Monitoring Year 3 Report
2022

Rough Horn Swamp Restoration Site
Monitoring Year – MY03
RFP #16-006310
DMS Site ID Number 97005, DMS Contract 6596
SAW-2015-00952 and NCDEQ DWR 2015-0903

Rough Horn Swamp II Restoration Site
RFP #16-007337
DMS Site ID Number 100053, DMS Contract 7514
SAW-2016-02026 and NCDEQ DWR 2015-0903

Columbus County, North Carolina

Prepared for:
NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699

Monitoring Data Collected: 2022
Date Submitted: February 2023

Monitoring and Design Firm

Prepared by:

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MEMORANDUM

Date:	February 8, 2023
To:	Emily Dunnigan, DMS Project Manager
From:	Adam Spiller, Project Manager KCI Associates of North Carolina, PA
Subject:	MY-03 Monitoring Report Comments Rough Horn Swamp DMS #97005, Contract 6596 Rough Horn Swamp II DMS #100053, Contract 7514

Please find below our responses in italics to the MY-03 Monitoring Report comments from NCDMS received on January 17, 2023, for the Rough Horn Swamp and Rough Horn Swamp II Restoration Sites.

1. Monitoring Results Vegetation Monitoring: Vegetation data was collected on June 22nd. Per the mitigation plan vegetation data is to be collected between July 1st and leaf drop. Keep that in mind for future monitoring years.
   KCI Response: This has been noted for future monitoring years.

2. Monitoring Results Vegetation Monitoring: Vegetation success criteria states a single species may not account for more than 50% of the required stems within any plot. Many of the vegetation plots have greater than 50% of a single species. Provide explanation for why single species are so high in certain plots across the site.
   KCI Response: Of the 41 vegetation monitoring plots, 20 of them have a single species that accounts for more than 50% of the stems. When removing the stems above 50% of the total from the density calculations, 6 plots are below 260 stems/acre. These plots are 8, 11, 16, 17, 19, and 25. With the exception of Plot 16, these plots are all located in some of the wettest areas of the site. The extended periods of saturation in these areas creates an environment that is very inhospitable to all but the most hydrophytic woody stems, as demonstrated by the fact that Bald Cypress is the dominant species in 5 of the 6 plots. Despite these prolonged periods of saturation, the entire site is well vegetated with a diverse mix of both woody and herbaceous vegetation. During MY03 vegetation monitoring, 17 total woody species were recorded, and 24 woody species have been counted across all monitoring years. KCI does not believe that these few areas of lower species diversity represent a problem for the site but rather are part of the site's natural mosaic.

3. Monitoring Results Stream Monitoring: It's surprising that the gauge and camera on UT3-2 did not capture a single day of flow. Especially considering the drainage area for UT3 is larger than UT1 and UT4, and they met flow requirements. Did the gauge or camera malfunction during year 3? Consider checking the measurements for the flow gauge on UT3-2 to ensure stream stage elevations are correct.
   KCI Response: The flow camera and gauge on UT3 recorded data from January through October 2022 and did not malfunction during this period. Although it has a larger drainage area than some of the other tributaries on site, UT3's hydrology is much more rainfall driven than the other tributaries. The unusually low amount of rainfall that the site received in 2022 is responsible for the lack of flow on this reach.

4. CCPV: Missing random plot 1, please update.
   KCI Response: This has been corrected.

5. CCPV: Please color code flow gauge(s) that are not meeting flow criteria.
   KCI Response: This change has been made.

6. Appendix C Table 5: There are a lot of red maple and sweetgum in some of the plots. How are volunteer stems being counted? DMS suggests only counting volunteer stems taller than 1 foot as many of the smaller stems will likely not survive from competition.
   KCI Response: Woody stems smaller than 1 foot are not included in volunteer stem counts. KCI is planning a treatment of areas of dense sweetgum and red maple in 2023.

7. Appendix C Table 5: DMS suggests providing an additional table that summarizes plot data with only those stems (planted and volunteers) that can count toward success criteria in future reports.
   KCI Response: Currently no volunteers are being counted towards the success criteria and all calculations of success are taken from the "Planted" columns of Table 5. Beginning in MY05, KCI will record the x, y coordinates of volunteer species that display enough vigor to be likely to survive into future monitoring years and are of appropriate species to count towards success criteria.

8. Appendix E Flow Gauge Graphs: Please use consistent labeling for the graph titles. T1 should be UT1, T2 should be UT2-2 etc.
   KCI Response: This change has been made.

9. Appendices: Include tables of performance for all headwater streams.
   KCI Response: These tables have been added to the report.

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

Sincerely,

Adam Spiller
Project Manager

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PROJECT SUMMARY

The Rough Horn Swamp Restoration Site (RHS) was completed in March 2020 and restored 20.267 acres of riparian wetlands and 11.873 of non-riparian wetlands. Additionally, 2,132 linear feet of stream (non-credited) was restored at RHS as part of restoring the hydrology of the riparian wetlands. The site is generating 20.267 riparian wetland mitigation credits, and 11.873 non-riparian wetland mitigation credits. The Rough Horn II Wetland Restoration Site (RHSII) is located immediately upstream of RHS (to the north and east) and was also completed in March 2020. RHSII restored 17.079 acres, enhanced 5.956 acres, and preserved 15.319 acres of riparian wetlands. The site also restored 1.619 acres of non-riparian wetlands (non-credited). Additionally, RHSII restored 4,446 linear feet, enhanced 164 linear feet, and preserved 516 linear feet of stream. The site is generating 20.993 riparian wetland mitigation credits and 4,564 stream mitigation credits.

RHS and RHSII are warm, riparian and non-riparian systems in the Lumber River Basin (03040203 8-digit HUC) in Columbus County, North Carolina, that were historically modified to maximize agricultural production. The completed project aims to restore an integrated stream/wetland ecosystem that will buffer and support the Long Bay Creek/Lumber River corridor.

The RHS is protected by a 34.5-acre permanent conservation easement, while RHSII is protected by a 62.3-acre permanent conservation easement, both held by the North Carolina State Property Office. Both sites are located near the Town of Evergreen in the west-central portion of Columbus County, NC. Specifically, the site is located just southwest of the intersection of Old Boardman Road and CCC Road.

The Lumber River Basin Restoration Priorities state the goals for the RHS and RHSII's 14-digit HUC are to protect and improve water quality throughout the Basin by reducing sediment and nutrient inputs into streams and rivers and to support efforts to restore local watersheds (NCDENR EEP, 2008). The project goals for RHS and RHSII are in line with the basin priorities and include the following:

- Replace buffer
- Repairing channelized streams
- Preserving existing resources

Additional goals for the project include:

- Restore an integrated wetland/stream system
- Reduce nutrient impacts to the Lumber River and its tributaries from existing and adjacent agricultural practices

The project goals will be addressed through the following objectives:

- Plant the site with native trees and shrubs that support the development of wetland communities
- Fill field ditches to slow the flow of surface and subsurface drainage
- Relocate channelized streams to their historic landscape position
- Convert existing agricultural land to wetland and stream buffer

Project planting and construction were completed in March 2020 and the monitoring components were installed at the same time.

To determine the success of the planted mitigation areas, 41 ten meter by ten meter vegetation monitoring plots were established. Of these, 25 are permanent plots, with 16 in RHS (Plots 1-16) and 9 in RHSII (Plots 17-25), and an additional 16 temporary plots were randomly placed and measured throughout RHS (R1-R16). These plots will be repeated throughout the course of monitoring, but at different locations each year. All permanent plots were installed with flagged metal conduit at each corner and a PVC pipe was installed

at the origin corner. In each of the permanent plots, the plant's height, species, location, and origin (planted versus volunteer) will be noted. In the random plots, species and height will be recorded. In all plots, invasive stems will also be recorded to determine the percentage of invasive stems present. Additionally, a photograph will be taken of each plot. The site's vegetation will be monitored in years 1, 2, 3, 5, and 7.

Vegetative success criteria for wetland/stream mitigation is a woody stem density of 260 stems/acre after five years and 210 stems/acre after seven years. Trees in each plot must average 7 feet in height at Year 5 and 10 feet at Year 7. A single species may not account for more than 50% of the required number of stems within any plot. Volunteers must be present for a minimum of two growing seasons before being included in performance standards in Year 5 and Year 7. For any volunteer tree stem to count toward vegetative success, it must be a species from the approved planting list. Visual assessments will also be used to identify problem areas.

Wetland hydrology is monitored with a series of 21 automatic gauges that record water table depth. The growing season for the project monitoring period will be March 1st through November 20th (265 days) based on correspondence with the USACE, as described in the approved Mitigation Plan. To meet the success criterion, the upper 12 inches of the soil profile must have continuously saturated or inundated conditions for at least 12.0% (32 days) of the growing season in the wetland mitigation areas during normal weather conditions. A "normal" year will be based on NRCS climatological data for Columbus County, and 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 USACE's Antecedent Precipitation Tool (APT) will also be used to place the overall rainfall totals into context.

In the headwater stream area, five pressure transducer gauges and five cameras, set to record a short video once a day, will document the presence of surface water flow. These gauges/cameras are located on Long Bay Creek, UT1, UT2-2, UT3-2, and UT4 (one gauge and camera, per reach). The project streams must meet the requirements for headwater stream hydrologic monitoring per the NCIRT 2016 guidelines. Each stream must have continuous surface water flow within a flowpath for a minimum of 30 continuous days within a calendar year (assuming normal precipitation) and for every year of monitoring. The stream must show signs of supporting flowpaths in all monitoring years. These indicators will be documented with pictures and may include evidence of: scour, sediment deposition and sorting, multiple flow events, wrack lines, flow over vegetation, leaf litter, matted vegetation, or water staining.

The site's geomorphology is monitored per the NCIRT's 2016 guidance for headwater streams. Adjustment and lateral movement following construction are anticipated for these headwater stream systems. In monitoring years one through four the streams will be monitored for specific signs of concentrated flow. This could include linear scour, areas of flow that are deeper than adjacent flow, preferential paths through the wetland that are developing, and signs of continuous flow as documented by a field camera. As the site progresses to years five through seven, there should be signs of developing bed and banks throughout the site. These may not always be continuous, but evidence of an ordinary high water mark should be developing. Three cross-sections were installed during MY-01 to monitor the sites' geomorphology and the development of areas of concentrated flow. All three of these cross-sections are located along Long Bay Creek, with XS1 located in RHSII and XS2 and XS3 located in RHS

MONITORING RESULTS

Vegetation Monitoring

Monitoring Year 3 vegetation data collection was completed on June 22, 2022. All 41 vegetation monitoring plots had greater than 364 stems/acre. Overall the site had an average of 727 planted stems/acre. There are several areas of dense sweetgum and red maple located on site. In some of these areas, the sweetgum and

red maple are mostly small seedlings, which do not threaten the much larger planted stems. In the area around the western boundary of RHSII, where it borders the farm fields, however, the red maple and sweetgum have outpaced the planted stems and are between 5 and 10 feet tall. A portion of the non-desireable stems in this area were treated by mechanical cutting and spraying on August 18, 2022. KCI is planning a more extensive removal effort for spring 2023. Overall the site is well vegetated with extensive herbaceous coverage and many diverse volunteer woody species.

Stream Monitoring

The Monitoring Year 3 cross-section survey found the stream stable and functioning as designed. Because the project streams are part of a headwater system with multiple flow paths, traditional cross-sections measurements such as cross-sectional area, bank height ratio, and entrenchment ratio cannot be calculated. These cross-sections were set to span the entire 100 foot width of the stream valley to monitor where and how the water is flowing through this valley. All three cross-sections showed evidence of the development of multiple flow paths. XS3, because of its proximity to the culvert under CCC Rd. showed the most evidence of having a single flow path, but even this cross-section demonstrated multiple flow paths. XS1 has shown some aggradation over the course of monitoring. While this would present a potential cause for concern in a traditional stream restoration project, this aggradation has helped to spread the flow of water outside of the main channel and has contributed to the development of multiple flow paths throughout the stream valley.

Four of the five stream flow monitoring gauges recorded greater than 30 days of continuous flow during 2022. The gauge on LBC recorded a maximum of 124 consecutive days of flow, while the gauges on T1, T2-2, and T4 recorded 118, 113, and 90 days, respectively. The stream flow gauge on T3-2 did not record any days of flow in 2022. The data from the gauges was further backed up by the cameras. The camera on LBC recorded flow for 125 consecutive days, while the cameras on T2 and T4 showed continuous flow for 127 and 89 days, respectively. The camera on T1 malfunction in the beginning of the year, during the period when the gauge showed the stream flowing, and was obscured by vegetation for most of the time that it did record. The camera on T3 did not show any flow during 2022. Differences between the maximum consecutive days recorded by the cameras and the gauges are mainly due to times when vegetation obscured the cameras.

Hydrology Monitoring

During 2022, the month of June experienced above average rainfall. The months of February, March, May, and October experienced below average rainfall and the months of January, April, July, August, September, and November experienced average rainfall. Overall the site experienced slightly below average rainfall during the 2022 growing season. See below for a more detailed analysis of the 2022 rainfall using the APT.

Eight out of the thirteen gauges at Rough Horn Swamp, and four out of the eight gauges at Rough Horn Swamp II achieved the success criteria of having continuously saturated or inundated conditions for at least 12.0% (32 days) of the growing season. These lower than normal rates of gauge success are largely due to the low rainfall that the site received in 2022, especially at the start of the growing season. Generally the water table is at its peak in the first three months of the growing season, before evapotranspiration rates have reached their peak later in the summer. According to APT, the area that the site is located in was experiencing much drier than normal conditions from February 15 until April 6. The site was than within normal conditions until May 6, at which point it experienced drier than normal conditions until June 4. These excessively dry periods at the very start of the growing season, combined with the low overall rainfall totals are largely responsible for the low rates of gauge success and the lack of flow on T3-2 in 2022.

REFERENCES

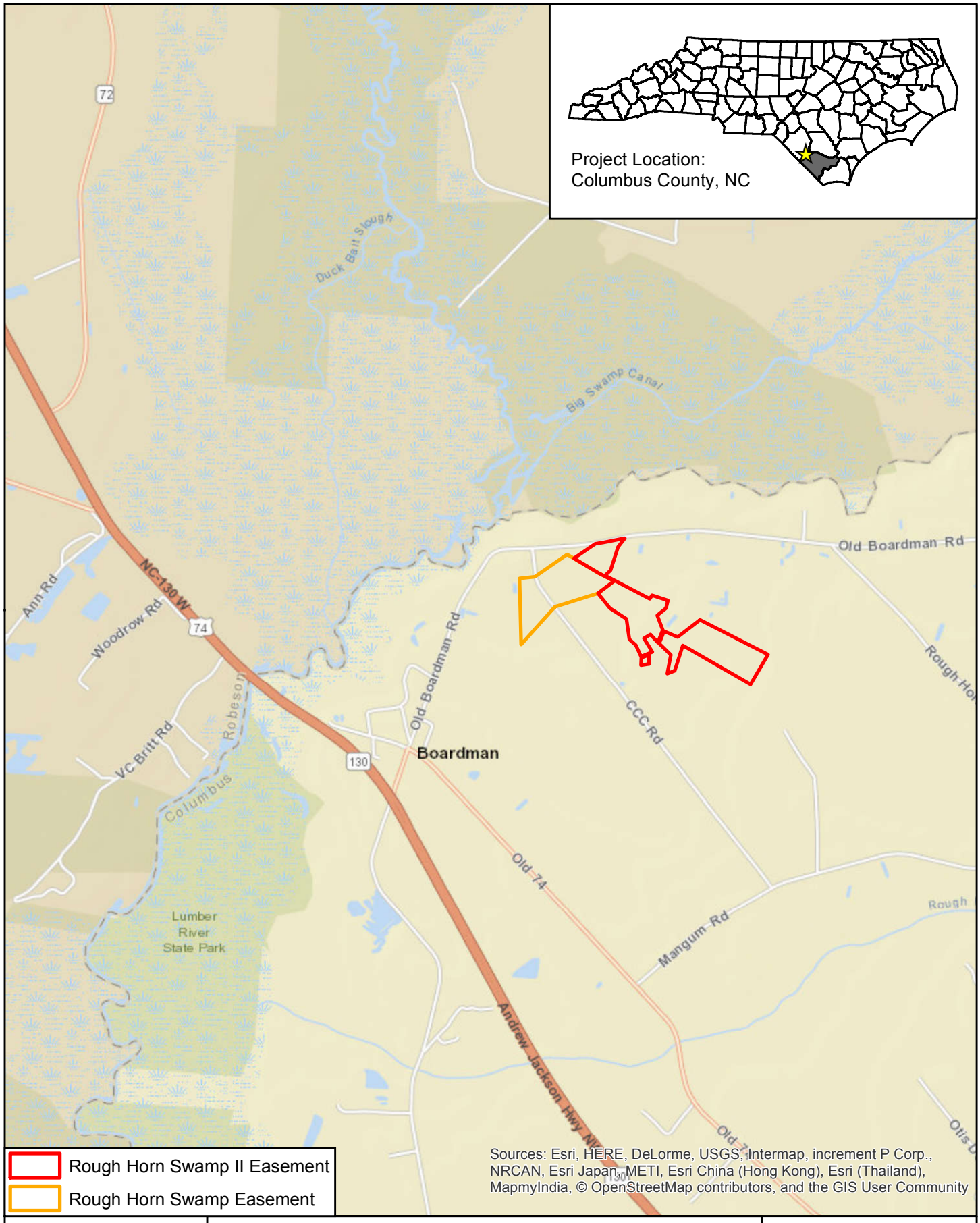
NCDEQ, Division of Mitigation Services. June 2017. "As-built Baseline Monitoring Report Format, Data and Content Requirement." https://files.nc.gov/ncdeq/Mitigation%20Services/Document%20Management%20Library/Guidance%20and%20Template%20Documents/6_AB_Baseline__Rep_Templ_June%202017.pdf

NCDENR, Ecosystem Enhancement Program. 2008. "Lumber River Restoration Priorities 2008." https://files.nc.gov/ncdeq/Mitigation%20Services/Watershed_Planning/Lumber_River_Basin/Lumber_RBRP_2008_FINAL.pdf

NCIRT. October 24, 2016. "Wilmington District Stream and Wetland Compensatory Mitigation Update." https://saw-reg.usace.army.mil/PN/2016/Wilmington-District-Mitigation-Update.pdf

USACE, Sprecher, S. W.; Warne, A. G. 2000. "Accessing and Using Meteorological Data to Evaluate Wetland Hydrology." https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/ADA378910.xhtml

USACE, Deters, J. C. 2021. "Antecedent Precipitation Tool." https://github.com/jDeters-USACE/Antecedent-Precipitation-Tool/releases/tag/v1.0.19



PROJECT VICINITY MAP
ROUGH HORN SWAMP RESTORATION SITE &
ROUGH HORN SWAMP II RESTORATION SITE
COLUMBUS COUNTY, NC

APPENDIX A

Background Tables

Table 1. Mitigation Assets and Components
Rough Horn Swamp Restoration Site
DMS Project #97005

Project Segment	Existing Footage or Acreage	Mitigation Plan Footage or Acreage	Mitigation Category	Restoration Level	Priority Level	Mitigation Ratio (X:1)	As-built Footage or Acreage	Comments
Long Bay Creek	3,470	1,959	Warm	Restoration	Low Energy Stream	0	1,959	60' ROW over CCC Rd.; completed for no stream credit
UT1	4	233	Warm	Restoration	Low Energy Stream	0	233	Completed for no stream credit
Riparian Wetland	None (drained wetland)	20.267	Riverine Riparian	Restoration (Re-establishment)		1	20.267	
Non-Riparian Wetland	0.16	11.873	Riverine Non-riparian	Restoration (Re-establishment)		1	11.873	

Project Credits

Restoration Level	Steam			Riparian Wetland		Non-riparian Wetland	Coastal Marsh
	Warm	Cool	Cold	Riverine	Non-riverine		
Restoration	2,132 (not credited)						
Re-establishment				20.267		11.873	
Rehabilitation							
Enhancement							
Enhancement I							
Enhancement II							
Creation							
Preservation							
Total				**20.267**		**11.873**	

Table 1. Mitigation Assets and Components
Rough Horn Swamp II Restoration Site
DMS Project #100053

Project Segment	Existing Footage or Acreage	Mitigation Plan Footage or Acreage	Mitigation Category	Restoration Level	Priority Level	Mitigation Ratio (X:1)	As-built Footage or Acreage	Comments
Long Bay Creek	2,077	2,049	Warm	Restoration	Low Energy Stream	1	2,049	30' crossing exception STA 14+66 to 14+96; 153'non-credited stream
UT1	815	917	Warm	Restoration	Headwater Stream	1	917	
UT2-1	516	516	Warm	Preservation	Headwater Stream	10	516	
UT2-2	120	120	Warm	Restoration	Headwater Stream	1	120	
UT3-1	168	164	Warm	Enhancement II	Headwater Stream	2.5	164	31' crossing exception STA 301+64 to 301+95
UT3-2	571	914	Warm	Restoration	Headwater Stream	1	914	
UT4	447	629	Warm	Restoration	Headwater Stream	1	629	
Riparian Wetland Restoration	None (drained wetland)	17.079	Riverine Riparian	Restoration (Re-establishment)		1	17.079	
Riparian Wetland Enhancement	7.900	5.956	Riverine Riparian	Enhancement		2.5	5.956	
Riparian Wetland Preservation	16.700	15.319	Riverine Riparian	Preservation		10	15.319	
Non-riparian Wetland Restoration	None (drained wetland)	1.619	Riverine Non-riparian	Restoration (Re-establishment)		0	1.619	Completed for no wetland credit

Project Credits

Restoration Level	Steam			Riparian Wetland		Non-riparian Wetland	Coastal Marsh
	Warm	Cool	Cold	Riverine	Non-riverine		
Restoration	4,446.000						
Re-establishment				17.079		1.619 (not credited)	
Rehabilitation							
Enhancement				2.382			
Enhancement I							
Enhancement II	65.600						
Creation							
Preservation	51.600			1.532			
Total	**4,563.200**			**20.993**			

Table 2. Project Activity & Reporting History **Rough Horn Swamp and Rough Horn Swamp II Restoration Sites** **DMS Project #97005 and 100053**		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan		April 2, 2019
Final Design - Construction Plans		April 16, 2019
Construction		January 24, 2020
Planting		March 13, 2020
Baseline Monitoring/Report	April 2020	April 2020
Vegetation Monitoring	*March 25, 2020*	
Photo Points	*April 8, 2020*	
Year 1 Monitoring	Dec 2020	Jan 2021
Cross-section Survey	*Aug 12, 2020*	
Vegetation Monitoring	*Nov 19, 2020*	
Photo Points	*Dec 3, 2020*	
Year 2 Monitoring	Nov 2021	Dec 2021
Cross-section Survey	*June 23, 2021*	
Vegetation Monitoring	*June 23, 2021*	
Photo Points	*Sept 15, 2021*	
Sweetgum Removal		August 18, 2022
Year 3 Monitoring	Nov 2022	Dec 2022
Cross-section Survey	*August 17, 2022*	
Vegetation Monitoring	*June 22, 2022*	
Photo Points	*Nov 29, 2022*	

Table 3. Project Contacts **Rough Horn Swamp and Rough Horn II Swamp Restoration Sites** **DMS Project #97005 and 100053**	
Design Firm	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
Construction Contractor	KCI Environmental Technologies and Construction 4505 Falls of Neuse Rd. Suite 400 Raleigh, NC 27609 Contact: Mr. Adam Spiller
Planting Contractor	Shenandoah Habitats 1983 Jefferson Highway Waynesboro, VA 22980 Contact: Mr. David Coleman Phone: (540) 941-0067
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 Attributes			
Rough Horn Swamp Restoration Site , DMS Project #97005			
Project Name	Rough Horn Swamp Restoration Site		
County	Columbus County		
Project Area (acres)	34.5 acres		
Project Coordinates (lat. and long.)	34.4481°, -78.9390°		
Project Watershed Summary Information			
Physiographic Province	Coastal Plain		
River Basin	Lumber		
USGS Hydrologic Unit 8-digit	03040203	**USGS Hydrologic Unit 14-digit**	03040203190010
DWQ Sub-basin	03-07-53		
Project Drainage Area (acres)	1,800 acres		
Project Drainage Area Percentage of Impervious Area	1%		
CGIA Land Use Classification	Agricultural Land, Forestland		
Reach Summery Information			
Parameters	**Long Bay Creek**		
Length of reach (linear feet)	3,702		
Valley classification	Type X		
Drainage area (acres)	1,800 acres		
NCDWQ Water Quality Classification	C (Aquatic Life, Secondary Recreation); Sw (Swamp Waters)		
Morphological Description (stream type)	N/A (Ditched Channel)		
Evolutionary trend	Channelized, Stage III		
Mapped Soil Series	Johnston		
Drainage class	Very poorly drained		
Soil Hydric status	Hydric A/D		
Slope	0%		
FEMA classification	Zone X		
Existing vegetation community	Row crops		
Wetland Summary Information (Post Restoration)			
Parameters			
Size of Wetland (acres)	0.16 (W3)		
Wetland Type	Headwater Forest		
Mapped Soil Series	Torhunta		
Drainage class	Very poorly drained		
Soil Hydric Status	Hydric A/D		
Source of Hydrology	Groundwater		
Hydrologic Impairment	Ditching		
Existing vegetation community	Row crops		
Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting**
Waters of the United States – Section 404	Yes	Yes	Jurisdictional Determination
Waters of the United States – Section 401	Yes	Yes	Jurisdictional Determination
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	Yes	Yes	FEMA Floodplain Checklist
Essential Fisheries Habitat**	No	N/A	N/A

Table 4. Project Attributes						
Rough Horn Swamp II Restoration Site, DMS Project #100053						
Project Name	Rough Horn Swamp II Restoration Site					
County	Columbus County					
Project Area (acres)	62.3 acres					
Project Coordinates (lat.	34.445253° , -81.937000°					
Project Watershed Summary Information						
Physiographic Province	Coastal Plain					
River Basin	Lumber					
USGS Hydrologic Unit 8-digit	03040203	**USGS Hydrologic Unit 14-digit**	03040203190010			
DWQ Sub-basin	03-07-53					
Project Drainage Area (acres)	1,684 acres (1,638 ac Long Bag Creek + 46 ac UT 1)					
Project Drainage Area Percentage of Impervious Area	1%					
CGIA Land Use Classification	Agricultural Land, Forestland					
Reach Summery Information						
Parameters	**Long Bay Creek**	**UT1**	**UT2**	**UT3**	**UT4**	**UT5**
Length of reach (lf)	2,077 (RHSII)	811 (RHSII)	636	739	447	597
Valley classification	Type X	Type X	Type X	Type X	Type X	Type X
Drainage area (acres)	1,638 acres	46 acres	602 acres	142 acres	84 acres	120 acres
NCDWQ Water Quality Classification	C; SW	C; SW	C; SW	C; SW	C; SW	C; SW
Morphological Description (stream type)	N/A (Ditched channel)	N/A (Ditched channel)	N/A (Ditched channel)	N/A (Ditched	N/A (Ditched channel)	N/A (Ditched channel)
Evolutionary trend	Channelized	Channelized	Channelized	Channelized	Channelized	Channelized
Mapped Soil Series	Johnston	Torhunta	Johnston	Johnston	Stallings	Johnston
Drainage class	Very poorly drained	Very poorly drained	Very poorly drained	Very poorly drained	Somewhat poorly drained	Very poorly drained
Soil Hydric status	Hydric A/D	Hydric A/D	Hydric A/D	Hydric A/D	Hydric A/D	Hydric A/D
Slope	0%	0%	0%	0%	0%	0%
FEMA classification	None	None	None	None	None	None
Existing vegetation community	Headwater Forest	Row crops	Headwater Forest	Headwater Forest	Headwater Forest	Headwater Forest
Wetland Summary Information						
Parameters	**W1, W2, WA**		**WC, WD**		**WB, WE**	
Size of Wetland (acres)	4.85 acres		3.05 acres		18.92 acres	
Wetland Type	Bottomland hardwood forest		Non-tidal freshwater marsh/headwater forest		Riverine swamp forest	
Mapped Soil Series	Johnston		Johnston		Johnston	
Drainage class	Very poorly drained		Very poorly drained		Very poorly drained	
Soil Hydric Status	Non-hydric		Hydric		Hydric	
Source of Hydrology	Surface water		Stream floodplain		Stream floodplain	
Hydrologic Impairment	Ditching		Ditching		Ditching	
Existing vegetation	Headwater forest		Headwater forest		Headwater forest	
Regulatory Considerations						
Regulation		**Applicable?**	**Resolved?**	**Supporting**		
Waters of the United States – Section 404		Yes	Yes	Jurisdictional		
Waters of the United States – Section 401		Yes	Yes	Jurisdictional		
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		Yes	Yes	FEMA Floodplain Checklist		
Essential Fisheries Habitat**		No	N/A	N/A		

APPENDIX B

Visual Assessment Data

Rough Horn Swamp Easement (34.5 ac)
Rough Horn Swamp II Easement (62.3 ac)
Filled Ditches
Unaltered Ditch
Coastal Plain Stream Corridor
Photo Points
Cross-sections

Wetland Gauges

Successful
Not Successful

Stream Gauge

Successful
Not Successful

RHS - Mitigation

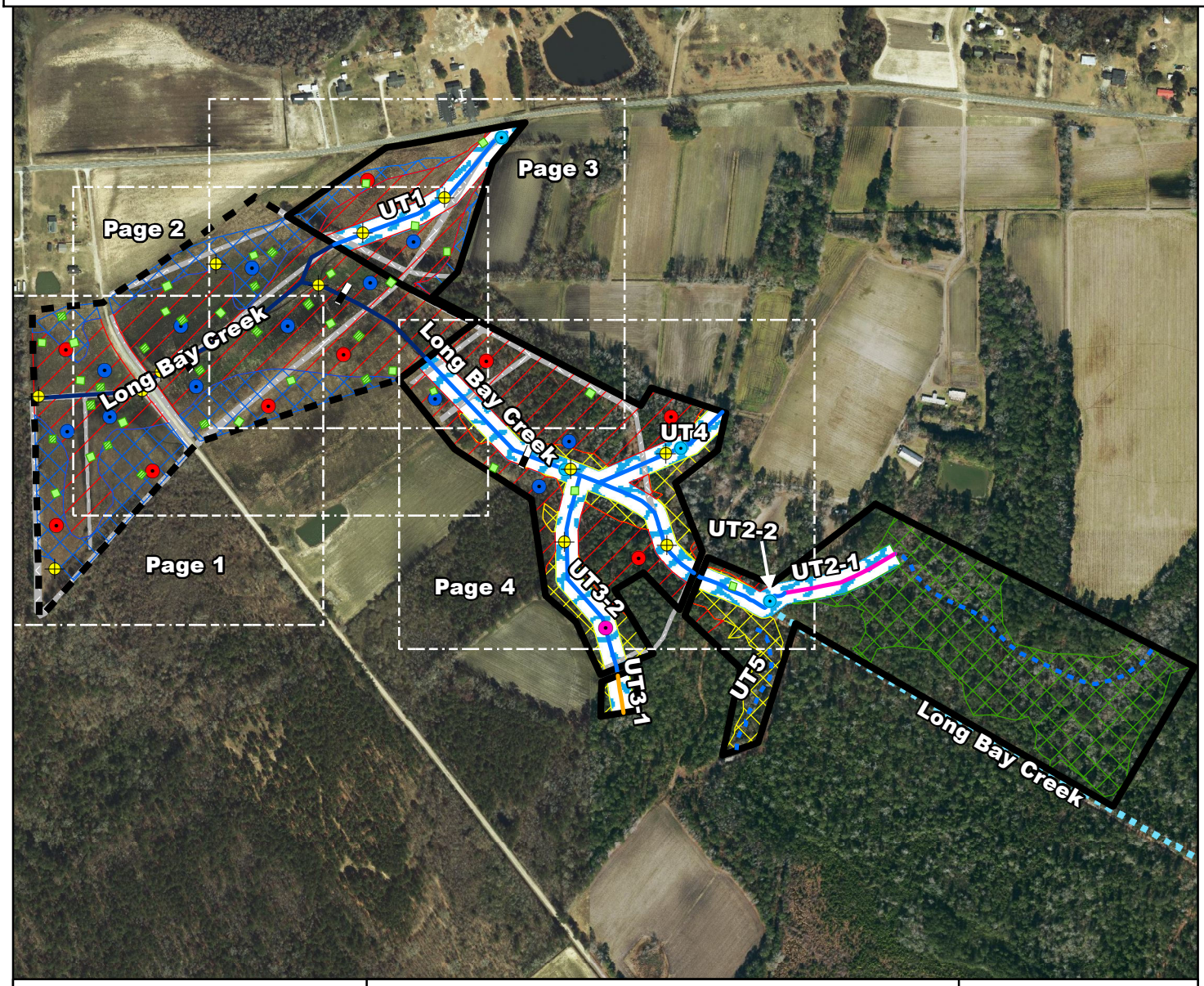
Nonriparian Re-establishment (11.873 ac / 11.873 WMCs)
Riparian Re-establishment (20.267 ac / 20.267 WMCs)
RHS - Stream Center Line (2,132 lf - No Credit)

RHSII - Mitigation

Non-Riparian Wetland Re-establishment (1.619 ac - No Credit)
Riparian Wetland Enhancement (5.956 ac / 2.382 WMCs)
Riparian Wetland Re-establishment (17.079 ac / 17.079 WMCs)
Riparian Wetland Preservation (15.319 ac / 1.532 WMCs)
No Credit
Stream Restoration (4,446 lf / 4,446 SMCs)
Stream Enhancement 2 (164 lf / 66 SMCs)
Stream Preservation (516 lf / 52 SMCs)

Vegetation Plots

Permanent, Successful
Permanent, Not Successful
Random, Successful
Random, Not Successful



0 400 800 Feet

CURRENT CONDITIONS PLANVIEW
ROUGH HORN SWAMP RESTORATION SITE &
ROUGH HORN SWAMP II RESTORATION SITE
COLUMBUS COUNTY, NC

N

Source: NC Statewide Orthoimagery, 2016 and 2017

Rough Horn Swamp Easement (34.5 ac)

Rough Horn Swamp II Easement (62.3 ac)

Filled Ditches

Cross-sections

Unaltered Ditch

Coastal Plain Stream Corridor

Photo Points

Wetland Gauges

Successful

Not Successful

Stream Gauge

Successful

Not Successful

RHS - Mitigation

Nonriparian Re-establishment (11.873 ac / 11.873 WMCs)

Riparian Re-establishment (20.267 ac / 20.267 WMCs)

RHS - Stream Center Line (2,132 lf - No Credit)

RHSII - Mitigation

Non-Riparian Wetland Re-establishment (1.619 ac - No Credit)

Riparian Wetland Enhancement (5.956 ac / 2.382 WMCs)

Riparian Wetland Re-establishment (17.079 ac / 17.079 WMCs)

Riparian Wetland Preservation (15.319 ac / 1.532 WMCs)

No Credit

Stream Restoration (4,446 lf / 4,446 SMCs)

Stream Enhancement 2 (164 lf / 66 SMCs)

Stream Preservation (516 lf / 52 SMCs)

Vegetation Plots

Permanent, Successful

Permanent, Not Successful

Random, Successful

Random, Not Successful

0 140 280 Feet

CURRENT CONDITIONS PLANVIEW
ROUGH HORN SWAMP RESTORATION SITE &
ROUGH HORN SWAMP II RESTORATION SITE
COLUMBUS COUNTY, NC

N

Source: NC Statewide Orthoimagery, 2016 and 2017

Rough Horn Swamp Easement (34.5 ac)

Rough Horn Swamp II Easement (62.3 ac)

Filled Ditches

Cross-sections

Unaltered Ditch

Coastal Plain Stream Corridor

Photo Points

Wetland Gauges

Successful

Not Successful

Stream Gauge

Successful

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Stream Preservation (516 lf / 52 SMCs)

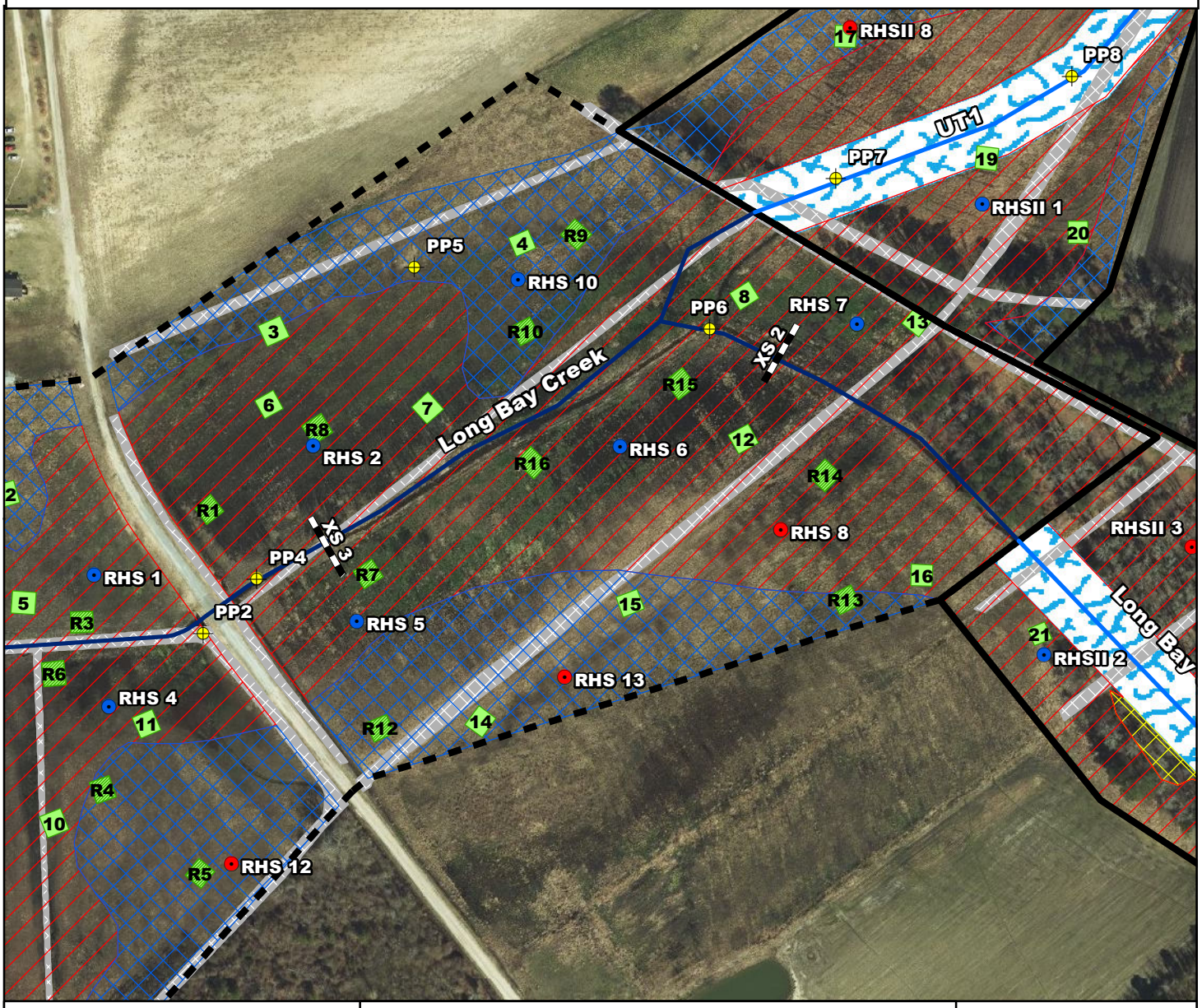
Vegetation Plots

Permanent, Successful

Permanent, Not Successful

Random, Successful

Random, Not Successful

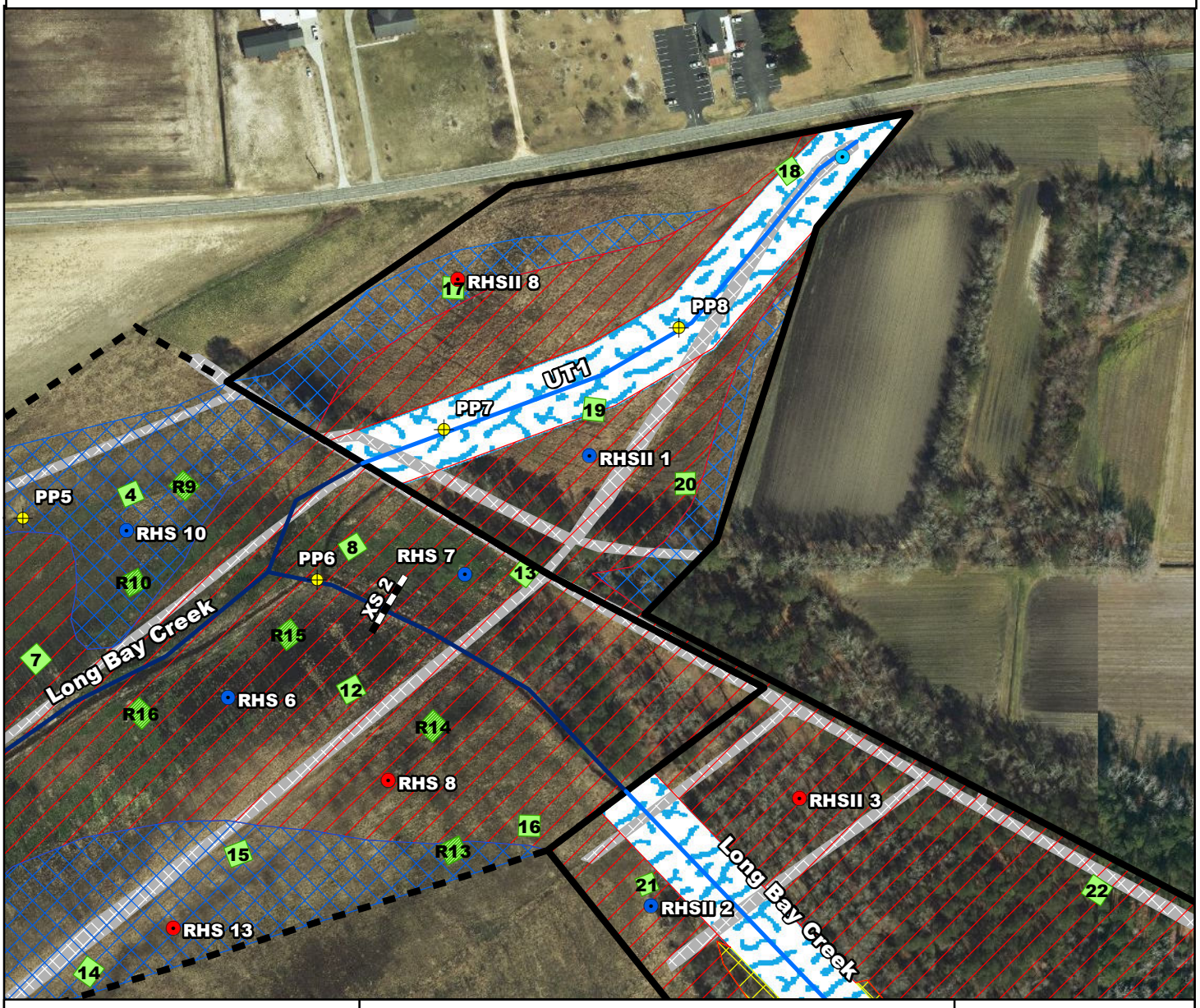


0 140 280 Feet

CURRENT CONDITIONS PLANVIEW
ROUGH HORN SWAMP RESTORATION SITE &
ROUGH HORN SWAMP II RESTORATION SITE
COLUMBUS COUNTY, NC

N

Source: NC Statewide Orthoimagery, 2016 and 2017



0 140 280 Feet

CURRENT CONDITIONS PLANVIEW
ROUGH HORN SWAMP RESTORATION SITE &
ROUGH HORN SWAMP II RESTORATION SITE
COLUMBUS COUNTY, NC

N

Source: NC Statewide Orthoimagery, 2016 and 2017

Rough Horn Swamp Easement (34.5 ac)
Rough Horn Swamp II Easement (62.3 ac)
Filled Ditches
Cross-sections
Unaltered Ditch
Coastal Plain Stream Corridor
Photo Points

Wetland Gauges
Successful
Not Successful

Stream Gauge
Successful
Not Successful

RHS - Mitigation
Nonriparian Re-establishment (11.873 ac / 11.873 WMCs)
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RHS - Stream Center Line (2,132 lf - No Credit)

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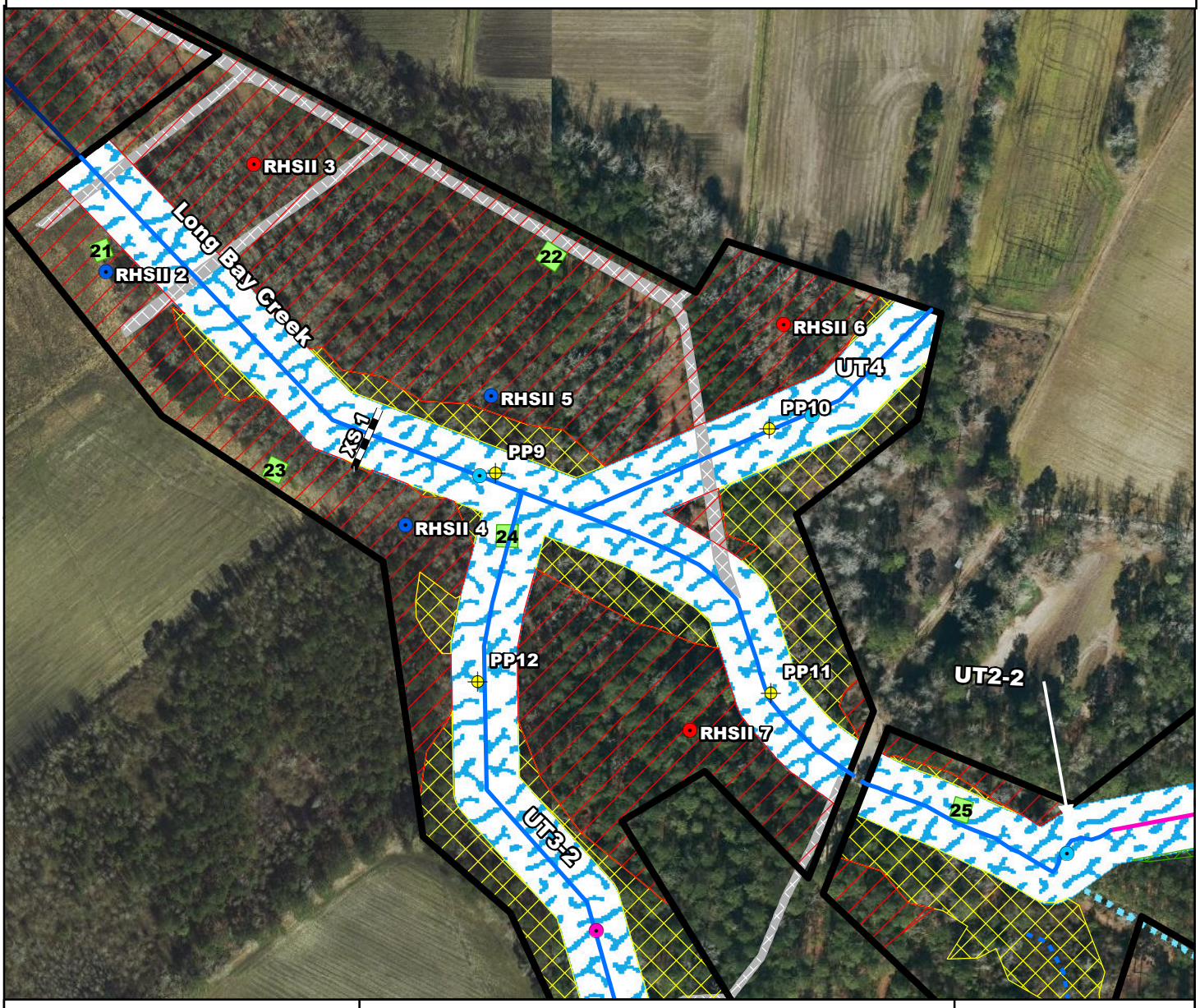
Stream Restoration (4,446 lf / 4,446 SMCs)
Stream Enhancement 2 (164 lf / 66 SMCs)
Stream Preservation (516 lf / 52 SMCs)

Vegetation Plots
Permanent, Successful
Permanent, Not Successful
Random, Successful
Random, Not Successful



0 140 280 Feet

CURRENT CONDITIONS PLANVIEW
ROUGH HORN SWAMP RESTORATION SITE &
ROUGH HORN SWAMP II RESTORATION SITE
COLUMBUS COUNTY, NC

N

Source: NC Statewide Orthoimagery, 2016 and 2017

Photo Reference Points

PP1 – MY-00 – 4/8/20

PP1 – MY-03 – 11/29/22

PP2 – MY-00 – 4/8/20

PP2 – MY-03 – 11/29/22

PP3 – MY-00 – 4/8/20

PP3 – MY-03 – 11/29/22

PP4 – MY-00 – 4/8/20

PP4 – MY-03 – 11/29/22

PP5 – MY-00 – 4/8/20

PP5 – MY-03 – 11/29/22

PP6 – MY-00 – 4/8/20

PP6 – MY-03 – 11/29/22

PP7 – MY-00 – 4/8/20

PP7 – MY-03 – 11/29/22

PP8 – MY-00 – 4/8/20

PP8 – MY-03 – 11/29/22

PP9 – MY-00 – 4/8/20

PP9 – MY-03 – 11/29/22

PP10 – MY-00 – 4/8/20

PP10 – MY-03 – 11/29/22

PP11 – MY-00 – 4/8/20

PP11 – MY-03 – 11/29/22

PP12 – MY-00 – 4/8/20

PP12 – MY-03 – 11/29/22

Vegetation Plot Photos

Vegetation Plot 1 – MY-03 – 6/16/2022

Vegetation Plot 2 – MY-03 – 6/16/2022

Vegetation Plot 3 – MY-03 – 6/22/2022

Vegetation Plot 4 – MY-03 – 6/22/2022

Vegetation Plot 5 – MY-03 – 6/16/2022

Vegetation Plot 6 – MY-03 – 6/22/2022

Vegetation Plot 7 – MY-03 – 6/22/2022

Vegetation Plot 8 – MY-03 – 6/22/2022

Vegetation Plot 9 – MY-03 – 6/16/2022

Vegetation Plot 10 – MY-03 – 6/16/2022

Vegetation Plot 11 – MY-03 – 6/16/2022

Vegetation Plot 12 – MY-03 – 6/22/2022

Vegetation Plot 13– MY-03 – 6/22/2022

Vegetation Plot 14 – MY-03 – 6/22/2022

Vegetation Plot 15 – MY-03 – 6/22/2022

Vegetation Plot 16 – MY-03 – 6/22/2022

Vegetation Plot 17 – MY-03 – 6/22/2022

Vegetation Plot 18 – MY-03 – 6/22/2022

Vegetation Plot 19 – MY-03 – 6/22/2022

Vegetation Plot 20 – MY-03 – 6/22/2022

Vegetation Plot 21 – MY-03 – 6/22/2022

Vegetation Plot 22 – MY-03 – 6/16/2022

Vegetation Plot 23 – MY-03 – 6/22/2022

Vegetation Plot 24 – MY-03 – 6/16/2022

Vegetation Plot 25 – MY-03 – 6/16/2022

Vegetation Plot R1 – MY-03 – 6/16/2022

Vegetation Plot R2 – MY-03 – 6/20/2022

Vegetation Plot R3 – MY-03 – 6/20/2022

Vegetation Plot R4 – MY-03 – 6/20/2022

Vegetation Plot R5 – MY-03 – 6/20/2022

Vegetation Plot R6 – MY-03 – 6/20/2022

Vegetation Plot R7 – MY-03 – 6/20/2022

Vegetation Plot R8 – MY-03 – 6/16/2022

Vegetation Plot R9 – MY-03 – 6/16/2022

Vegetation Plot R10 – MY-03 – 6/16/2022

Vegetation Plot R11 – MY-03 – 6/20/2022

Vegetation Plot R12 – MY-03– 6/20/2022

Vegetation Plot R13 – MY-03 – 6/20/2022

Vegetation Plot R14 – MY-03 – 6/20/2022

Vegetation Plot R15 – MY-03 – 6/20/2022

Vegetation Plot R16 – MY-03 – 6/20/2022

APPENDIX C

Vegetation Plot Data

Table 5. Stem Count by Plot and Species
Rough Horn Swamp and Rough Horn Swamp II, DMS Project #97005 and 100053

	Current Plot Data (MY03 2022)															
	Plot 01		Plot 02		Plot 03		Plot 04		Plot 05		Plot 06		Plot 07		Plot 08	
Species	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**
American Sycamore (*Platanus occidentalis*)			1	1	2	2										
Bald Cypress (*Taxodium distichum)*	13	13			3	3			7	7	8	8	13	13	20	20
Beautyberry (*Callicarpa americana*)																
Black Walnut (*Juglans nigra*)																
Black Willow (*Salix nigra*)		3		16		76		7						7		23
Boxelder (*Acer negundo*)																
Buttonbush (*Cephalanthus occidentalis*)	3	3							4	4			2	2	1	1
Eastern Baccharis (B*accharis halimifolia*)						5				2		1				
Eastern Cottonwood (*Populus deltoides*)																49
Laurel Oak (*Quercu s laurifolia*)			1	1												
Loblolly Pine (*Pinus taeda*)								5								3
Oak (*Quercus sp.)*																
Overcup Oak (*Quercus lyrata*)			1	1	1	1	1	1	1	1			1	1		
Red Chokeberry (*Aronia arbutifolia*)									1	1			1	1		
Red Maple (*Acer rubrum*)		45		4		2		2		13		68		15		11
River Birch (*Betula nigra*)	1	1	2	2	2	2	5	5	3	3	8	8				
Silky Dogwood (*Cornus amomum*)																
Southern Red Oak (*Quercus falcata*)																
Swamp Bay (*Persea palustris*)	4	4							2	2	2	2			1	1
Swamp Chestnut Oak (*Quercus michauxii*)			6	6			5	5								
Sweetgum (*Liquidambar styraciflua*)		129		53		1				66		14				19
Water Oak (*Quercus nigra*)																
Water Tupelo (*Nyssa aquatica*)					1	1					3	3	5	5		
Wax Mrytle (*Myrica cerifera*)																
Willow Oak (*Quercus phellos*)																
Unknown																
Stem count	21	198	11	84	9	93	11	25	18	99	21	104	22	44	22	127
size (ares)	1		1		1		1		1		1		1		1	
size (ACRES)	0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025	
Species count	4	7	5	8	5	9	3	6	6	9	4	7	5	7	3	8
Stems per ACRE	850	8,013	445	3,399	364	3,764	445	1,012	728	4,006	850	4,209	890	1,781	890	5,140

Table 5. Stem Count by Plot and Species
Rough Horn Swamp and Rough Horn Swamp II, DMS Project #97005 and 100053

	Current Plot Data (MY03 2022)															
	Plot 09		Plot 10		Plot 11		Plot 12		Plot 13		Plot 14		Plot 15		Plot 16	
Species	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**
American Sycamore (*Platanus occidentalis*)	1	1									2	2	3	3		
Bald Cypress (*Taxodium distichum)*	1	1	12	12	12	12	9	9	9	9			1	1	17	17
Beautyberry (*Callicarpa americana*)																
Black Walnut (*Juglans nigra*)																
Black Willow (*Salix nigra*)									2	5		2				1
Boxelder (*Acer negundo*)																
Buttonbush (*Cephalanthus occidentalis*)							2	2	1	1						
Eastern Baccharis (B*accharis halimifolia*)		4		4		2						1		2		
Eastern Cottonwood (*Populus deltoides*)																
Laurel Oak (*Quercus laurifolia*)	1	1	1	1	1	1							2	2		
Loblolly Pine (*Pinus taeda*)				4		3				2				9		31
Oak (*Quercus sp.)*																
Overcup Oak (*Quercus lyrata*)	4	4											1	1		
Red Chokeberry (*Aronia arbutifolia*)																
Red Maple (*Acer rubrum*)				4		12		1		17		21		4		20
River Birch (*Betula nigra*)	7	7	3	3	2	2	2	2	7	7	8	8	8	8	1	1
Silky Dogwood (*Cornus amomum*)																
Southern Red Oak (*Quercus falcata*)																
Swamp Bay (*Persea palustris*)			1	1											1	1
Swamp Chestnut Oak (*Quercus michauxii*)	2	2	2	2							2	2				
Sweetgum (*Liquidambar styraciflua*)		7		12		6		3		3		1		10		12
Water Oak (*Quercus nigra*)																
Water Tupelo (*Nyssa aquatica*)							1	1			1	1	2	2	1	1
Wax Mrytle (*Myrica cerifera*)																
Willow Oak (*Quercus phellos*)																
Unknown																
Stem count	16	27	19	43	15	38	14	18	19	44	13	38	17	42	20	84
size (ares)	1		1		1		1		1		1		1		1	
size (ACRES)	0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025	
Species count	6	8	5	9	3	7	4	6	4	7	4	8	6	10	4	8
Stems per ACRE	647	1,093	769	1,740	607	1,538	567	728	769	1,781	526	1,538	688	1,700	809	3,399

Table 5. Stem Count by Plot and Species
Rough Horn Swamp and Rough Horn Swamp II, DMS Project #97005 and 100053

	Current Plot Data (MY03 2022)															
	Plot 17		Plot 18		Plot 19		Plot 20		Plot 21		Plot 22		Plot 23		Plot 24	
Species	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**
American Sycamore (*Platanus occidentalis*)			3	3												
Bald Cypress (*Taxodium distichum)*					17	17	6	6	10	10	8	8	11	11	13	13
Beautyberry (*Callicarpa americana*)																
Black Walnut (*Juglans nigra*)																
Black Willow (*Salix nigra*)				85				4								
Boxelder (*Acer negundo*)																
Buttonbush (*Cephalanthus occidentalis*)					1	1							1	1	1	1
Eastern Baccharis (*Baccharis halimifolia*)								3		1						
Eastern Cottonwood (*Populus deltoides*)		5		2												
Laurel Oak (*Quercus laurifolia*)			3	3							2	2	1	1		
Loblolly Pine (*Pinus taeda*)				1				3		15		40		3		
Oak (*Quercus sp.)*																
Overcup Oak (*Quercus lyrata*)			4	4									1	1		
Red Chokeberry (*Aronia arbutifolia*)																
Red Maple (*Acer rubrum*)		7		2		14		2		76		11		83		26
River Birch (*Betula nigra*)	12	12	5	5	1	1	4	4	2	2			4	4	2	2
Silky Dogwood (*Cornus amomum*)																
Southern Red Oak (*Quercus falcata*)																
Swamp Bay (*Persea palustris*)											1	1	1	1	1	3
Swamp Chestnut Oak (*Quercus michauxii*)			2	2			1	1	1	1			2	2		
Sweetgum (*Liquidambar styraciflua*)						2		32		67		76		78		25
Water Oak (*Quercus nigra*)																
Water Tupelo (*Nyssa aquatica*)			4	4			3	3	2	2	6	6			1	3
Wax Mrytle (*Myrica cerifera*)																
Willow Oak (*Quercus phellos*)																
Unknown																
Stem count	12	24	21	111	19	35	14	58	15	174	17	144	21	185	18	73
size (ares)	1		1		1		1		1		1		1		1	
size (ACRES)	0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025	
Species count	1	3	6	10	3	5	4	9	4	8	4	7	7	10	5	7
Stems per ACRE	486	971	850	4,492	769	1,416	567	2,347	607	7,042	688	5,827	850	7,487	728	2,954

Table 5. Stem Count by Plot and Species
Rough Horn Swamp and Rough Horn Swamp II, DMS Project #97005 and 100053

	Current Plot Data (MY03 2022)															
	Plot 25		Plot R01		Plot R02		Plot R03		Plot R04		Plot R05		Plot R06		Plot R07	
Species	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**
American Sycamore (*Platanus occidentalis*)					1	1	1	1			2	2				
Bald Cypress (*Taxodium distichum)*	13	13	10	10	2	2	7	7			2	2	11	11	11	11
Beautyberry (*Callicarpa americana*)																
Black Walnut (*Juglans nigra*)																
Black Willow (*Salix nigra*)			1	1	1	1										
Boxelder (*Acer negundo*)																
Buttonbush (*Cephalanthus occidentalis*)			2	2			7	7					5	5	1	1
Eastern Baccharis (*Baccharis halimifolia*)								1		1		4				
Eastern Cottonwood (*Populus deltoides*)																
Laurel Oak (*Quercus laurifolia*)					2	2			4	4	1	1				
Loblolly Pine (*Pinus taeda*)						20				10		5		4		
Oak (*Quercus sp.)*																
Overcup Oak (*Quercus lyrata*)																
Red Chokeberry (*Aronia arbutifolia*)																
Red Maple (*Acer rubrum*)		2		8		13		19						15		10
River Birch (*Betula nigra*)			1	1	5	5	4	4	3	3	6	6	5	5	1	1
Silky Dogwood (*Cornus amomum*)																
Southern Red Oak (*Quercus falcata*)																
Swamp Bay (*Persea palustris*)		1					2	2	1	1			2	2	1	1
Swamp Chestnut Oak (*Quercus michauxii*)	1	1	1	1	6	6			3	3	1	1				
Sweetgum (*Liquidambar styraciflua*)				1		156		10						4		2
Water Oak (*Quercus nigra*)																
Water Tupelo (*Nyssa aquatica*)		2	3	3					2	2			1	1	6	6
Wax Mrytle (*Myrica cerifera*)																
Willow Oak (*Quercus phellos*)					7	7	11	11	2	2	4	4				
Unknown																
Stem count	14	19	18	27	24	213	32	62	15	26	16	25	24	47	20	32
size (ares)	1		1		1		1		1		1		1		1	
size (ACRES)	0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025	
Species count	14	19	18	27	24	213	32	62	15	26	16	25	24	47	20	32
Stems per ACRE	567	769	728	1,093	971	8,620	1,295	2,509	607	1,052	647	1,012	971	1,902	809	1,295

Table 5. Stem Count by Plot and Species
Rough Horn Swamp and Rough Horn Swamp II, DMS Project #97005 and 100053

	Current Plot Data (MY03 2022)															
	Plot R08		Plot R09		Plot R10		Plot R11		Plot R12		Plot R13		Plot R14		Plot R15	
Species	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**
American Sycamore (*Platanus occidentalis*)			6	6	4	4			4	4	4	4				
Bald Cypress (*Taxodium distichum)*	7	7									3	3	9	9	15	15
Beautyberry (*Callicarpa americana*)																
Black Walnut (*Juglans nigra*)																
Black Willow (*Salix nigra*)			1	1	3	3					3	3				
Boxelder (*Acer negundo*)																
Buttonbush (*Cephalanthus occidentalis*)	3	3													1	1
Eastern Baccharis (*Baccharis halimifolia*)								8		1		1				
Eastern Cottonwood (*Populus deltoides*)				3		2						2				
Laurel Oak (*Quercus laurifolia*)									3	3						
Loblolly Pine (*Pinus taeda*)				13				22		3		20				
Oak (*Quercus sp.)*																
Overcup Oak (*Quercus lyrata*)																
Red Chokeberry (*Aronia arbutifolia*)																
Red Maple (*Acer rubrum*)		15		32		18		31		10		41		3		1
River Birch (*Betula nigra*)	2	2	8	8	4	4	5	5	4	4	9	9	1	1	3	3
Silky Dogwood (*Cornus amomum*)																
Southern Red Oak (*Quercus falcata*)																
Swamp Bay (*Persea palustris*)	1	1									1	1	2	2	2	2
Swamp Chestnut Oak (*Quercus michauxii*)			1	1			1	1	7	7	1	1				
Sweetgum (*Liquidambar styraciflua*)		2		1		3		44		7		11		1		1
Water Oak (*Quercus nigra*)																
Water Tupelo (*Nyssa aquatica*)	1	1			3	3	4	4			6	6	4	4	3	3
Wax Mrytle (*Myrica cerifera*)																
Willow Oak (*Quercus phellos*)							4	4			6	6				
Unknown																
Stem count	14	31	16	65	14	37	14	119	18	39	33	108	16	20	24	26
size (ares)	1		1		1		1		1		1		1		1	
size (ACRES)	0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025	
Species count	5	7	4	8	4	7	4	8	4	8	8	13	4	6	5	7
Stems per ACRE	567	1,255	647	2,630	567	1,497	567	4,816	728	1,578	1,335	4,371	647	809	971	1,052

Table 5. Stem Count by Plot and Species
Rough Horn Swamp and Rough Horn Swamp II, DMS Project #97005 and 100053

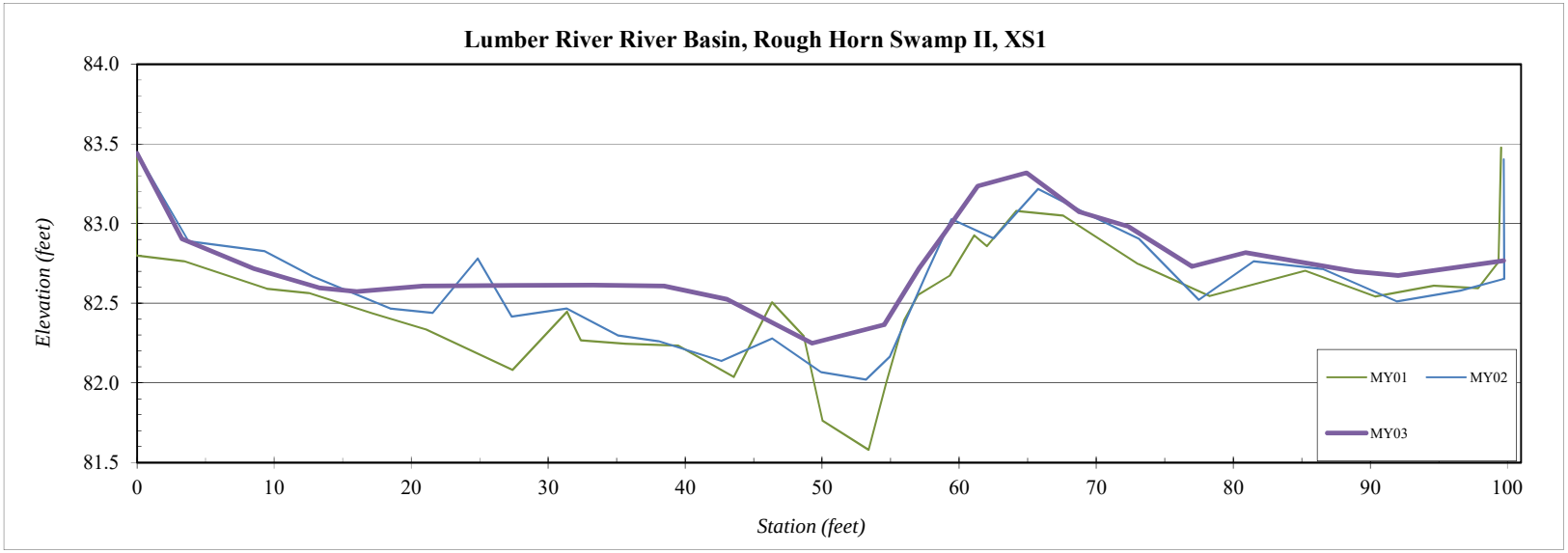
			Annual Means							
	Plot R16		MY03 (2022)		MY02 (2021)		MY01 (2020)		MY00 (2020)	
Species	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
American Sycamore (*Platanus occidentalis*)			34	34	36	36	36	36		
Bald Cypress (*Taxodium distichum)*	11	11	291	291	292	293	287	287	254	254
Beautyberry (*Callicarpa americana*)						1		1		
Black Walnut (*Juglans nigra*)						1				
Black Willow (*Salix nigra*)			11	238	49	163	82	222		1
Boxelder (*Acer negundo*)								1		
Buttonbush (*Cephalanthus occidentalis*)	1	1	36	36	37	37	33	33	2	2
Eastern Baccharis (*Baccharis halimifolia*)				41		2		1		
Eastern Cottonwood (*Populus deltoides*)				63		11		18		
Laurel Oak (*Quercus laurifolia*)			22	22	23	23	32	32	47	47
Loblolly Pine (*Pinus taeda*)				216						3
Oak (*Quercus sp.)*					1	1			221	221
Overcup Oak (*Quercus lyrata*)			15	15	23	23	42	42		
Red Chokeberry (*Aronia arbutifolia*)			2	2	3	3	3	3		
Red Maple (*Acer rubrum*)		2		680		171		242		21
River Birch (*Betula nigra*)	1	1	151	151	161	161	165	165	156	156
Silky Dogwood (*Cornus amomum*)							1	1	7	7
Southern Red Oak (*Quercus falcata*)						2		1		
Swamp Bay (*Persea palustris*)	3	3	29	32	24	32	31	37	33	33
Swamp Chestnut Oak (*Quercus michauxii*)			45	45	43	43	76	76	9	9
Sweetgum (*Liquidambar styraciflua*)				859		401		670		3
Water Oak (*Quercus nigra*)					3	3	8	8		
Water Tupelo (*Nyssa aquatica*)	4	4	67	71	63	65	54	54		
Wax Mrytle (*Myrica cerifera*)								3		
Willow Oak (*Quercus phellos*)			34	34	4	4			166	166
Unknown									166	166
Stem count	20	22	737	2830	762	1476	850	1933	1061	1089
size (ares)	1		41		41		41		41	
size (ACRES)	0.025		1.01		1.01		1.01		1.01	
Species count	5	6	12	17	14	21	13	21	10	14
Stems per ACRE	809	890	727	2,793	752	1,457	839	1,908	1,047	1,075

APPENDIX D

Stream Cross-section Data

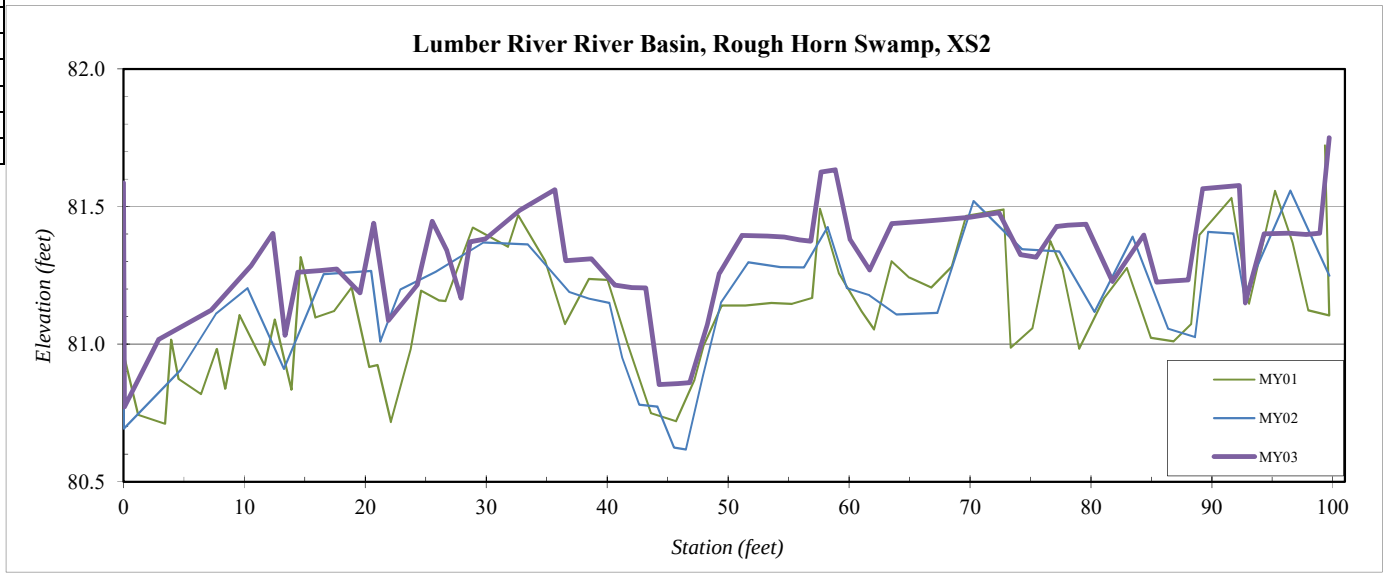
River Basin:	Lumber River
Site:	Rough Horn Swamp II
XS ID	XS1
Drainage Area (sq mi):	1.50
Date:	8/17/2022
Field Crew:	T. Seelinger, K. Bartlett

Station	Elevation
0.0	83.44
3.3	82.90
8.5	82.72
13.3	82.60
16.0	82.57
20.9	82.61
27.6	82.61
33.3	82.62
38.4	82.61
43.0	82.53
49.3	82.25
54.5	82.36
57.1	82.72
58.9	82.94
61.3	83.23
64.9	83.32
68.7	83.07
72.4	82.98
77.0	82.73
80.9	82.82
88.9	82.70
92.0	82.67
99.7	82.77
99.8	83.44



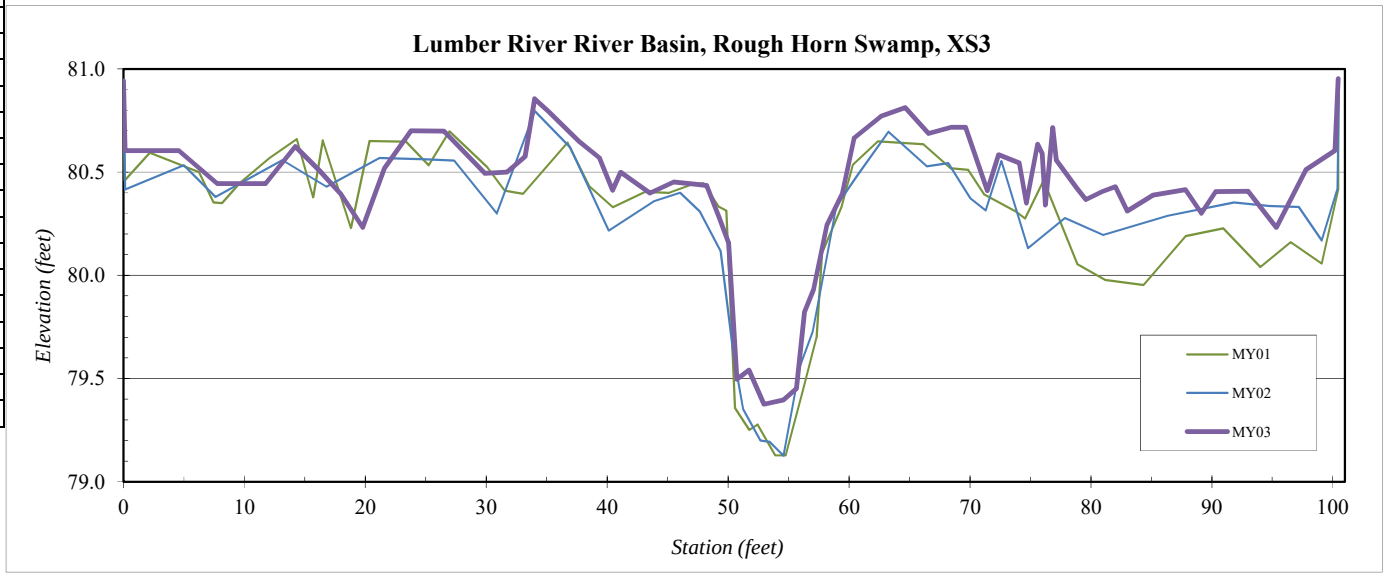
River Basin:	Lumber River
Site:	Rough Horn Swamp
XS ID	XS2
Drainage Area (sq mi):	1.60
Date:	8/17/2022
Field Crew:	T. Seelinger, K. Bartlett

Station	Elevation	Station	Elevation
0.0	81.59	72.4	81.48
0.1	80.77	74.2	81.33
2.9	81.02	75.5	81.32
7.3	81.12	77.2	81.43
10.6	81.29	78.1	81.43
12.3	81.40	79.6	81.44
13.4	81.03	81.8	81.23
14.4	81.26	84.4	81.40
16.2	81.27	85.4	81.23
17.6	81.27	86.8	81.23
19.5	81.19	88.1	81.23
20.7	81.44	89.2	81.57
21.9	81.09	92.3	81.58
24.3	81.22	92.8	81.15
25.5	81.45	94.3	81.40
26.7	81.34	96.3	81.40
27.9	81.17	97.8	81.40
28.6	81.37	98.9	81.40
29.9	81.38	99.7	81.75
32.8	81.49		
35.7	81.56		
36.6	81.30		
38.7	81.31		
40.6	81.22		
42.0	81.21		
43.2	81.21		
44.3	80.85		
45.8	80.86		
46.8	80.86		
48.3	81.07		
49.3	81.26		
51.1	81.40		
53.3	81.39		
54.6	81.39		
55.9	81.38		



River Basin:	Lumber River
Site:	Rough Horn Swamp
XS ID	XS3
Drainage Area (sq mi):	2.80
Date:	8/17/2022
Field Crew:	T. Seelinger, K. Bartlett

Station	Elevation	Station	Elevation
0.0	80.94	60.4	80.67
0.1	80.60	62.6	80.77
4.6	80.61	64.6	80.81
7.7	80.45	66.6	80.69
11.7	80.45	68.5	80.72
14.2	80.62	69.6	80.72
16.2	80.51	71.4	80.41
18.0	80.39	72.4	80.59
19.8	80.23	74.1	80.54
21.6	80.52	74.7	80.35
23.8	80.70	75.6	80.64
26.5	80.70	76.0	80.59
29.9	80.49	76.2	80.34
31.7	80.50	76.8	80.72
33.2	80.58	77.1	80.56
34.0	80.86	78.8	80.43
35.1	80.80	79.6	80.37
37.7	80.65	80.9	80.41
39.4	80.57	82.0	80.43
40.5	80.41	83.0	80.31
41.1	80.50	85.2	80.39
43.5	80.40	87.8	80.42
45.5	80.45	89.1	80.30
47.3	80.44	90.3	80.41
48.2	80.44	93.0	80.41
49.3	80.28	95.3	80.23
50.0	80.16	97.8	80.51
50.7	79.50	100.2	80.60
51.7	79.54	100.5	80.95
53.0	79.38		
54.6	79.40		
55.6	79.45		
56.3	79.82		
57.1	79.93		
58.2	80.25		
59.5	80.40		



APPENDIX E

Hydrologic Data

Rough Horn Swamp Restoration Site
30-70 Percentile Graph
WETS Station Name: Whiteville 7

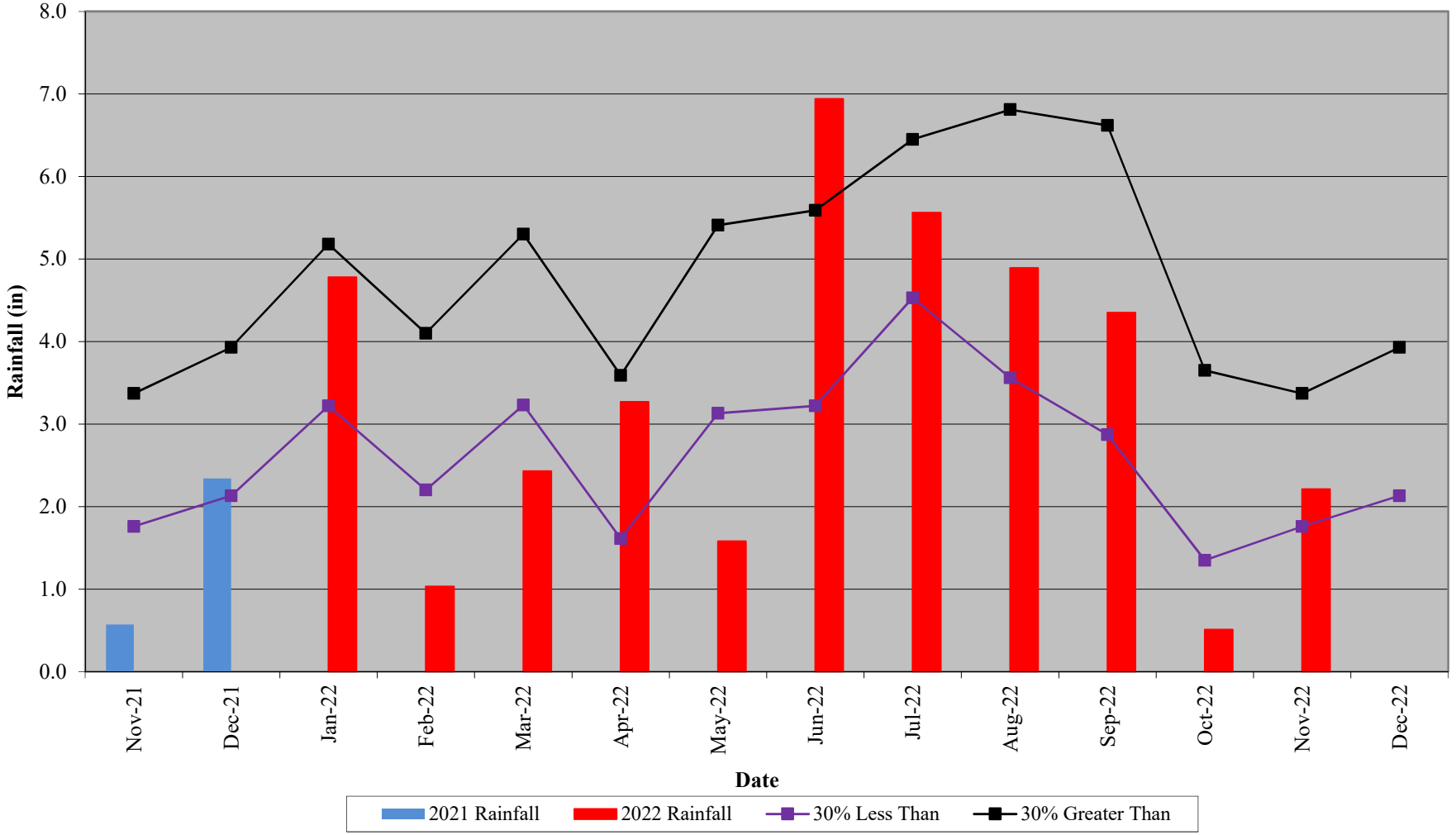


Table 6. Stream Flow Verification Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053				
	Gauge		Camera	
Reach	Dates Achieving	Maximum Consecutive Days	Dates Achieving	Maximum Consecutive Days
LBC	January 1 – May 4	124	January 1 – May 5	125
UT1	January 1 – April 28	118	Camera Malfunction	N/A
UT2-2	January 2 – April 24	113	January 1 – May 7	127
UT3-2	N/A	0	N/A	0
UT4	January 2 – April 1	90	January 3 – April 1	89

Table 7. Stream Flow Criteria Attainment Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
	Greater than 30 Days of Flow/Max Consecutive Days						
Reach	MY-01 2020	MY-02 2021	MY-03 2022	MY-04 2023	MY-05 2024	MY-06 2025	MY-07 2026
LBC (Gauge)	Yes/277	Yes/152	Yes/124				
LBC (Camera)	Yes/179	Yes/64	Yes/125				
UT1 (Gauge)	Yes/71	Yes/139	Yes/118				
UT1 (Camera)	Yes/71	Yes/136	N/A				
UT2-2 (Gauge)	Yes/71	Yes/112	Yes/113				
UT2-2 (Camera)	Yes/71	Yes/152	Yes/127				
UT3-2 (Gauge)	Yes/71	Yes/98	No/0				
UT3-2 (Camera)	Yes/78	Yes/93	No/0				
UT4 (Gauge)	Yes/71	Yes/108	Yes/90				
UT4 (Camera)	Yes/71	Yes/107	Yes/89				

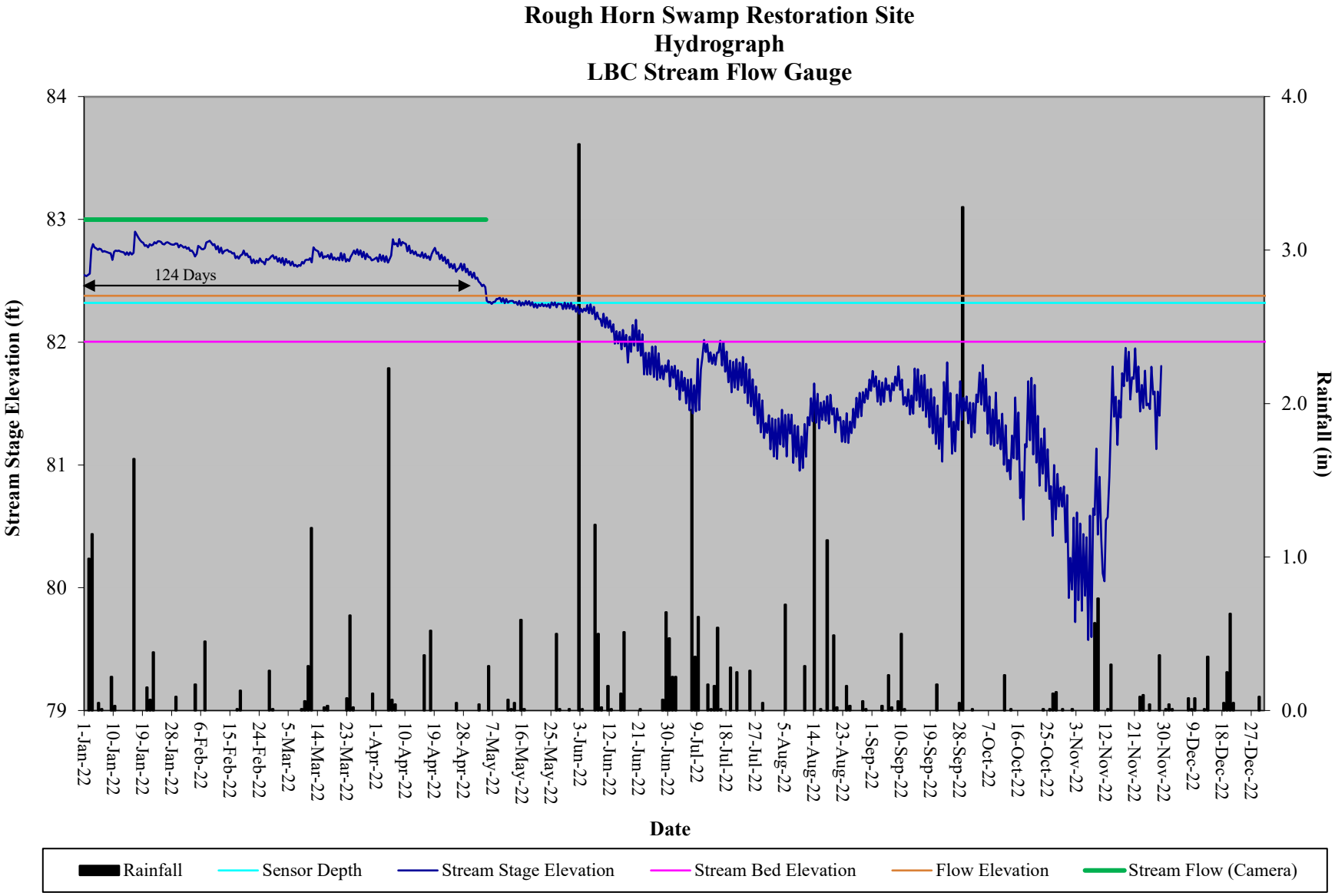
Table 8. Evidence of Channel Development Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
LBC	MY01 (2020)	MY02 (2021)	MY03 (2023)	MY04 (2024)	MY05 (2025)	MY06 (2026)	MY07 (2027)
Max consecutive days channel flow	277	152	124				
Presence of litter and debris (wracking)	Yes	Yes	Yes				
Leaf litter disturbed or washed away	Yes	Yes	Yes				
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes				
Sediment deposition and/or scour indicating sediment transport	No	No	No				
Water staining due to continual presence of water	Yes	Yes	Yes				
Formation of channel bed and banks	No	No	No				
Sediment sorting within the primary path of flow	Yes	Yes	Yes				
Sediment shelving or a natural line impressed on the banks	No	No	No				
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes				
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes				
Exposure of woody plant roots within the primary path of flow	Yes	Yes	Yes				
Other							

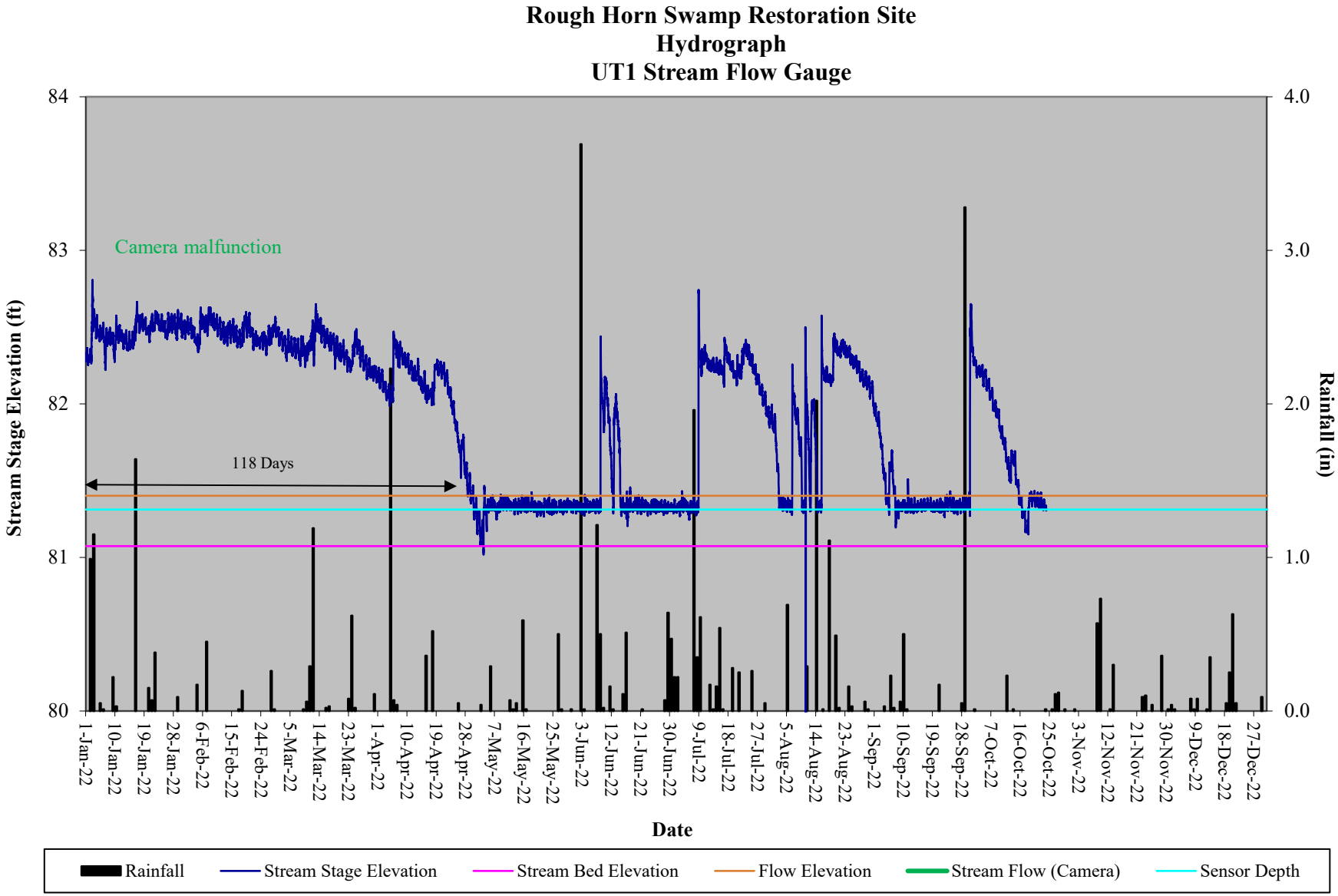
Table 8. Evidence of Channel Development Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
UT1	MY01 (2020)	MY02 (2021)	MY03 (2023)	MY04 (2024)	MY05 (2025)	MY06 (2026)	MY07 (2027)
Max consecutive days channel flow	71	139	118				
Presence of litter and debris (wracking)	No	No	No				
Leaf litter disturbed or washed away	Yes	Yes	Yes				
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes				
Sediment deposition and/or scour indicating sediment transport	No	Yes	Yes				
Water staining due to continual presence of water	Yes	Yes	Yes				
Formation of channel bed and banks	Yes	Yes	Yes				
Sediment sorting within the primary path of flow	Yes	Yes	Yes				
Sediment shelving or a natural line impressed on the banks	No	No	No				
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes				
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes				
Exposure of woody plant roots within the primary path of flow	No	No	No				
Other							

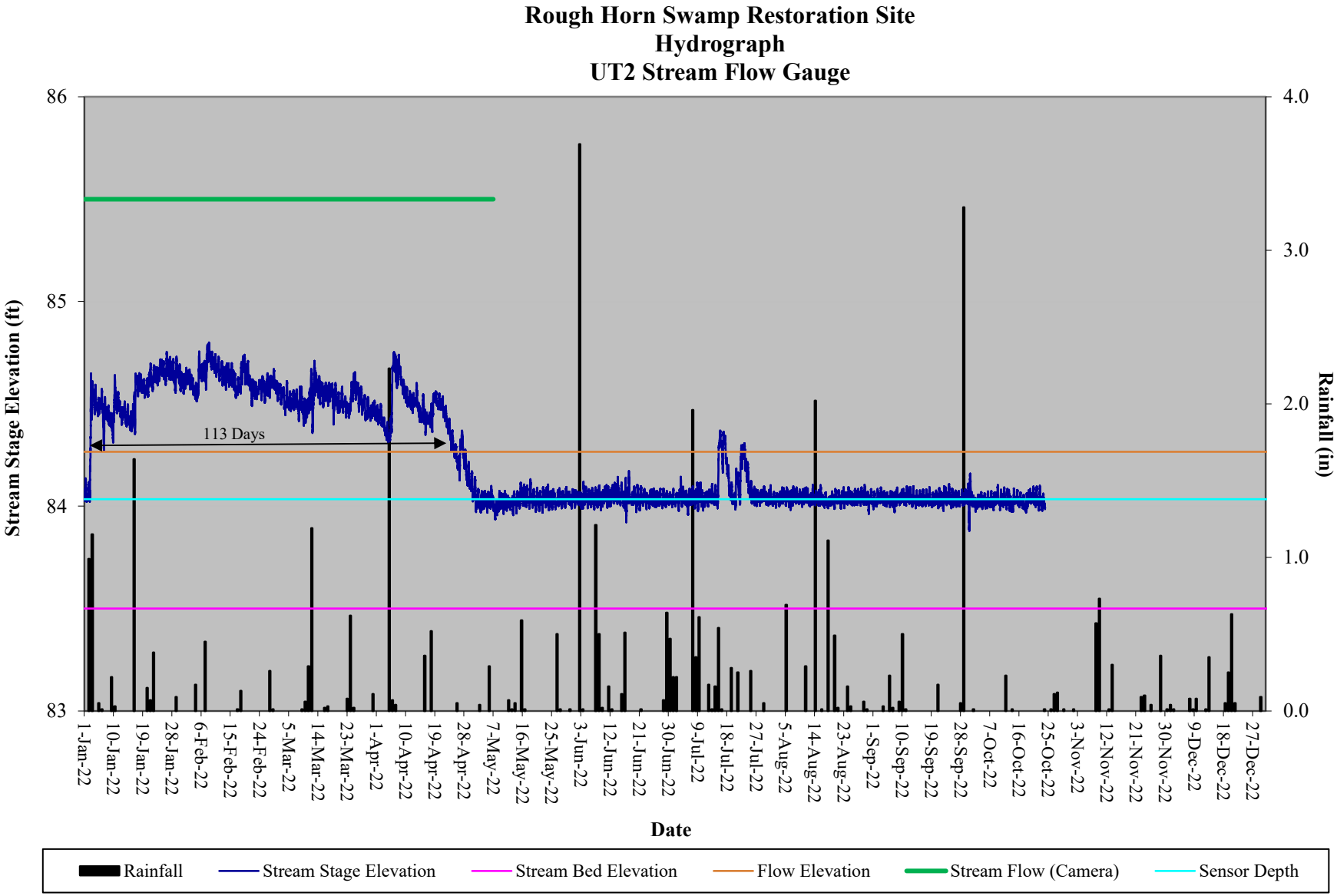
Table 8. Evidence of Channel Development Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
UT2	MY01 (2020)	MY02 (2021)	MY03 (2023)	MY04 (2024)	MY05 (2025)	MY06 (2026)	MY07 (2027)
Max consecutive days channel flow	71	112	113				
Presence of litter and debris (wracking)	Yes	Yes	Yes				
Leaf litter disturbed or washed away	Yes	Yes	Yes				
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes				
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes				
Water staining due to continual presence of water	Yes	Yes	Yes				
Formation of channel bed and banks	Yes	Yes	Yes				
Sediment sorting within the primary path of flow	Yes	Yes	Yes				
Sediment shelving or a natural line impressed on the banks	No	No	No				
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes				
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes				
Exposure of woody plant roots within the primary path of flow	No	No	No				
Other							

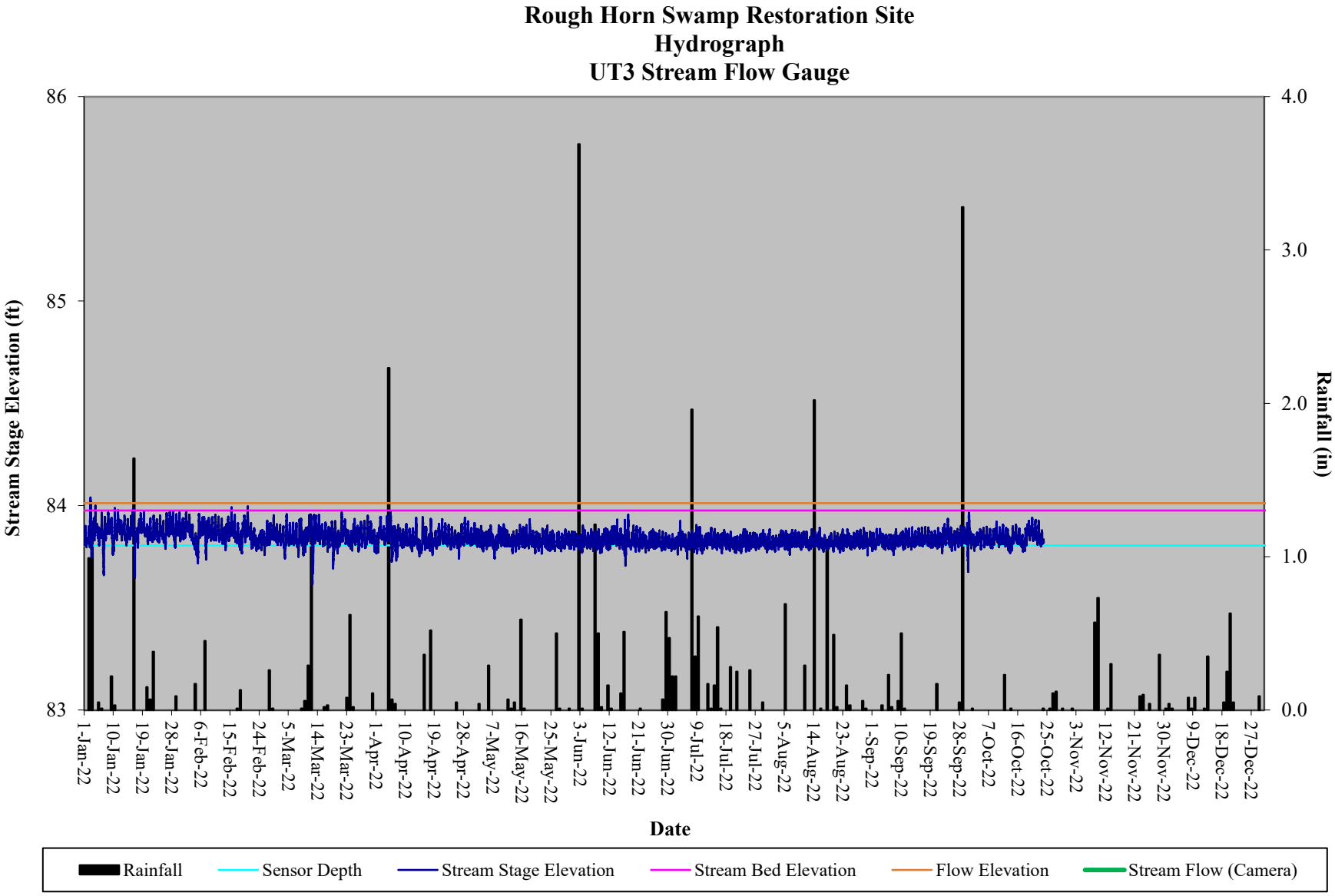
Table 8. Evidence of Channel Development Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
UT3	MY01 (2020)	MY02 (2021)	MY03 (2023)	MY04 (2024)	MY05 (2025)	MY06 (2026)	MY07 (2027)
Max consecutive days channel flow	71	98	0				
Presence of litter and debris (wracking)	Yes	Yes	No				
Leaf litter disturbed or washed away	No	No	No				
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	No				
Sediment deposition and/or scour indicating sediment transport	No	No	No				
Water staining due to continual presence of water	Yes	Yes	No				
Formation of channel bed and banks	No	No	No				
Sediment sorting within the primary path of flow	No	No	No				
Sediment shelving or a natural line impressed on the banks	No	No	No				
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	No	No	No				
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	No				
Exposure of woody plant roots within the primary path of flow	No	No	No				
Other							

Table 8. Evidence of Channel Development Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
UT4	MY01 (2020)	MY02 (2021)	MY03 (2023)	MY04 (2024)	MY05 (2025)	MY06 (2026)	MY07 (2027)
Max consecutive days channel flow	71	108	90				
Presence of litter and debris (wracking)	Yes	Yes	Yes				
Leaf litter disturbed or washed away	Yes	Yes	Yes				
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes				
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes				
Water staining due to continual presence of water	Yes	Yes	Yes				
Formation of channel bed and banks	Yes	Yes	Yes				
Sediment sorting within the primary path of flow	Yes	Yes	Yes				
Sediment shelving or a natural line impressed on the banks	Yes	Yes	Yes				
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes				
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes				
Exposure of woody plant roots within the primary path of flow	No	No	No				
Other							


Rough Horn Swamp Restoration Site
Hydrograph
LBC Stream Flow Gauge
Stream Stage Elevation (ft)
Rainfall (in)
Date
124 Days
84
83
82
81
80
79
4.0
3.0
2.0
1.0
0.0
1-Jan-22
10-Jan-22
19-Jan-22
28-Jan-22
6-Feb-22
15-Feb-22
24-Feb-22
5-Mar-22
14-Mar-22
23-Mar-22
1-Apr-22
10-Apr-22
19-Apr-22
28-Apr-22
7-May-22
16-May-22
25-May-22
3-Jun-22
12-Jun-22
21-Jun-22
30-Jun-22
9-Jul-22
18-Jul-22
27-Jul-22
5-Aug-22
14-Aug-22
23-Aug-22
1-Sep-22
10-Sep-22
19-Sep-22
28-Sep-22
7-Oct-22
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Sensor Depth
Stream Stage Elevation
Stream Bed Elevation
Flow Elevation
Stream Flow (Camera)


Rough Horn Swamp Restoration Site
Hydrograph
UT1 Stream Flow Gauge
Camera malfunction
118 Days
Stream Stage Elevation (ft)
Rainfall (in)
Date
84
83
82
81
80
4.0
3.0
2.0
1.0
0.0
1-Jan-22
10-Jan-22
19-Jan-22
28-Jan-22
6-Feb-22
15-Feb-22
24-Feb-22
5-Mar-22
14-Mar-22
23-Mar-22
1-Apr-22
10-Apr-22
19-Apr-22
28-Apr-22
7-May-22
16-May-22
25-May-22
3-Jun-22
12-Jun-22
21-Jun-22
30-Jun-22
9-Jul-22
18-Jul-22
27-Jul-22
5-Aug-22
14-Aug-22
23-Aug-22
1-Sep-22
10-Sep-22
19-Sep-22
28-Sep-22
7-Oct-22
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Stream Stage Elevation
Stream Bed Elevation
Flow Elevation
Stream Flow (Camera)
Sensor Depth


Rough Horn Swamp Restoration Site
Hydrograph
UT2 Stream Flow Gauge
Stream Stage Elevation (ft)
Rainfall (in)
86
85
84
83
4.0
3.0
2.0
1.0
0.0
113 Days
1-Jan-22
10-Jan-22
19-Jan-22
28-Jan-22
6-Feb-22
15-Feb-22
24-Feb-22
5-Mar-22
14-Mar-22
23-Mar-22
1-Apr-22
10-Apr-22
19-Apr-22
28-Apr-22
7-May-22
16-May-22
25-May-22
3-Jun-22
12-Jun-22
21-Jun-22
30-Jun-22
9-Jul-22
18-Jul-22
27-Jul-22
5-Aug-22
14-Aug-22
23-Aug-22
1-Sep-22
10-Sep-22
19-Sep-22
28-Sep-22
7-Oct-22
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Date
Rainfall
Stream Stage Elevation
Stream Bed Elevation
Flow Elevation
Stream Flow (Camera)
Sensor Depth


Rough Horn Swamp Restoration Site
Hydrograph
UT3 Stream Flow Gauge
Stream Stage Elevation (ft)
Rainfall (in)
86
85
84
83
4.0
3.0
2.0
1.0
0.0
1-Jan-22
10-Jan-22
19-Jan-22
28-Jan-22
6-Feb-22
15-Feb-22
24-Feb-22
5-Mar-22
14-Mar-22
23-Mar-22
1-Apr-22
10-Apr-22
19-Apr-22
28-Apr-22
7-May-22
16-May-22
25-May-22
3-Jun-22
12-Jun-22
21-Jun-22
30-Jun-22
9-Jul-22
18-Jul-22
27-Jul-22
5-Aug-22
14-Aug-22
23-Aug-22
1-Sep-22
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28-Sep-22
7-Oct-22
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Date
Rainfall
Sensor Depth
Stream Stage Elevation
Stream Bed Elevation
Flow Elevation
Stream Flow (Camera)

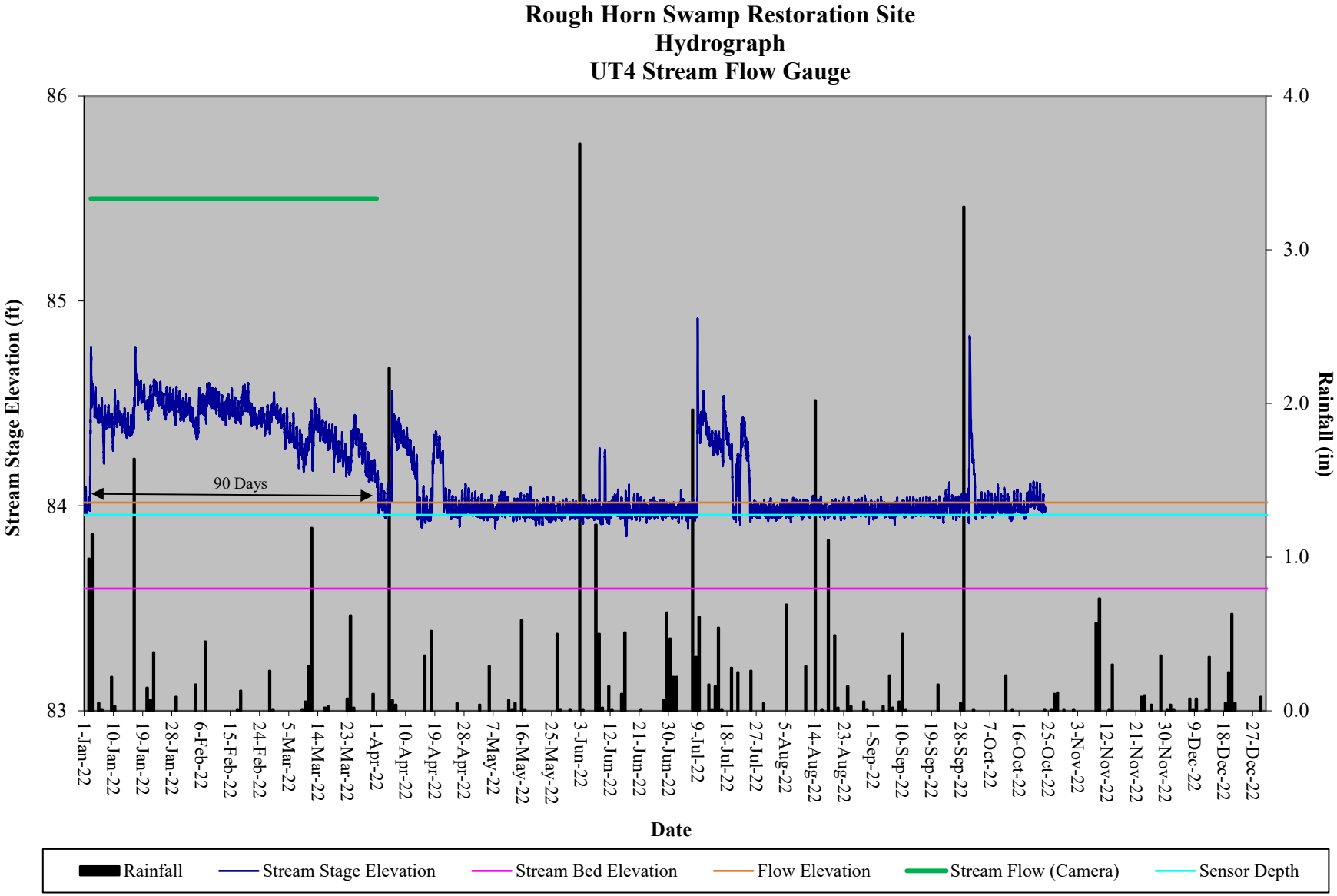
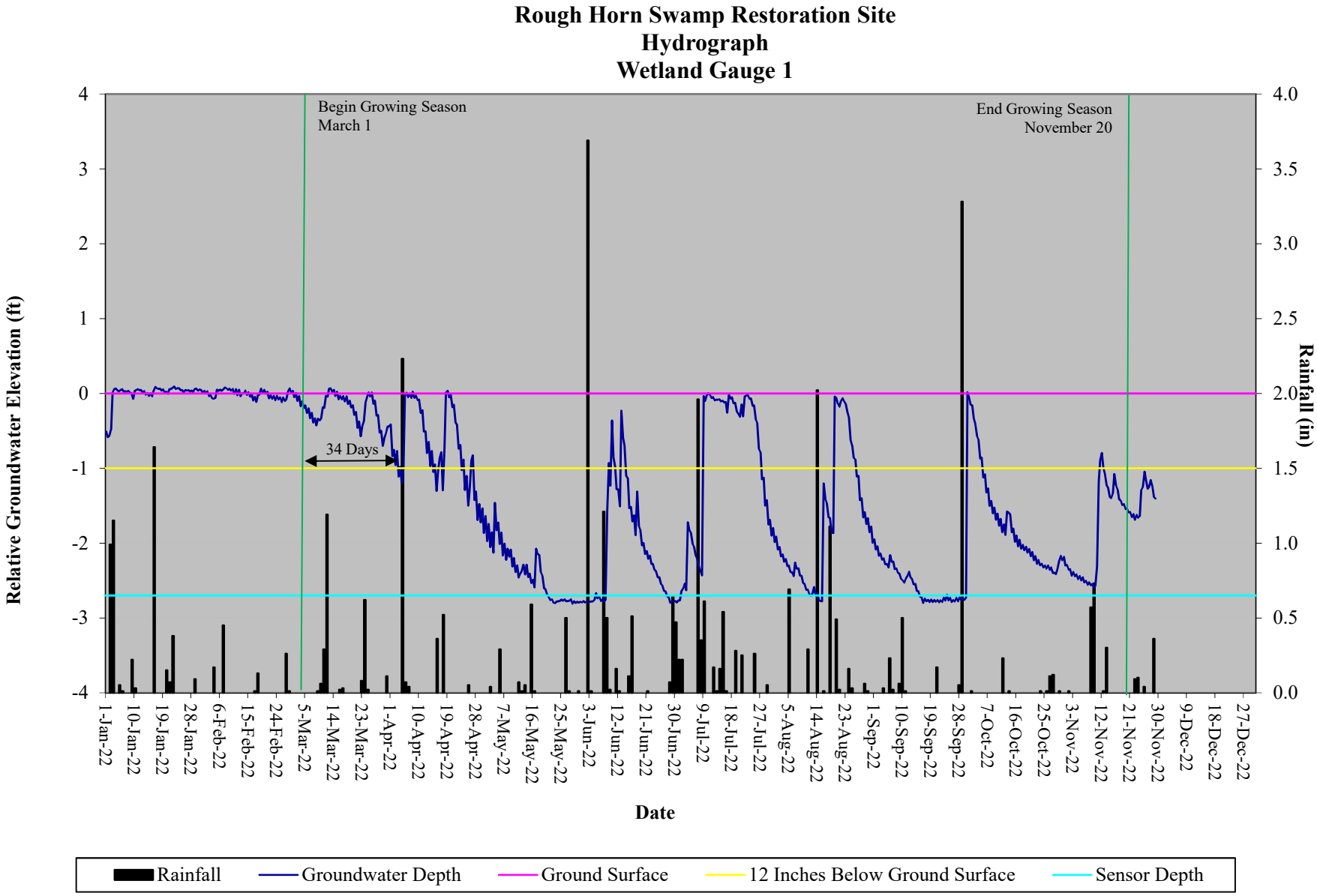
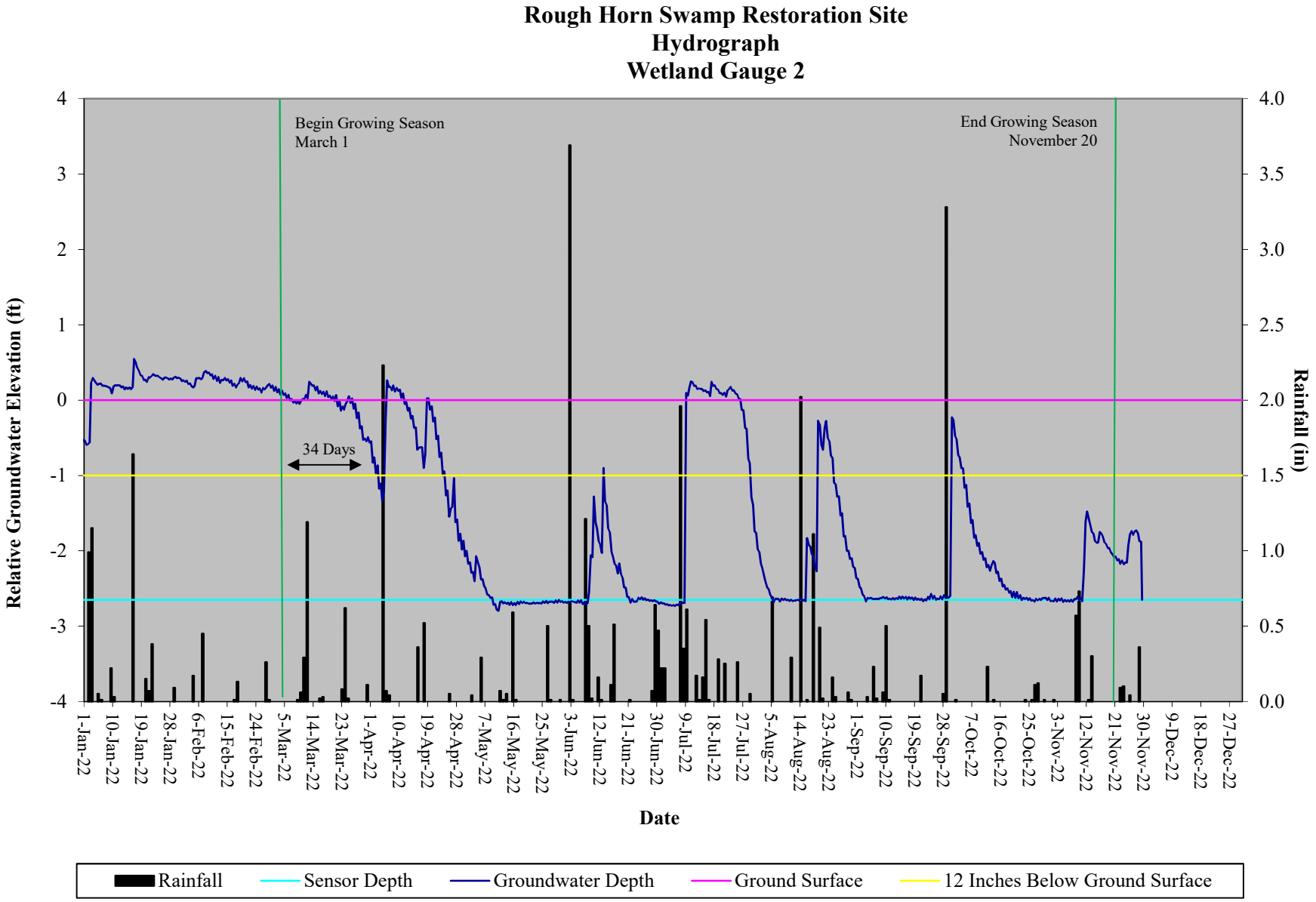

Rough Horn Swamp Restoration Site
Hydrograph
UT4 Stream Flow Gauge
Stream Stage Elevation (ft)
Rainfall (in)
86
85
84
83
4.0
3.0
2.0
1.0
0.0
90 Days
1-Jan-22
10-Jan-22
19-Jan-22
28-Jan-22
6-Feb-22
15-Feb-22
24-Feb-22
5-Mar-22
14-Mar-22
23-Mar-22
1-Apr-22
10-Apr-22
19-Apr-22
28-Apr-22
7-May-22
16-May-22
25-May-22
3-Jun-22
12-Jun-22
21-Jun-22
30-Jun-22
9-Jul-22
18-Jul-22
27-Jul-22
5-Aug-22
14-Aug-22
23-Aug-22
1-Sep-22
10-Sep-22
19-Sep-22
28-Sep-22
7-Oct-22
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Date
Rainfall
Stream Stage Elevation
Stream Bed Elevation
Flow Elevation
Stream Flow (Camera)
Sensor Depth

Table 8. Wetland Hydrology Criteria Attainment Table

Rough Horn Swamp and Rough Horn Swamp II Restoration Site, Project #97005/100053

	Success Criteria Achieved / Max Consecutive Days During Growing Season (Percentage)						
Success Criteria (32 Days) (12.0%)	**MY-01 2020**	**MY-02 2021**	**MY-03**	**MY-04**	**MY-05**	**MY-06**	**MY-07**
Gauge RHS-1	Yes/73 (27.5%)	Yes/40 (15.1%)	Yes/34 (12.8%)				
Gauge RHS-2	Yes/114 (43.0%)	Yes/53 (20.0%)	Yes/34 (12.8%)				
Gauge RHS-3	Yes/65 (24.5%)	Yes/37 (14.0%)	Yes/34 (12.8%)				
Gauge RHS-4	Yes/73 (27.5%)	Yes/50 (18.9%)	Yes/35 (13.2%)				
Gauge RHS-5	Yes/73 (27.5%)	Yes/49 (18.5%)	Yes/35 (13.2%)				
Gauge RHS-6	Yes/115 (43.4%)	Yes/50 (18.9%)	Yes/60 (22.6%)				
Gauge RHS-7	Yes/83 (31.3%)	Yes/52 (19.6%)	Yes/35 (13.2%)				
Gauge RHS-8	Yes/73 (27.5%)	Yes/36 (13.6%)	No/29 (10.9%)				
Gauge RHS-9	Yes/65 (24.5%)	Yes/37 (14.0%)	No/29 (10.9%)				
Gauge RHS-10	Yes/73 (27.5%)	Yes/49 (18.5%)	Yes/32 (12.1%)				
Gauge RHS-11	Yes/41 (15.5%)	Yes/37 (14.0%)	No/22 (8.3%)				
Gauge RHS-12	No/21 (7.9%)	Yes/36 (13.6%)	No/29 (10.9%)				
Gauge RHS-13	Yes/65 (24.5%)	Yes/35 (13.2%)	No/28 (10.6%)				
Gauge RHSII-1	Yes/73 (27.5%)	Yes/50 (18.9%)	Yes/33 (12.5%)				
Gauge RHSII-2	Yes/73 (27.5%)	Yes/51 (19.2%)	Yes/32 (12.1%)				
Gauge RHSII-3	Yes/65 (24.5%)	Yes/37 (14.0%)	No/9 (3.4%)				
Gauge RHSII-4	Yes/264 (99.6%)	Yes/63 (23.8%)	Yes/55 (20.8%)				
Gauge RHSII-5	Yes/264 (99.6%)	Yes/61 (23.0%)	Yes/55 (20.8%)				
Gauge RHSII-6	Yes/37 (14.0%)	Yes/36 (13.6%)	No/8 (3.0%)				
Gauge RHSII-7	Yes/33 (12.5%)	No/7 (2.6%)	No/0 (0.0%)				
Gauge RHSII-8	Yes/73 (27.5%)	Yes/50 (18.9%)	No/27 (10.2%)				
Gauge Ref	Yes/53 (20.0%)	Yes/44 (16.6%)	No/6 (2.3%)				


Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 1
Begin Growing Season
March 1
End Growing Season
November 20
34 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 2
Begin Growing Season
March 1
End Growing Season
November 20
34 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
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5-Mar-22
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25-May-22
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16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
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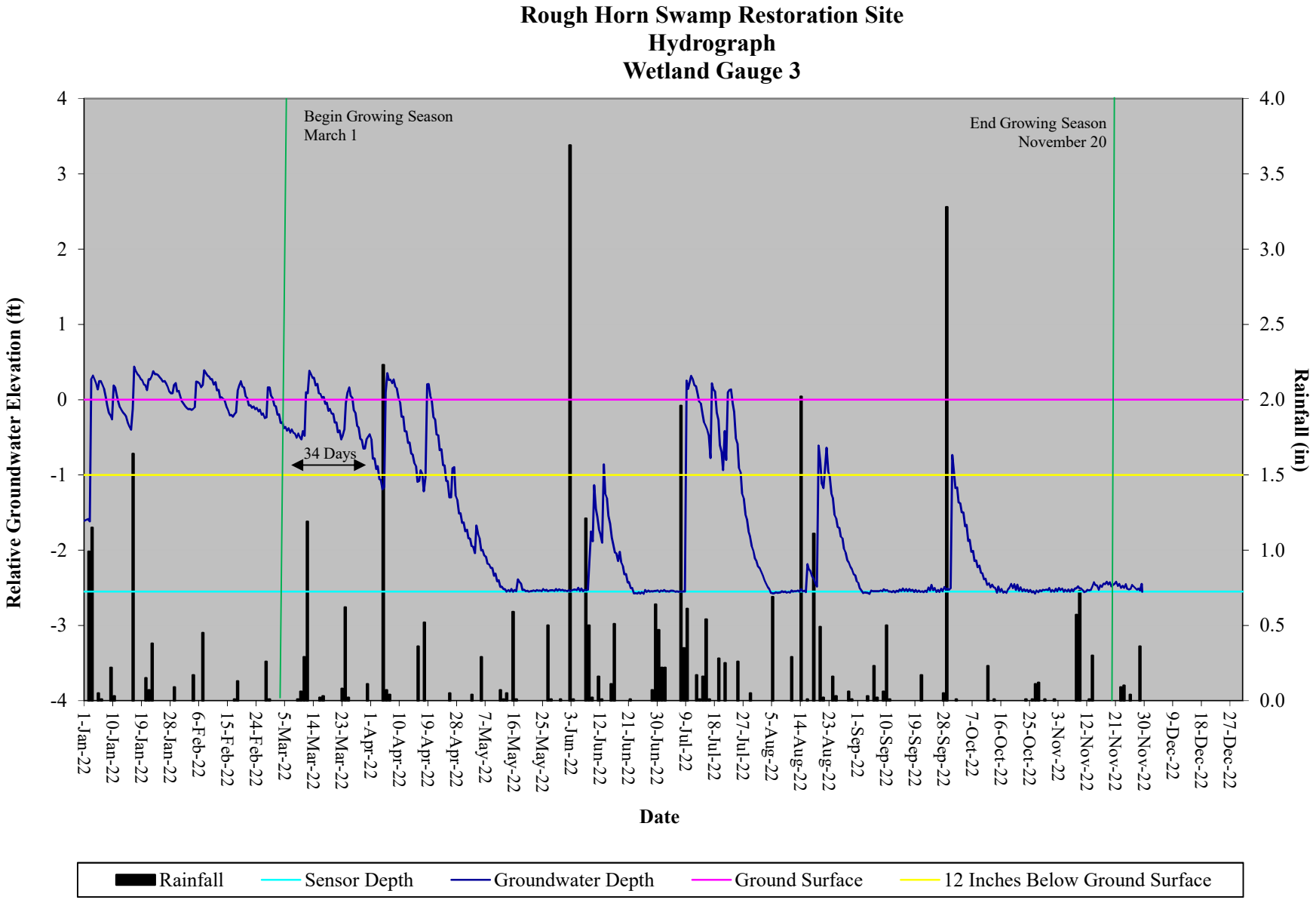
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface


Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 3
Begin Growing Season
March 1
End Growing Season
November 20
34 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
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-1
-2
-3
-4
4.0
3.5
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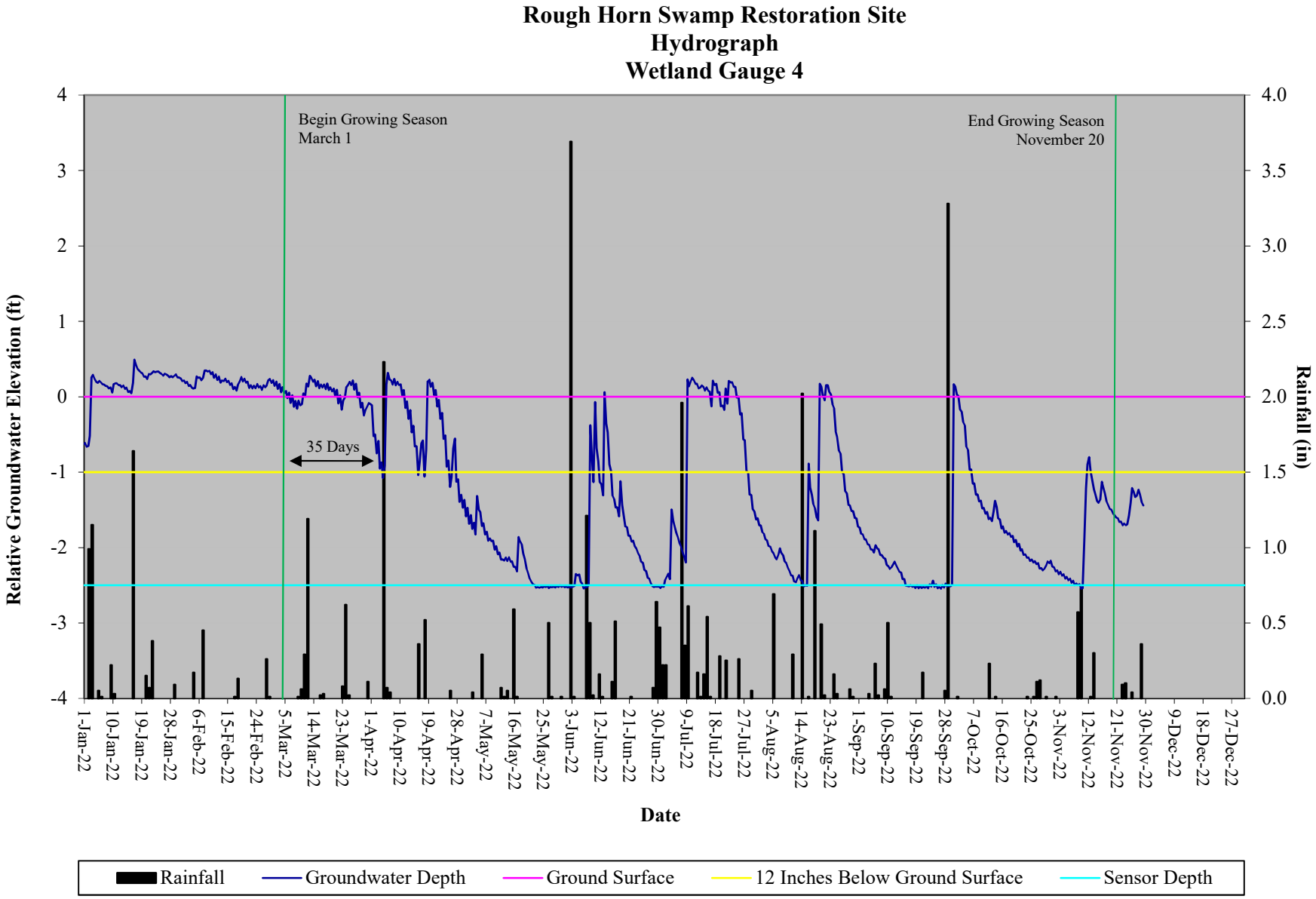
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface


Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 4
Begin Growing Season
March 1
End Growing Season
November 20
35 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
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16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
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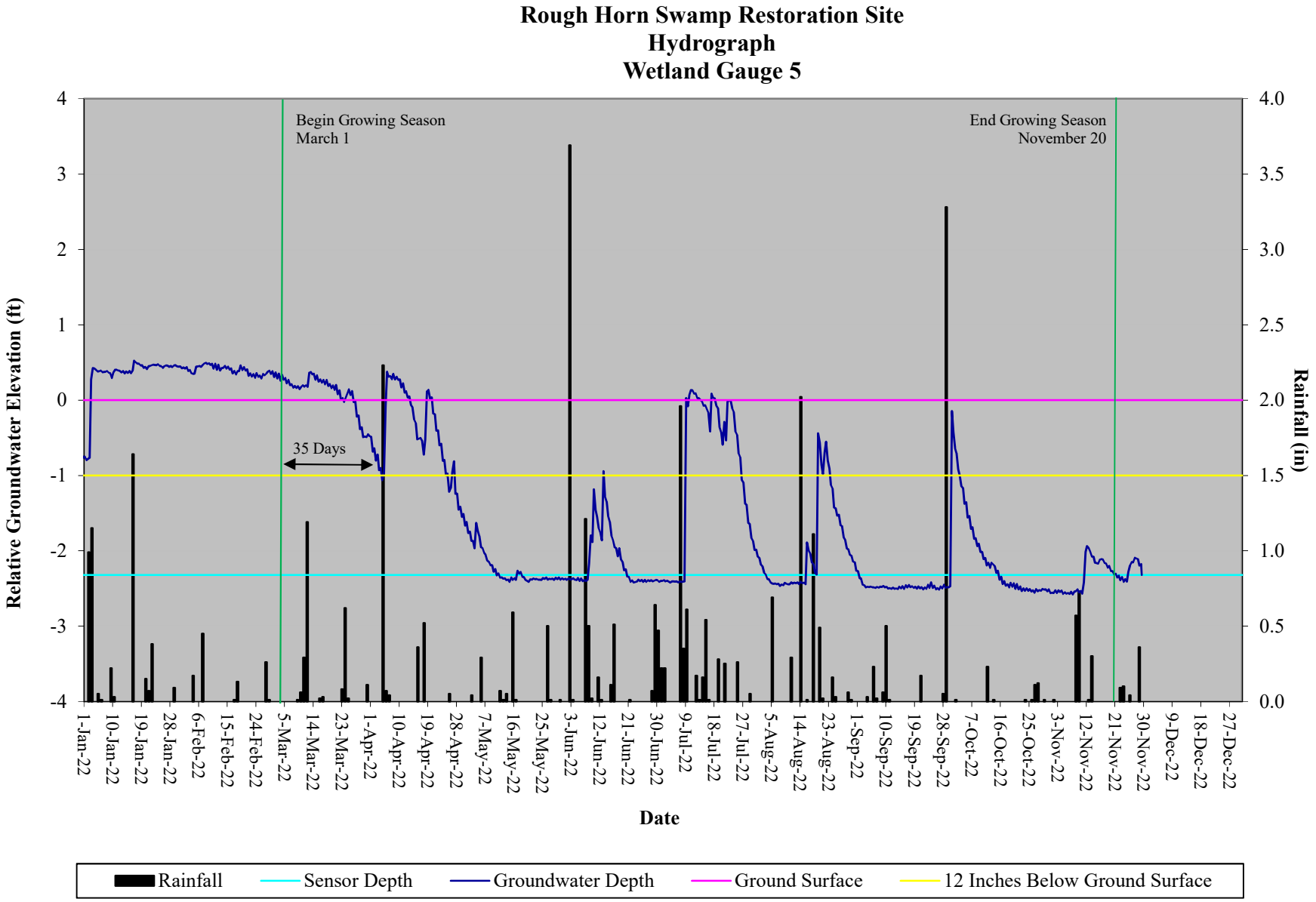
18-Dec-22
27-Dec-22
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 5
Begin Growing Season
March 1
End Growing Season
November 20
35 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
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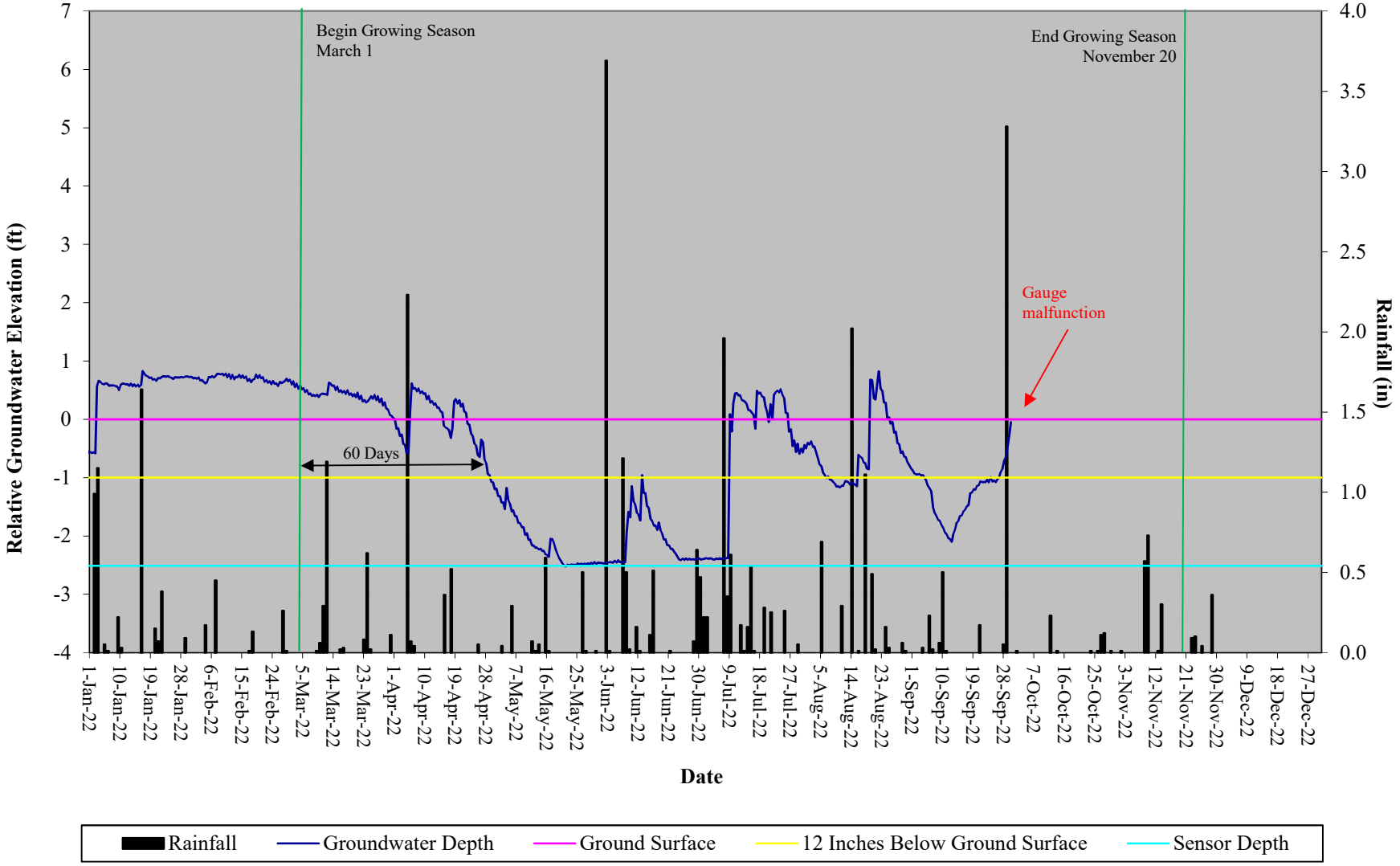
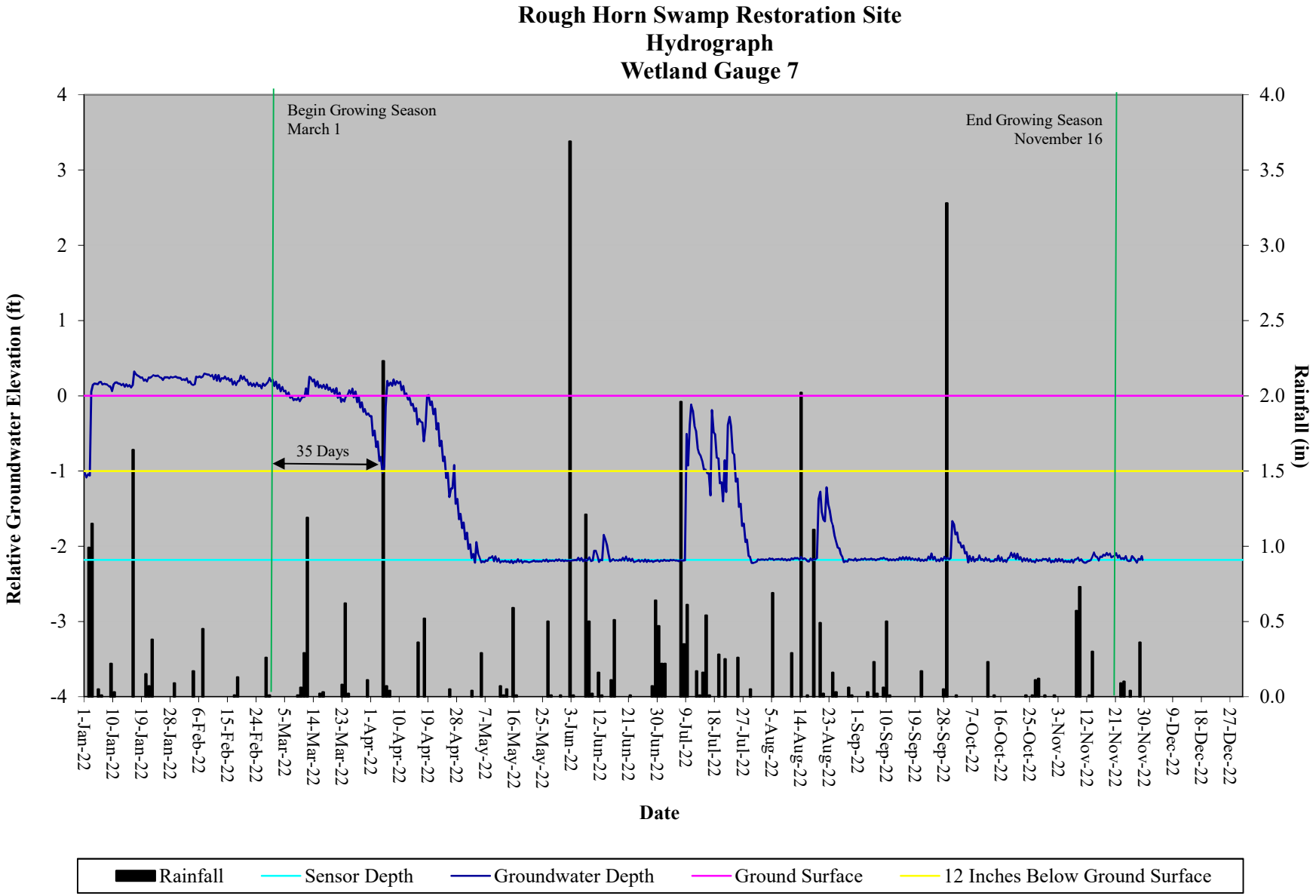
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface

Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 6




Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 7
Begin Growing Season
March 1
End Growing Season
November 16
35 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
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25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
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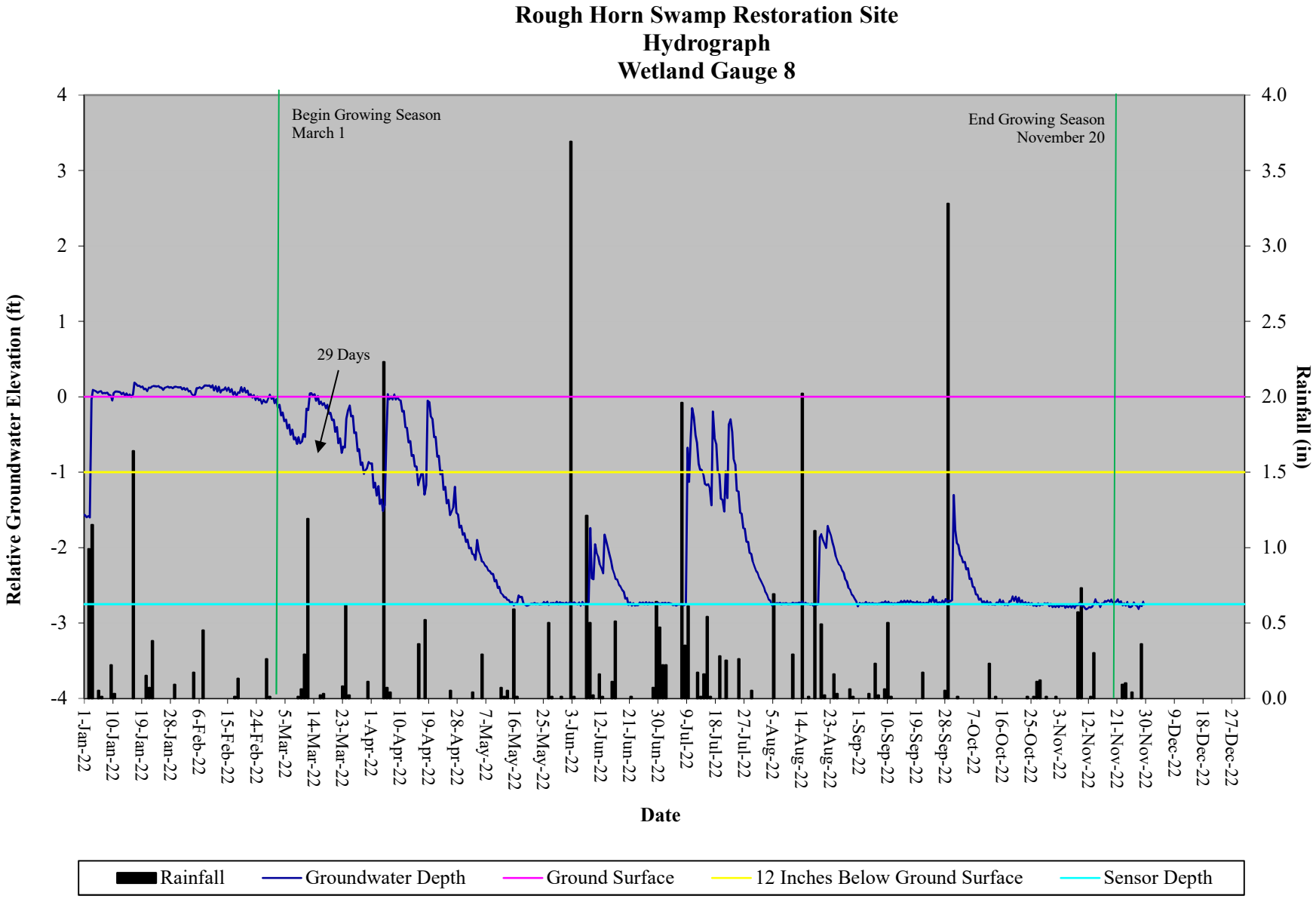
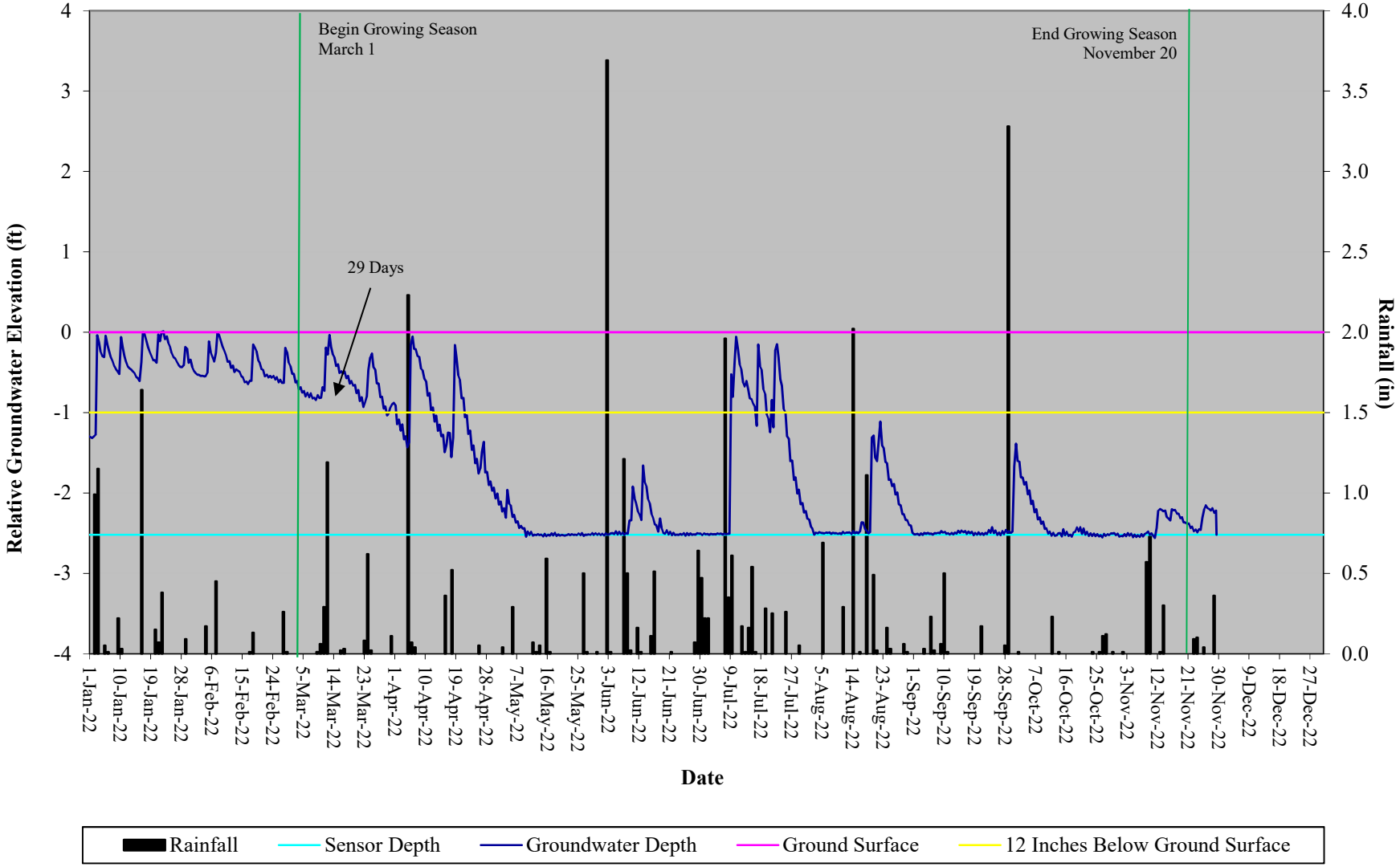
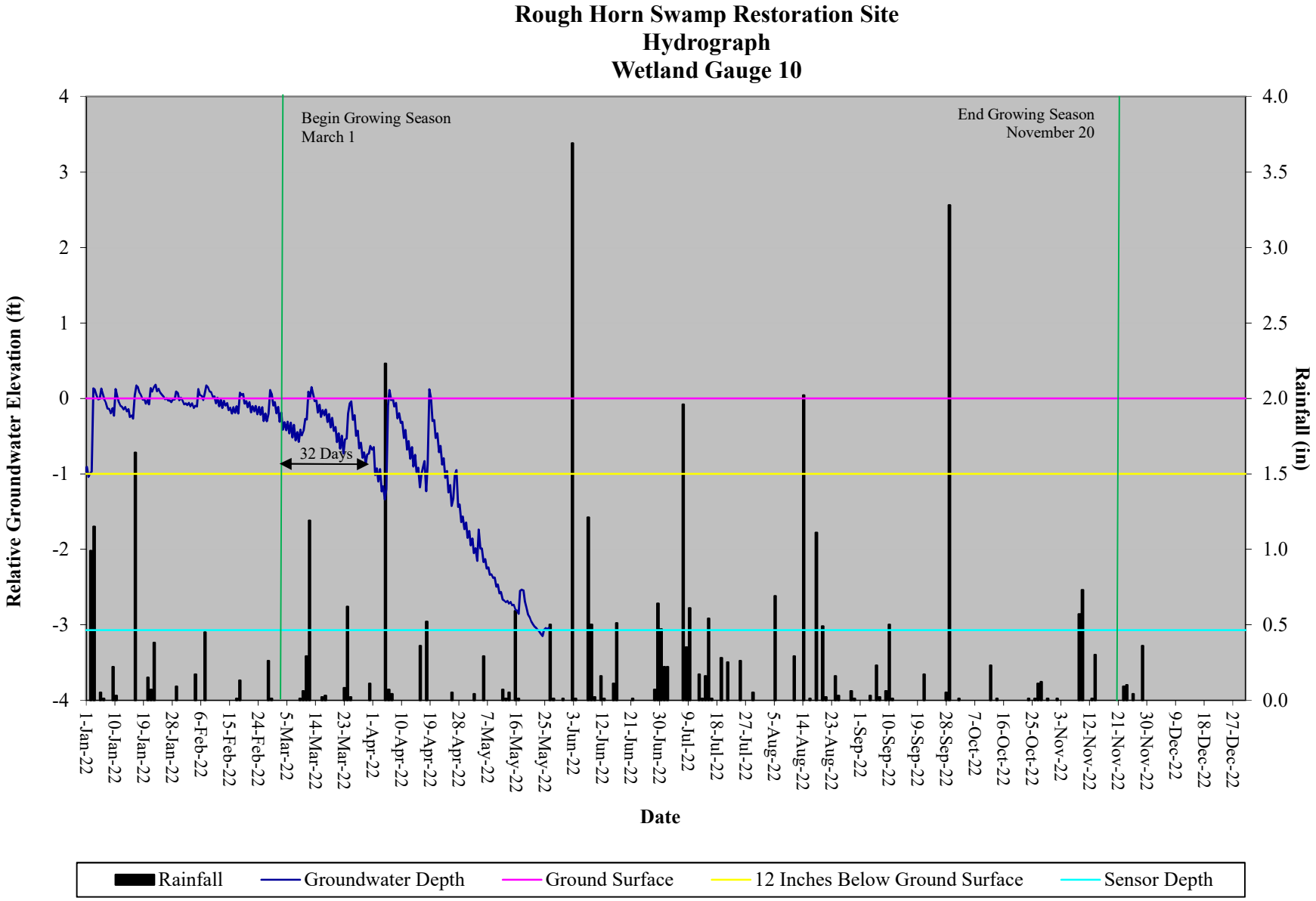
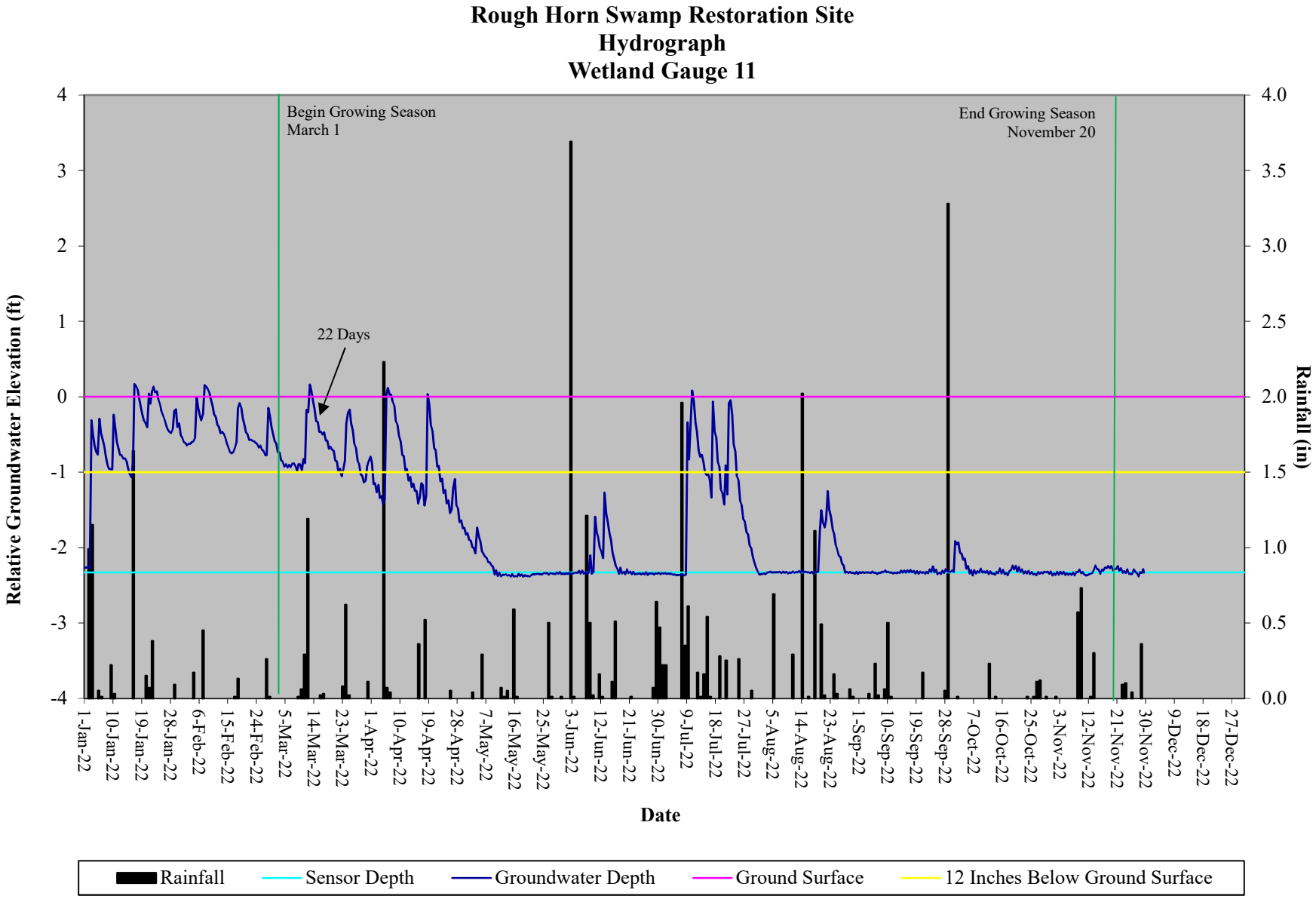
18-Dec-22
27-Dec-22
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface

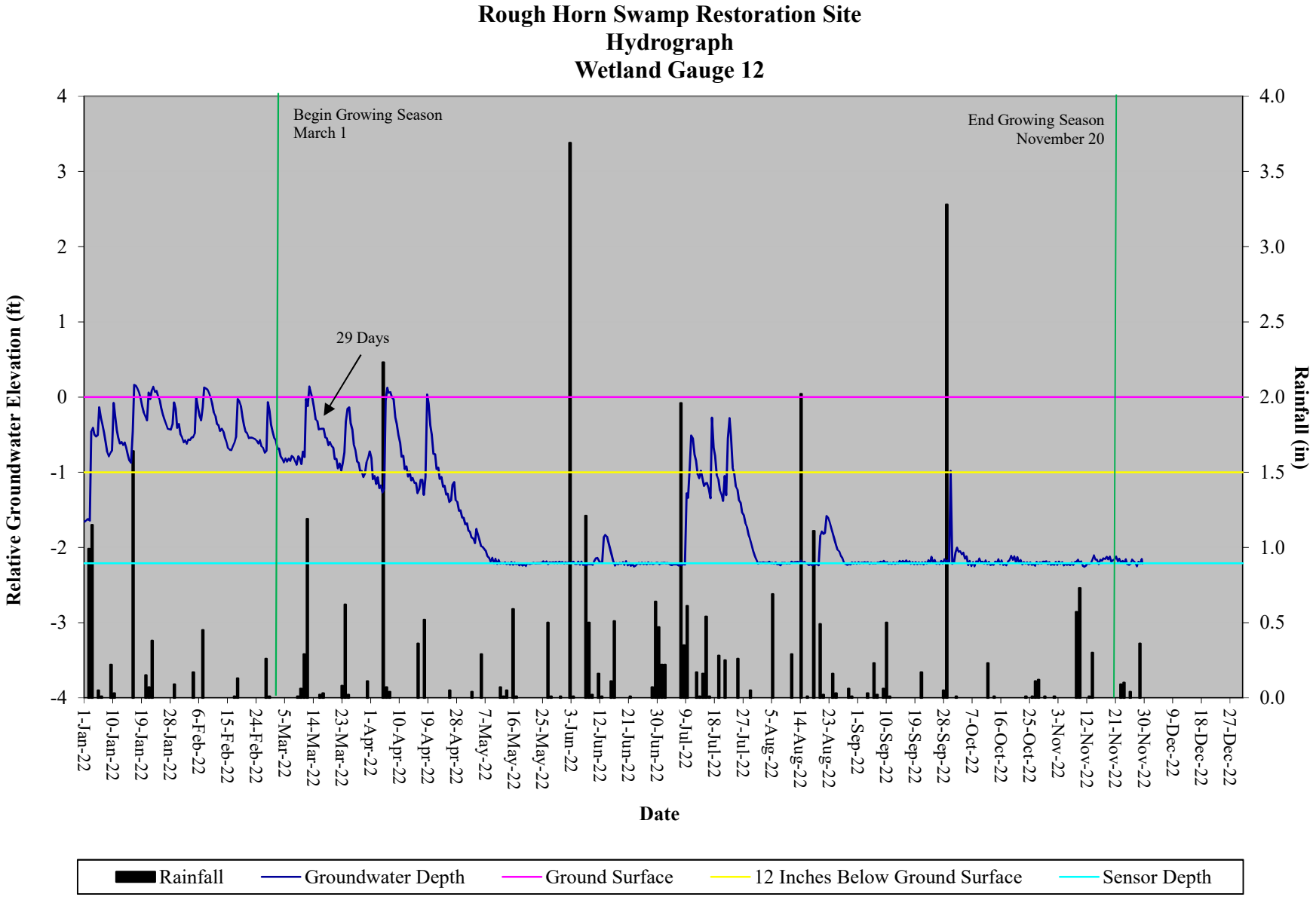

Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 8
Begin Growing Season
March 1
End Growing Season
November 20
29 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth

Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 9




Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 10
Begin Growing Season
March 1
End Growing Season
November 20
32 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 11
Begin Growing Season
March 1
End Growing Season
November 20
22 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface


Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 12
Begin Growing Season
March 1
End Growing Season
November 20
29 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
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5-Mar-22
14-Mar-22
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27-Jul-22
5-Aug-22
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23-Aug-22
1-Sep-22
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16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
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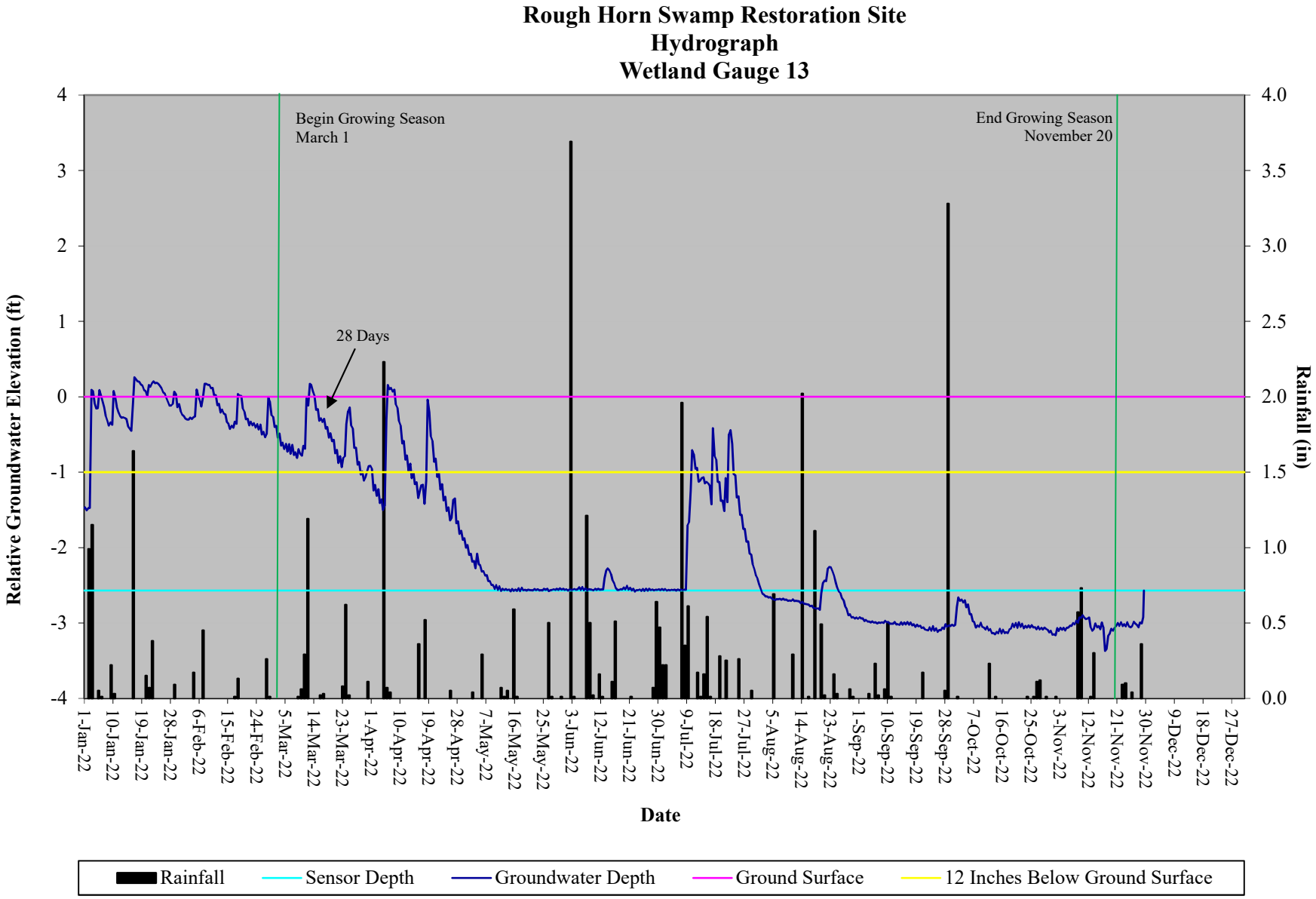
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 13
Begin Growing Season
March 1
End Growing Season
November 20
28 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
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-1
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-3
-4
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3.5
3.0
2.5
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25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
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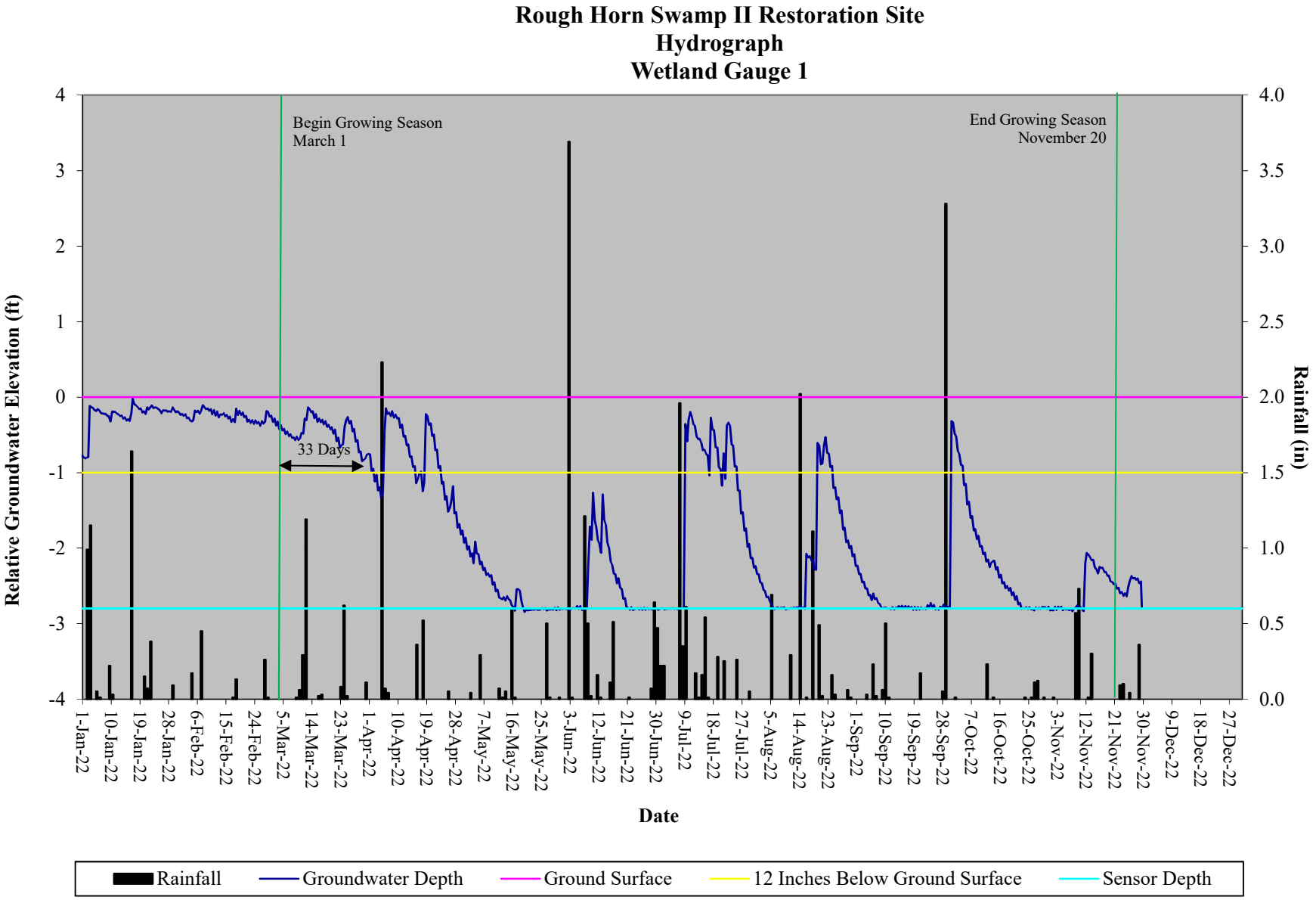
18-Dec-22
27-Dec-22
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface


Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 1
Begin Growing Season
March 1
End Growing Season
November 20
33 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
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3.5
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2.5
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25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
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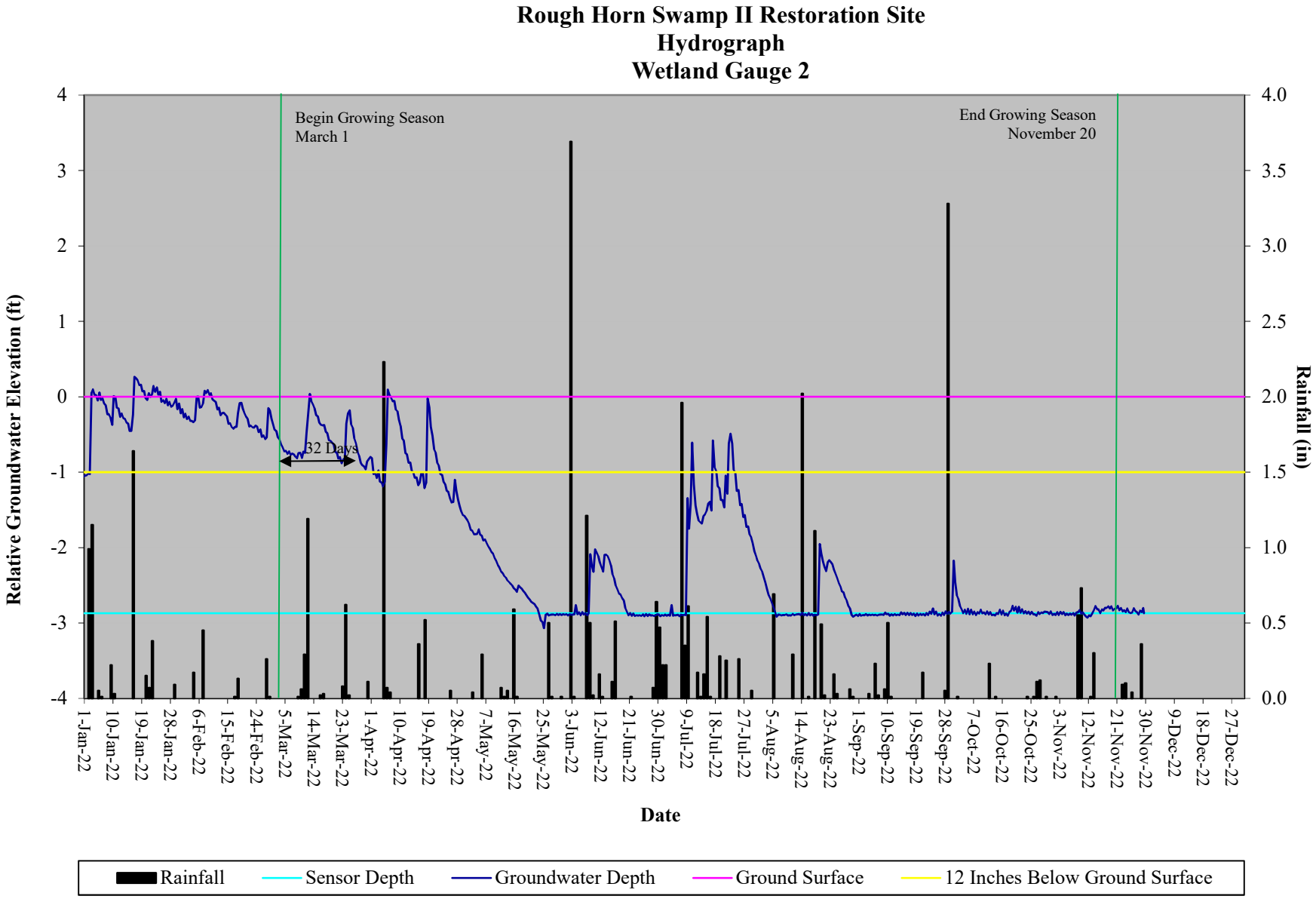
18-Dec-22
27-Dec-22
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 2
Begin Growing Season
March 1
End Growing Season
November 20
32 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
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2.5
2.0
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12-Nov-22
21-Nov-22
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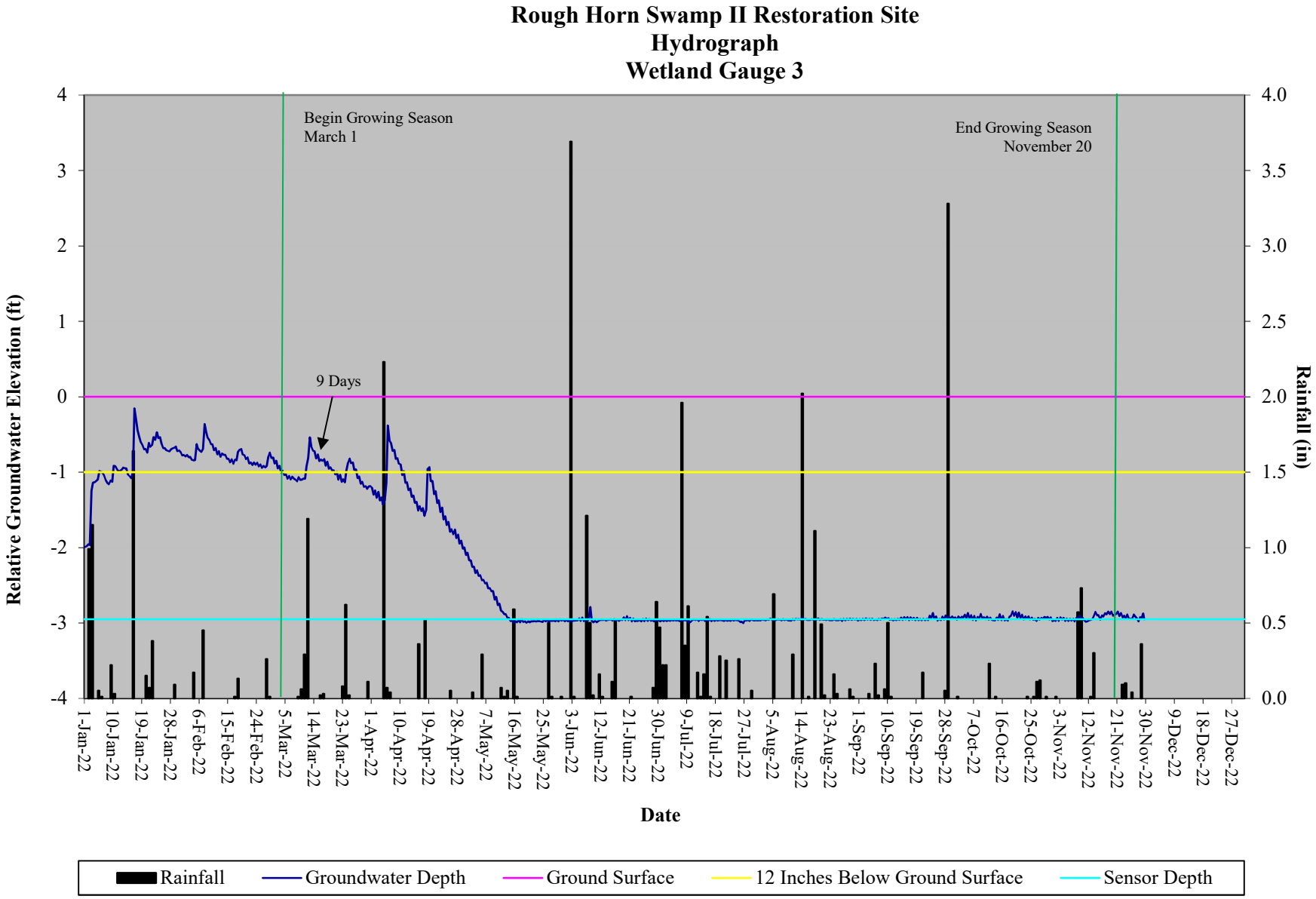
18-Dec-22
27-Dec-22
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface


Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 3
Begin Growing Season
March 1
End Growing Season
November 20
9 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
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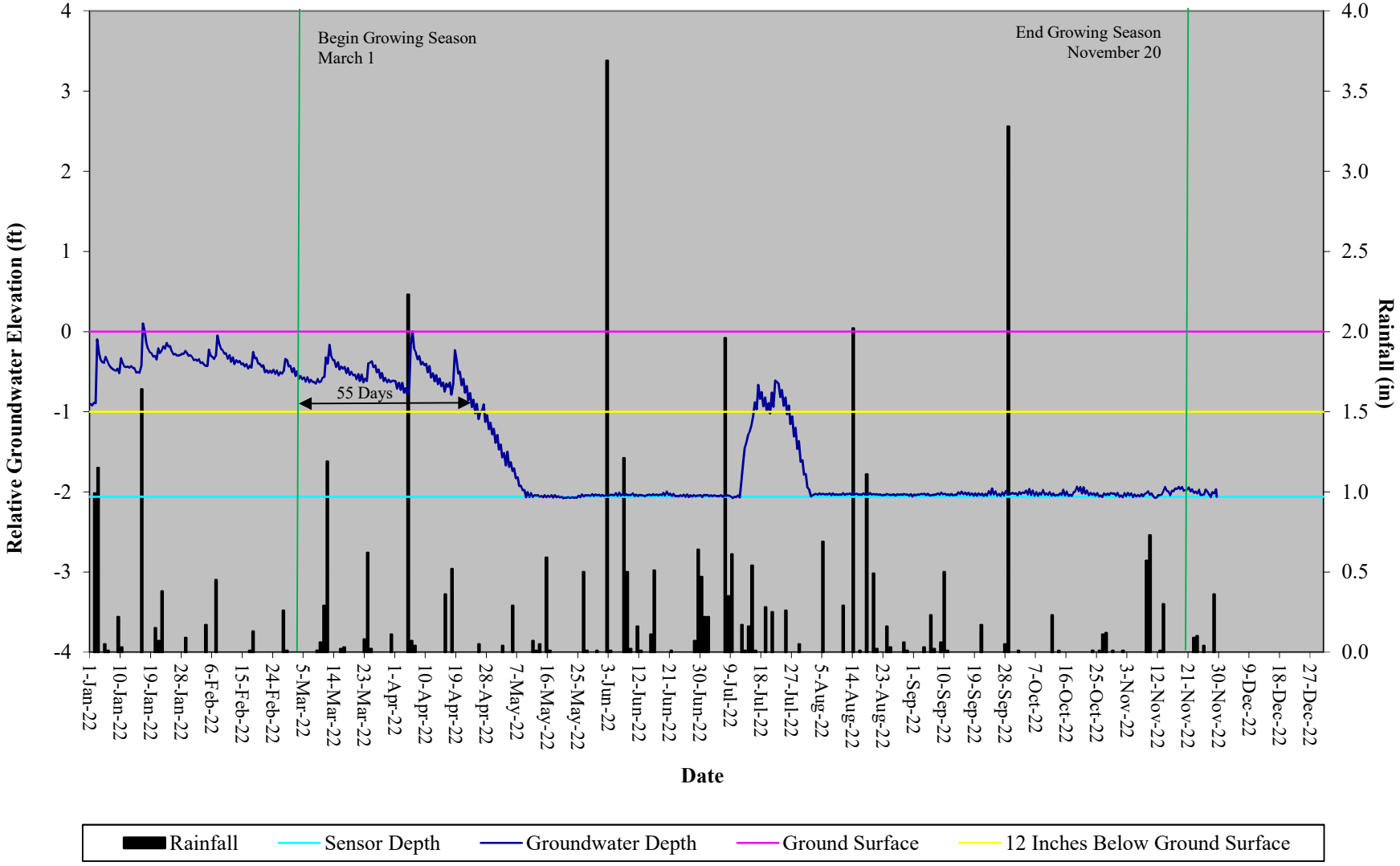
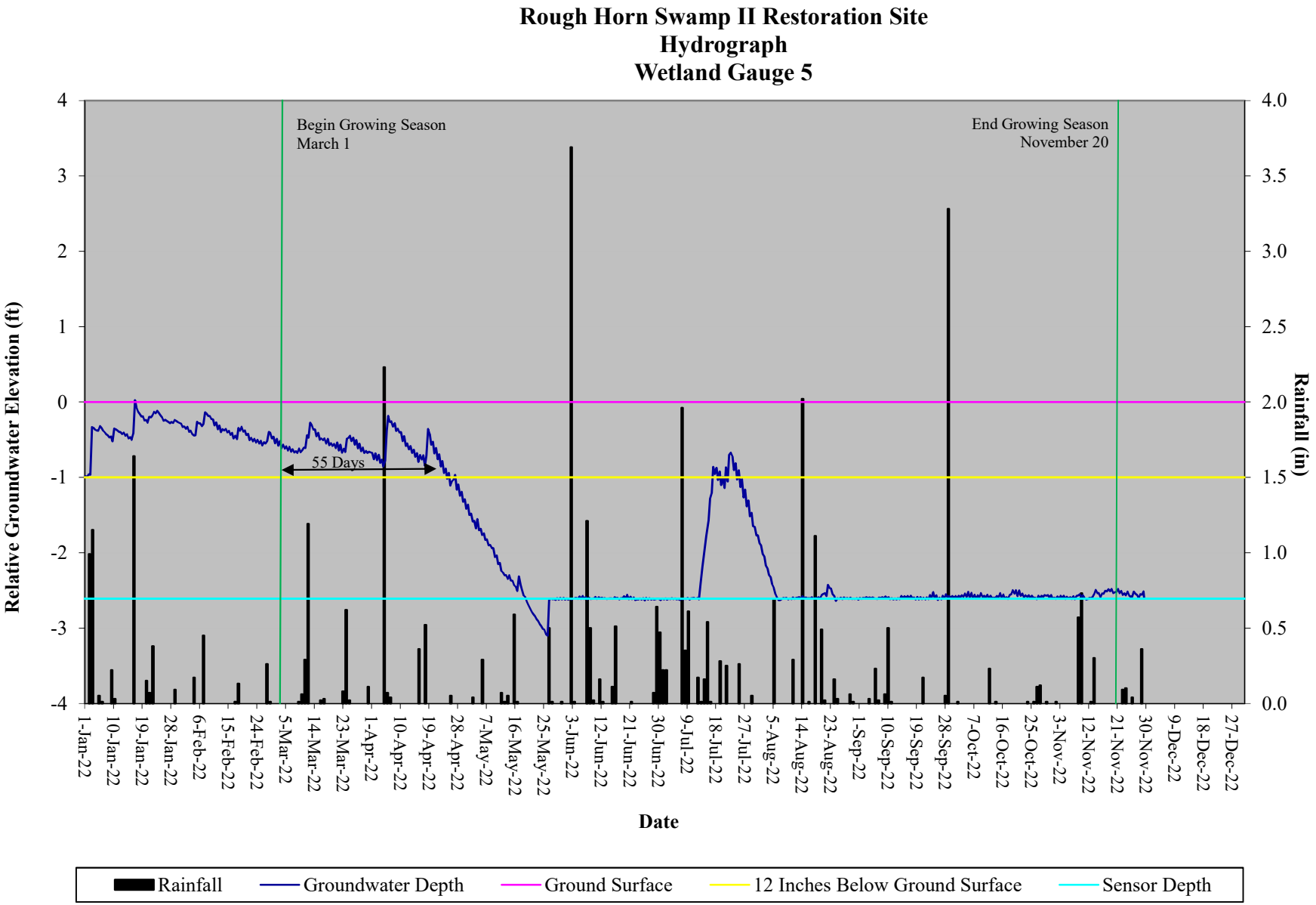
28-Sep-22
7-Oct-22
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth

Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 4




Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 5
Begin Growing Season
March 1
End Growing Season
November 20
55 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
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28-Jan-22
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24-Feb-22
5-Mar-22
14-Mar-22
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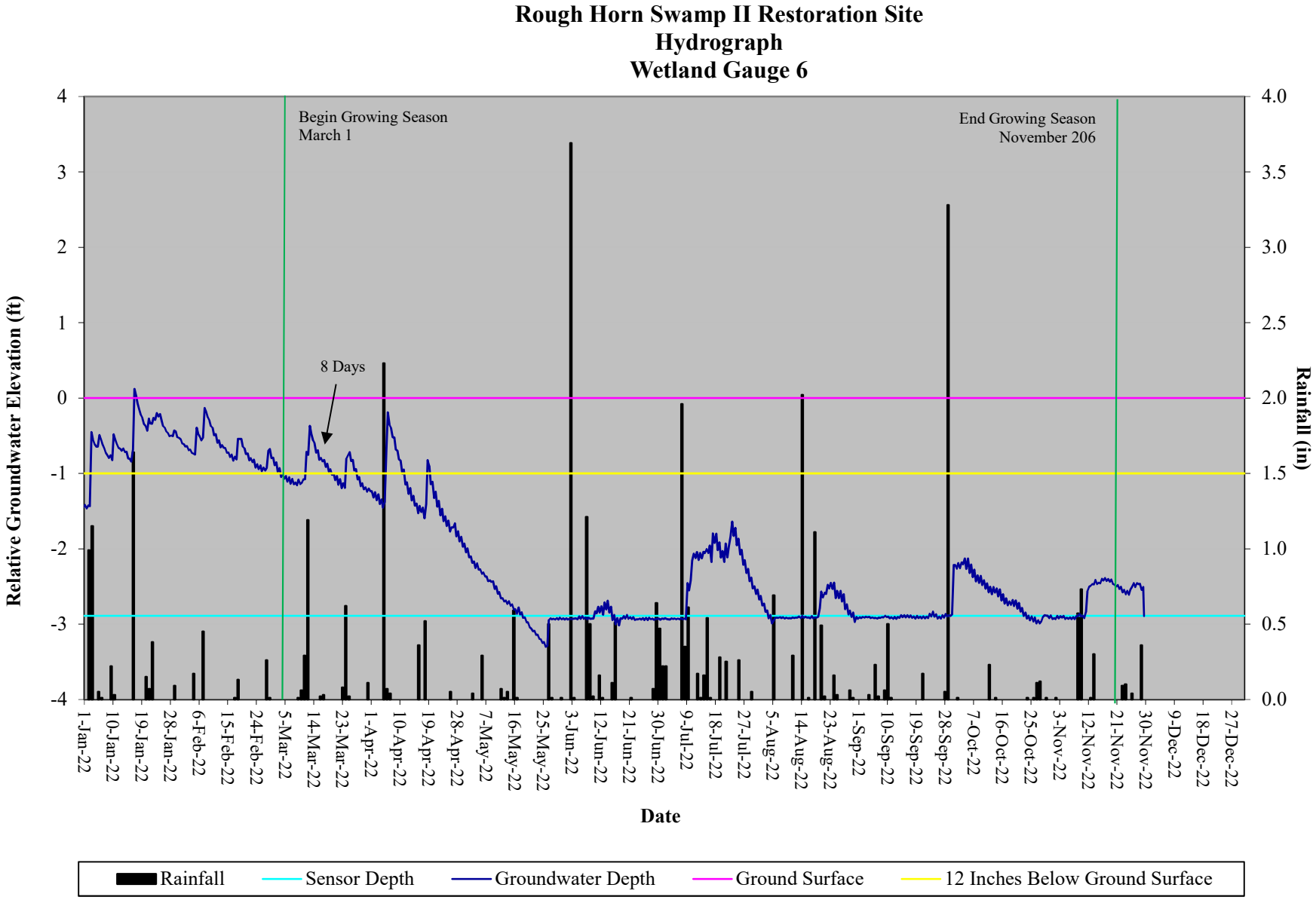
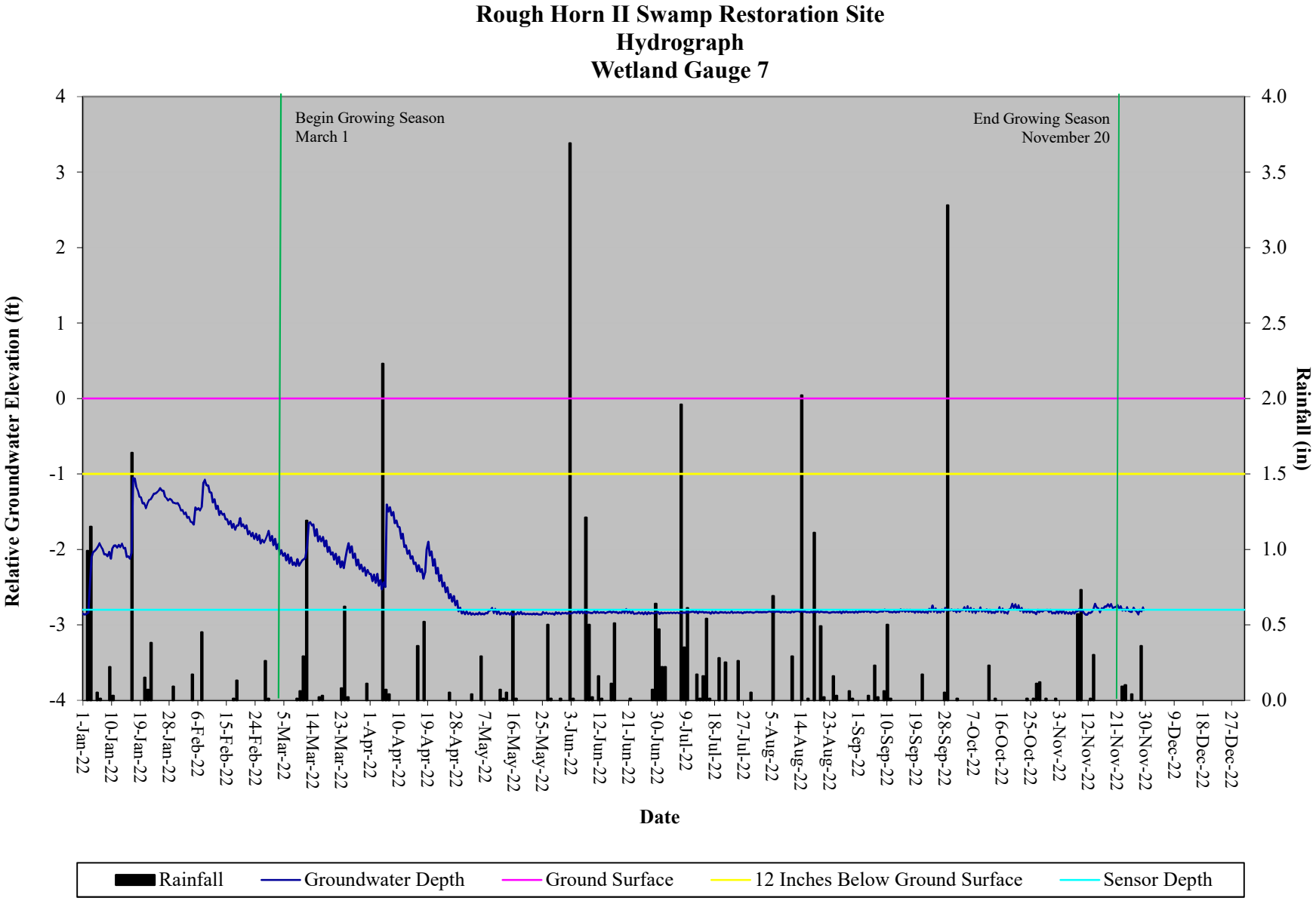
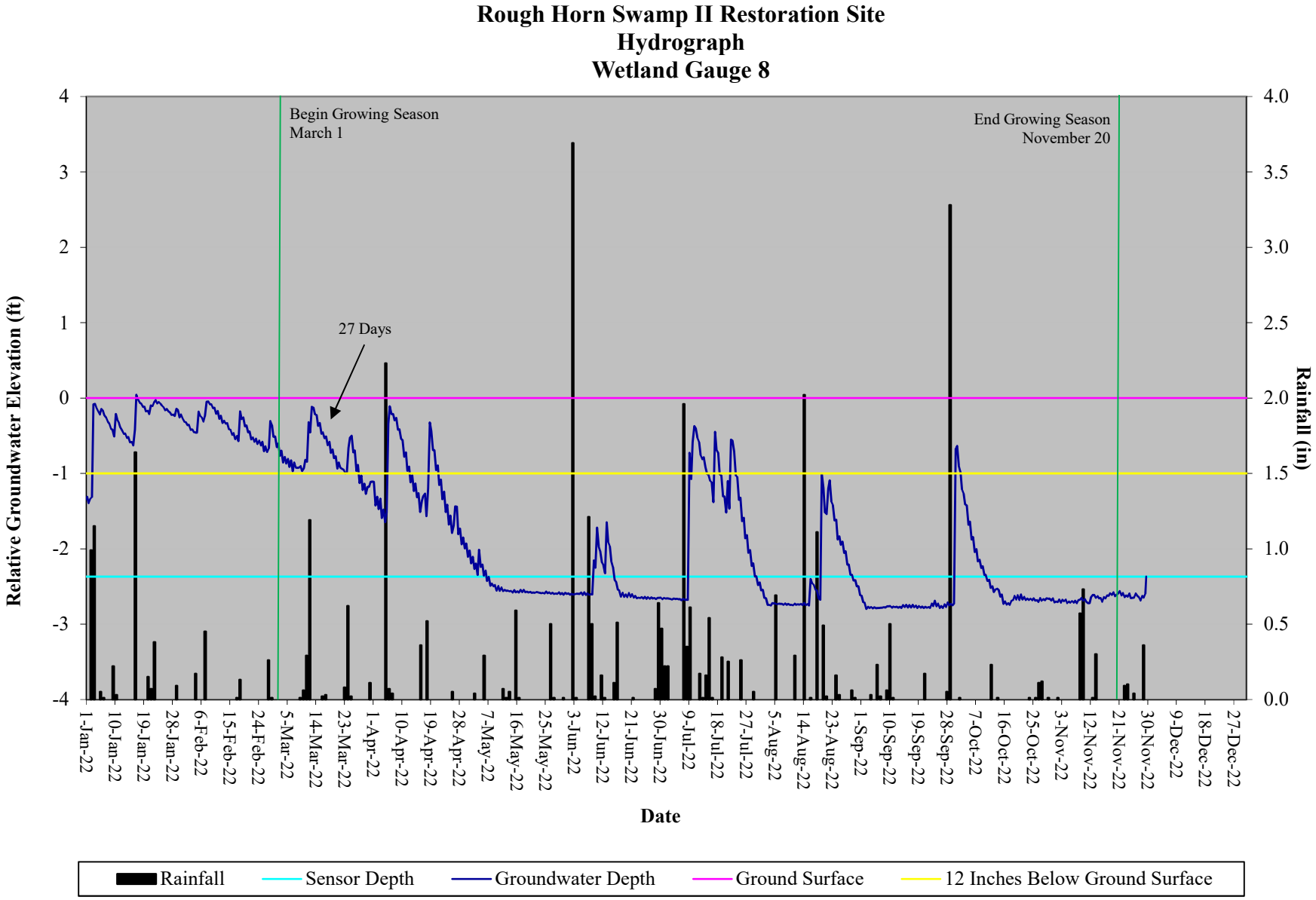
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 6
Begin Growing Season
March 1
End Growing Season
November 206
8 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-22
10-Jan-22
19-Jan-22
28-Jan-22
6-Feb-22
15-Feb-22
24-Feb-22
5-Mar-22
14-Mar-22
23-Mar-22
1-Apr-22
10-Apr-22
19-Apr-22
28-Apr-22
7-May-22
16-May-22
25-May-22
3-Jun-22
12-Jun-22
21-Jun-22
30-Jun-22
9-Jul-22
18-Jul-22
27-Jul-22
5-Aug-22
14-Aug-22
23-Aug-22
1-Sep-22
10-Sep-22
19-Sep-22
28-Sep-22
7-Oct-22
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface


Rough Horn II Swamp Restoration Site
Hydrograph
Wetland Gauge 7
Begin Growing Season
March 1
End Growing Season
November 20
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-22
10-Jan-22
19-Jan-22
28-Jan-22
6-Feb-22
15-Feb-22
24-Feb-22
5-Mar-22
14-Mar-22
23-Mar-22
1-Apr-22
10-Apr-22
19-Apr-22
28-Apr-22
7-May-22
16-May-22
25-May-22
3-Jun-22
12-Jun-22
21-Jun-22
30-Jun-22
9-Jul-22
18-Jul-22
27-Jul-22
5-Aug-22
14-Aug-22
23-Aug-22
1-Sep-22
10-Sep-22
19-Sep-22
28-Sep-22
7-Oct-22
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 8
Begin Growing Season
March 1
End Growing Season
November 20
27 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-22
10-Jan-22
19-Jan-22
28-Jan-22
6-Feb-22
15-Feb-22
24-Feb-22
5-Mar-22
14-Mar-22
23-Mar-22
1-Apr-22
10-Apr-22
19-Apr-22
28-Apr-22
7-May-22
16-May-22
25-May-22
3-Jun-22
12-Jun-22
21-Jun-22
30-Jun-22
9-Jul-22
18-Jul-22
27-Jul-22
5-Aug-22
14-Aug-22
23-Aug-22
1-Sep-22
10-Sep-22
19-Sep-22
28-Sep-22
7-Oct-22
16-Oct-22
25-Oct-22
3-Nov-22
12-Nov-22
21-Nov-22
30-Nov-22
9-Dec-22
18-Dec-22
27-Dec-22
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface

Rough Horn Swamp Restoration Site
Hydrograph
Reference Wetland Gauge