MONITORING REPORT (MY1)

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 2020
Submission: December 2020

Prepared for:

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

Arabia Bay Year 1, 2020 Monitoring Summary

General Notes

- No encroachment was identified in Year 1 (2020)
- No evidence of nuisance animal activity (i.e., heavy deer browsing) was observed.
- Project Photo Log: https://photos.app.goo.gl/wtHHbgvocfkBgpo96

Wetlands

- All fourteen of fourteen groundwater gauges met success for the Year 1 (2020) monitoring period. Wetland hydrology data is in Appendix D.

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 2nd, 2020*	March 2-November 12 (256 days)	**26 days**

*Based on observed/documented bud burst and data collected from a soil temperature data logger located on the Site.

Table 10. Groundwater Hydrology Data (Appendix D)

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%)						
2	Yes - 72 days (28.1%)						
3	Yes - 72 days (28.1%)						
4	Yes - 93 days (36.3%)						
5	Yes - 95 days (37.1%)						
6	Yes - 36 days (14.1%)						
7	Yes - 77 days (30.1%)						
8	Yes - 85 days (33.2%)						
9	Yes - 94 days (36.7%)						
10	Yes - 69 days (27.0%)						
11	Yes - 28 days (10.9%)						
12	Yes - 61 days (23.8%)						
13	Yes - 34 days (13.3%)						
14	Yes - 31 days (12.1%)						

Vegetation

- Measurements of all 16 plots resulted in an average of 513 planted stems/acre. Additionally, all individual plots met success criteria except plot 12, which was 1 stem shy of meeting success criteria (Tables 7-9, Appendix C).

Site Permitting/Monitoring Activity and Reporting History

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Technical Proposal (RFP No. 16-007332)	February 8th, 2018	February 8th, 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 24th, 2020
As-Built Survey	February 2020	March 2020
As-built Monitoring Report	February 2020	March 2020
MY1 Monitoring Report	November 2020	December 2020

Site Maintenance Report (2020)

Invasive Species Work	Maintenance work
07-09-2020 China Berry, Privet, Mimosa, Callery Pear, Sweet Gum 09-30-2020 Cattail, Privet, Callery Pear, Chinaberry Tree	None

Response to IRT Comments – As-Built and Baseline Monitoring Document

Comments Received April 15th, 2020
IRT Site Visit May 20th, 2020

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

USEPA Comments, Todd Bowers:

1. There seems to be baseline hydrology data missing. The monitoring summary table lists hydrology as a monitored parameter for the as-built report. Please clarify the language.
   Hydrology data is typically not provided during the As-Built/Baseline Monitoring Report, as wetland gauges have either just been installed or have not been in the ground long enough to provide relevant data.

DWR Comments, Erin Davis:

1. Page 4, Section 1.3 –
   a. First sentence - Should 16.1 WMUs and acres be 16.0 to be consistent with Table 1? Same with bullet #4 "Planted 16.1 acres". Also, "riparian" wetland restoration should be changed to "non-riparian".

   Restoration Systems' (RS) contract with the NC DMS is for 16 Non-Riparian WMUs. Though 16.1 acres were restored via a wetland re-establishment approach, RS is only requesting the 16 Non-Riparian WMUs. Table 1 (Appendix A) now reflects RS' contract amount, 16 WMUs.

   b. Bullet #3 states the average pool depth is 6 to 12 inches. However, the final mitigation plan states that the habitat pools will be a max. depth of 6 inches. Please explain this change in design and the implications for vegetation establishment related to inundation depth and duration.

   During construction, suitable clay material was located onsite and used for ditch plugs. The final grade was slightly below the proposed 6 inches in these areas but did not go below 12-inches. RS filled these areas with large woody debris.

   c. Bullet #4 states 10,600 stems planted, but Table 5 lists a total of 10,300 stems. And the final mitigation plan states that 10,900 stems will be planted. Please confirm the total number of stems planted, and if less than the approved design total please explain why.

   10,300 stems were planted. A reduced number of stems were planted given the reduced acreage of habitat pools between the mitigation plan (2.8 acres) and the as-built (1.6 acres).

2. Page 6, Monitoring Summary – Please include bud burst along with soil temperature data in support of the growing season start date.

   This information is provided above in the Monitoring Summary and within Appendix D

3. Table 2 – Should dates for earthwork completion, planting, and as-built survey be included?

   These dates have been added to Table 2, located in the Monitoring Summary and within Appendix A.

4. Figure 2 –
   a. Please confirm whether the total area of habitat pools is 1.6 acres (Fig. 2) or 1.8 acres (Sheet 3 of 4).

   The discrepancy between 1.6 and 1.8 acres results from the surveyor applying a polygon simplification algorithm to their work, which softens the lines seen in Figure 2. Figure 2 shows the actual surveyed points of the habitat pools.

   b. The location, size and quantity of habitat pools appear notably different from that presented in the final mitigation plan. The mitigation plan showed 14 pools located primarily around the perimeter of the restoration area. Figure 2 show 36 smaller pools, with the larger pools located near the center of the restoration area. DWR understands that some variability with size and location of pools from mit plan to as-built is expected, but would like a brief explanation for these construction field changes.

   The change is the result of finding suitable clay for ditch plugs within the larger pools. As a result of harvesting clay in these areas, fewer and small pools were required elsewhere for fill material.

c. Particularly for wetland restoration projects, it would be helpful to note if there are shifts (more than just a few feet) in monitoring locations (veg plots and wells) from the final monitoring plan.
Understood – See Figure below comment responses "Arabia Bay Wetland Mitigation Site Mit Plan Monitoring Device Location VS As-Built Location".

5. Table 6 – Please confirm whether common hackberry was planted or if it's a typo for buttonbush.
Hackberry was not planted and was a typo for buttonbush.

6. DWR appreciates the inclusion of soil boring logs for all of the groundwater well locations. This 2016 IRT Guidance Update condition (page 15, A.3.) is not often included in MY0 reports, but the collected data is useful. The Sheet 4 monitoring elevation data is also good information to have.
Thanks

7. The construction and planting photo log (including dates and descriptions) was helpful for this review.
Good to know

8. DWR would like to visit this Site within the next year.
We are happy to schedule a site visit when appropriate.

USACE Comments, Kim Browning:

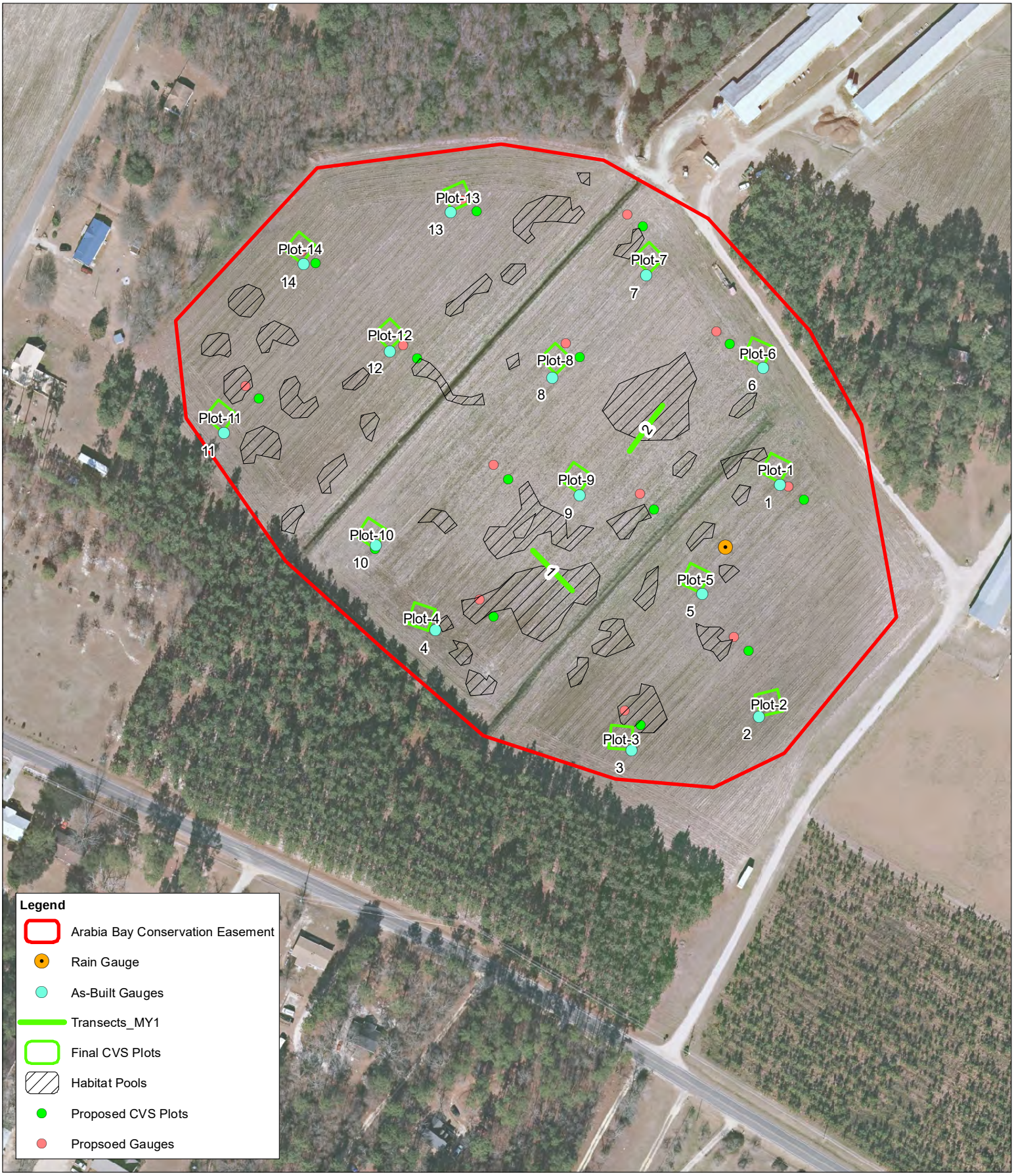
1. The success criteria for vegetation needs to be revised to exclude the statement "Volunteer Loblolly pine which is not included in the planting list is a desirable species for the restoration of the vegetative community and will count towards vegetative success." Loblolly Pine (P. teada) is not a desirable species and will likely inhabit the Site anyway given the surrounding vegetation on adjacent properties.
Loblolly pine has been removed from the vegetation success summary within the monitoring report.

2. There are concerns with the habitat pools being 6"-12" and the inundation effect on vegetation. The final mitigation plan response to IRT comments states, "We acknowledge the habitat areas will not exceed 6 inches in depth and will not include gauges. The location and extent of the habitat areas has been developed and is shown on the design sheets. The size and extent of the habitat areas was determined by back calculating the volume of fill needed to fill in the existing ditches. The volume of fill required to fill the ditches is 2,300 cubic-yards, which equates to 1.4 acre-feet. When factoring in the 6-inch max depth of the habitat areas the area required is doubled to 2.8 acres. The habitat areas vary in shape and are distributed throughout the Project. Habitat areas were not placed in the middle of the Project as it is expected this will be the wettest area of the Project and would not benefit from the constructed habitat areas. Habitat areas will comprise 2.8-acres and be constructed by excavating multiple depressions ranging in size from 0.10-0.35 acres with a depth of no greater than 6-inches."
Understood. The final location of habitat pools resulted from suitable clay being found onsite for use as ditch plugs. Clay was in the middle portion of the Site, and is why habitat pools were constructed in these areas. Yr.1 (2020) vegetation monitoring, including visual inspection, indicates the planted habitat pool species have established and are doing well. RS will continue to monitor these areas with random vegetation transects during out-year monitoring efforts.

3. It's noted that Bald Cypress (Taxodium distichum) was planted in the Riverine Wet Hardwood Forest. Are there concerns about meeting the vigor requirement given that Bald Cypress may take longer to establish the first few years?
   At this time, RS is not concerned with Bald Cypress meeting the vigor requirement. Given suitable habitat, Bald Cypress grows moderately fast, generally 1 to 2 feet per year (https://hgic.clemson.edu/factsheet/bald-cypress/#:~:text=Bald%2Dcypress%20(USDA%20cold%20hardiness,to%202%20feet%20per%20year)

4. Please add veg plots to the habitat pool areas, random is fine. The Pond Cypress success should be documented.
   RS conducted two random vegetation plots within the habitat pool areas in Year 1 (2020) monitoring and will continue to do so during out-year monitoring

5. This Site has been added to the back-logged list of IRT site visits.
   Understood.



RESTORATION SYSTEMS, LLC
1101 HAYNES ST, SUITE 211
RALEIGH, NC 27604
PHONE : 919.755.9490
FAX : 919.755.9492

SCALE: 1 in = 185 ft
DATE: 12-2020
SITE: L-03-001

Arabia Bay Wetland Mitigation Site
Mit Plan Monitoring Device Location VS As-Built Location

Feet
0 40 80 160 240 320

Aerial Imagery: (c) ESRI
Coordinate System: NAD_1983_SP_NC_FIPS_3200_Ft.

DRAFT

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And

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Table 2. Project Activity and Reporting History
Table 3. Project Contacts Table
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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.

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 of agricultural ditches and planting with 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.

Wetland Targeted Functions, Goals, and Objectives

Targeted Functions	Goals	Objectives
(1) HYDROLOGY		
(2) Surface Storage & Retention	• Minimize downstream flooding to the maximum extent possible.	• 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		
(1) WATER QUALITY		
(2) Pollution Change	• Remove direct nutrient, sediment, and pollutant inputs from the Site.	• 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	• Improve wildlife habitat within and adjacent to the Site.	• 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		

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]), and
- A permanent seed mix was applied across the Site.

Site design was completed in November 2018. Construction started on August 5th, 2019, and ended with a final walkthrough on August 22nd, 2019. The Site was planted on January 24th, 2020, and visits 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 24th, 2016, NC Interagency Review Team *Wilmington District Stream and Wetland Compensatory Mitigation Update*. Monitoring and success criteria relate to project goals and objectives. Several of the 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
• 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
• 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. o 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 24th, 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 31st 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							
Vegetation							
Visual Assessment							
Report Submittal							

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; *CVS-EEP Protocol for Recording Vegetation*, *Version 4.2* (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 and height

*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 2nd, 2020*	March 2-November 12 (256 days)	26 days

*Based on observed/documented bud burst and data collected from a soil temperature data logger located on the Site.

All 14 groundwater gauges met success criteria for the year 1 (2020) monitoring period (Appendix D).

Vegetation Summary

During quantitative vegetation sampling, 14 sample plots (10-meter by 10-meter) were installed within the Site as per guidelines established in *CVS-EEP Protocol for Recording Vegetation*, *Version 4.2* (Lee et al. 2008). Year 1 (2020) measurements occurred September 23rd, 2020, and included two (2) additional random plots (25-meter by 4-meter). Measurements of all 16 plots resulted in an average of 513 planted stems/acre. Additionally, all individual plots met success criteria except plot 12, which was 1 stem shy of meeting success criteria (Tables 7-9, Appendix C).

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

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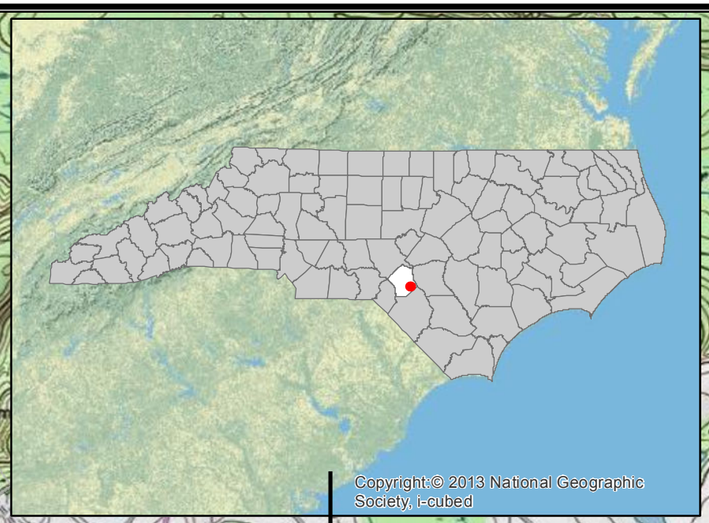
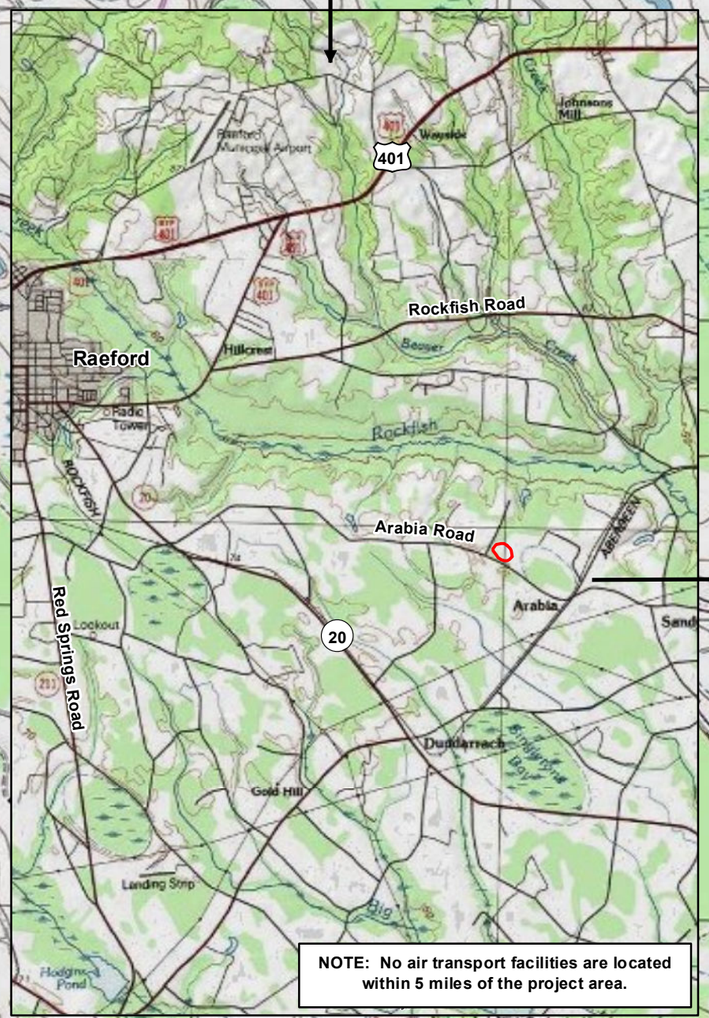
United States Department of Agriculture (USDA). 1984. Soil Survey of Cumberland and Hoke Counties, North Carolina. United States Department of Agriculture, Soil Conservation Service.

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.

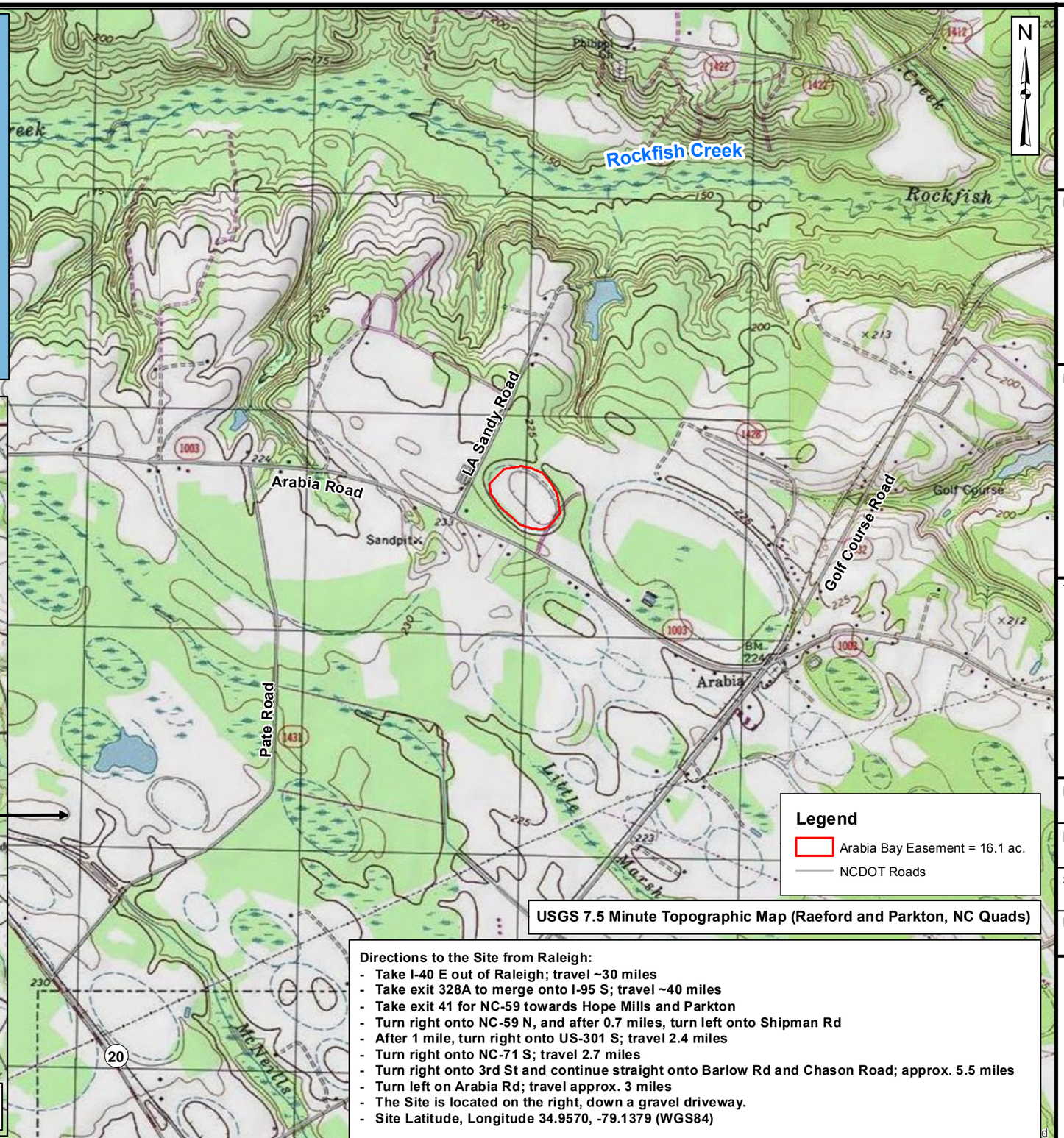
Appendix A
Background Tables and Map

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





NOTE: No air transport facilities are located within 5 miles of the project area.



Legend

- Arabia Bay Easement = 16.1 ac.
- NCDOT Roads

USGS 7.5 Minute Topographic Map (Raeford and Parkton, NC Quads)

Directions to the Site from Raleigh:

- Take I-40 E out of Raleigh; travel ~30 miles
- Take exit 328A to merge onto I-95 S; travel ~40 miles
- Take exit 41 for NC-59 towards Hope Mills and Parkton
- Turn right onto NC-59 N, and after 0.7 miles, turn left onto Shipman Rd
- After 1 mile, turn right onto US-301 S; travel 2.4 miles
- Turn right onto NC-71 S; travel 2.7 miles
- Turn right onto 3rd St and continue straight onto Barlow Rd and Chason Road; approx. 5.5 miles
- Turn left on Arabia Rd; travel approx. 3 miles
- The Site is located on the right, down a gravel driveway.
- Site Latitude, Longitude 34.9570, -79.1379 (WGS84)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

ARABIA BAY WETLAND MITIGATION SITE

Hoke County, NC

Title:

SITE LOCATION

Drawn by: KRJ

Date: JAN 2019

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 8th, 2018	February 8th, 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 24th, 2020
As-Built Survey	February 2020	March 2020
As-built Monitoring Report	February 2020	March 2020
MY1 Monitoring Report	November 2020	December 2020

Table 3. Project Contacts Table
Arabia Bay Restoration Site

Full Delivery Provider Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 Worth Creech 919-755-9490	**Construction Contractor** Land Mechanic Designs 780 Landmark Road Willow Spring, NC 27592 Lloyd Glover 919-639-6132
Designer Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693	**Planting Contractor** Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 Worth Creech 919-755-9490
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	**As-built Surveyor** K2 Design Group 5688 US Highway 70 East Goldsboro, NC 27534 John Rudolph 919-751-0075
	Baseline & Monitoring Data Collection Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693

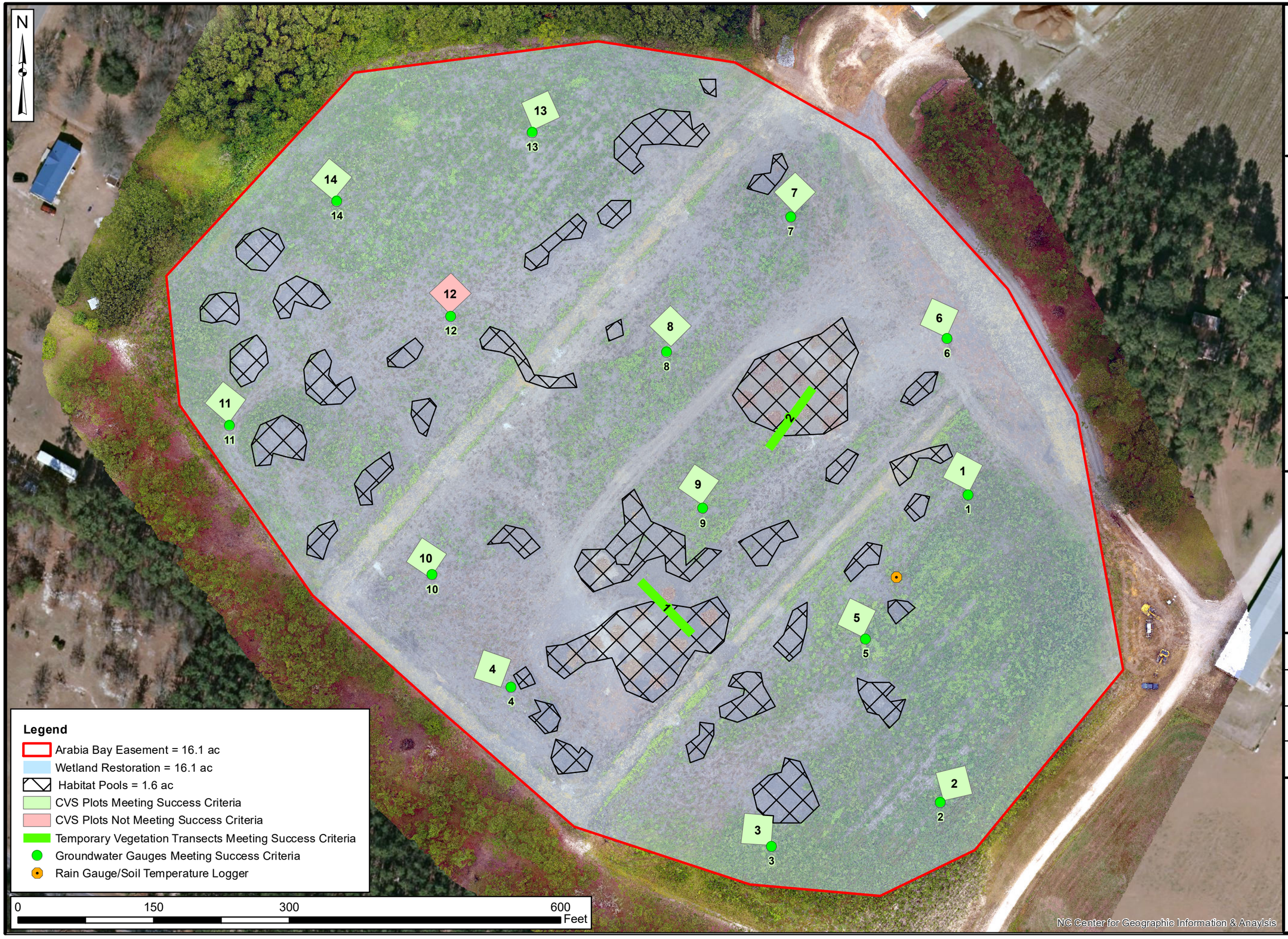
Table 4. Project Attribute Table
Arabia Bay Restoration Site

Project Information			
Project Name	Arabia Bay Restoration Site		
Project County	Hoke County, North Carolina		
Project Area (acres)	16.1		
Project Coordinates (latitude & latitude)	34.9570ºN, 79.1379ºW		
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	McColl		
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)
Waters of the United States-Section 404	Yes	Yes	Approved JD (App D)
Endangered Species Act	Yes	Yes	CE Document (App E)
Historic Preservation Act	Yes	Yes	CE Document (App E)
Coastal Zone Management Act	No	--	CE Document (App E)
FEMA Floodplain Compliance	No	--	CE Document (App E)
Essential Fisheries Habitat	No	--	CE Document (App E)

*Included in the Detailed Mitigation Plan

Appendix B
Visual Assessment Data

Figure 2. Current Conditions Plan View
Table 5. Vegetation Condition Assessment
Vegetation Plot Photographs



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

ARABIA BAY WETLAND MITIGATION SITE

Hoke County, NC

Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by: KRJ

Date: DEC 2020

Scale: 1:1200

Project No.: 18-016

FIGURE

2

Table 5 — Vegetation Condition Assessment

Arabia Bay

Planted Acreage[1] **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 Acreage[2] **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]	None	none	none	0	0.00	0.0%

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

2 = The acreage within the easement boundaries.

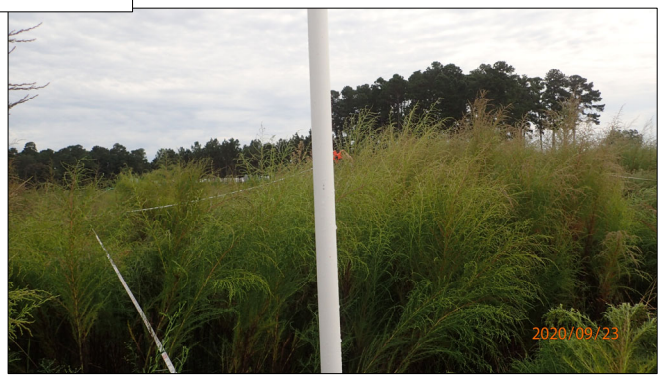
3 = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e.,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

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

Arabia Bay
MY-01 (2020) Vegetation Monitoring Photographs
Taken September 2020

Plot 1

Plot 2



Plot 3

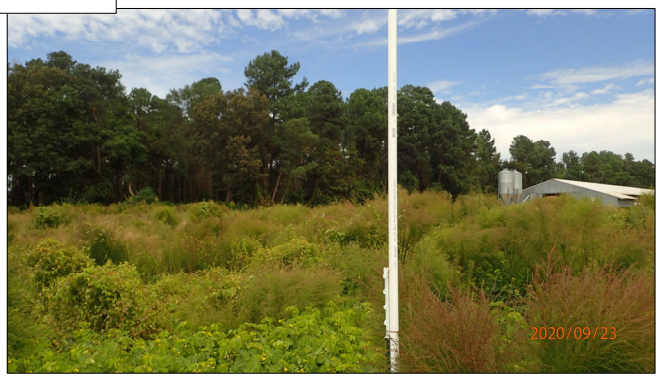
Plot 4

Plot 5

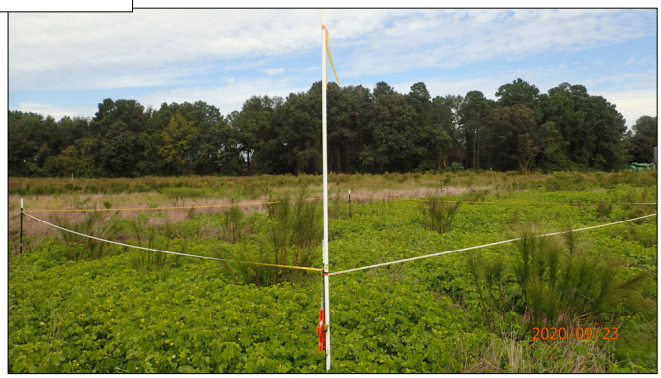
Plot 6

Arabia Bay
MY-01 (2020) Vegetation Monitoring Photographs
Taken September 2020

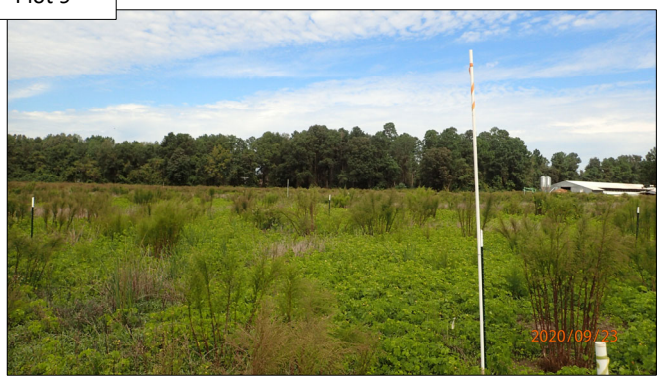
Plot 7



Plot 8



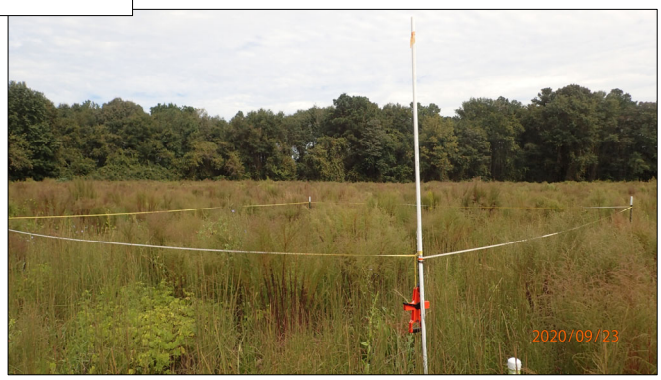
Plot 9



Plot 10

Plot 11

Plot 12



Arabia Bay
MY-01 (2020) Vegetation Monitoring Photographs
Taken September 2020

Plot 13

Plot 14

Appendix C
Vegetation Data

Table 6. Planted Bare Root Woody Vegetation
Table 7. Total Stems by Plot and Species
Table 8. Temporary Vegetation Plot Data
Table 9. Planted Vegetation Totals

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

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

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

Totals =	**10,300**

Table 7. Total Stems by Plot and Species
Project Code 18016. Project Name: Arabia Bay

			Current Plot Data (MY1 2020)																						
			18016-01-0001			18016-01-0002			18016-01-0003			18016-01-0004			18016-01-0005			18016-01-0006			18016-01-0007			18016-01-0008		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Celtis occidentalis	common hackberry	Tree																							
Cephalanthus occidentalis	common buttonbush	Shrub																						4	4	4
Fraxinus pennsylvanica	green ash	Tree	1	1	1	1	1	1	6	6	6							3	3	3						
Magnolia virginiana	sweetbay	Tree	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1				1	1	1			
Nyssa	tupelo	Tree				1	1	1				2	2	2				1	1	1	2	2	2	4	4	4
Nyssa sylvatica	blackgum	Tree							1	1	1	2	2	2												
Quercus	oak	Tree				1	1	1																		
Quercus bicolor	swamp white oak	Tree	1	1	1	1	1	1																1	1	1
Quercus lyrata	overcup oak	Tree				2	2	2	2	2	2	1	1	1	2	2	2	1	1	1	1	1	1			
Quercus michauxii	swamp chestnut oak	Tree				1	1	1	1	1	1										4	4	4	1	1	1
Quercus nigra	water oak	Tree	3	3	3				2	2	2	2	2	2				3	3	3	4	4	4	1	1	1
Quercus pagoda	cherrybark oak	Tree	1	1	1	9	9	9	1	1	1	1	1	1	1	1	1	1	1	1				1	1	1
Taxodium distichum	bald cypress	Tree	1	1	1				6	6	6	4	4	4	4	4	4				1	1	1			
Unknown		Shrub or Tree																								
		Stem count	8	8	8	18	18	18	20	20	20	13	13	13	8	8	8	9	9	9	13	13	13	12	12	12
		size (ares)	1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	6	6	6	8	8	8	8	8	8	7	7	7	4	4	4	5	5	5	6	6	6	6	6	6
		Stems per ACRE	323.7	323.7	323.7	728.4	728.4	728.4	809.4	809.4	809.4	526.1	526.1	526.1	323.7	323.7	323.7	364.2	364.2	364.2	526.1	526.1	526.1	485.6	485.6	485.6

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes
P-all = Planted including livestakes
T = All planted and natural recruits including livestakes
T includes natural recruits

Table 7. Total Stems by Plot and Species (continued)
Project Code 18016. Project Name: Arabia Bay

			Current Plot Data (MY1 2020)																	Annual Means					
			18016-01-0009			18016-01-0010			18016-01-0011			18016-01-0012			18016-01-0013			18016-01-0014			MY1 (2020)			MY0 (2020)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Celtis occidentalis	common hackberry	Tree																						1	1	1
Cephalanthus occidentalis	common buttonbush	Shrub																			4	4	4	2	2	2
Fraxinus pennsylvanica	green ash	Tree	2	2	2	2	2	2										2	2	2	17	17	17	17	17	17
Magnolia virginiana	sweetbay	Tree										1	1	1	6	6	6	2	2	2	16	16	16	20	20	20
Nyssa	tupelo	Tree				1	1	1	5	5	5	1	1	1				2	2	2	19	19	19	26	26	26
Nyssa sylvatica	blackgum	Tree							1	1	1	1	1	1	1	1	1				6	6	6	6	6	6
Quercus	oak	Tree							1	1	1										2	2	2	4	4	4
Quercus bicolor	swamp white oak	Tree	1	1	1	4	4	4										1	1	1	9	9	9	8	8	8
Quercus lyrata	overcup oak	Tree	5	5	5							2	2	2				1	1	1	17	17	17	22	22	22
Quercus michauxii	swamp chestnut oak	Tree																2	2	2	9	9	9	9	9	9
Quercus nigra	water oak	Tree	1	1	1							2	2	2				1	1	1	19	19	19	20	20	20
Quercus pagoda	cherrybark oak	Tree				2	2	2	2	2	2										19	19	19	29	29	29
Taxodium distichum	bald cypress	Tree				2	2	2	2	2	2				3	3	3				23	23	23	26	26	26
Unknown		Shrub or Tree																						2	2	2
		Stem count	9	9	9	11	11	11	11	11	11	7	7	7	10	10	10	11	11	11	160	160	160	192	192	192
		size (ares)	1			1			1			1			1			1			14			14		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.35			0.35		
		Species count	4	4	4	5	5	5	5	5	5	5	5	5	3	3	3	7	7	7	12	12	12	14	14	14
		Stems per ACRE	364.2	364.2	364.2	445.2	445.2	445.2	445.2	445.2	445.2	283.3	283.3	283.3	404.7	404.7	404.7	445.2	445.2	445.2	462.5	462.5	462.5	555	555	555

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes
P-all = Planted including livestakes
T = All planted and natural recruits including livestakes
T includes natural recruits

Table 8. Temporary Vegetation Plot Data
Arabia Bay Restoration Site

Species	25m x 4m Temporary Plot (Bearing)	
	T-1 (136°)	T-2 (37°)
Nyssa spp.	6	2
Taxodium ascendens	7	11
Taxodium distichum	9	6
Quercus nigra	1	
Diospyros virginiana		1
Total Stems	**23**	**20**
Total Stems/Acre	**931**	**810**

Table 9. Planted Vegetation Totals
Arabia Bay Restoration Site

Plot #	Planted Stems/Acre	Success Criteria Met?
1	324	Yes
2	728	Yes
3	809	Yes
4	526	Yes
5	324	Yes
6	364	Yes
7	526	Yes
8	486	Yes
9	364	Yes
10	445	Yes
11	445	Yes
12	283	No
13	405	Yes
14	445	Yes
T-1	931	Yes
T-2	810	Yes
Average Planted Stems/Acre	**513**	**Yes**

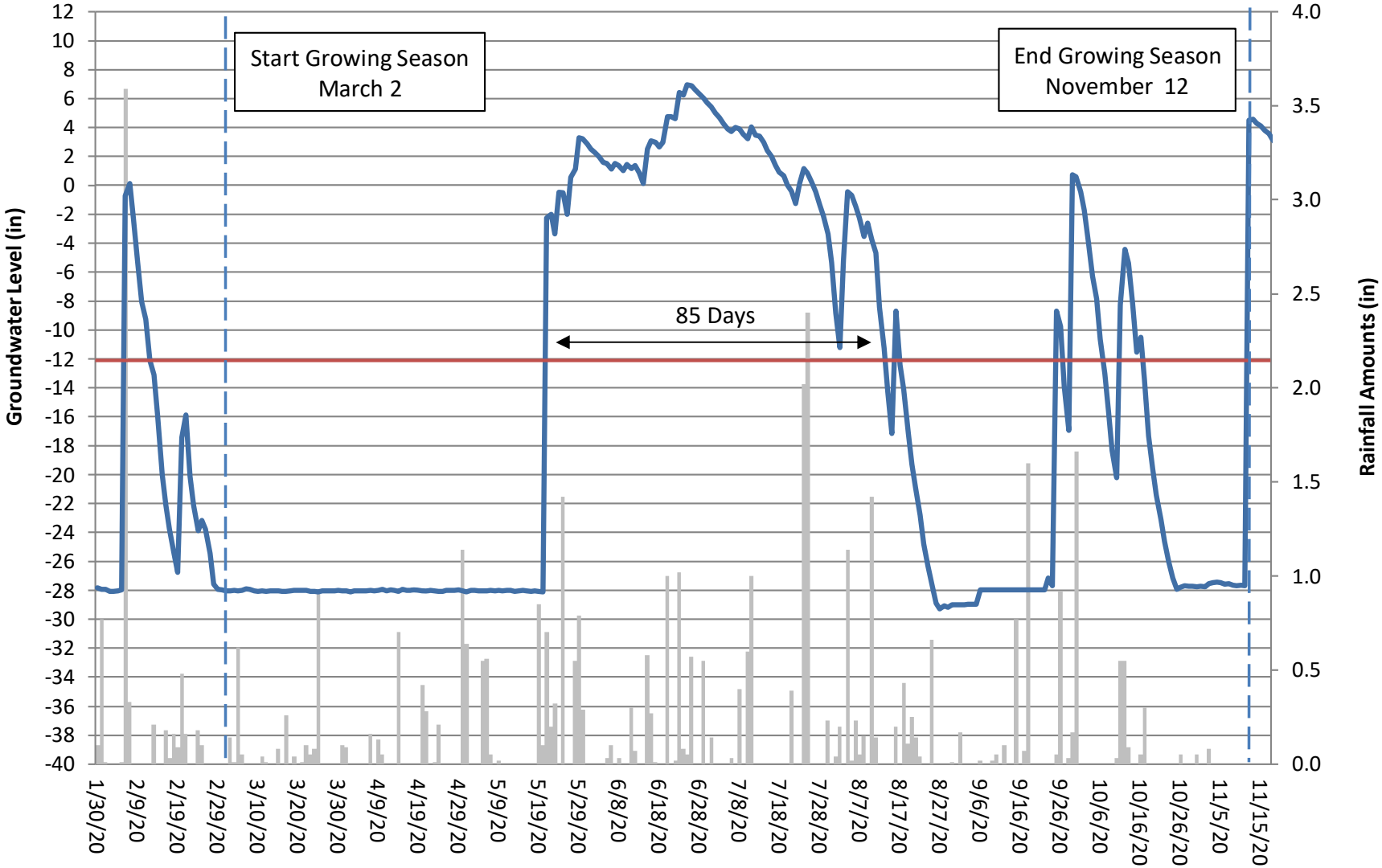
Appendix D
Hydrology Data

Table 10. Groundwater Hydrology Data
Groundwater Gauge Graphs

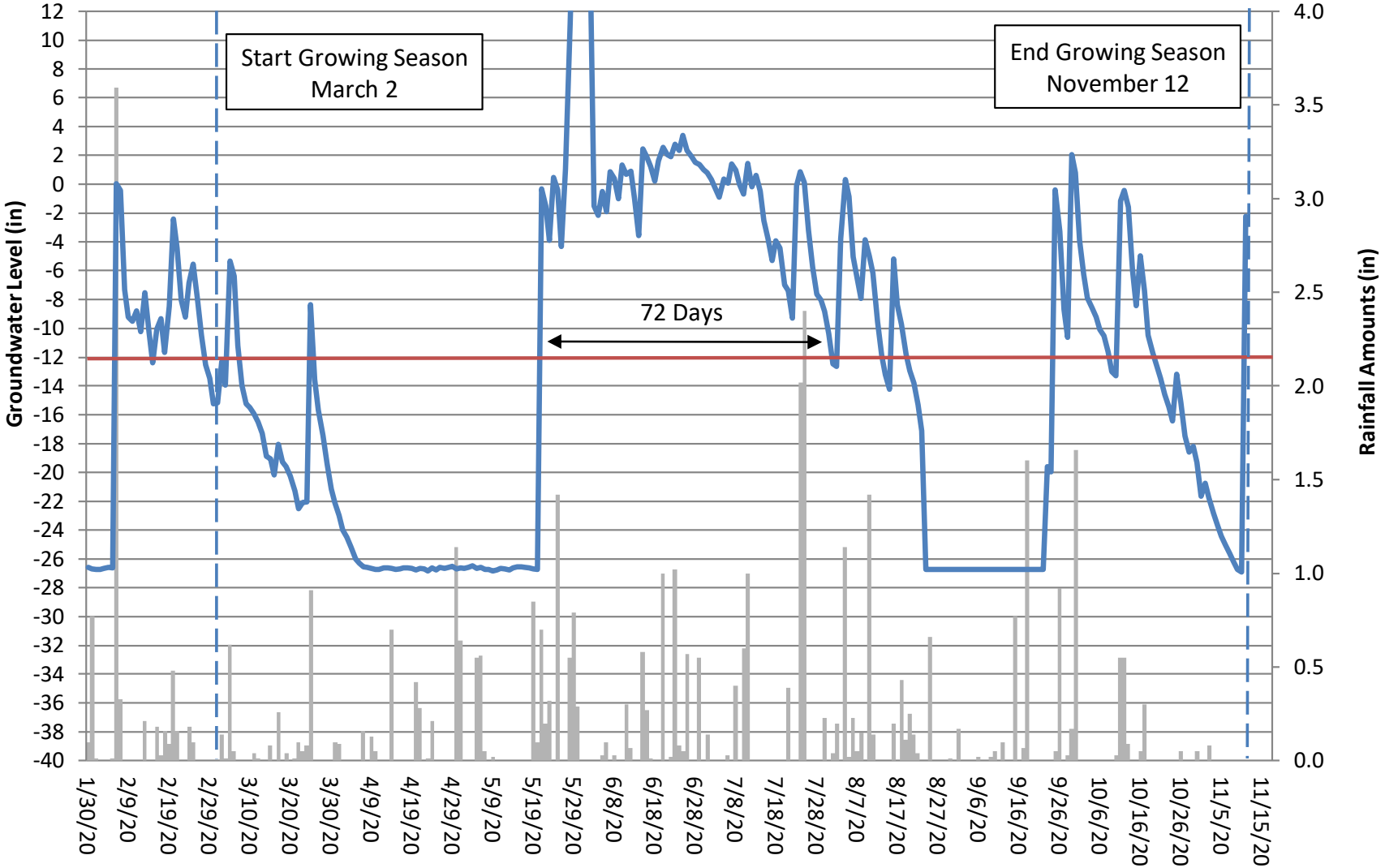
Table 10. Groundwater Hydrology Data

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%)						
2	Yes 72 days (28.1%)						
3	Yes 72 days (28.1%)						
4	Yes 93 days (36.3%)						
5	Yes 95 days (37.1%)						
6	Yes 36 days (14.1%)						
7	Yes 77 days (30.1%)						
8	Yes 85 days (33.2%)						
9	Yes 94 days (36.7%)						
10	Yes 69 days (27.0%)						
11	Yes 28 days (10.9%)						
12	Yes 61 days (23.8%)						
13	Yes 34 days (13.3%)						
14	Yes 31 days (12.1%)						

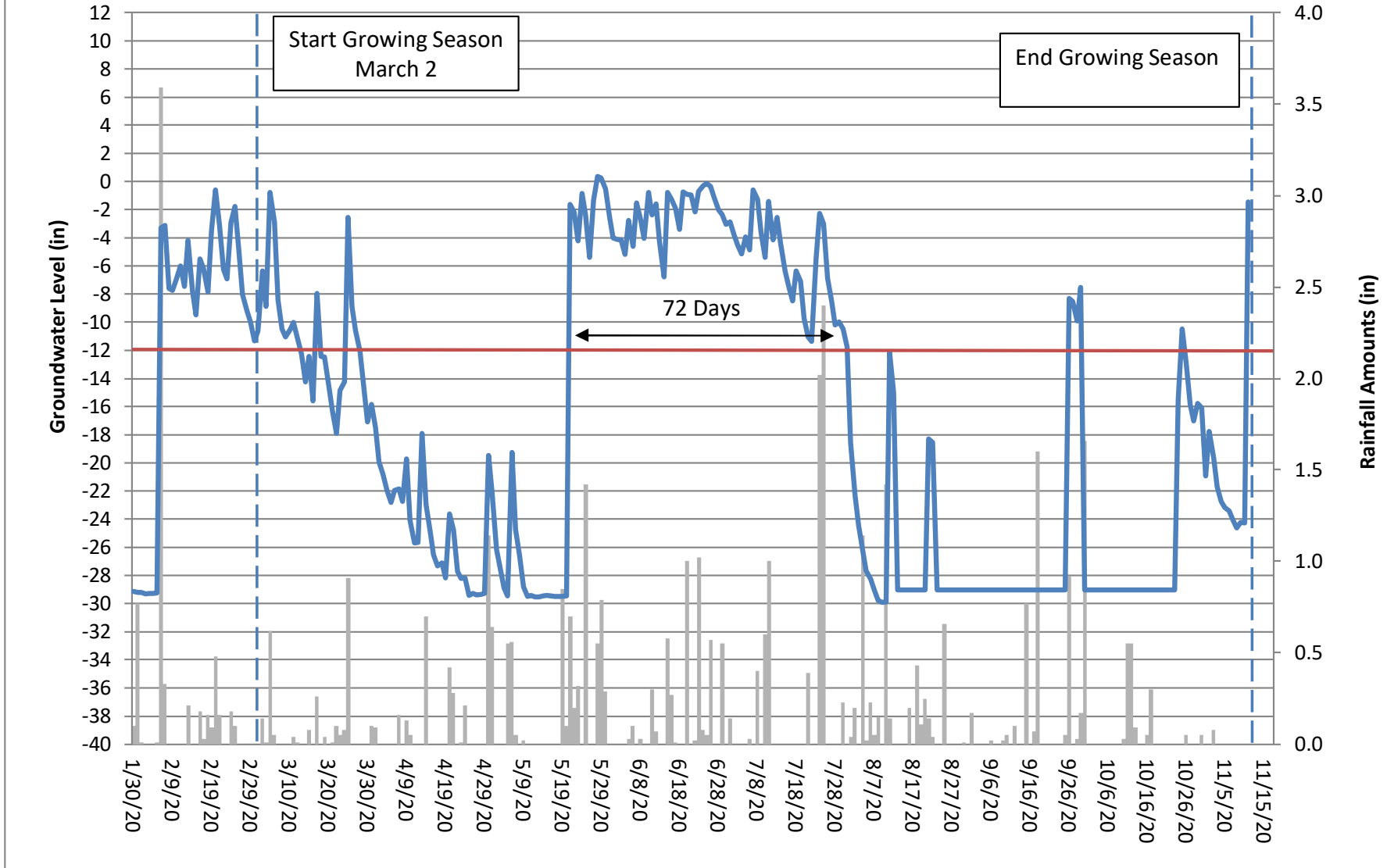
Arabia Bay Groundwater Gauge 1
Year 1 (2020 Data)

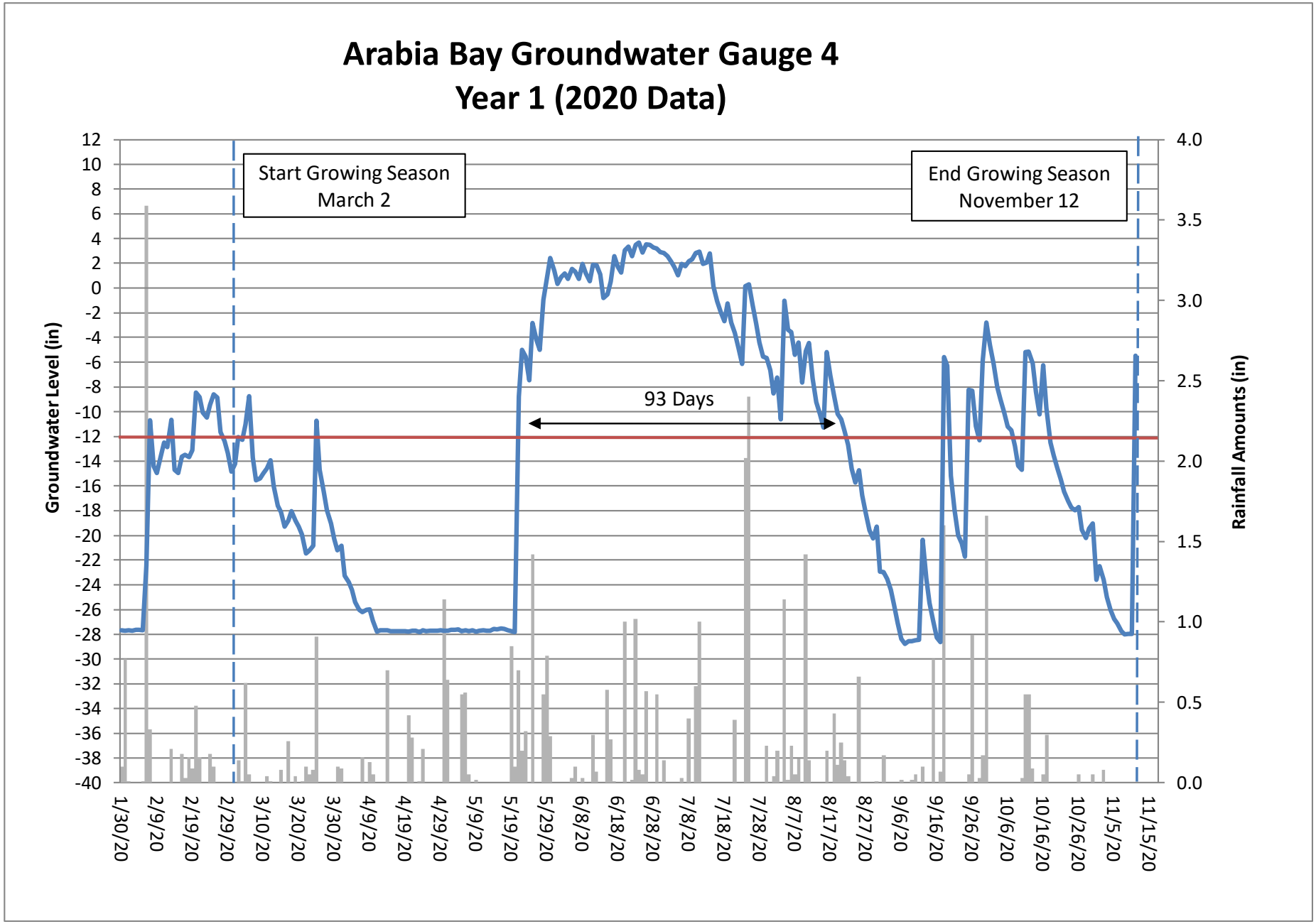


Arabia Bay Groundwater Gauge 2
Year 1 (2020 Data)

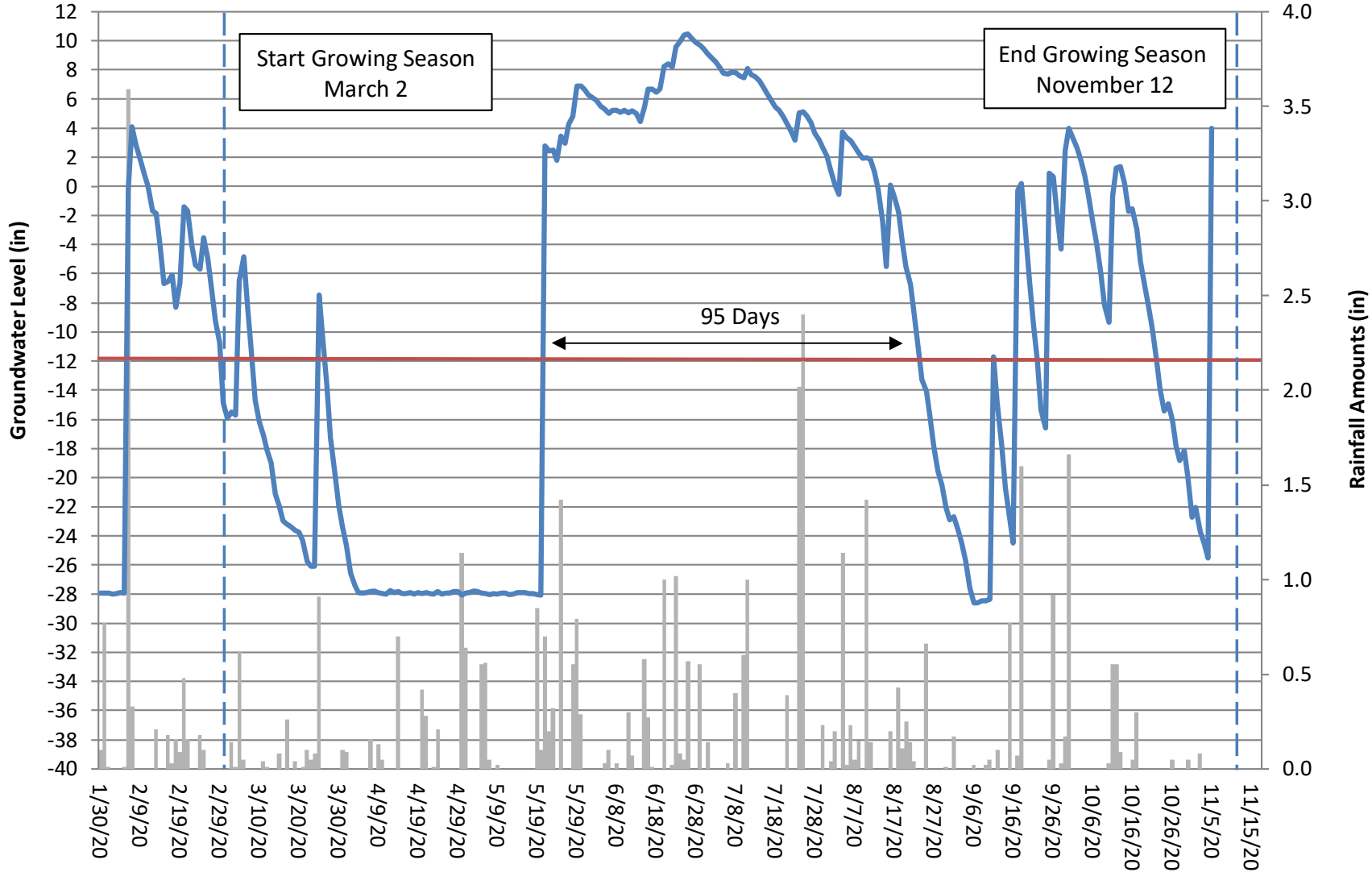


Arabia Bay Groundwater Gauge 3
Year 1 (2020 Data)

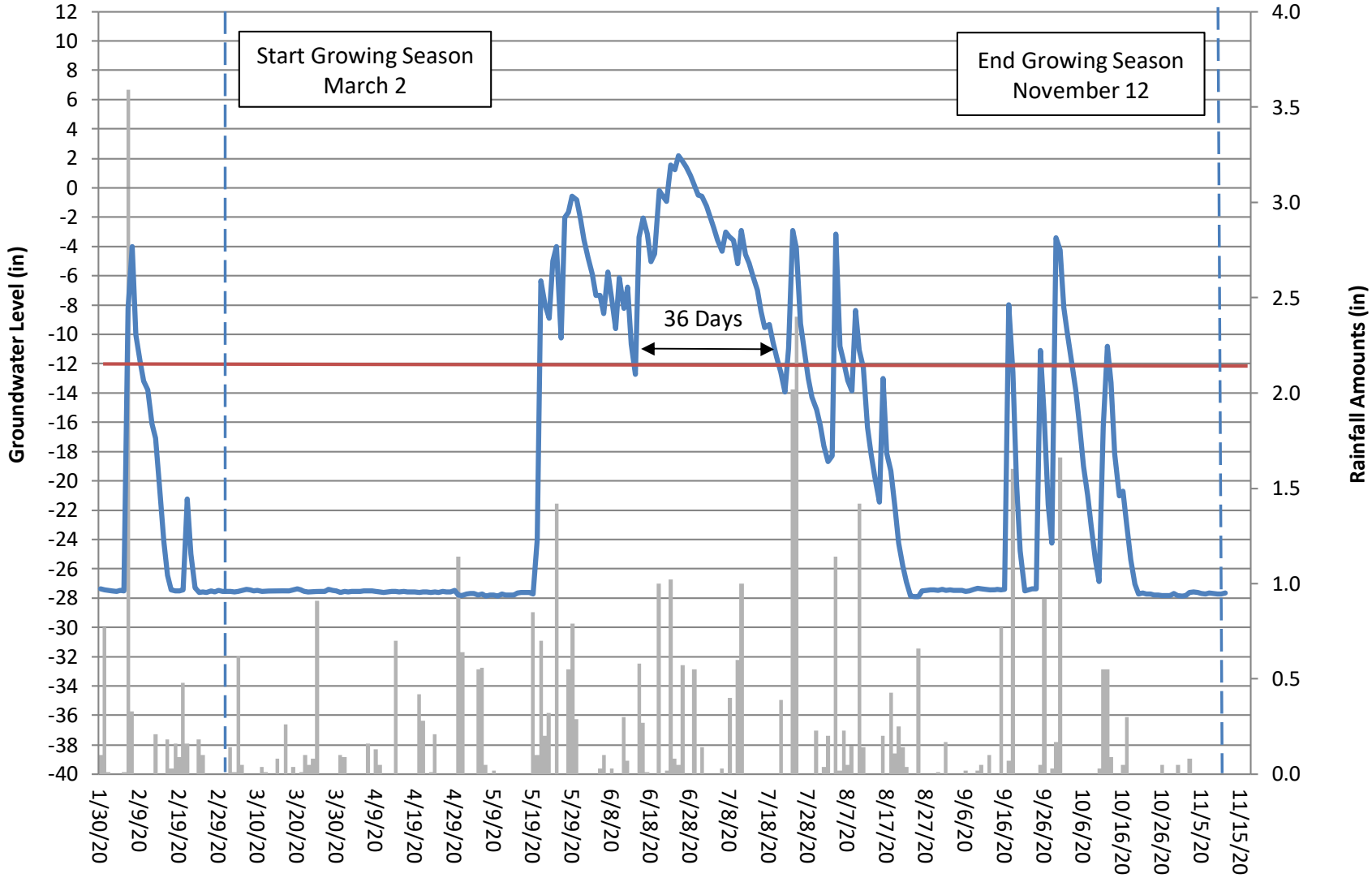



Arabia Bay Groundwater Gauge 4
Year 1 (2020 Data)
Start Growing Season
March 2
End Growing Season
November 12
93 Days
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/30/20
2/9/20
2/19/20
2/29/20
3/10/20
3/20/20
3/30/20
4/9/20
4/19/20
4/29/20
5/9/20
5/19/20
5/29/20
6/8/20
6/18/20
6/28/20
7/8/20
7/18/20
7/28/20
8/7/20
8/17/20
8/27/20
9/6/20
9/16/20
9/26/20
10/6/20
10/16/20
10/26/20
11/5/20
11/15/20

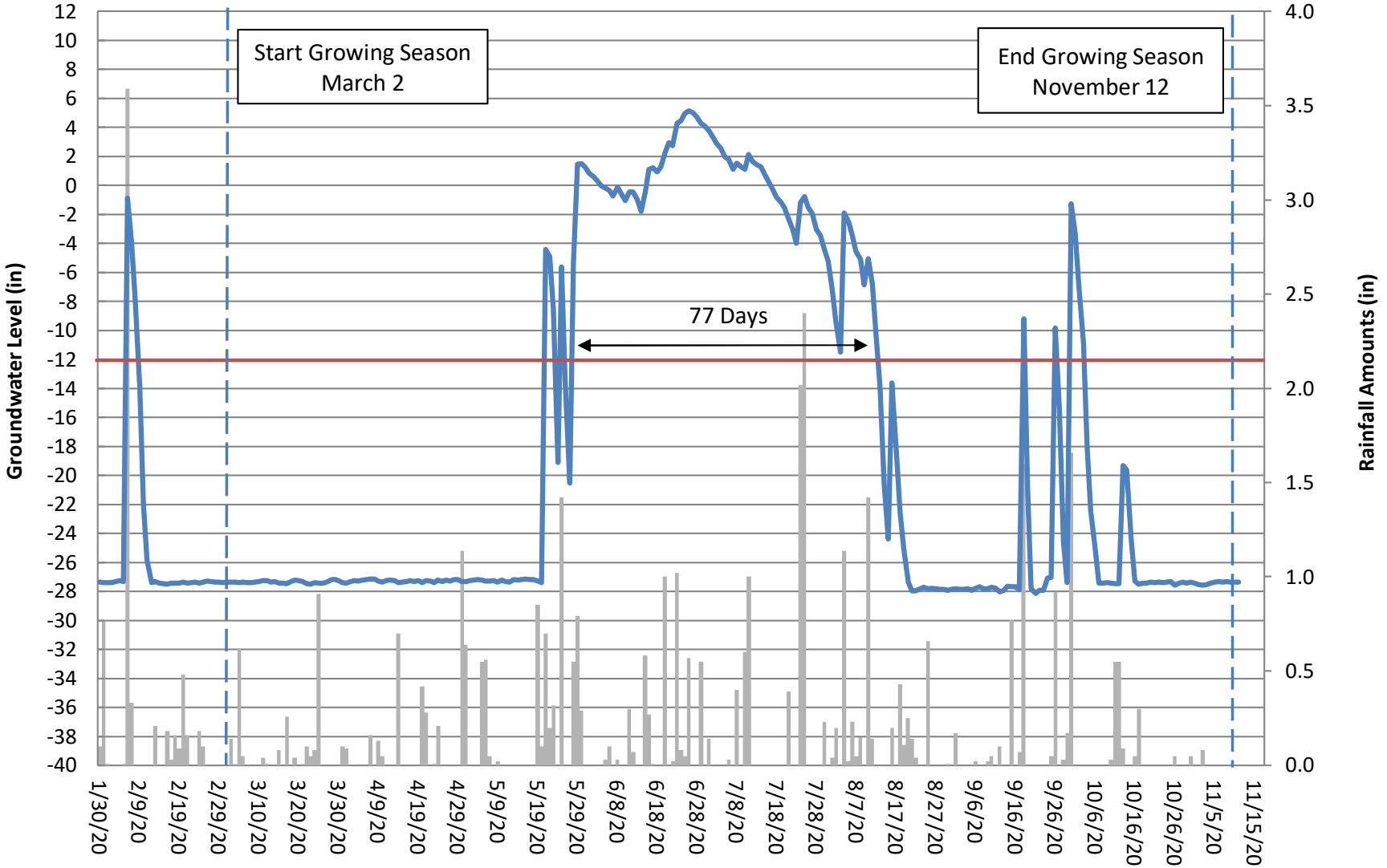
Arabia Bay Groundwater Gauge 5
Year 1 (2020 Data)



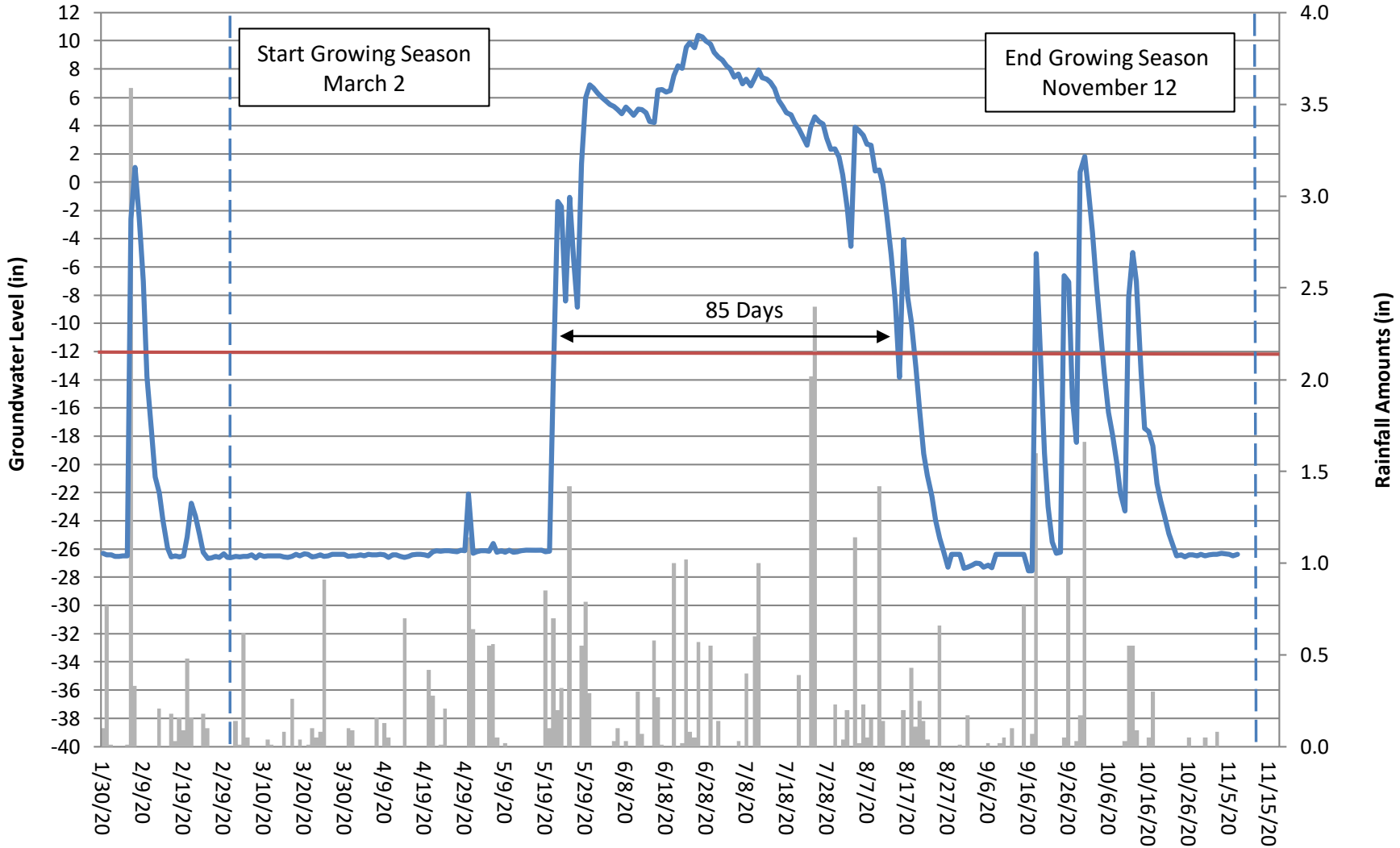
Arabia Bay Groundwater Gauge 6
Year 1 (2020 Data)



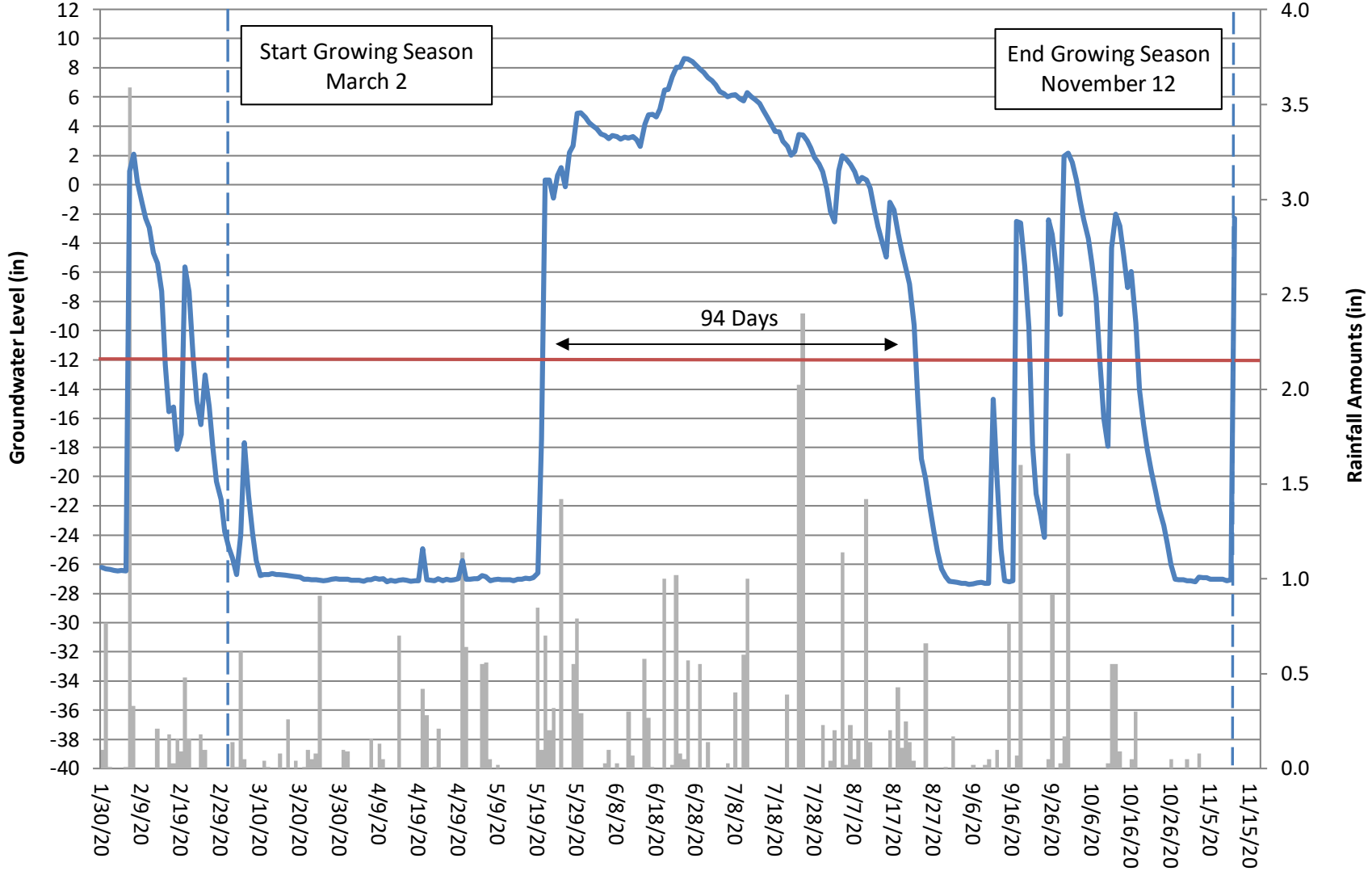
Arabia Bay Groundwater Gauge 7
Year 1 (2020 Data)

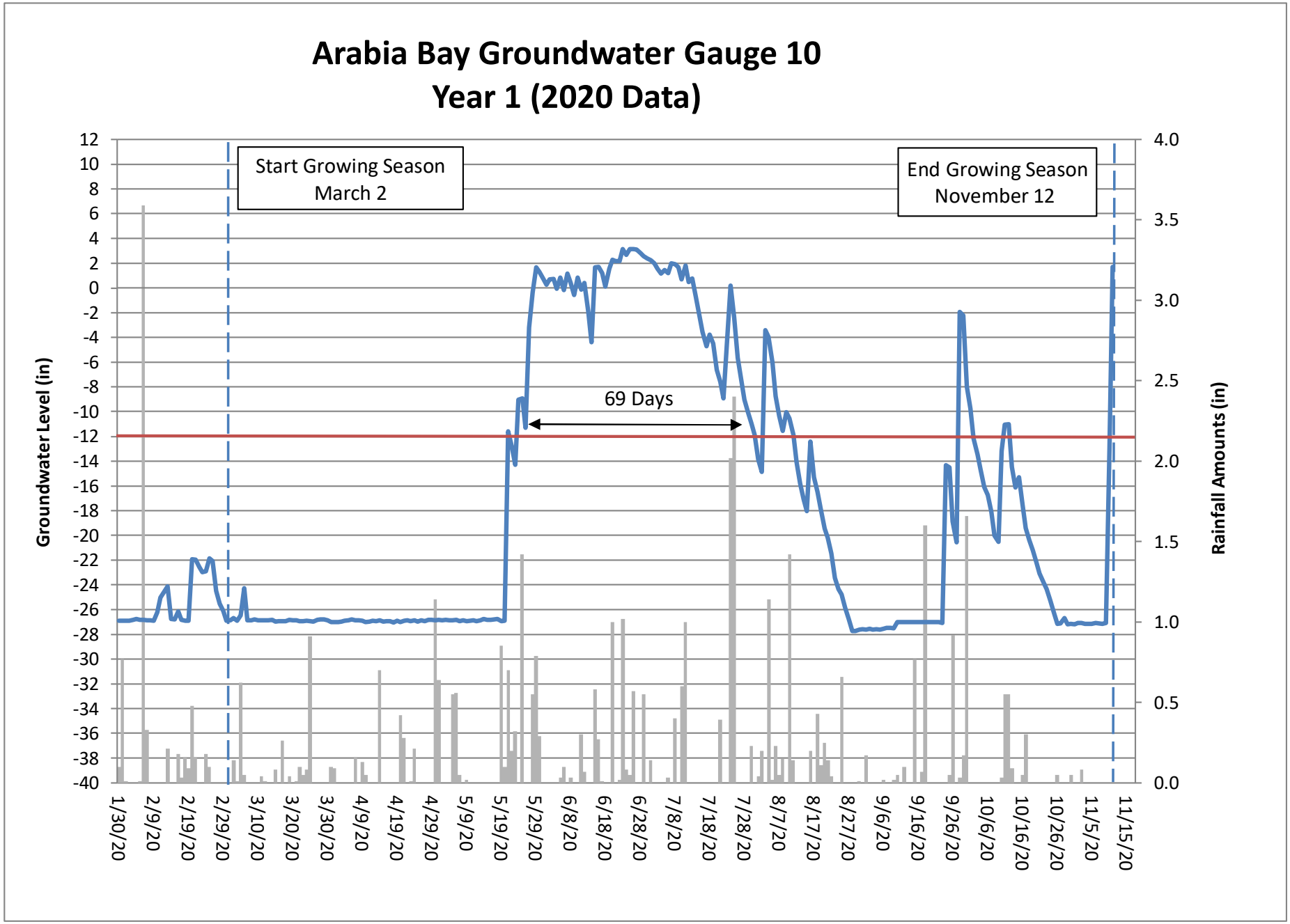


Arabia Bay Groundwater Gauge 8
Year 1 (2020 Data)

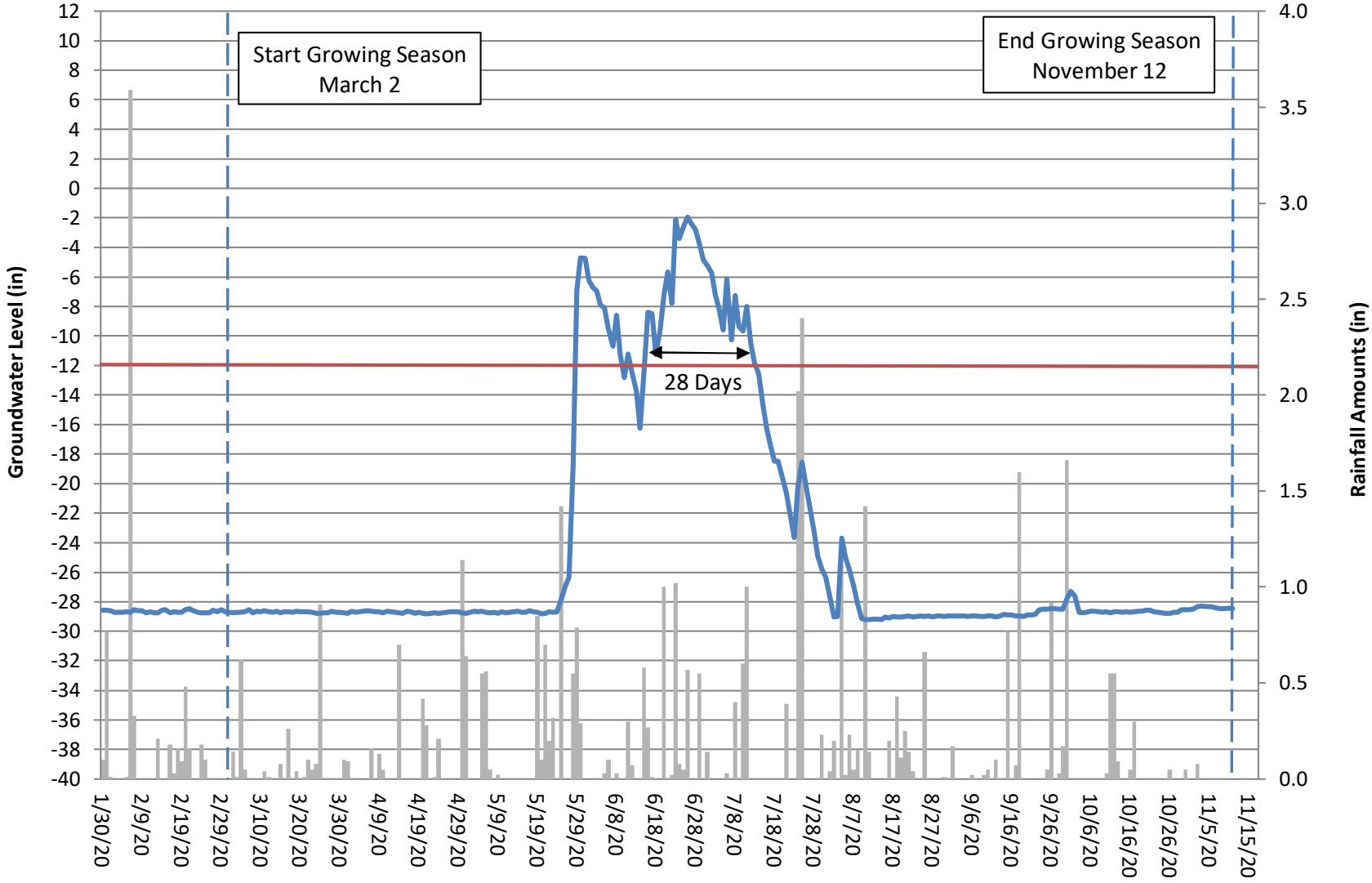


Arabia Bay Groundwater Gauge 9
Year 1 (2020 Data)

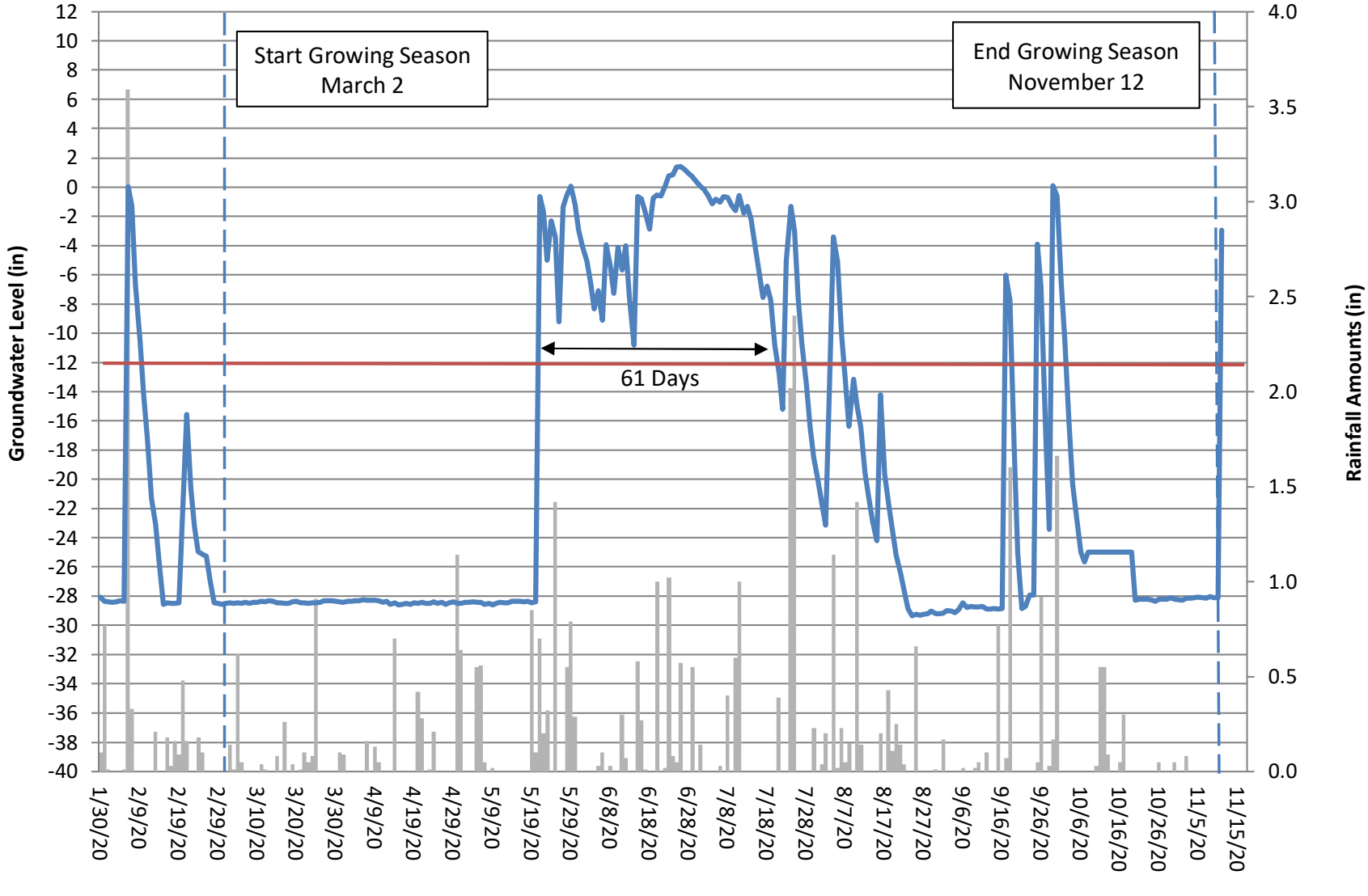



Arabia Bay Groundwater Gauge 10
Year 1 (2020 Data)
Start Growing Season
March 2
End Growing Season
November 12
69 Days
Groundwater Level (in)
Rainfall Amounts (in)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/30/20
2/9/20
2/19/20
2/29/20
3/10/20
3/20/20
3/30/20
4/9/20
4/19/20
4/29/20
5/9/20
5/19/20
5/29/20
6/8/20
6/18/20
6/28/20
7/8/20
7/18/20
7/28/20
8/7/20
8/17/20
8/27/20
9/6/20
9/16/20
9/26/20
10/6/20
10/16/20
10/26/20
11/5/20
11/15/20

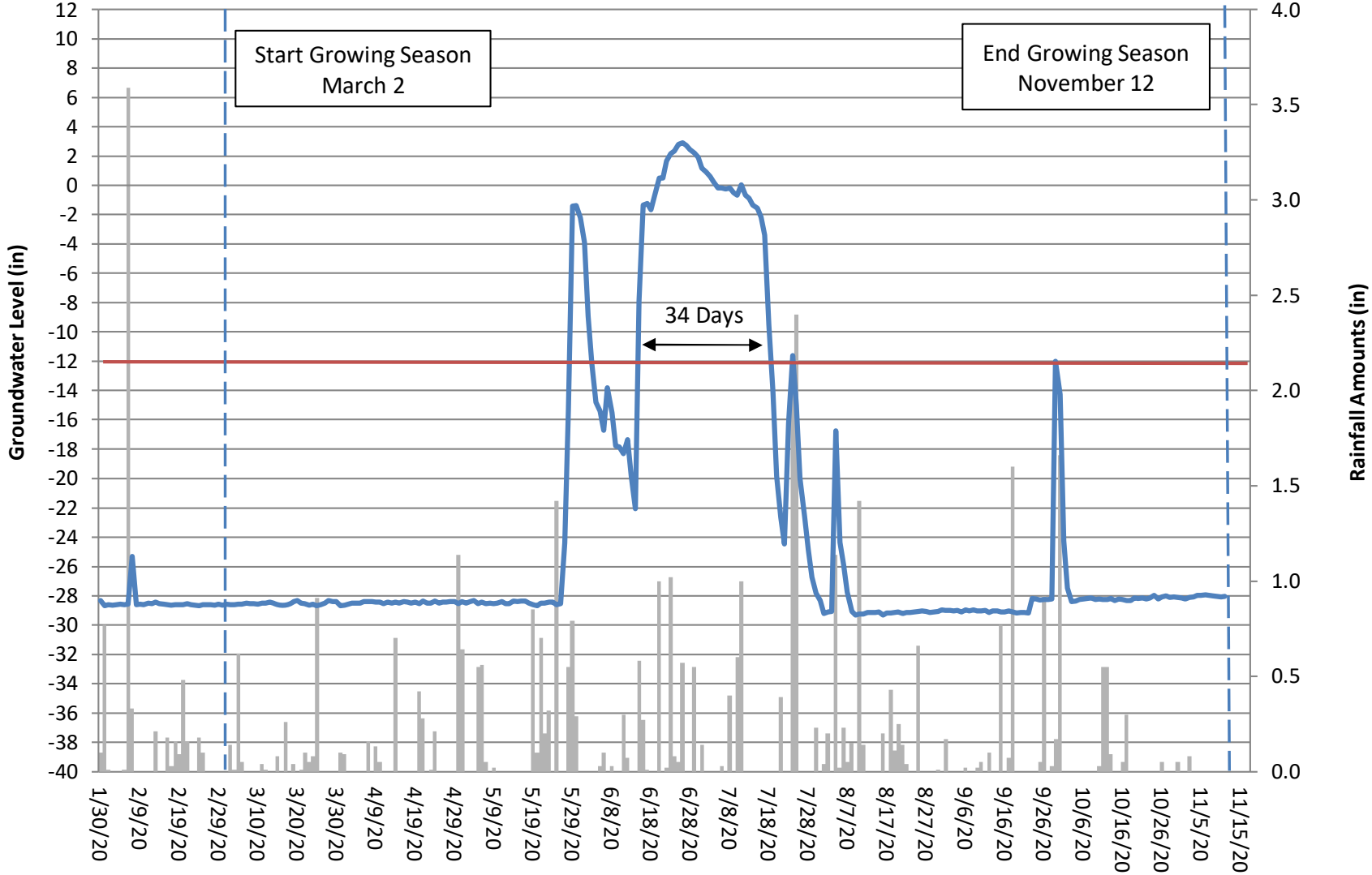
Arabia Bay Groundwater Gauge 11
Year 1 (2020 Data)



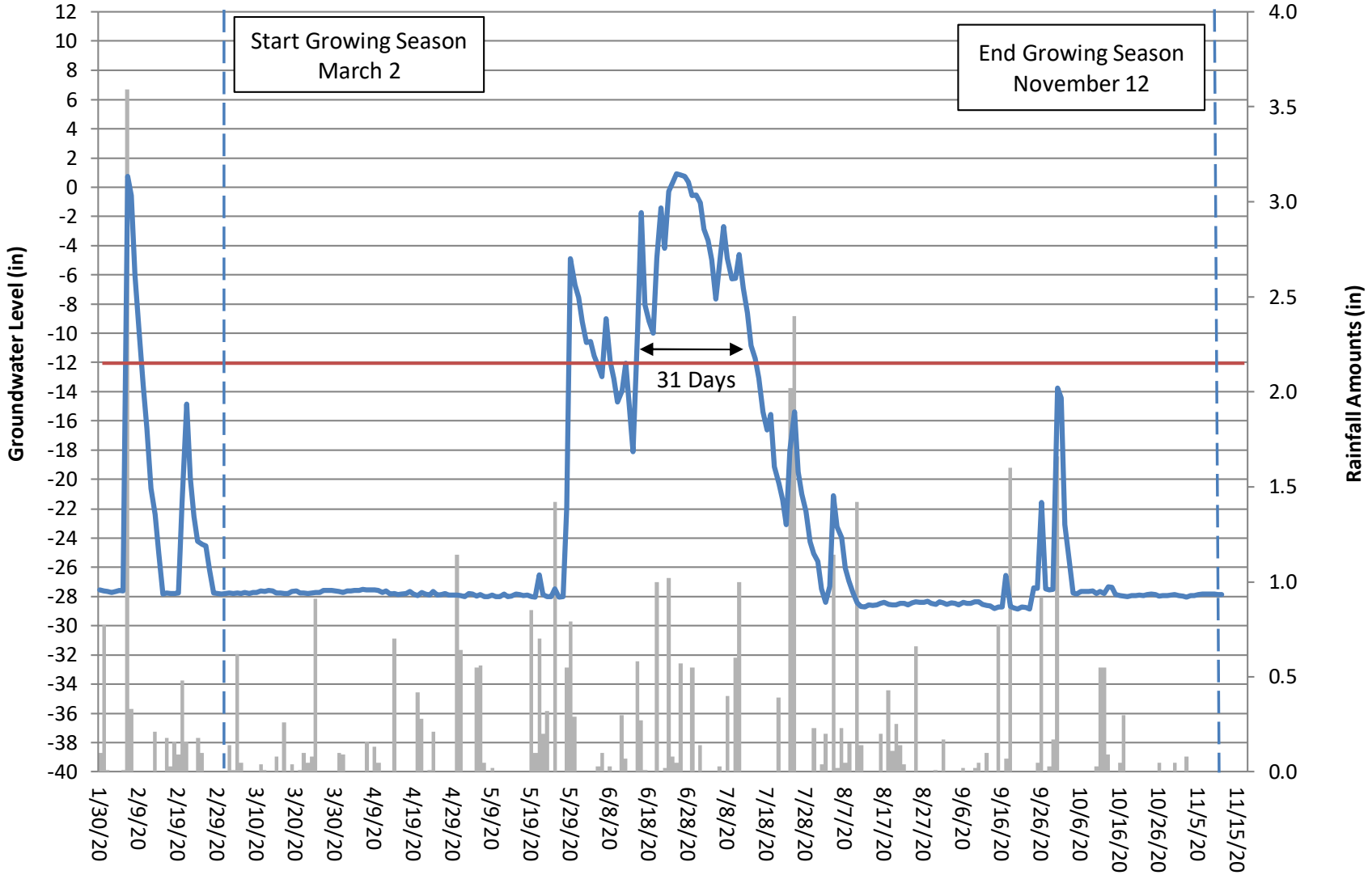
Arabia Bay Groundwater Gauge 12
Year 1 (2020 Data)



Arabia Bay Groundwater Gauge 13
Year 1 (2020 Data)



Arabia Bay Groundwater Gauge 14
Year 1 (2020 Data)



Appendix E. Notice of Credit Release

Mitigation Project Name	**Arabia Bay**	**USACE Action ID**	**2018-01151**
DMS ID	**100061**	**DWR Permit**	**2018-0784**
River Basin	**Cape Fear**	**Date Project Instituted**	**4/5/2018**
Cataloging Unit	**03030004**	**Stream/Wet. Service Area**	**Cape Fear 03030004**
County	**Hoke**	**Date Prepared**	**3/23/2020**

Signature & Date of Official Approving Credit Release

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

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

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

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

Credit Release Milestone	**Non-Riparian Credits**						
Project Credits	**Scheduled Releases %**	**Proposed Releases %**	**Proposed Released #**	**Not Approved # Releases**	**Approved Credits**	**Anticipated Release Year**	**Actual Release Date**
1 - Site Establishment	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 - Year 0 / As-Built	30.00%	30.00%	4.800	0.000	4.800	2020	3/23/2020
3 - Year 1 Monitoring	10.00%					2021	
4 - Year 2 Monitoring	10.00%					2022	
5 - Year 3 Monitoring	15.00%					2023	
6 - Year 4 Monitoring	5.00%					2024	
7 - Year 5 Monitoring	15.00%					2025	
8 - Year 6 Monitoring	5.00%					2026	
9 - Year 7 Monitoring	10.00%					2027	
Stream Bankfull Standard	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Totals		4.800		

Total Gross Credits	16.000
Total Unrealized Credits to Date	0.000
Total Released Credits to Date	4.800
Total Percentage Released	30.00%
Remaining Unreleased Credits	11.200

Notes

Contingencies (if any)

Project Quantities

Mitigation Type	**Restoration Type**	**Physical Quantity**
Non-Riparian	Restoration	16.000