Bowl Basin Restoration Site
Monitoring Report MY07
DMS Project # 95721
DMS Contract # 005012

Onslow County, NC
CU# 03020106
DWR# 2013-0864
SAW# 2013-00393

Submitted to:

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

Construction Completed: February 2015
Data Collection: 2021
Submitted: February 2022

Monitoring and Design Firm

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

Project Manager: Tim Morris
Email: tim.morris@kci.com
KCI Project No: 20122265

ROY COOPER
Governor

ELIZABETH BISER
Secretary

Mitigation Services
ENVIRONMENTAL QUALITY

January 13, 2022

Sent via email: Tommy Seelinger

Tommy Seelinger
KCI Associates, Inc.

Subject: DMS Comments
Bowl Basin, Project ID #95721 DMS Contract #5012

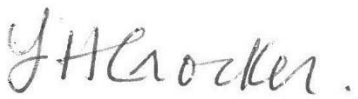
Tommy,

After receiving the MY7 draft report, DMS offers the following comments:

1. KCI describes areas of dense pines and sweetgum, but these are not the visual assessment table. Please update the visual assessment table for the areas treated. If not, please provide justification.
2. Provide area (measurement in acres) of the sweetgum and pine treatment shown on the CCPV.
3. The reason for failing gages was described by climate and influence of pines, but the area around failing gage 5 was not treated for pines. Confirm if the area around this gage was treated and update shapefile and area if needed.
4. Hight data was a required MY7 closeout requirement. Provide table of planted stem height average by plot or describe how KCI plans to justify that performance standard.
5. Please explain why five of the gages were re-installed on 3/19.
6. KCI may want to evaluate hydrology of the gauges with a more modern growing season estimate for discussion purposes.
7. Confirm that KCI is not proposing this site for close out in 2022 and provide plans for future close out in response letter and/or report narrative.

To date, KCI was paid for 90% of the contract value, equivalent to 9.72 WMUs. The project has 11.7 WMU of assets, and IRT has released 85% of the site assets, equivalent to 9.945 WMUs. DMS will withhold the remaining 10% contract value until the close out is completed by regulatory.

Thanks for your work,



Lindsay Crocker, DMS

KCI ASSOCIATES OF NORTH CAROLINA, PA

ENGINEERS • SCIENTISTS • SURVEYORS • CONSTRUCTION MANAGERS

4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 (919) 783-9214 (919) 783-9266 Fax

MEMORANDUM

Date: February 1, 2022
To: Lindsay Crocker, DMS Project Manager
From: Tim Morris, Project Manager
KCI Associates of North Carolina, PA
Subject: MY-07 Monitoring Report Comments
Bowl Basin DMS#95721, Contract 005012
White Oak River Basin CU 03030001
Onslow County, North Carolina

Please find below our responses in italics to the MY-07 Monitoring Report comments from NCDMS received on January 13, 2022, for the Bowl Basin Wetland Restoration Site.

1. KCI describes areas of dense pines and sweetgum, but these are not the visual assessment table. Please update the visual assessment table for the areas treated. If not, please provide justification.
KCI Response: Since the pines and sweetgums were treated prior to the visual assessment, no areas of dense pine and sweetgum were present on site at the time of the assessment. The table has been adjusted to include a row for "Pine and Sweetgum Treatment Area" and the date of the assessment has been added to the table.

2. Provide area (measurement in acres) of the sweetgum and pine treatment shown on the CCPV.
KCI Response: The sweetgum treatment area from previous monitoring years was 1.58 acres, and the current area of pine and sweetgum treatment was 7.34 acres. The current treatment area has been added to Table 5.

3. The reason for failing gauges was described by climate and influence of pines, but the area around failing gauge 5 was not treated for pines. Confirm if the area around this gage was treated and update shapefile and area if needed.
KCI Response: Due to the abundance of pine on the site and the depth at which their roots extend, the effects that they have on the water table extend beyond the area directly around where they are growing. KCI believes that the removal of the majority of the pines from the site will have a positive impact on the hydrology across the entire site. While there are pines present in the area around this gauge, this area was not as heavily colonized as other parts of the site and so was not included in the treatment area.

4. Height data was a required MY7 closeout requirement. Provide table of planted stem height average by plot or describe how KCI plans to justify that performance standard.
KCI Response: This data has been added to the report. The average height of the planted stems across all plots was 11.0 feet.

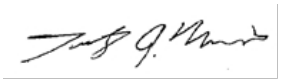
5. Please explain why five of the gauges were re-installed on 3/19.
KCI Response: Due to the batteries dying between the last download of 2020 and the first download of 2021, it was necessary to replace these gauges.

6. KCI may want to evaluate hydrology of the gauges with a more modern growing season estimate for discussion purposes.
   KCI Response: This evaluation resulted in minimal change in gauge success rates. KCI believes that all evidence points to the pines being responsible for the low rates of success seen in MY5-7. During the first 4 years of monitoring (2015 – 2019) there were only 3 unsuccessful gauges, while in the last 3 years (2019-2021) there were 14 unsuccessful gauges. This dramatic decrease in gauge success rates corresponds with the colonization of the site by loblolly pine in 2019.

7. Confirm that KCI is not proposing this site for close out in 2022 and provide plans for future close out in response letter and/or report narrative.
   KCI Response: KCI is not proposing to close out the site in 2022. KCI proposes to discontinue vegetation monitoring on the site but to continue monitoring hydrology in 2022 in order to see the effect that the removal of the pines from the site has on the site's hydrology. KCI believes that with the majority of the pines gone, success rates will be similar to those from the first four years of monitoring.

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

Sincerely,



Tim Morris
Project Manager

TABLE OF CONTENTS

Appendix A – Project Vicinity Map and Background Tables

Appendix B – Visual Assessment Data

Appendix C – Vegetation Plot Data

Appendix D – Hydrologic Data

1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The Bowl 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 03020106 Watershed Cataloging Unit (8-digit HUC) and the Local Watershed Unit (14-digit HUC) 03020106010010. In DMS' most recent publication of excluded and Targeted Local Watersheds/Hydrologic Units, the 03020106010010 14-digit HUC has been identified as a Targeted Local Watershed.

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 project site, which is protected by an 11.7-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 White Oak River Road approximately 13.5 miles north of Jacksonville, North Carolina.

The BBRS provided mitigation for wetland impacts within Hydrologic Unit 03020106 by restoring 11.7 acres of wetland, generating 11.7 non-riparian wetland mitigation units (WMU's).

The BBRS 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.

2.0 MONITORING RESULTS

2.1 VEGETATION MONITORING

The success criteria for the planted species in the mitigation area will be 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.

The seventh-year vegetation monitoring was based on the Level 2 CVS-EEP vegetation monitoring protocol. The site's average density for this monitoring period was 749 planted stems/acre. All ten plots had greater than 288 planted stems/acre. Including volunteers, the site averaged 3,642 total stems/acre. Four of the ten monitoring plots had an average planted stem height greater than 10 feet and overall the planted stems on the site averaged 11.0 feet. In general the site is well vegetated, with widespread herbaceous coverage and many tall, healthy, planted stems.

There are several areas of the site that have been densely colonized by sweetgum and loblolly pine. These areas were treated in the spring of 2017, spring of 2019, spring of 2020, and the fall of 2021. This treatment consisted of cutting the sweetgum and loblolly pine and then spraying the stumps with an herbicide. There was one area of treatment for just sweetgum that consisted of an area of 1.58 acres and another treatment for both loblolly pine and sweetgum that consisted of an area of 7.34 acres. Because of the large seed source for these species directly adjacent to the site, it is unrealistic to expect them to be completely eradicated from the site. These treatments were intended to give the planted stems a chance to grow to a height where they would not be out-competed by these fast growing, primary successional species. While there are still areas of dense sweetgum and loblolly present on the site, these areas are relatively limited and are interspersed with many large (>10 feet) planted stems. As the site continues to develop, it is expected that these areas of dense primary succession species will naturally thin out as they compete with each other and the much larger planted stems.

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 9% 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 (244 days). The water table of the restored wetlands must be within 12" of the soil surface continuously for at least 9% (22 days) of the 244-day growing season. Wetland hydrology will be monitored with eight automatic gauges that record water table depth.

The wetland gauges will be checked and/or downloaded every other month. Daily data will be collected from the automatic gauges over the 7-year monitoring period. On May 7, 2020, two additional gauges were installed on the western side of the site to monitor areas that were not adequately covered by the eight

gauges already installed on site. Gauge 2 was reinstalled on April 19, 2021 due to a gauge malfunction at the beginning of the growing season.

The daily rainfall data was obtained from a local weather station in Jacksonville, NC; provided by the NC State Climate Office. For the 2021 year, the months of January, July, and October experienced average rainfall, while March, April, May, September, and November experienced below average rainfall. February, June, and August experienced above average rainfall in 2021. Although the overall rainfall total for the site was average for the year, the majority of the rain that fell during the growing season fell during the months of June, July, and August, when evapotranspiration (ET) is greatest. The gauges have historically achieved the success criteria during either the first three (March, April, May) or last three (September, October, November) months of the growing season. Five of these six months recorded below average rainfall in 2021, with October being the only month of the six to achieve average rainfall. An evaluation of the rainfall using the USACE's Antecedent Precipitation Tool (APT) further backed up this analysis. The APT assigns a score to each day based on the amount of rainfall the area received in the past 90 days compared to 30 year rainfall averages. Scores between 10 and 14 are classified as "Normal Conditions," while lower scores are classified as "Drier than Normal," and higher scores are classified as "Wetter than Normal." According to the APT, the majority of the months of January, February, June and August were spent in wetter than normal conditions while March, July, and November were mostly under normal conditions. The months of April, May, September, and October were drier than normal for the majority of the month. Overall 12% of the growing season was classified as Wetter than Normal, 57% was classified as Normal Conditions, and 31% was classified as Drier than Normal. The average daily score for the site was 11.2.

During the site's seventh growing season, 5 of the 10 gauges had continuous saturation within 12 inches of the ground surface for 9% (22 days) of the 243 day growing season (March 18 to November 16). Overall the gauges on site averaged 19 days (8.2%) of continuous saturation. As discussed above, although the overall rainfall was normal for the site, the periods when the site experienced drier than normal conditions are the same periods when the gauges usually meet the success criteria. It is believed that this rainfall pattern is responsible for the low rate of success this year.

Another contributing factor to the low rate of success that was achieved this year and in the previous two monitoring years is the large number of loblolly pines that began colonizing the site in 2019. It is believed that the historically low amount of rainfall and resulting dry conditions on the site in 2019 allowed many pines to become established and thrive on the site which otherwise would have been too wet for this. Many studies have shown the outsized impact that loblolly pines can have in lowering the water table (Aguilos, et al, 2021; Grace, Skaggs, and Chescheir, 2006; Lebo and Hermann, 1998; McNulty, Vose, and Swank, 1996). Once these pines became established on site, it is believed that they were the driving force in lowering the water table that resulted in the low rates of gauge success in MY06 and 07. KCI believes that now that the majority of these pines have been treated and removed from the site, that the water table will rise back to its pre-2019 levels and there will be a corresponding rise in gauge success. To monitor this, KCI is proposing to continue hydrologic monitoring of the site in 2022.

3.0 REFERENCES

Aguilos, M., G. Sun, A. Noormets, J. Domec, S. McNulty, M. Gavazzi, K. Minick, B. Mitra, P. Prajapati, Y. Yang, and J. King. (2021). Effects of land-use change and drought on decadal evapotranspiration and water balance of natural and managed forested wetlands along the southeastern US lower coastal plan. *Agricultural and Forest Meteorology*, 303

Grace, J. M., R. W. Skaggs, G.M. Chescheir. (2006). Hydrologic and water quality effects of thinning loblolly pine. *Transactions of the ASABE*, 49(3): 645-654

Lebo, M. E. and R.B. Herman. (1998). Harvest impacts on forest outflow in coastal North Carolina. *Journal of Environmental Quality*, 27(6)

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)

McNulty, S. G., J. M. Vose, W. T. Swank, (1996). Loblolly pine hydrology and productivity across the southern United States. *Forest Ecology and Management*, 86: 241-251

Schultz, R. (1997). *Loblolly Pine: The Ecology and Culture of Loblolly Pine (Pinus taeda)*. US Department of Agriculture, Forest Service.

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

Appendix A

Project Vicinity Map and Background Tables

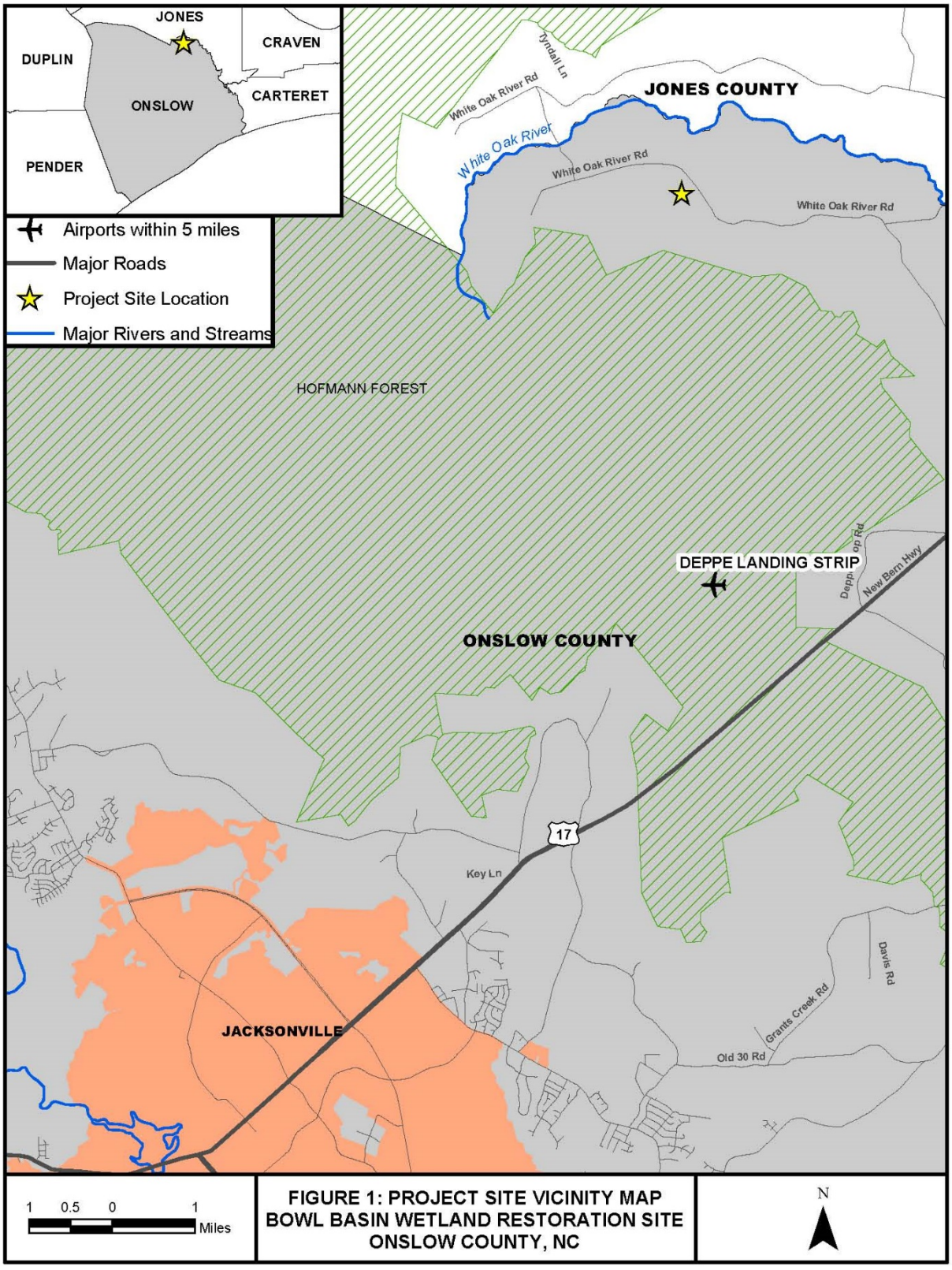

JONES
CRAVEN
DUPLIN
ONSLOW
CARTERET
PENDER
Airports within 5 miles
Major Roads
Project Site Location
Major Rivers and Streams
Tyndall Ln
White Oak River Rd
JONES COUNTY
White Oak River
White Oak River Rd
White Oak River Rd
HOFMANN FOREST
DEPPE LANDING STRIP
New Bern Hwy
ONSLOW COUNTY
17
Key Ln
Davis Rd
Grants Creek Rd
Old 30 Rd
JACKSONVILLE
1 0.5 0 1
Miles
FIGURE 1: PROJECT SITE VICINITY MAP
BOWL BASIN WETLAND RESTORATION SITE
ONSLOW COUNTY, NC
N

FIGURE 2: PROJECT SITE MITIGATION PLAN VIEW
BOWL BASIN WETLAND RESTORATION SITE
ONSLOW COUNTY, NC

Image Source: NC 2010 Statewide Orthoimagery.

Table 1. Project Components
Project Number and Name: 95721 – Bowl 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	-	-	-	-	11.7	-	-	-	-
Credits	-	-	-	-	11.7	-	-	-	-
TOTAL CREDITS	-		-		11.7		-	-	-

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	-	11.7 acres	-	Restoration	11.7 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				11.7 acres		
Enhancement						
Enhancement I						
Enhancement II						
Creation						
Preservation						
High Quality Preservation						
TOTAL	-	-	-	11.7 acres	-	-

Table 2. Project Activity & Reporting History Project Number and Name: 95721 - Bowl Basin Restoration Site		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan		Oct 2014
Final Design - Construction Plans		Dec 2014
Construction		March 2015
Planting		March 2015
Baseline Monitoring/Report	April 2015	May 2015
Vegetation Monitoring	May 20, 2015	
Photo Points	May 26, 2015	
Year 1 Monitoring	Nov 2015	Jan 2016
Vegetation Monitoring	Oct 16, 2015	
Photo Points	Oct 16, 2015	
Gauge Downloads	Nov 25, 2015	
Year 2 Monitoring	Nov 2016	Dec 2016
Vegetation Monitoring	June 30, 2016	
Photo Points	Aug 23, 2016	
Gauge Downloads	Nov 22, 2016	
Sweetgum Treatment		May 2017
Year 3 Monitoring	Dec 2017	Jan 2018
Vegetation Monitoring	June 26, 2017	
Photo Points	Nov 30, 2017	
Gauge Downloads	Dec 1, 2017	
Year 4 Monitoring	Nov 2018	Dec 2018
Vegetation Monitoring	N/A	
Photo Points	Nov 13, 2018	
Gauge Downloads	Nov 13, 2018	
Sweetgum Treatment		May 2019
Year 5 Monitoring	Nov 2019	Dec 2019
Vegetation Monitoring	July 15, 2019	
Photo Points	Nov 20, 2019	
Gauge Downloads	Nov 20, 2019	
Sweetgum Treatment		Sept 2020
Year 6 Monitoring	Nov 2020	Dec 2020
Vegetation Monitoring	N/A	
Photo Points	Dec 8, 2020	
Gauge Downloads	Dec 8, 2020	
Sweetgum and Pine Treatment		Nov 2021
Year 7 Monitoring	Nov 2021	Dec 2021
Vegetation Monitoring	June 24, 2021	
Photo Points	Sept 10, 2021	
Gauge Downloads	Nov 19, 2021	

Table 3. Project Contacts **Project Number and Name: 95721 - Bowl Basin Restoration Site**	
Design Firm	KCI Associates of North Carolina 4505 Falls of Neuse Road 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 Road 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 4505 Falls of Neuse Road 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: 95721 – Bowl Basin Restoration Site**			
County	Onslow County		
Project Area (acres)	11.7 acres		
Project Coordinates (lat. and long.)	34.922045 N , -77.319401 W		
Project Watershed Summary Information			
Physiographic Province	Coastal Plain		
River Basin	White Oak		
USGS Hydrologic Unit 8-digit	03020106	**USGS Hydrologic Unit 14-digit**	03020106010010
DWQ Sub-basin	03-05-01b		
Project Drainage Area (acres)	76.0 acres		
Project Drainage Area Percentage of Impervious Area	1%		
CGIA Land Use Classification	94% Cultivated, 4% Forest, and 2% Low-Intensity Development		
Wetland Summary Information			
Parameters	**Wetland Area**		
Size of Wetland (acres)	11.7 acres		
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Non-riparian		
Mapped Soil Series	Pantego loam by detailed soil investigation		
Drainage class	Poorly drained		
Soil Hydric Status	Drained Hydric		
Source of Hydrology	Groundwater / 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 ····· 3642/749
- WETLAND GAUGE ACHIEVING HYDROLOGIC CRITERION
- WETLAND GAUGE BELOW HYDROLOGIC CRITERION
- PHOTO POINT (PP)
- FILLED DITCHES
- CONSERVATION EASEMENT = NONRIPARIAN WETLAND RESTORATION = 11.7 ACRES
- SWEETGUM AND PINE TREATMENT (2021)
- SWEETGUM TREATMENT (2017, 2019, 2021)

IMAGE SOURCE: NC 2020 ORTHOIMAGERY

VEG PLOT #1 1862/728
PP1
GAUGE#1
VEG PLOT #2 1578/899
GAUGE#2
VEG PLOT #3 1658/728
VEG PLOT #9 1862/526
VEG PLOT #10 1902/769
GAUGE#5
GAUGE#8
PP6
PP2
GAUGE#9
VEG PLOT #8 4209/647
PP5
GAUGE#3
VEG PLOT #4 2914/850
VEG PLOT #7 4452/607
GAUGE#7
GAUGE#10
GAUGE#6
VEG PLOT #6 4126/890
PP4
VEG PLOT #5 11857/850
GAUGE#4
PP3
CORNWALLIS ROAD

NORTH
NAD 83 NSRS 2011

–60′ –30′ 0′ 60′ 120′
GRAPHIC SCALE

NO.	DESCRIPTION	DATE
	REVISIONS	

NCDEQ DIVISION OF MITIGATION SERVICES

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

BOWL BASIN RESTORATION SITE

DMS PROJECT #95721
ONSLOW COUNTY, NORTH CAROLINA
MONITORING YEAR 07

DATE: NOV 2021
SCALE: GRAPHIC

CURRENT CONDITION PLAN VIEW

SHEET 1 OF 1

FIGURE 3

Table 5. Vegetation Condition Assessment Assesment Date: 11/19/21

Project Number and Name: 95721 – Bowl Basin Restoration Site

Planted Acreage 11.7 **Easement Acreage 11.7**

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	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
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	0.00	0.0%
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. Pine and Sweetgum Treatment Area	Areas or points (if too small to render as polygons at map scale).	1000 SF	Pattern and Color	0	7.34	62.7%
6. 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%

Photo Reference Points

PP1 – MY-00 – 5/20/15

PP1 – MY-07 – 9/10/21

PP2 – MY-00 – 5/20/15

PP2 – MY-07 – 9/10/21

PP3 – MY-00 – 5/20/15

PP3 – MY-07 – 9/10/21

PP4 – MY-00 – 5/20/15

PP4 – MY-07 – 9/10/21

PP5 – MY-00 – 5/20/15

PP5 – MY-07 – 9/10/21

PP6 – MY-00 – 5/20/15

PP6 – MY-07 – 9/10/21

Vegetation Plot Photos

VP1 – MY-07 – 6/24/2021

VP2 – MY-07 – 6/24/2021

VP3 – MY-07 – 6/24/2021

VP4 – MY-07 – 6/24/2021

VP5 – MY-07 – 6/24/2021

VP6 – MY-07 – 6/24/2021

VP7 – MY-07 – 6/24/2021

VP8 – MY-07 – 6/24/2021

VP9 – MY-07 – 6/24/2021

VP10 – MY-07 – 6/24/2021

Vegetation Plot Photos

Area of sweetgum and pine treatment – 11/19/21

Area of sweetgum and pine treatment – 11/19/21

Appendix C

Vegetation Plot Data

Table 6. CVS Stem Count Total and Planted by Plot and Speceies																	
DMS Project Code 95721. Project Name: Bowl Basin			Current Plot Data MY07 (2021)														
		Species	95721-01-0001			95721-01-0002			95721-01-0003			95721-01-0004			95721-01-0005		
Scientific Name	Common Name	Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree															
Acer rubrum	red maple	Tree									1						1
Baccharis halimifolia	eastern baccharis	Shrub			4												
Betula nigra	river birch	Tree				1	1	1	1	1	1	6	6	6	1	1	1
Celtis occidentalis	common hackberry	Tree															
Cephalanthus occidentalis	common buttonbush	Shrub															
Diospyros virginiana	common persimmon	Tree									1						
Fraxinus pennsylvanica	green ash	Tree	5	5	5	6	6	6	10	10	10	9	9	9	11	11	11
Juglans nigra	black walnut	Tree															1
Liquidambar styraciflua	sweetgum	Tree			18			8			7			47			261
Magnolia virginiana	sweetbay	Tree	2	2	2	2	2	2									
Morella cerifera	wax myrtle	shrub															2
Nyssa aquatica	water tupelo	Tree													4	4	4
Nyssa biflora	swamp tupelo	Tree	1	1	1												
Pinus taeda	loblolly pine	Tree			5			8			10			4			3
Quercus lyrata	overcup oak	Tree			1												
Quercus michauxii	swamp chestnut oak	Tree				6	6	6	2	2	2						
Quercus nigra	water oak	Tree															
Quercus pagoda	cherrybark oak	Tree				1	1	1	2	2	3	2	2	2	2	2	2
Quercus phellos	willow oak	Tree				6	6	6				4	4	4	1	1	1
Quercus shumardii	Shumard's oak	Tree															
Salix nigra	black willow	Tree						1			3						4
Sambucus canadensis	American elderberry	Shrub															
Taxodium distichum	bald cypress	Tree	10	10	10				3	3	3				2	2	2
		Stem count	18	18	46	22	22	39	18	18	41	21	21	72	21	21	293
		Average Stem Height (feet)	6.2			15.9			14.9			20.7			19.6		
		size (ares)	1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02		
		Species count	4	4	8	6	6	9	5	5	10	4	4	6	6	6	12
		Stems per ACRE	728	728	1862	890	890	1578	728	728	1659	850	850	2914	850	850	11857

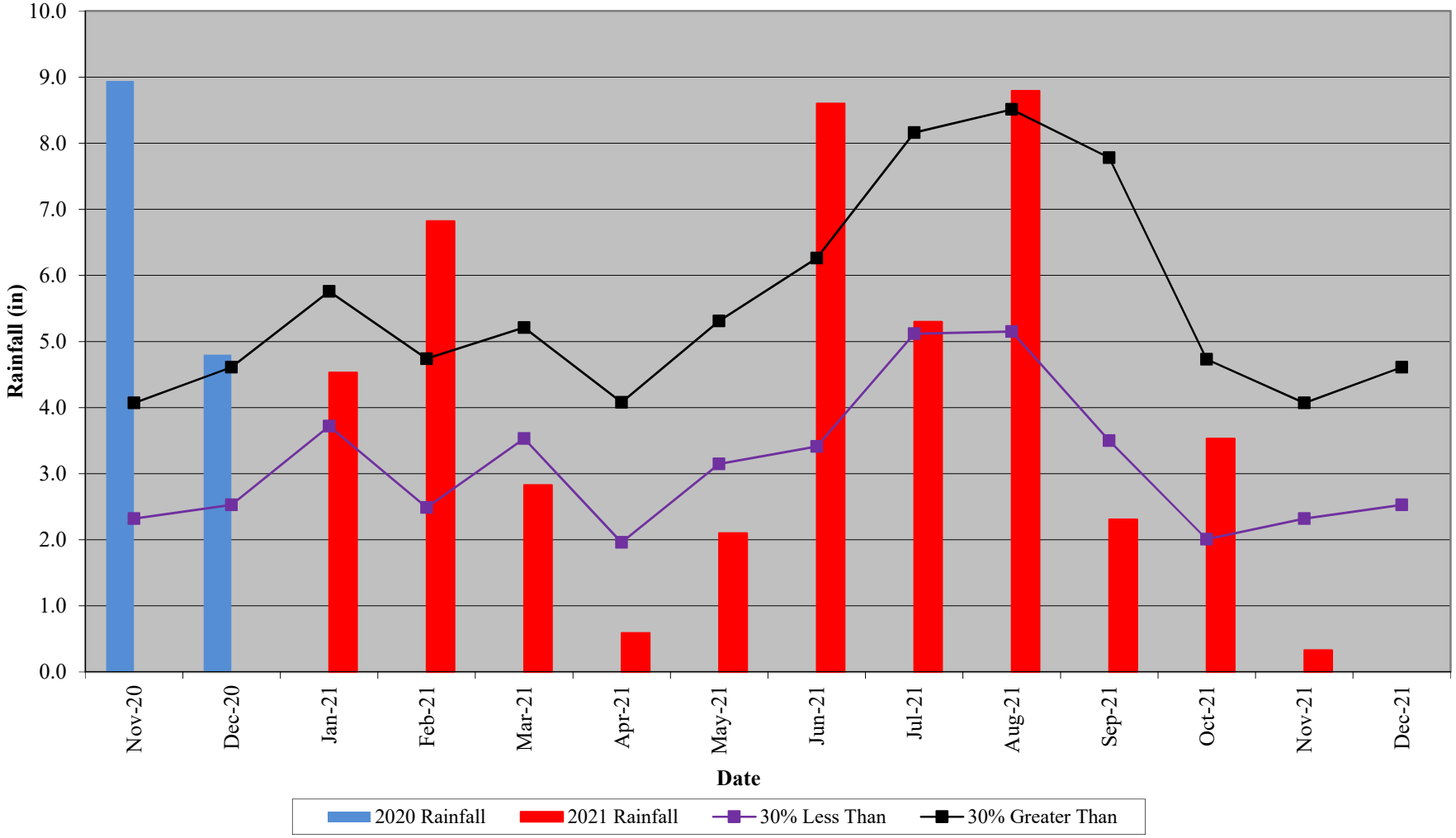
Table 6. CVS Stem Count Total and Planted by Plot and Speceies DMS Project Code 95721. Project Name: Bowl Basin			Current Plot Data MY07 (2021)														
		Species	95721-01-0006			95721-01-0007			95721-01-0008			95721-01-0009			95721-01-0010		
Scientific Name	Common Name	Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree															
Acer rubrum	red maple	Tree			2			3			1						
Baccharis halimifolia	eastern baccharis	Shrub						7			8						
Betula nigra	river birch	Tree							7	7	7				9	9	9
Celtis occidentalis	common hackberry	Tree															
Cephalanthus occidentalis	common buttonbush	Shrub				4	4	4	2	2	3	4	4	4			
Diospyros virginiana	common persimmon	Tree															
Fraxinus pennsylvanica	green ash	Tree	3	3	3	4	4	6				1	1	1	6	6	6
Juglans nigra	black walnut	Tree															
Liquidambar styraciflua	sweetgum	Tree			71			70			54			8			10
Magnolia virginiana	sweetbay	Tree							1	1	1	1	1	1			
Morella cerifera	wax myrtle	shrub									3			2			
Nyssa aquatica	water tupelo	Tree	1	1	1							1	1	1			
Nyssa biflora	swamp tupelo	Tree													3	3	3
Pinus taeda	loblolly pine	Tree			7			8			15			15			18
Quercus lyrata	overcup oak	Tree															
Quercus michauxii	swamp chestnut oak	Tree										3	3	3			
Quercus nigra	water oak	Tree															
Quercus pagoda	cherrybark oak	Tree													1	1	1
Quercus phellos	willow oak	Tree															
Quercus shumardii	Shumard's oak	Tree															
Salix nigra	black willow	Tree									6			8			
Sambucus canadensis	American elderberry	Shrub						5									
Taxodium distichum	bald cypress	Tree	18	18	18	7	7	7	6	6	6	3	3	3			
Stem count			22	22	102	15	15	110	16	16	104	13	13	46	19	19	47
Average Stem Height (feet)			7.5			4.3			8.5			5.1			1.9		
size (ares)			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			3	3	6	3	3	8	4	4	10	6	6	10	4	4	6
Stems per ACRE			890	890	4128	607	607	4452	647	647	4209	526	526	1862	769	769	1902

Table 6. CVS Stem Count Total and Planted by Plot and Speceies DMS Project Code 95721. Project Name: Bowl Basin			Annual Means																
		Species	MY7 (2021)			MY5 (2019)			MY3 (2017)			MY2 (2016)			MY1 (2015)			MY0 (2015)		
Scientific Name	Common Name	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
Acer negundo	boxelder	Tree												1						
Acer rubrum	red maple	Tree			8			5			2			2			1			
Baccharis halimifolia	eastern baccharis	Shrub			19			28			12			7						
Betula nigra	river birch	Tree	25	25	25	25	25	25	26	26	26	27	27	27	27	27	27	22	22	22
Celtis occidentalis	common hackberry	Tree												1						
Cephalanthus occidentalis	common buttonbush	Shrub	10	10	11	10	10	14	10	10	10	10	10	10	12	12	12	11	11	11
Diospyros virginiana	common persimmon	Tree			1			1			1			1						
Fraxinus pennsylvanica	green ash	Tree	55	55	57	56	56	57	55	55	56	57	57	57	55	55	59	51	51	51
Juglans nigra	black walnut	Tree			1			6			4			5			2			
Liquidambar styraciflua	sweetgum	Tree			554			578			437			417			280			
Magnolia virginiana	sweetbay	Tree	6	6	6	6	6	6	6	6	6	5	5	5	4	4	4	4	4	4
Morella cerifera	wax myrtle	shrub			7			4			3			2						
Nyssa aquatica	water tupelo	Tree	6	6	6	7	7	9	8	8	8	8	8	8	7	7	7	7	7	7
Nyssa biflora	swamp tupelo	Tree	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	3	3	3
Pinus taeda	loblolly pine	Tree			93			152			100			25						
Quercus lyrata	overcup oak	Tree			1															
Quercus michauxii	swamp chestnut oak	Tree	11	11	11	12	12	12	12	12	12	13	13	13	12	12	12	15	15	15
Quercus nigra	water oak	Tree						1												
Quercus pagoda	cherrybark oak	Tree	8	8	9	8	8	8	8	8	8	7	7	7	7	7	7	7	7	7
Quercus phellos	willow oak	Tree	11	11	11	11	11	11	12	12	12	11	11	11	9	9	11	9	9	9
Quercus shumardii	Shumard's oak	Tree										1	1	1	1	1	1	2	2	2
Salix nigra	black willow	Tree			22			22			8			3	1	1	2			
Sambucus canadensis	American elderberry	Shrub			5															
Taxodium distichum	bald cypress	Tree	49	49	49	49	49	49	49	49	49	47	47	48	48	48	48	45	45	45
		Stem count	185	185	900	189	189	993	191	191	759	191	191	656	188	188	478	176	176	176
		size (ares)	10			10			10			10			10			10		
		size (ACRES)	0.25			0.25			0.25			0.25			0.25			0.25		
		Species count	10	10	20	10	10	19	10	10	18	11	11	21	12	12	15	11	11	11
		Stems per ACRE	749	749	3642	765	765	4019	773	773	3072	773	773	2655	761	761	1934	712	712	712

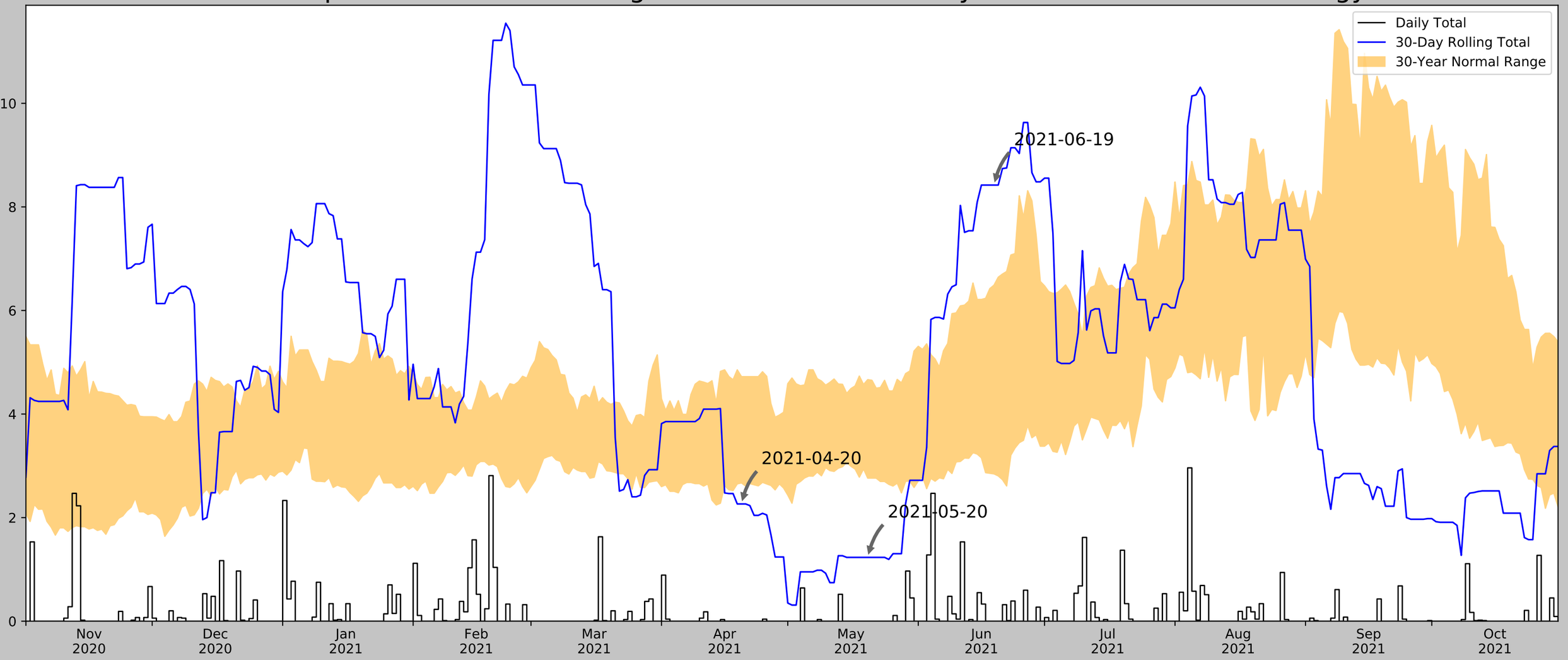
Appendix D

Hydrologic Data

Bowl Basin Wetland Restoration Site
30-70 Percentile Graph
WETS Station Name: NHOF, Hoffman Forest



Antecedent Precipitation vs Normal Range based on NOAA's Daily Global Historical Climatology Network



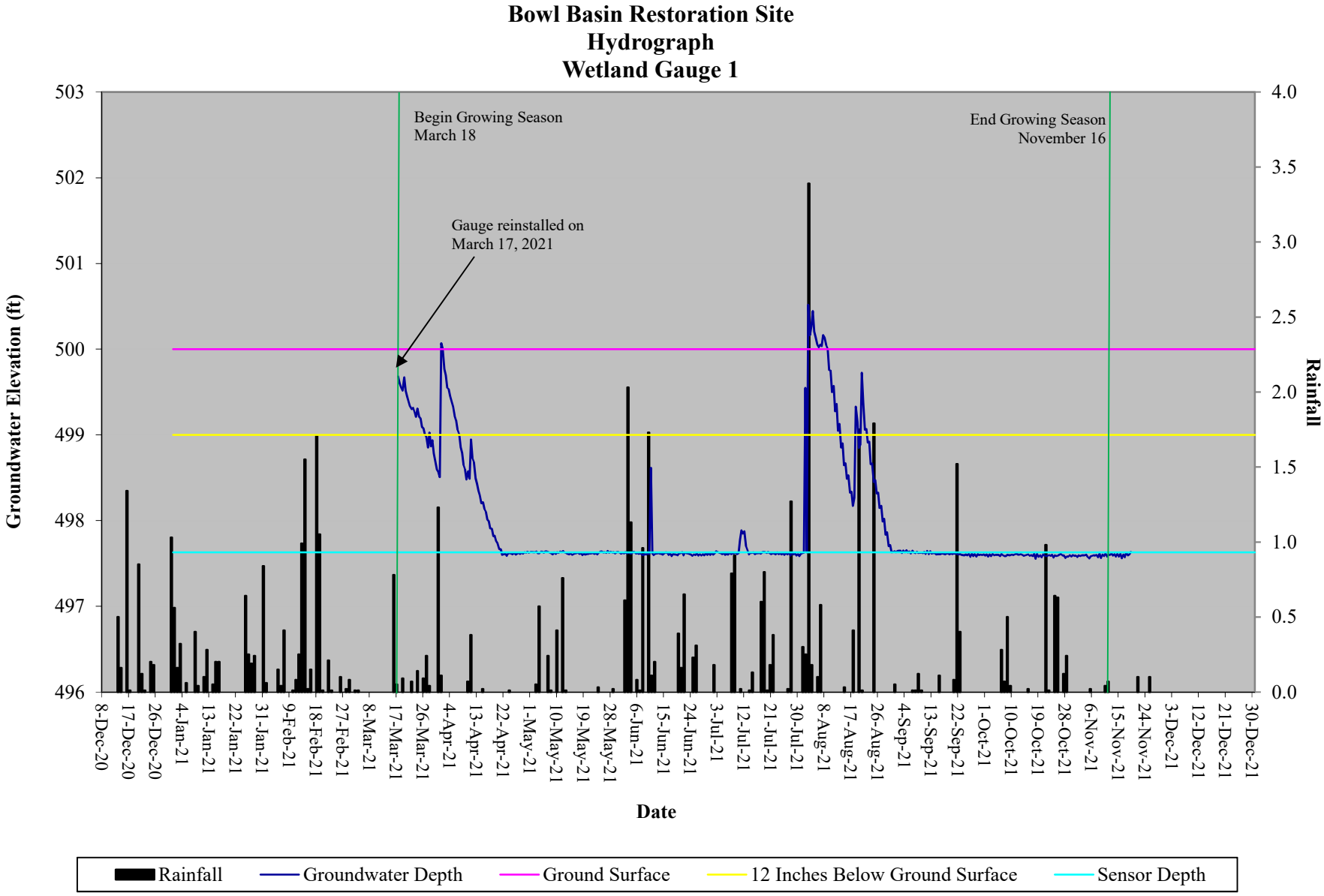
Coordinates	34.922045, -77.319401
Observation Date	2021-06-19
Elevation (ft)	41.33
Drought Index (PDSI)	Moderate wetness
WebWIMP H_2O Balance	Wet Season

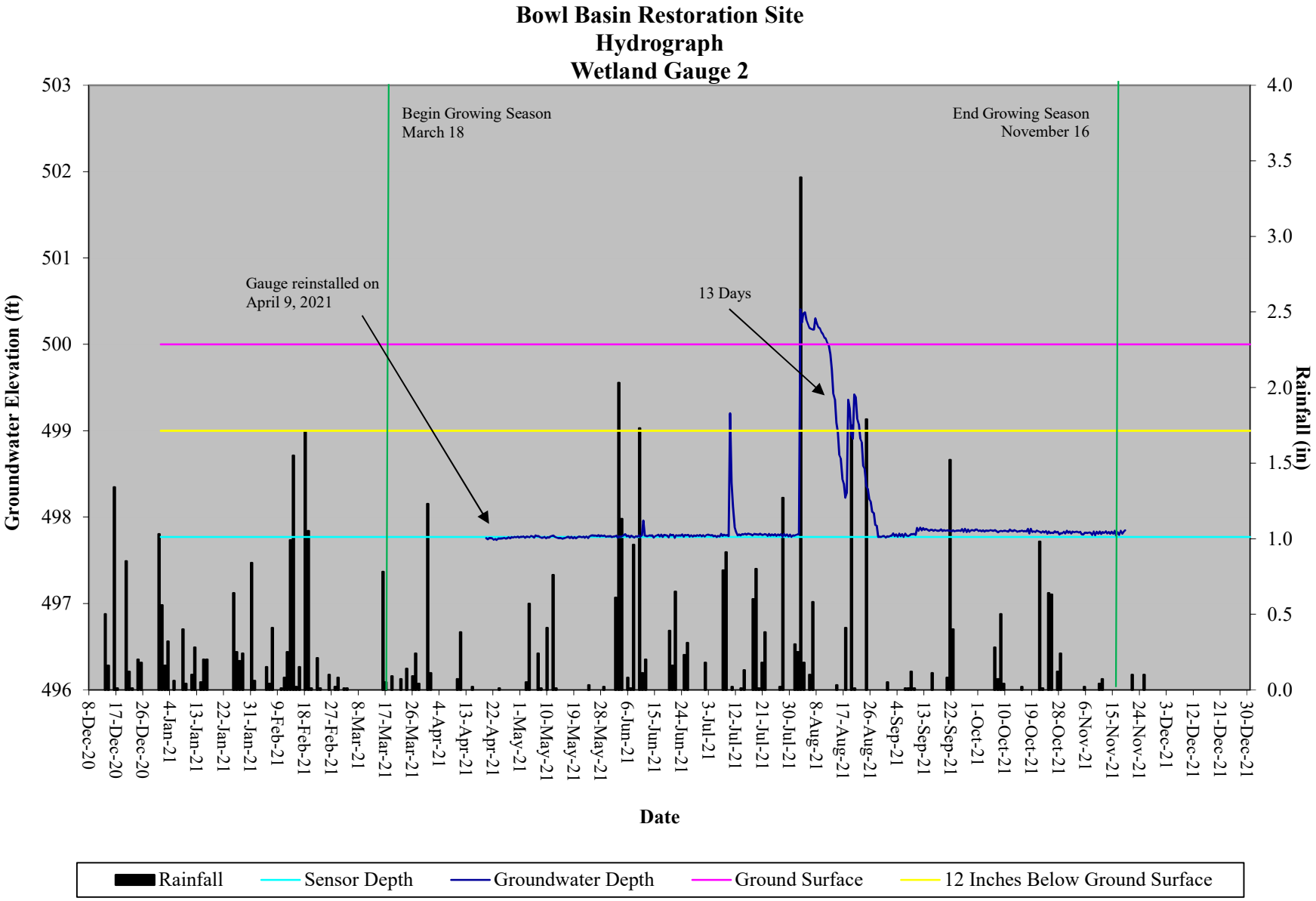
30 Days Ending	30th %ile (in)	70th %ile (in)	Observed (in)	Wetness Condition	Condition Value	Month Weight	Product
2021-06-19	2.844488	6.488977	8.42126	Wet	3	3	9
2021-05-20	2.762599	4.664567	1.232284	Dry	1	2	2
2021-04-20	2.670079	4.722047	2.26378	Dry	1	1	1
Result							Normal Conditions, 12

Figure and tables made by the
Antecedent Precipitation Tool
Version 1.0

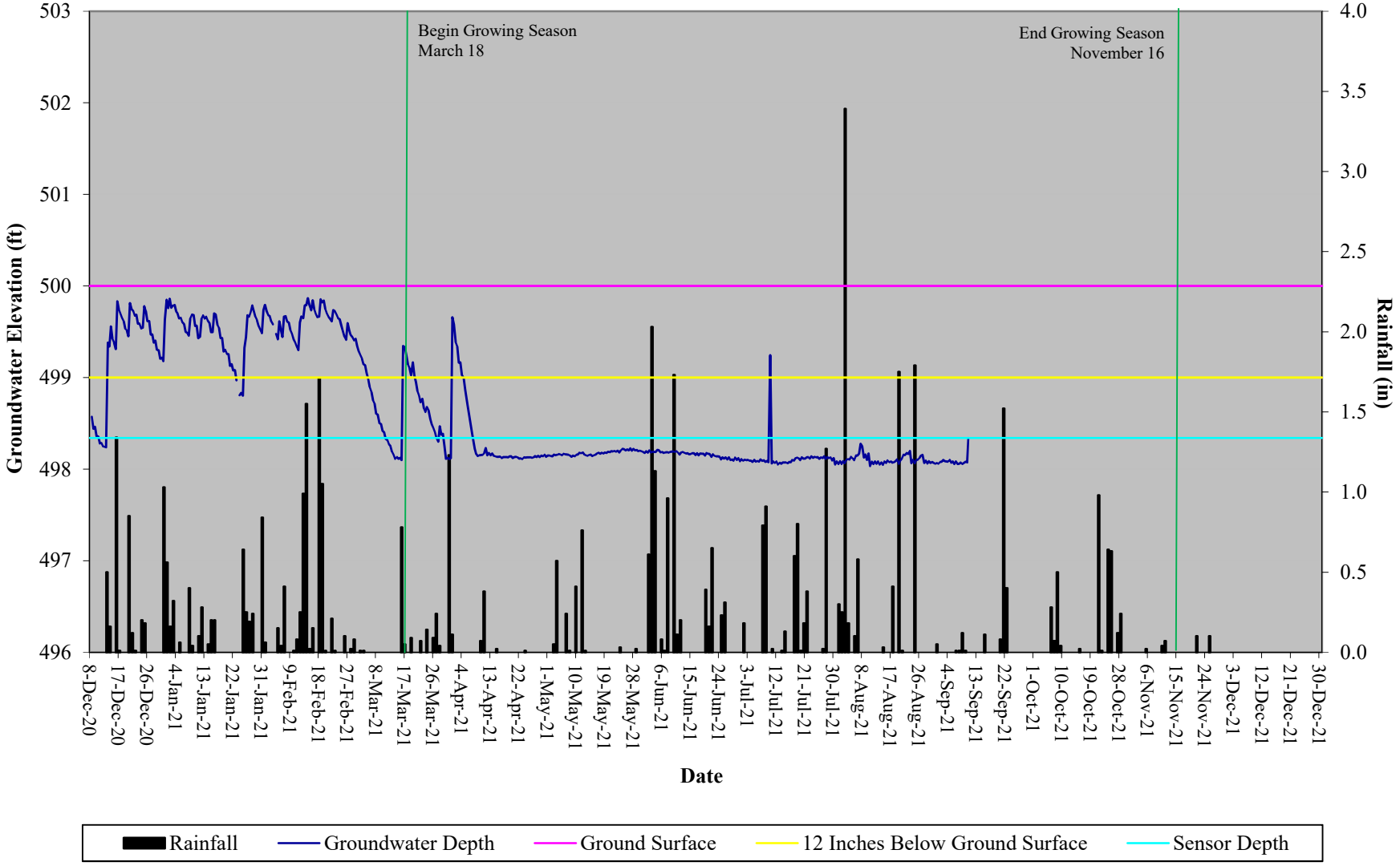
Written by Jason Deters
U.S. Army Corps of Engineers

Weather Station Name	Coordinates	Elevation (ft)	Distance (mi)	Elevation Δ	Weighted Δ	Days Normal	Days Antecedent
NEW BERN 8.8 W	35.141, -77.2324	42.979	15.909	1.649	7.185	2426	82
NEW BERN 5.3 SW	35.0747, -77.1536	21.982	14.118	19.348	6.626	271	5
NEW BERN 4.6 SW	35.0746, -77.1373	6.89	14.742	34.44	7.142	34	3
RIVER BEND 0.8 ENE	35.076, -77.1392	1128.937	14.737	1087.607	22.66	1	0
STELLA 0.6 ENE	34.7776, -77.1408	14.108	14.218	27.222	6.785	401	0
BEULAVILLE 0.5 NE	34.9275, -77.7655	88.911	25.274	47.581	12.576	136	0
ALBERTSON 1.8 SE	35.0946, -77.7978	140.092	29.583	98.762	16.234	2	0
BEULAVILLE 3.3 NNW	34.966, -77.795	69.882	27.107	28.552	12.972	3	0
NEW BERN 4.4 SW	35.0716, -77.1283	16.076	14.959	25.254	7.109	319	0
KINSTON 4.7 ESE	35.246, -77.5156	35.105	24.981	6.225	11.397	6	0
RICHLANDS 0.2 NNE	34.9029, -77.5459	62.992	12.901	21.662	6.085	398	0
SWANSBORO 3.3 NW	34.7264, -77.1672	20.013	16.039	21.317	7.559	679	0
HOFMANN FOREST	34.8358, -77.3031	46.916	6.03	5.586	2.747	6381	0
JACKSONVILLE EOC	34.7964, -77.4011	17.06	9.84	24.27	4.667	187	0
KINSTON 7 SE	35.1967, -77.5433	23.05	23.814	17.29	10.663	100	0

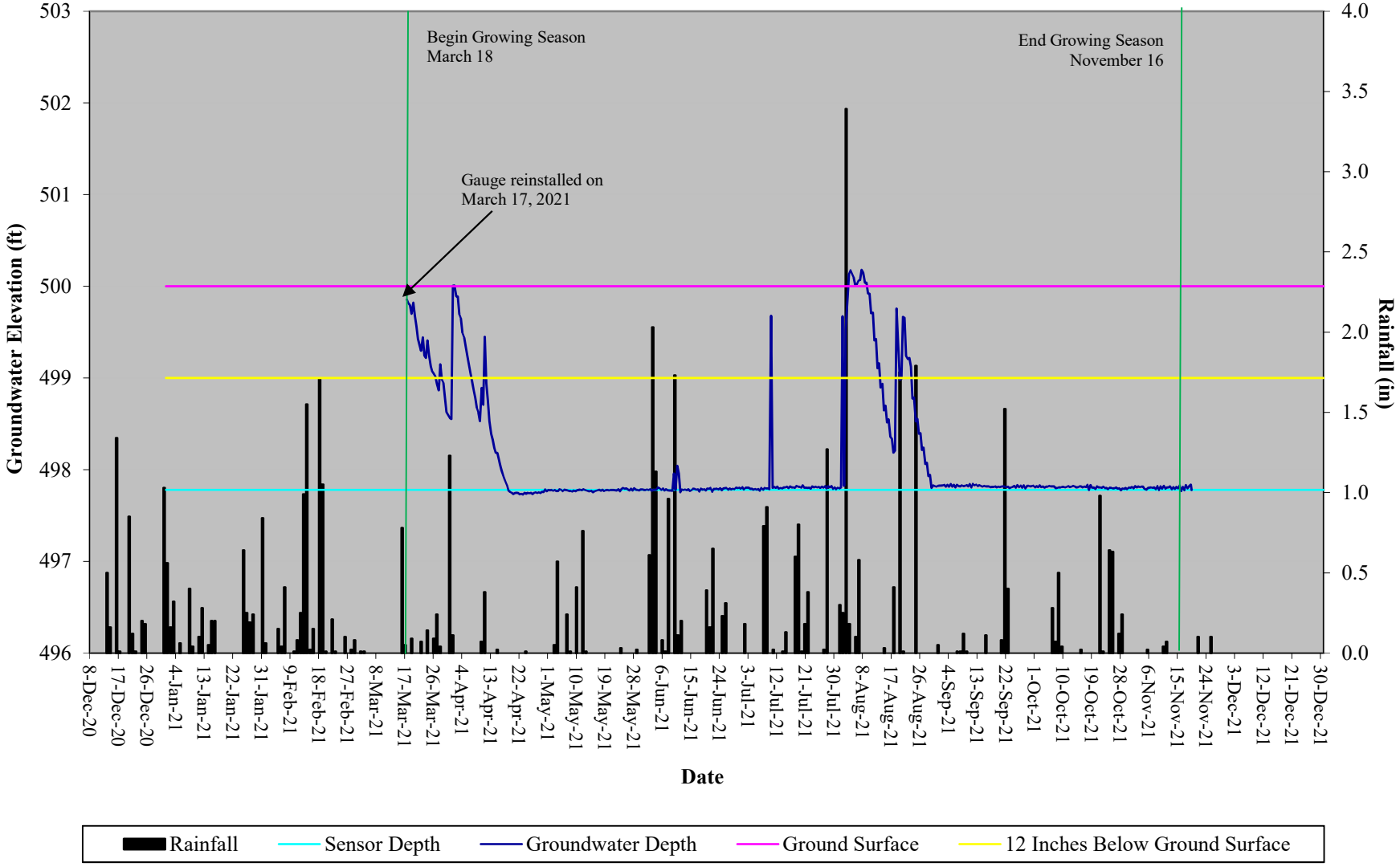

Bowl Basin Restoration Site
Hydrograph
Wetland Gauge 1
Begin Growing Season
March 18
End Growing Season
November 16
Gauge reinstalled on
March 17, 2021
Groundwater Elevation (ft)
Rainfall
Date
503
502
501
500
499
498
497
496
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
8-Dec-20
17-Dec-20
26-Dec-20
4-Jan-21
13-Jan-21
22-Jan-21
31-Jan-21
9-Feb-21
18-Feb-21
27-Feb-21
8-Mar-21
17-Mar-21
26-Mar-21
4-Apr-21
13-Apr-21
22-Apr-21
1-May-21
10-May-21
19-May-21
28-May-21
6-Jun-21
15-Jun-21
24-Jun-21
3-Jul-21
12-Jul-21
21-Jul-21
30-Jul-21
8-Aug-21
17-Aug-21
26-Aug-21
4-Sep-21
13-Sep-21
22-Sep-21
1-Oct-21
10-Oct-21
19-Oct-21
28-Oct-21
6-Nov-21
15-Nov-21
24-Nov-21
3-Dec-21
12-Dec-21
21-Dec-21
30-Dec-21
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Bowl Basin Restoration Site
Hydrograph
Wetland Gauge 2
Begin Growing Season
March 18
End Growing Season
November 16
Gauge reinstalled on
April 9, 2021
13 Days
Groundwater Elevation (ft)
Rainfall (in)
Date
503
502
501
500
499
498
497
496
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
8-Dec-20
17-Dec-20
26-Dec-20
4-Jan-21
13-Jan-21
22-Jan-21
31-Jan-21
9-Feb-21
18-Feb-21
27-Feb-21
8-Mar-21
17-Mar-21
26-Mar-21
4-Apr-21
13-Apr-21
22-Apr-21
1-May-21
10-May-21
19-May-21
28-May-21
6-Jun-21
15-Jun-21
24-Jun-21
3-Jul-21
12-Jul-21
21-Jul-21
30-Jul-21
8-Aug-21
17-Aug-21
26-Aug-21
4-Sep-21
13-Sep-21
22-Sep-21
1-Oct-21
10-Oct-21
19-Oct-21
28-Oct-21
6-Nov-21
15-Nov-21
24-Nov-21
3-Dec-21
12-Dec-21
21-Dec-21
30-Dec-21
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface

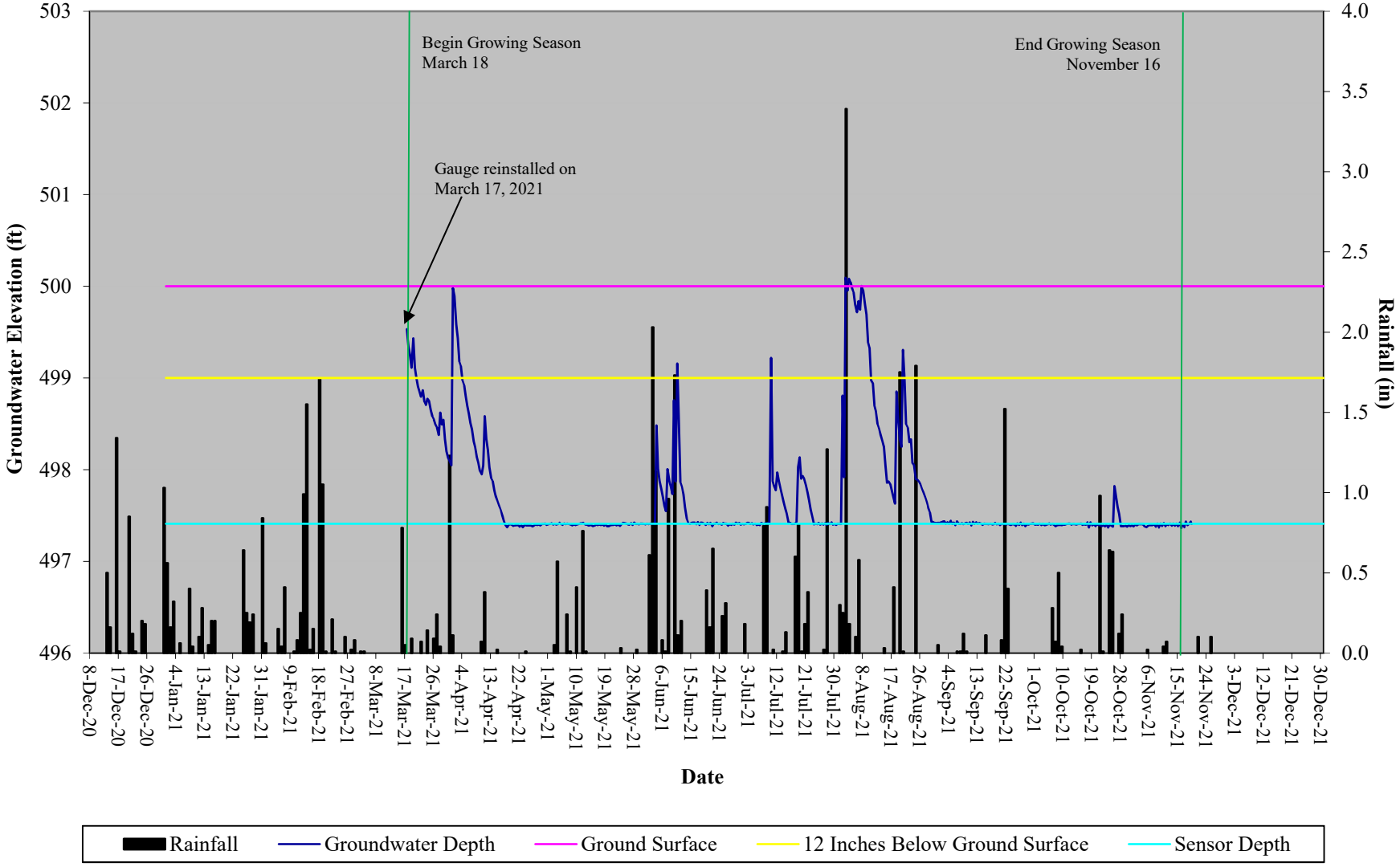
Bowl Basin Restoration Site
Hydrograph
Wetland Gauge 3



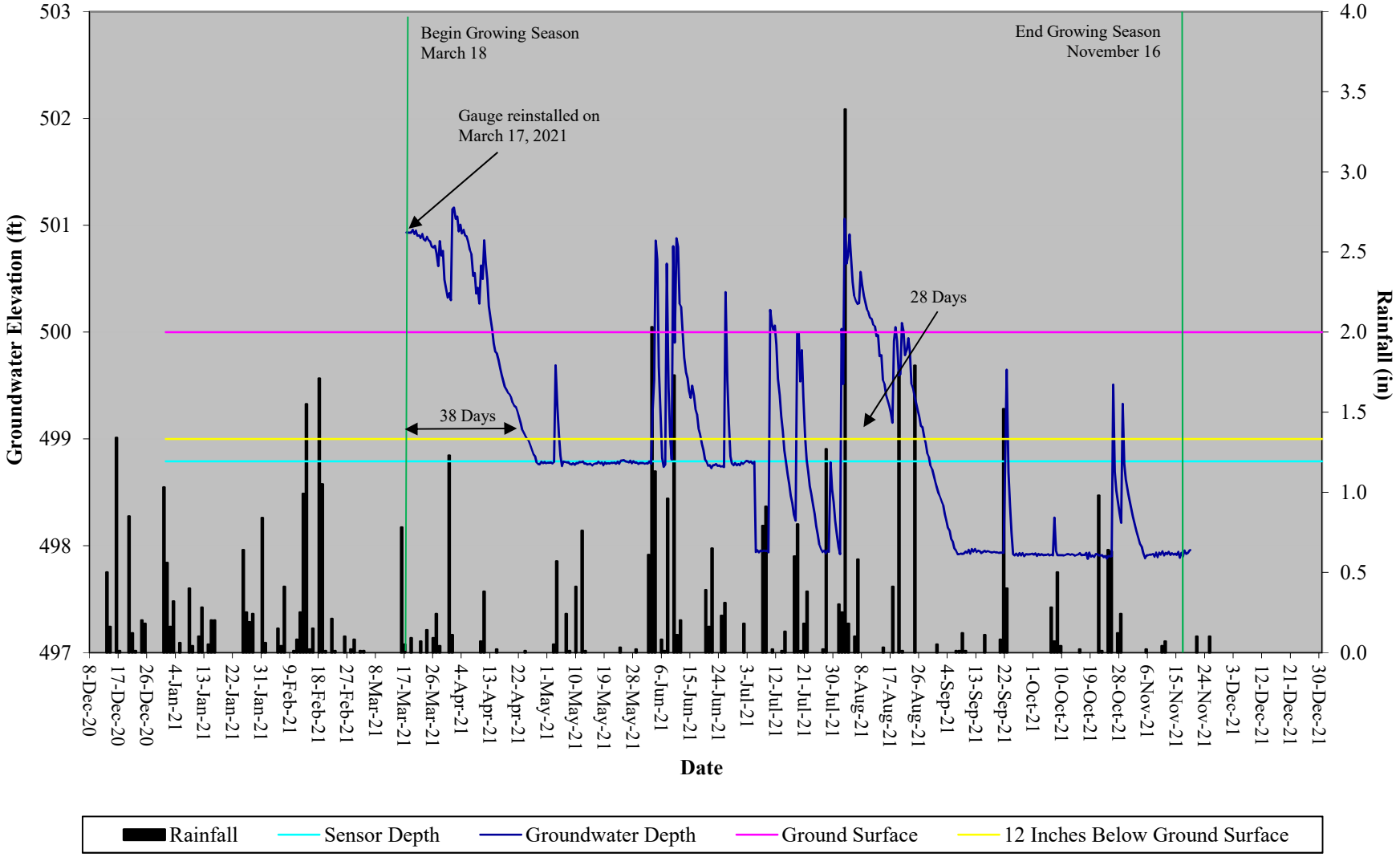
Bowl Basin Restoration Site
Hydrograph
Wetland Gauge 4



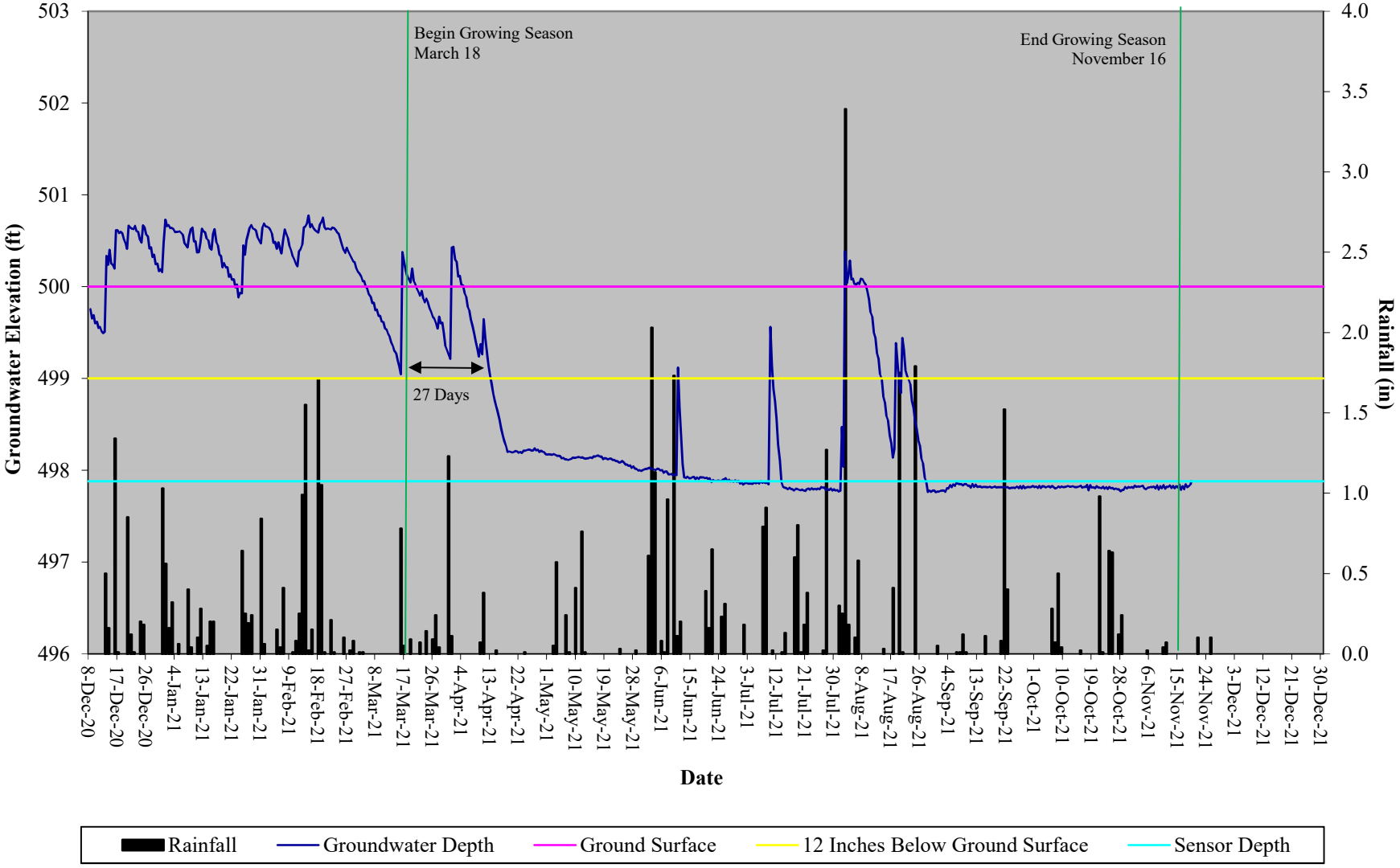
Bowl Basin Restoration Site
Hydrograph
Wetland Gauge 5



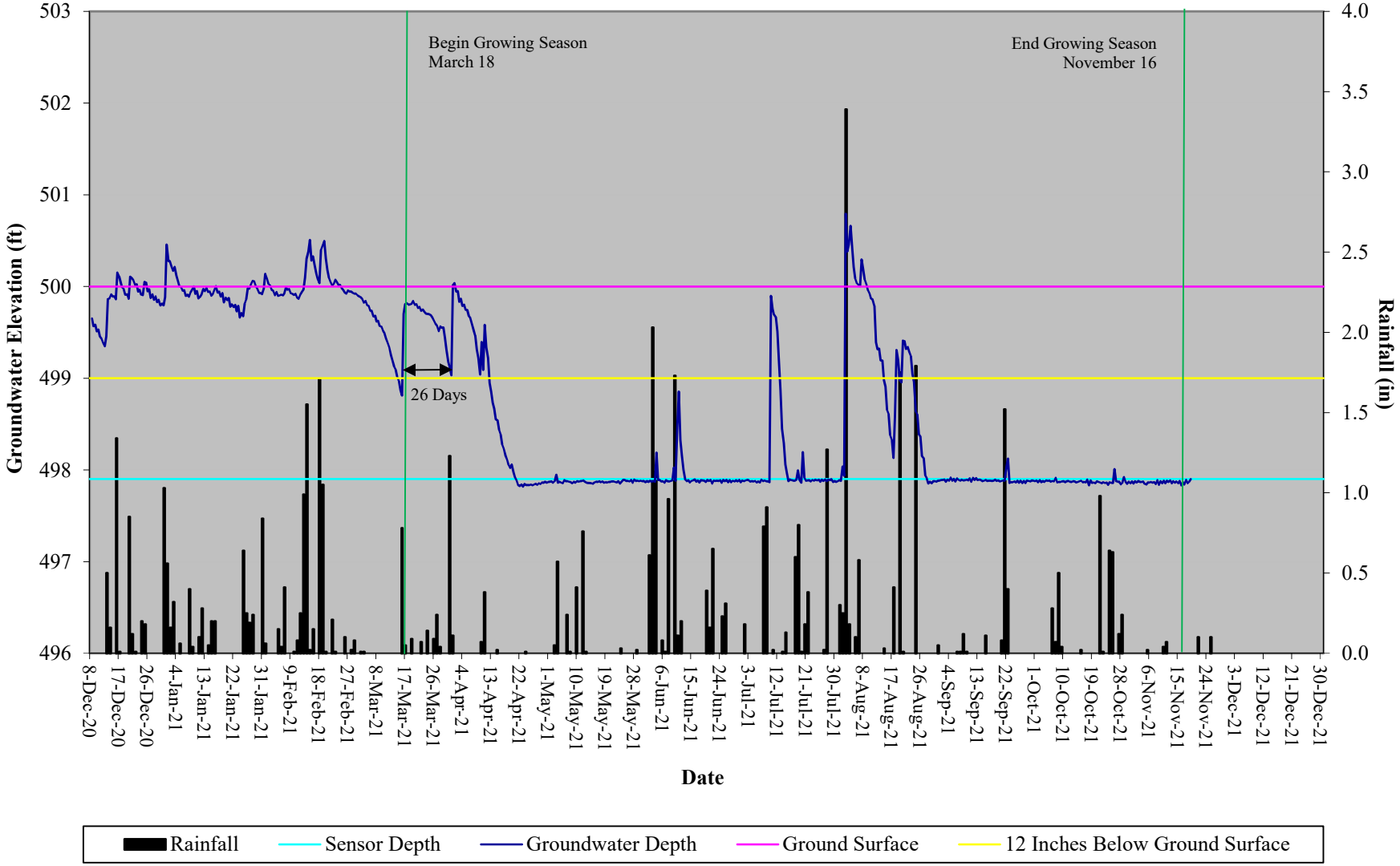
Bowl Basin Restoration Site
Hydrograph
Wetland Gauge 6



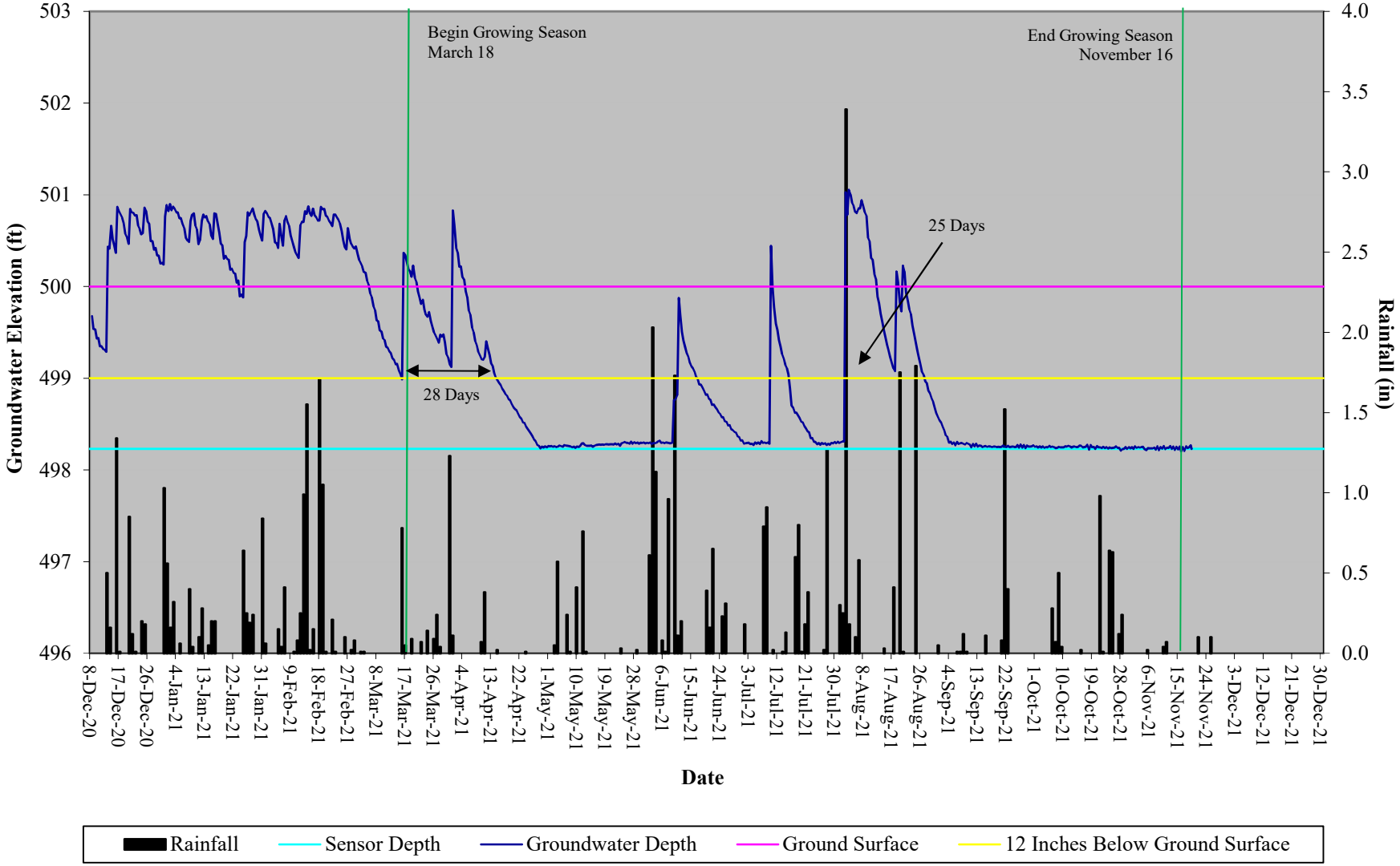
Bowl Basin Restoration Site
Hydrograph
Wetland Gauge 7



Bowl Basin Restoration Site
Hydrograph
Wetland Gauge 8



Bowl Basin Restoration Site
Hydrograph
Wetland Gauge 9



Bowl Basin Restoration Site
Hydrograph
Wetland Gauge 10

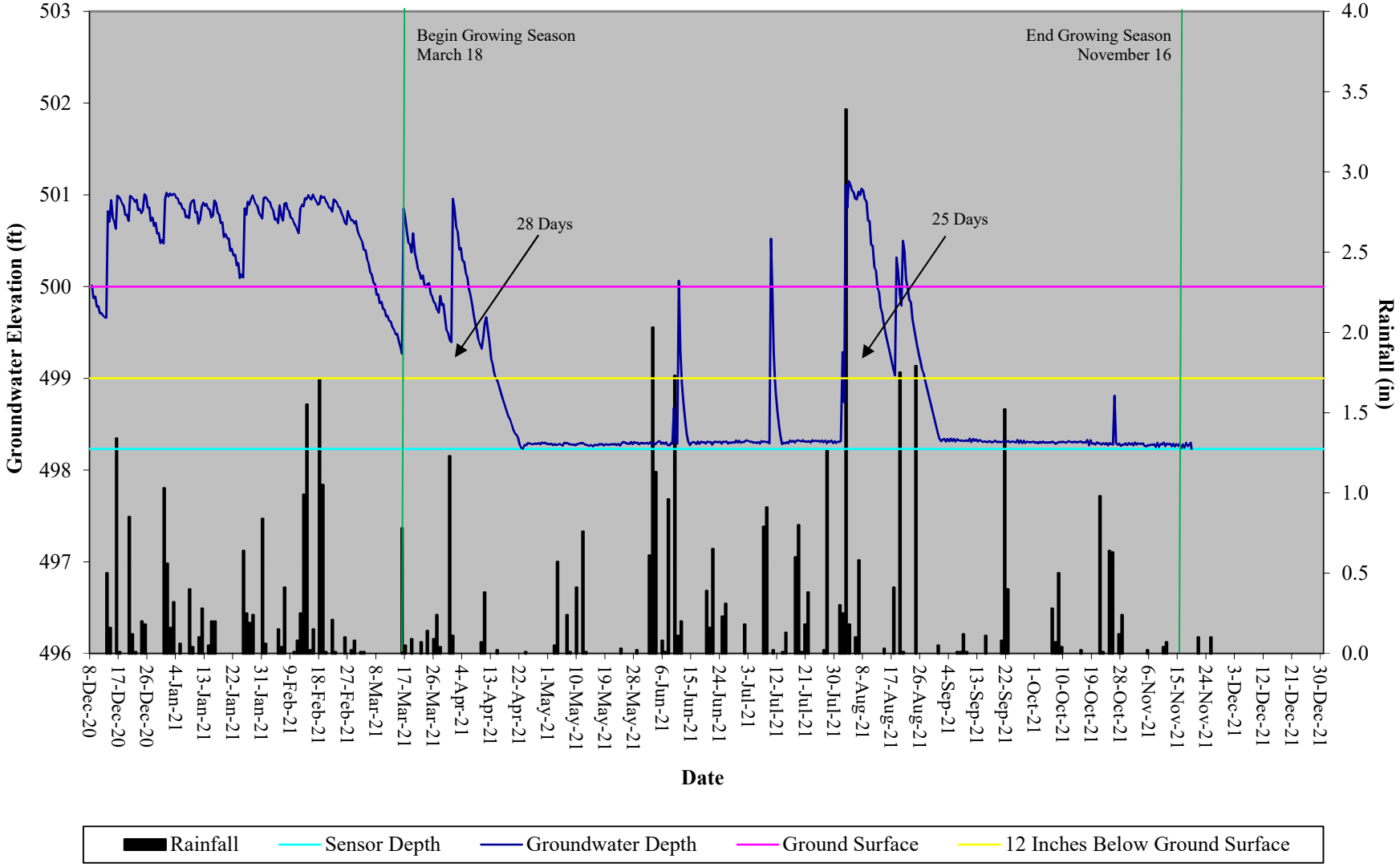


Table 7. Wetland Hydrology Criteria Attainment Table Project Number and Name: 95721 - Bowl Basin Restoration Site							
	Success Criteria Achieved / Max Consecutive Days During Growing Season (Percentage)						
Non-Riparian Gauges Success Criteria (22 Days) (9%)	**MY-01 2015**	**MY-02 2016**	**MY-03 2017**	**MY-04 2018**	**MY-05 2019**	**MY-06 2020**	**MY-07 2021**
Rainfall Conditions	Normal	Normal	Drier than Normal	Normal	Drier than Normal	Normal	Normal
Gauge 1	Yes/37 (15.2%)	Yes/29 (11.9%)	Yes/24 (9.8%)	Yes/35 (14.3%)	No/12 (4.9%)	No/18 (7.4%)	No/11 (4.5%)
Gauge 2	Yes/69 (28.3%)	Yes/49 (20.1%)	Yes/32 (13.1%)	Yes/37 (15.2%)	No/17 (7.0%)	Yes/22 (9.1%)	No/13 (5.3%)
Gauge 3	No/20 (8.2%)	Yes/27 (11.1%)	No/13 (5.3%)	Yes/27 (11.1%)	No/13 (5.3%)	No/14 (5.8%)	No/4 (1.6%)
Gauge 4	Yes/29 (11.9%)	Yes/41 (16.8%)	Yes/26 (10.7%)	Yes/32 (13.1%)	No/14 (5.7%)	No/18 (7.4%)	No/11 (4.5%)
Gauge 5	Yes/24 (9.8%)	Yes/52 (21.3%)	Yes/50 (20.5%)	Yes/36 (14.8%)	No/12 (4.9%)	No/5 (2.1%)	No/8 (3.3%)
Gauge 6	Yes/79 (32.4%)	Yes/60 (24.6%)	Yes/62 (25.4%)	Yes/58 (23.8%)	Yes/40 (16.4%)	Yes/41 (16.9%)	Yes/38 (15.6%)
Gauge 7	Yes/25 (10.2%)	Yes/38 (15.6%)	No/12 (4.9%)	Yes/31 (12.7%)	Yes/22 (9.0%)	Yes/24 (9.9%)	Yes/27 (11.1%)
Gauge 8	Yes/37 (15.2%)	Yes/51 (20.9%)	Yes/49 (20.1%)	Yes/40 (16.4%)	Yes/22 (9.0%)	Yes/61 (25.1%)	Yes/26 (10.7%)
Gauge 9*						Yes/61 (25.1%)	Yes/28 (11.5%)
Gauge 10*						Yes/61 (25.1%)	Yes/28 (11.5%)

*Gauge installed May 7, 2020