MY0 FINAL MONITORING REPORT

CRANE STREAM AND WETLAND MITIGATION SITE

Lee County, North Carolina
Cape Fear River Basin
Cataloging Unit 03030004

DMS Project No. 100165
Full Delivery Contract No. 0302-01
DMS RFP No. 16-20190302 (issued 12/20/2019)
USACE Action ID No. SAW-2020-01401
DWR Project No. 20201292

Data Collection: December 2022-February 2023
Submission: April 2023

Prepared for:

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

Mitigation Services
ENVIRONMENTAL QUALITY

Restoration Systems, LLC
1101 Haynes St. Suite 211
Raleigh, North Carolina
Ph: (919) 755-9490
Fx: (919) 755-9492

Response to DMS Comments
DMS Project ID No. 100165
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DMS Comments Received (Black Text) & Responses (Blue Text)

1. Title Page(s) – The RFP date of issue is incorrect. Please correct to 12/20/2019 or omit the issue date completely.
   The RFP issue date was corrected.

2. Section 1.1 – 2nd paragraph states site design was completed in February 2023. This should presumably be 2022.
   The site design completion date was corrected.

3. Table 1 – All original mit plan stream lengths and as-built stream lengths are identical. Please report the actual surveyed lengths in the as-built column.
   Table was revised to include the surveyed as-built stream lengths.

4. Table 2 – The report is generally using the latest DMS monitoring report template tables. For consistency, please update Table 2 with the latest version of the table. Updating Table 2 would make Section 1.2 and Table C redundant, and those sections could be removed.
   Table 2 was updated to the latest DMS template, and Section 1.2 (Table A) and Table C were removed.

5. Section 4.0 – For the MY0 report, it would be useful to discuss or list construction deviations (red lines) here, i.e, the vane arm not constructed and the change to seed mix.
   Construction deviation discussions were added to this section- stream deviation (omitted vane arm) in Section 4.1 and seed mix changes in section 4.3.

6. Were 1m x 1m herbaceous plots proposed in the mit plan completed, or will those begin with MY1?
   As-built monitoring was performed in February, just after the Site was planted, before significant herbaceous vegetation had established. Herbaceous plots will be surveyed beginning in MY1.

7. Figure 1 – Please differentiate purpose of stream gauges, i.e., crest gauge vs. flow gauge.
   Figure 1 was updated to differentiate crest gauges from flow gauges.

8. Appendix C – Recommend removing BHR calculation from pool cross sections.
   BHR calculation was removed from all pool cross-sections.

As-Built/Record Drawings:

9. Sheet C5.00 – Please verify whether the riffle at UT1 Sta. 6+94 was surveyed. If not, please survey constructed riffles in the future.
   Constructed riffles will be surveyed moving forward- we apologize for missing this one.

10. Please add in-stream crest and flow gauges to the drawings if they were surveyed (one is shown on Sheet C5.12, but not on any others).
    Stream gauges are shown in the revised 5/2/23 as-built drawings.

11. Sheet C5.04 & Sheet L2.01 – Gravel access path and bridge are called out in red text. Was this a construction deviation, and if so, what was the deviation? If not, recommend calling out in black.
    Callouts have been modified to appear black on paper.

Site Visit:

12. A small area along the fence line on the left side of the UT1 EII area may not have been planted. Please verify.
    This area was checked and has been planted.

13. Ditch above start of UT3 is still very deep, and there is concern about its effect on the adjacent re-establishment wetlands.
    The short section of ditch that remains open is expected to fill with organic material as the site matures and serve as a headwater feature for the surrounding wetlands to the restored stream. This wetland headwater stream transition is observed in the sandhills ecoregion where surrounding wetlands discharge along the toe of slope to headwater forest wetlands found at stream origins. As observed in reference conditions this type of complex maintains wetland hydrology as hydrology discharges at the soil surface along the edges of the depressional feature.

    We understand the concern for potential effects to adjacent wetland re-establishment assets. Given this type of complex in this ecoregion we propose to visually monitor the area for three years (MY1-3) to evaluate any potential effects to adjacent wetland assets. Annual visual monitoring of this area will include 4 fixed photo points of the ditch and surrounding area to document developments. During MY3 a delineation of the area including a minimum of three wetland delineation forms will be performed to identify any potential areas not meeting wetland re-establishment requirements.

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Prepared by:

Restoration Systems, LLC
1101 Haynes Street, Suite 211
Raleigh, North Carolina 27604
Contact: Raymond Holz
919-755-9490 (phone)
919-755-9492 (fax)

And

Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, North Carolina 27603
Contact: Grant Lewis
919-215-1693 (phone)

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1 PROJECT SUMMARY

Restoration Systems, LLC has established the North Carolina Division of Mitigation Services (NCDMS) Crane Stream and Wetland Mitigation Site (Site). The Site is on three land parcels along unnamed tributaries to Little Crane Creek in the Sandhills Ecoregion of North Carolina. Located in the Cape Fear River Basin, cataloging unit 03030004, the Site is in the Targeted Local Watershed (TLW) 03030004070010 and North Carolina Division of Water Resources (NCDWR) subbasin number 03-06-14. The Site is located within a Local Watershed Plan (LWP), Hydrology Targeted Resource Area (TRA), and Water Quality TRA due to modifications/stressors in the watershed. Site hydrology drains to unnamed tributaries and into Little Crane Creek (Stream Index Number 18-23-16-4), assigned a Best Usage Classification of WS-III (NCDWR 2021). Little Crane Creek is not listed on the NCDENR draft 2018 or final 2016 303(d) lists (NCDEQ 2018a, NCDEQ 2018b). Site watershed sizes range from approximately 0.02 square miles (12.2 acres) on UT3 to 0.15 square miles (97.5 acres) on UT 1 at the outfall.

1.1 Project Background, Components, and Structure

Located approximately 2 miles southwest of Lemon Springs, 8 miles southwest of Sanford, NC, and west of Rocky Fork Church Road (SR 1179) in Lee County, the Site encompasses 27.7 acres. Mitigation work within the Site included 1) stream restoration, 2) stream enhancement (Level II), 3) wetland reestablishment, 4) wetland rehabilitation, 5) wetland enhancement, and 6) vegetation planting. The Site is expected to provide 3,533 Stream Mitigation Units (SMUs) and 14.593 Riparian Wetland Mitigation Units (WMUs) by closeout (Table 1, Page 2). A conservation easement was granted to the State of North Carolina and recorded at the Lee County Register of Deeds on June 22, 2021.

Before construction, land use at the Site was characterized by livestock pasture and disturbed forest. Site design was completed in February 2022. Construction started on June 6, 2022 and ended within a final walkthrough on July 15, 2022. The Site was planted on February 3, 2023. Completed project activities, reporting history, completion dates, and project contacts are summarized in Tables 11-12 (Appendix E).

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Table 1. Crane Mitigation Site (ID-100165) 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 1, Reach 1	694	694	Warm	EII	2.5	237.600	Straight-line valley length used for credit calculation at request of IRT
UT 1, Reach 2 (above crossing)	1335	1330	Warm	R	1.0	1335.000	60 foot easement break for crossing
UT 1, Reach 2 (below crossing)	267	265	Warm	R	1.0	267.000	
UT 1, Reach 3	232	233	Warm	EII	2.5	93.200	
UT 2, Reach 1	437	425	Warm	R	1.0	437.000	
UT 2, Reach 2	88	88	Warm	EII	2.5	35.200	
UT 3	463	451	Warm	R	1.0	463.000	
UT 4	422	414	Warm	R	1.0	422.000	
UT 5	243	241	Warm	R	1.0	243.000	
					Total:	**3533.000**	
Wetland							
Wetland Reestablishment	8.815	8.815	R	REE	1.00000	8.815	
Wetland Rehabilitation	0.683	0.683	R	RH	1.50000	0.455	
Wetland Enhancement	10.646	10.646	R	E	2.00000	5.323	
					Total:	**14.593**	

Project Credits

	Stream			Riparian	Non-Rip	Coastal
Restoration Level	Warm	Cool	Cold	Wetland	Wetland	Marsh
Restoration	3167.000	0.000	0.000	0.000	0.000	0.000
Re-establishment				8.815	0.000	0.000
Rehabilitation				0.455	0.000	0.000
Enhancement				5.323	0.000	0.000
Enhancement I	0.000	0.000	0.000			
Enhancement II	366.000	0.000	0.000			
Creation				0.000	0.000	0.000
Preservation	0.000	0.000	0.000	0.000	0.000	
Totals	**3,533.000**	**0.000**	**0.000**	**14.593**	**0.000**	**0.000**

Total Stream Credit **3,533.000**
Total Wetland Credit **14.593**

Wetland Mitigation Category

CM	Coastal Marsh
R	Riparian
NR	Non-Riparian

Restoration Level

P	Preservation
E	Wetland Enhancement
EII	Stream Enhancement II
EI	Stream Enhancement I
C	Wetland Creation
RH	Wetland Rehabilitation
REE	Wetland Re-establishment
R	Restoration

Table 2: Summary: Goals, Performance and Results

Goal	Objective/Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime.	Reconstruct stream channels with appropriate bankfull dimensions and depth relative to the existing floodplain. Remove overburden to reconnect with adjacent wetlands.	Dispersion of high flows on the floodplain, an increase in biogeochemical cycling within the system, and recharging of riparian wetlands.	• The stream 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.	2 crest gauges (pressure transducers) on UT1 and UT2, and documentation of visual/physical evidence of bankfull events	To be determined
Improve stability of stream channels.	Construct stream channels that will maintain stable cross-sections, patterns, and profiles over time.	Reduction in sediment inputs from bank erosion, reduction of shear stress, and improved overall hydraulic function.	• All streams must maintain an Ordinary High-Water Mark (OHWM), per RGL 05-05. • Bank height ratio (BHR) cannot exceed 1.2 at any measured cross-section. • BHR at any measure riffle cross-section should not change by more than 10% from baseline condition during any given monitoring period. • Intermittent streams will demonstrate at least 30-days consecutive flow annually.	Total of 16 cross-sections on restored channels and surface flow gauges on UT2, UT3, UT4, and UT5.	Site streams are stable, functioning as designed, and stream measurements are within design parameters.
Restore and enhance native floodplain and streambank vegetation.	Plant native tree and understory species in riparian zones and plant appropriate species on streambanks.	Reduction in floodplain sediment inputs from runoff, increased bank stability, increased LWD and organic material in streams, increased	• 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. Natural recruits can only be counted toward success after they have been in the ground for 2 years. • Areas of herbaceous vegetation establishment will have a minimum of four species present.	17 permenant vegetation plots, 6 random vegetation plots, and 3 random herbaceous plots spread across the Site	All plots meeting performance criteria during MY0. Herbaceous plots will be surveyed beginning MY1 to allow time for herbaceous vegetation to establish.
Restore and enhance groundwater hydrology to drained or impacted hydric soil areas.	Reduce channel depth in incised stream reaches, fill drainage ditches, and alleviate soil compaction from agriculture activities.	Particulate and pollution conversion, groundwater storage and reduced downstream flooding, habitat diversification, and vegetative composition conversion.	• Annual 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.	15 groundwater gauges spread throughout restored wetlands	To be determined

Note: Onsite rain data will be collected throughout each monitoring period.

Table 3. Project Attribute Table					
Project Name	Crane Mitigation Site				
County	Lee County, North Carolina				
Project Area (acres)	27.66				
Project Coordinates (latitude and longitude decimal degrees)	35.367351ºN, 79.222369ºW				
Project Watershed Summary Information					
Physiographic Province	Sand Hills				
River Basin	Cape Fear				
USGS Hydrologic Unit 14-digit	3030004070010				
NCDWR Sub-basin	03-06-14				
Project Drainage Area (acres)	120.1				
Project Drainage Area Percentage of Impervious Area	<2%				
Land Use Classification	Managed Herbaceous Cover & Hardwood Swamps				
Reach Summary Information					
Parameters	**UT 1**	**UT 2**	**UT 3**	**UT4**	**UT5**
Pre-project length of reach (linear feet)	2170	489	345	373	319
Post-project length of reach (linear feet)	2429	525	463	421	243
Valley Classification & Confinement	Rosgen Type VIII and III	Rosgen Type VIII and III	Rosgen Type VIII	Rosgen Type VIII	Rosgen Type VIII
Drainage Area (acres)	97.5	22.6	12.2	13.2	47.4
Perennial, Intermittent, Ephemeral	Perennial	Intermittent	Intermittent	Intermittent	Intermittent/Perennial
NCDWR Water Quality Classification	WS III				
Existing Morphological Description (Rosgen 1996)	Eg 5	G 5	Eg 5	Eg 5	Ge 5
Proposed Morphological Description (Rosgen 1996)	Ce 5	Ce 5	Ce 5	Ce 5	Ce 5
Existing Evolutionary Stage (Simon and Hupp 1986)	III/IV	IV	IV	II/III	IV
Wetland Summary Information					
Parameters	**Wetlands**				
Pre-project (acres)	11.330				
Post-project (acres)	20.146				
Wetland Type (non-riparian, riparian)	Riparian riverine				
Mapped Soil Series	Wehadkee				
Hydric Soil Status	Hydric				
Regulatory Considerations					
Parameters	**Applicable?**	**Resolved?**	**Supporting Docs?**		
Water of the United States - Section 401	Yes	Yes	Section 401 Certification		
Water of the United States - Section 404	Yes	Yes	Section 404 Permit		
Endangered Species Act	Yes	Yes	CE Document		
Historic Preservation Act	Yes	Yes	CE Document		
Coastal Zone Management Act (CZMA or CAMA)	No	--	NA		
FEMA Floodplain Compliance	Yes	Yes	FEMA Mapping		
Essential Fisheries Habitat	No	--	NA		

2 AS-BUILT CONDITION (BASELINE)

Construction started on June 6, 2022 and ended within a final walkthrough on July 15, 2022. The Site was planted on February 3, 2023. As-built and MY0 data collection occurred between January 2023 and February 2023.

In general, no significant issues arose during the construction of the Site. A sealed half-size set of record drawings are provided in Appendix F, which includes the post-construction survey, alignments, structures, and monitoring features. These include redlines for any significant field adjustments made during construction that differ from the design plans.

Additional activities that occurred at the Site included the following.

- Planting 26.2 acres of the Site with 23,550 stems on February 3, 2023 – planted species are included in Table 6A (Appendix B).
- Applying seed mix across the Site. A species list is included in Table 6B (Appendix B).

3 PROJECT MONITORING – 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 31st of each monitoring year data is collected. The monitoring schedule is summarized in the following table.

Table A. 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
Visual Assessment	X	X	X	X	X	X	X
Report Submittal	X	X	X	X	X	X	X

3.1 Monitoring

The monitoring parameters are summarized in Table 2.

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4 MONITORING YEAR 0 – DATA ASSESSMENT

Annual monitoring and site visits were conducted between October 2022 and February 2023 to assess the condition of the project. Stream, wetland, and vegetation criteria for the Site follow the approved success criteria presented in the Mitigation Plan and summarized in Section 1.2; monitoring methods are detailed in Section 3.0.

4.1 Stream Assessment

Morphological surveys for MY0 were conducted on January 26, 2023. All streams within the Site are stable and functioning as designed. Refer to Appendix A for the Visual Stream Morphology Stability Assessment Table and Stream Photographs. Refer to Appendix C for Stream Geomorphology Data. No stream areas of concern were identified during MY0.

One field adjustment was made during construction that differs from the design plans. A vane arm was not constructed on a cross vane on UT 1 at the confluence with UT 5. The vane arm would have extended into the UT 5 streambed, and it was determined in the field to be unnecessary (Sheet C5.02, Appendix F).

4.2 Hydrology Assessment

15 groundwater monitoring gauges were installed throughout the Site's wetlands. Hydrologic data will be collected and reported during MY1 (2023).

4.3 Vegetative Assessment

The MY0 vegetative survey was completed on February 8, 2023. Vegetation monitoring resulted in a sitewide stem density average of 600 planted stems per acre, above the interim requirement of 320 stems per acre required at MY3. All 23 vegetation plots, including 17 fixed vegetation plots and 6 temporary vegetation plots, met the interim success criteria. Please refer to Appendix A for Vegetation Plot Photographs and the Vegetation Condition Assessment Table, and Appendix B for Vegetation Plot Data. No vegetation areas of concern were identified during MY0.

All twenty planted species were included in the approved Mitigation Plan planting list. Species approved in the Mitigation Plan were selected based on Reference Forest Ecosystem (RFE) data, on-site observations, and community descriptions from Classification of the Natural Communities of North Carolina (Schafale and Weakley 2012) – Coastal Plain Bottomland Hardwood Forest. Table 6A (Appendix B) summarizes planted species and their individual quantities in total.

Several changes were made to the Site seed mixes based on seed availability at the time of construction. Grain Rye (*Secale cereale*) was omitted from the temporary seed mix, and Brown Top Millet (*Urochloa ramosa*) was applied site-wide instead. In the permanent seed mix, *Agrostis perennans*, *Carex vulpinoidea*, *Eupatorium coelestinum*, *Eupatorium perfoliatum*, *Juncus effusus*, *Juncus tenuis*, and *Lespedeza capitata* were omitted and replaced with equivalent quantities of *Eupatorium fistulosum*, *Panicum dichotomiflorum*, *Panicum rigidulum*, and *Pycnanthemum tenuifolium*. See sheet L5.01 (Appendix F) for details regarding as-built seed mixes.

4.4 Monitoring Year 0 Summary

Overall, the Site looks good, is performing as intended, and is on track to meet success criteria. All vegetation plots are on track to exceed the MY3 interim requirement of 320 planted stems per acre, and all streams within the Site are stable and are meeting project goals.

5 REFERENCES

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.

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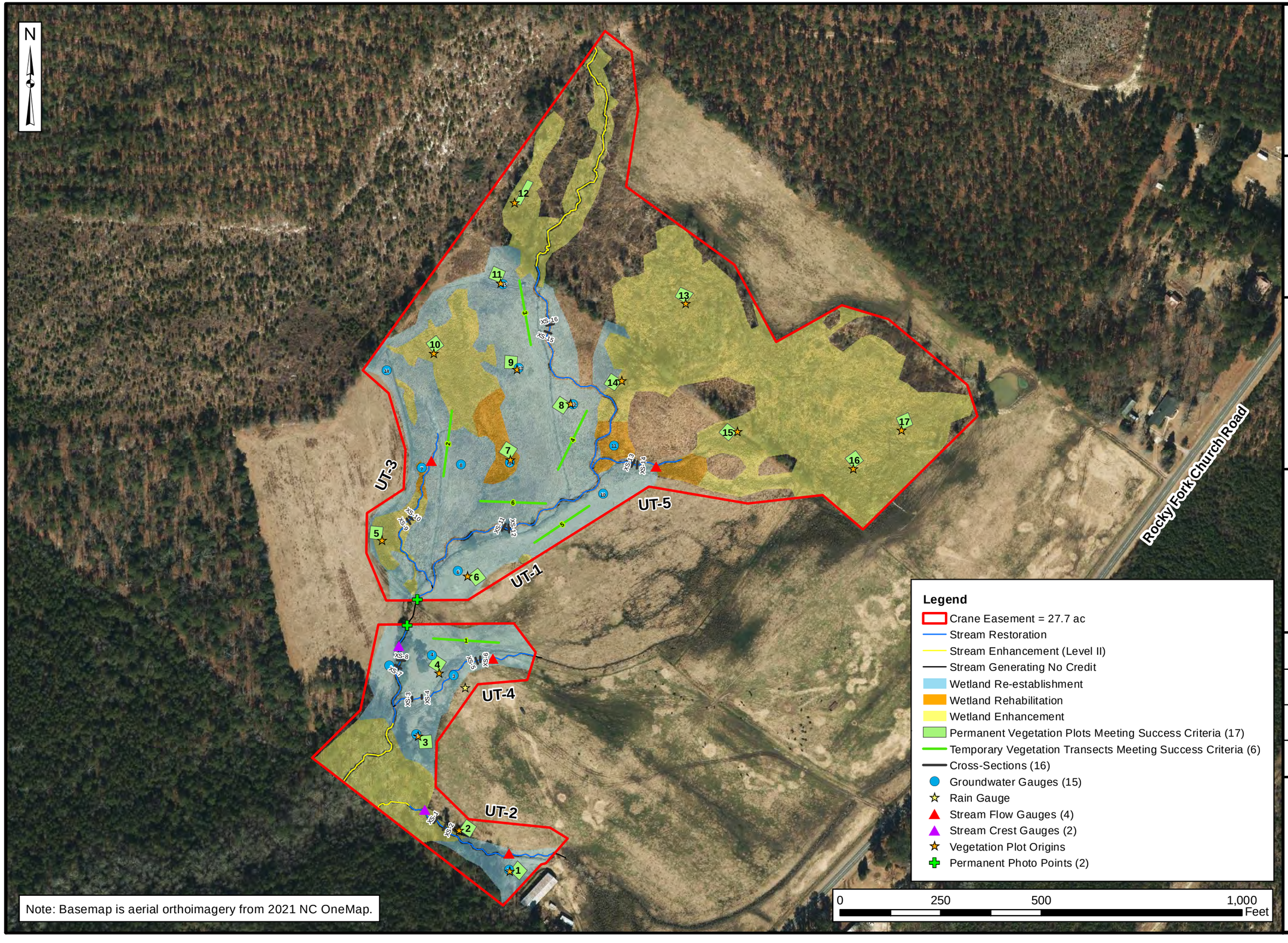
North Carolina Wetland Functional Assessment Team. (NC WFAT 2010). N.C. Wetland Assessment Method (NC WAM) User Manual. Version 4.1.

Schafale, M.P. and A.S. Weakley. 2012. Classification of the Natural Communities of North Carolina: Fourth Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, North Carolina Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

Appendix A: Visual Assessment Data

Figure 1. Current Conditions Plan View
Table 4A-E. Visual Stream Morphology Stability Assessment Table
Table 5. Visual Vegetation Condition Assessment Table
Vegetation Plot Photographs
Photo Log



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

CRANE MITIGATION SITE

Lee County, NC

Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by: BEF

Date: APR 2023

Scale: 1:2700

Project No.: 20-032

FIGURE

1

Table 4A. Visual Stream Stability Assessment

Reach UT 1, Reach 2

Assessed Stream Length 1602

Assessed Bank Length 3204

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.	35	35		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)	35	35		100%

Table 4B. Visual Stream Stability Assessment

Reach UT 2, Reach 1

Assessed Stream Length 437

Assessed Bank Length 874

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 4C. Visual Stream Stability Assessment

Reach UT 3

Assessed Stream Length 480

Assessed Bank Length 960

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.	22	22		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)	22	22		100%

Table 4D. Visual Stream Stability Assessment

Reach	UT 4
Assessed Stream Length	427
Assessed Bank Length	854

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.	14	14		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)	14	14		100%

Table 4E. Visual Stream Stability Assessment

Reach UT 5

Assessed Stream Length 248

Assessed Bank Length 496

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 5. Visual Vegetation Assessment

Planted acreage **26.2**

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 **27.66**

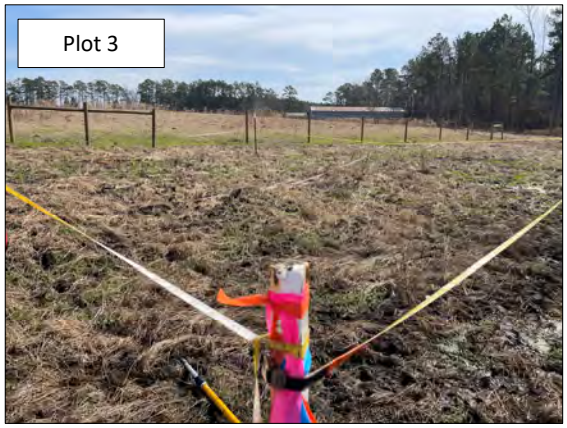
Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Invasives may occur outside of planted areas and within the easement and will therefore be calculated against the total easement acreage. Include species with the potential to directly outcompete 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	0 Encroachments noted	

Crane Mitigation Site
MY0 (2023) Vegetation Monitoring Photographs (taken February 8, 2023)

Plot 1

Plot 2

Plot 3



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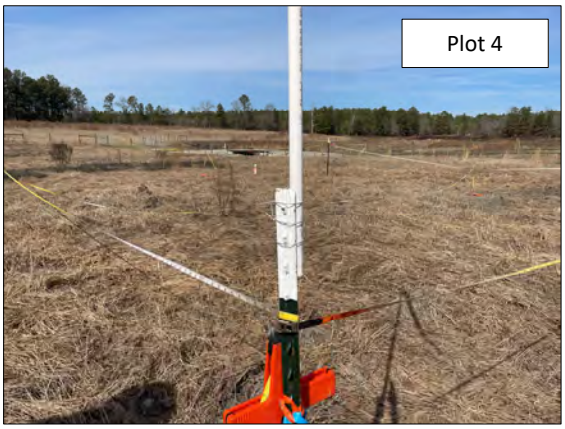

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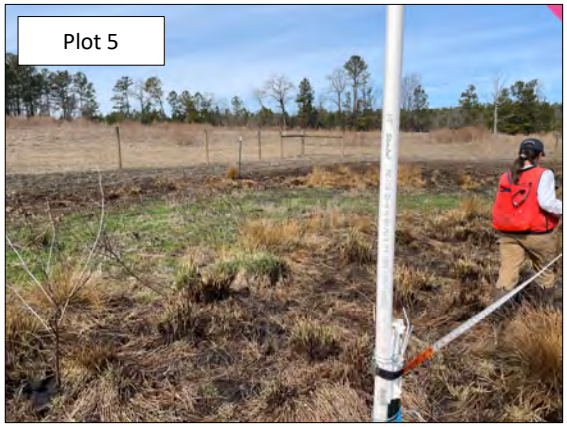

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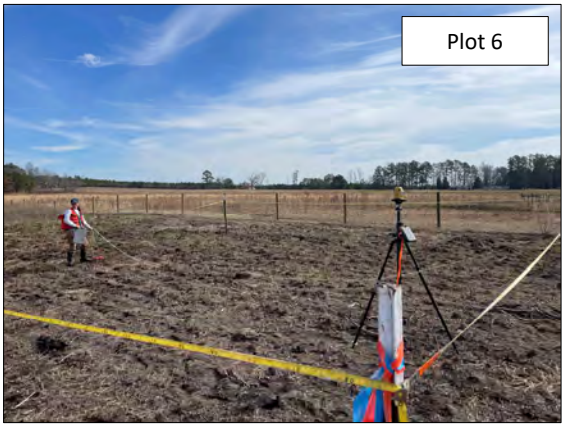

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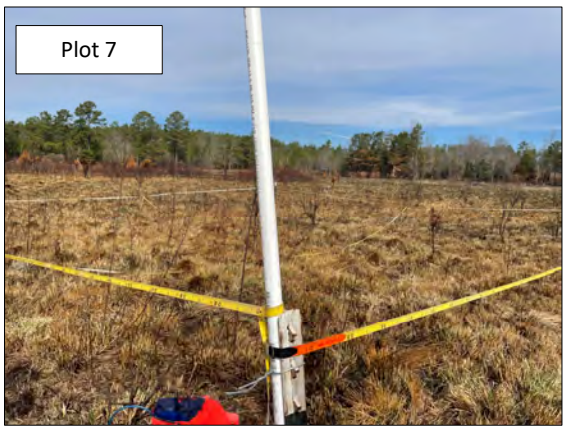
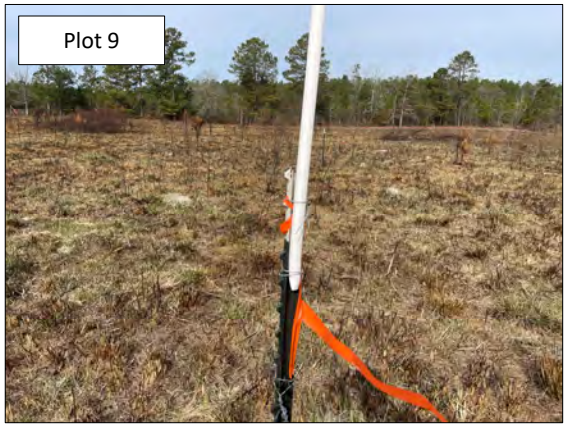
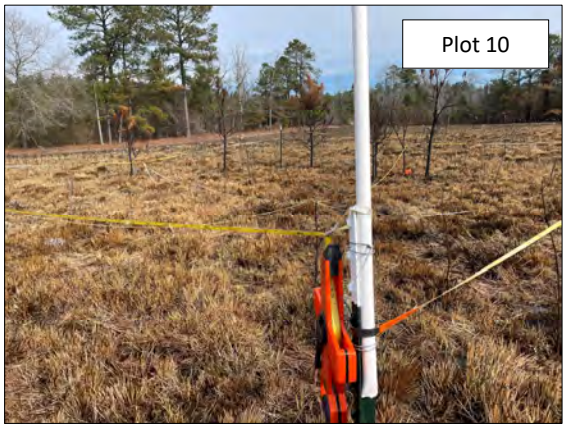
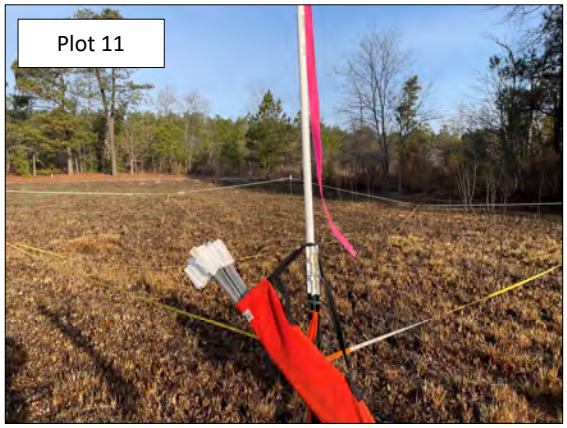


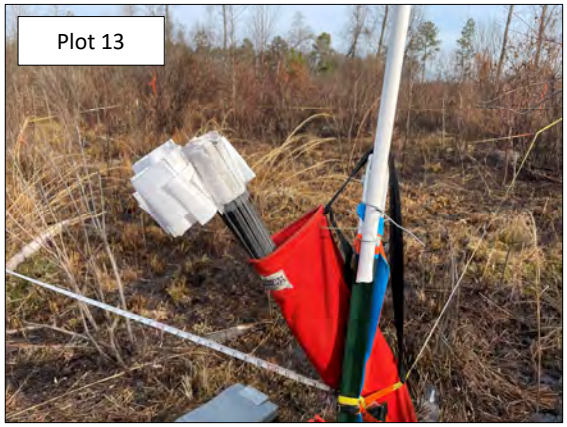
Plot 8

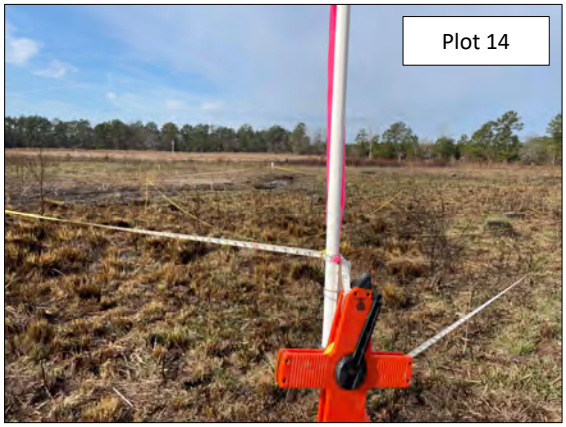
Crane Mitigation Site
MY0 (2023) Vegetation Monitoring Photographs (taken February 8, 2023)

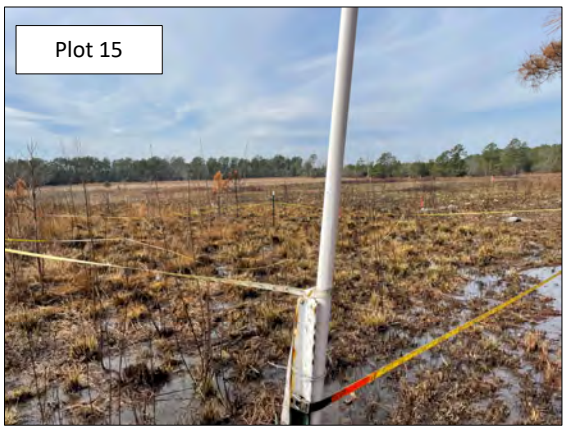


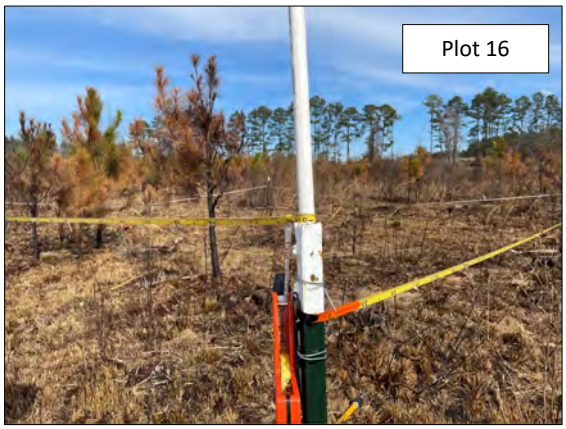












Crane Mitigation Site
MY0 (2023) Vegetation Monitoring Photographs (taken February 8, 2023)

Crane Mitigation Site
As-Built (2023) Photo Log

Photo 1: CCPV Permanent Photo Point 1
UT 1 Crossing, facing upstream

Photo 2: CCPV Permanent Photo Point 2
UT 1 Crossing, facing downstream

Crane Mitigation Site
As-Built (2023) Photo Log

Photo 3: Easement Fencing

Photo 4: West of GW-10 facing East within the easement

Crane Mitigation Site
As-Built (2023) Photo Log

Photo 5: UT-1 facing North

Photo 6: UT-2 facing West

Crane Mitigation Site
As-Built (2023) Photo Log

Photo 7: UT-2 facing Southeast

Photo 8: Wetland GA near UT-2 and UT-4 confluence

Crane Mitigation Site
As-Built (2023) Photo Log

Photo 9: UT-4 facing South

Photo 10: UT-3 facing South

Crane Mitigation Site
As-Built (2023) Photo Log

Photo 11: GW-8

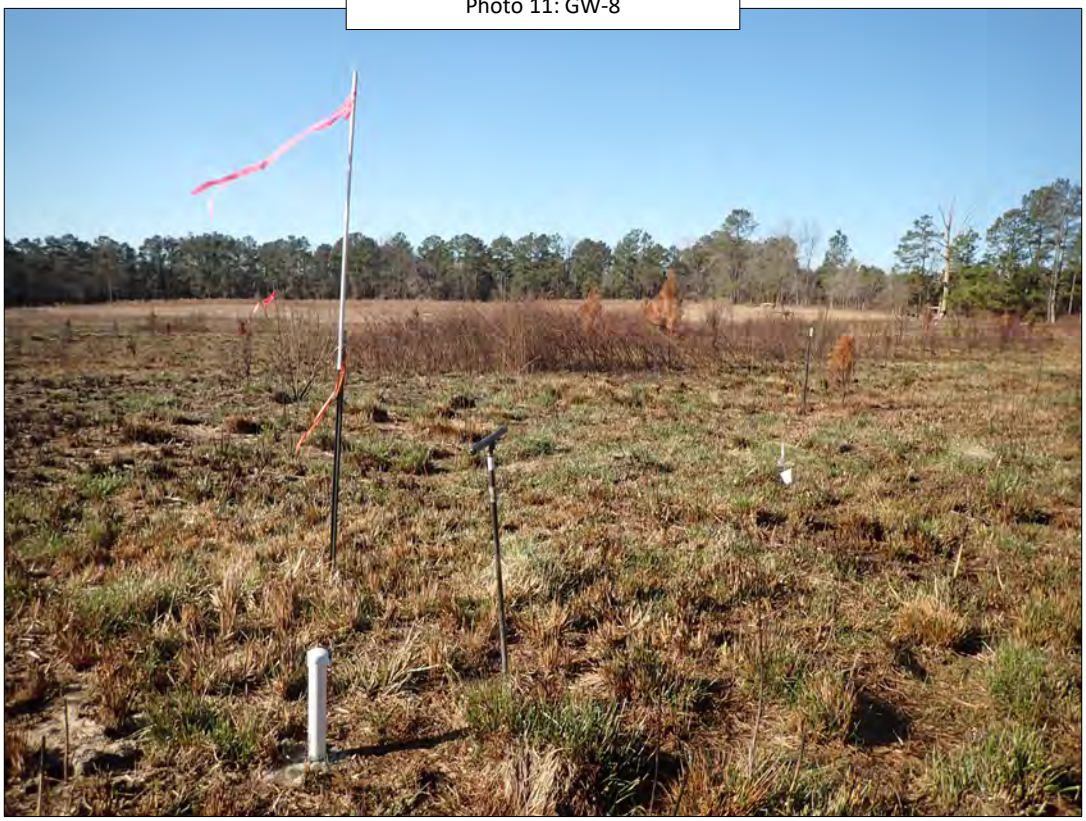


Photo 12: UT-1 Log Vanes

Crane Mitigation Site
As-Built (2023) Photo Log

Photo 13: Easement Signage

Appendix B: Vegetation Data

Table 6A. Planted Bare-Root Woody Vegetation
Table 6B. Permanent Seed Mix
Table 7. Vegetation Plot Counts and Densities
Table 8. Vegetation Plot Data Table from Vegetation Data Entry Tool

Table 6A. Planted Bare Root Woody Vegetation
Crane Stream and Wetland Mitigation Site

Vegetation Association		Coastal Plain Bottomland Hardwood Forest*		Coastal Plain Small Stream Swamp*		Stream-side Assemblage**		TOTAL
Area (acres)		8		15.4		2.8		26.2
Species	Indicator Status	# planted*	% of total	# planted*	% of total	# planted**	% of total	# planted
Swamp black gum (*Nyssa biflora)*	OBL	0	0.0%	1000	9.5%	0	0.0%	1000
Bald cypress (*Taxodium distichum*)	OBL	500	9.2%	1000	9.5%	0	0.0%	1500
Tupelo gum (*Nyssa aquatica*)	OBL	0	0.0%	1000	9.5%	0	0.0%	1000
Black gum (*Nyssa sylvatica*)	FAC	500	9.2%	1000	9.5%	700	9.2%	2200
Silky dogwood (*Cornus amomum*)	FACW	0	0.0%	0	0.0%	1500	19.7%	1500
Sweetbay (*Magnolia virginiana*)	FACW	0	0.0%	1000	9.5%	0	0.0%	1000
Red bay (*Persea borbonia*)	FAC	250	4.6%	500	4.8%	0	0.0%	750
River birch (*Betula nigra*)	FACW	500	9.2%	500	4.8%	1500	19.7%	2500
Hackberry (*Celtis occidentalis*)	FACW	300	5.5%	500	4.8%	400	5.3%	1200
American elm (*Ulmus americana*)	FACW	300	5.5%	500	4.8%	800	10.5%	1600
Tulip poplar (*Liriodendron tulipifera*)	FAC	300	5.5%	500	4.8%	800	10.5%	1600
Sycamore (*Platanus occidentalis*)	FACW	300	5.5%	500	4.8%	800	10.5%	1600
Swamp chestnut oak (*Quercus michauxii*)	FACW	300	5.5%	500	4.8%	0	0.0%	800
Water oak (*Quercus nigra*)	FAC	500	9.2%	300	2.9%	400	5.3%	1200
Laurel oak (*Quercus larifolia*)	FACW	300	5.5%	500	4.8%	0	0.0%	800
Cherrybark oak (*Quercus pagoda*)	FAC	200	3.7%	0	0.0%	400	5.3%	600
Willow oak (*Quercus phellos*)	FACW	300	5.5%	500	4.8%	0	0.0%	800
Shumard oak (*Quercus shumardii*)	FACW	300	5.5%	500	4.8%	0	0.0%	800
Shagbark hickory (*Carya ovata*)	FACU	300	5.5%	0	0.0%	0	0.0%	300
Bitternut hickory (*Carya cordiformis*)	FAC	300	5.5%	200	1.9%	300	3.9%	800
	TOTAL	**5450**		**10500**		**7600**		**23550**

* Planted at a density of 680 stems/acre.
** Planted at a density of 2720 stems/acre.

Table 6B. Permanent Seed Mix
Crane Stream and Wetland Mitigation Site

Temporary Seed (Erosion and Sediment Control)			
Species	**Application Rate**	**Application Date**	**Notes**
Urochloa ramosa (Brown Top Millet)	40 lbs. per acre	May - September	All disturbed soil

Permanent Seed- Sitewide @ 2lbs /acre			
Latin Species	**Common Name**	**Indicator**	**%**
Agrostis hyemalis	Winter bentgrass	FAC	3
Bidens aristosa	Bur-marigold	FACW	0.6
Carex albolutescens	Greenwhite Sedge	FACW	2
Carex lupulina	Hop Sedge	OBL	2
Chamaecrista fasciculata	Partridge Pea	FACU	6
Chamaecrista nictitans	Sensitive Pea	FACU	3
Coreopsis lanceolata	Lance-leaved Coreopsis	NI	5
Coreopsis tinctoria	Plains Coreopsis	FAC	5
Desmodium canadense	Showy ticktrefoil	FAC	5
Echinacea purpurea	Coneflower	NI	5
Elymus virginicus	Virginia Wildrye	FACW	7
Eupatorium fistulosum	Joe Pye Weed	FACW	0.1
Helianthus angustifolius	Narrowleaved Sunflower	FACW	2
Heliopsis helianthoides	Oxeye sunflower	UPL	5
Hibiscus moscheutos	Crimsoneyed rosemallow	OBL	0.1
Liatris spicata	Marsh Blazing Star	FAC	0.1
Monarda fistulosa	Wild Bergamot	FACU	1
Panicum anceps	Beaked panicgrass	FAC	5
Panicum clandestinum	Deertongue	FAC	10
Panicum dichotomiflorum	Smooth panicgrass	FACW	8
Panicum rigidulum	Redtop Panicgrass	FACW	2
Pycnanthemum tenuifolium	Narrowleaf mountainmint	FACW	0.1
Rudbeckia hirta	Black eyed Susan	FACU	5
Senna hebecarpa	Wild Senna	FAC	2
Tridens flavus	Purpletop	FACU	10
Verbena hastata	Blue vervain	FACW	6

Table 7. Planted Vegetation Totals
Laurel Springs Stream and Wetland Mitigation Site

Plot #	Planted Stems/Acre	Success Criteria Met?
1	405	Yes
2	526	Yes
3	648	Yes
4	607	Yes
5	607	Yes
6	607	Yes
7	486	Yes
8	607	Yes
9	324	Yes
10	526	Yes
11	688	Yes
12	607	Yes
13	445	Yes
14	526	Yes
15	607	Yes
16	607	Yes
17	729	Yes
R-1	607	Yes
R-2	729	Yes
R-3	607	Yes
R-4	364	Yes
R-5	891	Yes
R-6	1053	Yes
Average Planted Stems/Acre	**600**	**Yes**

https://ncdms.shinyapps.io/Veg_Table_Tool

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

Planted Acreage	26.2
Date of Initial Plant	2023-02-04
Date(s) of Supplemental Plant(s)	NA
Date(s) Mowing	2023-03-15
Date of Current Survey	2023-03-15
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	
					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	Betula nigra	river birch	Tree	FACW			1	1									1	1	2	2				
	Carya cordiformis	bitternut hickory	Tree	FAC			1	1																
	Carya ovata	shagbark hickory	Tree	FACU											1	1								
	Celtis occidentalis	common hackberry	Tree	FACU																				
	Cornus amomum	silky dogwood	Shrub	FACW																				
	Liriodendron tulipifera	tuliptree	Tree	FACU					1	1	3	3							3	3				
	Magnolia virginiana	sweetbay	Tree	FACW					1	1	1	1							3	3			1	1
	Nyssa aquatica	water tupelo	Tree	OBL	1	1	5	5			1	1	1	1	1	1	3	3	1	1	1	1	2	2
	Nyssa sylvatica	blackgum	Tree	FAC	1	1	1	1	2	2	2	2			1	1			2	2	1	1	4	4
	Persea borbonia	redbay	Tree	FACW					7	7														
	Platanus occidentalis	American sycamore	Tree	FACW			2	2	1	1	3	3	3	3	3	3	4	4						
	Quercus alba	white oak	Tree	FACU																				
	Quercus laurifolia	laurel oak	Tree	FACW	2	2							3	3	4	4	1	1	2	2				
	Quercus michauxii	swamp chestnut oak	Tree	FACW	1	1	1	1	1	1			1	1	2	2	1	1	1	1			1	1
	Quercus nigra	water oak	Tree	FAC	2	2									1	1							1	1
	Quercus pagoda	cherrybark oak	Tree	FACW	3	3	1	1					5	5	1	1	1	1			1	1		
	Quercus phellos	willow oak	Tree	FACW							1	1												
	Quercus rubra	northern red oak	Tree	FACU							2	2							1	1				
	Quercus shumardii	Shumard's oak	Tree	FAC									2	2	1	1	1	1					2	2
	Taxodium distichum	bald cypress	Tree	OBL			1	1	3	3	2	2									5	5	2	2
	Ulmus americana	American elm	Tree	FAC																				
Sum	Performance Standard				10	10	13	13	16	16	15	15	15	15	15	15	12	12	15	15	8	8	13	13
Mitigation Plan Performance Standard	Current Year Stem Count					10		13		16		15		15		15		12		15		8		13
	Stems/Acre					405		526		648		607		607		607		486		607		324		526
	Species Count					6		8		7		8		6		9		7		8		4		7
	Dominant Species Composition (%)					30		38		44		20		33		27		33		20		62		31
	Average Plot Height (ft.)					1		0		0		0		1		1		1		0		1		1
	% Invasives					0		0		0		0		0		0		0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					10		13		16		15		15		15		12		15		8		13
	Stems/Acre					405		526		648		607		607		607		486		607		324		526
	Species Count					6		8		7		8		6		9		7		8		4		7
	Dominant Species Composition (%)					30		38		44		20		33		27		33		20		62		31
	Average Plot Height (ft.)					1		0		0		0		1		1		1		0		1		1
	% Invasives					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.

https://ncdms.shinyapps.io/Veg_Table_Tool

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

Planted Acreage	26.2
Date of Initial Plant	2023-02-04
Date(s) of Supplemental Plant(s)	NA
Date(s) Mowing	2023-03-15
Date of Current Survey	2023-03-15
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 11 F		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 1 R	Veg Plot 2 R	Veg Plot 3 R	Veg Plot 4 R	Veg Plot 5 R	Veg Plot 6 R
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Total	Total	Total	Total	Total	Total
Species Included in Approved Mitigation Plan	Betula nigra	river birch	Tree	FACW			2	2															2	2
	Carya cordiformis	bitternut hickory	Tree	FAC									1	1						2			1	
	Carya ovata	shagbark hickory	Tree	FACU																1		1		
	Celtis occidentalis	common hackberry	Tree	FACU	2	2																		
	Cornus amomum	silky dogwood	Shrub	FACW				1															3	
	Liriodendron tulipifera	tuliptree	Tree	FACU				3		2			1	1						1	1	1	7	2
	Magnolia virginiana	sweetbay	Tree	FACW	3	3	2	2			2	2	1	1			1	1	1		1			3
	Nyssa aquatica	water tupelo	Tree	OBL	1	1			1	1										3				4
	Nyssa sylvatica	blackgum	Tree	FAC	2	2	1	1	1	1	2	2	1	1					2	2	4	1	2	
	Persea borbonia	redbay	Tree	FACW															1	2	3			3
	Platanus occidentalis	American sycamore	Tree	FACW			1	1	3	3	1	1	2	2			1	1	1	1	1			
	Quercus alba	white oak	Tree	FACU	2	2							2	2										
	Quercus laurifolia	laurel oak	Tree	FACW							4	4			4	4	9	9	1		2	2		
	Quercus michauxii	swamp chestnut oak	Tree	FACW					4	4			1	1	1	1	2	2	1	1		3		
	Quercus nigra	water oak	Tree	FAC	1	1							2	2	6	6	3	3	4	1			2	1
	Quercus pagoda	cherrybark oak	Tree	FACW			2	3											2	1	1	1		3
	Quercus phellos	willow oak	Tree	FACW	2	2					1	1	1	1					2	3			1	
	Quercus rubra	northern red oak	Tree	FACU	3	3					2	2			2	2	2	2						
	Quercus shumardii	Shumard's oak	Tree	FAC			1	1					2	2	2	2					2		1	
	Taxodium distichum	bald cypress	Tree	OBL	1	1	1	1			1	1	1	1										8
	Ulmus americana	American elm	Tree	FAC																			3	
Sum	Performance Standard				17	17	10	15	9	11	13	13	15	15	15	15	18	18	15	18	15	9	22	26
Mitigation Plan Performance Standard	Current Year Stem Count					17		15		11		13		15		15		18	15	18	15	9	22	26
	Stems/Acre					688		607		445		526		607		607		729	607	729	607	364	891	1053
	Species Count					9		9		5		7		11		5		6	9	11	8	6	9	8
	Dominant Species Composition (%)					18		20		36		31		13		40		50	27	17	27	33	32	31
	Average Plot Height (ft.)					0		0		1		0		1		1		0	0	0	0	0	0	0
	% Invasives					0		0		0		0		0		0		0	0	0	0	0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					17		15		11		13		15		15		18	15	18	15	9	22	26
	Stems/Acre					688		607		445		526		607		607		729	607	729	607	364	891	1053
	Species Count					9		9		5		7		11		5		6	9	11	8	6	9	8
	Dominant Species Composition (%)					18		20		36		31		13		40		50	27	17	27	33	32	31
	Average Plot Height (ft.)					0		0		1		0		1		1		0	0	0	0	0	0	0
	% Invasives					0		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

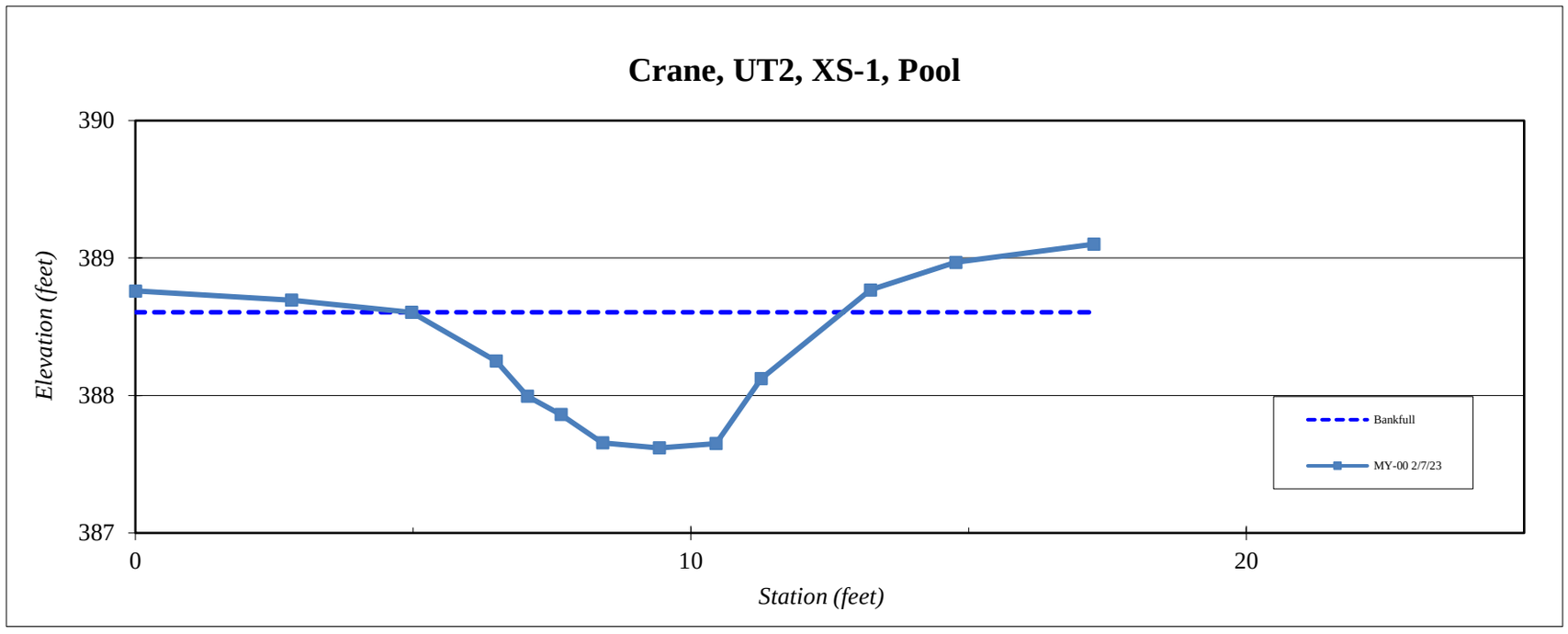
Cross-Sections with Annual Overlays
Longitudinal Profile
Table 9A-E. Baseline Stream Data Summary Tables
Table 10A-B. Cross-Section Morphology Monitoring Summary

Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT2, XS -1
Feature	Pool
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	388.7
2.8	388.6
5.0	388.5
6.5	388.1
7.1	387.8
7.7	387.6
8.4	387.4
9.4	387.4
10.5	387.4
11.3	387.9
13.2	388.7
14.8	388.9
17.3	389.0

SUMMARY DATA	
Bankfull Elevation:	388.48
Bank Hieght Ratio:	NA
Thalweg Elevation:	387.36
LTOB Elevation:	388.48
LTOB Max Depth:	1.12
LTOB Cross Sectional Area:	5.1

Stream Type	

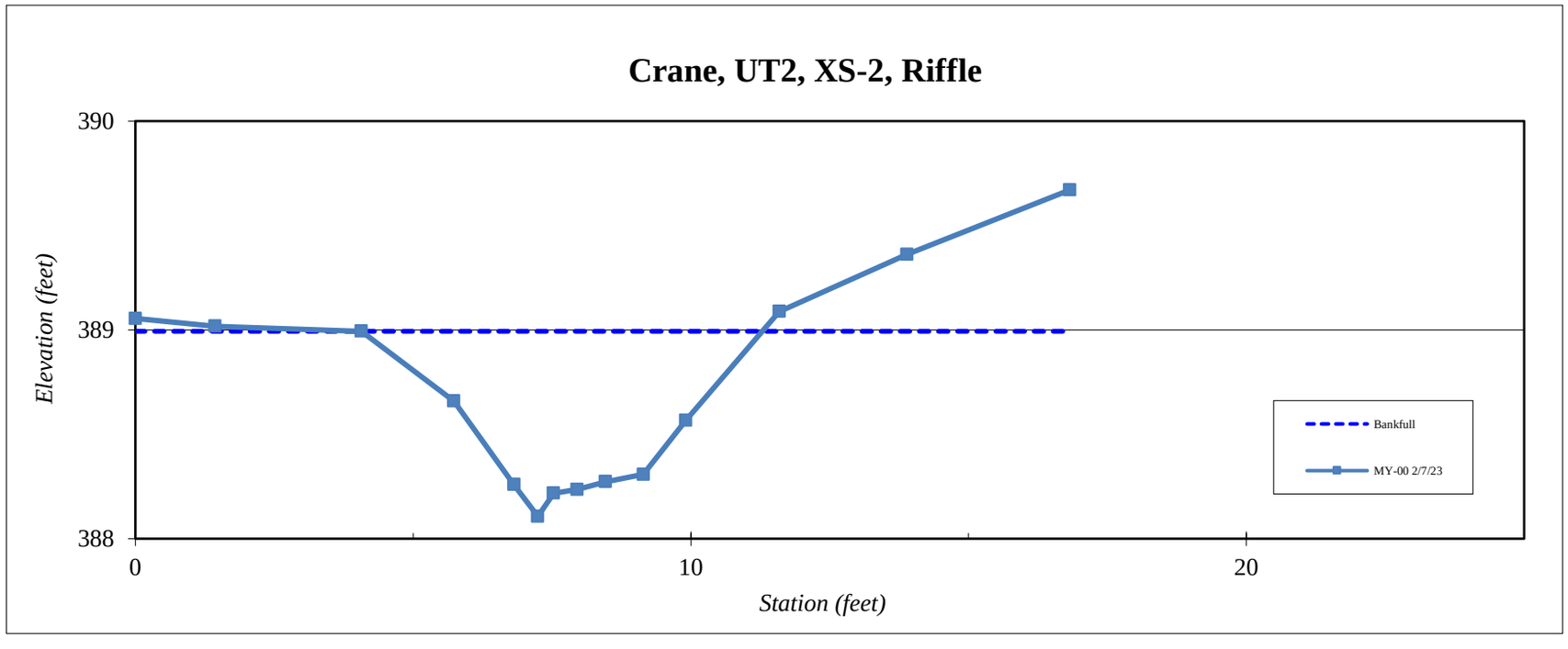


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT2, XS-2
Feature	Riffle
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	389.0
1.4	388.9
4.1	388.9
5.7	388.5
6.8	388.1
7.2	387.9
7.5	388.0
8.0	388.1
8.5	388.1
9.1	388.1
9.9	388.4
11.6	389.0
13.9	389.3
16.8	389.7

SUMMARY DATA	
Bankfull Elevation:	388.92
Bank Hieght Ratio:	1.00
Thalweg Elevation:	387.92
LTOB Elevation:	388.92
LTOB Max Depth:	1.00
LTOB Cross Sectional Area:	3.8

Stream Type	

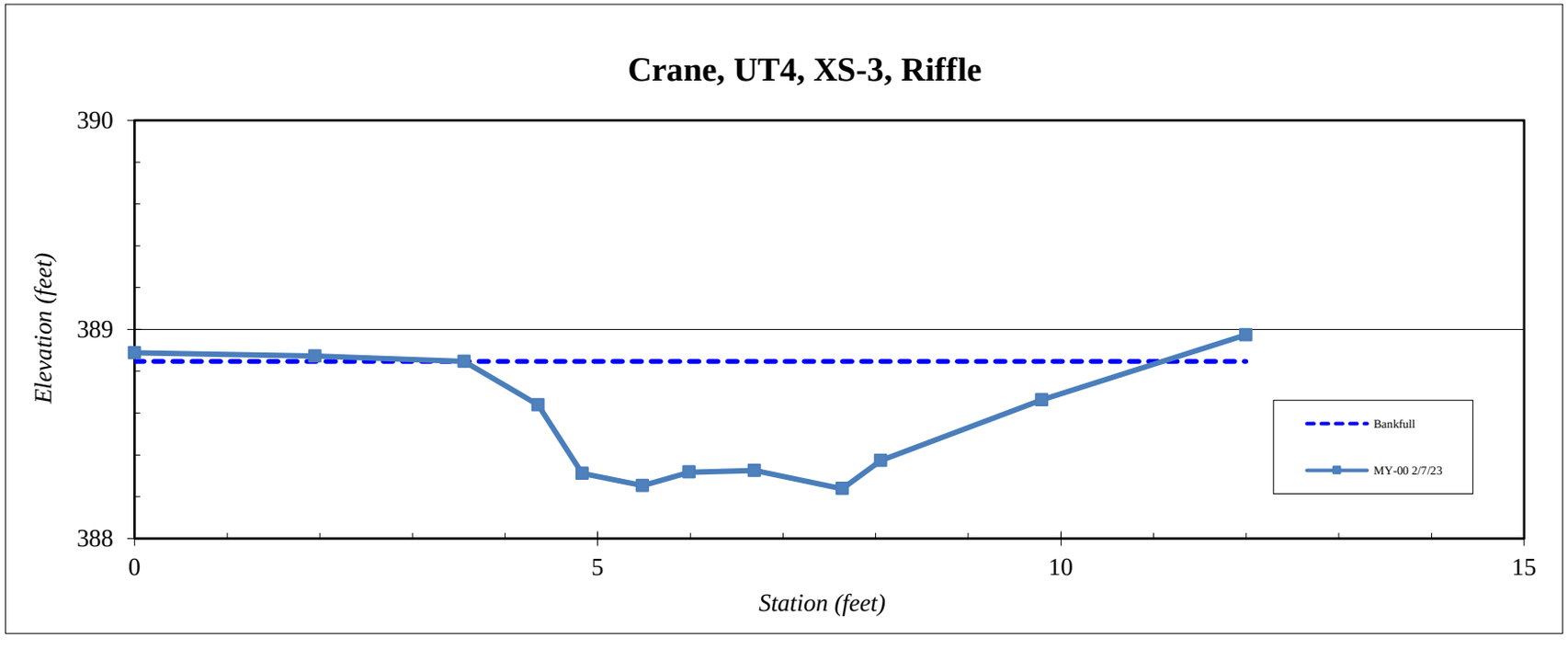


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT4, XS-3
Feature	Riffle
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	388.9
1.9	388.9
3.6	388.8
4.4	388.6
4.8	388.3
5.5	388.3
6.0	388.3
6.7	388.3
7.6	388.2
8.1	388.4
9.8	388.7
12.0	389.0

SUMMARY DATA	
Bankfull Elevation:	388.85
Bank Hieght Ratio:	1.00
Thalweg Elevation:	388.24
LTOB Elevation:	388.85
LTOB Max Depth:	0.61
LTOB Cross Sectional Area:	2.7

Stream Type	

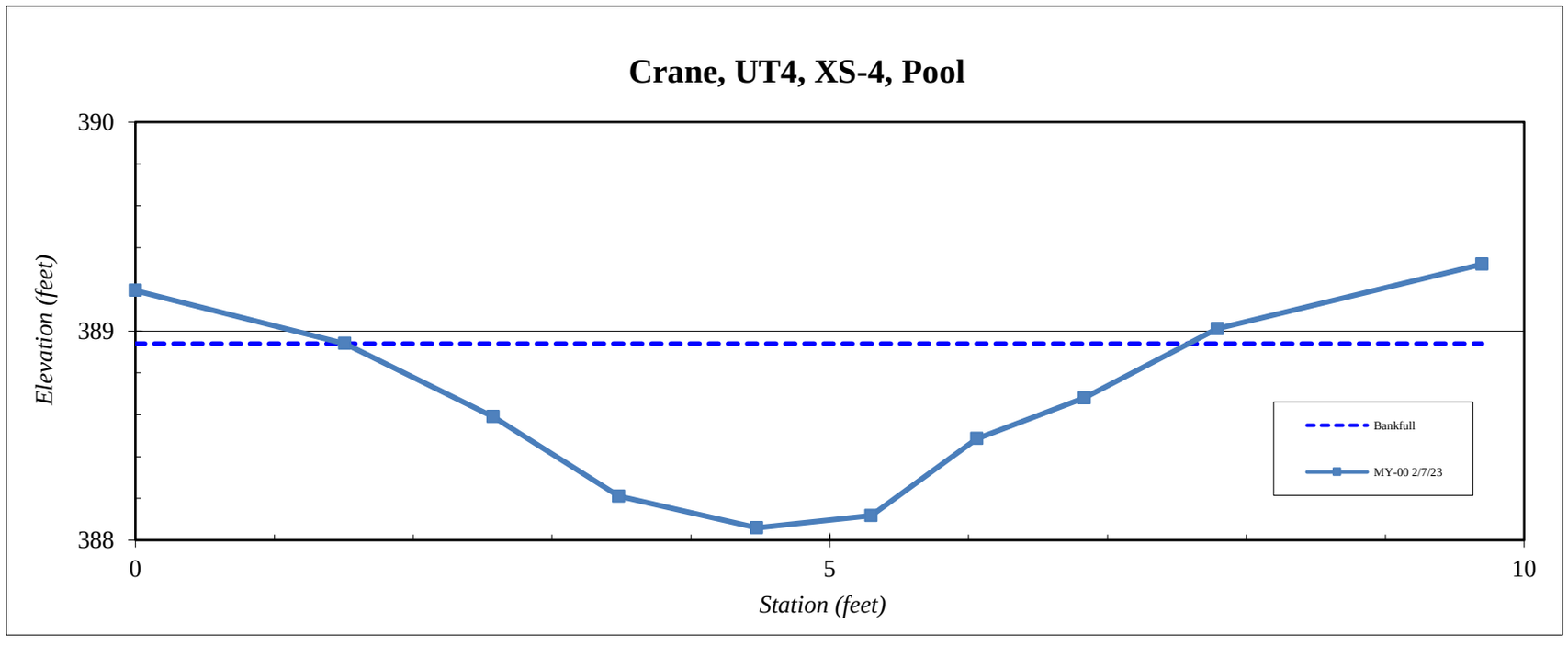


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT4, XS-4
Feature	Pool
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	389.2
1.5	388.9
2.6	388.6
3.5	388.2
4.5	388.1
5.3	388.1
6.1	388.5
6.8	388.7
7.8	389.0
9.7	389.3

SUMMARY DATA	
Bankfull Elevation:	388.94
Bank Hieght Ratio:	NA
Thalweg Elevation:	388.06
LTOB Elevation:	388.94
LTOB Max Depth:	0.88
LTOB Cross Sectional Area:	3.0

Stream Type	

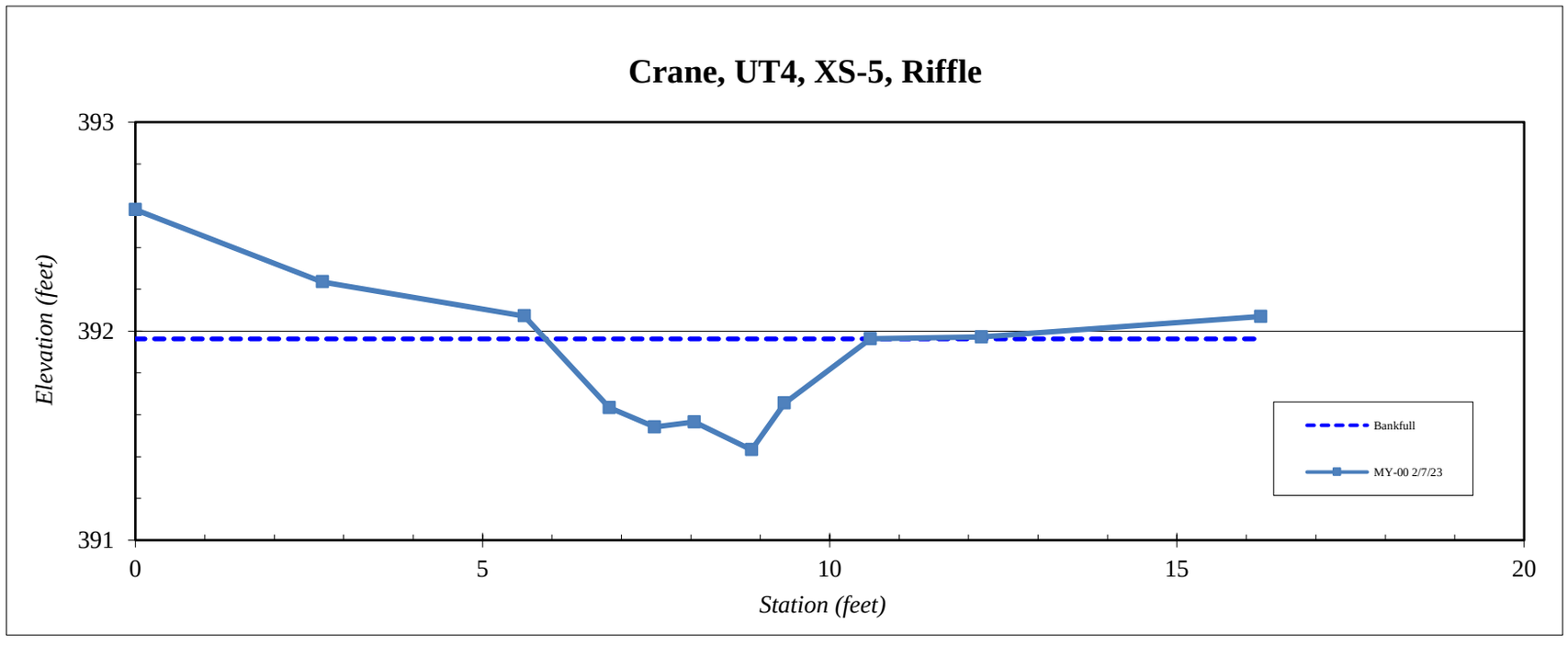


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT4, XS-5
Feature	Riffle
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	392.6
2.7	392.2
5.6	392.1
6.8	391.6
7.5	391.5
8.0	391.6
8.9	391.4
9.3	391.7
10.6	392.0
12.2	392.0
16.2	392.1

SUMMARY DATA	
Bankfull Elevation:	391.96
Bank Hieght Ratio:	1.00
Thalweg Elevation:	391.43
LTOB Elevation:	391.96
LTOB Max Depth:	0.53
LTOB Cross Sectional Area:	1.4

Stream Type	

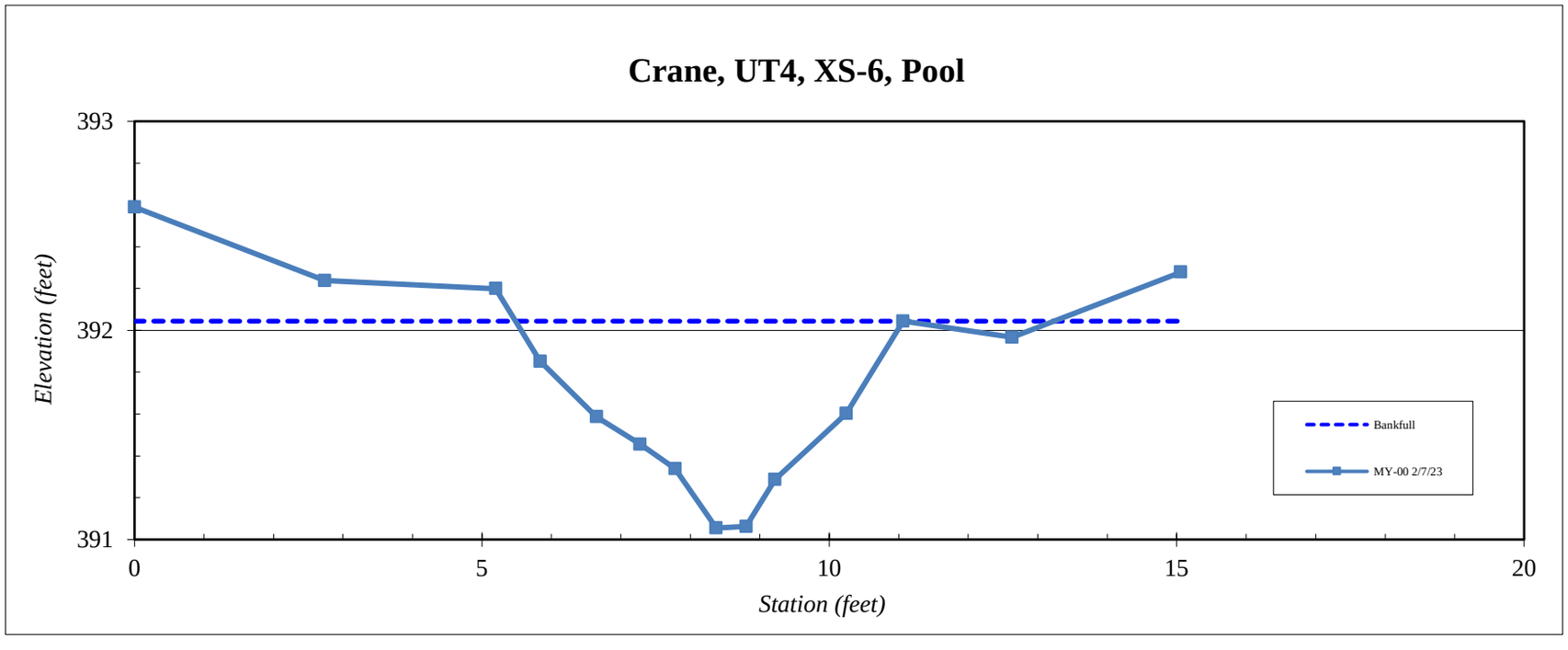


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT4, XS-6
Feature	Pool
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	392.6
2.7	392.2
5.2	392.2
5.8	391.9
6.6	391.6
7.3	391.5
7.8	391.3
8.4	391.1
8.8	391.1
9.2	391.3
10.2	391.6
11.1	392.0
12.6	392.0
15.1	392.3

SUMMARY DATA	
Bankfull Elevation:	392.04
Bank Hieght Ratio:	NA
Thalweg Elevation:	391.06
LTOB Elevation:	392.04
LTOB Max Depth:	0.99
LTOB Cross Sectional Area:	3.0

Stream Type	

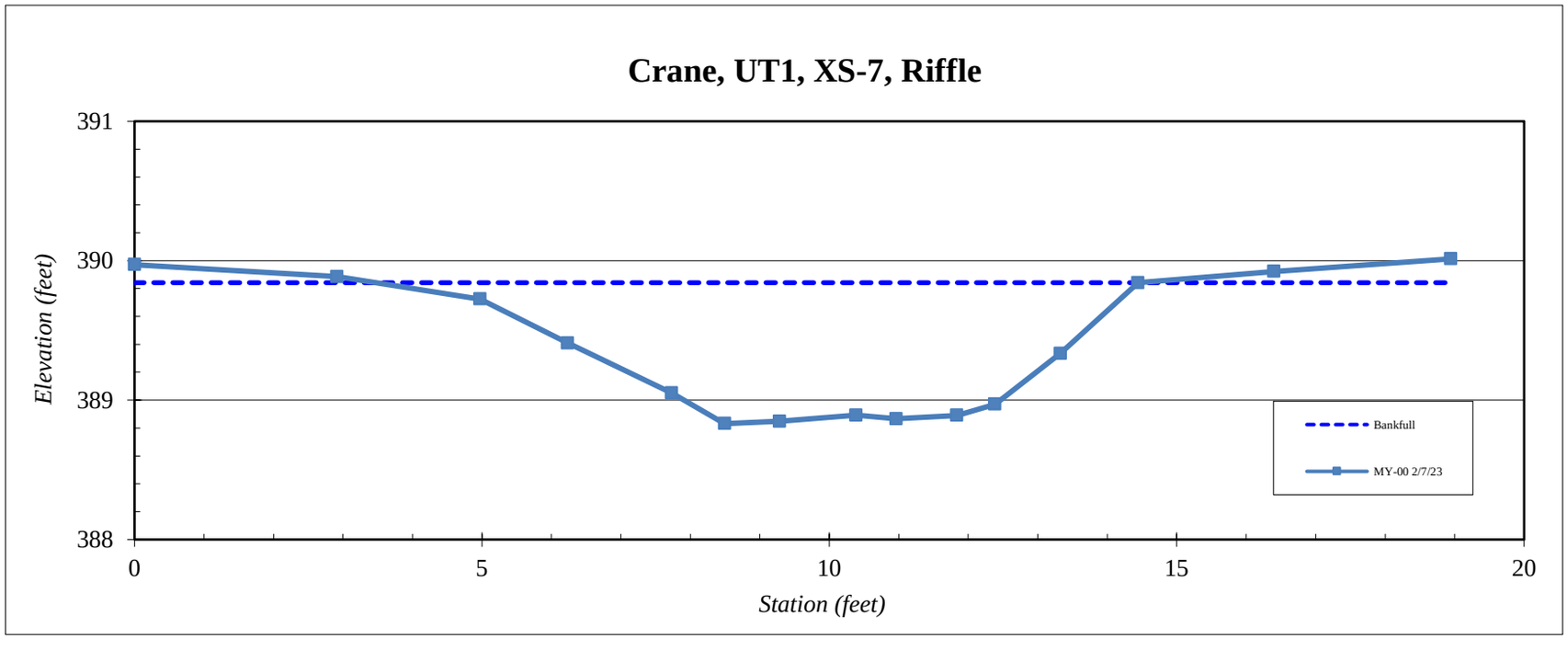


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT1, XS-7
Feature	Riffle
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	390.0
2.9	389.9
5.0	389.7
6.2	389.4
7.7	389.1
8.5	388.8
9.3	388.8
10.4	388.9
11.0	388.9
11.8	388.9
12.4	389.0
13.3	389.3
14.4	389.8
16.4	389.9
18.9	390.0

SUMMARY DATA	
Bankfull Elevation:	389.84
Bank Hieght Ratio:	1.00
Thalweg Elevation:	388.83
LTOB Elevation:	389.84
LTOB Max Depth:	1.01
LTOB Cross Sectional Area:	6.7

Stream Type	

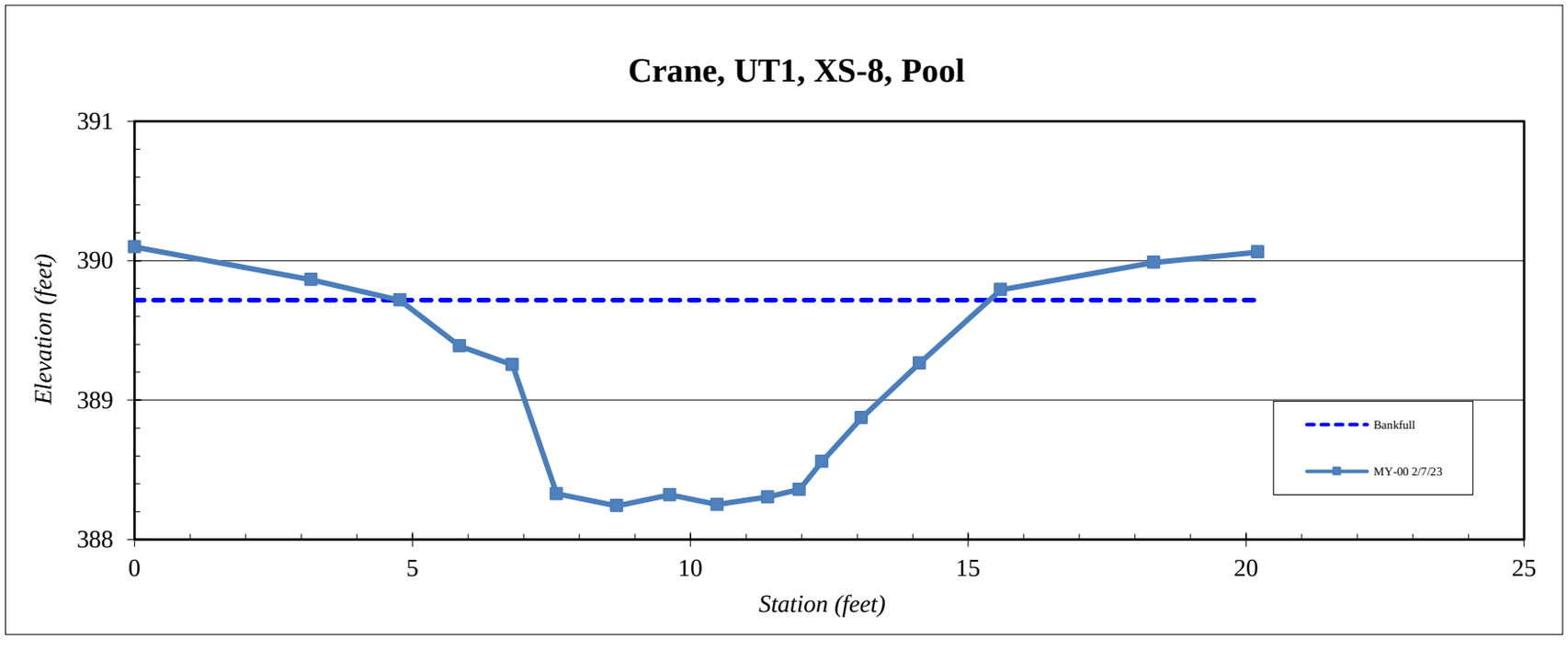


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT1, XS-8
Feature	Riffle
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	390.1
3.2	389.9
4.8	389.7
5.8	389.4
6.8	389.3
7.6	388.3
8.7	388.2
9.6	388.3
10.5	388.3
11.4	388.3
12.0	388.4
12.4	388.6
13.1	388.9
14.1	389.3
15.6	389.8
18.3	390.0
20.2	390.1

SUMMARY DATA	
Bankfull Elevation:	389.72
Bank Hieght Ratio:	NA
Thalweg Elevation:	388.24
LTOB Elevation:	389.72
LTOB Max Depth:	1.48
LTOB Cross Sectional Area:	9.7

Stream Type	

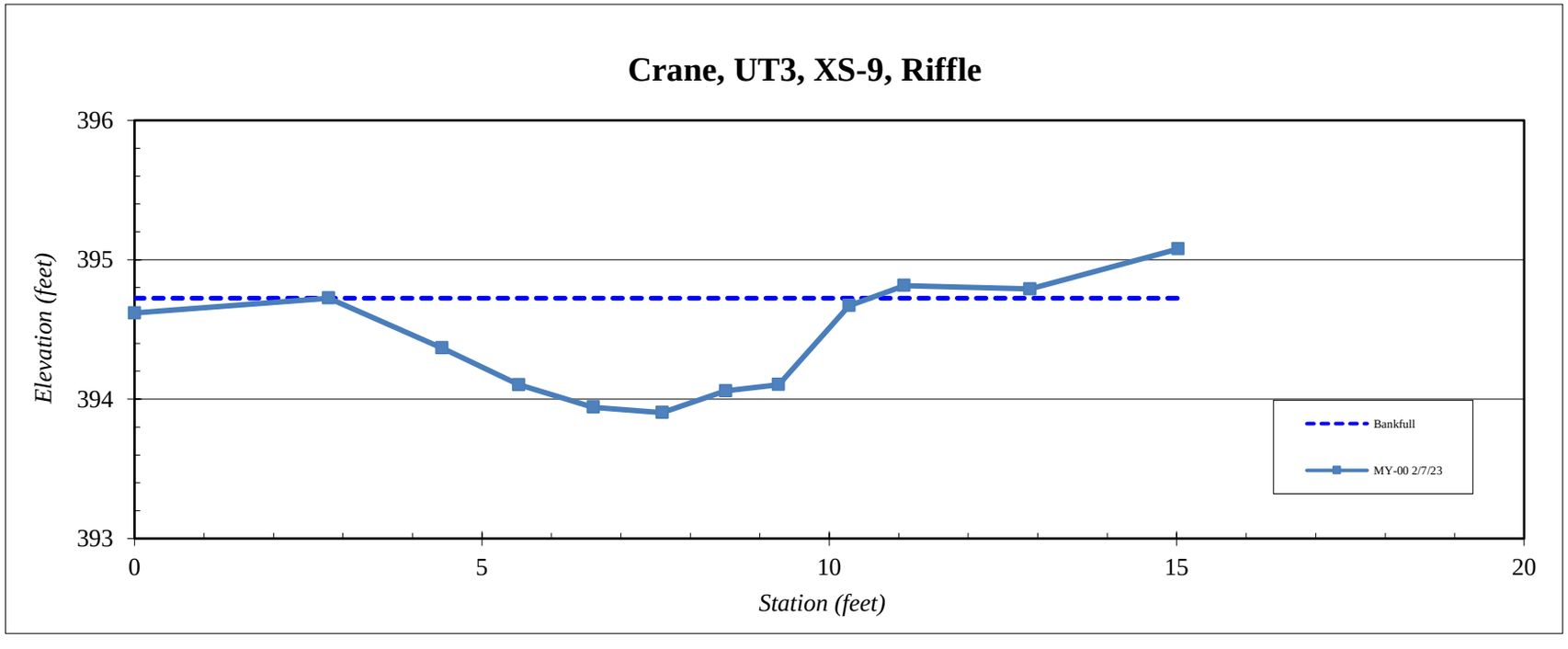


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT3, XS-9
Feature	Riffle
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	394.6
2.8	394.7
4.4	394.4
5.5	394.1
6.6	393.9
7.6	393.9
8.5	394.1
9.3	394.1
10.3	394.7
11.1	394.8
12.9	394.8
15.0	395.1

SUMMARY DATA	
Bankfull Elevation:	394.72
Bank Hieght Ratio:	1.00
Thalweg Elevation:	393.90
LTOB Elevation:	394.72
LTOB Max Depth:	0.82
LTOB Cross Sectional Area:	3.9

Stream Type	

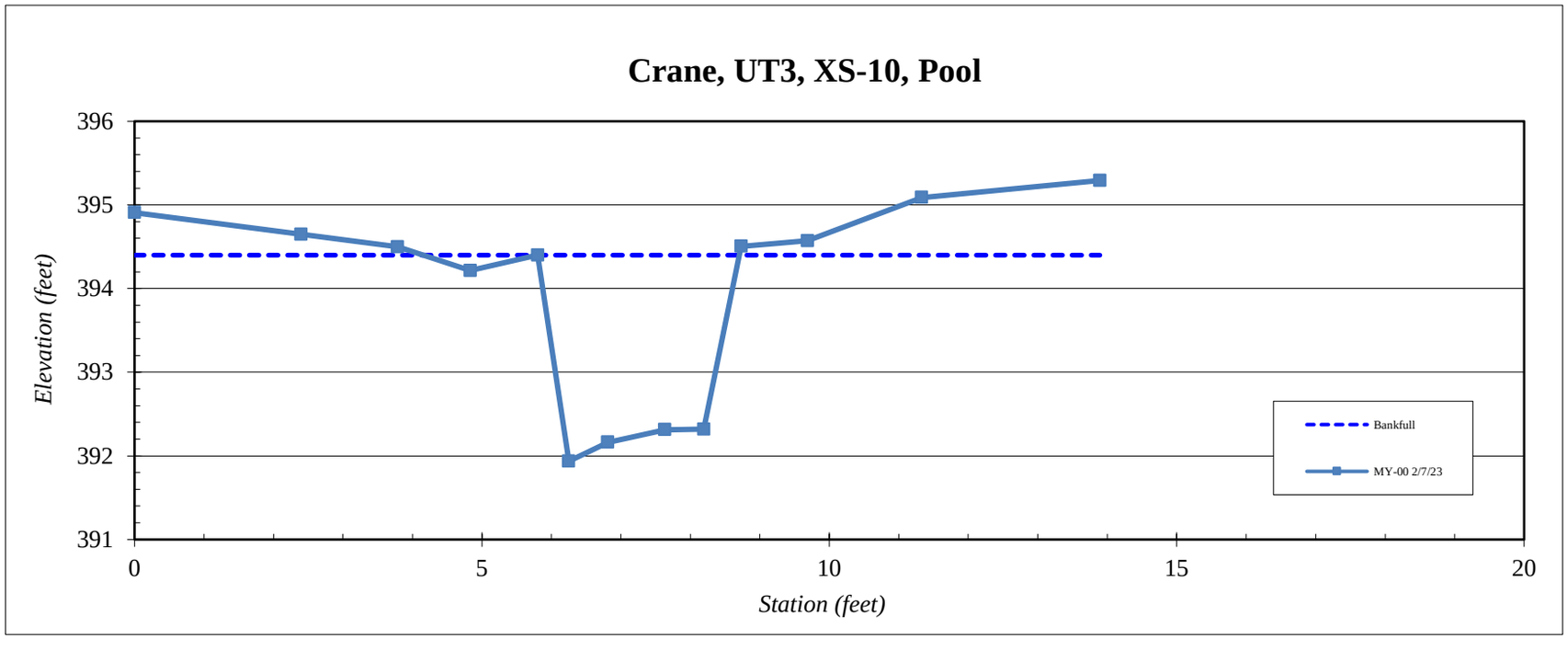


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT3, XS-10
Feature	Pool
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	394.9
2.4	394.6
3.8	394.5
4.8	394.2
5.8	394.4
6.3	391.9
6.8	392.2
7.6	392.3
8.2	392.3
8.7	394.5
9.7	394.6
11.3	395.1
13.9	395.3

SUMMARY DATA	
Bankfull Elevation:	394.40
Bank Hieght Ratio:	NA
Thalweg Elevation:	391.94
LTOB Elevation:	394.40
LTOB Max Depth:	2.46
LTOB Cross Sectional Area:	5.3

Stream Type	

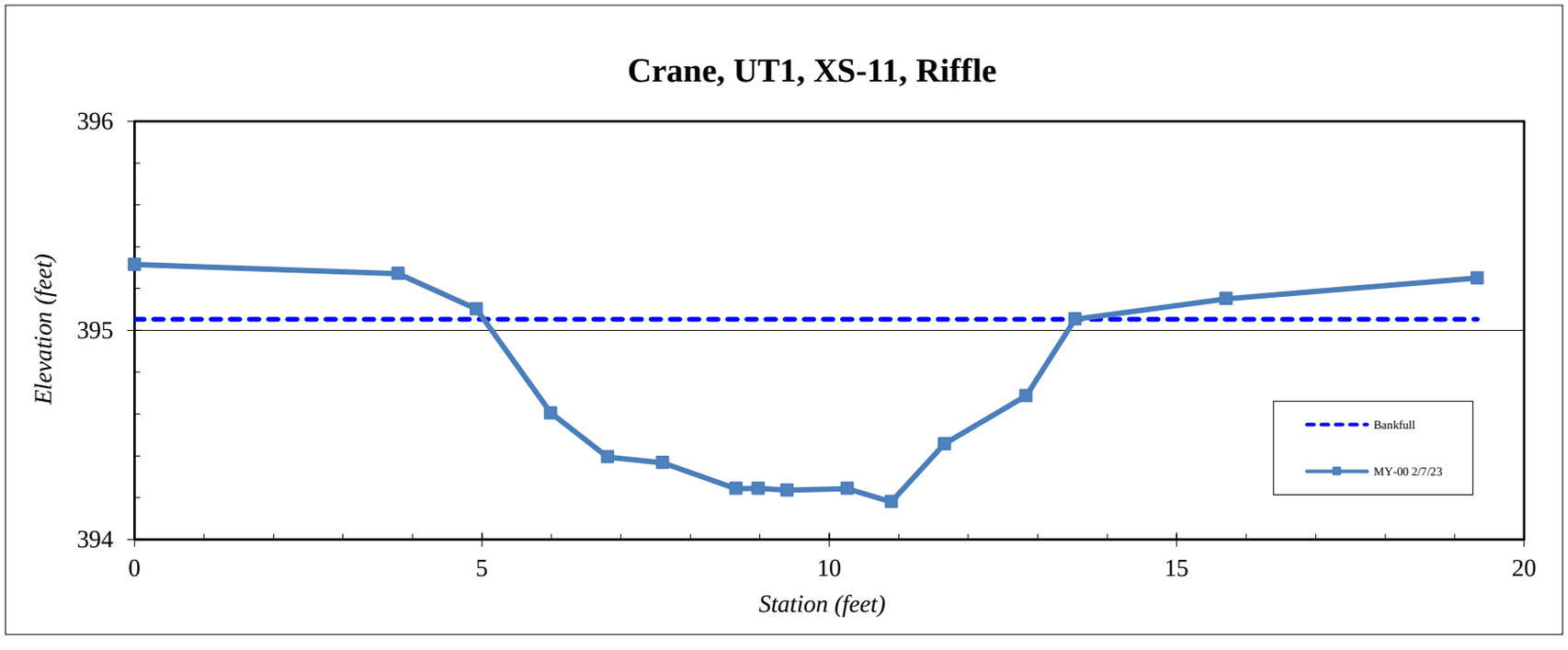


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT1, XS-11
Feature	Riffle
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	395.3
3.8	395.3
4.9	395.1
6.0	394.6
6.8	394.4
7.6	394.4
8.7	394.2
9.0	394.2
9.4	394.2
10.3	394.2
10.9	394.2
11.7	394.5
12.8	394.7
13.5	395.1
15.7	395.2
19.3	395.3

SUMMARY DATA	
Bankfull Elevation:	395.05
Bank Hieght Ratio:	1.00
Thalweg Elevation:	394.18
LTOB Elevation:	395.05
LTOB Max Depth:	0.87
LTOB Cross Sectional Area:	5.1

Stream Type	

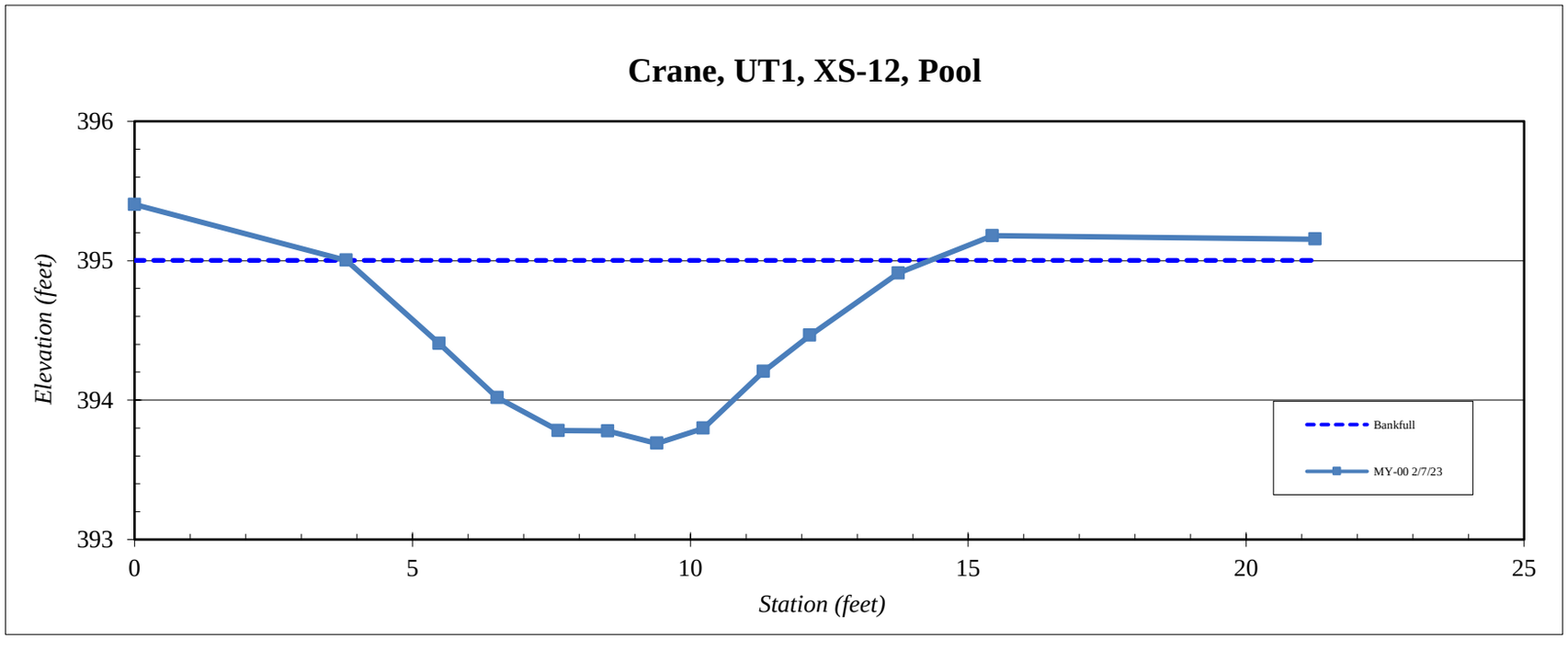


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT1, XS-12
Feature	Pool
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	395.4
3.8	395.0
5.5	394.4
6.5	394.0
7.6	393.8
8.5	393.8
9.4	393.7
10.2	393.8
11.3	394.2
12.1	394.5
13.7	394.9
15.4	395.2
21.2	395.2

SUMMARY DATA	
Bankfull Elevation:	395.00
Bank Hieght Ratio:	NA
Thalweg Elevation:	393.69
LTOB Elevation:	395.00
LTOB Max Depth:	1.31
LTOB Cross Sectional Area:	8.0

Stream Type	

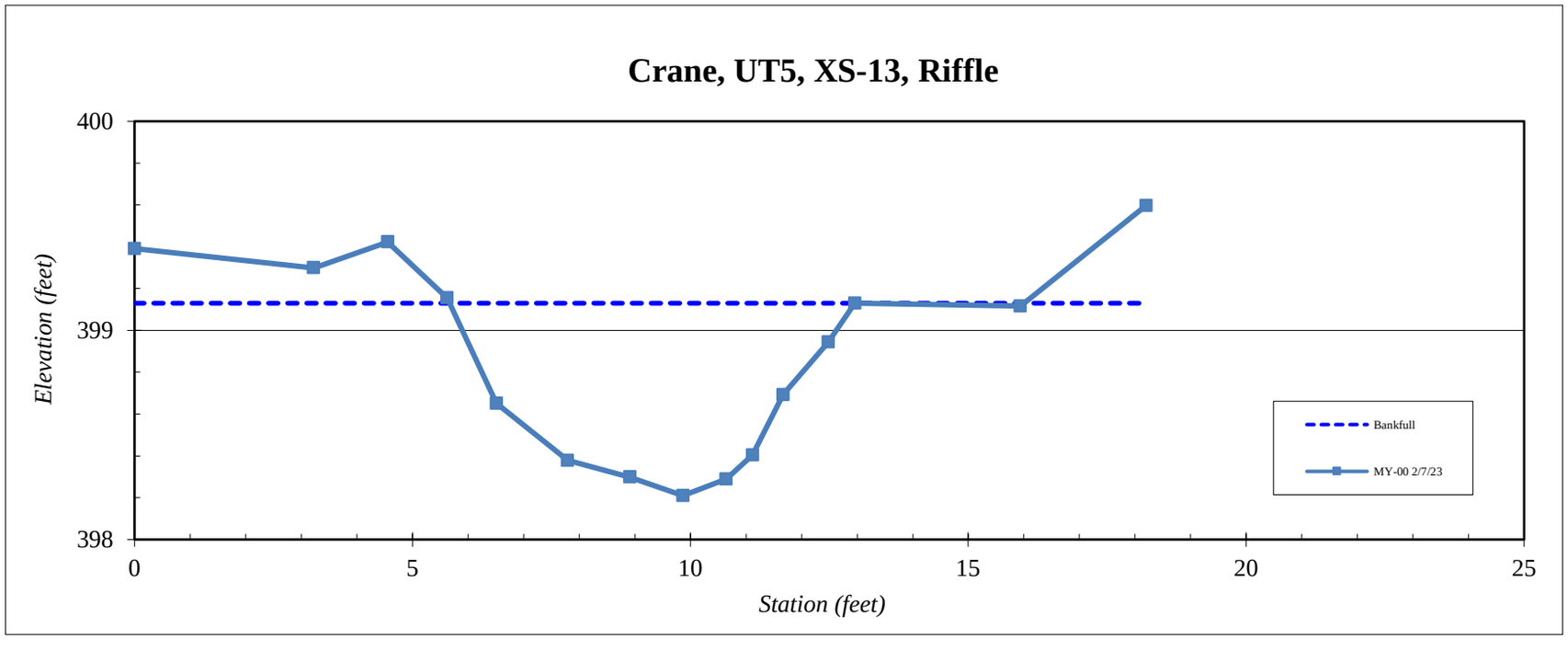


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT5, XS-13
Feature	Riffle
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	399.4
3.2	399.3
4.6	399.4
5.6	399.2
6.5	398.7
7.8	398.4
8.9	398.3
9.9	398.2
10.6	398.3
11.1	398.4
11.7	398.7
12.5	398.9
13.0	399.1
15.9	399.1
18.2	399.6

SUMMARY DATA	
Bankfull Elevation:	399.13
Bank Hieght Ratio:	1.00
Thalweg Elevation:	398.21
LTOB Elevation:	399.13
LTOB Max Depth:	0.92
LTOB Cross Sectional Area:	4.4

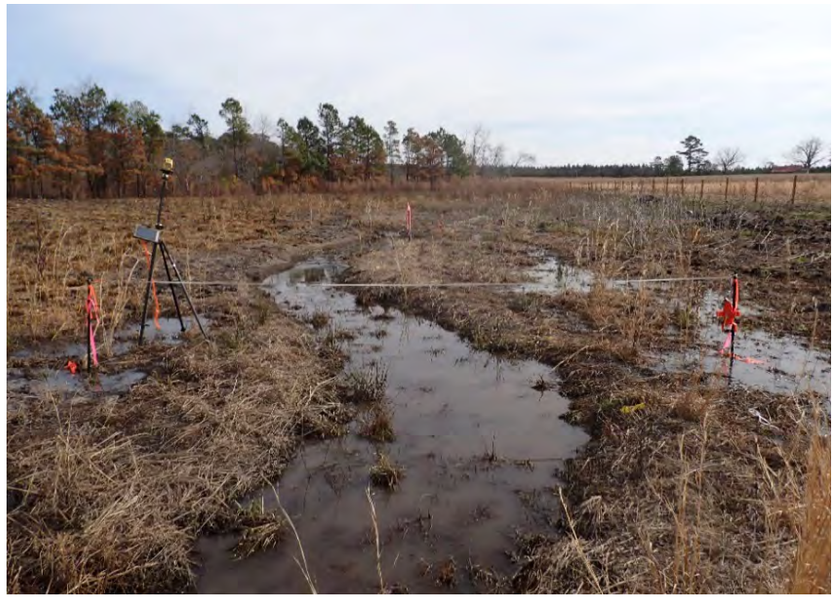
Stream Type	



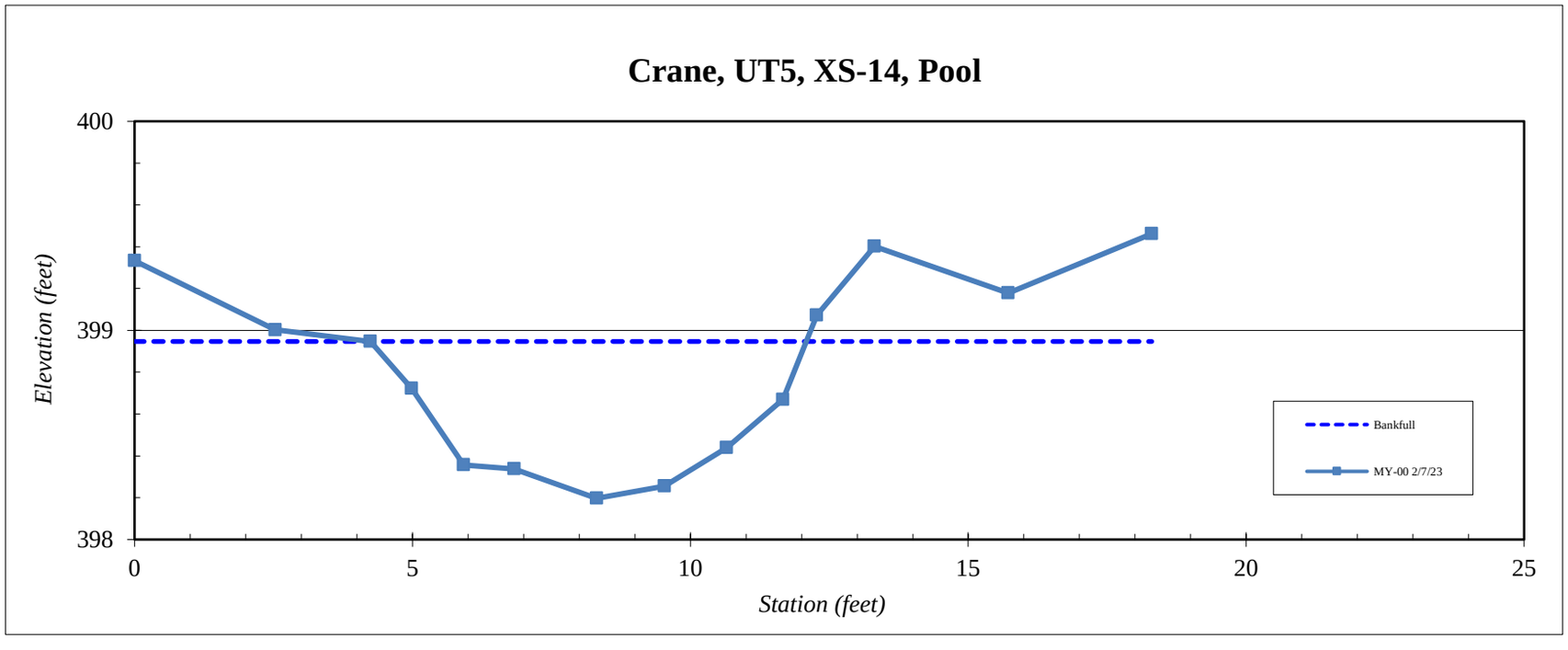
Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT5, XS-14
Feature	Pool
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	399.3
2.5	399.0
4.2	398.9
5.0	398.7
5.9	398.4
6.8	398.3
8.3	398.2
9.5	398.3
10.7	398.4
11.7	398.7
12.3	399.1
13.3	399.4
15.7	399.2
18.3	399.5

SUMMARY DATA	
Bankfull Elevation:	398.95
Bank Hieght Ratio:	NA
Thalweg Elevation:	398.20
LTOB Elevation:	398.95
LTOB Max Depth:	0.75
LTOB Cross Sectional Area:	4.0



Stream Type	

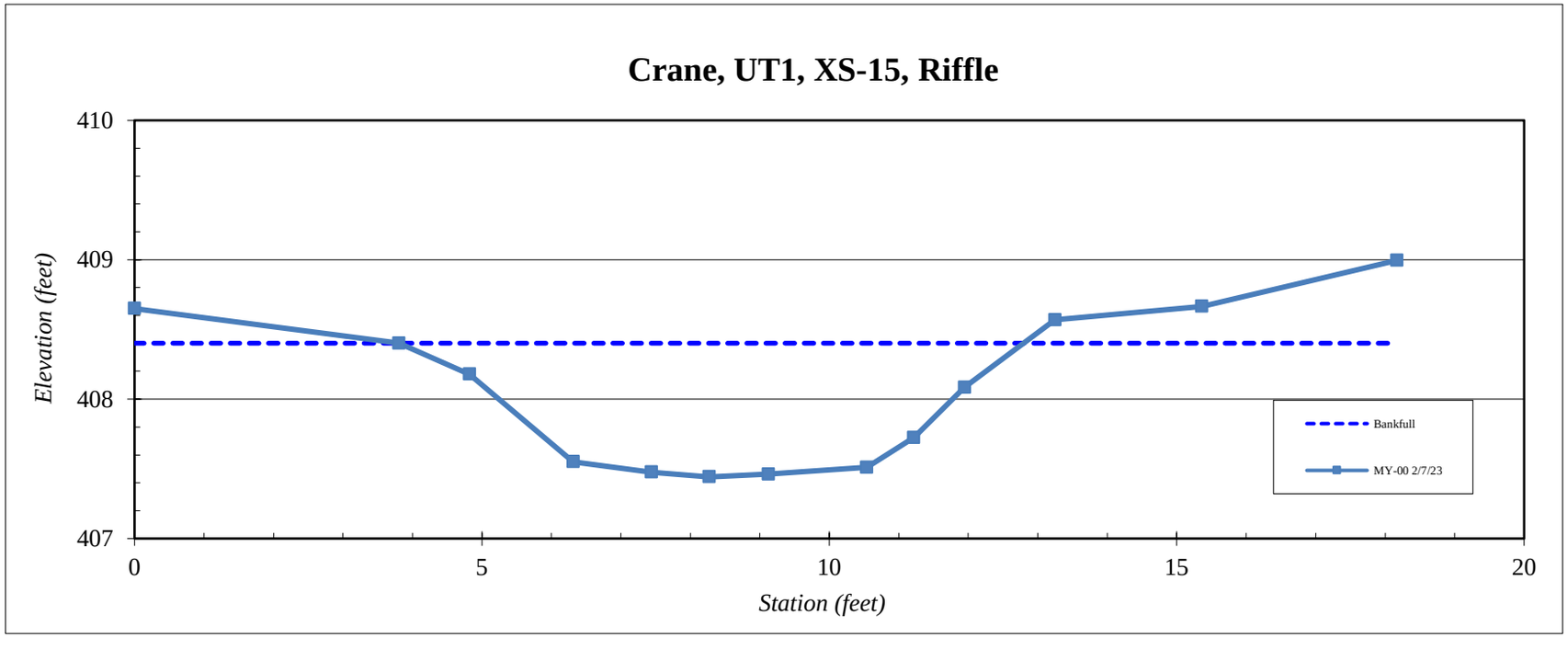


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT1, XS-15
Feature	Riffle
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	408.7
3.8	408.4
4.8	408.2
6.3	407.6
7.4	407.5
8.3	407.4
9.1	407.5
10.5	407.5
11.2	407.7
11.9	408.1
13.2	408.6
15.4	408.7
18.2	409.0

SUMMARY DATA	
Bankfull Elevation:	408.40
Bank Hieght Ratio:	1.00
Thalweg Elevation:	407.44
LTOB Elevation:	408.40
LTOB Max Depth:	0.96
LTOB Cross Sectional Area:	5.8

Stream Type	

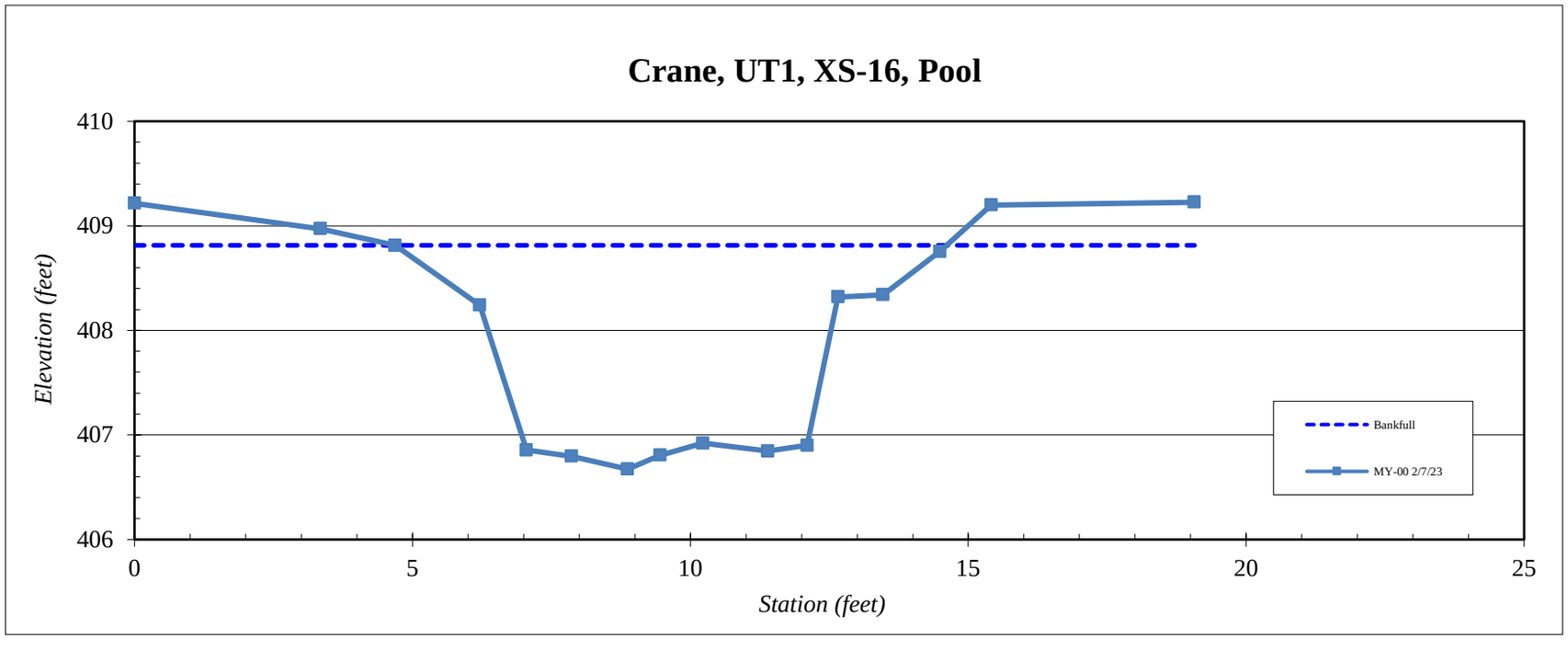


Site	Crane Site
Watershed:	Cape Fear River Basin, 03030004
XS ID	UT1, XS-16
Feature	Pool
Date:	2/7/2023
Field Crew:	Adams, Fleming, Smith

Station	Elevation
0.0	409.2
3.3	409.0
4.7	408.8
6.2	408.2
7.1	406.9
7.9	406.8
8.9	406.7
9.5	406.8
10.2	406.9
11.4	406.8
12.1	406.9
12.7	408.3
13.5	408.3
14.5	408.8
15.4	409.2
19.1	409.2

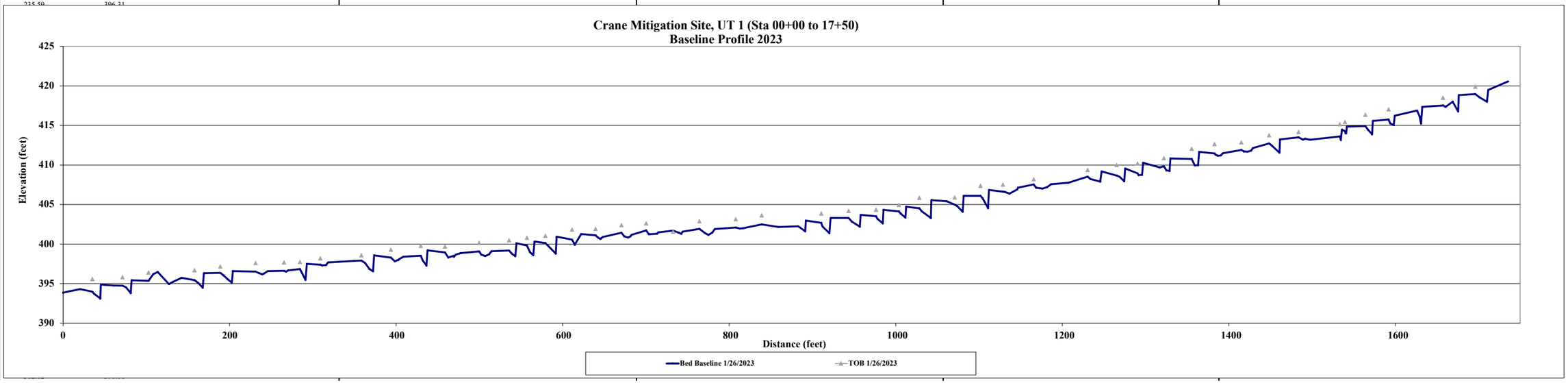
SUMMARY DATA	
Bankfull Elevation:	408.81
Bank Hieght Ratio:	NA
Thalweg Elevation:	406.67
LTOB Elevation:	408.81
LTOB Max Depth:	2.14
LTOB Cross Sectional Area:	12.9

Stream Type	



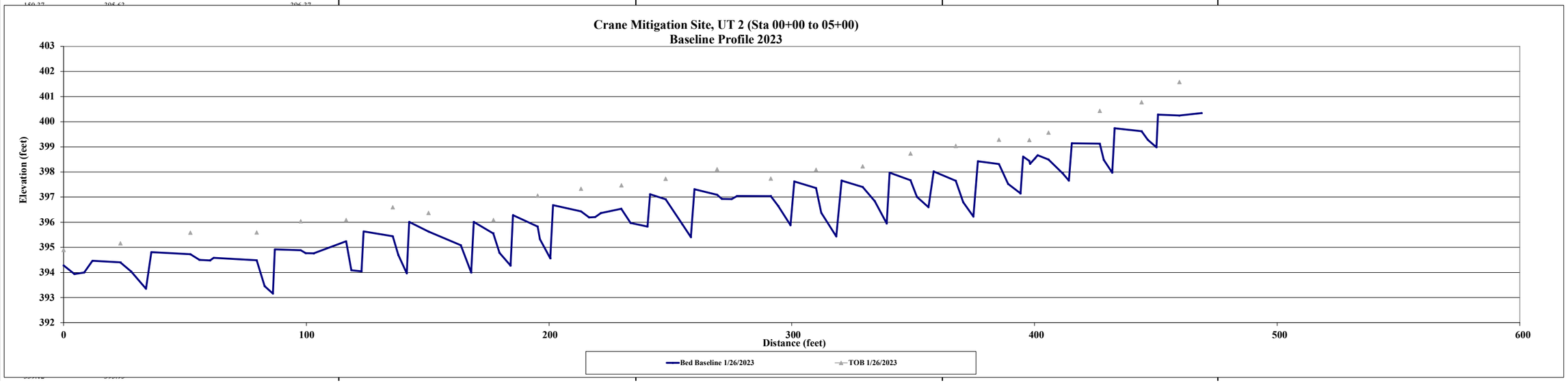
Project Name	Crane Mitigation Site - Baseline (2023) Profile
Reach	UT 1 (Sta 00+00 to 17+50)
Feature	Profile
Date	1/26/23
Crew	Perkinson, Smith

2023 Baseline Survey				As needed				As needed				As needed			
Station	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**
0	393.86														
20.36	394.29														
35.11	393.98		395.59												
37.09	393.73														
44.70	393.11														
45.43	394.88														
60.77	394.77														
71.34	394.74		395.82												
75.40	394.54														
81.23	393.80														
82.25	395.43														
102.63	395.37		396.41												
108.19	396.19														
113.54	396.46														
127.16	394.95														
132.30	395.25														
142.25	395.72														
157.83	395.44		396.70												
162.47	395.07														
167.71	394.49														
169.04	396.30														
188.66	396.36		397.17												
192.31	396.09														
197.36	395.57														
202.56	395.11														
203.90	396.59														
231.05	396.51		397.61												
235.59	396.31														



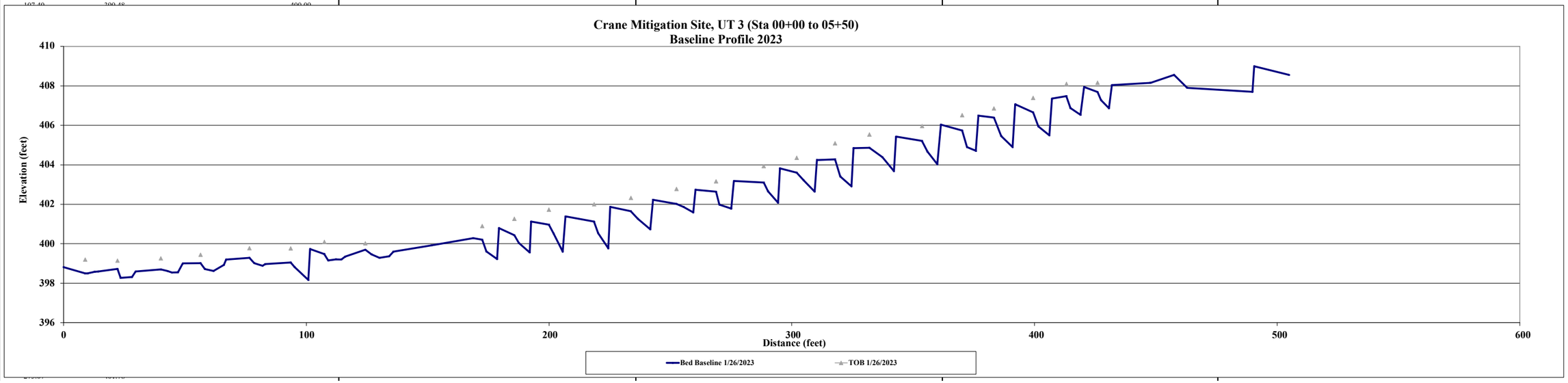
Project Name	Crane Mitigation Site - Baseline (2023) Profile
Reach	UT 2 (Sta 00+00 to 05+00)
Feature	Profile
Date	1/26/23
Crew	Perkinson, Smith

2023 Baseline Survey				As needed				As needed				As needed			
Station	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**
0	394.28		394.90												
4.45	393.94														
8.45	394.00														
11.87	394.46														
23.36	394.40		395.16												
27.82	394.04														
33.94	393.35														
36.13	394.81														
52.20	394.73		395.58												
56.01	394.50														
60.33	394.48														
61.81	394.58														
79.53	394.49		395.59												
82.86	393.45														
86.22	393.16														
87.05	394.92														
97.68	394.88		396.04												
99.73	394.77														
103.03	394.76														
116.39	395.24		396.09												
118.56	394.09														
122.72	394.05														
123.63	395.63														
135.62	395.44		396.60												
137.87	394.70														
141.39	393.97														
142.37	396.01														
150.37	395.62		396.37												



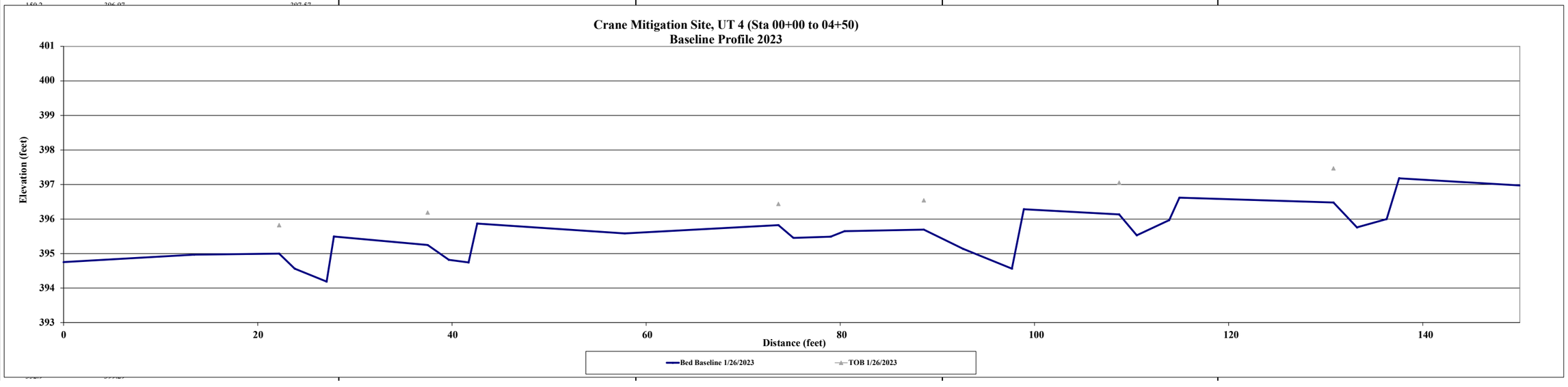
Project Name	Crane Mitigation Site - Baseline (2023) Profile
Reach	UT 3 (Sta 00+00 to 05+50)
Feature	Profile
Date	1/26/23
Crew	Perkinson, Smith

2023 Baseline Survey				As needed				As needed				As needed			
Station	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**
0.00	398.81														
8.88	398.50		399.19												
9.83	398.49														
12.71	398.58														
14.29	398.60														
22.21	398.73		399.14												
23.47	398.27														
28.17	398.32														
29.64	398.60														
40.01	398.70		399.26												
42.78	398.62														
44.63	398.54														
47.05	398.55														
49.10	399.00														
56.38	399.02		399.44												
58.18	398.72														
61.77	398.62														
66.00	398.93														
66.93	399.20														
76.56	399.29		399.78												
78.56	399.02														
81.97	398.89														
83.08	398.97														
93.54	399.05		399.76												
95.14	398.82														
100.85	398.16														
101.55	399.73														
107.40	399.48		400.09												



Project Name	Crane Mitigation Site - Baseline (2023) Profile
Reach	UT 4 (Sta 00+00 to 04+50)
Feature	Profile
Date	1/26/23
Crew	Perkinson, Smith

2023 Baseline Survey				As needed				As needed				As needed			
Station	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**
0.0	394.75														
13.5	394.97														
22.2	395.00		395.83												
23.8	394.56														
27.1	394.19														
27.8	395.50														
37.5	395.25		396.19												
39.7	394.82														
41.7	394.75														
42.6	395.87														
57.8	395.58														
73.6	395.83		396.44												
75.2	395.46														
79.0	395.49														
80.4	395.65														
88.6	395.69		396.54												
92.6	395.14														
97.7	394.57														
98.9	396.29														
108.7	396.13		397.06												
110.5	395.53														
113.9	395.97														
114.9	396.62														
130.8	396.48		397.47												
133.2	395.76														
136.3	396.00														
137.6	397.18														
150.2	396.07		397.57												



Project Name	Crane Mitigation Site - Baseline (2023) Profile
Reach	UT 5 (Sta 00+00 to 02+50)
Feature	Profile
Date	1/26/23
Crew	Perkinson, Smith

2023 Baseline Survey				As needed				As needed				As needed			
Station	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**	**Station**	**Bed Elevation**	**Water Elevation**	**TOB**
0.00	405.30														
25.13	405.35		406.27												
28.24	405.22														
32.78	405.20														
37.61	405.62														
45.39	405.42		406.51												
49.00	405.51														
53.94	405.46														
56.10	405.53														
72.60	405.47		406.31												
74.01	405.03														
79.62	404.52														
80.81	405.97														
96.46	405.48		406.45												
99.14	405.10														
103.70	404.16														
105.05	406.00														
120.25	405.90		406.73												
123.21	405.55														
132.98	405.49														
136.06	405.86														
144.95	405.95		407.00												
147.95	405.74														
155.63	405.25														
157.06	406.55														
173.62	406.26		407.09												
175.71	406.00														
180.70	405.27														

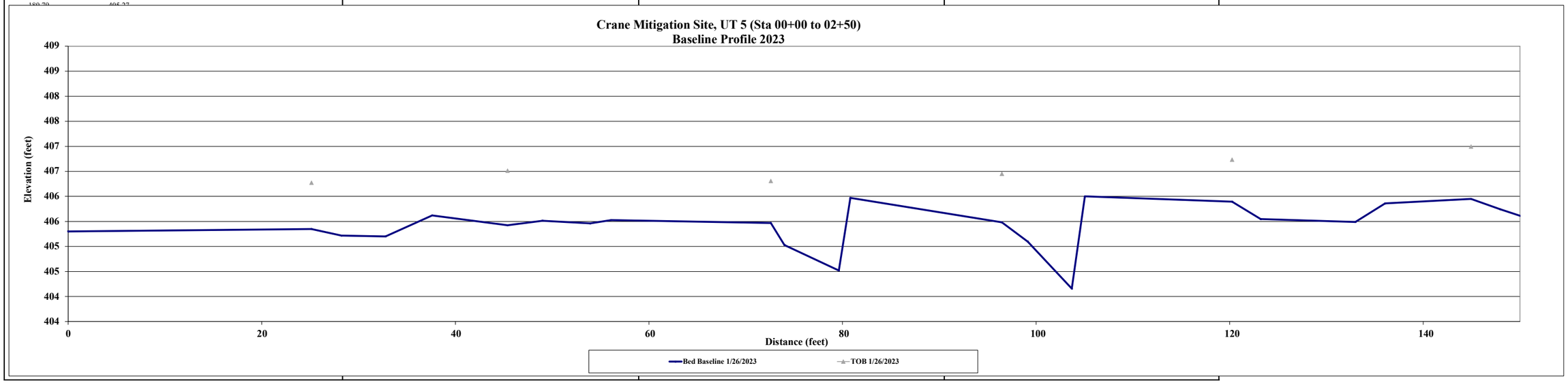


Table 9A. Baseline Stream Data Summary Crane - UT 1										
Parameter	**Pre-Existing Condition (applicable)**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	4.3	6.7		12.5		7.7	8.9	8.5	11.0	3
Floodprone Width (ft)	9	75		100		50	150	100	100	3
Bankfull Mean Depth (ft)	0.4	0.9		1.2		0.6	0.6	0.6	0.6	3
Bankfull Max Depth (ft)	0.9	1.8		2.9		0.7	1	0.9	1.0	3
Bankfull Cross Sectional Area (ft^2)	5	5		5		5	5	5.1	6.7	3
Width/Depth Ratio	3.6	10.6		31.3		12	16	13.9	17.9	3
Entrenchment Ratio	1.6	13		23.3		6.5	16.8	9.1	11.8	3
Bank Height Ratio	**1**	**1.7**		**2.8**		**1**	**1.3**	**1.0**	**1.0**	3
Max part size (mm) mobilized at bankfull										
Rosgen Classification	Eg 5					Ce 5		Ce 5		
Bankfull Discharge (cfs)	19					19		19		
Sinuosity (ft)	1.03					1.1		1.1		
Water Surface Slope (Channel) (ft/ft)	0.0179					0.0167		0.0167		
Other										

Table 9B. Baseline Stream Data Summary Crane - UT 2										
Parameter	**Pre-Existing Condition (applicable)**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	2.2	3.3		4.8		4.8	5.5	7.2	7.2	1
Floodprone Width (ft)	5	7		12		25	75	50.0	50.0	1
Bankfull Mean Depth (ft)	0.4	0.6		0.8		0.3	0.4	0.5	0.5	1
Bankfull Max Depth (ft)	0.6	1		1.4		0.4	0.6	1.0	1.0	1
Bankfull Cross Sectional Area (ft^2)	1.9	1.9		1.9		1.9	1.9	3.8	3.8	1
Width/Depth Ratio	2.8	6		12		12	16	13.8	13.8	1
Entrenchment Ratio	1.8	2.1		2.5		5.2	13.6	6.9	6.9	1
Bank Height Ratio	**2.2**	**2.5**		**3.1**		**1**	**1.3**	**1.0**	**1.0**	1
Max part size (mm) mobilized at bankfull										
Rosgen Classification	G 5					Ce 5		Ce 5		
Bankfull Discharge (cfs)	6.6					6.6		6.6		
Sinuosity (ft)	1.09					1.1		1.1		
Water Surface Slope (Channel) (ft/ft)	0.0145					0.0144		0.0144		
Other										

Table 9C. Baseline Stream Data Summary Crane - UT 3										
Parameter	**Pre-Existing Condition (applicable)**					**Design**		**Monitoring Baseline**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	2.1	3.4		4.2		3.8	4.4	7.8	7.8	1
Floodprone Width (ft)	4	23		50		25	75	50.0	50.0	1
Bankfull Mean Depth (ft)	0.3	0.4		0.6		0.3	0.3	0.5	0.5	1
Bankfull Max Depth (ft)	0.6	0.8		1.1		0.4	0.5	0.8	0.8	1
Bankfull Cross Sectional Area (ft^2)	1.2	1.2		1.2		1.2	1.2	3.9	3.9	1
Width/Depth Ratio	3.5	10.1		14		12	16	15.6	15.6	1
Entrenchment Ratio	1.3	8.1		23.8		6.6	17.1	6.4	6.4	1
Bank Height Ratio	**2**	**4**		**7.2**		**1**	**1.3**	**1.0**	**1.0**	1
Max part size (mm) mobilized at bankfull										
Rosgen Classification	Eg 5					Ce 5		Ce 5		
Bankfull Discharge (cfs)	4.2					4.2		4.2		
Sinuosity (ft)	1.01					1.1		1.1		
Water Surface Slope (Channel) (ft/ft)	0.0287					0.0264		0.0264		
Other										

Table 9D. Baseline Stream Data Summary Crane - UT 4										
Parameter	**Pre-Existing Condition (applicable)**					**Design**		**Monitoring Baseline**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	1.8	3.3		4.8		3.9	4.6	4.7	7.5	2
Floodprone Width (ft)	8	50		26		50	100	75.0	75.0	2
Bankfull Mean Depth (ft)	0.3	0.5		0.7		0.3	0.3	0.3	0.4	2
Bankfull Max Depth (ft)	0.4	0.8		1.2		0.4	0.5	0.5	0.6	2
Bankfull Cross Sectional Area (ft^2)	1.3	1.3		1.3		1.3	1.3	1.4	2.7	2
Width/Depth Ratio	2.6	8.9		16		12	16	15.6	20.8	2
Entrenchment Ratio	1.2	9.8		15.6		6.1	15.8	9.9	16.0	2
Bank Height Ratio	**1.3**	**1.9**		**2.8**		**1**	**1.3**	**1.0**	**1.0**	2
Max part size (mm) mobilized at bankfull										
Rosgen Classification	Eg 5					Ce 5		Ce 5		
Bankfull Discharge (cfs)	4.5					4.5		4.5		
Sinuosity (ft)	1.01					1.1		1.1		
Water Surface Slope (Channel) (ft/ft)	0.0145					0.0133		0.0133		
Other										

Table 9E. Baseline Stream Data Summary Crane - UT 5										
Parameter	**Pre-Existing Condition (applicable)**					**Design**		**Monitoring Baseline**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	3.7	4.1		4.7		6.1	7	10.3	10.3	1
Floodprone Width (ft)	6	8		11		50	150	100.0	100.0	1
Bankfull Mean Depth (ft)	0.6	0.7		0.8		0.4	0.5	0.4	0.4	1
Bankfull Max Depth (ft)	0.8	1		1.2		0.6	0.8	0.9	0.9	1
Bankfull Cross Sectional Area (ft^2)	3.1	3.1		3.1		3.1	3.1	4.4	4.4	1
Width/Depth Ratio	4.6	5.8		7.8		12	16	24.2	24.2	1
Entrenchment Ratio	1.3	1.9		2.6		8.2	21.3	9.7	9.7	1
Bank Height Ratio	**1.8**	**2.9**		**4.8**		**1**	**1.3**	**1.0**	**1.0**	1
Max part size (mm) mobilized at bankfull										
Rosgen Classification	Ge 5					Ce 5		Ce 5		
Bankfull Discharge (cfs)	11.3					11.3		11.3		
Sinuosity (ft)	1.01					1.1		1.1		
Water Surface Slope (Channel) (ft/ft)	0.0149					0.0136		0.0136		
Other										

Table 10A. Monitoring Data - Cross Section Morphology Monitoring Summary
(Crane/ DMS:100165) UT 1, UT 2, and UT 4

	UT 2 - Cross Section 1 (Pool)							UT 2 - Cross Section 2 (Riffle)							UT 4 - Cross Section 3 (Riffle)							UT 4 - Cross Section 4 (Pool)							UT 4 - 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	388.48							388.92							388.85							388.94							391.96						
Bank Height Ratio_Based on AB Bankfull[1] Area	NA							1.00							1.00							NA							1.00						
Thalweg Elevation	387.36							387.916							388.238							388.06							391.43						
LTOB[2] Elevation	388.48							388.918							388.85							388.94							391.96						
LTOB[2] Max Depth (ft)	1.12							1.00							0.61							0.88							0.53						
LTOB[2] Cross Sectional Area (ft^2)	5.1							3.8							2.7							3.0							1.4						
	UT 4 - Cross Section 6 (Pool)							**UT 1 - Cross Section 7 (Riffle)**							**UT 1 - Cross Section 8 (Pool)**																					
	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	392.04							389.84							389.72																					
Bank Height Ratio_Based on AB Bankfull[1] Area	NA							1.00							NA																					
Thalweg Elevation	391.06							388.831							388.24																					
LTOB[2] Elevation	392.04							389.842							389.72																					
LTOB[2] Max Depth (ft)	0.99							1.01							1.48																					
LTOB[2] Cross Sectional Area (ft^2)	3.0							6.7							9.7																					

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 bankfull 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
(Crane/ DMS:100165) UT 1, UT 3, and UT 5

	UT 3 - Cross Section 9 (Riffle)							UT 3 - Cross Section 10 (Pool)							UT 1 - Cross Section 11 (Riffle)							UT 1 - Cross Section 12 (Pool)							UT 5 - Cross Section 13 (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	394.72							394.40							395.05							395.00							399.13						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							NA							1.00							NA							1.00						
Thalweg Elevation	393.90							391.936							394.18							393.69							398.21						
LTOB[2] Elevation	394.72							394.399							395.05							395.00							399.13						
LTOB[2] Max Depth (ft)	0.82							2.46							0.87							1.31							0.92						
LTOB[2] Cross Sectional Area (ft^2)	3.9							5.3							5.1							8.0							4.4						
	UT 5 - Cross Section 14 (Pool)							**UT 1 - Cross Section 15 (Riffle)**							**UT 1 - Cross Section 16 (Pool)**																					
	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	398.95							408.40							408.81																					
Bank Height Ratio_Based on AB Bankfull[1] Area	NA							1.00							NA																					
Thalweg Elevation	398.20							407.442							406.67																					
LTOB[2] Elevation	398.95							408.401							408.81																					
LTOB[2] Max Depth (ft)	0.75							0.96							2.14																					
LTOB[2] Cross Sectional Area (ft^2)	4.0							5.8							12.9																					

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 bankfull 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

Groundwater Gauge Soil Profiles

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-1 35.363918, -79.223289**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-8	10 YR 4/2	100	-	-	-	-	Sand
8-24	10 YR 4/1	95	10 YR 4/6	5	C	M	Sandy Clay Loam
24+	4/10G	90	10 YR 4/6	10	C	M	Sandy Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-2 35.364841, -79.224065**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-8	10 YR 3/1	100	-	-	-	-	Sandy Loam
8-12	10 YR 5/1	97	10 YR 4/6	3	C	M	Sandy Loam
12+	10 YR 5/1	95	10 YR 4/6	5	C	M	Sandy Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-3 35.365244, -79.223755**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-18	10 YR 3/1	100	-	-	-	-	Sandy Loam
18-20	10 YR 3/1	95	10 YR 4/6	5	C	M	Sandy Clay Loam
20+	4/5BG	100	-	-	-	-	Sandy Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-4 35.365381, -79.223935**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-3	10 YR 3/1	100	-	-	-	-	Sandy Loam
3-8	10 YR 6/3	100	-	-	-	-	Sand
8+	10 YR 7/2	90	10 YR 5/6	10	C	M	Sandy Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-5 35.365311, -79.224294**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-30+	10 YR 2/1	100	-	-	-	-	Sandy Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-6 35.365957, -79.223721**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-24+	10 YR 3/1	100	-	-	-	-	Silty Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-7 35.36660, -79.224025**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-4	10 YR 3/1	100	-	-	-	-	Sandy Clay Loam
4-10	10 YR 4/1	95	10 YR 4/6	5	C	M	Sandy Clay Loam
10-24+	10 YR 4/1	90	10 YR 4/6	10	C	M	Sandy Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-8 35.366688, -79.223695**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-8	10 YR 4/1	100	-	-	-	-	Sandy Loam
8-12	10 Yr 4/2	100	-	-	-	-	Sandy Loam
12-24	10 YR 4/2	93	10 YR 4/6	7	C	M	Sandy Clay Loam
24+	10 YR 4/2	90	10 YR 4/6	10	C	M	Sandy Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-9 35.366699, -79.223292**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-30+	10 YR 2/1	100	-	-	-	-	Sandy Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-10 35.366487, -79.222511**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-20	10 YR 3/1	100	-	-	-	-	Silty Clay Loam
20+	4/5 BG	100	-	-	-	-	Silty Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-11 35.366820, -79.222421**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-8	10 YR 3/1	100	-	-	-	-	Silty Clay Loam
8-30	4/5 BG	100	-	-	-	-	Silty Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW-12 35.367102, -79.222764**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-24+	10 YR 3/1	100	-	-	-	-	Sandy Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW13 35.367350, -79.223216**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling				Texture
	Color	%	Color	%	Type	Location	
0-4	10 YR 3/1	100	-	-	-	-	Sandy Clay Loam
4-18	10 YR 4/2	93	10 YR 4/6	7	C	M	Sandy Clay Loam
18+	10 YR 5/1	100	-	-	-	-	Sandy Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW14 35.367330, -79.224318**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-12	10 YR 2/1	100	-	-	-	-	Sandy Loam
12-30+	10 YR 5/2	97	10 YR 4/6	3	C	M	Sandy Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Locaction: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 2/14/2023

Project/Site: 20-032/Crane

County, State: Lee, North Carolina

Sampling Point/
Coordinates: **GW15 35.367921, -79.223351**

Investigator: W. Grant Lewis

Soil Series:

Notes:

Depth (inches)	Matrix		Mottling		Type	Location	Texture
	Color	%	Color	%			
0-4	10 YR 2/1	100	-	-	-	-	Sandy Loam
4-8	10 YR 4/1	100	-	-	-	-	Sandy Loam
8-20+	10 YR 3/1	100	-	-	-	-	Sandy Clay Loam

Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. Location: PL=Pore Lining, M=Matrix.

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

Appendix E: Project Timeline and Contact Info

Table 11. Project Timeline
Table 12. Project Contacts

Table 11. Project Timeline

Activity or Deliverable	Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted	NA	30-Jul-20
Mitigation Plan Approved	NA	14-Feb-22
Construction (Grading) Completed	NA	15-Jul-22
Planting Completed	NA	3-Feb-23
As-built Survey Completed	NA	1-Mar-23
MY-0 Baseline Report	Jan-23	Mar-23
MY1+ Monitoring Reports		
Remediation Items (e.g. beaver removal, supplements, repairs etc.)		
Encroachment		

Table 12. Project Contacts

Crane Site/100165	
Provider	Restoration Systems, LLC 1101 Haynes Street, Suite 211 Raleigh, NC 27604
Mitigation Provider POC	Ray Holz 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
Primary construction POC	Charles Hill 919-639-6132

Appendix F: Record Drawings (As-Built Survey)

NC DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES

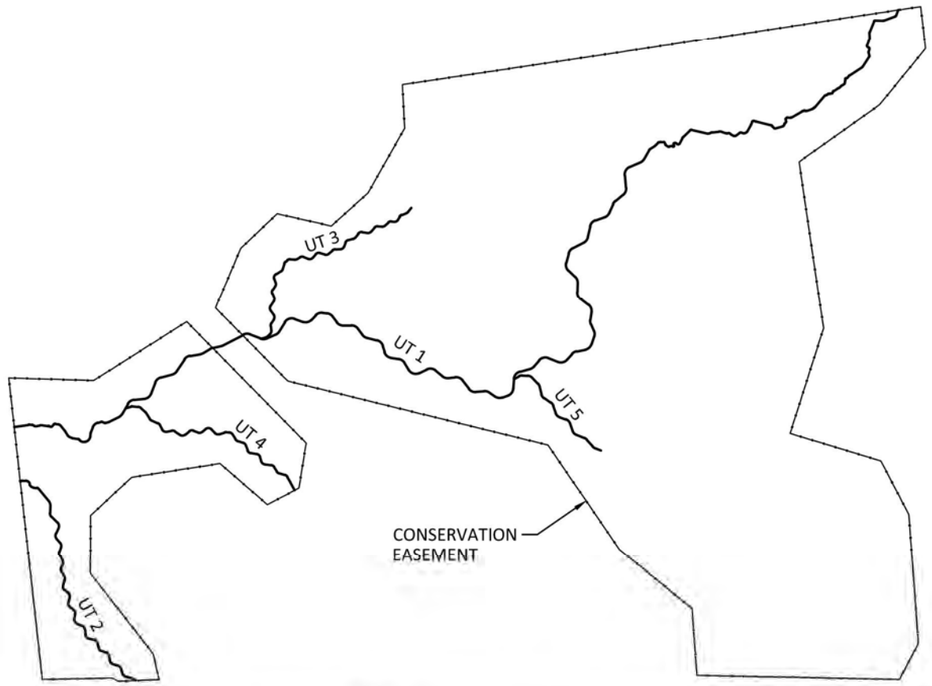
AS-BUILT DRAWINGS
CRANE MITIGATION SITE
LEE COUNTY, NORTH CAROLINA
DATE: MAY 2, 2023

REVISIONS

NO.	DATE	
1	05.02.2023	NCDMS AS-BUILT COMMENTS

SHEET INDEX

SITE DATA TABLE	
RIVER BASIN	CAPE FEAR
8-DIGIT HUC	03030004
TOTAL DISTURBED AREA	30.9 AC
DMS PROJECT ID NO.	100165
FULL DELIVERY CONTRACT NO.	0302-01
USACE ACTION ID NO.	SAW-2020-01401
DWR PROJECT NO.	20201292
RFP NO.	16-20190302
COORDINATE SYSTEM	NAD83 NORTH CAROLINA STATE PLANES, US FOOT

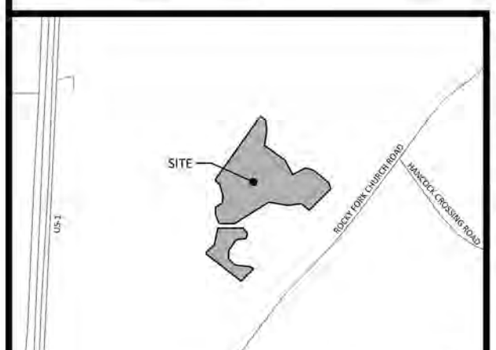


GRAPHIC SCALE
0 150 300 600
1 inch = 300 ft.

TOTAL DISTURBED AREA = 30.9 AC.

MITIGATION SUMMARY

TRIBUTARY	PROPOSED LENGTH
UT1	2428
UT2	525
UT3	463
UT4	422
UT5	243



VICINITY MAP
1" = 2000'

RESTORATION LEVEL	STREAM (LF)	RIPARIAN WETLAND (AC)	NON-RIPARIAN WETLAND (AC)
RESTORATION	3165	-	-
ENHANCEMENT II	915	-	-
REESTABLISHMENT	-	8.815	-
REHABILITATION	-	0.683	-
ENHANCEMENT	-	10.646	-
TOTALS	4180	20.144	-
MITIGATION UNITS	3533	14.593	-

*TOTAL STREAM MITIGATION UNITS INCLUDE UNITS FROM THE WIDER BUFFER TOOL
*STRAIGHT-LINE VALLEY LENGTH IS USED FOR UT1-R1 CREDIT CALCULATION
*WETLAND REHABILITATION, ENHANCEMENT, PRESERVATION, AND SOME RE-ESTABLISMENT ARE NOT CREDIT GENERATING.

The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

www.mcadamsco.com

AXIOM ENVIRONMENTAL, INC
218 SNOW AVENUE
RALEIGH, NC 27603
CONTACT: GRANT LEWIS
PHONE: 919.215.1693

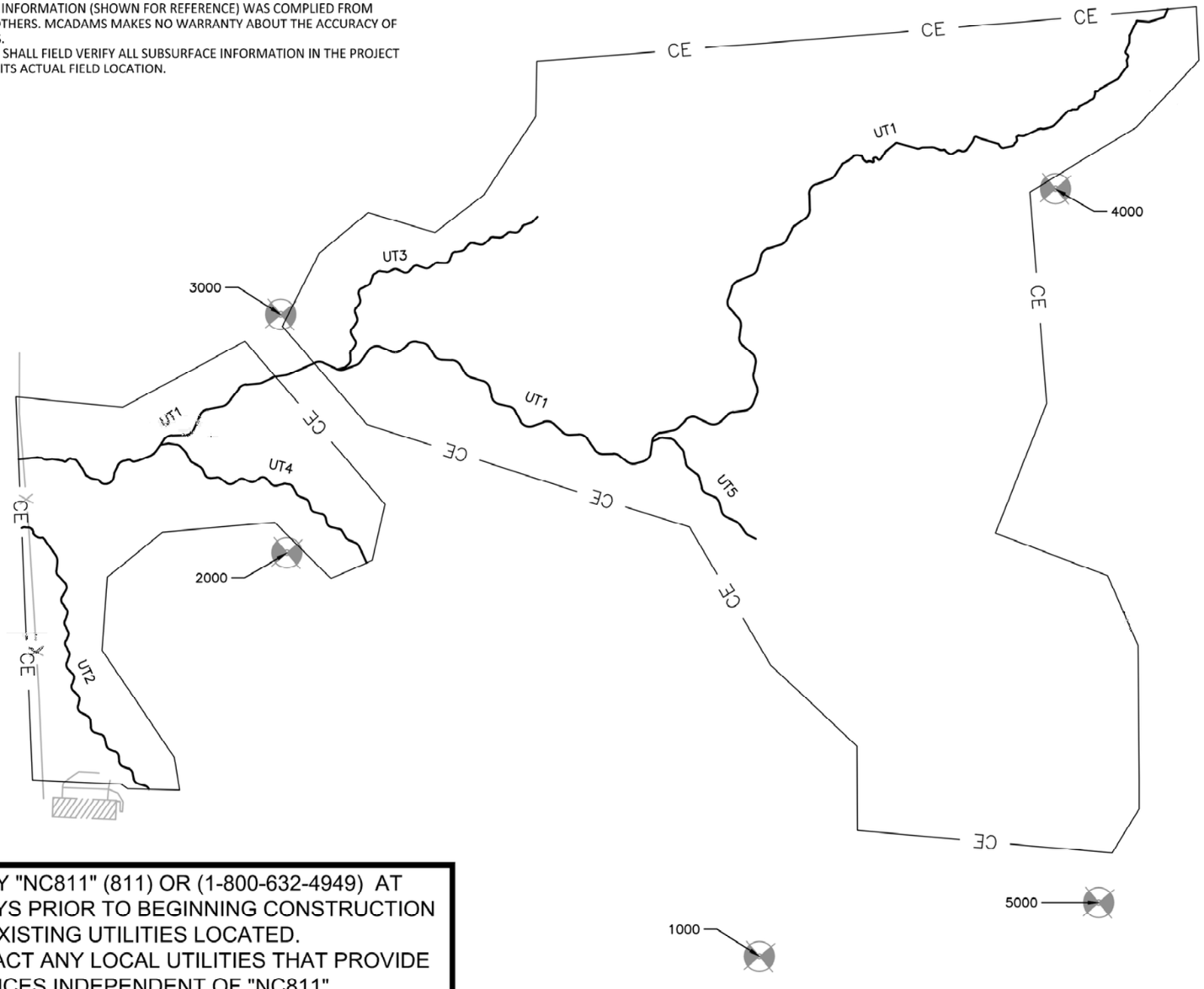
CLIENT
RESTORATION SYSTEMS, LLC
1101 HAYNES ST, SUITE 211
RALEIGH, NC 27604
CONTACT: WORTH CREECH
PHONE: 919.389.3888

RECORD DRAWINGS ONLY
Rebecca Stubbs
NORTH CAROLINA PROFESSIONAL SEAL 049073 ENGINEER REBECCA STUBBS
RECORD DRAWINGS ONLY
Digitally signed by Rebecca Stubbs
DN: cn=Rebecca Stubbs, c=US, o=North Carolina, e=rstubbs@mcadamsco.com
Date: 2023.05.02 13:36:51 -04'00'

GENERAL NOTES:

1. COORDINATE SYSTEM: NAD83 NORTH CAROLINA STATE PLANES, US FOOT
2. TOPOGRAPHY AND SPOT ELEVATIONS SHOWN ARE FROM AN ACTUAL FIELD SURVEY COMPLETED BY K2 DESIGN GROUP.
3. PLANIMETRICS, UTILITIES, INVERTS AND BUILDING INFORMATION (SHOWN FOR REFERENCE) WAS COMPLIED FROM AUTOCAD FILES PROVIDED TO MCADAMS FROM OTHERS. MCADAMS MAKES NO WARRANTY ABOUT THE ACCURACY OF THE INFORMATION SHOWN PROVIDED BY OTHERS.
4. PRIOR TO CONSTRUCTION, THE SITE CONTRACTOR SHALL FIELD VERIFY ALL SUBSURFACE INFORMATION IN THE PROJECT AREA TO ENSURE ITS ACCURACY AND DETERMINE ITS ACTUAL FIELD LOCATION.

CONTROL POINT LOCATIONS			
CONTROL POINT	NORTHING	EASTING	ELEVATION
1000	588051.47.48	1934363.0374	427.77
2000	587894.5162	1933401.5353	403.58
3000	588128.5384	1933110.0405	401.83
4000	589182.9861	1933744.0866	432.14
5000	588511.6462	1934642.2517	428.97



Know what's **below.**
Call before you dig.

CONTRACTOR SHALL NOTIFY "NC811" (811) OR (1-800-632-4949) AT LEAST 3 FULL BUSINESS DAYS PRIOR TO BEGINNING CONSTRUCTION OR EXCAVATION TO HAVE EXISTING UTILITIES LOCATED. CONTRACTOR SHALL CONTACT ANY LOCAL UTILITIES THAT PROVIDE THEIR OWN LOCATOR SERVICES INDEPENDENT OF "NC811". REPORT ANY DISCREPANCIES TO THE ENGINEER IMMEDIATELY.

GRAPHIC SCALE
0 100 200 400
1 inch = 200 ft.

RECORD DRAWINGS ONLY
NORTH CAROLINA
PROFESSIONAL SEAL
Rebecca Stubbs
Rebecca Stubbs PE Feb 27 2023 1:05:11
049073
ENGINEER
REBECCA STUBBS
RECORD DRAWINGS ONLY

The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

www.mcadamsco.com

McADAMS

CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

Axiom Environmental, Inc.

PLAN INFORMATION

PROJECT NO.	2021110220
FILENAME	C1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=200'
DATE	02.17.2023

CONSERVATION EASEMENT AND CONTROL POINTS

C1.00

EXISTING / PROPOSED LEGEND AND SYMBOLS

CE — PROPOSED CONSERVATION EASEMENT

PROPERTY LINE

250 — EXISTING MAJOR CONTOUR

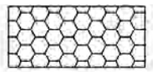
EXISTING MINOR CONTOUR

EXISTING STREAM CENTERLINE

EXISTING TOP OF BANK

EXISTING FENCING

10+00 — PROPOSED STREAM CENTERLINE



PROPOSED RIFFLE

PROPOSED LOG CROSS VANE

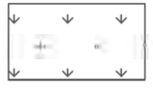
PROPOSED LOG VANE

PROPOSED SILL STEP

PROPOSED LOG SILL

WETLAND ENHANCEMENT

WETLAND REHABILITATION



WETLAND RE-ESTABLISHMENT

AS-BUILT LEGEND AND SYMBOLS

250 — MAJOR CONTOUR

MINOR CONTOUR

STREAM CENTERLINE

TOP OF BANK

X — X — FENCE

LOG CROSS VANE

LOG VANE

LOG SILL STEP

MONITORING – VEGETATION PLOT

MONITORING – CROSS SECTION

MONITORING – STREAM GAGUE

MONITORING – GROUNDWATER WELL

MONITORING – RAIN GAGUE

RECORD DRAWINGS ONLY
NORTH CAROLINA
PROFESSIONAL SEAL
Rebecca Stubbs
Feb 27 2023 1:16 PM
Rebecca Stubbs, PE
049073
ENGINEER
REBECCA STUBBS
RECORD DRAWINGS ONLY

MCADAMS

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Durham, NC 27713

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fax 919. 361. 2269
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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

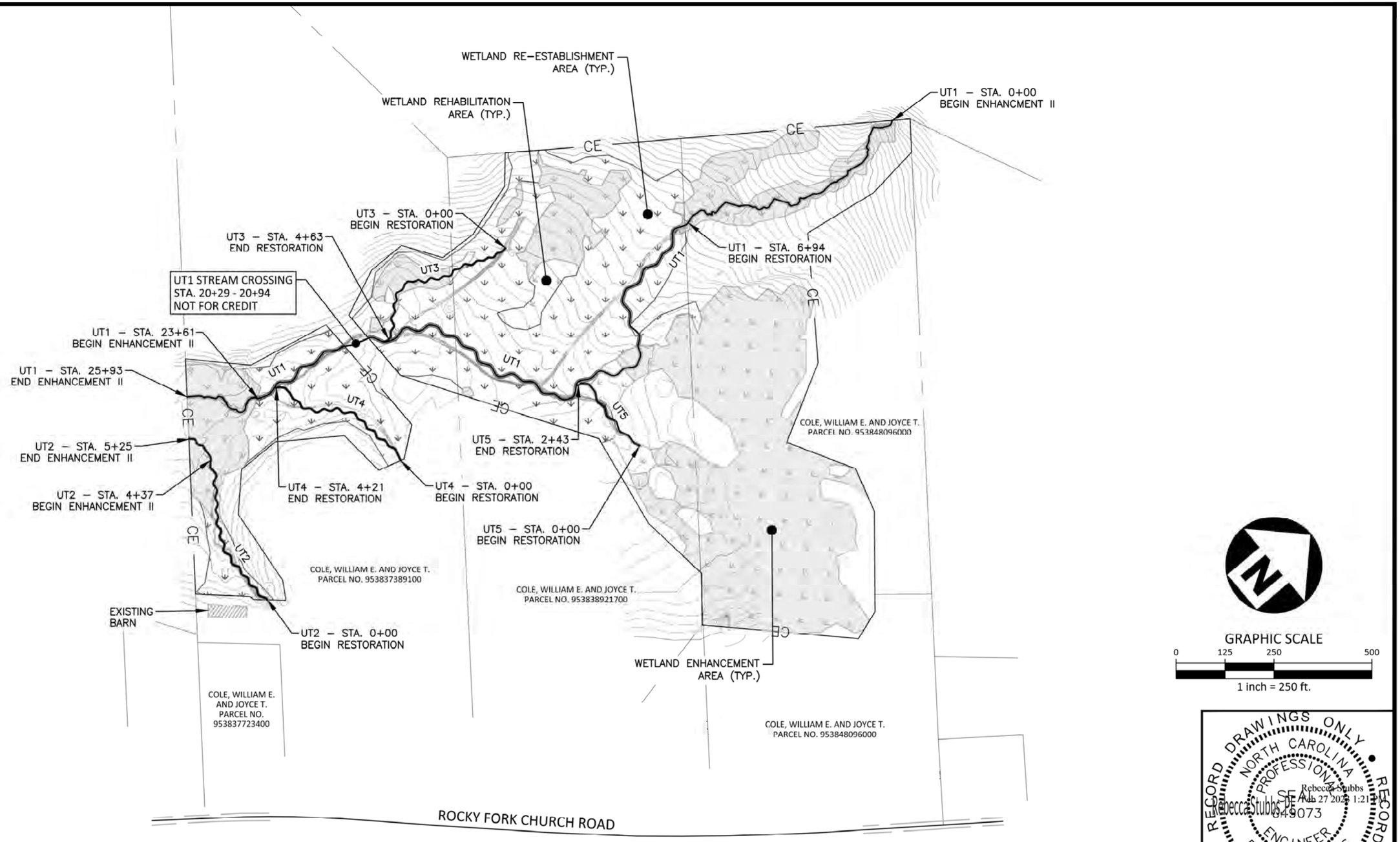
RESTORATION SYSTEMS | LLC

Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	C1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	
DATE	02.17.2023

LEGEND AND SYMBOLS

C1.01



GRAPHIC SCALE

0 125 250 500

1 inch = 250 ft.

RECORD DRAWINGS ONLY
NORTH CAROLINA PROFESSIONAL SEAL
Rebecca Stubbs
Rebecca Stubbs PE Feb 27 2023 1:21 PM
049073
ENGINEER
REBECCA STUBBS
RECORD DRAWINGS ONLY

The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

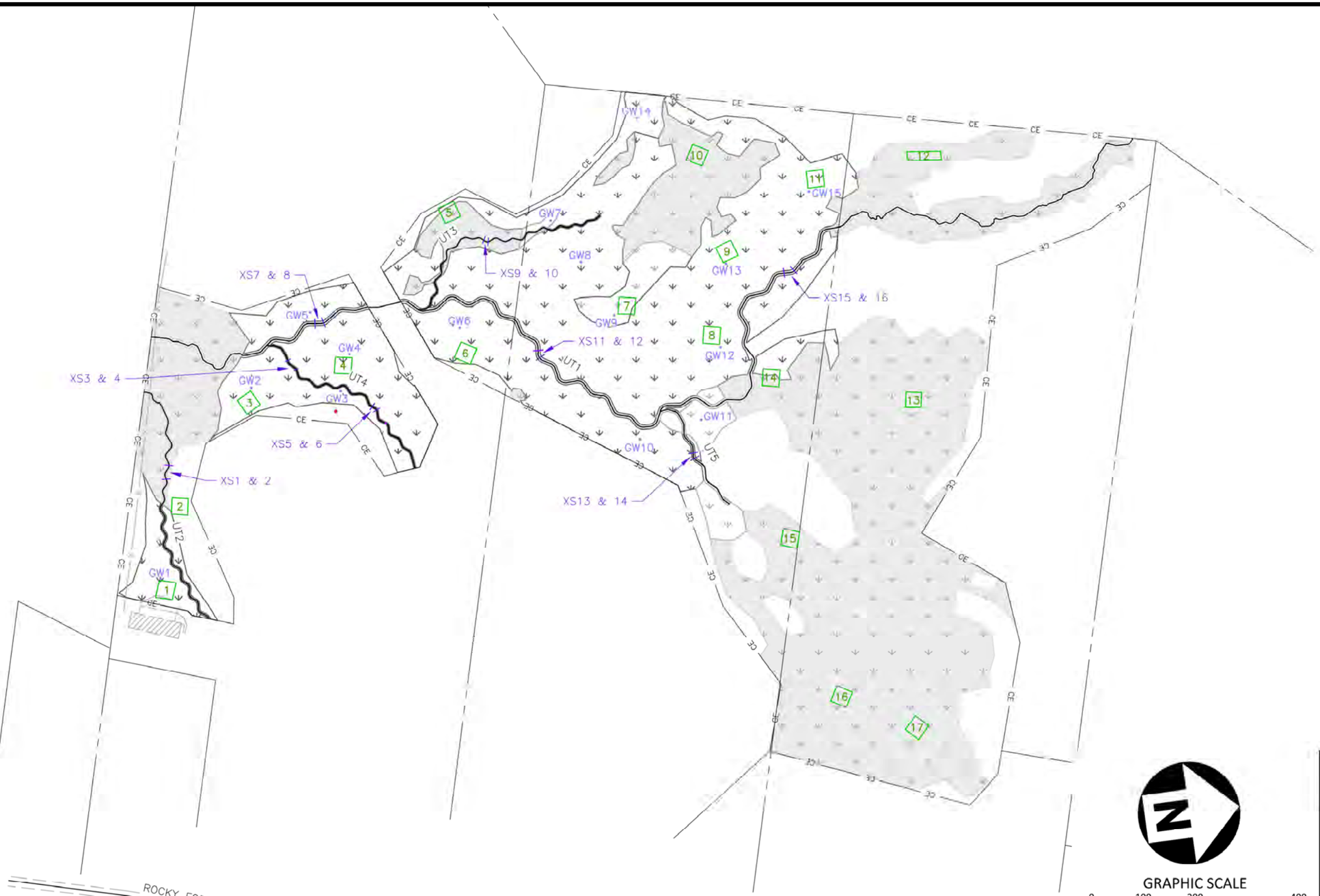
LEE COUNTY, NORTH CAROLINA

Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	C1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=250'
DATE	02.17.2023

PROJECT OVERVIEW

C1.02



GRAPHIC SCALE

0 100 200 400

1 inch = 200 ft.

RECORD DRAWINGS ONLY
NORTH CAROLINA
PROFESSIONAL SEAL
049073
ENGINEER
REBECCA STUBBS
Rebecca Stubbs
Aug 27 2023 1:25 PM
Rebecca Stubbs, PE

McADAMS

The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS | LLC

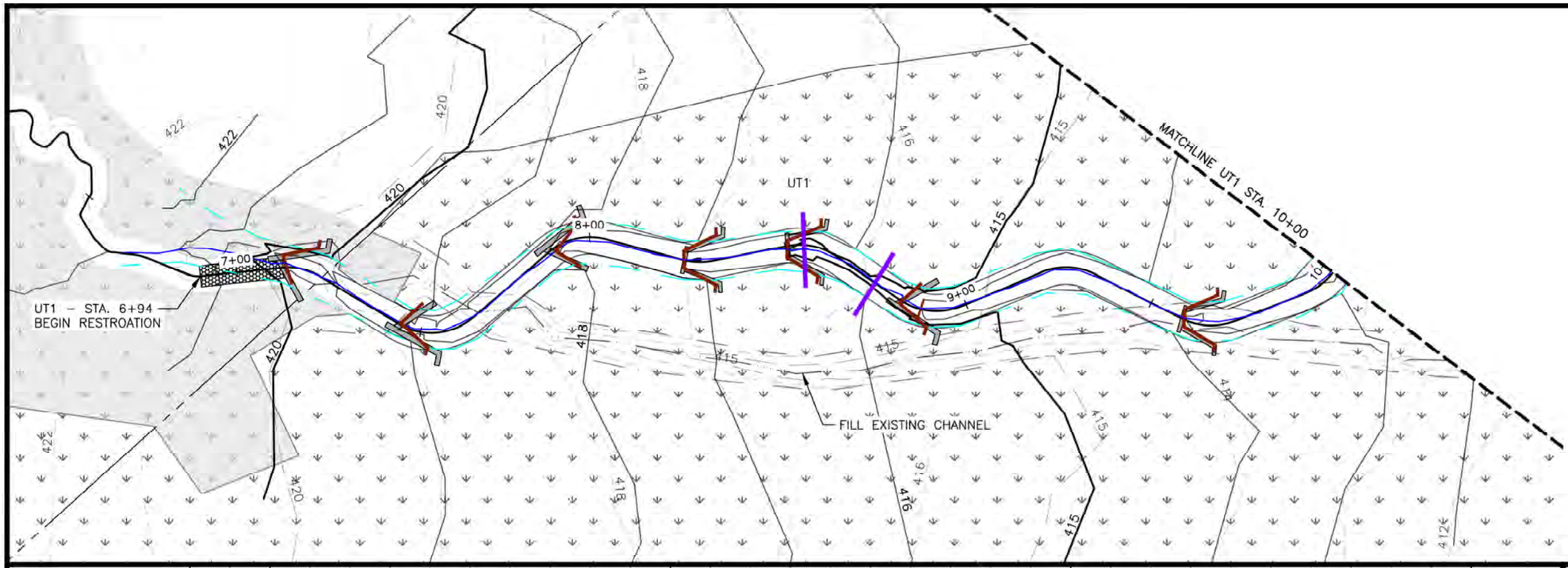
Axiom Environmental, Inc.

PLAN INFORMATION

PROJECT NO.	2021110220
FILENAME	C3
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=200'
DATE	02.17.2023

SITE MONITORING LAYOUT

C1.03



GRAPHIC SCALE

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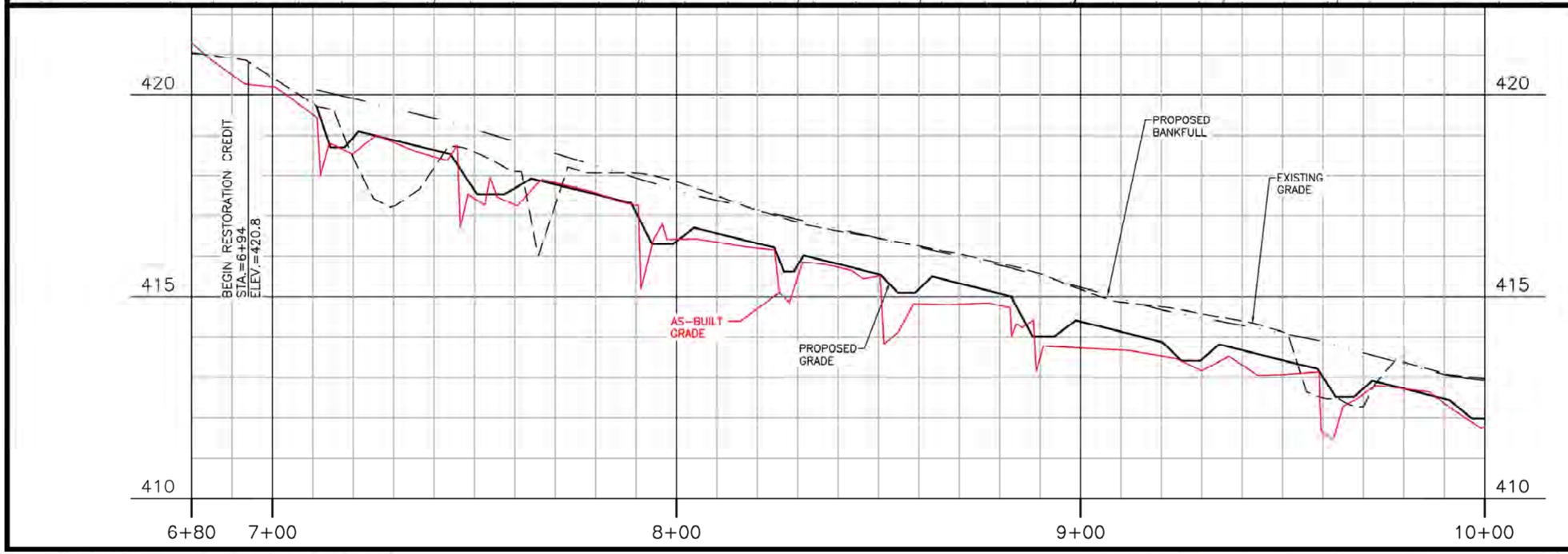
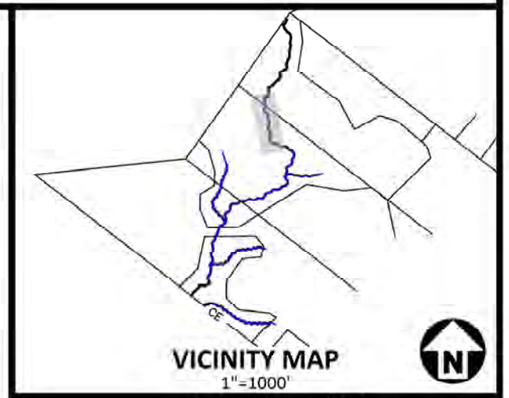
1 inch = 30 ft.

TOTAL DISTURBED AREA = 30.9 AC.





RECORD DRAWINGS ONLY
NORTH CAROLINA PROFESSIONAL SEAL
Rebecca Stubbs
Feb 27 2023 1:43:
Rebecca Stubbs, PE
049073
ENGINEER
REBECCA STUBBS
RECORD DRAWINGS ONLY

The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS | LLC

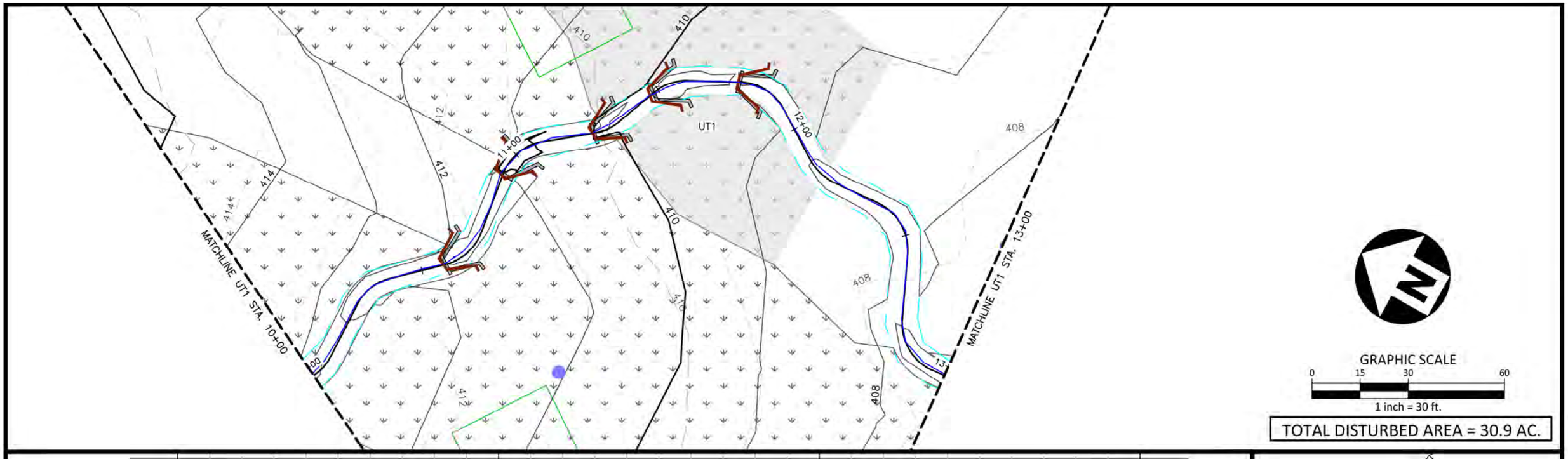
Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=30'
DATE	02.17.2023

PLAN AND PROFILE

UT1 STA 6+80 - 10+00

C5.00

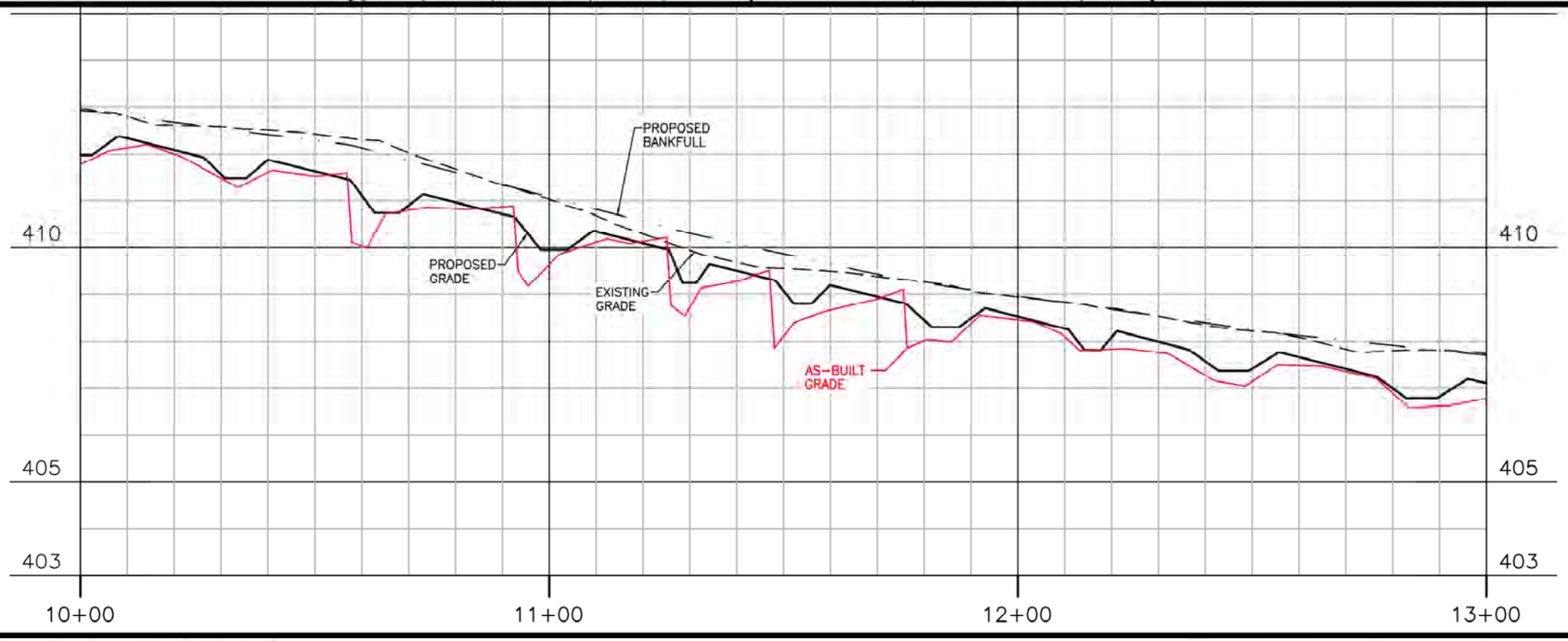


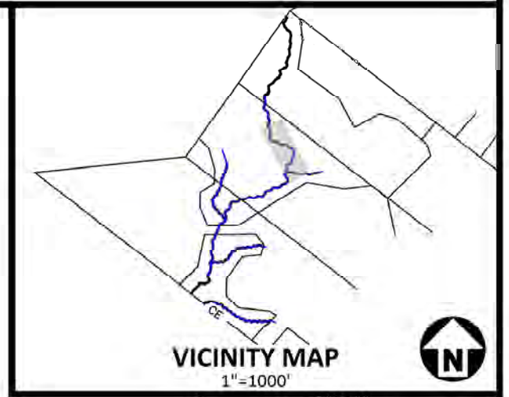
GRAPHIC SCALE

0 15 30 60

1 inch = 30 ft.

TOTAL DISTURBED AREA = 30.9 AC.





RECORD DRAWINGS ONLY
NORTH CAROLINA PROFESSIONAL SEAL 049073 ENGINEER REBECCA STUBBS
Rebecca Stubbs
Aug 27 2023 1:43 PM

The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

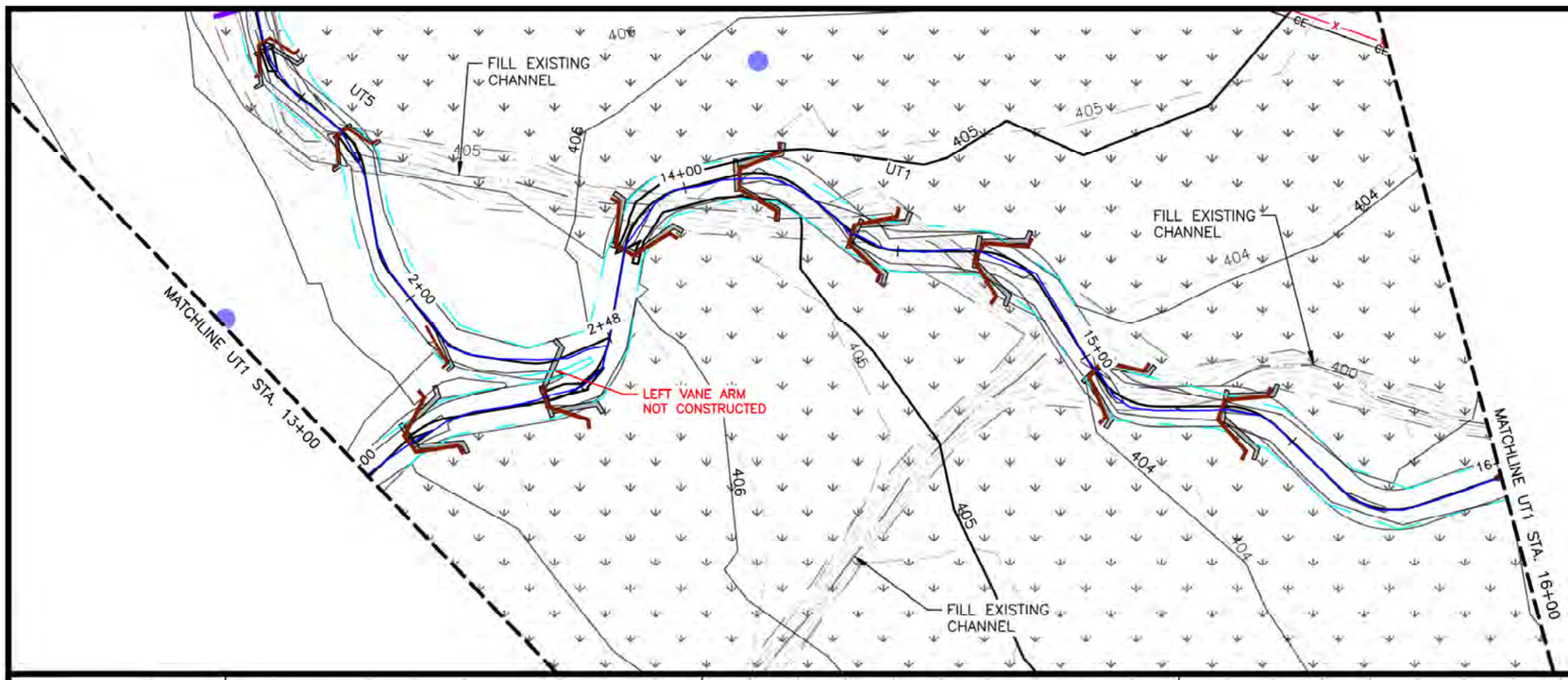
Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=30'
DATE	02.17.2023

PLAN AND PROFILE

UT1 STA 10+00 - 13+00

C5.01

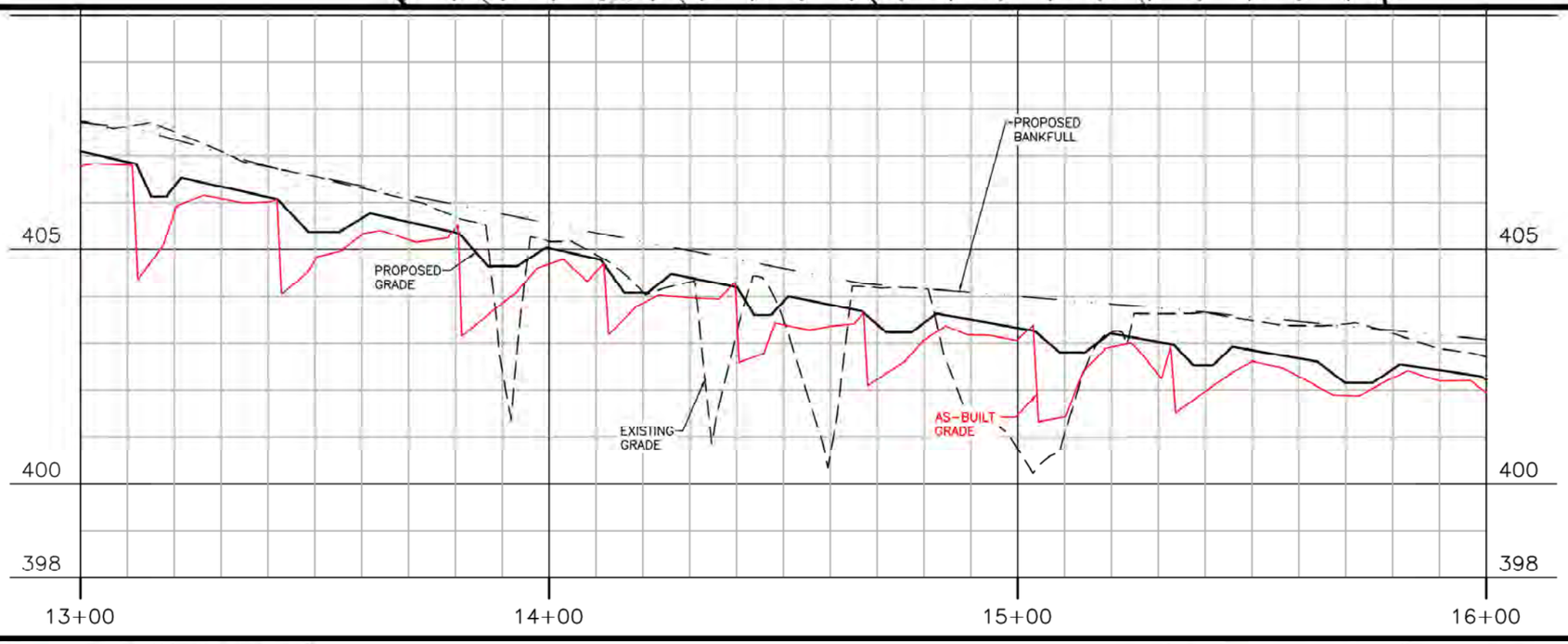


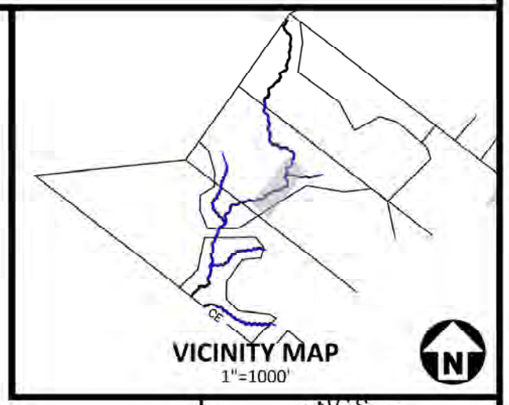
GRAPHIC SCALE

0 15 30 60

1 inch = 30 ft.

TOTAL DISTURBED AREA = 30.9 AC.





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The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

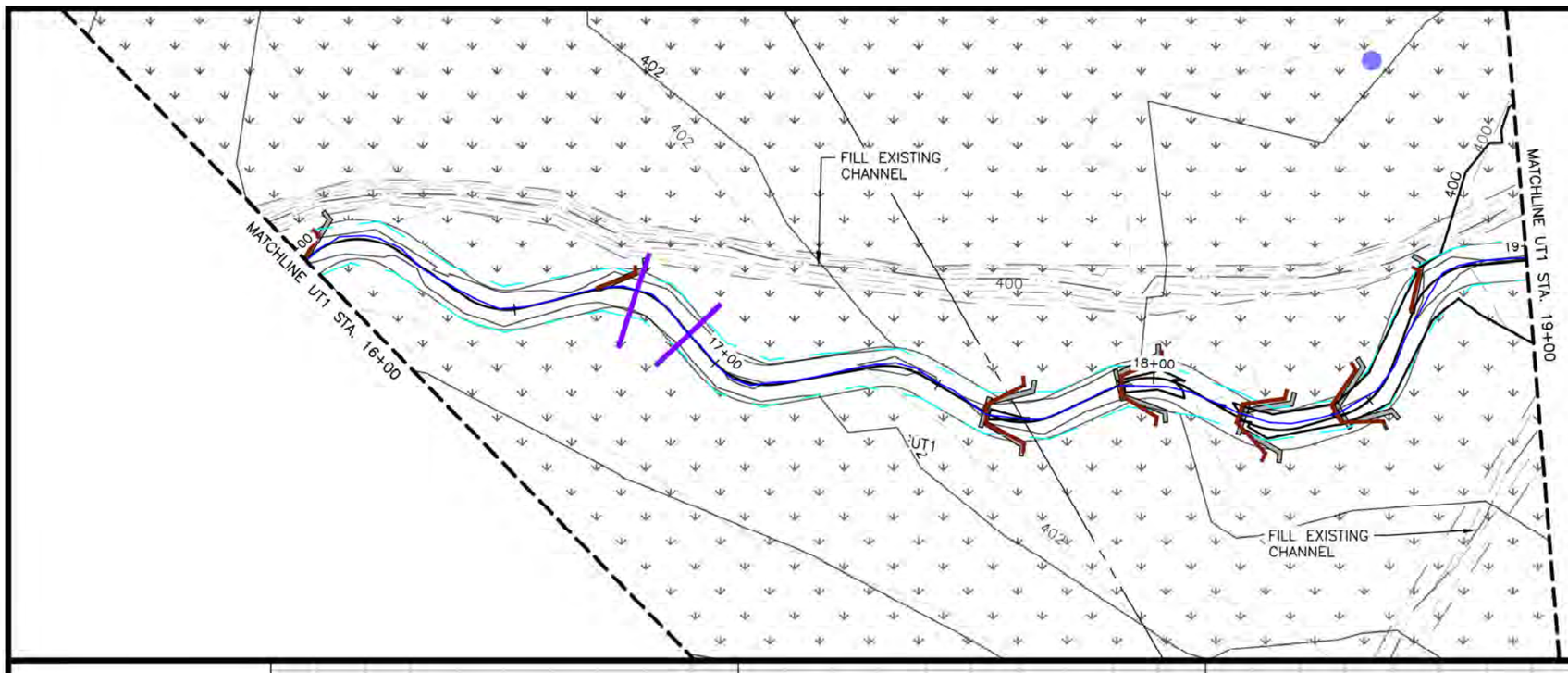
Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=30'
DATE	02.17.2023

PLAN AND PROFILE

UT1 STA 13+00 - 16+00

C5.02

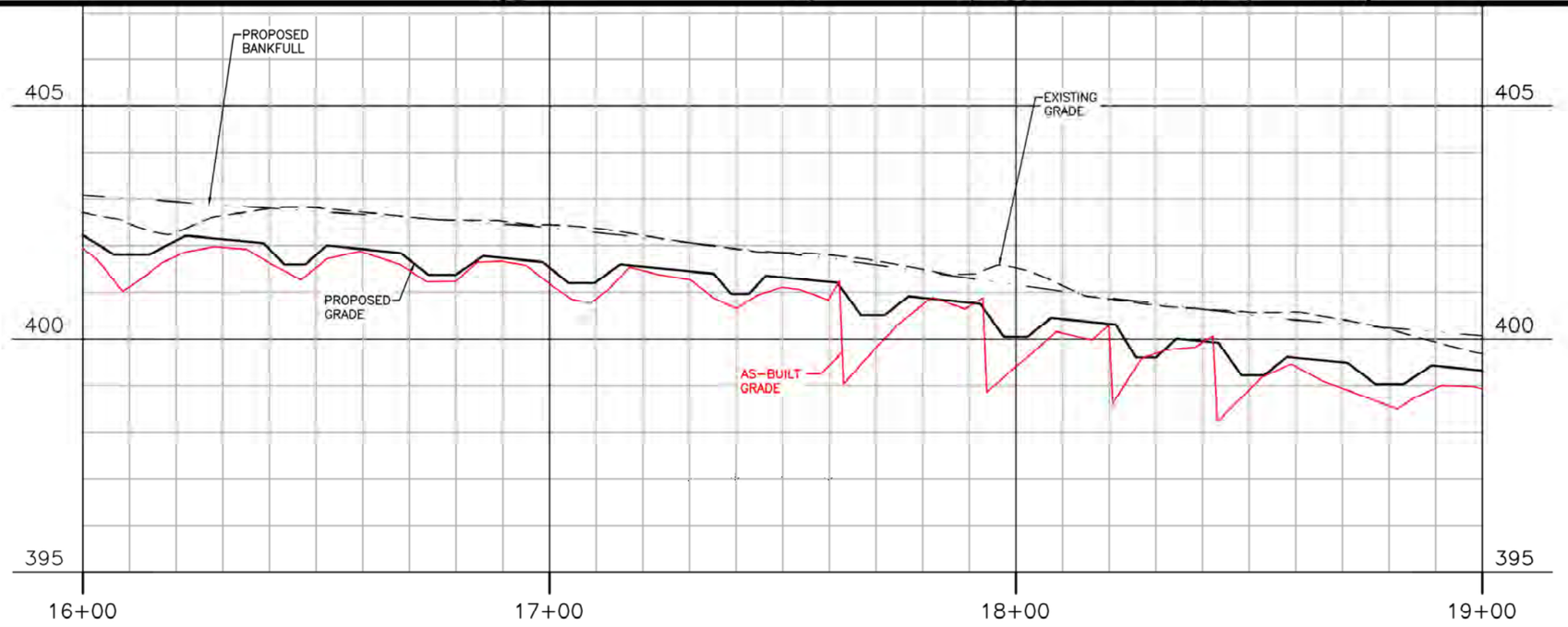


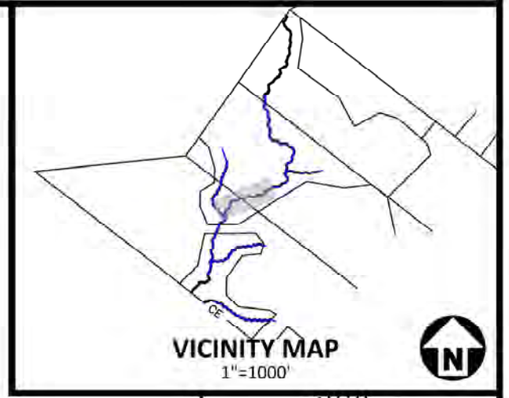
GRAPHIC SCALE

0 15 30 60

1 inch = 30 ft.

TOTAL DISTURBED AREA = 30.9 AC.





RECORD DRAWINGS ONLY
NORTH CAROLINA PROFESSIONAL SEAL 049073 ENGINEER REBECCA STUBBS
Rebecca Stubbs
Feb 27 2023 1:44 PM
RebeccaStubbs,PE

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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

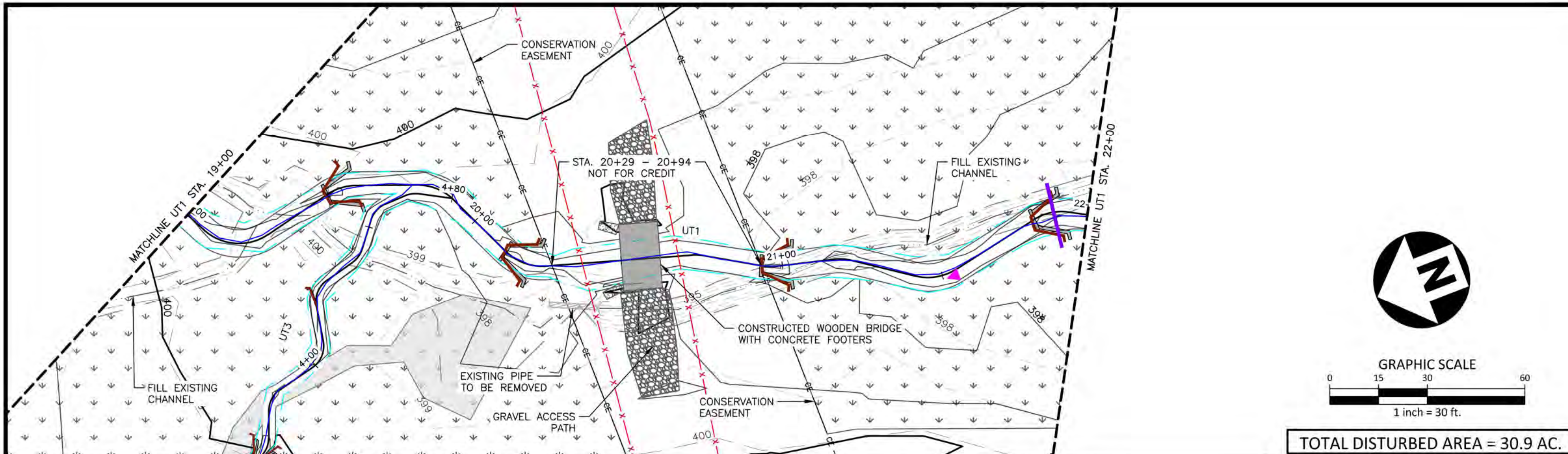
Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=30'
DATE	02.17.2023

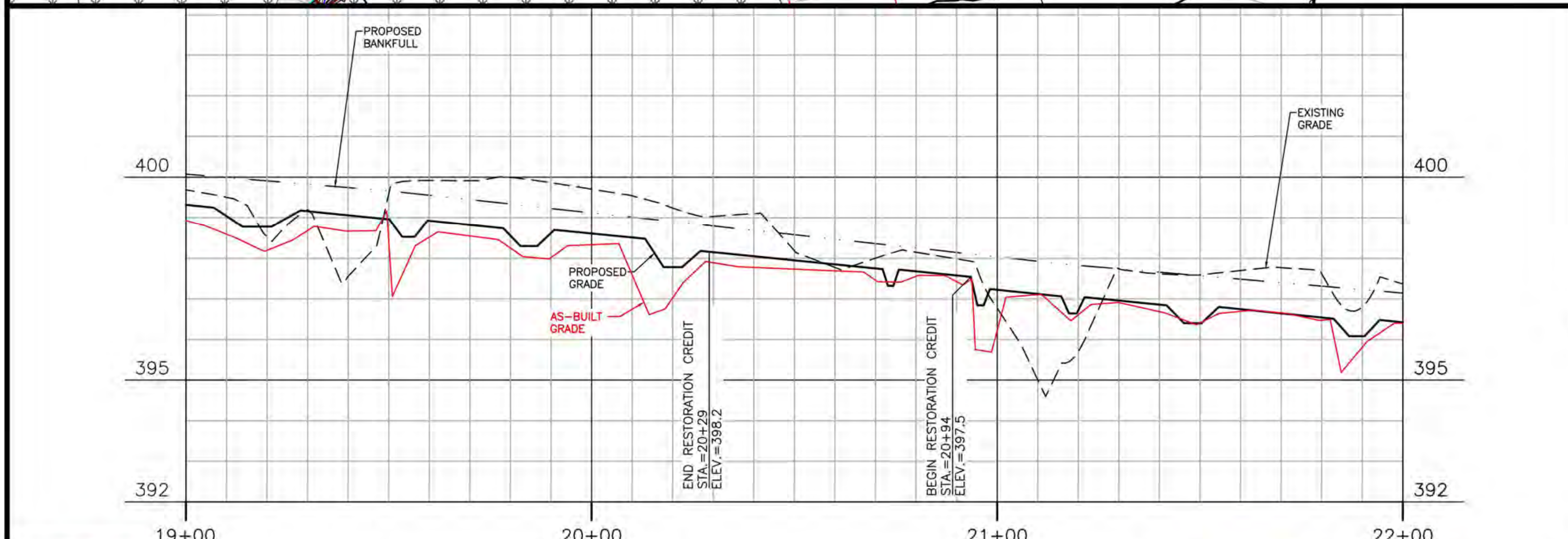
PLAN AND PROFILE

UT1 STA 16+00 - 19+00

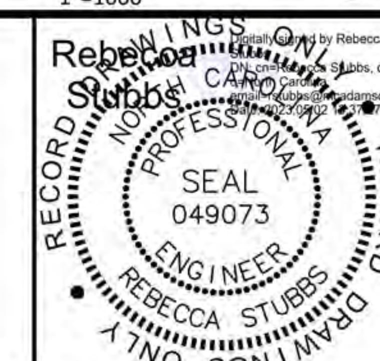
C5.03



TOTAL DISTURBED AREA = 30.9 AC.



VICINITY MAP
1"=1000'



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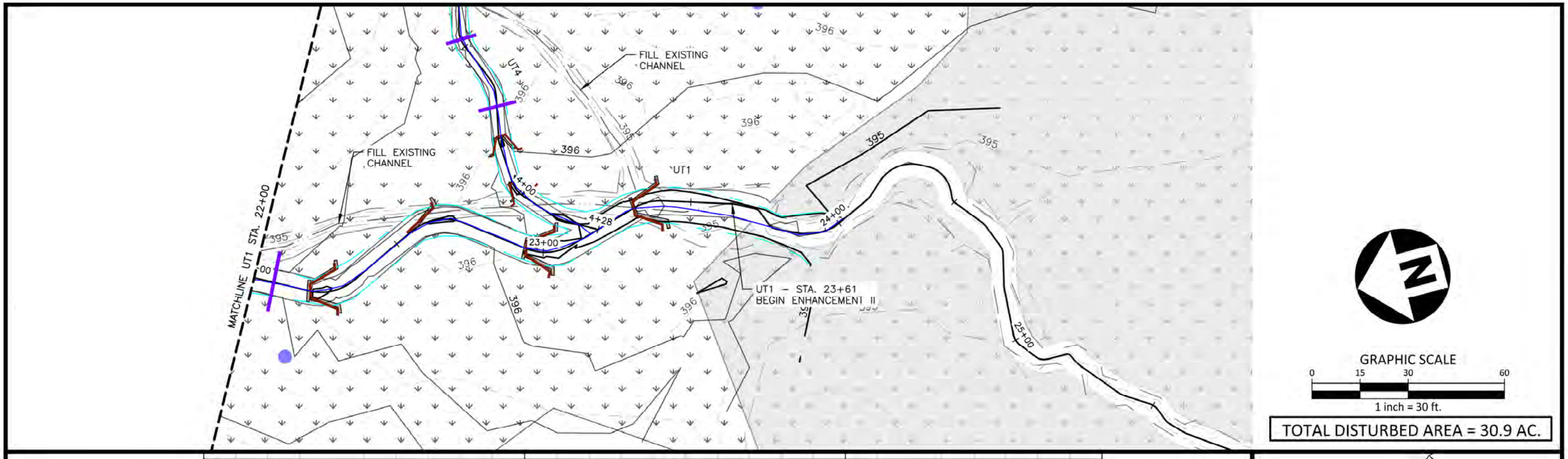
PLAN INFORMATION

PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=30'
DATE	05.02.2023

PLAN AND PROFILE
UT1 STA 19+00 - 22+00

C5.04

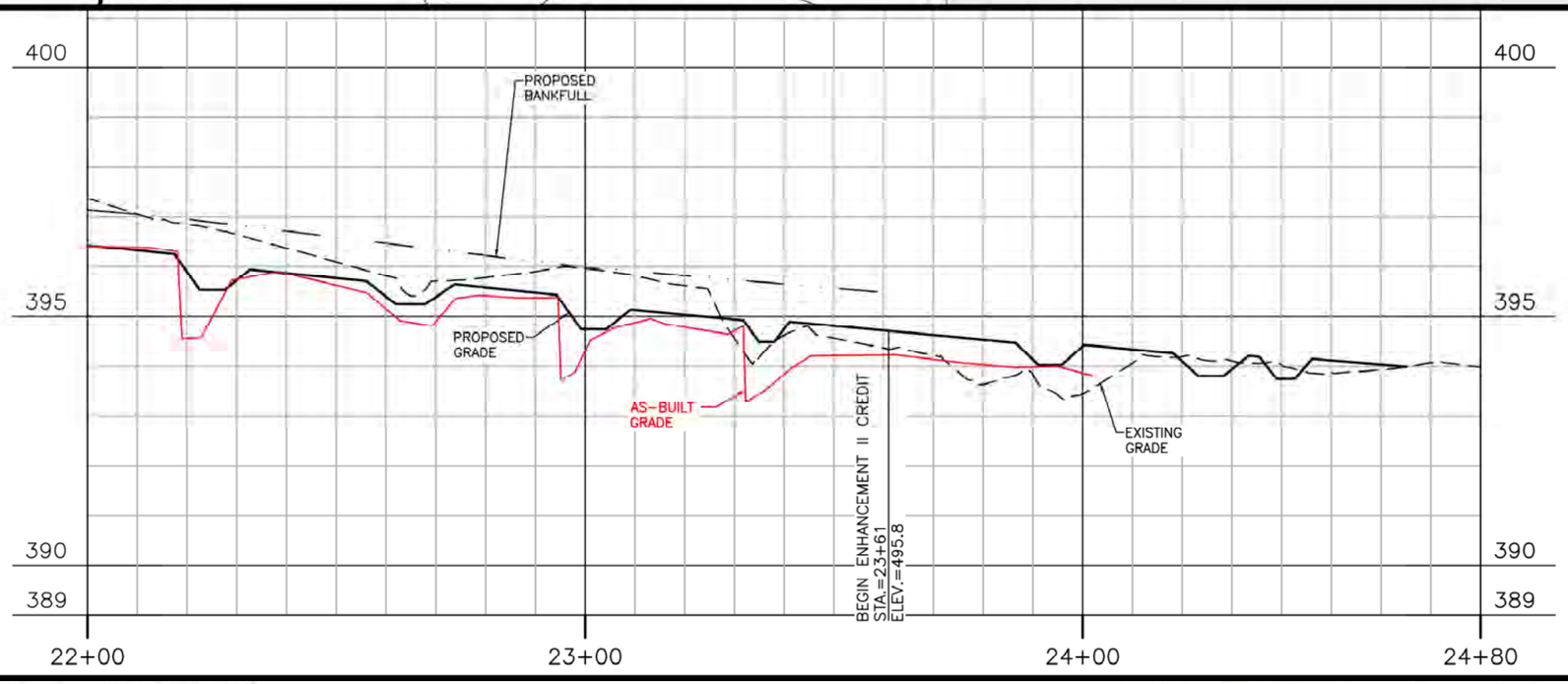


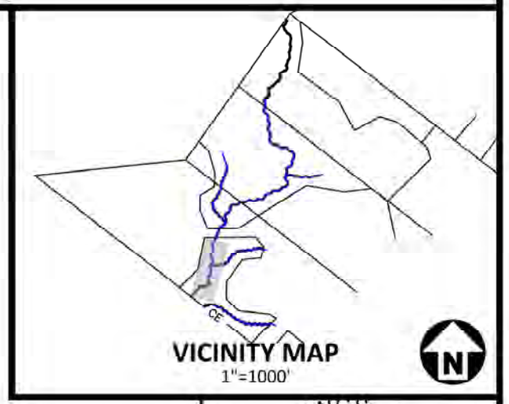
GRAPHIC SCALE

0 15 30 60

1 inch = 30 ft.

TOTAL DISTURBED AREA = 30.9 AC.





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NORTH CAROLINA PROFESSIONAL SEAL 049073 ENGINEER REBECCA STUBBS
Rebecca Stubbs, PE
Rebecca Stubbs
Aug 27 2023 1:44:

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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

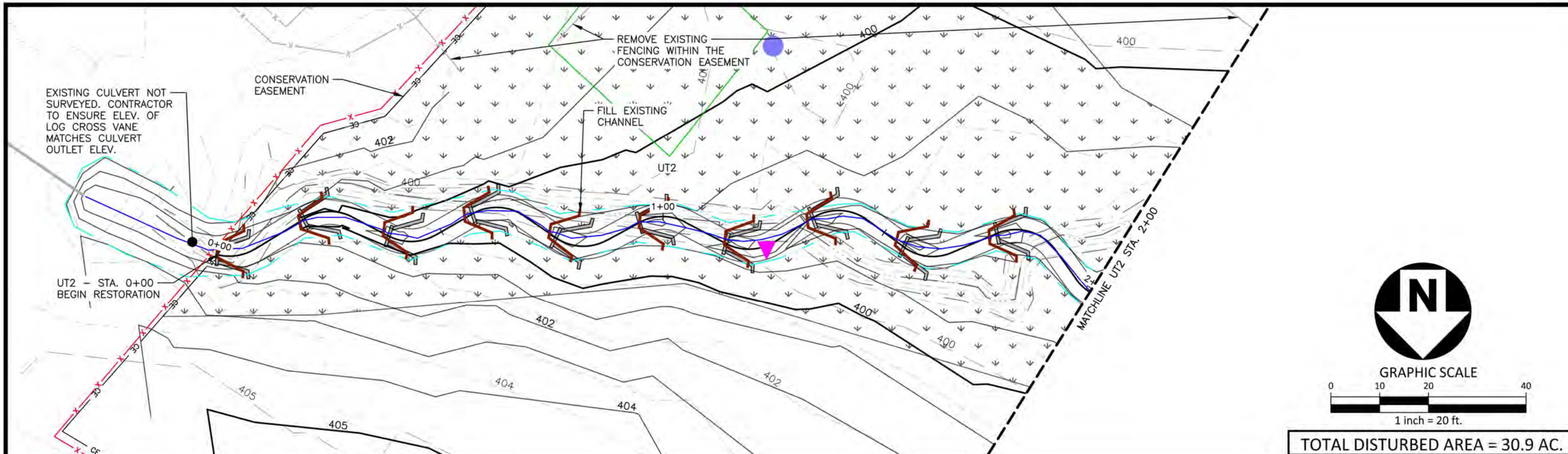
LEE COUNTY, NORTH CAROLINA

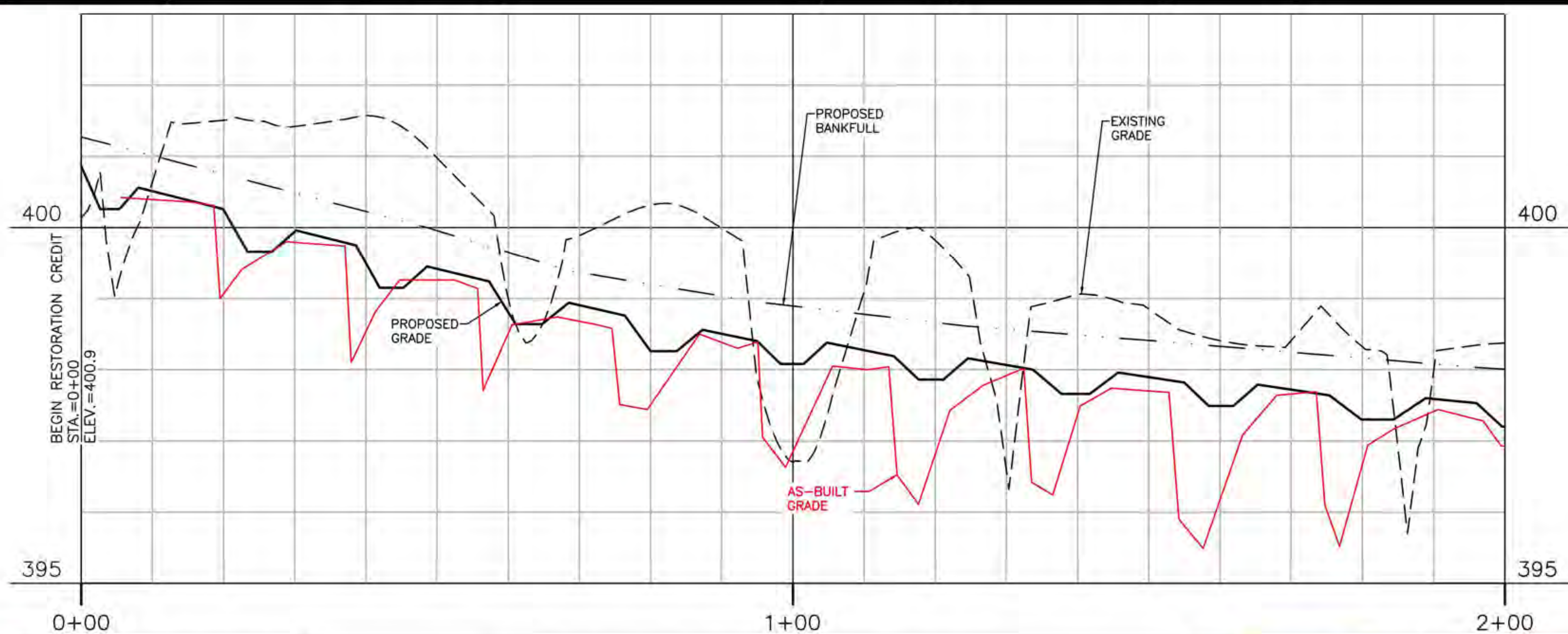
Axiom Environmental, Inc.

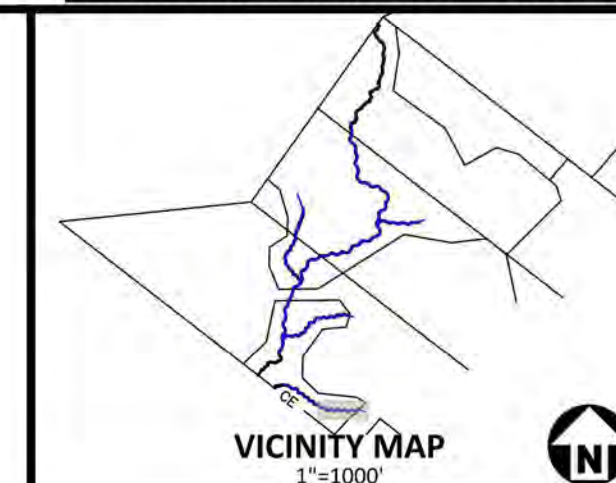
PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=30'
DATE	02.17.2023

PLAN AND PROFILE
UT1 STA 22+00 - 24+80

C5.05







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NORTH CAROLINA PROFESSIONAL SEAL 049073 ENGINEER
REBECCA STUBBS
Rebecca Stubbs

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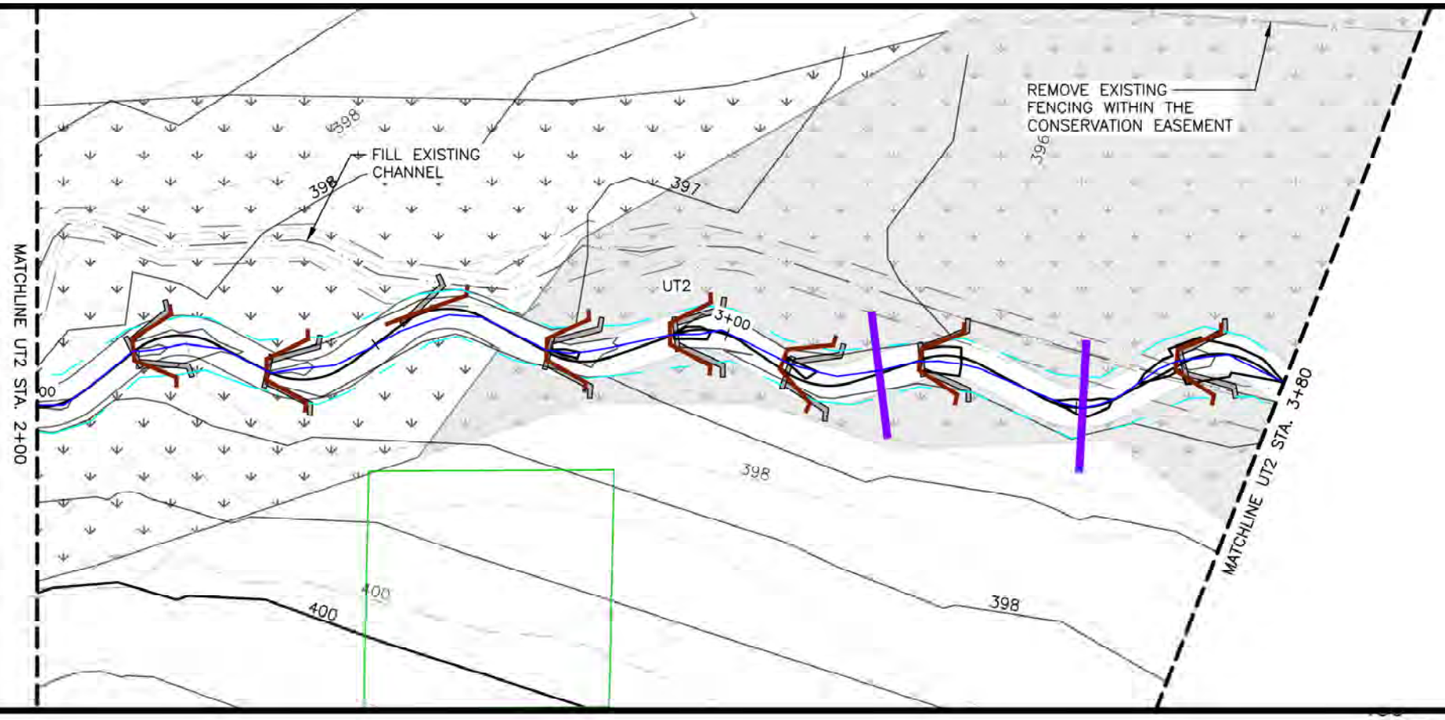
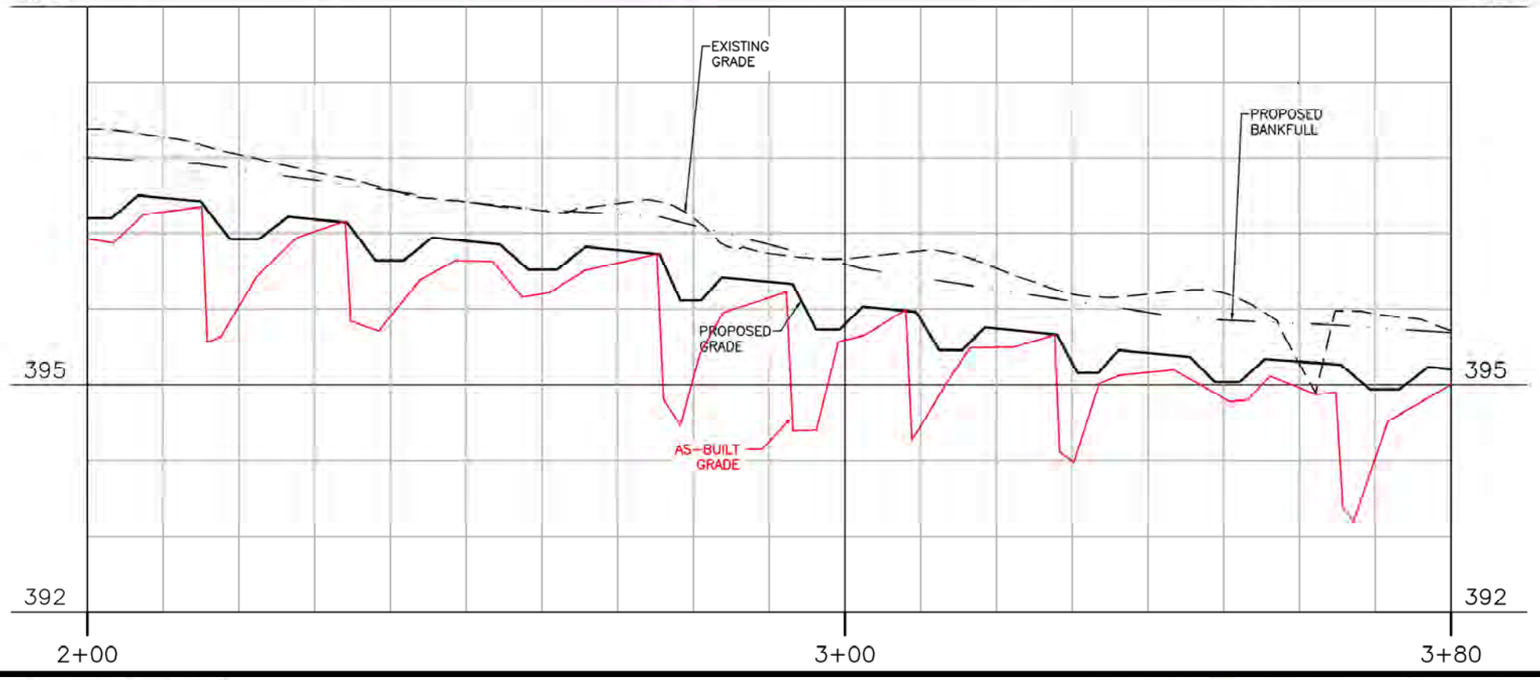
PLAN INFORMATION

PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=20'
DATE	05.02.2023

PLAN AND PROFILE
UT2 STA 0+00 - 2+00

C5.06



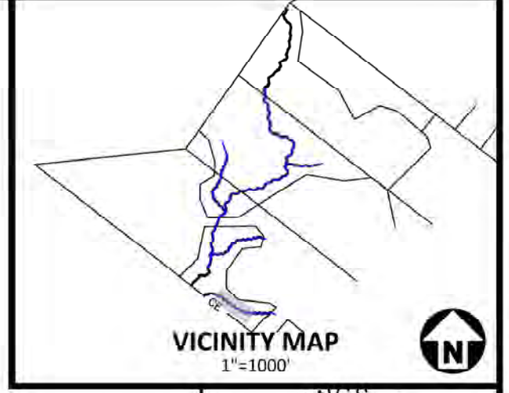


GRAPHIC SCALE

0 10 20 40

1 inch = 20 ft.

TOTAL DISTURBED AREA = 30.9 AC.



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049073
ENGINEER
REBECCA STUBBS
Rebecca Stubbs
Feb 27 2023 1:45
Rebecca Stubbs, PE

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2905 Meridian Parkway
Durham, NC 27713

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LEE COUNTY, NORTH CAROLINA

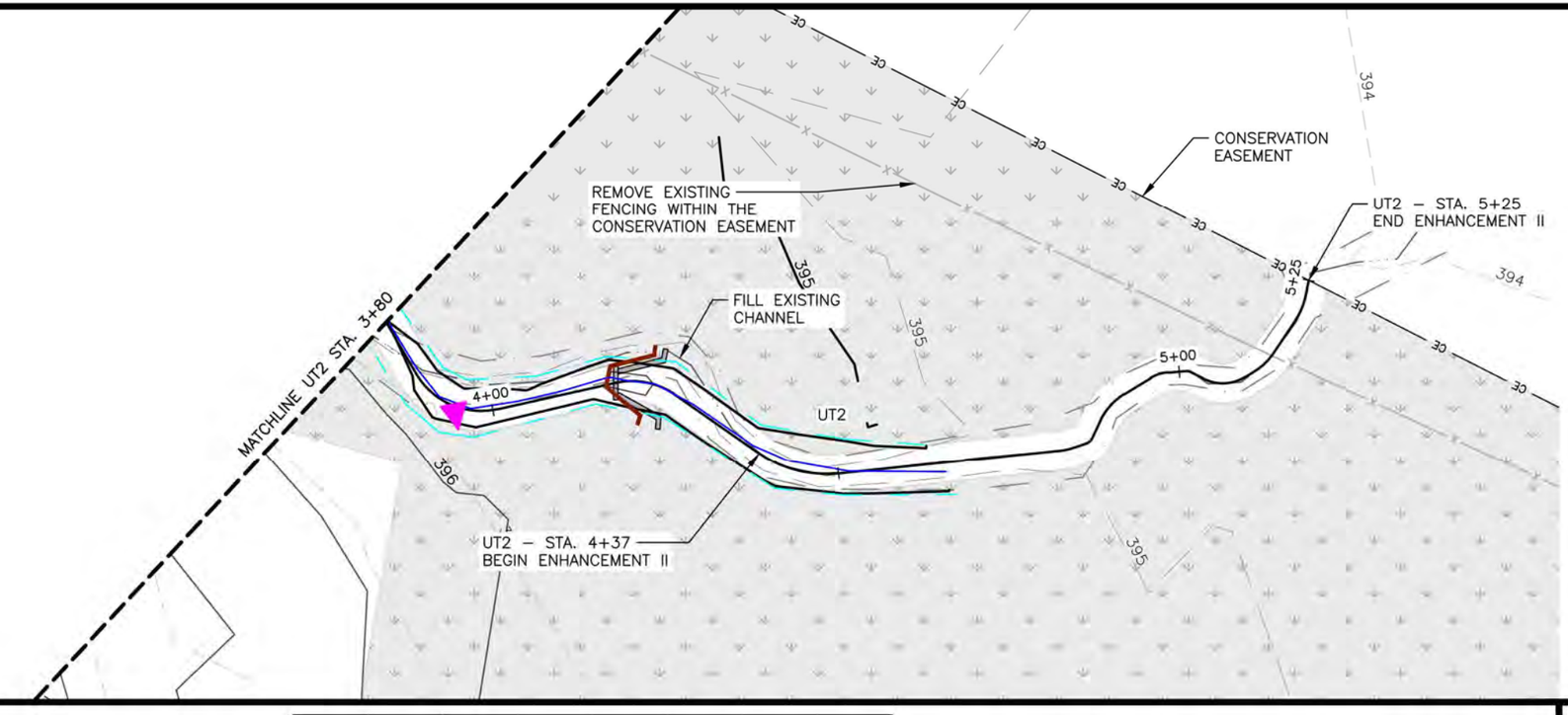
Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=20'
DATE	02.17.2023

PLAN AND PROFILE

UT2 STA 2+00 - 3+80

C5.07

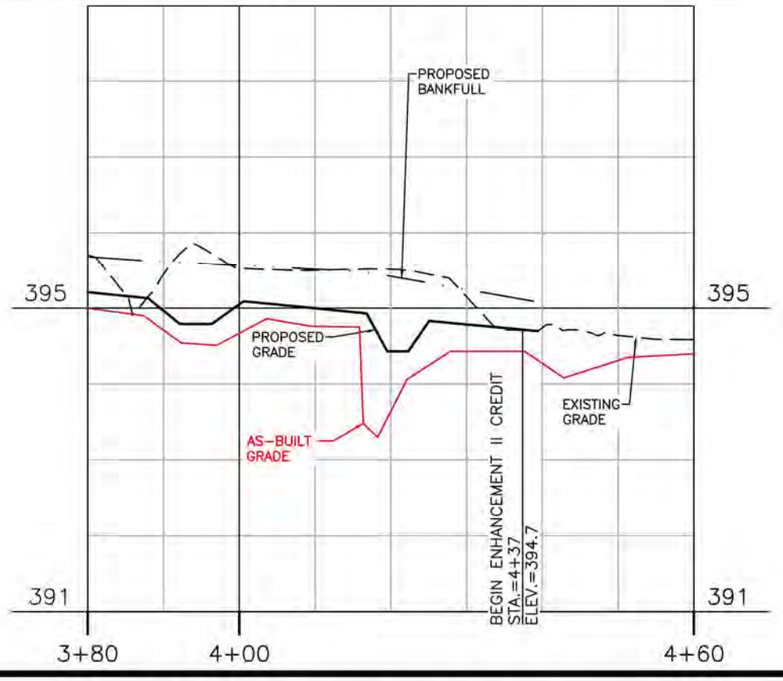


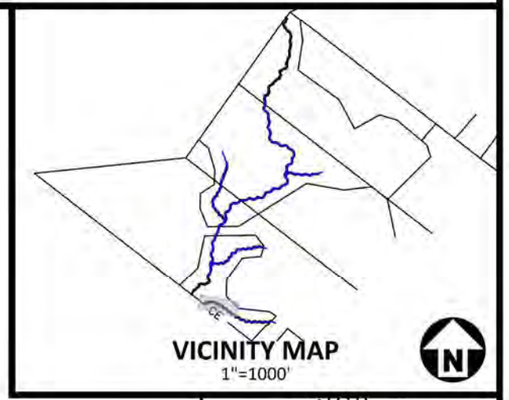
GRAPHIC SCALE

0 10 20 40

1 inch = 20 ft.

TOTAL DISTURBED AREA = 30.9 AC.





Rebecca Stubbs

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REBECCA STUBBS

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CRANE MITIGATION SITE

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LEE COUNTY, NORTH CAROLINA

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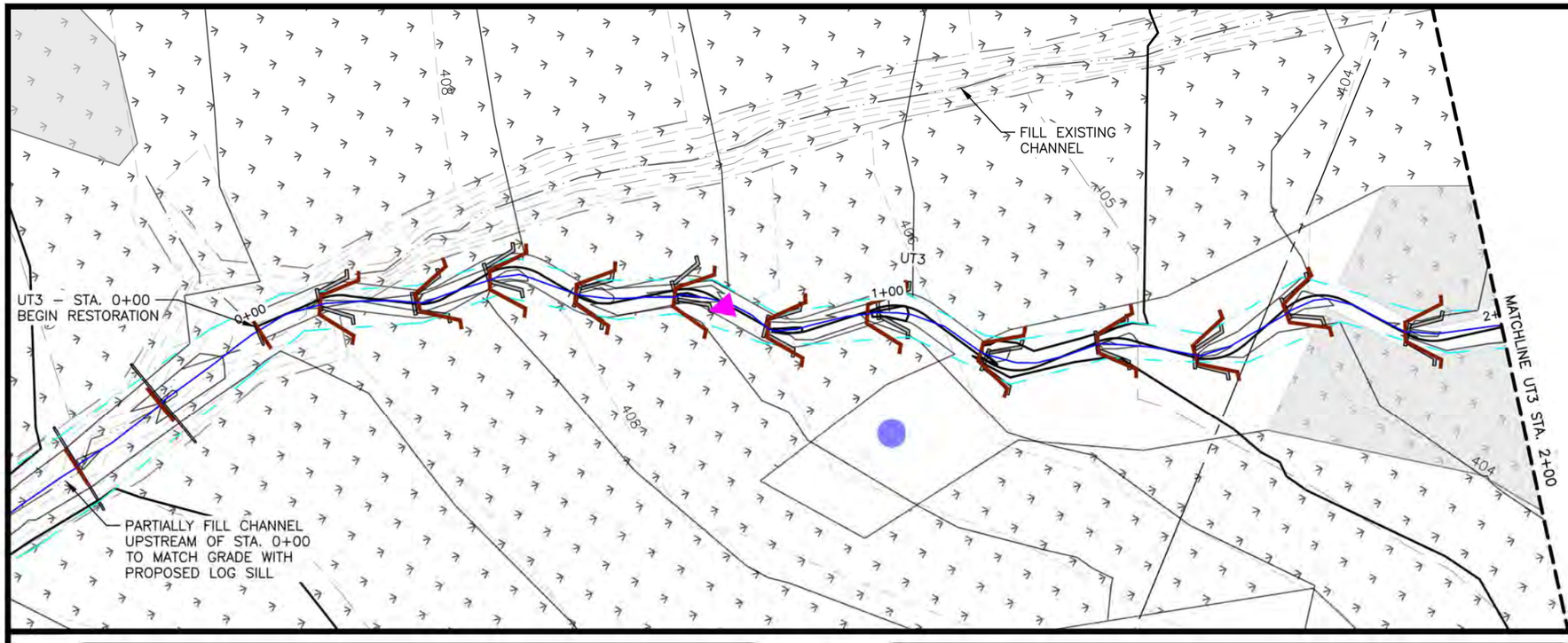
PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=20'
DATE	05.02.2023

PLAN AND PROFILE

UT2 STA 3+80 - 4+60

C5.08

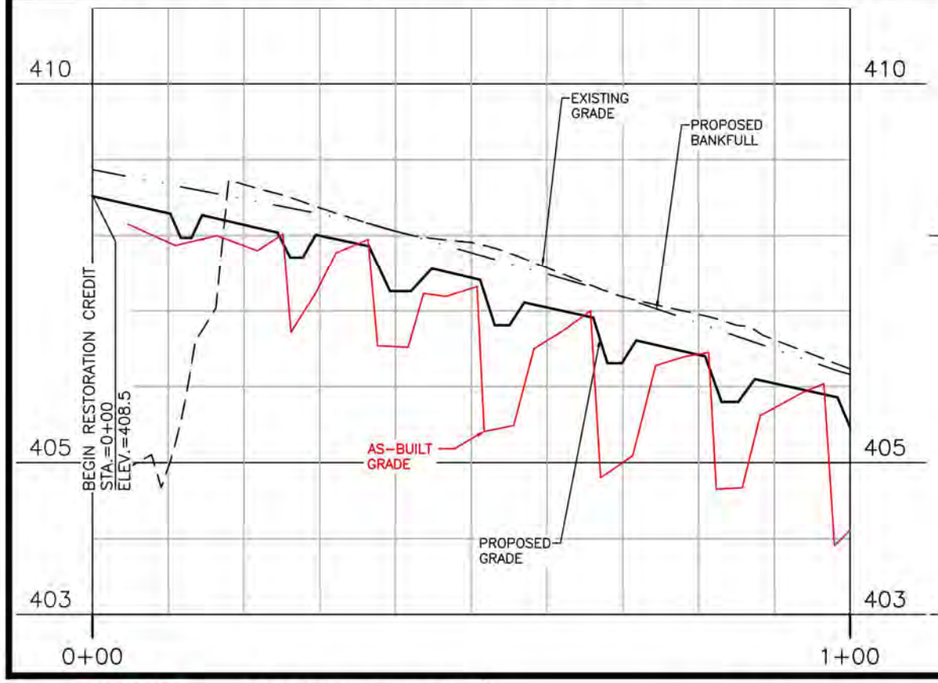


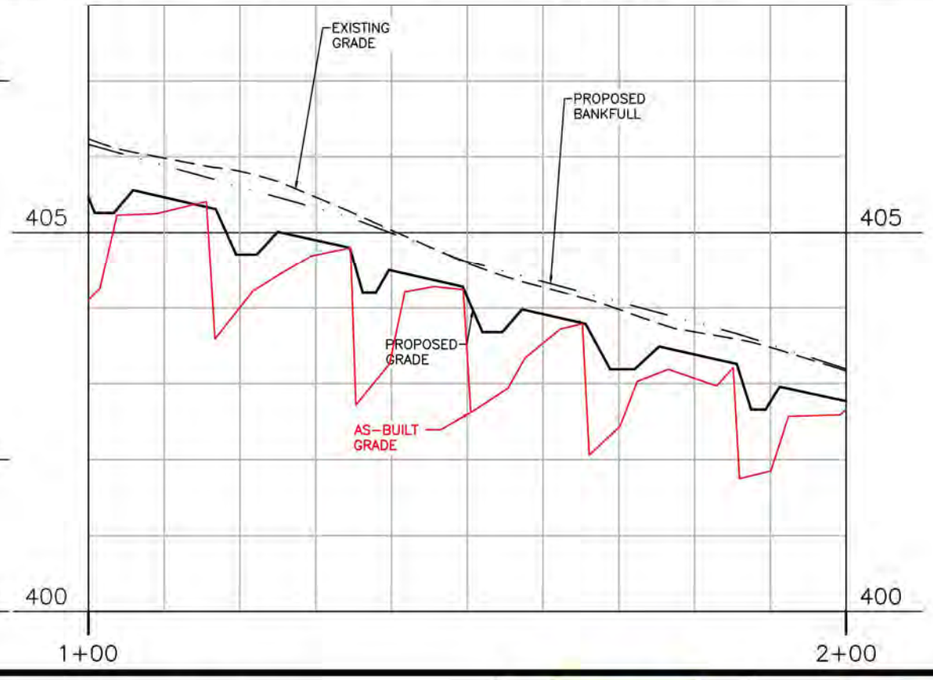
GRAPHIC SCALE

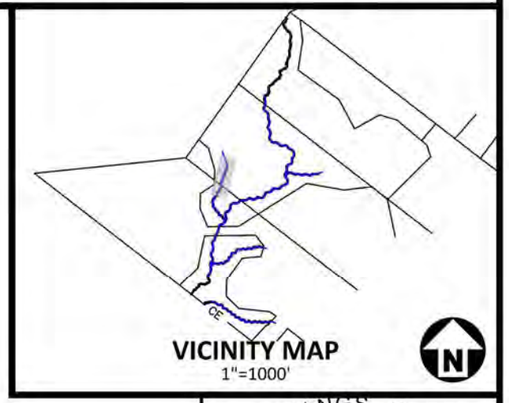
0 10 20 40

1 inch = 20 ft.

TOTAL DISTURBED AREA = 30.9 AC.







Digitally signed by Rebecca Stubbs
DN: cn=Rebecca Stubbs, c=US, o=North Carolina, email=rstubbs@mcadamsco.com
Date: 2023.05.02 14:38:05 -04'00'

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LEE COUNTY, NORTH CAROLINA

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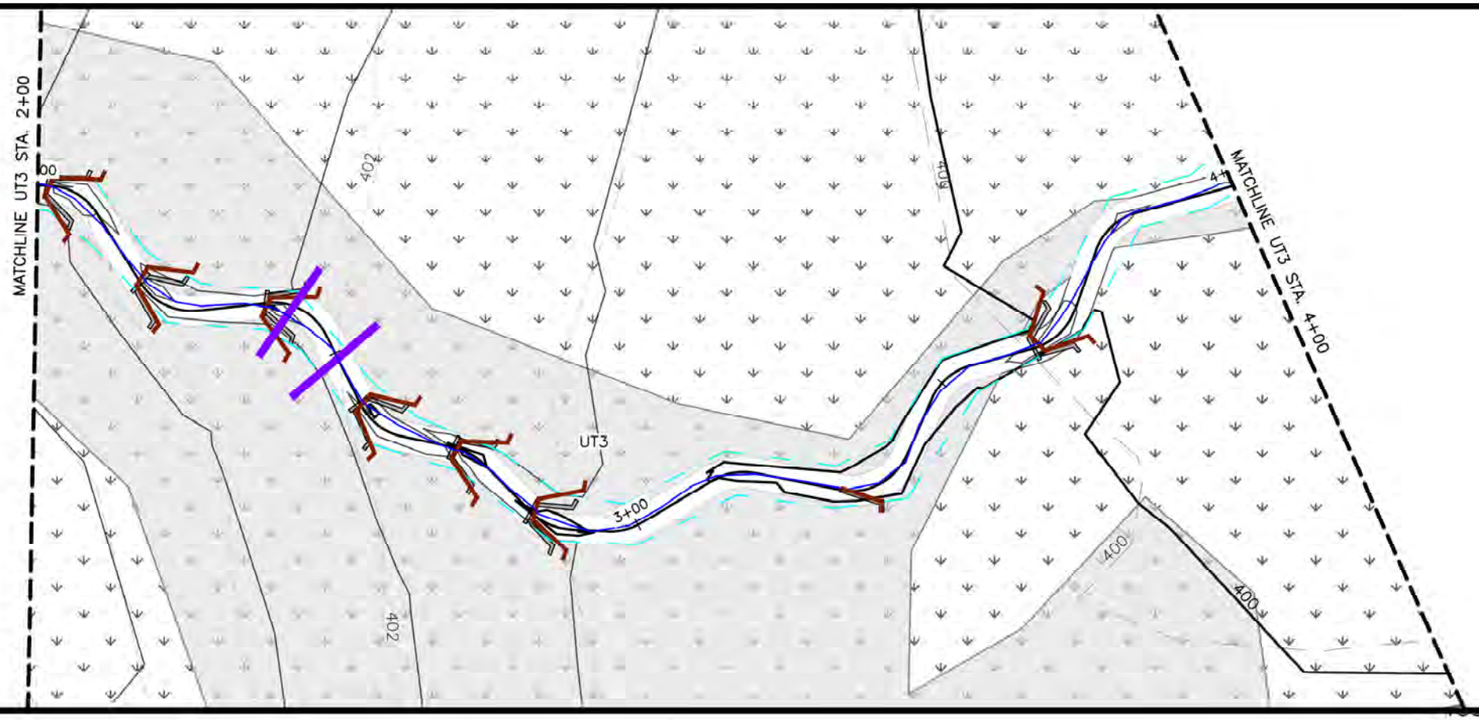
PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=20'
DATE	05.02.2023

PLAN AND PROFILE

UT3 STA 0+00 - 2+00

C5.09

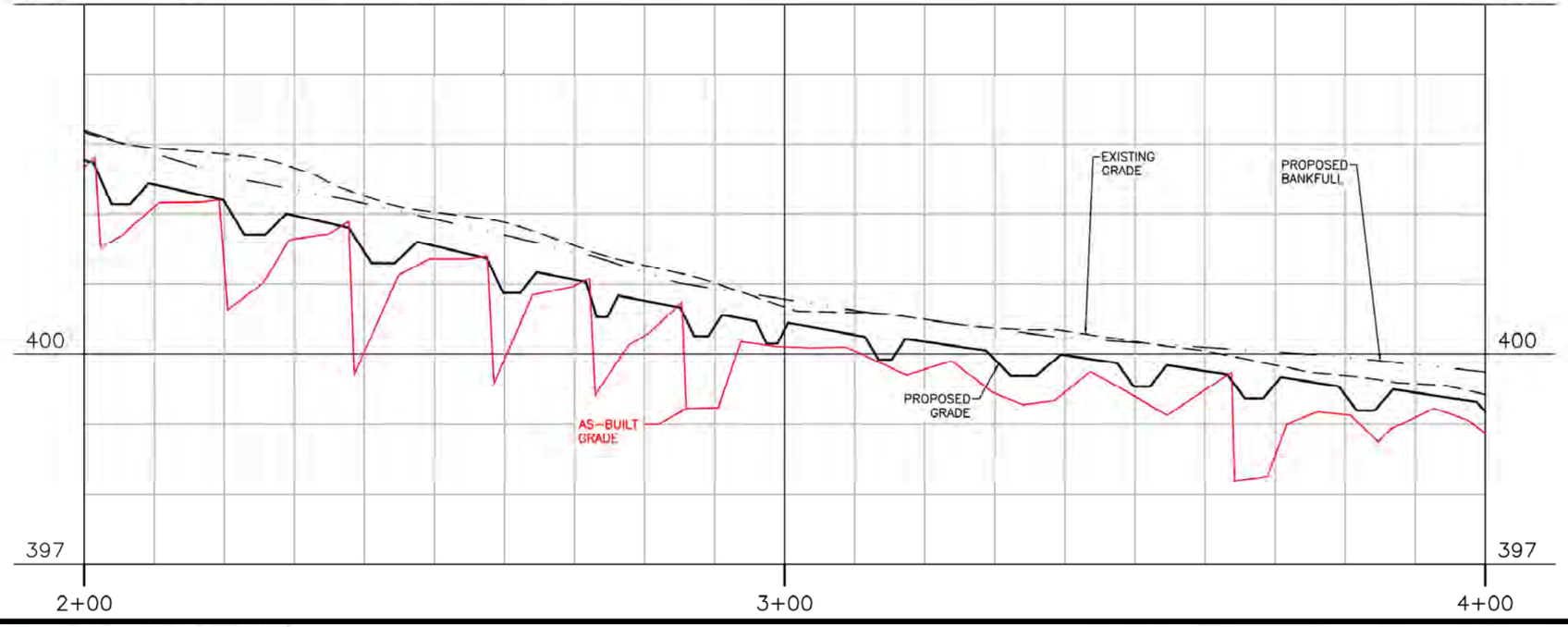


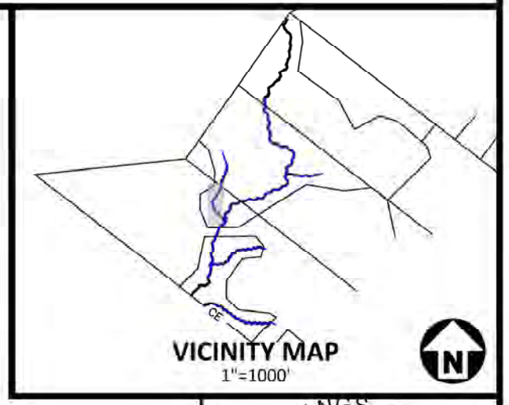
GRAPHIC SCALE

0 10 20 40

1 inch = 20 ft.

TOTAL DISTURBED AREA = 30.9 AC.





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049073
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Rebecca Stubbs, PE Feb 27 2023 13462

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AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

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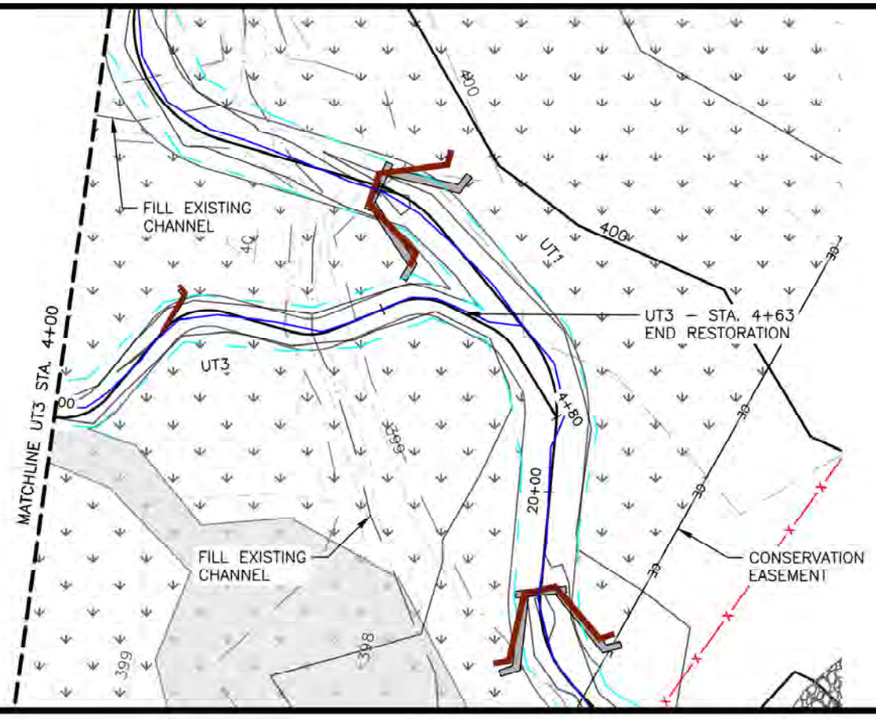
PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=20'
DATE	02.17.2023

PLAN AND PROFILE

UT3 STA 2+00 - 4+00

C5.10

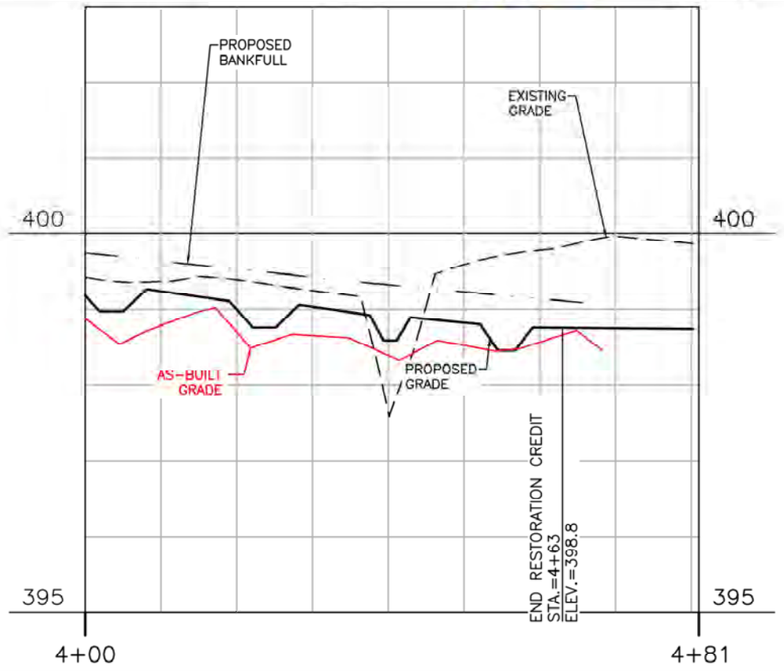


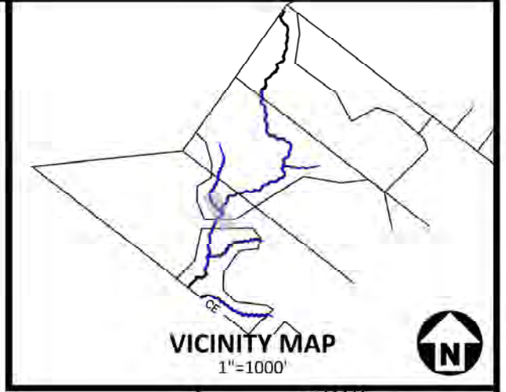
GRAPHIC SCALE

0 10 20 40

1 inch = 20 ft.

TOTAL DISTURBED AREA = 30.9 AC.





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RECORD DRAWINGS ONLY

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RebeccaStubbs,PE

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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

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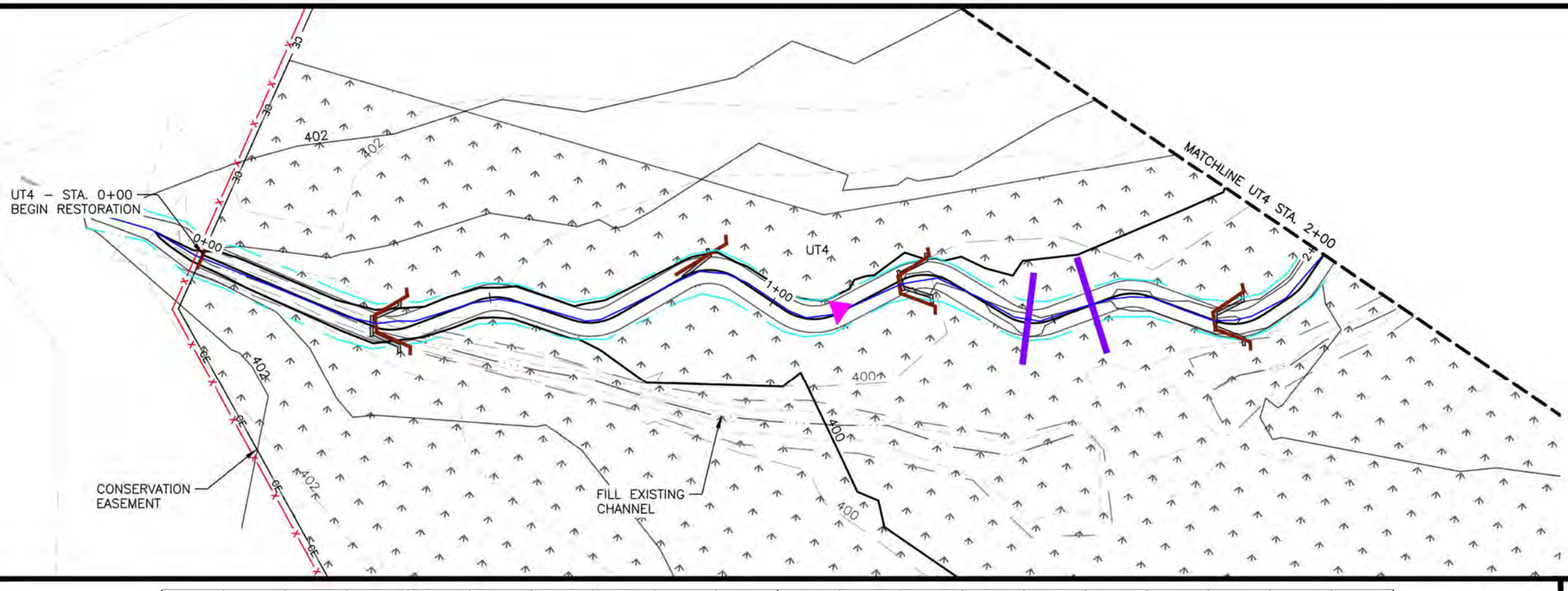
PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=20'
DATE	02.17.2023

PLAN AND PROFILE

UT3 STA 4+00 - 4+81

C5.11

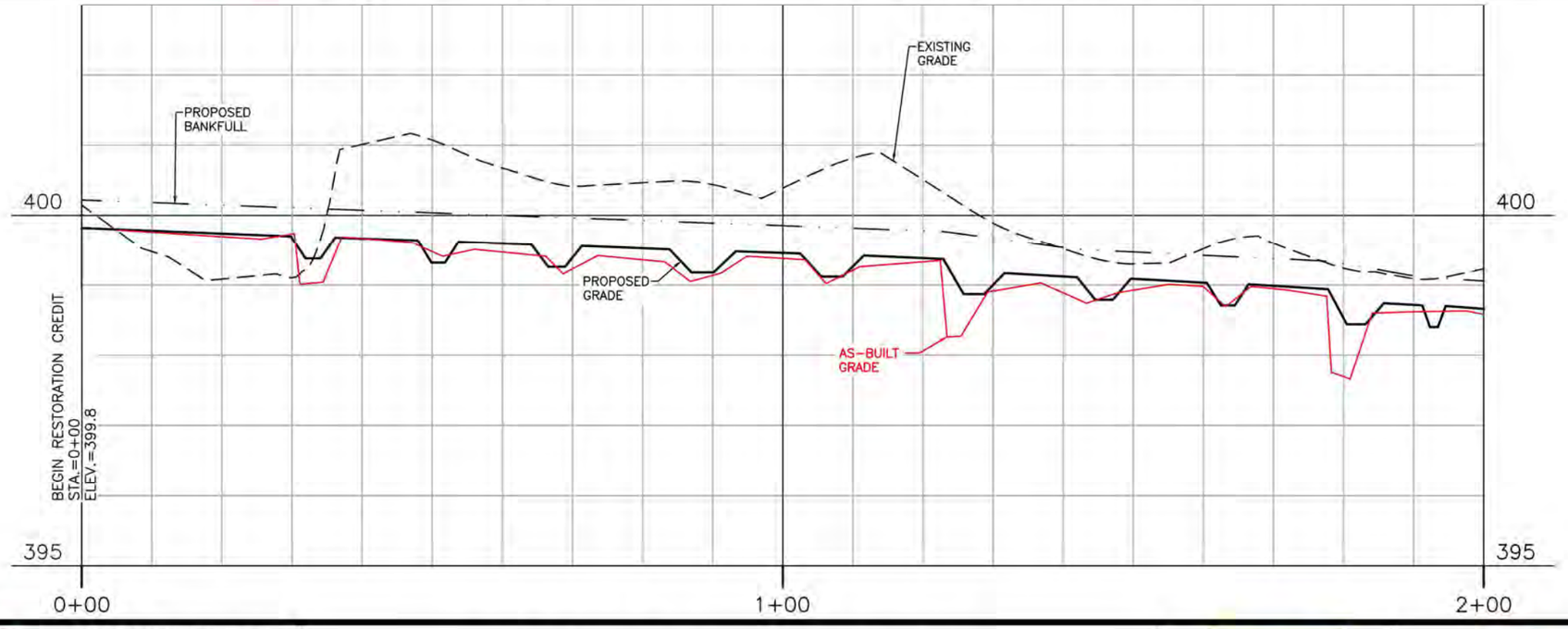


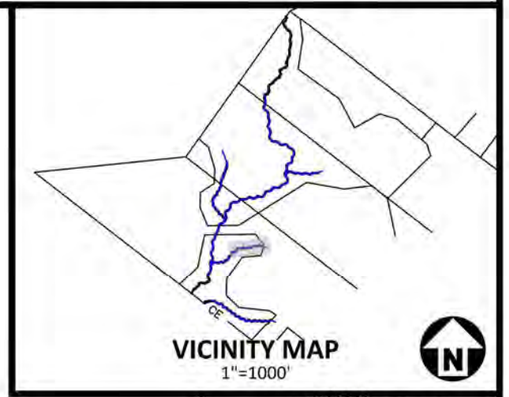
GRAPHIC SCALE

0 10 20 40

1 inch = 20 ft.

TOTAL DISTURBED AREA = 30.9 AC.





Digitally signed by Rebecca Stubbs
DN: cn=Rebecca Stubbs, c=US, o=North Carolina, email=rstubbs@mcadamsco.com
Date: 2023.05.02 14:38:08 -04'00'

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CRANE MITIGATION SITE

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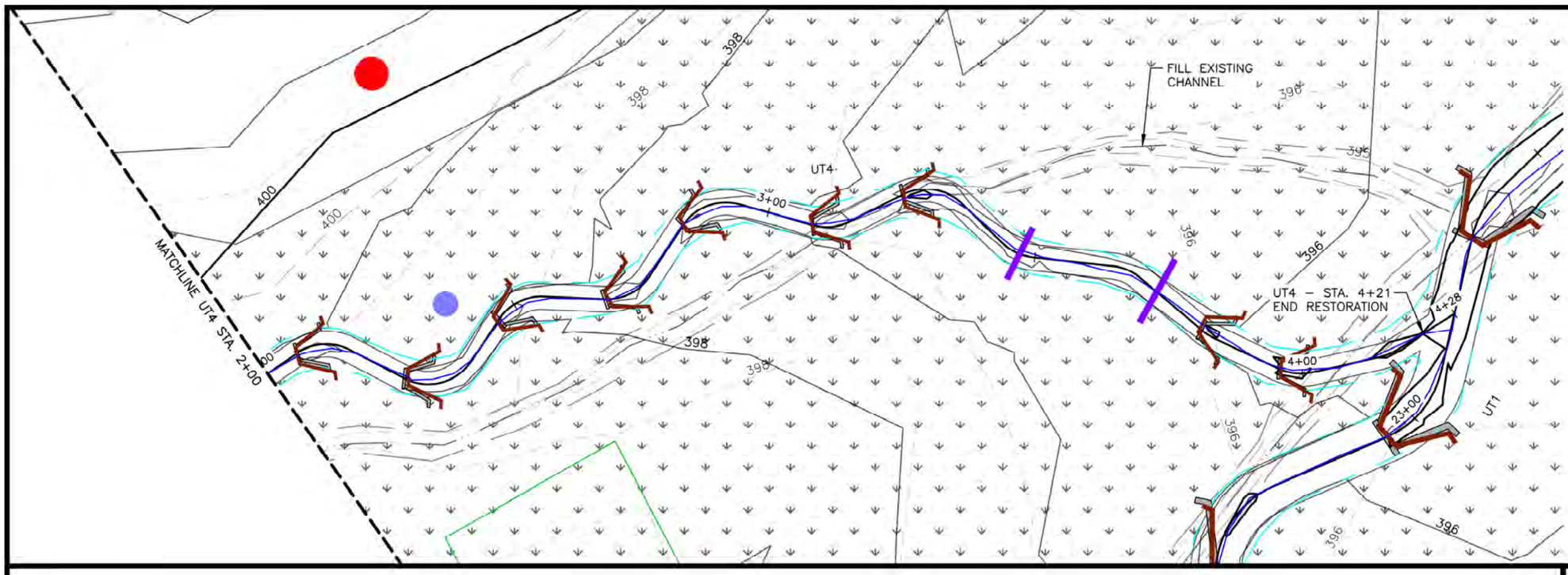
PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=20'
DATE	05.02.2023

PLAN AND PROFILE

UT4 STA 0+00 - 2+00

C5.12

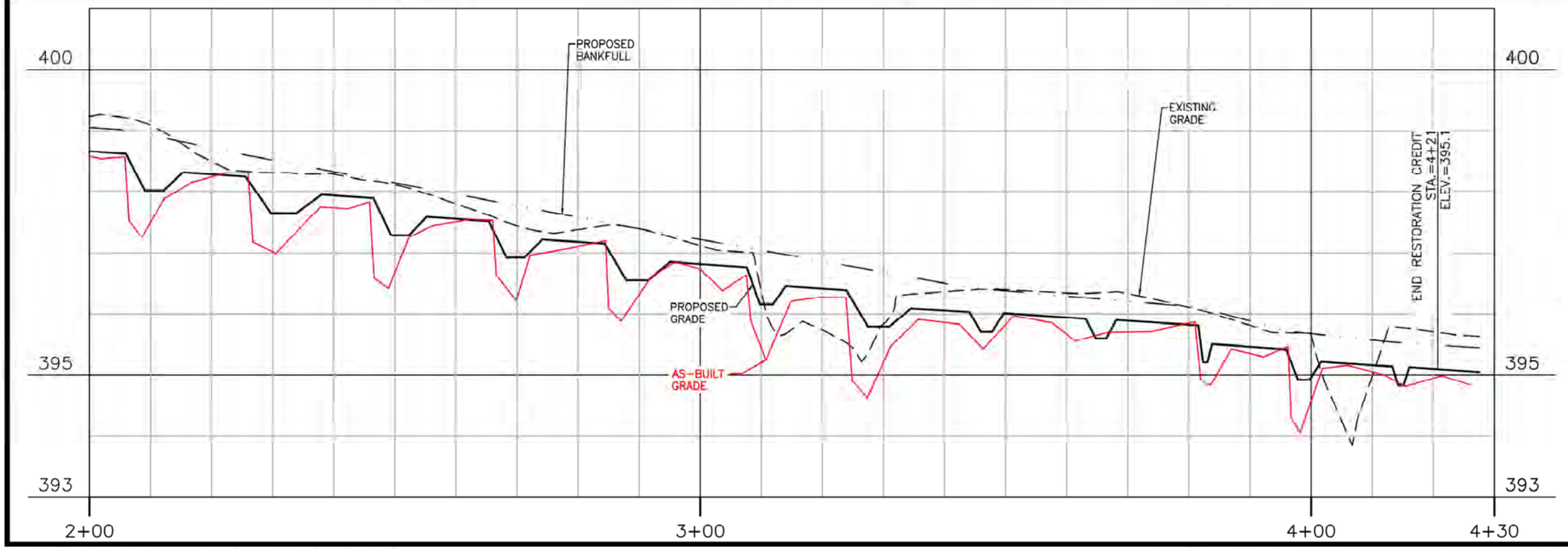


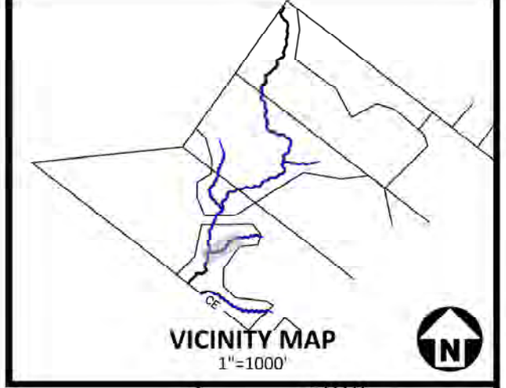
GRAPHIC SCALE

0 10 20 40

1 inch = 20 ft.

TOTAL DISTURBED AREA = 30.9 AC.





RECORD DRAWINGS ONLY
NORTH CAROLINA
PROFESSIONAL SEAL
049073
ENGINEER
REBECCA STUBBS
Rebecca Stubbs, PE
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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

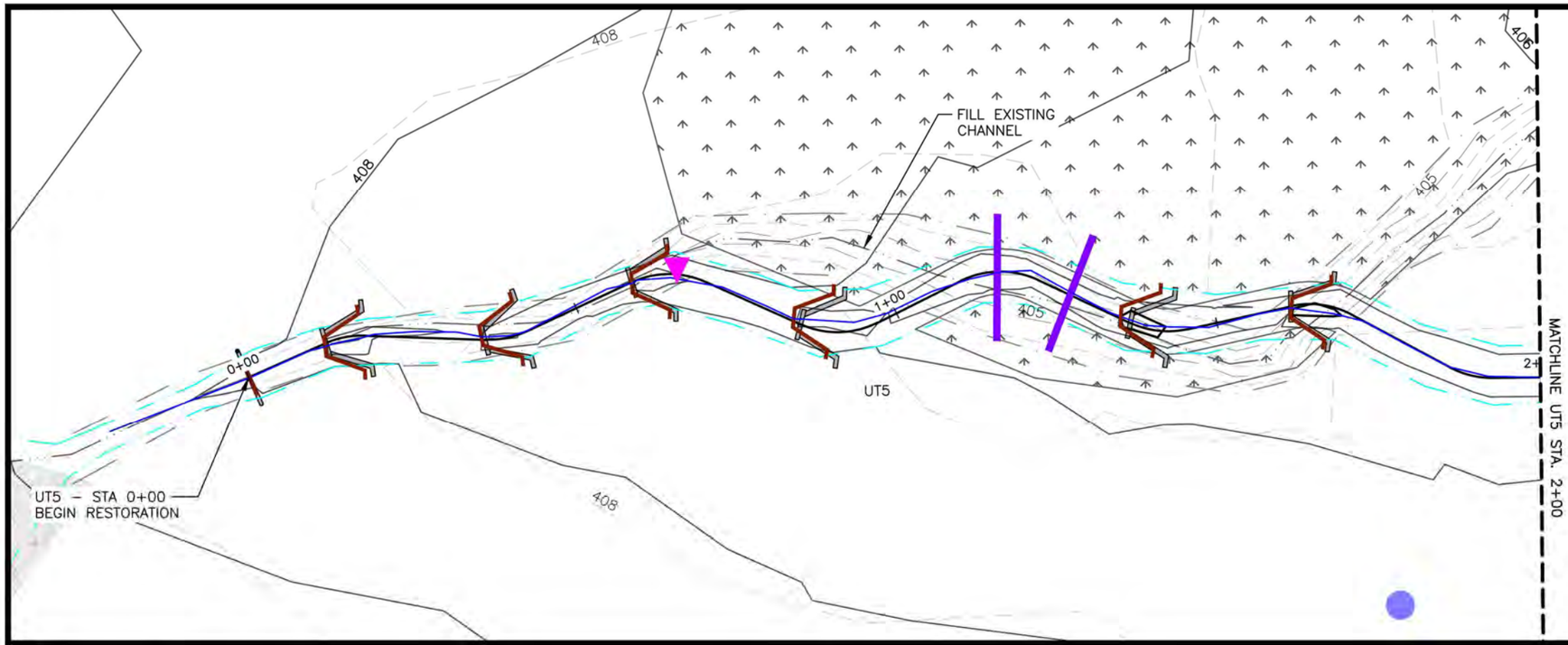
Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=20'
DATE	02.17.2023

PLAN AND PROFILE

UT4 STA 2+00 - 4+28

C5.13



GRAPHIC SCALE

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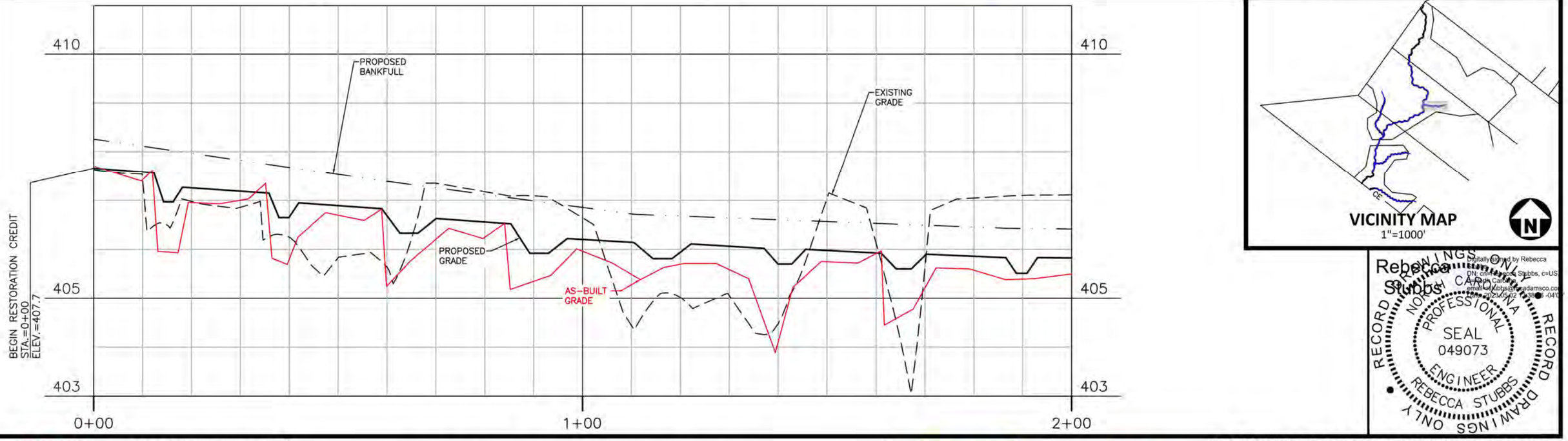
1 inch = 20 ft.

TOTAL DISTURBED AREA = 30.9 AC.



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The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

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PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
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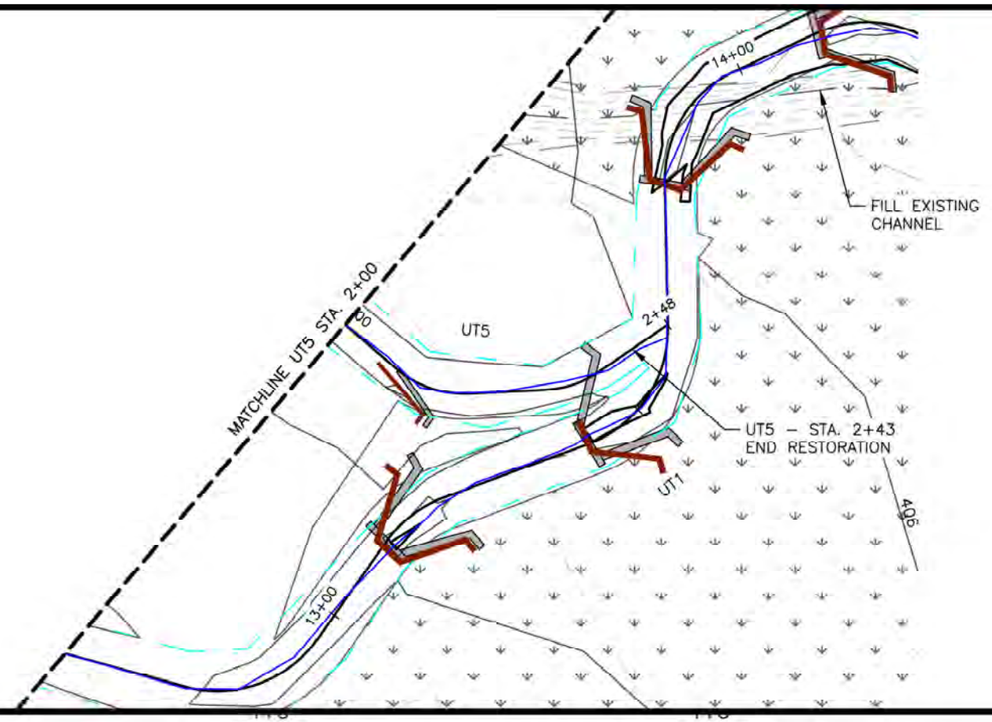
DATE	05.02.2023

PLAN AND PROFILE

UT5 STA 0+00 - 2+00

C5.14



GRAPHIC SCALE

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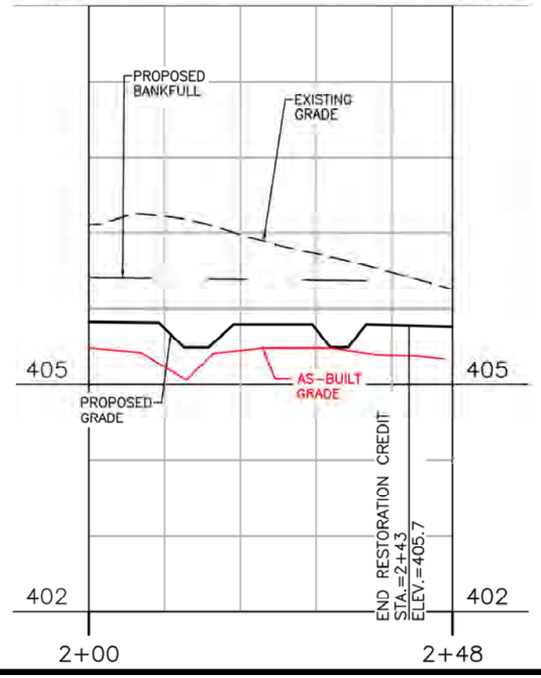
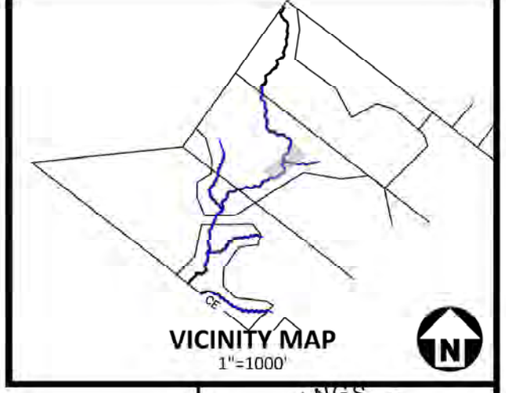
1 inch = 20 ft.

TOTAL DISTURBED AREA = 30.9 AC.





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2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
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CRANE MITIGATION SITE

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Axiom Environmental, Inc.

PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	P1
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DATE	02.17.2023

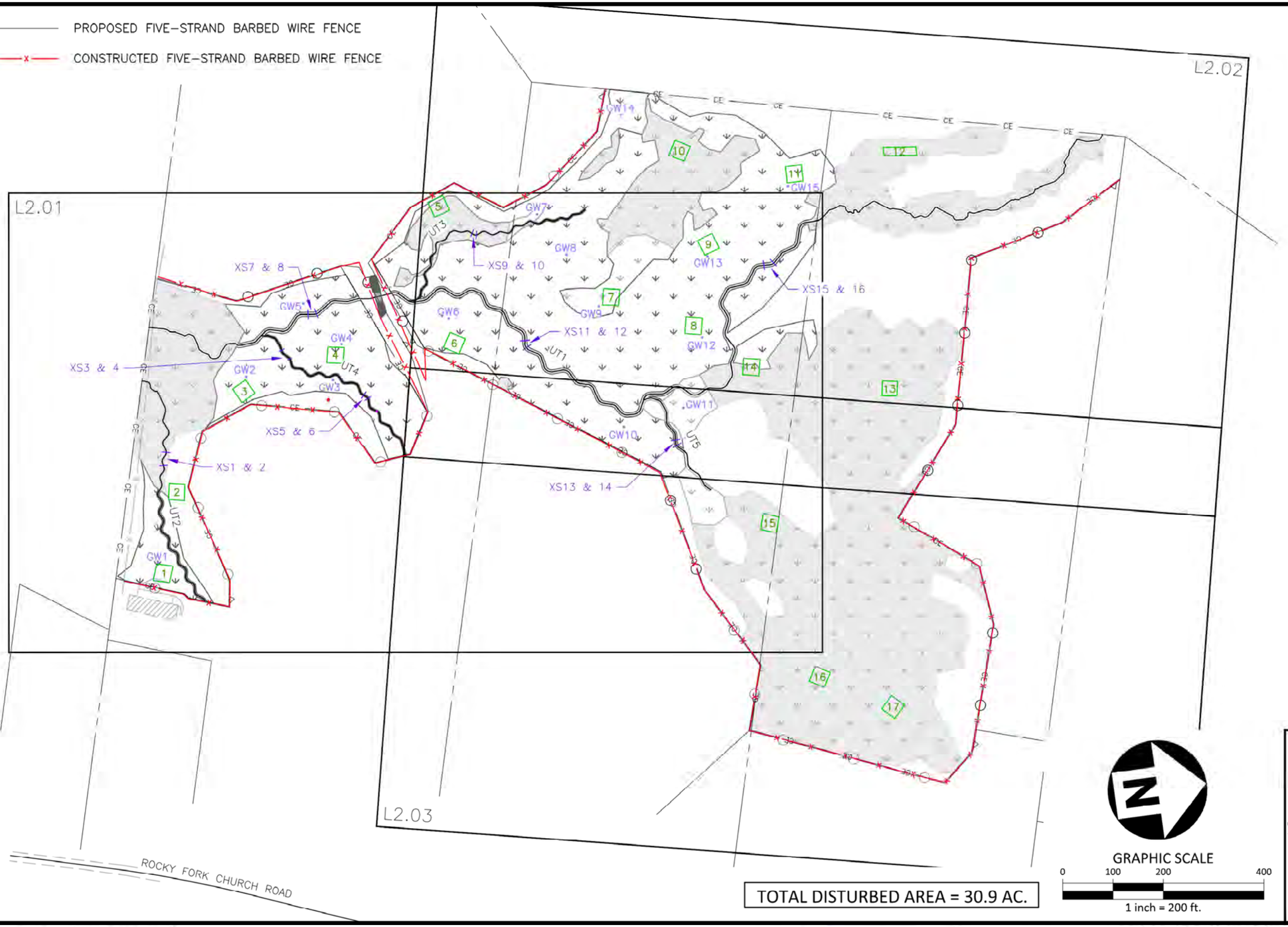
PLAN AND PROFILE

UT5 STA 2+00 - 2+48

C5.15

PROPOSED FIVE-STRAND BARBED WIRE FENCE

CONSTRUCTED FIVE-STRAND BARBED WIRE FENCE



TOTAL DISTURBED AREA = 30.9 AC.

GRAPHIC SCALE

0 100 200 400

1 inch = 200 ft.

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The John R. McAdams Company, Inc.
2905 Meridian Parkway
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phone 919. 361. 5000
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PLAN INFORMATION	
PROJECT NO.	2021110220
FILENAME	L2
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SCALE	1"=200'
DATE	02.17.2023

FENCING PLAN OVERVIEW

L2.00

PROPOSED FIVE-STRAND BARBED WIRE FENCE

CONSTRUCTED FIVE-STRAND BARBED WIRE FENCE

PROPOSED FENCING OFFSET 2' OUTWARD FROM EASEMENT

PROPOSED FENCING TO TIE TO EXISTING FENCING

CONSTRUCTED BRIDGE AND ACCESS ROAD

PROPOSED ACCESS ROAD

PROPOSED 2" TUBE 12' STEEL GATE

20' WIDE FENCE BREAK CENTERED ON PROPOSED ACCESS ROAD

MATCHLINE SHEET L2.02

UT1

UT2

UT3

UT4

UT5

REMOVE EXISTING FENCING WITHIN THE CONSERVATION EASEMENT

PROPOSED FENCING TO TIE TO EXISTING FENCING

PROPERTY LINE (TYP.)

PROPOSED 2" TUBE 12' STEEL GATE

PROPOSED FENCING OFFSET 2' OUTWARD FROM EASEMENT

PROPOSED FENCING OFFSET 2' OUTWARD FROM EASEMENT

PROPERTY LINE (TYP.)

PROPERTY LINE (TYP.)

MATCHLINE SHEET L2.03

TOTAL DISTURBED AREA = 30.9 AC.

GRAPHIC SCALE

0 50 100 200

1 inch = 100 ft.

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The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

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PLAN INFORMATION

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FENCING PLAN

L2.01

PROPOSED FIVE-STRAND BARBED WIRE FENCE

CONSTRUCTED FIVE-STRAND BARBED WIRE FENCE

PROPERTY LINE (TYP.)

PROPOSED FECNING TO END AT PROPERTY LINE

PROPOSED 2" TUBE 12' STEEL GATE

PROPOSED FENCING OFFSET 2' OUTWARD FROM EASEMENT

UT3

UT1

UT5

MATCHLINE SHEET L2.01

MATCHLINE SHEET L2.03

PROPERTY LINE (TYP.)

PROPOSED FECNING TO END AT PROPERTY LINE

PROPOSED 2" TUBE 12' STEEL GATE

PROPERTY LINE (TYP.)

PROPOSED FENCING OFFSET 2' OUTWARD FROM EASEMENT

GRAPHIC SCALE

0 50 100 200

1 inch = 100 ft.

TOTAL DISTURBED AREA = 30.9 AC.

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The John R. McAdams Company, Inc.
2905 Meridian Parkway
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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

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PLAN INFORMATION

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FENCING PLAN

L2.02

PROPOSED FIVE-STRAND BARBED WIRE FENCE

CONSTRUCTED FIVE-STRAND BARBED WIRE FENCE

MATCHLINE SHEET L2.01

MATCHLINE SHEET L2.02

UT5

PROPOSED FENCING OFFSET 2' OUTWARD FROM EASEMENT

PROPOSED FENCING OFFSET 2' OUTWARD FROM EASEMENT

PROPERTY LINE (TYP.)

PROPERTY LINE (TYP.)

PROPOSED 2" TUBE 12' STEEL GATE

GRAPHIC SCALE

0 50 100 200

1 inch = 100 ft.

TOTAL DISTURBED AREA = 30.9 AC.

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Apr 28 2023 8:35

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2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
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CRANE MITIGATION SITE

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FENCING PLAN

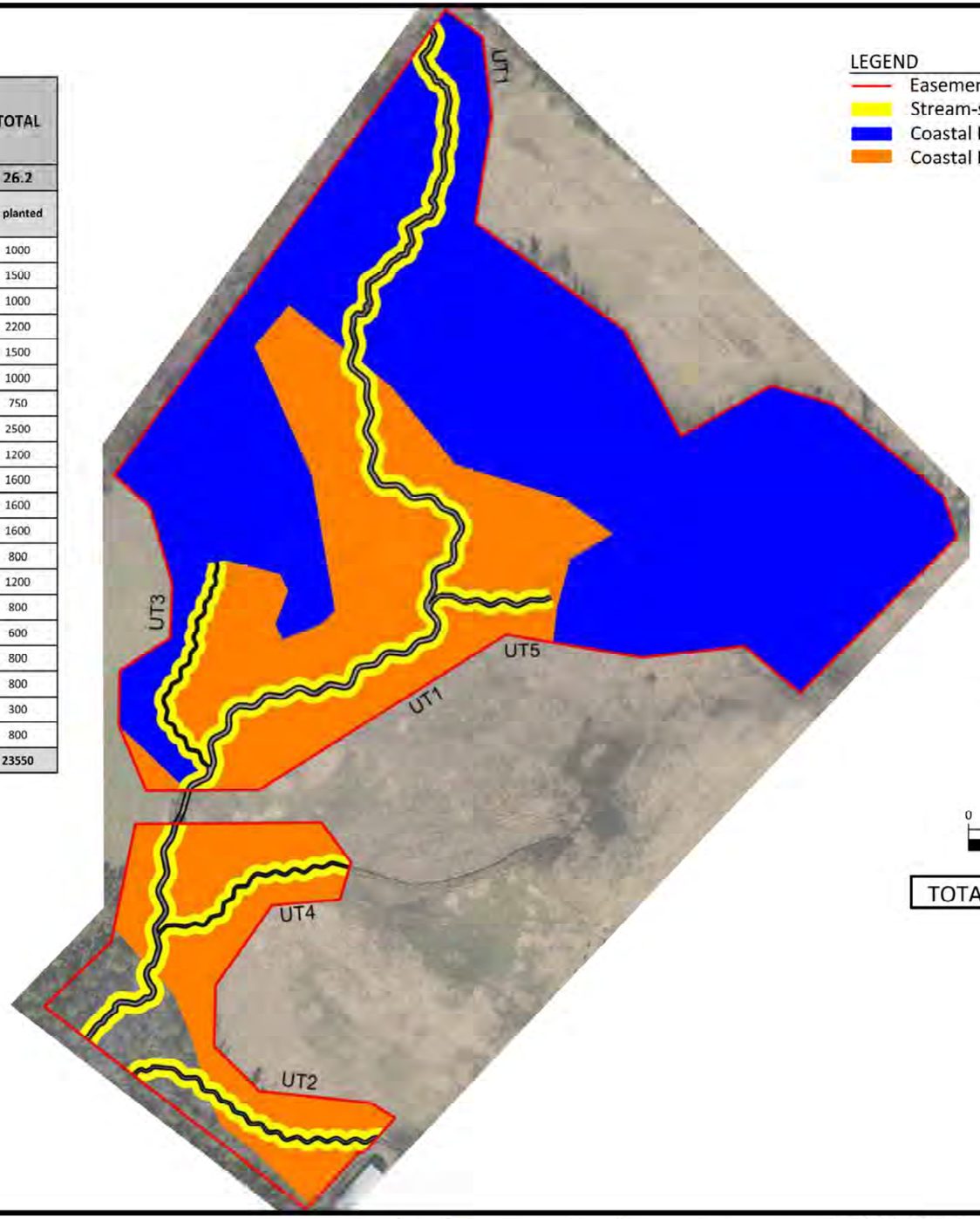
L2.03

Site Planted As Proposed

Vegetation Association		Coastal Plain Bottomland Hardwood Forest*		Coastal Plain Small Stream Swamp*		Stream-side Assemblage**		TOTAL
Area (acres)		8		15.4		2.8		26.2
Species	Indicator Status	# planted*	% of total	# planted*	% of total	# planted**	% of total	# planted
Swamp black gum (*Nyssa biflora*)	OBL	0	0.00%	1000	9.50%	0	0.00%	1000
Bald cypress (*Taxodium distichum*)	OBL	500	9.20%	1000	9.50%	0	0.00%	1500
Tupelo gum (*Nyssa aquatica*)	OBL	0	0.00%	1000	9.50%	0	0.00%	1000
Black gum (*Nyssa sylvatica*)	FAC	500	9.20%	1000	9.50%	700	9.20%	2200
Silky dogwood (*Cornus amomum*)	FACW	0	0.00%	0	0.00%	1500	19.70%	1500
Sweetbay (*Magnolia virginiana*)	FACW	0	0.00%	1000	9.50%	0	0.00%	1000
Red bay (*Persea borbonia*)	FAC	250	4.60%	500	4.80%	0	0.00%	750
River birch (*Betula nigra*)	FACW	500	9.20%	500	4.80%	1500	19.70%	2500
Hackberry (*Celtis occidentalis*)	FACW	300	5.50%	500	4.80%	400	5.30%	1200
American elm (*Ulmus americana*)	FACW	300	5.50%	500	4.80%	800	10.50%	1600
Tulip poplar (*Liriodendron tulipifera*)	FAC	300	5.50%	500	4.80%	800	10.50%	1600
Sycamore (*Platanus occidentalis*)	FACW	300	5.50%	500	4.80%	800	10.50%	1600
Swamp chestnut oak (*Quercus Michauxii*)	FACW	300	5.50%	500	4.80%	0	0.00%	800
Water oak (*Quercus nigra*)	FAC	500	9.20%	300	2.90%	400	5.30%	1200
Laurel oak (*Quercus laritolia*)	FACW	300	5.50%	500	4.80%	0	0.00%	800
Cherrybark oak (*Quercus pagoda*)	FAC	200	3.70%	0	0.00%	400	5.30%	600
Willow oak (*Quercus phellos*)	FACW	300	5.50%	500	4.80%	0	0.00%	800
Shumard oak (*Quercus shumardii*)	FACW	300	5.50%	500	4.80%	0	0.00%	800
Shagbark hickory (*Carya ovata*)	FACU	300	5.50%	0	0.00%	0	0.00%	300
Bitternut hickory (*Carya cordiformis*)	FAC	300	5.50%	200	1.90%	300	3.90%	800
	TOTAL	5450		10500		7600		23550

* Planted at a density of 680 stems/acre.

** Planted at a density of 2720 stems/acre.



LEGEND
- Easement Boundary = ~27.7 ac
- Stream-side Assemblage
- Coastal Plain Small Stream Swamp
- Coastal Plain Bottomland Hardwood Forest

N

GRAPHIC SCALE
0 100 200 400
1 inch = 200 ft.

TOTAL DISTURBED AREA = 30.9 AC.

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The John R. McAdams Company, Inc.
2905 Meridian Parkway
Durham, NC 27713

phone 919. 361. 5000
fax 919. 361. 2269
license number: C-0293, C-187

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CRANE MITIGATION SITE

AS-BUILT DRAWINGS

LEE COUNTY, NORTH CAROLINA

RESTORATION SYSTEMS LLC

Axiom Environmental, Inc.

PLAN INFORMATION

PROJECT NO.	2021110220
FILENAME	L1
CHECKED BY	RAS
DRAWN BY	RHW
SCALE	1"=200'
DATE	02.17.2023

PLANTING PLAN

L5.00

TEMPORARY SEEDING SCHEDULE:

TEMPORARY SEEDING SHALL BE APPLIED AS NEEDED DURING CONSTRUCTION TO STABILIZE BARE OR DISTURBED AREAS OF SOIL AND AT THE COMPLETION OR ALL GRADING AND EARTHWORK ACTIVITIES WITHIN A PARTICULAR AREA OF THE SITE. PERMANENT SEED MAY BE DISTRIBUTED WITH TEMPORARY SEED UPON THE FINAL APPLICATION OF TEMPORARY SEED.

SEEDING METHODS

1. EVENLY APPLY SEED USING A CYCLONE SEEDER, DRILL, CULTIPACKER SEEDER, OR HYDROSEEDER. THIS MUST BE DONE WITHIN 48 HOURS OF LAND DISTURBING ACTIVITIES.
2. MULCH WITH CLEAN WHEAT STRAW.
3. AFTER SEEDING, APPLY MULCH TO AREAS UNDER HARSH CONDITIONS SUCH AS AREAS THAT HAVE BEEN GRADED, OR THOSE WHICH WILL RECEIVE CONCENTRATED FLOWS. AREAS CONSIDERED TO BE UNDER HARSH CONDITIONS WILL BE CONSIDERED THE AREAS GRADED FOR THE WETLAND VALLEY.
4. RESEED AND MULCH AREAS WHERE SEEDLING EMERGENCE IS LESS THAN 80% COVERAGE, OR WHERE EROSION OCCURS, AS SOON AS POSSIBLE. DO NOT MOW. PROTECT FROM TRAFFIC AS MUCH AS POSSIBLE.

NOTES

1. TEMPORARY ANNUAL SEED SELECTION SHOULD BE BASED ON SEASON OF PROJECT INSTALLATION.
2. A SINGLE SPECIES FOR TEMPORARY COVER IS ACCEPTABLE
3. IN SOME CASES WHERE SEASONS OVERLAP, A MIXTURE OF TWO OR MORE SPECIES MAY BE NECESSARY. HOWEVER, APPLICATION RATES SHOULD NOT EXCEED THE TOTAL RECOMMENDED RATE PER ACRE.
4. TEMPORARY SEED SHOULD BE MIXED AND APPLIED SIMULTANEOUSLY WITH THE PERMANENT SEED MIX IF OPTIMAL PLANTING DATES ALLOW.

Temporary Seed (Erosion and Sediment Control)			
Species	**Application Rate**	**Application Date**	**Notes**
~~Secale cereale (Grain Rye)~~	~~130 lbs. per acre~~	~~Year-round~~	~~Disturbed or stockpile areas~~
Urochloa ramosa (Brown Top Millet)	40 ~~15~~ lbs. per acre	May - September	~~Near stream channels/banks~~ Applied to the entire site

PERMANENT SEEDING SCHEDULE:

PLANT MATERIAL SELECTION

1. REFER TO THE TABLES ON THIS SHEET FOR APPROPRATE SELECTION OF NATIVE PERMANENET SEEDS.
2. PERMANENT SEED MIXTURE SHOULD BE APPLIED USING AN APPLICATION RATE AND METHOD RECOMMENDED BY THE NURSERY.

SEEDBED PREPRATION

1. DISTURBED SOILS WITHIN THE RIPARIAN AREAS MUST BE AMMENDED TO PROVIDE AN OPTIMUM ENVORONMENT FR SEE GERMINATION AND SEEDNG GROWTH.
2. THE pH OF THE SOIL MUST BE SUCH THAT IT IS NOT TOXIC AND NUTRIENTS ARE AVAILABLE
3. SOIL ANALYSIS SHOULD BE PERFORMED TO DETERMINE NUTRIENT AND LIME NEEDS OF EACH SITE.
4. APROPRIATE pH LEVELS ARE BETWEEN 5.5 AND 7.0
5. RIPARIAN BUFFERS REGULATED FOR NUTRIENT MANAGEMENT MAY BE LIMITED TO A SINGLE APPLICATION OF FERTILIZER.
6. SUITABLE MECHANICAL MEANS SUCH AS DISKING, RAKING, AND HARROWING MUST BE EMPLOYED TO LOOSEN COMPACTED SOILS PRIOR TO SEEDING.

PLANTING

1. APPLY SEED UNIFORMLY WITH A CYCLONE SEEDER, DROP-TYPE SPREADER, DRILL, OR HYDROSEEDER ON A FIRM, FRIABLE SEEDBED.
2. IN FINE SOILS, SEEDS SHOULD BE DRILLED 0.25-0.5 INCHES. IN COURSE SAND SOILS, SEEDS SHOULD BE PLANTED NO MORE THAN 0.75 INCHES.

MULCH

1. MULCH ALL PLANTING AREAS IMMEDIATELY AFTER SEEDING.
2. IF PLANTING ON STREAMBANKS STEEPER THAN 10% OR OTHER AREAS SUBJEC TO FLOODING, A BIODEGRADEABLEL ROLLED EROSION CONTROL PRODUCT IS RECOMMENDED TO HOLD SEED AND SOIL IN PLACE.

MAINTENANCE

1. THE RECOMMENEDED PERMANENT GRASS SPECIES MAY REQIRE TWO YEARS FOR ESTABLISHMENT DEPENDIG ON SITE CONDITIONS
2. INSPECT SEEDED AREAS FOR FAILURE AND MAKE NECESSARY REPAIRS, SOIL AMENDMENTS, AND RE-SEEEDINGS.
3. IF WEEDY EXOTIC SPECIES HAVE TAKEN OVER AREAS AFTER THE FIRST GROING SEASON, THE INVASIVE SPECIES MUST BE ERADICATED TO ALLOW STAIVE SPECIES TO GROW.
4. MONITORING THE SITE UNTIL LONG-TERM STABILITY HAS BEEN ESTABLISHED.

Permanent Seed- Sitewide @ 2 lbs /acre		
Species	**Species**	**Species**
Agrostis hyemalis	*Desmodium canadense*	~~*Lespedeza capitata*~~
~~*Agrostis perennans*~~	*Echinacea purpurea*	*Liatris spicata*
Bidens aristosa	*Elymus virginicus*	*Monarda fistulosa*
Carex albolutescens	~~*Eupatorium coelestinum*~~	*Panicum anceps*
Carex lupulina	~~*Eupatorium perfoliatum*~~	*Panicum clandestinum*
~~*Carex vulpinoidea*~~	*Helianthus angustifolius*	*Rudbeckia hirta*
Chamaecrista fasciculata	*Heliopsis helianthoides*	*Senna hebecarpa*
Chamaecrista nictitans	*Hibiscus moscheutos*	*Tridens flavus*
Coreopsis lanceolata	~~*Juncus effusus*~~	*Verbena hastata*
Coreopsis tinctoria	~~*Juncus tenuis*~~	—
Eupatorium fistulosum	*Panicum dichotomiflorum*	*Panicum rigidulum*
Pycnanthemum tenuifolium		

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Rebecca Stubbs PE
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MCADAMS
The John R. McAdams Company, Inc.
2905 Meridian Parkway
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PLAN INFORMATION

PROJECT NO.	2021110220
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SCALE	NTS
DATE	02.17.2023

PLANTING AND SEEDING TABLES

L5.01