Monitoring Report – Year 2
FINAL VERSION
Edwards-Johnson Mitigation Project
Calendar Year of Data Collection: 2019

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: June-October 2019, Submission Date: December 2019

Prepared for:

Environmental Quality

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

Prepared by:

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Mitigation Project Name	**Edwards-Johnson**	**County**	**Johnston**	**USACE Action ID**	**2016-00883**
DMS ID	**97080**	**Date Project Instituted**	**3/18/2016**	**NCDWR Permit No**	**2016-0404**
River Basin	**Neuse**	**Date Prepared**	**8/19/2019**		
Cataloging Unit	**03020201**				

Credit Release Milestone	Stream Credits						Wetland Credits							
	Scheduled Releases (Stream)	Warm	Cool	Cold	Anticipated Release Year (Stream)	Actual Release Date (Stream)	Scheduled Releases (Forested)	Riparian Riverine	Riparian Non-riverine	Non-riparian	Scheduled Releases (Coastal)	Coastal	Anticipated Release Year (Wetland)	Actual Release Date (Wetland)
Potential Credits (Mitigation Plan)		**3,023.100**												
Potential Credits (As-Built Survey)		**3,023.100**												
1 (Site Establishment)	**N/A**				N/A	N/A	**N/A**				**N/A**		N/A	N/A
2 (Year 0 / As-Built)	**30%**	906.930			2019	3/22/2019	**30%**				**30%**		N/A	
3 (Year 1 Monitoring)	**10%**	302.310			2019	NO RELEASE	**10%**				**10%**		N/A	
4 (Year 2 Monitoring)	**10%**				2020		**10%**				**15%**		N/A	
5 (Year 3 Monitoring)	**10%**				2021		**15%**				**20%**		N/A	
6 (Year 4 Monitoring)	**5%**				2022		**5%**				**10%**		N/A	
7 (Year 5 Monitoring)	**10%**				2023		**15%**				**15%**		N/A	
8 (Year 6 Monitoring)	**5%**				2024		**5%**				**N/A**		N/A	
9 (Year 7 Monitoring)	**10%**				2025		**10%**				**N/A**		N/A	
Stream Bankfull Standard	**10%**						**N/A**				**N/A**			
Total Credits Released to Date		**906.930**												

NOTES:

8/19/2019:

CONTINGENCIES:

Signature of Wilmington District Official Approving Credit Release

27 Sept 2019

Date

1 - For NCDMS, no credits are released during the first milestone

2 - For NCDMS projects, the initial credit release milestone occurs when the as-built report (baseline monitoring report) has been approved by the NCIRT and posted it to the NCDMS Portal, provided the following criteria have been met:

1) Approval of the final Mitigation Plan
2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property
3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan
4) Reciept of necessary DA permit authorization or written DA approval for porjects where DA permit issuance is not required

3 - A 10% reserve of credits is to be held back until the bankfull event performance standard has been met

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Cataloging Unit	**03020201**				

DEBITS (released credits only)

			Ratios	1	1.5	2.5	10	1	3	2	5	1	3	2	5	1	3	2	5
				Stream Restoration	Stream Enhancment I	Stream Enhancement II	Stream Preservation	Riparian Restoration	Riparian Creation	Riparian Enhancement	Riparian Preservation	Nonriparian Restoration	Nonriparian Creation	Nonriparian Enhancement	Nonriparian Preservation	Coastal Marsh Restoration	Coastal Marsh Creation	Coastal Marsh Enhancement	Coastal Marsh Preservation
As-Built Amounts (feet and acres)				**2,949.000**			**741.000**												
As-Built Amounts (mitigation credits)				**2,949.000**			**74.100**												
Percentage Released				**30%**			**30%**												
Released Amounts (feet / acres)				**884.700**			**222.300**												
Released Amounts (credits)				**884.700**			**22.230**												
NCDWR Permit	USACE Action ID	Project Name																	
Remaining Amounts (feet / acres)				**884.700**			**222.300**												
Remaining Amounts (credits)				**884.700**			**22.230**												

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December 31, 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 8 Draft Monitoring Report Year 2 for the Edwards-Johnson Mitigation Project, NCDEQ DMS Full-Delivery Project ID #97080, Contract #006825, Neuse River Basin, Cataloging Unit 03020201, Johnston County, NC

Dear Ms. Crocker:

Water & Land Solutions, LLC (WLS) is pleased to present the Final Monitoring Report Year 2 for the Edwards-Johnson Mitigation Project to the North Carolina Department of Environmental Quality (NCDEQ) Division of Mitigation Services (DMS). The Final Monitoring Report Year 2 were developed by addressing NCDEQ DMS's review comments.

Under this cover, we are providing one hard copy of the Final Monitoring Report Year 2, 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 Monitoring Report Year 2 below. Each of the DMS review comments is copied below in **bold** text, followed by the appropriate response from WLS in regular text:

Report:

1. **DMS Comment: Page 6, Stream Hydrology. DMS understands that 2 bankfull events were documented in MY2. However, there must be two bankfull events in two separate years in order to achieve the bankfull standard credit release. Because MY1 only had one bankfull event, and the monitoring device was not installed until the end of MY1, that year is not eligible. Please update the report wording.** WLS Response: WLS has updated the wording on Page 6 of the report.

2. **DMS Comment: Page 7, vegetation. The average performance standard is based on a per plot basis and not an average. Update verbiage to reflect.** WLS Response: WLS has updated the appropriate verbiage to reflect the correct average performance standards.

3. **DMS Comment: As discussed in the field, update wording to explain that replant area will be where low density was discovered, rather than listing vegetation plots.** WLS Response: Wording has been updated in the report to reference low-density areas for replanting prior to March 2020.

4. **DMS Comment: As discussed, there was a small encroachment area along R1 that was replanted in MY2. Please provide the number of stems and species.** WLS Response: The encroachment area was planted with species from the approved planting list in the Mitigation Plan and totaled approximately 27 stems.

5. **DMS Comment: Ensure that replant stock is in keeping with the Mitigation Plan species for MY3.** WLS Response: Re-planting will be done only with species from the approved plant list in the Mitigation Plan.

6. **DMS Comment: The Mitigation Plan states that success is based on planted species, but the 2016 IRT guidance does allow volunteers to be counted toward success, if they were on the planted list. It may be prudent for WLS to note and / or present information that way if applicable.** WLS Response: Volunteer species will not be counted towards success in this report. In future reports they will be counted toward success if they are surviving for at least two years, are at least 18" tall, and were species in the approved planting plan. The total number of planted and recruited stems is available in Table 7.

7. **DMS Comment: Section 5.6 location of the wetland gauges was discussed in field. Ensure this is in keeping with DWR request.** WLS Response: WLS has installed the necessary monitoring gauge per the DMS request. All gauge data will be available for MY3.

8. **DMS Comment: X5- check change from BHR (looks like it should be positive, not -10%).** WLS Response: WLS has checked all BHR's to remove any negative percentages.

9. **DMS Comment: Table 8- please clarify that measurement is height above bankfull.** WLS Response: Table 8 measurement was clarified.

Digital Deliverables:

1. **DMS Comment: Morphology - Please submit the spreadsheets that include the cumulative overlays of the XS as shown in the report (all years). Include the particle distribution summary parameters in the morph summary tables. Check BHR calcs for XS5 and note that the percent change in the BHR should not be negative for that XS.** WLS Response: WLS added the XS spreadsheets including the cumulative overlays to the e-data submittal package. D50 particle distribution was added to the morphology summary table and represents the average across the site for all riffles and pools.

2. **DMS Comment: Calculation of XSA and Max depth are to completed using TOB in keeping with methods specified in the Industry Technical Work group memorandum. For clarity make sure the reader is aware that these methods are being employed. For example, please include a footnote to the effect: "*Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull dimensions are calculated based on the current year's low bank height.*"** WLS Response: WLS added footnote to all XS spreadsheets. Note: WLS uses MY1 in place of as-built (MY0) due to issues of the as-built survey which were identified in MY1.

3. **DMS Comment: Hydrology Data – Please make note of the gauge type (e.g. transducer, RDS etc.) used in the excel data file. Please also label any probe or benchmark elevations, the raw and corrected readings of the water elevations and any offsets applied. DMS needs to be able to clearly identify these key elevations before incorporating these into the DMS database permitting independent calculation/verification. The DMS Excel template is an example of what is needed for reference and is required for use as part of RFPS within the last several years (available here: https://ncdenr.s3.amazonaws.com/s3fs-public/Mitigation%20Services/Document%20Management%20Library/Guidance%20and%20Template%20Documents/7_Mon_Baseline_and_Annual_Rep_Tables%20-%20Jun%202017.xlsx).**
   WLS Response: WLS has updated the appropriate spreadsheet in the excel data file in accordance with the template.

4. **DMS Comment: Include precipitation data in the Hydrology files.** WLS Response: WLS has added precipitation data to the appropriate hydrology file.

5. **DMS Comment: Conservation Easement Shapefile- We need to determine if there is an issue with the Conservation easement file and the metes and bounds provided by the surveyor. DMS will review.** WLS Response: WLS confirmed metes and bounds provided by the surveyor are correct.

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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 35.7251°, 78.35636°. The Project site is located in the NCDEQ Sub-basin 03-04-06, in the Lower Buffalo Creek Priority Sub-watershed 030202011504.

The Project involved the restoration, preservation and permanent protection of four stream reaches (R1, R2, R3, and R4) totaling 3,729 linear feet of streams and their riparian buffers. Monitoring Year 2 (MY2) monitoring activities occurred between June and October 2019 (Table 2). This report presents the data for MY2. The Project meets the MY2 success criteria for stream hydrology, stream horizontal and vertical stability, and vegetation. Based on these results, the Project is expected to meet the Monitoring Year 3 (MY3) success criteria in 2020.

2 Project Background

2.1 Project Location, Setting, and Existing Conditions

The Project site is located in the Lower Buffalo Creek Priority Sub-watershed 030202011504 study area of the Neuse 01 Regional Watershed Plan, in the Wake-Johnston Collaborative Local Watershed Plan, and in Targeted Local Watershed 03020201180050.

The catchment area is 223 acres and has an impervious cover less than one percent. The dominant surrounding land uses are agriculture and mixed forest. Prior to 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 and 2015 Neuse 01 Regional Watershed Plan and include:

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

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

- 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.

3 Project Mitigation Components

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.

3.1 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.

4 Performance Standards

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

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, 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 gage	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.

Geomorphology (Level 3)	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 (MY3, MY5, MY7)	N/A	Increase leaf litter and organic matter critical to provide in-stream cover/shade, wood recruitment, and carbon sourcing.

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

4.1 Streams

4.1.1 Stream Hydrology

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

4.1.2 Stream Profiles, Vertical Stability, and Floodplain Access

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

4.1.3 Stream Horizontal Stability

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

4.1.4 Streambed Material Condition and Stability

After construction, there should be minimal change in the particle size distribution of the streambed materials, over time, given the current watershed conditions and future sediment supply regime. Since the

streams are predominantly sand-bed systems with minimal fine/coarse gravel, some coarsening is anticipated after restoration activities, however significant changes in particle size distribution are not expected. Streambed material condition is supplementary and is not part of success criteria.

4.1.5 Jurisdictional Stream Flow

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

4.2 Vegetation

Vegetative restoration success for the project during the intermediate monitoring years will be based on the survival of at least 320, three-year-old trees per acre at the end of Year 3 of the monitoring period and at least 260, five-year-old, 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 stems per acre in Year 7 of monitoring. Planted vegetation (for projects in coastal plain and piedmont counties) must average seven feet in height at Year 5 of monitoring and 10 feet in height at Year 7 of monitoring. Volunteer stems will only be counted toward success if they are surviving for at least 2 years, are at least 18" tall, and are species from the approved planting list. For all of the monitoring years (Year 1 through Year 7), the number of Red maple (*Acer rubrum*) stems cannot exceed 20 percent of the total stems in any of the vegetation monitoring plots.

5 Monitoring Year 2 Assessment and Results

Annual monitoring was conducted during MY2 in accordance with the monitoring plan as described in the approved mitigation plan to document the site conditions. All monitoring device locations are depicted on the CCPV (Figure 1). MY2 monitoring results are provided in the appendices. The Project meets the MY2 success criteria for stream hydrology, stream horizontal and vertical stability. Vegetation plots 1 and 2 meet the required success criteria, plots 3 and 4 do not.

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. At least three bankfull events occurred during MY2. These events were documented using the described photography (Table 8).

5.2 Stream Horizontal & Vertical Stability

Visual assessment was utilized for assessment of MY2 horizontal and vertical stream stability. The visual assessments for each stream reach concluded that the MY2 stream channel pattern and longitudinal profiles, instream structure locations, still closely match the profile design parameters and MY0/baseline conditions. The MY2 plan form geometry or pattern still appears to fall within acceptable ranges of the design parameters for all restored reaches.

Per IRT request, a new cross section (X8) was added across R3 that spans the floodplain, 50 linear feet below X6 to document any changes in sediment migration and channel morphology. Cross section 7 was also extended on R3 to include more of the left floodplain.

One area of significant erosion was found during the visual assessments. This area is approximately 15ft long and occurs in a pool at a meander bend of R4 at approximately STA 18+00. Photographs of the area can be found in Appendix B. This area will be monitored closely in MY3 to determine if remedial action will be needed. Overall, 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 immediate 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 in streambed material condition or stability during MY2.

5.4 Jurisdictional Stream Flow Documentation

Jurisdictional stream flow documentation and monitoring of restored intermittent reaches is achieved using a flow gage (continuous-read pressure transducers) within the thalweg 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 CLAY Central Crops Research Station in Johnston County, approximately nine miles southwest of the site. The flow 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 (Figure 4).

5.5 Vegetation

Vegetation monitoring for MY2 was conducted utilizing the four vegetation monitoring plots, with monitoring conducted in accordance with the CVS-EEP Level I & II Monitoring Protocol (CVS, 2008) and DMS Stream and Wetland Monitoring Guidelines (DMS, 2017). See Figure 1 in Appendix B for the vegetation monitoring plot locations. Summary data and photographs of each plot can be found in Appendix B.

Areas of low stem density were identified during MY1 in the vicinity of Plots 3 and 4 and were replanted in April 2019 (Figure 1) with approximately 176 stems with species from the approved planting list from the mitigation plan. In addition, a slight buffer encroachment along R2 was replanted with approximately 27 stems with species from the approved planting list from the mitigation plan and was left un-disturbed during MY2.

In MY2 Plots 3 and 4 failed to meet the year 3 minimum of 320 stems per acre. For Plot 3, loss in stem density from MY1 to MY2 is due to increased wetness and a dense herbaceous layer. Plot 4 saw a low survivability due to poor subsoil planting conditions.

The MY2 vegetation monitoring was also conducted utilizing visual assessment throughout the easement. Two areas of concern were found (VPA1 and VPA2) adjacent to Plots 4 and 3 respectively (Figure 1). Minor soil sloughing is occurring in VPA1 and will be addressed with fill and re-grading prior to replanting. Additionally, poor subsoil planting conditions occur throughout the area (pH ~5.5). Containerized trees will be used in replanting of the area to increase survivability to MY3. VPA2 has experienced increased

wetness and a dense herbaceous layer. Before replanting, areas of dense herbaceous layers will be strip or spot treated with herbicide to allow for better tree establishment. Replanting of both VPA1 and VPA2 will occur prior to March 15th to meet success criteria for MY3 with species from the approved planting list from the mitigation plan. The results of the visual assessment did not indicate any additional significant 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 along Reach R3. An additional groundwater monitoring well was installed along Reach R3 in early January 2019 (Figure 4). All groundwater monitoring wells are pressure transducers. Per NCIRT correspondence, an additional well was to be installed in the wetland preservation area near station 37+00. Data for the additional well will be available in MY3. These wells were installed to document groundwater levels within the restoration area 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 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:	**1 yrs 6 months**
Elapsed Time Since planting complete:	**1 yrs 6 months**
Number of reporting Years[0]:	**2**

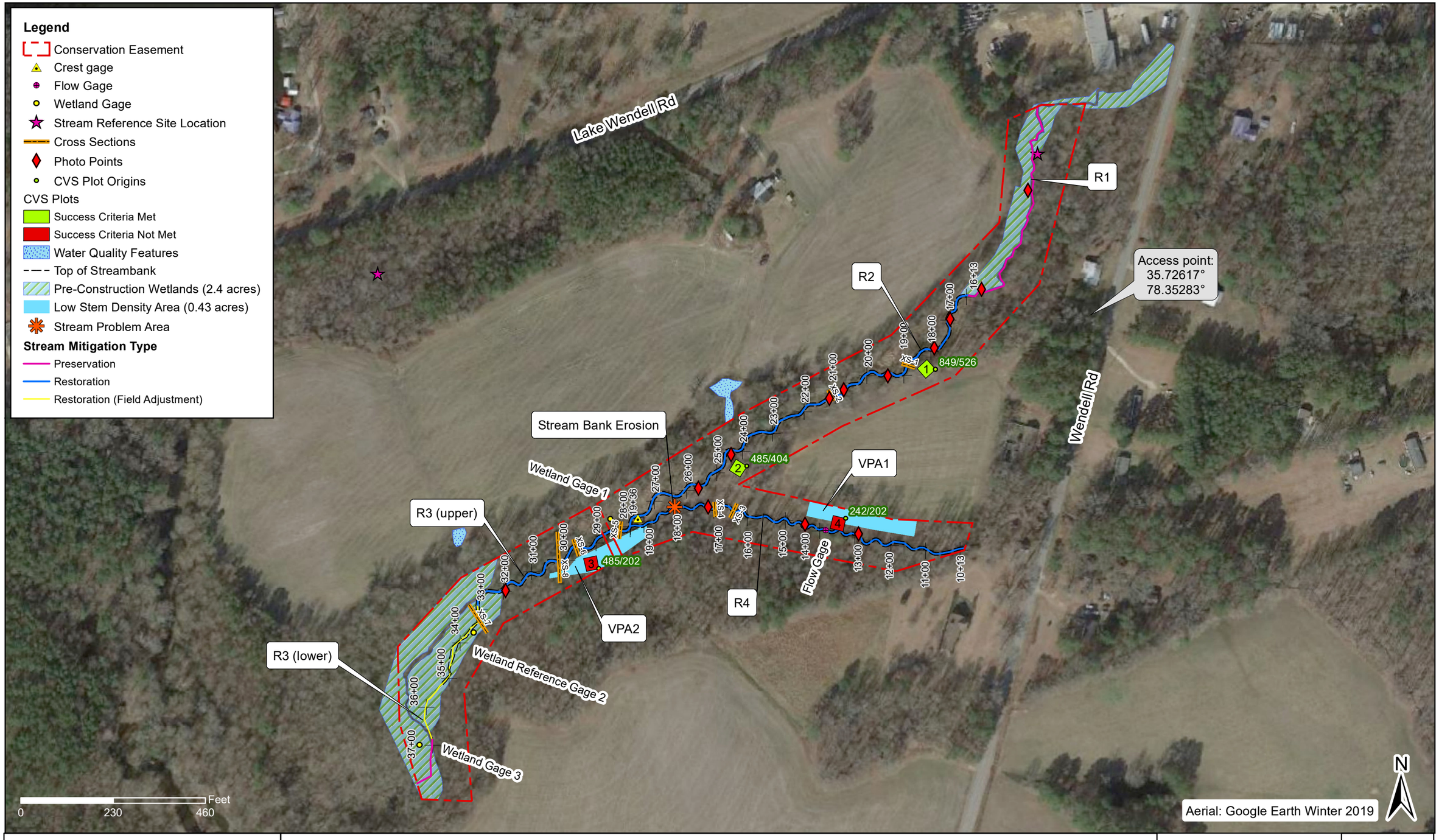
Activity or Deliverable	**Data Collection Complete**	**Completion or Delivery**
Project Contract Execution	N/A	3/18/2016
Final Mitigation Plan Submittal	N/A	9/29/2017
Section 404 General (Regional and Nationwide) Permit Verfication	N/A	1/12/2017
Begin Construction	N/A	3/23/2018
Mitigation Site Earthwork 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 Monitoring Report Submittal	10/18/2019	12/31/2019
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 7721 Six Forks Road, Suite 130, Raleigh, NC 27615
Primary Project POC	Catherine Manner Phone: 571-643-3165
Construction Contractor	RiverWorks Construction 114 W. Main Street, Suite 106, Clayton, NC 27520
Primary Project POC	Bill Wright Phone: 919-590-5193
Survey Contractor (Existing Condition Surveys)	WithersRavenel 115 MacKenan Drive, Cary, NC 27511
Primary Project POC	Marshall Wight, PLS Phone: 919-469-3340
Survey Contractor (Conservation Easement, Construction and As-Builts Surveys)	True Line Surveying, PC 205 West Main Street, Clayton, NC 27520
Primary Project POC	Curk T. Lane, PLS 919-359-0427
Planting Contractor	RiverWorks Construction 114 W. Main Street, Suite 106, Clayton, NC 27520
Primary Project POC	Bill Wright Phone: 919-590-5193
Seeding Contractor	RiverWorks Construction 114 W. Main Street, Suite 106, Clayton, NC 27520
Primary Project POC	Bill Wright Phone: 919-590-5193
Seed Mix Sources	Green Resource 5204 Highgreen Ct., Colfax, NC 27235 Rodney Montgomery Phone: 336-215-3458
Nursery Stock Suppliers	Foggy Mountain Nursery (Live Stakes) 797 Helton Creek Rd, Lansing, NC 28643 Glenn Sullivan Phone: 336-977-2958 Dykes & Son Nursery (Bare Root Stock) 825 Maude Etter Rd, Mcminnville, Tn 37110 Jeff Dykes Phone: 931-668-8833
Monitoring Performers	Water & Land Solutions, LLC 7721 Six Forks Road, Suite 130, Raleigh, NC 27615
Stream Monitoring POC	Emily Dunngian Phone: 269-908-6306
Vegetation Monitoring POC	Emily Dunnigan Phone: 269-908-6306

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
December 2019
MY2

Current Conditions
Plan View
Monitoring Year 2

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			1	15	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	1	15	100%	0	0	100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	47	47			100%			
	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.	12	12			100%			

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	0.43	11.9%
			Total	2	0.43	11.9%
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	0.43	11.9%

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	Pattern and Color	0	0.00	0.0%

1 = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project effort.

2 = The acreage within the easement boundaries.

3 = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e., item 1,2 or 3) as well as a parallel tally in item 5.

4 = Invasives may occur in or out of planted areas, but still within the easement and will therefore be calculated against the overall easement acreage. Invasives of concern/interest are listed below. The list of high concern spcies are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by EEP such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likley trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly ealry in a projects monitoring history. However, areas of discreet, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolzing invasives polygons, particularly for situations where the conditon for an area is somewhere between isolated specimens and dense, discreet patches. In any case, the point or polygon/area feature can be symbolized to describe things like high or low concern and species can be listed as a map inset, in legend items if the number of species are limited or in the narrative section of the executive summary.

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

Reach R1, facing upstream, October 14, 2019 (MY-02)

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

Reach R1, facing downstream, October 14, 2019 (MY-02)

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

Reach R2, facing upstream, Sta 17+00, October 14, 2019 (MY-02)

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

Reach R2, facing downstream, Sta 18+00, October 14, 2019 (MY-02)

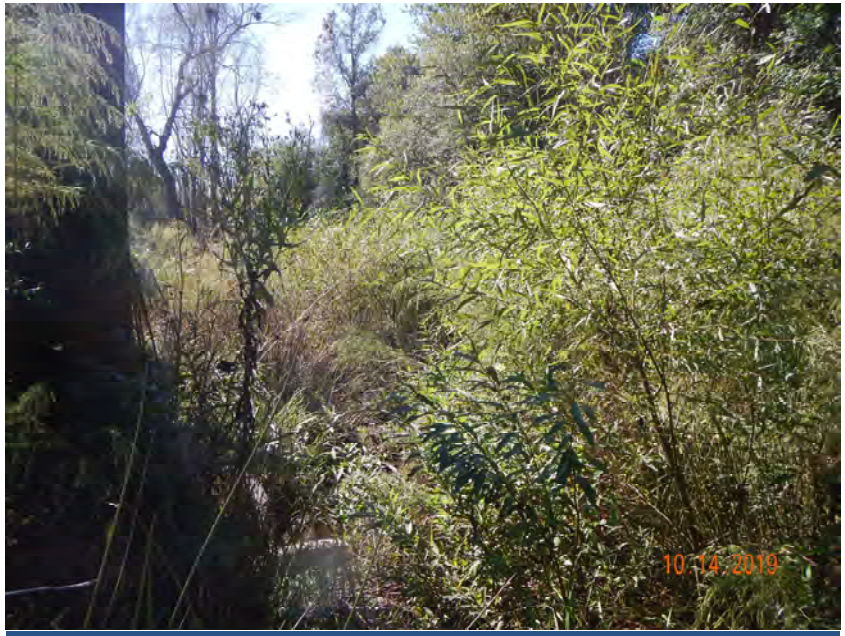
Reach R2, facing downstream, Sta 20+00, Sept 17, 2018 (MY-00)

Reach R2, facing downstream, Sta 20+00, October 14, 2019 (MY-02)

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

Reach R2, facing upstream, Sta 21+00, October 14, 2019 (MY-02)

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



Reach R2, facing downstream, Sta 21+00, October 14, 2019 (MY-02)

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

Reach R2, facing downstream, Sta 25+00, October 14, 2019 (MY-02)

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

Reach R2, facing upstream, Sta 26+00, October 14, 2019 (MY-02)

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

Reach R3, facing downstream, Sta 32+00, October 14, 2019 (MY-02)

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

Reach R4, facing upstream, Sta 13+00, October 14, 2019 (MY-02)

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

Reach R4, facing downstream, Sta 13+00, October 14, 2019 (MY-02)

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

Reach R4, facing upstream, Sta 15+00, October 14, 2019 (MY-02)

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

Reach R4, facing upstream, Sta 17+00, October 14, 2019 (MY-02)

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

Veg Plot 1, October 15, 2019 (MY-02)

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

Veg Plot 2, October 5, 2019 (MY-02)

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

Veg Plot 3, October 15, 2019 (MY-02)

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

Veg Plot 4, October 15, 2019 (MY-02)

Appendix C – Vegetation Plot Data

CVS Project Code 3. Project Name: Edwards Johnson Mitigation Project

Table 6

			Current Plot Data (MY2 2019)												Annual Means								
			003-01-0001			003-01-0002			003-01-0003			003-01-0004			MY2 (2019)			MY1 (2018)			MY0 (2018)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum		Tree	1	1	3						2				1	1	5	2	2	17	1	1	1
Alnus serrulata	Tag Alder, Smooth Alde	Shrub Tree																			3	3	3
Betula nigra	River Birch, Red Birch	Tree	4	4	4	1	1	1	1	1	1				6	6	6	7	7	7	8	8	8
Carpinus caroliniana		Shrub Tree																2	2	2			
Cornus amomum	Silky Dogwood	Shrub Tree	2	2	2				2	2	2				4	4	4	5	5	5	8	8	8
Cornus florida	Flowering Dogwood	Shrub Tree			2												2						
Diospyros virginiana	American Persimmon,	Tree																1	1	1			
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	1	1	1	1	1	1				2	2	2	4	4	4	4	4	5	4	4	4
Ilex verticillata	Winterberry	Shrub Tree																			1	1	1
Lindera benzoin	Northern Spicebush	Shrub Tree	1	1	1	2	2	2				1	1	1	4	4	4	8	8	8	11	11	11
Liquidambar styraciflua	Sweet Gum, Red Gum	Tree			2			1			3			1			7			4			
Liriodendron tulipifera		Tree			1			1									2			11	7	7	7
Platanus occidentalis	Sycamore, Plane-tree	Tree	4	4	4	1	1	1	1	1	2	2	2	2	8	8	9	7	7	8	10	10	10
Quercus michauxii	Basket Oak, Swamp Ch	Tree				2	2	2							2	2	2	3	3	3	4	4	4
Quercus nigra	Water Oak, Paddle Oak	Tree							1	1	1				1	1	1	2	2	2	6	6	6
Quercus phellos	Willow Oak	Tree				3	3	3							3	3	3	8	8	10	7	7	7
Rhus copallinum		Shrub Tree																					
Rhus typhina	Staghorn Sumac	Shrub																		1			
Salix nigra	Black Willow	Tree			1						1						2			6			
Sambucus canadensis	Common Elderberry	Shrub Tree																		5			
Ulmus rubra	Slippery Elm, Red Elm	Tree																		2			
		Stem count	13	13	21	10	10	12	5	5	12	5	5	6	33	33	51	49	49	97	70	70	70
		size (ares)	1			1			1			1			4			4			4		
		size (ACRES)	0.02			0.02			0.02			0.02			0.10			0.10			0.10		
		Species count	6	6	10	6	6	8	4	4	7	3	3	4	9	9	13	11	11	17	12	12	12
		Stems per ACRE	526.1	526.1	849.8	404.7	404.7	485.6	202.3	202.3	485.6	202.3	202.3	242.8	333.9	333.9	516	495.7	495.7	981.4	708.2	708.2	708.2

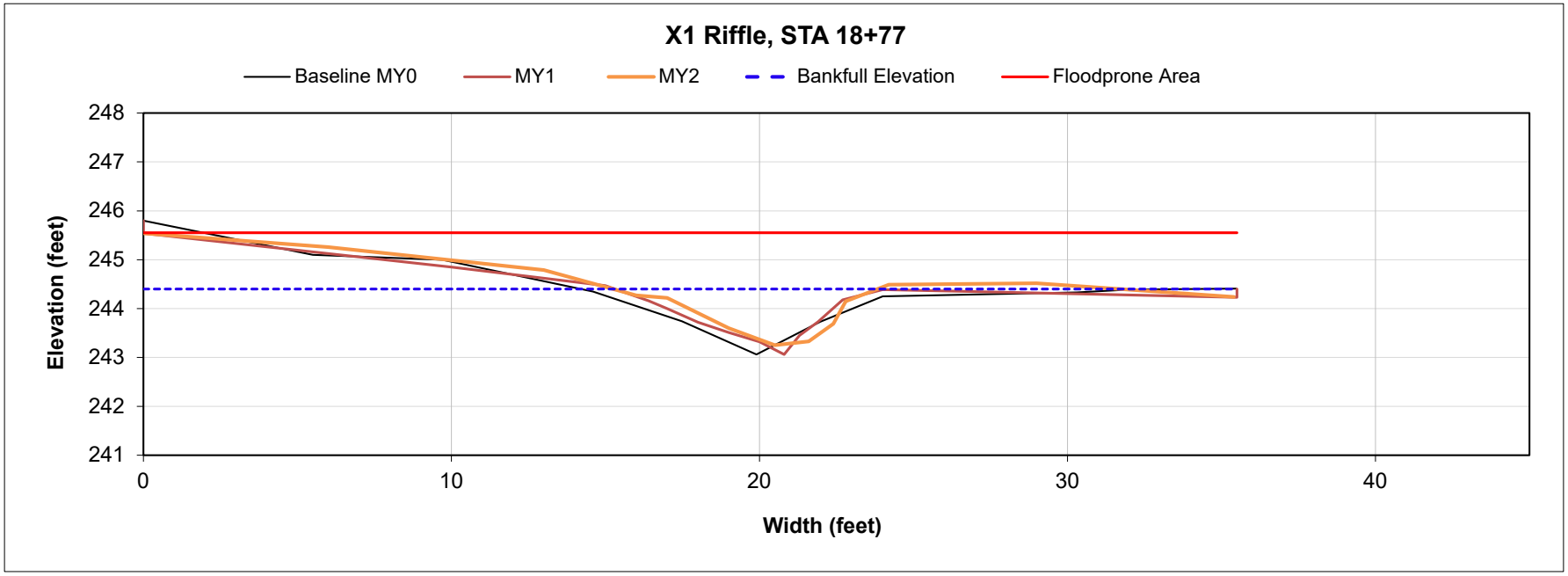
Volunteers were counted if they were at least 18" tall.

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	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY2 2019	
Bankfull Elevation (ft)	244.4
Low Bank Height Elevation (ft)	244.3
Bankfull Max Depth (ft)	1.2
Low Bank Height (ft)	1.3
Bank Height Ratio	0.9
Bankfull X-section Area (ft²)	4.9
% Change Bank Height Ratio	10.0%

Looking Downstream

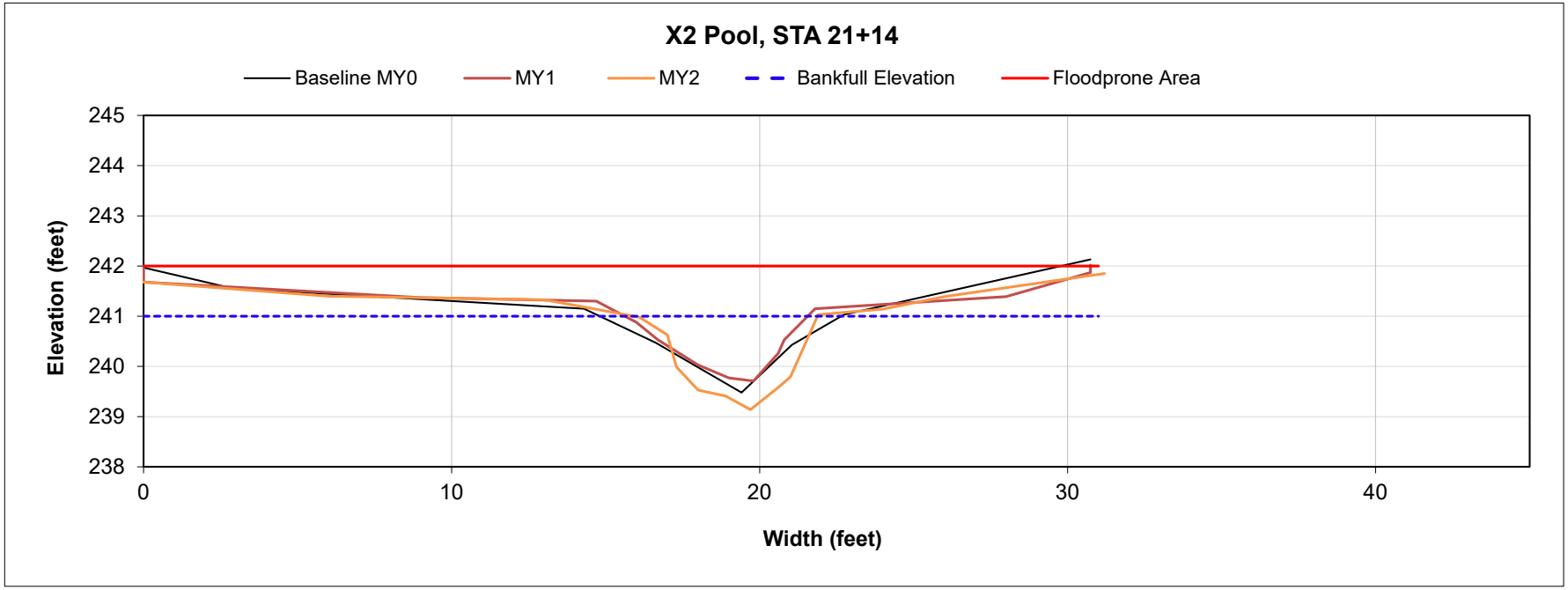


** Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull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

Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R2
Cross Section ID	X2
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY2 2019	
Bankfull Elevation (ft)	241.0
Low Bank Height Elevation (ft)	241.0
Bankfull Max Depth (ft)	1.8
Low Bank Height (ft)	1.8
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	6.5
% Change Bank Height Ratio	0.0%

Looking Downstream

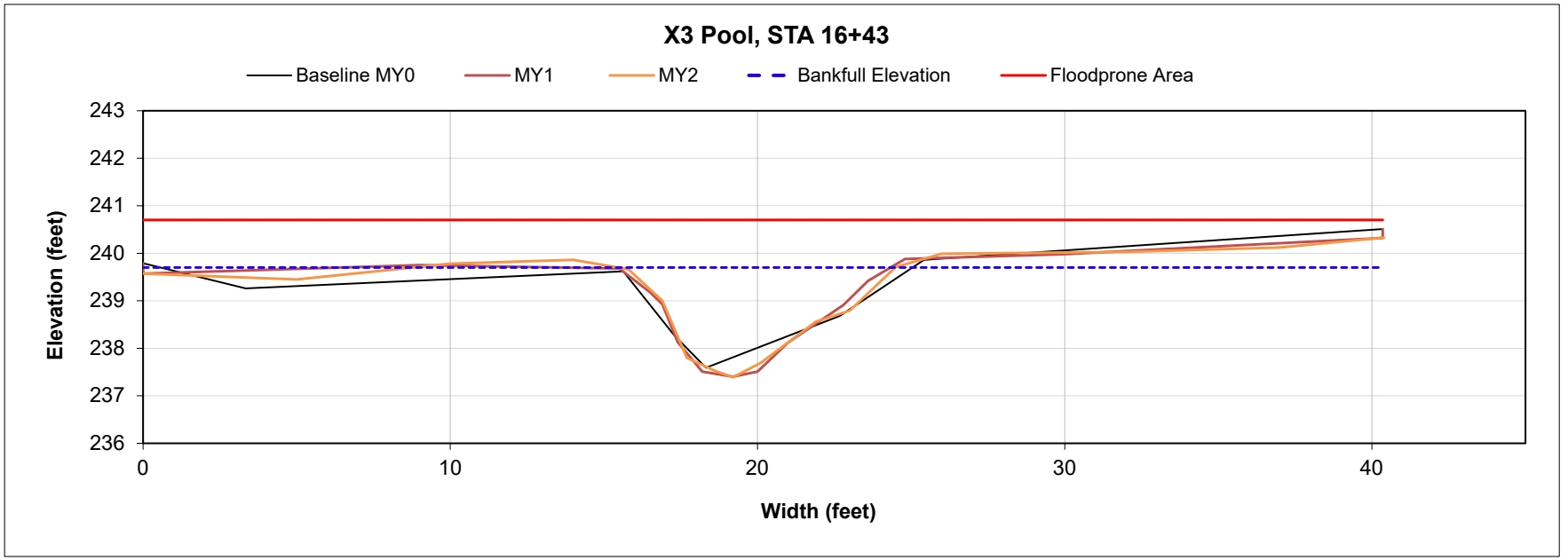


** Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull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

Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R4
Cross Section ID	X3
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY2 2019	
Bankfull Elevation (ft)	239.7
Low Bank Height Elevation (ft)	239.7
Bankfull Max Depth (ft)	2.3
Low Bank Height (ft)	2.3
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	11.0
% Change Bank Height Ratio	0.0%

Looking Downstream



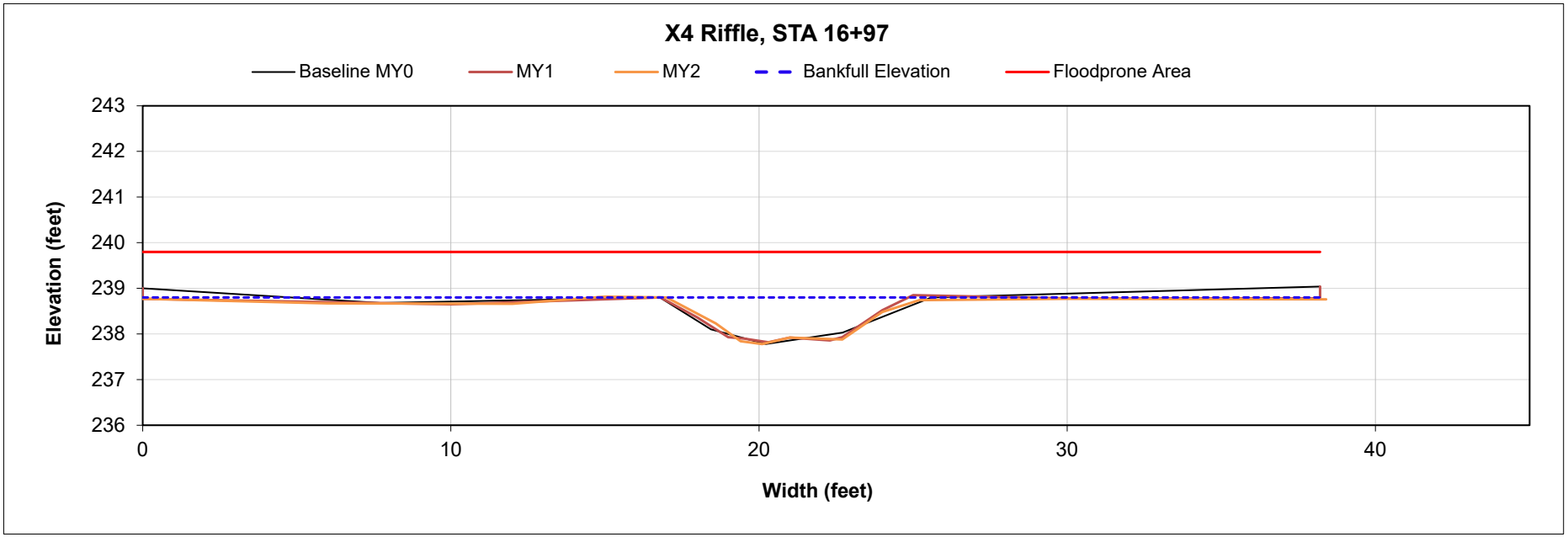
** Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull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

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

Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R4
Cross Section ID	X4
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY2 2019	
Bankfull Elevation (ft)	238.8
Low Bank Height Elevation (ft)	238.7
Bankfull Max Depth (ft)	1.0
Low Bank Height (ft)	0.9
Bank Height Ratio	0.9
Bankfull X-section Area (ft²)	5.2
% Change Bank Height Ratio	10.0%

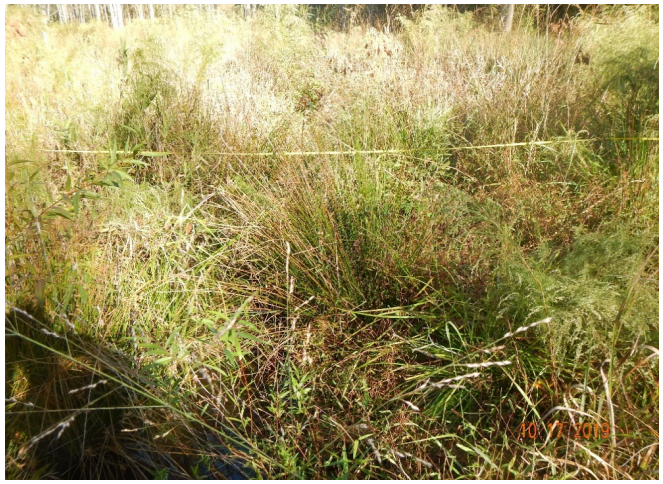
Looking Downstream



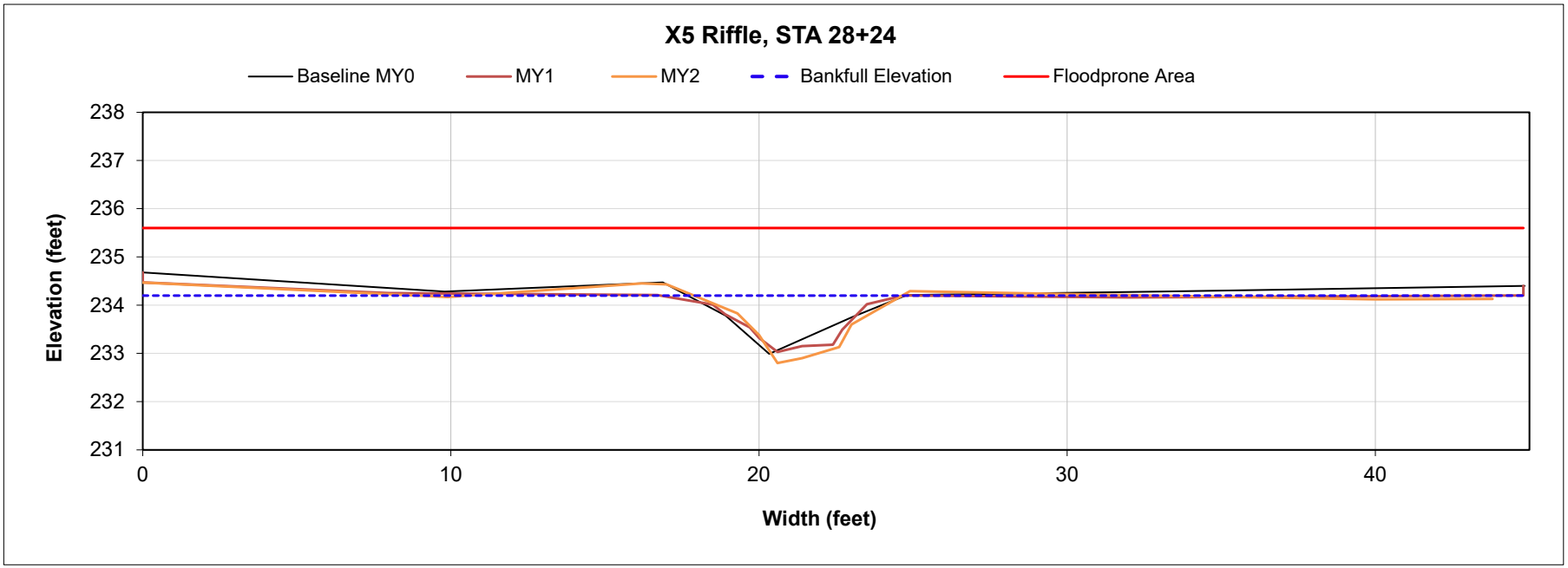
** Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull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

Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R3
Cross Section ID	X5
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY2 2019	
Bankfull Elevation (ft)	234.2
Low Bank Height Elevation (ft)	234.3
Bankfull Max Depth (ft)	1.4
Low Bank Height (ft)	1.5
Bank Height Ratio	1.1
Bankfull X-section Area (ft²)	4.7
% Change Bank Height Ratio	10.0%



Looking Downstream



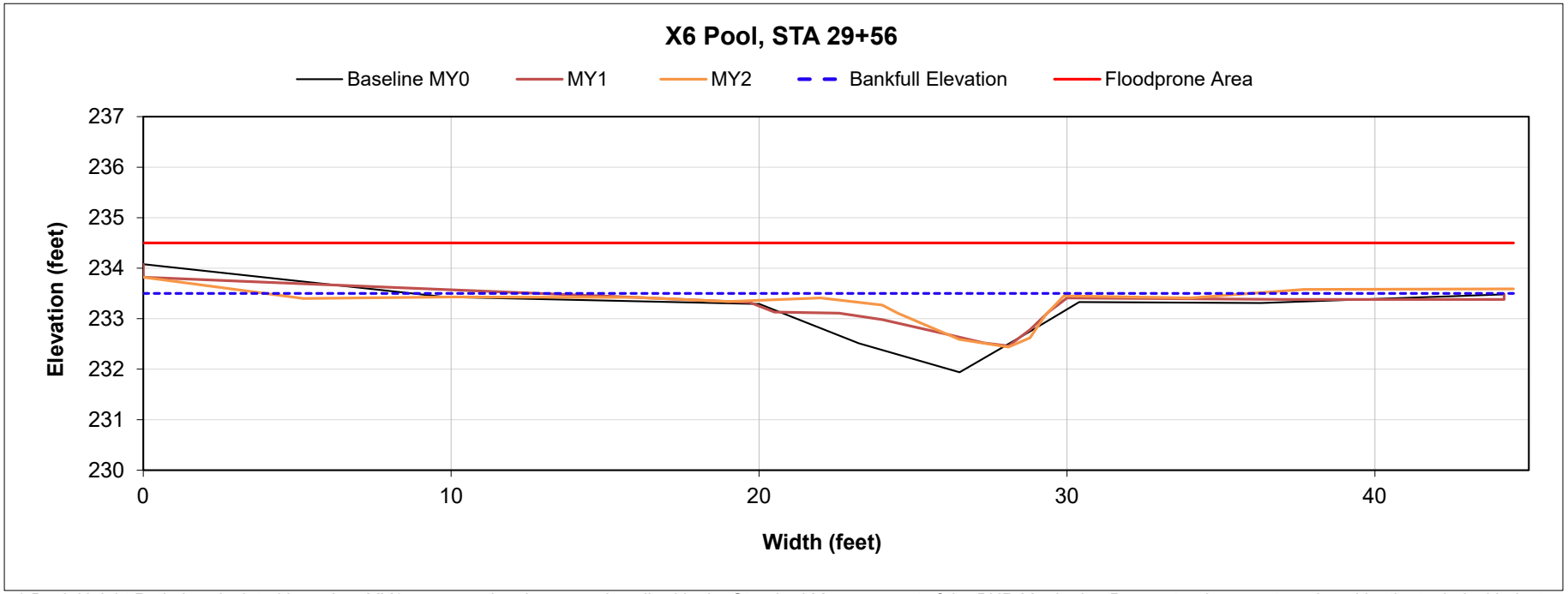
** Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull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

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

Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R3
Cross Section ID	X6
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY2 2019	
Bankfull Elevation (ft)	233.5
Low Bank Height Elevation (ft)	233.4
Bankfull Max Depth (ft)	1.0
Low Bank Height (ft)	0.9
Bank Height Ratio	0.9
Bankfull X-section Area (ft²)	5.6
% Change Bank Height Ratio	10.0%

Looking Downstream



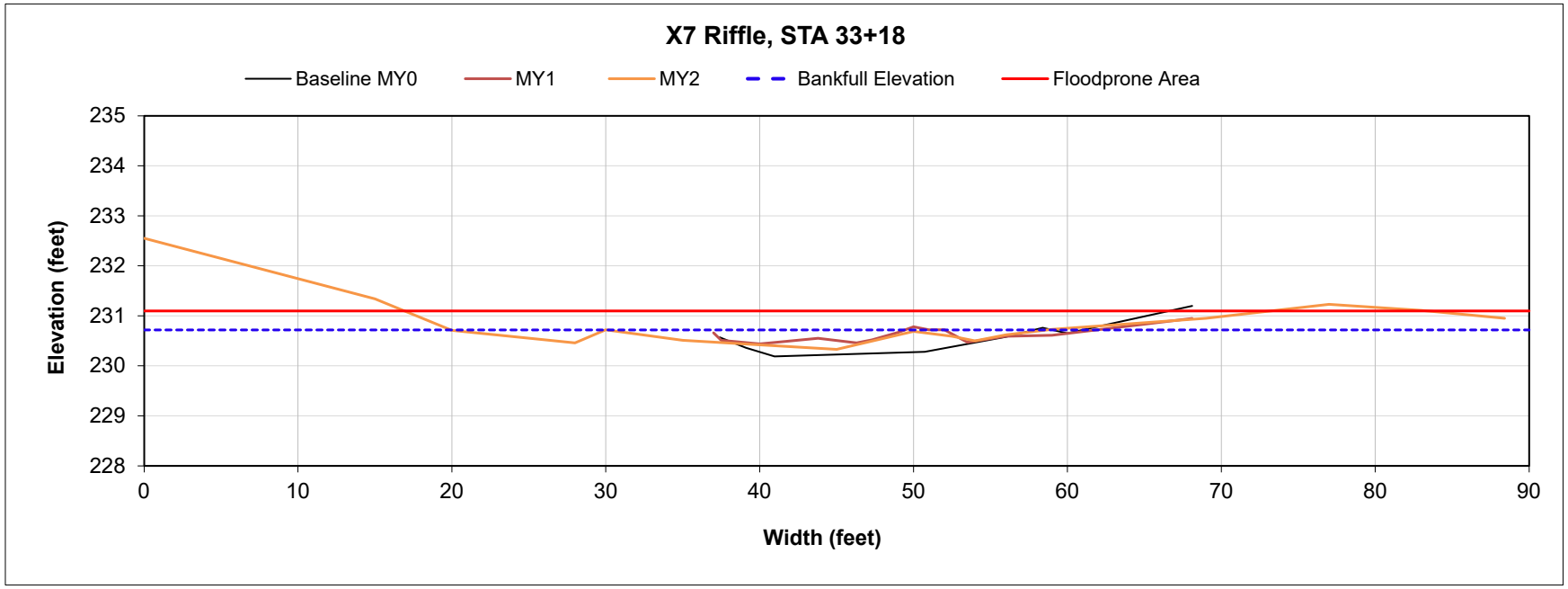
** Bank Height Ratio is calculated based on MY1 cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioner sin NC (9/2018). The remainder of the bankfull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

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

Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R3 (Multi-Thread Channel)
Cross Section ID	X7
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY2 2019	
Bankfull Elevation (ft)	230.7
Low Bank Height Elevation (ft)	230.8
Bankfull Max Depth (ft)	0.4
Low Bank Height (ft)	0.5
Bank Height Ratio	1.1
Bankfull X-section Area (ft²)	4.7
% Change Bank Height Ratio	10.0%

Looking Downstream



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

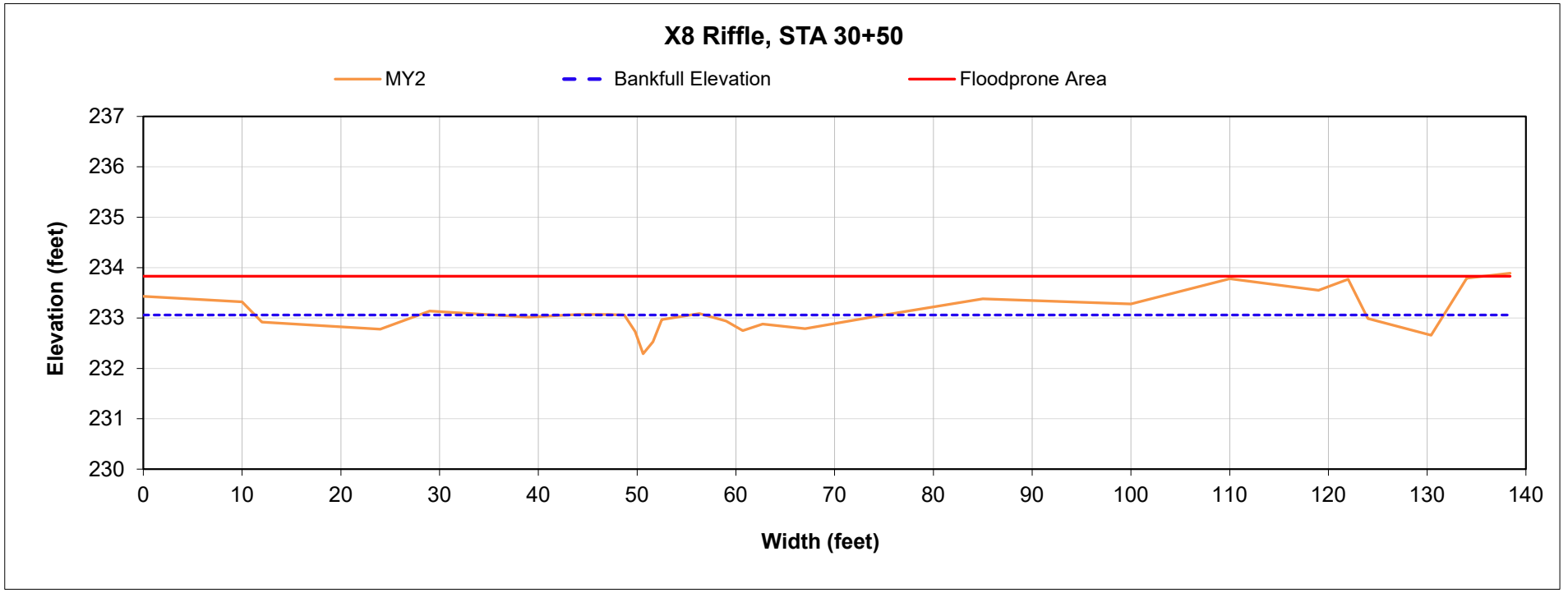
*** MY1 used in place of as-built (MY0) due to issues with the as-built survey standards identified during MY1.*

****X7 right and left pins extended per request after MY1*

Project Name	Edwards-Johnson Mitigation Project
Project ID	97080
Reach ID	R3 (Multi-Thread Channel)
Cross Section ID	X8
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY2 2019	
Bankfull Elevation (ft)	238.1
Low Bank Height Elevation (ft)	238.1
Bankfull Max Depth (ft)	0.8
Low Bank Height (ft)	0.8
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	4.7
% Change Bank Height Ratio	0.0%

Looking Downstream



**X8 added during MY1 post-monitoring site visit*

Figure 3: Edwards-Johnson
Pebble Count

Date Collected 9/21/2018 10/18/2019

MATERIAL	PARTICLE	SIZE (mm)	MY 1 Total #	MY2 Total #	MY3	MY4	MY5	MY6	MY7
SILT/CLAY	Silt / Clay	< .063	7	5					
SAND	Very Fine	.063 - .125	4	6					
	Fine	.125 - .25	14	7					
	Medium	.25 - .50	19	8					
	Coarse	.50 - 1.0	19	20					
	Very Coarse	1.0 - 2.0	19	13					
GRAVEL	Very Fine	2.0 - 2.8	7	7					
	Very Fine	2.8 - 4.0	4	7					
	Fine	4.0 - 5.6	2	7					
	Fine	5.6 - 8.0		4					
	Medium	8.0 - 11.0	1	3					
	Medium	11.0 - 16.0	1	6					
	Coarse	16 - 22.6	1	4					
	Coarse	22.6 - 32	2	3					
	Very Coarse	32 - 45							
	Very Coarse	45 - 64							
COBBLE	Small	64 - 90							
	Small	90 - 128							
	Large	128 - 180							
	Large	180 - 256							
BOULDER	Small	256 - 362							
	Small	362 - 512							
	Medium	512 - 1024							
	Large-Very Large	1024 - 2048							
BEDROCK	Bedrock	> 2048	100	100					
		Total							

Cumulative								
D16	0.16	0.2						
D35	0.36	0.66						
D50	0.62	1.1						
D65	1.1	2.5						
D84	2.4	7.8						
D95	N/A	19						

MY2

Riffle			Pool	
Channel materials			Channel materials	
D16 =	0.53		D16 =	0.067
D35 =	0.93		D35 =	0.13
D50 =	1.8		D50 =	0.3
D84 =	12		D84 =	3.2
D95 =	21		D95 =	7.5

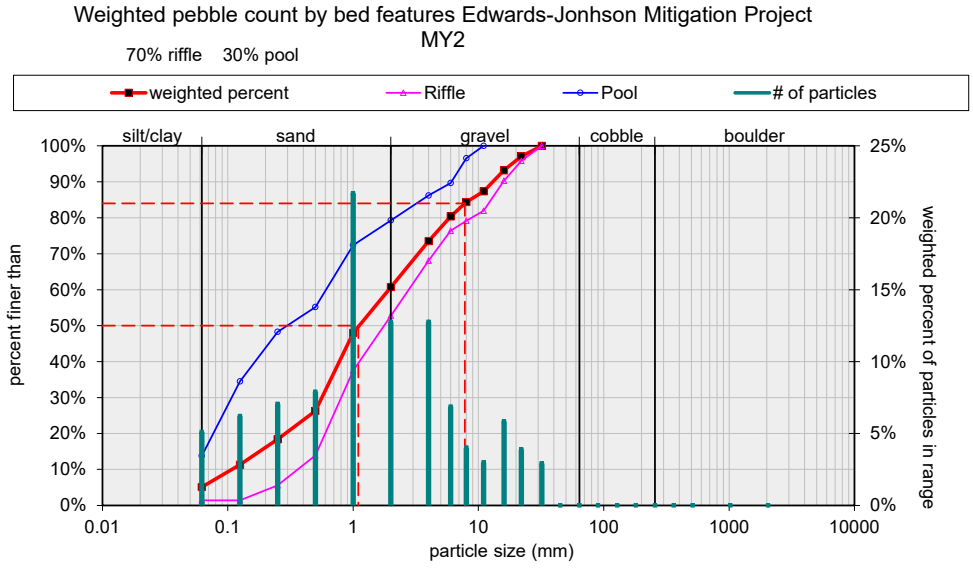


Table 7a. Baseline Stream Data Summary Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)								
Parameter	**Pre-Restoration Condition**		**Reference Reach Data**		**Design**		**As-Built/ Baseline**	
Reach ID: R1 (Preservation)								
Dimension (Riffle)	Min	Max	Min	Max	Min	Max	Min	Max
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)						
Parameters	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	8.9	7.7	8.6					8.4	13.3	5.8					9.2	9.3	8.7				
Floodprone Width (ft)	32.0	32.0	34.0					31.0	30.7	31.0					40.0	40.4	40.0				
Bankfull Mean Depth (ft)	0.6	0.7	0.6					0.8	0.5	1.1					1.1	1.2	1.3				
Bankfull Max Depth (ft)	1.2	1.3	1.2					1.7	1.6	1.8					2.0	2.1	2.3				
Bankfull Cross Sectional Area (ft^2)	5.2	4.9	4.9					6.7	6.5	6.5					10.4	11.0	11.0				
Bankfull Width/Depth Ratio	15.9	11.4	15.0					10.6	27.8	5.1					8.2	7.9	6.8				
Bankfull Entrenchment Ratio	3.6	4.2	4.0					3.7	2.3	5.4					4.3	4.3	4.6				
Bankfull Bank Height Ratio	1.0	<1.0	0.9					<1.0	<1.0	1.0					1.0	1.1	1.0				
d50 (mm)	N/a	0.8	1.8					N/a	0.4	0.3					N/a	0.4	0.3				
	Cross Section 4 (Riffle)							**Cross Section 5 (Riffle)**							**Cross Section 6 (Pool)**						
Parameters	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	8.8	8.2	8.2					8.8	8.0	6.8					10.4	14.3	25.7				
Floodprone Width (ft)	38.0	38.2	38.0					38.0	44.8	44.0					44.0	44.5	44.0				
Bankfull Mean Depth (ft)	0.6	0.6	0.6					0.6	0.7	0.7					0.7	0.4	0.2				
Bankfull Max Depth (ft)	1.0	1.0	1.0					1.0	1.3	1.4					1.4	1.1	1.0				
Bankfull Cross Sectional Area (ft^2)	5.4	5.2	5.2					5.5	4.7	4.7					7.7	5.6	5.6				
Bankfull Width/Depth Ratio	14.3	13.0	13.0					14.3	12.1	9.9					14.1	37.1	117.0				
Bankfull Entrenchment Ratio	4.3	4.7	4.6					4.3	5.6	6.4					4.2	3.1	1.7				
Bankfull Bank Height Ratio	1.0	1.0	0.9					1.0	1.0	1.1					1.0	<1.0	0.9				
d50 (mm)	N/a	0.8	1.8					N/a	0.8	1.8					N/a	0.4	0.3				
	Cross Section 7 (Riffle)							**Cross Section 8 (Riffle)**													
Parameters	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	18.4	18.1	27.2					N/A	N/A	24.8											
Floodprone Width (ft)	27.0	31.7	64.0					N/A	N/A	135.8											
Bankfull Mean Depth (ft)	0.3	0.3	0.4					N/A	N/A	0.2											
Bankfull Max Depth (ft)	0.4	0.3	0.2					N/A	N/A	0.8											
Bankfull Cross Sectional Area (ft^2)	4.7	4.7	4.7					N/A	N/A	4.7											
Bankfull Width/Depth Ratio	71.8	69.7	158.9					N/A	N/A	130.6											
Bankfull Entrenchment Ratio	1.5	1.7	2.4					N/A	N/A	5.5											
Bankfull Bank Height Ratio	1.0	1.0	1.1					N/A	N/A	1.0											
d50 (mm)	N/a	0.8	1.8					N/A	0.8	1.8											

	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												

Appendix E – Hydrologic Data

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	Measurement
9/17/2018	9/16-9/17/2018	Observed indicators of bankfull stage (wrack lines) after storm event	Bkf	Photo	
7/26/2019	7/24/2019	Crest Gage	Bkf	Photo	2.5 inches
8/20/2019	unknown	Crest Gage	Bkf	Photo	2.8 inches
9/6/2019	9/5/2019	Crest Gage	Bkf	Photo	2.5 inches
9/6/2019	9/5/2019	Observed indicators of bankfull stage (wrack lines) after storm event	Bkf	Photo	NA

9/17/2018

9/17/2018

7/26/2019

8/20/2019

9/6/2019

9/6/2019

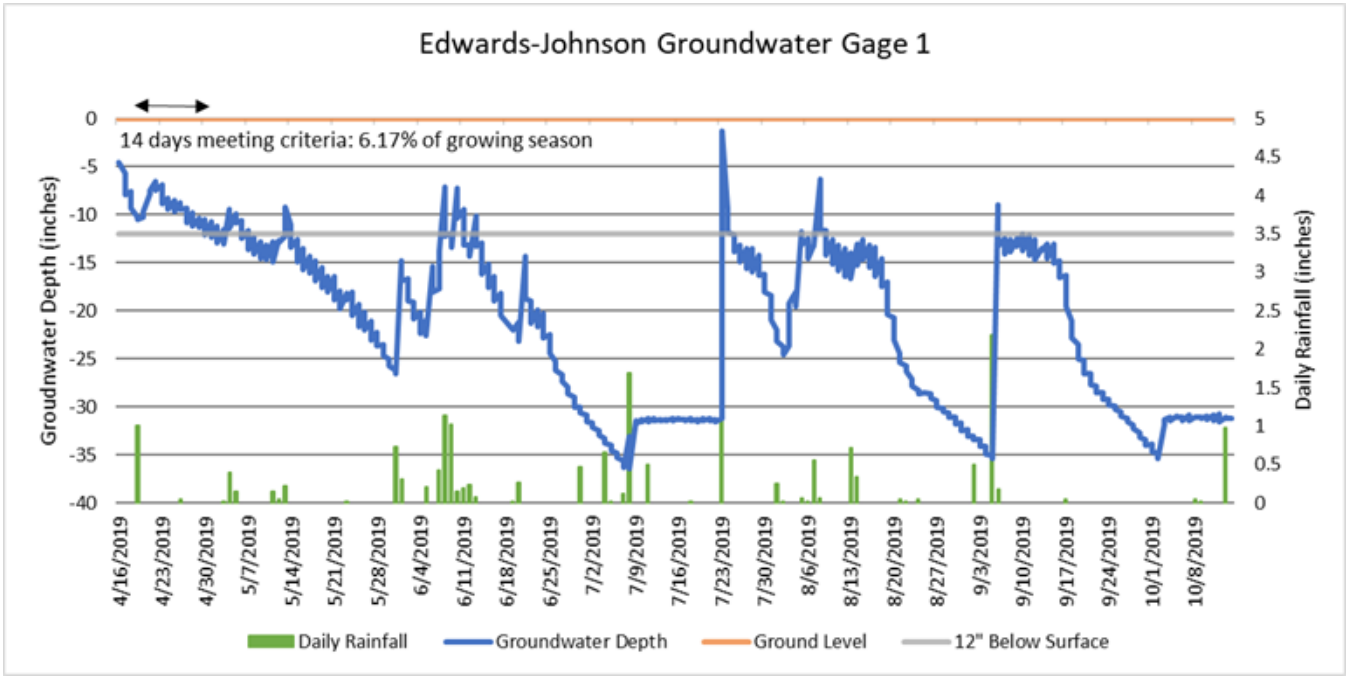
Figure 4 - Groundwater Gauge Data
Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)
MY2 2019

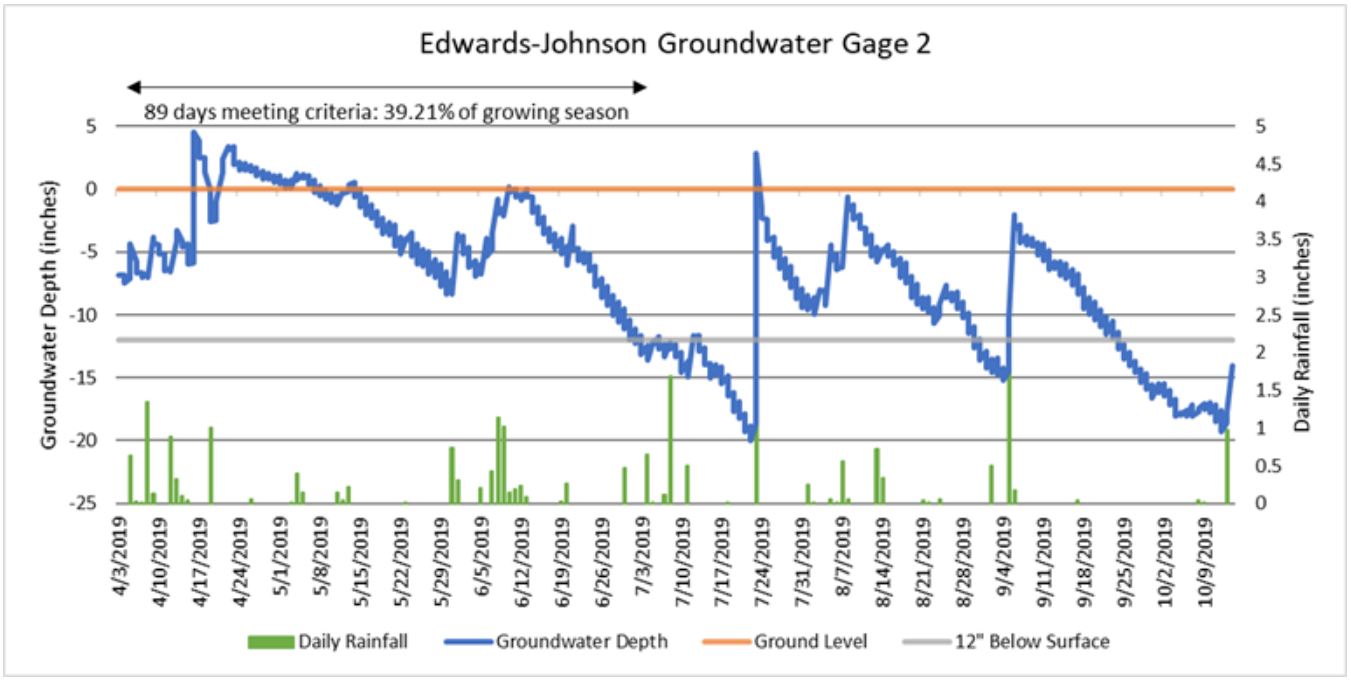
Monitoring Gauge Name	Max Consecutive Hydroperiod: Saturation within 12 Inches of Soil Surface (Percent of Growing Season) WETS Station: 317994 - Smithfield Growing Season: 4/6-11/4 (227 days)							
	2018	2019	2020	2021	2022	2023	2024	Mean
Edwards-Johnson Wetland Gage 1	M	6.17%						
Edwards-Johnson Reference Wetland Gage 2	M	39.21%						

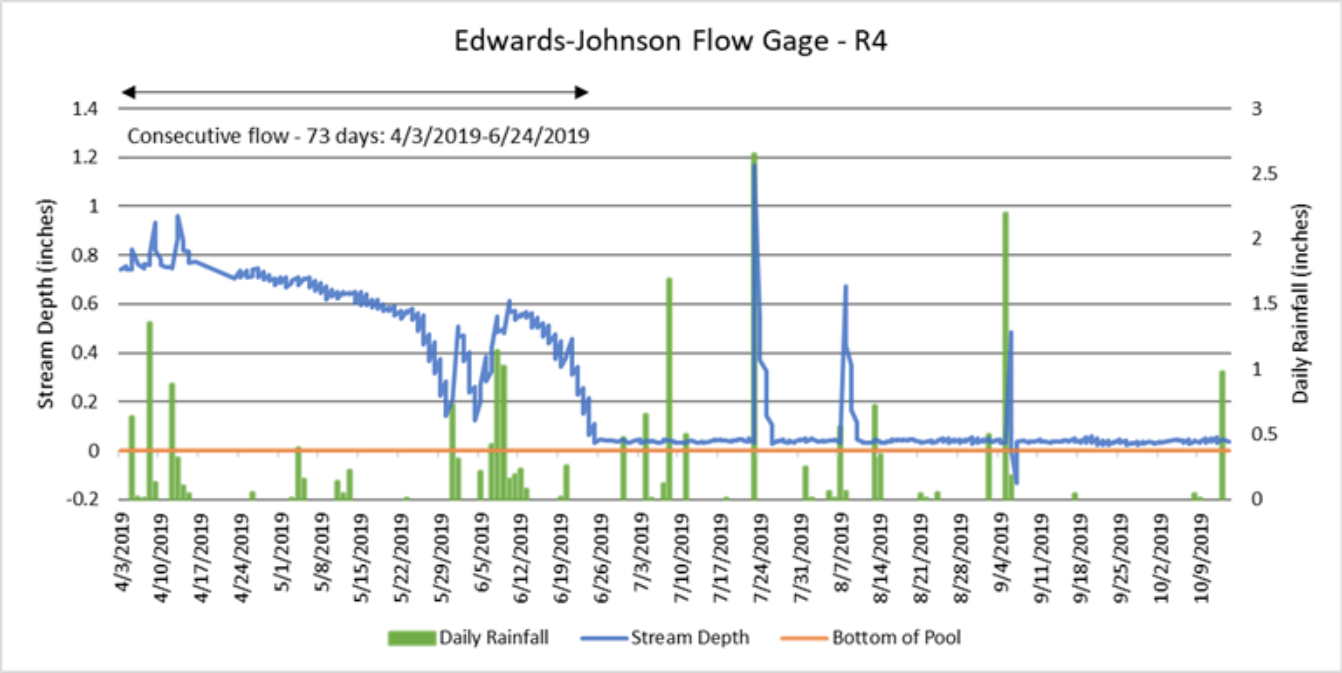
Annual Precip Total	NA
WETS 30th Percentile	42.7
WETS 70th Percentile	51.8
Normal	Y

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

Figure 4:

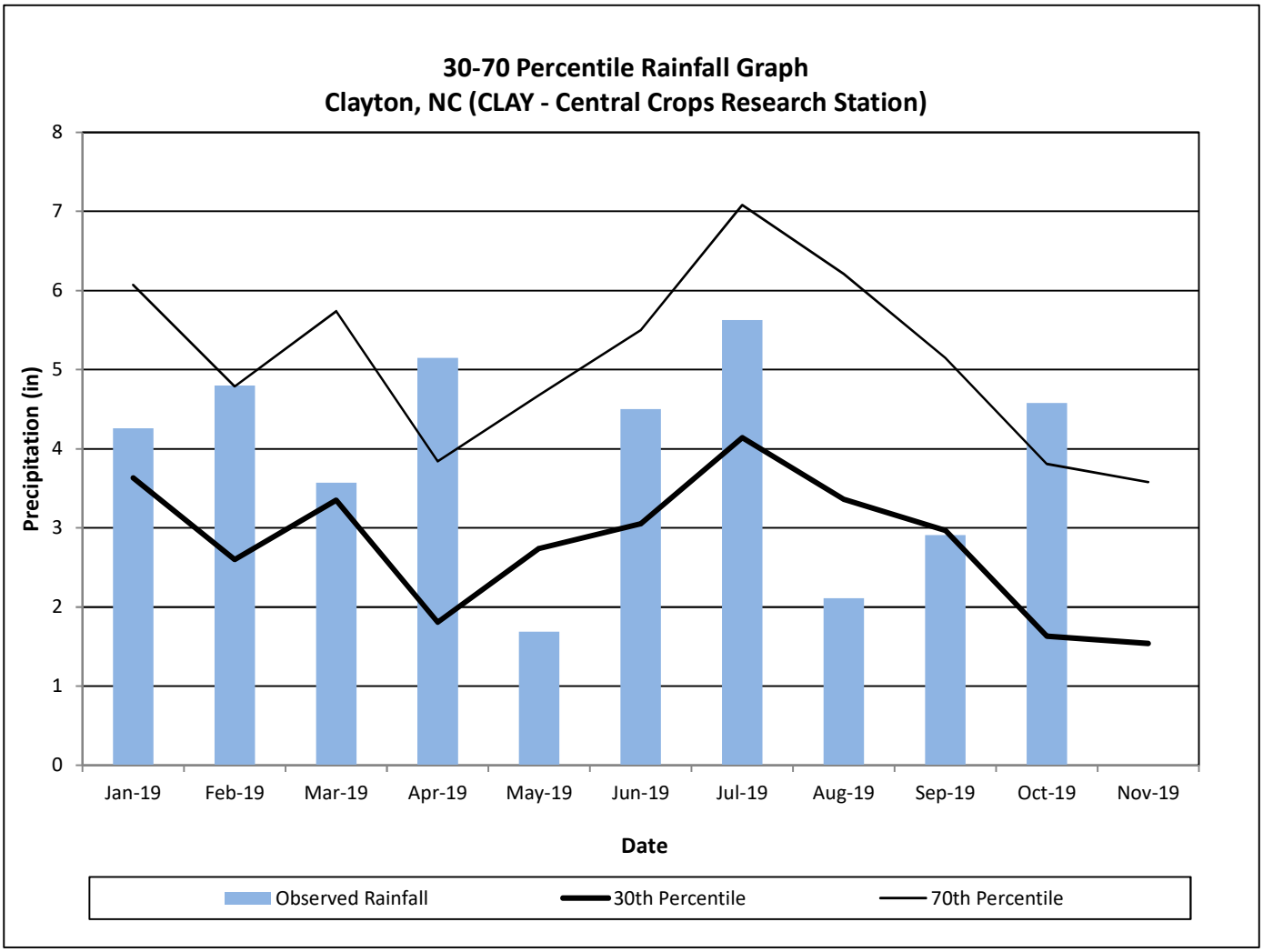

Edwards-Johnson Groundwater Gage 1
14 days meeting criteria: 6.17% of growing season
Groudnwater Depth (inches)
Daily Rainfall (inches)
0
-5
-10
-15
-20
-25
-30
-35
-40
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4/16/2019
4/23/2019
4/30/2019
5/7/2019
5/14/2019
5/21/2019
5/28/2019
6/4/2019
6/11/2019
6/18/2019
6/25/2019
7/2/2019
7/9/2019
7/16/2019
7/23/2019
7/30/2019
8/6/2019
8/13/2019
8/20/2019
8/27/2019
9/3/2019
9/10/2019
9/17/2019
9/24/2019
10/1/2019
10/8/2019
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface


Edwards-Johnson Groundwater Gage 2
89 days meeting criteria: 39.21% of growing season
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4/3/2019
4/10/2019
4/17/2019
4/24/2019
5/1/2019
5/8/2019
5/15/2019
5/22/2019
5/29/2019
6/5/2019
6/12/2019
6/19/2019
6/26/2019
7/3/2019
7/10/2019
7/17/2019
7/24/2019
7/31/2019
8/7/2019
8/14/2019
8/21/2019
8/28/2019
9/4/2019
9/11/2019
9/18/2019
9/25/2019
10/2/2019
10/9/2019
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface



*Pressure Transducers were used for all groundwater gages

Figure 5: Monthly Rainfall Data
Edwards-Johnson Mitigation Project (NCDEQ DMS Project ID# 97080)
MY2 2019



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

Month	30%	70%	Observed
Jan-19	3.63	6.07	4.26
Feb-19	2.60	4.79	4.8
Mar-19	3.35	5.74	3.57
Apr-19	1.81	3.84	5.15
May-19	2.74	4.68	1.69
Jun-19	3.05	5.50	4.5
Jul-19	4.14	7.08	5.63
Aug-19	3.36	6.21	2.11
Sep-19	2.97	5.15	2.91
Oct-19	1.63	3.81	4.58
Nov-19	1.54	3.58	**
Dec-19	**	**	**