

# Monitoring Report

**Twin Bays Wetland Restoration Site**

**DMS Contract 004739**

**DMS Project Number 95363**

**Duplin County, NC**

**CU #:03030007**

**DWR #: 2013-0455**

**USACE #: SAW-2012-01385**

**Monitoring Year 06**



Prepared for:

NCDMS, 1652 Mail Service Center, Raleigh, NC 27699-1652

**Construction Completed: March 2014**

**Data Collection: 2019**

**Submitted: December 2019**

Mitigation Project Name Twin Bays  
 DMS ID 95363  
 River Basin Cape Fear  
 Cataloging Unit 03030007

County Duplin  
 Date Project Instituted 7/27/2012  
 Date Prepared 6/13/2019

USACE Action ID 2012-01385  
 NCDWR Permit No 2013-0455

Credit Release Milestone	Stream Credits						Wetland Credits							
	Scheduled Releases (Stream)	Warm	Cool	Cold	Anticipated Release Year (Stream)	Actual Release Date (Stream)	Scheduled Releases (Forested)	Riparian Riverine	Riparian Non-riverine	Non-riparian	Scheduled Releases (Coastal)	Coastal	Anticipated Release Year (Wetland)	Actual Release Date (Wetland)
Potential Credits (Mitigation Plan)										11.000				
Potential Credits (As-Built Survey)										10.600				
1 (Site Establishment)	N/A				N/A	N/A	N/A				N/A		N/A	N/A
2 (Year 0 / As-Built)	N/A				N/A	N/A	30%			3.180	N/A		2014	6/25/2014
3 (Year 1 Monitoring)	N/A				N/A	N/A	10%			1.060	N/A		2015	4/23/2015
4 (Year 2 Monitoring)	N/A				N/A	N/A	10%			1.060	N/A		2016	4/25/2016
5 (Year 3 Monitoring)	N/A				N/A	N/A	10%			1.060	N/A		2017	4/3/2017
6 (Year 4 Monitoring)	N/A				N/A	N/A	10%			1.060	N/A		2018	4/25/2018
7 (Year 5 Monitoring)	N/A				N/A	N/A	10%			1.060	N/A		2019	4/26/2019
8 (Year 6 Monitoring)	N/A				N/A	N/A	10%				N/A		2020	
9 (Year 7 Monitoring)	N/A				N/A	N/A	10%				N/A		2021	
Stream Bankfull Standard	N/A				N/A	N/A	N/A				N/A			
Total Credits Released to Date										8.480				

NOTES:

CONTINGENCIES:

  
 Signature of Wilmington District Official Approving Credit Release

27 Sept 2019

Date

- 1 - For DMS, no credits are released during the first milestone
- 2 - For DMS projects, the second credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the NCIRT by posting it to the NCEEP Portal, provided the following criteria have been met:
  - 1) Approval of the 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

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DEBITS (released credits only)

Ratios			1	1.5	2.5	5	1	3	2	5	1	3	2	5	1	3	2	5
			Stream Restoration	Stream Enhancement I	Stream Enhancement II	Stream Preservation	Riparian Restoration	Riparian Creation	Riparian Enhancement	Riparian Preservation	Nonriparian Restoration	Nonriparian Creation	Nonriparian Enhancement	Nonriparian Preservation	Coastal Marsh Restoration	Coastal Marsh Creation	Coastal Marsh Enhancement	Coastal Marsh Preservation
<b>As-Built Amounts (feet and acres)</b>											10.600							
<b>As-Built Amounts (mitigation credits)</b>											10.600							
<b>Percentage Released</b>											80%							
<b>Released Amounts (feet / acres)</b>											8.480							
<b>Released Amounts (credits)</b>											8.480							
NCDWR Permit	USACE Action ID	Project Name																
2010-0459	2010-01735	Pender Co. Surface Water Treatment & Finished Water Trans Main									0.480							
	2009-00748	Bunn Brantley									0.120							
2008-1555	2008-01720	Shelter Creek Quarry									3.640							
2008-1555	2008-01720	Shelter Creek Quarry									1.060							
2008-1555	2008-01720	Shelter Creek Quarry									0.800							
	2011-00079	Kennedy Broiler Farm									0.170							
	2011-01172	Grady Sanderson Farms Site									0.090							
	2011-01172	Grady Sanderson Farms Site									0.333							
	2011-01367	American Towers, LLC 273409									0.300							
	2012-01630	Dollar General N. College Road									0.425							
	2004-00944	Country Haven (Caison Violation)									0.002							
	2012-01630	Dollar General N. College Road									0.043							
2013-0351	2012-02066	Smith Creek Alandale Pump Station Removal									0.140							
		Settlement - Rock Hill Road Borrow Pit									0.600							
<b>Remaining Amounts (feet / acres)</b>											0.277							
<b>Remaining Amounts (credits)</b>											0.277							

## **Design and Monitoring Firm**



**4505 Falls of Neuse Road  
Suite 400  
Raleigh, NC 27609  
Phone: (919) 278-2514  
Fax: (919) 783-9266**

**Project Contact: Tim Morris  
Email: [tim.morris@kci.com](mailto:tim.morris@kci.com)  
KCI Project No: 20122265**



**MEMORANDUM**

Date: February 6, 2020  
To: Lindsay Crocker, DMS Project Manager  
From: Adam Spiller, Project Manager  
KCI Associates of North Carolina, PA  
Subject: MY-06 Monitoring Report Comments  
Twin Bays IMS#95363, Contract 004739  
Cape Fear River Basin CU 03030007  
Duplin County, North Carolina

Please find below our responses in italics to the MY-06 Monitoring Report comments from NCDMS received on January 17, 2020, for the Twin Bays Restoration Site.

1. There are several malfunctioning gauges on this site that may cause concern by the IRT. Ensure that the gauges are checked at least quarterly for MY7.  
*KCI Response: Several of the gauges had batteries die during MY06. KCI has learned from this and other sites that the effective battery life of the gauges is between 5 and 6 years. Measures, including more frequent gauge downloads and replacement of gauges before the beginning of MY05, are being implemented to ensure data loss is kept to a minimum.*
2. DMS will request concurrence for KCI to omit MY7 vegetation monitoring at the credit release meeting.  
*KCI Response: KCI is prepared to bring this up at the credit release meeting.*
3. The report states that gauges 1, 4, and 14 did not meet success criteria but two of the gauges are right on the credit line and at least one is completely lacking data. DMS suggests adding a statement or clarifying that hydroperiods of the groundwater gauges depict that the wetland credit line is generally drawn accurately to match project success hydrology.  
*KCI Response: A statement clarifying this has been added to the report.*
4. DMS recommends that KCI label the gauges with % hydroperiod on the CCPV to show IRT how this line is generally accurate. This is not required for MY6 but may be beneficial for the report and certainly for MY7.  
*KCI Response: This will be added to the CCPV in MY07.*

Please contact me if you have any questions or would like clarification concerning these responses.

A handwritten signature in cursive script that reads 'Adam Spiller'.

Adam Spiller  
Project Manager



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## 1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The Twin Bays Wetland Restoration Site, (TBWRS) completed in March 2014, restored 10.6 acres of non-riparian wetland along with 0.4 acre of upland preservation. The TBWRS is a non-riparian wetland system in the Cape Fear Basin (03030007 8-digit HUC) in southern Duplin County, North Carolina. The project is located in the 14-digit HUC 03030007090040 (Rock Fish Creek), which DMS has identified as a Targeted Local Watershed (TLW) (NCDENR, EEP 2009).

The project site is protected by an 11.72-acre permanent conservation easement held by the State of North Carolina. TBWRS is located on a single parcel located off of Cornwallis Road approximately two miles northwest of Wallace, North Carolina. The project site is bounded by Cornwallis Road to the west, a ditch along the property line to the south, and agricultural land to the east and north. Prior to construction, the site was actively used for row crop farming. The site had a long history of hydrologic modification in order to allow for farming to take place on the property.

The Cape Fear River Basin Restoration Priorities state the goals for the TBWRS's 14-digit HUC are to expand restoration opportunities and repair riparian buffers (NCDENR EEP, 2009). The project goals for TBWRS are in line with the basin priorities and include the following:

- Slow and treat the runoff of upslope agricultural drainage.
- Restore a Hardwood Flats Community.
- Develop valuable wetland habitat niches within a drained agricultural landscape.

The project goals will be addressed through the following objectives:

- Fill field ditches to restore surface flow retention and elevate local groundwater levels.
- Redevelop longer wetland flow patterns to increase surface flow retention time.
- Modify an existing pond to its natural seep condition to feed the downslope wetland.
- Restore a native forested hardwood wetland community using natives trees and seed mixes.

There are three non-credit generating areas on the site. There is 0.4-acre of uplands located in the forested northeastern corner of the project boundary. This area remained undisturbed and is included in the TBWRS conservation easement. There is a 0.2 acre utility easement on the west side of the site along Cornwallis Road that remained undisturbed. Additionally, the southernmost ditch, located adjacent to the project easement, was left open and not filled. It is anticipated that leaving this ditch open will have minimal impacts to the overall hydrologic performance of the site. The hydrologic influence of this ditch was modeled using Lateral Effect, a software program that determines the lateral effect of a drainage ditch or borrow pit on adjacent wetland hydrology (NCSU BAE, 2011). This analysis determined that the potential horizontal drainage influence averages 76'. Due to the fact that the southern ditch cannot be filled because of the potential for hydrologic trespass, the area immediately adjacent to the ditch will not be a credit generating part of the site. It is assumed that with the onsite modifications, such as filling ditches and surface roughening, the entire site will have more surface and groundwater, which may decrease the effect of the ditch. For this reason, the non-credit generating portion of the site is assumed to be half of the zone of influence for the ditch.

The TBWRS provided mitigation for wetland impacts within Hydrologic Unit 03030007 by restoring 10.6 acres of wetland and preserving 0.4-acre of uplands, generating 10.6 riparian wetland mitigation units (WMU's). The TBWRS will be monitored to determine if the project is on-track to meeting jurisdictional wetland status. The wetland site will be deemed successful once hydrology is established and vegetation success criteria are met. During the site's sixth growing season, vegetation monitoring did



not take place as stipulated in the Mitigation Plan. Fourteen of the seventeen credit bearing groundwater monitoring gauges met the success criteria. Chinese privet (*Ligustrum sinense*) growing in the two fingers near the northeast corner of the site was cut and sprayed with herbicide in August 2018. An additional treatment of privet growing in these areas is planned for 2020.

Summary information/data related to the occurrence of items such as encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report and in the Mitigation Plan documents available on the DMS website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

## **2.0 MONITORING RESULTS**

The TBWRS will be monitored to determine if the project is on-track to meeting jurisdictional wetland status. The wetland restoration area will be deemed successful once hydrology is established and vegetation success criteria are met. The site will be monitored for at least seven years or until the success criteria are achieved.

### **2.1 VEGETATION MONITORING**

The success criteria for the planted species in the mitigation area is based on the vegetative density estimated as woody stems/acre based on monitoring plot data. The site will demonstrate the re-establishment of targeted vegetative communities through the survival and growth of planted species and volunteer colonization, with an average stem density of 320 stems/acre after three years, 288 stems/acre after four years, 260 stems/acre after five years, and 210 stems/acre after seven years to be considered successful. To determine the success of the planted mitigation area, ten permanent vegetation monitoring plots (10 by 10 meters) have been established in the wetland restoration area at a density that represents the total mitigation acreage. The average density of these plots will determine whether the site meets the success criterion.

No vegetation monitoring occurred during the sixth monitoring year, as stipulated in the Mitigation Plan. During an onsite meeting with the IRT on October 30, 2019, it was determined that vegetation monitoring did not need to be performed during Monitoring Year 7, due to the overwhelming success of the vegetation on site.

### **2.2 HYDROLOGY MONITORING**

Wetland hydrology is monitored with a series of automatic gauges that record water table depth. The site must present continuous saturated or inundated hydrologic conditions for at least 8% of the growing season with a 50% probability of reoccurrence during normal weather conditions. A “normal” year is based on NRCS climatological data for Duplin County using the 30th to 70th percentile thresholds as the range of normal as documented in the USACE Technical Report “Assessing and Using Meteorological Data to Evaluate Wetland Hydrology, April 2000.” The soil survey for Duplin County does not contain growing season data; therefore, due to its close proximity, the Sampson County soil survey was used. The estimated growing season begins March 18 and ends November 11 (239 days). The water table of the restored wetlands must be within 12” of the soils surface continuously for at least 8% (19 days) of the 239-day growing season. Wetland hydrology will be monitored with nineteen automatic gauges that record water table depth. Daily data is collected from the automatic gauges over the 7-year monitoring period.

To monitor the effect of the unfilled ditch described in Section 1.0, four sets of coupled gauges were installed perpendicular to the unfilled ditch. Each set includes a gauge that is 40' from the open ditch and another that is 75' from the ditch. An additional two gauges were installed between the coupled gauges to monitor hydrology less than 40' from the open ditch in the non-credit bearing zone.

The daily rainfall data were obtained from the NC State Climate Office for a local weather station in Jacksonville, NC. In 2019, the months of April and November experienced above average rainfall, while August, September, and October experienced average rainfall. The months of January, February, March, May, and June recorded below average rainfall for the site. Overall, the area experienced average rainfall during the 2019 growing season. With the exception of April, the first six months of the year were below average precipitation months. These months at the beginning of the growing season are when most of the gauges achieve success in a typical year, so these dry conditions likely contributed to any poor gauge results in 2019.

During the site's sixth growing season, fourteen of the seventeen credit-bearing gauges met the hydrologic success criteria. The three gauges that did not meet the success criteria were 1, 4, and 14. Gauge 1 has met the criteria for three of the previous five growing seasons. Gauge 4 malfunctioned throughout the growing season, and no viable data was collected, although it has had hydrology success in every previous growing season. Gauge 14 only collected data at the beginning of the growing season and then malfunctioned repeatedly for the rest of the growing season. That gauge has had hydrology success in four of the previous five growing seasons. Gauges 1 and 4 are both located right on the credit line and so are generally expected to be drier than other gauges located further into the wetland. KCI believes that the pattern of success seen in MY06 is evidence that the credit line is generally drawn accurately. In addition, one of the two non-credit bearing gauges also achieved the success criteria this year. This gauge (Gauge 6) has met the hydrology success criteria every previous growing season except for the first.

### 3.0 REFERENCES

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

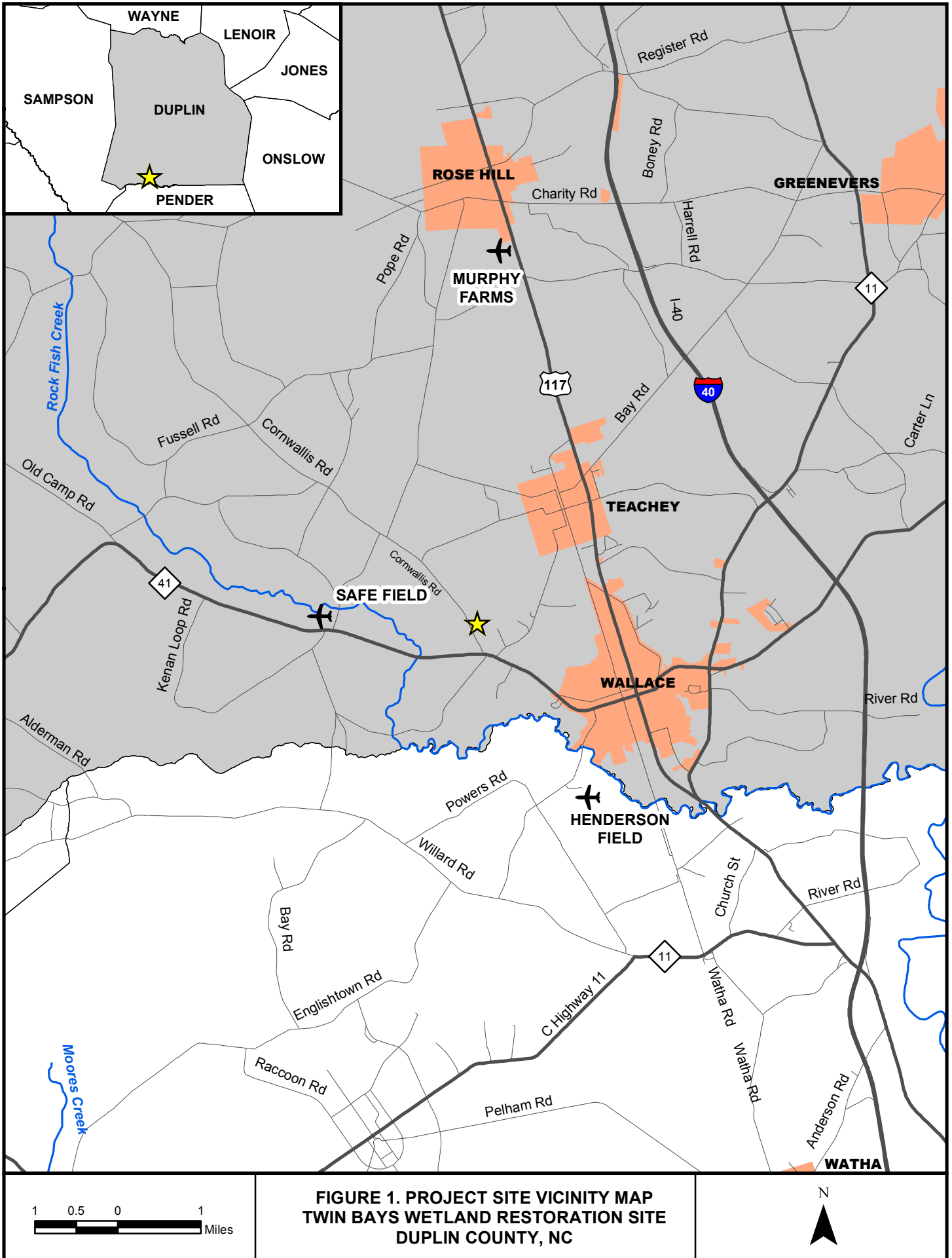
NCDENR, Ecosystem Enhancement Program. 2009. Lower Yadkin Pee-Dee River Basin Priorities 2009. Raleigh, NC.  
[http://www.nceep.net/services/restplans/Yadkin\\_Pee\\_De\\_RBRP\\_2009\\_Final.pdf](http://www.nceep.net/services/restplans/Yadkin_Pee_De_RBRP_2009_Final.pdf)

NCSU BAE. North Carolina State University, Biological and Agricultural Engineering. 2011. Method to Determine Lateral Effect of a Drainage Ditch on Adjacent Wetland Hydrology. Last accessed 11/2012 at:  
[http://www.bae.ncsu.edu/soil\\_water/projects/lateral\\_effect.html](http://www.bae.ncsu.edu/soil_water/projects/lateral_effect.html)

USACE. 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

# **Appendix A**

## **Project Vicinity Map and Background Tables**



<b>Table 1. Project Components and Mitigation Credits</b>									
<b>Twin Bays Wetland Restoration Site, DMS Project # 95363</b>									
<b>Mitigation Credits</b>									
	<b>Stream</b>		<b>Riparian Wetland</b>		<b>Non-riparian Wetland</b>		<b>Buffer</b>	<b>Nitrogen Nutrient Offset</b>	<b>Phosphorous Nutrient Offset</b>
<b>Type</b>	R	RE	R	RE	R	RE			
<b>Acres</b>					10.6				
<b>Credits</b>					10.6				
<b>TOTAL CREDITS</b>					10.6				
<b>Project Components</b>									
<b>Project Component -or- Reach ID</b>	<b>Stationing/ Location</b>		<b>Existing Footage/ Acreage</b>		<b>Approach (PI, PII etc.)</b>		<b>Restoration -or- Restoration Equivalent</b>	<b>Restoration Footage or Acreage</b>	<b>Mitigation Ratio</b>
Wetland Area	Central and Southern portion of project easement		10.6 acres		-		Restoration	10.6 acres	1:1
<b>Component Summation</b>									
<b>Restoration Level</b>	<b>Stream (linear feet)</b>		<b>Riparian Wetland (acres)</b>		<b>Non-riparian Wetland (acres)</b>		<b>Buffer (square feet)</b>	<b>Upland (acres)</b>	
			Riverine	Non-Riverine					
Restoration					10.6 acres				
Enhancement									
Enhancement I									
Enhancement II									
Creation									
Preservation									0.4 acre
High Quality Preservation									
<b>TOTAL</b>	-		-	-	<b>10.6 acres</b>		-		<b>0.4 acre</b>
<b>TOTAL WMU</b>	-		-	-	<b>10.6</b>		-		-

**Table 2. Project Activity & Reporting History  
Twin Bays Wetland Restoration Site, DMS Project # 95363**

<b>Activity or Report</b>	<b>Data Collection Complete</b>	<b>Actual Completion or Delivery</b>
Mitigation Plan		Oct 2013
Final Design - Construction Plans		Dec 2013
Construction		Feb/March 2014
Planting		March 2014
Baseline Monitoring/Report	April 2014	May 2014
Vegetation Monitoring	April 10, 2014	
Photo Points	April 10, 2015	
Year 1 Monitoring	Nov 2014	Dec 2014
Vegetation Monitoring	Nov 3, 2014	
Photo Points	Nov 3, 2014	
Gauge Download	Nov 2017, 2014	
Supplemental Planting		March 2015
Year 2 Monitoring	Nov 2015	Jan 2016
Vegetation Monitoring	July 30, 2015	
Photo Points	July 30, 2015	
Gauge Download	Nov 25, 2015	
Year 3 Monitoring	Dec 2016	Dec 2016
Vegetation Monitoring	July 6, 2016	
Photo Points	Aug 23, 2016	
Gauge Download	Dec 14, 2016	
Year 4 Monitoring	Nov 2017	Dec 2017
Vegetation Monitoring	N/A	
Photo Points	Nov 30, 2017	
Gauge Download	Nov 30, 2017	
Year 5 Monitoring	Nov 2018	Dec 2018
Vegetation Monitoring	July 13, 2018	
Photo Points	Nov 13, 2018	
Gauge Download	Nov 13, 2018	
Invasive Treatment		August 6, 2018
Year 6 Monitoring	Nov 2019	Dec 2019
Vegetation Monitoring	N/A	
Photo Points	Nov 13, 2019	
Gauge Download	Nov 13, 2019	

<b>Table 3. Project Contacts Twin Bays Wetland Restoration Site, DMS Project # 95363</b>	
<b>Design Firm</b>	KCI Associates of North Carolina, PA 4505 Falls of Neuse Rd. Suite 400 Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
<b>Construction Contractor</b>	KCI Environmental Technologies and Construction, Inc. 4505 Falls of Neuse Rd. Suite 400 Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
<b>Planting Contractor</b>	Forestree Management Co. 1280 Maudis Road Bailey, NC 27807 Contact: Mr. Tony Cortez Phone: (252) 243-2513
<b>Monitoring Performers</b>	
	KCI Associates of North Carolina, PA 4505 Falls of Neuse Rd. Suite 400 Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

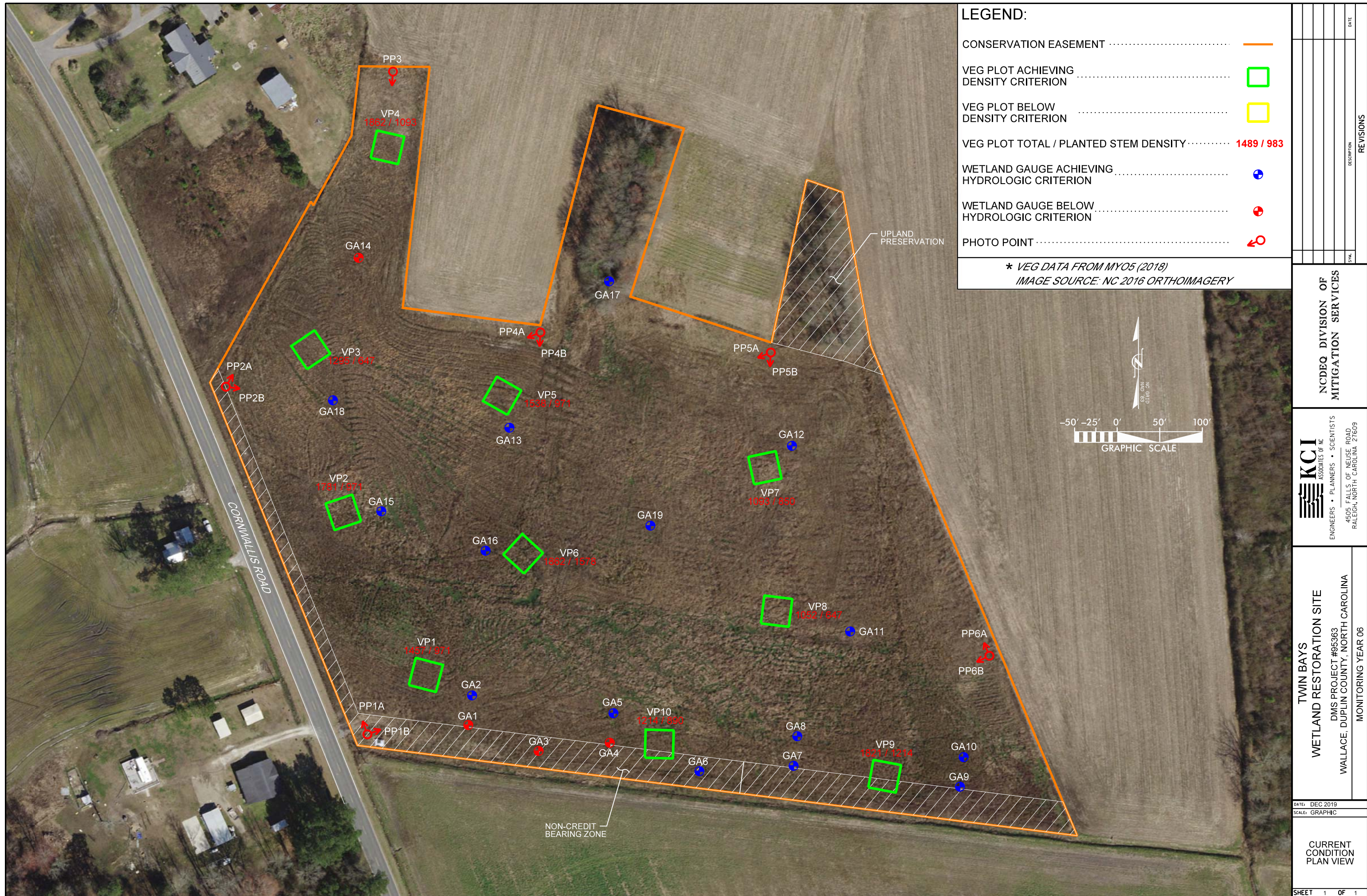


<b>Table 4. Project Information</b>			
<b>Twin Bays Wetland Restoration Site, DMS Project # 95363</b>			
<b>Project Name</b>	Twin Bays Wetland Restoration Site		
<b>County</b>	Duplin County		
<b>Project Area (acres)</b>	11.72 acres		
<b>Project Coordinates (lat. and long.)</b>	34.748418 N , -78.027129 W		
<b>Project Watershed Summary Information</b>			
<b>Physiographic Province</b>	Coastal Plain		
<b>River Basin</b>	Cape Fear		
<b>USGS Hydrologic Unit 8-digit</b>	03030007	<b>USGS Hydrologic Unit 14-digit</b>	03030007090040
<b>DWQ Sub-basin</b>	18-74-29b		
<b>Project Drainage Area (acres)</b>	25.4 acres		
<b>Project Drainage Area Percentage of Impervious Area</b>	2%		
<b>CGIA Land Use Classification</b>	93% Cultivated, 2% Mixed Shrubland, and 5% Low-Intensity Development		
<b>Wetland Summary Information (Post-Restoration)</b>			
<b>Parameters</b>	<b>Wetland Area</b>		
Size of Wetland (acres)	10.6 acres		
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Non-riparian		
Mapped Soil Series	Rains (Torhunta, Murville/Leon and Udorthents by detailed soil investigation)		
Drainage class	Poorly drained		
Soil Hydric Status	Drained Hydric		
Source of Hydrology	Hillside seepage / precipitation		
Hydrologic Impairment	Ditching and Crops		
Native vegetation community	Hardwood Flats Community		
Percent composition of exotic invasive vegetation	0%		
<b>Regulatory Considerations</b>			
<b>Regulation</b>	<b>Applicable?</b>	<b>Resolved?</b>	<b>Supporting Documentation</b>
Waters of the United States – Section 404	Yes	Yes, received 404 permit	N/A
Waters of the United States – Section 401	Yes	Yes, received 401 permit	N/A
Endangered Species Act*	No	N/A	N/A
Historic Preservation Act*	No	N/A	N/A
Coastal Zone Management Act * (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	No	N/A	FEMA Floodplain Checklist
Essential Fisheries Habitat*	No	N/A	N/A

# **Appendix B**

## **Visual Assessment Data**





**LEGEND:**

- CONSERVATION EASEMENT ..... ————
- VEG PLOT ACHIEVING DENSITY CRITERION ..... □
- VEG PLOT BELOW DENSITY CRITERION ..... □
- VEG PLOT TOTAL / PLANTED STEM DENSITY ..... **1489 / 983**
- WETLAND GAUGE ACHIEVING HYDROLOGIC CRITERION ..... ⊕
- WETLAND GAUGE BELOW HYDROLOGIC CRITERION ..... ⊖
- PHOTO POINT ..... ↻

\* VEG DATA FROM MY05 (2018)  
 IMAGE SOURCE: NC 2016 ORTHOIMAGERY

DATE	DESCRIPTION	REVISIONS

NCDEQ DIVISION OF  
 MITIGATION SERVICES

**KCI**  
 ASSOCIATES OF NC  
 ENGINEERS • PLANNERS • SCIENTISTS  
 4505 FALLS OF NEUSE ROAD  
 RALEIGH, NORTH CAROLINA 27609

TWIN BAYS  
 WETLAND RESTORATION SITE  
 DMS PROJECT #95363  
 WALLACE, DUPLIN COUNTY, NORTH CAROLINA  
 MONITORING YEAR 06

DATE: DEC 2019  
 SCALE: GRAPHIC  
 CURRENT  
 CONDITION  
 PLAN VIEW  
 SHEET 1 OF 1



<b>Table 5. Vegetation Condition Assessment</b>						
<b>Twin Bays Restoration Site, DMS Project #95363</b>						
<b>Planted Acreage 10.6</b>			<b>Easement Acreage 11.7</b>			
<b>Vegetation Category</b>	<b>Definitions</b>	<b>Mapping Threshold</b>	<b>CCPV Depiction</b>	<b>Number of Polygons</b>	<b>Combined Acreage</b>	<b>% of Planted Acreage</b>
<b>1. Bare Areas</b>	Very limited cover of both woody and herbaceous material.	0.1 acre	Pattern and Color	0	0.00	0.0%
<b>2. Low Stem Density Areas</b>	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acre	Pattern and Color	0	0.00	0.0%
<b>Total</b>				0	0.00	0.0%
<b>3. Areas of Poor Growth Rates or Vigor</b>	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acre	Pattern and Color	0	0.00	0.0%
<b>Cumulative Total</b>				0	0.00	0.0%
<b>4. Invasive Areas of Concern</b>	Areas or points (if too small to render as polygons at map scale).	1,000 SF	Pattern and Color	0	0.00	0.0%
<b>5. Easement Encroachment Areas</b>	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%



## Photo Reference Points



PP1a – MY-00 – 4/10/14



PP1a – MY06 – 11/13/19



PP1b– MY-00 – 4/10/14



PP1b – MY06 – 11/13/19



PP2a – MY-00 – 4/10/14



PP2a – MY06 – 11/13/19





PP2b – MY-00 – 4/10/14



PP2b – MY06 – 11/13/19



PP3 – MY-00 – 4/10/14



PP3 – MY06 – 11/13/19



PP4a – MY-00 – 4/10/14



PP4a – MY06 – 11/13/19





PP4b – MY-00 – 4/10/14



PP4b – MY06 – 11/13/19



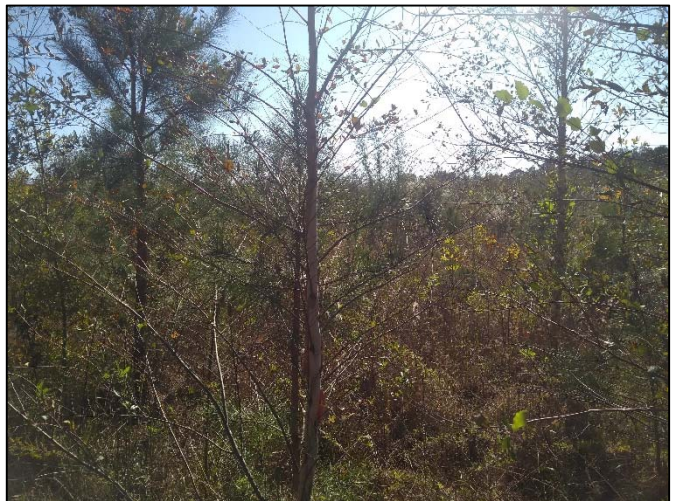
PP5a – MY-00 – 4/10/14



PP5a – MY06 – 11/13/19



PP5b – MY-00 – 4/10/14



PP5b – MY06 – 11/13/19





PP6a – MY-00 – 4/10/14



PP6a – MY06 – 11/13/19



PP6b– MY-00 – 4/10/14



PP6b – MY06 – 11/13/19



# **Appendix C**

## **Vegetation Plot Data**

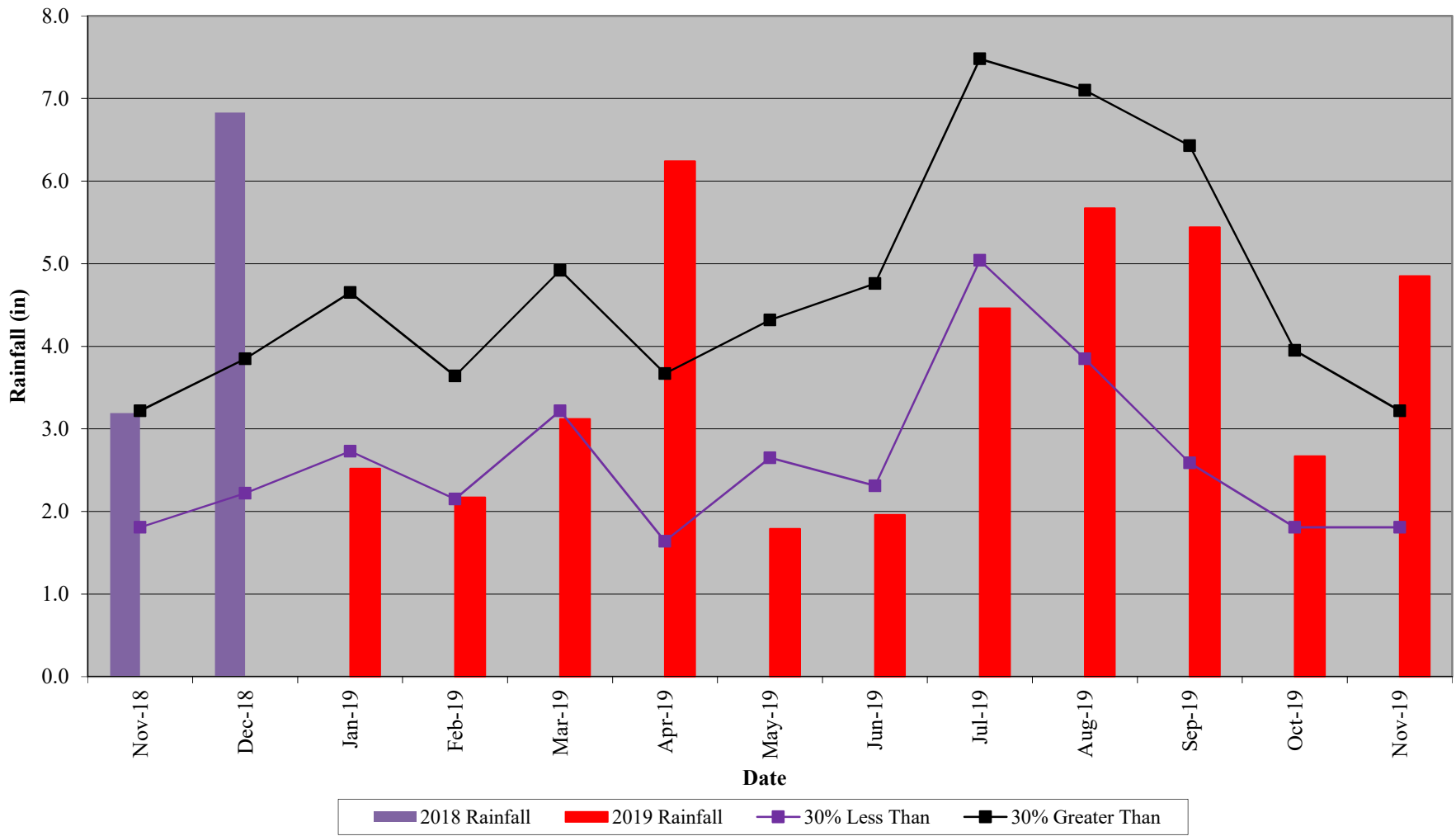
**Table 6. CVS Stem Count Total and Planted by Plot and Species**  
**DMS Project Code 95363. Project Name: Twin Bays Restoration Site**

			Annual Means														
Scientific Name	Common Name	Species Type	MY5 (2018)			MY3 (2016)			MY2 (2015)			MY1 (2014)			MY0 (2014)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	red maple	Tree	3	3	32	3	3	9	3	3	9	3	3	7	5	5	5
Aronia arbutifolia	Red Chokeberry	Shrub	8	8	8	8	8	11	7	7	7	8	8	8	11	11	11
Baccharis	baccharis	Shrub			16			12									
Baccharis halimifolia	eastern baccharis	Shrub						2			11			7			
Betula nigra	river birch	Tree	49	49	49	49	49	49	48	48	48	48	48	48	47	47	47
Diospyros virginiana	common persimmon	Tree						1									
Fraxinus pennsylvanica	green ash	Tree	26	26	26	25	25	25	26	26	26	24	24	24	5	5	5
Juglans nigra	black walnut	Tree			1												
Liquidambar styraciflua	sweetgum	Tree			4			1			1			1			
Liriodendron tulipifera	tuliptree	Tree	2	2	2	3	3	3	3	3	3	1	1	1	18	18	18
Magnolia virginiana	sweetbay	Tree	16	16	16	15	15	15	15	15	15	13	13	13	17	17	17
Nyssa biflora	swamp tupelo	Tree									5						
Pinus taeda	loblolly pine	Tree			42			2									
Platanus occidentalis	American sycamore	Tree	3	3	10	3	3	4	3	3	7	3	3	3			
Quercus michauxii	swamp chestnut oak	Tree	59	59	59	59	59	59	59	59	59	54	54	54			
Quercus pagoda	cherrybark oak	Tree	20	20	29	21	21	23	21	21	22	23	23	23	22	22	22
Quercus palustris	pin oak	Tree	1	1	1	1	1	1									
Quercus phellos	willow oak	Tree	20	20	21	20	20	20	20	20	20	9	9	9			
Salix nigra	black willow	Tree			11			7			2			3			
Sambucus	elderberry	Shrub			2												
Sambucus canadensis	Common Elderberry	Shrub									3						
Taxodium distichum	bald cypress	Tree	18	18	19	18	18	18	16	16	16	6	6	6	1	1	1
Ulmus americana	American elm	Tree													8	8	8
Unknown		Shrub or Tree										10	10	10	104	104	104
Vaccinium corymbosum	highbush blueberry	Shrub	18	18	20	19	19	19	22	22	22	20	20	20	22	22	22
<b>Stem count</b>			243	243	368	244	244	281	243	243	276	222	222	237	260	260	260
<b>size (ares)</b>			10			10			10			10			10		
<b>size (ACRES)</b>			0.25			0.25			0.25			0.25			0.25		
<b>Species count</b>			13	13	19	13	13	19	12	12	17	13	13	16	11	11	11
<b>Stems per ACRE</b>			983	983	1489	987	987	1137	983	983	1117	898	898	959	1052	1052	1052

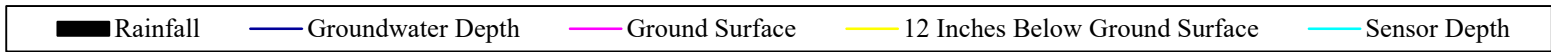
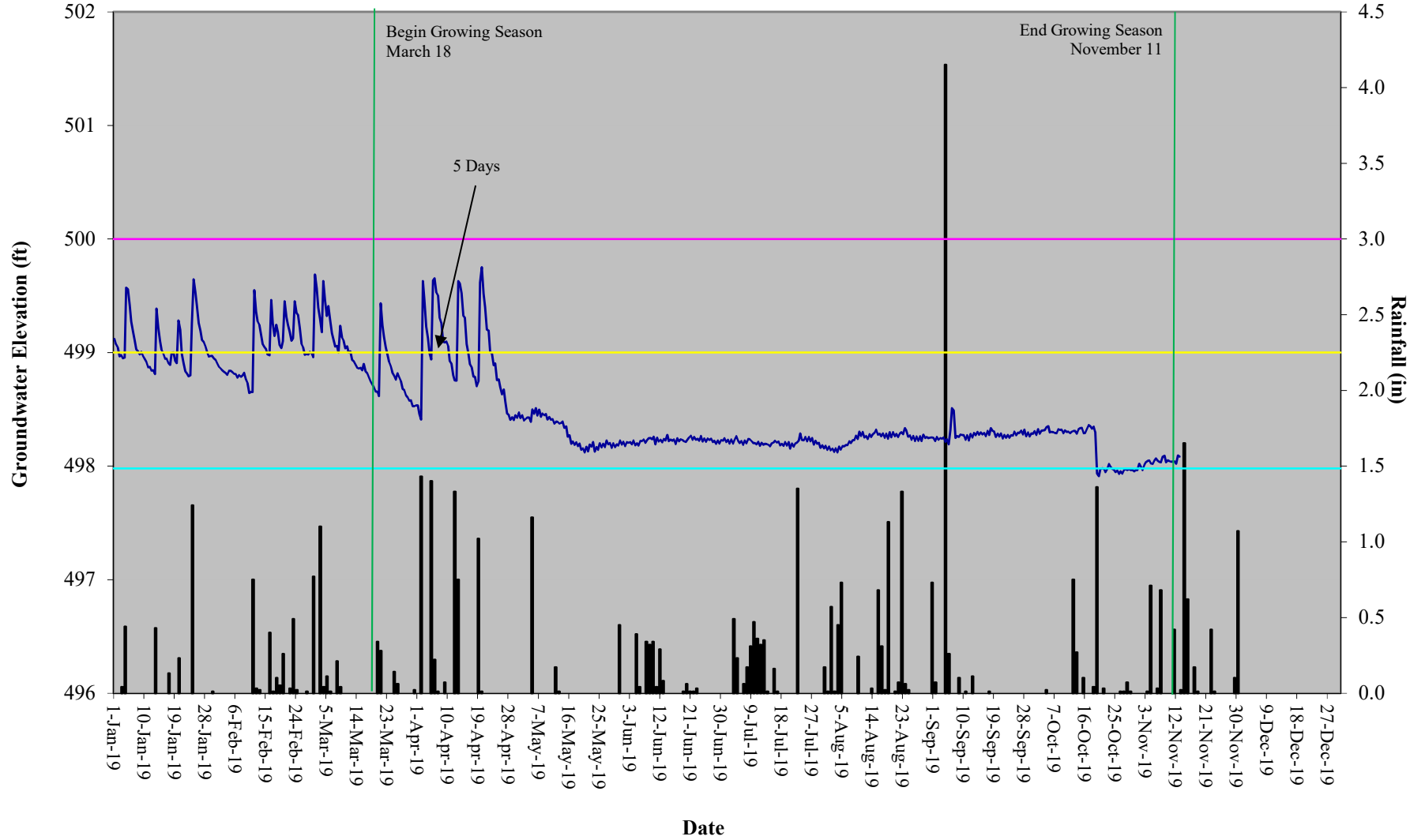
# **Appendix D**

## **Hydrologic Data**

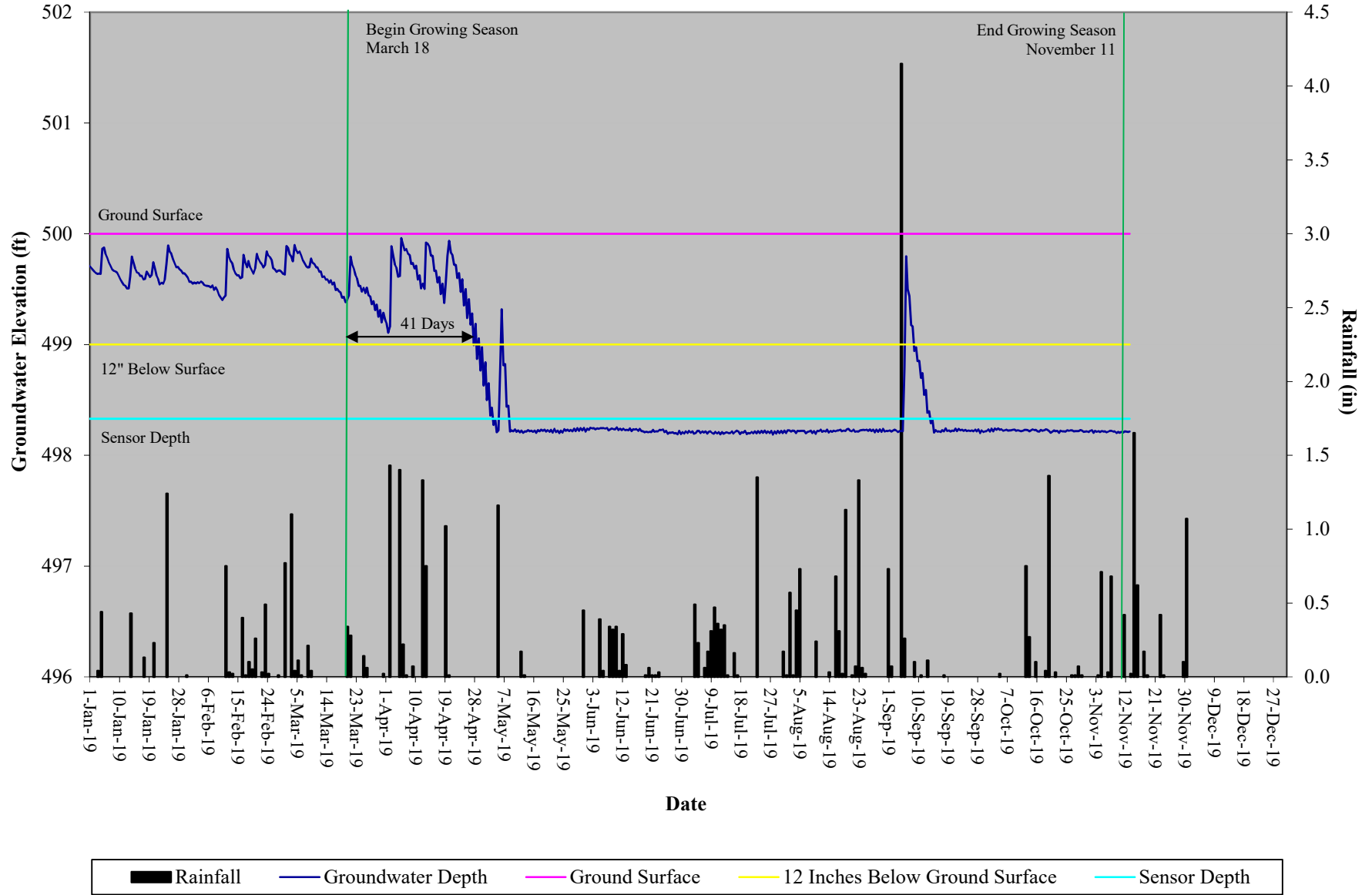
**Twin Bays Wetland Restoration Site  
30-70 Percentile Graph  
WETS Station Name: Warsaw, NC**



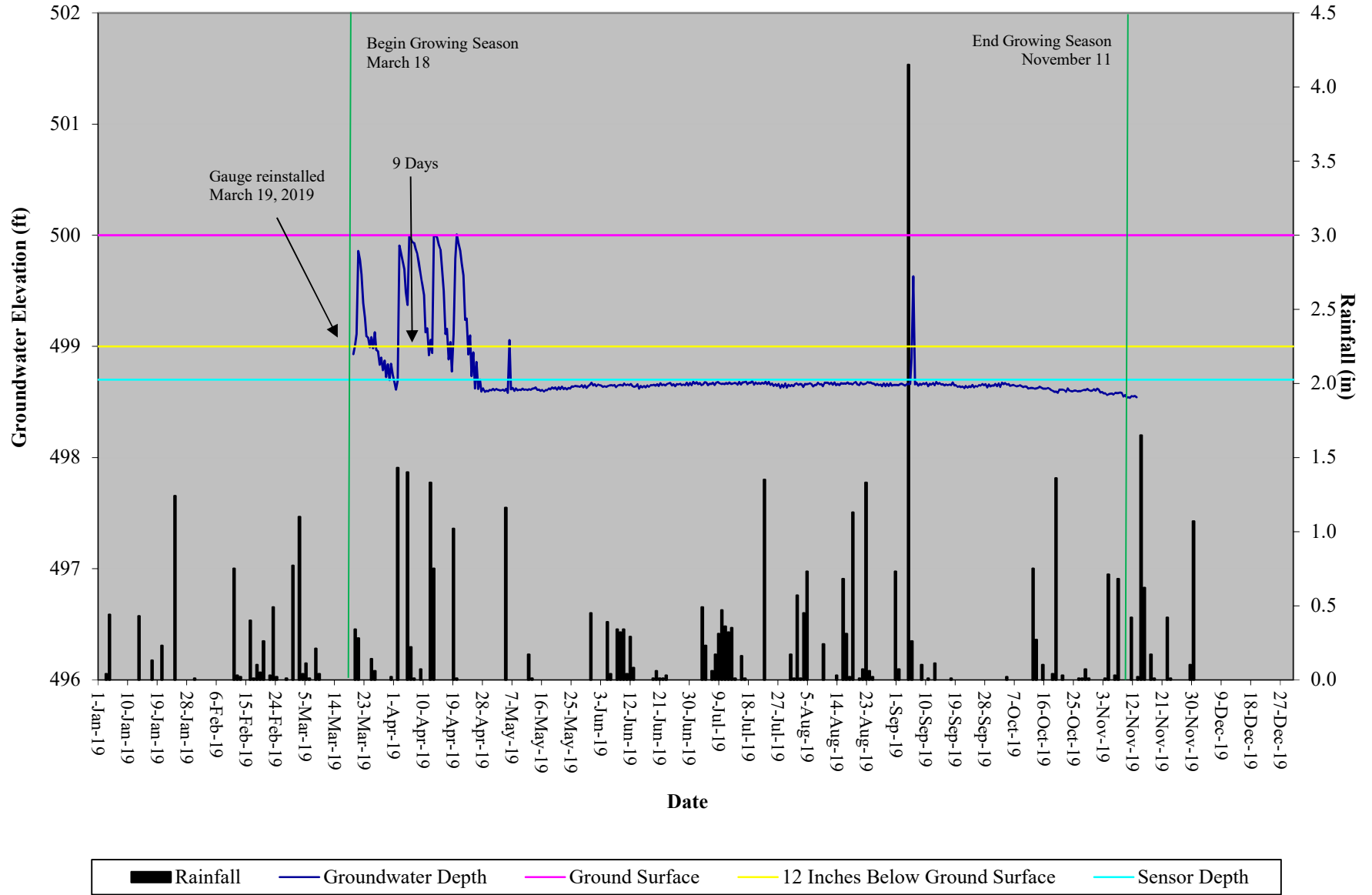
## Twin Bays Restoration Site Hydrograph Wetland Gauge 1



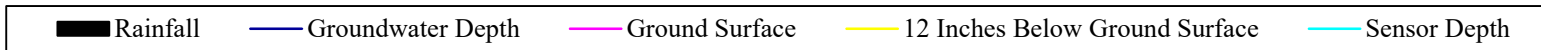
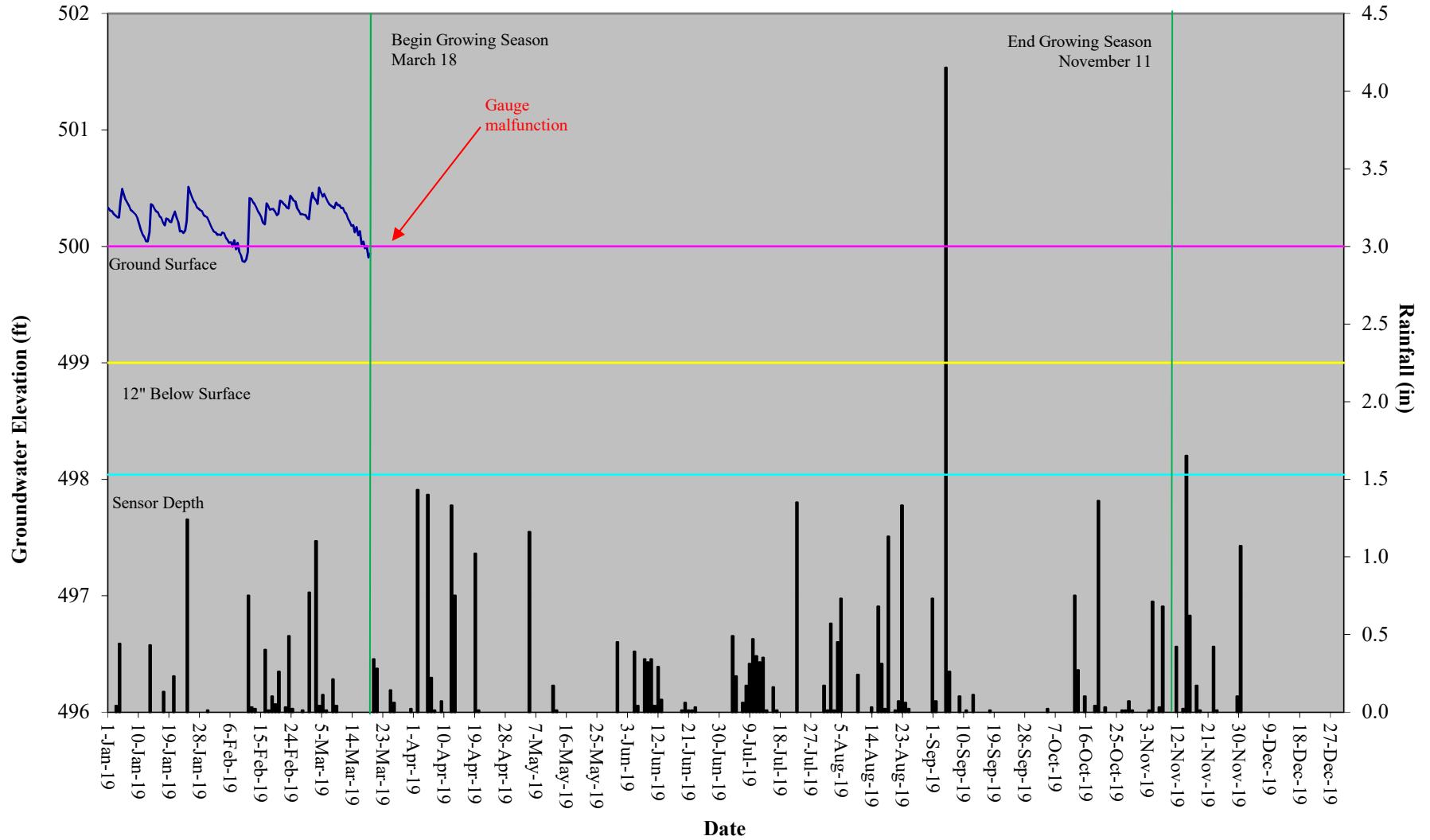
## Twin Bays Restoration Site Hydrograph Wetland Gauge 2



## Twin Bays Restoration Site Hydrograph Wetland Gauge 3 - non-credit bearing

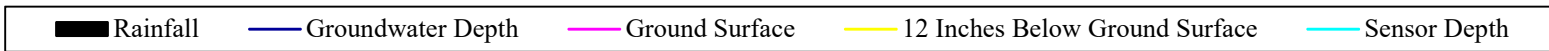
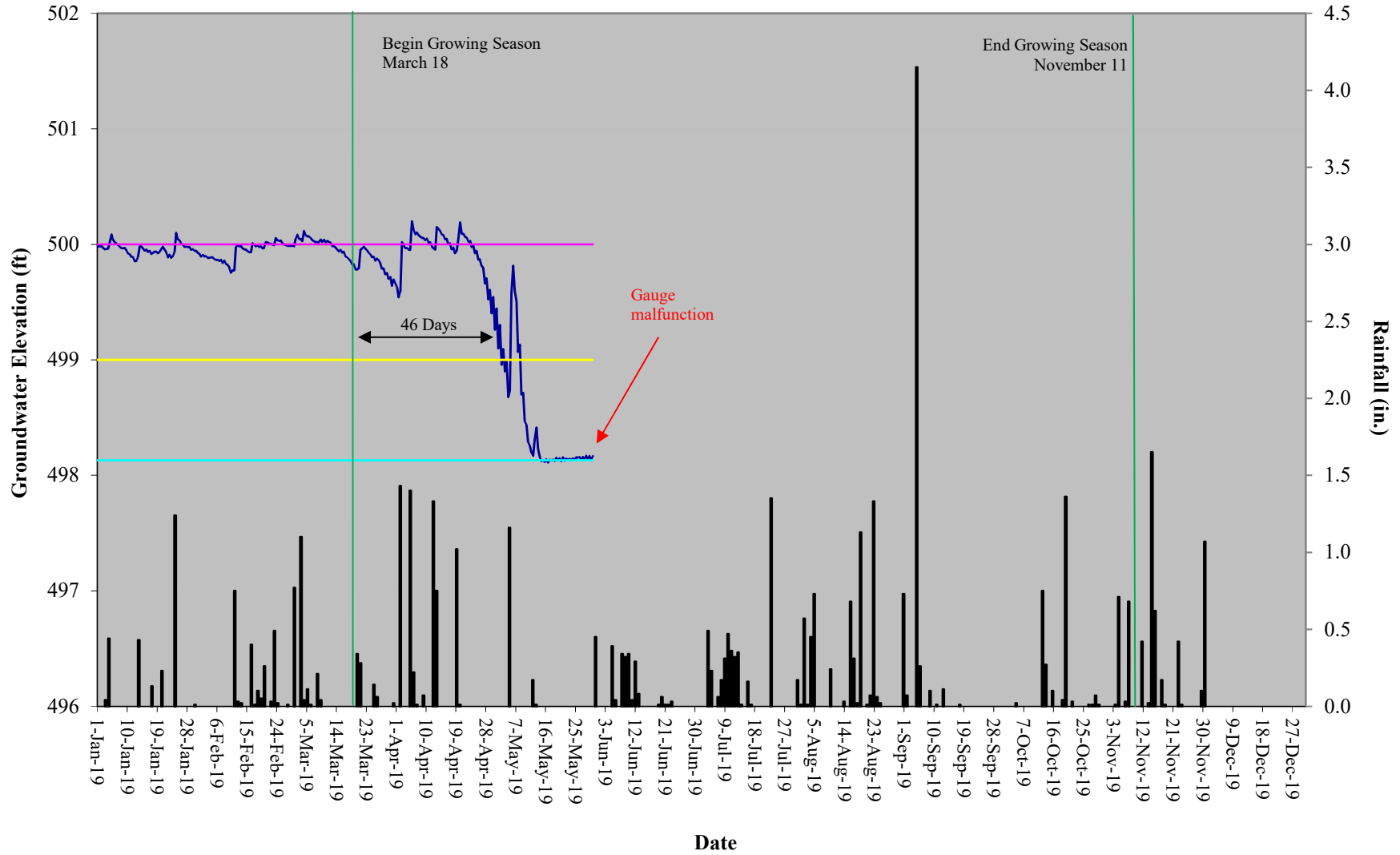


## Twin Bays Restoration Site Hydrograph Wetland Gauge 4

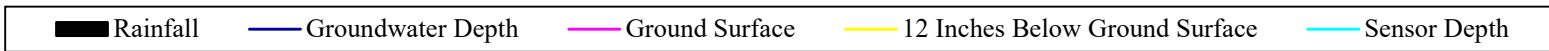
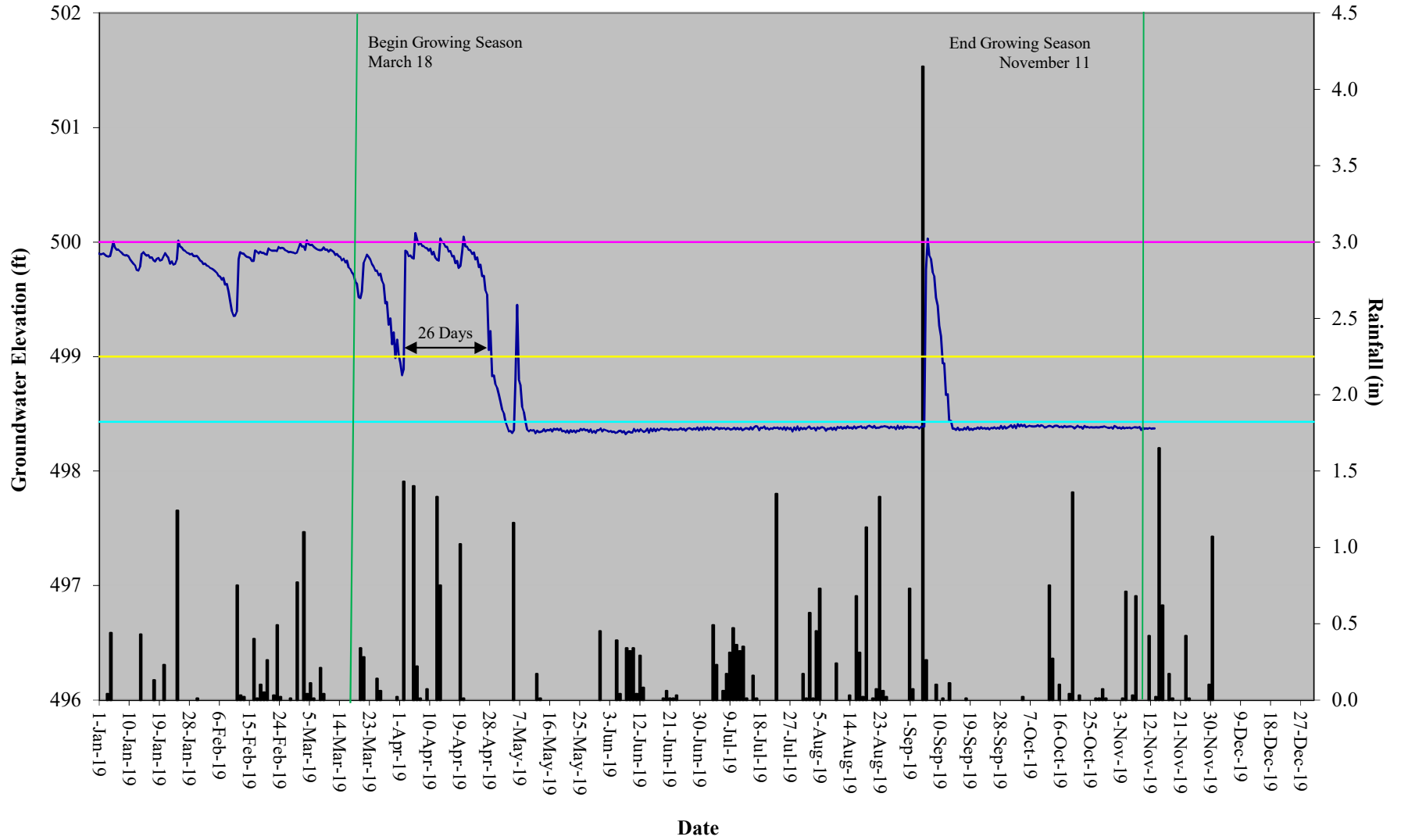




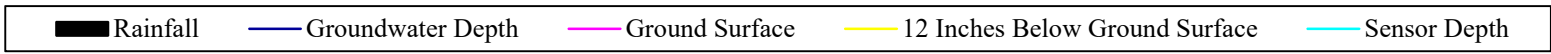
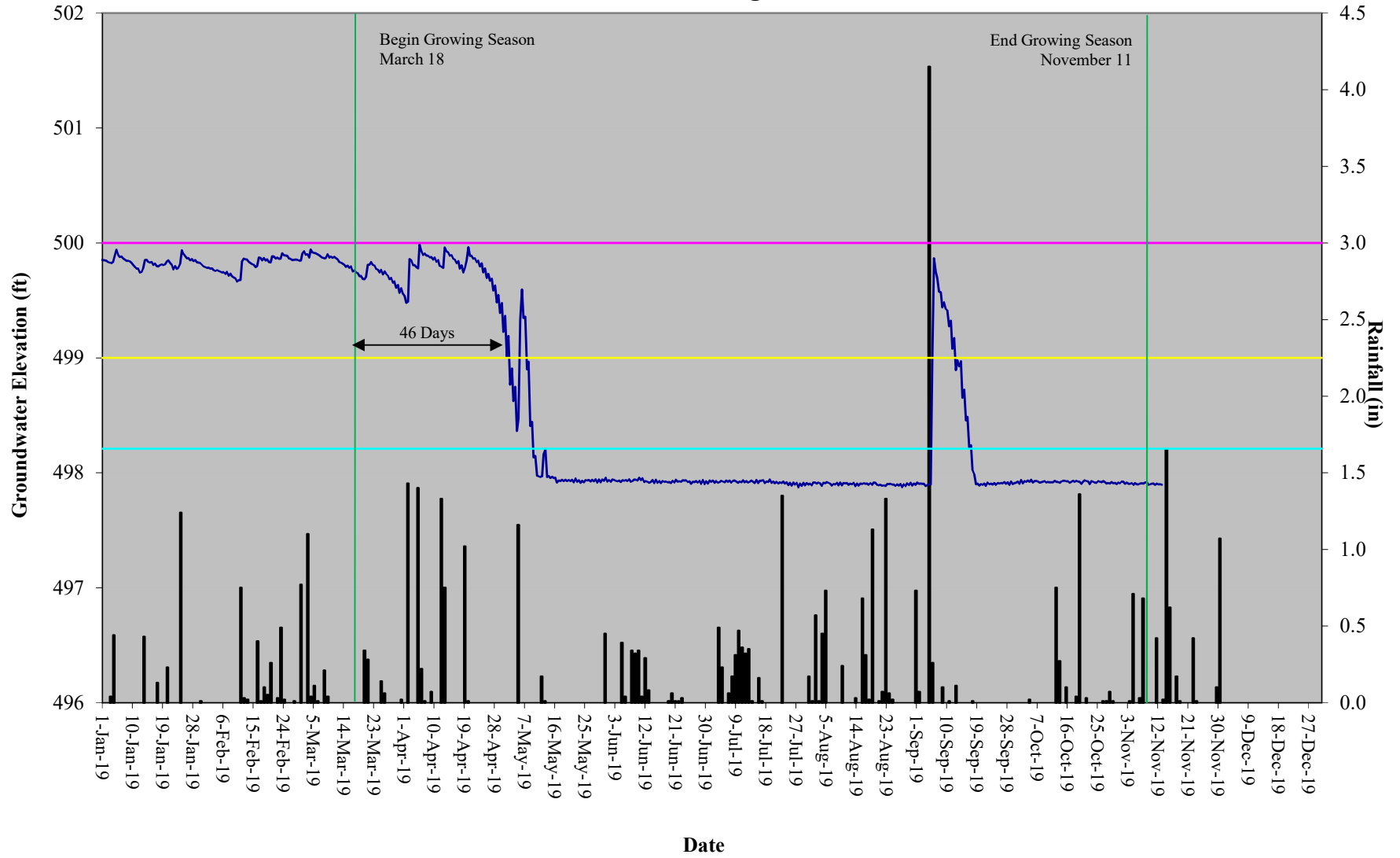
## Twin Bays Restoration Site Hydrograph Wetland Gauge 5



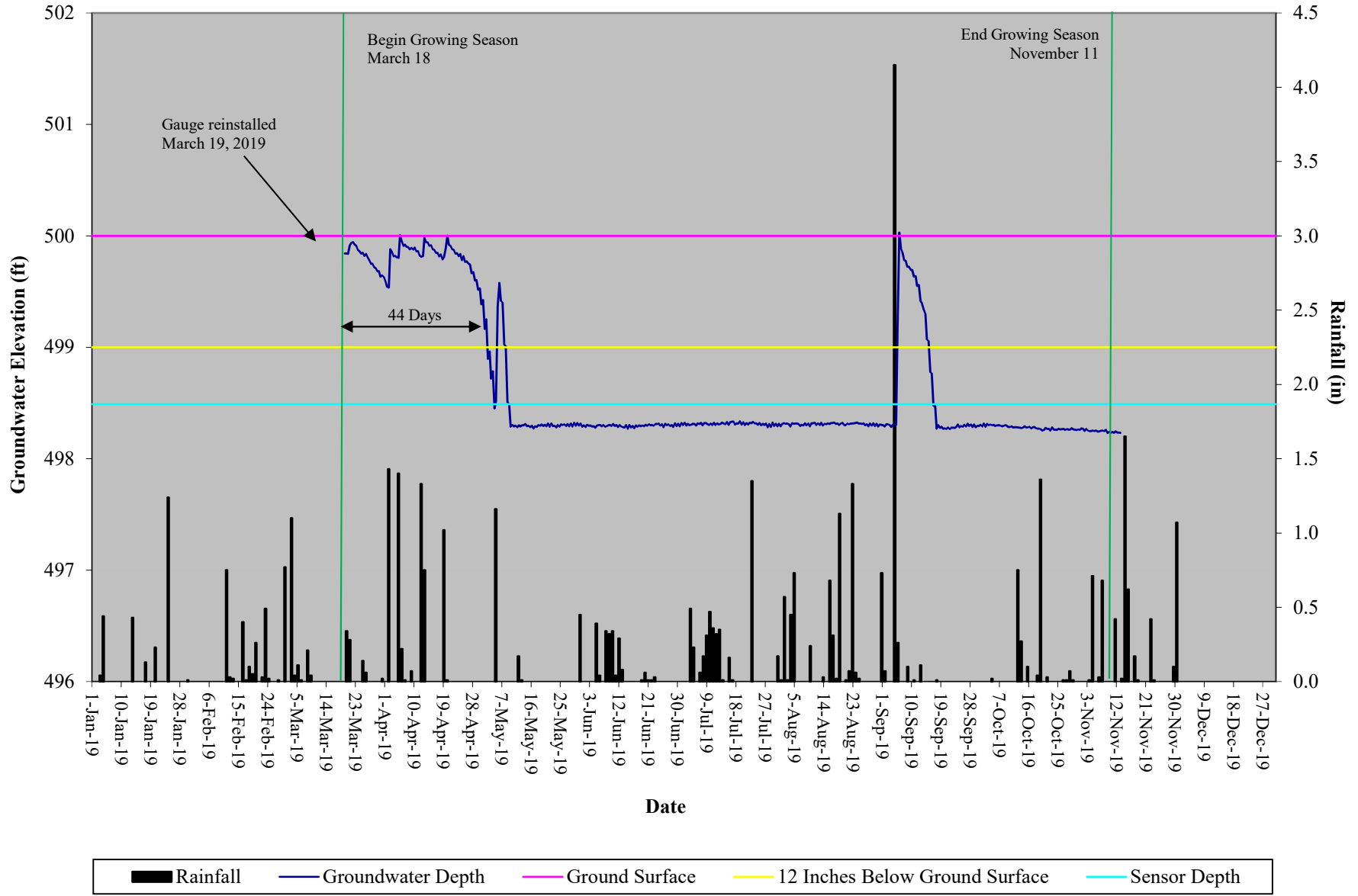
# Twin Bays Restoration Site Hydrograph Wetland Gauge 6 - non-credit bearing



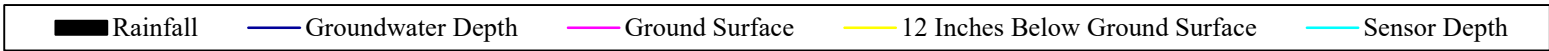
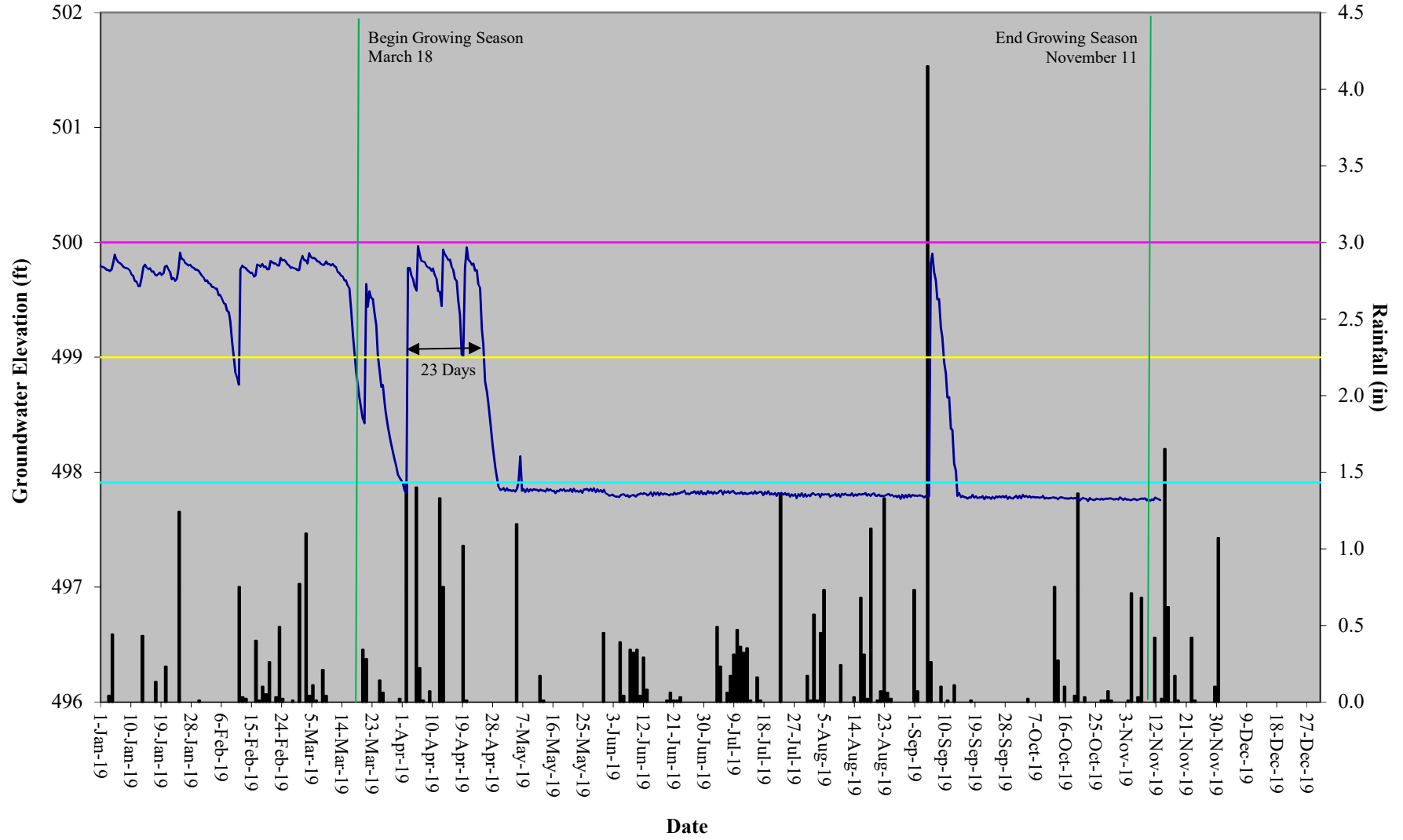
## Twin Bays Restoration Site Hydrograph Wetland Gauge 7



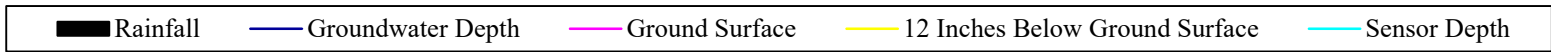
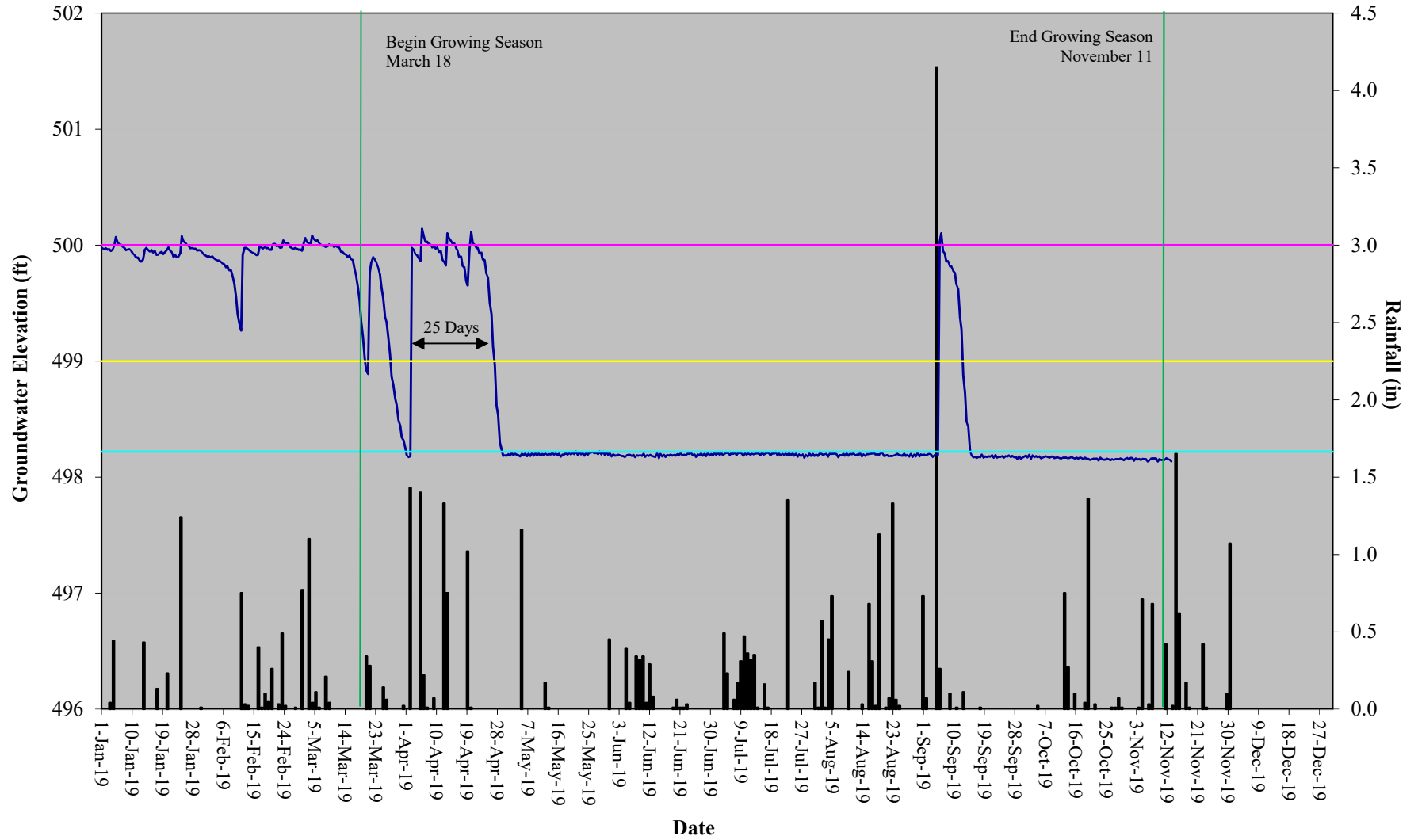
# Twin Bays Restoration Site Hydrograph Wetland Gauge 8



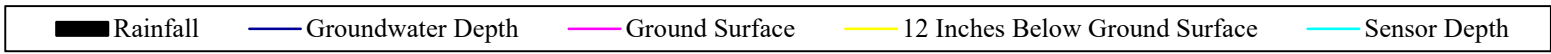
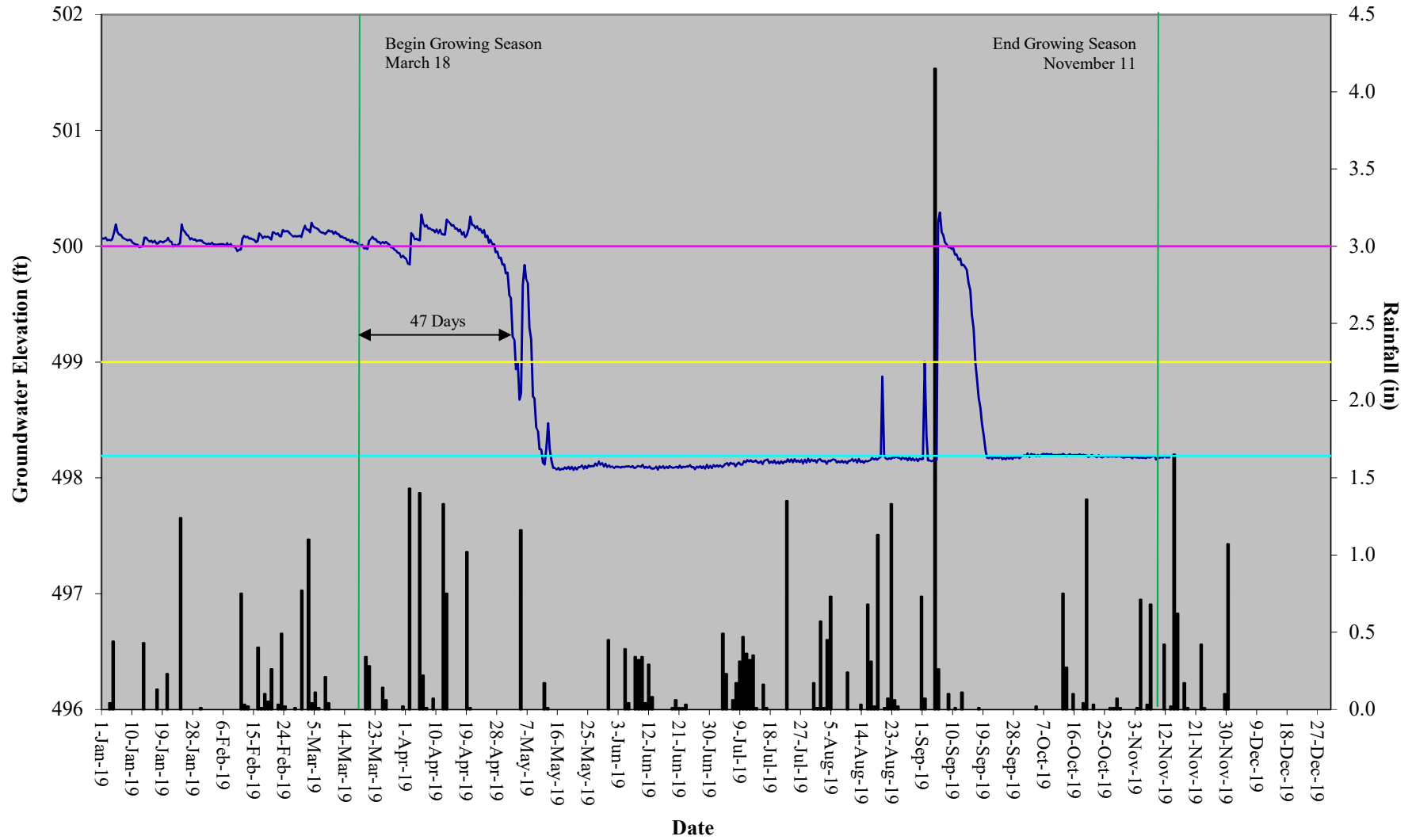
# Twin Bays Restoration Site Hydrograph Wetland Gauge 9



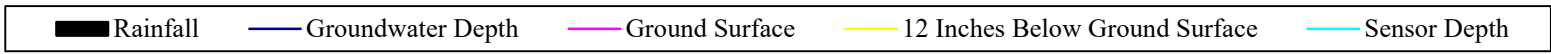
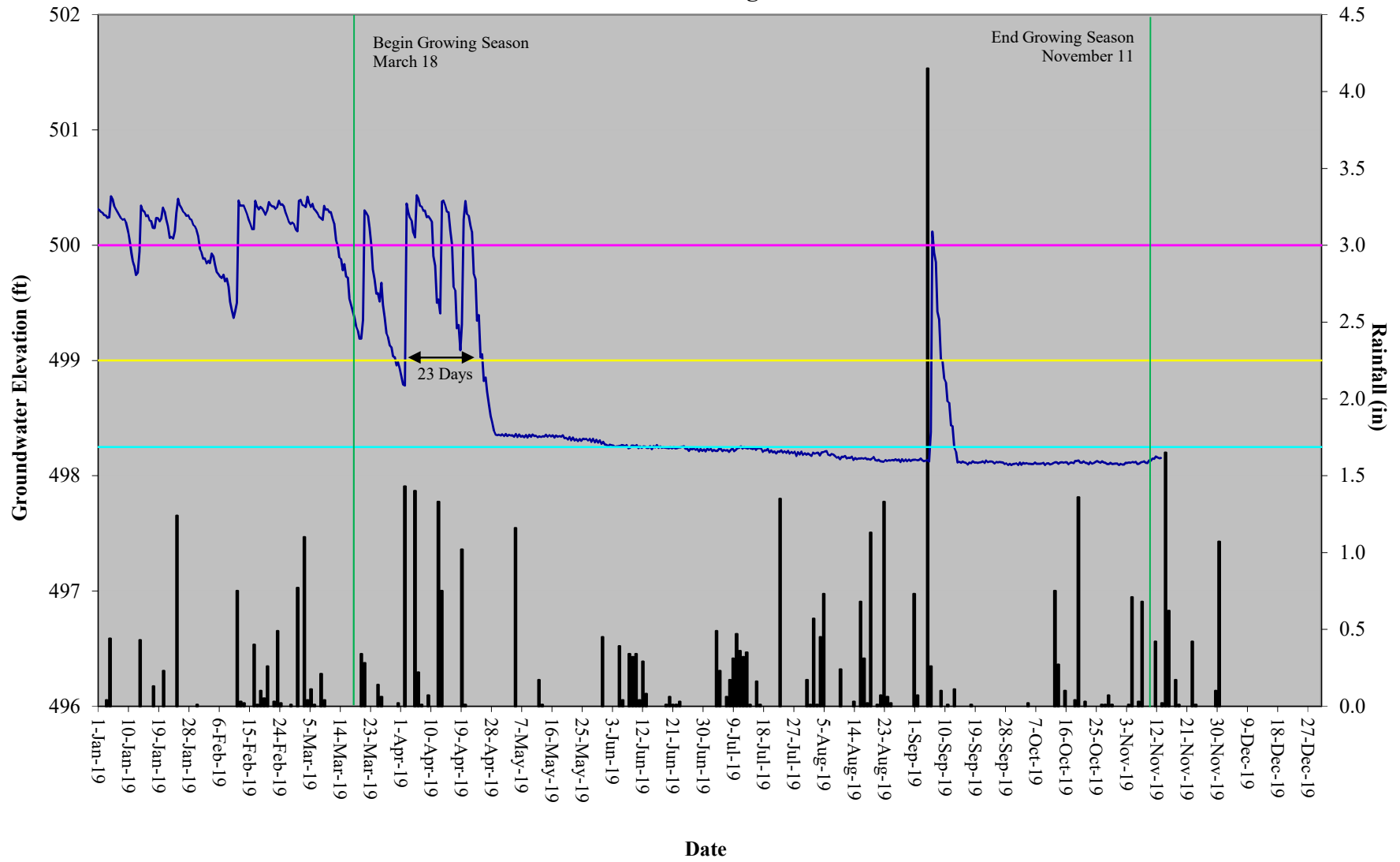
## Twin Bays Restoration Site Hydrograph Wetland Gauge 10



## Twin Bays Restoration Site Hydrograph Wetland Gauge 11

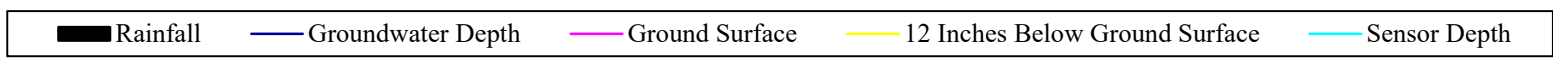
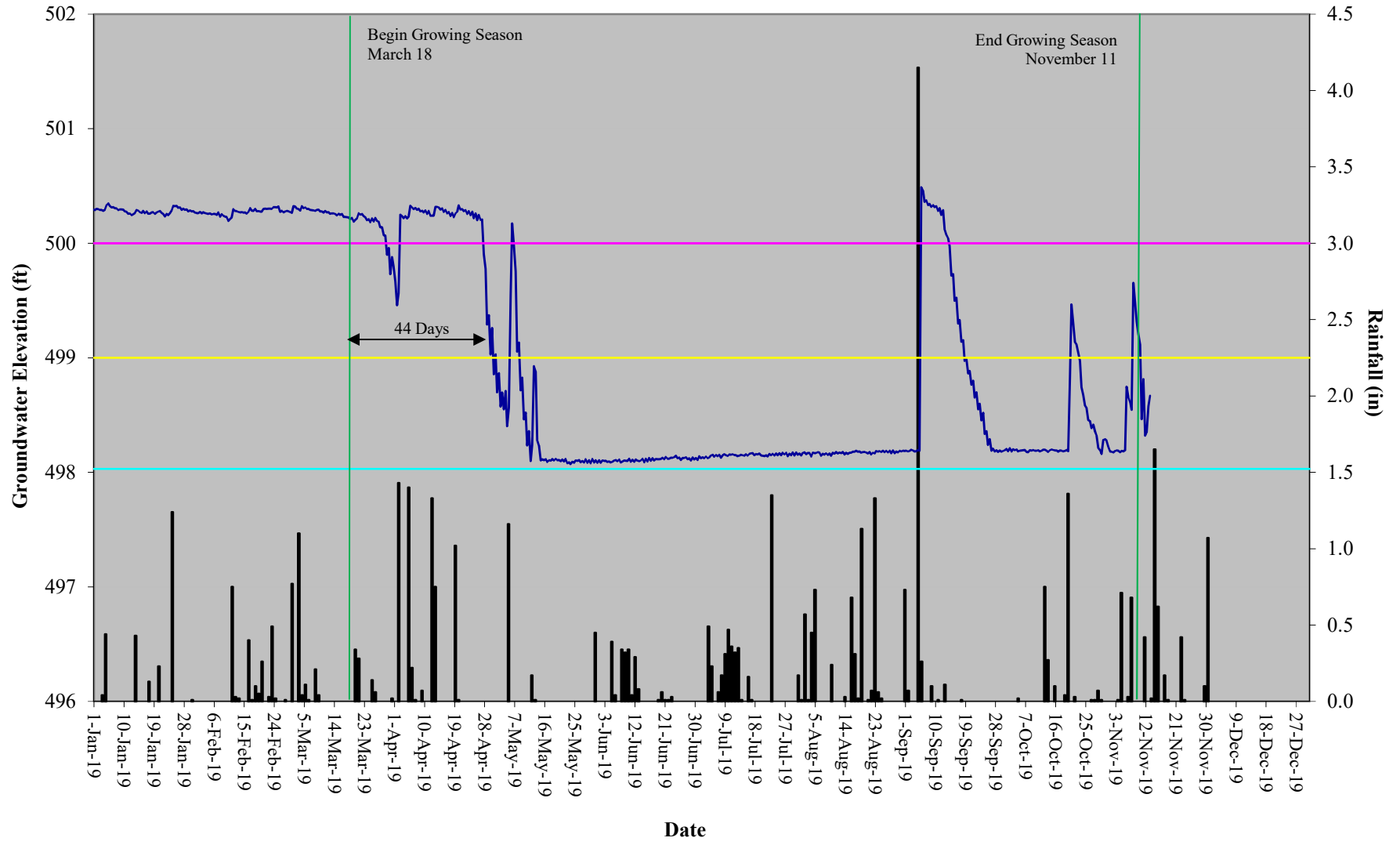


# Twin Bays Restoration Site Hydrograph Wetland Gauge 12

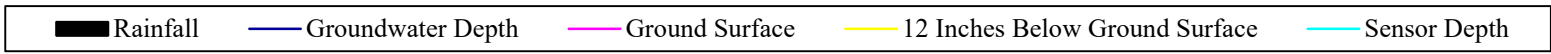
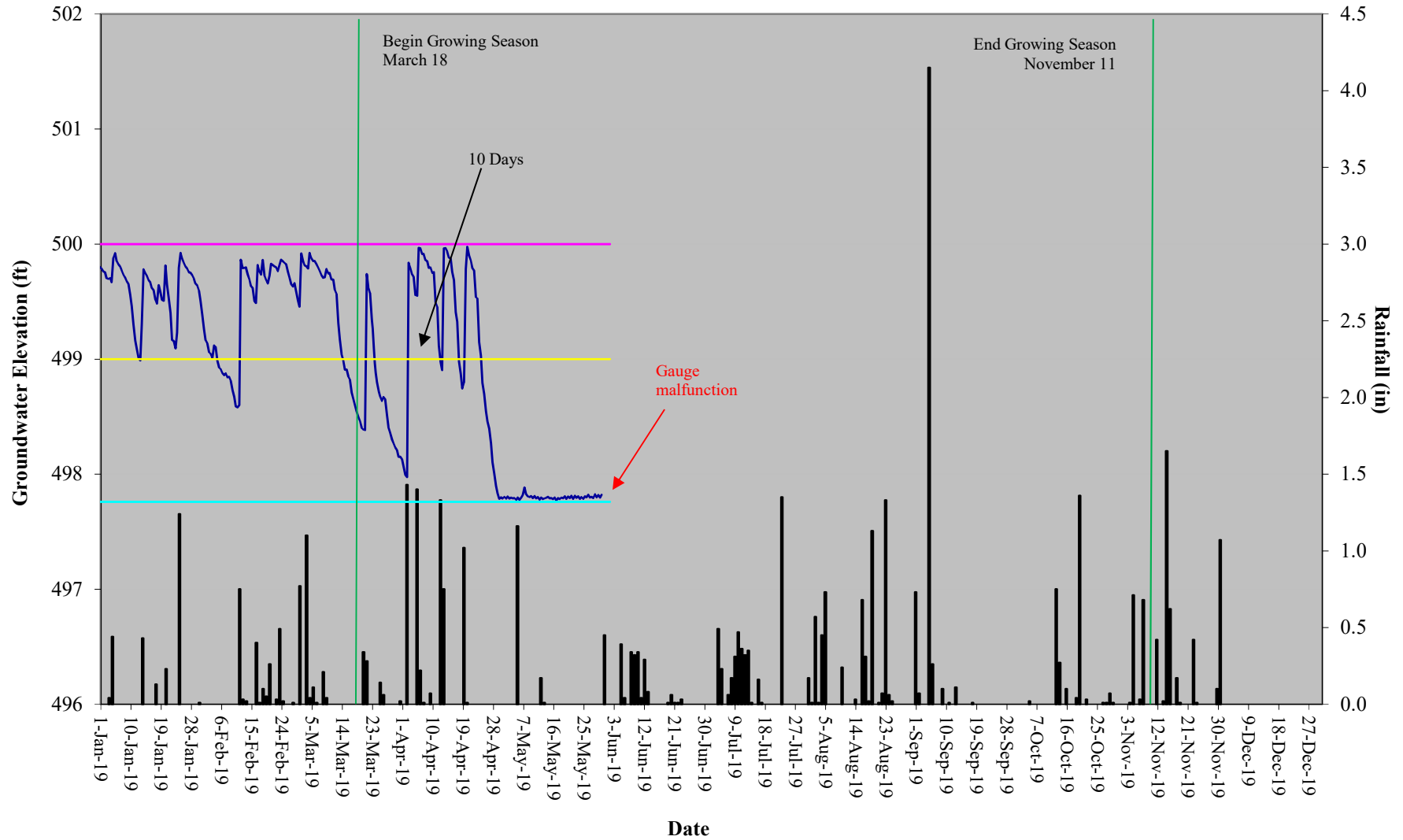




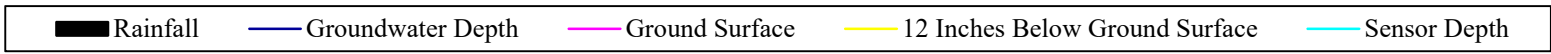
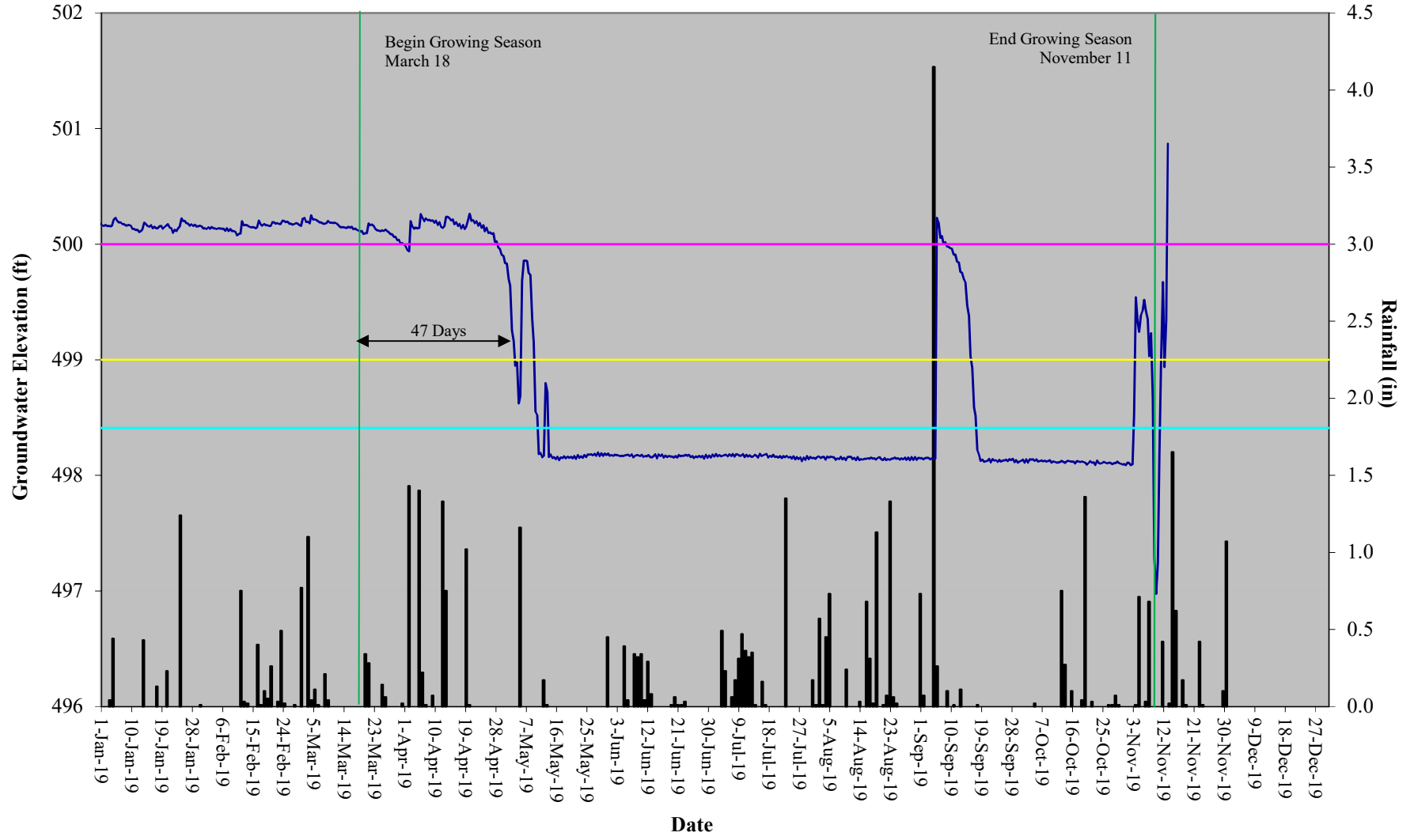
## Twin Bays Restoration Site Hydrograph Wetland Gauge 13



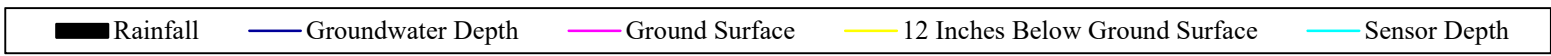
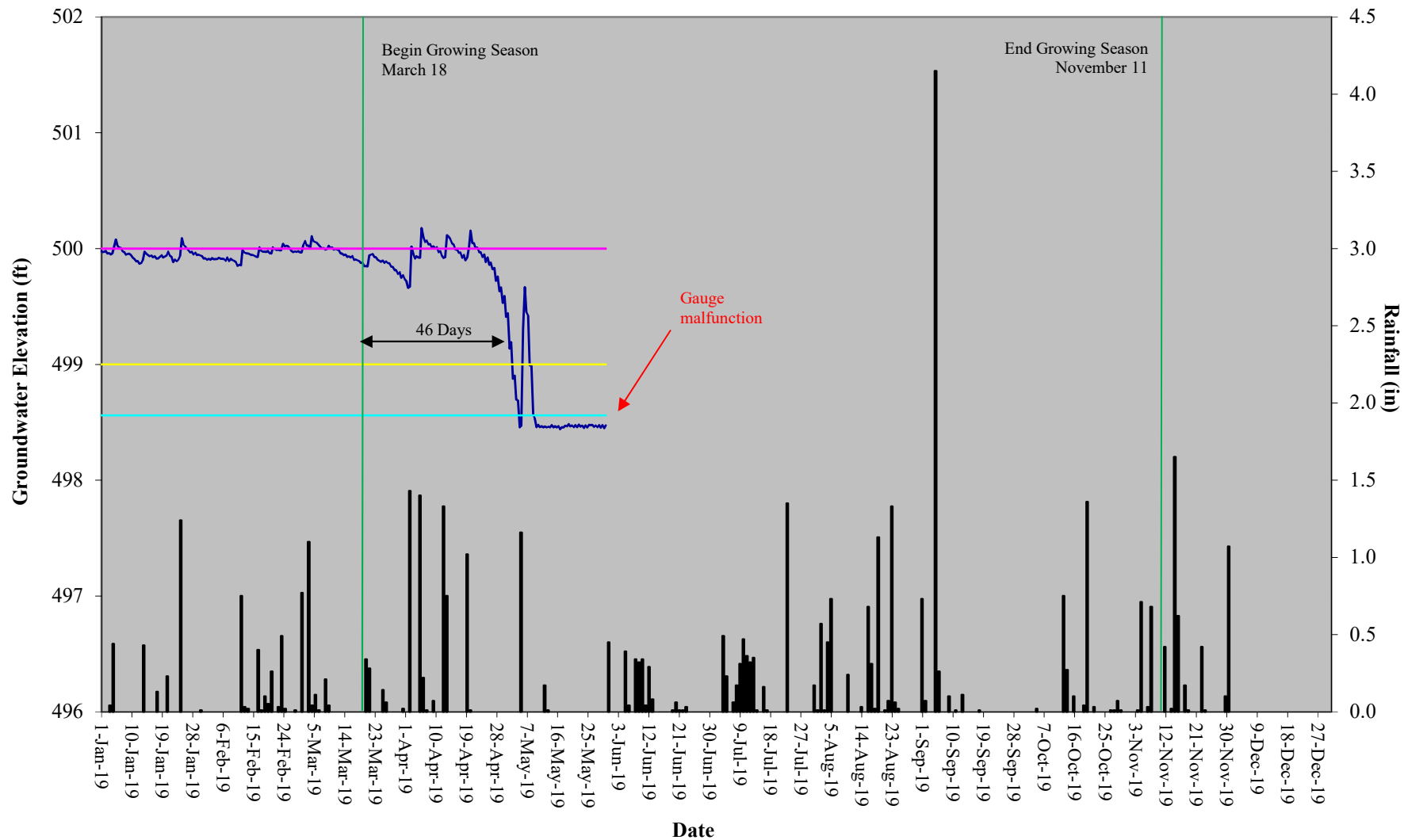
# Twin Bays Restoration Site Hydrograph Wetland Gauge 14



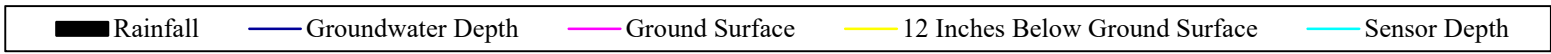
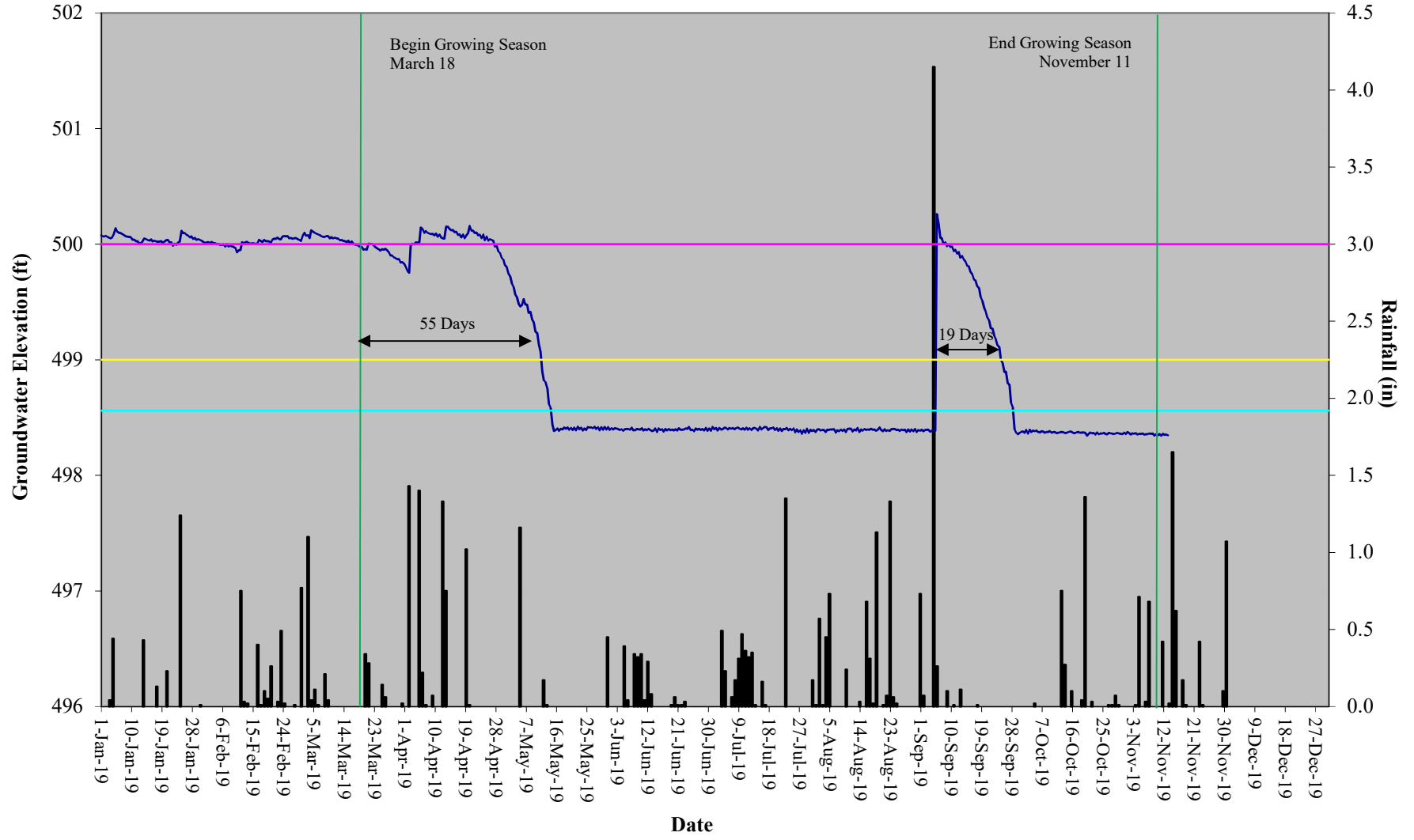
## Twin Bays Restoration Site Hydrograph Wetland Gauge 15



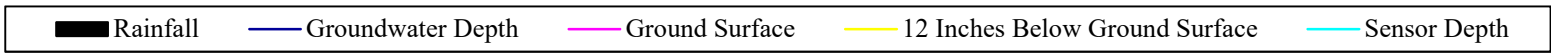
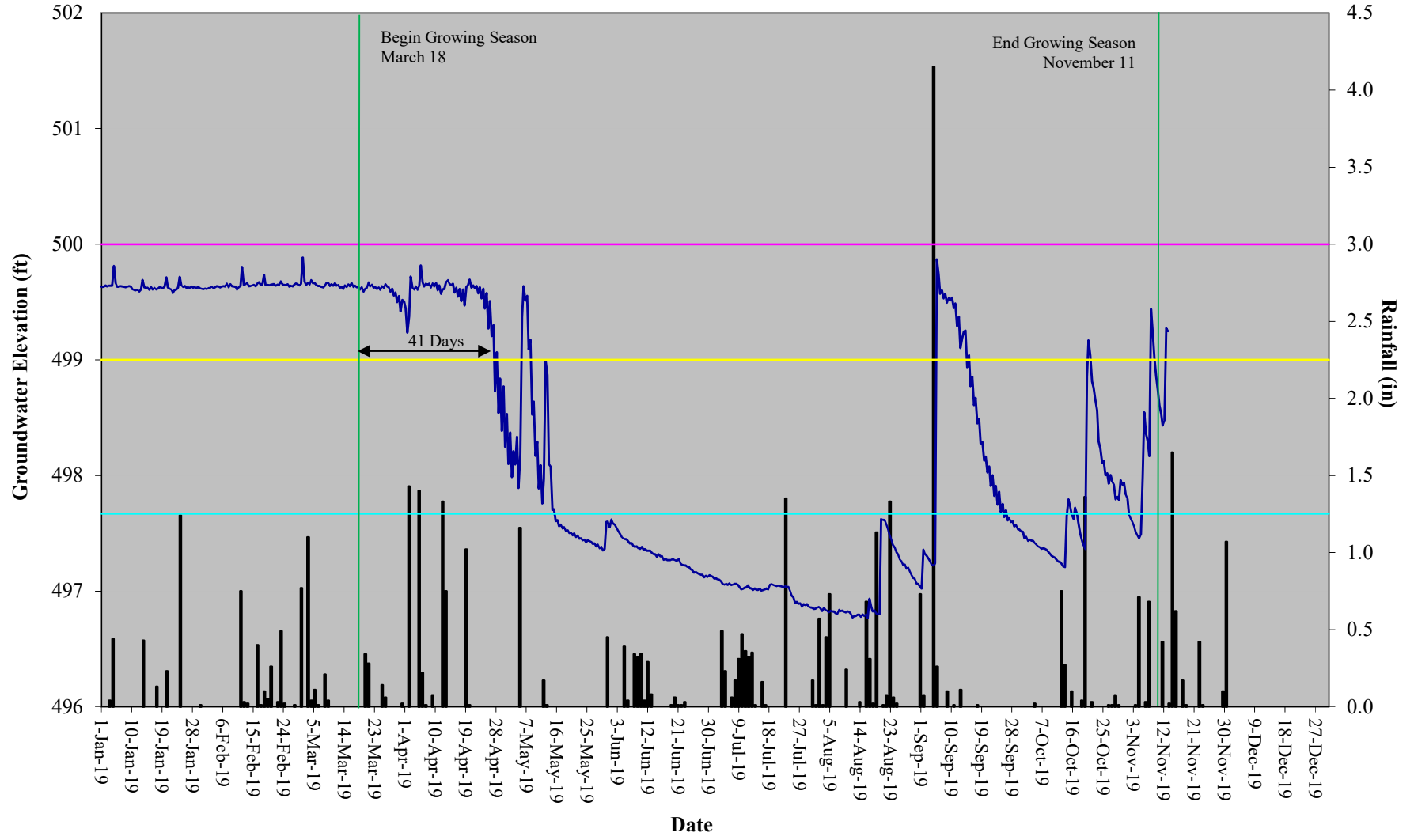
## Twin Bays Restoration Site Hydrograph Wetland Gauge 16



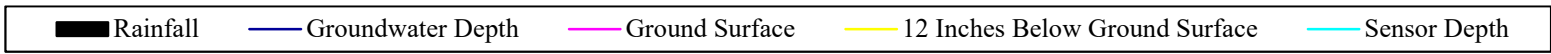
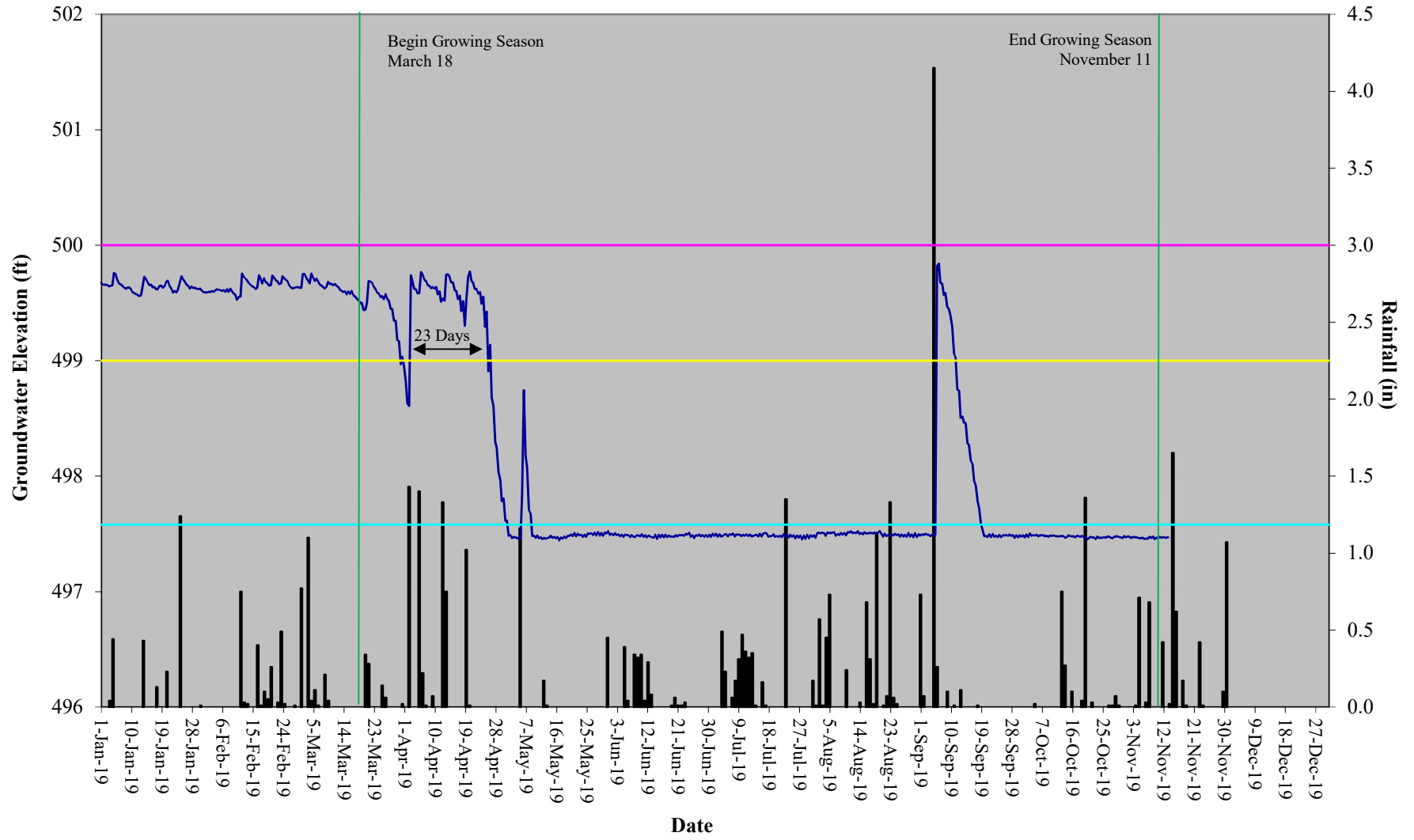
## Twin Bays Restoration Site Hydrograph Wetland Gauge 17



## Twin Bays Restoration Site Hydrograph Wetland Gauge 18



## Twin Bays Restoration Site Hydrograph Wetland Gauge 19



<b>Table 7. Wetland Hydrology Attainment Table Twin Bays Restoration Site, DMS Project #95363</b>							
	<b>Greater than 8% Continuous Saturation/Max Consecutive Days During Growing Season (Percentage)</b>						
<b>Gauge #</b>	<b>MY-01 2014</b>	<b>MY-02 2015</b>	<b>MY-03 2016</b>	<b>MY-04 2017</b>	<b>MY-05 2018</b>	<b>MY-06 2019</b>	<b>MY-07 2020</b>
Gauge 1	Yes/25 (10.5%)	Yes/105 (43.9%)	No/2 (0.8%)	No/9 (3.8%)	Yes/19 (8.0%)	No/5 (2.1%)	
Gauge 2	No/16 (6.5%)	Yes/75 (31.4%)	Yes/36 (14.9%)	Yes/30 (12.6%)	Yes/49 (20.3%)	Yes/41 (16.9%)	
Gauge 3*	13 (5.2%)	18 (7.3%)	10 (4.0%)	14 (5.9%)	19 (8.0%)	9 (3.8%)	
Gauge 4	Yes/26 (10.9%)	Yes/92 (38.5%)	Yes/36 (15.1%)	Yes/56 (23.4%)	Yes/57 (23.6%)	No/2‡ (0.6%)	
Gauge 5	Yes/27 (11.1%)	Yes/98 (41.0%)	Yes/53 (22.2%)	Yes/53 (22.2%)	Yes/57 (23.6%)	Yes/46 (19.0%)	
Gauge 6*	13 (5.4%)	41 (17.2%)	28 (11.5%)	26 (10.9%)	47 (19.7%)	26 (10.9%)	
Gauge 7	Yes/27 (11.1%)	Yes/75 (31.4%)	Yes/36 (14.9%)	Yes/51 (21.3%)	Yes/56 (23.2%)	Yes/46 (19.0%)	
Gauge 8	Yes/24 10.0%	Yes/75 (31.4%)	Yes/89 (37.0%)	Yes/37 (15.5%)	Yes/56 (23.2%)	Yes/44 (18.45)	
Gauge 9	No/17 (6.9%)	Yes/92 (38.3%)	Yes/27 (11.1%)	Yes/24 (10.0%)	Yes/21 (8.6%)	Yes/23 (9.6%)	
Gauge 10	Yes/24 (9.8%)	Yes/22 (9.2%)	Yes/49 (20.5%)	Yes/26 (10.9%)	Yes/47 (19.7%)	Yes/25 (10.3%)	
Gauge 11	Yes/28 (11.7%)	Yes/100 (41.8%)	Yes/92 (38.5%)	Yes/58 (24.3%)	Yes/57 (23.6%)	Yes/47 (19.5%)	
Gauge 12	No/14 (5.9%)	Yes/103 (43.1%)	No/18 (7.3%)	Yes/26 (10.9%)	Yes/34 (14.2%)	Yes/23 (9.6%)	
Gauge 13	No/15 (6.1%)	Yes/74 (30.8%)	Yes/54 (22.6%)	Yes/41 (17.2%)	Yes/56 (23.2%)	Yes/44 (18.2%)	
Gauge 14	Yes/22 (9.0%)	Yes/19 (8.0%)	No/13 (5.2%)	Yes/24 (10.0%)	Yes/19 (8.0%)	No/10‡ (4.0%)	
Gauge 15	Yes/27 (11.1%)	Yes/76 (31.8%)	Yes/95 (39.7%)	Yes/60 (25.1%)	Yes/59 (24.5%)	Yes/47 (19.5%)	
Gauge 16	Yes/49 20.3%	Yes/76 (31.8%)	Yes/59 (24.5%)	Yes/58 (24.3%)	Yes/58 (24.1%)	Yes/46 (19.0%)	
Gauge 17**	-	Yes/104 (43.5%)	Yes/103 (42.9%)	Yes/73 (30.5%)	Yes/118 (49.2%)	Yes/55 (22.8%)	
Gauge 18†	-	-	-	Yes/58 (24.3%)	Yes/48 (19.9%)	Yes/41 (16.9%)	
Gauge 19†	-	-	-	No/15 (6.3%)	Yes/36 (14.9%)	Yes/23 (9.6%)	

\* = Gauge in the non-credit bearing zone

\*\* = Gauge installed 3/8/2015

† = Gauge installed 4/6/2017

‡ = Gauge malfunctioned