MY2 MONITORING REPORT - *Stream Mitigation*

STRAWBERRY HILL MITIGATION PROJECT

Johnston County, North Carolina
Neuse River Basin
HUC 03020201

NCDMS Project #100094
DMS Contract #7745
RFP: 16-007576
USACE Action ID: SAW-2019-00124 | DWR Project #2019-0159

Provided by:

Resource Environmental Solutions, LLC
for Environmental Banc & Exchange – Neuse I, LLC

Prepared for:
NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

January 2023

ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
MARC RECKTENWALD
Director

NORTH CAROLINA
Environmental Quality

December 4, 2023

Via email: mdeangelo@res.us

Matt Deangelo
RES

Subject: DMS Comments on the MY2 Report
Strawberry Hill, Project ID #100094, DMS Contract 7745

Matt,
DMS received the MY2 draft report on 11/10/2023 and visited the site on 11/30/22. DMS offers the following comments for the report:

Stream Report

1. Section 1.5.1 – References applying a "liquid organic soil amendment" to bare areas on site. Please give more details about the soil amendment.
2. Section 1.5.2 – Incorrect statement that "One stage recorder and one flow gauge are documenting conditions on reaches JH1-A and JH1-B, respectively." This sentence implies that crest gauge data is being collected on JH1-A and flow data on JH1-B.
3. Please review cross sections. Some cross section BHRs are not reproducible with the numbers in the report. For example, XS-3 calculates to a 0.95 BHR based on report numbers (using formula *LTOB Max Depth / [BKFL Elev. Based on MY0 XSA – Thalweg Elevation*]) but is reported as 1.00. Reviewing the submitted Excel data (again using XS-3 as an example) to remove possibility of rounding errors produces similar results. We can reproduce all MY1 BHRs with the method described above.
4. A few minor encroachments (scalloping) were identified during the 11/30 site visit. Please add these areas to the CCPV and indicate how future encroachments will be prevented in these areas.

Buffer Report

1. Section 1.5 – Provide detail on "liquid organic soil amendment" proposed for application to bare areas.
2. A few minor encroachments (scalloping) were identified during the 11/30 site visit. Please add these areas to the CCPV and indicate how future encroachments will be prevented in these areas.

Please incorporate the revisions and provide a response to comments letter, one (1) hardcopy, and one (1) pdf copy along with any updated digital files that may be needed based on the comments above. If you have any questions, or wish to discuss these comments further, please contact me at any time. I can be reached at (919) 218-0226, or via email at jeremiah.dow@ncdenr.gov

Sincerely,

Jeremiah Dow
Eastern Regional Supervisor
NCDEQ Division of Mitigation Services

cc: Jamey McEachran, RES

3600 Glenwood Avenue, Suite 100
Raleigh, NC 27612

Corporate Headquarters
6575 W Loop S #300
Bellaire, TX 77401
Main: 713.520.5400

January 12, 2024

Jeremiah Dow
NC DEQ Division of Mitigation Services
217 West Jones Street
Raleigh, NC 27604

RE: DMS Comments on the MY2 Report Strawberry Hill, Project ID #100094, DMS Contract 7745

Listed below are comments provided by DMS on December 4, 2023 regarding the Strawberry Hill Stream and Riparian Buffer Mitigation Project Year 2 Monitoring Reports and RES' responses.

Stream Report Comments:

1. Section 1.5.1 – References applying a "liquid organic soil amendment" to bare areas on site. Please give more details about the soil amendment

This has been revised to clarify that the amendment is a liquid humic acid fertilizer.

2. Section 1.5.2 – Incorrect statement that "One stage recorder and one flow gauge are documenting conditions on reaches JH1-A and JH1-B, respectively." This sentence implies that crest gauge data is being collected on JH1-A and flow data on JH1-B.

The sentence has been revised.

3. Please review cross sections. Some cross section BHRs are not reproducible with the numbers in the report. For example, XS-3 calculates to a 0.95 BHR based on report numbers (using formula *LTOB Max Depth / [BKFL Elev. Based on MY0 XSA – Thalweg Elevation*]) but is reported as 1.00. Reviewing the submitted Excel data (again using XS-3 as an example) to remove possibility of rounding errors produces similar results. We can reproduce all MY1 BHRs with the method described above.

BHRs and Max Depths have been revised for all cross sections and respective morphology tables have been updated. The discrepancy stemmed from entering rounded numbers in the morph tables instead of the raw calculations. Then, the formulas in Table 11 Morphology data table were overwritten with the rounded calculations. These issues have been corrected and the updated calculations for BHR and Max Depth are accurate.

4. A few minor encroachments (scalloping) were identified during the 11/30 site visit. Please add these areas to the CCPV and indicate how future encroachments will be prevented in these areas. The CCPV has been revised to include these areas and discussion has been added to **Section 1.5.1**. The encroachments are very small and narrow and do not appear to result in any tree mortality. The areas are mapped as lines as the areal coverage is minimal.

Table of Contents

1 PROJECT SUMMARY

1.1 Project Location and Description

The Strawberry Hill Mitigation Project ("Project") is located within a mostly rural watershed in Johnston County near Smithfield, NC at the crossroads of Yelverton Grove Road and Brogden Road. The Project lies within the Neuse River Basin, North Carolina United States Geological Survey (USGS) 8-digit Cataloguing Unit 03020201 (Neuse 01) and 14-digit hydrologic unit code (HUC) 03020201140010, a NC Division of Mitigation Services (DMS) Targeted Local Watershed (TLW) and the Division of Water Resources (NCDWR) sub-basin 03-04-02 (**Figure 1**). The Project restores 3,719 linear feet (LF) that will provide water quality benefit for 383 acres of drainage area. Additionally, the Project restores and preserves riparian buffer area within the project area, which provides riparian buffer credits for the Neuse 01 watershed. Conditions pertaining to the buffer mitigation component of this Project will be provided in separate monitoring reports each year. Also, notably, the Project is in very close proximity (approximately 0.4 miles) to the RES Polecat Stream Mitigation Bank Site, offering even more functional uplift to the local watershed.

The Project area, in whole, is comprised of a 22.12-acre easement involving two unnamed tributaries to Polecat Branch, which eventually drains to the Neuse River. One of the tributary streams, and its associated ditches, are not subject to stream mitigation and are only utilized for buffer mitigation. That portion of the Project will not be discussed in this stream mitigation monitoring report but will be included in a separate monitoring report. Therefore, the stream mitigation component of the Project involves one tributary, whose total length prior to restoration was 3,267 LF.

The Project is accessible from both Yelverton Grove Road and Brogden Road. Coordinates for the Project area are approximately 35.469579, -78.323896 at the NC Department of Transportation (DOT) culvert exiting the Project at Brogden Road.

1.2 Project Components

Prior to restoration, the project stream was significantly impacted by historic relocation and straightening, crop production, timbering, and lack of riparian buffer. Proposed improvements to the Project will help meet the river basin needs expressed in the 2010 Neuse RBRP. Through stream restoration, the Project presents 3,719 LF of proposed stream, generating 3,719.000 Warm Stream Mitigation Units (SMUs). The Project Mitigation Quantities and Credits and Project Attributes are provided below in **Table 1.**

Table 1. Strawberry Hill Mitigation Project (ID-100094) Project Mitigation Quantities and Credit

Project Segment	Original Mitigation Plan Ft/Ac	As-Built Ft/Ac	Original Mitigation Category	Original Restoration Level	Original Mitigation Ratio (X:1)	Credits	Comments
Stream							
Reach JH1-A	1007	1007	Warm	R	1.00000	1,007.000	Channel restoration,installed log structures for grade control and habitat, riparian planting, installed livestakes (Stream Crossing: STA 11+64 to 12+59)
Reach JH1-B	1054	1054	Warm	R	1.00000	1,054.000	Channel restoration,installed log structures for grade control and habitat, riparian planting, installed livestakes, (Stream Crossing: STA 23+13 to 23+74), Removed trash/debris
Reach JH1-B	1658	1658	Warm	R	1.00000	1,658.000	Channel restoration, installed log structures for grade control and habitat, riparian planting, installed livestakes, Removed trash/debris
					Total:	**3,719.000**	
No Wetland Mitigation							

Project Credits

	Stream			Riparian	Non-Rip	Coastal
Restoration Level	Warm	Cool	Cold	Wetland	Wetland	Marsh
Restoration	3,719.000					
Totals	**3,719.000**					
Total Stream Credit	**3,719.000**					

1.3 Project Goals and Objectives

Prior to construction the stream had been significantly impacted by historic relocation and straightening, crop production, timbering and lack of riparian buffer. The past land use disturbances, absence of buffer vegetation, and current agricultural practices presented a significant opportunity for water quality and ecosystem improvements through the implementation of this Project. Through the comprehensive analysis of the Project's maximum functional uplift using the Stream Functions Pyramid Framework, specific, attainable goals and objectives are being realized by the Project. These goals clearly help to address the degraded water quality and nutrient input from agricultural practices that were identified as major watershed stressors in the 2010 Neuse River Basin Restoration Priorities (RBRP) (amended August 2018). Ultimately, the Project supports the RBRP Goals listed in the Approved Mitigation Plan. The Project Summary Goals, Performance, and Results are provided below in **Table 2**. The Project Attributes are found in **Table 3**.

Table 2: Summary: Goals, Performance and Results

Goal	Objective/Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Improve flood flow attenuation on site and downstream by allowing for overbanks flows and connection to the floodplain.	Designed and constructed stream channels sized to convey bankfull flows that will maintain a stable dimension, profile, and planform based on modeling, watershed conditions, and reference reach conditions.	Dispersion of high flows on the floodplain, increase in biogeochemical cycling within the system.	Four bankfull (BF) events and within monitoring period. Intermittent stream reaches must have 30 days of consectutive flow.	Stage recorder on JH1-B, and flow gauge on JH1-A.	4 BF - MY1 2 BF - MY2 47 flow days - MY1 93 flow days - MY2
To transport water within streams and floodplains in a stable, non-erosive, non-aggrading manner.	Improved flood bank connectivity by reducing bank height ratios and increase entrenchment ratios	Reduction in sediment inputs from bank erosion, reduction of shear stress, and improved overall hydraulic function.	Bank height ratios remain below 1.2. Visual assessments showing progression towards stability.	14 Cross section surveys	14/14 with BHR<1.2 - MY1 14/14 with BHR<1.2 - MY2
Restore and preserve native floodplain and streambank vegetation.	Established and increased forested riparian buffers to 50 feet and greater along both sides of the channel along the project reaches with a hardwood riparian plant community;	Reduction in floodplain sediment inputs from runoff, increased bank stability, increased LWD and organic material in streams, increased	Survival rate of 320 stems per acre at MY3, 260 planted stems per acre and 7 ft. tall at MY5, and 210 stems per acre and 10 ft. tall at MY7.	Seven fixed vegetation plots and four random vegetation plots (11 total plots)	11/11 passed - MY1 11/11 passed - MY2

Table 3. Project Attribute Table			
Project Name	Strawberry Hill Mitigation Project		
County	Johnston		
Project Area (acres)	22.12		
Project Coordinates (latitude and longitude decimal	35.469579, -78.323896		
Project Watershed Summary Information			
Physiographic Province	65m - Rolling Coastal Plain		
River Basin	Neuse		
USGS Hydrologic Unit 8-digit	3020201		
DWR Sub-basin	03-04-02		
Project Drainage Area (acres)	383 ac		
Project Drainage Area Percentage of Impervious Area	2%		
Land Use Classification	Bottomland Forest, Cultivated, Evergreen Shrubland, Southern Yellow Pine, Unconsolidated Sediment		
Reach Summary Information			
Parameters	**Reach JH1-A**	**Reach JH1-B**	
Pre-project length (feet)	901	2,336	
Post-project (feet)	1,007	2,712	
Valley confinement (Confined, moderately confined,	Unconfined	Unconfined	
Drainage area (acres)	193 ac	266 ac	
Perennial, Intermittent, Ephemeral	Intermittent	Intermittent	
NCDWR Water Quality Classification	None	None	
Dominant Stream Classification (existing)	F5	F5	
Dominant Stream Classification (proposed)	C5/E5	C5/E5	
Dominant Evolutionary class (Simon) if applicable	II	II	
Regulatory Considerations			
Parameters	**Applicable?**	**Resolved?**	**Supporting Docs?**
Water of the United States - Section 404	Yes	Yes	See PCN Approval
Water of the United States - Section 401	Yes	Yes	See PCN Approval
Endangered Species Act	Yes	Yes	Mit Plan, Appendix L
Historic Preservation Act	Yes	Yes	Mit Plan, Appendix L
Coastal Zone Management Act (CZMA or CAMA)	No	N/A	N/A
Essential Fisheries Habitat	No	N/A	N/A

1.4 Construction and As-Built Conditions

Project construction was completed on January 20th, 2022, and planting was completed on March 7th, 2022. The Strawberry Hill Project was built to design plans and guidelines. The record drawings are included in within the baseline report.

There were no changes to the planting plan. However, as some high-quality tree species were found within the cutover areas that were timbered over eight years ago, these species were left in place where feasible. Minor monitoring device location changes were made during as-built installation, however, the quantities remained as proposed in the Mitigation Plan.

1.5 Monitoring Performance (MY2)

The Strawberry Hill Year 2 Monitoring activities were performed in June and October 2023. All monitoring data is presented below and in the appendices. The Project is on track to meeting stream and vegetation interim success criteria.

1.5.1 Vegetation

Monitoring of the seven permanent vegetation plots and four random vegetation plots were completed October 3rd, 2023. Vegetation data are in **Appendix B**, associated photos are in

Appendix B, and plot locations are in **Appendix A**. MY2 monitoring data indicates that all plots are exceeding the interim success criteria of 320 planted stems per acre. Planted stem densities ranged from 445 to 688 planted stems per acre with a mean of 567 planted stems per acre across all plots. A total of twelve planted species were documented within the plots. Seven volunteer species were identified across the plots, and it is expected that more volunteers will establish in upcoming years. The average planted stem height in the vegetation plots was 2.6 feet.

Visual assessment of vegetation outside of the monitoring plots indicates that herbaceous vegetation is establishing in much of the riparian area. However, areas where Priority II stream restoration activities involved extensive grading are struggling to establish dense vegetative cover though still have adequate tree density at this time. The total area of bare areas amounts to 3.77 acres and are depicted in **Figure 2**. In November 2023, RES applied an organic soil amendment in the form of humic acid to these areas to promote soil health and vegetative growth while minimizing damage to planted trees. RES also noted that loblolly pine (*Pinus taeda*) is establishing in some areas, totaling about 3.9 acres (**Figure 2**). The pines are still short, but RES plans to treat these promptly to minimize their competition with desirable trees.

Inspection of the easement determined two minor encroachments have occurred. One area is located at the boundary edge near the top of JH1-B where the adjacent landowner is mowing his lawn around several of his fruit trees at the boundary, but no planted trees are harmed, and the areal coverage is minimal. For this issue, RES plans to discuss alternative, allowable methods with the landowner to protect his fruit trees while complying with the easement restrictions. Another area occurs at the lower end of JH1-B along the adjacent crop field. Farm equipment has slighty "scalloped" into the easement boundary. However, it is narrow enough that trees do not appear to be affected. For this issue, RES plans to add more easement markers along the boundary at shorter intervals to provide a more visible line. Additionally, RES did document several markers (t-posts and signs) throughout the Project area had been damaged by farm equipment along some of the crop field edges. RES will repair or replace these markers.

1.5.2 Stream Hydrology

One flow gauge and one stage recorder are documenting conditions on reaches JH1-A and JH1-B, respectively. The stage recorder is in place to document bankfull events. The flow gauge is in place to document presence and persistence of stream flow in the intermittent channel. In addition, a camera rig (flow camera) was installed in conjunction with the flow gauge on JH1-A in the attempt to capture daily images of stream flow through the riffle.

- The stage recorder on JH1-B recorded two bankfull events in MY2 with the highest stage occurring on August 31st, 2023 and measuring 0.24 feet above top of bank.
- The flow gauge on JH1-A recorded 15 flow events with the longest consecutive flow event lasting 93 days between January 22nd, 2023 and April 25th, 2023.
    - Concurrently, the flow camera captured daily images and visibly indicated about 10 flow events with the longest observable flow event lasting approximately 91 days between January 22nd,2023 and April 23rd, 2023. Evidence of flow is difficult to

observe in the images during the growing season as wetland and aquatic vegetation establishes in the shallow, intermittent stream and obstructs view.

Appendix E presents rainfall and stream hydrology data, including tables, hydrographs, and samples of flow camera photos during the longest flow event. Gauge locations can be found on **Figure 2** and photos are in **Appendix A**.

1.5.3 Stream Geomorphology

Cross section surveys and geomorphology data collection for MY2 was collected on June 13th, 2023. Summary tables and cross section plots are in **Appendix C**. Overall, there is very little change in cross sections, and they match the proposed design. MY2 conditions show that shear stress and velocities have been reduced for all restoration reaches. All reaches were designed as gravel bed channels and remain classified as gravel bed channels in MY2.

Visual assessment of the stream channel was performed to document signs of instability, such as eroding banks, structural instability, or excessive sedimentation. The channel is transporting sediment as designed and will continue to be monitored for aggradation and degradation (**Appendix C**). RES also established permanent photo points (PP-1 through PP-5) at all the constructed "hay bale toes" on reach JH1-A as these structure types have received considerable attention from the IRT in recent years. RES intends to take photos of their condition each year to present their ongoing condition. As of MY2, the hay bale toes appear stable and are absorbing sediment and live stake trees are successfully rooting in them. Photos are in **Appendix A** and corresponding photo point locations are depicted in **Figure 2**. RES also noted that NCDOT has replaced the culvert at Brogden Road and reach JH1-B, just below the downstream extent of the Project. The construction of the new crossing appears to have involved the removal of the suspected beaver dam downstream; therefore, water is no longer backing up within JH1-B. Photos of the new culvert are in **Appendix B**.

2 REFERENCES

Lee Michael T., Peet Robert K., Roberts Steven D., and Wentworth Thomas R., 2008. "CVS-EEP Protocol for Recording Vegetation Level." Version 4.2

North Carolina Division of Mitigation Services (NCDMS). "Neuse River Basin Restoration Priorities 2010. Amended August 2018."

Peet, R.K., Wentworth, T.S., and White, P.S. (1998). "A flexible, multipurpose method for recording vegetation composition and structure." Castanea 63:262-274

Resource Environmental Solutions (2020). "Strawberry Hill Final Mitigation Plan".

US Army Corps of Engineers (USACE). (2016). "Wilmington District Stream and Wetland Compensatory Mitigation Update." NC: Interagency Review Team (IRT).

Appendix A

Visual Assessment Data

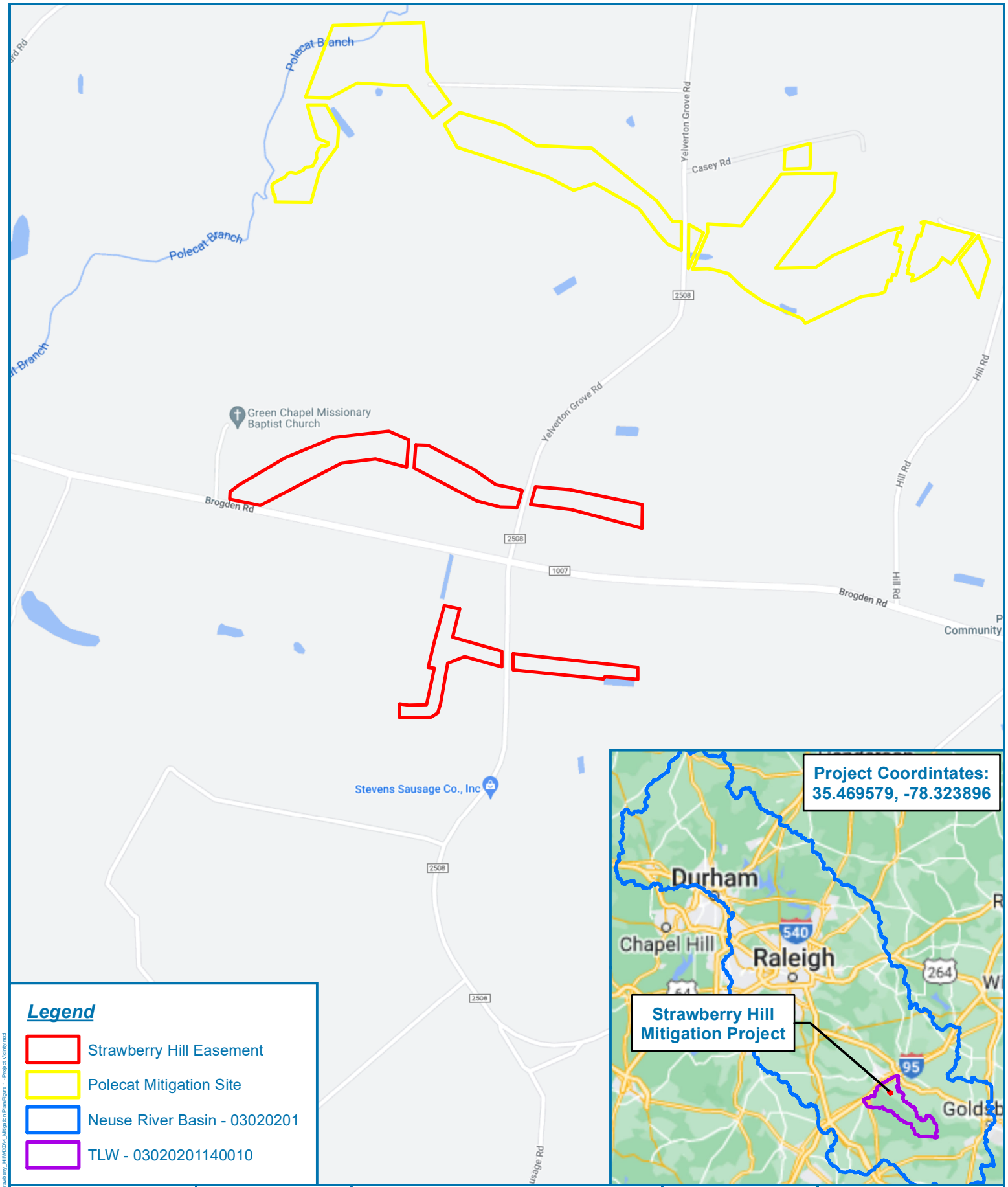


Figure 1 - Site Location Map

Strawberry Hill Mitigation Project

Johnston County, North Carolina

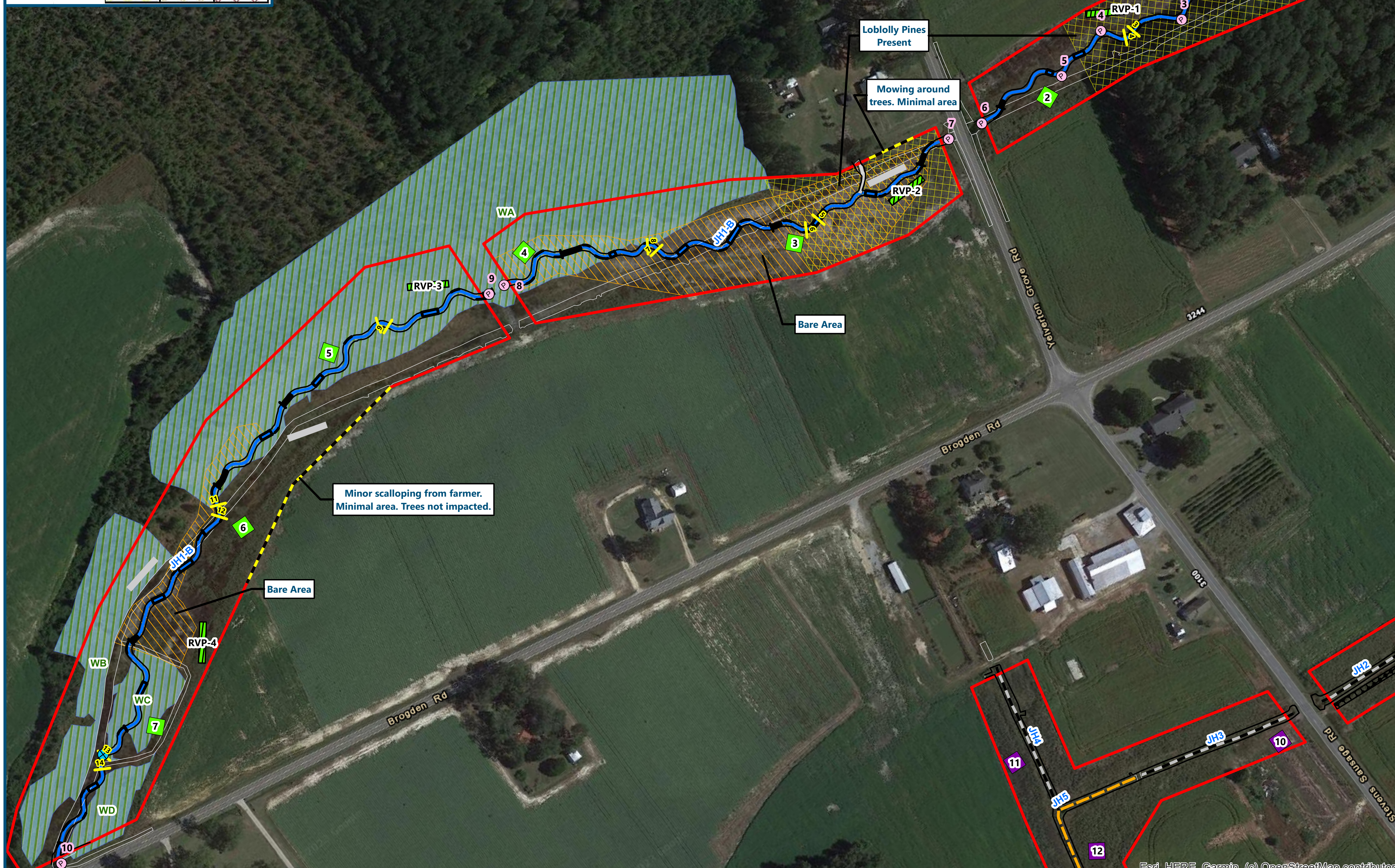
Date:	3/8/2022
Drawn by:	MDD
Checked by:	JRM
	1 inch = 1,000 feet

res

Document Path: R:\Regulatory\Projects\101018_Strawberry_Hill\MXD\4_Mitigation Plan\Figure 1 - Project Vicinity.mxd

Vegetation Condition Assessment

Invasive Species	Target Community: Present	Marginal	Absent
Absent	No Fill		
Present			



res
Restoring a resilient earth for a modern world

N E S W

0 100 200
Feet

Figure 2a - CCPV MY2 2023

Strawberry Hill Mitigation Project

Johnston County, North Carolina

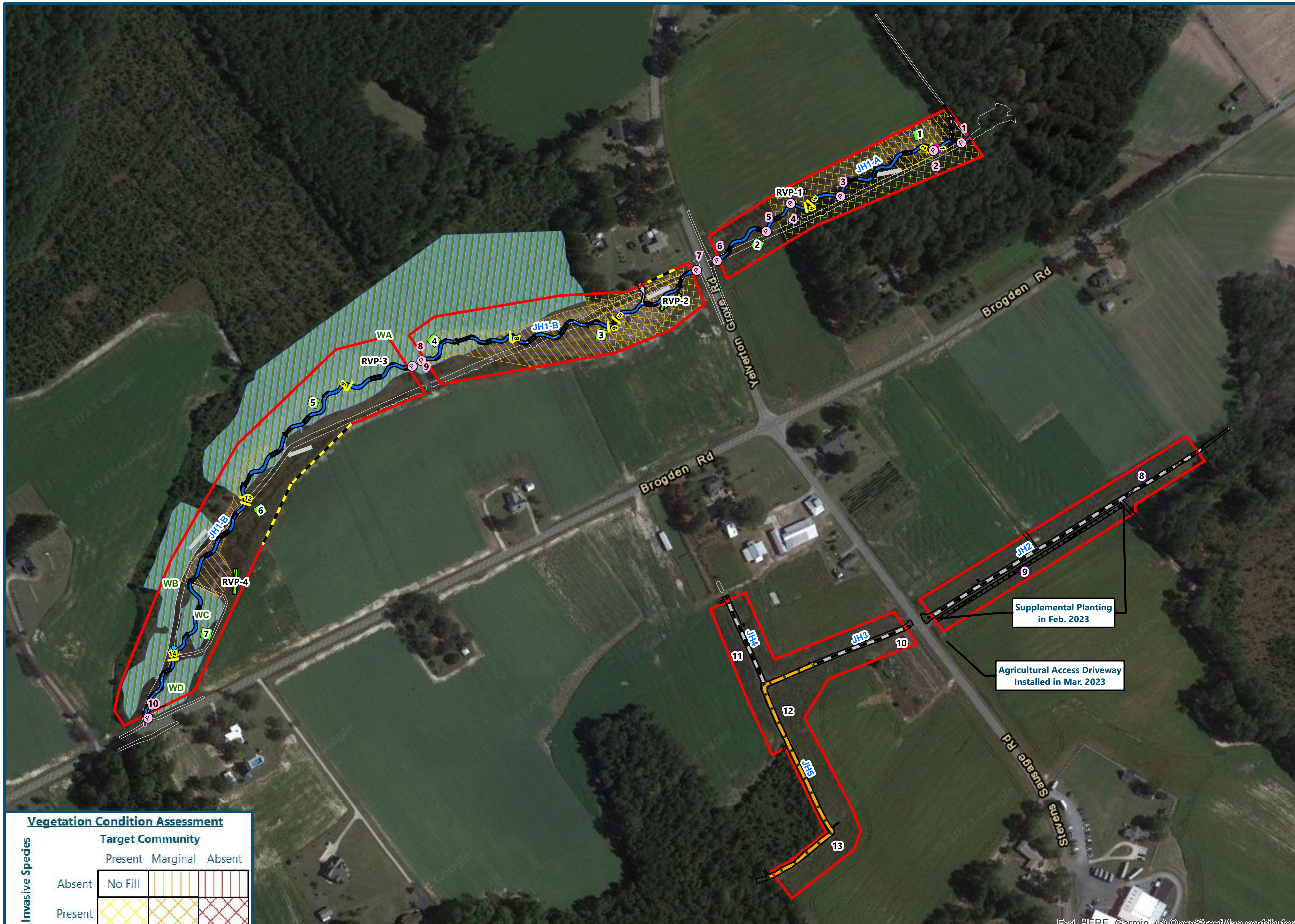
Date: 1/11/2024	Drawn by: MDD
1 in = 200 feet	Checked by: JRM

Recorded Easement (22.12 ac)

Fixed Vegetation Plot
- >320 stems/acre
- Buffer Only

Random Vegetation Plot
- >320 Stems/acre
- MY1 Random Vegetation Plot
- Existing Wetlands
- Pre-existing Top of Bank
- Surveyed Top of Bank
- Stream Structure
- Cross-section
- Encroachment Line

Stream Mitigation Approach
- Restoration
- No Credit
- Ditch
- Swale
- Stage Recorder
- Flow Gauge
- Photo Locations



res

Restoring a resilient earth for a modern world

N E S W

0 150 300

Feet

Figure 2b - CCPV MY2 2023

Strawberry Hill Mitigation Project

Johnston County, North Carolina

Date: 1/11/2024	Drawn by: MDD
1 in = 300 feet	Checked by: JRM

Legend

- Recorded Easement (22.12 ac)
- Supplemental Planting
- Existing Wetlands

Fixed Vegetation Plot

- >320 stems/acre
- Buffer Only

Random Vegetation Plot

- >320 Stems/acre
- MY1 Random Vegetation Plot
- Pre-existing Top of Bank
- Surveyed Top of Bank
- Stream Structure
- Cross-section
- Encroachment Line

Stream Mitigation Approach

- Restoration
- No Credit
- Ditch
- Swale
- Stage Recorder
- Flow Gauge
- Photo Locations

Visual Stream Stability Assessment

Reach JH1-A

Assessed Stream Length 1007

Assessed Bank Length 2014

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	9	9		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	7	7		100%

Visual Stream Stability Assessment

Reach JH1-B

Assessed Stream Length 2712

Assessed Bank Length 5424

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	21	21		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	28	28		100%

Visual Vegetation Assessment

Planted acreage **19.73**

Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	3.77	19.1%
Low Stem Density Areas*	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.1 acres	0.00	0.0%
		Total		
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.25 acres	0.00	0.0%
		Cumulative Total		0.0%

Easement Acreage **22.12**

Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Invasives may occur outside of planted areas and within the easement and will therefore be calculated against the total easement acreage. Include species with the potential to directly outcompete native, young, woody stems in the short-term or community structure for existing communities. Species included in summation above should be identified in report summary.	1000 SF	3.90	19.8%
Easement Encroachment Areas	Encroachment may be point, line, or polygon. Encroachment to be mapped consists of any violation of restrictions specified in the conservation easement. Common encroachments are mowing, cattle access, vehicular access. Encroachment has no threshold value as will need to be addressed regardless of impact area.	none	- Minor lawn mowing around trees at boundary near top of JH1-B. Minimal area. - Slight scalloping by farmer toward mid-lower end of JH1-B. Trees not affected.	

Strawberry Hill General Site Photos (MY2)

Photo Point 1 (PP-1) Hay Bale Toe (5/19/2023)

PP-1 Hay Bale Toe (10/3/2023)

PP-2 Hay Bale Toe (5/19/2023)

PP-2 Hay Bale Toe (10/3/2023)

PP-3 Hay Bale Toe (5/19/2023)

PP-3 Hay Bale Toe (10/3/2023)

PP-4 Hay Bale Toe (10/3/2023)

PP-4 Hay Bale Toe (10/3/2023)

PP-5 Hay Bale Toe (5/19/2023)

PP-5 Hay Bale Toe (10/3/2023)

JH1-A Upstream (5/19/2023)

Pines in JH1-A Riparian Area (10/3/2023)

Bare Area in JH1-A Riparian Area (10/3/2023)

Sunflowers in JH1-A Riparian Area (10/3/2023)

JH1-A Upstream (10/3/2023)

JH1-B Downstream (10/3/2023)

JH1-B Riparian Area (10/3/2023)

JH1-B Upstream (5/19/2023)

JH1-B Downstream (5/19/2023)

Crayfish Burrow in Riparian Wetland Area (6/13/2023)

Strawberry Hill Crossing Photos (MY2)

PP-6 DOT Culvert at Yelverton Grove Rd. (Entrance) (10/3/2023)

PP-7 DOT Culvert at Yelverton Grove Rd. (Exit) (10/3/2023)

PP-8 Culvert at JH1-B Crossing (Entrance) (10/3/2023)

PP-9 Culvert at JH1-B Crossing (Exit) (10/3/2023)

PP-10 **New** DOT Culvert at Brogden Rd. (Entrance) (10/3/2023)

Strawberry Hill Monitoring Device Photos (MY2)

Flow Gauge JH1-A (Looking Upstream) (10/3/2023)

Flow Camera JH1-A (6/13/2023)

Stage Recorder JH1-B (Looking Downstream) (10/3/2023)

Appendix B

Vegetation Plot Data

Table 7. Planted Species Summary

Common Name	Species	% Zone 1	% Zone 2	Total Planted Amount
River birch	*Betula nigra*	10	10	1,600
Buttonbush	*Cephalanthus occidentalis*	5	5	800
Yellow poplar	*Liriodendron tulipifera*	10	10	1,600
Wax Myrtle	*Morella cerifera*	5	10	1,000
Swamp tupelo	*Nyssa biflora*	5	5	800
American sycamore	*Platanus occidentalis*	10	10	1,600
Laurel oak	*Quercus laurifolia*	5	10	1,000
Overcup oak	*Quercus lyrata*	10	10	1,600
Swamp chestnut oak	*Quercus michauxii*	10	10	1,600
Water oak	*Quercus nigra*	10	10	1,600
Willow oak	*Quercus phellos*	10	10	1,600
Bald cypress	*Taxodium distichum*	10	0	1,000
			TOTAL	15,800

Table 8. Vegetation Plot Mitigation Success Summary

Plot #	Planted Stems/Acre	Volunteer Stems/Acre	Total Stems/Acre	Success Criteria Met?	Average Planted Stem Height
1	647	0	647	Yes	2.0
2	607	324	931	Yes	3.4
3	486	162	647	Yes	1.6
4	688	243	931	Yes	1.4
5	567	688	1255	Yes	3.2
6	567	607	1174	Yes	3.0
7	526	0	526	Yes	2.2
R1	486	0	486	Yes	3.6
R2	445	0	445	Yes	2.9
R3	567	0	567	Yes	2.6
R4	486	0	486	Yes	3.4
Project Avg	**567**	**289**	**856**	**Yes**	**2.6**

Table 9. Stem Count Total and Planted by Plot Species

Strawberry Hill			Current Plot Data (MY2 2023)																					
			101038-01-0001			101038-01-0002			101038-01-0003			101038-01-0004			101038-01-0005			101038-01-0006			101038-01-0007		
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	red maple	Tree															3						
Baccharis	baccharis	Shrub															1			15			
Betula nigra	river birch	Tree	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	2	2	2			
Cephalanthus occidentali	common buttonbush	Shrub				1	1	1															
Clethra alnifolia	coastal sweetpepper	Shrub															1						
Liquidambar styraciflua	sweetgum	Tree						2						6			11						
Liriodendron tulipifera	tuliptree	Tree	1	1	1	1	1	1				2	2	2									
Magnolia virginiana	sweetbay	Tree															1						
Morella cerifera	wax myrtle	shrub	2	2	2										1	1	1	2	2	2	4	4	4
Nyssa biflora	swamp tupelo	Tree																					
Pinus	pine	Tree									4												
Platanus occidentalis	American sycamore	Tree							2	2	2				3	3	3				2	2	2
Quercus laurifolia	laurel oak	Tree	2	2	2				3	3	3	2	2	2							1	1	1
Quercus lyrata	overcup oak	Tree	3	3	3	2	2	2				2	2	2	4	4	4						
Quercus michauxii	swamp chestnut oak	Tree				2	2	2	2	2	2	1	1	1				6	6	6			
Quercus nigra	water oak	Tree	2	2	2							1	1	1	2	2	2	2	2	2	2	2	2
Quercus phellos	willow oak	Tree	1	1	1	1	1	1	3	3	3	4	4	4	1	1	1	1	1	1	1	1	1
Sambucus	elderberry	Shrub						6															
Taxodium distichum	bald cypress	Tree	3	3	3	6	6	6				3	3	3				1	1	1	3	3	3
		Stem count	16	16	16	15	15	23	12	12	16	17	17	23	14	14	31	14	14	29	13	13	13
		size (ares)	1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	8	8	8	7	7	9	5	5	6	8	8	9	6	6	11	6	6	7	6	6	6
		Stems per ACRE	647.5	647.5	647.5	607	607	930.8	485.6	485.6	647.5	688	688	930.8	566.6	566.6	1255	566.6	566.6	1174	526.1	526.1	526.1

Strawberry Hill			Current Random Plot Data (MY2 2023)												Annual Means								
			R1			R2			R3			R4			MY2 (2023)			MY1 (2022)			MY0 (2022)		
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	red maple	Tree															3						
Baccharis	baccharis	Shrub															16						
Betula nigra	river birch	Tree	2	2	2				1	1	3				16	16	18	30	30	30	27	27	27
Cephalanthus occidentali	common buttonbush	Shrub													1	1	1	3	3	3	6	6	6
Clethra alnifolia	coastal sweetpepper	Shrub									1						2						
Liquidambar styraciflua	sweetgum	Tree															19						
Liriodendron tulipifera	tuliptree	Tree	1	1	1	2	2	2	2	2	2				9	9	9	7	7	7	21	21	21
Magnolia virginiana	sweetbay	Tree															1						
Morella cerifera	wax myrtle	shrub				1	1	1	3	3	3	1	1	1	14	14	14	10	10	10	20	20	20
Nyssa biflora	swamp tupelo	Tree							1	1	1				1	1	1	1	1	1	11	11	11
Pinus	pine	Tree															4						
Platanus occidentalis	American sycamore	Tree										6	6	6	13	13	13	10	10	10	12	12	12
Quercus laurifolia	laurel oak	Tree													8	8	8	5	5	5	26	26	26
Quercus lyrata	overcup oak	Tree	1	1	1	4	4	4	1	1	1	1	1	1	18	18	18	8	8	8	19	19	19
Quercus michauxii	swamp chestnut oak	Tree	3	3	3	1	1	1	2	2	2	2	2	2	19	19	19	21	21	21	15	15	15
Quercus nigra	water oak	Tree													9	9	9	15	15	15	26	26	26
Quercus phellos	willow oak	Tree	2	2	2	2	2	2							16	16	16	25	25	25	27	27	27
Sambucus	elderberry	Shrub															6			3			
Taxodium distichum	bald cypress	Tree	3	3	3	1	1	1	1	1	1	2	2	2	23	23	23	22	22	22	24	24	24
		Stem count	12	12	12	11	11	11	11	11	14	12	12	12	147	147	200	157	157	160	234	234	234
		size (ares)	1			1			1			1			11			11			11		
		size (ACRES)	0.02			0.02			0.02			0.02			0.27			0.27			0.27		
		Species count	6	6	6	6	6	6	7	7	8	5	5	5	12	12	19	12	12	13	12	12	12
		Stems per ACRE	485.6	485.6	485.6	445.2	445.2	445.2	445.2	445.2	566.6	485.6	485.6	485.6	540.8	540.8	735.8	577.6	577.6	588.6	860.9	860.9	860.9

Strawberry Hill Stream Vegetation Monitoring Plot Photos (MY2)

Fixed Vegetation Plot 1 (10/03/2023)

Fixed Vegetation Plot 2 (10/03/2023)

Fixed Vegetation Plot 3 (10/03/2023)

Fixed Vegetation Plot 4 (10/03/2023)

Fixed Vegetation Plot 5 (10/03/2023)

Fixed Vegetation Plot 6 (10/03/2023)

Fixed Vegetation Plot 7 (10/03/2023)

Strawberry Hill Stream Random Vegetation Monitoring Plot Photos (MY1)

Random Vegetation Plot 1 (10/03/2023)

Random Vegetation Plot 2 (10/03/2023)

Random Vegetation Plot 3 (10/03/2023)

Random Vegetation Plot 4 (10/03/2023)

Appendix C

Stream Morphology Data

Table 10. Baseline Stream Data Summary

Baseline Stream Data Summary Strawberry Hill JH1-A										
Parameter	**Pre-Existing Condition (applicaple)**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	6.7	9.3	9.3	11.8	2		9.6	9.6	10.1	2
Floodprone Width (ft)	12.4	14.0	14.0	15.5	2		>25	30	30	2
Bankfull Mean Depth (ft)	0.7	0.9	0.9	1.1	2		0.9	---	---	2
Bankfull Max Depth (ft)	1.2	1.4	1.4	1.5	2		1.4	1.3	1.5	2
Bankfull Cross Sectional Area (ft^2)	7.1	7.7	7.7	8.3	2		8.8	8.2	9.2	2
Width/Depth Ratio	6.3	11.6	11.6	16.9	2		10.4	---	---	2
Entrenchment Ratio	1.3	1.6	1.6	1.9	2		>2.2	>3.0	>3.1	2
Bank Height Ratio	1.5	1.7	1.7	1.9	2		1.0	**1**	**1**	2
Max part size (mm) mobilized at bankfull										
Rosgen Classification	F5					C5/E5		C5/E5		
Bankfull Discharge (cfs)										
Sinuosity (ft)	1.00					1.13		1.13		
Water Surface Slope (Channel) (ft/ft)										
Other										

Table 10. Baseline Stream Data Summary (cont'd)

Baseline Stream Data Summary Strawberry Hill JH1-B										
Parameter	**Pre-Existing Condition (applicaple)**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	9.3	9.5	9.5	9.6	2		9.6	8.8	11.1	5
Floodprone Width (ft)	11.6	15.9	15.9	20.2	2		>25	>30	>30	5
Bankfull Mean Depth (ft)	0.9	0.9	0.9	1.0	2		0.9	---	---	5
Bankfull Max Depth (ft)	1.4	1.5	1.5	1.6	2		1.4	1.4	1.6	5
Bankfull Cross Sectional Area (ft^2)	8.5	8.9	8.9	9.3	2		8.8	7.3	9.1	5
Width/Depth Ratio	9.3	10.1	10.1	10.8	2		10.4	---	---	5
Entrenchment Ratio	1.2	1.7	1.7	2.1	2		>2.2	>2.7	>3.4	5
Bank Height Ratio	1.7	2.0	2.0	2.3	2		1.0	**1**	**1**	5
Max part size (mm) mobilized at bankfull										
Rosgen Classification	F5					C5/E5		C5/E5		
Bankfull Discharge (cfs)										
Sinuosity (ft)	1.01					1.14		1.14		
Water Surface Slope (Channel) (ft/ft)										
Other										

Monitoring Data - Cross Section Morphology Monitoring Summary
Strawberry Hill/ DMS:100094 Reaches: JH1-A and JH1-B

	Cross Section 1 (Pool - JH1-A)							Cross Section 2 (Riffle - JH1-A)							Cross Section 3 (Riffle - JH1-A)							Cross Section 4 (Pool - JH1-A)							Cross Section 5 (Riffle - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull [1] Area	---	---	---					139.30	139.22	139.29					138.85	138.88	138.91					---	---	---					137.97	137.93	137.97				
Bank Height Ratio_Based on AB Bankfull [1] Area	---	---	---					1.00	1.04	1.00					1.00	0.96	0.97					---	---	---					1.00	0.97	0.94				
Thalweg Elevation	137.24	137.23	137.28					137.98	137.97	137.73					137.34	137.29	137.33					136.57	136.71	136.72					136.42	136.38	136.35				
LTOB[2] Elevation	138.91	138.93	138.59					139.30	139.27	139.29					138.85	138.82	138.86					138.71	138.78	138.67					137.97	137.88	137.88				
LTOB[2] Max Depth (ft)	1.67	1.70	1.31					1.32	1.30	1.56					1.51	1.53	1.53					2.14	2.07	1.95					1.55	1.51	1.53				
LTOB[2] Cross Sectional Area (ft^2)	7.60	9.00	5.40					8.20	8.70	8.70					9.20	8.60	8.70					13.70	14.40	13.00					9.10	8.60	8.20				

	Cross Section 6 (Pool - JH1-B)							Cross Section 7 (Riffle - JH1-B)							Cross Section 8 (Pool - JH1-B)							Cross Section 9 (Riffle - JH1-B)							Cross Section 10 (Pool - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull [1] Area	---	---	---					137.52	137.52	137.53					---	---	---					136.88	136.83	136.85					---	---	---				
Bank Height Ratio_Based on AB Bankfull [1] Area	---	---	---					1.00	0.97	0.96					---	---	---					1.00	1.03	0.99					---	---	---				
Thalweg Elevation	135.85	135.80	135.88					136.12	136.12	136.11					135.40	135.32	135.47					135.53	135.43	135.36					134.94	134.82	134.81				
LTOB[2] Elevation	137.91	137.86	137.92					137.52	137.48	137.48					137.57	137.52	137.66					136.88	136.87	136.83					136.81	136.81	136.76				
LTOB[2] Max Depth (ft)	2.05	2.06	2.04					1.40	1.36	1.37					2.17	2.20	2.19					1.36	1.44	1.47					1.87	1.99	1.95				
LTOB[2] Cross Sectional Area (ft^2)	11.50	11.70	11.50					8.30	7.90	7.80					12.50	11.40	12.90					8.30	8.70	8.20					12.20	12.20	11.60				

	Cross Section 11 (Riffle - JH1-B)							Cross Section 12 (Pool - JH1-B)							Cross Section 13 (Pool - JH1-B)							Cross Section 14 (Riffle - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull [1] Area	136.18	136.16	136.25					---	---	---					---	---	---					135.15	135.07	135.16				
Bank Height Ratio_Based on AB Bankfull [1] Area	1.00	1.10	1.02					---	---	---					---	---	---					1.00	1.00	0.95				
Thalweg Elevation	134.81	134.87	134.96					134.35	134.27	134.21					133.13	133.09	133.12					133.64	133.59	133.70				
LTOB[2] Elevation	136.18	136.29	136.28					136.22	136.24	136.23					135.07	134.92	135.02					135.15	135.08	135.08				
LTOB[2] Max Depth (ft)	1.37	1.43	1.32					1.87	1.98	2.02					1.93	1.83	1.90					1.51	1.49	1.38				
LTOB[2] Cross Sectional Area (ft^2)	7.30	8.50	7.60					10.10	11.20	11.30					9.70	8.20	8.50					8.30	8.30	7.50				

The above morphology parameters reflect the 2018 guidance that arose from the mitigation technical workgroup consisting of DMS, the IRT and industry mitigation providers/practitioners. The outcome resulted in the focus on three primary morphological parameters of interest for the purposes of tracking channel change moving forward. They are the bank height ratio using a constant As-built bankfull area and the cross sectional area and max depth based on each years low top of bank. These are calculated as follows:

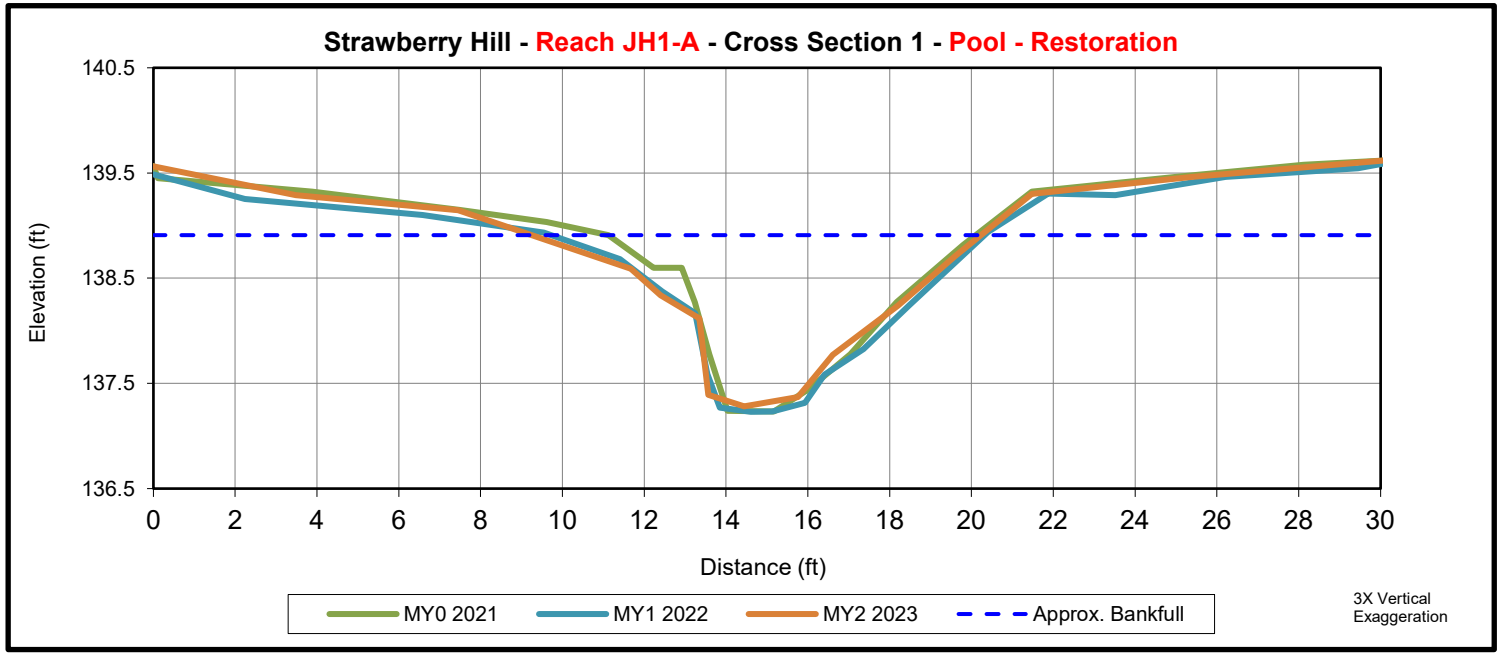
1 - **Bank Height Ratio (BHR)** takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation. For example if the As-built bankfull area was 10 ft2, then the MY1 bankfull elevation would be adjusted until the calculated bankfull area within the MY1 cross section survey = 10 ft2. The BHR would then be calculated with the difference between the low top of bank (LTOB) elevation for MY1 and the thalweg elevation for MY1 in the numerator with the difference between the MY1 bankfull elevation and the MY1 thalweg elevation in the denominator. This same process is then carried out in each successive year.

2 - **LTOB Area and Max depth -** These are based on the LTOB elevation for each years survey (The same elevation used for the LTOB in the BHR calculation). Area below the LTOB elevation will be used and tracked for each year as

Note: The smaller the channel the closer the survey measurements are to their limit of reliable detection, therefore inter-annual variation in morphological measurement (as a percentage) is by default magnified as channel size decereases. Some of the variability above is the result of this factor and some is due to the large amount of depositional sediments observed.

Upstream

Downstream

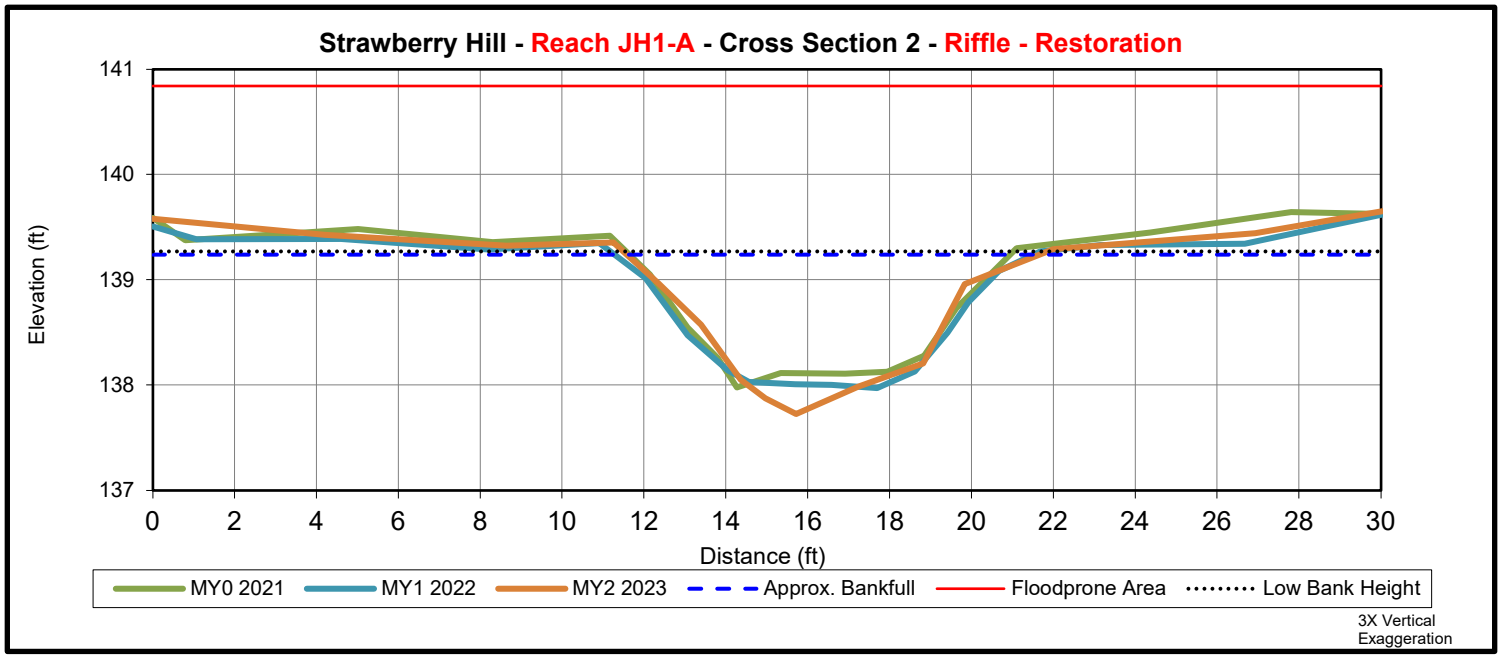


	Cross Section 1 (Pool - JH1-A)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	---	---	---				
Bank Height Ratio_Based on AB Bankfull[1] Area	---	---	---				
Thalweg Elevation	137.24	137.23	137.28				
LTOB[2] Elevation	138.91	138.93	138.59				
LTOB[2] Max Depth (ft)	1.7	1.70	1.31				
LTOB[2] Cross Sectional Area (ft^2)	7.60	9.00	5.40				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

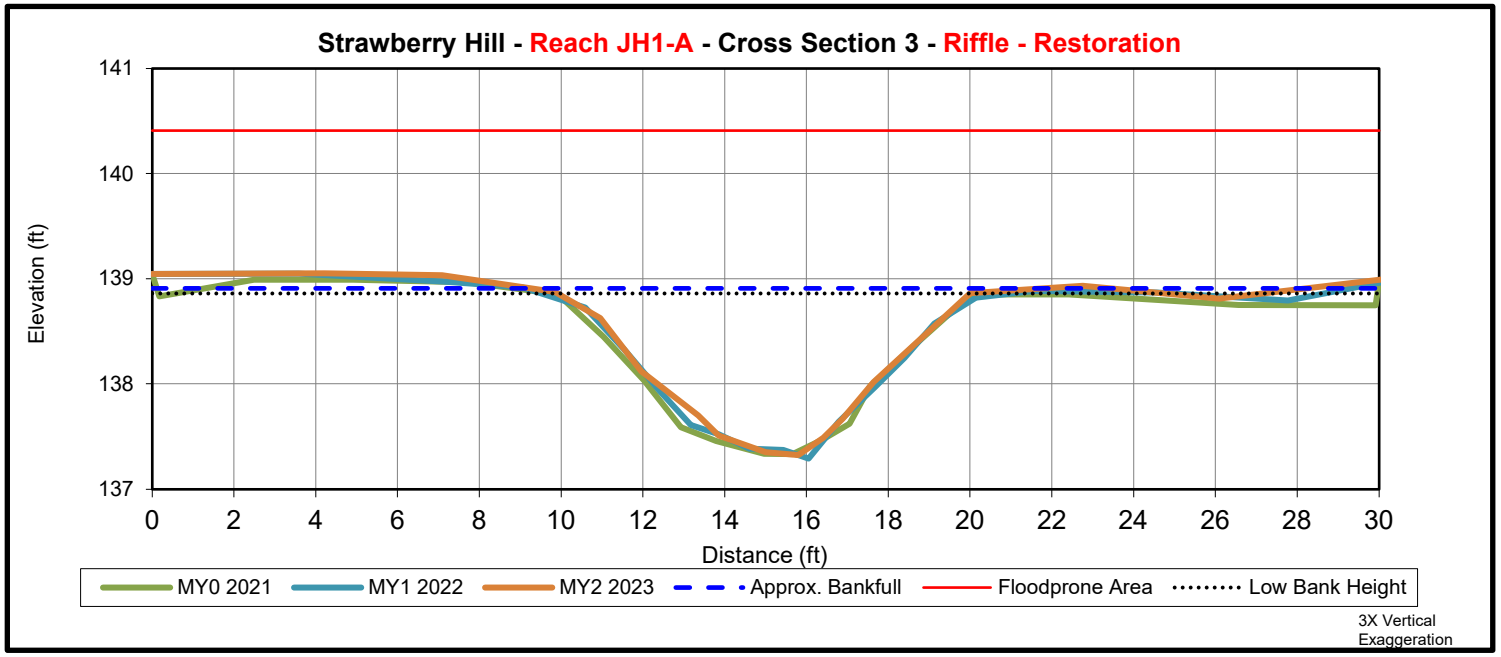


	Cross Section 2 (Riffle - JH1-A)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	139.30	139.22	139.29				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.04	1.00				
Thalweg Elevation	137.98	137.97	137.73				
LTOB[2] Elevation	139.30	139.27	139.29				
LTOB[2] Max Depth (ft)	1.3	1.30	1.56				
LTOB[2] Cross Sectional Area (ft^2)	8.20	8.70	8.70				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

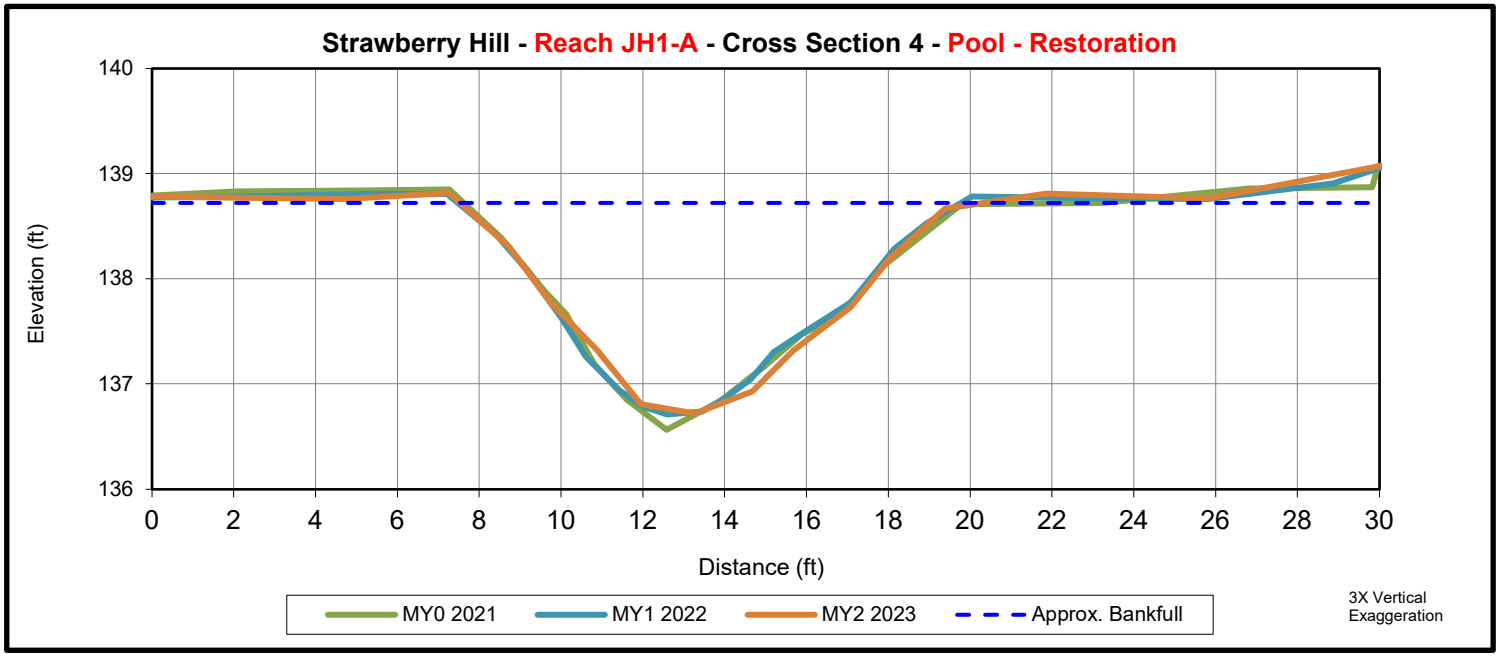


	Cross Section 3 (Riffle - JH1-A)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	138.85	138.88	138.91				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.96	0.97				
Thalweg Elevation	137.34	137.29	137.33				
LTOB[2] Elevation	138.85	138.82	138.86				
LTOB[2] Max Depth (ft)	1.5	1.53	1.53				
LTOB[2] Cross Sectional Area (ft^2)	9.20	8.60	8.70				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

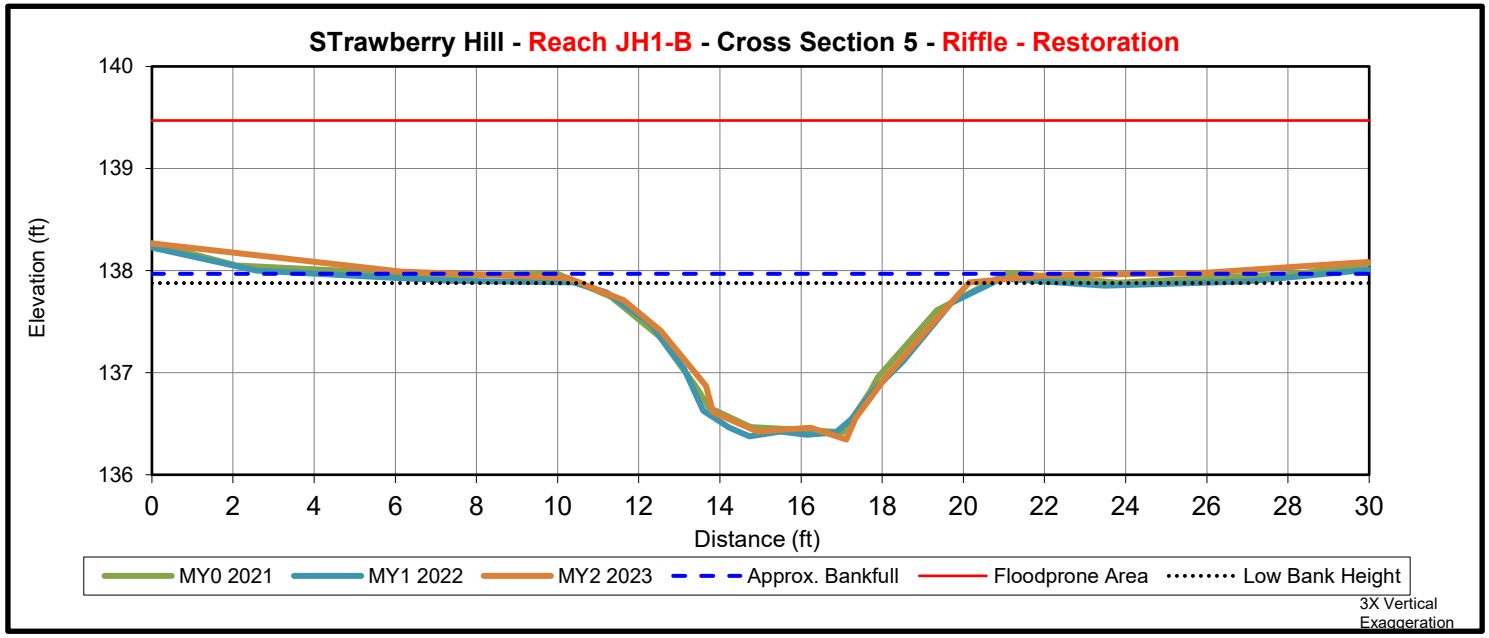


	Cross Section 4 (Pool - JH1-A)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	---	---	---				
Bank Height Ratio_Based on AB Bankfull[1] Area	---	---	---				
Thalweg Elevation	136.57	136.71	136.72				
LTOB[2] Elevation	138.71	138.78	138.67				
LTOB[2] Max Depth (ft)	2.1	2.07	1.95				
LTOB[2] Cross Sectional Area (ft^2)	13.70	14.40	13.00				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

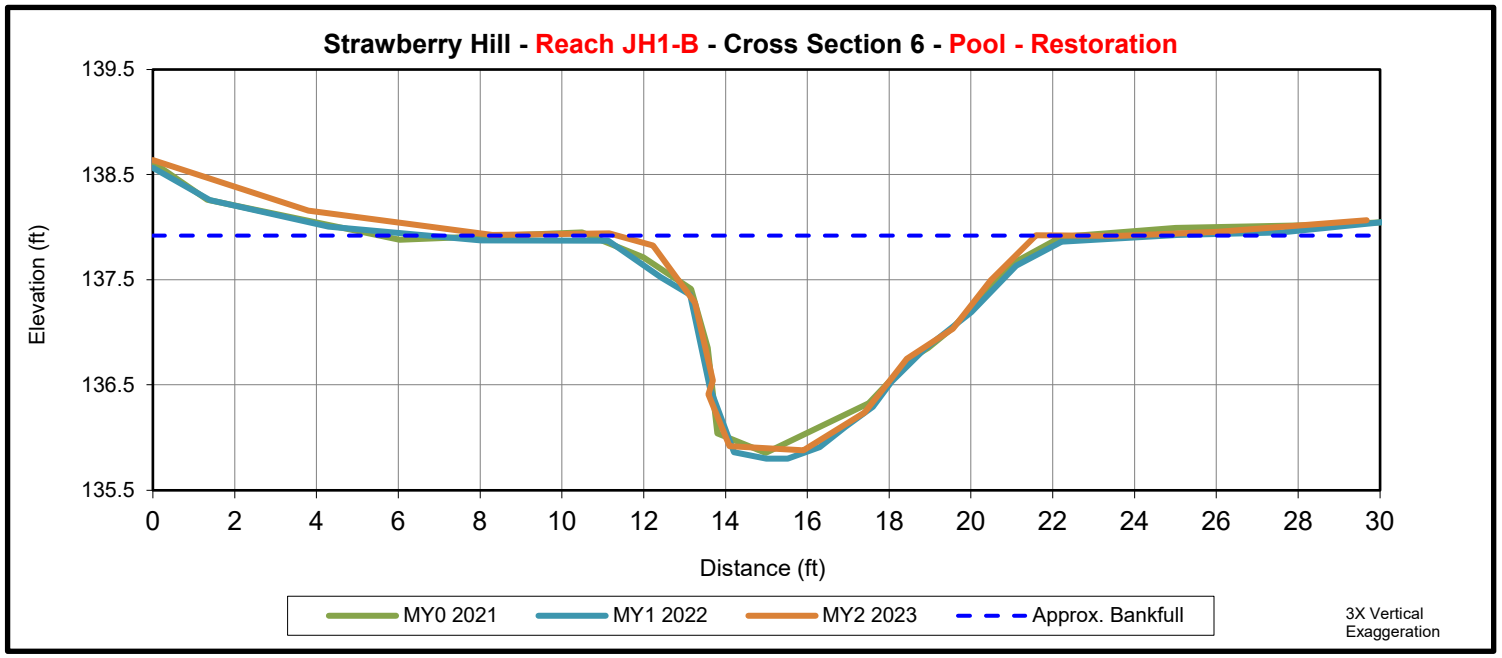


	Cross Section 5 (Riffle - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	137.97	137.93	137.97				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.97	0.94				
Thalweg Elevation	136.42	136.38	136.35				
LTOB[2] Elevation	137.97	137.88	137.88				
LTOB[2] Max Depth (ft)	1.6	1.51	1.53				
LTOB[2] Cross Sectional Area (ft^2)	9.10	8.60	8.20				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

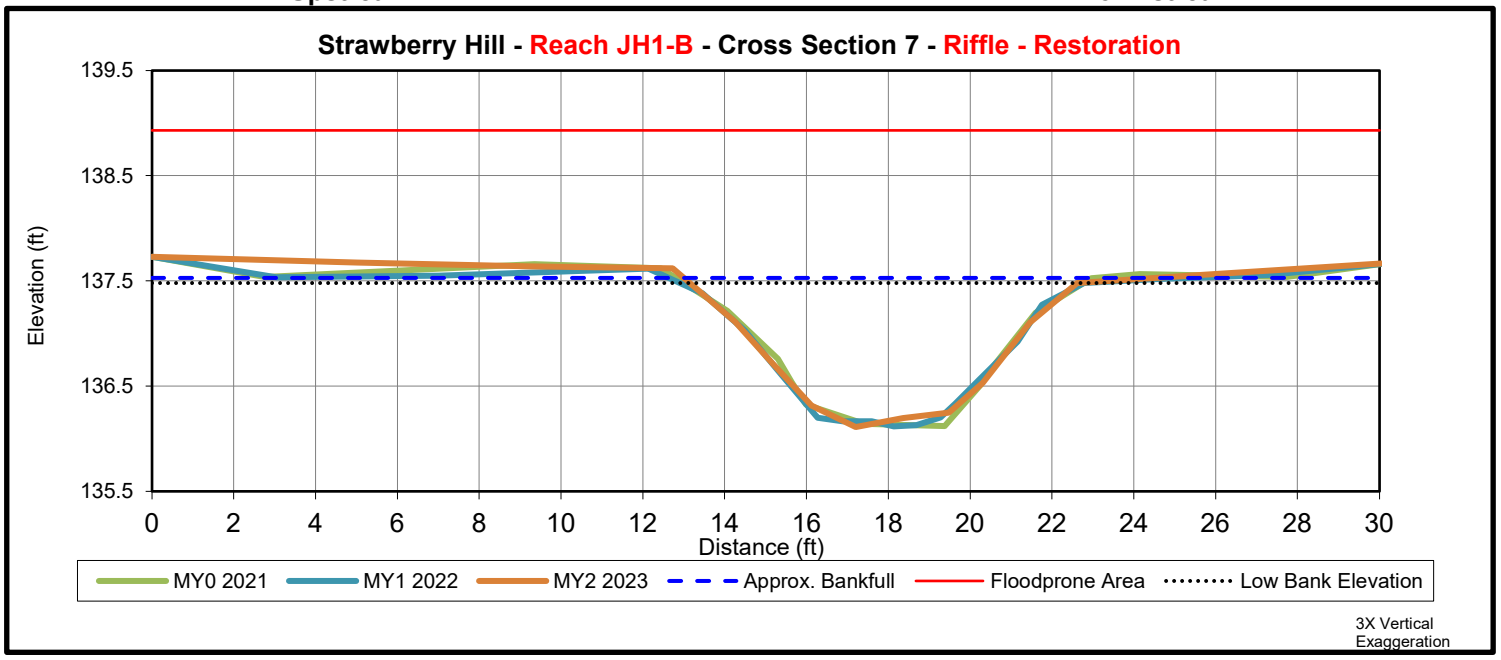


	Cross Section 6 (Pool - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	---	---	---				
Bank Height Ratio_Based on AB Bankfull[1] Area	---	---	---				
Thalweg Elevation	135.85	135.80	135.88				
LTOB[2] Elevation	137.91	137.86	137.92				
LTOB[2] Max Depth (ft)	2.1	2.06	2.04				
LTOB[2] Cross Sectional Area (ft^2)	11.50	11.70	11.50				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

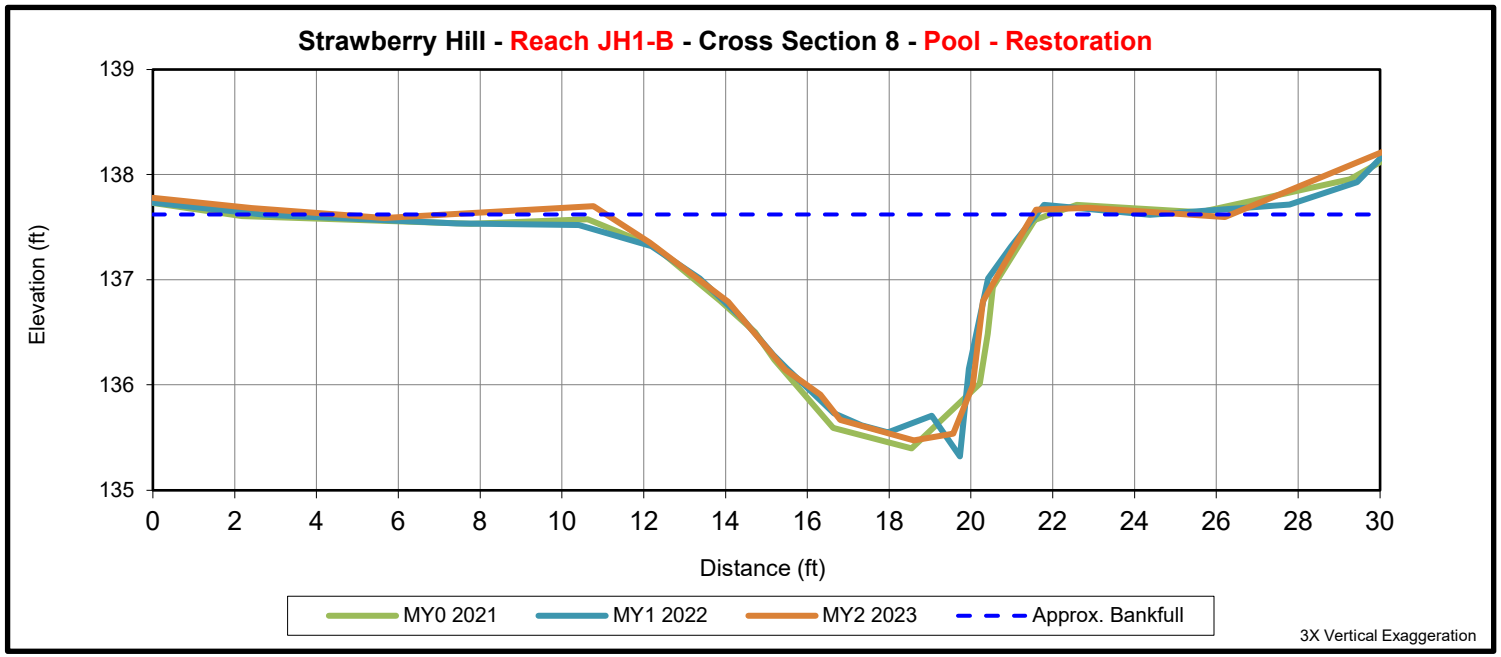


	Cross Section 7 (Riffle - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	137.52	137.52	137.53				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	0.97	0.96				
Thalweg Elevation	136.12	136.12	136.11				
LTOB[2] Elevation	137.52	137.48	137.48				
LTOB[2] Max Depth (ft)	1.4	1.36	1.37				
LTOB[2] Cross Sectional Area (ft^2)	8.30	7.90	7.80				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

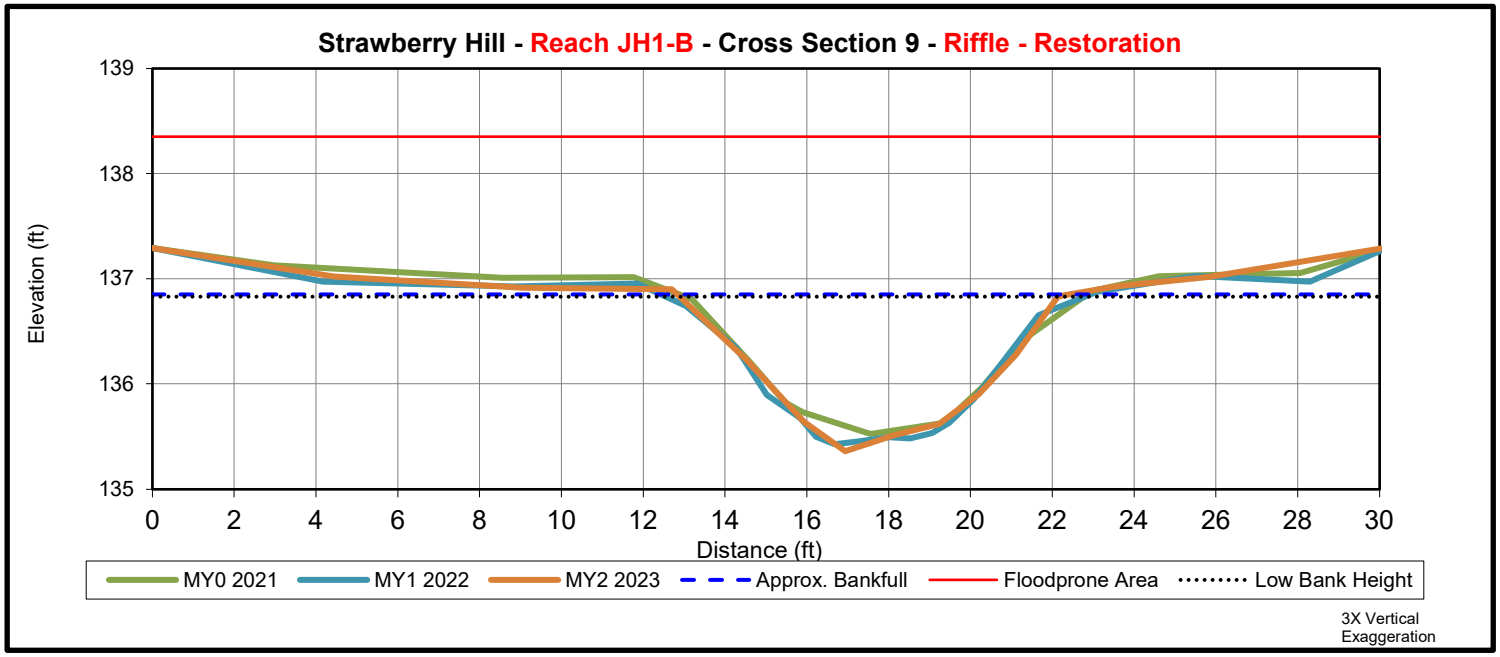


	Cross Section 8 (Pool - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	---	---	---				
Bank Height Ratio Based on AB Bankfull[1] Area	---	---	---				
Thalweg Elevation	135.40	135.32	135.47				
LTOB[2] Elevation	137.57	137.52	137.66				
LTOB[2] Max Depth (ft)	2.2	2.20	2.19				
LTOB[2] Cross Sectional Area (ft^2)	12.50	11.40	12.90				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

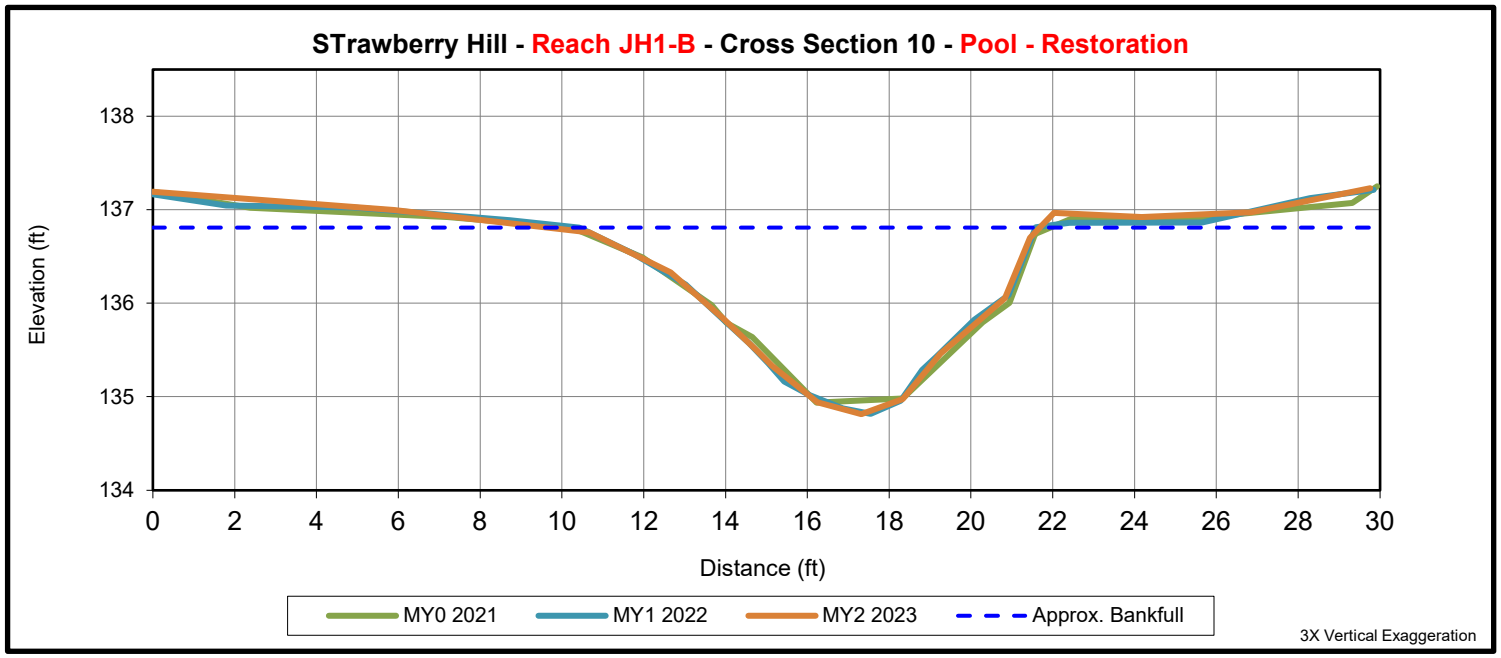


	Cross Section 9 (Riffle - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	136.88	136.83	136.85				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.03	0.99				
Thalweg Elevation	135.53	135.43	135.36				
LTOB[2] Elevation	136.88	136.87	136.83				
LTOB[2] Max Depth (ft)	1.4	1.44	1.47				
LTOB[2] Cross Sectional Area (ft^2)	8.30	8.70	8.20				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

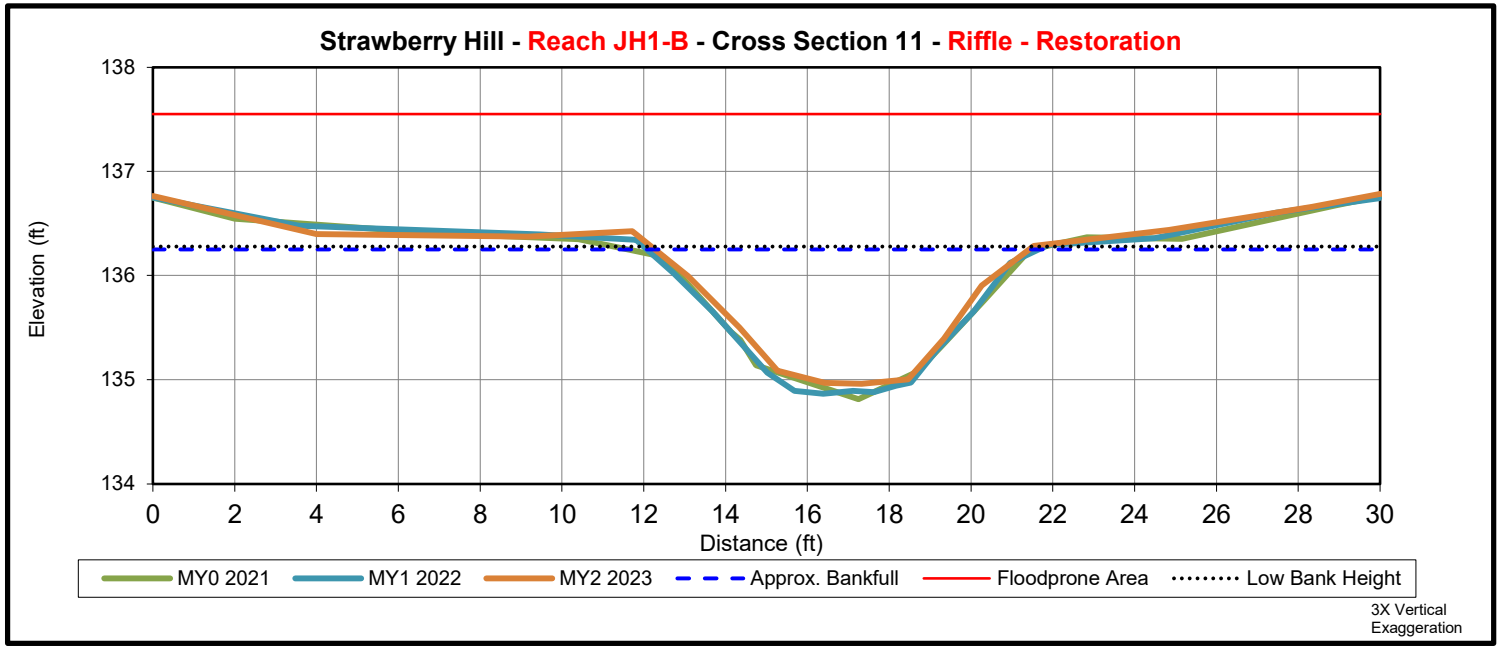


	Cross Section 10 (Pool - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	---	---	---				
Bank Height Ratio_Based on AB Bankfull[1] Area	---	---	---				
Thalweg Elevation	134.94	134.82	134.81				
LTOB[2] Elevation	136.81	136.81	136.76				
LTOB[2] Max Depth (ft)	1.9	1.99	1.95				
LTOB[2] Cross Sectional Area (ft^2)	12.20	12.20	11.60				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

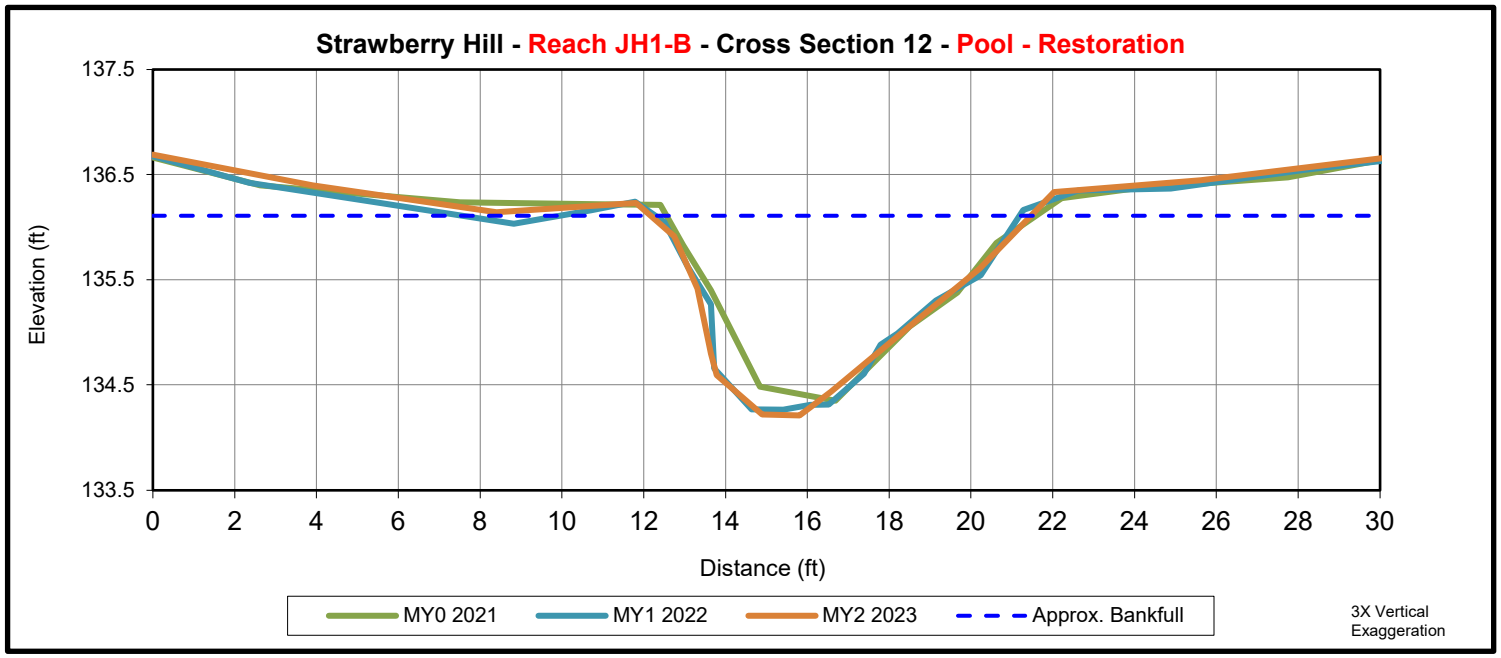


	Cross Section 11 (Riffle - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	136.18	136.16	136.25				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.10	1.02				
Thalweg Elevation	134.81	134.87	134.96				
LTOB[2] Elevation	136.18	136.29	136.28				
LTOB[2] Max Depth (ft)	1.4	1.43	1.32				
LTOB[2] Cross Sectional Area (ft^2)	7.30	8.50	7.60				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream



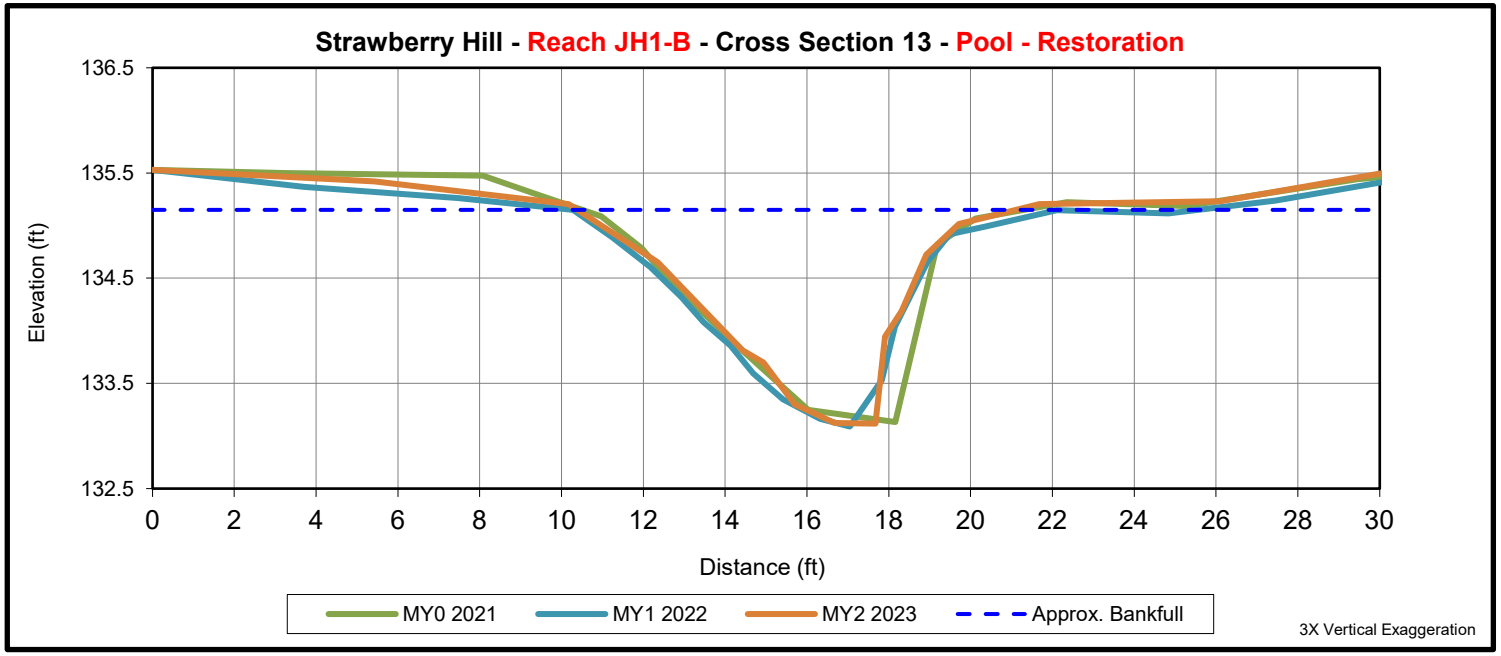
	Cross Section 12 (Pool - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	---	---	---				
Bank Height Ratio_Based on AB Bankfull[1] Area	---	---	---				
Thalweg Elevation	134.35	134.27	134.21				
LTOB[2] Elevation	136.22	136.24	136.23				
LTOB[2] Max Depth (ft)	1.9	1.98	2.02				
LTOB[2] Cross Sectional Area (ft^2)	10.10	11.20	11.30				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

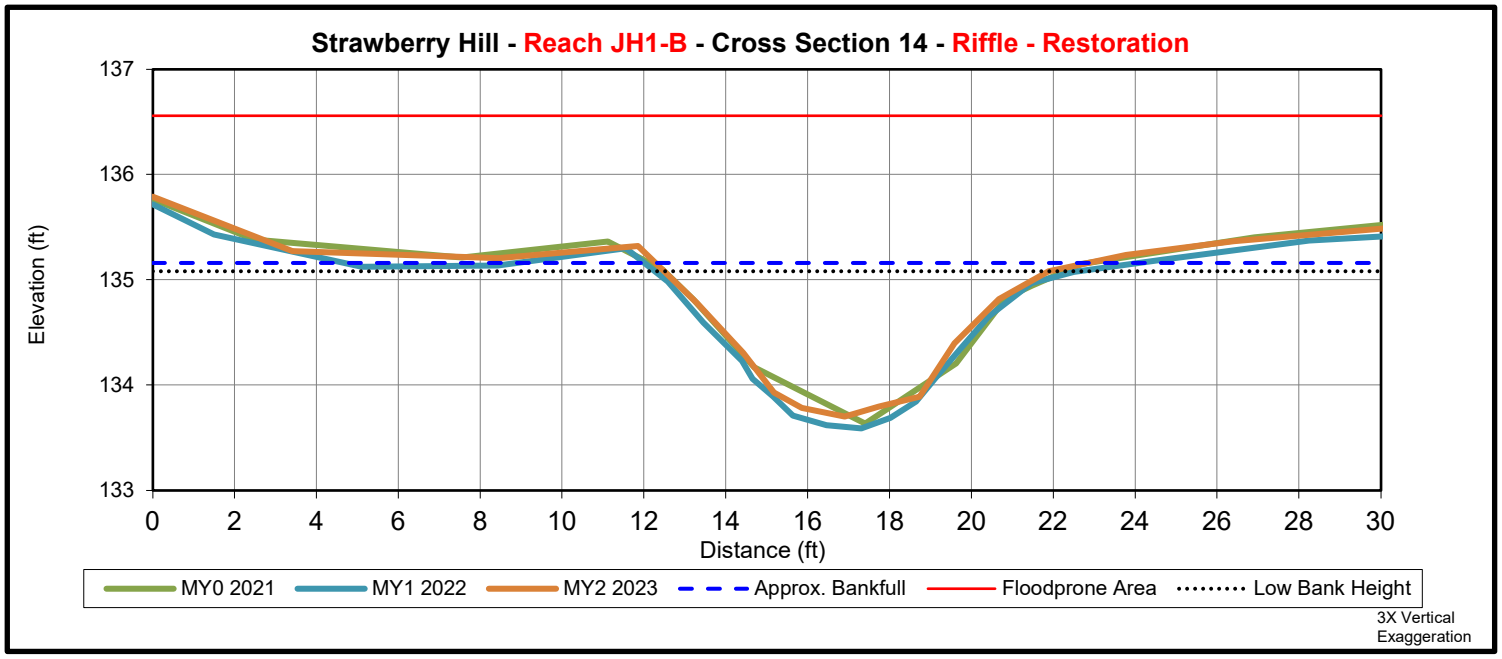


	Cross Section 13 (Pool - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	---	---	---				
Bank Height Ratio_Based on AB Bankfull[1] Area	---	---	---				
Thalweg Elevation	133.13	133.09	133.12				
LTOB[2] Elevation	135.07	134.92	135.02				
LTOB[2] Max Depth (ft)	1.9	1.83	1.90				
LTOB[2] Cross Sectional Area (ft^2)	9.70	8.20	8.50				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream



	Cross Section 14 (Riffle - JH1-B)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	135.15	135.07	135.16				
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.00	0.95				
Thalweg Elevation	133.64	133.59	133.70				
LTOB[2] Elevation	135.15	135.08	135.08				
LTOB[2] Max Depth (ft)	1.5	1.49	1.38				
LTOB[2] Cross Sectional Area (ft^2)	8.30	8.30	7.50				

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Appendix D

Hydrologic Data

Table 12. Rainfall Summary MY2 2023

Month	Average[1]	Normal Limits[1]		Project Location Precipitation*	
		30 Percent	70 Percent		
November	3.25	1.83	3.92	3.70	2022
December	3.25	2.27	4.04	4.70	
January	3.45	2.45	4.07	3.96	2023
February	3.31	2.12	3.97	3.20	
March	4.01	2.96	4.68	2.91	
April	3.69	2.42	4.35	4.83	
May	4.20	2.87	5.04	2.67	
June	4.67	3.19	5.60	5.74	
July	5.54	4.43	6.70	4.14	
August	5.28	3.63	6.35	10.74	
September	5.51	3.62	6.29	3.32	
October	3.21	2.16	3.88	-	
November	3.25	1.83	3.92	-	
December	3.25	2.27	4.04	-	
Total Annual **	49.37	44.67	52.62	41.52	

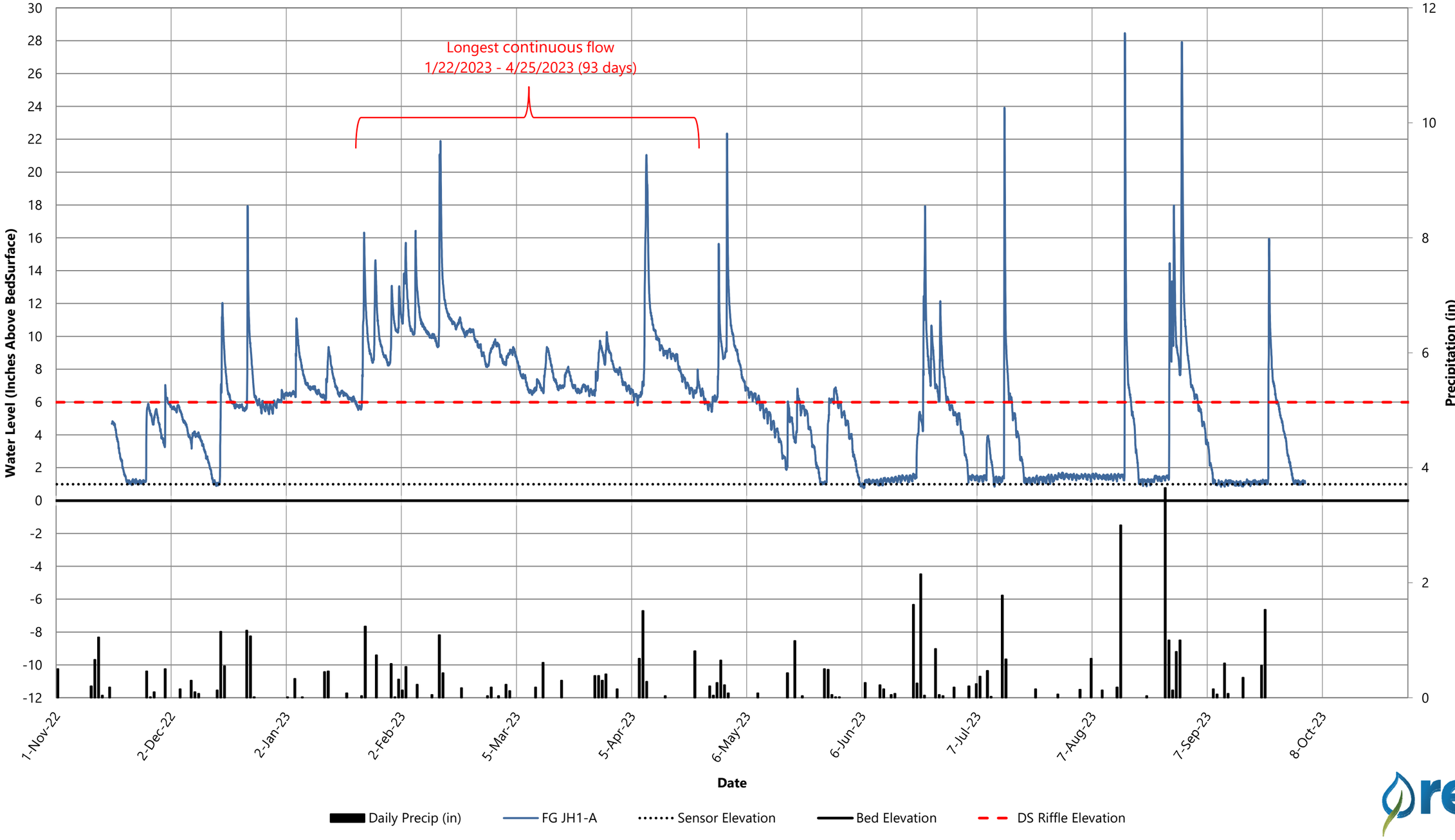
Above Normal Limits	Below Normal Limits

1 - Data according to Smithfield, NC WETS Station for 30-year period between 1991-2020
* - Project Location Precipitation is a location-weighted average of surrounding gauged data retrieved by the USACE Antecedent Precipitation Tool. Gauges used include Benson 7.5 ESE, Clayton 5.7 SSE, Clayton 6.8 ESE, Clayton WTP, Princeton 1.3 NNE, Princeton 1.6 WSW, Selma 2.3 N, Smithfield 2.8 SE, and Smithfield
** - Total Annual represents the average total precipitation, annually, as calculated by the 30-year period.

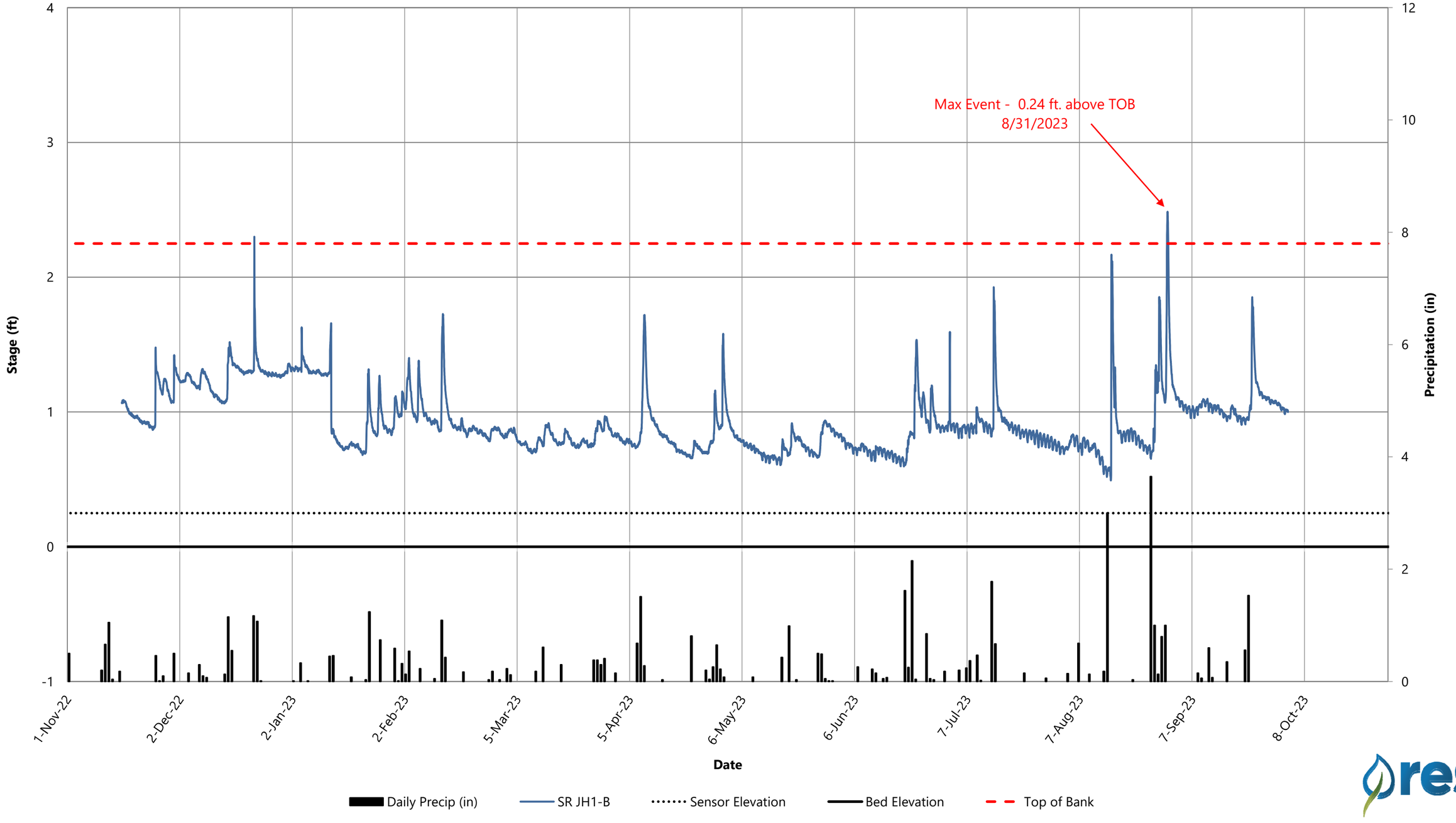
Table 13. Documentation of Geomorphically Significant Flow Events

Year	Number of Bankfull Events	Maximum Height Above Bankfull (ft)	Date of Maximum Bankfull Event	
Stage Recorder JH1-B				
MY1	4	0.72	3/12/2022	
MY2	2	0.24	8/31/2023	
Year	**Number of Flow Events**	**Maximum Consecutive Flow Days**	**Maximum Cumulative Flow Days**	**Maximum Consecutive Date Range**
Flow Gauge JH1-A				
MY1	13	47	75	2/16/2022 - 4/4/2022
MY2	15	93	149	1/22/2023 - 4/25/2023
Flow Camera JH1-A				
MY1*	5	4	10	7/8/2022 - 7/12/2022
MY2	10	91	N/A	1/22/2023 - 4/23/2023
* Flow Camera was not installed until 5/3/2022				

2023 Flow Gauge JH1-A



2023 JH1-B Stage Recorder Graph



Strawberry Hill Flow Cam Photos (MY2) – Longest Event (91 days; 1/22/23-4/23/23)


42 F
SH JH1A
02/06/2023 08:48:31AM


42 F
SH JH1A
02/12/2023 08:48:31AM


35 F
SH JH1A
02/19/2023 07:48:24AM


46 F
SH JH1A
02/26/2023 07:48:24AM


64 F
SH JH1A
03/02/2023 06:48:45PM


57 F
SH JH1A
03/04/2023 07:48:23AM


42 F
SH JH1A
03/12/2023 06:48:25PM


50 F
SH JH1A
03/18/2023 07:48:30AM


75 F
SH JH1A
03/27/2023 06:48:25PM


44 F
SH JH1A
04/08/2023 06:48:25PM


73 F
SH JH1A
04/15/2023 07:48:27PM

Appendix E

Project Timeline and

Contact Information

Table 4. Project Timeline and Contacts

Activity or Deliverable	Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted	NA	Dec-20
Mitigation Plan Approved	NA	Nov-20
Construction (Grading) Completed	NA	20-Jan-22
Planting Completed	NA	07-Mar-22
As-built Survey Completed	NA	May-22
MY-0 Baseline Report	Mar-22	May-22
Encroachment	Areas noted in Nov-22. Hunting driving path continued use and farm equipment cutting corners. Only applies to buffer mitigation-only section of Project. RES is actively resolving.	
MY1 Monitoring Report	Nov-22	Jan-23
Encroachment Adressed	Farmer access driveway relocated. Easement boundary markers and horse tape installed.	Mar-23
Supplemental Planting	Replanted 65 container trees on driving path encroachment area.	Feb-23
MY2 Monitoring Report	XS - June-23 VP - Oct-23	Nov-23
Remediation Items (e.g. beaver removal, supplements, repairs etc.)		

Strawberry Hill #100094	
Provider	RES / 3600 Glenwood Ave., Suite 100, Raleigh, NC 27612
Mitigation Provider POC	Jamey Mceachran (919) 623-9889
Designer	RES / 3600 Glenwood Ave., Suite 100, Raleigh, NC 27612
Primary project design POC	Ben Carroll, PE (336) 514-0927
Construction Contractor	RES / 3600 Glenwood Ave., Suite 100, Raleigh, NC 27612
Construction contractor POC	Jacy Kirkpatrick