MY3 FINAL MONITORING REPORT

BRAHMA SITE
Alamance County, North Carolina
Cape Fear River Basin
Cataloging Unit 03030002

DMS Project No. 100092
Full Delivery Contract No. 7743
DMS RFP No. 16-007571
USACE Action ID No. SAW-2019-00126
DWR Project No. 20190158

Data Collection: January - November 2023
Submission: January 2024

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NORTH CAROLINA 27699-1652

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ENVIRONMENTAL QUALITY

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Response to DMS Comments – MY3 (2023)

Brahma Mitigation Site (DMS #100092), Contract No. 7743
Cape Fear River Basin 03030002, Alamance County
USACE Action ID No. SAW-2019-00126, DWR Project No. 20190158

Comments Received (Black Text) & Responses (Blue Text)

Report & Field Visit:

1. During site visit, minor scour was observed on UT-1 a short distance upstream of UT-3 on outside of meander bend. Recommend watching the area to ensure that this does not become an issue. Overall, this site looks great.
   Response: The observed scour location is approximately four (4) feet in length and is on the right bank of UT1 within an Enhancement 1 portion of the stream. At this location exiting trees along the top of bank were avoided during construction. The scour is downstream of an existing root-wad and the channel is vertically stable. RS was able to plant five (5) live stakes in the scour area on 01/24/2024. Species included silky dogwood and black willow. RS will continue to observe this area during the monitoring period. The scour location has been added to the CCPV, and the shapefile is in the digital submittal.

Digital Comments:

1. The submission is missing all hydrology summary tables (surface water and groundwater gauge tables). Please submit the missing tables.
   Response: The missing hydrology summary tables (Tables 11-13) have been added to the Brahma_DMS_Tables_MY3_2023 file in the "Visual Assessment Data" > "Tables" folder of the digital submittal.

Brahma Year 3, 2023 Monitoring Summary

General Notes

- No encroachment was identified in Year 3 (2023).
- No evidence of nuisance animal activity (i.e., heavy deer browsing, beaver activated, etc.) was observed.

Streams

- Streams remained stable with few deviations from MY0 even after receiving several high discharge events.
  - During the DMS MY3 (2023) site visit with RS, minor scour was observed on UT-1 a short distance upstream of UT-3 on outside of meander bend. The observed scour location is approximately four (4) feet in length and is on the right bank of UT1 within an Enhancement 1 portion of the stream. At this location exiting trees along the top of bank were avoided during construction. The scour is downstream of an existing root-wad and the channel is vertically stable. RS was able to plant five (5) live stakes in the scour area on 01/24/2024. Species included silky dogwood and black willow. RS will continue to observe this area during the monitoring period. The scour location has been added to the CCPV, and the shapefile is in the digital submittal.
- All engineered structures were stable and functioning within design parameters.
- Three bankfull events were documented during MY3 (2023) making a total of 7 total bankfull events to date during the monitoring period (Table 11, Appendix D).
- Channel formation was evident in all Site tributaries during MY3 (Table 13A-E, Appendix D).
- In accordance with the monitoring schedule, year 5 (2023) benthic macroinvertebrate sampling occurred on June 13, 2023. See the table below for a summary of benthic macroinvertebrate results. MY3 (2023) results and habitat forms are in Appendix F.

Summary of Benthic Macroinvertebrate Data by Year

Sampling Station	Preconstruction		Year 3 (2023)		Year 5 (2025)		Year 7 (2027)	
	# EPT Taxa	Biotic Index	# EPT Taxa	Biotic Index	# EPT Taxa	Biotic Index	# EPT Taxa	Biotic Index
UT-1 upstream	0	9.27	0	9.38				
UT-1 downstream	0	9.30	2	8.03				

Wetlands

- All twelve groundwater gauges exceeded success criteria for the year 3 (2023) monitoring period. (Appendix D).

Yr. 3 (2023) Groundwater Hydrology Data

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)						
	Year 1 (2021)	Year 2 (2022)	Year 3 (2023)	Year 4 (2024)	Year 5 (2025)	Year 6 (2026)	Year 7 (2027)
1	Yes 60 days (25.4%)	Yes 66 days (28.0%)	Yes 100 days (42.4%)				
2	No 21 days (8.9%)	Yes 47 days (19.9%)	Yes 70 days (29.7%)				
3	No 18 days (7.6%)	Yes 28 days (12.0%)	Yes 69 days (29.2%)				
4	Yes 46 days (19.5%)	Yes 60 days (25.4%)	Yes 101 days (42.8%)				
5	Yes 47 days (19.9%)	Yes 59 days (25.0%)	Yes 85 days (36.0%)				
6	No 25 days (10.6%)	Yes 59 days (25.0%)	Yes 100 days (42.4%)				
7	Yes 227 days (96.2%)	Yes 236 days (100%)	Yes 66 days (28.1%)				
8	Yes 46 days (19.5%)	Yes 59 days (25.0%)	Yes 68 days (28.8%)				
9	Yes 49 days (20.8%)	Yes 59 days (25.0%)	Yes 70 days (29.7%)				
10	Yes 39 days (16.5%)	Yes 43 days (18.2%)	Yes 67 days (28.4%)				
11	Yes 46 Days (19.5%)	Yes 66 days (28.0%)	Yes 100 days (42.4%)				
12	No 21 Days (8.9%)	No 26 days (11.0%)	Yes 68 days (28.8%)				

Vegetation

- Measurements of the 23 vegetation plots (19 permanent and 4 random transects) resulted in an average of 451 planted stems/acre excluding livestakes. Sixteen of nineteen permanent plots and two of four random plots met success criteria (Tables 7-8, Appendix B).

Site Monitoring Activity and Reporting History

Project Millstones	Stream Monitoring Complete	Vegetation Monitoring Complete	Wetland Monitoring	Data Analysis Complete	Completion or Delivery
Construction Earthwork	--	--	--	--	December 9, 2020
Planting	--	--	--	--	January 12, 2021
As-Built Documentation	Jan. 11-12, 2021	Jan. 14-15, 2021	--	March 2021	April 2021
Year 1 Monitoring	October 19, 2021	July 28, 2021	Jan. – Nov. 2021	November 2021	January 2022
Year 2 Monitoring	October 26, 2022	July 7, 2022	Jan. – Nov. 2022	November 2022	December 2022
Year 3 Monitoring	April 19, 2023	July 25, 2023	Jan. – Nov. 2023	November 2023	December 2023

Soil Testing

- On February 7, 2023, soil samples were collected at four locations across the site. Results from the soil report indicate no negative impact from soil composition and tree vigor, see Soil Report (Appendix H).

Site Maintenance Report (2023)

Invasive Species Work	Maintenance work
5/15/2023-5/16/2023 Nodding Thistle. Chinse Privet, Russian Olive, Multiflora rose 9/13/2023 Chinese Privet, Russian Olive, Multiflora rose	2/7/2023 Soil sampling 8/22/2023 Two large dead trees were cut and left in the easement as habitat piles

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APPENDICES

1.0 PROJECT SUMMARY

Restoration Systems, LLC has established the North Carolina Division of Mitigation Services (NCDMS) Brahma Site (Site).

1.1 Project Background, Components, and Structure

The Brahma Site (hereafter referred to as the "Site") encompasses 22.7 acres of disturbed forest and livestock pasture along unnamed tributaries to Reedy Branch (warm water streams in the Jordan Lake watershed). The Site is located approximately 2 miles south of Snow Camp, NC, 5 miles northeast of Silk Hope, NC, and southwest of Clark Road (SR 2352) in southern Alamance County.

Before construction, land use at the Site was characterized by disturbed forest and livestock pasture. Riparian zones are primarily composed of herbaceous vegetation that is sparse and disturbed due to livestock grazing, bush hogging, and regular land-management activities.

During mitigation plan preparation, two Pilgrim's Pride chicken houses were being constructed on the property adjacent to the southeast portion of UT 1. The chicken houses were constructed on pads that have a groundwater drainage network leading to two pipes that discharge adjacent to the easement. The pipes do not drain effluent from the chicken houses and discharge clean water. Most drainage from the chicken house facilities drains through a draw that is treated at the easement boundary and then discharged in wetlands before entering Site tributaries.

Chicken waste management is being managed through a Joint Responsibility – Producer/Third-Party Applicator agreement in a manner consistent with requirements set forth by the State of North Carolina in 15A NCAC 02T Section 1400 (Manure Hauler Regulations) and NRCS standard 633 (Waste Utilization). Documentation of the agreement is available upon request. Under the agreement, the producer maintains the responsibility for keeping records on the amount of waste generated by the operation and providing the responsible third party with waste analysis records. The third-party applicator is responsible for applying materials at agronomic rates, soil testing, field evaluation, etc.

At present, no waste is to be discharged onto the property adjacent to the Site easement. If waste management changes, a minimum setback of 100 feet from perennial waters is required.

Proposed Site restoration activities generated 3881.066 Stream Mitigation Units (SMUs) and 6.655 Riparian Wetland Mitigation Units (WMUs) as described in Table 1.

Additional activities that occurred at the Site included the following.

- Planting 17.7 acres of the Site with 20,200 stems (planted species are included in Table 6 [Appendix B]).
- Fencing the entire conservation easement.

Table 1. Mitigation Site (ID-100092) Project Mitigation Quantities and Credits

Project Segment	Original Mitigation Plan Ft/Ac	As-Built Ft/Ac	Original Mitigation Category	Original Restoration Level	Original Mitigation Ratio (X:1)	Credits		Comments
Stream								
UT-1A	3034	3121	Warm	EI	1.50000	2,022.667		
UT-1B	192	191	Warm	EII	2.50000	76.800		
UT-1C	911	911	Warm	P	10.00000	91.100		
UT-2	1354	1392	Warm	EII	2.50000	12.000		
UT-2A	30	30	Warm	EII	2.50000	541.600		
UT-3	239	245	Warm	R	1.00000	239.000		
UT-4	129	135	Warm	EII	2.50000	51.600		
UT-5	626	631	Warm	EII	2.50000	250.400		
UT-6	501	511	Warm	R	1.00000	501.000		
UT-7	47	48	Warm	EII	2.50000	18.800		
					Total:	**3,804.967**		
Wetland								
Wetland Reestablish	4.740	4.736	R	REE	1.00000	4.740		
Wetland Enhancement	3.709	3.708	R	E	2.00000	1.855		
Wetland Preservation	0.601	0.601	R	P	10.00000	0.060		
					Total:	**6.655**		

Project Credits

	Stream			Riparian	Non-Rip	Coastal
Restoration Level	Warm	Cool	Cold	Wetland	Wetland	Marsh
Restoration	740.000			0.000	0.000	0.000
Re-establishment	0.000			4.740	0.000	0.000
Rehabilitation	0.000			0.000	0.000	0.000
Enhancement	0.000			1.855	0.000	0.000
Enhancement I	2,022.667	0.000	0.000			
Enhancement II	951.200	0.000	0.000			
Creation				0.000	0.000	0.000
Preservation	91.100	0.000	0.000	0.060	0.000	
Benthics 2%	76.099	0.000	0.000	0.000	0.000	
Totals	**3,881.066**	**0.000**	**0.000**	**6.655**	**0.000**	**0.000**

Total Stream Credit **3,881.066**
Total Wetland Credit **6.655**

Wetland Mitigation Category

CM	Coastal Marsh
R	Riparian
NR	Non-Riparian

Restoration Level

HQP	High Quality Preservation
P	Preservation
E	Wetland Enhancement - Veg and Hydro
EII	Stream Enhancement II
EI	Stream Enhancement I
C	Wetland Creation
RH	Wetland Rehabilitation - Veg and Hydro
REE	Wetland Re-establishment Veg and Hydro
R	Restoration

Site design was completed in August 2020. Construction started on August 29, 2020 and ended within a final walkthrough on December 9, 2020. The Site was planted on January 12, 2021. Completed project activities, reporting history, completion dates, and project contacts are summarized in Tables 14-15 (Appendix E).

1.2 Project Goals and Objectives

Project goals are based on the *Cape Fear River Basin Restoration Priorities* (RBRP) report (NCEEP 2009) and on-site data collection of channel morphology and function observed during field investigations. The Site is located within **Targeted Local Watershed (TLW) 03030002050050**. The RBRP report documents benthic ratings vary between "Fair" and "Good-Fair" possibly due to cattle, dairy, and poultry operations. The project is not located in a Regional or Local Watershed Planning Area; however, RBRP goals are addressed by project activities as follows with Site-specific information following the RBRP goals in parenthesis.

1. Reduce and control sediment inputs – reduction of 8.0 tons/year after mitigation is complete);
2. Reduce and manage nutrient inputs - livestock removed from streams resulting in a direct reduction of 1020.8 pounds of nitrogen, 84.6 pounds of phosphorus per year, and 11.2 x 10^{11} colonies of fecal coliform; fertilizer application has been eliminated; and marsh treatment areas were installed);
3. Protect and augment designated natural heritage areas (NA).

Site-specific mitigation goals and objectives were developed through the use of the North Carolina Stream Assessment Method (NC SAM) and North Carolina Wetland Assessment Method (NC WAM) analyses of pre-construction and reference stream systems at the Site (NC SFAT 2015 and NC WFAT 2010) (see table below).

Table 2. Summary: Goals, Performance, and Results

Targeted Functions	Goals	Objectives	Compatibility with Success Criteria
(1) HYDROLOGY			
(2) Flood Flow (4) Wooded Riparian Buffer (4) Microtopography	• Attenuate flood flow across the Site. • Minimize downstream flooding to the maximum extent possible. • Connect streams to functioning wetland systems.	• Construct new channel at historic floodplain elevation to restore overbank flows and restore jurisdictional wetlands • Plant woody riparian buffer • Remove livestock • Deep rip floodplain soils to reduce compaction and increase soil surface roughness • Protect riparian buffers with a perpetual conservation easement	• BHR not to exceed 1.2 • Document four overbank events in separate monitoring years • Livestock excluded from the easement • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded
(3) Stream Stability (4) Sediment Transport (4) Stream Geomorphology	• Increase stream stability within the Site so that channels are neither aggrading nor degrading.	• Construct channels with proper pattern, dimension, and longitudinal profile • Remove livestock • Construct stable channels with appropriate substrate • Plant woody riparian buffer • Stabilize stream banks	• Cross-section measurements indicate a stable channel with appropriate substrate • Visual documentation of stable channels and structures • BHR not to exceed 1.2 • ER of 2.2 or greater • < 10% change in BHR and ER in any given year • Livestock excluded from the easement • Attain Vegetation Success Criteria
(1) WATER QUALITY			
(2) Streamside Area Vegetation (3) Upland Pollutant Filtration (2) Indicators of Stressors (2) Aquatic Life Tolerance Wetland Particulate Change Wetland Physical Change	• Remove direct nutrient and pollutant inputs from the Site and reduce contributions to downstream waters.	• Remove livestock and reduce agricultural land/inputs • Install marsh treatment areas • Plant woody riparian buffer • Restore/enhance jurisdictional wetlands adjacent to Site streams • Provide surface roughness and reduce compaction through deep ripping/plowing. • Restore overbank flooding by constructing channels at historic floodplain elevation.	• Livestock excluded from the easement • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria
(1) HABITAT			
(2) In-stream Habitat (3) Substrate (3) In-Stream Habitat (2) Stream-side Habitat (3) Stream-side Habitat (3) Thermoregulation Wetland Physical Structure Wetland Landscape Patch Structure	• Improve instream and stream-side habitat.	• Construct stable channels with appropriate substrate • Plant woody riparian buffer to provide organic matter and shade • Construct new channel at historic floodplain elevation to restore overbank flows • Plant woody riparian buffer • Protect riparian buffers with a perpetual conservation easement • Restore/enhance jurisdictional wetlands adjacent to Site streams • Stabilize stream banks • Install in-stream structures	• Cross-section measurement indicate a stable channel with appropriate substrate • Visual documentation of stable channels and in-stream structures. • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded

1.3 Success Criteria

Monitoring and success criteria for stream restoration should relate to project goals and objectives identified from on-site NC SAM data collection. From a mitigation perspective, several of the goals and objectives are assumed to be functionally elevated by restoration activities without direct measurement. Other goals and objectives will be considered successful upon achieving success criteria. The following summarizes Site success criteria.

Success Criteria

Streams
• All streams must maintain an Ordinary High-Water Mark (OHWM), per RGL 05-05. • Continuous surface flow must be documented each year for at least 30 consecutive days. • Bank height ratio (BHR) cannot exceed 1.2 at any measured cross-section. • Entrenchment ratio (ER) must be no less than 2.2 at any measured riffle cross-section. • BHR and ER at any measure riffle cross-section should not change by more than 10% from baseline condition during any given monitoring period. • The stream project shall remain stable and all other performance standards shall be met through four separate bankfull events, occurring in separate years, during the monitoring years 1-7.
Wetland Hydrology
• Saturation or inundation within the upper 12 inches of the soil surface for, at a minimum, 12 percent of the growing season, during average climatic conditions.
Vegetation
• Within planted portions of the site, a minimum of 320 stems per acre must be present at year 3; a minimum of 260 stems per acre must be present at year 5; and a minimum of 210 stems per acre must be present at year 7. • Trees must average 7 feet in height at year 5, and 10 feet in height at year 7 in each plot. • Planted and volunteer stems are counted, provided they are included in the approved planting list for the site; natural recruits not on the planting list may be considered by the IRT on a case-by-case basis.

2.0 METHODS

Monitoring will be conducted by Axiom Environmental, Inc. Annual monitoring reports of the data collected will be submitted to the NCDMS by Restoration Systems no later than December 1 of each monitoring year data is collected. The monitoring schedule is summarized in the following table.

Monitoring Schedule

Resource	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Streams	X	X	X		X		X
Wetlands	X	X	X	X	X	X	X
Vegetation	X	X	X		X		X
Macroinvertebrates			X		X		X
Visual Assessment	X	X	X	X	X	X	X
Report Submittal	X	X	X	X	X	X	X

2.1 Monitoring

The monitoring parameters are summarized in the following table.

Monitoring Summary

Stream Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Stream Profile	Full longitudinal survey	As-built (unless otherwise required)	All restored stream channels	Graphic and tabular data.
Stream Dimension	Cross-sections	Years 1, 2, 3, 5, and 7	Total of 12 cross-sections on restored channels	Graphic and tabular data.
Channel Stability	Visual Assessments	Yearly	All restored stream channels	Areas of concern will be depicted on a plan view figure with a written assessment and photograph of the area included in the report.
	Additional Cross-sections	Yearly	Only if instability is documented during monitoring	Graphic and tabular data.
Stream Hydrology	Continuous monitoring surface water gauges and/or trail camera	Continuous recording through monitoring period	3 surface water gauges on UT 3, 5, and 6	Surface water data for each monitoring period
Bankfull Events	Continuous monitoring surface water gauges and/or trail camera	Continuous recording through monitoring period	3 surface water gauges on UT 3, 5, and 6	Surface water data for each monitoring period
	Visual/Physical Evidence	Continuous through monitoring period	1 crest gauge on UT 1	Visual evidence, photo documentation, and/or rain data.
Benthic Macroinvertebrates	"Qual 4" method described in *Standard Operating Procedures for Collection and Analysis of Benthic Macroinvertebrates, Version 5.0* (NCDWR 2016)	Pre-construction, Years 3, 5, and 7 during the "index period" referenced in *Small Streams Biocriteria Development* (NCDWQ 2009)	2 stations (on UT 1 upstream and UT 1 downstream); however, the exact locations will be determined at the time pre-construction benthics are collected	Results* will be presented on a site-by-site basis and will include a list of taxa collected, an enumeration of *Ephemeroptera, Plecoptera,* and *Tricopetera* taxa as well as Biotic Index values.
Wetland Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Wetland Restoration	Groundwater gauges	Years 1, 2, 3, 4, 5, 6, and 7 throughout the year with the growing season defined as March 1-October 22	10 gauges spread throughout restored wetlands	Soil temperature at the beginning of each monitoring period to verify the start of the growing season, groundwater and rain data for each monitoring period
Vegetation Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Vegetation establishment and vigor	Permanent vegetation plots 0.0247 acre (100 square meters) in size; *CVS-EEP Protocol for Recording Vegetation*, *Version 4.2* (Lee et al. 2008)	As-built, Years 1, 2, 3, 5, and 7	19 plots spread across the Site	Species, height, planted vs. volunteer, stems/acre
	Annual random vegetation plots, 0.0247 acre (100 square meters) in size	As-built, Years 1, 2, 3, 5, and 7	4 plots randomly selected each year	Species and height

*Benthic Macroinvertebrate sampling data will not be tied to success criteria; however, the data may be used as a tool to observe positive gains to in-stream habitat

Stream Summary

All streams are functioning as designed, and no stream areas of concern were observed during year 3 (2023) monitoring. Stream morphology data is available in Appendix C. Stream flow/crest data for UT1 was lost due to a gauge malfunction, however success criteria for surface flow was still met, and visual observations along with photo evidence shows year-round flow through the channel. The gauge was replaced on September 6, 2023 and is currently functioning properly.

In accordance with the monitoring schedule, year 5 (2023) benthic macroinvertebrate sampling occurred on June 13, 2023. See the table below for a summary of benthic macroinvertebrate results. MY3 (2023) results and habitat forms are in Appendix F.

Summary of Benthic Macroinvertebrate Data by Year

Sampling Station	Preconstruction		Year 3 (2023)		Year 5 (2025)		Year 7 (2027)	
	# EPT Taxa	Biotic Index	# EPT Taxa	Biotic Index	# EPT Taxa	Biotic Index	# EPT Taxa	Biotic Index
UT-1 upstream	0	9.27	0	9.38				
UT-1 downstream	0	9.30	2	8.03				

Wetland Summary

Summary of Monitoring Period/Hydrology Success Criteria by Year

Year	Soil Temperatures/Date Bud Burst Documented	Monitoring Period Used for Determining Success	12 Percent of Monitoring Period
2021 (Year 1)	March 1, 2021	March 1-October 22 (236 days)	28 days
2022 (Year 2)	March 1, 2022	March 1-October 22 (236 days)	28 days
2023 (Year 3)	March 1, 2023*	March 1-October 22 (236 days)	28 days

*Based on documented bud burst on 2/28/23 and an onsite soil temperature logger reading of 50.37°F on 3/1/23 and staying well above 41°F thereafter.

All twelve groundwater gauges exceeded success criteria for the year 3 (2023) monitoring period. (Appendix D). Monthly rainfall sum and 30-70 percentiles from historic WETs data are reported in Figure D1 (Appendix D).

Vegetation Summary

During quantitative vegetation sampling, 19 sample plots (10-meter by 10-meter) were installed within the Site as per guidelines established in *CVS-EEP Protocol for Recording Vegetation*, *Version 4.2* (Lee et al. 2008). Year 3 (2023) vegetation measurements occurred on July 25, 2023 and also included four temporary vegetation plots (50 meter by 2 meter). Measurements of the 23 vegetation plots (19 permanent and 4 temporary plots) resulted in an average of 451 planted stems/acre excluding livestakes.

Additionally, sixteen of the nineteen individual permanent plots and two of four random transects met success criteria (Tables 7-8, Appendix B).

Due to observed low stem density during MY2 (2022), RS implemented an adaptive management plan in February 2023. The plan included the supplemental planting of 3,650 bare-root stems over 13.08 of the original 17.7 acres of planted area. Remedial bare-root planting included species a minimum of 18-24 inches tall with adequate root mass to help reduce mortality. See table below for planted species and planting denisties.

Species and Quantity of Supplemental Planting
Vegetation Association: Piedmont/Low Mountain Alluvial Forest
Planting Area = 13.08 Acres

Species	Count	% of Total Replant	Listed Mitigation Plan Species	Wetland Indicator
River birch (*Betula nigra*)	600	16.44%	Yes	FACW
Black Gum (*Nyssa sylvatica*)	550	15.07%	Yes	FAC
Green Ash (*Fraxinus pennsylvanica*)	150	4.11%	Yes	FACW
Oak Water (*Quercus nigra)*	550	15.07%	Yes	FAC
Oak Willow (*Quercus phellos)*	350	9.59%	Yes	FACW
Silky Dogwood (*Cornus amomum*)	350	9.59%	Yes	FACW
Sycamore (*Platanus occidentalis*)	550	15.07%	Yes	FACW
Tulip Poplar (*Liriodendron tulipifera*)	550	15.07%	Yes	FAC
Total	3,650	100%		

Newly planted stems appear vigorous, and MY3 monitoring indicates significant improvement in sitewide planted stem density. Supplemental planting areas are depicted on Figure 1 (appendix A).

Table 3. Project Attribute Table								
Project Name	Brahma Site							
County	Alamance County, North Carolina							
Project Area (acres)	22.7							
Project Coordinates (latitude and longitude decimal degrees)	35.8540ºN, 79.4106ºW							
Project Watershed Summary Information								
Physiographic Province	Piedmont							
River Basin	Cape Fear							
USGS Hydrologic Unit 8-digit	03030002							
DWR Sub-basin	03-06-04							
Project Drainage Area (acres)	231							
Project Drainage Area Percentage of Impervious Area	<2%							
Land Use Classification	Managed Herbaceous Cover & Hardwood Swamps							
Reach Summary Information								
Parameters	**UT 1 (upstream of confluence with UT2)**	**UT 1 (downstream of confluence with UT2)**	**UT 2**	**UT 3**	**UT4**	**UT5**	**UT6**	**UT7**
Pre-project length (feet)	1071	3227	1384	239	129	657	501	47
Post-project (feet)	1072	3313	1390	245	135	662	511	48
Valley confinement (Confined, moderately confined, unconfined)	Alluvial, confined - moderately confined							
Drainage area (acres)	149.3	230.8	57.3	14.6	1.6	26.2	12.3	2.9
Perennial, Intermittent, Ephemeral	Per	Per	Int/Per	Int	Int	Int/Per	Int	Int
NCDWR Water Quality Classification	C, NSW							
Dominant Stream Classification (existing)	G5	Cg 4/5	G4/5	G5	F6	G/F4/5	F5	G5
Dominant Stream Classification (proposed)	C/E 4	C/E 4	G4/5	C/E 4	F6	C/F4/5	C/E 4	G5
Dominant Evolutionary class (Simon) if applicable	III/IV	III/IV	III	III	V	IV	III/IV	IV
Wetland Summary Information								
Parameters	**Wetlands**							
Pre-project (acres)	5.157 acres drained & 4.427 acres degraded							
Post-project (acres)	4.736 acres restored & 4.309 acres enhanced/preserved							
Wetland Type (non-riparian, riparian)	Riparian riverine							
Mapped Soil Series	Wehadkee							
Soil Hydric Status	Hydric							
Regulatory Considerations								
Parameters	**Applicable?**		**Resolved?**			**Supporting Docs?**		
Water of the United States - Section 404	Yes		Yes			401 Permit		
Water of the United States - Section 401	Yes		Yes			404 Certification		
Endangered Species Act	Yes		Yes			CE Document		
Historic Preservation Act	Yes		Yes			CE Document		
Coastal Zone Management Act (CZMA or CAMA)	NA		NA			NA		
Essential Fisheries Habitat	NA		NA			NA		

3.0 REFERENCES

Griffith, G.E., J.M. Omernik, J.A. Comstock, M.P. Schafale, W.H. McNab, D.R. Lenat, T.F. MacPherson, J.B. Glover, and V.B. Shelbourne. 2002. Ecoregions of North Carolina and South Carolina. U.S. Geological Survey, Reston, Virginia.

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.

North Carolina Division of Mitigation Services (NCDMS). 2014. Stream and Wetland Mitigation Monitoring Guidelines. North Carolina Department of Environmental Quality, Raleigh, North Carolina.

North Carolina Division of Water Resources (NCDWR). 2016. Standard Operating Procedures for Collection and Analysis of Benthic Macroinvertebrates (Version 5.0). (online). Available: https://files.nc.gov/ncdeq/Water%20Quality/Environmental%20Sciences/BAU/NCDWRMacroinvertebrate-SOP-February%202016_final.pdf

North Carolina Division of Water Quality (NCDWQ). 2009. Small Streams Biocriteria Development. Available: http://portal.ncdenr.org/c/document_library/get_file?uuid=2d54ad23-0345-4d6e-82fd-04005f48eaa7&groupId=38364

North Carolina Ecosystem Enhancement Program (NCEEP). 2008. Lumber River Basin Restoration Priorities (online). Available: https://files.nc.gov/ncdeq/Mitigation%20Services/Watershed_Planning/Lumber_River_Basin/Lumber_RBRP_2008_FINAL.pdf (January 9, 2018).

North Carolina Stream Functional Assessment Team. (NC SFAT 2015). N.C. Stream Assessment Method (NC SAM) User Manual. Version 2.1.

North Carolina Wetland Functional Assessment Team. (NC WFAT 2010). N.C. Wetland Assessment Method (NC WAM) User Manual. Version 4.1.

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, North Carolina Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

Simon A, Hupp CR. 1986. Geomorphic and Vegetative Recovery Processes Along Modified Tennessee Streams: An Interdisciplinary Approach to Disturbed Fluvial Systems. Forest Hydrology and Watershed Management. IAHS-AISH Publ.167.

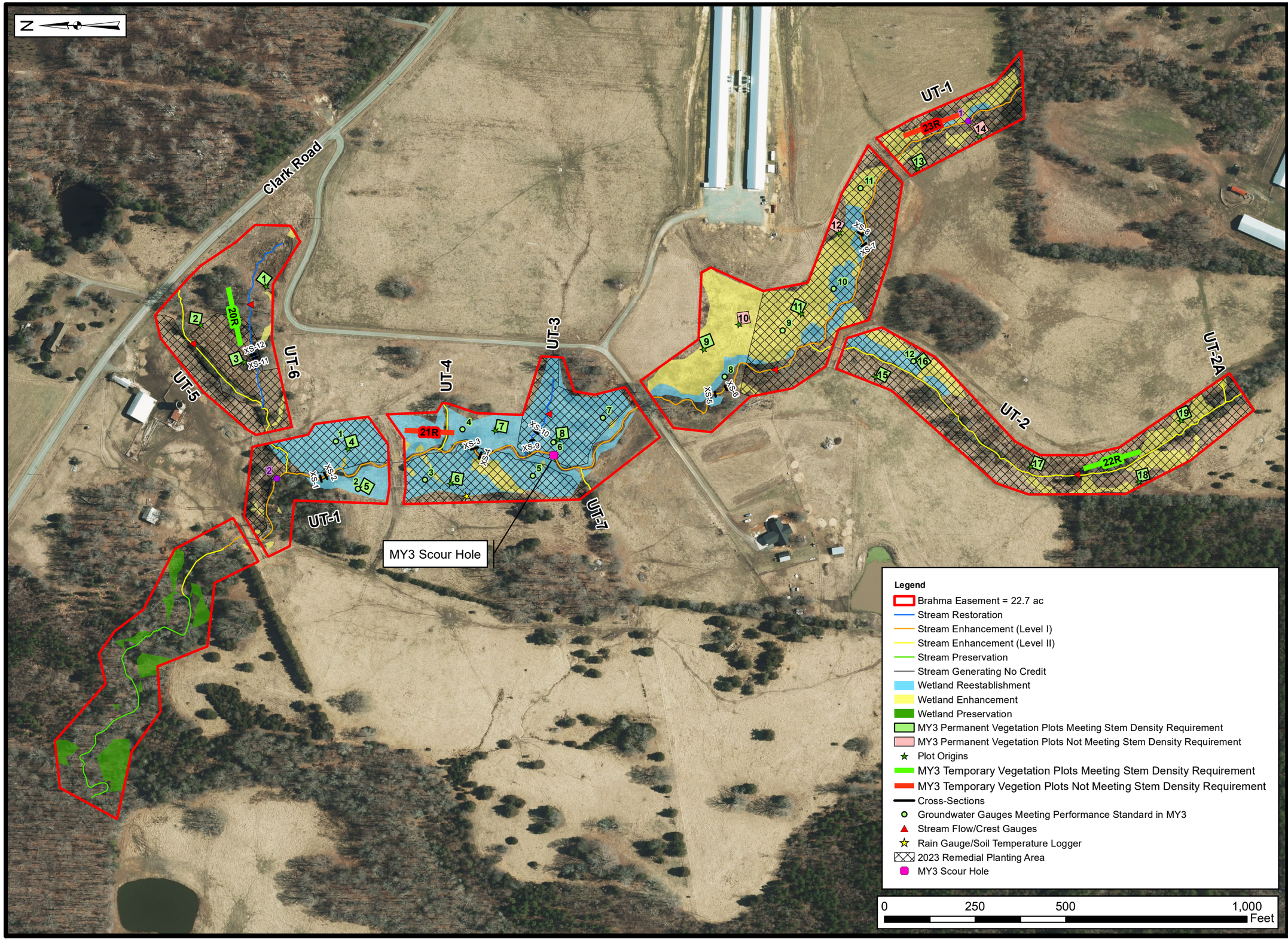
United States Department of Agriculture (USDA). 1990. Soil Survey of Alamance County, North Carolina. Soil Conservation Service.

United States Department of Agriculture (USDA). 2017. Web Soil Survey (online). Available: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm [May 7, 2018]. United States Department of Agriculture.

United States Department of Agriculture (USDA). 2022. Natural Resources Conservation Service National Weather and Climate Center. AgACIS Climate Data. Burlington Alamance Regional Airport WETS Station (online). Available: http://agacis.rcc-acis.org

Appendix A
Visual Assessment Data

Figure 1. Current Conditions Plan View
Tables 4 A-F. Stream Visual Stability Assessment
Table 5. Visual Vegetation Assessment
Vegetation Plot Photographs



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA SITE

Alamance County, NC

Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by: KRJ

Date: DEC 2023

Scale: 1:3000

Project No.: 19-006

FIGURE

1

Table 4A. Visual Stream Stability Assessment

Reach UT 1

Assessed Stream Length 3312

Assessed Bank Length 6624

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			4	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	4	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	33	33		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	33	33		100%

Table 4B. Visual Stream Stability Assessment

Reach UT 2

Assessed Stream Length 1390

Assessed Bank Length 2780

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	8	8		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	8	8		100%

Table 4C. Visual Stream Stability Assessment

Reach UT 3

Assessed Stream Length 245

Assessed Bank Length 490

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	6	6		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	6	6		100%

Table 4D. Visual Stream Stability Assessment

Reach	UT 4
Assessed Stream Length	135
Assessed Bank Length	270

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	0	0		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	0	0		100%

Table 4E. Visual Stream Stability Assessment

Reach UT 5

Assessed Stream Length 662

Assessed Bank Length 1324

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	0	0		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	0	0		100%

Table 4F. Visual Stream Stability Assessment

Reach UT 6

Assessed Stream Length 511

Assessed Bank Length 1022

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	19	19		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	19	19		100%

Table 5. Visual Vegetation Assessment

Planted acreage **17.7**

Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.10 acres	0.00	0.0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.10acres	0.00	0.0%
	Total		0.00	0.0%
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.10 acres	0.00	0.0%
	Cumulative Total		0.00	0.0%

Easement Acreage **22.7**

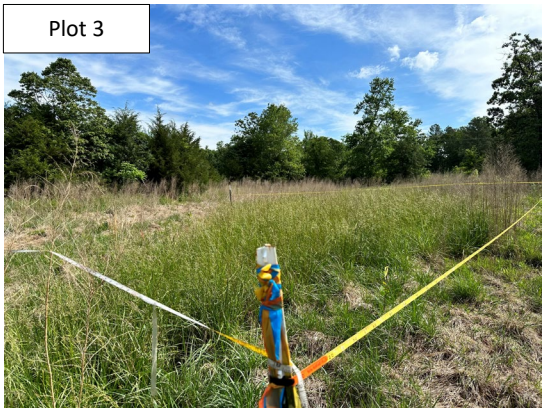
Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Invasives may occur outside of planted areas and within the easement and will therefore be calculated against the total easement acreage. Include species with the potential to directly outcompete native, young, woody stems in the short-term or community structure for existing communities. Species included in summation above should be identified in report summary.	0.10 acres	0.00	0.0%
Easement Encroachment Areas	Encroachment may be point, line, or polygon. Encroachment to be mapped consists of any violation of restrictions specified in the conservation easement. Common encroachments are mowing, cattle access, vehicular access. Encroachment has no threshold value as will need to be addressed regardless of impact area.	none	# Encroachments noted	

Brahma Site
MY3 (2023) Vegetation Monitoring Photographs (taken July 2023)

Plot 1

Plot 2

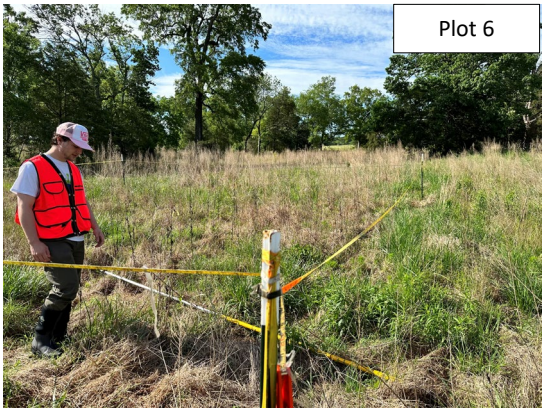
Plot 3



Plot 4

Plot 5

Plot 6



Plot 7

Plot 8

Brahma Site
MY3 (2023) Vegetation Monitoring Photographs (taken July 2023)

Plot 9

Plot 10

Plot 11

Plot 12

Plot 13

Plot 14

Plot 15

Plot 16

Brahma Site
MY3 (2023) Vegetation Monitoring Photographs (taken July 2023)

Plot 17

Plot 18

Plot 19

Transect 1

Transect 2

Transect 3

Transect 4

Appendix B
Vegetation Data

Table 6. Planted Bare-Root Woody Vegetation
Table 7. Vegetation Plot Counts and Densities
Table 8. Vegetation Plot Data Table from Vegetation Data Entry Tool

Table 6. Planted Bare Root Woody Vegetation
Brahma Site

Species	Total
Acres	**17.7**
Asimina triloba	200
Betula nigra	1500
Celtis occidentalis	500
Cephalanthus occidentalis	600
Cornus amomum	2700
Diospyros virginiana	500
Fraxinus pennsylvanica	900
Liriodendron tulipifera	1000
Morus rubra	600
Nyssa sylvatica	1000
Platanus occidentalis	2700
Quercus alba	1000
Quercus lyrata	500
Quercus nigra	2000
Quercus pagoda	1000
Quercus phellos	2000
Quercus shumardii	1000
Ulmus americana	500
TOTALS	**20,200**
Average Stems/Acre	**1141**

Table 7. Planted Vegetation Totals
Brahma Site

Plot #	Planted Stems/Acre	Success Criteria Met?
1	729	Yes
2	486	Yes
3	486	Yes
4	526	Yes
5	445	Yes
6	405	Yes
7	648	Yes
8	364	Yes
9	526	Yes
10	81	No
11	324	Yes
12	202	No
13	526	Yes
14	202	No
15	688	Yes
16	445	Yes
17	567	Yes
18	405	Yes
19	405	Yes
R-20	769	Yes
R-21	283	No
R-22	648	Yes
R-23	202	No
Average Planted Stems/Acre	**451**	**Yes**

Table 8. Vegetation Plot Data Table from Vegetation Data Entry Tool

Planted Acreage	17.7
Date of Initial Plant	2021-05-15
Date(s) of Supplemental Plant(s)	NA
Date(s) Mowing	NA
Date of Current Survey	2023-07-25
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 1 F		Veg Plot 2 F		Veg Plot 3 F		Veg Plot 4 F		Veg Plot 5 F		Veg Plot 6 F		Veg Plot 7 F		Veg Plot 8 F		Veg Plot 9 F		Veg Plot 10 F		Veg Plot 11 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Asimina triloba	pawpaw	Tree	FAC																					1	1
	Betula nigra	river birch	Tree	FACW			1	1	1	1					3	3									1	1
	Celtis occidentalis	common hackberry	Tree	FACU													3	3								
	Cornus amomum	silky dogwood	Shrub	FACW	3	3	1	1																		
	Diospyros virginiana	common persimmon	Tree	FAC	1	1	5	5	3	3					2	2					2	2				
	Fraxinus pennsylvanica	green ash	Tree	FACW			4	4											2	2						
	Liriodendron tulipifera	tuliptree	Tree	FACU	2	2					2	2														
	Morus rubra	red mulberry	Tree	FACU																						
	Nyssa sylvatica	blackgum	Tree	FAC					2	2					1	1										
	other																				1	1				
	Platanus occidentalis	American sycamore	Tree	FACW	3	3	1	1	1	1	1	1	1	1		1			1	1	6	6	2	2		
	Quercus alba	white oak	Tree	FACU	2	4			1	1			1	1					1	1					1	1
	Quercus lyrata	overcup oak	Tree	OBL							4	4	2	2			4	4			1	1				
	Quercus nigra	water oak	Tree	FAC																	1	1				
	Quercus pagoda	cherrybark oak	Tree	FACW	2	2					1	1	2	2	1	1	1	1	2	2						
	Quercus phellos	willow oak	Tree	FAC	1	1			4	4	3	3	3	3	2	2	6	6								
	Quercus rubra	northern red oak	Tree	FACU	1	1																				
	Quercus sp.				1	1					2	2	2	2			1	1	3	3	1	1			5	5
	Ulmus americana	American elm	Tree	FACW													1	1			1	1				
Sum	Performance Standard				16	18	12	12	12	12	13	13	11	11	9	10	16	16	9	9	13	13	2	2	8	8
Mitigation Plan Performance Standard	Current Year Stem Count					18		12		12		13		11		10		16		9		13		2		8
	Stems/Acre					729		486		486		526		445		405		648		364		526		40		283
	Species Count					9		5		6		6		6		6		6		5		7		1		4
	Dominant Species Composition (%)					22		42		33		31		27		30		38		33		46		100		62
	Average Plot Height (ft.)					2		3		2		2		2		2		2		2		3		4		2
	% Invasives					0		0		0		0		0		0		0		0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					18		12		12		13		11		10		16		9		13		2		8
	Stems/Acre					729		486		486		526		445		405		648		364		526		40		283
	Species Count					9		5		6		6		6		6		6		5		7		1		4
	Dominant Species Composition (%)					22		42		33		31		27		30		38		33		46		100		62
	Average Plot Height (ft.)					2		3		2		2		2		2		2		2		3		4		2
	% Invasives					0		0		0		0		0		0		0		0		0		0		0

1). Bolded species are proposed for the current monitoring year, italicized species are not approved, and a regular font indicates that the species has been approved.
2). The "Species Included in Approved Mitigation Plan" section contains only those species that were included in the original approved mitigation plan. The "Post Mitigation Plan Species" section includes species that are being proposed through a mitigation plan addendum for the current monitoring year (bolded) , species that have been approved in prior monitoring years through a mitigation plan addendum (regular font), and species that are not approved (italicized).
3). The "Mitigation Plan Performance Standard" section is derived only from stems included in the original mitigation plan, whereas the "Post Mitigation Plan Performance Standard" includes data from mitigation plan approved, post mitigation plan approved, and proposed stems.

Table 8. Vegetation Plot Data Table from Vegetation Data Entry Tool (continued)

Planted Acreage	17.7
Date of Initial Plant	2021-05-15
Date(s) of Supplemental Plant(s)	NA
Date(s) Mowing	NA
Date of Current Survey	2023-07-25
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 12 F		Veg Plot 13 F		Veg Plot 14 F		Veg Plot 15 F		Veg Plot 16 F		Veg Plot 17 F		Veg Plot 18 F		Veg Plot 19 F		Veg Plot 20 R	Veg Plot 21 R	Veg Plot 22 R	Veg Plot 23 R
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Total	Total	Total	Total
Species Included in Approved Mitigation Plan	Asimina triloba	pawpaw	Tree	FAC													1	1						
	Betula nigra	river birch	Tree	FACW									1	1							1			
	Celtis occidentalis	common hackberry	Tree	FACU	1	1	1	1																
	Cornus amomum	silky dogwood	Shrub	FACW															1	1				
	Diospyros virginiana	common persimmon	Tree	FAC	1	1			1	1			2	2			2	2			4		12	1
	Fraxinus pennsylvanica	green ash	Tree	FACW							4	4			3	3	1	1	3	3				2
	Liriodendron tulipifera	tuliptree	Tree	FACU											1	1			1	1				
	Morus rubra	red mulberry	Tree	FACU					2	2														
	Nyssa sylvatica	blackgum	Tree	FAC																	1		2	
	other						1	1			2	2												
	Platanus occidentalis	American sycamore	Tree	FACW			3	3	1	1			6	6	2	2	3	3			1		1	
	Quercus alba	white oak	Tree	FACU											1	1						1		
	Quercus lyrata	overcup oak	Tree	OBL											1	1	1	1			2			
	Quercus nigra	water oak	Tree	FAC									1	1	1	1			2	2		2		
	Quercus pagoda	cherrybark oak	Tree	FACW			2	2																
	Quercus phellos	willow oak	Tree	FAC	2	2			1	1	1	1			4	4			2	2	9	3	1	
	Quercus rubra	northern red oak	Tree	FACU																				
	Quercus sp.				1	1	6	6			10	10	1	1	1	1	1	1	1	1				2
	Ulmus americana	American elm	Tree	FACW													1	1			1	1		
Sum	Performance Standard				5	5	13	13	5	5	17	17	11	11	14	14	10	10	10	10	19	7	16	5
Mitigation Plan Performance Standard	Current Year Stem Count					5		13		5		17		11		14		10		10	19	7	16	5
	Stems/Acre					202		526		202		607		405		567		405		405	769	283	486	202
	Species Count					4		5		4		4		5		8		7		6	7	4	4	3
	Dominant Species Composition (%)					40		46		40		59		55		29		30		30	47	43	75	40
	Average Plot Height (ft.)					1		2		3		2		3		1		3		2	3	2	2	2
	% Invasives					0		0		0		0		0		0		0		0	0	0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					5		13		5		17		11		14		10		10	19	7	16	5
	Stems/Acre					202		526		202		607		405		567		405		405	769	283	486	202
	Species Count					4		5		4		4		5		8		7		6	7	4	4	3
	Dominant Species Composition (%)					40		46		40		59		55		29		30		30	47	43	75	40
	Average Plot Height (ft.)					1		2		3		2		3		1		3		2	3	2	2	2
	% Invasives					0		0		0		0		0		0		0		0	0	0	0	0

1). Bolded species are proposed for the current monitoring year, italicized species are not approved, and a regular font indicates that the species has been approved.
2). The "Species Included in Approved Mitigation Plan" section contains only those species that were included in the original approved mitigation plan. The "Post Mitigation Plan Species" section includes species that are being proposed through a mitigation plan addendum for the current monitoring year (bolded) , species that have been approved in prior monitoring years through a mitigation plan addendum (regular font), and species that are not approved (italicized).
3). The "Mitigation Plan Performance Standard" section is derived only from stems included in the original mitigation plan, whereas the "Post Mitigation Plan Performance Standard" includes data from mitigation plan approved, post mitigation plan approved, and proposed stems.

Appendix C
Stream Geomorphology Data

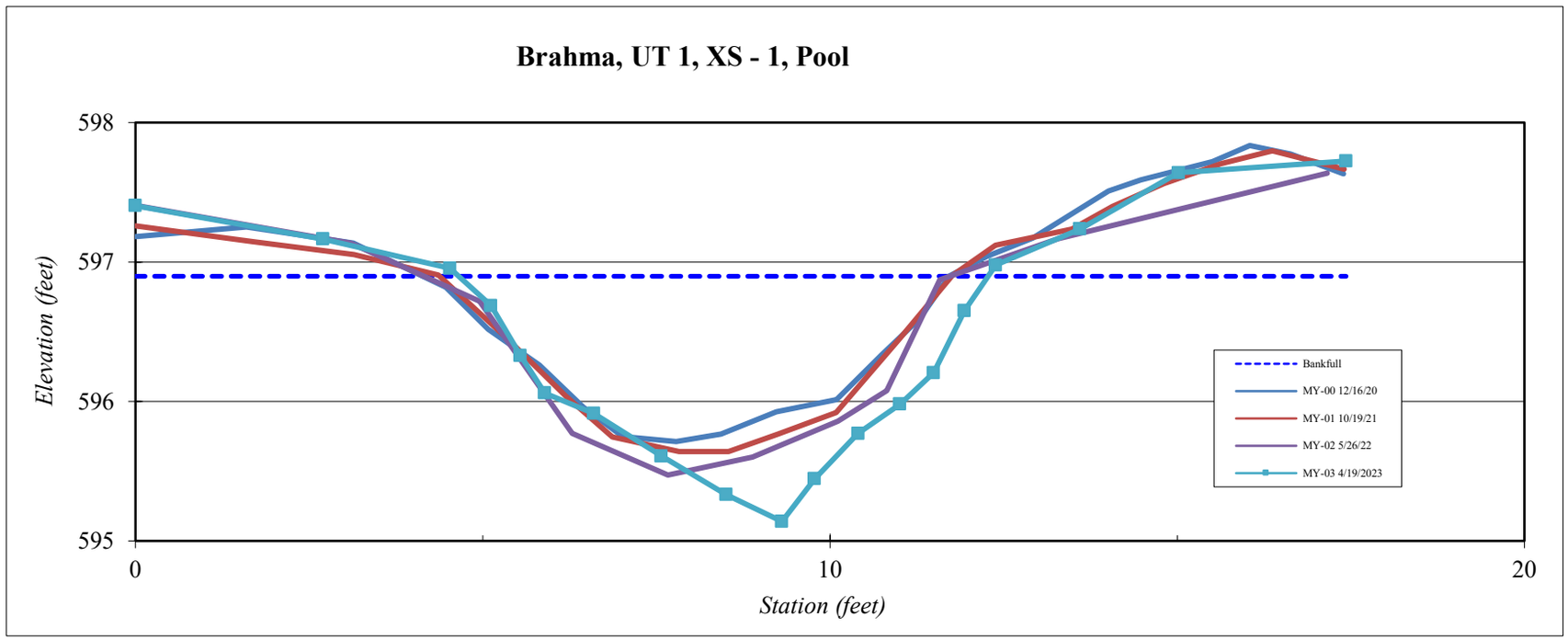
Cross-Sections with Annual Overlays
Table 9A-D. Baseline Stream Data Summary Tables
Table 10A-B. Cross-Section Morphology Monitoring Summary

Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT1, XS -1, Pool
Feature	Pool
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
0.0	597.4
2.7	597.1
4.5	596.9
5.1	596.6
5.5	596.2
5.9	595.9
6.6	595.7
7.6	595.4
8.5	595.1
9.3	594.9
9.8	595.2
10.4	595.6
11.0	595.8
11.5	596.1
11.9	596.6
12.4	596.9
13.6	597.2
15.0	597.7
17.4	597.8

SUMMARY DATA	
Bankfull Elevation:	596.8
Bank Hieght Ratio:	1.03
Thalweg Elevation:	594.9
LTOB Elevation:	596.9
LTOB Max Depth:	2.1
LTOB Cross Sectional Area:	9.2

Stream Type	E/C 5

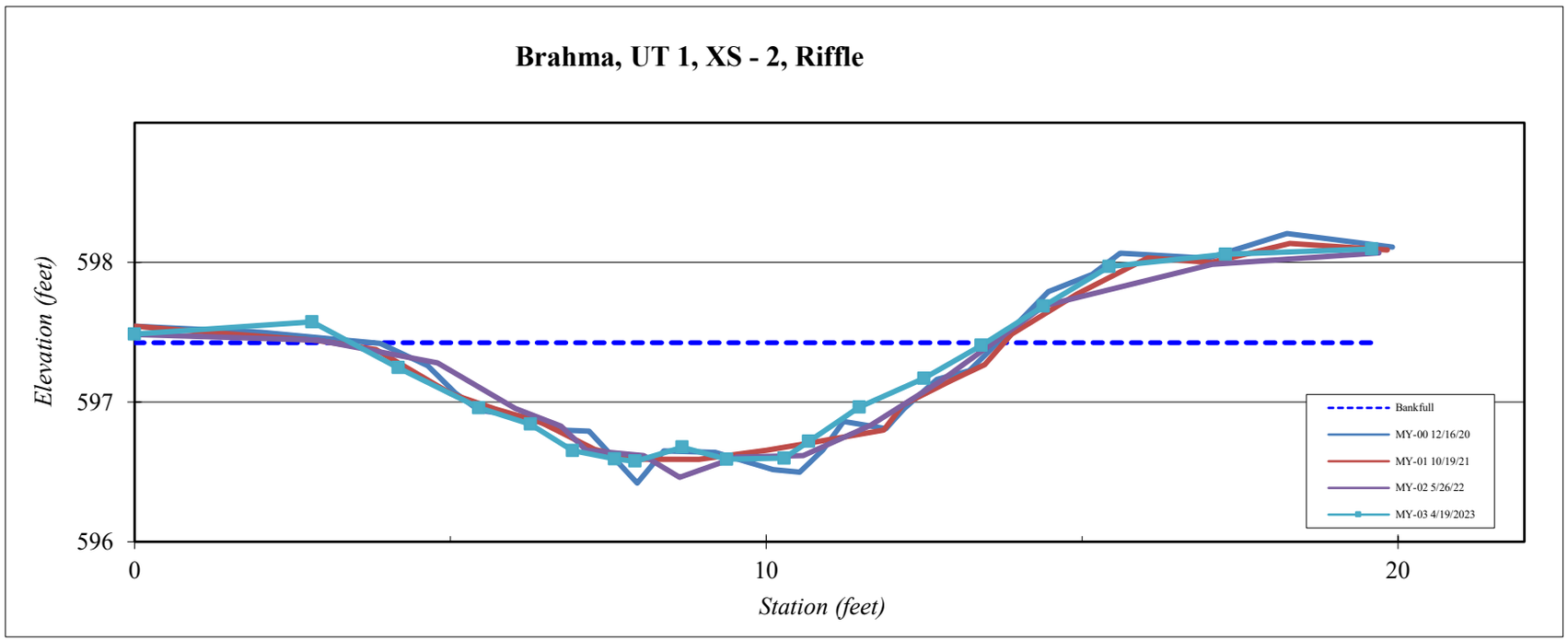


Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT1, XS -2, Riffle
Feature	Pool
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
0.0	597.5
2.8	597.6
4.2	597.2
5.5	596.9
6.3	596.8
6.9	596.6
7.6	596.5
7.9	596.5
8.7	596.6
9.4	596.5
10.3	596.5
10.7	596.6
11.5	596.9
12.5	597.1
13.4	597.4
14.4	597.7
15.4	598.1
17.3	598.2
19.6	598.2

SUMMARY DATA	
Bankfull Elevation:	597.4
Bank Hieght Ratio:	0.98
Thalweg Elevation:	596.5
LTOB Elevation:	597.4
LTOB Max Depth:	0.9
LTOB Cross Sectional Area:	5.8

Stream Type	E/C 5

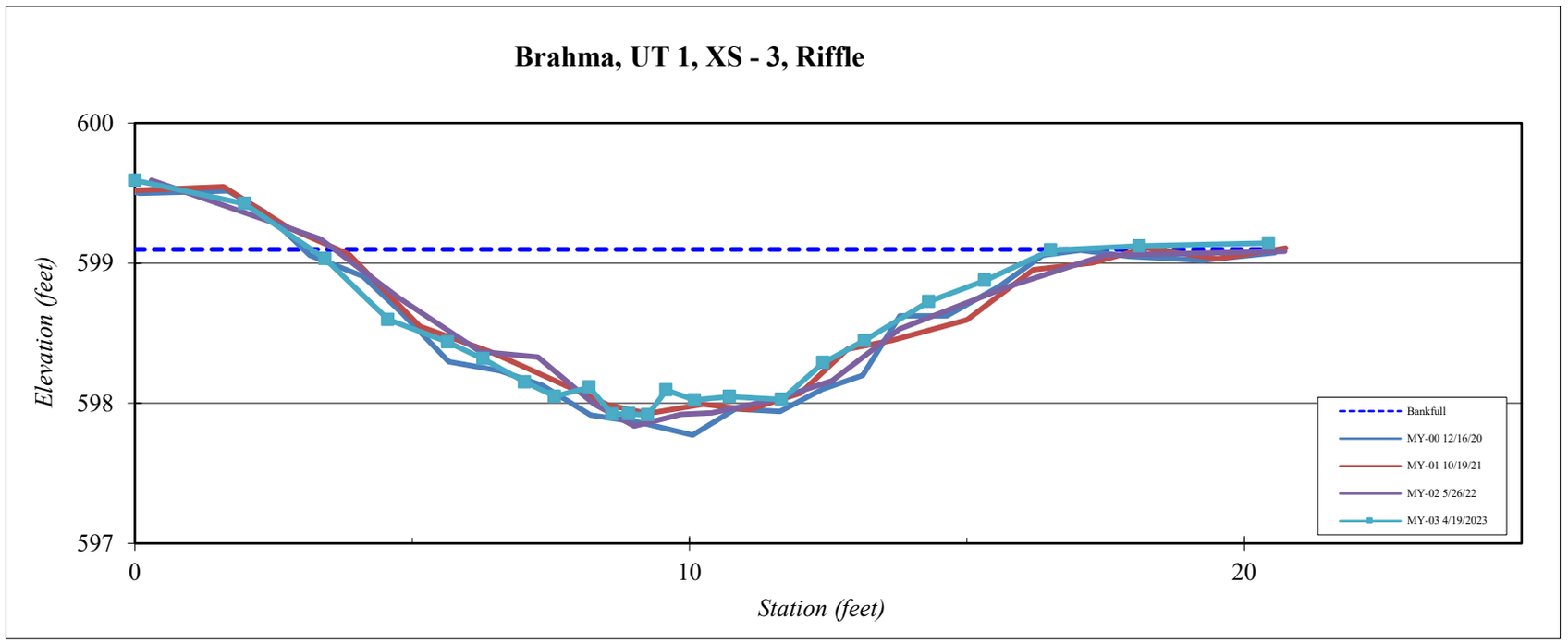


Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT1, XS -3, Riffle
Feature	Riffle
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
0.0	599.9
2.0	599.7
3.4	599.3
4.6	598.8
5.6	598.6
6.3	598.4
7.0	598.3
7.6	598.1
8.2	598.2
8.6	598.0
8.9	598.0
9.2	598.0
9.6	598.2
10.1	598.1
10.7	598.1
11.7	598.1
12.4	598.4
13.2	598.6
14.3	598.9
15.3	599.1
16.5	599.32
18.1	599.4
20.4	599.4

SUMMARY DATA	
Bankfull Elevation:	599.3
Bank Hieght Ratio:	1.00
Thalweg Elevation:	598.0
LTOB Elevation:	599.3
LTOB Max Depth:	1.3
LTOB Cross Sectional Area:	10.4

Stream Type	E/C 5

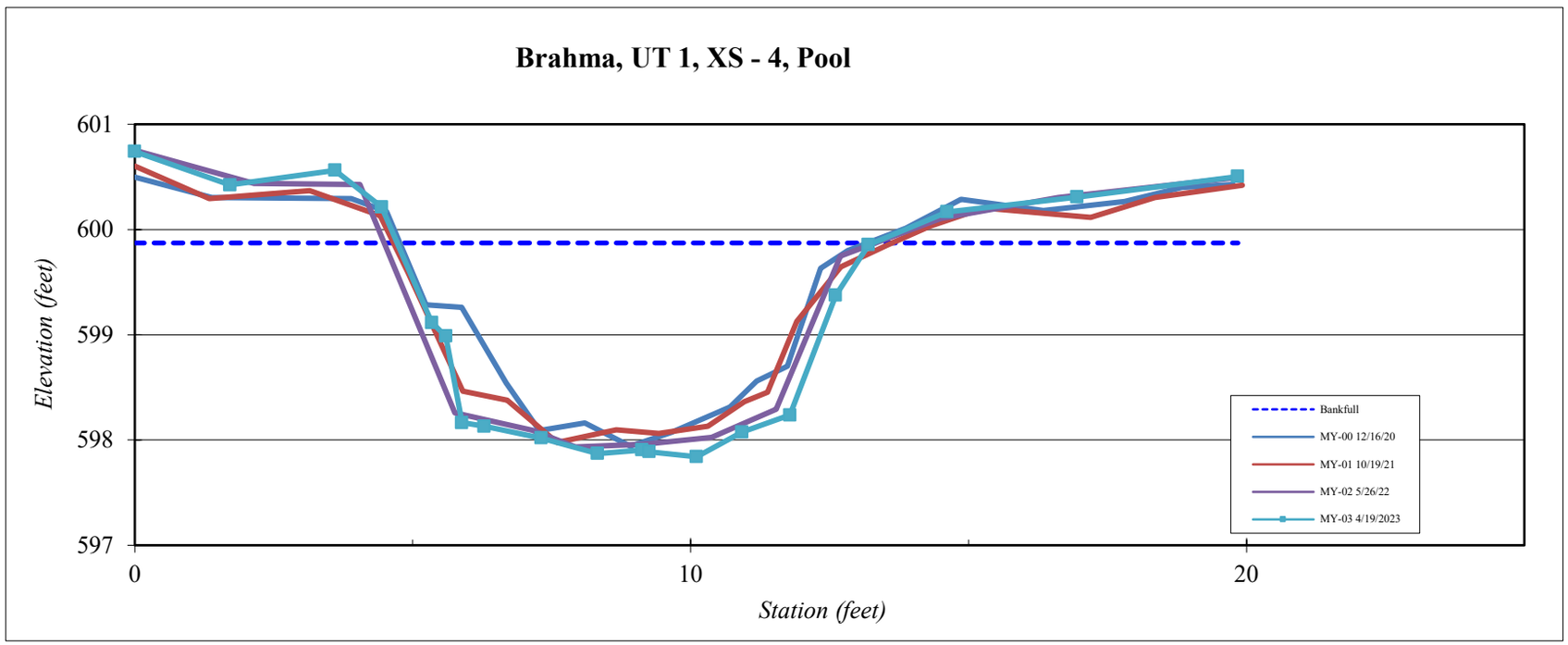


Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT1, XS -4, Pool
Feature	Pool
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
0.0	601.2
1.7	600.8
3.6	601.0
4.4	600.6
5.3	599.3
5.6	599.2
5.9	598.3
6.3	598.2
7.3	598.1
8.3	597.9
9.1	598.0
9.3	598.0
10.1	597.9
10.9	598.2
11.8	598.4
12.6	599.6
13.2	600.2
14.6	600.5
17.0	600.7
19.8	600.9

SUMMARY DATA	
Bankfull Elevation:	600.2
Bank Hieght Ratio:	0.99
Thalweg Elevation:	597.9
LTOB Elevation:	600.2
LTOB Max Depth:	2.3
LTOB Cross Sectional Area:	14.5

Stream Type	E/C 5

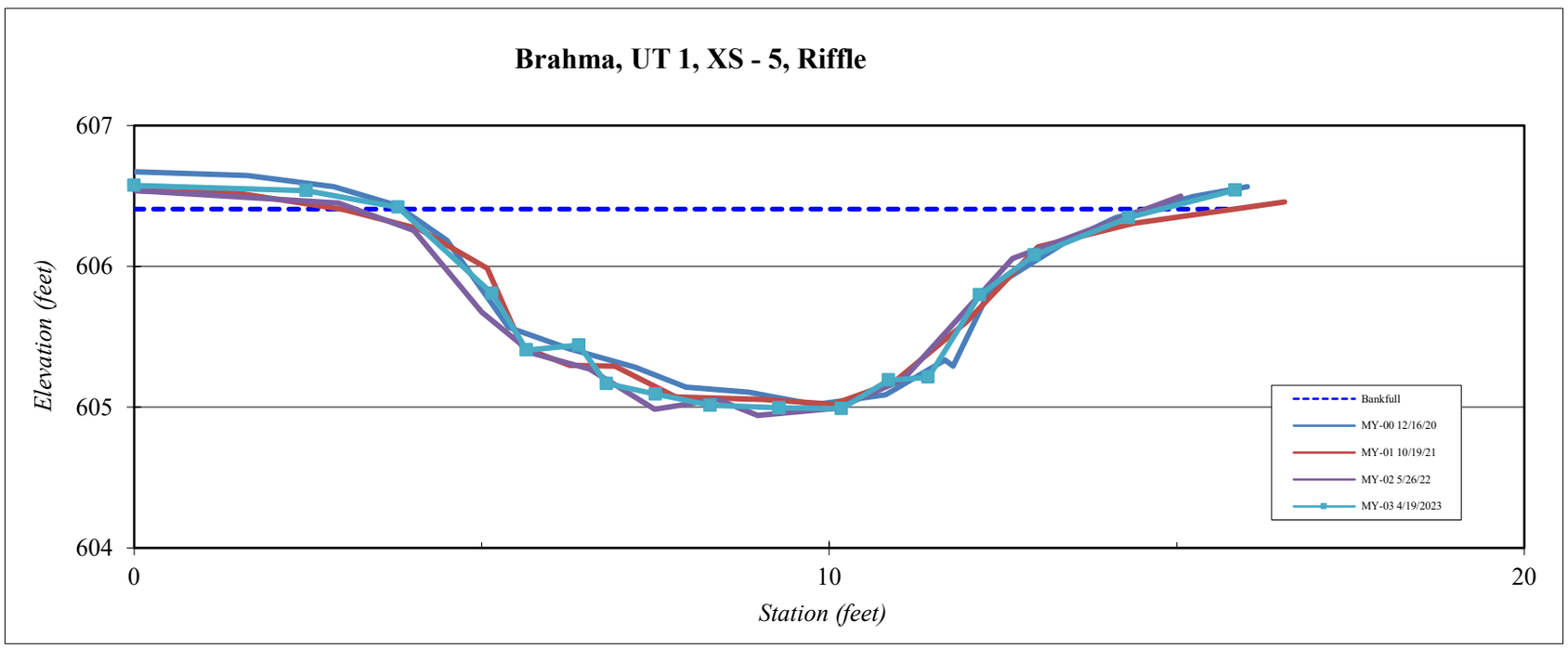


Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT1, XS - 5, Riffle
Feature	Riffle
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
0.0	606.7
2.5	606.6
3.8	606.5
5.2	605.8
5.6	605.3
6.4	605.4
6.8	605.1
7.5	605.0
8.3	604.9
9.3	604.9
10.2	604.9
10.9	605.1
11.4	605.1
12.2	605.8
13.0	606.1
14.3	606.4
15.8	606.6

SUMMARY DATA	
Bankfull Elevation:	606.5
Bank Hieght Ratio:	0.96
Thalweg Elevation:	604.9
LTOB Elevation:	606.4
LTOB Max Depth:	1.5
LTOB Cross Sectional Area:	10.0

Stream Type	E/C 5

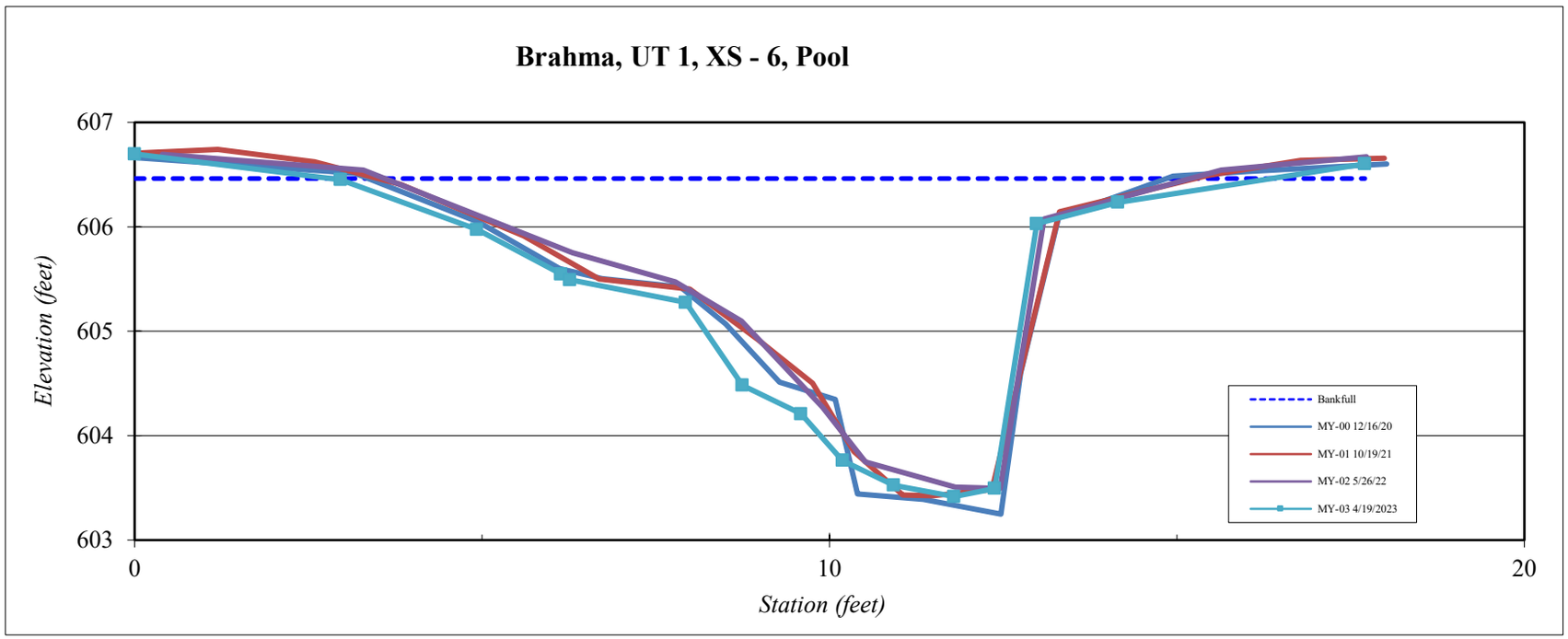


Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT1, XS - 6, Pool
Feature	Pool
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
0.0	606.8
3.0	606.5
4.9	606.0
6.1	605.5
6.3	605.4
7.9	605.2
8.7	604.3
9.6	604.0
10.2	603.5
10.9	603.2
11.8	603.1
12.4	603.2
13.0	606.0
14.2	606.3
17.7	606.7

SUMMARY DATA	
Bankfull Elevation:	606.5
Bank Hieght Ratio:	1.00
Thalweg Elevation:	603.1
LTOB Elevation:	606.5
LTOB Max Depth:	3.4
LTOB Cross Sectional Area:	17.8

Stream Type	E/C 5

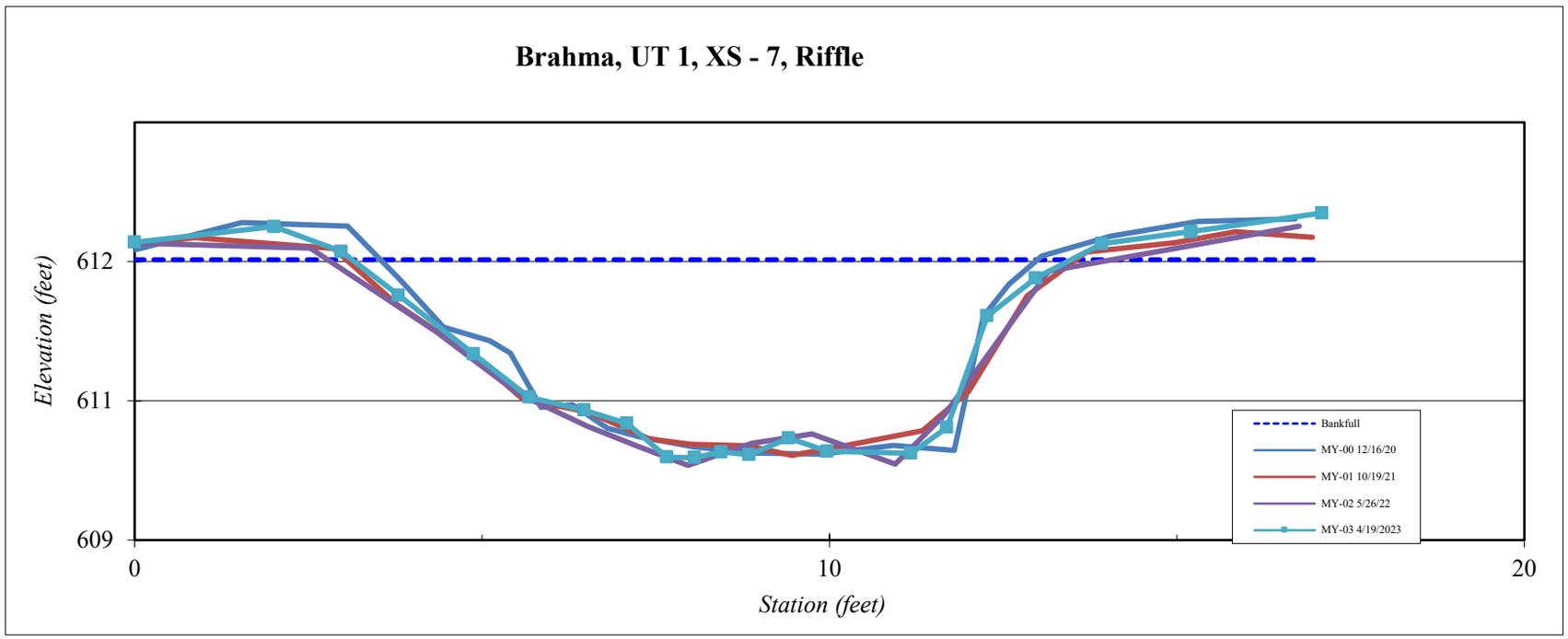


Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT1, XS - 7, Riffle
Feature	Riffle
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
0.0	611.8
2.0	611.9
3.0	611.7
3.8	611.4
4.9	610.9
5.7	610.6
6.5	610.4
7.1	610.3
7.7	610.1
8.1	610.1
8.4	610.1
8.8	610.1
9.4	610.2
10.0	610.1
11.2	610.1
11.7	610.3
12.3	611.2
13.0	611.5
13.9	611.8
15.2	611.9
15.2	611.90
17.1	612.0

SUMMARY DATA	
Bankfull Elevation:	611.7
Bank Hieght Ratio:	1.04
Thalweg Elevation:	610.1
LTOB Elevation:	611.7
LTOB Max Depth:	1.7
LTOB Cross Sectional Area:	11.7

Stream Type	E/C 5

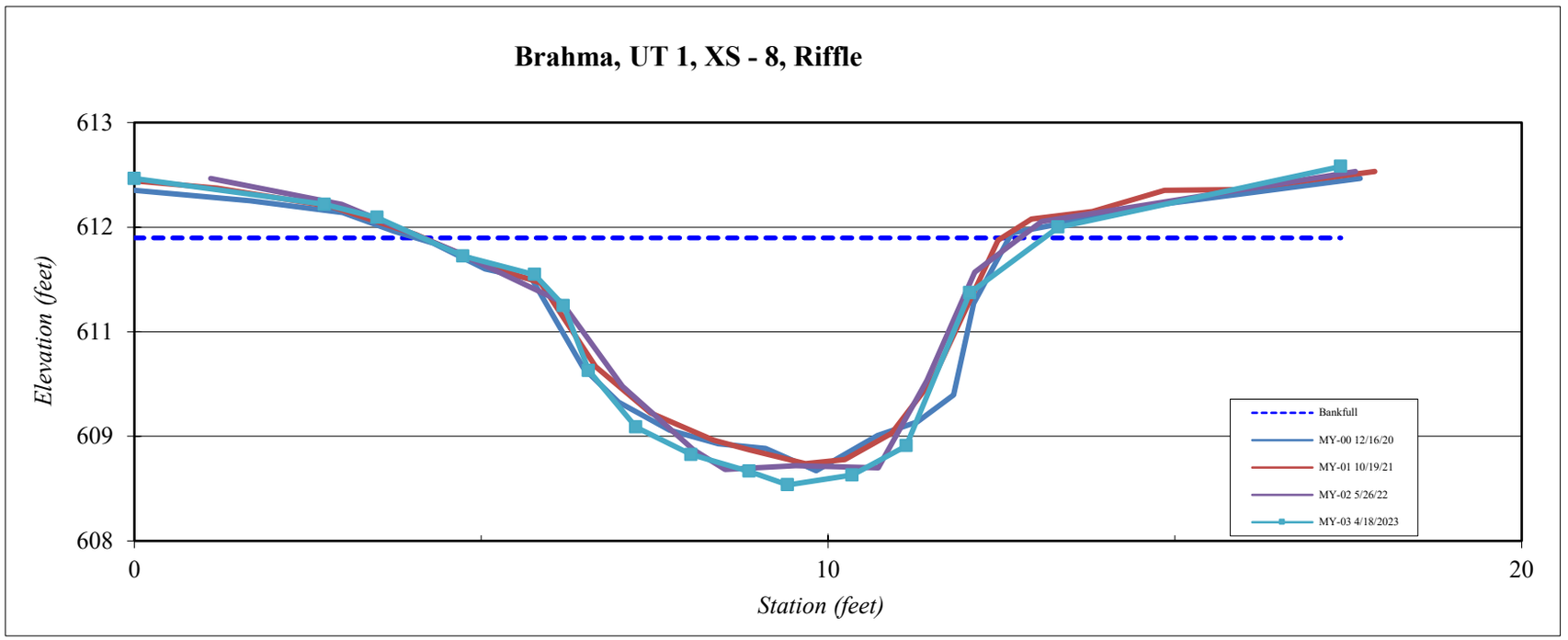


Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT1, XS - 8, Riffle
Feature	Riffle
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
0.0	612.2
2.7	611.9
3.5	611.8
4.7	611.3
5.8	611.1
6.2	610.8
6.5	610.1
7.2	609.5
8.0	609.2
8.9	609.0
9.4	608.9
10.3	609.0
11.1	609.3
12.0	610.9
13.3	611.7
17.4	612.3

SUMMARY DATA	
Bankfull Elevation:	611.5
Bank Hieght Ratio:	1.04
Thalweg Elevation:	608.9
LTOB Elevation:	611.7
LTOB Max Depth:	2.8
LTOB Cross Sectional Area:	14.4

Stream Type	E/C 5

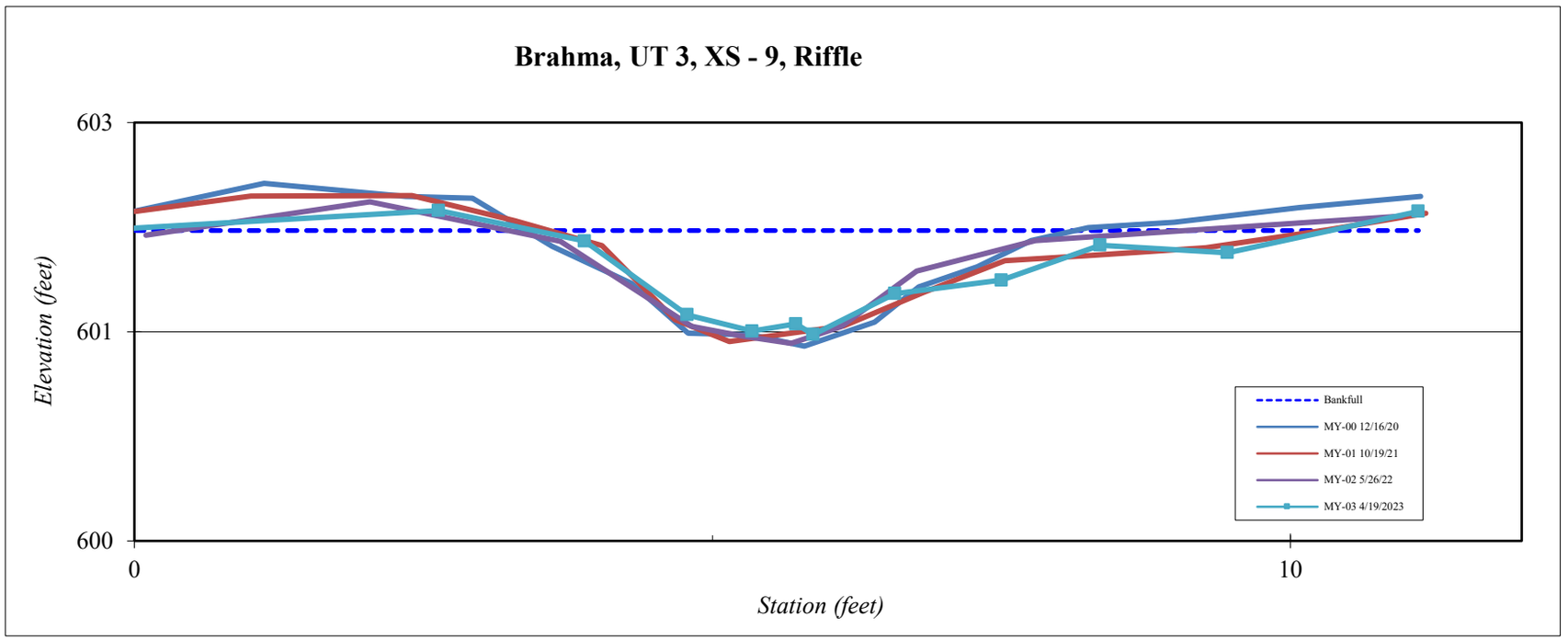


Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT3, XS - 9, Riffle
Feature	Riffle
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
-0.2	602.0
2.6	602.1
3.9	602.0
4.8	601.6
5.3	601.5
5.7	601.5
5.9	601.5
6.6	601.7
7.5	601.8
8.4	601.9
9.5	601.9
11.1	602.1

SUMMARY DATA	
Bankfull Elevation:	602.0
Bank Hieght Ratio:	0.90
Thalweg Elevation:	601.5
LTOB Elevation:	602.0
LTOB Max Depth:	0.5
LTOB Cross Sectional Area:	1.3

Stream Type	E/C 5

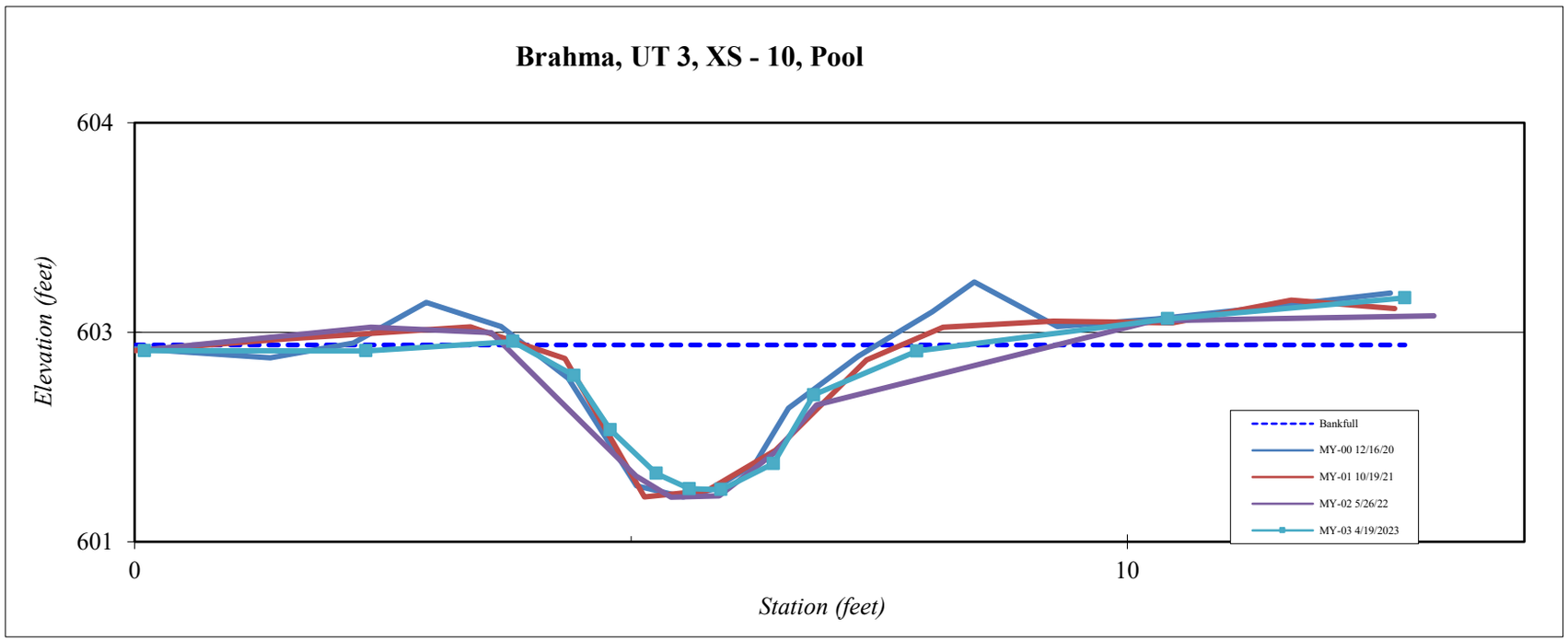


Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT3, XS - 10, Pool
Feature	Pool
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
0.1	602.5
2.3	602.5
3.8	602.6
4.4	602.4
4.8	602.1
5.3	601.8
5.6	601.8
5.9	601.8
6.4	601.9
6.8	602.3
7.9	602.5
10.4	602.7
12.8	602.8

SUMMARY DATA	
Bankfull Elevation:	602.5
Bank Hieght Ratio:	0.96
Thalweg Elevation:	601.8
LTOB Elevation:	602.5
LTOB Max Depth:	0.7
LTOB Cross Sectional Area:	1.5

Stream Type	E/C 5

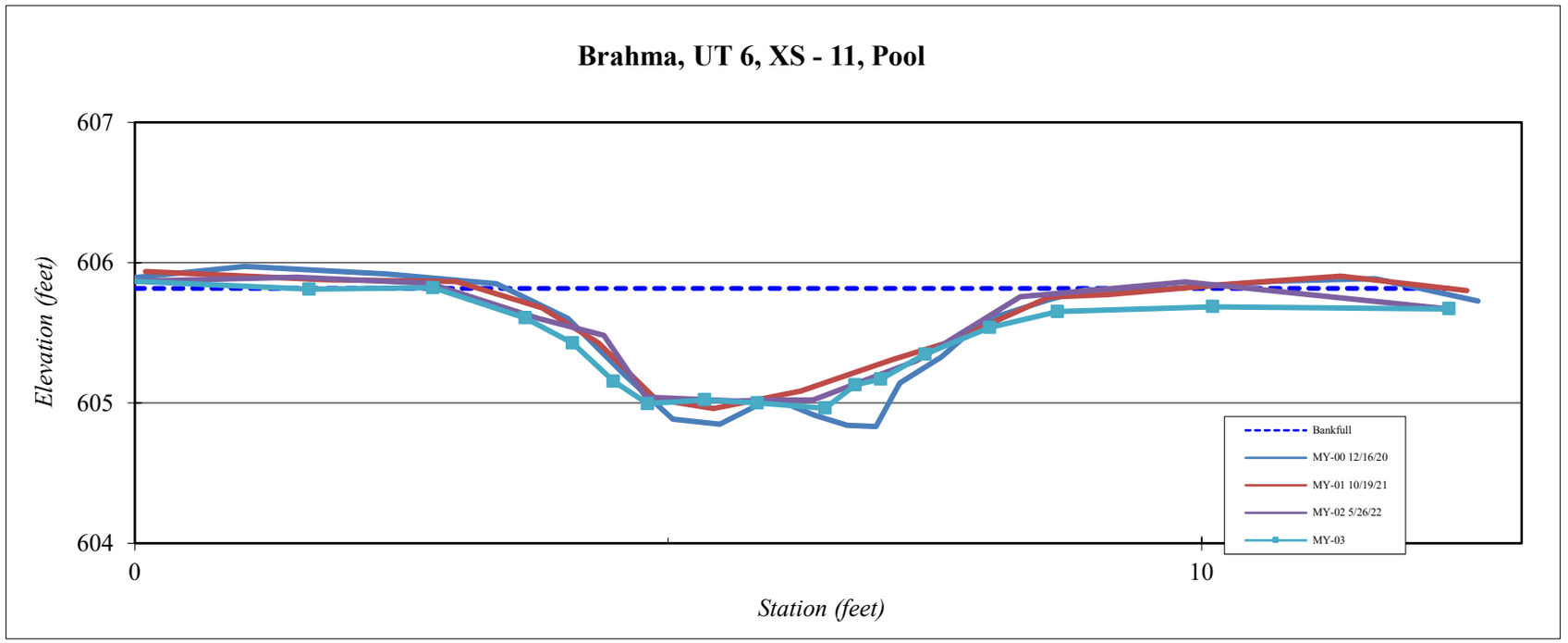


Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT6, XS - 11, Pool
Feature	Pool
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
-0.1	605.9
1.6	605.8
2.8	605.8
3.7	605.6
4.1	605.4
4.5	605.0
4.8	604.9
5.3	604.9
5.8	604.9
6.5	604.8
6.8	605.0
7.0	605.1
7.4	605.3
8.0	605.5
8.7	605.6
10.1	605.6
12.3	605.6

SUMMARY DATA	
Bankfull Elevation:	605.8
Bank Hieght Ratio:	1.01
Thalweg Elevation:	604.8
LTOB Elevation:	605.8
LTOB Max Depth:	1.0
LTOB Cross Sectional Area:	3.4

Stream Type	E/C 5



Site	Brahma Site
Watershed:	Cape Fear River Basin, 03030002
XS ID	UT6, XS - 12, Riffle
Feature	Riffle
Date:	4/19/2023
Field Crew:	Perkinson, Smith, Flemming, Adams

Station	Elevation
0.1	606.4
2.0	606.3
3.3	606.0
4.1	605.9
4.5	605.9
4.9	605.6
5.2	605.5
5.6	605.2
5.8	605.3
6.2	605.3
6.6	605.4
6.9	605.8
7.1	605.8
7.4	606.0
8.1	606.3
8.8	606.0
10.2	606.0
11.9	605.8

SUMMARY DATA	
Bankfull Elevation:	606.1
Bank Hieght Ratio:	0.89
Thalweg Elevation:	605.2
LTOB Elevation:	606.0
LTOB Max Depth:	0.8
LTOB Cross Sectional Area:	1.4

Stream Type	E/C 5

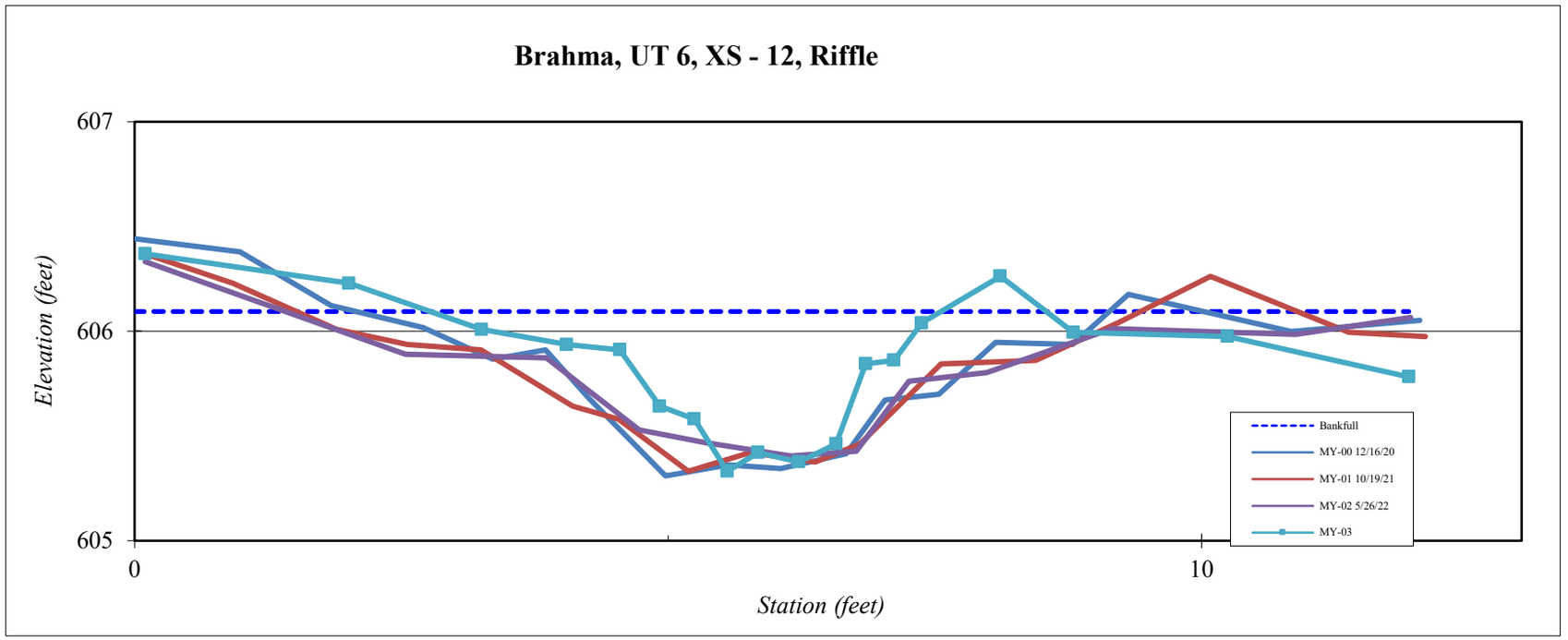


Table 9A. Baseline Stream Data Summary
Brahma - UT 1 (Upstream)

Parameter	Pre-Existing Condition (applicaple)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	5.8	8		16		9.4	10.8	9.8	12.9	3
Floodprone Width (ft)	6	8		14		40	100	100	100	3
Bankfull Mean Depth (ft)	0.5	0.9		1.3		0.7	0.8	0.6	1.0	3
Bankfull Max Depth (ft)	1	1.5		1.8		0.9	1.2	1.1	1.6	3
Bankfull Cross Sectional Area (ft^2)	7.3	7.3		7.3		7.3	7.3	6.2	10.7	3
Width/Depth Ratio	4.5	9.1		32		12	16	11.3	15.8	3
Entrenchment Ratio	0.9	1		1		4.3	9.3	7.8	10.2	3
Bank Height Ratio	**1.1**	**1.5**		**1.9**		**1**	**1.3**	**1.0**	**1.0**	3
Max part size (mm) mobilized at bankfull										
Rosgen Classification	G5					E/C 4		E/C 4		
Bankfull Discharge (cfs)	28.2					28.2		28.2		
Sinuosity (ft)	1.1					1.12		1.12		
Water Surface Slope (Channel) (ft/ft)	0.0076					0.0075		0.0073		
Other										

Table 9B. Baseline Stream Data Summary
Brahma - UT 1 (Downstream)

Parameter	Pre-Existing Condition (applicaple)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	5.4	8.2		16.9		10.2	11.8	9.6	9.6	1
Floodprone Width (ft)	14	19		100		50	150	75.0	75.0	1
Bankfull Mean Depth (ft)	0.5	1.1		1.6		0.7	0.9	1.1	1.1	1
Bankfull Max Depth (ft)	0.8	1.6		2.7		0.9	1.3	1.6	1.6	1
Bankfull Cross Sectional Area (ft^2)	8.7	8.7		8.7		8.7	8.7	11.0	11.0	1
Width/Depth Ratio	3.4	7.8		33.8		12	16	8.4	8.4	1
Entrenchment Ratio	1.3	2.4		13.3		4.9	12.7	7.8	7.8	1
Bank Height Ratio	**1.2**	**2.1**		**2.9**		**1**	**1.3**	**1.0**	**1.0**	1
Max part size (mm) mobilized at bankfull										
Rosgen Classification	Gg 4/5					E/C 4		E 4		
Bankfull Discharge (cfs)	34.4					34.4		34.4		
Sinuosity (ft)	1.33					1.33		1.33		
Water Surface Slope (Channel) (ft/ft)	0.0052					0.0052		0.0064		
Other										

Table 9C. Baseline Stream Data Summary
Brahma - UT 3

Parameter	Pre-Existing Condition (applicaple)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	3.1	3.8		5.9		4.1	4.7	4.9	4.9	1
Floodprone Width (ft)	3	5		8		25	75	50.0	50.0	1
Bankfull Mean Depth (ft)	0.3	0.4		0.5		0.3	0.4	0.3	0.3	1
Bankfull Max Depth (ft)	0.4	0.6		0.7		0.4	0.5	0.6	0.6	1
Bankfull Cross Sectional Area (ft^2)	1.5	1.5		1.5		1.5	1.5	1.7	1.7	1
Width/Depth Ratio	6.2	9.5		19.7		12	16	14.3	14.3	1
Entrenchment Ratio	0.8	1.4		1.6		6.1	15.8	10.2	10.2	1
Bank Height Ratio	**2.3**	**3.2**		**4**		**1**	**1.3**	**1.0**	**1.0**	1
Max part size (mm) mobilized at bankfull										
Rosgen Classification	G 5					E/C 4		E/C 4		
Bankfull Discharge (cfs)	5.4					5.4		5.4		
Sinuosity (ft)	1.08					1.12		1.12		
Water Surface Slope (Channel) (ft/ft)	0.017					0.0173		0.0195		
Other										

Table 9D. Baseline Stream Data Summary
Brahma - UT 6

Parameter	Pre-Existing Condition (applicaple)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	3.3	6.5		16.3		4.1	4.7	4.1	4.1	1
Floodprone Width (ft)	5	13		23		25	75	50.0	50.0	1
Bankfull Mean Depth (ft)	0.1	0.2		0.4		0.3	0.4	0.4	0.4	1
Bankfull Max Depth (ft)	0.2	0.4		0.7		0.4	0.5	0.7	0.7	1
Bankfull Cross Sectional Area (ft^2)	1.4	1.4		1.4		1.4	1.4	1.8	1.8	1
Width/Depth Ratio	3.6	32.5		163		12	16	9.6	9.6	1
Entrenchment Ratio	1.2	1.5		2.7		6.1	15.8	12.1	12.1	1
Bank Height Ratio	**1**	**3.1**		**5**		**1**	**1.3**	**1.0**	**1.0**	1
Max part size (mm) mobilized at bankfull										
Rosgen Classification	F 5					E/C 4		E 4		
Bankfull Discharge (cfs)	4.8					4.8		4.8		
Sinuosity (ft)	1.02					1.12		1.12		
Water Surface Slope (Channel) (ft/ft)	0.0203					0.0173		0.0297		
Other										

Table 10A. Monitoring Data - Cross Section Morphology Monitoring Summary
(Brahma/ DMS:100092) UT 1

	UT 1 - Cross Section 1 (Pool)							UT 1 - Cross Section 2 (Riffle)							UT 1 - Cross Section 3 (Riffle)							UT 1 - Cross Section 4 (Pool)							UT 1 - Cross Section 5 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	597.11	597.07	596.99	596.84				597.43	597.41	597.43	597.44				599.24	599.30	599.30	599.33				600.54	600.41	600.27	600.20				606.49	606.47	606.43	606.46			
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.02	0.90	1.03				1.00	1.05	1.03	0.98				1.00	0.99	0.98	1.00				1.00	1.04	0.91	0.99				1.00	0.99	1.05	0.96			
Thalweg Elevation	595.50	595.42	595.23	594.85				596.4	596.49	596.35	596.48				597.83	598.00	597.90	597.99				598.02	598.06	598.01	597.91				604.89	604.89	604.80	604.86			
LTOB[2] Elevation	597.11	597.09	596.81	596.91				597.4	597.45	597.46	597.41	`			599.24	599.29	599.28	599.32				600.54	600.50	600.06	600.18				606.49	606.46	606.51	606.39			
LTOB[2] Max Depth (ft)	1.61	1.67	1.58	2.05				1.04	0.96	1.11	0.94				1.41	1.28	1.38	1.33				2.52	2.44	2.05	2.28				1.60	1.56	1.70	1.54			
LTOB[2] Cross Sectional Area (ft^2)	8.7	9.01	7.46	9.20				6.0	6.51	6.31	5.81				10.5	10.35	10.14	10.41				14.6	15.47	12.96	14.46				10.7	10.55	11.57	10.01			

	UT 1 - Cross Section 6 (Pool)							UT 1 - Cross Section 7 (Riffle)							UT 1 - Cross Section 8 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	606.58	606.65	606.70	606.52				611.70	611.65	611.62	611.67				611.59	611.68	611.68	611.54			
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.01	0.97	1.00				1.00	1.07	0.97	1.04				1.00	1.03	1.03	1.04			
Thalweg Elevation	602.89	603.09	603.17	603.08				610.1	610.08	610.00	610.06				609.02	609.10	609.10	608.87			
LTOB[2] Elevation	606.58	606.70	606.62	606.51				611.7	611.76	611.58	611.74				611.59	611.74	611.74	611.65			
LTOB[2] Max Depth (ft)	3.69	3.61	3.45	3.43				1.61	1.68	1.58	1.67				2.57	2.64	2.64	2.79			
LTOB[2] Cross Sectional Area (ft^2)	18.0	18.67	16.89	17.83				11.0	12.13	10.48	11.68				13.3	13.94	13.94	14.39			

Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area							
Bank Height Ratio_Based on AB Bankfull[1] Area							
Thalweg Elevation							
LTOB[2] Elevation							
LTOB[2] Max Depth (ft)							
LTOB[2] Cross Sectional Area (ft^2)							

The above morphology parameters reflect the 2018 guidance that arose from the mitigation technical workgroup consisting of DMS, the IRT and industry mitigation providers/practitioners. The outcome resulted in the focus on three primary morphological parameters of interest for the purposes of tracking channel change moving forward. They are the bank height ratio using a constant As-built bankfull area and the cross sectional area and max depth based on each years low top of bank. These are calculated as follows:

1 - **Bank Height Ratio (BHR)** takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation. For example if the As-built bankfull area was 10 ft2, then the MY1 bankfull elevation would be adjusted until the calculated bankfull area within the MY1 cross section survey = 10 ft2. The BHR would then be calculated with the difference between the low top of bank (LTOB) elevation for MY1 and the thalweg elevation for MY1 in the numerator with the difference between the MY1 bankfull elevation and the MY1 thalweg elevation in the denominator. This same process is then carried out in each successive year.
2 - **LTOB Area and Max depth -** These are based on the LTOB elevation for each years survey (The same elevation used for the LTOB in the BHR calculation). Area below the LTOB elevation will be used and tracked for each year as above. The difference between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

Note: The smaller the channel the closer the survey measurements are to their limit of reliable detection, therefore inter-annual variation in morphological measurement (as a percentage) is by default magnified as channel size decereases. Some of the variability above is the result of this factor and some is due to the large amount of depositional sediments observed.

Table 10B. Monitoring Data - Cross Section Morphology Monitoring Summary
(Brahma/ DMS:100092) UT 3 and UT 6

	UT 3 - Cross Section 9 (Riffle)							UT 3 - Cross Section 10 (Pool)							UT 6 - Cross Section 11 (Pool)							UT 6 - Cross Section 12 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	602.04	602.02	596.99	602.02				602.55	602.53	597.43	602.54				605.79	605.85	605.85	605.79				605.90	605.89	605.95	606.11			
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00	1.02	0.90	0.90				1.00	1.12	1.03	0.96				1.00	1.00	0.99	1.01				1.00	1.01	0.86	0.89			
Thalweg Elevation	601.40	601.43	595.23	601.46				601.7	601.72	601.72	601.76				604.69	604.83	604.89	604.83				605.26	605.25	605.33	605.25			
LTOB[2] Elevation	602.04	602.03	596.81	601.97				602.6	602.64	602.61	602.51	`			605.79	605.85	605.83	605.80				605.90	605.90	605.86	606.01			
LTOB[2] Max Depth (ft)	0.64	0.60	1.58	0.50				0.83	0.91	0.89	0.75				1.10	1.02	0.95	0.97				0.64	0.65	0.53	0.76			
LTOB[2] Cross Sectional Area (ft^2)	1.7	1.77	7.46	1.34				1.6	2.06	2.51	1.51				3.4	3.34	3.29	3.42				1.6	1.83	1.39	1.39			

Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area							
Bank Height Ratio_Based on AB Bankfull[1] Area							
Thalweg Elevation							
LTOB[2] Elevation							
LTOB[2] Max Depth (ft)							
LTOB[2] Cross Sectional Area (ft^2)							

The above morphology parameters reflect the 2018 guidance that arose from the mitigation technical workgroup consisting of DMS, the IRT and industry mitigation providers/practitioners. The outcome resulted in the focus on three primary morphological parameters of interest for the purposes of tracking channel change moving forward. They are the bank height ratio using a constant As-built bankfull area and the cross sectional area and max depth based on each years low top of bank. These are calculated as follows:

1 - **Bank Height Ratio (BHR)** takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation. For example if the As-built bankfull area was 10 ft2, then the MY1 bankfull elevation would be adjusted until the calculated bankfull area within the MY1 cross section survey = 10 ft2. The BHR would then be calculated with the difference between the low top of bank (LTOB) elevation for MY1 and the thalweg elevation for MY1 in the numerator with the difference between the MY1 bankfull elevation and the MY1 thalweg elevation in the denominator. This same process is then carried out in each successive year.
2 - **LTOB Area and Max depth -** These are based on the LTOB elevation for each years survey (The same elevation used for the LTOB in the BHR calculation). Area below the LTOB elevation will be used and tracked for each year as above. The difference between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

Note: The smaller the channel the closer the survey measurements are to their limit of reliable detection, therefore inter-annual variation in morphological measurement (as a percentage) is by default magnified as channel size decereases. Some of the variability above is the result of this factor and some is due to the large amount of depositional sediments observed.

Appendix D
Hydrologic Data

Table 11. Verification of Bankfull Events
Table 12. Groundwater Hydrology Data
Groundwater Gauge Graphs
Tables 13 A-E. Channel Evidence
Surface Water Gauge Graphs
Figure D1. 30/70 Percentile Graph for Rainfall
Soil Temperature Graph

Table 11. Verification of Bankfull Events

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
December 24, 2020	December 24, 2020	Trail cameras and crest gauges documented a bankfull event on UT1 and UT2 after 1" of rain was captured by an on-site rain gauge on December 24.	1, 2
January 31, 2021	January 31, 2021	Trail cameras and crest gauges documented a bankfull event on tributaries 1, 2, 3, and 4 after 2.25" of rain was captured by an on-site gauge between January 25 – 31.	3, 4, 5, 6
March 12, 2022	March 12, 2022	Trail cameras and crest gauges documented a bankfull event on UT1, UT3, and UT5 after 1.15" of rain was captured by an on-site gauge on March 12, 2022.	7, 8, 9
October 26, 2022	September 30, 2022	Crest gauges documented bankfull flows on all site tributaries after 3.22" of rain was captured by an on-site gauge on September 30, 2022 as a result of Tropical Storm Ian.	--
January 19, 2023	January 11, 2023	Stream gauges documented high flows on all tributaries after 3.69" of rain was captured by an on-site gauge on January 11, 2023. Wrack and laid-back vegetation were observed in the UT2 floodplain on January 19, 2023.	10
April 18, 2023	April 7, 2023	Stream gages documented bankfull flows on all site tributaries after 4.10" of rain was captured by an on-site rain gauge between April 6-7, 2023.	--
September 6, 2023	June 22, 2023	Trail cameras and crest gauges documented a bankfull event on UT3, UT4, and UT6 after 1.66" of rain was captured by an on-site gauge June 22, 2023.	11

Photo 1: UT1 during a bankfull event.

Photo 2: UT2 during a bankfull event.

Photo 3: UT1 during a bankfull event.

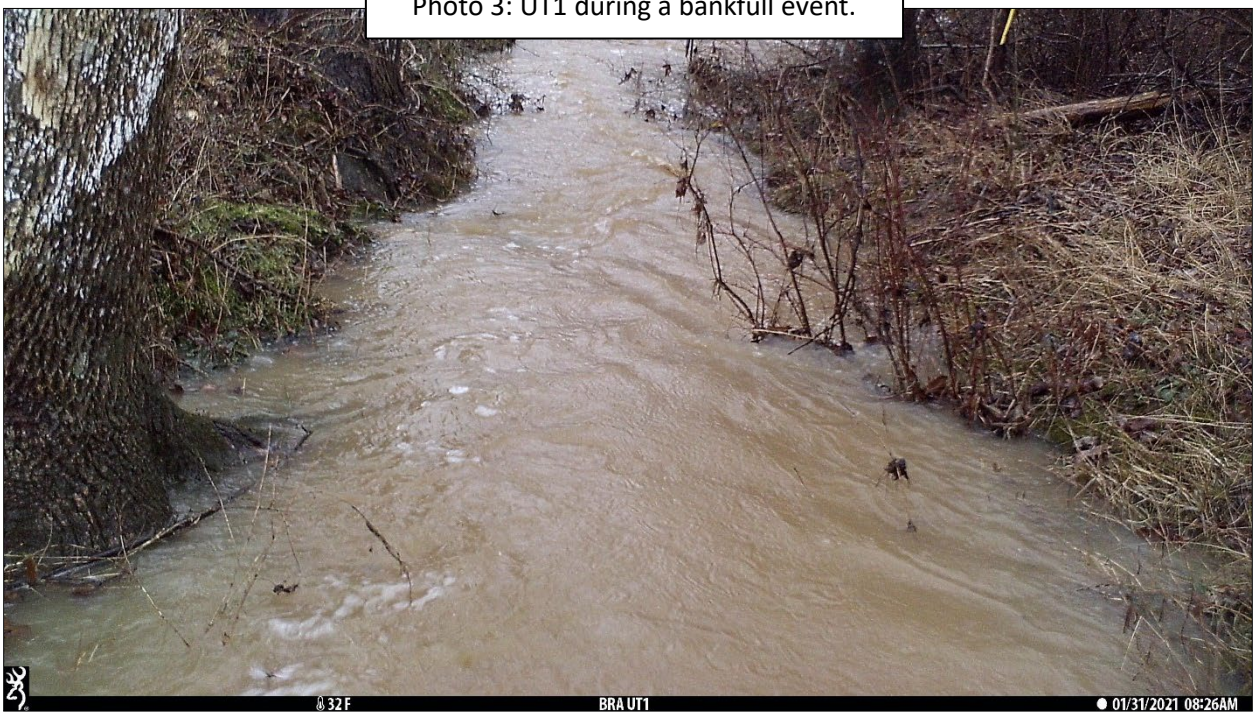


Photo 4: UT2 during a bankfull event.

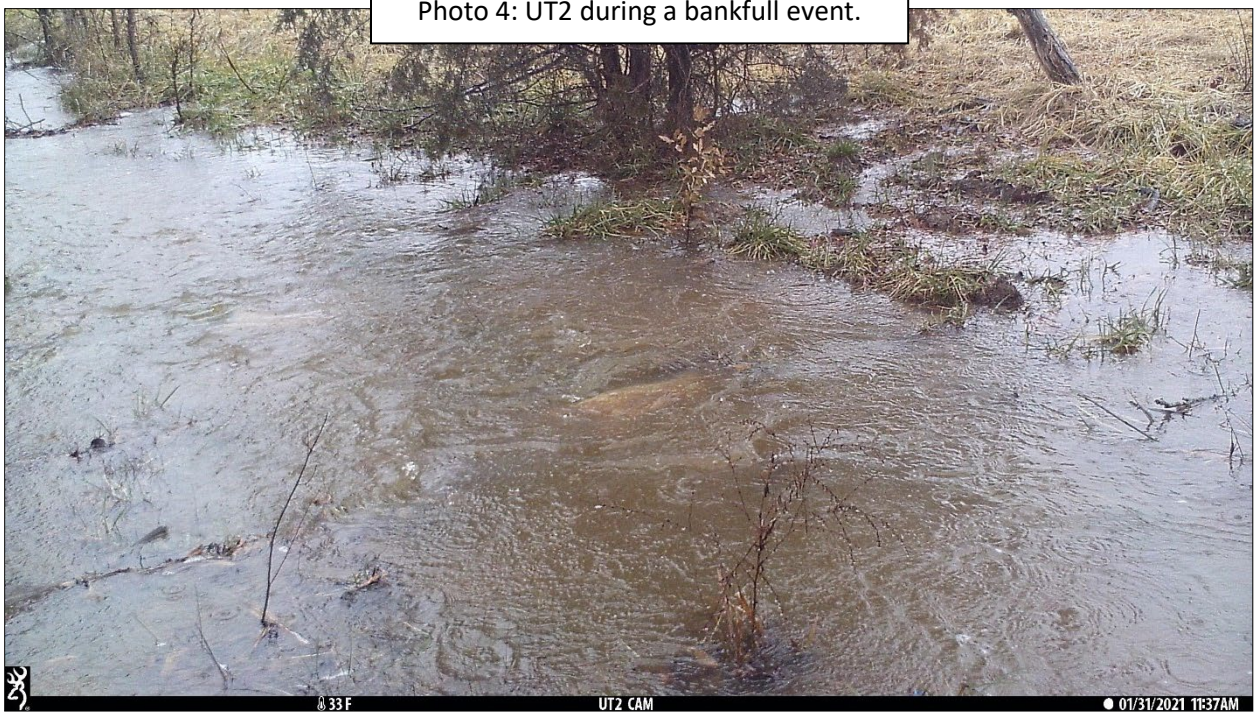


Photo 5: UT3 during a bankfull event.

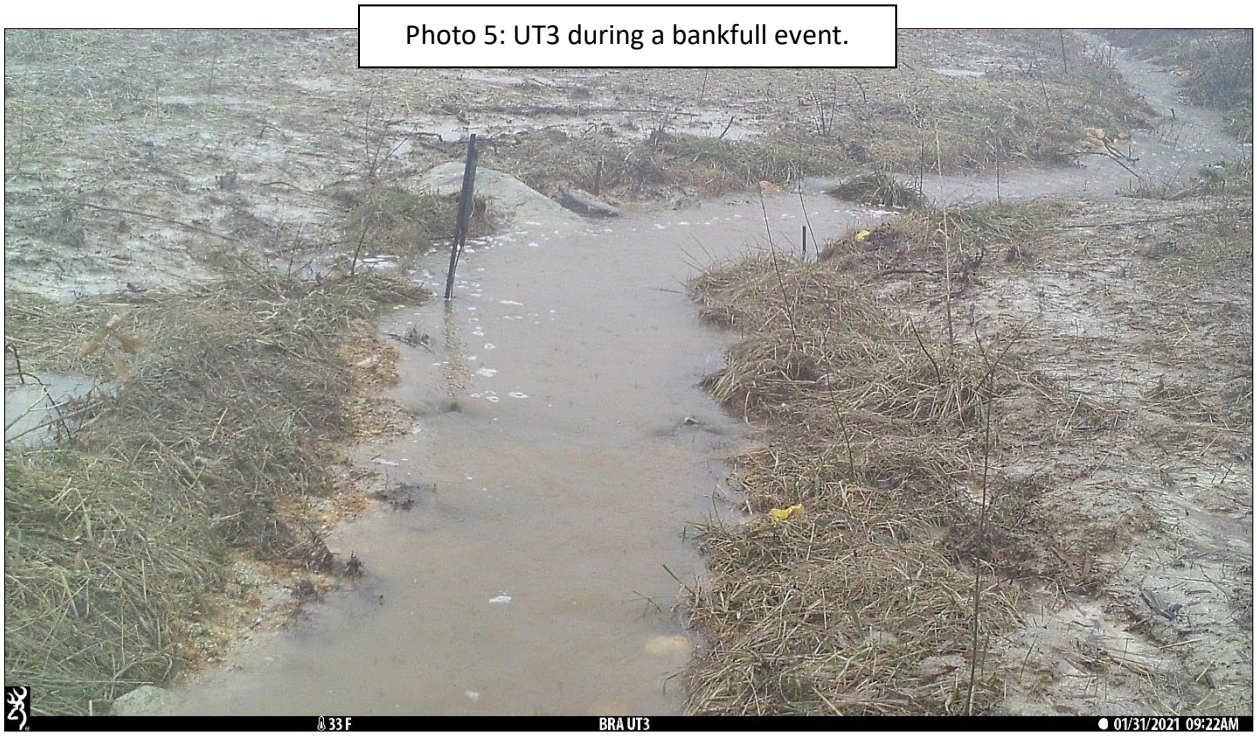


Photo 6: UT5 receding from a bankfull event.

Photo 7: UT1 during a bankfull event.

Photo 8: UT3 during a bankfull event.

Photo 9: UT5 rising just before a bankfull event.

Photo 10: Wrack and laid-back vegetation observed in the UT2 floodplain just after a bankfull event.

Photo 11: UT5 rising during a bankfull event

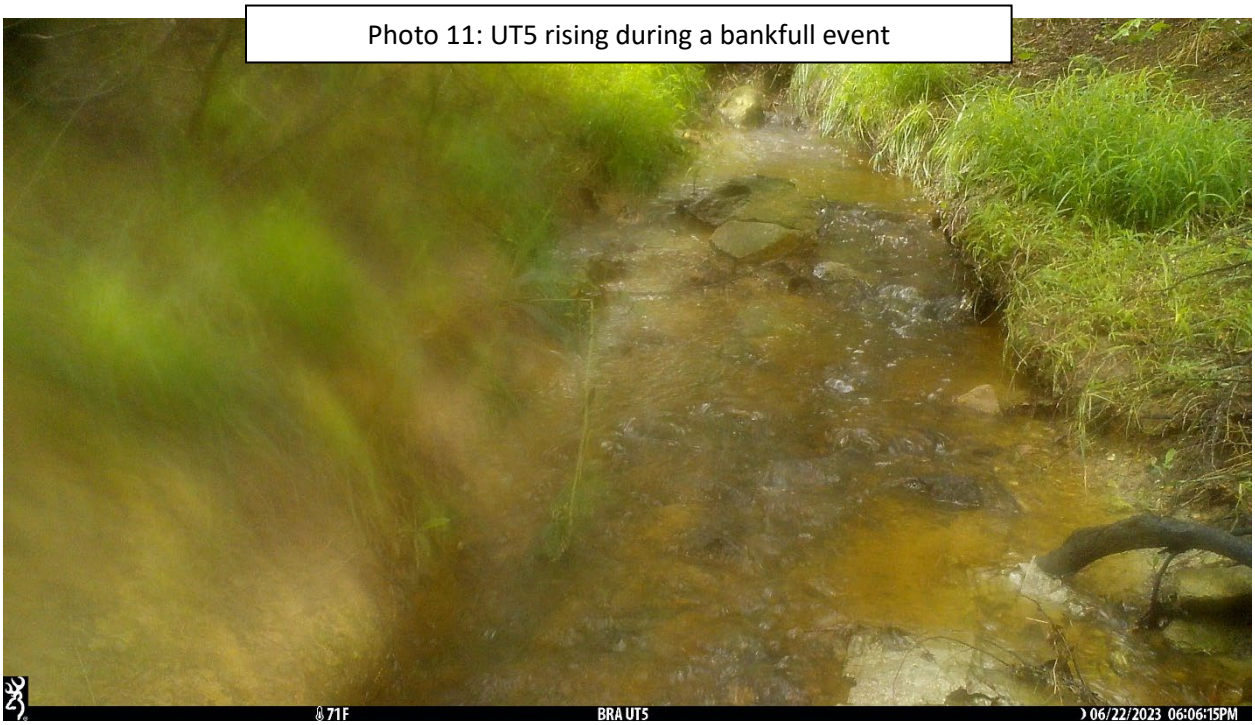
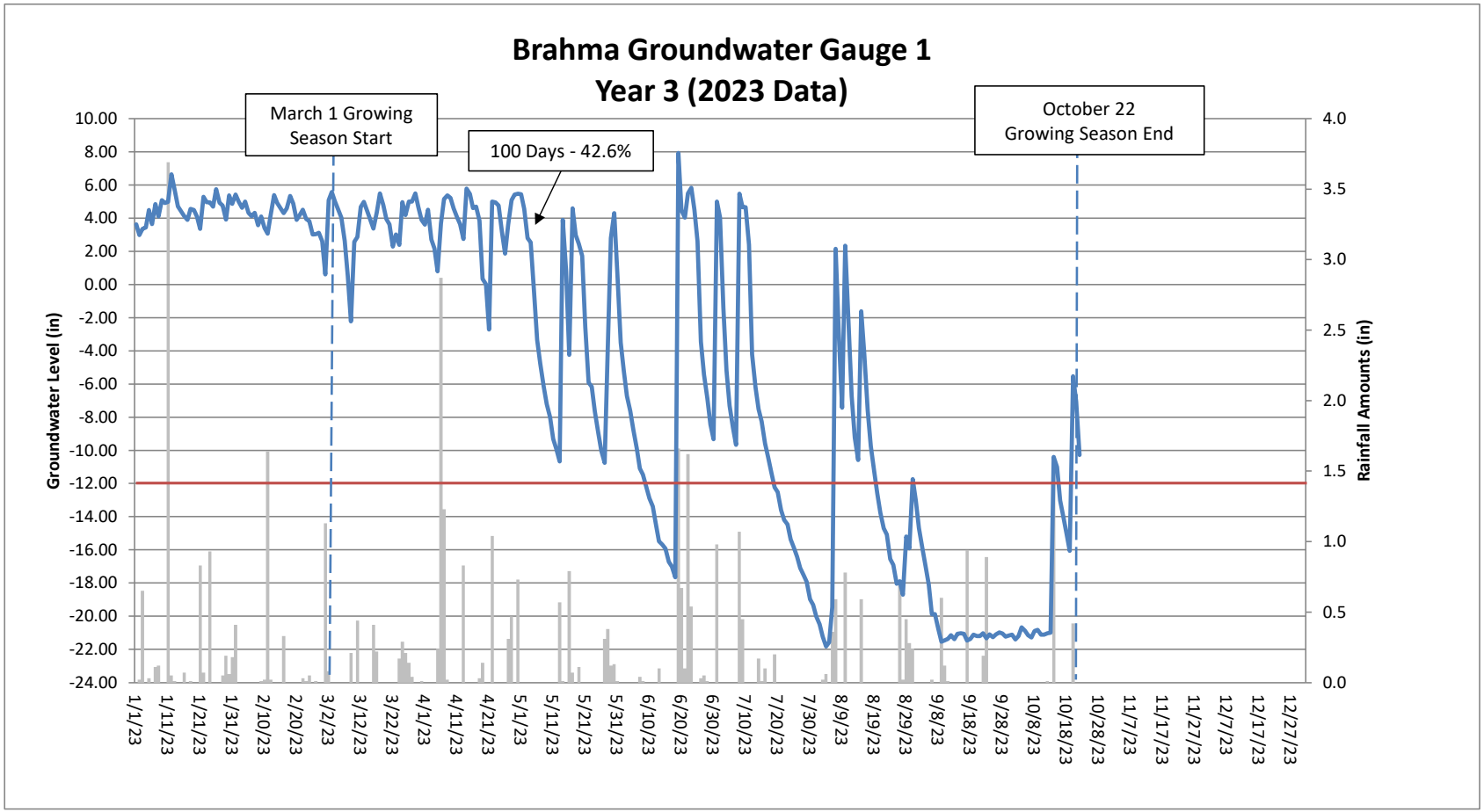


Table 12. Groundwater Hydrology Data

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)						
	Year 1 (2021)	Year 2 (2022)	Year 3 (2023)	Year 4 (2024)	Year 5 (2025)	Year 6 (2026)	Year 7 (2027)
1	Yes 60 days (25.4%)	Yes 66 days (28.0%)	Yes 100 days (42.4%)				
2	No 21 days (8.9%)	Yes 47 days (19.9%)	Yes 70 days (29.7%)				
3	No 18 days (7.6%)	Yes 28 days (12.0%)	Yes 69 days (29.2%)				
4	Yes 46 days (19.5%)	Yes 60 days (25.4%)	Yes 101 days (42.8%)				
5	Yes 47 days (19.9%)	Yes 59 days (25.0%)	Yes 85 days (36.0%)				
6	No 25 days (10.6%)	Yes 59 days (25.0%)	Yes 100 days (42.4%)				
7	Yes 227 days (96.2%)	Yes 236 days (100%)	Yes 66 days (28.1%)				
8	Yes 46 days (19.5%)	Yes 59 days (25.0%)	Yes 68 days (28.8%)				
9	Yes 49 days (20.8%)	Yes 59 days (25.0%)	Yes 70 days (29.7%)				
10	Yes 39 days (16.5%)	Yes 43 days (18.2%)	Yes 67 days (28.4%)				
11	Yes 46 Days (19.5%)	Yes 66 days (28.0%)	Yes 100 days (42.4%)				
12	No 21 Days (8.9%)	No 26 days (11.0%)	Yes 68 days (28.8%)				


Brahma Groundwater Gauge 1
Year 3 (2023 Data)
March 1 Growing Season Start
100 Days - 42.6%
October 22 Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
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11/27/23
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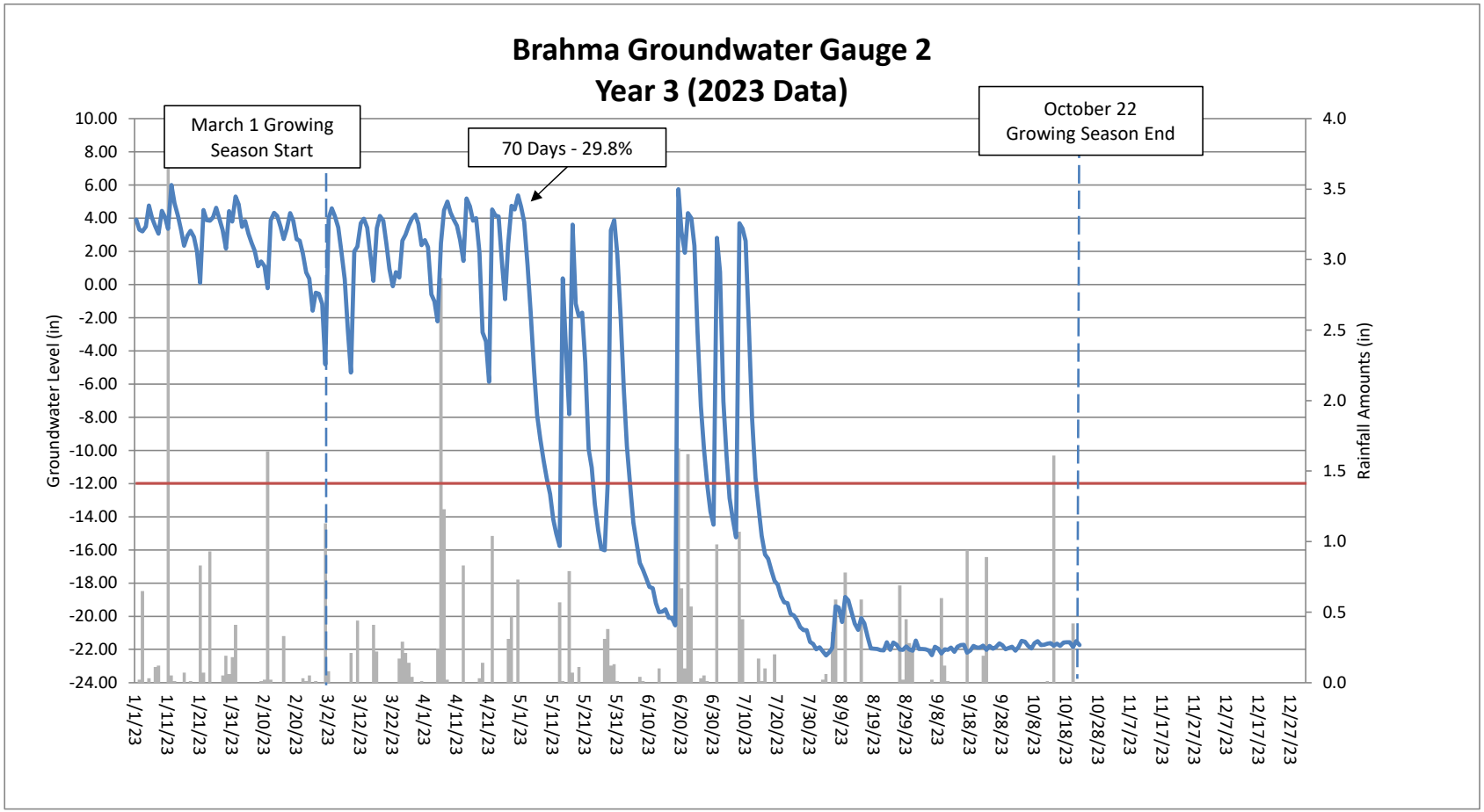
12/17/23
12/27/23


Brahma Groundwater Gauge 2
Year 3 (2023 Data)
March 1 Growing Season Start
70 Days - 29.8%
October 22 Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
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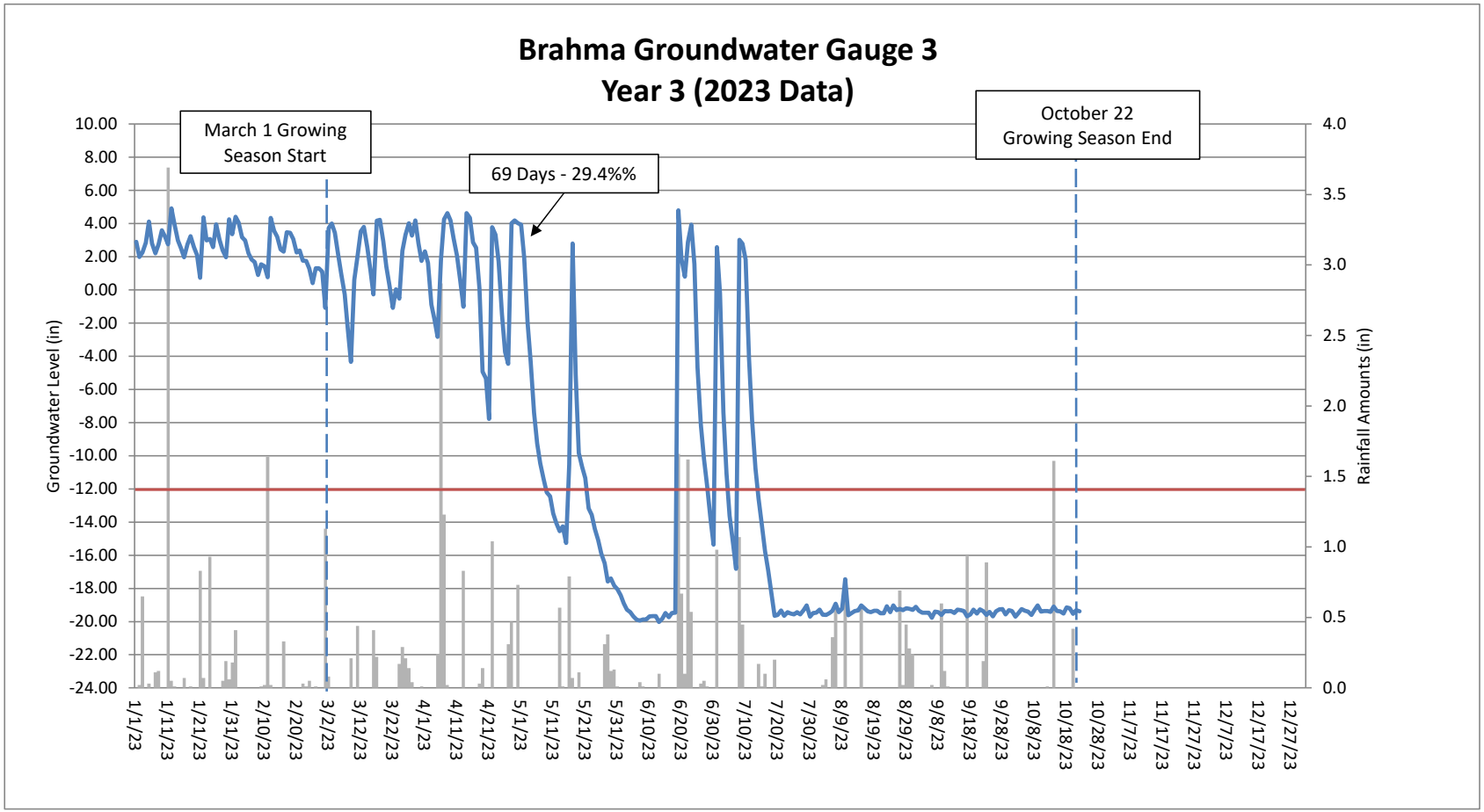
11/27/23
12/7/23
12/17/23
12/27/23


Brahma Groundwater Gauge 3
Year 3 (2023 Data)
March 1 Growing Season Start
69 Days - 29.4%%
October 22 Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
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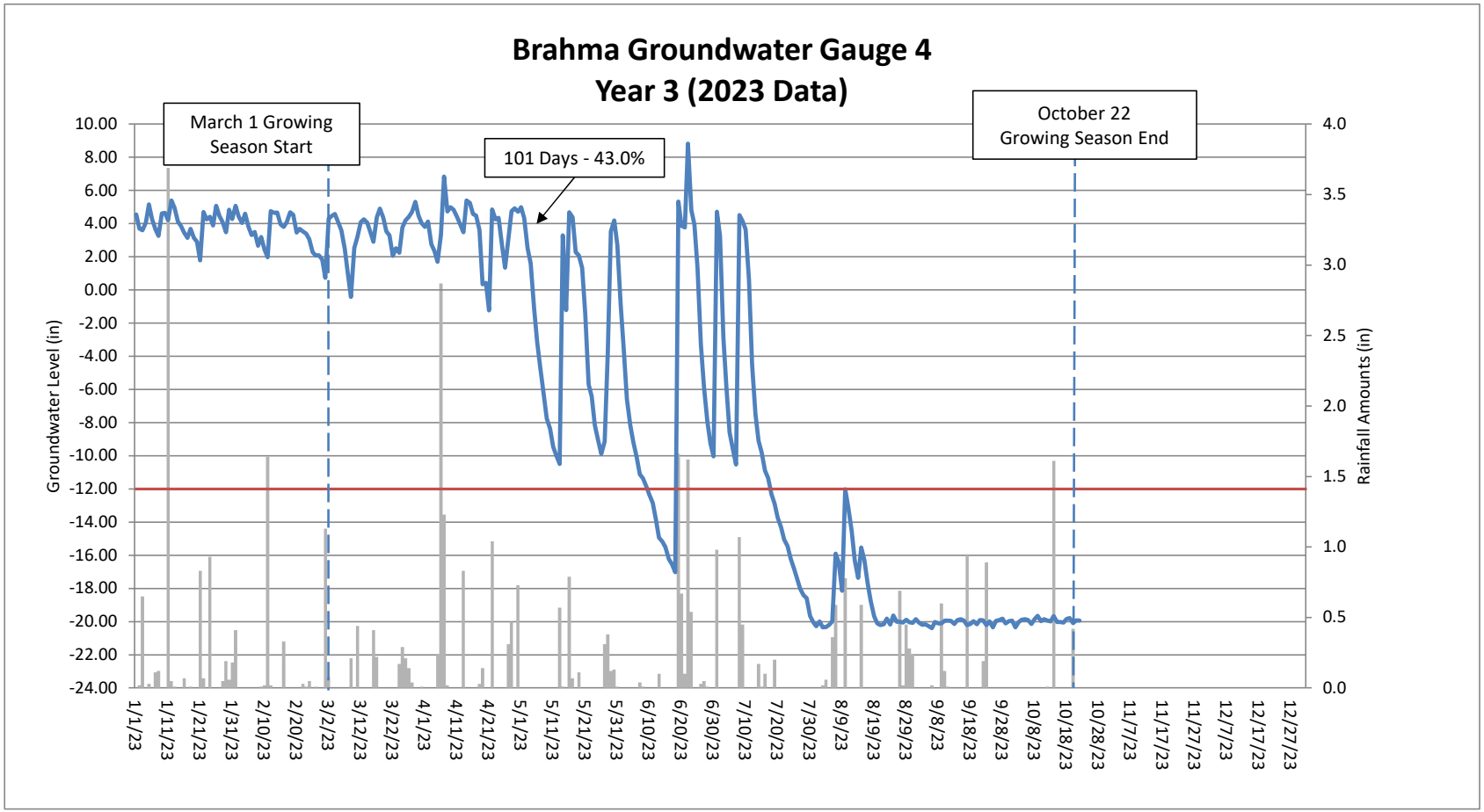
12/27/23


Brahma Groundwater Gauge 4
Year 3 (2023 Data)
March 1 Growing Season Start
101 Days - 43.0%
October 22 Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
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8/19/23
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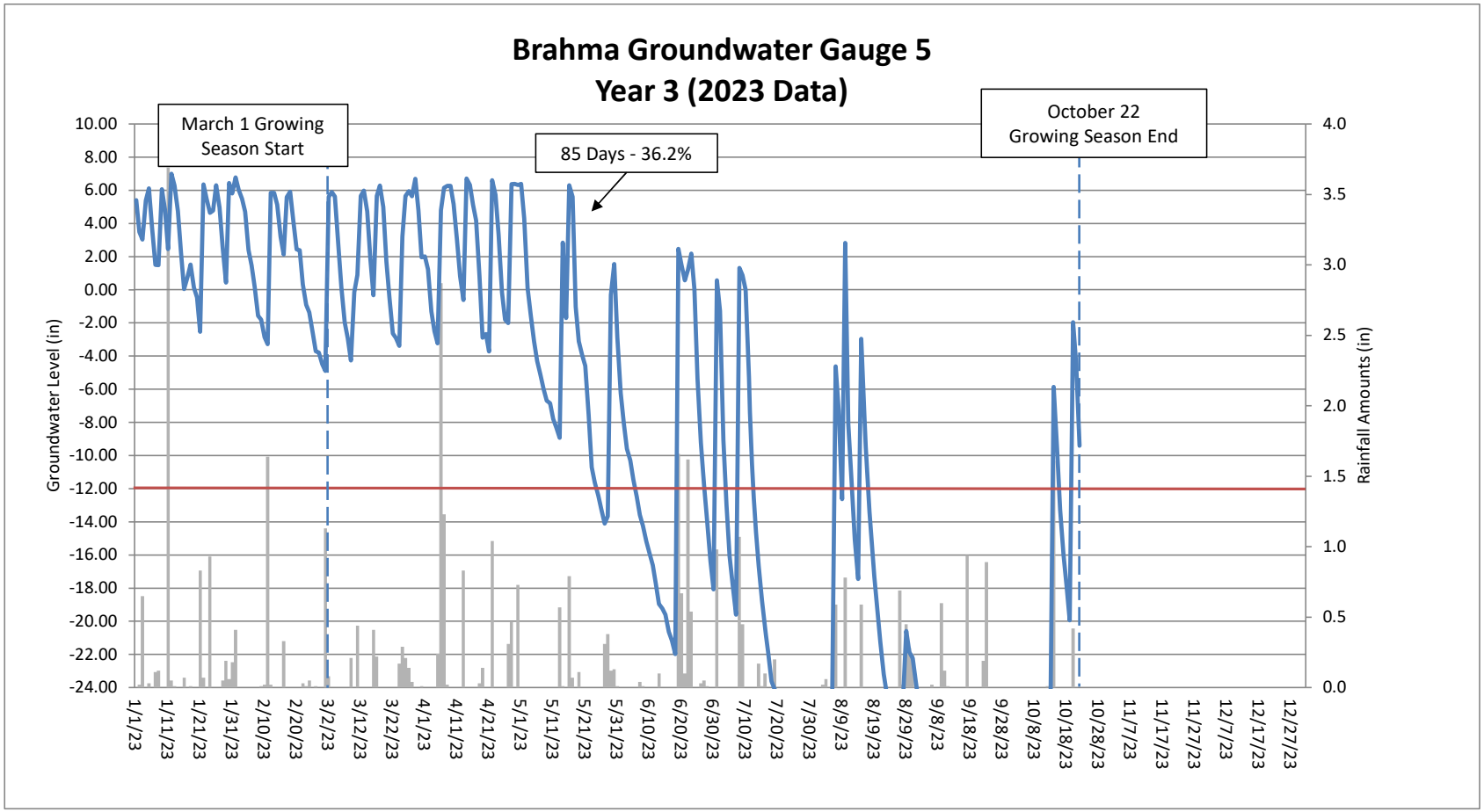
12/27/23


Brahma Groundwater Gauge 5
Year 3 (2023 Data)
March 1 Growing Season Start
85 Days - 36.2%
October 22 Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
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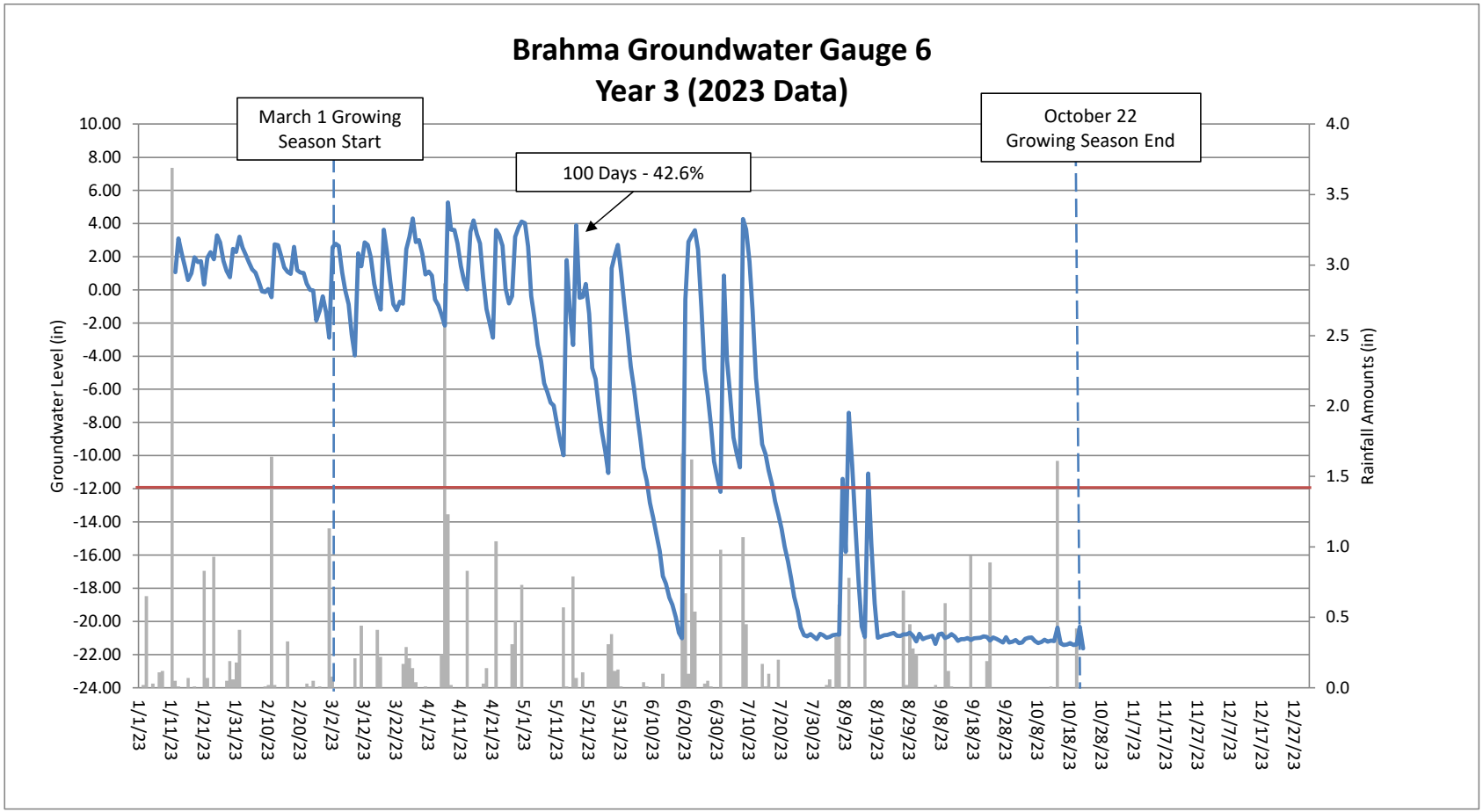
12/27/23


Brahma Groundwater Gauge 6
Year 3 (2023 Data)
March 1 Growing Season Start
October 22 Growing Season End
100 Days - 42.6%
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
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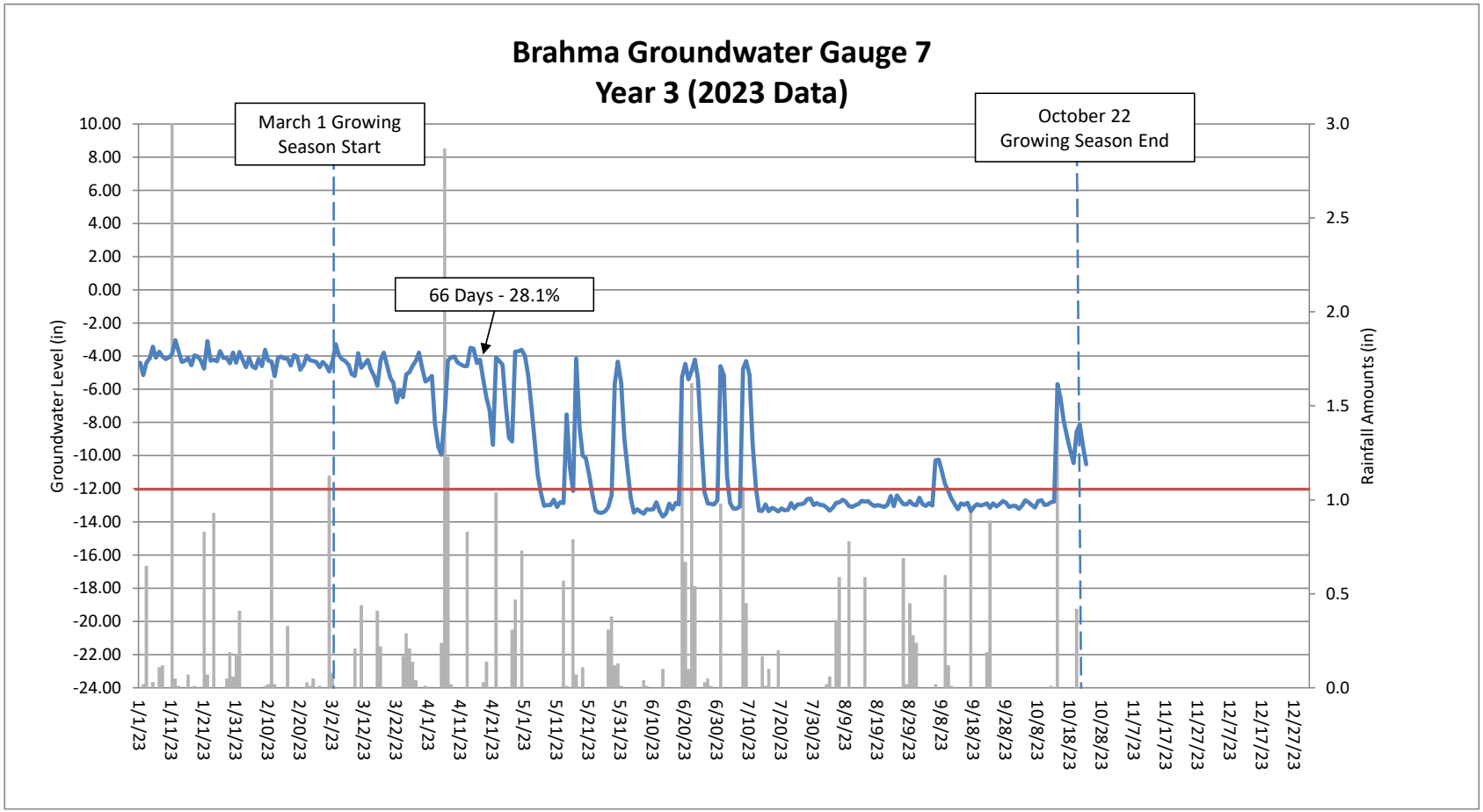
12/27/23


Brahma Groundwater Gauge 7
Year 3 (2023 Data)
March 1 Growing Season Start
October 22 Growing Season End
66 Days - 28.1%
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
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7/10/23
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8/9/23
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8/29/23
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9/18/23
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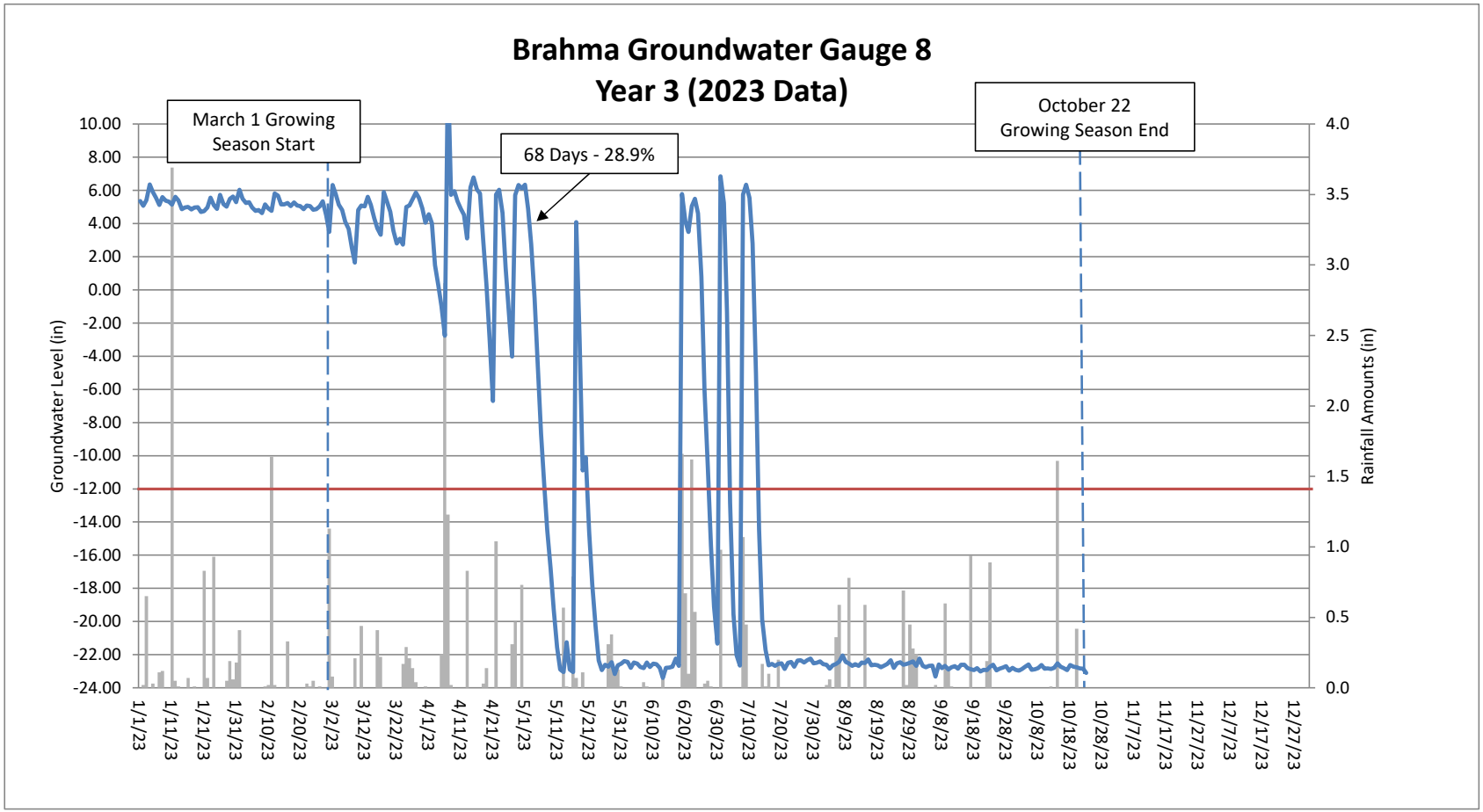
12/27/23


Brahma Groundwater Gauge 8
Year 3 (2023 Data)
March 1 Growing Season Start
68 Days - 28.9%
October 22 Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
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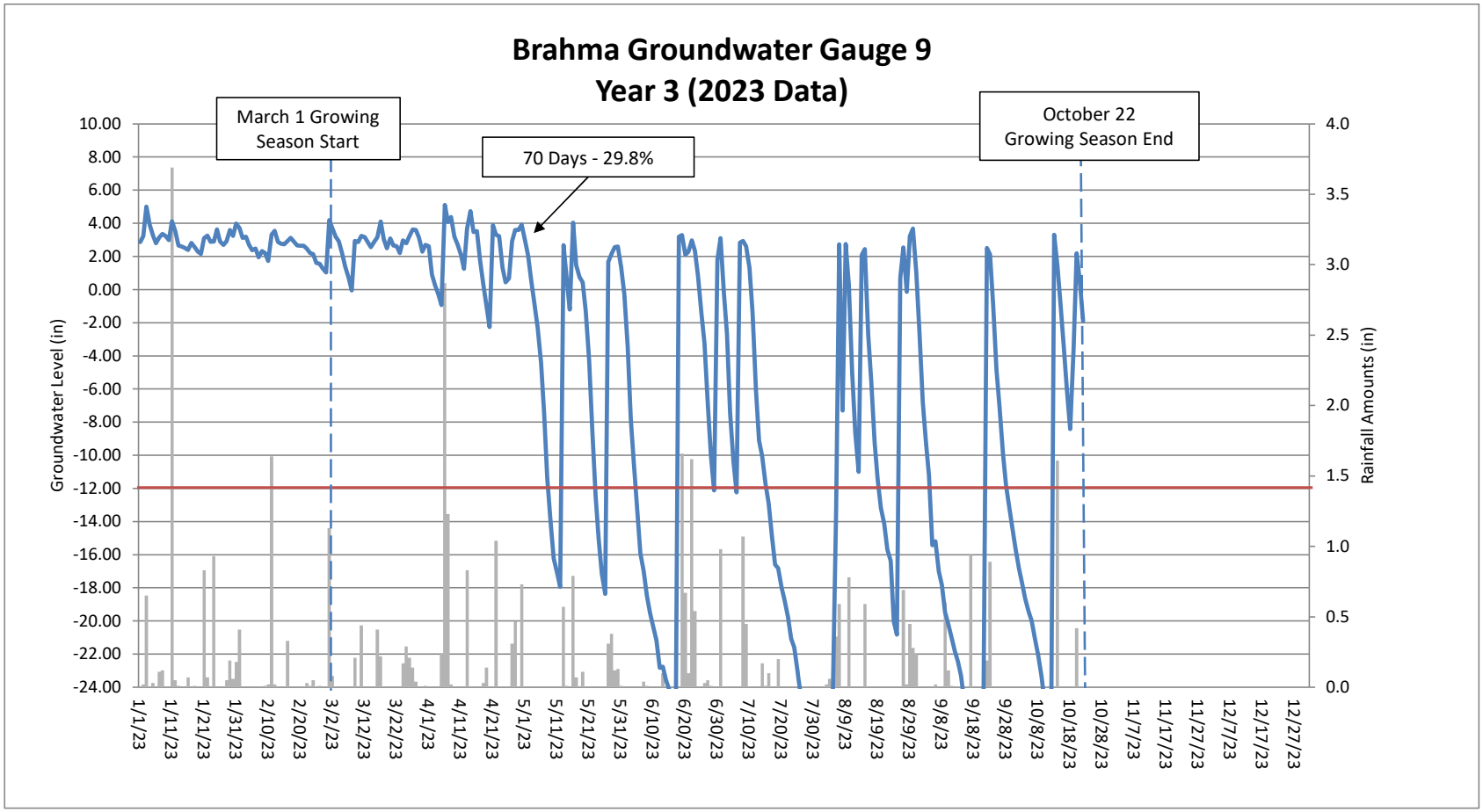
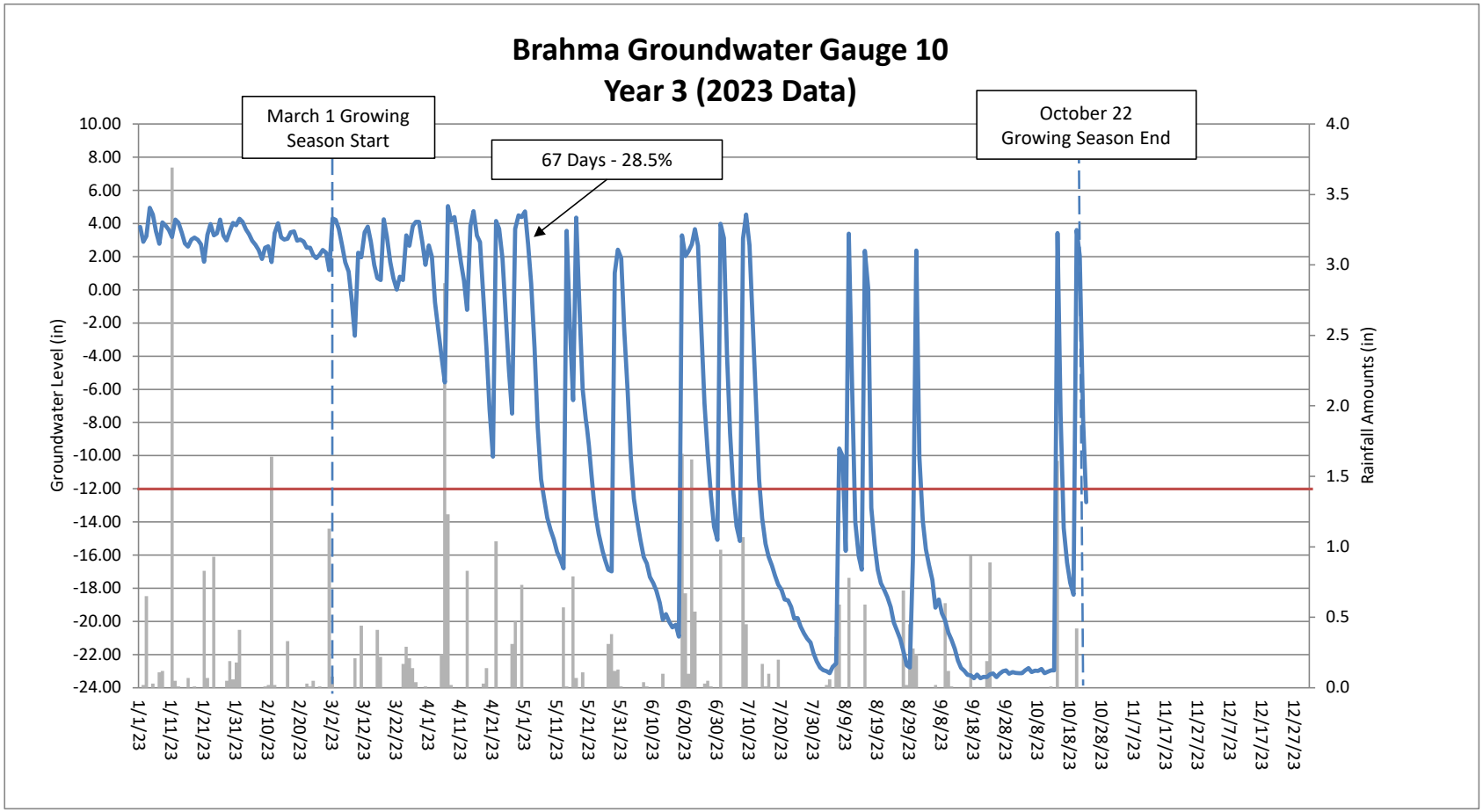
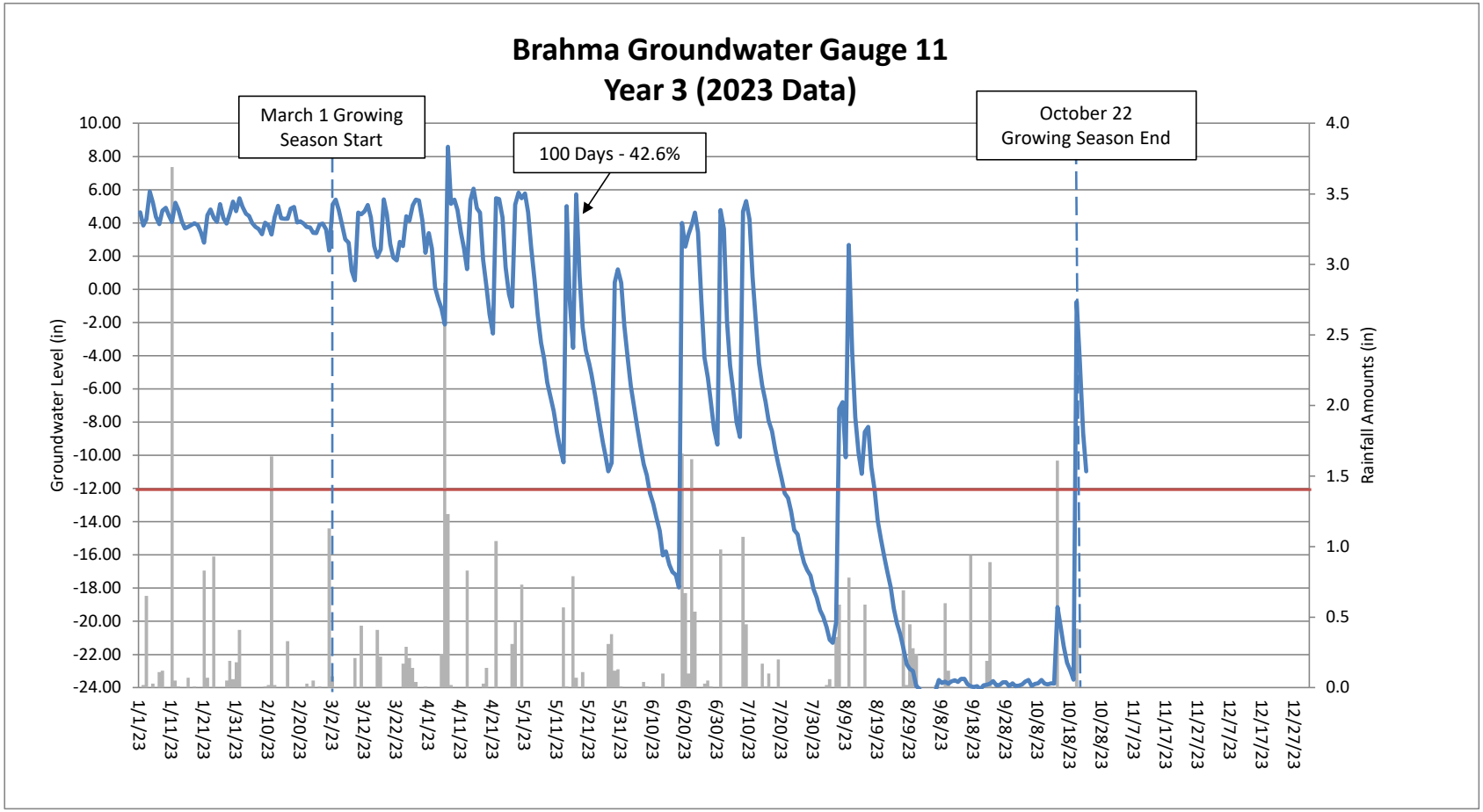
12/27/23


Brahma Groundwater Gauge 9
Year 3 (2023 Data)
March 1 Growing Season Start
70 Days - 29.8%
October 22 Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
10/8/23
10/18/23
10/28/23
11/7/23
11/17/23
11/27/23
12/7/23
12/17/23
12/27/23


Brahma Groundwater Gauge 10
Year 3 (2023 Data)
March 1 Growing Season Start
67 Days - 28.5%
October 22 Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
10/8/23
10/18/23
10/28/23
11/7/23
11/17/23
11/27/23
12/7/23
12/17/23
12/27/23


Brahma Groundwater Gauge 11
Year 3 (2023 Data)
March 1 Growing Season Start
100 Days - 42.6%
October 22 Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
10/8/23
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10/28/23
11/7/23
11/17/23
11/27/23
12/7/23
12/17/23
12/27/23

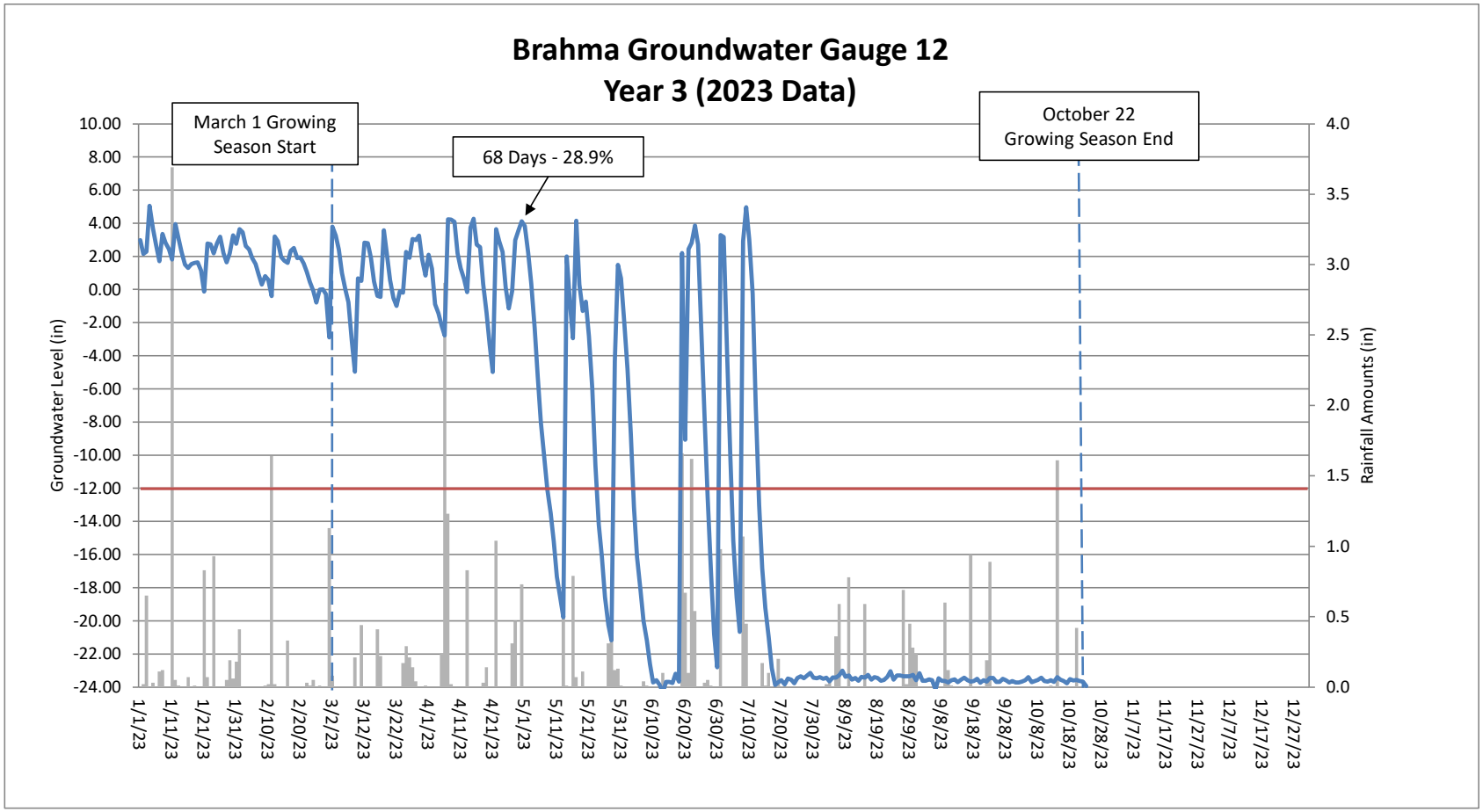

Brahma Groundwater Gauge 12
Year 3 (2023 Data)
March 1 Growing Season Start
68 Days - 28.9%
October 22 Growing Season End
Groundwater Level (in)
Rainfall Amounts (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
-22.00
-24.00
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
10/8/23
10/18/23
10/28/23
11/7/23
11/17/23
11/27/23
12/7/23
12/17/23
12/27/23

Table 13A. UT-1 Channel Evidence

UT-1 Channel Evidence	Year 1 (2021)	Year 2 (2022)	Year 3 (2023)
Max consecutive days channel flow	83	133	31*
Presence of litter and debris (wracking)	Yes	Yes	Yes
Leaf litter disturbed or washed away	Yes	Yes	Yes
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes
Water staining due to continual presence of water	Yes	Yes	Yes
Formation of channel bed and banks	Yes	Yes	Yes
Sediment sorting within the primary path of flow	Yes	Yes	Yes
Sediment shelving or a natural line impressed on the banks	Yes	Yes	Yes
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes
Exposure of woody plant roots within the primary path of flow	No	No	No
Other:			

*Gauge malfunctioned resulting in data loss for the majority of the year.

Table 13B. UT-2 Channel Evidence

UT-2 Channel Evidence	Year 1 (2021)	Year 2 (2022)	Year 3 (2023)
Max consecutive days channel flow	78	139	121
Presence of litter and debris (wracking)	Yes	Yes	Yes
Leaf litter disturbed or washed away	Yes	Yes	Yes
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes
Water staining due to continual presence of water	Yes	Yes	Yes
Formation of channel bed and banks	Yes	Yes	Yes
Sediment sorting within the primary path of flow	Yes	Yes	Yes
Sediment shelving or a natural line impressed on the banks	Yes	Yes	Yes
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes
Exposure of woody plant roots within the primary path of flow	No	No	No
Other:			

Table 13C. UT-3 Channel Evidence

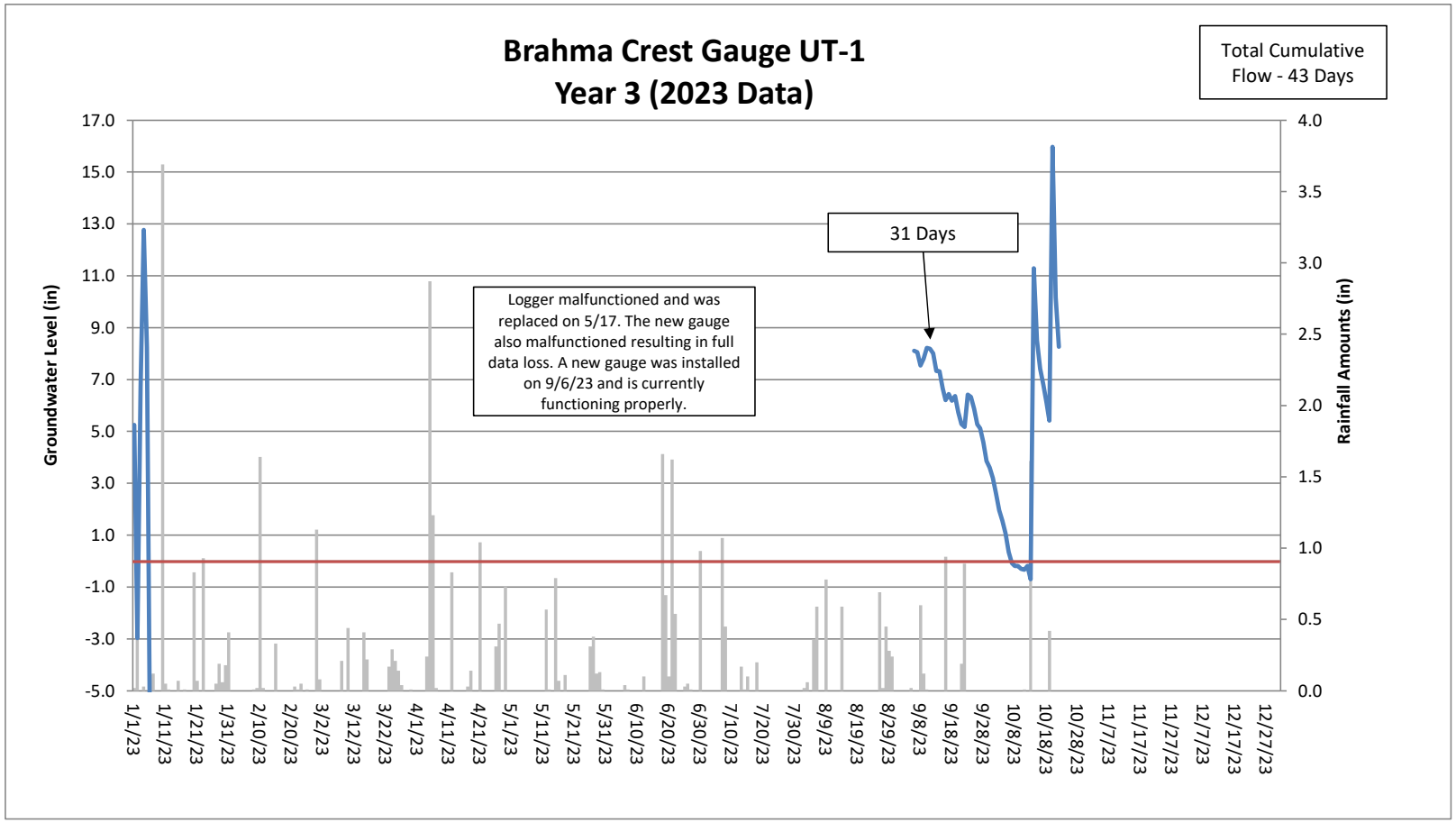
UT-3 Channel Evidence	Year 1 (2021)	Year 2 (2022)	Year 3 (2023)
Max consecutive days channel flow	266	226	277
Presence of litter and debris (wracking)	Yes	Yes	Yes
Leaf litter disturbed or washed away	Yes	Yes	Yes
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes
Water staining due to continual presence of water	Yes	Yes	Yes
Formation of channel bed and banks	Yes	Yes	Yes
Sediment sorting within the primary path of flow	Yes	Yes	Yes
Sediment shelving or a natural line impressed on the banks	Yes	Yes	Yes
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes
Exposure of woody plant roots within the primary path of flow	No	No	No
Other:			

Table 13D. UT-5 Channel Evidence

UT-5 Channel Evidence	Year 1 (2021)	Year 2 (2022)	Year (2023)
Max consecutive days channel flow	50	86	210
Presence of litter and debris (wracking)	Yes	Yes	Yes
Leaf litter disturbed or washed away	Yes	Yes	Yes
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes
Water staining due to continual presence of water	Yes	Yes	Yes
Formation of channel bed and banks	Yes	Yes	Yes
Sediment sorting within the primary path of flow	Yes	Yes	Yes
Sediment shelving or a natural line impressed on the banks	Yes	Yes	Yes
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes
Exposure of woody plant roots within the primary path of flow	No	No	No
Other:			

Table 13E. UT-6 Channel Evidence

UT-6 Channel Evidence	Year 1 (2021)	Year 2 (2022)	Year (2023)
Max consecutive days channel flow	73	92	135
Presence of litter and debris (wracking)	Yes	Yes	Yes
Leaf litter disturbed or washed away	Yes	Yes	Yes
Matted, bent, or absence of vegetation (herbaceous or otherwise)	Yes	Yes	Yes
Sediment deposition and/or scour indicating sediment transport	Yes	Yes	Yes
Water staining due to continual presence of water	Yes	Yes	Yes
Formation of channel bed and banks	Yes	Yes	Yes
Sediment sorting within the primary path of flow	Yes	Yes	Yes
Sediment shelving or a natural line impressed on the banks	Yes	Yes	Yes
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)	Yes	Yes	Yes
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems	Yes	Yes	Yes
Exposure of woody plant roots within the primary path of flow	No	No	No
Other:			


Brahma Crest Gauge UT-1
Year 3 (2023 Data)
Total Cumulative Flow - 43 Days
31 Days
Logger malfunctioned and was replaced on 5/17. The new gauge also malfunctioned resulting in full data loss. A new gauge was installed on 9/6/23 and is currently functioning properly.
Groundwater Level (in)
Rainfall Amounts (in)
17.0
15.0
13.0
11.0
9.0
7.0
5.0
3.0
1.0
-1.0
-3.0
-5.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
10/8/23
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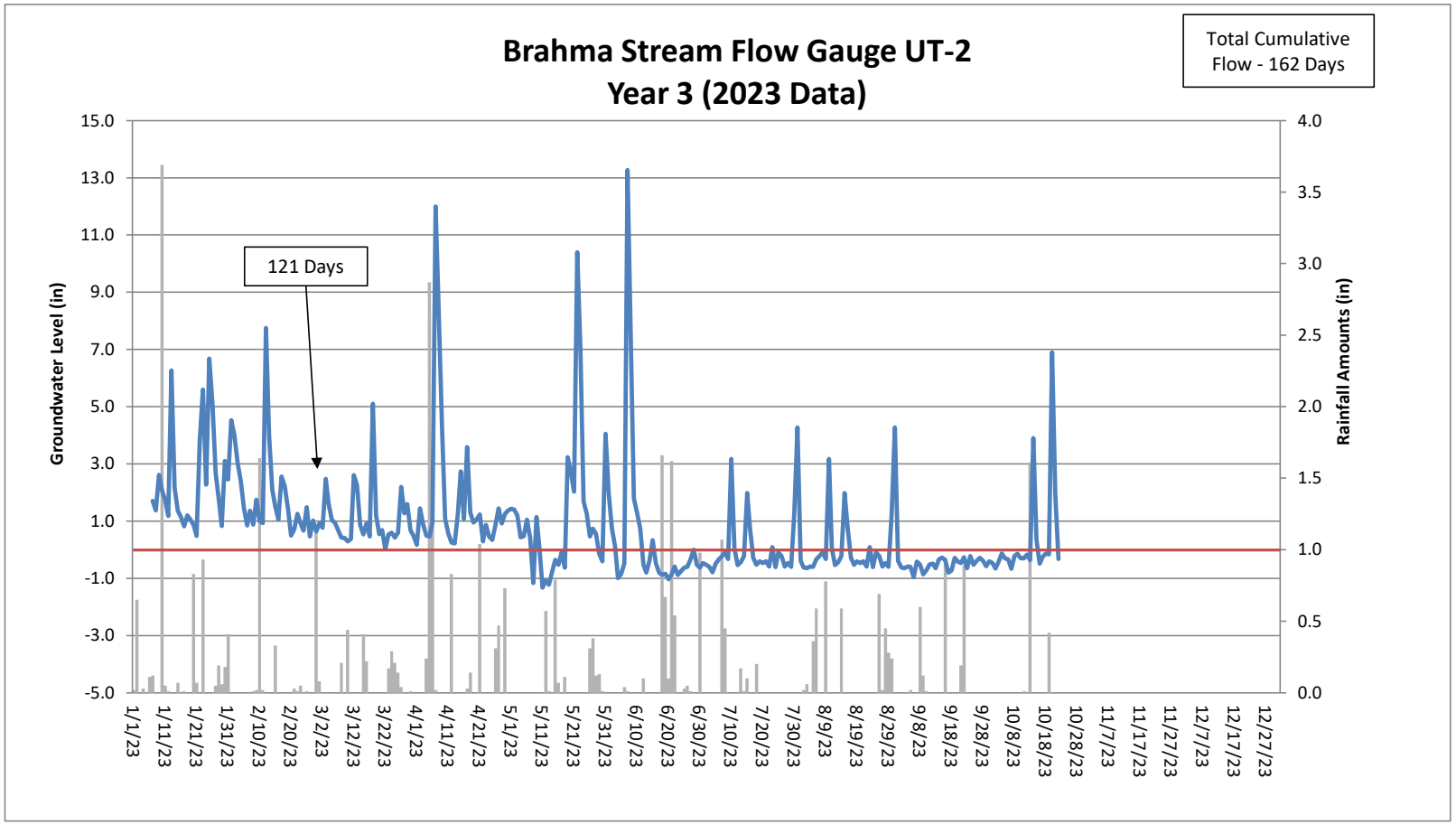
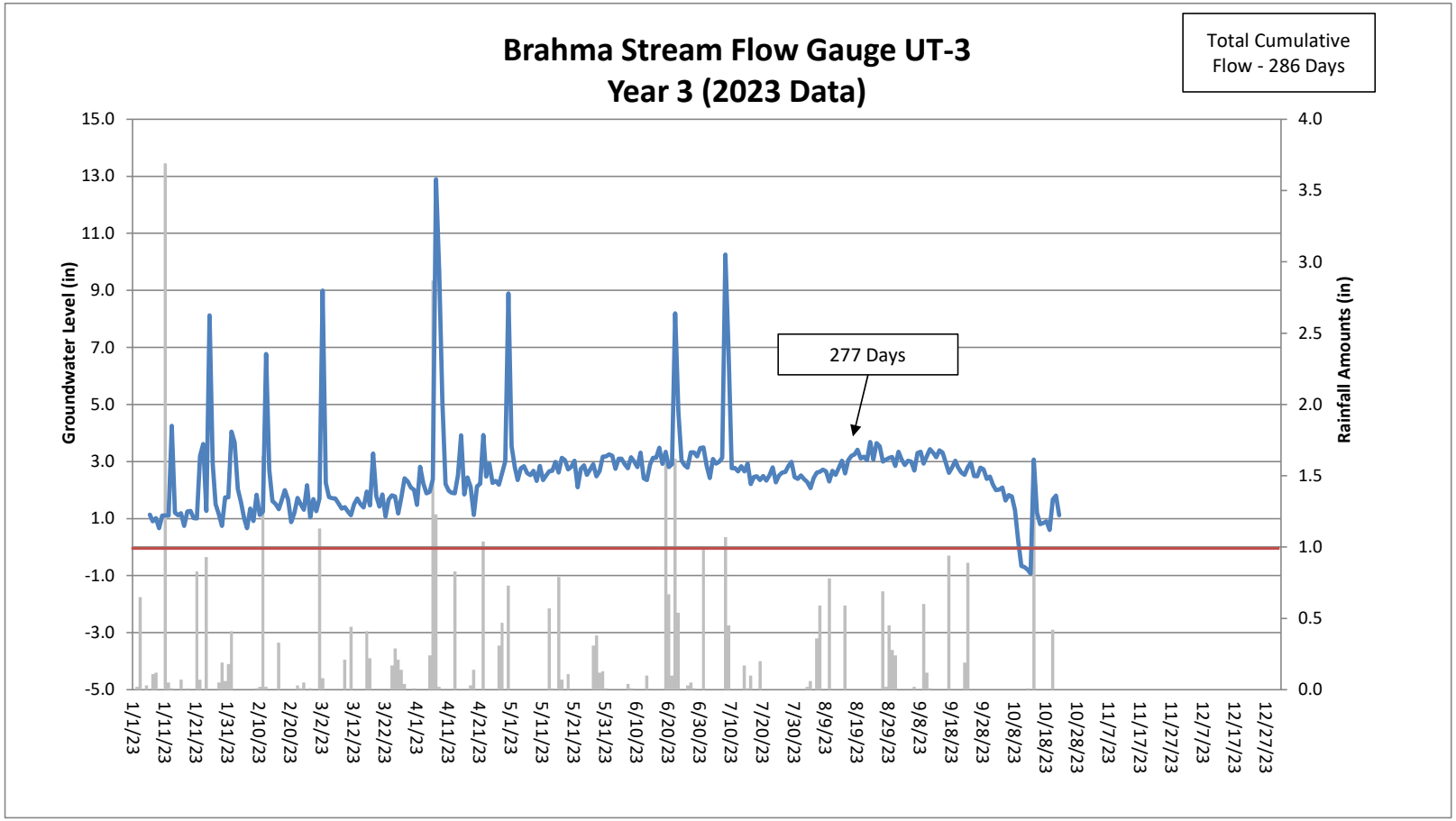
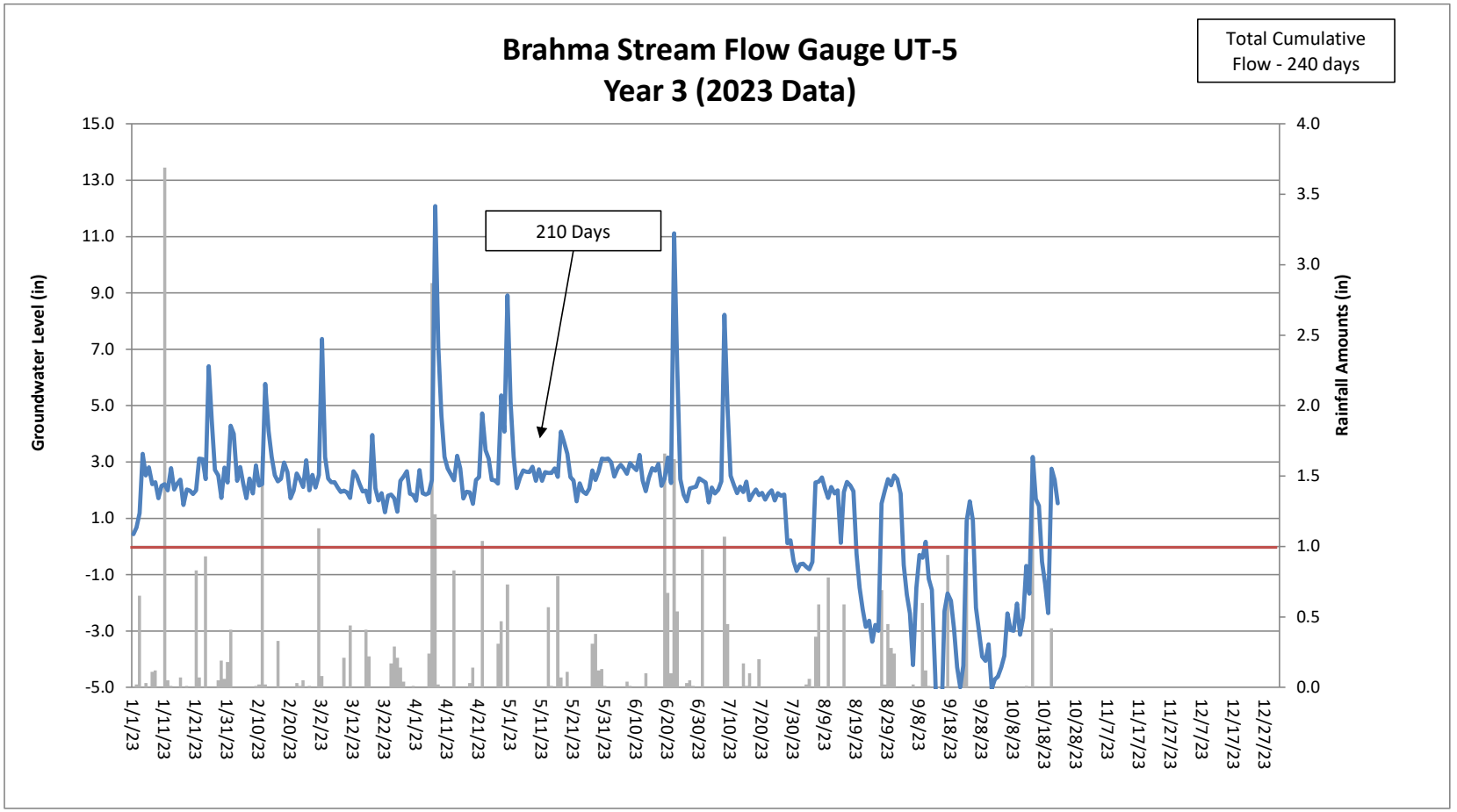
11/7/23
11/17/23
11/27/23
12/7/23
12/17/23
12/27/23


Brahma Stream Flow Gauge UT-2
Year 3 (2023 Data)
Total Cumulative Flow - 162 Days
121 Days
Groundwater Level (in)
Rainfall Amounts (in)
15.0
13.0
11.0
9.0
7.0
5.0
3.0
1.0
-1.0
-3.0
-5.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
10/8/23
10/18/23
10/28/23
11/7/23
11/17/23
11/27/23
12/7/23
12/17/23
12/27/23


Brahma Stream Flow Gauge UT-3
Year 3 (2023 Data)
Total Cumulative Flow - 286 Days
277 Days
Groundwater Level (in)
Rainfall Amounts (in)
15.0
13.0
11.0
9.0
7.0
5.0
3.0
1.0
-1.0
-3.0
-5.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
10/8/23
10/18/23
10/28/23
11/7/23
11/17/23
11/27/23
12/7/23
12/17/23
12/27/23


Brahma Stream Flow Gauge UT-5
Year 3 (2023 Data)
Total Cumulative Flow - 240 days
210 Days
Groundwater Level (in)
Rainfall Amounts (in)
15.0
13.0
11.0
9.0
7.0
5.0
3.0
1.0
-1.0
-3.0
-5.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
10/8/23
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10/28/23
11/7/23
11/17/23
11/27/23
12/7/23
12/17/23
12/27/23

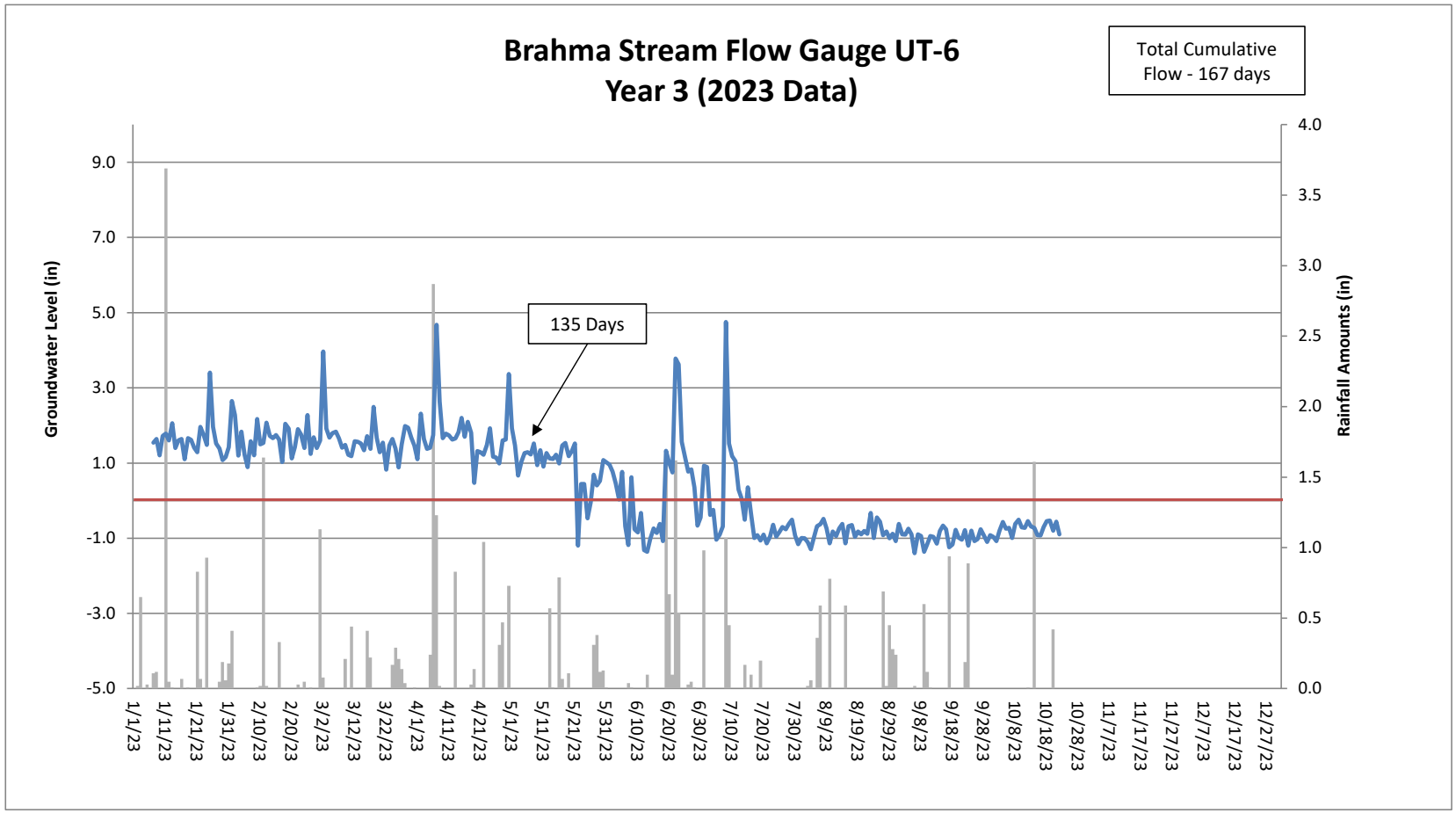
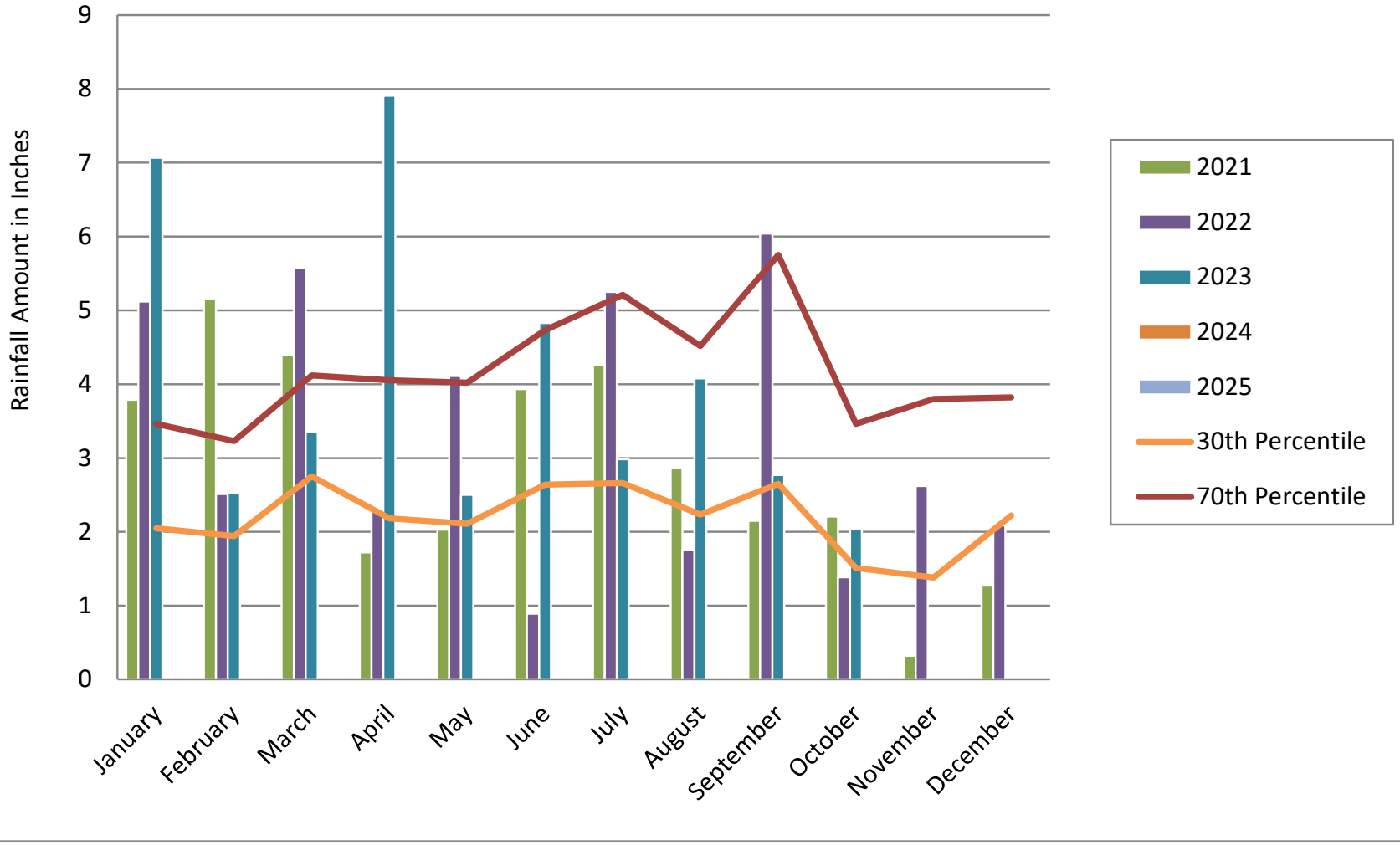
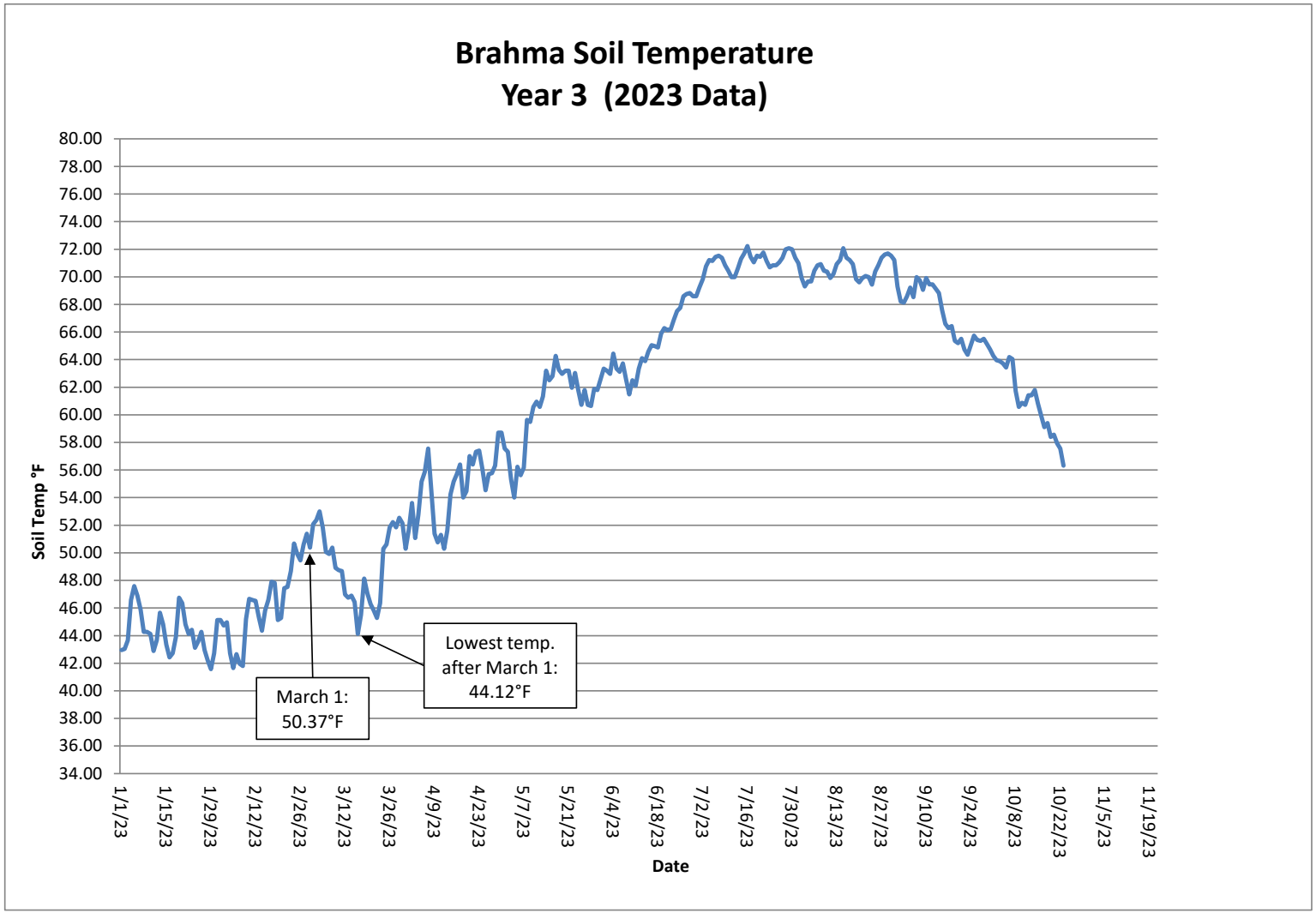

Brahma Stream Flow Gauge UT-6
Year 3 (2023 Data)
Total Cumulative Flow - 167 days
135 Days
Groundwater Level (in)
Rainfall Amounts (in)
9.0
7.0
5.0
3.0
1.0
-1.0
-3.0
-5.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/1/23
1/11/23
1/21/23
1/31/23
2/10/23
2/20/23
3/2/23
3/12/23
3/22/23
4/1/23
4/11/23
4/21/23
5/1/23
5/11/23
5/21/23
5/31/23
6/10/23
6/20/23
6/30/23
7/10/23
7/20/23
7/30/23
8/9/23
8/19/23
8/29/23
9/8/23
9/18/23
9/28/23
10/8/23
10/18/23
10/28/23
11/7/23
11/17/23
11/27/23
12/7/23
12/17/23
12/27/23

Figure D1: Brahma
30-70 Percentile Graph for Rainfall
Current year data from onsite rain gauge
30-70th percentile data from WETS Station: Burlington Alamance Regional Airport




Brahma Soil Temperature
Year 3 (2023 Data)
Soil Temp °F
80.00
78.00
76.00
74.00
72.00
70.00
68.00
66.00
64.00
62.00
60.00
58.00
56.00
54.00
52.00
50.00
48.00
46.00
44.00
42.00
40.00
38.00
36.00
34.00
March 1:
50.37°F
Lowest temp.
after March 1:
44.12°F
1/1/23
1/15/23
1/29/23
2/12/23
2/26/23
3/12/23
3/26/23
4/9/23
4/23/23
5/7/23
5/21/23
6/4/23
6/18/23
7/2/23
7/16/23
7/30/23
8/13/23
8/27/23
9/10/23
9/24/23
10/8/23
10/22/23
11/5/23
11/19/23
Date

Appendix E
Project Timeline and Contact Info

Table 14. Project Timeline
Table 15. Project Contacts

Table 14. Project Timeline

Activity or Deliverable	Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted	NA	Dec-18
Mitigation Plan Approved	NA	8-Jul-20
Construction (Grading) Completed	NA	9-Dec-21
Planting Completed	NA	12-Jan-21
As-built Survey Completed	15-Jan-20	Feb-21
MY-0 Baseline Report	Jan-21	Apr-21
Year 1 Monitoring Report	Nov-21	Dec-21
Year 2 Monitoring Report	Nov-22	Dec-22
Year 3 Monitoring Report	Nov-23	Jan-24
Remediation Items (e.g. beaver removal, supplements, repairs etc.)		
Encroachment		

Table 15. Project Contacts

Brahma Site/100092	
Provider	Restoration Systems, LLC 1101 Haynes Street, Suite 211 Raleigh, NC 27604
Mitigation Provider POC	Worth Creech 919-755-9490
Designer	Axiom Environmental, Inc. 218 Snow Ave Raleigh, NC 27603
Primary project design POC	Grant Lewis 919-215-1693
Construction Contractor	Land Mechanics Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592
	Charles Hill 919-639-6132

Appendix F
Benthic Data

Benthic Sampling Results
Benthic Habitat Data Forms

PA ID NO			56916	56917
STATION			Brahma	Brahma
			UT1U	UT1D
DATE			6/13/2023	6/13/2023
SPECIES	Tolerance Value	Functional Feeding Group		
PLATYHELMINTHES				
MOLLUSCA				
Bivalvia				
Veneroida				
Sphaeriidae		**FC**		
Musculium lacustre		**FC**	5	
Pisidium sp.	6.6	**FC**		
Gastropoda				
Basommatophora				
Physidae				
Physella sp.	8.7	**CG**	4	2
ANNELIDA				
Clitellata				
Oligochaeta		**CG**		
Lumbriculida				
Lumbriculidae		**CG**		
Lumbriculus sp.		**CG**	1	
Hirudinea		**P**		
Arhynchobdellida				
Erpobdellidae		**P**		
Rhynchobdellida				
Glossiphoniidae		**P**		
Helobdella sp.		**P**		
ARTHROPODA				
Cladocera				
Daphnidae				
Ceriodaphnia sp.				
Copepoda				
Cyclopoida				
Cyclopidae				
Mesocyclops edax				
Isopoda				
Asellidae		**SH**		
Caecidotea sp.	8.4	**CG**		
Amphipoda		**CG**		
Crangonyctidae				
Crangonyx sp.	7.2	**CG**		
Insecta				
Ephemeroptera				
Baetidae		**CG**		16
Odonata				
Aeshnidae		**P**		
Aeshna umbrosa		**P**	2	
Anax junius		**P**		
Coenagrionidae		**P**		4
Corduliidae				
Somatochlora sp.	8.9	**P**	5	
Libellulidae		**P**		
Libellula vibrans	9.4	**P**		1
Pachydiplax longipennis	9.6			

PA ID NO			56916	56917
STATION			Brahma	Brahma
			UT1U	UT1D
DATE			6/13/2023	6/13/2023
SPECIES	Tolerance Value	Functional Feeding Group		
Plecoptera				
Perlidae		**P**		
Perlesta sp.	2.9	**P**		
Hemiptera				
Belostomatidae				
Belostoma sp.	9.5	**P**		
Corixidae		**PI**	14	11
Hesperocorixa sp.		**PI**		
Notonectidae				
Notonecta sp.		**P**		
Megaloptera				
Corydalidae		**P**		
Chauliodes rastricornis		**P**	2	
Sialidae		**P**		
Sialis sp.	7	**P**		2
Trichoptera				
Hydropsychidae		**FC**		
Cheumatopsyche sp.	6.6	**FC**		1
Limnephilidae				
Pycnopsyche sp.	2.5	**SH**		
Coleoptera				
Dytiscidae		**P**		
Neoporus sp.	5			
Thermonectus sp.		**P**		
Hydrophilidae		**P**		
Tropisternus sp.	*9.3*	**P**	1	
Diptera				
Chaboridae				
Chaoborus albatus		**P**		
Chironomidae				
Ablabesmyia mallochi	*7.4*	**P**		4
Chironomus sp.	*9.3*	**CG**	1	1
Conchapelopia sp.	8.4	**P**	1	2
Cryptochironomus sp.	*6.4*	**P**		
Microtendipes pedellus gp.	*3.9*	**CG**		
Natarsia sp.	*9.6*	**P**	2	
Paratendipes albimanus/duplicatus	*5.6*			
Procladius sp.	*8.8*	**P**	5	2
Psectrotanypus dyari	*10*	**P**	16	
Tanytarsus sp.	*6.6*	**FC**		
Zavrelimyia sp.	*8.6*	**P**		2
Culicidae		**FC**		
Anopheles sp.	*8.6*	**FC**		
Culex sp.		**FC**	2	
Psychodidae		**CG**		
TOTAL NO. OF ORGANISMS			**102067**	**102055**
TOTAL NO. OF TAXA			**16**	**14**
EPT INDEX			**0**	**2**
BIOTIC INDEX Assigned Values			**9.38**	**8.03**

Brahma UT 1 up

3/06 Revision 6

Brahma 19-006

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ

TOTAL SCORE 82

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream Brahma UT 1 up Location/road: Nearby (Road Name Clarke) County Alamance

Date 230613 **CC#** 030302 Basin Cape Fear Subbasin 03-06-04

Observer(s) TP LB Type of Study: ☐ Fish ☑ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

Latitude 35.8520 Longitude 79.4084 Ecoregion: ☐ MT ☑ P ☑ Slate Belt ☐ Triassic Basin

Water Quality: Temperature ~ °C DO ~ mg/l Conductivity (corr.) ~ µS/cm pH ~

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: 20 %Forest 5 %Residential 70 %Active Pasture _____% Active Crops
_____%Fallow Fields 5 % Commercial _____%Industrial _____%Other - Describe: _____

Watershed land use : ☑ Forest ☑ Agriculture ☐ Urban ☑ Animal operations upstream chicken houses

Width: (meters) Stream 1-2 Channel (at top of bank) 1 **Stream Depth**: (m) Avg .1 Max ____
☐ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m)_____

Bank Angle: 90 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐ Channelized Ditch
☐ Deeply incised-steep, straight banks ☐ Both banks undercut at bend ☐ Channel filled in with sediment
☐ Recent overbank deposits ☐ Bar development ☐ Buried structures ☐ Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐ Green tinge ☐ Sewage smell
Manmade Stabilization: ☐ N ☑ Y: ☐ Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐ Berm/levee
Flow conditions : ☐ High ☐ Normal ☑ Low
Turbidity: ☐ Clear ☐ Slightly Turbid ☑ Turbid ☐ Tannic ☐ Milky ☐ Colored (from dyes)
Good potential for Wetlands Restoration Project?? ☐ **YES** ☐ **NO Details** Site of stream restoration

Channel Flow Status

Useful especially under abnormal or low flow conditions.

A. Water reaches base of both lower banks, minimal channel substrate exposed	☐
B. Water fills >75% of available channel, or <25% of channel substrate is exposed	☑
C. Water fills 25-75% of available channel, many logs/snags exposed	☐
D. Root mats out of water	☐
E. Very little water in channel, mostly present as standing pools	☐

Weather Conditions: Drf - warm **Photos:** ☐ N ☐ Y ☐ Digital ☐ 35mm

Remarks: _____

VFI UP

I. Channel Modification Score

A. channel natural, frequent bends..... 5
B. channel natural, infrequent bends (channelization could be old)..... 4
C. some channelization present..... 3
D. more extensive channelization, >40% of stream disrupted..... 2
E. no bends, completely channelized or rip rapped or gabioned, etc..... 0

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☐Banks of uniform shape/height
Remarks_____ Subtotal 4

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

✓ **Rocks** ___ **Macrophytes** ✓ **Sticks and leafpacks** ___ **Snags and logs** ✓ **Undercut banks or root mats**

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score	20-40% Score	<20% Score
4 or 5 types present.....	20	16	12	8
3 types present.....	19	(15)	11	7
2 types present.....	18	14	10	6
1 type present.....	17	13	9	5
No types present.....	0			

☐ No woody vegetation in riparian zone Remarks_____ Subtotal 15

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

A. substrate with good mix of gravel, cobble and boulders Score
1. embeddedness <20% (very little sand, usually only behind large boulders)..... 15
2. embeddedness 20-40%..... 12
3. embeddedness 40-80%..... 8
4. embeddedness >80%..... 3

B. substrate gravel and cobble
1. embeddedness <20%..... 14
2. embeddedness 20-40%..... (11)
3. embeddedness 40-80%..... 6
4. embeddedness >80%..... 2

C. substrate mostly gravel
1. embeddedness <50%..... 8
2. embeddedness >50%..... 4

D. substrate homogeneous
1. substrate nearly all bedrock..... 3
2. substrate nearly all sand..... 3
3. substrate nearly all detritus..... 2
4. substrate nearly all silt/ clay..... 1

Remarks_____ Subtotal 11

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

A. Pools present Score
1. Pools Frequent (>30% of 200m area surveyed)
a. variety of pool sizes..... 10
b. pools about the same size (indicates pools filling in)..... 8
2. Pools Infrequent (<30% of the 200m area surveyed)
a. variety of pool sizes..... 6
b. pools about the same size..... 4

B. Pools absent..... 0 6

Subtotal____

☐ Pool bottom boulder-cobble=hard ☐ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth
Remarks_____

Page Total 36

UT, UP

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles **Frequent** Score	Riffles **Infrequent** Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	16	12
B. riffle as wide as stream but riffle length is not 2X stream width	(14)	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☐Typical for area ☐Steep=fast flow ☐Low=like a coastal stream Subtotal 14

VI. Bank Stability and Vegetation

FACE UPSTREAM	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	(7)	(7)
B. Erosion areas present		
1. diverse **trees**, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and **shrubs**; vegetation appears generally healthy.....	5	5
3. sparse **mixed** vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly **grasses**, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0
		Total 14

Remarks _____

VII. Light Penetration Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with **good** canopy with some breaks for light penetration	(10)
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** canopy - sunlight and shading are essentially equal.....	7
D. Stream with **minimal** canopy - full sun in all but a few areas.....	2
E. **No canopy** and no shading.....	0

Remarks _____ Subtotal 10

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM

Dominant vegetation: ☐Trees ☑Shrubs ☐Grasses ☐ Weeds/old field ☐Exotics (kudzu, etc)

	Lft. Bank Score	Rt. Bank Score
A. Riparian zone **intact** (no breaks)		
1. width > 18 meters.....	5	5
2. width 12-18 meters.....	(4)	(4)
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0
		Total 8

Remarks _____

Page Total 46

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 82

3/06 Revision 6

UT, Down

Mrahma 19-006

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ

TOTAL SCORE 82

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream Brahma Location/road: Nevlin (Road Name Clark) County Alamance

Date 6/13/23 **CC#** 03030002 Basin Cape Fear Subbasin 03-06-04

Observer(s) BF DM Type of Study: ☐ Fish ☑ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

Latitude 35.85721 Longitude -79.41177 Ecoregion: ☐ MT ☑ P ☑ Slate Belt ☐ Triassic Basin

Water Quality: Temperature _____ °C DO _____ mg/l Conductivity (corr.) _____ µS/cm pH _____

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: 60 %Forest _____ %Residential 40 %Active Pasture _____ % Active Crops
_____ %Fallow Fields _____ % Commercial _____ %Industrial _____ %Other - Describe: _____

Watershed land use : ☐Forest ☐Agriculture ☐Urban ☐ Animal operations upstream

Width: (meters) Stream 1.5-2 Channel (at top of bank) 2 **Stream Depth:** (m) Avg 0.3 Max 0.6
☒ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 1

Bank Angle: 100 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐ Channelized Ditch
☐Deeply incised-steep, straight banks ☐Both banks undercut at bend ☐Channel filled in with sediment
☐ Recent overbank deposits ☐Bar development ☐Buried structures ☒Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐Green tinge ☐ Sewage smell
Manmade Stabilization: ☑N ☐Y: ☐Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐Berm/levee
Flow conditions : ☐High ☐Normal ☑Low
Turbidity: ☑Clear ☐ Slightly Turbid ☐Turbid ☐Tannic ☐Milky ☐Colored (from dyes) Steam not...
Good potential for Wetlands Restoration Project?? ☒YES ☐NO **Details** _____

Channel Flow Status

Useful especially under abnormal or low flow conditions.

A. Water reaches base of both lower banks, minimal channel substrate exposed	☐
B. Water fills >75% of available channel, or <25% of channel substrate is exposed	☐
C. Water fills 25-75% of available channel, many logs/snags exposed	☑
D. Root mats out of water	☐
E. Very little water in channel, mostly present as standing pools	☐

Weather Conditions: 71° Sunny **Photos:** ☐N ☑Y ☐ Digital ☐35mm

Remarks: _____

I. Channel Modification

	Score
A. channel natural, frequent bends	(5)
B. channel natural, infrequent bends (channelization could be old)	4
C. some channelization present	3
D. more extensive channelization, >40% of stream disrupted	2
E. no bends, completely channelized or rip rapped or gabioned, etc	0

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☐Banks of uniform shape/height

Remarks _____ Subtotal 5

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

A Rocks R Macrophytes R Sticks and leafpacks R Snags and logs R Undercut banks or root mats

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score	20-40% Score	<20% Score
4 or 5 types present	20	16	12	8
3 types present	19	15	11	7
2 types present	18	14	10	6
1 type present	17	(13)	9	5
No types present	0			

☐ No woody vegetation in riparian zone Remarks _____ Subtotal 13

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

	Score
A. substrate with good mix of gravel, cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	12
3. embeddedness 40-80%	(8)
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	11
3. embeddedness 40-80%	6
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	8
2. embeddedness >50%	4
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Remarks _____ Subtotal 8

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

	Score
A. Pools present	
1. Pools Frequent (>30% of 200m area surveyed)	
a. variety of pool sizes	(10)
b. pools about the same size (indicates pools filling in)	8
2. Pools Infrequent (<30% of the 200m area surveyed)	
a. variety of pool sizes	6
b. pools about the same size	4
B. Pools absent	0

Subtotal 10

☒ Pool bottom boulder-cobble=hard ☐ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth

Remarks _____

Page Total 34

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles **Frequent** Score	Riffles **Infrequent** Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	16	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☐Typical for area ☐Steep=fast flow ☐Low=like a coastal stream Subtotal 14

VI. Bank Stability and Vegetation

FACE UPSTREAM	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	7	0
B. Erosion areas present		
1. diverse **trees**, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and **shrubs**; vegetation appears generally healthy.....	5	5
3. sparse **mixed** vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly **grasses**, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0
		Total 14

Remarks _____

VII. Light Penetration Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with **good** canopy with some breaks for light penetration	10
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** canopy - sunlight and shading are essentially equal.....	7
D. Stream with **minimal** canopy - full sun in all but a few areas.....	2
E. **No canopy** and no shading.....	0

Remarks _____ Subtotal 10

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM	Lft. Bank Score	Rt. Bank Score
Dominant vegetation: ☑ Trees ☑ Shrubs ☐ Grasses ☐ Weeds/old field ☐ Exotics (kudzu, etc)		
A. Riparian zone **intact** (no breaks)		
1. width > 18 meters.....	5	5
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0
		Total 6

Remarks _____

Page Total 46

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 92

Appendix G
MY3 Photo Log

Brahma
MY-03 (2023) Photo Log

Photo 1: Enhancement (Level I) on UT1

Photo 2: Enhancement (Level II) on UT2

Brahma
MY-03 (2023) Photo Log

Photo 3: UT-1 Northernmost Piped Crossing – Upstream End

Photo 4: UT-1 Northernmost Piped Crossing – Downstream End

Brahma
MY-03 (2023) Photo Log

Photo 5: UT-1 Piped Crossing North of UT-4 – Upstream End

Photo 6: UT-1 Piped Crossing North of UT-4 – Downstream End

Brahma
MY-03 (2023) Photo Log

Photo 7: UT-1 Road Crossing Piped Crossing – Upstream End

Photo 8: UT-1 Road Crossing Piped Crossing – Downstream End

Brahma
MY-03 (2023) Photo Log

Photo 9: UT-1 Southernmost Piped Crossing – Upstream End

Photo 10: UT-1 Southernmost Piped Crossing – Downstream End

Brahma
MY-03 (2023) Photo Log

Photo 11: UT-2 Piped Crossing – Upstream End

Photo 12: UT-2 Piped Crossing – Downstream End

Brahma
MY-03 (2023) Photo Log

Photo 13: UT-5 Piped Crossing – Upstream End

Photo 14: UT-5 Piped Crossing – Downstream End

Brahma
MY-03 (2023) Photo Log

Photo 15: Bud Burst of Carpinus caroliniana
Photo Taken 2/28/23

Photo 16: Bud Burst of Ulmus americana
Photo Taken 2/28/23

Brahma
MY-03 (2023) Photo Log

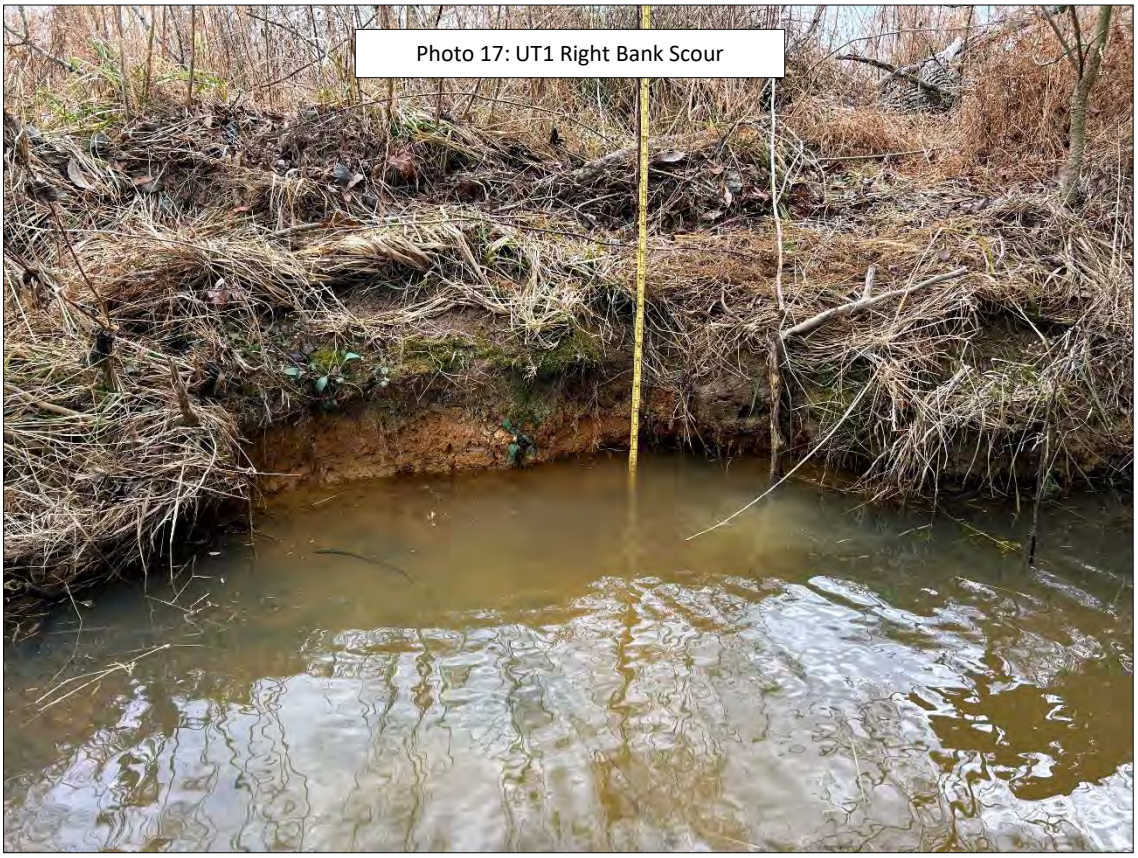


Photo 17: UT1 Right Bank Scour

Photo 18: UT1 Right Bank Scour – live stakes

Appendix H
Soil Report

Predictive

Soil Report

Mehlich-3 Extraction

Links to Helpful Information

Client: Matthew Harrell
1101 Haynes Street Suite 211
Raleigh, NC 27603

Sampled County : Alamance

Client ID: 524468

Advisor:

Advisor ID:

Sampled: 02/07/2023 **Received:** 02/08/2023 **Completed:** 03/03/2023 **Farm:** Brahma

Sample ID: CVS17

Lime History:

Recommendations: Crop	Lime (tons/acre)	Nutrients (lb/acre) N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B	More Information
1 - Hardwood, E	0.5	0	0	50	0			0	0	0	Note: 11
2 -	0.0										

Test Results [units - W/V in g/cm^3; CEC and Na in meq/100 cm^3; NO_3-N in mg/dm^3]: **Soil Class:** Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.36	0.91	7.0	72	1.9	5.1	62	32	50	20	36	223			190	190	121	0.2	3		

Sample ID: CVS12

Lime History:

Recommendations: Crop	Lime (tons/acre)	Nutrients (lb/acre) N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B	More Information
1 - Hardwood, E	0.0	0	0	50	0			0	0	0	Note: 11
2 -	0.0										

Test Results [units - W/V in g/cm^3; CEC and Na in meq/100 cm^3; NO_3-N in mg/dm^3]: **Soil Class:** Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.27	0.97	5.6	76	1.4	5.5	113	33	58	15	36	142			158	158	119	0.1	2		

Reprogramming of the laboratory-information-management system that makes this report possible is being funded through a grant from the North Carolina Tobacco Trust Fund Commission.

Thank you for using agronomic services to manage nutrients and safeguard environmental quality.

- *Steve Troxler, Commissioner of Agriculture*

Sample ID: CVS16

Lime History:

Recommendations: Crop	Lime (tons/acre)	Nutrients (lb/acre) N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B	More Information
1 - Hardwood, E	0.4	0	0	40	0			0	0	0	Note: 11
2 -	0.0										

Test Results [units - W/V in g/cm^3; CEC and Na in meq/100 cm^3; NO_3-N in mg/dm^3]: **Soil Class:** Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.27	0.86	7.2	74	1.9	5.2	114	39	54	17	45	299			242	242	131	0.2	3		

Sample ID: P3P4C

Lime History:

Recommendations: Crop	Lime (tons/acre)	Nutrients (lb/acre) N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B	More Information
1 - Hardwood, E	0.3	0	0	20	0			0	0	0	Note: 11
2 -	0.0										

Test Results [units - W/V in g/cm^3; CEC and Na in meq/100 cm^3; NO_3-N in mg/dm^3]: **Soil Class:** Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.36	0.94	7.9	77	1.8	5.3	66	58	54	19	59	292			165	165	128	0.2	3		

Understanding the Soil Report: explanation of measurements, abbreviations and units

Recommendations

Lime

If testing finds that soil pH is too low for the crop(s) indicated, a ***lime recommendation*** will be given in units of either ton/acre or lb/1000 sq ft. For best results, mix the lime into the top 6 to 8 inches of soil several months before planting. For no-till or established plantings where this is not possible, apply no more than 1 to 1.5 ton/acre (50 lb/1000 sq ft) at one time, even if the report recommends more. You can apply the rest in similar increments every six months until the full rate is applied. If MG is recommended and lime is needed, use dolomitric lime.

Fertilizer

Recommendations ***for field crops or other large areas*** are listed separately for each nutrient to be added (in units of lb/acre unless otherwise specified). Recommendations for N (and sometimes for B) are based on research/field studies for the crop being grown, not on soil test results. K-I and P-I values are based on test results and should be > 50. If they are not, follow the fertilizer recommendations given. If Mg is needed and no lime is recommended, 0-0-22 (11.5% Mg) is an excellent source; 175 to 250 lb per acre alone or in a fertilizer blend will usually satisfy crop needs, SS-I levels appear only on reports for greenhouse soil or problem samples.

Farmers and other commercial producers should pay special attention to ***micronutrient levels***. If *$*, *pH$*, *$pH*, *C* or *Z* notations appear on the soil report, refer to *$Note: Secondary Nutrients and Micronutrients*. In general, homeowners do not need to be concerned about micronutrients. Various crop notes also address lime fertilizer needs; visit ncagr.gov/agronomi/pubs.htm.

Recommendations ***for small areas, such as home lawns/gardens,*** are listed in units of lb/1000 sq ft . If you cannot find the exact fertilizer grade recommended on the report, visit *www.ncagr.gov/agronomi/obpart4.htm#fs* to find information that may help you choose a comparable alternate. For more information, read *A Homeowner's Guide to Fertilizer.*

Test Results

The first seven values [soil class, HM%, W/V, CEC, BS%, Ac and pH] describe the soil and its degree of acidity. The remaining 16 [P-I, K-I, Ca%, Mg%, Mn-I, Mn-AI1, Mn-AI2, Zn-I, Zn-AI, Cu-I, S-I, SS-I, Na, ESP, SS-I, NO_3-N (not routinely available)] indicate levels of plant nutrients or other fertility measurement. Visit *www.ncagr.gov/agronomi/uyrst.htm*

Report Abbreviations

Ac	exchangeable acidity
B	boron
BS%	% CEC occupied by basic cations
Ca%	% CEC occupied by calcium
CEC	cation exchange capacity
Cu-I	copper index
ESP	exchangeable sodium percent
HM%	percent humic matter
K-I	potassium index
K_2O	potash
Mg%	% CEC occupied by magnesium
MIN	mineral soil class
Mn	manganese
Mn-AI1	Mn-availability index for crop 1
Mn-AI2	Mn-availability index for crop 2
Mn-I	manganese index
M-O	mineral-organic soil class
N	nitrogen
Na	sodium
NO_3-N	nitrate nitrogen
ORG	organic soil class
pH	current soil pH
P-I	phosphorus index
P_2O_5	phosphate
S-I	sulfur index
SS-I	soluble salt index
W/V	weight per volume
Zn-AI	zinc availability index
Zn-I	zinc index