CEDAR CREEK STREAM AND WETLAND RESTORATION PROJECT
MONITORING REPORT
MONITORING YEAR 6
FINAL

SAMPSON COUNTY, NORTH CAROLINA
CONTRACT NO. 005011 - PROJECT NO. 95718
USACE ACTION ID NO. 2012-00389 – NCDWR PROJECT NO. 2013-0186

Prepared for:

Division of Mitigation Services

North Carolina Department of Environmental Quality
1652 Mail Service Center
Raleigh, NC 27699-1652

January 2021

Mitigation Project Name	**Cedar Creek**	**USACE Action ID**	**2013-00389**
DMS ID	**95718**	**DWR Permit**	**2013-0186**
River Basin	**Cape Fear**	**Date Project Instituted**	**12/14/2012**
Cataloging Unit	**03030006**	**Date Prepared**	**4/21/2020**
County	**Sampson**	**Stream/Wet. Service Area**	**Cape Fear 03030006**

Todd J Tugwell 9/21/2020

Signature & Date of Official Approving Credit Release

1 - For NCDMS, no credits are released during the first milestone

2 - For NCDMS projects, the initial credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the IRT by posting it to the DMS portal, provided the following have been met:

1) Approved of Final Mitigation Plan

2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property.

3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan.

4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

3 - A 10% reserve of credits is to be held back until the bankfull event performance standard has been met.

Credit Release Milestone	**Warm Stream Credits**						
Project Credits	**Scheduled Releases %**	**Proposed Releases %**	**Proposed Released #**	**Not Approved # Releases**	**Approved Credits**	**Anticipated Release Year**	**Actual Release Date**
1 - Site Establishment	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 - Year 0 / As-Built	30.00%	30.00%	1,582.780	0.000	1,582.780	2016	2/16/2016
3 - Year 1 Monitoring	10.00%	10.00%	527.593	0.000	527.593	2016	4/25/2016
4 - Year 2 Monitoring	10.00%	10.00%	522.993	18.400	504.593	2017	8/8/2017
5 - Year 3 Monitoring	10.00%	10.00%	522.993	0.000	522.993	2018	4/26/2019
6 - Year 4 Monitoring	5.00%	5.00%	261.497	0.000	261.497	2019	4/26/2019
7 - Year 5 Monitoring	10.00%	10.00%	522.993	0.000	522.993	2020	4/21/2020
8 - Year 6 Monitoring	5.00%					2021	
9 - Year 7 Monitoring	10.00%					2022	
Stream Bankfull Standard	10.00%	10.00%	522.993	0.000	522.993	2019	4/26/2019
			Totals	18.400	4,445.442		

Total Gross Credits	5,229.934
Total Unrealized Credits to Date	0.000
Total Released Credits to Date	4,445.442
Total Percentage Released	85.00%
Remaining Unreleased Credits	784.492

Credit Release Milestone	**Riparian Credits**						
Project Credits	**Scheduled Releases %**	**Proposed Releases %**	**Proposed Released #**	**Not Approved # Releases**	**Approved Credits**	**Anticipated Release Year**	**Actual Release Date**
1 - Site Establishment	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 - Year 0 / As-Built	30.00%	30.00%	4.116	0.000	4.116	2016	2/19/2016
3 - Year 1 Monitoring	10.00%	10.00%	1.372	0.000	1.372	2016	4/25/2016
4 - Year 2 Monitoring	10.00%	10.00%	1.310	0.248	1.062	2017	8/8/2017
5 - Year 3 Monitoring	10.00%	10.00%	1.310	0.000	1.310	2018	4/26/2019
6 - Year 4 Monitoring	10.00%	10.00%	1.310	0.000	1.310	2019	4/26/2019
7 - Year 5 Monitoring	10.00%	10.00%	1.310	0.000	1.310	2020	4/21/2020
8 - Year 6 Monitoring	10.00%					2021	
9 - Year 7 Monitoring	10.00%					2022	
Stream Bankfull Standard	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Totals	0.248	10.480		

Total Gross Credits	13.100
Total Unrealized Credits to Date	0.000
Total Released Credits to Date	10.480
Total Percentage Released	80.00%
Remaining Unreleased Credits	2.620

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Project Quantities

Mitigation Type	Restoration Type	Physical Quantity
Riparian	Restoration	13.100
Warm Stream	Enhancement I	680.000
Warm Stream	Enhancement II	4,584.000
Warm Stream	Restoration	2,943.000

Notes

8/8/2017: Adjustment required due to IRT concerns on how the as-built credits were calculated.
5/22/2018: Due to concerns expressed by the IRT, no stream or wetland credits were released from this site for the 2017 monitoring cycle.

Contingencies (if any)

Debits

							Stream Restoration Credits	**Riparian Restoration**
Beginning Balance (mitigation credits)							**5,229.934**	**13.100**
Released Credits							**4,445.442**	**10.480**
Unrealized Credits							**0.000**	**0.000**
Owning Program	**Req. Id**	**TIP #**	**Project Name**	**USACE Permit #**	**DWR Permit #**	**DCM Permit #**		
NCDOT Stream & Wetland ILF Program	REQ-005840	R-2303C	NC 24 Improvements - Section C	1992-03237	2012-0240		896.700	
NCDOT Stream & Wetland ILF Program	REQ-005840	R-2303C	NC 24 Improvements - Section C	1992-03237	2012-0240		136.000	
NCDOT Stream & Wetland ILF Program	REQ-005840	R-2303C	NC 24 Improvements - Section C	1992-03237	2012-0240		415.600	
NCDOT Stream & Wetland ILF Program	REQ-005843	R-2303D	NC 24 Improvements - Section D	1992-03237	2012-0240		134.480	
NCDOT Stream & Wetland ILF Program	REQ-005843	R-2303D	NC 24 Improvements - Section D	1992-03237	2012-0240		298.900	
NCDOT Stream & Wetland ILF Program	REQ-005843	R-2303D	NC 24 Improvements - Section D	1992-03237	2012-0240		45.330	
NCDOT Stream & Wetland ILF Program	REQ-005843	R-2303D	NC 24 Improvements - Section D	1992-03237	2012-0240		183.360	
NCDOT Stream & Wetland ILF Program	REQ-005843	R-2303D	NC 24 Improvements - Section D	1992-03237	2012-0240		275.900	
NCDOT Stream & Wetland ILF Program	REQ-005843	R-2303D	NC 24 Improvements - Section D	1992-03237	2012-0240		45.330	
NCDOT Stream & Wetland ILF Program	REQ-005843	R-2303D	NC 24 Improvements - Section D	1992-03237	2012-0240		183.360	
NCDOT Stream & Wetland ILF Program	REQ-008169	I-5877	I-5877 - I-95 Improvements	2018-02276	2019-0214		1,208.000	
NCDOT Stream & Wetland ILF Program	REQ-008243	R-2303E	NC 24 Improvements - Section E	1992-03237	2012-0240		99.490	
NCDOT Stream & Wetland ILF Program	REQ-005841	R-2303C	NC 24 Improvements - Section C	1992-03237	2012-0240			4.120
NCDOT Stream & Wetland ILF Program	REQ-005844	R-2303D	NC 24 Improvements - Section D	1992-03237	2012-0240			1.370
Statewide Stream & Wetland ILF Program	REQ-006784		PNG Line 22 Pipeline Replacement	2017-00953	2017-0295			0.190
NCDOT Stream & Wetland ILF Program	REQ-008171	I-5877	I-5877 - I-95 Improvements	2018-02276	2019-0214			1.100

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NCDOT Stream & Wetland ILF Program	REQ-008245	R-2303E	NC 24 Improvements - Section E	1992-03237	2012-0240			1.800
Total Credits Debited							**3,922.450**	**8.580**
Remaining Available balance (Released credits)							**522.992**	**1.900**
Remaining balance (Unreleased credits)							**784.492**	**2.620**

Cedar Creek
Sampson County, North Carolina
DMS Project ID 95718

Cape Fear River Basin
HUC 3030006090060

Prepared by:

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January 14, 2021

Jeremiah Dow
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217 West Jones Street
Raleigh, NC 27604

RE: Cedar Creek Stream and Wetland Restoration Site: MY6 Monitoring Report (NCDMS ID 95718)

Listed below are comments provided by DMS on December 14, 2020 regarding the Cedar Creek Stream and Wetland Restoration Site: Year 6 Monitoring Report and RES' responses.

1. Section 4.2 a. Please discuss the preliminary estimation of 1.50 acres of at-risk credit around gauge AW7 and revise language to indicate that a delineation and soil development investigation will be conducted to further refine the extent of the lost credit area if needed based on MY7 data.
The at-risk wetland area is actually 1.20 not 1.50 acres. This error was discovered when creating the shapefile for the at-risk wetland area.

2. Section 5.1.5 a. Same comment as 1a above regarding the preliminary estimate of 1.5 acres of wetland at-risk.
Done.

3. Appendix B
a. Figure 3b – Please add polygon showing approximate area of at-risk wetlands.
Done.

4. Digital Files a. Last year, DMS requested features for Cedar Creek to ensure spatial features matched reported lengths. However, the following segments in the asset table still have feature lengths that do not match reported lengths, described below as reported length in Table 1 vs. feature length. If available, please provide features that accurately represent these segments.

- UT1 44+60 to 53+51 827 ft vs. 844 ft
- UT2 3+48 to 9+12 504 ft vs. 519 ft
- UT4 0+36 to 1+14 78 ft vs. 87 ft

b. If available, please provide the feature that connects the segments of UT1 44+60 to 53+51 and UT2 3+48 to 9+12 through their easement breaks.

Two shapefiles with the accurate spatial features are now in the support files. One shapefile contains the restoration reaches and one contains the enhancement reaches.

TABLE OF CONTENTS

Appendices

1 PROJECT GOALS, BACKGROUND AND ATTRIBUTES

1.1 Location and Setting

The Cedar Creek Stream and Wetland Site is located in Sampson County approximately 3.1 miles southwest of Clinton, NC (**Figure 1**). To access the Site from the town of Clinton, travel west on Highway 24 (Sunset Avenue), take a left onto Airport Road and go 1.3 miles. Turn right onto West Main Street Extension, go approximately 350 feet, and turn left onto a dirt farm path. Follow the farm path along the cultivated field edge to the southwest corner and enter the forest. Follow the dirt path to cultivated fields adjacent to the project below UT2. Turning to the left will take you to UT2. Going to the right will take you to UT3.

1.2 Project Goals and Objectives

The Cedar Creek Stream and Wetland Restoration Project has provided numerous ecological and water quality benefits within the Cape Fear River Basin. While many of these benefits are limited to the project area, others, such as pollutant removal and improved aquatic and terrestrial habitat, have more far-reaching effects. Expected improvements to water quality, hydrology, and habitat are outlined below.

Design Goals and Objectives

Benefits Related to Water Quality	
Nutrient removal	Benefit will be achieved through filtering of runoff from adjacent agricultural fields through buffer areas, the conversion of active farm fields to forested buffers, improved denitrification and nutrient uptake through buffer zones, and installation of BMPs at the headwaters of selected reaches.
Sediment removal	Benefit will be achieved through the stabilization of eroding stream banks and reduction of sediment loss from field areas due to lack of vegetative cover. Channel velocities will also be decreased through a reduction in slope, therefore decreasing erosive forces.
Increase dissolved oxygen concentration	Benefit will be achieved through the construction of instream structures to increase turbulence and dissolved oxygen concentrations and riparian canopy restoration to lower water temperature to increase dissolved oxygen capacity.
Runoff filtration	Benefit will be achieved through the restoration of buffer areas that will receive and filter runoff, thereby reducing nutrients and sediment concentrations reaching water bodies downstream.
Benefits to Flood Attenuation	
Water storage	Benefit will be achieved through the restoration of buffer areas which will infiltrate more water during precipitation events than under current site conditions. Wetland areas will provide additional storage of runoff and flood waters.
Improved groundwater recharge	Benefit will be achieved through the increased storage of precipitation in buffer areas, ephemeral depressions, and reconnection of existing floodplain. Greater storage of water will lead to improved infiltration and groundwater recharge.
Improved/restored hydrologic connections	Benefit will be achieved by restoring the stream to a natural meandering pattern with an appropriately sized channel, such that the channel's floodplain will be flooded more frequently at flows greater than the bankfull stage.
Benefits Related to Ecological Processes	
Restoration of habitats	Benefit will be achieved by restoring riparian buffer habitat to appropriate bottomland hardwood ecosystem. Protected riparian corridors will create contiguous natural areas with uninterrupted migration corridors.
Improved substrate and instream cover	Benefit will be achieved through the construction of instream structures designed to improve bedform diversity and to trap detritus. Stream will be designed with the appropriate channel dimension and will prevent aggradation and sedimentation within the channel. Substrate will become coarser as a result of the stabilization of stream banks and an overall decrease in the amount fine materials deposited in the stream.

Addition of large woody debris	Benefit will be achieved through the addition of wood structures as part of the restoration design. Such structures may include log vanes, root wads, and log weirs.
Reduced temperature of water due to shading	Benefit will be achieved through the restoration of canopy tree species to the stream buffer areas.
Restoration of terrestrial habitat	Benefit will be achieved through the restoration of riparian buffer bottomland hardwood habitats.

The Cedar Creek Stream and Wetland Restoration Project is located in the Great Coharie Creek Watershed (http://portal.ncdenr.org/web/DMS/priorities-map). This 14-digit Hydrologic Unit Code (HUC 03003006090060) is identified as a Targeted Local Watershed (TLW) in the Cape Fear River Basin Restoration Priority (RBRP).

The North Carolina Division of Mitigation Services (NCDMS) develops River Basin Restoration Priorities (RBRP) to guide its restoration activities within each of the state's 54 cataloging units. RBRPs delineate specific watersheds that exhibit both the need and opportunity for wetland, stream and riparian buffer restoration. These TLWs receive priority for DMS planning and restoration project funds. Currently, no Local Watershed Plan (LWP) is available for the project area.

The 2009 Cape Fear RBRP identified water quality and agricultural impacts as major stressors within this TLW. The Cedar Creek Stream and Wetland Restoration Project was identified as a Stream and Wetland opportunity to improve water quality, habitat, and hydrology within the TLW.

The project goals addressed stressors identified in the TLW, and include the following:

- Water quality improvements,
- Natural resource protection, and
- Manage agricultural impacts.

The project goals were addressed through the following project objectives:

- Converting active farm fields to forested buffers,
- Stabilization of eroding stream banks,
- Reduction in stream bank slope,
- Restoration of riparian buffer bottomland hardwood habitats, and
- Construction of in-stream structures designed to improve bedform diversity.

1.3 Project Structure

Following 2016 monitoring the NCIRT requested a review of the differential between the Approved Mitigation Plan and Baseline Monitoring Report. The table below details the discrepancies by reach. The primary causes of increased baseline SMUs was minor field adjustments during construction along with survey methodology (thalweg vs. centerline). The Mitigation Plan lengths were based on centerline. Wetland credits increased to include restoration of a backfilled pond bed (0.22 acres) that was identified as an opportunity to expand the easement following approval of the Mitigation Plan. RES does not plan on submitting an asset revision and will revert to the Approved Mitigation Plan assets.

Table 1a. Cedar Creek Site Project Components – Stream Mitigation

Reach	Mitigation Type*	Proposed Length (LF)	Mitigation Ratio	Proposed SMUs	Baseline SMUs
UT1	Enhancement II	3,064	2.5:1	1,226	1,226
UT1	Enhancement I	415	1.5:1	277	277
UT1	Enhancement II	615	2.5:1	246	246
UT1	Enhancement I	265	1.5:1	177	177
UT1	Enhancement II	827	2.5:1	331	331
UT2	Headwater Valley	337	1:1	337	337
UT2	P1 Restoration	504	1:1	504	518
UT2C	Headwater Valley	190	1:1	190	193
UT3	P1 Restoration	1,912	1:1	1,912	1,941
UT4	Enhancement II	78	2.5:1	31	31
	Total	**8,207**		**5,230**	**5,276**

*P1=Priority 1

**The contracted amount of credits for this Site is 5,000 SMUs

Wetland	Mitigation Type	Mitigation Area (ac)	Mitigation Ratio	Proposed WMUs	Baseline WMUs
W1	Restoration	13.10	1:1	13.10	13.72
	Total	**13.10**		**13.10**	**13.72**

*The contracted amount of credits for this Site is 9.00 WMUs

1.3.1 Restoration Type and Approach

Stream restoration efforts along the unnamed tributaries to Great Coharie Creek were accomplished through analyses of geomorphic conditions and watershed characteristics. The design approach applied a combination of analytical and reference and/or analog reach based design methods that meet objectives commensurate with both ecological and geomorphic improvements. Proposed treatment activities ranged from minor bank grading and planting to re-establishing stable planform and hydraulic geometry. Reaches that required full restoration, natural design concepts have been applied and verified through rigorous engineering analyses and modeling. The objective of this approach was to design a geomorphically stable channel that provides habitat improvements and ties into the existing landscape.

Priority Level I stream restoration, headwater valley restoration, stream Enhancement Levels I and II, and stream buffers throughout the project site have been restored and protected in perpetuity. Priority Level I stream restoration was incorporated into the design of a single-thread meandering channel, with parameters based on data taken from the reference site. Priority 1 stream restoration was proposed on 2,416 linear feet of stream channel. Headwater valley restoration was applied to 527 linear feet of channel. Enhancement Level I was applied to 680 linear feet of channel that required buffer enhancement, bank stabilization and habitat improvements. Enhancement Level II was applied to an additional 4,584 linear feet of channel that required buffer enhancement and/or minimal bank and habitat improvements.

UT1
UT1 flows from southeast to northwest across the project, totaling 5,186 linear feet of Enhancement Level I and II. The upper-most portion of UT1 (reaches UT1A and UT1B) is stable and has a forested buffer along both banks; however, privet was dominant within the right buffer. The downstream portion of UT1 (reaches UT1C, UTD and UT1E) was moderately stable and exhibited some areas of localized erosion prior to mitigation activities. The buffer along this section consisted of a five year old clear-cut along the left bank and cultivated fields along the right bank. A 60-foot easement break is present within the downstream section (UT1E) to account for an existing farm crossing which has been upgraded. 680 linear feet of Enhancement Level I was performed along reach UT1. Selective locations were identified to include streambed structures, minor bank grading, planting a native stream buffer and invasive species control. Primarily, Stabilization/Enhancement II activities included performing minor bank grading, planting the buffer with native vegetation, and invasive species control.

UT2
UT2 is the middle tributary of the project, totaling 337 linear feet of headwater valley restoration along the upstream section and 518 linear feet of Priority 1 restoration through the downstream section. The upper section of the channel was channelized and bordered by cultivated fields to the northwest and a pine stand to the southeast, while the lower portion was a small ditch surrounded by cultivated fields. The headwater valley portion relocated the flow path to the natural valley (to the left of the existing ditch), and the abandoned ditch has been back filled. The performed P1 restoration included relocating the channel to follow the natural valley and emptying into Cedar Creek near STA 25+50. A 60-foot easement break crossing is present at STA 4+66 along UT2. Twin 24" HDPE culverts were installed within the easement break crossing. Restoration activities included constructing a meandering channel, installing habitat and drop structures, filling and plugging the abandoned channel, planting the buffer with native vegetation, and invasive species control.

UT2C
UT2C is also located in the middle of the project (adjacent to UT2), totaling 193 linear feet of headwater valley restoration. The upstream end of the reach begins at an existing wetland that borders a farm path to the north. Flow from the wetland originally had been diverted to a ditch that ran east-west along the farm path before it was conveyed across the path and into UT2 near the upstream end. Restoration activities involved redirecting channel flow to the natural valley and grading out the existing ditch and path such that the area matches existing grade on either side of the path. Additional activities included planting the buffer with native vegetation and invasive species control.

UT3
UT3 is the western most tributary of the project, totaling 1,941 linear feet of Priority 1 restoration. The upper section of the channel was incised/oversized and began at a pond outlet east of the airport and flowed through a wooded area consisting of saplings and some mature hardwoods, while the lower section flowed through a cultivated field. The restored channel has been relocated to the west to follow the natural valley, and now flows through the middle of the wetland restoration area (W1). UT3 now

outlets into Cedar Creek near STA 43+10. Restoration activities included constructing a meandering channel, installing habitat and grade control structures, filling and plugging the abandoned channel, planting the buffer with native vegetation, and invasive species control. Small ditches located adjacent to UT3 and within the conservation easement have also been plugged and filled to redirect and diffuse flow through the wetland restoration area and/or into UT3.

UT4
UT4 is the eastern most tributary of the project, totaling 78 linear feet of Enhancement Level II. The reach was relatively stable, but had been historically channelized. The buffer along this section consisted of an agricultural field along the right bank, and a forested buffer along the left bank; however, privet was common within the left buffer. Stabilization/Enhancement II activities included performing minor bank grading, cutting a floodplain bench, and planting the buffer with native vegetation, and invasive species control.

Wetland W1
This 13.72-acre wetland is located along UT3 and where it reaches the confluence of with UT1 Reach E. The pre-restoration land use was sparsely wooded and active cropland. Wetland restoration activities consisted of removing valley fill, filling drainage ditches, removing subsurface drainage tiles, and raising adjacent stream channels to reconnect the floodplain with seasonal and out of bank flows. Raising the stream bed will also reduce the "dry shoulder" effect near the stream channel. Specific wetland restoration activities included: reconnecting low lying areas of hydric soil with the floodplain, plugging agricultural drainage ditches, planting native tree and shrub species commonly found in small stream swamp ecosystems, and surface roughening to increase infiltration and storage. Wetland restoration activities also included the breaching, backfilling, and planting of an old pond (0.22 acres) that was identified after Mitigation Plan approval. The IRT has not approved these additional 0.22 acres therefore RES will revert back to the 13.10 WMUs from the Approved Mitigation Plan. Wetland restoration limits and hydroperiods will be determined by on-site soil investigations and hydrologic modeling in conjunction with pre-construction water table monitoring at the restoration sites and reference wetlands. Combined with the stream restoration, these actions will result in a sufficiently high water table and flood frequency to support hydrophytic vegetation and wetland hydrology, resulting in restored riparian wetlands.

1.4 Project History, Contacts and Attribute Data

1.4.1 Project History

The Cedar Creek Stream and Wetland Restoration Site was restored by Resource Environmental Solutions, LLC (RES) through a full-delivery contract awarded by NCDMS in 2012. Tables 2, 3, and 4 in **Appendix A** provide a time sequence and information pertaining to the project activities, history, contacts, and baseline information.

1.4.2 Project Watersheds

The easement totals 42.0 acres and is broken into four tributaries, UT1, UT2, UT3, and UT4. The land use in the 2,778-acre (4.34 mi^2) project watershed that drains to UT1 consisted of row crop production, livestock production, silviculture, and sand mining areas. Past land use practices caused increased erosion and sedimentation along drainage-ways and stream banks in the watershed.

UT2 has a drainage area of 32 acres (0.05 mi^2) and flows southwest into UT1. Land use in this small drainage area consisted entirely of row crop production and disturbed hardwood forest. UT2 originated in a disturbed hardwood forest and flows through a cultivated field to its confluence with UT1.

UT3 has a drainage area of 147 acres (0.23 mi^2) and flows south into UT1. Land use in this drainage area consisted of row crop production, historical and future livestock production, disturbed hardwood forest, maintained open space, and impervious surfaces associated with residential commercial development. Portions of the Sampson County Airport, including parts of the runway, terminal, and apron areas, lie within the UT3 drainage area. UT3 originates at a pond that is adjacent to the airport property. This reach flowed through a disturbed hardwood forest, and then through a cultivated field to its confluence with UT1.

UT4 has a drainage area of 77 acres (0.12 mi^2), originates within a disturbed hardwood forest, and flows southwest into UT1. Land use in this small drainage area consisted of a mix of row crop production and disturbed hardwood forest located primarily along the drainage way.

UT2, UT3 and UT4 were straightened, dredged, or re-aligned in the past to promote drainage. Soil investigations showed that much of the low-lying landscape adjacent to UT1 and its confluences with UT2 and UT3 exhibited hydric characteristics and a shallow seasonal high water table. The low lying fields in this area were considered prior converted wetlands (PC) that were drained and are currently utilized for row crop and livestock production.

The land use in the watershed is characterized by evergreen forest (47 percent), cultivation (31 percent), woody wetlands (9 percent), open space (8 percent) and shrub/scrub (5 percent).

2 Success Criteria

The success criteria for the Cedar Creek Site stream restoration will follow accepted and approved success criteria presented in the USACE Stream Mitigation Guidelines and subsequent NCDMS and agency guidance. Specific success criteria components are presented below.

2.1 Stream Restoration

2.1.1 Bankfull Events

Two bankfull flow events must be documented within the seven-year monitoring period. The two bankfull events must occur in separate years. Otherwise, the stream monitoring will continue until two bankfull events have been documented in separate years. Bankfull events will be documented using crest gauges, auto-logging crest gauges, photographs, and visual assessments for evidence of debris rack lines.

2.1.2 Cross Sections

There should be little 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 down-cutting 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 are 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.

2.1.3 Bank Pin Arrays

Bank pin arrays will be used as a supplemental method to monitor erosion on selected meander bends where there is not a cross section. Bank pin arrays will be installed along the outer bend of the meander. Bank pins will be installed just above the water surface and every two feet above the lowest pin. Bank pin exposure will be recorded at each monitoring event, and the exposed pin will be driven flush with

the bank. There should be little 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 down-cutting 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).

2.1.4 Digital Image Stations

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.

2.2 Wetland Restoration

Success criteria and monitoring for wetland hydrology within the wetland restoration areas on the site follows NCDMS Guidance dated 7 November 2011. The target minimum wetland hydroperiod is 9 percent of the growing season. Stream hydrology and water balance calculations indicate the wetland area will meet jurisdictional criteria (5 percent hydroperiod). However, due to immature vegetation and reduced PET, a longer success criterion is appropriate. Auto recording gauges are used to measure daily groundwater elevations throughout the Sampson County growing season in all seven years of monitoring.

If a hydrology gauge location fails to meet these success criteria in the seven-year monitoring period then monitoring may be extended, remedial actions may be undertaken, or groundwater modeling may be used to demonstrate the limits of wetland restoration.

2.3 Vegetation Success Criteria

Specific and measurable success criteria for plant density within the wetland restoration and riparian buffers on the site will follow NCDMS Guidance dated 7 November 2011. Vegetation monitoring plots are a minimum of 0.02 acres in size, and cover a minimum of two percent of the planted area. The following data is recorded for all trees in the plots: species, height, planting date (or volunteer), and grid location. Monitoring occurs in the fall of Years 1, 2, 3, 5, and 7. The interim measures of vegetative success for the site is the survival of at least 320 three-year old planted trees per acre at the end of Year 3, and 260 planted trees per acre at the end of Year 5. The final vegetative success criteria is the survival of 210 planted trees per acre at the end of Year 7 of the monitoring period.

Invasive and noxious species will be monitored and controlled so that none become dominant or alter the desired community structure of the site. If necessary, RES will develop a species-specific control plan.

2.4 Scheduling/Reporting

The monitoring program will be implemented to document system development and progress toward achieving the success criteria. The restored stream morphology is assessed to determine the success of the mitigation. The monitoring program will be undertaken for seven years or until the final success criteria are achieved, whichever is longer.

Monitoring reports will be prepared in the fall of each year of monitoring and submitted to NCDMS. The monitoring reports will include all information, and be in the format required by NCDMS in Version 2.0 of the NCDMS Monitoring Report Template (Oct. 2010).

3 MONITORING PLAN

Annual monitoring data will be reported using the NCDMS monitoring template. Annual monitoring shall be conducted for stream, wetland, and vegetation monitoring parameters as noted below.

3.1 Stream Restoration

3.1.1 As-Built Survey

An as-built survey was conducted following construction to document channel size, condition, and location. The survey will include a complete profile of thalweg, water surface, bankfull, and top of bank to compare with future geomorphic data. Longitudinal profiles will not be required in annual monitoring reports unless requested by NCDMS or USACE.

3.1.2 Bankfull Events

Three sets of manual and auto-logging crest gauges were installed on the site, one along UT2, one along UT2C, and one along UT3. The auto logging crest gauges were installed within the channel and will continuously record flow conditions at an hourly interval. Manual crest gauges were installed on the bank at bankfull elevation. Crest gauges will be checked during each site visit to determine if a bankfull event has occurred since the last site visit. Crest gauge readings and debris rack lines will be photographed to document evidence of bankfull events.

3.1.3 Cross Sections

A total of 27 permanent cross sections were installed to monitor channel dimensions and stability. Cross sections were typically located at representative riffle/shallows and pool sections along each stream reach. Four cross sections were installed along UT1 where enhancement activities were performed. Eight cross sections (three pools, two runs, and three shallows) were installed along UT2. UT2C has one cross section installed throughout its length. Stream reach UT3 has 14 cross sections installed along its length where stream restoration was performed. Each cross section was permanently marked with 3/8 rebar pin to establish a monument location at each end. A marker pole was also installed at both ends of each cross section to allow ease locating during monitoring activities. Cross section surveys will be performed once a year during annual monitoring years 1, 2, 3, 5, and 7 and will include all breaks in slope including top of bank, bottom of bank, streambed, edge of water, and thalweg.

3.1.4 Digital Image Stations

Digital photographs will be taken at least once a year to visually document stream and vegetation conditions. This monitoring practice will continue for seven years following construction and planting. Permanent photo point locations at cross sections and vegetation plots have been established so that the same directional view and location may be repeated each monitoring year. Monitoring photographs will also be used to document any stream and vegetation problematic areas such as erosion, stream and bank instability, easement encroachment and vegetation damage.

3.1.5 Bank Pin Arrays

Eight bank pin array sets have been installed at pool cross sections located along UT2 and UT3. These bank pin arrays were installed along the upstream and downstream third of the meander. Bank pins are a minimum of three feet long, and have been installed just above the water surface and every two feet above the lowest pin. Bank pin exposure will be recorded at each monitoring event, and the exposed pin will be driven flush with the bank.

3.1.6 Visual Assessment Monitoring

Visual monitoring of all mitigation areas is conducted a minimum of twice per monitoring year by qualified individuals. The visual assessments include vegetation density, vigor, invasive species, and easement encroachments. Visual assessments of stream stability include a complete stream walk and structure inspection. Digital images are taken at fixed representative locations to record each monitoring event as well as any noted problem areas or areas of concern. Results of visual monitoring are presented in a plan view exhibit with a brief description of problem areas and digital images. Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures. Longitudinal photos should indicate the absence of developing bars within the channel or an excessive increase in channel depth. Lateral photos should not indicate excessive erosion or continuing degradation of the banks over time. A series of photos over time should indicate successional maturation of riparian vegetation.

3.1.7 Surface Flow

The headwater valley restoration reaches on UT2 and UT2C will be monitored to document intermittent or seasonal surface flow. This will be accomplished through direct observation, photo documentation of dye tests, and continuous flow monitoring devices (pressure transducers). An auto logging crest gauges has been installed within the headwater valley channel and will continuously record flow conditions at an hourly interval. This gauge will be downloaded during each site visit to determine if intermittent or seasonal flows conditions are present.

3.2 Wetland Hydrology

Wetland hydrology will be monitored to document hydric conditions in the wetland restoration areas. This will be accomplished with automatic recording pressure transducer gauges installed in representative locations across the restoration areas and reference wetland areas. A total of fourteen automatic recording pressure transducers (Auto-Wells) have been installed on the site. Eleven auto-wells have been installed within the wetland restoration area and three within reference areas. The gauges will be downloaded quarterly and wetland hydroperiods will be calculated during the growing season. Gauge installation followed current regulatory and DMS guidance. Visual observations of primary and secondary wetland hydrology indicators will also be recorded during quarterly site visits.

3.3 Vegetation

A total of 20 vegetation plots were randomly established within the planted stream riparian buffer easement. Vegetation plots measure 10 meters by 10 meters or 5 meters by 20 meters (0.02 acres) and have all four corners marked with metal posts. Planted woody vegetation was assessed within each plot to establish a baseline dataset. Within each vegetation plot, each planted stem was identified for species, “X” and “Y” origin located, and measured for height. Reference digital photographs were also captured to document baseline conditions. Species composition, density, growth patterns, damaged stems, and survival ratios will be measured and reported on an annual basis. Vegetation plot data will be reported for each plot as well as an overall site average.

4 MAINTENANCE AND CONTINGENCY PLAN

All identified problematic areas or areas of concern such as stream bank erosion/instability, aggradation/degradation, lack of targeted vegetation, and invasive/exotic species which prevent the site from meeting performance success criteria will be evaluated on a case by case basis. These areas will be documented and remedial actions will be discussed with NCDMS staff to determine a plan of action. If it is determined remedial action is required, a plan will be provided.

4.1 Stream

No stream problems were identified in MY6.

4.2 Wetlands

One wetland problem area was noted during the Year 6 monitoring period. AW7 did not meet success criteria for the sixth year in a row. However, in MY5 and MY6 the hydroperiod did increase compared to the previous years and is trending in the right direction. An area, about 1.20 acres, has been considered as at-risk credits. If this well does not meet success again in MY7, RES will perform a wetland delineation and soil development investigation to refine and remove the unsuccessful area from crediting.

4.3 Vegetation

There were no vegetation problems identified in the Year 6 monitoring period. RES performed routine invasive species treatment and pine thinning across the entire site in July 2020.

5 YEAR 6 MONITORING CONDITIONS (MY6)

The Cedar Creek Year 6 Monitoring activities were completed in August and November 2020. Year 6 wetland, stream hydrology, and vegetation monitoring data is present below and in the appendices. Per the Approved Mitigation Plan, cross section monitoring was not collected in MY6, however, MY5 data is presented below and in the appendices for reference. Data presented shows the site has no stream problem areas and no vegetation problem areas. The site is on track to meeting stream, wetland, and vegetation interim success criteria.

5.1 Year 6 Monitoring Data Collection

5.1.1 Morphological State of the Channel (MY5)

Morphological stream data was not collected in MY6 per the Approved Mitigation Plan. The data below is from MY5 collected during the annual monitoring survey performed during May 2019. MY6 visual assessments found no stream problem areas. **Appendix B** includes summary data tables, morphological parameters, and stream photographs.

Profile
The baseline (MY-0) profiles closely matches the proposed design profiles. The plotted longitudinal profiles can be found on the As-Built Drawings. Longitudinal profiles will not be performed in annual monitoring reports unless requested by NCDMS or USACE. Morphological summary data tables can be found in **Appendix D**.

Dimension
The Year 5 (MY-5) cross sectional dimensions closely matches the baseline cross section parameters. Minimal changes were noticed for most Year 5 cross section surveys resulting from stable bed and bank conditions. All cross-section plots and data tables can be found in **Appendix D**.

Sediment Transport
The Year 5 conditions show that shear stress and velocities have been reduced for all six restoration reaches. Pre-construction conditions documented all six reaches as sand bed channels and remain classified as sand bed channels post-construction. Visual assessments (**Appendix B**) show the channels are transporting sediment as designed and will continue to be monitored for aggradation and degradation.

Bank Pin Arrays
Eight pool cross section locations with bank pin arrays were observed and measured for bank erosion located on the outside meander bends. If bank pin exposure was noticeable, it was measured, recorded, photographed, and then driven flush with the bank at each monitoring location. No bank pin arrays recorded any exposure during the Year 5 monitoring season (**Table 12**).

5.1.2 Vegetation

The Year 6 monitoring vegetation survey was completed in early August 2020 and resulted in an average of 621 planted stems per acre, well above the interim survival density of 210 stems per acre at the end of Year 7 monitoring. The stems per acre in plots ranged from 324 to 1,255. Eight volunteer tree species were noted during MY6 activities. The average planted stem height was 10.6 feet. Vegetation summary data tables can be found in **Appendix C** and vegetation plot photos in **Figure 5**.

5.1.3 Photo Documentation

Permanent photo point locations have been established at cross sections, vegetation plots, stream crossings, and stream structures by RES staff. Any additional problem areas or areas of concern will also be documented with a digital photograph during monitoring activities. Stream digital photographs can be found in **Figure 4** and **Figure 5** for vegetation photos.

5.1.4 Stream Hydrology

Three sets of manual and auto-logging crest gauges were installed on the site, one along UT2, one along UT2C, and one along UT3. The auto logging crest gauges were installed within the channel and continuously record flow conditions at hourly intervals. Crest Gauge 1 and 3 are recording bankfull events and Crest Gauge 2 is recording flow days. Due to maintenance issues and unreliable data on the manual crest gauges, RES only used HOBO readings to record bankfull events in MY6. Bankfull events were recorded on both crest gauges this year. Crest Gauge 1 documented eight bankfull events in MY6 with the highest reading being 0.67 feet above bankfull elevation. Crest Gauge 3 documented five bankfull events in MY6 with the highest reading being 0.13 feet above bankfull elevation. Crest Gauge 2, on the headwater valley restoration reach UT-2C, documented 104 consecutive flow days and 182 cumulative flow days in MY6. Stream hydrology data can be found in **Appendix E**.

5.1.5 Wetland Hydrology

Ten of the eleven wetland gauges achieved the success criteria by remaining continuously within 12 inches of the soil surface for at least nine percent of the growing season. Groundwater gauge data indicate the hydroperiods being very responsive to rainfall events. Wetland hydrology gauge AW7 fell short of the nine percent success criteria. AW7 documented 13 days consecutively (five percent) throughout the growing season. AW7 did not meet success criteria for the sixth year in a row. However, in MY5 and MY6 the hydroperiod did increase compared to the previous years and is trending in the right direction. An area, about 1.20 acres, has been considered as at-risk credits. If this well does not meet success again in MY7, RES will perform a wetland delineation and soil development investigation to refine and remove the unsuccessful area from crediting. REFAW2 and REFAW3 reference gauges documented hydroperiods well above the nine percent success criteria at 52 and 51 percent of the growing season, respectively. Wetland gauge and rainfall data is presented in **Table 15** and **Figure 8**.

6 REFERENCES

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Appendix A

Project Background Data and Maps

Table 1. Project Components and Mitigation Credits

Mitigation Credits

	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	5,230	0	13.10*	N/A	N/A	N/A	N/A	N/A	N/A

Project Components

Project Component -or- Reach ID	Mitigation Plan Stationing/Location (LF)	Existing Footage/Acreage	Approach (PI, PII etc.)	Restoration or-Restoration Equivalent	Mitigation Plan Restoration Footage or Acreage	Mitigation Ratio	SMUs/ WMUs
UT1	1+01 to 31+65	3,064	Enhancement II	R	3,064	1 : 2.5	1,226
UT1	31+65 to 35+80	415	Enhancement I	R	415	1 : 1.5	277
UT1	35+80 to 41+95	615	Enhancement II	R	615	1 : 2.5	246
UT1	41+95 to 44+60	265	Enhancement I	R	265	1 : 1.5	177
UT1	44+60 to 53+51	891	Enhancement II	R	827	1 : 2.5	331
UT2	0+11 to 3+48	364	Headwater Valley	R	337	1 : 1.0	337
UT2	3+48 to 9+12	587	P1 Restoration	R	504	1 : 1.0	504
UT2C	0+02 to 1+92	NA	Headwater Valley	R	190	1 : 1.0	190
UT3	0+60 to 19+72	1,428	P1 Restoration	R	1,912	1 : 1.0	1,912
UT4	0+36 to 1+14	78	Enhancement II	R	78	1 : 2.5	31
Wetland 1	Adjacent to UT1 & UT3	17.3	Restoration	R	13.10	1 : 1.0	13.10*

*1.20 acres of wetland are at-risk for credit due to unsuccessful hydrology data from AW7

Component Summation

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	2,416	13.10				
Headwater Valley	527					
Enhancement I	680					
Enhancement II	4,584					
Creation						
Preservation						
High Quality Preservation						

BMP Elements

Element	Location	Purpose/Function	Notes
---	---	---	---
---	---	---	---
---	---	---	---

BMP Elements

BR = Bioretention Cell; SF = Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP = Dry Detention Pond; FS = Filter Strip; S = Grassed Swale; LS = Level Spreader; NI = Natural Infiltration Area; FB = Forested Buffer

Credit calculations were originally calculated along the as-built thalweg. For Monitoring Year 3 forward, credits were updated to be calculated along stream centerlines following discussions stemming from the April 3, 2017 Credit Release Meeting

Table 2. Project Activity and Reporting History

Project Activity and Reporting History Cedar Creek Stream and Wetland Restoration Project / DMS Project #95718		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Mitigation Plan	NA	Aug-14
Final Design – Construction Plans	NA	Dec-14
Construction Completed	Mar-15	May-15
Site Planting Completed	May-15	May-15
Baseline Monitoring Document (Year 0 Monitoring – baseline)	Jul-15	Nov-15
Year 1 Monitoring	Dec-15	Feb-16
Year 2 Monitoring	Oct-16	Dec-16
Year 3 Monitoring	XS: July-17 VP: Aug-17	Feb-18
Beaver Management	NA	Sep-17
Year 4 Monitoring	VP: Aug-18	Jan-19
Stream and Wetland Repair	NA	Oct-18
Year 5 Monitoring	XS: May-19 VP: Aug-19	Jan-20
Invasive Treatment and Pine Thinning	NA	Jul-20
Year 6 Monitoring	VP: August-20	Nov-20
Year 7 Monitoring		

Table 3. Project Contacts

Project Contacts Table **Cedar Creek Stream and Wetland Restoration Project /DMS Project # 95718**	
Designer	WK Dickson and Co., Inc. 720 Corporate Center Drive Raleigh, NC 27607 (919) 782-0495 Frasier Mullen, PE
Construction Contractor	Wright Contracting PO Box 545 Siler City, NC 27344 (919) 663-0810 Joseph Wright
Planting Contractor	Resource Environmental Solutions, LLC 3600 Glenwood Avenue, Suite 100 Raleigh, NC 27612 (919) 209-1061 David Godley
Seeding Contractor	Wright Contracting PO Box 545 Siler City, NC 27344 (919) 663-0810 Joseph Wright
Seed Mix Sources	Green Resource
Nursery Stock Suppliers	Arbogen, NC Forestry Services Nursery
Full Delivery Provider Project Manager:	Resource Environmental Solutions, LLC 3600 Glenwood Avenue, Suite 100 Raleigh, NC 27612 Brad Breslow
Monitoring Performers Project Manager:	Resource Environmental Solutions, LLC 3600 Glenwood Avenue, Suite 100 Raleigh, NC 27612 (919) 741-6268 Ryan Medric

Table 4. Project Information

Project Information	
Project Name	Cedar Creek Site
County	Sampson
Project Area (acres)	42
Project Coordinates (latitude and longitude)	34° 57' 59.663" N 78° 22' 0.778" W

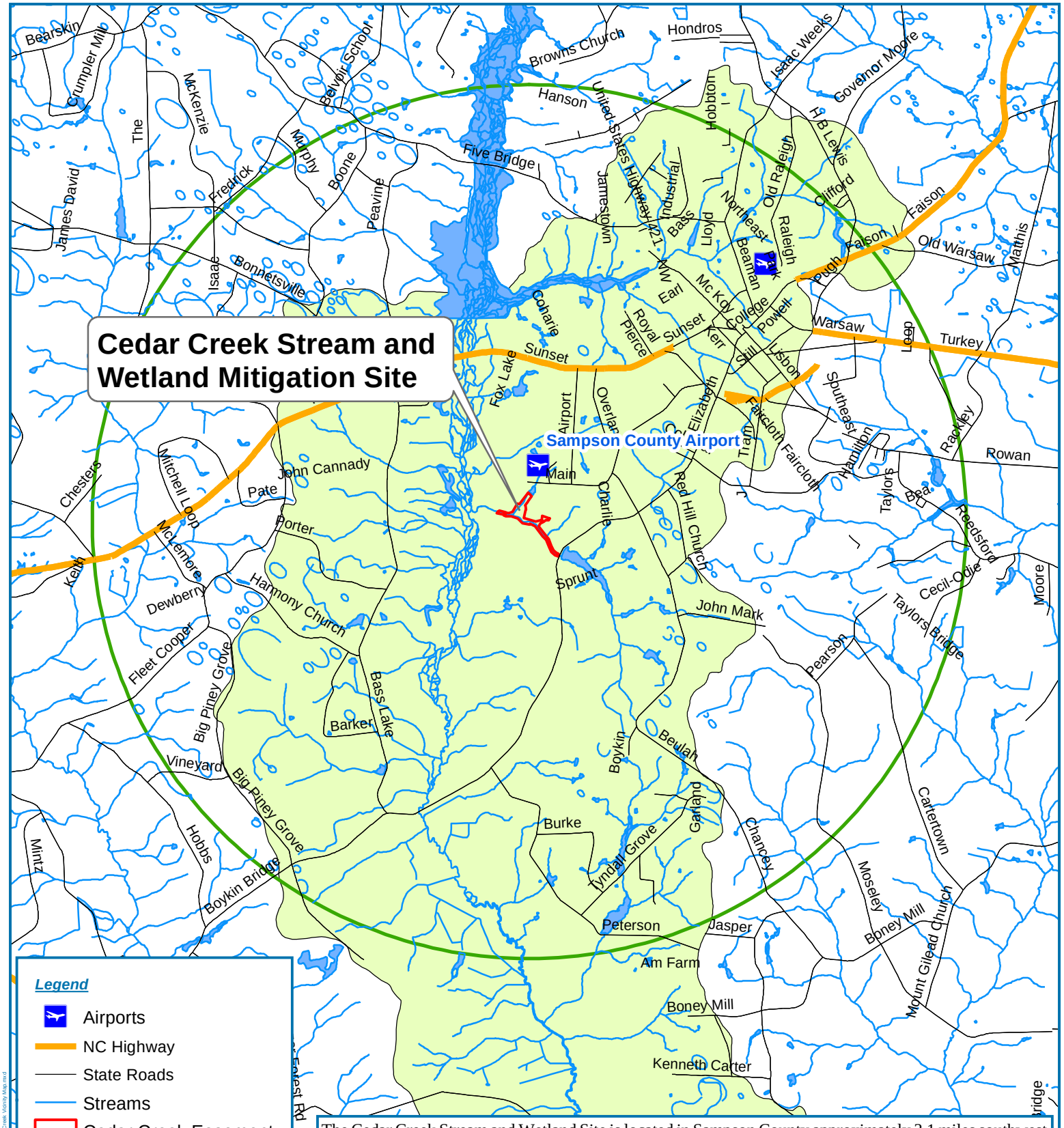
Project Watershed Summary Information	
Physiographic Province	Outer Coastal Plain
River Basin	Cape Fear
USGS Hydrologic Unit 8-digit	03030006
USGS Hydrologic Unit 14-digit	03003006090060
DWQ Sub-basin	03-06-19
Project Drainage Area (acres)	2,890 acres
DA Percentage of Impervious Area	4.50%
CGIA Land Use Classification	Woody wetlands, Shrub/scrub, cultivated crops, evergreen forest

Reach Summary Information (As-Built Conditions)				
Parameters	**UT1**	**UT2**	**UT3**	**UT4**
Length of reach (linear feet)	5,186	1,048	1,941	78
Valley Classification	X	X	X	X
Drainage area (acres)	2780	35	151	77
NCDWQ stream identification score	50	34.5	40	42.5
NCDWQ Water Quality Classification	N/A	N/A	N/A	N/A
Morphological Description (stream type)	E5	E5	E5	E5
Evolutionary trend	Stage II	Stage II/III	Stage II/III	Stage II/III
Underlying mapped soils	BH	Jo	BH	BH
Drainage class	frequently flooded	undrained	frequently flooded	frequently flooded
Soil Hydric status	Hydric	Hydric	Hydric	Hydric
Slope	0.20%	1.40%	1.10%	1.00%
FEMA classification	N/A	N/A	AE	N/A
Native vegetation community	cultivated, mixed hardwood forest	cultivated, mixed hardwood forest	mixed hardwood forest	mixed hardwood forest
Percent composition of exotic invasive vegetation	<5	0	0	<5

Table 4 con't. Project Information

Wetland Summary Information	
Parameters	**Wetland 1 UT1/3**
Size of Wetland (acres)	13.72
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian Riverine
Mapped Soil Series	Bibb/Johnson
Drainage class	Frequently Flooded
Soil Hydric Status	Hydric
Source of Hydrology	Runoff/Groundwater Discharge
Hydrologic Impairment	Incised Channel, Dredging
Native vegetation community	Forested
Percent composition of exotic invasive vegetation	1 – 2%

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States - Section 404	Yes	Yes	SAW-2013-00389
Waters of the United States - Section 401	Yes	Yes	DWR # 13-0186
Endangered Species Act	Yes	Yes	USFWS (Corr. Letter)
Historic Preservation Act	Yes	Yes	SHPO (Corr. Letter)
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	NA	N/A
FEMA Floodplain Compliance	Yes	Yes	EEP Floodplain Requirements Checklist
Essential Fisheries Habitat	No	NA	N/A



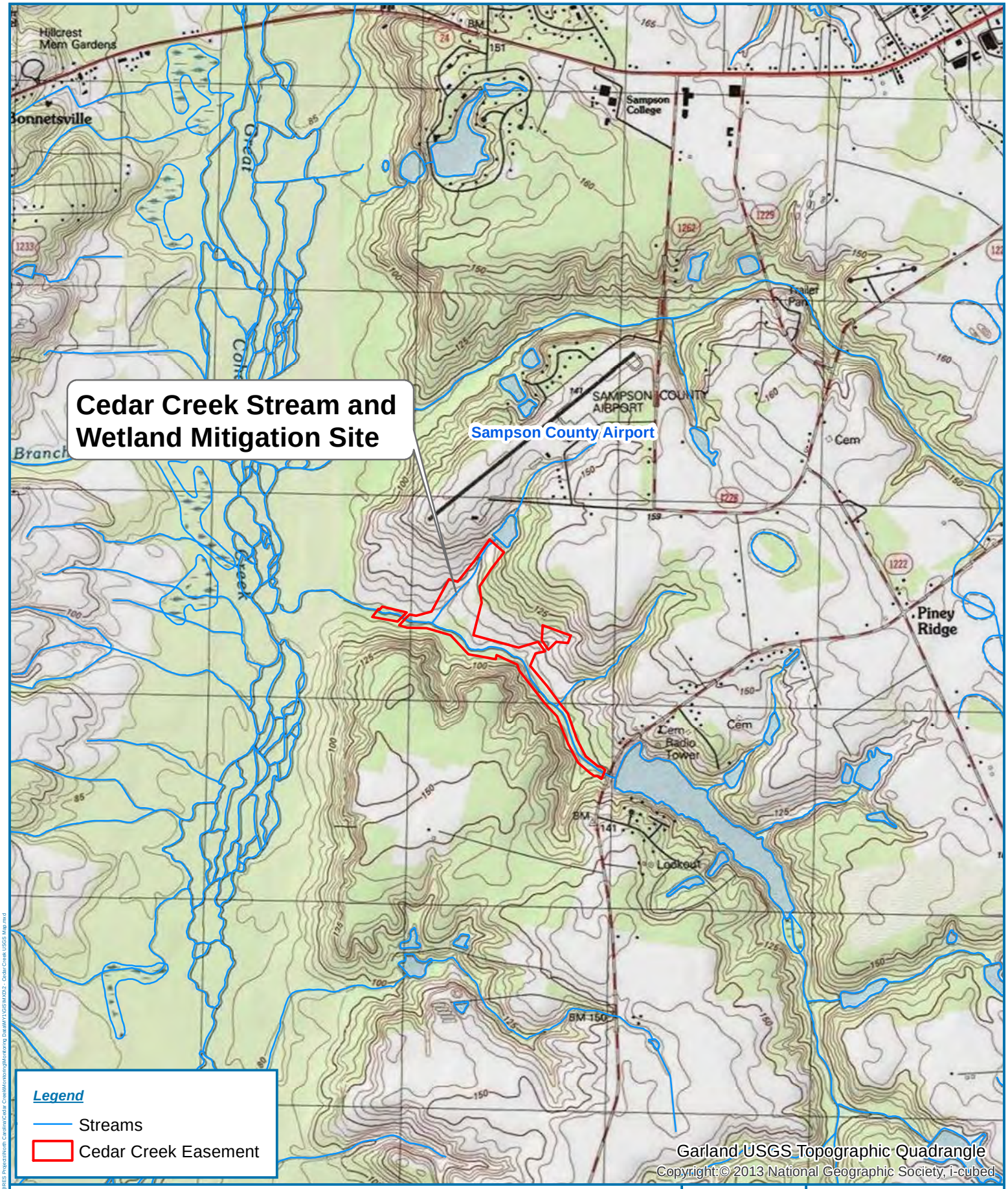
The Cedar Creek Stream and Wetland Site is located in Sampson County approximately 3.1 miles southwest of Clinton, NC. To access the Site from the town of Clinton, travel west on Highway 24 (Sunset Avenue), take a left onto Airport Road and go 1.3 miles. Turn right onto West Main Street Extension, go approximately 350 feet, and turn left onto a dirt farm path. Follow the farm path along the cultivated field edge to the southwest corner and enter the forest. Follow the dirt path to cultivated fields adjacent to the project below UT2. Turning to the left will take you to UT2. Going to the right will take you to UT3.

Figure1
Project Vicinity Map
Cedar Creek Stream and Wetland Restoration Site
Sampson County, North Carolina

Date: 11/6/2015
Drawn by: BSH

res

Document Path: E:\RES Files\Cedar Creek\MXD\GIS\MXD\MYD Baseline Monitoring Report\1 - Cedar Creek Vicinity Map.mxd



0 1,000 2,000
Feet

Figure2
Project USGS Map
Cedar Creek Stream and Wetland Restoration Site
Sampson County, North Carolina

Date: 2/16/2016
Drawn by: BSH

res

Document Path: C:\Users\bhodnett\Dropbox (RES)\RES Projects\North Carolina\Cedar Creek\Monitoring\Monitoring Data\MXY\GIS\MXD\2 - Cedar Creek USGS Map.mxd

Appendix B

Visual Assessment Data

res

0 100 200
Feet
1 inch = 200 feet

Figure 3b

Cedar Creek Restoration Project MY6 2020

Current Conditions Plan View

Date: 1/14/2021 | Drawn by: RTM

LEGEND

- Conservation Easement
- Wetland Restoration Area
- At Risk Wetland Area
- VP >210 stems/acre
- Cross Sections
- P1 Restoration
- Headwater Valley Restoration
- Enhancement I
- Enhancement II
- Bankpin
- Flow Gauge
- Crest Gauge

MY6 Well Hydroperiod

- >9%
- 5-8%
- No Data

Vegetation Condition Assessment

Invasive Species	Target Community: Present	Marginal	Absent
Absent	No Fill		
Present			

res

0 100 200
Feet

1 inch = 200 feet

Figure 3b

Cedar Creek Restoration Project MY6 2020

Current Conditions Plan View

Date: 1/14/2021 | Drawn by: RTM

LEGEND

- Conservation Easement
- Wetland Restoration Area
- At Risk Wetland Area
- VP >210 stems/acre
- Cross Sections
- P1 Restoration
- Headwater Valley Restoration
- Enhancement I
- Enhancement II
- Bankpin
- Flow Gauge
- Crest Gauge

MY6 Well Hydroperiod

- >9%
- 5-8%
- No Data

Vegetation Condition Assessment

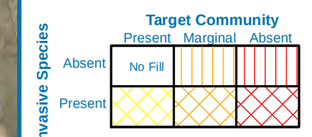


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Table 5 **Visual Stream Morphology Stability Assessment**
Reach ID **UT1**
Assessed Length **5186**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	5	5			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	5	5			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence doesnot exceed 15%. (See guidance for this table in EEP monitoring guidance document)	5	5			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	5	5			100%			

Table 5 **Visual Stream Morphology Stability Assessment**
Reach ID **UT2**
Assessed Length **855**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	21	21			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	21	21			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	21	21			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence doesnot exceed 15%. (See guidance for this table in EEP monitoring guidance document)	21	21			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	21	21			100%			

Table 5 **Visual Stream Morphology Stability Assessment**
Reach ID **UT2C**
Assessed Length **193**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	3	3			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	3	3			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	3	3			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence doesnot exceed 15%. (See guidance for this table in EEP monitoring guidance document)	3	3			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	3	3			100%			

Table 5 **Visual Stream Morphology Stability Assessment**
Reach ID **UT3**
Assessed Length **1941**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	19	19			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	19	19			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	19	19			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence doesnot exceed 15%. (See guidance for this table in EEP monitoring guidance document)	19	19			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	19	19			100%			

Table 5 **Visual Stream Morphology Stability Assessment**
Reach ID **UT4**
Assessed Length **78**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%			100%
				Totals	0	0	100%			100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	0	0			N/A			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	3. Bank Protection	Bank erosion within the structures extent of influence doesnot exceed 15%. (See guidance for this table in EEP monitoring guidance document)	0	0			N/A			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	0	0			N/A			

Table 6 Vegetation Condition Assessment

Planted Acreage[1] **20**

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	0.00	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	0.00	0.0%

Easement Acreage[2] **37.6**

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.

Table 7. Stream Problem Areas Cedar Creek Stream and Wetland Restoration Project - Project # 95718			
Feature Issue	**Station # / Range**	**Suspected Cause; Repair**	**Photo Number**

Table 8. Vegetation Problem Areas Cedar Creek Stream and Wetland Restoration Project - Project # 95718			
Feature Category	**Station Numbers**	**Suspected Cause; Repair**	**Photo Number**

Figure 5. MY6 Vegetation Plot Photos (8/5/2020)


Vegetation Plot 1


Vegetation Plot 2


Vegetation Plot 3


Vegetation Plot 4


Vegetation Plot 5


Vegetation Plot 6

Cedar Creek MY6 Vegetation Plot Photos (8/5/2020)


Vegetation Plot 7


Vegetation Plot 8


Vegetation Plot 9


Vegetation Plot 10


Vegetation Plot 11


Vegetation Plot 12

Cedar Creek MY6 Vegetation Plot Photos (8/5/2020)


Vegetation Plot 13


Vegetation Plot 14


Vegetation Plot 15


Vegetation Plot 16


Vegetation Plot 17


Vegetation Plot 18

Cedar Creek MY6 Vegetation Plot Photos (8/5/2020)

Vegetation Plot 19

Vegetation Plot 20

Appendix C

Vegetation Plot Data

Table 9a. Vegetation Plot Criteria Attainment Summary
Table 9b. CVS Vegetation Plot Metadata
Table 9c. Planted and Total Stem Counts (Species by Plot)

Table 9a. Vegetation Plot Criteria Attainment Summary

Plot #	Planted Stems/Acre	Volunteer Stems/Acre	Total Stems/Acre	Success Criteria Met?	Average Stem Height (ft)
1	971	971	1942	Yes	10.3
2	1255	40	1295	Yes	9.8
3	890	1093	1983	Yes	8.9
4	688	24483	25171	Yes	12.8
5	405	0	405	Yes	14.7
6	607	324	931	Yes	9.9
7	405	162	567	Yes	5.3
8	607	1174	1781	Yes	15
9	324	486	809	Yes	13.9
10	445	283	728	Yes	4.6
11	567	0	567	Yes	12.5
12	688	0	688	Yes	15.3
13	526	0	526	Yes	18
14	688	769	1457	Yes	5.8
15	809	728	1538	Yes	14.2
16	445	81	526	Yes	9.8
17	445	0	445	Yes	9.4
18	971	931	1902	Yes	2.2
19	324	0	324	Yes	10.4
20	364	162	526	Yes	9.6
Project Avg	**621**	**1584**	**2206**	Yes	**10.6**

Table 9b. CVS Vegetation Plot Metadata Cedar Creek Stream and Wetland Restoration Site	
Report Prepared By	Grayson Sanner
Date Prepared	9/18/2020 10:41
database name	Cedar_Creek_MY6_2020.mdb
database location	S:\@RES Projects\North Carolina\0104 - Cedar Creek\Monitoring\Monitoring Data\MY6_2020\Vegetation Data
computer name	DESKTOP-SN39OLO
file size	76546048
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY	
Project Code	95718
project Name	Cedar Creek Restoration Site
Description	
River Basin	Cape Fear
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	20

Table 9c. Planted and Total Stem Counts (Species by Plot)

Cedar Creek			Current Plot Data (MY6 2020)																												
			95718-01-0001			95718-01-0002			95718-01-0003			95718-01-0004			95718-01-0005			95718-01-0006			95718-01-0007			95718-01-0008			95718-01-0009			95718-01-0010		
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	PnoLS	P-all	T
Acer rubrum	red maple	Tree			15						25			600												25						
Asimina triloba	pawpaw	Tree																												5	5	5
Betula nigra	river birch	Tree	11	11	11							1	1	1	1	1	1							2	2	2						
Carya ovata	shagbark hickory	Tree																														
Chamaecyparis thyoides	Atlantic white cedar	Tree							5	5	5																6	6	6			
Crataegus aestivalis	may hawthorn	Shrub Tree																														
Diospyros virginiana	common persimmon	Tree	1	1	3													1	1	1	3	3	3									
Fraxinus pennsylvanica	green ash	Tree						1																								
Liquidambar styraciflua	sweetgum	Tree			7									3						8			3			2			3			
Liriodendron tulipifera	tuliptree	Tree												2												1						
Malus	apple	Tree																														
Morella cerifera	wax myrtle	shrub																											4			5
Nyssa sylvatica	blackgum	Tree																														
Pinus	pine	Tree																														
Pinus taeda	loblolly pine	Tree																				1				1			5			2
Platanus occidentalis	American sycamore	Tree	1	1	1							6	6	6	1	1	1							8	8	8				1	1	1
Quercus	oak	Tree																														
Quercus alba	white oak	Tree										1	1	1																		
Quercus lyrata	overcup oak	Tree	6	6	6				1	1	1	3	3	3	4	4	4	6	6	6										2	2	2
Quercus michauxii	swamp chestnut oak	Tree	1	1	1				1	1	1	1	1	1	1	1	1	4	4	4	5	5	5	1	1	1				2	2	2
Quercus nigra	water oak	Tree																														
Quercus phellos	willow oak	Tree	4	4	4				1	1	1	5	5	5										1	1	1				1	1	1
Rhus glabra	smooth sumac	shrub																														
Salix nigra	black willow	Tree									2																					
Sambucus	elderberry	Shrub																														
Taxodium distichum	bald cypress	Tree				31	31	31	14	14	14				3	3	3	4	4	4	2	2	2	3	3	3	2	2	2			
Unknown		Shrub or Tree																														
		Stem count	24	24	48	31	31	32	22	22	49	17	17	622	10	10	10	15	15	23	10	10	14	15	15	44	8	8	20	11	11	18
		size (ares)	1			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			0.02		
		Species count	6	6	8	1	1	2	5	5	7	6	6	9	5	5	5	4	4	5	3	3	5	5	5	9	2	2	5	5	5	7
		Stems per ACRE	971	971	1942	1255	1255	1295	890	890	1983	688	688	25171	405	405	405	607	607	931	405	405	567	607	607	1781	324	324	809	445	445	728

Cedar Creek			Current Plot Data (MY6 2020)																												
			95718-01-0011			95718-01-0012			95718-01-0013			95718-01-0014			95718-01-0015			95718-01-0016			95718-01-0017			95718-01-0018			95718-01-0019			95718-01-0020		
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	PnoLS	P-all	T
Acer rubrum	red maple	Tree															10														
Asimina triloba	pawpaw	Tree	1	1	1				1	1	1																				
Betula nigra	river birch	Tree	1	1	1										4	4	4														
Carya ovata	shagbark hickory	Tree																													
Chamaecyparis thyoides	Atlantic white cedar	Tree				11	11	11													2	2	2								
Crataegus aestivalis	may hawthorn	Shrub Tree										2	2	2																	
Diospyros virginiana	common persimmon	Tree										4	4	4															1	1	1
Fraxinus pennsylvanica	green ash	Tree																													
Liquidambar styraciflua	sweetgum	Tree												19			8			2											
Liriodendron tulipifera	tuliptree	Tree													1	1	1									11					
Malus	apple	Tree																													
Morella cerifera	wax myrtle	shrub																													
Nyssa sylvatica	blackgum	Tree																													
Pinus	pine	Tree																													
Pinus taeda	loblolly pine	Tree																								12					
Platanus occidentalis	American sycamore	Tree	1	1	1				4	4	4				7	7	7							2	2	2				1	1	1
Quercus	oak	Tree																													
Quercus alba	white oak	Tree										4	4	4										5	5	5					
Quercus lyrata	overcup oak	Tree	1	1	1				3	3	3	1	1	1	4	4	4	1	1	1	1	1	1	12	12	12				2	2	2
Quercus michauxii	swamp chestnut oak	Tree	3	3	3							3	3	3				3	3	3	2	2	2	1	1	1						
Quercus nigra	water oak	Tree	1	1	1				1	1	1																			1	1	1
Quercus phellos	willow oak	Tree	2	2	2							3	3	3	1	1	1	3	3	3				4	4	4	1	1	1			
Rhus glabra	smooth sumac	shrub																													
Salix nigra	black willow	Tree																													4
Sambucus	elderberry	Shrub																													
Taxodium distichum	bald cypress	Tree	4	4	4	6	6	6	4	4	4				3	3	3	4	4	4	6	6	6				7	7	7	4	4	4
Unknown		Shrub or Tree																													
		Stem count	14	14	14	17	17	17	13	13	13	17	17	36	20	20	38	11	11	13	11	11	11	24	24	47	8	8	8	9	9	13
		size (ares)	1			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			0.02		
		Species count	8	8	8	2	2	2	5	5	5	6	6	7	6	6	8	4	4	5	4	4	4	5	5	7	2	2	2	5	5	6
		Stems per ACRE	567	567	567	688	688	688	526	526	526	688	688	1457	809	809	1538	445	445	526	445	445	445	971	971	1902	324	324	324	364	364	526

Cedar Creek			Annual Means																		
			MY6 (2020)			MY5 (2019)			MY4 (2018)			MY3 (2017)			MY2 (2016)			MY1 (2015)			MY0 (2015)		
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
Acer rubrum	red maple	Tree			675			181			1839			1042						15			
Asimina triloba	pawpaw	Tree	7	7	7	8	8	8	13	13	13	13	13	13	16	16	16	22	22	22	30	30	30
Betula nigra	river birch	Tree	20	20	20	20	20	20	21	21	21	21	21	21	22	22	22	22	22	22	28	28	28
Carya ovata	shagbark hickory	Tree												2									
Chamaecyparis thyoides	Atlantic white cedar	Tree	24	24	24	24	24	24	24	24	24	25	25	25	28	28	28	32	32	32	34	34	34
Crataegus aestivalis	may hawthorn	Shrub Tree	2	2	2	2	2	2	2	2	2	2	2	2									
Diospyros virginiana	common persimmon	Tree	10	10	12	12	12	12	5	5	5	5	5	5	4	4	4						
Fraxinus pennsylvanica	green ash	Tree			1																		
Liquidambar styraciflua	sweetgum	Tree			55			278			36			170						16			
Liriodendron tulipifera	tuliptree	Tree	1	1	15	1	1	32	1	1	315	1	1	47	3	3	3	9	9	9	19	19	19
Malus	apple	Tree													3	3	3	4	4	4	10	10	10
Morella cerifera	wax myrtle	shrub			9			5															
Nyssa sylvatica	blackgum	Tree				1	1	1	3	3	3	4	4	4	1	1	1						
Pinus	pine	Tree									25												
Pinus taeda	loblolly pine	Tree			21			38						3									
Platanus occidentalis	American sycamore	Tree	32	32	32	32	32	32	32	32	32	32	32	32	33	33	33	35	35	35	40	40	40
Quercus	oak	Tree							4	4	4	5	5	5	10	10	10	20	20	20	181	181	181
Quercus alba	white oak	Tree	10	10	10	10	10	10															
Quercus lyrata	overcup oak	Tree	47	47	47	50	50	56	49	49	49	48	48	48	55	55	55	54	54	54			
Quercus michauxii	swamp chestnut oak	Tree	28	28	28	28	28	28	33	33	33	35	35	35	51	51	51	61	61	61	35	35	35
Quercus nigra	water oak	Tree	3	3	3	3	3	9	7	7	16	6	6	27	7	7	7	9	9	9	2	2	2
Quercus phellos	willow oak	Tree	26	26	26	27	27	27	30	30	30	34	34	37	35	35	35	44	44	44	21	21	21
Rhus glabra	smooth sumac	shrub						5															
Salix nigra	black willow	Tree			6			8			9			7									
Sambucus	elderberry	Shrub																			1	1	1
Taxodium distichum	bald cypress	Tree	97	97	97	97	97	97	98	98	98	98	98	98	102	102	102	107	107	107	142	142	142
Unknown		Shrub or Tree																			3	3	3
		Stem count	307	307	1090	315	315	873	322	322	2554	329	329	1623	370	370	370	419	419	450	546	546	546
		size (ares)	20			20			20			20			20			20			20		
		size (ACRES)	0.49			0.49			0.49			0.49			0.49			0.49			0.49		
		Species count	13	13	19	14	14	20	14	14	18	14	14	19	14	14	14	12	12	14	13	13	13
		Stems per ACRE	621	621	2206	637	637	1766	652	652	5168	666	666	3284	749	749	749	848	848	911	1105	1105	1105

Appendix D

Stream Geomorphology Data

Table 10. Cedar Creek Morphological Parameters

	Reference Reach			Existing[1]										Design				As-Built			
				UT1 (Upper)		UT1 (Lower)		UT2 Reach A		UT3 Reach A (Upper)	UT3 Reach A (Lower)		UT4	UT2		UT3		UT2		UT3	
Feature	Pool	Run	Shallow	Shallow	Pool	Shallow	Pool	Shallow	Run	Run	Shallow	Run	Shallow	Shallow	Pool	Shallow	Pool	Shallow	Pool	Shallow	Pool
Drainage Area (ac)	81			2514		2780		34		116	150		79	41		146		41		146	
Drainage Area (mi^2)	0.13			3.93		4.34		0.05		0.18	0.23		0.12	0.06		0.23		0.06		0.23	
NC Regional Curve Discharge (cfs)[2]	---	---	3.7	44.3		47.7		2.0		4.8	5.8		3.7	2.3		5.7		2.3		5.7	
NC Regional Curve Discharge (cfs)[3]	---	---	1.8	24.9		26.8		0.9		2.4	2.9		1.8	1.1		2.9		1.1		2.9	
Design/Calculated Discharge (cfs)	---	---	5	---		---		---		---	---		---	4.0		6.0		4.0		6.0	
Dimension																					
BF Width (ft)	6.3	14.0	6.2	18.2	14.1	11.0	10.9	4.8	5.2	4.0	10.4	7.7	6.2	4.6	5.4	6.0	7.0	7.5	7.1	7.9	7.2
Floodprone Width (ft)	100.0	100.0	100.0	100	100	100	100	100	100	100	100	100	100	>50	>50	>50	>50	>50	>50	>50	>50
BF Cross Sectional Area (ft^2)	4.0	5.9	2.9	42.1	46.4	32.2	29.2	2.4	3.0	3.4	5.5	4.8	5.6	2.2	3.1	3.6	4.8	2.9	2.9	4.1	4.2
BF Mean Depth (ft)	0.6	0.4	0.5	2.3	3.3	2.9	2.7	0.5	0.6	0.9	0.5	0.6	0.9	0.5	0.6	0.6	0.7	0.4	0.4	0.5	0.6
BF Max Depth (ft)	1.0	0.5	0.8	3.2	4.4	3.7	3.3	0.7	0.9	1.0	0.8	1.1	1.3	0.7	1.0	0.8	1.2	0.9	0.9	1.0	1.2
Width/Depth Ratio	10.2	33.3	13.4	7.9	4.3	3.8	4.1	9.6	10.5	4.7	19.7	12.2	6.9	10.2	9.4	10.2	10.1	20.1	18.1	15.6	13.2
Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	1.2	1.3	1.6	2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2
Wetted Perimeter (ft)	7.1	14.2	6.7	20.4	18.8	15.8	16.2	5.2	5.9	5.8	10.7	8.2	7.1	4.9	5.9	6.4	7.6	7.7	7.5	8.3	7.7
Hydraulic Radius (ft)	0.6	0.4	0.4	2.1	2.5	2.0	1.8	0.5	0.5	0.6	0.5	0.6	0.8	0.4	0.5	0.6	0.6	0.4	0.4	0.5	0.5
Substrate																					
	Medium/Coarse Sand			Medium/Coarse Sand										Medium/Coarse Sand				Medium/Coarse Sand			
Pattern																					
	Min	**Max**	**Med**	---		---		---		---	---		---	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Channel Beltwidth (ft)	13.0	19.3	13.9	---		---		---		---	---		---	10.5	15.7	12.6	18.8	10.3	23.9	14.3	23.3
Radius of Curvature (ft)	5.2	11.7	9.9	---		---		---		---	---		---	4.2	9.4	5.1	11.3	8.6	22.0	6.4	20.8
Radius of Curvature Ratio	0.7	1.6	1.3	---		---		---		---	---		---	1.0	3.0	1.0	3.0	1.1	2.9	0.8	2.6
Meander Wavelength (ft)	13.3	22.5	21.1	---		---		---		---	---		---	4.6	13.8	6.0	18.0	5.0	18.3	6.5	19.5
Meander Width Ratio	2.1	3.1	2.2	---		---		---		---	---		---	2.1	3.1	2.1	3.1	1.4	3.2	1.8	2.9
Profile																					
Shallow Length (ft)	2.0	30.9	10.9	---		---		---		---	---		---	1.6	24.5	1.9	29.4	2.5	26.2	2.3	33.2
Run Length (ft)	1.0	20.1	6.9	---		---		---		---	---		---	0.8	15.9	0.9	19.1	2.1	18.5	2.3	23.2
Pool Length (ft)	2.6	12.1	5.8	---		---		---		---	---		---	2.1	9.6	2.5	11.5	3.2	10.2	3.7	12.2
Pool -to-Pool Spacing (ft)	10.1	61.0	28.6	---		---		---		---	---		---	8.0	48.3	9.6	57.9	12.5	55.6	10.1	60.7
Additional Reach Parameters																					
Valley Length (ft)	164			3376		1515		255		486	731		78	643		1600		643		1600	
Channel Length (ft)	203			3694		1574		275		496	739		78	724		1912		740		1941	
Sinuosity	1.24			1.09		1.04		1.08		1.02	1.01		1.00	1.13		1.20		1.15		1.21	
Water Surface Slope (ft/ft)	0.009			---		---		---		---	---		---	---		---		---		---	
Channel Slope (ft/ft)	0.009			0.0022		0.0016		0.012		0.0164	0.007		0.010	0.0170		0.0095		0.0202		0.0130	
Rosgen Classification	E/C5			E5		E5		E5		E5	E5		E5	E5		E5		E5		E5	

[1] Bankfull stage was estimated using NC Regional Curve equations and existing conditions data

[2] NC Regional Curve equations source: Doll et al. (2003)

[3] NC Regional Curve equations source: Sweet and Geratz (2003)

Appendix D. Table 11. - Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)

Project Name/Number: Cedar Creek Site/ NCDMS Project # 95718

	Cross Section 1 (Run)							Cross Section 2 (Run)							Cross Section 3 (Riffle)							Cross Section 4 (Run)							Cross Section 5 (Riffle)						
Dimension	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]	89.8	89.8	89.8	89.8	89.6			89.2	89.2	89.2	89.2	88.2			88.1	88.1	88.1	88.1	88.1			85.8	85.8	85.8	85.8	85.4			106.1	106.1	106.1	106.1	106.3		
Bankfull Width (ft)[1]	19.0	18.5	19.0	18.9	17.4			14.3	14.2	14.4	16.5	16.7			23.8	26.1	23.5	23.1	20.2			14.4	14.5	15.0	16.7	13.7			6.9	6.3	6.9	6.6	7.2		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.0			50.0	50.0	50.0	50.0	43.8			50.0	50.0	50.0	50.0	50.2			50.0	50.0	50.0	50.0	46.4			50.0	50.0	50.0	50.0	33.2		
Bankfull Mean Depth (ft)	2.2	2.1	2.3	2.3	-			2.7	2.8	3.0	3.7	-			1.9	1.7	2.0	1.9	-			1.7	1.8	2.0	1.9	-			0.5	0.5	0.5	0.5	-		
Bankfull Max Depth (ft)[2]	3.8	3.8	4.0	3.9	4.2			3.9	4.1	4.0	5.3	5.1			3.3	3.1	3.6	3.7	3.4			2.5	2.6	2.8	2.5	3.3			1.0	0.8	0.9	0.9	0.7		
Low Bank Elevation (ft)	-	-	-	-	89.8			-	-	-	-	90.4			-	-	-	-	87.6			-	-	-	-	86.5			-	-	-	-	106.2		
Bankfull Cross Sectional Area (ft2)[2]	41.6	38.9	43.6	42.8	45.0			38.0	40.1	43.1	61.3	82.9			45.5	43.7	46.8	44.6	37.6			24.7	26.3	29.8	31.4	41.4			3.7	3.2	3.2	3.3	2.8		
Bankfull Width/Depth Ratio	8.6	8.8	8.2	8.3	-			5.4	5.1	4.8	44.0	-			12.4	15.6	11.8	12.0	-			8.4	8.0	7.5	8.9	-			12.8	12.2	14.5	13.1	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2			2.1	1.9	2.1	2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.1	1.8			1.0	1.0	1.0	1.1	<1			1.0	1.0	1.0	1.1	1.5			1.0	1.0	1.0	1.0	<1		

	Cross Section 6 (Pool)							Cross Section 7 (Riffle)							Cross Section 8 (Pool)							Cross Section 9 (Riffle)							Cross Section 10 (Pool)						
Dimension	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]	105.3	105.3	105.3	105.3	105.4			103.5	103.5	103.5	103.5	103.7			103.5	103.5	103.5	103.5	103.5			97.9	97.9	97.9	97.9	98.1			97.4	97.4	97.4	97.4	97.5		
Bankfull Width (ft)[1]	5.9	4.6	5.3	4.9	5.3			7.3	6.5	7.7	6.5	6.7			7.1	8.1	7.6	7.8	8.3			7.5	5.7	6.6	5.5	8.3			5.7	5.3	4.9	4.6	7.5		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.0			50.0	50.0	50.0	50.0	50.2			50.0	50.0	50.0	50.0	50.0			50.0	50.0	50.0	50.0	50.3			50.0	50.0	50.0	50.0	50.0		
Bankfull Mean Depth (ft)	0.4	0.4	0.4	0.4	-			0.6	0.6	0.6	0.6	-			0.7	0.6	0.7	0.7	-			0.5	0.4	0.5	0.4	-			0.6	0.5	0.7	0.6	-		
Bankfull Max Depth (ft)[2]	0.7	0.6	0.9	0.9	0.8			1.1	1.0	1.0	1.0	1.2			1.2	1.4	1.5	1.6	1.6			1.0	0.8	0.9	0.8	0.9			1.1	1.0	1.0	1.2	1.5		
Low Bank Elevation (ft)	-	-	-	-	105.4			-	-	-	-	103.7			-	-	-	-	103.5			-	-	-	-	97.9			-	-	-	-	97.7		
Bankfull Cross Sectional Area (ft2)[2]	2.1	1.6	2.0	2.1	2.1			4.5	3.9	4.6	4.1	4.7			5.0	5.1	5.6	5.5	4.8			4.0	2.4	3.0	2.2	2.9			3.5	2.4	3.3	2.9	5.0		
Bankfull Width/Depth Ratio	16.0	12.8	13.7	11.2	-			11.8	10.9	12.9	10.5	-			9.9	13.0	10.3	10.9	-			14.2	13.5	14.4	13.7	-			9.1	11.7	7.2	7.2	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A			>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	N/A	N/A			>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A			1.0	1.0	1.0	1.0	1.0			1.0	1.0	1.0	N/A	N/A			1.0	1.0	1.0	1.2	<1			1.0	1.0	1.0	N/A	N/A		

	Cross Section 11 (Riffle)							Cross Section 12 (Pool)							Cross Section 13 (Pool)							Cross Section 14 (Riffle)							Cross Section 15 (Riffle)						
Dimension	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]	93.5	93.5	93.5	93.5	93.5			93.1	93.1	93.1	93.1	93.4			90.9	90.9	90.9	90.9	91.3			90.9	90.9	90.9	90.9	91.1			89.0	89.0	89.0	89.0	89.0		
Bankfull Width (ft)[1]	10.4	6.9	9.3	11.7	10.6			8.1	6.6	6.5	7.6	17.0			9.3	5.4	7.0	5.9	7.5			9.6	6.2	6.4	6.5	7.0			6.8	6.4	6.9	6.7	7.0		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.2			50.0	50.0	50.0	50.0	50.2			50.0	50.0	50.0	50.0	50.3			50.0	50.0	50.0	50.0	50.2			50.0	50.0	50.0	50.0	50.2		
Bankfull Mean Depth (ft)	0.5	0.6	0.4	0.4	-			0.8	0.7	0.8	0.6	-			0.4	0.2	0.4	0.4	-			0.4	0.5	0.4	0.4	-			0.6	0.5	0.6	0.6	-		
Bankfull Max Depth (ft)[2]	1.1	0.9	1.0	1.0	1.1			1.8	1.7	1.8	1.4	1.6			0.9	0.4	0.8	0.7	0.8			1.0	1.0	0.8	0.7	0.7			1.0	1.1	1.3	1.3	1.3		
Low Bank Elevation (ft)	-	-	-	-	93.4			-	-	-	-	93.3			-	-	-	-	91.0			-	-	-	-	90.8			-	-	-	-	89.0		
Bankfull Cross Sectional Area (ft2)[2]	4.8	4.2	3.6	4.8	3.9			6.6	4.7	5.1	4.9	5.5			3.9	1.2	2.6	2.2	1.8			3.7	2.9	2.7	2.3	2.2			4.3	3.5	4.1	4.1	4.3		
Bankfull Width/Depth Ratio	22.2	11.1	24.0	28.6	-			10.0	9.3	8.3	11.7	-			22.2	23.2	19.0	15.9	-			25.0	13.4	15.2	18.0	-			10.8	11.9	11.7	11.1	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	N/A	N/A			>2.2	>2.2	>2.2	N/A	N/A			>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	0.9	<1			1.0	1.0	1.0	N/A	N/A			1.0	1.0	1.0	N/A	N/A			1.0	1.0	1.0	1.0	<1			1.0	1.0	1.0	1.0	1.0		

	Cross Section 16 (Pool)							Cross Section 17 (Pool)							Cross Section 18 (Riffle)							Cross Section 19 (Run)							Cross Section 20 (Run)						
Dimension	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]	88.8	88.8	88.8	88.8	88.8			87.4	87.4	87.4	87.4	87.5			87.1	87.1	87.1	87.1	87.2			108.8	108.8	108.8	108.8	109.8			105.4	105.4	105.4	105.4	105.5		
Bankfull Width (ft)[1]	7.1	7.1	8.5	6.6	7.3			7.1	7.2	7.1	6.3	6.2			7.0	6.9	7.7	6.7	6.8			7.5	6.3	6.8	7.2	6.4			8.8	5.9	5.9	6.1	11.1		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.2			50.0	50.0	50.0	50.0	49.9			50.0	50.0	50.0	50.0	50.0			50.0	50.0	50.0	50.0	49.9			50.0	50.0	50.0	50.0	50.0		
Bankfull Mean Depth (ft)	0.5	0.5	0.5	0.6	-			0.6	0.6	0.6	0.6	-			0.6	0.5	0.5	0.5	-			0.4	0.3	0.3	0.3	-			0.3	0.4	0.3	0.3	-		
Bankfull Max Depth (ft)[2]	1.1	1.0	1.1	1.1	1.2			1.3	1.3	1.4	1.3	1.5			1.1	1.0	1.0	1.0	1.1			0.8	0.6	0.5	0.8	0.7			0.6	0.7	0.6	0.6	0.4		
Low Bank Elevation (ft)	-	-	-	-	88.8			-	-	-	-	87.6			-	-	-	-	87.2			-	-	-	-	108.8			-	-	-	-	105.3		
Bankfull Cross Sectional Area (ft2)[2]	3.8	3.5	3.8	3.9	3.8			4.2	4.0	4.2	3.7	4.7			4.0	3.5	3.7	3.5	3.9			2.9	2.1	2.0	2.2	1.4			2.7	2.2	2.0	2.1	1.2		
Bankfull Width/Depth Ratio	13.1	14.4	18.8	11.4	-			12.0	13.0	12.0	10.8	-			12.3	13.7	16.0	12.9	-			19.6	19.4	23.4	23.5	-			29.1	15.7	17.4	17.7	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A			>2.2	>2.2	>2.2	N/A	N/A			>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A			1.0	1.0	1.0	N/A	N/A			1.0	1.0	1.0	1.1	1.0			1.0	1.0	1.0	1.0	<1			1.0	1.0	1.0	1.2	<1		

Note: In MY3, BHR was calculated on riffles using the baseline bankfull elevation. This method was used because the dimension of the channels has not changed enough to alter the bankfull elevation. None of the riffle cross sections exceeded a 1.2 BHR.
Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull elevation. These changes reflect the 2018 guidance that arose from the mitigation technical workgroup consisting of DMS, the IRT, and industry mitigation providers.

Appendix D. Table 11. - Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)

Project Name/Number: Cedar Creek Site/ NCDMS Project # 95718

	Cross Section 21 (Pool)							Cross Section 22 (Riffle)							Cross Section 23 (Riffle)							Cross Section 24 (Pool)							Cross Section 25 (Pool)						
Dimension	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]	101.8	101.8	101.8	101.8	101.8			101.3	101.3	101.3	101.3	101.4			95.6	95.6	95.6	95.6	95.6			95.4	95.4	95.4	95.4	95.5			91.5	91.5	91.5	91.5	91.6		
Bankfull Width (ft)[1]	8.9	11.1	10.0	9.9	9.9			6.0	5.9	6.7	6.4	6.9			8.3	8.7	7.0	7.5	7.4			5.9	5.7	6.4	6.5	7.4			6.6	6.6	6.8	6.3	8.7		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.9			50.0	50.0	50.0	50.0	49.7			50.0	50.0	50.0	50.0	49.8			50.0	50.0	50.0	50.0	49.8			50.0	50.0	50.0	50.0	49.8		
Bankfull Mean Depth (ft)	0.3	0.4	0.3	0.4	-			0.5	0.6	0.4	0.5	-			0.4	0.3	0.5	0.4	-			0.5	0.4	0.5	0.4	-			0.4	0.4	0.4	0.4	-		
Bankfull Max Depth (ft)[2]	0.9	0.9	0.7	0.9	0.7			0.9	1.0	0.8	0.9	0.5			1.3	1.0	1.4	1.1	1.2			1.1	1.0	1.1	1.1	1.1			0.8	8.0	0.8	0.8	0.9		
Low Bank Elevation (ft)	-	-	-	-	101.6			-	-	-	-	101.2			-	-	-	-	95.6			-	-	-	-	95.4			-	-	-	-	91.5		
Bankfull Cross Sectional Area (ft2)[2]	3.1	4.0	3.3	3.7	1.9			3.1	3.3	2.7	3.2	1.8			3.1	2.9	3.3	3.2	2.6			3.0	2.2	2.9	2.5	2.9			2.6	2.9	2.5	2.5	2.3		
Bankfull Width/Depth Ratio	25.6	30.8	30.6	26.8	-			11.6	10.7	16.8	13.0	-			21.9	26.1	15.0	17.2	-			11.8	14.7	14.1	16.7	-			17.0	15.3	18.8	16.1	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A			>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	N/A	N/A			>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A			1.0	1.0	1.0	0.9	<1			1.0	1.0	1.0	0.9	1.0			1.0	1.0	1.0	N/A	N/A			1.0	1.0	1.0	N/A	N/A		

	Cross Section 26 (Riffle)							Cross Section 27 (Run)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	91.3	91.3	91.3	91.3	91.4			105.3	105.3	105.3	105.3	105.5		
Bankfull Width (ft)[1]	6.8	8.2	6.0	6.8	11.5			6.4	5.7	5.7	6.8	8.6		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.9			50.0	50.0	50.0	50.0	49.9		
Bankfull Mean Depth (ft)	0.4	0.3	0.3	0.3	-			0.4	0.4	0.4	0.4	-		
Bankfull Max Depth (ft)[2]	0.7	0.7	0.6	0.6	0.5			0.9	0.8	0.8	0.9	0.9		
Low Bank Elevation (ft)	-	-	-	-	91.2			-	-	-	-	105.4		
Bankfull Cross Sectional Area (ft2)[2]	2.5	2.4	1.9	2.1	1.4			2.8	2.1	2.1	2.6	2.3		
Bankfull Width/Depth Ratio	18.1	27.3	18.9	21.8	-			14.8	15.2	15.5	17.9	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2			>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.0	<1			1.0	1.0	1.0	1.0	<1		

Note: In MY3, BHR was calculated on riffles using the baseline bankfull elevation. This method was used because the dimension of the channels has not changed enough to alter the bankfull elevation. None of the riffle cross sections exceeded a 1.2 BHR.

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull elevation. These changes reflect the 2018 guidance that arose from the mitigation technical workgroup consisting of DMS, the IRT, and industry mitigation providers.

Table 12.Cedar Creek Bank Pin Array Summary

Cross Section	Location	Position	Year 1 Reading	Year 2 Reading	Year 3 Reading	Year 5 Reading
XS 6 @ Sta. 3+25 Reach UT3	US	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
	DS	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
XS 10 @ Sta. 8+80 Reach UT3	US	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
	DS	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
XS 12 @ Sta. 12+90 Reach UT3	US	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
	DS	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
XS 13 @ Sta. 14+50 Reach UT3	US	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
	DS	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
XS 16 @ Sta. 16+95 Reach UT3	US	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
	DS	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
XS 17 @ Sta. 18+50 Reach UT3	US	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
	DS	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
XS 24 @ Sta. 6+60 Reach UT2	US	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
	DS	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
XS 25 @ Sta. 8+25 Reach UT2	US	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0
	DS	Top	0.0	0.0	0.0	0.0
		Bottom	0.0	0.0	0.0	0.0

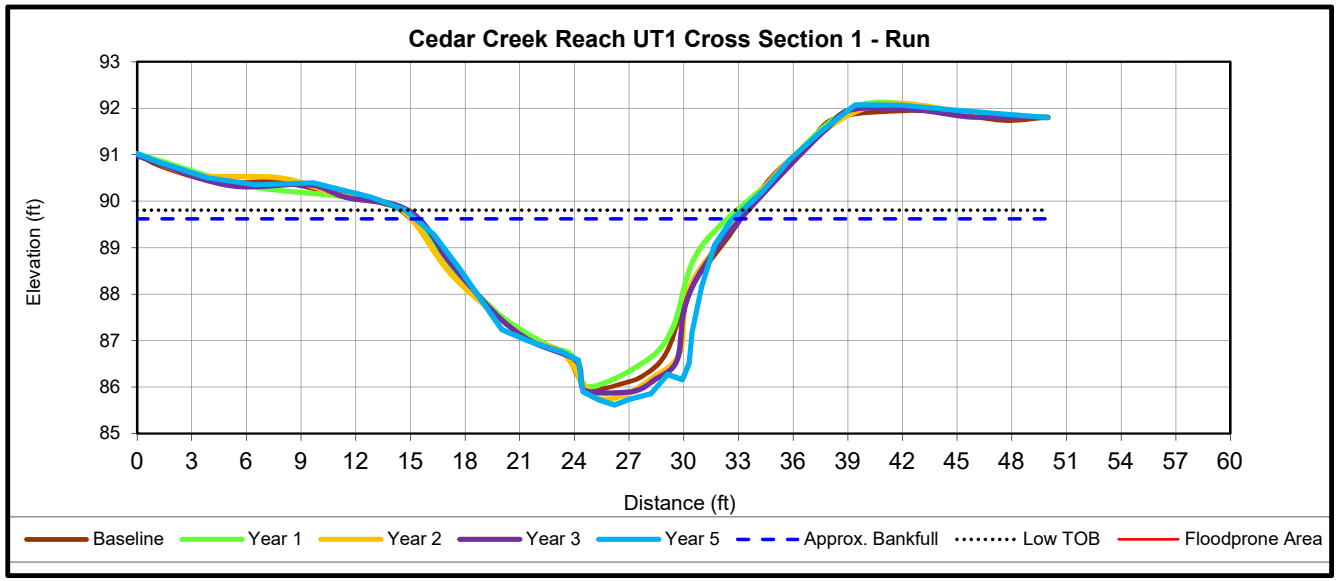
Notes:

US - Upstream from cross section

DS - Downstream from cross section

Upstream

Downstream

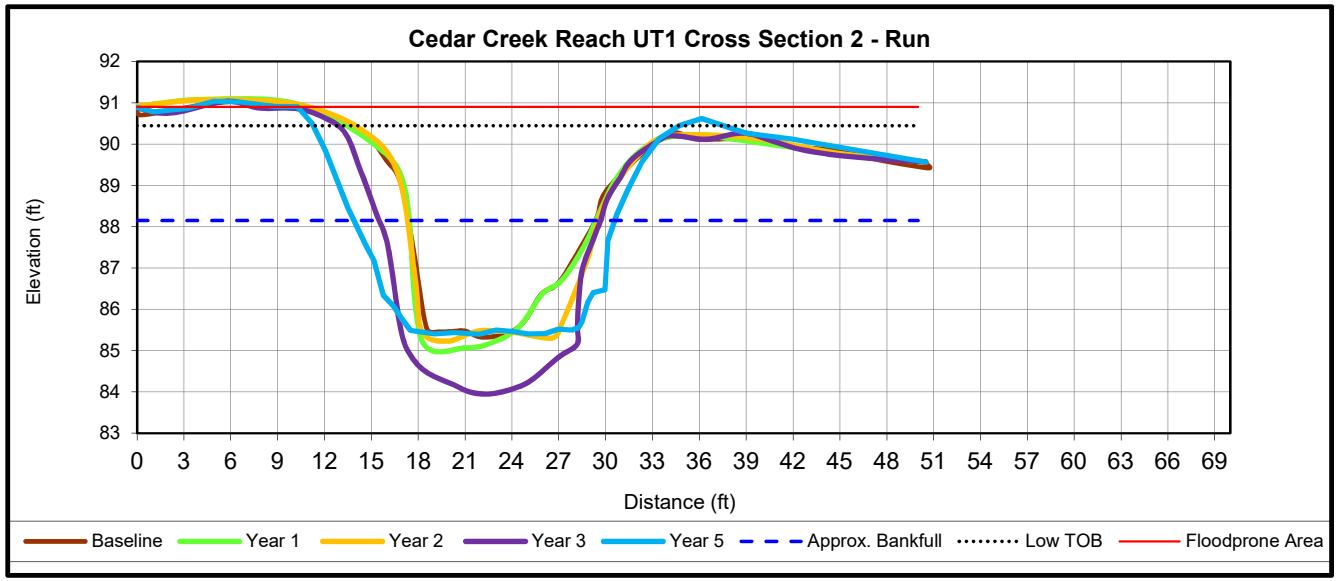


	Cross Section 1 (Run)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	89.8	89.8	89.8	89.8	89.6		
Bankfull Width (ft)[1]	19.0	18.5	19.0	18.9	17.4		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.0		
Bankfull Mean Depth (ft)	2.2	2.1	2.3	2.3	-		
Bankfull Max Depth (ft)[2]	3.8	3.8	4.0	3.9	4.2		
Low Bank Elevation (ft)	-	-	-	-	89.8		
Bankfull Cross Sectional Area (ft^2)[2]	41.6	38.9	43.6	42.8	45.0		
Bankfull Width/Depth Ratio	8.6	8.8	8.2	8.3	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.0	1.0		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

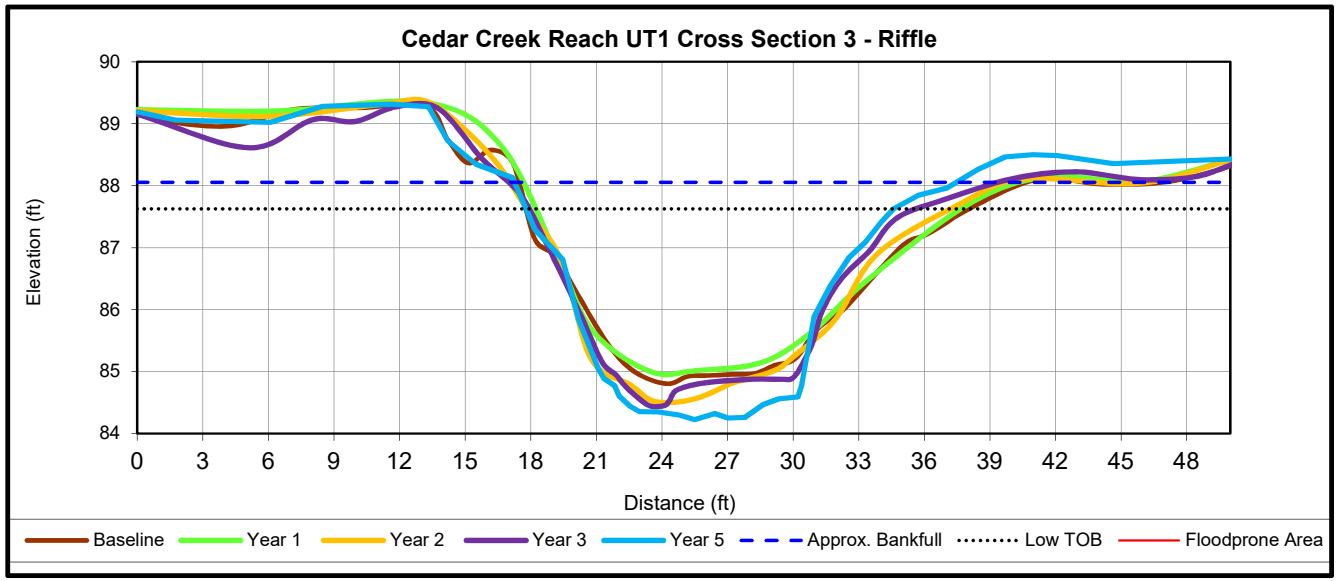


	Cross Section 2 (Run)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	89.2	89.2	89.2	89.2	88.2		
Bankfull Width (ft)[1]	14.3	14.2	14.4	16.5	16.7		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	43.8		
Bankfull Mean Depth (ft)	2.7	2.8	3.0	3.7	-		
Bankfull Max Depth (ft)[2]	3.9	4.1	4.0	5.3	5.1		
Low Bank Elevation (ft)	-	-	-	-	90.4		
Bankfull Cross Sectional Area (ft^2)[2]	38.0	40.1	43.1	61.3	82.9		
Bankfull Width/Depth Ratio	5.4	5.1	4.8	44.0	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.1	1.8		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

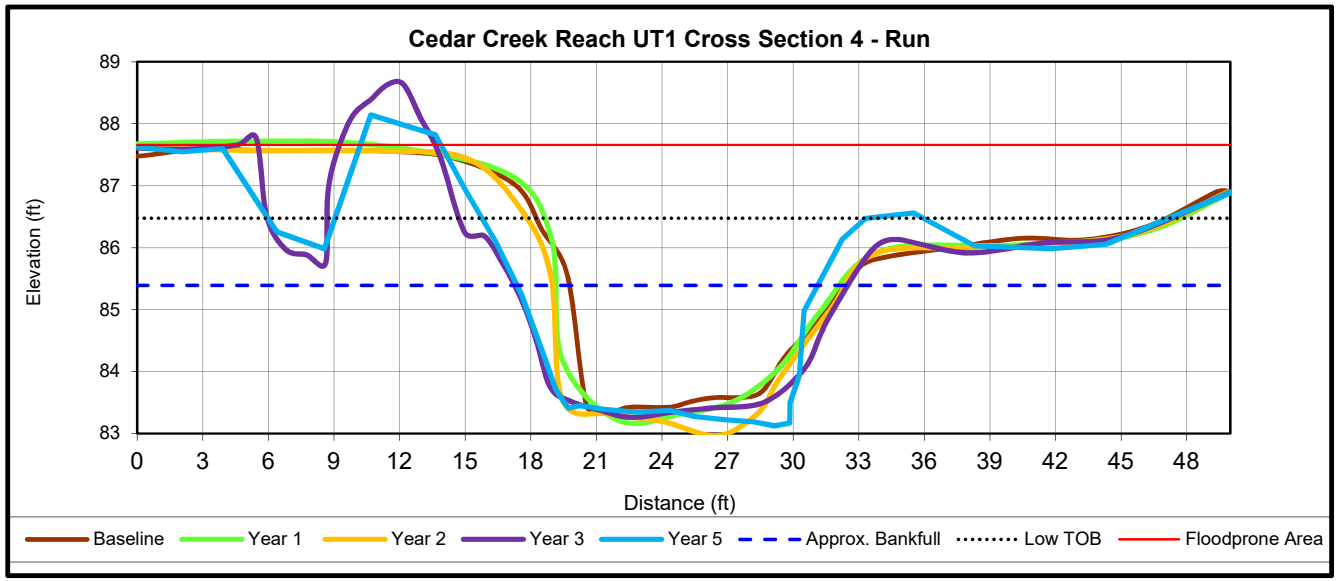


	Cross Section 3 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	88.1	88.1	88.1	88.1	88.1		
Bankfull Width (ft)[1]	23.8	26.1	23.5	23.1	20.2		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.2		
Bankfull Mean Depth (ft)	1.9	1.7	2.0	1.9	-		
Bankfull Max Depth (ft)[2]	3.3	3.1	3.6	3.7	3.4		
Low Bank Elevation (ft)	-	-	-	-	87.6		
Bankfull Cross Sectional Area (ft^2)[2]	45.5	43.7	46.8	44.6	37.6		
Bankfull Width/Depth Ratio	12.4	15.6	11.8	12.0	-		
Bankfull Entrenchment Ratio[1]	2.1	1.9	2.1	2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.1	<1		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Left Bank *Note Downed Tree

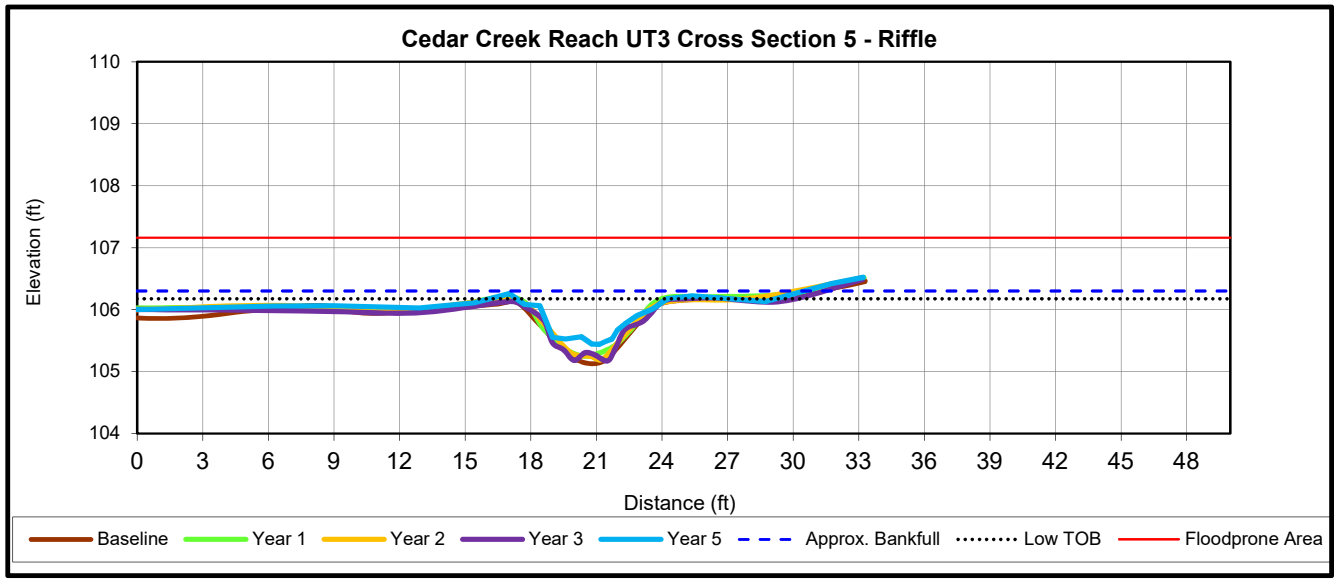


	Cross Section 4 (Run)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	85.8	85.8	85.8	85.8	85.4		
Bankfull Width (ft)[1]	14.4	14.5	15.0	16.7	13.7		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	46.4		
Bankfull Mean Depth (ft)	1.7	1.8	2.0	1.9	-		
Bankfull Max Depth (ft)[2]	2.5	2.6	2.8	2.5	3.3		
Low Bank Elevation (ft)	-	-	-	-	86.5		
Bankfull Cross Sectional Area (ft^2)[2]	24.7	26.3	29.8	31.4	41.4		
Bankfull Width/Depth Ratio	8.4	8.0	7.5	8.9	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.1	1.5		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

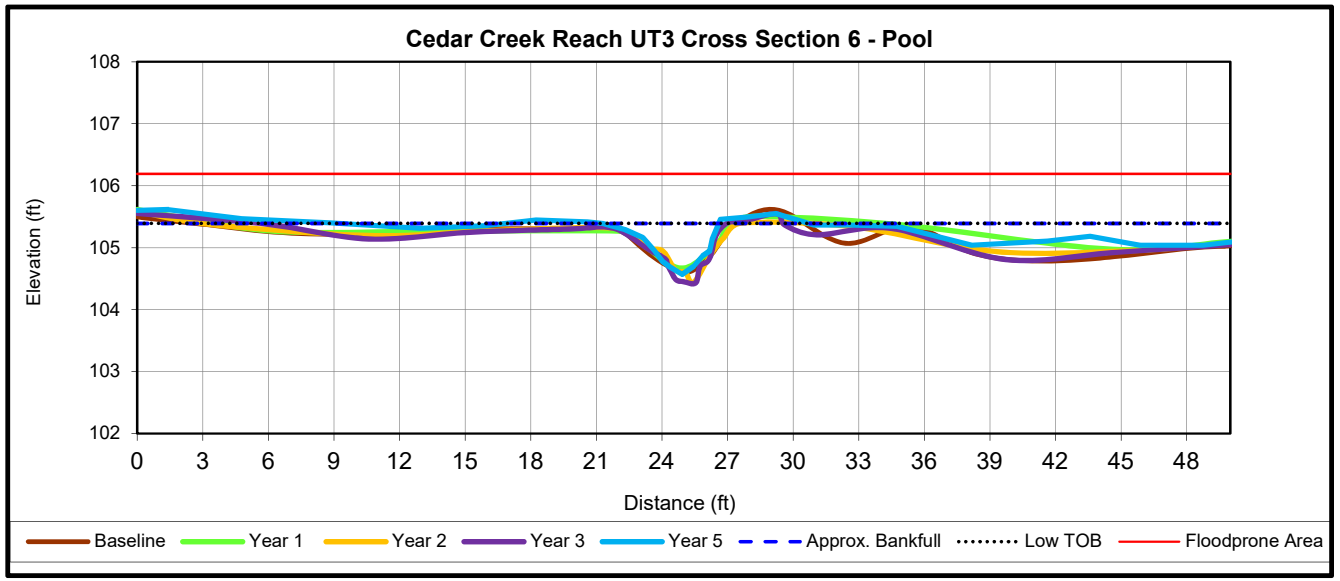


	Cross Section 5 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	106.1	106.1	106.1	106.1	106.3		
Bankfull Width (ft)[1]	6.9	6.3	6.9	6.6	7.2		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	33.2		
Bankfull Mean Depth (ft)	0.5	0.5	0.5	0.5	-		
Bankfull Max Depth (ft)[2]	1.0	0.8	0.9	0.9	0.7		
Low Bank Elevation (ft)	-	-	-	-	106.2		
Bankfull Cross Sectional Area (ft^2)[2]	3.7	3.2	3.2	3.3	2.8		
Bankfull Width/Depth Ratio	12.8	12.2	14.5	13.1	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.0	<1		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

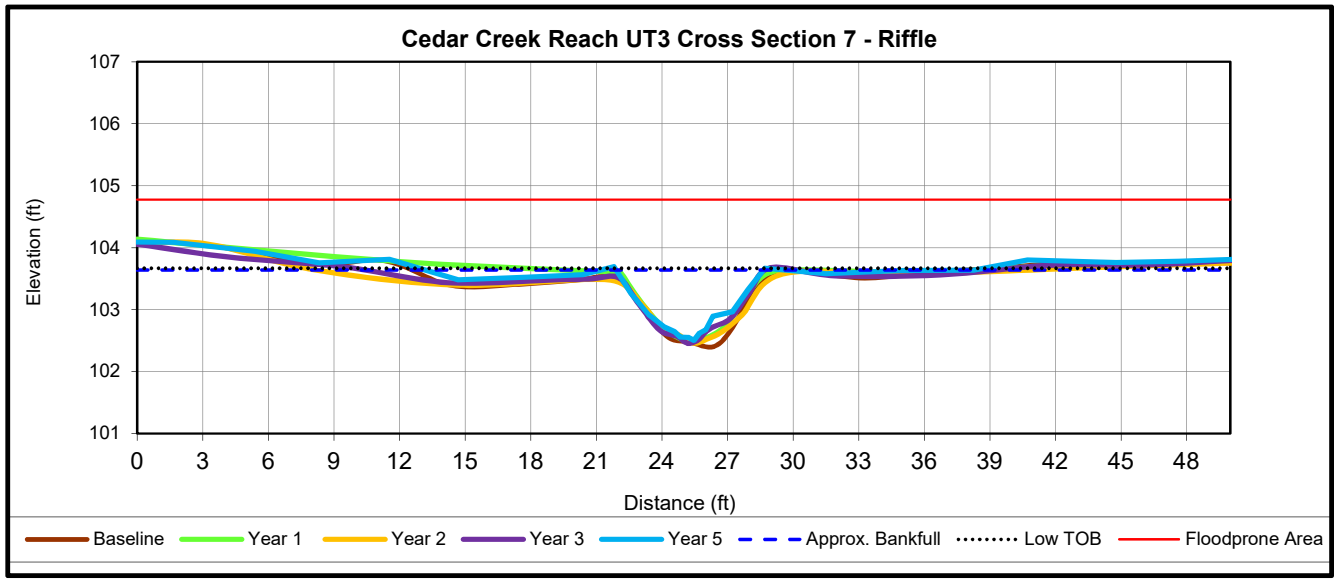


	Cross Section 6 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	105.3	105.3	105.3	105.3	105.4		
Bankfull Width (ft)[1]	5.9	4.6	5.3	4.9	5.3		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.0		
Bankfull Mean Depth (ft)	0.4	0.4	0.4	0.4	-		
Bankfull Max Depth (ft)[2]	0.7	0.6	0.9	0.9	0.8		
Low Bank Elevation (ft)	-	-	-	-	105.4		
Bankfull Cross Sectional Area (ft^2)[2]	2.1	1.6	2.0	2.1	2.1		
Bankfull Width/Depth Ratio	16.0	12.8	13.7	11.2	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

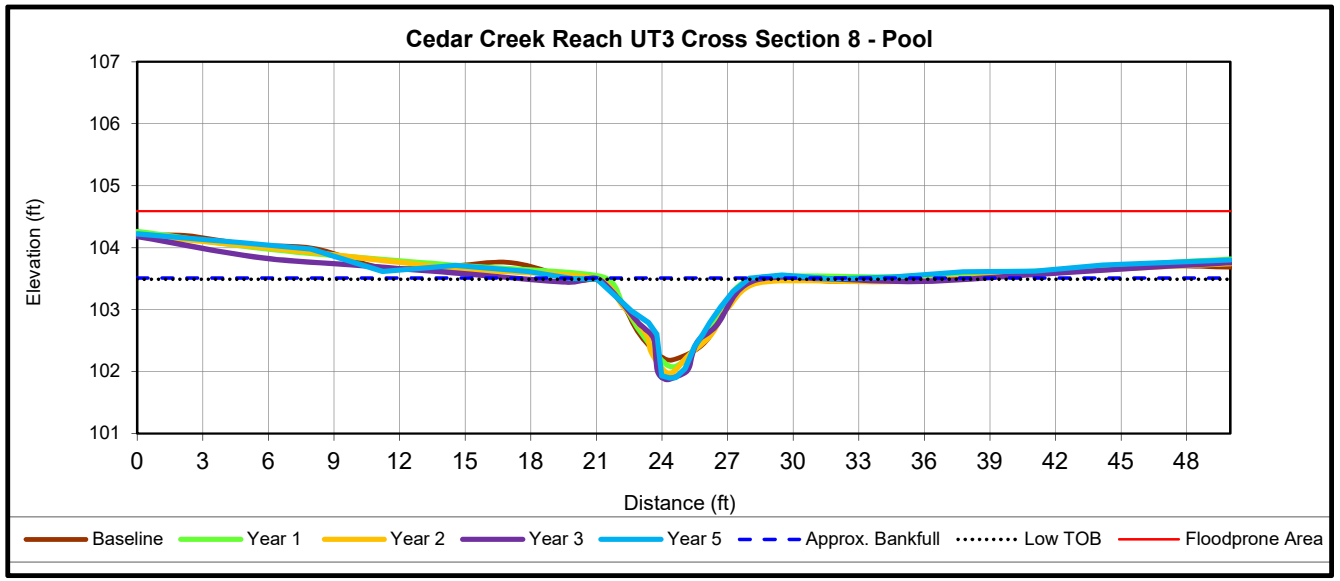


	Cross Section 7 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	103.5	103.5	103.5	103.5	103.7		
Bankfull Width (ft)[1]	7.3	6.5	7.7	6.5	6.7		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.2		
Bankfull Mean Depth (ft)	0.6	0.6	0.6	0.6	-		
Bankfull Max Depth (ft)[2]	1.1	1.0	1.0	1.0	1.2		
Low Bank Elevation (ft)	-	-	-	-	103.7		
Bankfull Cross Sectional Area (ft^2)[2]	4.5	3.9	4.6	4.1	4.7		
Bankfull Width/Depth Ratio	11.8	10.9	12.9	10.5	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.0	1.0		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

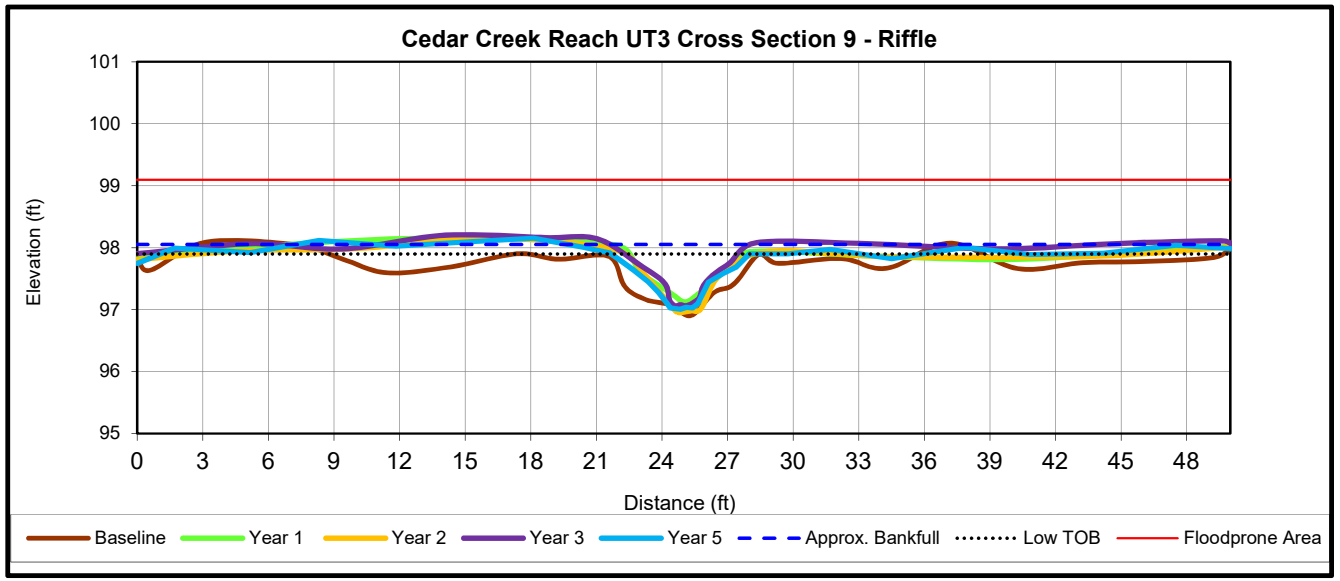


	Cross Section 8 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	103.5	103.5	103.5	103.5	103.5		
Bankfull Width (ft)[1]	7.1	8.1	7.6	7.8	8.3		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.0		
Bankfull Mean Depth (ft)	0.7	0.6	0.7	0.7	-		
Bankfull Max Depth (ft)[2]	1.2	1.4	1.5	1.6	1.6		
Low Bank Elevation (ft)	-	-	-	-	103.5		
Bankfull Cross Sectional Area (ft^2)[2]	5.0	5.1	5.6	5.5	4.8		
Bankfull Width/Depth Ratio	9.9	13.0	10.3	10.9	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

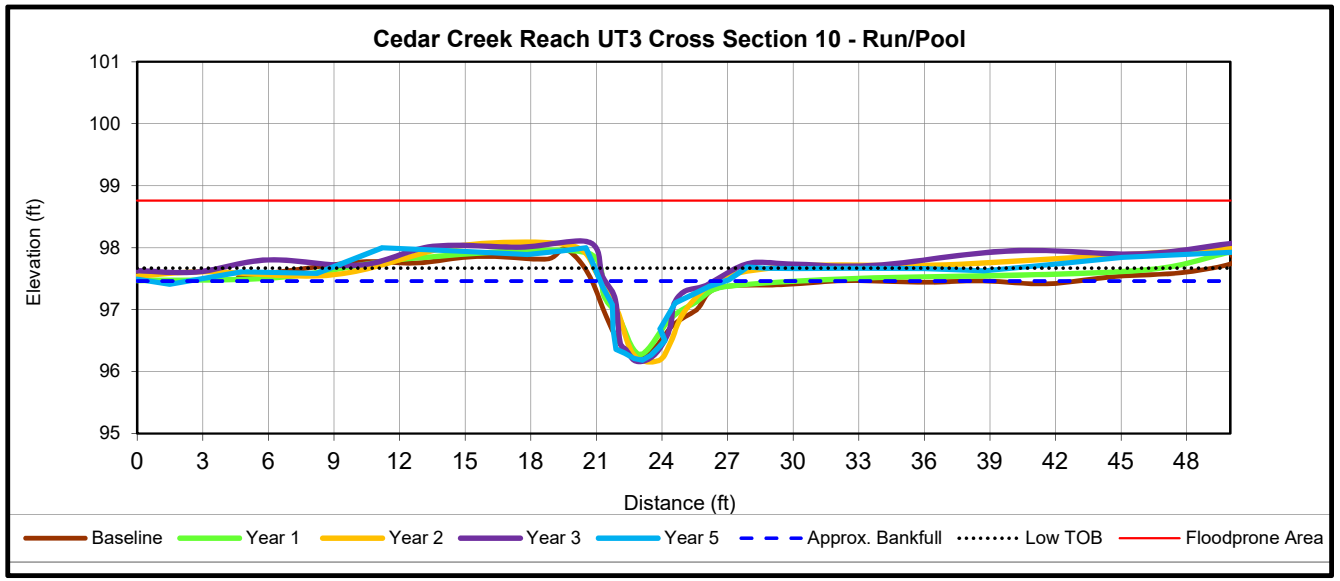


	Cross Section 9 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	97.9	97.9	97.9	97.9	98.1		
Bankfull Width (ft)[1]	7.5	5.7	6.6	5.5	8.3		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.3		
Bankfull Mean Depth (ft)	0.5	0.4	0.5	0.4	-		
Bankfull Max Depth (ft)[2]	1.0	0.8	0.9	0.8	0.9		
Low Bank Elevation (ft)	-	-	-	-	97.9		
Bankfull Cross Sectional Area (ft^2)[2]	4.0	2.4	3.0	2.2	2.9		
Bankfull Width/Depth Ratio	14.2	13.5	14.4	13.7	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.2	<1		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

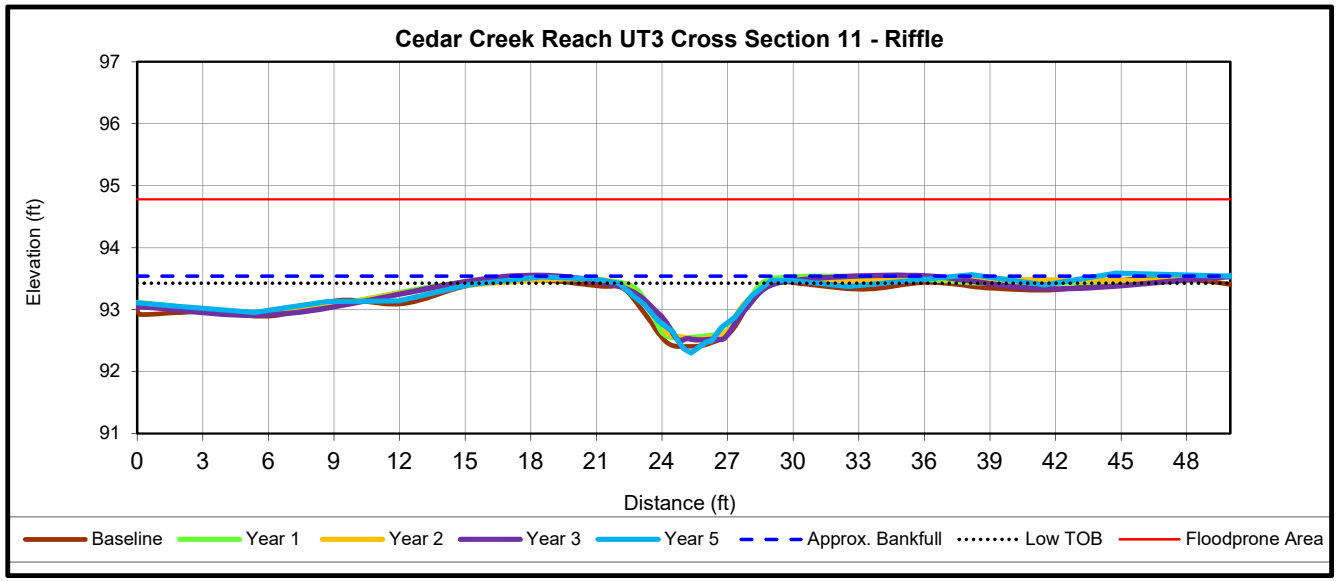


	Cross Section 10 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	97.4	97.4	97.4	97.4	97.5		
Bankfull Width (ft)[1]	5.7	5.3	4.9	4.6	7.5		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.0		
Bankfull Mean Depth (ft)	0.6	0.5	0.7	0.6	-		
Bankfull Max Depth (ft)[2]	1.1	1.0	1.0	1.2	1.5		
Low Bank Elevation (ft)	-	-	-	-	97.7		
Bankfull Cross Sectional Area (ft^2)[2]	3.5	2.4	3.3	2.9	5.0		
Bankfull Width/Depth Ratio	9.1	11.7	7.2	7.2	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

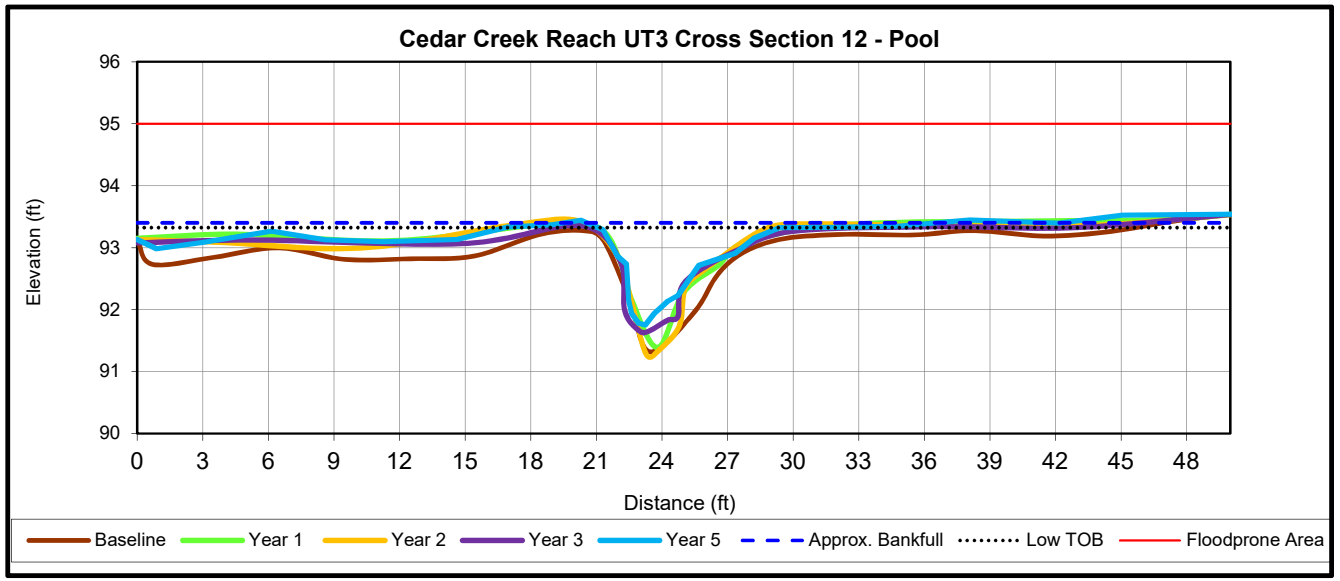


	Cross Section 11 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	93.5	93.5	93.5	93.5	93.5		
Bankfull Width (ft)[1]	10.4	6.9	9.3	11.7	10.6		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.2		
Bankfull Mean Depth (ft)	0.5	0.6	0.4	0.4	-		
Bankfull Max Depth (ft)[2]	1.1	0.9	1.0	1.0	1.1		
Low Bank Elevation (ft)	-	-	-	-	93.4		
Bankfull Cross Sectional Area (ft^2)[2]	4.8	4.2	3.6	4.8	3.9		
Bankfull Width/Depth Ratio	22.2	11.1	24.0	28.6	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	0.9	<1		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

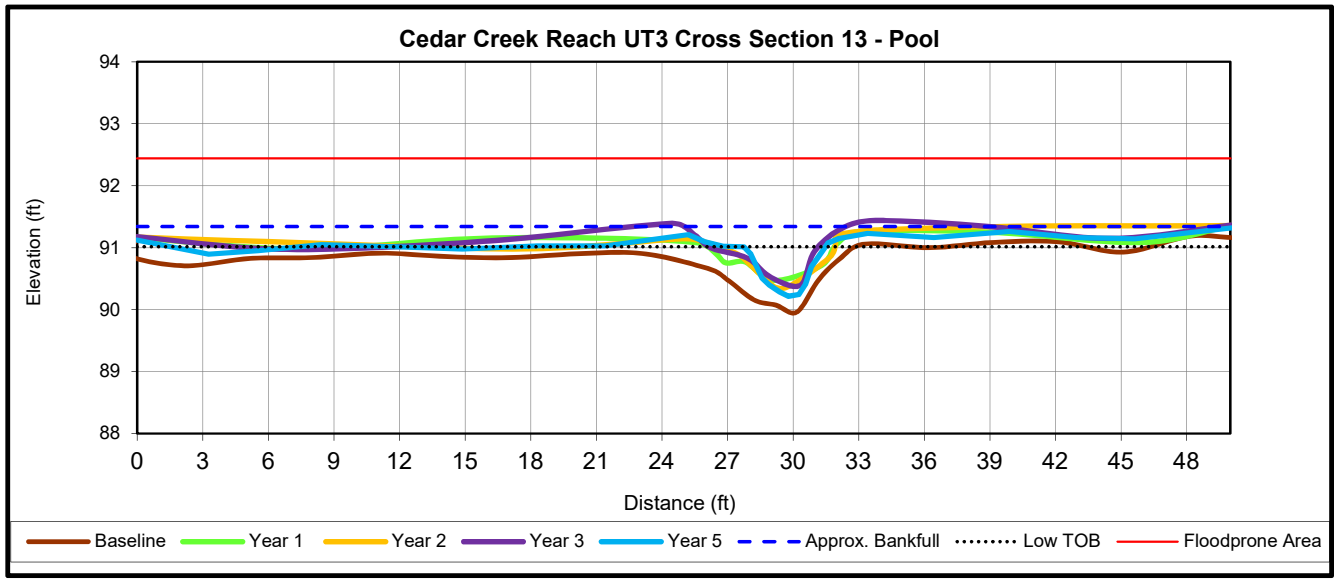


	Cross Section 12 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	93.1	93.1	93.1	93.1	93.4		
Bankfull Width (ft)[1]	8.1	6.6	6.5	7.6	17.0		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.2		
Bankfull Mean Depth (ft)	0.8	0.7	0.8	0.6	-		
Bankfull Max Depth (ft)[2]	1.8	1.7	1.8	1.4	1.6		
Low Bank Elevation (ft)	-	-	-	-	93.3		
Bankfull Cross Sectional Area (ft^2)[2]	6.6	4.7	5.1	4.9	5.5		
Bankfull Width/Depth Ratio	10.0	9.3	8.3	11.7	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

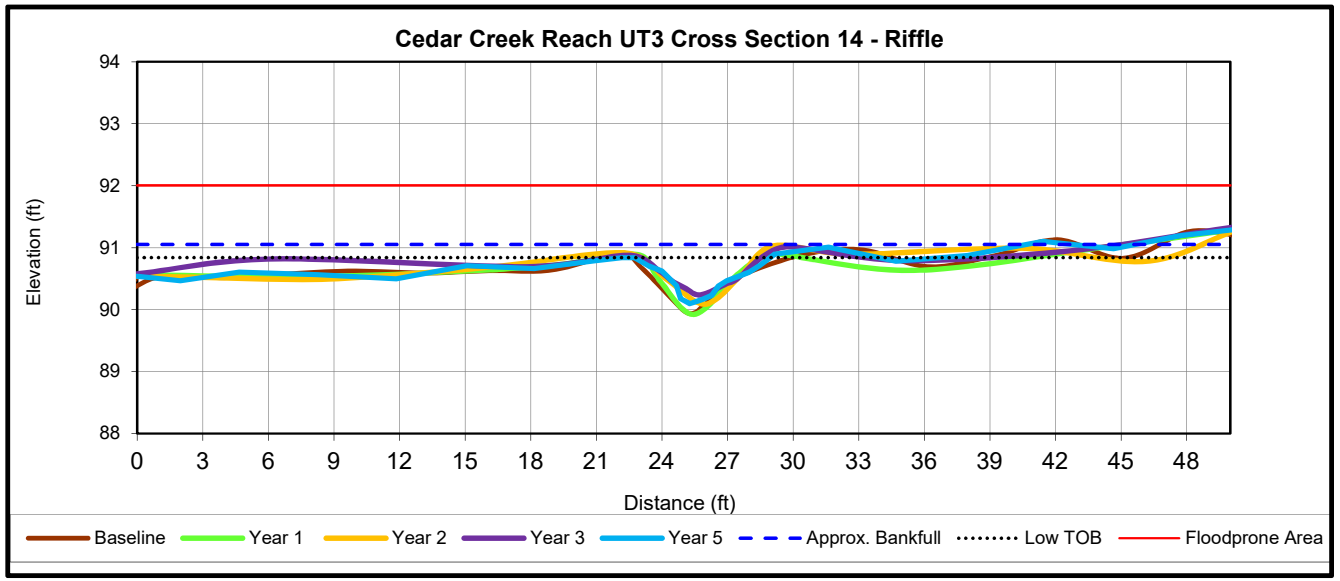


	Cross Section 13 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	90.9	90.9	90.9	90.9	91.3		
Bankfull Width (ft)[1]	9.3	5.4	7.0	5.9	7.5		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.3		
Bankfull Mean Depth (ft)	0.4	0.2	0.4	0.4	-		
Bankfull Max Depth (ft)[2]	0.9	0.4	0.8	0.7	0.8		
Low Bank Elevation (ft)					91.0		
Bankfull Cross Sectional Area (ft^2)[2]	3.9	1.2	2.6	2.2	1.8		
Bankfull Width/Depth Ratio	22.2	23.2	19.0	15.9	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

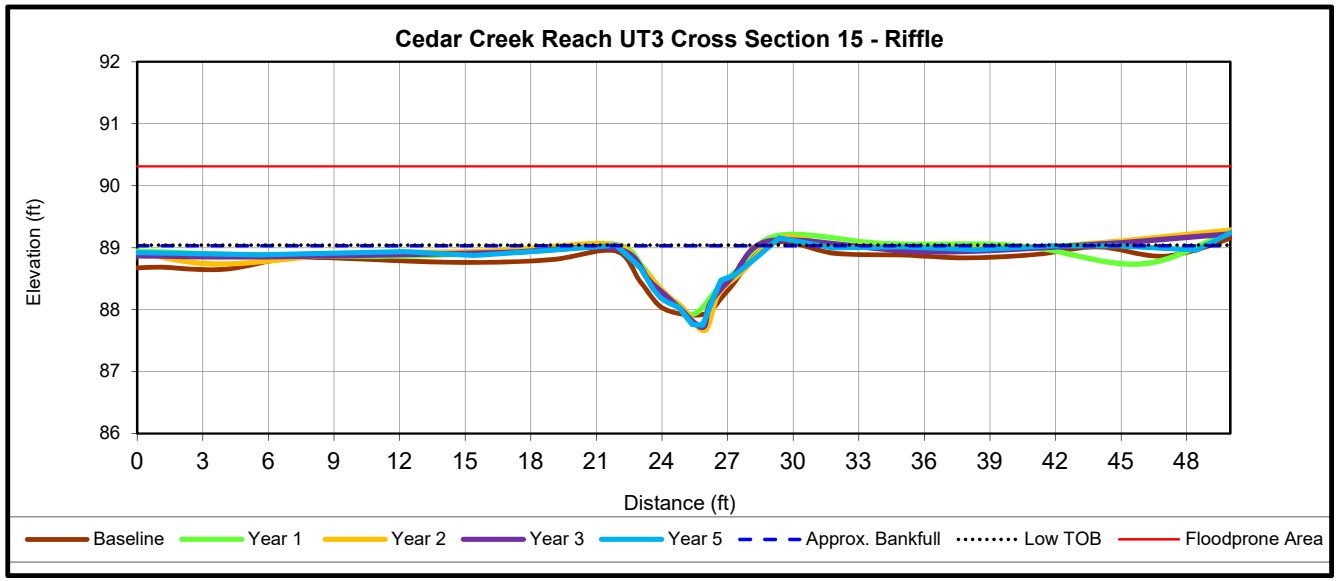


	Cross Section 14 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	90.9	90.9	90.9	90.9	91.1		
Bankfull Width (ft)[1]	9.6	6.2	6.4	6.5	7.0		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.2		
Bankfull Mean Depth (ft)	0.4	0.5	0.4	0.4	-		
Bankfull Max Depth (ft)[2]	1.0	1.0	0.8	0.7	0.7		
Low Bank Elevation (ft)	-	-	-	-	90.8		
Bankfull Cross Sectional Area (ft^2)[2]	3.7	2.9	2.7	2.3	2.2		
Bankfull Width/Depth Ratio	25.0	13.4	15.2	18.0	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.0	<1		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

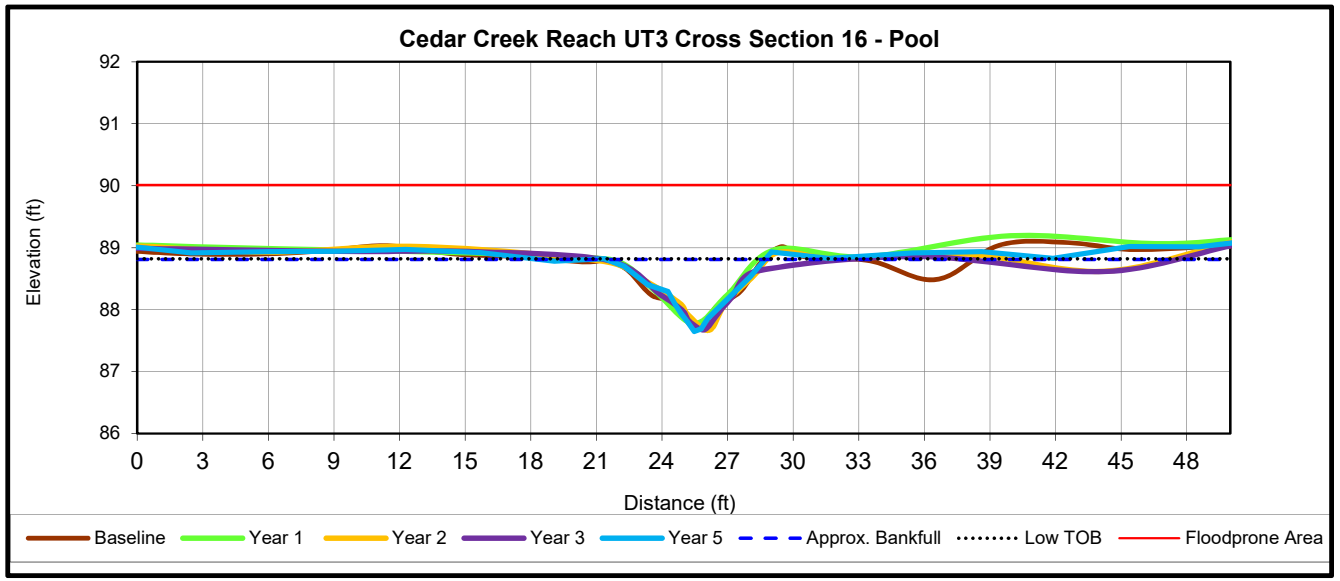


	Cross Section 15 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	89.0	89.0	89.0	89.0	89.0		
Bankfull Width (ft)[1]	6.8	6.4	6.9	6.7	7.0		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.2		
Bankfull Mean Depth (ft)	0.6	0.5	0.6	0.6	-		
Bankfull Max Depth (ft)[2]	1.0	1.1	1.3	1.3	1.3		
Low Bank Elevation (ft)	-	-	-	-	89.0		
Bankfull Cross Sectional Area (ft^2)[2]	4.3	3.5	4.1	4.1	4.3		
Bankfull Width/Depth Ratio	10.8	11.9	11.7	11.1	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.0	1.0		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

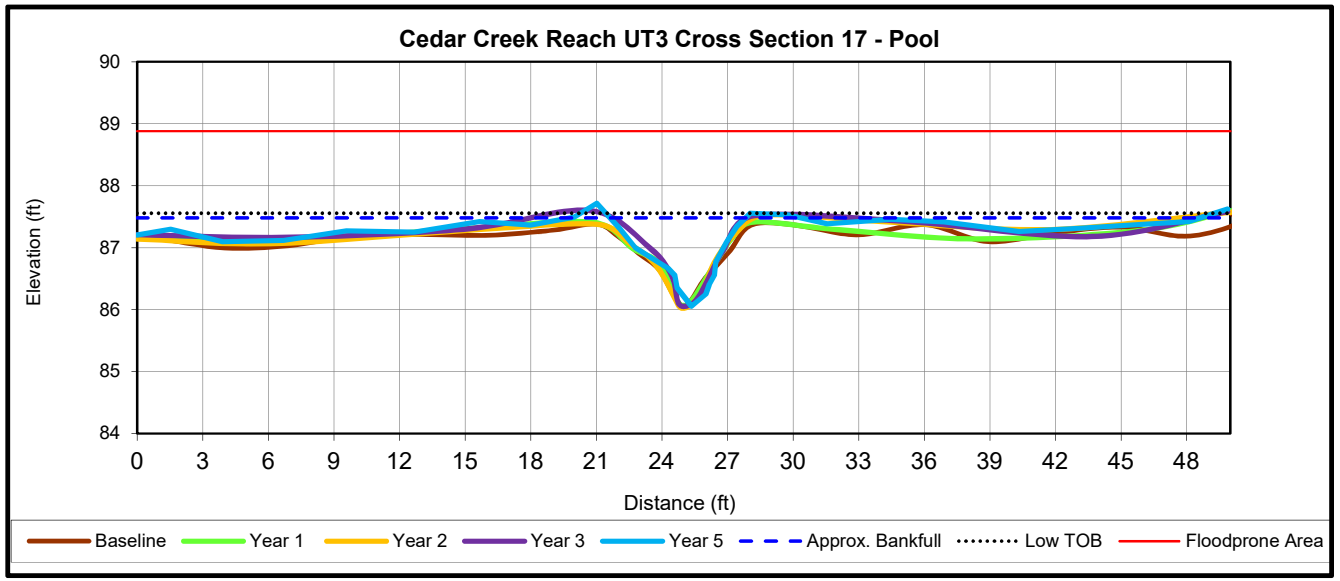


	Cross Section 16 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	88.8	88.8	88.8	88.8	88.8		
Bankfull Width (ft)[1]	7.1	7.1	8.5	6.6	7.3		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.2		
Bankfull Mean Depth (ft)	0.5	0.5	0.5	0.6	-		
Bankfull Max Depth (ft)[2]	1.1	1.0	1.1	1.1	1.2		
Low Bank Elevation (ft)	-	-	-	-	88.8		
Bankfull Cross Sectional Area (ft^2)[2]	3.8	3.5	3.8	3.9	3.8		
Bankfull Width/Depth Ratio	13.1	14.4	18.8	11.4	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

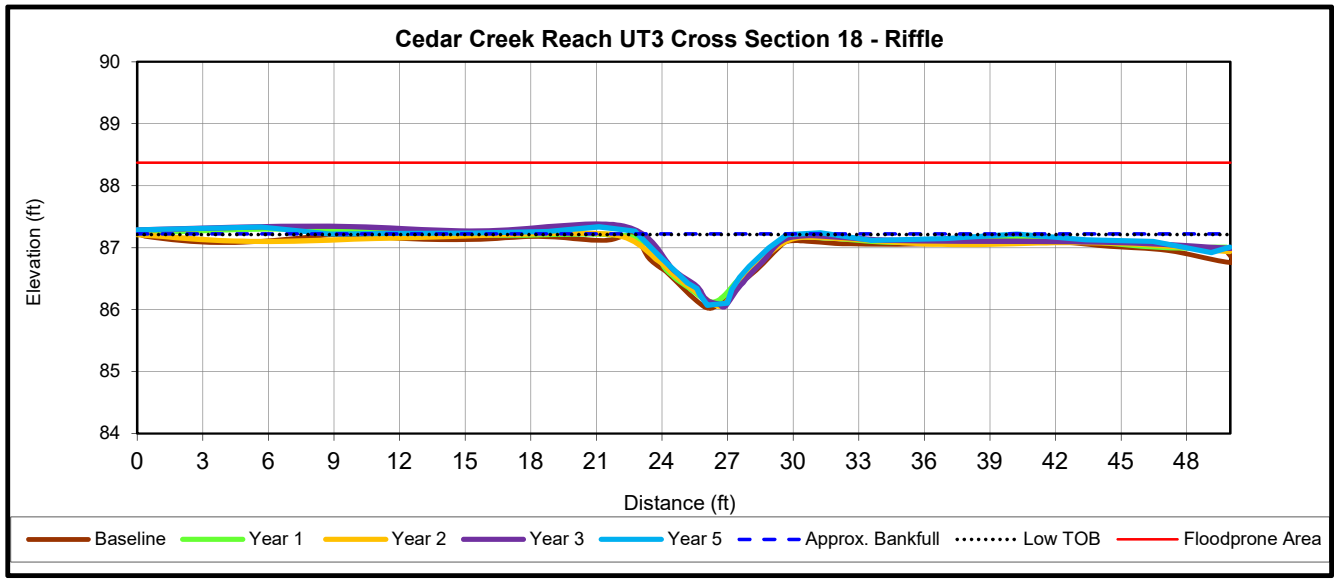


	Cross Section 17 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	87.4	87.4	87.4	87.4	87.5		
Bankfull Width (ft)[1]	7.1	7.2	7.1	6.3	6.2		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.9		
Bankfull Mean Depth (ft)	0.6	0.6	0.6	0.6	-		
Bankfull Max Depth (ft)[2]	1.3	1.3	1.4	1.3	1.5		
Low Bank Elevation (ft)					87.6		
Bankfull Cross Sectional Area (ft^2)[2]	4.2	4.0	4.2	3.7	4.7		
Bankfull Width/Depth Ratio	12.0	13.0	12.0	10.8	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

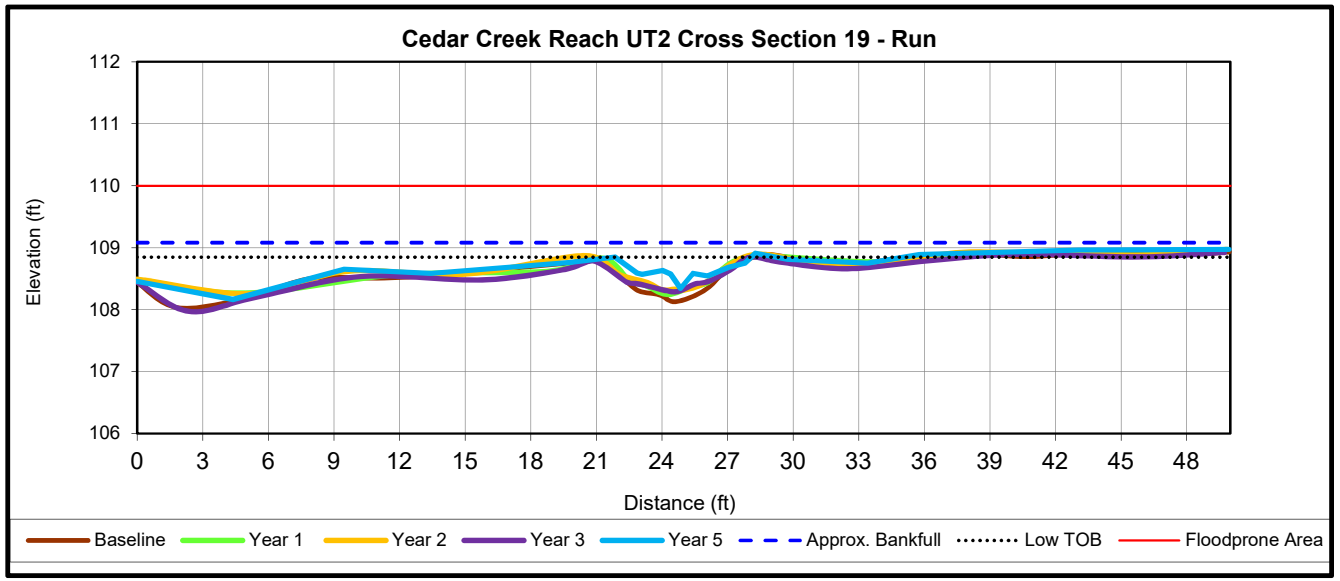


	Cross Section 18 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	87.1	87.1	87.1	87.1	87.2		
Bankfull Width (ft)[1]	7.0	6.9	7.7	6.7	6.8		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.0		
Bankfull Mean Depth (ft)	0.6	0.5	0.5	0.5	-		
Bankfull Max Depth (ft)[2]	1.1	1.0	1.0	1.0	1.1		
Low Bank Elevation (ft)	-	-	-	-	87.2		
Bankfull Cross Sectional Area (ft^2)[2]	4.0	3.5	3.7	3.5	3.9		
Bankfull Width/Depth Ratio	12.3	13.7	16.0	12.9	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.1	1.0		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

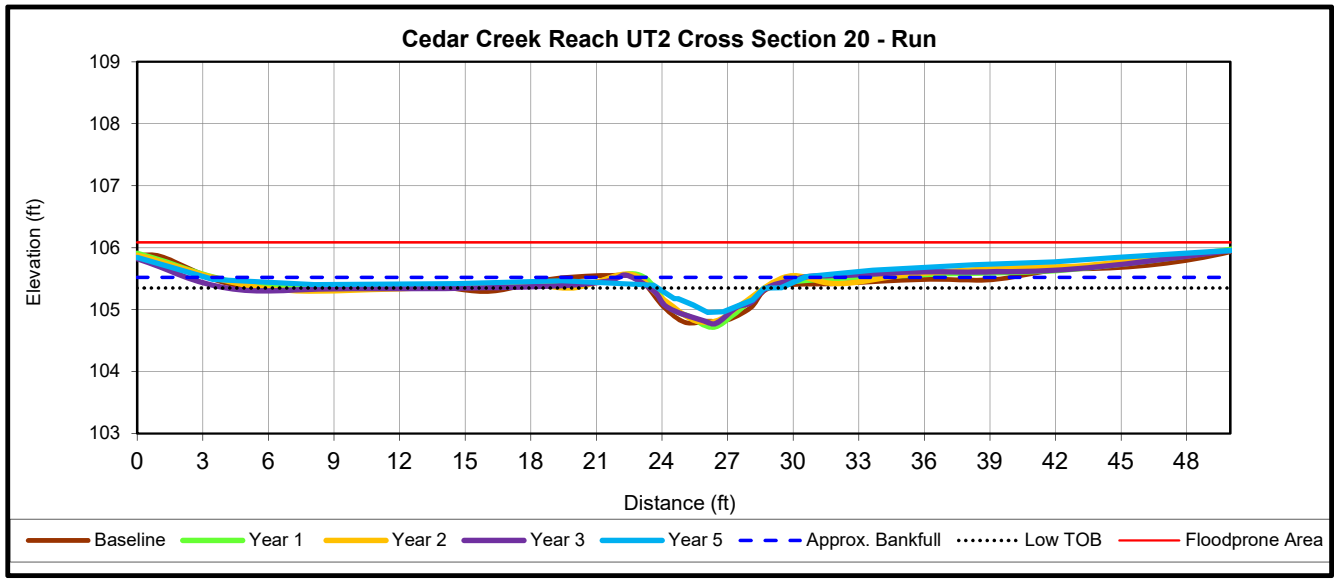


	Cross Section 19 (Run)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	108.8	108.8	108.8	108.8	109.8		
Bankfull Width (ft)[1]	7.5	6.3	6.8	7.2	6.4		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.9		
Bankfull Mean Depth (ft)	0.4	0.3	0.3	0.3	-		
Bankfull Max Depth (ft)[2]	0.8	0.6	0.5	0.8	0.7		
Low Bank Elevation (ft)					108.8		
Bankfull Cross Sectional Area (ft^2)[2]	2.9	2.1	2.0	2.2	1.4		
Bankfull Width/Depth Ratio	19.6	19.4	23.4	23.5	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.0	<1		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

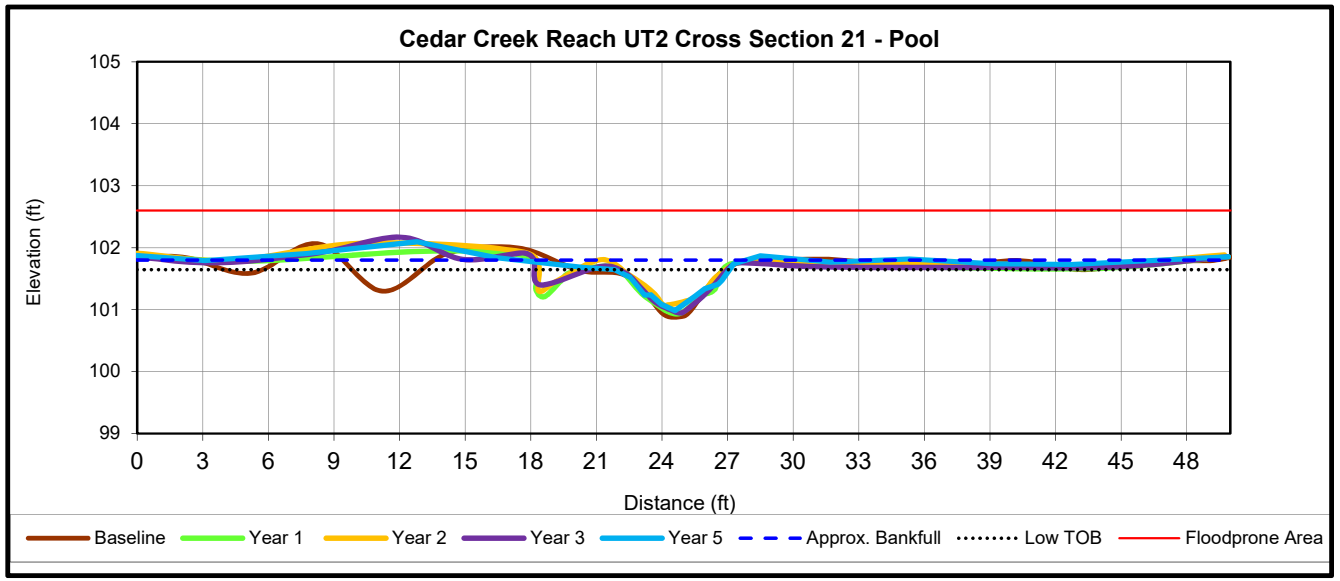


	Cross Section 20 (Run)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	105.4	105.4	105.4	105.4	105.5		
Bankfull Width (ft)[1]	8.8	5.9	5.9	6.1	11.1		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	50.0		
Bankfull Mean Depth (ft)	0.3	0.4	0.3	0.3	-		
Bankfull Max Depth (ft)[2]	0.6	0.7	0.6	0.6	0.4		
Low Bank Elevation (ft)	-	-	-	-	105.3		
Bankfull Cross Sectional Area (ft^2)[2]	2.7	2.2	2.0	2.1	1.2		
Bankfull Width/Depth Ratio	29.1	15.7	17.4	17.7	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.2	<1		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

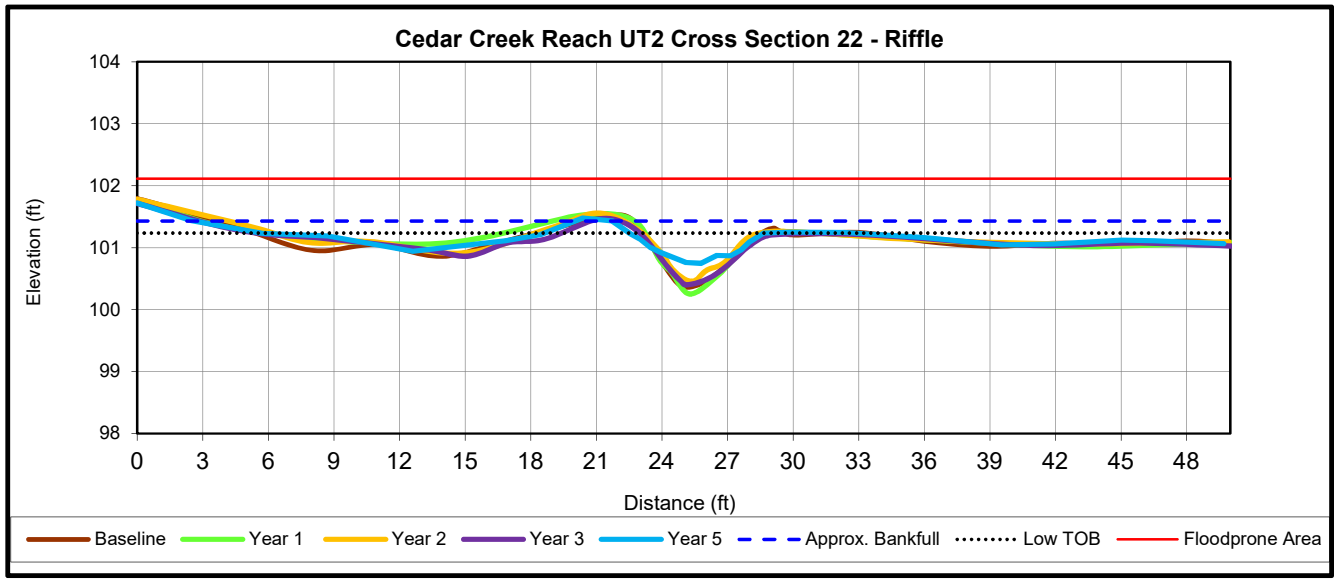


	Cross Section 21 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	101.8	101.8	101.8	101.8	101.8		
Bankfull Width (ft)[1]	8.9	11.1	10.0	9.9	9.9		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.9		
Bankfull Mean Depth (ft)	0.3	0.4	0.3	0.4	-		
Bankfull Max Depth (ft)[2]	0.9	0.9	0.7	0.9	0.7		
Low Bank Elevation (ft)	-	-	-	-	101.6		
Bankfull Cross Sectional Area (ft^2)[2]	3.1	4.0	3.3	3.7	1.9		
Bankfull Width/Depth Ratio	25.6	30.8	30.6	26.8	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

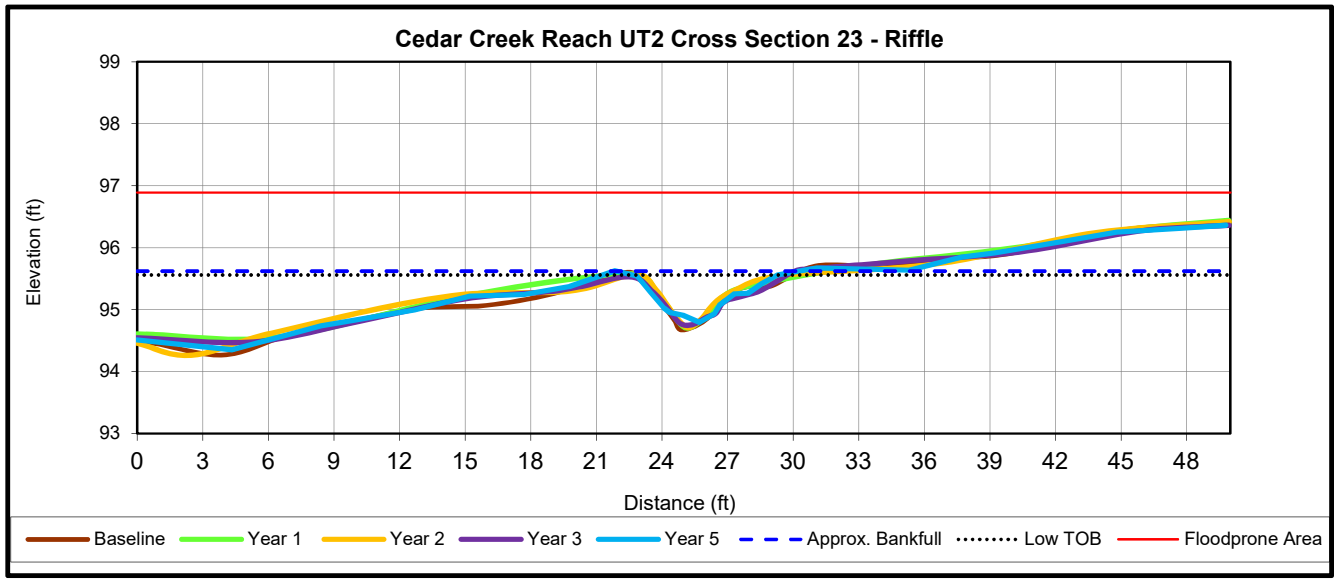


	Cross Section 22 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	101.3	101.3	101.3	101.3	101.4		
Bankfull Width (ft)[1]	6.0	5.9	6.7	6.4	6.9		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.7		
Bankfull Mean Depth (ft)	0.5	0.6	0.4	0.5	-		
Bankfull Max Depth (ft)[2]	0.9	1.0	0.8	0.9	0.5		
Low Bank Elevation (ft)	-	-	-	-	101.2		
Bankfull Cross Sectional Area (ft^2)[2]	3.1	3.3	2.7	3.2	1.8		
Bankfull Width/Depth Ratio	11.6	10.7	16.8	13.0	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	0.9	<1		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Left Bank

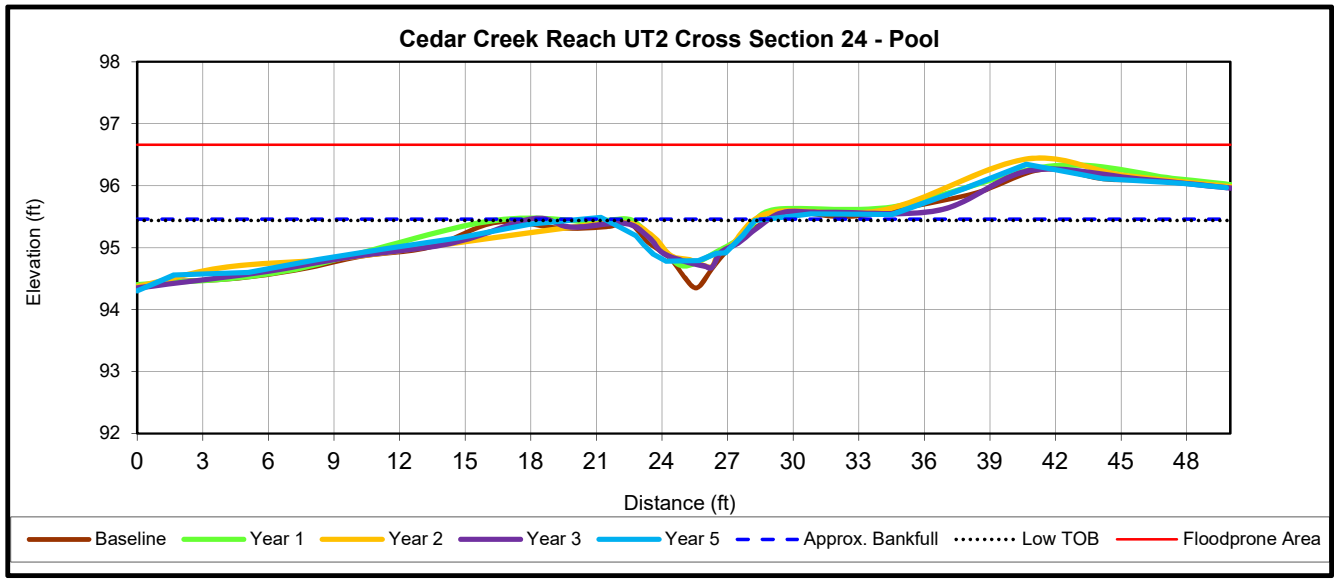


	Cross Section 23 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	95.6	95.6	95.6	95.6	95.6		
Bankfull Width (ft)[1]	8.3	8.7	7.0	7.5	7.4		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.8		
Bankfull Mean Depth (ft)	0.4	0.3	0.5	0.4	-		
Bankfull Max Depth (ft)[2]	1.3	1.0	1.4	1.1	1.2		
Low Bank Elevation (ft)					95.6		
Bankfull Cross Sectional Area (ft^2)[2]	3.1	2.9	3.3	3.2	2.6		
Bankfull Width/Depth Ratio	21.9	26.1	15.0	17.2	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	0.9	1.0		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

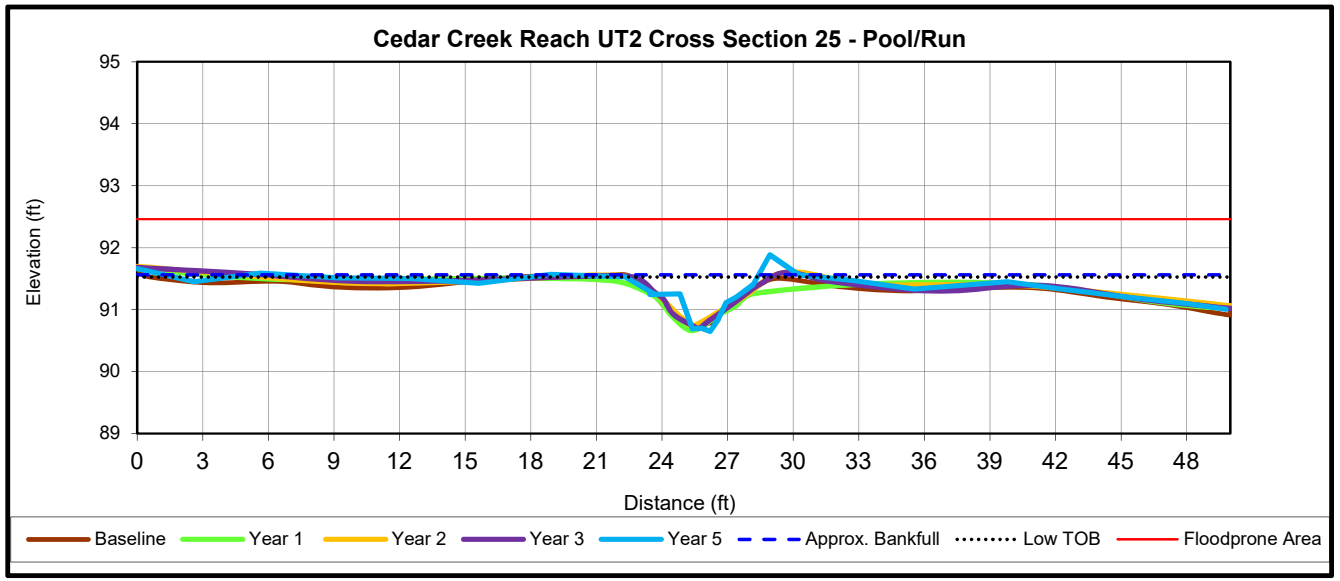


	Cross Section 24 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	95.4	95.4	95.4	95.4	95.5		
Bankfull Width (ft)[1]	5.9	5.7	6.4	6.5	7.4		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.8		
Bankfull Mean Depth (ft)	0.5	0.4	0.5	0.4	-		
Bankfull Max Depth (ft)[2]	1.1	1.0	1.1	1.1	1.1		
Low Bank Elevation (ft)	-	-	-	-	95.4		
Bankfull Cross Sectional Area (ft^2)[2]	3.0	2.2	2.9	2.5	2.9		
Bankfull Width/Depth Ratio	11.8	14.7	14.1	16.7	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

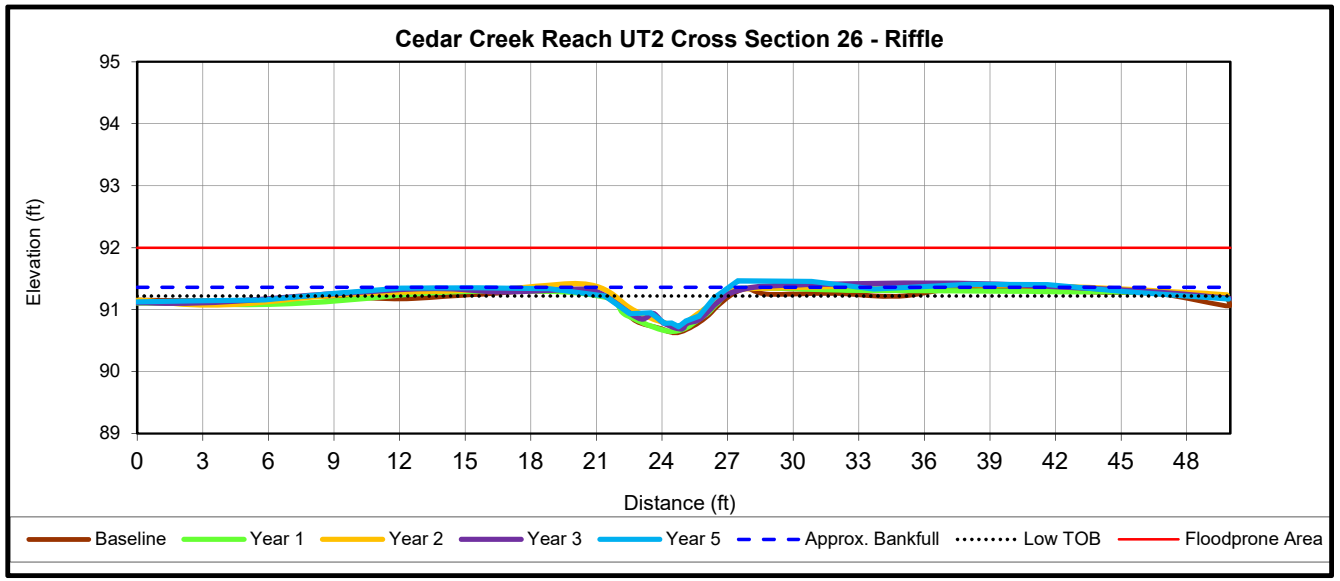


	Cross Section 25 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	91.5	91.5	91.5	91.5	91.6		
Bankfull Width (ft)[1]	6.6	6.6	6.8	6.3	8.7		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.8		
Bankfull Mean Depth (ft)	0.4	0.4	0.4	0.4	-		
Bankfull Max Depth (ft)[2]	0.8	8.0	0.8	0.8	0.9		
Low Bank Elevation (ft)	-	-	-	-	91.5		
Bankfull Cross Sectional Area (ft^2)[2]	2.6	2.9	2.5	2.5	2.3		
Bankfull Width/Depth Ratio	17.0	15.3	18.8	16.1	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	N/A	N/A		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	N/A	N/A		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream

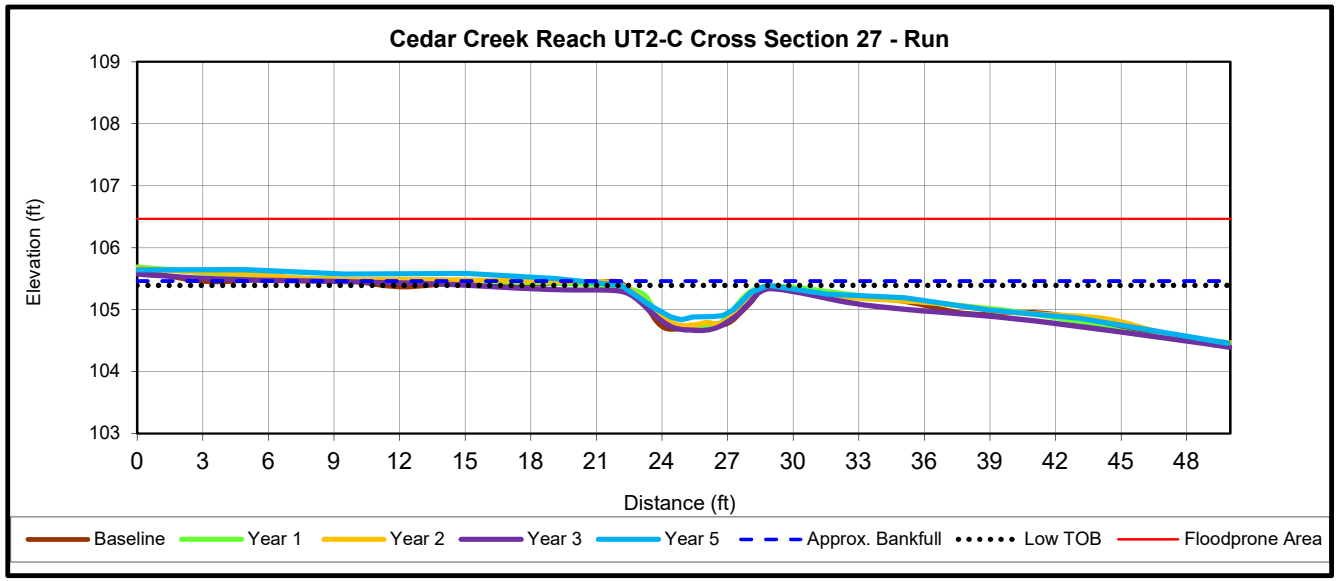


	Cross Section 26 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	91.3	91.3	91.3	91.3	91.4		
Bankfull Width (ft)[1]	6.8	8.2	6.0	6.8	11.5		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.9		
Bankfull Mean Depth (ft)	0.4	0.3	0.3	0.3	-		
Bankfull Max Depth (ft)[2]	0.7	0.7	0.6	0.6	0.5		
Low Bank Elevation (ft)					91.2		
Bankfull Cross Sectional Area (ft^2)[2]	2.5	2.4	1.9	2.1	1.4		
Bankfull Width/Depth Ratio	18.1	27.3	18.9	21.8	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.0	<1		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Upstream

Downstream



	Cross Section 27 (Run)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	105.3	105.3	105.3	105.3	105.5		
Bankfull Width (ft)[1]	6.4	5.7	5.7	6.8	8.6		
Floodprone Width (ft)[1]	50.0	50.0	50.0	50.0	49.9		
Bankfull Mean Depth (ft)	0.4	0.4	0.4	0.4	-		
Bankfull Max Depth (ft)[2]	0.9	0.8	0.8	0.9	0.9		
Low Bank Elevation (ft)					105.4		
Bankfull Cross Sectional Area (ft^2)[2]	2.8	2.1	2.1	2.6	2.3		
Bankfull Width/Depth Ratio	14.8	15.2	15.5	17.9	-		
Bankfull Entrenchment Ratio[1]	>2.2	>2.2	>2.2	>2.2	>2.2		
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0	1.0	<1		

Note: Starting in MY5, the parameters denoted with [1] were calculated using the as-built cross sectional area as the basis for adjusting the bankfull elevation and the parameters denoted with [2] were calculated using the current years low top of bank as the bankfull.

Appendix E

Hydrology Data

Table 13. Documentation of Geomorphologically Significant Flow Events

Crest Gauge	Flow Events	Maximum Consecutive Flow Days	Cumulative Flow Days
Crest Gauge 2 (HWV UT-2C)			
MY2	36	117	186
MY3	36	35	130
MY4	32	57	168
MY5	6	122	151
MY6	11	104	182

Note: Starting in MY5, flow days were calculated using the height of the downstream riffle

Crest Gauge	Number of Bankfull Events	Maximum Bankfull Height (ft.)
Crest Gauge 1 (UT3)		
MY1	0	NA
MY2	4	1.15
MY3	0	NA
MY4	4	1.05
MY5	3	0.8
MY6	8	0.67
Crest Gauge 3 (UT2)		
MY1	0	NA
MY2	1	0.4
MY3	0	NA
MY4	2	0.25
MY5	0	N/A
MY6	5	0.13

Table 14. 2020 Rainfall Summary

Month	Average	Normal Limits		Clinton Precipitation
		30 Percent	70 Percent	
January	4.33	3.32	5.03	3.62
February	3.23	2.14	3.87	3.76
March	4.50	3.23	5.32	2.66
April	3.16	1.70	3.85	2.75
May	3.68	2.69	4.34	13.35
June	4.49	3.11	5.34	4.57
July	6.06	4.16	7.22	3.87
August	5.40	3.12	6.56	7.40
September	5.00	2.04	6.07	6.18
October	3.21	1.62	3.92	5.04
November	2.89	1.83	3.49	5.91
December	3.24	2.14	3.88	---
Total	49.19	31.10	58.89	59.11

Table 15a. 2020 Wetland Hydrology Criteria Attainment

2020 Max Hydroperiod (Growing Season 17-Mar through 14-Nov, 243 days) Success Criterion 9%					
Gauge	Consecutive		Cumulative		
	Days	Percent of growing Season	Days	Percent of growing Season	Occurrences
AW1	243	100	243	100	1
AW2	243	100	243	100	1
AW3**	142	58	142	58	1
AW4**	59	24	130	54	5
AW5**	57	23	94	39	10
AW6	124	51	231	95	4
AW7	13	5	50	20	15
AW8	22	9	104	43	17
AW9	105	43	247	102	9
AW10	43	18	166	69	16
AW11	26	11	117	48	19
RAW1*	---	---	---	---	---
RAW2	127	52	241	100	2
RAW3	123	51	236	98	3

*Reference Well 1 was destroyed during Hurricane Florence

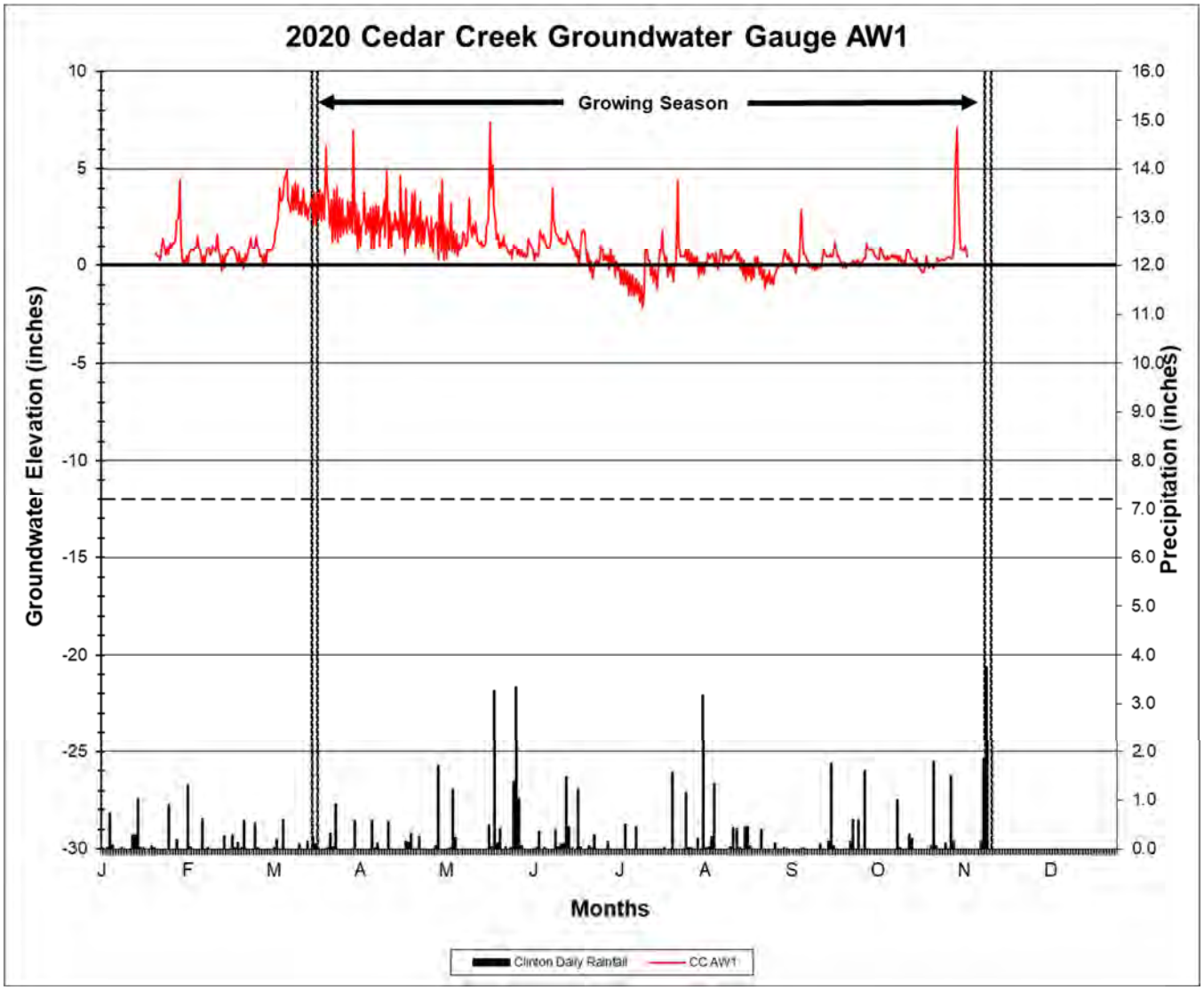
**HOBOs died in August 2020, data represents the first 140 days of the growing season

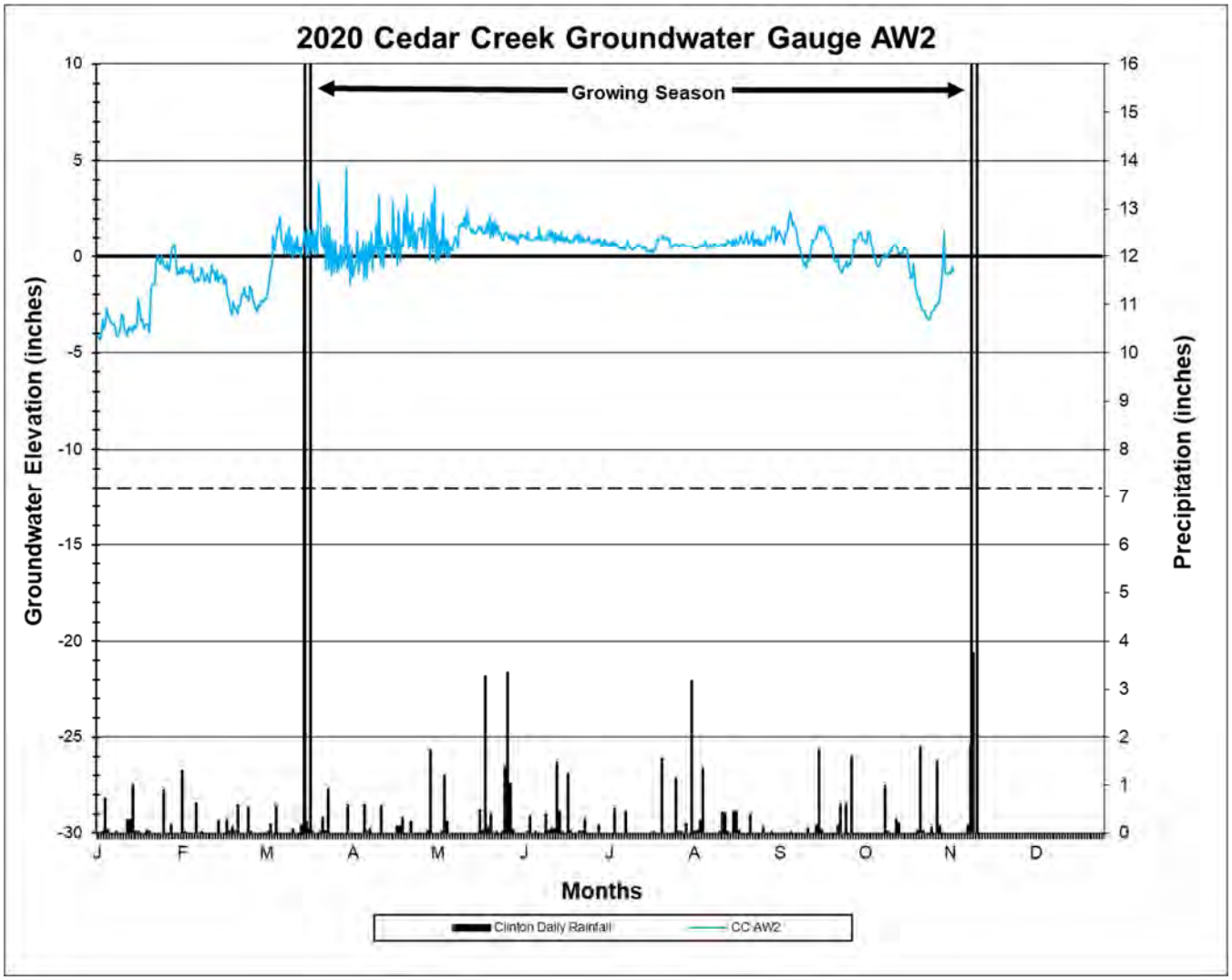
Table 15b. Wetland Hydrology Gauge Summary

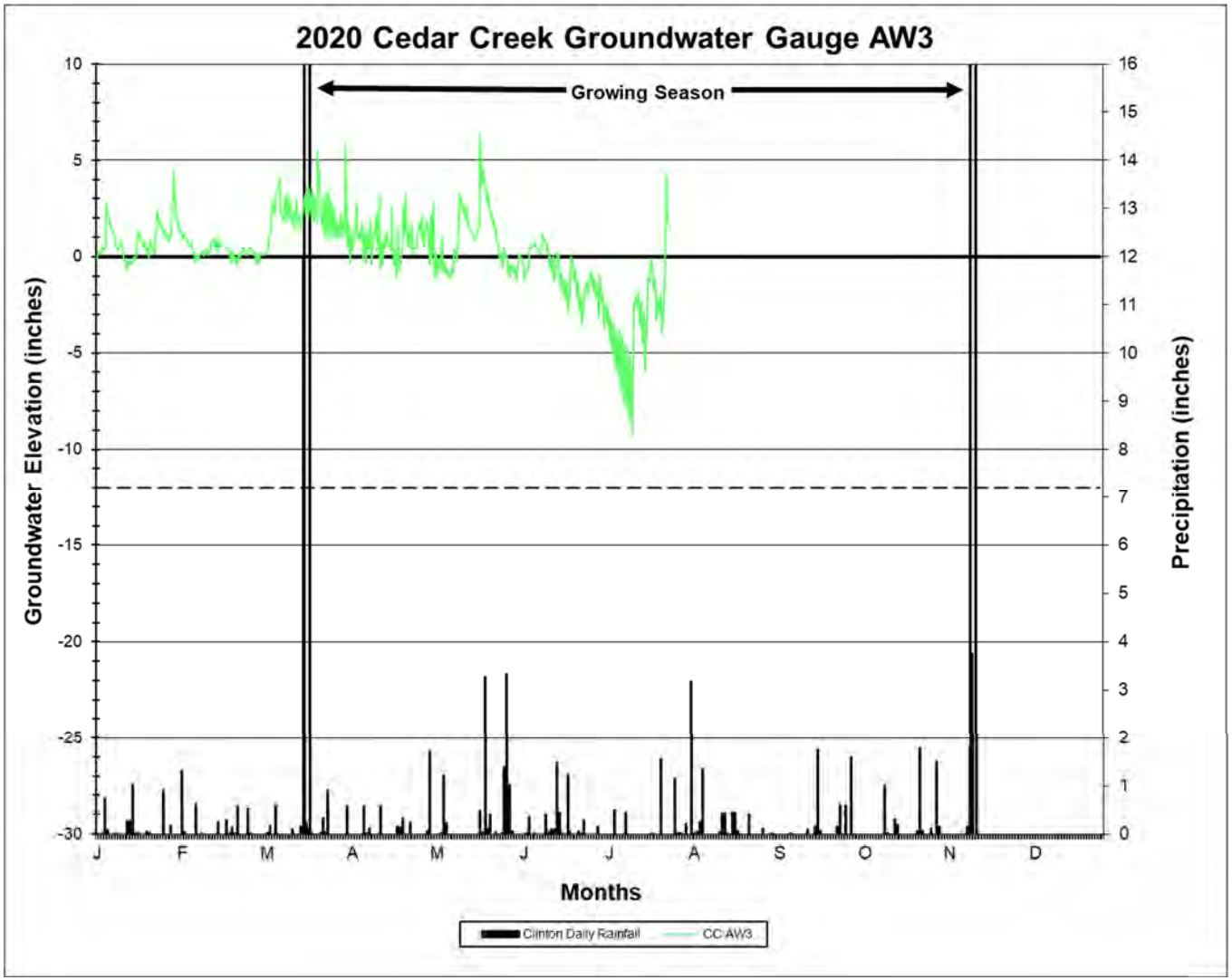
Gauge	MY1 - 2015		MY2 - 2016		MY3 - 2017		MY4 - 2018		MY5 - 2019		MY6 - 2020	
	Consecutive		Consecutive		Consecutive		Consecutive		Consecutive		Consecutive	
	Days	Percent of growing Season	Days	Percent of growing Season	Days	Percent of growing season	Days	Percent of growing season	Days	Percent of growing season	Days	Percent of growing season
AW1	162	67	229	94	240	99	242	100	243	100	243	100
AW2	162	67	229	94	240	99	242	100	243	100	243	100
AW3	71	29	134	55	242	100	242	100	243	100	142	58
AW4	100	41	229	94	131	54	242	100	133	55	59	24
AW5	51	21	60	25	53	22	49	20	43	18	57	23
AW6	51	21	96	39	79	32	98	40	67	27	124	51
AW7	5	2	4	2	2	1	7	3	6	2	13	5
AW8	21	9	34	14	28	12	19	8	44	18	22	9
AW9	51	21	33	13	61	25	49	20	43	18	105	43
AW10	50	21	35	14	31	13	36	15	43	18	43	18
AW11	13	5	6	2	24	10	19	8	33	13	26	11
RAW1	23	10	56	23	177	73	36	15	---	---	---	---
RAW2	52	21	99	41	191	79	62	25	90	37	127	52
RAW3	51	21	88	36	63	26	62	25	90	37	123	51

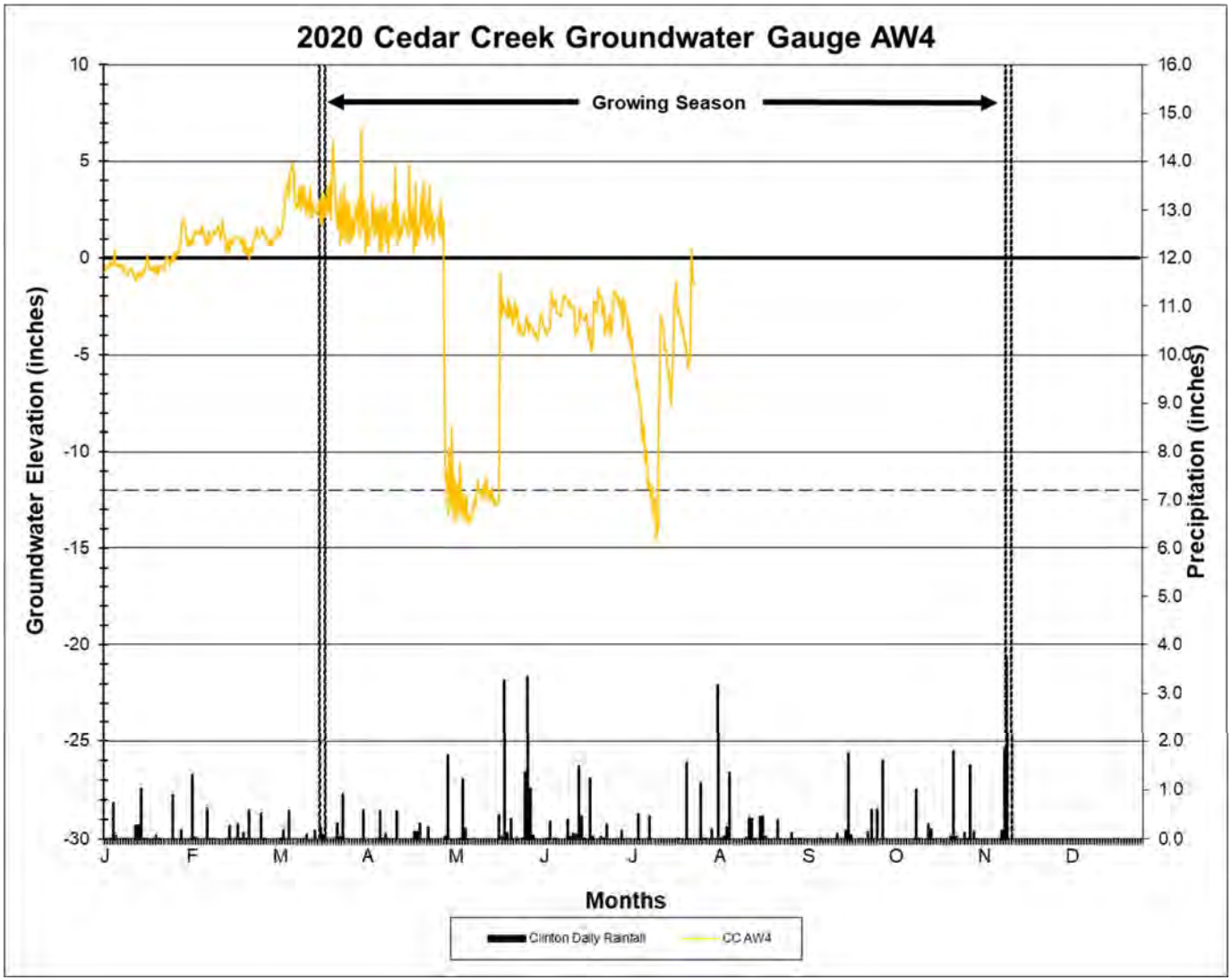
<5%	5-8%	≥9%

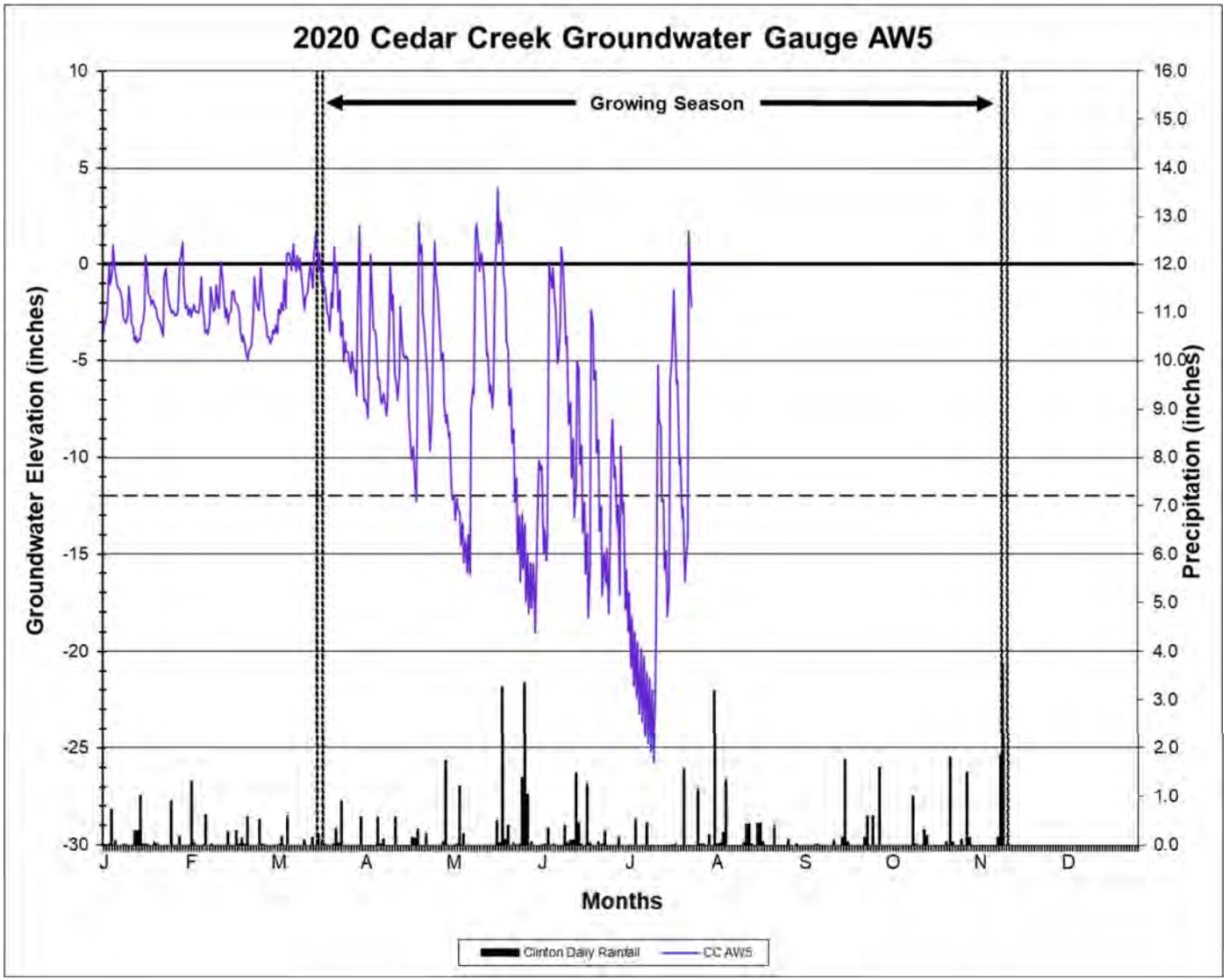
Figure 8. 2020 Cedar Creek Groundwater Monitoring Gauge Hydrographs

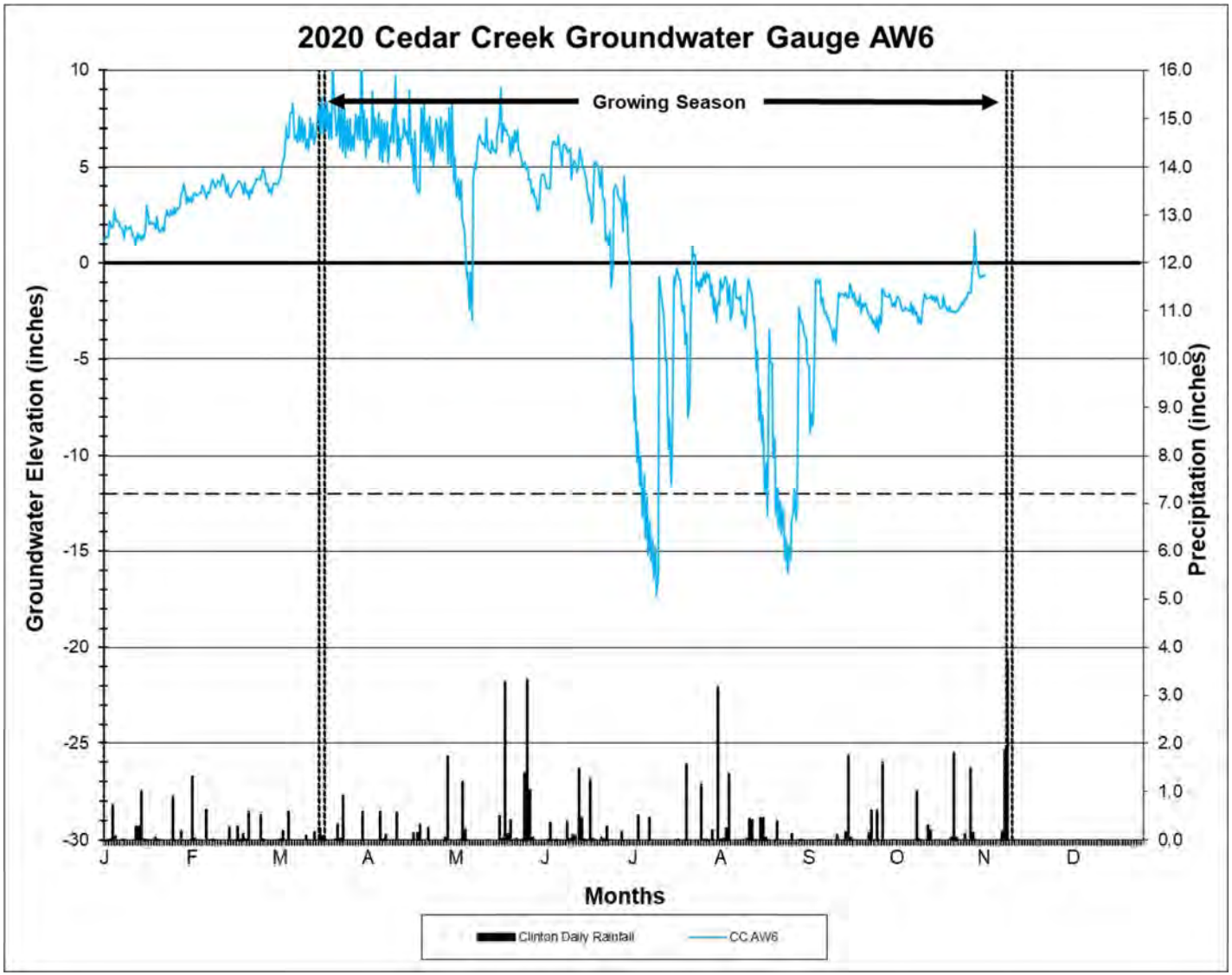


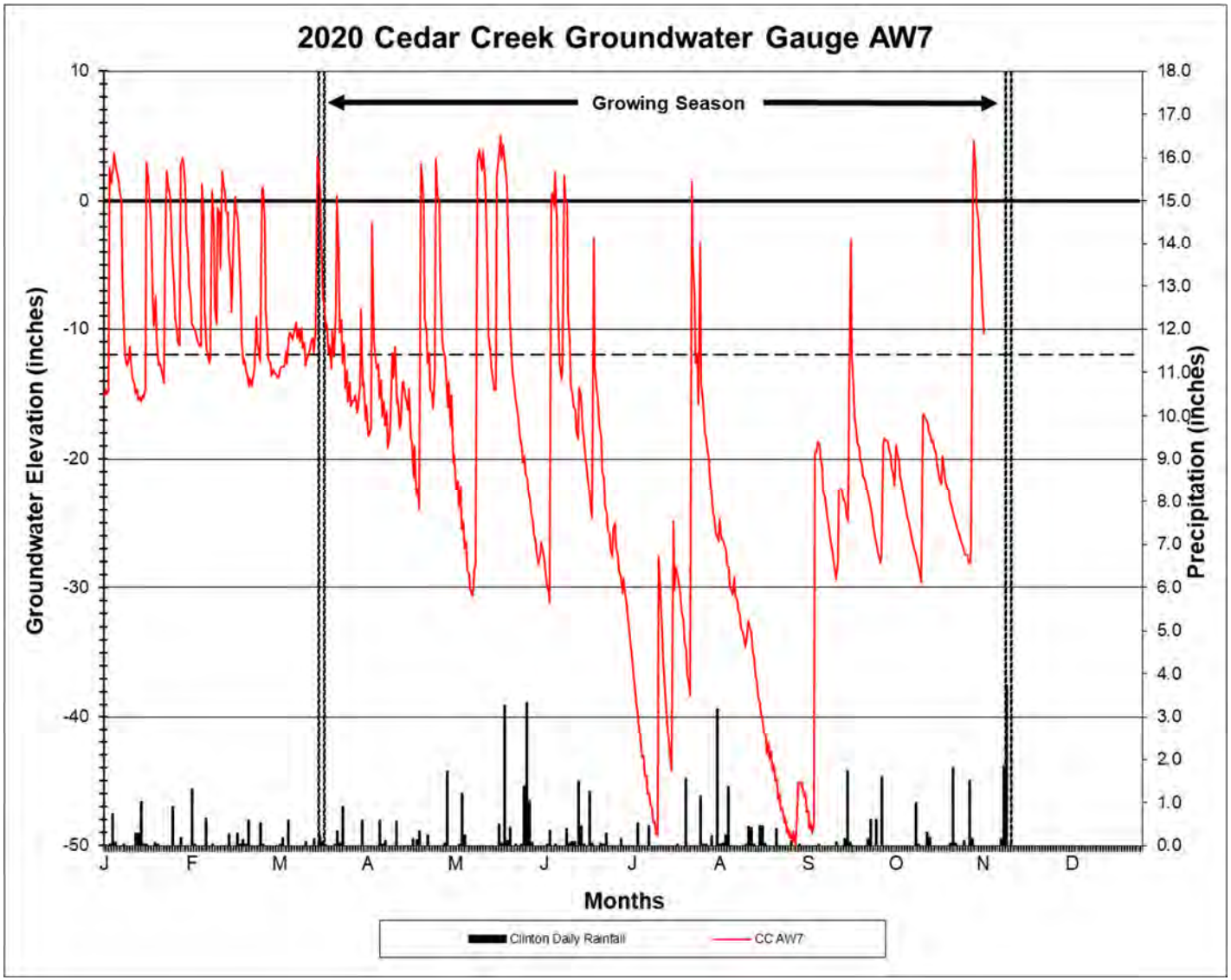

2020 Cedar Creek Groundwater Gauge AW2
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
10
5
0
-5
-10
-15
-20
-25
-30
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Rainfall
CC AW2

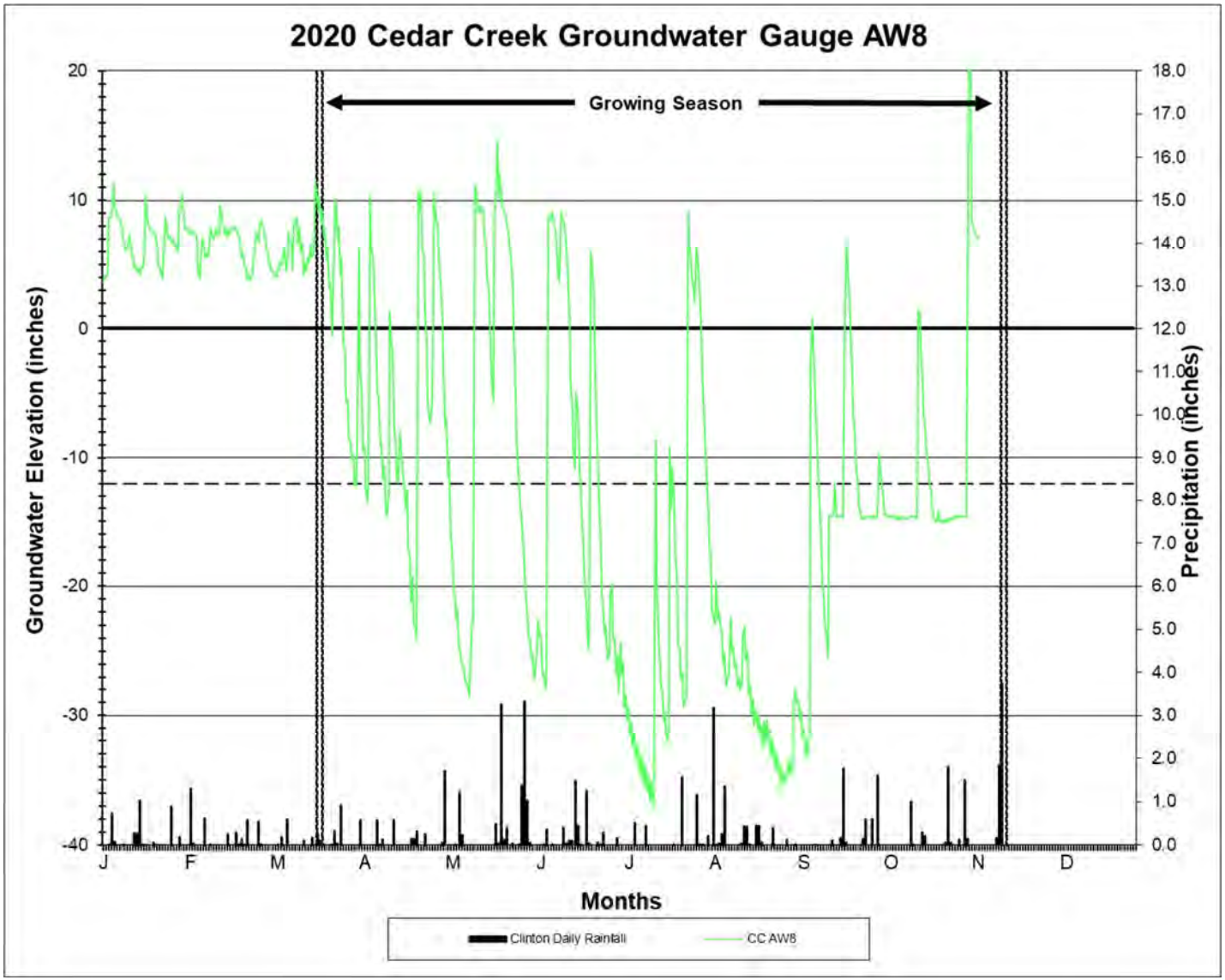

2020 Cedar Creek Groundwater Gauge AW3
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
10
5
0
-5
-10
-15
-20
-25
-30
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Rainfall
CC AW3

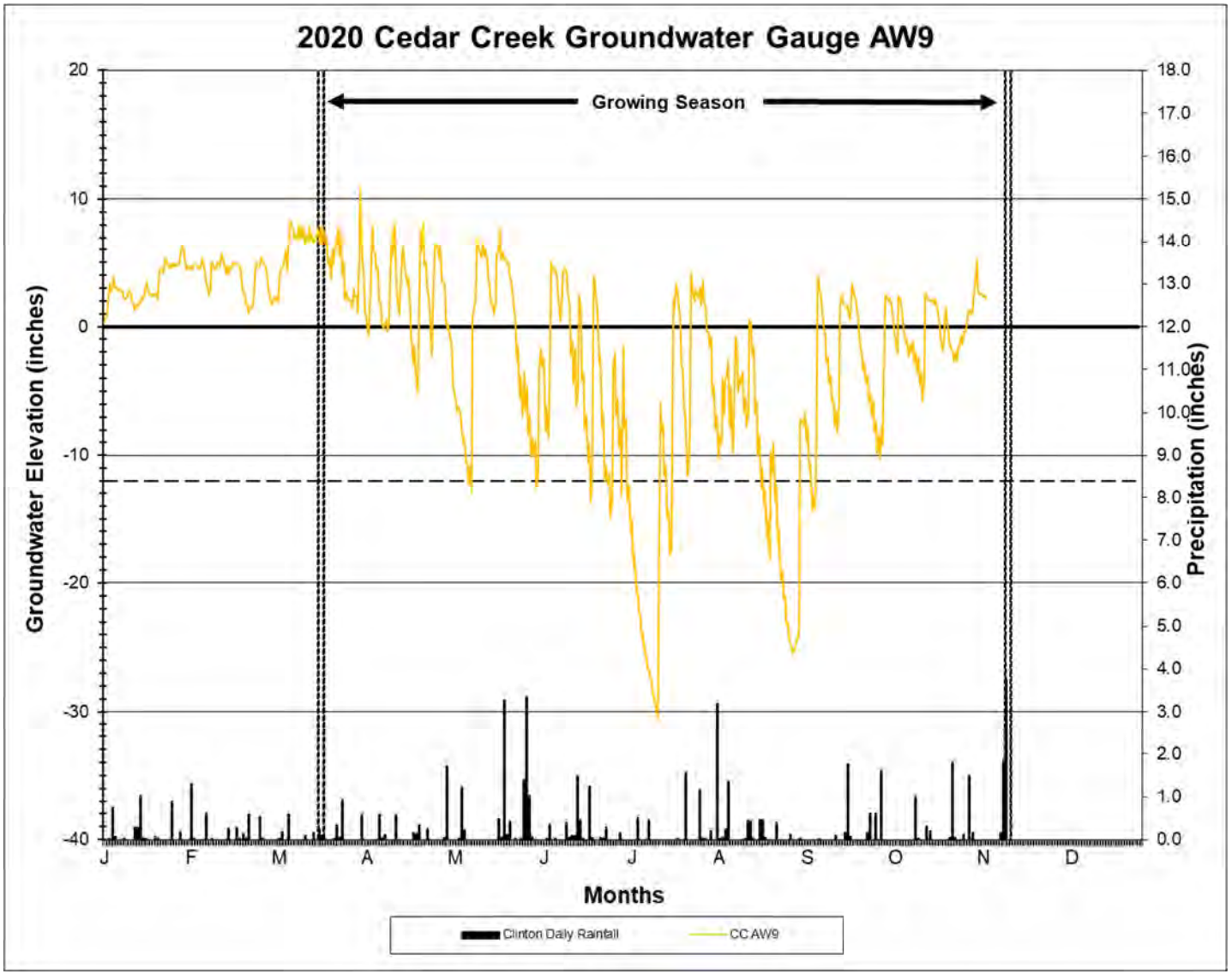

2020 Cedar Creek Groundwater Gauge AW4
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
10
5
0
-5
-10
-15
-20
-25
-30
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Rainfall
CC AW4

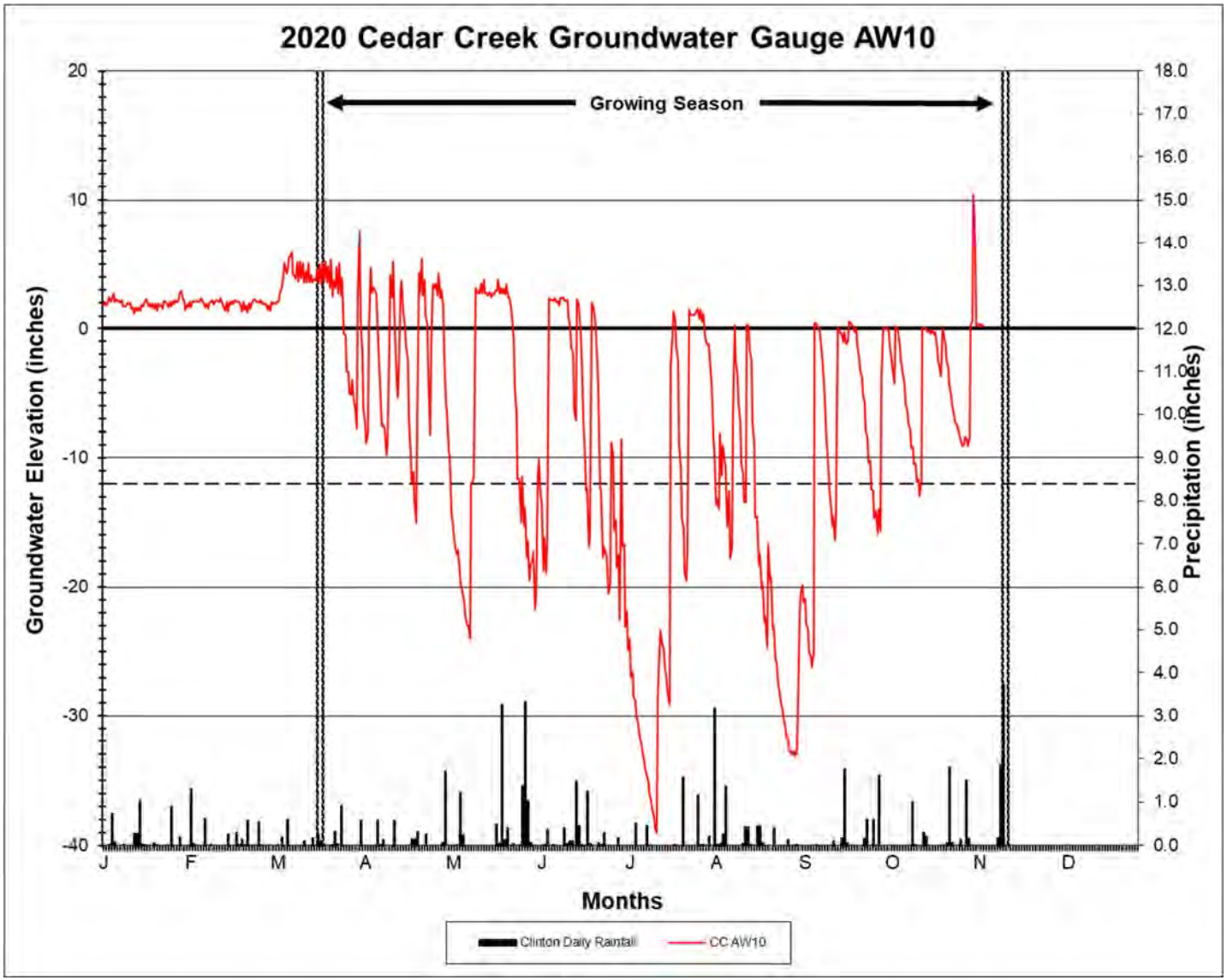

2020 Cedar Creek Groundwater Gauge AW5
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
10
5
0
-5
-10
-15
-20
-25
-30
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Rainfall
CC AW5

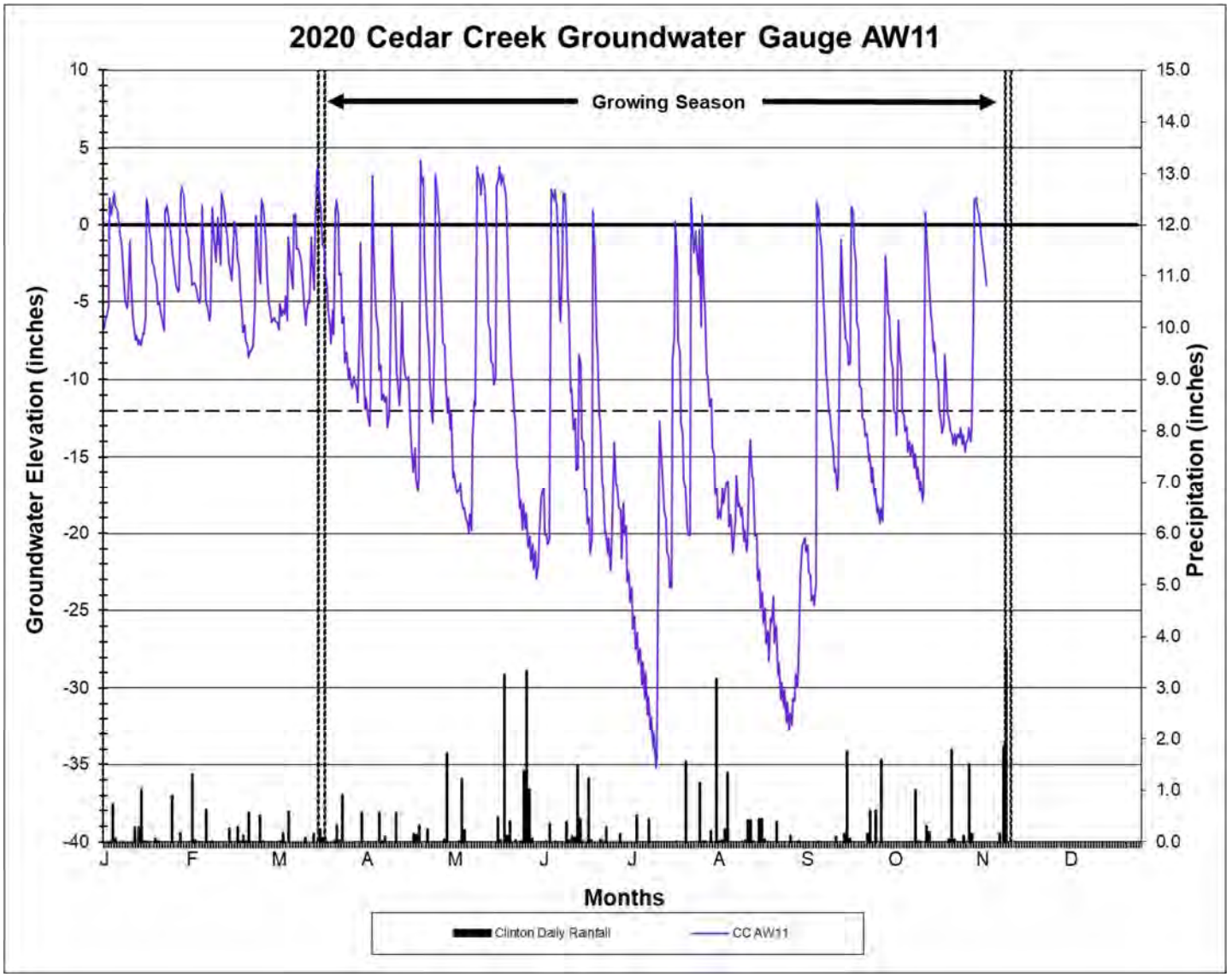

2020 Cedar Creek Groundwater Gauge AW6
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
10
5
0
-5
-10
-15
-20
-25
-30
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Rainfall
CC AW6

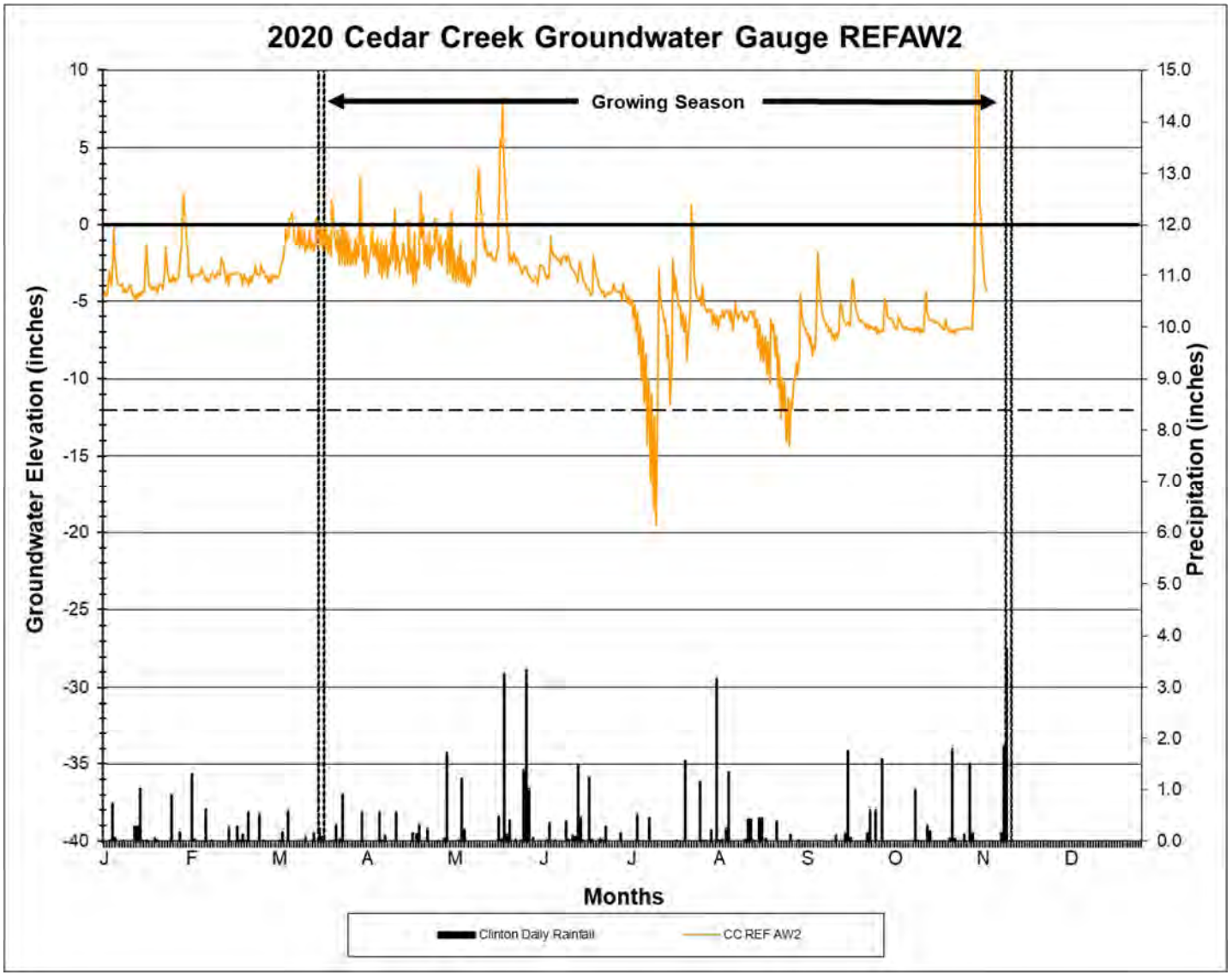

2020 Cedar Creek Groundwater Gauge AW7
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
10
0
-10
-20
-30
-40
-50
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Rainfall
CC AW7


2020 Cedar Creek Groundwater Gauge AW8
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
20
10
0
-10
-20
-30
-40
18.0
17.0
16.0
15.0
14.0
13.0
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
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Raintall
CC AW8


2020 Cedar Creek Groundwater Gauge AW9
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
20
10
0
-10
-20
-30
-40
18.0
17.0
16.0
15.0
14.0
13.0
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
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Raintall
CC AW9


2020 Cedar Creek Groundwater Gauge AW10
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
20
10
0
-10
-20
-30
-40
18.0
17.0
16.0
15.0
14.0
13.0
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
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Raintall
CC AW10


2020 Cedar Creek Groundwater Gauge AW11
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
15.0
14.0
13.0
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
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Rainfall
CC AW11


2020 Cedar Creek Groundwater Gauge REFAW2
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
15.0
14.0
13.0
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
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Rainfall
CC REF AW2

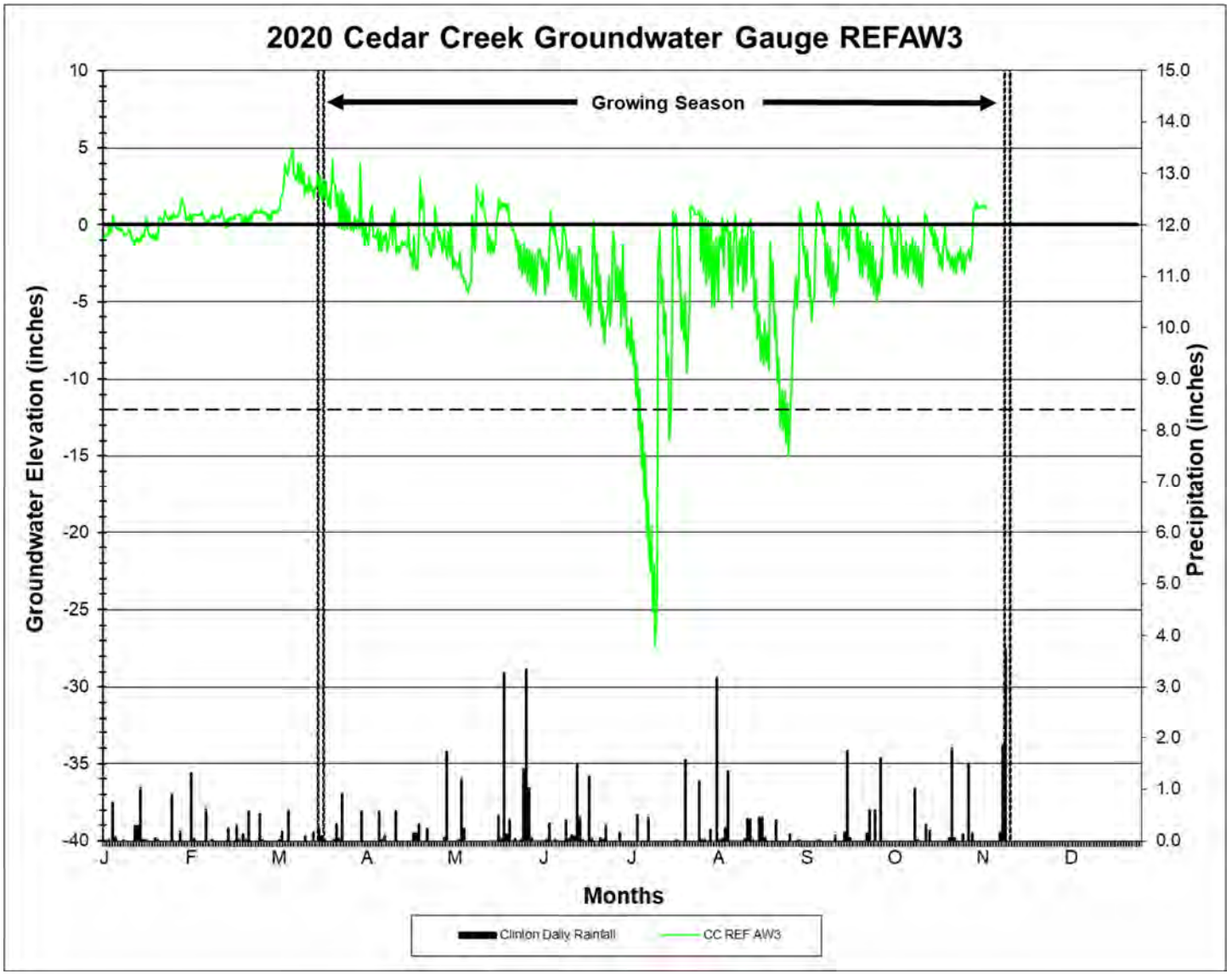

2020 Cedar Creek Groundwater Gauge REFAW3
Growing Season
Groundwater Elevation (inches)
Precipitation (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
J
F
M
A
M
J
J
A
S
O
N
D
Months
Clinton Daily Raintall
CC REF AW3

Figure 9. Headwater Valley Restoration Flow Chart