Tar River Headwaters Wetland Restoration Site

Person County NC -- Tar-Pamlico River HUC# 03020101-0102

MY-5 (2021) Annual Fall Monitoring Report

NC-DEQ Division of Mitigation Services: DMS Project # 97071
DEQ Contract #6746 DWR # 2016-0233 ACE #SAW-2016-01101
Data Collected: Sep-Oct 2021 Final Report: November 2021

NC Environmental Quality	**Submitted To:** **N.C. Department of Environmental Quality** **DEQ Division of Mitigation Services** **1652 Mail Service Ctr, Raleigh, NC 27699-1652** --- **DMS Project Manager: Lindsay Crocker** **DEQ-DMS Contract # 006746**

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MOGENSEN MITIGATION, INC

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1.0. Project Background Summary

1.1. Project Location and Setting

The Tar River Headwaters Wetland Restoration Site (TRHWR) is a full-delivery wetland mitigation project located in eastern Person County, between Roxboro and Oxford, North Carolina, within the Piedmont Physiographic Province (Figure 1). The easement comprises 9.98 acres, most of which was drained and degraded wetlands or former wetlands with hydric soil indicators. The remaining areas include non-hydric soils, drainage ditches, and a 570-foot long riparian corridor along a ditch and intermittent stream connecting the TRHWR site to the adjacent Tar River Headwaters Riparian Buffer and Nutrient Offset Mitigation Bank project. Both projects are implemented by Mogensen Mitigation, Inc. (MMI), and are located on a 228-acre farm owned by Roy and Joyce Huff, in the Tar-Pamlico River Basin 12-digit HUC # 03020101-0102. The Huff Farm property is located at 333 Bunnie Huff Road, Oxford NC 27565. The access road into the TRHWR site is at Latitude = 36.3913, Longitude = -78.8171.

1.2. Pre-Restoration Conditions

The TRHWR site was cleared and ditched for pasture use in the 1940s according to the owner, and was used for grazing cattle until January 2017 when the conservation easement fence was installed. The project involved plugging drainage ditches to restore wetland hydrology, fencing to exclude livestock, and planting native trees and shrubs to restore a Headwater Forest wetland ecosystem similar to what occurred prior to site clearing and drainage. Remnant native trees left for shade, hydrophytic groundcover plants mixed among the pasture grasses, and plant species recorded in adjacent natural forests (on the same soil mapping unit) provided data for the planting plan.

The project will restore approximately 7.65 acres of headwater riparian wetland (6.53 acres reestablishment plus 1.12 acres rehabilitation) and will generate an estimated 7.28 or more riparian wetland mitigation credits. Approximately 1.27 acres with non-hydric soils in the southeast corner of the mitigation site will also be reforested, and a 100-foot wide by 570-ft long riparian corridor (1.06 acre) extending southeastward along the ditch will connect the TRHWR site to MMI's adjacent stream restoration and nutrient buffer bank project to the south. Total acreage of the wetland mitigation site and riparian connector is 9.98 acres.

Restoration activities including tree planting, surface flow dispersal, and cattle exclusion has reduced soil erosion and nutrient-enriched runoff from adjacent pasture and cropland within its watershed, and helped retain agricultural chemicals used on these lands. It is expected to improve water quality and habitat in the receiving tributary and reduce fine sediment loading which will enhance the overall watershed, particularly in the adjacent stream and nutrient mitigation bank and downstream.

1.3. Mitigation Goals and Performance Criteria

The subject watershed HUC #03020101-0102 is designated by NCDEQ as a Targeted Local Watershed (TLW) for water quality improvement projects, and the Tar River reach within and downstream of this local HUC is recognized as a Significant Natural Heritage Area (SNHA) for its high diversity of aquatic life including protected species of river mussels and fishes. The TRHWR project is intended to support

these TLW and SNHA designations by improving water quality and habitat on the property and downstream. Specific project goals and objectives as identified in the TRHWR Final Mitigation Plan (December 2016) include:

GOALS:

- Restore the natural jurisdictional wetland hydro-period to five or more acres of forested wetland within a nine-acre site;
- Restore forested wetland habitat and improve habitat connectivity between Denny Store Gabbro Forest (NHP Natural Heritage Area) to the north and the Tar River tributaries;
- Buffer storm water runoff from fecal and other cattle-related pollutants and fertilizer.

OBJECTIVES:

- Plug existing ditches and create sheet flows throughout the site. Aerate soils to reduce compaction, improve infiltration, and create micro-topography to retain surface flows;
- Preserve the remnant mature Swamp White Oaks (a regionally rare species) for seed source. Plant appropriate native hardwood trees at a sufficient frequency to establish a diverse bottomland wetland forest. Treat and/or remove invasive species which may cause problems for site restoration, including Chinese privet and multi-flora rose;
- Install fencing to exclude cattle and establish a conservation easement to provide permanent protection on the site.

PERFORMANCE STANDARDS and MONITORING:

GOAL	OBJECTIVE	PERFORMANCE STANDARD	MONITORING APPROACH
Restore natural hydro-period for headwater forest wetland.	Plug existing ditches and create sheet flow throughout the site. Aerate soils to reduce compaction, improve infiltration, and create micro-topography to retain surface flows.	Water must be on or within 12 inches of the surface for 10% of the growing season. Hydrographs will indicate jurisdictional hydrology.	Use 11 shallow groundwater self-reading gauges throughout the site at a frequency of about one per acre. Visual inspection of ponding duration.
Restore forested wetland habitat and improve habitat connectivity with existing forests.	Preserve mature swamp white oak trees for seed source. Plant appropriate native hardwood trees at 10-ft average spacing (435 stems/ac) Treat invasive species.	Survival of 320 stems per acre at year 3, 260 stems per acre at year 5 and 210 stems per acre at MY 7.	Monitor vegetation plots annually and calculate densities of surviving planted & volunteer stems.
Buffer storm water runoff from fecal and other cattle-related nutrient inputs.	Plant trees, fence perimeter and establish a permanent conservation easement.	Insure the integrity of the cattle exclusion fencing for the life of the contract.	Visual inspection will note fence condition through site pictures. Observations will be included in annual monitoring reports.

1.4. Mitigation Approach

Prior to restoration, the TRHWR project area contained 6.53 acres of former riparian wetland (ditched and drained, grazed pasture) with redoximorphic soil characteristics indicating hydric soils, but lacking adequate wetland hydrology based on groundwater gauge data and field observations during 2015-2016. Although the drainage ditches are shallow, they have effectively reduced water retention across much of the site over the past 70 years due to the slow infiltration rate, rapid runoff, and shallow hardpan in these soils. The project will re-establish jurisdictional wetlands in this area by plugging the drainage ditches to increase rainfall retention and dispersal, fencing out livestock, controlling invasive species, and planting suitable native tree species. These 6.53 acres of wetland restoration will generate riparian wetland credits at 1:1 ratio, yielding 6.53 WMU.

Another 1.12 acres in the TRHWR project area has been less effectively drained by the ditches, and still has sufficient hydrology to meet jurisdictional wetland criteria, based on groundwater gauge data and field observations during 2015-2016. The project will rehabilitate these areas of degraded jurisdictional wetland (grazed pasture with reduced hydrology) by plugging ditches to increase hydrology, fencing out livestock, and planting suitable native tree species. These 1.12 acres of wetland rehabilitation will generate riparian wetland credits at 1.5:1 ratio, yielding 0.75 WMU. TRHWR project components and mitigations assets are summarized in Table 1, matching the proposed assets in the Mitigation Plan.

2.0. Monitoring Methods

Vegetation plots are monitored annually in accordance with current DMS monitoring guidance (June 2017). The nine installed CVS vegetation plots, each 10 x 10 meters, represents 2.8 percent of the planted mitigation area. Vegetation monitoring will occur between September and early November, prior to the loss of leaves. The vegetation success criteria are specified in the Performance Standards above. If success criteria are not met, site maintenance and monitoring will continue until the success criteria are met.

The twelve onsite groundwater monitoring gauges (RDS and Hobo) and one offsite reference wetland gauge are downloaded and maintained at least quarterly. Gauge data in the mitigation credit areas are plotted and evaluated for success based on the mitigation plan performance standard of continuous saturation within 12 inches of the ground surface for 10 percent of the growing season. Growing season based on air temperature at a weather station east of Roxboro is from March 28 to November 3, which is 221 days (from USDA WETS table). MMI installed a Hobo dual-probe soil temperature logger near the middle of the TRHWR site (beside GW-H) in late January 2017. Soil temperature on the site remained above 41 F at both 10-inch and 20-inch depths throughout February and March 2017. The lowest temperatures recorded were 42.7 F at 10 inches and 45.4 F at 20 inches. Based on soil temperatures remaining above the USDA-designated temperature for plant physiological activity, March 1 is used as the start of the growing season, based on field discussions with DMS and USACE. The revised growing season length is thus 248 days, and the groundwater hydrology success criterion is 25 days. Subsequent data from 2018 to 2020 confirm that soil temperature has remained above 42 F after the end of February each year. These data along with late-February bud swelling on *Acer, Betula,* and *Salix*, plus new growth of groundcover plants (*Lamium, Cardamine, Lactuca, Allium, Bromus, Alopecurus, Ranunculus, Senecio, Geranium, Plantago, Viola,* and *Persicaria*) support the use of March 1 as the growing season start date.

The conservation easement perimeter fence and ditch plug integrity have been monitored visually and documented with photo points.

3.0. Current Conditions Summary

Groundwater gauge data for 2020 were collected from January 1 through September 16; CVS vegetation plot data and photos were collected in late September. MMI scientists made several visits to the TRHWR site between February and September 2020 to collect gauge data and evaluate the condition of the ditches, ditch plugs, and planted and volunteer trees. All nine CVS plots had 7 or more surviving planted trees and exceeded the 260 stems per acre success criteria for MY-5 based on planted stems alone (Tables 6 and 7). Some trees reported as dead in previous years had resprouted in 2021. The average density across all nine plots was 364 planted stems per acre and 567 total stems of planted species (including volunteers) per acre.

Outside of the CVS plots, planted stem survival is generally good throughout the site, with an estimated 15 to 25 percent apparent mortality since the original planting. Leader die-back is common on many of the taller saplings, especially on tulip poplar, river birch, and musclewood, but many of the trees exhibiting leader die-back also had vigorous basal sprouts. Small unflagged trees outside of the CVS plots remain difficult to see in summer and fall due to the dense groundcover, especially resprouted trees.

The dense, sticky Iredell clay loam soil on the site is challenging for trees to get established. Undisturbed headwater flats with Iredell soil often support "Piedmont prairie" or "glade" plant communities with a relatively open tree canopy compared with other Piedmont natural forest communities. Several of the rare plant communities with an open canopy recognized by the NC Natural Heritage Program occur on headwater flats with Iredell soils. Natural plants on the project site that suggest a historic sparse canopy include milkweeds (*Asclepias purpurascens* and *A. incarnata*), mistflower (*Conoclinum coelestinum*), sneezeweed (*Helenium autumnale*), Carolina rose (*Rosa carolina*), mountain mint (*Pycnanthemum* spp), skullcap (*Scutellaria* spp), Lobelia (*Lobelia* spp), and swamp white oak (*Quercus bicolor*). The slow growth rates of planted trees on this project site may be a natural artifact of the native soil.

Six temporary strip plots (100 m2 each) were sampled in early May 2021 in the areas identified in October 2020 that appeared to have low woody stem density. A measuring tape was extended to 108 feet and pinned to stakes at each end, and live stems of planted woody species within 5 feet on each side the tape were counted (Figure 2B). Two of the six temporary plots on the eastern side of the site yielded 5 and 6 stems (202 to 243 stems per acre); these are in the area mapped as "low stem density" in Figure 2A. The other four temporary plots on the western side of the site yielded 7 to 8 stems (283 to 324 stems per acre) and meet success criteria.

A few isolated plants of Multiflora rose, Chinese privet, and Callery pear were treated.in October 2020 and May 2021, and no "invasive exotic" problem areas were identified in September 2021. Groundcover vegetation is dense and diverse throughout the site, in both the treated areas (non-wetland and drained wetland) and non-treated areas (existing wetland). Exotic grasses including fescue (*Lolium*) and carpet grass (*Arthraxon*) are abundant in some areas, but have not been treated. All ditch plugs appear to be stable and performing as designed. Survival of planted trees, live-stakes, and herbaceous cover on the plug slopes and tops appears to be providing good protection; no erosion on the plugs was observed. Most of the ditches are now obscured by vegetation. Ponding behind each ditch plug was evident in early spring, but the ditches were mostly dry from May to September.

Twelve groundwater gauges (A through L) on the project site are roughly arranged in four transects perpendicular to the main ditch, as recommended by mitigation plan reviewers during field meetings (Figure 2). Three gauges (A, H and J) are within existing wetland rehabilitation areas, seven gauges (D, E, F, G, I, L, and K) are within the drained wetland reestablishment areas, and two gauges (B and C) are downslope from ditch plug #4 in areas not expected to generate wetland credits. Wetland hydrology success for the TRHWR site is based on saturation within 12 inches of the ground surface for 10% of the 248-day growing season (March 1 to November 3). The gauges measure the free water table depth and do not account for capillary fringe saturation which can extend above the free water table in fine-textured soils (https://vernonjames.ces.ncsu.edu/eleventh-annual-on-site/soil-wetness/). Manual water table measurements were also collected at each well one or more times during the year, and depth data were adjusted accordingly to fit the actual measurements.

Rainfall in 2021, relative to the 30-year normal values (1981 to 2010), was above the monthly 50th percentile during January, February, and July, and below normal in all other months through October. The total for March, April, and May, the first three months of the growing season was only 7.1 inches, or 63 percent of the normal rainfall for that period (11.1 inches). All 13 gauges (ten in the mitigation credit area, two outside the credit area, and one off-site reference gauge) exceeded the minimum of 25 consecutive days for hydrologic success during the early part of the growing season, with consecutive day saturation periods ranging from 45 to 59 days (Table 8).

Soil temperature data for 2021 support the accepted growing season start date of March 1. The lowest recorded soil temperature at 10 inches deep was 38.4 F on February 1. From March 1 forward the soil temperature remained above 41 F; the lowest temperature on or after March 1 was 43.5 F.

4.0. References

Lee, Michael T., Peet, Robert K., Roberts, Steven D., Wentworth, Thomas R. (2008). *CVS-EEP Protocol for Recording Vegetation version 4.2, October 2008*. Retrieved September 2011, from: http://cvs.bio.unc.edu/methods.htm

LeGrand, Harry E. Jr. (2007) Natural Areas Inventory of Person County, NC. NC Natural Heritage Program, Raleigh NC.

NC Division of Mitigation Services. (2017). *NC-DMS Annual Monitoring Report Format, Data Requirements, and Content Guidance, June 2017*. http://portal.ncdenr.org/web/eep/dbb-resources

Schafale, M.P., Weakley, A.S. 1990. Classification of the Natural Communities of North Carolina, Third Approximation. NC Natural Heritage Program, Raleigh, NC.

Sink, Larry T. (1995). *Soil Survey of Person County, North Carolina*. USDA Soil Conservation Service (Natural Resources Conservation Service), Raleigh, NC.

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APPENDIX A. Project Background Data

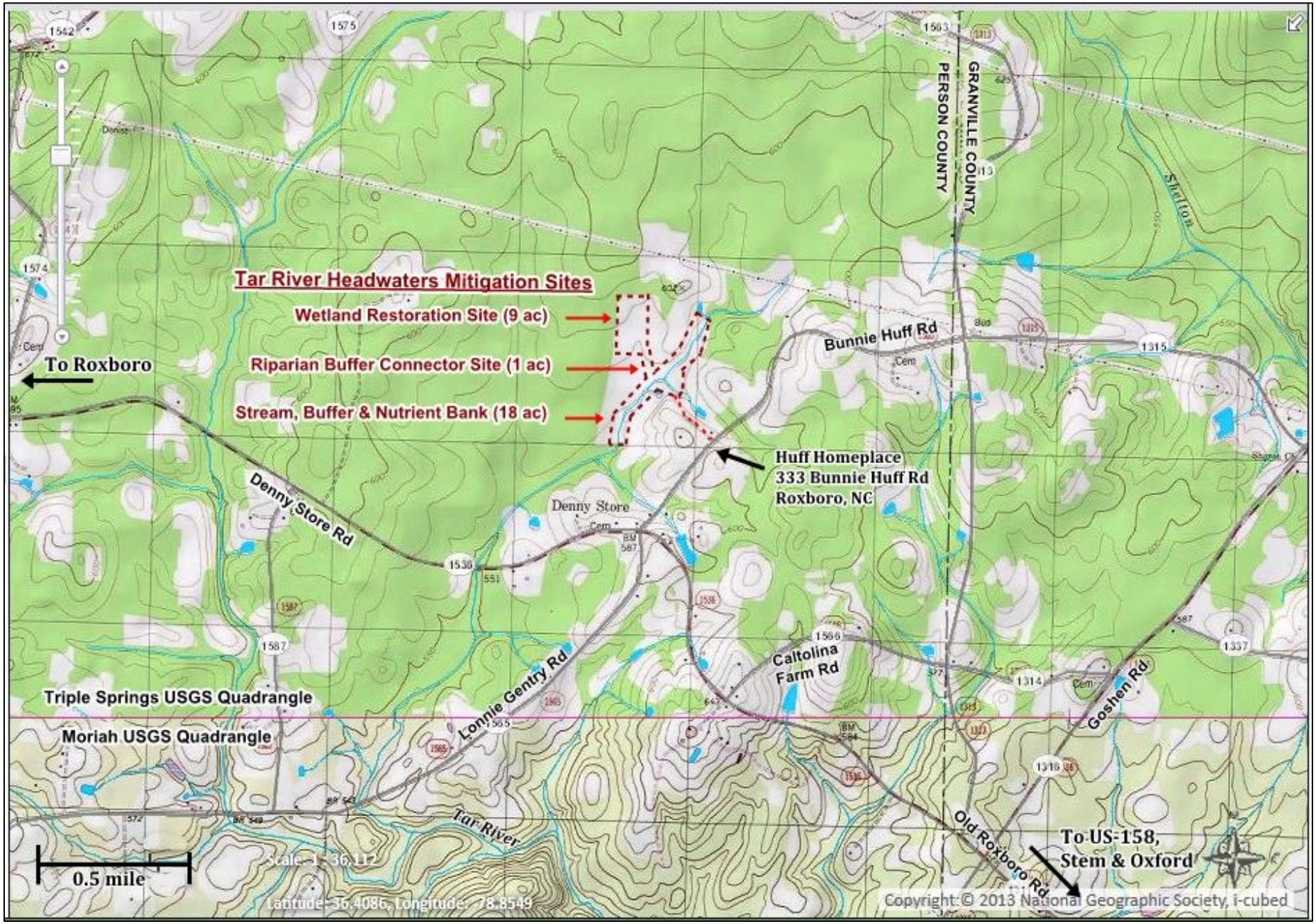


Figure 1. Project Vicinity Map: Tar River Headwaters Wetland Restoration Site and related mitigation projects on the Huff Farm property, Person County NC, Tar-Pamlico River HUC# 03020101-0102. DIRECTIONS: From US-158 in Berea, Granville County NC, turn right (northwest) on Old Roxboro Rd, which becomes Denny Store Rd where it crosses into Person County. Turn right (north) on Bunnie Huff Rd, go 0.4 mile, and turn left into the driveway just past the Huff Homeplace sign. Proceed through the gate at end of driveway to the project sites.

Table 1. Project Components and Mitigation Credits -- Tar River Headwaters Wetland Restoration Site, DMS Project # 97071									
Mitigation Credits									
	Stream		**Riparian Wetland**		**Non-riparian Wetland**		**Buffer**	**Nutrient Offset**	
Type	**R**	**RE**	**R**	**RE**	**R**	**RE**			
Acres			7.650						
Credits			7.270						
TOTAL CREDITS			7.277						

Project Components						
Project Component or Reach ID	**Stationing/ Location**	**Existing Footage or Acreage**	**Approach (PI, PII etc.)**	**Restoration or Restoration Equivalent**	**Restoration Footage or Acreage**	
Drained Wetland	--	6.530	Restore Hydrology, Fence & Plant	R (Reestablish)	6.530 ac	
Grazed Wetland	--	1.120	Fence & Plant	R (Rehabilitate)	1.120 ac	

Component Summation						
Restoration Level	**Stream (lin. feet)**	**Riparian Wetland (acres)**		**Non-Riparian Wetland (acres)**	**Buffer (sq. feet)**	**Upland (acres)**
		Riverine	**Non-Riverine**			
Re-establishment **(1: 1.0)**			6.530 ac			
Rehabilitation **(1: 1.5)**			1.120 ac			
Enhancement I						
Enhancement II						
Creation						
Preservation						
High Quality Preservation						
TOTAL feet or acres	**-**	**-**	**7.650 ac**			
TOTAL WMU	**-**	**-**	**7.277**			

Table 2. Project Activity & Reporting History		
Tar River Headwaters Wetland Restoration Site, DMS Project# 97071		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan		Dec 2016
Final Construction Plans		Dec 2016
Construction		Jan 2017
Planting		Feb 2017
Baseline Monitoring/Report	Feb 2017	Apr 2017
Year 1 Monitoring	Nov 2017	Dec 2017
Year 2 Monitoring	Nov 2018	Dec 2018
Year 3 Monitoring	Nov 2019	Jan 2020
Year 4 Monitoring	Nov 2020	Dec 2020
Year 5 Monitoring	Oct 2021	Nov 2021
Year 6 Monitoring		
Year 7 Monitoring		

Table 3. Project Contacts Table **Tar River Headwaters Wetland Restoration Site, DMS Project # 97071**	
Designer	Ecological Engineering, Raleigh NC Heather Smith: 919-557-0929
Construction Contractor	KBS Earthworks, Greensboro NC Kory Strader & Brett Strader: 336-685-4339
Survey Contractor	Michael T. Brandon, PLS, Roxboro NC Michael Brandon: 336-597-8673
Fence Contractor	Strader Fencing, Inc., Julian NC Kenneth Strader: 336-314-2935
Herbicide and Seeding	KBS Earthworks, Greensboro NC Kory Strader & Brett Strader: 336-685-4339
Planting Contractor	Mogensen Mitigation Inc, Charlotte NC Rich Mogensen: 704-576-1111; Gerald Pottern: 919-556-8845
Nursery Stock Suppliers	Mellowmarsh Farms, Siler City NC Joanie McLean: 919-742-1200
Monitoring Performers	Mogensen Mitigation Inc, Charlotte NC Rich Mogensen: 704-576-1111; Gerald Pottern: 919-556-8845

Table 4. Project Attributes			
Tar River Headwaters Wetland Restoration Site, DMS Project # 97071			
Project Name	Tar River Headwaters Wetland Restoration Site		
County	Person County		
Project Area (acres)	9.9 acres (Wetland + Buffer Easement combined)		
Project Coordinates (lat. and long.)	36.3895, -78.8153		
Project Watershed Summary Information			
Physiographic Province	Piedmont, Carolina Slate Belt		
River Basin	Tar-Pamlico River-01		
USGS Hydrologic Unit 8-digit	3020101	**USGS Hydrologic Unit 12-digit**	-0102
DWQ Sub-basin	Tar-Pam-01		
Project Drainage Area (acres)	60		
Project Drainage Area Percentage of Impervious Area	0%		
CGIA Land Use Classification	Pasture, Crop, and Deciduous Forest		
Wetland Summary Information (Post-Restoration)			
Parameters	**Wetland Area**		
Size of Wetland (acres)	1.12 ac existing + 6.53 ac drained = 7.65 ac		
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian non-riverine (Headwater)		
Mapped Soil Series	Iredell Loam (IrB)		
Drainage class	Iredell = moderately well; Hydric inclusions = poorly		
Soil Hydric Status	Drained Hydric		
Source of Hydrology	Shallow ponding; perched on shallow aquitard		
Hydrologic Impairment	Drainage ditches (1940s)		
Native vegetation community	Headwater depression wetland forest (prior to pasture conversion)		
Percent composition exotic invasive vegetation	20% Fescue (sprayed)		
Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Prelim JD
Waters of the United States – Section 401	Yes	Yes	Prelim JD
Endangered Species Act	No	N/A	US FWS Letter
Historic Preservation Act	No	N/A	NC SHPO Letter
Coastal Zone Management Act (CZMA) Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	No	N/A	NC Floodmaps Data
Essential Fisheries Habitat	No	N/A	N/A

APPENDIX B. Visual Assessment Data

Figure 2A. Current Conditions Plan View
Figure 2B. Temporary Strip Plots, May 2021
Table 5. Vegetation Conditions Assessment
Figure 3. Vegetation Plot Photos
Figure 4. Photo Point Photos

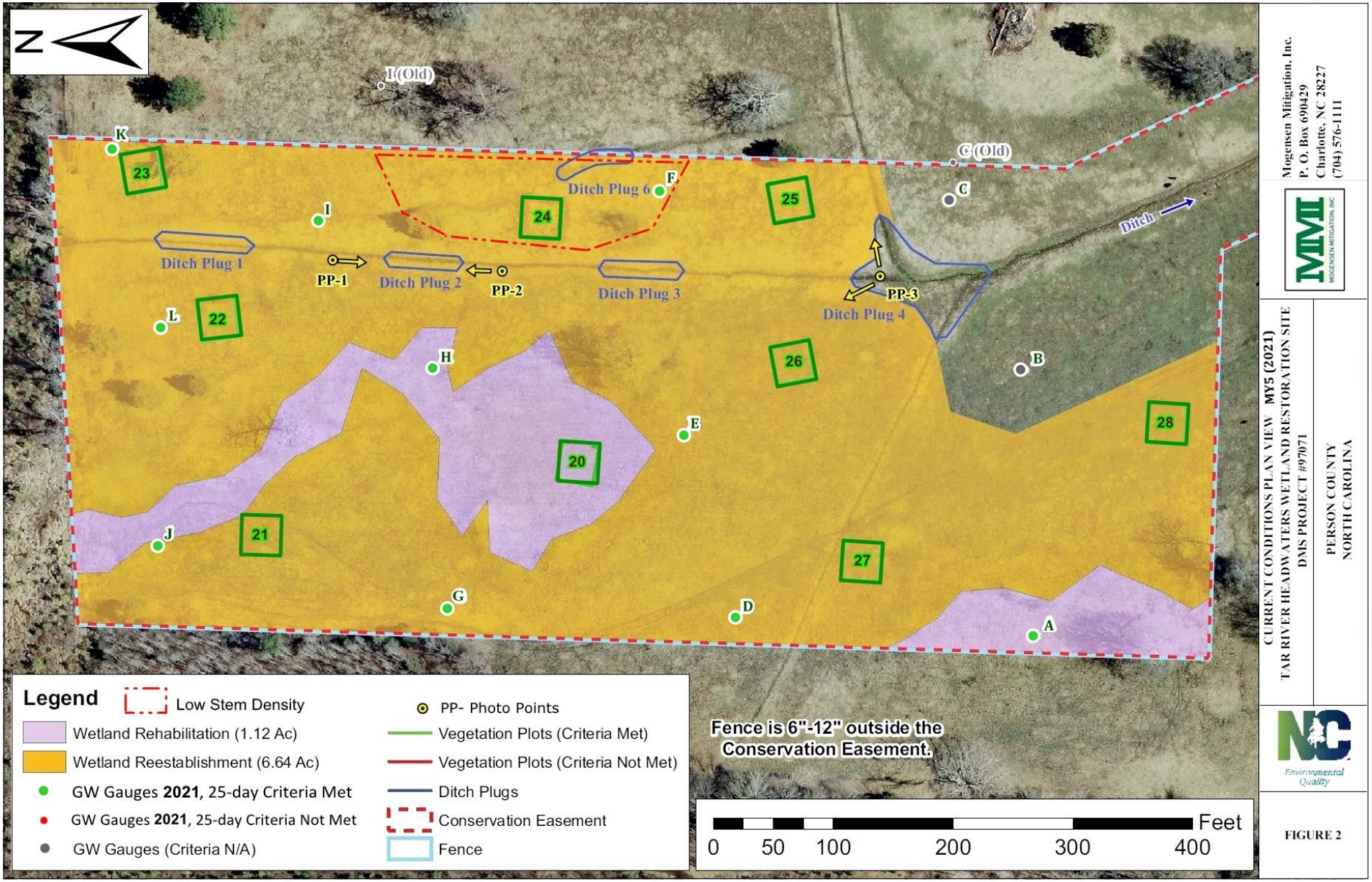


Figure 2A. Current Conditions Plan View, Fall 2021, MY-5.

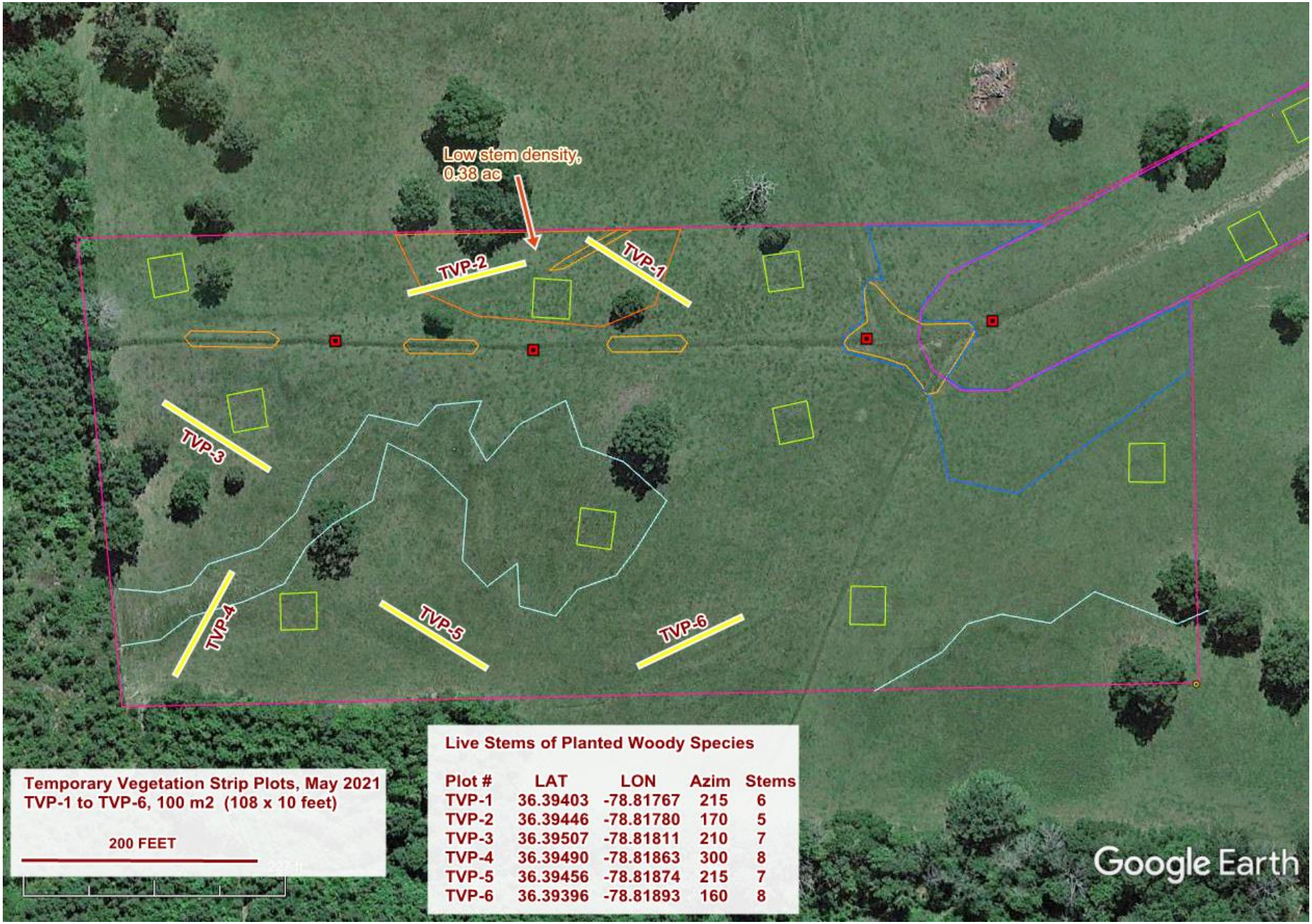


Figure 2B. Temporary Vegetation Strip Plots, May 2021.

Table 5: Vegetation Condition Assessment Table -- MY-5 (2021)

Tar River Headwaters Wetland Restoration #97071. Person County HUC #03020101-0102

Planted Acreage = 7.65

Vegetation Problem Category	Definitions	Mapping Threshold (acres)	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material	0.10	N/A	0	0	0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.10	N/A	1	0.38	5%
			Total	**0**		**5%**
Areas of Poor Growth Rates or Vigor *	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25	N/A	0	0	0%
			Cumulative Total	0	0	**0%**

Easement Acreage = 9.98

Vegetation Problem Category	Definitions	Mapping Threshold (SF)	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000	N/A	0	0	0%
Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	N/A	0	0	0%

Figure 3. Vegetation Plots: Tar River Headwaters Wetland Restoration Site #97071 MY-5 Fall 2021

CVS VegPlot-20: MY-0 Spring 2017

CVS VegPlot-20: MY-5 Sep 2021

CVS VegPlot-21: MY-0 Spring 2017

CVS VegPlot-21: MY-5 Sep 2021

Figure 3. Vegetation Plots: Tar River Headwaters Wetland Restoration Site #97071 MY-5 Fall 2021

CVS VegPlot-22: MY-0 Spring 2017

CVS VegPlot-22: MY-5 Sep 2021

CVS VegPlot-23: MY-0 Spring 2017

CVS VegPlot-23: MY-5 Sep 2021

Figure 3. Vegetation Plots: Tar River Headwaters Wetland Restoration Site #97071 MY-5 Fall 2021

CVS VegPlot-24: MY-0 Spring 2017

CVS VegPlot-24: MY-5 Sep 2021

CVS VegPlot-25: MY-0 Spring 2017

CVS VegPlot-25: MY-5 Sep 2021

Figure 3. Vegetation Plots: Tar River Headwaters Wetland Restoration Site #97071 MY-5 Fall 2021

CVS VegPlot-26: MY-0 Spring 2017

CVS VegPlot-26: MY-5 Sep 2021

CVS VegPlot-27: MY-0 Spring 2017

CVS VegPlot-27: MY-5 Sep 2021

Figure 3. Vegetation Plots: Tar River Headwaters Wetland Restoration Site #97071 MY-5 Fall 2021

CVS VegPlot-28: MY-0 Spring 2017

CVS VegPlot-28: MY-5 Sep 2021

Figure 4. Photo Points: Tar River Headwaters Wetland Restoration Site #97071 MY-5 Fall 2021

Photo Point 1: MY-0 Spring 2017

Photo Point 1: MY-5 Sept 2021

Photo Point 2: MY-0 Spring 2017

Photo Point 2: MY-5 Sept 2021

Figure 4. Photo Points: Tar River Headwaters Wetland Restoration Site #97071 MY-5 Fall 2021

Photo Point 3-East: MY-0 Spring 2017

Photo Point 3-East: MY-5 Sept 2021

Photo Point 3-North: MY-0 Spring 2017

Photo Point 3-North: MY-5 Sept 2021

APPENDIX C. Vegetation Plot Data

Table 6. Vegetation Plot Success Summary
Table 7. Vegetation Plot Stem Count Data

Tar River Headwaters Wetland Restoration (TRHWR) Project, DMS # 97071.
Monitoring Year 5 (Sept 2021) -- Person County NC. Tar-Pam HUC# 03020101

Table 6. CVS Plot Stem Density and Success Summary

CVS Plot #	Wetland Planted Stems		Planted + Volunteer Stems		Invasive Woody Stems	Success Criteria Met?
	per plot	per acre	per plot	per acre		
97071- 20	9	364	15	607	0	Yes
97071- 21	7	283	20	809	0	Yes
97071- 22	8	324	14	567	0	Yes
97071- 23	12	486	23	931	0	Yes
97071- 24	8	324	10	405	0	Yes
97071- 25	9	364	10	405	0	Yes
97071- 26	9	364	11	445	0	Yes
97071- 27	9	364	11	445	0	Yes
97071- 28	10	405	12	486	0	Yes
Plots 20-28	81		126		0	
Project Avg	9.0	364	14.0	567	0	Yes

Success Criteria = 320 planted + volunteer stems per acre at MY3, 260 planted + volunteer stems at MY5, and 210 planted + volunteer stems per acre at MY7 (planted species only).

Color codes for Success	MY4 to MY5
Exceeds criteria by 10% or more	**(287 or more)**
Exceeds criteria by less than 10%	**(260 - 286)**
Fails criteria by less than 10%	**(234 - 259)**
Fails criteria by more than 10%	**(258 or less)**

Tar River Headwaters Wetland Restoration (TRHWR) Project, DMS # 97071.

Monitoring Year 5 (Sept 2021) -- Person County NC. Tar-Pamlico HUC# 03020101-0102.

Table 7. CVS Plot Stem Counts and Density by Species.

			Current Plot Data (MY5- Sept 2021)													
			97071-20		97071-21		97071-22		97071-23		97071-24		97071-25		97071-26	
Scientific Name	Common Name	Growth Type	Plant	Total	Plant	Total	Plant	Total	Plant	Total	Plant	Total	Plant	Total	Plant	Total
Baccharis halimifolia	Groundsel-tree	Shrub														
Betula nigra	River Birch	Tree (P)	4	4	3	3	1	1	4	4					7	7
Carpinus caroliniana	Musclewood	Tree (P)														
Cornus amomum	Silky dogwood	Shrub (P)	1	1												
Diospyros virginiana	Persimmon	Tree (P)	2	4		3		2			2	2		1		
Fraxinus pennsylvanica	Green Ash	Tree (P)		2	1	8	3	6	2	10	1	3				2
Ilex vomitoria	Yaupon holly	Shrub (P)									1	1	1	1		
Liquidambar styraciflua	Sweetgum	Tree		1		5		1		6						1
Liriodendron tulipifera	Tulip Poplar	Tree (P)			2	2										
Nyssa biflora	Swamp Blackgum	Tree (P)														
Pinus taeda	Loblolly pine	Tree								2						
Platanus occidentalis	Sycamore	Tree (P)	2	2			2	2								
Quercus bicolor *	Swamp White Oak	Tree (P)									1	1	1	1		
Quercus michauxi *	Swp Chestnut Oak	Tree (P)							2	2						
Quercus nigra *	Water Oak	Tree (P)														
Quercus phellos *	Willow Oak	Tree (P)					1	1	4	4	2	2	7	7	2	2
Ulmus alata	Winged Elm	Tree						2								
Ulmus americana	American Elm	Tree (P)		2	1	4	1	2		3	1	1				
	Planted & Total Stem count		9	15	7	20	8	14	12	23	8	10	9	10	9	11
(P) = planted species		**ares**	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		acres	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
		Species count	4	7	4	6	5	8	4	7	6	6	3	4	2	4
		Stems per ACRE	364	607	283	810	324	567	486	931	324	405	364	405	364	445

Table 7, continued.

			Plot Data (MY5 Sep 2021)				Annual Means 2017 - 2021											
			97071-27		97071-28		MY0 (2017)		MY1 (2017)		MY2 (2018)		MY3 (2019)		MY4 (2020)		MY5 (2021)	
Scientific Name	Common Name	Growth Type	Plant	Total	Plant	Total	Plant	Total	Plant	Total	Plant	Total	Plant	Total	Plant	Total	Plant	Total
Baccharis halimifolia	Groundsel-tree	Shrub		2		1										2		3
Betula nigra	River Birch	Tree (P)			2	2	23	23	23	23	22	22	22	22	22	22	21	21
Carpinus caroliniana	Musclewood	Tree (P)	2	2	4	4	6	6	6	6	6	6	6	6	6	6	6	6
Cornus amomum	Silky dogwood	Shrub (P)										1		1	1	1	1	1
Diospyros virginiana	Persimmon	Tree (P)					2	2			1	3	1	4	1	13	4	12
Fraxinus pennsylvanica	Green Ash	Tree (P)	2	3	2	3	9	9	10	10	10	17	10	23	10	32	11	37
Ilex vomitoria	Yaupon holly	Shrub (P)														1	2	2
Liquidambar styraciflua	Sweetgum	Tree		1												12		14
Liriodendron tulipifera	Tulip Poplar	Tree (P)					12	12	6	6	1	2	2	2	2	2	2	2
Nyssa biflora	Swamp Blackgum	Tree (P)					1	1										
Pinus taeda	Loblolly pine	Tree										3		1		3		2
Platanus occidentalis	Sycamore	Tree (P)	1	1			5	5	5	5	5	5	5	5	5	5	5	5
Quercus bicolor *	Swamp White Oak	Tree (P)					3	3	3	3	4	4	2	2	2	2	2	2
Quercus michauxi *	Swp Chestnut Oak	Tree (P)											2	2	2	2	2	2
Quercus nigra *	Water Oak	Tree (P)					14	14	1	1								
Quercus phellos *	Willow Oak	Tree (P)			2	2	6	6	17	17	18	19	19	19	19	19	18	18
Ulmus alata	Winged Elm	Tree												4		2		2
Ulmus americana	American Elm	Tree (P)	4	5		1	10	10	11	14	5	18	8	18	6	17	7	18
	Planted & Total Stem count		9	11	10	12	91	91	82	85	72	97	77	104	76	122	81	126
(P) = planted species		**ares**	1	1	1	1	9	9	9	9	9	9	9	9	9	9	9	9
		acres	0.025	0.025	0.025	0.025	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222
	Species count		4	5	4	5	11	11	11	11	9	11	10	13	11	15	12	15
	Stems per ACRE		364	445	405	486	409	409	369	382	324	436	346	468	342	549	364	567

Plant = Planted Stems; Total = Planted + Volunteer Stems of planted species on **Red = volunteer non-planted species, NOT counted in totals or density.**

Blue highlight = Totals that include 1 or more volunteer stems of planted species.

*** Quercus seedlings misidentified in 2017 were corrected in 2018-2019, thus the changes in names and numbers**

Color codes for Plot Density & Success	MY1 to MY3	MY4 to MY5	MY6 to MY7
Exceeds criteria by 10% or more	(352 or more)	(287 or more)	(232 or more)
Exceeds criteria by less than 10%	(320 - 351)	(260 - 286)	(210 - 231)
Fails criteria by less than 10%	(289 - 319)	(234 - 259)	(189 - 209)
Fails criteria by more than 10%	(288 or less)	(233 or less)	(188 or less)

APPENDIX D. Hydrologic Data

Figure 5. Monthly Rainfall Totals (2021) with 30th, 50th, and 70th normal percentiles.

30-year historical data (1981-2010) at ROXBORO 7 ESE Gauge # 317516 from NC State Climate Office

		30-year Climate Normal precipitation		
Month	**2021 Precip**	**30th %**	**50th %**	**70th %**
Jan-21	3.93	2.45	3.81	4.46
Feb-21	6.62	2.58	3.33	3.82
Mar-21	2.71	2.99	4.45	5.32
Apr-21	1.97	2.18	3.34	4.21
May-21	2.38	2.51	3.35	4.04
Jun-21	3.44	2.15	3.84	4.45
July-21	5.22	3.38	4.57	5.44
Aug-21	3.33	2.57	3.89	4.90
Sep-21	3.57	1.94	3.91	4.85
Oct-21	1.95	2.65	3.72	4.72
Nov-21		1.89	3.46	4.42
Dec-21		2.56	3.71	4.52
Annual Ave			45.38	

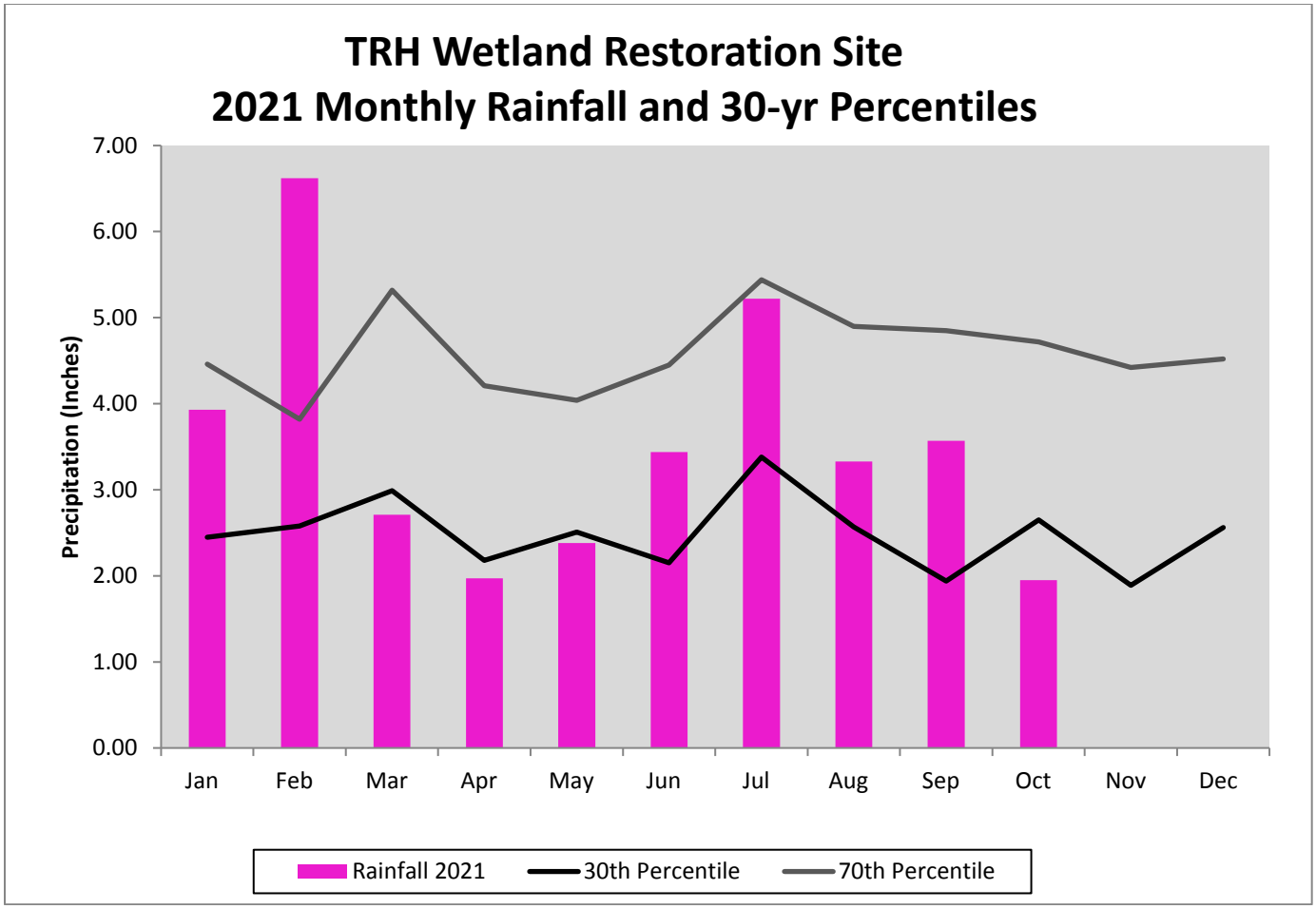
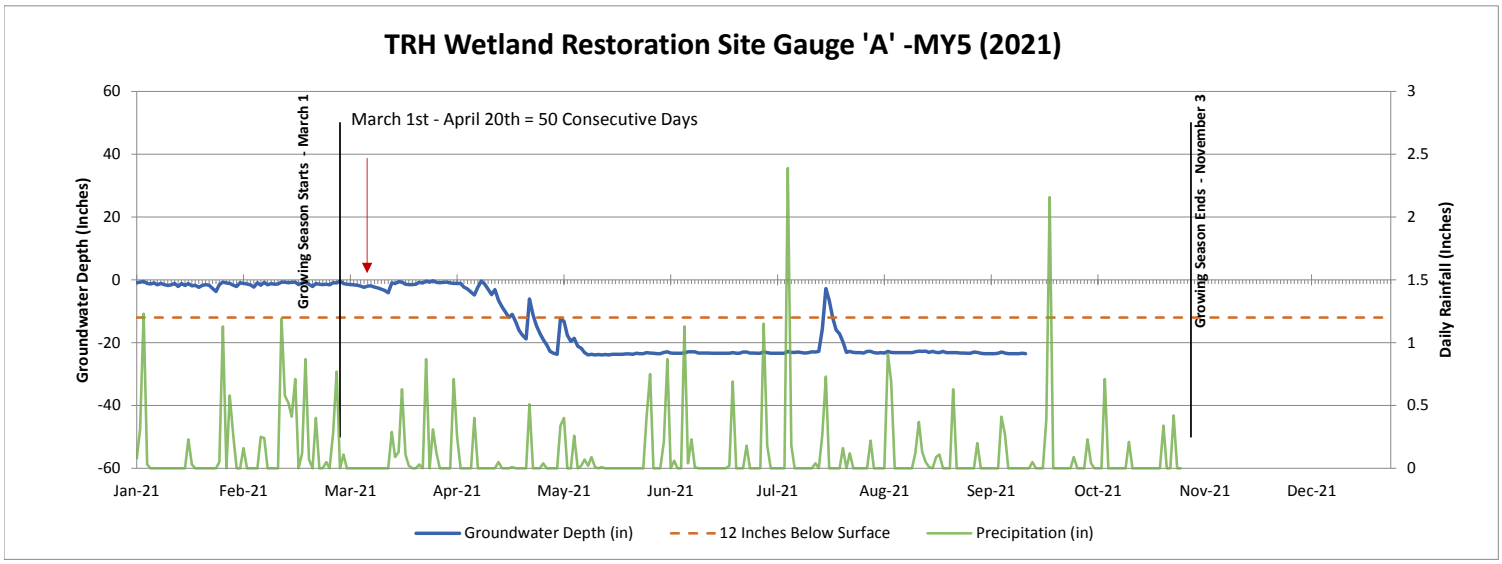
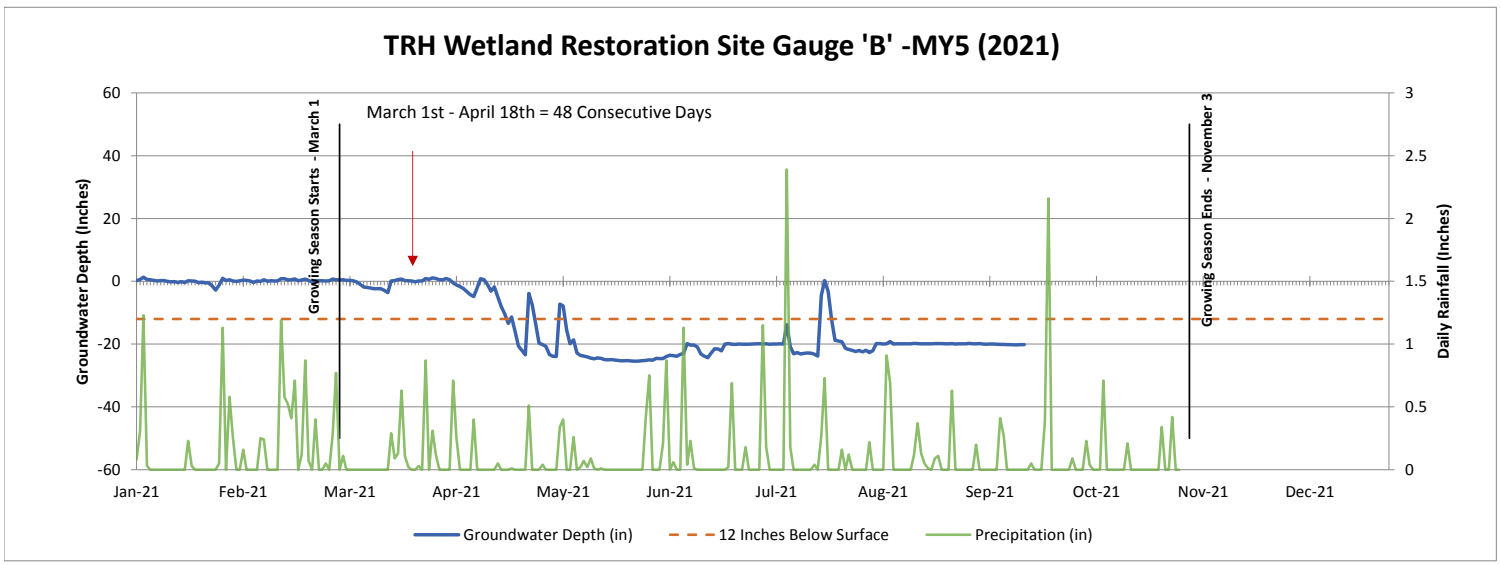


Figure 6A. Groundwater Gauges and Rainfall Data Plots -- Tar River Headwaters Wetland Restoration # 97071





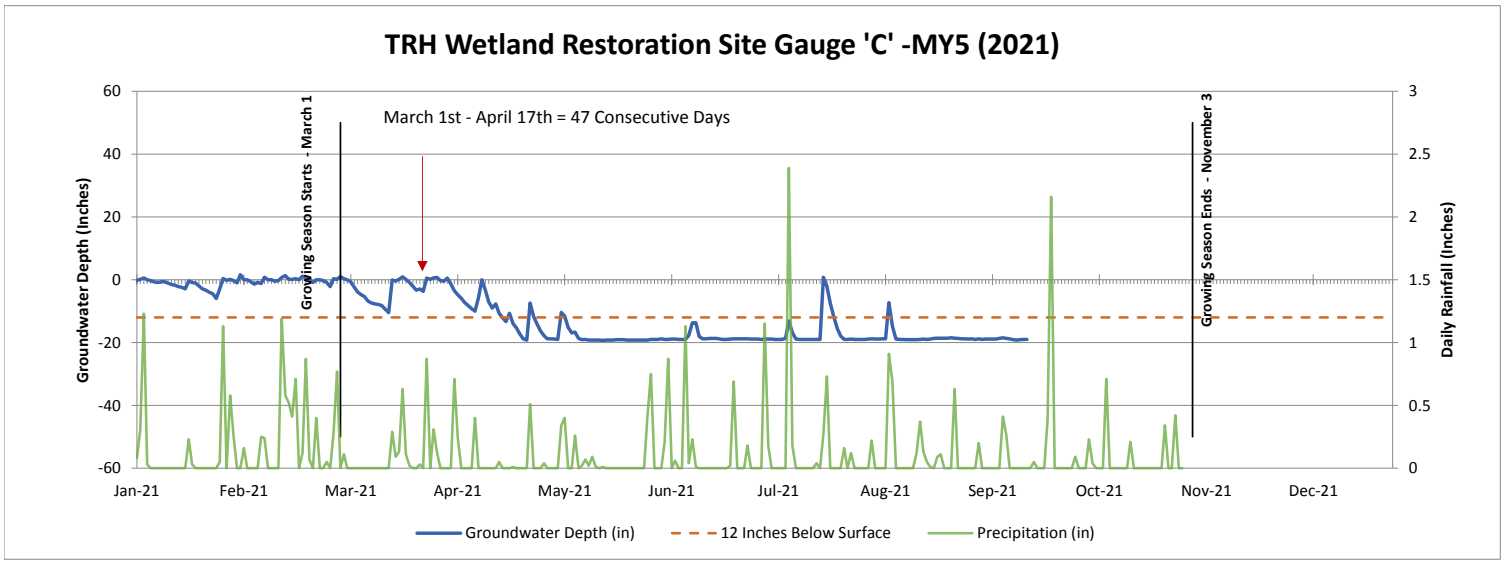
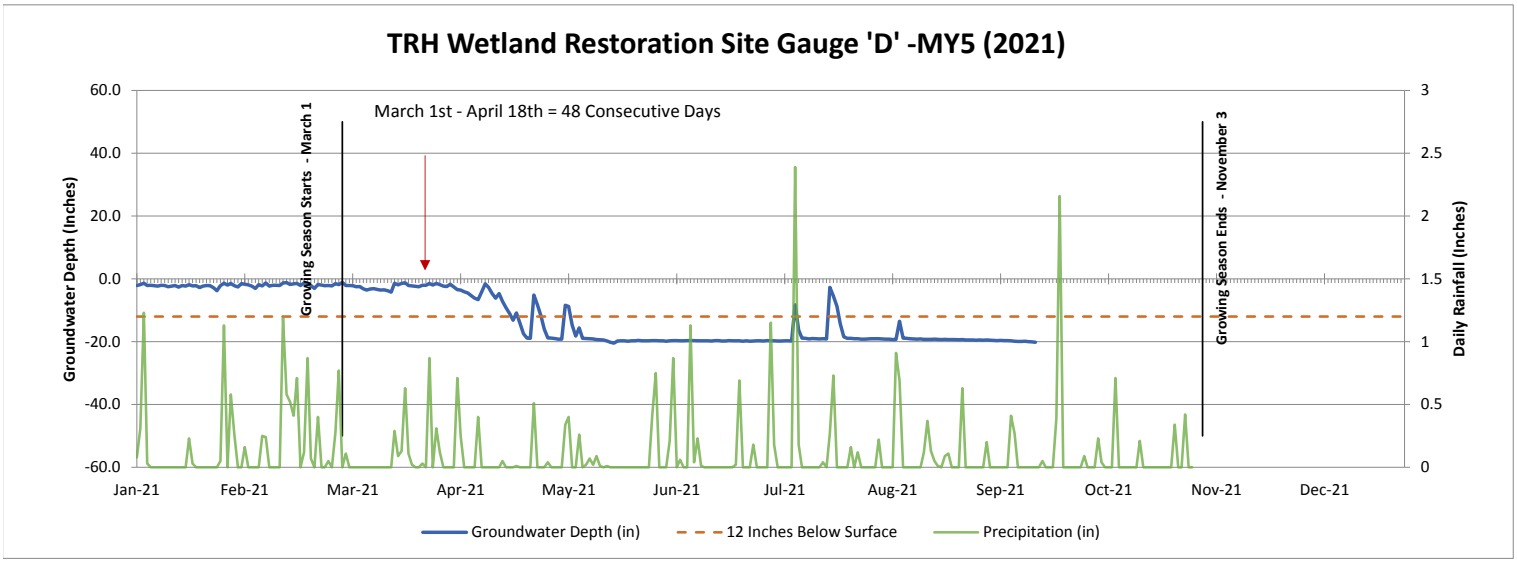
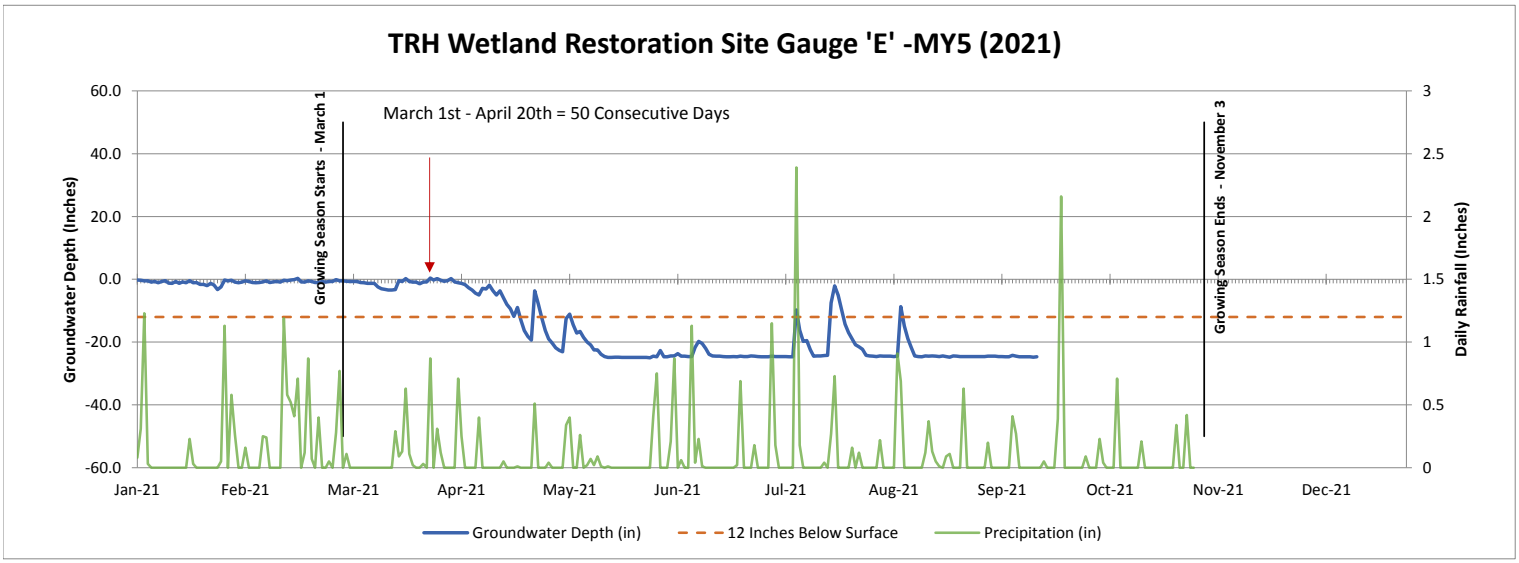


Figure 6B. Groundwater Gauges and Rainfall Data Plots -- Tar River Headwaters Wetland Restoration # 97071





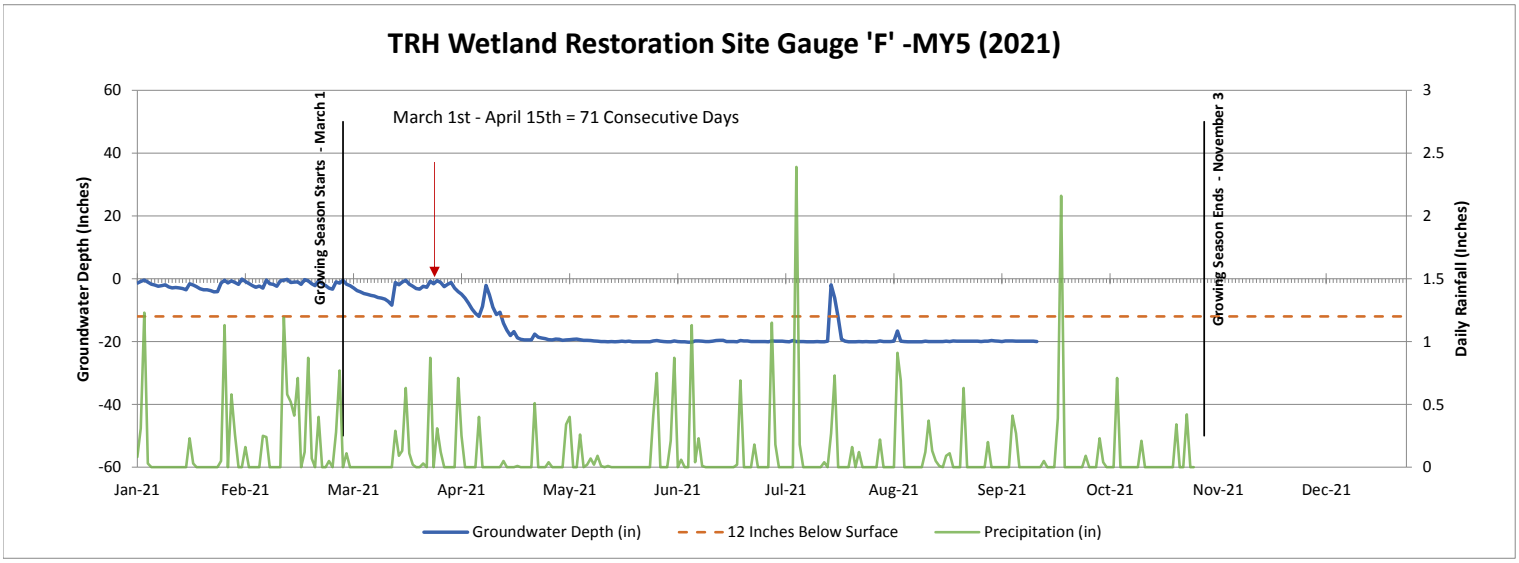
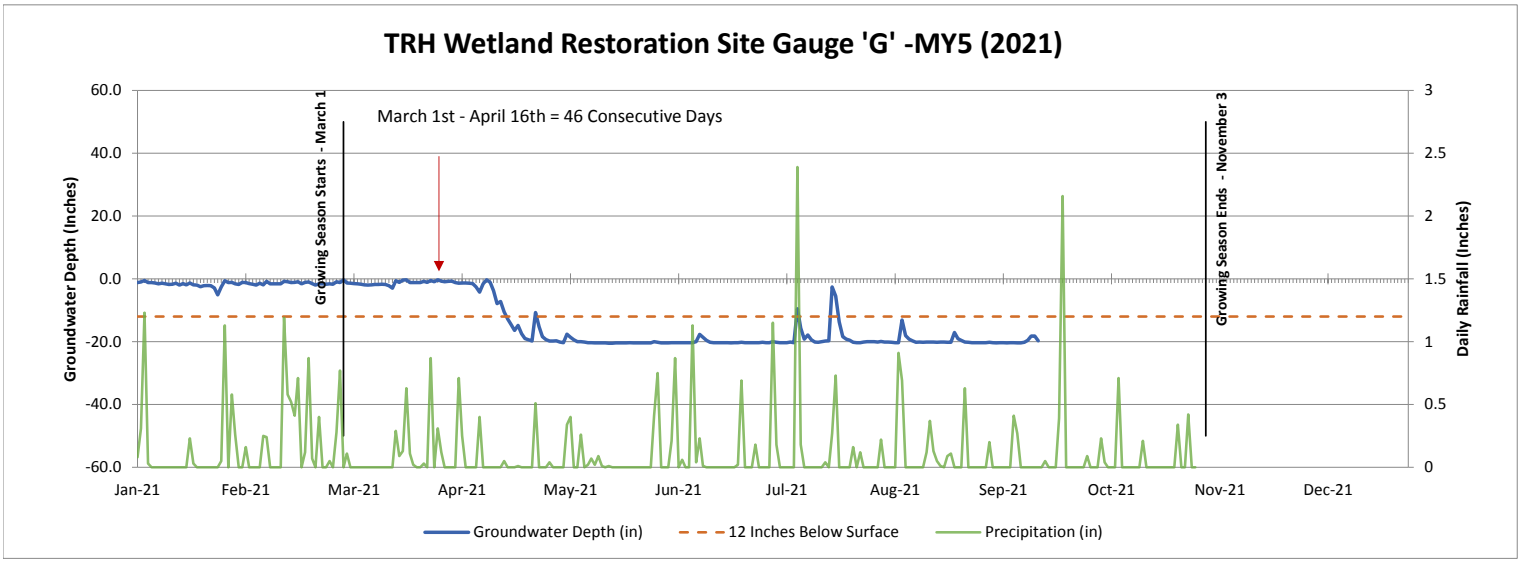
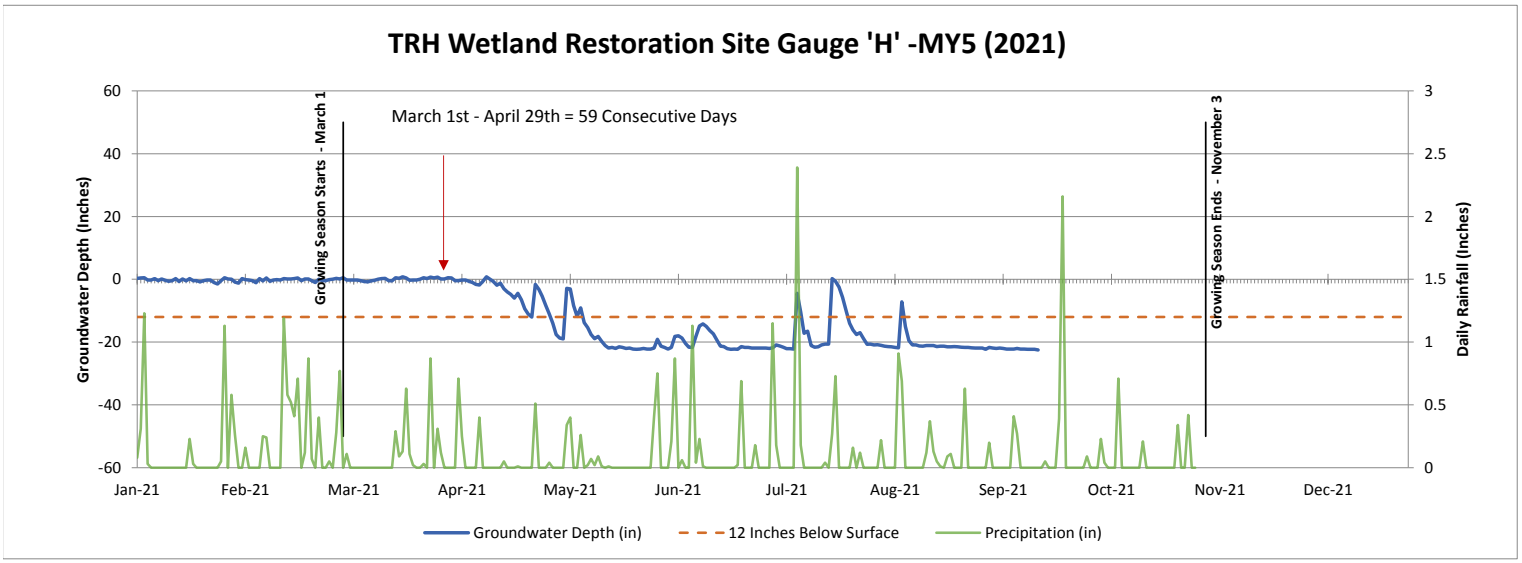


Figure 6C. Groundwater Gauges and Rainfall Data Plots -- Tar River Headwaters Wetland Restoration # 97071





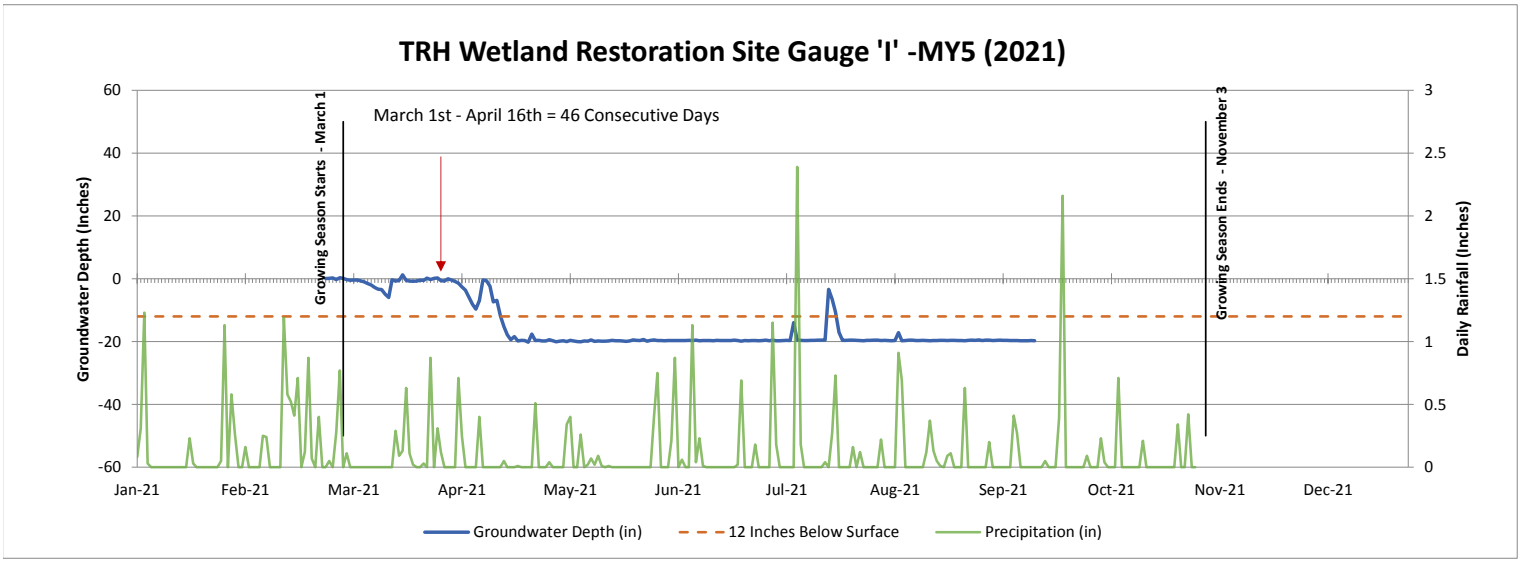
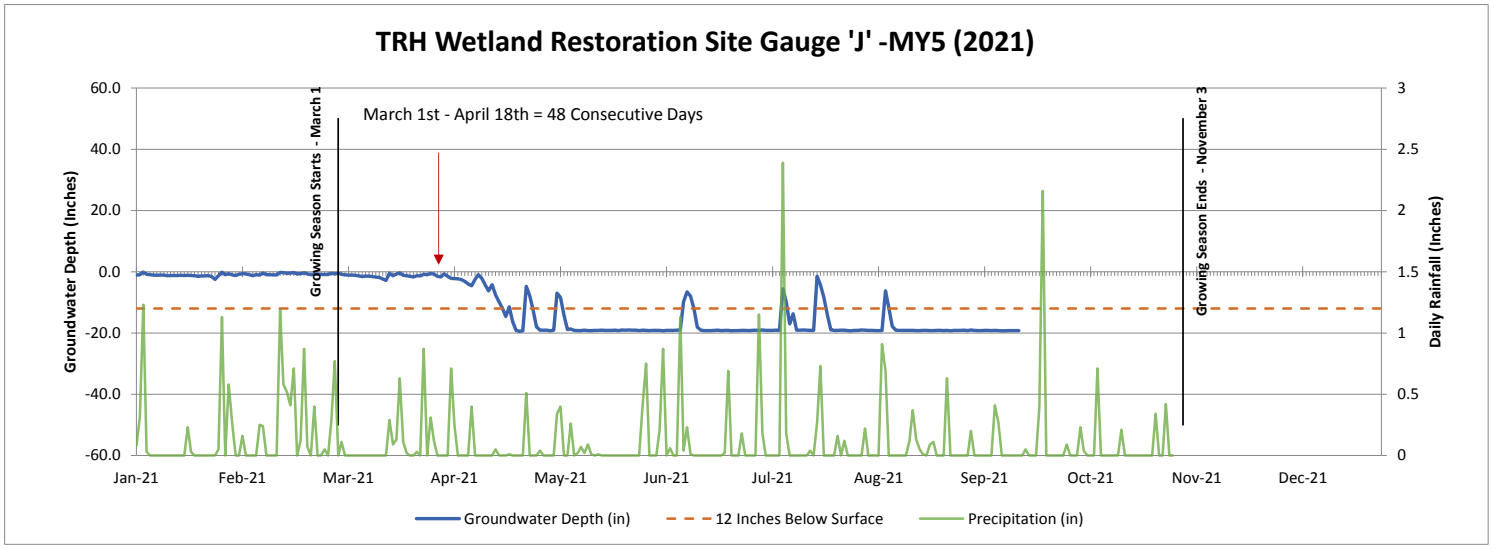
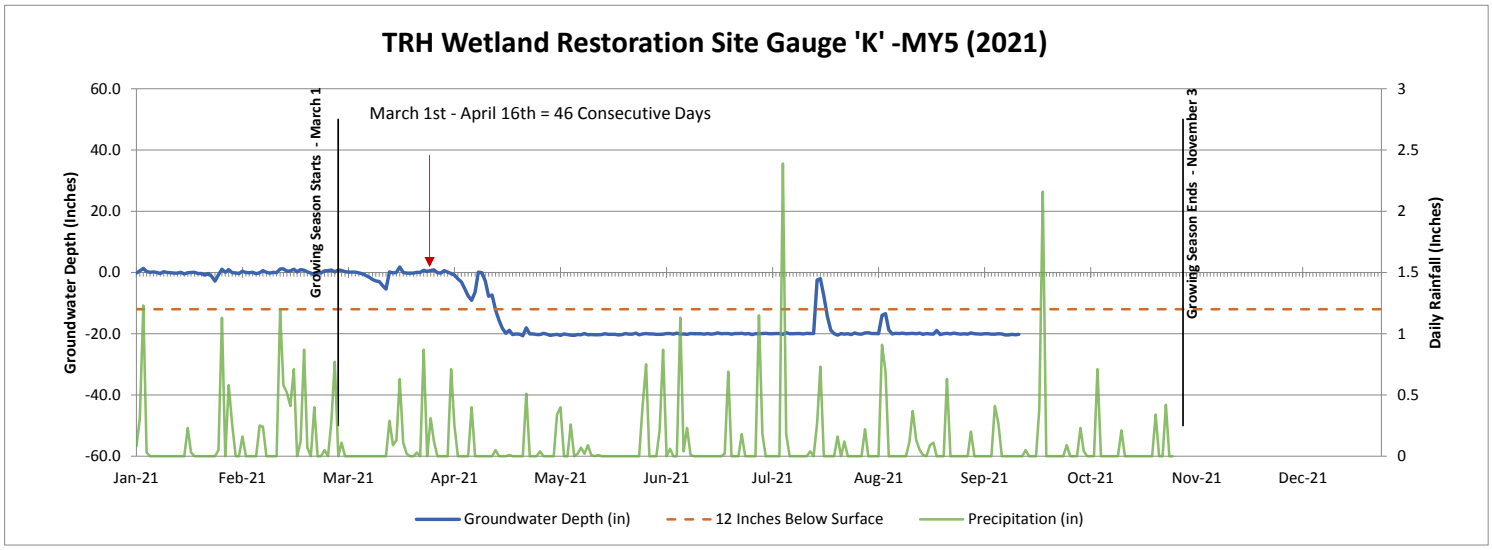


Figure 6D. Groundwater Gauges and Rainfall Data Plots -- Tar River Headwaters Wetland Restoration # 97071





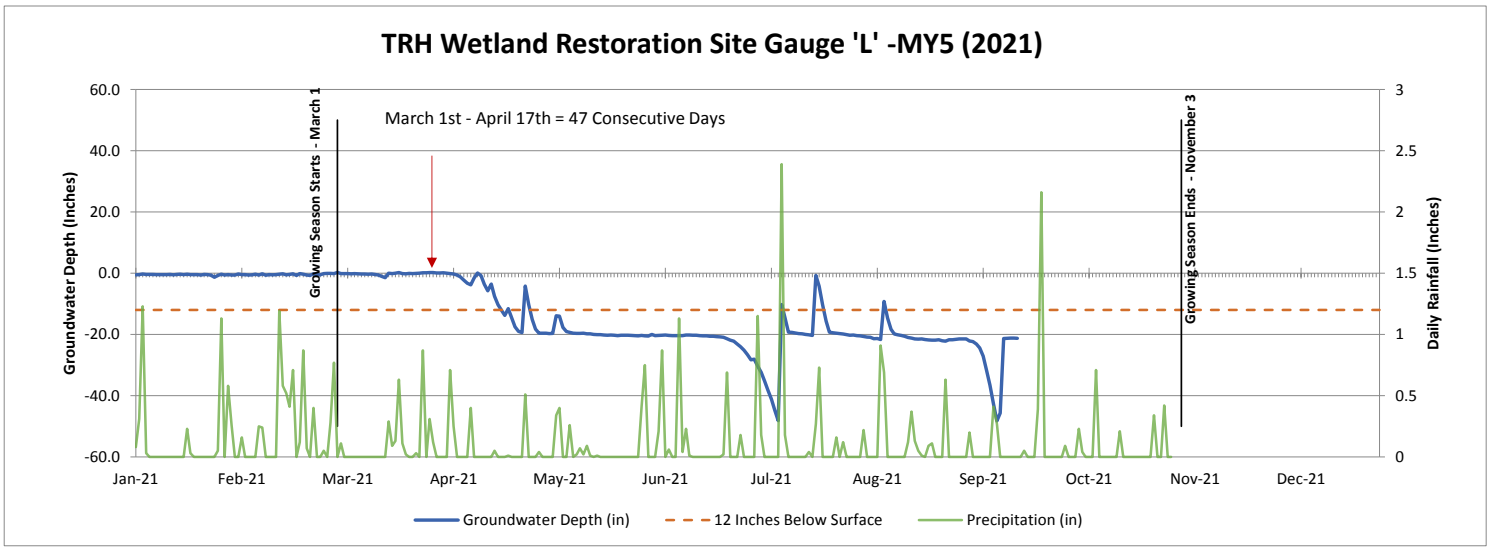


Figure 6E. Groundwater Gauges and Rainfall Data Plots -- Tar River Headwaters Wetland Restoration # 97071

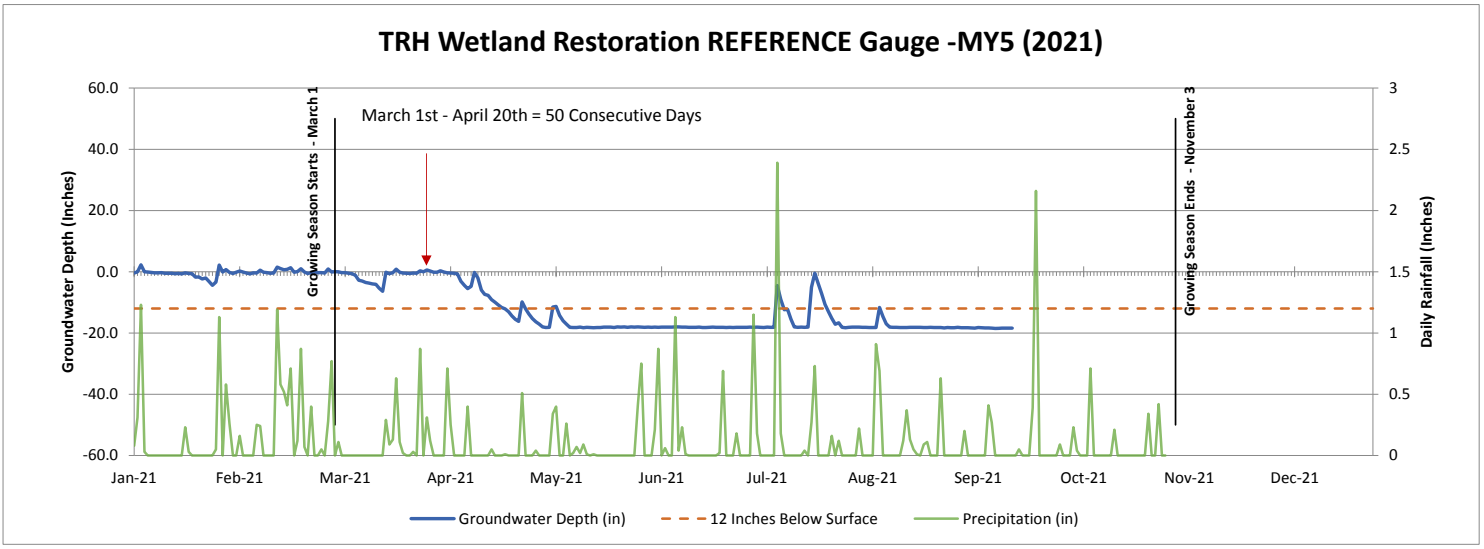


Table 8. Hydrologic Success Attainment 2016 - 2021, Groundwater Wells
Tar River Headwaters Wetland Mitigation Site # 97071.

Maximum Consecutive Days in Growing Season with Water Table above -12.0 inches

	2016 MY0				2017 MY1				2018 MY2				2019 MY3			
WELL	start	end	days	% GS	start	end	days	% GS	start	end	days	% GS	start	end	days	% GS
A	4/27	5/27	31	12	4/23	5/16	24	10	3/1	5/4	65	26	3/1	4/3	34	14
B *	4/28	5/9	12	5	4/23	5/16	24	10	3/1	6/7	99	40	3/1	5/1	62	25
C *	6/23	7/11	19	8	4/23	5/21	29	12	3/1	5/14	75	30	3/1	4/24	55	22
D	4/27	5/16	20	8	3/13	4/11	30	12	3/1	5/12	73	29	3/1	4/30	61	25
E	4/23	6/2	41	17	4/24	5/17	24	10	3/1	5/3	64	26	3/1	4/30	61	25
F	3/1	3/20	20	8	3/31	4/10	11	4	3/1	5/3	64	26	3/1	4/25	56	23
G	4/27	5/15	19	8	3/31	4/13	14	6	3/1	5/9	70	28	3/1	4/28	59	24
H	3/1	4/7	38	15	4/23	5/17	25	10	3/1	6/9	101	41	3/1	5/4	65	26
I	4/22	5/12	21	8	4/23	5/20	28	11	3/1	5/3	64	26	3/1	4/24	55	22
J	4/28	5/16	19	8	5/22	6/2	12	5	3/1	5/12	73	29	3/1	5/1	62	25
K	4/27	5/11	15	6	3/31	4/10	11	4	3/1	5/2	63	25	3/1	4/25	56	23
L	na	na	na	na	3/1	6/10	102	41	3/1	6/15	107	43	3/1	5/1	62	25
Ref	4/1	6/14	75	30	3/1	6/9	101	41	3/1	5/14	75	30	3/1	5/14	75	30

Groundwater Gauges -- Maximum Consecutive Days in Growing Season with Water Table above -12.0 inches

	2020 MY4				2021 MY5				2022 MY6				2023 MY7			
WELL	start	end	days	% GS	start	end	days	% GS	start	end	days	% GS	start	end	days	% GS
A	3/1	5/11	72	29	3/1	4/20	50	20								
B *	3/1	5/14	75	30	3/1	4/18	48	19								
C *	3/1	5/12	73	29	3/1	4/17	47	19								
D	3/1	5/12	73	29	3/1	4/18	48	19								
E	3/1	5/13	74	30	3/1	4/20	50	20								
F	3/1	5/10	71	29	3/1	4/15	45	18								
G	3/1	5/09	70	28	3/1	4/16	46	19								
H	3/1	5/17	78	31	3/1	4/29	59	24								
I	3/1	5/09	70	28	3/1	4/16	46	19								
J	3/1	5/12	73	29	3/1	4/18	48	19								
K	3/1	4/05	36	15	3/1	4/16	46	19								
L	3/1	4/30	61	25	3/1	4/17	47	19								
Ref	3/1	5/15	76	31	3/1	4/20	50	20								

Adjusted Growing Season based on on-site soil temperature > 41° F is Mar 1 to Nov 3 (248 Days).
Mitigation Plan success criterion is 10% of growing season (25 consecutive days WT < 12" below surface).
Blue = Gauge meets hydrologic success. Brown = Gauge does not meet hydrologic success
* Gauges B and C are in non-credit areas and do not contribute to project success evaluation.
Yellow = Gauge failure; actual end of hydroperiod may have been later.

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Percent of 2021 Growing Season with consecutive days of WT at -12 inches or higher.