Monitoring Report

FINAL

Harrell Stream and Wetland Mitigation Site
Monitoring Year 2 (2021)
NCDMS Project No. 100005
NCDMS Contract No. 007006
DWR# 20161077
USACE Action ID: SAW-2016-02202
Jackson County, North Carolina
Data Collected: April 2021 and Sept 2021
Date Submitted: February 2022

Submitted to:

NCDEQ-Division of Mitigation Services
1652 Mail Service Center Raleigh N C 27699-1652

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February 1, 2022

Paul Wiesner
Western Regional Supervisor
NCDEQ – Division of Mitigation Services
5 Ravenscroft Drive., Suite 102
Asheville, NC 28801

Subject: Draft Monitoring Year 2 (MY2) Report for the
Harrell Stream and Wetland Site
Little Tennessee River Basin – CU# 06010203– Jackson County
DMS Project ID No. 100005
Contract # 007006

Dear Mr. Wiesner:

On December 14, 2021, the NCDEQ – Division of Mitigation Services (DMS) received the Draft Monitoring Year 2 (MY2) Report for the Harrell Stream and Wetland Site from EW Solutions.

The report established the MY2 (2021) conditions at the project site. Anticipated mitigation on the site includes 1,790 linear feet of stream restoration; 640 linear feet of stream preservation; 3.31 acres of wetland Re-Establishment (1:1 mitigation ratio); 0.22 acres of wetland Rehabilitation (1:1 mitigation ratio) for a total of 1,854 Stream Mitigation Units (SMUs) and 3.53 Wetland Mitigation Units (WMUs). The following are our responses (**Red**) to the comments on the MY2 draft report and digital support files:

General: In the report text, please briefly note and discuss the 8/31/2021 IRT meeting on the project site and reference the meeting minutes provided in Appendix F. Please also confirm that the IRT requests from the on-site meeting and meeting notes were addressed/ resolved. **Text added.**

General: At the 2021 credit release meeting, the IRT requested that EW Solutions add photo points at all culverts and crossing locations on the site. EW Solutions committed to include these additional photo points in MY2 (2021). Supplemental photos were provide as requested; however, the IRT wanted supplemental photos on the culvert inlets and outlets to confirm crossing stability and sufficient organism passage. If possible, please provide the additional crossing photos in the revised MY2 report. If not available, please include these supplemental crossing photos in the MY3 (2022) report and future monitoring reports. **EWS now understands a specific need behind the request from the IRT and will provide the requested photo documentation beginning in MY3 and moving forward.**

General: Please ensure that project monitoring equipment is checked prior to the start of the growing season and at least quarterly thereafter to confirm that it is functioning properly and collecting data through the full growing season/ monitoring year. **The logger download schedule will be modified to focus on the growing season window in future monitoring years.**

F). **Section 1.1 Project Setting and Background:** This section indicates; "*The Notice of Initial Credit Release was received from the US Army Corps of Engineers on March 11, 2020, (Appendix*" This notice/ documentation was included in the MY1 report and does not need to be included in MY2. Please review and update the text accordingly. **Retained credit release timeframe statement as a part of the project history. Removed credit release document Appendix reference.**

Section 1.2. Project Goals and Objectives: "*Provide a buffer from agricultural activates and row crops;*". Please correct the spelling error in the Objectives section. **Spelling corrected.**

Section 1.5. Project Performance: The NCDMS link for project documents is: https://deq.nc.gov/about/divisions/mitigation-services/dms-project-documents-table Please update the report text accordingly. **Link updated.**

Table 2: Please include the February 2021 Supplemental Planting effort in the table. Please make sure all maintenance activities are captured in the table for the applicable monitoring year. **Updated table.**

MY2 Overview Map: DMS recommends removing any legend items not shown on the map. This map is typically referred to as the "Project Asset Map" in monitoring reports. **Updated title.**

CCPV Maps: Please include a legend item noting that vegetation plots (fixed or random) shown in "Red" are not currently meeting the interim vegetation success criteria. The legend should also show "Green" vegetation plots as meeting the interim vegetation success criteria. **Legend corrected.**

Table 5 & Table 6: Please include the date that the project was visually assessed at the top of each table. This was an IRT request at the 2021 credit release meeting. **Dates added.**

Photo point #1 supplemental: Please review and confirm that the stream feature shown is not a head cut that requires attention/ maintenance. **Reviewed and confirmed. This feature was a pre-existing drop into a culverted crossing and has remained stable. This photo is representative of both the culvert intake at the Reach 1A-B transition and as documentation of the removal of construction debris as discussed during the August 31, 2021 IRT meeting.**

Table 7a & 7b: Please review Table 7a and confirm that all of the plot data not currently meeting the interim vegetation success criteria are properly color coded. The vegetation performance standards summary table (7b) should also be color coded per the DMS template. Please review the tables and update accordingly. **Additional color coding added to report formatted tables.**

Table 10. Verification of Bankfull Events: Please add an additional column noting the applicable monitoring year for each bankfull event reported. **Table updated**

Digital Support File Comments:

It appears that certain conditional formatting may have been changed in the Veg Tool output (e.g. color coding of Vegetation Performance Standards Summary Table). Please include a version of the output where the content is unaltered and submit the input template with the digital submittal. **Raw data file and a separate output table included in the digital deliverables. Color coding retained in the report formatted tables.**

- Please submit a feature characterizing the supplemental planting area. **Feature added.**

Please provide an electronic comment response letter addressing the DMS comments received. This comment response letter should also be included in the final MY2 report after the report cover. **Comment letter provided in the digital submission and included in the final report.**

Sincerely,

David Tuch
Managing Partner
EW Solutions
37 Haywood Street, Suite 100
Asheville, NC 28801

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Prepared for:

EW SOLUTIONS

37 Haywood Street, Suite 100
Asheville, NC 28801

Prepared by:

EQUINOX

balance through proper planning

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1.0 PROJECT SUMMARY

1.1. Project Setting and Background

The Harrell Stream and Wetland Mitigation Site (Harrell Mitigation Site) is located in the Little Tennessee River (CU 06010203). The Harrell Mitigation Site also lies within the lower portion of the Eastern Little Tennessee River Basin (HUC 06010203010060) watershed which is identified as a Targeted Local Watershed (TLW) according to the 2008 Little Tennessee River Basin Restoration Priorities (RBRP) Plan. Project work at the Harrell Site was completed in early September 2019, and included construction, monitoring feature installation, and boundary marking; bare root and live stake installation occurred in mid-January 2020. Notice of Initial Credit Release was received from the US Army Corps of Engineers on March 11, 2020. A follow-up to the initial credit release meeting was conducted on August 31, 2021. Members of the IRT, DMS, and EWS assessed the site and discussed comments and concerns. A summary of the meeting notes, additional IRT comments, and EWS commitments are located in Appendix F. These comments have been addressed within this report. Through the project work, a total of 1,756 linear feet of stream were restored, 640 linear feet were preserved, 0.22 acre of wetland were rehabilitated, and 3.31 acres of wetland were re-established. The Harrell Mitigation Site generated a total of 1,854 SMU's and 3.53 WMU's. Refer to Table 1 for the project components and mitigation credit information and Figure 2 for the Project Asset Map.

Historic land use at the Harrell Mitigation Site consisted of silvicultural logging and agricultural use for at least 40 years, according to historic aerial photos. Historic agricultural practices, relocation of the channel, and berm construction along the right descending bank of Harrell Creek had functionally removed the stream's connectivity with the floodplain and adjacent wetlands, resulting in highly degraded wetland function. Two poorly functioning culverts have also degraded the ecological connectivity of the stream at the headwaters of the Harrell Mitigation Site. The lack of deep-rooted vegetation and unstable channel characteristics have contributed to the degradation of the streambanks on both sides of the project. Ecological function has been restored to the existing streams, wetlands, and riparian corridor by returning the existing stream and wetlands to a stable condition. The relocation of Harrell Creek to the historic floodplain and removal of the berm has restored proper floodplain connectivity and improved wetland hydrology. The restoration of the upper reach addressed a perched culvert, removed a second pipe crossing, and corrected erosion issues from an existing logging road through the installation of stormwater control devices. At the downstream end of Harrell Creek, the profile of the channel was raised, and proper channel dimensions were restored. Additional measures that promoted functional uplift included stabilizing and revegetating stream banks and adjacent disturbed areas, restoring floodplain connectivity and wetland hydrology, reestablishing wooded riparian areas. These measures contribute to reduced downstream sediment and nutrient loads, as well as improving aquatic and terrestrial habitat.

This project is protected by an 8.45-acre conservation easement and is located approximately 2.8 miles southeast of Cullowhee, NC in Jackson County at 35.300553° N, -83.133689° W. The Harrell Mitigation Site is bounded by agricultural land and mountainous woodlands.

1.2. Project Goals and Objectives

The project goals address stressors identified in the TLW and priority sub-watershed, as outlined in the Final Mitigation Plan, and include:

- Provide a network of streams with natural, stable forms that support proper stream functions;
- Improve groundwater hydrology to support recovery of native riparian vegetation;

- Reduce sediment inputs from eroding stream banks to reduce fine sediment loads and percentage of fines in the bed-material load;
- Restore proper sediment transport to support channel stability and bedform diversity;
- Improve substrate quality to facilitate hyporheic flow and support aquatic communities;
- Improve quantity, quality, and diversity of habitats to support healthy aquatic communities;
- Reduce pollutant inputs to the project streams (fecal coliform, nitrogen, phosphorus) to restore a balance to proper nutrient cycles;
- Improve riparian vegetation community to provide temperature regulation of the stream, provide a future source of organic inputs, and aid in long-term channel bank stability;
- Restore areas of former riparian wetlands so that the hydrology and soils will support wetland vegetative communities and wildlife;
- Improve landscape connectivity that allows space for biotic and abiotic processes and provides a source and sink for natural populations; and,
- Prevent the site from future impacts of development and agricultural issues.

The following objectives are proposed for accomplishing the above listed goals as outlined in the Final Mitigation Plan:

- Construct stream channels that will maintain proper dimension, pattern, and profile;
- Construct streams with proper bankfull to floodplain relationship;
- Construct streams that provide naturally stable dimensions and stabilize constructed banks with appropriate bioengineering;
- Construct streams that maintain an appropriate sediment transport balance with the sediment that is supplied by the watershed so that the overall stream profile neither aggrades nor degrades over time;
- Create and improve stream bedform diversity by constructing pools of varied depths and riffles of varied slopes;
- Construct stable riffles that provide an improved diversity of bed material clast and a reduction in fines relative to existing conditions;
- Construct in-stream habitat features from native material to provide diversity of habitat;
- Provide a buffer from agricultural activities and row crops;
- Plant native climax tree species and understory species in the riparian zone;
- Reconstruct stream channels that are properly connected to the riparian wetlands;
- Re-grade topography to eliminate ditches and drainage features;
- Plant native wetland tree and shrub species; and,
- Establish a conservation easement that provides a minimum buffer from future activities in the adjacent watershed and ensure aquatic organism passage by correcting perched culverts or removing other barriers within the easement.

1.3. Project Performance Standards

The stream restoration performance standards for the project will follow accepted and approved criteria based on the Final Mitigation Plan for the Harrell Mitigation Site (2019). Performance standards conform with the performance criteria provided in The Harrell Site Mitigation Plan which references the DMS Stream and Wetland Mitigation Plan Template and Guidance (October 2015), the Annual Monitoring Template (April 2015), and the Closeout Report Template (v2.1 March 2015). Performance criteria will be evaluated throughout the seven-year monitoring period.

Harrell Mitigation Site Performance Standards		
Objective	**Performance Standard**	**Monitoring Approach**
Construct stream channels that will maintain proper dimension, pattern and profile	· Riffle section W/D ratios should remain within the range of the appropriate stream type. · BHR should not exceed 1.2. BHR should not change more than 10% in any given monitoring interval. Changes that do occur should indicate a trend toward stability. · Entrenchment Ratios should be ≥ 2.2 for C/E channels and ≥ 1.4 for B Channels. · Document continuous surface flow in tributaries for at least 30 consecutive days in each year	Survey of select cross sections and visual assessment. Continuous stage recorders
Construct streams with proper bankfull to floodplain relationship	Four bankfull events or greater, in separate years, will be documented during the monitoring period	Crest gauges, continuous stage recorders, and debris lines.
Construct streams that provide naturally stable dimensions and stabilize constructed banks with appropriate bioengineering	Channel banks should generally remain stable. Where bank migration does occur, it should not exceed 20% of the bankfull width.	Visual assessment and bank pin monitoring as necessary.
Construct streams that maintain an appropriate sediment transport balance with the sediment that is supplied by the watershed so that the overall stream profile neither aggrades nor degrades over time.	Profile adjustments should not indicate significant aggradation or degradation. BHR requirements as stated above.	Resurvey of longitudinal profile if visual assessment indicates potential instability.
Create and improve stream bedform diversity by constructing pools of varied depths and riffles of varied slopes	Profile should maintain a diversity of depths expressed in riffle/pool forms.	Visual assessment
Construct stable riffles that provide an improved diversity of bed material clast and a reduction in fines relative to existing conditions	Substrate material should progress towards or maintain coarser material in riffles and runs with finer material present in pools and glides.	Pebble count measurements at surveyed cross sections
Construct in-stream habitat features from native material to provide a diversity of habitats	In-stream habitat structures should remain intact and functional.	Visual assessment
Provide a buffer from agricultural activities and row crops	Record conservation easement prior to implementation.	None
Plant native climax tree species and understory species in the riparian zone	Minimum of 320 stems/ac present at MY-3. Minimum of 260 stems/ac present at MY-5. Minimum of 210 stems/ac present at MY-7.	Vegetation plots

Objective	Performance Standard	Monitoring Approach
Reconstruct stream channels that are properly connected to the riparian wetlands	Groundwater elevation within 12 inches of the ground surface for 12% of the growing season.	Groundwater monitoring gauges
Re-grade topography to eliminate ditches and drainage features	Groundwater elevation within 12 inches of the ground surface for 12% of the growing season.	Groundwater monitoring gauges
Plant native wetland tree and shrub species	Minimum of 320 stems/ac present at MY-3. Minimum of 260 stems/ac present at MY-5. Minimum of 210 stems/ac present at MY-7.	Vegetation plots
Establish a conservation easement that provides a minimum buffer from future activities in the adjacent watershed.	Record conservation easement prior to implementation.	None

1.4. Mitigation Components

The Harrell Mitigation Site is anticipated to generate 1,854 SMUs and 3.53 WMUs. Refer to Figure 2 for the project component/ asset map for a visual description of the project assets and Table 1 for project components and mitigation credit information for the Harrell Site. These credits are based on the IRT approved Harrell Mitigation Plan.

1.5. Project Performance

Monitoring data was collected from April 29th, 2021, to October 1st, 2021. Monitoring activities included visual assessment of Harrell Creek, the conservation easement, collection of images at eight permanent photo stations, inventory of five permanent vegetation monitoring plots, three random vegetation plots, surveying of six cross-sections, conducting three pebble counts, maintenance of nine groundwater monitoring wells, and one continuous stage recorder.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information can be found in the Baseline Monitoring Report and in the Mitigation Plan documents available on the NCDMS website (https://deq.nc.gov/about/divisions/mitigation-services/dms-project-documents-table). All raw data supporting the tables and figures in the appendices is available from DMS upon request.

1.5.1. Vegetation

Visual assessment of vegetation outside of the monitoring plots (Appendix B – Table 6) indicates that both the herbaceous vegetation and planted stems were becoming established throughout much of the project. In the wetter portions of the site, Harrell Reach 1D and the area of Vegetation Plot #4, planted stems have struggled due to inundation coupled with competition by herbaceous vegetation. Supplemental planting of more wet tolerant species was conducted in these areas in February 2021. Areas of the right-descending bank of Reach 1C were also identified has having low stem density/survival in MY2.

Monitoring of the permanent vegetation plots (n = 5) and random vegetation plots (n=3) was completed in October 2021. Summary tables and photographs associated with MY2 vegetation monitoring are located in Appendix B and Appendix C. A total of nine species of planted stems were documented within the plots. Planted stem densities among the five plots ranged from 405 to 526 planted

stems per acre. Supplemental planting of more wet-tolerant species within the vicinity of Vegetation Plots 4 and 5 was conducted on February 4, 2021, and consisted of 1–2-year-old bare root plants, planted on 6-foot centers, with silky dogwood (*Cornus amomum*), tag alder (*Alnus serrulata*), and black willow (*Salix nigra*). A map and summary of the supplemental plantings can be found in Appendix F.

Three Random Vegetation Plots (RVP) were sampled during MY2. Random plots were located along Reach 1B, Reach 1C, and Reach 1D. Reach 1C (RVP 2) was targeted as a direct request from the NC IRT, citing concerns about low stem density. Stem densities among the three random plots ranged from 202 to 364 planted stems per acre. When natural stems are tallied the density ranges from 202 to 485 with an average of 323 stems per acre (Table 7a and 7b, Appendix C). A second round of supplemental planting of bare root and live stakes is planned for early 2022. Stem densities and survival will continue to be monitored in future years.

Invasive species have been documented throughout the site, with overall low abundance. These areas were treated on June 6, 2020, June 16, 2020, and June 25, 2021. The primary species documented at the Harrell Site include Chinese Privet (*Ligustrum sinensis*), Multiflora Rose (*Rosa multiflora*), Oriental bittersweet (*Celastrus orbiculatus*), and Japanese Honeysuckle (*Lonicera japonica*) along the fringes. Treatment of these invasive species populations will be continued throughout subsequent monitoring years. Details on invasive species density and area can be found in Table 6, the CCPV, Appendix B, Table 7a and 7b, Appendix C). Treatment logs and a treatment map can be found in Appendix F.

1.5.2. Stream Geomorphology

Visual assessment of the stream channel was performed to document signs of instability, such as beaver activity, eroding banks, structural instability, or excessive sedimentation. No areas of immediate concern were identified during MY2. Monitoring of the NCDOT culvert at the bottom of the project area will be ongoing and has been conducted by both NCDOT and Equinox Staff.

Geomorphic data for MY2 was collected in late September 2021. Summary tables and cross-section data plots related to stream morphology are located in Appendix D. Cross-sectional dimensions remained stable between baseline conditions and the MY2 monitoring efforts. Some shifts in depth and bankfull width were noted within the cross-sections. Similar to observations in MY1, debris mobilized during numerous overbank events has been depicted within three of the six cross-sections, (XS2, XS5, and XS6, Appendix D). In cross section #2 overbank deposition has resulted in some bank building and has resulted in continued filling of a floodplain depression present in MY0. This depression previously entrained a log and debris which was transported into the cross-section during MY1. Movement of debris has caused a similar change in the dimension noted at cross-section #5 and 6. Both cross-sections in Reach 1D have been impacted by the effects of the undersized culvert at the bottom of the reach. Routine maintenance of this culvert has allowed for increased transport of materials out of the reach during high flows and resulted in dimensional trends back toward As-Built conditions (Appendix D, Table 9a & b). Additionally, the pool at cross-section 6 occurs in a tight bend and has shifted downstream and toward the left-descending bank resulting in a slightly oblique angle to the profile along the cross-section. None of the above observations were considered indicative of channel instability. Stream dimension will be monitored in future years for changes in dimension.

Pebble count D_{50} fell into the medium gravel category for Harrell Creek Reach 1 D, cross-section 5, very coarse to medium sand range for Harrell Creek Reach 1C, cross-sections 2 and 4, respectively. An increase in the relative percentages of silt was noted in both cross-sections 4 and 5 (Appendix D, Pebble Count Graphics and Tables). A similar observation was made in cross-section 2 in the previous monitoring year indicating a movement of fines through the system. Conversely, the increased coarseness

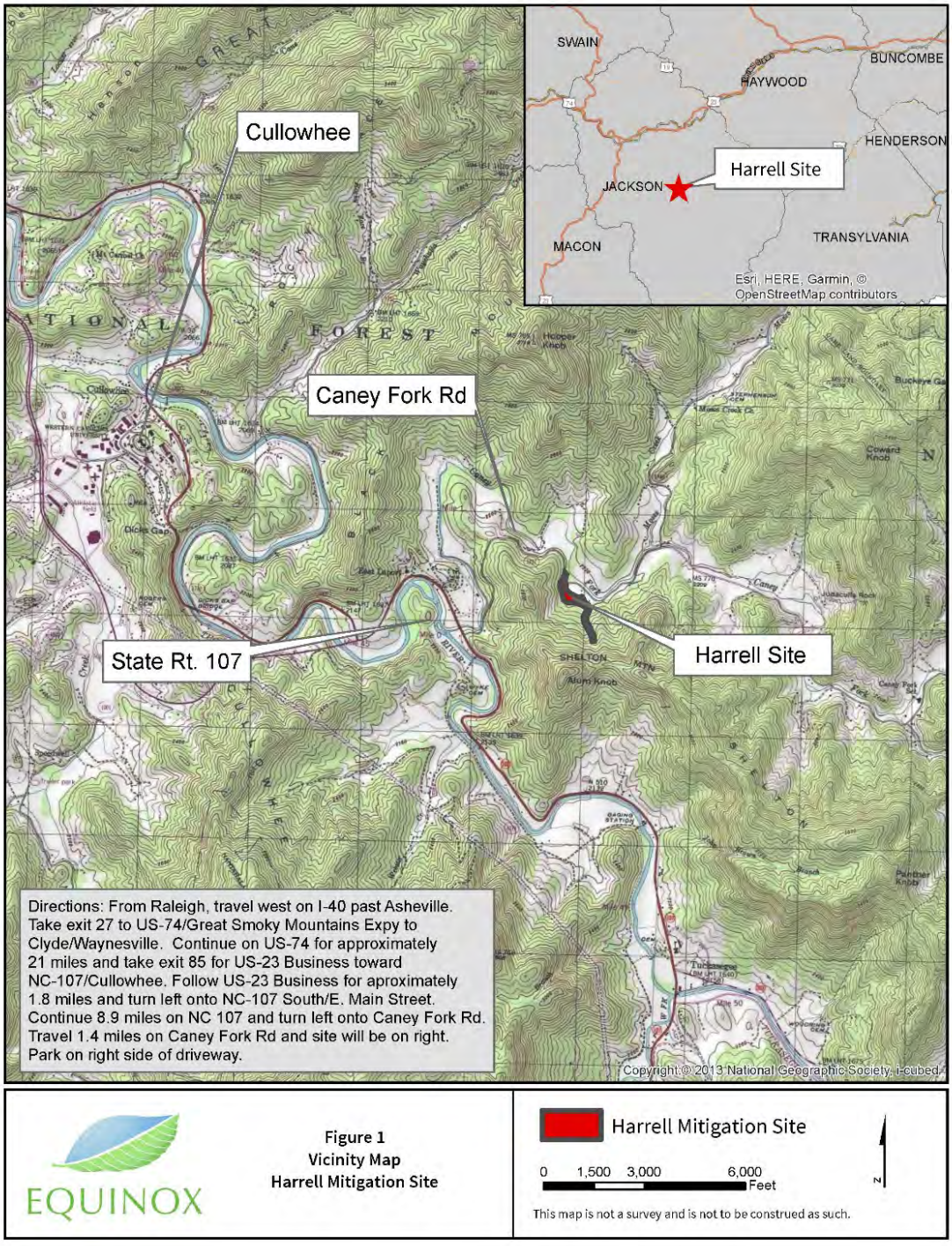
noted in Cross-section 2 during MY2 suggests a reduction in fine sediment inputs from upstream. The channel substrate will continue to be monitored in future years for shifts in particle size distribution.

1.5.3.Hydrology

Since project completion in early 2020, 16 bankfull events have been documented at the Harrell Mitigation Site. The continuous stage recorder at Cross-Section #4 failed on May 6, 2021, and was restarted in September of 2021. A crest gauge will be installed in MY3 as a redundancy measure to mitigate for potential transducer failures moving forward. The suspected dates and associated precipitation records can be found in Table 10, Appendix E.

Three groundwater wells, #1, 5 and 7, failed to meet the success criteria during MY2. Monitoring well #1 fell just short of the performance criteria at 11%. Monitoring well #2 was meeting at a marginal level, 13%. At the suggestion of the IRT, supplemental soil profiles will be conducted in MY3, MY5, and MY7 to capture any changes in wetland soil indicators. Groundwater gage graphics and supporting tables can be found in Appendix E.

1.6. Vicinity Map



2.0 REFERENCES

NCDENR. 2007. DMS Stream and Wetland Mitigation Annual Monitoring Template (June 2017).

NCDENR. 2021. DMS Veg Table Production Tool, Version 8/23/2021. Retrieved from https://ncdms.shinyapps.io/Veg_Table_Tool/.

Harrelson, Cheryl C., Rawlins, C. L., Potyondy, John, P., (1994) Stream Channel Reference Sites: An illustrated guide to field technique.

Kee Mapping and Survey. 2019. As-Built Survey of Harrell Creek Restoration Project. Prepared for EW Solutions.

Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation, Version 4.2 (http://cvs.bio.unc.edu/methods.htm).

Stantec Consulting, Inc. 2019. Final Mitigation Plan – Harrell Mitigation Site. Prepared for North Carolina Department of Environmental Quality, Division of Mitigation Services. DMS Project No. 100005.

Appendix A
Background Tables

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Table 1. Project Mitigation Assets and Components
Harrell Mitigation Site

Project Segment	Existing Footage or Acreage	Mitigation Plan Footage or Acreage	Mitigation Category	Restoration Level	Priority Level	Mitigation Ratio (X:1)		As-Built Centerline Footage or Acreage^	Comments
Reach 1A	654	640	Cold	P	NA	10.0		640	
Reach 1B	286	273	Cold	R	PI	1.0		273	Less 38' for crossing and outlet protection. Less than 30' buffer for 41 LF
Reach 1C	1,265	1,268	Cold	R	PI	1.0		1,189	0.026 ac impact to Wetland B
Reach 1D	223	249	Cold	R	P1	1.0		294	Less 13' for ROW Less than 30' buffer for 32 LF 0.008 ac impact to Wetland A
Wetland A	1.59	1.58	RNR	Re (Pres)		0.0		1.58	Existing wetland will be protected 0.008 ac impact to Wetland A for stream construction
Wetland A	1.59	0.26	RNR	R(Re-est)		1.0		0.26	Area of the existing channel within the wetland was filled and replanted
Wetland B	0.24	0.22	RNR	R (Rehab)		1.0		0.22	0.026 ac impact to Wetland B for stream construction
Wetland C	-	3.05	RNR	R (Re-Est)		1.0		3.05	

^ Based on centerline calculations from the as-built survey, accounts for breaks in conservation easement and utility right-of-ways.

Project Credits

Restoration Level	Stream			Riparian Wetland		Non-Rip	Coastal
	Warm	Cool	Cold	Riverine	Non-Riv	Wetland	Marsh
Restoration	-	-	1790	-	-	-	-
Re-establishment				-	3.31	-	-
Rehabilitation				-	0.22	-	-
Enhancement				-	-	-	-
Enhancement I	-	-	-				
Enhancement II	-	-	-				
Creation				-	-	-	-
Preservation	-	-	64	-	-	-	
Total Credits [%]	-	-	**1,854**	-	**3.53**	-	-

[%] Project credits reflect the sum of credits outlined in the IRT approved mitigation plan. Mitigation plan credits account for breaks in conservation easements and are based on centerline design stream stationing and taken from the IRT approved mitigation plan. Mitigation plan credits are the same as the IRT approved mitigation plan.

* Wetland A will be protected but is not generating wetland credit due to the 100% Restoration credit requirement in RFP 16-008611

Table 2. Project Activity and Reporting History
Harrell Mitigation Site

Activity or Report	Data Collection Complete	Completion or Delivery
Mitigation Plan	Dec - 2018	Jan - 2019
Mitigation Plan Addendum	-	-
Final Design - Construction Plans	-	June - 2019
Construction	-	Aug - 2019
Temporary S&E Mix Applied	-	Aug - 2019
Permanent Seed Mix Applied	-	Aug - 2019
Bare Root and Live Stake Plantings	-	Jan - 2020
Baseline Monitoring Document (Year 0 Monitoring - Baseline)	Jan - 2020	Feb - 2020
Stream Assessment	Jan - 2020	
Vegetation Assessment	Jan - 2020	
Year 1 Monitoring	-	Dec-2020
Initial Site Assessment	April-2020	
Stream Assessment	Sept - 2020	
Vegetation Assessment	Sept - 2020	
Invasive Vegetation Treatments		Nov-2020
Year 2 Monitoring	-	Dec-2021
Supplemental vegetation planting	Feb-2021	
Initial Site Assessment	April-2021	
Stream Assessment	Sept - 2021	
Vegetation Assessment	Oct - 2021	
Invasive Vegetation Treatments	-	June - 2021
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		
Year 6 Monitoring		
Year 7 Monitoring		

Table 3. Project Contacts Harrell Mitigation Site	
Prime Contractor	EW Solutions 37 Haywood Street, Suite 100 Asheville, NC 28801 David Tuch (828) 253-6856
Designer	Stantec Consulting, Inc 56 College Street, Suite 201 Asheville, North Carolina 28801 Grant Ginn (828) 449-1930
Construction Contractor	Penland Contracting, Inc 300 NP&L Loop Franklin, NC 28734 Lewis Penland (828) 421-1753
Seeding Contractor	Penland Contracting, Inc 300 NP&L Loop Franklin, NC 28734 Lewis Penland (828) 421-1753
Planting Contractor	Equinox 37 Haywood St. Asheville, North Carolina 28801 Owen Carson (828) 253-6856
As-built Surveys	Kee Mapping 88 Central Ave. Asheville, NC 28801 Brad Kee (828) 575-9021
Seeding Mix Source	Hancock Farm & Seed 18724 Hancock Farm Rd Dade City, Fl 333523 (352) 567-6971
Bare Roots/Live Stakes	Mellow Marsh Farms 1312 Woody Store Road Siler City, NC 27344 (919) 742-1200
Monitoring Performers (MY2)-2021	Equinox 37 Haywood St. Asheville, North Carolina 28801 Owen Carson (828) 253-6856 ext. 204 Danvey Walsh (828) 253-6856 ext.201

Table 4. Project Baseline Information and Attributes

Project Information

Project Name	Harrell Stream and Wetland Mitigation Site
County	Jackson
Project Area (acres)	8.45
Project Coordinates (latitude and longitude)	35.300533° N, -83.133689° W
Project Thermal Regime	Cold

Project Watershed Summary Information

Physiographic Province		Blue Ridge Mountains	
River Basin		Little Tennessee	
USGS Hydrologic Unit 8-digit	6010203	USGS Hydrologic Unit 14-digit	06010203010060
DWR Sub-basin		04-04-02	
Project Drainage Area (acres)		102.0	
Project Drainage Area Percentage of Impervious Area		< 1%	
CGIA Land Use Classification		Agricultural	

Reach Summary Information

Parameters	Reach 1A	Reach 1B	Reach 1C	Reach 1D
Length of Reach (linear feet)	640	273	1,268	249
Valley Confinement (Rosgen)	II	II	VII	VII
Drainage area (miles^2)	0.05	0.07	0.16	0.17
Perrenial, Intermittent, Ephemeral	Perrenial	Perrenial	Perrenial	Perrenial
NCDWR Water Quality Classification	C	C	C	C
Stream Classification (existing)	A & B	G	E & F	E
Stream Classification (proposed)	A	B4	E4	E4
FEMA classification	-	-	-	-

Wetland Summary Information

Parameters	Wetland A	Wetland B	Wetland C
Size of Wetland (acres)	1.58	0.22	3.05
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian	Riparian	Riparian
Mapped Soil Series	NkA	NkA	NkA
Drainage class	poorly	poorly	poorly
Soil Hydric Status	Hydric	Hydric	Hydric
Source of Hydrology	Groundwater	Groundwater	Groundwater
Hydrologic Impairment	Agriculture/ Ditching	Agriculture/ Ditching	Agriculture/ Ditching
Native vegetation community	Swamp-Forest Bog	Swamp-Forest Bog	Swamp-Forest Bog
Percent composition of exotic invasive vegetation	15%	15%	1%

Regulatory Considerations

Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States – Section 404	Yes	Yes	404 Permit #SAW-2016-02202
Waters of the United States – Section 401	Yes	Yes	401 Permit #20161077
Endangered Species Act	Yes	Yes	FFHWA Categorical Exclusion (CE)/ERTR
Historic Preservation Act	No	N/A	FFHWA Categorical Exclusion (CE)/ERTR
Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	FEMA Floodplain Requirements Checklist (Jan-2019) Jackson County, NC Floodplain Development Permit #2019-F187
Essential Fisheries Habitat	No	N/A	N/A

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Appendix B
Visual Assessment Data

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Mitigation Services
ENVIRONMENTAL QUALITY

Project Assets
Harrell Mitigation Site
Jackson County, NC

0 30 60 120 180 240 300
Feet

Conservation Easement Boundary

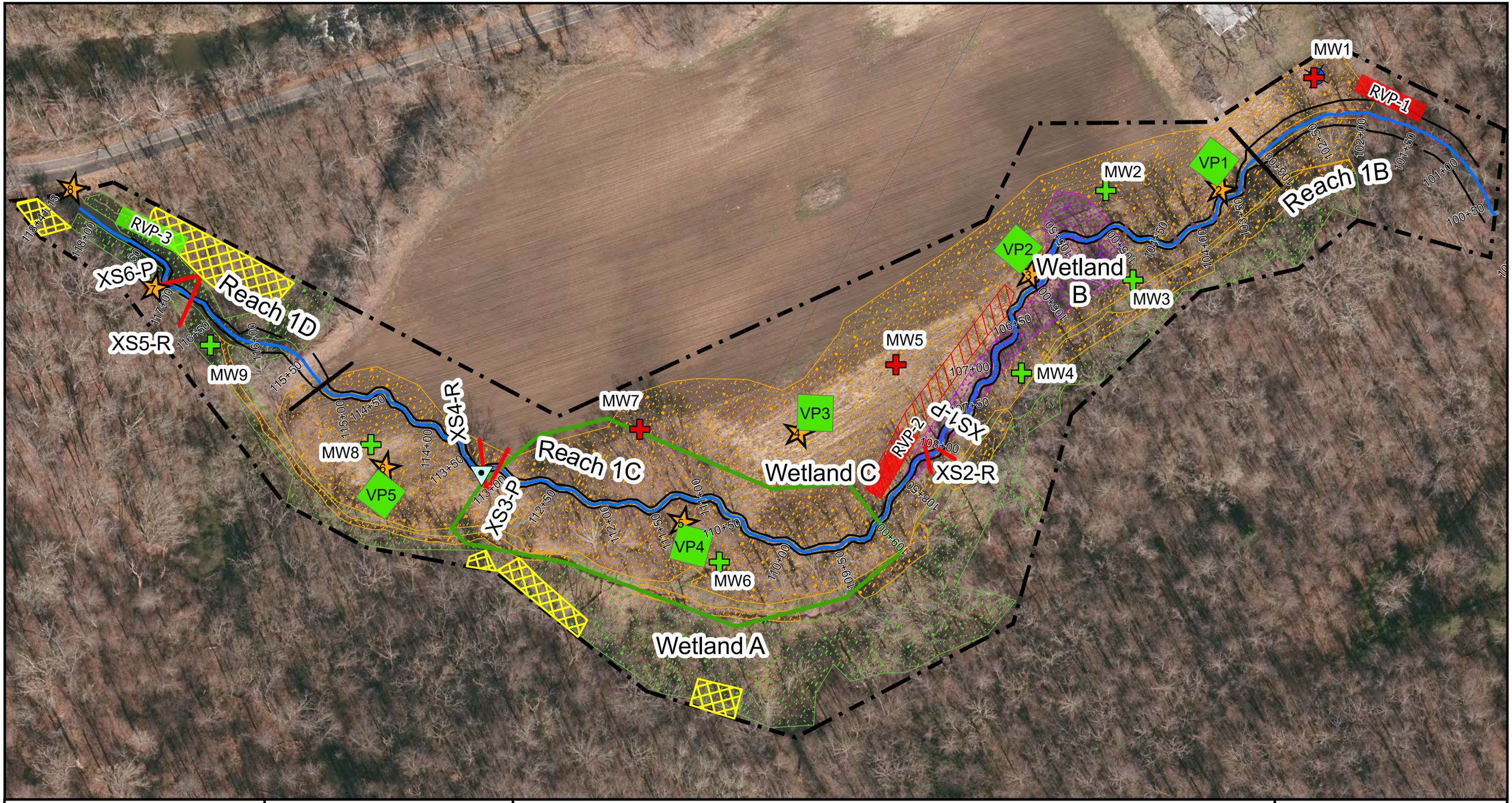
Wetlands

- Reestablishment
- Rehabilitation
- Preservation (No Credit)

Streams

- Preservation
- Restoration
- Reach Breaks

EQUINOX



MY2 CCPV
Harrell Mitigation Site
Jackson County, NC
October 2021

0 15 30 60 90 120 150 Feet

Mitigation Services
ENVIRONMENTAL QUALITY

- Conservation Easement Boundary
- Monitoring
  - Continuous Stage Recorder
  - Cross-Section
  - Rain Gauge
  - Photopoints
- Low Stem Density
- Invasive Vegetation
- Groundwater Gauge
  - Not Meeting Criteria
  - Meeting Criteria
- Fixed Vegetation Plot
  - Exceed Criteria > 10%
- Random Vegetation Plot
  - Meeting Criteria
  - Not Meeting Criteria
- Wetlands
  - Reestablishment
  - Rehabilitation
  - Preservation (No Credit)
- Replanted Area 2021
- Streams
  - Restoration
  - Reach Breaks

EQUINOX

Table 5 Visual Stream Morphology Stability Assessment
Harrell Mitigation Site - Harrell Reach 1B - Restoration P1
Assessed Length 286 feet (April 29th and September 29, 2021)

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%	N/A	N/A	N/A
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	N/A	N/A	N/A
				Totals	0	0	100%	N/A	N/A	N/A
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	15	15			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	15	15			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	15	15			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does NOT exceed 15%.	15	15			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	15	15			100%			

N/A - Item does not apply.

Table 5 cont'd. Visual Stream Morphology Stability Assessment
Harrell Mitigation Site - Harrell Reach 1C - Restoration P1
Assessed Length 1268 feet (April 29th and September 29, 2021)

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%	N/A	N/A	N/A
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	N/A	N/A	N/A
				Totals	0	0	100%	N/A	N/A	N/A
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	9	9			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	9	9			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	9	9			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does NOT exceed 15%.	9	9			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	9	9			100%			

N/A - Item does not apply.

Table 5 cont'd. Visual Stream Morphology Stability Assessment
Harrell Mitigation Site - Harrell Reach 1D - Restoration P1
Assessed Length 223 feet (April 29th and September 29, 2021)

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%	N/A	N/A	N/A
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	N/A	N/A	N/A
				Totals	0	0	100%	N/A	N/A	N/A
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.					100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	3	3			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	3	3			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does NOT exceed 15%.	3	3			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	3	3			100%			

N/A - Item does not apply.

Table 6. Vegetation Condition Assessment Harrell Mitigation Site						
Planted Acreage: 4.46 (Assessed April 29th and Sept 29, 2021)						
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.	0.1 acres	n/a	0	0	0.00%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres		1	0.09	1.07%
			Total	1	0.09	1.07%
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	n/a	0	0	0.00%
			Cumulative Total	1	0.09	1.07%
Easement Acreage:	**8.43**					
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Easement Acreage**
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale). High Density	1000 SF		0	0	0.00%
	Areas or points (if too small to render as polygons at map scale). Low Density	1000 SF		5	0.19	2.25%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	n/a	0	0	0.00%

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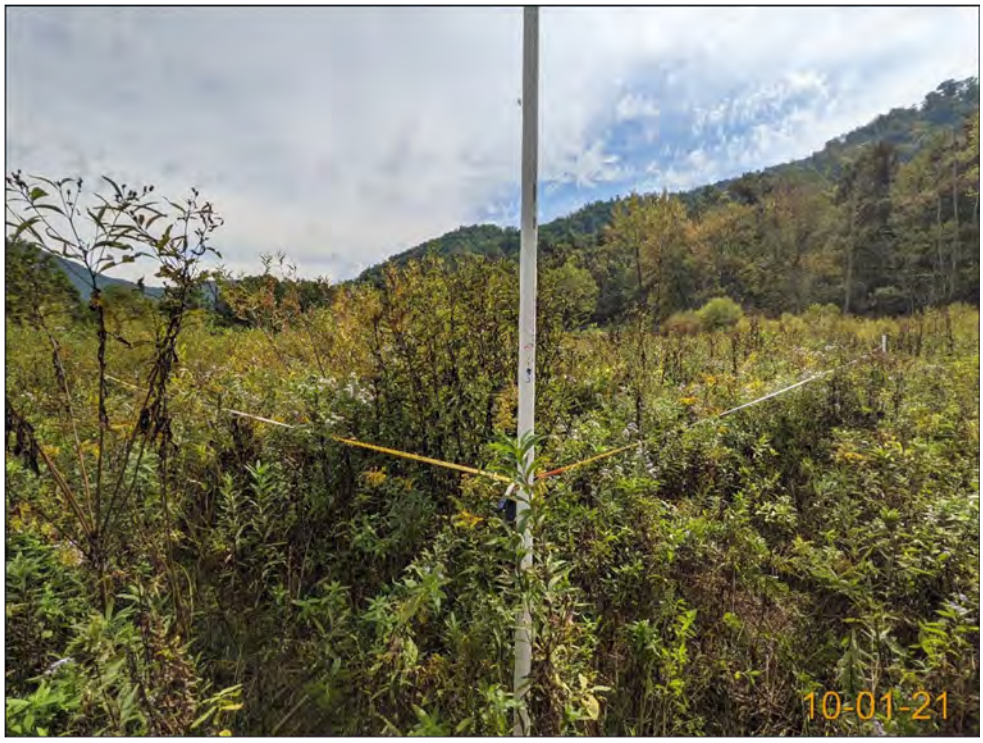
Vegetation Plot Photos

Vegetation Monitoring Plot 1

Vegetation Monitoring Plot 2



Vegetation Monitoring Plot 3

Vegetation Monitoring Plot 4

Vegetation Monitoring Plot 5

Permanent Photo Stations

Photo point #1, facing upstream at Reach 1A.

Photo point #1 supplemental, facing stormwater control measure along Reach 1A boundary.

Photo point #1, facing downstream at Reach 1B.

Photo point #1 supplemental, facing downstream at Reach 1B channel.

Photo point #2, facing upstream towards, Reach 1B.

Photo point #2, facing downstream, Reach 1C and Wetland B.

Photo point #2 supplemental, Reach 1C channel.

Photo point #3, facing upstream, Reach 1C and Wetland B

Photo point #3, facing downstream, Reach 1C and Wetland 1C.

Photo point #3 supplemental, facing upstream Reach 1C channel.

Photo point #4, facing upstream, Reach 1C and Wetland C.

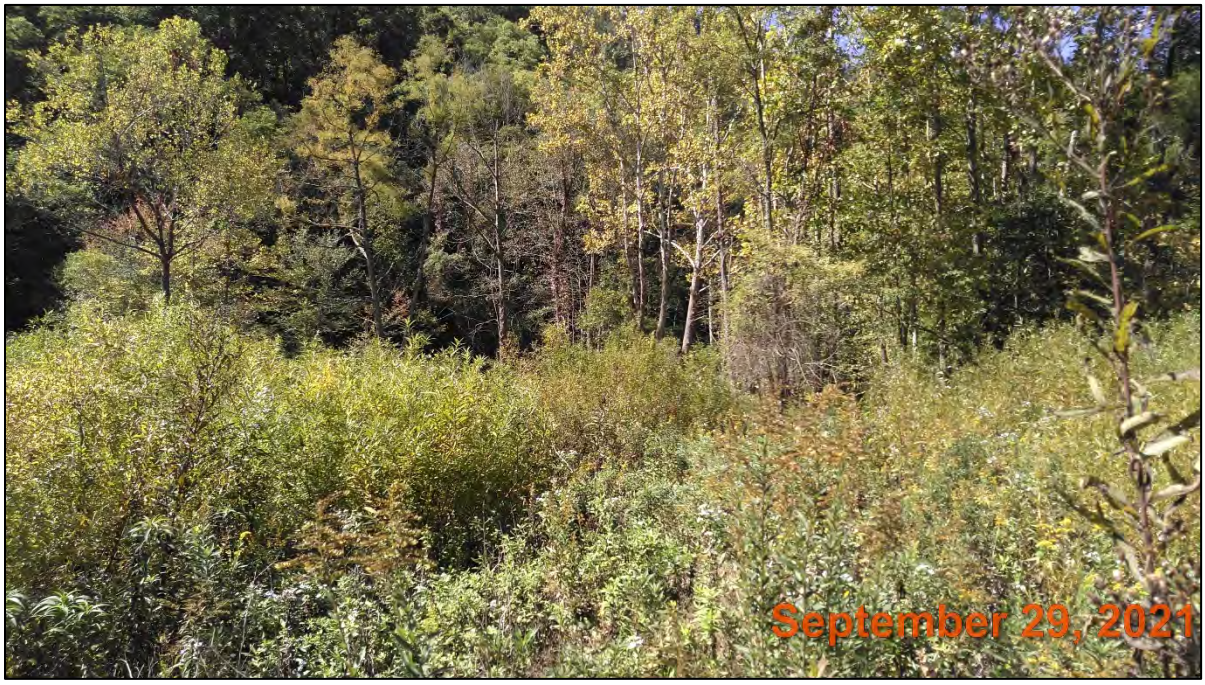


Photo point #4, facing downstream, Reach 1C and Wetland C.

Photo point #4 supplemental, facing downstream, Reach 1C channel.

Photo point #5, facing upstream, Reach 1C and Wetland C.

Photo point #5, facing downstream, Reach 1C and Wetland C.

Photo point #5 supplemental, facing upstream, Reach 1C channel.

Photo point #6, facing upstream, Reach 1C and Wetland C.

Photo point #6, facing downstream. Reach 1C and Wetland C.

Photo point #6 supplemental, facing upstream from XS3, Reach 1C channel.

Photo point #6 supplemental, facing upstream, Reach 1C channel.

Photo point #7, facing upstream from XS 5, Reach 1D.

Photo point #7, facing downstream from XS 5, Reach 1D.

Photo point #7 supplemental, facing downstream from XS 6, Reach 1D.

Photo point #8, facing upstream from Caney Fork Road, Reach 1D.

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Appendix C
Vegetation Plot Data

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https://ncdms.shinyapps.io/Veg_Table_Tool/

Planted Acreage	4.46
Date of Initial Plant	2020-01-15
Date(s) of Supplemental Plant(s)	2021-02-04
Date(s) Mowing	#N/A
Date of Current Survey	2021-10-01
Plot size (ACRES)	0.0247

Table 7a. Harrell Stream & Wetland Mitigation Site (100005) Vegetation Plot Table

	Scientific Name	Common Name	Tree/ Shrub	Indicator Status	Veg Plot 1 F		Veg Plot 2 F		Veg Plot 3 F		Veg Plot 4 F		Veg Plot 5 F		Veg Plot 1 R	Veg Plot 2 R	Veg Plot 3 R
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Total	Total	Total
Species Included in Approved Mitigation Plan	Alnus serrulata	hazel alder	Tree	OBL	5	5	2	2	1	1	2	2	5	5	3	2	
	Betula nigra	river birch	Tree	FACW							1	1	1	1		1	
	Cephalanthus occidentalis	common buttonbush	Shrub	OBL					2	2	2	2	1	1			3
	Cornus amomum	silky dogwood	Shrub	FACW	2	2	3	3	4	4	2	2	1	1	2	1	2
	Fraxinus pennsylvanica	green ash	Tree	FACW	2	2	3	3	3	3	1	1					
	Ilex verticillata	common winterberry	Tree	FACW	1	1					1	1	1	1			
	Lindera benzoin	northern spicebush	Tree	FAC													4
	Liriodendron tulipifera var. tulipifera	tuliptree	Tree	FACU											2	1	
	Salix nigra	black willow	Tree	OBL	2	2	2	2			2	2	4	4			
Sum	Performance Standard				12	12	10	10	10	10	11	11	13	13	7	5	9
Post Mitigation Plan Species	*Acer rubrum*	*red maple*	*Tree*	*FAC*													*1*
	Carya sp.																*1*
	Robinia pseudoacacia	*black locust*	*Tree*	*FACU*													*1*
Sum	Proposed Standard				12	12	10	10	10	10	11	11	13	13	7	5	9
Invasives	*Rosa multiflora*	*multiflora rose*	*Shrub*	*FACU*				*2*							*3*		*6*
Mitigation Plan Performance Standard	Current Year Stem Count					12		10		10		11		13	7	5	9
	Stems/Acre					486		405		405		445		526	283	202	364
	Species Count					5		4		4		7		6	3	4	3
	Dominant Species Composition (%)					42		25		40		18		38	30	40	33
	Average Plot Height					2		3		2		2		2	2	1	4
	% Invasives					0		17		0		0		0	30	0	40
Post Mitigation Plan Performance Standard	Current Year Stem Count					12		10		10		11		13	7	5	9
	Stems/Acre					486		405		405		445		526	283	202	364
	Species Count					5		4		4		7		6	3	4	3
	Dominant Species Composition (%)					42		25		40		18		38	30	40	33
	Average Plot Height					2		3		2		2		2	2	1	4
	% Invasives					0		17		0		0		0	30	0	40

1). Bolded species are proposed for the current monitoring year, italicized species are not approved, and a regular font indicates that the species has been approved.
2). The "Species Included in Approved Mitigation Plan" section contains only those species that were included in the original approved mitigation plan. The "Post Mitigation Plan Species" section includes species that are being proposed through a mitigation plan addendum for the current monitoring year (bolded) , species that have been approved in prior monitoring years through a mitigation plan addendum (regular font), and species that are not approved (italicized).
3). The "Mitigation Plan Performance Standard" section is derived only from stems included in the original mitigation plan, whereas the "Post Mitigation Plan Performance Standard" includes data from mitigation plan approved, post mitigation plan approved, and proposed stems.

Table 7b. Harrell Stream & Wetland Mitigation Site (100005) Vegetation Performance Standards Summary Table

	Veg Plot 1 F				Veg Plot 2 F				Veg Plot 3 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2	486		5	0	405		4	17	405		4	0
Monitoring Year 1	445		6	0	526		6	0	405		4	0
Monitoring Year 0	486		6	0	526		6	0	445		4	0
	Veg Plot 4 F				Veg Plot 5 F				Veg Plot Group 1 R			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2	445		7	0	526		6	0	283		3	30
Monitoring Year 1	202		3	0	769		7	0				
Monitoring Year 0	1052		9	0	972		7	0				
	Veg Plot Group 2 R				Veg Plot Group 3 R							
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives				
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2	202		4	0	364		3	40				
Monitoring Year 1												
Monitoring Year 0												

*Each monitoring year represents a different plot for the random vegetation plot "groups". Random plots are denoted with an R, and fixed plots with an F.

Appendix D
Stream Measurement and Geomorphology Data

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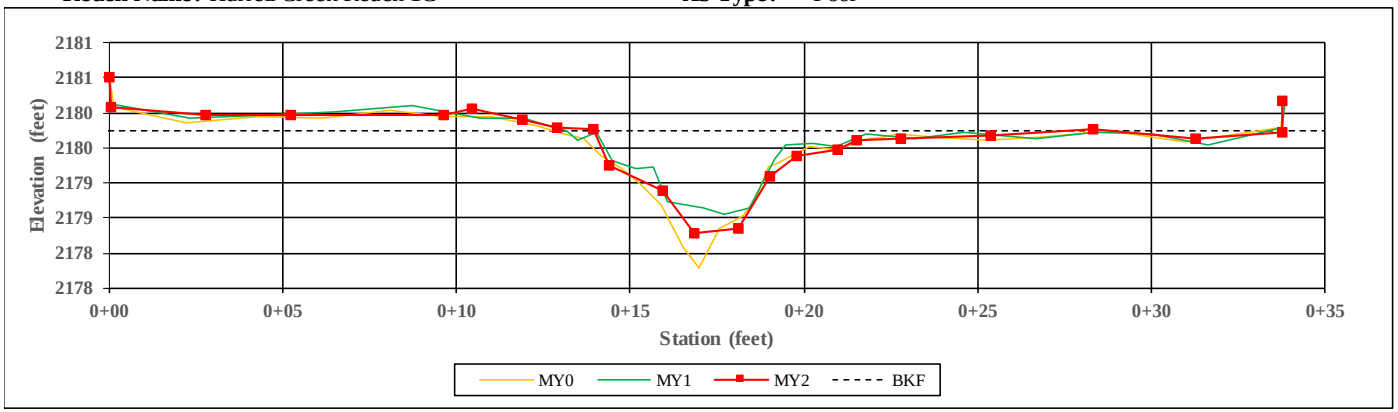
Project Name: Harrell Stream & Wetland **XS Number:** 1 **Station:** 107+75

Reach Name: Harrell Creek Reach 1C **XS Type:** Pool



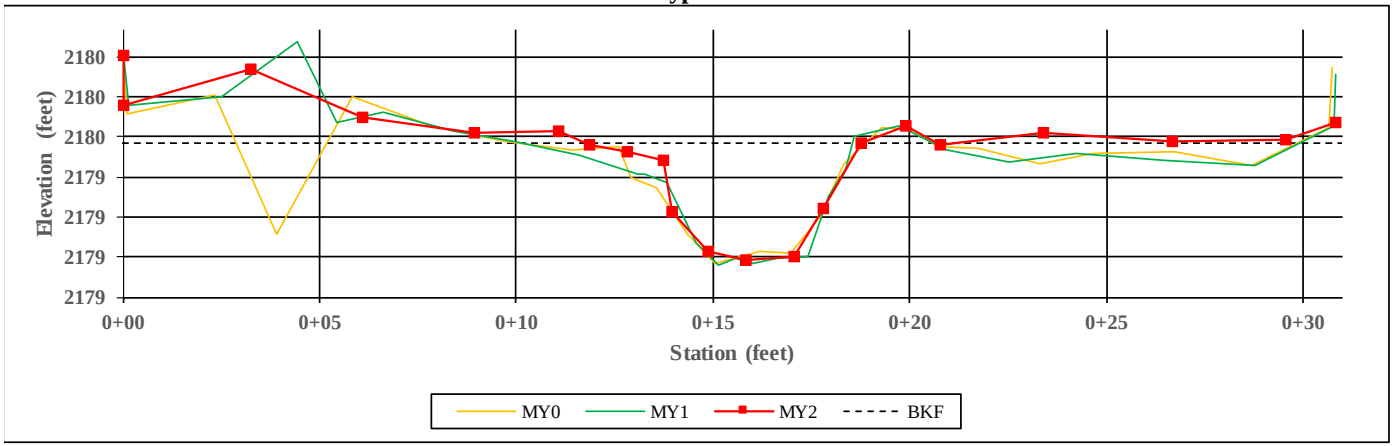
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	9.6	20.4	11.0	-	-	-	-	-
Floodprone Width (ft)	50.0	50.0	50.0	-	-	-	-	-
Bankfull Mean Depth (ft)	0.6	0.3	0.6	-	-	-	-	-
Bankfull Max Depth (ft)	1.9	1.2	1.5	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	6.0	6.0	6.0	-	-	-	-	-
Width/Depth Ratio	15.2	69.1	19.9	-	-	-	-	-
Entrenchment Ratio	5.2	2.5	4.6	-	-	-	-	-
Bank Height Ratio	1.0	0.9	0.9	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Harrell Stream & Wetland **XS Number:** 2 **Station:** 107+88

Reach Name: Harrell Creek Reach 1C **XS Type:** Riffle



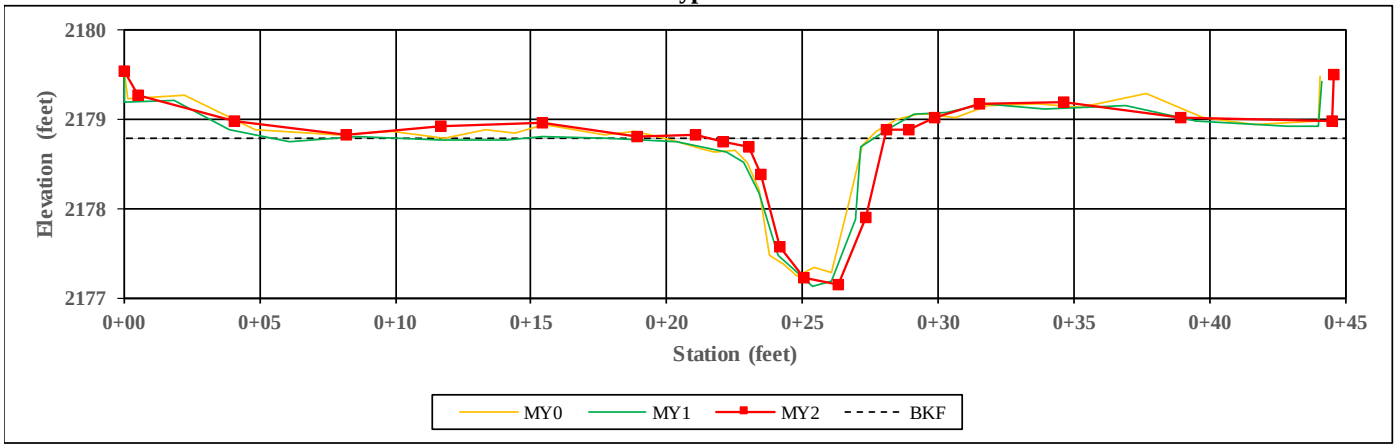
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	6.2	6.8	6.9	-	-	-	-	-
Floodprone Width (ft)	50.0	50.0	50.0	-	-	-	-	-
Bankfull Mean Depth (ft)	0.6	0.5	0.5	-	-	-	-	-
Bankfull Max Depth (ft)	0.9	0.9	0.9	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	3.4	3.4	3.4	-	-	-	-	-
Width/Depth Ratio	11.2	13.7	14.1	-	-	-	-	-
Entrenchment Ratio	8.1	7.4	7.2	-	-	-	-	-
Bank Height Ratio	1.1	1.2	1.1	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Harrell Stream & Wetland **XS Number:** 3 **Station:** 112+76

Reach Name: Harrell Creek Reach 1C **XS Type:** Pool



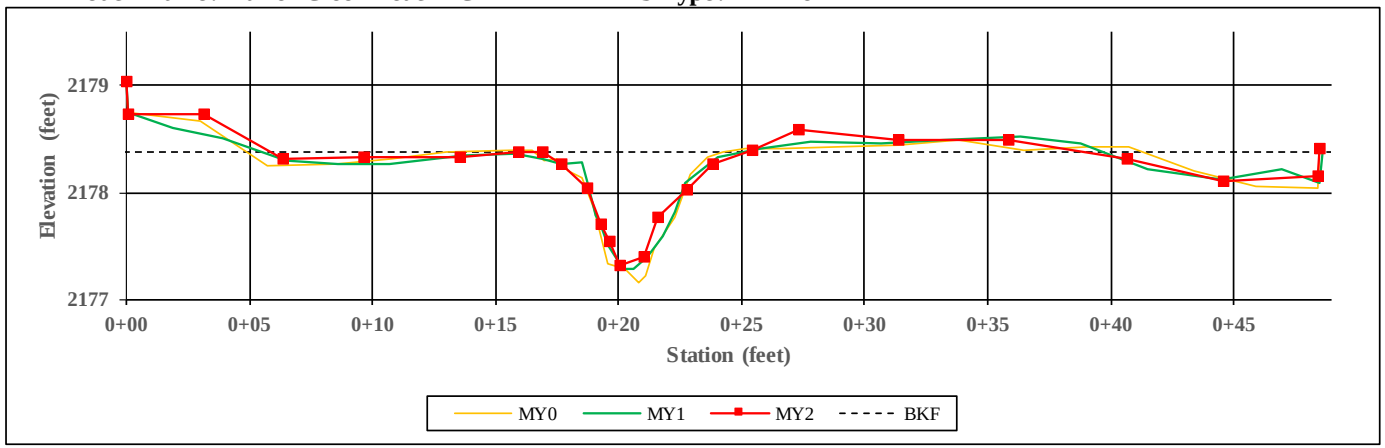
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	5.2	6.8	5.3	-	-	-	-	-
Floodprone Width (ft)	50.0	50.0	50.0	-	-	-	-	-
Bankfull Mean Depth (ft)	1.0	0.8	1.0	-	-	-	-	-
Bankfull Max Depth (ft)	1.6	1.6	1.6	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	5.3	5.3	5.3	-	-	-	-	-
Width/Depth Ratio	5.1	8.8	5.2	-	-	-	-	-
Entrenchment Ratio	9.6	7.4	9.5	-	-	-	-	-
Bank Height Ratio	1.1	1.0	1.0	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Harrell Stream & Wetland **XS Number:** 4 **Station:** 112+90

Reach Name: Harrell Creek Reach 1C **XS Type:** Riffle



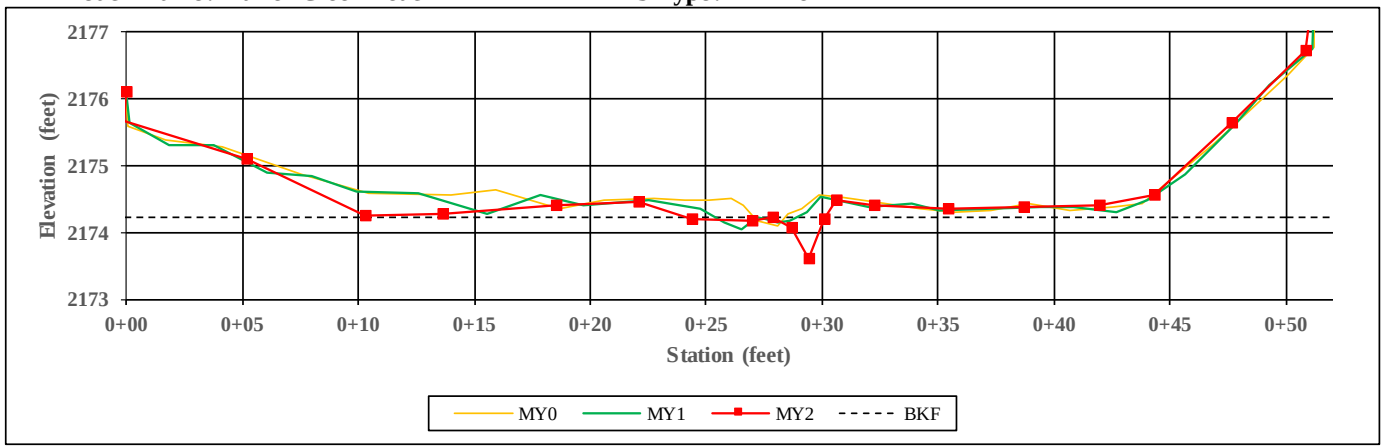
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	6.8	7.1	6.9	-	-	-	-	-
Floodprone Width (ft)	50.0	50.0	50.0	-	-	-	-	-
Bankfull Mean Depth (ft)	0.5	0.5	0.5	-	-	-	-	-
Bankfull Max Depth (ft)	1.2	1.1	1.1	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	3.6	3.6	3.6	-	-	-	-	-
Width/Depth Ratio	12.6	14.2	13.4	-	-	-	-	-
Entrenchment Ratio	14.8	7.0	7.2	-	-	-	-	-
Bank Height Ratio	1.0	1.0	1.0	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Harrell Stream & Wetland **XS Number:** 5 **Station:** 116+36

Reach Name: Harrell Creek Reach 1D **XS Type:** Riffle



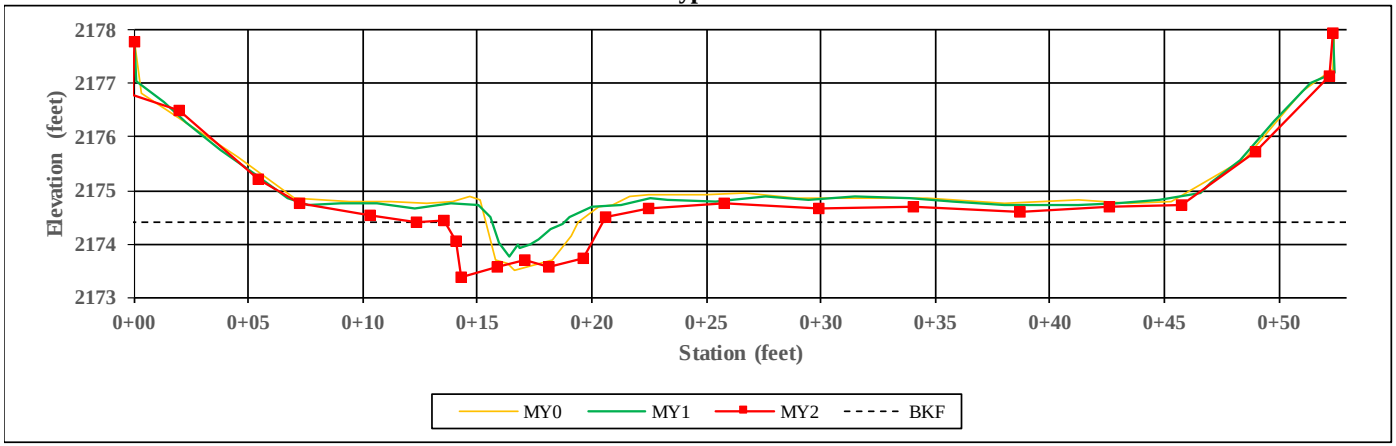
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	2.5	4.4	5.8	-	-	-	-	-
Floodprone Width (ft)	33.4	33.4	33.4	-	-	-	-	-
Bankfull Mean Depth (ft)	0.3	0.2	0.1	-	-	-	-	-
Bankfull Max Depth (ft)	0.4	0.3	0.6	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	0.7	0.7	0.7	-	-	-	-	-
Width/Depth Ratio	8.6	29.6	46.4	-	-	-	-	-
Entrenchment Ratio	13.2	7.5	5.8	-	-	-	-	-
Bank Height Ratio	1.0	1.1	1.4	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Harrell Stream & Wetland **XS Number:** 6 **Station:** 116+65

Reach Name: Harrell Creek Reach 1D **XS Type:** Pool



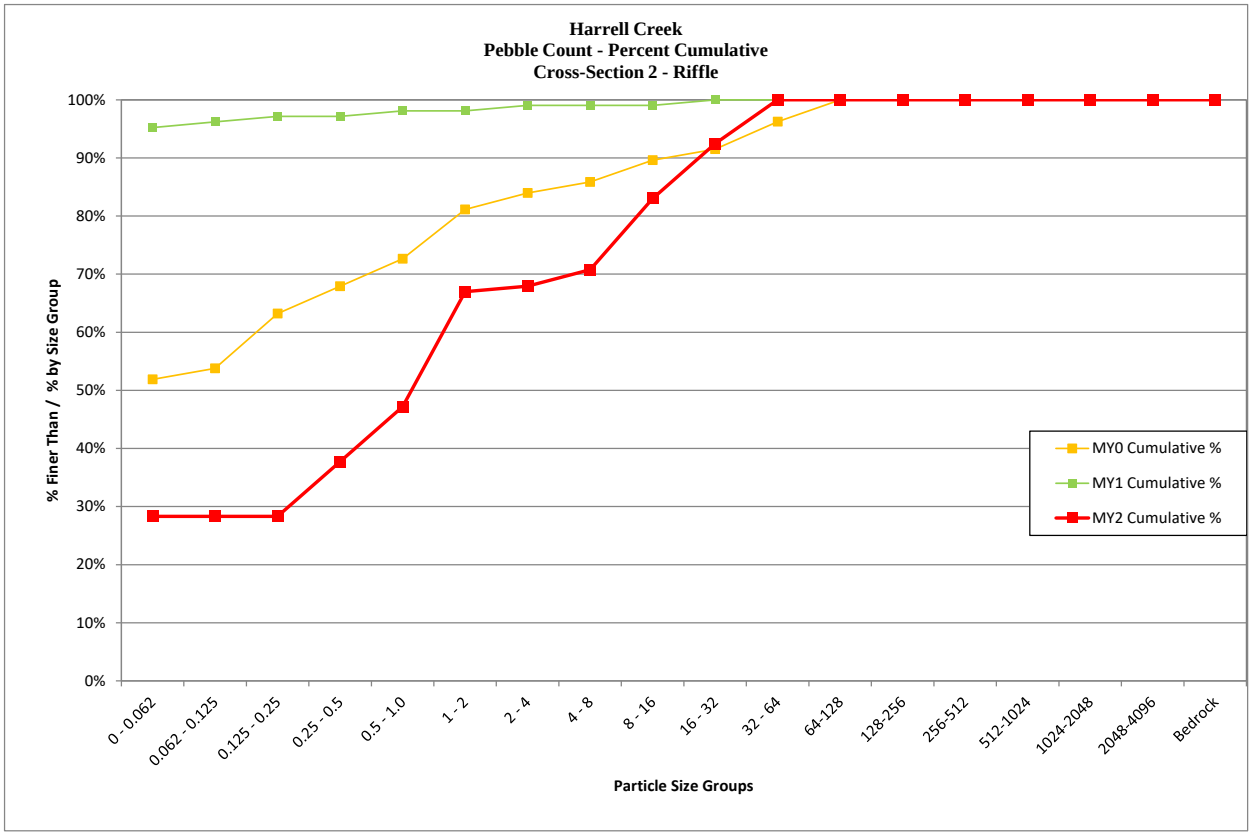
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	6.1	20.0	5.5	-	-	-	-	-
Floodprone Width (ft)	38.3	38.3	38.3	-	-	-	-	-
Bankfull Mean Depth (ft)	0.7	0.2	0.8	-	-	-	-	-
Bankfull Max Depth (ft)	1.3	1.1	1.0	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	4.5	4.5	4.5	-	-	-	-	-
Width/Depth Ratio	8.3	89.9	6.8	-	-	-	-	-
Entrenchment Ratio	6.3	1.9	6.9	-	-	-	-	-
Bank Height Ratio	1.0	0.9	1.0	-	-	-	-	-

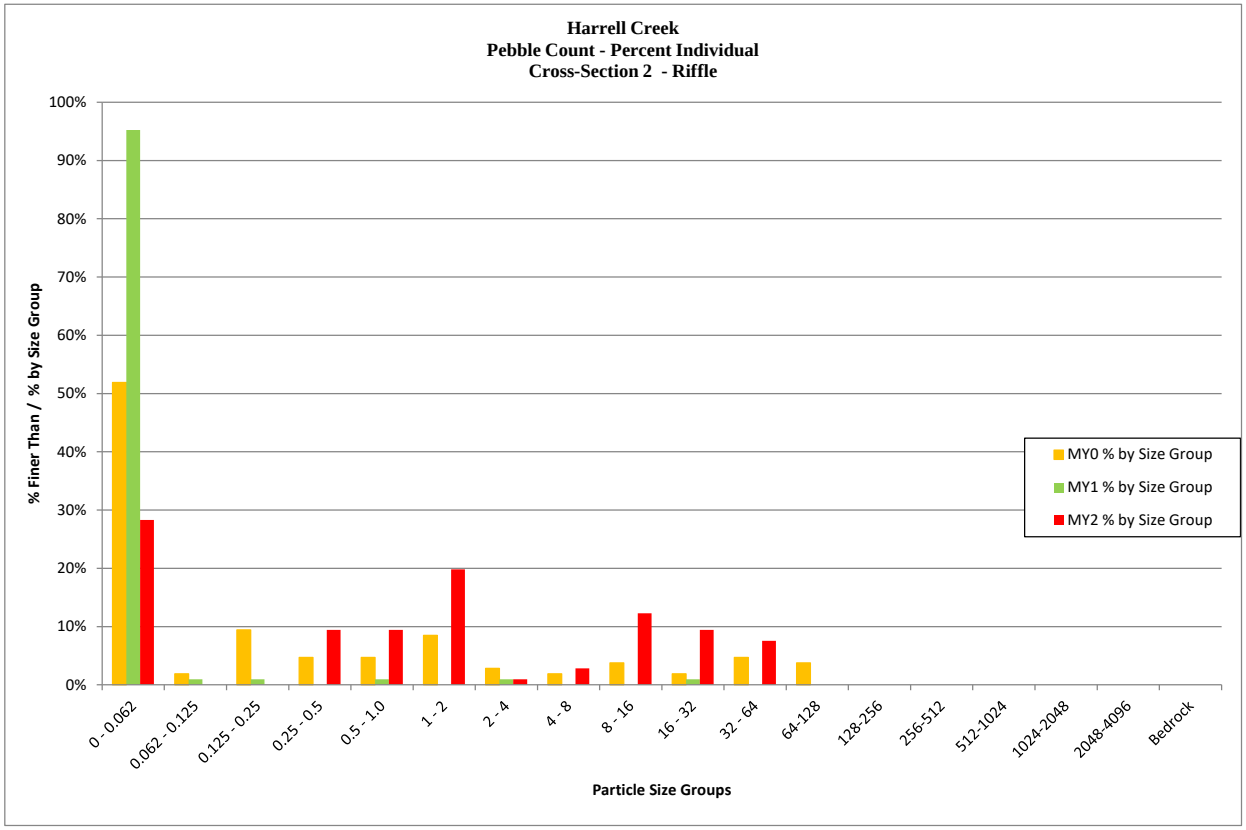
Left Descending Bank

Right Descending Bank

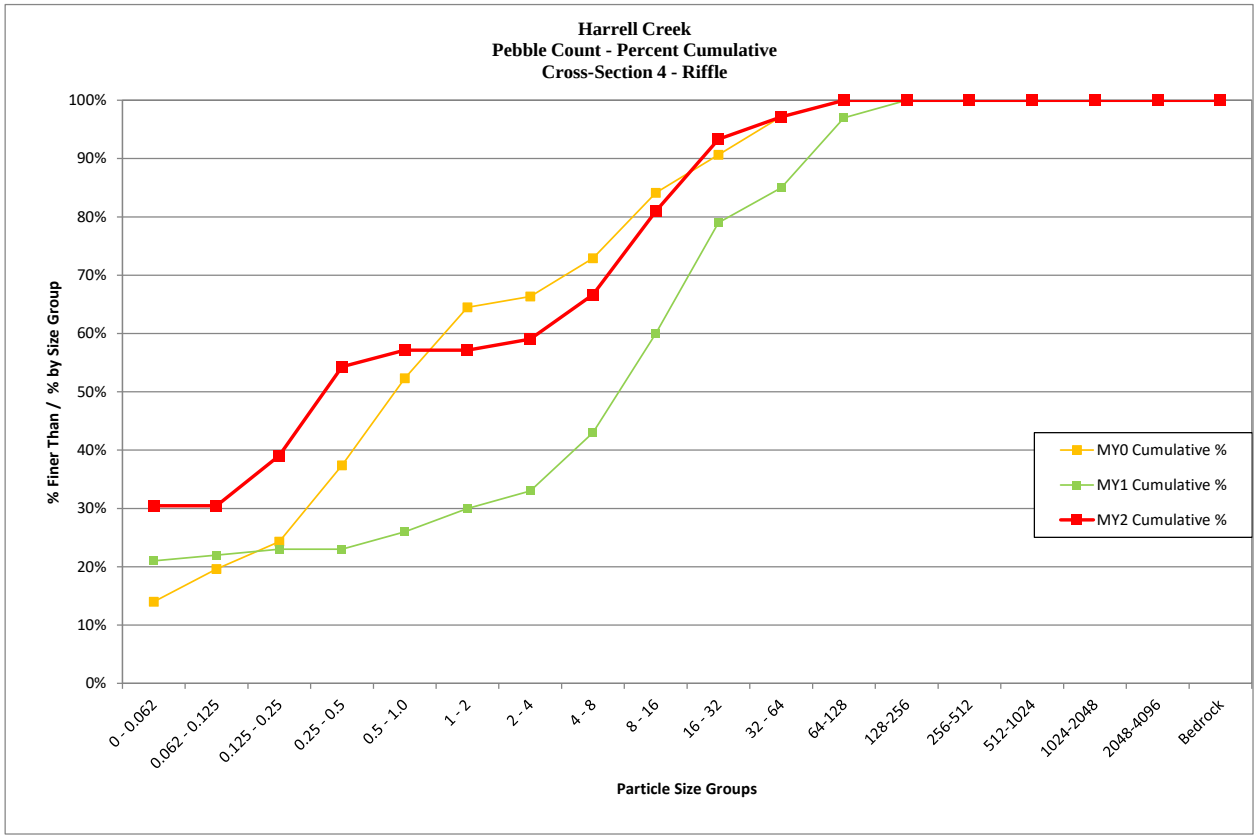
Harrell			
Cross Section 2 - Riffle			
Monitoring Year - 2021; MY2			
Bed Surface Material Particle Size Class (mm)	**Number**	**% Individual**	**% Cumulative**
0 - 0.062	30	28.3%	28%
0.062 - 0.125	0	0.0%	28%
0.125 - 0.25	0	0.0%	28%
0.25 - 0.5	10	9.4%	38%
0.5 - 1.0	10	9.4%	47%
1 - 2	21	19.8%	67%
2 - 4	1	0.9%	68%
4 - 8	3	2.8%	71%
8 - 16	13	12.3%	83%
16 - 32	10	9.4%	92%
32 - 64	8	7.5%	100%
64-128	0	0.0%	100%
128-256	0	0.0%	100%
256-512	0	0.0%	100%
512-1024	0	0.0%	100%
1024-2048	0	0.0%	100%
2048-4096	0	0.0%	100%
Bedrock	0	0.0%	100%
Total	**106**	**100%**	**100%**

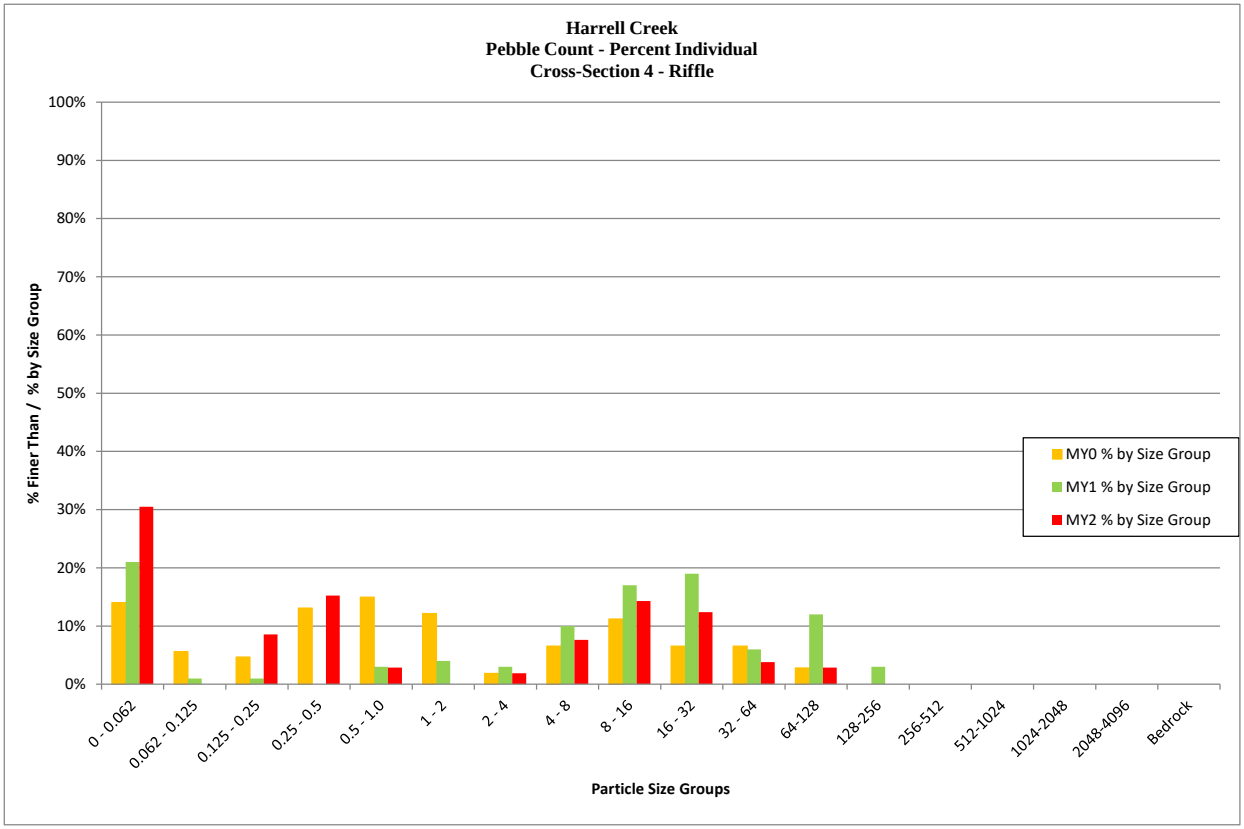
Summary Data	
D50	**1.1**
D84	**17**
D95	**36**


Harrell Creek
Pebble Count - Percent Cumulative
Cross-Section 2 - Riffle
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% Finer Than / % by Size Group
MY0 Cumulative %
MY1 Cumulative %
MY2 Cumulative %
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups

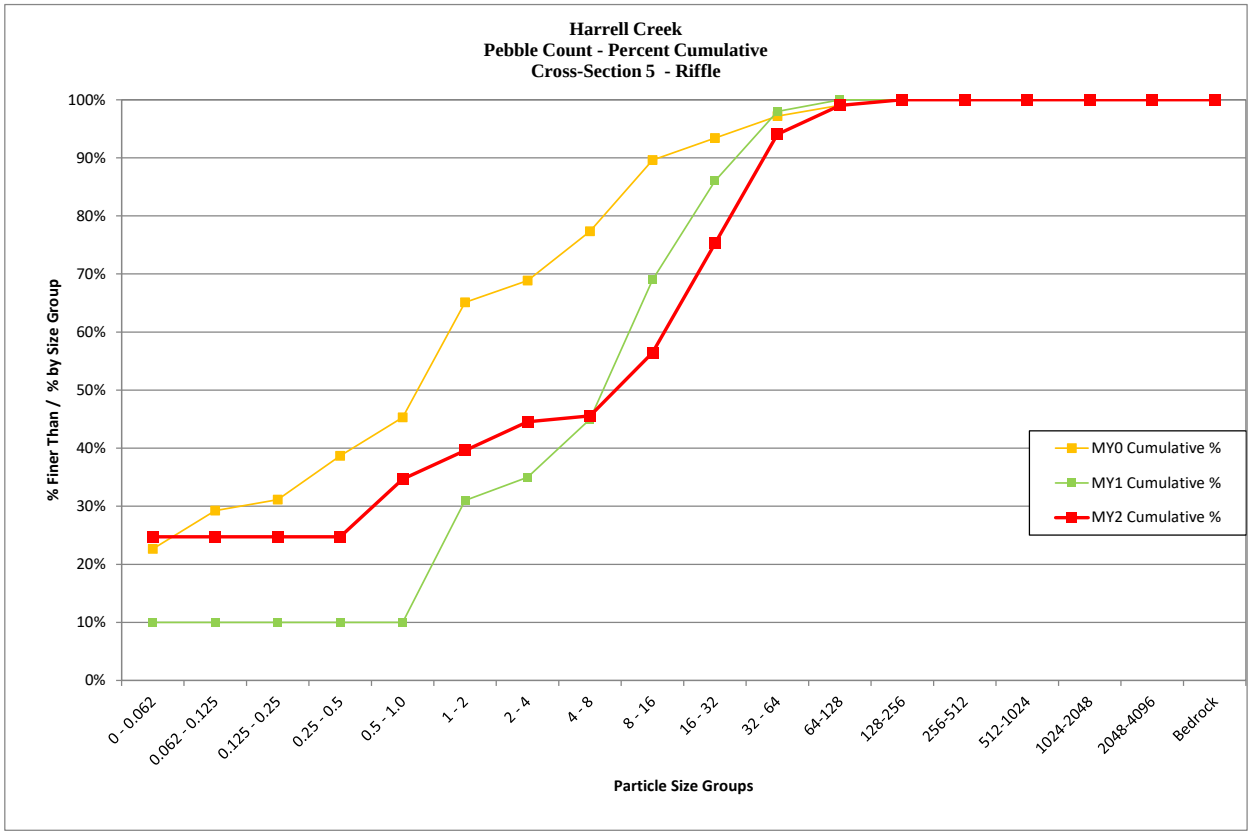

Harrell Creek
Pebble Count - Percent Individual
Cross-Section 2 - Riffle
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% Finer Than / % by Size Group
MY0 % by Size Group
MY1 % by Size Group
MY2 % by Size Group
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups

Harrell			
Cross Section 4 - Riffle			
Monitoring Year - 2021; MY2			
Bed Surface Material Particle Size Class (mm)	**Number**	**% Individual**	**% Cumulative**
0 - 0.062	32	30.5%	30%
0.062 - 0.125	0	0.0%	30%
0.125 - 0.25	9	8.6%	39%
0.25 - 0.5	16	15.2%	54%
0.5 - 1.0	3	2.9%	57%
1 - 2	0	0.0%	57%
2 - 4	2	1.9%	59%
4 - 8	8	7.6%	67%
8 - 16	15	14.3%	81%
16 - 32	13	12.4%	93%
32 - 64	4	3.8%	97%
64-128	3	2.9%	100%
128-256	0	0.0%	100%
256-512	0	0.0%	100%
512-1024	0	0.0%	100%
1024-2048	0	0.0%	100%
2048-4096	0	0.0%	100%
Bedrock	0	0.0%	100%
Total	**105**	**100%**	**100%**
		Summary Data	
		D50	**0.41**
		D84	**18**
		D95	**49**


Harrell Creek
Pebble Count - Percent Cumulative
Cross-Section 4 - Riffle
% Finer Than / % by Size Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups
MY0 Cumulative %
MY1 Cumulative %
MY2 Cumulative %


Harrell Creek
Pebble Count - Percent Individual
Cross-Section 4 - Riffle
% Finer Than / % by Size Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups
MY0 % by Size Group
MY1 % by Size Group
MY2 % by Size Group

Harrell			
Cross Section 5 - Riffle			
Monitoring Year - 2021; MY2			
Bed Surface Material Particle Size Class (mm)	**Number**	**% Individual**	**% Cumulative**
0 - 0.062	25	24.8%	25%
0.062 - 0.125	0	0.0%	25%
0.125 - 0.25	0	0.0%	25%
0.25 - 0.5	0	0.0%	25%
0.5 - 1.0	10	9.9%	35%
1 - 2	5	5.0%	40%
2 - 4	5	5.0%	45%
4 - 8	1	1.0%	46%
8 - 16	11	10.9%	56%
16 - 32	19	18.8%	75%
32 - 64	19	18.8%	94%
64-128	5	5.0%	99%
128-256	1	1.0%	100%
256-512	0	0.0%	100%
512-1024	0	0.0%	100%
1024-2048	0	0.0%	100%
2048-4096	0	0.0%	100%
Bedrock	0	0.0%	100%
Total	**101**	**100%**	**100%**
		Summary Data	
		D50	**12**
		D84	**42**
		D95	**88**


Harrell Creek
Pebble Count - Percent Cumulative
Cross-Section 5 - Riffle
% Finer Than / % by Size Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups
MY0 Cumulative %
MY1 Cumulative %
MY2 Cumulative %

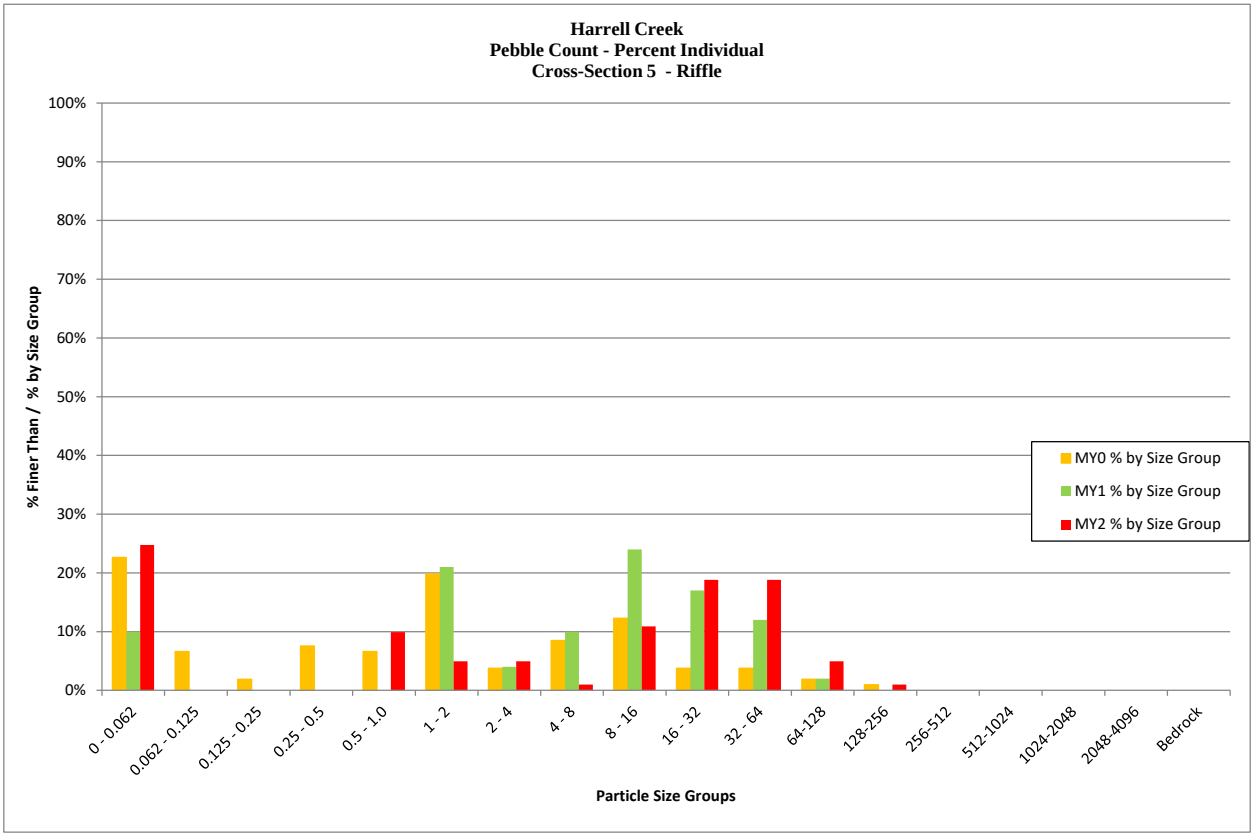

Harrell Creek
Pebble Count - Percent Individual
Cross-Section 5 - Riffle
% Finer Than / % by Size Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups
MY0 % by Size Group
MY1 % by Size Group
MY2 % by Size Group

Table 8. Baseline Stream Data Summary
Harrell Mitigation Site - Harrell Creek Reach 1C (1,189 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-Built / Baseline					
Dimension & Substrate - Riffle	**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**
Bankfull Width (ft)	-	-	-	4.1	7.1	5.0	10.0	3.7	5	6.3	8.5	-	10.7	-	-	-	4.1	-	6.2	6.5	-	6.8	0.4	2
Floodprone Width (ft)	-	-	-	11.0	13.4	13.0	13.0	1.8	5	25.0	32.2	-	40	-	-	-	>50	-	50.0	50.0	-	50.0	0.0	2
Bankfull Mean Depth (ft)	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	0.7	-	0.5	0.6	-	0.6	0.1	2
Bankfull Max Depth (ft)	-	-	-	0.2	0.6	0.6	0.9	0.3	5	1.2	1.4	-	1.6	-	-	-	0.9	-	0.9	1.0	-	1.2	0.2	2
Bankfull Cross Sectional Area (ft^2)	-			1.9	2.4	2.3	3.7	0.7	5	8.8	8.8	-	10	-	-	-	2.7	-	3.4	3.5	-	3.6	0.1	2
Width/Depth Ratio	-	-	-	7.4	26.6	13.4	77.8	29.7	5	5.2	8.4	-	10.5	-	-	-	6.1	-	11.2	11.9	-	12.6	1.0	2
Entrenchment Ratio	-	-	-	1.3	2.2	2.5	2.6	0.9	5	2.5	3.5	-	3.8	-	-	-	8.6	-	8.1	11.4	-	14.8	4.7	2
Bank Height Ratio	-	-	-	1.0	1.7	1.7	2.0	0.4	5	0.8	1.0	-	1.1	-	-	-	1.0	-	1.0	1.1	-	1.1	0.1	2
d50 (mm)	-	-	-	-	-	-	-	-	-	-	13.0	-	-	-	-	-	-	-	0.1	0.5	-	0.9	0.59	2
Profile																								
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	4.0	6.6	-	10.0	-	-	-	-	-	4.5	11.6	9.8	34.0	6.2	35
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	0.9	2.2	-	4.0	-	-	0.004	-	0.06	1.156	1.321	0.000	1.725	0.167	35
Pool Length (ft)	-	-	-	-	-	-	-	-	-	3.0	15.2	-	23.0	-	-	-	-	-	3.3	10.6	0.0	38.5	6.0	56
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.9	1.8	0.0	2.9	0.4	60
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	0.8	1.6	-	2.5	-	-	8.2	10.9	13.6	1.0	18.7	0.0	41.0	7.8	64
Pattern																								
Channel Belt Width (ft)	-	-	-	-	-	-	-	-	-	20.0	33.0	-	53.0	-	-	-	-	-	2.7	8.7	8.0	29.4	4.1	52
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	7.5	11.2	-	15.0	-	-	-	18.0	-	16.8	17.8	17.6	19.2	0.9	8
Rc: Bankfull Width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.6	2.8	2.7	3.0	0.1	8
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	25.0	41.0	-	56.0	-	-	-	-	-	24.6	37.7	38.7	58.3	7.9	30
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.1	-	0.4	1.3	1.2	4.5	0.6	8
Substrate, Bed and Transport Parameters																								
Reach Shear Stress (Competency) lb/ft^2	-			-						-						-			-					
Max Part Size (mm) Mobilized at Bankfull	-			-						-						-			-					
Stream Power (Transport Capacity) W/m^2	-			-						-						-			-					
Additional Reach Parameters																								
Drainage Area (mi^2)	-			0.16						0.25						0.16			0.16					
Rosgen Classification	-			E						E;F						E4			E4					
Bankfull Velocity (fps)	-			-						-						-			-					
Bankfull Discharge (cfs)	-			-						-						13.0			-					
Valley Length (ft)	-			-						-						-			1,000					
Channel Thalweg Length (ft)	-			-						-						-			1,189					
Sinuosity	-			-						1.63						1.25			1.19					
Water Surface Slope (ft/ft)	-			-						-						0.005			0.005					
Bankfull Slope (ft/ft)	-			-						-						0.008			0.005					
Bankfull Floodplain Area (acres)	-			-						-						-			-					
% of Reach with Eroding Banks	-			-						-						-			-					
Channel Stability or Habitat Metric	-			-						-						-			-					
Biological or Other	-			-						-						-			-					

Table 8. Baseline Stream Data Summary
Harrell Mitigation Site - Harrell Creek Reach 1D (294 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-Built / Baseline					
Dimension & Substrate - Riffle	**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**
Bankfull Width (ft)	-	-	-	2.9	-	-	2.9	-	1	6.3	8.5	-	10.7	-	-	-	4.2	-	2.5	-	-	2.5	0.0	1
Floodprone Width (ft)	-	-	-	35.0	-	-	35.0	-	1	25.0	32.2	-	40	-	-	-	>50	-	33.4	-	-	33.4	0.0	1
Bankfull Mean Depth (ft)	-	-	-	0.7	-	-	0.7	-	1	-	-	-	-	-	-	-	1.6	-	0.3	-	-	0.3	0.0	1
Bankfull Max Depth (ft)	-	-	-	1.0	-	-	1.0	-	1	1.2	1.4	-	1.6	-	-	-	2.3	-	0.4	-	-	0.4	0.0	1
Bankfull Cross Sectional Area (ft^2)	-			2.4	-	-	2.4	-	1	8.8	8.8	-	10	-	-	-	2.8	-	0.7	-	-	0.7	0.0	1
Width/Depth Ratio	-	-	-	3.5	-	-	3.5	-	1	5.2	8.4	-	10.5	-	-	-	6.1	-	8.6	-	-	8.6	0.0	1
Entrenchment Ratio	-	-	-	12.1	-	-	12.1	-	1	2.5	3.5	-	3.8	-	-	-	8.4	-	13.2	-	-	13.2	0.0	1
Bank Height Ratio	-	-	-	1.0	-	-	1.0	-	1	0.8	1.0	-	1.1	-	-	-	1.0	-	1.0	-	-	1.0	0.0	1
d50 (mm)	-	-	-	-	-	-	-	-	-	-	13.0	-	-	-	-	-	-	-	1.2	-	-	1.2	0	1
Profile																								
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	4.0	6.6	-	10.0	-	-	4.0	6.6	-	10.0	-	-	27.0	7.2	35
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	0.9	2.2	-	4.0	-	-	0.9	2.2	-	4.0	-	-	0.97	0.03	35
Pool Length (ft)	-	-	-	-	-	-	-	-	-	3.0	15.2	-	23.0	-	-	3.0	15.2	-	23.0	-	-	48.5	23.3	2
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4	0.2	2
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	0.8	1.6	-	2.5	-	-	0.8	1.6	-	2.5	-	-	72.0	n/a	1
Pattern																								
Channel Belt Width (ft)	-	-	-	-	-	-	-	-	-	20.0	33.0	-	53.0	-	-	-	-	-	53.0	-	-	15.4	1.1	3
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	7.5	11.2	-	15.0	-	-	-	18.0	-	15.0	-	-	22.0	0.2	2
Rc: Bankfull Width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.8	0.1	2
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	25.0	41.0	-	56.0	-	-	-	-	-	56.0	-	-	102.9	19.7	5
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.1	-	-	-	-	6.2	0.4	2
Substrate, Bed and Transport Parameters																								
Reach Shear Stress (Competency) lb/ft^2	-			-						-						-			-					
Max Part Size (mm) Mobilized at Bankfull	-			-						-						-			-					
Stream Power (Transport Capacity) W/m^2	-			-						-						-			-					
Additional Reach Parameters																								
Drainage Area (mi^2)	-			0.17						0.25						0.17			0.17					
Rosgen Classification	-			E						E;F						E4			E4					
Bankfull Velocity (fps)	-			-						-						-			-					
Bankfull Discharge (cfs)	-			-						-						14			-					
Valley Length (ft)	-			-						-						-			275					
Channel Thalweg Length (ft)	-			-						-						-			294					
Sinuosity	-			-						1.63						1.06			1.07					
Water Surface Slope (ft/ft)	-			-						-						0.003			0.005					
Bankfull Slope (ft/ft)	-			-						-						0.003			0.006					
Bankfull Floodplain Area (acres)	-			-						-						-			-					
% of Reach with Eroding Banks	-			-						-						-			-					
Channel Stability or Habitat Metric	-			-						-						-			-					
Biological or Other	-			-						-						-			-					

^ Channel Centerline (ft): Based on stream centerline stationing from design stream stationing; accounts for breaks in conservation easement and utility right-of-ways.

- Information unavailable.

Non-Applicable.

Table 9a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Harrell Mitigation Site

	Cross Section 1 (Pool) Harrell Creek Reach 1C								Cross Section 2 (Riffle) Harrell Creek Reach 1C								Cross Section 3 (Pool) Harrell Creek Reach 1C							
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Record Elevation (datum) Used	2179.7	2179.8	2179.7						2179.6	2179.6	2179.7						2178.4	2178.3	2178.3					
Low Bank Height Elevation (datum) Used	2179.7	2179.7	2179.6						2179.8	2179.8	2179.8						2178.6	2178.3	2178.3					
Bankfull Width (ft)	9.6	20.4	11.0						6.2	6.8	6.9						5.2	6.8	5.3					
Floodprone Width (ft)	50.0	50.0	50.0						50.0	50.0	50.0						50.0	50.0	50.0					
Bankfull Mean Depth (ft)	0.6	0.3	0.6						0.6	0.5	0.5						1.0	0.8	1.0					
Bankfull Max Depth (ft)	1.9	1.2	1.5						0.9	0.9	0.9						1.6	1.6	1.6					
Bankfull Cross Sectional Area (ft^2)	6.0	6.0	6.0						3.4	3.4	3.4						5.3	5.3	5.3					
Bankfull Width/Depth Ratio	15.2	69.1	19.9						11.2	13.7	14.1						5.1	8.8	5.2					
Bankfull Entrenchment Ratio	5.2	2.5	4.6						8.1	7.4	7.2						9.6	7.4	9.5					
Bankfull Bank Height Ratio	1.0	0.9	0.9						1.1	1.2	1.1						1.1	1.0	1.0					
Low Top of Bank Depth (ft)	1.9	1.1	1.3						1.0	1.0	1.0						1.8	1.6	1.7					
	Cross Section 4 (Riffle) Harrell Creek Reach 1C								**Cross Section 5 (Riffle) Harrell Creek Reach 1D**								**Cross Section 6 (Pool) Harrell Creek Reach 1D**							
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Record Elevation (datum) Used	2178.3	2178.4	2178.4						2174.5	2174.3	2174.2						2174.3	2174.4	2173.9					
Low Bank Height Elevation (datum) Used	2178.3	2178.4	2178.4						2174.5	2174.4	2174.5						2174.3	2174.3	2173.9					
Bankfull Width (ft)	6.8	7.1	6.9						2.5	4.4	5.8						6.1	20.0	5.5					
Floodprone Width (ft)	50.0	50.0	50.0						33.4	33.4	33.4						38.3	38.3	38.3					
Bankfull Mean Depth (ft)	0.5	0.5	0.5						0.3	0.2	0.1						0.7	0.2	0.8					
Bankfull Max Depth (ft)	1.2	1.1	1.1						0.4	0.3	0.6						1.3	1.1	1.0					
Bankfull Cross Sectional Area (ft^2)	3.6	3.6	3.6						0.7	0.7	0.7						4.5	4.5	4.5					
Bankfull Width/Depth Ratio	12.6	14.2	13.4						8.6	29.6	46.4						8.3	89.9	6.8					
Bankfull Entrenchment Ratio	14.8	7.0	7.2						13.2	7.5	5.8						6.3	1.9	6.9					
Bankfull Bank Height Ratio	1.0	1.0	1.0						1.0	1.1	1.4						1.0	0.9	1.0					
Low Top of Bank Depth (ft)	1.2	1.1	1.1						0.4	0.3	0.8						1.3	1.0	1.1					

- Information Unavailable

N/A - Information does not apply.

Table 9b Cont'd. Monitoring Data - Stream Reach Data Summary
Harrell Reach 1C (1,189 feet)

Parameter	Baseline						MY - 1						MY - 2						MY - 3						MY - 5						MY - 7					
Dimension & Substrate - Riffle	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**
Bankfull Width (ft)	6.2	6.5	-	6.8	0.4	2	6.8	6.9	-	7.1	0.2	2	6.9	0.0	-	6.9	0.0	2																		
Floodprone Width (ft)	50.0	50.0	-	50.0	0.0	2	50	50.0	-	50	0.0	2	50	50	-	50	0.0	2																		
Bankfull Mean Depth (ft)	0.5	0.6	-	0.6	0.1	2	0.5	0.5	-	0.5	0.0	2	0.5	0.5	-	0.5	0.0	2																		
Bankfull Max Depth (ft)	0.9	1.0	-	1.2	0.2	2	0.9	1.0	-	1.1	0.2	2	1.0	3.5	-	0.9	0.1	2																		
Bankfull Cross-Sectional Area (ft^2)	3.4	3.5	-	3.6	0.1	2	3.4	3.5	-	3.6	0.1	2	3.4	3.5		3.5	0.1	2																		
Width/Depth Ratio	11.2	11.9	-	12.6	1.0	2	13.7	13.9	-	14.2	0.3	2	13.4	13.7	-	14.1	0.5	2																		
Entrenchment Ratio	8.1	11.4	-	14.8	4.7	2	7.0	7.2	-	7.4	0.2	2	7.2	7.2	-	7.2	0.0	2																		
Bank Height Ratio	1.0	1.1	-	1.1	0.1	2	1.0	1.1	-	1.2	0.1	2	1.0	1.1	-	1.1	0.1	2																		
Profile																																				
Riffle Length (ft)	4.5	11.6	9.8	34.0	6.2	35																														
Riffle Slope (ft/ft)	1.156	1.321	0.000	1.725	0.167	35																														
Pool Length (ft)	3.3	10.6	0.0	38.5	6.0	56																														
Pool Max Depth (ft)	0.9	1.8	0.0	2.9	0.4	60																														
Pool Spacing (ft)	1.0	18.7	0.0	41.0	7.8	64																														
Pattern																																				
Channel Belt Width (ft)	2.7	8.7	8.0	29.4	4.1	52																														
Radius of Curvature (ft)	6.8	7.8	7.6	9.2	0.9	8																														
Rc: Bankfull Width (ft/ft)	1.0	1.2	1.2	1.4	0.1	8																														
Meander Wavelength (ft)	24.6	37.7	38.7	58.3	7.9	30																														
Meander Width Ratio	3.8	5.8	6.0	9.0	1.2	30																														
Additional Reach Parameters																																				
Rosgen Classification	E4																																			
Channel Thalweg Length (ft)	1,189																																			
Sinuosity (ft)	1.19																																			
Water Surface Slope (Channel) (ft/ft)	0.0050																																			
Bankfull Slope (ft/ft)	0.0050																																			
Ri% / Ru% / P% / G% / S%	32%	3%	48%	16%	0%																															

- Information Unavailable

N/A - Information does not apply.

Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step

Table 9b Cont'd. Monitoring Data - Stream Reach Data Summary
Harrell Reach 1D (249 feet)

Parameter	Baseline						MY - 1						MY - 2						MY - 3						MY - 5						MY - 7					
Dimension & Substrate - Riffle	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**
Bankfull Width (ft)	2.5	-	-	2.5	0.0	1	4.4	-	-	4.4	0	1	5.8	-	-	5.8	-	1																		
Floodprone Width (ft)	33.4	-	-	33.4	0.0	1	33.4	-	-	33.4	0	1	33	-	-	33	-	1																		
Bankfull Mean Depth (ft)	0.3	-	-	0.3	0.0	1	0.2	-	-	0.2	0	1	0.1	-	-	0.1	-	1																		
Bankfull Max Depth (ft)	0.4	-	-	0.4	0.0	1	0.3	-	-	0.3	0	1	0.6	-	-	0.6	-	1																		
Bankfull Cross-Sectional Area (ft^2)	0.7	-	-	0.7	0.0	1	0.7	-	-	0.7	0	1	0.7	-	-	0.7	-	1																		
Width/Depth Ratio	8.6	-	-	8.6	0.0	1	29.6	-	-	29.6	0	1	46.4	-	-	46.4	-	1																		
Entrenchment Ratio	13.2	-	-	13.2	0.0	1	7.5	-	-	7.5	0	1	5.8	-	-	5.8	-	1																		
Bank Height Ratio	1.0	-	-	1.0	0.0	1	1.1	-	-	1.1	0	1	1.4	-	-	1.4	-	1																		
Profile																																				
Riffle Length (ft)	12.7	19.6	9.8	27.0	7.2	35																														
Riffle Slope (ft/ft)	0.90	0.94	0.00	0.97	0.03	35																														
Pool Length (ft)	15.5	32.0	0.0	48.5	23.3	2																														
Pool Max Depth (ft)	1.1	1.2	0.0	1.4	0.2	2																														
Pool Spacing (ft)	72.0	72.0	0.0	72.0	n/a	1																														
Pattern																																				
Channel Belt Width (ft)	12.7	19.6	9.8	27.0	7.2	35																														
Radius of Curvature (ft)	0.9	0.9	0.0	1.0	0.0	35																														
Rc: Bankfull Width (ft/ft)	15.5	32.0	0.0	48.5	23.3	2																														
Meander Wavelength (ft)	1.1	1.2	0.0	1.4	0.2	2																														
Meander Width Ratio	72.0	72.0	0.0	72.0	n/a	1																														
Additional Reach Parameters																																				
Rosgen Classification	E4																																			
Channel Thalweg Length (ft)	294																																			
Sinuosity (ft)	1.07																																			
Water Surface Slope (Channel) (ft/ft)	0.005																																			
Bankfull Slope (ft/ft)	0.006																																			
Ri% / Ru% / P% / G% / S%	19%	41%	21%	8%	11%																															

- Information Unavailable

N/A - Information does not apply.

Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step

Appendix E
Hydrologic Data

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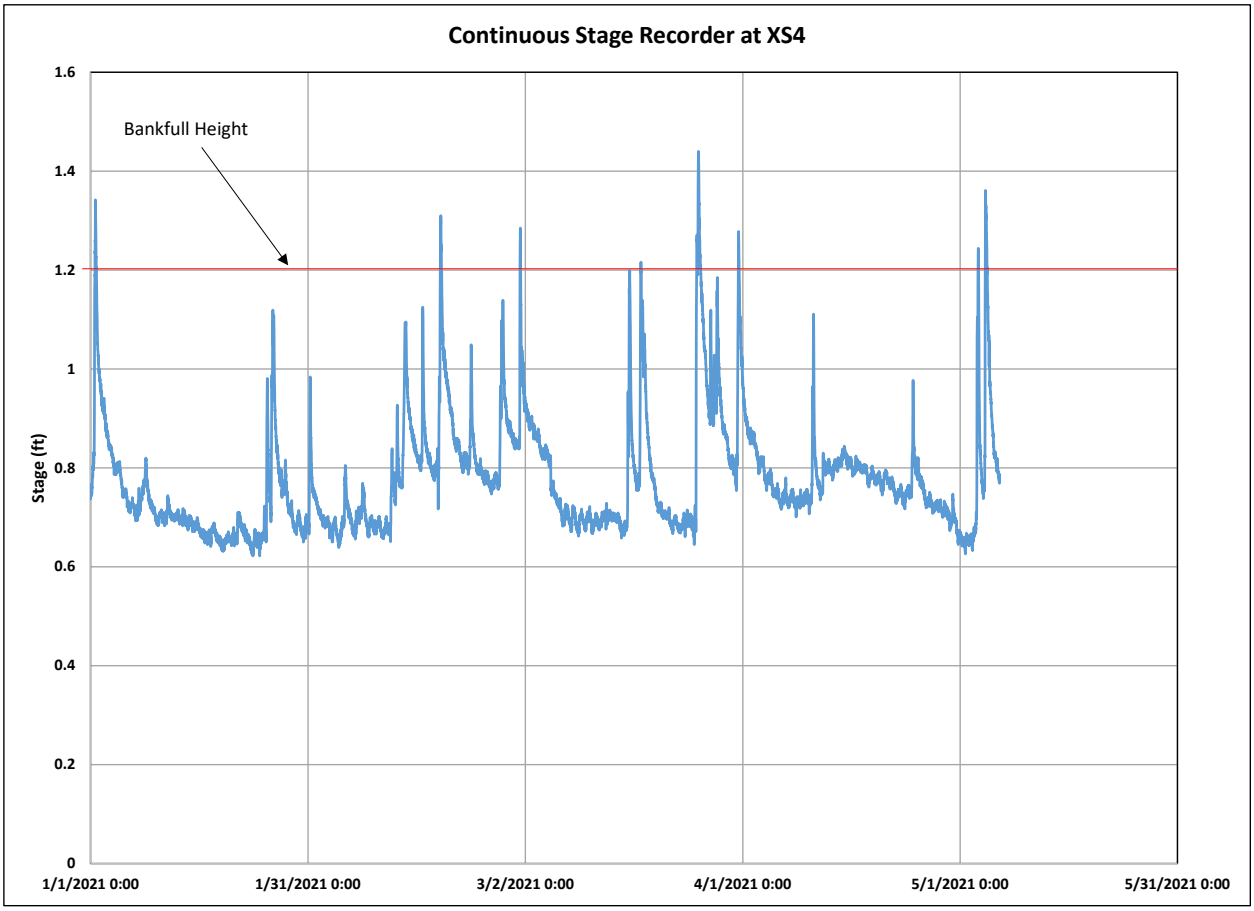
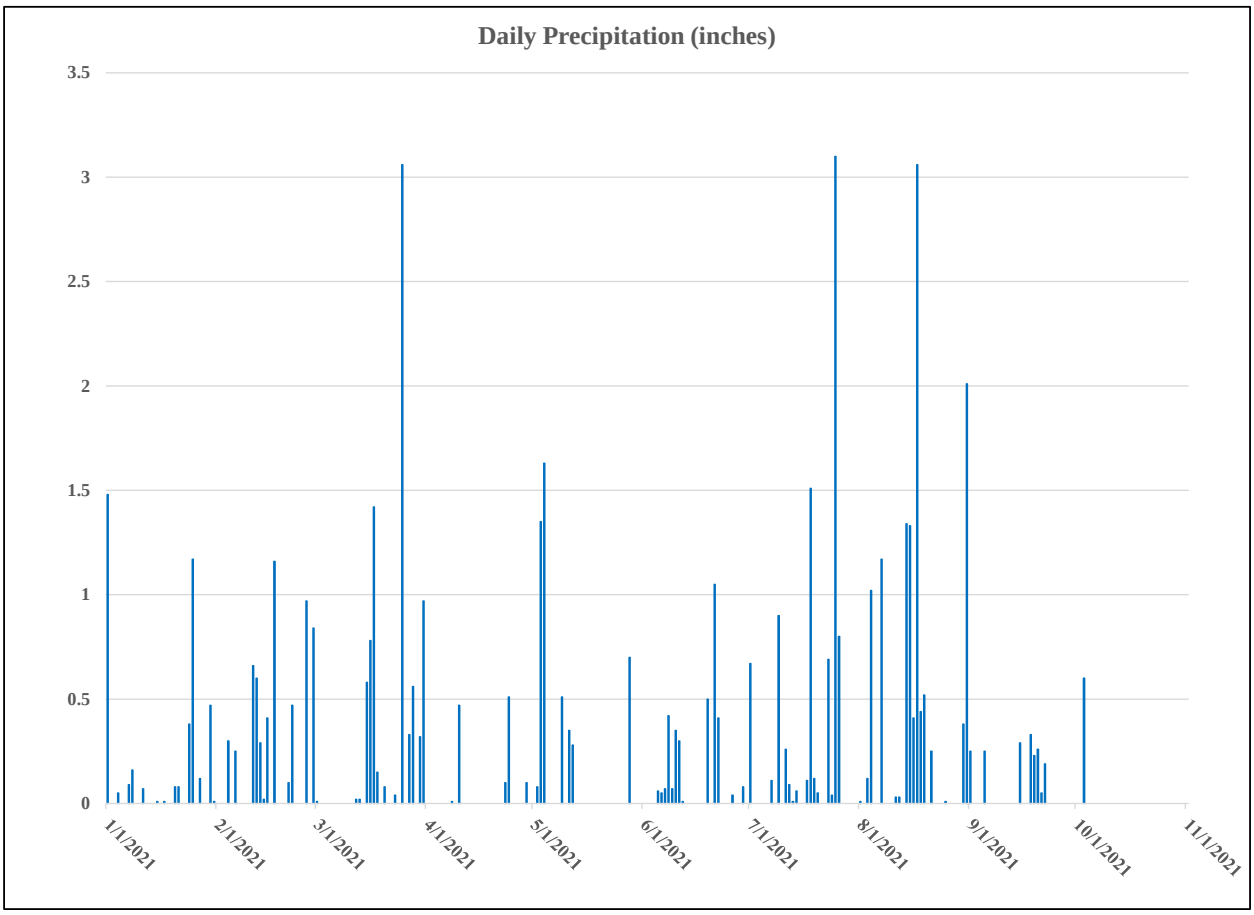
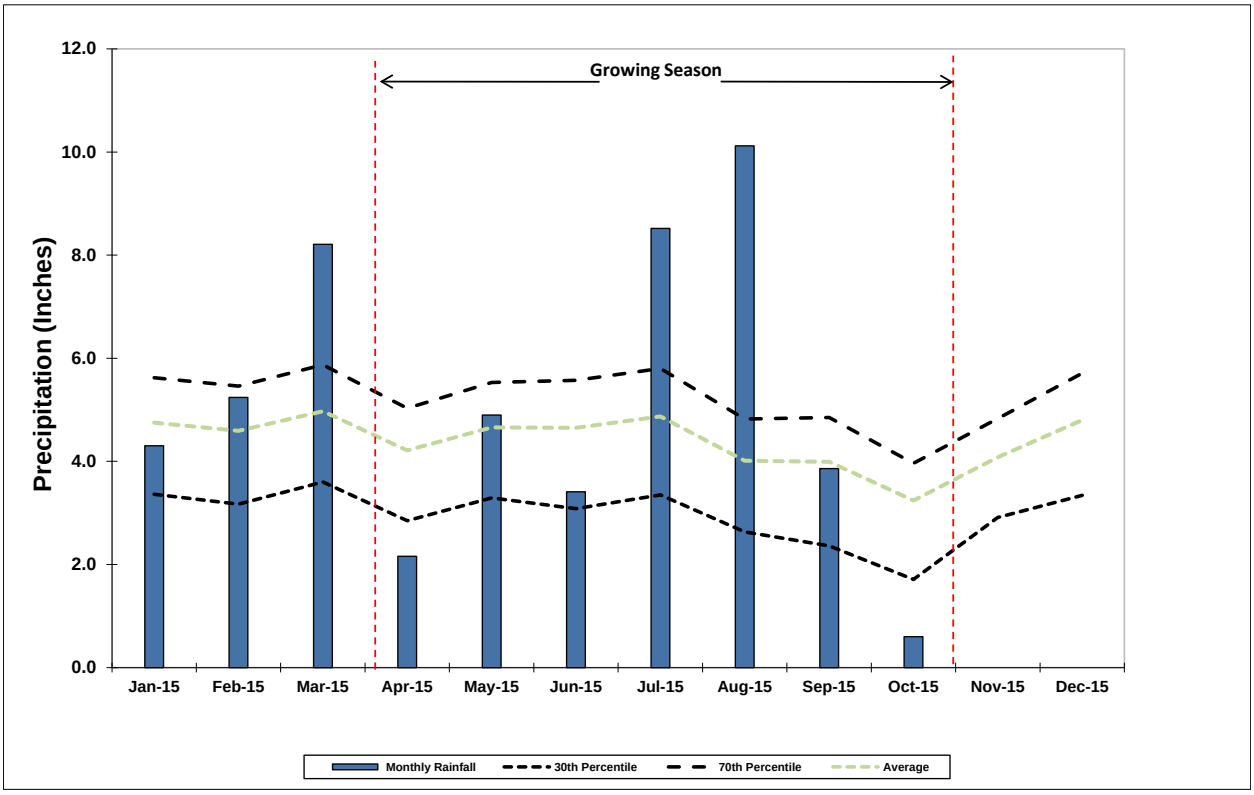
Table 10. Verification of Bankfull Events Harrell Creek Mitigation Project					
Reach 1					
Date of Data Collection	**Date of Occurrence**	**Method**	**Feet Above Bankfull Elevation**	**Photo # (if available)**	**Monitoring Year**
4/1/2020	2/6/2020	Stage Recorder	0.43	n/a	MY1
4/1/2020	2/11/2020	Stage Recorder	>0.01	n/a	
4/1/2020	2/13/2020	Stage Recorder	0.2	n/a	
4/1/2020	3/25/2020	Stage Recorder	0.23	n/a	
9/10/2020	4/13/2020	Stage Recorder	0.42	n/a	
9/10/2020	6/14 - 6/15/2020	Stage Recorder	0.39	n/a	
9/10/2020	7/1 &7/3/2020	Stage Recorder	0.38	n/a	
9/10/2020	7/20, 7/22, and 7/24/2020	*Stage Recorder	Unknown	n/a	
9/10/2020	7/28/2020	Stage Recorder	0.27	n/a	
9/10/2020	8/21-8/22/2020	Wrack Lines	0.35	n/a	
9/29/2021	1/1/2021	Stage Recorder	0.14	n/a	MY2
9/29/2021	2/18/2021	Stage Recorder	0.11	n/a	
9/29/2021	3/1/2021	Stage Recorder	0.09	n/a	
9/29/2021	3/25/2021	Stage Recorder	0.24	n/a	
9/29/2021	3/31/2021	Stage Recorder	0.07	n/a	
9/29/2021	5/4/2021	+Stage Recorder	0.16	n/a	

* Crest Gage recorded abnormally high bankfull event relative to rainfall. True event elevation undetermined.

+ Stage recorder failed on May 6, 2021.

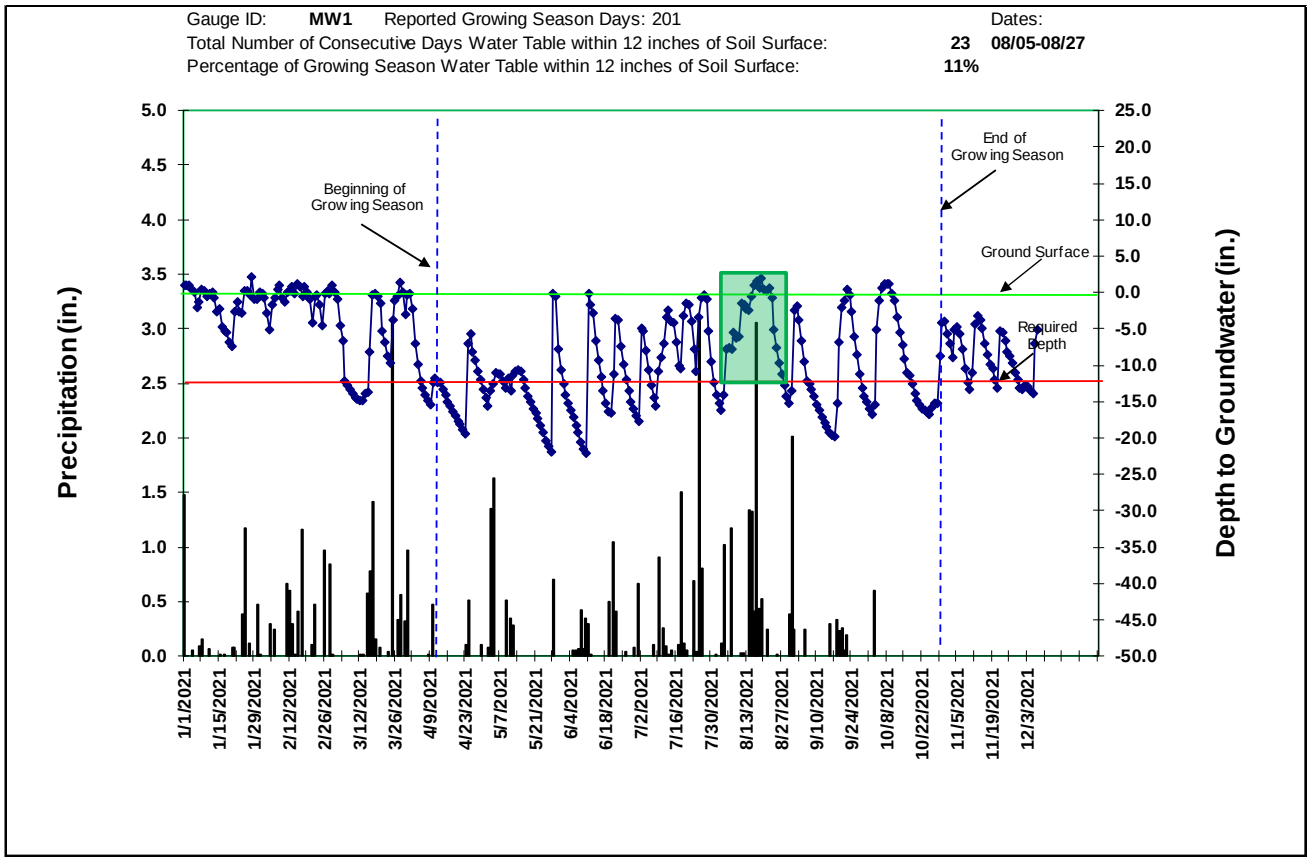


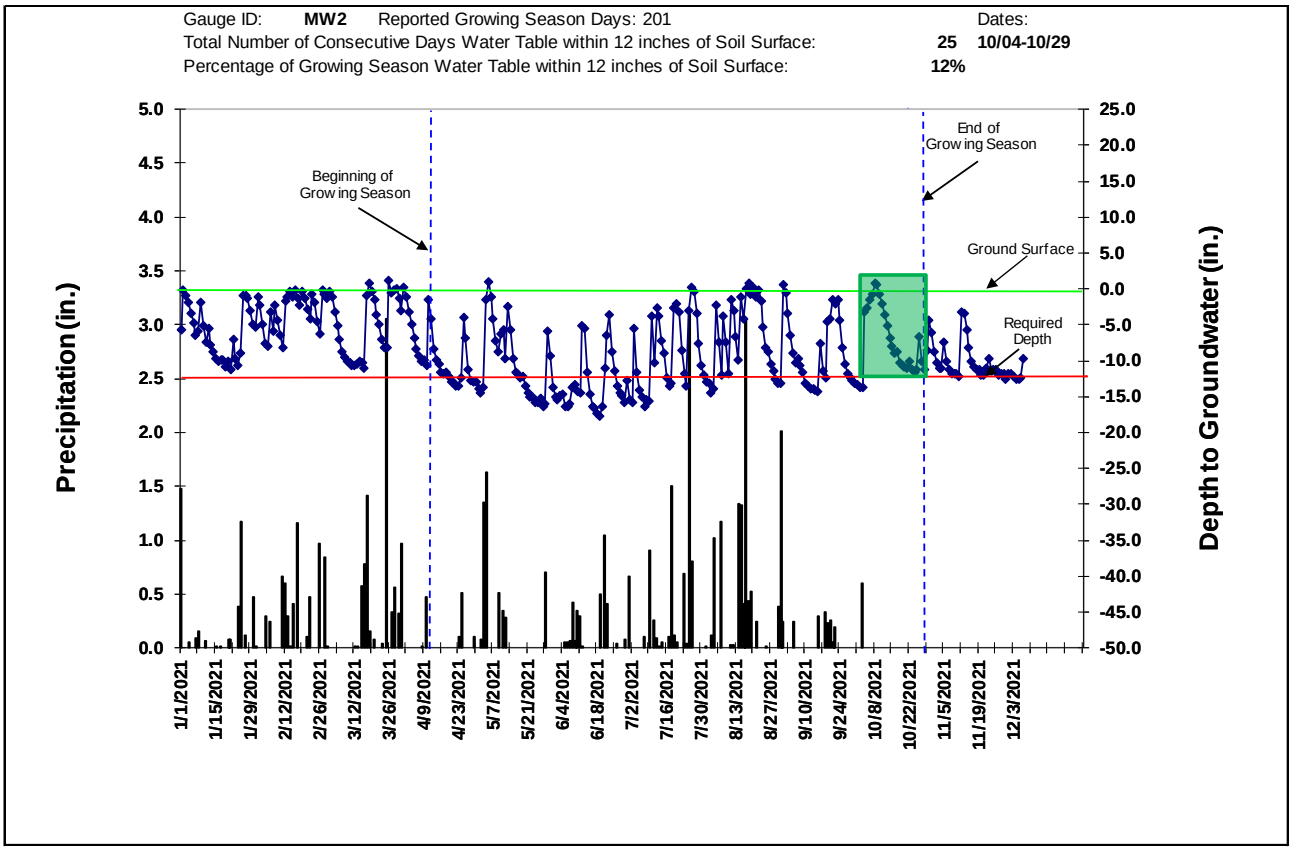

Daily Precipitation (inches)
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2021
2/1/2021
3/1/2021
4/1/2021
5/1/2021
6/1/2021
7/1/2021
8/1/2021
9/1/2021
10/1/2021
11/1/2021


Growing Season
Precipitation (Inches)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Jan-15
Feb-15
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
Oct-15
Nov-15
Dec-15
Monthly Rainfall
30th Percentile
70th Percentile
Average

Monitoring Gauge	Performance Standard: **12 %** WETS Station: **Cullowhee, NC** Growing Season: **4/11 to 10/28 (201 days)**						
	Max. Consecutive Hydroperiod (%)						
	MY-1 (2020)	**MY-2 (2021)**	**MY-3 (2022)**	**MY-4 (2024)**	**MY-5 (2025)**	**MY-6 (2026)**	**MY-7 (2027)**
MW-1	22	11	-	-	-	-	-
MW-2	17	12	-	-	-	-	-
MW-3	24	50	-	-	-	-	-
MW-4	71	85	-	-	-	-	-
MW-5	3	5	-	-	-	-	-
MW-6	76	85	-	-	-	-	-
MW-7	3	5	-	-	-	-	-
MW-8	51	13*	-	-	-	-	-
MW-9	100	85	-	-	-	-	-
Meets	Fails to meet						

*Gauge failed to reset after deployment, occuring over a period of 208 days between March 5, 2021 and September 29, 2021. MY2 results are reflective of the period after reset.




Gauge ID: MW2 Reported Growing Season Days: 201
Dates:
Total Number of Consecutive Days Water Table within 12 inches of Soil Surface: 25 10/04-10/29
Percentage of Growing Season Water Table within 12 inches of Soil Surface: 12%
Beginning of Growing Season
End of Growing Season
Ground Surface
Required Depth
Precipitation (in.)
Depth to Groundwater (in.)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
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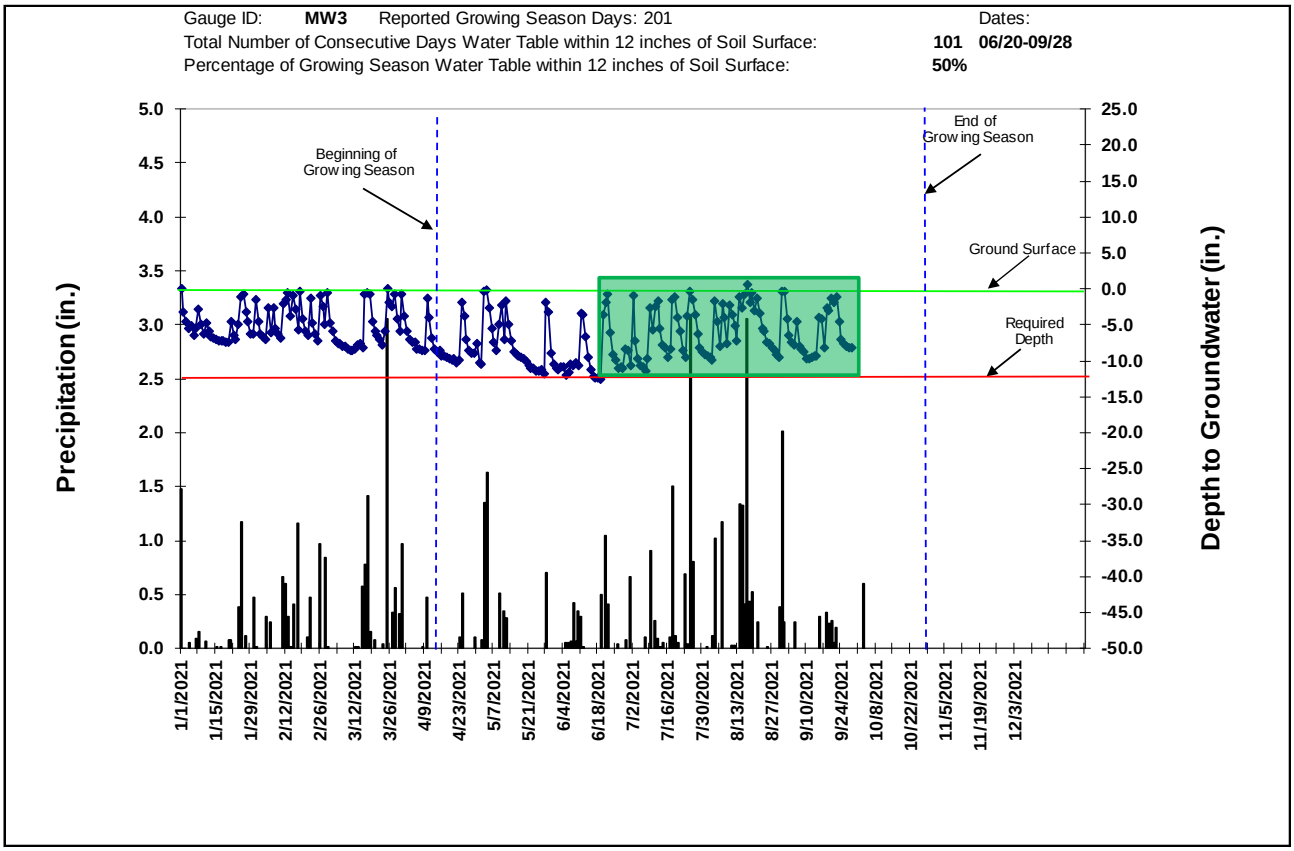
10/22/2021
11/5/2021
11/19/2021
12/3/2021


Gauge ID: MW3 Reported Growing Season Days: 201
Dates:
Total Number of Consecutive Days Water Table within 12 inches of Soil Surface: 101 06/20-09/28
Percentage of Growing Season Water Table within 12 inches of Soil Surface: 50%
Beginning of Growing Season
End of Growing Season
Ground Surface
Required Depth
Precipitation (in.)
Depth to Groundwater (in.)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
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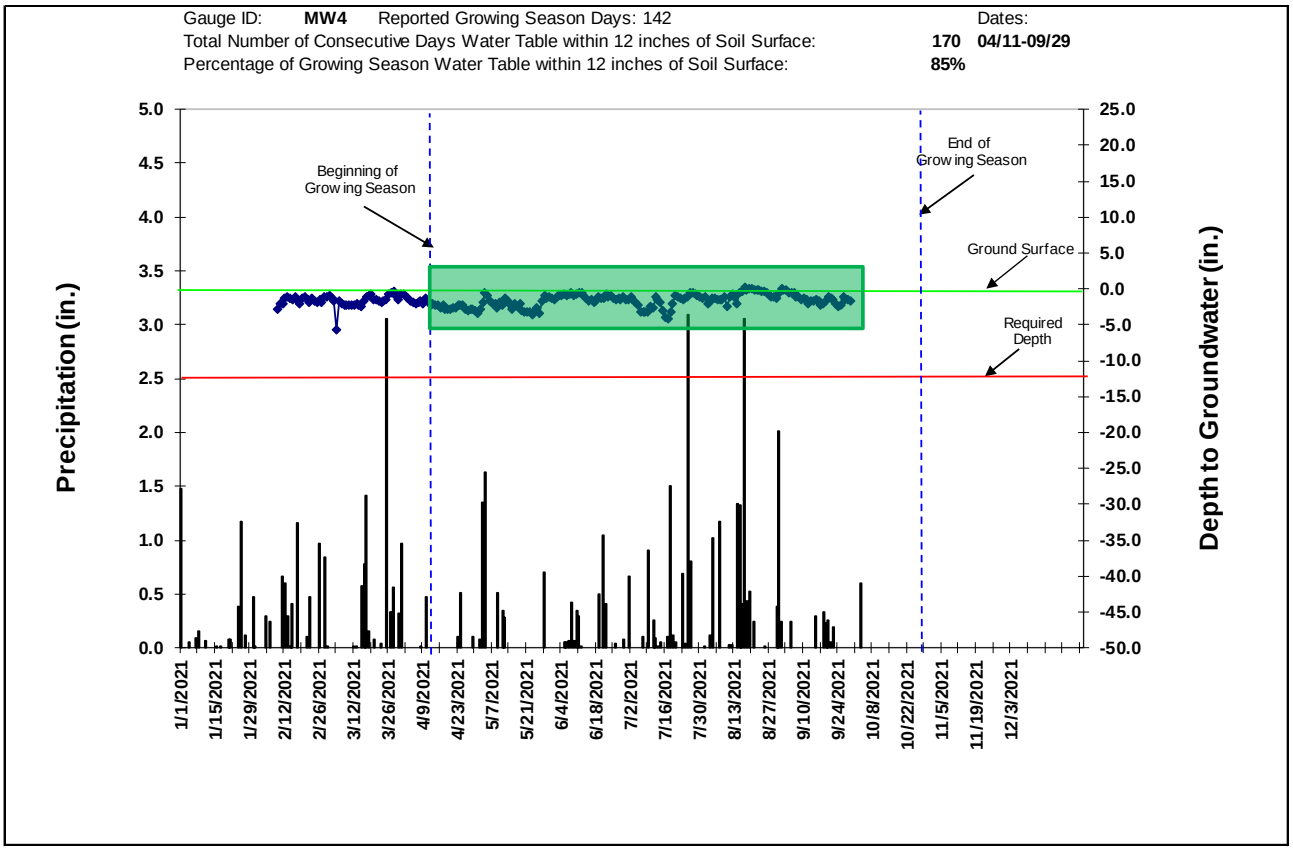
11/5/2021
11/19/2021
12/3/2021


Gauge ID: MW4 Reported Growing Season Days: 142
Dates:
Total Number of Consecutive Days Water Table within 12 inches of Soil Surface: 170 04/11-09/29
Percentage of Growing Season Water Table within 12 inches of Soil Surface: 85%
Beginning of Growing Season
End of Growing Season
Ground Surface
Required Depth
Precipitation (in.)
Depth to Groundwater (in.)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
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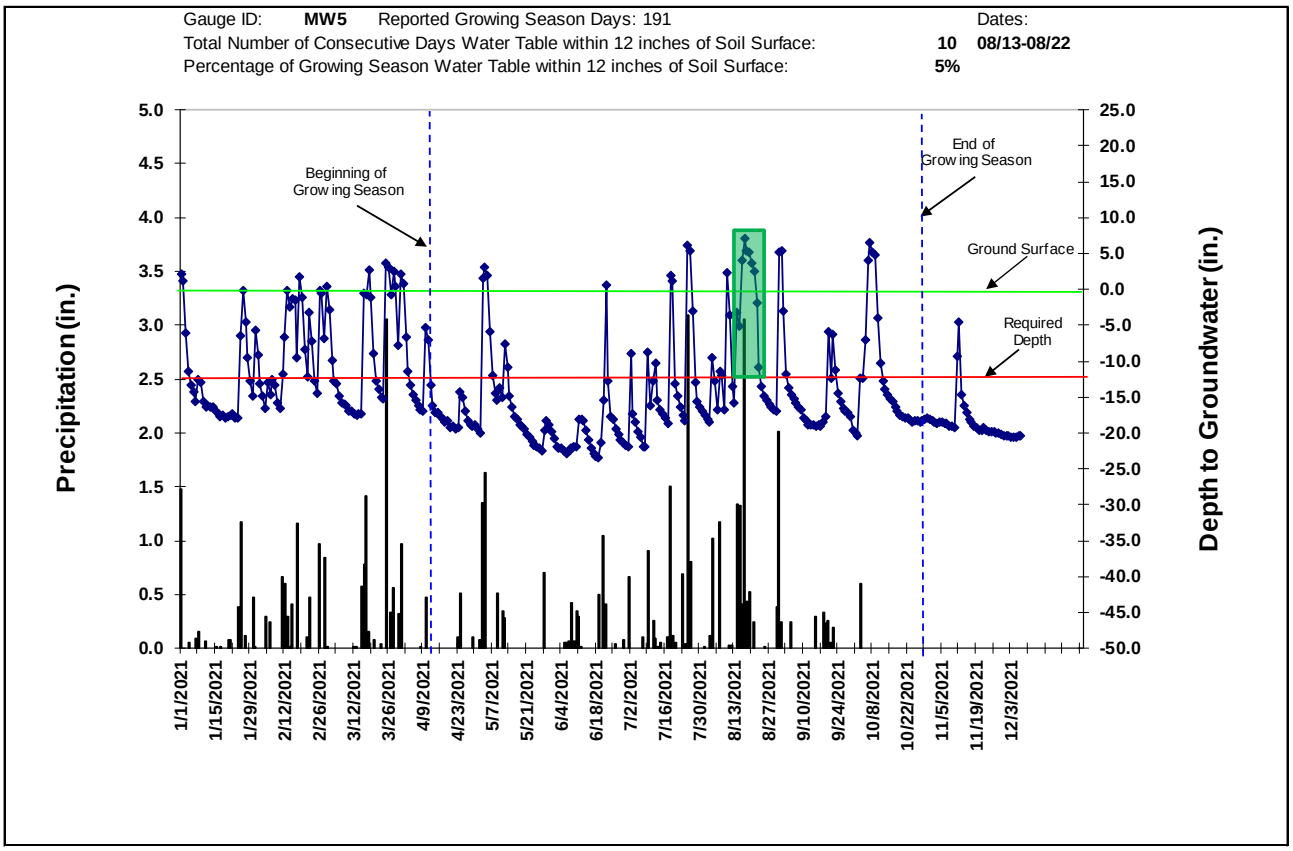
11/5/2021
11/19/2021
12/3/2021


Gauge ID: MW5 Reported Growing Season Days: 191
Dates:
Total Number of Consecutive Days Water Table within 12 inches of Soil Surface: 10 08/13-08/22
Percentage of Growing Season Water Table within 12 inches of Soil Surface: 5%
Beginning of Growing Season
End of Growing Season
Ground Surface
Required Depth
Precipitation (in.)
Depth to Groundwater (in.)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
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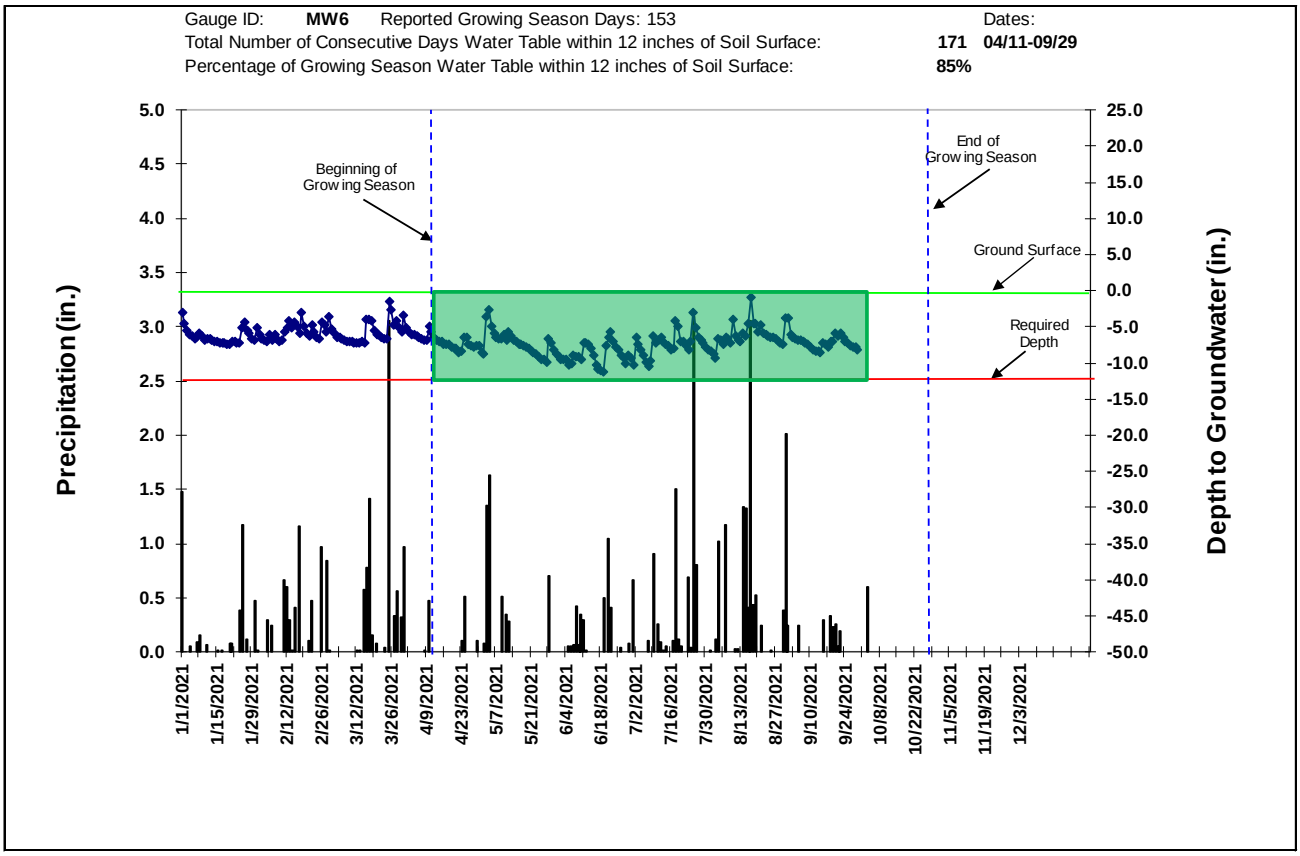
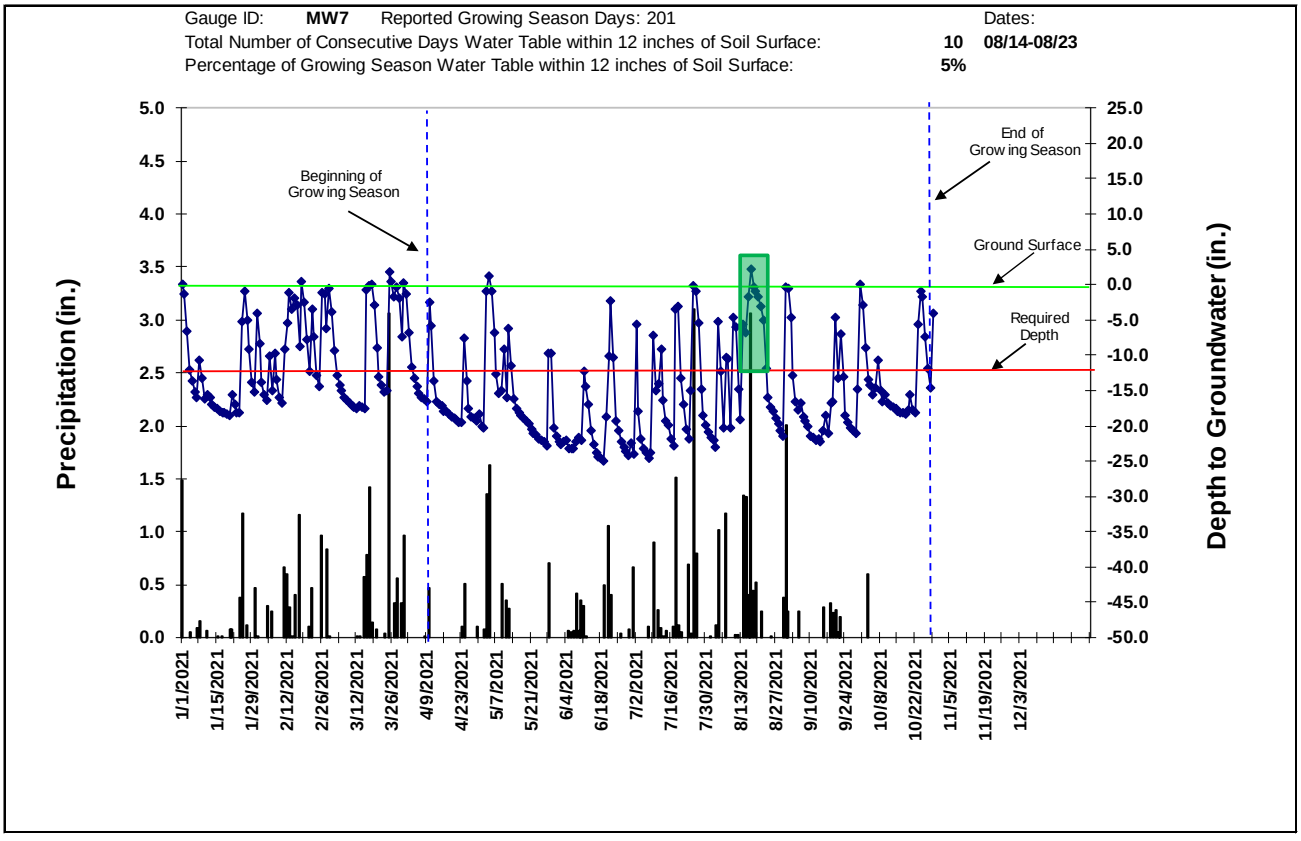
11/5/2021
11/19/2021
12/3/2021

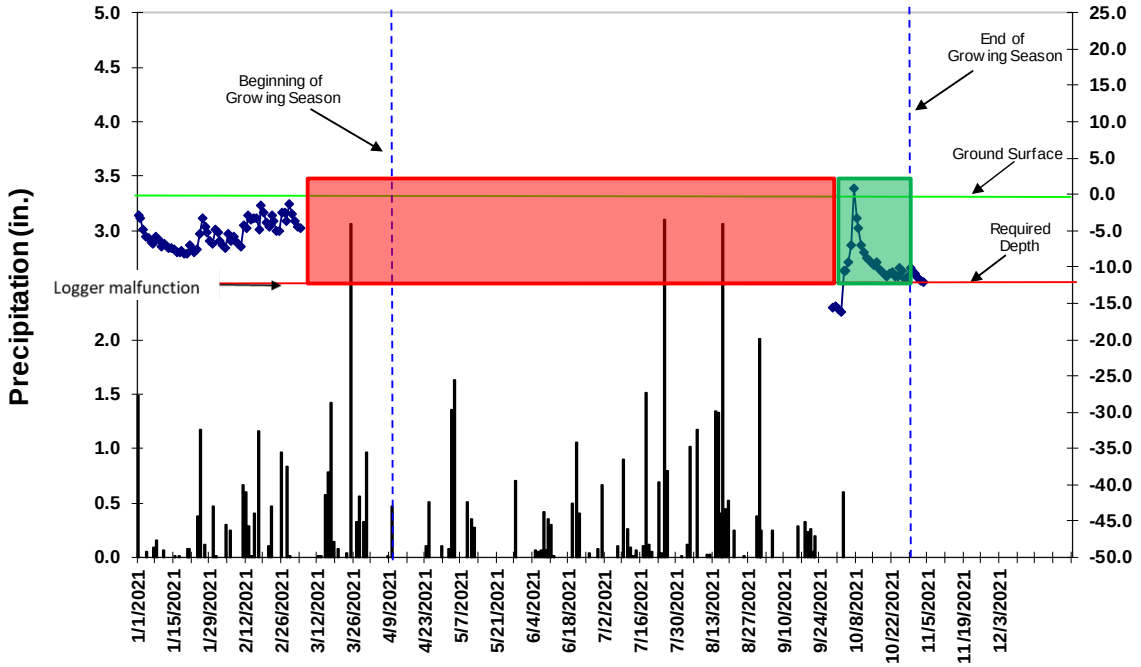

Gauge ID: MW6 Reported Growing Season Days: 153
Dates:
Total Number of Consecutive Days Water Table within 12 inches of Soil Surface: 171 04/11-09/29
Percentage of Growing Season Water Table within 12 inches of Soil Surface: 85%
Beginning of Growing Season
End of Growing Season
Ground Surface
Required Depth
Precipitation (in.)
Depth to Groundwater (in.)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
9/10/2021
9/24/2021
10/8/2021
10/22/2021
11/5/2021
11/19/2021
12/3/2021


Gauge ID: MW7 Reported Growing Season Days: 201
Dates:
Total Number of Consecutive Days Water Table within 12 inches of Soil Surface: 10 08/14-08/23
Percentage of Growing Season Water Table within 12 inches of Soil Surface: 5%
Beginning of Growing Season
End of Growing Season
Ground Surface
Required Depth
Precipitation (in.)
Depth to Groundwater (in.)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
1/1/2021
1/15/2021
1/29/2021
2/12/2021
2/26/2021
3/12/2021
3/26/2021
4/9/2021
4/23/2021
5/7/2021
5/21/2021
6/4/2021
6/18/2021
7/2/2021
7/16/2021
7/30/2021
8/13/2021
8/27/2021
9/10/2021
9/24/2021
10/8/2021
10/22/2021
11/5/2021
11/19/2021
12/3/2021

Gauge ID: **MW8** Reported Growing Season Days: 201 Dates:

Total Number of Consecutive Days Water Table within 12 inches of Soil Surface: **26** **10/03-10/28**

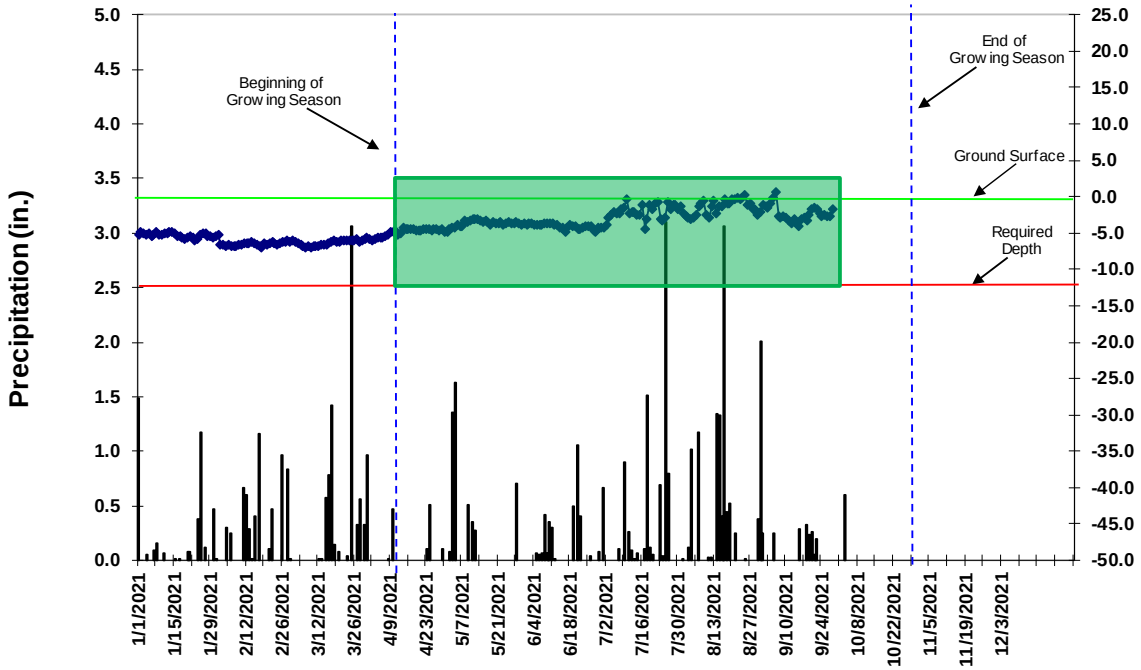
Percentage of Growing Season Water Table within 12 inches of Soil Surface: **13%**



Gauge ID: **MW9** Reported Growing Season Days: 201 Dates:

Total Number of Consecutive Days Water Table within 12 inches of Soil Surface: **170** **04/11-09/29**

Percentage of Growing Season Water Table within 12 inches of Soil Surface: **85%**



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Appendix F
MY2 Supplemental Information

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IRT Site Visit-Harrell Stream and Restoration Site

8/31/2021

Meeting start time 9:30 am

Attendees:

- USACE: Todd Tugwell, Kim Browning, Casey Haywood
- NCDWR: Erin Davis
- NCDMS: Paul Wiesner, Matthew Reid
- EWS: Grant Ginn, Danvey Walsh, Charles Lawson

Previous comments were reviewed and previous areas of concern where identified. The site visit began at the crossing between the restoration reach (Reach 1A) and Reach 1B and proceeded downstream to the end of the project with discussion of current conditions and future concerns within the project. Below is a list of points discussed during the site visit.

- The IRT expressed concern about the remaining sandbags and plastic at the culverted crossing between the Restoration Reach (Reach 1A) and Reach 1B. EW Solutions (EWS) committed to removal of the remaining construction debris from this location.
- The removal of monitoring features and non-natural materials from restoration sites in general was discussed as a future requirement from DMS and the IRT. Equinox staff committed to removal of materials as outlined in future guidance documents.
- It was suggested that soil profiles be conducted as part of monitoring of the proposed wetlands in and around the groundwater wells which were not meeting criteria (GG5 and GG7). Documentation of soil profile characteristics (i.e. redoximorphic features) will provide support for groundwater data and will be included in future monitoring reports.
- IRT requested photo documentation in the non-growing season to provide additional evidence of channel stability and continuity. EWS collects photos in the spring but has not previously included them in the monitoring report. EWS committed to providing non-growing season photo documentation of stream features as part of the yearly monitoring report.
- The collection of random vegetation plot data was discussed. EWS committed to collection of random vegetation plot data as outlined in the current guidance documents.
- Some areas of sparse woody vegetation along the inner bend of Harrell Creek were discussed. Supplemental planting may be required in this location dependent upon results of random vegetation monitoring plots.
- Documentation of planting density, location, and planted species was requested for all supplemental planting conducted within the site. EWS provided a map and description of supplemental planting efforts to date and committed to future documentation to be included in subsequent reports.
- Continuing concerns were expressed for the stability and long-term viability of Reach 1D. EWS continues to monitor the culvert under Caney Fork Rd.

Charles Lawson

From: Haywood, Casey M CIV (USA) <Casey.M.Haywood@usace.army.mil>
Sent: Thursday, September 9, 2021 3:20 PM
To: Tugwell, Todd J CIV USARMY CESAW (USA); Wiesner, Paul; Browning, Kimberly D CIV USARMY CESAW (USA); Davis, Erin B
Cc: Reid, Matthew; Charles Lawson; Danvey Walsh; David Tuch; Owen Carson; Grant Ginn
Subject: RE: Harrell Stream and Wetland Site_100005_8-31-2021 IRT Site Visit Notes - DMS# 100005 _ SAW 2016-02202_DWR#20161077

Thanks Paul. I agree with Todd, the notes captured the overall conversation on site. I would like to add just a few points.

- As mentioned in the notes, IRT recommended collecting soil profiles near failed gauges as part of monitoring in years 3, 5, & 7.
- Recommended adding a random transect to the bare area in Wetland C near veg plot 3. It will also be important to have some transects closer to the stream. There was a good bit of discussion about the importance of shading.
- To address the concern for Reach 1D it was suggested to have photo documentation down near the culvert to provide with the cross sectional data.

Thank you,
Casey

-----Original Message-----
From: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>
Sent: Thursday, September 9, 2021 12:58 PM
To: Wiesner, Paul <paul.wiesner@ncdenr.gov>; Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>; Haywood, Casey M CIV (USA) <Casey.M.Haywood@usace.army.mil>; Davis, Erin B <erin.davis@ncdenr.gov>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>; Charles Lawson <charles@equinoxenvironmental.com>; Danvey Walsh <danvey@equinoxenvironmental.com>; David Tuch <david@equinoxenvironmental.com>; Owen Carson <owen@equinoxenvironmental.com>; Grant Ginn <grant.ginn@stantec.com>
Subject: RE: Harrell Stream and Wetland Site_100005_8-31-2021 IRT Site Visit Notes - DMS# 100005 _ SAW 2016-02202_DWR#20161077

Thanks Paul. These look consistent with the discussion.

Todd

-----Original Message-----
From: Wiesner, Paul <paul.wiesner@ncdenr.gov>
Sent: Friday, September 03, 2021 4:05 PM
To: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>; Haywood, Casey M CIV (USA) <Casey.M.Haywood@usace.army.mil>; Davis, Erin B <erin.davis@ncdenr.gov>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>; Charles Lawson <charles@equinoxenvironmental.com>; Danvey Walsh <danvey@equinoxenvironmental.com>; David Tuch <david@equinoxenvironmental.com>; Owen Carson <owen@equinoxenvironmental.com>; Grant Ginn <grant.ginn@stantec.com>

Subject: [Non-DoD Source] Harrell Stream and Wetland Site_100005_8-31-2021 IRT Site Visit Notes - DMS# 100005 _ SAW 2016-02202_DWR#20161077

Casey, Erin, Kim, Todd;

The meeting minutes from the August 31, 2021 site visit at Harrell Stream and Wetland Site are attached for your review.

Please let us know if you have any comments, questions or concerns.

Thanks

Paul Wiesner

Western Regional Supervisor

North Carolina Department of Environmental Quality

Division of Mitigation Services

828-273-1673 Mobile

paul.wiesner@ncdenr.gov <mailto:paul.wiesner@ncdenr.gov>

Western DMS Field Office

5 Ravenscroft Drive

Suite 102

Asheville, N.C. 28801

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Area received supplemental planting using one year-old bare root plants at a rate of 700 stems/acre; the most wet-tolerant species were selected from the approved As-Built planting list (wetland plantings) and included: Silky dogwood, buttonbush, Tag alder, Winterberry, and green ash.

MW1
Reach 1B
MW2
VP1
VP2
Wetland B
MW3
MW5
MW4
XS1-P
XS2-R
VP3
Reach 1C
Wetland C
MW7
XS4-R
XS3-P
MW8
VP5
XS5-R
XS6-P
Reach 1D
MW9
VP4
MW6
Wetland A

Mitigation Services
ENVIRONMENTAL QUALITY

Supplemental Planting
Harrell Mitigation Site
Jackson County, NC
February 2021

0 112.5 225 Feet

Monitoring Features
- Continuous Stage Recorder
- Groundwater Gauge
- Cross-section
- Vegetation Plot
- Conservation Easement Boundary
- Photopoints
- Rain Gauge
- Invasive Vegetation Present

Streams
- Preservation
- Restoration
- Reach Breaks
- Log Sills
- Rock Sills
- TOB

Wetlands
- Preservation (No Credit)
- Reestablishment
- Rehabilitation

EQUINOX

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Project Name	Monitoring Year	Date	3% Glyphosate gallons	3% Triclopyr gallons	50% Glyphosate ounces	20% Garlon 4 in Oil Oz.	Target Species
Harrell	2020	6/2/2020		21			*Rosa multiflora, Berberis spp.*
		6/16/2020	4		14		*Rosa multiflora, Celastrus orbiculatus*
	2021	6/25/2021	6			16	*Rosa multiflora, Celastrus orbiculatus, Ligustrum spp.*
TOTAL HERBICIDE USE			10	21	14	16	