMA)	No	N/A	N/A		
FEMA Floodplain Compliance	Yes	Yes	Categorical Exclusion		
Essential Fisheries Habitat	No	N/A	Categorical Exclusion		

Appendix B – Visual Assessment Data

WATER & LAND™ SOLUTIONS

Edwards-Johnson Mitigation Project
Johnston County, North Carolina

NCDMS Contract No. 6825
NCDMS Project No. 97080
November 2018
MY1

Current Conditions
Plan View
Monitoring Year 1

NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

FIGURE
1

Table 5. **Visual Stream Morphology Stability Assessment**
Project **Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)**
Reach ID **R1, R2, R3 (upper) and R3 (lower)**
Assessed Length **3609**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
*	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	46	47			98%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	24	24			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	11	11			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)	14	14			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	11	12			92%			

*** 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	Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)					
Planted Acreage[1]	3.6					
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	solid light blue	2	0.26	7.2%
			Total	2	0.26	7.2%
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	2	0.26	7.2%

Easement Acreage[2]	10.97					
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	yellow hatched	1	0.05	1.4%

Reach R1, facing upstream, April 12, 2018 (MY-00)

Reach R1, facing upstream, December 6, 2018 (MY-01)

Reach R1, facing upstream, April 12, 2018 (MY-00)

Reach R1, facing downstream, December 6, 2018 (MY-01)

Reach R2, facing upstream, Sta 17+00, April 23, 2018 (MY-00)

Reach R2, facing upstream, Sta 17+00, Dec 6, 2018 (MY-01)

Reach R2, facing downstream, Sta 18+00, April 23, 2018 (MY-00)

Reach R2, facing downstream, Sta 18+00, Dec 6, 2018 (MY-01)

Reach R2, facing downstream, Sta 20+00, Sept 17, 2018 (MY-00)

Reach R2, facing downstream, Sta 20+00, Dec 6, 2018 (MY-01)

Reach R2, facing upstream, Sta 21+00, April 23, 2018 (MY-00)

Reach R2, facing upstream, Sta 21+00, Dec 6, 2018 (MY-01)

Reach R2, facing downstream, Sta 21+00, April 23, 2018 (MY-00)

Reach R2, facing downstream, Sta 21+00, Dec 6, 2018 (MY-01)

Reach R2, facing downstream, Sta 25+00, April 23, 2018 (MY-00)

Reach R2, facing downstream, Sta 25+00, Dec 6, 2018 (MY-01)

Reach R2, facing upstream, Sta 26+00, April 23, 2018 (MY-00)

Reach R2, facing upstream, Sta 26+00, Dec 6, 2018 (MY-01)

Reach R3, facing downstream, Sta 32+00, April 19, 2018 (MY-00)

Reach R3, facing downstream, Sta 32+00, June 11, 2018 (MY-01)

Reach R4, facing upstream, Sta 13+00, June 11, 2018 (MY-00)

Reach R4, facing upstream, Sta 13+00, Dec 6, 2018 (MY-01)

Reach R4, facing downstream, Sta 13+00, June 11, 2018 (MY-00)

Reach R4, facing downstream, Sta 13+00, Sept 17, 2018 (MY-01)

Reach R4, facing upstream, Sta 15+00, June 11, 2018 (MY-00)

Reach R4, facing upstream, Sta 15+00, Sept 17, 2018 (MY-01)

Reach R4, facing upstream, Sta 17+00, June 11, 2018 (MY-00)

Reach R4, facing upstream, Sta 17+00, Dec 6, 2018 (MY-01)

Veg Plot 1 May 14, 2018 (MY-00)

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

Veg Plot 2 May 14, 2018 (MY-00)

Veg Plot 2 November 5, 2018 (MY-01)

Veg Plot 3 May 14, 2018 (MY-00)

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

Veg Plot 4 May 14, 2018 (MY-00)
*plot origin at corner to the right

Veg Plot 4 November 5, 2018 (MY-01)

Appendix C – Vegetation Plot Data

Table 6. MY1 Stem Counts

Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)

			Current Plot Data (MY1-2018)												Annual Means					
			003-01-0001			003-01-0002			003-01-0003			003-01-0004			MY0 (2018)			MY1 (2018)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red Maple	Tree	2	2	11			5						1	1	1	1	2	2	17
Alnus serrulata	Tag Alder, Smooth Alder, Hazel Alder	Shrub Tree													3	3	3			
Betula nigra	River Birch, Red Birch	Tree	3	3	3	2	2	2	1	1	1	1	1	1	8	8	8	7	7	7
Carpinus caroliniana	Ironwood	Shrub Tree	2	2	2													2	2	2
Cornus amomum	Silky Dogwood	Shrub Tree	2	2	2				3	3	3				8	8	8	5	5	5
Diospyros virginiana	American Persimmon, Possumwood	Tree	1	1	1													1	1	1
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	1	1	2	1	1	1				2	2	2	4	4	4	4	4	5
Ilex verticillata	Winterberry	Shrub Tree													1	1	1			
Lindera benzoin	Northern Spicebush	Shrub Tree	3	3	3	4	4	4				1	1	1	11	11	11	8	8	8
Liquidambar styraciflua	Sweet Gum, Red Gum	Tree			3						1									4
Liriodendron tulipifera	Tulip Tree	Tree						3			6			2	7	7	7			11
Platanus occidentalis	Sycamore, Plane-tree	Tree	3	3	3	1	1	1	1	1	2	2	2	2	10	10	10	7	7	8
Quercus michauxii	Basket Oak, Swamp Chestnut Oak	Tree				3	3	3							4	4	4	3	3	3
Quercus nigra	Water Oak, Paddle Oak	Tree							2	2	2				6	6	6	2	2	2
Quercus phellos	Willow Oak	Tree	2	2	2	4	4	4				2	2	4	7	7	7	8	8	10
Rhus typhina	Staghorn Sumac	Shrub												1						1
Salix nigra	Black Willow	Tree			6															6
Sambucus canadensis	Common Elderberry	Shrub Tree									5									5
Ulmus rubra	Slippery Elm, Red Elm	Tree									2									2
		Stem count	19	19	38	15	15	23	7	7	22	8	8	14	70	70	70	49	49	97
		size (ares)	1			1			1			1			4			4		
		size (ACRES)	0.02			0.02			0.02			0.02			0.10			0.10		
		Species count	9	9	11	6	6	8	4	4	8	5	5	8	12	12	12	11	11	17
		Stems per ACRE	768.9	768.9	1538	607.0	607.03	930.8	283.3	283.3	890.3	323.7	323.7	566.6	708.2	708.2	708.2	495.7	495.7	981.4

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

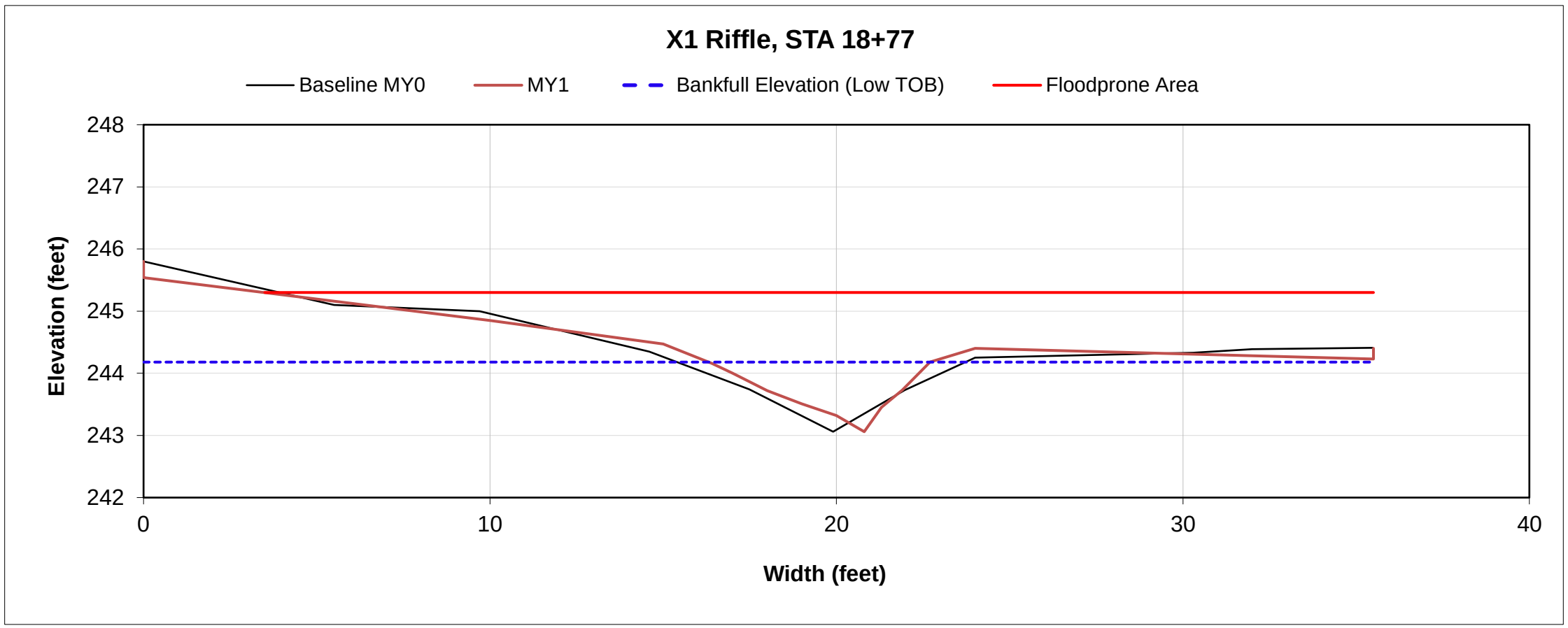
Fails to meet requirements by more than 10%

Appendix D – Stream Measurement and Geomorphology Data

Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R2
Cross Section ID	X1
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	244.2
Bankfull Cross Sectional Area ($ft^{2)}$	5.2
XS Area Change from As-built (%)	-5.8%
Bankfull Width (ft)	7.7
Max Depth (ft)	1.1
Mean Depth (ft)	0.7
Width/Depth Ratio	11.4
Flood Prone Area Width (ft)	32.0
Entrenchment Ratio	4.2
Bank Height Ratio	1.0

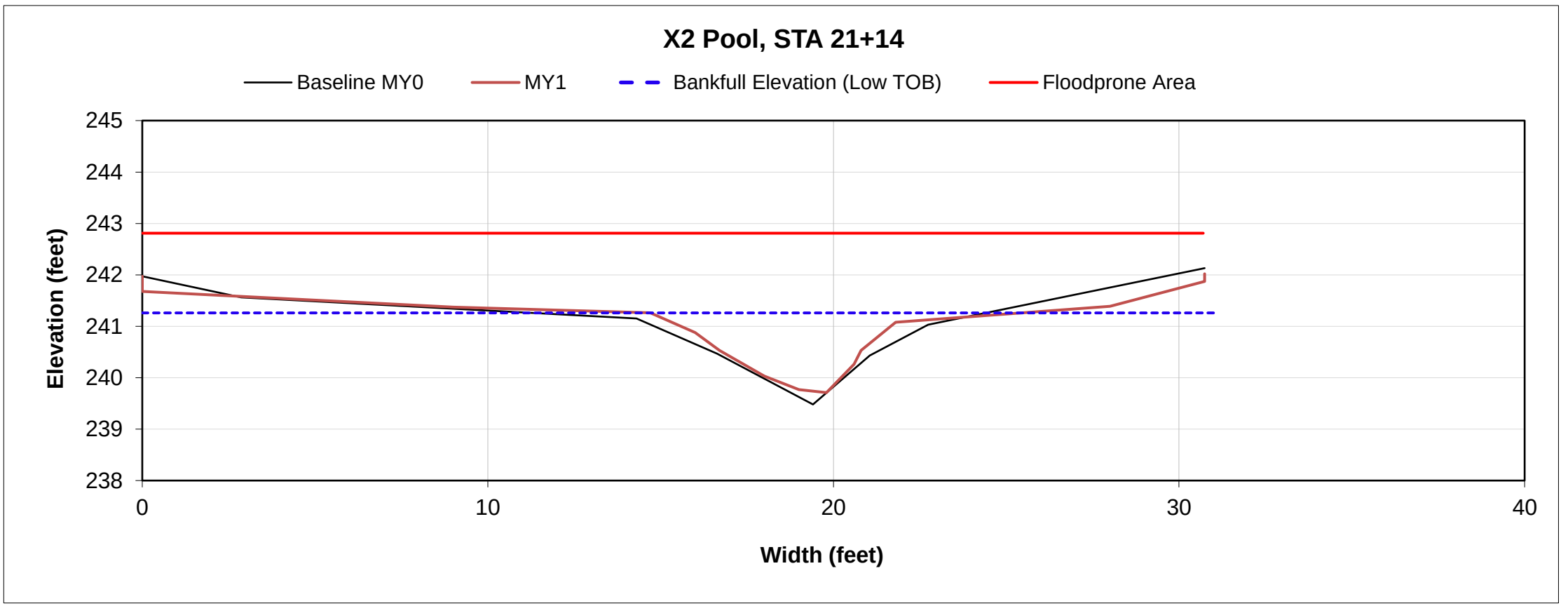
Looking Downstream



Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R2
Cross Section ID	X2
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	241.3
Bankfull Cross Sectional Area ($ft^{2)}$	6.1
XS Area Change from As-built (%)	-8.8%
Bankfull Width (ft)	13.3
Max Depth (ft)	1.6
Mean Depth (ft)	0.5
Width/Depth Ratio	28.8
Flood Prone Area Width (ft)	30.7
Entrenchment Ratio	2.3
Bank Height Ratio	0.9

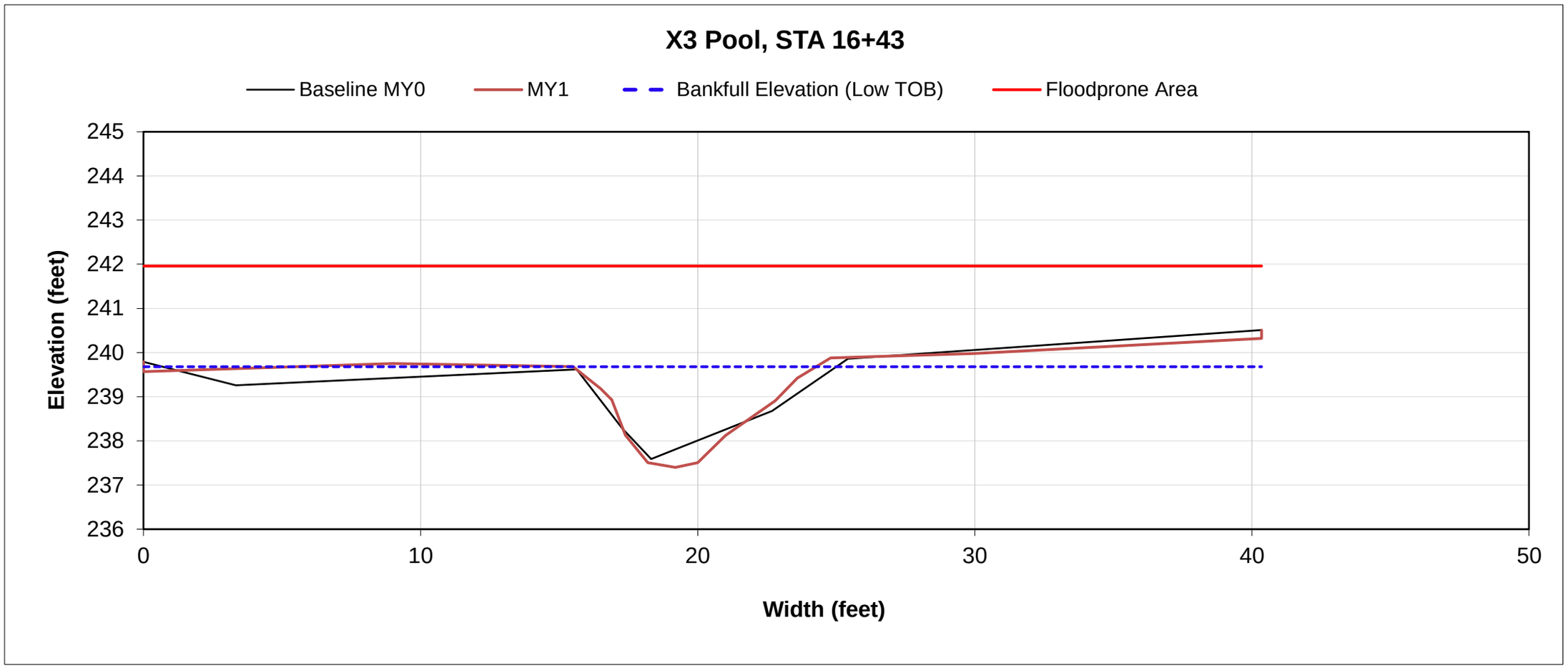
Looking Downstream



Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R4
Cross Section ID	X3
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	239.7
Bankfull Cross Sectional Area ($ft^{2)}$	11.0
XS Area Change from As-built (%)	6.7%
Bankfull Width (ft)	9.3
Max Depth (ft)	2.3
Mean Depth (ft)	1.2
Width/Depth Ratio	7.9
Flood Prone Area Width (ft)	40.4
Entrenchment Ratio	4.3
Bank Height Ratio	1.0

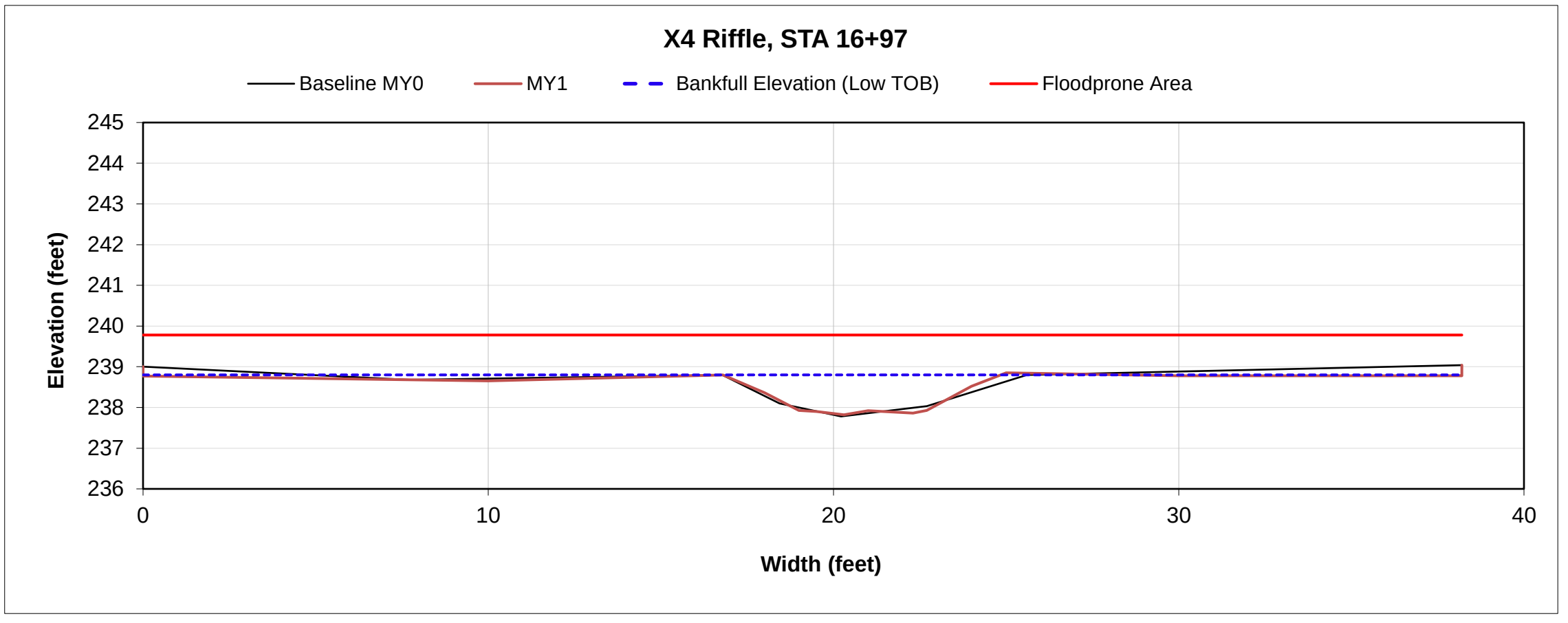
Looking Downstream



Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R4
Cross Section ID	X4
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	238.8
Bankfull Cross Sectional Area ($ft^{2)}$	5.2
XS Area Change from As-built (%)	-5.2%
Bankfull Width (ft)	8.2
Max Depth (ft)	1.0
Mean Depth (ft)	0.6
Width/Depth Ratio	13.0
Flood Prone Area Width (ft)	38.2
Entrenchment Ratio	4.7
Bank Height Ratio	1.0

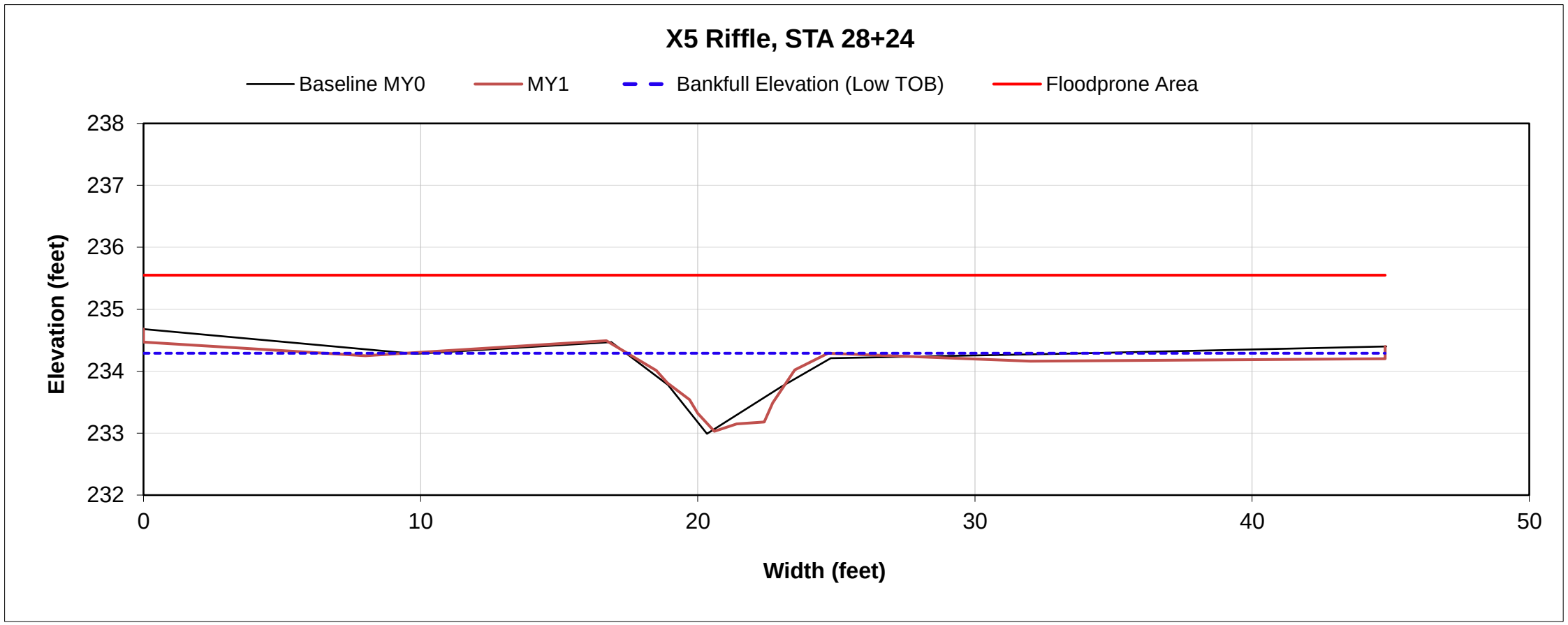
Looking Downstream



Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R3
Cross Section ID	X5
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	234.3
Bankfull Cross Sectional Area ($ft^{2)}$	5.3
XS Area Change from As-built (%)	-12.9%
Bankfull Width (ft)	8.0
Max Depth (ft)	1.3
Mean Depth (ft)	0.7
Width/Depth Ratio	12.1
Flood Prone Area Width (ft)	44.8
Entrenchment Ratio	5.6
Bank Height Ratio	1.0

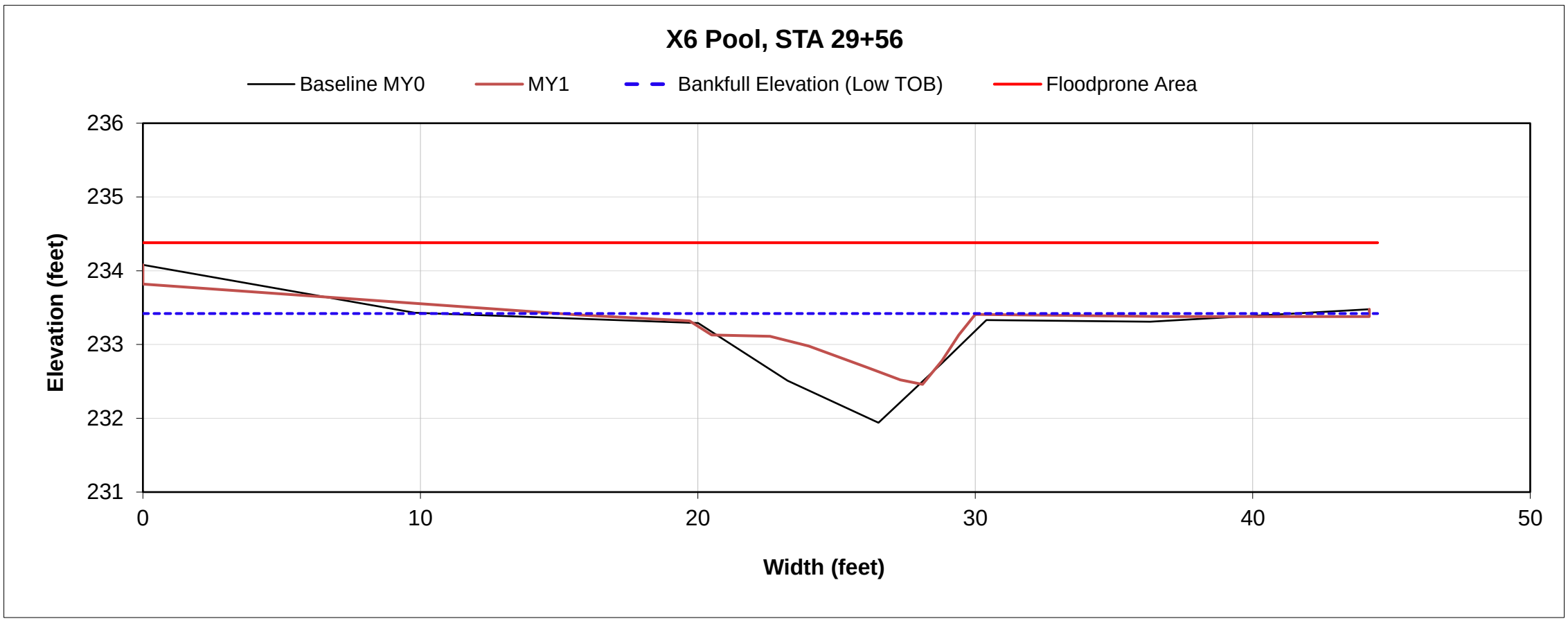
Looking Downstream



Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R3
Cross Section ID	X6
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	233.4
Bankfull Cross Sectional Area ($ft^{2)}$	5.6
XS Area Change from As-built (%)	-23.4%
Bankfull Width (ft)	14.3
Max Depth (ft)	1.0
Mean Depth (ft)	0.4
Width/Depth Ratio	36.5
Flood Prone Area Width (ft)	44.5
Entrenchment Ratio	3.1
Bank Height Ratio	1.0

Looking Downstream



Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R3 (Multi-Thread Channel)
Cross Section ID	X7
Field Crew	C. Manner, A. McIntyre

DIMENSION DATA SUMMARY: MY1 2018	
Low Top of Bank Elevation (ft)	230.7
Bankfull Cross Sectional Area ($ft^{2)}$	4.7
XS Area Change from As-built (%)	4.4%
Bankfull Width (ft)	18.1
Max Depth (ft)	0.3
Mean Depth (ft)	0.3
Width/Depth Ratio	69.7
Flood Prone Area Width (ft)	31.1
Entrenchment Ratio	1.7
Bank Height Ratio	1.0

Looking Downstream

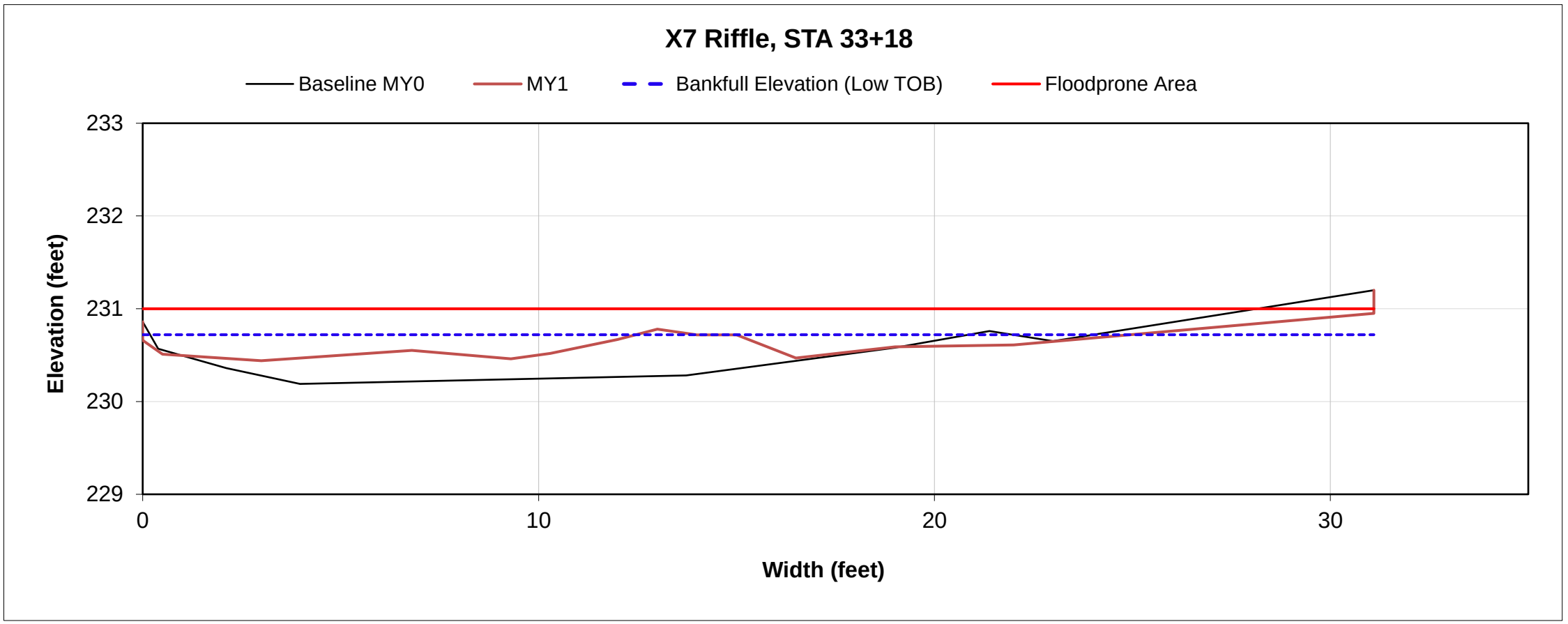


Table 7a. Baseline Stream Data Summary Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)								
Parameter	**Pre-Restoration Condition**		**Reference Reach Data**		**Design**		**As-Built/ Baseline**	
Reach ID: R1 (Preservation)								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	5.5	7.2	4.5	8.3	-	-	-	-
Floodprone Width (ft)	30.0	80.0	10.0	20.0	-	-	-	-
Bankfull Mean Depth (ft)	0.4	0.8	0.8	1.6	-	-	-	-
Bankfull Max Depth (ft)	0.5	0.9	0.9	1.3	-	-	-	-
Bankfull Cross Sectional Area (ft^2)	4.1	5.0	3.0	5.0	-	-	-	-
Width/Depth Ratio	8.2	15.2	6.2	14.2	-	-	-	-
Entrenchment Ratio	4.2	12.0	7.1	8.4	-	-	-	-
Bank Height Ratio	1.1	1.1	0.9	1.1	-	-	-	-
Profile								
Riffle Length (ft)	7.5	38.2	9.5	22.7	-	-	-	-
Riffle Slope (ft/ft)	0.011	0.014	0.009	0.015	-	-	-	-
Pool Length (ft)	4.1	7.9	6.1	8.7	-	-	-	-
Pool Max Depth (ft)	1.2	1.4	1.8	2.4	-	-	-	-
Pool Spacing (ft)	22.0	50.0	14.4	22.3	-	-	-	-
Pattern								
Channel Beltwidth (ft)	22.0	28.0	23.4	29.0	-	-	-	-
Radius of Curvature (ft)	11.3	19.1	11.2	17.5	-	-	-	-
Rc:Bankfull Width (ft/ft)	1.6	2.9	1.6	2.5	-	-	-	-
Meander Wavelength (ft)	27.0	60.0	43.4	65.1	-	-	-	-
Meander Width Ratio	2.2	6.4	3.9	4.5	-	-	-	-
Transport Parameters								
Boundary Shear Stress ($lb/ft^{2)}$	-		-		-		-	
Max part size (mm) mobilized at bankfull	-		-		-		-	
Stream Power ($W/m^{2)}$	-		-		-		-	
Additional Reach Parameters								
Rosgen Classification	C5		E5/C5		E5/C5		E5/C5	
Bankfull Velocity (fps)	4.1		4.5		-		-	
Bankfull Discharge (cfs)	20.0		---		-		-	
Sinuosity	1.21		1.1 - 1.3		-		-	
Water Surface Slope (Channel) (ft/ft)	0.010		0.015		-		-	
Bankfull Slope (ft/ft)	0.012		0.015		-		-	

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
Reach ID: R2								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	4.4	7.2	4.5	8.3	7.7		8.9	
Floodprone Width (ft)	30.0	70.0	10.0	20.0	20.0	50.0	32.0	
Bankfull Mean Depth (ft)	0.4	0.8	0.8	1.6	0.6		0.6	
Bankfull Max Depth (ft)	1.3	1.5	0.9	1.3	0.9		1.2	
Bankfull Cross Sectional Area (ft^2)	3.3	5.1	3.0	5.0	5.0		5.0	
Width/Depth Ratio	8.2	15.2	6.2	14.2	12.0		16.0	
Entrenchment Ratio	4.3	10.0	7.1	8.4	2.2		3.6	
Bank Height Ratio	1.1	1.6	0.9	1.1	1.0		1.0	
Profile								
Riffle Length (ft)	17.0	44.0	9.5	22.7	10.0	30.0	12.0	34.0
Riffle Slope (ft/ft)	0.011	0.013	0.009	0.015	0.010	0.022	0.017	0.029
Pool Length (ft)	3.9	6.0	6.1	8.7	6.0	9.0	6.2	9.9
Pool Max Depth (ft)	1.2	1.3	1.8	2.4	1.1	1.5	1.1	1.6
Pool Spacing (ft)	22.0	39.0	14.4	22.3	30.0	55.0	11.8	36.1
Pattern								
Channel Beltwidth (ft)	28.0		23.4	29.0	28.0	51.0	27.0	46.0
Radius of Curvature (ft)	11.3	19.1	11.2	17.5	15.0	25.0	13.0	29.0
Rc:Bankfull Width (ft/ft)	1.6	2.9	1.6	2.5	2.0	3.0	2.1	3.5
Meander Wavelength (ft)	31.0	45.0	43.4	65.1	55.0	100.0	35.0	88.0
Meander Width Ratio	2.3	6.4	3.9	4.5	3.0	8.0	4.4	7.6
Transport Parameters								
Boundary Shear Stress ($lb/ft^{2)}$	-		-		0.49		-	
Max part size (mm) mobilized at bankfull	-		-		2.00		-	
Stream Power ($W/m^{2)}$	-		-		31.00		-	
Additional Reach Parameters								
Rosgen Classification	G5		E5/C5		C5		C5	
Bankfull Velocity (fps)	4.1		4.5		4.7		4.7	
Bankfull Discharge (cfs)	26.0		-		26.0		26.0	
Sinuosity	1.16		1.1 - 1.3		1.17		1.17	
Water Surface Slope (Channel) (ft/ft)	0.011		0.015		0.011		0.012	
Bankfull Slope (ft/ft)	0.012		0.015		0.012		0.013	

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
Reach ID: R3 (lower) Preservation								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	4.4	7.2	4.5	8.3	-	-	-	-
Floodprone Width (ft)	30.0	70.0	10.0	35.0	-	-	-	-
Bankfull Mean Depth (ft)	0.4	0.8	0.8	1.6	-	-	-	-
Bankfull Max Depth (ft)	0.5	0.9	0.9	1.3	-	-	-	-
Bankfull Cross Sectional Area (ft^2)	3.3	5.3	3.0	5.0	-	-	-	-
Width/Depth Ratio	8.0	20.0	6.2	14.2	-	-	-	-
Entrenchment Ratio	3.0	8.0	7.1	8.4	-	-	-	-
Bank Height Ratio	1.0	-	0.9	1.1	-	-	-	-
Profile								
Riffle Length (ft)	11.0	22.0	9.5	22.7	-	-	-	-
Riffle Slope (ft/ft)	0.008	0.009	0.009	0.015	-	-	-	-
Pool Length (ft)	5.0	8.0	6.1	8.7	-	-	-	-
Pool Max Depth (ft)	1.3	1.7	1.8	2.4	-	-	-	-
Pool Spacing (ft)	22.0	39.0	14.4	22.3	-	-	-	-
Pattern								
Channel Beltwidth (ft)	28.0	40.0	23.4	29.0	-	-	-	-
Radius of Curvature (ft)	11.0	19.0	11.2	17.5	-	-	-	-
Rc:Bankfull Width (ft/ft)	1.6	2.9	1.6	2.5	-	-	-	-
Meander Wavelength (ft)	27.0	50.0	43.4	65.1	-	-	-	-
Meander Width Ratio	6.4	8.5	3.9	4.5	-	-	-	-
Transport Parameters								
Boundary Shear Stress ($lb/ft^{2)}$	-		-		0.49		-	
Max part size (mm) mobilized at bankfull	-		-		2.00		-	
Stream Power ($W/m^{2)}$	-		-		29.00		-	
Additional Reach Parameters								
Rosgen Classification	E5		E5/C5		-		-	
Bankfull Velocity (fps)	4.1		4.0		-		-	
Bankfull Discharge (cfs)	37.0		-		-		-	
Sinuosity	1.21		1.1 - 1.3		-		-	
Water Surface Slope (Channel) (ft/ft)	0.008		0.015		-		-	
Bankfull Slope (ft/ft)	0.009		0.015		-		-	

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
Reach ID: R3 (upper)								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	4.4	7.2	4.5	8.3	8.2		8.8	18.4
Floodprone Width (ft)	30.0	70.0	10.0	35.0	30.0	80.0	38.0	27.0
Bankfull Mean Depth (ft)	1.0	1.8	0.8	1.6	0.7		0.6	0.3
Bankfull Max Depth (ft)	1.5	2.3	0.9	1.3	1.0		1.0	0.4
Bankfull Cross Sectional Area (ft^2)	3.3		3.0	5.0	5.6		5.5	4.7
Width/Depth Ratio	8.2	15.2	6.2	14.2	12.0		14.3	71.8
Entrenchment Ratio	4.3	10.0	7.1	8.4	3.7	8.0	4.3	1.5
Bank Height Ratio	1.1	1.7	0.9	1.1	1.0		1.0	1.0
Profile								
Riffle Length (ft)	33.0	55.0	9.5	22.7	12.0	33.0	10.0	30.0
Riffle Slope (ft/ft)	0.007	0.009	0.009	0.015	0.011	0.014	0.020	0.035
Pool Length (ft)	8.0	13.0	6.1	8.7	8.0	11.0	7.0	10.0
Pool Max Depth (ft)	1.4	2.0	1.8	2.4	1.4	2.0	1.1	1.6
Pool Spacing (ft)	22.0	39.0	14.4	22.3	25.0	51.0	11.8	35.5
Pattern								
Channel Beltwidth (ft)	28.0		23.4	29.0	25.0	45.0	30.0	45.0
Radius of Curvature (ft)	10.0		11.2	17.5	12.0	22.0	15.0	25.0
Rc:Bankfull Width (ft/ft)	1.6		1.6	2.5	2.0	3.0	2.5	4.2
Meander Wavelength (ft)	27.0		43.4	65.1	30.0	42.0	30.0	44.8
Meander Width Ratio	6.4		3.9	4.5	3.3	5.1	5.1	7.6
Transport Parameters								
Boundary Shear Stress ($lb/ft^{2)}$	-		-		0.51		-	
Max part size (mm) mobilized at bankfull	-		-		2.00		-	
Stream Power ($W/m^{2)}$	-		-		28.90		-	
Additional Reach Parameters								
Rosgen Classification	E5 incised		E5/C5		C5		C5	
Bankfull Velocity (fps)	4.1		4.5		5.7		4.5	
Bankfull Discharge (cfs)	34.0		-		34.0		34.0	
Sinuosity	1.20		1.1 - 1.3		1.20		1.16	
Water Surface Slope (Channel) (ft/ft)	0.007		0.015		0.009		0.009	
Bankfull Slope (ft/ft)	0.009		0.015		0.011		0.011	

Parameter	Pre-Restoration Condition		Reference Reach Data		Design		As-Built/ Baseline	
Reach ID: R4								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
Bankfull Width (ft)	6.9	-	4.5	8.3	6.6		8.8	
Floodprone Width (ft)	6.1	-	10.0	35.0	25.0	70.0	38.0	
Bankfull Mean Depth (ft)	2.4	-	0.8	1.6	0.5		0.6	
Bankfull Max Depth (ft)	3.1	-	0.9	1.3	0.7		1.0	
Bankfull Cross Sectional Area (ft^2)	15.8	-	3.0	5.0	3.6		5.5	
Width/Depth Ratio	5.6	-	10.3	14.2	12.0		14.3	
Entrenchment Ratio	1.0	-	2.0	5.0	3.8	10.0	4.3	
Bank Height Ratio	1.7	-	0.9	1.1	1.0		1.0	
Profile								
Riffle Length (ft)	17.0	44.0	5.1	13.9	13.0	31.0	12.0	27.0
Riffle Slope (ft/ft)	0.019	0.027	0.017	0.026	0.016	0.027	0.015	0.027
Pool Length (ft)	4.0	6.6	4.5	7.0	6.8	9.4	6.0	8.7
Pool Max Depth (ft)	1.9	2.2	1.1	1.7	1.1	1.6	1.1	1.6
Pool Spacing (ft)	38.0	87.0	10.0	30.0	22.0	50.0	19.0	41.0
Pattern								
Channel Beltwidth (ft)	-	-	23.4	29.0	22.0	35.0	19.0	31.0
Radius of Curvature (ft)	-	-	11.2	17.5	12.0	20.0	10.0	19.0
Rc:Bankfull Width (ft/ft)	-	-	1.6	2.5	1.8	3.0	2.1	3.4
Meander Wavelength (ft)	-	-	43.4	65.1	40.0	60.0	34.0	77.0
Meander Width Ratio	-	-	3.9	4.5	3.3	5.3	3.0	6.0
Transport Parameters								
Boundary Shear Stress (lb/ft^2)	-		-		0.48		-	
Max part size (mm) mobilized at bankfull	-		-		2.00		-	
Stream Power (W/m^2)	-		-		24.50		-	
Additional Reach Parameters								
Rosgen Classification	G5c		C5		C5		C5	
Bankfull Velocity (fps)	7.0		4.0		4.5		4.5	
Bankfull Discharge (cfs)	16.0		-		16.0		16.0	
Sinuosity	1.06		1.1 - 1.2		1.15		1.14	
Water Surface Slope (Channel) (ft/ft)	0.019		0.015		0.017		0.017	
Bankfull Slope (ft/ft)	0.018		0.015		0.017		0.017	

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

Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)							Cross Section 3 (Pool)							Cross Section 4 (Riffle)							Cross Section 5 (Riffle)						
Parameters	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)	8.9	7.7						8.4	13.3						9.2	9.3						8.8	8.2						8.8	8					
Floodprone Width (ft)	32	32						31	30.7						40	40.4						38	38.2						38	44.8					
Bankfull Mean Depth (ft)	0.6	0.7						0.8	0.5						1.1	1.2						0.6	0.6						0.6	0.7					
Bankfull Max Depth (ft)	1.2	1.1						1.7	1.6						2	2.3						1	1						1	1.3					
Bankfull Cross Sectional Area (ft^2)	5	5.2						6.7	6.1						10.4	11						5.5	5.2						5.5	5.3					
Bankfull Width/Depth Ratio	16	11.4						10.6	28.8						8.2	7.9						14.3	13						14.3	12.1					
Bankfull Entrenchment Ratio	3.6	4.2						3.7	2.3						4.3	4.3						4.3	4.7						4.3	5.6					
Bankfull Bank Height Ratio	1	1						0.9	0.9						1	1						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					
	Cross Section 6 (Pool)							**Cross Section 7 (Riffle)**																													
Parameters	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)	10.4	14.3						18.4	18.1																										
Floodprone Width (ft)	44	44.5						27	31.7																										
Bankfull Mean Depth (ft)	0.7	0.4						0.3	0.3																										
Bankfull Max Depth (ft)	1.4	1						0.4	0.3																										
Bankfull Cross Sectional Area (ft^2)	7.7	5.6						4.7	4.7																										
Bankfull Width/Depth Ratio	14	36.5						71.8	69.7																										
Bankfull Entrenchment Ratio	4.2	3.1						1.5	1.7																										
Bankfull Bank Height Ratio	1	1						1	1																										
d50 (mm)	N/a	N/a						N/a	N/a																										

	Table 7c. Monitoring Data - Stream Reach Summary Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)											
Parameter	**Baseline**		**MY1**		**MY2**		**MY3**		**MY4**		**MY5**	
Reach ID: R1 (Preservation)												
	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)	1.21											
Water Surface Slope (Channel) (ft/ft)	0.01											
BF slope (ft/ft)	0.012											
[3]Ri% / Ru% / P% / G% / S%												
[3]SC% / Sa% / G% / C% / B% / Be%												
[3]d16 / d35 / d50 / d84 / d95 /												
[2]% of Reach with Eroding Banks												
Channel Stability or Habitat Metric												
Biological or Other												

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

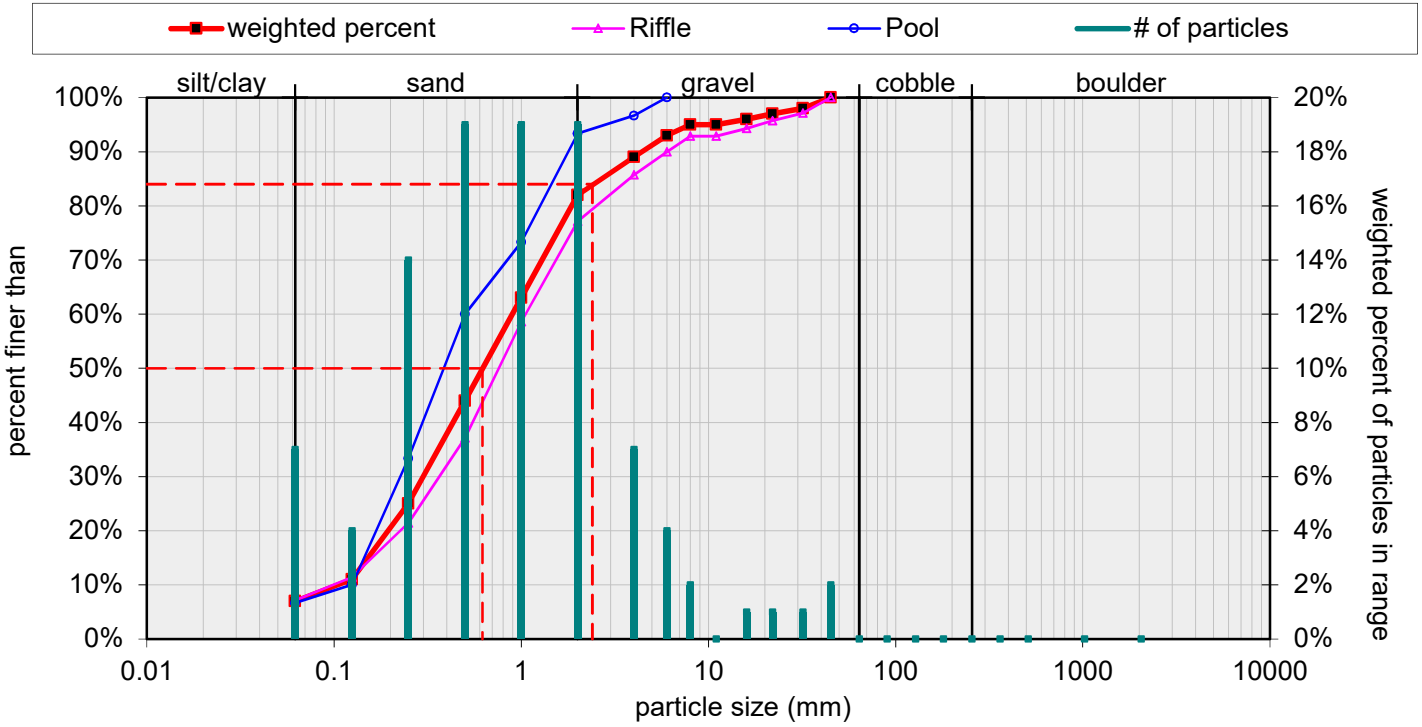
Parameter	Baseline		MY1		MY2		MY3		MY4		MY5	
Reach ID: R2												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	12	34										
Riffle Slope (ft/ft)	0.017	0.029										
Pool Length (ft)	6.2	9.9										
Pool Max depth (ft)	1.1	1.6										
Pool Spacing (ft)	11.8	36.1										
Pattern												
Channel Beltwidth (ft)	27	46										
Radius of Curvature (ft)	13	29										
Rc:Bankfull width (ft/ft)	2.1	3.5										
Meander Wavelength (ft)	35	88										
Meander Width Ratio	4.4	7.6										
Additional Reach Parameters												
Rosgen Classification	C5											
Sinuosity (ft)	1.17											
Water Surface Slope (Channel) (ft/ft)	0.012											
BF slope (ft/ft)	0.013											
[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												

Parameter	Baseline		MY1		MY2		MY3		MY4		MY5	
Reach ID: R3 (upper)												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	10	30										
Riffle Slope (ft/ft)	0.02	0.035										
Pool Length (ft)	7	10										
Pool Max depth (ft)	1.1	1.6										
Pool Spacing (ft)	11.8	35.5										
Pattern												
Channel Beltwidth (ft)	30	45										
Radius of Curvature (ft)	15	25										
Rc:Bankfull width (ft/ft)	2.5	4.2										
Meander Wavelength (ft)	30	44.8										
Meander Width Ratio	5.1	7.6										
Additional Reach Parameters												
Rosgen Classification	C5											
Sinuosity (ft)	1.16											
Water Surface Slope (Channel) (ft/ft)	0.009											
BF slope (ft/ft)	0.011											
[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												

Parameter	Baseline		MY1		MY2		MY3		MY4		MY5	
Reach ID: R4												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	12	27										
Riffle Slope (ft/ft)	0.015	0.027										
Pool Length (ft)	6	8.7										
Pool Max depth (ft)	1.1	1.6										
Pool Spacing (ft)	19	41										
Pattern												
Channel Beltwidth (ft)	19	31										
Radius of Curvature (ft)	10	19										
Rc:Bankfull width (ft/ft)	2.1	3.4										
Meander Wavelength (ft)	34	77										
Meander Width Ratio	3	6										
Additional Reach Parameters												
Rosgen Classification	C5											
Sinuosity (ft)	1.14											
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												

MY1 - Edwards-Johnson Mitigation Project, Sediment Sample

70% riffle 30% pool



Size (mm)	
D16	0.16
D35	0.36
D50	0.62
D65	1.1
D84	2.4
D95	#N/A

Size Distribution	
mean	0.6
dispersion	3.9
skewness	0.00

Type	
silt/clay	7%
sand	75%
gravel	18%
cobble	0%
boulder	0%

Table 8. Verification of Flow Events Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)				
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 bankfull stage (wrack lines) after storm event	Bkf	Photos

9/17/2018

9/17/2018

9/17/2018

9/17/2018

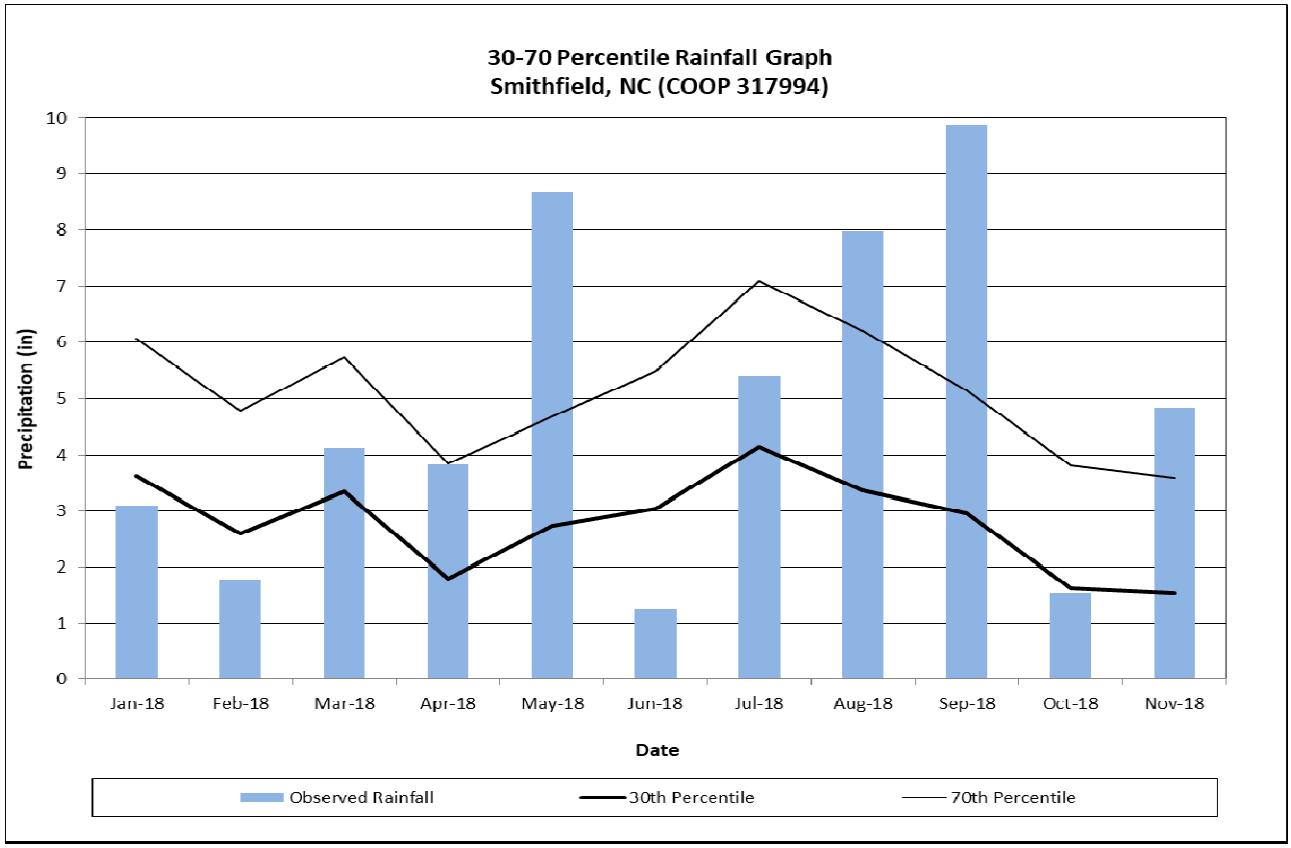
9/17/2018

9/17/2018

9/17/2018

9/17/2018

Monthly Rainfall Data
Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)
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	**		**		**

Groundwater Gauge Data
Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)
MY1 2018

Monitoring Gauge Name	Max Consecutive Hydroperiod: Saturation within 12 Inches of Soil Surface (Percent of Growing Season) WETS Station: 317994 - Smithfield Growing Season: 4/6-11/4 (227							
	2018	2019	2020	2021	2022	2023	2024	Mean
Edwards-Johnson Reference Wetland	M							**M**

Annual Precip Total	0
WETS 30th Percentile	42.7
WETS 70th Percentile	51.8
Normal	Y

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

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

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 Edwards-Johnson Mitigation Project, NCDEQ DMS Full-Delivery Project ID #97080, Contract #6825, 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 Edwards-Johnson 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 lower wooded section. Ensure locations are correct.** 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: If desired for future reports, extend XS-7 further across the headwater valley to capture potential future stream movement. Update cross section to reflect this in MY0 and baseline if desired.** WLS Response: WLS will plan to extend the horizontal limits of Cross Section 7 at Reach R3 Lower, as suggested, during Monitoring Year 2 to more completely span the headwater stream valley for monitoring potential stream dimension adjustments.
- **DMS Comment: GPS wetland reference gauge and locate in proper location on CCPV and provide updated shapefile.** WLS Response: WLS has field located the wetland reference gauge as shown on the updated CCPV map. We have included the wetland gauge location with the GIS shapefiles in the correct projections.
- **DMS Comment: Crest gauge shown in field is not shown on CCPV. Capture this shape and add to CCPV and provide shapefile.** WLS Response: WLS has field located the crest gauge as shown on the updated CCPV map. We have included the crest gauge location with the GIS shapefiles in the correct projections.

Electronic Deliverables:

- **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: Hydro folder in support file appears to be from another project. Update.** WLS Response: The correct data had been added to the Hydro Folder as requested.
- **DMS Comment: Provide the wetland reference gauge, crest gauge from MY0; provide encroachment shapefile, vegetative areas of concern for MY1.** WLS Response: WLS has included referenced features with the GIS shapefiles in the correct projections as shown on CCPV.
- **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 corrected the shapefile and verified the stream lengths match the assets presented in Table 1.
- **DMS Comment: The As-built center line does not match the as-built table (Table 1). Update shapefile to cut out any asset outside the easement and attribute each feature to match Table 1 in the attribute table.** WLS Response: WLS has corrected the shapefile and verified the stream lengths match the assets presented in Table 1.
- **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 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 2016-0404).** WLS Response: The NCDEQ DWR Project Number (NCDEQ DWR Project # 2016-0404) has been added as requested to the cover page for the As-built Baseline Monitoring Report and Monitoring Report Year 1 where previously missing.
2. **DMS Comment: Page 1 and 2, WLS lists 3,781 linear feet of stream, but the numbers in the tables don't add up to that. Where is that number from? Please correct and update.** WLS Response: WLS has corrected and verified the stream lengths match the assets presented in Table 1.
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, the Objectives and Performance standards listed in this bullet list do not match the Mitigation Plan. See page 25 and 52 of your Mitigation Plan. Why is WLS proposing to add items to document project success? You can use these same tables from Mitigation Plan in all your future reports to avoid confusion if desired.** 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 referenced 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 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.
8. **DMS Comment: Page 11, 6.3.1.1, Does WLS want to indicate this field change decision was discussed via phone with Andrea Hughes or the update to a wider easement because of decision? OK as is, just thought it might be good for record if desired.** WLS Response: WLS edited the referenced language Sub-section 6.3.1.1 Stream Horizontal Pattern & Longitudinal Profile, as suggested, to read as follows: "During project construction, the alignment of the lower end of R3 and the corresponding conservation easement boundaries were revised slightly from what was proposed to in the approved final mitigation plan. This section of R3 was restored by re-diverting the reach flow to the historic abandoned multi-thread channel (approximate stations 33+07.35 to 37+43.92), rather than constructing the new single thread alignment proposed in the approved final mitigation plan. This field adjustment restored a more natural diffuse flow pattern within the topographic low-point of the valley while minimizing disturbance to existing jurisdictional wetlands and native species vegetation in this area. The described field adjustment was discussed by phone with and approve by Andrea Hughes (USACE, NCIRT) in early May 2018 immediately prior to implementation. See appendices for as-built plans."

9. **DMS Comment: Table 1. If you are using Mitigation Plan numbers for the assets on this project, update total Stream Linear feet to match that (2,949 instead of 2,934).** WLS Response: WLS has corrected and verified the stream lengths match the assets presented in Table 1.
10. **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."
11. **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 a table if this would be helpful.** 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).
12. **DMS Comment: Morphological Table R3 (Upper), it appears you may have the max and min of the dimensions parameters switched (max showing min and vis versa). 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, and 10 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: 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.
3. **DMS Comment: Page 7, Bankfull events, please reference Table 8 for verification of bankfull events. Also, you state that there were 2 events but only one is showing in the table. Table 8 in the notes sections should contain notes (Example: how much rain occurred that date, what elevation was the crest gauge showing). Update and clarify.** WLS Response: The requested reference to Table 8 has been added to Sub-section 5.1 Stream Hydrology, as requested, and the sub-section has been edited for clarification as follows: "Monitoring to document the occurrence of the two required bankfull events (overbank flows) and the two required "geomorphically significant" flow events (Qgs=0.66Q2) within the monitoring period, along with floodplain access by flood flows, is being conducted using a crest gauge, installed December 12, 2018, on the floodplain of and across the dimension of the restored channel at the left top of bank of Reach R2, immediately upstream of the confluence of Reach R2 and R4 (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. Because the crest gage was installed after the submission of the Draft As-built Baseline Monitoring Reports and Draft Monitoring Reports Year 1, only the described photographic measures will be used for Year 1 stream hydrologic monitoring. At least one bankfull events occurred during MY1. This event was documented using the described photography (Table 8). The documented occurrence of this flow event satisfies the requirement of the occurrence of one of the two bankfull events (overbank flows) and the one of the two "geomorphically significant" flow events (Qgs=0.66Q2) within the monitoring period, along with floodplain access by flood flows."
4. **DMS Comment: Page 7, jurisdictional stream flow, you can't state in a report that the site meets success criteria for flow when your monitoring device was not functioning. This was stated on Page 1 and Page 6. Revise report to state that this success criteria is not met or unknown for flow.** WLS Response: WLS has removed the two noted references to meeting the jurisdictional stream flow success criteria (due to flow gage malfunction), and the following sentence has been added to the end of Sub-section 5.4 Jurisdictional Stream Flow Documentation for clarification: "WLS did observe stream flow along Reach R4, as well as along all of other project reaches, during each pre- and post-construction site visit in 2018, with WLS staff visiting the site on a monthly basis. These observations correspond do the monitoring flow gage documentation results at the nearby Lake Wendell and Pen Dell Mitigation Project Sites."
5. **DMS Comment: Page 8, first paragraph states that there were no negative changes to vegetation with visual assessment but then goes on to describe some negative changes. Suggest removing this sentence as it is misleading.** WLS Response: The referenced sentence in Sub-section 5.5 Vegetation was revised as requested to read as follows: "The results of the visual assessment did not indicate any significant negative changes to the existing vegetation community.".
6. **DMS Comment: Page 8, wetland gauge: the installation and monitoring of this device was agreed to by WLS and DWR, although DMS advised WLS that they were not contractually required. WLS documented understanding of installing 2 gauges on this project in their comment responses to the IRT. 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? 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 two 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 R3. The well data was unrecoverable and therefore an additional groundwater monitoring well was installed along Reach R3 (preservation) after the first year of monitoring, in early January 2019. The wells were installed to document groundwater levels within the stream and wetland restoration for reference and comparison to the preservation areas, at the request of the NCIRT (DWR)."

7. **DMS Comment: Table 6, There are more species showing as planted on this table between MY0 and MY1. What is going on? Any mis-identification should be footnoted at bottom of table for clarification. Why is Red Maple shown as planted? QA/QC both of these tables.** WLS Response: For Monitoring Year 0/Baseline, the referenced table is "Table 6., Planted Stem Counts", and for Monitoring Year 1, the referenced table is "Table 6., Planted and Total Stem Counts". As such, the differences in the species types and numbers reported in the referenced tables between Monitoring Year 0/Baseline and for Monitoring Year 1 reflects stem mortality and volunteer stem recruitment. WLS does not believe that there are any species mis-identification. Red maple was planted as proposed in the final approved mitigation plans.
8. **DMS Comment: Geomorph data: XS-6 (pool) is showing signs of aggrading, but this is not discussed in the verbiage for this report. Do you have any concerns or feel that it is necessary to mention this in the report along with an explanation as to why this is not a big deal?** WLS Response: WLS is not concerned about the adjustments to the referenced pool cross section, 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 two tenths and therefore the BHR would be ~0.87 (<1). The morph table parameters have been updated to reflect this change.
9. **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 EJ_97080_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.
10. **DMS Comment: Groundwater gauge data: is this a malfunction or purposeful omission?** WLS Response: The groundwater monitoring gage was not installed correctly by WLS and therefore no data was collected for Monitoring Year 1. WLS has resolved this issue and groundwater monitoring will be conducted for all subsequent monitoring years.

Other Comments:

- **DMS Comment: There is a lot of repetition of verbiage from the mitigation plan, which is good but cumbersome. Much of the written information could be made into bullets or tables for a faster update of future reports and ease of reading in terms of monitoring success. This may be a suggestion for future reports? (Example you have a table in the Mitigation Plan that could replace all of Sections 4 (Table 22 in mitigation plan) and the 'Functional Uplift' column could be replaced with Monitoring Success where you indicate the number of monitoring features and their success results in lieu of verbiage. No response required here.** WLS Response: WLS will definitely take these recommendations into consideration for future reports and we sincerely appreciate the guidance.

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

Sincerely,

Water & Land Solutions, LLC

William "Scott" Hunt, III, PE
Vice President of Technical Operations
7721 Six Forks Road, Suite 130
Raleigh, NC 27615
Office Phone: (919) 614-5111
Mobile Phone: (919) 270-4646
Email: scott@waterlandsolutions.com