Bear Basin Restoration Site
Monitoring Report MY04
DMS Project # 95362
DMS Contract # 004741

Onslow County, NC
CU# 03030001
DWR# 2013-0456
SAW# 2012-01391

Submitted to:

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

Construction Completed: February 2015
Data Collection: 2018
Submitted: December 2018

Monitoring and Design Firm

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KCI Project No: 20122266

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1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The Bear Basin Restoration Site (BBRS) is a full-delivery project that was developed for the North Carolina Division of Mitigation Services (DMS). Construction was completed in February 2015. The site is within the 03030001 Watershed Cataloging Unit (8-digit HUC) and the Local Watershed Unit (14-digit HUC) 03030001010010. In DMS' most recent publication of excluded and Targeted Local Watersheds/Hydrologic Units, the 03030001010010 14-digit HUC has been identified as a Targeted Local Watershed.

The project site, which is protected by an 11.9-acre permanent conservation easement held by the State of North Carolina, is situated in Onslow County in the Carolina Flatwoods ecoregion of the Coastal Plains physiographic province. The site is located on a single parcel located off of Jesse Williams Road approximately five miles west of Richlands, North Carolina.

The project goals and objectives are listed below.

Project Goals

- Protect and improve water quality by reducing sediment and nutrient inputs
- The protection of a watershed draining into shellfish harvesting waters
- Provide habitat for aquatic flora and fauna by improving physical structure and vegetative composition
- Increase the local hydroperiod by encouraging both surface and subsurface storage and retention
- Restore and establish a functional and diverse wetland community

Project 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.
- Restore a diverse wetland vegetation community through maintenance and germination of existing wetland seed stores, planting of wetland trees and shrubs, and incorporation of a custom wetland seed mix.

The BBRS provided mitigation for wetland impacts within Hydrologic Unit 03030001 by restoring 8.6 acres of wetland and preserving 1.9 acres of upland, generating 8.6 non-riparian wetland mitigation units (WMU's). The wetland site will be monitored to determine if the project is on-track to meeting jurisdictional wetland status. In the restoration areas, the wetland site 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.

As designed, the western and southernmost ditches, located adjacent to the project easement were left open and not filled during construction. It is anticipated that leaving these ditches open will have minimal impacts to the overall hydrologic performance of the site. The hydrologic influence of these ditches 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 85'. Due to the fact that these ditches 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 field ditches and surface roughening, the entire site will have more surface and groundwater storage, which may decrease the effect of the open ditches. For this reason, the non-credit generating portion of the site is assumed to be half of the zone of influence for the ditch.

2.0 MONITORING RESULTS

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, seven 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. Vegetation monitoring was not conducted in year four, per the mitigation plan, but will resume in year five.

2.2 HYDROLOGY MONITORING

Wetland hydrology will be 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 Onslow County using the 30th to 70th percentile thresholds as the range of normal as documented in the USACE Technical Report "Accessing and Using Meteorological Data to Evaluate Wetland Hydrology, April 2000." The growing season for Onslow County is considered to extend from March 18 to November 16 (243 days). The water table of the restored wetlands must be within 12" of the soil surface continuously for at least 8% (20 days) of the 243-day growing season. Wetland hydrology will be monitored with twenty automatic gauges that record water table depth.

To monitor the effect of the unfilled ditches described in Section 1.0, four sets of coupled gauges were installed perpendicular to the unfilled ditches. Each set includes a gauge that is 50' from the open ditch and another that is 80' from the ditch. An additional four gauges were installed between the coupled gauges to monitor hydrology less than 42.5' from the open ditch in the non-credit bearing zone.

The daily rainfall data was obtained from a local weather station in Jacksonville, NC; provided by the NC State Climate Office. For the 2018 year, the months of April, May, June, July, September and November experienced above average rainfall, while January, August, and October experienced average rainfall. The months of February and March recorded below average rainfall for the site. Overall, the area experienced above average rainfall during the 2018 growing season.

On March 7, 2018, five additional gauges were added to the site in the vicinity of gauges that had not consistently achieved the success criteria in the previous 3 monitoring years. During the site's fourth growing season, all 21 of the credit bearing gauges achieved the success criteria. Additionally, two of the four non-credit bearing gauges achieved the success criteria.

To make sure that there is no hydrologic trespass, there are some areas of open water on-site that connect to off-site ditches. This open water area has been brought up as a concern by the IRT during credit release meetings. In November 2018, KCI mapped this area (1.06 ac), which is shown in Figure 3, and will continue to monitor the extent of this area. It is expected that this area will decrease in size as vegetation continues to encroach on the open water. This will be documented in future monitoring reports.

3.0 REFERENCES

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

Sprecher, S. W. and Warne, A. G. 2000. "Accessing and Using Meteorological Data to Evaluate Wetland Hydrology," ERDC/EL TR-WRAP-00-01, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Appendix A

Project Vicinity Map and Background Tables

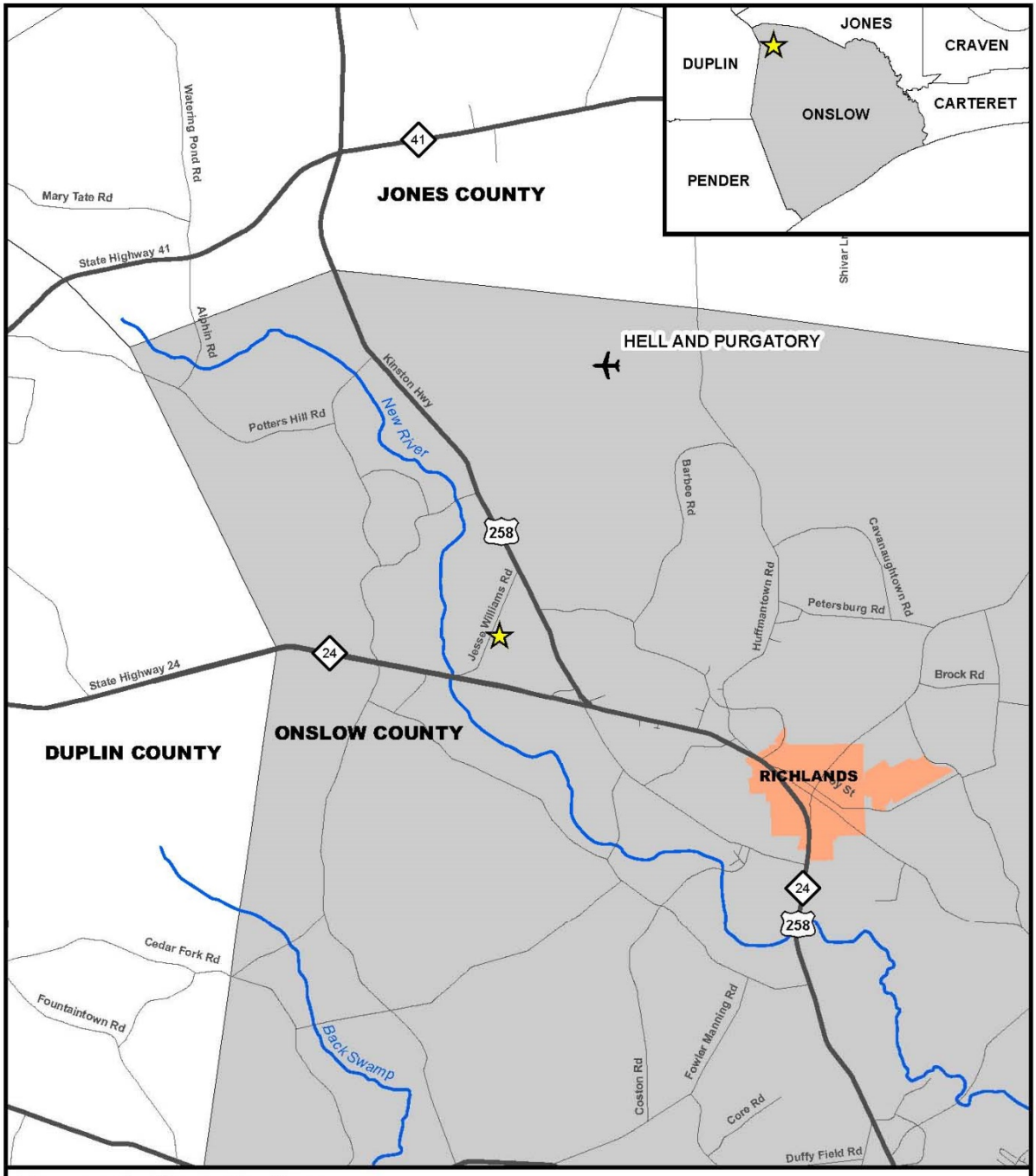


Figure 1. Vicinity Map

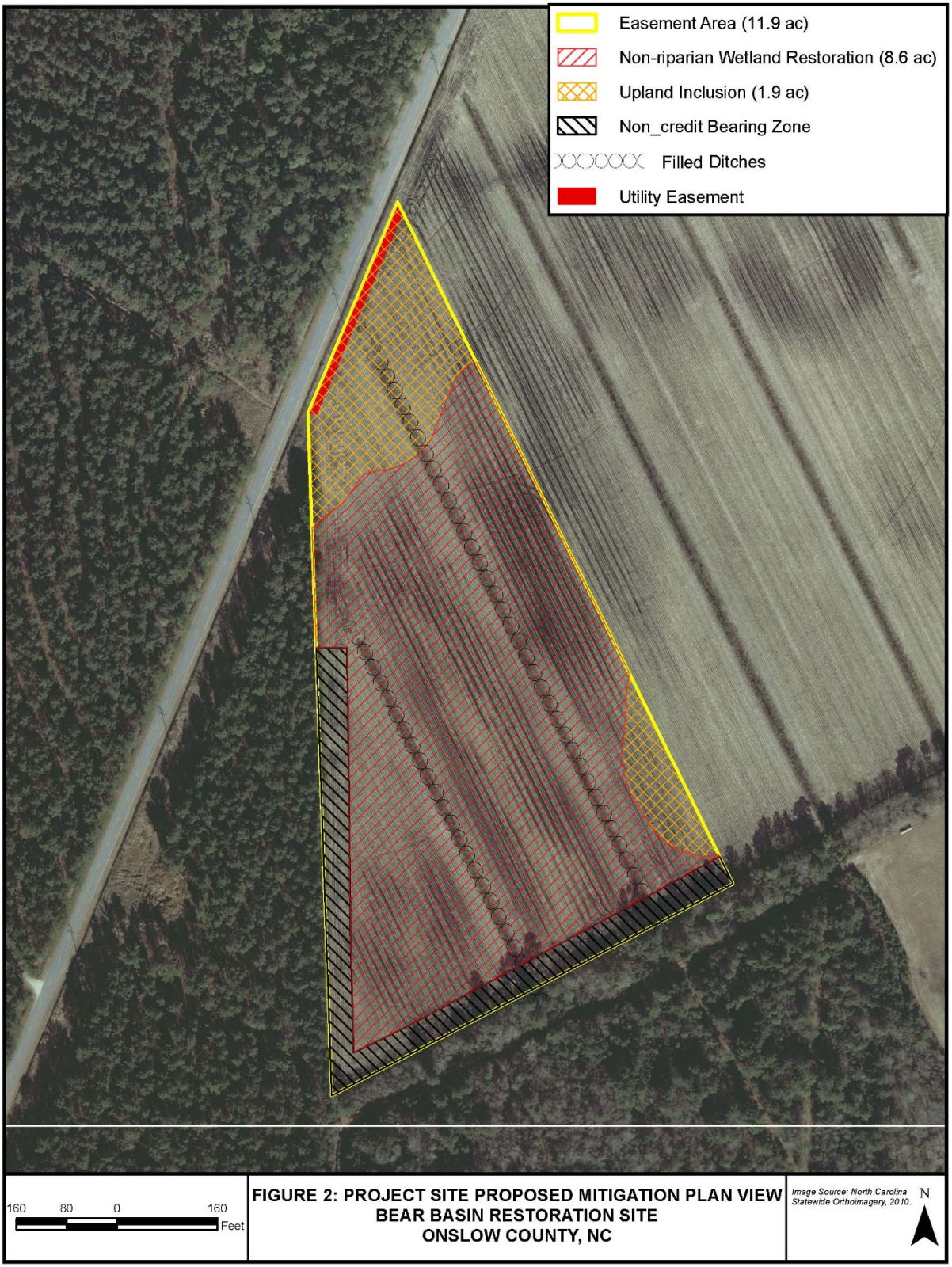

Easement Area (11.9 ac)
Non-riparian Wetland Restoration (8.6 ac)
Upland Inclusion (1.9 ac)
Non_credit Bearing Zone
Filled Ditches
Utility Easement
160 80 0 160
Feet
FIGURE 2: PROJECT SITE PROPOSED MITIGATION PLAN VIEW
BEAR BASIN RESTORATION SITE
ONSLOW COUNTY, NC
Image Source: North Carolina Statewide Orthoimagery, 2010.
N

Table 1. Project Components
Project Number and Name: 95362 – Bear Basin Restoration Site

Mitigation Credits									
	Stream		**Riparian Wetland**		**Non-riparian Wetland**		**Buffer**	**Nitrogen Nutrient Offset**	**Phosphorous Nutrient Offset**
Type	R	RE	R	RE	R	RE			
Acres	-	-	-	-	8.6	-	-	-	-
Credits	-	-	-	-	8.6	-	-	-	-
TOTAL CREDITS	-		-		8.6		-	-	-

Project Components						
Project Component -or- Reach ID	**Stationing/ Location**	**Existing Footage/ Acreage**	**Approach (PI, PII etc.)**	**Restoration -or- Restoration Equivalent**	**Restoration Footage or Acreage**	**Mitigation Ratio**
Wetland Area	-	8.6 acres	-	Restoration	8.6 acres	1:1

Component Summation						
Restoration Level	**Stream (linear feet)**	**Riparian Wetland (acres)**		**Non-riparian Wetland (acres)**	**Buffer (square feet)**	**Upland (acres)**
		Riverine	Non-Riverine			
Restoration	-	-	-	8.6 acres	-	-
Enhancement		-	-	-	-	-
Enhancement I	-					
Enhancement II	-					
Creation		-	-	-		-
Preservation	-	-	-	-		1.9 acres
High Quality Preservation	-	-	-	-		-
TOTAL	-	-	-	8.6 acres		1.9 acres

Table 2. Project Activity & Reporting History		
Bear Basin Wetland Restoration Site, DMS Project# 95362		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan		July 2014
Final Design – Construction Plans		July 2014
Construction		Dec 2014
Planting		March 2015
Baseline Monitoring/Report	May 2015	June 2015
Vegetation Monitoring	May 19, 2015	
Photo Points	May 26, 2015	
Year 1 Monitoring	Nov 2015	Jan 2015
Vegetation Monitoring	Oct 13, 2015	
Photo Points	Oct 13, 2015	
Gauge Downloads	Nov 25, 2015	
Year 2 Monitoring	Dec 2016	Dec 2016
Vegetation Monitoring	July 5, 2016	
Photo Points	Aug 16, 2016	
Gauge Downloads	Dec 14, 2016	
Year 3 Monitoring	Nov 2017	Jan 2018
Vegetation Monitoring	July 5, 2017	
Photo Points	Nov 30, 2017	
Gauge Downloads	Nov 30, 2017	
Year 4 Monitoring	Nov 2018	Dec 2018
Vegetation Monitoring	N/A	
Photo Points	Nov 13, 2018	
Gauge Downloads	Nov 13, 2018	

Table 3. Project Contacts Project Number and Name: 95362 - Bear Basin Restoration Site	
Design Firm	KCI Associates of North Carolina, PC 4505 Falls of Neuse Rd. Suite 400 Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
Construction Contractor	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
Planting Contractor	Bruton Nurseries and Landscapes PO Box 1197 Freemont, NC 27830 Contact: Mr. Charlie Bruton Phone: (919) 242-6555
Monitoring Performers	
	KCI Associates of North Carolina, PC 4505 Falls of Neuse Rd. Suite 400 Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

Table 4. Project Attribute Table Project Number and Name: 95362 – Bear Basin Restoration Site			
County	Onslow County		
Project Area (acres)	11.9 acres		
Project Coordinates (lat. and long.)	34.925365 N , -77.607461 W		
Project Watershed Summary Information			
Physiographic Province	Coastal Plain		
River Basin	White Oak		
USGS Hydrologic Unit 8-digit	03030001	**USGS Hydrologic Unit 14-digit**	03030001010010
DWQ Sub-basin	03-05-02b		
Project Drainage Area (acres)	32.7 acres		
Project Drainage Area Percentage of Impervious Area	2%		
CGIA Land Use Classification	44% Cultivated, 4% Managed Herbaceous Cover, 50% Southern Yellow Pine, and 2% High-Intensity Developed		
Wetland Summary Information			
Parameters	**Wetland Area**		
Size of Wetland (acres)	8.6 acres		
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Non-riparian		
Mapped Soil Series	Rains and Stallings (Pantego and Lynchburg by detailed soil investigation)		
Drainage class	Poorly drained		
Soil Hydric Status	Drained Hydric		
Source of Hydrology	Precipitation		
Hydrologic Impairment	Ditching and Crops		
Native vegetation community	Crops		
Percent composition of exotic invasive vegetation	0%		

Appendix B

Visual Assessment Data

LEGEND:

VEG PLOT ACHIEVING DENSITY CRITERION * ----------

VEG PLOT BELOW DENSITY CRITERION * ----------

VEG PLOT TOTAL / PLANTED STEM DENSITY * -------- 937/786

WETLAND GAUGE ACHIEVING HYDROLOGIC CRITERION ----------

WETLAND GAUGE BELOW HYDROLOGIC CRITERION ----------

PHOTO POINT (PP) ----------

FILLED DITCHES ----------

NONRIPARIAN WETLAND RESTORATION = 8.6 ACRES ----------

CONSERVATION EASEMENT ----------

BARE AREA / OPEN WATER ----------

*VEG DATA FROM MY03 (2017)

IMAGE SOURCE: NC 2016 ORTHOIMAGERY

NC GRID NAD '83

–60′ –30′ 0′ 60′ 120′

GRAPHIC SCALE

VEG PLOT #1 971/769

VEG PLOT #2 728/607

VEG PLOT #3 1376/1295

VEG PLOT #4 1174/1174

VEG PLOT #5 607/526

VEG PLOT #6 1012/728

VEG PLOT #7 890/607

GA1 GA2 GA3 GA4 GA5 GA6 GA7 GA8 GA9 GA10 GA11 GA12 GA13 GA14 GA15 GA16 GA17 GA18 GA19 GA20 GA21 GA22 GA23 GA24 GA25

PP1 PP2 PP3 PP4 PP5 PP6

NON-CREDIT BEARING ZONE

NON-CREDIT BEARING ZONE

CORNWALLIS ROAD

REVISIONS		
SYM.	DESCRIPTION	DATE

NCDEQ DIVISION OF MITIGATION SERVICES

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

BEAR BASIN RESTORATION SITE

DMS PROJECT #95362
RICHLANDS, ONSLOW COUNTY, NORTH CAROLINA

MONITORING YEAR 04

DATE: DEC 2018
SCALE: GRAPHIC

CURRENT CONDITION PLAN VIEW

SHEET 1 OF 1

FIGURE 3

Table 5. Vegetation Condition Assessment

Project Number and Name: 95362 – Bear Basin Restoration Site

Planted Acreage 11.9 **Easement Acreage 8.6**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Pattern and Color	1*	1.06	8.9%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Not Depicted, Covers Most of Restoration Area	0	0.00	0.0%
			Total	0	1.06	8.9%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	1.06	8.9%
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%

*=this polygon represents the area of open water discussed in Section 2.2

Photo Reference Points

PP1 – MY-00 – 5/26/15

PP1 – MY-04 – 11/13/18

PP2 – MY-00 – 5/26/15

PP2 – MY-04 – 11/13/18

PP3 – MY-00 – 5/26/15

PP3 – MY-04 – 11/13/18

PP4 – MY-00 – 5/26/15

PP4 – MY-04 – 11/13/18

PP5 – MY-00 – 5/26/15

PP5 – MY-04 – 11/13/18

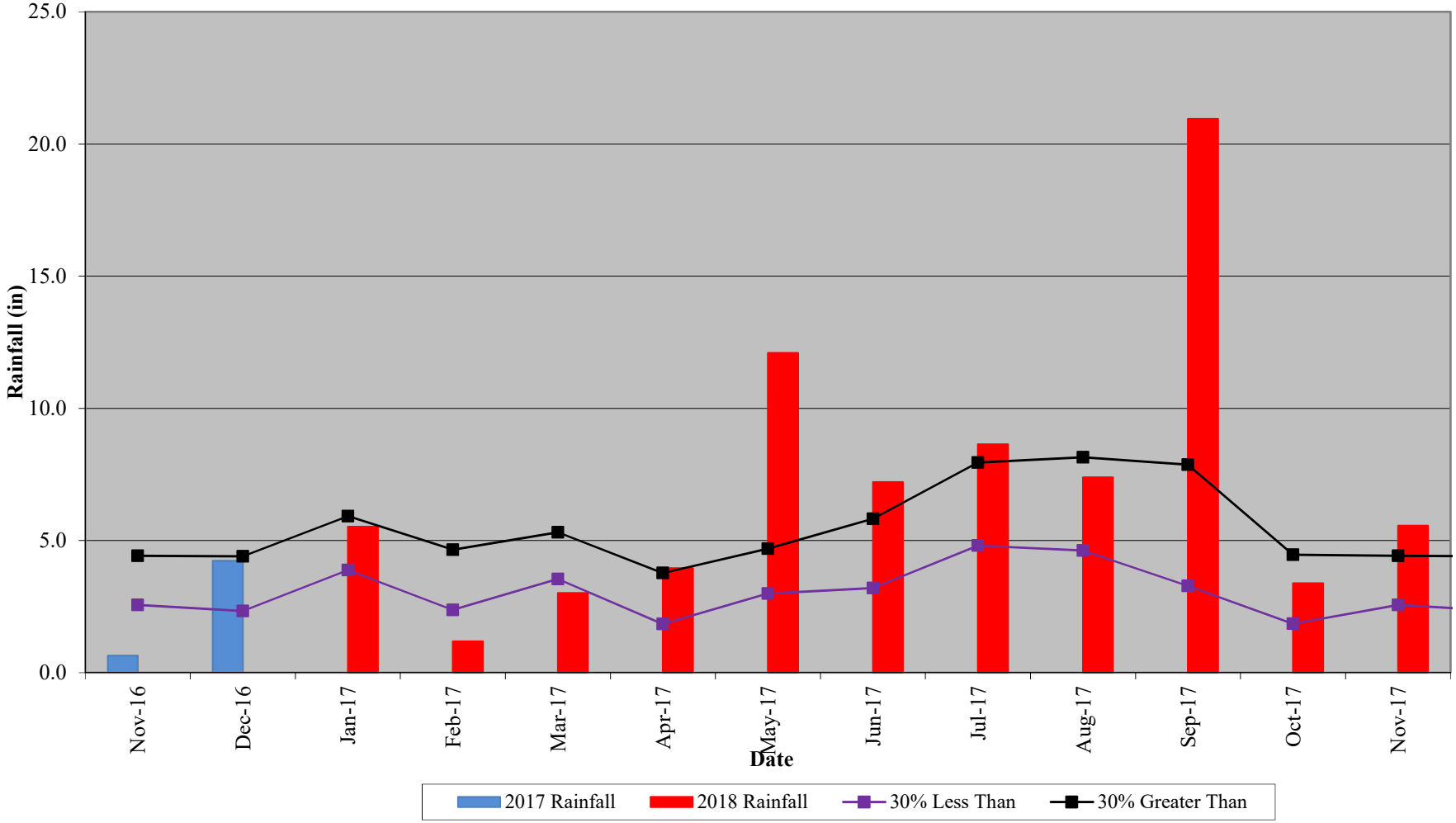
PP6 – MY-00 – 5/26/15

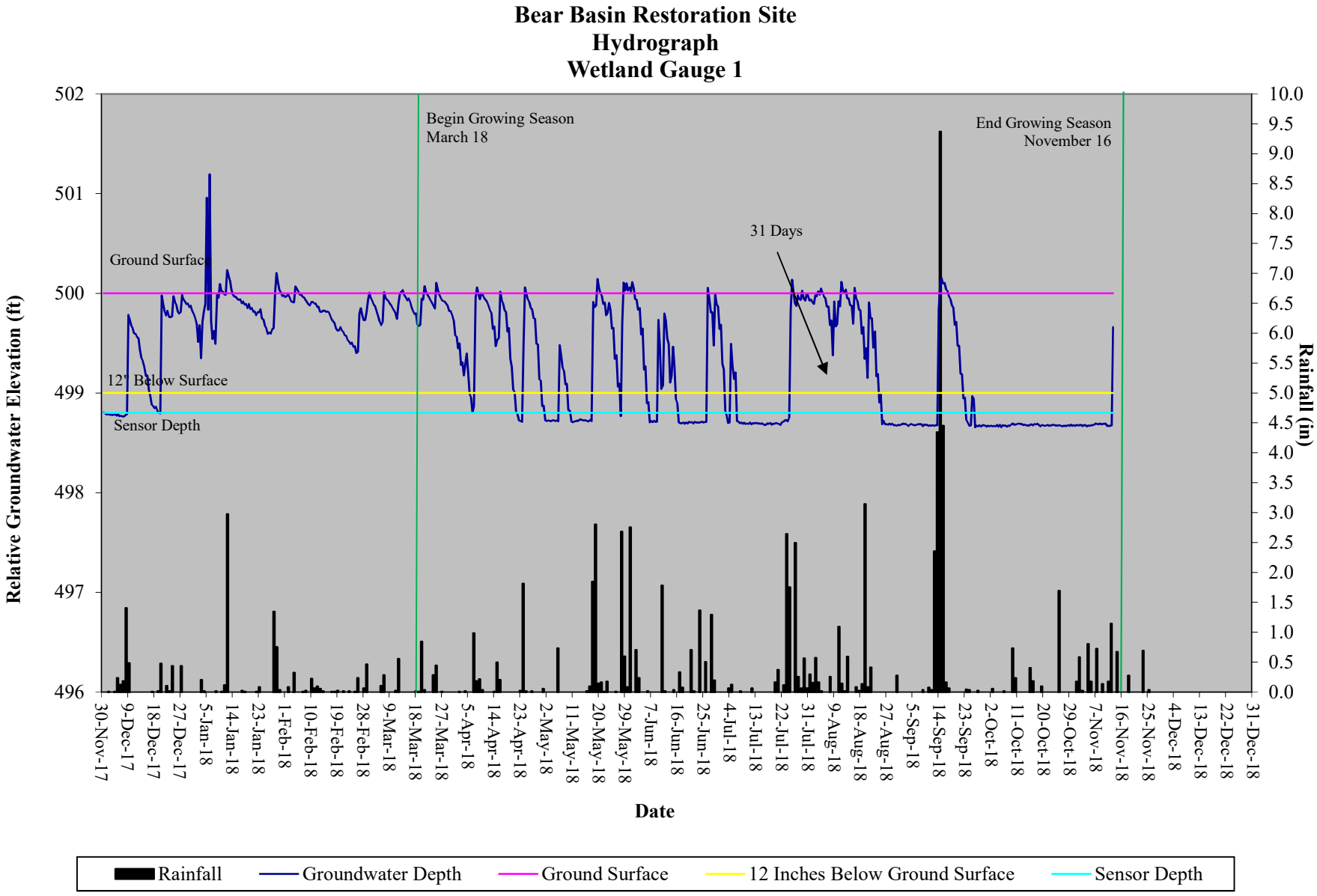
PP6 – MY-04 – 11/13/18

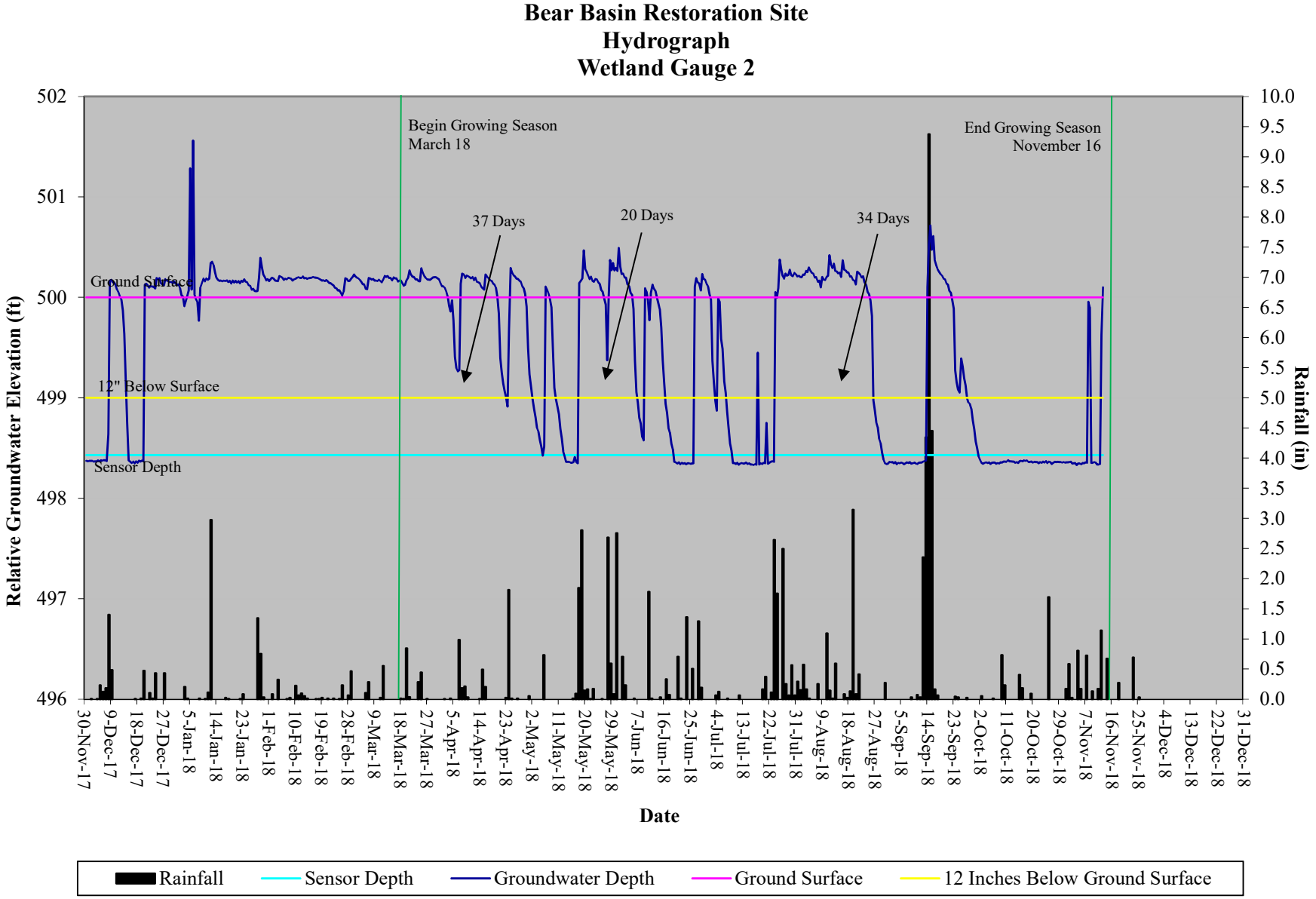
Appendix C

Hydrologic Data

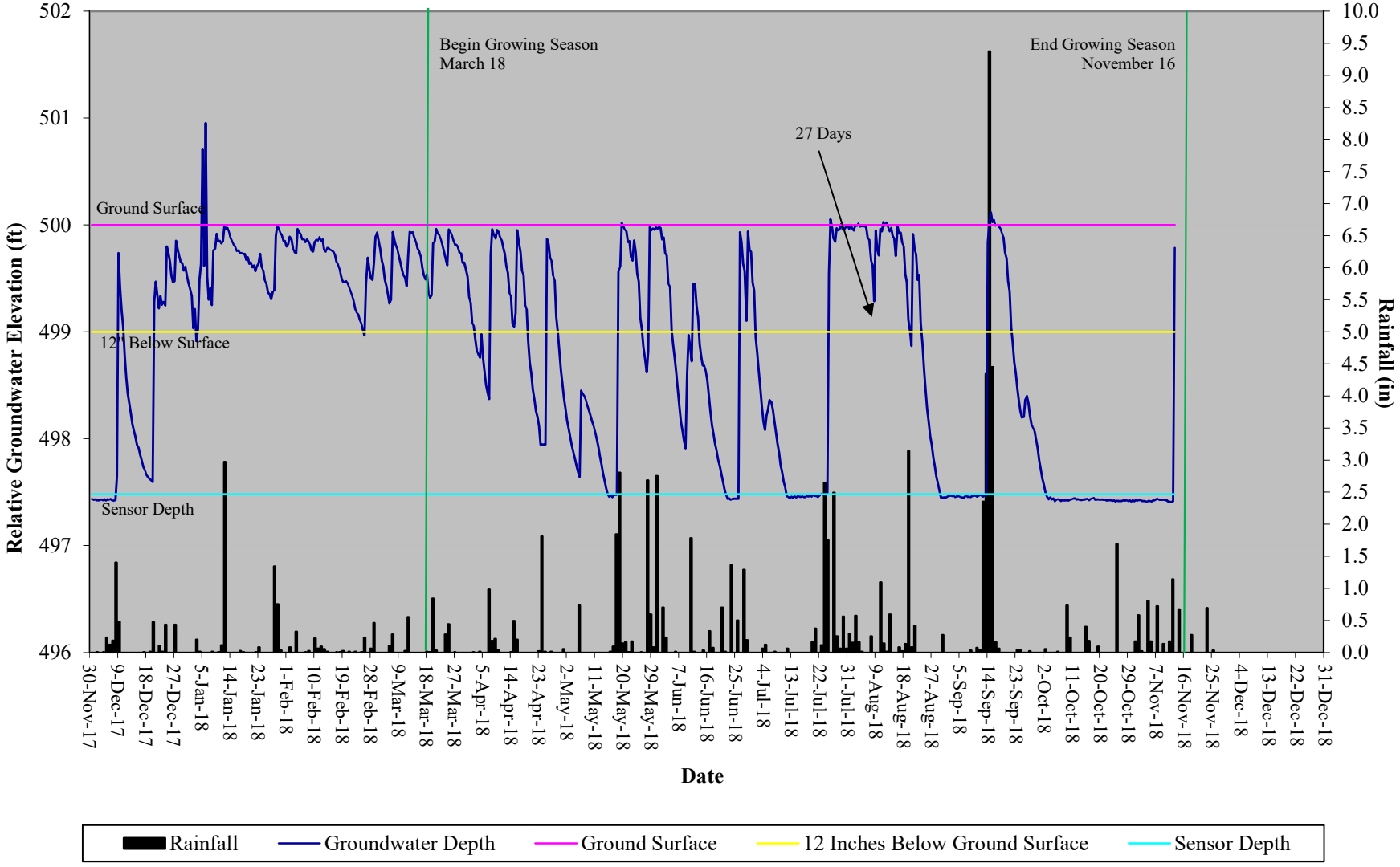
Bear Basin Wetland Restoration Site
30-70 Percentile Graph
WETS Station Name: Maysville, NC



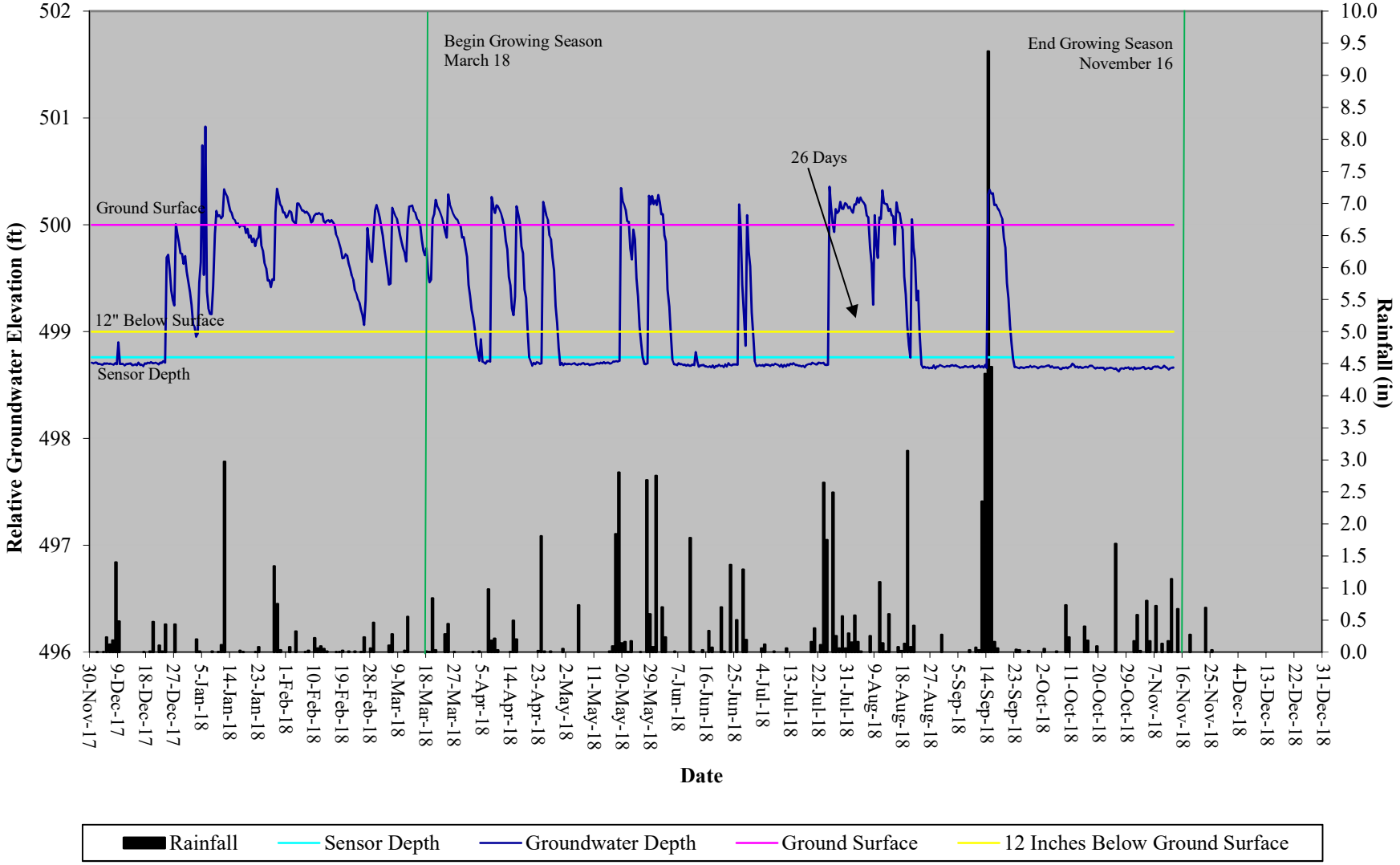

Bear Basin Restoration Site
Hydrograph
Wetland Gauge 1
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Begin Growing Season
March 18
End Growing Season
November 16
31 Days
Ground Surface
12" Below Surface
Sensor Depth
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Bear Basin Restoration Site
Hydrograph
Wetland Gauge 2
Begin Growing Season
March 18
End Growing Season
November 16
37 Days
20 Days
34 Days
Ground Surface
12" Below Surface
Sensor Depth
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface

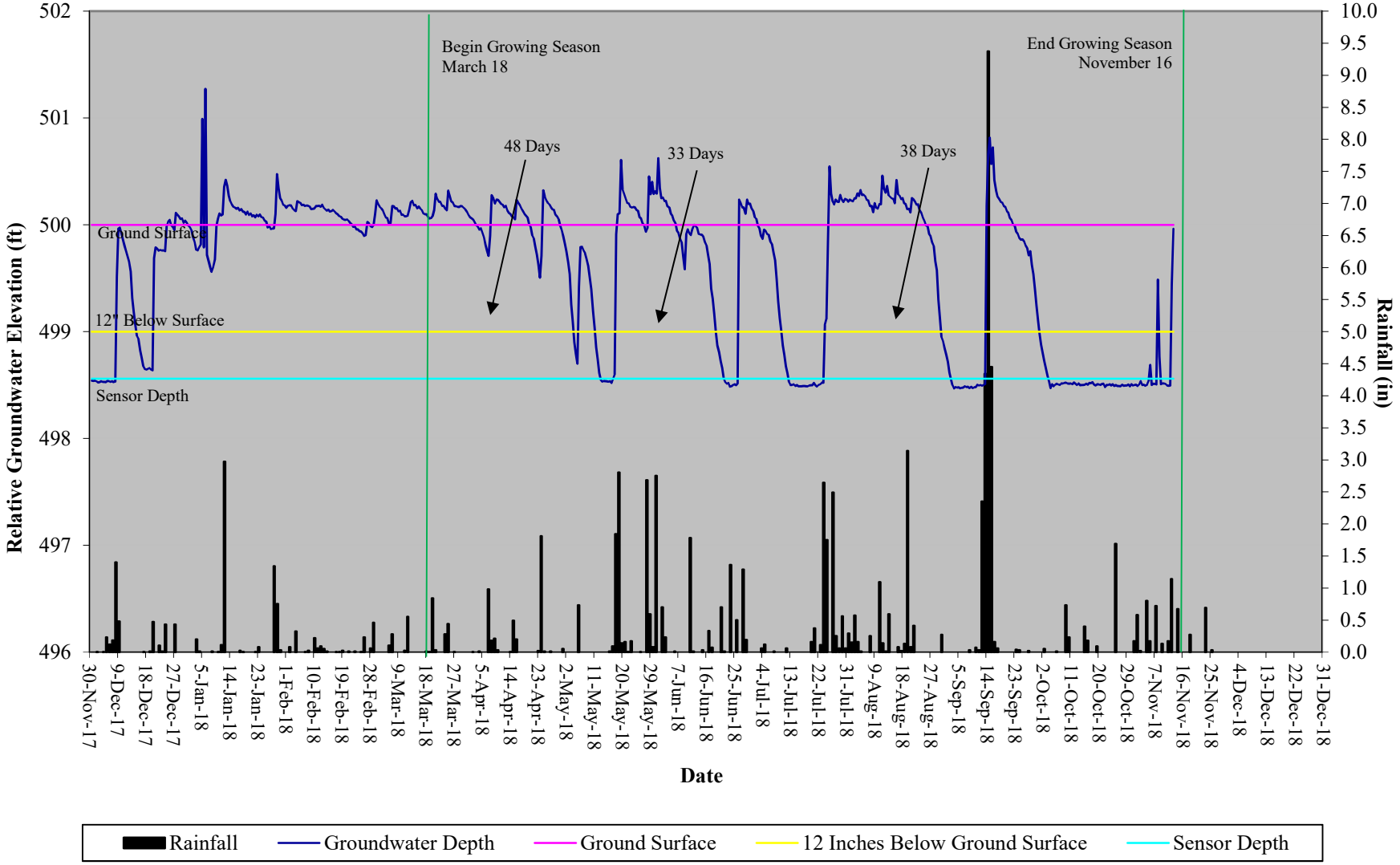
Bear Basin Restoration Site
Hydrograph
Wetland Gauge 3



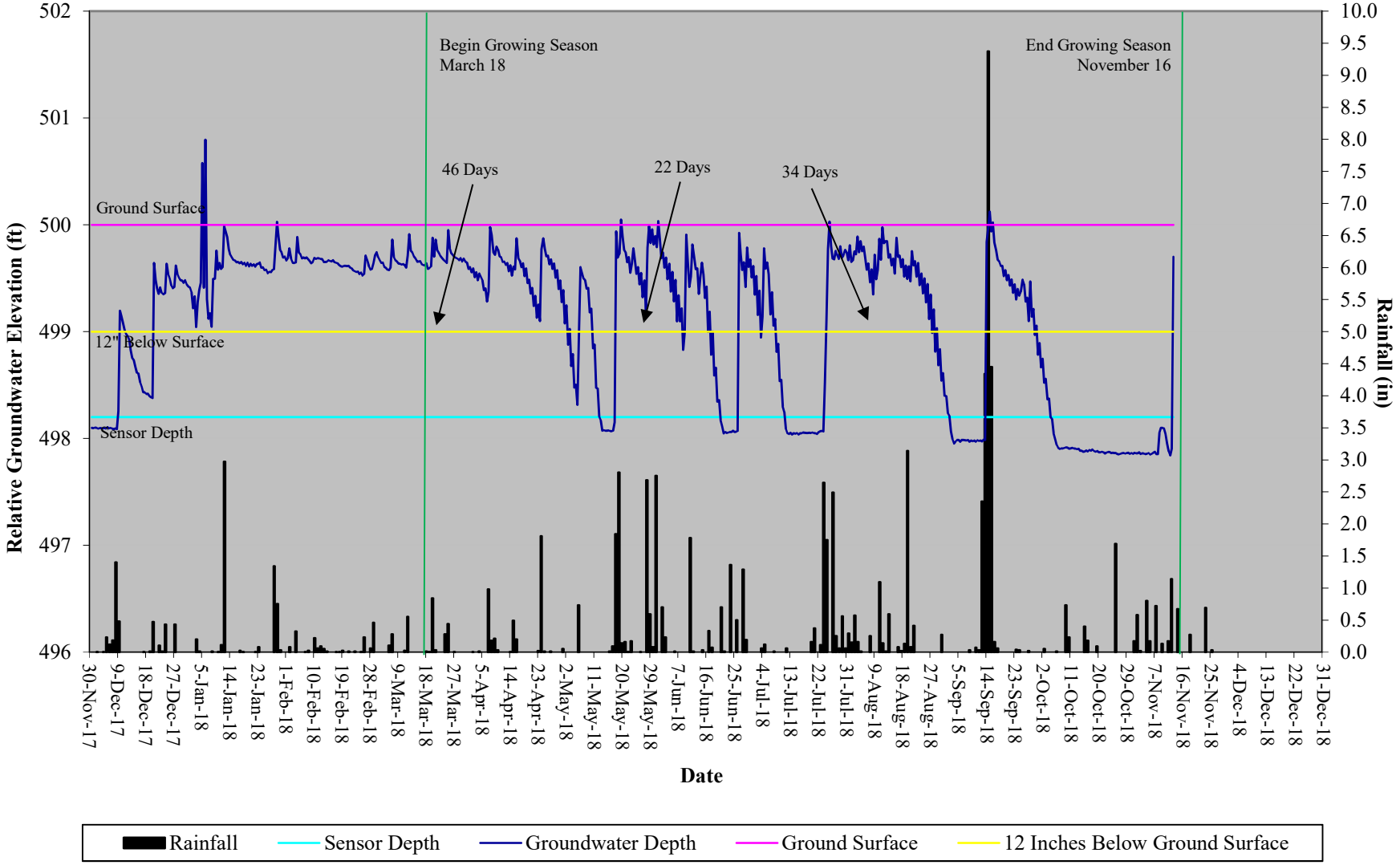
Bear Basin Restoration Site
Hydrograph
Wetland Gauge 4



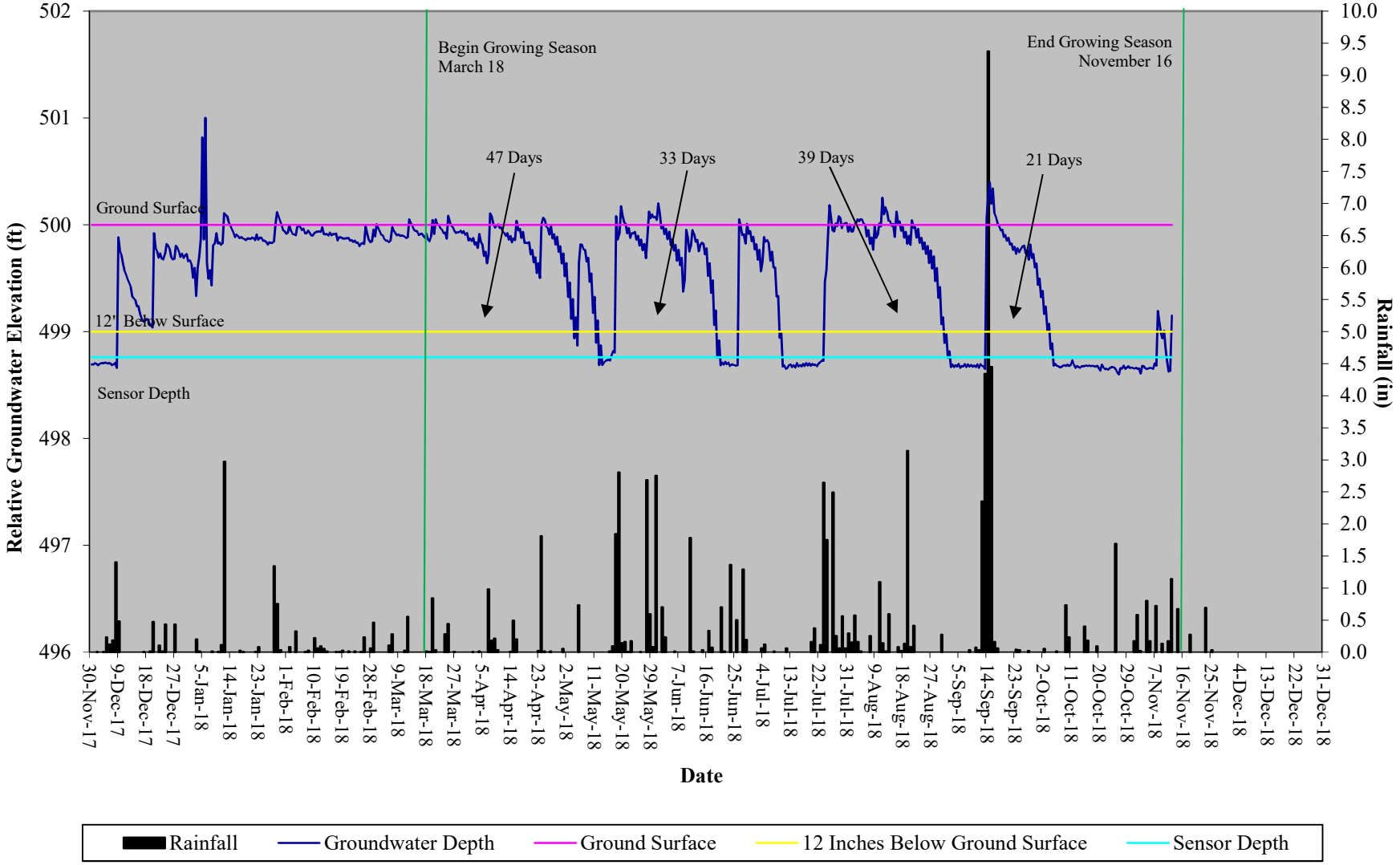
Bear Basin Restoration Site
Hydrograph
Wetland Gauge 5

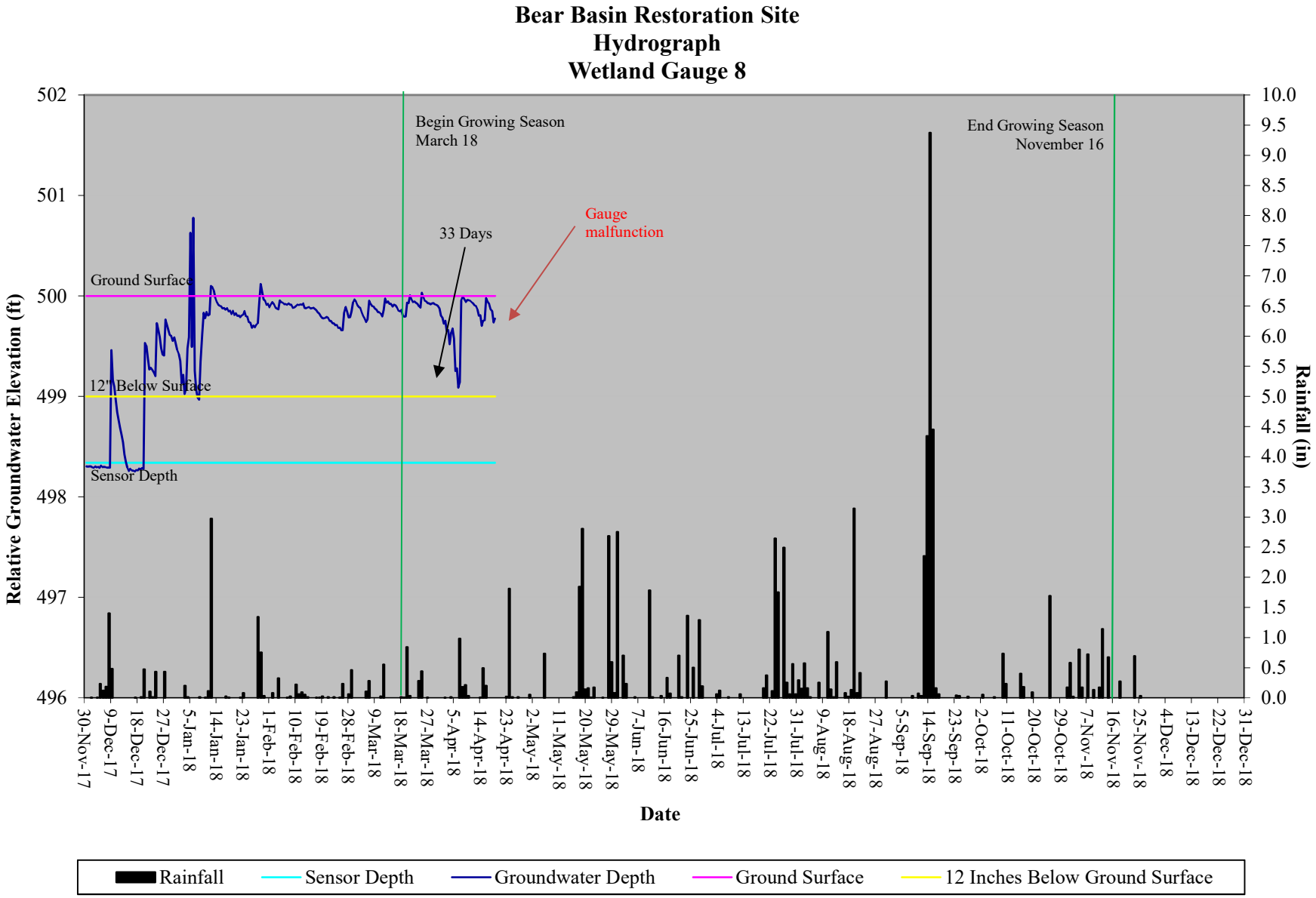


Bear Basin Restoration Site
Hydrograph
Wetland Gauge 6

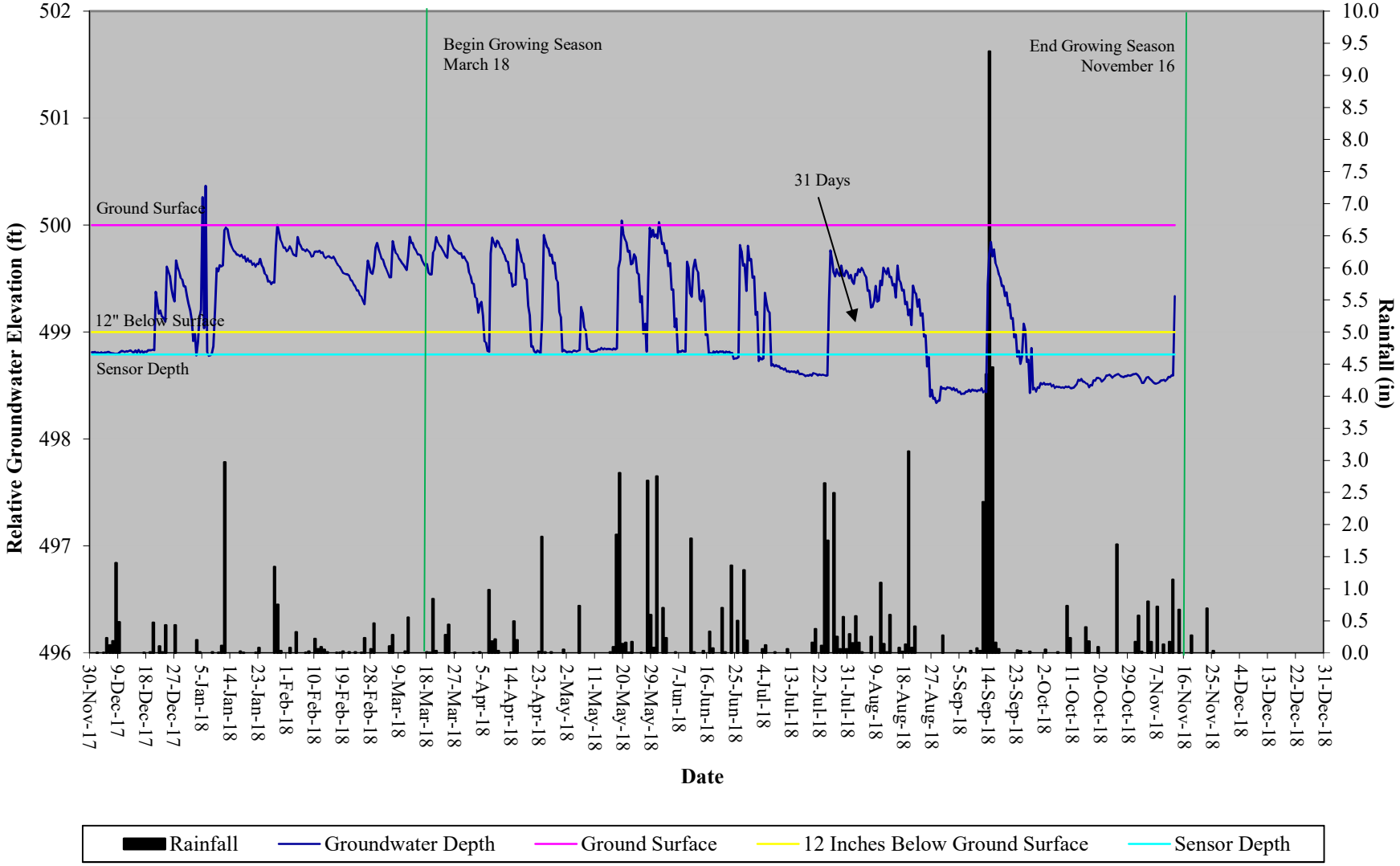


Bear Basin Restoration Site
Hydrograph
Wetland Gauge 7

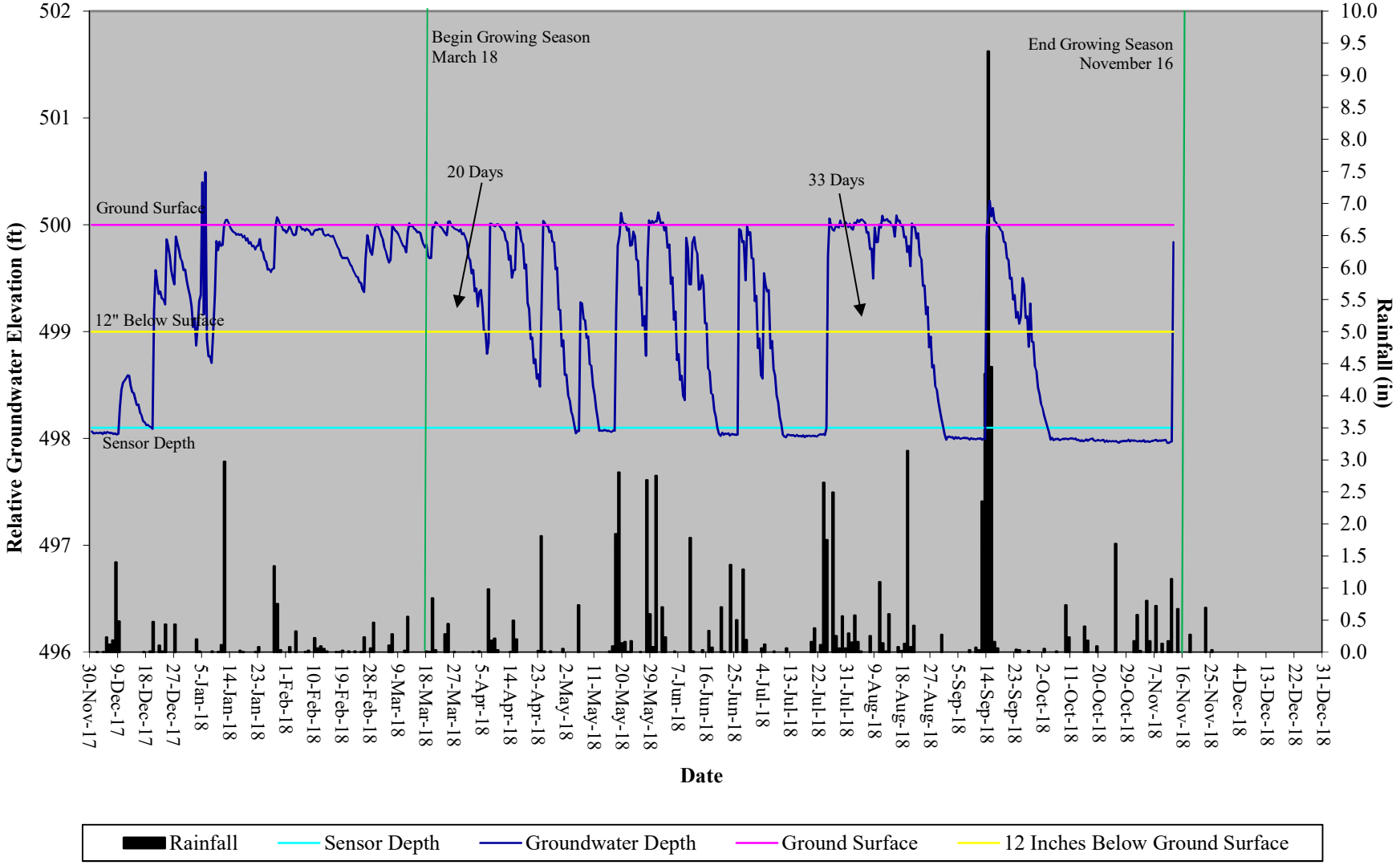



Bear Basin Restoration Site
Hydrograph
Wetland Gauge 8
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Begin Growing Season
March 18
End Growing Season
November 16
Gauge
malfunction
33 Days
Ground Surface
12" Below Surface
Sensor Depth
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface

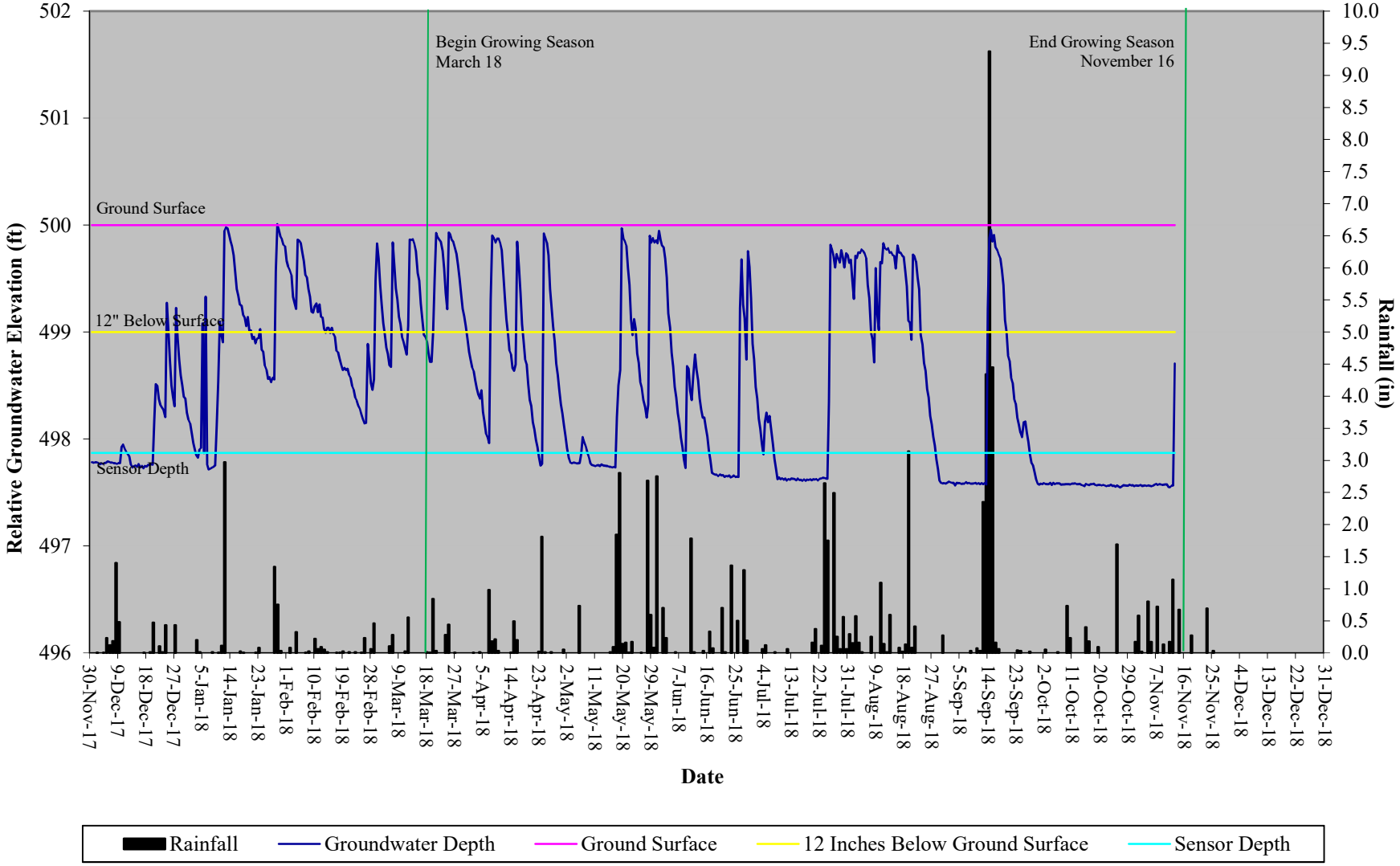
Bear Basin Restoration Site
Hydrograph
Wetland Gauge 9



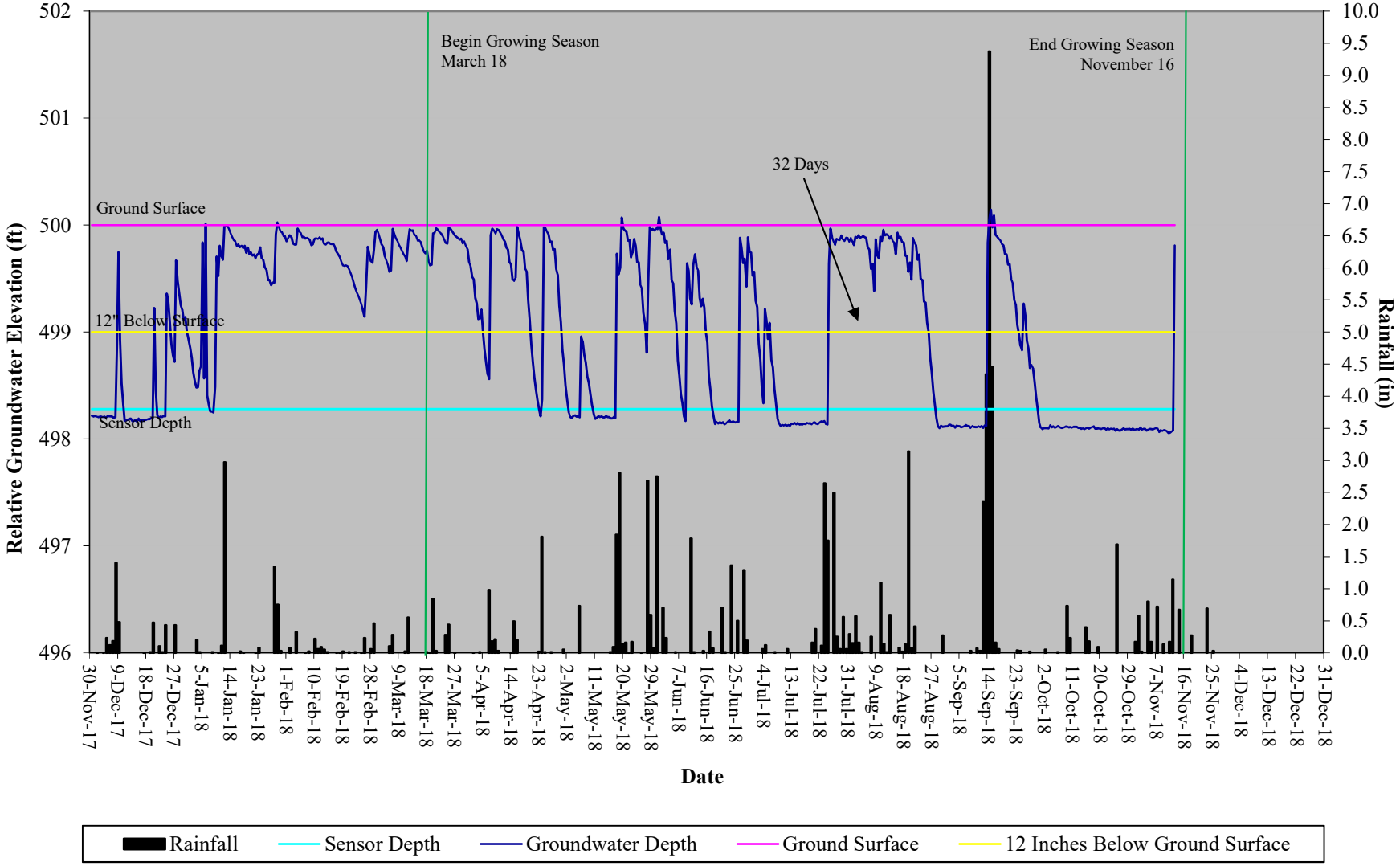
Bear Basin Restoration Site
Hydrograph
Wetland Gauge 10

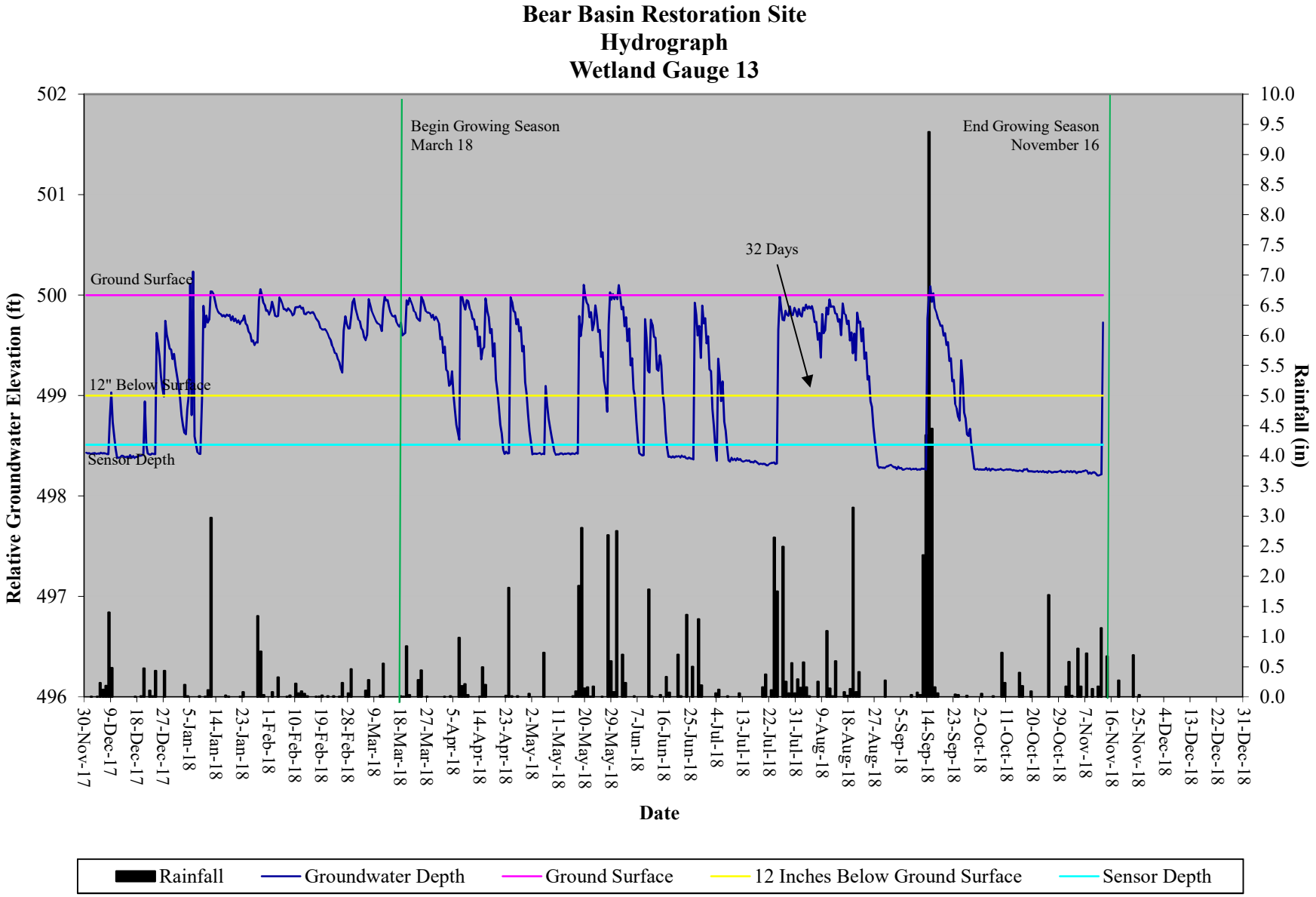


Bear Basin Restoration Site
Hydrograph
Wetland Gauge 11 - non-credit zone

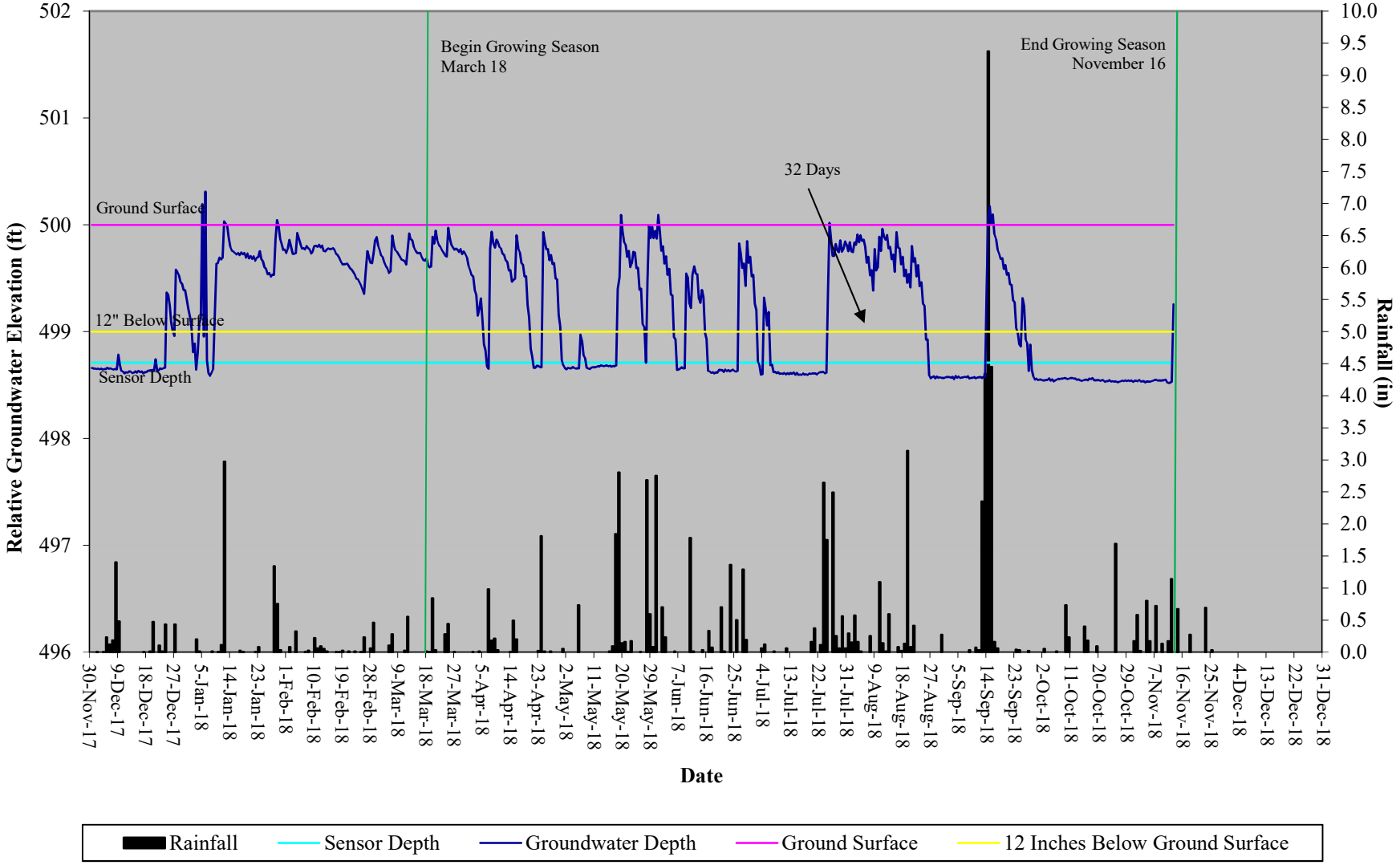


Bear Basin Restoration Site
Hydrograph
Wetland Gauge 12 - non-credit zone

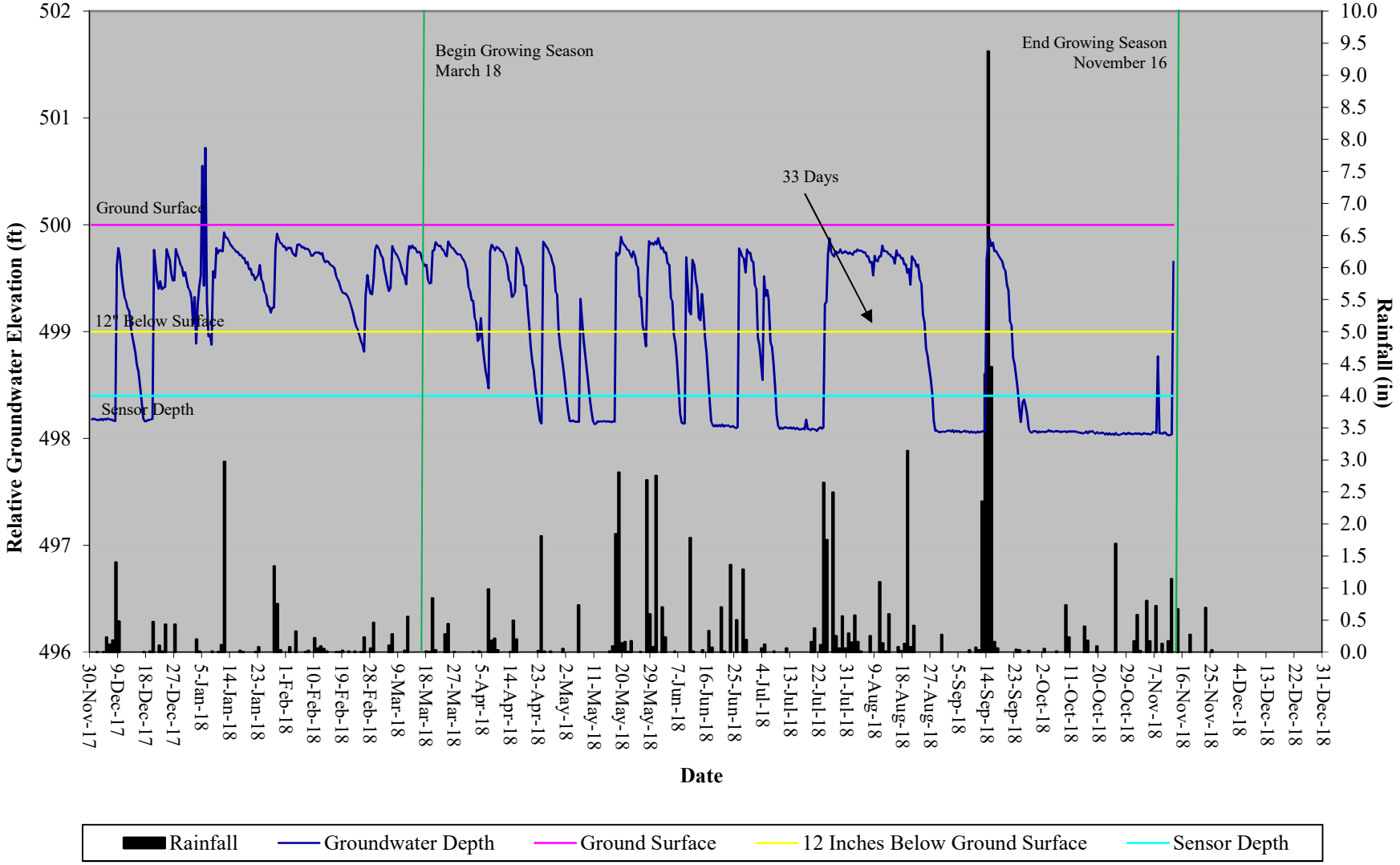



Bear Basin Restoration Site
Hydrograph
Wetland Gauge 13
Begin Growing Season
March 18
End Growing Season
November 16
32 Days
Ground Surface
12" Below Surface
Sensor Depth
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth

Bear Basin Restoration Site
Hydrograph
Wetland Gauge 14



Bear Basin Restoration Site
Hydrograph
Wetland Gauge 15



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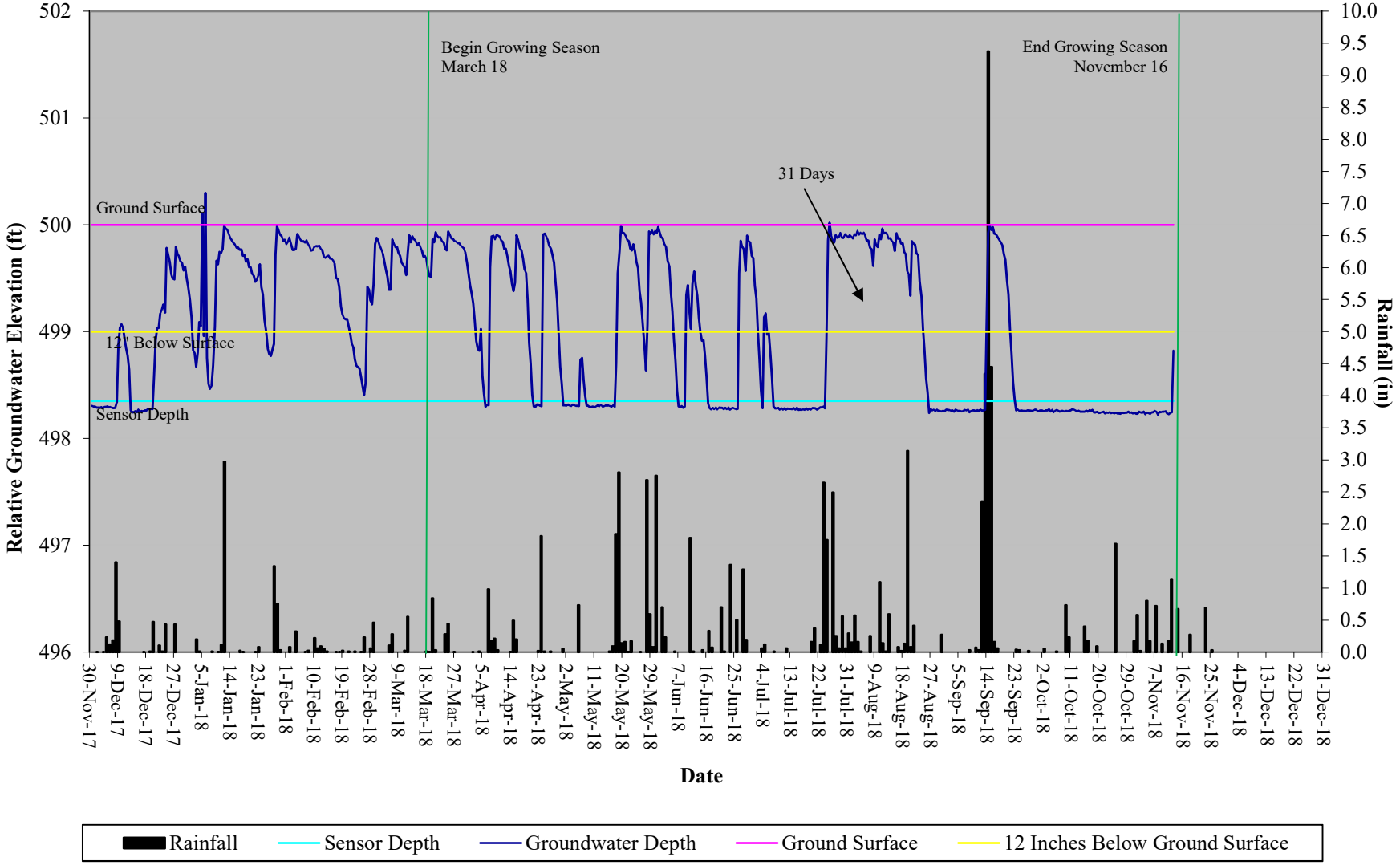
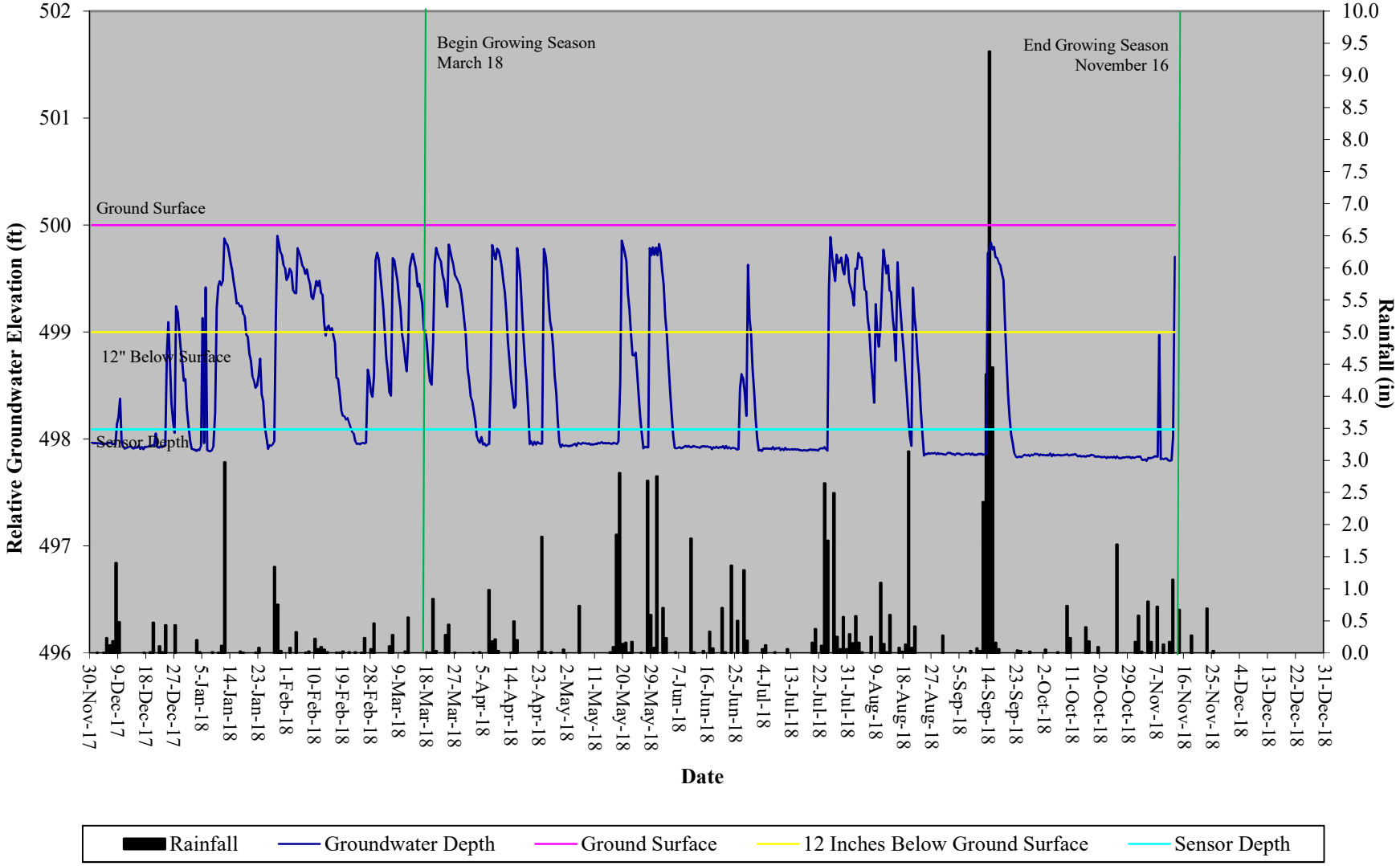
Wetland Gauge 16



Bear Basin Restoration Site
Hydrograph
Wetland Gauge 17 - non-credit zone



Bear Basin Restoration Site
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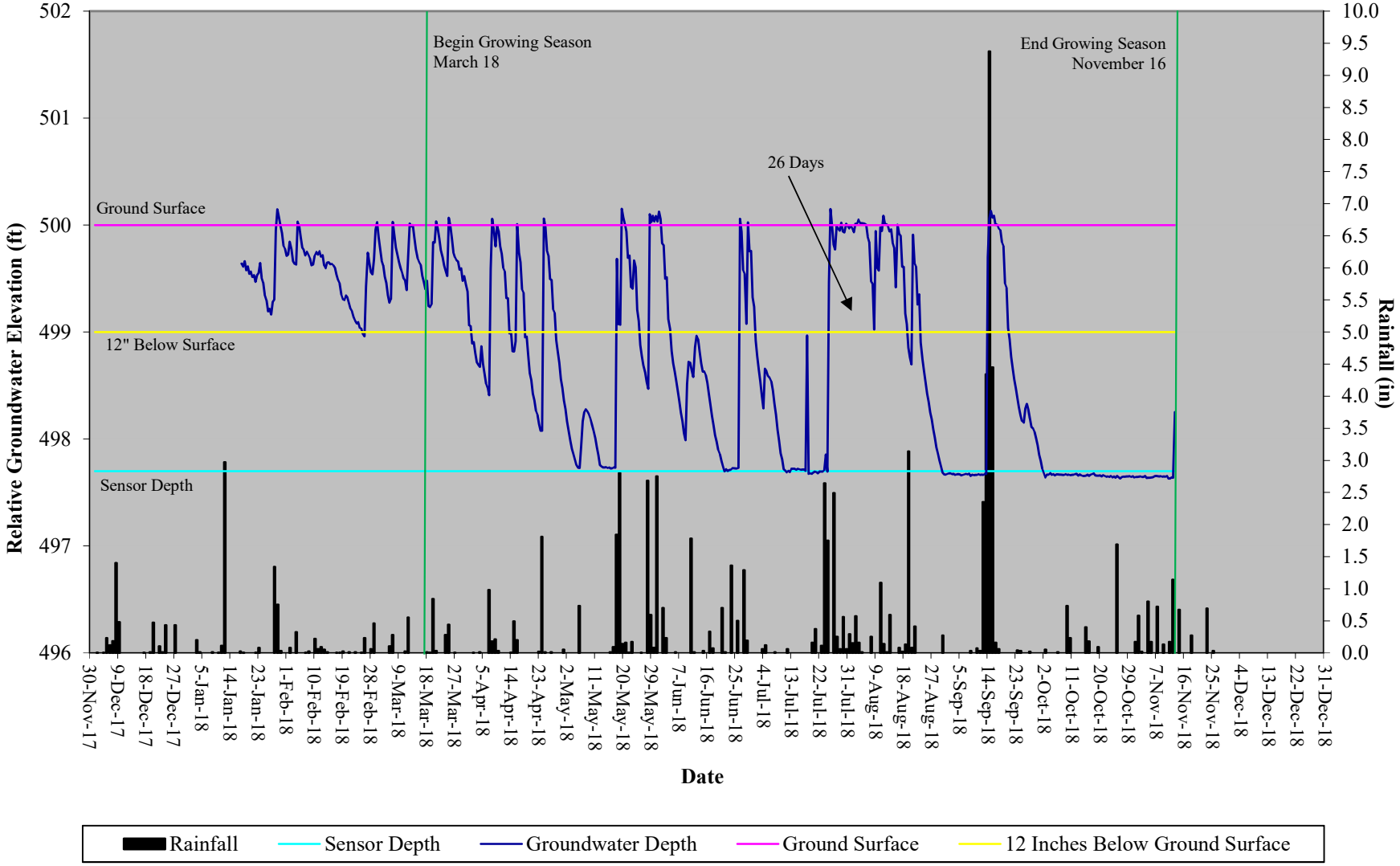
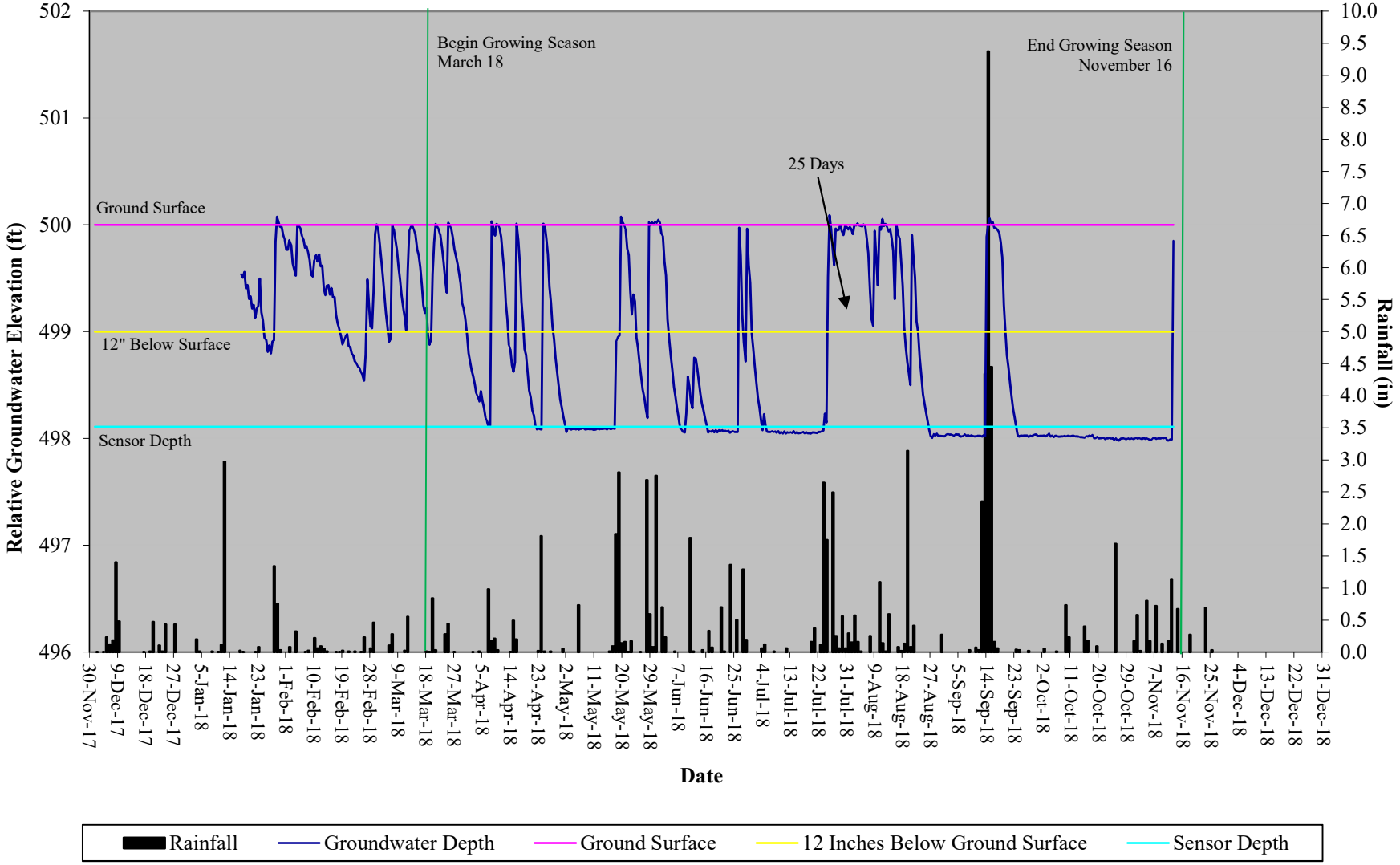
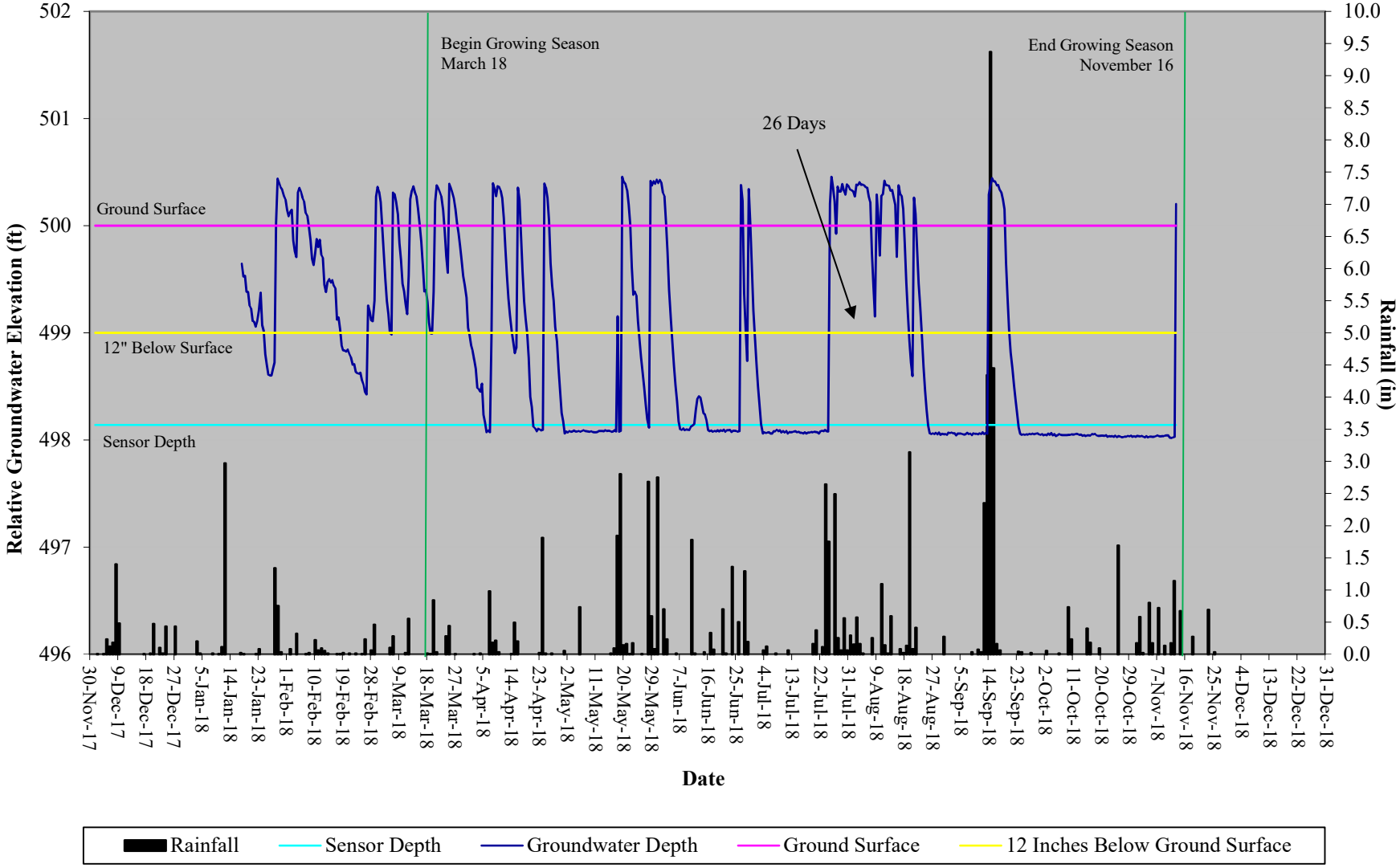
Wetland Gauge 18

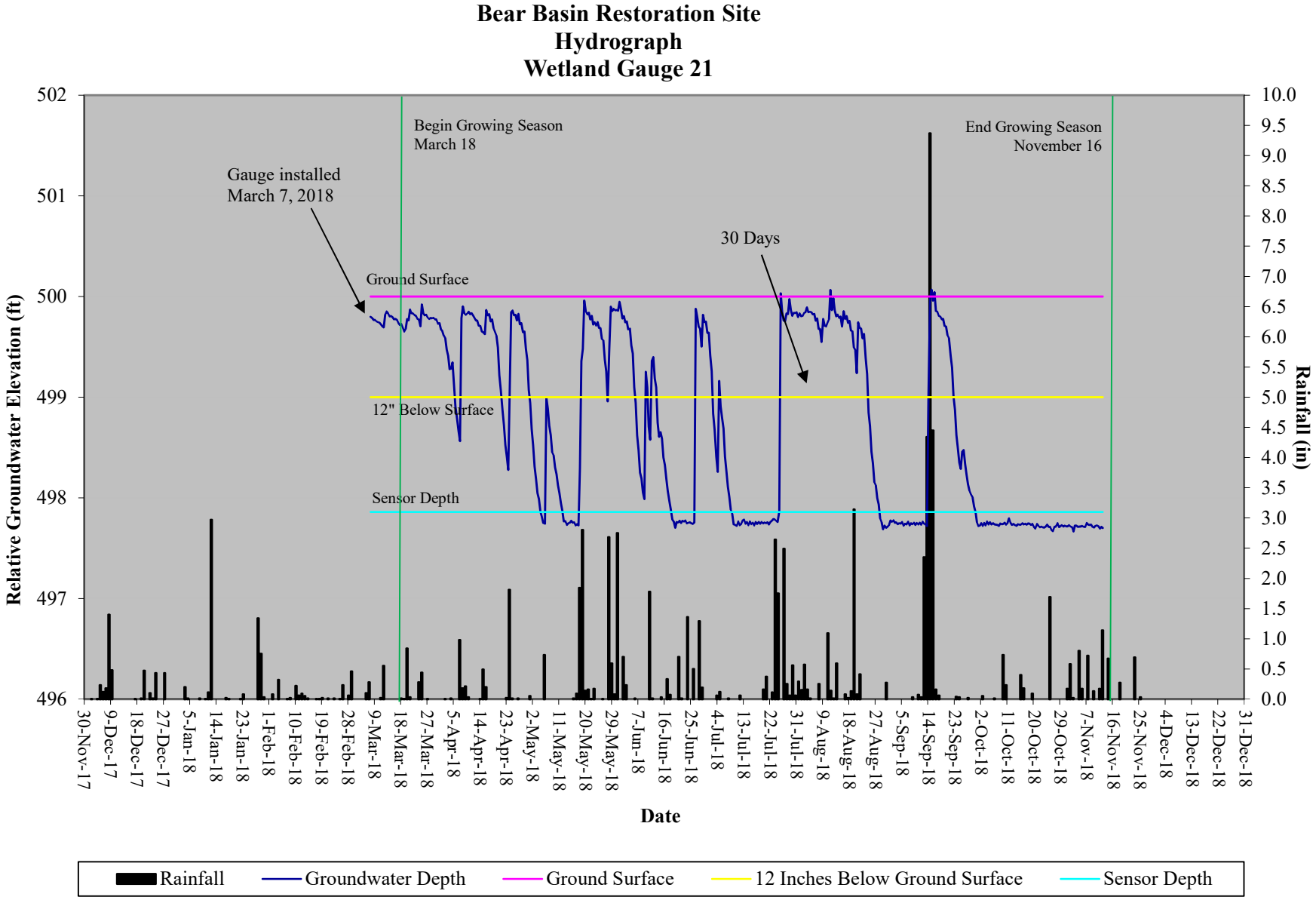


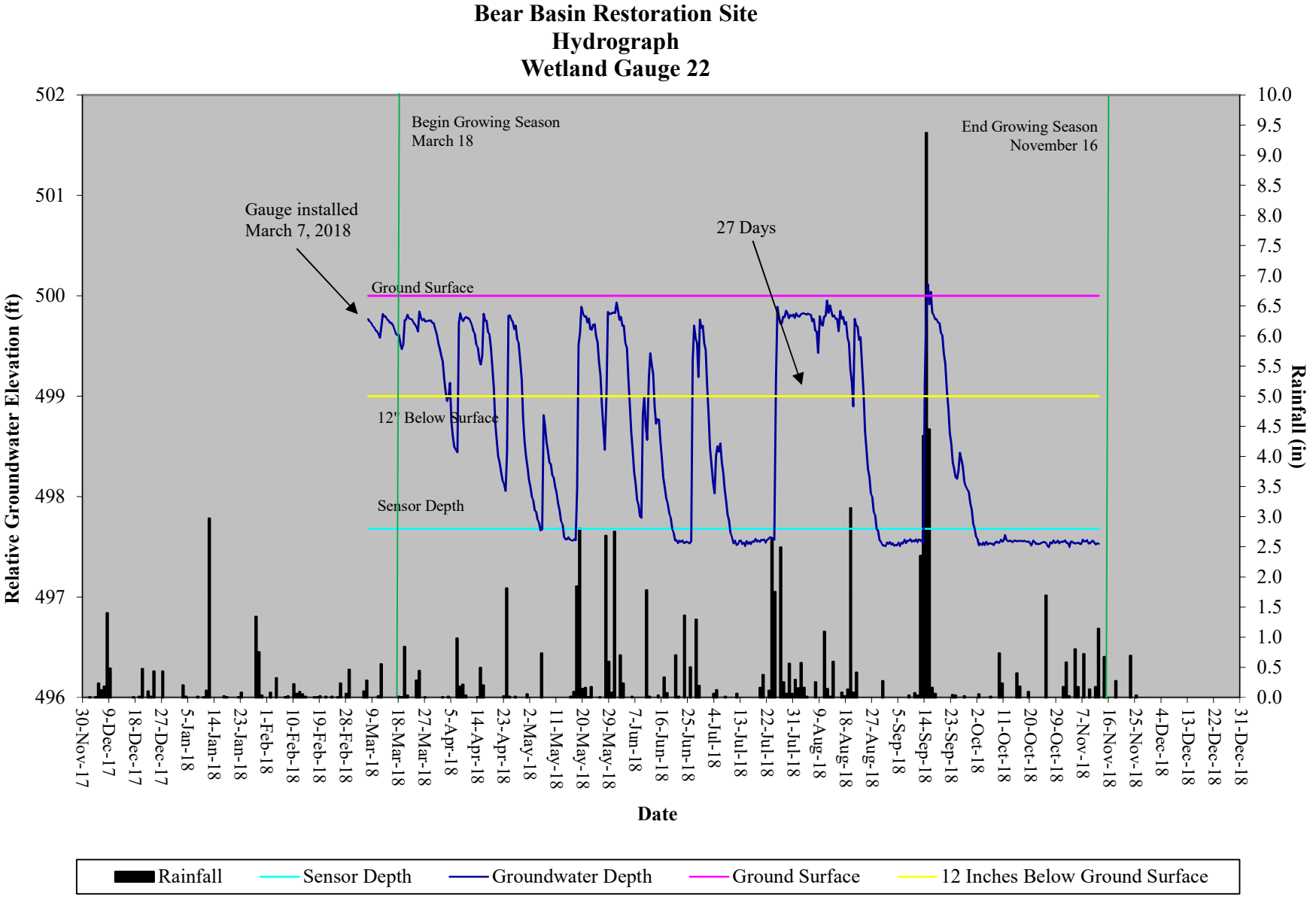
Bear Basin Restoration Site
Hydrograph
Wetland Gauge 19

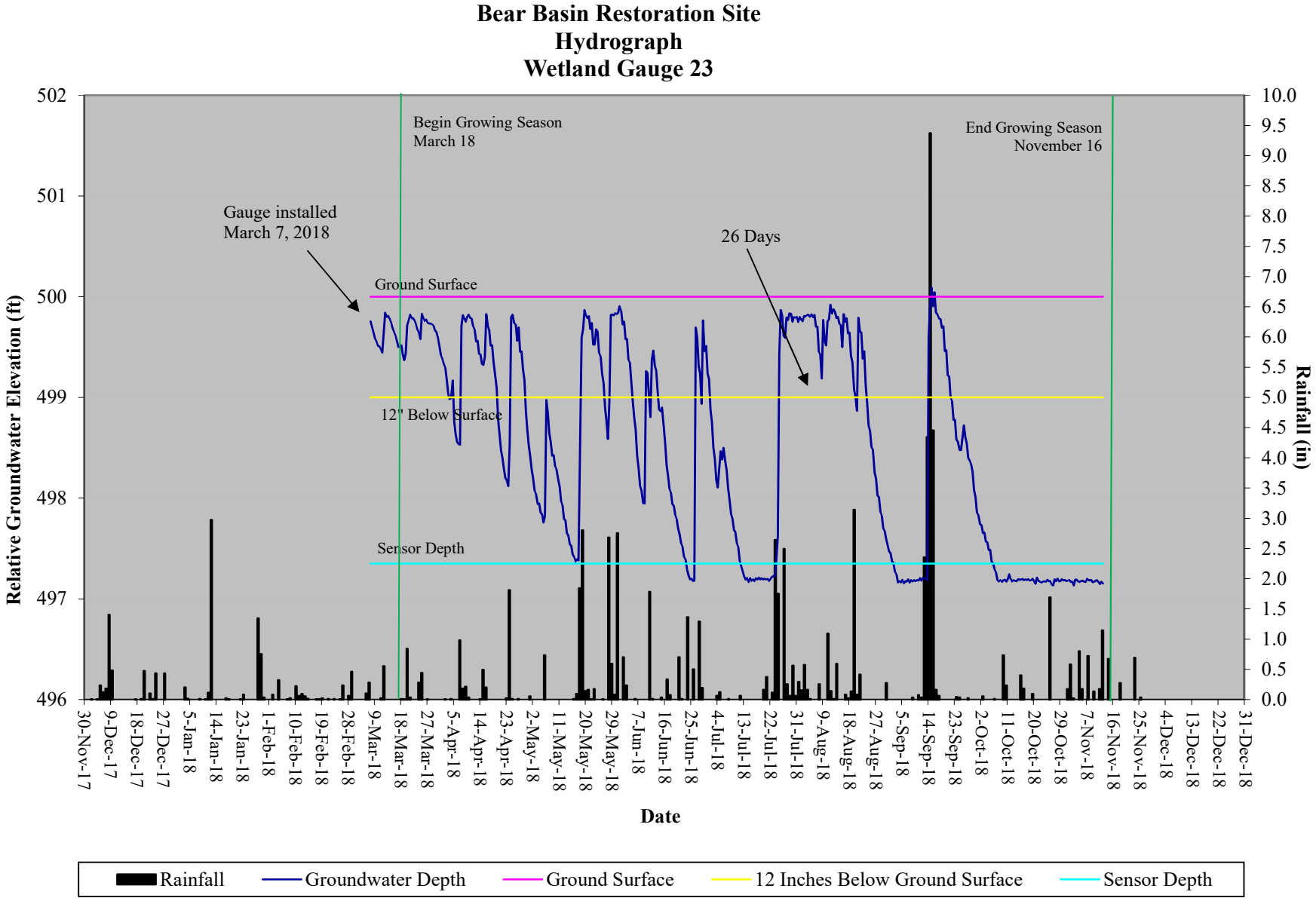


Bear Basin Restoration Site
Hydrograph
Wetland Gauge 20 - non-credit zone

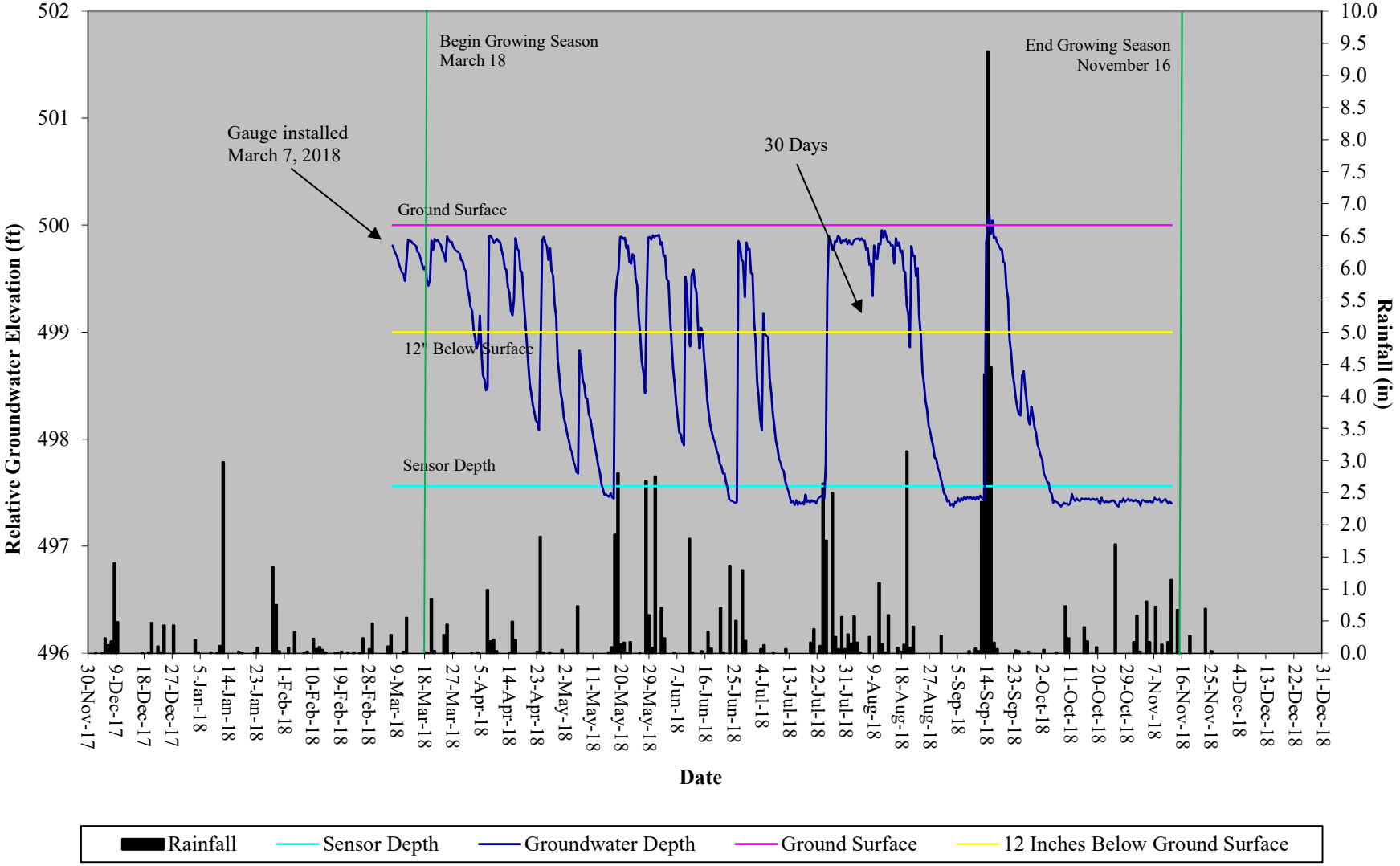



Bear Basin Restoration Site
Hydrograph
Wetland Gauge 21
Begin Growing Season
March 18
End Growing Season
November 16
Gauge installed
March 7, 2018
30 Days
Ground Surface
12" Below Surface
Sensor Depth
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Bear Basin Restoration Site
Hydrograph
Wetland Gauge 22
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Begin Growing Season
March 18
End Growing Season
November 16
Gauge installed
March 7, 2018
27 Days
Ground Surface
12" Below Surface
Sensor Depth
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface


Bear Basin Restoration Site
Hydrograph
Wetland Gauge 23
Begin Growing Season
March 18
End Growing Season
November 16
Gauge installed
March 7, 2018
26 Days
Ground Surface
12" Below Surface
Sensor Depth
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth

Bear Basin Restoration Site
Hydrograph
Wetland Gauge 24



Bear Basin Restoration Site
Hydrograph
Wetland Gauge 25

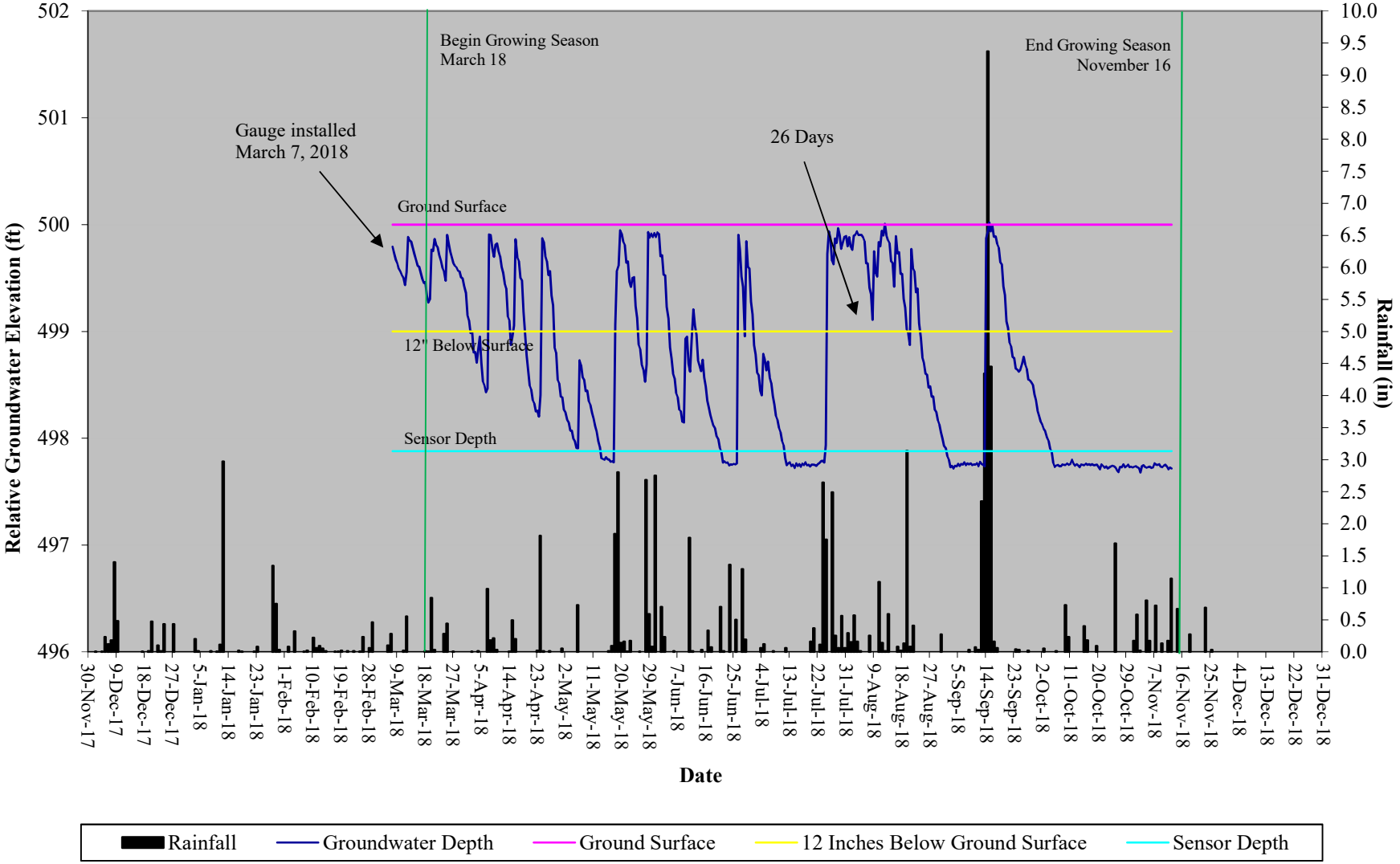


Table 9. Wetland Hydrology Criteria Attainment Table Project Number and Name: 95362 - Bear Basin Restoration Site							
	Success Criteria Achieved / Max Consecutive Days During Growing Season (Percentage)						
Success Criteria (21 Days) (8%)	MY-01 2015	MY-02 2016	MY-03 2017	MY-04 2018	MY-05	MY-06	MY-07
Gauge 1	Yes/23 (9.3%)	Yes/24 (9.7%)	Yes/26 (10.7%)	Yes/31 (12.8%)			
Gauge 2	Yes/28 (11.3%)	Yes/42 (17.1%)	Yes/28 (11.5%)	Yes/37 (15.2%)			
Gauge 3	Yes/22 (9.1%)	No/14 (5.6%)	No/10 (4.1%)	Yes/27 (11.1%)			
Gauge 4	No/17 (7.0%)	No/15 (6.0%)	Yes/25 (10.3%)	Yes/26 (10.7%)			
Gauge 5	Yes/90 (36.8%)	Yes/48 (19.5%)	Yes/30 (12.3%)	Yes/48 (19.8%)			
Gauge 6	Yes/28 (11.3%)	Yes/41 (16.9%)	Yes/29 (11.9%)	Yes/46 (18.9%)			
Gauge 7	Yes/51 (20.8%)	Yes/45 (18.5%)	Yes/25 (10.3%)	Yes/47 (19.3%)			
Gauge 8	Yes/28 (11.3%)	Yes/42 (17.1%)	Yes/27 (11.1%)	Yes/33 (13.6%)			
Gauge 9	Yes/23 (9.3%)	Yes/23 (9.3%)	Yes/25 (10.3%)	Yes/31 (12.8%)			
Gauge 10	Yes/24 (9.7%)	No/18 (7.4%)	Yes/26 (10.7%)	Yes/33 (13.6%)			
Gauge 11*	15 (6.2%)	15 (6.2%)	4 (1.6%)	13 (5.3%)			
Gauge 12*	25 (10.3%)	19 (7.6%)	25 (10.3%)	32 (13.2%)			
Gauge 13	Yes/27 (11.1%)	Yes/42 (17.1%)	Yes/26 (10.7%)	Yes/32 (13.2%)			
Gauge 14	Yes/25 (10.3%)	No/19 (7.6%)	Yes/26 (10.7%)	Yes/32 (13.2%)			
Gauge 15	Yes/35 (14.2%)	Yes/42 (17.1%)	Yes/27 (11.1%)	Yes/33 (13.6%)			
Gauge 16	Yes/22 (9.1%)	No/14 (5.6%)	No/10 (4.1%)	Yes/31 (12.8%)			
Gauge 17*	23 (9.3%)	14 (5.6%)	9 (3.7%)	14 (5.8%)			
Gauge 18	Yes/22 (9.1%)	No/14 (5.6%)	No/9 (3.7%)	Yes/26 (10.7%)			
Gauge 19	No/18 (7.4%)	No/12 (4.9%)	No./7 (2.9%)	Yes/25 (10.3%)			
Gauge 20*	19 (7.6%)	12 (4.9%)	7 (2.9%)	26 (10.7%)			
Gauge 21**				Yes/30 (12.3%)			
Gauge 22**				Yes/27 (11.1%)			
Gauge 23**				Yes/26 (10.7%)			
Gauge 24**				Yes/27 (11.1%)			
Gauge 25**				Yes/26 (10.7%)			

*=non-credit bearing area **=Gauge installed March 7, 2018