MY0 MONITORING REPORT

Swamp Grape Stream and Wetland Mitigation Site

Robeson County, North Carolina
Lumber River Basin
Cataloging Unit 03040204

DMS Project No. 100115
Full Delivery Contract No. 7869
DMS RFP No. 16-007705
USACE Action ID No. SAW-2019-00904
DWR Project No. 2019-0675

Data Collection: September 2021-January 2022
Submission: February 2022

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
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Response to DMS Comments – Draft Baseline Document (MY0) and As-built Drawings
DMS Project No. 100115
Full Delivery Contract No. 7869
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USACE Action ID No. SAW-2019-00904
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Comments Received (Black Text) & Responses (Blue Text)

1. Cover pages: check USACE ID no; DMS has 2019-00904 in its records.
   Response: The USACE ID was corrected to 2019-00904.

2. Present the 2021 pre-restoration groundwater gage data in the MY0 report.
   Response: We have included the 2020 and 2021 pre-construction groundwater gauge data in Appendix D.

3. In the field, we discussed that the pre-restoration gages numbers were not the same as post-restoration gage numbers. Provide a map of the pre-restoration gage locations and numbers. It may be useful to provide a discussion of the 2020 and 2021 data for context.
   Response: We have included figures for 2020 and 2021 showing pre-construction gauge locations and numbers as Figures 1 and 2 in Appendix D. A discussion of the hydrology data is included in Section 4.2, Paragraph 2.

4. We discussed the three herbaceous random plots planned in the Mitigation Plan. Provide a description in the as-built why those are not included.
   Response: The Mitigation Plan outlined random herbaceous plots beginning in MY1 and a description has been provided in Section 4.3, Paragraph 2.

5. Table 6A appears to have some changes in species (added) and percentages. Suggest adding table 19 from the Mitigation Plan and to compare the changes (in red) or describe these changes in report. Possibly put the planting plan from the As-built into the report.
   Response: We have added the planting plan table from the mitigation plan and compared changes at as-built (Table 6C, Appendix B). A description of the changes has been provided in Section 4.3, Paragraph 3 of the document.

6. Confirm in the report that the planting zones match the plan in the drawings.
   Response: Confirmed. The planting zones match the plan in the drawings.

7. Monitoring devices: check the numbers of cross-sections and groundwater gages to ensure they match the number proposed in Mitigation Plan. Ensure that any IRT requests on gage location was considered.
   Response: The number of cross sections and groundwater gauges has been corrected to match the number proposed in the Mitigation Plan.

8. Correct typo on Sampling Point for GW12 on the last 4 logs (GW12 is repeated 4 times).
   Response: The typo has been corrected.

9. Consider removing the as-built grading drawing that was discussed in the field. This may not be useful if it does not apply.
   Response: We have removed the as-built grading drawing and replaced it with a figure showing topographic contour lines.

10. As discussed in the field, it may be beneficial to mention that brush piles were added and that ephemeral features are in the general areas that match the planting plan cypress swamp vegetation type.
    Response: We have included a statement noting that brush piles were added and that ephemeral features match the general areas of the cypress swamp planting area.

11. Add some line posts to better mark boundary intervals as discussed in the field. Most posts and fencing looks great, but would be helpful to have on 200' interval. Guidance here under Survey Specifications (https://deq.nc.gov/about/divisions/mitigation-services/dms-vendors/templates-guidelines-tools-projects)
    RS will add additional posts and easement signage along easement boundary lines that are over 200'.

Digital Data

1. The shapefile for AsBuilt_Centerline is throwing an error saying the number of shapes does not match the number of table records. Please review, correct, and resubmit.
   Response: The error has been corrected and the shapefile has been replaced.

2. The monitoring summary table suggests there should be 16 groundwater gauges, but only 15 were provided. Please either submit the missing gauge feature or update the table.
   Response: The number of groundwater gauges has been corrected to 16.

3. Note that in the monitoring table the entry for bankfull events it appears that 3 "surface water gauges on UT1 and UT2" should be in the row above its current location.
   Response: We have moved the table entry to the above row.

4. The monitoring table suggests that there should have been random plot data submitted in MY0. Please submit these data and the features representing MY0 random veg plots.
   Response: The mitigation plan outlined random herbaceous plots starting in MY1 after establishment has occurred and a description as to why the random herbaceous plots were not included in MYO has been included in Section 4.3, Paragraph 2.

5. Please submit the design cad files.
   Response: Design CAD files have been included in the electronic submittal.

6. Please explain why in several cross sections the low bank height is different from the bankfull elevation given that it is MY0.
   Response: These errors have been resolved with the DMS tool exported cross sections.

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APPENDICES

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1 PROJECT SUMMARY

Restoration Systems, LLC has established the North Carolina Division of Mitigation Services (NCDMS) Swamp Grape Stream and Wetland Mitigation Site (Site). The Site is on two contiguous parcels used primarily for row crop production with small pockets of livestock pasture in the Atlantic Southern Loam Plains portion of the Southeastern Plains ecoregion of North Carolina. Located in the Lumber River Basin, Cataloging Unit 03040204, the Site is in the Targeted Local Watershed (TLW) 03040204048010 and North Carolina Division of Water Resources [NCDWR] subbasin number 03-07-55. The Site is not located in a Local Watershed Plan (LWP), Regional Watershed Plan (RWP), or Targeted Resource Area (TRA). Site watersheds range from approximately 0.41 of a square mile (263 acres) on UT2 to 1.53 square miles (977 acres) at the Site's outfall.

1.1 Project Background, Components, and Structure

Located approximately 4 miles northwest of Rowland and 2.5 miles southwest of Alfordsville along the southwest edge of Robeson County, the Site encompasses 24.68 acres. Mitigation work within the Site included 1) stream restoration, 2) stream enhancement (Level I), 3) stream enhancement (Level II), 4) wetland reestablishment, 5) wetland rehabilitation, 6) wetland enhancement, 7) wetland creation, and 7) vegetation planting. The Site is expected to provide 3,228.333 warm water stream credits and 12.705 riparian wetland credits by closeout (Table 1, Page 2). A conservation easement was granted to the State of North Carolina and recorded at the Robeson County Register of Deeds on February 23, 2021.

Before construction, land use at the Site was characterized by breached agriculture ponds, failed/eroded agricultural crossings, row crops, livestock pasture, and disturbed forest. Site design was completed in June 2021; construction started on July 12, 2021, and ended within a final walkthrough on September 23, 2021. The Site was planted on January 18, 2022. Completed project activities, reporting history, completion dates, and project contacts are summarized in Tables 11-12 (Appendix E).

Table 1. Swamp Grape Mitigation Site (ID-100115) Project Mitigation Quantities and Credits

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								
UT 1 Reach 1	297	296	Warm	EI	2.00000	148.500		
UT 1 Reach 2	1215	1211	Warm	R	1.00000	1,215.000		
UT 1 Reach 3	546	544	Warm	EI	2.00000	273.000		
UT 1 Reach 4	235	235	Warm	EII	3.00000	78.333		
UT 1 Reach 5	230	230	Warm	R	1.00000	230.000		
UT 1 Reach 6	165	166	Warm	EI	2.00000	82.500		
UT 1 Reach 7	206	207	Warm	R	1.00000	206.000		
UT 1 Reach 8	87	88	Warm	EI	2.00000	43.500		
UT 2 Reach 1	684	681	Warm	R	1.00000	684.000		
UT 2 Reach 2	266	265	Warm	EI	2.00000	133.000		
UT 3 Reach 1	133	132	Warm	EI	2.00000	66.500		
UT 3 Reach 2	68	66	Warm	R	1.00000	68.000		
					Total:	**3,228.333**		
Wetland								
Wetland Reestablish	4.470	4.47	R	REE	1.00000	4.470		
Wetland Rehabilitation	2.671	2.671	R	RH	1.50000	1.781		
Wetland Enhancement	12.244	12.244	R	E	2.00000	6.122		
Wetland Creation	0.997	0.997	R	C	3:100	0.332		
					Total:	**12.705**		

Project Credits

	Stream			Riparian	Non-Rip	Coastal
Restoration Level	Warm	Cool	Cold	Wetland	Wetland	Marsh
Restoration	2,403.000					
Re-establishment				4.470		
Rehabilitation				1.781		
Enhancement				6.122		
Enhancement I	747.000					
Enhancement II	78.333					
Creation				0.332		
Preservation	0.000					
Totals	**3,228.333**			**12.705**		

Total Stream Credit **3,228.333**
Total Wetland Credit **12.705**

Wetland Mitigation Category

CM	Coastal Marsh
R	Riparian
NR	Non-Riparian

Restoration Level

HQP	High Quality Preservation
P	Preservation
E	Wetland Enhancement - Veg and Hydro
EII	Stream Enhancement II
EI	Stream Enhancement I
C	Wetland Creation
RH	Wetland Rehabilitation - Veg and Hydro
REE	Wetland Re-establishment Veg and Hydro
R	Restoration

Table 2. Summary: Goals, Performance, and Results

Goals	Objectives	Success Criteria
(1) HYDROLOGY		
• Minimize downstream flooding to the maximum extent possible. • Connect streams to functioning wetland systems.	• Construct new channel at historic floodplain elevation to restore overbank flows and restore jurisdictional wetlands • Plant woody riparian buffer • Remove livestock • Remove a ditch/drain tile network that contributes surface waters directly to the channel • Protect riparian buffers with a perpetual conservation easement	• BHR not to exceed 1.2 • Document four overbank events in separate monitoring years • Livestock excluded from the easement • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded
• Increase stream stability within the Site so that channels are neither aggrading nor degrading.	• Construct channels with the proper pattern, dimension, and longitudinal profile • Remove livestock from the Site • Construct stable channels that do not contribute sediment to downstream receiving waters. • Plant woody riparian buffer	• Cross-section measurements indicate a stable channel with appropriate substrate • Visual documentation of stable channels and structures • BHR not to exceed 1.2 • < 10% change in BHR in any given year • Livestock excluded from the easement • Attain Vegetation Success Criteria
(1) WATER QUALITY		
• Remove direct nutrient and pollutant inputs from the Site and reduce contributions to downstream waters.	• Remove livestock and reduce agricultural land/inputs • Plant woody riparian buffer • Restore/enhance jurisdictional wetlands adjacent to Site streams • Remove a ditch/drain tile network that contributes surface waters directly to the channel • Restore overbank flooding by constructing channels at historic floodplain elevation.	• Livestock excluded from the easement • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria
(1) HABITAT		
• Improve instream and stream-side habitat.	• Construct stable channels with woody debris available as instream habitat • Plant woody riparian buffer to provide organic matter and shade • Construct new channel at historic floodplain elevation to restore overbank flows • Protect riparian buffers with a perpetual conservation easement • Restore/enhance jurisdictional wetlands adjacent to Site streams • Stabilize stream banks • Install in-stream structures	• Cross-section measurement indicates a stable channel with appropriate substrate • Visual documentation of stable channels and in-stream structures. • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded

Table 3. Project Attribute Table				
Project Name	Swamp Grape Stream and Wetland Mitigation Site			
County	Robeson County, North Carolina			
Project Area (acres)	24.7			
Project Coordinates (latitude and longitude decimal	34.5639ºN, 79.3490ºW			
Project Watershed Summary Information				
Physiographic Province	Atlantic Southern Loam Plains			
River Basin	Lumber			
USGS Hydrologic Unit 8-digit	3040204048010			
DWR Sub-basin	03-07-55			
Project Drainage Area (acres)	977			
Project Drainage Area Percentage of Impervious Area	<2%			
Land Use Classification	Managed Herbaceous Cover & Hardwood Swamps			
Reach Summary Information				
Parameters	**UT 1 (upstream)**	**UT 1 (downstream)**	**UT 2**	**UT 3**
Pre-project length (feet)	1293	1673	826	149
Post-project (feet)	1849	1157	1070	199
Valley confinement (Confined, moderately confined,	Wide and flat alluvial valley			
Drainage area (acres)	192	977	263	392
Perennial, Intermittent, Ephemeral	Per	Per	Per	Per
NCDWR Water Quality Classification	C, Sw			
Dominant Stream Classification (existing) (Rosgen	F5	Eg 5	Cg 5	Eg 5
Dominant Stream Classification (proposed)	Ce 5	Ce 5	Ce 5	Ce 5
Dominant Evolutionary class (Simon) if applicable	III/IV	V	V	III/IV
Wetland Summary Information				
Parameters	**Wetlands**			
Pre-project (acres)	5.32 acres drained & 15.07 acres degraded			
Post-project (acres)	4.470 acres restored & 14.915 acres enhanced/preserved			
Wetland Type (non-riparian, riparian)	Riparian riverine			
Mapped Soil Series	Bibb			
Soil Hydric Status	Hydric			
Regulatory Considerations				
Parameters	**Applicable?**	**Resolved?**	**Supporting Docs?**	
Water of the United States - Section 404	Yes	Yes	Section 401 Certification	
Water of the United States - Section 401	Yes	Yes	Section 404 Permit	
Endangered Species Act	Yes	Yes	CE Document	
Historic Preservation Act	Yes	Yes	CE Document	
Coastal Zone Management Act (CZMA or CAMA)	NA	NA	NA	
Essential Fisheries Habitat	NA	NA	NA	

1.2 Project Success Criteria

Monitoring and success criteria for stream restoration should relate to project goals and objectives identified from on-site NC SAM and NC WAM data collection. From a mitigation perspective, several goals and objectives are assumed to be functionally elevated by restoration activities without direct measurement. Other goals and objectives will be considered successful upon achieving success criteria. The following summarizes Site success criteria.

Project Success Criteria

Streams
• All streams must maintain an Ordinary High-Water Mark (OHWM), per RGL 05-05. • Bank height ratio (BHR) cannot exceed 1.2 at any measured cross-section. • BHR at any measure riffle1 cross-section should not change by more than 10% from baseline condition during any given monitoring period. • The stream project shall remain stable, and all other performance standards shall be met through four separate bankfull events, occurring in separate years, during the monitoring years 1-7.
Wetland Hydrology
• Saturation or inundation within the upper 12 inches of the soil surface for, at a minimum, 12 percent of the growing season, during average climatic conditions.
Vegetation
• Within planted portions of the site, a minimum of 320 stems per acre must be present at year 3; a minimum of 260 stems per acre must be present at year 5, and a minimum of 210 stems per acre must be present at year 7. • Trees must average 7 feet in height at year 5 and 10 feet at year 7 in each plot. • Planted and volunteer stems are counted, provided they are included in the approved planting list for the site; natural recruits not on the planting list may be considered by the IRT on a case-by-case basis. • Herbaceous vegetation plots must have a minimum of three species present.

2 AS-BUILT CONDITION (BASELINE)

Site construction started on July 12, 2021, and ended within a final walkthrough on September 23, 2021. The Site was planted on January 18, 2022. As-built and MY0 data collection occurred between September 2021 and January 2022.

In general, no significant issues arose during the construction of the Site. A sealed half-size set of record drawings are provided in Appendix G, which includes the post-construction survey, alignments, structures, and monitoring features. These include redlines for any significant field adjustments made during construction that differ from the design plans. Where needed, adjustments were made during construction based on field evaluations and are listed below.

Location	Deviation	Explanation
UT-1 sta. 7+81	Log cross vane added	Slope in field conditions required structure
UT-1 sta. 33+65	Log cross vane not constructed	Slope in field conditions did not require structure
UT-1 sta. 34+20	Log cross vane not constructed	Slope in field conditions did not require structure

Additional activities that occurred at the Site included the following.

- Planting 22.5 acres of the Site with 17,750 stems on January 18, 2022 – planted species are included in Table 6 (Appendix B).
- A site prep burn was conducted on January 13, 2022, on approximately four acres before bare-root and live stake planting occurred. This burn targeted areas of dense cattail (Typha latifolia) and soft rush (Juncus effuses) vegetation. The fire improved planting conditions significantly by providing better physical access for the planting crew and promoting higher survival rates for bare-root plantings. Additional burn benefits include the suppression of Juncus and cattail monocultures and the encouragement of a diverse native herbaceous layer. For further information on the benefits of burning Juncus-dominated marsh and the promotion of marsh diversity, see the referenced Davison and Bratton article, *"Vegetation Response and Regrowth after Fire on Cumberland Island National Seashore,"* cited and linked in Section 5.0, References.
- Applying a permanent seed mix at 1 lb per acre across the Site. A species list is included in Table 6B (Appendix B).
- Fencing around the upper area of the conservation easement.

2.1 Modification of Project Culverts/Crossings

During construction, concern grew that the design of the two culvert crossings, given their size and landscape position, would be replicating the scenario that had resulted in the failure of the existing crossing many times before. That the crossing would act as an earthen dam across the narrow valley and prevent the necessary passage of water during significant rainfall events. Though Site culverts were designed to carry a 100-year storm discharge, significantly larger rainstorm events are becoming more and more common in Robeson County. During rainstorms above the 100-year level, it was believed stormwater would back up behind the crossings and possibly overtop them, resulting in a failure of the crossing.

<u>UT-1 Crossing</u>

The UT-1 crossing was designed as an in-place culvert/crossing upgrade with a final roadbed elevation of 135.00, 3-feet higher than the existing roadbed elevation, and an elevation difference of 9.5-feet between the invert out and roadbed elevation. Given the concern noted above, the following modification to the culvert replacement was made.

- The existing 72" corrugated metal pipe (CMP) was left in place.
- UT-1 and its floodplain were constructed as designed, and the existing pipe was backfilled approximately 3-feet.
- Six, as opposed to the two, 24" floodplain pipes, were installed.
- Class 1 rip-rap was placed on the upstream and downstream sides of the crossing.

<u>UT-2 Crossing</u>

The UT-2 crossing was designed to replace a failed piped crossing located immediately downstream. Similar to the UT-1 crossing, the designed Ut-2 crossing would have resulted in a roadbed elevation 10-feet above the floodplain. An alternative crossing approach was developed and presented to Travis Wilson with the N.C. Wildlife Resources Commission to minimize the storage potential behind the crossing and the crossing effect to the floodplain. The proposed alternative, which was agreed upon and constructed, was a Vented Ford Crossing. A construction sheet was developed by the Project Engineer at McAdams. E-mail correspondence between Worth Creech and Travis Wilson and the McAdams construction sheet is included in Appendix F; photos of each crossing are included in the Appendix F Photo Log.

3 PROJECT MONITORING – METHODS

Monitoring will be conducted by Axiom Environmental, Inc. Annual monitoring reports of the data collected will be submitted to the NCDMS by Restoration Systems no later than December 31 of each monitoring year data is collected. The monitoring schedule is summarized in the following table.

Monitoring Schedule

Resource	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Streams	X	X	X		X		X
Wetlands	X	X	X	X	X	X	X
Vegetation	X	X	X		X		X
Visual Assessment	X	X	X	X	X	X	X
Report Submittal	X	X	X	X	X	X	X

3.1 Monitoring

The monitoring parameters are summarized in the following table.

Monitoring Summary

Stream Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Stream Profile	Full longitudinal survey	As-built (unless otherwise required)	All restored stream channels	Graphic and tabular data.
Stream Dimension	Cross-sections	Years 1, 2, 3, 5, and 7	Total of 16 cross-sections on restored channels	Graphic and tabular data.
Channel Stability	Visual Assessments	Yearly	All restored stream channels	Areas of concern will be depicted on a plan view figure with a written assessment and photograph of the area included in the report.
	Additional Cross-sections	Yearly	Only if instability is documented during monitoring	Graphic and tabular data.
Stream Hydrology	NA	NA	NA	NA
Bankfull Events	Continuous monitoring surface water gauges (pressure transducers) and/or trail camera	Continuous recording through monitoring period	3 surface water gauges on UT 1 and UT 2	Surface water data for each monitoring period
	Visual/Physical Evidence	Continuous through monitoring period	N.A.	Visual evidence, photo documentation, and/or rain data.

Note: All vegetation plots and stream cross sections have fixed photo point locations. In addition, fixed photo points will be installed at two culverts entering the Site.

Monitoring Summary (continued)

Wetland Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Wetland Restoration	Groundwater gauges	As-built, Years 1, 2, 3, 4, 5, 6, and 7 throughout the year with the growing season defined as March 1-November 6	16 gauges spread throughout restored wetlands	Soil temperature at the beginning of each monitoring period to verify the start of the growing season, groundwater and rain data for each monitoring period. Graphic and tabular data.
Vegetation Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Vegetation establishment and vigor	Permanent vegetation plots 0.0247 acre (100 square meters) in size; *CVS-EEP Protocol for Recording Vegetation*, *Version 4.2* (Lee et al. 2008)	As-built, Years 1, 2, 3, 5, and 7	23 plots spread across the Site (2 plots in cypress gum swamp and 21 plots in C.P. small stream swamp)	Species, height, planted vs. volunteer, stems/acre, areas of concern
	Annual random vegetation plots, 0.0247 acre (100 square meters) in size	As-built, Years 1, 2, 3, 5, and 7	As needed to determine vegetation density in a questionable area	Species and height
	Annual random herbaceous vegetation plots, 0.00247 acre (5 meters by 2 meters) in size	Years 1, 2, 3, 5, and 7	3 plots located in herbaceous dominated vegetation areas	Number of species in plot

Note: Vegetation data should be collected between July 1 and leaf drop. In addition, vegetation data will not be collected until 180 days after Site planting.

4 MONITORING YEAR 0 – DATA ASSESSMENT

Annual monitoring and site visits were conducted between September 2021 and January 2022 to assess the condition of the project. Stream, wetland, and vegetation criteria for the Site follow the approved success criteria presented in the Mitigation Plan and summarized in Section 1.3; monitoring methods are detailed in Section 3.0.

4.1 Stream Assessment

Morphological surveys for MY0 were conducted on September 29, 2021. All streams within the Site are stable and functioning as designed. Refer to Appendix A for the Visual Stream Morphology Stability Assessment Table and Stream Photographs. Refer to Appendix C for Stream Geomorphology Data. No stream areas of concern were identified during MY0.

4.2 Hydrology Assessment

16 groundwater monitoring gauges were installed throughout the Site's wetlands. Hydrologic data will be collected and reported during MY1 (2022).

Pre-construction groundwater data and figures are included in Appendix D. Pre-construction gauges for 2020 were installed in May and therefore are not very conclusive concerning wetland hydroperiods at the beginning of the growing season. In 2020, Gauges 8, 10, and 12 met the typical 12% hydroperiod wetland success criteria and are located in rehabilitation areas (Figure 1), however, climate data from a nearby WETS station in Lumberton (15 miles from Site) indicates well above average rainfall for 2020 in May – June and September – December (Appendix D, WETS Data). Unfortunately, several 2020 gauges malfunctioned and did not collect any data. Groundwater gauges for 2021 captured the beginning of the growing season, however, gauges were removed for construction on June 7th, 2021. None of the gauges met the typical 12% hydroperiod success criteria in 2021. Several 2021 groundwater gauges malfunctioned at the start of the growing season, however, these were in nested transects and adjacent gauge data supplements malfunctioned data to indicate drainage of soils. Overall, gauge data indicates that the majority of the site is effectively drained by ditching and stream incision.

4.3 Vegetative Assessment

The MY0 vegetative survey was completed in January 2022. Vegetation monitoring resulted in a sitewide stem density average of 601 planted stems per acre permanent plot average (789 stems per acre sitewide average), above the interim requirement of 320 stems per acre required at MY3. All 23 fixed vegetation plots met the interim success criteria. Please refer to Appendix A for Vegetation Plot Photographs and the Vegetation Condition Assessment Table, and Appendix B for Vegetation Plot Data. No vegetation areas of concern were identified during MY0.

The Mitigation Plan monitoring summary outlined three random plots in herbaceous dominated areas beginning in MY1. Based on observations of herbaceous establishment after construction and into the winter of 2021/2022, these were not included in the MY0 survey. Targeted herbaceous areas and freshwater marsh communities will be identified once establishment has occurred and subsequent random plots will be surveyed in those areas for annual monitoring reports. Additionally, freshwater marsh communities will be identified on CCPVs in annual monitoring reports to show general areas of Site coverage.

During construction, brush piles were added in order to increase woody habitat and structure in the cypress-gum swamp planting area. Additionally, ephemeral features and pools are located in the general areas that match the planting plan cypress-gum swamp vegetation type.

Two species were added to the Site planting list, river birch (*Betula nigra*) and water hickory (*Carya aquatica*), that were not included in the mitigation plan planting list (Table 6A, Appendix B); however, these are typical species for the target natural community type, coastal plain small stream swamp and stream-side assemblage, and they are expected to thrive. Changes in the number of individuals and percentages for other species occurred due to nursery stock and availability. A complete account of planting changes can be found in Table 6C, Appendix B.

4.4 Monitoring Year 0 Summary

Overall, the Site looks good, is performing as intended, and is on track to meet success criteria. All vegetation plots are on track to exceed the MY3 interim requirement of 320 planted stems per acre, and all streams within the Site are stable and are meeting project goals.

5 REFERENCES

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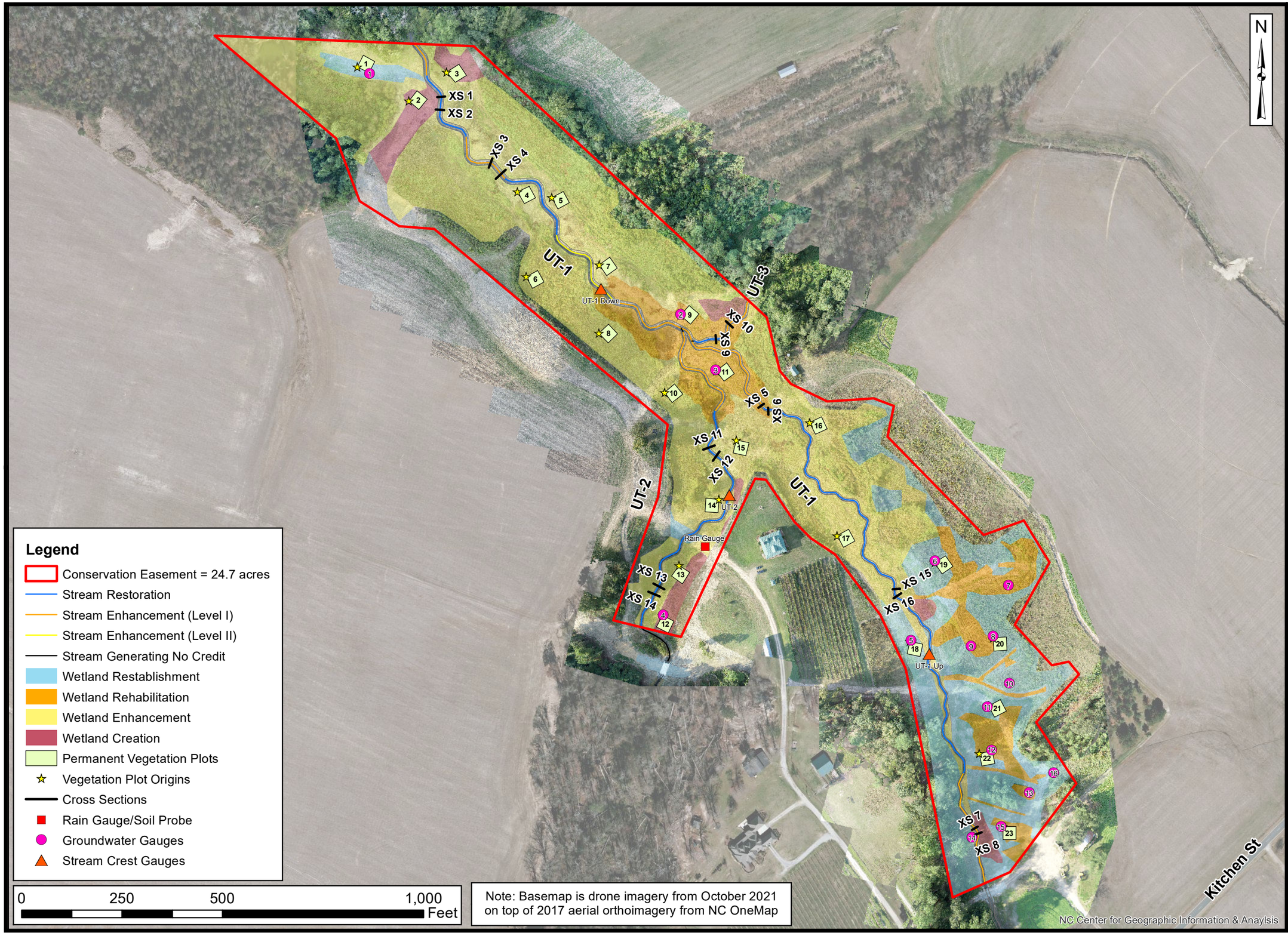
Appendix A
Visual Assessment Data

Figure 1. Current Conditions Plan View
Tables 4A-G. Stream Visual Stability Assessment
Table 5. Visual Vegetation Assessment
Vegetation Plot Photographs



Legend

- Conservation Easement = 24.7 acres
- Stream Restoration
- Stream Enhancement (Level I)
- Stream Enhancement (Level II)
- Stream Generating No Credit
- Wetland Restablishment
- Wetland Rehabilitation
- Wetland Enhancement
- Wetland Creation
- Permanent Vegetation Plots
- Vegetation Plot Origins
- Cross Sections
- Rain Gauge/Soil Probe
- Groundwater Gauges
- Stream Crest Gauges

0 250 500 1,000 Feet

Note: Basemap is drone imagery from October 2021 on top of 2017 aerial orthoimagery from NC OneMap

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SWAMP GRAPE MITIGATION SITE

Robeson County, NC

Title:

CCPV

Drawn by: JMH

Date: MAR 2022

Scale: 1:2700

Project No.: 20-003

FIGURE

1

Table 4A. Visual Stream Stability Assessment

Reach UT 1 Upstream
Assessed Stream Length 1849 Survey Date: January 24, 2022
Assessed Bank Length 3698

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.	28	28		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%

Table 4B. Visual Stream Stability Assessment

Reach UT 1 Downstream
Assessed Stream Length 1157 Survey Date: January 24, 2022
Assessed Bank Length 2314

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.	5	5		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)	5	5		100%

Table 4C. Visual Stream Stability Assessment

Reach UT 2
Assessed Stream Length 1070
Assessed Bank Length 2140

Survey Date: January 24, 2022

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.	6	6		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)	6	6		100%

Table 4D. Visual Stream Stability Assessment

Reach UT 3
Assessed Stream Length 199
Assessed Bank Length 398

Survey Date: January 24, 2022

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.	3	3		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)	3	3		100%

Table 5. Visual Vegetation Assessment

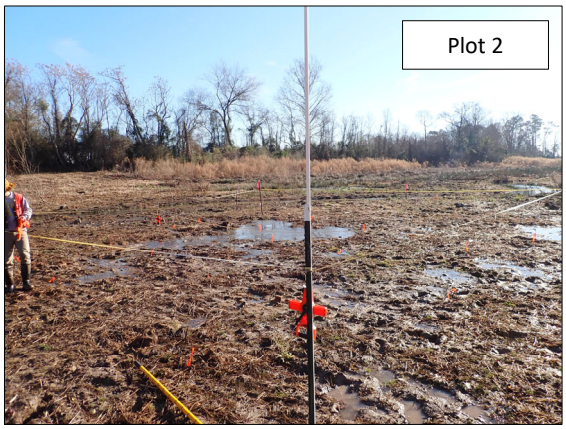
Planted acreage **22.5** Survey Date: January 24, 2022

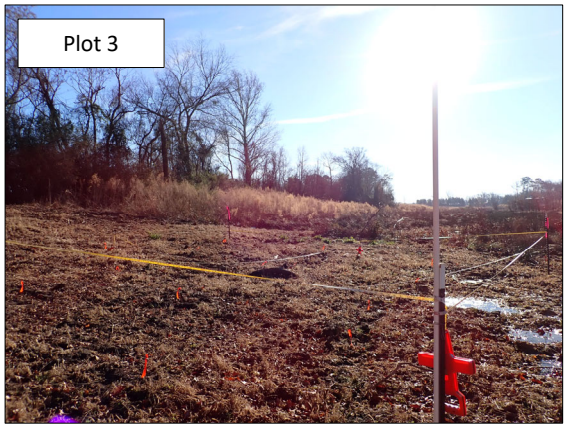
Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.10 acres	0.00	0.0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.10acres	0.00	0.0%
		Total	0.00	0.0%
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.10 acres	0.00	0.0%
		Cumulative Total	0.00	0.0%

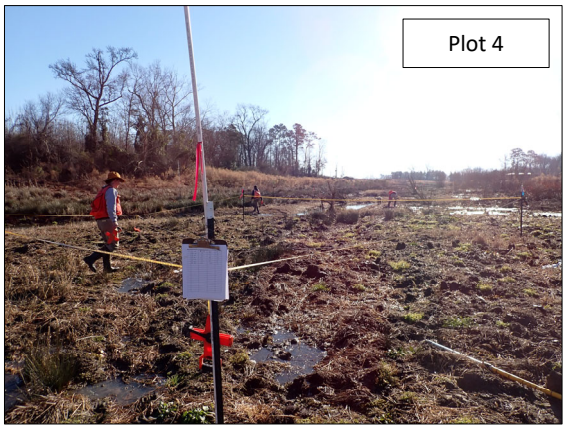
Easement Acreage **24.7**

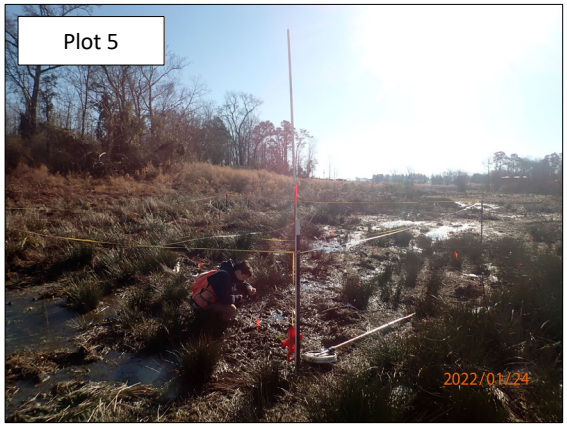
Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Invasives may occur outside of planted areas and within the easement and will therefore be calculated against the total easement acreage. Include species with the potential to directly outcompete 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.	0.10 acres	0.00	0.0%
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	0 Encroachments noted	

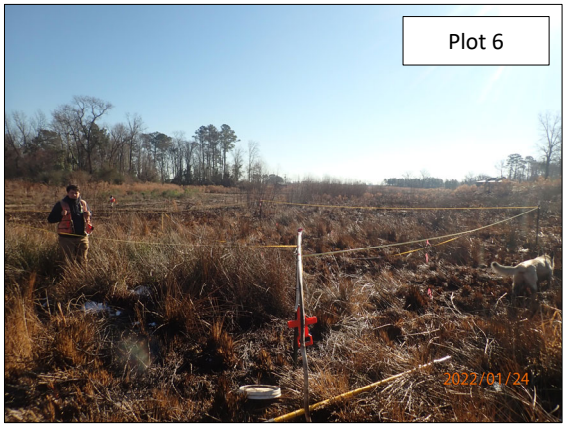
Swamp Grape Site
MY0 (2022) Vegetation Monitoring Photographs (taken January 24, 2022)

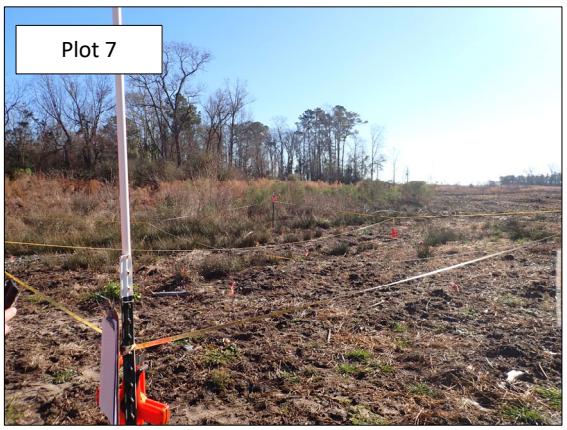


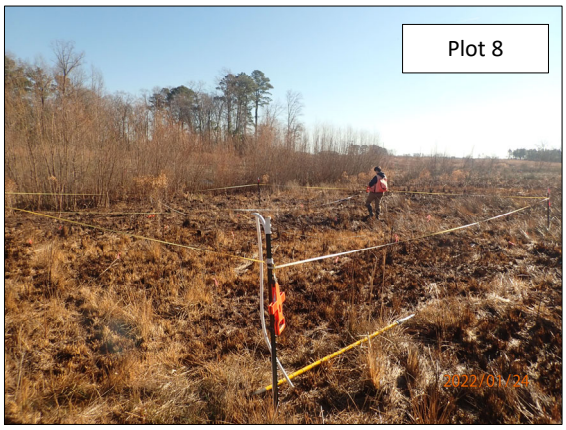




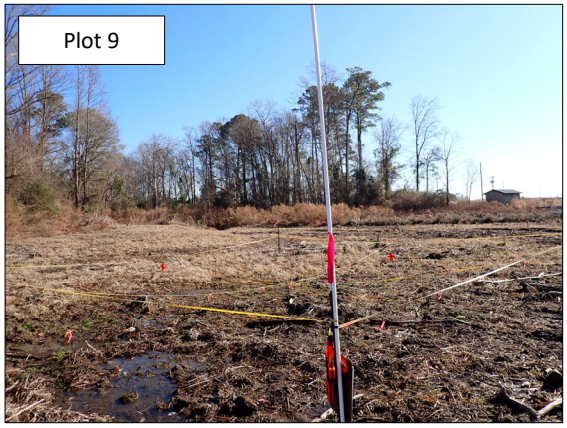


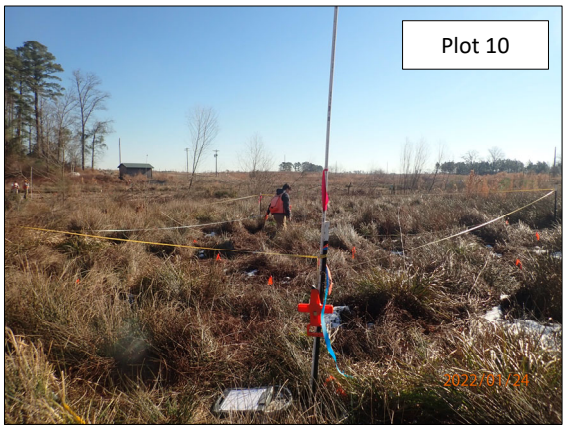


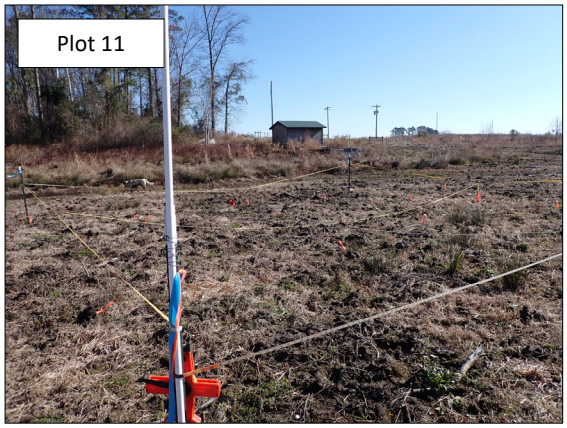


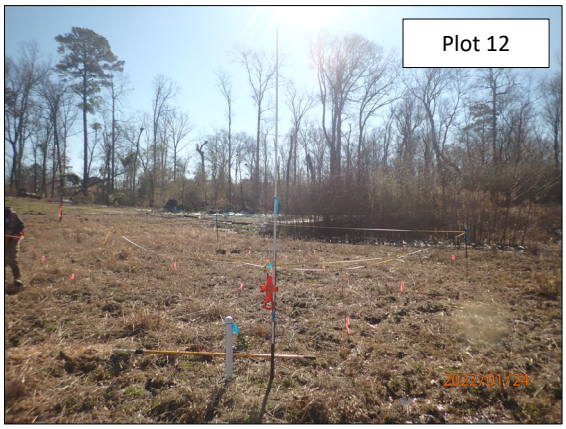


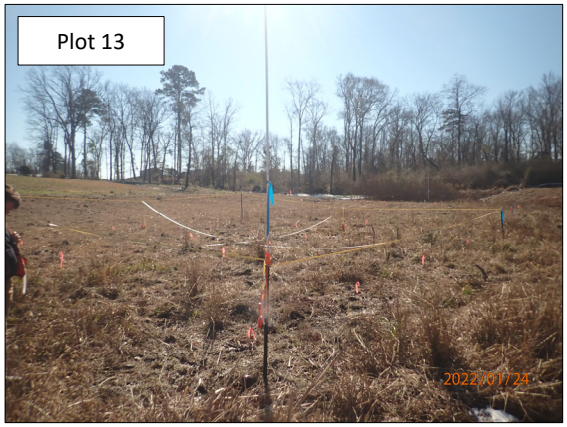
Swamp Grape Site
MY0 (2022) Vegetation Monitoring Photographs (taken January 24, 2022)

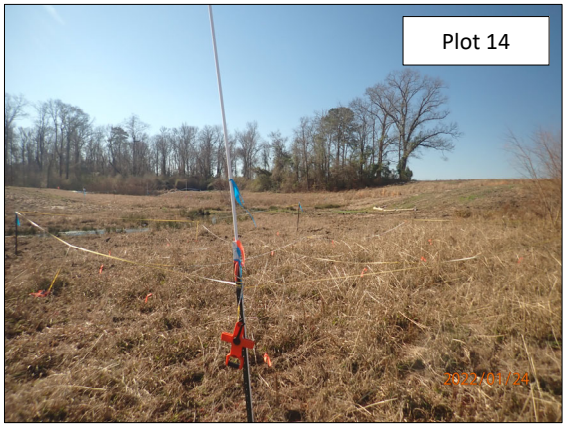


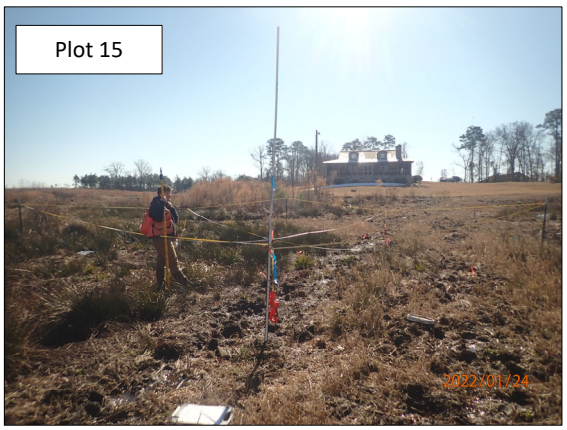


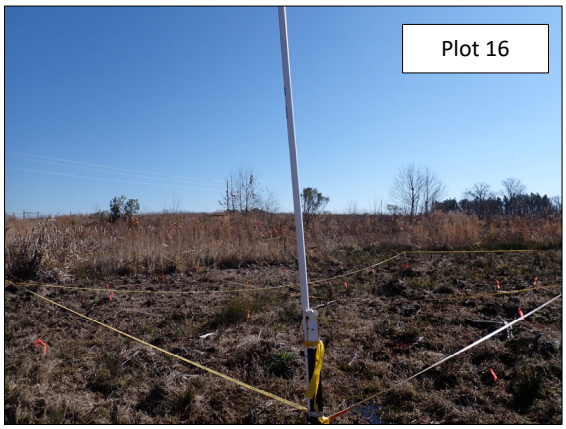






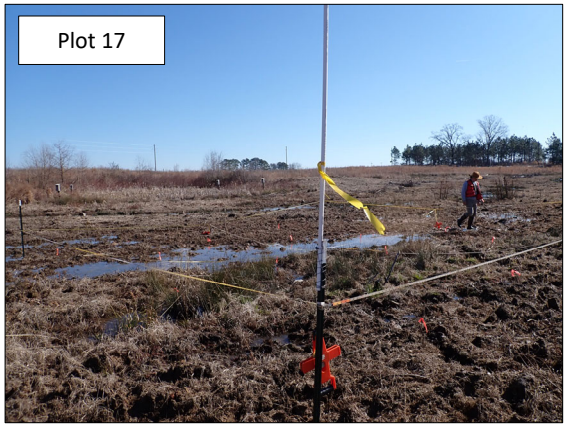




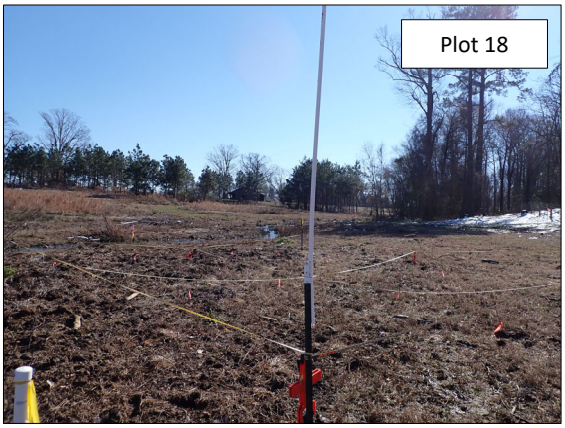


Swamp grape Site,
MY0 (2022) Vegetation Monitoring Photographs (taken January 24 2022)

Plot 17



Plot 18



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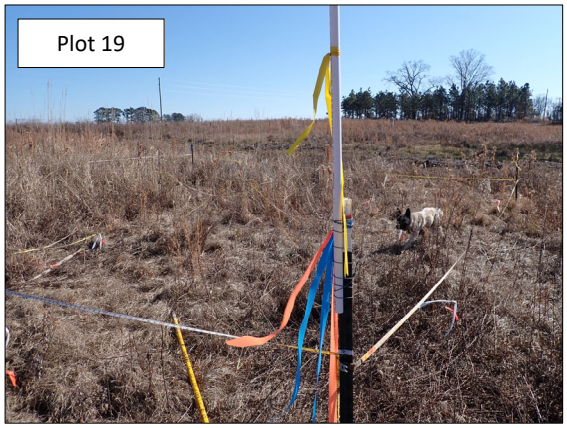

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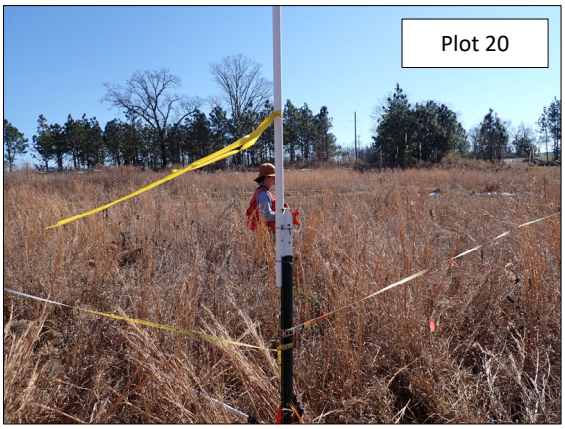

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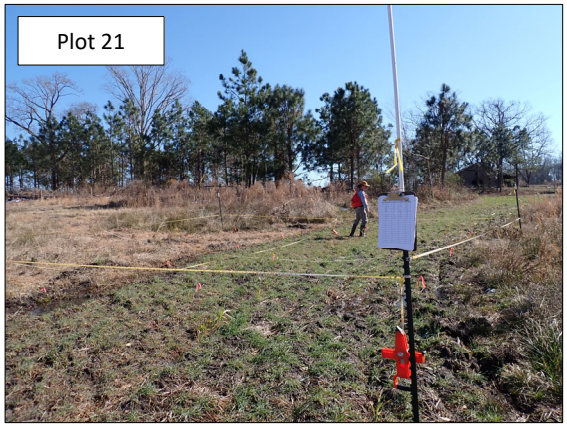


Plot 22

Plot 23

Appendix B
Vegetation Data

Table 6A. Planted Bare-Root Woody Vegetation
Table 6B. Permanent Seed Mix
Table 6C. Mitigation Plan Planting Plan and As-Built Planting Comparison
Table 7. Vegetation Plot Counts and Densities
Table 8. Vegetation Plot Data Table from Vegetation Data Entry Tool

Table 6A. Planted Bare Root Woody Vegetation
Swamp Grape Stream and Wetland Mitigation Site

Species	Total
Acres	**22.5**
Betula nigra	1,000
Cephalanthus occidentalis	800
Carya ovata	800
Carya aquatica	800
Alnus serrulata	750
Taxodium ascendens	1,000
Nyssa aquatica	500
Taxodium distichum	3,000
Nyssa sylvatica	700
Quercus nigra	2,200
Quercus phellos	2,200
Quercus shumardii	2,000
Ulmus americana	2,000
TOTALS	**17,750**
Average Stems/Acre	**789**

Table 6B. Permanent Seed Mix
Swamp Grape Stream and Wetland Mitigation Site

Species*	%	Species*	%
Common Yarrow (*Achillea millefolium*)	1	Showy Ticktrefoil (*Desmodium canadense*)	1
Redtop (*Agrostis gigantea*)	15	Purple Coneflower (*Echinacea purpurea*)	6
Winter Bentgrass (*Agrostis hyemalis*)	5	Virginia Wildrye, 'Madison' (*Elymus virginicus*)	5
Creeping Bentgrass (*Agrostis stolonifera*)	5	Perennial Gaillardia (Blanketflower) (*Gaillardia perennial*)	2
Clusterspike False Indigo (*Amorpha herbacea*)	1	Narrowleaf Sunflower (*Helianthus angustifolius*)	1.5
Showy Aster (*Aster ericoides*)	1	Oxeye Sunflower (*Heliopsis helianthoides*)	1
Blue False Indigo (*Baptisia australis*)	2	Wild Bergamot (*Monarda fistulosa*)	0.5
Oxeye Daisy (*Leucanthemum vulgare*)	5	Deertongue, Tioga (*Dichanthelium clandestinum*)	5
Shasta Daisy (*Leucanthemum superbum*)	3	Tall White Beardtongue (*Penstemon digitalis*)	1
Lanceleaf Coreopsis (*Coreopsis lanceolata*)	5	Clasping Coneflower (*Dracopis amplexicaulis*)	1
Plains Coreopsis (*Coreopsis tinctoria*)	5	Blackeyed Susan (*Rudbeckia hirta*)	3
Cosmos (*Cosmos bipinnatus*)	2	Purpletop (*Tridens flavus*)	20
Rocket Larkspur (*Consolida ajacis*)	2	Blue Vervain (*Verbena hastata*)	1
			Total = 100% (24.7 lbs)

* This seed mix was applied at 1 lbs per acre sitewide.

Table 6C. Mitigation Plan Planting Plan (in black) and As-Built Planting (in red)

Vegetation Association	Cypress Gum Swamp*		Coastal Plain Small Stream Swamp*		Stream-side Assemblage**		TOTAL
Area (acres)	**2.3**		**17.4**		**2.8**		**22.5**
Species	**# planted***	**% of total**	**# planted***	**% of total**	**# planted****	**% of total**	**# planted**
Swamp black gum (*Nyssa biflora)*	~~391~~ 328	25	~~2366~~ 1887	~~20~~ 19	~~776~~ 621	~~10~~ 9.5	~~3533~~ 700
Bald cypress (Taxodium distichum)	~~391~~ 328	25	~~2366~~ 1887	~~20~~ 19	~~776~~ 621	~~10~~ 9.5	~~3533~~ 3000
Tupelo gum (Nyssa aquatica)	~~391~~ 328	25	--	--	--	--	~~391~~ 500
Pond cypress (Taxodium ascendens)	~~391~~ 328	25	--	--	--	--	~~391~~ 1000
Water oak (Quercus nigra)	--	--	~~1775~~ 1390	~~15~~ 14	~~776~~ 621	~~10~~ 9.5	~~2550~~ 2200
Willow oak (Quercus phellos)	--	--	~~1775~~ 1390	~~15~~ 14	~~776~~ 621	~~10~~ 9.5	~~2550~~ 2200
Schumard oak (Quercus schumardii)	--	--	~~1183~~ 894	~~10~~ 9	~~776~~ 621	~~10~~ 9.5	~~1959~~ 2000
American elm (*Ulmus americana*)	--	--	~~1183~~ 894	~~10~~ 9	~~776~~ 621	~~10~~ 9.5	~~1959~~ 2000
Shagbark hickory (*Carya ovata*)	--	--	~~1183~~ 894	~~10~~ 9	~~776~~ 621	~~10~~ 9.5	~~1959~~ 800
~~Black willow~~ Water Hickory (Carya aquatica)	--	--	--	--	~~776~~ 621	~~10~~ 9.5	~~776~~ 800
Tag alder (Alnus serrulata)	--	--	--	--	~~776~~ 621	~~10~~ 9.5	~~776~~ 750
Buttonbush (Cephalanthus occidentalis)	--	--	--	--	~~776~~ 621	~~10~~ 9.5	~~776~~ 800
River birch (*Betula nigra*)	--	--	-- 700	-- 7	-- 300	-- 5	-- 1000
TOTAL	~~1564~~ 1312	100	~~11832~~ 9929	100	~~7756~~ 6509	100	~~21,152~~ 17,750

* Planted at a density of 680 stems/acre.
** Planted at a density of 2720 stems/acre.

Table 7. Planted Vegetation Totals
Swamp Grape Stream and Wetland Mitigation Site

Plot #	Planted Stems/Acre	Success Criteria Met?
1	607	Yes
2	567	Yes
3	607	Yes
4	648	Yes
5	688	Yes
6	607	Yes
7	648	Yes
8	567	Yes
9	688	Yes
10	526	Yes
11	567	Yes
12	688	Yes
13	688	Yes
14	567	Yes
15	648	Yes
16	607	Yes
17	607	Yes
18	688	Yes
19	324	Yes
20	567	Yes
21	607	Yes
22	729	Yes
23	405	Yes
Average Planted Stems/Acre	**602**	**Yes**

Table 8. Vegetation Plot Data Table from Vegetation Data Entry Tool

Planted Acreage	22.5
Date of Initial Plant	1/18/2022
Date(s) of Supplemental Plant(s)	
Date(s) Mowing	
Date of Current Survey	2022-01-24
Plot size (ACRES)	0.0247

	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 6 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Alnus serrulata	hazel alder	Tree	FACW	4	4	2	2					1	1		
	Betula nigra	river birch	Tree	FACW									1	1		
	Carya sp.	hickory														
	Cephalanthus occidentalis	common buttonbush	Shrub	OBL	1	1			1	1	1	1				
	Nyssa sp.	gum											2	2		
	Nyssa sylvatica	blackgum	Tree	FAC			2	2	1	1	1	1				
	Quercus nigra	water oak	Tree	FAC	3	3	1	1					4	4	4	4
	Quercus phellos	willow oak	Tree	FACW	2	2	1	1			5	5				
	Quercus shumardii	Shumard's oak	Tree	FAC	1	1					2	2			1	1
	Quercus sp.	oak			2	2	7	7	5	5	2	2	3	3	7	7
	Taxodium sp.	cypress			1	1	1	1	8	8	4	4	5	5		
	Ulmus americana	American elm	Tree	FAC	1	1					1	1	1	1	3	3
Sum	Performance Standard				15	15	14	14	15	15	16	16	17	17	15	15
Mitigation Plan Performance Standard	Current Year Stem Count					15		14		15		16		17		15
	Stems/Acre					607		567		607		648		688		607
	Species Count					8		6		4		7		7		4
	Dominant Species Composition (%)					27		50		53		31		29		47
	Average Plot Height (ft.)					2		2		2		1		2		2
	% Invasives					0		0		0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					15		14		15		16		17		15
	Stems/Acre					607		567		607		648		688		607
	Species Count					8		6		4		7		7		4
	Dominant Species Composition (%)					27		50		53		31		29		47
	Average Plot Height (ft.)					2		2		2		1		2		2
	% Invasives					0		0		0		0		0		0

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 8. Vegetation Plot Data Table from Vegetation Data Entry Tool (continued)

Planted Acreage	22.5
Date of Initial Plant	1/18/2022
Date(s) of Supplemental Plant(s)	
Date(s) Mowing	
Date of Current Survey	2022-01-24
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 7 F		Veg Plot 8 F		Veg Plot 9 F		Veg Plot 10 F		Veg Plot 11 F		Veg Plot 12 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Alnus serrulata	hazel alder	Tree	FACW	1	1	2	2	1	1					4	4
	Betula nigra	river birch	Tree	FACW												
	Carya sp.	hickory														
	Cephalanthus occidentalis	common buttonbush	Shrub	OBL			1	1	2	2	1	1	2	2	1	1
	Nyssa sp.	gum							1	1	3	3				
	Nyssa sylvatica	blackgum	Tree	FAC					6	6			1	1		
	Quercus nigra	water oak	Tree	FAC			4	4					3	3		
	Quercus phellos	willow oak	Tree	FACW	2	2	1	1			1	1				
	Quercus shumardii	Shumard's oak	Tree	FAC												
	Quercus sp.	oak			3	3	6	6			1	1	1	1	5	5
	Taxodium sp.	cypress			10	10			6	6	7	7	7	7	7	7
	Ulmus americana	American elm	Tree	FAC					1	1						
Sum	Performance Standard				16	16	14	14	17	17	13	13	14	14	17	17
Mitigation Plan Performance Standard	Current Year Stem Count					16		14		17		13		14		17
	Stems/Acre					648		567		688		526		567		688
	Species Count					4		5		6		5		5		4
	Dominant Species Composition (%)					62		43		35		54		50		41
	Average Plot Height (ft.)					2		2		2		2		2		2
	% Invasives					0		0		0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					16		14		17		13		14		17
	Stems/Acre					648		567		688		526		567		688
	Species Count					4		5		6		5		5		4
	Dominant Species Composition (%)					62		43		35		54		50		41
	Average Plot Height (ft.)					2		2		2		2		2		2
	% Invasives					0		0		0		0		0		0

Table 8. Vegetation Plot Data Table from Vegetation Data Entry Tool (continued)

Planted Acreage	22.5
Date of Initial Plant	1/18/2022
Date(s) of Supplemental Plant(s)	
Date(s) Mowing	
Date of Current Survey	2022-01-24
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 13 F		Veg Plot 14 F		Veg Plot 15 F		Veg Plot 16 F		Veg Plot 17 F		Veg Plot 18 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Alnus serrulata	hazel alder	Tree	FACW												
	Betula nigra	river birch	Tree	FACW	1	1	5	5	1	1						
	Carya sp.	hickory														
	Cephalanthus occidentalis	common buttonbush	Shrub	OBL												
	Nyssa sp.	gum					4	4	10	10						
	Nyssa sylvatica	blackgum	Tree	FAC							3	3	3	3		
	Quercus nigra	water oak	Tree	FAC	2	2			4	4	2	2	2	2	1	1
	Quercus phellos	willow oak	Tree	FACW	5	5			1	1	3	3	1	1	3	3
	Quercus shumardii	Shumard's oak	Tree	FAC	1	1										
	Quercus sp.	oak									2	2	3	3	3	3
	Taxodium sp.	cypress			6	6	2	2			4	4	2	2	7	7
	Ulmus americana	American elm	Tree	FAC	2	2	3	3			1	1	4	4	3	3
Sum	Performance Standard				17	17	14	14	16	16	15	15	15	15	17	17
Mitigation Plan Performance Standard	Current Year Stem Count					17		14		16		15		15		17
	Stems/Acre					688		567		648		607		607		688
	Species Count					6		4		4		6		6		5
	Dominant Species Composition (%)					35		36		62		27		27		41
	Average Plot Height (ft.)					2		2		2		2		1		2
	% Invasives					0		0		0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					17		14		16		15		15		17
	Stems/Acre					688		567		648		607		607		688
	Species Count					6		4		4		6		6		5
	Dominant Species Composition (%)					35		36		62		27		27		41
	Average Plot Height (ft.)					2		2		2		2		1		2
	% Invasives					0		0		0		0		0		0

Table 8. Vegetation Plot Data Table from Vegetation Data Entry Tool (continued)

Planted Acreage	22.5
Date of Initial Plant	1/18/2022
Date(s) of Supplemental Plant(s)	
Date(s) Mowing	
Date of Current Survey	2022-01-24
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 19 F		Veg Plot 20 F		Veg Plot 21 F		Veg Plot 22 F		Veg Plot 23 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Alnus serrulata	hazel alder	Tree	FACW										
	Betula nigra	river birch	Tree	FACW	1	1					3	3		
	Carya sp.	hickory							3	3	2	2	3	3
	Cephalanthus occidentalis	common buttonbush	Shrub	OBL									1	1
	Nyssa sp.	gum											1	1
	Nyssa sylvatica	blackgum	Tree	FAC	4	4	1	1						
	Quercus nigra	water oak	Tree	FAC					1	1	1	1		
	Quercus phellos	willow oak	Tree	FACW	1	1					4	4	2	2
	Quercus shumardii	Shumard's oak	Tree	FAC			3	3						
	Quercus sp.	oak					4	4	4	4	4	4	1	1
	Taxodium sp.	cypress			2	2	4	4	7	7	3	3	2	2
	Ulmus americana	American elm	Tree	FAC			2	2			1	1		
Sum	Performance Standard				8	8	14	14	15	15	18	18	10	10
Mitigation Plan Performance Standard	Current Year Stem Count					8		14		15		18		10
	Stems/Acre					324		567		607		729		405
	Species Count					4		5		4		7		6
	Dominant Species Composition (%)					50		29		47		22		30
	Average Plot Height (ft.)					2		2		2		1		1
	% Invasives					0		0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					8		14		15		18		10
	Stems/Acre					324		567		607		729		405
	Species Count					4		5		4		7		6
	Dominant Species Composition (%)					50		29		47		22		30
	Average Plot Height (ft.)					2		2		2		1		1
	% Invasives					0		0		0		0		0

Appendix C
Stream Geomorphology Data

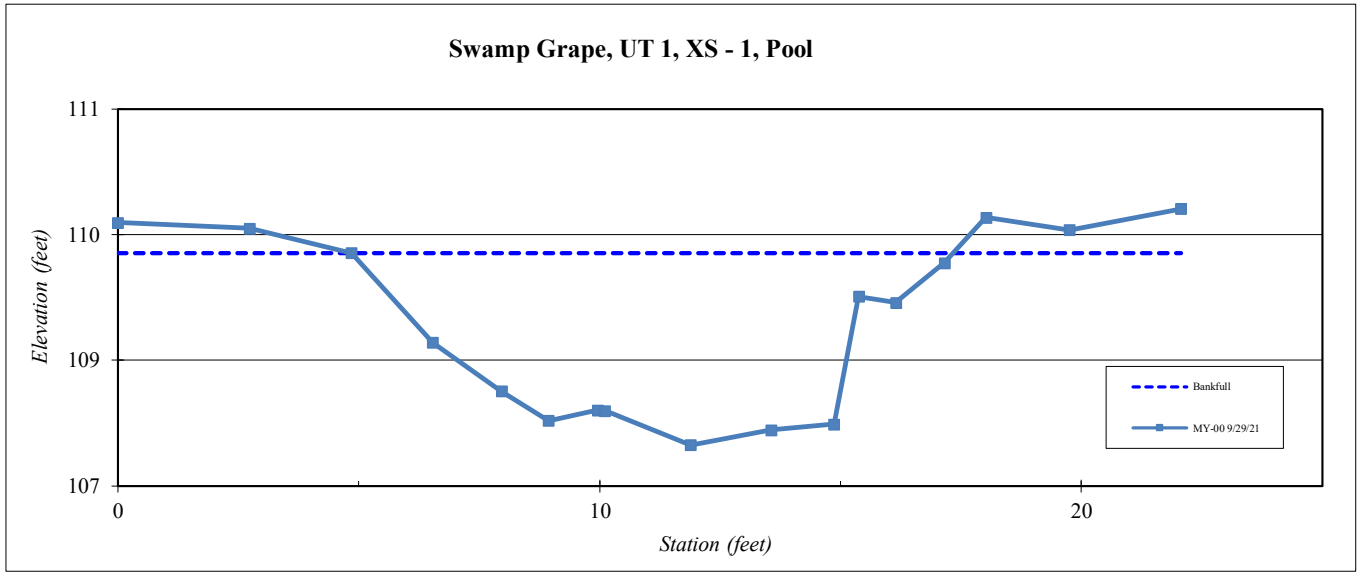
Cross-Sections with Annual Overlays
Longitudinal Profile
Table 9A-D. Baseline Stream Data Summary Tables
Table 10A-C. Cross-Section Morphology Monitoring Summary

Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT1, XS -1, Pool
Feature	Pool
Date:	9/29/2021
Field Crew:	Perkinson

Station	Elevation
0.0	109.8
2.7	109.7
4.8	109.5
6.5	108.7
8.0	108.3
8.9	108.0
10.0	108.1
10.1	108.1
11.9	107.8
13.6	107.9
14.9	108.0
15.4	109.1
16.1	109.1
17.2	109.4
18.0	109.8
19.8	109.7
22.1	109.9

SUMMARY DATA	
Bankfull Elevation:	109.50
Bank Hieght Ratio:	1.00
Thalweg Elevation:	107.77
LTOB Elevation:	109.50
LTOB Max Depth:	1.73
LTOB Cross Sectional Area:	13.9

Stream Type	E/C 5

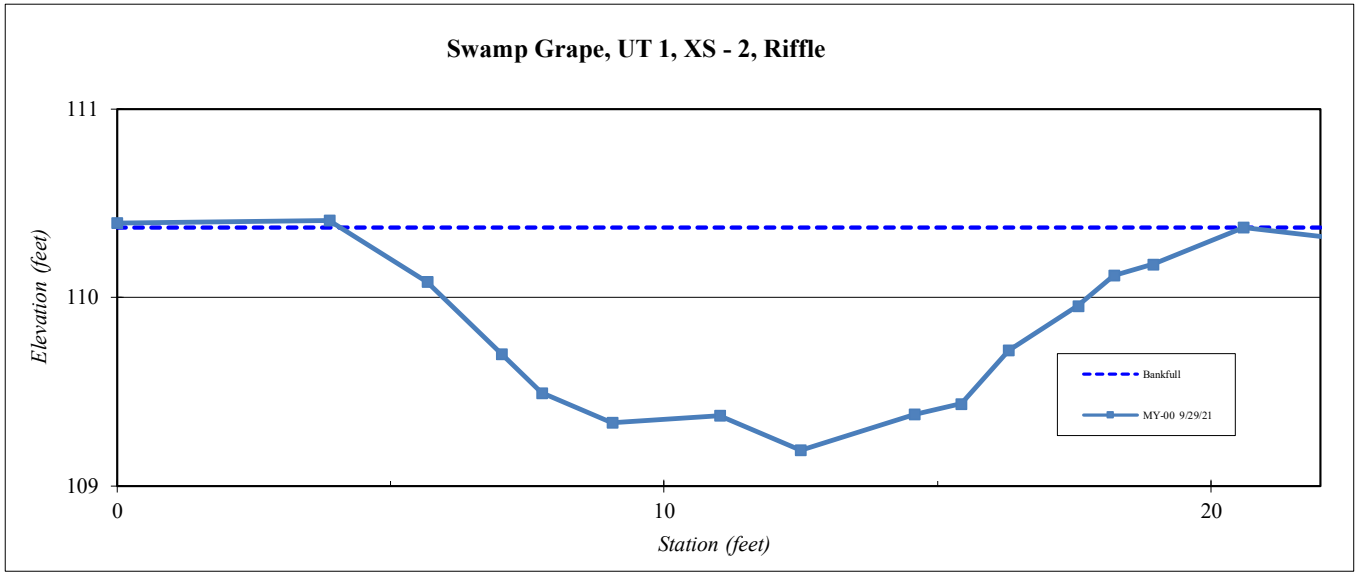


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT1, XS -2, Riffle
Feature	Riffle
Date:	9/29/2021
Field Crew:	Perkinson

Station	Elevation
0.0	110.1
3.9	110.1
5.7	109.8
7.0	109.3
7.8	109.1
9.0	108.9
11.0	109.0
12.5	108.8
14.6	109.0
15.4	109.0
16.3	109.4
17.6	109.6
18.2	109.8
18.9	109.9
20.6	110.1
22.0	110.0

SUMMARY DATA	
Bankfull Elevation:	110.09
Bank Hieght Ratio:	1.00
Thalweg Elevation:	108.75
LTOB Elevation:	110.09
LTOB Max Depth:	1.34
LTOB Cross Sectional Area:	12.8

Stream Type	E/C 5

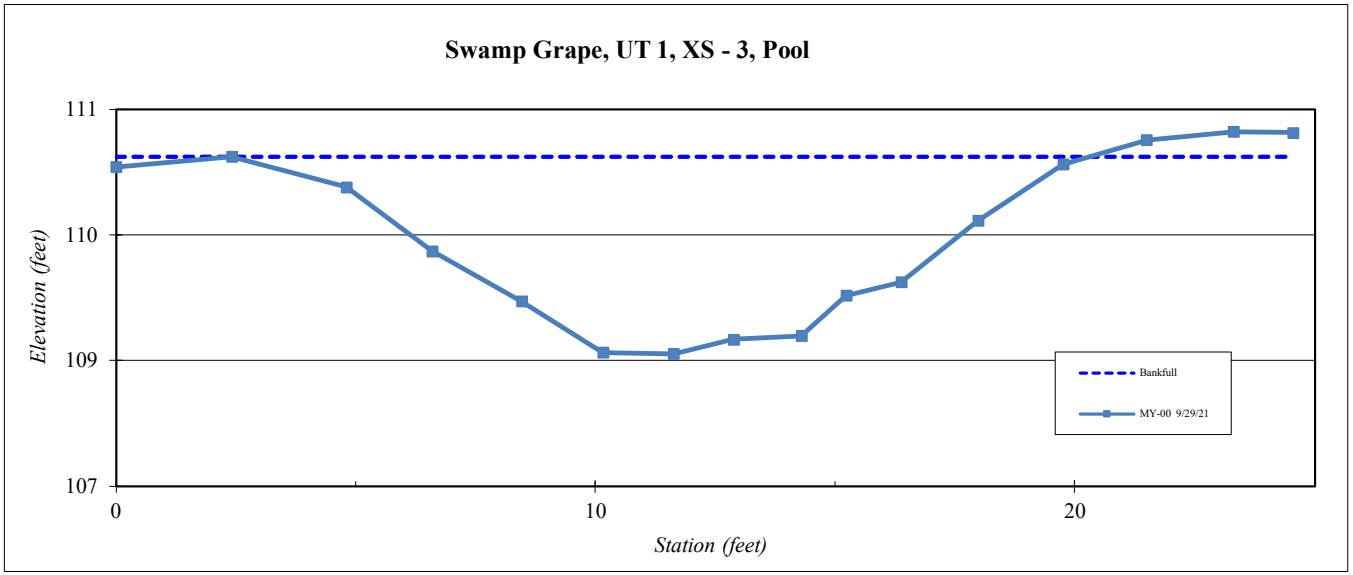


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT1, XS -3, Pool
Feature	Pool
Date:	9/29/2021
Field Crew:	Perkinson

Station	Elevation
0.0	110.3
2.4	110.4
4.8	110.1
6.6	109.5
8.5	109.1
10.2	108.6
11.6	108.6
12.9	108.7
14.3	108.8
15.2	109.1
16.4	109.2
18.0	109.8
19.8	110.3
21.5	110.5
23.3	110.6
24.5	110.6

SUMMARY DATA	
Bankfull Elevation:	110.37
Bank Hieght Ratio:	1.00
Thalweg Elevation:	108.60
LTOB Elevation:	110.37
LTOB Max Depth:	1.77
LTOB Cross Sectional Area:	17.8

Stream Type	E/C 5

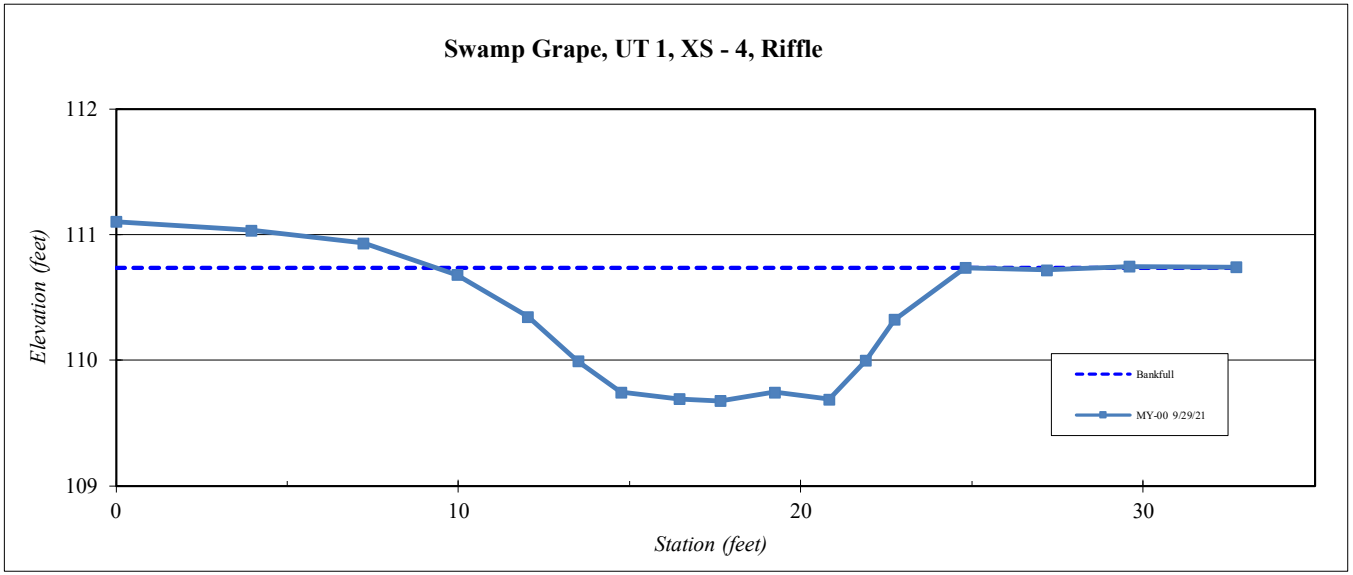


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT1, XS -4, Pool
Feature	Riffle
Date:	9/29/2021
Field Crew:	Perkinson

Station	Elevation
0.0	110.9
3.9	110.8
7.2	110.7
10.0	110.4
12.0	110.1
13.5	109.7
14.8	109.4
16.5	109.3
17.6	109.3
19.2	109.4
20.8	109.3
21.9	109.7
22.7	110.0
24.8	110.5
27.2	110.5
29.6	110.5
32.7	110.5

SUMMARY DATA	
Bankfull Elevation:	110.50
Bank Hieght Ratio:	1.00
Thalweg Elevation:	109.30
LTOB Elevation:	110.50
LTOB Max Depth:	1.20
LTOB Cross Sectional Area:	11.9

Stream Type	E/C 5

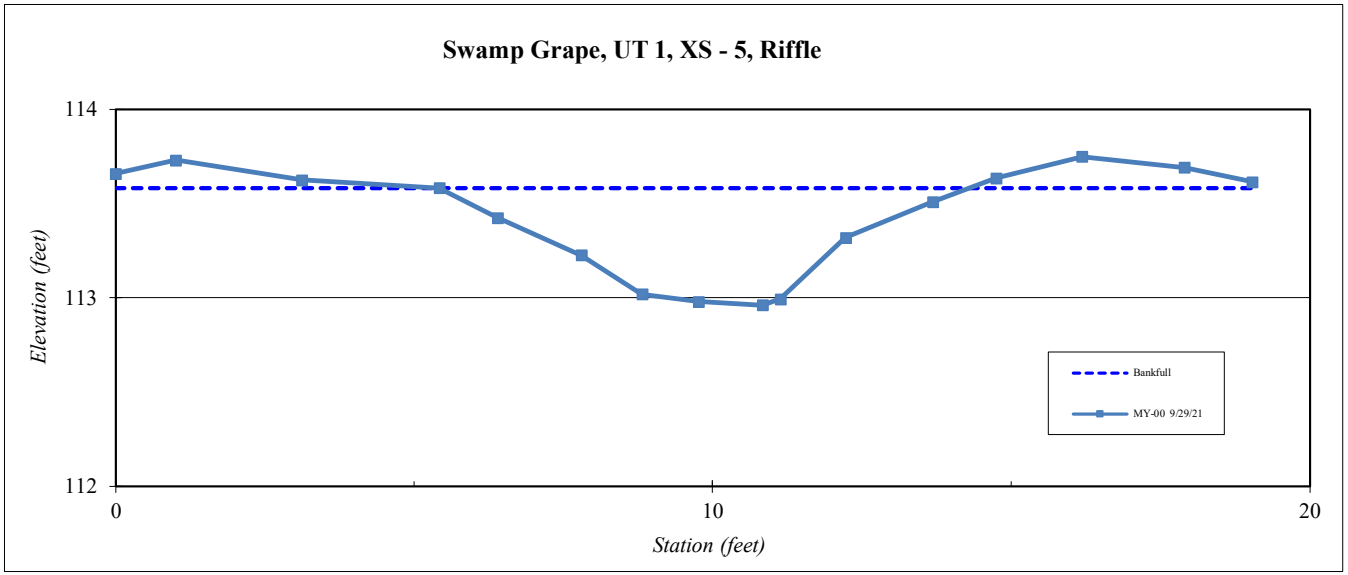


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT1, XS - 5, Riffle
Feature	Riffle
Date:	9/29/2021
Field Crew:	Perkinson

Station	Elevation
0.0	113.8
1.0	113.9
3.1	113.8
5.4	113.7
6.4	113.5
7.8	113.3
8.8	113.1
9.8	113.0
10.8	113.0
11.1	113.1
12.2	113.4
13.7	113.6
14.8	113.8
16.2	113.9
17.9	113.8
19.0	113.8

SUMMARY DATA	
Bankfull Elevation:	113.72
Bank Hieght Ratio:	1.00
Thalweg Elevation:	113.01
LTOB Elevation:	113.72
LTOB Max Depth:	0.70
LTOB Cross Sectional Area:	3.4

Stream Type	E/C 5

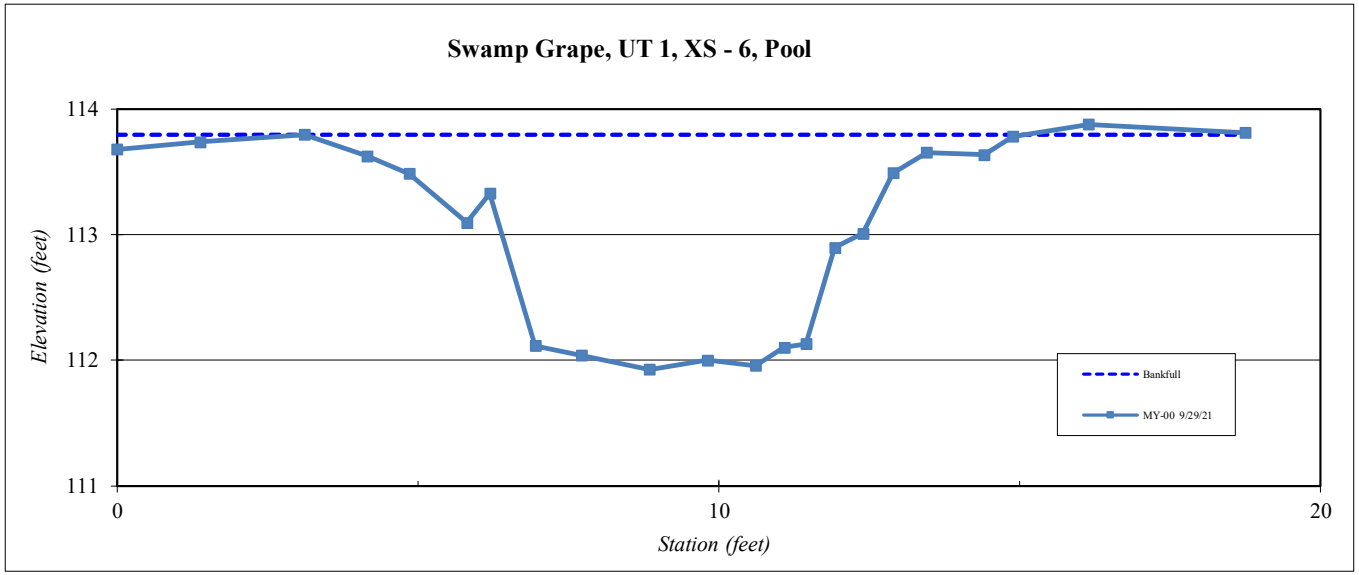


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT1, XS - 6, Pool
Feature	Pool
Date:	9/29/2021
Field Crew:	Perkinson

Station	Elevation
0.0	113.8
1.4	113.9
3.1	114.0
4.2	113.8
4.9	113.6
5.8	113.2
6.2	113.4
7.0	112.1
7.7	112.0
8.8	111.8
9.8	111.9
10.6	111.9
11.1	112.0
11.5	112.1
11.9	112.9
12.4	113.1
12.9	113.6
13.5	113.8
14.4	113.8
14.9	113.9
16.1	114.05
18.8	114.0

SUMMARY DATA	
Bankfull Elevation:	113.96
Bank Hieght Ratio:	1.00
Thalweg Elevation:	111.84
LTOB Elevation:	113.96
LTOB Max Depth:	2.11
LTOB Cross Sectional Area:	13.1

Stream Type	E/C 5

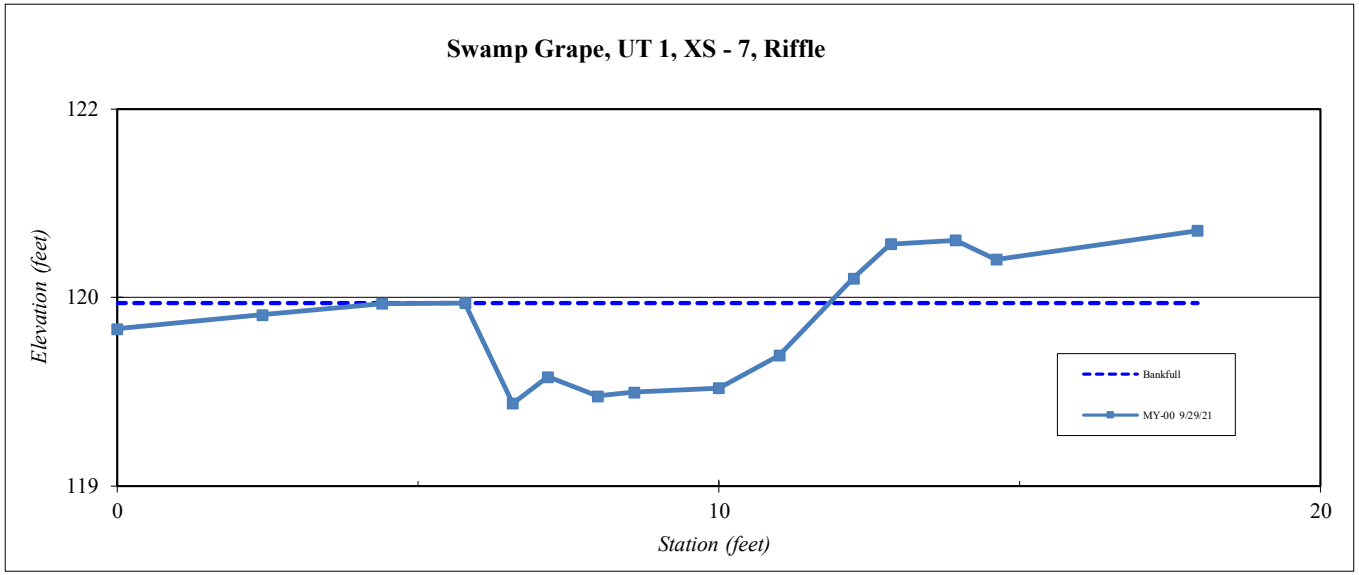


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT1, XS - 7, Riffle
Feature	Riffle
Date:	9/29/2021
Field Crew:	Perkinson

Station	Elevation
0.0	120.2
2.4	120.3
4.4	120.4
5.8	120.4
6.6	119.8
7.2	120.0
8.0	119.8
8.6	119.9
10.0	119.9
11.0	120.1
12.2	120.5
12.9	120.7
13.9	120.8
14.6	120.7
18.0	120.8

SUMMARY DATA	
Bankfull Elevation:	120.40
Bank Hieght Ratio:	1.00
Thalweg Elevation:	119.79
LTOB Elevation:	120.40
LTOB Max Depth:	0.60
LTOB Cross Sectional Area:	2.9

Stream Type	E/C 5

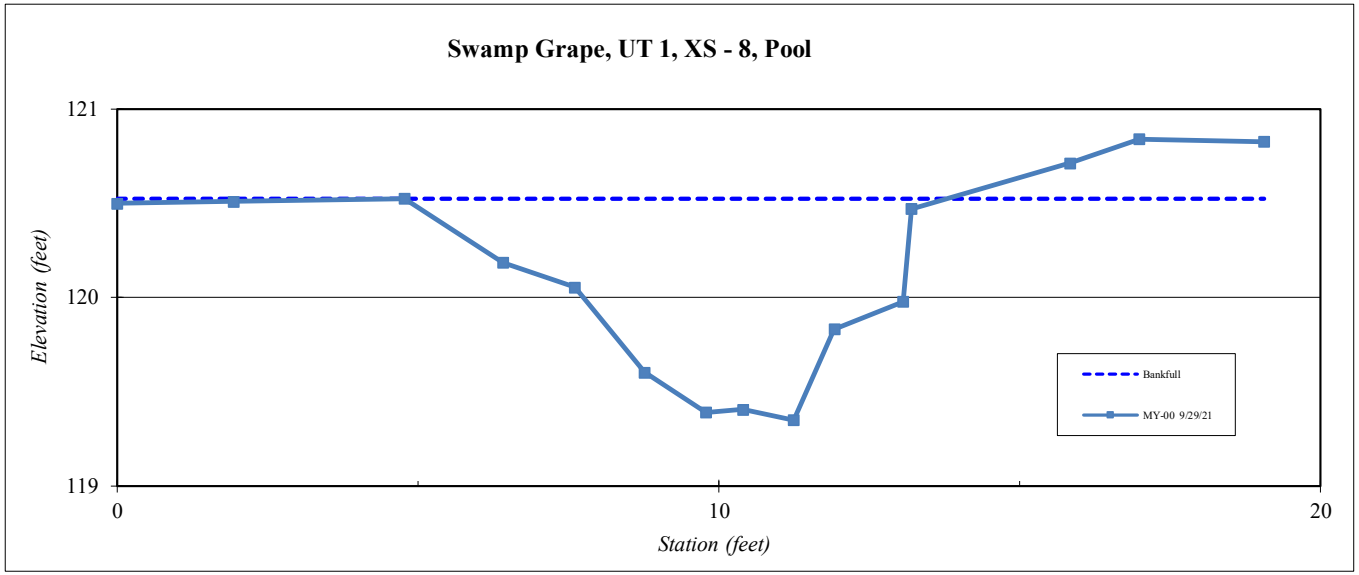


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT1, XS - 8, Pool
Feature	Pool
Date:	9/29/2021
Field Crew:	Perkinson

Station	Elevation
0.0	120.4
1.9	120.4
4.8	120.4
6.4	120.1
7.6	119.9
8.8	119.4
9.8	119.2
10.4	119.2
11.2	119.1
11.9	119.7
13.1	119.8
13.2	120.4
15.8	120.6
17.0	120.8
19.1	120.8

SUMMARY DATA	
Bankfull Elevation:	120.44
Bank Hieght Ratio:	1.00
Thalweg Elevation:	119.11
LTOB Elevation:	120.44
LTOB Max Depth:	1.33
LTOB Cross Sectional Area:	6.5

Stream Type	E/C 5

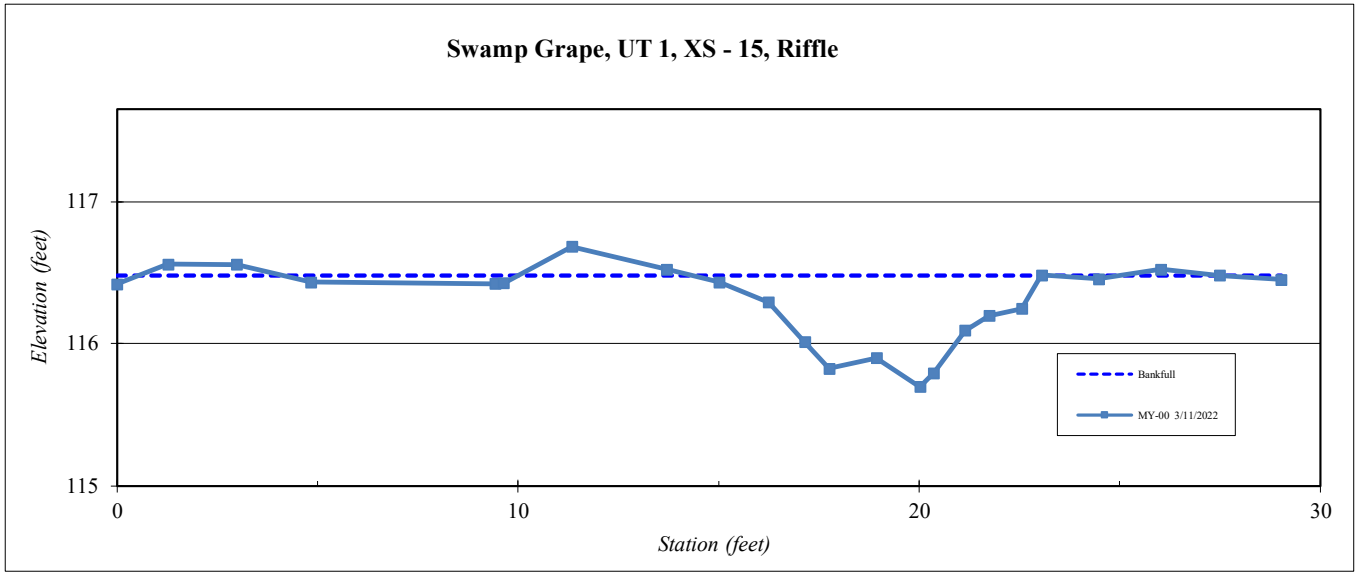


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT1, XS - 15, Riffle
Feature	Riffle
Date:	3/11/2022
Field Crew:	Perkinson

Station	Elevation
0.0	116.6
1.3	116.8
3.0	116.8
4.8	116.6
9.4	116.6
9.6	116.6
11.3	116.9
13.7	116.7
15.0	116.6
16.2	116.5
17.1	116.1
17.8	115.9
18.9	116.0
20.0	115.8
20.4	115.9
21.1	116.2
21.7	116.4
22.6	116.4
23.1	116.7
24.5	116.6
26.0	116.72
27.5	116.7
29.0	116.6

SUMMARY DATA	
Bankfull Elevation:	116.68
Bank Hieght Ratio:	1.00
Thalweg Elevation:	115.79
LTOB Elevation:	116.68
LTOB Max Depth:	0.89
LTOB Cross Sectional Area:	3.9

Stream Type	E/C 5

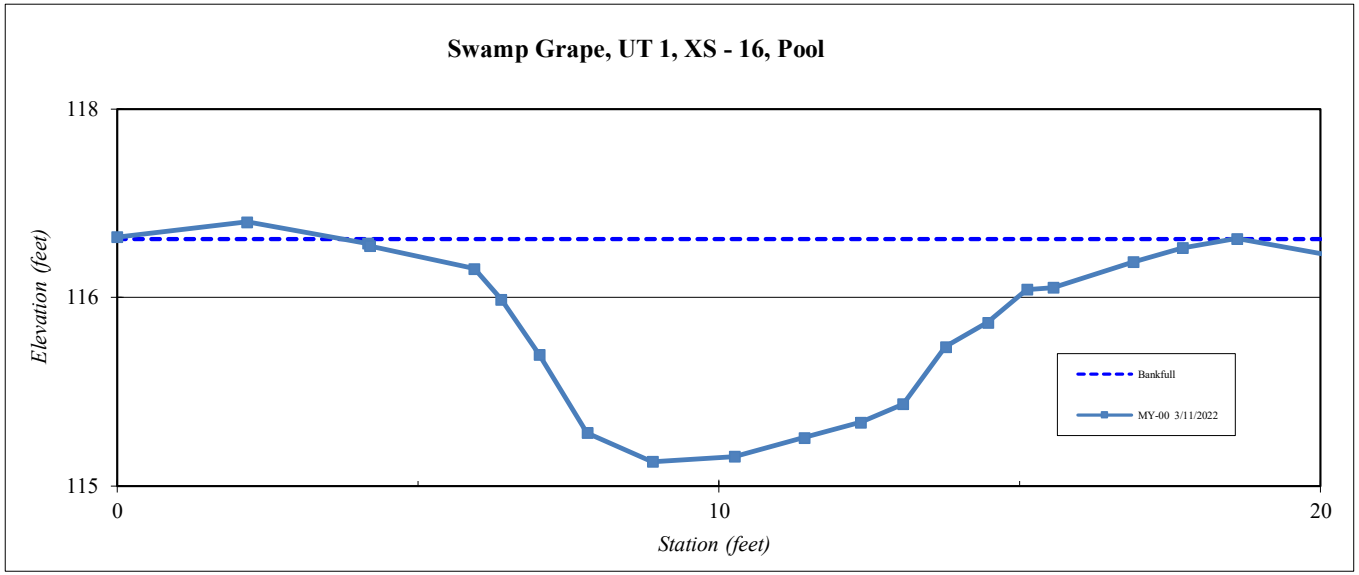


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT1, XS - 16, Pool
Feature	Pool
Date:	3/11/2022
Field Crew:	Perkinson

Station	Elevation
0.0	116.8
2.2	116.9
4.2	116.8
4.2	116.8
5.9	116.6
6.4	116.4
7.0	116.1
7.8	115.6
8.9	115.5
10.3	115.5
11.4	115.6
12.4	115.7
13.1	115.8
13.8	116.2
14.5	116.3
15.1	116.5
15.6	116.5
16.9	116.7
17.7	116.7
18.6	116.8
20.0	116.71
21.6	116.8

SUMMARY DATA	
Bankfull Elevation:	116.80
Bank Hieght Ratio:	1.00
Thalweg Elevation:	115.47
LTOB Elevation:	116.80
LTOB Max Depth:	1.34
LTOB Cross Sectional Area:	9.6

Stream Type	E/C 5

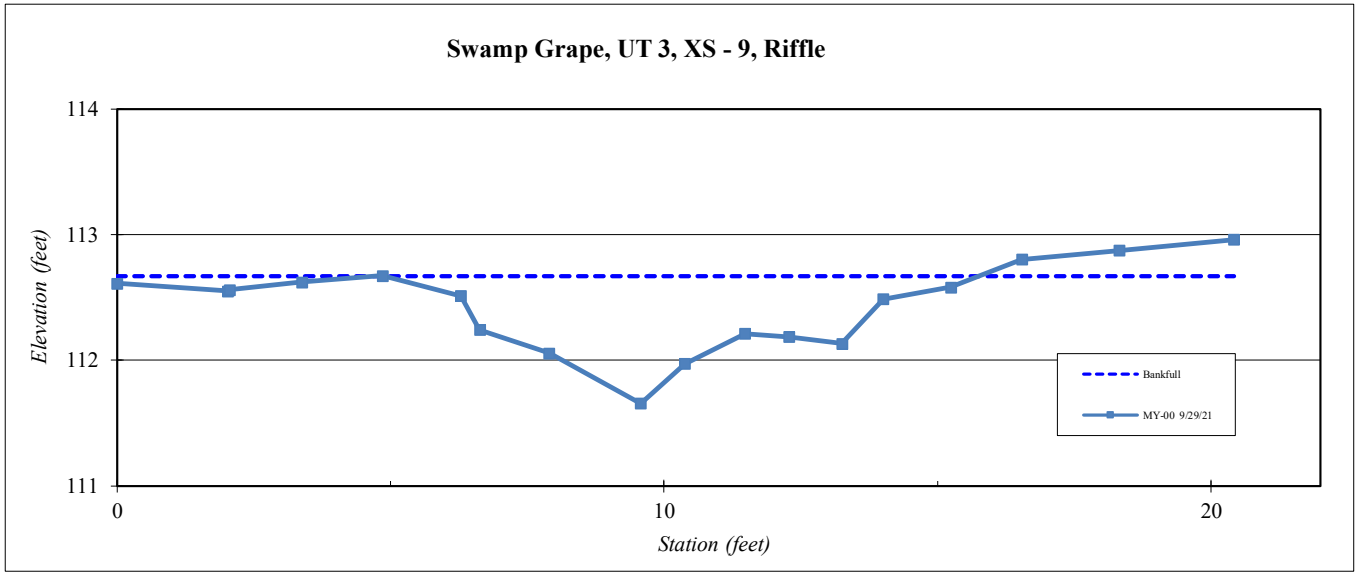


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT3, XS - 9, Riffle
Feature	Riffle
Date:	9/29/2021
Field Crew:	Harris, Adams

Station	Elevation
0.0	112.6
2.0	112.6
2.1	112.6
3.4	112.6
4.8	112.7
6.3	112.5
6.6	112.2
7.9	112.0
9.6	111.5
10.4	111.9
11.5	112.2
12.3	112.1
13.2	112.1
14.0	112.5
15.2	112.6
16.5	112.8
18.3	112.9
20.4	113.0

SUMMARY DATA	
Bankfull Elevation:	112.69
Bank Hieght Ratio:	1.00
Thalweg Elevation:	111.54
LTOB Elevation:	112.69
LTOB Max Depth:	1.15
LTOB Cross Sectional Area:	5.9

Stream Type	E/C 5

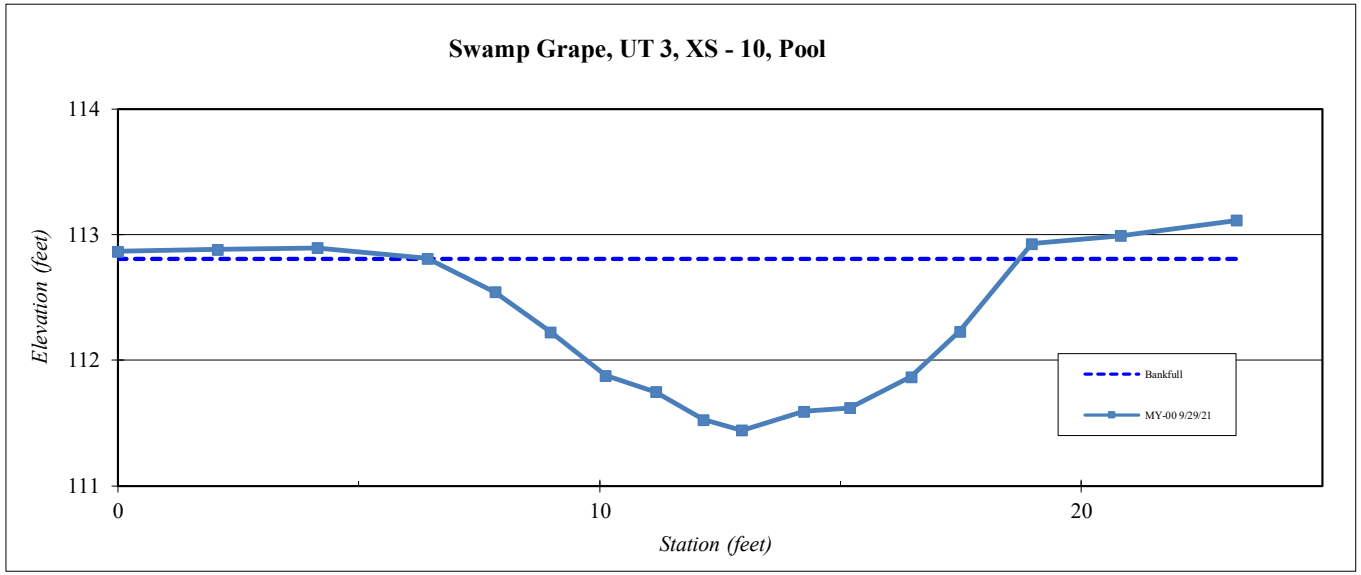


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT3, XS - 10, Pool
Feature	Pool
Date:	9/29/2021
Field Crew:	Harris, Adams

Station	Elevation
0.0	112.9
2.1	112.9
4.1	112.9
6.4	112.8
7.8	112.5
9.0	112.2
10.1	111.8
11.2	111.6
12.2	111.4
12.9	111.3
14.2	111.5
15.2	111.5
16.5	111.8
17.5	112.2
19.0	113.0
20.8	113.0
23.2	113.2

SUMMARY DATA	
Bankfull Elevation:	112.84
Bank Hieght Ratio:	1.00
Thalweg Elevation:	111.30
LTOB Elevation:	112.84
LTOB Max Depth:	1.54
LTOB Cross Sectional Area:	11.4

Stream Type	E/C 5

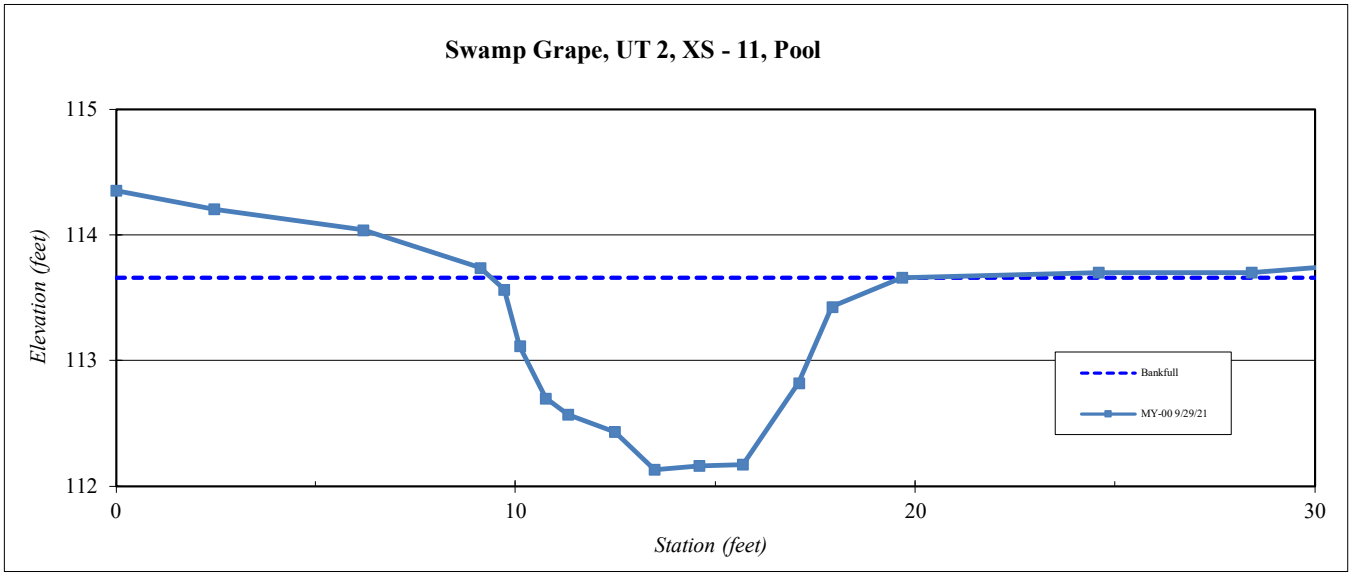


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT2, XS - 11, Pool
Feature	Pool
Date:	9/29/2021
Field Crew:	Harris, Adams

Station	Elevation
0.0	114.6
2.5	114.4
6.2	114.2
9.1	113.9
9.7	113.7
10.1	113.2
10.8	112.7
11.3	112.6
12.5	112.4
13.5	112.1
14.6	112.1
15.7	112.1
17.1	112.9
17.9	113.5
19.7	113.8
24.6	113.9
28.4	113.8
30.4	113.9

SUMMARY DATA	
Bankfull Elevation:	113.81
Bank Hieght Ratio:	1.00
Thalweg Elevation:	112.08
LTOB Elevation:	113.81
LTOB Max Depth:	1.73
LTOB Cross Sectional Area:	10.8

Stream Type	E/C 5

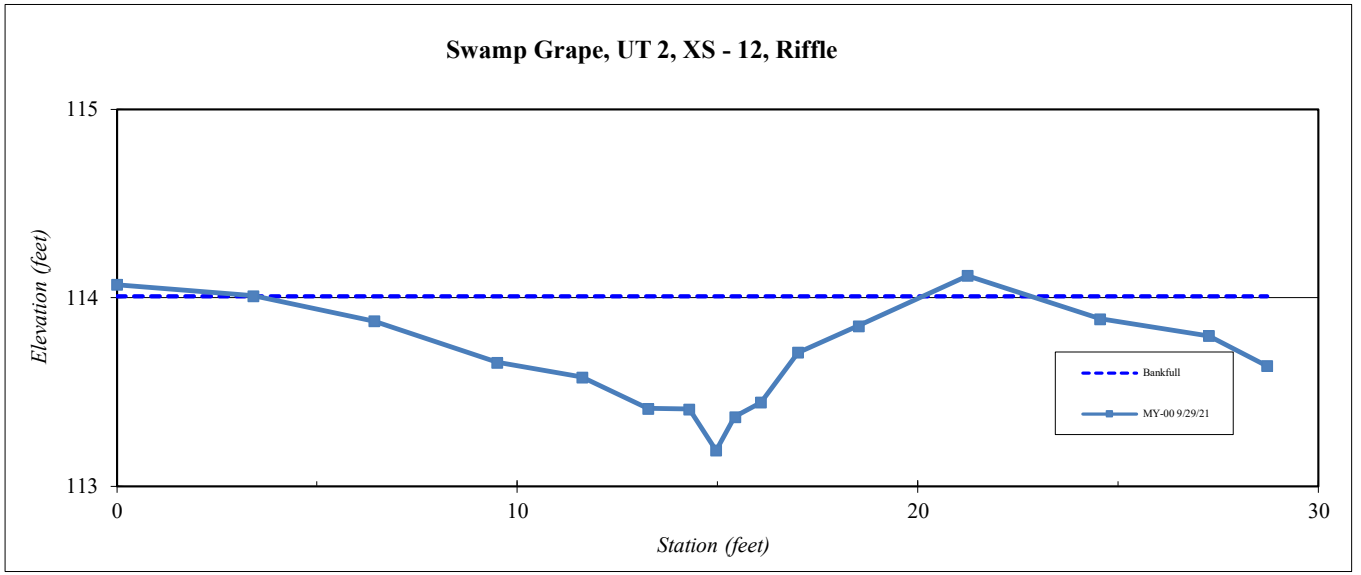


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT2, XS - 12, Riffle
Feature	Riffle
Date:	9/29/2021
Field Crew:	Harris, Adams

Station	Elevation
0.0	114.3
3.4	114.2
6.4	114.0
9.5	113.8
11.6	113.7
13.3	113.5
14.3	113.5
15.0	113.3
15.4	113.5
16.1	113.6
17.0	113.9
18.5	114.0
21.2	114.3
24.6	114.1
27.3	114.0
28.7	113.8

SUMMARY DATA	
Bankfull Elevation:	114.20
Bank Hieght Ratio:	1.00
Thalweg Elevation:	113.28
LTOB Elevation:	114.20
LTOB Max Depth:	0.92
LTOB Cross Sectional Area:	6.0

Stream Type	E/C 5

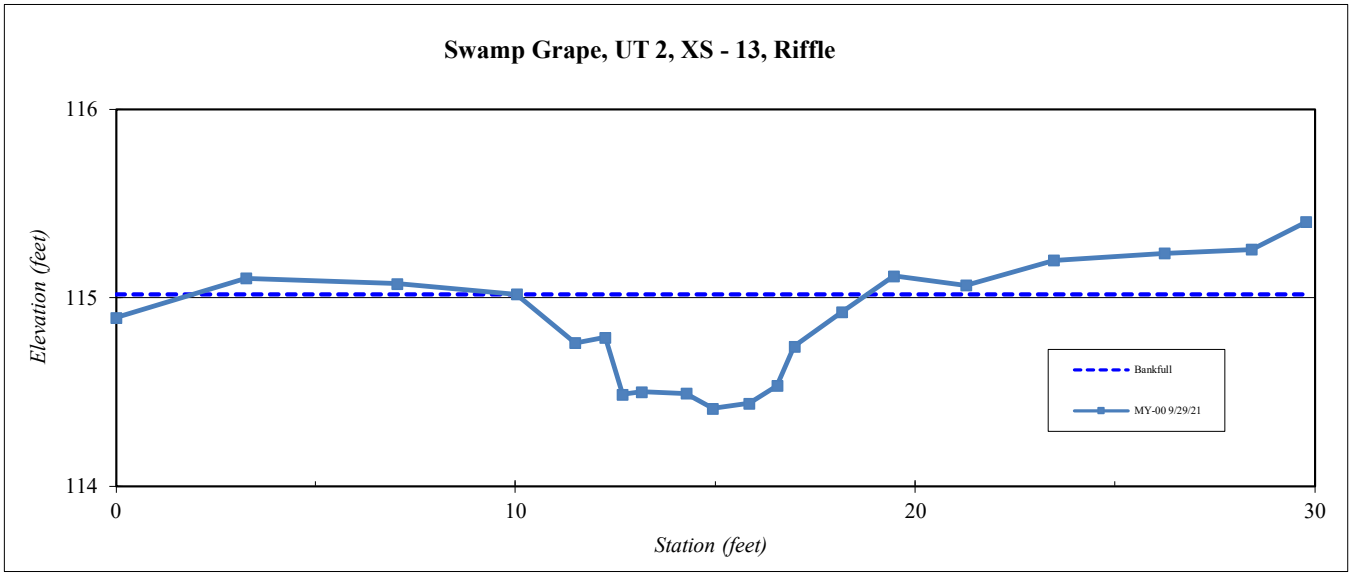


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT2, XS - 13, Riffle
Feature	Riffle
Date:	9/29/2021
Field Crew:	Harris, Adams

Station	Elevation
0.0	114.8
3.3	115.0
7.0	115.0
10.0	115.0
11.5	114.7
12.3	114.7
12.7	114.4
13.2	114.4
14.3	114.4
14.9	114.3
15.8	114.3
16.5	114.4
17.0	114.6
18.2	114.8
19.5	115.1
21.3	115.0
23.5	115.2
26.2	115.2
28.4	115.2
29.8	115.4

SUMMARY DATA	
Bankfull Elevation:	114.95
Bank Hieght Ratio:	1.00
Thalweg Elevation:	114.27
LTOB Elevation:	114.95
LTOB Max Depth:	0.68
LTOB Cross Sectional Area:	3.5

Stream Type	E/C 5

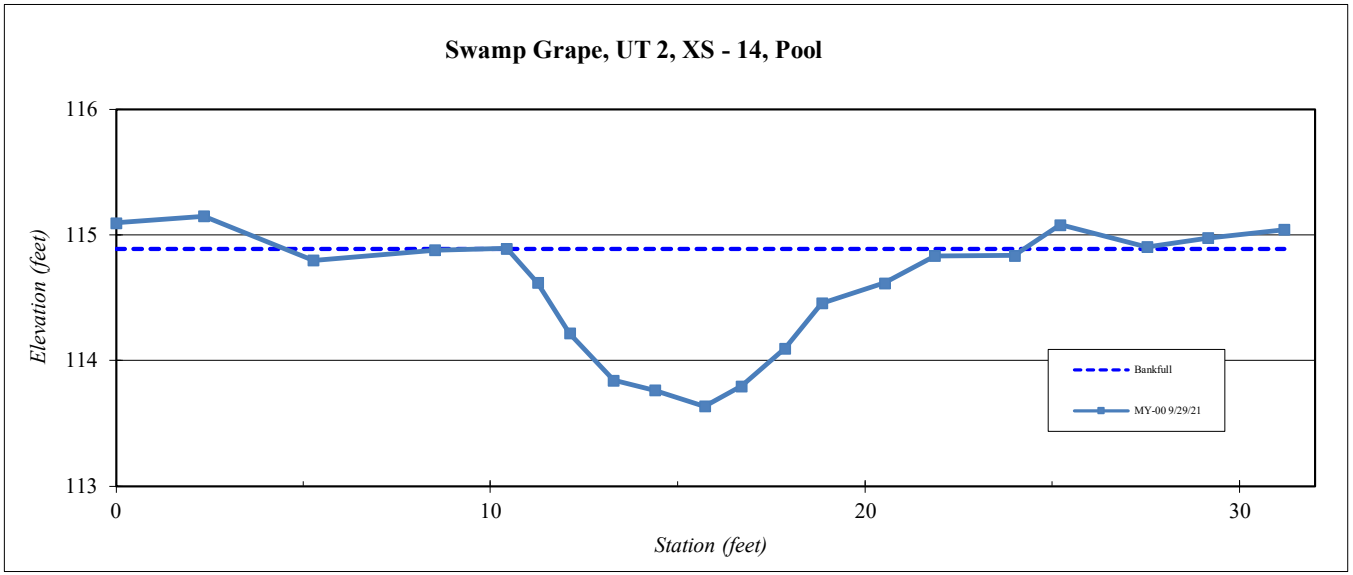


Site	Swamp Grape Site
Watershed:	Lumber River Basin, 03040204
XS ID	UT2, XS - 14, Pool
Feature	Pool
Date:	9/29/2021
Field Crew:	Harris, Adams

Station	Elevation
0.0	115.4
2.4	115.5
5.3	115.1
8.5	115.2
10.4	115.2
11.3	114.9
12.1	114.4
13.3	114.0
14.4	113.9
15.7	113.8
16.7	114.0
17.9	114.3
18.8	114.7
20.5	114.9
21.9	115.1
24.0	115.1
25.2	115.4
27.5	115.2
29.2	115.3
31.2	115.4

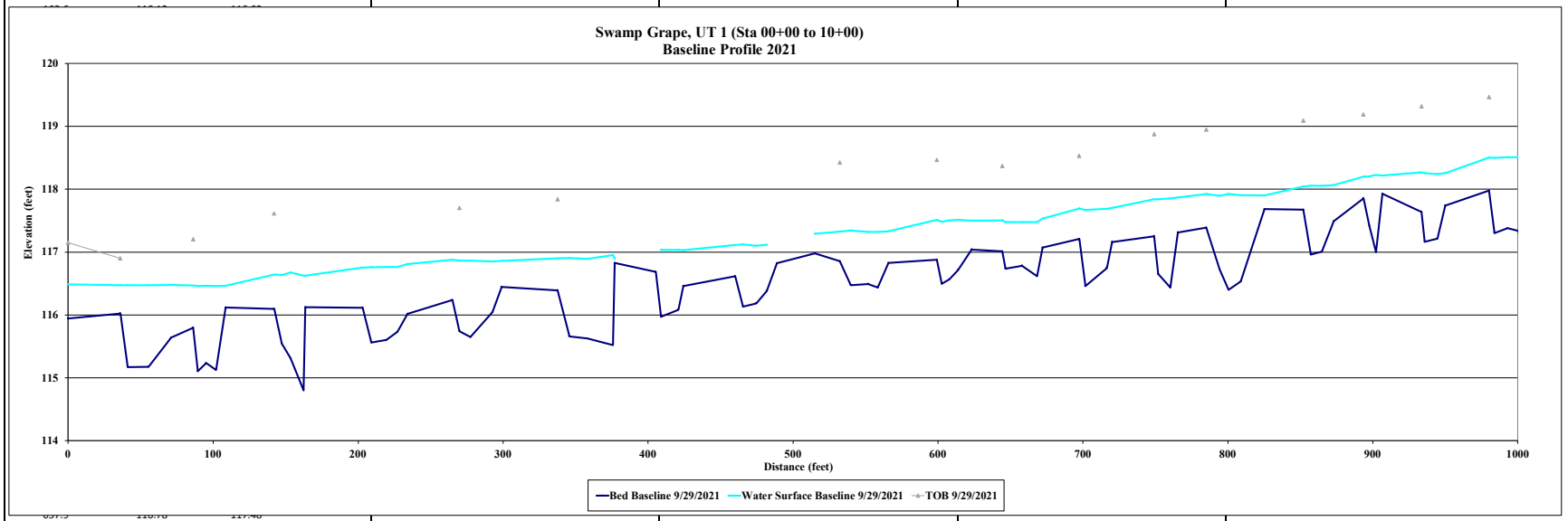
SUMMARY DATA	
Bankfull Elevation:	115.20
Bank Hieght Ratio:	1.00
Thalweg Elevation:	113.78
LTOB Elevation:	115.20
LTOB Max Depth:	1.42
LTOB Cross Sectional Area:	9.2

Stream Type	E/C 5



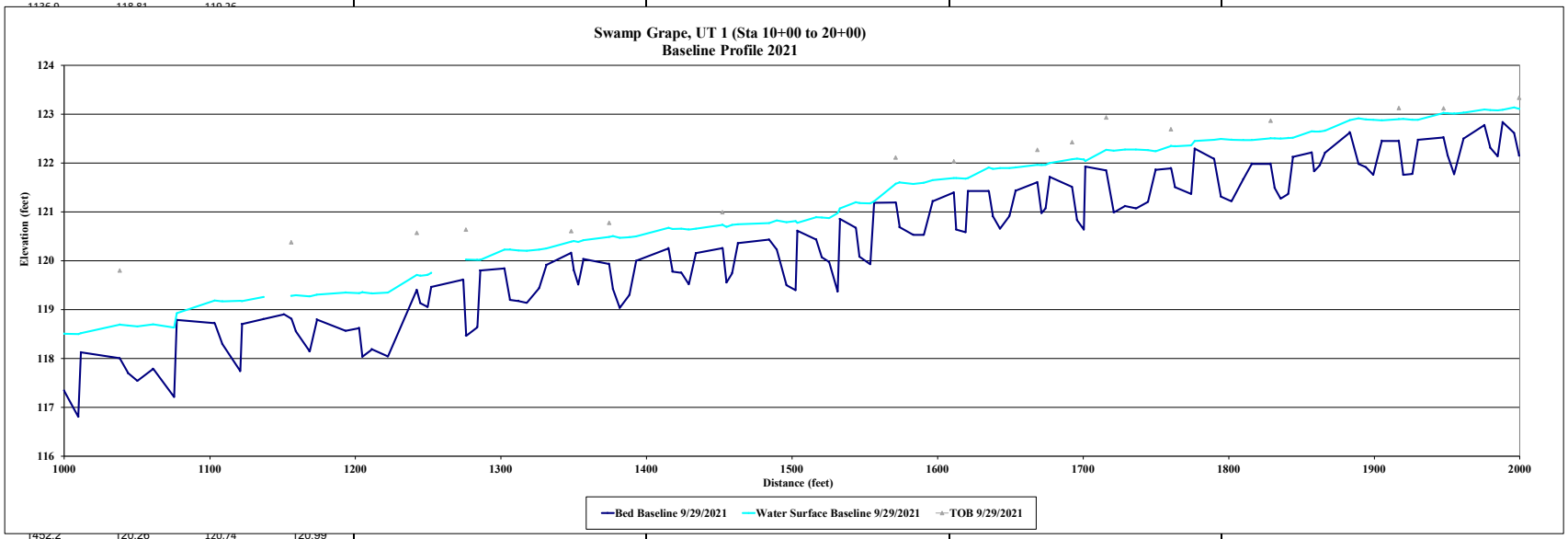
Project Name	Swamp Grape - Baseline (2021) Profile
Reach	UT 1 (Sta 00+00 to 10+00)
Feature	Profile
Date	9/29/21
Crew	Perkinson

2021 Baseline Survey				As needed				As needed				As needed			
Station	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**
0.0	115.94	116.49	117.15												
35.9	116.02	116.47	116.90												
41.1	115.17	116.47													
55.4	115.17	116.47													
71.0	115.64	116.48													
86.3	115.80	116.47	117.21												
89.4	115.11	116.46													
95.1	115.23	116.46													
101.9	115.13	116.46													
108.6	116.12	116.47													
142.1	116.10	116.64	117.61												
147.3	115.55	116.63													
153.4	115.31	116.68													
162.4	114.80	116.62													
668.4	116.62	117.48													
672.1	117.07	117.53													
697.4	117.21	117.70	118.53												
701.6	116.46	117.67													
716.4	116.75	117.69													
720.2	117.16	117.70													
749.1	117.25	117.84	118.87												
751.9	116.65	117.84													
760.5	116.44	117.85													
765.4	117.31	117.87													
785.1	117.39	117.92	118.95												
794.2	116.72	117.90													
800.4	116.40	117.92													



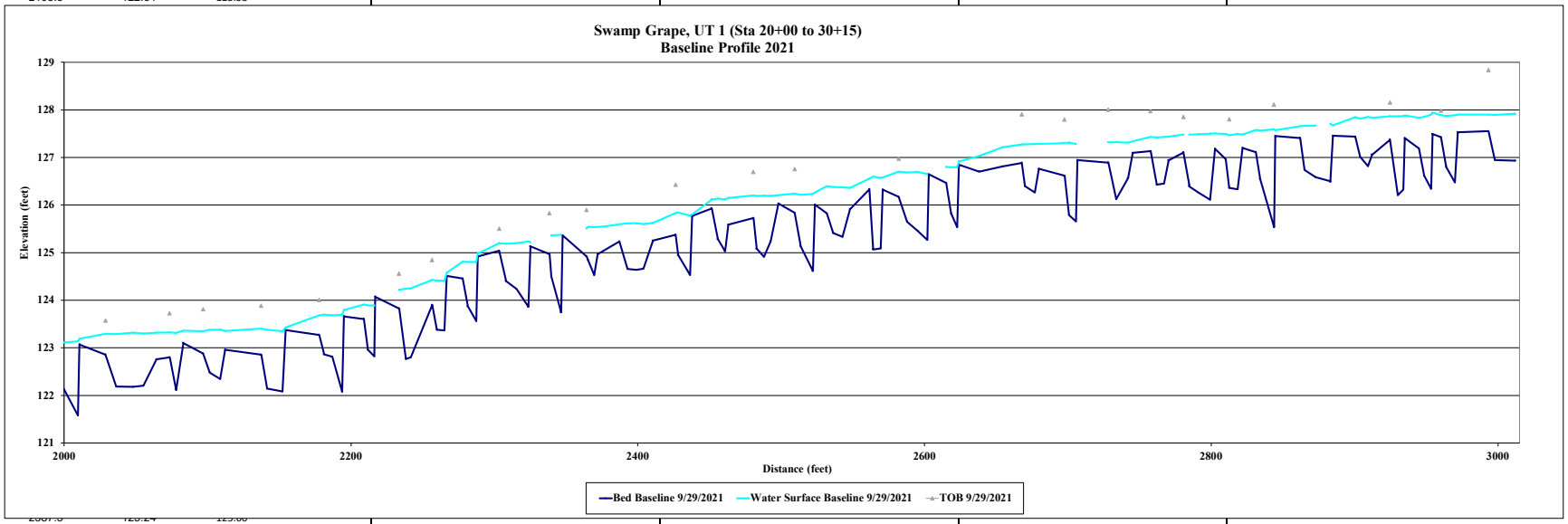
Project Name	Swamp Grape - Baseline (2021) Profile
Reach	UT 1 (Sta 10+00 to 20+00)
Feature	Profile
Date	9/29/21
Crew	Perkinson

2021 Baseline Survey				As needed				As needed				As needed			
Station	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**
1000.0	117.34	118.51													
1009.8	116.81	118.50													
1011.5	118.13	118.52													
1038.1	118.00	118.69	119.80												
1043.8	117.70	118.67													
1050.2	117.54	118.66													
1061.1	117.79	118.70													
1075.5	117.21	118.63													
1077.3	118.79	118.93													
1103.3	118.73	119.19													
1108.6	118.29	119.17													
1120.9	117.74	119.18													
1122.0	118.71	119.17													
1452.2	120.26	120.74	120.99												
1458.7	119.74	120.73													
1462.8	120.36	120.75													
1484.3	120.43	120.77													
1489.5	120.23	120.82													
1496.2	119.50	120.79													
1502.5	119.40	120.81													
1503.7	120.61	120.78													
1520.5	120.07	120.88													
1525.4	119.98	120.87													
1531.2	119.37	120.97													
1532.8	120.85	121.07													



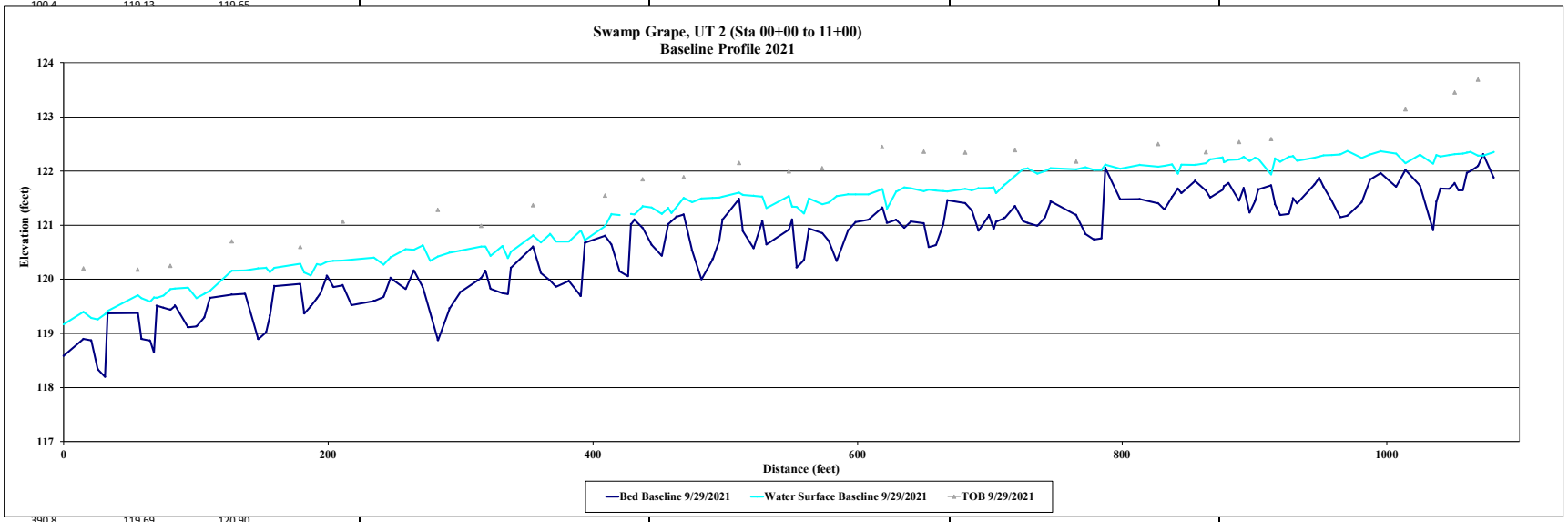
Project Name	Swamp Grape - Baseline (2021) Profile
Reach	UT 1 (Sta 20+00 to 30+15)
Feature	Profile
Date	9/29/21
Crew	Perkinson

2021 Baseline Survey				As needed				As needed				As needed			
Station	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**
1999.5	122.15	123.11	123.34												
2009.7	121.58	123.13													
2010.8	123.07	123.19													
2028.9	122.86	123.29	123.57												
2036.3	122.19	123.29													
2048.0	122.18	123.32													
2055.3	122.20	123.30													
2064.4	122.76	123.32													
2073.6	122.80	123.32	123.72												
2078.1	122.11	123.31													
2083.0	123.10	123.36													
2096.8	122.88	123.35	123.81												
2101.5	122.48	123.38													
2108.8	122.34	123.38													
2397.9	124.66	125.62													
2399.1	124.64	125.62													
2403.9	124.66	125.60													
2410.6	125.25	125.62													
2426.4	125.38	125.83	126.42												
2428.2	124.95	125.84													
2436.4	124.53	125.78													
2437.8	125.77	125.80													
2451.6	125.93	126.12													
2455.8	125.28	126.14													
2460.9	125.03	126.12													
2463.2	125.59	126.15													
2480.7	125.73	126.20	126.69												



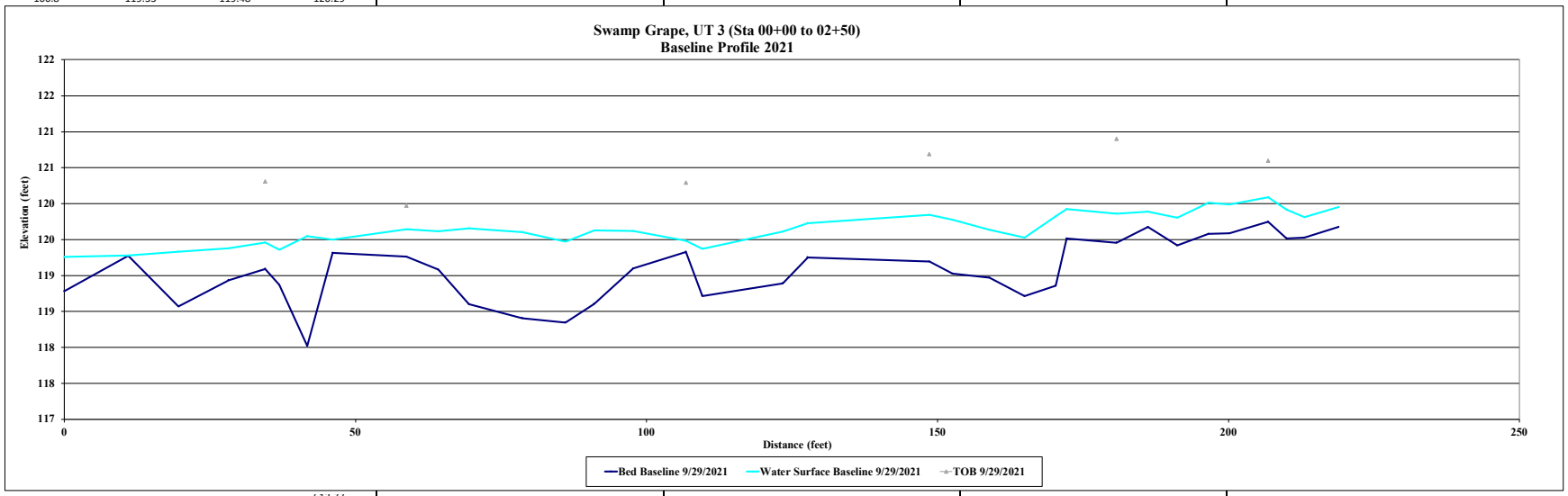
Project Name	Swamp Grape - Baseline (2021) Profile
Reach	UT 2 (Sta 00+00 to 11+00)
Feature	Profile
Date	9/29/21
Crew	Harris, Adams

2021 Baseline Survey				As needed				As needed				As needed			
Station	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**
0.0	118.58	119.17													
15.1	118.90	119.40	120.20												
21.0	118.87	119.29													
26.0	118.34	119.26													
31.5	118.20	119.35													
33.4	119.37	119.42													
56.1	119.38	119.71	120.18												
58.8	118.90	119.65													
65.3	118.87	119.59													
68.3	118.64	119.67													
70.3	119.51	119.66													
75.5	119.47	119.70													
80.7	119.44	119.82	120.25												
84.2	119.51	119.83													
93.9	119.11	119.85													
100.4	119.13	119.65													
390.8	119.69	120.90													
393.9	120.67	120.72													
409.1	120.80	120.99	121.55												
413.9	120.64	121.21													
420.1	120.15	121.19													
426.6	120.06														
428.7	121.02	121.21													
431.3	121.10	121.20													
437.6	120.95	121.35	121.85												
444.3	120.64	121.33													
452.1	120.44	121.21													
456.9	121.02	121.32													



Project Name	Swamp Grape - Baseline (2021) Profile
Reach	UT 3 (Sta 00+00 to 02+50)
Feature	Profile
Date	9/29/21
Crew	Harris, Adams

2021 Baseline Survey				As needed				As needed				As needed			
Station	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**
0.0	118.78	119.26													
11.0	119.28	119.28													
19.6	118.57	119.33													
28.2	118.94	119.38													
34.5	119.09	119.46	120.31												
36.9	118.87	119.36													
41.7	118.02	119.55													
46.1	119.31	119.50													
58.8	119.26	119.64	119.97												
64.2	119.08	119.62													
69.5	118.60	119.66													
78.6	118.41	119.60													
86.1	118.35	119.47													
91.0	118.61	119.63													
97.7	119.10	119.62													
106.8	119.33	119.48	120.29												



613.77

615.00

Table 9A. Baseline Stream Data Summary Swamp Grape - UT 1 (Upstream)										
Parameter	**Pre-Existing Condition (applicaple)**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	5.2		13.2	17.6	8	6.8	7.9	8.8	11.8	3
Floodprone Width (ft)	8		20	50	8	50	150	100	100	3
Bankfull Mean Depth (ft)	0.2		0.3	0.8	8	0.5	0.6	0.2	0.4	3
Bankfull Max Depth (ft)	0.4		0.7	1.5	8	0.6	0.9	0.6	0.9	3
Bankfull Cross Sectional Area (ft^2)	3.9		3.9	3.9	8	3.9	3.9	2.9	3.9	3
Width/Depth Ratio	6.5		44	88	8	12	16	19.8	48.0	3
Entrenchment Ratio	1		1.5	9.3	8	7.3	19	8.4	11.3	3
Bank Height Ratio	**1.5**		**2.8**	**6.6**	**8**	**1**	**1.3**	**1**	**1**	**3**
Max part size (mm) mobilized at bankfull										
Rosgen Classification	F 5					Ce 5		Ce 5		
Bankfull Discharge (cfs)	3.5					3.5		3.5		
Sinuosity (ft)	1.01					1.15		1.15		
Water Surface Slope (Channel) (ft/ft)	0.0062					0.0031		0.0024		
Other										

Table 9B. Baseline Stream Data Summary Swamp Grape - UT 1 (Downstream)										
Parameter	**Pre-Existing Condition (applicaple)**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	10.2		12.2	20.3	7	12.4	14.4	17.9	19.4	2
Floodprone Width (ft)	50		150	150	7	100	200	100	100	2
Bankfull Mean Depth (ft)	0.6		1.1	2.4	7	0.9	1	0.6	0.7	2
Bankfull Max Depth (ft)	1.1		1.8	2.4	7	1.2	1.6	1.2	1.3	2
Bankfull Cross Sectional Area (ft^2)	12.9		12.9	12.9	7	12.9	12.9	11.9	12.8	2
Width/Depth Ratio	7.8		11.1	33.8	7	12	16	25.1	31.5	2
Entrenchment Ratio	2.8		12.3	14.7	7	8	13.9	5.2	5.6	2
Bank Height Ratio	**1**		**1.3**	**1.8**	**7**	**1**	**1.3**	1	1	**2**
Max part size (mm) mobilized at bankfull										
Rosgen Classification	Eg 5					Ce 5		Ce 5		
Bankfull Discharge (cfs)	12.1					12.1		12.1		
Sinuosity (ft)	1.3					1.15		1.15		
Water Surface Slope (Channel) (ft/ft)	0.0036					0.0054		0.00474		
Other										

Table 9C. Baseline Stream Data Summary Swamp Grape - UT 2										
Parameter	**Pre-Existing Condition (applicaple)**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	6.9		7.5	7.9		7.7	8.9	8.8	16.7	2
Floodprone Width (ft)	50		75	75		100	200	100.0	100.0	2
Bankfull Mean Depth (ft)	0.6		0.6	0.7		0.6	0.6	0.4	0.4	2
Bankfull Max Depth (ft)	1.2		1.4	1.7		0.7	1	0.7	0.9	2
Bankfull Cross Sectional Area (ft^2)	4.9		4.9	4.9		4.9	4.9	3.5	6.0	2
Width/Depth Ratio	9.9		12.5	13.2		12	16	22.2	46.5	2
Entrenchment Ratio	6.7		9.5	10.9		13	22.6	6.0	11.4	2
Bank Height Ratio	**1.1**		**1.3**	**1.4**		**1**	**1.3**	1.0	1.0	**2**
Max part size (mm) mobilized at bankfull										
Rosgen Classification	Cg 5					Ce 5		Ce 5		
Bankfull Discharge (cfs)	4.5					4.5		4.5		
Sinuosity (ft)	1.02					1.15		1.15		
Water Surface Slope (Channel) (ft/ft)	0.0042					0.0035		0.0029		
Other										

Table 9D. Baseline Stream Data Summary Swamp Grape - UT 3										
Parameter	**Pre-Existing Condition (applicaple)**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	6.8		7.8	8.8		8.9	10.3	15.8	15.8	1
Floodprone Width (ft)	27		31	35		100	200	100.0	100.0	1
Bankfull Mean Depth (ft)	0.7		0.9	1		0.6	0.7	0.4	0.4	1
Bankfull Max Depth (ft)	1.2		1.3	1.4		0.8	1.1	1.1	1.1	1
Bankfull Cross Sectional Area (ft^2)	6.6		6.6	6.6		6.6	6.6	5.9	5.9	1
Width/Depth Ratio	6.8		9.7	12.6		12	16	42.0	42.0	1
Entrenchment Ratio	3.1		4.1	5.1		11.2	19.5	6.3	6.3	1
Bank Height Ratio	**1.4**		**1.6**	**1.8**		**1**	**1.3**	1.0	1.0	**1**
Max part size (mm) mobilized at bankfull										
Rosgen Classification	Eg 5					Ce 5		Ce 5		
Bankfull Discharge (cfs)	6.1					6.1		6.1		
Sinuosity (ft)	1.17					1.15		1.15		
Water Surface Slope (Channel) (ft/ft)	0.0125					0.0039		0.0032		
Other										

Table 10A. Monitoring Data - Cross Section Morphology Monitoring Summary

(Swamp Grape/ DMS:100115) UT 1

	UT 1 - Cross Section 1 (Pool)							UT 1 - Cross Section 2 (Riffle)							UT 1 - Cross Section 3 (Pool)							UT 1 - Cross Section 4 (Riffle)							UT 1 - Cross Section 5 (Riffle)						
	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	109.50							110.09							110.37							110.50							113.72						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00							1.00							1.00							1.00						
Thalweg Elevation	107.77							108.75							108.60							109.30							113.01						
LTOB[2] Elevation	109.50							110.09							110.37							110.50							113.72						
LTOB[2] Max Depth (ft)	1.73							1.34							1.77							1.20							0.70						
LTOB[2] Cross Sectional Area (ft^2)	13.9							12.8							17.8							11.9							3.4						
	UT 1 - Cross Section 6 (Pool)							UT 1 - Cross Section 7 (Riffle)							UT 1 - Cross Section 8 (Pool)							UT 1 - Cross Section 15 (Riffle)							UT 1 - Cross Section 16 (Pool)						
	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	114.21							120.40							120.44							116.68							116.80						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00							1.00							1.00							1.00						
Thalweg Elevation	113.00							119.79							119.11							115.79							115.47						
LTOB[2] Elevation	114.21							120.40							120.44							116.68							116.80						
LTOB[2] Max Depth (ft)	1.22							0.60							1.33							0.89							1.34						
LTOB[2] Cross Sectional Area (ft^2)	6.2							2.9							6.5							3.9							9.6						

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 above. The difference between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

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.

Table 10B. Monitoring Data - Cross Section Morphology Monitoring Summary

(Swamp Grape/ DMS:100115) UT 2

	UT 2 - Cross Section 11 (Pool)							UT 2 - Cross Section 12 (Riffle)							UT 2 - Cross Section 13 (Riffle)							UT 2 - Cross Section 14 (Pool)						
	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	113.81							114.20							114.95							115.20						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00							1.00							1.00						
Thalweg Elevation	112.08							113.28							114.27							113.78						
LTOB[2] Elevation	113.81							114.2				`			114.95							115.20						
LTOB[2] Max Depth (ft)	1.73							0.92							0.68							1.42						
LTOB[2] Cross Sectional Area (ft[2])	10.8							6.0							3.5							9.19						
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area																												
Bank Height Ratio_Based on AB Bankfull[1] Area																												
Thalweg Elevation																												
LTOB[2] Elevation																												
LTOB[2] Max Depth (ft)																												
LTOB[2] Cross Sectional Area (ft[2])																												
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area																												
Bank Height Ratio_Based on AB Bankfull[1] Area																												
Thalweg Elevation																												
LTOB[2] Elevation																												
LTOB[2] Max Depth (ft)																												
LTOB[2] Cross Sectional Area (ft[2])																												

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 above. The difference between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

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.

Table 10C. Monitoring Data - Cross Section Morphology Monitoring Summary

(Swamp Grape/ DMS:100115) UT 3

	UT 3 - Cross Section 9 (Riffle)							UT 3 - Cross Section 10 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	112.69							112.84						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00						
Thalweg Elevation	111.54							111.30						
LTOB[2] Elevation	112.69							112.84						
LTOB[2] Max Depth (ft)	1.15							1.54						
LTOB[2] Cross Sectional Area (ft^2)	5.9							11.4						
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area														
Bank Height Ratio_Based on AB Bankfull[1] Area														
Thalweg Elevation														
LTOB[2] Elevation														
LTOB[2] Max Depth (ft)														
LTOB[2] Cross Sectional Area (ft^2)														
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area														
Bank Height Ratio_Based on AB Bankfull[1] Area														
Thalweg Elevation														
LTOB[2] Elevation														
LTOB[2] Max Depth (ft)														
LTOB[2] Cross Sectional Area (ft^2)														

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 above. The difference between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

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.

Appendix D
Hydrologic Data

Groundwater Gauge Soil Profiles
Pre-Construction Groundwater Gauge Data (2020 & 2021)
Figure 1. 2020 Pre-Construction Groundwater Gauges
Figure 2. 2021 Pre-Construction Groundwater Gauges
WETS Data (2020 &2021)

AXIOM ENVIRONMENTAL, INC

218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW1 / 34.566072, -79.352016

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-4	10YR 3/2	100			Sand
4-14	10YR 5/1	95	10YR 5/6	5	Sandy Clay
14+	10YR 6/1	95	10YR 5/6	5	Sandy Clay

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC

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Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW2 / 34.564435, -79.349441

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-12	10YR 4/3	95	10 YR 5/6	5	Sandy Clay Loam
12+	10YR 6/1	100			Sandy Clay Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC

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Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW3 / 34.564057, -79.349150

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-10	10YR 4/1	100			Sandy Clay Loam
10+	10YR 3/1	100			Sandy Clay Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW4 / 34.562381, -79.349576

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-4	10YR 4/2	100			Sandy Clay Loam
4-18	10YR 4/1	60	10YR 5/1	38	Sandy Clay Loam
			10YR 5/6	2	
18+	10YR 6/1	100			Sandy Clay Loam

North Carolina Licensed Soil Scientist

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Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC

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Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW5 / 34.562213, -79.347527

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-10	10YR 4/2	100			Sandy Clay
10+	10YR 6/2	90	10YR 4/6	10	Sandy Clay Loam

North Carolina Licensed Soil Scientist

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Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW6 / 34.562756, -79.347331

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-8	10YR 3/2	100			Sand
8-20	10YR 6/1	90	10YR 4/6	10	Sandy Clay
20+	10YR 6/1	90	10YR 4/6	10	Sandy Clay Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW7 / 34.562590, -79.346724

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-7	10YR 3/2	100			Sand
7-15	10YR 6/1	100			Sandy Clay
15+	10YR 6/1	85	10YR 4/6	15	Sand

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW8 / 34.562244, -79.346849

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-8	10YR 3/2	100	-	-	Sand
8-12	10YR 3/3	70	10YR 4/6	30	Sand
12-24	10YR 6/2	85	10YR 4/6	15	Sandy Clay Loam
24+	10YR 6/2	70	10YR 4/6	30	Sandy Clay Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW9 / 34.562175, -79.347032

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-8	10YR 3/2	100			Sand
8-20	10YR 6/1	90	10YR 6/6	10	Sand
20+	10YR 6/1	90	10YR 6/6	10	Sandy Clay Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW10 / 34.561921, -79.346713

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-8	10YR 3/2	100			Sand
8-12	10YR 6/1	90	10YR 6/6	10	Sand
12+	10YR 6/1	90	10YR 6/6	10	Sandy Clay

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW11 / 34.561760, -79.346897

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-6	10YR 3/2	100			Sand
6-13	10YR 6/1	95	10YR 6/5	5	Sand
13+	10YR 6/1	95	10YR 6/5	5	Sandy Clay

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW12 / 34.561465, -79.346859

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-8	10YR 3/2	100			Sand
8+	10YR 6/1	100			Sandy Clay Loam

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Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW13 / 34.561173, -79.346544

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-12	10YR 3/2	100			Sand
12-25	10YR 6/1	100			Sand
25+	10YR 6/1	70			Sand
	10YR 5/6	30			

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Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW14 / 34.560866, -79.347019

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-4	10YR 4/1	100			Sandy Clay
4-10	10YR 3/1	80			Sandy Clay
	10YR 4/6	20			
10-20	10YR 3/1	100			Sandy Clay
20-34	10YR 3/1	70			Sandy Clay
	10YR 5/1	30			

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Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW15 / 34.560943, -79.346776

Investigator: Lewis

Notes:

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-10	10YR 3/1	95	10YR 6/5	5	Sandy Clay Loam
10+	10YR 5/1	100			Sandy Clay Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Swamp Grape Site

County, State: Robeson, NC

Sampling Point/
Coordinates: GW16 / 34.561310, -79.346348

Investigator: Lewis

Notes:

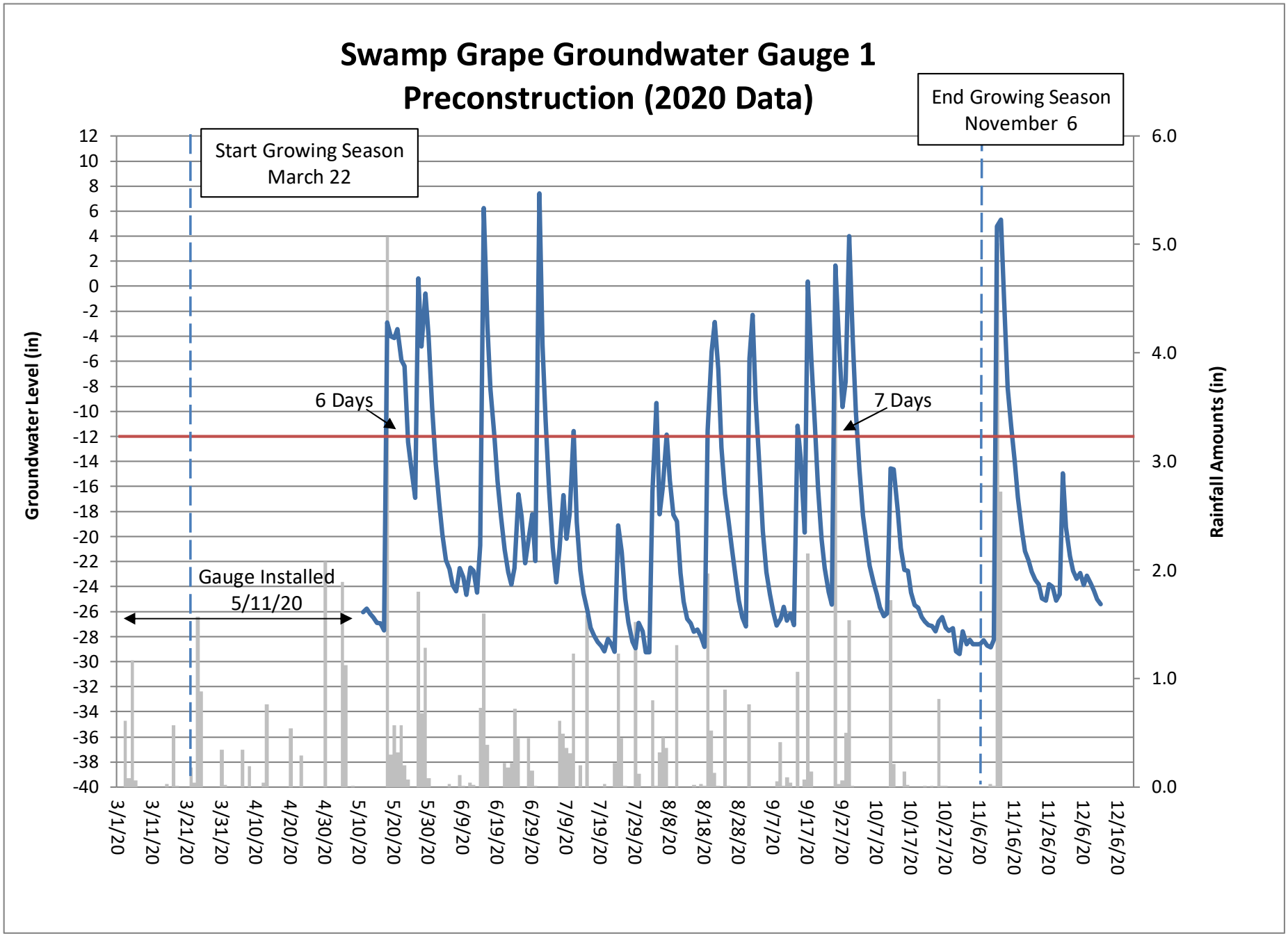
Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-8	10YR 2/1	100			Sandy Clay Loam
8-20	10YR 3/1	80	10YR 4/6	20	Sandy Loam
20+	10YR 5/2	80	10YR 5/6	20	Sandy Clay Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis


Swamp Grape Groundwater Gauge 1
Preconstruction (2020 Data)
Start Growing Season
March 22
End Growing Season
November 6
6 Days
7 Days
Gauge Installed
5/11/20
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3/1/20
3/11/20
3/21/20
3/31/20
4/10/20
4/20/20
4/30/20
5/10/20
5/20/20
5/30/20
6/9/20
6/19/20
6/29/20
7/9/20
7/19/20
7/29/20
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8/18/20
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9/7/20
9/17/20
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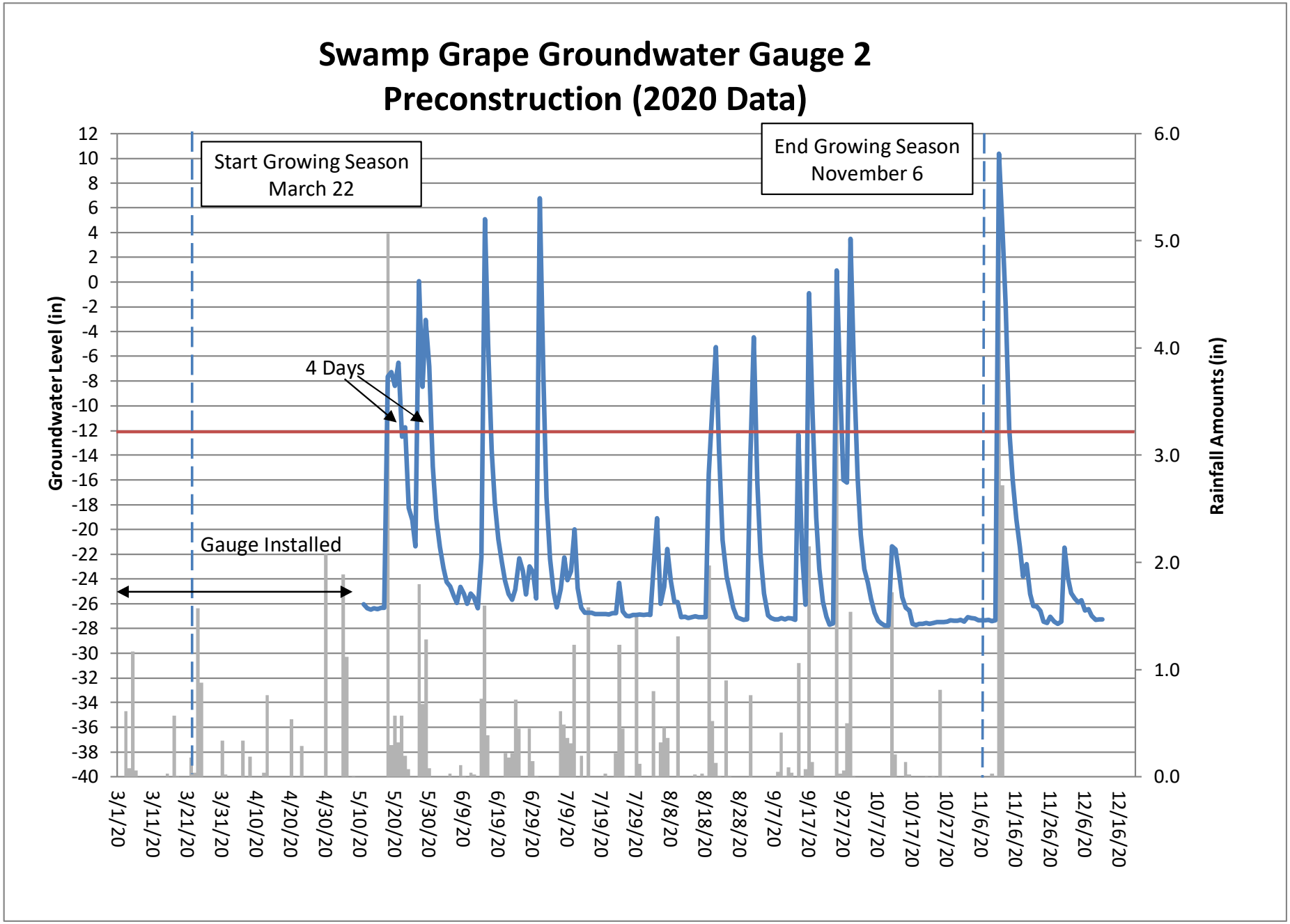
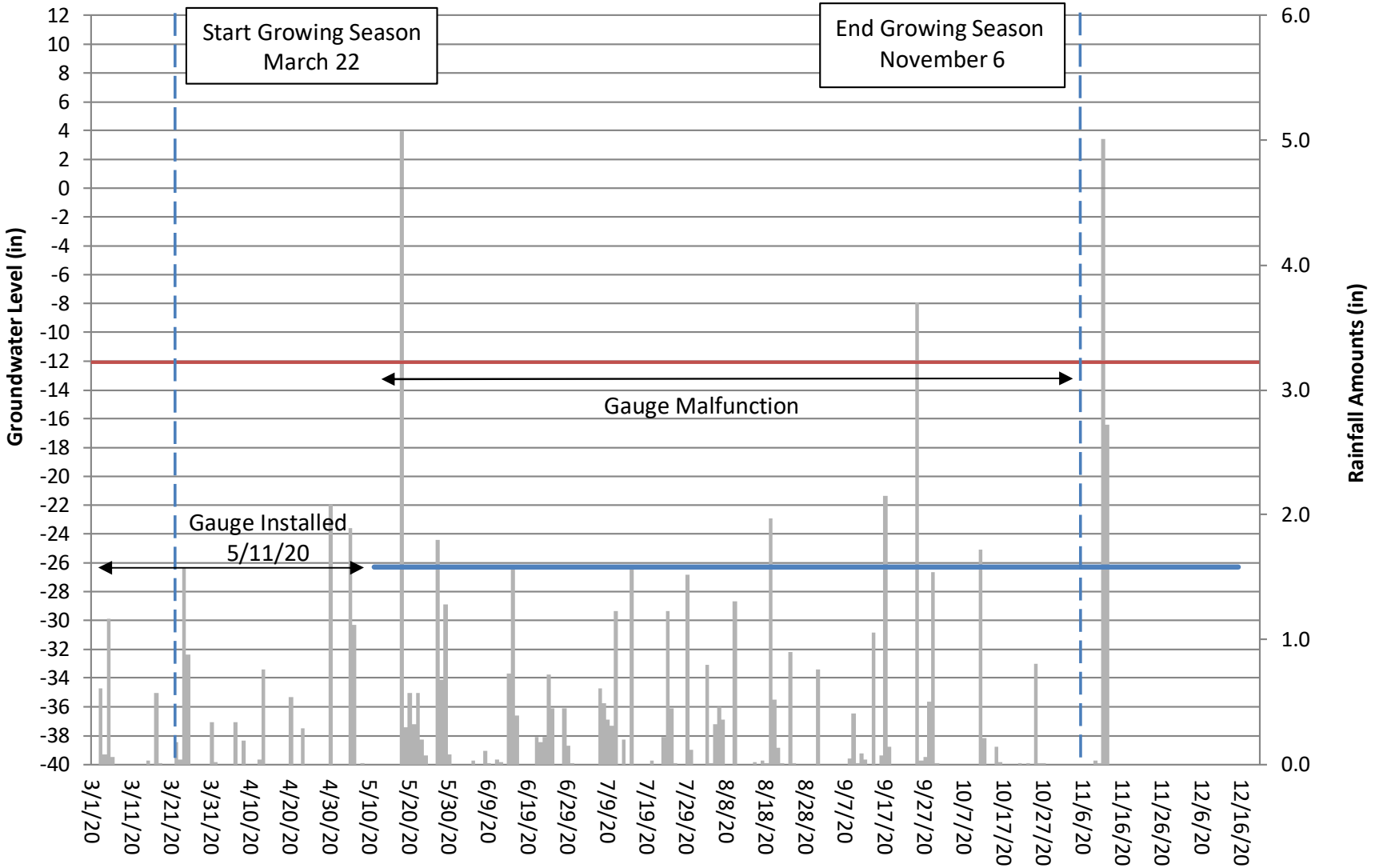
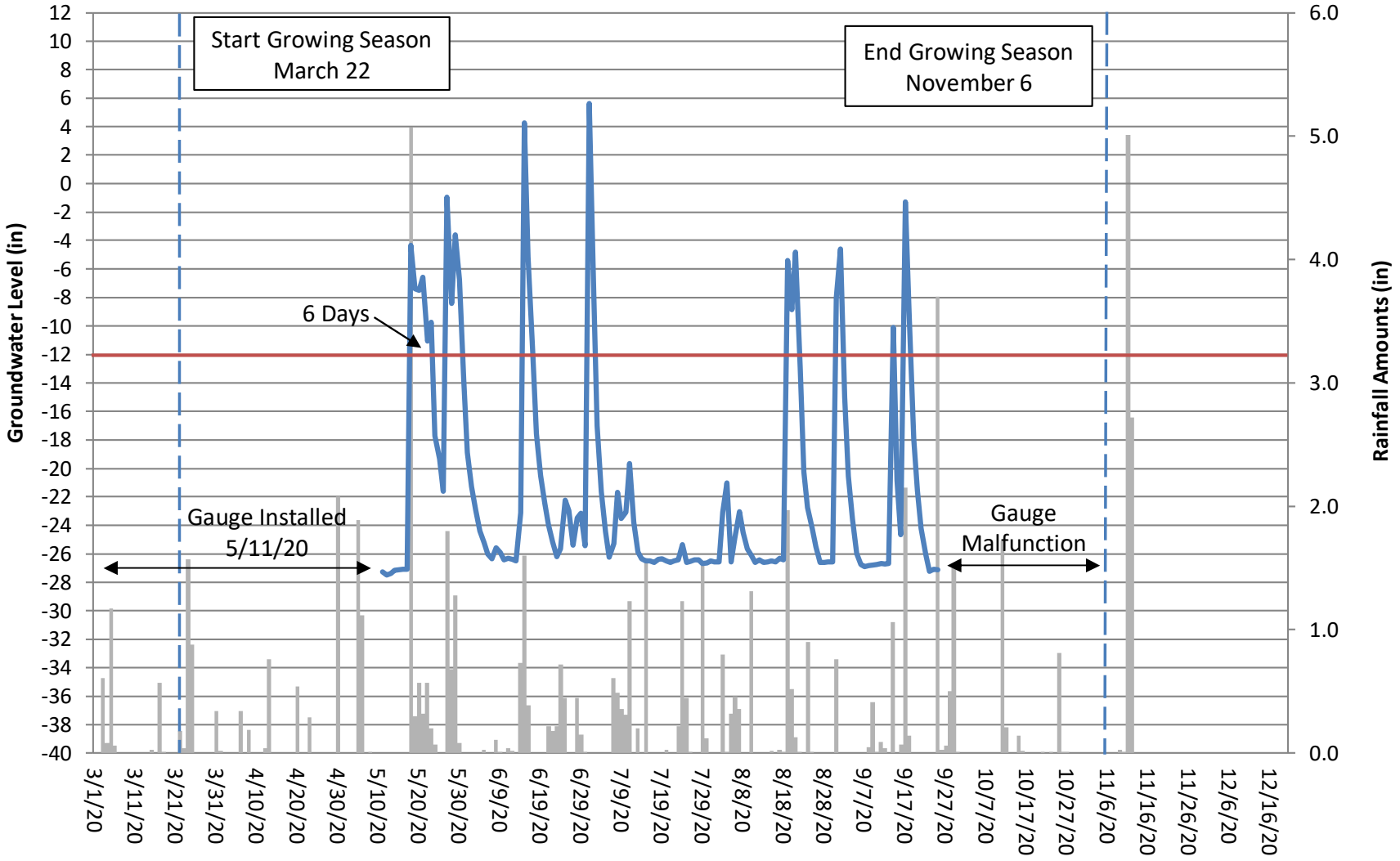
12/6/20
12/16/20

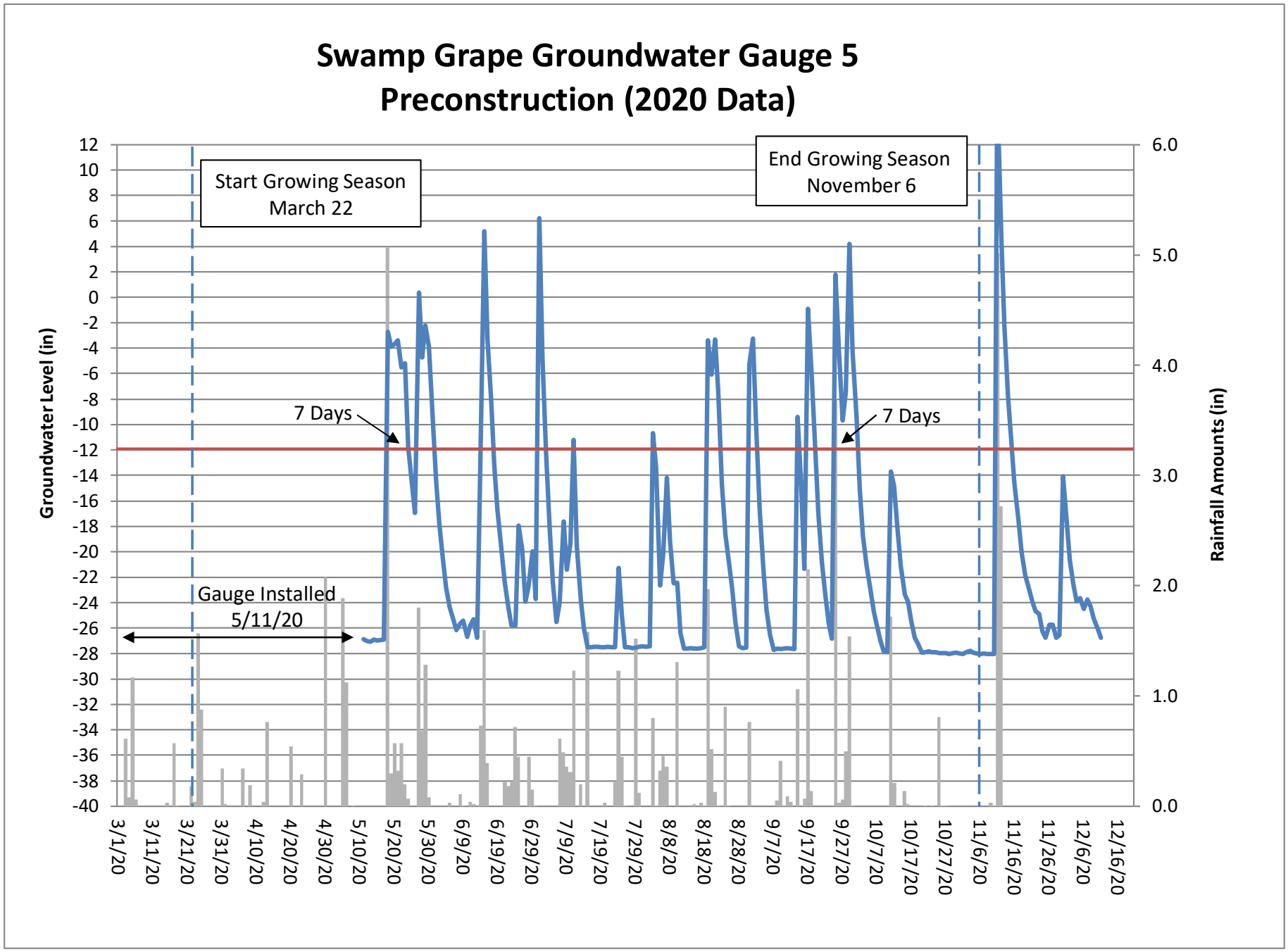

Swamp Grape Groundwater Gauge 2
Preconstruction (2020 Data)
Start Growing Season
March 22
End Growing Season
November 6
4 Days
Gauge Installed
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3/1/20
3/11/20
3/21/20
3/31/20
4/10/20
4/20/20
4/30/20
5/10/20
5/20/20
5/30/20
6/9/20
6/19/20
6/29/20
7/9/20
7/19/20
7/29/20
8/8/20
8/18/20
8/28/20
9/7/20
9/17/20
9/27/20
10/7/20
10/17/20
10/27/20
11/6/20
11/16/20
11/26/20
12/6/20
12/16/20

Swamp Grape Groundwater Gauge 3
Preconstruction (2020 Data)

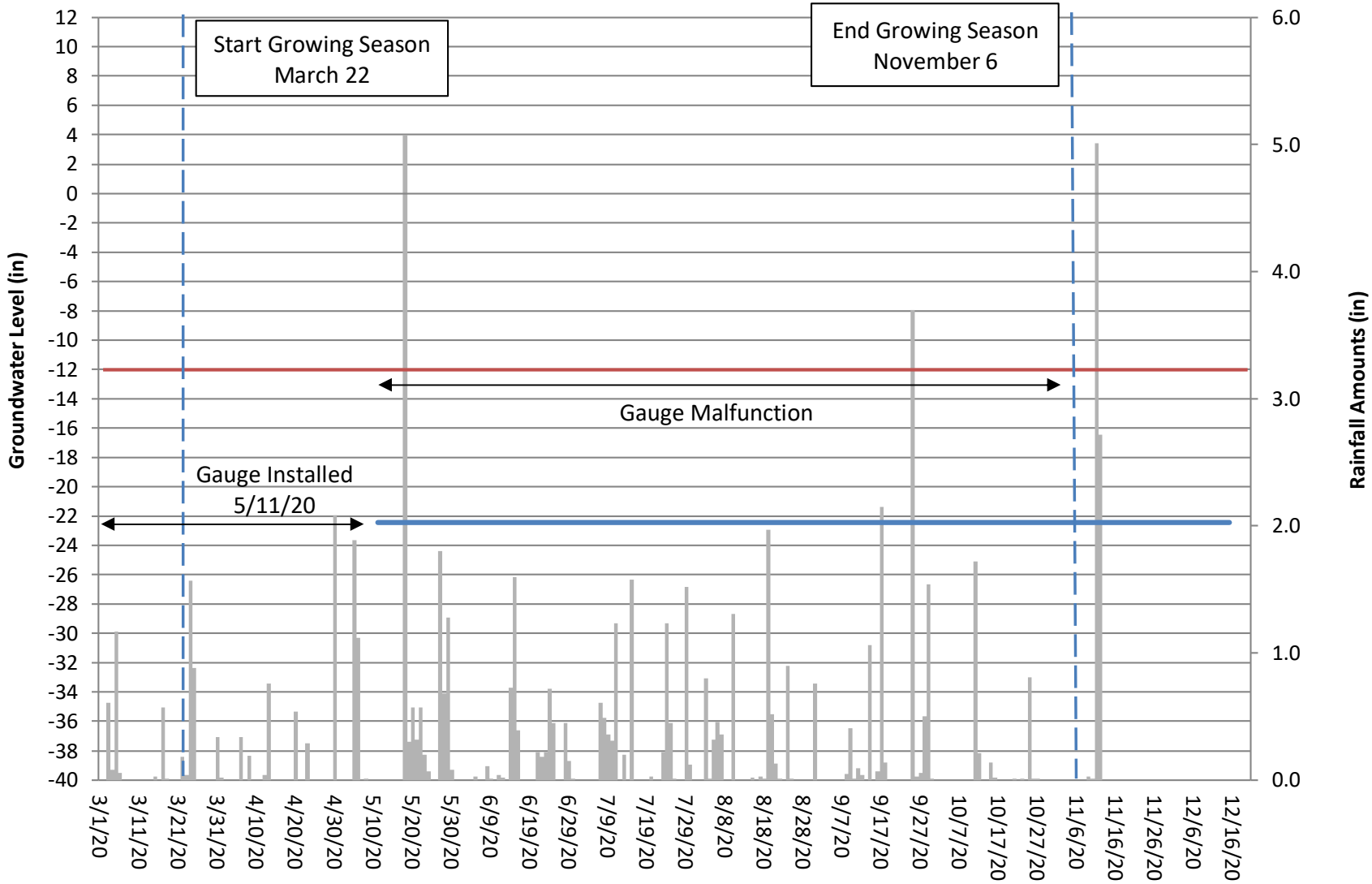


Swamp Grape Groundwater Gauge 4
Preconstruction (2020 Data)

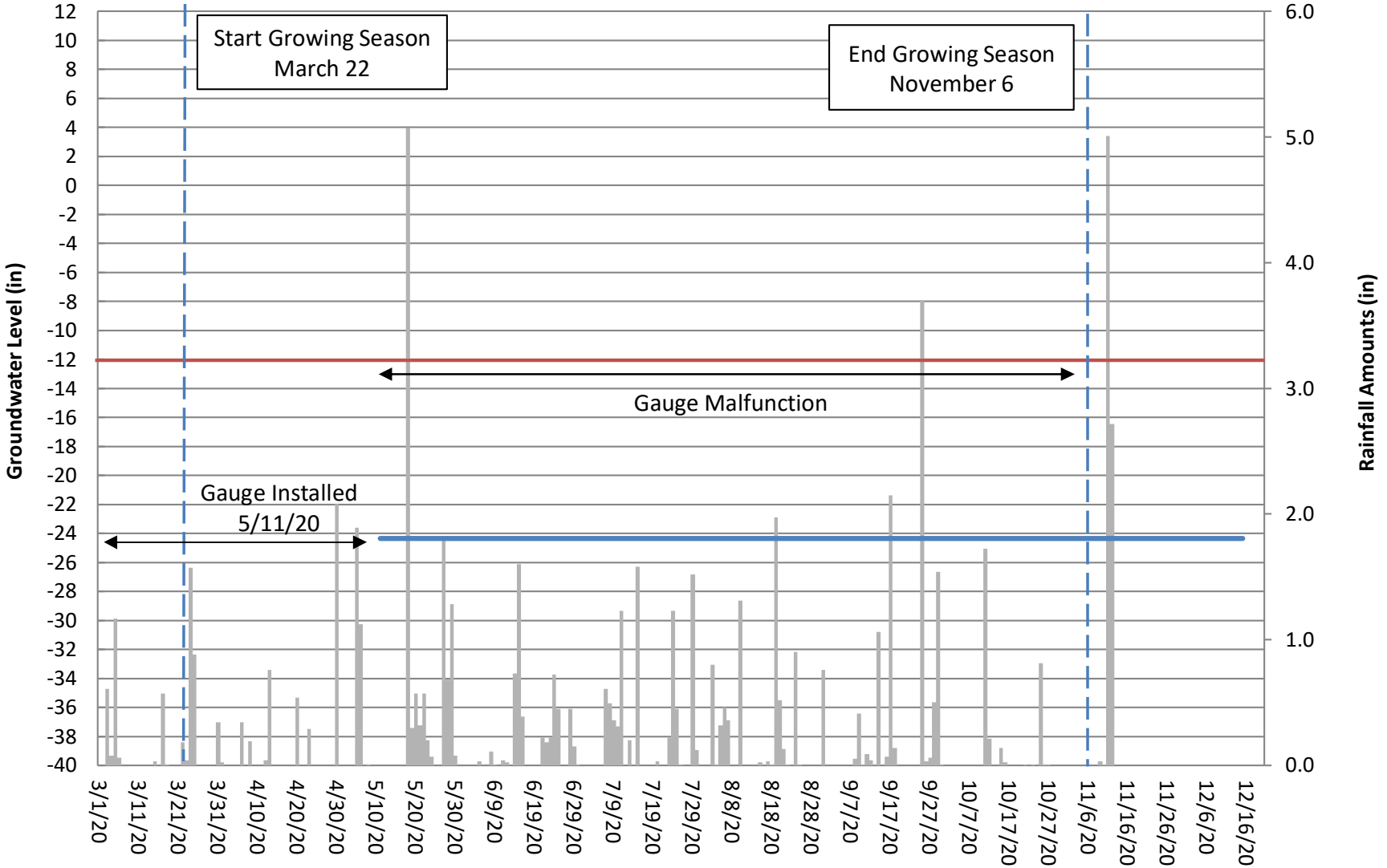


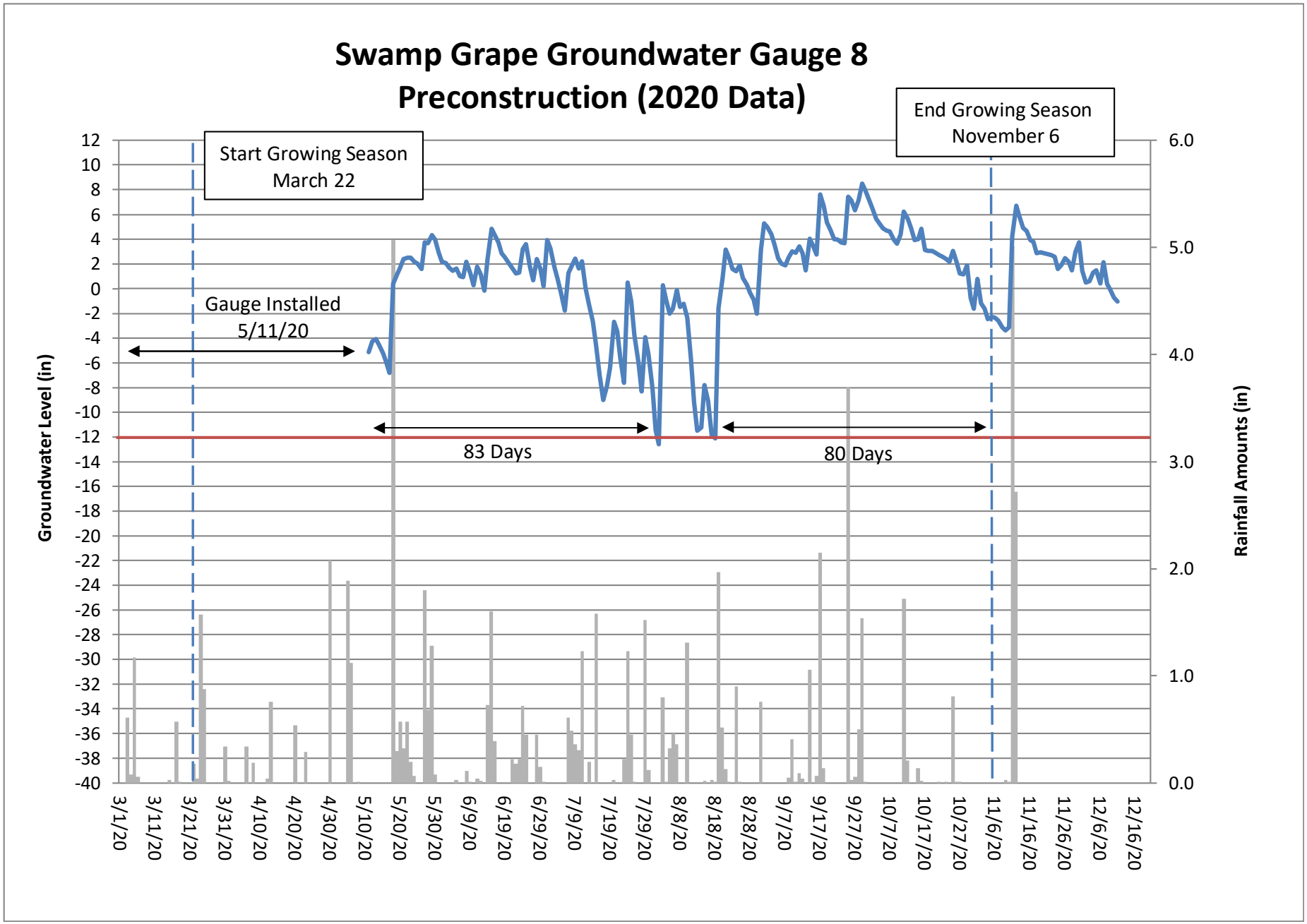

Swamp Grape Groundwater Gauge 5
Preconstruction (2020 Data)
Start Growing Season
March 22
End Growing Season
November 6
7 Days
7 Days
Gauge Installed
5/11/20
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3/1/20
3/11/20
3/21/20
3/31/20
4/10/20
4/20/20
4/30/20
5/10/20
5/20/20
5/30/20
6/9/20
6/19/20
6/29/20
7/9/20
7/19/20
7/29/20
8/8/20
8/18/20
8/28/20
9/7/20
9/17/20
9/27/20
10/7/20
10/17/20
10/27/20
11/6/20
11/16/20
11/26/20
12/6/20
12/16/20

Swamp Grape Groundwater Gauge 6
Preconstruction (2020 Data)

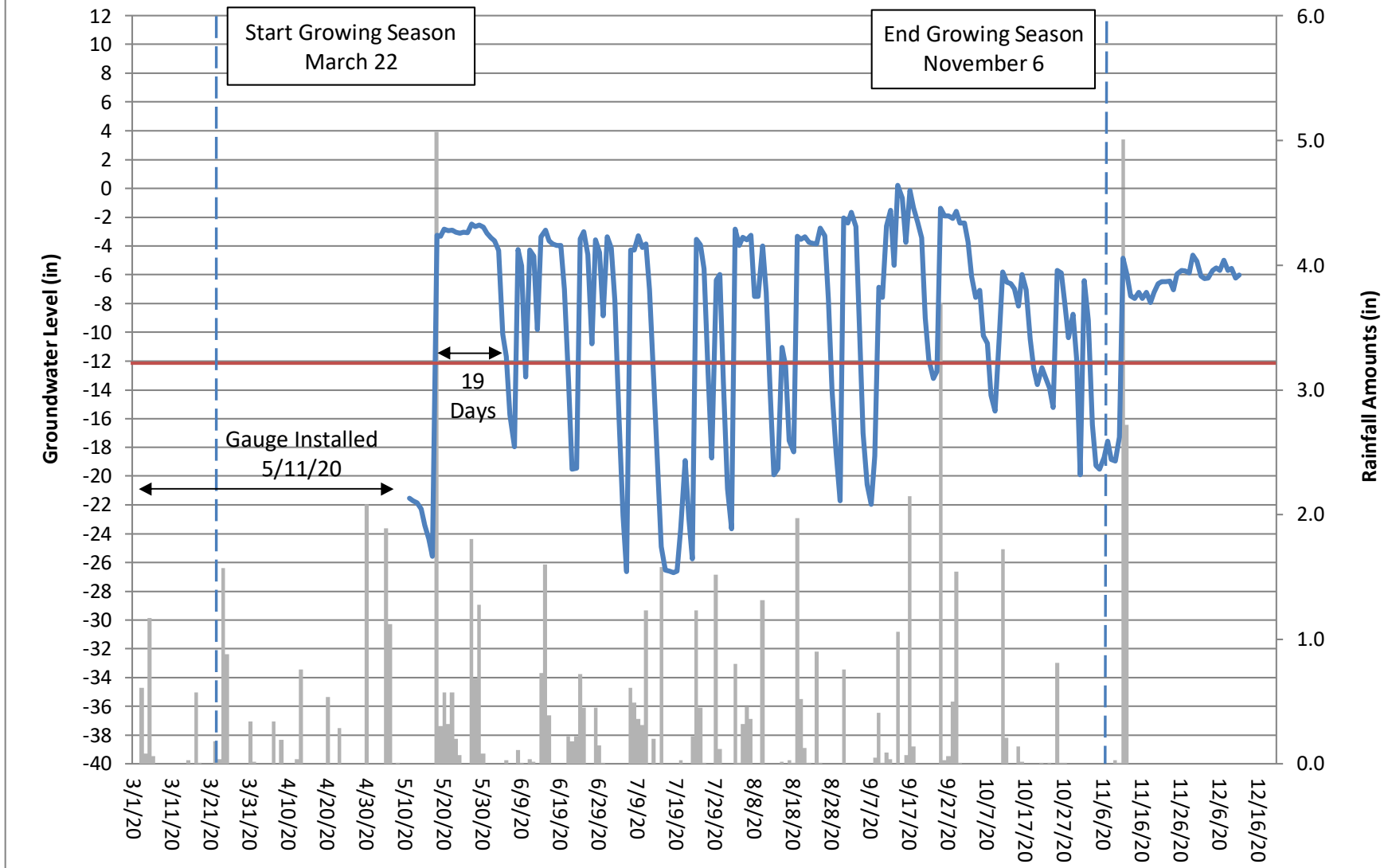


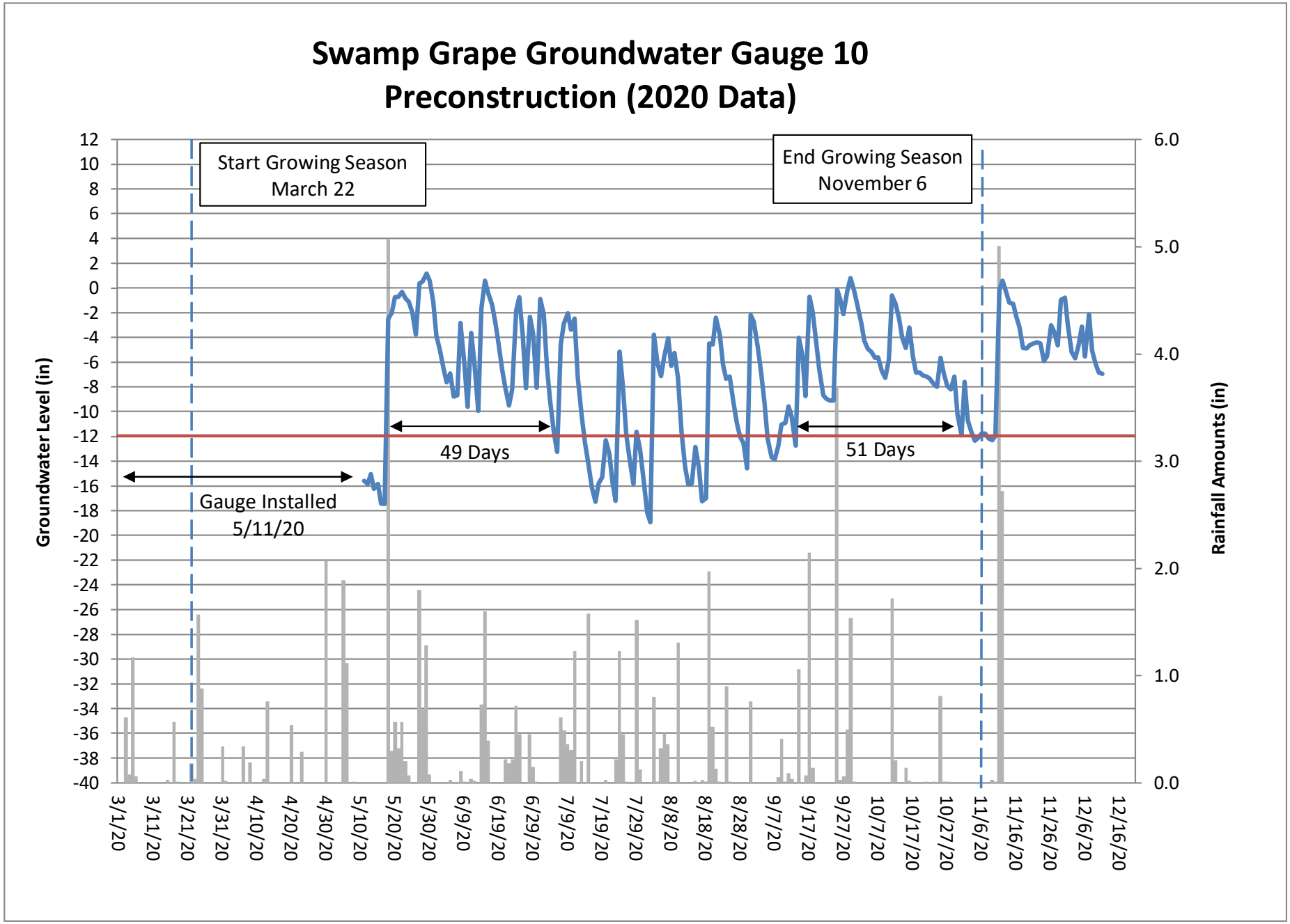
Swamp Grape Groundwater Gauge 7
Preconstruction (2020 Data)



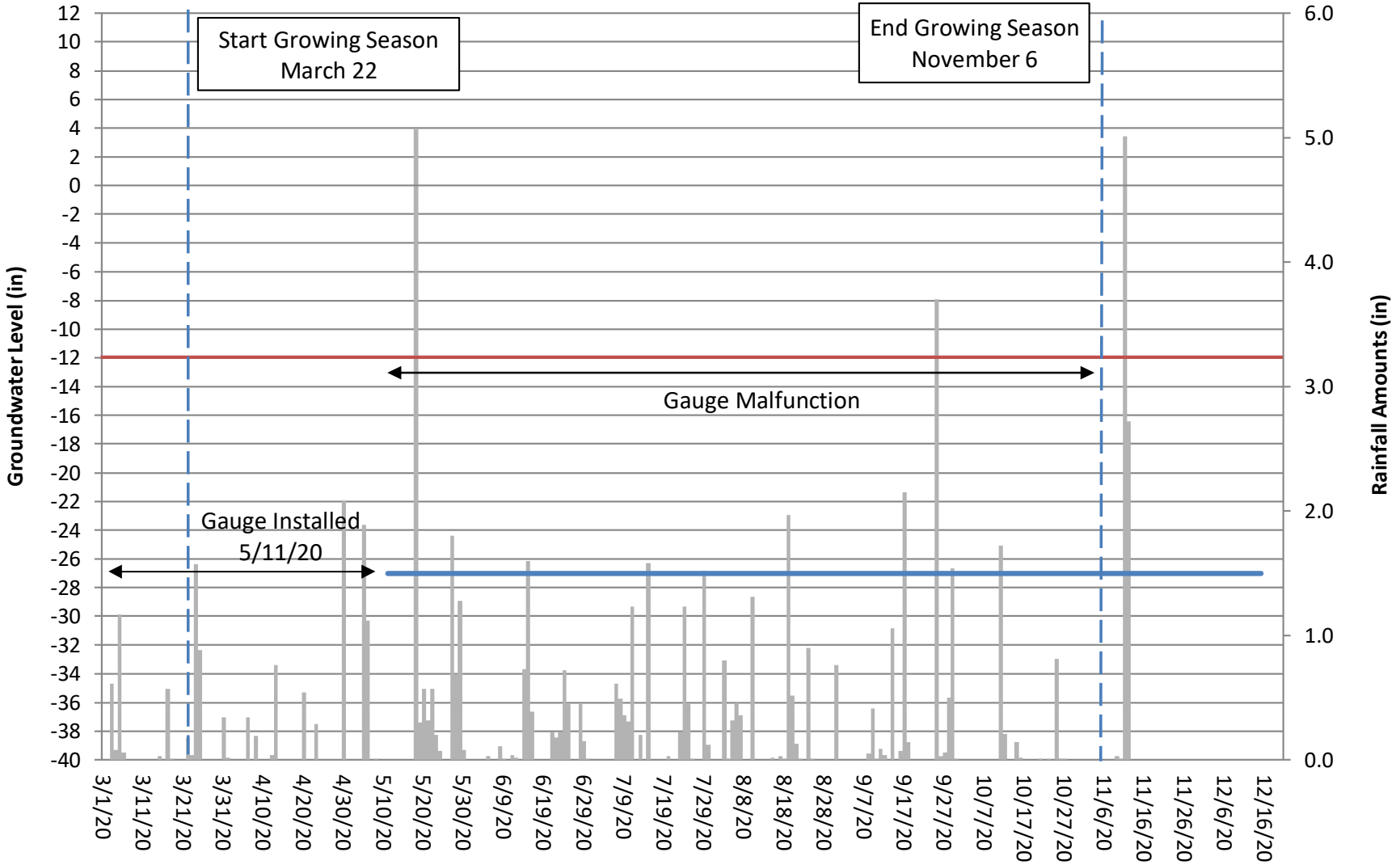

Swamp Grape Groundwater Gauge 8
Preconstruction (2020 Data)
Start Growing Season
March 22
End Growing Season
November 6
Gauge Installed
5/11/20
83 Days
80 Days
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3/1/20
3/11/20
3/21/20
3/31/20
4/10/20
4/20/20
4/30/20
5/10/20
5/20/20
5/30/20
6/9/20
6/19/20
6/29/20
7/9/20
7/19/20
7/29/20
8/8/20
8/18/20
8/28/20
9/7/20
9/17/20
9/27/20
10/7/20
10/17/20
10/27/20
11/6/20
11/16/20
11/26/20
12/6/20
12/16/20

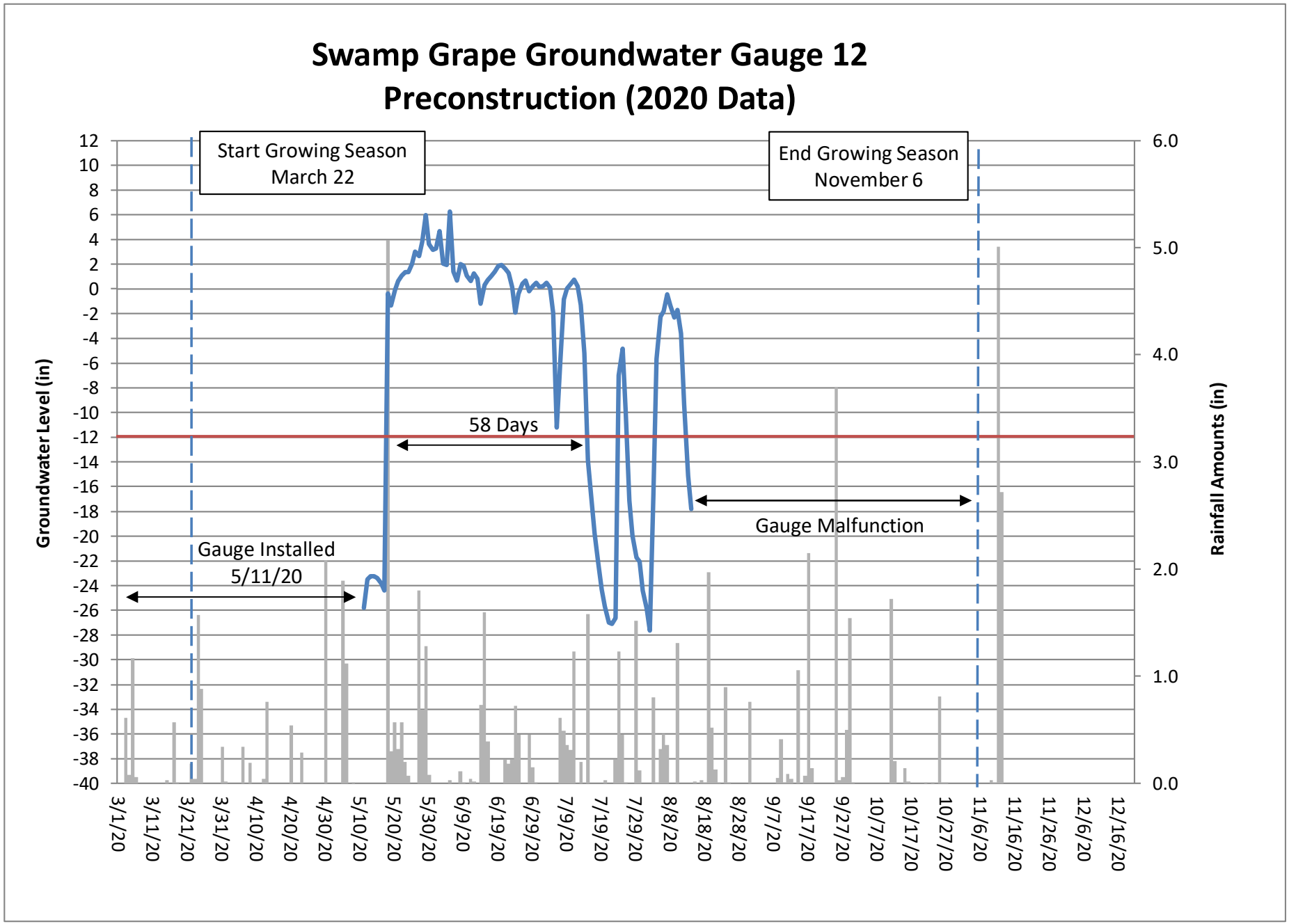
Swamp Grape Groundwater Gauge 9
Preconstruction (2020 Data)




Swamp Grape Groundwater Gauge 10
Preconstruction (2020 Data)
Start Growing Season
March 22
End Growing Season
November 6
49 Days
51 Days
Gauge Installed
5/11/20
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3/1/20
3/11/20
3/21/20
3/31/20
4/10/20
4/20/20
4/30/20
5/10/20
5/20/20
5/30/20
6/9/20
6/19/20
6/29/20
7/9/20
7/19/20
7/29/20
8/8/20
8/18/20
8/28/20
9/7/20
9/17/20
9/27/20
10/7/20
10/17/20
10/27/20
11/6/20
11/16/20
11/26/20
12/6/20
12/16/20

Swamp Grape Groundwater Gauge 11
Preconstruction (2020 Data)




Swamp Grape Groundwater Gauge 12
Preconstruction (2020 Data)
Start Growing Season
March 22
End Growing Season
November 6
58 Days
Gauge Installed
5/11/20
Gauge Malfunction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3/1/20
3/11/20
3/21/20
3/31/20
4/10/20
4/20/20
4/30/20
5/10/20
5/20/20
5/30/20
6/9/20
6/19/20
6/29/20
7/9/20
7/19/20
7/29/20
8/8/20
8/18/20
8/28/20
9/7/20
9/17/20
9/27/20
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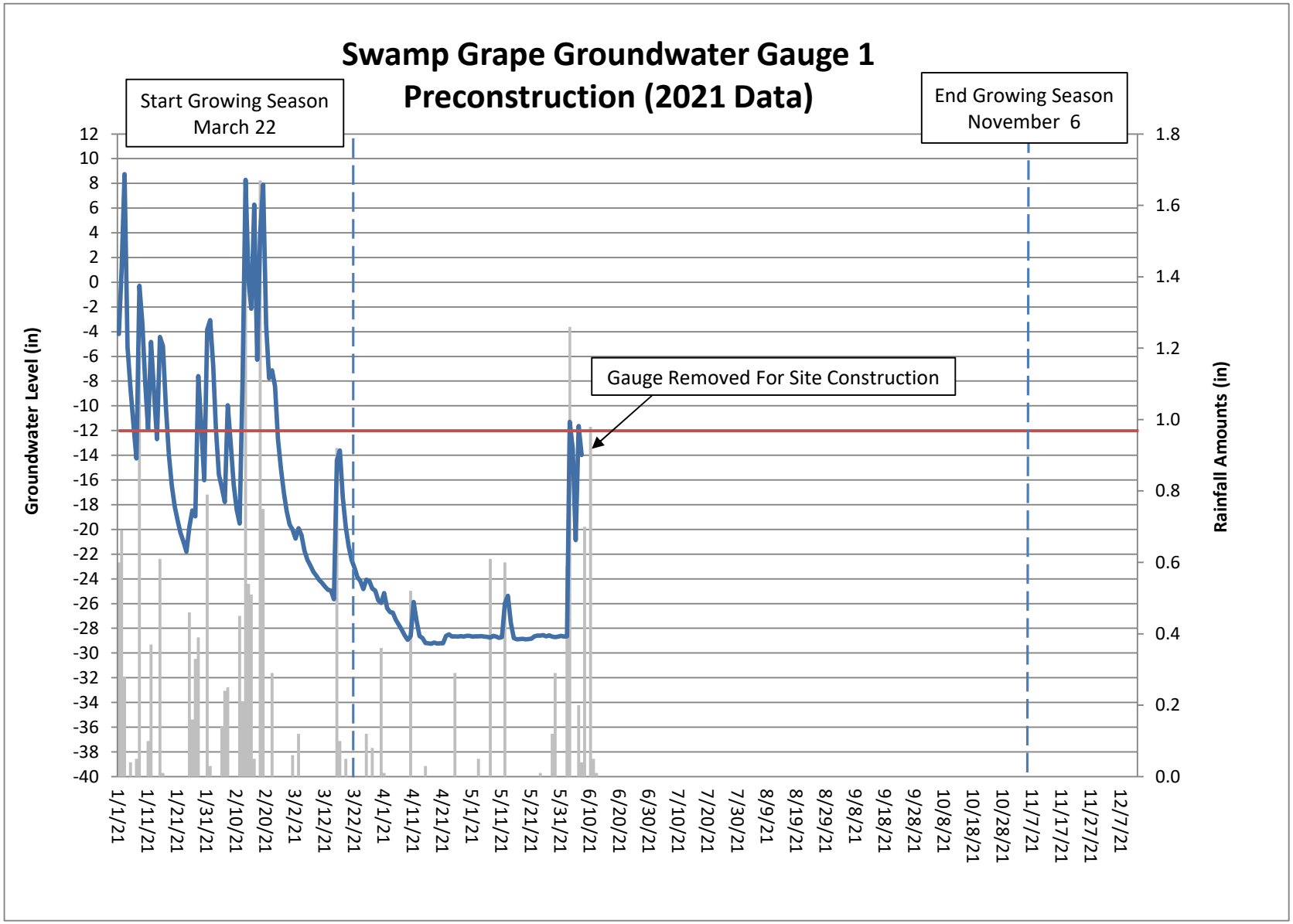
10/17/20
10/27/20
11/6/20
11/16/20
11/26/20
12/6/20
12/16/20


Swamp Grape Groundwater Gauge 1
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
Gauge Removed For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
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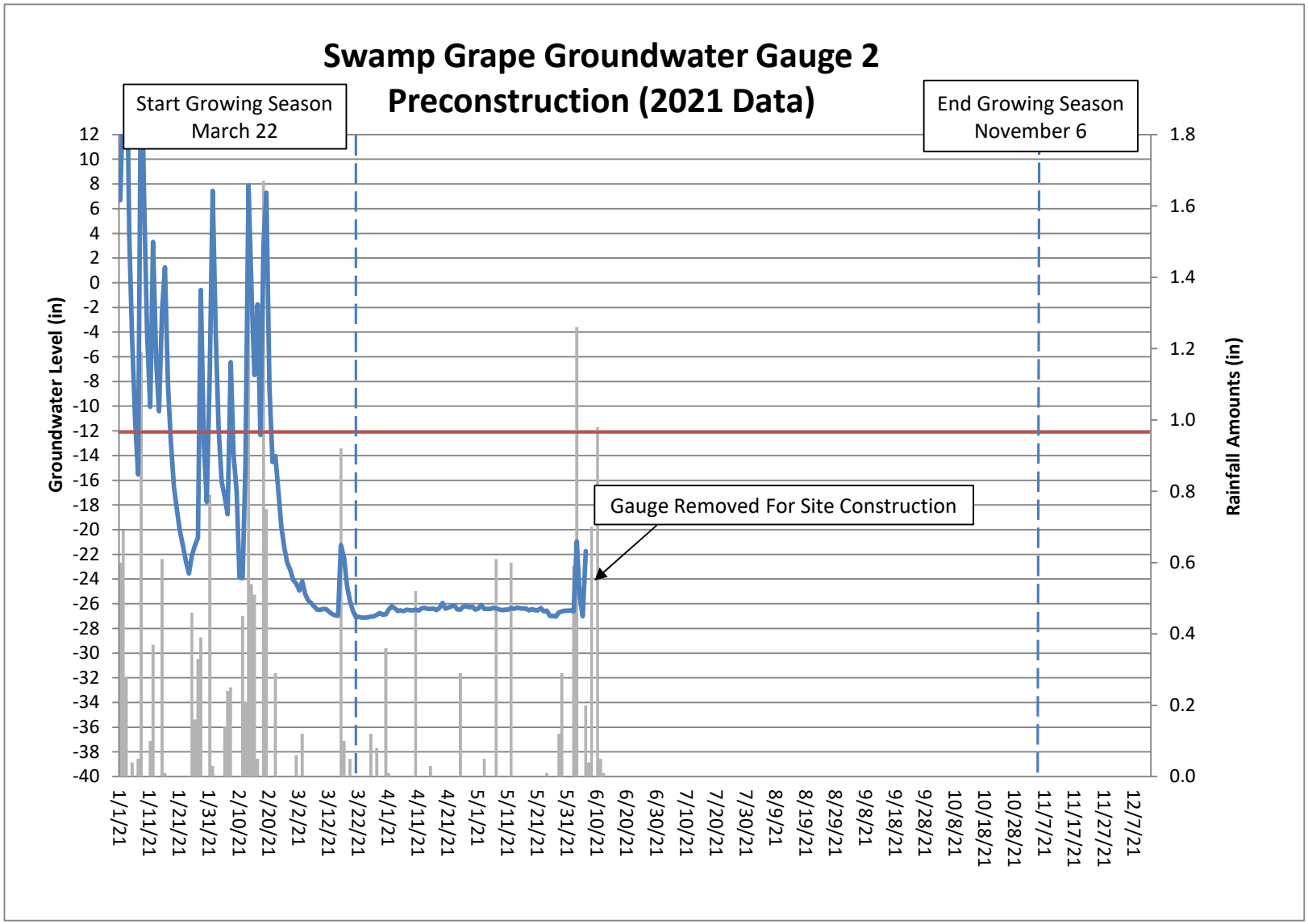
11/27/21
12/7/21


Swamp Grape Groundwater Gauge 2
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
Gauge Removed For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
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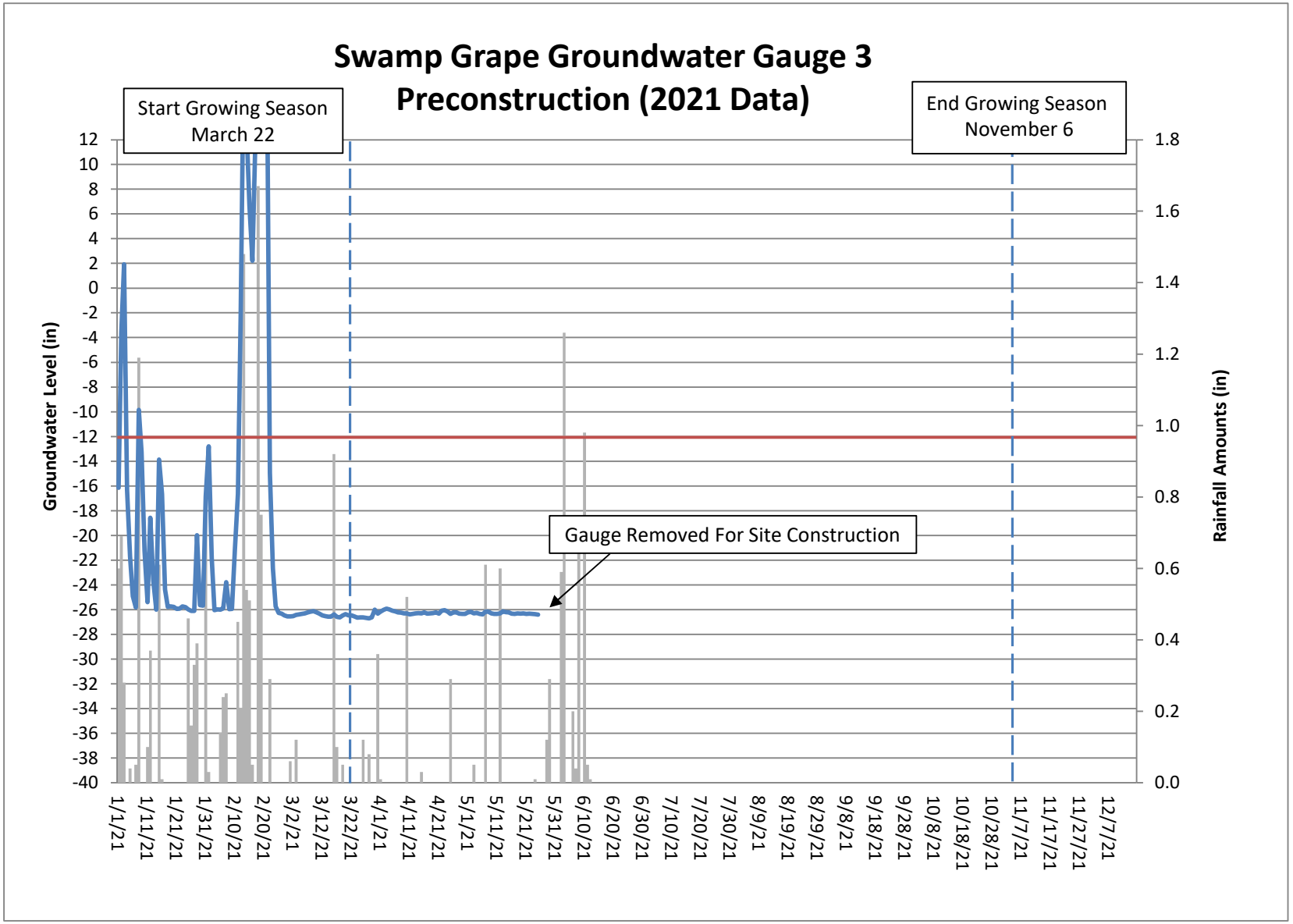
11/27/21
12/7/21


Swamp Grape Groundwater Gauge 3
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
Gauge Removed For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
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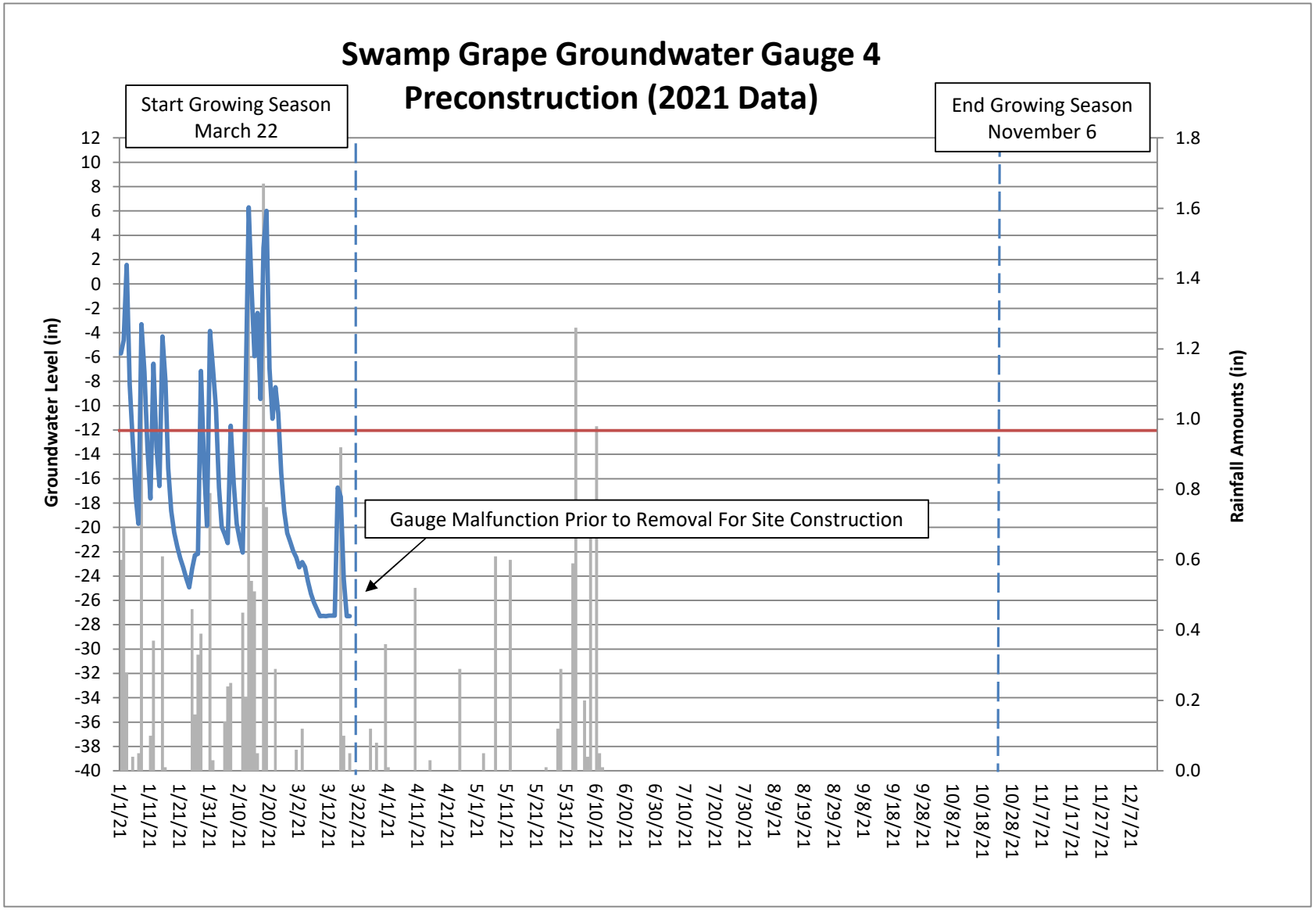
11/7/21
11/17/21
11/27/21
12/7/21


Swamp Grape Groundwater Gauge 4
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
Gauge Malfunction Prior to Removal For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
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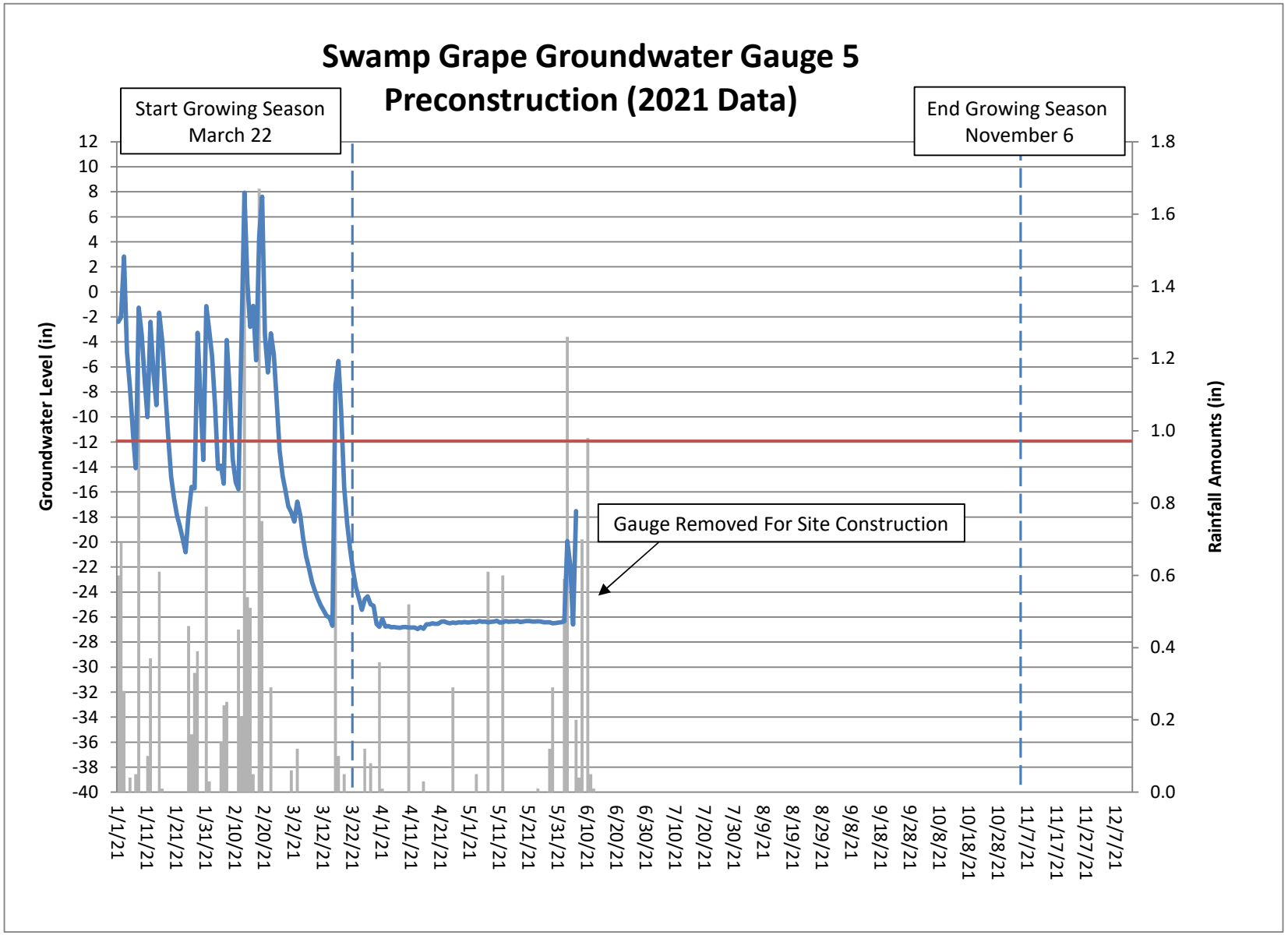
11/27/21
12/7/21


Swamp Grape Groundwater Gauge 5
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
Gauge Removed For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
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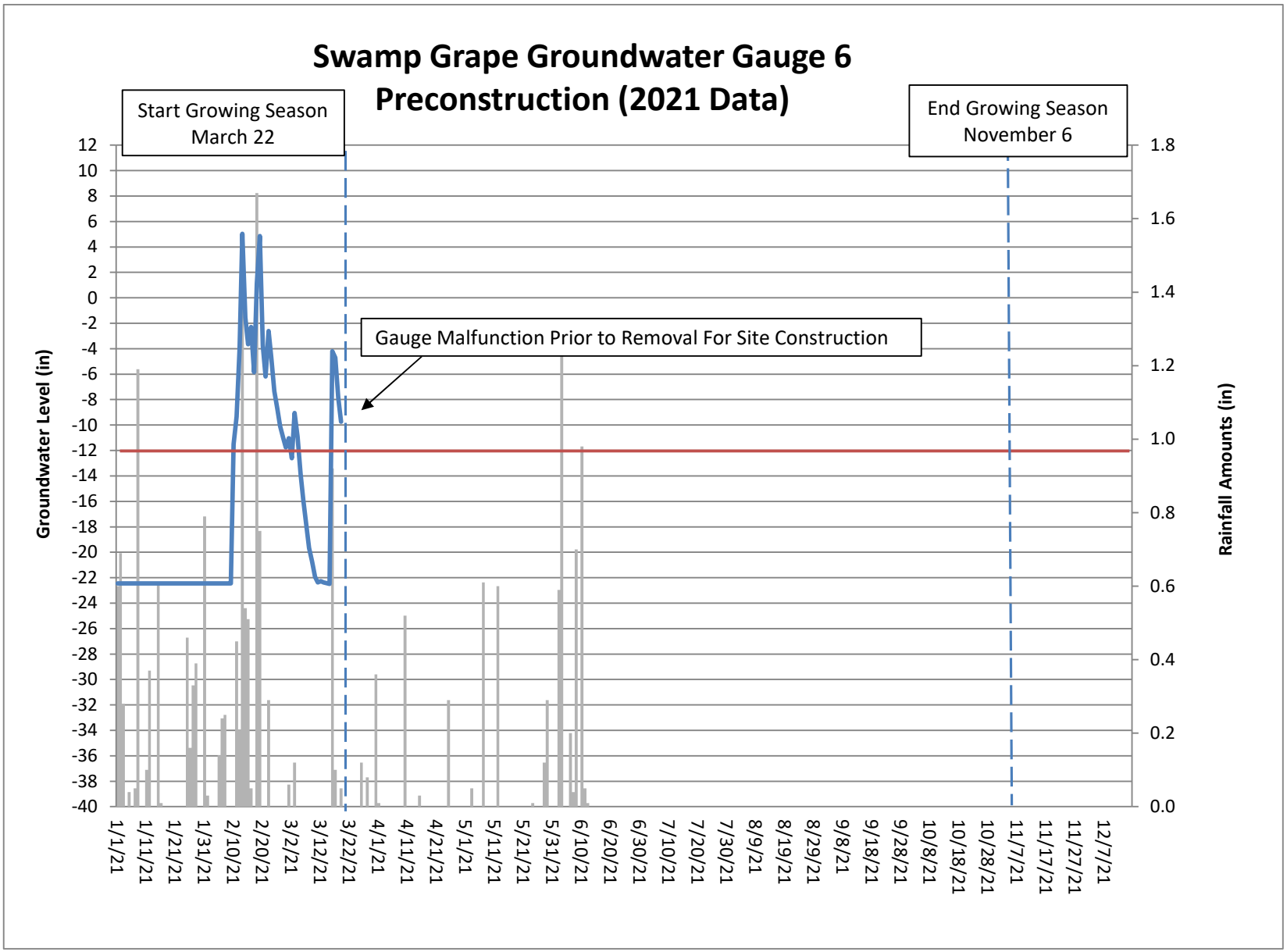
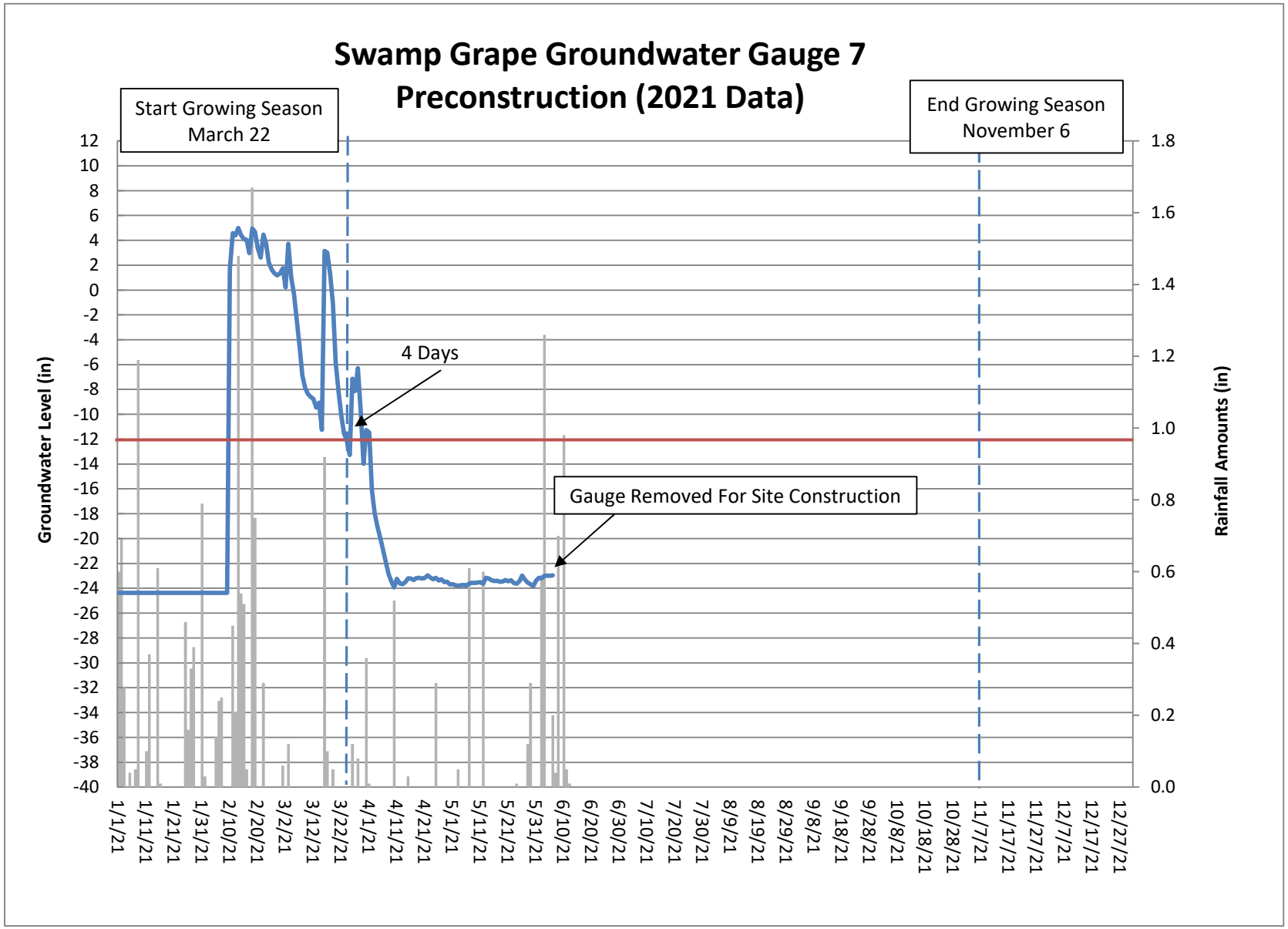
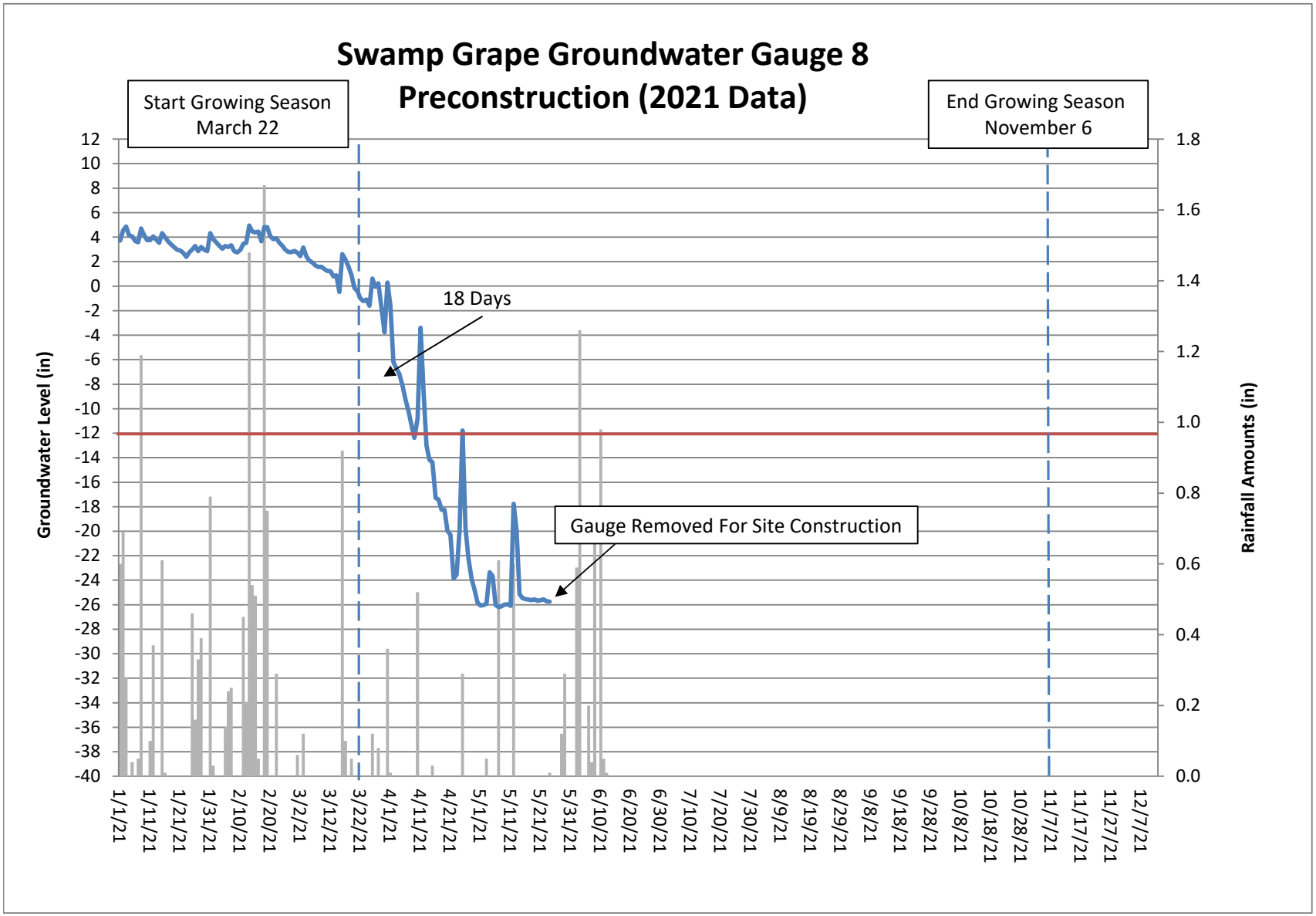
11/27/21
12/7/21


Swamp Grape Groundwater Gauge 6
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
Gauge Malfunction Prior to Removal For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
9/18/21
9/28/21
10/8/21
10/18/21
10/28/21
11/7/21
11/17/21
11/27/21
12/7/21


Swamp Grape Groundwater Gauge 7
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
4 Days
Gauge Removed For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
9/18/21
9/28/21
10/8/21
10/18/21
10/28/21
11/7/21
11/17/21
11/27/21
12/7/21
12/17/21
12/27/21


Swamp Grape Groundwater Gauge 8
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
18 Days
Gauge Removed For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
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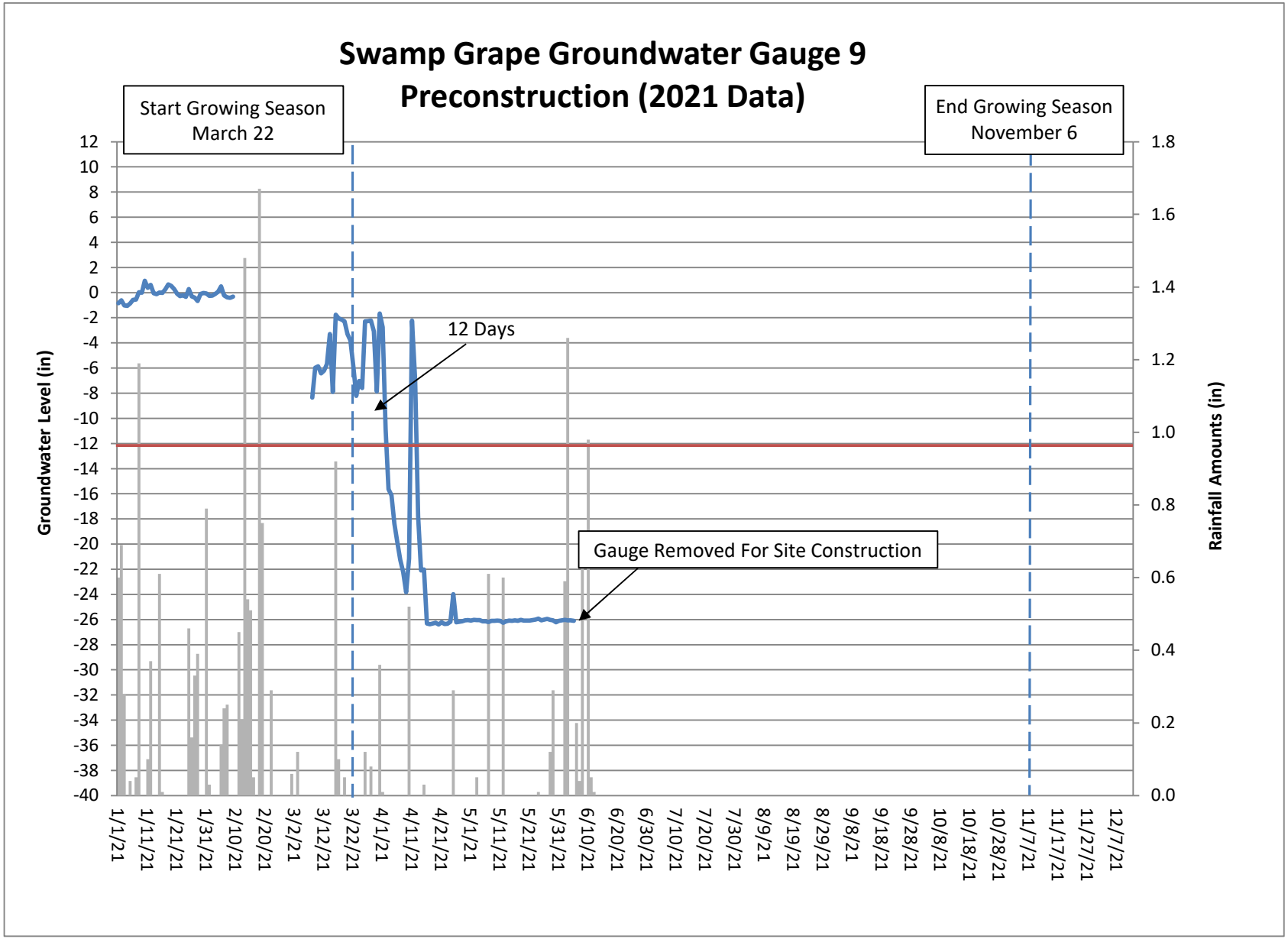
11/27/21
12/7/21


Swamp Grape Groundwater Gauge 9
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
12 Days
Gauge Removed For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
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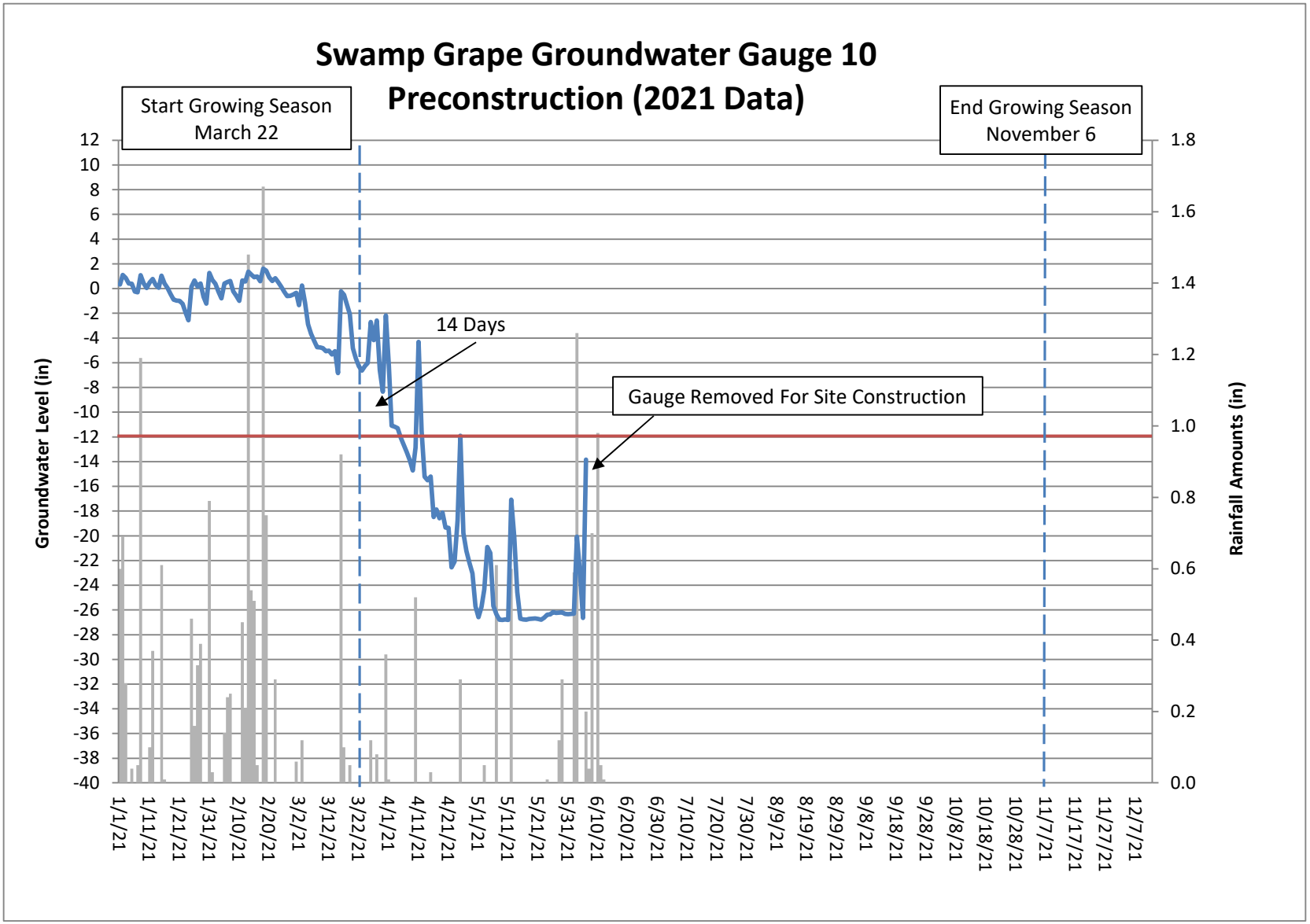
11/27/21
12/7/21


Swamp Grape Groundwater Gauge 10
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
14 Days
Gauge Removed For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
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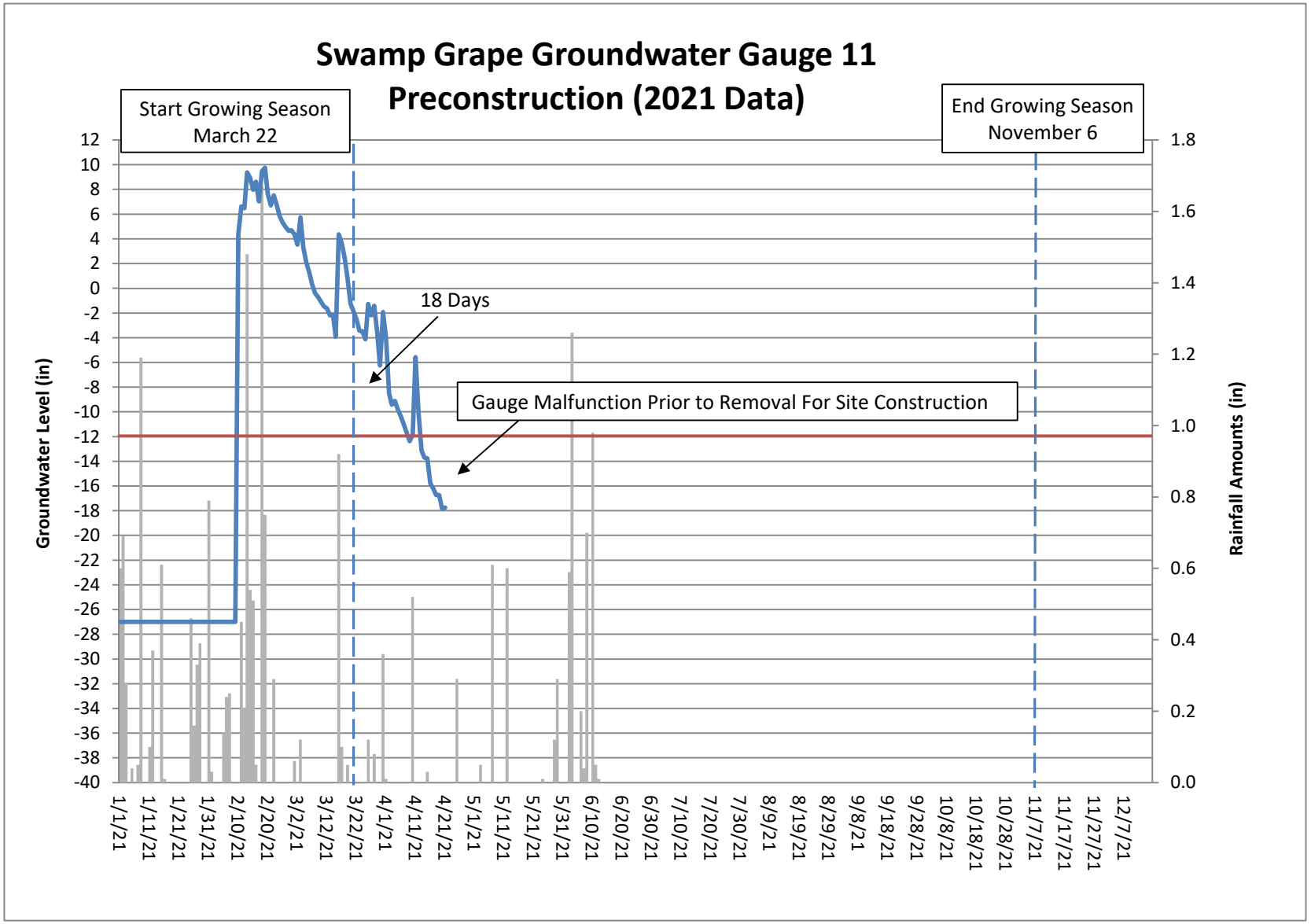
11/27/21
12/7/21


Swamp Grape Groundwater Gauge 11
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
18 Days
Gauge Malfunction Prior to Removal For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
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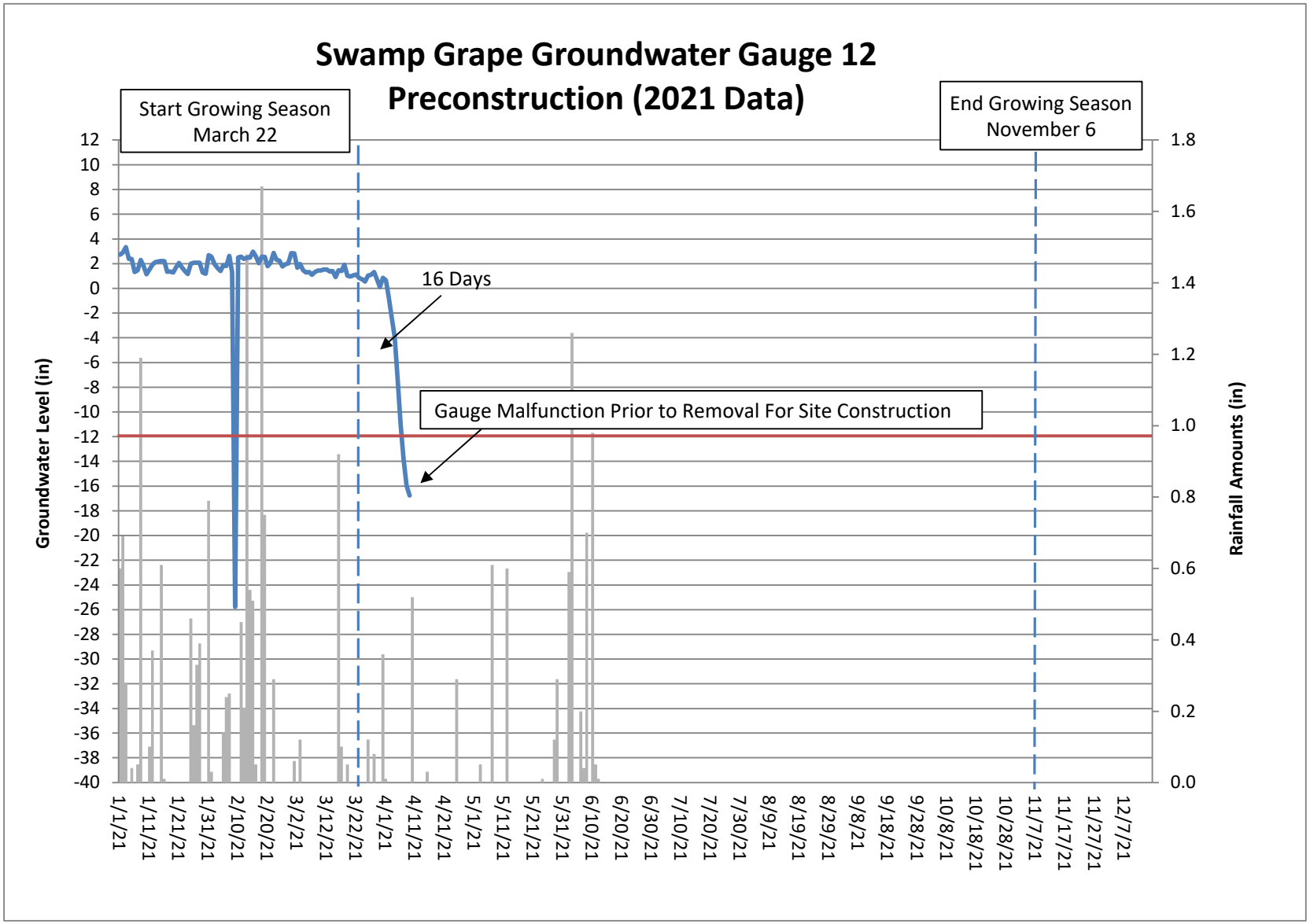
11/27/21
12/7/21


Swamp Grape Groundwater Gauge 12
Preconstruction (2021 Data)
Start Growing Season
March 22
End Growing Season
November 6
16 Days
Gauge Malfunction Prior to Removal For Site Construction
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1/1/21
1/11/21
1/21/21
1/31/21
2/10/21
2/20/21
3/2/21
3/12/21
3/22/21
4/1/21
4/11/21
4/21/21
5/1/21
5/11/21
5/21/21
5/31/21
6/10/21
6/20/21
6/30/21
7/10/21
7/20/21
7/30/21
8/9/21
8/19/21
8/29/21
9/8/21
9/18/21
9/28/21
10/8/21
10/18/21
10/28/21
11/7/21
11/17/21
11/27/21
12/7/21

Typical Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)		
Gauge	**2020**	**2021**
1	No/7 Days (2%)	No/0 Days (0%)
2	No/4 Days (1%)	No/0 Days (0%)
3	Gauge Malfunction	No/0 Days (0%)
4	No/6 Days (2%)	No/0 Days (0%)
5	No/7 Days (2%)	No/0 Days (0%)
6	Gauge Malfunction	No/0 Days (0%)
7	Gauge Malfunction	No/4 Days (1%)
8	Yes/83 Days (23%)	No/18 Days (5%)
9	No/19 Days (5%)	No/12 Days (3%)
10	Yes/51 Days (14%)	No/14 Days (4%)
11	Gauge Malfunction	No/18 Days (5%)
12	Yes/58 Days (16%)	No/16 Days (4%)

Legend

- Swamp Grape Easement = 24.7 ac
- Wetland Restablishment
- Wetland Rehabilitation
- Wetland Enhancement
- Wetland Creation
- Groundwater Gauge Meeting 12% Success Criteria
- Groundwater Gauge Not Meeting 12% Success Criteria
- Groundwater Gauge Malfunction

0 300 600 Feet

Note: Basemap is drone imagery from October 2021 on top of 2017 aerial orthoimagery from NC OneMap

Groundwater Gauges Nested at 10, 20, and 45 ft from Channel.

UT-1
UT-2
UT-3
GW-01
GW-02
GW-03
GW-04
GW-05
GW-06
GW-07
GW-08
GW-09
GW-10
GW-11
GW-12

N

NC Center for Geographic Information & Analysis

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SWAMP GRAPE MITIGATION SITE

Robeson County, NC

Title:

PRE-CONSTRUCTION GROUNDWATER GAUGES 2020

Drawn by: JMH

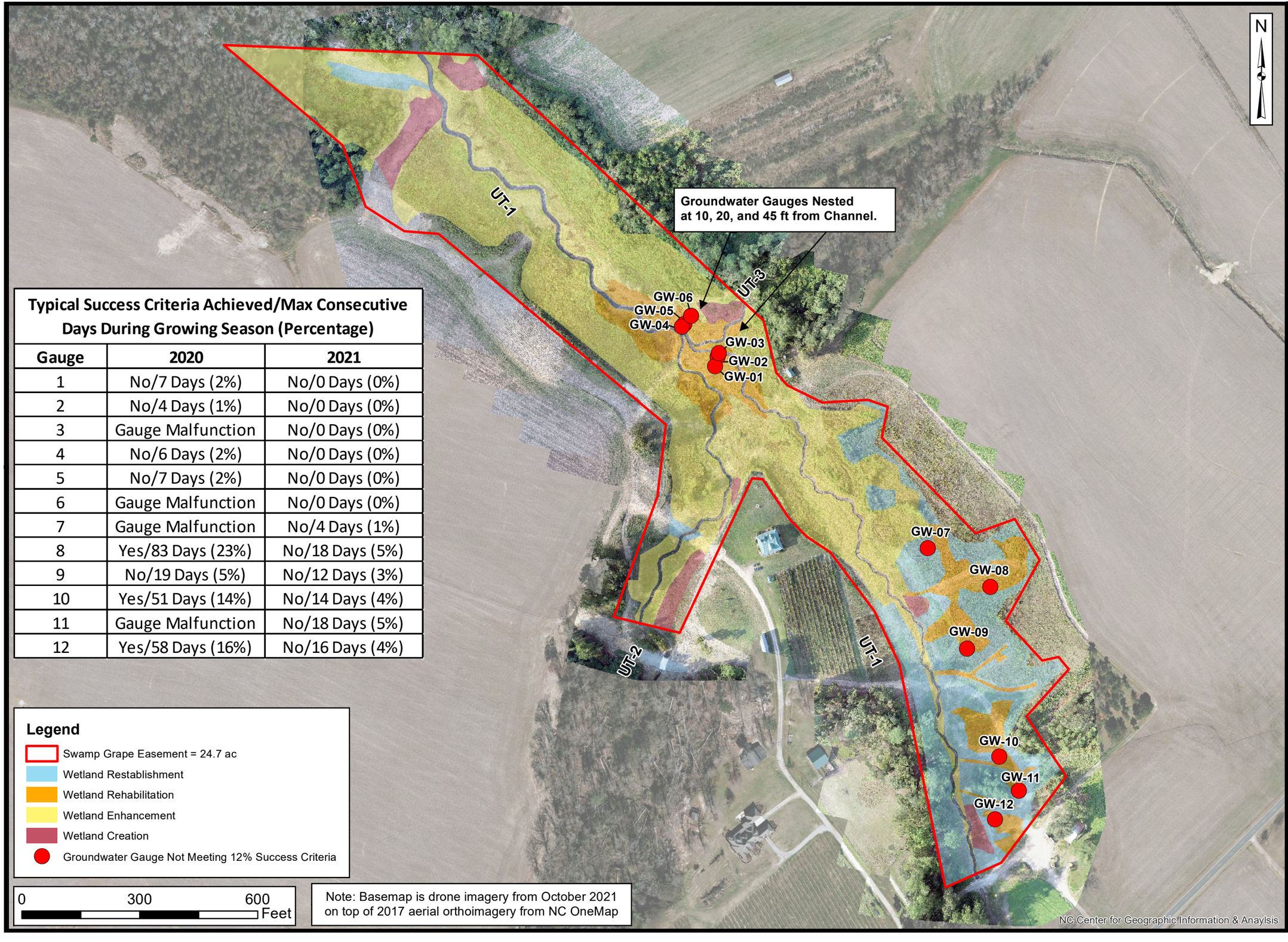
Date: MAR 2022

Scale: 1:2750

Project No.: 20-003

FIGURE

1



Typical Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)		
Gauge	**2020**	**2021**
1	No/7 Days (2%)	No/0 Days (0%)
2	No/4 Days (1%)	No/0 Days (0%)
3	Gauge Malfunction	No/0 Days (0%)
4	No/6 Days (2%)	No/0 Days (0%)
5	No/7 Days (2%)	No/0 Days (0%)
6	Gauge Malfunction	No/0 Days (0%)
7	Gauge Malfunction	No/4 Days (1%)
8	Yes/83 Days (23%)	No/18 Days (5%)
9	No/19 Days (5%)	No/12 Days (3%)
10	Yes/51 Days (14%)	No/14 Days (4%)
11	Gauge Malfunction	No/18 Days (5%)
12	Yes/58 Days (16%)	No/16 Days (4%)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SWAMP GRAPE MITIGATION SITE

Robeson County, NC

Title:

PRE-CONSTRUCTION GROUNDWATER GAUGES 2021

Drawn by: JMH

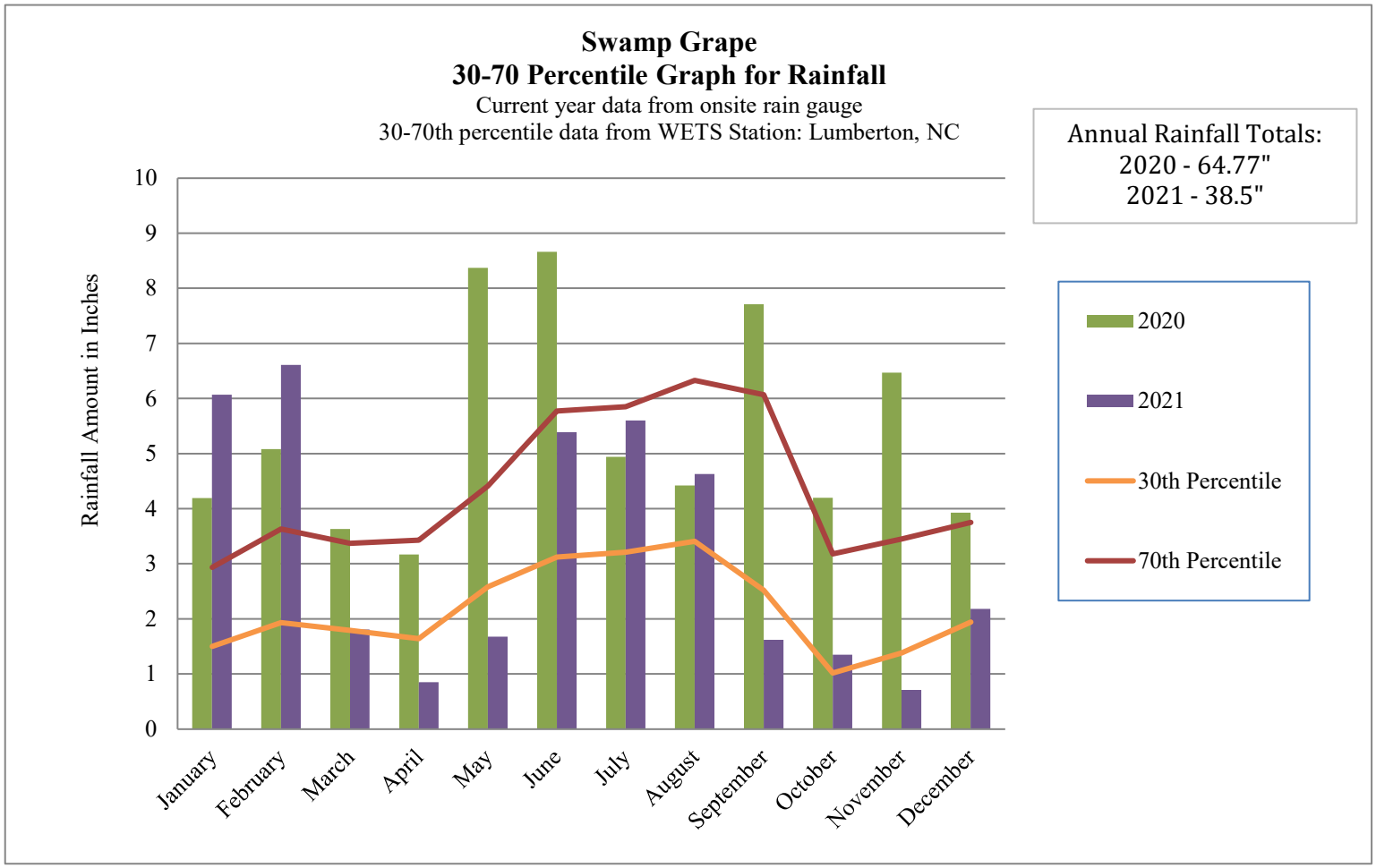
Date: MAR 2022

Scale: 1:2750

Project No.: 20-003

FIGURE

2


Swamp Grape
30-70 Percentile Graph for Rainfall
Current year data from onsite rain gauge
30-70th percentile data from WETS Station: Lumberton, NC
Annual Rainfall Totals:
2020 - 64.77"
2021 - 38.5"
Rainfall Amount in Inches
0
1
2
3
4
5
6
7
8
9
10
January
February
March
April
May
June
July
August
September
October
November
December
2020
2021
30th Percentile
70th Percentile

Appendix E
Project Timeline and Contact Info

Table 11. Project Timeline
Table 12. Project Contacts

Table 11. Project Timeline

Activity or Deliverable	Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted	NA	Apr-19
Mitigation Plan Approved	NA	Feb-21
Construction (Grading) Completed	NA	23-Sep-21
Planting Completed	NA	18-Jan-22
As-built Survey Completed	NA	Sep-21
MY-0 Baseline Report	Jan-21	Feb-21
MY1+ Monitoring Reports		

Table 12. Project Contacts

Swamp Grape Stream and Wetland Mitigation Site/100115	
Provider	Restoration Systems, LLC 1101 Haynes Street, Suite 211 Raleigh, NC 27604
Mitigation Provider POC	Worth Creech 919-755-9490
Designer	Axiom Environmental, Inc. 218 Snow Ave Raleigh, NC 27603
Primary project design POC	Grant Lewis 919-215-1693
Construction Contractor	Land Mechanics Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Charles Hill 919-639-6132

Appendix F
Other Data

UT-2 Crossing Change

E-mail exchange between Worth Creech (R.S.) & Travis Wilson (NCWRC)

Revised Design Sheet (McAdams)

Figure F-1. Fencing

Photo Log

Worth Creech

From: Wilson, Travis W. <travis.wilson@ncwildlife.org>
Sent: Monday, May 17, 2021 1:16 PM
To: Worth Creech
Subject: RE: [External] RE: modular bottomless culverts

I'm ok with it, I think it's a good option.

From: Worth Creech <worth@restorationsystems.com>
Sent: Monday, May 17, 2021 12:02 PM
To: Wilson, Travis W. <travis.wilson@ncwildlife.org>
Subject: RE: [External] RE: modular bottomless culverts

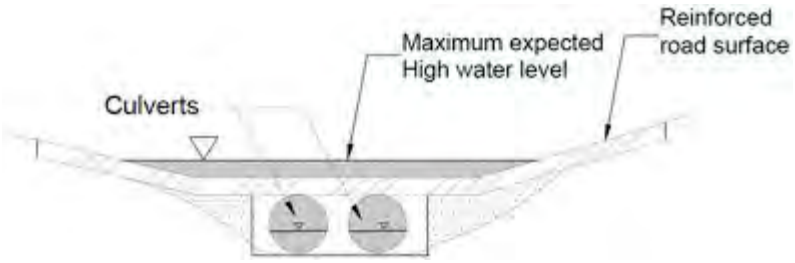
Gotcha- we will design something that is reinforced at the inlet and outlet to accommodate frequent storm flows.
So are you good with us pursuing?

From: Wilson, Travis W. <travis.wilson@ncwildlife.org>
Sent: Monday, May 17, 2021 10:10 AM
To: Worth Creech <worth@restorationsystems.com>
Subject: RE: [External] RE: modular bottomless culverts

Something to keep in mind is one of the differences I have seen in a vented ford verses simply a reinforced road with culverts that overtop is a vented ford will be reinforced at the inlet and outlet. Not really traditional headwalls but similar. It allows the culverts to be installed closer together and with less material covering the pipes without risk of them blowing out during a storm.

From: Worth Creech <worth@restorationsystems.com>
Sent: Monday, May 17, 2021 8:59 AM
To: Wilson, Travis W. <travis.wilson@ncwildlife.org>
Subject: [External] RE: modular bottomless culverts

Travis, we're trying to figure out the best crossing for Swamp Grape's UT2. When you and I talked we discussed a ford. The landowner uses this crossing during his corn harvest with multiple 18 wheeler trucks. He wasn't to sure about ford because of the approach angles. Would you be ok if we tried an engineered vented ford in this location? I found the detail below on the web. I think we would use 3 or 4 pipes depending on what the engineer comes up with. The top would be concrete and the approaches armored with rock.



Also, we are close to having a new detail for the bridge at Laurel Springs Site. The engineer ran the flood models and the bridge was best with floodplains pipes. There is a local bridge builder that can knock it out.

Thanks for any insight. Worth

From: Wilson, Travis W. <travis.wilson@ncwildlife.org>
Sent: Friday, May 7, 2021 11:34 AM
To: Worth Creech <worth@restorationsystems.com>
Subject: modular bottomless culverts

http://www.envirospan.ca/

The link above is for the modular bottomless culverts. The link below is just a brochure I found that does a good job of illustrating a whole host of structure types. What it covers for the most part is not applicable to the scale needed in restoration projects but there are other companies that handle smaller scale of the same type. Such as small con spans or plate arch pipes.

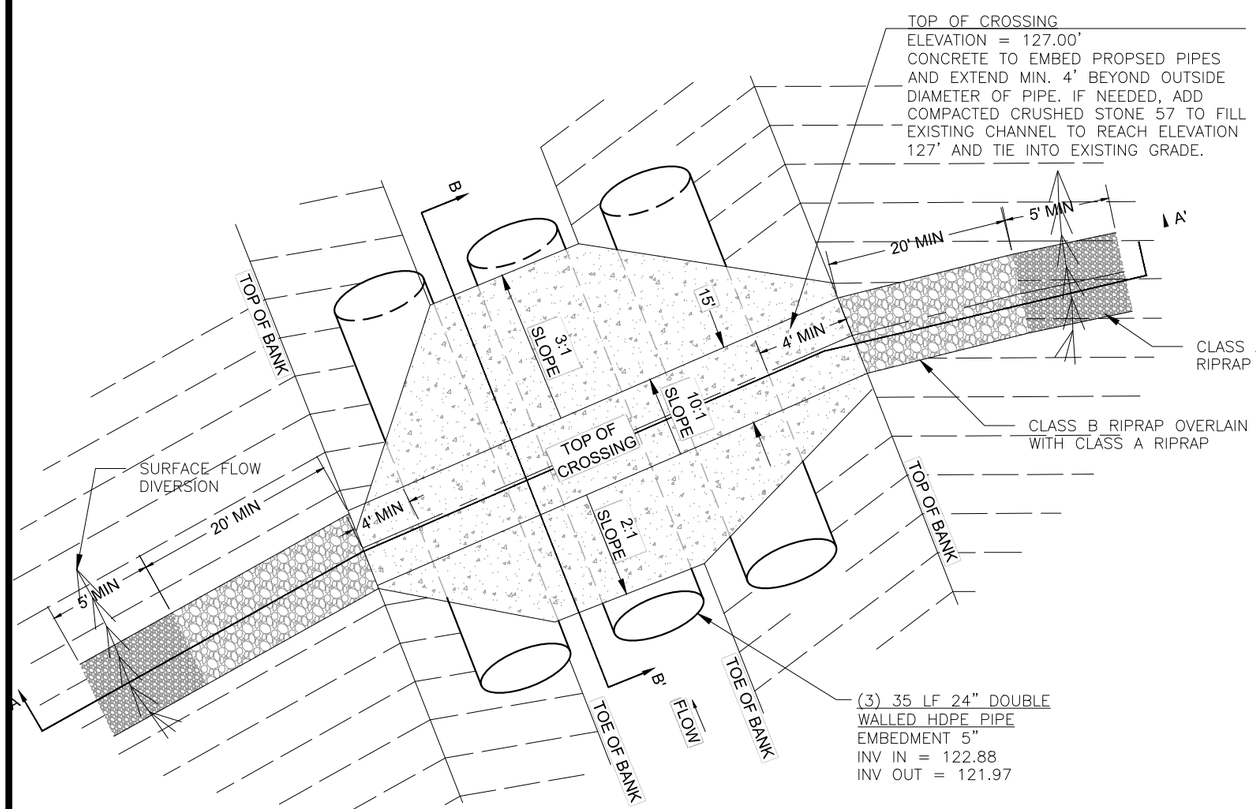
https://www.conteches.com/Portals/0/Documents/Brochures/Structures-Reference-Guide.pdf?ver=2018-05-16-090513-030

Travis W. Wilson
Eastern DOT Habitat Conservation Coordinator
Habitat Conservation Program

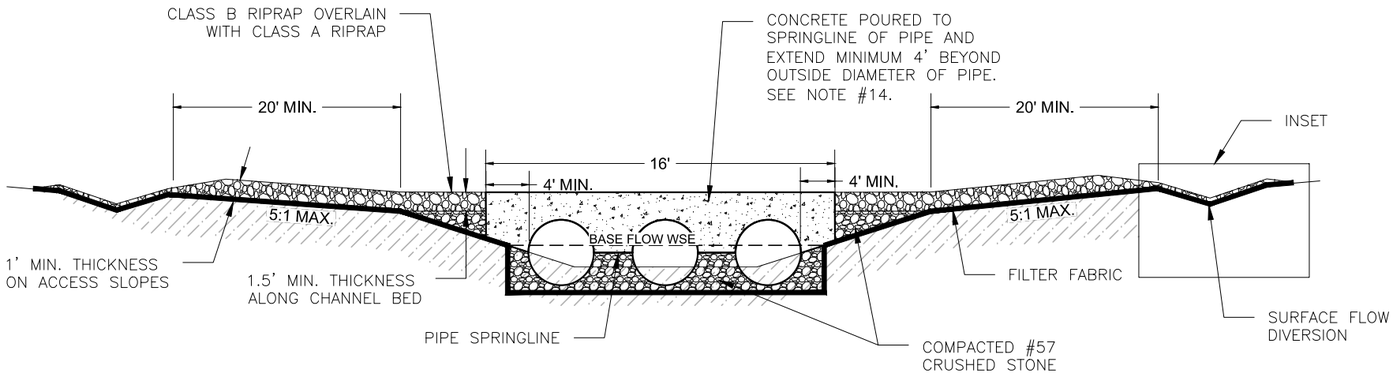
NC Wildlife Resources Commission
1718 Hwy 56 West
Creedmoor, NC 27522
Phone: 919-707-0370
Fax: 919-528-2524
Travis.Wilson@ncwildlife.org

NOTES

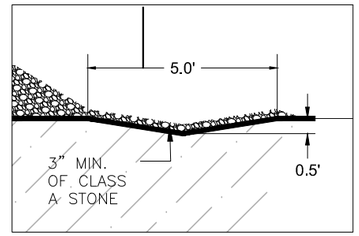
1. CONSTRUCT FORD CROSSING IN THE DRY, FOLLOWING EROSION CONTROL PUMPING PLAN.
2. HAVE ALL NECESSARY MATERIALS AND EQUIPMENT ON-SITE BEFORE WORK BEGINS.
3. FORD CROSSING SHALL BE INSTALLED PERPENDICULAR TO CHANNEL BANKS.
4. ALIGN ROAD APPROACHES WITH THE CENTER OF THE CROSSING FOR A MINIMUM OF 20 FEET.
5. ACCESS SLOPE SHALL BE GRADED PERPENDICULAR TO THE FORD CROSSING AT A MAX SLOPE OF 5:1.
6. MAINTAIN CROSSING SO THAT RUNNOFF IN THE CONSTRUCTION ROAD DOES NOT ENTER EXISTING CHANNEL.
7. GEOTEXTILE FILTER FABRIC SHALL BE PLACED ALONG THE LENGTH OF THE ACCESS SLOPES AND FORD CROSSING.
8. CLASS B RIPRAP SHALL BE OVERLAIN WITH CLASS A RIPRAP WITH A MINIUM THICKNESS OF 1.5 FEET ACROSS THE CHANNEL BED AND A MINIMUM THICKNESS OF 1.0 FEET ON ACCESS SLOPES AND FLOODPLAIN.
9. RIPRAP MIX SHALL EXTEND 20 FEET BEYOND TOP OF CHANNEL.
10. WIDTH OF THE CROSSING SHALL BE A MINIMUM OF 15 FEET.
11. CONCRETE POURED FROM SPRINGLINE OF PIPES TO TOP OF CROSSING ELEVATION AND TO EXTEND 4 FEET HORIZONTALLY BEYOND THE OUTSIDE DIAMETER OF PIPE.
12. POURED CONCRETE SHALL MEET THE FOLLOWING SPECIFICATIONS UNLESS OTHERWISE NOTED:
    -MINIMUM 3000 PSI (28 DAY)
    -SLUMP = 3" - 5"
    -ENTRAINED AIR = 5% - 7%
    PLEASE NOTE NO CONCRETE SHALL BE POURED WHEN THE AMBIENT AIR TEMPERATURES ARE EXPECTED TO BE ABOVE 85°F OR BELOW 40°F.



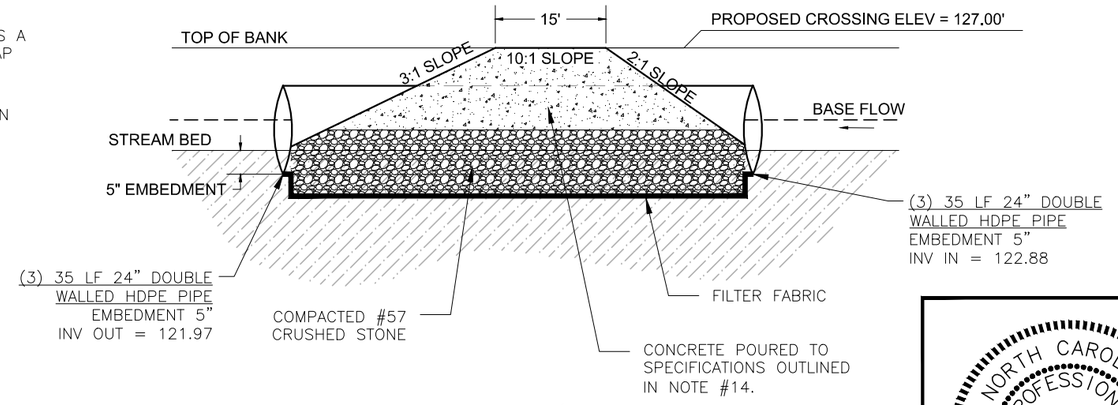
ISOMETRIC VIEW



SECTION A-A'



INSET



SECTION B-B'

NOTE: UPSTREAM INVERT HDPES SHALL BE FIELD VERIFIED BASED ON SITE CONDITIONS ENSURING POSITIVE DRAINAGE AND THAT 5 INCHES OF EMBEDMENT IS ACHIEVED.

NORTH CAROLINA PROFESSIONAL SEAL 049073 ENGINEER REBECCA STUBBS

UT 2 FORD/CULVERT CROSSING
N.T.S.

McADAMS
The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713
phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187
www.mcadamsco.com

SWAMP GRAPE MITIGATION PLAN

CONSTRUCTION DRAWINGS
ROBESON COUNTY, NORTH CAROLINA

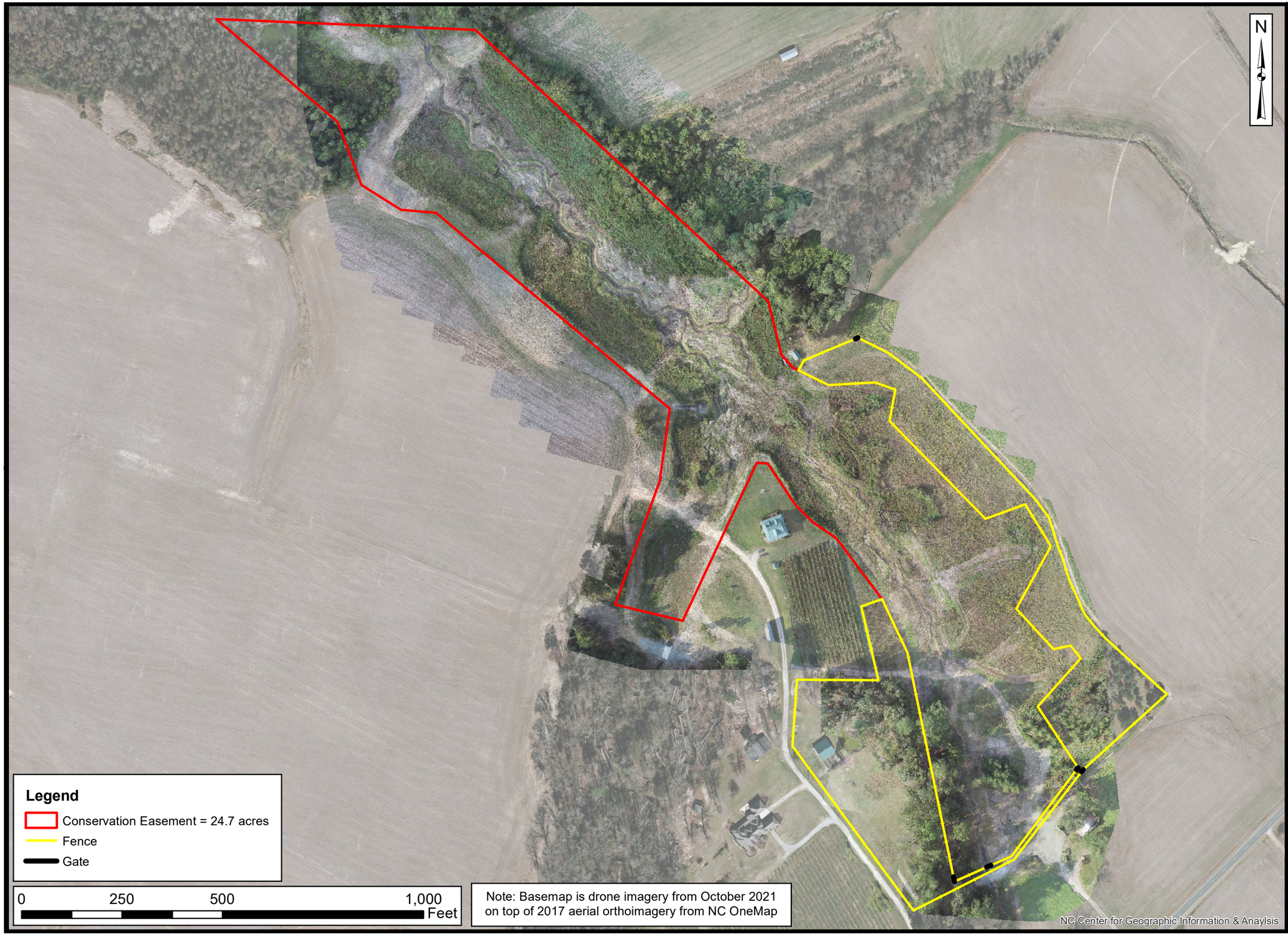
RESTORATION SYSTEMS | LLC

Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	AXI-19010
FILENAME	AXI19010-D1
CHECKED BY	RAS
DRAWN BY	KEG
SCALE	N.T.S.
DATE	06.04.2021

CULVERT DETAILS

C8.04



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SWAMP GRAPE MITIGATION SITE

Robeson County, NC

Title:

ASBUILT FENCING

Drawn by: JMH

Date: FEB 2022

Scale: 1:2700

Project No.: 20-003

FIGURE

F-1

Swamp Grape Mitigation Site: Task 6 – Construction Photos
DMS Contract #: 7869; DMS Project ID: 100115; RFP # 16-007705

09/13/2021

09/13/2021

09/13/2021

09/13/2021

09/13/2021

09/29/2021

01/24/2022

09/23/2021, UT-1 Crossing

09/23/2021, UT-2 Crossing

09/23/2021, UT-2 Crossing

01/14/2022, Controlled burn for herbaceous species control prior to bare-root/live-stake planting

01/14/2022, Controlled burn for herbaceous species control prior to bare-root/live-stake planting

Bare-root planting - 01/18/2022

Veg Plot and Groundwater Gauge - 01/18/2022

Plot and Groundwater Gauge - 01/18/2022

Live stake planting - 01/18/2022

Live stake planting - 01/18/2022

Bare-root planting - 01/18/2022

Bare-root planting - 01/18/2022

Bare-root planting - 01/18/2022

Live stake planting - 01/18/2022

Bare-root planting - 01/18/2022

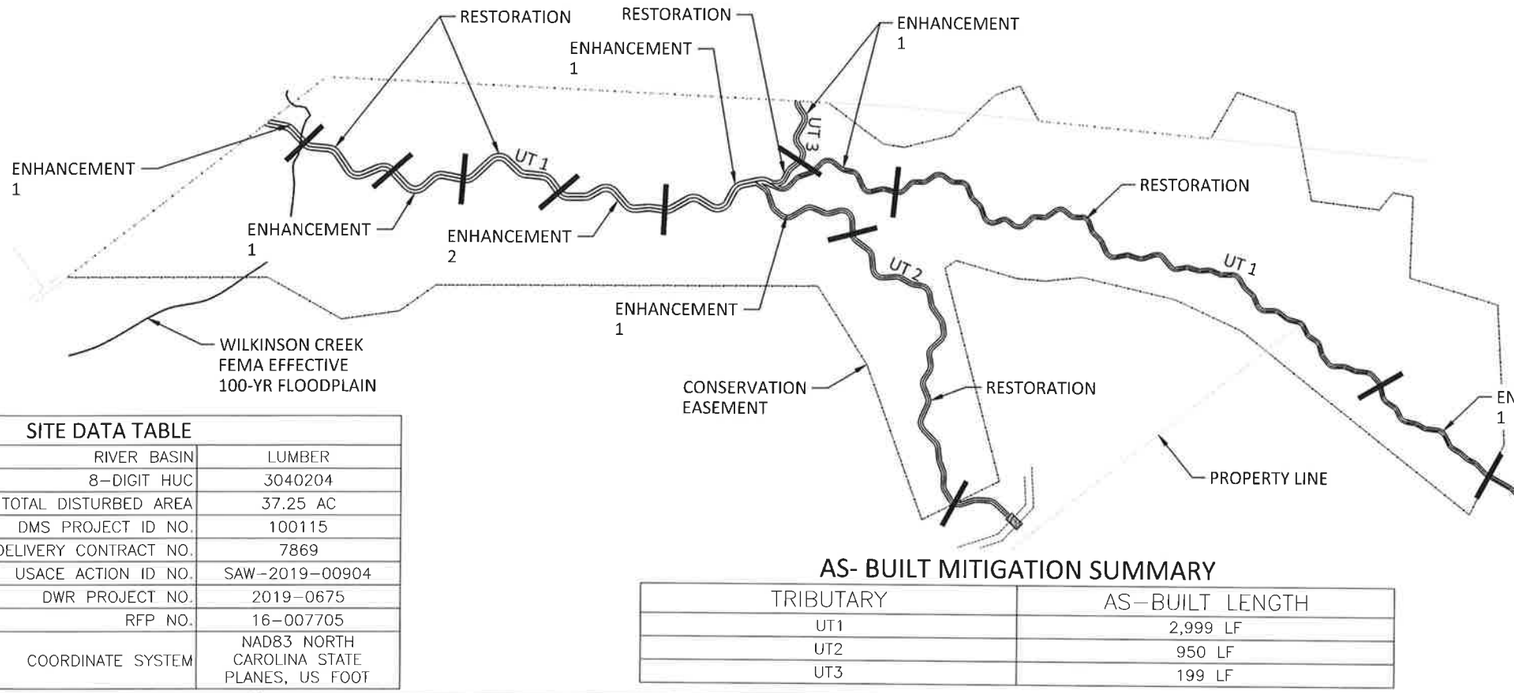
Live stake planting - 01/18/2022

Live stake planting - 01/18/2022

Appendix G
Record Drawings (As-built Survey)

NC DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES

AS-BUILT DRAWINGS
SWAMP GRAPE MITIGATION SITE
ROBESON COUNTY
DATE: MARCH 17, 2022

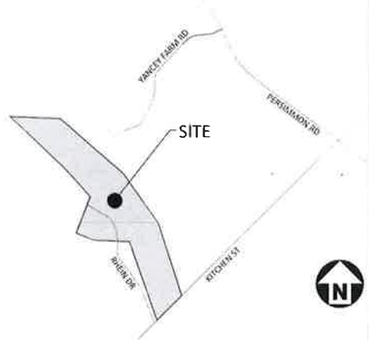


SHEET INDEX

SITE DATA TABLE	
RIVER BASIN	LUMBER
8-DIGIT HUC	3040204
TOTAL DISTURBED AREA	37.25 AC
DMS PROJECT ID NO.	100115
FULL DELIVERY CONTRACT NO.	7869
USACE ACTION ID NO.	SAW-2019-00904
DWR PROJECT NO.	2019-0675
RFP NO.	16-007705
COORDINATE SYSTEM	NAD83 NORTH CAROLINA STATE PLANES, US FOOT

AS- BUILT MITIGATION SUMMARY

TRIBUTARY	AS-BUILT LENGTH
UT1	2,999 LF
UT2	950 LF
UT3	199 LF



VICINITY MAP
1" = 2000'

RESTORATION LEVEL	STREAM (LF)	RIPARIAN WETLAND (AC)	NON-RIPARIAN WETLAND (AC)
RESTORATION	2,397	-	-
ENHANCEMENT I	1,516	-	-
ENHANCEMENT II	235	-	-
REESTABLISHMENT	-	4.470	-
REHABILITATION	-	2.671	-
ENHANCEMENT	-	12.244	-
CREATION	-	0.997	-
TOTALS	4,132	20.382	-
MITIGATION UNITS	3,228.333	12.705	-

MCADAMS
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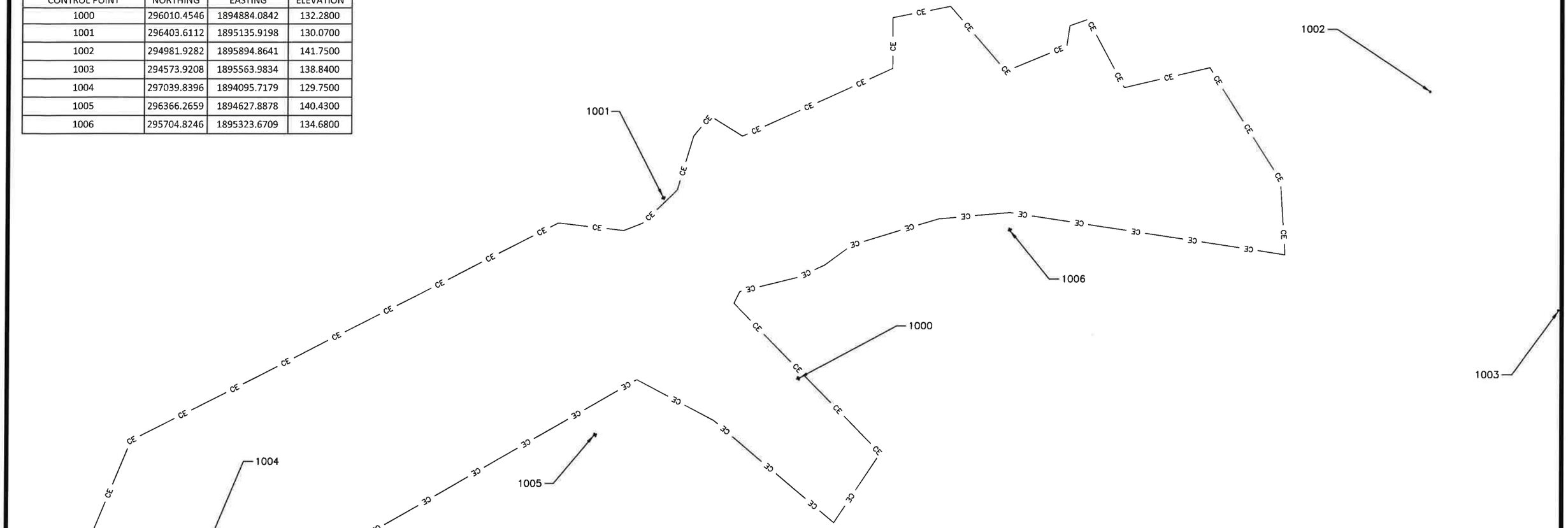
fax 919. 361. 2269
license number: C-0293, C-187
www.mcadamsco.com

AXIOM ENVIRONMENTAL, INC.
218 SNOW AVENUE
RALEIGH, NC 27603
CONTACT: GRANT LEWIS
PHONE: 919. 215. 1693
Axiom Environmental, Inc.

CLIENT
RESTORATION SYSTEMS, LLC
1101 HAYNES ST, SUITE 211
RALEIGH, NC 27604
CONTACT: WORTH CREECH
PHONE: 919. 389. 3888
RESTORATION SYSTEMS | LLC

RECORD DRAWINGS ONLY
NORTH CAROLINA
PROFESSIONAL
SEAL
049073 3-21-22
ENGINEER
REBECCA STUBBS
RECORD DRAWINGS ONLY

CONTROL POINT LOCATIONS			
CONTROL POINT	NORTHING	EASTING	ELEVATION
1000	296010.4546	1894884.0842	132.2800
1001	296403.6112	1895135.9198	130.0700
1002	294981.9282	1895894.8641	141.7500
1003	294573.9208	1895563.9834	138.8400
1004	297039.8396	1894095.7179	129.7500
1005	296366.2659	1894627.8878	140.4300
1006	295704.8246	1895323.6709	134.6800



GENERAL NOTES:

1. COORDINATE SYSTEM: NAD83 NORTH CAROLINA STATE PLANES, US FOOT
2. TOPOGRAPHY AND SPOT ELEVATIONS SHOWN ARE FROM AN ACTUAL FIELD SURVEY COMPLETED BY K2 DESIGN GROUP.
3. PLANIMETRICS, UTILITIES, INVERTS AND BUILDING INFORMATION (SHOWN FOR REFERENCE) WAS COMPLIED FROM AUTOCAD FILES PROVIDED TO MCADAMS FROM OTHERS. MCADAMS MAKES NO WARRANTY ABOUT THE ACCURACY OF THE INFORMATION SHOWN PROVIDED BY OTHERS.
4. FLOOD NOTE: A PORTION OF THE EASEMENT IS LOCATED IN A SPECIAL FLOOD HAZARD ZONE. IT IS LOCATED IN ZONE "AE" AS DEFINED BY F.E.M.A F.I.R.M COMMUNITY PANEL #3710828800J DATED JANUARY 19, 2005.

GRAPHIC SCALE

0 100 200 400

1 inch = 200 ft.

RECORD DRAWINGS ONLY
NORTH CAROLINA PROFESSIONAL SEAL 049073 ENGINEER REBECCA STUBBS
RECORD DRAWINGS ONLY

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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS

ROBESON COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	AXI-19010
FILENAME	AXI19010-ESMT
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1" = 200'
DATE	01.05.2022

CONSERVATION EASEMENT AND CONTROL POINTS EXHIBIT

C1.00

LEGEND AND SYMBOLS

- 250 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 250 — PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- CE CE — PROPOSED CONSERVATION EASEMENT
- EXISTING PROPERTY LINE
- PROPOSED ACCESS EASEMENT
- EXISTING FLOODPLAIN
- PROPOSED STREAM CENTERLINE
- PROPOSED TOP OF BANK
- OU OU — PROPOSED OVERHEAD ELECTRIC
- PROPOSED LOG CROSS VANE
- PROPOSED LOG VANE
- WETLAND REHABILITATION AREA
- APPROVED JD WETLANDS
- HYDRIC SOILS
- WETLAND CREATION AREA
- DEPOSITED SEDIMENT

AS-BUILT LEGEND AND SYMBOLS

- 250 — MAJOR CONTOUR
- MINOR CONTOUR
- STREAM CENTERLINE
- TOP OF BANK
- LOG CROSS VANE
- LOG VANE
- STREAM CULVERT
- MONITORING – VEGETATION PLOT
- MONITORING – CROSS SECTION
- MONITORING – STREAM GAGUE
- MONITORING – GROUNDWATER WELL
- MONITORING – RAIN GAGUE

RECORD DRAWINGS ONLY
NORTH CAROLINA
REGISTERED
SEAL
049073
ENGINEER
REBECCA STUBBS
1.26.22
RECORD DRAWINGS ONLY

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fax 919. 361. 2269
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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS

ROBESON COUNTY, NORTH CAROLINA

RS RESTORATION SYSTEMS, LLC

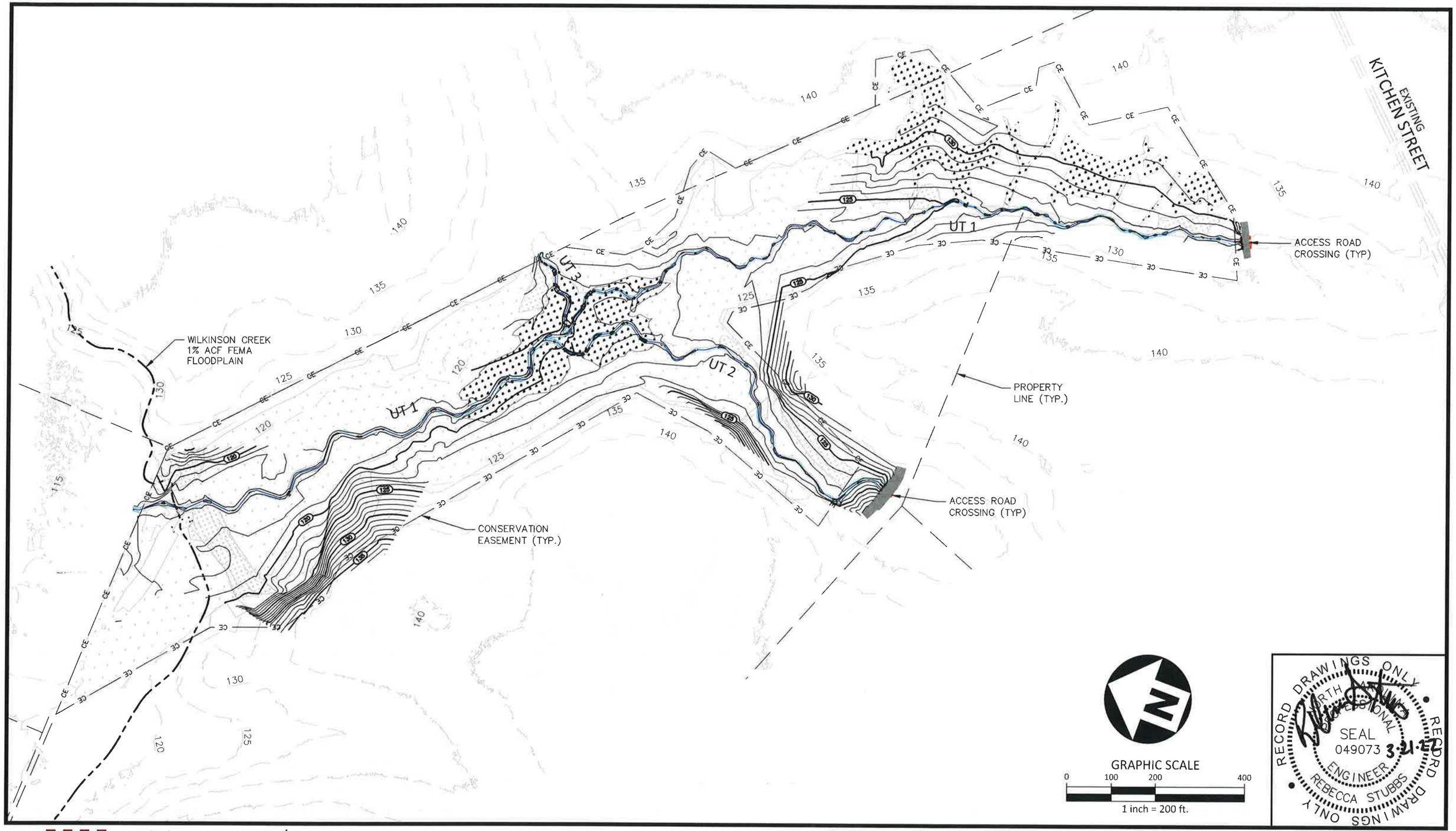
Axiom Environmental, Inc.

PLAN INFORMATION

PROJECT NO.	AXI-19010
FILENAME	AXI19010-S1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	N.T.S.
DATE	01.05.2022

SITE PLAN
LEGEND AND SYMBOLS

C2.00



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phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS

ROBESON COUNTY, NORTH CAROLINA

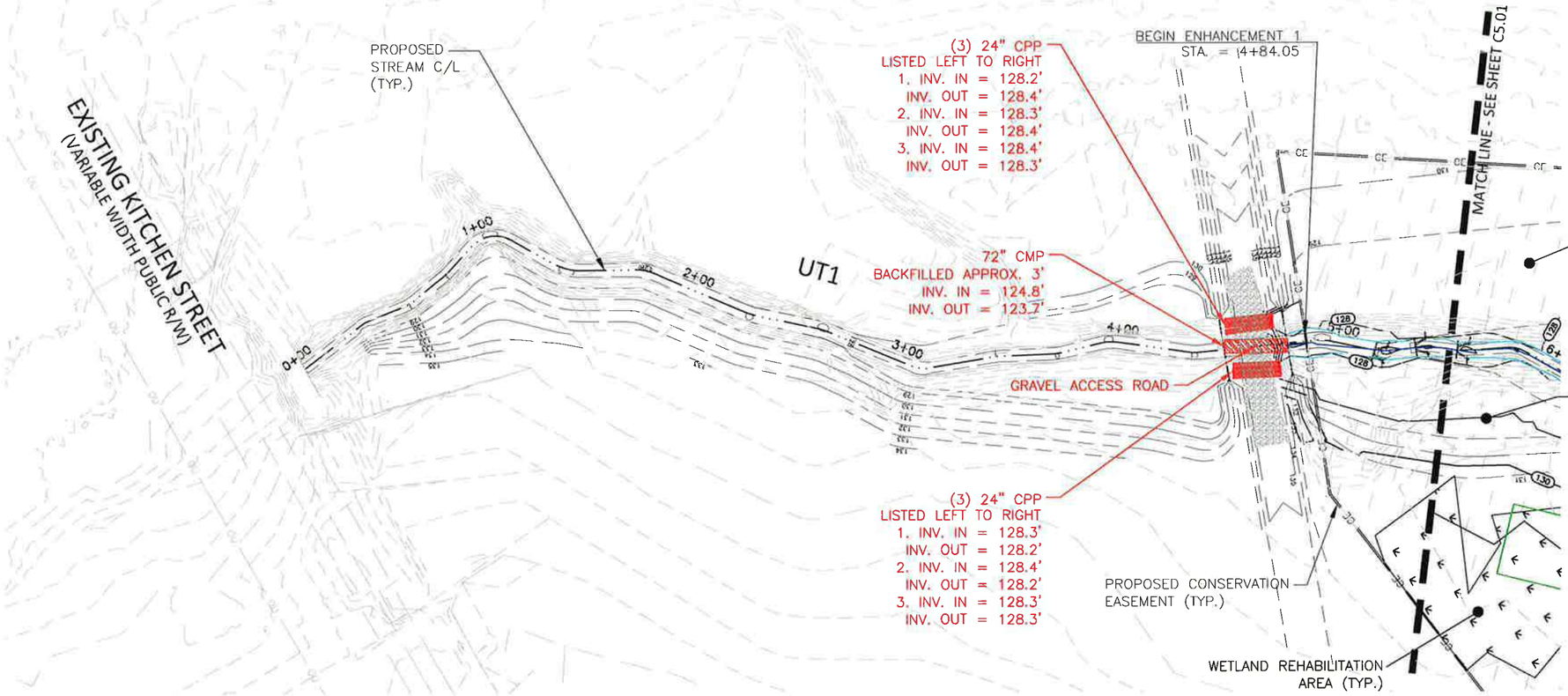
RESTORATION SYSTEMS LLC

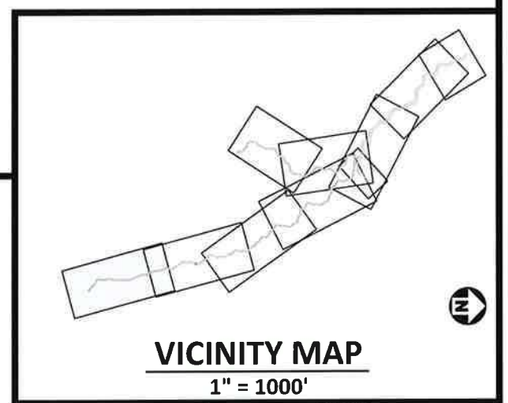
Axiom Environmental, Inc.

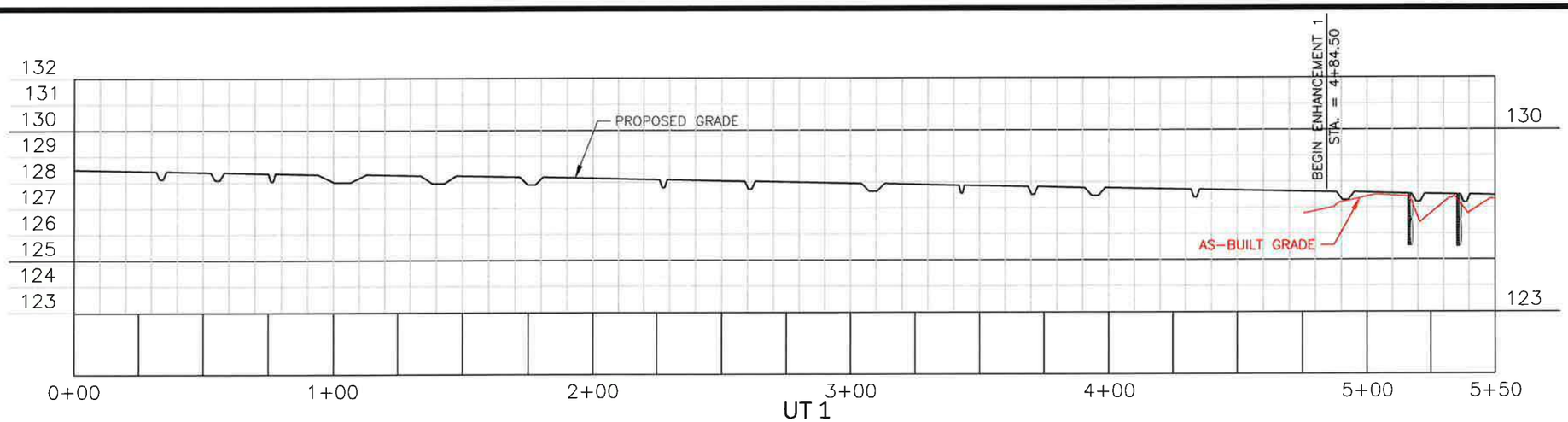
PLAN INFORMATION	
PROJECT NO.	AXI-19010
FILENAME	AXI19010-G1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1" = 200'
DATE	03.17.2022

AS-BUILT SITE GRADING

C3.00







UT 1
STATION 0+00 to 5+50

RECORD DRAWINGS ONLY
NORTH CAROLINA PROFESSIONAL SEAL 049073 ENGINEER REBECCA STUBBS
2.24.22

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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS

ROBESON COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

Axiom Environmental, Inc.

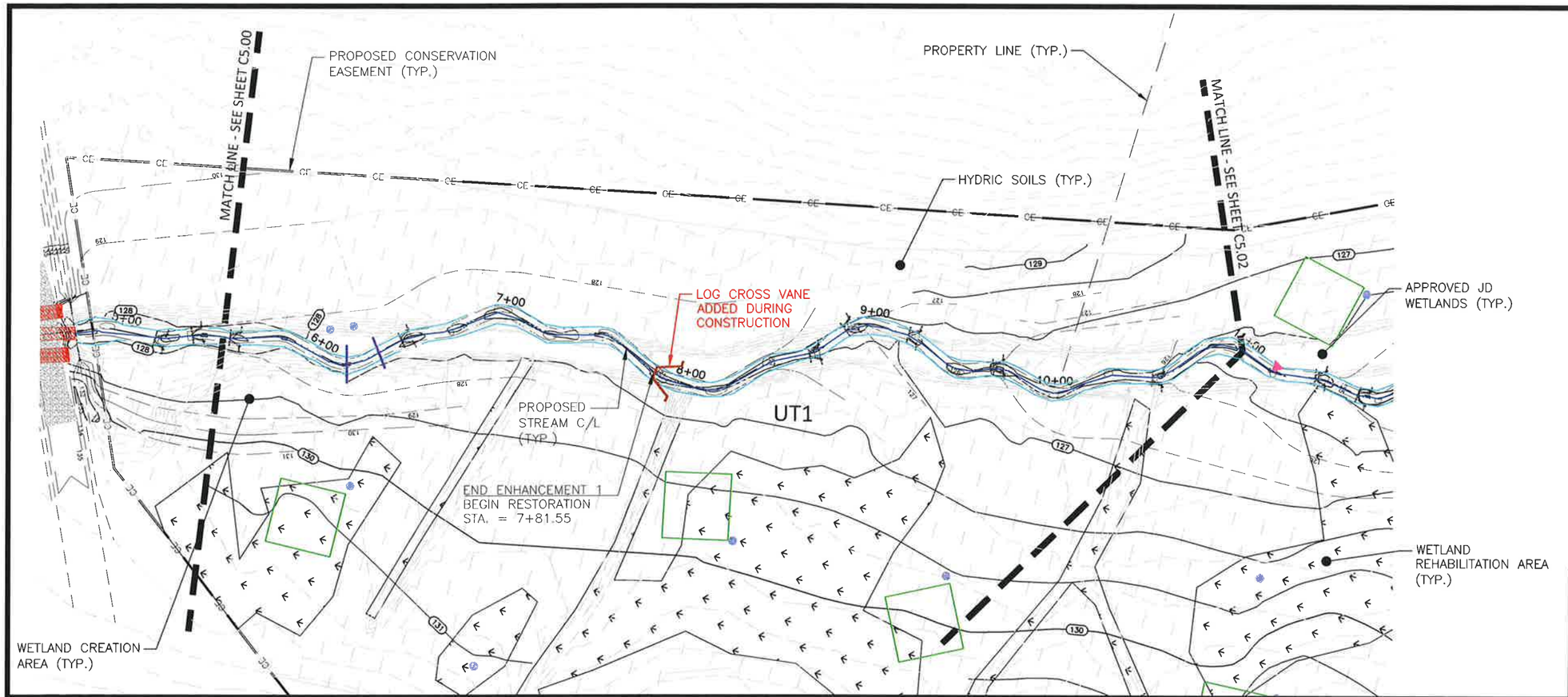
PLAN INFORMATION	
PROJECT NO.	AXI-19010
FILENAME	AXI19010-P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=60' / 1"=50'
DATE	01.05.2022

PLAN AND PROFILE

UNNAMED TRIBUTARY 1

STA. 00+00 THRU STA. 5+50

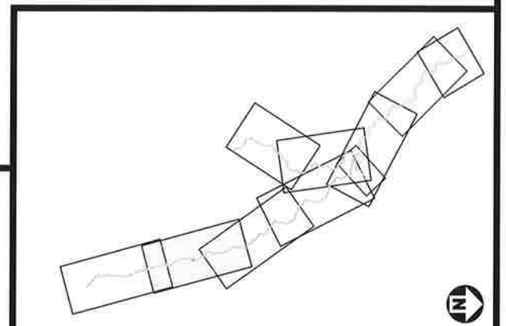
C5.00



GRAPHIC SCALE

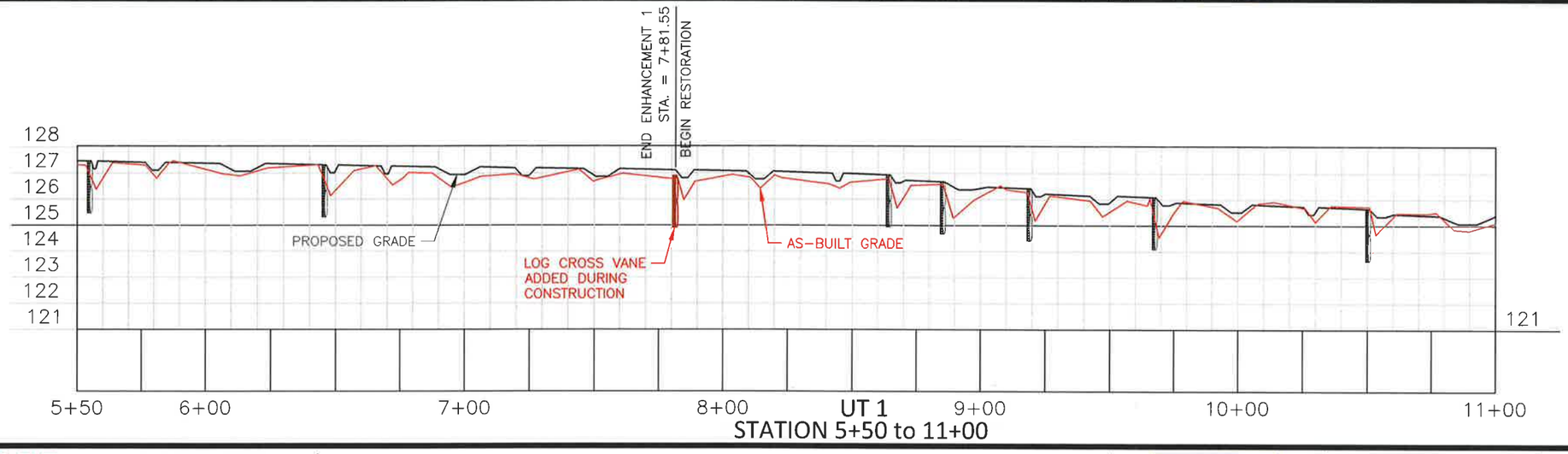
0 30 60 120

1 inch = 60 ft.

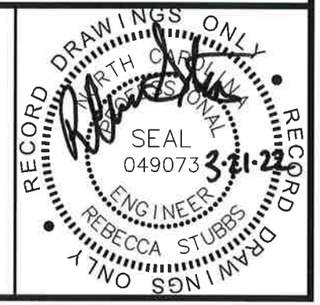


VICINITY MAP

1" = 1000'



STATION 5+50 to 11+00



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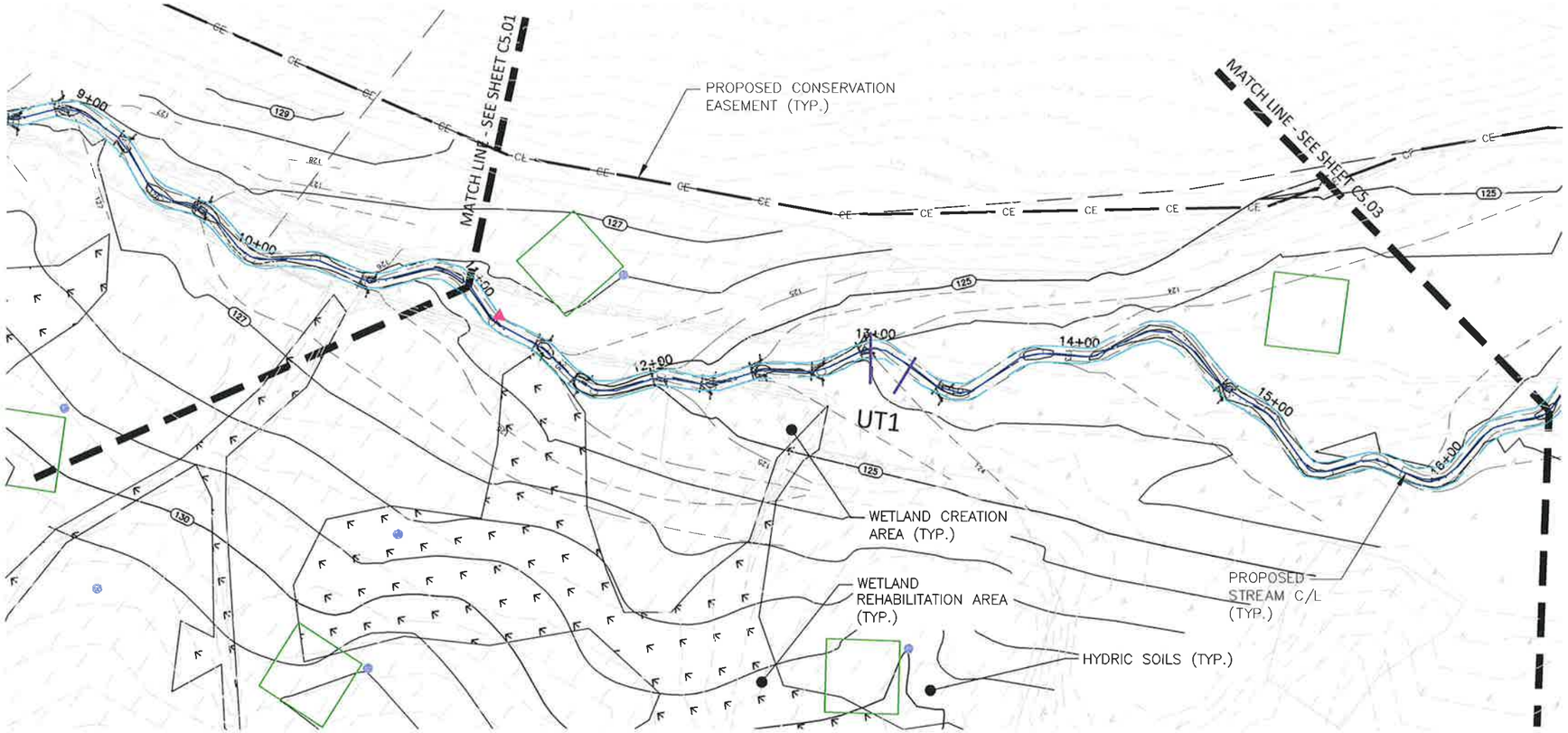
PROJECT NO.	AXI-19010
FILENAME	AXI19010-P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=60' / 1"=50'
DATE	03.17.2022

PLAN AND PROFILE

UNNAMED TRIBUTARY 1

STA. 5+50 THRU STA. 11+00

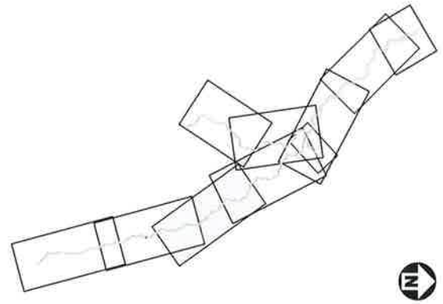
C5.01



GRAPHIC SCALE

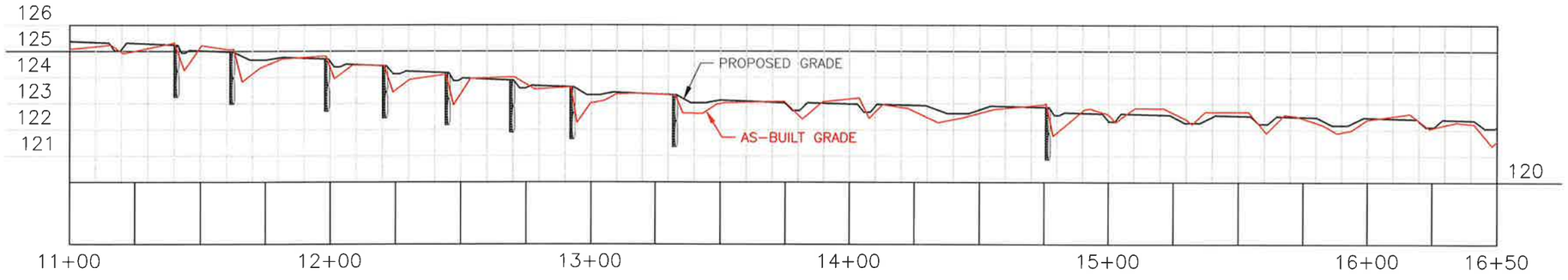
0 30 60 120

1 inch = 60 ft.



VICINITY MAP

1" = 1000'



UT 1
STATION 11+00 to 16+50

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3-21-22
ENGINEER
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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS

ROBESON COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS | LLC

Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	AXI-19010
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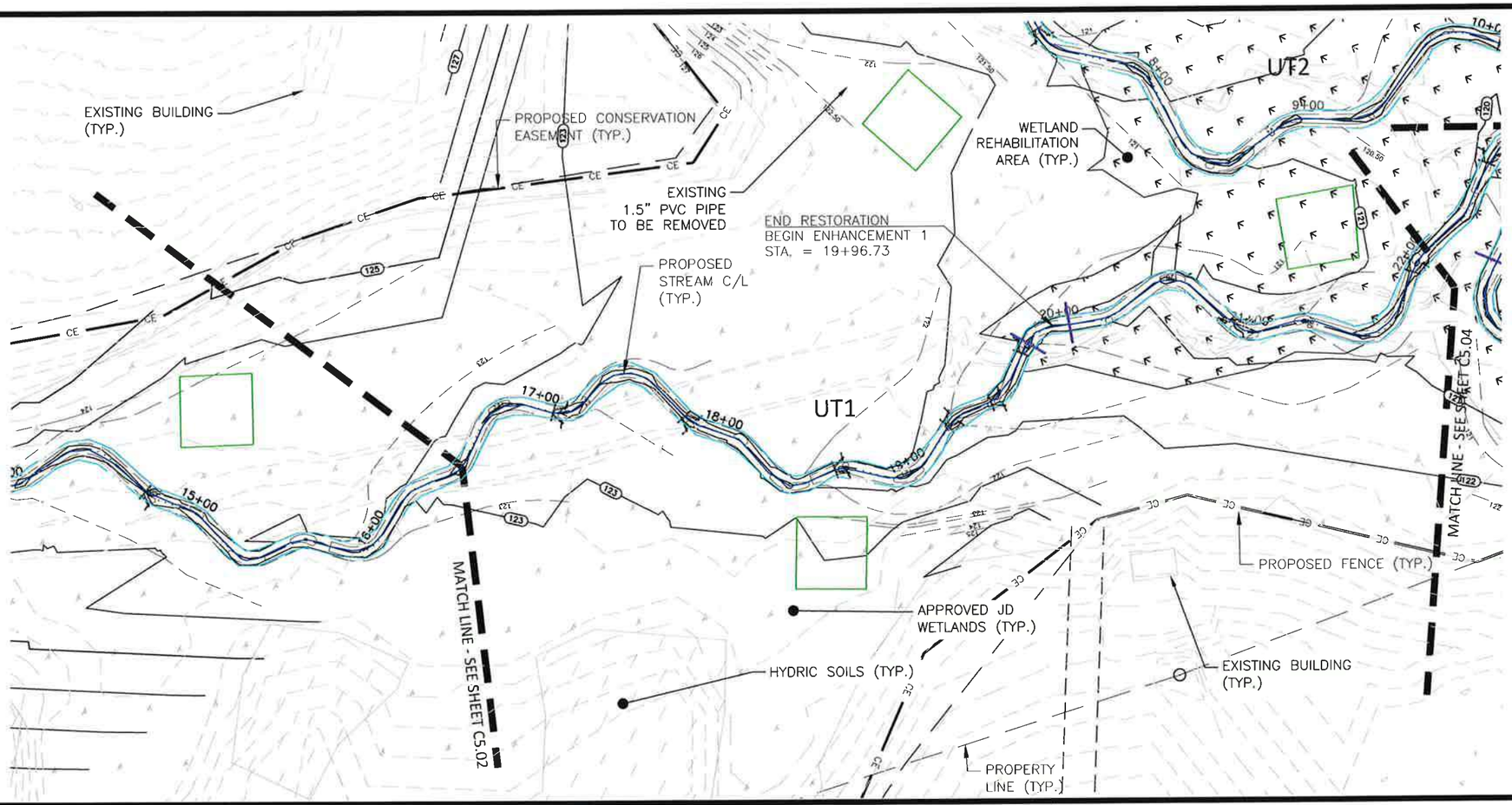
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=60' / 1"=50'
DATE	03.17.2022

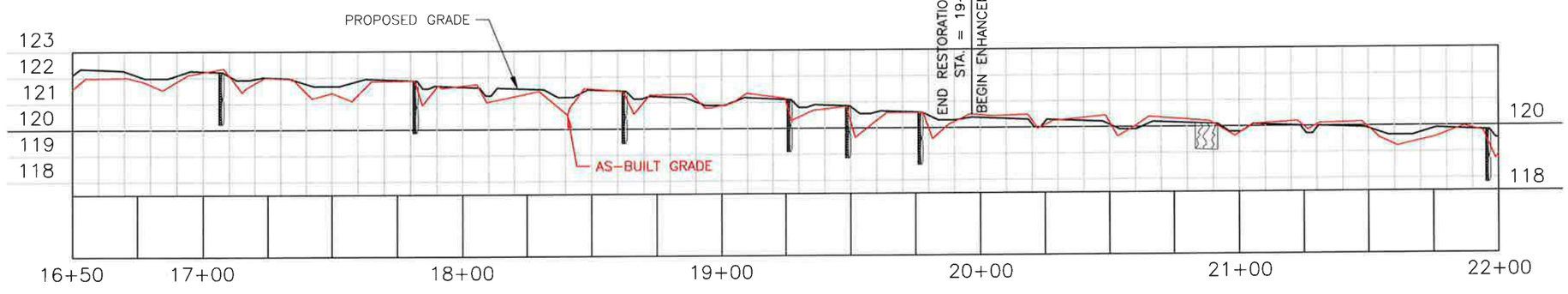
PLAN AND PROFILE

UNNAMED TRIBUTARY 1

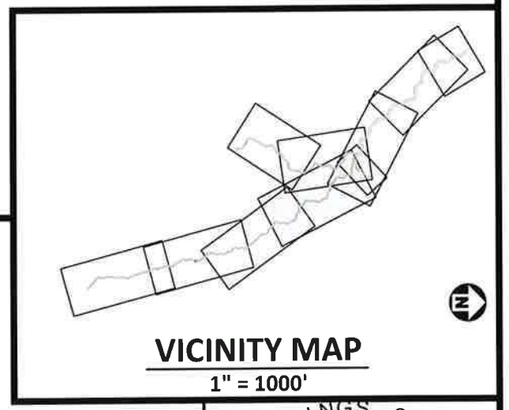
STA. 11+00 THRU STA. 16+50

C5.02





UT 1
STATION 16+50 to 22+00



VICINITY MAP
1" = 1000'

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2.24.22

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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS
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RESTORATION SYSTEMS LLC

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PLAN INFORMATION

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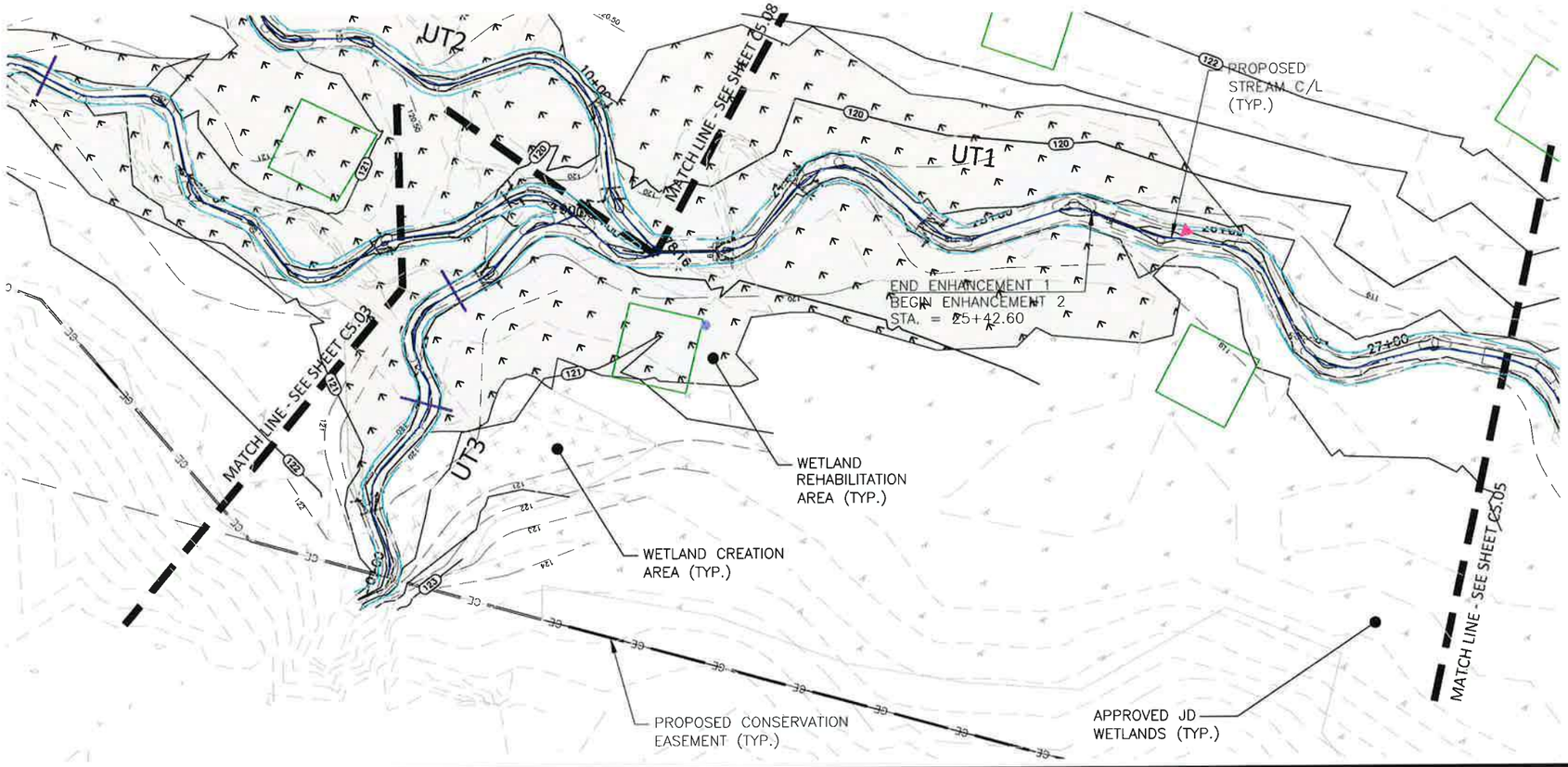
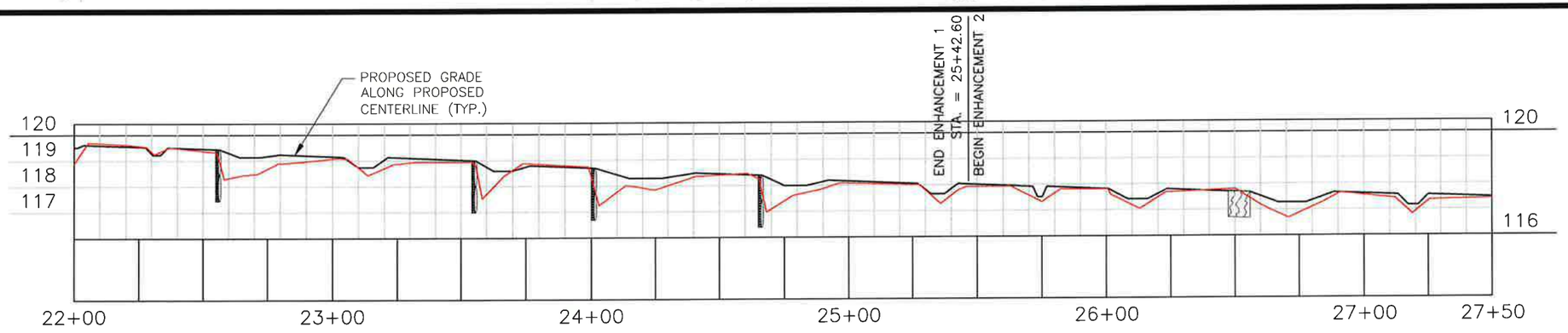
DATE	01.05.2022

PLAN AND PROFILE
UNNAMED TRIBUTARY 1
STA. 16+50 THRU STA. 22+00

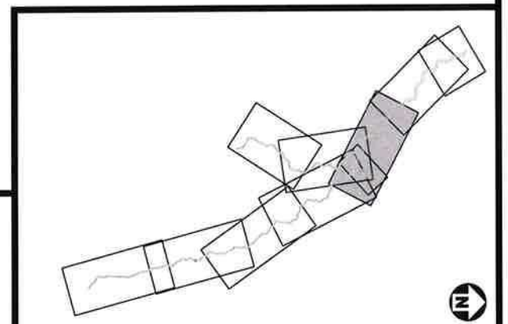
C5.03





UT 1
STATION 22+00 to 27+50

GRAPHIC SCALE
0 30 60 120
1 inch = 60 ft.



VICINITY MAP
1" = 1000'

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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS
ROBESON COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

Axiom Environmental, Inc.

PLAN INFORMATION	
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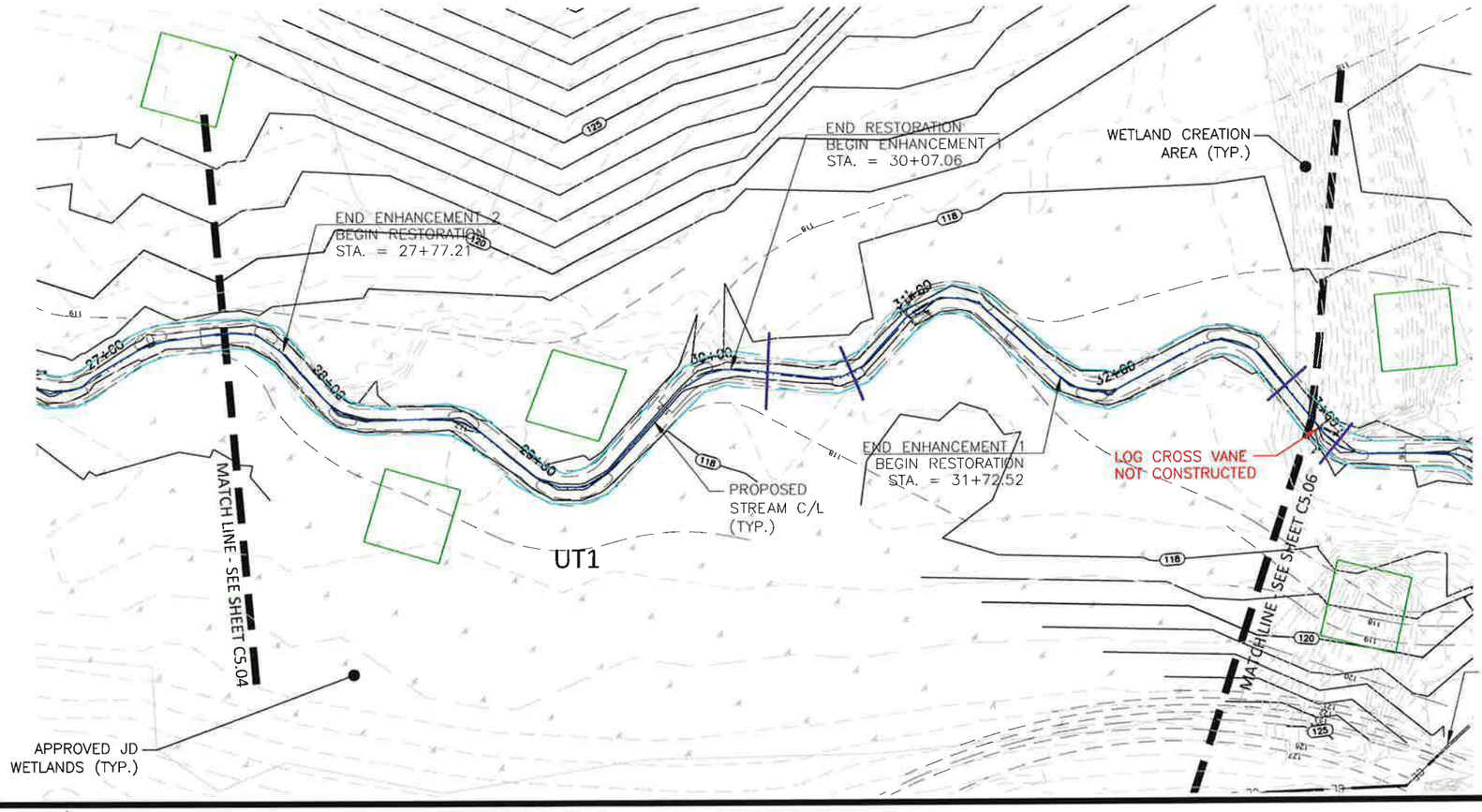
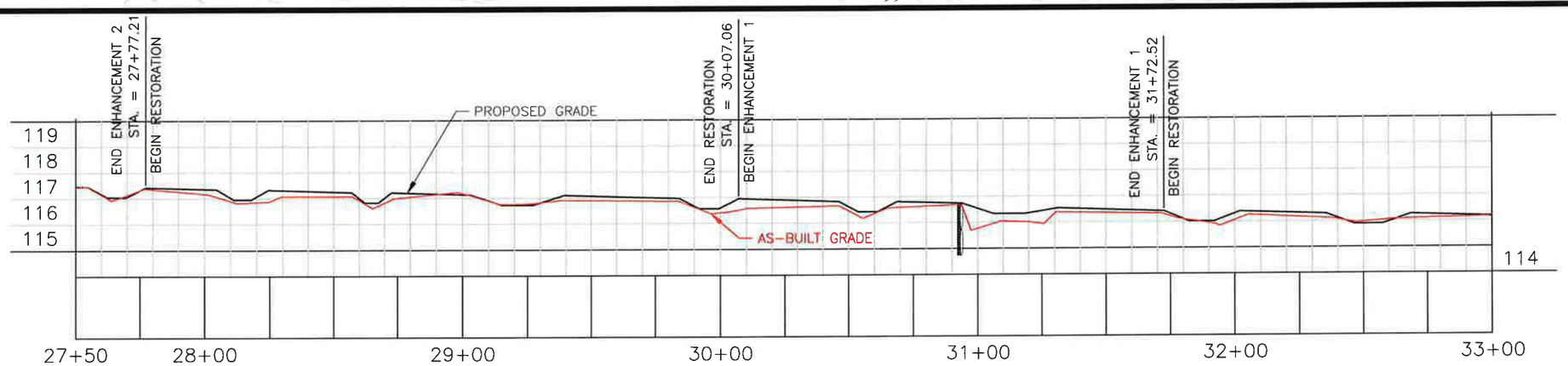
DRAWN BY	RHW
SCALE	1"=60' / 1"=50'
DATE	01.05.2022

PLAN AND PROFILE
UNNAMED TRIBUTARY 1
STA. 22+00 THRU STA. 27+50

C5.04





UT 1
STATION 27+50 to 33+00

GRAPHIC SCALE
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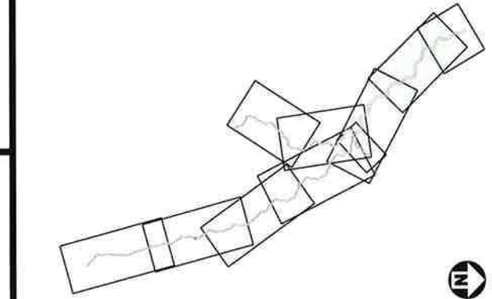
1 inch = 60 ft.



VICINITY MAP
1" = 1000'

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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS
ROBESON COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

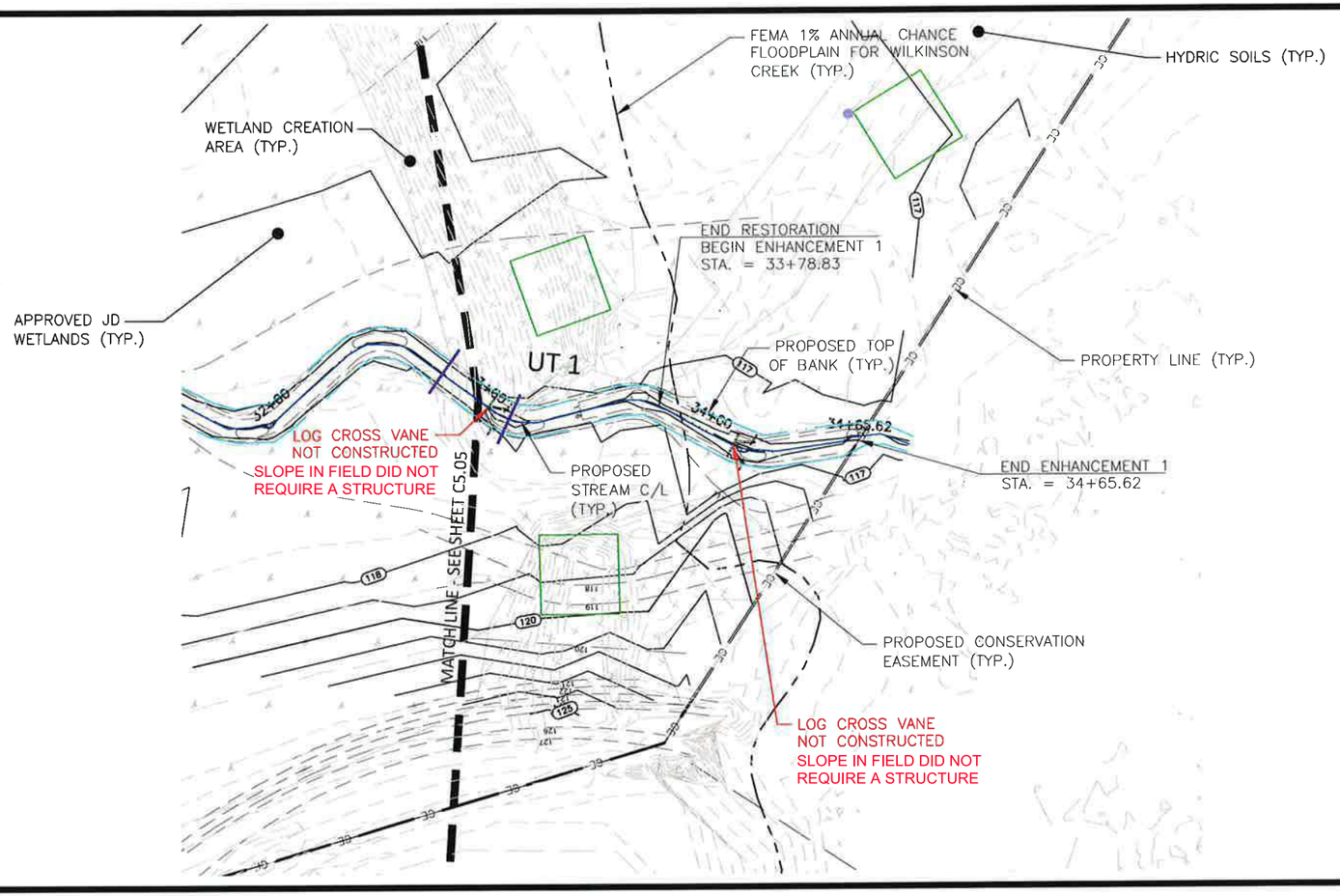
Axiom Environmental, Inc.

PLAN INFORMATION

PROJECT NO.	AXI-19010
FILENAME	AXI19010-P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=60' / 1"=50'
DATE	01.05.2022

PLAN AND PROFILE
UNNAMED TRIBUTARY 1
STA. 27+50 THRU STA. 33+00

C5.05



GRAPHIC SCALE

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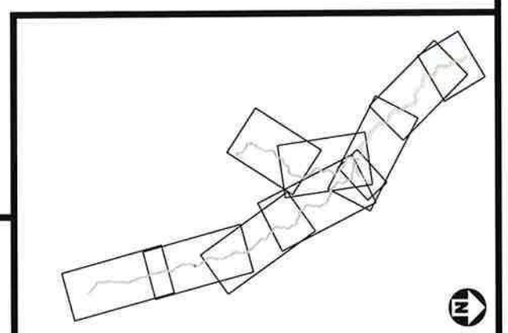
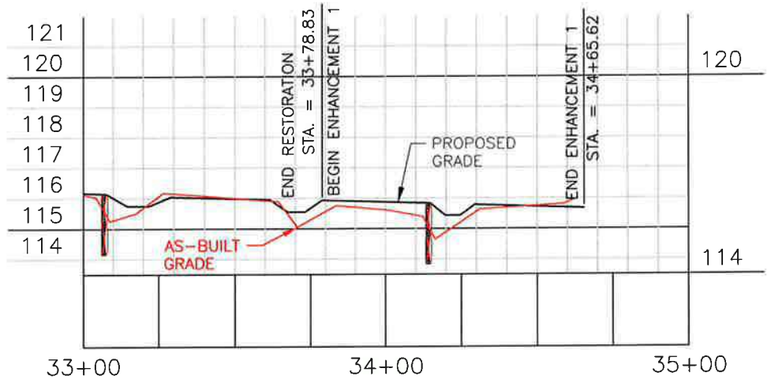
1 inch = 60 ft.



VICINITY MAP

1" = 1000'



UT 1

STATION 33+00 to 34+65.62

RECORD DRAWINGS ONLY
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2.24.22

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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS

ROBESON COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

Axiom Environmental, Inc.

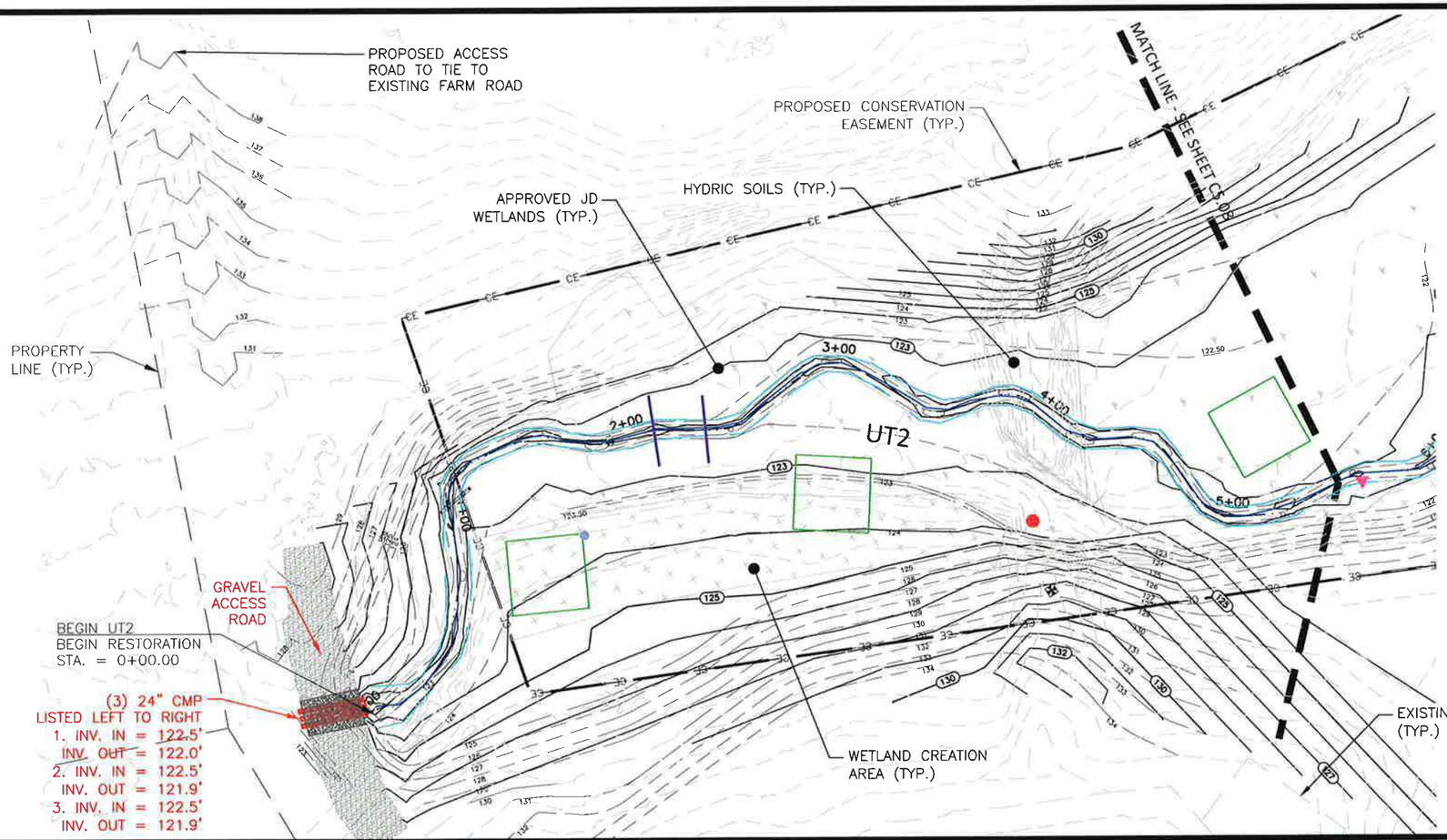
PLAN INFORMATION	
PROJECT NO.	AXI-19010
FILENAME	AXI19010-P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=60' / 1"=50'
DATE	01.05.2022

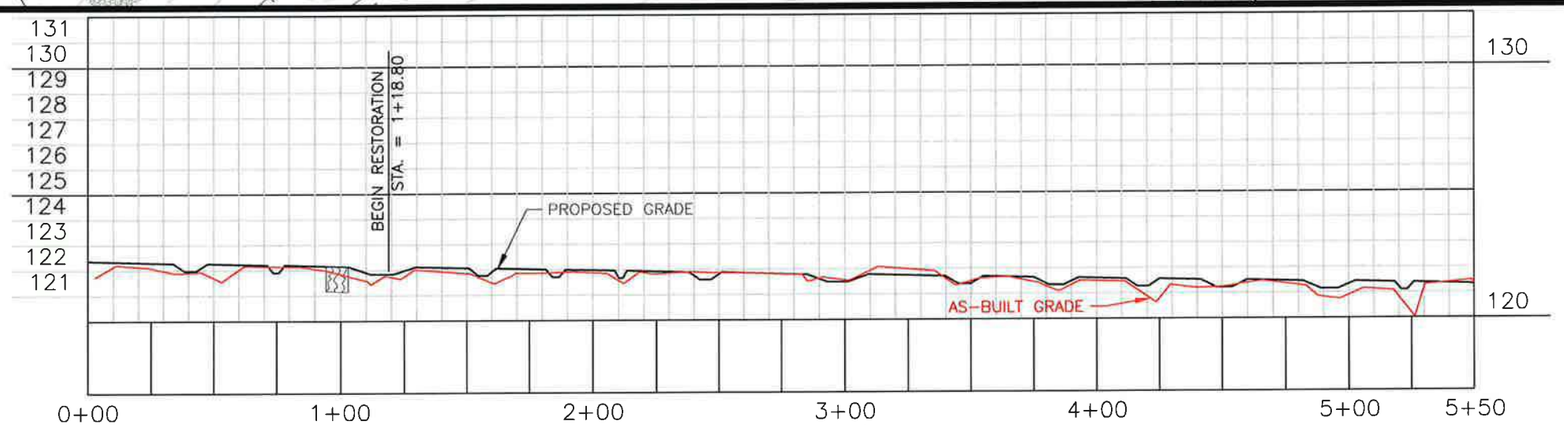
PLAN AND PROFILE

UNNAMED TRIBUTARY 1

STA. 33+00 THRU STA. 34+65.62

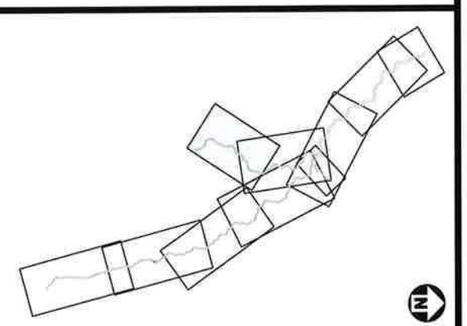
C5.06





UT 2
STATION 00+00 to 5+50

GRAPHIC SCALE
0 30 60 120
1 inch = 60 ft.



VICINITY MAP
1" = 1000'

RECORD DRAWINGS ONLY
NORTH CAROLINA
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SEAL
049073
ENGINEER
REBECCA STUBBS
2-24-22

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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS
ROBESON COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS, LLC

Axiom Environmental, Inc.

PLAN INFORMATION	
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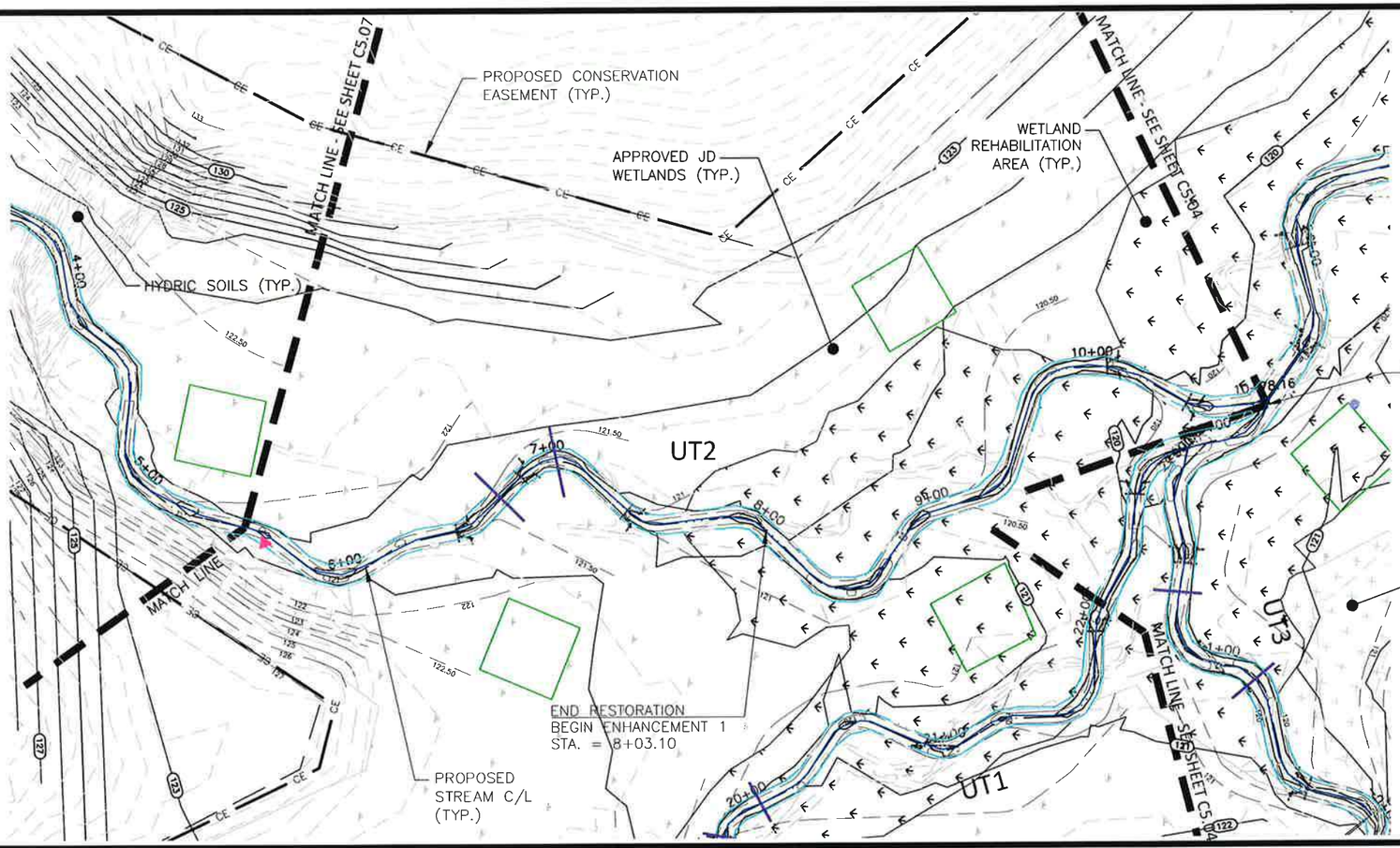
FILENAME	AXI19010-P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=60' / 1"=60'
DATE	01.05.2022

PLAN AND PROFILE

UNNAMED TRIBUTARY 2
STA. 00+00 THRU STA. 5+50

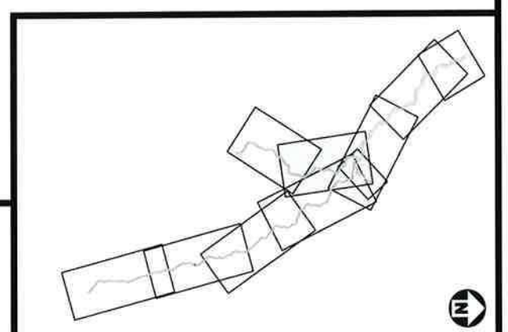
C5.07

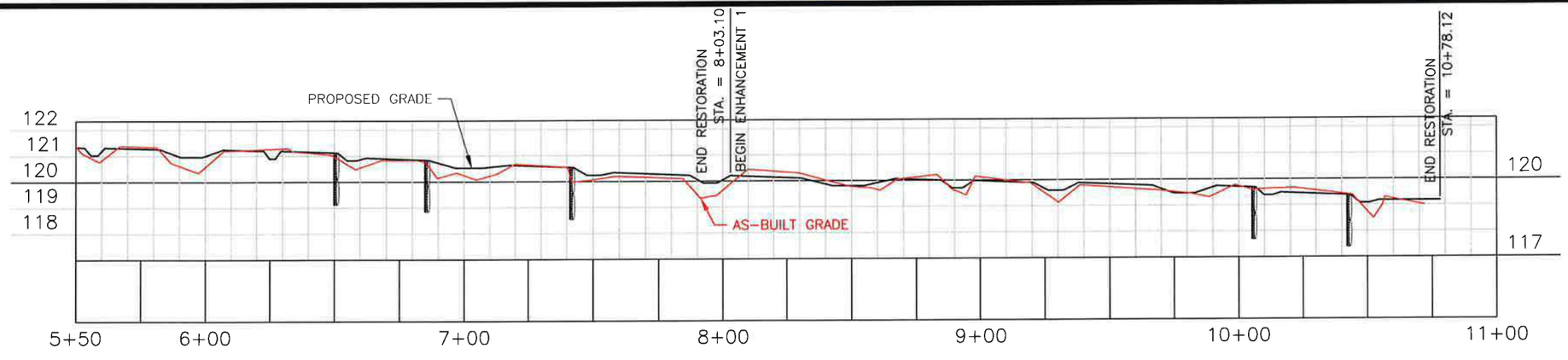


GRAPHIC SCALE

0 30 60 120

1 inch = 60 ft.





UT 2
STATION 5+50 to 10+78.12

RECORD DRAWINGS ONLY
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2.24.22

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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS

ROBESON COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

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PLAN INFORMATION	
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FILENAME	AXI19010-P1
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DRAWN BY	RHW
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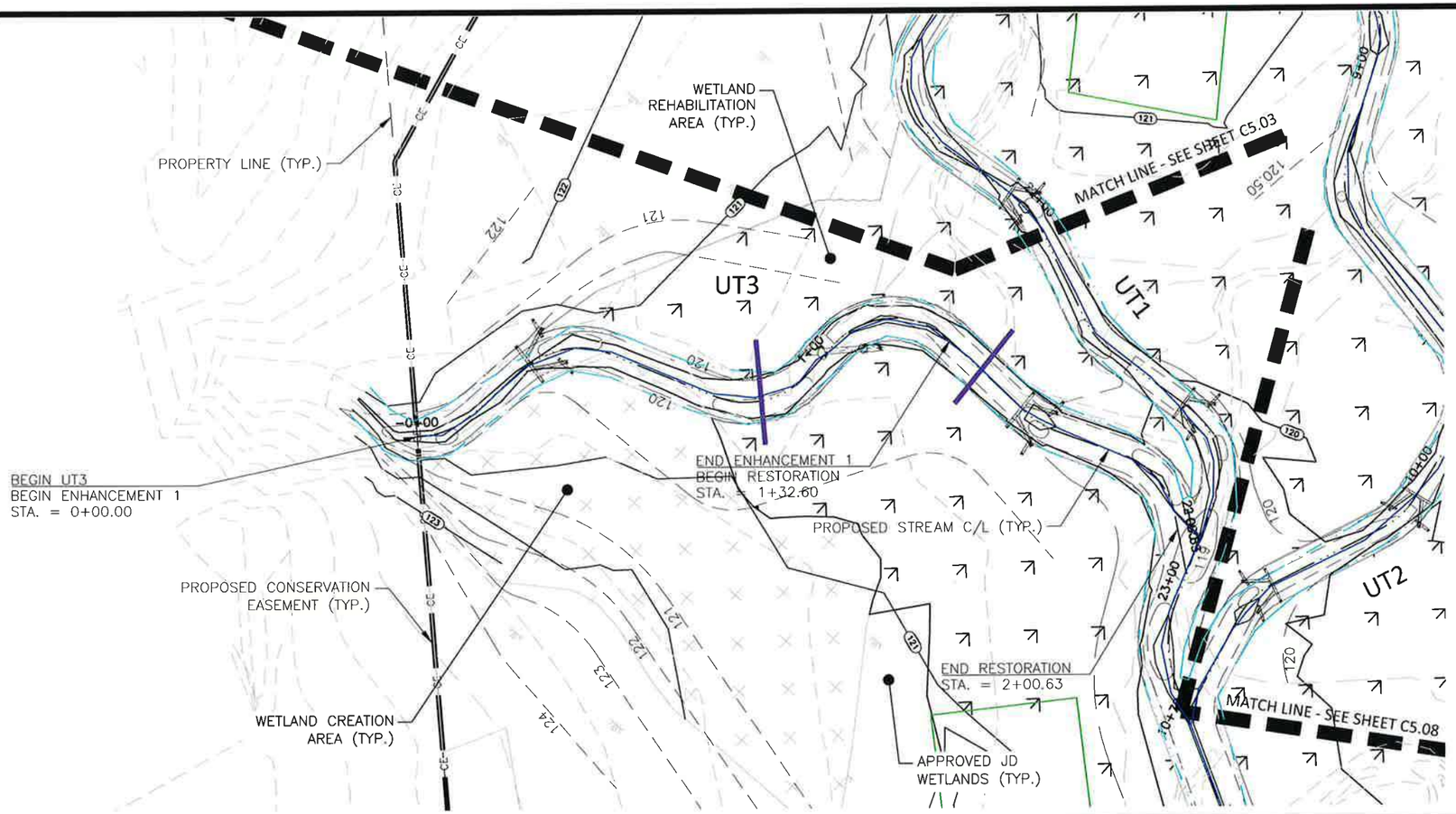
DATE	01.05.2022

PLAN AND PROFILE

UNNAMED TRIBUTARY 2

STA. 5+50 THRU STA. 10+78.12

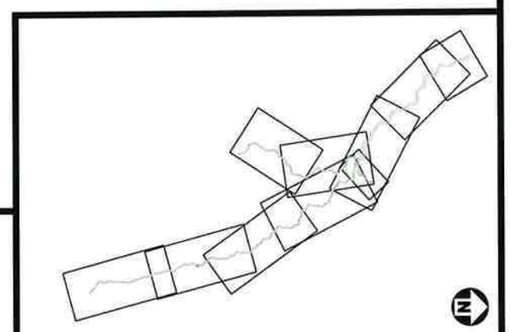
C5.08



GRAPHIC SCALE

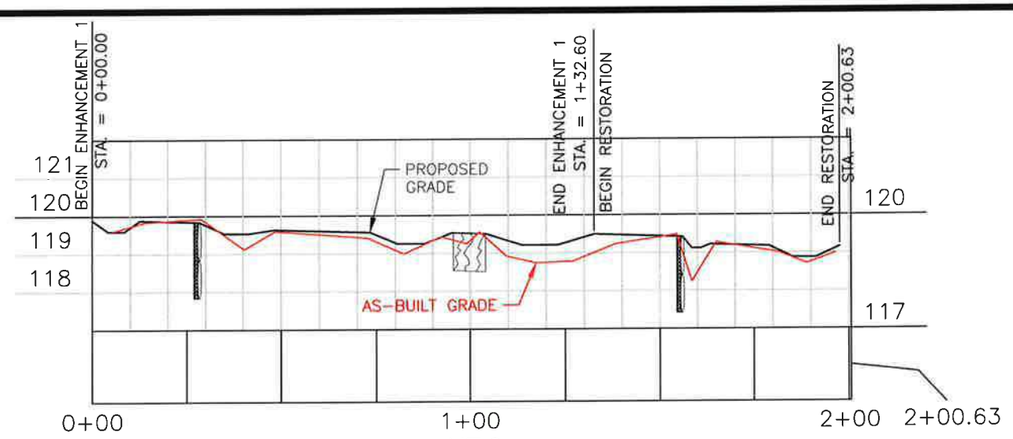
0 15 30 60

1 inch = 30 ft.



VICINITY MAP

1" = 1000'



UT 3

STATION 00+00 to 2+00.63

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SWAMP GRAPE MITIGATION PLAN

AS-BUILT DRAWINGS

ROBESON COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

Axiom Environmental, Inc.

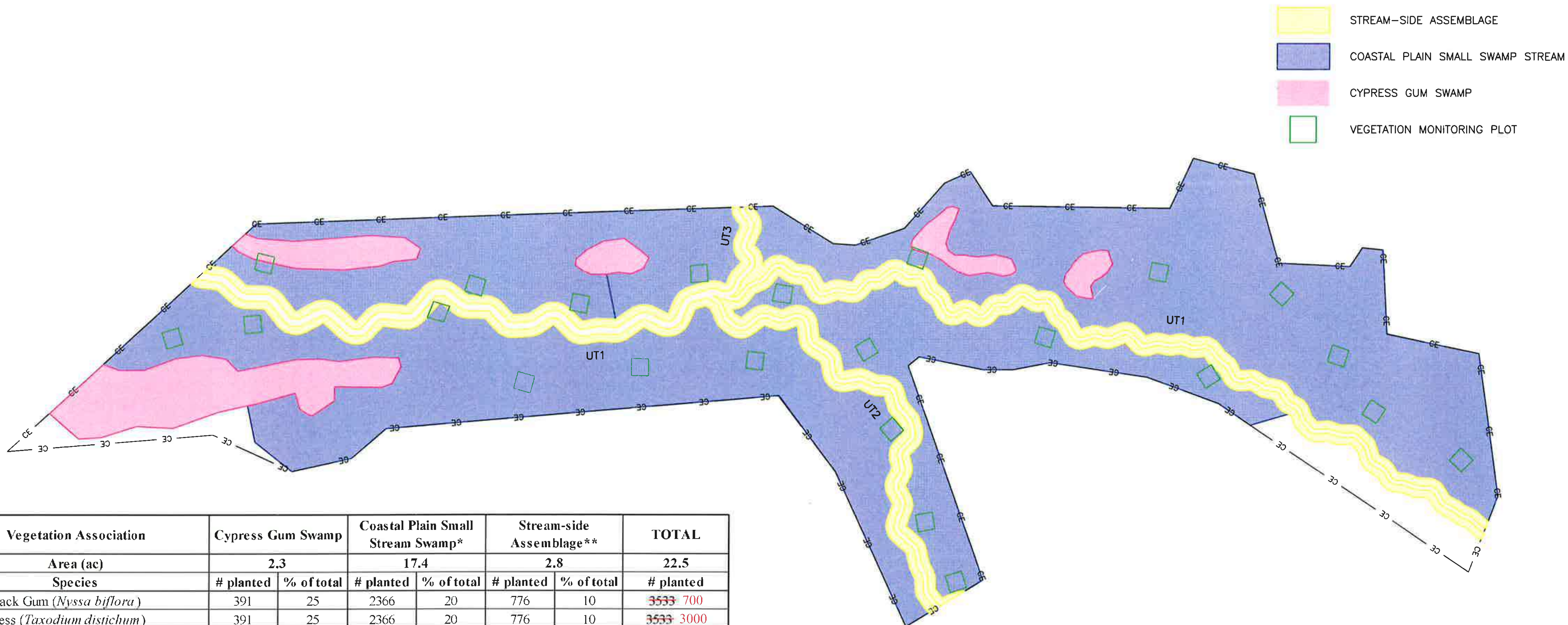
PLAN INFORMATION	
PROJECT NO.	AXI-19010
FILENAME	AXI19010-P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=30' / 1"=40'
DATE	01.05.2022

PLAN AND PROFILE

UNNAMED TRIBUTARY 3

STA. 00+00 THRU STA. 2+00.63

C5.09



Vegetation Association	Cypress Gum Swamp		Coastal Plain Small Stream Swamp*		Stream-side Assemblage**		TOTAL
Area (ac)	**2.3**		**17.4**		**2.8**		**22.5**
Species	**# planted**	**% of total**	**# planted**	**% of total**	**# planted**	**% of total**	**# planted**
Swamp Black Gum (*Nyssa biflora*)	391	25	2366	20	776	10	~~3533~~ 700
Bald Cypress (*Taxodium distichum*)	391	25	2366	20	776	10	~~3533~~ 3000
Tupelo Gum (*Nyssa aquatica*)	391	25	--	--	--	--	~~391~~ 500
Pond Cypress (*Taxodium ascendens*)	391	25	--	--	--	--	~~391~~ 1000
Water Oak (*Quercus nigra*)	--	--	1775	15	776	10	~~2550~~ 2200
Willow Oak (*Quercus phellos*)	--	--	1775	15	776	10	~~2550~~ 2200
Shumard Oak (*Quercus schumardii*)	--	--	1183	10	776	10	~~1959~~ 2000
American Elm (*Ulmus americana*)	--	--	1183	10	776	10	~~1959~~ 2000
Shagbark Hickory (*Carya ovata*)	--	--	1183	10	776	10	~~1959~~ 2000
~~Black Willow~~ Water Hickory (*Carya aquatica*)	--	--	--	--	776	10	~~776~~ 800
Tag Alder (*Alnus serrulata*)	--	--	--	--	776	10	~~776~~ 750
Buttonbush (*Cephalanthus occidentalis*)	--	--	--	--	776	10	~~776~~ 800
River Birch (*Betula nigra*)							1000
TOTAL	**1564**	**100**	**11832**	**100**	**7756**	**100**	~~**21152**~~ **17750**

* Planted at a density of 670 stems/acre.

** Planted at a density of 2720 stems/acre.

***NO SPECIES TO ACCOUNT FOR MORE THAN 20% IN THE COASTAL PLAIN SMALL STREAM SWAMP PLANTING ZONE

GRAPHIC SCALE
0 100 200 400
1 inch = 200 ft.

RECORD DRAWINGS ONLY
NORTH CAROLINA PROFESSIONAL SEAL 049073 ENGINEER REBECCA STUBBS
1-24-22

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SWAMP GRAPE MITIGATION PLAN
AS-BUILT DRAWINGS
ROBESON COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS | LLC

Axiom Environmental, Inc.

PLAN INFORMATION
PROJECT NO. AXI-19010
FILENAME AXI19010-LS1
CHECKED BY RAS
DRAWN BY RHW
SCALE 1"=200'
DATE 01.05.2022

PLANTING PLAN

L5.00

TEMPORARY SEEDING SCHEDULE:

TEMPORARY SEEDING SHALL BE APPLIED AS NEEDED DURING CONSTRUCTION TO STABILIZE BARE OR DISTURBED AREAS OF SOIL AND AT THE COMPLETION OR ALL GRADING AND EARTHWORK ACTIVITIES WITHIN A PARTICULAR AREA OF THE SITE. PERMANENT SEED MAY BE DISTRIBUTED WITH TEMPORARY SEED UPON THE FINAL APPLICATION OF TEMPORARY SEED.

SEEDING DATE	SEEDING MIXTURE	APPLICATION RATE
AUG 15 - APR 15	RYE (GRAIN)	30 LBS/AC
AUG 15 - APR 15	WHEAT	30 LBS/AC
APR 15 - AUG 15	GERMAN MILLET	10 LBS/AC
APR 15 - AUG 15	BROWNTOP MILLET	10 LBS/AC

SEEDING METHODS

1. EVENLY APPLY SEED USING A CYCLONE SEEDER, DRILL, CULTIPACKER SEEDER, OR HYDROSEEDER. THIS MUST BE DONE WITHIN 48 HOURS OF LAND DISTURBING ACTIVITIES.
2. MULCH WITH CLEAN WHEAT STRAW.
3. AFTER SEEDING, APPLY MULCH TO AREAS UNDER HARSH CONDITIONS SUCH AS AREAS THAT HAVE BEEN GRADED, OR THOSE WHICH WILL RECEIVE CONCENTRATED FLOWS. AREAS CONSIDERED TO BE UNDER HARSH CONDITIONS WILL BE CONSIDERED THE AREAS GRADED FOR THE WETLAND VALLEY.
4. RESEED AND MULCH AREAS WHERE SEEDLING EMERGENCE IS LESS THAN 80% COVERAGE, OR WHERE EROSION OCCURS, AS SOON AS POSSIBLE. DO NOT MOW. PROTECT FROM TRAFFIC AS MUCH AS POSSIBLE.

NOTES

1. TEMPORARY ANNUAL SEED SELECTION SHOULD BE BASED ON SEASON OF PROJECT INSTALLATION.
2. A SINGLE SPECIES FOR TEMPORARY COVER IS ACCEPTABLE
3. IN SOME CASES WHERE SEASONS OVERLAP, A MIXTURE OF TWO OR MORE SPECIES MAY BE NECESSARY. HOWEVER, APPLICATION RATES SHOULD NOT EXCEED THE TOTAL RECOMMENDED RATE PER ACRE.
4. TEMPORARY SEED SHOULD BE MIXED AND APPLIED SIMULTANEOUSLY WITH THE PERMANENT SEED MIX IF OPTIMAL PLANTING DATES ALLOW.

PERMANENT SEEDING SCHEDULE:

PLANT MATERIAL SELECTION

1. REFER TO TABLE BELOW FOR APPROPRIATE SELECTIONS OF NATIVE PERMANENT SEEDS.
2. PERMANENT SEED INCLUSION IN THE MIXTURE SHOULD TOTAL 15 LBS OF PURE LIVE SEED (PLS) PER ACRE DRILLED OR 20 LBS PLS/AC BROADCAST APPLIED.
3. AT LEAST 4 SPECIES SHOULD BE SELECTED FOR THE MIXTURE. SELECTION OF MORE THAN 4 SPECIES IS RECOMMENDED FOR INCREASING CHANCES OF SUCCESSFUL VEGETATION ESTABLISHMENT.
4. IF OTHER SPECIES SUCH AS WILDFLOWERS ARE ADDED TO THE MIX, THEY SHOULD NOT BE COUNTED IN THE MINIMUM SEEDING RATE.

SEEDBED PREPARATION

1. DISTURBED SOILS WITHIN RIPARIAN AREAS MUST BE AMENDED TO PROVIDE AN OPTIMUM ENVIRONMENT FOR SEED GERMINATION AND SEEDLING GROWTH.
2. THE pH OF THE SOIL MUST BE SUCH THAT IT IS NOT TOXIC AND NUTRIENTS ARE AVAILABLE.
3. SOIL ANALYSIS SHOULD BE PERFORMED TO DETERMINE NUTRIENT AND LIME NEEDS OF EACH SITE.
4. APPROPRIATE pH LEVELS ARE BETWEEN 5.5 - 7.
5. RIPARIAN BUFFERS REGULATED FOR NUTRIENT MANAGEMENT MAY BE LIMITED TO A SINGLE APPLICATION OF FERTILIZER.
6. SUITABLE MECHANICAL MEANS SUCH AS DISKING, RAKING, OR HARROWING MUST BE EMPLOYED TO LOOSEN COMPACTED SOIL PRIOR TO SEEDING.

PLANTING

1. APPLY SEED UNIFORMLY WITH A CYCLONE SEEDER, DROP-TYPE SPREADER, DRILL, OR HYDROSEEDER ON A FIRM, FRIABLE SEEDBED.
2. IN FINE SOILS, SEEDS SHOULD BE DRILLED 0.25 - 0.5 INCHES. IN COARSE SANDY SOILS, SEEDS SHOULD BE PLANTED NO DEEPER THAN 0.75 INCHES.

MULCH

1. MULCH ALL PLANTINGS IMMEDIATELY AFTER SEEDING.
2. IF PLANTING ON STREAM BANKS STEEPER THAN 10% OR AREAS SUBJECT TO FLOODING, A BIODEGRADABLE ROLLED EROSION CONTROL PRODUCT IS RECOMMENDED TO HOLD SEED AND SOIL IN PLACE.

MAINTENANCE

1. THE RECOMMENDED PERMANENT GRASS SPECIES MAY REQUIRE TWO YEARS FOR ESTABLISHMENT, DEPENDING ON SITE CONDITIONS.
2. INSPECT SEEDED AREAS FOR FAILURE AND MAKE NECESSARY REPAIRS, SOIL AMENDMENTS, AND RE-SEEDINGS.
3. IF WEEDY EXOTIC SPECIES HAVE TAKEN OVER THE AREAS AFTER THE FIRST GROWING SEASON, THE INVASIVE SPECIES MUST BE ERADICATED TO ALLOW NATIVE SPECIES TO GROW.
4. MONITOR THE SITE UNTIL LONG-TERM STABILITY HAS BEEN ESTABLISHED.

FRESHWATER MARSH - COASTAL PLAIN SEMI-PERMANENT IMPOUNDMENT			
POYGONUM SPP.	VARIES	LIMNOBIUM SPONGIA	OBL
PELTANDRA VIRGINICA	OBL	NYMPHOIDES SPP.	OBL
NYMPHAEA ODORATA	OBL	POTAMOGETON SPP.	OBL
NUPHAR LUTEA	OBL	UTRICULARIA SPP.	OBL
CERATOPHYLLUM SPP.	OBL	PONTEDERIA CORDATA	OBL
MYRIOPHYLLUM SPP.	OBL	SAGITTARIA SPP.	OBL
LEMNA SPP.	OBL	CEPHALANTHUS OCCIDENTALIS	OBL
EGERIA DENSA	OBL	ROSA PALUSTRIS	OBL
ELODEA SPP.	OBL	DECODON VERTICILLATUS	OBL

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PLANTING NOTES

L5.01