YEAR 5 MONITORING REPORT

UT MILLERS CREEK
Duplin County, North Carolina
DMS Project ID No. 95719, Contract No. 5000, USACE Action ID No. SAW-2013-00386
DWR Project No. 13-0187

Prepared for:

NCDEQ Division of Mitigation Services (DMS)
217 West Jones St., Suite 3000A
Raleigh, North Carolina 27603

Construction Completed: February 2015
Morphology Data Collected: March 29, 2019
Vegetation Data Collected: October 17, 2019
Submitted: January 2020

Mitigation Project Name	**UT to Millers Creek**	**County**	**Duplin**	**USACE Action ID**	**2013-00386**
DMS ID	**95719**	**Date Project Instituted**	**12/12/2021**	**NCDWR Permit No**	**2013-0187**
River Basin	**Cape Fear**	**Date Prepared**	**6/18/2019**		
Cataloging Unit	**03030006**				

Credit Release Milestone	Stream Credits						Wetland Credits							
	Scheduled Releases (Stream)	Warm	Cool	Cold	Anticipated Release Year (Stream)	Actual Release Date (Stream)	Scheduled Releases (Forested)	Riparian Riverine	Riparian Non-riverine	Non-riparian	Scheduled Releases (Coastal)	Coastal	Anticipated Release Year (Wetland)	Actual Release Date (Wetland)
Potential Credits (Mitigation Plan)		**2,679.000**						**8.200**						
Potential Credits (As-Built Survey)		**2,709.000**						**8.000**						
1 (Site Establishment)	**N/A**				N/A	N/A	**N/A**				**N/A**		N/A	N/A
2 (Year 0 / As-Built)	**30%**	812.700			2016	3/31/2016	**30%**	2.400			**30%**		2016	3/31/2016
3 (Year 1 Monitoring)	**10%**	270.900			2016	4/26/2016	**10%**	0.800			**10%**		2016	4/26/2016
4 (Year 2 Monitoring)	**10%**	270.900			2017	4/3/2017	**10%**	0.800			**15%**		2017	4/3/2017
5 (Year 3 Monitoring)	**10%**	270.900			2018	4/25/2018	**15%**	1.200			**20%**		2018	4/25/2018
6 (Year 4 Monitoring)	**5%**	135.450			2019	4/26/2019	**5%**	0.400			**10%**		2019	4/26/2019
7 (Year 5 Monitoring)	**10%**				2020		**15%**				**15%**		2020	
8 (Year 6 Monitoring)	**5%**				2021		**5%**				**N/A**		2021	
9 (Year 7 Monitoring)	**10%**				2022		**10%**				**N/A**		2022	
Stream Bankfull Standard	**10%**	270.900			2017	4/3/2017	**N/A**				**N/A**			
Total Credits Released to Date		**2,031.750**						**5.600**						

NOTES:
1/16/2019: During the review of the Year 4 monitoring report, DMS discovered that the schedule of credit release was incorrect from what was in the final mitigation plan. The credit release schedule has been adjusted for the unreleased credits after 4/25/2018.

CONTINGENCIES:

Signature of Wilmington District Official Approving Credit Release

27 Sept 2019

Date

1 - For NCEEP, no credits are released during the first milestone
2 - For NCEEP projects, the second credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the NCIRT by posting it to the NCEEP Portal, provided the following criteria have been met:
1) Approval of the 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) Reciept of necessary DA permit authorization or written DA approval for porjects 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

Mitigation Project Name	**UT to Millers Creek**	**County**	**Duplin**	**USACE Action ID**	**2013-00386**
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River Basin	**Cape Fear**	**Date Prepared**	**6/18/2019**		
Cataloging Unit	**03030006**				

DEBITS (released credits only)

			Ratios	1	1.5	2.5	5	1.09625	3	2	5	1	3	2	5	1	3	2	5
				Stream Restoration	Stream Enhancment I	Stream Enhancement II	Stream Preservation	Riparian Restoration	Riparian Creation	Riparian Enhancement	Riparian Preservation	Nonriparian Restoration	Nonriparian Creation	Nonriparian Enhancement	Nonriparian Preservation	Coastal Marsh Restoration	Coastal Marsh Creation	Coastal Marsh Enhancement	Coastal Marsh Preservation
As-Built Amounts (feet and acres)				**2,709.000**				**8.770**											
As-Built Amounts (mitigation credits)				**2,709.000**				**8.000**											
Percentage Released				**75%**				**70%**											
Released Amounts (feet / acres)				**2,031.75**				**6.139**											
Released Amounts (credits)				**2,031.75**				**5.600**											
NCDWR Permit	USACE Action ID	Project Name																	
	2001-01309	NCDOT TIP B-3906 - Bridges over Six Runs Cr, Sampson Co						0.121											
	2003-00152	NCDOT TIP B-3654 - Bridges on NC 55, Harnett & Sampson Co						0.504											
	2000-01472	NCDOT TIP B-3152 - Bridge on NC 242, Sampson & Cumberland Co						0.274											
	2010-00123	NCDOT TIP B-5116 - Bridge on SR 1502, Bladen Co						0.219											
2012-0219	2010-00334	NCDOT TIP B-4543 - Bridge on SR 1558, Harnett Co						0.329											
	2009-00859	NCDOT TIP B-5143 - Bridge on SR 1105, Duplin Co						0.142											
	2014-00131	NCDOT TIP R-5526 - SR 1841 Improvements - Division 6, Harnett Co						0.515											
	2013-02241	NCDOT TIP B-5117 - Bridge on NC 210, Bladen Co						0.230											
	2010-00917	The Pork Company S&J Villari Livestock		110.000															
2012-0240	1992-03237	NCDOT TIP R-2303C - NC 24, Sampson County		702.700				0.301											
2012-0240	1992-03237	NCDOT TIP R-2303C - NC 24, Sampson County		270.900				0.877											
2012-0240	1992-03237	NCDOT TIP R-2303D - NC 24, Sampson County		541.800															
2016-0525	2013-01815	SR 1715 - Bridge 300278 - Division 3, Duplin County		72.000															
Remaining Amounts (feet / acres)				**334.350**				**2.627**											
Remaining Amounts (credits)				**334.350**				**2.396**											

ROY COOPER
Governor

Mitigation Services
ENVIRONMENTAL QUALITY

January 14, 2019
Sent via email to bfurr@lmgroup.net and Vickie.Miller@hdrinc.com

Vickie Miller
HDR | ICA Engineering, Inc.
5121 Kingdom Way, Suite 100
Raleigh, NC 27607

Re: UT to Millers Creek Draft Year 5 Monitoring Report
Cape Fear River Basin, CU 03030006, Duplin County, DMS Project No. 95719

Ben and Vicki,

The Division of Mitigation Services (DMS) received the subject report on 12/30/19 and a site visit occurred during 1/14/2020. After review, DMS offers the following comments:

Digital:

- In table 9, BHR for XS 1 is listed as > 1 but should be < 1
- At next gauge download, please provide DMS with the hydrology data files where the report leaves off (post October 19th, 2019).

General:

1. Appendix E, Table 11. Bankfull events. Please update this table to show cumulative bankfull events (merge this table with Appendix C of MY4 monitoring report table.)
2. CCPV. The Pond area is show as shaded but appears outlined on the CCPV.

Upon revision, please submit one hardcopy and one digital file of the revised report, along with any updated digital data.

Sincerely,

LHCrocker.

Lindsay Crocker, Project Manager
NCDEQ Division of Mitigation Services

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1.0 PROJECT SUMMARY

The following report summarizes the vegetation establishment, stream stability, and wetland hydrology for Year 5 monitoring for the UT Millers Creek Site (hereafter referred to as the "Site") in Duplin County, North Carolina.

1.1 Goals and Objectives

The primary goals of the UT Millers Creek stream and wetland mitigation project focus on:

- Reducing stressors to water quality
- Providing and enhancing flood attenuation
- Restoring and enhancing aquatic, semi-aquatic and riparian habitat, and
- Restoring and enhancing habitat connectivity with adjacent natural habitats.

The following objectives accomplish the goals listed above:

1. Removing stressors to water quality and increasing attenuation is directly tied to:
    a. Restoration of the formerly deeply incised and entrenched UT as a Priority I (PI) restoration where bankfull and larger flows access the historic floodplain allowing nutrients, sedimentation, trash and debris from upstream urban runoff to settle from floodwaters.
    b. Restoration of the UT as PI restoration allows the Site to mitigate flood flows by reconnecting bankfull and higher flows to its historic floodplain.
    c. Restoration of the riparian buffers and wetlands adjacent to the UT (i.e. restoration of an existing pond and ditch back to riparian wetlands) allows floodwaters to attenuate, in turn reducing stressors from upstream impacts.
    d. Restoration of wetland hydrology within the riparian buffer supports hydrophytic vegetation, which assists in the uptake, storage and fixation of nutrients and sedimentation from overbank flows. Adjacent low-quality pine plantations were removed and planted with native hydrophytic vegetation.
2. Restoring and enhancing aquatic, semi-aquatic and terrestrial habitat is directly tied to:
    a. Introduction of woody materials such as planted vegetation, log sills, soil lifts and toe wood to the restored channel. Woody materials will promote shading, bed form diversity and foraging opportunities for aquatic organisms, benthic macroinvertebrates, and fish.
    b. Restoration of native vegetation to the stream channel banks and the adjacent riparian corridor has diversified flora and provides an abundance of available foraging and cover habitat for amphibians, reptiles, mammals and birds.
    c. Restoration of wetland hydrology and introducing floodwaters back to the historic floodplain provides a diversity of habitats for semi-aquatic flora and fauna that may have not been seen on the Site since before anthropogenic disturbances.
3. Habitat restoration and connectivity can be directly tied to:
    a. The removal of existing pine plantations and replanting of native vegetation.
    b. The restored community ensures a protected habitat corridor between the Site and the downstream mature riparian buffers and upland habitats.

1.2 Success Criteria

Monitoring of restoration efforts will be performed until success criteria are fulfilled. Monitoring includes stream channel/hydraulics, wetland hydrology, and vegetation. In general, the restoration success criteria, and required remediation actions, are based on the Stream Mitigation Guidelines (USACE et al. 2003) and the Ecosystem Enhancement Program Monitoring Requirements and Performance Standards for stream and/or Wetland Mitigation (NCEEP 2011). Project success criteria are further detailed in the Baseline Monitoring Document & As-Built Baseline Report (ICA 2015).

1.3 Background Summary

The North Carolina Department of Environmental and Natural Resources Department of Mitigation Services (DMS) contracted ICA Engineering, Inc. (ICA) to restore 2,625 linear feet of the Unnamed Tributary to Millers Creek (UT) and 4.5 acres of riparian wetlands within the Site to assist in fulfilling stream mitigation goals in the watershed (Table 1 and Table 4). The Site is located approximately one-half (0.5) mile west of Magnolia in Duplin County, North Carolina and contains an unnamed tributary to Millers Creek and associated restored riparian wetlands (Figure 1). The Site is located within DMS Targeted Local Watershed Catalogue Unit (CU) 03030006. The Site is comprised of one property owned by William Jeffrey Hatcher and wife Susan King Hatcher (PIN # 247100987405). Additional information concerning project history is presented in Table 2.

1.4 Vegetation

Vegetation is meeting success criteria across the site following the fifth year of monitoring. Overall, the site is averaging 674 planted stems per acre; exceeding the success criteria of 260 stems per acre after Year 5 Monitoring. Additionally, all plots are individually exceeding success criteria by over 80%.

In Plots 3 and 6, planted stems are averaging less than 3 feet in height. Even though there has been slow growth in these plots, 85% of the stems have a vigor of 3 or higher. This is an improvement from Year 3 when it was noted that the majority of stems in Plot 3 had a vigor of 2 or less. It is expected that these plots will meet the Year 7 requirement of 210 stems per acre, however it is unlikely that average stem height will reach 10 feet. HDR will continue to closely monitor vegetation in this area and may take corrective action if necessary.

Two areas of low stem density are present on-site. Total acreage of low stem density area is 0.2 acres (approximately 1.6% of planted acreage). Low stem density is noted from station 14+50 - 16+30 as well as from station 33+60 – 36+00. It is expected that volunteer species will establish in these areas over time. Pine saplings have become dense along the right floodplain of UT to Millers Creek. The pine does not appear to be outcompeting planted stems, however HDR will continue to monitor the pine and take corrective actions if necessary.

1.5 Stream Stability

UT Millers Creek is stable and functioning as designed. Cross section geometry has remained stable over the course of Monitoring Year 5. Cross sections 5, 7, and 9 have experienced minor reductions in channel cross sectional area which can be attributed to maturation of vegetation along the channel banks and toes.

Two log sills are experiencing erosion along the banks immediately downstream of the structures. Both areas were noted in Year 4 and do not appear to have increased in length, therefore no remedial action is recommended at this time.

The site has experienced several bankfull flows throughout the monitoring period. Bankfull event documentation can be found in Appendix E.

Bank pins were inspected on-site and showed no signs of bank erosion over the course of the monitoring period.

1.6 Wetlands

Based upon the Final Mitigation Plan, the hydrologic criteria for restored wetlands at the Site are as follows (based upon the corresponding landscape position and wetland community type):

a. For the **riparian bottomland hardwood forest community**, the hydrologic criterion will be the establishment of a static water table at, or within, 12 inches of the soil surface for a minimum of 12.5 percent of the growing season, equivalent to 38 days based upon hydrologic monitoring undertaken from Feb 1st through Nov 30th of each monitoring year.
b. For the **headwater riparian community (zero-order geomorphic position)**, the hydrologic criterion will be the establishment of a static water table at, or within, 12 inches of the soil surface for a minimum of 10 percent of the growing season, equivalent to 30 days based upon hydrologic monitoring undertaken from Feb 1st through Nov 30th of each monitoring year.

The UT Millers site exhibits a range of hydrologic conditions characteristic of small stream swamp wetland community types of the inner Coastal Plain of North Carolina. All of the groundwater gauges documented elevated groundwater levels at or near the soil surface for extended periods of time during the growing season. In addition, portions of the site exhibited intermittent to prolonged periods of surface inundation. Refer to the attached gauge hydrographs (Figures 7.1 – 7.8) depicting recorded groundwater and surface water levels from February 1 through November 30.

All the groundwater gauges located on the mitigation site exhibit hydrology indicative of jurisdictional wetlands (i.e. hydroperiods greater than 5% of the growing season), and all of the six gauges exceeded the minimum success criteria as outlined above. While the specific durations of wetland hydrology at each gauge varied across the site, each gauge also displayed prolonged wetland hydroperiods during normal rainfall conditions.

The summary of hydroperiods for each gauge is presented in Table 12 and gauge locations are depicted in Figure 2.1.

2.0 METHODOLOGY

Year 5 monitoring surveys were completed using a Total Station. Each cross section was marked with a rebar monument at their beginning and ending points. The rebar has been located vertically and horizontally in NAD 83-State Plane. Surveying these monuments throughout the Site

ensured proper orientation. The survey data was imported into MicroStation for verification. RIVERMorph and the Ohio Department of Natural Resources' "The Reference Reach Spreadsheet Version 4.3L" were used to analyze cross section data (Mecklenburg 2006). Tables and figures were created using Microsoft Excel. The channel is entirely a sand bed system; therefore, a pebble count was not conducted. Bank pins were not exposed (i.e. no erosion occurred at bank pin locations) and therefore were not surveyed.

Vegetation monitoring was completed using CVS level II methods, for nine, 100 square meter vegetation plots (Lee et al. 2006). The taxonomic standard for vegetation used for this document was Flora of the Southern and Mid-Atlantic States (Weakley 2011).

Groundwater hydrology was monitored using nine automated gauges (RDS, Inc. WM-20s) located within the riparian wetland restoration areas. Two reference gauges were installed; one in a Headwater Riparian Wetland and one in a Bottomland Hardwood Wetland. Gauges were installed in accordance with installation methods outlined in the Wetlands Regulatory Assistance Program (WRAP) Technical Note 00-02 (Sprecher, 2000). Water levels were recorded once daily, and the data was downloaded every two months.

3.0 REFERENCES

ICA Engineering, Inc. As-Built Monitoring Document & As-Built Baseline Report for UT Millers Creek Full Delivery Site. 2015.

Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (http://cvs.bio.unc.edu/methods.htm).

Mecklenburg, Dan. 2006. The Reference Reach Spreadsheet Version 4.3L. 2006. Ohio Department of Natural Resources. Division of Soil and Water. (http://www.dnr.state.oh.us/tabid/9188/default.aspx)

NCEEP. Ecosystem Enhancement Program Monitoring Requirements and Performance Standards for stream and/or Wetland Mitigation. 2011.

Sprecher, S. W. (2000). "Installing Monitoring Wells/Piezometers in Wetlands," ERDC TN-WRAP-00-02, U.S. Army Research and Development Center, Vicksburg, MS.

US Army Corps of Engineers Wilmington District. Stream Mitigation Guidelines. 2003

Weakley, Alan S. 2011. Flora of the Southern and Mid-Atlantic States (online). Available: http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2011-May-nav.pdf [May 15, 2011]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

APPENDICES

Appendix A. Project Vicinity Map and Background Tables

Vicinity Map

UT to Millers Creek Mitigation Site, Duplin County, NC

0 750 1,500 3,000 4,500 6,000 Feet

1 inch = 2,000 feet

Figure 1

Table 1. Project Components and Mitigation Credits
UT to the Millers Creek, Duplin County
DMS Project ID No. 95719

Mitigation Credits									
	Stream (SMU)		Riparian Wetland (WMU)		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE	--	--	--
Totals	2,709		8.00						

Project Components							
Project Component or Reach ID	Stationing/ Location	Existing Footage/ Acreage	Approach (PI, PII, etc.)	Restoration or Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio	SMU or WMU
UT Millers Creek	10+13 – 37+22	2,100	PI	Restoration	2,709	1:1	2,709
Drained Wetland (Headwater)	NA	1.22	NA	Restoration	1.22	1:1	1.22
Drained Wetland (Pines)	NA	3.78	NA	Restoration	3.78	1:1	3.78
Drained Wetland (Mature Woods)	NA	2.55	NA	Restoration	2.55	1.25:1	2.04
Drained Wetland (Berm/Spoil Along UT)	NA	0.45	NA	Restoration	0.45	1:1	0.45
Pond	NA	0.77	NA	Restoration	0.77	1.5:1	0.51
TOTAL	NA	2,100/8.77	PI/NA	Restoration	2,709/8.77	1 – 1.5:1	2,709/8.00

Component Summation						
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	2,709	8.77				

BMP Elements			
Element	Location	Purpose/Function	Notes
Forested Buffer	UT Millers buffer	Buffer to protect stream	Filter nutrients and provide cover, foraging areas, habitat, woody debris, and wildlife

Table 2. Project Activity and Reporting History UT to Millers Creek (DMS Project ID No. 95719)		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Restoration Plan	Aug-13	Sep-14
Final Design – Construction Plans	Sep-14	Sep-14
Construction	3-Nov-14	23-Jan-15
Temporary S&E Mix Applied to Entire Project Area	---	23-Jan-15
Permanent Seed Mix Applied to Entire Project Area	---	23-Jan-15
Bare Root, Containerized, and B&B plantings for Entire Project Area	---	10-Mar-15
Mitigation Plan/As-built (Year 0 Monitoring-Baseline)	Mar-15	Apr-15
Year 1 Monitoring	Oct-15	Dec-15
Year 2 Monitoring	Nov-16	Feb-17
Year 3 Monitoring	Nov-17	Jan-18
Year 4 Monitoring	Dec-18	Jan-19
Year 5 Monitoring	Oct-19	Jan-20
Year 6 Monitoring		
Year 7 Monitoring		

Table 3. Project Contacts Table UT to Millers Creek (DMS Project ID No. 95719)	
Designer Primary project design POC	Land Management Group, Inc 3101 Poplarwood Court, Suite 120 Raleigh, North Carolina 27604 Kevin Williams (919) 810-6525
Construction Contractor Construction Contractor POC	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Lloyd Glover (919) 639-6132
Planting Contractor Planting Contractor POC	River Works, Inc. 6105 Chapel Hill Road Raleigh, NC 27607 Phillip Todd (919) 582-3574
Seeding Contractor Seeding Contractor POC	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Lloyd Glover (919) 639-6132
Seed Mix Sources	Green Resources – Triangle Office
Nursery Stock Suppliers	1) ArborGen 2) Mellow Marsh Farm, Inc. 3) Foggy Mountain Nursery (live stakes)
Monitoring Performers	HDR|ICA 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Alex DiGeronimo (LMG) (843) 830-1536
Stream Monitoring POC	HDR|ICA 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Alex DiGeronimo (LMG) (843) 830-1536
Vegetation Monitoring POC	Land Management Group, Inc 3805 Wrightsville Avenue, Suite 15 Wilmington, NC 28403 Kim Williams (910) 452-0001 x 1908

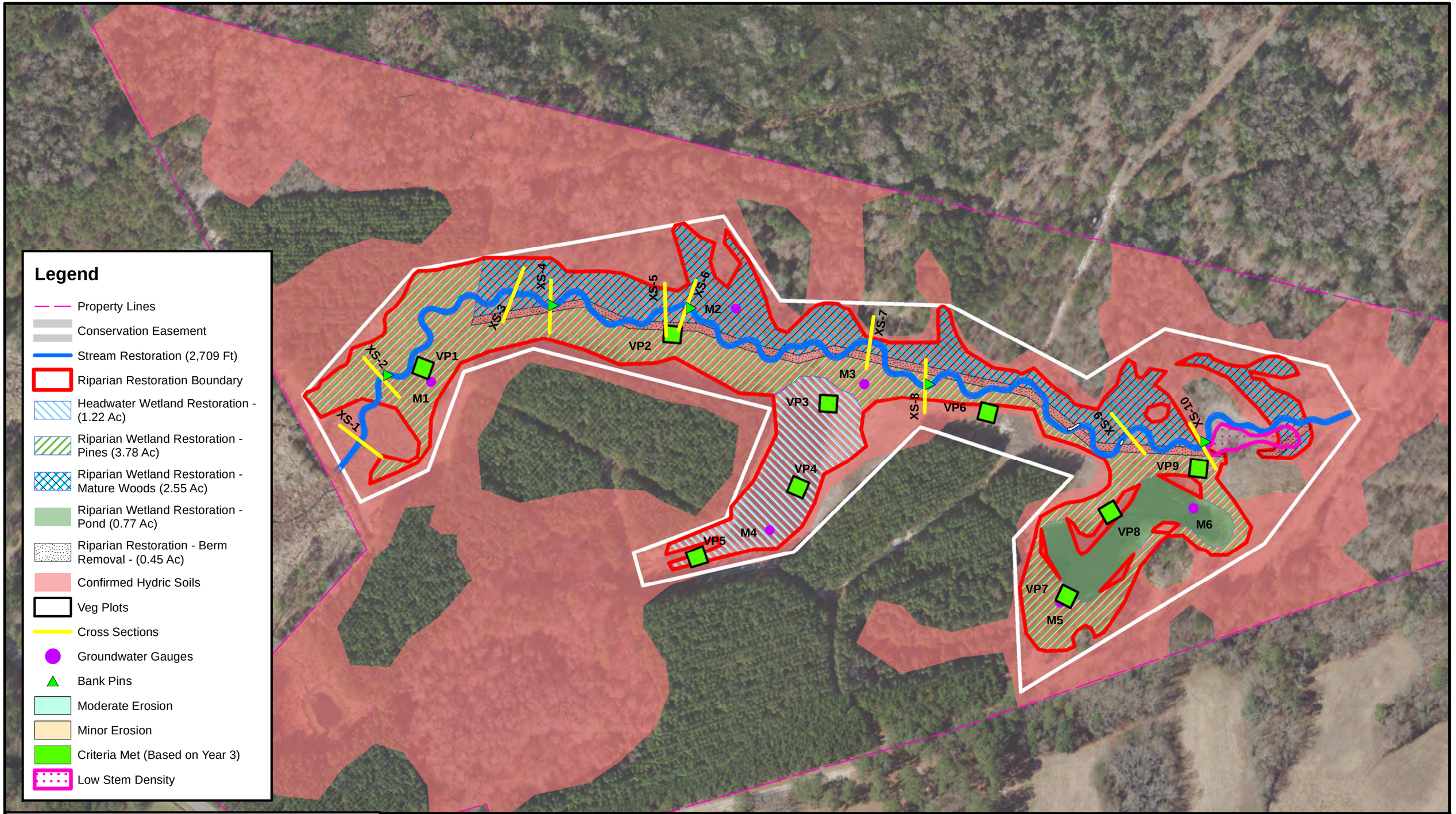
Table 4. Project Information UT to Millers Creek (DMS Project ID No. 95719)	
Project Information	
Project Name	UT to Millers Creek Stream and Wetland Mitigation Site
Project County	Duplin
Project Area (acres)	15.944 AC
Project Coordinates	34.894467,-78.067625
Project Watershed Summary Information	
Physiographic Region	Coastal Plain
Ecoregion	Southeastern Plains
Project River Basin	Cape Fear
USGS 8-digit HUC	3030006
USGS 14-digit HUC	3030006110040
NCDWQ Subbasin	03-06-19
Project Drainage Area	250 AC
Watershed Land Use	Cultivated, Southern Yellow Pine, Bottomland Forest / Hardwood Swamps

Reach Summary Information	
Parameters	**UT to Millers Creek**
Restored length	2,709 linear feet
Drainage Area	250 AC.
NCDWQ Index Number	36
NCDWQ Classification	C, Sw
Valley Type/Morphological Description	X/Existing G/5/Restored E5
Dominant Soil Series	Bibb sandy loam and Torhunta fine sandy loam (USDA/NRCS records). Cape Fear, Rains, Plummer, Rutlege and Lynn Haven Soil series (additional series mapped by LMG)
Drainage Class	Poorly and very poorly
Soil Hydric Status	Bibb sandy loam (hydric) Torhunta mucky fine sandy loam (hydric)
Slope	0.0016
FEMA Classification	Zone X
Native Vegetation Community	Mixed stand of hardwoods and pine
Percent Composition of Exotic Invasives	<5%

Wetland Summary Information			
Parameters	**Wetland 1**	**Wetland 2**	**Wetland 3**
Size of Wetland (acres)	0.21	0.12	0.59
Wetland Type (non-riparian riverine or riparian non-riv	Riparian Non-Riverine	Riparian Non-Riverine	Riparian Non-Riverine
Mapped Soil Series	BbA	ToA	BnB
Drainage class	Poorly Drained	Very Poorly Drained	Moderately Well Drained
Soil Hydric Status	Hydric	Hydric	Partially Hydric
Source of Hydrology	Groundwater	Groundwater	Groundwater
Hydrologic Impairment	Stream Incision	Stream Incision	Stream Incision/Beavers
Native vegetation community	Forested	Forested	Emergent
Percent composition of exotic invasion vegetation	0	0	0

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the U.S. –Sections 404 and 401	Yes	Yes	Restoration Plan/NW 27
Endangered Species Act	No	Yes	NCNHP/USFWS
Historic Preservation Act	No	Yes	NCSHPO
CZMA/CAMA	No	Yes	--
FEMA Floodplain Compliance	Yes	Yes	HECRAS
Essential Fisheries Habitat	No	N/A	--

Appendix B. Visual Assessment Data



Current Condition Plan View - Year 5

UT Millers Creek, Duplin County, North Carolina

0 87.5 175 350 525 700 Feet

HDR | ICA

NC Environmental Quality

Figure 2.1

Table 5: Visual Stream Morphology Stability Assessment
Reach ID: UT Millers Creek
Assessed Length: 2,709 FT

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. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	N/A	N/A			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	5	5			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	61	61			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	57	57			100%			
		2. Thalweg centering at downstream of meander (Glide)	57	57			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			2	30	98.9%	N/A	N/A	N/A
	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%	N/A	N/A	N/A
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	N/A	N/A	N/A
				Totals	2	30	98.9%	N/A	N/A	N/A
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	12	12			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	12	12			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	12	12			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	12	12			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	12	12			100%			

Table 6 Vegetation Condition Assessment

Planted Acreage **12.35**

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.	0.05 acres	polygons filled with orange dots and x's	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.	.1 acres	Pink dots	2	0.2	1.6%
			Total			
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	.1 acres	Pattern and Color	0	0.0	0.0%
			Cumulative Total			

Easement Acreage **15.94**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale)	1000 SF	Pattern and Color	N/A	N/A	N/A
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale)	none	Pattern and Color	N/A	N/A	N/A

Figures 3.1 - 3.13. Vegetation Plot Photos and Problem Areas

3.1 Vegetation Plot 1

3.2 Vegetation Plot 2

3.3 Vegetation Plot 3

3.4 Vegetation Plot 4

3.5 Vegetation Plot 5

3.6 Vegetation Plot 6

3.7 Vegetation Plot 7

3.8 Vegetation Plot 8

3.9 Vegetation Plot 9

3.10 Low stem density area near STA 15+00

3.11 Minor bank erosion near STA 30+00

3.12 Moderate erosion near XS 9

3.13 Low stem density area near STA 34+50

Appendix C. Vegetation Plot Data

Table 7. DMS Project Code 95719. Project Name: UT Millers Creek

Current Plot Data (MY5 2019)

			95719-01-0001			95719-01-0002			95719-01-0003			95719-01-0004			95719-01-0005			95719-01-0006			95719-01-0007			95719-01-0008			95719-01-0009		
Scientific Name	**Common Name**	**Species Type**	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	red maple	Tree																					12			12			
Betula nigra	river birch	Tree				2	2	2										1	1	1							1	1	1
Fraxinus pennsylvanica	green ash	Tree				1	1	1	1	1	1							4	4	4	10	10	10	5	5	5	4	4	4
Laurus nobilis	sweet bay							1																					
Liquidambar styraciflua	sweetgum	Tree			4			49			4									23			3			4			2
Liriodendron tulipifera	tuliptree	Tree				1	1	1	1	1	1							1	1	1				1	1	1	4	4	4
Magnolia virginiana	sweetbay	Tree				1	1	1																					
Morella cerifera	wax myrtle	shrub													2	2	2												
Myrica	sweetgale	shrub									1						1						1						
Nyssa sylvatica	blackgum	Tree				1	1	1																					
Persea borbonia	redbay	tree																											
Pinus	pine	Tree																											
Pinus taeda	loblolly pine	Tree						3			10						13			4			2			7			3
Platanus occidentalis	American sycamore	Tree													8	8	8												
Prunus serotina	black cherry	Tree																											
Quercus	oak	Tree																											
Quercus michauxii	swamp chestnut oak	Tree	3	3	3	3	3	3	3	3	3							5	5	5				2	2	2	4	4	4
Quercus nigra	water oak	Tree																		5									1
Quercus phellos	willow oak	Tree				2	2	2	4	4	4							9	9	9							3	3	3
Salix nigra	black willow	Tree															8												
Taxodium distichum	bald cypress	Tree	9	9	9	5	5	5	4	4	4	12	12	12	7	7	7	1	1	1	10	10	10	10	10	10	5	5	5
		Stem count	12	12	16	16	16	69	13	13	28	12	12	12	17	17	39	21	21	53	20	20	38	18	18	41	21	21	27
		size (ares)	1			1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	2	2	3	8	8	11	5	5	8	1	1	1	3	3	6	6	6	9	2	2	6	4	4	7	6	6	9
		Stems per ACRE	485.6	485.6	647.5	647.5	647.5	2792	526.1	526.1	1133	485.6	485.6	485.6	688	688	1578	849.8	849.8	2145	809.4	809.4	1538	728.4	728.4	1659	849.8	849.8	1093

Annual Means

			MY5 (2019)			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
Acer rubrum	red maple	Tree			24			3									
Betula nigra	river birch	Tree	4	4	4	4	4	4	3	3	4	8	8	8	13	13	13
Fraxinus pennsylvanica	green ash	Tree	25	25	25	27	27	27	27	27	27	27	27	27	28	28	28
Laurus nobilis	sweet bay				1												
Liquidambar styraciflua	sweetgum	Tree			89			35			23			5			
Liriodendron tulipifera	tuliptree	Tree	8	8	8	14	14	14	13	13	13	15	15	15	19	19	19
Magnolia virginiana	sweetbay	Tree	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Morella cerifera	wax myrtle	shrub	2	2	2	2	2	4	2	2	2	2	2	2	3	3	3
Myrica	sweetgale	shrub			3												
Nyssa sylvatica	blackgum	Tree	1	1	1			3									
Persea borbonia	redbay	tree						1									
Pinus	pine	Tree									3						
Pinus taeda	loblolly pine	Tree			42			12									
Platanus occidentalis	American sycamore	Tree	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Prunus serotina	black cherry	Tree									1						
Quercus	oak	Tree									2						
Quercus michauxii	swamp chestnut oak	Tree	20	20	20	19	19	19	20	20	20	21	21	21	22	22	22
Quercus nigra	water oak	Tree			6												
Quercus phellos	willow oak	Tree	18	18	18	19	19	19	21	21	21	25	25	25	28	28	28
Salix nigra	black willow	Tree			8			6			1						
Taxodium distichum	bald cypress	Tree	63	63	63	65	65	65	64	64	64	64	64	64	67	67	67
		Stem count	150	150	323	159	159	221	159	159	190	171	171	176	189	189	189
		size (ares)	9			9			9			9			9		
		size (ACRES)	0.22			0.22			0.22			0.22			0.22		
		Species count	10	10	17	9	9	15	9	9	14	9	9	10	9	9	9
		Stems per ACRE	674.5	674.5	1452	714.9	714.9	993.7	714.9	714.9	854.3	768.9	768.9	791.4	849.8	849.8	849.8

Color for Density

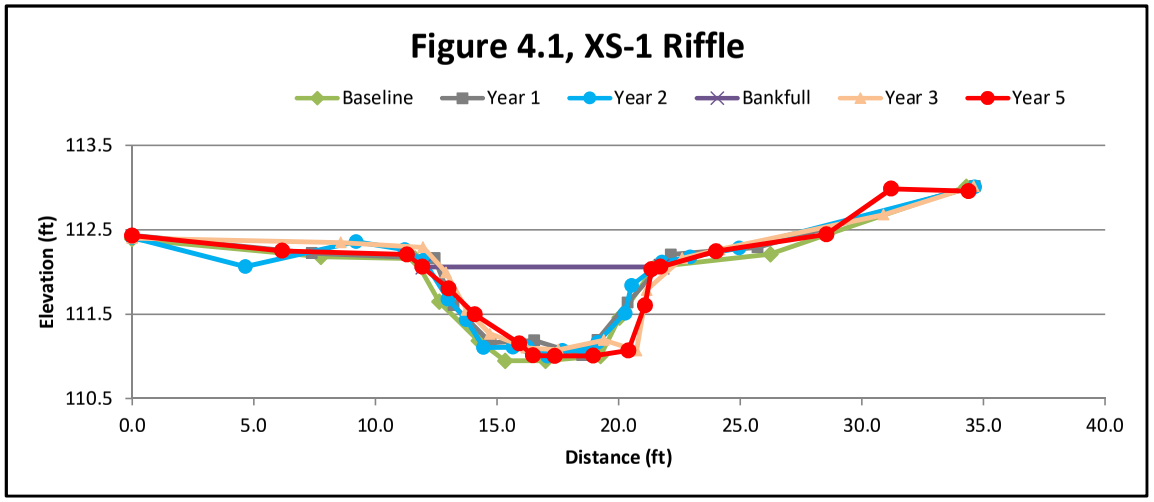
Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

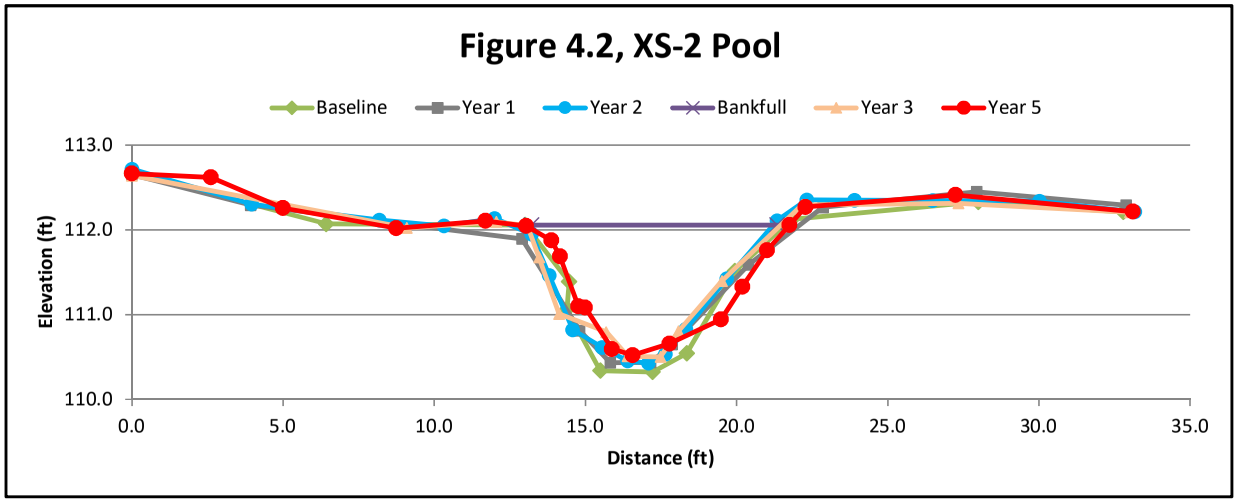
Fails to meet requirements by more than 10%

Appendix D. Stream Survey Data

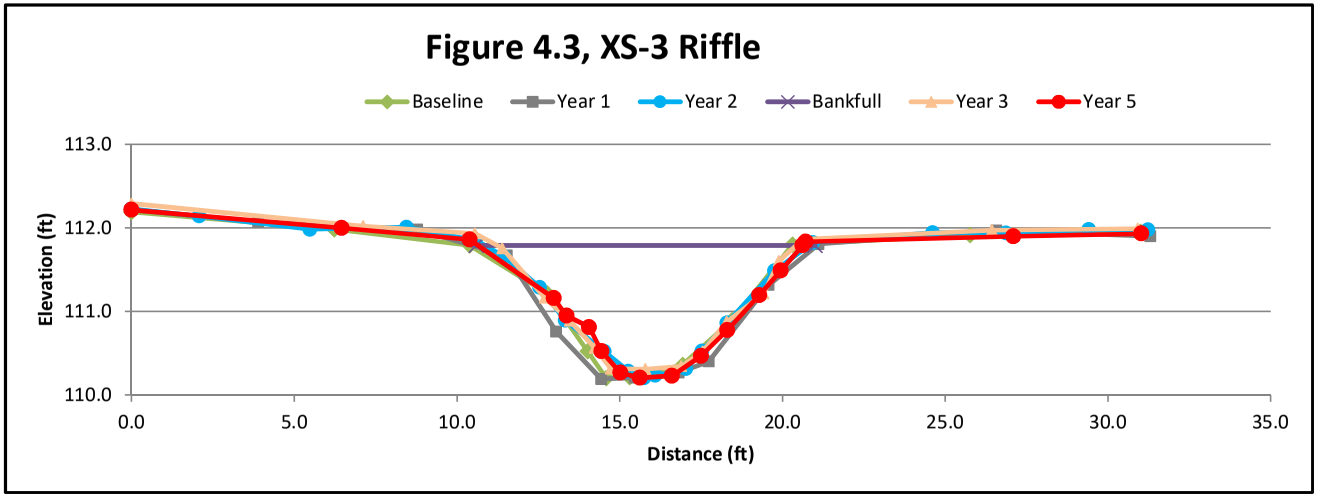


	Cross Section 1 (Riffle)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.7	9.1	9.4	9.5	9.8	
Floodprone Width (ft)	195.2	195.2	195.2	195.2	195.2	
Bankfull Mean Depth (ft)	0.8	0.7	0.7	0.7	0.7	
Bankfull Max Depth (ft)	1.1	1.0	1.1	1.0	1.1	
Bankfull Cross Sectional Area (ft^2)	7.7	6.3	6.7	6.8	7.1	
Bankfull Width/Depth Ratio	12.2	13.2	13.2	13.2	13.4	
Bankfull Entrenchment Ratio	20.2	21.4	20.8	20.5	20.0	
Low Bank Height (ft)	---	---	---	---	1.0	
Bankfull Bank Height Ratio*	1.0	1.1	1.1	1.1	>1	

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

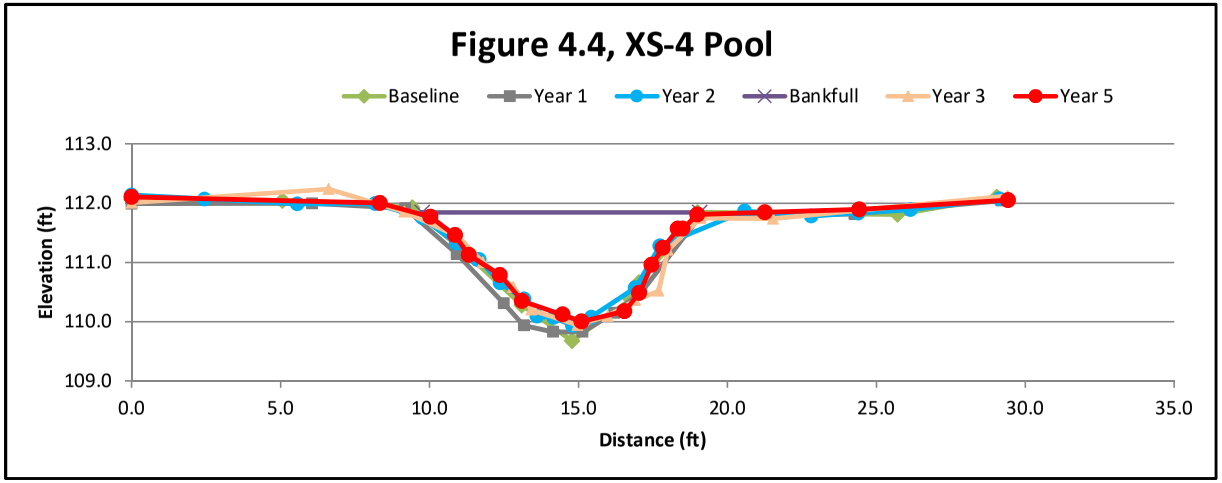


	Cross Section 2 (Pool)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	8.6	8.6	7.8	8.0	9.1	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.0	0.9	1.0	0.9	0.9	
Bankfull Max Depth (ft)	1.7	1.5	1.5	1.5	1.5	
Bankfull Cross Sectional Area (ft^2)	8.8	7.3	7.3	7.0	8.0	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bankfull Bank Height Ratio						

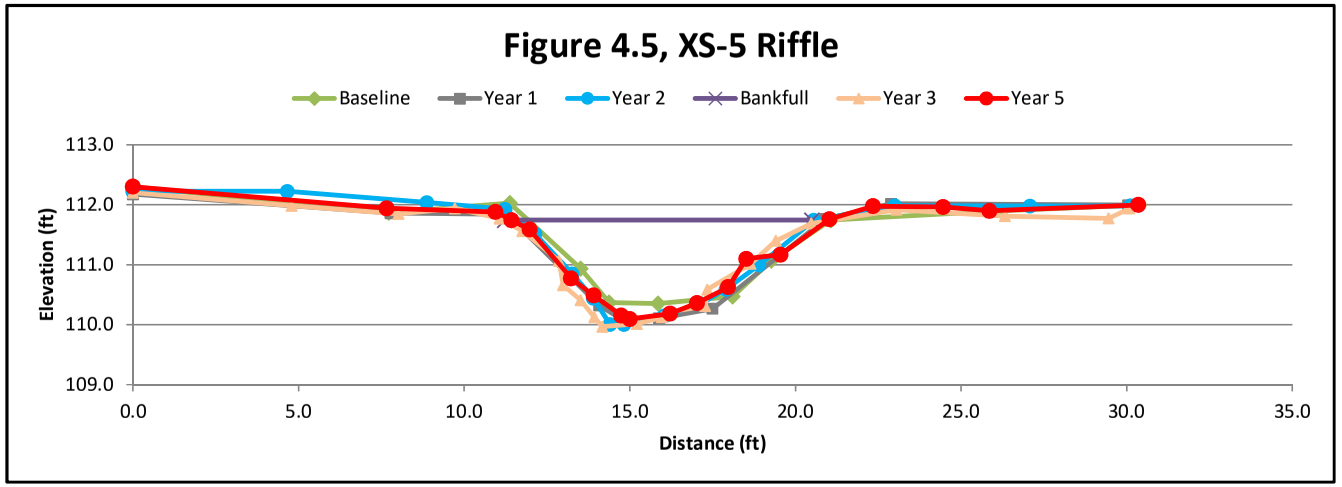


	Cross Section 3 (Riffle)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.9	10.6	10.0	9.2	10.0	
Floodprone Width (ft)	126.3	126.3	126.3	126.3	126.3	
Bankfull Mean Depth (ft)	0.9	0.9	0.9	0.9	0.9	
Bankfull Max Depth (ft)	1.6	1.6	1.6	1.5	1.6	
Bankfull Cross Sectional Area (ft^2)	8.8	9.9	8.5	8.5	8.8	
Bankfull Width/Depth Ratio	11.1	11.4	11.6	10.0	11.3	
Bankfull Entrenchment Ratio	12.8	11.9	12.7	13.8	12.7	
Low Bank Height (ft)	---	---	---	---	1.6	
Bankfull Bank Height Ratio*	1.0	1.0	1.0	1.1	1.1	

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

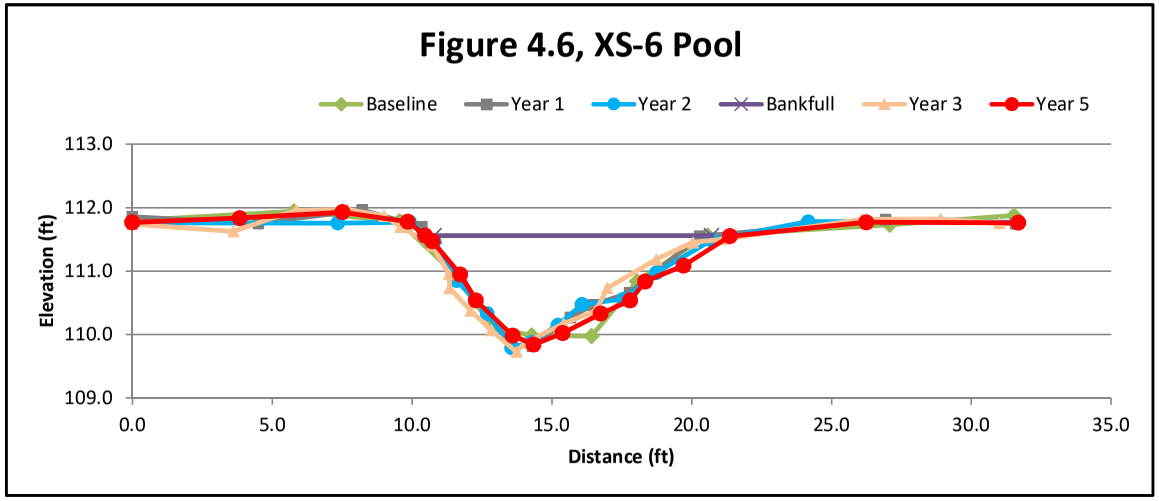


	Cross Section 4 (Pool)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.4	9.8	10.2	12.2	9.5	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.2	1.2	0.9	0.8	1.1	
Bankfull Max Depth (ft)	2.2	1.9	1.8	1.8	1.8	
Bankfull Cross Sectional Area (ft^2)	10.9	11.4	9.4	9.8	10.0	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bankfull Bank Height Ratio						

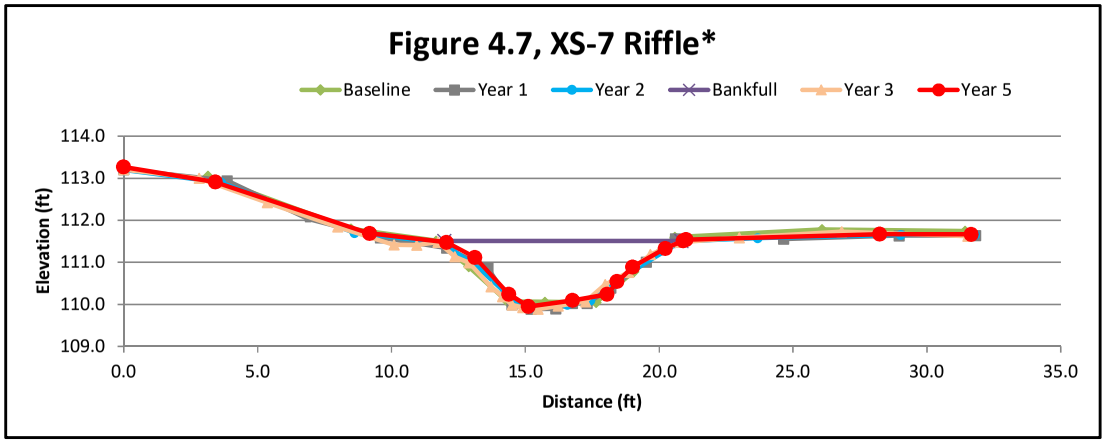


	Cross Section 5 (Riffle)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.1	9.4	8.9	9.9	9.5	
Floodprone Width (ft)	182.9	182.9	182.9	182.9	182.9	
Bankfull Mean Depth (ft)	0.9	1.0	1.0	0.9	0.9	
Bankfull Max Depth (ft)	1.4	1.6	1.7	1.8	1.6	
Bankfull Cross Sectional Area (ft^2)	8.4	9.7	9.1	9.3	8.9	
Bankfull Width/Depth Ratio	10.0	9.1	8.7	10.5	10.2	
Bankfull Entrenchment Ratio	20.0	19.5	20.5	18.5	19.2	
Low Bank Height (ft)	---	---	---	---	1.8	
Bankfull Bank Height Ratio*	1.0	1.1	1.0	1.0	1.1	

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.



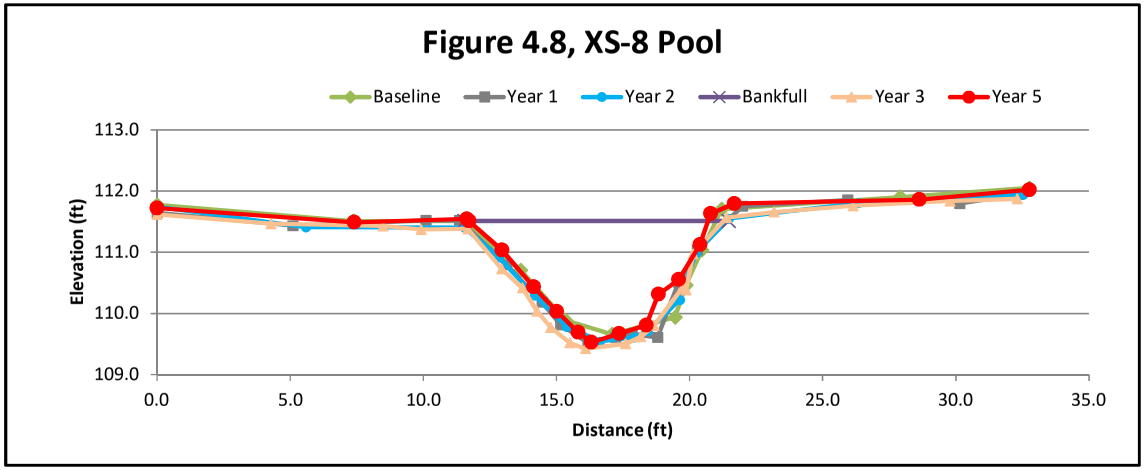
	Cross Section 6 (Pool)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	10.5	9.7	9.8	9.5	11.1	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.0	1.0	0.9	0.9	0.9	
Bankfull Max Depth (ft)	1.6	1.7	1.7	1.7	1.7	
Bankfull Cross Sectional Area (ft^2)	10.1	9.3	8.7	8.4	10.2	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bankfull Bank Height Ratio*						



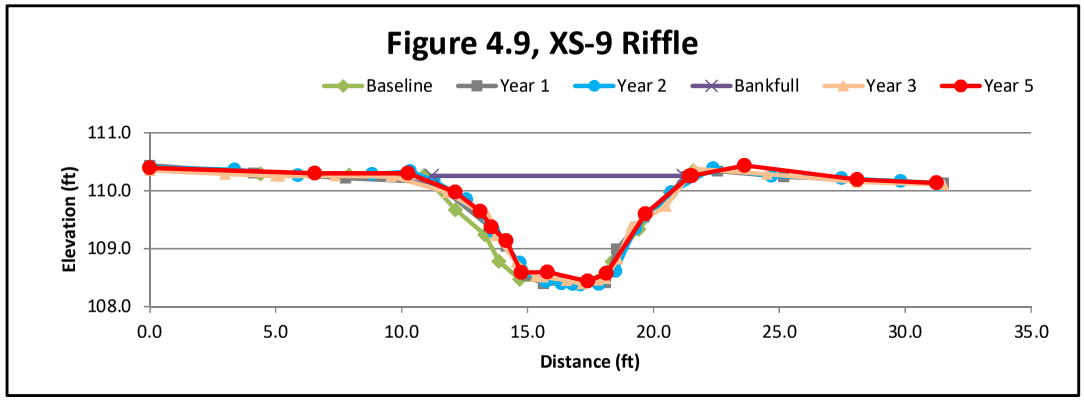
*Baseline cross-section was not started on left pin

	Cross Section 7 (Riffle)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	8.8	10.2	9.6	9.7	9.4	
Floodprone Width (ft)	162.2	162.2	162.2	162.2	162.2	
Bankfull Mean Depth (ft)	1.0	0.9	0.9	0.9	0.9	
Bankfull Max Depth (ft)	1.5	1.6	1.6	1.6	1.6	
Bankfull Cross Sectional Area (ft^2)	8.7	8.6	8.5	8.7	8.0	
Bankfull Width/Depth Ratio	8.8	12.0	10.9	10.9	11.0	
Bankfull Entrenchment Ratio	18.5	16.0	16.8	16.7	17.3	
Low Bank Height (ft)	---	---	---	---	1.6	
Bankfull Bank Height Ratio*	1.0	1.0	1.0	1.0	1.0	

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

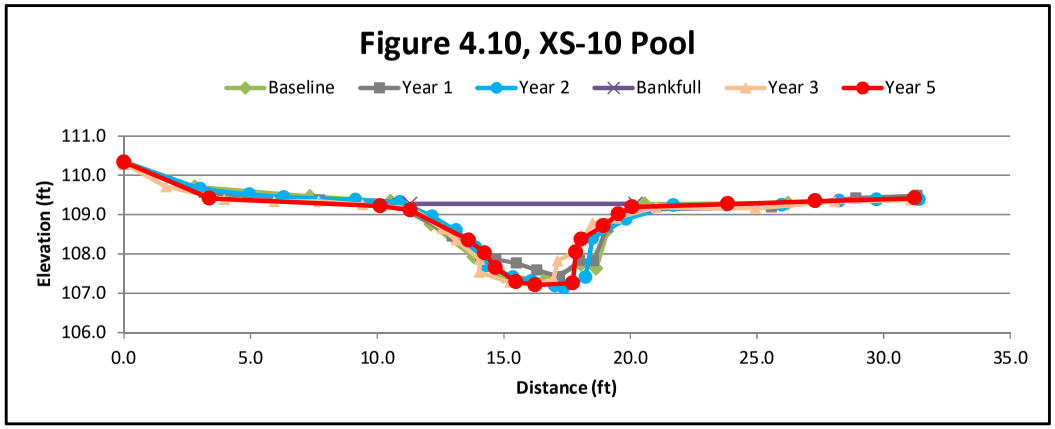


	Cross Section 8 (Pool)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.5	10.0	9.6	9.3	9.0	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.2	1.2	1.1	1.2	1.2	
Bankfull Max Depth (ft)	1.9	2.0	1.9	2.0	2.0	
Bankfull Cross Sectional Area (ft^2)	11.1	11.9	10.8	11.4	10.5	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bankfull Bank Height Ratio						



	Cross Section 9 (Riffle)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	10.5	10.2	11.1	11.7	11.1	
Floodprone Width (ft)	219.0	219.0	219.0	219.0	219.0	
Bankfull Mean Depth (ft)	1.1	1.1	1.0	1.0	1.0	
Bankfull Max Depth (ft)	1.8	1.9	1.9	1.9	1.8	
Bankfull Cross Sectional Area (ft^2)	12.0	11.1	11.3	11.2	10.7	
Bankfull Width/Depth Ratio	9.1	9.4	10.9	12.2	11.5	
Bankfull Entrenchment Ratio	20.9	21.5	19.8	18.8	19.8	
Low Bank Height (ft)	---	---	---	---	1.9	
Bankfull Bank Height Ratio*	1.0	0.9	1.0	1.1	1.0	

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.



	Cross Section 10 (Pool)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.8	9.2	10.5	9.6	9.9	
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.2	1.0	1.0	1.0	1.0	
Bankfull Max Depth (ft)	1.9	1.7	2.1	2.1	2.1	
Bankfull Cross Sectional Area (ft^2)	11.4	8.7	10.7	10.2	10.1	
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bankfull Bank Height Ratio						

Table 8. Baseline Stream Data Summary
UT to Millers Creek, DMS Project ID No. 95719
UT to Millers Creek: 2,709 LF

Parameter	Regional Curve			Pre-Existing Condition	Reference - Wildcat Branch	Referece - UT Brick Bound Swamp	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Eq.			Mean	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)				9.7	8.2	6.1	8.8	8.8	9.6	9.7	10.5	0.7	5
Floodprone Width (ft)				12.3	130.0	24.5	125.0	126.3	177.1	182.9	219.0	35.1	5
Bankfull Mean Depth (ft)				0.75	1.03	0.50	0.92	0.8	0.9	0.9	1.1	0.1	5
Bankfull Max Depth (ft)				1.1	1.6	1.0	1.4	1.1	1.5	1.5	1.8	0.3	5
Bankfull Cross Sectional Area (ft^2)				7.2	8.5	3.1	8.3	7.7	9.1	8.7	12.0	1.7	5
Width/Depth Ratio				12.9	8.0	12.2	9.5	8.8	10.2	10.0	12.2	1.4	5
Entrenchment Ratio				1.3	15.9	4.0	14.3	11.9	13.1	12.9	14.3	0.9	5
Bank Height Ratio				4.83	1.09	1.00	1.00	1.0	1.0	1.0	1.0	0.0	5
d50 (mm)				sand	sand	sand	sand						
Profile													
Riffle Length (ft)								8.6	21.9	22.8	33.6	9.0	7
Riffle Slope (ft/ft)				Channelized	0.0022	0.0012	0.0007	0.0039	0.0069	0.0075	0.0096	0.0019	7
Pool Length (ft)								9.1	27.0	25.7	53.9	11.6	61
Pool Max depth (ft)				Channelized	1.75	1.25	1.75	1.60	1.86	1.90	2.20	0.23	5
Pool Spacing (ft)				Channelized	14.0 - 16.6	15.29 - 27.81	20.1 - 84.9	12.5	41.8	40.3	96.3	18.4	63
Pool Cross Sectional Area (ft^2)								8.80	10.46	10.90	11.40	1.05	5
Pattern													
Channel Beltwidth (ft)				Channelized	13.8 - 19.4	13.8 - 19.4	17.5 - 52.5						
Radius of Curvature (ft)				Channelized	10.9 - 15.3	5.0 - 9.0	20.1 - 22.8						
Rc: Bankfull Width (ft/ft)				Channelized	1.3 - 1.9	0.9 - 1.5	2.3 - 2.6						
Meander Wavelength (ft)				Channelized	22.5 - 29.0	23.0 - 29.0	14.0 - 56.0						
Meander Width Ratio				Channelized	1.7 - 2.4	2.3 - 3.2	2.0 - 6.0						
Substrate, bed and transport parameters													
Ri% / P%								33/67					
SC% / Sa% / G% / C% / B% / Be%													
d16 / d35 / d50 / d84 / d95/ di^p / di^{sp} (mm)													
Reach Shear Stress (competency) lb/ft^2													
Max part size (mm) mobilized at bankfull													
Unit Stream Power (transport capacity) lbs/ft.s				0.01			0.01	0.02					
Additional Reach Parameters													
Drainage Area (SM)				0.37	0.44	0.11	0.37						
Impervious cover estimate (%)													
Rosgen Classification				G-F/5	E5	E5	E5	E5					
Bankfull Velocity (fps)					1.00	0.97	0.80						
Bankfull Discharge (cfs)				8.4	8.5	3.0	8.4						
Valley length (ft)				2126			2126	2126					
Channel Thalweg length (ft)				2339			2679	2709					
Sinuosity (ft)				1.10	1.15	1.35	1.26	1.27					
Water Surface Slope (Channel) (ft/ft)				0.0011	0.0024	0.0016	0.0005	0.0005					
BF slope (ft/ft)							0.0005	0.0005					
Bankfull Floodplain Area (acres)													
Proportion over wide (%)													
Entrenchment Class (ER Range)													
Incision Class (BHR Range)													
BEHI VL% / L% / M% / H% / VH% / E%													
Channel Stability or Habitat Metric													
Biological or Other													

Table 9. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)
UT to Millers Creek (DMS Project No. 95719)
UT to Millers Creek: 2,709 LF

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	9.7	9.1	9.4	9.5	9.8			8.6	8.6	7.8	8.0	9.1		
Floodprone Width (ft)	195.2	195.2	195.2	195.2	195.2									
Bankfull Mean Depth (ft)	0.8	0.7	0.7	0.7	0.7			1.0	0.9	1.0	0.9	0.9		
Bankfull Max Depth (ft)	1.1	1.0	1.1	1.0	1.1			1.7	1.5	1.5	1.5	1.5		
Bankfull Cross Sectional Area (ft^2)	7.7	6.3	6.7	6.8	7.1			8.8	7.3	7.3	7.0	8.0		
Bankfull Width/Depth Ratio	12.2	13.2	13.2	13.2	13.4									
Bankfull Entrenchment Ratio	20.2	21.4	20.8	20.5	20.0									
Low Bank Height (ft)	---	---	---	---	1.0									
Bankfull Bank Height Ratio*	1.0	1.1	1.1	1.1	<1									
	Cross Section 3 (Riffle)							**Cross Section 4 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	9.9	10.6	10.0	9.2	10.0			9.4	9.8	10.2	12.2	9.5		
Floodprone Width (ft)	126.3	126.3	126.3	126.3	126.3									
Bankfull Mean Depth (ft)	0.9	0.9	0.9	0.9	0.9			1.2	1.2	0.9	0.8	1.1		
Bankfull Max Depth (ft)	1.6	1.6	1.6	1.5	1.6			2.2	1.9	1.8	1.8	1.8		
Bankfull Cross Sectional Area (ft^2)	8.8	9.9	8.5	8.5	8.8			10.9	11.4	9.4	9.8	10.0		
Bankfull Width/Depth Ratio	11.1	11.4	11.6	10.0	11.3									
Bankfull Entrenchment Ratio	12.8	11.9	12.7	13.8	12.7									
Low Bank Height (ft)	---	---	---	---	1.6									
Bankfull Bank Height Ratio*	1.0	1.0	1.0	1.1	1.1									
	Cross Section 5 (Riffle)							**Cross Section 6 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation[1]														
Bankfull Width (ft)	9.1	9.4	8.9	9.9	9.5			10.5	9.7	9.8	9.5	11.1		
Floodprone Width (ft)	182.9	182.9	182.9	182.9	182.9									
Bankfull Mean Depth (ft)	0.9	1.0	1.0	0.9	0.9			1.0	1.0	0.9	0.9	0.9		
Bankfull Max Depth (ft)	1.4	1.6	1.7	1.8	1.6			1.6	1.7	1.7	1.7	1.7		
Bankfull Cross Sectional Area (ft^2)	8.4	9.7	9.1	9.3	8.9			10.1	9.3	8.7	8.4	10.2		
Bankfull Width/Depth Ratio	10.0	9.1	8.7	10.5	10.2									
Bankfull Entrenchment Ratio	20.0	19.5	20.5	18.5	19.2									
Low Bank Height (ft)	---	---	---	---	1.8									
Bankfull Bank Height Ratio*	1.0	1.1	1.0	1.0	1.1									
	Cross Section 7 (Riffle)							**Cross Section 8 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	8.8	10.2	9.6	9.7	9.4			9.5	10.0	9.6	9.3	9.0		
Floodprone Width (ft)	162.2	162.2	162.2	162.2	162.2									
Bankfull Mean Depth (ft)	1.0	0.9	0.9	0.9	0.9			1.2	1.2	1.1	1.2	1.2		
Bankfull Max Depth (ft)	1.5	1.6	1.6	1.6	1.6			1.9	2.0	1.9	2.0	2.0		
Bankfull Cross Sectional Area (ft^2)	8.7	8.6	8.5	8.7	8.0			11.1	11.9	10.8	11.4	10.5		
Bankfull Width/Depth Ratio	8.8	12.0	10.9	10.9	11.0									
Bankfull Entrenchment Ratio	18.5	16.0	16.8	16.7	17.3									
Low Bank Height (ft)	---	---	---	---	1.6									
Bankfull Bank Height Ratio*	1.0	1.0	1.0	1.0	1.0									
	Cross Section 9 (Riffle)							**Cross Section 10 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	10.5	10.2	11.1	11.7	11.1			9.8	9.2	10.5	9.6	9.9		
Floodprone Width (ft)	219.0	219.0	219.0	219.0	219.0									
Bankfull Mean Depth (ft)	1.1	1.1	1.0	1.0	1.0			1.2	1.0	1.0	1.0	1.0		
Bankfull Max Depth (ft)	1.8	1.9	1.9	1.9	1.8			1.9	1.7	2.1	2.1	2.1		
Bankfull Cross Sectional Area (ft^2)	12.0	11.1	11.3	11.2	10.7			11.4	8.7	10.7	10.2	10.1		
Bankfull Width/Depth Ratio	9.1	9.4	10.9	12.2	11.5									
Bankfull Entrenchment Ratio	20.9	21.5	19.8	18.8	19.8									
Low Bank Height (ft)	---	---	---	---	1.9									
Bankfull Bank Height Ratio*	1.0	0.9	1.0	1.1	1.0									

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

Table 10. Monitoring Data - Stream Reach Data Summary
UT to Millers Creek (DMS Project No. 95719)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 5						MY- 7					
Dimension and Substrate	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	8.8	9.6	9.7	10.5	0.7	5	9.1	9.9	10.2	10.6	0.6	5	8.9	9.8	9.6	11.1	0.8	5	9.2	10.0	9.7	11.7	1.0	5	9.4	9.9	9.8	11.1	0.7	5						
Floodprone Width (ft)	126.3	177.1	182.9	219.0	35.1	5	126.3	177.1	182.9	219.0	35.1	5	126.3	177.1	182.9	219.0	35.1	5	126.3	177.1	182.9	219.0	35.1	5	126.3	177.1	182.9	219.0	35.1	5						
Bankfull Mean Depth (ft)	0.8	0.9	0.9	1.1	0.1	5	0.7	0.9	0.9	1.1	0.2	5	0.7	0.9	0.9	1.0	0.1	5	0.7	0.9	0.9	1.0	0.1	5	0.7	0.9	0.9	1.0	0.1	5						
[1]Bankfull Max Depth (ft)	1.1	1.5	1.5	1.8	0.3	5	1.0	1.6	1.6	1.9	0.3	5	1.1	1.6	1.6	1.9	0.3	5	1.0	1.5	1.6	1.9	0.3	5	1.1	1.5	1.6	1.8	0.3	5						
Bankfull Cross Sectional Area (ft[2])	7.7	9.1	8.7	12.0	1.7	5	6.3	9.1	9.7	11.1	1.8	5	6.7	8.8	8.5	11.3	1.6	5	6.8	8.9	8.7	11.2	1.6	5	7.1	8.7	8.8	10.7	1.3	5						
Width/Depth Ratio	8.8	10.2	10.0	12.2	1.4	5	9.1	11.0	11.4	13.2	1.7	5	8.7	11.1	10.9	13.2	1.6	5	10.0	11.4	10.9	13.2	1.3	5	10.2	11.5	11.3	13.4	1.2	5						
Entrenchment Ratio	11.9	13.1	12.9	14.3	0.9	5	11.9	18.1	19.5	21.5	4.1	5	12.7	18.1	19.8	20.8	3.4	5	13.8	17.6	18.5	20.5	2.6	5	12.7	17.8	19.2	20.0	3.0	5						
Low Bank Height (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.0	1.6	1.6	1.9	0.3	5						
[1]Bank Height Ratio	1.0	1.0	1.0	1.0	0.0	5	0.9	1.0	1.0	1.1	0.1	5	1.0	1.0	1.0	1.0	0.0	5	1.0	1.0	1.1	1.1	0.1	5	1.0	1.0	1.0	1.1	0.0	5						
Profile																																				
Riffle Length (ft)	8.6	21.9	22.8	33.6	9.0	7																														
Riffle Slope (ft/ft)	0.0039	0.0069	0.0075	0.0096	0.0019	7																														
Pool Length (ft)	9.1	27.0	25.7	53.9	11.6	61																														
Pool Max depth (ft)	1.60	1.86	1.90	2.20	0.23	5																														
Pool Spacing (ft)	12.5	41.8	40.3	96.3	18.4	63																														
Pattern*																																				
Channel Beltwidth (ft)		17.5 - 52.5																																		
Radius of Curvature (ft)		20.1 - 22.8																																		
Rc:Bankfull width (ft/ft)		2.3 - 2.6																																		
Meander Wavelength (ft)		14.0 - 56.0																																		
Meander Width Ratio		2.0 - 6.0																																		
Additional Reach Parameters																																				
Rosgen Classification	E5																																			
Channel Thalweg length (ft)	2709																																			
Sinuosity (ft)	1.27																																			
Water Surface Slope (Channel) (ft/ft)	0.0011																																			
BF slope (ft/ft)	0.0005																																			
[3]Ri% / Ru% / P% / G% / S%	33		67																																	
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.

2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table

3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

4. = Of value/needed only if the n exceeds 3

*Pattern data taken from design calculations as stream was built according to design plans per As-Built drawings

Appendix E. Hydrologic Data

Table 11. Verification of Bankfull Events

Date	Crest Gauge Info		Gauge Reading (ft)	Gauge Elevation (ft)	Crest Elevation (ft)	Bankfull Elevation (ft)	Height above Bankfull (ft)
	Site	Sta.					
7/14/2015	2	37+03	2.29	107.16	109.45	107.71	1.74
10/19/2015	1	10+62	1.50	111.46	112.96	112.07	0.89
4/27/2016	1	10+62	1.88	111.46	113.34	112.07	1.26
4/27/2016	2	37+03	3.70	107.16	110.87	107.71	3.15
10/10/2016	1	10+62	2.79	111.46	114.25	112.07	2.18
10/10/2016	2	37+03	3.43	107.16	110.59	107.71	2.88
10/10/2016	N/A	Approx 20+00	Visual	Visual	Visual	Visual	Visual
1/17/2017	1	10+62	2.29	111.46	113.75	112.07	1.68
1/17/2017	2	37+03	3.13	107.16	110.29	107.71	2.58
4/26/2017	1	10+62	2.00	111.46	113.46	112.07	1.39
4/26/2017	2	37+03	4.06	107.16	111.22	107.71	3.51
3/13/2018	1	10+62	3.58	111.46	115.04	112.07	2.97
3/13/2018	2	37+03	3.58	107.16	110.74	107.71	3.03
9/12/2018	1	10+62	4.5	111.46	115.96	112.07	3.89
9/12/2018	2	37+03	4.0	107.16	111.16	107.71	3.45
3/29/2019	1	10+62	2.42	111.46	113.88	112.07	1.81
3/29/2019	2	37+03	1.50	107.16	108.66	107.71	0.95
10/17/2019	1	10+62	2.25	111.46	113.71	112.07	1.64
10/17/2019	2	37+03	1.42	107.16	108.58	107.71	0.87

Figures 5.1 - 5.4 Crest Gauge Photos

5.1 Crest Gauge 1 (3/29/2019)

5.2 Crest Gauge 2 (3/29/2019)

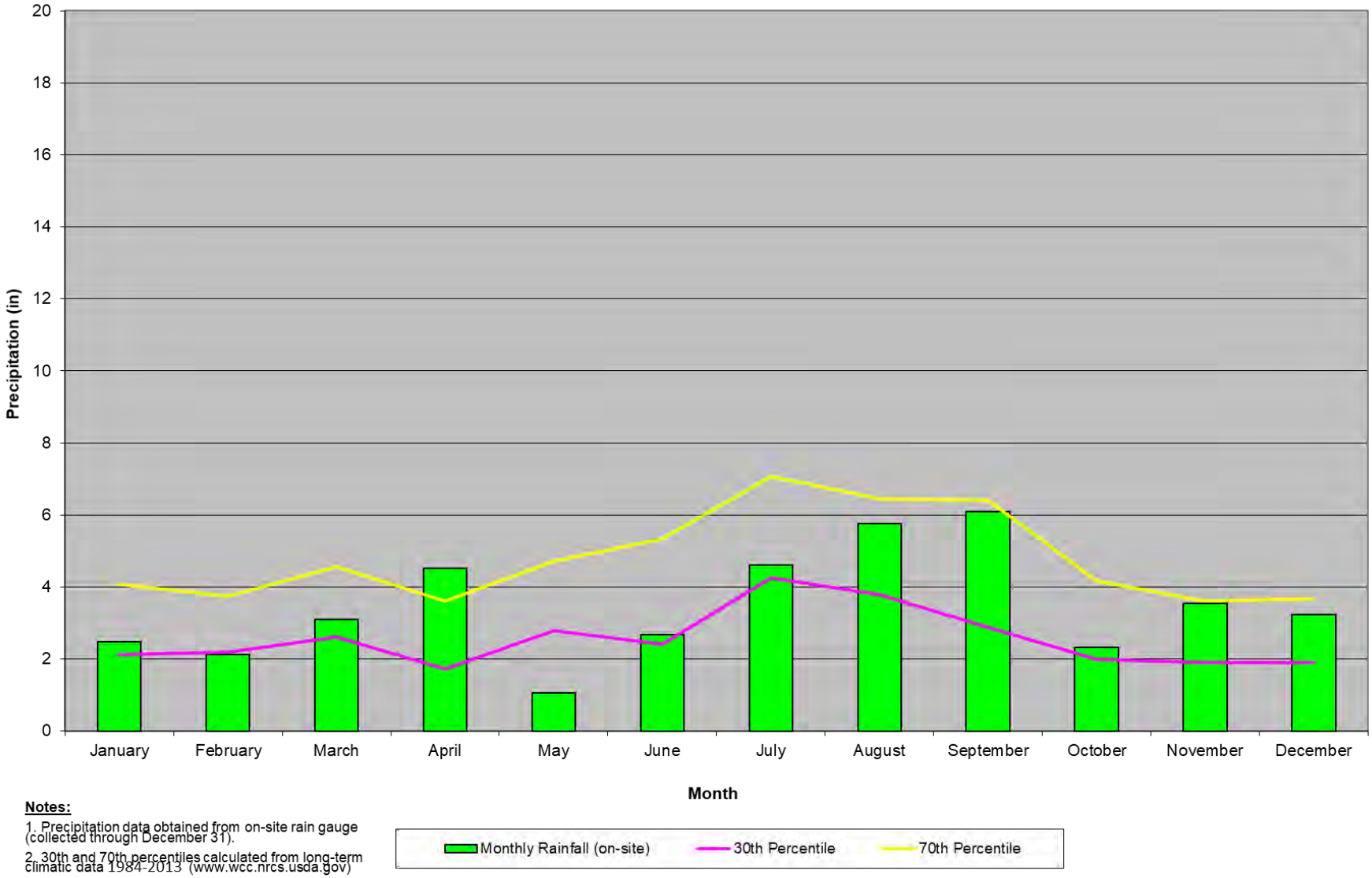
5.3 Crest Gauge 1 (10/17/2019)

5.4 Crest Gauge 2 (10/17/2019)

Table 12. Summary of Gauge Hydrologic Data

Gauge Number	Wetland Community Type	Target Hydroperiod	Percentage of Growing Season Year 1	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 1 Growing Season	Percentage of Growing Season Year 2	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 2 Growing Season	Percentage of Growing Season Year 3	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 3 Growing Season	Percentage of Growing Season Year 4	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 4 Growing Season	Percentage of Growing Season Year 5	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 5 Growing Season
1	Riparian Bottomland Hardwood	12.5%	43	130	23	69	7.6	23	13	40	30	90
2	Riparian Bottomland Hardwood	12.5%	53	161	49	149	43.6	132	52	155	36	109
3	Riparian Bottomland Hardwood	12.5%	10	30	21	65	5.6	17	12.5	38	28	86
4	Headwater Riparian (Zero Order)	10%	70	212	100	304	52.5	159	54	162	45	137
5	Riparian Bottomland Hardwood	12.5%	32	97	49	149	49.2	149	52	155	37	112
6	Riparian Bottomland Hardwood	12.5%	52	158	48	146	51.5	156	54	162	39	117
Reference	Headwater Riparian (Zero Order)	10%	39	118	46	141	17.8	54	47	142	35	105
Reference	Riparian Bottomland Hardwood	12.5%	36	108	26	79	26.1	79	35	106	29	88

Figure 6. UT to Millers Creek
Monthly Precipitation 2019 (30th/70th Percentiles)



Notes:

1. Precipitation data obtained from on-site rain gauge (collected through December 31).
2. 30th and 70th percentiles calculated from long-term climatic data 1984-2013 (www.wcc.nrcs.usda.gov)

Figure 7.1 Reference: Zero-Order Wetland Gauge (EBDE114)

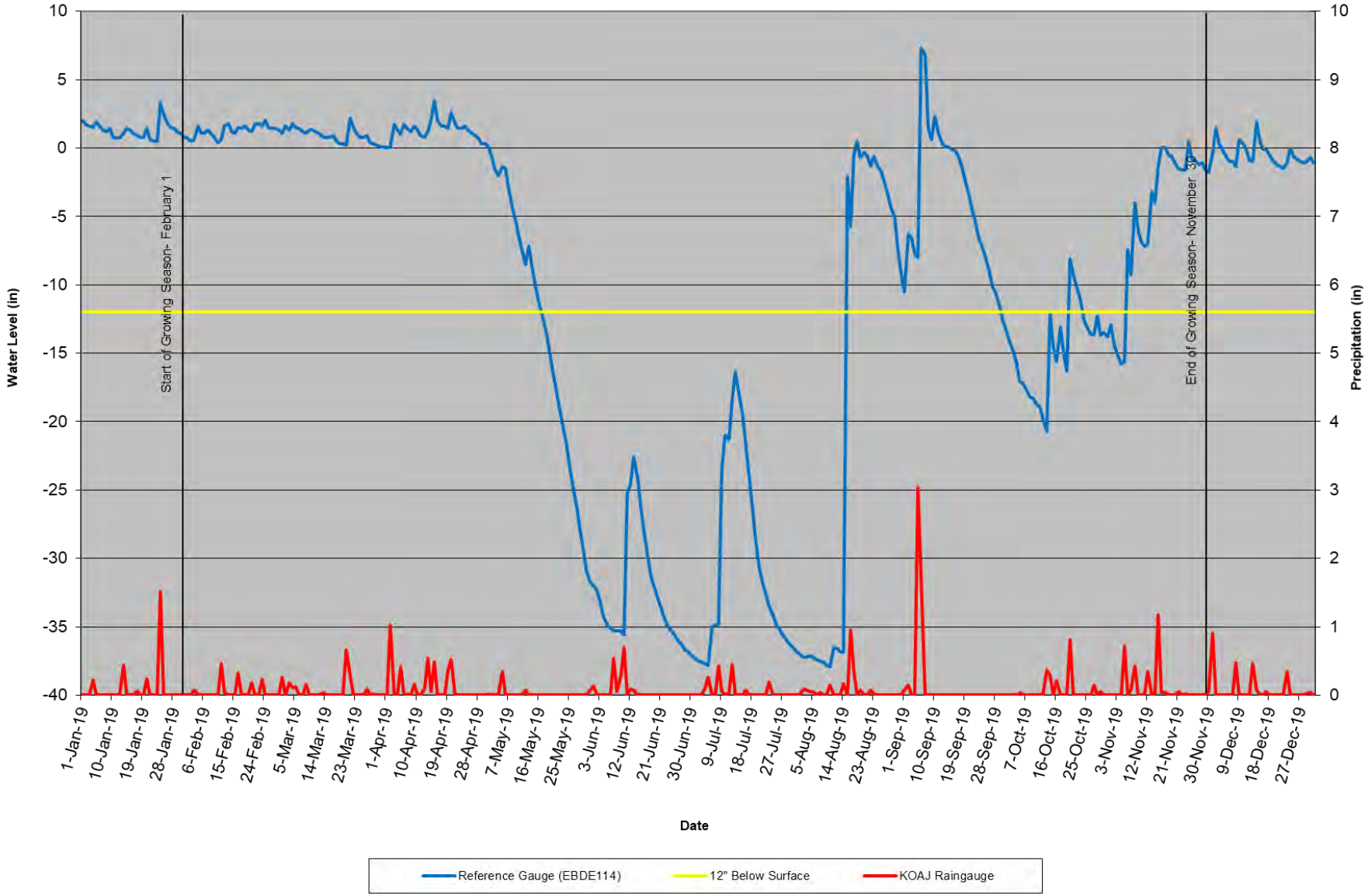


Figure 7.2 Reference: Second-Order Wetland Gauge (14EB20BB)

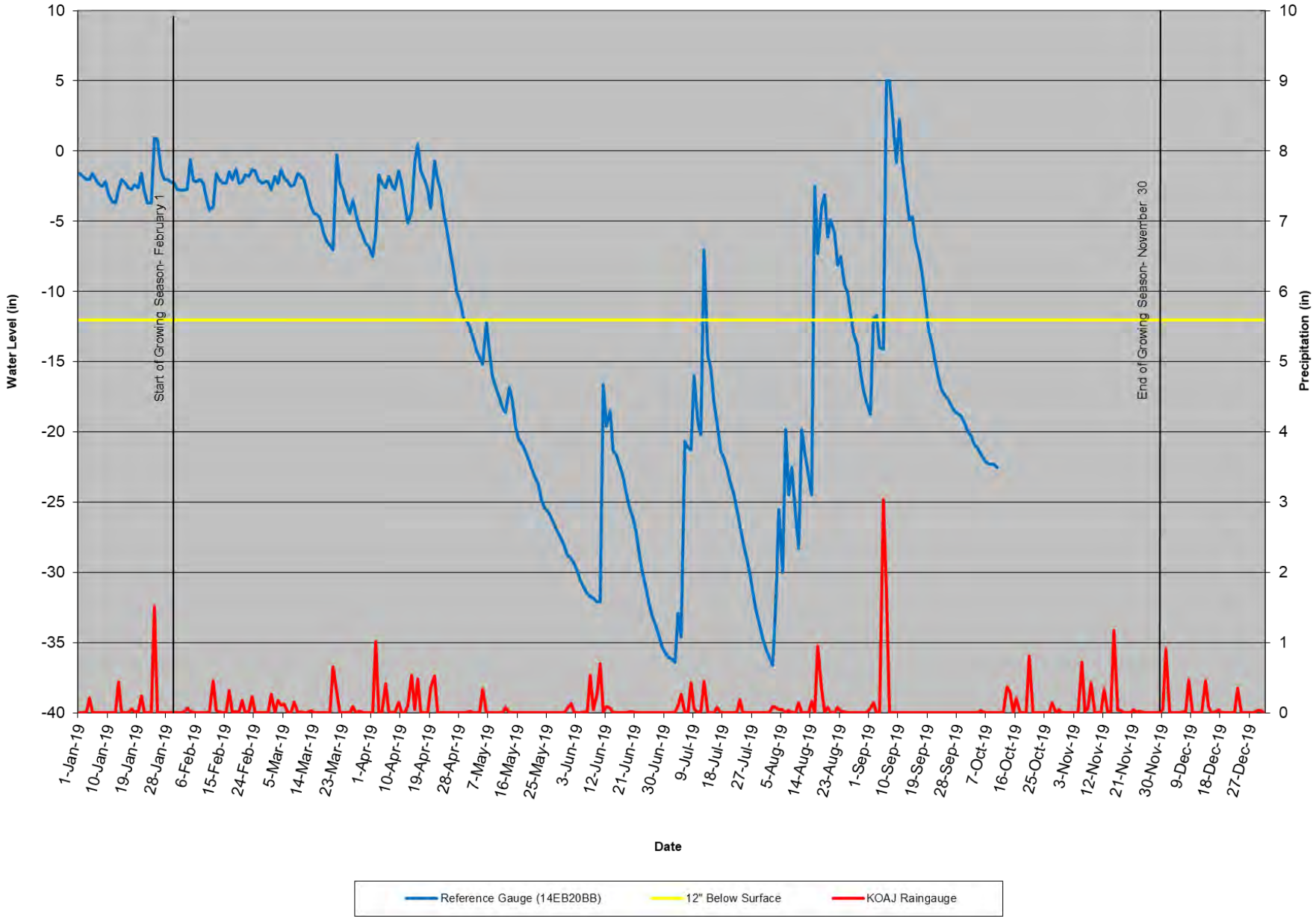


Figure 7.3 Gauge 1 (14E14CEA)

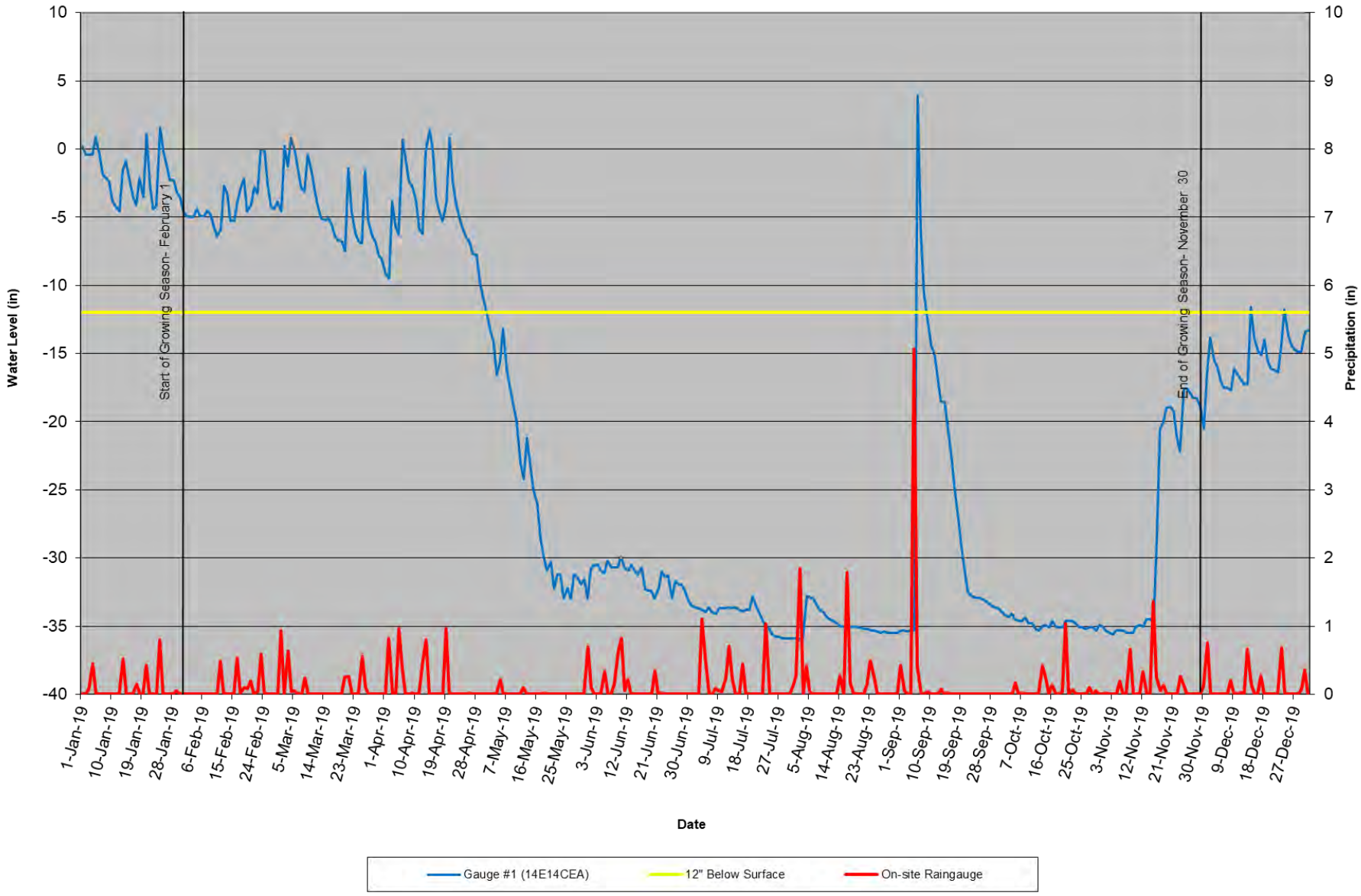


Figure 7.4 Gauge 2 (A2873A5)

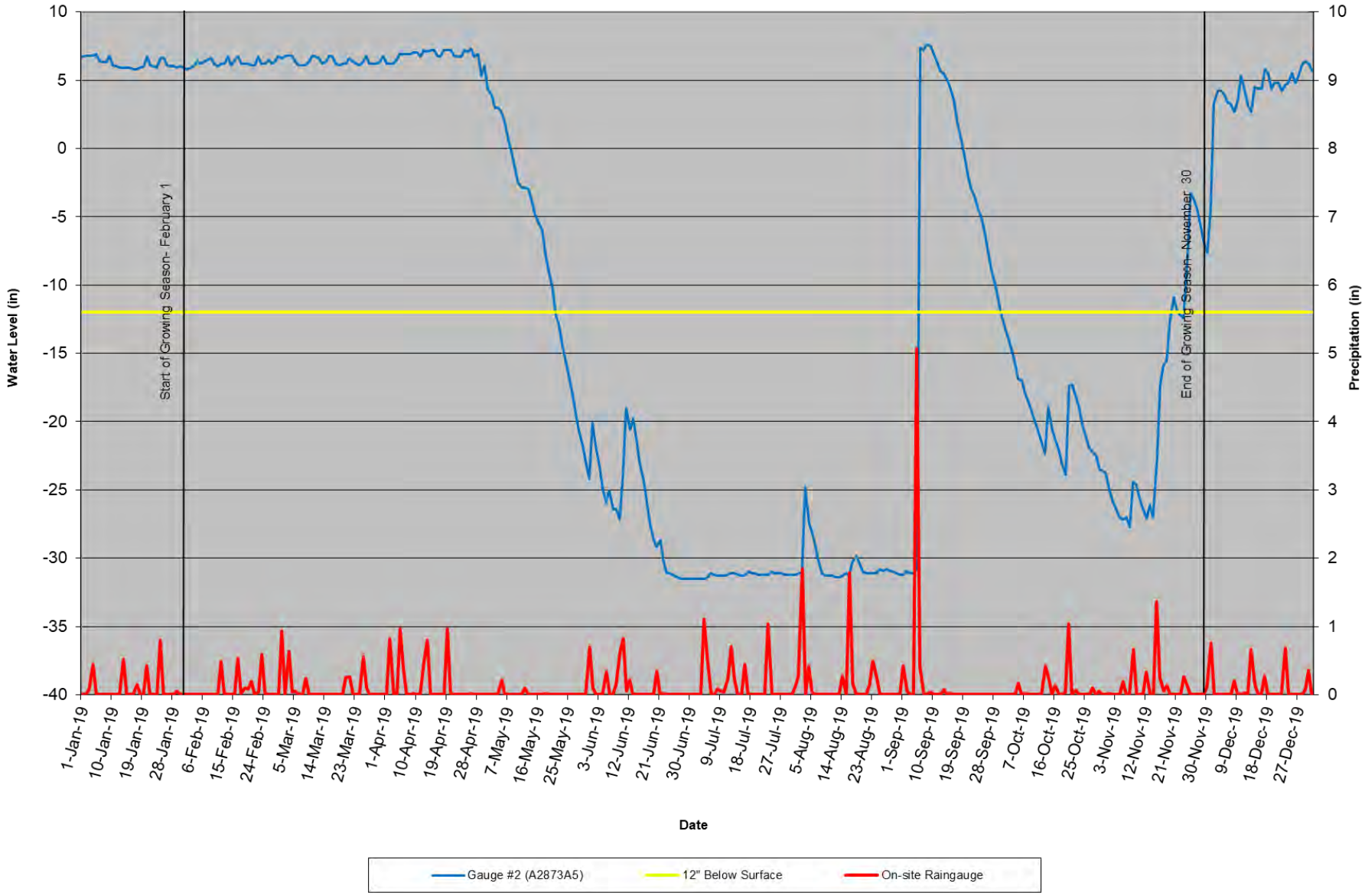


Figure 7.5 Gauge 3 (1130D7E0)

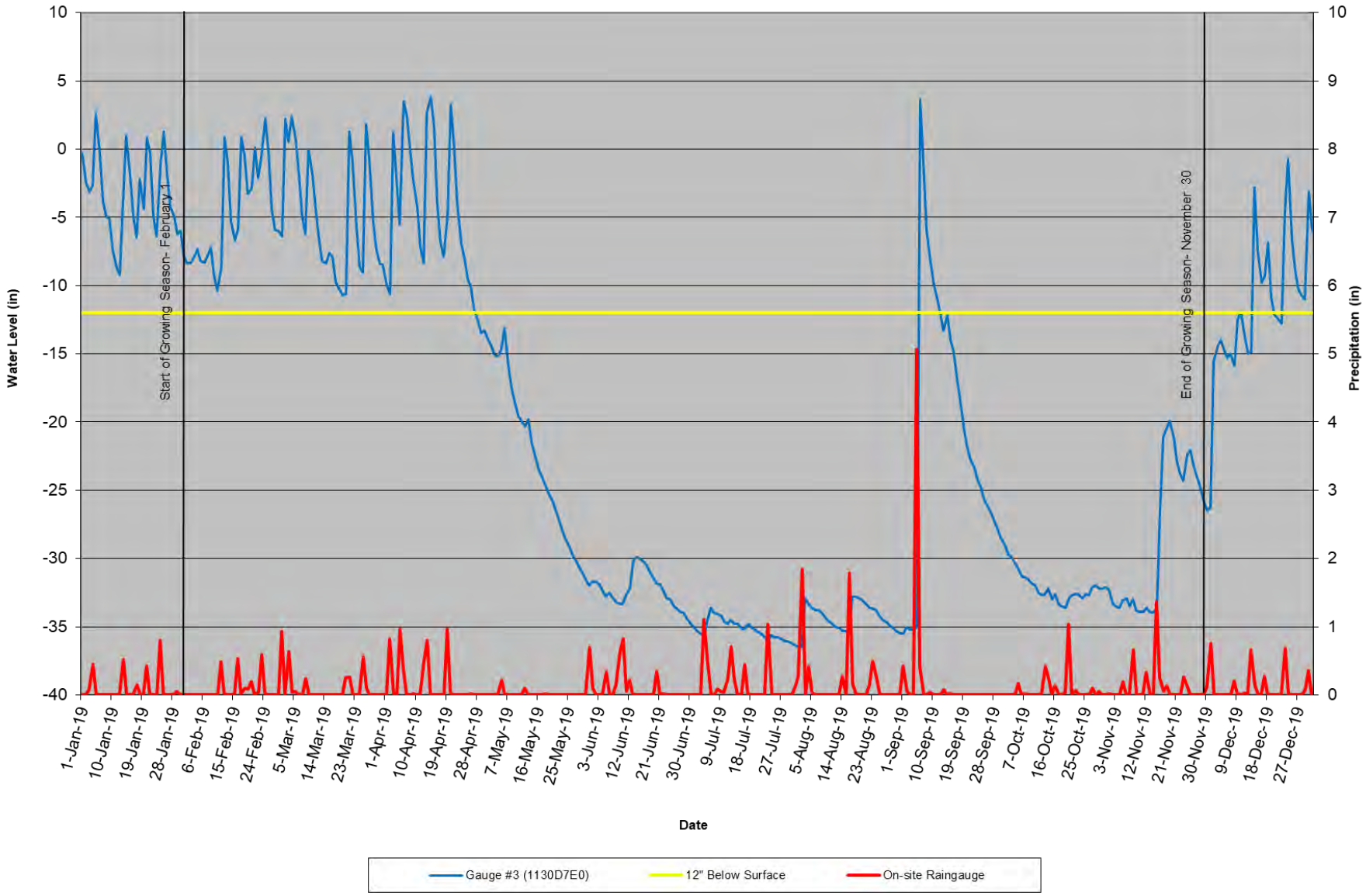


Figure 7.6 Gauge 4 (14E1949D)

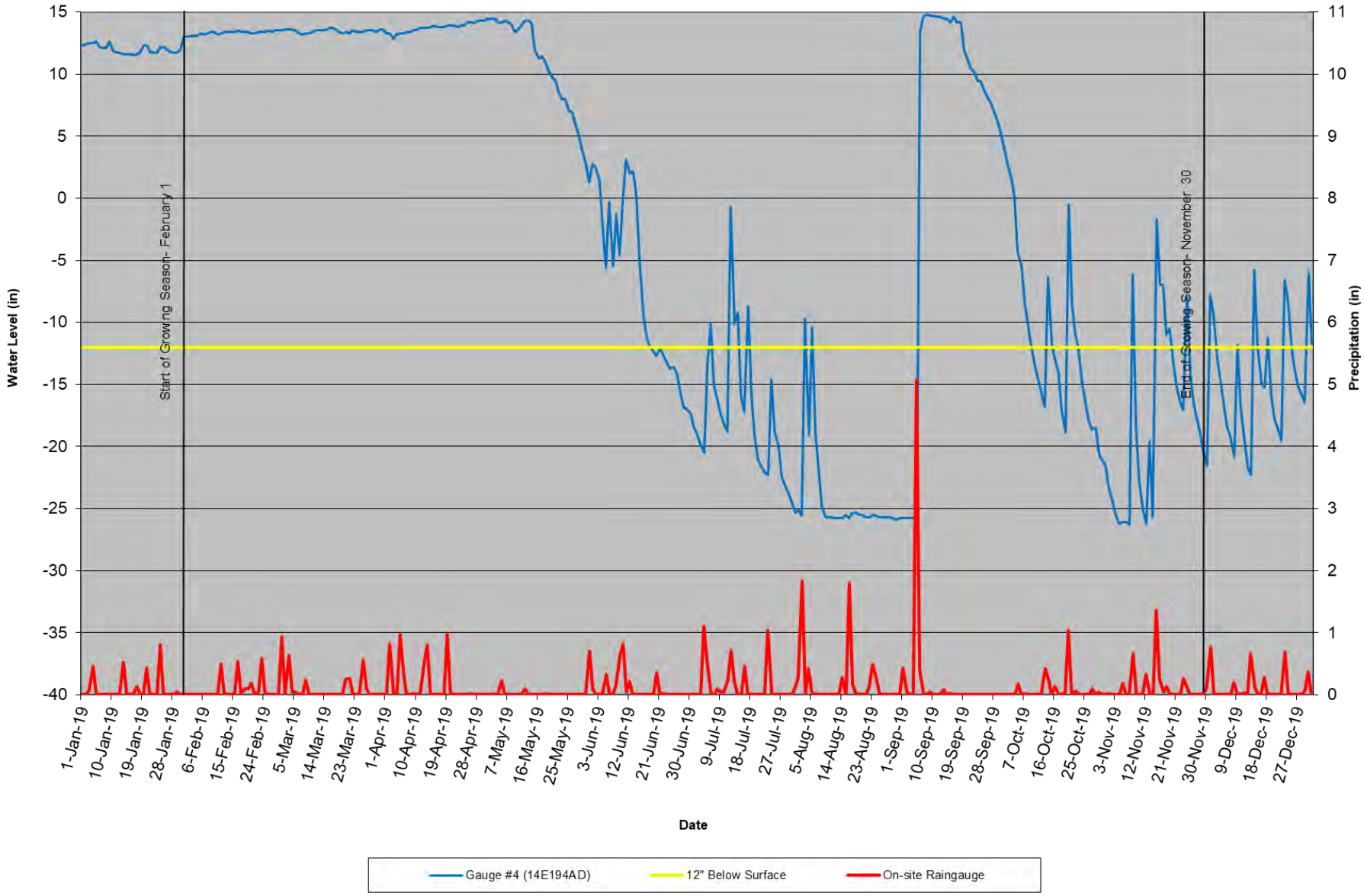


Figure 7.7 Gauge 5 (14E1ABFA)

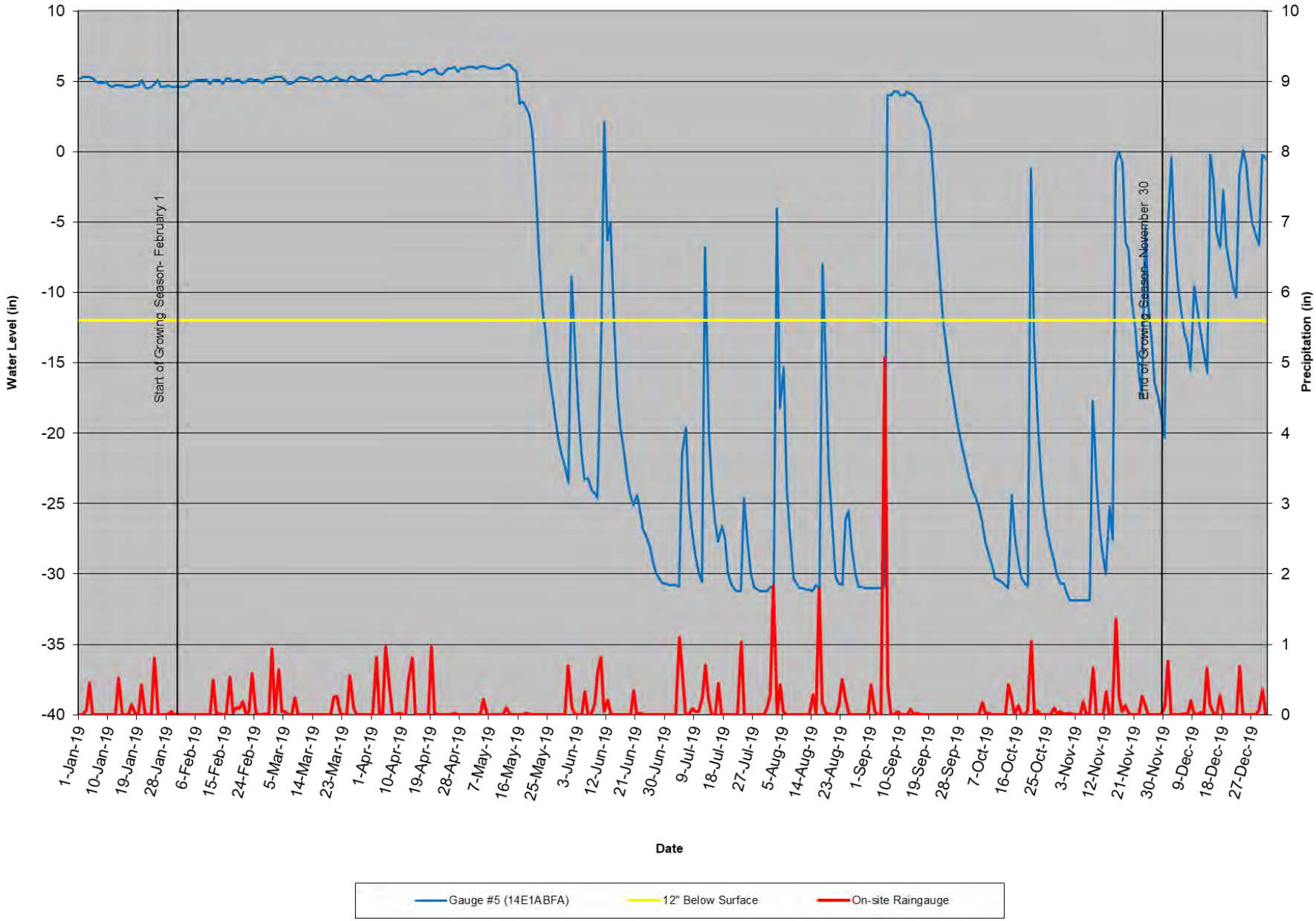


Figure 7.8 Gauge 6 (14E142FD)