

FINAL
MONITORING REPORT (MY4)

ARABIA BAY WETLAND MITIGATION SITE

Hoke County, North Carolina

DMS Project ID No. 100061
Full Delivery Contract No. 7529
USACE Action ID No. SAW-2018-01151
DWR Project No. 2018-0784
RFP No. 16-007332

Cape Fear River Basin
Cataloging Unit 03030004

Data Collection: January - November 2023
Submission: January 2024



Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NORTH CAROLINA 27699-1652



Response to Monitoring Year 4 (2023) DMS Comments

Arabia Bay Wetland Mitigation Site (DMS #100061)
Cape Fear River Basin 03030004, Hoke County
Contract No. 7529

Comments Received (Black Text) & Responses (Blue Text)

Report & Field Visit:

1. Encroachment of approximately 300 sq. ft was observed during site visit. The encroachment was near the southeast conservation easement boundary line, next to the driveway going to the turkey coops. Please indicate what corrective action will be taken. Overall, the vegetation looked great.

The encroachment area has been added to the report, CCPV, and digital submittal. The landowner was contacted and a discussion was had that noted no mowing and/or cutting of vegetation in the easement is allowed. Also, additional easement markings and horse tape will be added to this area to prevent future encroachments. Lastly, the area will be replanted with container trees from the approved mitigation plan to account for any loss of woody stems.

Digital Comments:

1. The submission is complete.

Thank you. The digital submission was updated to include the encroachment area observed during the DMS monitoring site visit.

Arabia Bay Year 4, 2023 Monitoring Summary

Wetlands

- None of the 14 groundwater gauges met success criteria during the Year 4 (2023) monitoring period (Appendix C). A detailed analysis is provided in Section 2.1.
- Terracell outlet structure and ditch plugs are in place and functioning as designed.
- A wetland reference gauge was installed July 20, 2023 and is described in Section 2.1.

Year	Soil Temperatures/ Date Bud Burst Documented*	Monitoring Period Used for Determining Success	10 Percent of Monitoring Period
2020 (Year 1)	March 2, 2020	March 2-November 12 (256 days)	26 days
2021 (Year 2)	March 1, 2021	March 1-November 12 (257 days)	26 days
2022 (Year 3)	March 1, 2022	March 1-November 12 (257 days)	26 days
2023 (Year 4)	March 1, 2023	March 1-November 12 (257 days)	26 days

*Based on data collected from a soil temperature data logger located on the Site.

Summary of Monitoring Period/Hydrology Success Criteria by Year

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)						
	Year 1 (2020)	Year 2 (2021)	Year 3 (2022)	Year 4 (2023)	Year 5 (2024)	Year 6 (2025)	Year 7 (2026)
1	Yes - 85 days (33.2%)	Yes - 77 Days (28%)	No – 0 Days (0%)	No – 0 Days (0%)			
2	Yes - 72 days (28.1%)	Yes - 75 Days (27%)	No – 0 Days (0%)	No – 0 Days (0%)			
3	Yes - 72 days (28.1%)	Yes -76 Days (28%)	No – 0 Days (0%)	No – 0 Days (0%)			
4	Yes - 93 days (36.3%)	Yes - 79 Days (29%)	No – 0 Days (0%)	No – 0 Days (0%)			
5	Yes - 95 days (37.1%)	Yes - 82 Days (30%)	No – 0 Days (0%)	No – 0 Days (0%)			
6	Yes - 36 days (14.1%)	Yes - 75 Days (27%)	No – 1 Day (0.5%)	No – 1 Day (0.5%)			
7	Yes - 77 days (30.1%)	Yes - 75 Days (27%)	No – 1 Day (0.5%)	No – 1 Day (0.5%)			
8	Yes - 85 days (33.2%)	Yes - 79 Days (29%)	No – 1 Day (0.5%)	No – 1 Day (0.5%)			
9	Yes - 94 days (36.7%)	Yes - 81 Days (29%)	No – 2 Days (0.8%)	No – 2 Days (0.8%)			
10	Yes - 69 days (27.0%)	Yes - 74 Days (27%)	No – 0 Days (0%)	No – 0 Days (0%)			
11	Yes - 28 days (10.9%)	Yes - 52 Days (19%)	No – 0 Days (0%)	No – 0 Days (0%)			
12	Yes - 61 days (23.8%)	Yes - 74 Days (27%)	No – 1 Day (0.5%)	No – 3 Days (1.2%)			
13	Yes - 34 days (13.3%)	Yes - 69 Days (25%)	No – 0 Days (0%)	No – 0 Days (0%)			
14	Yes - 31 days (12.1%)	Yes - 62 Days (22%)	No – 0 Days (0%)	No – 0 Days (0%)			

Vegetation

- In accordance with the monitoring schedule, vegetation plot monitoring was not performed in Year 4 (2023). Visual assessment indicates that vegetation on the Site remains vigorous, and no vegetation areas of concern were observed during Year 4 (2023) (Table 5, Appendix B).

General Notes

- One encroachment area totaling 0.01 acres was observed from grass mowing adjacent to the easement. This area will be replanted with gallon containerized species from the approved Site Mitigation Plan. Additional easement markings and horse tape will be added along the easement boundary to improve visibility. A conversation was had with the landowner to ensure encroachment ceases.
- No evidence of nuisance animal activity (i.e., heavy deer browsing) was observed.

Site Permitting/Monitoring Activity and Reporting History

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Technical Proposal (RFP No. 16-007332)	February 8, 2018	February 8, 2018
Institution Date (NCDMS Contract No. 7529)	--	April 4, 2018
Mitigation Plan	October 2018	April 30th, 2019
Construction Plans	--	November 2018
Earthwork Completion	--	August 13th, 2019
Planting	--	January 24, 2020
As-Built Survey	February 2020	March 2020
As-Built Monitoring Report	February 2020	March 2020
MY1 Monitoring Report	November 2020	December 2020
MY2 Monitoring Report	November 2021	December 2021
MY3 Monitoring Report	November 2022	December 2022
MY4 Monitoring Report	November 2023	January 2024

Site Maintenance Report (2023)

Invasive Species Work	Maintenance work
05/23/2023 Chinaberry, Sweetgum, Mimosa, Callery Pear, and Pines	None
10/12/2023 Chinaberry, Privet, Mimosa, and Callery Pear	

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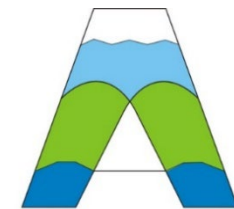
NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY
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1.0 PROJECT SUMMARY

Restoration Systems, LLC (RS) has established the North Carolina Division of Mitigation Services (NCDMS) Arabia Bay Wetland Restoration Site (Site).

1.1 Project Goals & Objectives

Project goals were based on the *Cape Fear River Basin Restoration Priorities* (CFRBRP) report (NCEEP 2009). Goals are addressed by project objectives as follows:

1. CFRBRP Goal – Reduce and control sediment inputs
Site-specific objective – Cessation of row crop production and conversion of a ditched Carolina Bay to a depressional wetland, removal of agricultural sediment outputs from the Site, and control of sediments within the Site.

2. CFRBRP Goal – Reduce and manage nutrient inputs
Site-specific objective – Cessation of row crop production may result in a direct reduction of 160 pounds of nitrogen and 280 pounds of phosphorus per year (based on the nutrient model) from the elimination of agricultural nutrient inputs/fertilizer application at the Site.

Site-specific mitigation goals and objectives have been developed through the North Carolina Wetland Assessment Method (NC WAM) analyses of preconstruction and reference wetland systems (NC WFAT 2010) as outlined in the following table.

1.2 Project Background

The Site is situated in a Carolina Bay that was historically cleared, drained, and farmed. In the NC Geological Survey 1956 aerial photograph for Hoke County, the Site was in agricultural production, indicating the area was cleared before 1956. The bay is an isolated depression surrounded by sand rims along the northwest and southeast margins. Land use adjacent to the bay includes rural residential properties, timber tracts, and additional row crops. Before construction, the Site land use was characterized entirely by agricultural row crops. Herbaceous vegetation and a few shrubby species grew along Site ditches, which were regularly maintained by bush hogging and herbicide application.

Wetland Targeted Functions, Goals, and Objectives

Targeted Functions	Goals	Objectives
(1) HYDROLOGY		
(2) Surface Storage & Retention	<ul style="list-style-type: none"> • Minimize downstream flooding to the maximum extent possible. 	<ul style="list-style-type: none"> • Filled agriculture ditches to restore jurisdictional hydrology • Planted native woody vegetation • Ceased row crop production within the easement • Plowed soils (6-8 inches) to reduce surface compaction and increase surface roughness • Protected the Site with a perpetual conservation easement
(2) Sub-surface Storage & Retention		

Wetland Targeted Functions, Goals, and Objectives (continued)

(1) WATER QUALITY		
(2) Pollution Change	<ul style="list-style-type: none"> Remove direct nutrient, sediment, and pollutant inputs from the Site. 	<ul style="list-style-type: none"> Removed agricultural land uses and agricultural inputs from the Site Filled the ditch network to restore ground and surface hydrology within the Site Planted woody vegetation Restored jurisdictional wetlands
(1) HABITAT		
(2) Physical Structure	<ul style="list-style-type: none"> Improve wildlife habitat within and adjacent to the Site. 	<ul style="list-style-type: none"> Planted woody vegetation to provide organic matter and shade Filled ditches to provide groundwater hydrology and plant woody native vegetation Protected the Site with a perpetual conservation easement Restored jurisdictional wetlands
(2) Landscape Patch Structure		
(2) Vegetation Composition		

The 1956 NC Geological Survey aerial photograph and 1974 aerial photograph included in the Hoke and Cumberland Counties Soil Survey show a historic ditch that was not present before Site restoration (USDA 1984). The ditch was located in the middle of the field and ran from the southeast to the northwest, connecting to the westernmost primary ditch. The historical ditch appeared to be a secondary ditch that was not necessary for agricultural production and was therefore filled in during the 1980s. A field investigation was performed using hand tools to locate the historic ditch location and determine if the subsurface clay layer was intact. Based on the field investigation, it appears the clay layer within the footprint of the historic ditch is intact.

A Detailed Restoration Plan was prepared for the Site that outlined backfilling agricultural ditches and planting native forest vegetation. In addition, an outlet structure was designed as an emergency spillway if the bay filled during significant storm events. The detailed plan was approved by the NCDMS and Interagency Review Team (IRT) and implemented during the summer of 2019.

1.3 Project Components and Structure

Proposed Site restoration activities generated 16.0 Non-riparian Wetland Mitigation Units (WMUs) resulting from 16.1 acres of non-riparian wetland restoration.

Additional activities that occurred at the Site included the following:

- Moving the access road off the Carolina bay bed and onto the adjacent sand rim. The road was built according to the construction plans at an average elevation of 223 feet,
- Installation of an overflow drop structure to release water from the Carolina bay during significant storm events (at a water depth of approximately 2.5 feet in the Carolina bay bottom),
- Excavation of shallow, elliptical depressions to form hummocks and pools for habitat variation across the Site,
- Plant 16.1 acres of the Site with 10,300 stems (planted species and densities by zone are included in Table 6 [Appendix C]).
- A permanent seed mix was applied across the Site.

Site design was completed in November 2018. Construction started on August 5, 2019, and ended with a final walkthrough on August 22, 2019. The Site was planted on January 24, 2020, and visited by IRT members in May 2020. Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 1-4 (Appendix A).

1.4 Success Criteria

Project success criteria were established per the October 24, 2016, NC Interagency Review Team *Wilmington District Stream and Wetland Compensatory Mitigation Update*. Monitoring and success criteria relate to project goals and objectives. Several goals and objectives are assumed to be functionally elevated by restoration activities without direct measurement from a mitigation perspective. Other goals and objectives will be considered successful upon achieving success criteria. The following table summarizes Site success criteria.

Success Criteria

Wetland Hydrology
<ul style="list-style-type: none"> • Saturation or inundation within the upper 12 inches of the soil surface for, at a minimum, 10 percent of the growing season, during average climatic condition based on the Wilmington District Stream and Wetland Compensatory Mitigation Update (USACE 2016), Table 1, for a Typic Paleaquult (Rains).
Vegetation
<ul style="list-style-type: none"> • 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 in height 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. • Any single species can only account for 50% of the required stems within any vegetation plot. <ul style="list-style-type: none"> ○ Ephemeral pool "habitat areas" are a normal component of Carolina bays. Areas of freshwater marsh are expected to be comprised of herbaceous emergent vegetation and not forested woody vegetation. Ephemeral pool "habitat areas" are expected to encompass approximately 20% of the bay area and should not be held to the above vegetative success criteria.

2.0 METHODS

Monitoring requirements and success criteria outlined in this plan follow the October 24, 2016, NC Interagency Review Team *Wilmington District Stream and Wetland Compensatory Mitigation Update*. 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
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

2.1 Monitoring

The monitoring parameters are summarized in the following table.

Monitoring Summary

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 2-November 12	14 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
	Visual Assessment	As-built, Years 1, 2, 3, 5, and 7	Terracell outlet structure and ditch plugs	Visually inspect features to ensure they are performing as designed and retaining hydrological inputs
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; <i>CVS-EEP Protocol for Recording Vegetation, Version 4.2</i> (Lee et al. 2008)	As-built, Years 1, 2, 3, 5, and 7	14 plots spread across the Site	Species, height, planted vs. volunteer, stems/acre
	Annual random vegetation plots, 0.0247 acre (100 square meters) in size	As needed	As needed	Species

*Soil Temperature will be measured with a continuous recording soil probe. Temperatures will be measured from February to the end of April in each monitoring year.

Wetland Summary

Summary of Monitoring Period/Hydrology Success Criteria by Year

Year	Soil Temperatures/Date Bud Burst Documented*	Monitoring Period Used for Determining Success	10 Percent of Monitoring Period
2020 (Year 1)	March 2, 2020	March 2-November 12 (256 days)	26 days
2021 (Year 2)	March 1, 2021	March 1-November 12 (257 days)	26 days
2022 (Year 3)	March 1, 2022	March 1-November 12 (257 days)	26 days
2023 (Year 4)	March 1, 2023	March 1-November 12 (257 days)	26 days

*Based on data collected from a soil temperature data logger located on the Site.

None of the 14 groundwater gauges met success criteria during the Year 4 (2023) monitoring period (Appendix D). Except for several significant but sporadic rain events, rainfall amounts remained low through March, April, and May (Figure D1, Appendix D). Under normal rainfall conditions, the water table is expected to be elevated during these months before dropping off for the dry season. Due to this unseasonable dryness, all portions of the Site remained visibly dry throughout the year.

A visual assessment of the terracell outlet and ditch plugs found that all features are intact and performing as designed. There is no indication that these features are failing to retain hydrological inputs.

A reference gauge was installed on July 20, 2023. The reference location is ~1.75-miles west of the Site and was selected in a similarly sized Carolina Bay within the same mapped soil series, McColl loam, as the Site (Figure 1, Appendix A). Also, a review of historic imagery and discussions with the landowner indicated the area has not been ditched. The vegetation is currently a successional Nonriverine Wet Hardwood Forest, as the area was timbered between 2004-2005. A detailed soil profile description was recorded at the time of the gauge installation (Appendix D). Reference gauge data indicate that the reference wetland remained dry July through November. The gauge will continue to be monitored for the remainder of the monitoring period, and data will be compared with Site hydrology.

Vegetation Summary

In accordance with the monitoring schedule, vegetation plot monitoring was not performed in Year 4 (2023). Visual assessment indicates that vegetation on the Site remains vigorous, and no vegetation areas of concern were observed during Year 4 (2023) (Table 5, Appendix B).

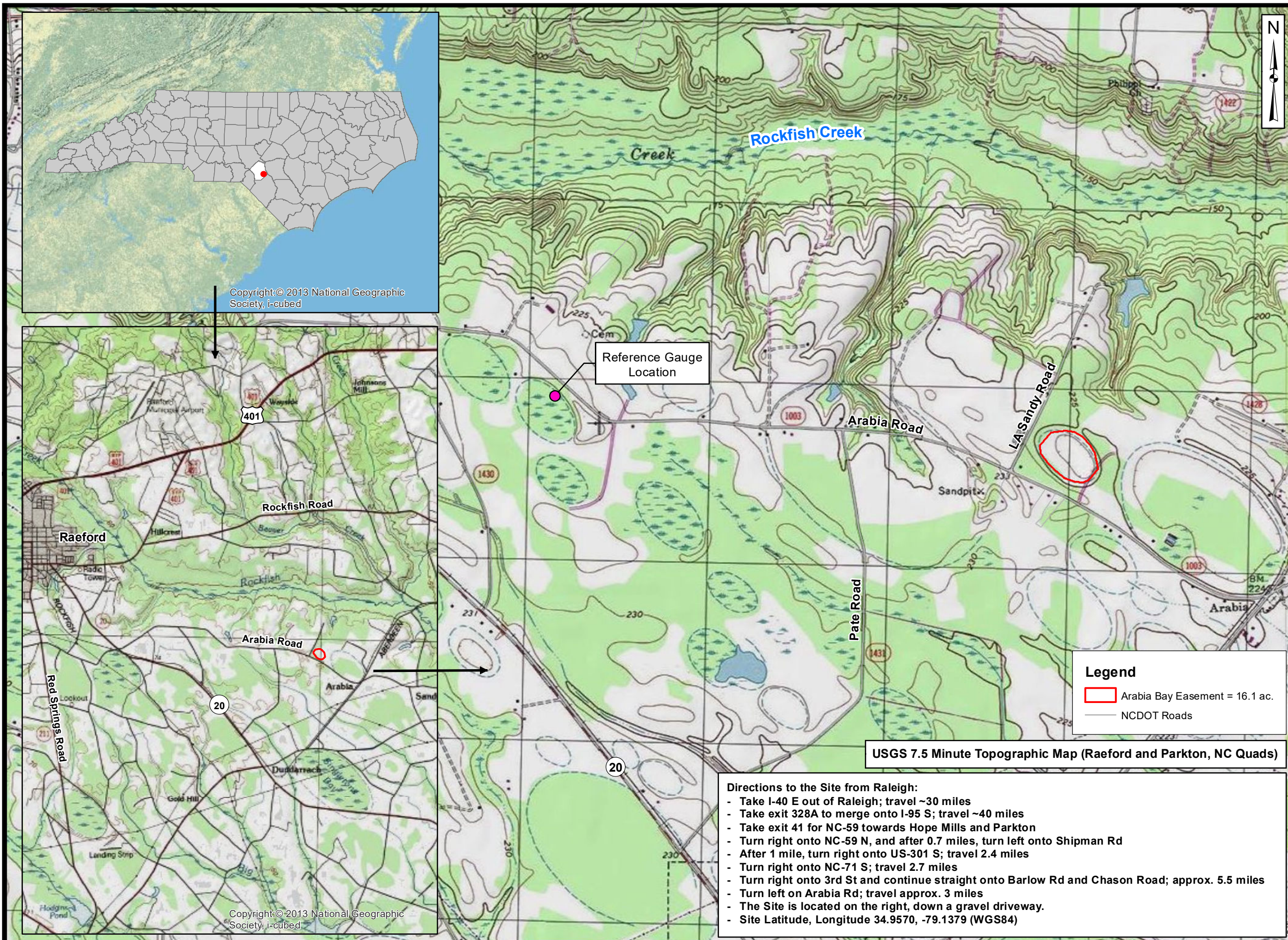
3.0 REFERENCES

- Lee, M.T., R.K. Peet, SD. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.
- North Carolina Ecosystem Enhancement Program (NCEEP). 2009. Cape Fear River Basin Restoration Priorities 2009 (online). Available: http://portal.ncdenr.org/c/document_library/get_file?uuid=864e82e8-725c-415e-8ed9-c72dfcb55012&groupId=60329
- North Carolina Wetland Functional Assessment Team. (NC WFAT 2010). NC Wetland Assessment Method (NC WAM) User Manual. Version 4.1.
- Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, North Carolina Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.
- United States Department of Agriculture (USDA). 1984. Soil Survey of Cumberland and Hoke Counties, North Carolina. United States Department of Agriculture, Soil Conservation Service.
- United States Department of Agriculture (USDA). 2017. Web Soil Survey (online). Available: <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm> [May 8, 2018]. United States Department of Agriculture.

Appendix A

Background Tables and Map

- Figure 1. Project Location
- Table 1. Project Components and Mitigation Units
- Table 2. Project Activity and Reporting History
- Table 3. Project Contacts Table
- Table 4. Project Attributes Table



Project:

ARABIA BAY WETLAND MITIGATION SITE

Hoke County, NC

Title:

SITE LOCATION

Drawn by: KRJ

Date: DEC 2023

Scale: 1:20,000

Project No.: 18-016

FIGURE 1

**Table 1. Project Components and Mitigation Credits
Arabia Bay Restoration Site**

Reach ID	Wetland Type	Existing Acreage	Restoration Acreage	Restoration Level	Restoration or Restoration Equivalent	Mitigation Ratio	Mitigation Credits
Wetland Restoration	Non-riparian	--	16.000	Restoration	16.000	1:1	16.000

Length & Area Summations by Mitigation Category	
Restoration Level	Non-riparian Wetland (acreage)
Restoration	16.000

Overall Assets Summary	
Asset Category	Overall Credits
Non-riparian Wetland	16.000

**Table 2. Project Activity and Reporting History
Arabia Bay Restoration Site**

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Technical Proposal (RFP No. 16-007332)	February 8, 2018	February 8, 2018
Institution Date (NCDMS Contract No. 7529)	--	April 4, 2018
Mitigation Plan	October 2018	April 30th, 2019
Construction Plans	--	November 2018
Earthwork Completion	--	August 13th, 2019
Planting	--	January 24, 2020
As-Built Survey	February 2020	March 2020
As-Built Monitoring Report	February 2020	March 2020
MY1 Monitoring Report	November 2020	December 2020
MY2 Monitoring Report	November 2021	December 2021
MY3 Monitoring Report	November 2022	December 2022
MY4 Monitoring Report	November 2023	January 2024

Table 3. Project Contacts Table

Arabia Bay Restoration Site

<p>Full Delivery Provider Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 Worth Creech 919-755-9490</p>	<p>Construction Contractor Land Mechanic Designs 780 Landmark Road Willow Spring, NC 27592 Lloyd Glover 919-639-6132</p>
<p>Designer Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693</p>	<p>Planting Contractor Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 Worth Creech 919-755-9490</p>
<p>Construction Plans and Sediment and Erosion Control Plans Sungate Design Group, PA 915 Jones Franklin Road Raleigh, NC 27606 Joshua G. Dalton, PE 919-859-2243</p>	<p>As-built Surveyor K2 Design Group 5688 US Highway 70 East Goldsboro, NC 27534 John Rudolph 919-751-0075</p>
	<p>Baseline & Monitoring Data Collection Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693</p>

**Table 4. Project Attribute Table
Arabia Bay Restoration Site**

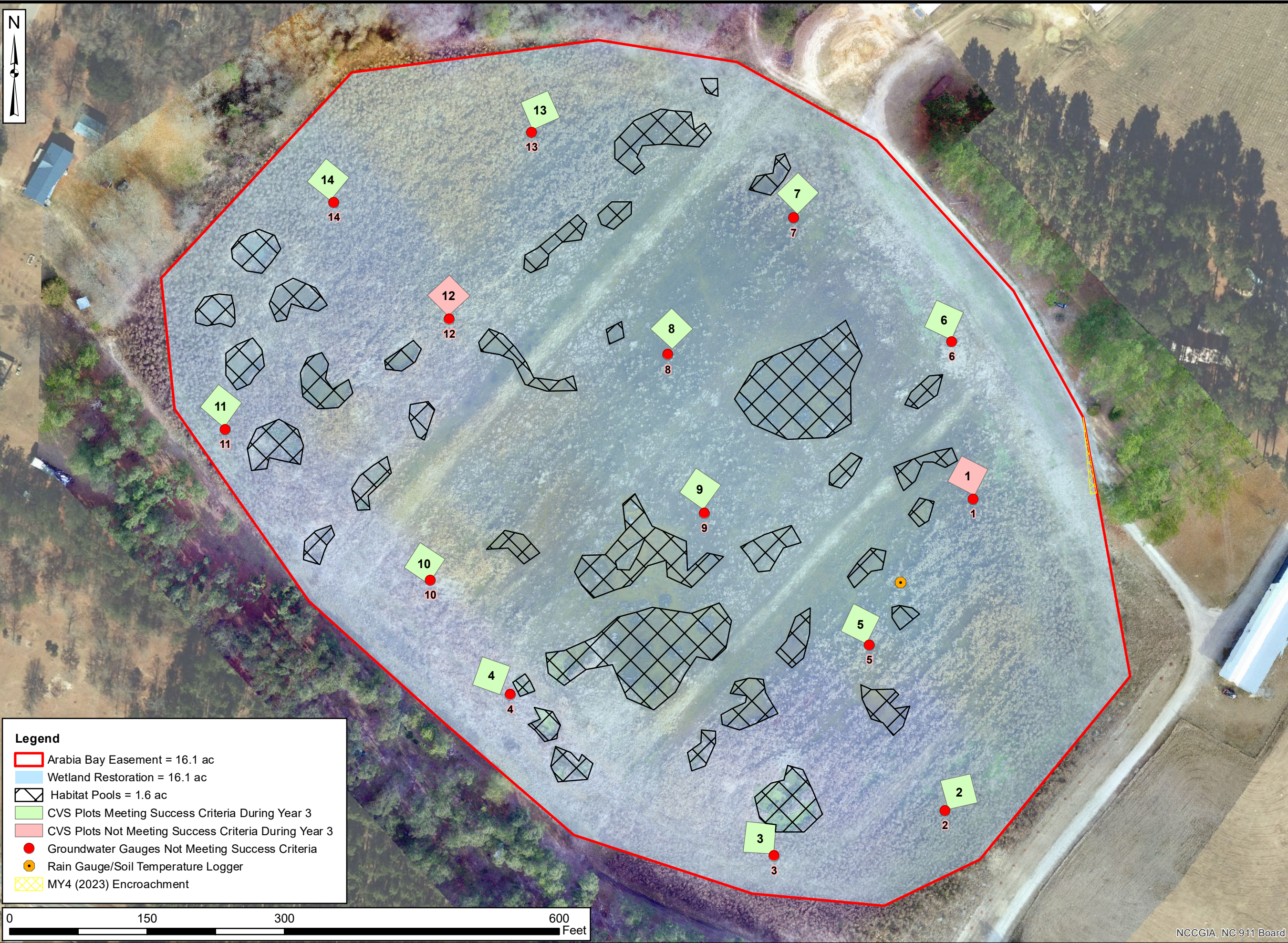
Project Information			
Project Name	Arabia Bay Restoration Site		
Project County	Hoke County, North Carolina		
Project Area (acres)	16.1		
Project Coordinates (latitude & longitude)	34.9570°N, 79.1379°W		
Planted Area (acres)	16.1		
Project Watershed Summary Information			
Physiographic Province	Piedmont		
Project River Basin	Cape Fear		
USGS HUC for Project (14-digit)	03030004150011		
NCDWR Sub-basin for Project	03-06-15		
Project Drainage Area (acres)	NA		
Percentage of Project Drainage Area that is Impervious	<5%		
CGIA Land Use Classification	Cultivated		
Wetland Summary Information			
Parameters	Wetlands		
Wetland acreage	16.1 acres drained		
Wetland Type	Non-riparian		
Mapped Soil Series	McCull		
Drainage Class	Poorly drained		
Hydric Soil Status	Hydric		
Source of Hydrology	Precipitation, groundwater		
Hydrologic Impairment	Ditched and drained		
Native Vegetation Community	Bay Forest/Small Depression Pocosin		
% Composition of Exotic Invasive Vegetation	0%		
Restoration Method	Hydrologic, vegetative		
Enhancement Method	NA		
Regulatory Considerations			
Regulation	Applicable?	Resolved?	Supporting Documentation*
Waters of the United States-Section 401	Yes	Yes	Approved JD (App D Mitigation Plan)
Waters of the United States-Section 404	Yes	Yes	Approved JD (App D Mitigation Plan)
Endangered Species Act	Yes	Yes	CE Document (App E Mitigation Plan)
Historic Preservation Act	Yes	Yes	CE Document (App E Mitigation Plan)
Coastal Zone Management Act	No	--	CE Document (App E Mitigation Plan)
FEMA Floodplain Compliance	No	--	CE Document (App E Mitigation Plan)
Essential Fisheries Habitat	No	--	CE Document (App E Mitigation Plan)

*Included in the Detailed Mitigation Plan

Appendix B

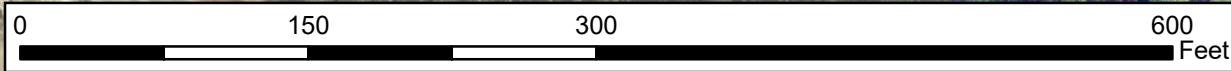
Visual Assessment Data

Figure 2. Current Conditions Plan View
Table 5. Vegetation Condition Assessment
Photo Log



Legend

- Arabia Bay Easement = 16.1 ac
- Wetland Restoration = 16.1 ac
- Habitat Pools = 1.6 ac
- CVS Plots Meeting Success Criteria During Year 3
- CVS Plots Not Meeting Success Criteria During Year 3
- Groundwater Gauges Not Meeting Success Criteria
- Rain Gauge/Soil Temperature Logger
- MY4 (2023) Encroachment



Project:
**ARABIA BAY
 WETLAND
 MITIGATION
 SITE**

Hoke County, NC

Title:
**CURRENT
 CONDITIONS
 PLAN VIEW**

Drawn by: KRJ

Date: JAN 2024

Scale: 1:1200

Project No.: 18-016

**FIGURE
 2**

Table 5

Vegetation Condition Assessment
Arabia Bay

Planted Acreage¹

16.1

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	None	0.1 acres	none	0	0.00	0.0%
2. Low Stem Density Areas	None	0.1 acres	none	0	0.00	0.0%
2B. Low Planted Stem Density Areas	None	0.1 acres	none	0	0.00	0.0%
Total				0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	None	0.25 acres	none	0	0.00	0.0%
Cumulative Total				0	0.00	0.0%

Easement Acreage²

16.1

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern ⁴	None	1000 SF	none	0	0.00	0.0%
5. Easement Encroachment Areas ³	Small area of encroachment along the eastern easement boundary	none	Yellow Hatching	1	0.01	0.0%

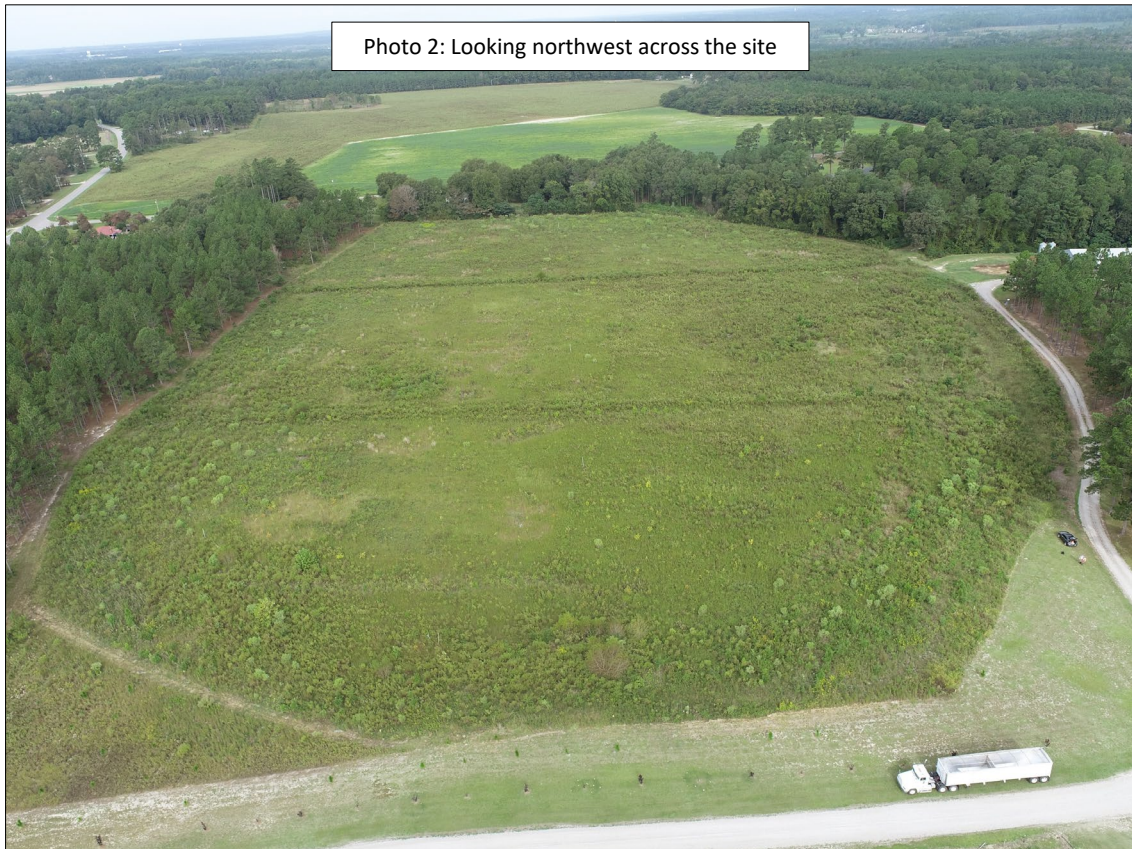
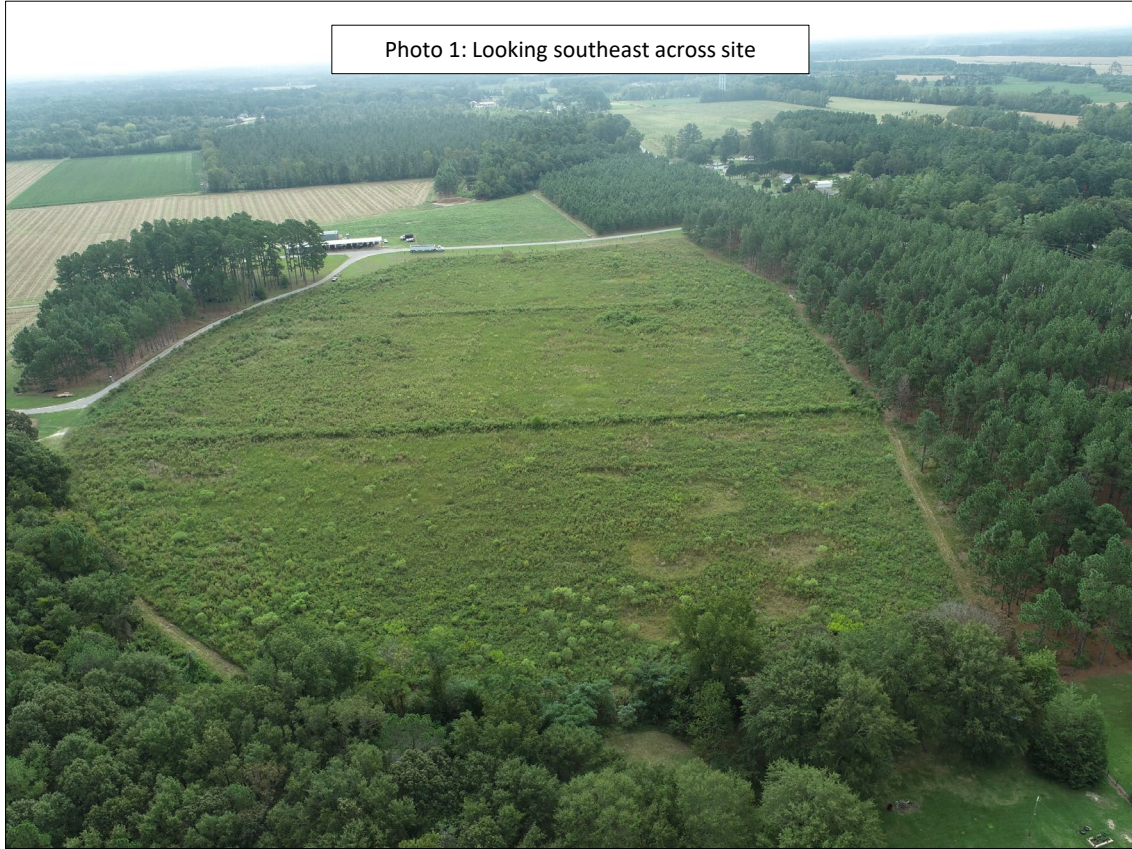
¹ = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project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

² = The acreage within the easement boundaries.

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

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

**Arabia Bay
MY-04 (2023) Photo Log**



Arabia Bay
MY-04 (2023) Photo Log

Photo 3: Mowing along well-marked easement boundary (no encroachment)



Photo 4: *Quercus michauxii*



**Arabia Bay
MY-04 (2023) Photo Log**

Photo 5: Easement boundary, looking northwest



Photo 6: Easement boundary, looking west



**Arabia Bay
MY-04 (2023) Photo Log**

Photo 7: Plot 5, looking north



Photo 8: From Plot 2, looking north



**Arabia Bay
MY-04 (2023) Photo Log**

Photo 9: Bud burst on *Prunus serotina*
(Taken 2/28/23)



Photo 10: Bud burst on *Quercus* sp.
(Taken 2/28/23)



Appendix C Vegetation Data

Table 6. Planted Bare Root Woody Vegetation

**Table 6. Planted Bare Root Woody Vegetation
Arabia Bay Restoration Site**

Nonriverine Wet Hardwood Forest		
Species	Quantity	Percentage
<i>Cephalanthus occidentalis</i>	100	1%
<i>Fraxinus pennsylvanica</i>	600	6%
<i>Magnolia virginiana</i>	1,000	10%
<i>Nyssa sylvatica v sylvatica</i>	1,000	10%
<i>Quercus bicolor</i>	600	6%
<i>Quercus laurifolia</i>	1,000	10%
<i>Quercus michauxii</i>	600	6%
<i>Quercus nigra</i>	1,000	10%
<i>Quercus pagoda</i>	600	6%
<i>Taxodium distichum</i>	800	8%
	7,300	71%

Cypress Savanna (Habitat Pools)		
Species	Quantity	Percentage
<i>Nyssa sylvatica v biflora</i>	1,000	10%
<i>Taxodium ascendens</i>	2,000	19%
	3,000	29%

Totals =

10,300

Appendix D

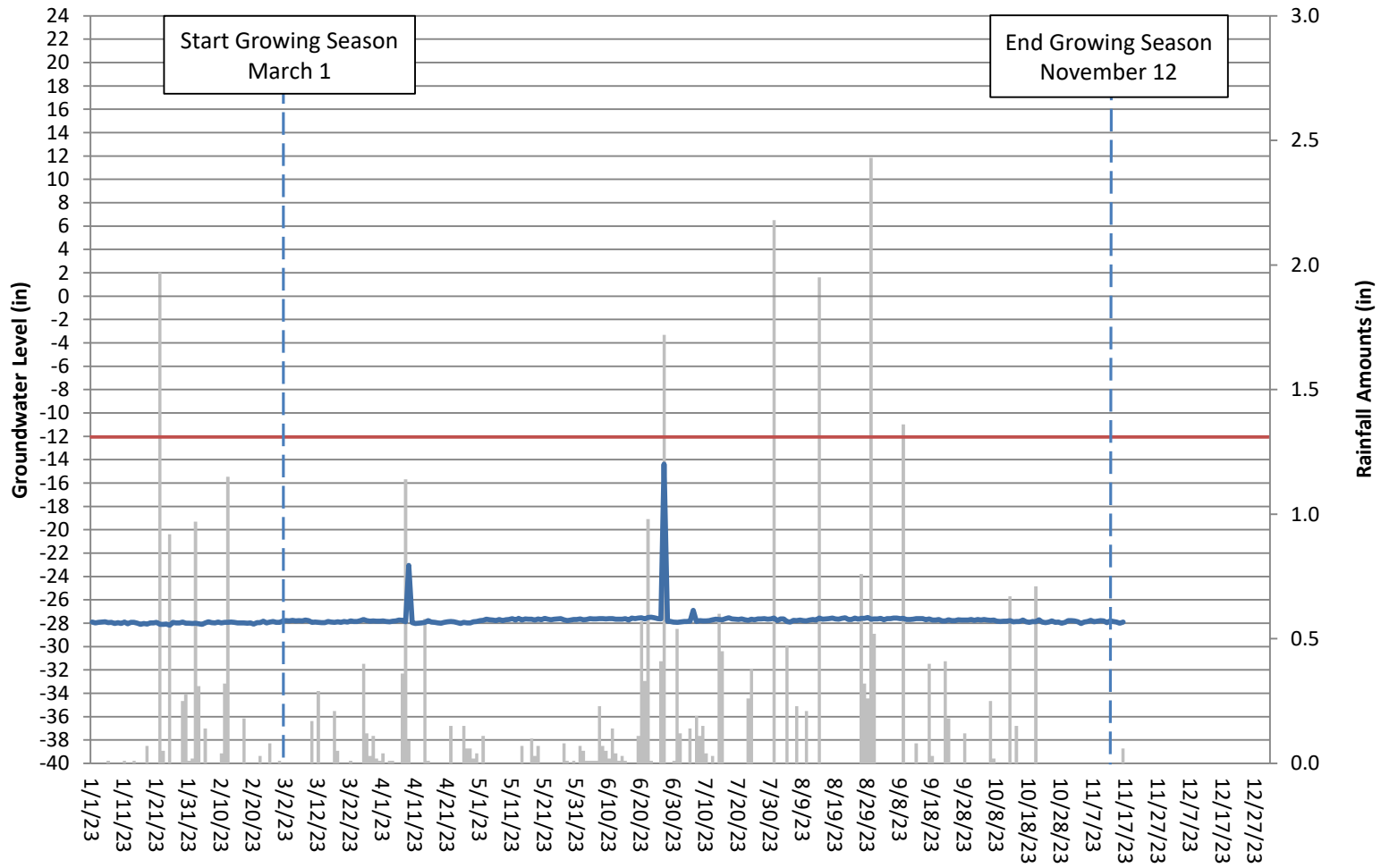
Hydrology Data

Table 6. Groundwater Hydrology Data
Groundwater Gauge Graphs
Soil Temperature Graph
Figure D1. 30-70th Percentile Graph for Rainfall
Reference Gauge Soil Profile Description

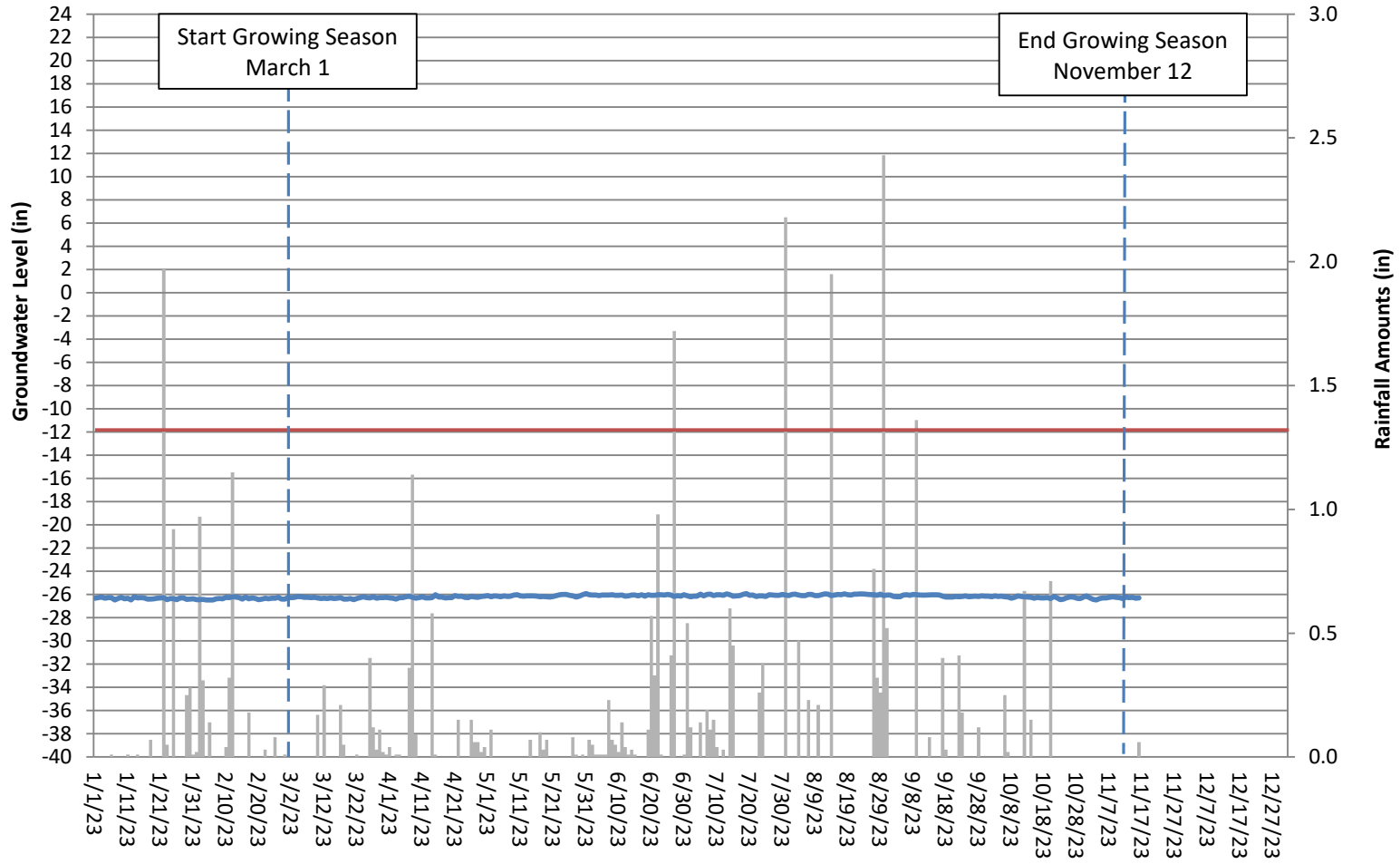
Table 6. Groundwater Hydrology Data

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)						
	Year 1 (2020)	Year 2 (2021)	Year 3 (2022)	Year 4 (2023)	Year 5 (2024)	Year 6 (2025)	Year 7 (2026)
1	Yes - 85 days (33.2%)	Yes - 77 Days (28%)	No – 0 Days (0%)	No – 0 Days (0%)			
2	Yes - 72 days (28.1%)	Yes - 75 Days (27%)	No – 0 Days (0%)	No – 0 Days (0%)			
3	Yes - 72 days (28.1%)	Yes -76 Days (28%)	No – 0 Days (0%)	No – 0 Days (0%)			
4	Yes - 93 days (36.3%)	Yes - 79 Days (29%)	No – 0 Days (0%)	No – 0 Days (0%)			
5	Yes - 95 days (37.1%)	Yes - 82 Days (30%)	No – 0 Days (0%)	No – 0 Days (0%)			
6	Yes - 36 days (14.1%)	Yes - 75 Days (27%)	No – 1 Day (0.5%)	No – 1 Day (0.5%)			
7	Yes - 77 days (30.1%)	Yes - 75 Days (27%)	No – 1 Day (0.5%)	No – 1 Day (0.5%)			
8	Yes - 85 days (33.2%)	Yes - 79 Days (29%)	No – 1 Day (0.5%)	No – 1 Day (0.5%)			
9	Yes - 94 days (36.7%)	Yes - 81 Days (29%)	No – 2 Days (0.8%)	No – 2 Days (0.8%)			
10	Yes - 69 days (27.0%)	Yes - 74 Days (27%)	No – 0 Days (0%)	No – 0 Days (0%)			
11	Yes - 28 days (10.9%)	Yes - 52 Days (19%)	No – 0 Days (0%)	No – 0 Days (0%)			
12	Yes - 61 days (23.8%)	Yes - 74 Days (27%)	No – 1 Day (0.5%)	No – 3 Days (1.2%)			
13	Yes - 34 days (13.3%)	Yes - 69 Days (25%)	No – 0 Days (0%)	No – 0 Days (0%)			
14	Yes - 31 days (12.1%)	Yes - 62 Days (22%)	No – 0 Days (0%)	No – 0 Days (0%)			

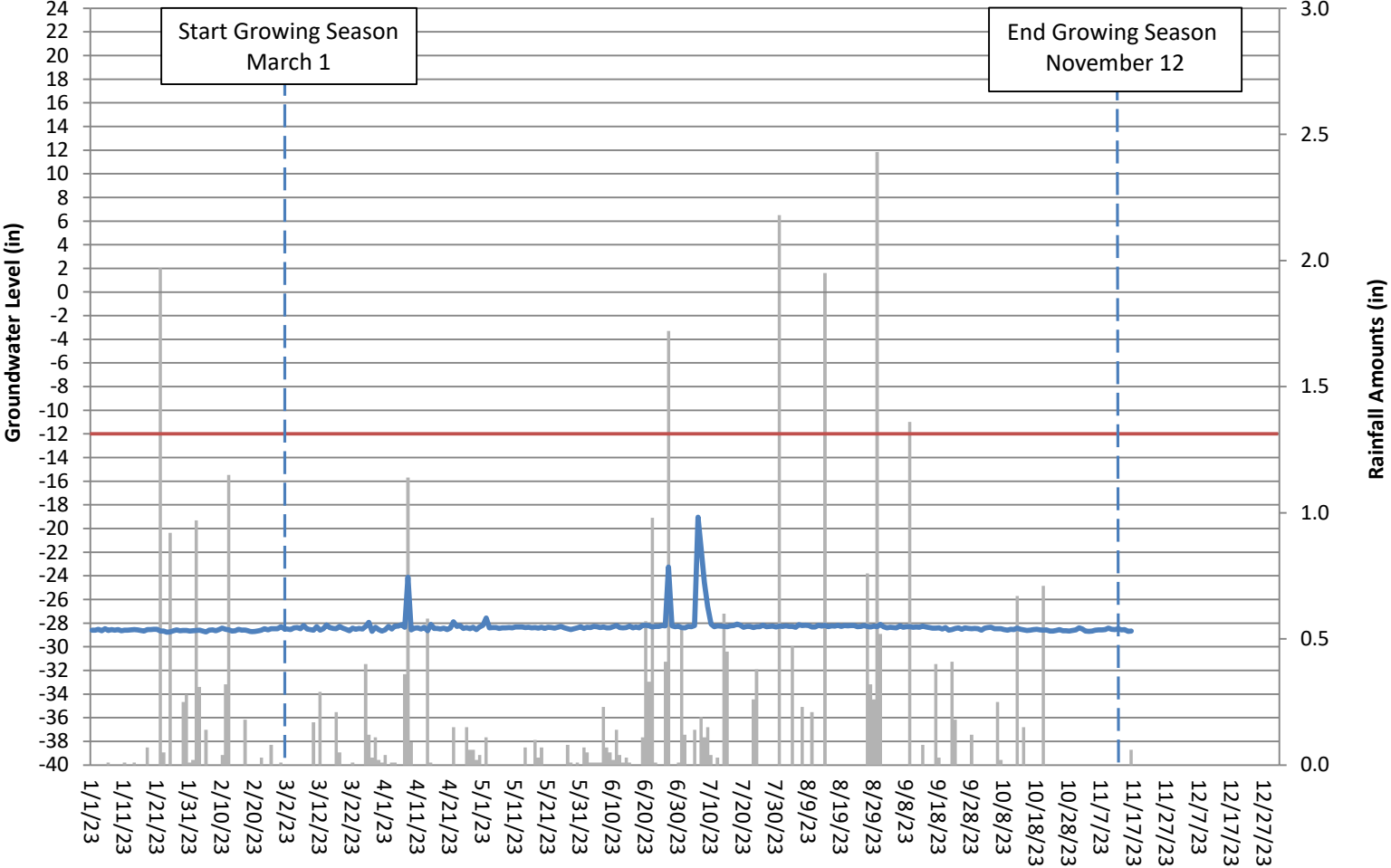
Arabia Bay Groundwater Gauge 1 Year 4 (2023 Data)



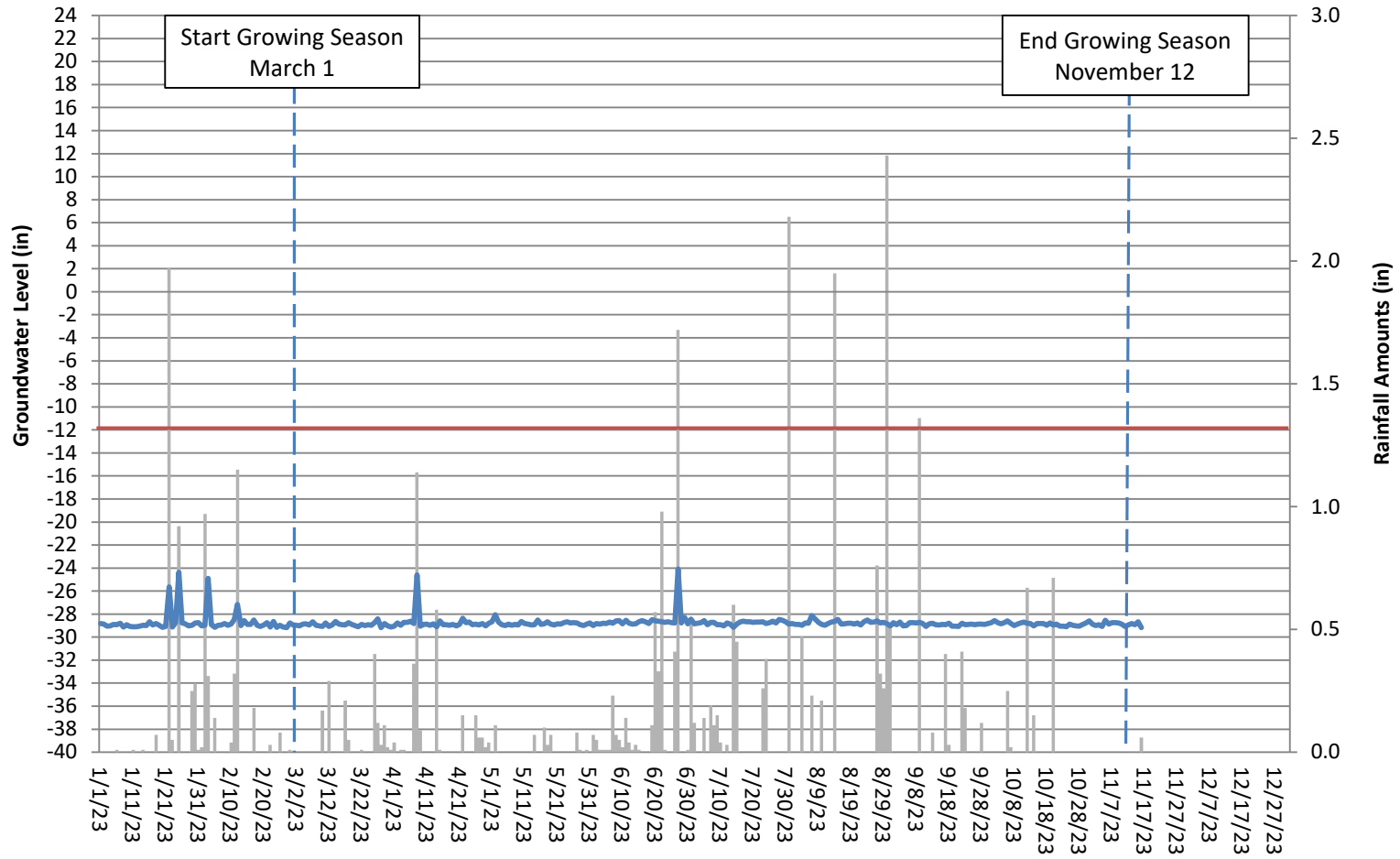
Arabia Bay Groundwater Gauge 2 Year 4 (2023 Data)



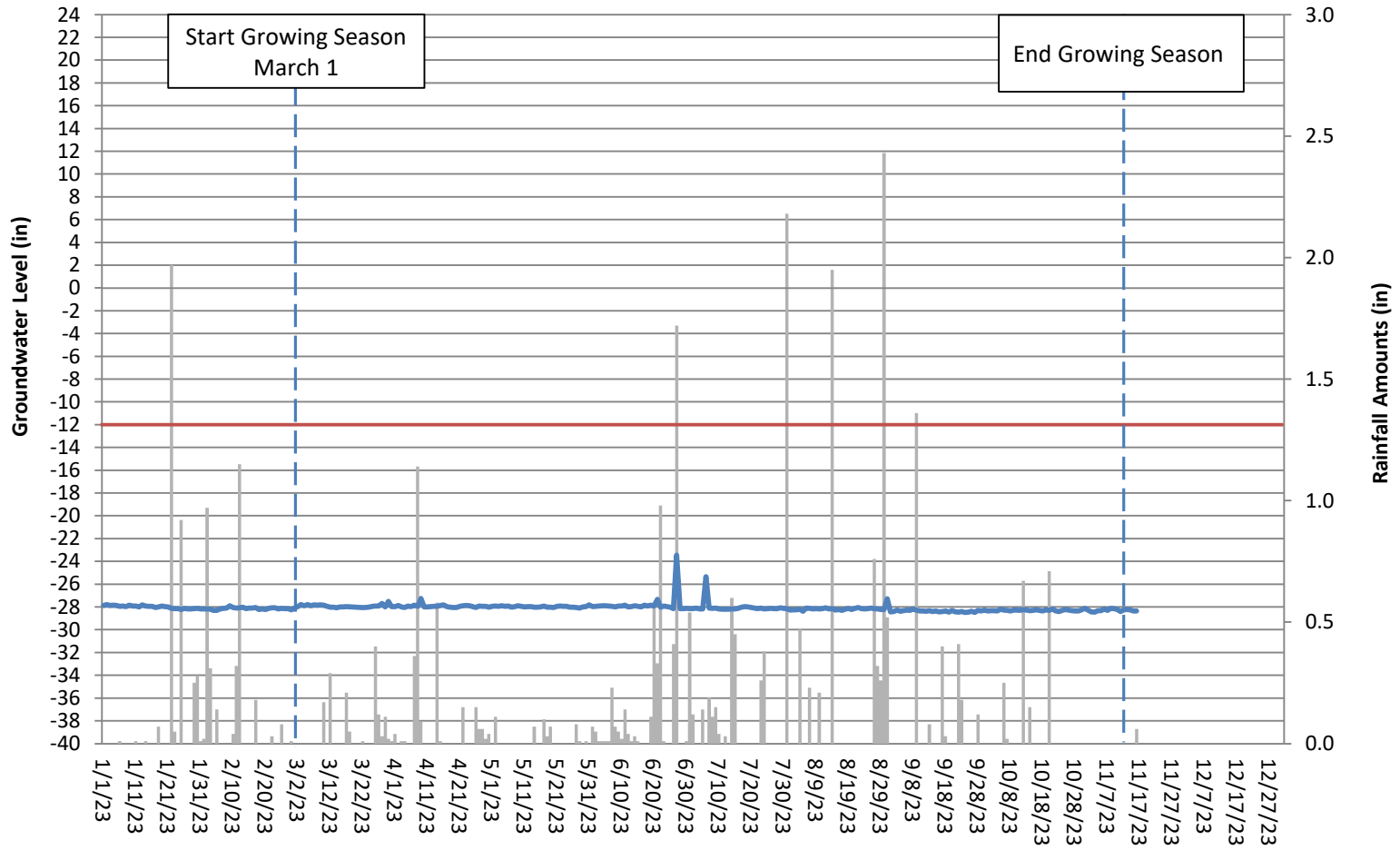
Arabia Bay Groundwater Gauge 3 Year 4 (2023 Data)



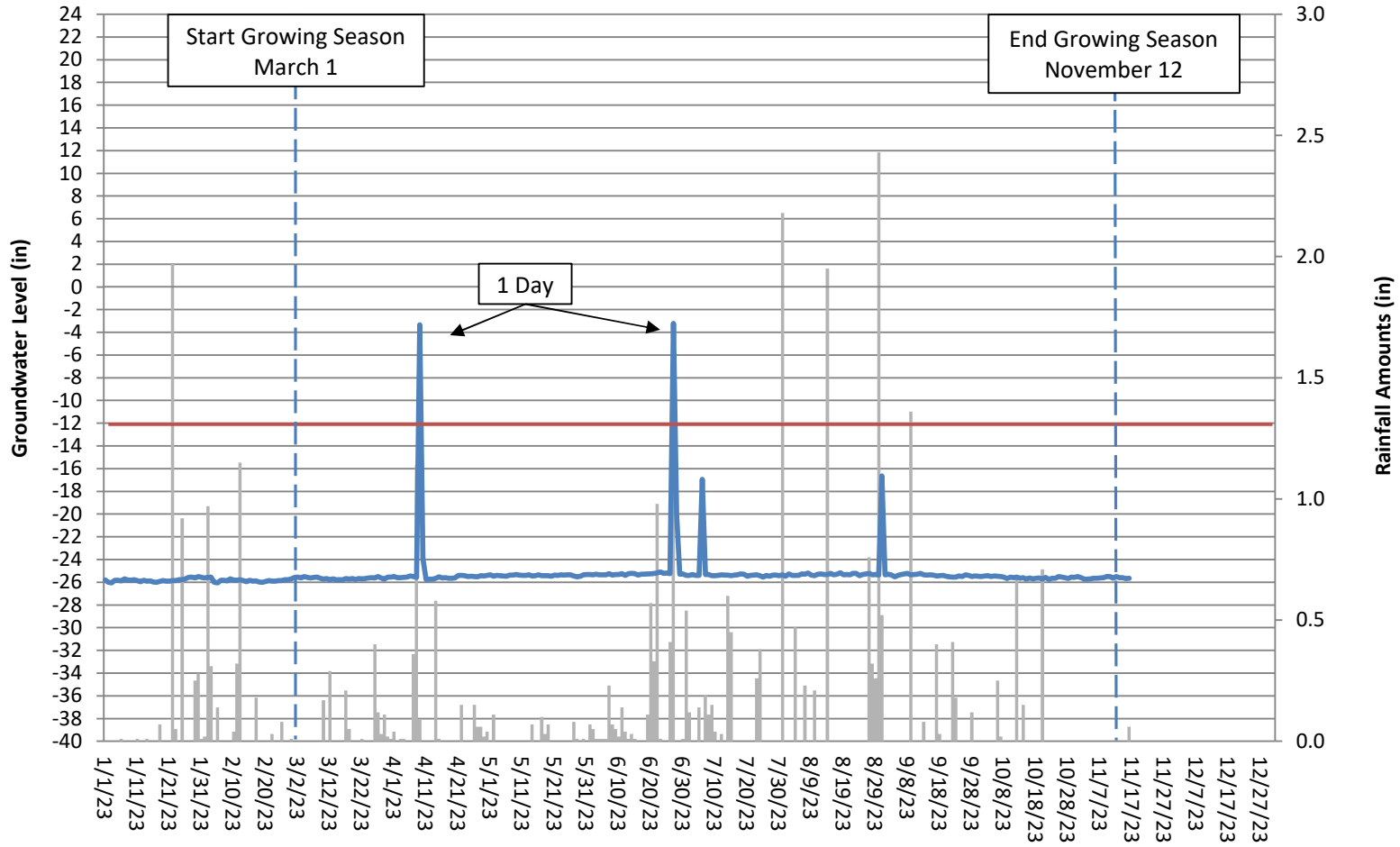
Arabia Bay Groundwater Gauge 4 Year 4 (2023 Data)



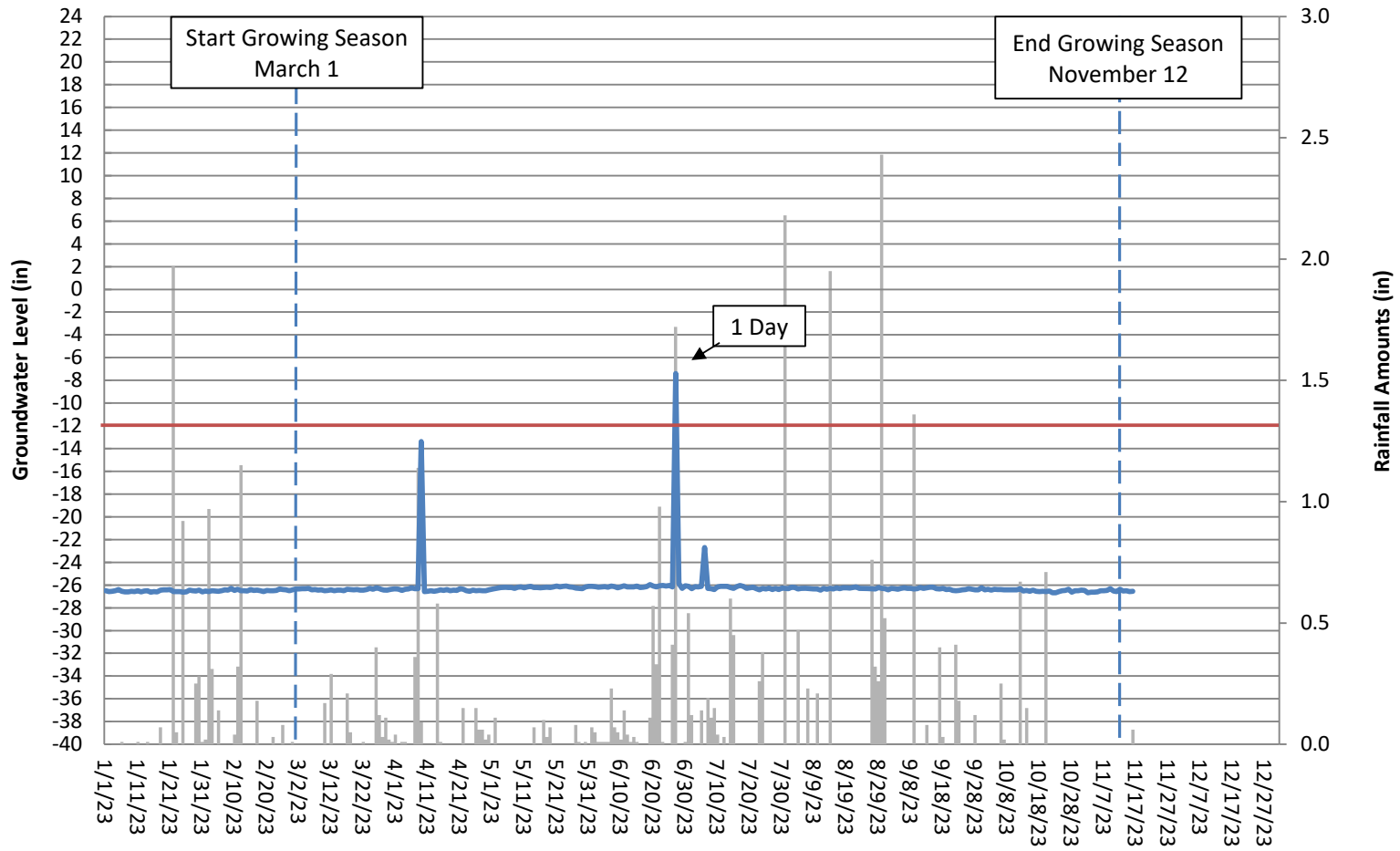
Arabia Bay Groundwater Gauge 5 Year 4 (2023 Data)



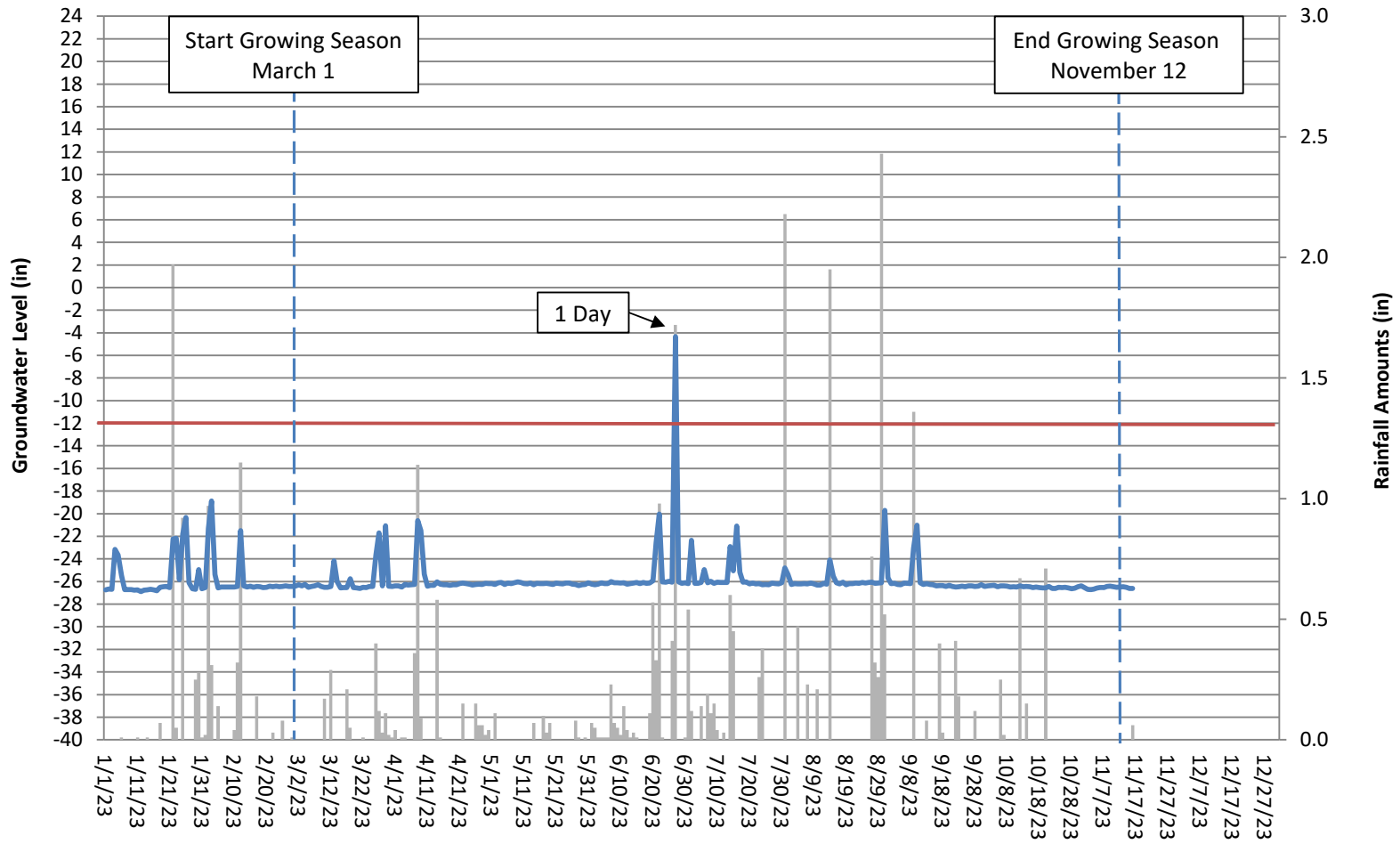
Arabia Bay Groundwater Gauge 6 Year 4 (2023 Data)



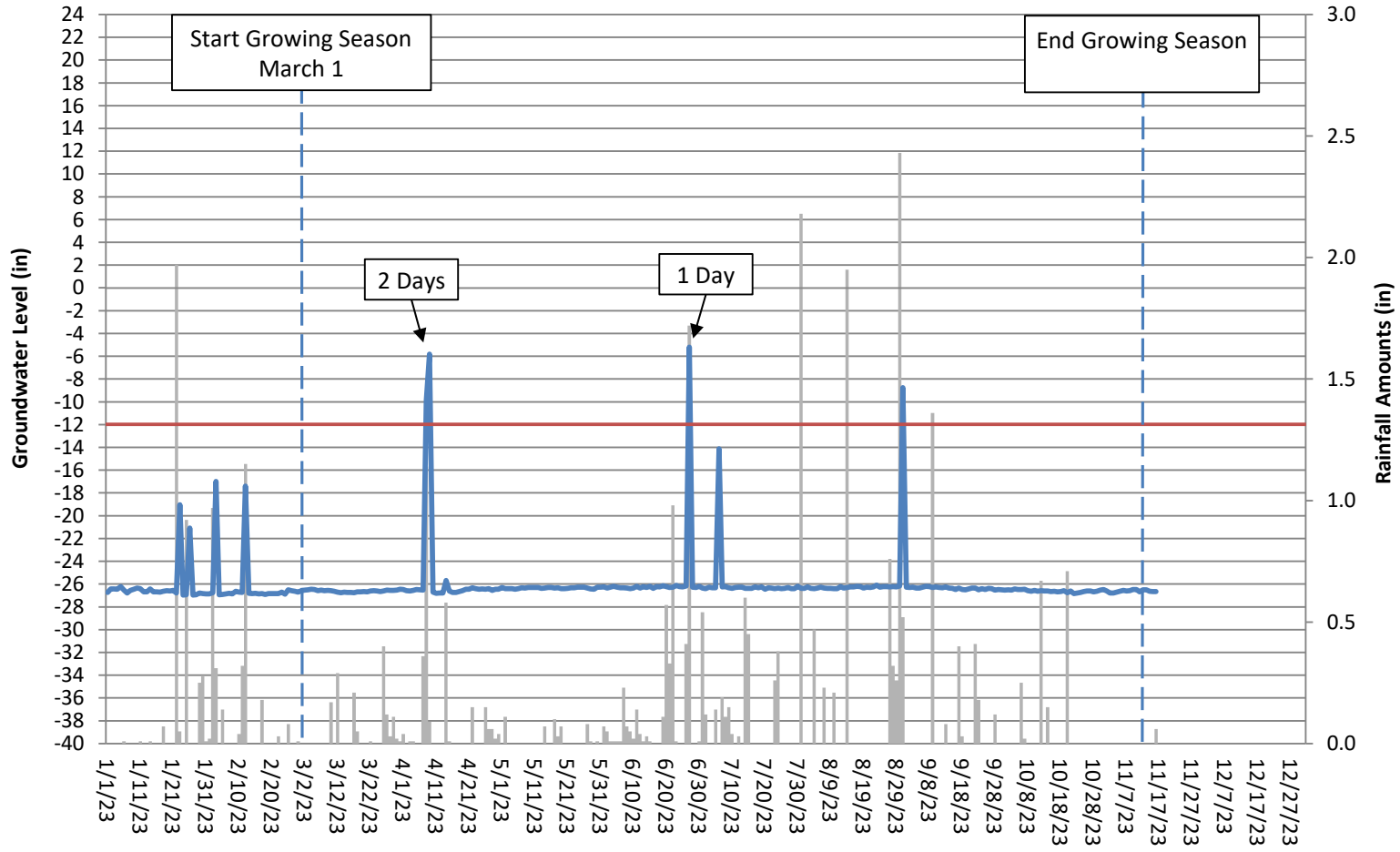
Arabia Bay Groundwater Gauge 7 Year 4 (2023 Data)



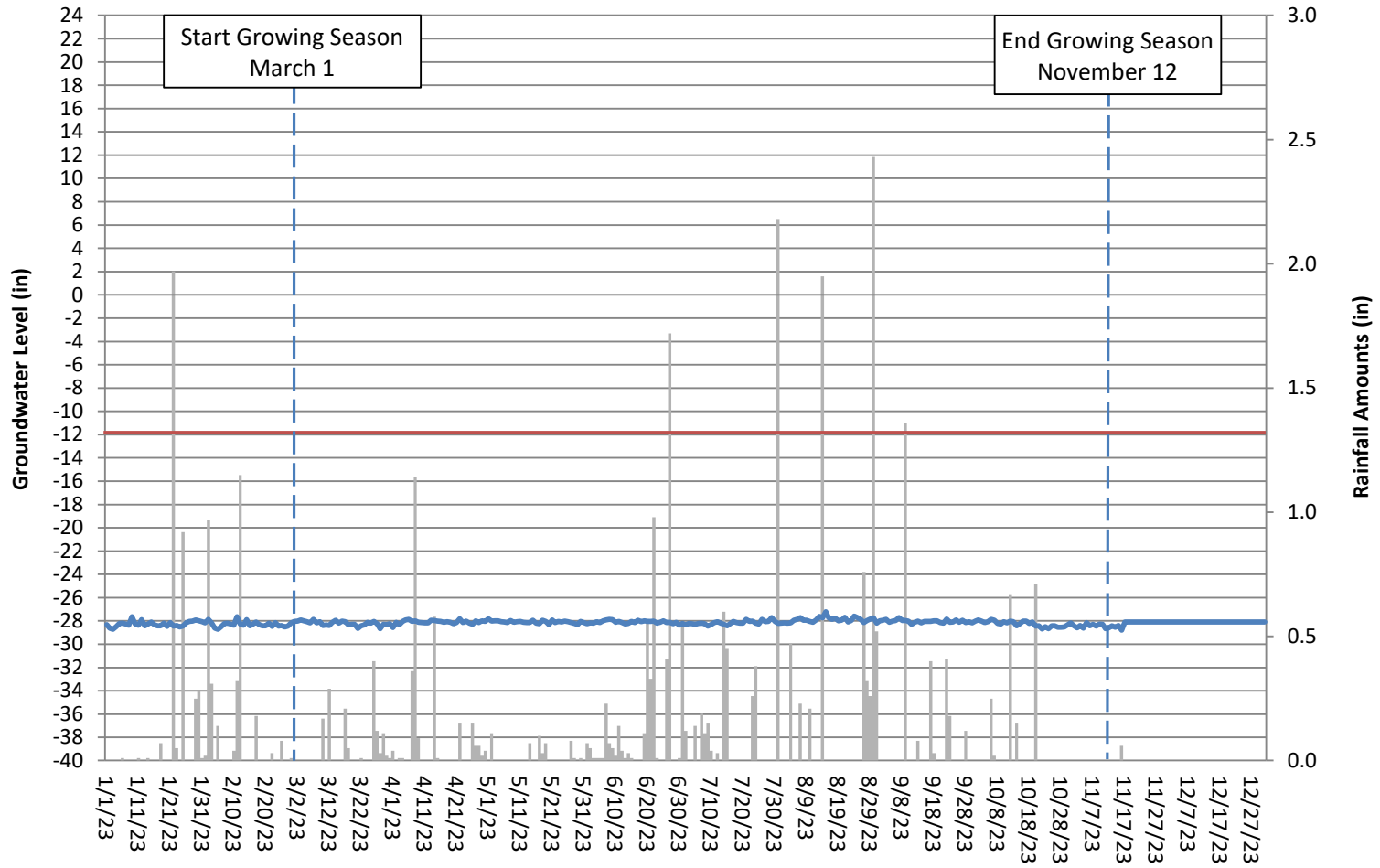
Arabia Bay Groundwater Gauge 8 Year 4 (2023 Data)



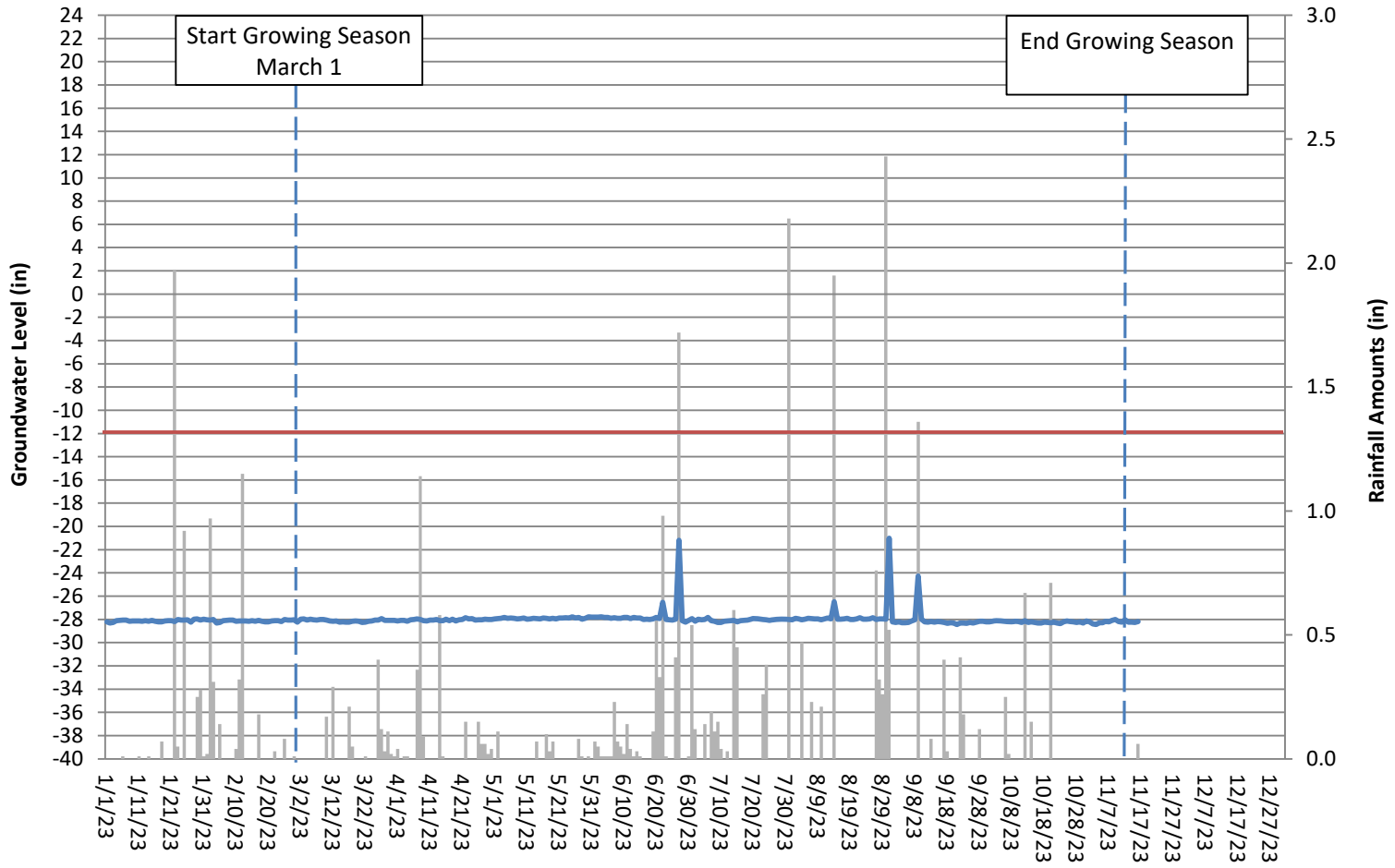
Arabia Bay Groundwater Gauge 9 Year 4 (2023 Data)



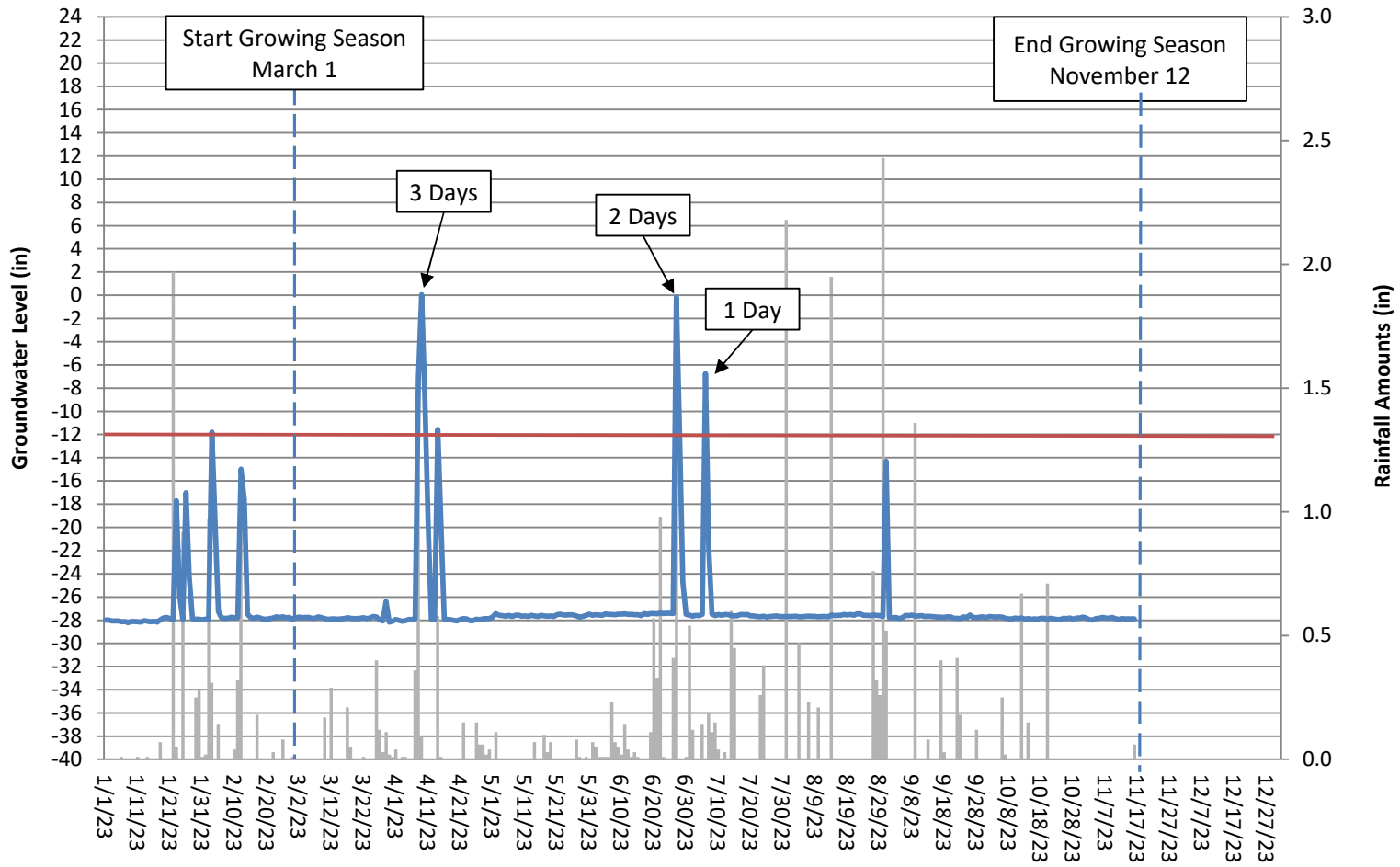
Arabia Bay Groundwater Gauge 10 Year 4 (2023 Data)



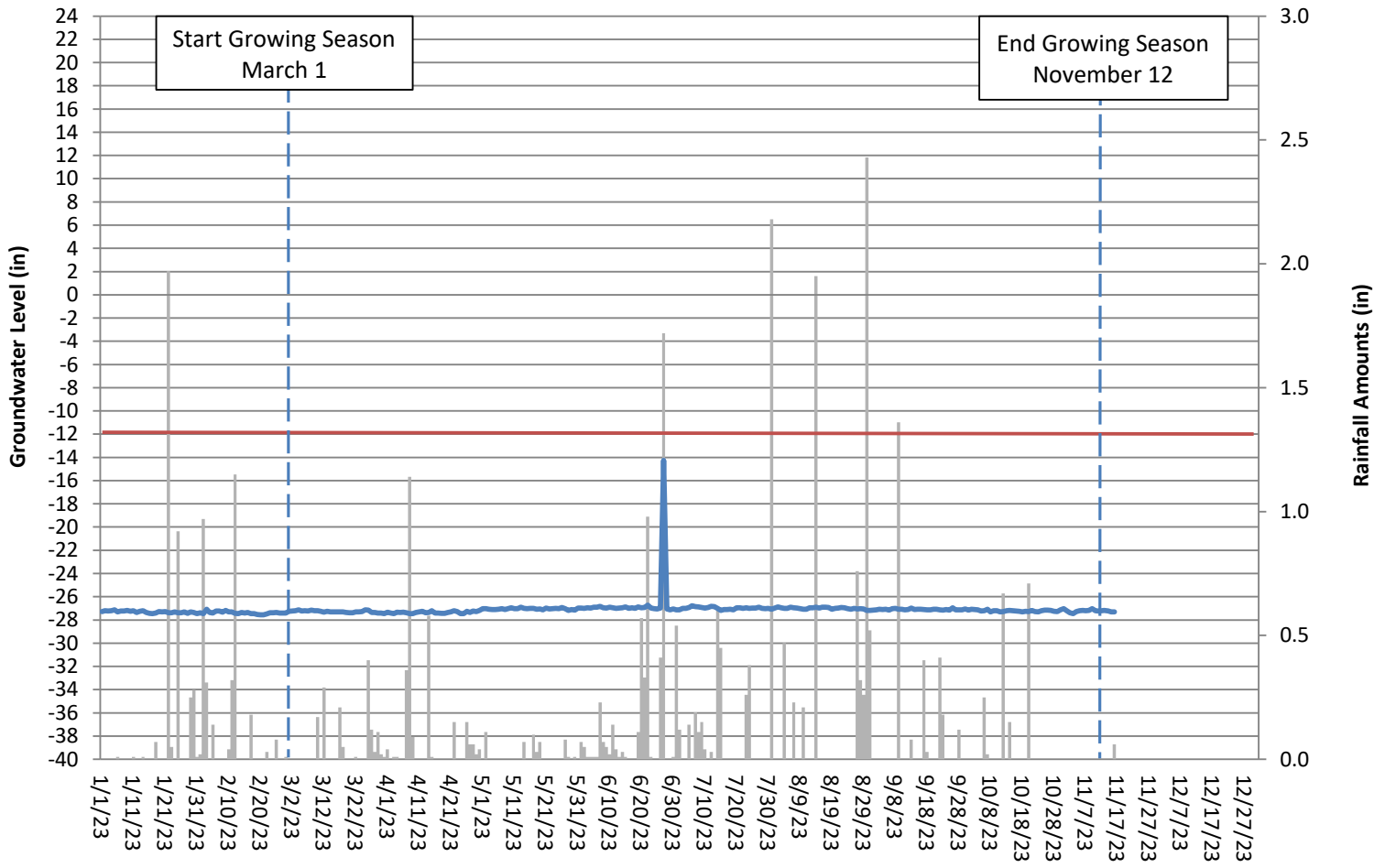
Arabia Bay Groundwater Gauge 11 Year 4 (2023 Data)



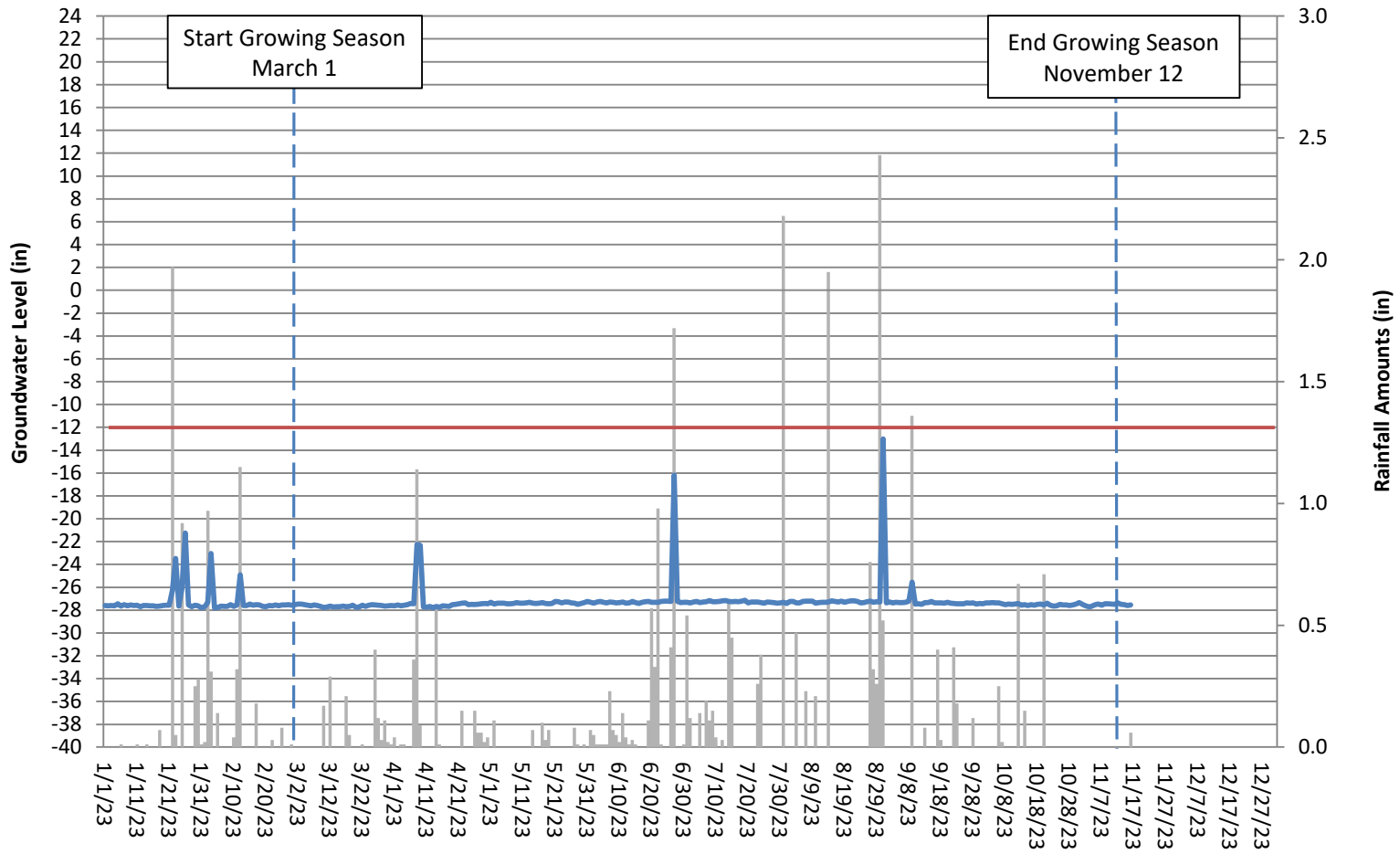
Arabia Bay Groundwater Gauge 12 Year 4 (2023 Data)



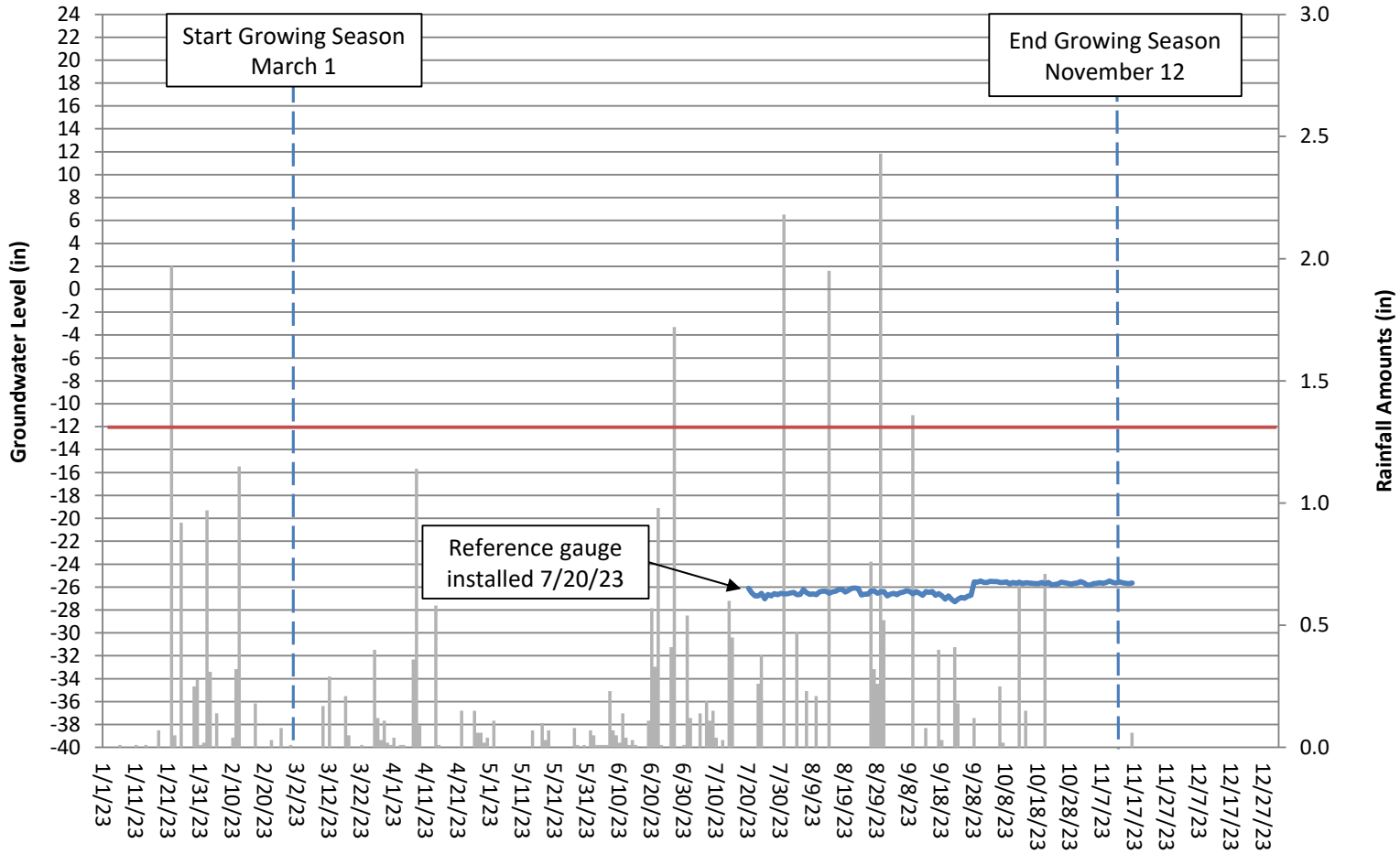
Arabia Bay Groundwater Gauge 13 Year 4 (2023 Data)



Arabia Bay Groundwater Gauge 14 Year 4 (2023 Data)



Arabia Bay Groundwater Reference Year 4 (2023 Data)



Arabia Bay Soil Temperature Data Year 4 (2023)

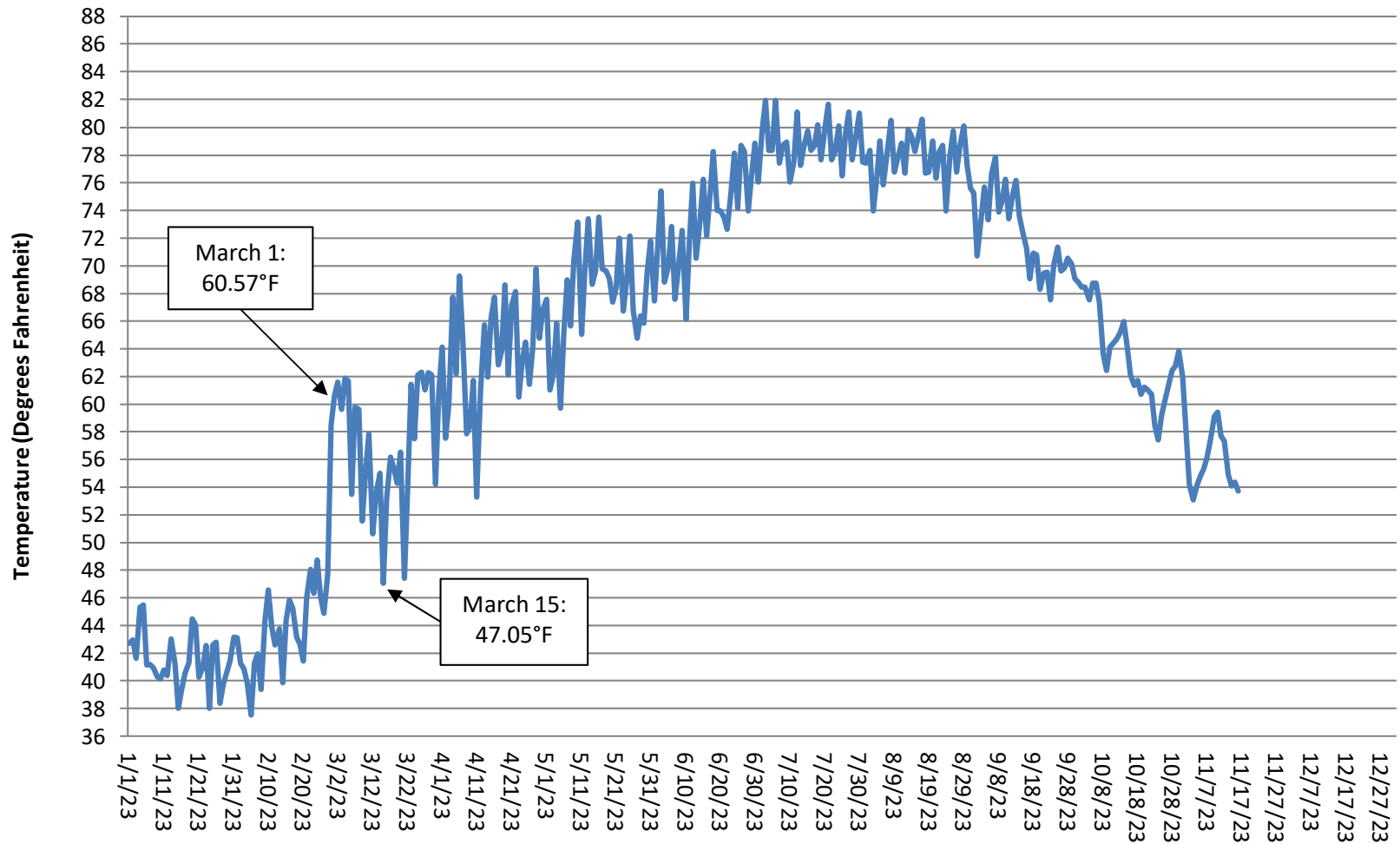
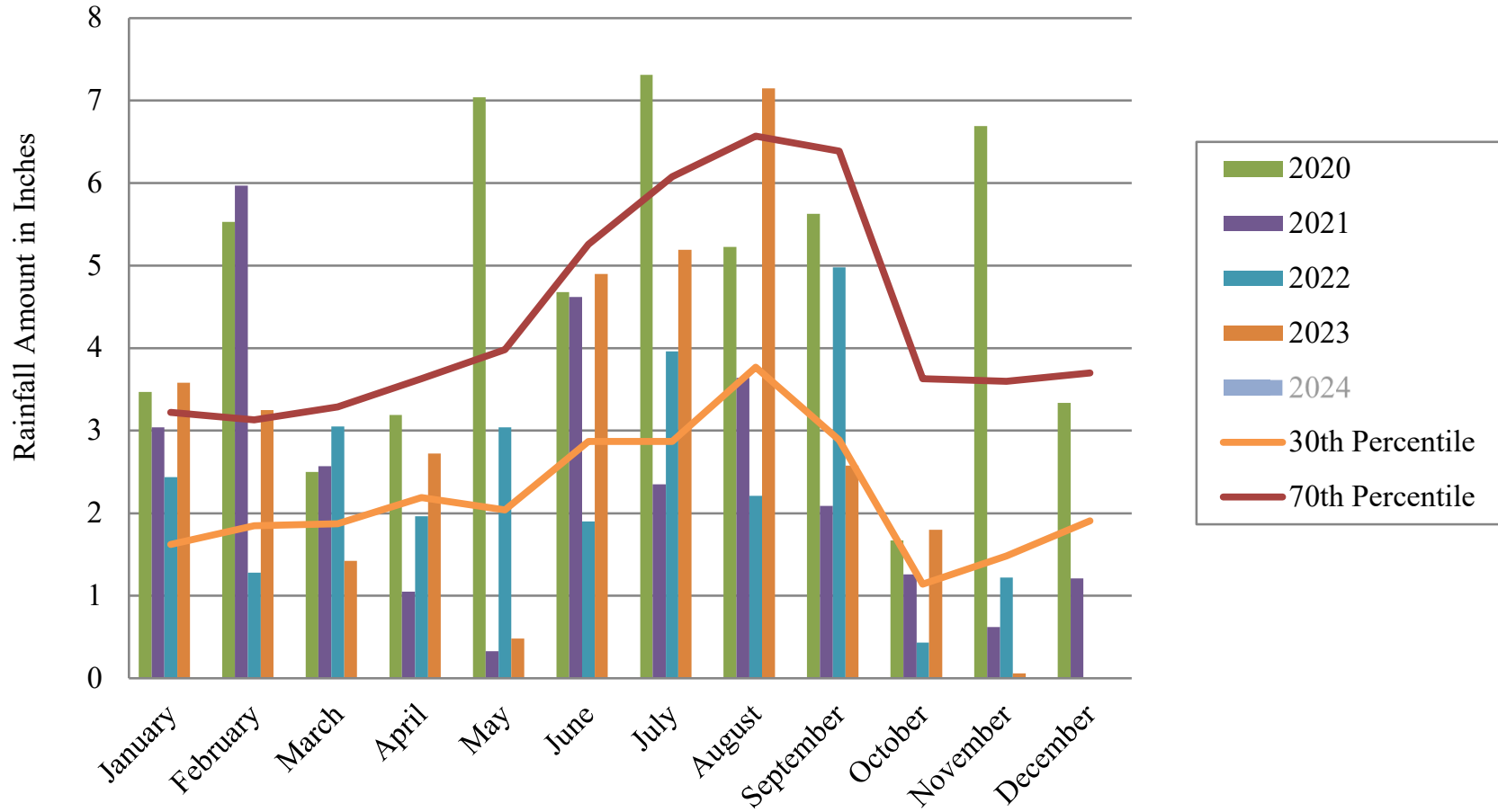


Figure D1: Arabia Bay 30-70 Percentile Graph for Rainfall

Current year data from onsite rain gauge

30-70th percentile data from WETS Station: Fayetteville, NC



SOIL PROFILE DESCRIPTION FORM

PROFILE ID: Arabia Reference

NAME: A. Baldwin

DATE: July 20, 2023

PROJECT NUMBER/NAME: Arabia Bay – Reference

LOCATION: 2190 Arabia Rd, Raeford, NC (34.959864, -79.169201)

WEATHER: Cloudy 72°

LANDSCAPE POSITION: Carolina Bay SLOPE (%): 0

VEGETATION/CROP: Successional forest (pines, red maple, sweet gum, holly, blueberry, smilax)

SOIL MAP UNIT: Mc - McColl HYDRIC SOIL FIELD INDICATOR: F3 – Depleted Matrix

DEPTH TO WATER: N/A DEPTH TO SHWT: ~6-inches

DEPTH (inches)	MATRIX		REDOXIMORHIC FEATURES			TEXTURE
	COLOR	%	TYPE ¹ /LOCATION ²	COLOR	%	
0-6	10YR 2/1	100				SL
6-13	10YR 5/1	60	D/M	10YR 3/1	40	C
13-20	10YR 5/1	85	D/M	10YR 3/1	15	C
20-29+	10YR 4/6					SCL

¹Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. ²Location: PL=Pore Lining, M=Matrix.

NOTES: Timbered b/w 2003-2005, water marks on trees

