MONITORING YEAR 1 ANNUAL REPORT

Final

January 2022

BUG HEADWATERS MITIGATION SITE

Wilkes County, NC
Yadkin River Basin
HUC 03040101

DMS Project No. 100084
DMS RFP No. 16-007406
NCDEQ Contract No. 7617
USACE Action ID No. 2018-01788
DWR Project No. 2018-1273

Data Collection Dates: October 2021

PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

January 24, 2022

Matthew Reid
Western Project Manager
NCDENR- Division of Mitigation Services
5 Ravenscroft Dr, Suite 102
Asheville, NC 28801

Subject: MY1 Report Review
Bug Headwaters Mitigation Site, Wilkes County
Yadkin River Basin: 03040101
DMS Project ID No. 100084
DEQ Contract #7617

Dear Mr. Reid:

On January 3, 2022, Wildlands Engineering received comments from the North Carolina Division of Mitigation Services (DMS) regarding the Draft As-Built Baseline Report dated December 8, 2021. The following letter documents DMS feedback and Wildlands' corresponding responses and revisions to the MY1 Report.

2.1 Vegetation Assessment: Please include a discussion regarding the request to change 3 fixed plots to 3 random plots in this section. Please include the email correspondence with the IRT in Appendix F.

Response: A discussion has been included.

2.3 Stream Assessment: Please add the following statement or something similar following the pebble count data discussion: The IRT reserves the right to request pebble counts data/particle distributions if deemed necessary during the monitoring period.

Response: The statement has been included.

2.7 Adaptive Management Plan: The IRT should be notified prior to any adaptive management activities occurring on the site. This includes supplemental plantings. A phone call may be sufficient, but larger efforts may require species lists, quantities/density, planting area, maps and whether selected species deviate from the approved Mitigation Plan. The IRT will determine if a formal Adaptive Management Plan is necessary.

Response: The IRT has been notified, and correspondence is located in Appendix F.

Murdannia is widespread on the site. All stream channels and wetlands are affected. DMS recommends discussing this problem with the IRT and developing an Adaptive Management Plan for this issue. This invasive species is aggressive and difficult to control and will likely be an ongoing issue throughout monitoring.

Response: The IRT has been notified, and correspondence is located in Appendix F.

Tables 4 and 5: Please add the dates that assessment work occurred on to these tables. The IRT has requested this information be included on these tables at the 2021 Credit Release Meeting.

Response: Dates are now included in Tables 4 and 5.

Please include figures displaying the crest gauge data to illustrate the occurrence of bankfull events.

Response: Crest gauge data in included in Appendix D.

Thank you for your review and providing comments on this submittal. If you have any further questions, please contact me at (919) 851-9986, or by email (jlorch@wildlandseng.com).

Sincerely,

Jason Lorch, *Monitoring Coordinator*

PREPARED BY:

WILDLANDS
ENGINEERING

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BUG HEADWATERS MITIGATION SITE

Monitoring Year 1 Annual Report

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Section 1: PROJECT OVERVIEW

The Bug Headwaters Mitigation Site (Site) is located in Wilkes County, approximately 9.5 miles northwest of the Town of Elkin. The Site is on two adjacent row crop and livestock farms in the foothills of the Blue Ridge Mountains. It is near the border of the piedmont and mountain physiographic region but is technically in the piedmont. Table 3 presents information related to the project attributes.

1.1 Project Quantities and Credits

The Site is located on two parcels under 2 different landowners and a conservation easement was recorded on 22.50 acres. Mitigation work within the Site included restoration, enhancement I, and enhancement II of perennial and intermittent stream channels. Table 1 below shows stream credits by reach and the total amount of stream credits expected at closeout.

Table 1: Project Quantities and Credits

PROJECT MITIGATION QUANTITIES							
Project Segment	**Mitigation Plan Footage**	**As-Built Footage**	**Mitigation Category**	**Restoration Level**	**Mitigation Ratio (X:1)**	**Credits**	**Comments**
Stream							
Big Bugaboo Creek R1	868	869	Cool	R	1.0	868.000	Full Channel Restoration, Fencing Out Livestock
Big Bugaboo Creek R2	981	981	Cool	EI	1.5	654.000	Constructed Riffles, Fencing Out Livestock, Internal Crossing
Big Bugaboo Creek R3	1,764	1,756	Cool	R	1.0	1,764.000	Pond Removal, Full Channel Restoration, Fencing Out Livestock, Internal Crossing
Big Bugaboo Creek R4	394	390	Cool	EI	1.5	262.666	Graded Bankfull Bench, Fencing Out Livestock
UT1	389	390	Cool	R	1.0	389.000	Full Channel Restoration, Fencing Out Livestock
UT2 R1	505	505	Cool	EII	2.5	202.000	Fencing Out Livestock, Minor Bank Grading
UT2 R2	80	78	Cool	EI	1.5	53.333	Raised Riffle Bed, Fencing Out Livestock, Utility Crossing
UT2 R3	436	440	Cool	R	1.0	436.000	Full Channel Restoration, Fencing Out Livestock
UT2 R4	314	301	Cool	EI	1.5	209.333	Bank Grading, Fencing Out Livestock
UT2 R5	741	729	Cool	R	1.0	741.000	Full Channel Restoration, Fencing Out Livestock, Internal Crossing
UT2A R1	135	134	Cool	EII	2.5	54.000	Fencing Out Livestock, Utility Crossing
UT2A R2	445	445	Cool	R	1.0	445.000	Full Channel Restoration, Fencing Out Livestock

UT2B	168	167	Cool	EII	2.5	67.200	Bank Stabilization, Fencing Out Livestock
UT3	1,412	1,384	Cool	R	1.0	1,412.000	Pond Removal, Full Channel Restoration, Fencing Out Livestock
UT4	128	131	Cool	EII	4.0	32.000	Fencing Out Livestock
					Total:	**7,589.533**	

Restoration Level	**Stream**		
	Warm	**Cool**	**Cold**
Restoration		6,055.000	
Enhancement I		1,179.333	
Enhancement II		355.200	
Preservation			
Totals		7,589.533	
Total Stream Credit	7,589.533		

1.2 Project Goals and Objectives

The project is intended to provide numerous ecological benefits. Table 2 below describes expected outcomes to water quality and ecological processes and provides project goals and objectives.

Table 2: Goals, Performance Criteria, and Functional Improvements

Goal	Objective/ Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Improve the stability of stream channels.	Construct stream channels that will maintain stable cross-sections, patterns, and profiles over time.	Reduce erosion and sediment inputs; maintain appropriate bed forms and sediment size distribution.	ER stays over 2.2 and BHR below 1.2 with visual assessments showing progression towards stability.	Cross-section monitoring and visual inspections.	Minor deviations from design due to in-stream vegetation. Will be treated in MY2.
Improve instream habitat.	Install habitat features such as cover logs, log sills, and bush toes into restored/enhanced streams. Add woody materials to channel beds. Construct pools of varying depth. Fence out livestock.	Support biological communities and processes. Provide aquatic habitats for diverse populations of aquatic organisms.	There is no required performance standard for this metric.	N/A	N/A

Goal	Objective/ Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Reconnect channels with floodplains and riparian wetlands.	Reconstruct stream channels with appropriate bankfull dimensions and depth relative to existing floodplain.	Reduce shear stress on channel; hydrate adjacent wetland areas; filter pollutants out of overbank flows; provide surface storage of water on floodplain; increase groundwater recharge while reducing outflow of stormwater; support water quality and habitat goals.	Four bankfull events in separate years within monitoring period. 30 consecutive days of flow for intermittent channels.	Crest gauges and/or pressure transducers recording flow elevations.	Bankfull events recorded for Big Bugaboo Reach 3 and Reach 4, UT2 Reach 5, and UT3 in MY1. UT1, UT2 Reach 1, UT2A Reach 2, and UT2B exceeded 30 days of consecutive flow during MY1.
Improve water quality.	Stabilize stream banks. Plant riparian buffers with native trees. Construct BMPs to treat pasture runoff. Fence out livestock.	Reduce sediment and nutrient inputs from stream banks; reduce sediment, nutrient, and bacteria inputs from pasture runoff; keep livestock out of streams, further reducing pollutants in project streams.	There is no required performance standard for this metric.	N/A	N/A
Restore / improve riparian buffers.	Plant native tree species in riparian zones that are currently insufficient.	Provide a canopy to shade streams and reduce thermal loadings; stabilize stream banks and floodplain; support water quality and habitat goals.	Survival rate of 320 stems per acre at MY3, 260 planted stems per acre at MY5, and 210 stems per acre at MY7. Height requirement is 7 feet at MY5 and 10 feet at MY7.	One hundred square meter vegetation plots are placed on 2% of the planted area of the Site and monitored annually.	13 of the 15 vegetation plots have a planted stem density greater than 320 stems per acre. Winter replanting will occur along 1.75 acres.
Permanently protect the project Site from harmful uses.	Establish conservation easements on the Site.	Ensure that development and agricultural uses that would damage the Site or reduce the benefits of the project are prevented.	Prevent easement encroachment.	Visually inspect the perimeter of the Site to ensure no easement encroachment is occurring.	No easement encroachments.

1.3 Project Attributes

The Site includes the headwaters of Big Bugaboo Creek. All project reaches and the majority of the watershed areas are contained within two farms, the larger of which is owned by Horace Randle Wood while the smaller is owned by Gaye Swaim. Mr. Wood has owned the property and used it exclusively to graze cattle since 2012. His property was historically used for grazing cattle though tobacco was also cultivated on small sections of the property. Prior to construction, the Wood property remained mostly non-forested cattle pasture with cattle having access to all surface waters on the property other than a

pond just below the confluence of Big Bugaboo Creek and UT2 and short reaches of both of these streams just upstream of the pond. Cattle access had severely degraded a majority of the streams. The Swaim property has been in the family for over 60 years and had primarily been used for row crop agriculture. Prior to construction, it was used to cultivate corn and soybeans. There was an in-line pond on the Swaim property that received heavy sediment loads whenever the fields were tilled due to the absence of a vegetated buffer around the pond. The remaining portions of the watershed outside of the Wood and Swaim properties are mostly cleared and used for pasture and row crops, although there is a pocket of forested area on the southeastern side of the watershed and wooded riparian corridors are present on the far upstream and downstream ends of the Site. Table 3 below and Table 8 in Appendix C present additional information on pre-restoration conditions.

Table 3: Project Attributes

PROJECT INFORMATION						
Project Name	Bug Headwaters Mitigation Site		County		Wilkes County	
Project Area (acres)	22.50		Project Coordinates		36.32139 N, 80.98432 W	
PROJECT WATERSHED SUMMARY INFORMATION						
Physiographic Province	Piedmont		River Basin		Yadkin	
USGS HUC 8-digit	03040101		USGS HUC 14-digit		03040101070010	
DWR Sub-basin	03-07-01		Land Use Classification		86% agriculture, 12% forested, 2% developed	
Project Drainage Area (acres)	322		Percentage of Impervious Area		2%	
RESTORATION TRIBUTARY SUMMARY INFORMATION						
Parameters	**Big Bugaboo Creek**	**UT1**	**UT2**	**UT2A**	**UT3**	
Pre-project length (feet)	4,007	389	2,076	580	1,412	
Post-project (feet)	3,996	390	2,053	579	1,384	
Valley confinement	Confined to Unconfined	Confined	Moderately Confined	Confined	Moderately Confined	
Drainage area (acres)	322	7	65	17	96	
Perennial, Intermittent, Ephemeral	Perennial	Intermittent	Perennial	Intermittent	Perennial	
DWR Water Quality Classification	C					
Dominant Stream Classification (existing)	F4/B4	B4	F4b	A4	G4	
Dominant Stream Classification (proposed)	B4/C4	B4	C4b	B4A	C4	
Dominant Evolutionary class (Simon) if applicable	Stage III					
REGULATORY CONSIDERATIONS						
Parameters	**Applicable?**	**Resolved?**	**Supporting Documentation**			
Water of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No. 27 and DWQ 401 Water Quality Certification No. 4134.			
Water of the United States - Section 401	Yes	Yes				
Endangered Species Act	Yes	Yes	Categorical Exclusion in Mitigation Plan (Wildlands, 2020)			
Historic Preservation Act	Yes	Yes				
Coastal Zone Management Act (CZMA or CAMA)	N/A	N/A	N/A			
Essential Fisheries Habitat	N/A	N/A	N/A			

Section 2: Monitoring Year 1 Data Assessment

Annual monitoring and site visits were conducted during MY1 to assess the condition of the project. The vegetation and stream success criteria for the Site follow the approved success criteria presented in the Mitigation Plan (Wildlands, 2020). Performance criteria for vegetation, stream, and hydrologic assessment are located in Section 1.2 Table 3: Goals, Performance Criteria, and Functional Improvements. Methodology for annual monitoring is presented in the MY0 Annual Report (Wildlands, 2021).

2.1 Vegetative Assessment

In the approved Mitigation Plan (2020), only fixed vegetation plots were proposed on the site. After discussions with the IRT (Appendix F) during as-built, it was determined that random vegetation plots were required for the Site. Three vegetation plots were switched from fixed plots to random plots. The three fixed vegetation plots from MY0 that were switched to random plots were VP 3, VP 5, and VP 15. The table below are the vegetation plots with the updated name changes.

Table 4: Updated Vegetation Plot Names

Updated Name for MY1-MY7	Original Name for MY0	Updated Name for MY1-MY7	Original Name for MY0
VP 1	VP 1	VP 9	VP 11
VP 2	VP 2	VP 10	VP 12
VP 3	VP 4	VP 11	VP 13
VP 4	VP 5	VP 12	VP 14
VP 5	VP 7	*RVP 13*	*VP 4*
VP 6	VP 8	*RVP 14*	*VP 5*
VP 7	VP 9	*RVP 15*	*VP 15*
VP 8	VP 10		

The MY1 vegetative survey was completed in October 2021. Vegetation monitoring resulted in a stem density range of 40 to 607 planted stems per acre. Out of the 15 vegetation plots, thirteen are meeting the interim requirement of 320 stems per acre required at MY3. Fixed vegetation plot 12 and random vegetation plot 15, are both located along UT3 which was the bottom of a former pond. Both vegetation plots are not meeting the interim requirement with only 40 planted stems per acre surviving in each plot. Herbaceous vegetation is also abundant across the Site and includes native pollinator species indicating a healthy riparian habitat. The riparian habitat is helping to reduce nutrient runoff from the cattle fields outside the easement and stabilizing the stream banks. Refer to Appendix A for Vegetation Plot Photographs and the Vegetation Condition Assessment Table and Appendix B for Vegetation Plot Data.

2.2 Vegetation Areas of Concern

The MY1 assessment indicated only a small number of planted trees survived in the old pond bottoms along the right side of Big Bugaboo Creek Reach 3 and both sides of UT3 (Figure 1b-c). The visual assessment of the right side of Big Bugaboo Creek Reach 3 indicated some planted trees survived, but

not at the appropriate densities to meet the MY7 final requirement of 210 stems per acre. The visual assessment of UT3 indicated only black willows *(Salix nigra)* are becoming established. The major cause for the tree mortality in these areas is likely highly saturated soils. These areas in the old pond bottom are naturally low spots in the floodplain and have standing water on them for a portion of the year. These areas will be evaluated and planted in the winter of 2022 with woody stems more suited for saturated conditions. The low stem density areas are only nine percent (1.75 acres) of the entire planted acreage (19.00 acres). Even though many of the planted trees did not survive the saturated soil conditions, herbaceous vegetation, including pollinator species, is thriving. Refer to Section 2.7 for more information on the management plan for the low stem density areas.

Murdannia has grown throughout the existing wetlands (6.61 acres) on the Site (Figure 1a-c). The invasive vegetation was treated in July 2021 using a chemical treatment but follow up treatments will occur in MY2. Refer to Section 2.7 for more information on the management plan for *Murdannia*.

2.3 Stream Assessment

Morphological surveys for MY1 were conducted in October 2021. All streams within the Site are stable and functioning as designed. All 18 cross-sections at the Site show little to no change in the bankfull area and width-to-depth ratio, and bank height ratios are less than 1.2. Pebble count data is no longer required per the September 29, 2021 Technical Work Group Meeting and is not included in this report. The IRT reserves the right to request pebble count data/particle distributions if deemed necessary during the monitoring period. Refer to Appendix A for the Visual Stream Morphology Stability Assessment Table and Stream Photographs and Appendix C for Stream Geomorphology Data.

2.4 Stream Areas of Concern

Murdannia has spread from the wetlands into the stream channels on the Site (Figure 1a-c). The in-stream vegetation was also treated in July 2021 at the same time as the wetland treatments. Due to the amount of in-stream vegetation throughout the channels, some sediment deposition has occurred. Once the invasive vegetation is removed, it is expected the sediment will flush through the system. Refer to Section 2.7 for more information on the management plan for *Murdannia*.

2.5 Hydrology Assessment

Bankfull events were recorded on Big Bugaboo Reach 3 and Reach 4, UT2 Reach 5, and UT3. All channels are on track to meet the hydrologic success criteria of four bankfull events in separate years.

In addition, the presence of baseflow must be documented on intermittent reaches (UT1, UT2 Reach 1, UT2A Reach 2, and UT2B) for a minimum of 30 consecutive days during a normal precipitation year. Intermittent reaches maintained baseflow from 102 to 211 consecutive days. Refer to Appendix D for hydrologic data.

2.6 Wetland Assessment

The extent of wetlands will be reverified during MY5 to document wetland acreage was not lost due to stream restoration. No performance standard is tied to reverification.

2.7 Adaptive Management Plan

Supplemental planting will occur in the former pond bottoms along the right side of Big Bugaboo Creek Reach 3 and both sides of UT3. Due to saturated soil conditions, a mixture of bare roots and live stakes will be planted in the winter of 2022. While species selection will be dependent on nursery availability, the current plan includes black willow *(Salix nigra)*, silky willow *(Salix sericea)*, elderberry *(Sambucus spp.),* and button bush *(Cephalanthus occidentalis)* as live stakes and sycamore *(Platanus occidentalis)*,

river birch *(Betula nigra)*, box elder *(Acer negundo)*, and tag alder *(Alnus serrulata)* as bare roots. Refer to Appendix F for IRT correspondence.

An aggressive treatment will occur during MY2 to treat the widespread *Murdannia* in the wetlands and stream channels. Depending on the effectiveness, multiple chemical treatments may occur between the end of May and August. Refer to Appendix F for IRT correspondence.

2.8 Monitoring Year 1 Summary

Out of the 15 vegetation plots, 13 are exceeding the MY3 interim requirement of 320 planted stems per acre. A mixture of live stakes and bare roots will be planted on 1.75 acres during the winter of 2022. All streams within the Site are stable and meeting project goals. *Murdannia* was documented across stream channels and wetlands and will be treated aggressively throughout MY2. Bankfull events were documented on all stream reaches and greater than 30 days of consecutive flow was recorded on all intermittent reaches, fulfilling MY1 success requirements. Overall, the Site is meeting its goals of preventing excess nutrients and sediment from entering the Yadkin River tributaries and is on track to meet final success criteria.

Summary information and data related to the performance of various project and monitoring elements can be found in the tables and figures in the report appendices. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

Section 3: REFERENCES

Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E. 2003. Stream Restoration A Natural Channel Design Handbook.

Harrelson, C.C., Rawlins, C.L., Potyondy, J.P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

Rosgen, D. L. 1994. A classification of natural rivers. *Catena* 22:169-199.

Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

Rosgen, D.L. 1997. A Geomorphological Approach to Restoration of Incised Rivers. Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision. Center For Computational Hydroscience and Bioengineering, Oxford Campus, University of Mississippi, Pages 12-22.

North Carolina Division of Water Resources (DWR). 2008. Yadkin-Pee Dee River Basin Plan.

North Carolina Ecosystem Enhancement Program (EEP), 2009. Upper Yadkin River Basin Restoration Priorities.

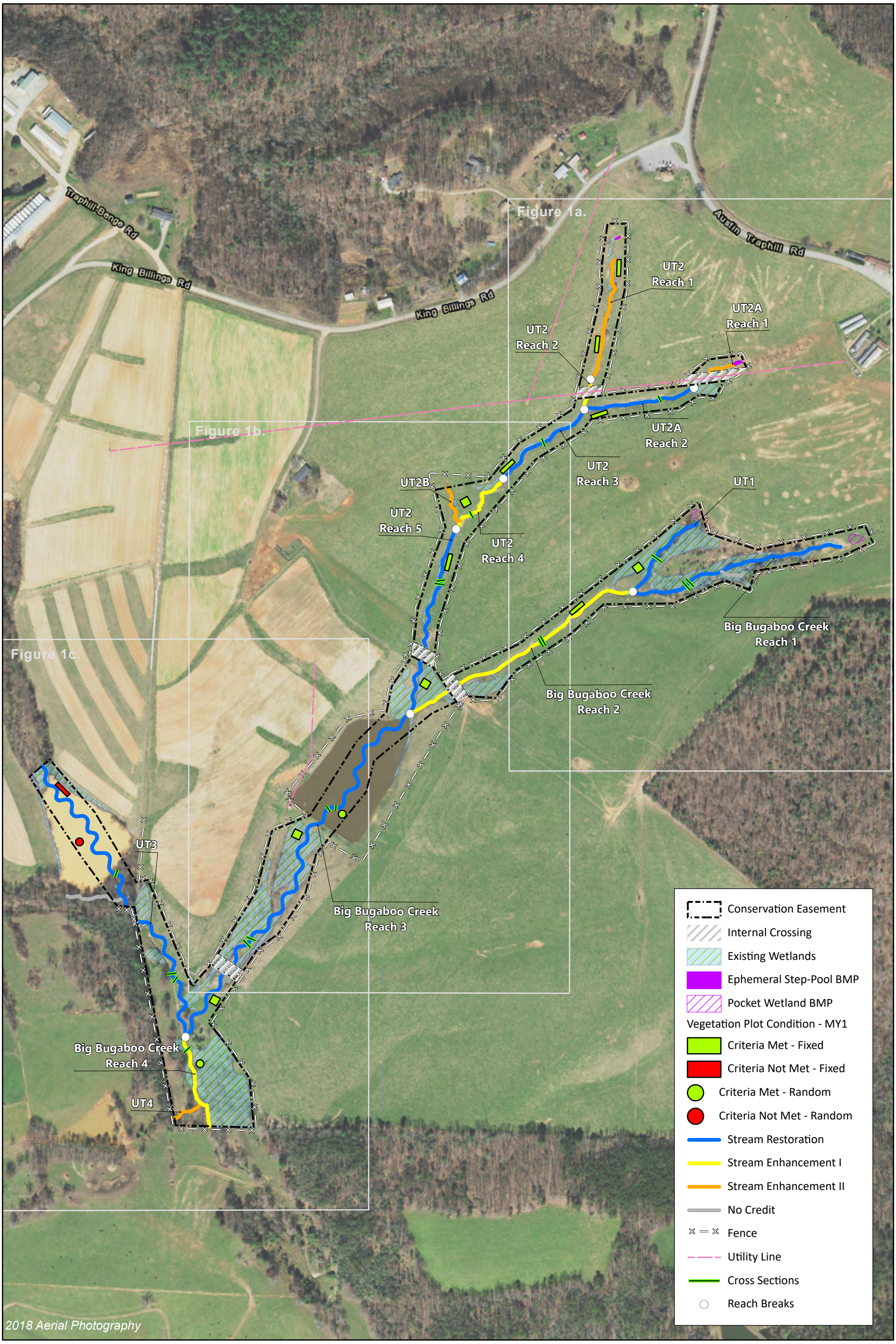
North Carolina Interagency Review Team (NCIRT). 2016. Wilmington District Stream and Wetland Compensatory Mitigation Update. Accessed at: https://saw-reg.usace.army.mil/PN/2016/Wilmington-District-Mitigation-Update.pdf

United States Army Corps of Engineers. 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

United States Geological Survey. 1998. North Carolina Geology.

Wildlands Engineering, Inc. 2020. Bug Headwaters Mitigation Project Mitigation Plan. DMS, Raleigh, NC.

Wildlands Engineering, Inc. 2021. Bug Headwaters Mitigation Project Monitoring Year 0 (MY0) Annual Report. DMS, Raleigh, NC



WILDLANDS ENGINEERING

0 350 700 Feet

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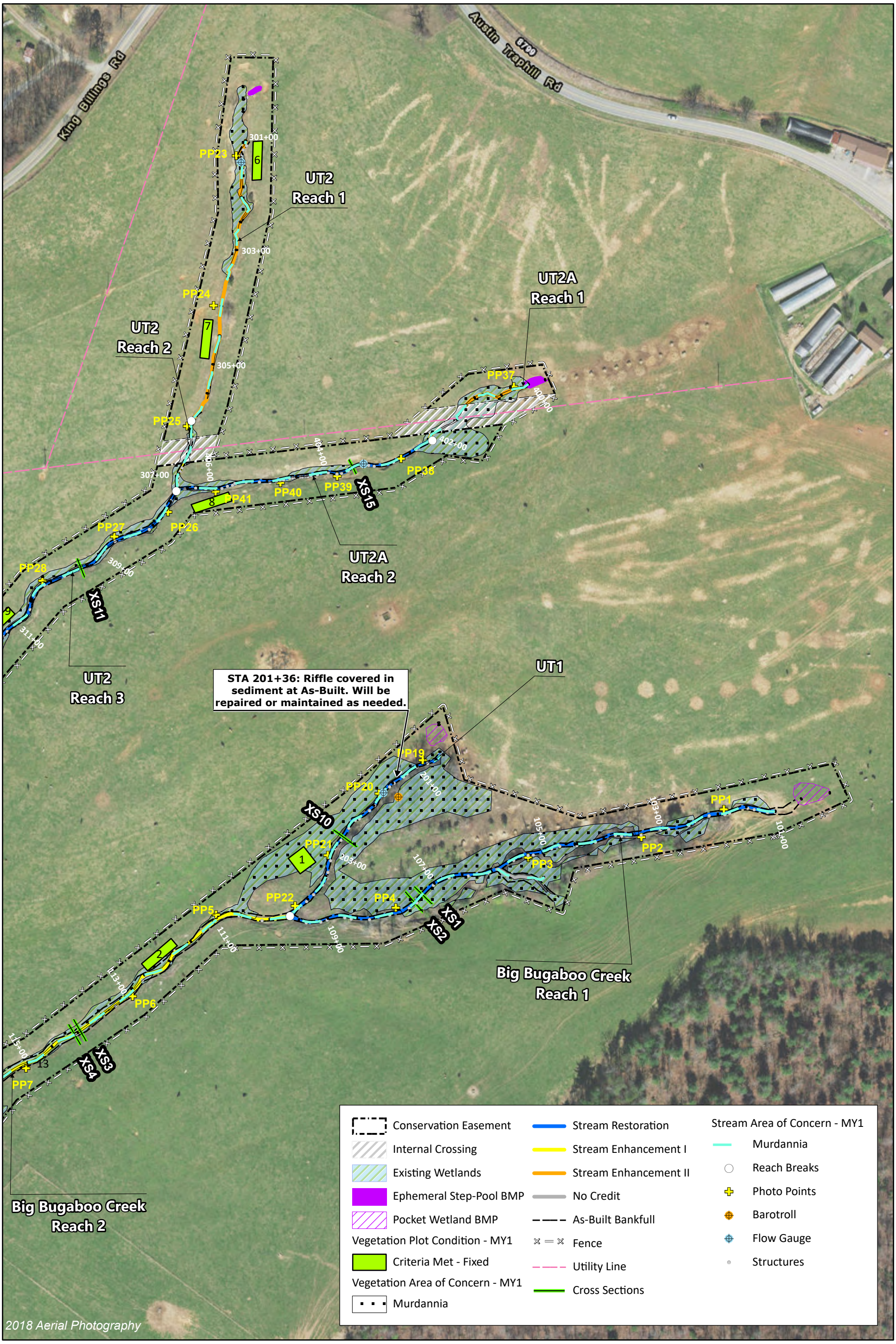
Figure 1. Current Condition Plan View Key
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Wilkes County, NC



WILDLANDS ENGINEERING

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Figure 1a. Current Condition Plan View
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Wilkes County, NC

Conservation Easement
Internal Crossing
Existing Wetlands
Vegetation Plot Condition - MY1
Criteria Met - Fixed
Criteria Met - Random
Vegetation Area of Concern - MY1
Low Stem Density
Murdannia
Stream Restoration
Stream Enhancement I
Stream Enhancement II
No Credit
As-Built Bankfull
Fence
Utility Line
Cross Sections
Stream Area of Concern - MY1
Murdannia
Reach Breaks
Photo Points
Crest Gauge
Flow Gauge
Structures

UT2B
UT2 Reach 5
UT2 Reach 4
UT2 Reach 3
Big Bugaboo Creek Reach 2
Big Bugaboo Creek Reach 3

PP27
PP28
PP29
PP30
PP31
PP32
PP33
PP34
PP35
PP36
PP42
PP7
PP8
PP9
PP10
PP11
PP12
PP13
PP14
PP15
PP16

XS11
XS12
XS13
XS14
XS3
XS4
XS5
XS6
XS7
XS8

309+00
311+00
313+00
315+00
317+00
319+00
321+00
113+00
115+00
117+00
119+00
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123+00
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2018 Aerial Photography

WILDLANDS ENGINEERING

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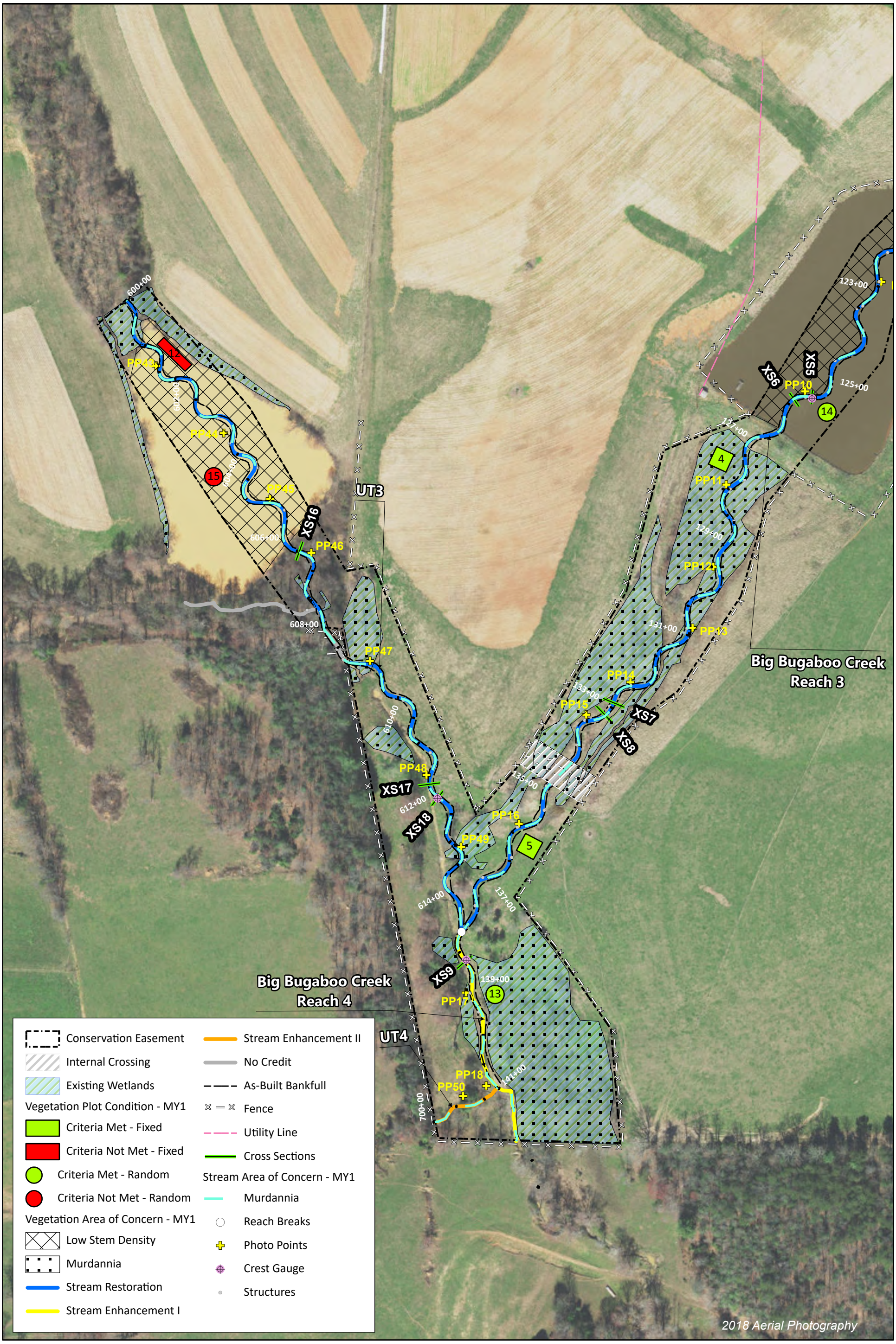
Figure 1b. Current Condition Plan View
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Wilkes County, NC



WILDLANDS ENGINEERING

0 150 300 Feet

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Figure 1c. Current Condition Plan View
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Wilkes County, NC

APPENDIX A. Visual Assessment Data

Table 4. Visual Stream Morphology Stability Assessment Table

Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Big Bugaboo Reach 1 - 4

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	3,996
					Assessed Bank Length	7,992
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.	25	25		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	58	58		100%

Visual assessment was completed October 27, 2021.

UT1

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	390
					Assessed Bank Length	780
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.	15	15		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	4	4		100%

Visual assessment was completed October 27, 2021.

Table 4. Visual Stream Morphology Stability Assessment Table

Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

UT2 Reach 1 - 5

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	2,053
					Assessed Bank Length	4,106
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.	22	22		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	30	30		100%

Visual assessment was completed October 27, 2021.

UT2A Reach 1 - 2

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	579
					Assessed Bank Length	1,160
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.	14	14		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	7	7		100%

Visual assessment was completed October 27, 2021.

Table 4. Visual Stream Morphology Stability Assessment Table

Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

UT2B

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	167
					Assessed Bank Length	336
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%.	0	0		N/A

Visual assessment was completed October 27, 2021.

UT3

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	1,384
					Assessed Bank Length	2,768
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.	0	0		N/A
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	23	23		100%

Visual assessment was completed October 27, 2021.

Table 4. Visual Stream Morphology Stability Assessment Table

Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

UT4

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-Built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	131
					Assessed Bank Length	256
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.	0	0		N/A
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	0	0		N/A

Visual assessment was completed October 27, 2021.

Table 5. Vegetation Condition Assessment Table
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Planted Acreage **19.00**

Vegetation Category	Definitions	Mapping Threshold (ac)	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.10	0	0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.10	1.75	9%
		Total	**1.75**	**9%**
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.10	0	0%
		Cumulative Total	**1.75**	**9%**

Visual assement was completed October 27, 2021.

Easement Acreage **22.50**

Vegetation Category	Definitions	Mapping Threshold (ac)	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Invasives may occur outside of planted areas and within the easement and will therefore be calculated against the total easement acreage. Include species with the potential to directly outcompete native, young, woody stems in the short-term or community structure for existing communities. Invasive species included in summation above should be identified in report summary.	0.10	6.61	29%
			9,188 lf*	100%
Easement Encroachment Areas	Encroachment may be point, line, or polygon. Encroachment to be mapped consists of any violation of restrictions specified in the conservation easement. Common encroachments are mowing, cattle access, vehicular access. Encroachment has no threshold value as will need to be addressed regardless of impact area.	none	0 Encroachments Noted / 0 ac	

*In-stream invasive vegetation (*Murdannia spp.*) was documented in all stream channels using linear feet instead of acres.

STREAM PHOTOGRAPHS

PHOTO POINT 1 Big Bugaboo R1 – upstream *(10/27/2021)*

PHOTO POINT 1 Big Bugaboo R1 – downstream *(10/27/2021)*

PHOTO POINT 2 Big Bugaboo R1 – upstream *(10/27/2021)*

PHOTO POINT 2 Big Bugaboo R1 – downstream *(10/27/2021)*

PHOTO POINT 3 Big Bugaboo R1 – upstream *(10/27/2021)*

PHOTO POINT 3 Big Bugaboo R1 – downstream *(10/27/2021)*

PHOTO POINT 4 Big Bugaboo R1 – upstream *(10/27/2021)*

PHOTO POINT 4 Big Bugaboo R1 – downstream *(10/27/2021)*

PHOTO POINT 5 Big Bugaboo R2 – upstream *(10/27/2021)*

PHOTO POINT 5 Big Bugaboo R2 – downstream *(10/27/2021)*

PHOTO POINT 6 Big Bugaboo R2 – upstream *(10/27/2021)*

PHOTO POINT 6 Big Bugaboo R2 – downstream *(10/27/2021)*

PHOTO POINT 7 Big Bugaboo R2 – upstream *(10/27/2021)*

PHOTO POINT 7 Big Bugaboo R2 – downstream *(10/27/2021)*

PHOTO POINT 8 Big Bugaboo R3 – upstream *(10/27/2021)*

PHOTO POINT 8 Big Bugaboo R3 – downstream *(10/27/2021)*

PHOTO POINT 9 Big Bugaboo R3 – upstream *(10/27/2021)*

PHOTO POINT 9 Big Bugaboo R3 – downstream *(10/27/2021)*

	
PHOTO POINT 10 Big Bugaboo R3 – upstream *(10/27/2021)*	**PHOTO POINT 10 Big Bugaboo R3 – downstream *(10/27/2021)***
	
PHOTO POINT 11 Big Bugaboo R3 – upstream *(10/27/2021)*	**PHOTO POINT 11 Big Bugaboo R3 – downstream *(10/27/2021)***
	
PHOTO POINT 12 Big Bugaboo R3 – upstream *(10/27/2021)*	**PHOTO POINT 12 Big Bugaboo R3 – downstream *(10/27/2021)***

PHOTO POINT 13 Big Bugaboo R3 – upstream *(10/27/2021)*

PHOTO POINT 13 Big Bugaboo R3 – downstream *(10/27/2021)*

PHOTO POINT 14 Big Bugaboo R3 – upstream *(10/27/2021)*

PHOTO POINT 14 Big Bugaboo R3 – downstream *(10/27/2021)*

PHOTO POINT 15 Big Bugaboo R3 – upstream *(10/27/2021)*

PHOTO POINT 15 Big Bugaboo R3 – downstream *(10/27/2021)*

PHOTO POINT 16 Big Bugaboo R3 – upstream *(10/27/2021)*

PHOTO POINT 16 Big Bugaboo R3 – downstream *(10/27/2021)*

PHOTO POINT 17 Big Bugaboo R4 – upstream *(10/27/2021)*

PHOTO POINT 17 Big Bugaboo R4 – downstream *(10/27/2021)*

PHOTO POINT 18 Big Bugaboo R4 – upstream *(10/27/2021))*

PHOTO POINT 18 Big Bugaboo R4 – downstream *(10/27/2021)*

PHOTO POINT 19 UT1 – upstream *(10/27/2021)*

PHOTO POINT 19 UT1 – downstream *(10/27/2021)*

PHOTO POINT 20 UT1 – upstream *(10/27/2021)*

PHOTO POINT 20 UT1 – downstream *(10/27/2021)*

PHOTO POINT 21 UT1 – upstream *(10/27/2021)*

PHOTO POINT 21 UT1 – downstream *(10/27/2021)*

PHOTO POINT 22 UT1 – upstream *(10/27/2021)*

PHOTO POINT 22 UT1 – downstream *(10/27/2021)*

PHOTO POINT 23 UT2 R1 – upstream *(10/27/2021)*

PHOTO POINT 23 UT2 R1 – downstream *(10/27/2021)*

PHOTO POINT 24 UT2 R1 – upstream *(10/27/2021)*

PHOTO POINT 24 UT2 R1 – downstream *(10/27/2021)*

	
PHOTO POINT 25 UT2 R2 – upstream *(10/27/2021)*	**PHOTO POINT 25 UT2 R2 – downstream *(10/27/2021)***
	
PHOTO POINT 26 UT2 R3 – upstream *(10/27/2021)*	**PHOTO POINT 26 UT2 R3 – downstream *(10/27/2021)***
	
PHOTO POINT 27 UT2 R3 – upstream *(10/27/2021)*	**PHOTO POINT 27 UT2 R3 – downstream *(10/27/2021)***

PHOTO POINT 28 UT2 R3 – upstream *(10/27/2021)*

PHOTO POINT 28 UT2 R3 – downstream *(10/27/2021)*

PHOTO POINT 29 UT2 R3 – upstream *(10/27/2021)*

PHOTO POINT 29 UT2 R3 – downstream *(10/27/2021)*

PHOTO POINT 30 UT2 R4 – upstream *(10/27/2021)*

PHOTO POINT 30 UT2 R4 – downstream *(10/27/2021)*

	
PHOTO POINT 31 UT2 R5 – upstream *(10/27/2021)*	**PHOTO POINT 31 UT2 R5 – downstream *(10/27/2021)***
	
PHOTO POINT 32 UT2 R5 – upstream *(10/27/2021)*	**PHOTO POINT 32 UT2 R5 – downstream *(10/27/2021)***
	
PHOTO POINT 33 UT2 R5 – upstream *(10/27/2021)*	**PHOTO POINT 33 UT2 R5 – downstream *(10/27/2021)***

PHOTO POINT 34 UT2 R5 – upstream *(10/27/2021)*

PHOTO POINT 34 UT2 R5 – downstream *(10/27/2021)*

PHOTO POINT 35 UT2 R5 – upstream *(10/27/2021)*

PHOTO POINT 35 UT2 R5 – downstream *(10/27/2021)*

PHOTO POINT 36 UT2 R5 – upstream *(10/27/2021)*

PHOTO POINT 36 UT2 R5 – downstream *(10/27/2021)*

PHOTO POINT 37 UT2A R1 – upstream *(10/27/2021)*

PHOTO POINT 37 UT2A R1 – downstream *(10/27/2021)*

PHOTO POINT 38 UT2A R2 – upstream *(10/27/2021)*

PHOTO POINT 38 UT2A R2 – downstream *(10/27/2021)*

PHOTO POINT 39 UT2A R2 – upstream *(10/27/2021)*

PHOTO POINT 39 UT2A R2 – downstream *(10/27/2021)*

PHOTO POINT 40 UT2A R2 – upstream *(10/27/2021)*

PHOTO POINT 40 UT5A – downstream *(10/27/2021)*

PHOTO POINT 41 UT2A R2 – upstream *(10/27/2021)*

PHOTO POINT 41 UT2A R2 – downstream *(10/27/2021)*

PHOTO POINT 42 UT2B – upstream *(10/27/2021)*

PHOTO POINT 42 UT2B – downstream *(10/27/2021)*

PHOTO POINT 43 UT3 – upstream *(10/27/2021)*

PHOTO POINT 43 UT3 – downstream *(10/27/2021)*

PHOTO POINT 44 UT3 – upstream *(10/27/2021)*

PHOTO POINT 44 UT3 – downstream *(10/27/2021)*

PHOTO POINT 45 UT3 – upstream *(10/27/2021)*

PHOTO POINT 45 UT3 – downstream *(10/27/2021)*

PHOTO POINT 46 UT3 – upstream *(10/27/2021)*

PHOTO POINT 46 UT3 – downstream *(10/27/2021)*

PHOTO POINT 47 UT3 – upstream *(10/27/2021)*

PHOTO POINT 47 UT3 – downstream *(10/27/2021)*

PHOTO POINT 48 UT3 – upstream *(10/27/2021)*

PHOTO POINT 48 UT3 – downstream *(10/27/2021)*

	
PHOTO POINT 49 UT3 – upstream *(10/27/2021)*	**PHOTO POINT 49 UT3 – downstream *(10/27/2021)***
	
PHOTO POINT 50 UT4 – upstream *(10/27/2021)*	**PHOTO POINT 50 UT4 – downstream *(10/27/2021)***

CULVERT CROSSING PHOTOGRAPHS

Big Bugaboo Creek R2 - Looking Upstream *(10/27/2021)*

Big Bugaboo Creek R2 - Looking Downstream *(10/27/2021)*

Big Bugaboo Creek R3 - Looking Upstream *(10/27/2021)*

Big Bugaboo Creek R3 - Looking Downstream *(10/27/2021)*

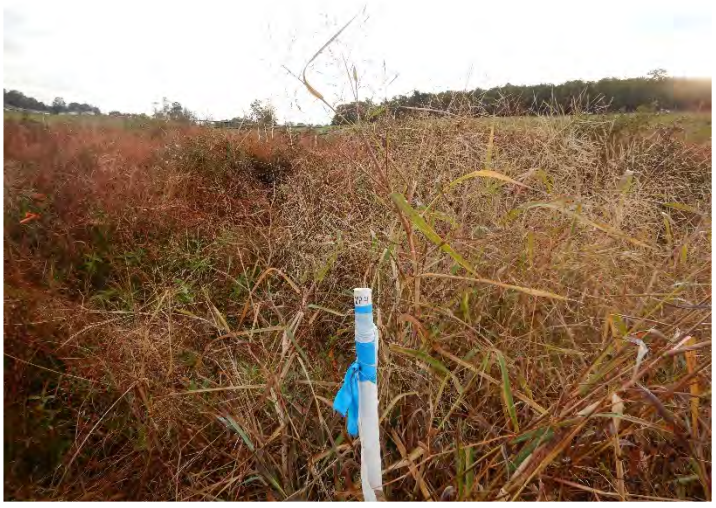
UT2 R5 - Looking Upstream *(10/27/2021)*

UT2 R5 - Looking Downstream *(10/27/2021)*

VEGETATION PLOT PHOTOGRAPHS

FIXED VEG PLOT 1 *(10/27/2021)*

FIXED VEG PLOT 2 *(10/27/2021)*



FIXED VEG PLOT 3 *(10/27/2021)*

FIXED VEG PLOT 4 *(10/27/2021)*

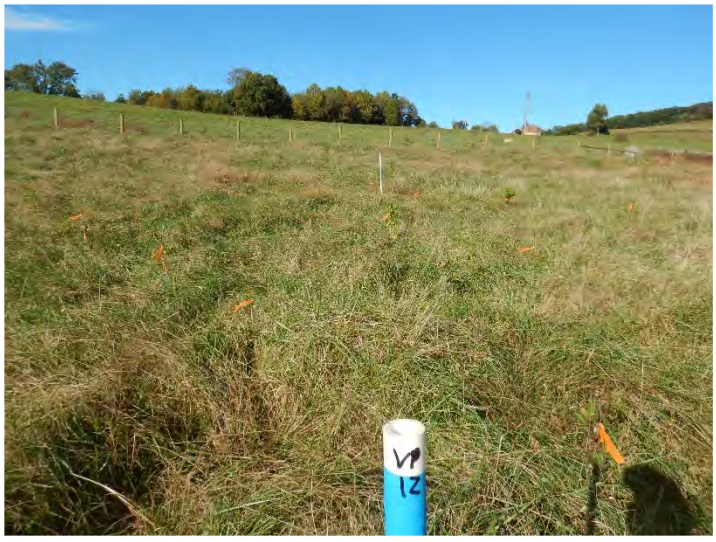
FIXED VEG PLOT 5 *(10/27/2021)*

FIXED VEG PLOT 6 *(10/27/2021)*

FIXED VEG PLOT 7 ***(10/27/2021)***

FIXED VEG PLOT 8 ***(10/27/2021)***

FIXED VEG PLOT 9 ***(10/27/2021)***



FIXED VEG PLOT 10 ***(10/27/2021)***

FIXED VEG PLOT 11 ***(10/27/2021)***

FIXED VEG PLOT 12 ***(10/27/2021)***

RANDOM VEG PLOT 13 ***(10/27/2021)***

RANDOM VEG PLOT 14 ***(10/27/2021)***

RANDOM VEG PLOT 15 ***(10/27/2021)***

APPENDIX B. Vegetation Plot Data

Table 6. Vegetation Plot Data
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Planted Acreage	19
Date of Initial Plant	2021-04-29
Date of Current Survey	2021-10-27
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/ Shrub	Indicator Status	Veg Plot 1 F		Veg Plot 2 F		Veg Plot 3 F		Veg Plot 4 F		Veg Plot 5 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Acer negundo	boxelder	Tree	FAC	1	1	1	1	1	1	3	3	1	1
	Betula nigra	river birch	Tree	FACW	3	3	2	2	2	2	2	2	1	1
	Diospyros virginiana	common persimmon	Tree	FAC			1	1					2	2
	Liriodendron tulipifera	tuliptree	Tree	FACU										
	Morus rubra	red mulberry	Tree	FACU			1	1						
	Nyssa sylvatica	blackgum	Tree	FAC	2	2	1	1	2	2			2	2
	Platanus occidentalis	American sycamore	Tree	FACW	4	4	1	1	1	1	3	3	2	2
	Prunus serotina	black cherry	Tree	FACU										
	Quercus phellos	willow oak	Tree	FACW	3	3	2	2	3	3	3	3	2	2
	Quercus rubra	northern red oak	Tree	FACU			1	1					1	1
	Salix nigra	black willow	Tree	OBL										
	Ulmus americana	American elm	Tree	FAC	1	1	5	5	3	3			1	1
	Ulmus rubra	slippery elm	Tree	FAC										
Sum				Performance Standard	14	14	15	15	12	12	11	11	12	12
Mitigation Plan Performance Standard				Current Year Stem Count		14		15		12		11		12
				Stems/Acre		567		607		486		445		486
				Species Count		6		9		6		4		8
				Dominant Species Composition (%)		29		33		25		27		17
				Average Plot Height		2		2		2		2		2
				% Invasives		0		0		0		0		0
Post Mitigation Plan Performance Standard				Current Year Stem Count		14		15		12		11		12
				Stems/Acre		567		607		486		445		486
				Species Count		6		9		6		4		8
				Dominant Species Composition (%)		29		33		25		27		17
				Average Plot Height		2		2		2		2		2
				% Invasives		0		0		0		0		0

Table 6. Vegetation Plot Data
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Planted Acreage	19
Date of Initial Plant	2021-04-29
Date of Current Survey	2021-10-27
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/ Shrub	Indicator Status	Veg Plot 6 F		Veg Plot 7 F		Veg Plot 8 F		Veg Plot 9 F		Veg Plot 10 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Acer negundo	boxelder	Tree	FAC							1	1	1	1
	Betula nigra	river birch	Tree	FACW			2	2	3	3	2	2	2	2
	Diospyros virginiana	common persimmon	Tree	FAC			1	1						
	Liriodendron tulipifera	tuliptree	Tree	FACU							1	1		
	Morus rubra	red mulberry	Tree	FACU	2	2							1	1
	Nyssa sylvatica	blackgum	Tree	FAC			1	1	2	2	1	1	2	2
	Platanus occidentalis	American sycamore	Tree	FACW	1	1	3	3	2	2	1	1	2	2
	Prunus serotina	black cherry	Tree	FACU	2	2	1	1					1	1
	Quercus phellos	willow oak	Tree	FACW	3	3	1	1	1	1	2	2	2	2
	Quercus rubra	northern red oak	Tree	FACU			1	1	2	2	2	2	2	2
	Salix nigra	black willow	Tree	OBL										
	Ulmus americana	American elm	Tree	FAC	3	3	1	1	2	2	3	3	2	2
	Ulmus rubra	slippery elm	Tree	FAC										
Sum				Performance Standard	11	11	11	11	12	12	13	13	15	15
Mitigation Plan Performance Standard				Current Year Stem Count		11		11		12		13		15
				Stems/Acre		445		445		486		526		607
				Species Count		5		8		6		8		9
				Dominant Species Composition (%)		27		27		25		23		13
				Average Plot Height		2		2		2		3		2
				% Invasives		0		0		0		0		0
Post Mitigation Plan Performance Standard				Current Year Stem Count		11		11		12		13		15
				Stems/Acre		445		445		486		526		607
				Species Count		5		8		6		8		9
				Dominant Species Composition (%)		27		27		25		23		13
				Average Plot Height		2		2		2		3		2
				% Invasives		0		0		0		0		0

Table 6. Vegetation Plot Data

Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Planted Acreage	19
Date of Initial Plant	2021-04-29
Date of Current Survey	2021-10-27
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/ Shrub	Indicator Status	Veg Plot 11 F		Veg Plot 12 F		Veg Plot 13 R	Veg Plot 14 R	Veg Plot 15 R
					Planted	Total	Planted	Total	Total	Total	Total
Species Included in Approved Mitigation Plan	Acer negundo	boxelder	Tree	FAC					1	1	
	Betula nigra	river birch	Tree	FACW	3	3			4	4	
	Diospyros virginiana	common persimmon	Tree	FAC					2		
	Liriodendron tulipifera	tuliptree	Tree	FACU							
	Morus rubra	red mulberry	Tree	FACU	1	1					
	Nyssa sylvatica	blackgum	Tree	FAC	3	3					
	Platanus occidentalis	American sycamore	Tree	FACW	2	2			1	1	
	Prunus serotina	black cherry	Tree	FACU							
	Quercus phellos	willow oak	Tree	FACW	1	1			1		
	Quercus rubra	northern red oak	Tree	FACU							
	Salix nigra	black willow	Tree	OBL							1
	Ulmus americana	American elm	Tree	FAC	3	3	1	1		1	
	Ulmus rubra	slippery elm	Tree	FAC	1	1			1		
Sum				Performance Standard	14	14	1	1	10	7	1
Mitigation Plan Performance Standard				Current Year Stem Count		14		1	10	7	1
				Stems/Acre		567		40	405	283	40
				Species Count		7		1	6	4	1
				Dominant Species Composition (%)		21		100	40	57	100
				Average Plot Height		2		2	2	3	3
				% Invasives		0		0	0	0	0
Post Mitigation Plan Performance Standard				Current Year Stem Count		14		1	10	7	1
				Stems/Acre		567		40	405	283	40
				Species Count		7		1	6	4	1
				Dominant Species Composition (%)		21		100	40	57	100
				Average Plot Height		2		2	2	3	3
				% Invasives		0		0	0	0	0

Table 7. Vegetation Performance Standards Summary Table

Bug Headwaters Mitigation Site

DMS Project No. 100084

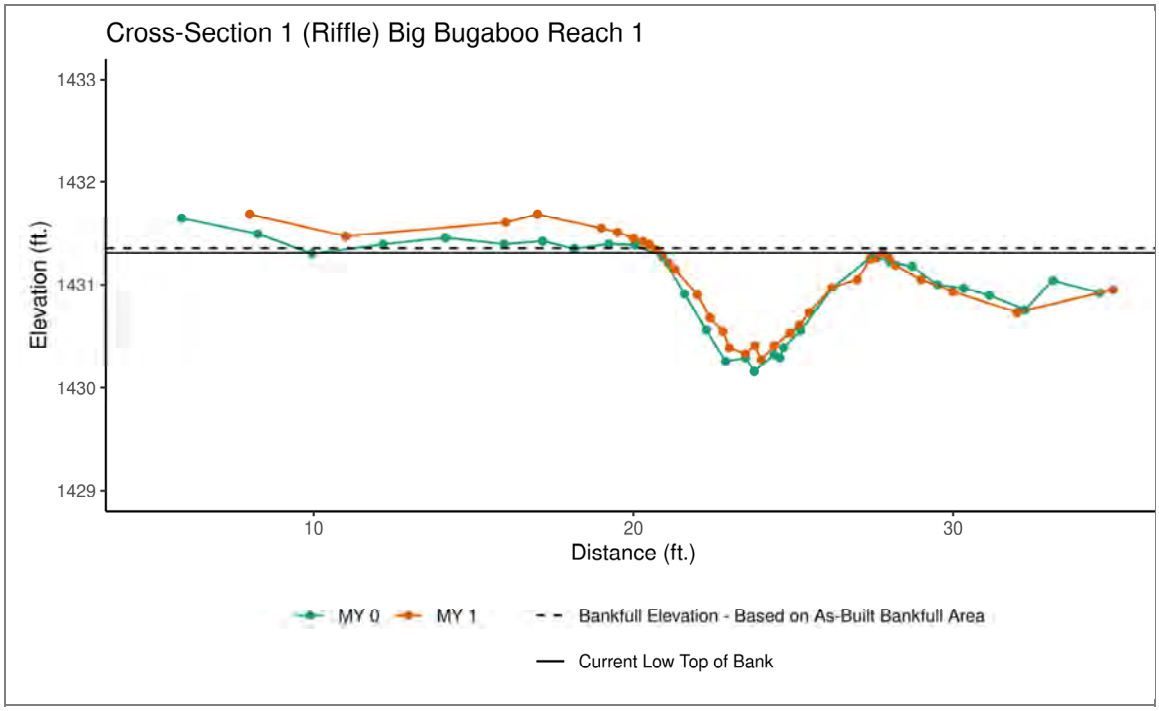
Monitoring Year 1 - 2021

	Veg Plot 1 F				Veg Plot 2 F				Veg Plot 3 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	567	2	6	0	607	2	9	0	486	2	6	0
Monitoring Year 0	607	2	6	0	648	2	9	0	607	2	6	0
	Veg Plot 4 F				Veg Plot 5 F				Veg Plot 6 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	445	2	4	0	486	2	8	0	445	2	5	0
Monitoring Year 0	607	2	5	0	526	2	8	0	607	2	9	0
	Veg Plot 7 F				Veg Plot 8 F				Veg Plot 9 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	445	2	8	0	486	2	6	0	526	3	8	0
Monitoring Year 0	607	2	8	0	607	2	6	0	607	2	8	0
	Veg Plot 10 F				Veg Plot 11 F				Veg Plot 12 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	607	2	9	0	567	2	7	0	40	2	1	0
Monitoring Year 0	607	2	9	0	607	2	8	0	607	2	8	0
	Veg Plot Group 13 R				Veg Plot Group 14 R				Veg Plot Group 15 R			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	405	2	6	0	283	3	4	0	40	3	1	0
Monitoring Year 0	526	2	7	0	607	2	5	0	567	2	7	0

*Each monitoring year represents a different plot for the random vegetation plot "groups". Random plots are denoted with an R, and fixed plots with an F.

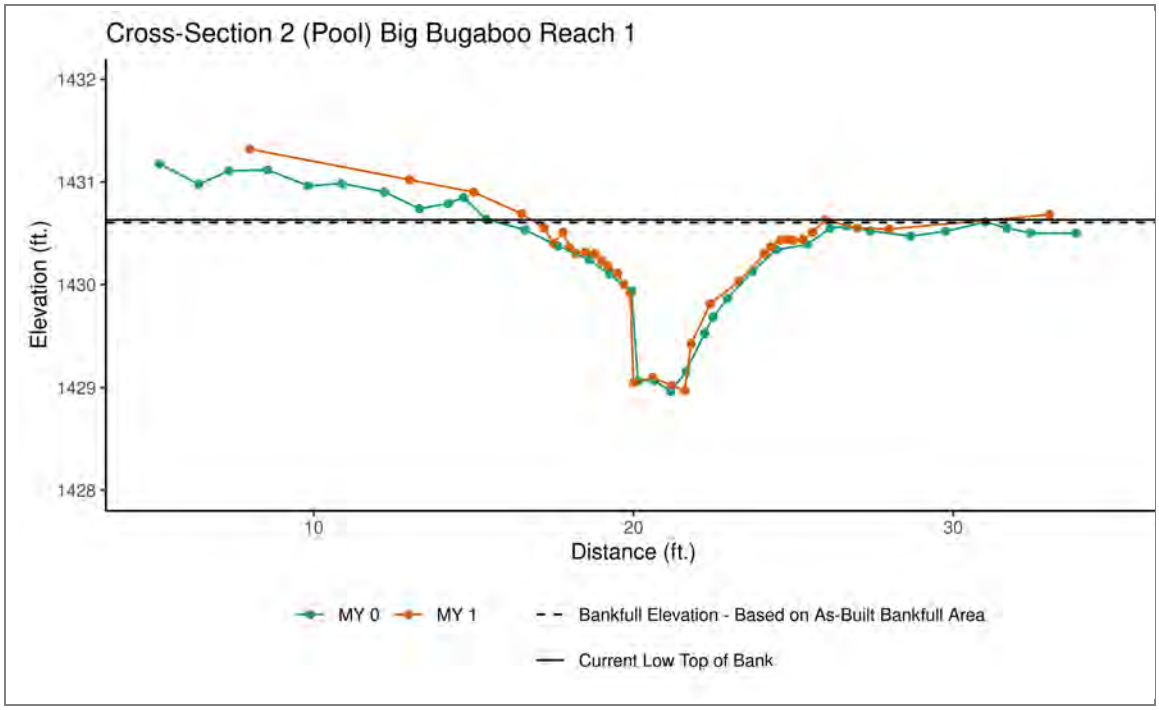
APPENDIX C. Stream Geomorphology Data

Cross-Section Plots



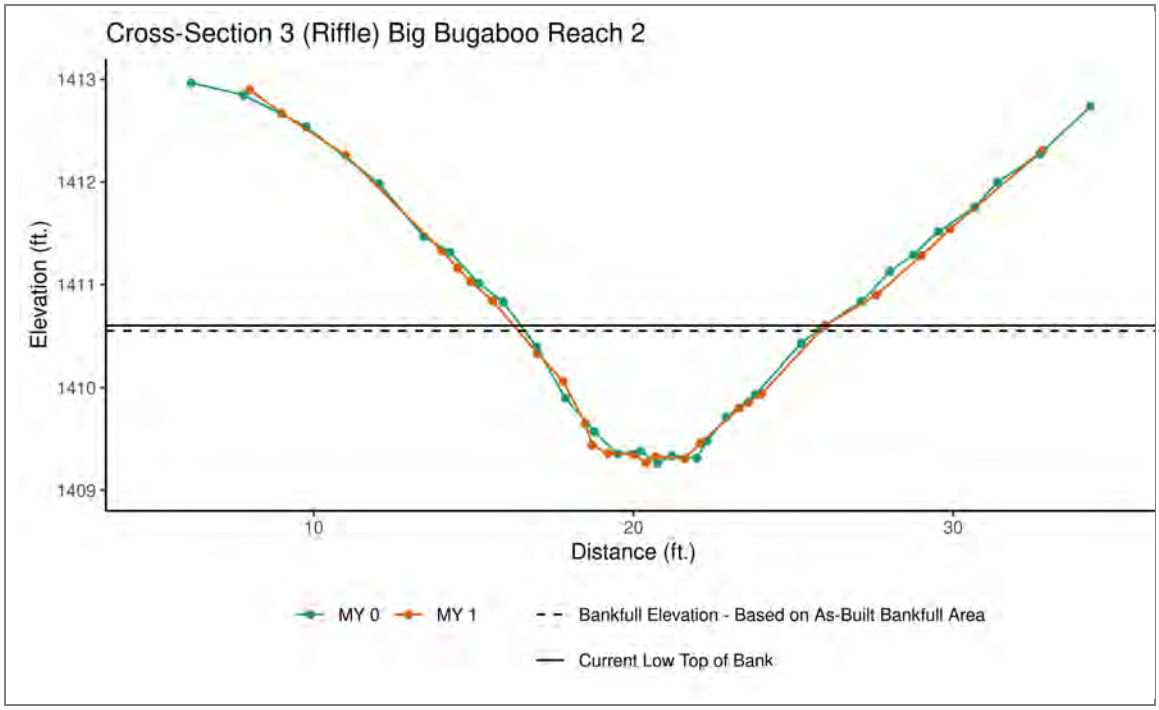
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,431.28	1,431.36				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.96				
Thalweg Elevation	1,430.16	1,430.27				
LTOB Elevation	1,431.28	1,431.31				
LTOB Max Depth	1.127	1.040				
LTOB Cross-Sectional Area	4.03	3.71				

Downstream *(10/27/2021)*



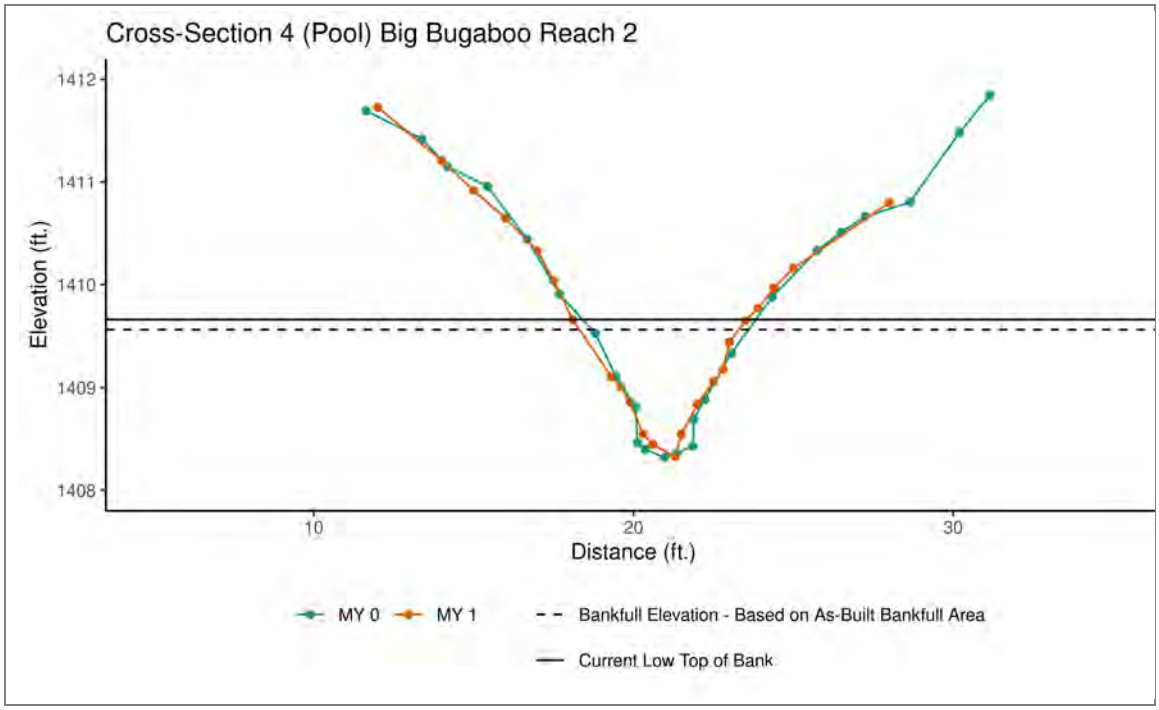
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,430.55	1,430.60				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.02				
Thalweg Elevation	1,428.97	1,428.97				
LTOB Elevation	1,430.55	1,430.63				
LTOB Max Depth	1.582	1.660				
LTOB Cross-Sectional Area	5.61	5.85				

Downstream *(10/27/2021)*



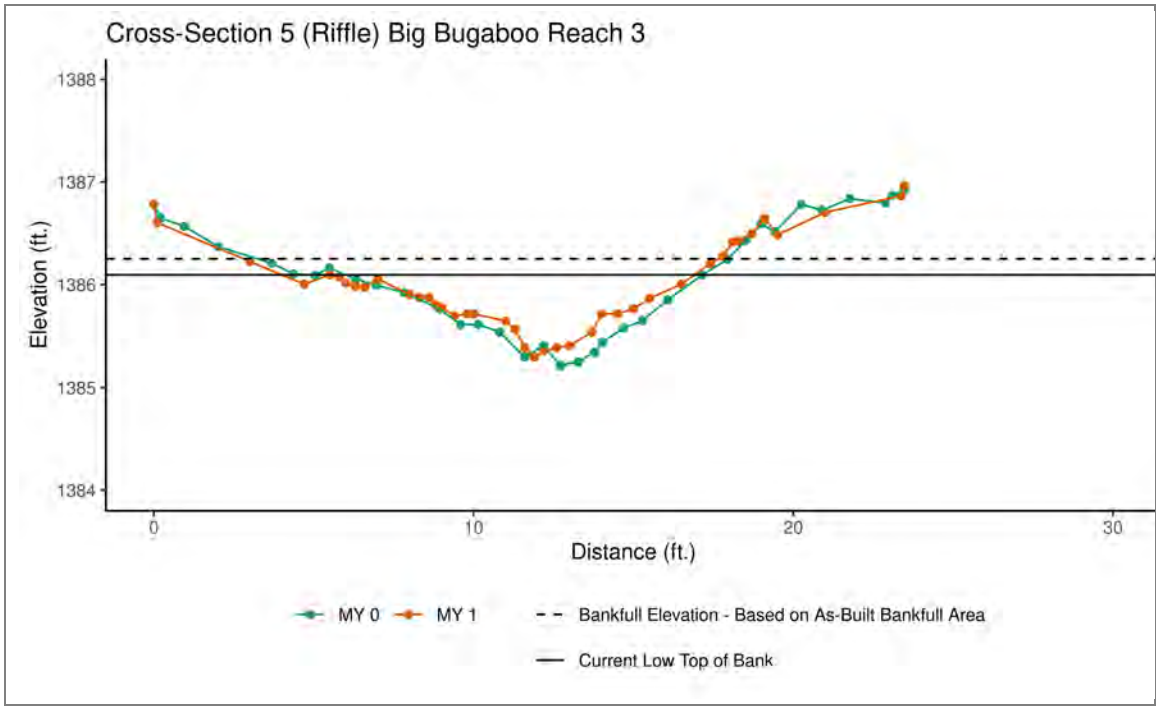
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,410.57	1,410.55				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.04				
Thalweg Elevation	1,409.27	1,409.27				
LTOB Elevation	1,410.57	1,410.60				
LTOB Max Depth	1.301	1.330				
LTOB Cross-Sectional Area	7.26	7.75				

Downstream *(10/27/2021)*



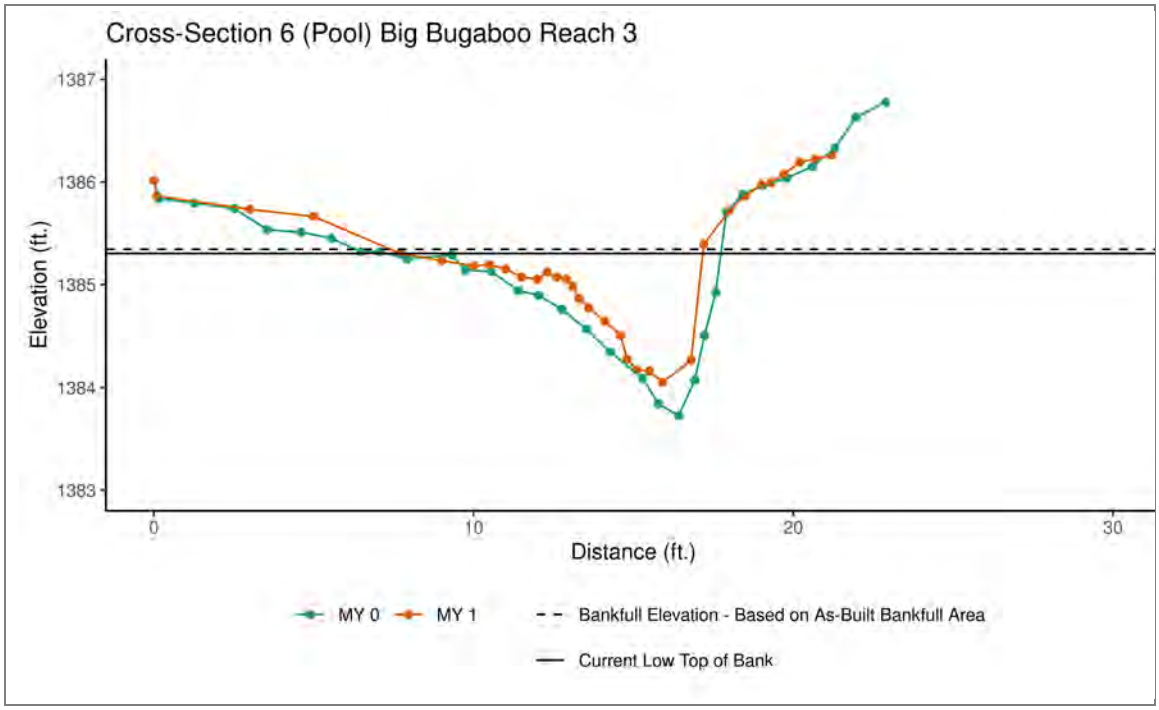
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,409.53	1,409.56				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.08				
Thalweg Elevation	1,408.32	1,408.33				
LTOB Elevation	1,409.53	1,409.66				
LTOB Max Depth	1.205	1.330				
LTOB Cross-Sectional Area	3.20	3.72				

Downstream *(10/27/2021)*



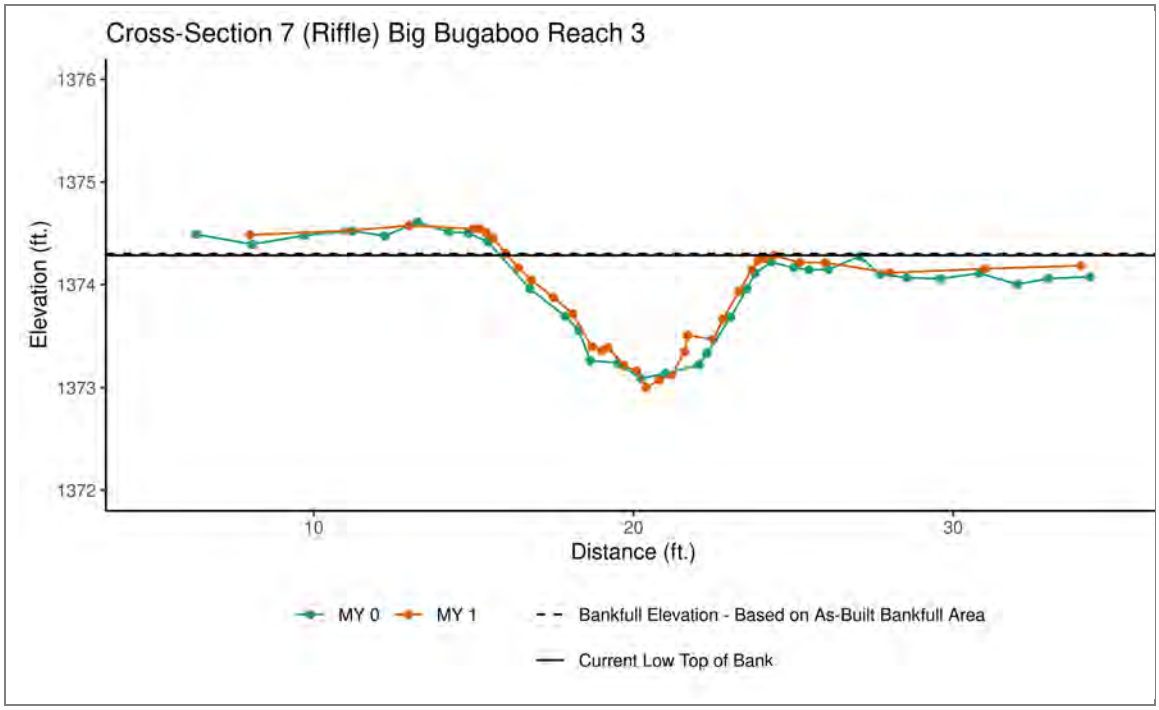
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,386.16	1,386.25				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.84				
Thalweg Elevation	1,385.21	1,385.29				
LTOB Elevation	1,386.16	1,386.09				
LTOB Max Depth	0.949	0.800				
LTOB Cross-Sectional Area	5.66	3.88				

Downstream *(10/27/2021)*



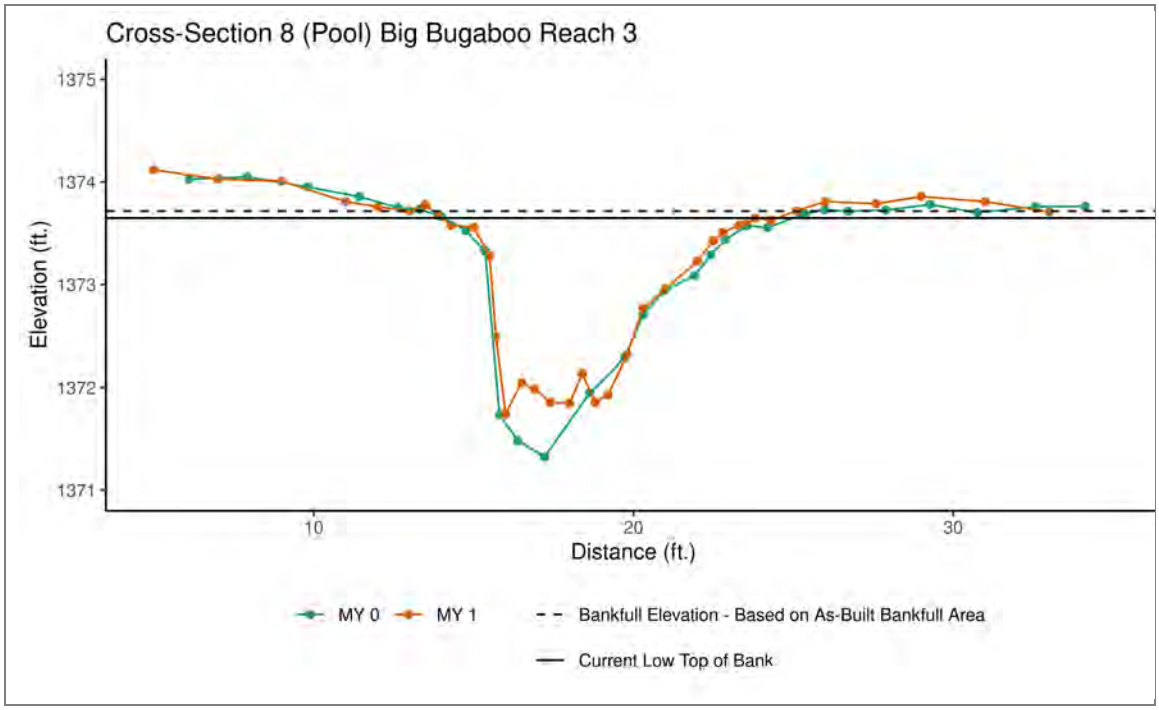
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,385.13	1,385.34				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.97				
Thalweg Elevation	1,383.73	1,384.05				
LTOB Elevation	1,385.13	1,385.30				
LTOB Max Depth	1.400	1.250				
LTOB Cross-Sectional Area	4.66	4.28				

Downstream *(10/27/2021)*



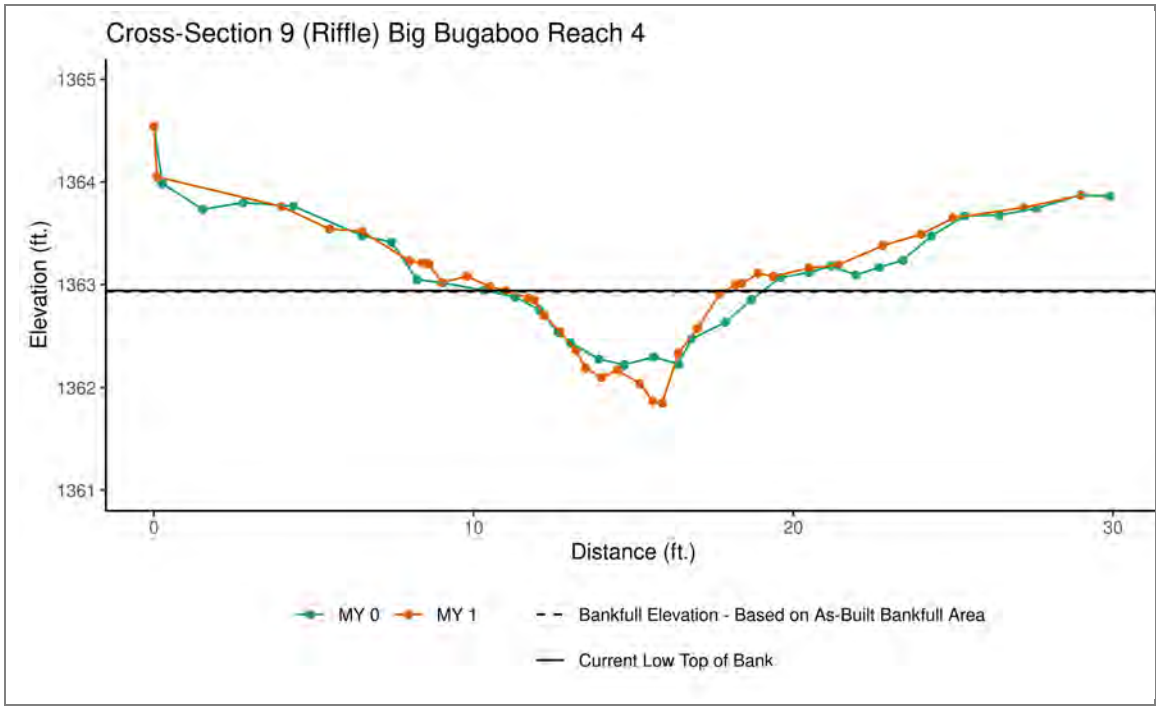
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,374.22	1,374.30				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.99				
Thalweg Elevation	1,373.09	1,373.00				
LTOB Elevation	1,374.22	1,374.28				
LTOB Max Depth	1.126	1.280				
LTOB Cross-Sectional Area	5.64	5.50				

Downstream *(10/27/2021)*



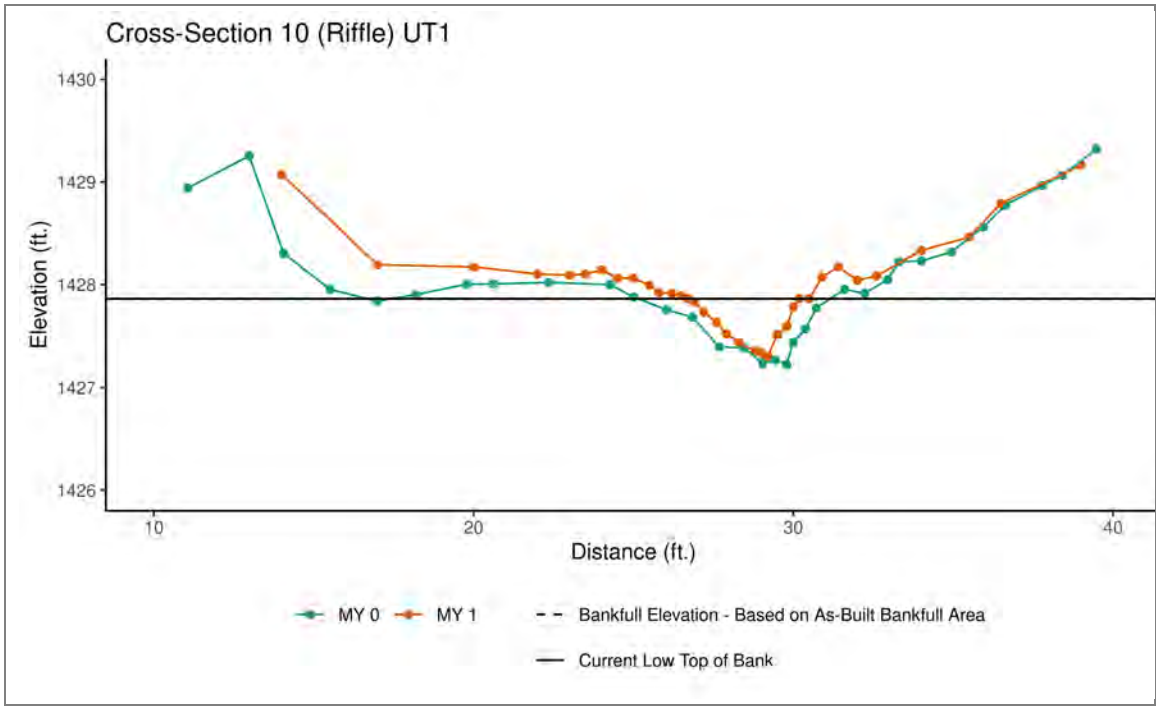
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,373.57	1,373.72				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.97				
Thalweg Elevation	1,371.33	1,371.75				
LTOB Elevation	1,373.57	1,373.65				
LTOB Max Depth	2.246	1.900				
LTOB Cross-Sectional Area	9.80	9.14				

Downstream *(10/27/2021)*



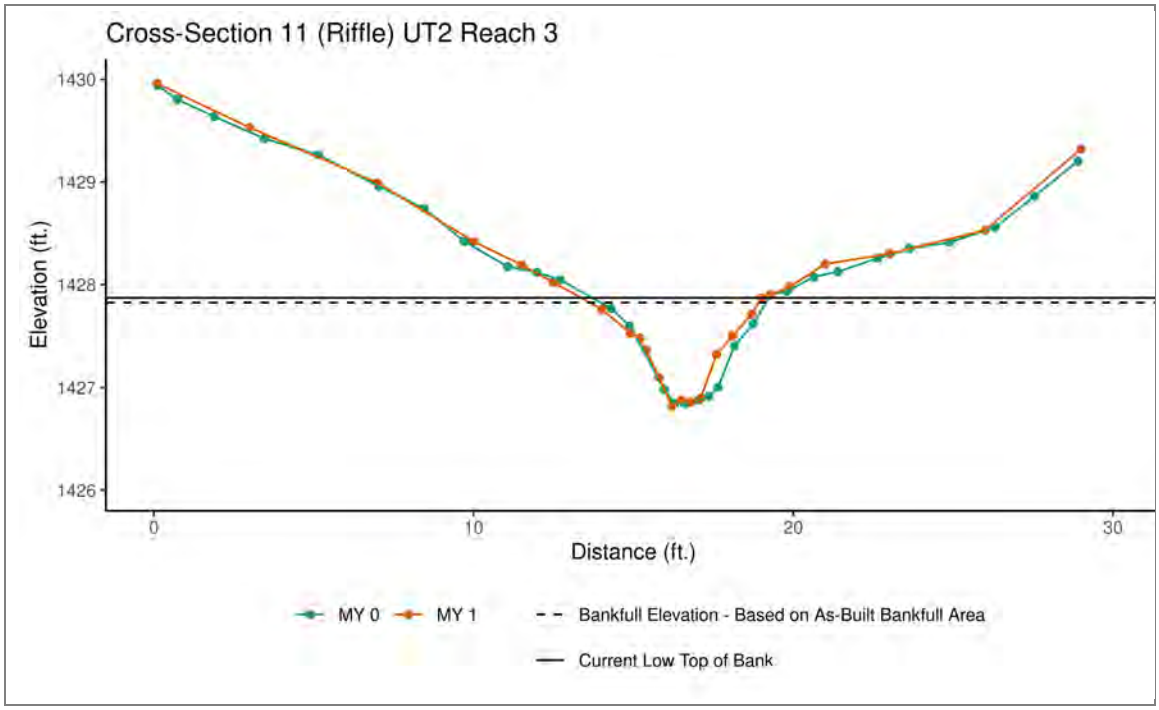
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,362.95	1,362.93				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.01				
Thalweg Elevation	1,362.22	1,361.85				
LTOB Elevation	1,362.95	1,362.94				
LTOB Max Depth	0.726	1.090				
LTOB Cross-Sectional Area	3.58	3.66				

Downstream *(10/27/2021)*



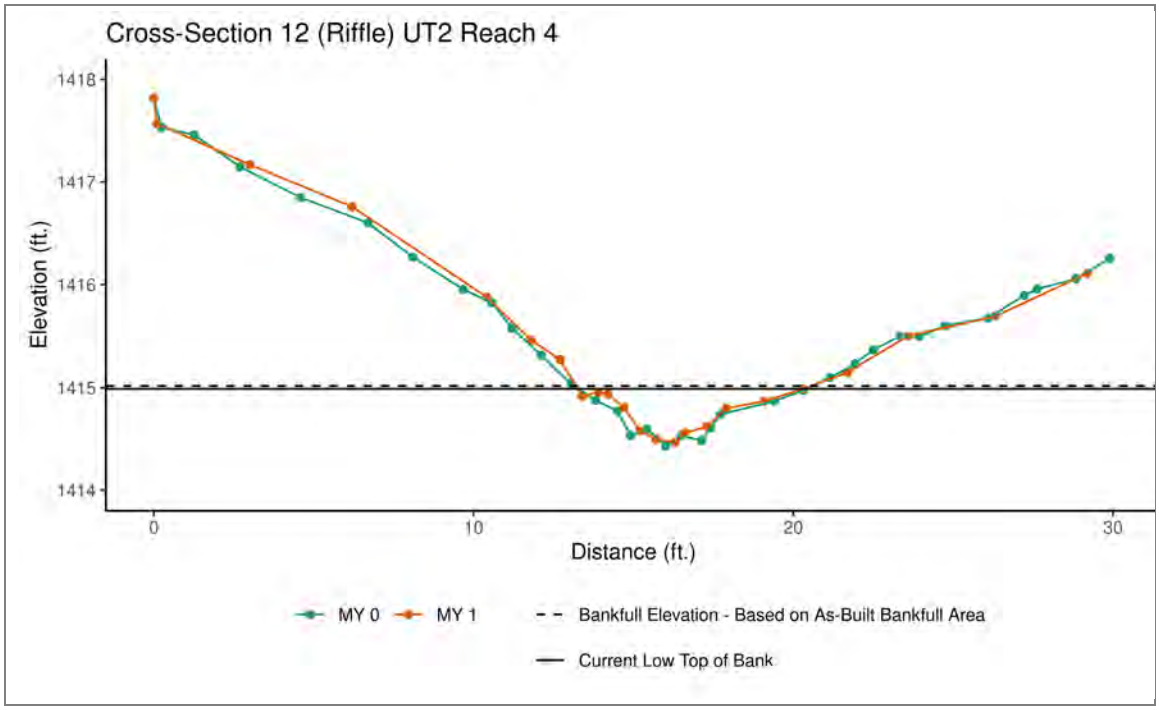
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,427.68	1,427.86				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.00				
Thalweg Elevation	1,427.22	1,427.30				
LTOB Elevation	1,427.68	1,427.86				
LTOB Max Depth	0.460	0.560				
LTOB Cross-Sectional Area	1.05	1.06				

Downstream *(10/27/2021)*



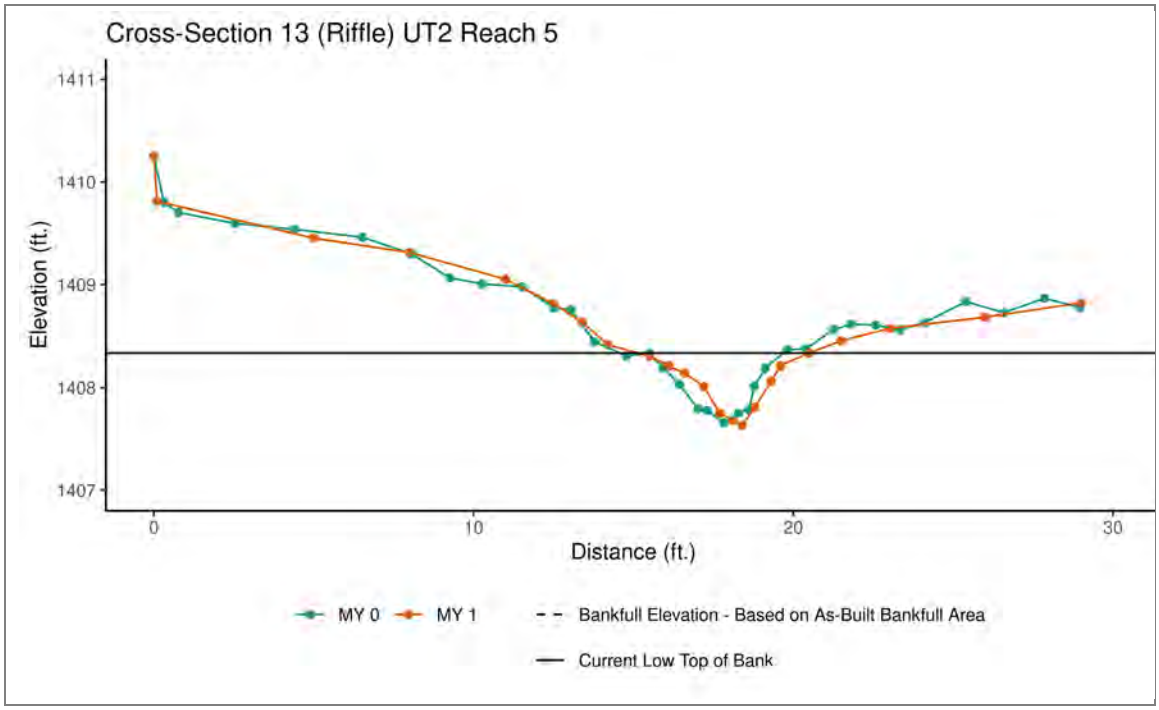
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,427.77	1,427.82				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.05				
Thalweg Elevation	1,426.85	1,426.82				
LTOB Elevation	1,427.77	1,427.87				
LTOB Max Depth	0.922	1.050				
LTOB Cross-Sectional Area	2.50	2.75				

Downstream *(10/27/2021)*



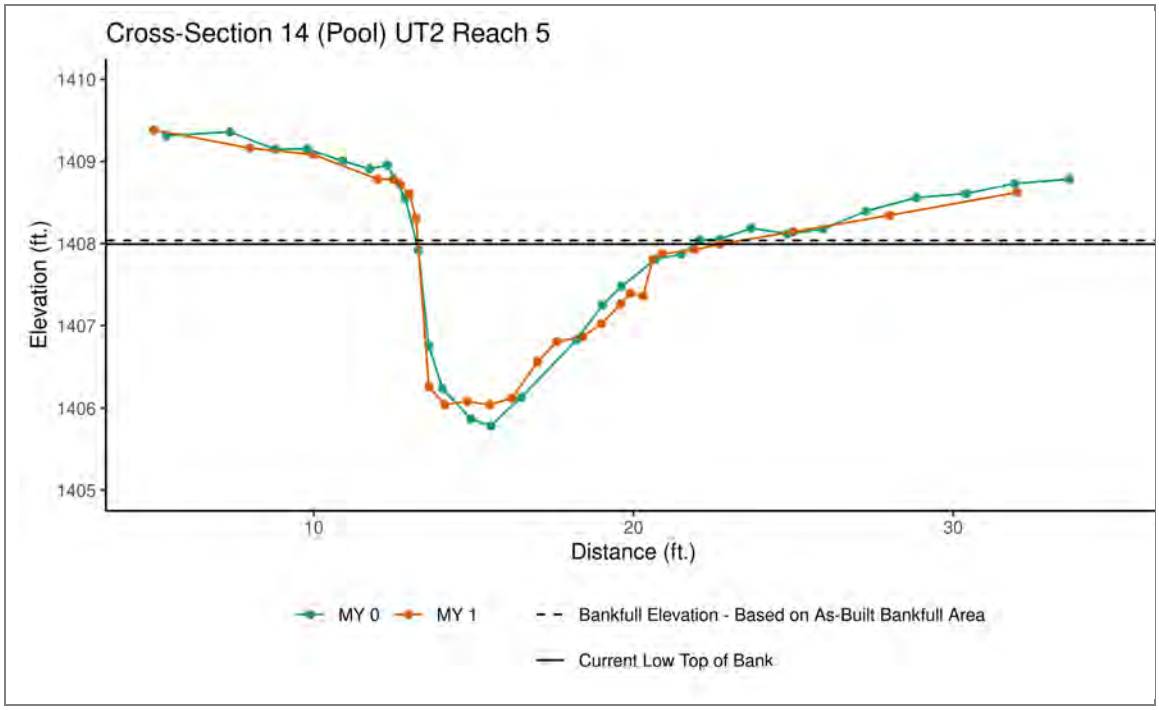
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,414.97	1,415.02				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.95				
Thalweg Elevation	1,414.43	1,414.47				
LTOB Elevation	1,414.97	1,414.99				
LTOB Max Depth	0.545	0.520				
LTOB Cross-Sectional Area	1.82	1.62				

Downstream *(10/27/2021)*



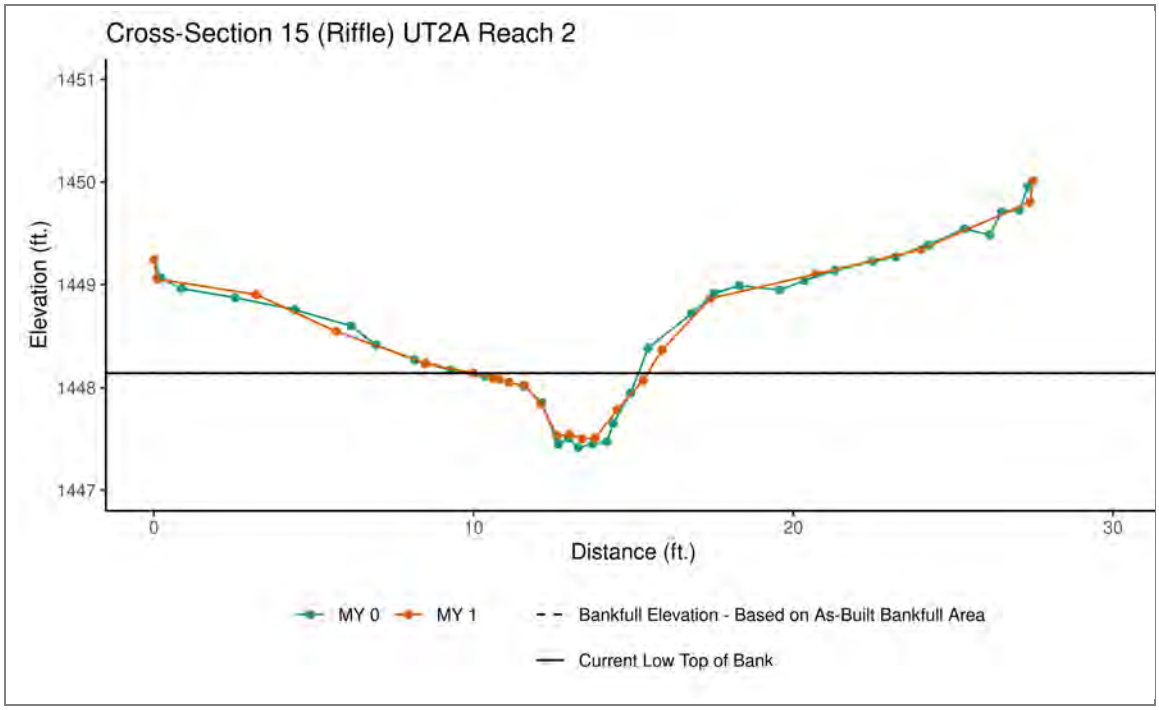
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,408.33	1,408.33				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.00				
Thalweg Elevation	1,407.66	1,407.63				
LTOB Elevation	1,408.33	1,408.33				
LTOB Max Depth	0.668	0.700				
LTOB Cross-Sectional Area	1.50	1.51				

Downstream *(10/27/2021)*



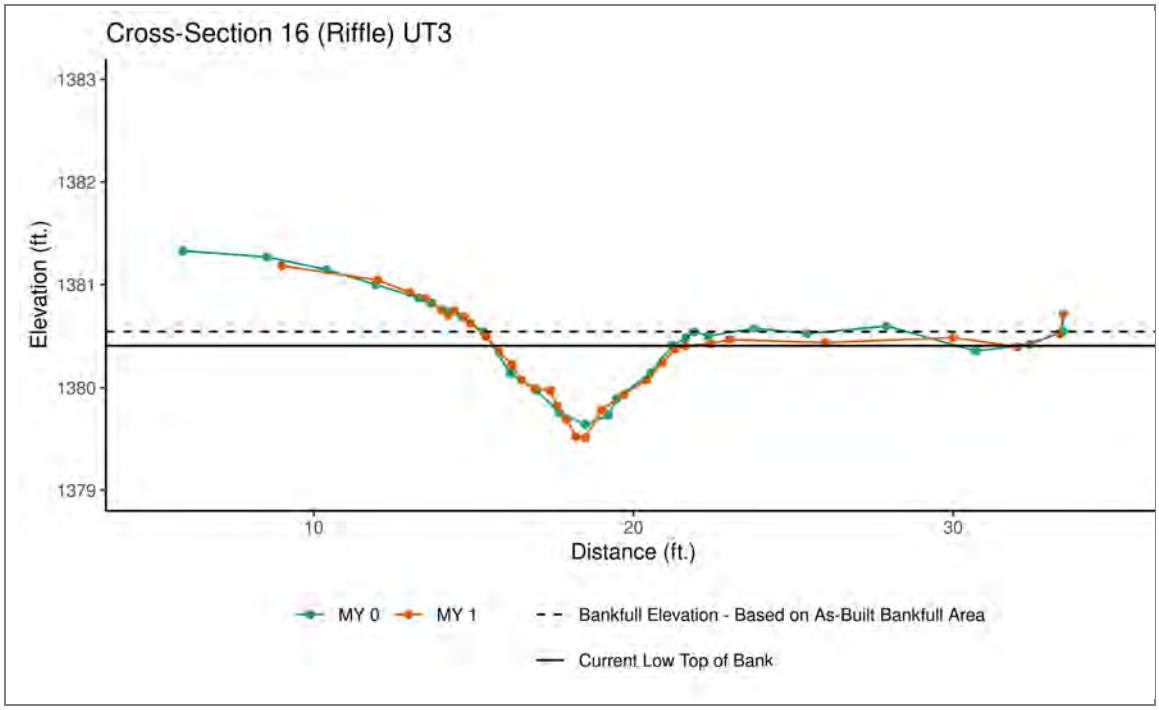
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,408.04	1,408.04				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.98				
Thalweg Elevation	1,405.79	1,406.04				
LTOB Elevation	1,408.04	1,407.99				
LTOB Max Depth	2.255	1.950				
LTOB Cross-Sectional Area	10.58	10.16				

Downstream *(10/27/2021)*



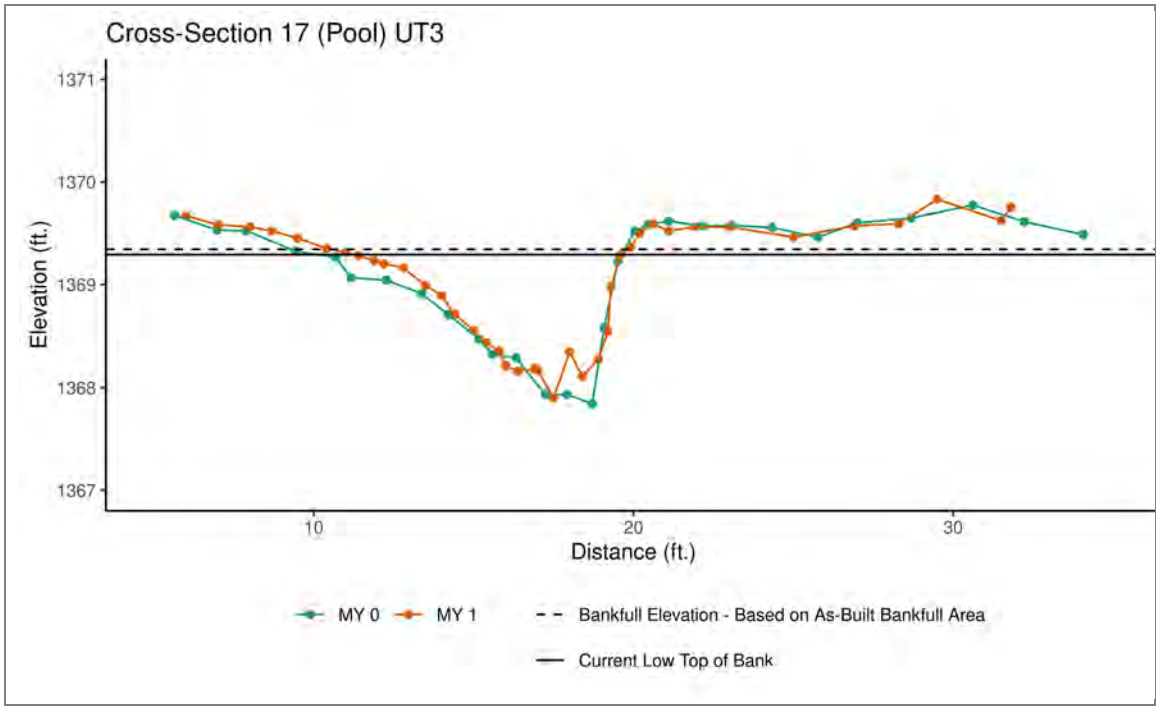
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,448.11	1,448.14				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.00				
Thalweg Elevation	1,447.42	1,447.50				
LTOB Elevation	1,448.11	1,448.14				
LTOB Max Depth	0.694	0.640				
LTOB Cross-Sectional Area	1.68	1.70				

Downstream *(10/27/2021)*



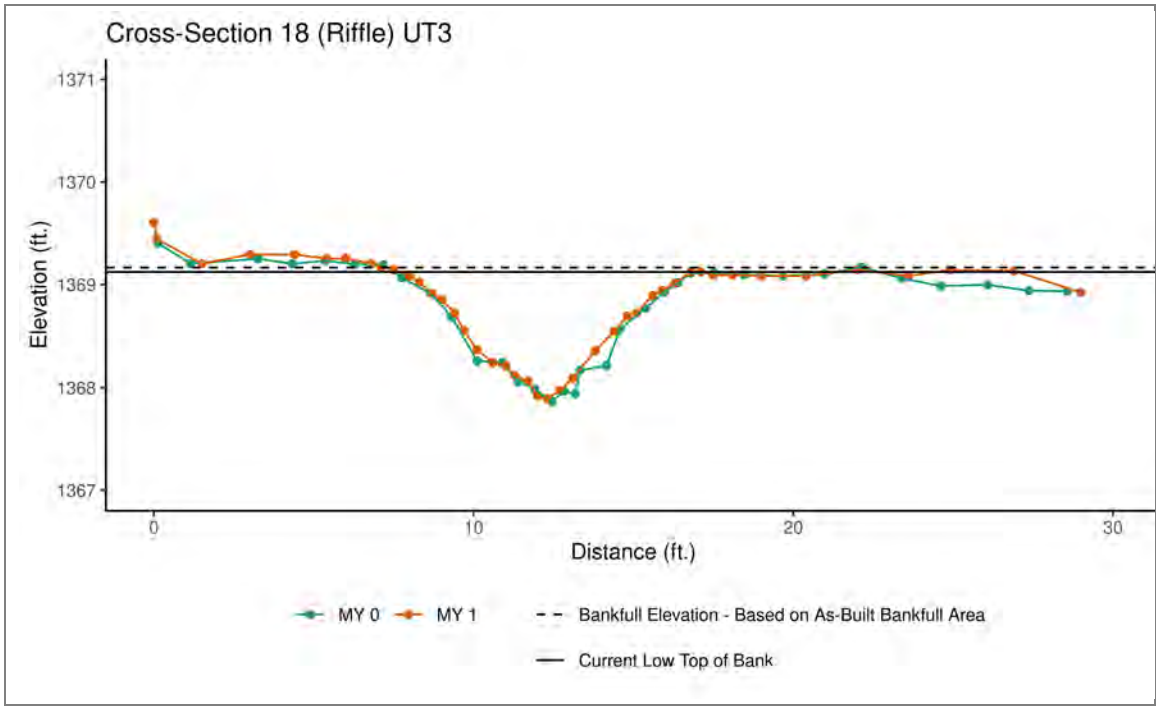
	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,380.54	1,380.54				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.87				
Thalweg Elevation	1,379.64	1,379.51				
LTOB Elevation	1,380.54	1,380.40				
LTOB Max Depth	0.896	0.890				
LTOB Cross-Sectional Area	3.31	2.49				

Downstream *(10/27/2021)*



	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,369.27	1,369.34				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.96				
Thalweg Elevation	1,367.93	1,367.90				
LTOB Elevation	1,369.27	1,369.29				
LTOB Max Depth	1.333	1.390				
LTOB Cross-Sectional Area	6.00	5.57				

Downstream *(10/27/2021)*



	MY0	MY1	MY2	MY3	MY6	MY7
Bankfull Elevation - Based on AB-Bankfull Area	1,369.11	1,369.17				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.97				
Thalweg Elevation	1,367.87	1,367.89				
LTOB Elevation	1,369.11	1,369.12				
LTOB Max Depth	1.245	1.230				
LTOB Cross-Sectional Area	5.85	5.46				

Downstream *(10/27/2021)*

Table 8. Baseline Stream Data Summary

Bug Headwaters Mitigation Site

DMS Project No. 100084

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**Big Bugaboo Reach 1**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	11.3		1	6.5		6.7		1
Floodprone Width (ft)	14		1	8	14	80		1
Bankfull Mean Depth	0.3		1	0.5		0.6		1
Bankfull Max Depth	0.6		1	0.8		1.1		1
Bankfull Cross Sectional Area (ft^2)	3.5		1	3.3		4.0		1
Width/Depth Ratio	36.3		1	13.0		11.0		1
Entrenchment Ratio	1.2		1	>1.4		12.0		1
Bank Height Ratio	3.3		1	1.0		1.0		1
Max part size (mm) mobilized at bankfull	31			80		61		
Rosgen Classification	F4b			B4		B4		
Bankfull Discharge (cfs)	10.9		1	12.4		19.3		
Sinuosity	1.04			1.02		1.02		
Water Surface Slope ($ft/ft)^2$	0.0330		1	0.0315	0.0346	0.0350		
Other	---			---		---		
Parameter	**Big Bugaboo Reach 2**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	4.2		1	9.0		9.3		1
Floodprone Width (ft)	16		1	11	20	19		1
Bankfull Mean Depth	0.8		1	0.7		0.8		1
Bankfull Max Depth	1.1		1	1.0		1.3		1
Bankfull Cross Sectional Area (ft^2)	3.4		1	6.0		7.3		1
Width/Depth Ratio	5.3		1	13.5		11.9		1
Entrenchment Ratio	3.9		1	>1.4		2.0		1
Bank Height Ratio	1.6		1	1.0		1.0		1
Max part size (mm) mobilized at bankfull	50			66		49		
Rosgen Classification	B4			B4		B4		
Bankfull Discharge (cfs)	14.1		1	20.4		32.7		
Sinuosity	1.07			1.02		1.02		
Water Surface Slope ($ft/ft)^2$	0.0228		1	0.0196	0.0216	0.0217		
Other	---			---		---		
Parameter	**Big Bugaboo Reach 3**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	6.0		1	10.4		8.3	12.5	2
Floodprone Width (ft)	9		1	23	52	48	80	2
Bankfull Mean Depth	1.1		1	0.8		0.5	0.7	2
Bankfull Max Depth	1.4		1	1.2		0.9	1.1	2
Bankfull Cross Sectional Area (ft^2)	6.6		1	8.2		5.6	5.7	2
Width/Depth Ratio	5.4		1	13.0		12.2	27.4	2
Entrenchment Ratio	1.5		1	>2.2		3.8	9.6	2
Bank Height Ratio	2.6		1	1.0		1.0		2
Max part size (mm) mobilized at bankfull	65			66		23	34	2
Rosgen Classification	B4			C4		C4		
Bankfull Discharge (cfs)	34.9		1	34.0		16.2	20.5	2
Sinuosity	1.01			1.16		1.16		
Water Surface Slope ($ft/ft)^2$	0.0230		1	0.0173	0.0189	0.0171		
Other	---			---		---		

Table 8. Baseline Stream Data Summary

Bug Headwaters Mitigation Site

DMS Project No. 100084

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**Big Bugaboo Reach 4**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	18.6		1	11.8		8.7		1
Floodprone Width (ft)	23		1	26	59	20		1
Bankfull Mean Depth	0.8		1	0.1		0.4		1
Bankfull Max Depth	1.2		1	1.3		0.7		1
Bankfull Cross Sectional Area (ft^2)	14.1		1	10.3		3.5		1
Width/Depth Ratio	24.6		1	14.0		21.2		1
Entrenchment Ratio	1.2		1	>2.2		2.3		1
Bank Height Ratio	2.7		1	1.0		1.0		1
Max part size (mm) mobilized at bankfull	37			84		20		
Rosgen Classification	F4			C4		C4		
Bankfull Discharge (cfs)	54.5		1	48.3		9.2		
Sinuosity	1.03		1	1.02		1.02		
Water Surface Slope ($ft/ft)^2$	0.0160		1	0.0127	0.0138	0.0166		
Other	---			---		---		
Parameter	**UT1**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	11.6		1	4.2		3.7		1
Floodprone Width (ft)	20		1	5	9	19		1
Bankfull Mean Depth	0.2		1	0.3		0.3		1
Bankfull Max Depth	0.4		1	0.5		0.5		1
Bankfull Cross Sectional Area (ft^2)	2.7		1	1.4		1.0		1
Width/Depth Ratio	50.7		1	13.0		13.3		1
Entrenchment Ratio	1.7		1	>1.4		5.1		1
Bank Height Ratio	5.0		1	1.0		1.0		1
Max part size (mm) mobilized at bankfull	24			53		32		
Rosgen Classification	B4			B4		B4		
Bankfull Discharge (cfs)	6.9		1	3.9		3.2		
Sinuosity	1.01		1	1.00		1.00		
Water Surface Slope ($ft/ft)^2$	0.0350		1	0.0329	0.0362	0.0387		
Other	---			---		---		
Parameter	**UT2 Reach 3**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	9.0		1	7.1		4.7		1
Floodprone Width (ft)	12		1	16	36	19		1
Bankfull Mean Depth	0.4		1	0.5		0.5		1
Bankfull Max Depth	0.9		1	0.8		0.9		1
Bankfull Cross Sectional Area (ft^2)	4.0		1	3.8		2.5		1
Width/Depth Ratio	23.0		1	13.0		9.0		1
Entrenchment Ratio	1.3		1	67.0		4.0		1
Bank Height Ratio	3.4		1	1.0		1.0		1
Max part size (mm) mobilized at bankfull	34			>1.4		45		
Rosgen Classification	B4			B4		B4		
Bankfull Discharge (cfs)	13.8		1	14.6		10.0		
Sinuosity	1.10			1.04		1.04		
Water Surface Slope ($ft/ft)^2$	0.0520		1	0.0244	0.0266	0.0301		
Other	---			---		---		

Table 8. Baseline Stream Data Summary

Bug Headwaters Mitigation Site

DMS Project No. 100084

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**UT2 Reach 4**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	9.0		1	7.1		6.9		1
Floodprone Width (ft)	12		1	16	36	13		1
Bankfull Mean Depth	0.4		1	0.5		0.3		1
Bankfull Max Depth	0.9		1	0.8		0.5		1
Bankfull Cross Sectional Area (ft^2)	4.0		1	3.8		1.8		1
Width/Depth Ratio	23.0		1	13.0		26.5		1
Entrenchment Ratio	1.3		1	>1.4		1.9		1
Bank Height Ratio	3.4		1	1.0		1.0		1
Max part size (mm) mobilized at bankfull	34			---		26		
Rosgen Classification	B4			B4		B4		
Bankfull Discharge (cfs)	13.8		1	14.6		5.0		
Sinuosity	1.07			1.07		1.07		
Water Surface Slope ($ft/ft)^2$	0.0369		1	0.0282	0.0307	0.0334		
Other	---			---		---		
Parameter	**UT2 Reach 5**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	9.0		1	8.4		4.2		1
Floodprone Width (ft)	12		1	19	24	25		1
Bankfull Mean Depth	0.4		1	0.6		0.4		1
Bankfull Max Depth	0.9		1	1.5		0.7		1
Bankfull Cross Sectional Area (ft^2)	4.0		1	5.4		1.5		1
Width/Depth Ratio	23.0		1	13.0		11.6		1
Entrenchment Ratio	1.3		1	>2.2		6.0		1
Bank Height Ratio	3.4		1	1.0		1.0		1
Max part size (mm) mobilized at bankfull	34			48		18		
Rosgen Classification	F4b			C4b		C4b		
Bankfull Discharge (cfs)	13.8		1	18.8		3.6		
Sinuosity	1.01			1.06		1.06		
Water Surface Slope ($ft/ft)^2$	0.0200		1	0.0183	0.0200	0.0175		
Other	---			---		---		
Parameter	**UT2A Reach 2**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	5.0		1	5.1		4.8		1
Floodprone Width (ft)	12		1	6	11	14		1
Bankfull Mean Depth	0.4		1	0.4		0.4		1
Bankfull Max Depth	0.6		1	0.6		0.7		1
Bankfull Cross Sectional Area (ft^2)	2.0		1	2.0		1.7		1
Width/Depth Ratio	11.0		1	13.0		13.5		1
Entrenchment Ratio	2.4		1	>1.4		2.9		1
Bank Height Ratio	4.8		1	1.0		1.0		1
Max part size (mm) mobilized at bankfull	58			84		40		
Rosgen Classification	A4			B4a		B4a		
Bankfull Discharge (cfs)	8.3		1	7.3		5.9		
Sinuosity	1.04			1.03		1.03		
Water Surface Slope ($ft/ft)^2$	0.0490		1	0.0454	0.0514	0.0398		
Other	---			---		---		

Table 8. Baseline Stream Data Summary

Bug Headwaters Mitigation Site

DMS Project No. 100084

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**UT3**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	7		1	9.5		6.6	9.2	2
Floodprone Width (ft)	9		1	21	48	90		2
Bankfull Mean Depth	0.8		1	0.7		0.5	0.6	2
Bankfull Max Depth	1.1		1	1.1		0.9	1.2	2
Bankfull Cross Sectional Area (ft^2)	5		1	6.8		3.3	5.8	2
Width/Depth Ratio	8		1	13.0		13.1	14.6	2
Entrenchment Ratio	1.4		1	>2.2		9.8	13.7	2
Bank Height Ratio	2.1		1	1.0		1.0		2
Max part size (mm) mobilized at bankfull	43			54		24	30	2
Rosgen Classification	G4			C4b		C4b		
Bankfull Discharge (cfs)	21.7		1	24.6		9.7	19.8	2.0
Sinuosity	1.04			1.21		1.21		
Water Surface Slope ($ft/ft)^2$	0.0199		1	0.0142	0.0154	0.0164		
Other	---			---		---		

Table 9. Cross-Section Morphology Monitoring Summary

Bug Headwaters Mitigation Site

DMS Project No. 100084

Monitoring Year 1 - 2021

	Big Bugaboo Reach 1												Big Bugaboo Reach 2					
	Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)						Cross-Section 3 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,431.28	1,431.36					N/A	N/A					1,410.57	1,410.55				
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	0.96					N/A	N/A					1.00	1.04				
Thalweg Elevation	1,430.16	1,430.27					1,428.97	1,428.97					1,409.27	1,409.27				
LTOB[2] Elevation	1,431.28	1,431.31					1,430.55	1,430.63					1,410.57	1,410.60				
LTOB[2] Max Depth (ft)	1.127	1.040					1.582	1.660					1.301	1.330				
LTOB[2] Cross Sectional Area (ft^2)	4.03	3.71					5.61	5.85					7.26	7.75				
	Big Bugaboo Reach 2						Big Bugaboo Reach 3											
	Cross-Section 4 (Pool)						Cross-Section 5 (Riffle)						Cross-Section 6 (Pool)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A					1,386.16	1,386.25					N/A	N/A				
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A					1.00	0.84					N/A	N/A				
Thalweg Elevation	1,408.32	1,408.33					1,385.21	1,385.29					1,383.73	1,384.05				
LTOB[2] Elevation	1,409.53	1,409.66					1,386.16	1,386.09					1,385.13	1,385.30				
LTOB[2] Max Depth (ft)	1.205	1.330					0.949	0.800					1.40	1.250				
LTOB[2] Cross Sectional Area (ft^2)	3.20	3.72					5.66	3.88					4.66	4.28				
	Big Bugaboo Reach 3												Big Bugaboo Reach 4					
	Cross-Section 7 (Riffle)						Cross-Section 8 (Pool)						Cross-Section 9 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,374.22	1,374.30					N/A	N/A					1,362.95	1,362.93				
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	0.99					N/A	N/A					1.00	1.01				
Thalweg Elevation	1,373.09	1,373.00					1,371.33	1,371.75					1,362.22	1,361.85				
LTOB[2] Elevation	1,374.22	1,374.28					1,373.57	1,373.65					1,362.95	1,362.94				
LTOB[2] Max Depth (ft)	1.126	1.280					2.246	1.900					0.726	1.090				
LTOB[2] Cross Sectional Area (ft^2)	5.64	5.50					9.80	9.14					3.58	3.66				

[1]Bank Height Ratio (BHR) takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation.

[2]LTOB Area and Max depth - These are based on the LTOB elevation for each years survey (The same elevation used for the LTOB in the BHR calculation). Area below the LTOB elevation will be used and tracked for each year as above. The difference between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

Table 9. Cross-Section Morphology Monitoring Summary

Bug Headwaters Mitigation Site

DMS Project No. 100084

Monitoring Year 1 - 2021

	UT1						UT2 Reach 3						UT2 Reach 4					
	Cross-Section 10 (Riffle)						Cross-Section 11 (Riffle)						Cross-Section 12 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,427.68	1,427.86					1,427.77	1,427.82					1,414.97	1,415.02				
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	1.00					1.00	1.05					1.00	0.95				
Thalweg Elevation	1,427.22	1,427.30					1,426.85	1,426.82					1,414.43	1,414.47				
LTOB[2] Elevation	1,427.68	1,427.86					1,427.77	1,427.87					1,414.97	1,414.99				
LTOB[2] Max Depth (ft)	0.460	0.560					0.922	1.050					0.545	0.520				
LTOB[2] Cross Sectional Area (ft^2)	1.05	1.06					2.50	2.75					1.82	1.62				
	UT2 Reach 5												UT2A					
	Cross-Section 13 (Riffle)						Cross-Section 14 (Pool)						Cross-Section 15 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,408.33	1,408.33					N/A	N/A					1,448.11	1,448.14				
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	1.00					N/A	N/A					1.00	1.00				
Thalweg Elevation	1,407.66	1,407.63					1,405.79	1,406.04					1,447.42	1,447.50				
LTOB[2] Elevation	1,408.33	1,408.33					1,408.04	1,407.99					1,448.11	1,448.14				
LTOB[2] Max Depth (ft)	0.668	0.700					2.255	1.950					0.694	0.640				
LTOB[2] Cross Sectional Area (ft^2)	1.50	1.51					10.58	10.16					1.68	1.70				
	UT3																	
	Cross-Section 16 (Riffle)						Cross-Section 17 (Pool)						Cross-Section 18 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,380.54	1,380.54					N/A	N/A					1,369.11	1,369.17				
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	0.87					N/A	N/A					1.00	0.97				
Thalweg Elevation	1,379.64	1,379.51					1,367.93	1,367.90					1,367.87	1,367.89				
LTOB[2] Elevation	1,380.54	1,380.40					1,369.27	1,369.29					1,369.11	1,369.12				
LTOB[2] Max Depth (ft)	0.896	0.890					1.333	1.390					1.245	1.230				
LTOB[2] Cross Sectional Area (ft^2)	3.31	2.49					6.00	5.57					5.85	5.46				

[1]Bank Height Ratio (BHR) takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation.

[2]LTOB Area and Max depth - These are based on the LTOB elevation for each years survey (The same elevation used for the LTOB in the BHR calculation). Area below the LTOB elevation will be used and tracked for each year as above. The difference between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

APPENDIX D. Hydrology Data

Table 10. Bankfull Events

Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Reach	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
Big Bugaboo Creek Reach 3	8/15/2021 8/18/2021 10/6/2021						
Big Bugaboo Creek Reach 4	8/17/2021						
UT2 Reach 5	3/31/2021 6/12/2021 7/2/2021						
UT3	8/18/2021 9/1/2021 9/18/2021 10/6/2021						

Table 11. Rainfall Summary

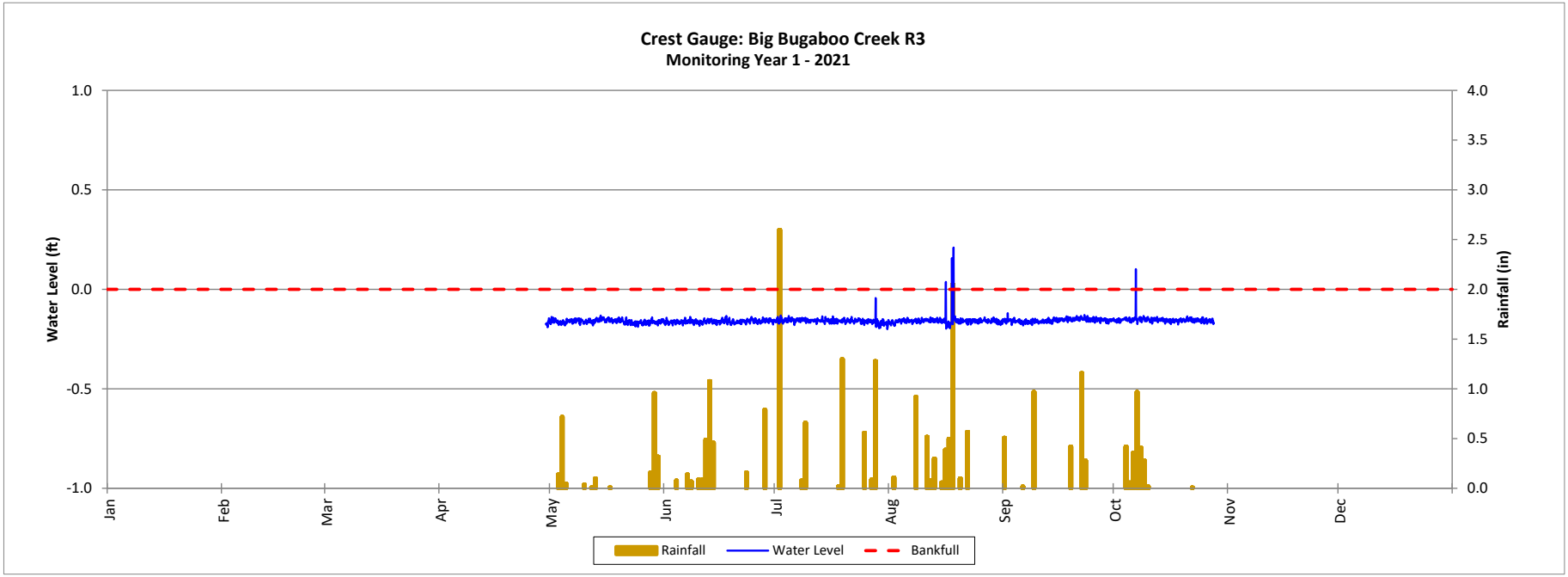
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
Annual Precip Total	40.56*						
WETS 30th Percentile	43.05						
WETS 70th Percentile	53.13						
Normal	*						

*Annual precipitation total was collected up until 10/27/2021. Data will be updated in MY2.

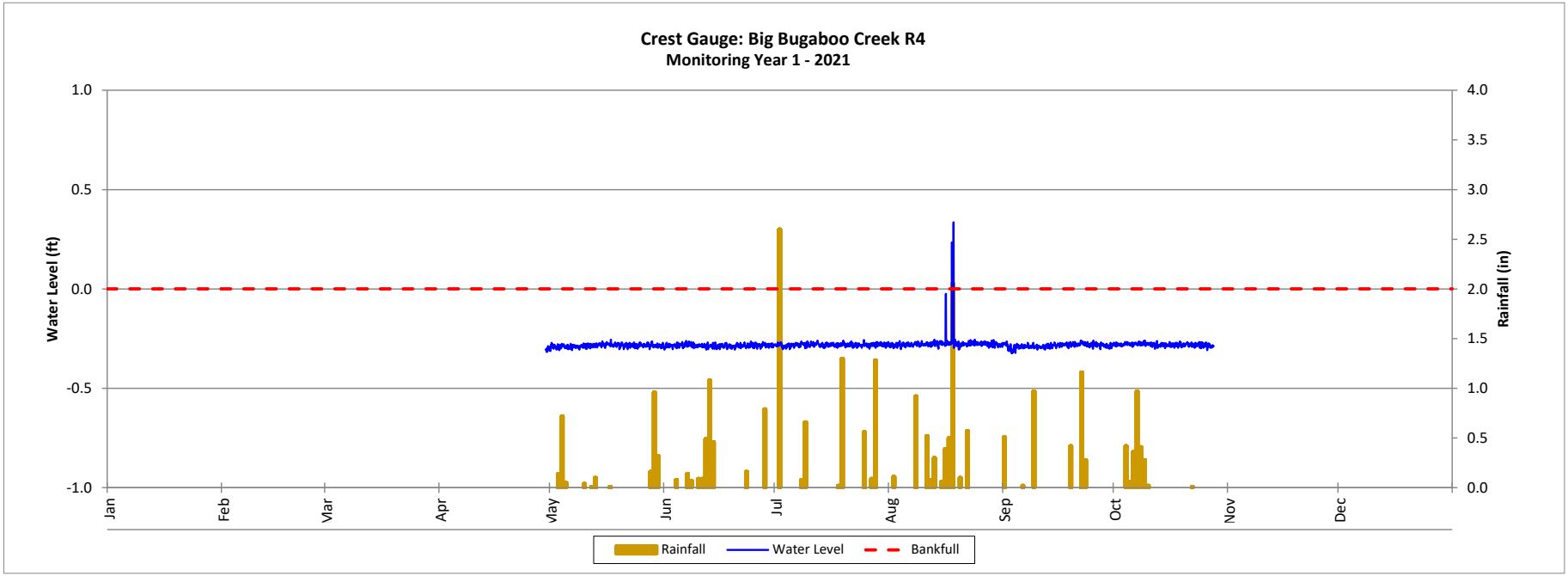
Recorded Bankfull Event Plots

Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021



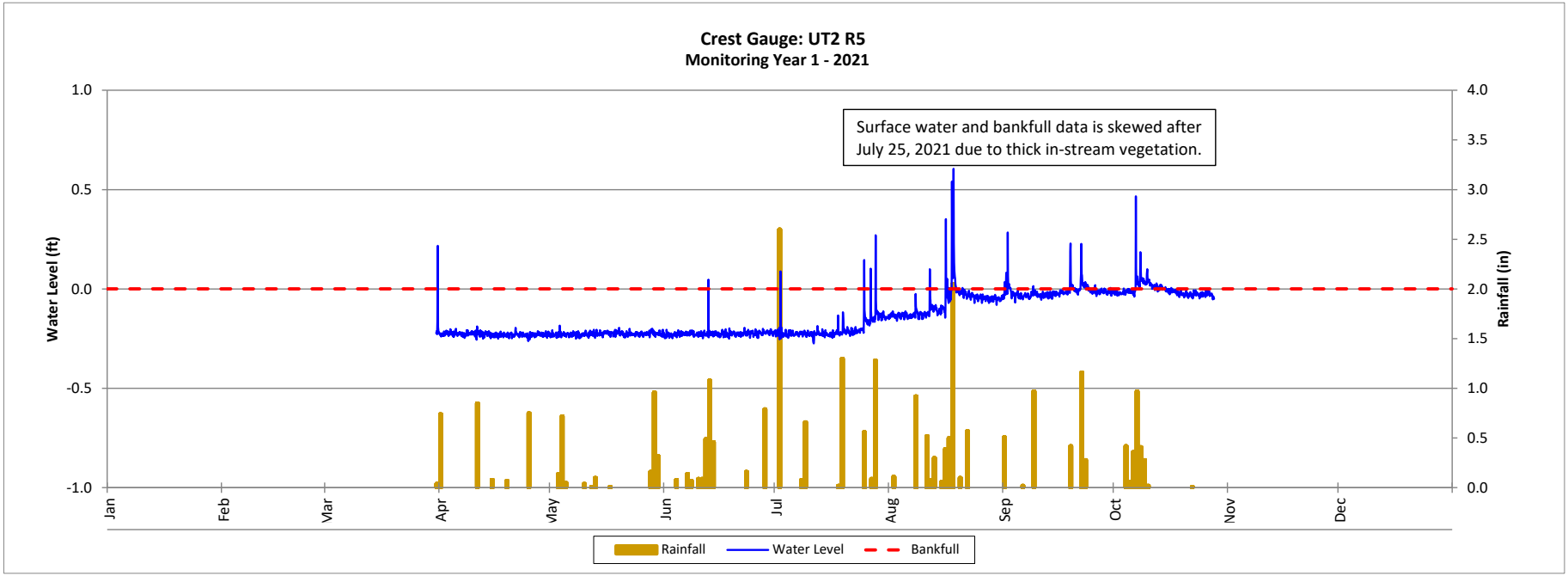
Recorded Bankfull Event Plots

Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021



Recorded Bankfull Event Plots

Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021



Recorded Bankfull Event Plots

Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

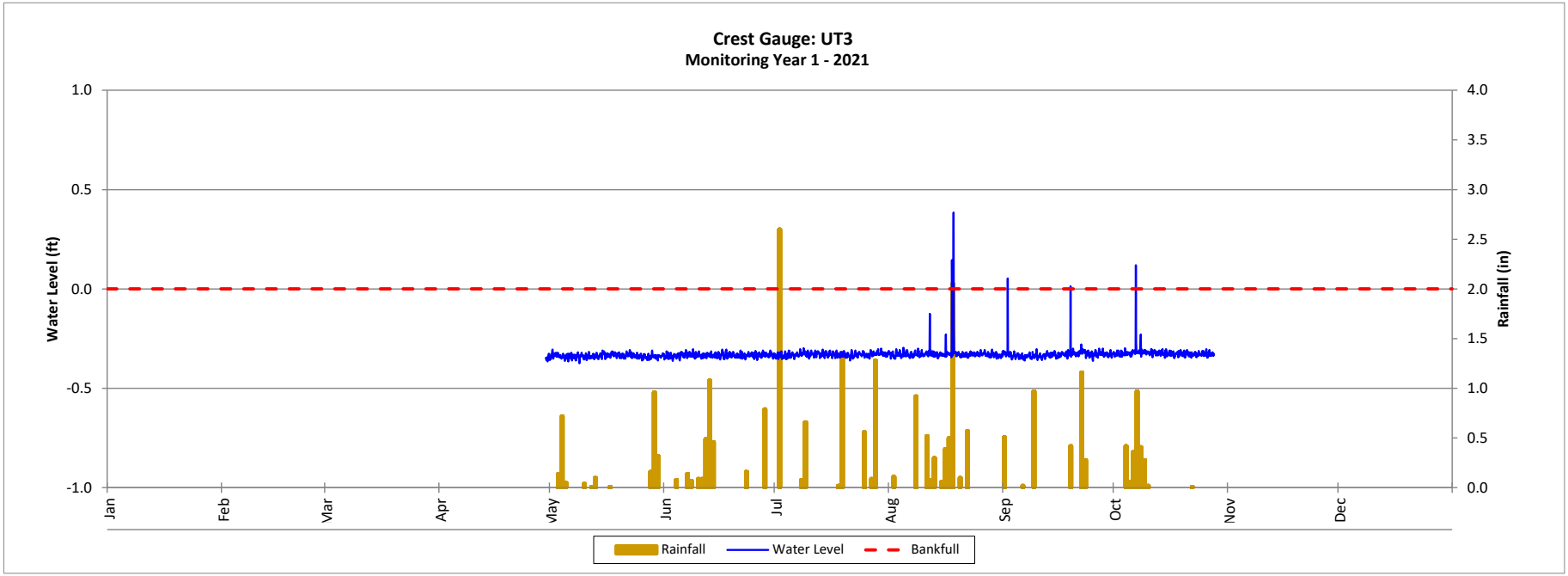


Table 12. Recorded In-Stream Flow Events Summary
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Reach	Max Consecutive Days/ Total Days Meeting Success Criteria*						
	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
UT1	210 Days/ 210 Days						
UT2 Reach 1	102 Days/ 107 Days						
UT2A Reach 2	211 Days/ 211 Days						
UT2B	189 Days/ 189 Days						

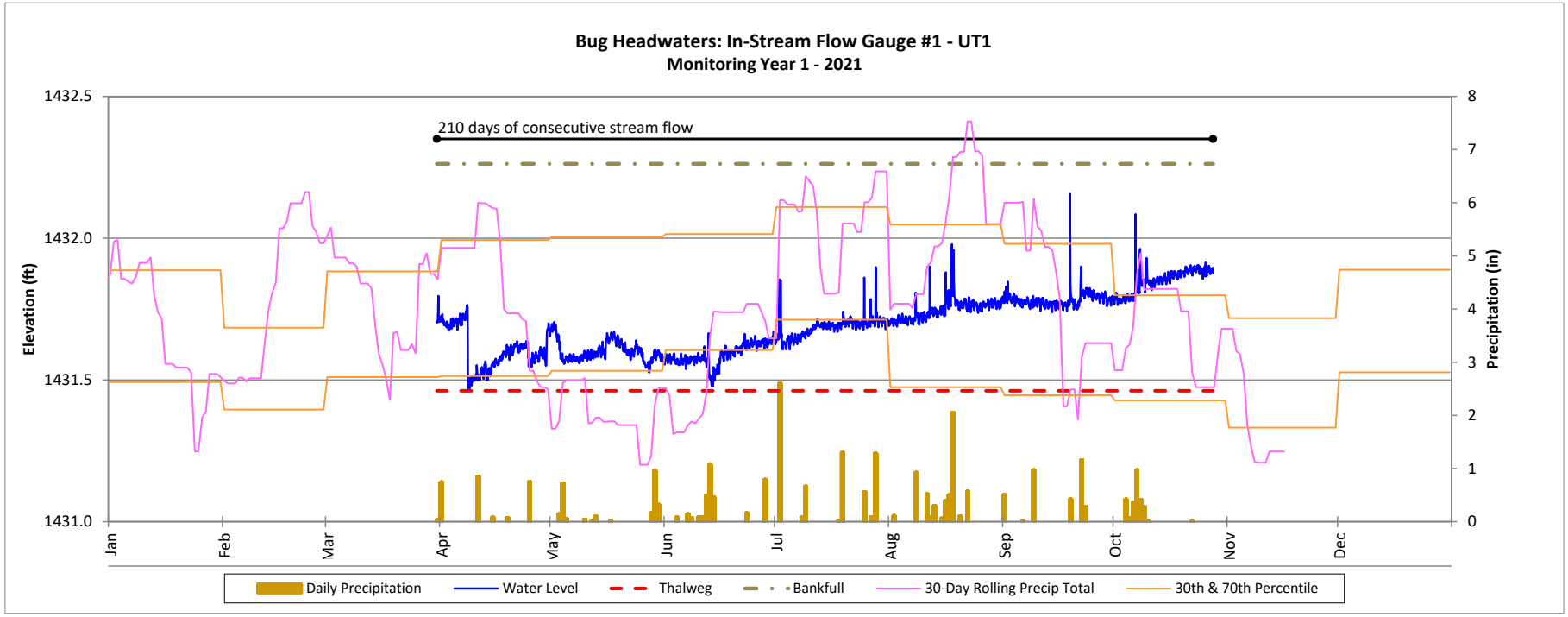
*Success criteria is 30 consecutive days of flow.

Recorded In-Stream Flow Events Plots

Bug Headwaters Mitigation Site

DMS Project No. 100084

Monitoring Year 1 - 2021

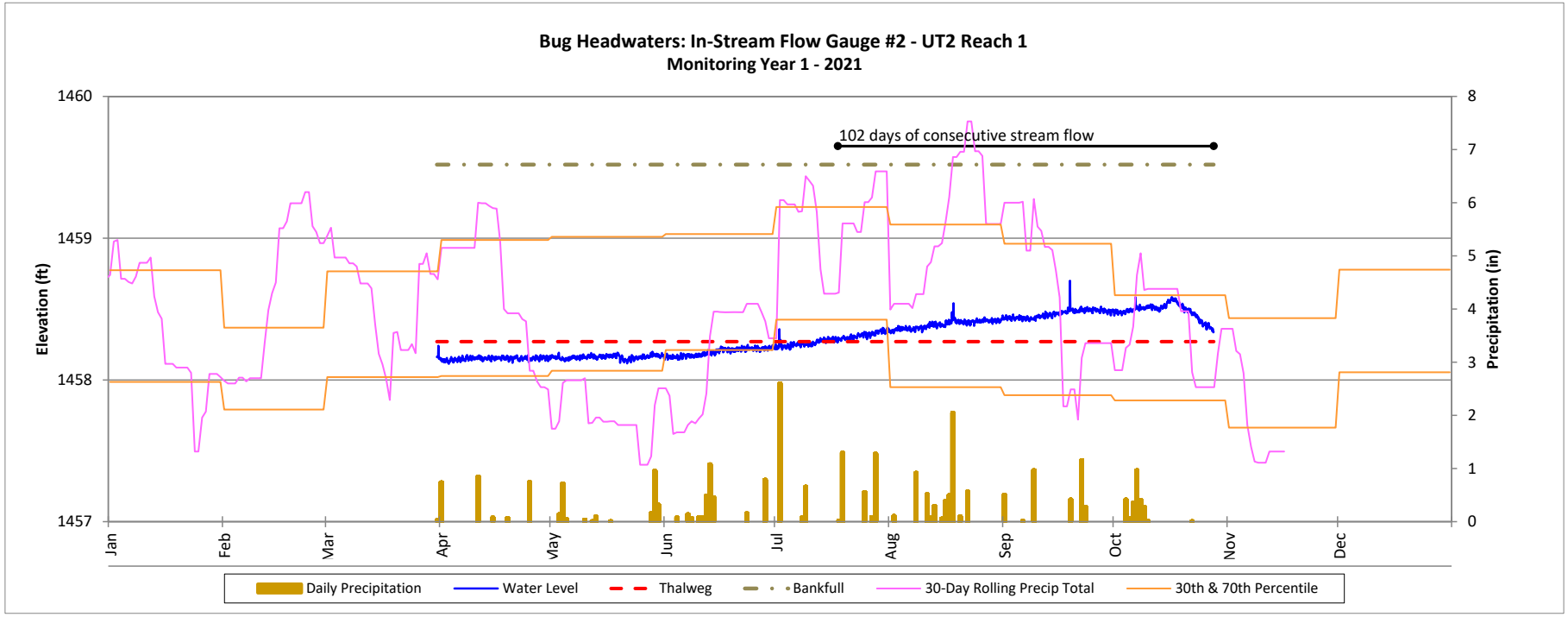


Recorded In-Stream Flow Events Plots

Bug Headwaters Mitigation Site

DMS Project No. 100084

Monitoring Year 1 - 2021

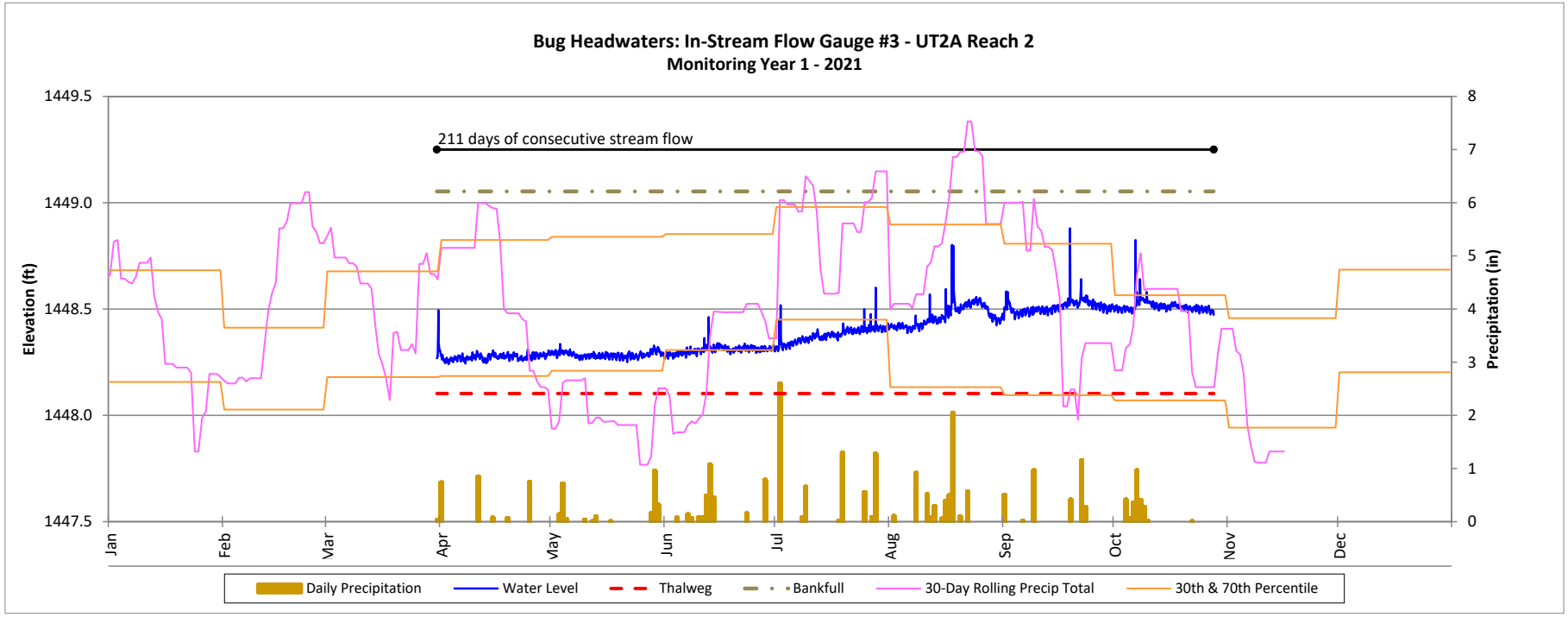


Recorded In-Stream Flow Events Plots

Bug Headwaters Mitigation Site

DMS Project No. 100084

Monitoring Year 1 - 2021

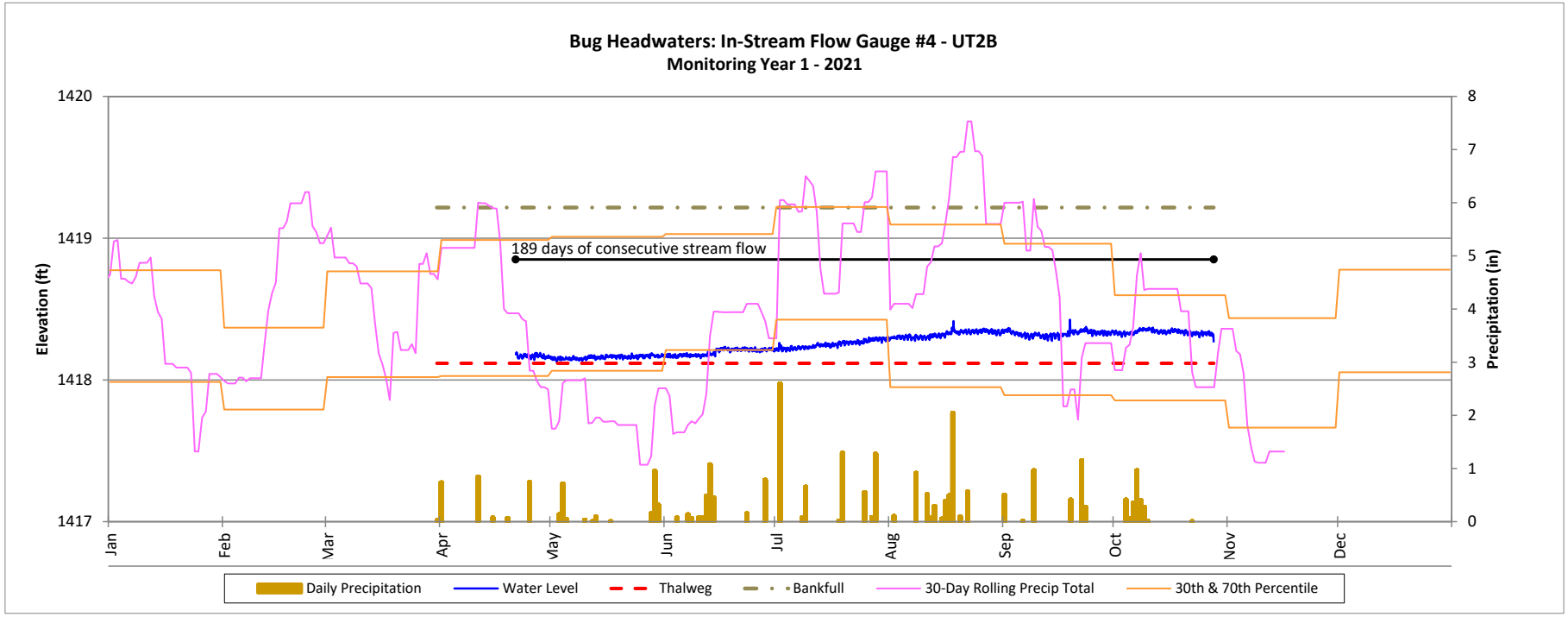


Recorded In-Stream Flow Events Plots

Bug Headwaters Mitigation Site

DMS Project No. 100084

Monitoring Year 1 - 2021



APPENDIX E. Project Timeline and Contact Info

Table 13. Project Activity and Reporting History
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Activity or Deliverable		Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted		NA	June 2018
Mitigation Plan Approved		September 2020	September 2020
Construction (Grading) Completed		NA	April 2021
Planting Completed		NA	April 2021
As-Built Survey Completed		May 2021	May 2021
Baseline Monitoring Document (Year 0)	Stream Survey	April 2021	October 2021
	Vegetation Survey	April 2021	
In-Stream Vegetation Treatment			July 2021
Year 1 Monitoring	Stream Survey	October 2021	December 2021
	Vegetation Survey	October 2021	
Year 2 Monitoring	Stream Survey	2022	December 2022
	Vegetation Survey	2022	
Year 3 Monitoring	Stream Survey	2023	December 2023
	Vegetation Survey	2023	
Year 4 Monitoring			December 2024
Year 5 Monitoring	Stream Survey	2025	December 2025
	Vegetation Survey	2025	
Year 6 Monitoring			December 2026
Year 7 Monitoring	Stream Survey	2027	December 2027
	Vegetation Survey	2027	

Table 14. Project Contact Table
Bug Headwaters Mitigation Site
DMS Project No. 100084
Monitoring Year 1 - 2021

Designer Nicole Macaluso Millns, PE	**Wildlands Engineering, Inc.** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Wildlands Construction** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609
Monitoring Performers Monitoring, POC	**Wildlands Engineering, Inc.** Jason Lorch 919.851.9986

APPENDIX F. Additional Documentation

IRT Correspondence:
Random Vegetation Plots

RE: Bug Headwaters Veg Plots

Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Tue 10/26/2021 5:12 PM

To: Carolyn Lanza <clanza@wildlandseng.com>; Jeff Keaton <jkeaton@wildlandseng.com>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>

Hi Carolyn,
That's fine if you make plots 5 and 15 random, as long as the veg in the pond bottoms is captured annually. I couldn't tell from the map that the wetland was already forested, but if supplemental planting occurred or the outside edge of the buffer was planted, I'd like that area captured in a random plot at least once during monitoring. It also helps us see if invasives are present in unplanted areas. It's also important to put random plots in areas where existing wetlands were, and in the planted area where the dams were removed. Ideally, I'd like plots 5 and 15 to be permanent and have at least two additional random plots. I'm OK with what you proposed, but we may request additional random plots in future monitoring years if we feel we're not getting an overall picture of veg success.

Here's a section from our draft guidance that may help you determine where to place plots, and what we're looking for:

Vegetation monitoring plots should be located across the site to provide a random sampling of all the vegetation community types reestablished on the site. For projects that include both streams and wetland, the plots should be located to cover both the stream buffers and wetlands. If ponds have been removed as part of the work, the area of the former pond beds must contain monitoring plots. The monitoring plots must make up a minimum of 2% of the planted portion of the site with a minimum of 4 plots. Regardless of the percentage of the site sampled, vegetation plots must cover all soil types, vegetation communities, different hydrology regimes, and mitigation approaches on the site, as well as any other areas of concern (e.g., near the easement boundary where encroachments are more likely, areas where soils have been disturbed or compacted, dam removal, etc.).

Feel free to give me a call if you need to discuss.
Thanks
Kim

Kim Browning
Mitigation Project Manager, Regulatory Division I U.S. Army Corps of Engineers

-----Original Message-----
From: Carolyn Lanza <clanza@wildlandseng.com>
Sent: Tuesday, October 26, 2021 2:56 PM
To: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>; Jeff Keaton <jkeaton@wildlandseng.com>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>
Subject: [Non-DoD Source] RE: Bug Headwaters Veg Plots

Good Afternoon Kim,

My name is Carolyn Lanza, the lead scientist working on Bug Headwaters. Jeff asked me to communicate directly with you to discuss the random veg plots. Wildlands will plan to make Veg Plot 5 and 15 random

but keep them in the general areas of both ponds throughout the monitoring lifecycle. We will also convert Veg Plot 3 to random and can move it around different wetland areas throughout the site. However, the wetland along Big Bugaboo Creek Reach 4 was predominantly forested and was left undisturbed. There was only a small section that was planted. Putting a random veg plot in that area every year would not leave us much room to move it around. We can move Veg Plot 3 to the planted areas along Big Bugaboo Creek Reach 4 once or twice throughout the monitoring lifecycle, if requested by the IRT. Attached is the planting plan for Big Bugaboo Creek Reach 4 along with the CCPV.

Thank you,

Carolyn Lanza | Environmental Scientist
O: 919.851.9986 x113 M: 313.969.7318

Wildlands Engineering, Inc.
312 West Millbrook Road, Suite 225
Raleigh, NC 27609

-----Original Message-----
From: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Sent: Monday, October 25, 2021 3:14 PM
To: Jeff Keaton <jkeaton@wildlandseng.com>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>; Carolyn Lanza <clanza@wildlandseng.com>
Subject: RE: Bug Headwaters Veg Plots

Hey Jeff
The District Guidance states that a combination of permanent and fixed plots and random plots should be used to demonstrate vegetation coverage, so it's assumed when we review the draft mitigation plans that random plots are included. As long as the plots make up the minimum 2% of the planted portion of the site, I'm fine with switching 3 of them to random. I'm definitely going to want to see veg data where the pond was dewatered, so it might be good to plan for plot 5 to be permanent, or have a random plot in that general area each year. I can't tell if plot 15 is an area where a pond was removed, but if so, I'll want to see veg data here annually as well. I also noted a lot of existing wetlands on the site that aren't captured with plot data, so putting a random plot on Big Bugaboo Creek Reach 4, near station 141+00, will likely be a request in future monitoring years. So, I'm ok with making those three plots random, but I'd like to capture data in the general areas where the ponds were removed annually.
Thanks
Kim

Kim Browning
Mitigation Project Manager, Regulatory Division I U.S. Army Corps of Engineers

-----Original Message-----
From: Jeff Keaton <jkeaton@wildlandseng.com>
Sent: Monday, October 25, 2021 10:52 AM
To: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>; Carolyn Lanza <clanza@wildlandseng.com>
Subject: [Non-DoD Source] Bug Headwaters Veg Plots

Hi Kim,

The Bug Headwaters Mit Plan was approved without any indication of using random veg plots. Our scientists installed 15 fixed veg plots for MY0 without including any random veg plots. Based on DMS comments, Wildlands is requesting converting veg plots 3, 5, and 15 to random veg plots for future monitoring reports. Please let me know if this is OK and if you need any more information to support this change. CCPV maps for MY0 attached. Thanks.

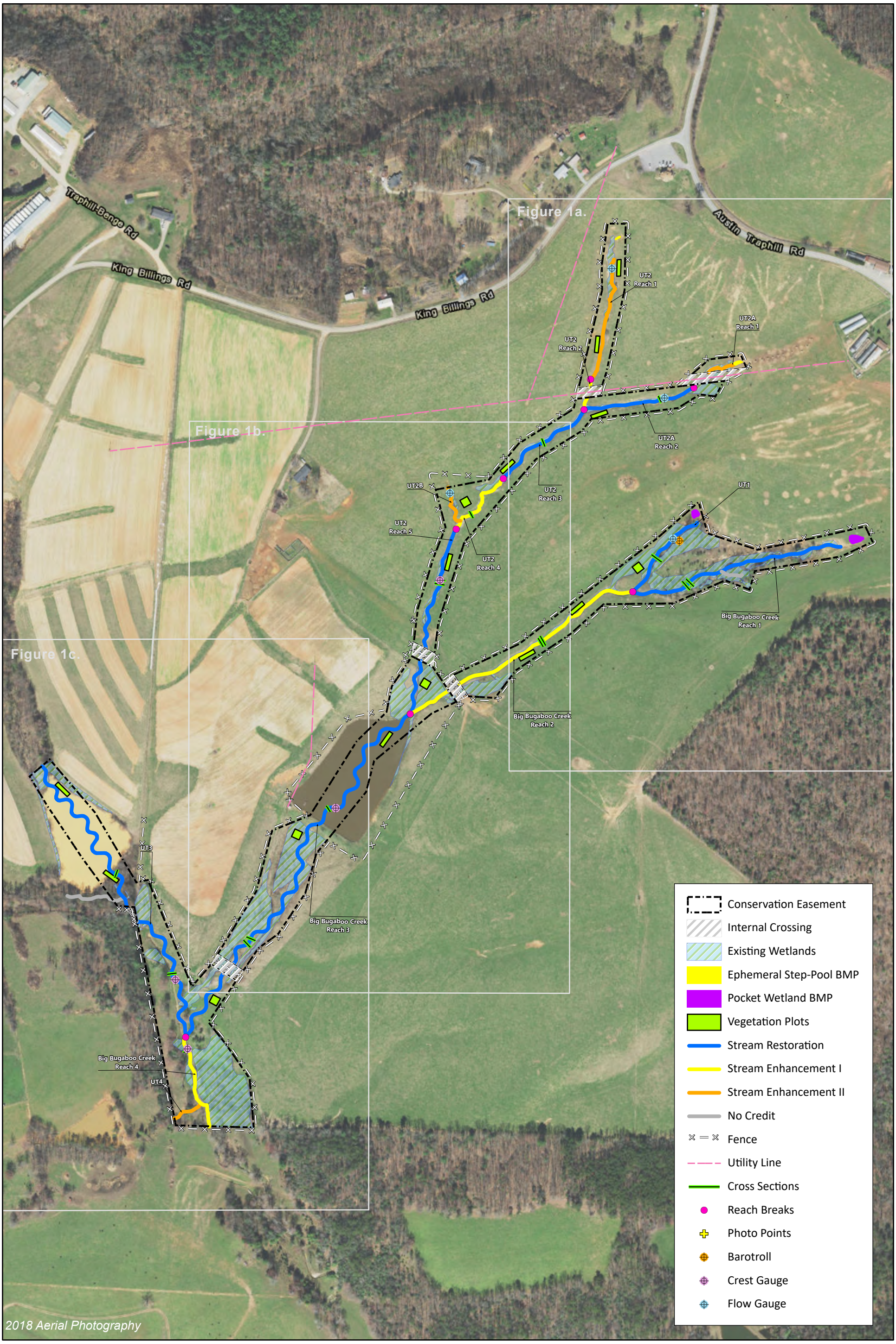
Jeff Keaton, PE | Senior Water Resources Engineer

O: 919.851.9986 x103 M: 919.302.6919

Wildlands Engineering, Inc. <Blockedhttp://Blockedwww.wildlandseng.com/>

312 West Millbrook Road, Suite 225

Raleigh, NC 27609



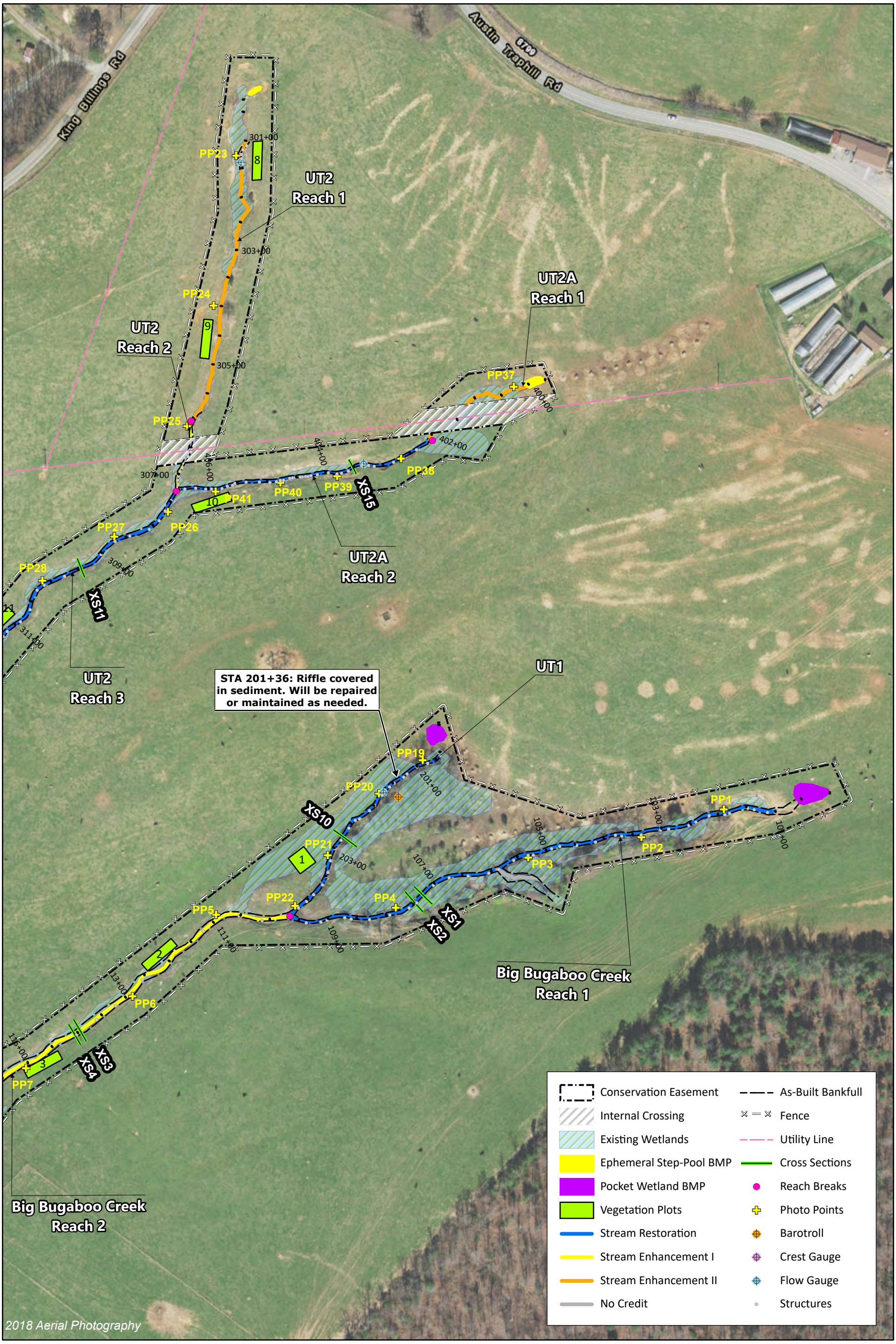
WILDLANDS ENGINEERING

0 350 700 Feet

N

Figure 1. Current Condition Plan View Key
Bug Headwaters Mitigation Site
Yadkin Basin 03040101
Monitoring Year 0 - 2021

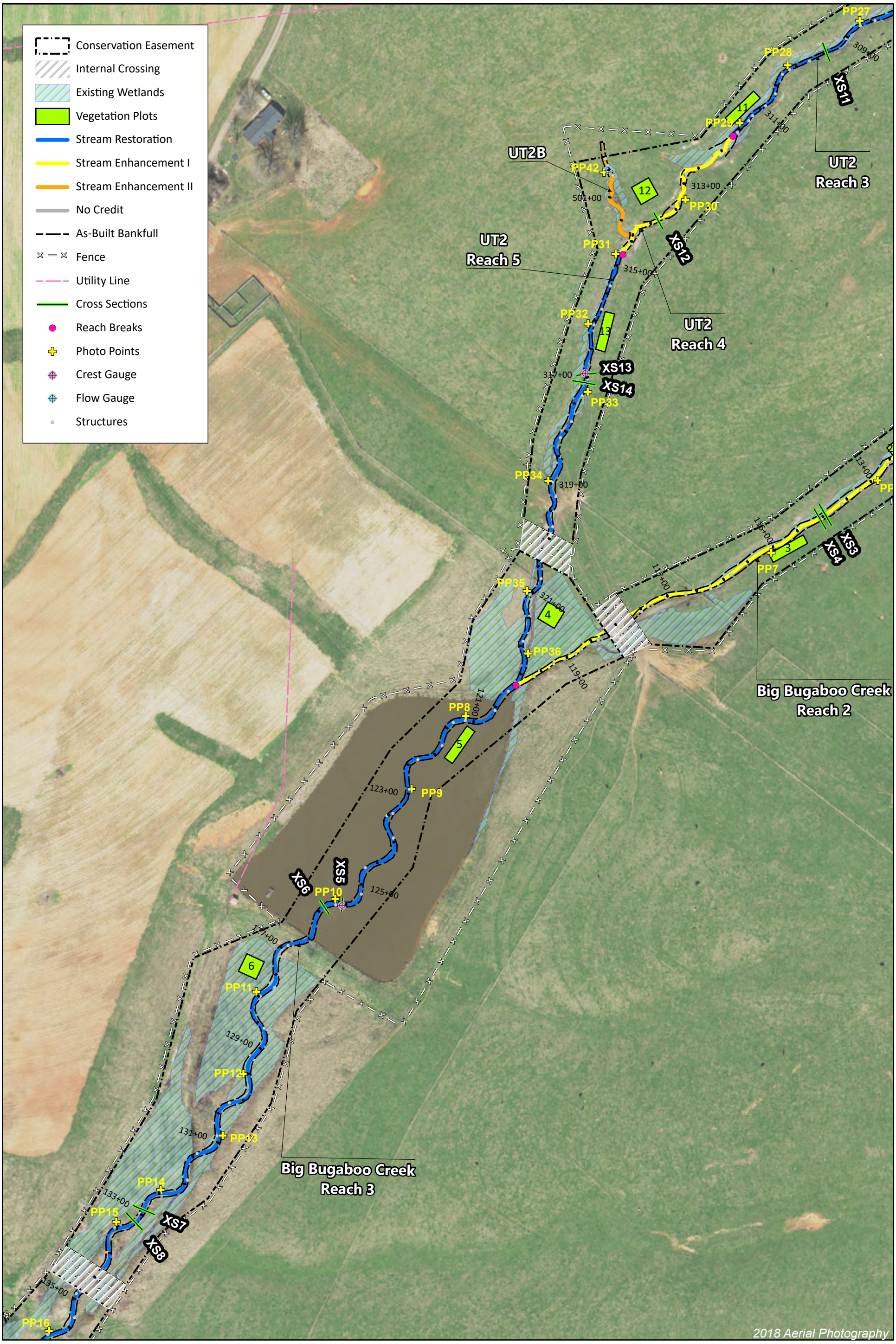
Wilkes County, NC



WILDLANDS ENGINEERING

Figure 1a. Current Condition Plan View
Bug Headwaters Mitigation Site
Yadkin Basin 03040101
Monitoring Year 0 - 2021

Wilkes County, NC



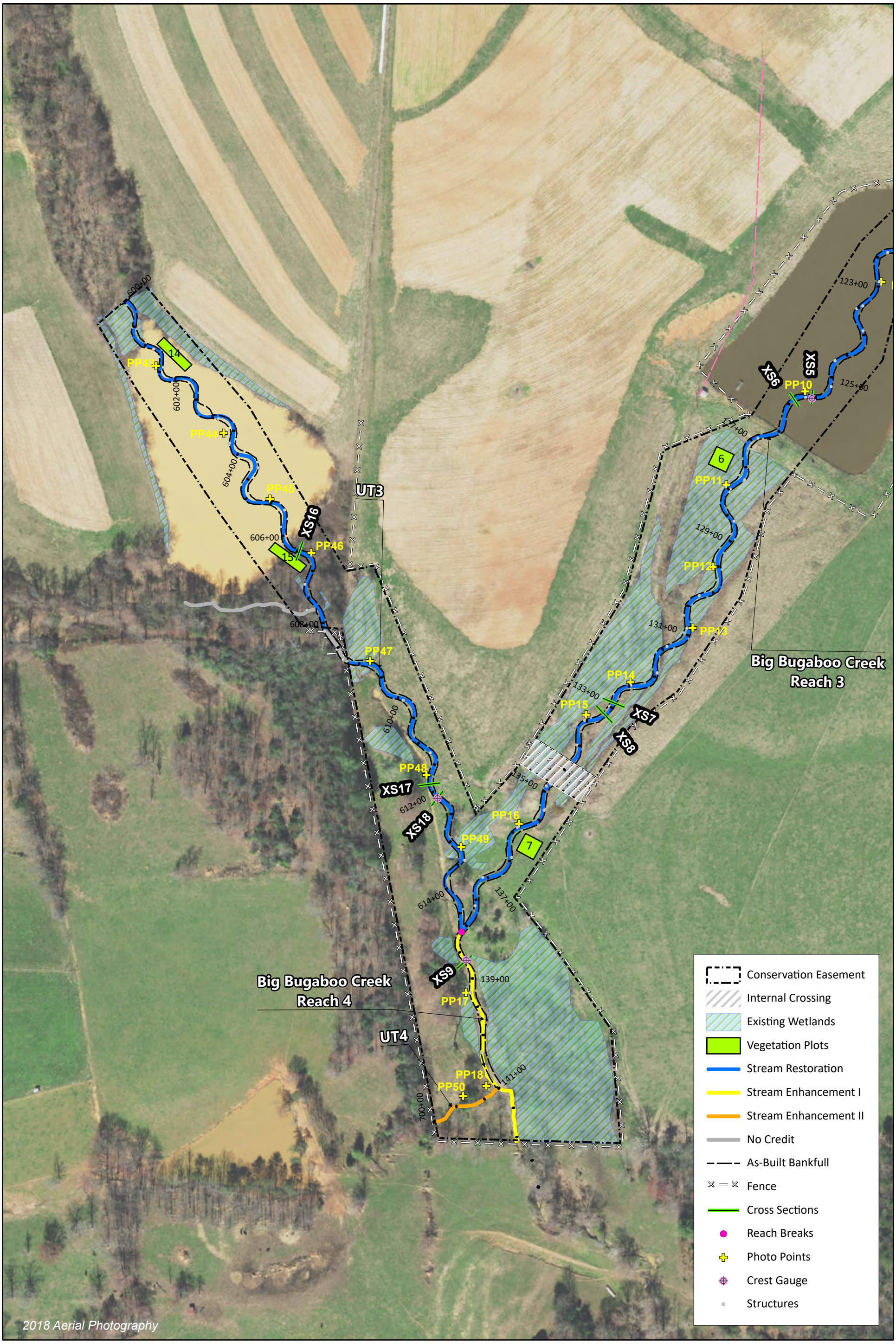
WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 1b. Current Condition Plan View
Bug Headwaters Mitigation Site
Yadkin Basin 03040101
Monitoring Year 0 - 2021

Wilkes County, NC



WILDLANDS ENGINEERING

Figure 1c. Current Condition Plan View
Bug Headwaters Mitigation Site
Yadkin Basin 03040101
Monitoring Year 0 - 2021

Wilkes County, NC

As-Built IRT Comments

December 1, 2021

U.S. Army Corps of Engineers
Regulatory Division
Raleigh Field Office
3331 Heritage Trade Drive, Suite 105
Wake Forest, NC 27587

Attention: Kim Browning

Subject: Monitoring Year 0 Report
Bug Headwaters Mitigation Project, Wilkes County
Yadkin River Basin HUC 03040101
USACE Action ID No. SAW-2018-01788/DWR No. 2018-1273

Dear Kim:

We have reviewed the IRT's comments on the Monitoring Year 0 Report for the Bug Headwaters Mitigation Site that you sent via email on November 23, 2021. Below are responses to each of the IRT's comments in your email. Your original comments are provided followed by our responses in bold italics. This letter will also be included with the MY1 Report.

USACE Comments, Kim Browning:

1. Ground instability in both pond bottoms will likely be something to watch during monitoring with regard to vegetation establishment. Was the sediment from the pond removed, and were soil amendments added prior to plating?

   For both ponds, sediment was removed from the stream corridor and replaced with stable fill material for channel construction. Additional sediment was removed from the pond bottom along Big Bugaboo Reach 3 to reach bankfull and floodplain elevations. Soil amendments were added during temporary and permanent seeding activities. Herbaceous vegetation has been established including a variety of pollinator species. The pond bottom along the right side of Big Bugaboo Creek Reach 3 and both sides of UT3 will receive supplemental plantings this winter. This will be addressed in the MY1 report.

2. What is the source of sediment covering the riffle at STA 201+36?

   Bank settling was an issue in this area due to the surrounding saturated soil in wetlands. Vegetation has been established and the sediment is expected to clear as the channel and floodplain continue to stabilize.

3. If the existing wetlands were planted, please capture some of those areas with random veg plots in future monitoring years.

The MY1 assessment has captured some existing wetlands with the random vegetation plots as well as with fixed plots 1, 3, and 4. Wildlands will continue to rotate the random plots around throughout the monitoring period to capture other existing wetlands.

4. Were planting substitutions made? It's difficult to tell the percent of each species planted from Table 6.

   Tag alder (Alnus serrulata) was not available for the wetland planting zone. This species was not replaced due to very limited nursery stock availability of appropriate species, but species percentage was adjusted accordingly in the As-Built Record Drawings Sheet 3.00 Planting Table.

DWR Comments, Erin Davis:

1. Overall, DWR was pleased with the level of detail included in the MY0 Report. We also appreciated DMS' comments. And thank you for providing the drone video, it was very helpful for this review.

   Noted, thank you.

2. UT3 & UT6 – It could simply be a terminology thing, but "stone bank fortification" raises a yellow flag about riprapping a section of stream. Please provide a brief description of what was done as part of the stone bank fortification, as well as a brief justification of need.

   Similar to much of the site, quarry stone was used at the UT3/UT6 confluence because no native stone was available. UT6 is not generating any credit. The pre-construction alignment of UT6 was not altered but required 3'+ of fill to match the proposed UT3 grade. Larger stone was added to the riffle matrix and extended partially up the banks to deter settling and ensure stability of the confluence.

3. Looking at the redline drawing set restoration reaches profiles, many of the as-built pools are shallower than the design. Are these features expected to deepen over time? Will changes be captured by the project cross-sections?

   Several heavy rain events occurred during construction before vegetation was established contributing to sediment in the pools. Bank and floodplain vegetation has now been established and the sediment is expected to flush through the system over time. Cross-sections will be surveyed during monitoring years 1, 2, 3, 5, and 7, and data will be included in the annual monitoring reports showing any changes captured in the cross-sections.

4. Based on observations from the video, if channel maintenance is being considered to manage any vegetation growing within stream channels it should be proposed within the next two years. In general, DWR does not support channel maintenance beyond MY3 in order to evaluate the trajectory of a credit feature's functions (stream vs. wetland).

   An aggressive in-stream vegetation treatment will occur in 2022 to manage the vegetation growing within the stream channels and floodplain wetlands. Once the live stakes become established and an effective treatment has occurred, it is expected that no channel maintenance will be needed.

EPA Comments, Todd Bowers:

I have performed a cursory review of the Bug Headwaters mitigation site As-Built and MY0 Reports dated October 2021. At this time I do not have any specific comments or concerns with the site as

presented by Wildlands Engineering. The major deviations such as rock sill replacement with log sills, the realignment of UT 3, brush toe and riffle enhancements, fence realignments, BMP enhancements, and the replacement of tag alder with other species in the planting plan were all noted and acceptable.

Noted.

Please contact me at 919-851-9986 x103 if you have any questions.

Thank you,

Jeff Keaton, PE
Project Manager

IRT Correspondence:
Adaptive Management Activities

Carolyn Lanza

From: Carolyn Lanza
Sent: Friday, January 21, 2022 12:41 PM
To: Carolyn Lanza
Subject: Bug Headwaters

From: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Sent: Friday, January 21, 2022 11:36 AM
To: Jason Lorch <jlorch@wildlandseng.com>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>; Jeff Keaton <jkeaton@wildlandseng.com>; andrea.leslie@ncwildlife.org; 'Wilson, Travis W. (travis.wilson@ncwildlife.org)' <travis.wilson@ncwildlife.org>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; erin.davis@ncdenr.gov; Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Wiesner, Paul <paul.wiesner@ncdenr.gov>
Subject: RE: Bug Headwaters

Good morning Jason,

Thanks for the feedback. We don't have any further questions. We're fine with your approach to replant the pond beds as long as additional veg transects are added to monitor success.

Have a good weekend,
Kim

Kim Browning
Mitigation Project Manager, Regulatory Division I U.S. Army Corps of Engineers

-----Original Message-----
From: Jason Lorch <jlorch@wildlandseng.com>
Sent: Friday, January 21, 2022 7:29 AM
To: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>; Jeff Keaton <jkeaton@wildlandseng.com>; andrea.leslie@ncwildlife.org; 'Wilson, Travis W. (travis.wilson@ncwildlife.org)' <travis.wilson@ncwildlife.org>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; erin.davis@ncdenr.gov; Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Wiesner, Paul <paul.wiesner@ncdenr.gov>
Subject: [Non-DoD Source] RE: Bug Headwaters

Kim, we share your concern over the murdannia this early in the project, however, we are prepared to deal with it. We have people who are experienced in treating it and will be working on controlling it at the site. The areas of murdannia will be carefully treated to reduce non-target damage as much as possible. We will work to establish temporary seed after the last treatment of the season in August, and once the murdannia is effectively under control, a native seed mix will be seeded in the treated areas. We will re-evaluate and replant woody species as necessary.

As stated in the mitigation plan, the pond sediments were removed along the stream corridor through each pond and replaced with fill material from the removed dams. The new stream channels were constructed through the fill material. Beyond the stream corridor, the pond bed sediments were not removed. The old pond bed along Big Bugaboo Creek does not have cracking, but portions of the old pond bed along UT3 do. We have seen this on other successful projects such as Bethel Branch and Catfish Pond. Once the old pond beds dry out during MY1, vegetation seems to grow well. There is no plan to remove the old pond sediment since we feel that these areas have drained enough for vegetation to adequately grow.

Let me know if you have any other questions or concerns before we move forward with these actions. Thanks!

Jason Lorch, GISP | Senior Environmental Scientist
O: 919.851.9986 x107 M: 919.413.1214

Wildlands Engineering, Inc.
312 West Millbrook Road, Suite 225
Raleigh, NC 27609

-----Original Message-----
From: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Sent: Thursday, January 13, 2022 4:15 PM
To: Jason Lorch <jlorch@wildlandseng.com>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>; Jeff Keaton <jkeaton@wildlandseng.com>; andrea.leslie@ncwildlife.org; 'Wilson, Travis W. (travis.wilson@ncwildlife.org)' <travis.wilson@ncwildlife.org>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; erin.davis@ncdenr.gov; Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Wiesner, Paul <paul.wiesner@ncdenr.gov>
Subject: RE: Bug Headwaters

Hi Jason,
Erin, Travis, Andrea, Casey and I discussed this and since this is only the first year for this project, the IRT is OK with the proposed treatment of the murdannia. If this was later in monitoring, we'd likely require an adaptive management plan. It is concerning that it is already covering a large portion of the site. From my understanding, glyphosate is somewhat effective; however, it will likely eliminate the herbaceous layer as well. We anticipate that several years of treatment will be required until the present seed source has germinated and been treated. Once the murdannia has been eliminated from the site, we will require a native herbaceous seed mix to be planted. Hopefully you will be able to treat it in the wetland areas that are adjacent to the conservation easement as well.

Regarding the pond beds, was the site constructed during a wet time of year that prevented you from removing the sediment from the pond bottom prior to planting? Is the sediment dried and cracking? Does the replanting include removing the old sediment and applying soil amendments, or do you feel that the areas have drained enough that a second planting would be successful? We've observed many restoration projects through old pond beds where the sediment was not removed and it results in a fractured surface with a herbaceous layer and very limited stem survival. We would suggest that you look at the wetland indicator status for the proposed species and only plant those that are FACW and OBL; for example, Northern Red Oak is FACU. Lastly, we'll require additional veg transects in the replanted areas to monitor success.

Please follow up with more details for the pond bed replanting. Reach out with any questions.
Thanks
Kim

Kim Browning
Mitigation Project Manager, Regulatory Division I U.S. Army Corps of Engineers

-----Original Message-----
From: Jason Lorch <jlorch@wildlandseng.com>
Sent: Friday, January 07, 2022 2:40 PM
To: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>; Davis, Erin B <erin.davis@ncdenr.gov>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>; Jeff Keaton <jkeaton@wildlandseng.com>
Subject: [URL Verdict: Neutral][Non-DoD Source] Bug Headwaters

Kim and Erin, I wanted to give you a quick update on Bug Headwaters and make sure you are fine with our proposed management of the project this year. The first issue is that murdannia is growing in the wetlands and streams throughout the project. Attached are the CCPV Maps showing the locations of the murdannia and the Vegetation Condition Assessment Table from the MY1 Monitoring Report. The plan is to spray the murdannia site-wide in May and assess the site a month later to determine what further actions will be necessary. A follow up treatment will most likely be necessary, but until we see how the murdannia responds to the original treatment, we won't know what our plan of action will be.

The second issue is that portions of the old pond beds are very saturated and a majority of the planted trees have not survived. This encompasses an area of 1.75 acres, approximately 9% of the planted area of the site. Attached is a proposed planting list with the species, type of plant, quantities, and a note to which plants were in the approved Mitigation Plan. The plan is to plant these areas in late February 2022.

If you could review the attached information and let us know if you have any concerns with our management plan moving forward, it would be greatly appreciated. Let me know if you have any questions about it. Thanks!

Jason Lorch, GISP | Senior Environmental Scientist

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