Monitoring Year 4 Report
Final
2023

Rough Horn Swamp Restoration Site
Monitoring Year – MY04
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: 2023
Date Submitted: January 2024

Monitoring and Design Firm

Prepared by:

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ENGINEERS • SCIENTISTS • SURVEYORS • CONSTRUCTION MANAGERS

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MEMORANDUM

Date:	February 22, 2024
To:	Emily Dunnigan, DMS Project Manager
From:	Adam Spiller, Project Manager KCI Associates of North Carolina, PA
Subject:	MY-04 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-04 Monitoring Report comments from NCDMS received on January 24, 2024, for the Rough Horn Swamp and Rough Horn Swamp II Restoration Sites.

1. During the MY3 site visit there was a significant amount of pine recruitment across RHSI that could result in limited survival of planted and/or desirable volunteer species. Email correspondence with KCI indicated that pine would be thinned during the spring of MY4. Was pine management completed? Please describe site conditions in terms of pine competition/recruitment in the narrative.
   KCI Response: Nuisance vegetation, including loblolly pine, red maple, and sweetgum, was treated in August 2022 and June 2023. This treatment occurred primarily along the western boundary of RHSII where it borders the farm fields. Other areas of nuisance vegetation are present within the site but this area presented the greatest threat to the planted woody stems. KCI is planning continued nuisance vegetation treatment for 2024 that will primarily focus on areas of loblolly pine in the non-riparian areas of RHS near the southwest corner of the site. The discussion of the nuisance vegetation treatment has been expanded to discuss the areas of pine and KCI's plans for continued treatment.

2. Groundwater gauges that currently fail to meet criteria appear to have a positive trajectory, please keep in mind if failure of gauges continues, KCI will need to identify the extent of the at-risk wetlands and discuss in next year's monitoring report.
   KCI Response: As of MY04 there are 4 gauges that have met the success criteria in 2 out of the 4 years they have been installed, and 1 gauge that has met the success criteria in only 1 out of the 4 years that it was installed. All 4 of the gauges that met 2/4 years failed to meet the success criteria in 2022 and 2023, which were very low rainfall years. KCI believes that as the water table recharges these gauges will begin to demonstrate successful hydrology again. Gauge RHSII-7 met during MY01 but has not achieved the success criteria since. Gauge RHSII-9 was installed to begin determining the extent of any at-risk area and KCI will investigate the soils and vegetation between these two gauges during MY05 to further establish the extent of this area.

3. CCPV: Please update groundwater gauge color coding to match MY4 data. Ex: RHSI 11 met criteria, but it's shown as not meeting.
   KCI Response: This error has been corrected.

4. CCPV: Please label RHSII 9.
   KCI Response: This has been corrected.

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

Vegetation monitoring did not take place during MY04, as stipulated in the Mitigation Plan. 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-desirable stems in this area were treated by mechanical cutting and spraying on August 18, 2022. This area was treated again in June 2023 and the majority of sweetgum and red maple stems were removed from this area. Other areas of nuisance vegetation are present on the site but this area represented the biggest threat to the planted woody stems. The non-riparian area near the southwest corner of RHS has many large loblolly pine stems growing on it. Although the planted vegetation in this area has so far kept pace with the pines and there are many large river birch, willow oaks, and other planted stems, KCI is planning to treat the pines in this area during MY05 to ensure that they don't impact the project success. There is another area of large pines and many red maple saplings located near the southeastern end of RHS where it joins RHSII. This area will also be treated during MY05 to ensure the success of the planted woody vegetation. Overall the site is well vegetated with extensive herbaceous coverage and many diverse volunteer woody species.

Stream Monitoring

The cross-sections were not surveyed during MY04, as stipulated in the Mitigation Plan. Visual monitoring of the stream was conducted throughout MY04 and many signs of channel development were noted. These signs included the development of multiple flow paths, matted/bent/absent vegetation within the primary flow path, wrack lines and the removal of leaf litter from the primary flow path, and sediment sorting within the primary flow path. Photographic evidence of these signs was collected, where possible. Please see Appendix B – Visual Assessment Data for more information.

Four of the five stream flow monitoring gauges recorded greater than 30 days of continuous flow during 2023. The gauge on LBC recorded a maximum of 158 consecutive days of flow, while the gauges on T1, T2-2, and T4 recorded 143, 117, and 107 days, respectively. The stream flow gauge on T3-2 recorded 7 days of flow in 2023. The data from the gauges was further backed up by the cameras. The camera on LBC recorded flow for 94 consecutive days, while the cameras on T1, T2 and T4 showed continuous flow for 136, 31, and 42 days, respectively. The camera on T3 did not show any flow during 2023, as it malfunctioned during the period when the gauge recorded flow. Differences between the maximum consecutive days recorded by the cameras and the gauges are mainly due to times when vegetation obscured the cameras.

After recording 71 and 98 days of flow during MY01 and 02, the gauge on T3 has failed to meet the success criteria in the past two years (recording 0 days in 2022 and 7 days in 2023). KCI believes that the lack of flow that this reach has experienced is a result of the very low amount of rainfall that the site received in 2022 and the inconsistent rainfall received in 2023. According to the Army Corps of Engineers' Antecedent Precipitation Tool, the site experienced "drier than normal" conditions from August 2021 until January 2023, with one brief period of "normal conditions" from mid-December 2021 until mid February 2022. This extended period of drier than normal conditions led to the water table being depleted and the stream drying up. This trend was reflected in the wetland gauges, which experienced much lower rates of success than in the first two years. After a brief period of "wetter than normal" conditions in February 2023, the site returned to "drier than normal" conditions for the month of March. It then remained under normal conditions for most of the rest of the year, with a period of "drier than normal conditions" in late May/early June, and a longer period of "drier than normal conditions" for all of October and most of November. While the extended periods of normal conditions that the site saw in 2023 allowed the water table to begin recharging, as reflected by the sporadic periods of flow that T3 saw, the intervening periods of "drier than normal" conditions prevented it from fully recharging from the extremely dry conditions it experienced last year. KCI is hopefully that with continued and sustained periods of normal conditions, the stream will return to the levels of flow seen during the first two monitoring years. At a meeting with the IRT to evaluate this reach on July 14, 2023, the IRT acknowledged that the T3 stream corridor showed evidence of previous flow events and appeared to have the appropriate geomorphology for the designed system, while also

expressing concern at the lack of flow. KCI will continue to monitor this area closely heading into the fifth growing season.

Hydrology Monitoring

During 2023, the month of April experienced above average rainfall. The months of March, May, July, September, October, and December experienced below average rainfall and the months of January, February, June, August, and November experienced average rainfall. Overall the site experienced below average rainfall during the 2023 growing season.

Twelve out of the thirteen gauges at Rough Horn Swamp, and five 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. The lower rates of success that the site has experienced in MY03 and MY04 compared to MY01-02 are due to the very low amount of rainfall that the site saw in 2022 and the subsequent need for the water table to recharge, as described above. Evidence of the water table beginning to recharge can be seen in Gauge RHS-8. During the first two monitoring years this gauge displayed a pattern typical of wetlands in the eastern part of NC. This consists of a water table at or near the surface throughout the winter and spring that drops below 12 inches of the surface in the summer for a period before rising back to at or near the surface in the late fall/early winter. This pattern held true for RHS-8 until the summer of 2022, when it fell below 12 inches of the soil surface and did not rise above this level again in the winter except for brief periods directly after heavy rains. The MY03 growing season, then, began with the water table at approximately 24 inches below the soil surface instead of its usual position at this point in the year of at or near the surface. As a result, Gauge RHS-8 did not achieve the success criteria in 2023 but evidence of the water table recharging could be seen during the fall, when it achieved two periods of 13 and 14 consecutive days within 12 inches of the soil surface before an extended period of “drier than normal” conditions in October and November caused the water table to fall below 12 inches of the surface again. Further evidence of the water table was seen after this extended dry period ended in mid-November. At this point the water table returned to its usual December level of at or near the surface, which it had not reached since the winter of 2021/2022. The reference gauge provided further confirmation of the trend described above. After achieving the success criteria in MY01 and MY02, the reference wetland only recorded 6 consecutive days within 12” during MY03. MY04 saw an increase in the number of consecutive days with 12” of the surface, but the reference wetland still failed to achieve the success criteria. KCI believes that, as with T3, with continued and sustained periods of normal conditions on the site, the gauges will return to their previous rates of success.

At the July 14, 2023 meeting with the IRT, it was recommended that additional groundwater gauges should be installed within the 100 foot wide T3 stream corridor to monitor the water table as it recharges and to provide additional data if flow does not return and it is necessary to convert this portion of the site to wetland credits. It was also recommended that an additional gauge be installed in the vicinity of Gauge RHII-7, which has only achieved the success criteria in one out of the four monitoring years. These gauges were installed on August 1, 2023, with two (RHII-10 and RHII-11) within the T3 stream corridor and one (RHII-9) approximately 250 feet northwest of RHII-7. Because they were installed so late in the growing season, they did not capture what is typically the wettest part of the year, and so only RHII-10 (on the lower portion of the T3 stream corridor) achieved the success criteria in 2023.

REFERENCES

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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

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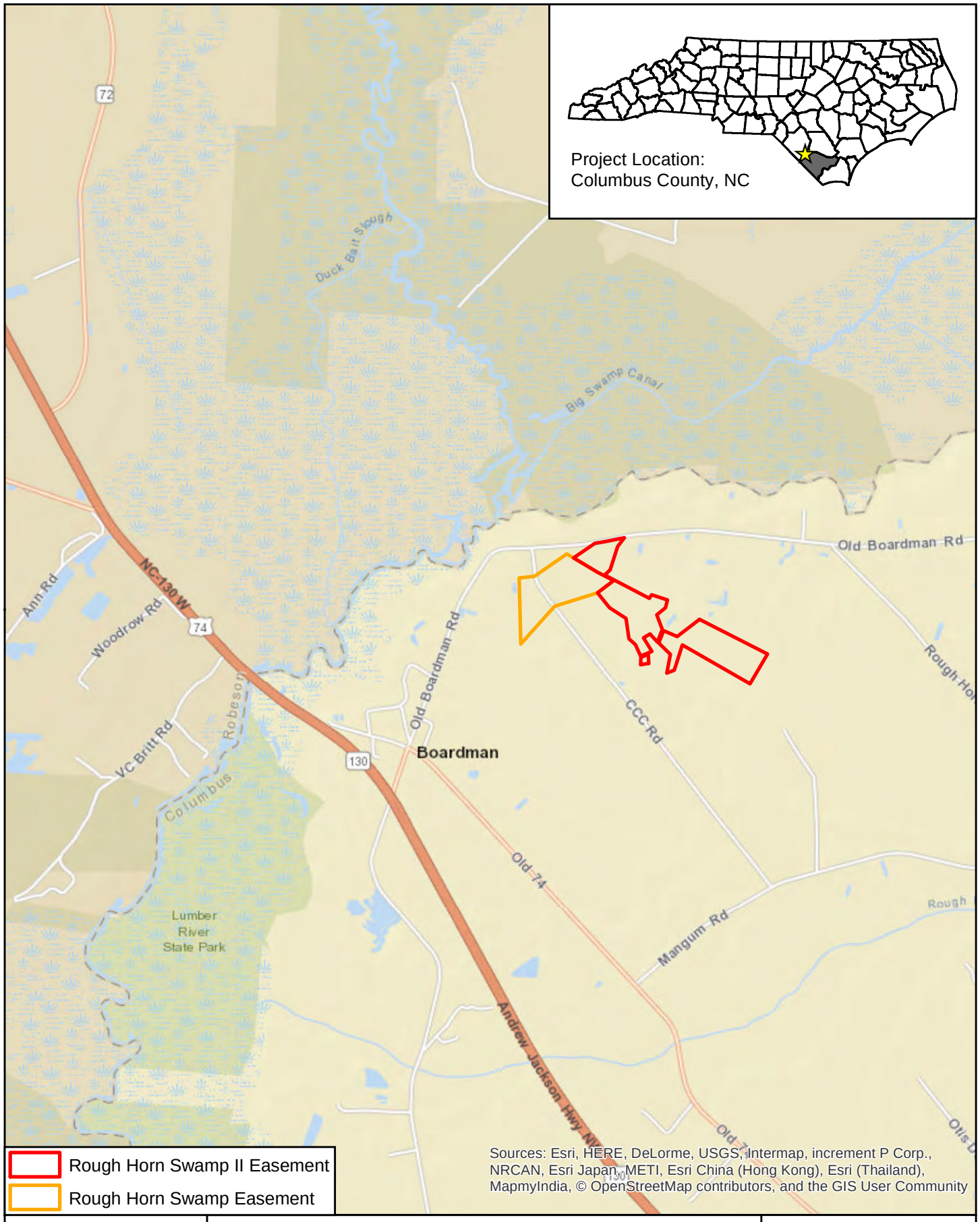


PROJECT VICINITY MAP
ROUGH HORN SWAMP RESTORATION SITE &
ROUGH HORN SWAMP II RESTORATION SITE
COLUMBUS COUNTY, NC

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*	
Year 1 Monitoring	Dec 2020	Jan 2021
Cross-section Survey	*Aug 12, 2020*	
Vegetation Monitoring	*Nov 19, 2020*	
Year 2 Monitoring	Nov 2021	Dec 2021
Cross-section Survey	*June 23, 2021*	
Vegetation Monitoring	*June 23, 2021*	
Sweetgum Removal		August 18, 2022
Year 3 Monitoring	Nov 2022	Dec 2022
Cross-section Survey	*August 17, 2022*	
Vegetation Monitoring	*June 22, 2022*	
Year 4 Monitoring	Dec 2023	Jan 2024

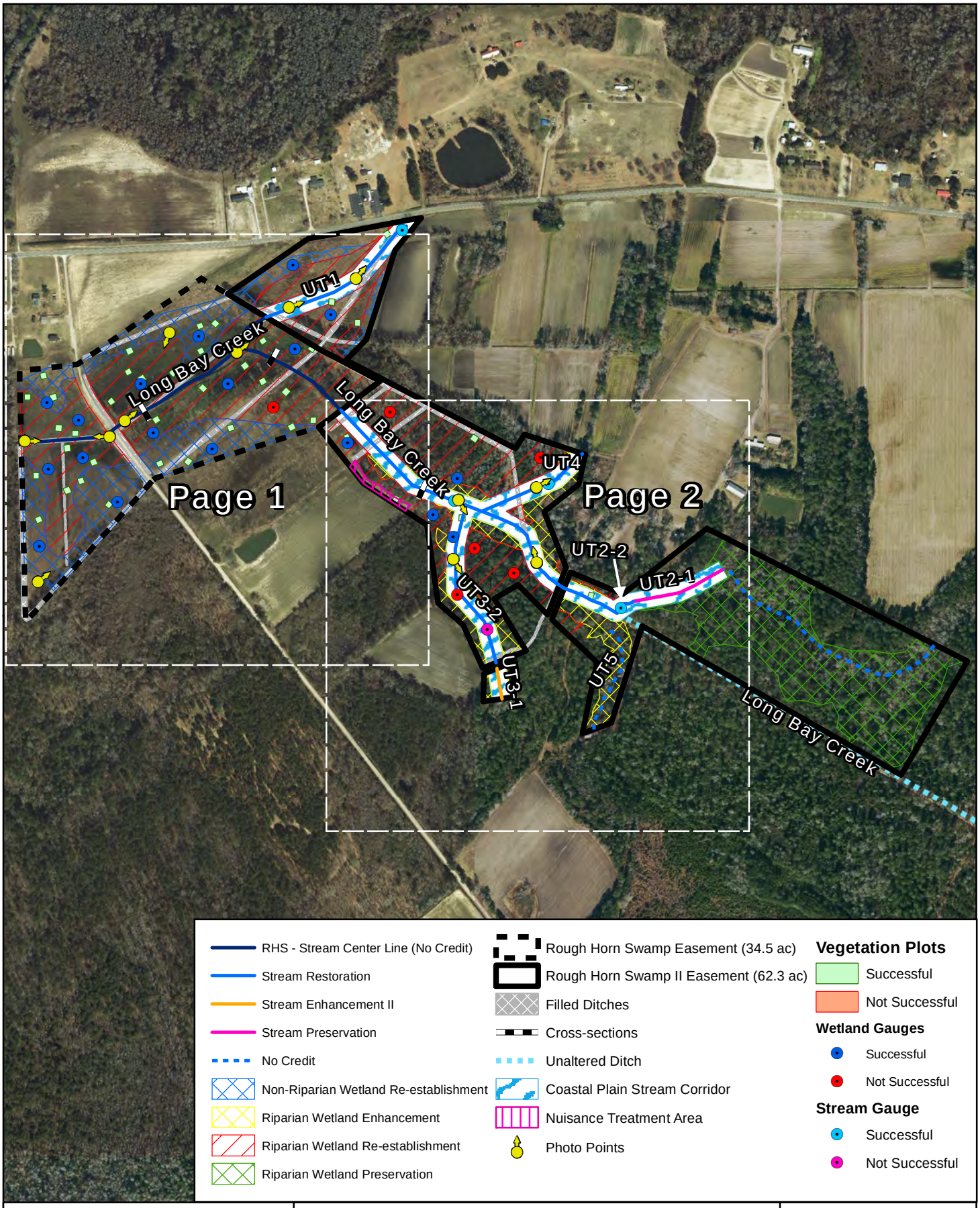
Table 3. Project Contacts **Rough Horn Swamp and Rough Horn II Swamp Restoration Sites** **DMS Project #97005 and 100053**	
Design Firm	KCI Associates of North Carolina, PA 4505 Falls of Neuse Rd. Suite 400 Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266
Construction 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, PA 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



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

Nuisance Treatment Area

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)

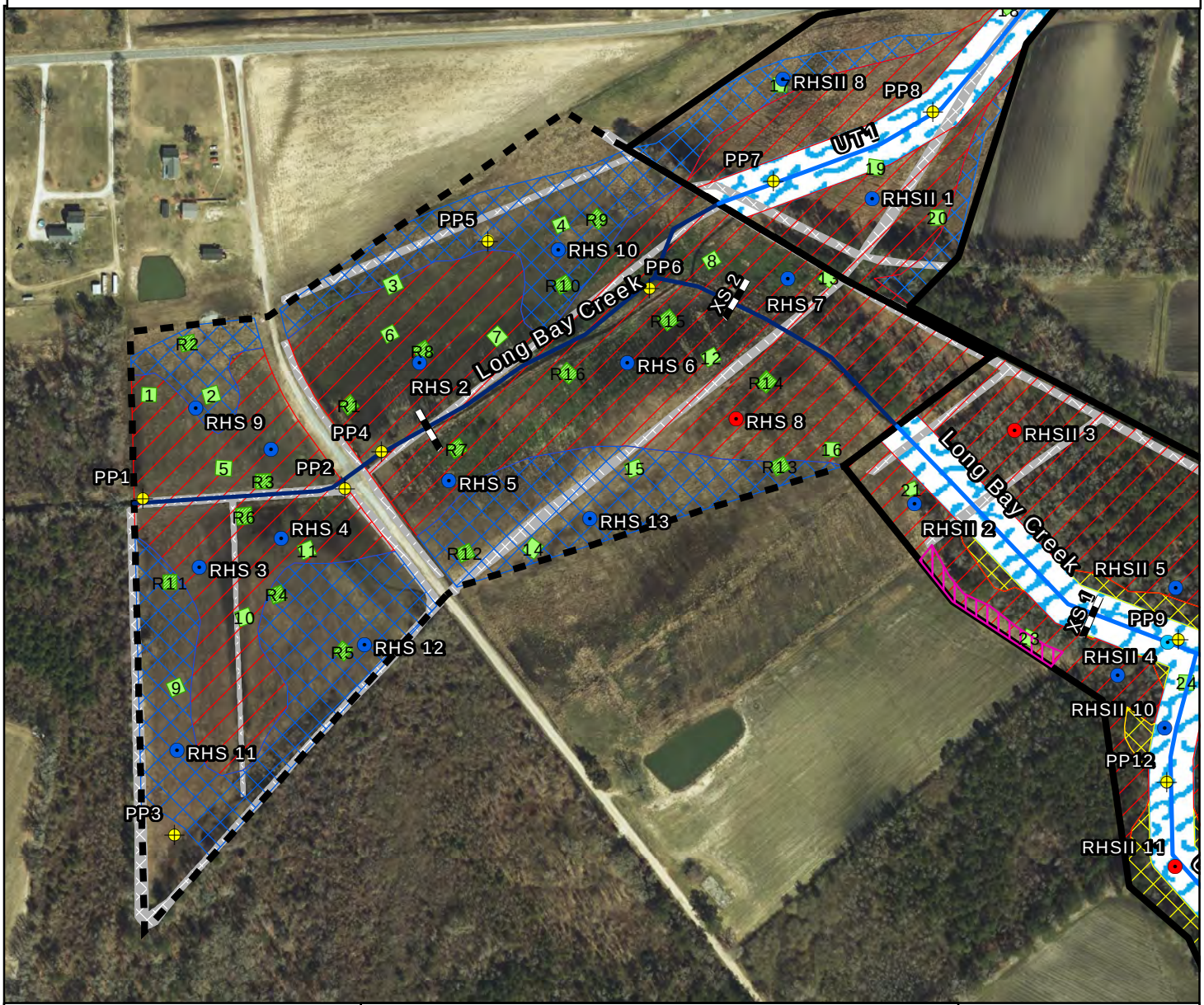
Vegetation Plots

Permanent, Successful

Permanent, Not Successful

Random, Successful

Random, Not Successful



0 205 410 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

Nuisance Treatment Area

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)

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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)

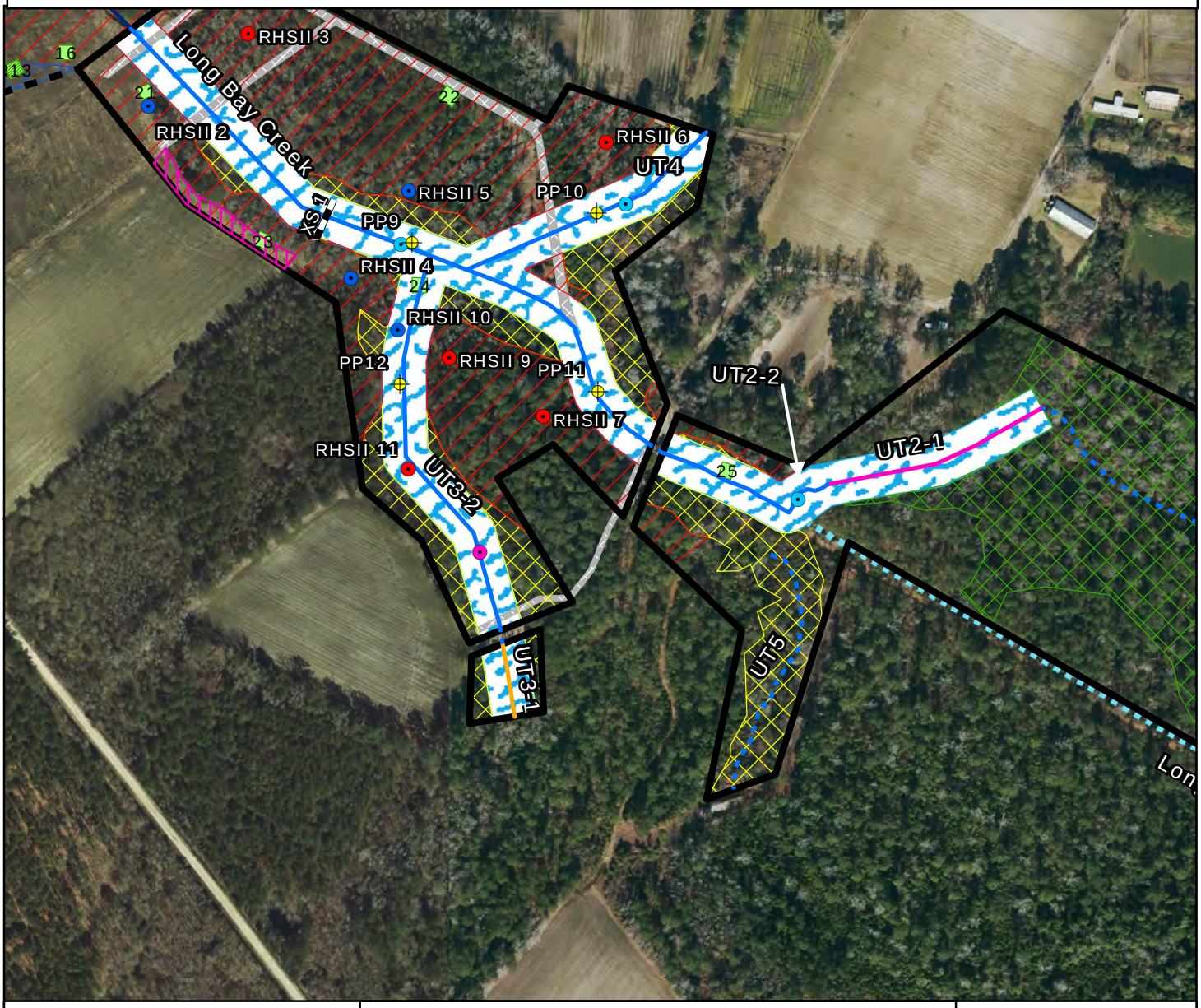
Vegetation Plots

Permanent, Successful

Permanent, Not Successful

Random, Successful

Random, Not Successful



0 205 410 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-04 – 12/12/23

PP2 – MY-00 – 4/8/20

PP2 – MY-04 – 12/12/23

PP3 – MY-00 – 4/8/20

PP3 – MY-04 – 12/12/23

PP4 – MY-00 – 4/8/20

PP4 – MY-04 – 12/12/23

PP5 – MY-00 – 4/8/20

PP5 – MY-04 – 12/12/23

PP6 – MY-00 – 4/8/20

PP6 – MY-04 – 12/12/23

PP7 – MY-00 – 4/8/20

PP7 – MY-04 – 12/12/23

PP8 – MY-00 – 4/8/20

PP8 – MY-04 – 12/12/23

PP9 – MY-00 – 4/8/20

PP9 – MY-04 – 12/12/23

PP10 – MY-00 – 4/8/20

PP10 – MY-04 – 12/12/23

PP11 – MY-00 – 4/8/20

PP11 – MY-04 – 12/12/23

PP12 – MY-00 – 4/8/20

PP12 – MY-04 – 12/12/23

Table 5. Evidence of Channel Development Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
LBC	MY01 (2020)	MY02 (2021)	MY03 (2022)	MY04 (2023)	MY05 (2024)	MY06 (2025)	MY07 (2026)
Max consecutive days channel flow	277	152	124	158			
Presence of litter and debris (wracking)	Yes	Yes	Yes	Yes			
Leaf litter disturbed or washed away	Yes	Yes	Yes	Yes			
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes	Yes			
Sediment deposition and/or scour indicating sediment transport	No	No	No	No			
Water staining due to continual presence of water	Yes	Yes	Yes	Yes			
Formation of channel bed and banks	No	No	No	No			
Sediment sorting within the primary path of flow	Yes	Yes	Yes	Yes			
Sediment shelving or a natural line impressed on the banks	No	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	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	Yes			
Exposure of woody plant roots within the primary path of flow	Yes	Yes	Yes	Yes			
Other							

Table 5. Evidence of Channel Development Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
UT1	MY01 (2020)	MY02 (2021)	MY03 (2022)	MY04 (2023)	MY05 (2024)	MY06 (2025)	MY07 (2026)
Max consecutive days channel flow	71	139	118	143			
Presence of litter and debris (wracking)	No	No	No	No			
Leaf litter disturbed or washed away	Yes	Yes	Yes	Yes			
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes	Yes			
Sediment deposition and/or scour indicating sediment transport	No	Yes	Yes	No			
Water staining due to continual presence of water	Yes	Yes	Yes	Yes			
Formation of channel bed and banks	Yes	Yes	Yes	Yes			
Sediment sorting within the primary path of flow	Yes	Yes	Yes	Yes			
Sediment shelving or a natural line impressed on the banks	No	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	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	Yes			
Exposure of woody plant roots within the primary path of flow	No	No	No	No			
Other							

Table 5. Evidence of Channel Development Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
UT2	MY01 (2020)	MY02 (2021)	MY03 (2022)	MY04 (2023)	MY05 (2024)	MY06 (2025)	MY07 (2026)
Max consecutive days channel flow	71	112	113	117			
Presence of litter and debris (wracking)	Yes	Yes	Yes	Yes			
Leaf litter disturbed or washed away	Yes	Yes	Yes	Yes			
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes	Yes			
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes	No			
Water staining due to continual presence of water	Yes	Yes	Yes	Yes			
Formation of channel bed and banks	Yes	Yes	Yes	Yes			
Sediment sorting within the primary path of flow	Yes	Yes	Yes	Yes			
Sediment shelving or a natural line impressed on the banks	No	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	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	Yes			
Exposure of woody plant roots within the primary path of flow	No	No	No	No			
Other							

Table 5. Evidence of Channel Development Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
UT3	MY01 (2020)	MY02 (2021)	MY03 (2022)	MY04 (2023)	MY05 (2024)	MY06 (2025)	MY07 (2026)
Max consecutive days channel flow	71	98	0	7			
Presence of litter and debris (wracking)	Yes	Yes	No	No			
Leaf litter disturbed or washed away	No	No	No	No			
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	No	No			
Sediment deposition and/or scour indicating sediment transport	No	No	No	No			
Water staining due to continual presence of water	Yes	Yes	No	No			
Formation of channel bed and banks	No	No	No	No			
Sediment sorting within the primary path of flow	No	No	No	No			
Sediment shelving or a natural line impressed on the banks	No	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	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	No			
Exposure of woody plant roots within the primary path of flow	No	No	No	No			
Other							

Table 5. Evidence of Channel Development Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053							
UT4	MY01 (2020)	MY02 (2021)	MY03 (2022)	MY04 (2023)	MY05 (2024)	MY06 (2025)	MY07 (2026)
Max consecutive days channel flow	71	108	90	107			
Presence of litter and debris (wracking)	Yes	Yes	Yes	Yes			
Leaf litter disturbed or washed away	Yes	Yes	Yes	Yes			
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes	Yes			
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes	No			
Water staining due to continual presence of water	Yes	Yes	Yes	Yes			
Formation of channel bed and banks	Yes	Yes	Yes	Yes			
Sediment sorting within the primary path of flow	Yes	Yes	Yes	Yes			
Sediment shelving or a natural line impressed on the banks	Yes	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	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	Yes			
Exposure of woody plant roots within the primary path of flow	No	No	No	No			
Other							

APPENDIX C

Vegetation Plot Data

Table 6. Stem Count by Plot and Species Rough Horn Swamp and Rough Horn Swamp II, DMS Project #97005 and 100053								
	Annual Means							
	MY03 (2022)		MY02 (2021)		MY01 (2020)		MY00 (2020)	
Species	Planted	Total	Planted	Total	Planted	Total	Planted	Total
American Sycamore (*Platanus occidentalis*)	34	34	36	36	36	36		
Bald Cypress (*Taxodium distichum)*	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*)	36	36	37	37	33	33	2	2
Eastern Baccharis (B*accharis 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 (*Quercu*s *lyrata*)	15	15	23	23	42	42		
Red Chokeberry (*Aronia arbutifolia*)	2	2	3	3	3	3		
Red Maple (*Acer rubrum*)		680		171		242		21
River Birch (*Betula nigra*)	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*)	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*)	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	737	2830	762	1476	850	1933	1061	1089
size (ares)	41		41		41		41	
size (ACRES)	1.01		1.01		1.01		1.01	
Species count	12	17	14	21	13	21	10	14
Stems per ACRE	727	2,793	752	1,457	839	1,908	1,047	1,075

APPENDIX D

Hydrologic Data

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

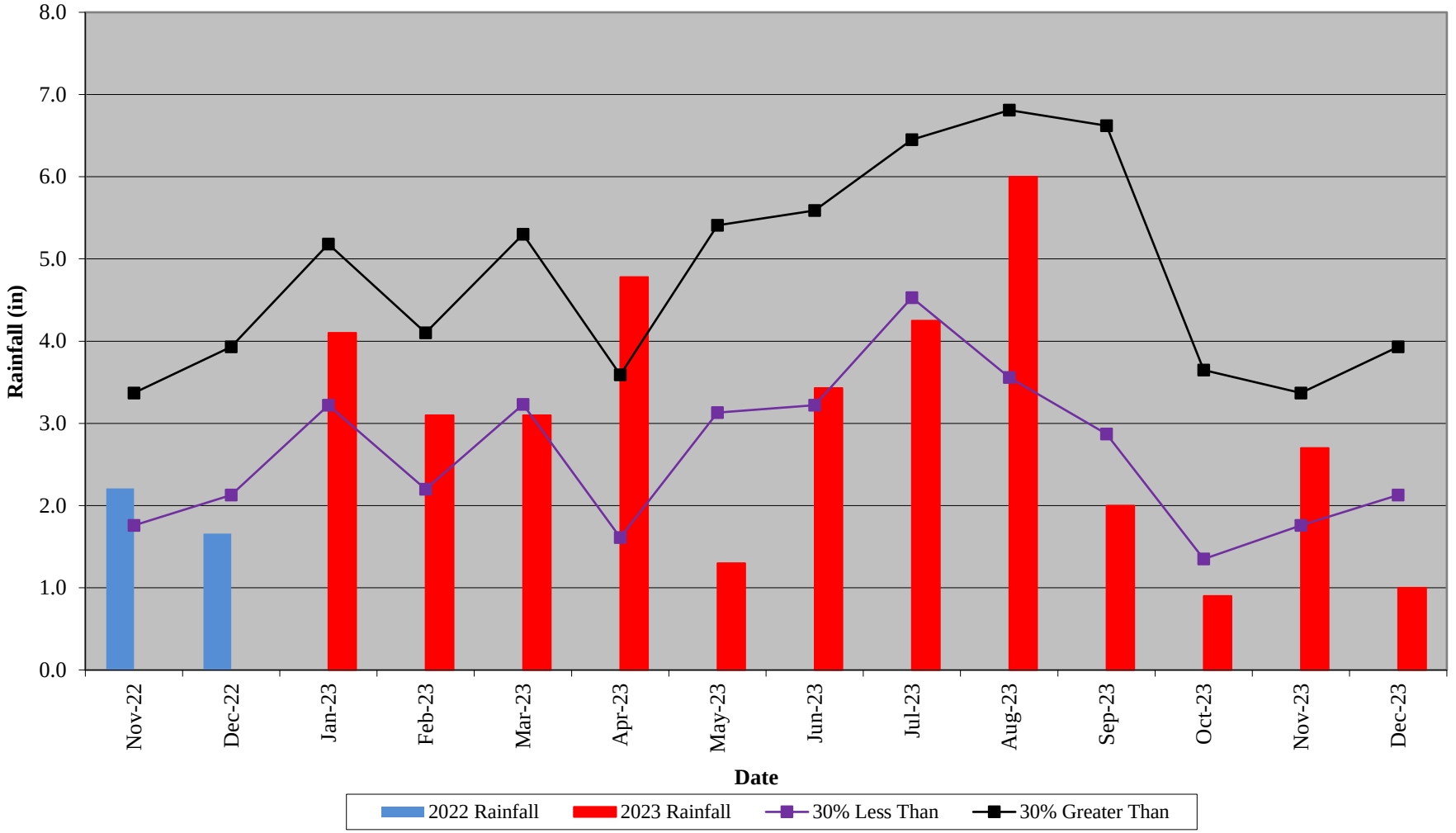
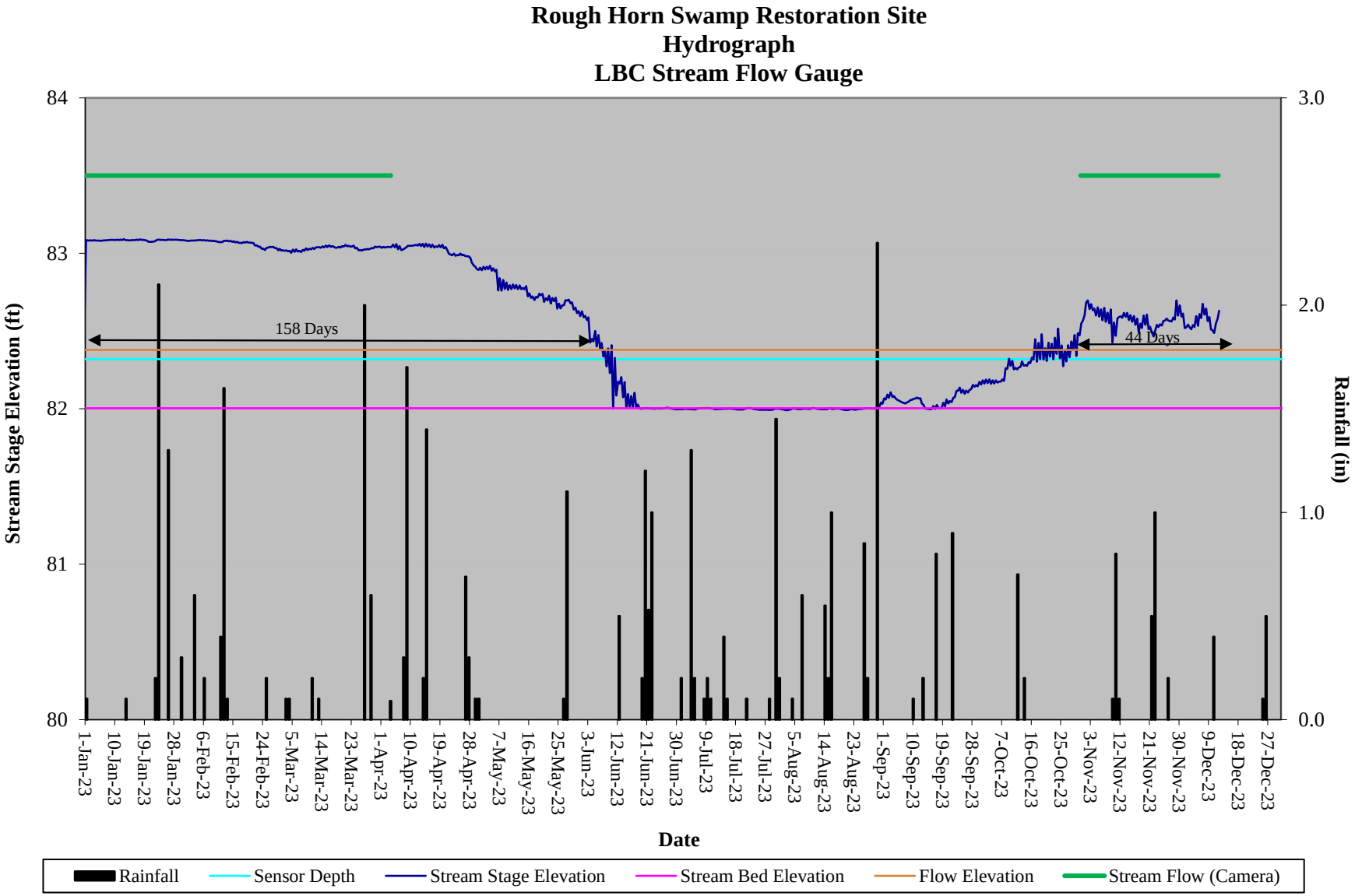
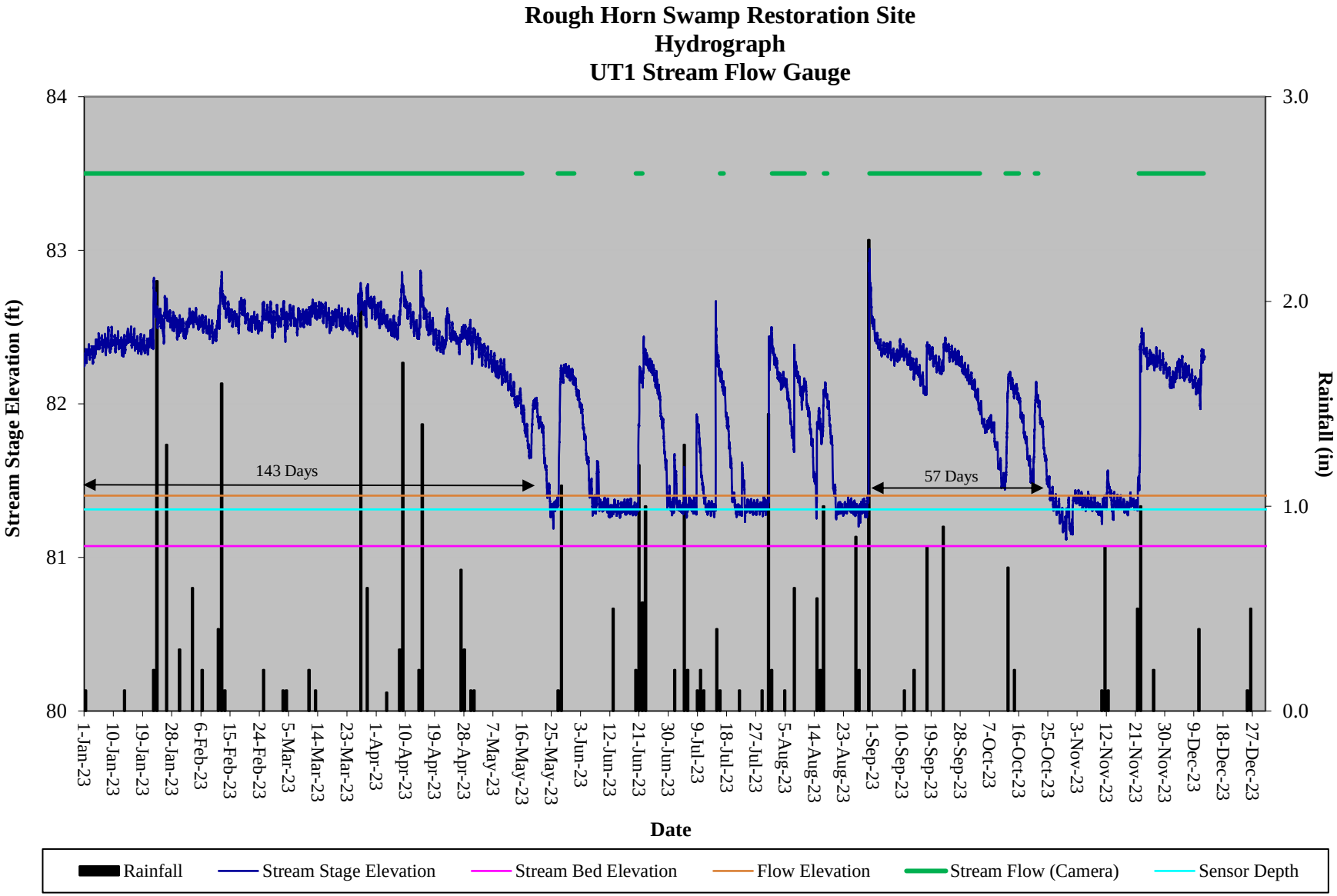


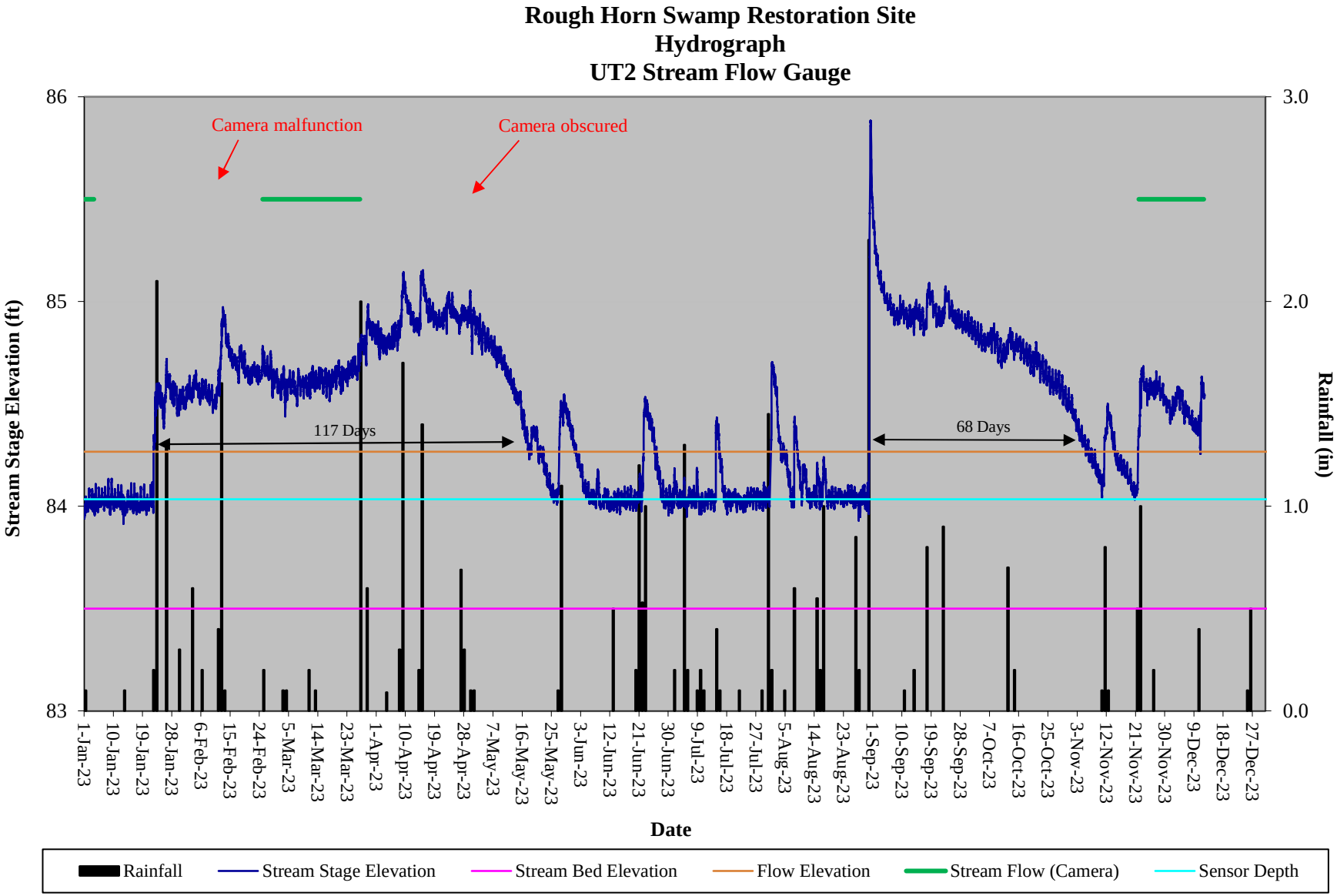
Table 7. Stream Flow Verification Rough Horn Swamp and Rough Horn Swamp II Restoration Site, DMS Project #97005/100053				
	Gauge		Camera	
Reach	Dates Achieving	Maximum Consecutive Days	Dates Achieving	Maximum Consecutive Days
LBC	January 1 – June 7; October 30 – December 12	158	January 1 – April 5	94
UT1	January 1 – May 23; August 30 – October 25	143	January 1 – May 16; August 31 – October 4	136
UT2-2	January 22 –May 18; August 30 – November 5	117	February 25 – March 27	31
UT3-2	N/A	7	Camera Malfunction	
UT4	January 22 –May 8; August 30 – October 5	107	March 23 – May 3	42

Table 8. 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	Yes/158			
LBC (Camera)	Yes/179	Yes/64	Yes/125	Yes/94			
UT1 (Gauge)	Yes/71	Yes/139	Yes/118	Yes/143			
UT1 (Camera)	Yes/71	Yes/136	*	Yes/136			
UT2-2 (Gauge)	Yes/71	Yes/112	Yes/113	Yes/117			
UT2-2 (Camera)	Yes/71	Yes/152	Yes/127	Yes/31			
UT3-2 (Gauge)	Yes/71	Yes/98	No/0	No/7			
UT3-2 (Camera)	Yes/78	Yes/93	No/0	*			
UT4 (Gauge)	Yes/71	Yes/108	Yes/90	Yes/107			
UT4 (Camera)	Yes/71	Yes/107	Yes/89	Yes/42			

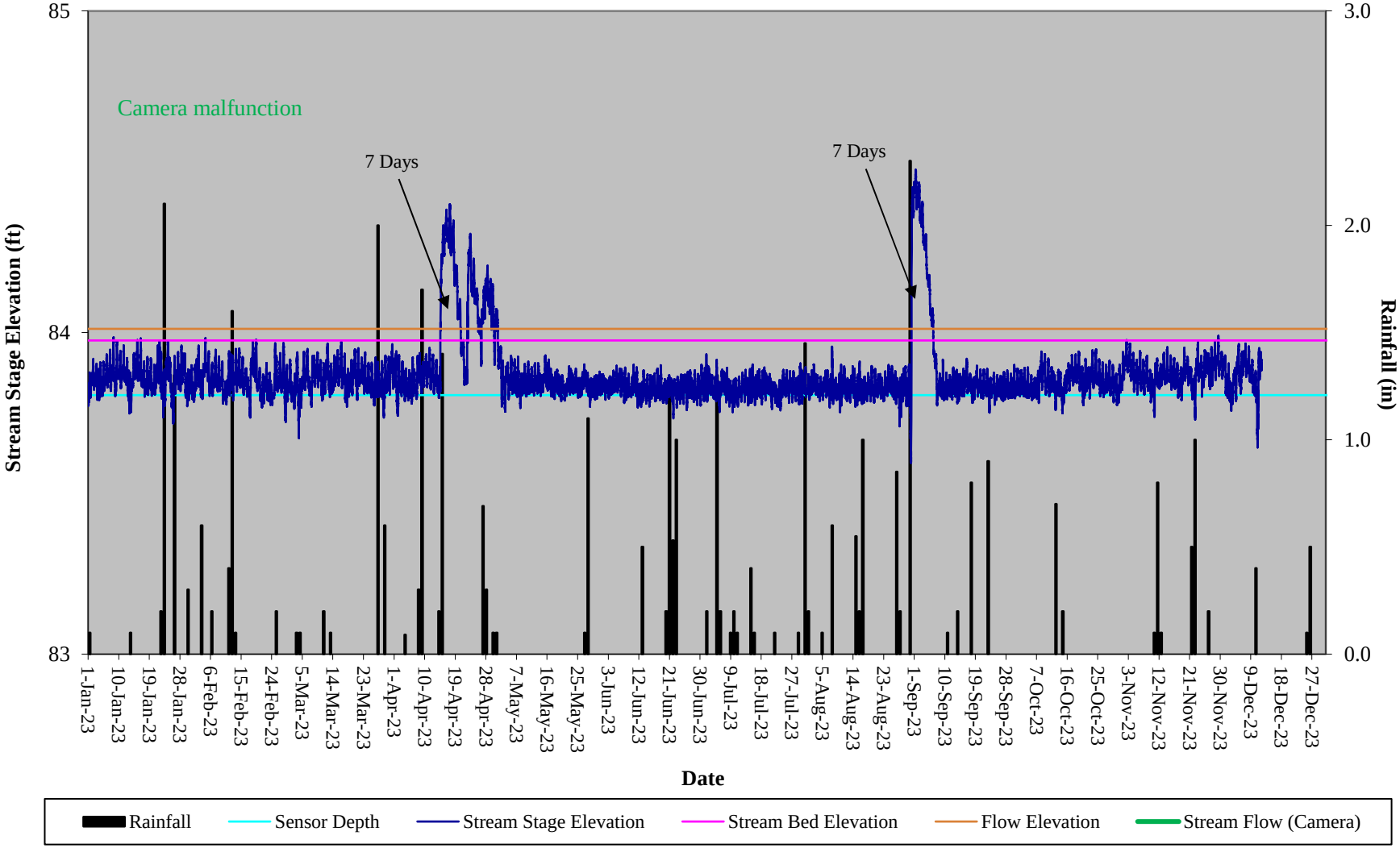
*Camera malfunction


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


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


Rough Horn Swamp Restoration Site
Hydrograph
UT2 Stream Flow Gauge
Camera malfunction
Camera obscured
117 Days
68 Days
Stream Stage Elevation (ft)
Rainfall (in)
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



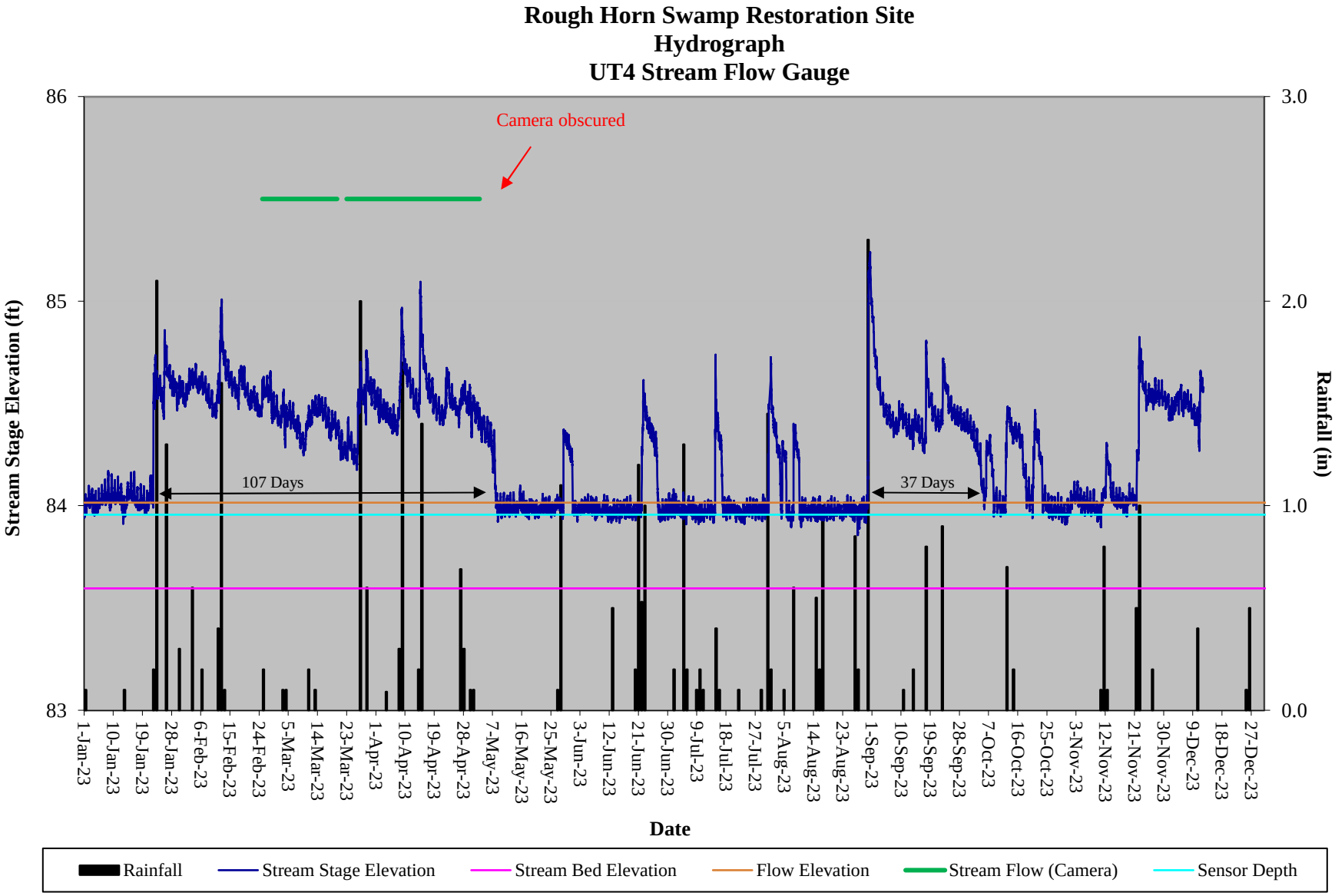
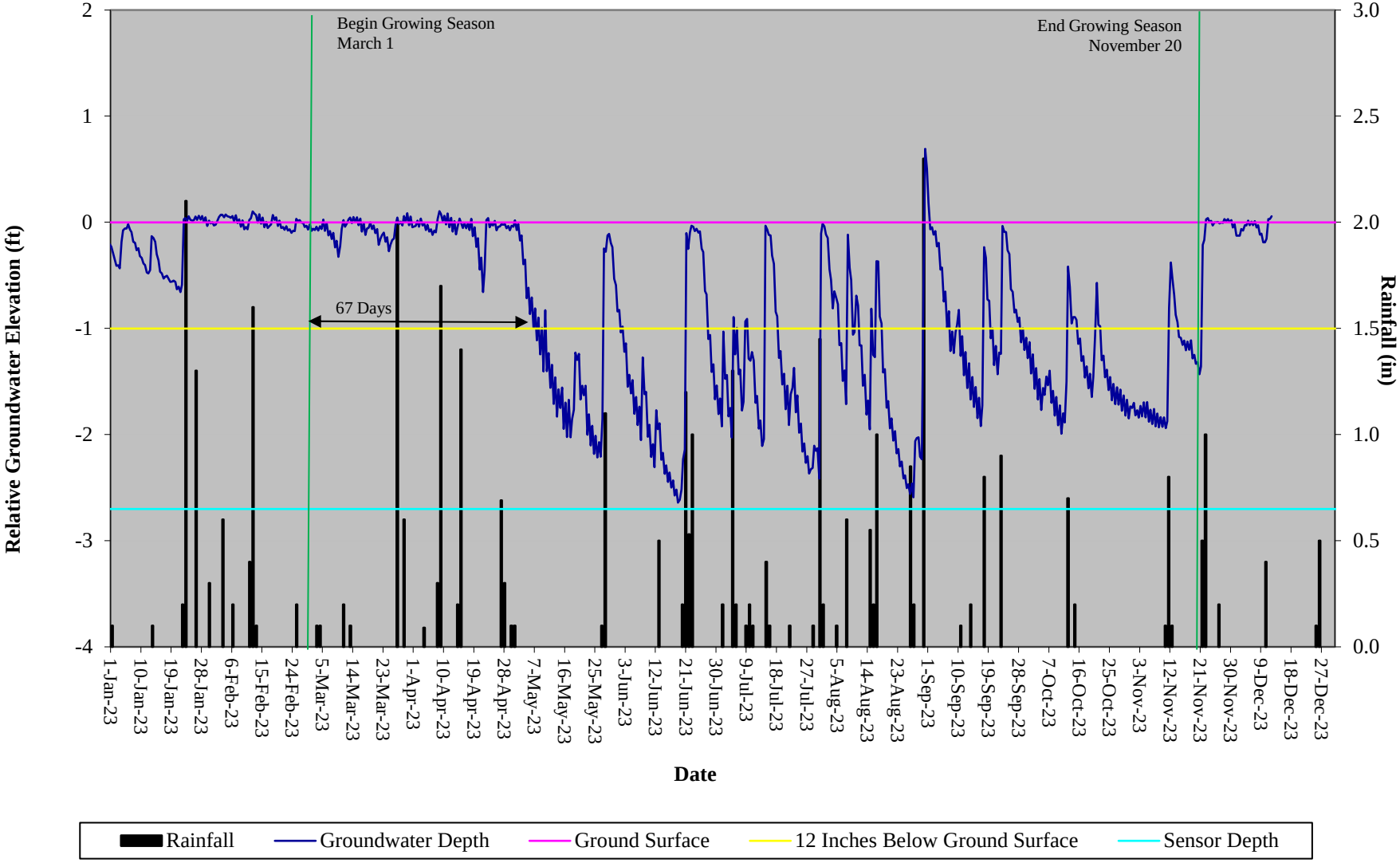

Rough Horn Swamp Restoration Site
Hydrograph
UT4 Stream Flow Gauge
Camera obscured
107 Days
37 Days
Stream Stage Elevation (ft)
Rainfall (in)
Date
86
85
84
83
3.0
2.0
1.0
0.0
1-Jan-23
10-Jan-23
19-Jan-23
28-Jan-23
6-Feb-23
15-Feb-23
24-Feb-23
5-Mar-23
14-Mar-23
23-Mar-23
1-Apr-23
10-Apr-23
19-Apr-23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

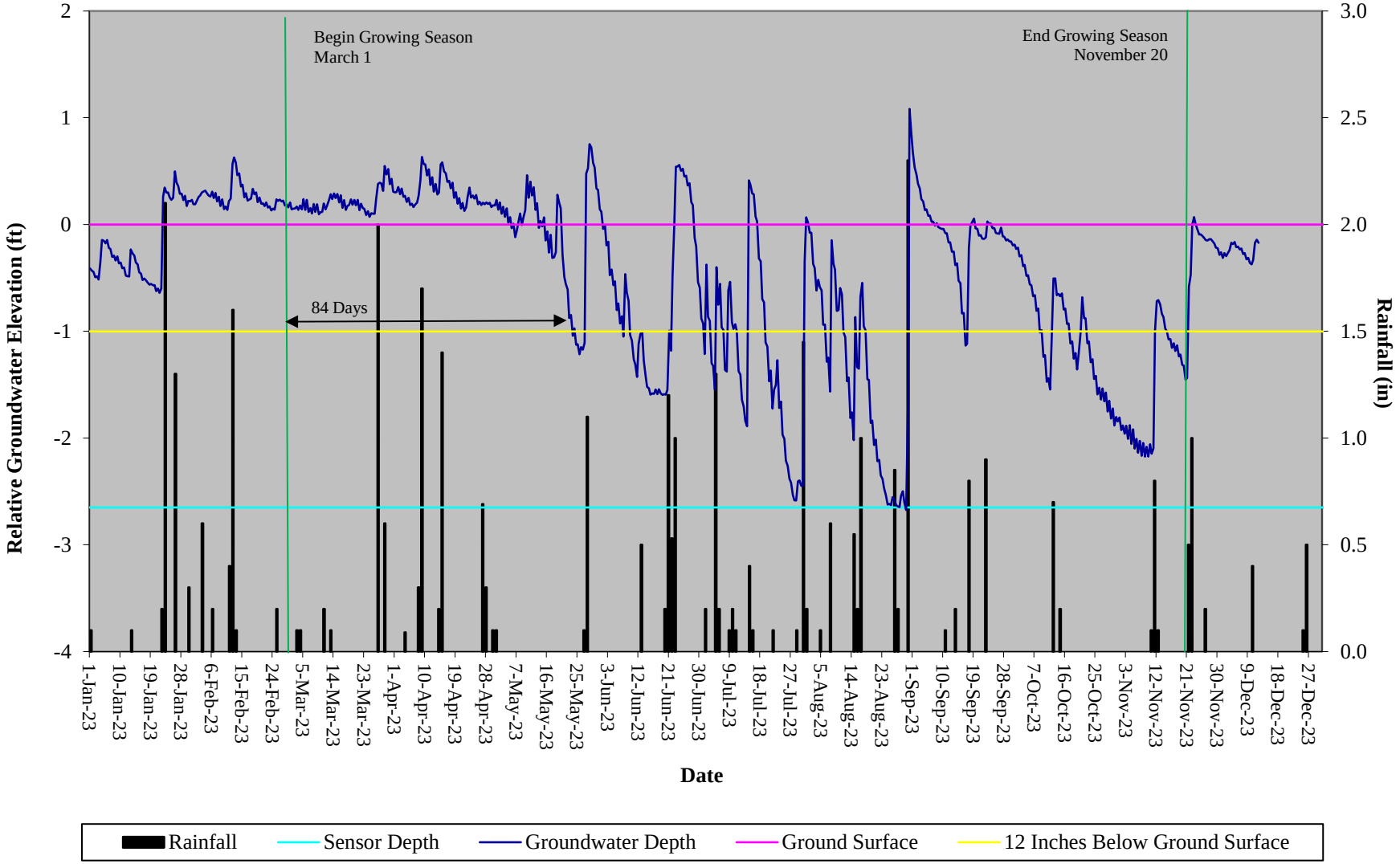
	Success Criteria Achieved / Max Consecutive Days During Growing Season (Percentage)						
Success Criteria (32 Days) (12.0%)	**MY-01 2020**	**MY-02 2021**	**MY-03**	**MY-04**	**MY-05**	**MY-06**	**MY-07**
Gauge RHS-1	Yes/73 (27.5%)	Yes/40 (15.1%)	Yes/34 (12.8%)	Yes/67 (25.3%)			
Gauge RHS-2	Yes/114 (43.0%)	Yes/53 (20.0%)	Yes/34 (12.8%)	Yes/84 (31.7%)			
Gauge RHS-3	Yes/65 (24.5%)	Yes/37 (14.0%)	Yes/34 (12.8%)	Yes/65 (24.5%)			
Gauge RHS-4	Yes/73 (27.5%)	Yes/50 (18.9%)	Yes/35 (13.2%)	Yes/69 (26.0%)			
Gauge RHS-5	Yes/73 (27.5%)	Yes/49 (18.5%)	Yes/35 (13.2%)	Yes/69 (26.0%)			
Gauge RHS-6	Yes/115 (43.4%)	Yes/50 (18.9%)	Yes/60 (22.6%)	Yes/68 (25.7%)			
Gauge RHS-7	Yes/83 (31.3%)	Yes/52 (19.6%)	Yes/35 (13.2%)	Yes/71 (26.8%)			
Gauge RHS-8	Yes/73 (27.5%)	Yes/36 (13.6%)	No/29 (10.9%)	No/14 (5.3%)			
Gauge RHS-9	Yes/65 (24.5%)	Yes/37 (14.0%)	No/29 (10.9%)	Yes/65 (24.5%)			
Gauge RHS-10	Yes/73 (27.5%)	Yes/49 (18.5%)	Yes/32 (12.1%)	Yes/70 (26.4%)			
Gauge RHS-11	Yes/41 (15.5%)	Yes/37 (14.0%)	No/22 (8.3%)	Yes/55 (20.8%)			
Gauge RHS-12	No/21 (7.9%)	Yes/36 (13.6%)	No/29 (10.9%)	Yes/42 (15.8%)			
Gauge RHS-13	Yes/65 (24.5%)	Yes/35 (13.2%)	No/28 (10.6%)	Yes/36 (13.6%)			
Gauge RHSII-1	Yes/73 (27.5%)	Yes/50 (18.9%)	Yes/33 (12.5%)	Yes/67 (25.3%)			
Gauge RHSII-2	Yes/73 (27.5%)	Yes/51 (19.2%)	Yes/32 (12.1%)	Yes/65 (24.5%)			
Gauge RHSII-3	Yes/65 (24.5%)	Yes/37 (14.0%)	No/9 (3.4%)	No/25 (9.4%)			
Gauge RHSII-4	Yes/264 (99.6%)	Yes/63 (23.8%)	Yes/55 (20.8%)	Yes/101 (38.1%)			
Gauge RHSII-5	Yes/264 (99.6%)	Yes/61 (23.0%)	Yes/55 (20.8%)	Yes/86 (32.5%)			
Gauge RHSII-6	Yes/37 (14.0%)	Yes/36 (13.6%)	No/8 (3.0%)	No/14 (5.3%)			
Gauge RHSII-7	Yes/33 (12.5%)	No/7 (2.6%)	No/0 (0.0%)	No/6 (2.3%)			
Gauge RHSII-8	Yes/73 (27.5%)	Yes/50 (18.9%)	No/27 (10.2%)	Yes/64 (24.2%)			
Gauge RHSII-9				4* (1.5%)			
Gauge RHSII-10				Yes/68* (25.7%)			
Gauge RHSII-11				13* (4.9%)			
Gauge Ref	Yes/53 (20.0%)	Yes/44 (16.6%)	No/6 (2.3%)	No/31 (11.7%)			

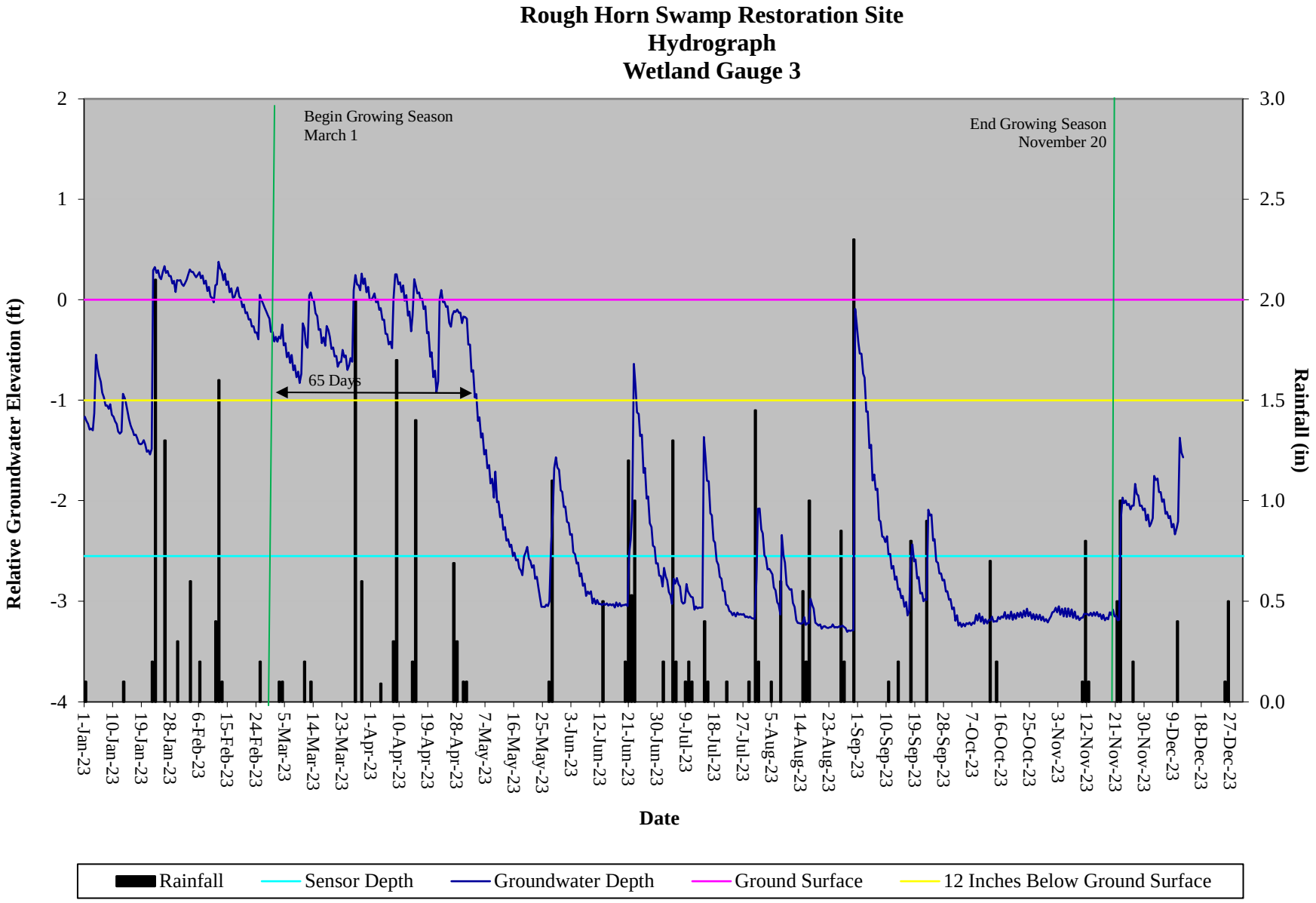
*Gauge installed 8/1/2023 and did not record for most of the growing season

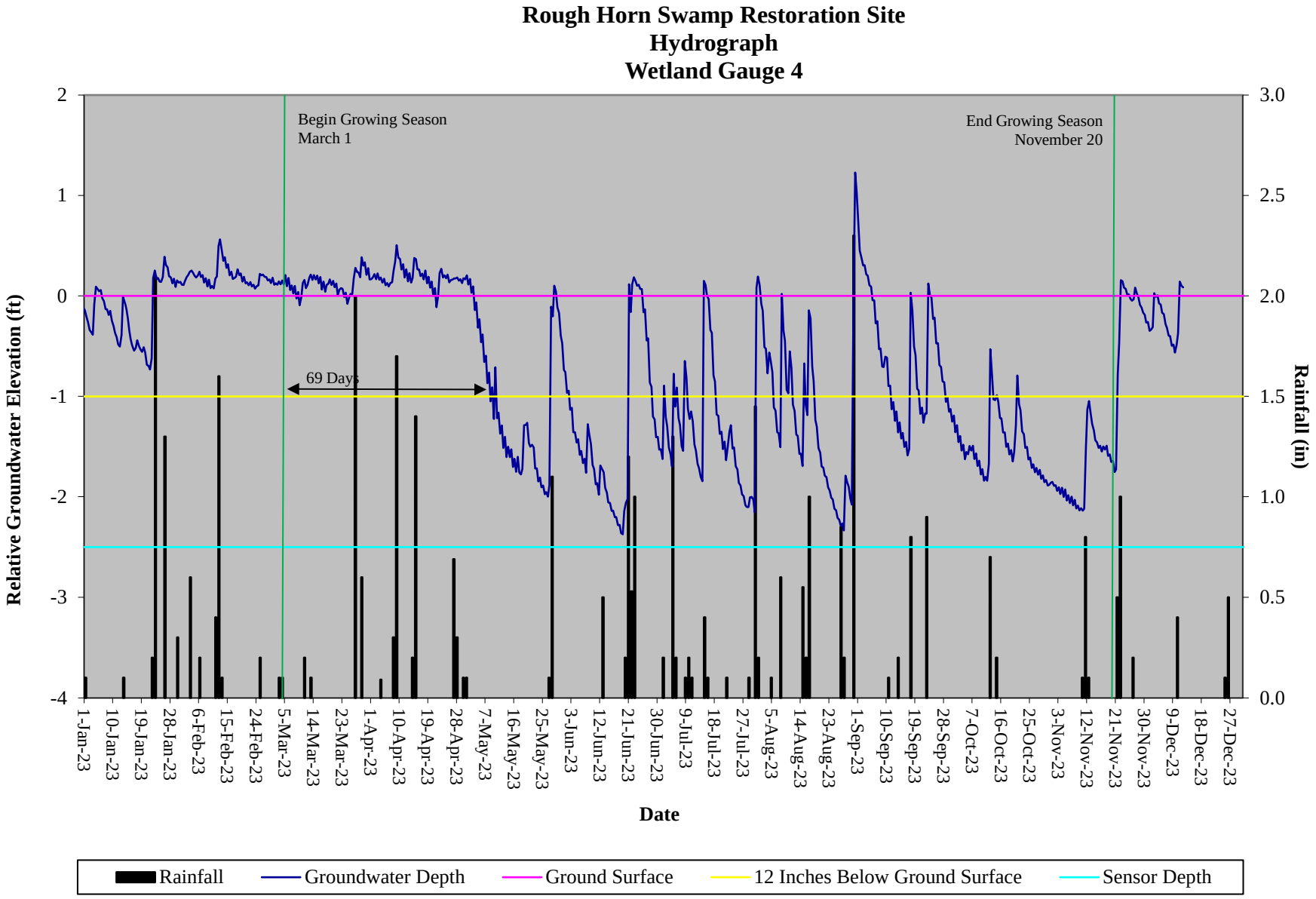
Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 1

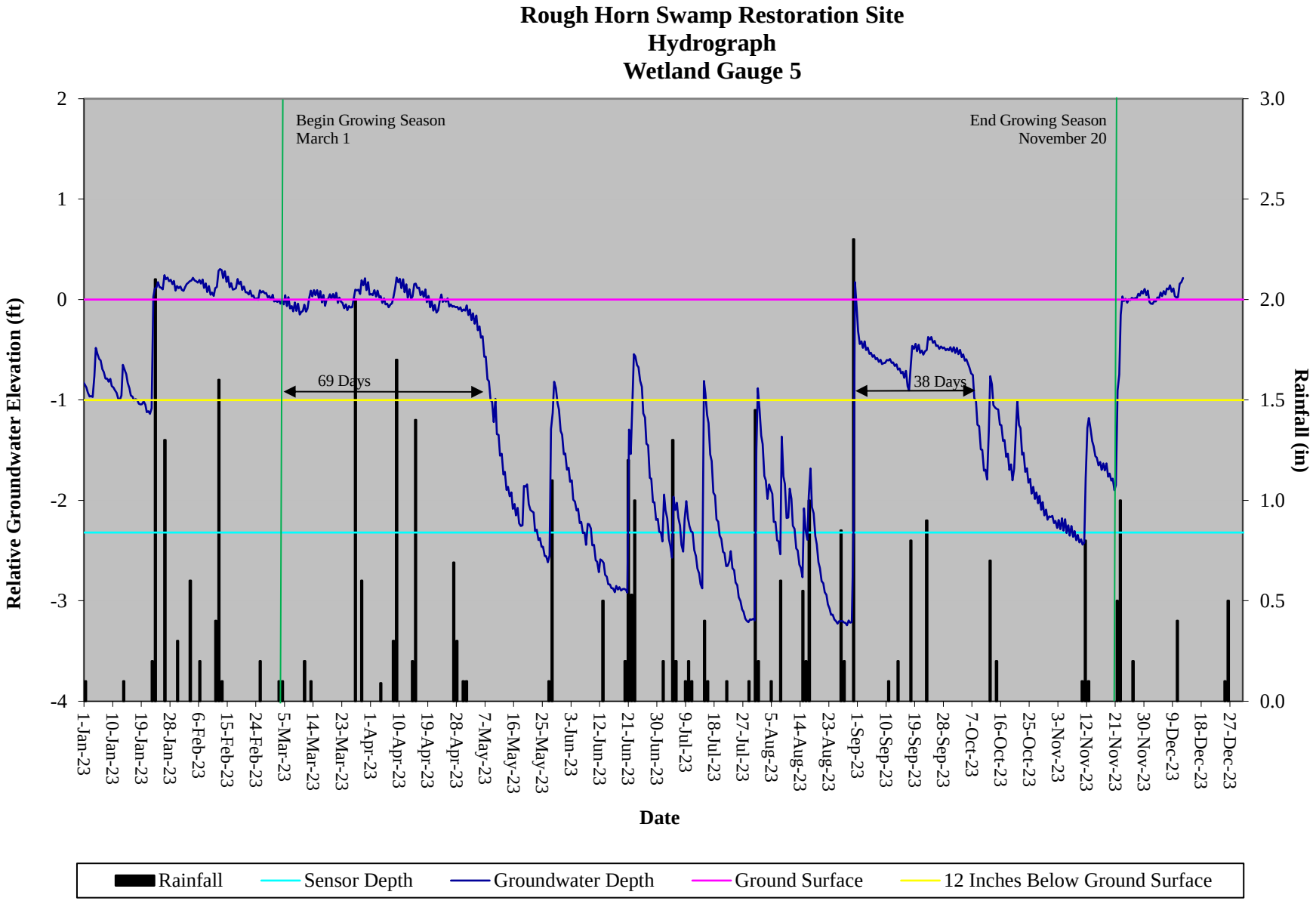


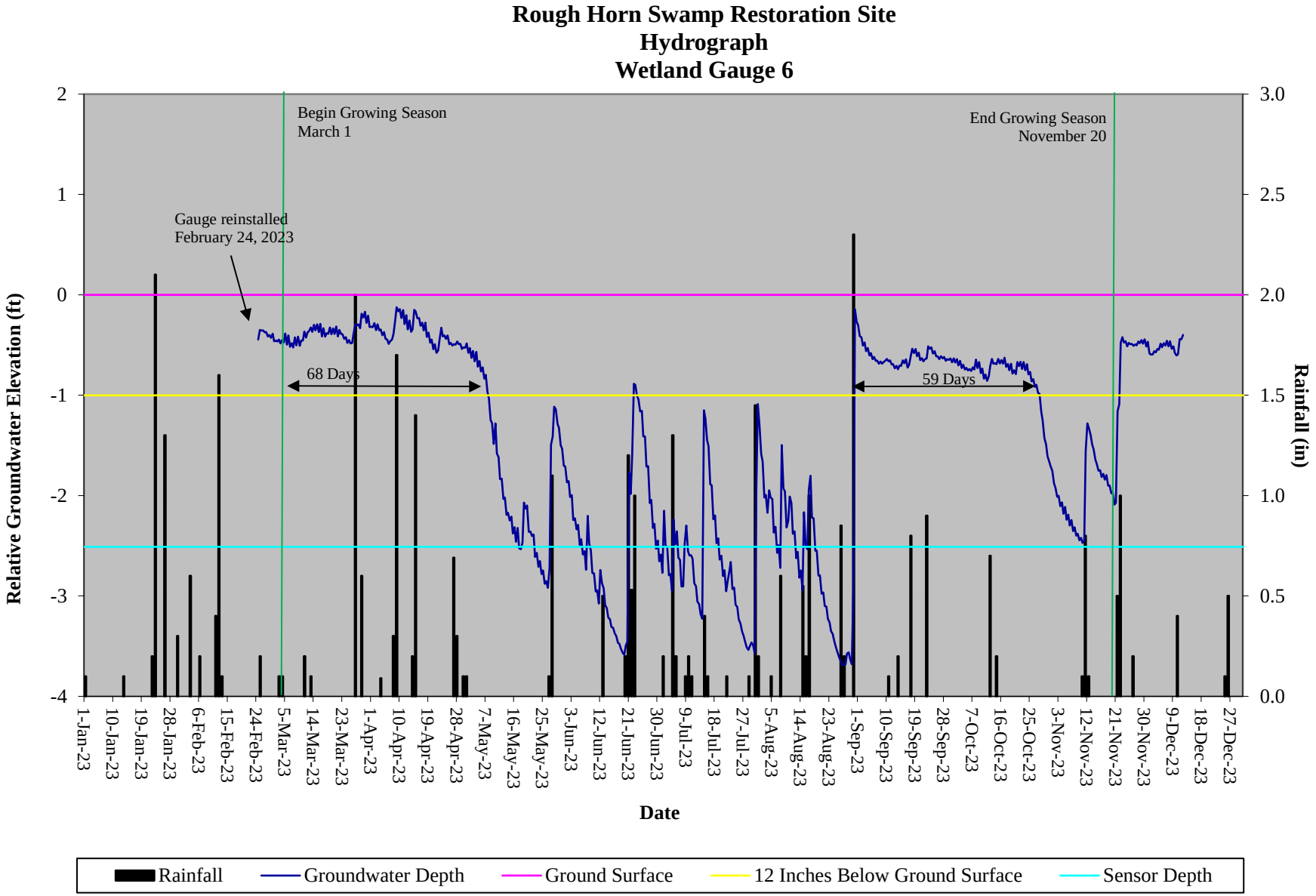
Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 2

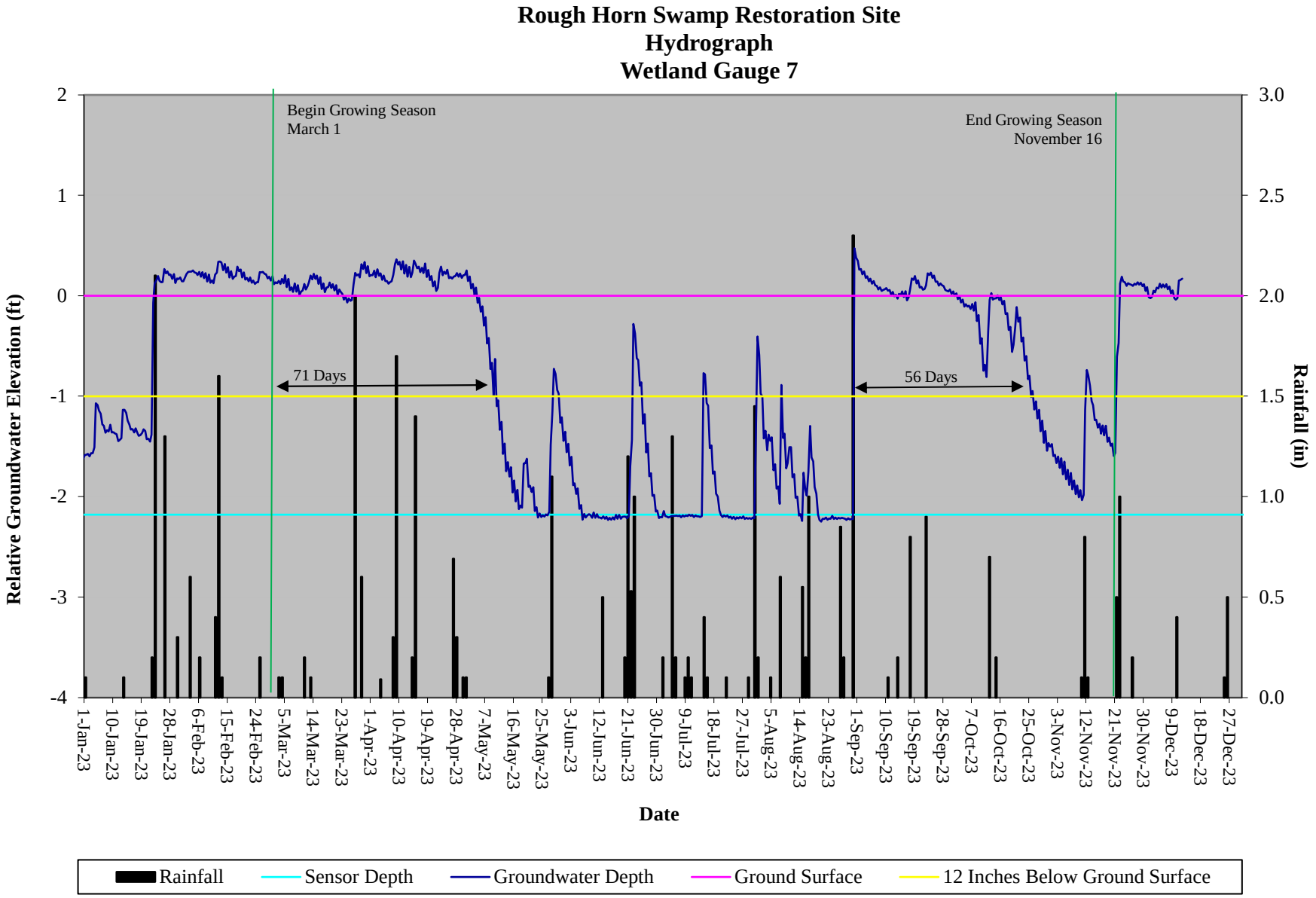



Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 3
Begin Growing Season
March 1
End Growing Season
November 20
65 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
2
1
0
-1
-2
-3
-4
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-23
10-Jan-23
19-Jan-23
28-Jan-23
6-Feb-23
15-Feb-23
24-Feb-23
5-Mar-23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

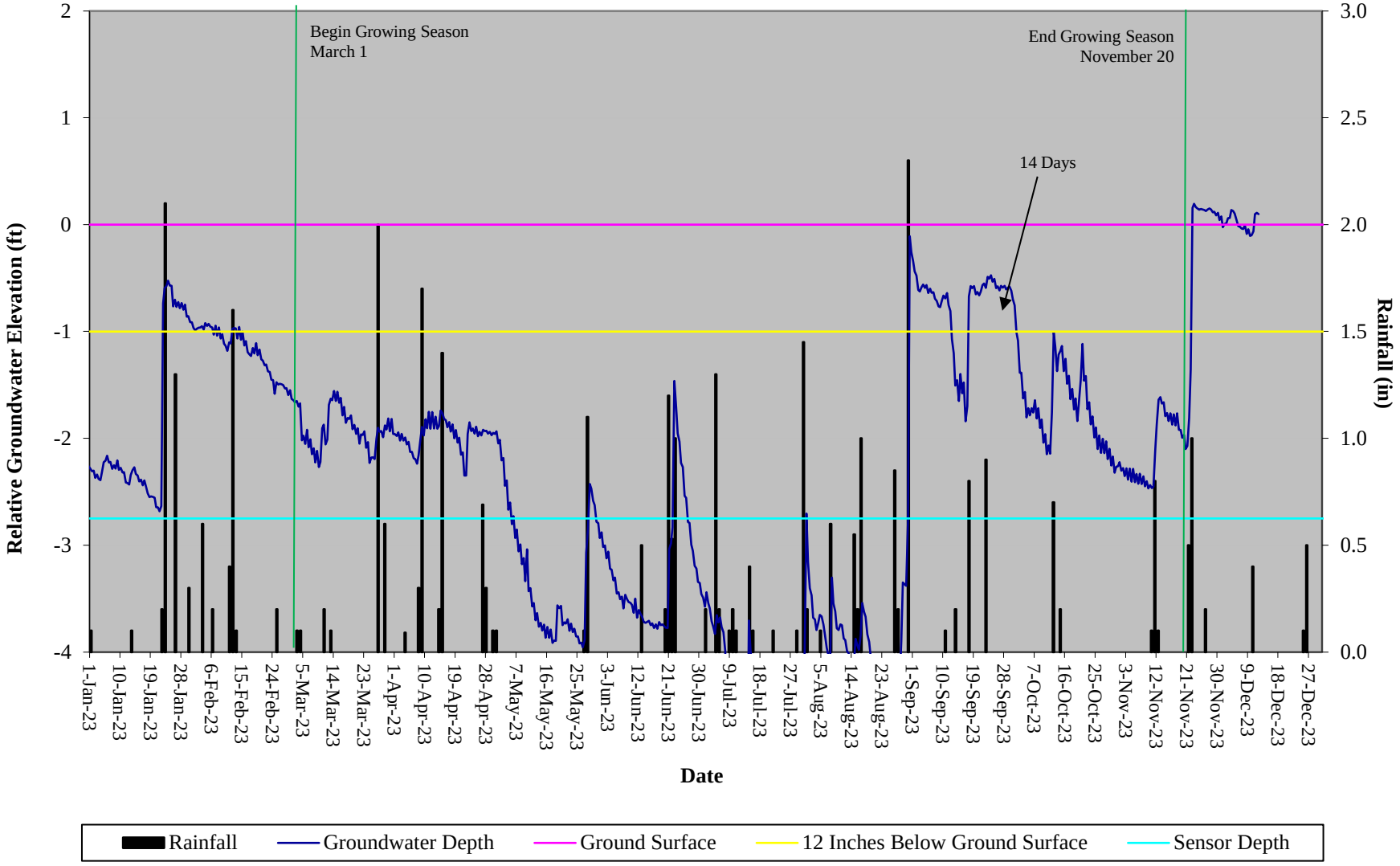

Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 4
Begin Growing Season
March 1
End Growing Season
November 20
69 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
2
1
0
-1
-2
-3
-4
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-23
10-Jan-23
19-Jan-23
28-Jan-23
6-Feb-23
15-Feb-23
24-Feb-23
5-Mar-23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

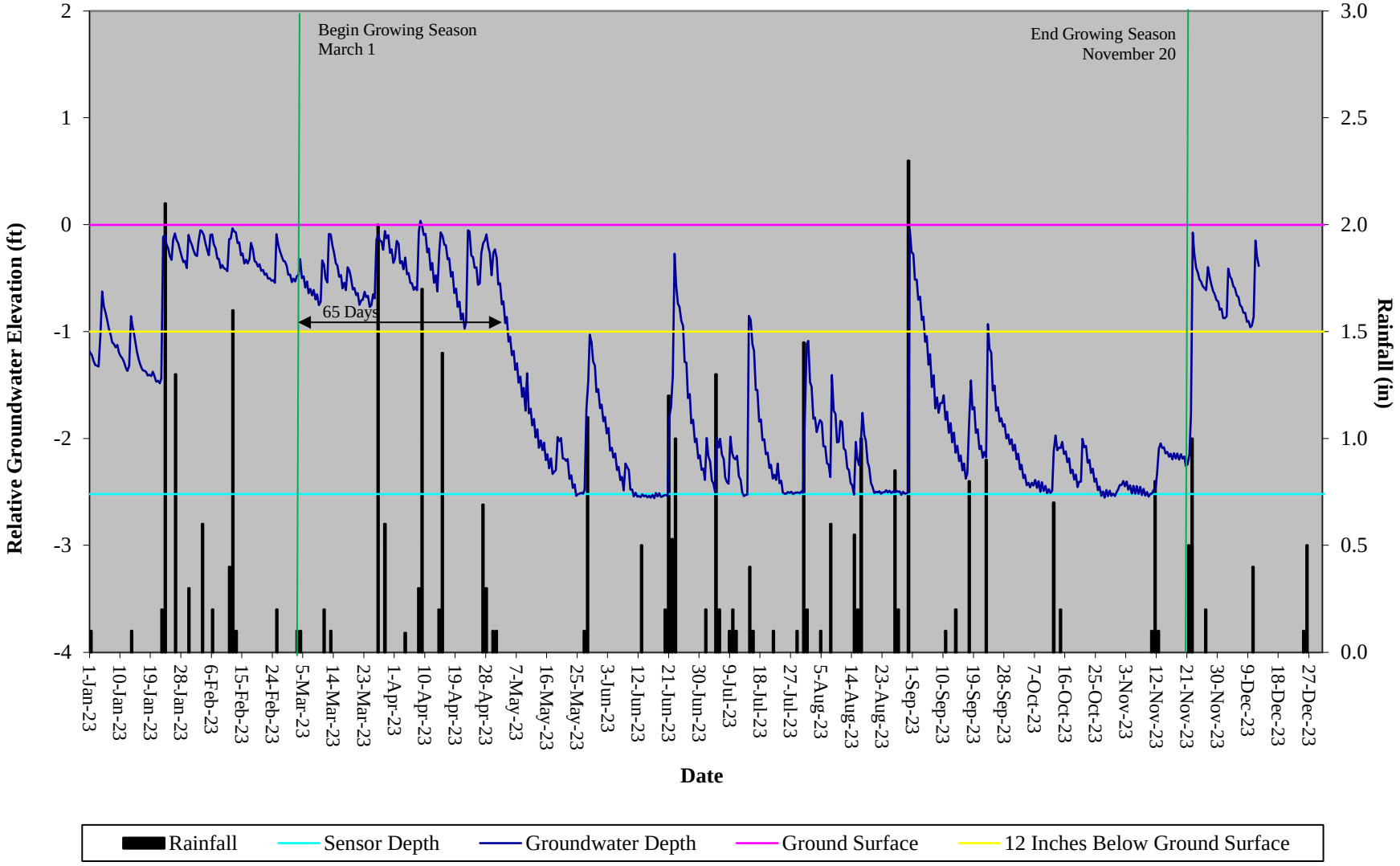

Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 6
Begin Growing Season
March 1
End Growing Season
November 20
Gauge reinstalled
February 24, 2023
68 Days
59 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
2
1
0
-1
-2
-3
-4
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-23
10-Jan-23
19-Jan-23
28-Jan-23
6-Feb-23
15-Feb-23
24-Feb-23
5-Mar-23
14-Mar-23
23-Mar-23
1-Apr-23
10-Apr-23
19-Apr-23
28-Apr-23
7-May-23
16-May-23
25-May-23
3-Jun-23
12-Jun-23
21-Jun-23
30-Jun-23
9-Jul-23
18-Jul-23
27-Jul-23
5-Aug-23
14-Aug-23
23-Aug-23
1-Sep-23
10-Sep-23
19-Sep-23
28-Sep-23
7-Oct-23
16-Oct-23
25-Oct-23
3-Nov-23
12-Nov-23
21-Nov-23
30-Nov-23
9-Dec-23
18-Dec-23
27-Dec-23
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


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

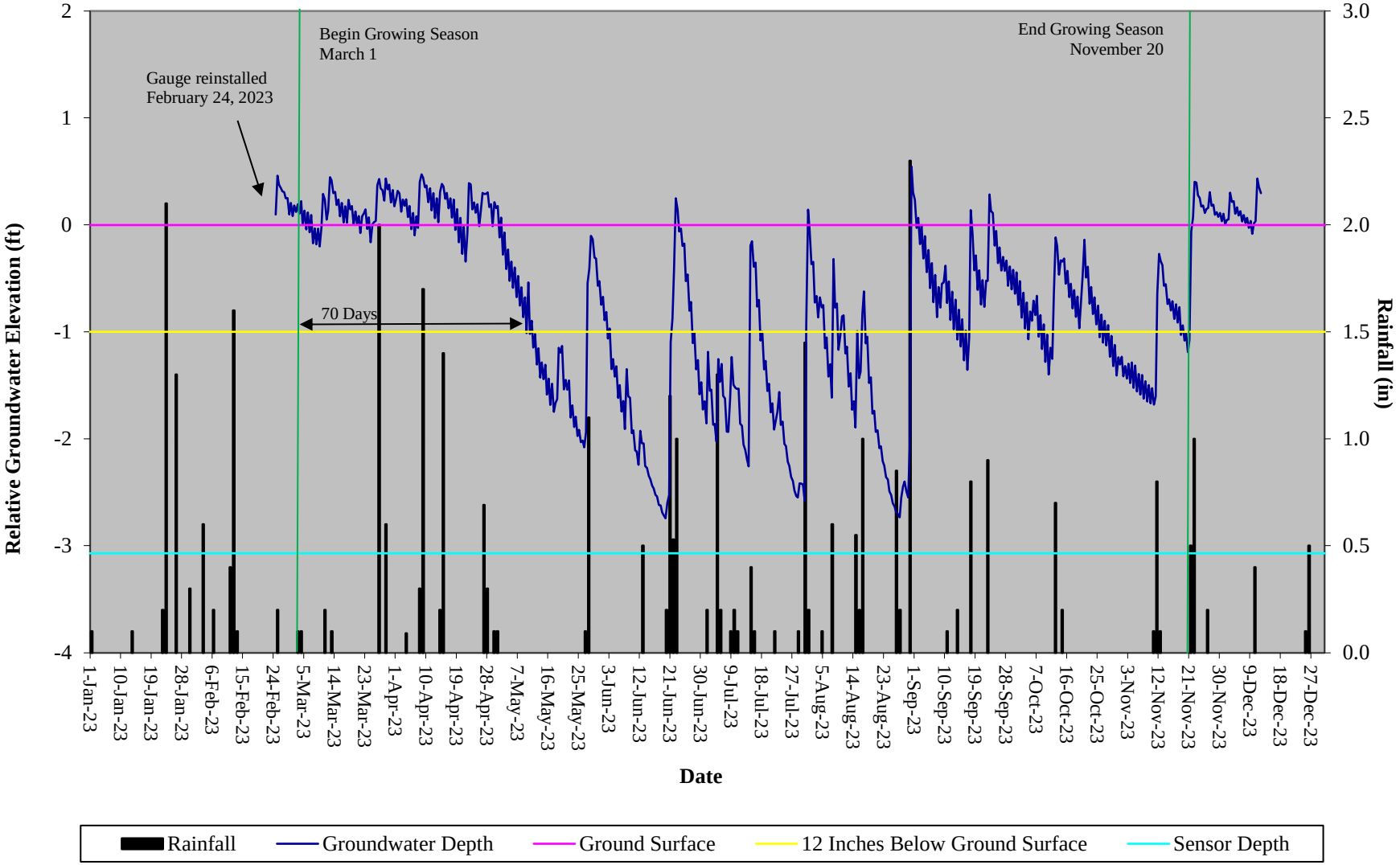
Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 8



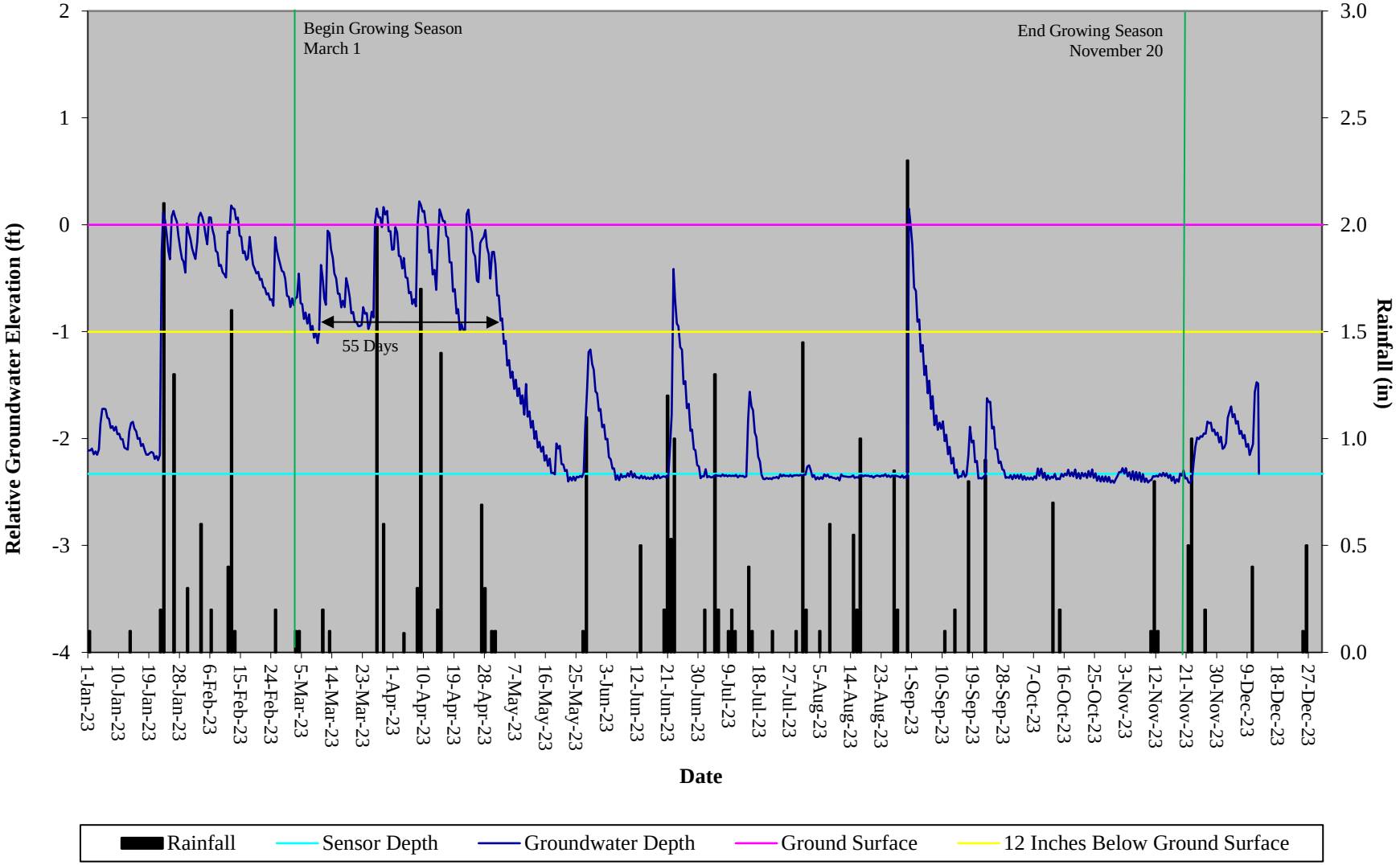
Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 9



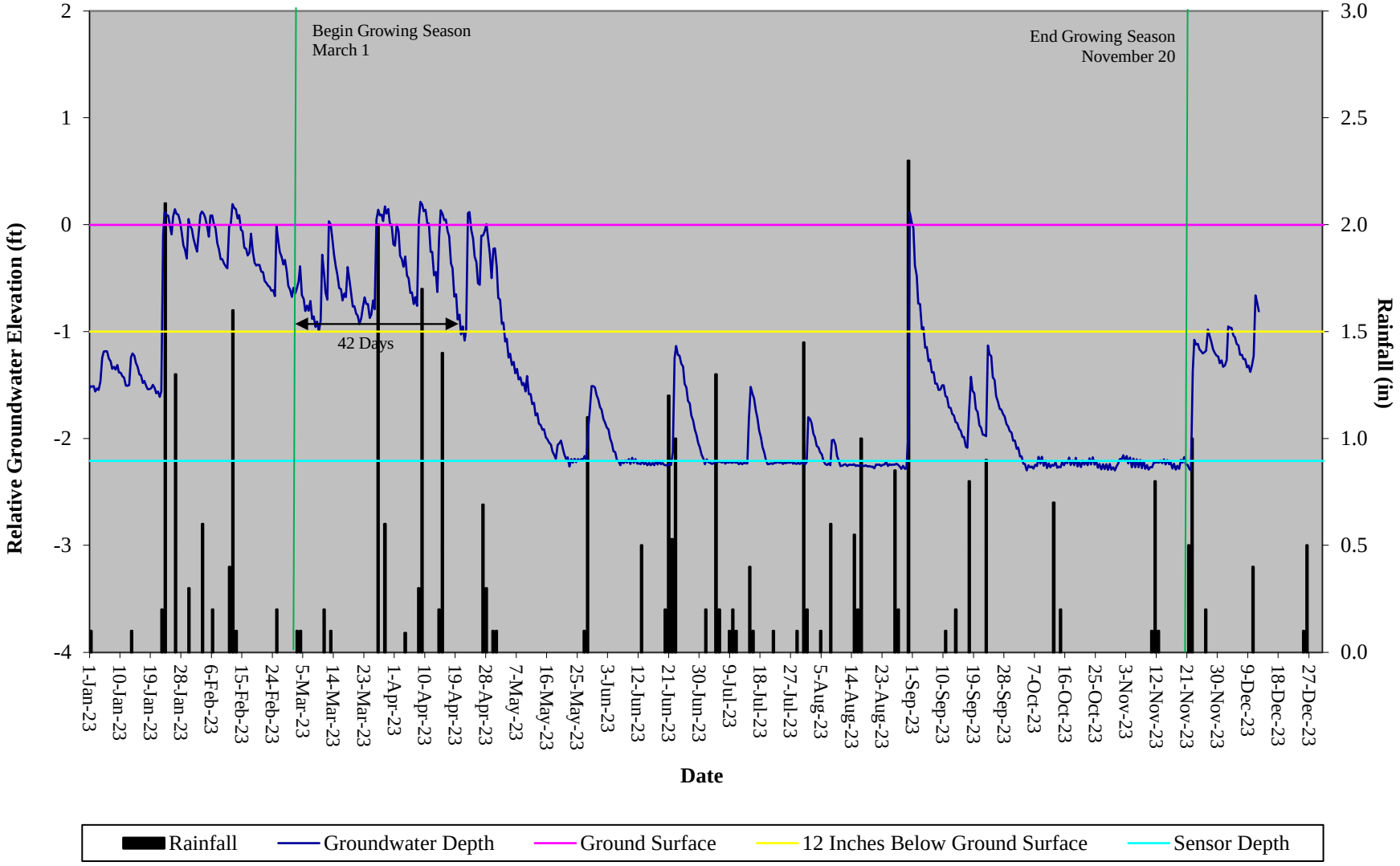
Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 10



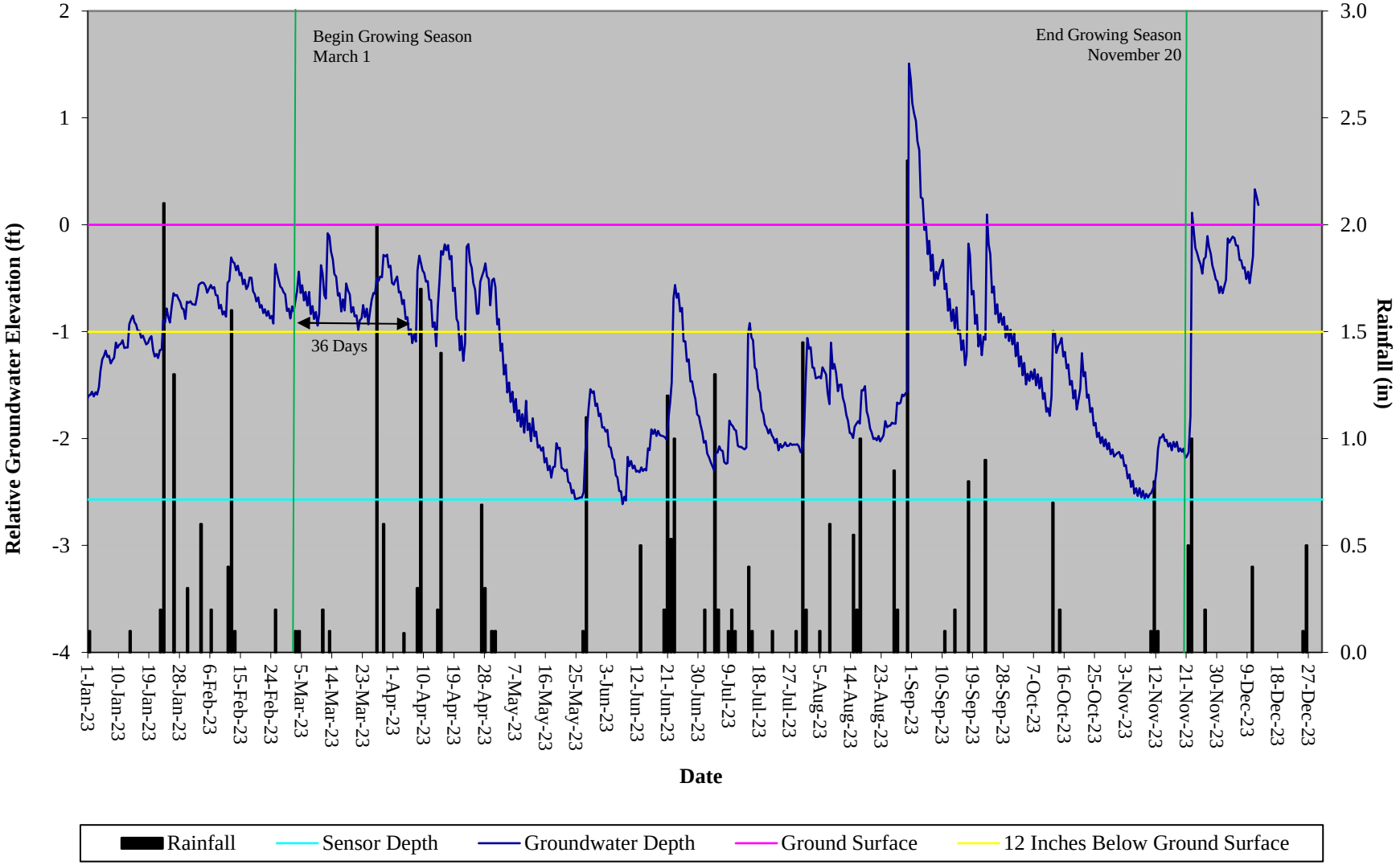
Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 11

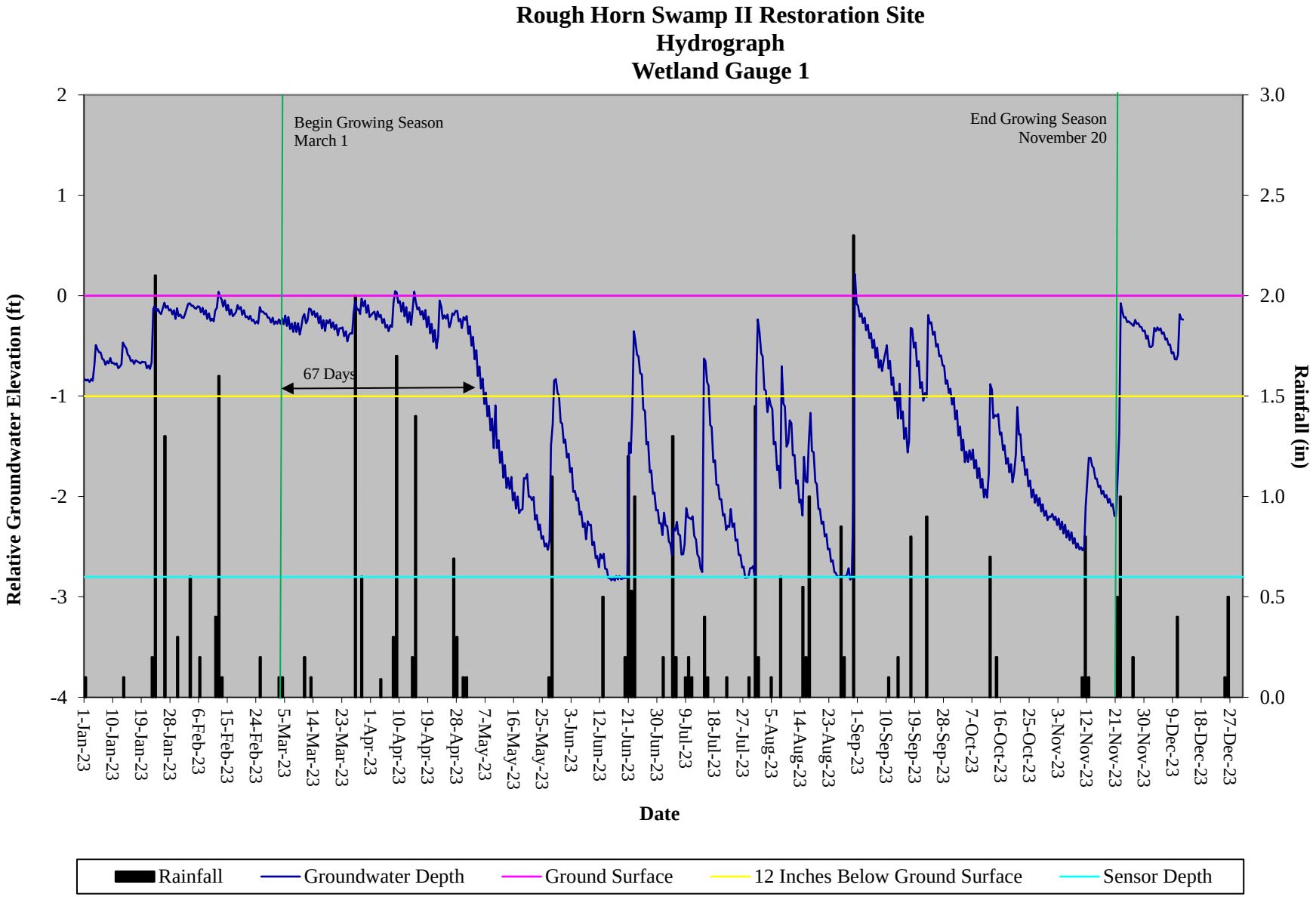


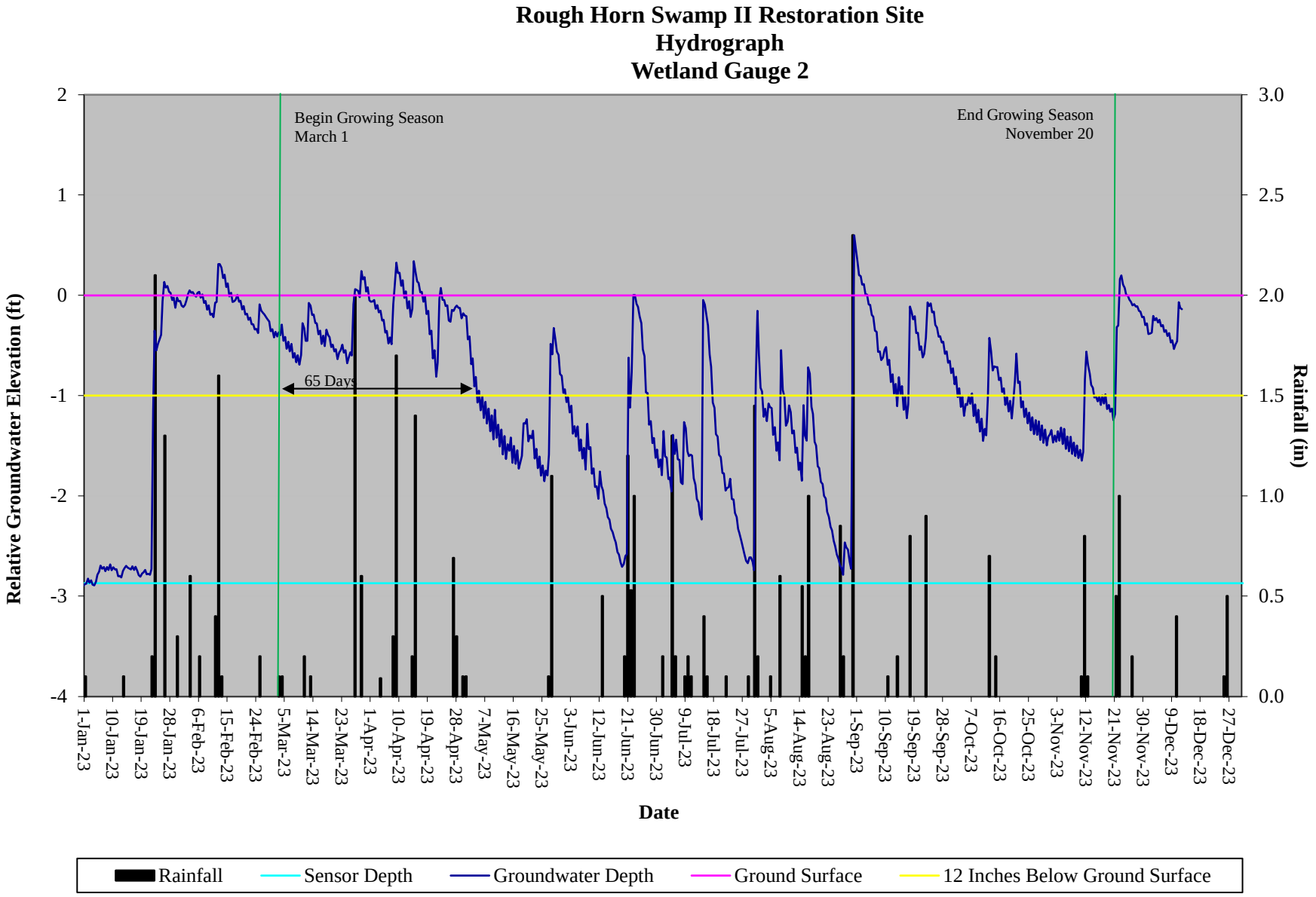
Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 12



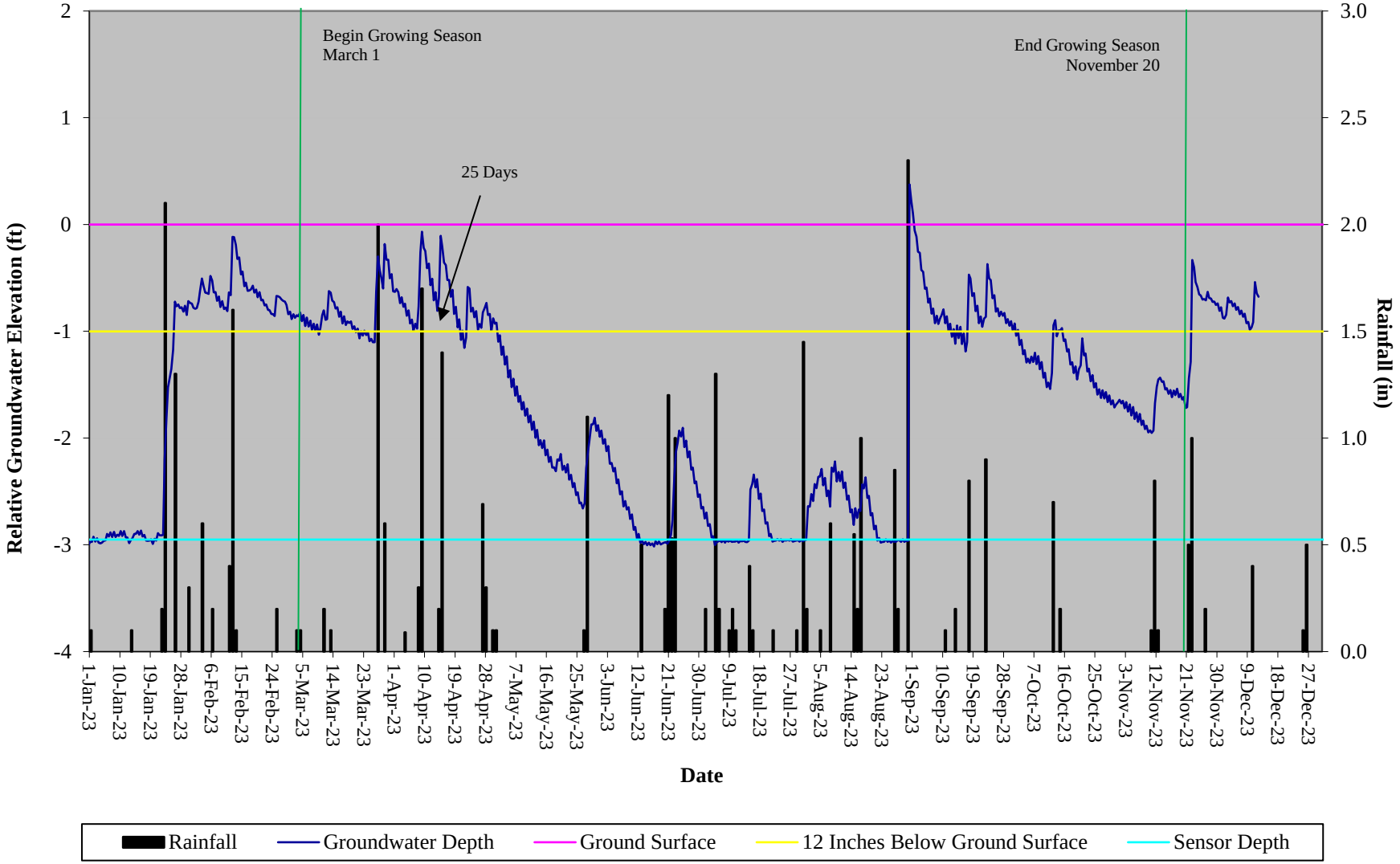
Rough Horn Swamp Restoration Site
Hydrograph
Wetland Gauge 13

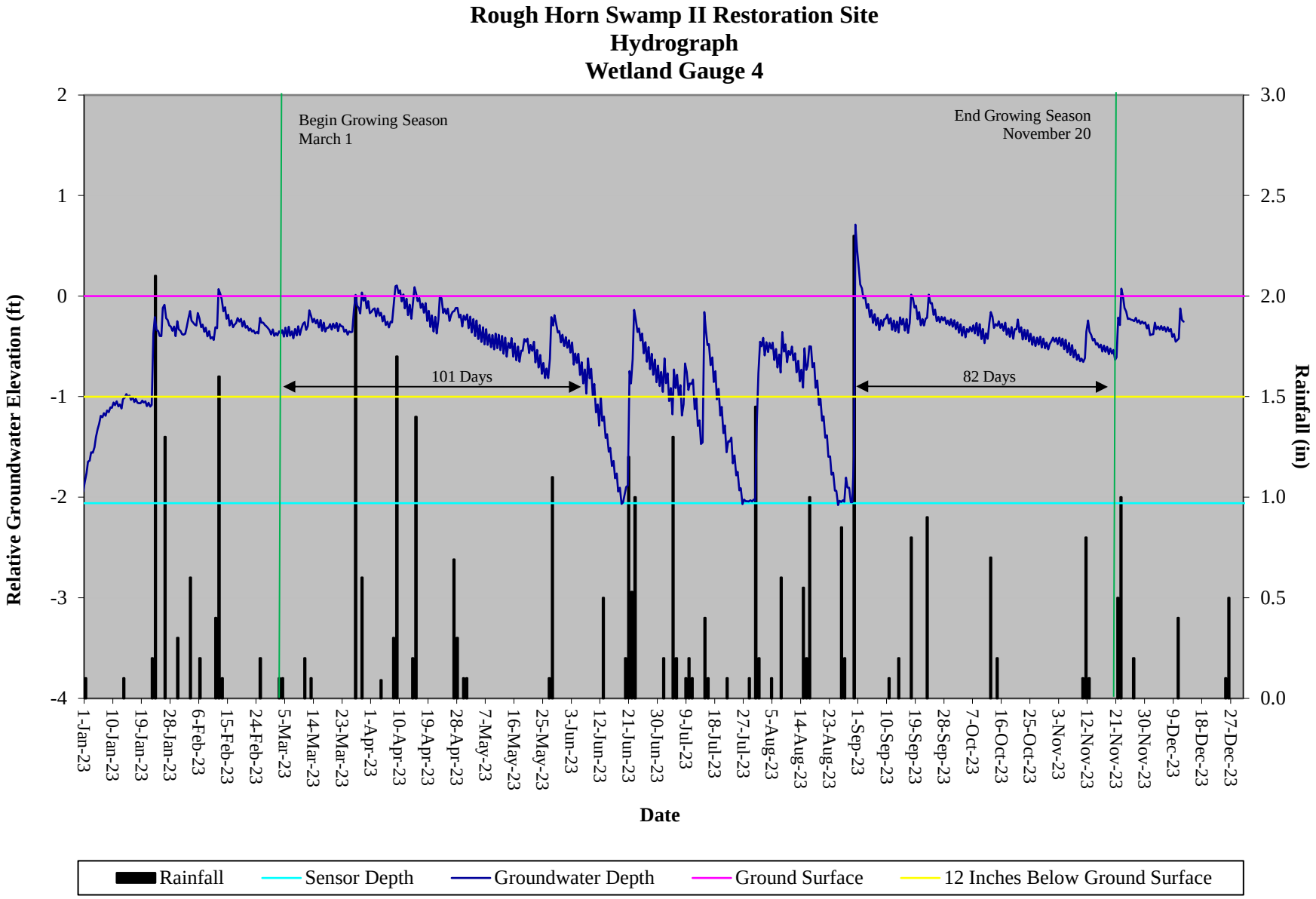



Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 1
Begin Growing Season
March 1
End Growing Season
November 20
67 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
2
1
0
-1
-2
-3
-4
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-23
10-Jan-23
19-Jan-23
28-Jan-23
6-Feb-23
15-Feb-23
24-Feb-23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

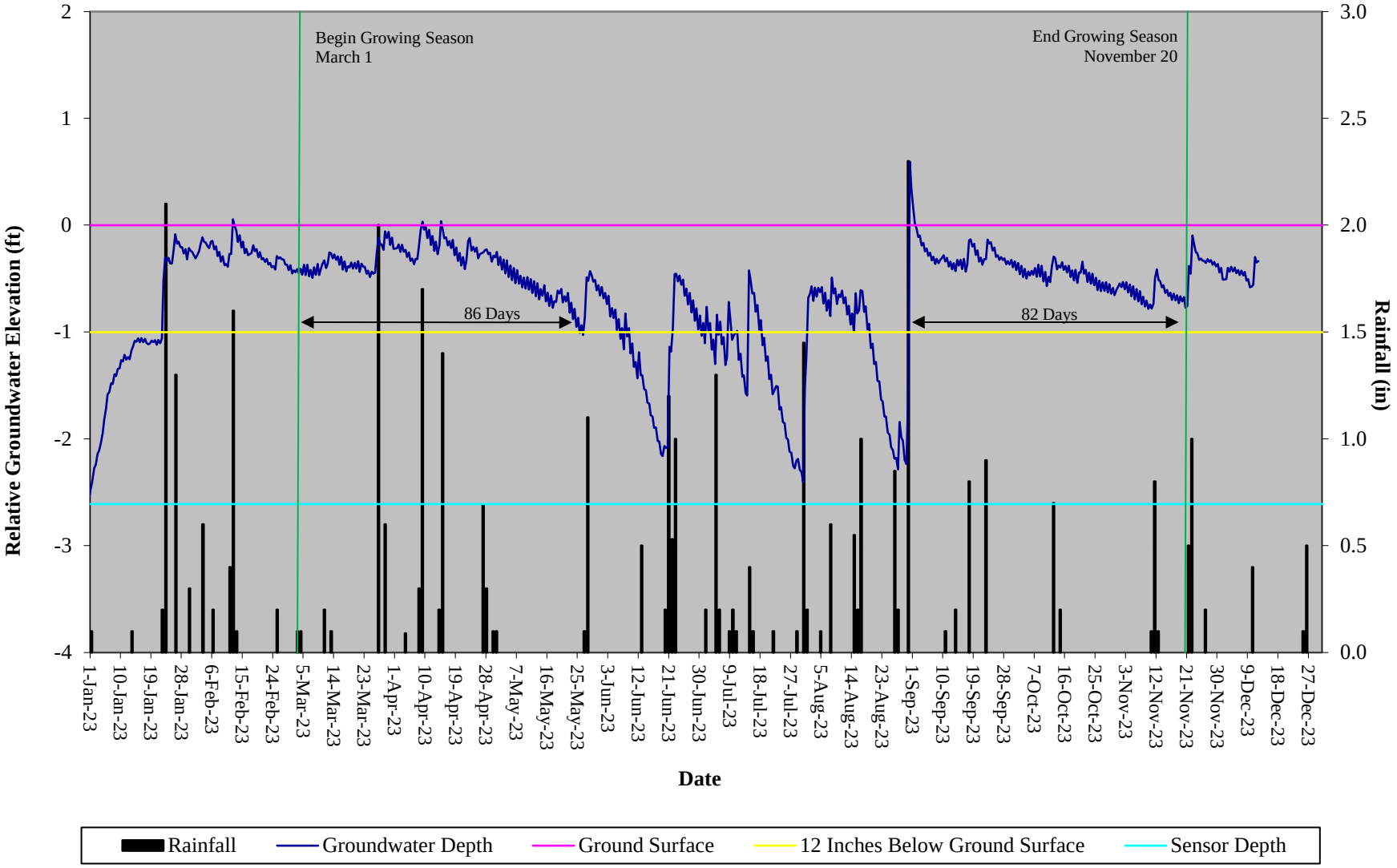

Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 2
Begin Growing Season
March 1
End Growing Season
November 20
65 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
2
1
0
-1
-2
-3
-4
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-23
10-Jan-23
19-Jan-23
28-Jan-23
6-Feb-23
15-Feb-23
24-Feb-23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

Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 3

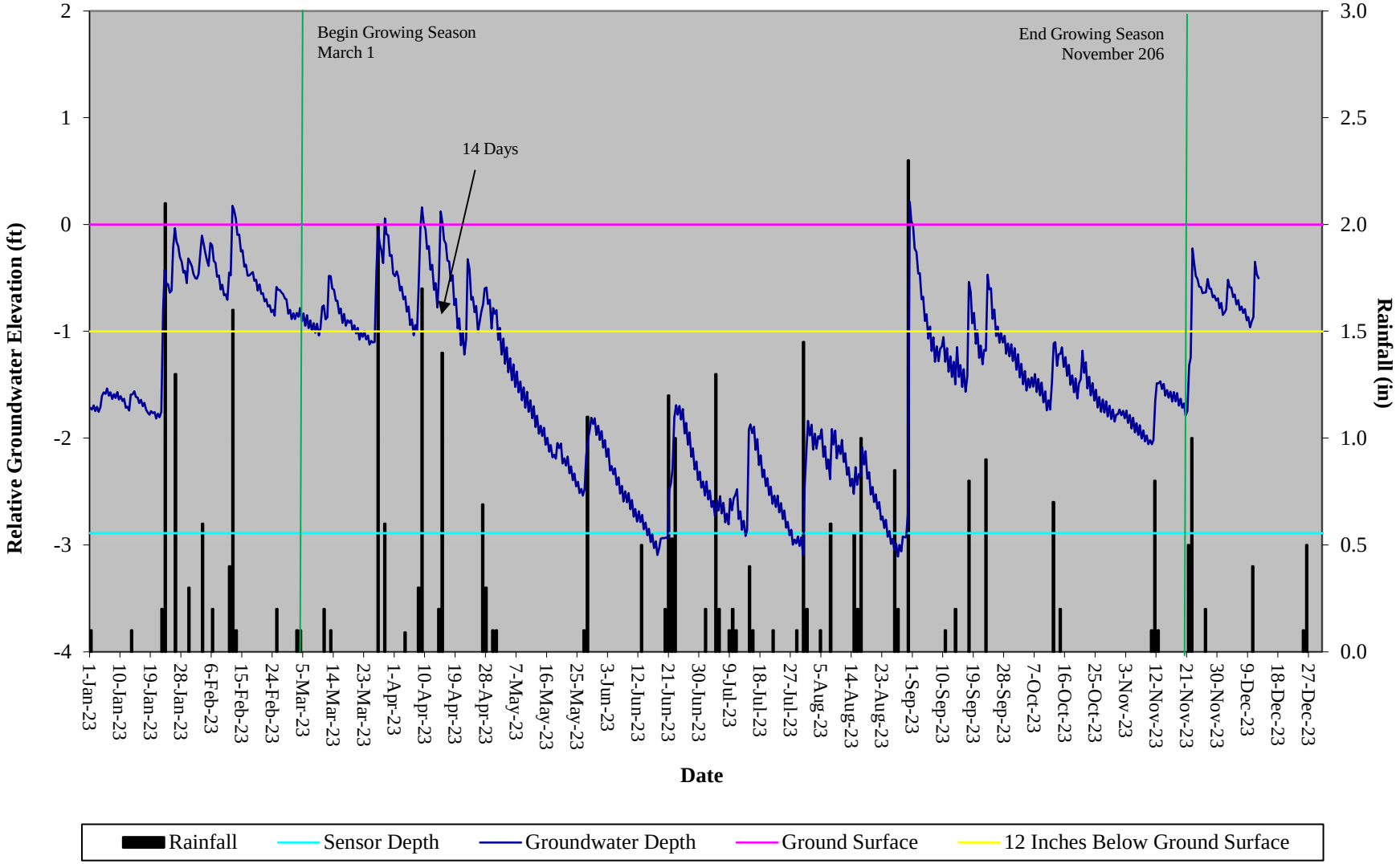



Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 4
Begin Growing Season
March 1
End Growing Season
November 20
101 Days
82 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
2
1
0
-1
-2
-3
-4
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-23
10-Jan-23
19-Jan-23
28-Jan-23
6-Feb-23
15-Feb-23
24-Feb-23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

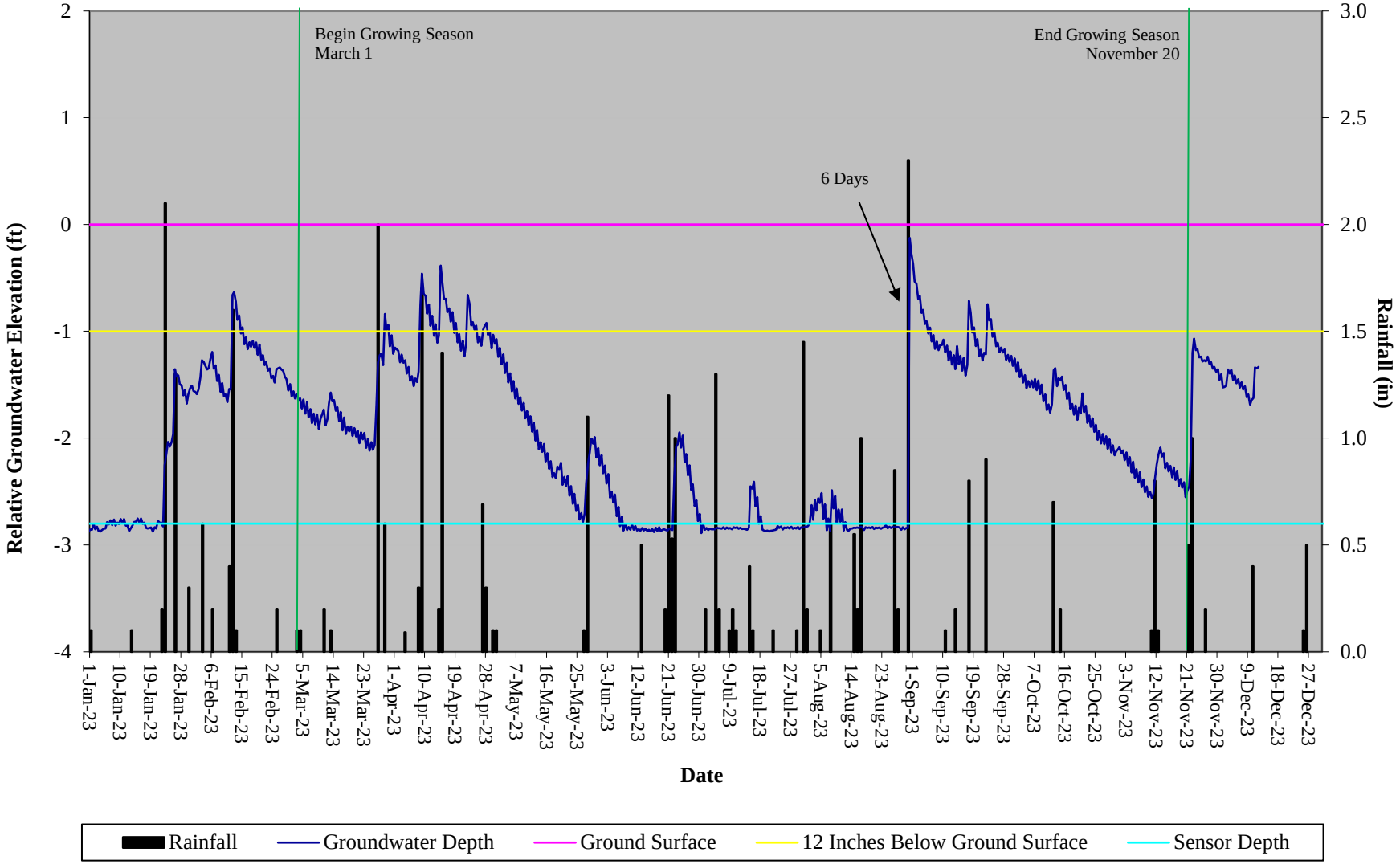
Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 5



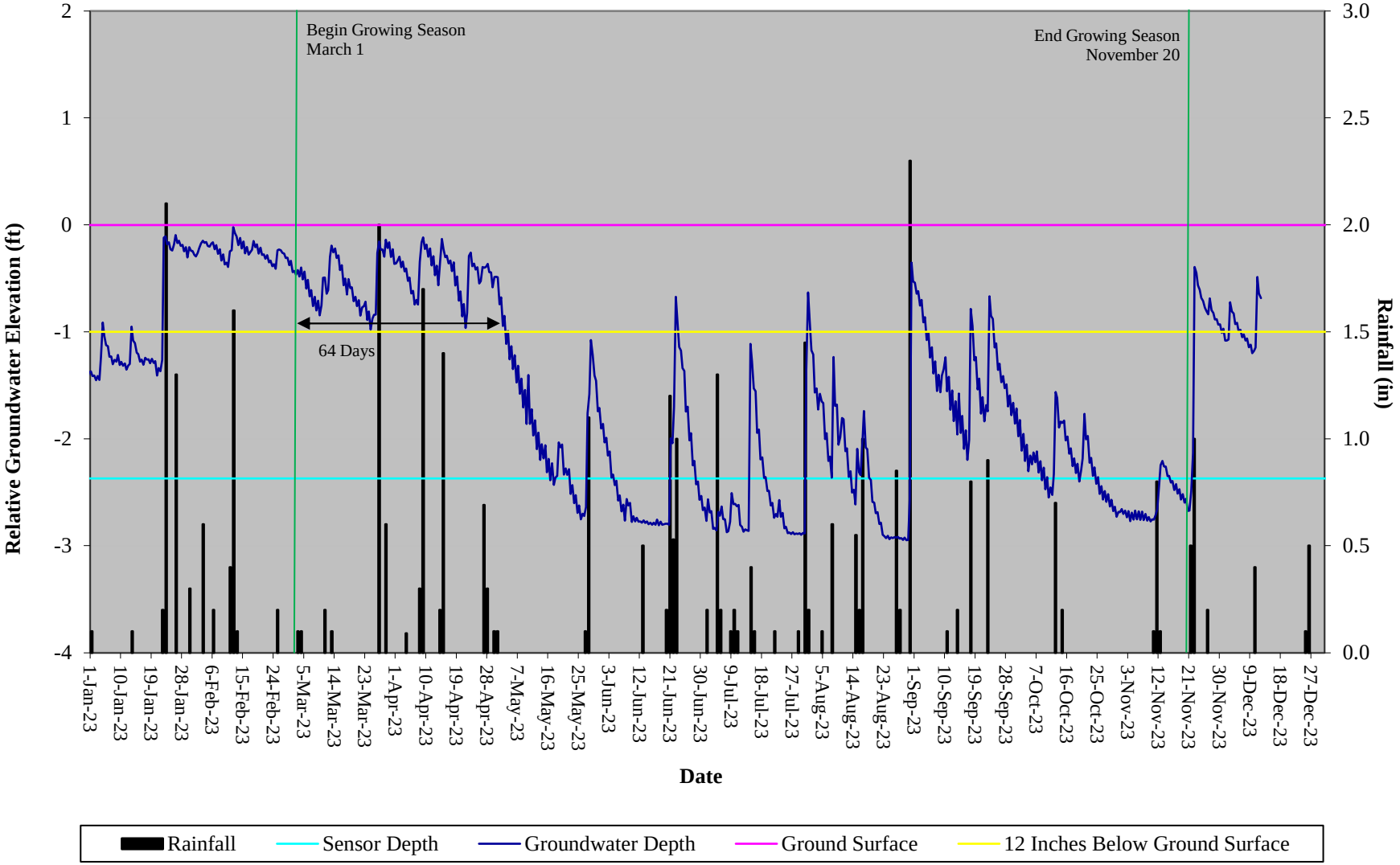
Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 6



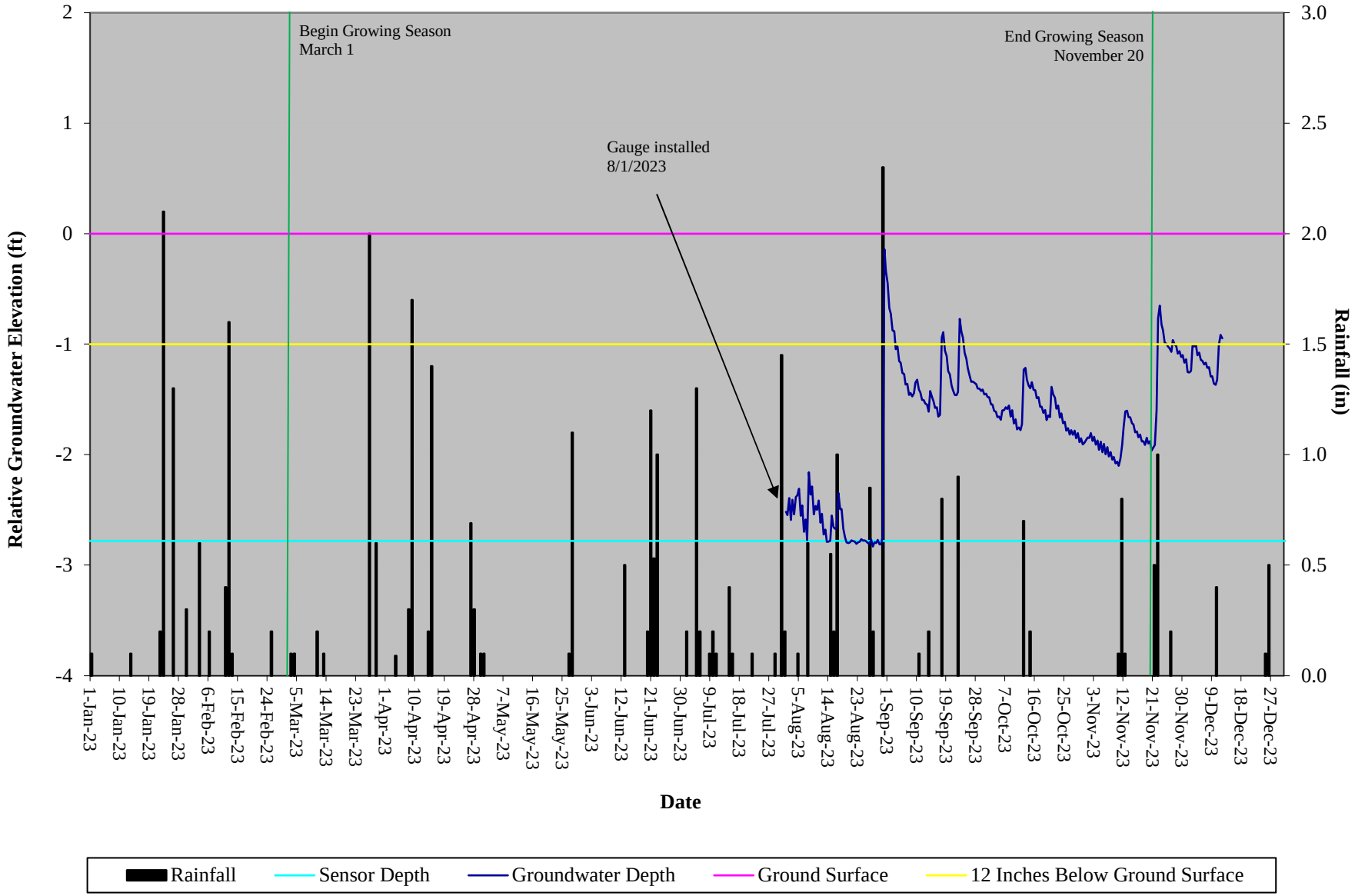
Rough Horn II Swamp Restoration Site
Hydrograph
Wetland Gauge 7



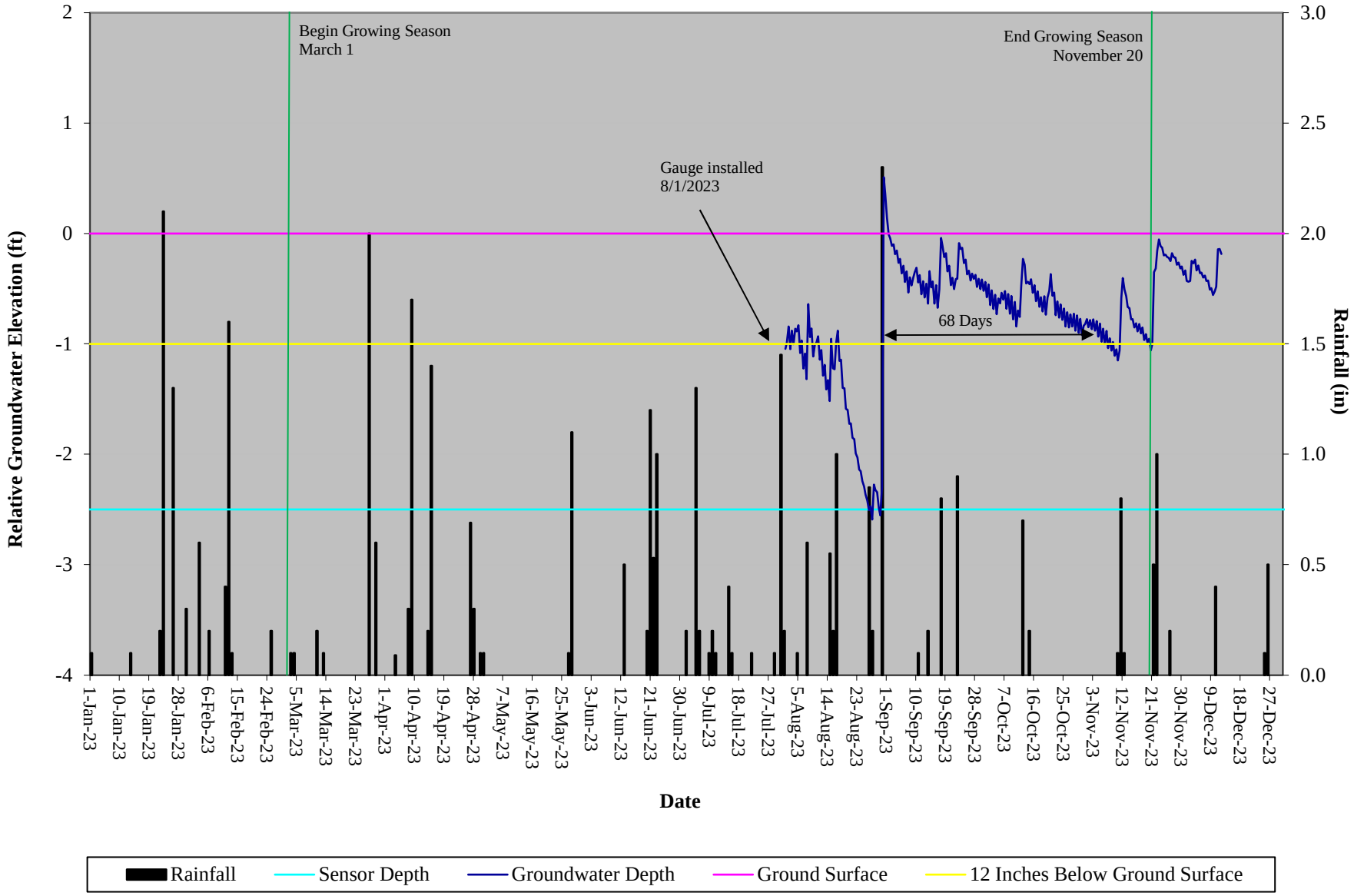
Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 8



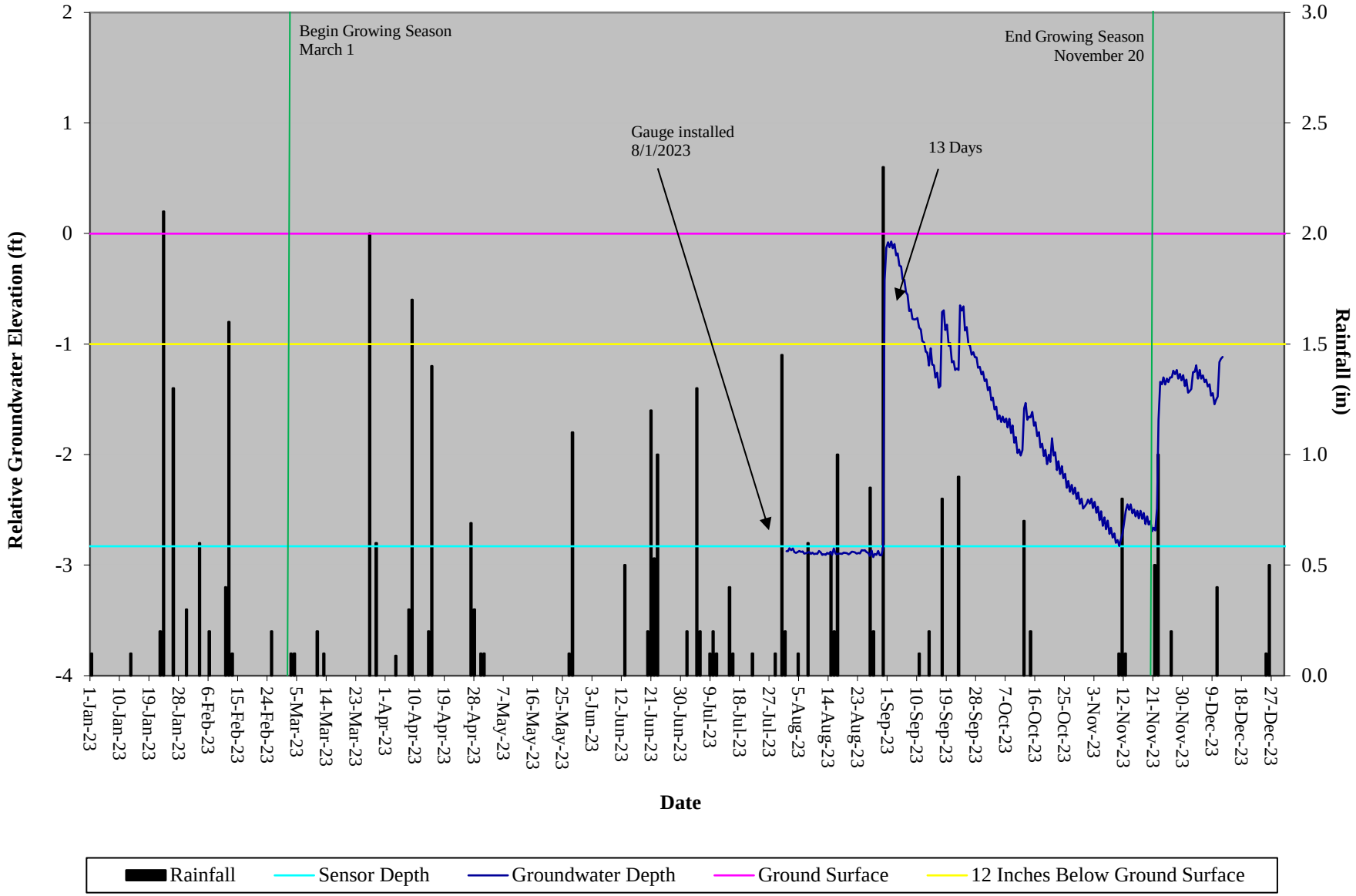
Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 9



Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 10



Rough Horn Swamp II Restoration Site
Hydrograph
Wetland Gauge 11



Rough Horn Swamp Restoration Site
Hydrograph
Reference Wetland Gauge