As-Built Baseline Monitoring Report

FINAL

COWFORD PROJECT

NCDMS Project #100095 (Contract #0007746)
USACE Action ID: SAW-2019-00487
DWR Project #2019-0495

Onslow County, North Carolina
White Oak River Basin
HUC 03030001

Provided by:

Resource Environmental Solutions, LLC
for Environmental Banc & Exchange, LLC

Provided for:
NC Department of Environmental Quality
Division of Mitigation Services

May 2022

M E M O R A N D U M

3600 Glenwood Avenue, Suite 100 Raleigh, North Carolina 27612 919.770.5573 tel. 919.829.9913 fax

TO: **Division of Mitigation Services**

FROM: **Matt Butler – RES**

DATE: **May 31, 2022**

RE: **DMS Comments on the Draft Mitigation Plan**
Cowford, Project ID #100095, DMS Contract #0007746

Comments:

1. Update contract number on cover pages.
   Done.
2. Check that project objectives match the Mitigation Plan. Even though the changes may be only minor differences, the baseline report is not an appropriate time to expound on or modify project objectives.
   Done.
3. Mitigation plan requests a fixed photo point at Kinston Highway and pictures of all culverted crossings. Add this photo to the report.
   Done.
4. Please add the IRT requested soil profiles at all groundwater gage locations to the report.
   Done.
5. There was suggestion to add woody debris to the depressional areas for habitat and it appears to be done to some extent. Suggest adding this to as-built narrative if this wood was added.
   Woody debris was not added to the depressional areas.
6. Add construction and as-built drawings to back of report.
   Done.
7. Confirm with surveyor that points 20-22 on the plat were installed and are marked.
   Points 20-22 have been confirmed and are marked.

Electronic Comments:

1. Re-submit x-sections with full complement of monitoring stations with the monitoring station name attributed; there are 15 cross sections identified on Figure 2 of the Draft MY0 report and eight cross sections submitted in digital data x section file.
   Done.
2. Resubmit the vegetation monitoring plots, the draft submission included only random plots.

Done.

3. Resubmit the stream structures with complete list of structures installed; Figure 2 indicates cross vanes were installed and the visual assessment tables indicate that multiple grad control structures were installed as part of this mitigation project.
   Done.
4. Resubmit the As-built centerline or thalweg with reach brakes as indicated in Figure 2 and the Mitigation Assets and Components Table and include restoration or re-establishment to the wetland assets attribute table.
   Done.
5. Submit the final recorded easement boundary to ensure that most up to date recorded easement is being used during monitoring phase of the project.
   Done.
6. Submit visual assessment photo points with labels or numbers to enable spatial and visual reference.
   Done.

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Appendix F: Soil Profile and Hydrology Data

Soil Profile Sampling Forms
Summary of Groundwater Monitoring Results

1.0 Project Summary

1.1 Project Location and Description

The Cowford Project (Project) is located within a rural watershed in Onslow County, North Carolina approximately three and half miles northwest of Richlands, North Carolina. The Project lies within the White Oak River Basin, North Carolina United States Geological Survey (USGS) 8-digit Cataloguing Unit 03030001 and 14-digit hydrologic unit code (HUC) 03030001010010, a Targeted Local Watershed (TLW) and the Division of Water Resources (NCDWR) sub-basin 03-05-02 (**Figure 1**). The Project provides 3,337 linear feet (LF) of stream as well as re-establish 2.991 acres of wetland that will provide water quality benefit for 238 acres of drainage area.

The Project area is comprised of a 17.20-acre easement involving one unnamed tributary within an entrenched channel between agricultural fields, totaling 2,988 existing LF, that drains into Cowford Branch, which eventually drains to the New River. The Project is accessible from U.S. route NC-258. Coordinates for the Project areas are approximately 34.9233, -77.5917, at the crossing in the middle of the project.

1.2 Project Goals and Objectives

Through the comprehensive analysis of the Project's maximum functional uplift using the Stream Functions Pyramid Framework and conclusions based on a Site Hydric Soils Detailed Study, the Project will realize specific, attainable goals and objectives. These goals clearly address the degraded water quality and nutrient input from agricultural practices that were identified as major watershed stressors in the 2010 White Oak RBRP. The Project will address outlined RBRP Goal one and two of the TLW specific goals (listed in **Section 2**).

The Project goals are:

- Re-establish hydrology to a historical stream/wetland complex that has been impacted by historic channel realignment, channel entrenchment, field ditching, and field drain tiling;
- To transport water in a stable, non-erosive manner and maintain a stable water table in riparian floodplain wetlands that will also contribute to stream baseflow;
- Improve flood flow attenuation on site and downstream by allowing for overbank flows and connection to the floodplain;
- Create diverse bedforms and stable channels that achieve healthy dynamic equilibrium and provide suitable in-stream habitat for aquatic organisms;
- Limit sediment and nutrient inputs into stream system;
- Re-establish wetland;
- Restore native wetland and riparian vegetation;
- Indirectly support the goals of the 2010 White Oak RBRP to improve water quality and to reduce sediment and nutrient loads; and
- To support the life histories of aquatic and riparian plants and animals through stream restoration activities.

Functional uplift, benefits, and improvements within the Project area, as based on the Function Based Framework are outlined in the table below.

Functional Benefits and Improvements Table.

Level	Function	Goal	Objective	Measurement Method
1	***Hydrology*°** *Transport of water from the watershed to the channel*	to transport water from the watershed to the channel in a non-erosive manner and maintain a stable water table in the riparian wetland	Convert the land-use of streams and their watersheds from cropland into riparian forest Maintain appropriate hydroperiod for Muckalee soil series	Percent Project drainage area converted to riparian forest (indirect measurement) Groundwater wells
2	***Hydraulic*** *Transport of water in the channel, on the floodplain, and through the sediments*	to transport water in a stable non-erosive manner	Improve flood bank connectivity by reducing bank height ratios and increasing entrenchment ratios Maintain regular, seasonal flow in restored, intermittent streams	Cross sections Stage Recorders Bank Height Ratio Entrenchment Ratio Flow gauge
3	**Geomorphology** *Transport of wood and sediment to create diverse bedforms and dynamic equilibrium*	to create a diverse bedform and a stable channel that achieves healthy dynamic equilibrium and provides suitable habitat for life	Limit erosion rates and increase channel stability to reference reach conditions Improve bedform diversity (pool spacing, percent riffles, etc.) Increase buffer width to at least 50 feet	As-built stream profile Cross sections Visual monitoring Vegetation plots
4	**Physicochemical °** *Temperature and oxygen regulation; processing of organic matter and nutrients*	Indirectly support the goals of the 2010 White Oak RBRP to achieve appropriate levels for water temperature, dissolved oxygen concentration, and other important nutrients including but not limited to Nitrogen and Phosphorus through buffer/wetland planting and wetland hydrologic restoration	Establish native hardwood riparian buffer to provide canopy shade and absorb nutrients Install in-stream structures to created aeration zones Promote sediment filtration, nutrient cycling, and organic accumulation through natural wetland biogeochemical processes	
5	**Biology °** *Biodiversity and life histories of aquatic life histories and riparian life*	to achieve functionality in levels 1-4 to support the life histories of aquatic and riparian plants and animals through instream	Improve aquatic habitat by installing habitat features, constructing pools of varying depths, and planting the riparian buffer and wetlands	

° *These are benefits that are presumed and will not be measured by the monitoring*

1.3 Project Success Criteria

The success criteria for the Project will follow the 2016 USACE Wilmington District Stream and Wetland Compensatory Mitigation Update, the Cowford Site Final Mitigation Plan, and subsequent agency guidance. Specific success criteria components are presented below. Cross section and vegetation plot monitoring takes place in Years 0, 1, 2, 3, 5, and 7. Hydrology and visual monitoring takes place annually. Specific success criteria components are presented below.

Stream Restoration Success Criteria

Four bankfull flow events must be documented within the seven-year monitoring period. The bankfull events must occur in separate years. Otherwise, the stream monitoring will continue until four bankfull events have been documented in separate years.

There should be minor change in as-built cross sections. If changes do take place, they should be evaluated to determine if they represent a movement toward a less stable condition (for example downcutting or erosion) or are minor changes that represent an increase in stability (for example settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross sections shall be classified using the Rosgen stream classification method, and all monitored cross sections should fall within the quantitative parameters defined for channels of the design stream type. Bank height ratio shall not exceed 1.2, and the entrenchment ratio shall be above 2.2 within restored riffle cross sections (for C and E streams).

Digital images are used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures. Longitudinal images should not indicate the absence of developing bars within the channel or an excessive increase in channel depth. Lateral images should not indicate excessive erosion or continuing degradation of the banks over time. A series of images over time should indicate successional maturation of riparian vegetation.

Stream restoration reaches will be monitored to document intermittent or seasonal surface flow. This will be accomplished through direct observation and the use of hydraulic pressure transducers with data loggers. Reaches must demonstrate a minimum of 30 consecutive days of flow. One flow gauge was installed on KJ1-A and one stage recorder was installed on KJ1-C.

Headwater Stream Restoration Success Criteria

Continuous surface water flow must be documented every year for at least 30 days. Channel formation must be documented through consistent indicators. Monitoring years 1-4 require evidence of scour, sediment deposition, sediment sorting, multiple observed flow events, destruction of terrestrial vegetation, presence of litter and debris, wracking, vegetation matted down or bet, and leaf litter disturbed. Monitoring years 5-7, the headwater valley reach must meet the previous requirements as well as demonstrate bed and banks, natural line impressed on the bank, shelving, water staining, change in plant community and changes in character of soil.

Wetland Hydrology Success Criteria

The Natural Resources Conservation Service (NRCS) has a current WETs table (1990-2019) for Onslow County upon which to base a normal rainfall amount and average growing season. The closest comparable data station was determined to be the WETS station for New River MCAF, NC. The growing season for Onslow County is 269 days long, extending from March 10 to December 4, and is based on a daily minimum temperature greater than 28 degrees Fahrenheit occurring in five of ten years.

Based upon field observation across the site the NRCS mapping units show a good correlation to actual site conditions in areas of the site. Mitigation guidance for soils in the Coastal Plain suggests a hydroperiod for the Muckalee soil of 12-16 percent of the growing season. The hydrology success criterion for the Site is to restore the water table so that it will remain continuously within 12 inches of the soil surface for 12-16 percent of the growing season (approximately 33 days) at each groundwater gauge location. Due to the

extensive drainage efforts, it may take at least a year for the site to become completely saturated and reach the target hydroperiods.

Vegetation Success Criteria

Specific and measurable success criteria for plant density within the riparian buffers on the Project will follow IRT Guidance. The interim measures of vegetative success for the Project will be the survival of at least 320 planted three-year old trees per acre at the end of Year 3, 260 five-year old trees at seven feet in height at the end of Year 5, and the final vegetative success criteria will be 210 trees per acre with an average height of ten feet at the end of Year 7. Volunteer trees that are listed on the approved planting list will be counted, identified to species, and included in the yearly monitoring reports, and if established for two or more years, may be counted towards the success criteria of total planted stems. Moreover, any single species can only account for up to 50 percent of the required number of stems within any vegetation plot. Any stems more than 50 percent will be shown in the monitoring table but will not be used to demonstrate success.

1.4 Project Components

The streams and wetlands provided for restoration have been significantly impacted by ditching, drain tiling, and other agricultural practices for over 50 years. Provided improvements to the Project will help address impacts specifically discussed as priorities in in the 2010 White Oak River Basin Restoration Priorities (RBRP).

Through stream restoration, headwater valley (HWV) restoration, and wetland restoration, the Project presents 3,347 LF of provided stream, generating 3,538.67 Warm Stream Mitigation Units (SMU) and 2.991 acres of provided wetland, generating 2.991 Wetland Mitigation Units (WMU).

Cowford Project Components Summary (Mitigation Plan)

Stream Mitigation			
Mitigation Approach	**Linear Feet**	**Ratio**	**Warm SMU**
Restoration (HWV)	923	1:1	913.000*
Restoration	2,424	1:1	2,424.000
Total	**3,347**		**3,337**
Non-standard Buffer Width Adjustment			**201.670**
Total Adjusted SMU's			**3,538.67**
Wetland Mitigation			
Mitigation Approach	**Area (acres)**	**Ratio**	**WMU**
Re-establishment	2.991	1:1	2.991
Total	**2.991**		**2.991**

**Headwater valley credits are calculated from valley length, not included in NSBW calculations.*
*** Credit adjustment for Non-standard Buffer Width calculation using the Wilmington District Stream Buffer Credit Calculator issued by the USACE in January 2021. See Section 6.6 for further information*

1.5 Stream and Wetland Design/Approach

Streams

The Project includes stream and headwater valley restoration. Stream restoration will incorporate the design of a single-thread, meandering channel, with parameters based on data taken from reference site, published empirical relationships, regional curves developed from existing project streams, and NC Regional Curves.

Analytical design techniques will also be a crucial element of the project and will be used to determine the design discharge and to verify the design. Based on soil type, valley slope, and drainage area headwater valley restoration was incorporated in the design. Headwater valley restoration includes the design of a vegetated diffuse flow system that will allow for the passive development of a headwater stream.

The Project has been broken into the following design reaches:

Reach KJ1-A (HWV)
A headwater valley restoration approach is provided for this reach to address historic ditching and buffer impacts. Restoration activities includes:

- Grading a headwater valley,
- Installing wood structures to provide grade control and habitat,
- Installing live stakes to stabilize the bed and banks,
- Riparian planting.

Reach KJ1-B
An offline restoration approach is provided for this reach to address historic ditching and buffer impacts. Restoration activities includes:

- Grading a new, single-thread channel in the existing floodplain (Priority I Restoration),
- Installing log structures to provide grade control and habitat,
- Establishing a riffle-pool sequence throughout the new channel,
- Installing toe protection on meander bends,
- Installing live stakes to stabilize the banks and provide channel shading,
- Filling and grading the existing channel to create wetland habitat,
- Riparian planting.

Reach KJ1-C
An inline, P2 restoration approach is provided for this reach to address historic ditching, channelization, and buffer impacts. Restoration activities includes:

- Grading a new, single-thread channel in an excavated floodplain,
- Installing rock and log structures to provide grade control and habitat,
- Establishing a riffle-pool sequence throughout the new channel,
- Installing toe protection on meander bends,
- Installing live stakes to stabilize the banks and provide channel shading,
- Filling the existing channel,
- Riparian planting, and
- Invasive vegetation treatment.

Wetlands

The Cowford Project offers a total ecosystem restoration opportunity. As such, the wetland restoration is closely tied to the stream restoration and drain tile interruption. The Project provides 2.991 WMUs through wetland re-establishment. Wetland re-establishment is only provided in areas that have been determined appropriate for wetland restoration by a licensed soil scientist due to the presence of hydric soils and potential hydrology. Re-establishment activities includes a successful restoration that raises the local groundwater elevation, allows frequent flooding, the plugging of ditches, removing all drain tiles within the easement, and creating shallow depression features in the wetland.

A 2D model of the provided stream restoration was run in HEC-RAS to evaluate the effectiveness of the design at increasing wetland flooding. Inundation maps from this model of the 1- and 10-year design storms demonstrate that the provided design will function in this capacity. These activities help to raise the local groundwater and have a more natural hydrologic cycle in the riparian zone. Surface roughening through shallow soil ripping improves infiltration and slow runoff through the floodplain. Surface roughening also create microtopography and shallow depressional areas, re-establishing more natural conditions and establishing habitat diversity. Historic land-use impacts will be addressed through the planting of a native hardwood wetland community.

1.6 Construction and As-Built Conditions

Site construction was completed on July 30th, 2021, and planting was completed on March 8th, 2022. The Cowford Site was overall built to design plans and guidelines, as-built stream and wetland areas were only slightly different than proposed. Wetland Depressions were designed to be 0.3-0.5 feet deep but As-Built Wetland Depressions were found to be slightly deeper than proposed ranging from 0.5-1.0 feet deep. During construction additional drain tiles were found, which were then interrupted at the easement boundary. Additionally, extra t-posts were installed around the boundary of the easement in 100-foot intervals to reduce concerns of encroachment by farming practices. The record drawings are included in **Appendix E**. Minor monitoring device location changes were made during as-built installation, however, the quantities remained as proposed in the Mitigation Plan.

1.7 Baseline Monitoring Performance (MY0)

The Cowford Baseline Monitoring activities were performed in January and March 2022. All Baseline Monitoring data is present below and in the appendices. The Site is on track to meeting vegetation, wetland, and stream interim success criteria.

Vegetation

Setup and monitoring of the nine permanent vegetation plots and five random vegetation plots were completed after planting and stream construction on March 16th, 2021. Vegetation data are in **Appendix C**, associated photos are in **Appendix B,** and plot locations are in **Appendix B**. MY0 monitoring data indicates that all plots are exceeding the interim success criteria of 320 planted stems per acre. Planted stem densities ranged from 567 to 1,012 planted stems per acre with a mean of 749 planted stems per acre across all plots. A total of ten species were documented within the plots. Volunteer species were not noted at baseline monitoring but are expected to establish in upcoming years. The average stem height in the vegetation plots was 1.5 feet. Visual assessment of vegetation outside of the monitoring plots indicates that the herbaceous vegetation is becoming well established throughout the project.

Stream Geomorphology

Cross section setup and geomorphology data collection for MY0 was collected on January 19th, 2021. Summary tables and cross section plots are in **Appendix D**. Overall the baseline cross sections and profile relatively match the proposed design. The as-built conditions show that shear stress and velocities have been reduced for all restoration/enhancement reaches.

Visual assessment of the stream channel was performed to document signs of instability, such as eroding banks, structural instability, or excessive sedimentation. The channel is transporting sediment as designed and will continue to be monitored for aggradation and degradation.

Stream Hydrology

One stage recorder on KJ1-C, was installed on January 19th, 2022. One flow gauge, on KJ1-A, was installed on January 19th, 2022. The stage recorder is in place to document bankfull events, while the flow gauge is in place to track frequency and duration of stream flow events. Stream hydrology data will be included in the Monitoring Year 1 Report in this section and in the appendices. Gauge locations can be found on Figure 2 and photos are in **Appendix B**.

Wetland Hydrology

A total of five groundwater wells with automatic recording pressure transducers were installed throughout the wetland areas on November 2nd, 2021, and April 28th, 2022. These will record water table depths at a frequency of twice per day. Preconstruction wetland hydrology data for 2020 and 2021 can be found in **Appendix F**. Furthermore, soil profiles have been taken at each groundwater well on November 2nd, 2021, or March 27th, 2022, and can be found in **Appendix F**.

Headwater Valley

Setup of cross sections 1, 2, and 3 in the headwater valley took place on January 19th, 2022. Continuous surface water flow must be documented every year for at least 30 days. Channel formation must be documented through consistent indicators. In year 1 through 4 RES will be looking for evidence that demonstrates a concentration of flow indicative of channel formation within the topographic low point of the valley or crenulation. During monitoring years 5 through 7, the stream must successfully meet the requirements for year 1 through 4 and the preponderance of evidence must demonstrate the development of stream bed and banks. The indicators are still being established and in years to follow will be documented with a visual assessment and digital images.

Visual Assessment

Digital images will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures. Digital images will also capture the headwater valley, boundaries, and culverts of the site, located in **Appendix B**.

2.0 Methods

Stream monitoring was conducted using a Topcon GTS-312 Total Station. Three-dimensional coordinates associated with cross-section data were collected in the field (NAD83 State Plane feet FIPS 3200). Morphological data were collected at 15 cross-sections. Survey data were imported into CAD, ArcGIS®, and Microsoft Excel® for data processing and analysis. The stage recorders include an automatic pressure transducer placed in PVC casing in a pool. The elevation of the bed and top of bank at each stage recorder are used to detect bankfull events.

Vegetation success is being monitored at nine permanent vegetation plots and five random vegetation plots. Vegetation plot monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition and density of planted species. Data are processed using the CVS data entry tool. In the field, the four corners of each plot were permanently marked with PVC at the origin and metal conduit at the other corners. Photos of each plot are to be taken from the origin each monitoring year. The random plots are to be collected in locations where there are no permanent vegetation plots. Random plots are collected in the form of 100 square meter belt transects with variable

dimensions. Tree species and height will be recorded for each planted stem and the transects will be mapped and new locations will be monitored in subsequent years.

Wetland hydrology is monitored to document success in wetland restoration areas where hydrology was affected. This is accomplished with three automatic pressure transducer gauges (located in groundwater wells) that record daily groundwater levels. Three have been installed within the wetland restoration crediting area and one within the adjacent upland area to document the wetland boundary. One automatic pressure transducer is installed above ground for use as a barometric reference. Gauges are downloaded quarterly and wetland hydroperiods are calculated during the growing season. Gauge installation followed current regulatory guidance. Visual observations of primary and secondary wetland hydrology indicators are also recorded during quarterly site visits.

3.0 References

Griffith, G.E., J.M.Omernik, J.A. Comstock, M.P. Schafale, W.H.McNab, D.R.Lenat, T.F.MacPherson, J.B. Glover, and V.B. Shelburne. (2002). Ecoregions of North Carolina and South Carolina, (color Poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).

Lee Michael T., Peet Robert K., Roberts Steven D., and Wentworth Thomas R., 2008. *CVS-EEP Protocol for Recording Vegetation Level*. Version 4.2

Peet, R.K., Wentworth, T.S., and White, P.S. (1998), *A flexible, multipurpose method for recording vegetation composition and structure*. Castanea 63:262-274

Resource Environmental Solutions (2021). Cowford Site Final Mitigation Plan.

Schafale, M.P. 2012. Classification of the Natural Communities of North Carolina, Third Approximation. North Carolina Natural Heritage Program, Division of Parks, and Recreation, NCDENR, Raleigh, NC.

USACE. (2016). Wilmington District Stream and Wetland Compensatory Mitigation Update. NC: Interagency Review Team (IRT).

Appendix A

Background Tables

Table 1. Cowford (100095) - Mitigation Assets and Components

Project Segment	Existing Footage or Acreage	Mitigation Plan Footage or Acreage	Mitigation Category	Restoration Level	Priority Level	Mitigation Ratio (X:1)	Mitigation Plan Credits		As-Built Footage or Acreage	Comments
KJ1-A*	923	913	Warm	Restoration	HWV	1.00000	913.000		935	Headwater valley restoration, riparian planting
KJ1-B	647	852	Warm	Restoration	P1	1.00000	852.000		852	Channel restoration, riparian planting
KJ1-C	1,428	1,572	Warm	Restoration	P2	1.00000	1572.000		1,574	Channel restoration, riparian planting
WA	0	2.991	RR	Re-establishment		1.00000	2.991		2.969	Stream restoration, drain tile interruption, native planting

*Headwater valley credits are calculated from valley length, not included in NSBW calculations.

Project Credits

Restoration Level	Stream			Riparian Wetland	Non-Rip Wetland	Coastal Marsh
	Warm	Cool	Cold			
Restoration	**3337.000**					
Re-establishment					**2.991**	
Rehabilitation						
Enhancement						
Enhancement I						
Enhancement II						
Creation						
Preservation						
NSBW Adjustment	**201.670**					
Total	**3538.670**				**2.991**	

Table 2. Project Activity and Reporting History
Cowford Mitigation Site

Elapsed Time Since grading complete: **9 months**
Elapsed Time Since planting complete: **1 month**
Number of reporting Years[1]: **0**

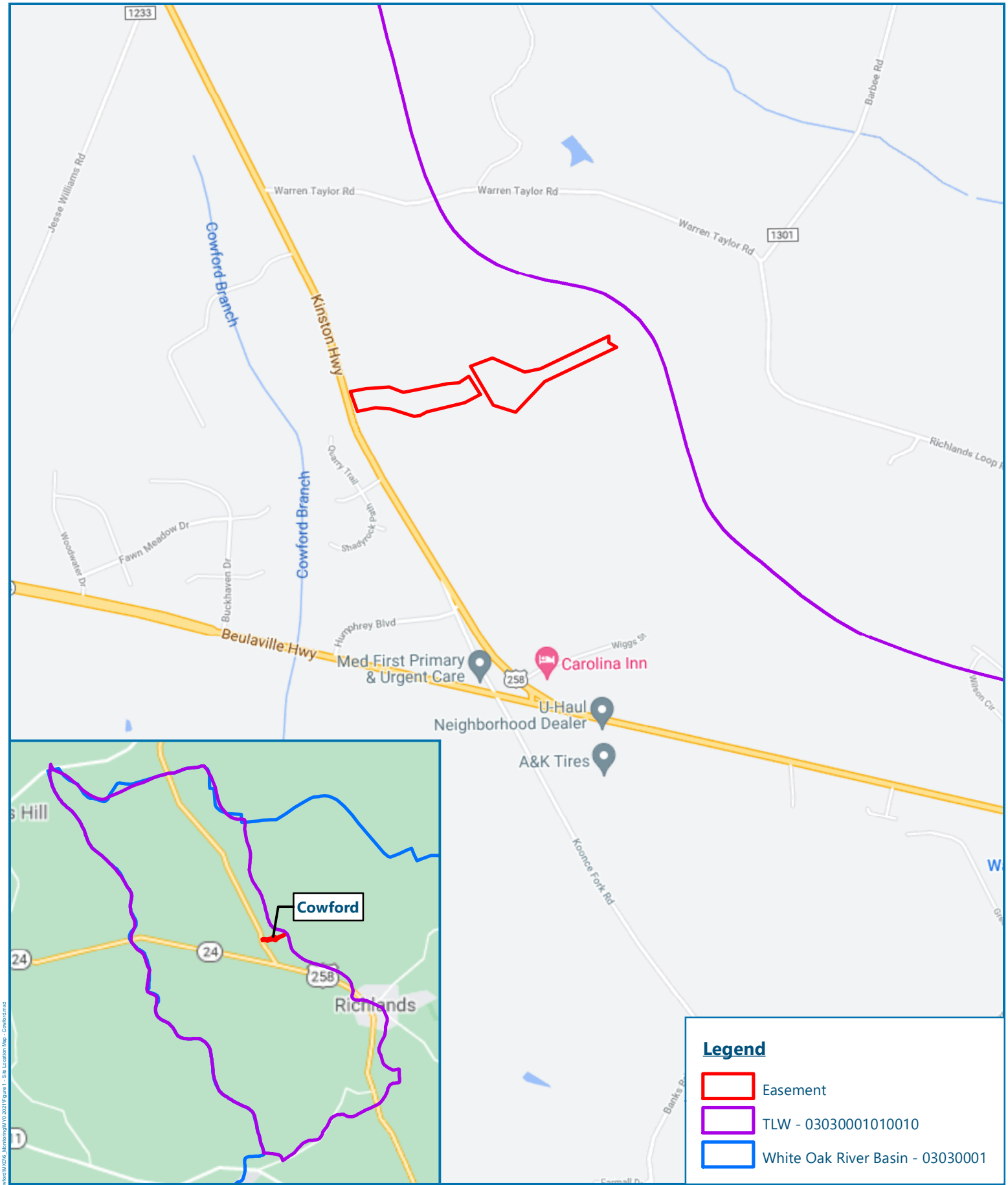
Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	NA	26-Mar-21
Final Design – Construction Plans	NA	03-May-21
Stream Construction	NA	30-Jul-21
Site Planting	NA	08-Mar-22
As-built (Year 0 Monitoring – baseline)	Jan/March 2022	Apr-22
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		
Year 6 Monitoring		
Year 7 Monitoring		

1 = The number of reports or data points produced excluding the baseline

Table 3. Project Contacts Table Cowford Mitigation Site	
Designer	RES / 3600 Glenwood Ave., Suite 100, Raleigh, NC 27612
Primary project design POC	Benton Carroll, PE
Construction Contractor	RES / 3600 Glenwood Ave., Suite 100, Raleigh, NC 27612
Construction POC	Andrew Dimmette
Survey Contractor	RES / 3600 Glenwood Ave., Suite 100, Raleigh, NC 27612
Survey POC	Brian Hockett
Planting Contractor	Shenandoah Habitats
Planting contractor POC	David Coleman
Monitoring Performers	RES / 3600 Glenwood Ave, Suite 100, Raleigh, NC 27612
Monitoring POC	Hannah Gadai

Table 4. Project Background Information				
Project Name		Cowford Project		
County		Onslow		
Project Area (acres)		17.20		
Project Coordinates (latitude and longitude)		34.92293, -77.5917		
Planted Acreage (Acres of Woody Stems Planted)		16.35		
Project Watershed Summary Information				
Level IV Ecoregion		63h - Carolina Flatwoods		
River Basin		White Oak		
USGS Hydrologic Unit 8-digit	3020302	USGS Hydrologic Unit 14-digit	30203020102	
DWR Sub-basin		03-05-02		
Project Drainage Area (Acres and Square Miles)		238 ac (.37 sqmi)		
Project Drainage Area Percentage of Impervious Area		<1%		
Reach Summary Information				
Parameters		**Reach KJ1-A**	**Reach KJ1-B**	**Reach KJ1-C**
Length of reach (linear feet)		935	852	1574
Valley confinement (Confined, moderately confined, unconfined)		Unconfined	Unconfined	Moderately confined
Drainage area (Acres and Square Miles)		115	181	238
Perennial, Intermittent, Ephemeral		Intermittent	Intermittent	Intermittent
NCDWR Water Quality Classification		None	None	None
Stream Classification (existing)		G5	G5	G5 to E5
Stream Classification (proposed)		N/A	E5 / C5	E4 / C4
Evolutionary trend (Simon)		III	III	III-IV
FEMA classification		Zone X (Minimal Risk)	Zone X (Minimal Risk)	Zone X (Minimal Risk)

Wetland Summary Information	
Parameters	**WA**
Size of Wetland (acres)	2.969
Wetland Type	RR
Mapped Soil Series	Muckalee loam
Drainage Class	Poorly
Soil Hydric Status	Yes (LESS)
Source of Hydrology	GW, OL, SF
Restoration or enhancement method	H, V


1233
Warren Taylor Rd
Warren Taylor Rd
Warren Taylor Rd
1301
Barbee Rd
Jesse Williams Rd
Cowford Branch
Kinston Hwy
Quarry Trail
Shadyrock Path
Richlands Loop
Fawn Meadow Dr
Woodwater Dr
Buckhaven Dr
Cowford Branch
Humphrey Blvd
Beulaville Hwy
Med First Primary & Urgent Care
258
Carolina Inn
Wiggs St
Wilson Cir
U-Haul Neighborhood Dealer
A&K Tires
Koonce Fork Rd
Banks
Farmall Dr
Hill
Cowford
24
24
258
Richlands
11
Legend
Easement
TLW - 03030001010010
White Oak River Basin - 03030001
0
500
1,000
Feet
Figure 1 - Site Location Map
Cowford Mitigation Site
Onslow County, North Carolina
Date: 2/17/2022
Drawn by: HRG
Checked by: JRM
1 inch = 1,000 feet
res
Document Path: R:\Resilience\gis\Projects\101900_Cowford\MXD\6_Monitoring\MY0 2021\Figure 1 - Site Location Map - Cowford.mxd

Appendix B

Visual Assessment Data

res

N
W E
S

0 150 300
Feet

Figure 2

Current Conditions
Plan View

MY0 2022

Cowford
Mitigation Project

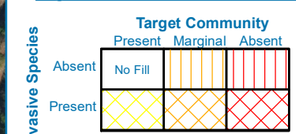
Onslow County, NC

Date: 6/14/2022	Drawn by: HRG
Lat: 35.671107	Long: -82.669235

LEGEND

- Easement - 17.20
- Wetland Re-establishment
- Wetland
- Fixed Plot
- Random Plot
- Cross
- Stream Restoration
- HWV Restoration
- Top of
- Engineered Sediment
- Drain Tile Outlet
- Flow
- Stage Recorder
- Wetland
- Photo Point
- Existing Ag Ditch

Vegetation Condition Assessment



Visual Stream Stability Assessment

Reach JK1-A
Assessed Stream Length 925
Assessed Bank Length 1850

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)	3	3		100%

Visual Stream Stability Assessment

Reach JK1-B

Assessed Stream Length 850

Assessed Bank Length 1700

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.	7	7		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)	16	16		100%

Visual Stream Stability Assessment

Reach JK1-C

Assessed Stream Length 1572

Assessed Bank Length 3144

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.	17	17		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)	28	28		100%

Table 6 Vegetation Condition Assessment

Planted Acreage[1] **16.4**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Red Simple Hatch	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Orange Simple Hatch	0	0.00	0.0%
			Total			0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Orange Simple Hatch	0	0.00	0.0%
			Cumulative Total			0.0%

Easement Acreage[2] **17.2**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern[4]	Areas or points (if too small to render as polygons at map scale).	1000 SF	Yellow Crosshatch	0	0.00	0.0%
5. Easement Encroachment Areas[3]	Areas or points (if too small to render as polygons at map scale).	none	Red Simple Hatch	0	0.00	0.0%

1 = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project effort.

2 = The acreage within the easement boundaries.

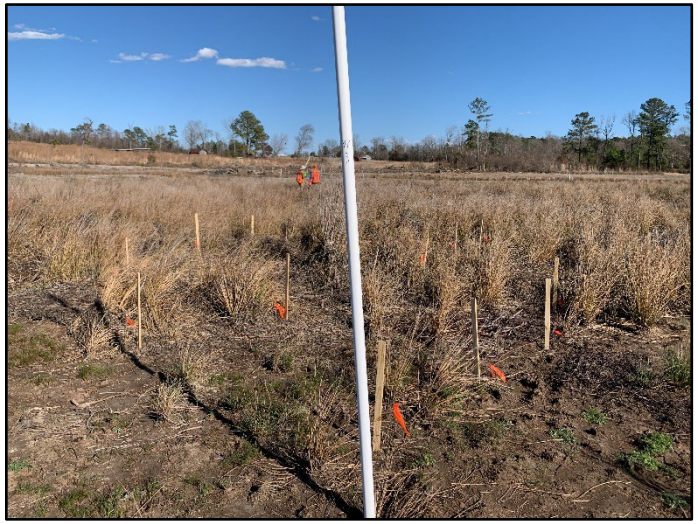
3 = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e., item 1,2 or 3) as well as a parallel tally in item 5.

4 = Invasives may occur in or out of planted areas, but still within the easement and will therefore be calculated against the overall easement acreage. Invasives of concern/interest are listed below. The list of high concern spcies are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by EEP such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likley trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly ealry in a projects monitoring history. However, areas of discreet, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolzing invasives polygons, particulalry for situations where the conditon for an area is somewhere between isolated specimens and dense, discreet patches. In any case, the point or polygon/area feature can be symbolized to describe things like high or low concern and species can be listed as a map inset, in legend items if the number of species are limited or in the narrative section of the executive summary.

Cowford MY0 Vegetation Monitoring Plot Photos

Vegetation Plot 1 (3/16/2022)

Vegetation Plot 2 (3/16/2022)



Vegetation Plot 3 (3/16/2022)

Vegetation Plot 4 (3/16/2022)

Vegetation Plot 5 (3/16/2022)

Vegetation Plot 6 (3/16/2022)

Vegetation Plot 7 (3/16/2022)

Vegetation Plot 8 (3/16/2022)

Vegetation Plot 9 (3/16/2022)

Cowford MY0 Random Vegetation Monitoring Plot Photo

Random Vegetation Plot 1 (3/16/2022)

Random Vegetation Plot 2 (3/16/2022)

Random Vegetation Plot 3 (3/16/2022)

Random Vegetation Plot 4 (3/16/2022)

Random Vegetation Plot 5 (3/16/2022)

Cowford Monitoring Device Photos MY0 2022

Stage Recorder KJ1-C (1/19/2022)

Flow Gauge KJ1-A (1/19/2022)

Wetland Gauge 1 (3/8/2022)

Wetland Gauge 2 (3/8/2022)

Wetland Gauge 3 (3/8/2022)

Wetland Gauge 4 (3/8/2022)

Wetland Gauge 5 (3/8/2022)

Cowford General Site Photos MY0 2022

Culvert at the top of KJ1-C (3/8/2022)

Culvert at the bottom of KJ1-B (3/8/2022)

Culvert at edge of Wetland (4/28/2022)

Culvert at Kinston Highway (4/28/2022)

ESP & Treatment Pool (3/16/2022)

Haybale brush toe in BJ1-B (3/16/2022)

Headwater Valley (3/16/2022)

Headwater Valley (3/16/2022)

Headwater Valley (4/28/2022)

Easement Marker (3/8/2022)

Appendix C

Vegetation Plot Data

Table 7. Planted Species Summary

Bare Root Planting Tree Species				
Common Name	**Scientific Name**	**Mit Plan %**	**As-Built %**	**Total Stems Planted**
River Birch	*Betula nigra*	15	15	2,000
Buttonbush	*Cephalanthus occidentalis*	15	15	2,000
Bald Cypress	*Taxodium distichum*	10	10	1,300
Water Oak	*Quercus nigra*	10	10	1,300
Willow Oak	*Quercus phellos*	10	10	1,300
Overcup Oak	*Quercus lyrata*	10	10	1,300
Swamp Tupelo	*Nyssa biflora*	10	10	1,300
American sycamore	*Platanus occidentalis*	10	10	1,300
Southern red oak	*Quercus falcata*	5	5	700
Green ash	*Fraxinus pennsylvanica*	5	5	700
			Total	13,200
			Planted Area	16.35
			As-built Planted Stems/Acre	807

Table 8. Vegetation Plot Mitigation Success Summary

Wetland/Stream Vegetation Totals (per acre)					
Plot #	**Planted Stems/Acre**	**Volunteer Stems/Acre**	**Total Stems/Acre**	**Success Criteria Met?**	**Average Planted Stem Height (ft)**
1	971	0	971	Yes	1.5
2	971	0	971	Yes	1.4
3	769	0	769	Yes	1.6
4	567	0	567	Yes	1.7
5	931	0	931	Yes	1.3
6	688	0	688	Yes	1.5
7	607	0	607	Yes	1.7
8	850	0	850	Yes	1.4
9	728	0	728	Yes	1.7
R1	1012	0	1012	Yes	1.4
R2	567	0	567	Yes	1.5
R3	607	0	607	Yes	1.4
R4	647	0	647	Yes	1.4
R5	567	0	567	Yes	1.8
Project Avg	**749**	**0**	**749**	**Yes**	**1.5**

Table 9. Stem Count Total and Planted by Plot Species

EEP Project Code 100095. Project Name: Cowford

			Current Plot Data (MY0 2021)																									
			100043-01-0001			100043-01-0002			100043-01-0003			100043-01-0004			100043-01-0005			100043-01-0006			100043-01-0007			100043-01-0008			100043-01-0009		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	10	10	10	3	3	3	8	8	8	4	4	4										5	5	5	1	1	1
Cephalanthus occidentalis	common buttonbush	Shrub	1	1	1	5	5	5										1	1	1				2	2	2	1	1	1
Fraxinus pennsylvanica	green ash	Tree	1	1	1							2	2	2										4	4	4	1	1	1
Nyssa biflora	swamp tupelo	Tree	4	4	4	3	3	3	2	2	2				6	6	6	4	4	4	7	7	7	1	1	1	4	4	4
Platanus occidentalis	American sycamore	Tree	1	1	1	3	3	3	2	2	2	3	3	3	6	6	6	2	2	2	5	5	5	1	1	1	2	2	2
Quercus falcata	southern red oak	Tree	2	2	2	1	1	1	1	1	1				4	4	4	1	1	1	1	1	1	1	1	1			
Quercus lyrata	overcup oak	Tree													3	3	3	3	3	3				2	2	2	1	1	1
Quercus nigra	water oak	Tree	4	4	4							1	1	1				1	1	1	1	1	1	2	2	2	1	1	1
Quercus phellos	willow oak	Tree	1	1	1	4	4	4	5	5	5	2	2	2	4	4	4	1	1	1	1	1	1	3	3	3	1	1	1
Taxodium distichum	bald cypress	Tree				5	5	5	1	1	1	2	2	2				4	4	4							6	6	6
		Stem count	24	24	24	24	24	24	19	19	19	14	14	14	23	23	23	17	17	17	15	15	15	21	21	21	18	18	18
		size (ares)	1			1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	8	8	8	7	7	7	6	6	6	6	6	6	5	5	5	8	8	8	5	5	5	9	9	9	9	9	9
		Stems per ACRE	971	971	971	971	971	971	769	769	769	567	567	567	931	931	931	688	688	688	607	607	607	850	850	850	728	728	728

			Current Plot Data (MY0 2021)															Annual Means		
			100043-01-R1			100043-01-R2			100043-01-R3			100043-01-R4			100043-01-R5			MY0 (2021)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	7	7	7	3	3	3	1	1	1	3	3	3	2	2	2	47	47	47
Cephalanthus occidentalis	common buttonbush	Shrub	1	1	1	3	3	3	3	3	3	2	2	2				19	19	19
Fraxinus pennsylvanica	green ash	Tree	2	2	2	2	2	2							1	1	1	13	13	13
Nyssa biflora	swamp tupelo	Tree	4	4	4							1	1	1	5	5	5	41	41	41
Platanus occidentalis	American sycamore	Tree	2	2	2				1	1	1				4	4	4	32	32	32
Quercus falcata	southern red oak	Tree	2	2	2	4	4	4				1	1	1	1	1	1	19	19	19
Quercus lyrata	overcup oak	Tree	3	3	3				1	1	1	1	1	1				14	14	14
Quercus nigra	water oak	Tree	1	1	1				1	1	1	1	1	1				13	13	13
Quercus phellos	willow oak	Tree	2	2	2	1	1	1	1	1	1	6	6	6	1	1	1	33	33	33
Taxodium distichum	bald cypress	Tree	1	1	1	2	2	2	7	7	7							28	28	28
		Stem count	25	25	25	15	15	15	15	15	15	15	15	15	14	14	14	259	259	259
		size (ares)	1			1			1			1			1			14		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.35		
		Species count	10	10	10	6	6	6	7	7	7	7	7	7	6	6	6	10	10	10
		Stems per ACRE	1012	1012	1012	607	607	607	607	607	607	607	607	607	567	567	567	749	749	749

Appendix D

Stream Measurement and

Geomorphology Data

Table 8. Baseline Stream Data Summary
Cowford Mitigation Site - Reach KJ1-B

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)		---	---	---	---	---	4.9	---	---	1	---	---	---	---	---	---	---	8.0	---	9.5	10.4	10.4	11.3	1.3	2
Floodprone Width (ft)					---	---	7.3	---	---	1	---	---	---	---	---	---	---	>50	---	48.7	49.0	49.0	49.3	0.4	2
Bankfull Mean Depth (ft)		---	---	---	---	---	0.9	---	---	1	---	---	---	---	---	---	---	0.6	---	0.6	0.7	0.7	0.8	0.1	2
[1]Bankfull Max Depth (ft)					---	---	1.3	---	---	1	---	---	---	---	---	---	---	1.0	---	1.0	1.1	1.1	1.2	0.1	2
Bankfull Cross Sectional Area (ft^2)		---	---	---	---	---	4.5	---	---	1	---	---	---	---	---	---	---	5.0	---	6.4	6.9	6.9	7.3	0.6	2
Width/Depth Ratio					---	---	5.3	---	---	1	---	---	---	---	---	---	---	12.8	---	17.2	17.3	17.3	17.4	0.1	2
Entrenchment Ratio					---	---	1.5	---	---	1	---	---	---	---	---	---	---	>2.2	---	4.3	4.8	4.8	5.2	0.6	2
[1]Bank Height Ratio					---	---	3.9	---	---	1	---	---	---	---	---	---	---	1.0	---	1.0	1.0	1.0	1.0	0.0	2
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	5	---	27	---	---	---	---	---	---
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	9	---	30	---	---	---	---	---	---
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	---	---	---	---	---	---	20	---	53	---	---	---	---	---	---
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	4	---	27	4	---	---	27	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	---	---	---	---	---	---	10	---	14	10	---	---	14	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	1.3	---	1.8	1.3	---	---	1.8	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	---	---	---	---	---	---	33	---	61	33	---	---	61	---	---
Meander Width Ratio					---	---	---	---	---	---	---	---	---	---	---	---	4.1	---	7.6	4.1	---	---	7.6	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---						---						---			---					
Max part size (mm) mobilized at bankfull					---						---						---			---					
Stream Power (transport capacity) W/m^2					---						---						---			---					
Additional Reach Parameters																									
Rosgen Classification					G5						---						E5/C5			E4					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---						---						---			---					
Valley length (ft)					680						---						602			601					
Channel Thalweg length (ft)					688						---						852			850					
Sinuosity (ft)					1.01						---						1.42			1.41					
Water Surface Slope (Channel) (ft/ft)					---						---						---			---					
Channel slope (ft/ft)					0.007						---						0.002			0.002					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 8. Baseline Stream Data Summary
Cowford Mitigation Site - Reach KJ1-C

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)		---	---	---	6.6	6.7	6.7	6.7	---	2	---	---	---	---	---	---	---	8.0	---	8.6	11.0	9.7	16.1	3.4	4
Floodprone Width (ft)					12.5	13.4	13.4	14.3	---	2	---	---	---	---	---	---	---	>50	---	46.00	47.8	47.9	49.4	1.4	4
Bankfull Mean Depth (ft)		---	---	---	1.0	1.1	1.1	1.2	---	2	---	---	---	---	---	---	---	0.6	---	0.5	0.5	0.5	0.5	0.0	4
[1]Bankfull Max Depth (ft)					1.5	1.6	1.6	1.7	---	2	---	---	---	---	---	---	---	1.0	---	0.8	1	1.1	1.1	0.1	4
Bankfull Cross Sectional Area (ft^2)		---	---	---	6.5	7.4	7.4	8.2	---	2	---	---	---	---	---	---	---	5.0	---	4.5	5.6	5.1	7.8	1.5	4
Width/Depth Ratio					5.4	6.1	6.1	6.8	---	2	---	---	---	---	---	---	---	12.8	---	16.4	21.7	18.7	33.1	7.7	4
Entrenchment Ratio					1.9	2.0	2.0	2.1	---	2	---	---	---	---	---	---	---	>2.2	---	3.1	4.6	4.9	5.3	1.0	4
[1]Bank Height Ratio					1.8	3.0	3.0	4.2	---	2	---	---	---	---	---	---	---	1.0	---	1.00	1.0	1.0	1.0	0.0	4
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	8	---	32	---	---	---	---	---	---
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	9	---	30	---	---	---	---	---	---
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	---	---	---	---	---	---	20	---	49	---	---	---	---	---	---
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	7	---	23	7	---	---	23	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	---	---	---	---	---	---	11	---	24	11	---	---	24	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	1.4	---	3	1.4	---	---	3	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	---	---	---	---	---	---	38	---	77	38	---	---	77	---	---
Meander Width Ratio					---	---	---	---	---	---	---	---	---	---	---	---	4.8	---	9.6	4.8	---	---	9.6	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---						---						---			---					
Max part size (mm) mobilized at bankfull					---						---						---			---					
Stream Power (transport capacity) W/m^2					---						---						---			---					
Additional Reach Parameters																									
Rosgen Classification					G5 to E5						---						E4/C4			E4/C4					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---						---						---			---					
Valley length (ft)					1395						---						1392			1392					
Channel Thalweg length (ft)					1429						---						1572			1572					
Sinuosity (ft)					1.02						---						1.13			1.13					
Water Surface Slope (Channel) (ft/ft)					---						---						---			---					
Channel slope (ft/ft)					0.007						---						0.003			0.003					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Appendix D. Table 9 - Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)

Cowford

	Cross Section 1 (Pool)							Cross Section 2 (Riffle)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)							Cross Section 5 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	(Headway Valley Restoration) No Morphological Parameters were determined for HWV Reach A							(Headway Valley Restoration) No Morphological Parameters were determined for HWV Reach A							(Headway Valley Restoration) No Morphological Parameters were determined for HWV Reach A							65.6							65.8						
Bankfull Width (ft)[1]																						11.0							11.3						
Floodprone Width (ft)[1]																						-							49						
Bankfull Max Depth (ft)[2]																						1.5							1.2						
Low Bank Elevation (ft)																						65.6							65.8						
Bankfull Cross Sectional Area (ft^2)[2]																						8.6							7.3						
Bankfull Entrenchment Ratio[1]																						-							4.3						
Bankfull Bank Height Ratio[1]																						-							1.0						

	Cross Section 6 (Riffle)							Cross Section 7 (Pool)							Cross Section 8 (Pool)							Cross Section 9 (Riffle)							Cross Section 10 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	65.1							65.0							61.0							60.8							57.9						
Bankfull Width (ft)[1]	9.5							8.2							11.1							9.5							9.9						
Floodprone Width (ft)[1]	49.3							-							-							48.1							48						
Bankfull Max Depth (ft)[2]	1.0							1.5							1.6							1.1							1.0						
Low Bank Elevation (ft)	65.1							65.0							61.0							60.8							57.9						
Bankfull Cross Sectional Area (ft^2)[2]	5.3							6.4							6.6							4.8							5.3						
Bankfull Entrenchment Ratio[1]	5.2							-							-							5.0							4.8						
Bankfull Bank Height Ratio[1]	1.0							-							-							1.0							1.0						

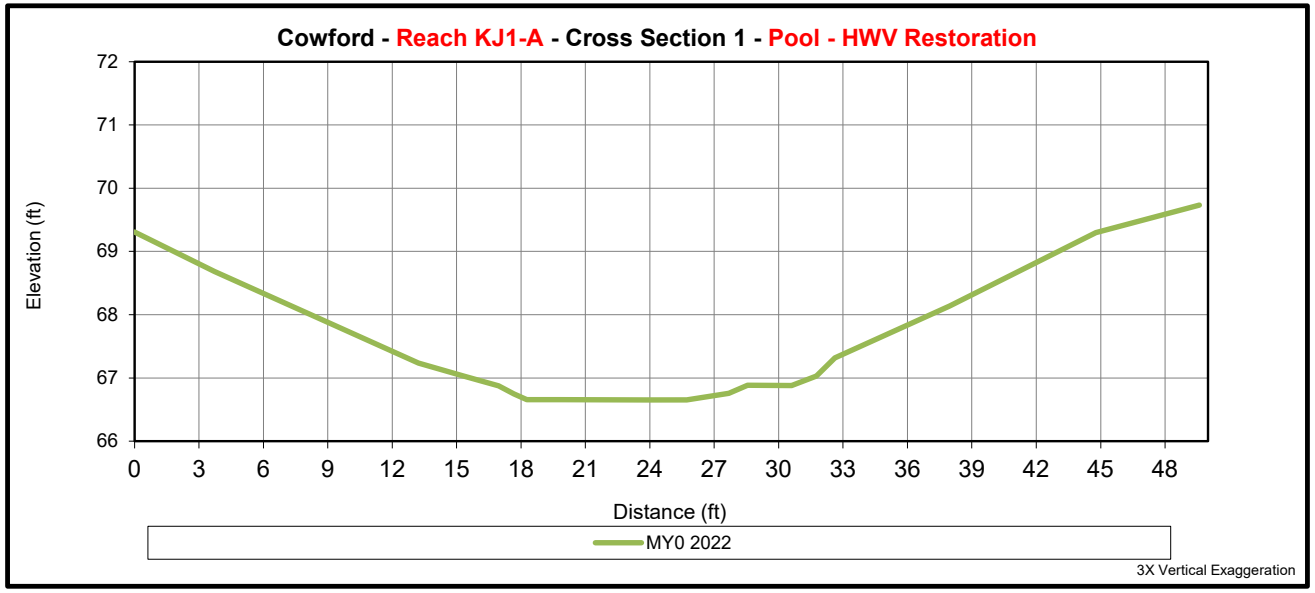
	Cross Section 11 (Pool)							Cross Section 12 (Riffle)							Cross Section 13 (Pool)							Cross Section 14 (Riffle)							Cross Section 15 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	57.9							54.6							54.7							48.0							47.6						
Bankfull Width (ft)[1]	11.8							8.6							10.3							16.1							9.1						
Floodprone Width (ft)[1]	-							46.0							-							49.4							-						
Bankfull Max Depth (ft)[2]	1.6							0.8							1.9							1.1							3.4						
Low Bank Elevation (ft)	57.9							54.6							54.7							48.0							47.6						
Bankfull Cross Sectional Area (ft^2)[2]	8.4							4.5							9.3							7.8							12.3						
Bankfull Entrenchment Ratio[1]	-							5.3							-							3.1							-						
Bankfull Bank Height Ratio[1]	-							1.0							-							1.0							-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

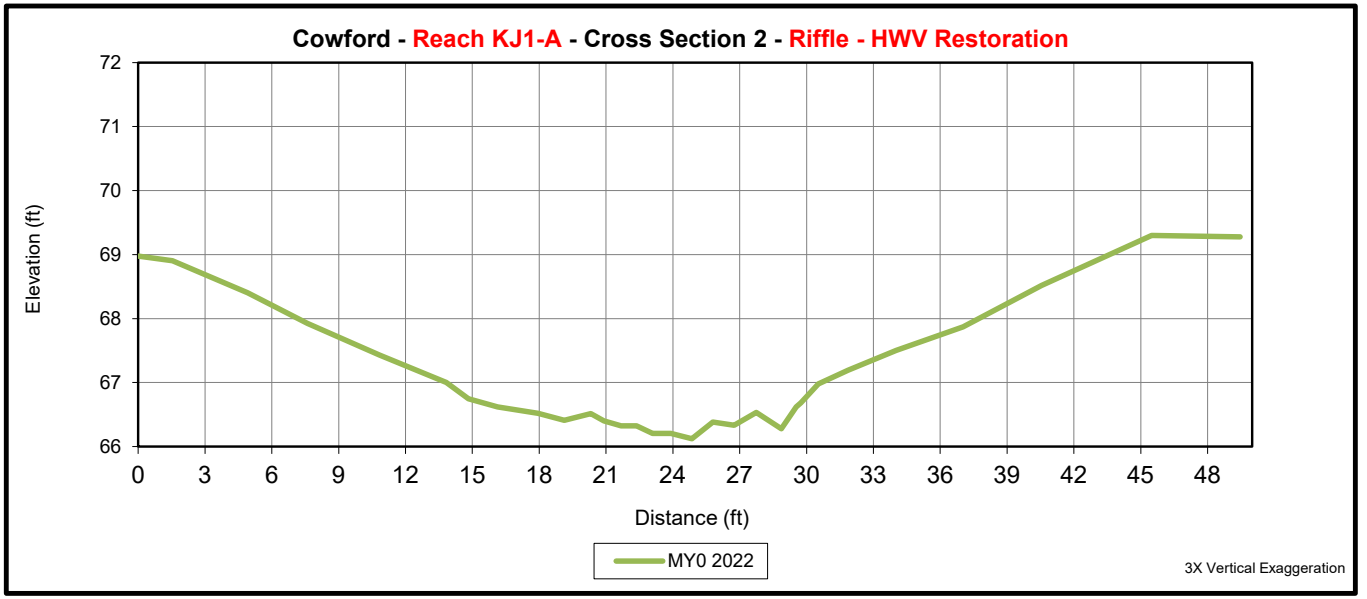


	Cross Section 1 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	(Headway Valley Restoration) No Morphological Parameters were determined for HWV Reach A						
Bankfull Width (ft)[1]							
Floodprone Width (ft)[1]							
Bankfull Max Depth (ft)[2]							
Low Bank Elevation (ft)							
Bankfull Cross Sectional Area (ft^2)[2]							
Bankfull Entrenchment Ratio[1]							
Bankfull Bank Height Ratio[1]							

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

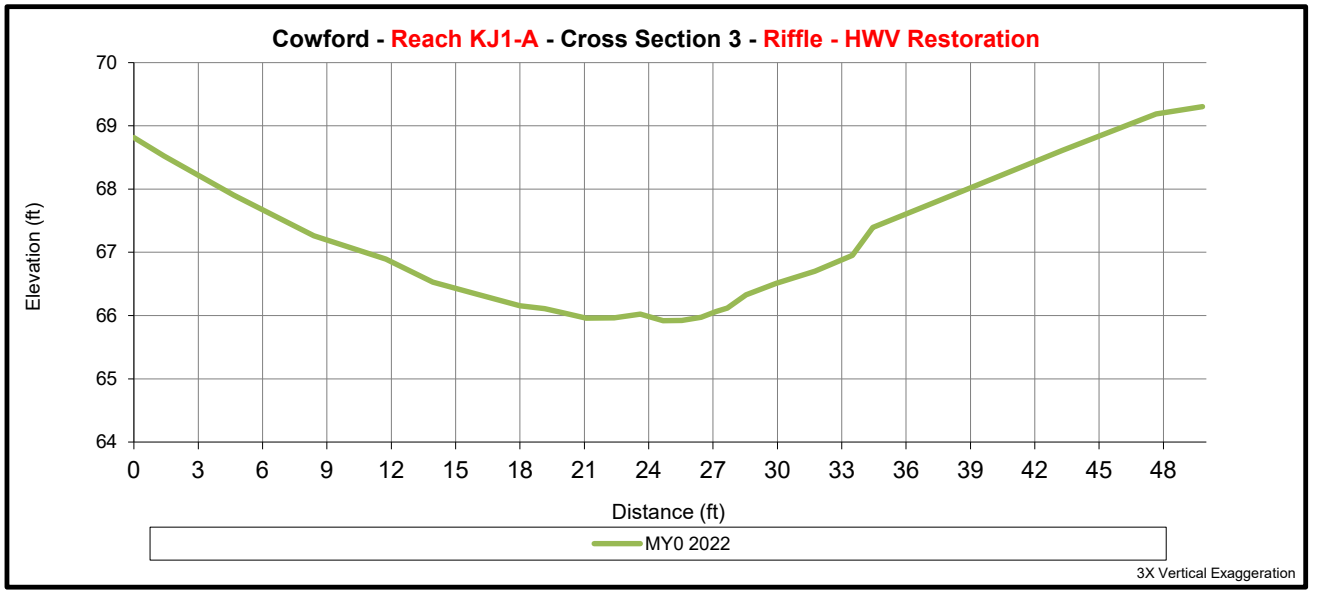


	Cross Section 2 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	(Headway Valley Restoration) No Morphological Parameters were determined for HWV Reach A						
Bankfull Width (ft)[1]							
Floodprone Width (ft)[1]							
Bankfull Max Depth (ft)[2]							
Low Bank Elevation (ft)							
Bankfull Cross Sectional Area (ft^2)[2]							
Bankfull Entrenchment Ratio[1]							
Bankfull Bank Height Ratio[1]							

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

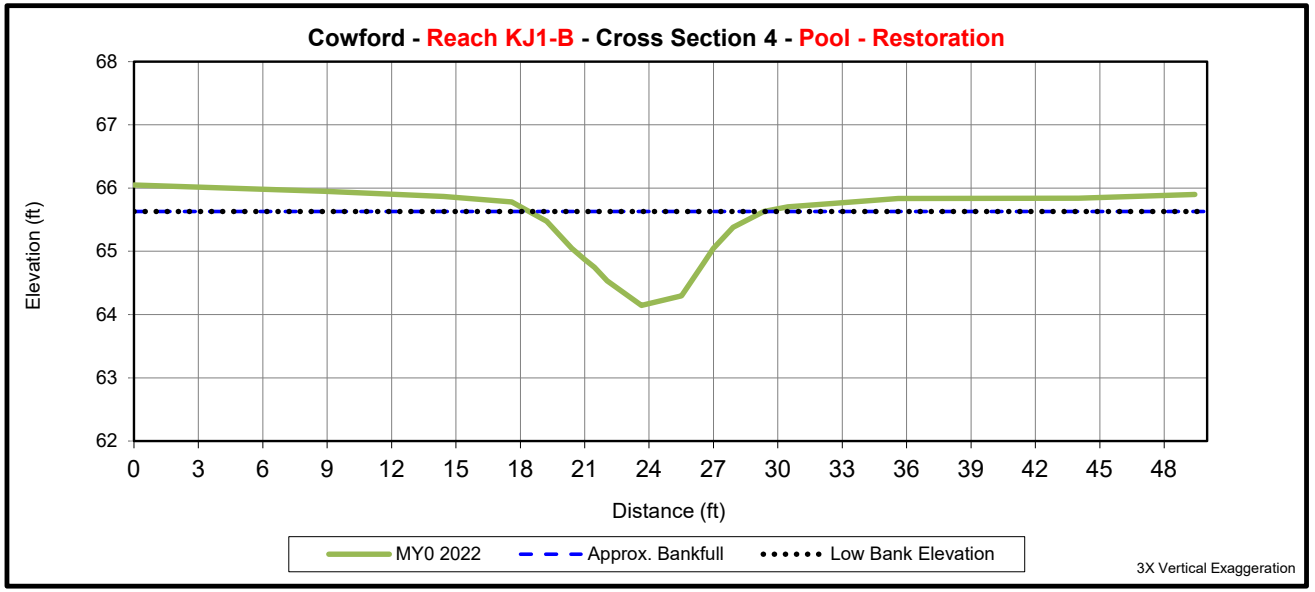


	Cross Section 3 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	(Headway Valley Restoration) No Morphological Parameters were determined for HWV Reach A						
Bankfull Width (ft)[1]							
Floodprone Width (ft)[1]							
Bankfull Max Depth (ft)[2]							
Low Bank Elevation (ft)							
Bankfull Cross Sectional Area (ft^2)[2]							
Bankfull Entrenchment Ratio[1]							
Bankfull Bank Height Ratio[1]							

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

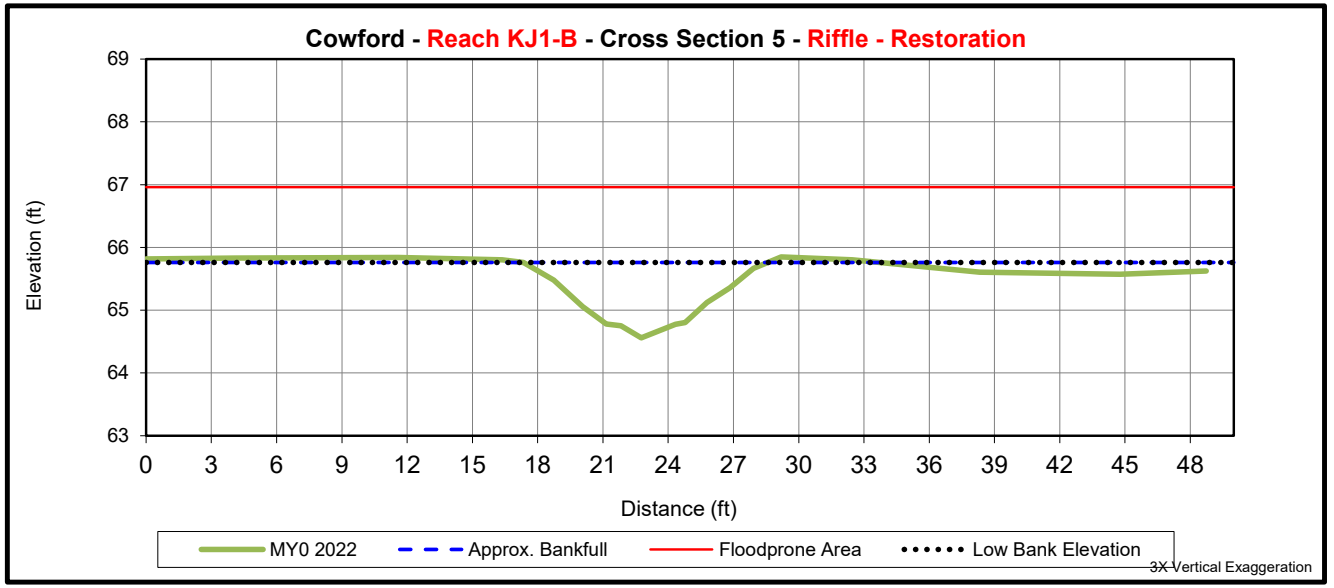


	Cross Section 4 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	65.63						
Bankfull Width (ft)[1]	11.0						
Floodprone Width (ft)[1]	-						
Bankfull Max Depth (ft)[2]	1.5						
Low Bank Elevation (ft)	65.63						
Bankfull Cross Sectional Area (ft^2)[2]	8.6						
Bankfull Entrenchment Ratio[1]	-						
Bankfull Bank Height Ratio[1]	-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

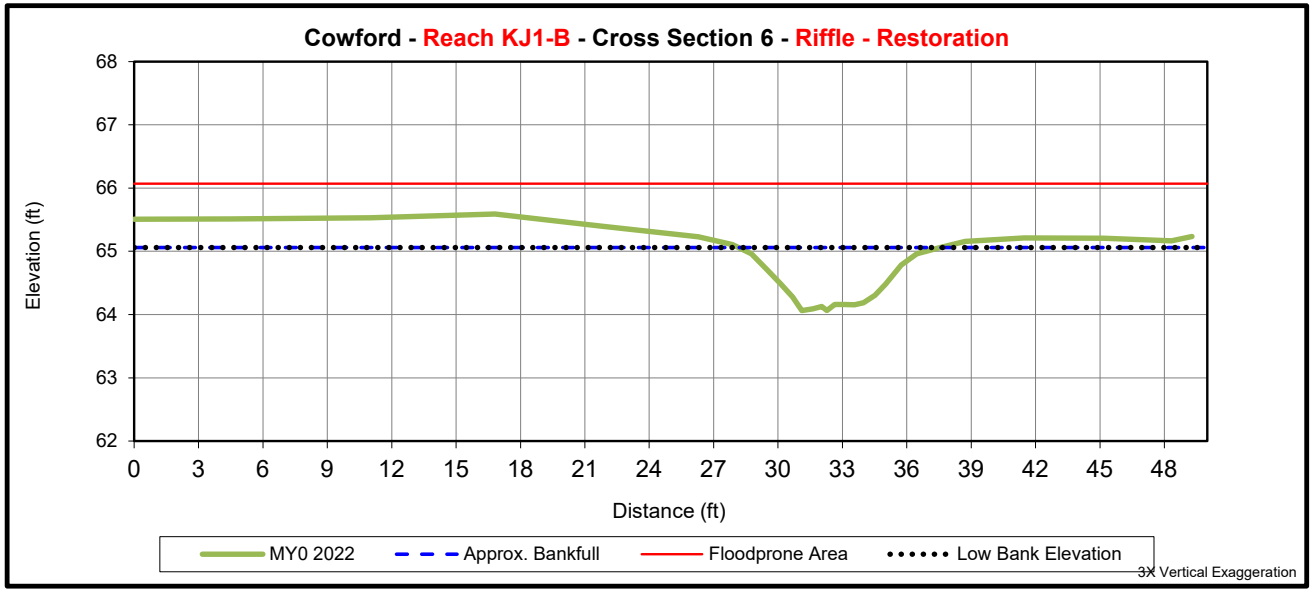


	Cross Section 5 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	65.76						
Bankfull Width (ft)[1]	11.3						
Floodprone Width (ft)[1]	49						
Bankfull Max Depth (ft)[2]	1.2						
Low Bank Elevation (ft)	65.76						
Bankfull Cross Sectional Area (ft^2)[2]	7.3						
Bankfull Entrenchment Ratio[1]	4.3						
Bankfull Bank Height Ratio[1]	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

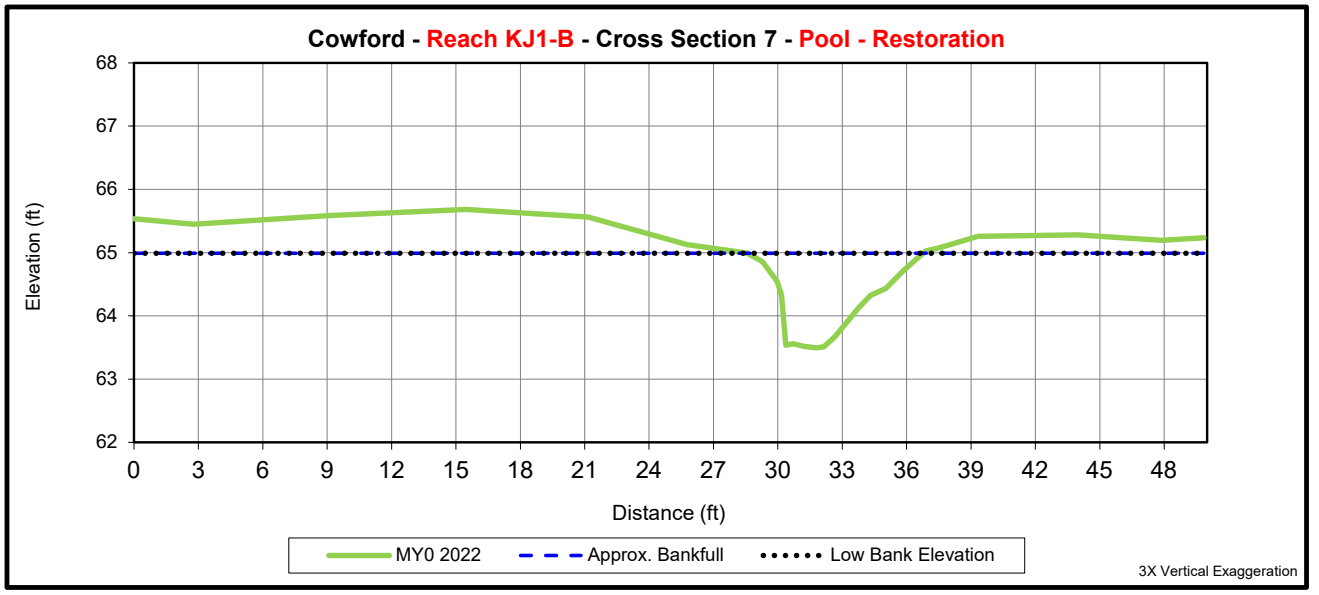


	Cross Section 6 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	65.06						
Bankfull Width (ft)[1]	9.5						
Floodprone Width (ft)[1]	49.3						
Bankfull Max Depth (ft)[2]	1.0						
Low Bank Elevation (ft)	65.06						
Bankfull Cross Sectional Area (ft^2)[2]	5.3						
Bankfull Entrenchment Ratio[1]	5.2						
Bankfull Bank Height Ratio[1]	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

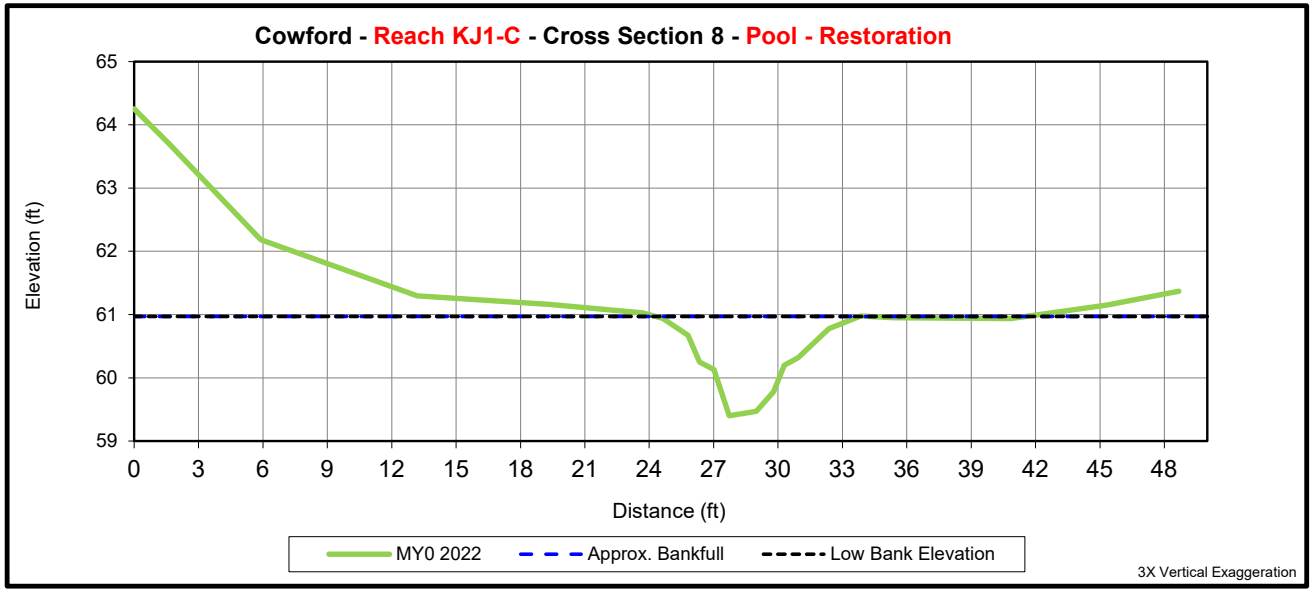


	Cross Section 7 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	64.99						
Bankfull Width (ft)[1]	8.2						
Floodprone Width (ft)[1]	-						
Bankfull Max Depth (ft)[2]	1.5						
Low Bank Elevation (ft)	64.99						
Bankfull Cross Sectional Area (ft^2)[2]	6.4						
Bankfull Entrenchment Ratio[1]	-						
Bankfull Bank Height Ratio[1]	-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

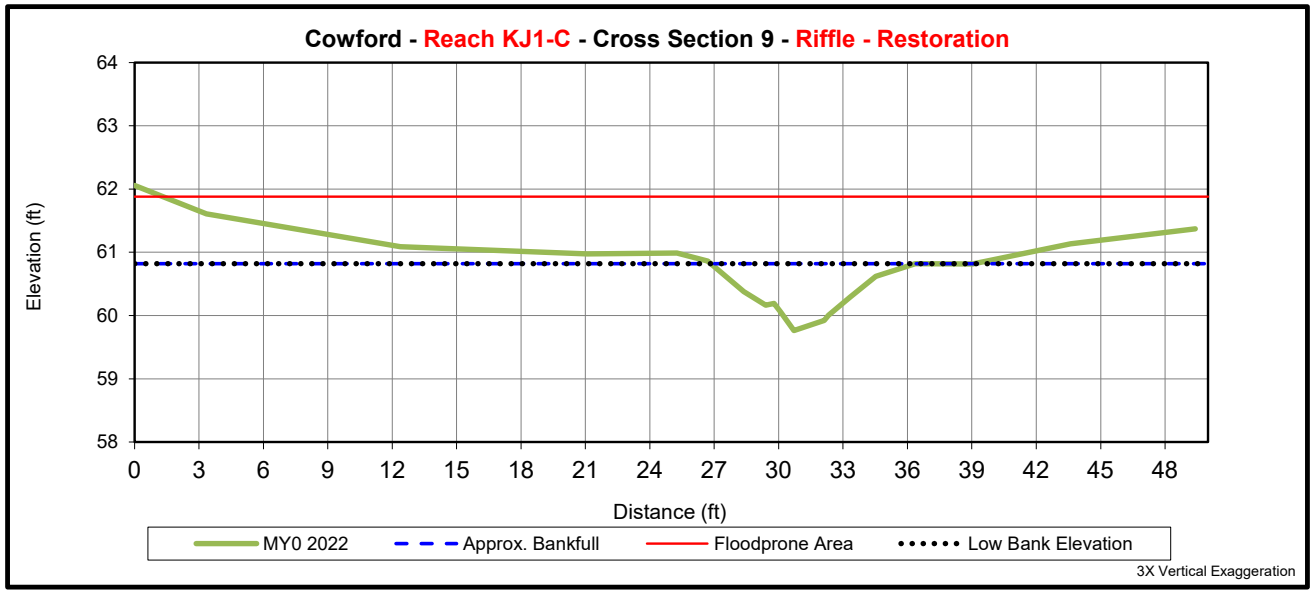


	Cross Section 8 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	60.97						
Bankfull Width (ft)[1]	11.1						
Floodprone Width (ft)[1]	-						
Bankfull Max Depth (ft)[2]	1.6						
Low Bank Elevation (ft)	60.97						
Bankfull Cross Sectional Area (ft^2)[2]	6.6						
Bankfull Entrenchment Ratio[1]	-						
Bankfull Bank Height Ratio[1]	-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

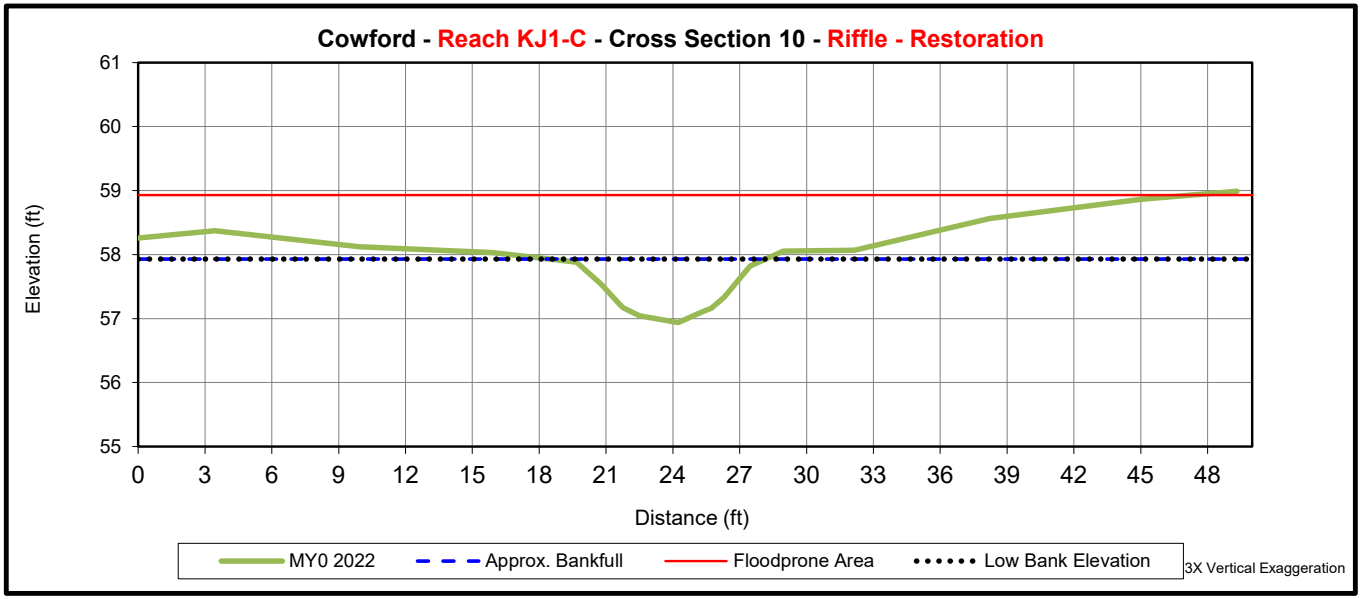


	Cross Section 9 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	60.82						
Bankfull Width (ft)[1]	9.5						
Floodprone Width (ft)[1]	48.1						
Bankfull Max Depth (ft)[2]	1.1						
Low Bank Elevation (ft)	60.82						
Bankfull Cross Sectional Area (ft^2)[2]	4.8						
Bankfull Entrenchment Ratio[1]	5.0						
Bankfull Bank Height Ratio[1]	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

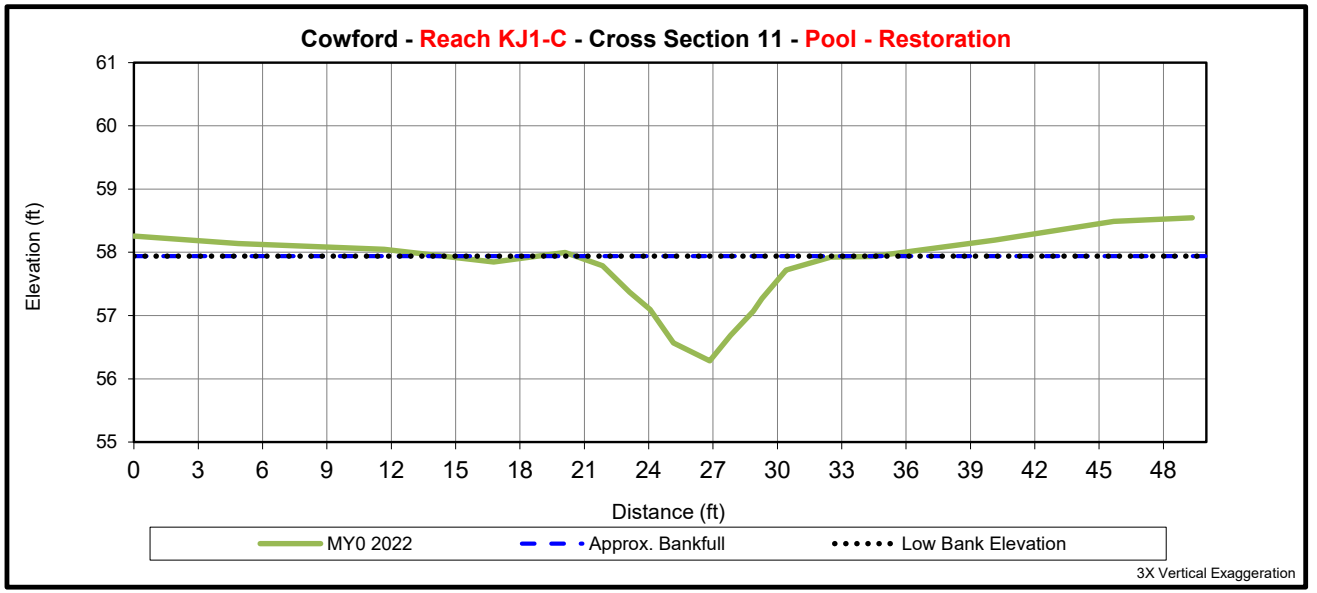


	Cross Section 10 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	57.93						
Bankfull Width (ft)[1]	9.9						
Floodprone Width (ft)[1]	48						
Bankfull Max Depth (ft)[2]	1.0						
Low Bank Elevation (ft)	57.93						
Bankfull Cross Sectional Area (ft^2)[2]	5.3						
Bankfull Entrenchment Ratio[1]	4.8						
Bankfull Bank Height Ratio[1]	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

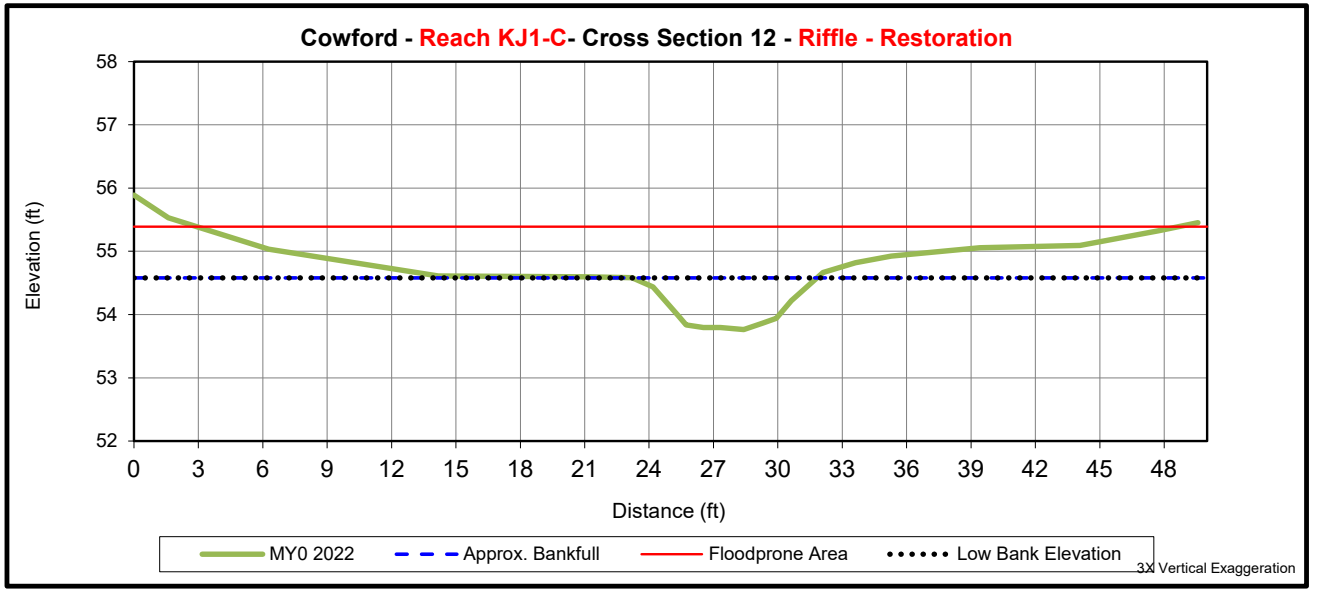


	Cross Section 11 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	57.92						
Bankfull Width (ft)[1]	11.8						
Floodprone Width (ft)[1]	-						
Bankfull Max Depth (ft)[2]	1.6						
Low Bank Elevation (ft)	57.92						
Bankfull Cross Sectional Area (ft^2)[2]	8.4						
Bankfull Entrenchment Ratio[1]	-						
Bankfull Bank Height Ratio[1]	-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

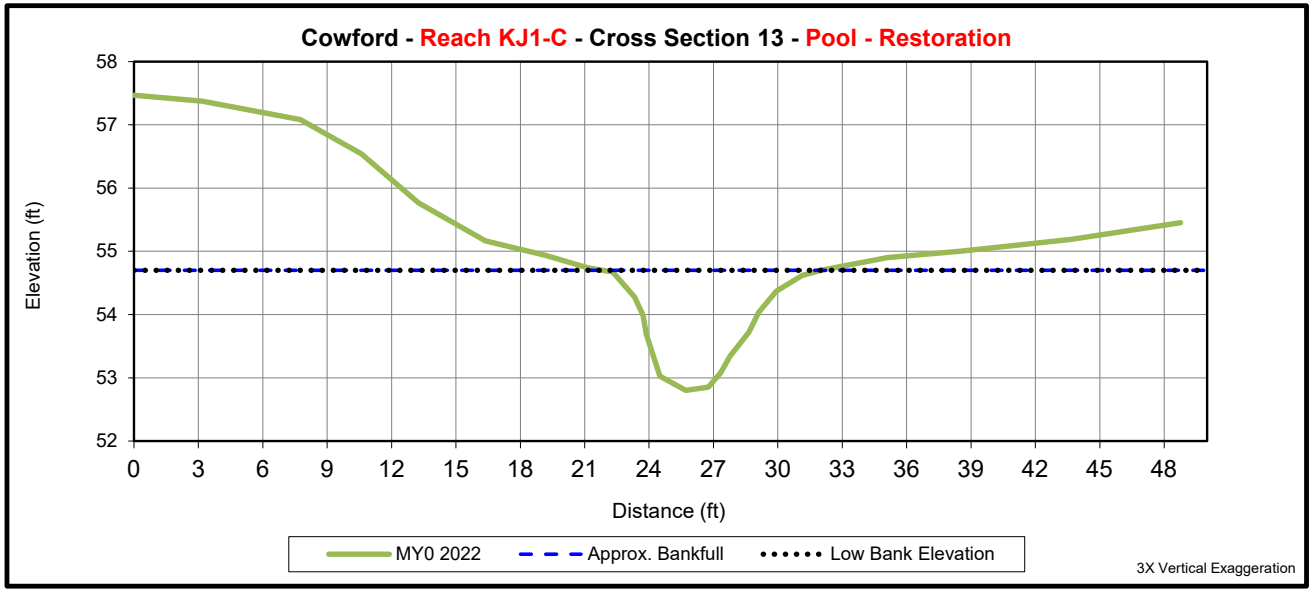


	Cross Section 12 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	54.58						
Bankfull Width (ft)[1]	8.6						
Floodprone Width (ft)[1]	46.0						
Bankfull Max Depth (ft)[2]	0.8						
Low Bank Elevation (ft)	54.58						
Bankfull Cross Sectional Area (ft^2)[2]	4.5						
Bankfull Entrenchment Ratio[1]	5.3						
Bankfull Bank Height Ratio[1]	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

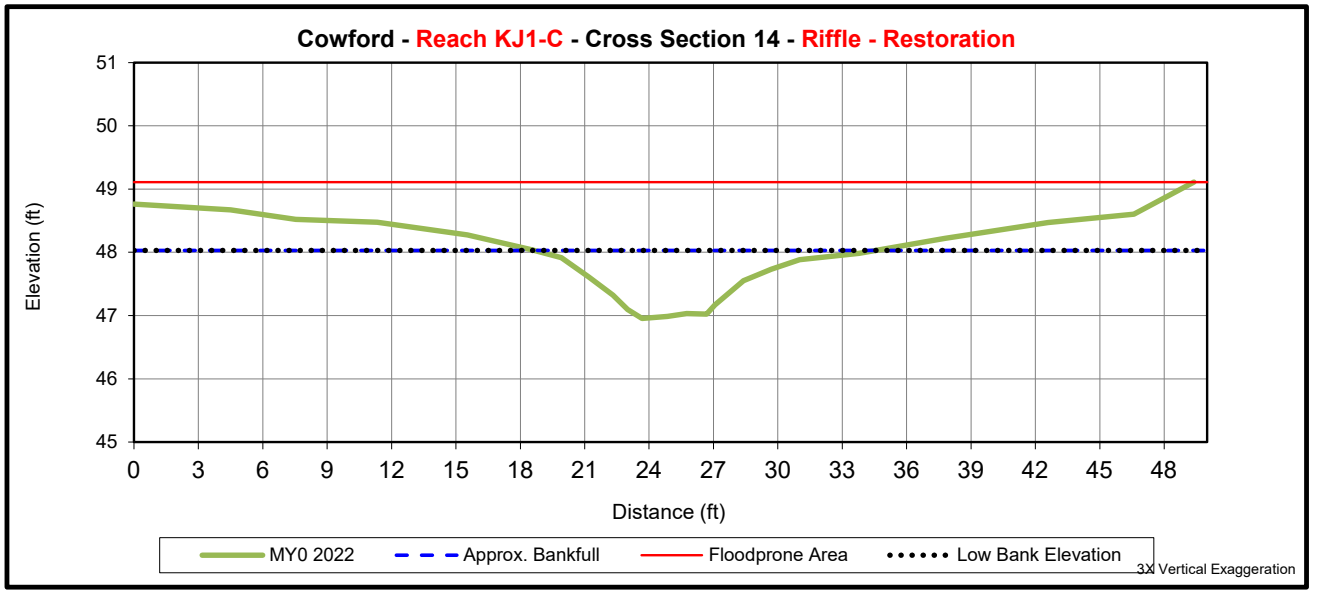


	Cross Section 13 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	54.70						
Bankfull Width (ft)[1]	10.3						
Floodprone Width (ft)[1]	-						
Bankfull Max Depth (ft)[2]	1.9						
Low Bank Elevation (ft)	54.70						
Bankfull Cross Sectional Area (ft^2)[2]	9.3						
Bankfull Entrenchment Ratio[1]	-						
Bankfull Bank Height Ratio[1]	-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream

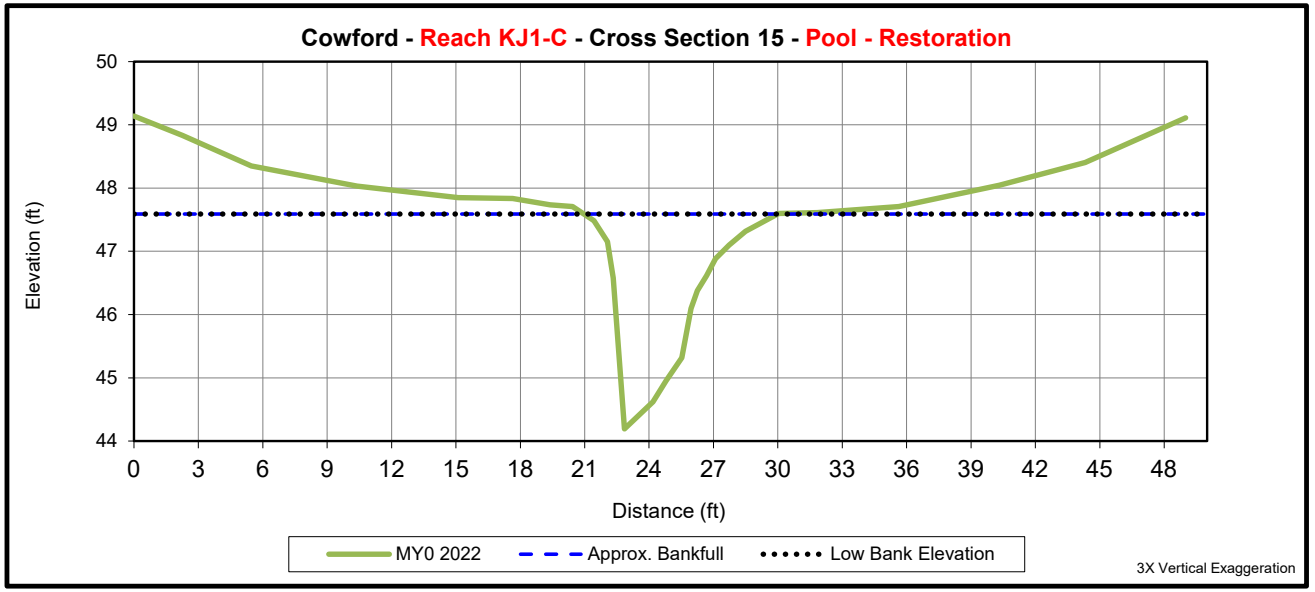


	Cross Section 14 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	48.03						
Bankfull Width (ft)[1]	16.1						
Floodprone Width (ft)[1]	49.4						
Bankfull Max Depth (ft)[2]	1.1						
Low Bank Elevation (ft)	48.03						
Bankfull Cross Sectional Area (ft^2)[2]	7.8						
Bankfull Entrenchment Ratio[1]	3.1						
Bankfull Bank Height Ratio[1]	1.0						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Upstream

Downstream



	Cross Section 15 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	47.59						
Bankfull Width (ft)[1]	9.1						
Floodprone Width (ft)[1]	-						
Bankfull Max Depth (ft)[2]	3.4						
Low Bank Elevation (ft)	47.59						
Bankfull Cross Sectional Area (ft^2)[2]	12.3						
Bankfull Entrenchment Ratio[1]	-						
Bankfull Bank Height Ratio[1]	-						

1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation
2 - Uses the current years low top of bank as the basis for adjusting each subsequent years bankfull elevation

Appendix E

Record Drawings

COWFORD MITIGATION SITE AS-BUILT

ONSLOW COUNTY, NORTH CAROLINA

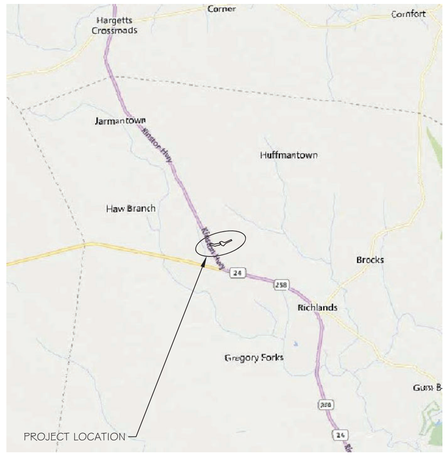
WHITE OAK RIVER BASIN: HUC 03030001

APRIL 2022

RESOURCE ENVIRONMENTAL SOLUTIONS, LLC

3600 GLENWOOD AVE, SUITE 100

RALEIGH, NC 27612



VICINITY MAP
NTS

I, BRIAN S. HOCKETT CERTIFY THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION AND THAT THIS GROUND SURVEY WAS PERFORMED AT THE 90% CONFIDENCE LEVEL TO MEET FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS; THAT THIS SURVEY WAS PERFORMED TO MEET THE REQUIIREMENTS FOR A TOPOGRAPHIC/PLANIMETRIC SURVEY TO THE ACCURACY OF CLASS "A" AND VERTICAL ACCURACY WHEN APPLICABLE TO THE CLASS "A" STANDARD, AND THAT THE ORIGINAL DATA WAS OBTAINED ON JUNE 24th 2021; THAT THE SURVEY WAS COMPLETED ON MARCH 22nd 2022; THAT CONTOURS SHOWN AS BROKEN LINES MAY NOT MEET THE STATED STANDARD; AND ALL COORDINATES ARE BASED ON NAD83 (2011) AND ELEVATIONS ARE BASED ON NAVD88 (GEOID18)

1. CLASS OF SURVEY: CLASS A
2. POSITIONAL ACCURACY: 0.08'
3. TYPE OF GPS FIELD PROCEDURE: RTK/VRS
4. DATES OF SURVEY: 6-24-2021 - 3-22-2022
5. GEOID MODEL: 18
6. UNITS: U.S. SURVEY FEET

WITNESS MY ORIGINAL SIGNATURE, LICENSE NUMBER AND SEAL THIS 13th DAY OF April, 2022, A.D.

Brian S. Hockett

BRIAN S. HOCKETT L-5165

PROJECT DIRECTORY

OWNER:
LINDSAY CROCKER
NC DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
217 WEST JONES ST., SUITE 3000A
RALEIGH, NC 27603

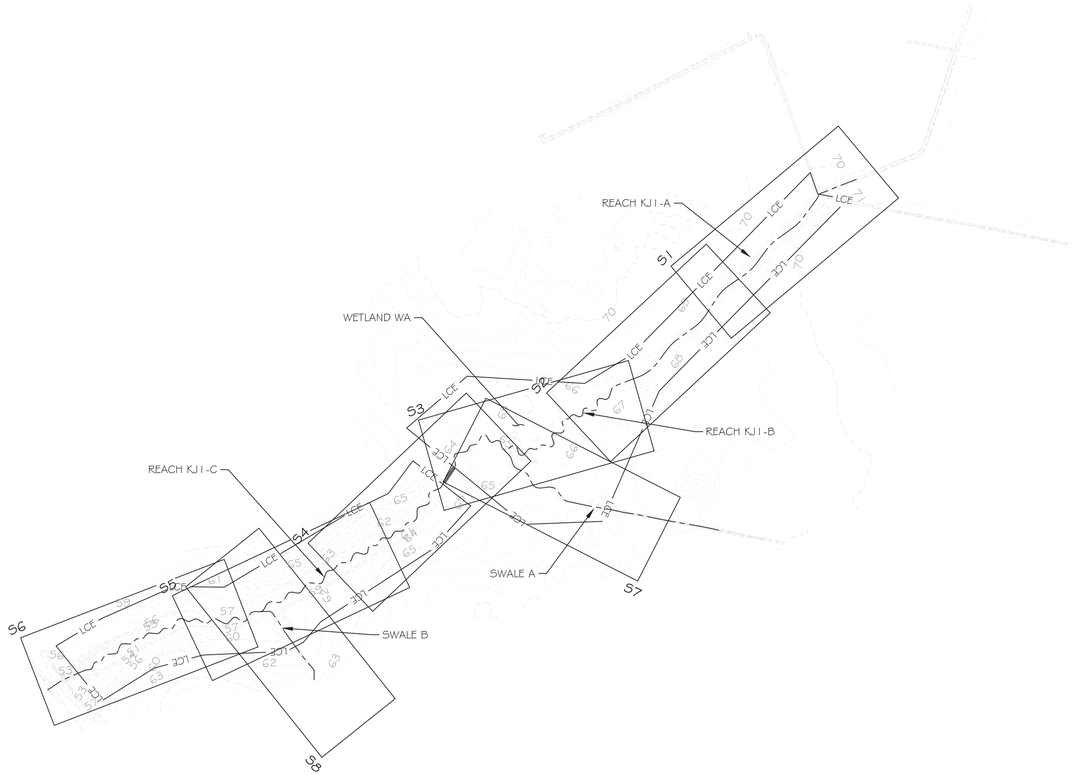
DESIGNED BY:
RESOURCE ENVIRONMENTAL SOLUTIONS, LLC
3600 GLENWOOD AVE., SUITE 100
RALEIGH, NC 27612

AS-BUILT SURVEY BY:
RESOURCE ENVIRONMENTAL SOLUTIONS, LLC
3600 GLENWOOD AVE., SUITE 100
RALEIGH, NC 27612

DMS PROJECT #: 100095
CONTRACT #: 7746
USACE ACTION ID #: SAW-2019-00487
RFP #: 16-007577
DWR #: 2019-0495

NOTES:

- ALL DISTANCES ARE HORIZONTAL GROUND MEASUREMENTS IN U.S. SURVEY FEET UNLESS OTHERWISE NOTED.
- HORIZONTAL DATUM IS NAD83(2011); VERTICAL DATUM IS NAVD 88
- THIS MAP IS NOT INTENDED FOR RECORDATION, SALES OR CONVEYANCES
- THE PURPOSE OF THIS MAP AND AS-BUILT DRAWING IS TO ILLUSTRATE THE POST- CONSTRUCTION "AS-BUILT CONDITIONS" OF THE STREAM RESTORATION AND MAY NOT SHOW ALL IMPROVEMENTS OR UTILITIES.
- NO PROPERTY LINES WERE SURVEYED, ALL BOUNDARY AND CONSERVATION EASEMENT LINES WERE REFERENCED FROM RECORDED PLATS
- STATE PLANE COORDINATES AND ELEVATIONS WERE DERIVED FROM EXISTING ONSITE CONTROL SURVEY PREPARED AND ESTABLISHED BY WSP USA INC.



SITE MAP
NTS

Sheet List Table	
Sheet Number	Sheet Title
--	COVER
S1	REACH KJ1
S2	REACH KJ1
S3	REACH KJ1
S4	REACH KJ1
S5	REACH KJ1
S6	REACH KJ1
S7	SWALE A
S8	SWALE B

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3600 Glenwood Ave, Suite 100
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Main: 919.829.9909
www.res.us

Engineering Services Provided By:
RES Environmental Operating Company, LLC
License: F-1428

SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5165 LAND SURVEYOR BRIAN S. HOCKETT 4/13/22

PLOT DATE: 4/13/2022

REVISIONS:

RELEASED FOR: AS-BUILT DRAWINGS

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	BRC

SHEET NUMBER:

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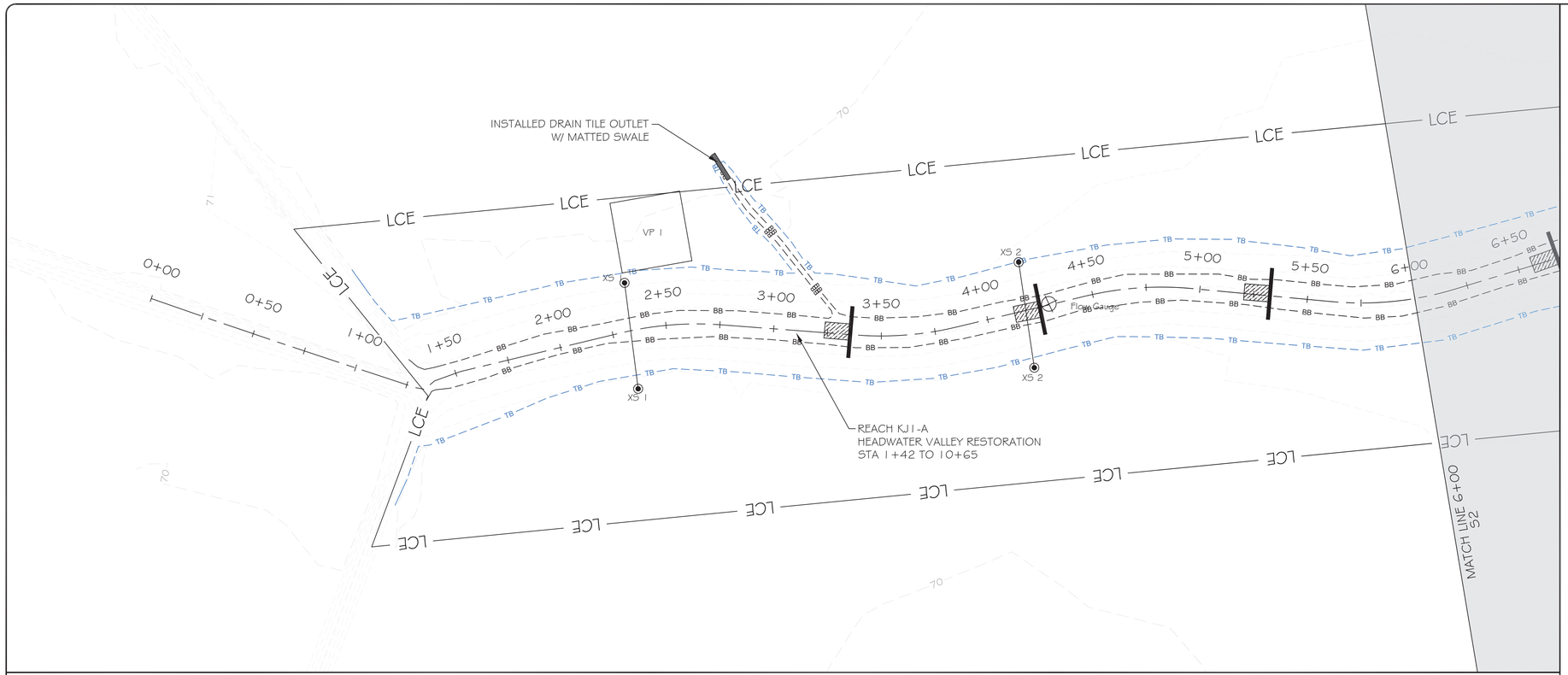

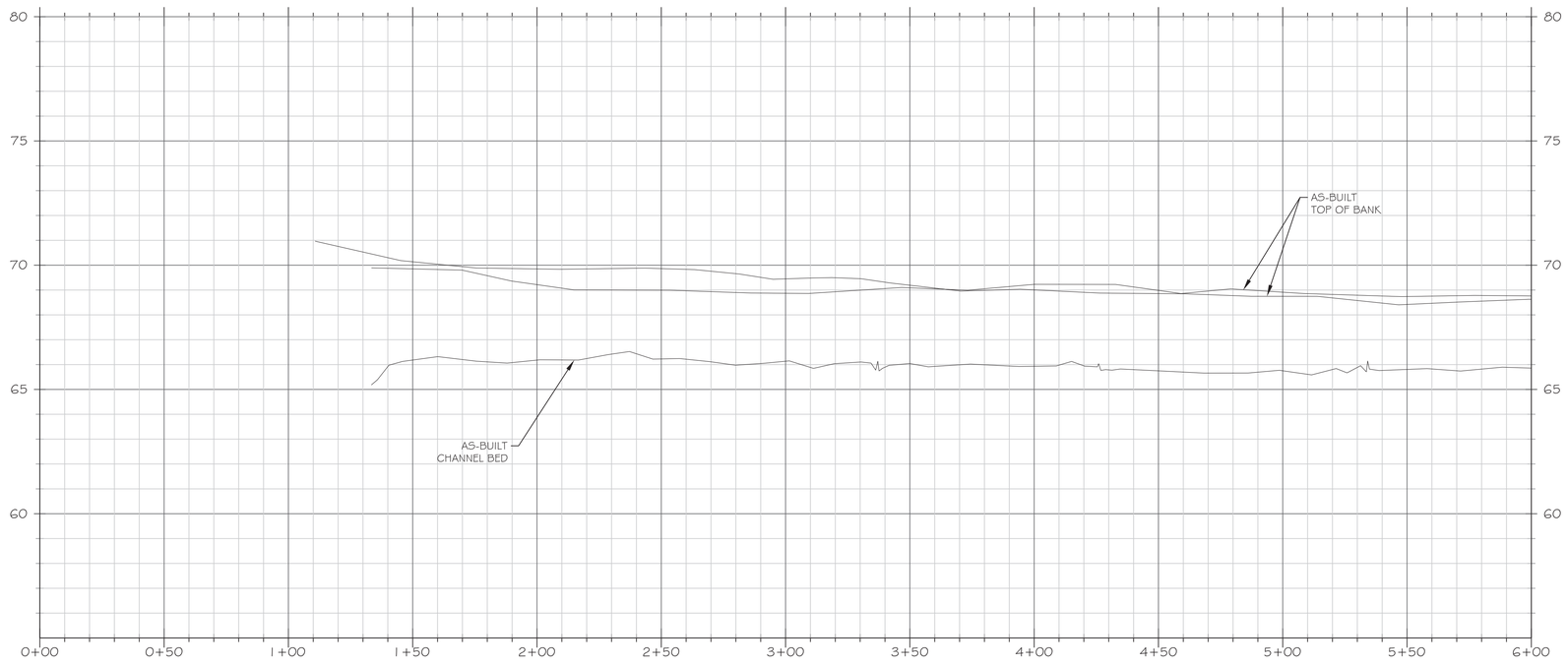

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

- CONTOUR MAJOR
- CONTOUR MINOR
- WETLAND
- TOP OF BANK
- BOTTOM OF BANK
- TREELINE
- LIMITS OF CONSERVATION EASEMENT
- WETLAND DEPRESSION
- BRUSH TOE PROTECTION
- HAYBALE TOE PROTECTION
- ENGINEERED SEDIMENT PACK
- LOG STRUCTURE
- ROCK STRUCTURE
- BRUSH BED SILL
- GROUNDWATER MONITORING WELL
- STAGE RECORDER
- FLOW GAUGE
- MONITORING CROSS SECTION
- VEGETATION MONITORING PLOT (VP#)

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License: F-1428

SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5165 LAND SURVEYOR BRIAN S. TOCKETT
4/13/22

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/13/2022

REVISIONS:

RELEASED FOR: AS-BUILT DRAWINGS

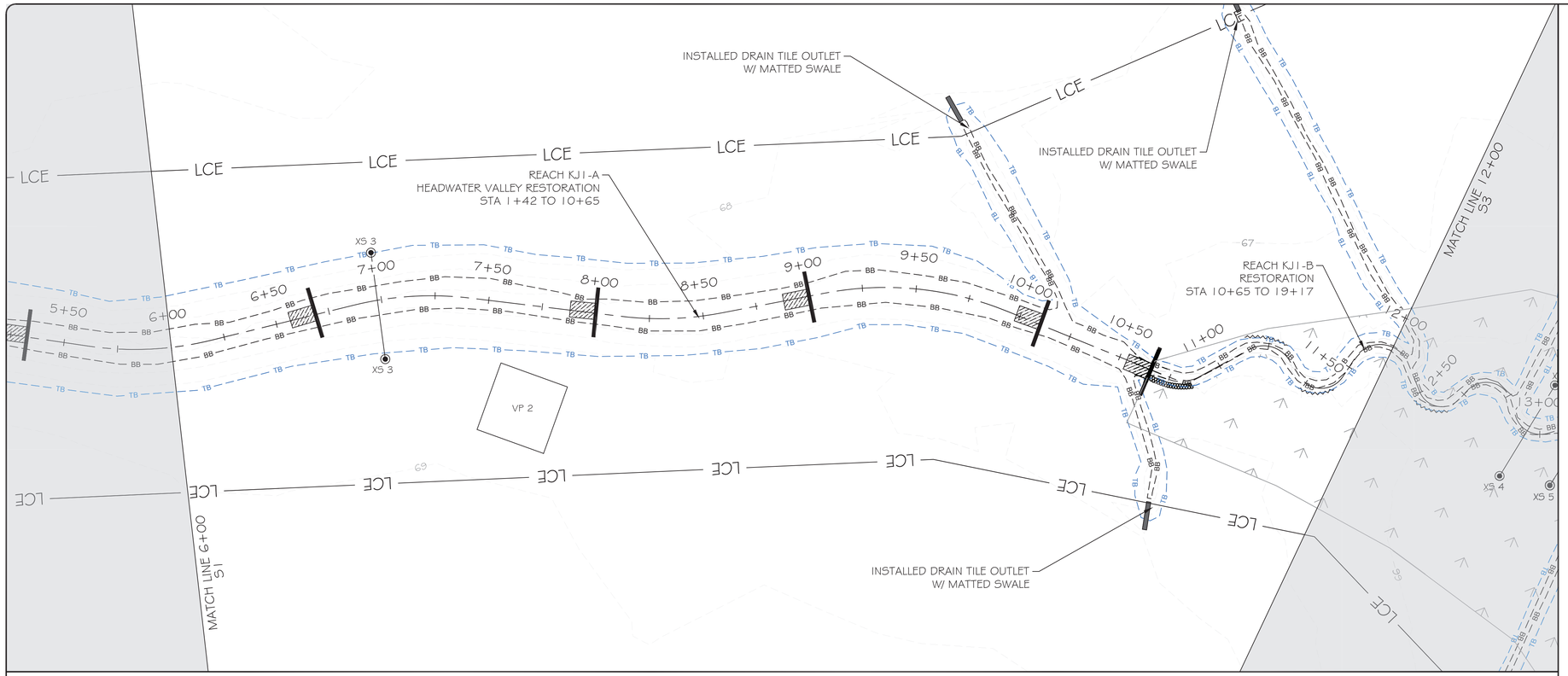
PROJECT NAME: COWFORD MITIGATION SITE AS-BUILT
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	TRS

SHEET NUMBER: S1

FILE NAME:R:\Res\a\Projects\100900-Cowford\ABRL\100900_AB_Design.dwg SAVED BY: Bhockett



SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

- CONTOUR MAJOR
- CONTOUR MINOR
- WETLAND
- TOP OF BANK
- BOTTOM OF BANK
- TREELINE
- LIMITS OF CONSERVATION EASEMENT
- WETLAND DEPRESSION
- BRUSH TOE PROTECTION
- HAYBALE TOE PROTECTION
- ENGINEERED SEDIMENT PACK
- LOG STRUCTURE
- ROCK STRUCTURE
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Engineering Services Provided By:
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License: F-1428

SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5165 LAND SURVEYOR BRIAN S. HOCKETT

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/13/2022

REVISIONS:

RELEASED FOR: AS-BUILT DRAWINGS

PROJECT NAME:
COWFORD MITIGATION SITE AS-BUILT
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE:
REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	TRS

SHEET NUMBER:

S2

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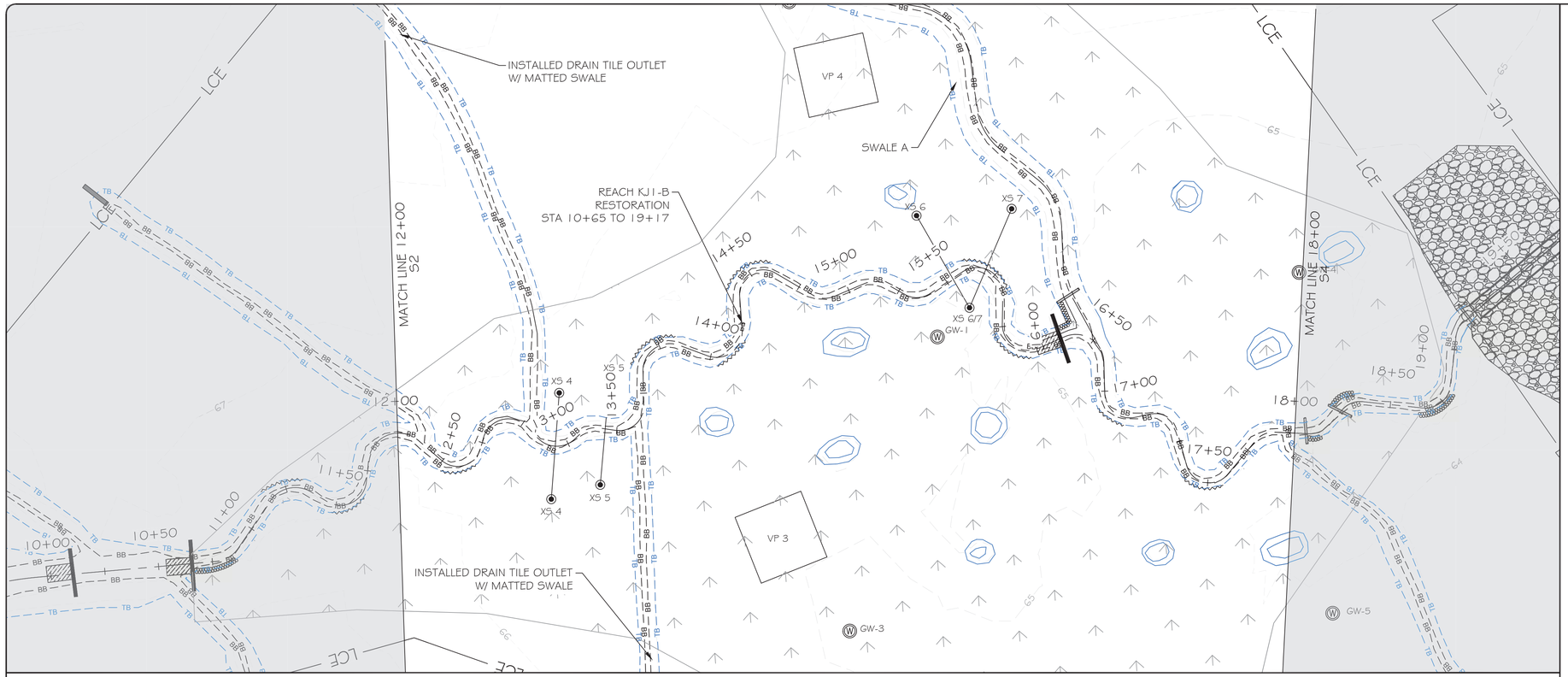

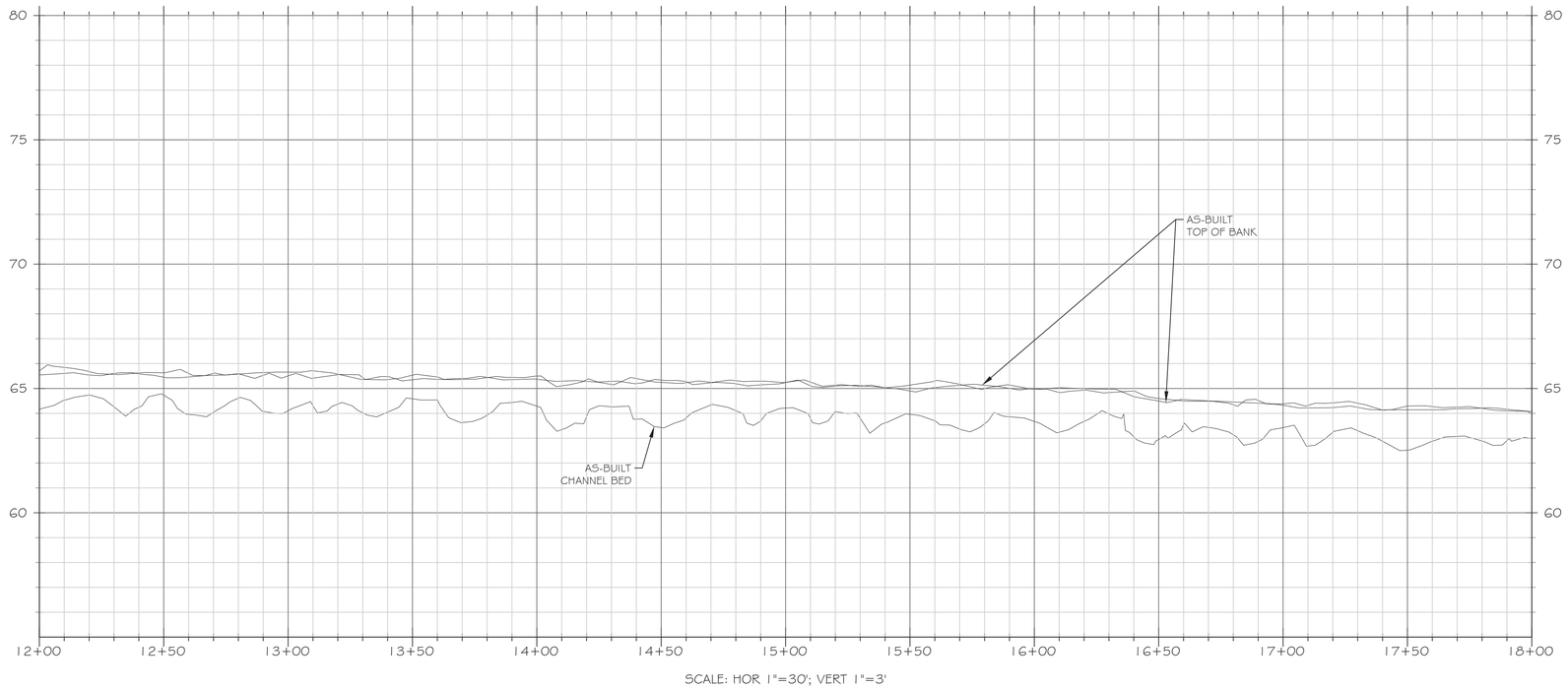

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

- CONTOUR MAJOR
- CONTOUR MINOR
- WETLAND
- TOP OF BANK (TB)
- BOTTOM OF BANK (BB)
- TREELINE
- LIMITS OF CONSERVATION EASEMENT (LCE)
- WETLAND DEPRESSION
- BRUSH TOE PROTECTION
- HAYBALE TOE PROTECTION
- ENGINEERED SEDIMENT PACK
- LOG STRUCTURE
- ROCK STRUCTURE
- BRUSH BED SILL
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Engineering Services Provided By:
RES Environmental Operating Company, LLC
License: F-1428

SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5165 LAND SURVEYOR BRIAN S. HOCKETT
4/13/22

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/13/2022

REVISIONS:

RELEASED FOR: AS-BUILT DRAWINGS

PROJECT NAME:
COWFORD MITIGATION SITE AS-BUILT
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE:
REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	TRS

SHEET NUMBER:

S3

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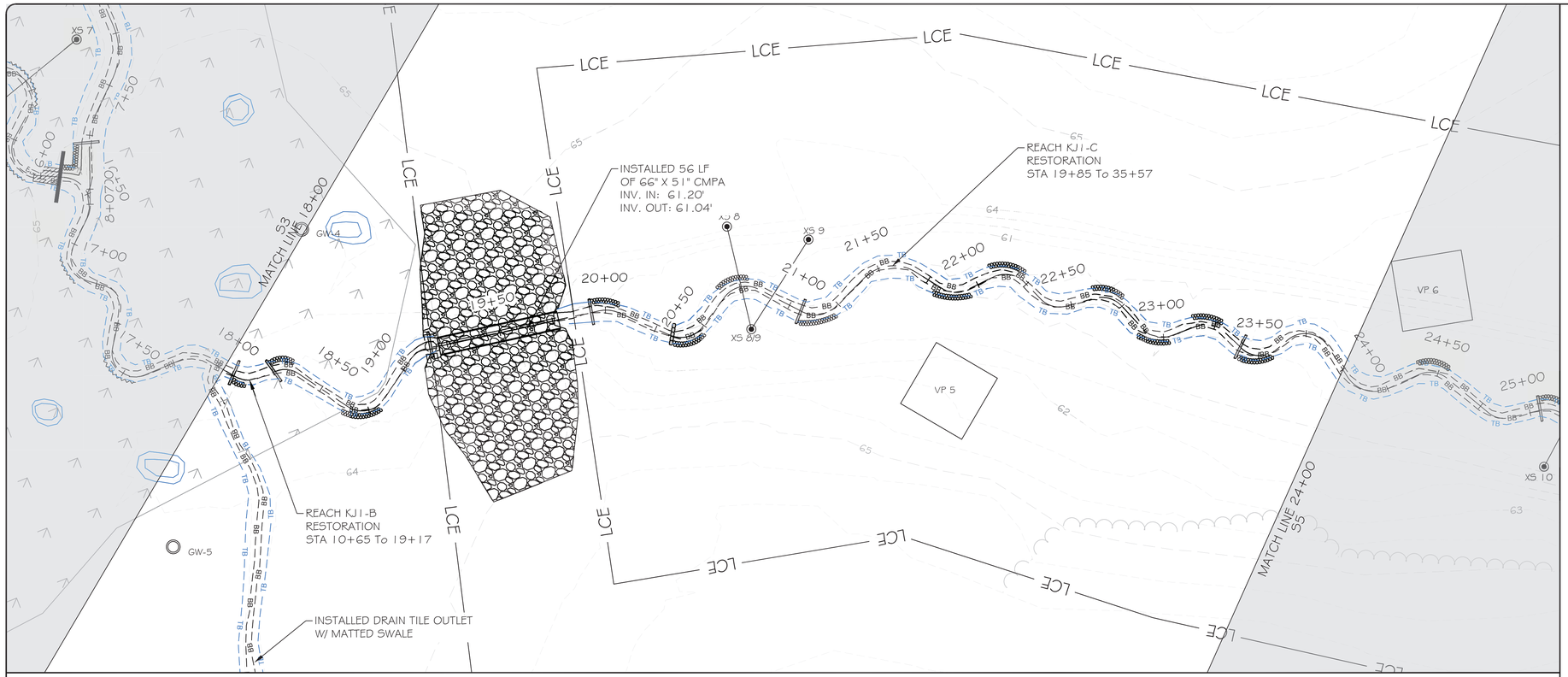

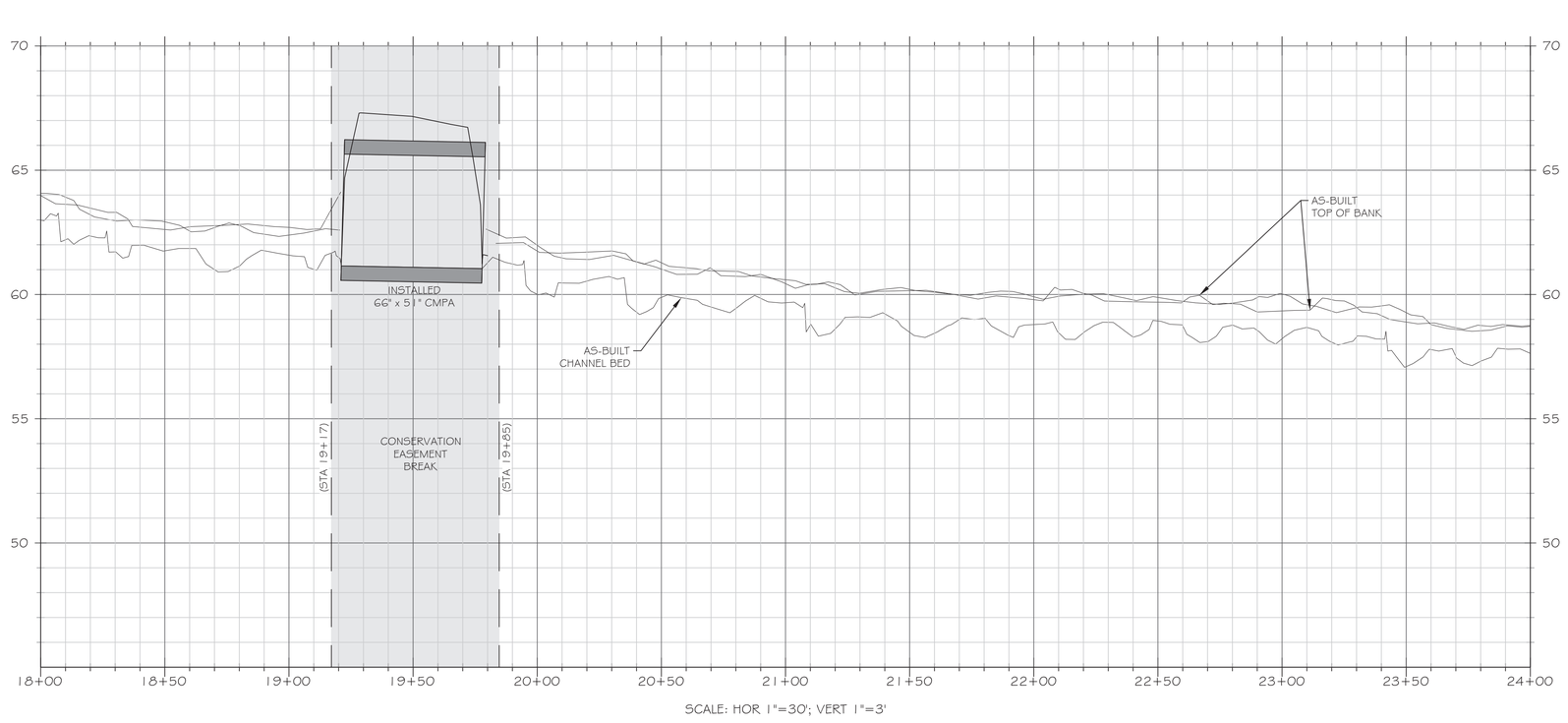

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

- CONTOUR MAJOR
- CONTOUR MINOR
- WETLAND
- TOP OF BANK (TB)
- BOTTOM OF BANK (BB)
- TREELINE
- LIMITS OF CONSERVATION EASEMENT (LCE)
- WETLAND DEPRESSION
- BRUSH TOE PROTECTION
- HAYBALE TOE PROTECTION
- ENGINEERED SEDIMENT PACK
- LOG STRUCTURE
- ROCK STRUCTURE
- BRUSH BED SILL
- GROUNDWATER MONITORING WELL (W)
- STAGE RECORDER
- FLOW GAUGE
- MONITORING CROSS SECTION
- VEGETATION MONITORING PLOT (VP#)

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SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5165 LAND SURVEYOR BRIANNE S. HOCKETT

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/13/2022

REVISIONS:

RELEASED FOR: AS-BUILT DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE AS-BUILT
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	TRS

SHEET NUMBER: S4

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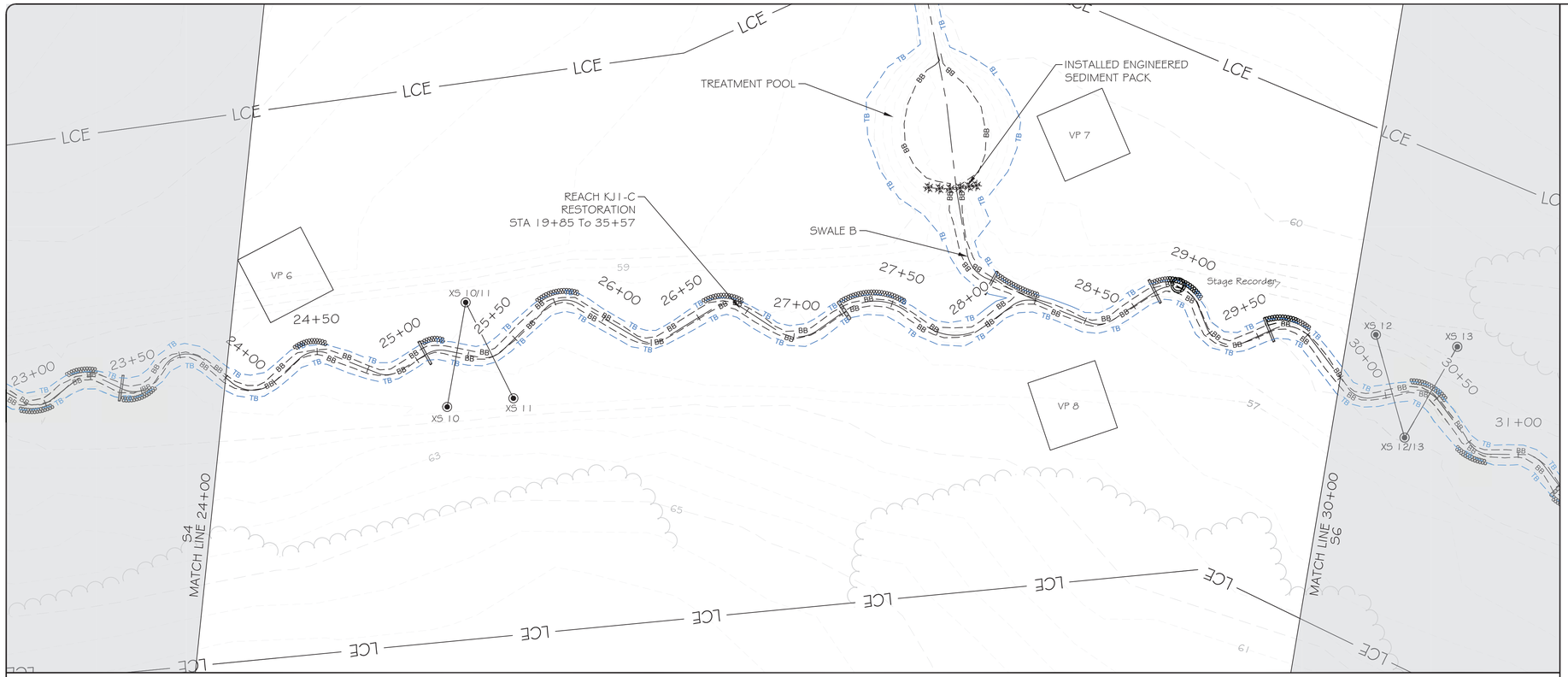

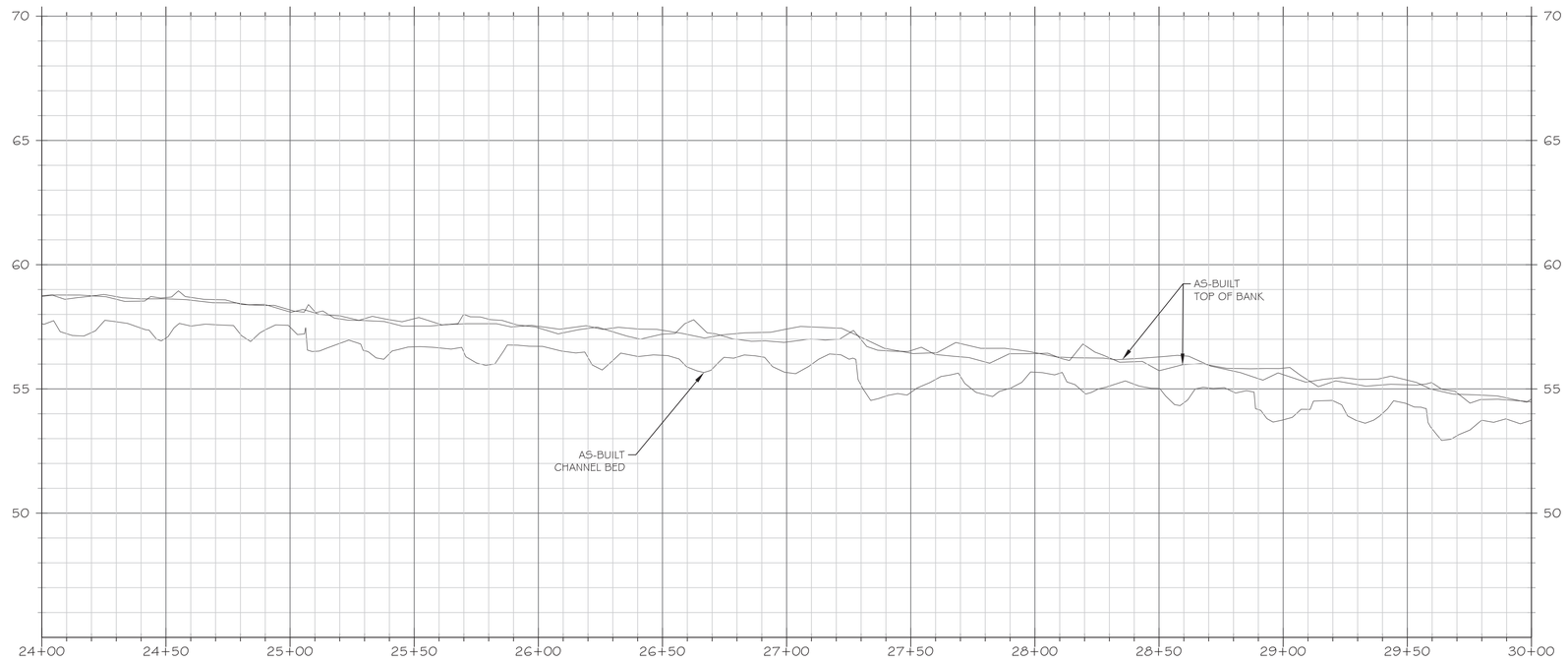

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

- CONTOUR MAJOR — 50
- CONTOUR MINOR — 46
- WETLAND
- TOP OF BANK — TB
- BOTTOM OF BANK — BB
- TREELINE
- LIMITS OF CONSERVATION EASEMENT — LCE
- WETLAND DEPRESSION
- BRUSH TOE PROTECTION
- HAYBALE TOE PROTECTION
- ENGINEERED SEDIMENT PACK
- LOG STRUCTURE
- ROCK STRUCTURE
- BRUSH BED SILL
- GROUNDWATER MONITORING WELL — W
- STAGE RECORDER
- FLOW GAUGE
- MONITORING CROSS SECTION
- VEGETATION MONITORING PLOT — VP#

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Engineering Services Provided By:
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License: F-1428

SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5165 LAND SURVEYOR BRIAN S HACKETT
4/13/22

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/13/2022

REVISIONS:

RELEASED FOR: AS-BUILT DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE AS-BUILT
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	TRS

SHEET NUMBER:

S5

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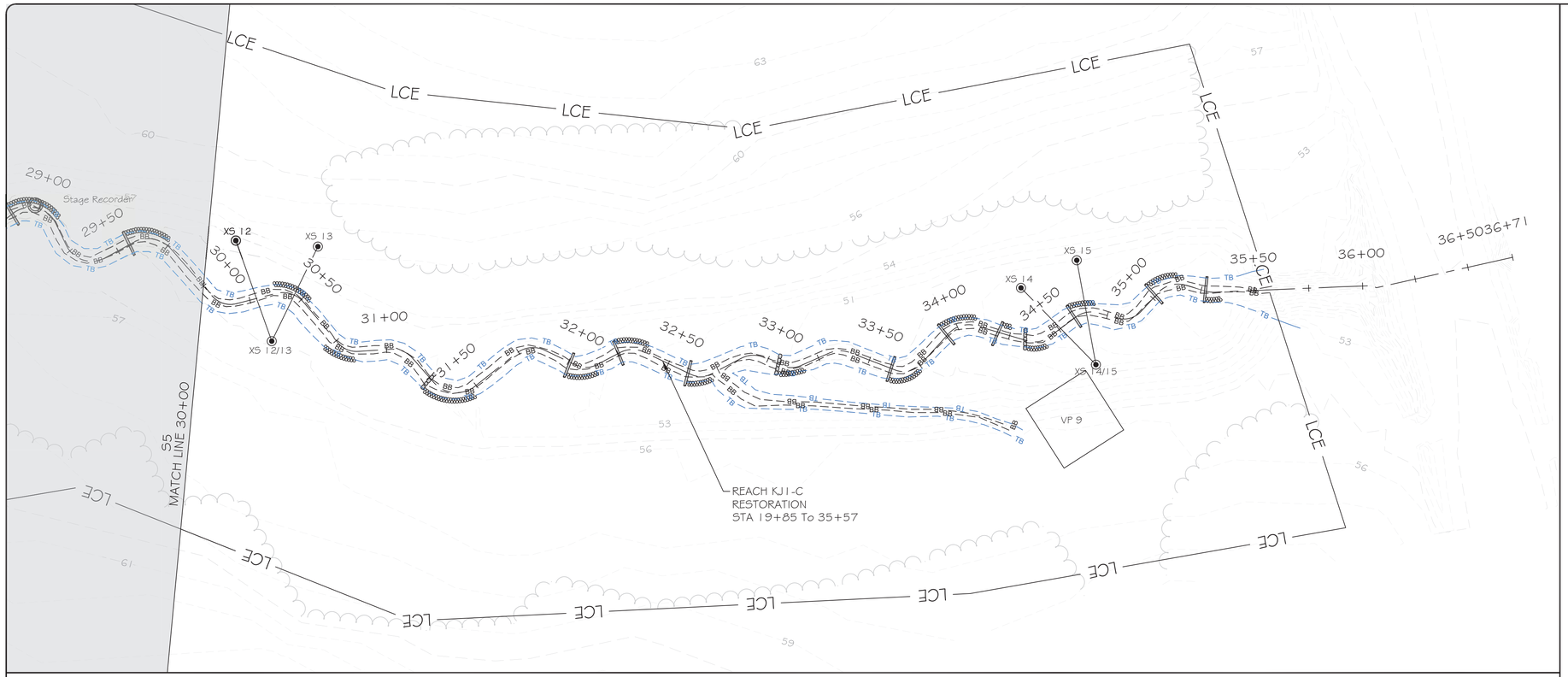

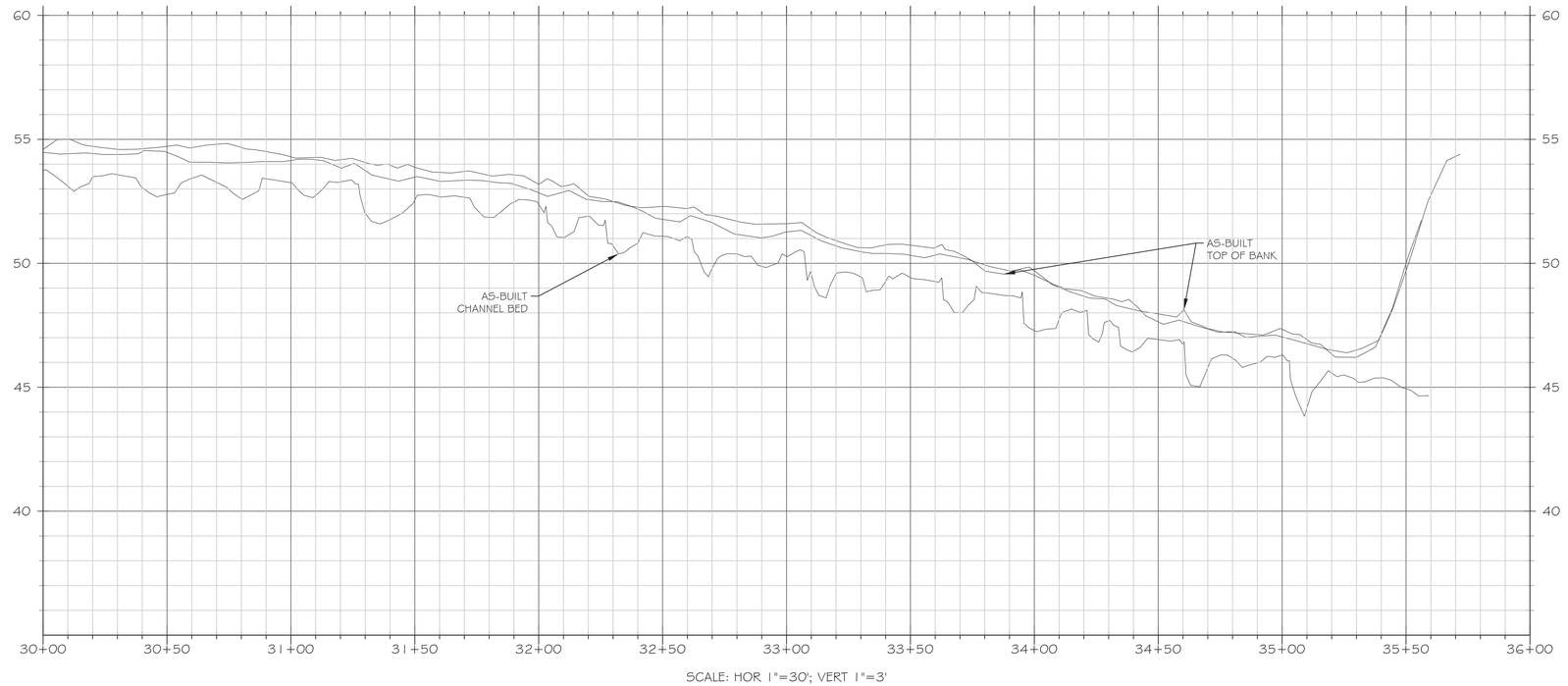

LEGEND

- CONTOUR MAJOR
- CONTOUR MINOR
- WETLAND
- TOP OF BANK (TB)
- BOTTOM OF BANK (BB)
- TREELINE
- LIMITS OF CONSERVATION EASEMENT (LCE)
- WETLAND DEPRESSION
- BRUSH TOE PROTECTION
- HAYBALE TOE PROTECTION
- ENGINEERED SEDIMENT PACK
- LOG STRUCTURE
- ROCK STRUCTURE
- BRUSH BED SILL
- GROUNDWATER MONITORING WELL
- STAGE RECORDER
- FLOW GAUGE
- MONITORING CROSS SECTION
- VEGETATION MONITORING PLOT (VP#)

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Engineering Services Provided By:
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License: F-1428

SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5165 LAND SURVEYOR BRIAN S. TUCKETT
4/13/22

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/13/2022

REVISIONS:

RELEASED FOR: AS-BUILT DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE AS-BUILT
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	TRS

SHEET NUMBER:

S6

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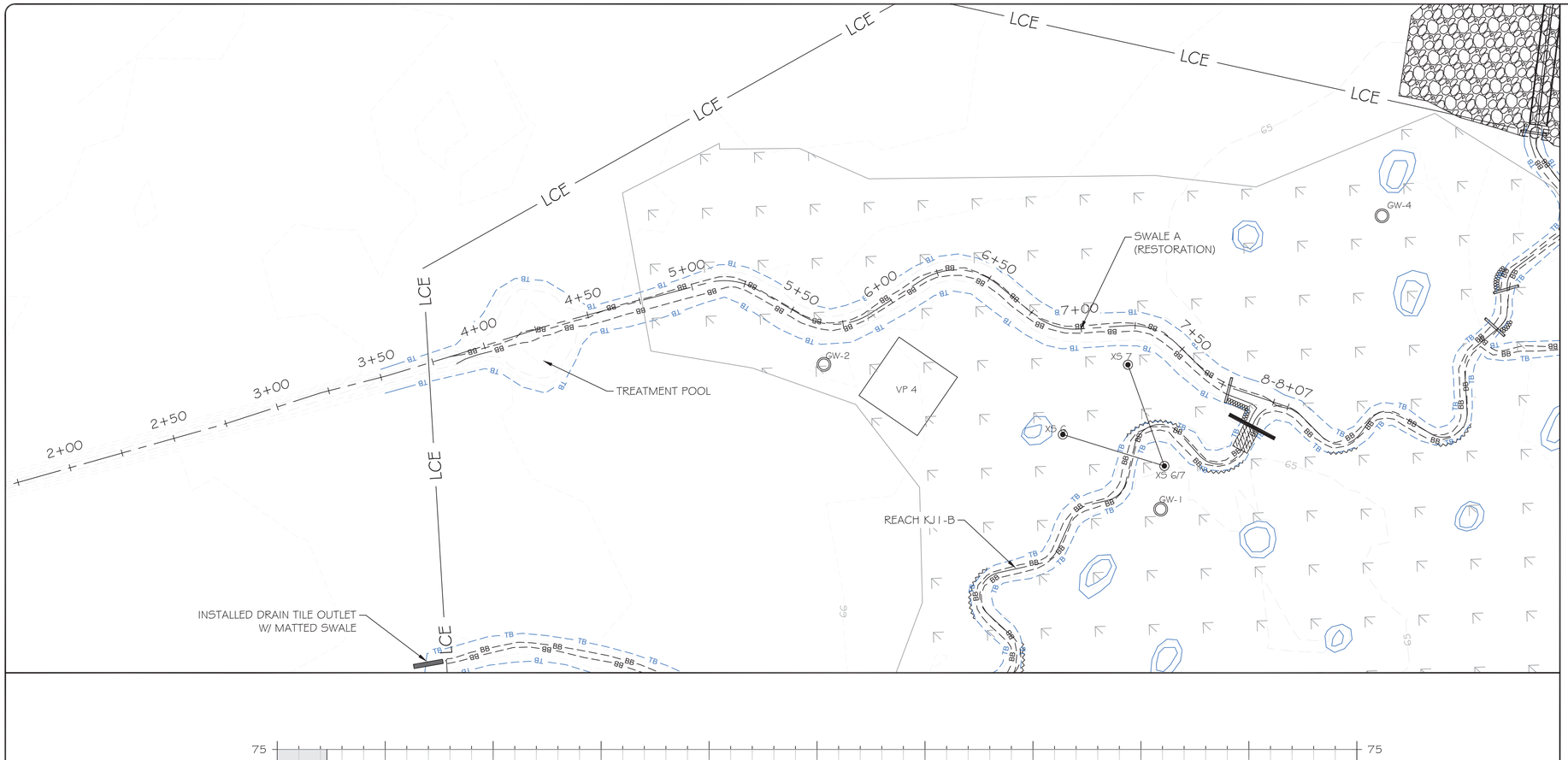

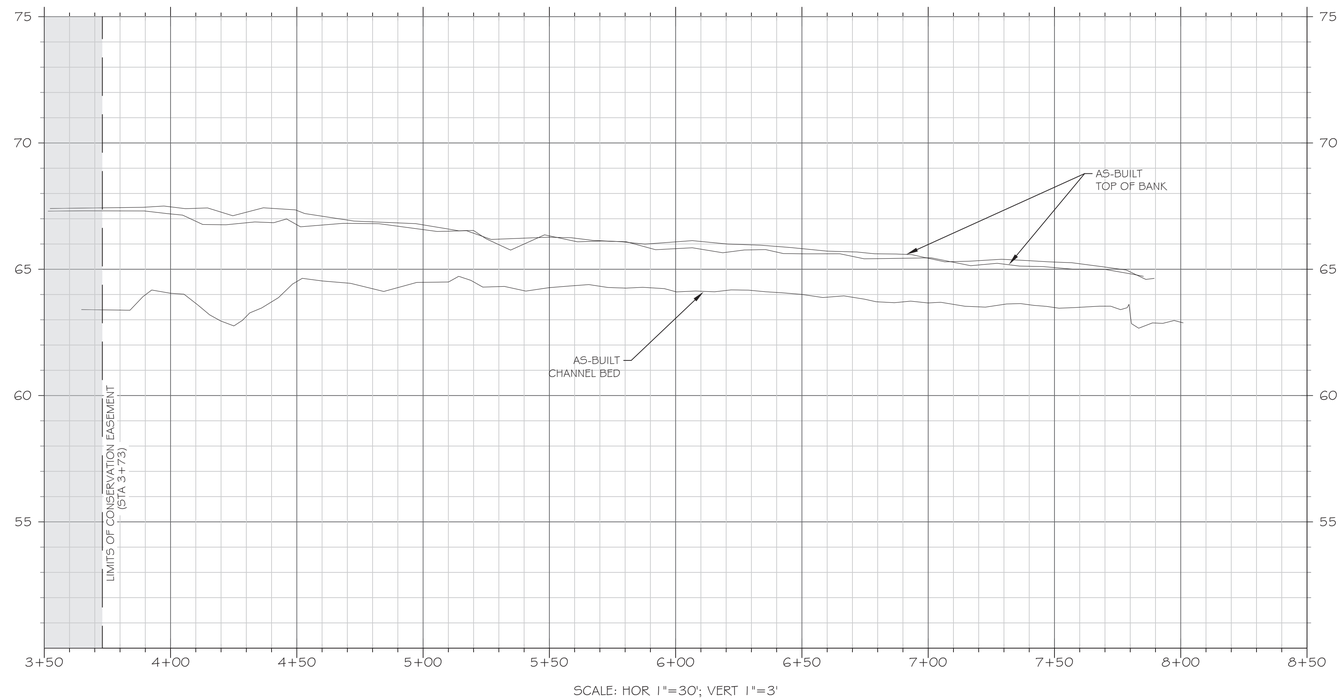

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

- CONTOUR MAJOR — 50
- CONTOUR MINOR — 46
- WETLAND
- TOP OF BANK — TB
- BOTTOM OF BANK — BB
- TREELINE
- LIMITS OF CONSERVATION EASEMENT — LCE
- WETLAND DEPRESSION
- BRUSH TOE PROTECTION
- HAYBALE TOE PROTECTION
- ENGINEERED SEDIMENT PACK
- LOG STRUCTURE
- ROCK STRUCTURE
- BRUSH BED SILL
- GROUNDWATER MONITORING WELL — W
- STAGE RECORDER
- FLOW GAUGE
- MONITORING CROSS SECTION
- VEGETATION MONITORING PLOT — VP#

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License: F-1428

SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5165 LAND SURVEYOR BRIAN S. TUCKETT
4/13/22

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/13/2022

REVISIONS:

RELEASED FOR: AS-BUILT DRAWINGS

PROJECT NAME:
COWFORD MITIGATION SITE AS-BUILT
ONSLOW COUNTY, NORTH CAROLINA

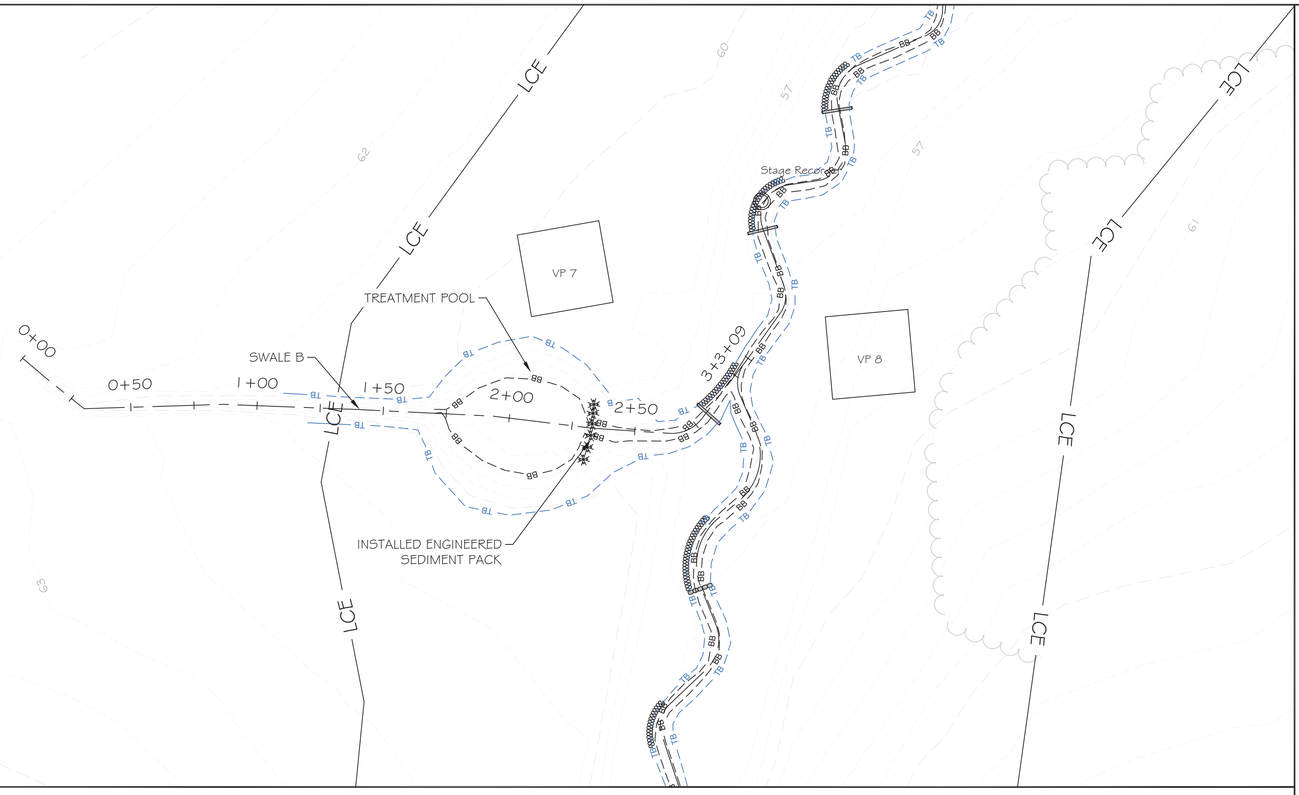
DRAWING TITLE:
SWALE A

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	TRS

SHEET NUMBER:

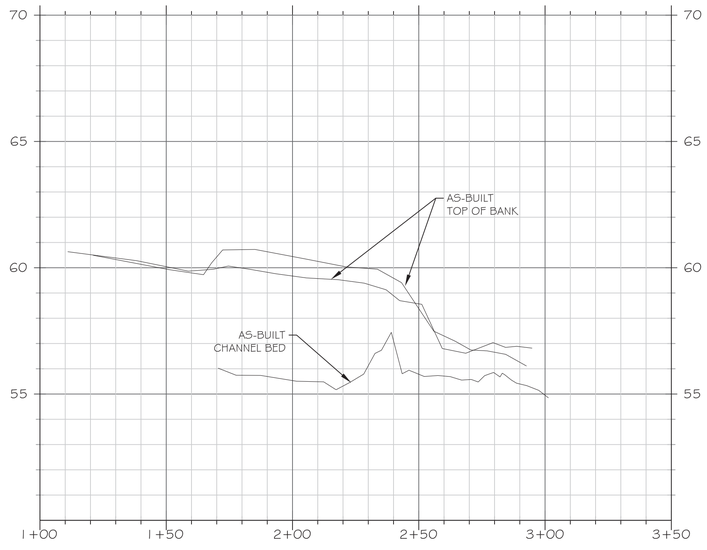
S7

FILE NAME:R:\Resca\Projects\100900-Cowford\ABRL\100900_AB_Design.dwg SAVED BY: Bhockett



LEGEND

- CONTOUR MAJOR — 50
- CONTOUR MINOR — 46
- WETLAND
- TOP OF BANK — TB
- BOTTOM OF BANK — BB
- TREELINE
- LIMITS OF CONSERVATION EASEMENT — LCE
- WETLAND DEPRESSION
- BRUSH TOE PROTECTION
- HAYBALE TOE PROTECTION
- ENGINEERED SEDIMENT PACK
- LOG STRUCTURE
- ROCK STRUCTURE
- BRUSH BED SILL
- GROUNDWATER MONITORING WELL — W
- STAGE RECORDER
- FLOW GAUGE
- MONITORING CROSS SECTION
- VEGETATION MONITORING PLOT — VP#



SCALE: HOR 1"=30'; VERT 1"=3'

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Raleigh, NC 27612
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www.res.us

Engineering Services Provided By:
RES Environmental Operating Company, LLC
License: F-1428

SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5165 LAND SURVEYOR BRIAN R. CROUCH 4/13/22

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/13/2022

REVISIONS:

RELEASED FOR: AS-BUILT DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE AS-BUILT
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: SWALE B

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	TRS

SHEET NUMBER: S8

FILE NAME:R:\Resca\Projects\100900-Cowford\ABRL\100900_AB_Design.dwg SAVED BY: Bhockett

COWFORD MITIGATION SITE

ONSLOW COUNTY, NORTH CAROLINA

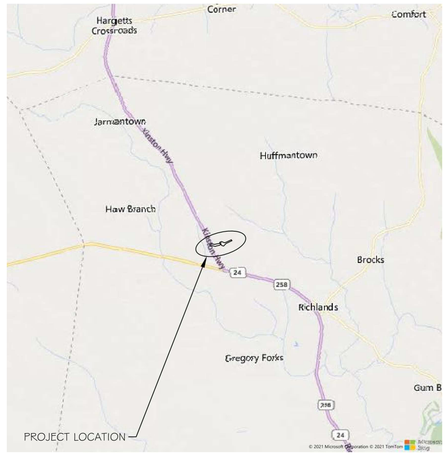
WHITE OAK RIVER BASIN: HUC 03030001

APRIL 2022

RESOURCE ENVIRONMENTAL SOLUTIONS, LLC

3600 GLENWOOD AVE, SUITE 100

RALEIGH, NC 27612



VICINITY MAP

NTS

PROJECT DIRECTORY

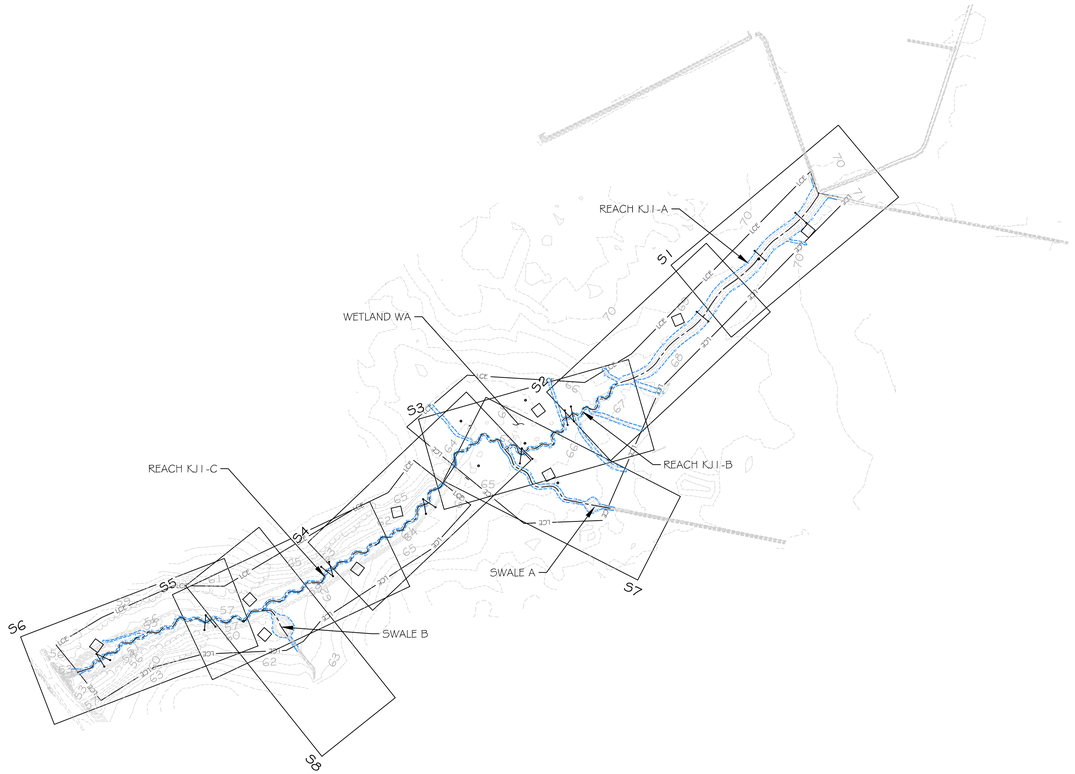
OWNER:
LINDSAY CROCKER
NC DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
217 WEST JONES ST., SUITE 3000A
RALEIGH, NC 27603

DESIGNED BY:
RESOURCE ENVIRONMENTAL SOLUTIONS, LLC
3600 GLENWOOD AVE., SUITE 100
RALEIGH, NC 27612

AS-BUILT SURVEY BY:
RESOURCE ENVIRONMENTAL SOLUTIONS, LLC
3600 GLENWOOD AVE., SUITE 100
RALEIGH, NC 27612

DMS PROJECT #: 100095
CONTRACT #: 7746
USACE ACTION ID #: SAW-2019-00487
RFP #: 16-007577
DWR #: 2019-0495

COWFORD MITIGATION SITE AS-BUILT SURVEY SEALED BY BRIAN S. HOCKETT, PLS (L-5165) ON APRIL 13, 2022.



SITE MAP

NTS

Sheet List Table	
Sheet Number	Sheet Title
--	COVER
S1	REACH KJ1
S2	REACH KJ1
S3	REACH KJ1
S4	REACH KJ1
S5	REACH KJ1
S6	REACH KJ1
S7	SWALE A
S8	SWALE B

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Raleigh, NC 27612
Main: 919.829.9909
www.res.us

Engineering Services Provided By:
RES Environmental Operating Company, LLC
License: F-1428

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 042580 ENGINEER BENTON R. CARROLL 4/14/2022

PLOT DATE: 4/14/2022

REVISIONS:

RELEASED FOR: RECORD DRAWINGS

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	BRC

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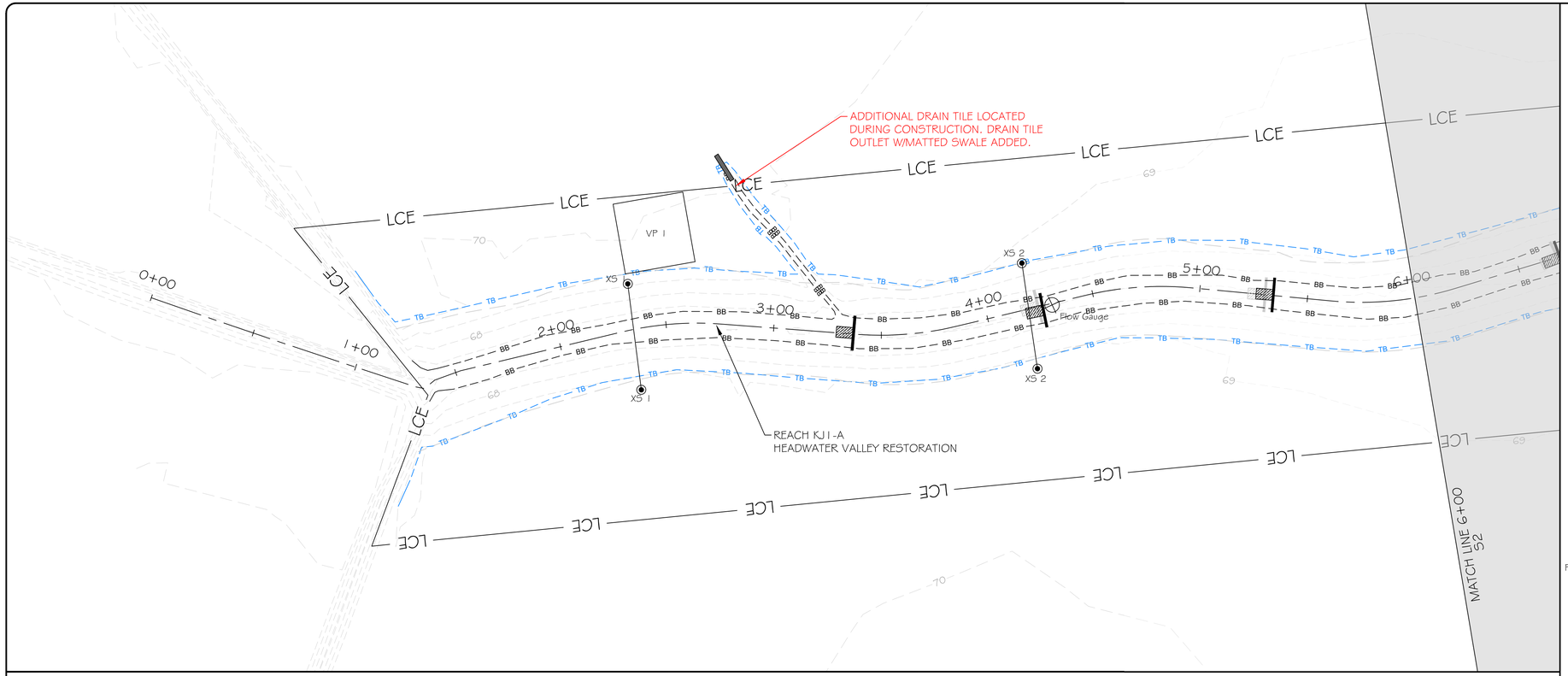

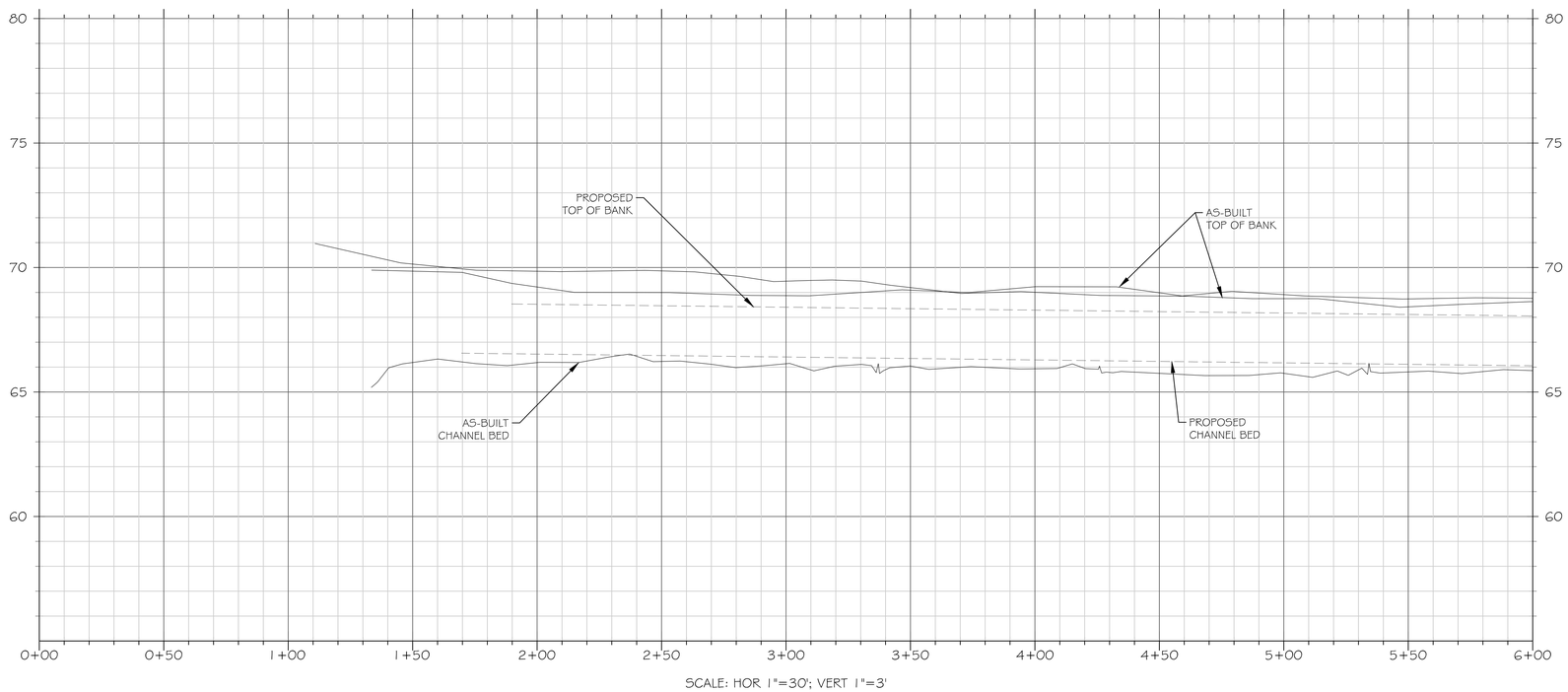

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

- CONTOUR MAJOR
- CONTOUR MINOR
- WETLAND
- TOP OF BANK (TB)
- BOTTOM OF BANK (BB)
- TREELINE
- LIMITS OF CONSERVATION EASEMENT (LCE)
- PROPOSED BRUSH TOE PROTECTION
- PROPOSED HAYBALE PROTECTION
- PROPOSED LOG STRUCTURE
- PROPOSED ROCK STRUCTURE
- PROPOSED BRUSH BED SILL
- PROPOSED ENGINEERED SEDIMENT PACK
- AS-BUILT BRUSH TOE PROTECTION
- AS-BUILT HAYBALE PROTECTION
- AS-BUILT LOG STRUCTURE
- AS-BUILT ROCK STRUCTURE
- AS-BUILT BRUSH BED SILL
- AS-BUILT ENGINEERED SEDIMENT PACK
- GROUNDWATER MONITORING WELL
- STAGE RECORDER
- FLOW GAUGE
- MONITORING CROSS SECTION
- VEGETATION MONITORING PLOT (VP#)

NOTE: ALL SIGNIFICANT CHANGES FROM THE DESIGN ARE SHOWN IN RED

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SEAL

NORTH CAROLINA PROFESSIONAL SEAL 042580 ENGINEER BENTON R. CARROLL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/14/2022

REVISIONS:

RELEASED FOR: RECORD DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	BRC

SHEET NUMBER:

S1

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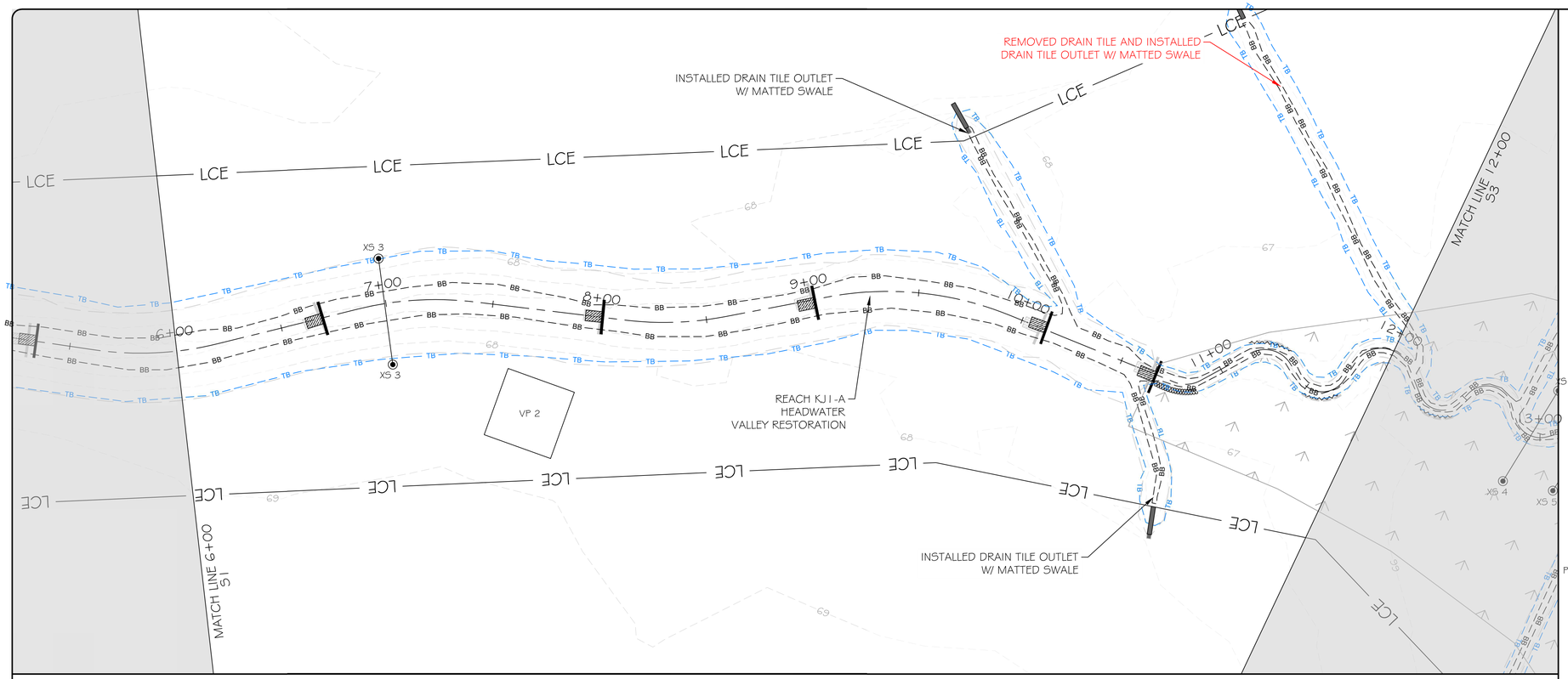

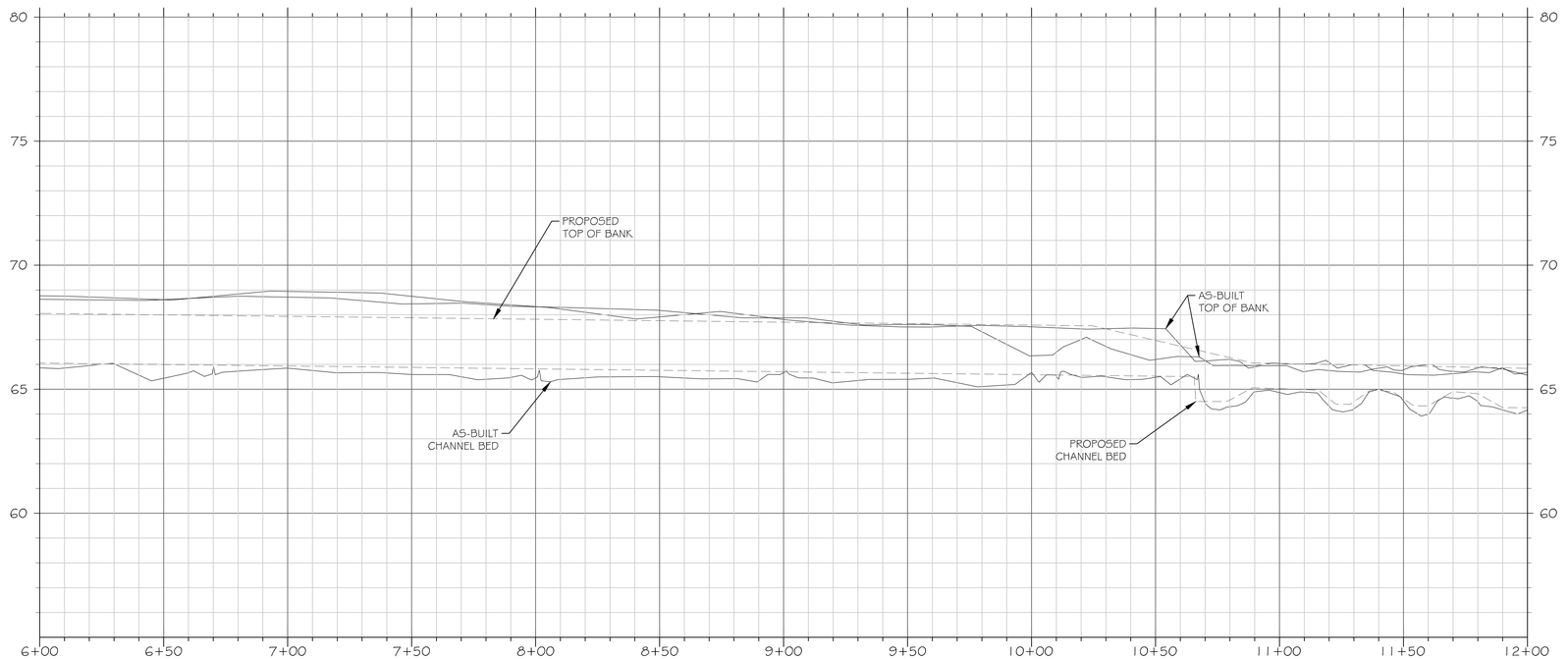

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

- CONTOUR MAJOR
- CONTOUR MINOR
- WETLAND
- TOP OF BANK (TB)
- BOTTOM OF BANK (BB)
- TREELINE
- LIMITS OF CONSERVATION EASEMENT (LCE)
- PROPOSED BRUSH TOE PROTECTION
- PROPOSED HAYBALE PROTECTION
- PROPOSED LOG STRUCTURE
- PROPOSED ROCK STRUCTURE
- PROPOSED BRUSH BED SILL
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SEAL

NORTH CAROLINA PROFESSIONAL SEAL 042580 ENGINEER BENJAMIN R. CARROLL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/14/2022

REVISIONS:

RELEASED FOR: RECORD DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	BRC

SHEET NUMBER:

S2

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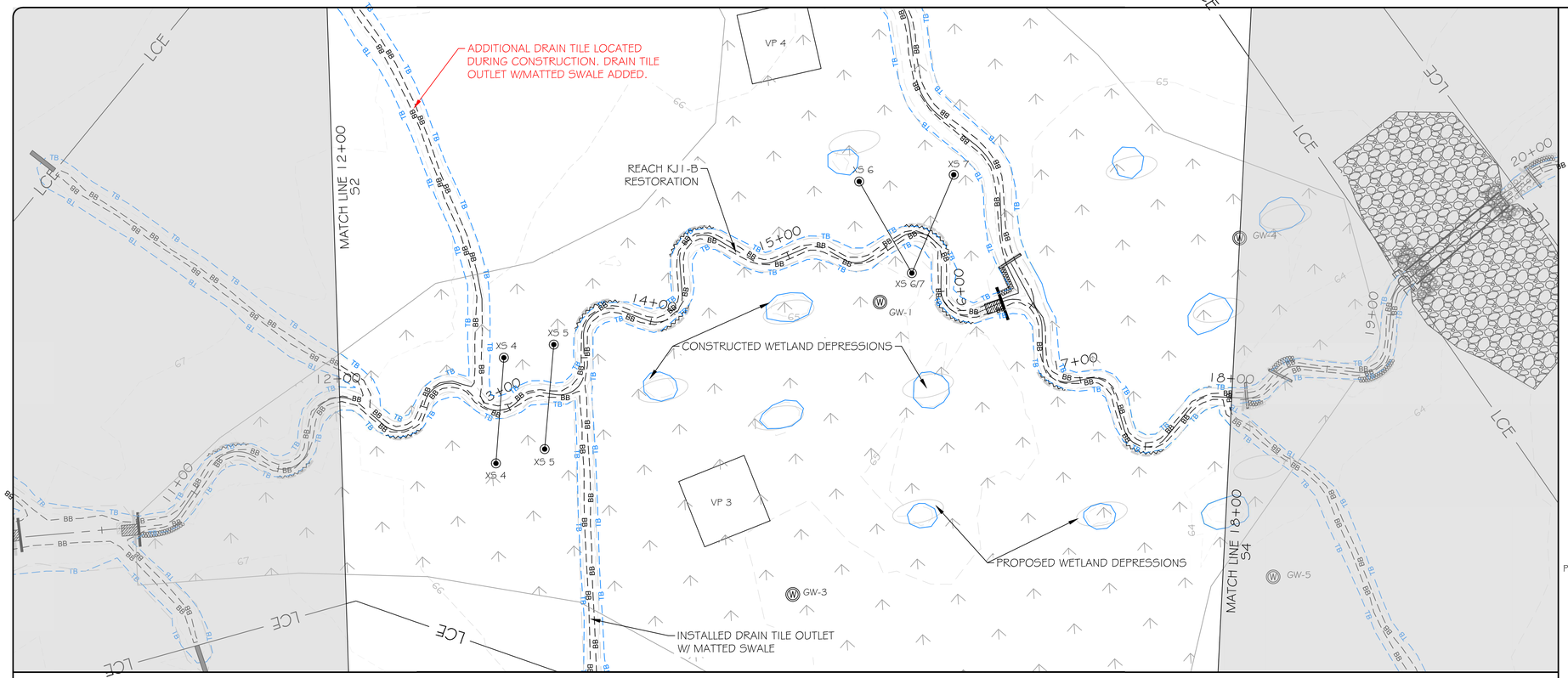

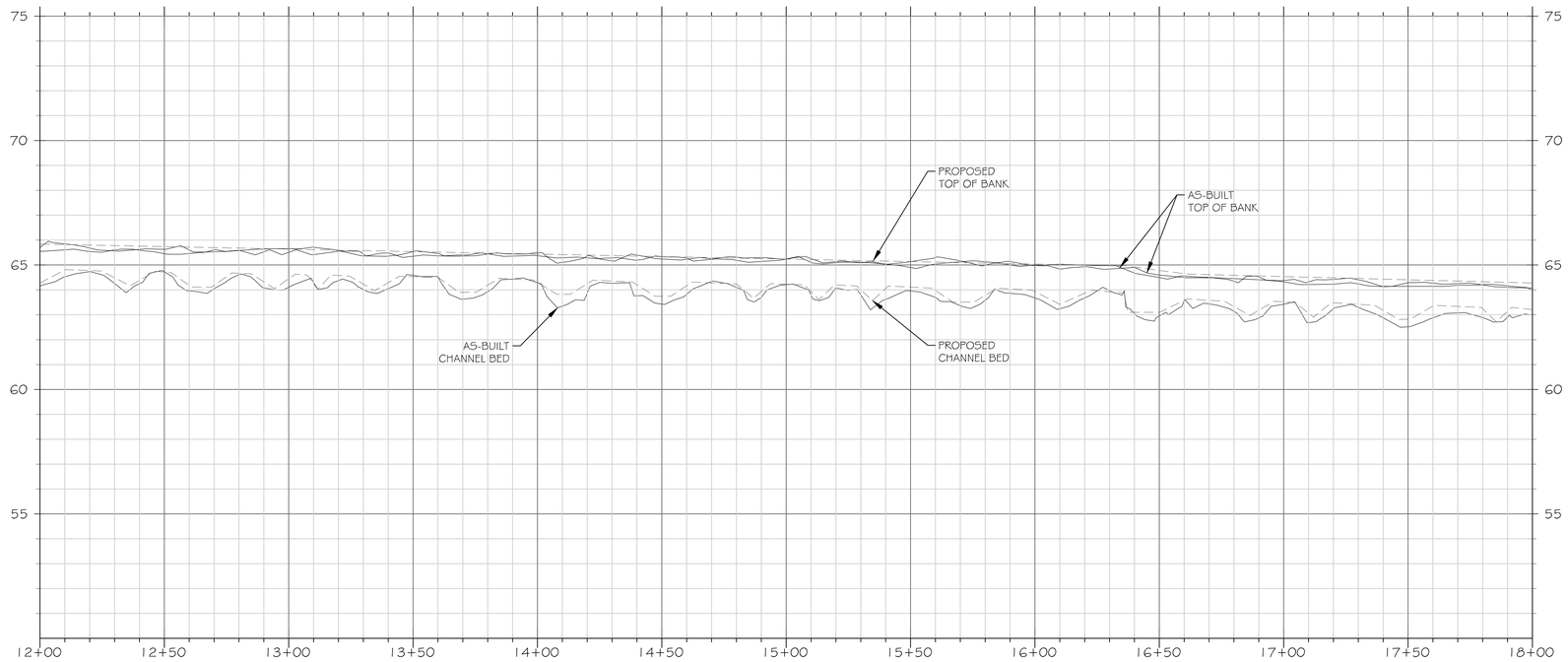

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

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SEAL

NORTH CAROLINA PROFESSIONAL SEAL 042580 ENGINEER BENTON R. CARROLL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/14/2022

REVISIONS:

RELEASED FOR: RECORD DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	BRC

SHEET NUMBER: S3

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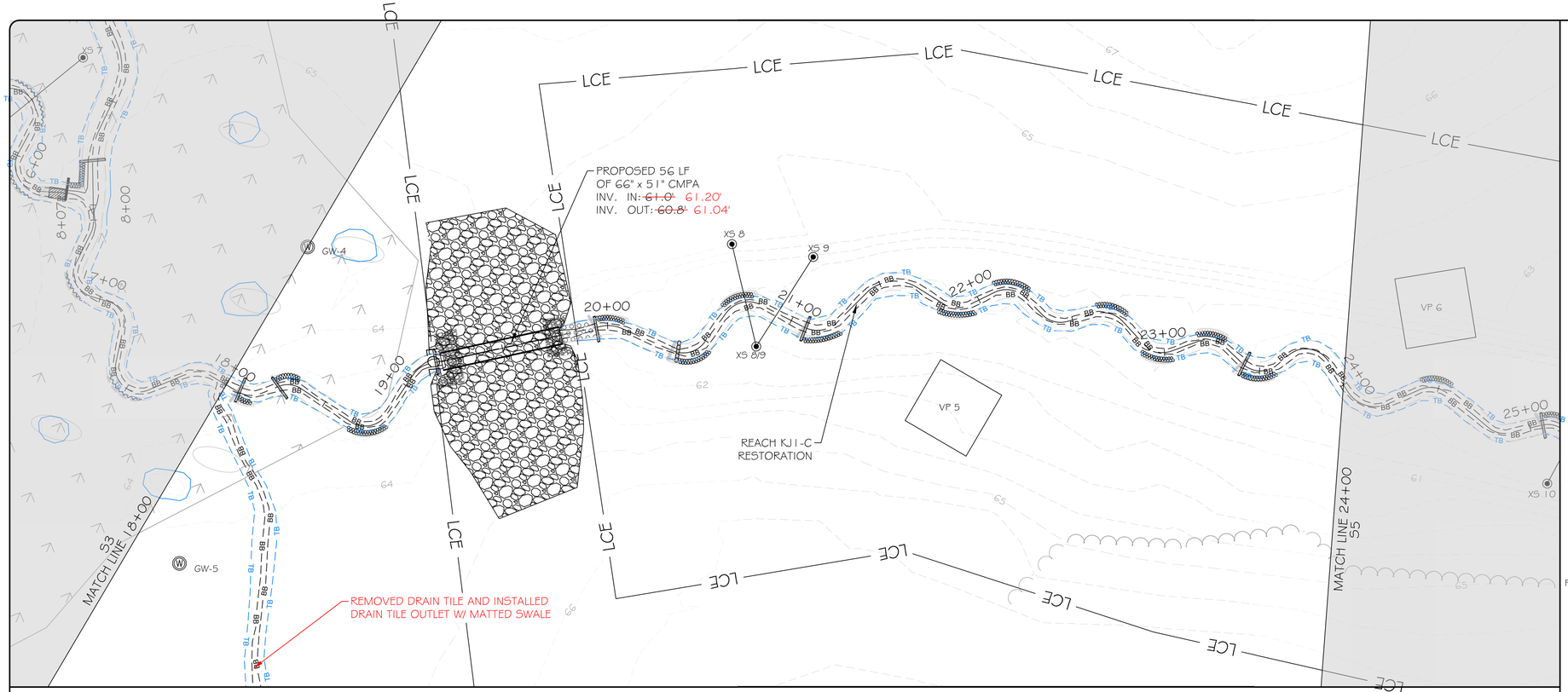

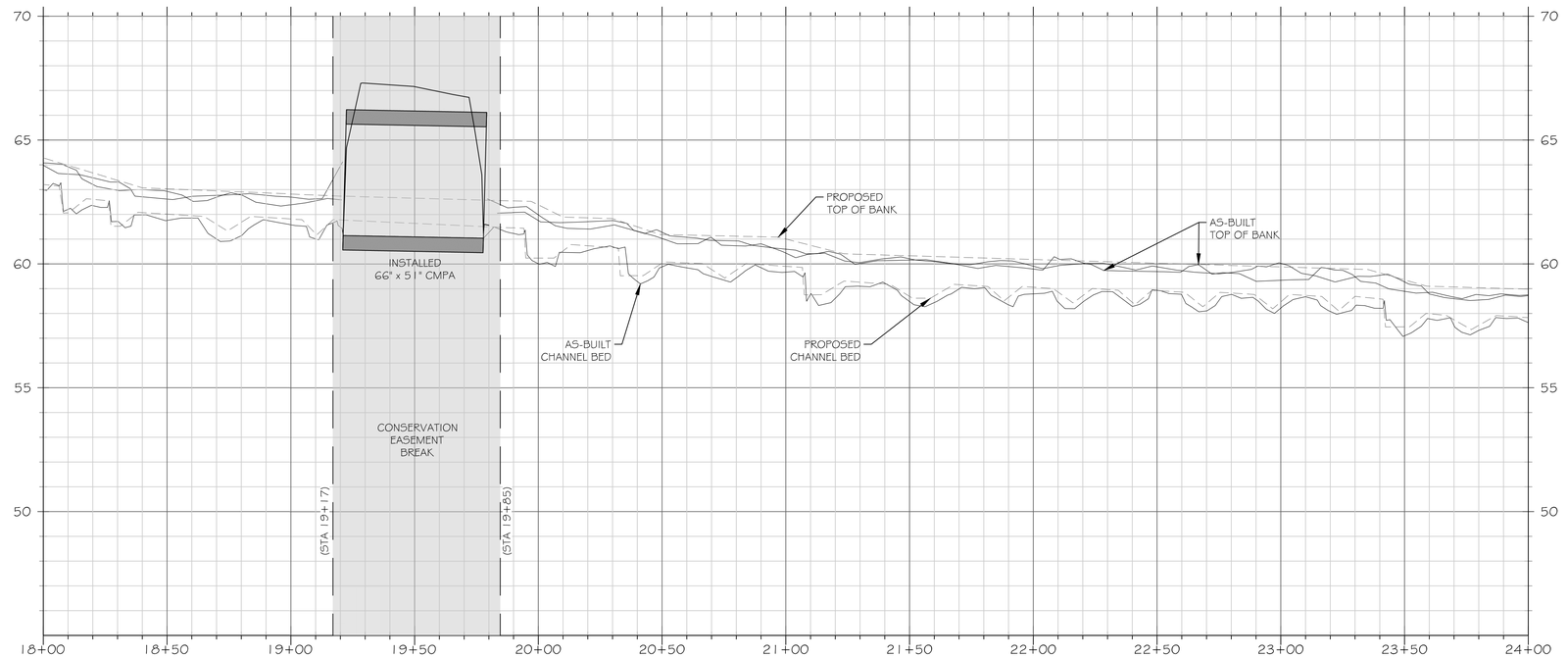

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

- CONTOUR MAJOR
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- BOTTOM OF BANK (BB)
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SEAL

NORTH CAROLINA PROFESSIONAL SEAL 042580 ENGINEER BENJAMIN R. CARROLL 4/14/22

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/14/2022

REVISIONS:

RELEASED FOR: RECORD DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	BRC

SHEET NUMBER:

S4

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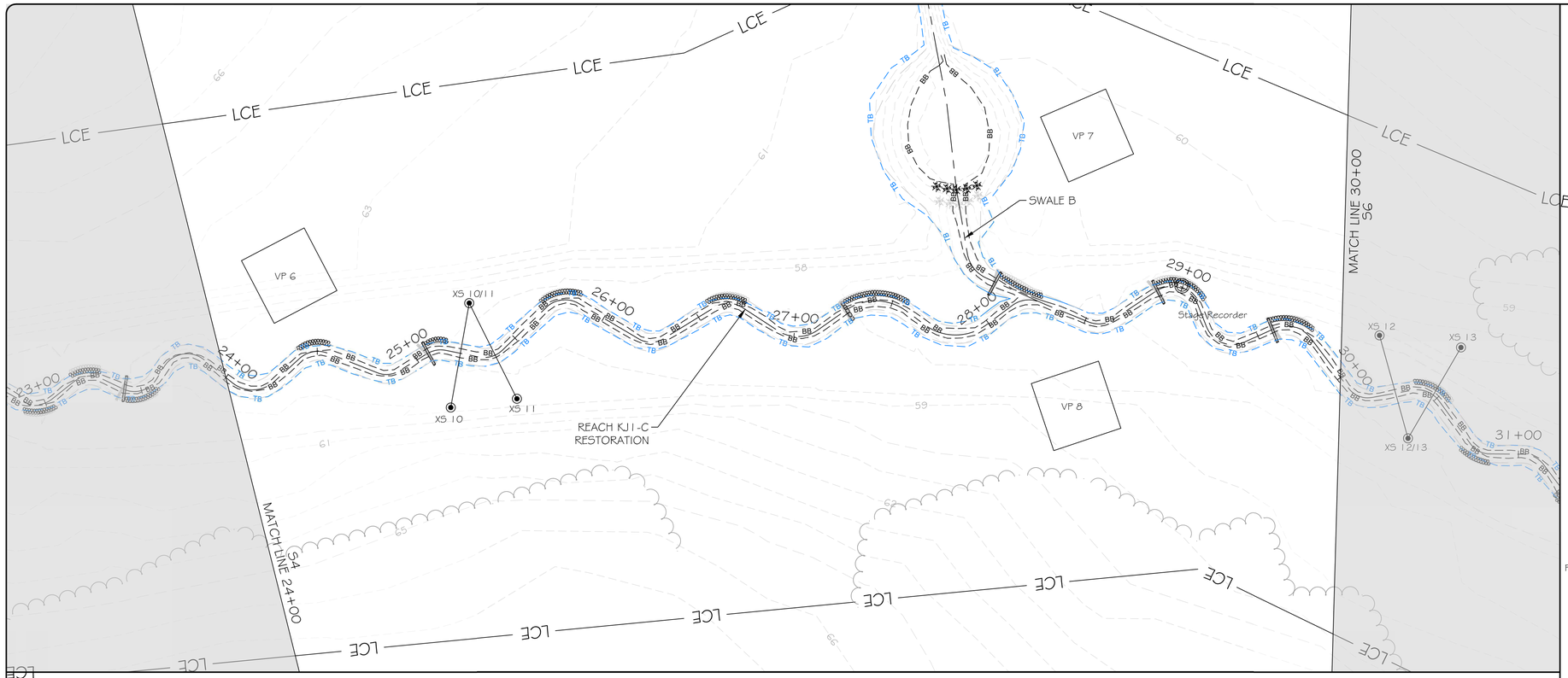

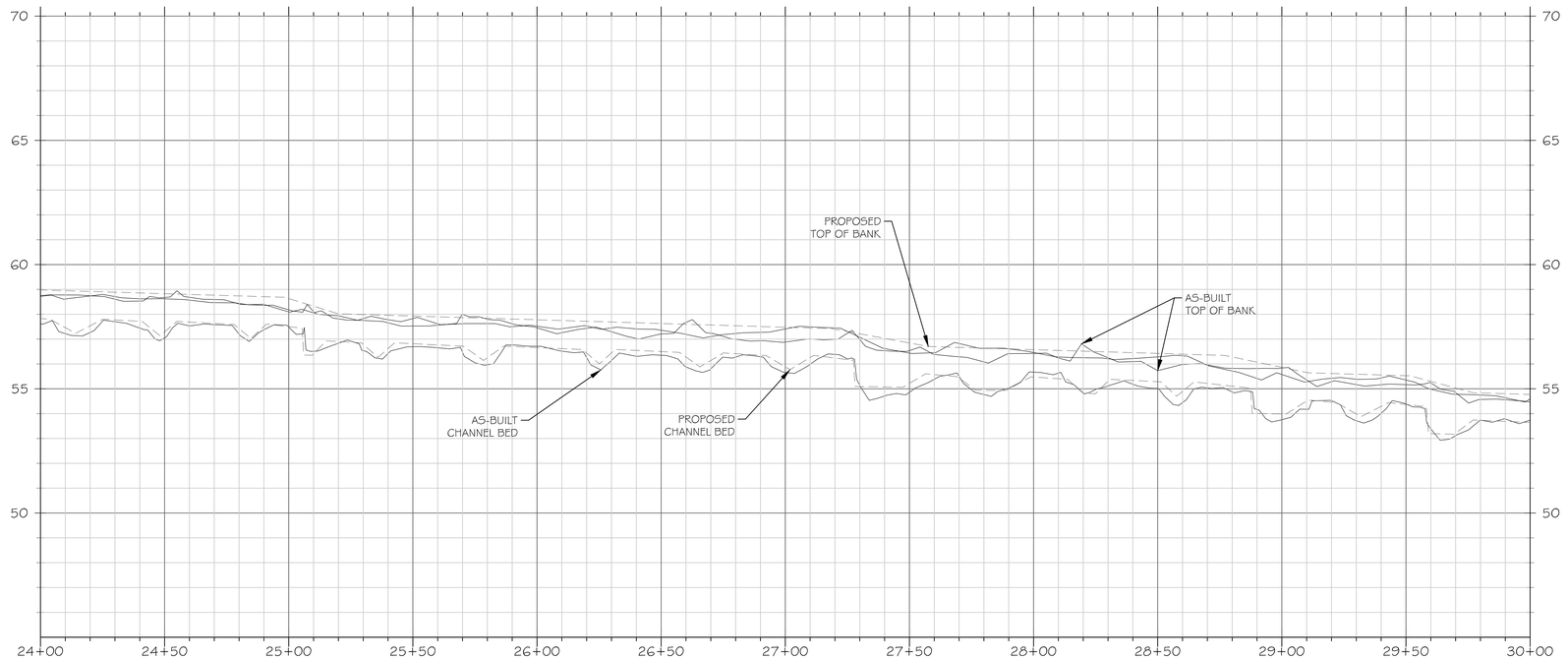

SCALE: HOR 1"=30'; VERT 1"=3'

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SEAL

NORTH CAROLINA PROFESSIONAL SEAL 042580 ENGINEER BENTON R. CARROLL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/14/2022

REVISIONS:

RELEASED FOR: RECORD DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	BRC

SHEET NUMBER:

S5

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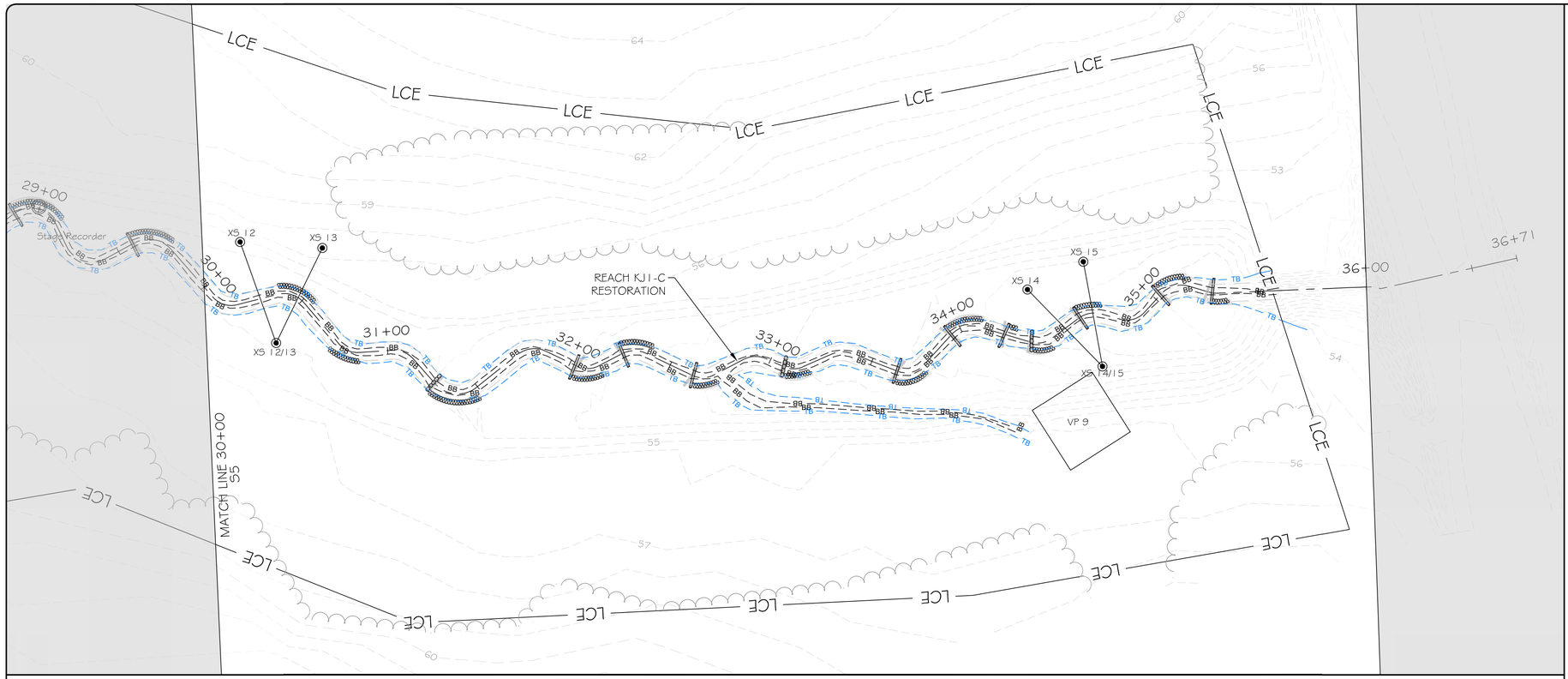

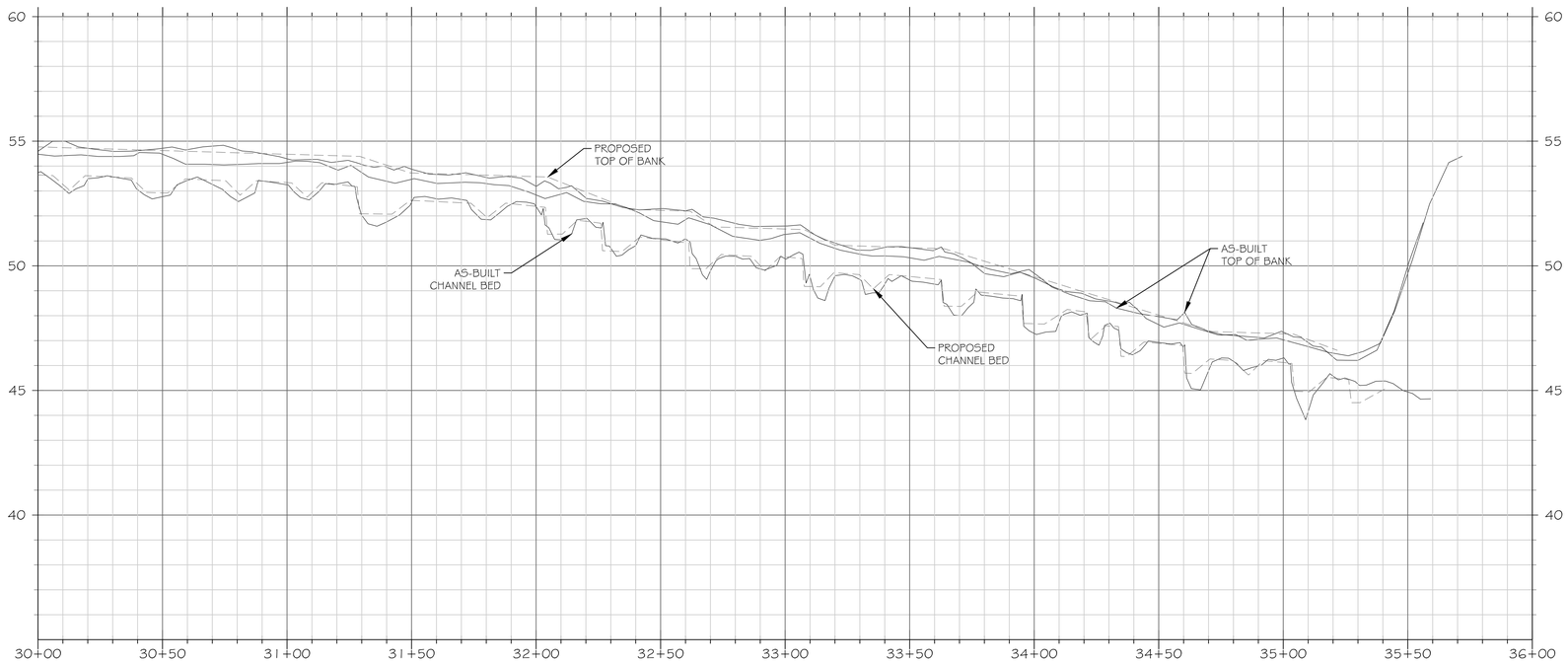

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SEAL

NORTH CAROLINA PROFESSIONAL SEAL 042580 ENGINEER BENTON R CARROLL 4/14/22

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/14/2022

REVISIONS:

RELEASED FOR: RECORD DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH KJ1

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	BRC

SHEET NUMBER:

S6

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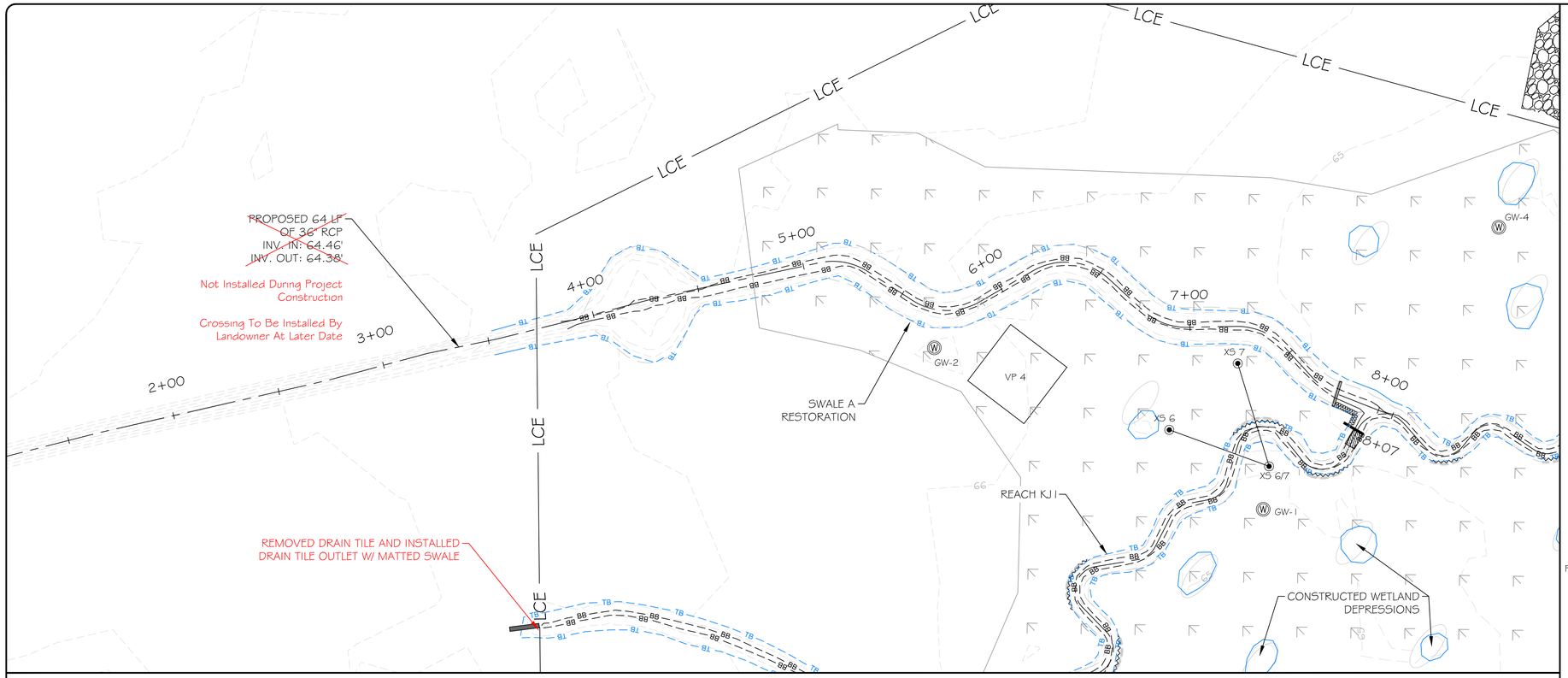

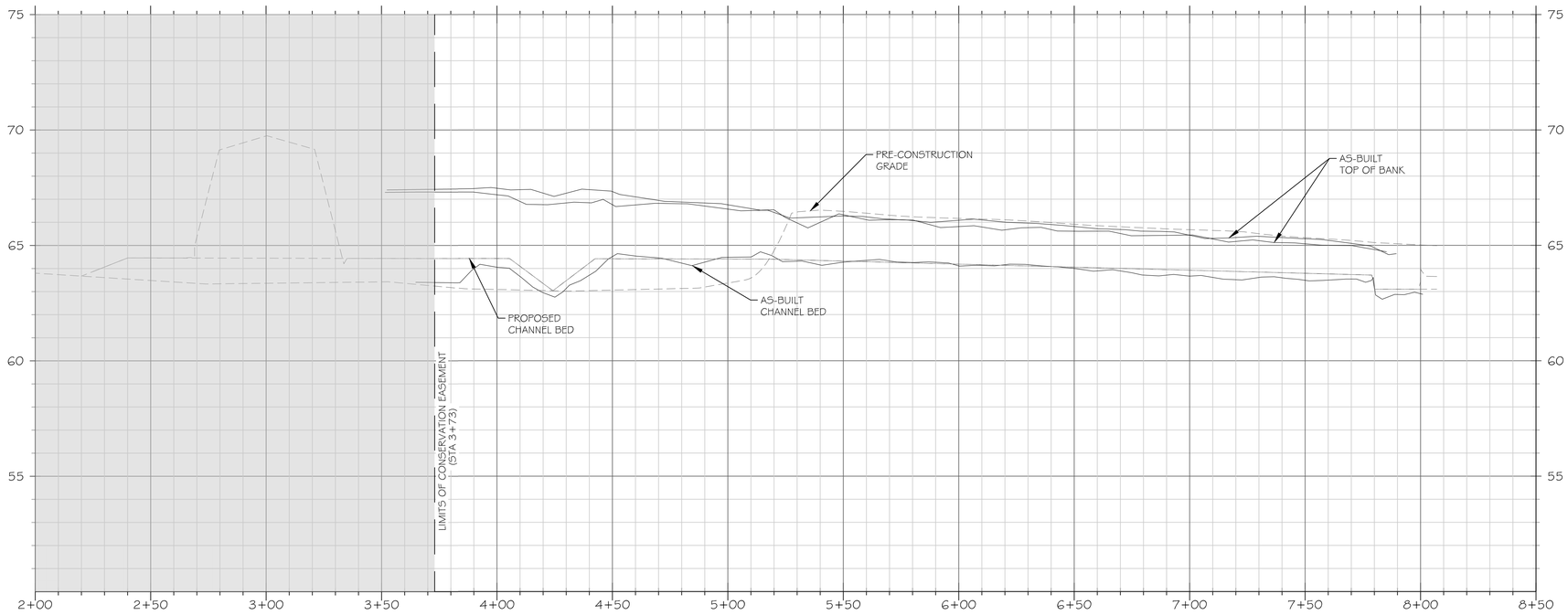

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

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License: F-1428

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 042580 ENGINEER BENTON R CARROLL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/14/2022

REVISIONS:

RELEASED FOR: RECORD DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: SWALE A

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	BRC

SHEET NUMBER: S7

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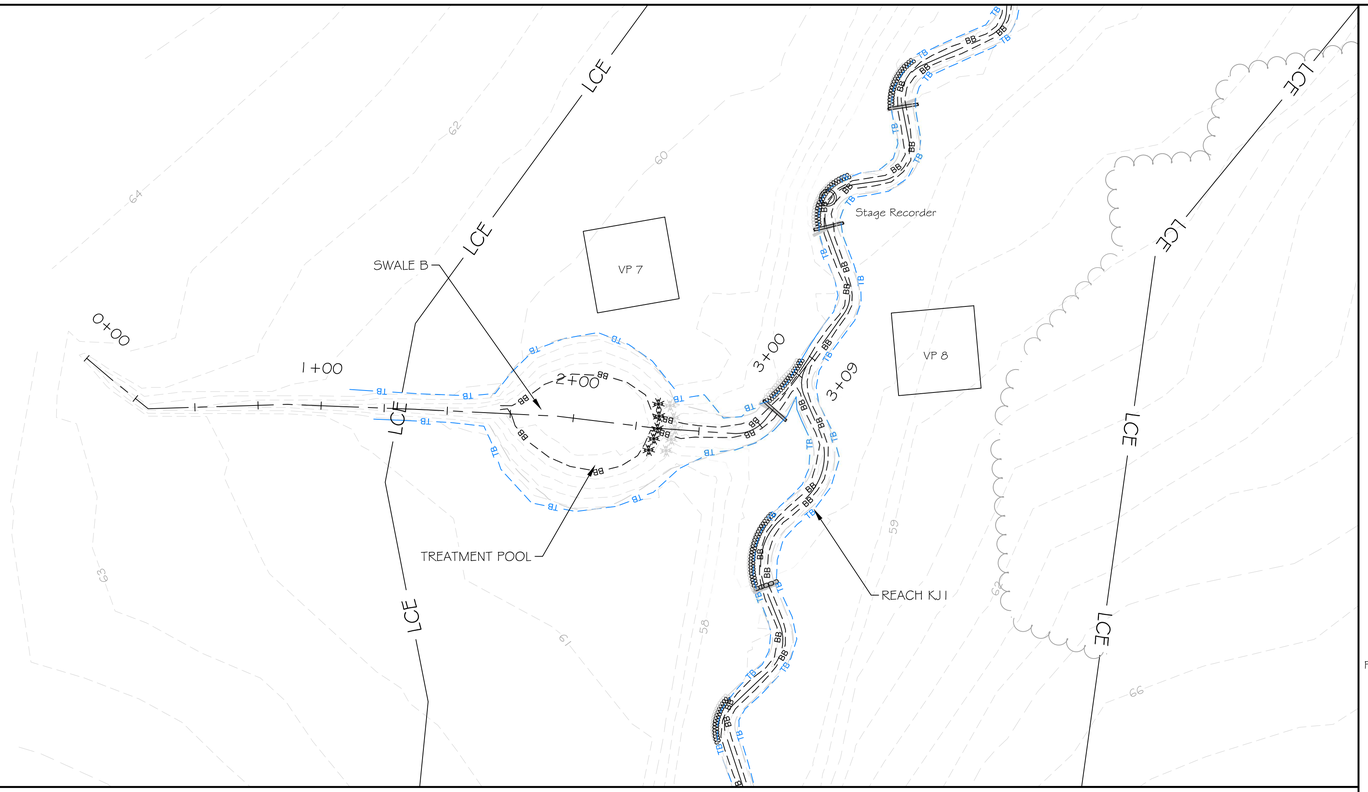

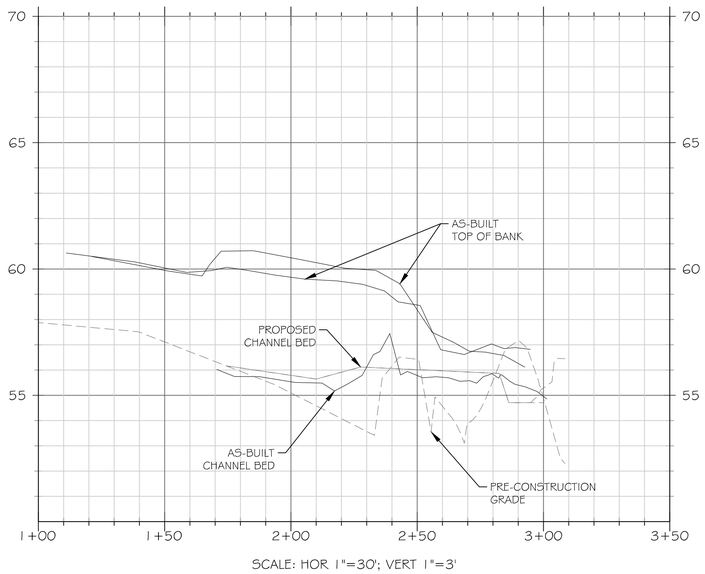

SCALE: HOR 1"=30'; VERT 1"=3'

LEGEND

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SEAL

NORTH CAROLINA PROFESSIONAL SEAL 042580 ENGINEER BENTON R. CARROLL 4/14/22

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

PLOT DATE: 4/14/2022

REVISIONS:

RELEASED FOR: RECORD DRAWINGS

PROJECT NAME: COWFORD MITIGATION SITE
ONSLOW COUNTY, NORTH CAROLINA

DRAWING TITLE: SWALE B

PROJECT NUMBER:	100900
PROJECT MANAGER:	MGB
DESIGNED:	BRC
DRAWN:	BSH
CHECKED:	BRC

SHEET NUMBER:

S8

FILE NAME:R:\Resad\Projects\100900-Cowford\ABRL\Record Drawings\100900_RD_DESIGN.dwg SAVED BY: Bhockett

Appendix F

Soil Profile

Cowford Mitigation Project | Soil Profile Sampling

Soil Sample ID: GW1	**Staff:** Hannah Gadai	**Date:** April 28, 2022

Horizon (in.)	Color	Redox	Redox Percent	Texture	Structure	Consistency	Notes
0-16	10YR 2/2	Yes	5%	Silt loam	Granular		
16-24	10YR 3/1	No		Clay loam	Sub-angular blocky		
24-28	10YR 6/3	No		Clay	Blocky		

Soil Profile:

Soil Sample ID: GW2	**Staff:** Ryan Medric and Heath Hidlay	**Date:** November 2, 2021

Horizon (in.)	Color	Redox	Redox Percent	Texture	Structure	Consistency	Notes
0-6	10YR 3/2	No		Silt loam	Granular		
6-20	10YR 6/4	Yes Concentrations/ depletions	50%	Clay loam	Sub-angular blocky		Conc. 7YR 5/8 Dep. 10YR 7/1
20+	10YR 6/1	Yes Concentrations	5%	Clay	Blocky		Conc. 10YR 7/6

Soil Profile:

Soil Sample ID: GW3	**Staff:** Ryan Medric and Heath Hidlay	**Date:** November 2, 2021

Horizon (in.)	**Color**	**Redox**	**Redox Percent**	**Texture**	**Structure**	**Consistency**	**Notes**
0-12	10YR 3/2	No		Silt loam	Granular		
12-20	10YR 7/2	Yes Concentrations	5%	Silty clay loam	Sub-angular blocky		Conc. 10YR 8/6
20+	10YR 6/2	Yes Concentrations	10%	Clay loam	Sub-angular Blocky		Conc. 10YR 7/8

Soil Profile:

Soil Sample ID: GW4	**Staff:** Ryan Medric and Heath Hidlay	**Date:** November 2, 2021

Horizon (in.)	Color	Redox	Redox Percent	Texture	Structure	Consistency	Notes
0-9	10YR 3/2	No		Silt loam	Granular		
9-21	10YR 6/4	Yes Concentrations/ depletions	15%	Clay loam	Sub-angular blocky		Conc. 10YR 6/8 Dep. 10YR 7/1
21+	10YR 6/1	Yes Concentrations	30%	Clay loam	Blocky		Conc. 10YR 5/8

Soil Profile:

Soil Sample ID: GW5	**Staff:** Ryan Medric and Heath Hidlay	**Date:** November 2, 2021

Horizon (in.)	Color	Redox	Redox Percent	Texture	Structure	Consistency	Notes
0-9	10YR 3/2	No		Silt loam	Granular		
9-15	10YR 5/2	No		Silty clay loam	Sub-angular blocky		
15-20	10YR 4/3	Yes Concentrations/ Depletions	10%	Silty clay loam	Sub-angular blocky		Conc. 10YR 8/6 Dep. 10YR 7/2
20+	10YR 6/1	Yes Concentrations	25%	Clay Loam	Blocky		Conc. 10YR 7/6

Soil Profile:

Summary of Groundwater Monitoring Results Cowford											
Well ID	Wetland ID	Ground Elevation (ft)	Hydroperiod (%)								
			Pre Con (2020)	Pre Con (2021)	Year 1 (2022)	Year 2 (2023)	Year 3 (2024)	Year 4 (2025)	Year 5 (2026)	Year 6 (2027)	Year 7 (2028)
GW1	WA	62.30	1.00	0.00							
GW2	WA										
GW3	WA										
GW4	WA										
GW5	WA										