Year 2 Monitoring Report

FINAL

UT WEST BRANCH ROCKY RIVER RESTORATION SITE

NCDMS Project #92684 (Contract # WBRR010521)
USACE Action ID: SAW-2017-00342 | NCDWR Project #18-1696

Mecklenburg County, North Carolina
Yadkin River Basin | HUC 03040105

Provided by:

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

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

January 2023

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January 16, 2023

Harry Tsomides
NC DEQ Division of Mitigation Services
5 Ravenscroft Drive, Suite 102
Asheville, NC 28801

RE: UT West Branch Rocky River Project: Year 2 Monitoring Report

Listed below are comments provided by DMS on January 03, 2023 regarding the UT West Branch Rocky River Project: Year 2 Monitoring Report and RES' responses.

- As a reminder, monitoring providers are required to walk the entire boundary of all DMS projects and report any property issues. Please confirm the integrity of the boundary and easement, or note any issues present.
  The easement is intact and shows no evidence of encroachment or issues at this time, this is now noted in section 1.8 of the monitoring report.
- Please correct subsection title in section 1.8 to reflect MY2 monitoring results.
  This title has now been corrected.
- Vegetation discussion – please indicate that DMS has retained an invasives contractor through June 2028 to treat any previously treated invasives resprouts, and any new occurrences, as needed.
  This is now noted in the final paragraph of the vegetation section under section 1.8 of the report.
- DMS project culvert photos must be included in all monitoring reports; if possible, please include close up culvert photos for the installed culverts along UTWB2, UTWB3, and UT2-2, in order to show the status of any debris jamming, infilling, perching, etc.
  Appendix B has now been updated with culvert crossing photos and included in the final report, support files have also been updated.
- Report footer indicates Year 3 monitoring report; this is the Year 2 monitoring report
  This has been corrected.

Digital Support Files

- None, nice work.
  Thank you.

Table of Contents

Stream Flow Hydrographs

1.0 Project Summary

1.1 Project Location and Description

The UT West Branch Rocky River Restoration Site (UTWBRR) is a stream mitigation project for the North Carolina Division of Mitigation Services (DMS) within the Yadkin River Basin (Hydrologic Unit Code 03040105) in Mecklenburg County, North Carolina. The project provides compensatory mitigation credits for the NCDMS ILF Program to offset impacts to waters of the United States within the US Army Corps of Engineers Wilmington District. The project site exists within the Southern Outer Piedmont Level IV Ecoregion in the Piedmont physiographic province.

The project site is located approximately 4.7 miles east of Davidson, NC in Mecklenburg County as seen in **Figure 1**. The project streams consist of UT West Branch Rocky River (UTWB), Unnamed Tributary 1 (UT1), and Unnamed Tributary 2 (UT2). The project lies to the east of Fisher Road along the eastern boundary of the Town of Davidson's Fisher Farm Park. A conservation easement for the project has already been recorded and measures 58.9 acres. The original conservation easement (April 2010) did not allow enough room for the designed restoration of this project. A negotiated modification (2014) resulted in adding additional land needed to complete the stream restoration while allowing for a partial release of the original easement to allow the gas utility to complete their line. The Tarheel Trail Blazers maintain approximately 5.2 miles of single-track mountain bike trails throughout Fisher Farm Park, and some trails exist within the conservation easement per the conservation easement deed allowance. Bike trails do not impact the stream project, and are maintained in most locations more than 50 feet off the constructed channel.

1.2 Project Goals and Objectives

Goals	Objective	Functional Level	Function-Based Parameter Effects	Monitoring Measurement Tool
Restore an incised stream to a C-type channel with an active floodplain	Relocated streams to a meandering landscape position to capture hillside seepage	Hydraulics	Floodplain Connectivity	Flood Frequency Bank Height Ratio and Entrenchment Ratio
	Installed a cross-section sized to the bankfull discharge	Geomorphology	Bank Migration/Lateral Stability	Cross-Sectional Survey Visual Inspection of Bank Stability
	Created bedform diversity with pools, riffles, and habitat structures	Geomorphology	Bed Form Diversity	Visual Inspection of Feature Maintenance
Restore a forested riparian buffer to provide bank stability and shading	Planted the site with native trees and shrubs	Geomorphology	Vegetation	Density Species Composition/Diversity

1.3 Performance Criteria

Monitoring of the UT West Branch Site shall occur for a minimum of seven years following construction. The following performance standards for stream mitigation are based on the Wilmington District Stream and Wetland Compensatory Mitigation Update (NCIRT 2016) and the Approved Mitigation Plan (11/28/20218) and will be used to judge site success.

Vegetation Performance

The site must achieve a woody stem density of 260 stems/acre after five years and 210 stems/acre after seven years to be considered successful. Trees in each plot must average 7 feet in height at Year 5 and 10 feet at Year 7. A single species may not account for more than 50% of the required number of stems within any plot. Volunteers must be present for a minimum of two growing seasons before being included performance standards in Year 5 and Year 7. If monitoring indicates that any of these standards are not being met, corrective actions will take place.

Stream Hydrologic Performance

During the monitoring period, a minimum of four bankfull events must be recorded within the seven-year monitoring period. These bankfull events must occur in separate monitoring years. Bankfull events will be verified using a minimum of one automatic stream monitoring gauge on UTWB to record daily stream depth readings. Any Qgs flows at the project during the monitoring period will also be measured. In addition, continuous surface water flow must be documented for at least 30 consecutive days during the calendar year. Additional monitoring may be required if surface water flow cannot be documented due to abnormally dry conditions.

Stream Geomorphology Performance

The site's geomorphology will be monitored per the NRIRT 2016 monitoring guidelines. The bank height ratio (BHR) must not exceed 1.2 and the entrenchment ratio (ER) should be at least 2.2 for C channels. BHR and ER at any measured riffle cross-section should not change by more than 10% from the baseline condition during any given monitoring interval (e.g., no more than 10% between years 1 and 2, 2 and 3, 3 and 5, or 5 and 7). Adjustment and lateral movement following construction and as the channel settles over the monitoring period are to be expected. Geomorphological measurements of cross-sections will be used to determine if any adjustments that occur are out of the range typically expected for this type of stream.

1.4 Project Monitoring

Monitoring of UTWBRR consists of the collection and analysis of stream hydrology, stability, and vegetation survivability data to support the evaluation of the project in meeting established performance criteria described above. Vegetation plot and cross section monitoring will take place in Years 1, 2, 3, 5, and 7 and hydrology and visual monitoring will take place annually. **Figure 2** shows the locations of monitoring features described below:

UT West Branch Restoration Site				
Required	**Parameter**	**Quantity**	**Frequency**	**Notes**
Yes	Pattern and Profile	UTWB-1, UTWB-2, UTWB-3, UT1-2, UT2-2	Once, during as-built survey	Additional measurements in later years may be taken, as necessary.

Yes	Stream Dimension	14 cross-sections (7 riffles, 7 pools)	Monitoring Years 1, 2, 3, 5, and 7	
Yes	Stream Hydrology	3 monitoring devices	Annual – throughout year	1 pressure transducer gauge on middle UTWB-3 and two other monitoring devices (gauge or camera) on UT-1 and UT-2.
Yes	Vegetation	12 vegetation monitoring plots	Monitoring Years 1, 2, 3, 5, and 7	6 permanently fixed, 6 randomly located each monitoring visit
Yes	Visual	14 photo stations	Annual	Crossings, confluences, and general photos
Yes	Exotic and nuisance vegetation		Annual	Locations of invasive vegetation will be mapped
Yes	Project boundary		Semi-annual	Locations of vegetation damage, boundary encroachments, etc. will be mapped

1.5 Project Components

The proposed streams include an Unnamed Tributary to West Branch Rocky River (UTWB), Unnamed Tributary 1 (UT1), and Unnamed Tributary 2 (UT2). UTWB is divided into three reaches - UTWB-1, UTWB-2, and UTWB-3. Reaches UTWB-1, 2, and 3 were improved through a combination of Priority 1 and Priority 2 stream restoration over 3,612 linear feet of proposed single-thread channel. For UT1, 143 linear feet of stream was improved through Enhancement II and Priority I stream restoration. UT2 has 304 linear feet that underwent Enhancement I and restoration. The table below summarizes the project mitigation credits.

Stream Mitigation			
Mitigation Approach	**Creditable Linear Feet**	**Ratio**	**SMU**
Restoration	3,837	1	3,837.000
Enhancement I	45	1.5	30.000
Enhancement II	49	2.5	19.600
Total	**3,931**		**3,886.600**

1.6 Stream Design/Approach

UT West Branch Rocky River (UTWB)

For UTWB-1, restoration was used on the first-order, single-thread stream, starting at the northern end of the conservation easement. UTWB-1 serves as a transitional Priority 2/1 reach as it begins at the upstream incised channel and connects downstream to the Priority 1 restoration on UTWB-2. The designed stream has a width/depth ratio of 16.3, entrenchment ratio of > 2.2, and a slope of 1.4%. At the upper end of UTWB-1, floodplain grading was completed to ensure a smooth transition from the upstream top of bank elevations into a restored floodprone channel with entrenchment ratios of 2.2 or greater. The designed stream for this reach incorporated riffle-pool sequences with the goal of attaining improved habitat diversity within the system due to the addition of varying flow regimes and depths. Many of the riffles are constructed riffles to provide stability in the higher gradient riffles. Step pools were avoided as much as possible since they are not as typical in this type of stream but were necessary in four locations with single step pools. Woody debris harvested onsite was added to the channel along selected outside meander bends for increased stability and in-stream habitat. Channel plugs were utilized within the abandoned channel in the areas where the old channel intersects the designed stream to prevent any re-channelization of the old channel. Existing spoil piles lining the old channel were removed and used as fill material in the abandoned channel. Incoming flowpaths, which are currently inducing erosion along the existing stream, were incorporated into the restored stream system. Channel design through this reach included working around desirable, mature trees already existing within the valley, but site grading necessitated by the Priority 2 transition required the removal of certain mature trees.

UTWB-2 begins approximately 78 linear feet upstream of the confluence with UT-1 and continues to the confluence with UT-2. The design approach was similar to UTWB-1, except for that the design consisted of Priority 1 Restoration for the majority of the reach with a bankfull elevation matching the existing historic floodplain as much as feasible. Then the final stretch of UTWB-2 was used as a transition to Priority 2 Restoration in the final reach (UTWB-3). The designed stream has a width/depth ratio of 16.3, entrenchment ratio of > 2.2, and a slope of 1.6%. The planform utilized the full extent of the valley floor as much as feasible and the resultant sinuosity for the reach is 1.2. An existing trail crossing was relocated slightly to the east. The existing culvert at the crossing was replaced with a 48" corrugated metal pipe embedded 1 foot below grade.

UTWB-3 begins at the confluence of UT-2 and continues to the end of the project at an existing gas easement crossing and used a Priority 2 approach. In particular, downstream of the second culverted crossing, a new stream valley was excavated to accommodate a floodplain wide enough for a C-type channel. In this reach, the riffle slopes of 3% or less. The excavated material generated by the Priority 2 Restoration was used to backfill the highly incised existing channel throughout the site. The designed stream has a width/depth ratio of 16.0, entrenchment ratio of >2.2, and a slope of 1.3%, typical of a Rosgen C-type channel. The resultant sinuosity for this reach is 1.3. The reach has riffle-pool sequences installed to create bedform diversity, and the stream incorporated woody debris along selected outside meander bends. Channel plugs were utilized to prevent re-channelization of the existing channel. Similar to the previous reach, many of the riffles are constructed riffles to ensure stability in the higher gradient areas. An existing stream crossing used for recreation trails and utility easement access was relocated slightly. The existing culvert at the crossing was replaced with two 48" corrugated metal pipes embedded 1 foot below the thalweg.

UTWB-2 begins as Priority 1 but transitions to Priority 2. The cross-section connects to the existing bank elevations at the upper portions of the reach, but as the stream moves further downstream, an excavated floodplain was necessary. UTWB-3 was entirely Priority 2. A new floodplain was constructed at the channel elevation with enough capacity to accommodate out-of-bank flows without inducing elevated shear stresses on the newly constructed valley side slopes. At the end of UTWB-3, a series of soil lifts constructed at approximately 45 degrees toward the upstream transition the restoration floodplain into the existing stream valley downstream of the project.

Unnamed Tributary 1 (UT1)

UT1 enters UTWB approximately 400 linear feet downstream of the beginning of the UTWB-1. Enhancement II was used for the beginning at the top of the tributary (UT1-1), and continuing to a headcut located at an existing fence running perpendicular to the channel. Approximately 46 lf of Priority 1 Restoration (UT1-2) was used, beginning at the headcut/fence line and ending at the newly located confluence with UTWB-2. Priority 1 Restoration included stabilizing the existing headcut with a step pool structure and establishing a bankfull elevation equal to the historic floodplain. A channel block was utilized in the area where UT1 intersected the old UTWB to prevent any re-channelization of the old channel. The channel has a width/depth ratio of 16.1, entrenchment ratio of > 2.2, and a slope of 1.6%.

Unnamed Tributary 2 (UT2)

UT2 is the larger of the two tributaries entering UTWB, approximately 2,200 lf downstream of the beginning of the project. UT2 begins at an existing fence line that lies perpendicular to the current stream and flows southwest until converging with UTWB. Enhancement I was used for the top 45 linear feet (UT2-1) of the stream, which begins at an existing fence line. Priority 1/2 Restoration was used for the remaining section (UT2-2) with the purpose of addressing stream bank instability and bed degradation. The channel

has a width/depth ratio of 15.6, entrenchment ratio of > 2.2, and a slope of 1.8%, which are typical for C-type channels. Channel incision was the main deficiency; therefore, increasing the bed elevation and adjusting the designed bankfull elevation to match the historic floodplain reduces stress on the stream bed and improved stability in the reach. The designed stream has riffle-pool sequences that created bedform variation that this reach currently lacks. Constructed riffles were utilized for additional stability in higher gradient riffles. Wood toe structures were added along selected outside meander bends for increased stability and aquatic habitat. The existing culverted crossing for the bike trail was moved slightly south of its current location and replaced with a 48" corrugated metal pipe embedded 1' below the thalweg elevation.

The designed stream abandoned the old channel location after UT2-1, and meanders adjacent to an existing electric utility easement before entering UTWB. Channel plugs were utilized in the abandoned channel to prevent any re-channelization of the old channel.

1.7 Construction and As-Built Conditions

Stream construction was completed on February 12, 2021 and planting was completed on March 5, 2021. The UTWBRR project was built to design plans and guidelines. Minor changes to the design plans were made during construction and are outlined in the table below and in the record drawings in **Appendix E**.

The only planting plan change was the removal of green ash (*Fraxinus pennsylvanica*). Quantities of the other species on the planting list were increased to compensate for the removal of green ash. The only minor monitoring device location change was VP6 was moved slightly upstream to avoid backwater influence from West Branch Rocky River. The other locations and quantities remained as proposed in the Approved Final Mitigation Plan.

Project Segment	Creditable Mitigation Plan Footage	As-Built Footage or Acreage	Difference between MP and As built	Comments
UTWB-1	423	426	3	Slight increase due to differences between proposed center line and as-built surveyed thalweg.
UTWB-2	1747	1786	39	Minor difference in surveyed location of UTWB-UT2 confluence added approx. 5'. Other increases due to differences between proposed center line and as-built surveyed thalweg.
UTWB-3	1314	1327	13	Increase due to differences between proposed center line and as-built surveyed thalweg.
UT1-1	49	49	0	No difference
UT1-2	94	90	-4	Slight decrease in as-built length due to adjustment in pool just upstream of confluence with UTWB.
UT2-1	45	45	0	No difference
UT2-2	259	268	9	Minor difference in surveyed location of UTWB-UT2 confluence added approx. 3'. Remaining increase due to differences between proposed center line and as-built surveyed thalweg.

1.8 Monitoring Performance (MY2)

The UTWBRR Year 2 monitoring activities were performed in October 2022. All Year 2 monitoring data is present below and in the appendices. The Project is on track to meeting interim success criteria and the easement boundary is intact with no encroachments or issues present.

Vegetation

Monitoring of six fixed vegetation plots and six random vegetation plots were completed in October 2022. Vegetation data can be found in **Appendix C**, associated photos are in **Appendix B,** and plot locations are in **Appendix B**. MY2 monitoring data indicates that all but one random plot (RVP2) are exceeding the interim success criteria of 320 planted stems per acre. Random vegetation plot two tree density was lower than the 320 stems per acre criteria, we believe this is due to low tree detection in higher herbaceous areas as opposed to a lower stem density than the rest of the site. This area will be monitored over the next monitoring year to determine if any remedial action is needed. Planted stem densities ranged from 283 to 1052 planted stems per acre with a mean of 651 planted stems per acre across all plots. The average stem height in the plots was 2.4 feet. A total of 15 species were documented within the plots.

Visual assessment of vegetation outside of the monitoring plots indicates that the herbaceous vegetation has become well established throughout the project. Invasive species treatments were performed in 2021 but much of the treated areas show signs of resprouting. Treatments consisted of cut spray method and were largely effective. Three areas of invasive species remained at the end of Year 1 and further areas have been identified in Year 2. Many areas are in the southeastern portion of the easement in the existing woods. The invasive species in this area consist mostly of large autumn olive (*Elaeagnus umbellata*) shrubs with a few Chinese privet (*Ligustrum sinense*) mixed in. Another area is in the woods on the left bank side of the easement. The invasives (mostly autumn olive) in this area were cut in MY1, however, continue to vigorously resprout. These areas with notable invasive vegetation density total 9.94 acres. Further invasive species treatment is recommended for 2023. An invasive vegetation management contactor has been retained by NCDMS through June 2028 to treat any new or previously treated invasive vegetation communities on site.

Stream Geomorphology

Cross section monitoring took place in June 2022. Summary tables and cross section overlay plots are in **Appendix D**. Overall the cross sections relatively match the baseline conditions. The as-built conditions show that shear stress and velocities have been reduced for the restoration reach. The reach was designed as a gravel bed channel and remain classified as a gravel bed channel post-construction.

Visual assessment of the stream channel was performed to document signs of instability, such as eroding banks, structural instability, or excessive sedimentation. Overall, the channel is transporting sediment as designed and will continue to be monitored for aggradation and degradation. In-stream vegetation is established through much of the main channel and in the future may contribute to excessive aggradation. In MY2 all stream cross sections are stable and show no signs of any major alterations. Two structures were found to be piping on UTWB2 and will continue to be monitored to determine if remedial action is required, pictures can be found in Appendix B.

Stream Hydrology

One stage recorder and two flow gauges were installed on April 15, 2021 and will document bankfull events and flow days, respectively. The stage recorder was installed on UTWB-2 and the flow gauges were installed on UT1-2 and UT2-2. In MY2, the stage recorder logged one bankfull event on July 13th, 2022. The annual rainfall average was not above the 70th percentile, so RES expects bankfull events to occur in subsequent years when larger rainfall events take place. Stage recorder data recorded in late 2021, is included in the MY2 report. Both flow gauges recorded 299 consecutive flow days. The gauge locations can be found on **Figure 2**, photos are in **Appendix B**, and associated data is in **Appendix E**.

2.0 Methods

Stream profile and cross section monitoring was conducted using a Topcon GTS-312 Total Station. Three-dimensional coordinates associated with cross-section data were collected in the field (NAD83 State Plane feet FIPS 3200). Morphological data were collected at 14 cross-sections. Survey data were imported into CAD, ArcGIS®, and Microsoft Excel® for data processing and analysis. The stage recorders include an automatic pressure transducer placed in PVC casing in a pool. The elevation of the bed and top of bank at each stage recorder are used to detect bankfull events.

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

Permanent photo stations were established at 14 locations. The photo stations are marked with metal conduit in the field. Each photo station is intended to visually monitor crossings, confluences, reaches entering and exiting the project, and other general areas on site.

3.0 References

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

KCI Associates of North Carolina (2018). UT West Branch Rocky River Restoration Site Final Mitigation Plan.

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

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

Rosgen, D.L. 1994. A Classification of Natural Rivers. Catena 22: 169-199.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

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

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

Appendix A

Background Tables

Table 1. UT West Branch Rocky River Restoration Site (ID-92684) - Mitigation Assets and Components

Project Segment	Existing Footage or Acreage	Creditable Mitigation Plan Footage	Mitigation Category	Restoration Level	Priority Level	Mitigation Ratio (X:1)	Mitigation Plan Credits		As-Built Footage or Acreage	Comments
UTWB-1	364	423	Warm	R	1/2	1.00000	423.000		426	PII transition at top, then PI
UTWB-2	1512	1747	Warm	R	1	1.00000	1747.000		1786	Exludes 20' for piped bike path crossing
UTWB-3	1144	1314	Warm	R	1/2	1.00000	1314.000		1327	No credit for 108' of stream length in utility easement
UT1-1	49	49	Warm	EII	NA	2.50000	19.600		49	
UT1-2	46	94	Warm	R	1	1.00000	94.000		90	
UT2-1	45	45	Warm	EI	NA	1.50000	30.000		45	
UT2-2	274	259	Warm	R	1	1.00000	259.000		268	Excludes 20' for piped bike path crossing

Project Credits

Restoration Level	Stream			Riparian Wetland	Non-rip Wetland	Coastal Marsh
	Warm	Cool	Cold			
Restoration	3837.000					
Re-establishment						
Rehabilitation						
Enhancement						
Enhancement I	30.000					
Enhancement II	19.600					
Creation						
Preservation						
TOTALS	**3,886.600**					

Table 2. Project Activity and Reporting History
UT West Branch Rocky River Restoration Site

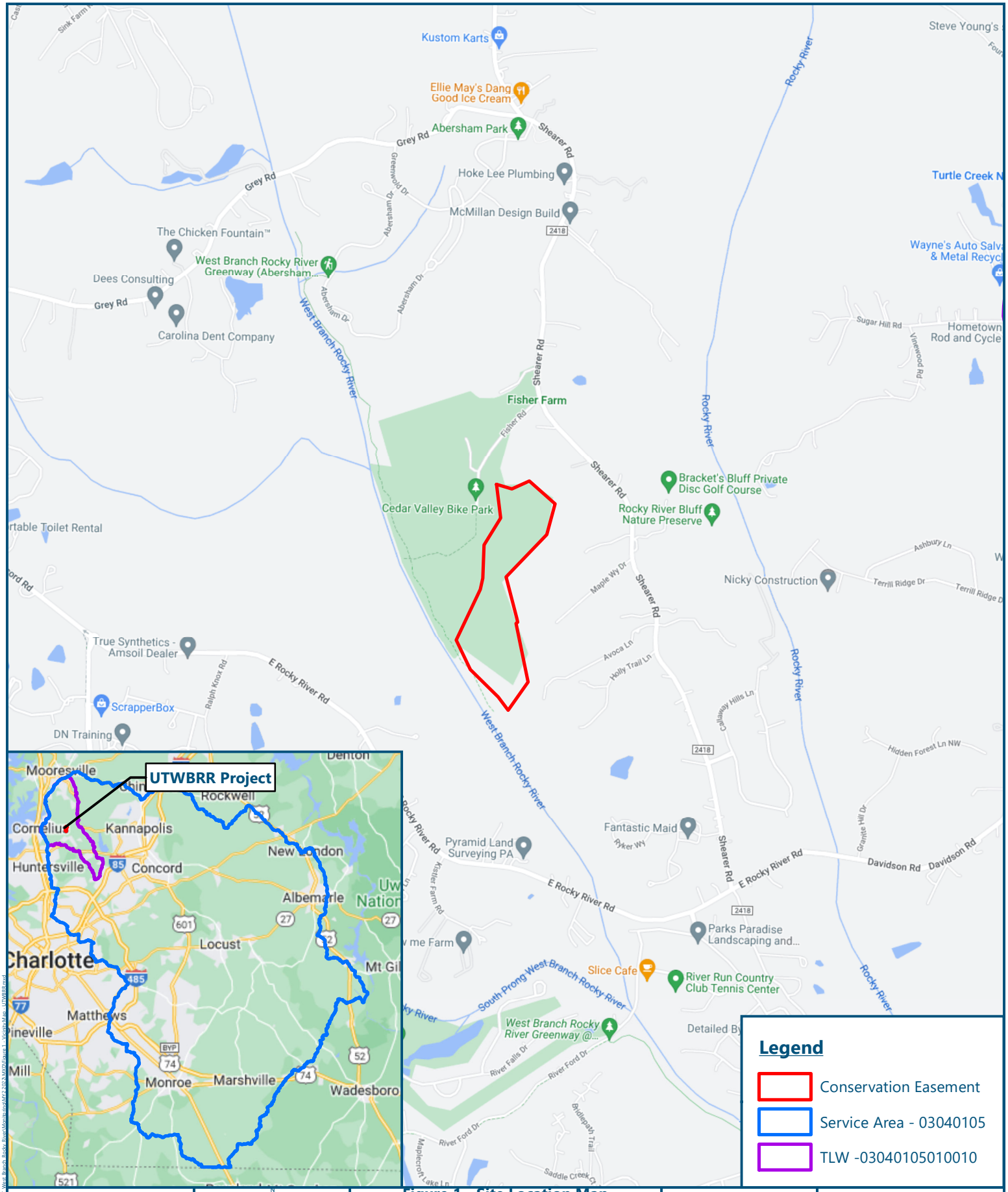
Elapsed Time Since grading complete: 1 year 6 months
Elapsed Time Since planting complete: 1 year 6 months
Number of reporting Years[1]: 2

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	---	11/28/2018
Final Design – Construction Plans	---	2/5/2020
Stream Construction	---	2/12/2021
Site Planting	---	3/5/2021
As-built (Year 0 Monitoring – baseline)	VP: 4/14/2021 XS/LP: 4/15/2021	6/2/2021
Invasive Species Treatment	---	2/2021 - 11/2021
Year 1 Monitoring	XS: 10/19/2021 VP: 10/19/2021	11/20/2021
Year 2 Monitoring	XS: 06/02/2022 VP: 09/10/2022	11/22/2022
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		
Year 6 Monitoring		
Year 7 Monitoring		

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

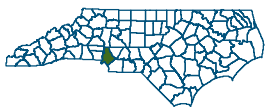
Table 3. Project Contacts Table UT West Branch Rocky River Restoration Site	
Designer	KCI Associates of North Carolina, PC / 4505 Falls of Neuse Road, Suite 400, Raleigh, NC 27609
Primary project design POC	Kristin Knight, PE
Construction Contractor	CEC (RES) / 150 Pine Ridge Road, Mt. Airy, NC 27030
Construction contractor POC	Joanne Cheatham
Survey Contractor	Turner Land Surveying / P.O. Box 148, Swannanoa, NC 28778
Survey contractor POC	David Turner, PLS
Planting Contractor	HARP / 301 McCullough Drive, Suite 400, Charlotte, NC 28262
Planting contractor POC	Alan Peoples
Monitoring Performers	RES / 3600 Glenwood Ave, Suite 100, Raleigh, NC 27612
Monitoring POC	Ryan Medric (919) 741-6268

Table 4. Project Background Information				
Project Name		UT West Branch Rocky River		
County		Mecklenburg		
Project Area (acres)		58.86		
Project Coordinates (latitude and longitude)		352914.45 N, -804754.81 W		
Planted Acreage (Acres of Woody Stems Planted)		11.6		
Project Watershed Summary Information				
Physiographic Province		Piedmont		
River Basin		Yadkin		
USGS Hydrologic Unit 8-digit	3040105	USGS Hydrologic Unit 14-digit	3040105010010	
DWR Sub-basin		03-04-11		
Project Drainage Area (Acres)		167		
Project Drainage Area Percentage of Impervious Area		2%		
CGIA Land Use Classification		Forest, Open/Grassland, Utility Easement, Roads		
Reach Summary Information				
Parameters		**UTWB**	**UT1**	**UT2**
Length of reach (linear feet)		3,028	94	319
Valley confinement (Confined, moderately confined, unconfined)		Confined		
Drainage area (Acres)		167	4	75.1
Perennial, Intermittent, Ephemeral		Perennial	Intermittent	Perennial
NCDWR Water Quality Classification		C		
Stream Classification (existing)		G5	G5	G5
Evolutionary trend (Simon)		Stage III		
FEMA classification		Zone X		



Legend

- Conservation Easement
- Service Area - 03040105
- TLW -03040105010010



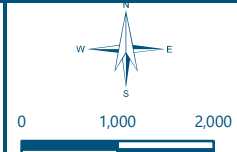


Figure 1 - Site Location Map

UT West Branch Rocky River Mitigation Project

Mecklenburg County, North Carolina

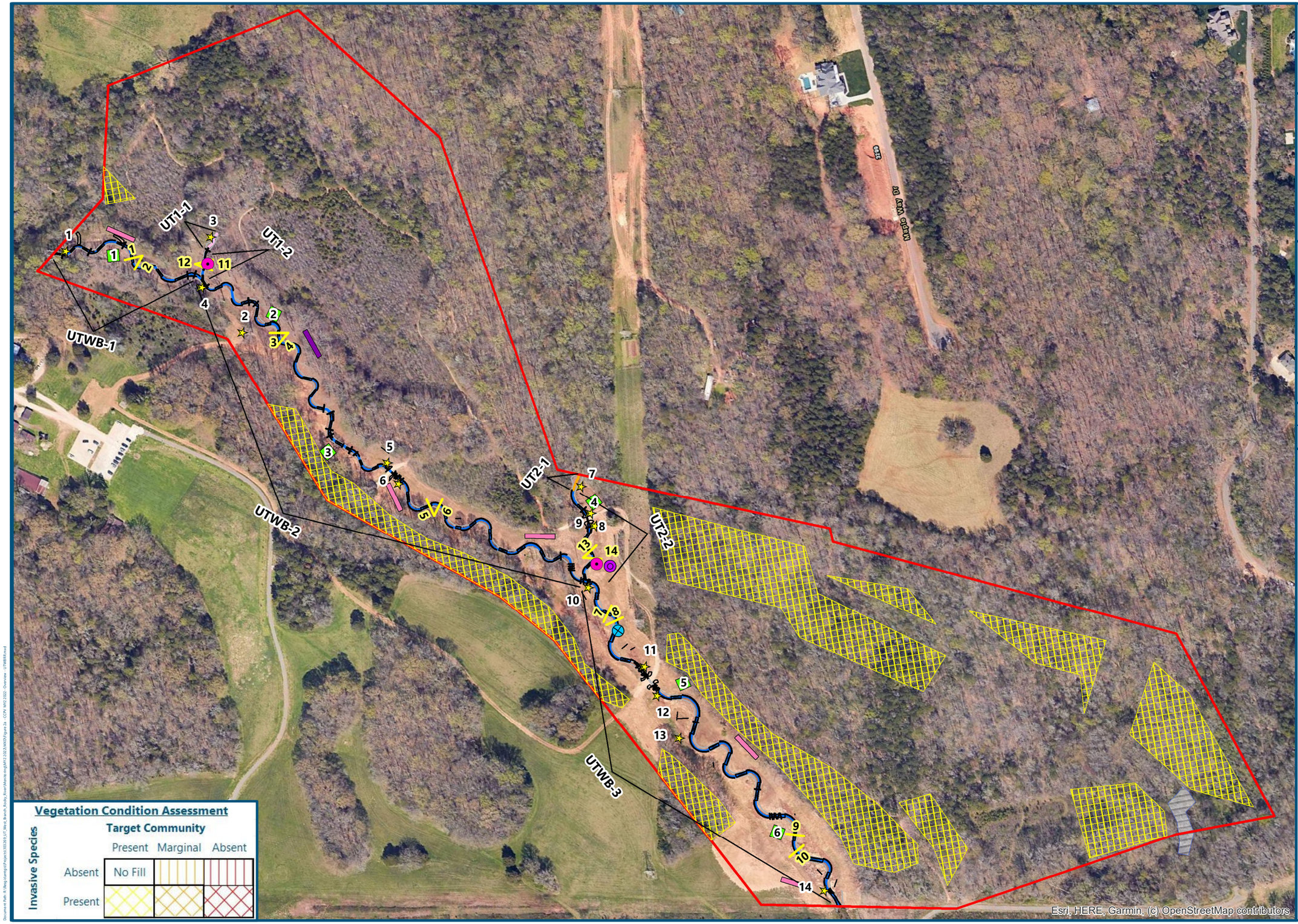
Date: 10/31/2022	
Drawn by: GDS	
Checked by: RTM	
1 inch = 2,000 feet	

res

Restoring a resilient earth for a modern world

Appendix B

Visual Assessment Data



res

Restoring a resilient earth for a modern world

N E S W

0 125 250

Feet

Figure 2a - CCPV MY2 Overview

UT West Branch Rocky River Mitigation Project

Mecklenburg County, North Carolina

Date: 11/23/2022	Drawn by: GDS
1 in = 250 feet	Checked by: DGD

Vegetation Condition Assessment

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

Legend

- Conservation Easement
- Existing Wetland

Fixed Vegetation Plot

- >320 stems/acre

Random Vegetation Plot

- >320 stems/acre
- <320 stems/acre

Stream Mitigation

- Restoration
- Enhancement I
- Enhancement II
- No Credit
- Cross Section
- Structure
- Top of Bank

Monitoring Devices

- Stage Recorder
- Flow Gauge
- Ambient/Rain Gauge
- Photo Station

res

Restoring a resilient earth for a modern world

N E S W

0 50 100

Feet

Figure 2b - CCPV MY2

UT West Branch Rocky River Mitigation Project

Mecklenburg County, North Carolina

Date: 11/23/2022	Drawn by: DGD
1 in = 100 feet	Checked by: xxx

UT1-1

UT1-2

UTWB-1

UTWB-2

Fisher Rd

Piping Structure

Piping Structure

1 2 3 4 5 6 11 12

1 2 3

Vegetation Condition Assessment

Target Community

Invasive Species	Present	Marginal	Absent
Absent	No Fill		
Present			

- Conservation
- Existing

Fixed Vegetation

- >320

MY2 RVP > 320

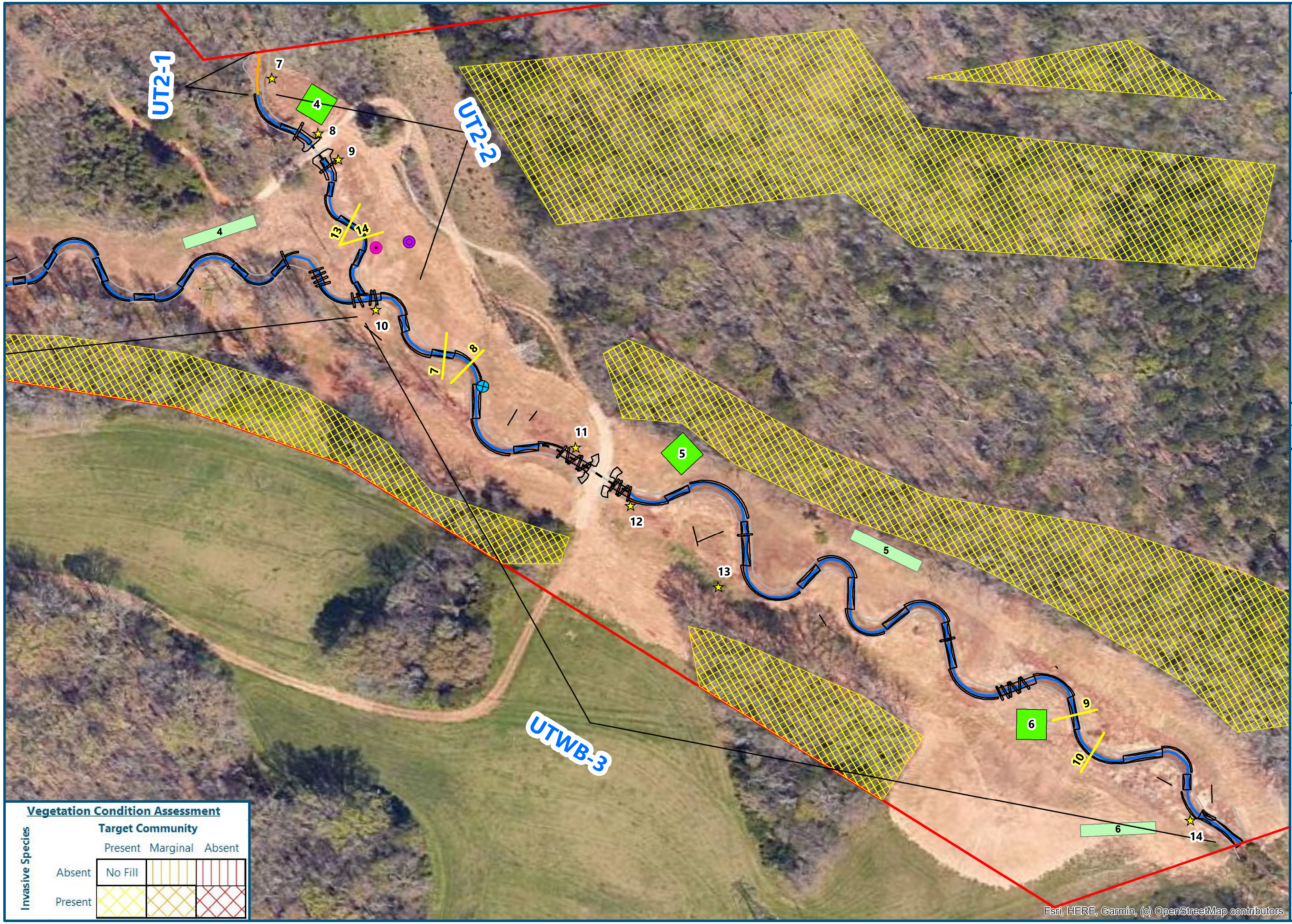
- Yes

Stream

- Enhancement I
- Enhancement II
- No
- Cross
- Top of

Monitoring Devices

- Stage
- Flow
- Ambient/Rain
- Photo



res
Restoring a resilient earth for a modern world

N E S W

0 50 100
Feet

Figure 2b - CCPV MY2

UT West Branch Rocky River Mitigation Project

Mecklenburg County, North Carolina

Date: 11/23/2022	Drawn by: DGD
1 in = 100 feet	Checked by: xxx

Conservation
Existing
Fixed Vegetation
>320
MY2 RVP > 320
Yes
Stream
Enhancement I
Enhancement II
No
Cross
Top of
Monitoring Devices
Stage
Flow
Ambient/Rain
Photo

Table 5. Visual Stream Stability Assessment

Reach UTWB-1
Assessed Stream Length 423
Assessed Bank Length 846
Date Assessed 10/10/2022

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	4	4		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	8	8		100%

Table 5. Visual Stream Stability Assessment

Reach UTWB-2
Assessed Stream Length 1747
Assessed Bank Length 3494
Date Assessed 10/10/2022

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	13	15		87%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	29	29		100%

Table 5. Visual Stream Stability Assessment

Reach UTWB-3
Assessed Stream Length 1314
Assessed Bank Length 2628
Date Assessed 10/10/2022

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	5	5		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	16	16		100%

Table 5. Visual Stream Stability Assessment

Reach UT1
Assessed Stream Length 94
Assessed Bank Length 188
Date Assessed 10/10/2022

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	4	4		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	0	0		N/A

Table 5. Visual Stream Stability Assessment

Reach UT2
Assessed Stream Length 259
Assessed Bank Length 518
Date Assessed 10/10/2022

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	**Surface Scour/Bare Bank**	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
Totals					0	100%
Structure	**Grade Control**	Grade control structures exhibiting maintenance of grade across the sill.	6	6		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	4	4		100%

Table 6 Vegetation Condition Assessment

Date Assessed 10/10/2022

Planted Acreage[1] **11.6**

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

Easement Acreage[2] **58.86**

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	9	9.94	16.9%
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.

UTWBRR MY2 Fixed Vegetation Monitoring Plot Photos (10/10/2022)

Vegetation Plot 1

Vegetation Plot 2

Vegetation Plot 3

Vegetation Plot 4

Vegetation Plot 5

Vegetation Plot 6

UTWBRR MY2 Random Vegetation Monitoring Plot Photo (10/10/2022)

Random Vegetation Plot 1

Random Vegetation Plot 2

Random Vegetation Plot 3

Random Vegetation Plot 4

Random Vegetation Plot 5

Random Vegetation Plot 6

UTWBRR Monitoring Device Photos (6/2/2022)

Stage Recorder UTWB-3

Flow Gauge UT1

Flow Gauge UT2

UT to West Branch Rocky River Crossing Photos (10/10/2022)

Crossing UTWB2 - Upstream

Crossing UTWB2– Downstream

Crossing UTWB3 - Upstream

Crossing UTWB3– Downstream

UT to West Branch Rocky River Crossing Photos (10/10/2022)

Crossing UT2-2 - Upstream

Crossing UT2-2– Downstream

UTWBRR Photo Station Photos (6/2/2022)

Photo Station 1
UTWB-1 entering the project area

Photo Station 2
UTWB-2 looking downstream

Photo Station 3
UT1-1 entering the project area

Photo Station 4
Confluence of UTWB-1 and UT1-2

Photo Station 5
Crossing on UTWB-2 looking downstream

Photo Station 6
Crossing on UTWB-2 looking upstream

Photo Station 7
UT2-1 entering the project area

Photo Station 8
Crossing on UT2-2 looking downstream

Photo Station 9
Crossing on UT2-2 looking upstream

Photo Station 10
Confluence of UTWB-2 and UT2-2

Photo Station 11
Crossing on UTWB-3 looking downstream

Photo Station 12
Crossing on UTWB-3 looking upstream

Photo Station 13
UTWB-3 looking downstream

Photo Station 14
UTWB-3 exiting the project area

UTWB-2 Station 14+32 piping rock sill (4/4/2022)

UTWB-2 Station 15+63 piping rock sill (10/10/2022)

Appendix C

Vegetation Plot Data

Table 7. Planted Species Summary

Common Name	Scientific Name	Mitigation Plan %	As-Built %	Total Stems Planted
River Birch	*Betula nigra*	9	11	1,050
American Sycamore	*Platanus occidentalis*	9	12	1,150
Willow Oak	*Quercus phellos*	10	10	900
Flowering Dogwood	*Cornus florida*	5	6	550
American Witchhazel	*Hamamelis virginiana*	5	4	400
White Oak	*Quercus alba*	10	9	800
Swamp Chestnut Oak	*Quercus michauxii*	10	9	800
American Hornbeam	*Carpinus caroliniana*	9	9	800
Tulip Poplar	*Liriodendron tulipifera*	9	12	1,150
American Elm	*Ulumus americana*	10	10	900
Hazel Alder	*Alnus serrulata*	5	8	750
Green Ash	*Fraxinus pennyslvanica*	9	0	0
			Total	9,250
			Planted Area	11.6
			As-built Planted Stems/Acre	671

Table 8. Vegetation Plot Mitigation Success Summary

Wetland/Stream Vegetation Totals (per acre)					
Plot #	**Planted Stems/Acre**	**Volunteers Stems/Acre**	**Total Stems/Acre**	**Success Criteria Met?**	**Average Planted Stem Height (ft)**
1	567	0	567	Yes	2.0
2	486	0	486	Yes	2.3
3	931	0	931	Yes	3.7
4	364	243	567	Yes	3.6
5	850	0	850	Yes	2.1
6	526	0	526	Yes	1.1
R1	486	0	486	Yes	2.9
R2	283	0	283	No	2.4
R3	890	0	890	Yes	2.4
R4	769	0	769	Yes	3.0
R5	607	0	607	Yes	2.2
R6	1052	0	1052	Yes	1.5
Project Avg	**651**	**40**	**654**	**Yes**	2.4

Table 9. Stem Count Total and Planted by Plot Species

			Current Plot Data (MY2 2022)																									
			92684-01-0001			92684-01-0002			92684-01-0003			92684-01-0004			92684-01-0005			92684-01-0006			92684-01-R1			92684-01-R2			92684-01-R3		
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																										
Alnus serrulata	hazel alder	Shrub													1	1	1											
Betula nigra	river birch	Tree	4	4	4	4	4	4	3	3	3	2	2	2	9	9	9				4	4	4	1	1	1	2	2	2
Carpinus caroliniana	American hornbeam	Tree																4	4	4							1	1	1
Cornus florida	flowering dogwood	Tree										1	1	1	2	2	2												
Diospyros virginiana	common persimmon	Tree												1							1	1	1				1	1	1
Elaeagnus	elaeagnus	Exotic												1														
Fraxinus pennyslvatica	Green Ash	Tree																			1	1	1	1	1	1			
Hamamelis virginiana	American witchhazel	Tree	2	2	2				1	1	1				2	2	2	3	3	3				1	1	1	4	4	4
Liquidambar styraciflua	sweetgum	Tree												4														
Liriodendron tulipifera	tuliptree	Tree	1	1	1										3	3	3				1	1	1	2	2	2	2	2	2
Platanus occidentalis	American sycamore	Tree				1	1	1	8	8	8	4	4	4	2	2	2				3	3	3	2	2	2	6	6	6
Quercus alba	white oak	Tree	1	1	1	2	2	2	6	6	6	1	1	1	1	1	1										1	1	1
Quercus michauxii	swamp chestnut oak	Tree							2	2	2	1	1	1	1	1	1												
Quercus phellos	willow oak	Tree	6	6	6	5	5	5	2	2	2										2	2	2				5	5	5
Ulmus alata	winged elm	Tree																										
Ulmus americana	American elm	Tree							1	1	1							6	6	6									
Stem count			14	14	14	12	12	12	23	23	23	9	9	15	21	21	21	13	13	13	12	12	12	7	7	7	22	22	22
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			5	5	5	4	4	4	7	7	7	5	5	8	8	8	8	3	3	3	6	6	6	5	5	5	8	8	8
Stems per ACRE			567	567	567	486	486	486	931	931	931	364	364	607	850	850	850	526	526	526	486	486	486	283	283	283	890	890	890

			Current Plot Data (MY2 2022)									Annual Means								
			92684-01-R4			92684-01-R5			92684-01-R6			MY2 (2022)			MY1 (2021)			MY0 (2021)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	red maple	Tree															10			
Alnus serrulata	hazel alder	Shrub										1	1	1	2	2	2	2	2	2
Betula nigra	river birch	Tree	5	5	5	2	2	2	1	1	1	37	37	37	31	31	31	25	25	25
Carpinus caroliniana	American hornbeam	Tree				4	4	4				9	9	9	7	7	7	6	6	6
Cornus florida	flowering dogwood	Tree										3	3	3	1	1	1			
Diospyros virginiana	common persimmon	Tree										3	3	3	8	8	8	10	10	10
Elaeagnus	elaeagnus	Exotic												1	8	8	8			
Fraxinus pennsylivatica	Green Ash	Tree												1						
Hamamelis virginiana	American witchhazel	Tree	2	2	2	2	2	2	1	1	1	18	18	18	22	22	22	9	9	9
Liquidambar styraciflua	sweetgum	Tree												4			30			
Liriodendron tulipifera	tuliptree	Tree				2	2	2				11	11	11	11	11	26	7	7	7
Platanus occidentalis	American sycamore	Tree	9	9	9	5	5	5	18	18	18	58	58	58	46	46	58	15	15	15
Quercus alba	white oak	Tree	1	1	1				5	5	5	18	18	18	24	24	24	10	10	10
Quercus michauxii	swamp chestnut oak	Tree										5	5	5	4	4	4	4	4	4
Quercus phellos	willow oak	Tree	1	1	1							21	21	21	24	24	24	18	18	18
Ulmus alata	winged elm	Tree													1	1	16			
Ulmus americana	American elm	Tree	1	1	1				1	1	1	9	9	9	20	20	20	8	8	8
		Stem count	19	19	19	15	15	15	26	26	26	193	193	199	209	209	291	114	114	114
		size (ares)	1			1			1			12			12			6		
		size (ACRES)	0.02			0.02			0.02			0.30			0.30			0.15		
		Species count	6	6	6	5	5	5	5	5	5	12	12	15	14	14	16	11	11	11
		Stems per ACRE	769	769	769	607	607	607	1052	1052	1052	651	651	671	705	705	981	769	769	769

Appendix D

Stream Measurement and

Geomorphology Data

Table 10. Baseline Stream Data Summary
UT West Branch Rocky River Mitigation Site - Reach UTWB-1

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Dimension and Substrate - Riffle Only																									
Bankfull Width (ft)		---	---	---	3.4	4.5	---	5.6	---	2	---	---	---	---	---	2	---	8.4	---	---	---	9.8	---	---	1
Floodprone Width (ft)					5.4	5.8	---	6.2	---	2	---	---	---	---	---	2	---	>18.5	---	---	---	>49.2	---	---	1
Bankfull Mean Depth (ft)		---	---	---	0.8	0.9	---	1.0	---	2	---	---	---	---	---	2	---	0.5	---	---	---	---	---	---	---
[1]Bankfull Max Depth (ft)					1.2	1.4	---	1.5	---	2	---	---	---	---	---	2	---	0.6	---	---	---	0.9	---	---	1
Bankfull Cross Sectional Area (ft^2)		---	---	---	2.7	4.2	---	5.6	---	2	---	---	---	---	---	2	---	4.3	---	---	---	5.7	---	---	1
Width/Depth Ratio					4.3	5.0	---	5.6	---	2	10.0	12.0	---	14.0	---	2	---	16.3	---	---	---	---	---	---	---
Entrenchment Ratio					1.1	1.4	---	1.6	---	2	>2.2	>2.2	---	>2.2	---	2	---	>2.2	---	---	---	>5	---	---	1
[1]Bank Height Ratio					4.0	4.4	---	4.8	---	2	1.0	1.1	---	1.1	---	2	---	1.0	---	---	---	1.0	---	---	1
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	7.4	19.2	---	33.2	---	---
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.29	1.5	---	2.7	---	---
Pool Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	15	---	25	20.0	33.7	---	44.2	---	---
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	---	---	---	---	---	---	40	---	67	27.4	53.4	---	77.3	---	---
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	35	---	43	35	---	---	43	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	---	---	---	---	---	---	18	---	30	18	---	---	30	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	2	---	---	3	---	---	2.1	---	3.6	2.1	---	---	3.6	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	---	---	---	---	---	---	72	---	93	72	---	---	93	---	---
Meander Width Ratio					---	---	---	---	---	---	3	---	---	8	---	---	4.2	---	5.1	4.2	---	---	5.1	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					G5						C5						C5			C5					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---						---						---			---					
Valley length (ft)					---						---						---			---					
Channel Thalweg length (ft)					---						---						---			---					
Sinuosity (ft)					1						1.2, 1.5						1.2			1.2					
Water Surface Slope (Channel) (ft/ft)					0.036						---						0.014			0.014					
Channel slope (ft/ft)					---						---						---			---					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

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

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

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

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

Table 10. Baseline Stream Data Summary
UT West Branch Rocky River Mitigation Site - Reach UTWB-2

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)		---	---	---	---	---	5.0	---	---	1	---	---	---	---	---	2	---	8.4	---	7.0	8.0	---	8.9	1.3	2
Floodprone Width (ft)					---	---	9.2	---	---	1	---	---	---	---	---	2	---	>18.5	---	>48.2	>48.8	---	>49.3	0.8	2
Bankfull Mean Depth (ft)		---	---	---	---	---	1.1	---	---	1	---	---	---	---	---	2	---	0.5	---	---	---	---	---	---	---
[1]Bankfull Max Depth (ft)					---	---	1.6	---	---	1	---	---	---	---	---	2	---	0.6	---	0.8	0.8	---	0.8	0.0	2
Bankfull Cross Sectional Area (ft^2)		---	---	---	---	---	5.3	---	---	1	---	---	---	---	---	2	---	4.3	---	4.1	4.3	---	4.5	0.3	2
Width/Depth Ratio					---	---	4.7	---	---	1	10.0	12.0	---	14.0	---	2	---	16.3	---	---	---	---	---	---	---
Entrenchment Ratio					---	---	1.8	---	---	1	>2.2	>2.2	---	>2.2	---	2	---	>2.2	---	>5.6	>6.3	---	>6.9	0.9	2
[1]Bank Height Ratio					---	---	3.4	---	---	1	1.0	1.1	---	1.1	---	2	---	1.0	---	1.0	1.0	---	1.0	0.0	2
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4.3	15.8	---	29.3	---	---
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	10	---	26	12.5	40.1	---	62.4	---	---
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	---	---	---	---	---	---	38	---	92	18.7	55.9	---	84.6	---	---
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	41	---	63	41	---	---	63	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	---	---	---	---	---	---	18	---	36	18	---	---	36	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	2	---	---	3	---	---	2.1	---	4.3	2.1	---	---	4.3	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	---	---	---	---	---	---	77	---	162	77	---	---	162	---	---
Meander Width Ratio					---	---	---	---	---	---	3	---	---	8	---	---	4.9	---	7.5	4.9	---	---	7.5	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					G5						C5						C5			C5					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---						---						---			---					
Valley length (ft)					---						---						---			---					
Channel Thalweg length (ft)					---						---						---			---					
Sinuosity (ft)					1.06						1.2, 1.5						1.2			1.2					
Water Surface Slope (Channel) (ft/ft)					0.0195						---						0.014			0.014					
Channel slope (ft/ft)					---						---						---			---					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

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

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

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

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

Table 10. Baseline Stream Data Summary
UT West Branch Rocky River Mitigation Site - Reach UTWB-3

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Dimension and Substrate - Riffle Only																									
Bankfull Width (ft)		---	---	---	7.4	8.3	---	9.1	---	2	---	---	---	---	---	2	---	12.0	---	11.0	13.8	---	16.5	3.9	2
Floodprone Width (ft)					11.3	12.0	---	12.7	---	2	---	---	---	---	---	2	---	>26.4	---	>49	>49.1	---	>49.2	0.1	2
Bankfull Mean Depth (ft)		---	---	---	0.9	1.1	---	1.2	---	2	---	---	---	---	---	2	---	0.8	---	---	---	---	---	---	---
[1]Bankfull Max Depth (ft)					1.5	1.6	---	1.7	---	2	---	---	---	---	---	2	---	0.9	---	1.0	1.2	---	1.3	0.2	2
Bankfull Cross Sectional Area (ft^2)		---	---	---	8.5	8.9	---	9.2	---	2	---	---	---	---	---	2	---	9.0	---	7.5	10.2	---	12.9	3.8	2
Width/Depth Ratio					6.0	7.9	---	9.7	---	2	10.0	12.0	---	14.0	---	2	---	16.0	---	---	---	---	---	---	---
Entrenchment Ratio					1.3	1.5	---	1.7	---	2	>2.2	>2.2	---	>2.2	---	2	---	>2.2	---	>3	>3.8	---	>4.5	1.1	2
[1]Bank Height Ratio					4.7	4.9	---	5.0	---	2	1.0	1.1	---	1.1	---	2	---	1.0	---	1.0	1.0	---	1.0	0.0	2
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.3	20.3	---	42.8	---	---
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.20	1.8	---	3.1	---	---
Pool Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	14	---	39	12.9	58.2	---	96.6	---	---
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	---	---	---	---	---	---	55	---	133	31.3	79.3	---	139.5	---	---
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	36	---	93	36	---	---	93	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	---	---	---	---	---	---	20	---	40	20	---	---	40	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	2	---	---	3	---	---	1.7	---	3.3	1.7	---	---	3.3	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	---	---	---	---	---	---	108	---	195	108	---	---	195	---	---
Meander Width Ratio					---	---	---	---	---	---	3	---	---	8	---	---	3	---	7.8	3	---	---	7.8	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					G5						C5						C5			C5					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---						---						---			---					
Valley length (ft)					---						---						---			---					
Channel Thalweg length (ft)					---						---						---			---					
Sinuosity (ft)					1.07						1.2, 1.5						1.3			1.3					
Water Surface Slope (Channel) (ft/ft)					0.0121						---						0.013			0.013					
Channel slope (ft/ft)					---						---						---			---					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

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

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

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

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

Table 10. Baseline Stream Data Summary
UT West Branch Rocky River Mitigation Site - Reach UT1

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)		---	---	---	2.2	2.5	---	2.8	---	2	---	---	---	---	---	2	---	5.5	---	---	---	5.3	---	---	1
Floodprone Width (ft)					5.4	5.8	---	6.1	---	2	---	---	---	---	---	2	---	>12.1	---	---	---	36.7	---	---	1
Bankfull Mean Depth (ft)		---	---	---	0.4	0.5	---	0.5	---	2	---	---	---	---	---	2	---	0.3	---	---	---	---	---	---	---
[1]Bankfull Max Depth (ft)					0.6	0.7	---	0.7	---	2	---	---	---	---	---	2	---	0.4	---	---	---	0.6	---	---	1
Bankfull Cross Sectional Area (ft^2)		---	---	---	0.9	1.1	---	1.3	---	2	---	---	---	---	---	2	---	1.9	---	---	---	2.1	---	---	1
Width/Depth Ratio					5.4	5.8	---	6.1	---	2	10.0	12.0	---	14.0	---	2	---	16.1	---	---	---	---	---	---	---
Entrenchment Ratio					1.5	2.0	---	2.4	---	2	>2.2	>2.2	---	>2.2	---	2	---	>2.2	---	---	---	7.0	---	---	1
[1]Bank Height Ratio					3.4	3.9	---	4.4	---	2	1.0	1.1	---	1.1	---	2	---	1.0	---	---	---	1.0	---	---	1
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	8.6	11.9	---	15.1	---	---
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.60	2.4	---	2.7	---	---
Pool Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	5	---	6	8.5	15.7	---	21.4	---	---
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	---	---	---	---	---	---	34	---	37	18.7	27.0	---	36.5	---	---
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	20	---	25	20	---	---	25	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	---	---	---	---	---	---	11	---	15	11	---	---	15	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	2	---	---	3	---	---	2	---	2.7	2	---	---	2.7	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	---	---	---	---	---	---	54	---	60	54	---	---	60	---	---
Meander Width Ratio					---	---	---	---	---	---	3	---	---	8	---	---	3.6	---	4.5	3.6	---	---	4.5	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					G5						C5						C5			C5					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---						---						---			---					
Valley length (ft)					---						---						---			---					
Channel Thalweg length (ft)					---						---						---			---					
Sinuosity (ft)					1.02						1.2, 1.5						1.1			1.1					
Water Surface Slope (Channel) (ft/ft)					0.062						---						0.015			0.015					
Channel slope (ft/ft)					---						---						---			---					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

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

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

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

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

Table 10. Baseline Stream Data Summary
UT West Branch Rocky River Mitigation Site - Reach UT2

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)		---	---	---	4.9	5.1	---	5.3	---	2	---	---	---	---	---	2	---	9.3	---	---	---	9.8	---	---	1
Floodprone Width (ft)					6.2	6.5	---	6.8	---	2	---	---	---	---	---	2	---	>20.5	---	---	---	>41.3	---	---	1
Bankfull Mean Depth (ft)		---	---	---	0.4	0.5	---	0.5	---	2	---	---	---	---	---	2	---	0.6	---	---	---	---	---	---	---
[1]Bankfull Max Depth (ft)					0.7	0.8	---	0.8	---	2	---	---	---	---	---	2	---	0.7	---	---	---	0.8	---	---	1
Bankfull Cross Sectional Area (ft^2)		---	---	---	1.8	2.1	---	2.4	---	2	---	---	---	---	---	2	---	5.5	---	---	---	5.3	---	---	1
Width/Depth Ratio					11.6	12.4	---	13.1	---	2	10.0	12.0	---	14.0	---	2	---	15.6	---	---	---	---	---	---	---
Entrenchment Ratio					1.3	1.3	---	1.3	---	2	>2.2	>2.2	---	>2.2	---	2	---	>2.2	---	---	---	>4.3	---	---	1
[1]Bank Height Ratio					9.6	10.5	---	11.3	---	2	1.0	1.1	---	1.1	---	2	---	1.0	---	---	---	1.0	---	---	1
Profile																									
Riffle Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	5.3	23.2	---	65.1	---	---
Riffle Slope (ft/ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.10	1.3	---	2.2	---	---
Pool Length (ft)					---	---	---	---	---	---	---	---	---	---	---	---	7	---	13	14.8	23.9	---	39.5	---	---
Pool Max depth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pool Spacing (ft)					---	---	---	---	---	---	---	---	---	---	---	---	43	---	53	20.0	49.3	---	89.5	---	---
Pattern																									
Channel Beltwidth (ft)					---	---	---	---	---	---	---	---	---	---	---	---	26	---	43	26	---	---	43	---	---
Radius of Curvature (ft)					---	---	---	---	---	---	---	---	---	---	---	---	18	---	34	18	---	---	34	---	---
Rc:Bankfull width (ft/ft)					---	---	---	---	---	---	2	---	---	3	---	---	1.9	---	3.7	1.9	---	---	3.7	---	---
Meander Wavelength (ft)					---	---	---	---	---	---	---	---	---	---	---	---	74	---	123	74	---	---	123	---	---
Meander Width Ratio					---	---	---	---	---	---	3	---	---	8	---	---	2.8	---	4.6	2.8	---	---	4.6	---	---
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					---												---			---					
Max part size (mm) mobilized at bankfull					---												---			---					
Stream Power (transport capacity) W/m^2					---												---			---					
Additional Reach Parameters																									
Rosgen Classification					G5						C5						C5			C5					
Bankfull Velocity (fps)		---	---	---	---						---						---			---					
Bankfull Discharge (cfs)		---	---	---	---						---						---			---					
Valley length (ft)					---						---						---			---					
Channel Thalweg length (ft)					---						---						---			---					
Sinuosity (ft)					1						1.2, 1.5						1.1			1.1					
Water Surface Slope (Channel) (ft/ft)					0.047						---						0.017			0.017					
Channel slope (ft/ft)					---						---						---			---					
[3]Bankfull Floodplain Area (acres)					---						---						---			---					
[4]% of Reach with Eroding Banks					---						---														
Channel Stability or Habitat Metric					---						---														
Biological or Other					---						---														

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

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

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

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

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

Project Name/Number: UT West Branch Rocky River #92684

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)							Cross Section 5 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	704.6	704.6	704.6					704.2	704.1	704.2					694.2	694.2	694.4					694.1	694.1	694.2					682.1	682.1	682.1				
Bankfull Width (ft)[1]	9.8	9.9	10.4					NA	NA	NA					8.9	6.9	7.5					NA	NA	NA					7.0	7.0	7.7				
Floodprone Width (ft)[1]	>49.2	>49.1	>49.2					NA	NA	NA					>49.3	>49.3	>49.1					NA	NA	NA					>48.2	>49.1	>49.1				
Bankfull Max Depth (ft)[2]	0.9	0.9	0.8					2.2	2.1	2.0					0.8	0.8	0.8					2.2	1.8	1.7					0.8	0.8	0.7				
Low Bank Elevation (ft)	704.56	704.6	704.5					704.2	704.1	704.1					694.2	694.2	694.3					694.1	694.1	694.1					682.1	682.1	682.0				
Bankfull Cross Sectional Area (ft^2)[2]	5.7	5.5	4.3					11.5	11.5	11.1					4.5	4.2	4.3					10.4	10.2	9.7					4.1	4.1	3.8				
Bankfull Entrenchment Ratio[1]	>5	>5	>4.7					NA	NA	NA					>5.6	>7.1	>6.6					NA	NA	NA					>6.9	>7	>6.3				
Bankfull Bank Height Ratio[1]	1.0	1.0	0.9					NA	NA	NA					1.0	1.0	1.0					NA	NA	NA					1.0	1.0	0.9				

	Cross Section 6 (Pool)							Cross Section 7 (Riffle)							Cross Section 8 (Pool)							Cross Section 9 (Riffle)							Cross Section 10 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	681.6	681.6	681.5					672.3	672.3	672.4					672.1	672.1	672.2					659.1	659.2	659.1					658.2	658.3	658.3				
Bankfull Width (ft)[1]	NA	NA	NA					11.0	10.1	10.3					NA	NA	NA					16.5	15.4	17.3					NA	NA	NA				
Floodprone Width (ft)[1]	NA	NA	NA					>49.2	>49.2	>49					NA	NA	NA					>49	>49.1	>49					NA	NA	NA				
Bankfull Max Depth (ft)[2]	2.3	2.1	1.9					1.0	1.0	0.9					1.5	2.0	1.1					1.3	1.4	1.3					2.1	2.0	1.7				
Low Bank Elevation (ft)	681.6	681.7	681.6					672.3	672.2	672.3					672.1	672.2	671.6					659.1	659.1	659.0					658.2	658.0	658.2				
Bankfull Cross Sectional Area (ft^2)[2]	11.2	12.5	11.8					7.5	6.9	6.6					12.3	13.8	5.4					12.7	12.5	11.5					10.8	8.1	9.2				
Bankfull Entrenchment Ratio[1]	NA	NA	NA					>4.5	>4.9	>4.8					NA	NA	NA					>3.0	>3.2	>2.8					NA	NA	NA				
Bankfull Bank Height Ratio[1]	NA	NA	NA					1.0	0.9	0.9					NA	NA	NA					1.0	1.0	0.9					NA	NA	NA				

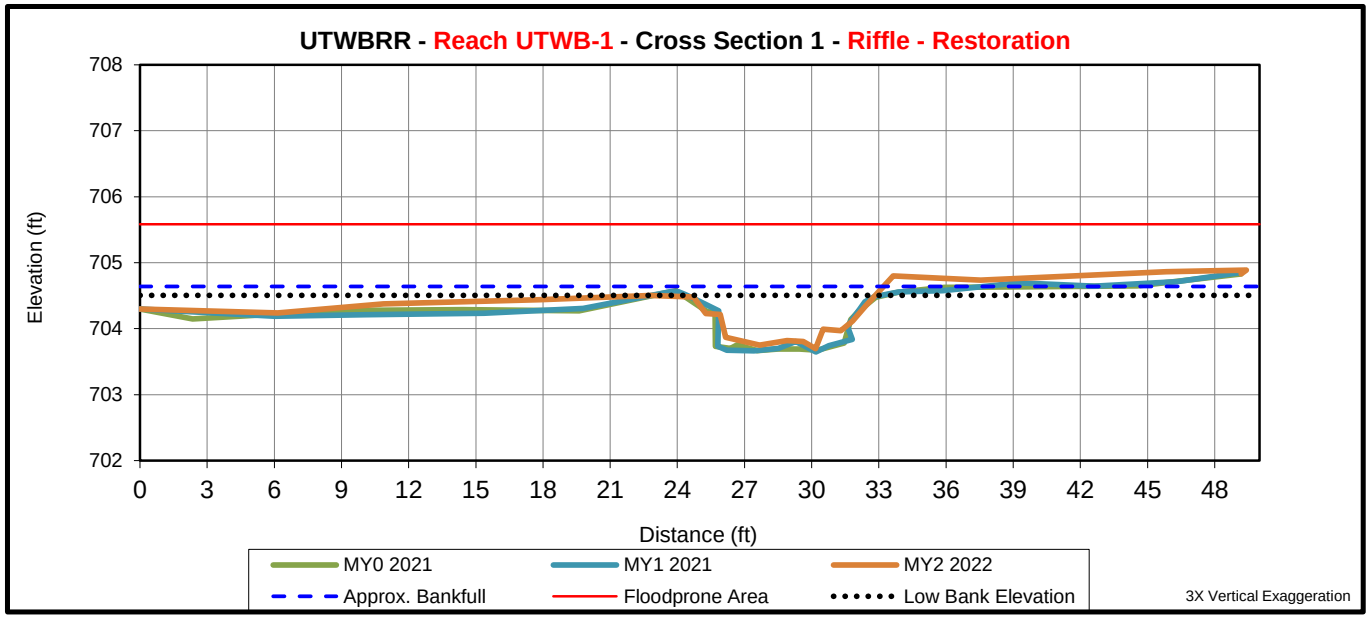
	Cross Section 11 (Pool)							Cross Section 12 (Riffle)							Cross Section 13 (Riffle)							Cross Section 14 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	700.3	700.3	700.4					700.2	700.2	700.3					675.0	675.0	675.1					674.9	674.9	675.1				
Bankfull Width (ft)[1]	NA	NA	NA					5.3	5.1	5.4					9.8	9.0	12.0					NA	NA	NA				
Floodprone Width (ft)[1]	NA	NA	NA					36.7	37.7	37.7					>41.8	>43.5	>42.4					NA	NA	NA				
Bankfull Max Depth (ft)[2]	1.6	1.5	1.3					0.6	0.6	0.5					0.8	0.8	0.7					1.0	0.9	1.0				
Low Bank Elevation (ft)	700.3	700.2	700.4					700.2	700.2	700.3					675.0	675.0	675.0					674.9	674.9	675.0				
Bankfull Cross Sectional Area (ft^2)[2]	7.5	6.9	7.0					2.1	2.0	1.7					5.3	5.0	4.3					7.0	6.6	6.8				
Bankfull Entrenchment Ratio[1]	NA	NA	NA					7.0	7.4	7.0					>4.3	>4.8	>3.5					NA	NA	NA				
Bankfull Bank Height Ratio[1]	NA	NA	NA					1.0	1.0	0.9					1.0	1.0	0.9					NA	NA	NA				

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

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

Upstream

Downstream

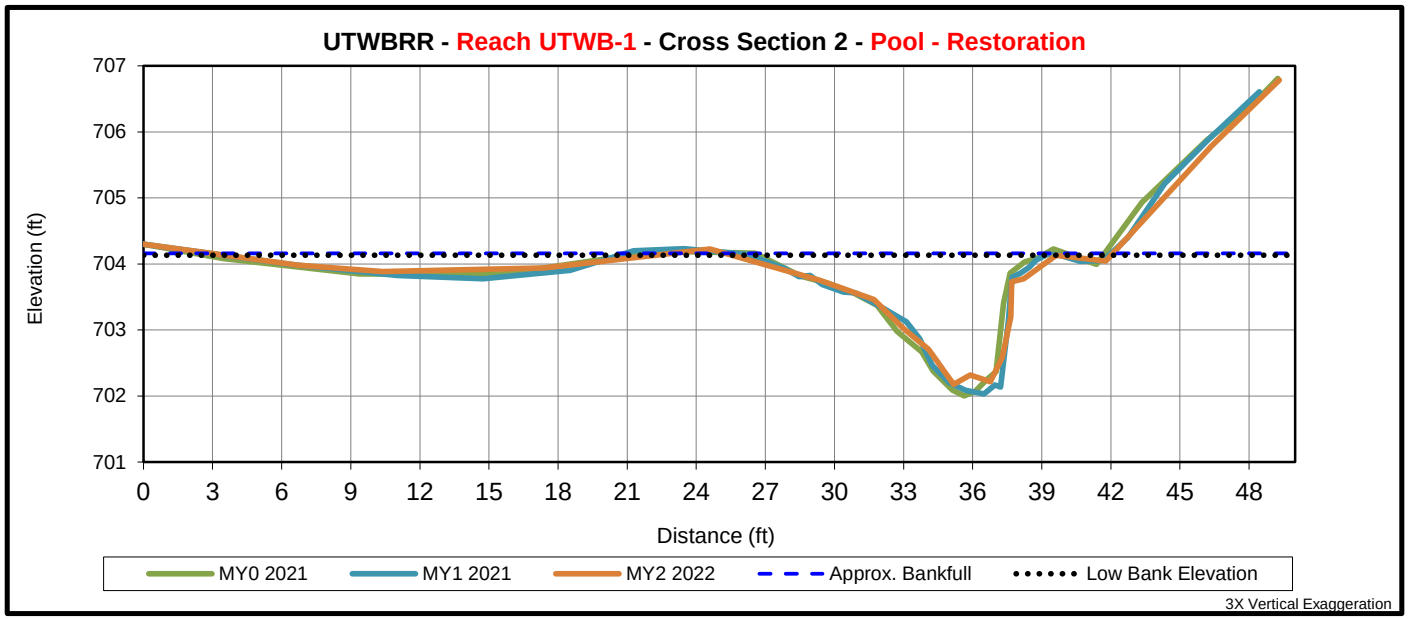


	Cross Section 1 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	704.56	704.6	704.6				
Bankfull Width (ft)[1]	9.8	9.9	10.4				
Floodprone Width (ft)[1]	>49.2	>49.1	>49.2				
Bankfull Max Depth (ft)[2]	0.9	0.9	0.8				
Low Bank Elevation (ft)	704.56	704.6	704.5				
Bankfull Cross Sectional Area (ft^2)[2]	5.7	5.5	4.3				
Bankfull Entrenchment Ratio[1]	>5	>5	>4.7				
Bankfull Bank Height Ratio[1]	1.0	1.0	0.9				

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

Upstream

Downstream

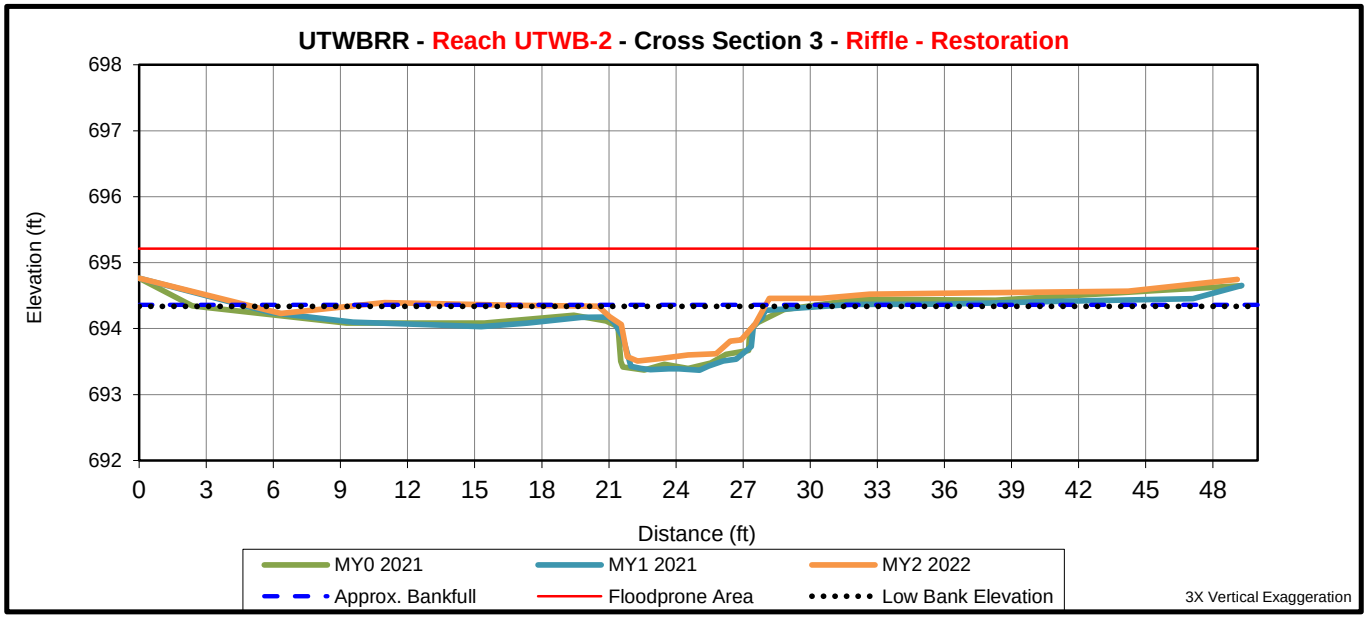


	Cross Section 2 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	704.16	704.1	704.2				
Bankfull Width (ft)[1]	NA	NA	NA				
Floodprone Width (ft)[1]	NA	NA	NA				
Bankfull Max Depth (ft)[2]	2.2	2.1	2.0				
Low Bank Elevation (ft)	704.16	704.1	704.1				
Bankfull Cross Sectional Area (ft^2)[2]	11.5	11.5	11.1				
Bankfull Entrenchment Ratio[1]	NA	NA	NA				
Bankfull Bank Height Ratio[1]	NA	NA	NA				

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

Upstream

Downstream

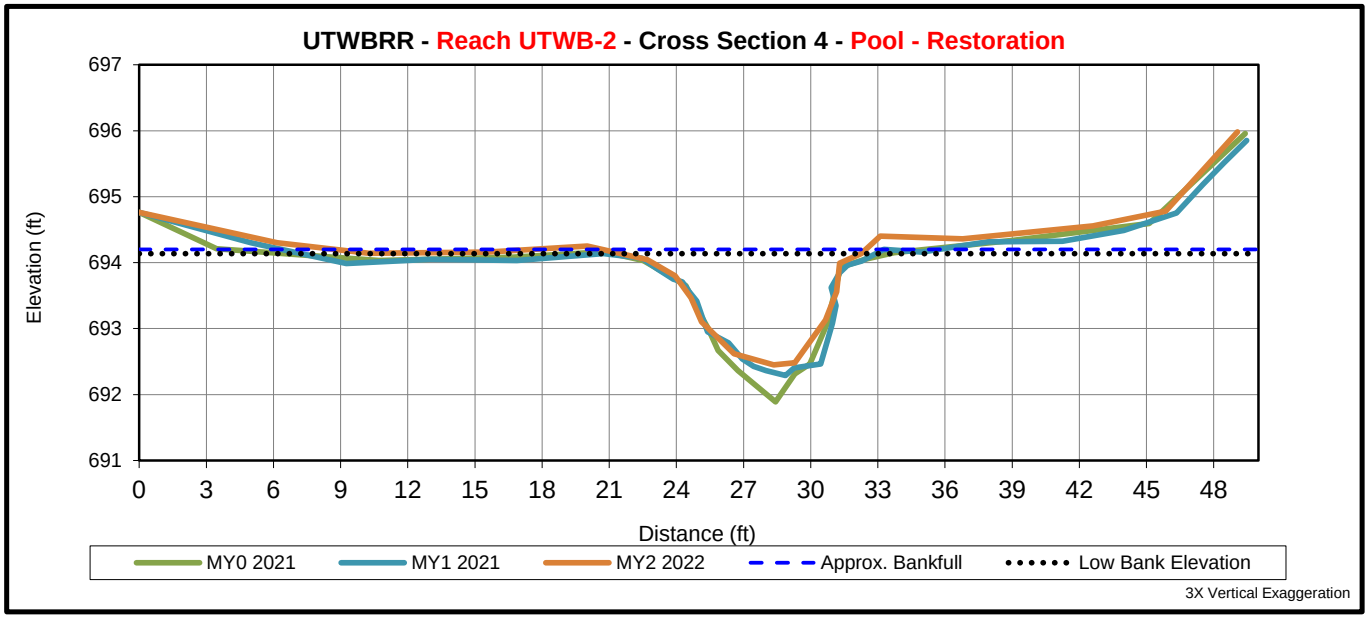


	Cross Section 3 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	694.20	694.2	694.4				
Bankfull Width (ft)[1]	8.9	6.9	7.5				
Floodprone Width (ft)[1]	>49.3	>49.3	>49.1				
Bankfull Max Depth (ft)[2]	0.8	0.8	0.8				
Low Bank Elevation (ft)	694.20	694.2	694.3				
Bankfull Cross Sectional Area (ft^2)[2]	4.5	4.2	4.3				
Bankfull Entrenchment Ratio[1]	>5.6	>7.1	>6.6				
Bankfull Bank Height Ratio[1]	1.0	1.0	1.0				

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

Upstream

Downstream

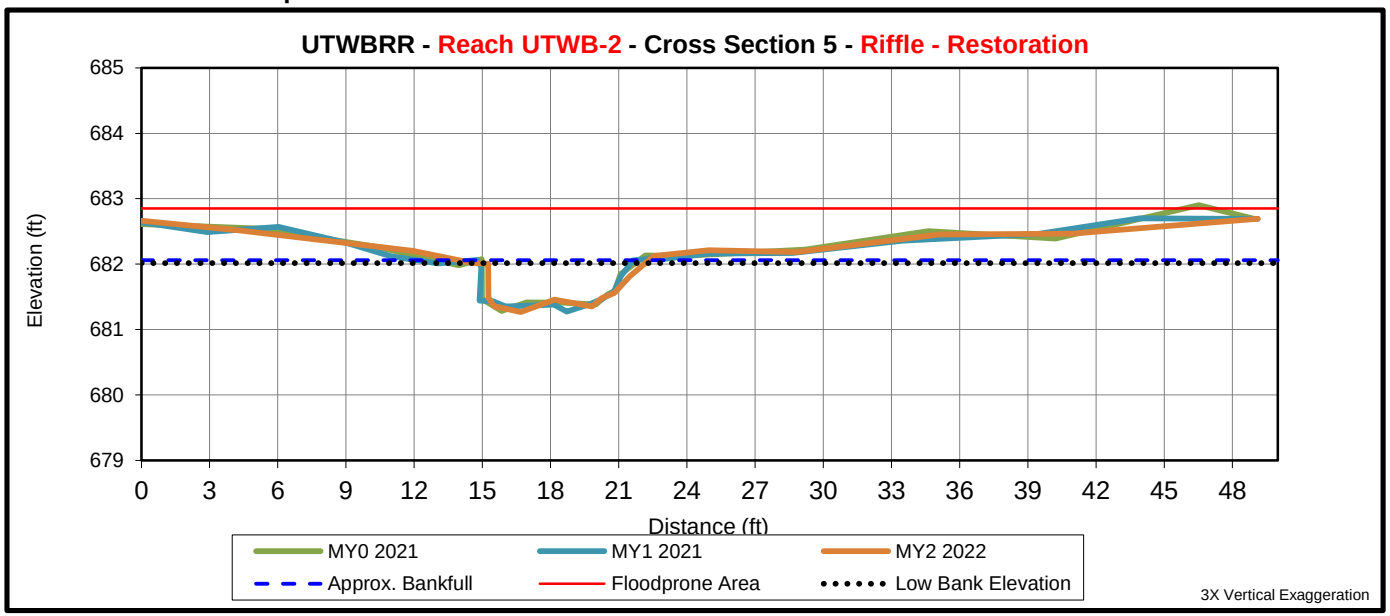


	Cross Section 4 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	694.05	694.1	694.2				
Bankfull Width (ft)[1]	NA	NA	NA				
Floodprone Width (ft)[1]	NA	NA	NA				
Bankfull Max Depth (ft)[2]	2.2	1.8	1.7				
Low Bank Elevation (ft)	694.05	694.1	694.1				
Bankfull Cross Sectional Area (ft^2)[2]	10.4	10.2	9.7				
Bankfull Entrenchment Ratio[1]	NA	NA	NA				
Bankfull Bank Height Ratio[1]	NA	NA	NA				

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

Upstream

Downstream

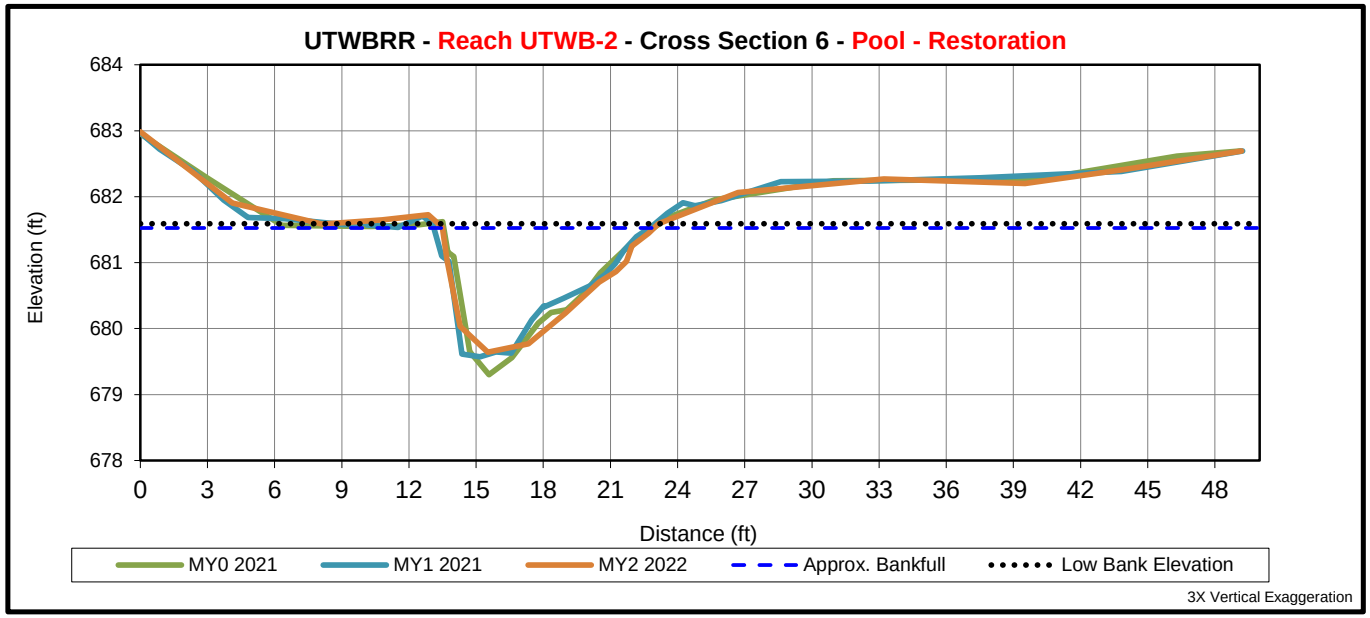


	Cross Section 5 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	682.08	682.1	682.1				
Bankfull Width (ft)[1]	7.0	7.0	7.7				
Floodprone Width (ft)[1]	>48.2	>49.1	>49.1				
Bankfull Max Depth (ft)[2]	0.8	0.8	0.7				
Low Bank Elevation (ft)	682.08	682.1	682.0				
Bankfull Cross Sectional Area (ft^2)[2]	4.1	4.1	3.8				
Bankfull Entrenchment Ratio[1]	>6.9	>7	>6.3				
Bankfull Bank Height Ratio[1]	1.0	1.0	0.9				

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

Upstream

Downstream

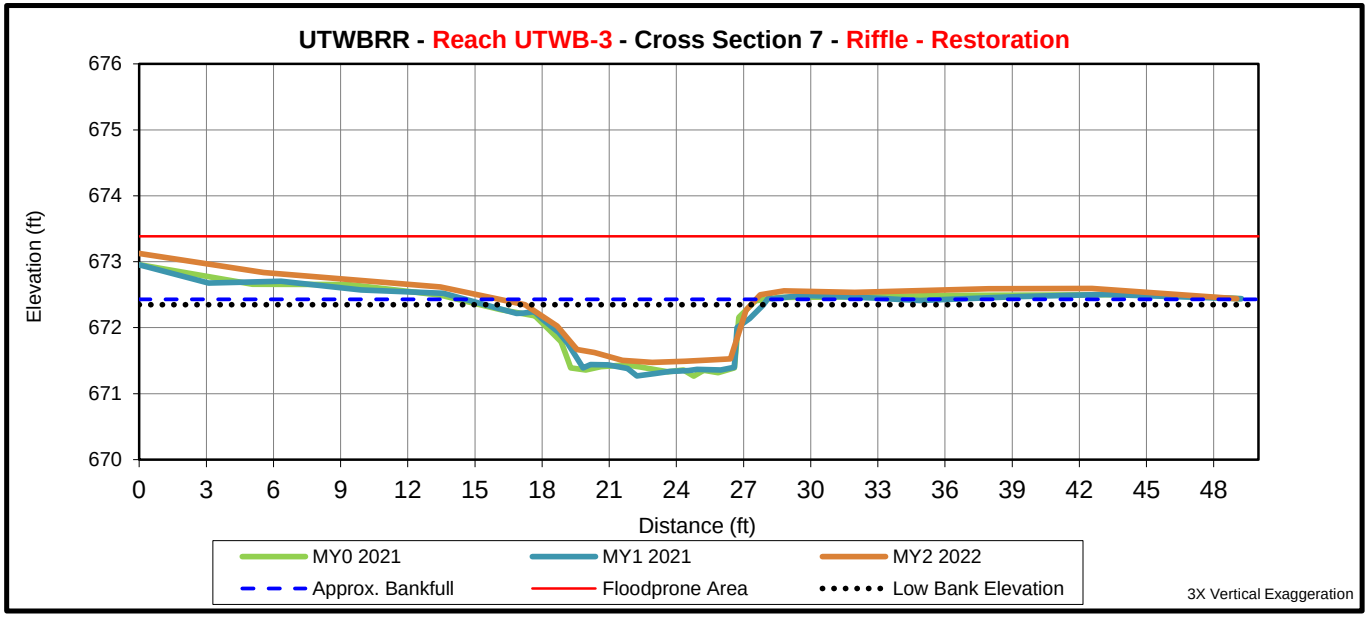


	Cross Section 6 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	681.58	681.6	681.5				
Bankfull Width (ft)[1]	NA	NA	NA				
Floodprone Width (ft)[1]	NA	NA	NA				
Bankfull Max Depth (ft)[2]	2.3	2.1	1.9				
Low Bank Elevation (ft)	681.58	681.7	681.6				
Bankfull Cross Sectional Area (ft^2)[2]	11.2	12.5	11.8				
Bankfull Entrenchment Ratio[1]	NA	NA	NA				
Bankfull Bank Height Ratio[1]	NA	NA	NA				

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

Upstream

Downstream

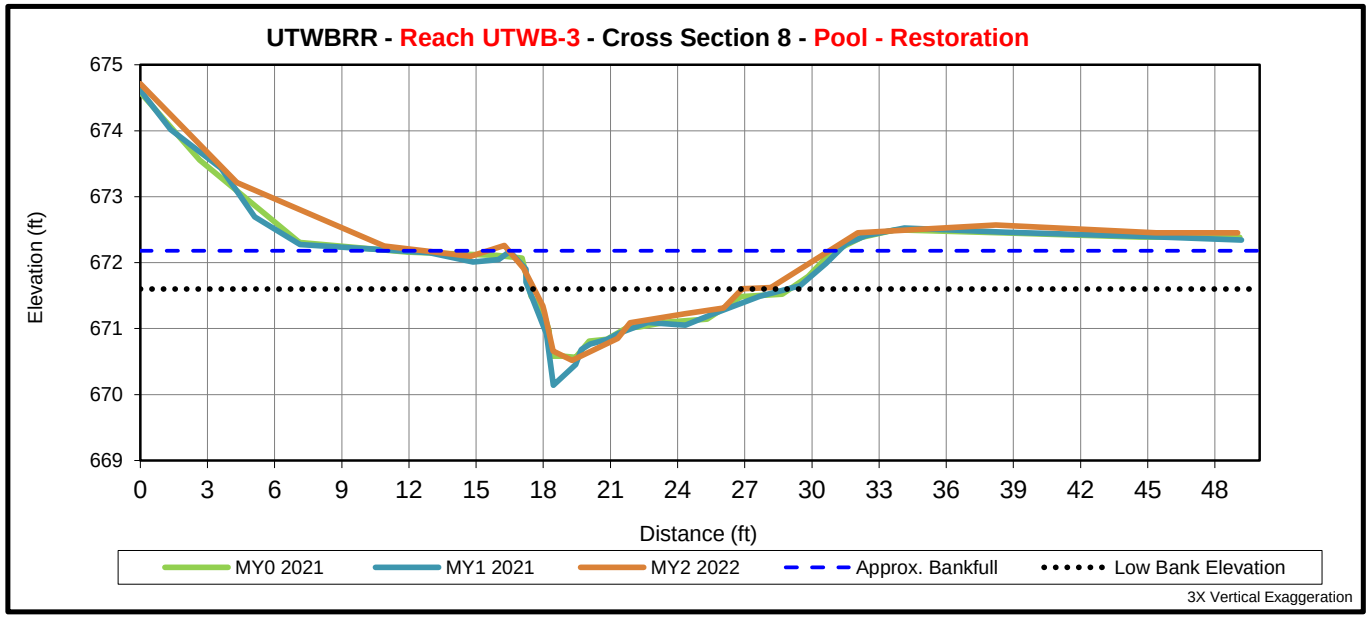


	Cross Section 7 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	672.28	672.3	672.4				
Bankfull Width (ft)[1]	11.0	10.1	10.3				
Floodprone Width (ft)[1]	>49.2	>49.2	>49				
Bankfull Max Depth (ft)[2]	1.0	1.0	0.9				
Low Bank Elevation (ft)	672.28	672.2	672.3				
Bankfull Cross Sectional Area (ft^2)[2]	7.5	6.9	6.6				
Bankfull Entrenchment Ratio[1]	>4.5	>4.9	>4.8				
Bankfull Bank Height Ratio[1]	1.0	0.9	0.9				

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

Upstream

Downstream

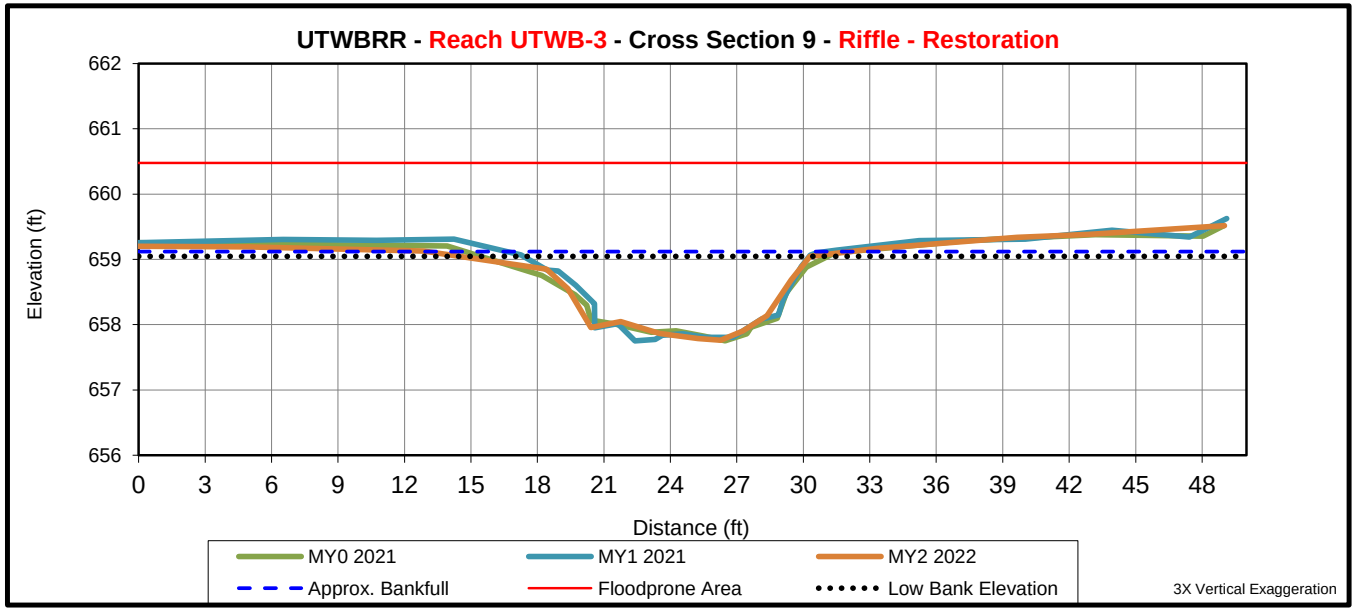


	Cross Section 8 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	672.11	672.1	672.2				
Bankfull Width (ft)[1]	NA	NA	NA				
Floodprone Width (ft)[1]	NA	NA	NA				
Bankfull Max Depth (ft)[2]	1.5	2.0	1.7				
Low Bank Elevation (ft)	672.11	672.2	672.3				
Bankfull Cross Sectional Area (ft^2)[2]	12.3	13.8	13.5				
Bankfull Entrenchment Ratio[1]	NA	NA	NA				
Bankfull Bank Height Ratio[1]	NA	NA	NA				

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

Upstream

Downstream

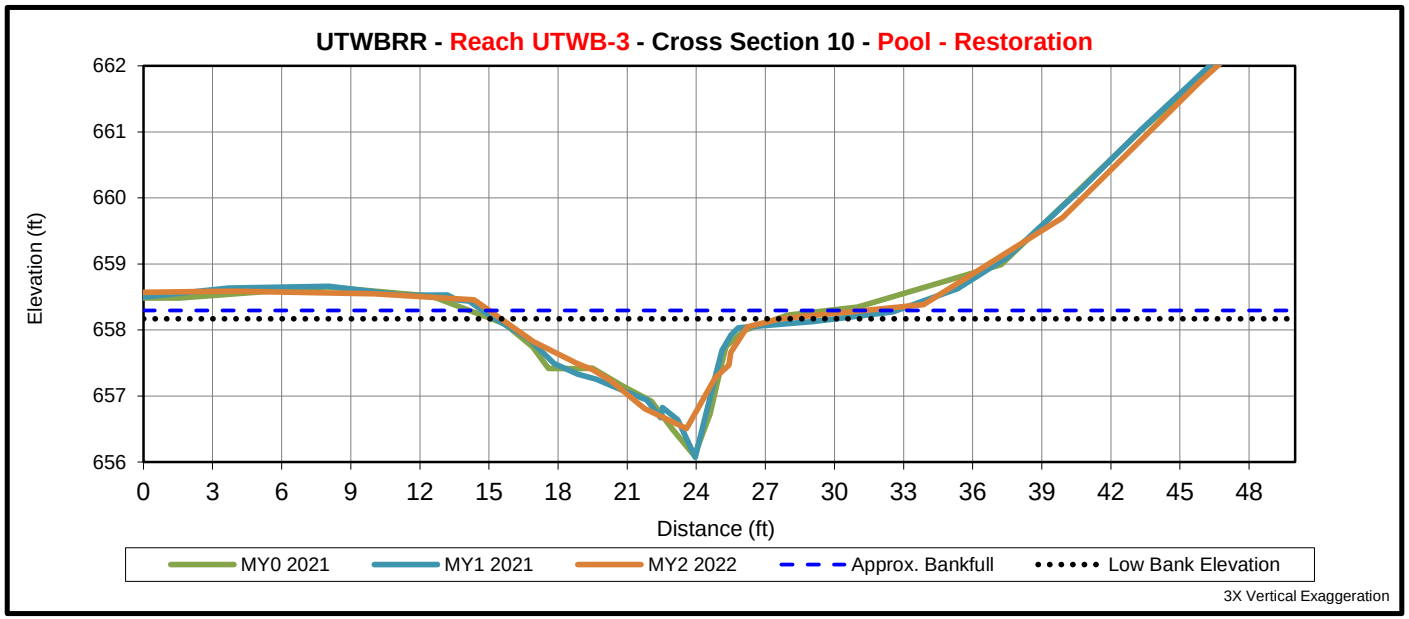


	Cross Section 9 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	659.10	659.2	659.1				
Bankfull Width (ft)[1]	16.5	15.4	17.3				
Floodprone Width (ft)[1]	>49	>49.1	>49				
Bankfull Max Depth (ft)[2]	1.3	1.4	1.3				
Low Bank Elevation (ft)	659.10	659.1	659.0				
Bankfull Cross Sectional Area (ft^2)[2]	12.7	12.5	11.5				
Bankfull Entrenchment Ratio[1]	>3.0	>3.2	>2.8				
Bankfull Bank Height Ratio[1]	1.0	1.0	0.9				

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

Upstream

Downstream

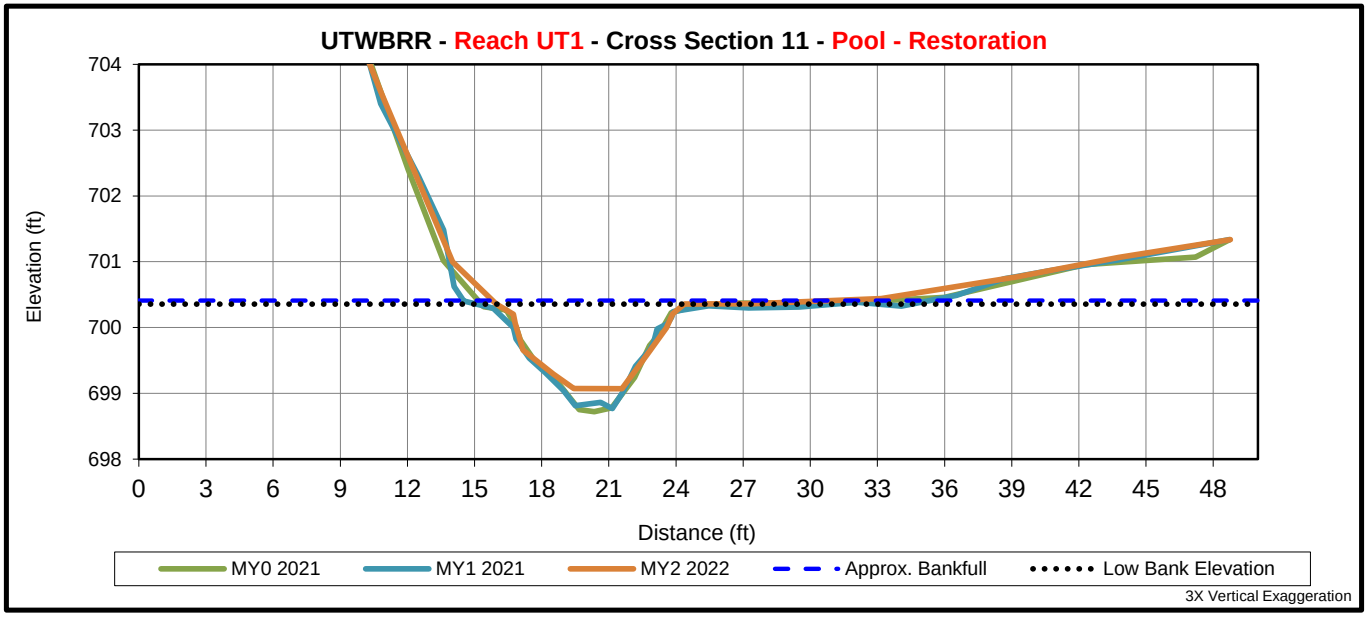


	Cross Section 10 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	658.23	658.3	658.3				
Bankfull Width (ft)[1]	NA	NA	NA				
Floodprone Width (ft)[1]	NA	NA	NA				
Bankfull Max Depth (ft)[2]	2.1	2.0	1.7				
Low Bank Elevation (ft)	658.23	658.0	658.2				
Bankfull Cross Sectional Area (ft^2)[2]	10.8	8.1	9.2				
Bankfull Entrenchment Ratio[1]	NA	NA	NA				
Bankfull Bank Height Ratio[1]	NA	NA	NA				

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

Upstream

Downstream

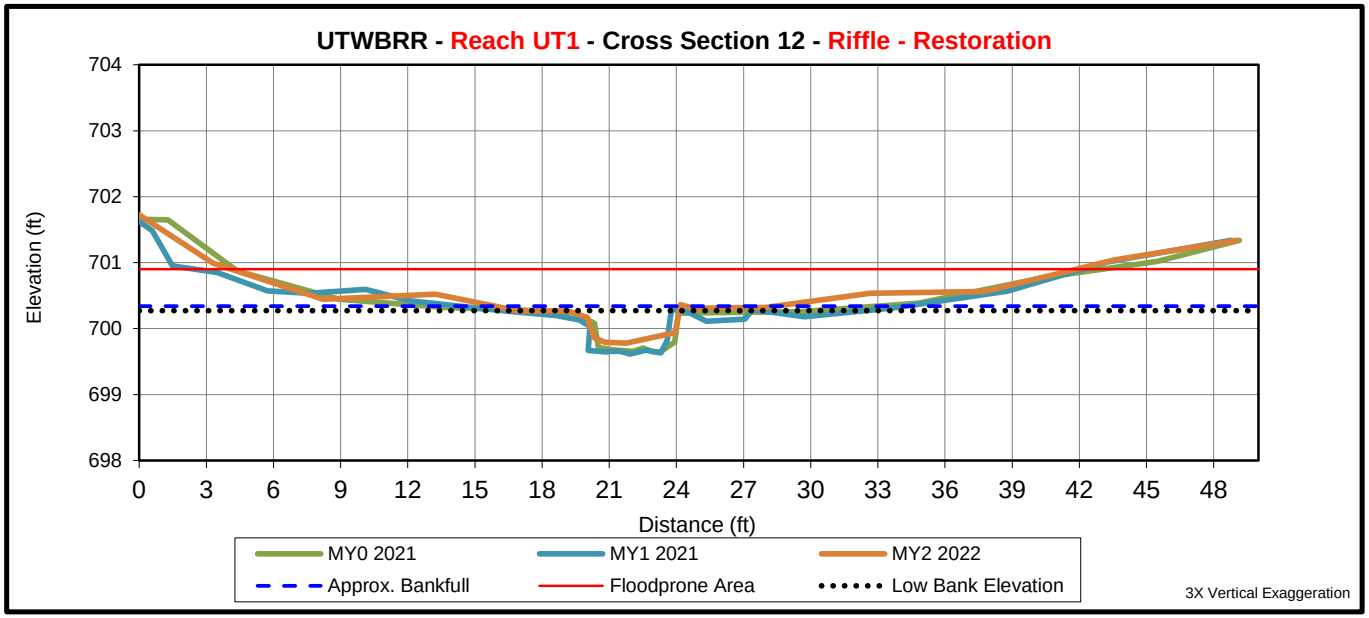


	Cross Section 11 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	700.32	700.3	700.4				
Bankfull Width (ft)[1]	NA	NA	NA				
Floodprone Width (ft)[1]	NA	NA	NA				
Bankfull Max Depth (ft)[2]	1.6	1.5	1.3				
Low Bank Elevation (ft)	700.32	700.2	700.4				
Bankfull Cross Sectional Area (ft^2)[2]	7.5	6.9	7.0				
Bankfull Entrenchment Ratio[1]	NA	NA	NA				
Bankfull Bank Height Ratio[1]	NA	NA	NA				

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

Upstream

Downstream

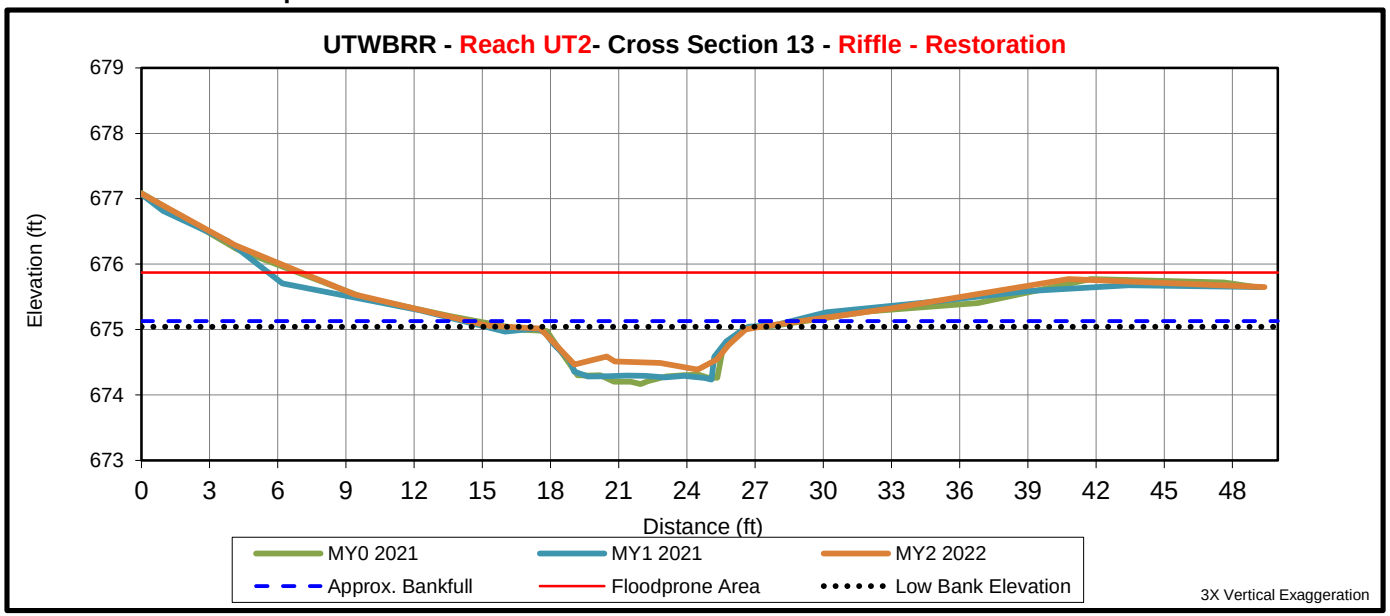


	Cross Section 12 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	700.24	700.2	700.3				
Bankfull Width (ft)[1]	5.3	5.1	5.4				
Floodprone Width (ft)[1]	36.7	37.7	37.7				
Bankfull Max Depth (ft)[2]	0.6	0.6	0.5				
Low Bank Elevation (ft)	700.24	700.2	700.3				
Bankfull Cross Sectional Area (ft^2)[2]	2.1	2.0	1.7				
Bankfull Entrenchment Ratio[1]	7.0	7.4	7.0				
Bankfull Bank Height Ratio[1]	1.0	1.0	0.9				

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

Upstream

Downstream

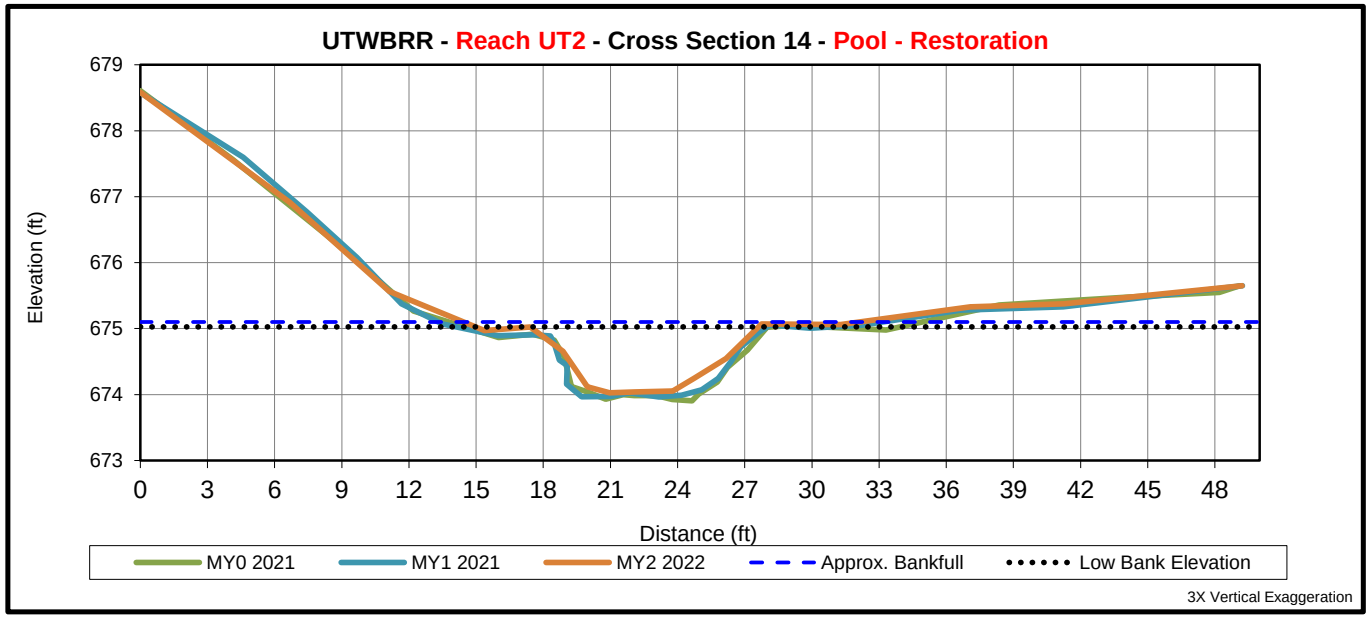


	Cross Section 13 (Riffle)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	675.00	675.0	675.1				
Bankfull Width (ft)[1]	9.8	9.0	12.0				
Floodprone Width (ft)[1]	>41.8	>43.5	>42.4				
Bankfull Max Depth (ft)[2]	0.8	0.8	0.7				
Low Bank Elevation (ft)	675.00	675.0	675.0				
Bankfull Cross Sectional Area (ft^2)[2]	5.3	5.0	4.3				
Bankfull Entrenchment Ratio[1]	>4.3	>4.8	>3.5				
Bankfull Bank Height Ratio[1]	1.0	1.0	0.9				

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

Upstream

Downstream



	Cross Section 14 (Pool)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-XSA[1]	674.91	674.9	675.1				
Bankfull Width (ft)[1]	NA	NA	NA				
Floodprone Width (ft)[1]	NA	NA	NA				
Bankfull Max Depth (ft)[2]	1.0	0.9	1.0				
Low Bank Elevation (ft)	674.91	674.9	675.0				
Bankfull Cross Sectional Area (ft^2)[2]	7.0	6.6	6.8				
Bankfull Entrenchment Ratio[1]	NA	NA	NA				
Bankfull Bank Height Ratio[1]	NA	NA	NA				

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

Appendix E

Hydrology Data

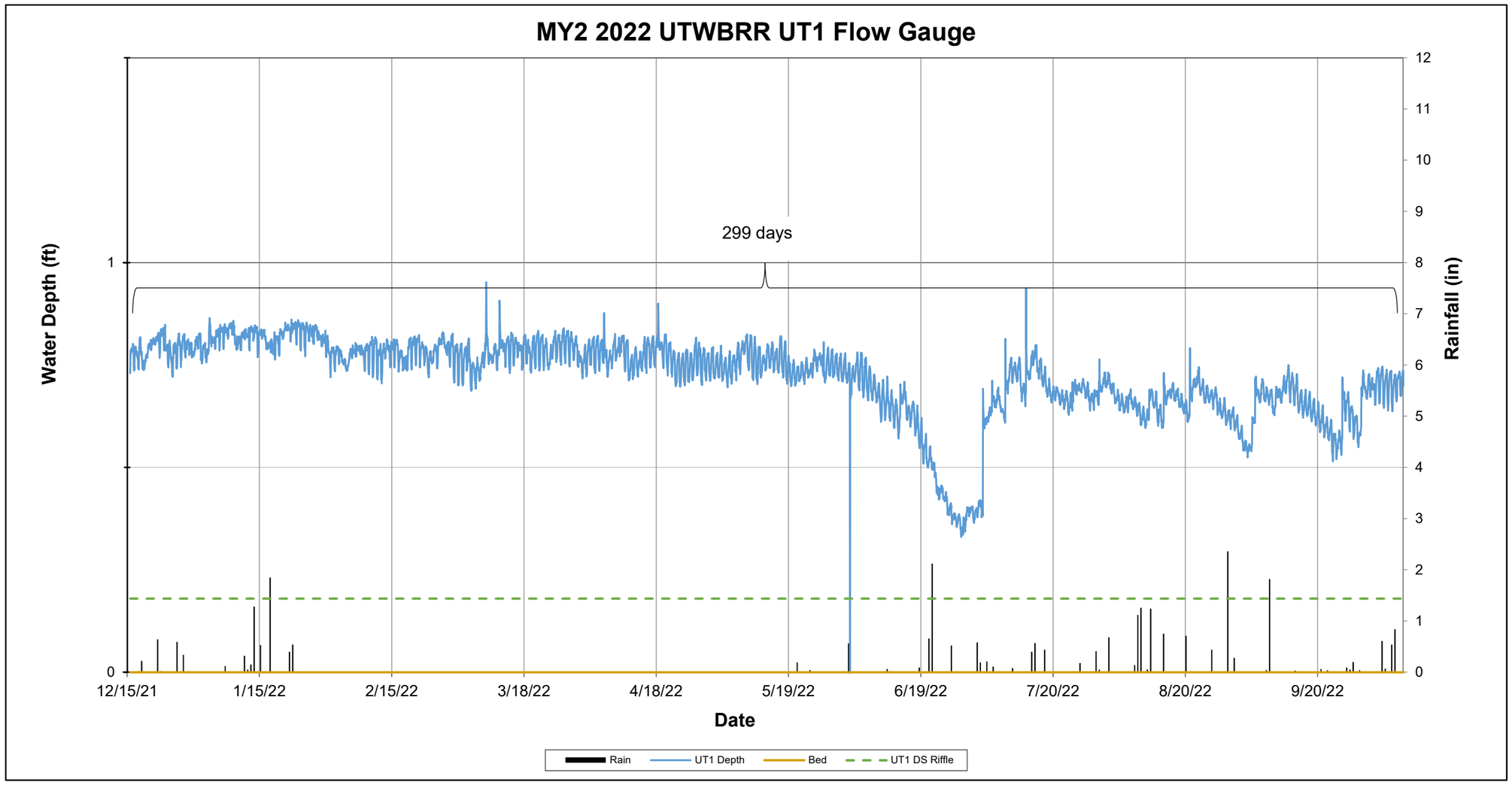
Table 12. 2022 Rainfall Summary

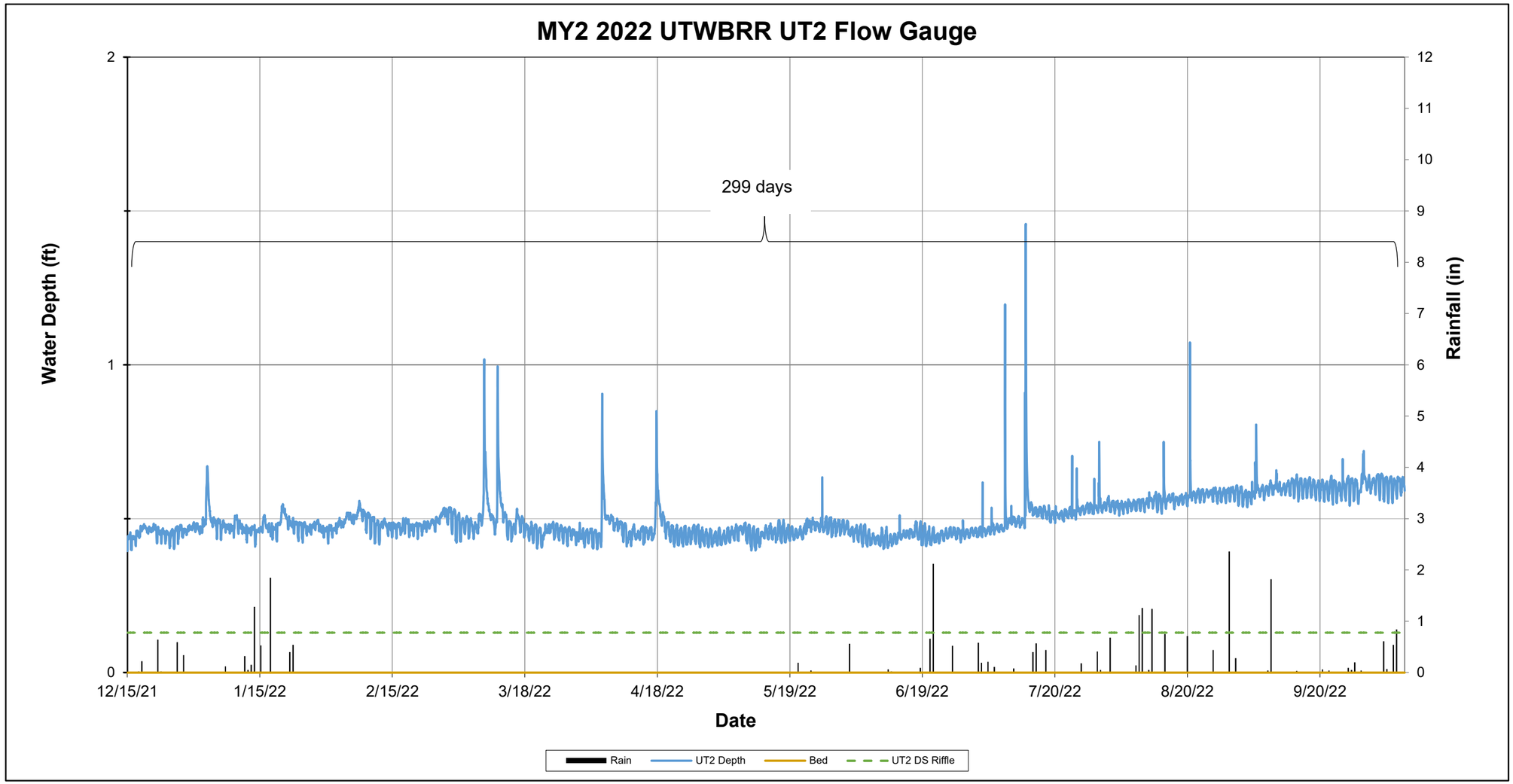
Month	Average	Normal Limits		Mt. Island Lake Station Precipitation
		30 Percent	70 Percent	
December	3.56	2.48	4.24	0.76
January	3.50	2.60	4.10	4.48
February	3.19	2.38	3.73	2.75
March	3.97	2.81	4.70	5.72
April	3.77	2.35	4.55	4.54
May	3.31	1.94	4.02	2.56
June	3.98	2.42	4.82	1.96
July	3.77	2.58	4.50	5.96
August	4.31	2.55	5.23	5.93
September	3.68	2.09	4.47	3.00
October	3.16	1.79	3.81	2.86
November	3.31	1.90	4.03	2.45
Total	39.95	25.41	47.96	42.97
Above Normal Limits	Below Normal Limits			

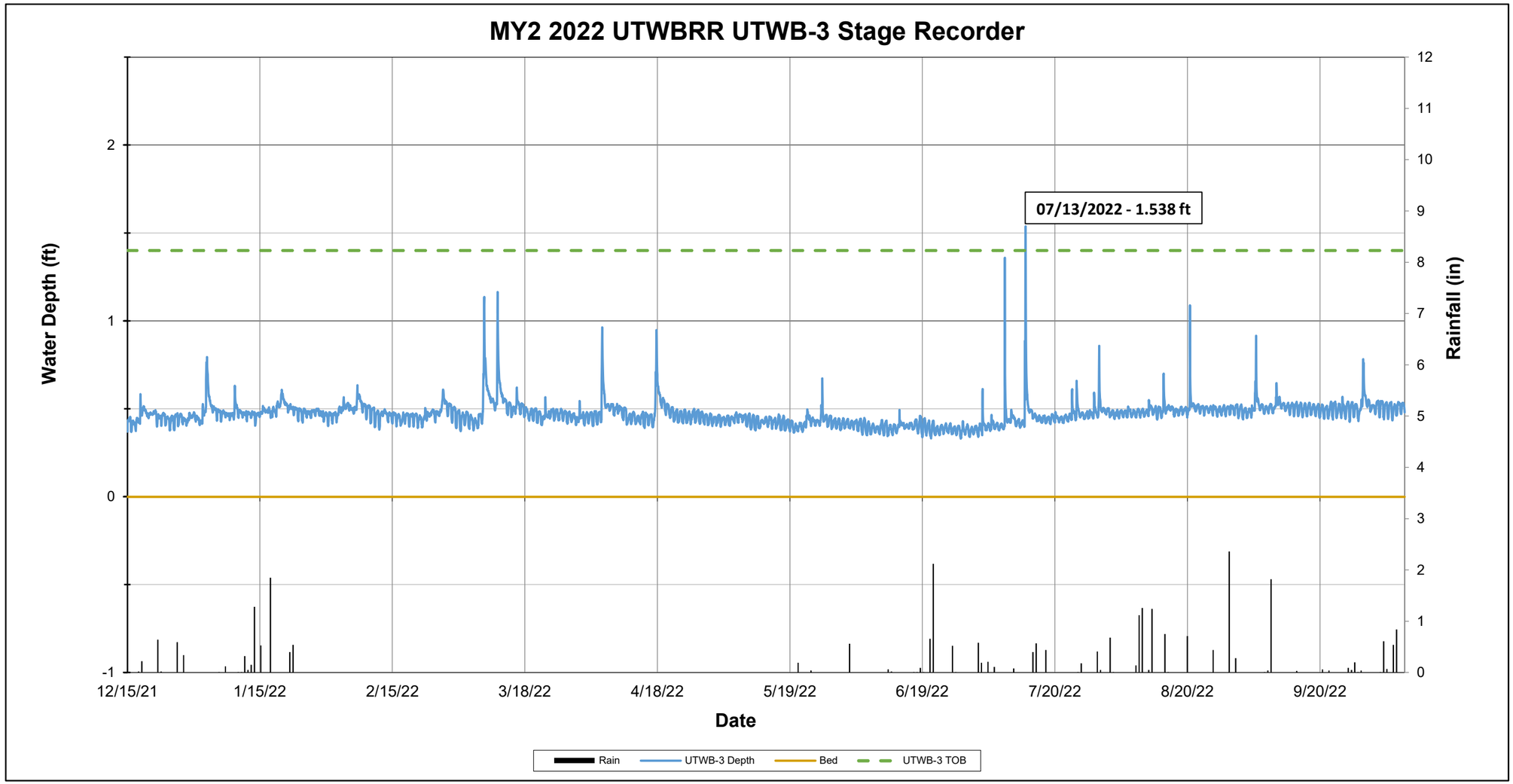
Note: The onsite rain gauge malfunctioned in MY1. The Mt. Island Lake Station is approximately 10 miles from the site

Table 13. Documentation of Geomorphically Significant Flow Events

Year	Number of Bankfull Events	Maximum Bankfull Height (ft)	Date of Maximum Bankfull Event	
Stage Recorder UTWB-3				
MY1 2021	0	N/A	N/A	
MY2 2022	1	0.14	7/13/2022	
Year	**Number of Flow Events**	**Maximum Consecutive Flow Days**	**Maximum Cummlative Flow Days**	**Maximum Consecutive Flow Date Range**
Flow Gauge UT1				
MY1 2021	1	243	243	4/16/2021 - 12/15/2021
MY2 2022	1	299	299	12/152021 - 10/10/2022
Flow Gauge UT2				
MY1 2021	1	243	243	4/16/2021 - 12/15/2021
MY2 2022	1	299	299	12/152021 - 10/10/2022


MY2 2022 UTWBRR UT1 Flow Gauge
Water Depth (ft)
Rainfall (in)
299 days
1
0
12
11
10
9
8
7
6
5
4
3
2
1
0
12/15/21
1/15/22
2/15/22
3/18/22
4/18/22
5/19/22
6/19/22
7/20/22
8/20/22
9/20/22
Date
Rain
UT1 Depth
Bed
UT1 DS Riffle


MY2 2022 UTWBRR UT2 Flow Gauge
Water Depth (ft)
Rainfall (in)
299 days
2
1
0
12
11
10
9
8
7
6
5
4
3
2
1
0
12/15/21
1/15/22
2/15/22
3/18/22
4/18/22
5/19/22
6/19/22
7/20/22
8/20/22
9/20/22
Date
Rain
UT2 Depth
Bed
UT2 DS Riffle


MY2 2022 UTWBRR UTWB-3 Stage Recorder
Water Depth (ft)
Rainfall (in)
07/13/2022 - 1.538 ft
2
1
0
-1
12
11
10
9
8
7
6
5
4
3
2
1
0
12/15/21
1/15/22
2/15/22
3/18/22
4/18/22
5/19/22
6/19/22
7/20/22
8/20/22
9/20/22
Date
Rain
UTWB-3 Depth
Bed
UTWB-3 TOB