Year 1 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

January 2023

3600 Glenwood Avenue, Suite 100
Raleigh, NC 27612

Corporate Headquarters
6575 W Loop S #300
Bellaire, TX 77401
Main: 713.520.5400

January 25, 2023

Lindsay Crocker
NC DEQ Division of Mitigation Services
217 West Jones Street
Raleigh, NC 27604

RE: Cowford, Project ID #100095, DMS Contract #0007746

Listed below are comments provided by DMS on January, 2023 as well as IRT Baseline Review comments regarding the Cowford Site: Year 1 Monitoring Report and RES' responses.

Comments:
1. Please include IRT Baseline review comments and provide responses.
The IRT Baseline review comments were included (comments 5-9) with responses.

2. Please include IRT correspondence regarding Cowford conservation easement.
IRT correspondence is included in Appendix F.

3. Explain how the planted stems increased in many of the species from MY0 to MY1 in the vegetation plots.
In Table 9, MY0 total planted stems were not updated to include random vegetation plot stems. This has been updated to the correct number of total planted stems in MY0, which was 259.

4. Include table of performance for headwater portion of stream (KJ1-A, see attached example).
A headwater valley performance table has been added to Appendix D.

5.Please QAQC the 2021 references throughout page 6.
Done

6.The IRT had initially raised some questions/concerns regarding the single swale proposed from the CE boundary to the stream through the wetland credit area. Looking at the as-built, it appears that six swales were constructed at least partially overlapping the wetland credit area. Were the five additional swales constructed to similar dimensions as the Swale A typical detail/section? If not, please provide more information on the dimensions of the added swales. DWR is concerned with the potential drainage effect of these new swales and may request additional groundwater gauges to demonstrate that wetland credit areas bisected by the swales meet the performance standard. Was the option of diffuse flow through the buffer evaluated as at any of the drain tile outlets, please explain? Also, please confirm that the drain tile outlets and swales will be monitored for stability annually throughout the monitoring period.
The design plans submitted with the mitigation plan show proposed Swale A and 3 proposed Drain Tile Outlets (DTO) (See sheets W1 and D3). During construction excavation 3 additional existing drain tiles were found requiring 3 additional DTOs to be installed. These additional

exiting drain tiles were not visible in the stream bank and were therefore not observed until construction. All swales associated with DTOs were constructed per the detail on sheet D3: Bottom Width = 4’ / Bank Slopes = 3:1 / Max Channel Slope = 0.3%

RES understands the expressed concerns but determined that additional swales were necessary to ensure that the adjacent farming practices could continue unabated. During design, RES determined maintaining the groundwater level below surrounding agricultural fields required drain tile outlets below the existing ground elevation, therefore swales would need to be used to convey this flow to the stream. Because the swales were required diffuse flow could not be achieved, however, the swales were designed to fall within the NCDEQ Treatment Swale requirements, are live staked, and convey groundwater not runoff so they are not anticipated to supply significant nutrient or sediment loading to the system. RES can confirm drain tile outlets and swales will be monitored for stability annually. These swales were designed with low flow velocities, have been matted, seeded, and live staked to help ensure long-term stability.

7. Lastly, in looking at the cross-sections for the headwater valley restoration on KJ1-A, do you anticipate that the pilot channel that was constructed will function more as a single-thread channel rather than a headwater system?
RES did not design a low flow (pilot) channel through the HWV reach and expects the reach to develop into a headwater system.

8. Since a foot of inundation (vs. designed 6-inch depressions) can affect tree establishment and growth, DWR requests that a random veg plot capture representative depression(s) within the wetland credit area throughout monitoring.
In MY1, random vegetation plot #3 captures a wetland depressional area. RES will continue to monitor vegetation success in wetland depression areas.

9. DWR appreciates the inclusion of the soil and groundwater data. To confirm, GW1 had a zero hydroperiod in 2021 and this wasn't due to a gauge malfunction or relocation? Moving forward in monitoring, it can be helpful to include data on both the consecutive days/% and the cumulative days/% hydroperiod, as well as note the growing season start/end dates and the minimum hydroperiod performance standard value within the wetland hydrology summary table.
GW1 had a zero hydroperiod in 2021, this was not due to gauge malfunction or relocation. The wetland hydrology table has been updated to include consecutive days/%, cumulative days/%, growing season start/end dates, and minimum hydroperiod performance values.

Table of Contents

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. Minor monitoring device location changes were made during as-built installation, however, the quantities remained as proposed in the Mitigation Plan.

1.7 Year 1 Monitoring Performance (MY1)

The Cowford Year 1 monitoring activities were performed in November 2022. All Year 1 Monitoring data is present below and in the appendices. The Site is on track to meeting vegetation, wetland, and stream interim success criteria.

Vegetation

Monitoring of the nine permanent vegetation plots and five random vegetation plots were completed on November 3rd, 2022. Vegetation data are in **Appendix C**, associated photos are in **Appendix B,** and plot locations are in **Appendix B**. MY1 monitoring data indicates that all plots are exceeding the interim success criteria of 320 planted stems per acre. Planted stem densities ranged from 324 to 931 planted stems per acre with a mean of 659 planted stems per acre across all plots. A total of 10 species were documented within the plots. Volunteer species were noted in one out of nine plots during Year 1 monitoring and are expected to increase in upcoming years. The average stem height in the vegetation plots was 2.0 feet. In April 2022, an additional 45 three-gallon trees (Tag alder, Tulip poplar, Sycamore, and Elm) were planted along the northern easement edge above KJ1-C. Visual assessment of vegetation outside of the monitoring plots indicates that the herbaceous vegetation is becoming well established throughout the project. Chinese privet was treated in an area near VP 9 before As-built in November, 2021. No additional invasives were present during MY1 site visits.

Stream Geomorphology

Cross section geomorphology data collection for MY1 was collected on November 1st, 2022. Summary tables and cross section plots are in **Appendix D**. Overall the baseline cross sections and profile relatively match the proposed design. The MY1 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. The stage recorder on KJ1-C measured two bankfull events with the highest being 0.38 feet above the top of bank. The flow gauge on KJ1-A measured 11 flow events with the longest flow event lasting 55 days. 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. All five groundwater wells failed to meet success of 12-16 percent of the growing season (GW1 0%, GW2 1%, GW3 7%, GW4 4%, and GW5 5%) **Appendix E**. It is important to note that GW5 is located outside of the wetland crediting area. Although all five groundwater wells did not meet success, it was noted that due to extensive draining efforts that it may take at least a year for the site to become completely saturated and reach the target hydroperiods. Onslow county has experienced drought conditions for more than 70% of 2022 and rainfall amounts in February and June were below normal limits which could have attributed to lower hydroperiods. Therefore, RES expects the hydroperiods to increase in subsequent years as the wetlands continue to establish.

Headwater Valley

Setup of cross sections 1, 2, and 3 in the headwater valley took place on January 19th, 2022. Overall, the baseline cross sections and profile relatively match the proposed design. The flow gauge located in the headwater valley measured 55 consecutive flow days. The livestakes are becoming established within the channel and will provide opportunities for flow paths to develop in subsequent years. Additional headwater valley channel performance criteria are listed in **Appendix D**. Digital images can be found in **Appendix B**. Visual assessments and updated images will be documented in years to follow as indicators are established.

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

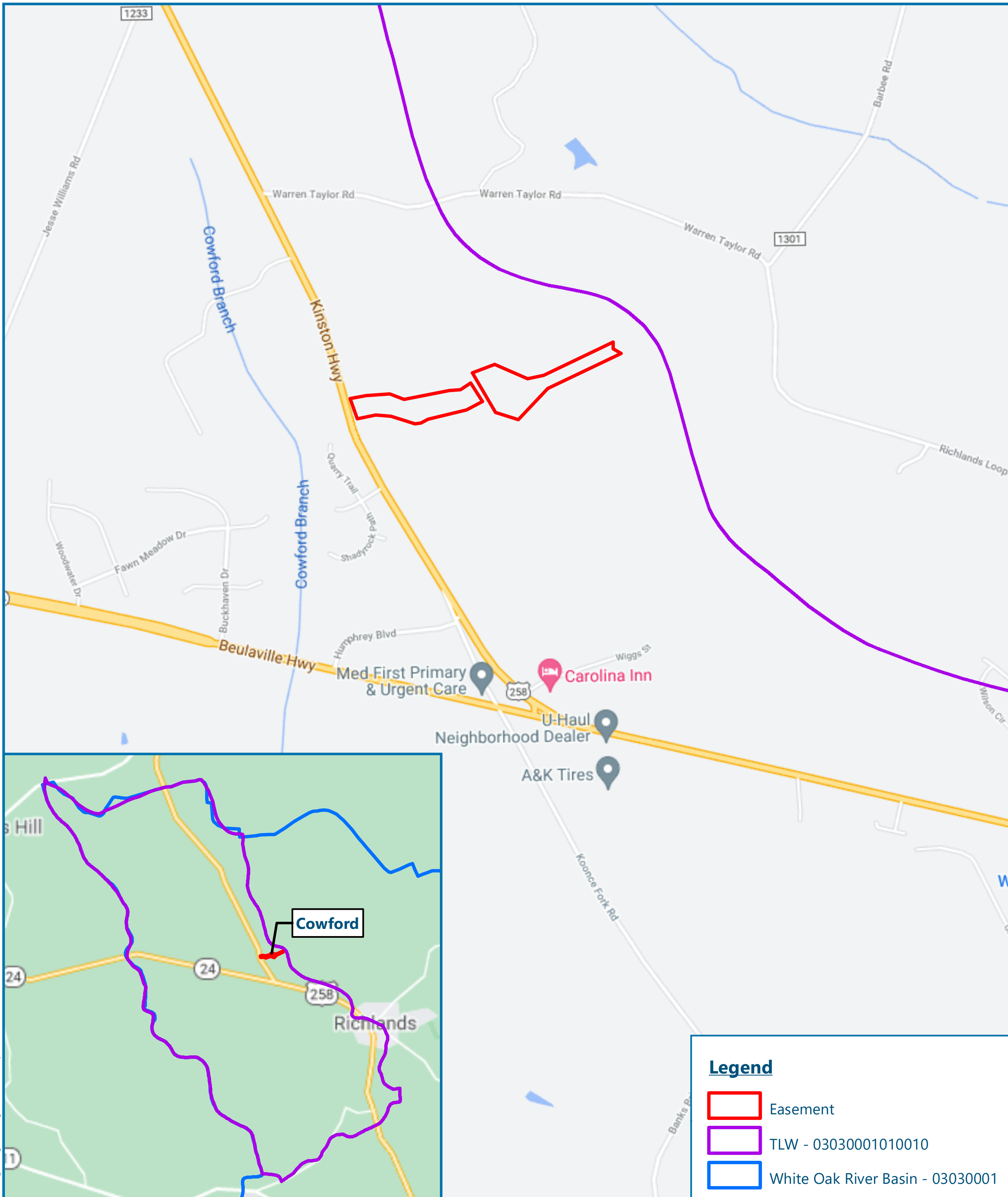
Elapsed Time Since grading complete: **16 months**
Elapsed Time Since planting complete: **8 months**
Number of reporting Years[1]: **1**

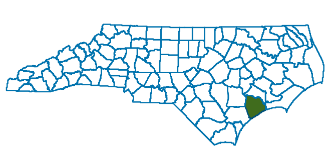
Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	NA	26-Mar-21
Final Design – Construction Plans	NA	03-May-21
Stream Construction	NA	30-Jul-21
Site Planting	NA	08-Mar-22
Invasive Treatment	NA	21-Nov-22
As-built (Year 0 Monitoring – baseline)	Jan/March 2022	Apr-22
Supplemental Planting	NA	Apr-22
Year 1 Monitoring	Nov-22	Dec-22
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		





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

Document Path: R:\Resgis\entgis\Projects\100900_Cowford\MXD\6_Monitoring\MY0 2021\Figure 1 - Site Location Map - Cowford.mxd

Appendix B

Visual Assessment Data


KJ1-A
KJ1-B
KJ1-C
Supplemental Planting (4/29/2022)
45 3-gal trees
Treatment Pool
Treatment Pool
FG1
SR1
NC Center for Geographic Information & Analysis
res
N
W
E
S
0
150
300
Feet
Figure 2
Current Conditions
Plan View
MY1 2022
Cowford
Mitigation Project
Onslow County, NC
Date: 12/19/2022
Drawn by: HRG
Lat: 35.671107
Long: -82.669235
LEGEND
Easement - 17.20 Acres
Wetland Re-establishment
Existing Ag Ditch
Engineered Sediment Pack
Drain Tile Outlet
Flow Gauge
Stage Recorder
Wetland Well Hydroperiod
5-12%
<5%
Fixed Plot
Random Veg Plots MY1
MY0 Random Veg Plot
Wetland Depressions
Cross Sections
Photo Point
Stream Restoration
HWV Restoration
Structures
Top of Bank
Vegetation Condition Assessment
Target Community
Present
Marginal
Absent
Invasive Species
Absent
Present
No Fill

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 MY1 Vegetation Monitoring Plot Photos

Vegetation Plot 1 (11/3/2022)

Vegetation Plot 2 (11/3/2022)

Vegetation Plot 3 (11/3/2022)

Vegetation Plot 4 (11/3/2022)


Vegetation Plot 5 (11/3/2022)


Vegetation Plot 6 (11/3/2022)


Vegetation Plot 7 (11/3/2022)


Vegetation Plot 8 (11/3/2022)

Vegetation Plot 9 (11/3/2022)

Cowford MY0 Random Vegetation Monitoring Plot Photo


Random Vegetation Plot 1 (11/3/2022)


Random Vegetation Plot 2 (11/3/2022)


Random Vegetation Plot 3 (11/3/2022)


Random Vegetation Plot 4 (11/3/2022)


Random Vegetation Plot 5 (11/3/2022)

Cowford Monitoring Device Photos MY1 2022

Stage Recorder KJ1-C (11/3/2022)

Flow Gauge KJ1-A (11/3/2022)

Wetland Gauge 1 (11/3/2022)

Wetland Gauge 2 (11/3/2022)


Wetland Gauge 3 (11/3/2022)


Wetland Gauge 4 (11/3/2022)


Wetland Gauge 5 (11/3/2022)

Cowford General Site Photos MY1 2022

Photo Point 1: Culvert at the bottom of KJ1-B (11/3/2022)

Photo Point 2: Culvert at the top of KJ1-C (11/3/2022)

Photo Point 3: Treatment pool at edge of Wetland (11/3/2022)

Photo Point 4: Culvert at Kinston Highway (11/3/2022)


ESP & Treatment Pool (11/3/2022)


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


Headwater Valley (11/3/2022)


Easement marker (11/3/2022)

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

Plot #	Planted Stems/Acre	Volunteer Stems/Acre	Total Stems/Acre	Success Criteria Met?	Average Planted Stem Height (ft)
1	931	0	931	Yes	2.6
2	931	0	931	Yes	2.2
3	688	0	688	Yes	2.4
4	567	0	567	Yes	2.2
5	850	0	850	Yes	1.3
6	647	0	647	Yes	1.7
7	526	0	526	Yes	1.7
8	809	0	809	Yes	1.7
9	607	40	647	Yes	2.3
R1	728	0	0	Yes	2.3
R2	688	0	0	Yes	2
R3	486	0	0	Yes	2.2
R4	445	0	0	Yes	2
R5	324	0	0	Yes	2.3
Project Avg	**659**	**4**	**662**	**Yes**	2.0

Table 9. Stem Count Total and Planted by Plot Species

Cowford			Current Plot Data (MY1 2022)																										
			100095-01-0001			100095-01-0002			100095-01-0003			100095-01-0004			100095-01-0005			100095-01-0006			100095-01-0007			100095-01-0008			100095-01-0009		
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	6	6	6	3	3	3										5	5	5	1	1	1
Cephalanthus occidentalis	common buttonbush	Shrub				5	5	5				2	2	2				1	1	1				2	2	2	1	1	1
Fraxinus pennsylvanica	green ash	Tree	2	2	2							2	2	2							1	1	1	3	3	3	1	1	2
Nyssa biflora	swamp tupelo	Tree	5	5	5	1	1	1	1	1	1				4	4	4	4	4	4	5	5	5	1	1	1	4	4	4
Platanus occidentalis	American sycamore	Tree				2	2	2	2	2	2	1	1	1	5	5	5	2	2	2	4	4	4	1	1	1			
Quercus falcata	southern red oak	Tree	3	3	3	3	3	3	1	1	1				3	3	3	1	1	1	1	1	1	1	1	1			
Quercus lyrata	overcup oak	Tree										5	5	5	5	5	5	3	3	3				2	2	2	1	1	1
Quercus nigra	water oak	Tree	1	1	1																1	1	1	2	2	2	1	1	1
Quercus phellos	willow oak	Tree	2	2	2	4	4	4	6	6	6				4	4	4	2	2	2	1	1	1	3	3	3	1	1	1
Taxodium distichum	bald cypress	Tree				5	5	5	1	1	1	1	1	1				3	3	3							5	5	5
		Stem count	23	23	23	23	23	23	17	17	17	14	14	14	21	21	21	16	16	16	13	13	13	20	20	20	15	15	16
		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	6	6	6	7	7	7	6	6	6	6	6	6	5	5	5	7	7	7	6	6	6	9	9	9	8	8	8
		Stems per ACRE	931	931	931	931	931	931	688	688	688	567	567	567	850	850	850	648	648	648	526	526	526	809	809	809	607	607	648

Cowford			Current Plot Data (MY1 2022)															Annual Means					
			R1			R2			R3			R4			R5			MY1 (2022)			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	PnoLS	P-all	T
Betula nigra	river birch	Tree	6	6	6	6	6	6	3	3	3	3	3	3	3	3	3	49	49	49	47	47	47
Cephalanthus occidentalis	common buttonbush	Shrub	3	3	3	6	6	6										20	20	20	19	19	19
Fraxinus pennsylvanica	green ash	Tree	2	2	2				3	3	3	2	2	2				16	16	17	13	13	13
Nyssa biflora	swamp tupelo	Tree	1	1	1	1	1	1				3	3	3	1	1	1	31	31	31	41	41	41
Platanus occidentalis	American sycamore	Tree							2	2	2							19	19	19	32	32	32
Quercus falcata	southern red oak	Tree																13	13	13	19	19	19
Quercus lyrata	overcup oak	Tree							3	3	3	1	1	1	2	2	2	22	22	22	14	14	14
Quercus nigra	water oak	Tree				1	1	1										6	6	6	13	13	13
Quercus phellos	willow oak	Tree	6	6	6	2	2	2	1	1	1				1	1	1	33	33	33	33	33	33
Taxodium distichum	bald cypress	Tree				1	1	1				2	2	2	1	1	1	19	19	19	28	28	28
		Stem count	18	18	18	17	17	17	12	12	12	11	11	11	8	8	8	228	228	229	259	259	259
		size (ares)	1			1			1			1			1			14			14		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.35			0.35		
		Species count	5	5	5	6	6	6	5	5	5	5	5	5	5	5	5	10	10	10	10	10	10
		Stems per ACRE	728	728	728	688	688	688	486	486	486	445	445	445	324	324	324	659	659	662	749	749	749

Appendix D

Stream Measurement and

Geomorphology Data

Table 10. 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 10. 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 11 - 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]	(Headwater Valley Restoration) No Morpohological Parameters were determined for HWV Reach A							(Headwater Valley Restoration) No Morpohological Parameters were determined for HWV Reach A							(Headwater Valley Restoration) No Morpohological Parameters were determined for HWV Reach A							65.6	65.6						65.8	65.7					
Bankfull Width (ft)[1]																						11.0	11.9						11.3	12.1					
Floodprone Width (ft)[1]																						-	-						49	48.7					
Bankfull Max Depth (ft)[2]																						1.5	1.4						1.2	1.1					
Low Bank Elevation (ft)																						65.6	65.5						65.8	65.6					
Bankfull Cross Sectional Area (ft^2)[2]																						8.6	8.0						7.3	6.3					
Bankfull Entrenchment Ratio[1]																						-	-						4.3	4.0					
Bankfull Bank Height Ratio[1]																						-	-						1.0	0.9					

	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						65.0	64.9						61.0	60.9						60.8	60.8						57.9	57.9					
Bankfull Width (ft)[1]	9.5	9.6						8.2	9.9						11.1	8.4						9.5	8.8						9.9	9.4					
Floodprone Width (ft)[1]	49.3	49.2						-	-						-	-						48.1	46.9						48	46.6					
Bankfull Max Depth (ft)[2]	1.0	1.0						1.5	1.5						1.6	1.4						1.1	0.8						1.0	1.0					
Low Bank Elevation (ft)	65.1	64.9						65.0	65.0						61.0	60.8						60.8	60.7						57.9	57.8					
Bankfull Cross Sectional Area (ft^2)[2]	5.3	4.6						6.4	7.6						6.6	5.6						4.8	3.8						5.3	5.0					
Bankfull Entrenchment Ratio[1]	5.2	5.1						-	-						-	-						5.0	5.3						4.8	5.0					
Bankfull Bank Height Ratio[1]	1.0	0.9						-	-						-	-						1.0	0.9						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	57.9						54.6	54.5						54.7	54.6						48.0	47.9						47.6	47.4					
Bankfull Width (ft)[1]	11.8	10.7						8.6	9.2						10.3	10.0						16.1	14.9						9.1	8.9					
Floodprone Width (ft)[1]	-	-						46.0	45.5						-	-						49.4	49.3						-	-					
Bankfull Max Depth (ft)[2]	1.6	1.6						0.8	0.8						1.9	1.7						1.1	1.2						3.4	3.4					
Low Bank Elevation (ft)	57.9	57.9						54.6	54.5						54.7	54.5						48.0	48.0						47.6	47.5					
Bankfull Cross Sectional Area (ft^2)[2]	8.4	7.9						4.5	4.2						9.3	8.7						7.8	9.1						12.3	13.7					
Bankfull Entrenchment Ratio[1]	-	-						5.3	4.9						-	-						3.1	3.3						-	-					
Bankfull Bank Height Ratio[1]	-	-						1.0	1.0						-	-						1.0	1.0						-	-					

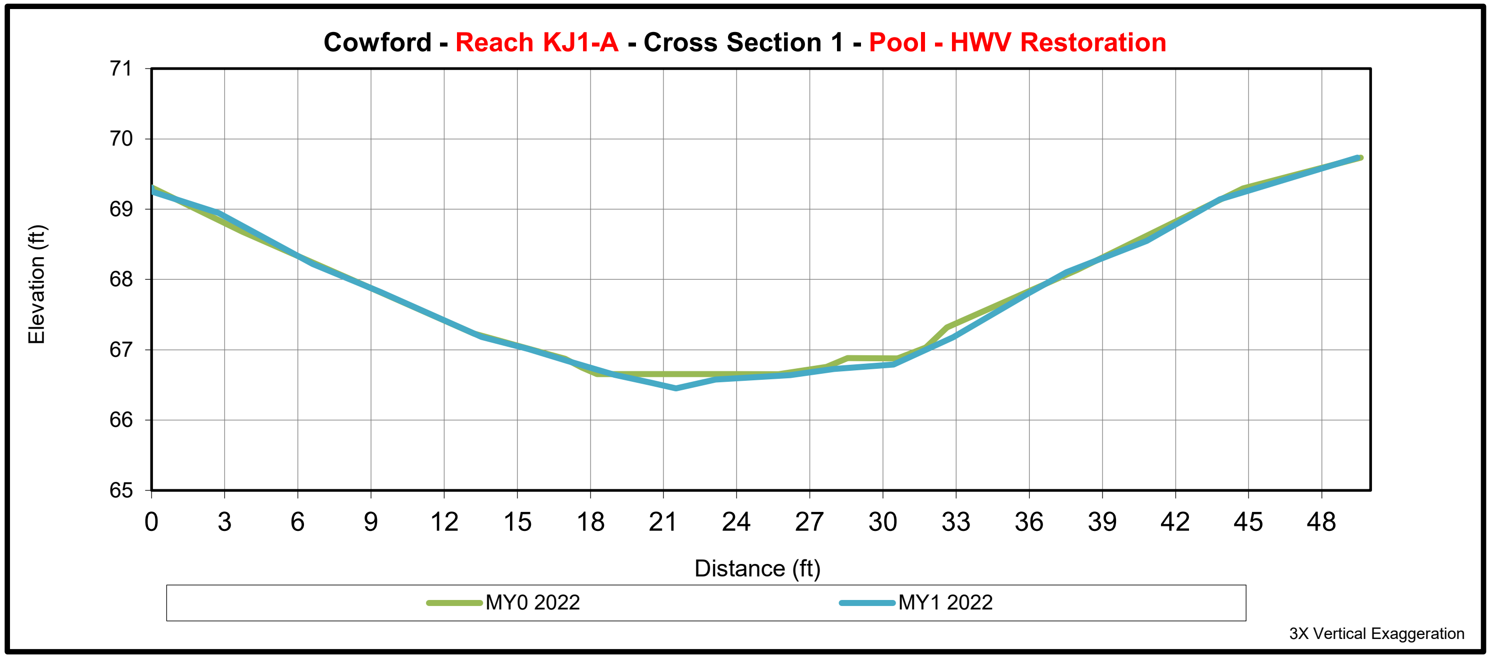
1 - Uses the as-built cross sectional area as the basis for adjusting each subsequent years bankfull elevation

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

Headwater Valley Performance Table							
KJ1-A Channel Evidence	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
Max consecutive days of channel flow	55						
Presence of litter and debris (wracking)	No						
Leaf litter disturbed or washed away	No						
Matted, bent, or absence of vegetation (herbaceous or otherwise)	No						
Sediment depostion and/or scour indicating sediment transport	No						
Water staining due to continual presence of water*	No						
Formation of channel bed and banks*	No						
Sediment sorting within the primary path of flow	No						
Sediment shelving or a natural line impressed on the banks*	No						
Change in plant community (absence or destruction of terrestrial vegetation and/or transition to species adapted for flow or inundation for a long duration, including hydrophytes)*	No						
Development of channel pattern (meander bends and/or channel braiding) at natural topographic breaks, woody debris piles, or plant root systems*	No						
Exposure of woody plant roots within the primary path of flow*	No						
Other:	NA						
**represents indicators that are required in monitoring years 5-7*							

Upstream

Downstream

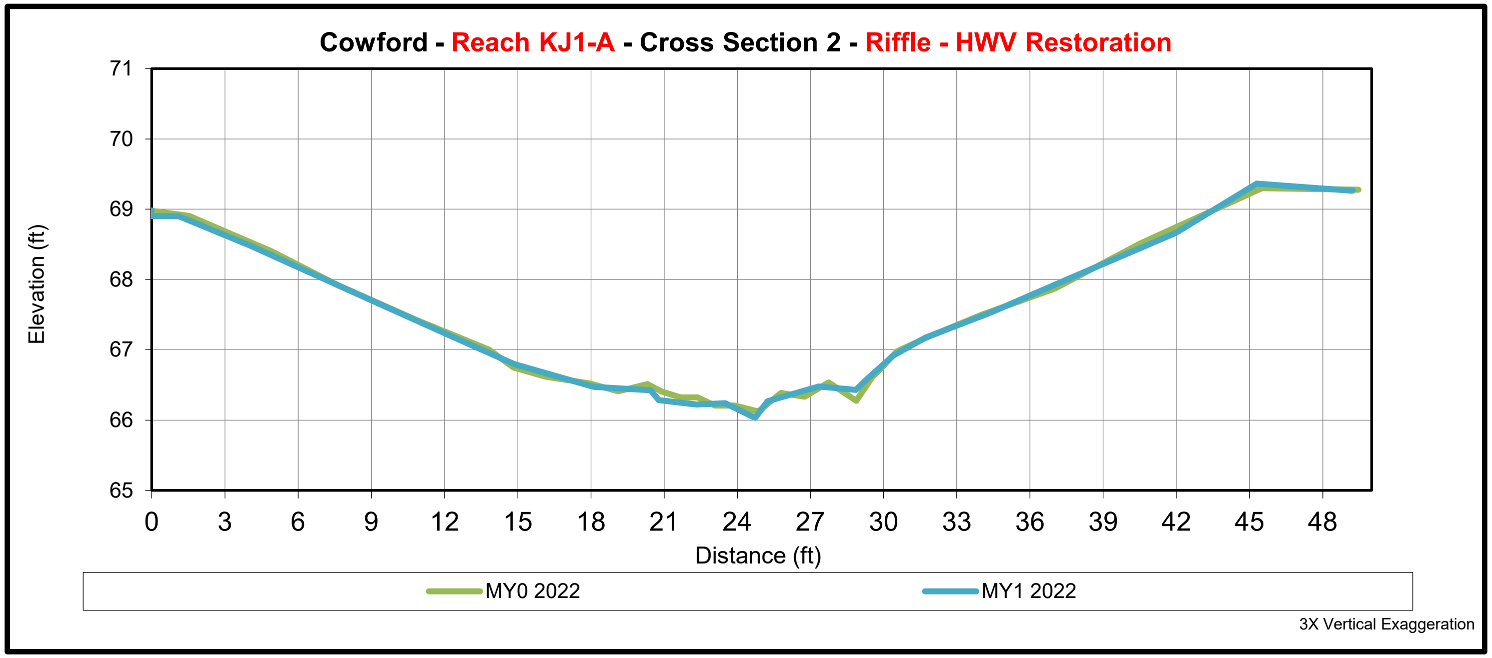


	Cross Section 1 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	(Headwater Valley Restoration) No Morphological Parameters were determined for HWV Reach A						
Bankfull Width (ft)[1]							
Floodprone Width (ft)[1]							
Bankfull Max Depth (ft)[2]							
Low Bank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

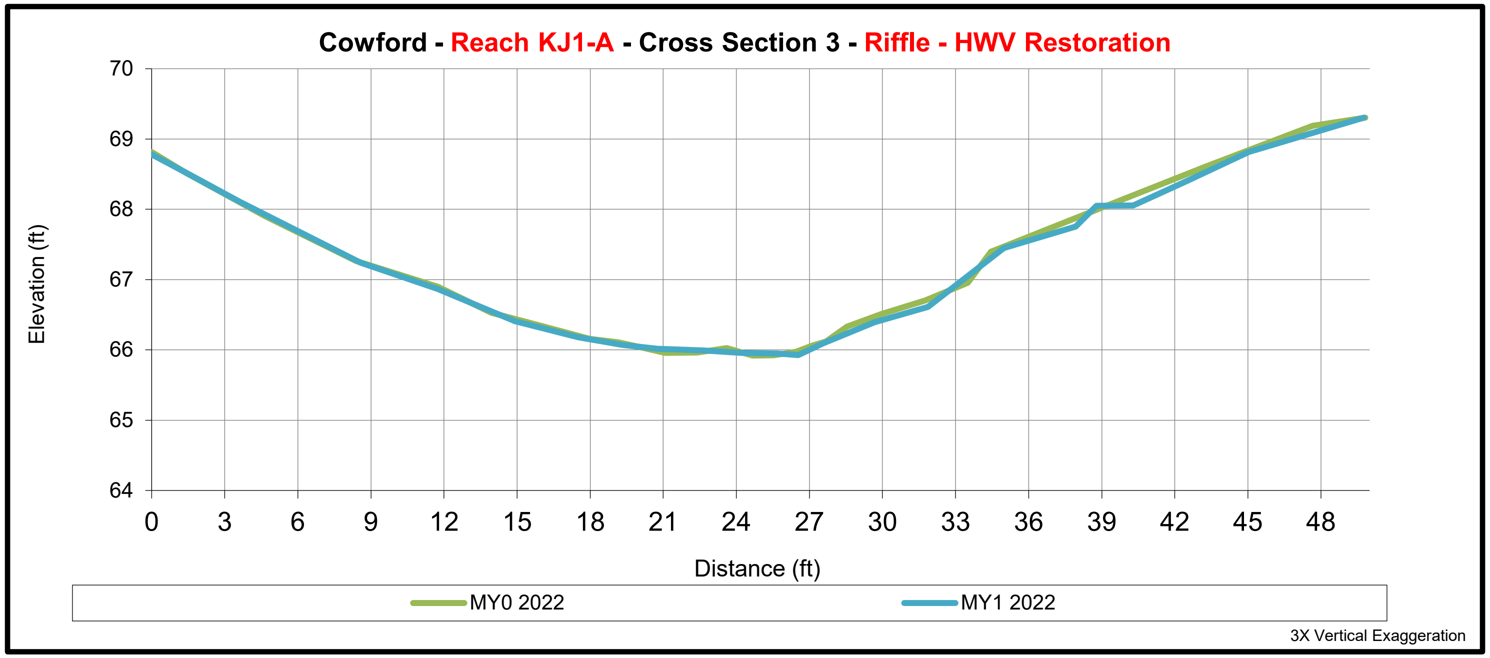


	Cross Section 2 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	(Headwater Valley Restoration) No Morpohological Parameters were determined for HWV Reach A						
Bankfull Width (ft)[1]							
Floodprone Width (ft)[1]							
Bankfull Max Depth (ft)[2]							
Low 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

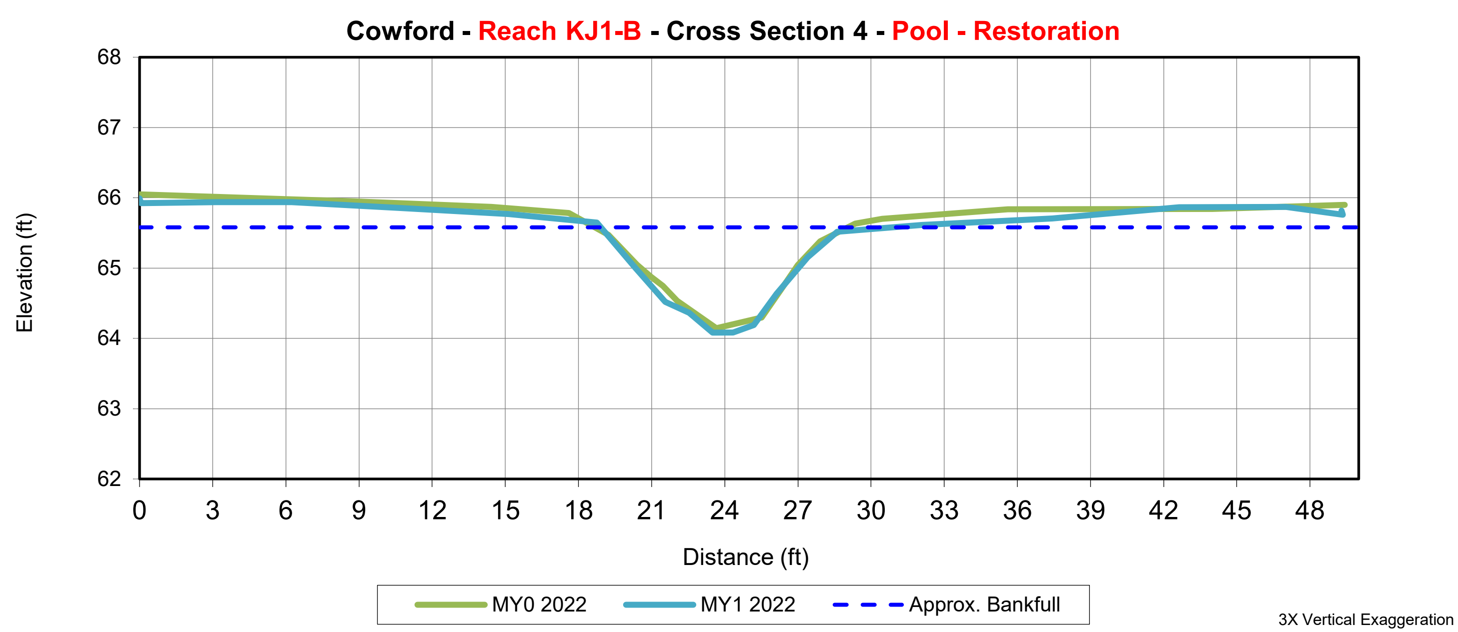


	Cross Section 3 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	(Headwater Valley Restoration) No Morpohological Parameters were determined for HWV Reach A						
Bankfull Width (ft)[1]							
Floodprone Width (ft)[1]							
Bankfull Max Depth (ft)[2]							
Low 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

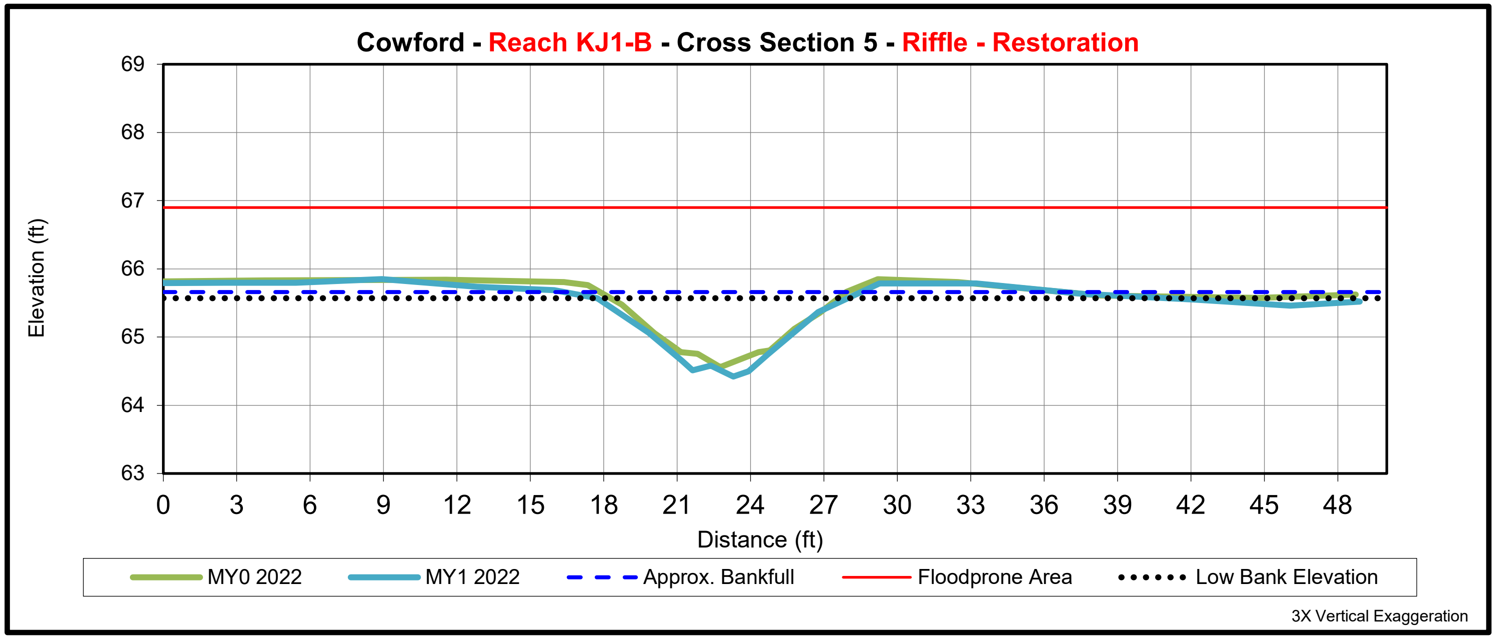


	Cross Section 4 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	65.63	65.6					
Bankfull Width (ft)[1]	11.0	11.9					
Floodprone Width (ft)[1]	-	-					
Bankfull Max Depth (ft)[2]	1.5	1.4					
Low Bank Elevation (ft)	65.63	65.5					
Bankfull Cross Sectional Area (ft^2)[2]	8.6	8.0					
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

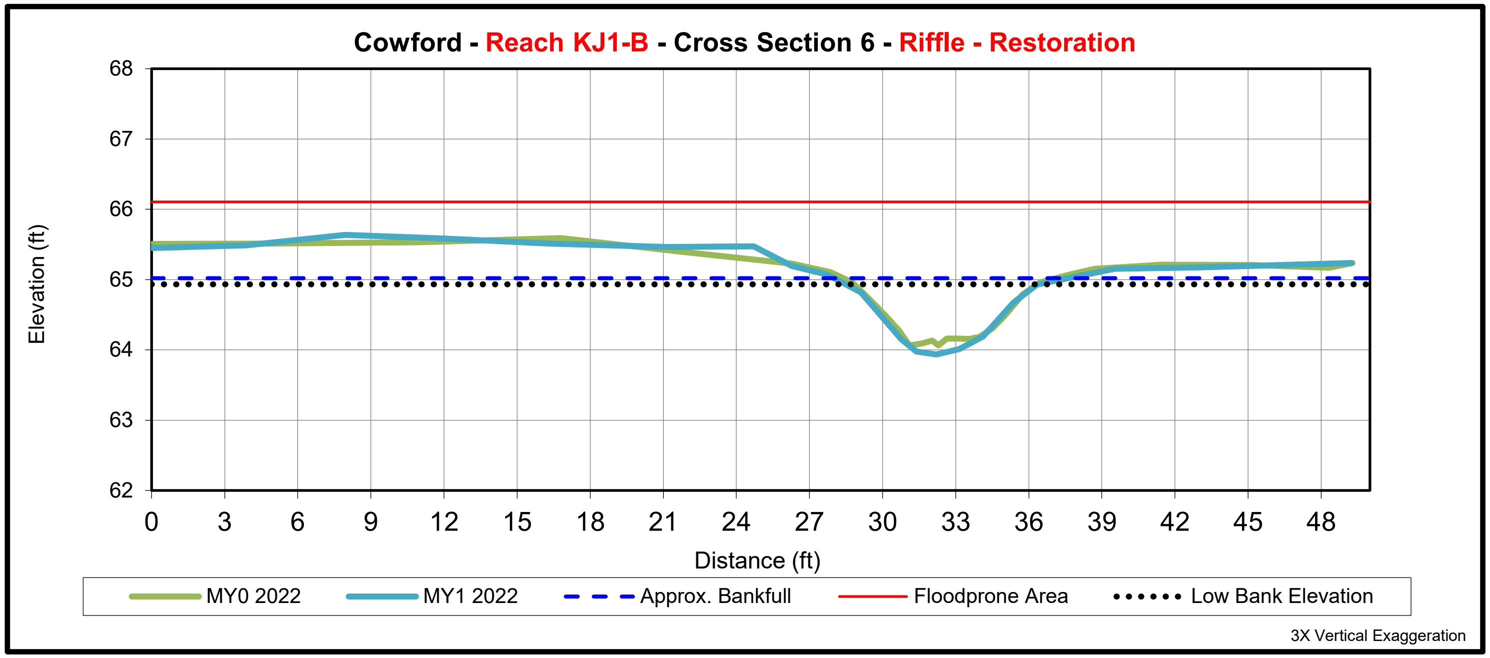


	Cross Section 5 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	65.76	65.7					
Bankfull Width (ft)[1]	11.3	12.1					
Floodprone Width (ft)[1]	49	48.7					
Bankfull Max Depth (ft)[2]	1.2	1.1					
Low Bank Elevation (ft)	65.76	65.6					
Bankfull Cross Sectional Area (ft^2)[2]	7.3	6.3					
Bankfull Entrenchment Ratio[1]	4.3	4.0					
Bankfull Bank Height Ratio[1]	1.0	0.9					

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



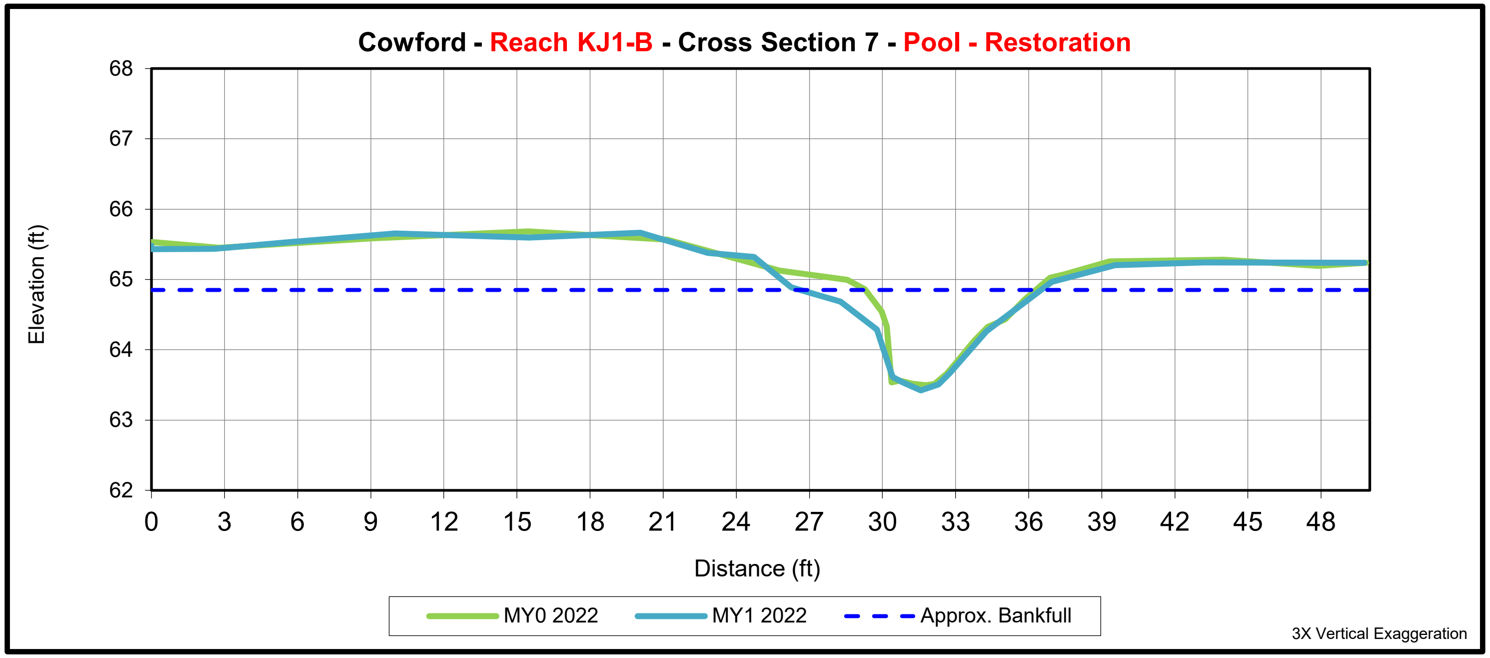
	Cross Section 6 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	65.06	65.0					
Bankfull Width (ft)[1]	9.5	9.6					
Floodprone Width (ft)[1]	49.3	49.2					
Bankfull Max Depth (ft)[2]	1.0	1.0					
Low Bank Elevation (ft)	65.06	64.9					
Bankfull Cross Sectional Area (ft^2)[2]	5.3	4.6					
Bankfull Entrenchment Ratio[1]	5.2	5.1					
Bankfull Bank Height Ratio[1]	1.0	0.9					

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

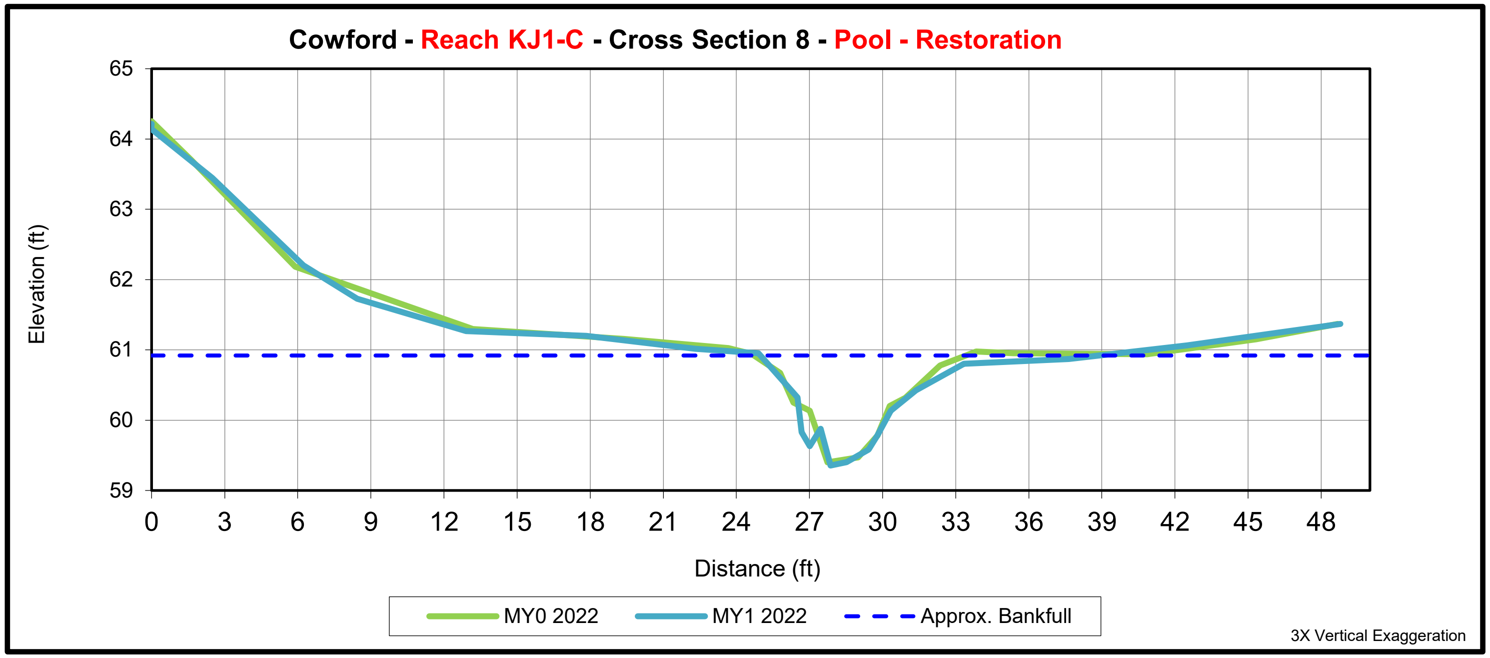


	Cross Section 7 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	64.99	64.9					
Bankfull Width (ft)[1]	8.2	9.9					
Floodprone Width (ft)[1]	-	-					
Bankfull Max Depth (ft)[2]	1.5	1.5					
Low Bank Elevation (ft)	64.99	65.0					
Bankfull Cross Sectional Area (ft^2)[2]	6.4	7.6					
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

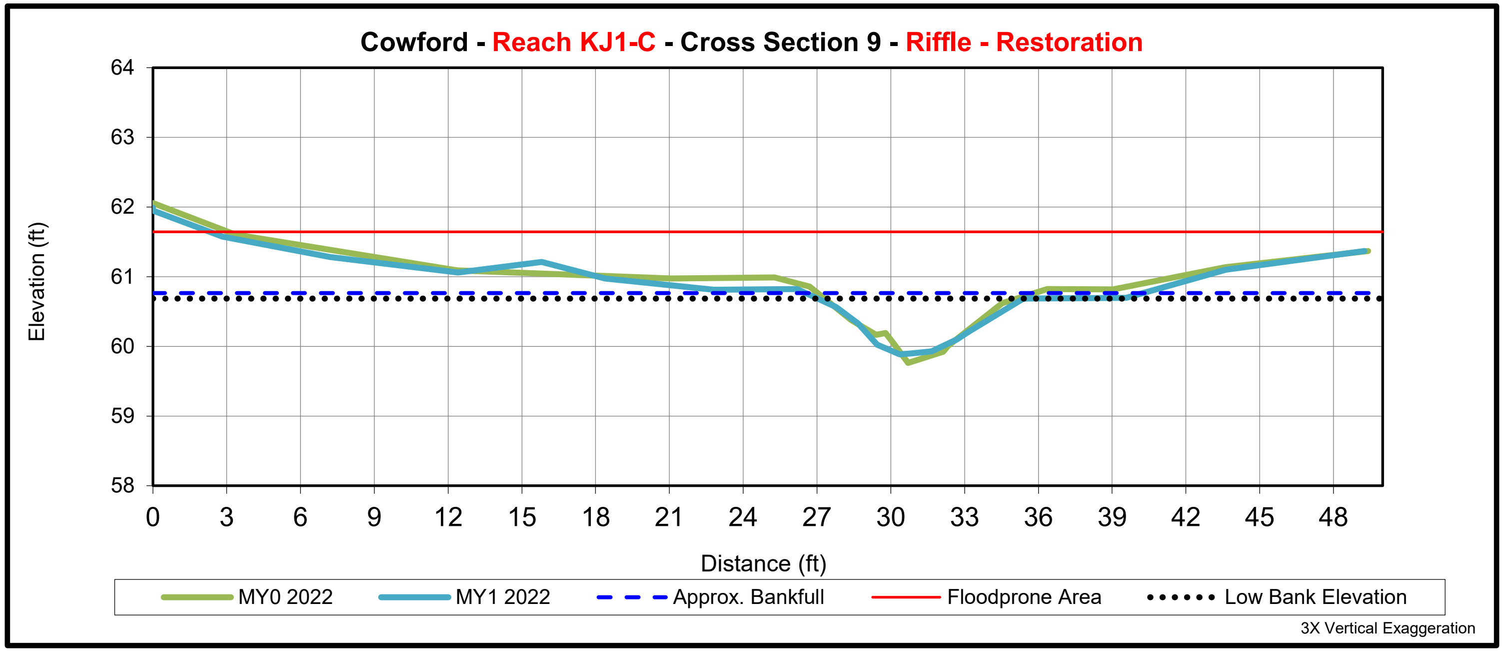


	Cross Section 8 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	60.97	60.9					
Bankfull Width (ft)[1]	11.1	8.4					
Floodprone Width (ft)[1]	-	-					
Bankfull Max Depth (ft)[2]	1.6	1.4					
Low Bank Elevation (ft)	60.97	60.8					
Bankfull Cross Sectional Area (ft^2)[2]	6.6	5.6					
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

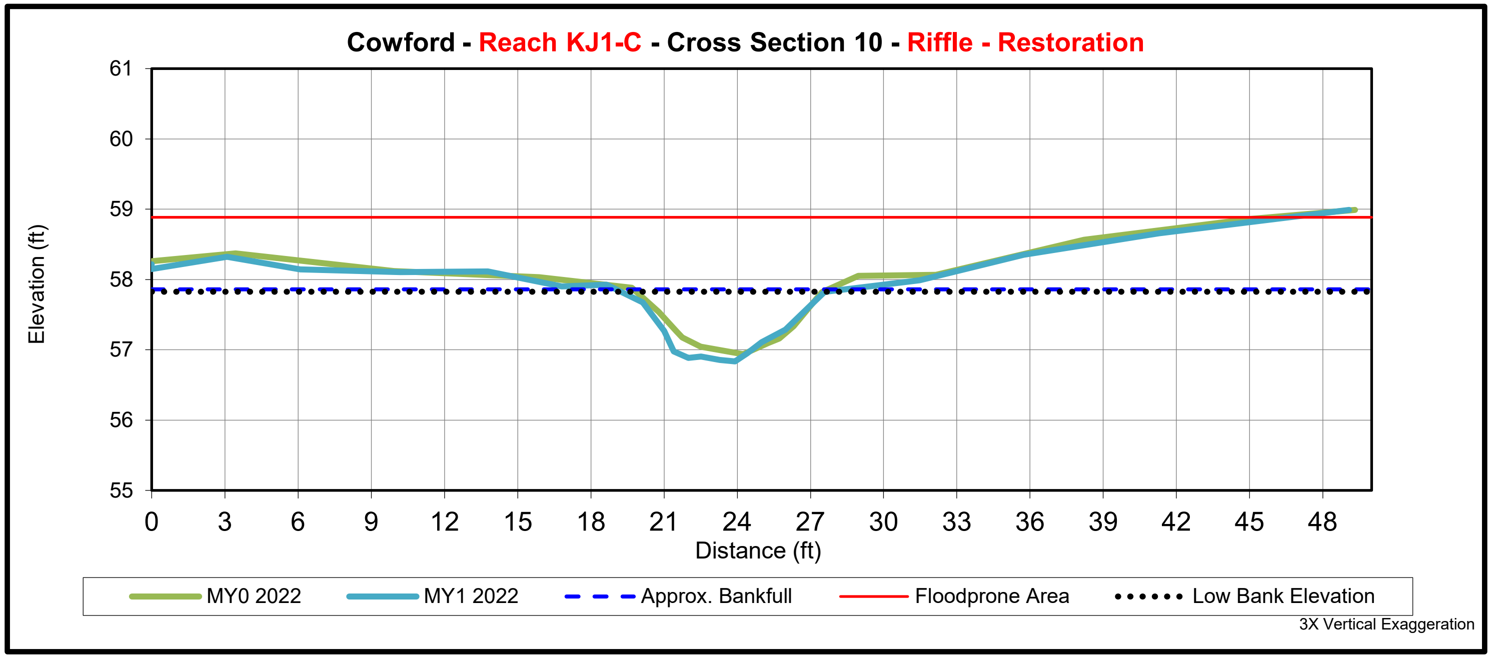


	Cross Section 9 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	60.82	60.8					
Bankfull Width (ft)[1]	9.5	8.8					
Floodprone Width (ft)[1]	48.1	46.9					
Bankfull Max Depth (ft)[2]	1.1	0.8					
Low Bank Elevation (ft)	60.82	60.7					
Bankfull Cross Sectional Area (ft^2)[2]	4.8	3.8					
Bankfull Entrenchment Ratio[1]	5.0	5.3					
Bankfull Bank Height Ratio[1]	1.0	0.9					

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

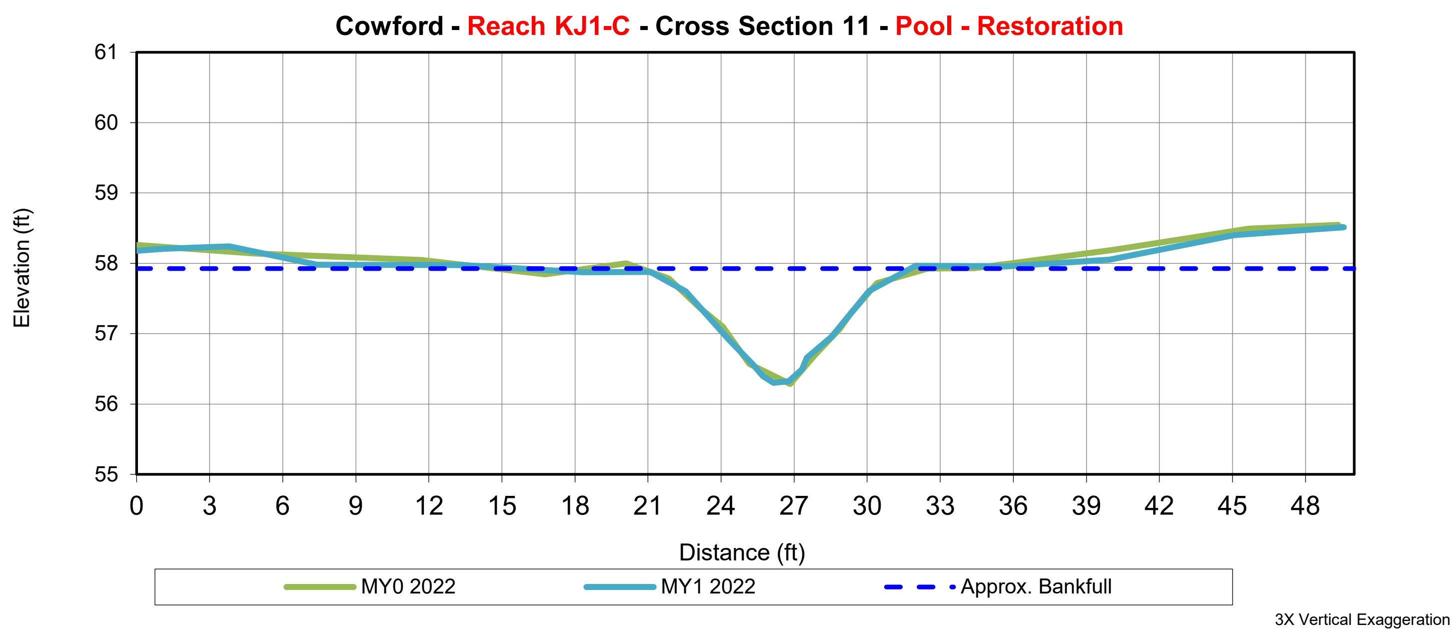


	Cross Section 10 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	57.93	57.9					
Bankfull Width (ft)[1]	9.9	9.4					
Floodprone Width (ft)[1]	48	46.6					
Bankfull Max Depth (ft)[2]	1.0	1.0					
Low Bank Elevation (ft)	57.93	57.8					
Bankfull Cross Sectional Area (ft^2)[2]	5.3	5.0					
Bankfull Entrenchment Ratio[1]	4.8	5.0					
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

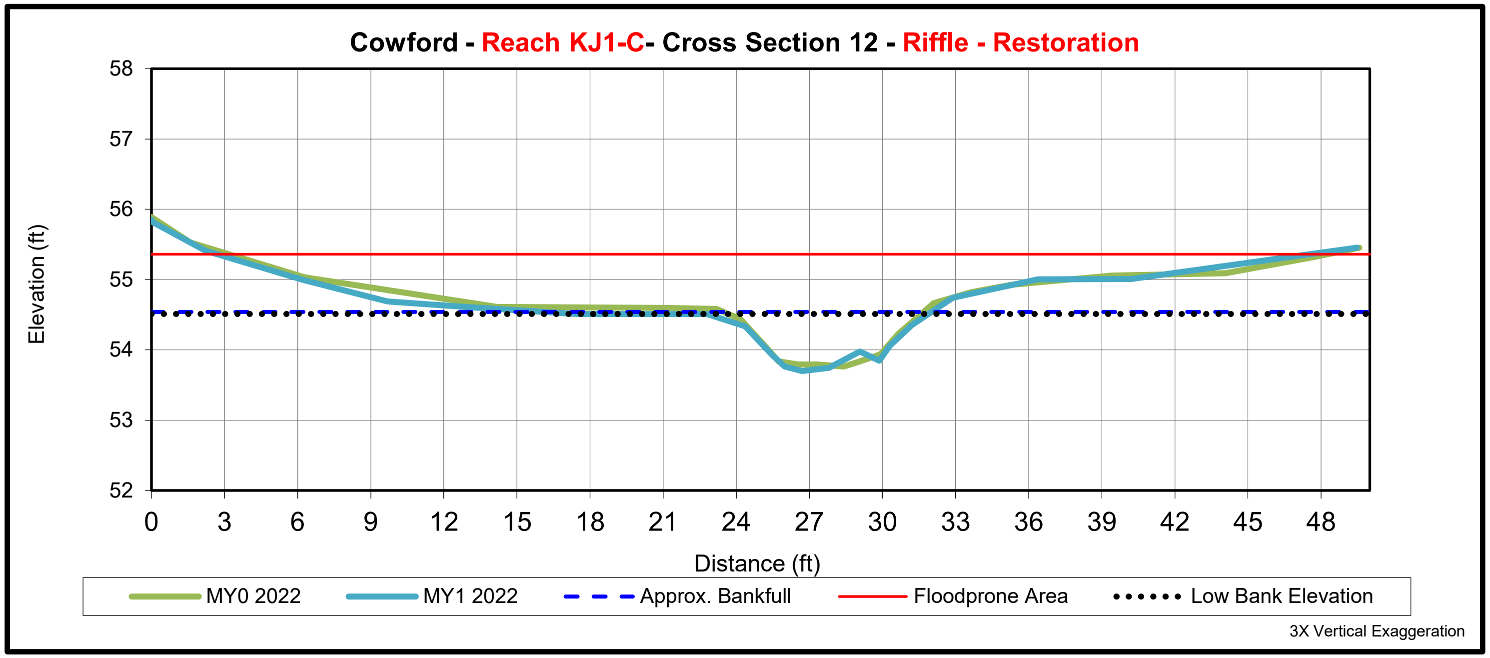


	Cross Section 11 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	57.92	57.9					
Bankfull Width (ft)[1]	11.8	10.7					
Floodprone Width (ft)[1]	-	-					
Bankfull Max Depth (ft)[2]	1.6	1.6					
Low Bank Elevation (ft)	57.92	57.9					
Bankfull Cross Sectional Area (ft^2)[2]	8.4	7.9					
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

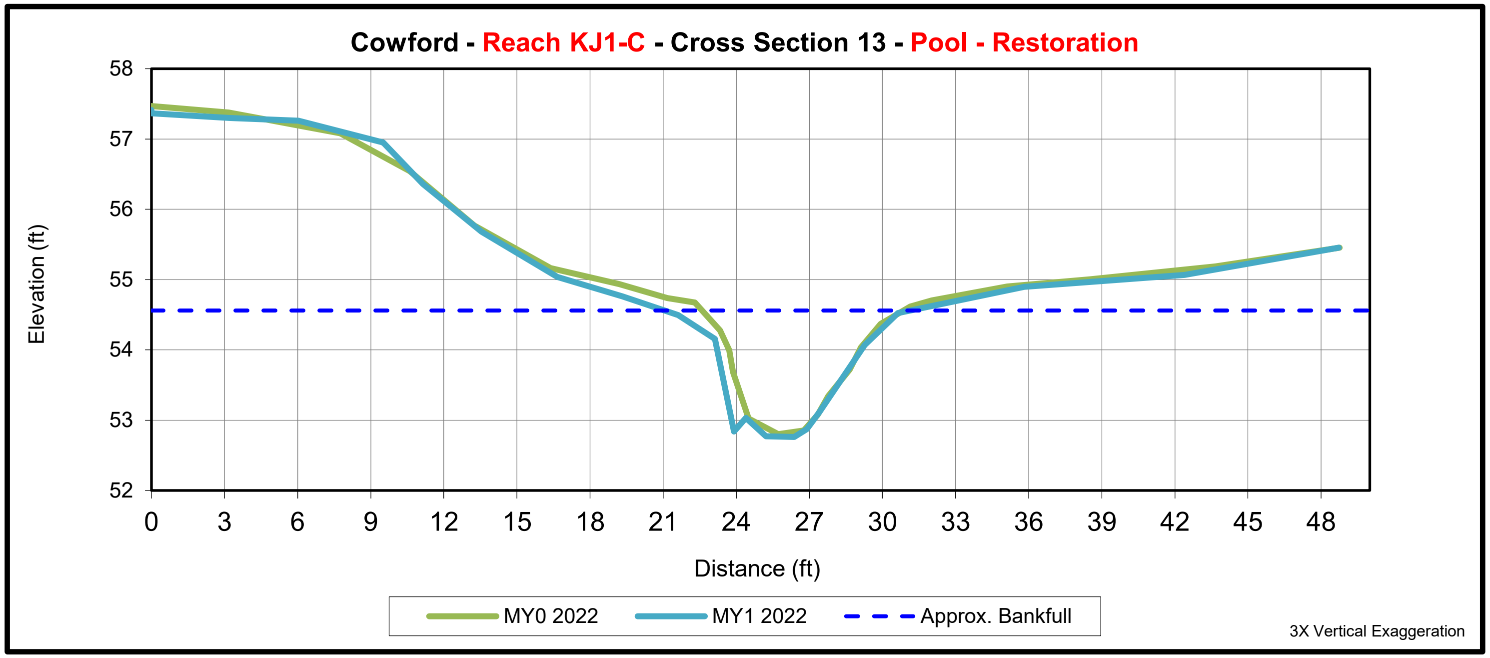


	Cross Section 12 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	54.58	54.5					
Bankfull Width (ft)[1]	8.6	9.2					
Floodprone Width (ft)[1]	46.0	45.5					
Bankfull Max Depth (ft)[2]	0.8	0.8					
Low Bank Elevation (ft)	54.58	54.5					
Bankfull Cross Sectional Area (ft^2)[2]	4.5	4.2					
Bankfull Entrenchment Ratio[1]	5.3	4.9					
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

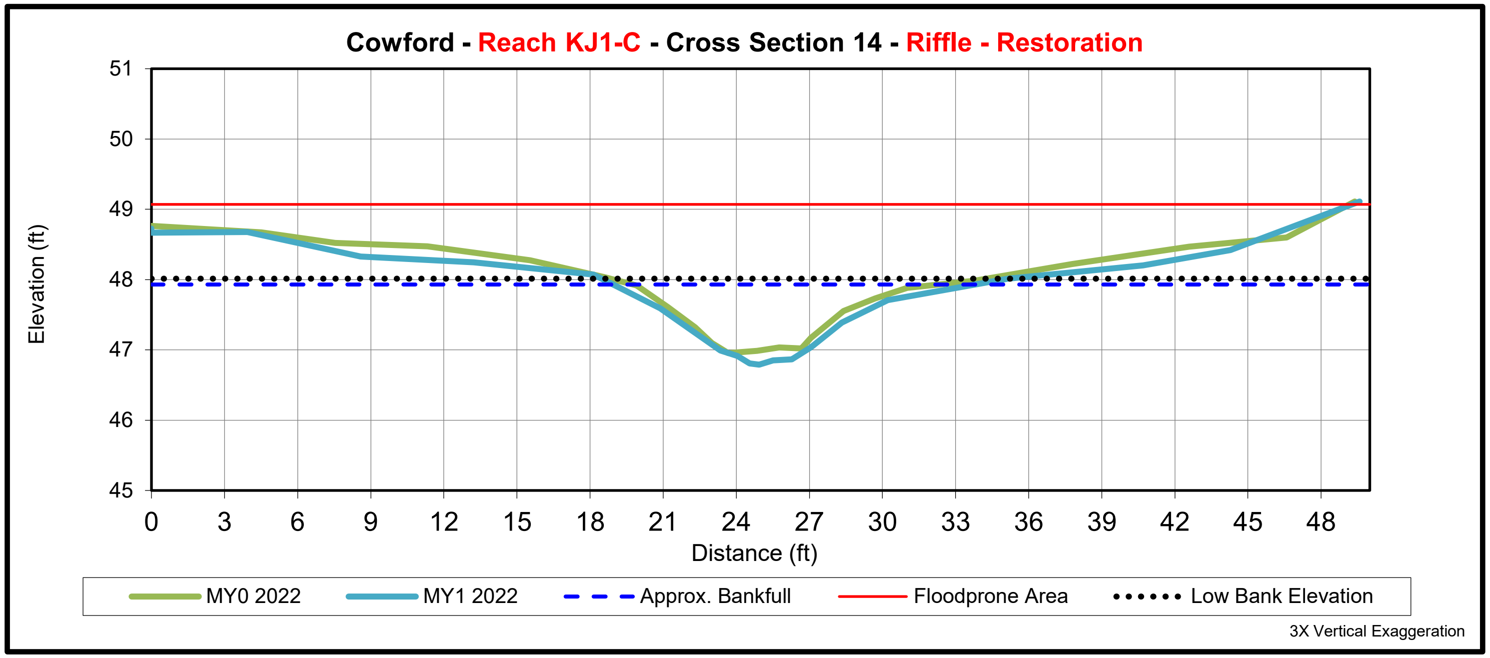


	Cross Section 13 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	54.70	54.6					
Bankfull Width (ft)[1]	10.3	10.0					
Floodprone Width (ft)[1]	-	-					
Bankfull Max Depth (ft)[2]	1.9	1.7					
Low Bank Elevation (ft)	54.70	54.5					
Bankfull Cross Sectional Area (ft^2)[2]	9.3	8.7					
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

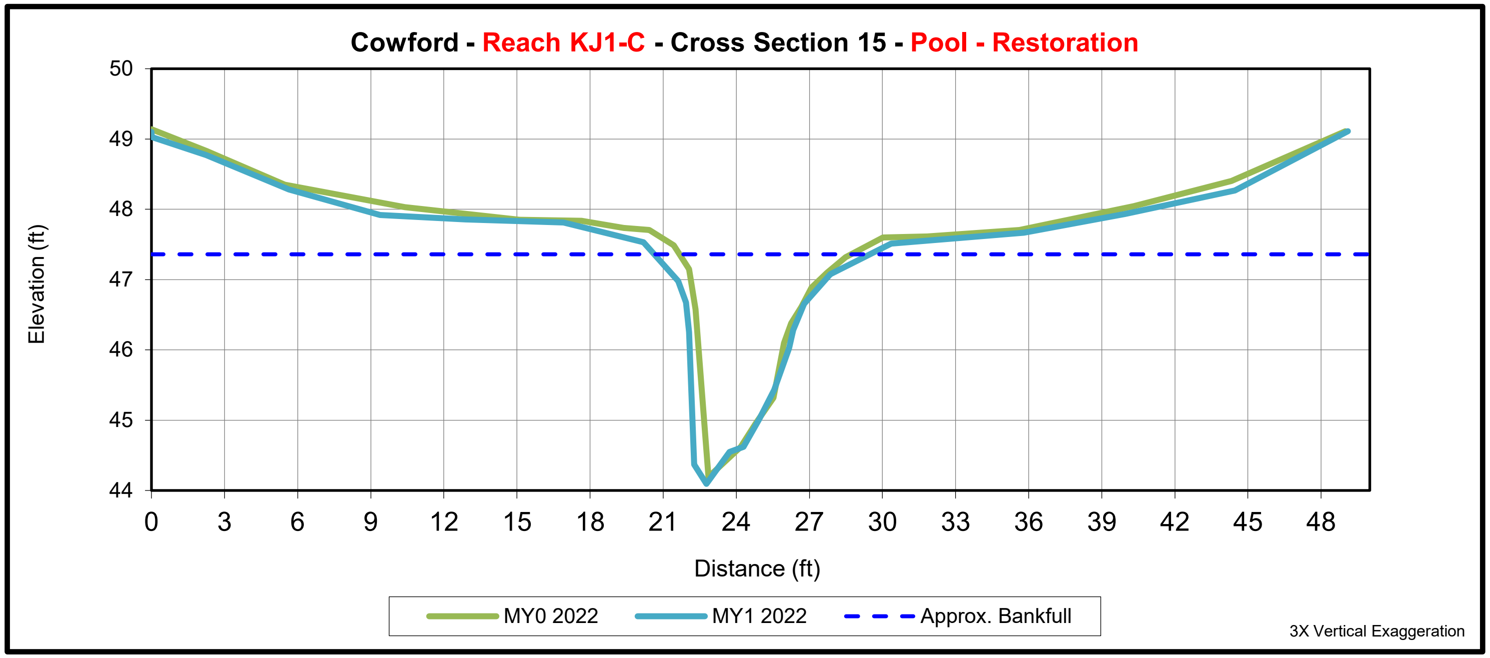


	Cross Section 14 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	48.03	47.9					
Bankfull Width (ft)[1]	16.1	14.9					
Floodprone Width (ft)[1]	49.4	49.3					
Bankfull Max Depth (ft)[2]	1.1	1.2					
Low Bank Elevation (ft)	48.03	48.0					
Bankfull Cross Sectional Area (ft^2)[2]	7.8	9.1					
Bankfull Entrenchment Ratio[1]	3.1	3.3					
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 15 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	47.59	47.4					
Bankfull Width (ft)[1]	9.1	8.9					
Floodprone Width (ft)[1]	-	-					
Bankfull Max Depth (ft)[2]	3.4	3.4					
Low Bank Elevation (ft)	47.59	47.5					
Bankfull Cross Sectional Area (ft^2)[2]	12.3	13.7					
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

Hydrology

Data

Table 12. Rainfall Summary MY1 2022

Month	Average	Normal Limits		Richland Station Precipitation*
		30 Percent	70 Percent	
January	3.70	2.78	4.57	4.55
February	3.50	2.32	4.20	0.93
March	3.76	2.68	4.43	2.85
April	3.00	1.69	3.77	4.91
May	4.11	2.51	4.85	3.70
June	5.31	3.51	6.38	3.50
July	6.05	4.40	7.46	4.75
August	7.23	3.66	8.95	4.40
September	7.02	3.91	8.39	5.02
October	4.11	2.24	4.97	4.27
November	3.68	1.96	4.41	-
December	3.66	2.63	4.27	-
Total Annual**		34.29	66.65	38.88

Above Normal Limits	Below Normal Limits

*Rainfall data was acquired from Richland Station which is approximately 4 miles from the Site.

**Normal Limits were determined from WETS Station New River MCAF, NC. Approximately 20 miles from the Site

Table 13. Documentation of Geomorphically Significant Flow Events

Year	Number of Bankfull Events	Height Above Bankfull (ft)	Date of Maximum Bankfull Event	
Stage Recorder KJ1-C				
MY1	2	0.38	4/5/2022	
Year	**Number of Flow Events**	**Maximum Consecutive Flow Days**	**Maximum Cummlative Flow Days**	**Maximum Consecutive Date Range**
Flow Gauge KJ1-A				
MY1	11	55	160	3/9/2022-5/3/2022

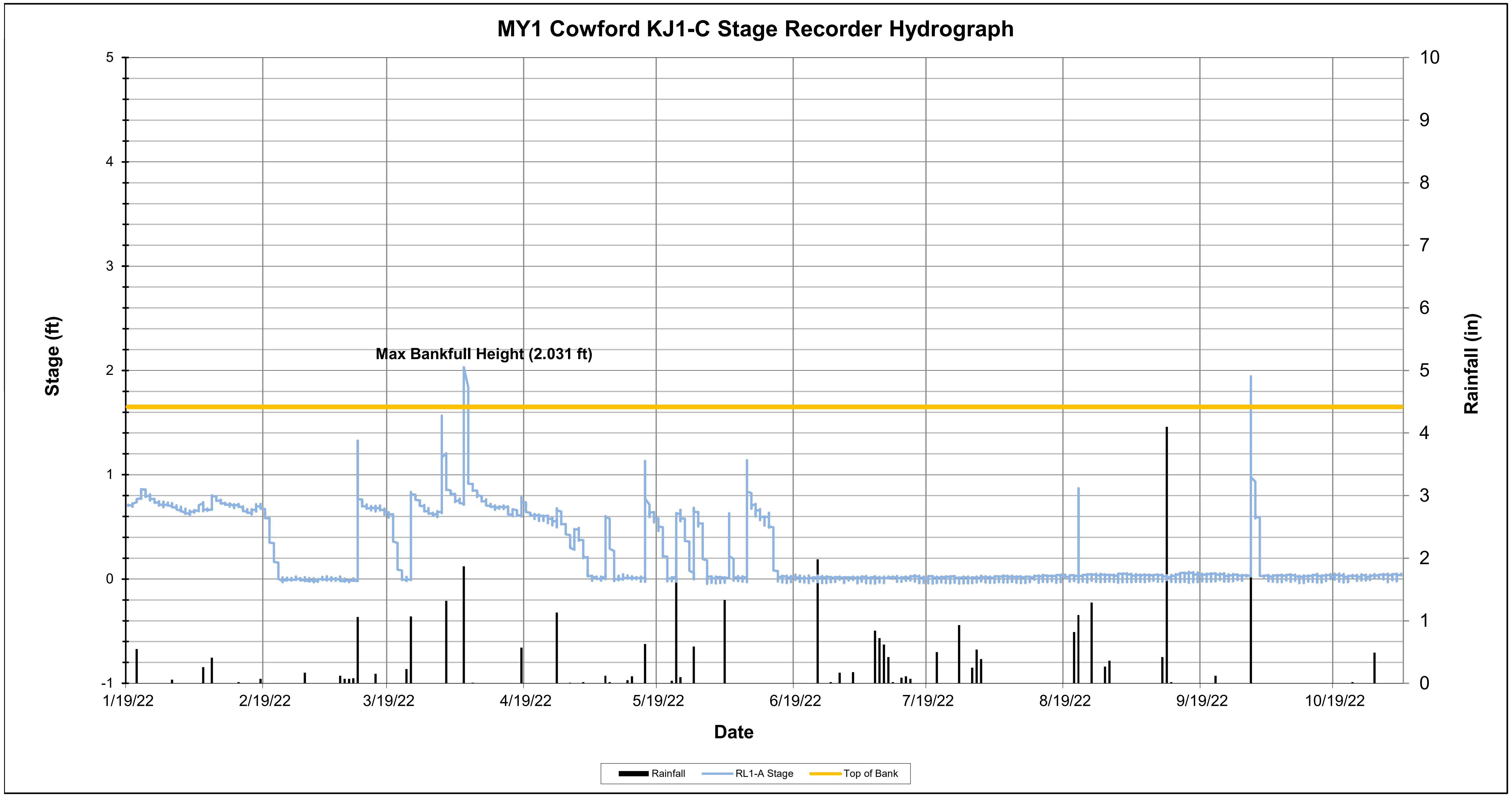
Table 14. 2022 Max Hydroperiod

2022 Max Hydroperiod (Growing Season 10-Mar through 2-Dec, 267 days)					
Well ID	Consecutive		Cumulative		Occurrences
	Days	Hydroperiod (%)	Days	Hydroperiod (%)	
GW1	1	0	2.0	1	4
GW2	2	1	6	2	4
GW3	19	7	34.5	13	10
GW4	12	4	23	9	6
GW5	13	5	20.5	8	4

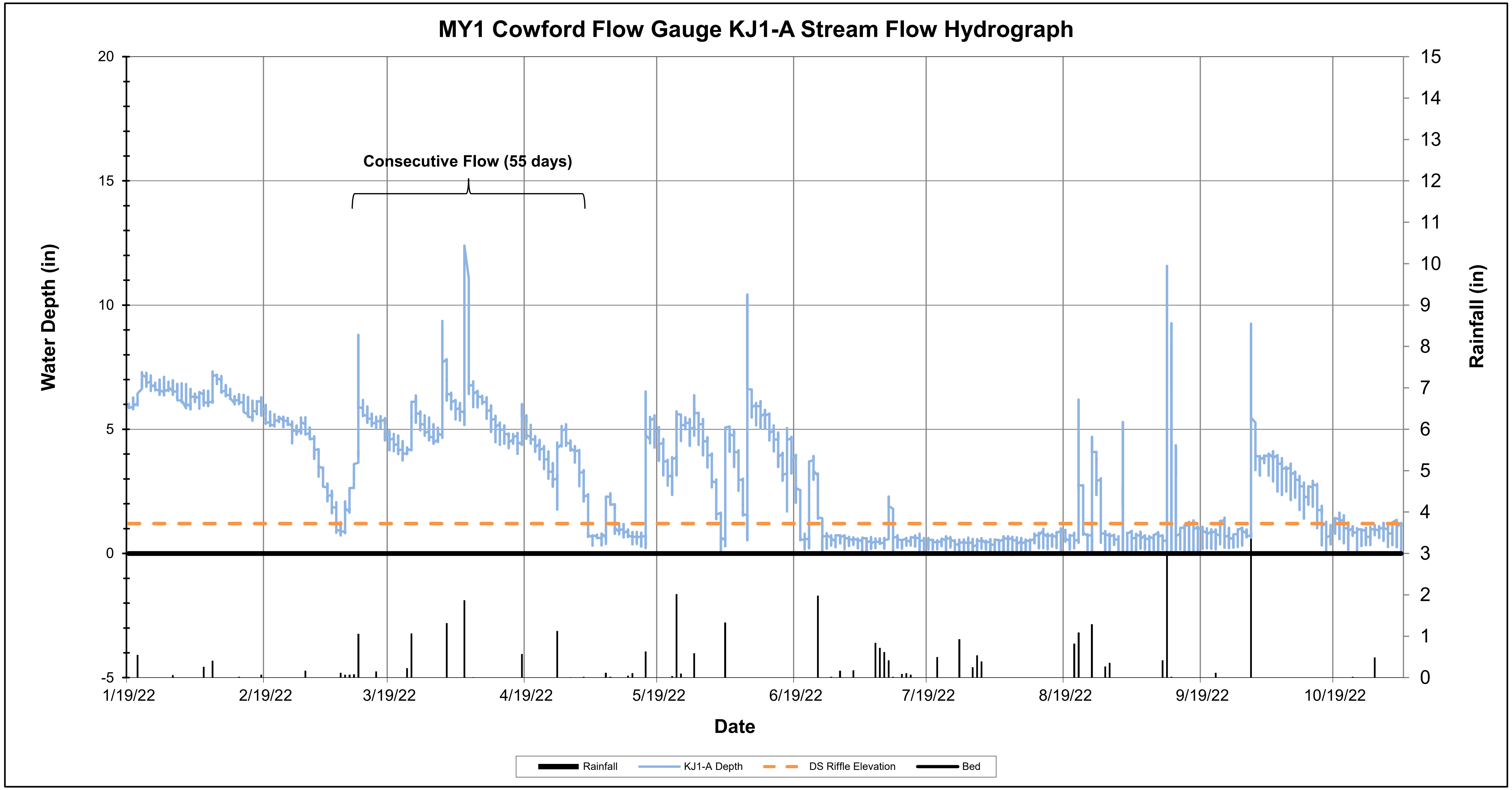
<5%	5-12%	>12%

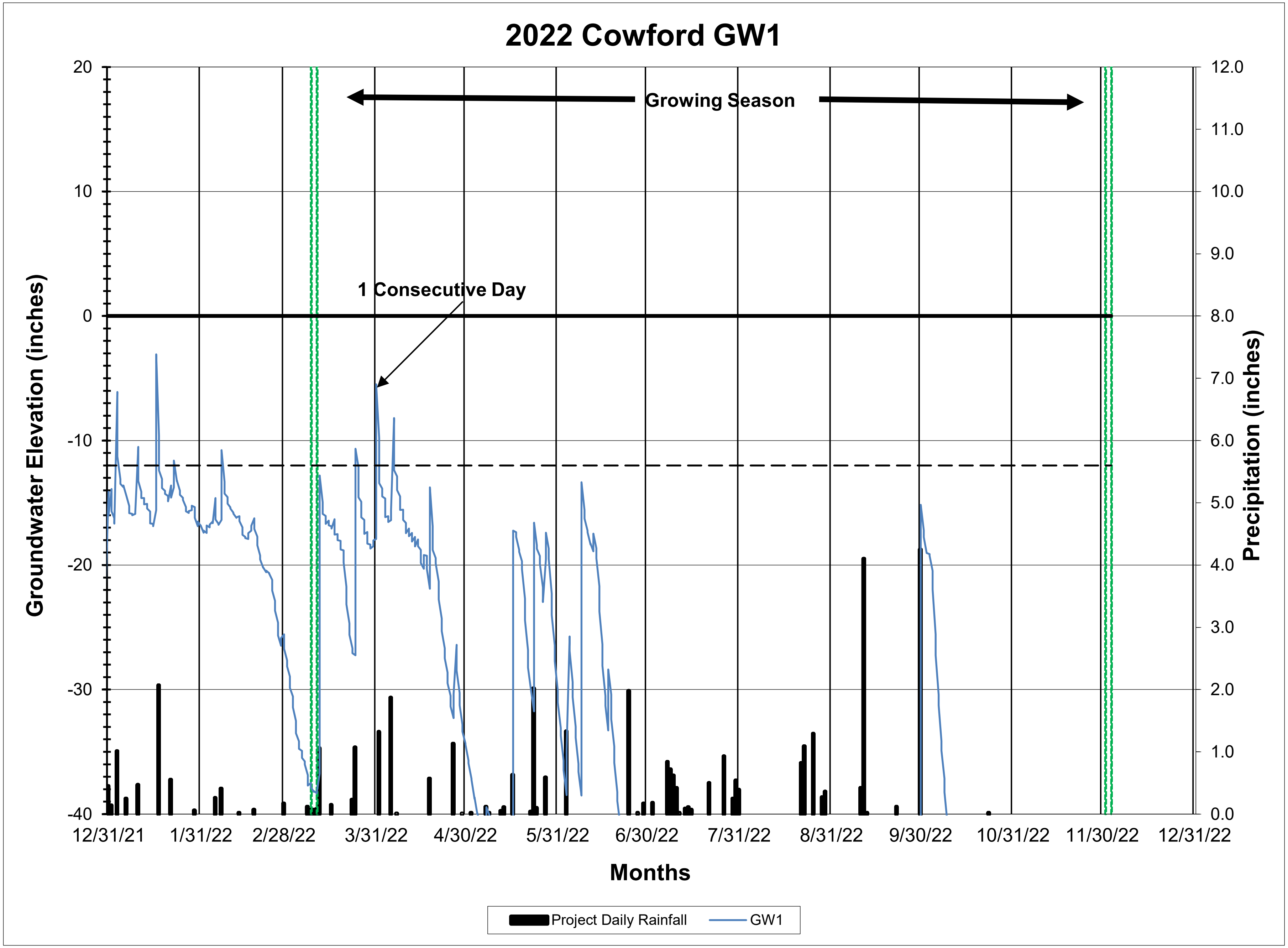
Table 15. Summary of Groundwater Monitoring Results

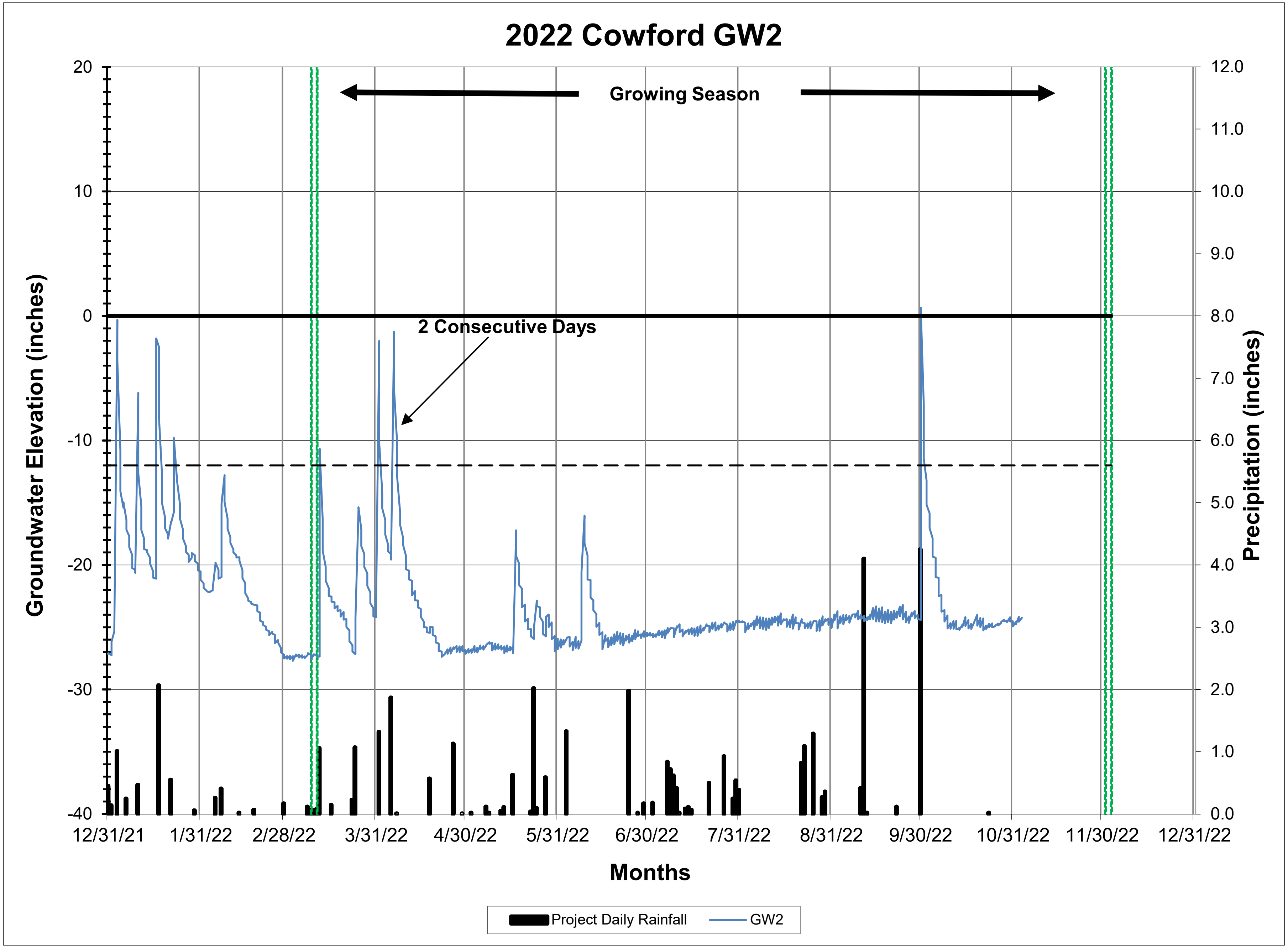
Summary of Groundwater Monitoring Results Cowford										
Well ID	Wetland ID	Hydroperiod (%)								
		Pre Con (2020)	Pre Con (2021)	Year 1 (2022)	Year 2 (2023)	Year 3 (2024)	Year 4 (2025)	Year 5 (2026)	Year 6 (2027)	Year 7 (2028)
GW1	WA	1.0	0.0	0.0						
GW2	WA			1.0						
GW3	WA			7.0						
GW4	WA			4.0						
GW5	WA			5.0						



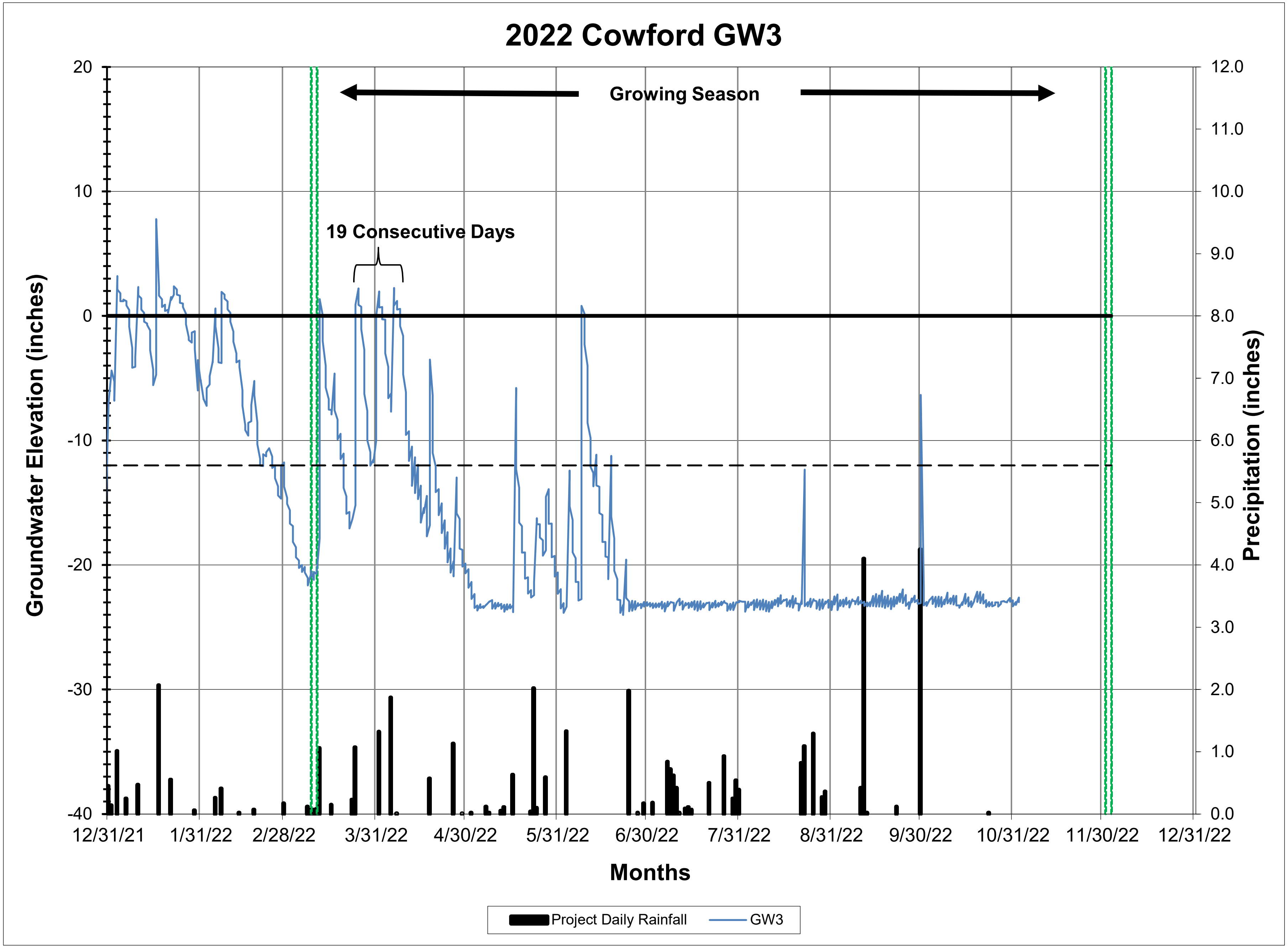
MY1 Cowford KJ1-C Stage Recorder Hydrograph
Max Bankfull Height (2.031 ft)
Stage (ft)
Rainfall (in)
Date
5
4
3
2
1
0
-1
10
9
8
7
6
5
4
3
2
1
0
1/19/22
2/19/22
3/19/22
4/19/22
5/19/22
6/19/22
7/19/22
8/19/22
9/19/22
10/19/22
Rainfall
RL1-A Stage
Top of Bank

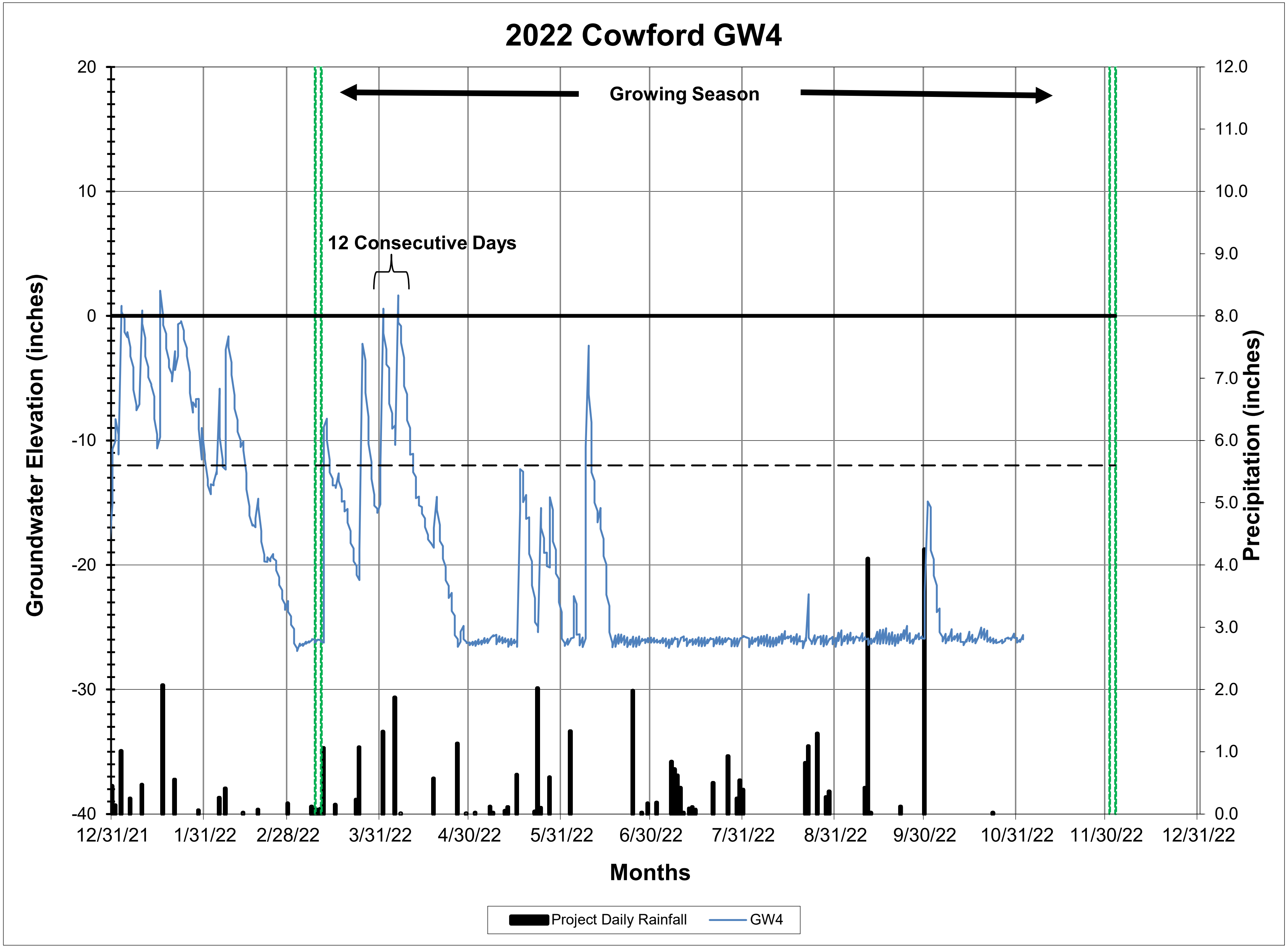

MY1 Cowford Flow Gauge KJ1-A Stream Flow Hydrograph
Consecutive Flow (55 days)
Water Depth (in)
Rainfall (in)
Date
20
15
10
5
0
-5
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1/19/22
2/19/22
3/19/22
4/19/22
5/19/22
6/19/22
7/19/22
8/19/22
9/19/22
10/19/22
Rainfall
KJ1-A Depth
DS Riffle Elevation
Bed


2022 Cowford GW1
Growing Season
1 Consecutive Day
Groundwater Elevation (inches)
Precipitation (inches)
Months
20
10
0
-10
-20
-30
-40
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12/31/21
1/31/22
2/28/22
3/31/22
4/30/22
5/31/22
6/30/22
7/31/22
8/31/22
9/30/22
10/31/22
11/30/22
12/31/22
Project Daily Rainfall
GW1

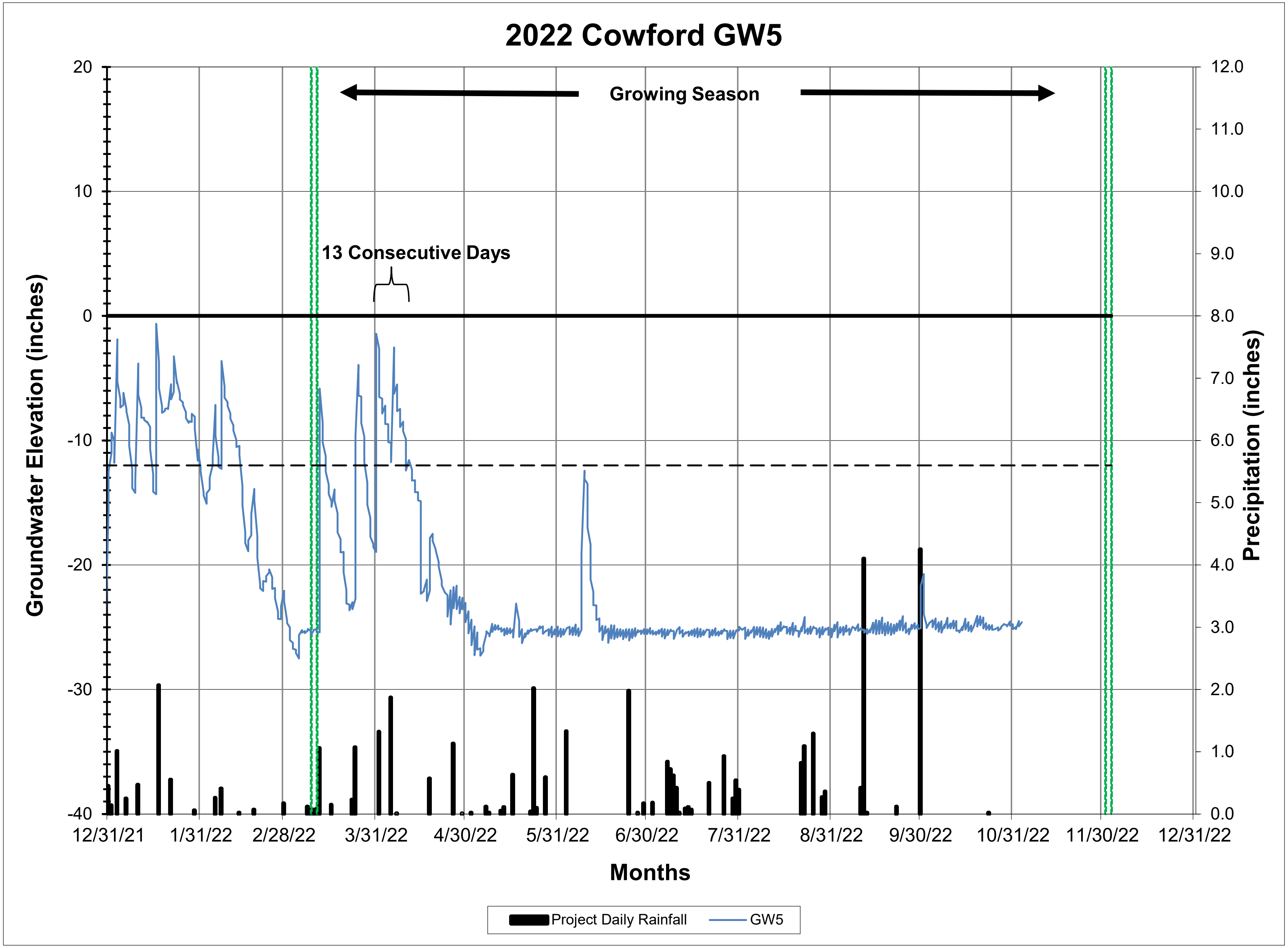


2022 Cowford GW2
Growing Season
2 Consecutive Days
Groundwater Elevation (inches)
Precipitation (inches)
Months
20
10
0
-10
-20
-30
-40
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12/31/21
1/31/22
2/28/22
3/31/22
4/30/22
5/31/22
6/30/22
7/31/22
8/31/22
9/30/22
10/31/22
11/30/22
12/31/22
Project Daily Rainfall
GW2


2022 Cowford GW3
Growing Season
19 Consecutive Days
Groundwater Elevation (inches)
Precipitation (inches)
20
10
0
-10
-20
-30
-40
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12/31/21
1/31/22
2/28/22
3/31/22
4/30/22
5/31/22
6/30/22
7/31/22
8/31/22
9/30/22
10/31/22
11/30/22
12/31/22
Months
Project Daily Rainfall
GW3



2022 Cowford GW4
Growing Season
12 Consecutive Days
Groundwater Elevation (inches)
Precipitation (inches)
20
10
0
-10
-20
-30
-40
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12/31/21
1/31/22
2/28/22
3/31/22
4/30/22
5/31/22
6/30/22
7/31/22
8/31/22
9/30/22
10/31/22
11/30/22
12/31/22
Months
Project Daily Rainfall
GW4


2022 Cowford GW5
Growing Season
13 Consecutive Days
Groundwater Elevation (inches)
Precipitation (inches)
Months
20
10
0
-10
-20
-30
-40
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
12/31/21
1/31/22
2/28/22
3/31/22
4/30/22
5/31/22
6/30/22
7/31/22
8/31/22
9/30/22
10/31/22
11/30/22
12/31/22
Project Daily Rainfall
GW5

Appendix F

Conservation

Easement

Clarification

From:	Isenhour, Kimberly T CIV USARMY CESAW (USA)
To:	Allen, Melonie
Cc:	erin.davis@ncdenr.gov; travis.wilson@ncwildlife.org; Tugwell, Todd J CIV USARMY CESAW (USA); bowers.todd@epa.gov; Merritt, Katie
Subject:	RE: Clarification request on IRT protection mechanism clarification vs. amendment
Date:	Thursday, June 23, 2022 3:42:56 PM

Melonie
Erin and I discussed these projects yesterday. The CE protection mechanism is one of the most critical elements of a mitigation project, and any modifications to the easement should be proposed to the Corps for IRT review. Below are comments on the two projects. If you would prefer to decouple this from the As-built review and address these changes separately, that's fine too.

Cowford:
We both had concerns about existing ditches and buffers around the wetlands due to the adjacent landowner's need to decrease hydrology in his fields. For this specific project, we are ok with the CCPV callout as long as the narrative discussion provides context/clarity. I agree that this can be treated as an easement clarification that you can handle with a Transfer Illustration and CCPV note; however, situations like this should be discussed during the post-contract stage moving forward.

We agree that there is a big difference between leaving a ditch open as part of project construction and allowing landowner ditch maintenance within an easement. I don't recall that this was a discussion topic during the post-contract visit or the draft mitigation plan review. If the existing ditch is centerlined in the CE and labeled "to remain open," we would assume that the ditch has potential future maintenance; however, if the ditch is located fully in the CE, we would assume there would be no maintenance by the landowner. CE signage will be important in this area. Additionally, DWR requests that "no mow" signs be added to clearly indicate the extent of the allowable ditch maintenance area.

For future reference, if a new ditch is proposed outside of the CE and during construction ends up partially within the CE and is expected to be maintained, then this should be a formal IRT discussion before DMS/SPO action is taken. Similarly, if an existing road/path to be maintained is located within the CE but was not identified in the mit plan, or a new road/path is constructed partially within the CE contrary to the approved mit plan, I would not assume IRT concurrence with a CE clarification and would recommend formal IRT discussion before DMS/SPO action is taken.

UT to Rush Fork:
Any new or shifted structures or roads installed within the easement, particularly if they require future maintenance, should be identified for IRT review prior to actions taken by DMS/SPO. In this case, I would suggest that DMS submit the proposal to modify the easement (or remove the structures from the easement) prior to making any changes. Paul can submit this request with the As-Built review request so that the review timeline is only 30-days, and not 15-days for the As-Built plus an additional 30-days for the easement mod.

I've copied Katie Merritt because I believe Cowford is one of her projects, and other IRT members for their awareness during the As-Built reviews. Please let me know if you still have questions.
Thanks
Kim

Kim (Browning) Isenhour
Mitigation Project Manager, Regulatory Division I U.S. Army Corps of Engineers l 919.946.5107

From: Allen, Melonie
Sent: Friday, June 17, 2022 10:49 AM
To: Kim Browning <Kimberly.D.Browning@usace.army.mil>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; Davis, Erin B <erin.davis@ncdenr.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; Tugwell, Todd J CIV USARMY CESAW (US)

<Todd.J.Tugwell@usace.army.mil>
Subject: Clarification request on IRT protection mechanism clarification vs. amendment

IRT,

Yesterday I responded to two very different easement scenarios that I'd like to get clarification on if possible.

I. Cowford Project: 100095 Onslow County White Oak MY1

i. The recorded plat indicated the existing ditch located partially or fully in the easement on the far east side of the CE (see screen shot below with ditch annotation in red box). It was the intention to leave the ditch and enable the landowner(s) to maintain the ditch when the easement was acquired. Filling the ditch was never proposed in the RFP technical proposal or Mitigation Plan. Ideally when the easement was acquired a line following the 'centerline of ditch' should have been added to indicate; ditch to remain and may be maintained. It is the property boundary.

* I interpret this as an easement clarification: I propose that DMS be able to handle interpretations such as this with a Transfer illustration and note it in the CCPV. The transfer illustration would protect the landowner from SP interpretation of violation upon maintenance. The call out in the CCPV would alert the IRT that the ditch is to remain.

II. Ut to Rush Fork: 100068 Haywood Co. French Broad, MY0 review

i. The recorded plat indicates a road upstream of UT 4 and the installed crossing culvert and headwall extend the easement. There is also an installed BMP that extends beyond the easement. These are clearly mistakes and I interpret this to require moving the infrastructure or amending the easement to ensure the infrastructure is excluded and BMP is included (much more likely scenario). In this case, I propose that DMS notify the IRT of intent to modify easement and get concurrence prior to making any changes.

Let me know if you need any additional information or have any questions,

Thanks,

Melonie

Melonie Allen

Closeout & Credit Release

Division of Mitigation Services

N.C. Department of Environmental Quality

919-707-8540 office

919-368-9352 cell

Melonie.Allen@ncdenr.gov <mailto:Melonie.Allen@ncdenr.gov>

217 West Jones St.

Raleigh, NC 27603