MONITORING YEAR 1 ANNUAL REPORT
Final

January 2022

LYON HILLS MITIGATION SITE
Wilkes County, NC
Yadkin River Basin
HUC 03040101

DMS Project No. 100085
NCDEQ Contract No. 7620
USACE Action ID No. SAW-2018-01784
DWR Project No. 2018-1274 v1
Data Collection Dates: April-November 2021

DMS RFP No. 16-007406
June 19, 2018

PREPARED FOR:

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

January 19, 2022

Mr. Kelly Phillips
Project Manager
NCDEQ- Division of Mitigation Services
610 East Center Avenue, Suite 301
Mooresville, NC 28115

Subject: Lyon Hills Mitigation Site – Monitoring Year 1 Draft Report
Yadkin River Basin – CU# 03040101
Wilkes County
DMS Project ID No. 100085
Contract # 7620

Dear Mr. Phillips:

On January 14, 2022, Wildlands Engineering received comments from the North Carolina Division of Mitigation Services (DMS) regarding the Draft Monitoring Year 1 Report for the Lyon Hills Mitigation Site dated December 3, 2021. The following letter documents DMS feedback and Wildlands' corresponding responses and revisions to the Monitoring Year 1 Report.

Section 2.4 Stream Areas of Concern: Indicate the current status of the sediment source that caused the aggradation along UT5. Did the pond function as a sediment sink and is the sediment source adequately controlled?

Response: A statement has been added addressing the sediment source.

Section 2.4 Stream Areas of Concern: Please include discussion of the perched culvert on Hanks Branch Reach 3 (Appendix A culvert photographs).

Response: A discussion of the perched culvert has been added.

Section 2.5 Hydrology Assessment: Indicate if the UT1 gauge has been repaired and is currently operational.

Response: Text has been added to Section 2.5 on the status of UT1 crest gauge.

Section 2.6 Adaptive Management Plan: Please add discussion for the perched culvert repair plan for Hanks Branch Reach 3 as indicated in the MY0 report.

Response: A discussion of the perched culvert has been added.

Visual Assessment Tables: Please include the date that the project was visually assessed at the top of each table.

Response: The date has been added.

Digital Deliverable:

Please review cross section calculations and ensure that all points outside of the main channel (defined by the low top of bank elevation) are excluded using the omit bankfull boxes. This must be done before adjusting the bankfull elevation to achieve the MY0 cross sectional area. For example, cross section 11 should have a BHR of less than 1 after the bankfull elevation is adjusted to achieve the MY0 cross sectional area.

Response: All necessary cross sections have been reviewed and updated.

Please include figures displaying the crest gauge and precipitation data.

Response: Crest gauge data is now included.

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:

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ENGINEERING

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LYON HILLS MITIGATION SITE

Monitoring Year 1 Annual Report

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Section 1: PROJECT OVERVIEW

The Lyon Hills Mitigation Site (Site) is located in Wilkes County, approximately eleven miles northwest of the Town of Elkin. The Site contains a network of streams that range in drainage area from five acres to 9.58 square miles. These include a portion of Sparks Creek, Hanks Branch (tributary to Sparks Creek), five unnamed tributaries to Hanks Branch; four of which originate within the project limits, and two unnamed tributaries to Sparks Creek. Sparks Creek and its tributaries are located within the East Prong Roaring River 12-digit HUC (030401010600). The site is within a targeted local watershed (TLW) but is not in a local watershed planning (LWP) area. The HUC is described in the 2009 Upper Yadkin Pee-Dee River Basin Restoration Priorities (RBRP) document (NC EEP, 2009).

1.1 Project Quantities and Credits

A conservation easement was recorded on 20.72 acres. Mitigation work within the Site included restoration, enhancement I, and enhancement II of 9,363 linear feet of perennial and intermittent stream channels. The project is expected to provide 5,304.783 stream credits 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**
STREAMS							
Spark Creek - Not For Credit	215	215	Cool	EII	2.5	0	No buffer on right side
Sparks Creek	405	405	Cool	EII	2.5	162.000	Fenced Out Cattle, Planted Buffer
Sparks Creek - Not For Credit	42	42	Cool	EII	2.5	0	Ford Crossing
Sparks Creek	332	332	Cool	EII	2.5	132.800	Fenced Out Cattle, Planted Buffer
Hanks Branch Reach 1	1,678	1,659	Cool	EII	2.5	671.200	Localized Bank Repairs, Floodplain Bench at Upstream End, Fenced Out Cattle
Hanks Branch Reach 2	1,065	1,012	Cool	EII	2.5	426.000	Fenced Out Cattle, Localized Bank Repairs, Planted Buffer, Add Wood to Channel
Hanks Branch Reach 2 - Not for Credit	42	42	Cool	EII	2.5	0	Culvert Crossing
Hanks Branch Reach 3	581	585	Cool	EI	1.5	387.333	Fenced Out Cattle, Floodplain Bench, Planted Buffer
UT1 - Not for Credit	60	57	Cool	R	1	0	TCE to work above property line
UT1	659	657	Cool	R	1	659.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT1 - Not for Credit	40	40	Cool	R	1	0	Culvert Crossing
UT1	106	105	Cool	R	1	106.000	Restored Dimension, Pattern, and Profile, Planted Buffer

UT2	78	78	Cool	EII	3	26.000	Fenced Out Cattle
UT3 Reach 1	655	652	Cool	R	1	655.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT3 Reach 2	447	436	Cool	EII	2.5	178.800	Fenced Out Cattle, Localized Bank Repairs, Planted Buffer
UT3 Reach 3	513	512	Cool	R	1	513.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT3 Reach 3 - Not for Credit	45	45	Cool	R	1	0	Culvert Crossing
UT3 Reach 3	74	74	Cool	R	1	74.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT3 Reach 4	272	271	Cool	EII	4	68.000	Fenced Out Cattle, Planted Buffer
UT3A	253	252	Cool	EII	2.5	101.200	Fenced Out Cattle, Planted Buffer
UT4 Reach 1	233	233	Cool	R	1	233.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT4 Reach 2	323	319	Cool	EII	2.5	129.200	Fenced Out Cattle, Stabilize Headcuts, Planted Buffer
UT4 Reach 3	140	139	Cool	R	1	140.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT4 Reach 3 - Not for Credit	40	40	Cool	R	1	0	Culvert Crossing
UT4 Reach 3	100	100	Cool	R	1	100.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT5 Reach 1	437	437	Cool	EII	4	109.250	Fenced Out Cattle
UT5 Reach 2	220	221	Cool	R	1	220.000	Restored Dimension, Pattern, and Profile, Planted Buffer, Removed Impoundment
UT5 Reach 2 - Not for Credit	35	35	Cool	R	1	0	Culvert Crossing
UT5 Reach 2	107	107	Cool	R	1	107.000	Restored Dimension, Pattern, and Profile, Planted Buffer
UT5A	318	318	Cool	EII	3	106.000	Fenced Out Cattle
					Total	5,304.783	

Restoration Level	**Stream**		
	Warm	**Cool**	**Cold**
Restoration		2,807.000	
Enhancement I		387.333	
Enhancement II		2,110.450	
Preservation		---	
Totals		5,304.783	
Total Stream Credit	**5,304.783**		

1.2 Project Goals and Objectives

The project is intended to provide numerous ecological benefits within the Yadkin River Basin. While benefits such as habitat improvement and geomorphic stability are limited to the Site, reduced nutrient and sediment loading have farther reaching effects. Table 2 below describes expected outcomes to water quality and ecological processes associated with the project goals and objectives. These goals were established and completed with careful consideration of goals and objectives described in the RBRP and to meet the DMS mitigation needs while maximizing the ecological and water quality uplift within the watershed.

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 a stable pattern and profile considering hydrologic and sediment inputs to the system; install bank revetments and grade control; install bank vegetation.	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.
Reconnect channels with floodplains and riparian wetlands	Reconstruct stream channels with appropriate bankfull dimensions and depth relative to the 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 channel.	Crest gauges and/or pressure transducers recording flow elevations.	Hanks Branch Reach 3, UT3 Reach 3, UT4 Reach 3, and UT5 Reach 2 obtained bankfull events in MY1. UT1 crest gauge had a gauge malfunction. UT4 Reach 1 obtained 259 days of consecutive flow during MY1.
Improve instream habitat	Install habitat features such as cover logs, log sills, and brush toes into restored/enhanced streams. Add woody materials to channel beds. Construct a variety of riffle features and 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
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 zone where 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.	All 9 vegetation plots have a planted stem density greater than 320 stems per acre.
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

According to the RBRP, agricultural land use, including 30 animal operations, is a major stressor to aquatic resources in the lower portion of the HUC. Degraded riparian buffers are also noted as a significant stressor. Stressors described for the 8- digit CU include erosion and sedimentation (including erosion from pasture lands), which lead to aquatic habitat degradation. Turbidity and fecal coliform bacteria violations have been documented across the CU. The Site is located in DWR Subbasin 03-07-01. The 2008 Yadkin Pee-Dee River Basinwide Water Quality Plan (NC DWR, 2008) indicates that fecal coliform concentrations often exceeded the maximum regulatory limit in the CU which creates a potential health risk. The plan also notes major stressors in the Yadkin River Basin include excessive sedimentation and changes in hydrology and geomorphology due to urban development and agriculture. Agriculture was identified in the plan as the most significant stressor leading to water quality degradation in the Yadkin River basin.

Table 3: Project Attributes

PROJECT INFORMATION			
Project Name	Lyon Hills Mitigation Site	County	Wilkes County
Project Area (acres)	20.72	Project Coordinates	36.32924° N, 81.01018° W
PROJECT WATERSHED SUMMARY INFORMATION			
Physiographic Province	Piedmont	River Basin	Yadkin
USGS HUC 8-digit	03040101	USGS HUC 14-digit	03040101060030
DWR Sub-basin	03-07-01	Land Use Classification	66% forested, 28% agriculture, 6%developed,
Project Drainage Area (acres)	6,131	Percentage of Impervious Area	<1%

RESTORATION TRIBUTARY SUMMARY INFORMATION					
Parameters	**Hanks Branch**	**UT1**	**UT3**	**UT4**	**UT5**
Pre-project length (feet)	3,384	930	2,112	836	793
Post-project (feet)	3,298	802	1,990	831	800
Valley confinement (Confined, moderately confined, unconfined)	Unconfined		Confined		Unconfined
Drainage area (acres)	669	37	46	12	13
Perennial, Intermittent, Ephemeral	Perennial				
DWR Water Quality Classification	C				
Dominant Stream Classification (existing)	C4	B4	B4	B4	B4
Dominant Stream Classification (proposed)	C4	B4	B4	B4	C4b
Dominant Evolutionary class (Simon) if applicable	Stage I		Stage IV		

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, 2019)
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.

2.1 Vegetative Assessment

The MY1 vegetative survey was completed in September 2021. Vegetation monitoring resulted in a stem density range of 324 to 607 planted stems per acre which is well above the interim requirement of 320 stems per acre required at MY1. Average stem density was 499 planted stems per acre. All 9 vegetation plots exceeded the interim success criterion and are on track to meet the final success criterion required for MY7. Along with a successful tree planting, the herbaceous vegetation is dense 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

No vegetation areas of concern were identified during MY1.

2.3 Stream Assessment

Morphological surveys for MY1 were conducted in September 2021. All streams within the Site are stable and functioning as designed. All 11 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. Refer to Appendix A for the Visual Stream Morphology Stability Assessment Table and Stream Photographs. Refer to Appendix C for Stream Geomorphology Data.

2.4 Stream Areas of Concern

Dense in-stream vegetation was observed along UT5 Reach 2 and sporadically found along UT4 Reach 1 and 3 (Figure 1c). Before vegetation was established on the banks, excess sediment washed into the channel from the surrounding areas after the pond was removed, causing aggradation along UT5 Reach 2. The in-stream vegetation continued to trap the sediment, preventing sediment from naturally moving through the system. Once the in-stream vegetation is treated in 2022, it is expected the sediment will flush through UT5. Dense vegetation has become established on the floodplain where the pond was removed, preventing further sediment from entering the stream. See Section 2.6 for further information on treating the in-stream vegetation.

Out of the six internal easement breaks, one culvert crossing became perched (Appendix 2 Culvert Crossing Photographs) after a major storm event in MY0. The culvert crossing along Hanks Branch was installed on bedrock, and material below the downstream invert washed away during the storm, thus creating a perched but stable culvert. Wildlands will continue to assess the situation to determine if there is a potential solution on fixing the perched culvert.

2.5 Hydrology Assessment

Bankfull events were recorded on Hanks Branch Reach 3, UT3 Reach 3, UT4 Reach 3, and UT5 Reach 2. The crest gauge on UT1 malfunctioned so no data was obtained, however, it has been fixed and is

operational. 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 restored intermittent reaches (UT4 Reach 1) for a minimum of 30 consecutive days during a normal precipitation year. In-stream flow gauges equipped with pressure transducers were installed to monitor continuity of baseflow. UT4 Reach 1 maintained baseflow for 259 consecutive days. Refer to Appendix 5 for hydrologic data.

2.6 Adaptive Management Plan

As discussed in Section 2.4, in-stream vegetation will be treated along UT5 Reach 2, and UT4 Reach 1 and 3. A chemical and manual treatment will occur in the spring of 2022. Follow up treatments will be conducted as necessary. It is expected the excess sediment along UT5 Reach 2 will naturally move downstream once the in-stream vegetation has been treated.

After further review, adding in a log sill directly downstream of the perched culvert along Hanks Branch did not appear feasible due to existing bedrock along the channel. Also, adding more material to the downstream invert will likely not solve the issue because the new material would likely wash away with the next major storm event. Wildlands will continue to reassess the culvert and try to determine a way to fix the issue.

2.7 Monitoring Year 1 Summary

All vegetation plots are on track to exceed the MY3 interim requirement of 320 planted stems per acre, and all streams within the Site are stable and meeting project goals. In-stream vegetation was noted in UT5 Reach2, and UT4 Reach 1 and 3, and will be treated in the spring of 2022. Bankfull events were documented on all stream reaches, except for UT1 which had a gauge malfunction. Greater than 30 days of consecutive flow was recorded on the intermittent section of UT4 Reach 1 fulfilling MY1 success requirement. 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 criterion.

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: METHODOLOGY

Geomorphic data was collected following the standards outlined in The Stream Channel Reference Site: An Illustrated Guide to Field Techniques (Harrelson et al., 1994) and in Stream Restoration: A Natural Channel Design Handbook (Doll et al., 2003). All Integrated Current Condition Mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcGIS. Crest gauges and pressure transducers were installed in riffle cross-sections and monitored throughout the year. Hydrologic monitoring instrument installation and monitoring methods are in accordance with the United States Army Corps of Engineers standards (USACE, 2003). Vegetation monitoring protocols followed the Wilmington District Stream and Wetland Compensatory Mitigation Update (NCIRT, 2016).

Section 4: REFERENCES

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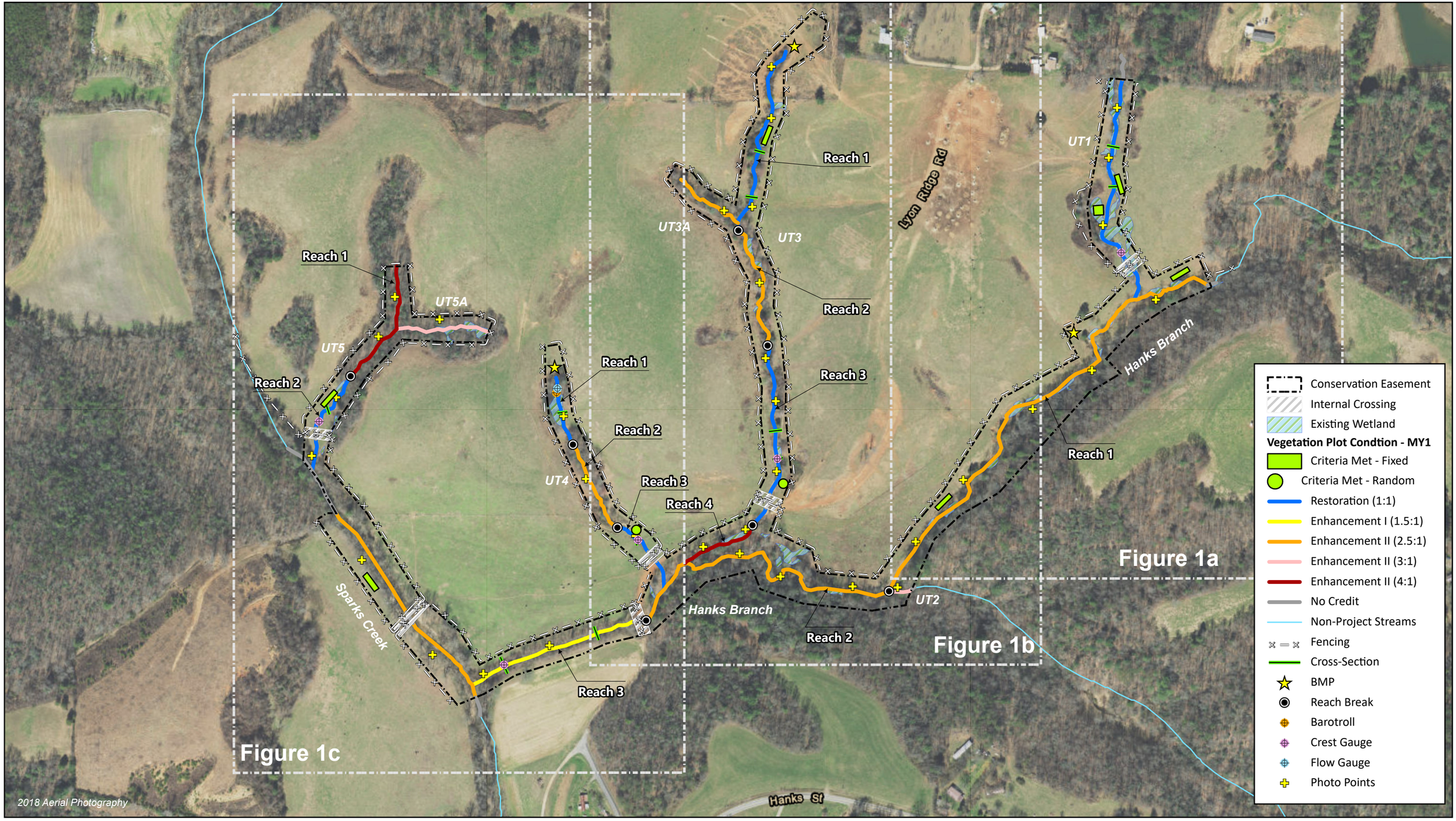
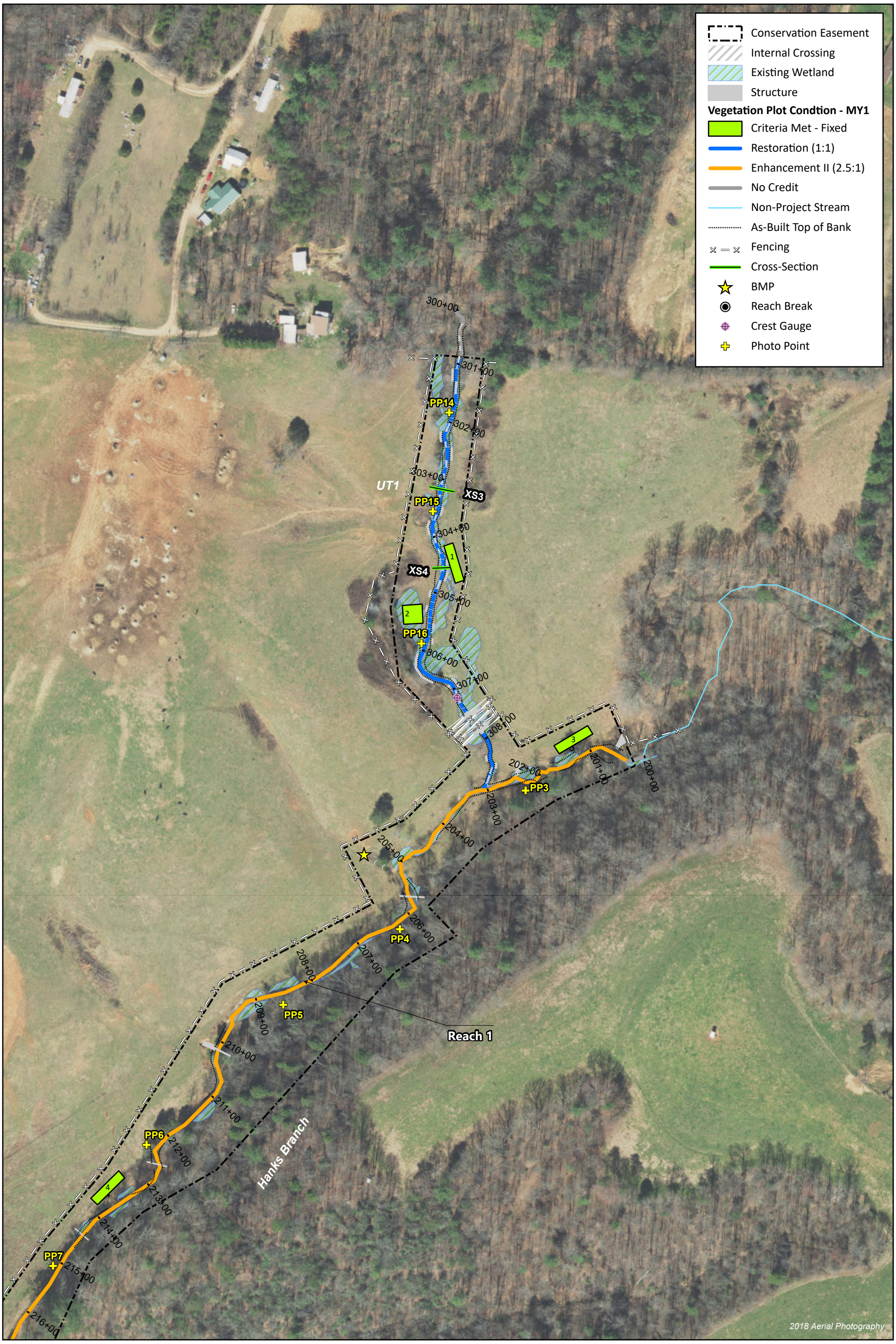


WILDLANDS ENGINEERING

Figure 1. Current Condition Plan View Key
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 -2021

Wilkes County, NC



WILDLANDS ENGINEERING

0 150 300 Feet

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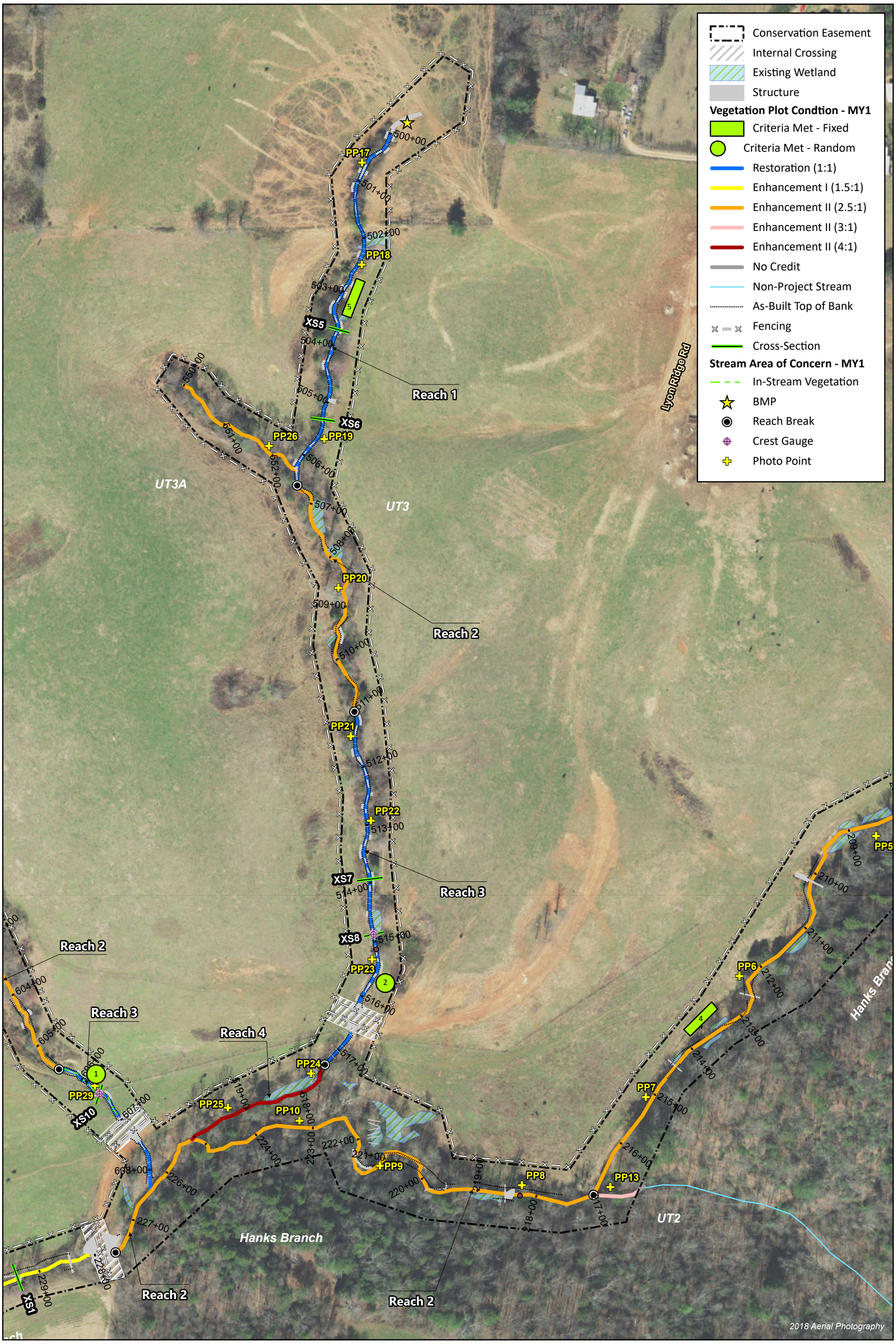
Figure 1a. Current Condition Plan View
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Wilkes County, NC



WILDLANDS ENGINEERING

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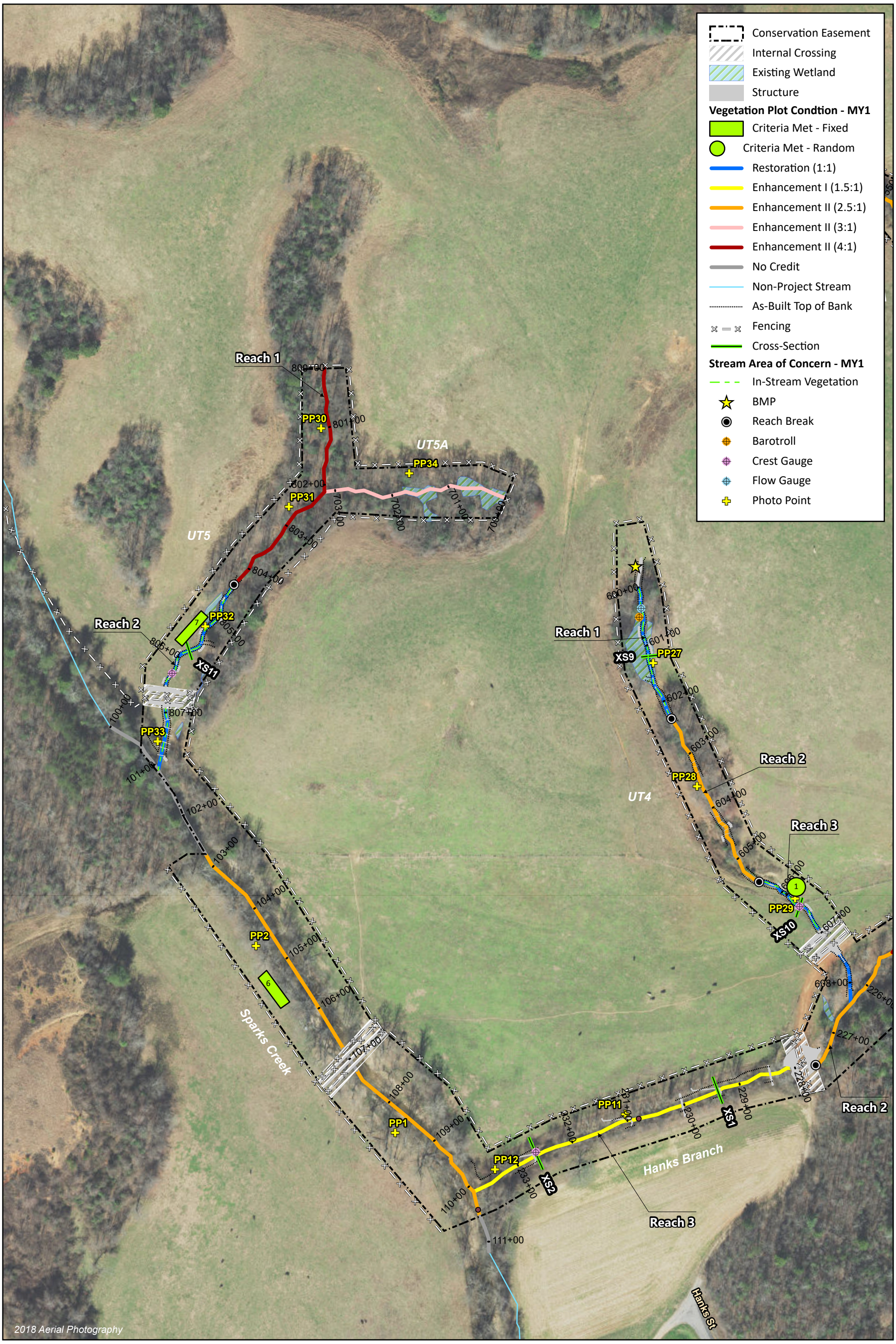
Figure 1b. Current Condition Plan View
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Wilkes County, NC



WILDLANDS ENGINEERING

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Figure 1c. Current Condition Plan View
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Wilkes County, NC

APPENDIX A. Visual Assessment Data

Table 4. Visual Stream Morphology Stability Assessment Table

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Hanks Branch Reach 3

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	585
					Assessed Bank Length	1,170
Bank	Surface Scour/ Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour.			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse.			0	100%
				Totals:	0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	0	0		0%

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	802
					Assessed Bank Length	1,604
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%.	15	15		100%

Visual assessment was completed October 27, 2021.

Table 4. Visual Stream Morphology Stability Assessment Table

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

UT3 Reach 1

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	625
					Assessed Bank Length	1,304
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.	36	36		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	11	11		100%

Visual assessment was completed October 27, 2021.

UT3 Reach 3

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	586
					Assessed Bank Length	1,172
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.	31	31		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	10	10		100%

Visual assessment was completed October 27, 2021.

Table 4. Visual Stream Morphology Stability Assessment Table

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

UT4 Reach 1

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	233
					Assessed Bank Length	466
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%.	2	2		100%

Visual assessment was completed October 27, 2021.

UT4 Reach 3

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	239
					Assessed Bank Length	478
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.	11	11		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

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

UT5 Reach 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		328
				Assessed Bank Length		435
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%.	6	6		100%

Visual assessment was completed October 27, 2021.

Table 5. Vegetation Condition Assessment Table
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Planted Acreage **10.80**

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	0	0%
		Total	**0**	**0%**
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.10	0	0%
		Cumulative Total	**0.0**	**0%**

Visual assessment was completed October 27, 2021.

Easement Acreage **20.72**

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	0	0%
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	

STREAM PHOTOGRAPHS

	
PHOTO POINT 1 Spark's Creek – upstream *(10/12/2021)*	**PHOTO POINT 1 Spark's Creek – downstream *(10/12/2021)***
	
PHOTO POINT 2 Spark's Creek – upstream *(10/12/2021)*	**PHOTO POINT 2 Spark's Creek – downstream *(10/12/2021)***
	
PHOTO POINT 3 Hank's Branch R1 – upstream *(10/12/2021)*	**PHOTO POINT 3 Hank's Branch R1 – downstream *(10/12/2021)***

PHOTO POINT 4 Hank's Branch R1 – upstream *(10/12/2021)*

PHOTO POINT 4 Hank's Branch R1 – downstream *(10/12/2021)*

PHOTO POINT 5 Hank's Branch R1 – upstream *(10/12/2021)*

PHOTO POINT 5 Hank's Branch R1 – downstream *(10/12/2021)*

PHOTO POINT 6 Hank's Branch R1 – upstream *(10/12/2021)*

PHOTO POINT 6 Hank's Branch R1 – downstream *(10/12/2021)*

PHOTO POINT 7 Hank's Branch R1 – upstream *(10/12/2021)*

PHOTO POINT 7 Hank's Branch R1 – downstream *(10/12/2021)*

PHOTO POINT 8 Hank's Branch R2 – upstream *(10/12/2021)*

PHOTO POINT 8 Hank's Branch R2 – downstream *(10/12/2021)*

PHOTO POINT 9 Hank's Branch R2 – upstream *(10/12/2021)*

PHOTO POINT 9 Hank's Branch R2 – downstream *(10/12/2021)*

PHOTO POINT 10 Hank's Branch R2 – upstream *(10/12/2021)*

PHOTO POINT 10 Hank's Branch R2 – downstream *(10/12/2021)*

PHOTO POINT 11 Hank's Branch R3 – upstream *(10/12/2021)*

PHOTO POINT 11 Hank's Branch R3 – downstream *(10/12/2021)*

PHOTO POINT 12 Hank's Branch R3 – upstream *(10/12/2021)*

PHOTO POINT 12 Hank's Branch R3 – downstream *(10/12/2021)*

PHOTO POINT 13 UT2 – upstream *(10/12/2021)*

PHOTO POINT 13 UT2 – downstream *(10/12/2021)*

PHOTO POINT 14 UT1 – upstream *(10/12/2021)*

PHOTO POINT 14 UT1 – downstream *(10/12/2021)*

PHOTO POINT 15 UT1 – upstream *(10/12/2021)*

PHOTO POINT 15 UT1 – downstream *(10/12/2021)*

	
PHOTO POINT 16 UT1 – upstream *(10/12/2021)*	**PHOTO POINT 16 UT1 – downstream *(10/12/2021)***
	
PHOTO POINT 17 UT3 R1 – upstream *(10/12/2021)*	**PHOTO POINT 17 UT3 R1 – downstream *(10/12/2021)***
	
PHOTO POINT 18 UT3 R1 – upstream *(10/12/2021)*	**PHOTO POINT 18 UT3 R1 – downstream *(10/12/2021)***

PHOTO POINT 19 UT3 R1 – upstream *(10/12/2021)*

PHOTO POINT 19 UT3 R1 – downstream *(10/12/2021)*

PHOTO POINT 20 UT3 R2 – upstream *(10/12/2021)*

PHOTO POINT 20 UT3 R2 – downstream *(10/12/2021)*

PHOTO POINT 21 UT3 R3 – upstream *(10/12/2021)*

PHOTO POINT 21 UT3 R3 – downstream *(10/12/2021)*

	
PHOTO POINT 22 UT3 R3 – upstream *(10/12/2021)*	**PHOTO POINT 22 UT3 R3 – downstream *(10/12/2021)***
	
PHOTO POINT 23 UT3 R3 – upstream *(10/12/2021)*	**PHOTO POINT 23 UT3 R3 – downstream *(10/12/2021)***
	
PHOTO POINT 24 UT3 R3 – upstream *(10/12/2021)*	**PHOTO POINT 24 UT3 R3 – downstream *(10/12/2021)***

	
PHOTO POINT 25 UT3 R4 – upstream *(10/12/2021)*	**PHOTO POINT 25 UT3 R4 – downstream *(10/12/2021)***
	
PHOTO POINT 26 UT3A – upstream *(10/12/2021)*	**PHOTO POINT 26 UT3A – downstream *(10/12/2021)***
	
PHOTO POINT 27 UT4 R1 – upstream *(10/12/2021)*	**PHOTO POINT 27 UT4 R1 – downstream *(10/12/2021)***

	
PHOTO POINT 28 UT4 R2 – upstream *(10/12/2021)*	**PHOTO POINT 28 UT4 R2 – downstream *(10/12/2021)***
	
PHOTO POINT 29 UT4 R3 – upstream *(10/12/2021)*	**PHOTO POINT 29 UT4 R3 – downstream *(10/12/2021)***
	
PHOTO POINT 30 UT5 R1 – upstream *(10/12/2021)*	**PHOTO POINT 30 UT5 R1 – downstream *(10/12/2021)***

	
PHOTO POINT 31 UT5 R1 – upstream *(10/12/2021)*	**PHOTO POINT 31 UT5 R1 – downstream *(10/12/2021)***
	
PHOTO POINT 32 UT5 R2 – upstream *(10/12/2021)*	**PHOTO POINT 32 UT5 R2 – downstream *(10/12/2021)***
	
PHOTO POINT 33 UT5 R2 – upstream *(10/28/2021)*	**PHOTO POINT 33 UT5 R2 – downstream *(10/28/2021)***

	
PHOTO POINT 34 UT5A – upstream *(10/28/2021)*	**PHOTO POINT 34 UT5A – downstream *(10/28/2021)***

CULVERT CROSSING PHOTOGRAPHS

	
Hanks Branch R3 - Perched - Looking Upstream *(09/27/2021)*	**Hanks Branch R3 - Looking Downstream (09/27/2021)**
	
UT1 - Looking Upstream *(10/12/2021)*	**UT1 - Looking Downstream (10/12/2021)**
	
UT3 R3 - Looking Upstream *(09/27/2021)*	**UT3 R3 - Looking Downstream (10/12/2021)**

	
UT4 R3 - Looking Upstream *(09/27/2021)*	**UT4 R3 - Looking Downstream (09/27/2021)**
	
UT5 R2 - Looking Upstream *(09/27/2021)*	**UT5 R2 - Looking Downstream (10/12/2021)**

VEGETATION PLOT PHOTOGRAPHS

FIXED VEG PLOT 1 *(09/27/2021)*

FIXED VEG PLOT 2 *(09/27/2021)*

FIXED VEG PLOT 3 *(09/27/2021)*

FIXED VEG PLOT 4 *(09/27/2021)*

FIXED VEG PLOT 5 *(09/27/2021)*

FIXED VEG PLOT 6 *(09/27/2021)*

FIXED VEG PLOT 7 ***(09/27/2021)***

RANDOM VEG PLOT 1 ***(10/28/2021)***

RANDOM VEG PLOT 2 ***(10/28/2021)***

APPENDIX B. Vegetation Plot Data

Table 6. Vegetation Plot Data
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Planted Acreage	10.80
Date of Initial Plant	2021-03-22
Date of Current Survey	2021-09-27
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	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Acer negundo	boxelder	Tree	FAC			1	1				
	Betula nigra	river birch	Tree	FACW	3	3	2	2	3	3	1	1
	Diospyros virginiana	common persimmon	Tree	FAC	1	1			1	1	1	1
	Liriodendron tulipifera	tuliptree	Tree	FACU							1	1
	Morus rubra	red mulberry	Tree	FACU	1	1						
	Nyssa sylvatica	blackgum	Tree	FAC	3	3	4	4	1	1	3	3
	Platanus occidentalis	American sycamore	Tree	FACW	1	1	1	1	5	5	3	3
	Prunus serotina	black cherry	Tree	FACU					1	1		
	Quercus phellos	willow oak	Tree	FACW	3	3	2	2	1	1	3	3
	Quercus rubra	northern red oak	Tree	FACU	1	1			2	2	1	1
	Ulmus americana	American elm	Tree	FAC	1	1	2	2	1	1	2	2
Sum	Performance Standard				14	14	12	12	15	15	15	15
Mitigation Plan Performance Standard	Current Year Stem Count					14		12		15		15
	Stems/Acre					567		486		607		607
	Species Count					8		6		8		8
	Dominant Species Composition (%)					21		33		33		20
	Average Plot Height					2		3		2		3
	% Invasives					0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					14		12		15		15
	Stems/Acre					567		486		607		607
	Species Count					8		6		8		8
	Dominant Species Composition (%)					21		33		33		20
	Average Plot Height					2		3		2		3
	% Invasives					0		0		0		0

1). Bolded species are proposed for the current monitoring year, italicized species are not approved, and a regular font indicates that the species has been approved.
2). The "Species Included in Approved Mitigation Plan" section contains only those species that were included in the original approved mitigation plan. The "Post Mitigation Plan Species" section includes species that are being proposed through a mitigation plan addendum for the current monitoring year (bolded) , species that have been approved in prior monitoring years through a mitigation plan addendum (regular font), and species that are not approved (italicized).
3). The "Mitigation Plan Performance Standard" section is derived only from stems included in the original mitigation plan, whereas the "Post Mitigation Plan Performance Standard" includes data from mitigation plan approved, post mitigation plan approved, and proposed stems.

Table 6. Vegetation Plot Data
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Planted Acreage	10.80
Date of Initial Plant	2021-03-22
Date of Current Survey	2021-09-27
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 5 F		Veg Plot 6 F		Veg Plot 7 F		Veg Plot 1 R	Veg Plot 2 R
					Planted	Total	Planted	Total	Planted	Total	Total	Total
Species Included in Approved Mitigation Plan	Acer negundo	boxelder	Tree	FAC								
	Betula nigra	river birch	Tree	FACW	1	1	2	2	3	3	2	
	Diospyros virginiana	common persimmon	Tree	FAC	2	2	1	1	1	1	1	
	Liriodendron tulipifera	tuliptree	Tree	FACU	1	1						
	Morus rubra	red mulberry	Tree	FACU								
	Nyssa sylvatica	blackgum	Tree	FAC	1	1	1	1	1	1	2	1
	Platanus occidentalis	American sycamore	Tree	FACW	1	1	3	3	2	2	1	5
	Prunus serotina	black cherry	Tree	FACU								
	Quercus phellos	willow oak	Tree	FACW	3	3	3	3	3	3		1
	Quercus rubra	northern red oak	Tree	FACU	1	1	2	2	2	2	2	1
	Ulmus americana	American elm	Tree	FAC	2	2	2	2				1
Sum	Performance Standard				12	12	14	14	12	12	8	9
Mitigation Plan Performance Standard	Current Year Stem Count					12		14		12	8	9
	Stems/Acre					486		567		486	324	364
	Species Count					8		7		6	5	5
	Dominant Species Composition (%)					25		21		25	25	56
	Average Plot Height					3		3		3	2	2
	% Invasives					0		0		0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					12		14		12	8	9
	Stems/Acre					486		567		486	324	364
	Species Count					8		7		6	5	5
	Dominant Species Composition (%)					25		21		25	25	56
	Average Plot Height					3		3		3	2	2
	% Invasives					0		0		0	0	0

1). Bolded species are proposed for the current monitoring year, italicized species are not approved, and a regular font indicates that the species has been approved.
2). The "Species Included in Approved Mitigation Plan" section contains only those species that were included in the original approved mitigation plan. The "Post Mitigation Plan Species" section includes species that are being proposed through a mitigation plan addendum for the current monitoring year (bolded) , species that have been approved in prior monitoring years through a mitigation plan addendum (regular font), and species that are not approved (italicized).
3). The "Mitigation Plan Performance Standard" section is derived only from stems included in the original mitigation plan, whereas the "Post Mitigation Plan Performance Standard" includes data from mitigation plan approved, post mitigation plan approved, and proposed stems.

Table 7. Vegetation Performance Standards Summary Table

Lyon Hills Mitigation Site

DMS Project No. 100085

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	8	0	486	3	6	0	607	2	8	0
Monitoring Year 0	607	2	8	0	607	3	6	0	607	2	8	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	607	3	8	0	486	3	8	0	567	3	7	0
Monitoring Year 0	607	2	8	0	526	2	8	0	607	2	7	0
	Veg Plot 7 F				Veg Plot Group 1 R				Veg Plot Group 2 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	486	3	6	0	324	2	5	0	364	2	5	0
Monitoring Year 0	526	2	6	0	445	2	9	0	607	3	9	0

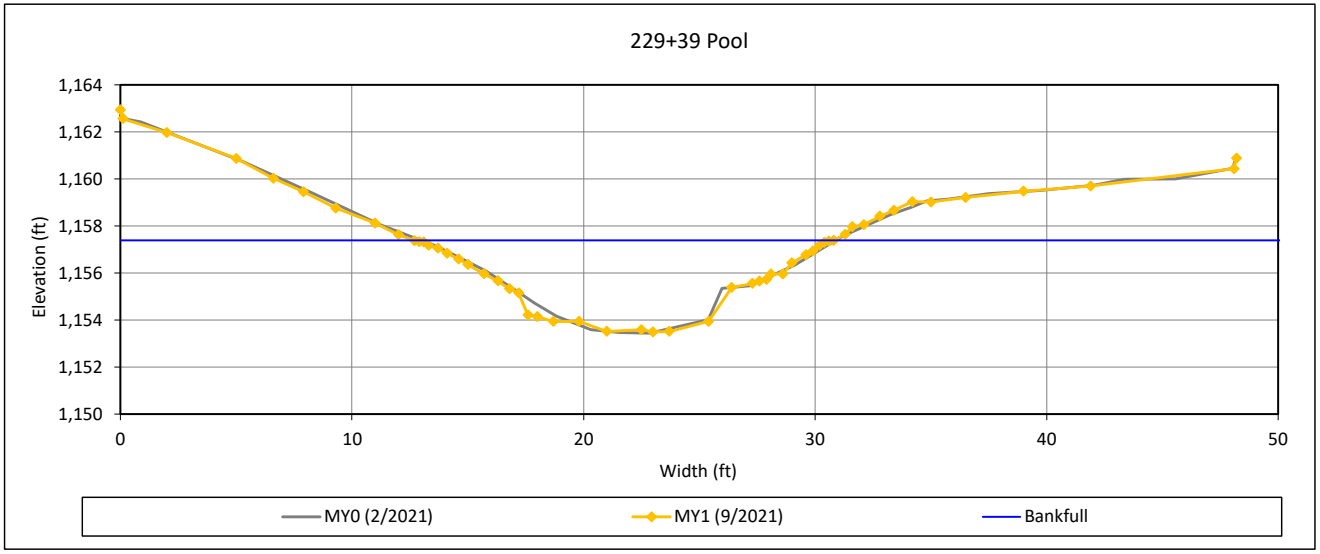
*Each monitoring year represents a different plot for the random vegetation plot "groups". Random plots are denoted with an R, and fixed plots with an F.

APPENDIX C. Stream Geomorphology Data

Cross-Section Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 1-Hanks Branch Reach 3



Bankfull Dimensions	
41.9	x-section area (ft.sq.)
18.1	width (ft)
2.3	mean depth (ft)
3.9	max depth (ft)
20.9	wetted perimeter (ft)
2.0	hydraulic radius (ft)
7.9	width-depth ratio

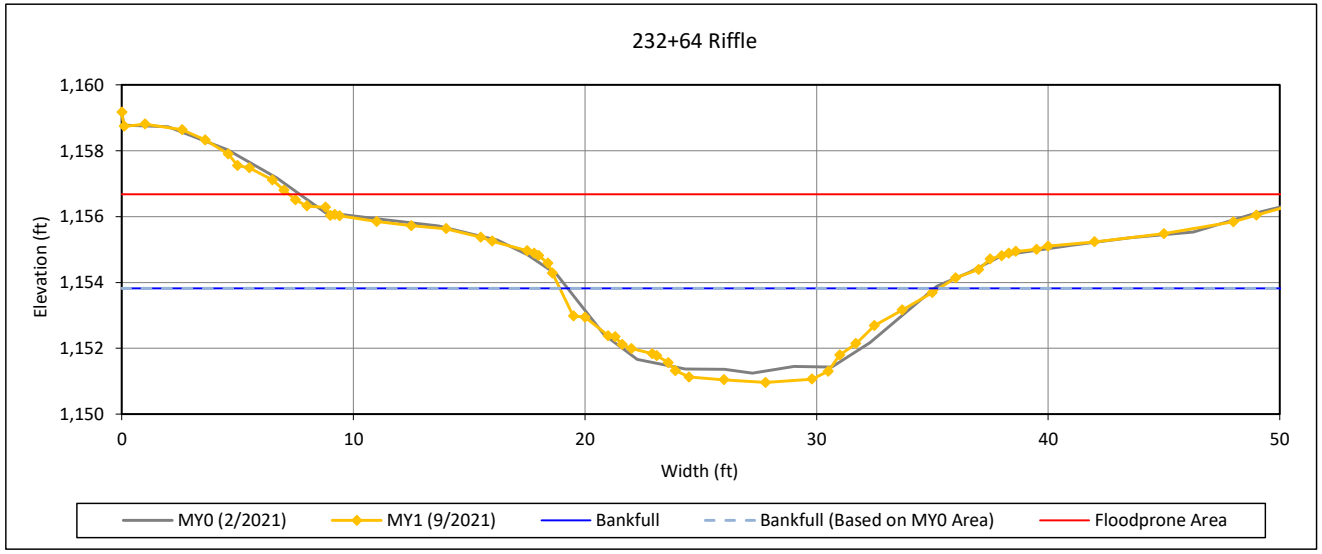
Survey Date: 9/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 2-Hanks Branch Reach 3



Bankfull Dimensions	
30.7	x-section area (ft.sq.)
16.4	width (ft)
1.9	mean depth (ft)
2.9	max depth (ft)
18.0	wetted perimeter (ft)
1.7	hydraulic radius (ft)
8.7	width-depth ratio
37.6	W flood prone area (ft)
2.3	entrenchment ratio
1.0	low bank height ratio

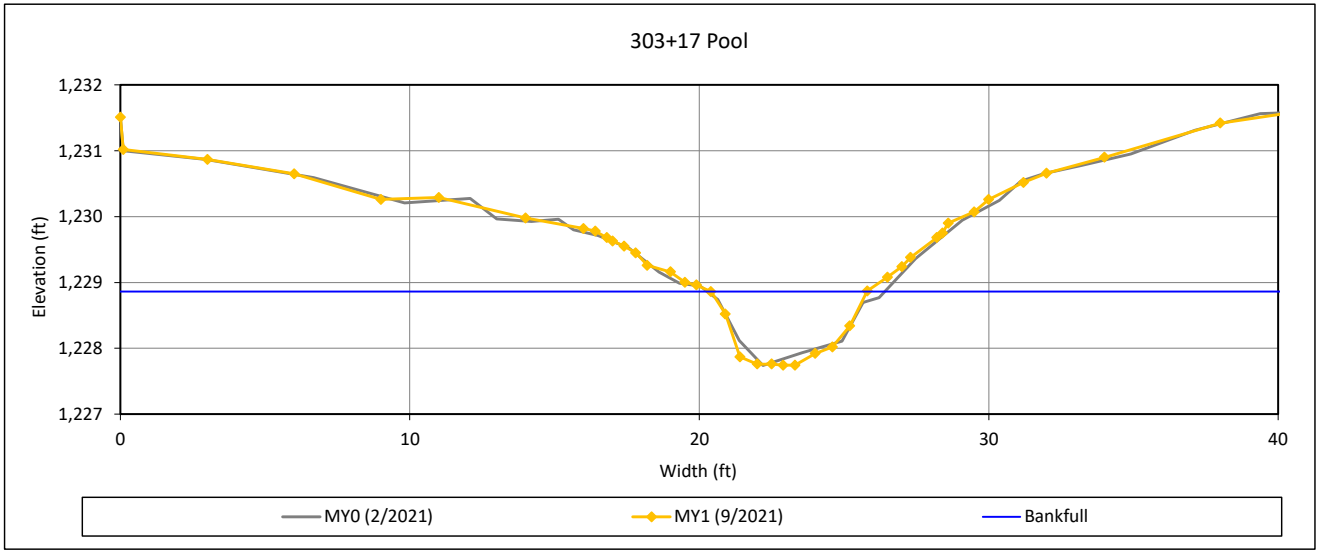
Survey Date: 9/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 3-UT1



Bankfull Dimensions	
4.3	x-section area (ft.sq.)
5.4	width (ft)
0.8	mean depth (ft)
1.1	max depth (ft)
6.1	wetted perimeter (ft)
0.7	hydraulic radius (ft)
6.7	width-depth ratio

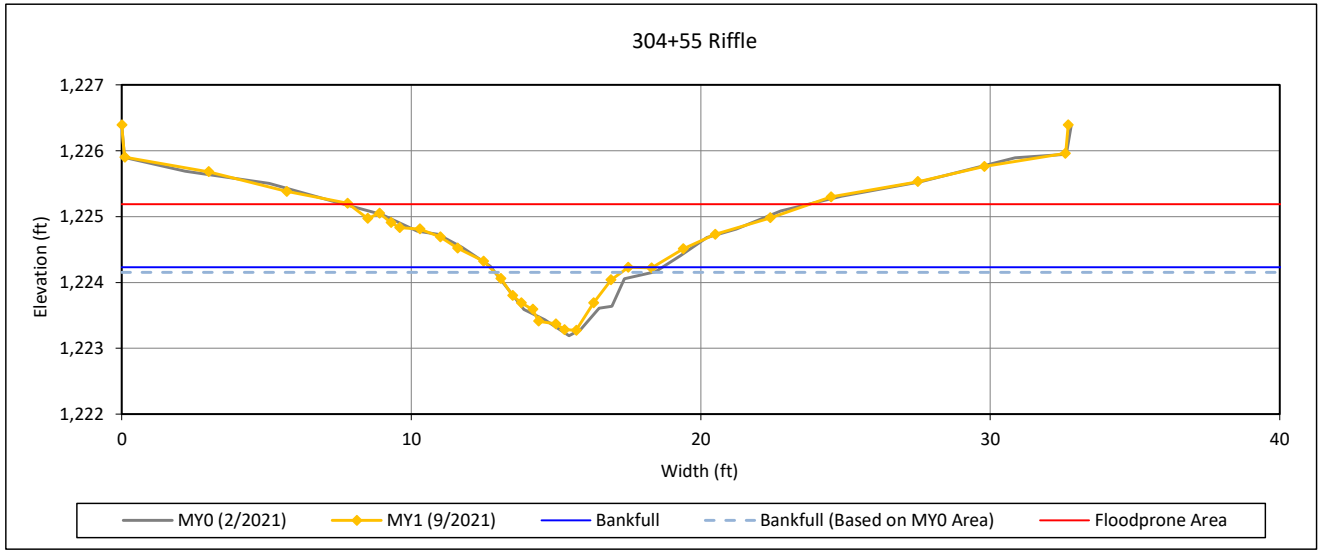
Survey Date: 9/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 4-UT1



Bankfull Dimensions	
2.6	x-section area (ft.sq.)
4.8	width (ft)
0.5	mean depth (ft)
1.0	max depth (ft)
5.3	wetted perimeter (ft)
0.5	hydraulic radius (ft)
8.9	width-depth ratio
12.4	W flood prone area (ft)
2.6	entrenchment ratio
1.1	low bank height ratio

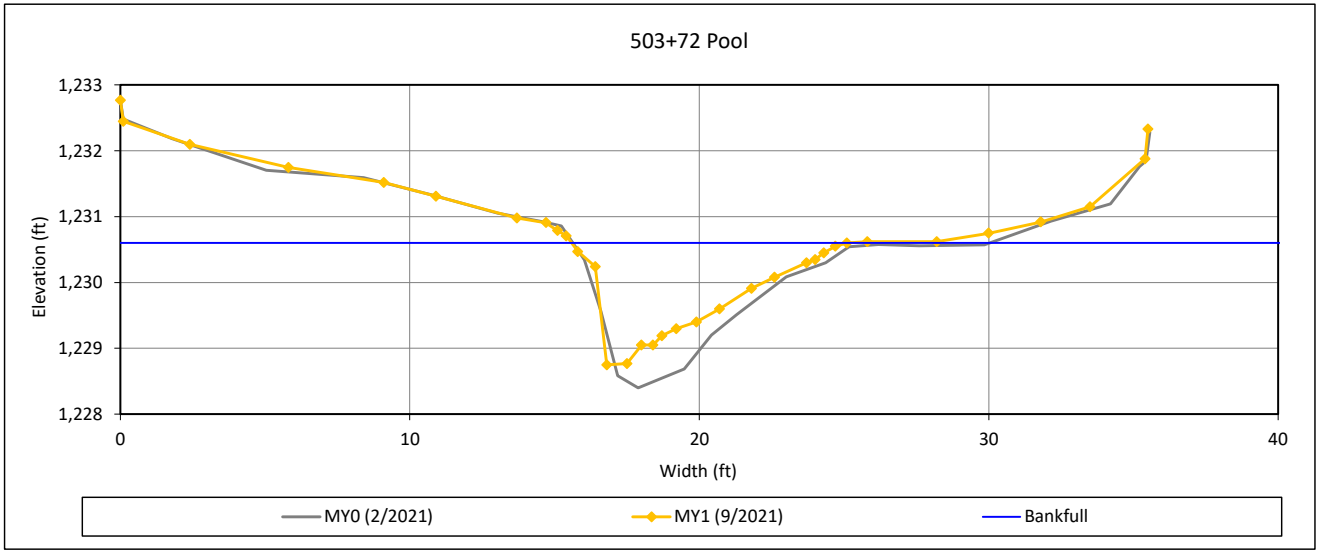
Survey Date: 9/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 5-UT3 Reach 1



Bankfull Dimensions	
8.3	x-section area (ft.sq.)
9.6	width (ft)
0.9	mean depth (ft)
1.9	max depth (ft)
11.1	wetted perimeter (ft)
0.8	hydraulic radius (ft)
11.0	width-depth ratio

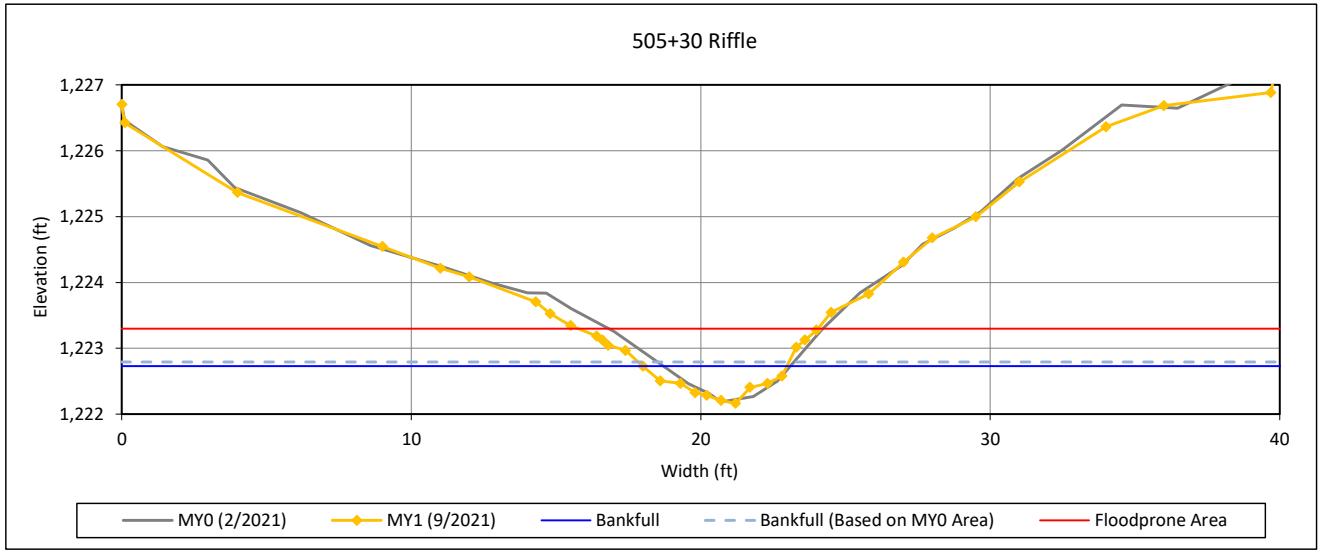
Survey Date: 9/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 6-UT3 Reach 1



Bankfull Dimensions	
1.6	x-section area (ft.sq.)
5.0	width (ft)
0.3	mean depth (ft)
0.6	max depth (ft)
5.2	wetted perimeter (ft)
0.3	hydraulic radius (ft)
15.5	width-depth ratio
8.4	W flood prone area (ft)
1.7	entrenchment ratio
< 1.0	low bank height ratio

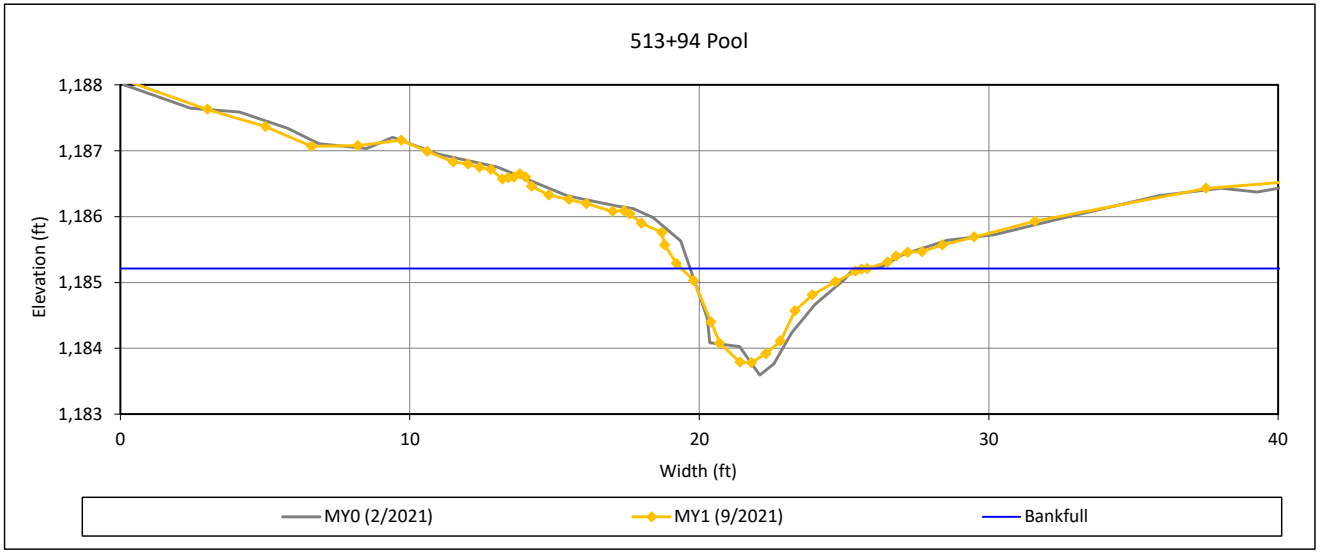
Survey Date: 9/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 7-UT3 Reach 3



Bankfull Dimensions	
4.4	x-section area (ft.sq.)
6.4	width (ft)
0.7	mean depth (ft)
1.4	max depth (ft)
7.2	wetted perimeter (ft)
0.6	hydraulic radius (ft)
9.3	width-depth ratio

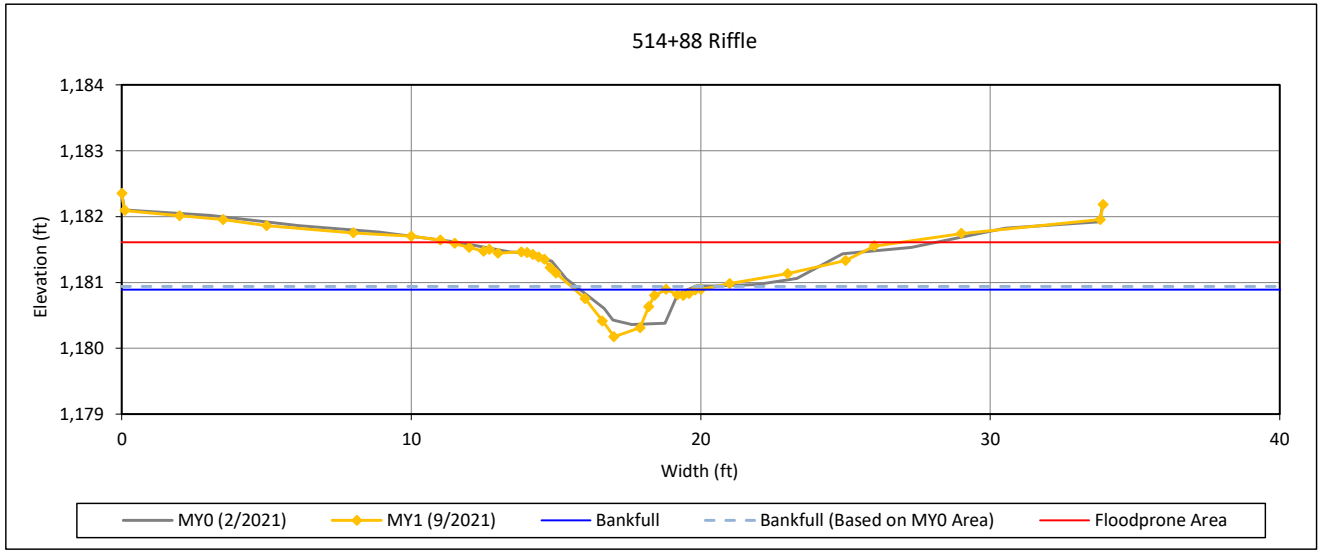
Survey Date: 9/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

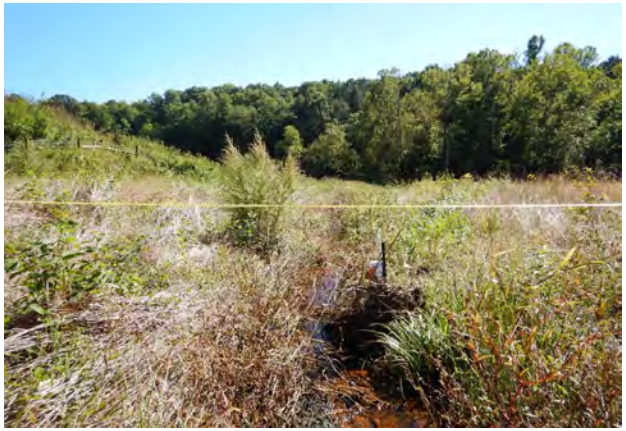
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 8-UT3 Reach 3



Bankfull Dimensions	
1.2	x-section area (ft.sq.)
3.1	width (ft)
0.4	mean depth (ft)
0.7	max depth (ft)
3.5	wetted perimeter (ft)
0.3	hydraulic radius (ft)
8.2	width-depth ratio
14.9	W flood prone area (ft)
4.8	entrenchment ratio
< 1.0	low bank height ratio

Survey Date: 9/2021
Field Crew: Wildlands Engineering

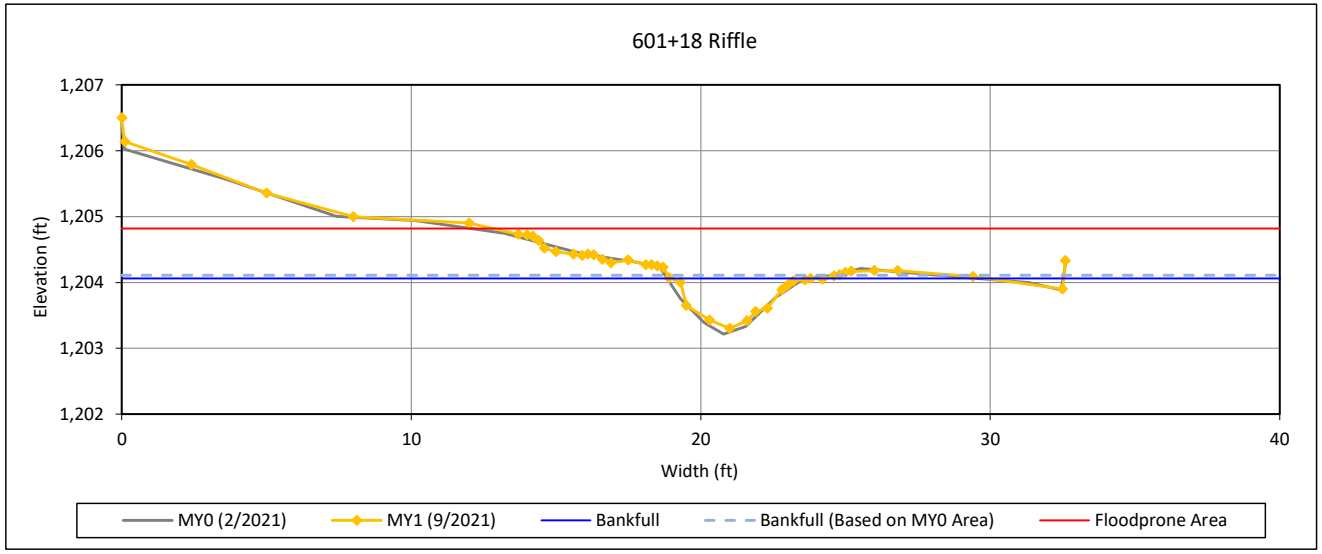


View Downstream

Cross-Section Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 9-UT4 Reach 1



Bankfull Dimensions	
2.0	x-section area (ft.sq.)
4.8	width (ft)
0.4	mean depth (ft)
0.8	max depth (ft)
5.2	wetted perimeter (ft)
0.4	hydraulic radius (ft)
12.0	width-depth ratio
35.0	W flood prone area (ft)
7.2	entrenchment ratio
< 1.0	low bank height ratio

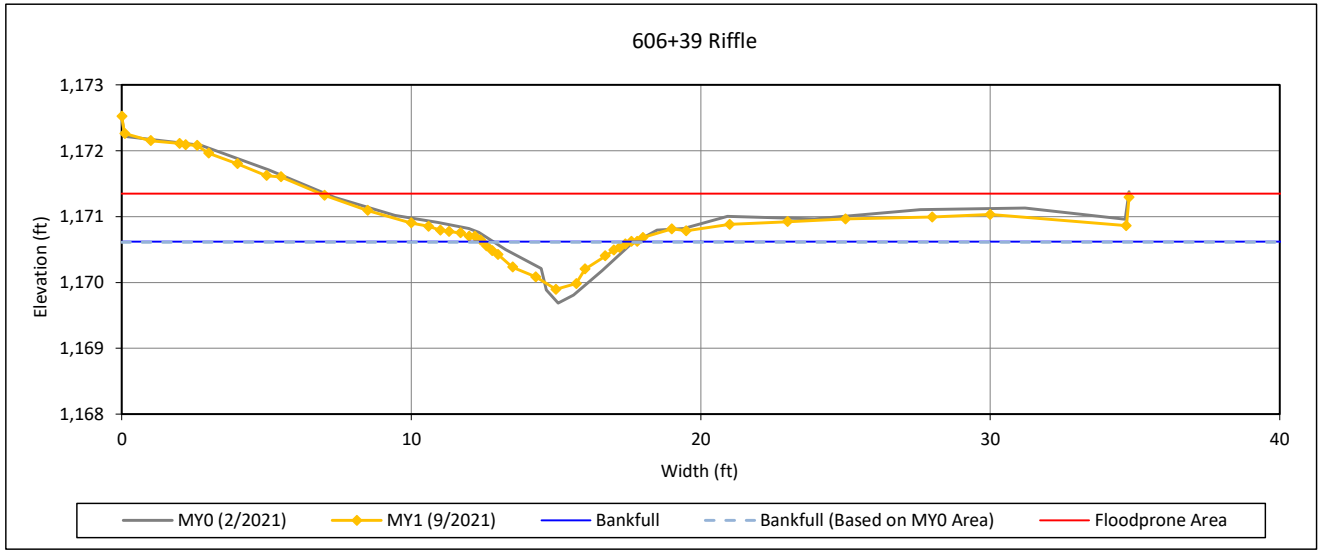
Survey Date: 9/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 10-UT4 Reach 3



Bankfull Dimensions	
2.0	x-section area (ft.sq.)
5.1	width (ft)
0.4	mean depth (ft)
0.7	max depth (ft)
5.4	wetted perimeter (ft)
0.4	hydraulic radius (ft)
13.4	width-depth ratio
35.0	W flood prone area (ft)
6.8	entrenchment ratio
1.0	low bank height ratio

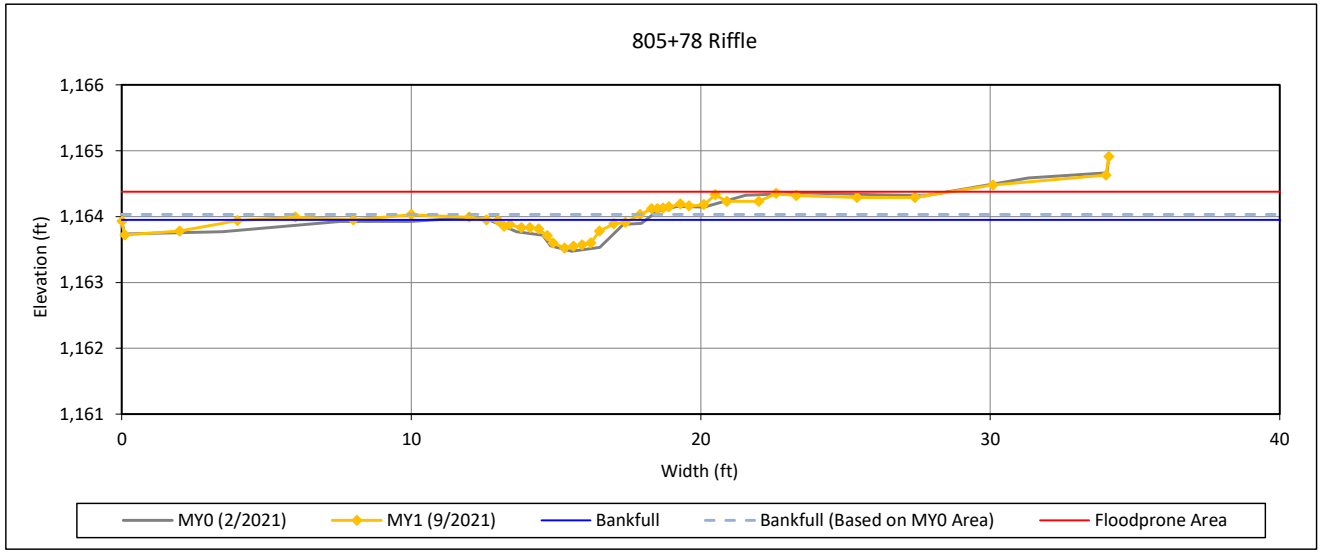
Survey Date: 9/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Cross-Section 11-UT5 Reach 2



Bankfull Dimensions	
0.9	x-section area (ft.sq.)
4.9	width (ft)
0.2	mean depth (ft)
0.4	max depth (ft)
5.1	wetted perimeter (ft)
0.2	hydraulic radius (ft)
26.3	width-depth ratio
35.0	W flood prone area (ft)
7.1	entrenchment ratio
< 1.0	low bank height ratio

Survey Date: 9/2021
Field Crew: Wildlands Engineering

View Downstream

Table 8. Baseline Stream Data Summary

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN			MONITORING BASELINE (MY0)		
Parameter	**Hanks Branch Reach 3**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**n**	**Min**	**Max**	**n**
Bankfull Width (ft)	13		1	15.5			16		1
Floodprone Width (ft)	---		1	34	78		38		1
Bankfull Mean Depth	1		1	1.1			1.9		1
Bankfull Max Depth	1.2		1	1.7			2.7		1
Bankfull Cross Sectional Area (ft^2)	13.4		1	17.7			30.7		1
Width/Depth Ratio	12.6		1	14.0			8.4		1
Entrenchment Ratio	1.2		1	2.2	5.0		2.3		1
Bank Height Ratio	4.8		1	14.0			1.0		1
Max part size (mm) mobilized at bankfull	95			79			93		
Rosgen Classification	C4			C4			C4		
Bankfull Discharge (cfs)	68.8			85.0			145.0		1
Sinuosity	1.06			---			---		
Water Surface Slope ($ft/ft)^2$	0.0210		1	0.017	0.020		0.012		1
Other	---			---			---		
Parameter	**UT1**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**n**	**Min**	**Max**	**n**
Bankfull Width (ft)	7		1	6.6			4.3		1
Floodprone Width (ft)	---		1	9	15		12		1
Bankfull Mean Depth	0.5		1	0.5			0.5		1
Bankfull Max Depth	1.2		1	0.6	0.7		0.9		1
Bankfull Cross Sectional Area (ft^2)	3.3		1	3.2			2.2		1
Width/Depth Ratio	13.5		1	14.0			8.4		1
Entrenchment Ratio	6.7		1	>1.4			2.9		1
Bank Height Ratio	1.7		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	54			99			117		
Rosgen Classification	B4			B4			B4		
Bankfull Discharge (cfs)	13.2			13.0			10.0		1
Sinuosity	1.10			1.05			1.05		
Water Surface Slope ($ft/ft)^2$	0.051		1	0.051	0.056		0.052		1
Other	---			---			---		

Table 8. Baseline Stream Data Summary

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN			MONITORING BASELINE (MY0)		
Parameter	**UT3 Reach 1**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**		**Min**	**Max**	**n**
Bankfull Width (ft)	7.3		1	5.9			4.9		1
Floodprone Width (ft)	10.4		1	8	13		8		1
Bankfull Mean Depth	0.4		1	0.5			0.4		1
Bankfull Max Depth	0.6		1	0.7			0.6		1
Bankfull Cross Sectional Area (ft^2)	3.1		1	2.7			1.9		1
Width/Depth Ratio	17.5		1	13.0			12.5		1
Entrenchment Ratio	1.4		1	>1.4			1.7		1
Bank Height Ratio	2.7		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	114			87			75		
Rosgen Classification	B4			B4			B4		
Bankfull Discharge (cfs)	15.0			10.0			6.6		1
Sinuosity	1.02			1.10			1.10		
Water Surface Slope ($ft/ft)^2$	0.056		1	0.036	0.040		0.042		1
Other	---			---			---		
Parameter	**UT3 Reach 3**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**		**Min**	**Max**	**n**
Bankfull Width (ft)	6.0		1	6.8			4.7		1
Floodprone Width (ft)	8.7		1	10	15		15		1
Bankfull Mean Depth	0.8		1	0.5			0.3		1
Bankfull Max Depth	1.0		1	0.8			0.6		1
Bankfull Cross Sectional Area (ft^2)	4.8		1	3.5			1.5		1
Width/Depth Ratio	7.5		1	13.0			14.4		1
Entrenchment Ratio	1.4		1	>1.4			3.2		1
Bank Height Ratio	2.6		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	128			102			64		
Rosgen Classification	B4			B4			B4		
Bankfull Discharge (cfs)	27.5			15.0			4.8		1
Sinuosity	1.03			1.05			1.05		
Water Surface Slope ($ft/ft)^2$	0.039		1	0.042	0.053		0.044		1
Other	---			---			---		

Table 8. Baseline Stream Data Summary

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN			MONITORING BASELINE (MY0)		
Parameter	**UT4 Reach 1**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**		**Min**	**Max**	**n**
Bankfull Width (ft)	6.2		1	4.0			4.7		1
Floodprone Width (ft)	7.4		1	6	9		35		1
Bankfull Mean Depth	0.5		1	0.3			0.5		1
Bankfull Max Depth	0.7		1	0.5			0.8		1
Bankfull Cross Sectional Area (ft^2)	3.1		1	1.3			2.2		1
Width/Depth Ratio	12.5		1	13.0			10.2		1
Entrenchment Ratio	1.2		1	>1.4			7.4		1
Bank Height Ratio	1.7		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	122			74			159		
Rosgen Classification	B4			B4			B4		
Bankfull Discharge (cfs)	15.5			4.0			11.3		1
Sinuosity	1.10			1.05			1.05		
Water Surface Slope ($ft/ft)^2$	0.053		1	0.054	0.059		0.073		1
Other	---			---			---		
Parameter	**UT4 Reach 3**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**		**Min**	**Max**	**n**
Bankfull Width (ft)	7.3		1	4.9			4.5		1
Floodprone Width (ft)	9.0		1	7	11		35		1
Bankfull Mean Depth	0.3		1	0.4			0.4		1
Bankfull Max Depth	0.4		1	0.6			0.9		1
Bankfull Cross Sectional Area (ft^2)	1.8		1	1.9			1.9		1
Width/Depth Ratio	29.1		1	13.0			11.0		1
Entrenchment Ratio	1.2		1	>1.4			7.7		1
Bank Height Ratio	2.3		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	140			67			86		
Rosgen Classification	B4			B4			B4		
Bankfull Discharge (cfs)	5.6			6.0			7.0		1
Sinuosity	1.00			1.05			1.05		
Water Surface Slope ($ft/ft)^2$	0.044		1	0.045	0.049		0.046		1
Other	---			---			---		

Table 8. Baseline Stream Data Summary

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN			MONITORING BASELINE (MY0)		
Parameter	**UT5 Reach 2**								
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**		**Min**	**Max**	**n**
Bankfull Width (ft)	5.4		1	5.0			5.4		1
Floodprone Width (ft)	11.0		1	11	25		35		1
Bankfull Mean Depth	0.4		1	0.4			0.2		1
Bankfull Max Depth	0.6		1	0.6			0.5		1
Bankfull Cross Sectional Area (ft^2)	2.2		1	1.9			1.3		1
Width/Depth Ratio	13.0		1	13.0			21.6		1
Entrenchment Ratio	2.1		1	2.2	5.0		6.5		1
Bank Height Ratio	1.7		1	1.0			1.0		1
Max part size (mm) mobilized at bankfull	79			49			39		
Rosgen Classification	C4b			C4b			C4b		
Bankfull Discharge (cfs)	9.0			6.0			4.9		1
Sinuosity	1.10			1.20			1.20		
Water Surface Slope ($ft/ft)^2$	0.051		1	0.028	0.033		0.035		1
Other	---								

Table 9. Cross-Section Morphology Monitoring Summary
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

	Hanks Branch Reach 3												UT1					
	Cross-Section 1 (Pool)						Cross-Section 2 (Riffle)						Cross-Section 3 (Pool)					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,157.57	1,157.39					1,153.89	1,153.82					1,228.70	1,228.86				
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A					1.00	1.00					N/A	N/A				
Thalweg Elevation	1,153.44	1,153.50					1,151.24	1,150.96					1,227.74	1,227.74				
LTOB[2] Elevation	1,157.57	1,157.39					1,153.89	1,153.82					1,228.70	1,228.86				
LTOB[2] Max Depth (ft)	4.13	3.89					2.65	2.86					1.00	1.12				
LTOB[2] Cross Sectional Area (ft^2)	44.10	41.91					30.70	30.69					3.20	4.30				
	UT1						UT3 Reach 1											
	Cross-Section 4 (Riffle)						Cross-Section 5 (Pool)						Cross-Section 6 (Riffle)					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,224.06	1,224.15					1,230.54	1,230.60					1,222.82	1,222.79				
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	1.09					N/A	N/A					1.00	0.90				
Thalweg Elevation	1,223.19	1,223.27					1,228.40	1,228.75					1,222.18	1,222.17				
LTOB[2] Elevation	1,224.06	1,224.23					1,230.54	1,230.60					1,222.82	1,222.73				
LTOB[2] Max Depth (ft)	0.90	0.96					2.10	1.85					0.60	0.56				
LTOB[2] Cross Sectional Area (ft^2)	2.20	2.56					10.20	8.30					1.90	1.61				
	UT3 Reach 3												UT4 Reach 1					
	Cross-Section 7 (Pool)						Cross-Section 8 (Riffle)						Cross-Section 9 (Riffle)					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,185.20	1,185.21					1,180.95	1,180.94					1,204.05	1,204.11				
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A					1.00	0.94					1.00	0.94				
Thalweg Elevation	1,183.59	1,183.79					1,180.36	1,180.17					1,203.22	1,203.30				
LTOB[2] Elevation	1,185.20	1,185.21					1,180.95	1,180.98					1,204.05	1,204.06				
LTOB[2] Max Depth (ft)	1.60	1.43					0.60	0.72					0.80	0.76				
LTOB[2] Cross Sectional Area (ft^2)	4.90	4.45					1.50	1.20					2.20	1.95				
	UT4 Reach 3						UT5 Reach 2											
	Cross-Section 10 (Riffle)						Cross-Section 11 (Riffle)											
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**						
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	1,170.57	1,170.61					1,163.95	1,164.03										
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	1.01					1.00	0.84										
Thalweg Elevation	1,169.68	1,169.89					1,163.47	1,163.52										
LTOB[2] Elevation	1,170.57	1,170.62					1,163.95	1,163.95										
LTOB[2] Max Depth (ft)	0.90	0.73					0.50	0.43										
LTOB[2] Cross Sectional Area (ft^2)	1.90	1.96					1.30	0.92										

[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.

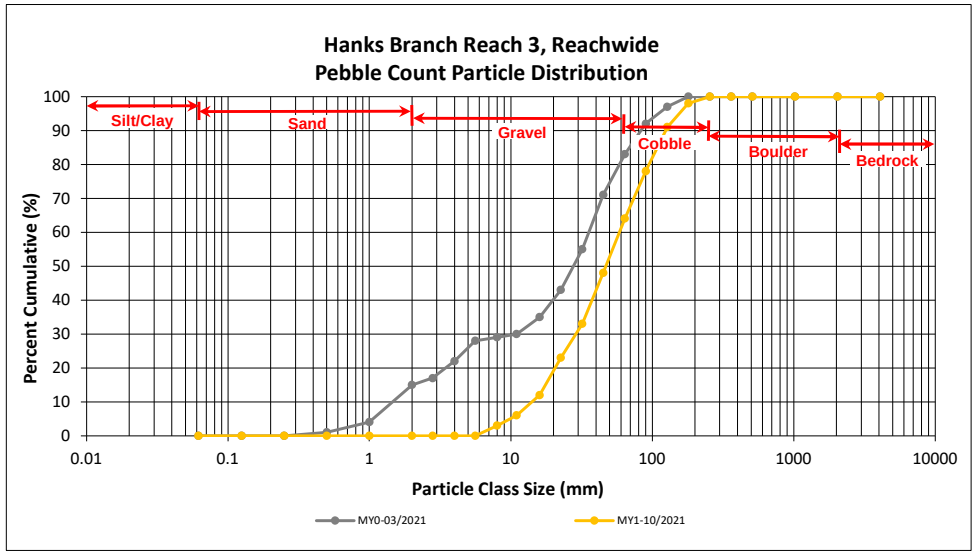
Reachwide Pebble Count Plots

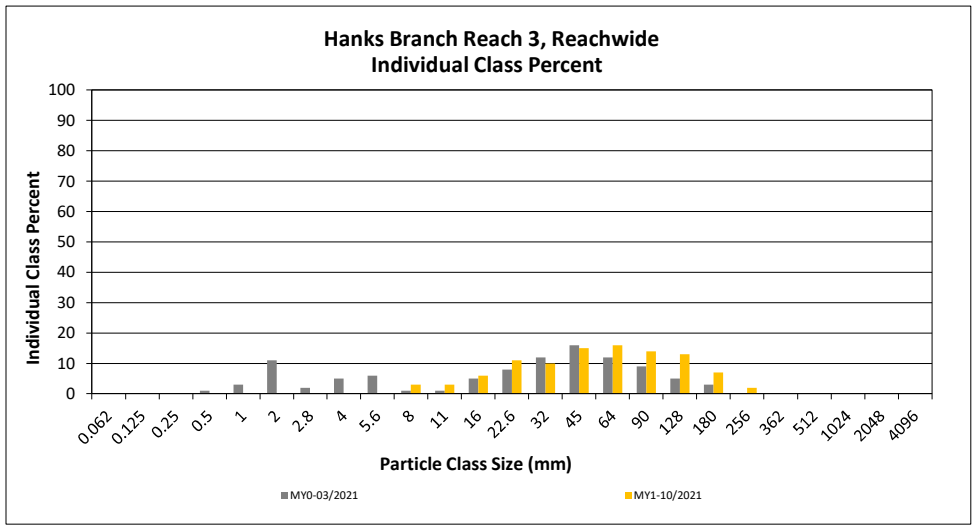
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Hanks Branch Reach 3, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062					0
SAND	Very fine	0.062	0.125					0
	Fine	0.125	0.250					0
	Medium	0.25	0.50					0
	Coarse	0.5	1.0					0
	Very Coarse	1.0	2.0					0
GRAVEL	Very Fine	2.0	2.8					0
	Very Fine	2.8	4.0					0
	Fine	4.0	5.6					0
	Fine	5.6	8.0		3	3	3	3
	Medium	8.0	11.0		3	3	3	6
	Medium	11.0	16.0	4	2	6	6	12
	Coarse	16.0	22.6	5	6	11	11	23
	Coarse	22.6	32	6	4	10	10	33
	Very Coarse	32	45	8	7	15	15	48
	Very Coarse	45	64	14	2	16	16	64
COBBLE	Small	64	90	12	2	14	14	78
	Small	90	128	12	1	13	13	91
	Large	128	180	7		7	7	98
	Large	180	256	2		2	2	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**70**	**30**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	18.14
D_{35} =	33.49
D_{50} =	47.0
D_{84} =	105.9
D_{95} =	155.5
D_{100} =	256.0





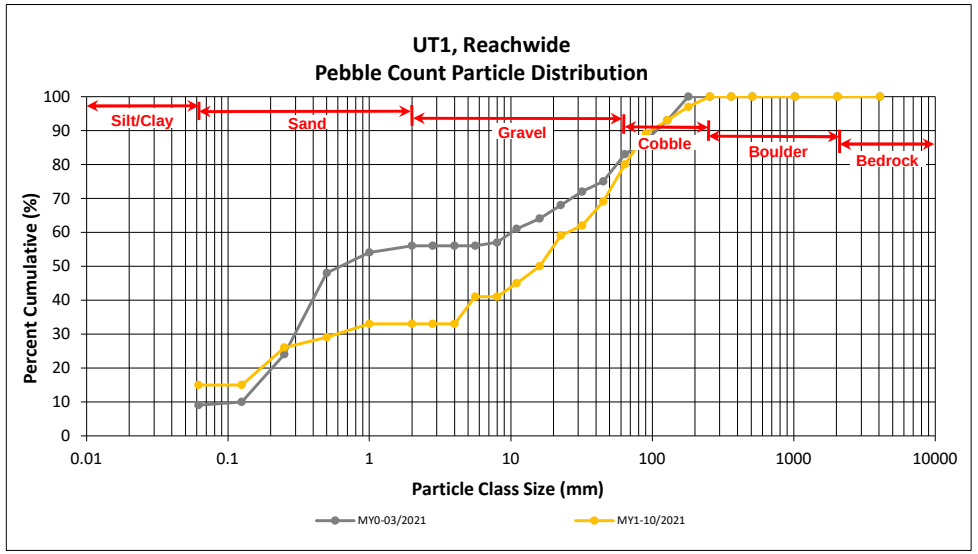
Reachwide Pebble Count Plots

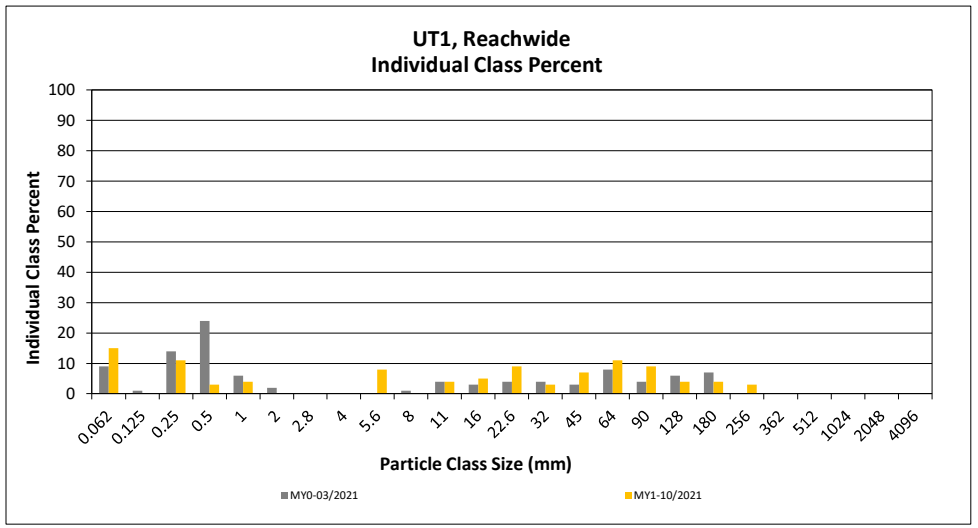
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

UT1, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	11	15	15	15
SAND	Very fine	0.062	0.125					15
	Fine	0.125	0.250	1	10	11	11	26
	Medium	0.25	0.50	3		3	3	29
	Coarse	0.5	1.0	1	3	4	4	33
	Very Coarse	1.0	2.0					33
GRAVEL	Very Fine	2.0	2.8					33
	Very Fine	2.8	4.0					33
	Fine	4.0	5.6	3	5	8	8	41
	Fine	5.6	8.0					41
	Medium	8.0	11.0	2	2	4	4	45
	Medium	11.0	16.0	3	2	5	5	50
	Coarse	16.0	22.6	7	2	9	9	59
	Coarse	22.6	32	3		3	3	62
	Very Coarse	32	45	6	1	7	7	69
	Very Coarse	45	64	10	1	11	11	80
COBBLE	Small	64	90	6	3	9	9	89
	Small	90	128	4		4	4	93
	Large	128	180	4		4	4	97
	Large	180	256	3		3	3	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**60**	**40**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.13
D_{35} =	4.35
D_{50} =	16.0
D_{84} =	74.5
D_{95} =	151.8
D_{100} =	256.0





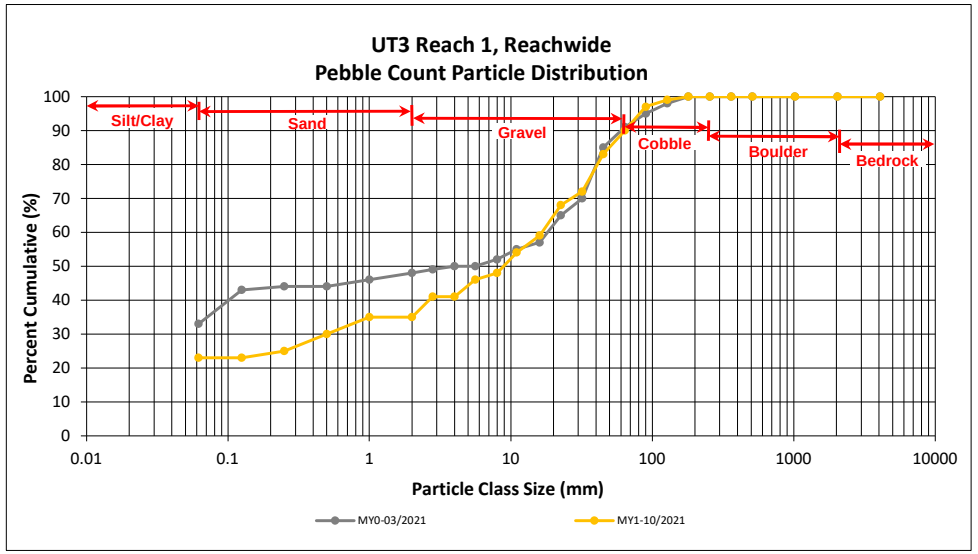
Reachwide Pebble Count Plots

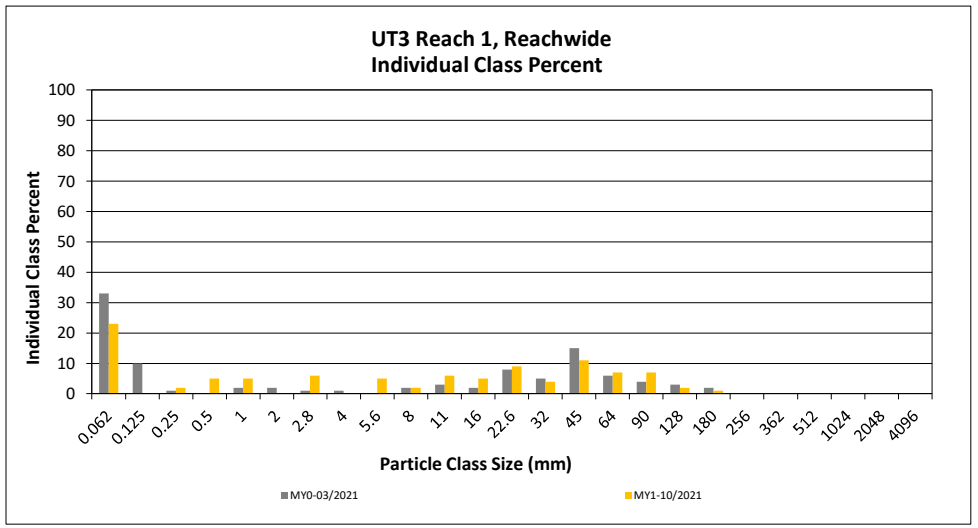
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

UT3 Reach 1, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	19	23	23	23
SAND	Very fine	0.062	0.125					23
	Fine	0.125	0.250	1	1	2	2	25
	Medium	0.25	0.50	2	3	5	5	30
	Coarse	0.5	1.0		5	5	5	35
	Very Coarse	1.0	2.0					35
GRAVEL	Very Fine	2.0	2.8		6	6	6	41
	Very Fine	2.8	4.0					41
	Fine	4.0	5.6	1	4	5	5	46
	Fine	5.6	8.0	1	1	2	2	48
	Medium	8.0	11.0	3	3	6	6	54
	Medium	11.0	16.0	3	2	5	5	59
	Coarse	16.0	22.6	6	3	9	9	68
	Coarse	22.6	32	3	1	4	4	72
	Very Coarse	32	45	9	2	11	11	83
	Very Coarse	45	64	7		7	7	90
COBBLE	Small	64	90	7		7	7	97
	Small	90	128	2		2	2	99
	Large	128	180	1		1	1	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	1.00
D_{50} =	8.9
D_{84} =	47.3
D_{95} =	81.6
D_{100} =	180.0





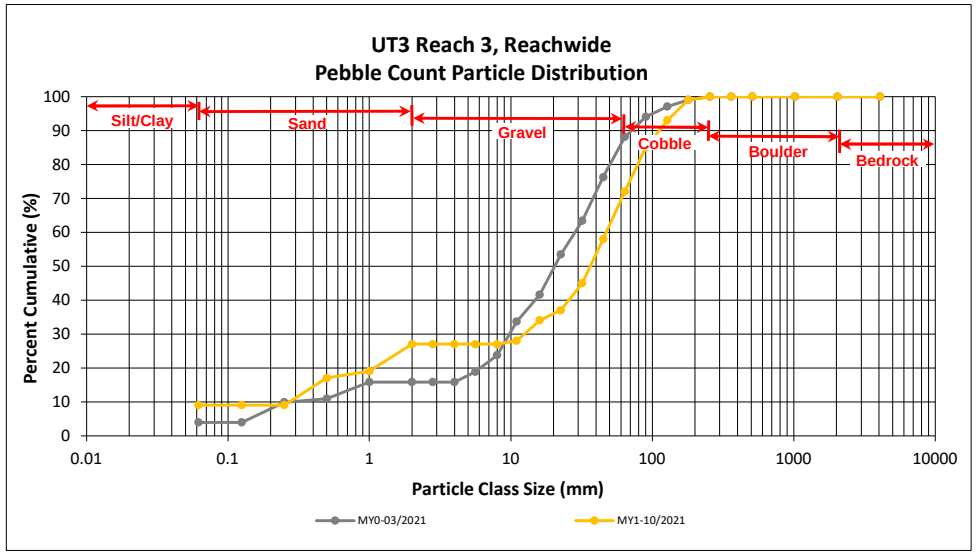
Reachwide Pebble Count Plots

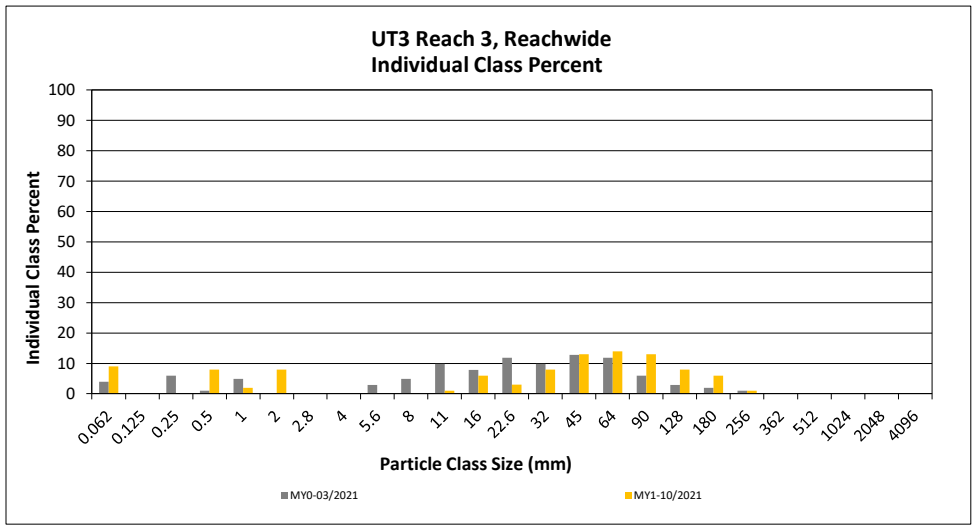
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

UT3 Reach 3, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		9	9	9	9
SAND	Very fine	0.062	0.125					9
	Fine	0.125	0.250					9
	Medium	0.25	0.50		8	8	8	17
	Coarse	0.5	1.0		2	2	2	19
	Very Coarse	1.0	2.0		8	8	8	27
GRAVEL	Very Fine	2.0	2.8					27
	Very Fine	2.8	4.0					27
	Fine	4.0	5.6					27
	Fine	5.6	8.0					27
	Medium	8.0	11.0		1	1	1	28
	Medium	11.0	16.0	6		6	6	34
	Coarse	16.0	22.6	3		3	3	37
	Coarse	22.6	32	8		8	8	45
	Very Coarse	32	45	12	1	13	13	58
	Very Coarse	45	64	14		14	14	72
COBBLE	Small	64	90	13		13	13	85
	Small	90	128	8		8	8	93
	Large	128	180	5	1	6	6	99
	Large	180	256	1		1	1	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**70**	**30**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.46
D_{35} =	17.95
D_{50} =	36.5
D_{84} =	87.7
D_{95} =	143.4
D_{100} =	256.0





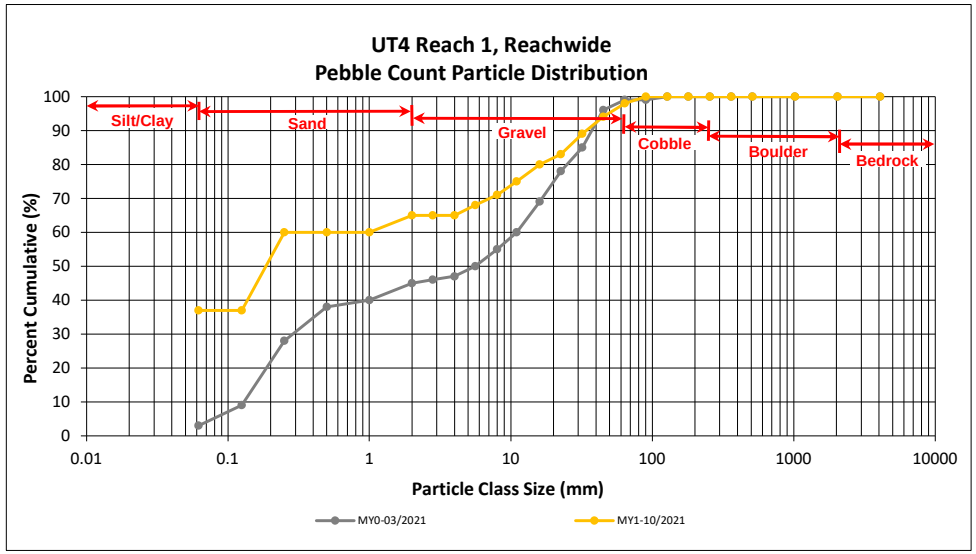
Reachwide Pebble Count Plots

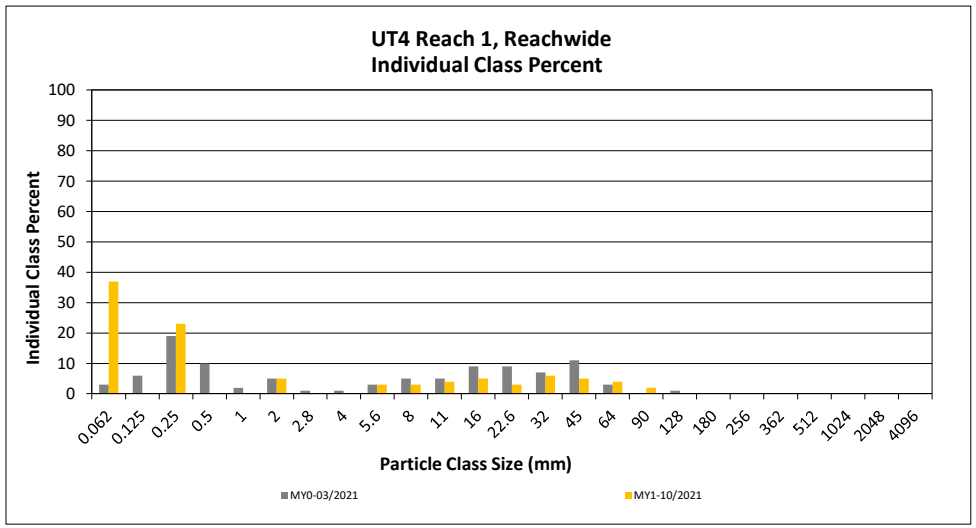
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

UT4 Reach 1, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	20	17	37	37	37
SAND	Very fine	0.062	0.125					37
	Fine	0.125	0.250	10	13	23	23	60
	Medium	0.25	0.50					60
	Coarse	0.5	1.0					60
	Very Coarse	1.0	2.0	5		5	5	65
GRAVEL	Very Fine	2.0	2.8					65
	Very Fine	2.8	4.0					65
	Fine	4.0	5.6	3		3	3	68
	Fine	5.6	8.0	3		3	3	71
	Medium	8.0	11.0	4		4	4	75
	Medium	11.0	16.0	5		5	5	80
	Coarse	16.0	22.6	3		3	3	83
	Coarse	22.6	32	6		6	6	89
	Very Coarse	32	45	5		5	5	94
	Very Coarse	45	64	4		4	4	98
COBBLE	Small	64	90	2		2	2	100
	Small	90	128					100
	Large	128	180					100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**70**	**30**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	0.2
D_{84} =	23.9
D_{95} =	49.1
D_{100} =	90.0





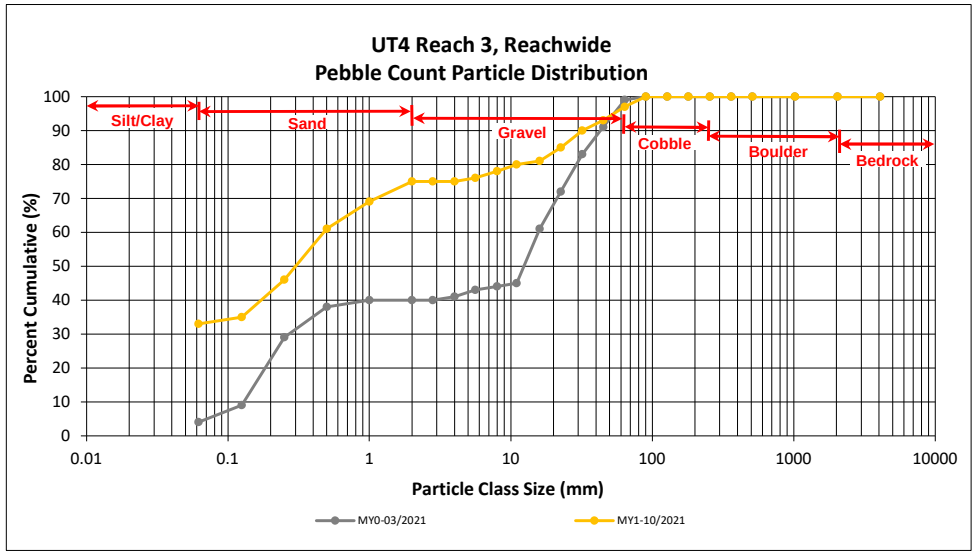
Reachwide Pebble Count Plots

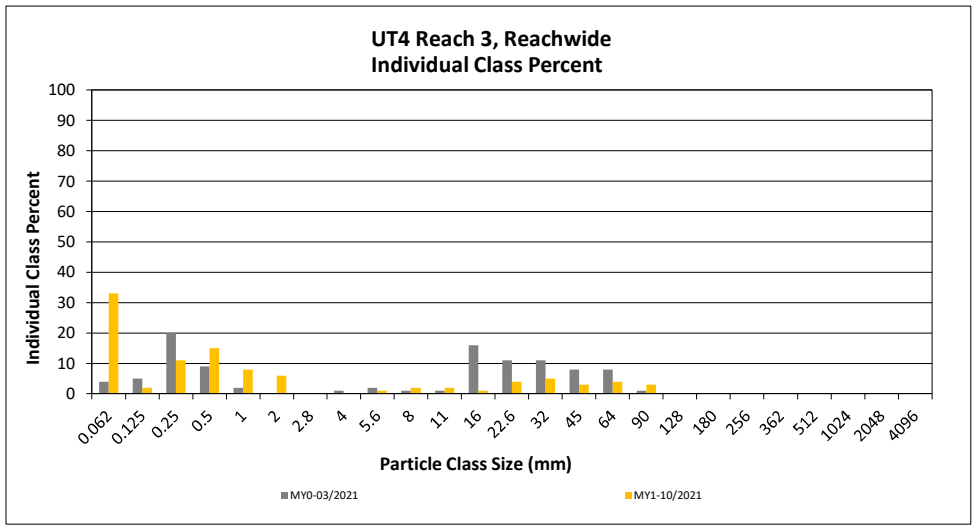
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

UT4 Reach 3, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	13	20	33	33	33
SAND	Very fine	0.062	0.125		2	2	2	35
	Fine	0.125	0.250	4	7	11	11	46
	Medium	0.25	0.50	9	6	15	15	61
	Coarse	0.5	1.0	4	4	8	8	69
	Very Coarse	1.0	2.0	5	1	6	6	75
GRAVEL	Very Fine	2.0	2.8					75
	Very Fine	2.8	4.0					75
	Fine	4.0	5.6	1		1	1	76
	Fine	5.6	8.0	2		2	2	78
	Medium	8.0	11.0	2		2	2	80
	Medium	11.0	16.0	1		1	1	81
	Coarse	16.0	22.6	4		4	4	85
	Coarse	22.6	32	5		5	5	90
	Very Coarse	32	45	3		3	3	93
	Very Coarse	45	64	4		4	4	97
COBBLE	Small	64	90	3		3	3	100
	Small	90	128					100
	Large	128	180					100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**60**	**40**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.13
D_{50} =	0.3
D_{84} =	20.7
D_{95} =	53.7
D_{100} =	90.0





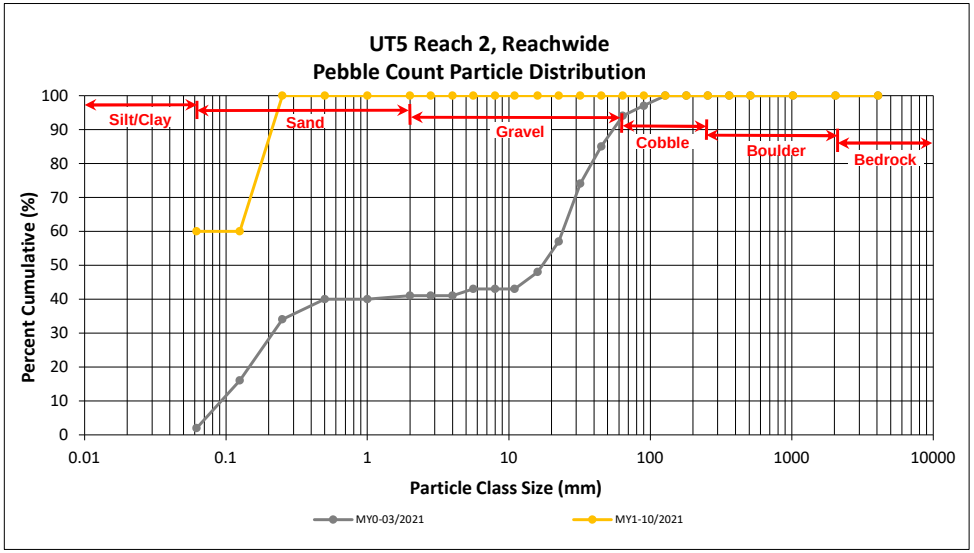
Reachwide Pebble Count Plots

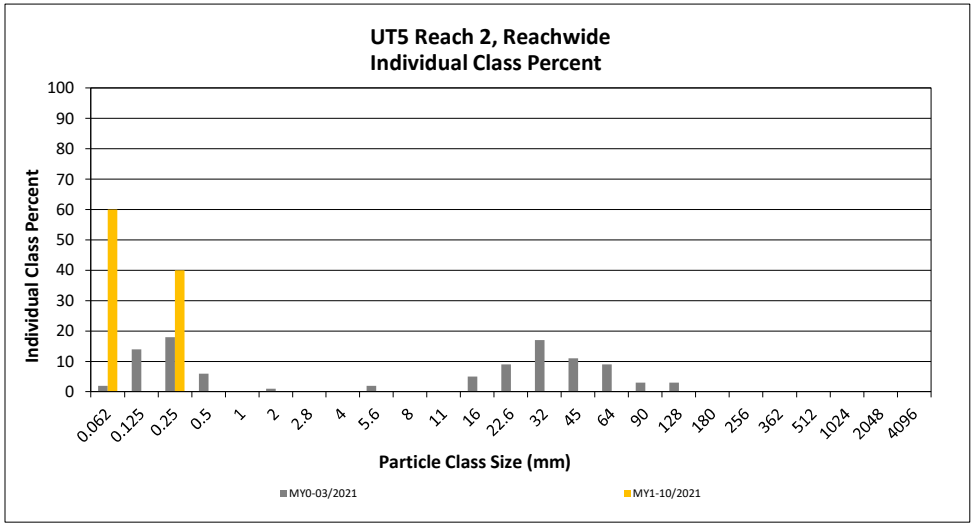
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

UT5 Reach 2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	30	30	60	60	60
SAND	Very fine	0.062	0.125					60
	Fine	0.125	0.250	30	10	40	40	100
	Medium	0.25	0.50					100
	Coarse	0.5	1.0					100
	Very Coarse	1.0	2.0					100
GRAVEL	Very Fine	2.0	2.8					100
	Very Fine	2.8	4.0					100
	Fine	4.0	5.6					100
	Fine	5.6	8.0					100
	Medium	8.0	11.0					100
	Medium	11.0	16.0					100
	Coarse	16.0	22.6					100
	Coarse	22.6	32					100
	Very Coarse	32	45					100
	Very Coarse	45	64					100
COBBLE	Small	64	90					100
	Small	90	128					100
	Large	128	180					100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**60**	**40**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	Silt/Clay
D_{84} =	0.2
D_{95} =	0.2
D_{100} =	0.3





APPENDIX D. Hydrology Data

Table 10. Bankfull Events

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Reach	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
Hanks Branch Reach 3	2/17/2021 2/20/2021 8/18/2021						
UT1	*						
UT3 Reach 3	1/26/2021 8/15/2021 8/18/2021						
UT4 Reach 3	8/15/2021						
UT5 Reach 2	2/16/2021 2/21/2021 3/3/2021 3/20/2021 6/12/2021 7/26/2021 8/15/2021 8/17/2021 8/25/2021 9/1/2021 10/6/2021						

*Gauge malfunction

Table 11. Rainfall Summary

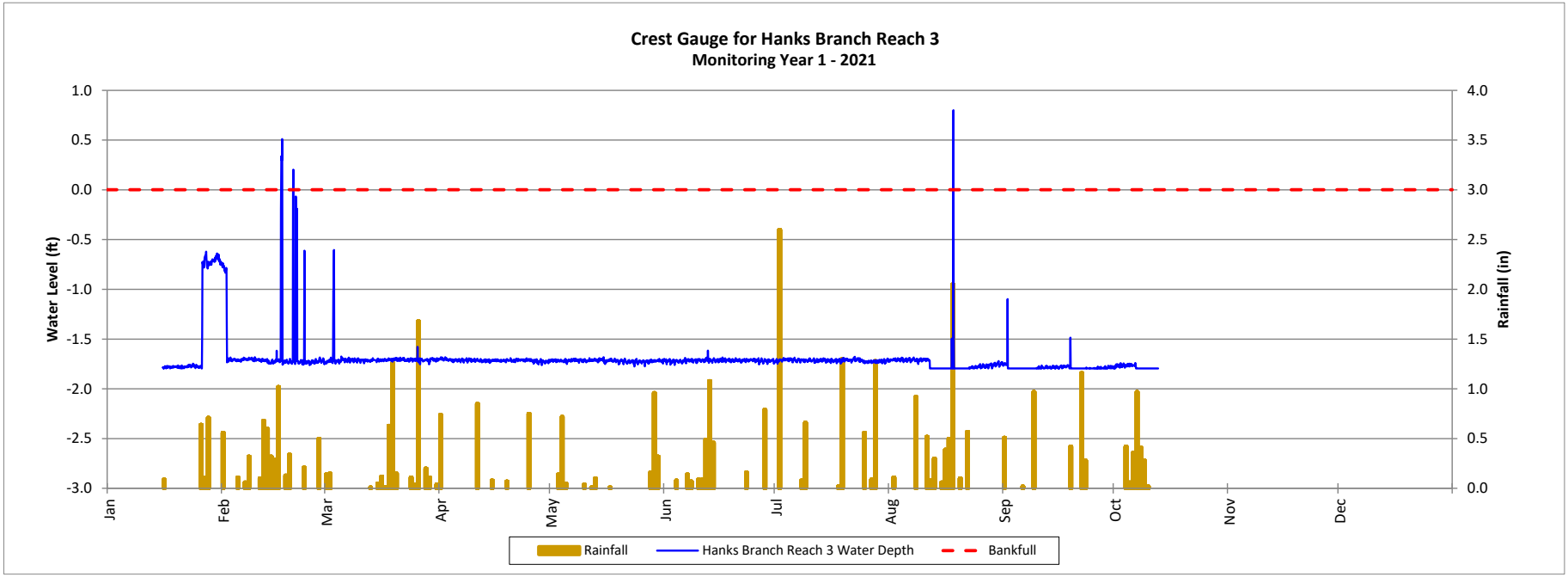
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
Annual Precip Total	39.24*						
WETS 30th Percentile	43.05						
WETS 70th Percentile	53.13						
Normal	*						

*Annual precipitation total was collected up until 10/16/2021. Data will be updated in MY2.

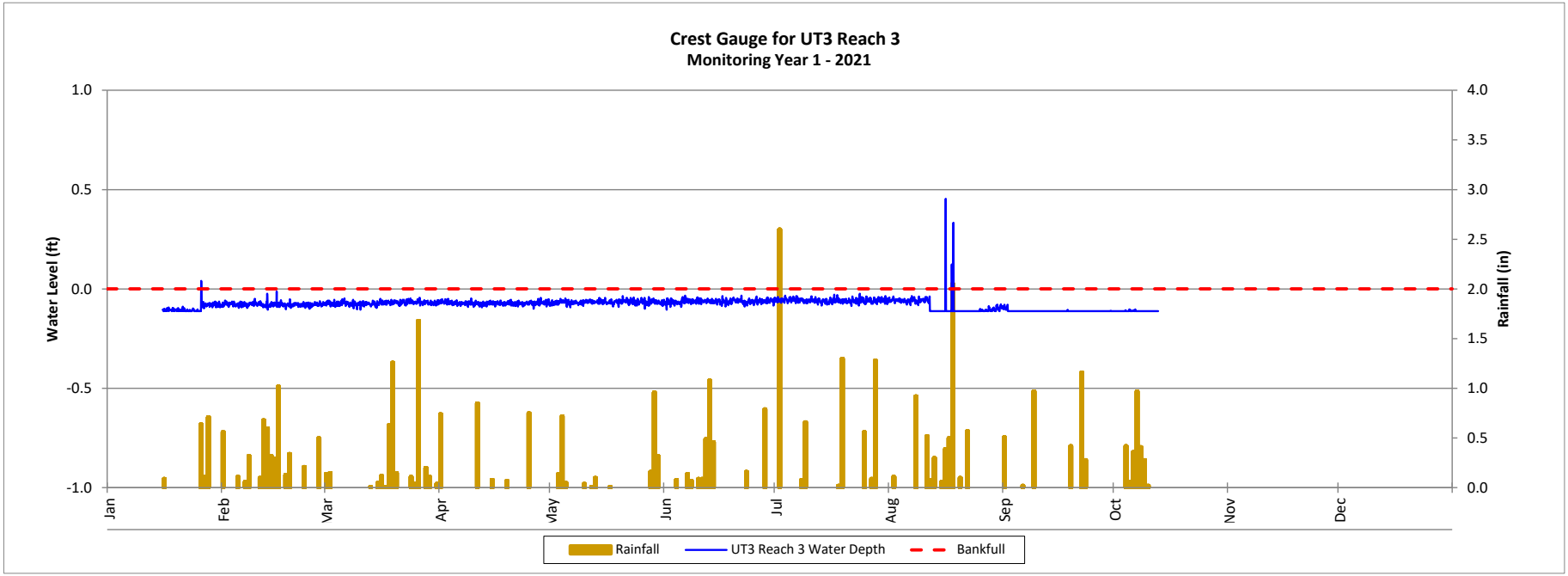
Recorded Bankfull Event Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021



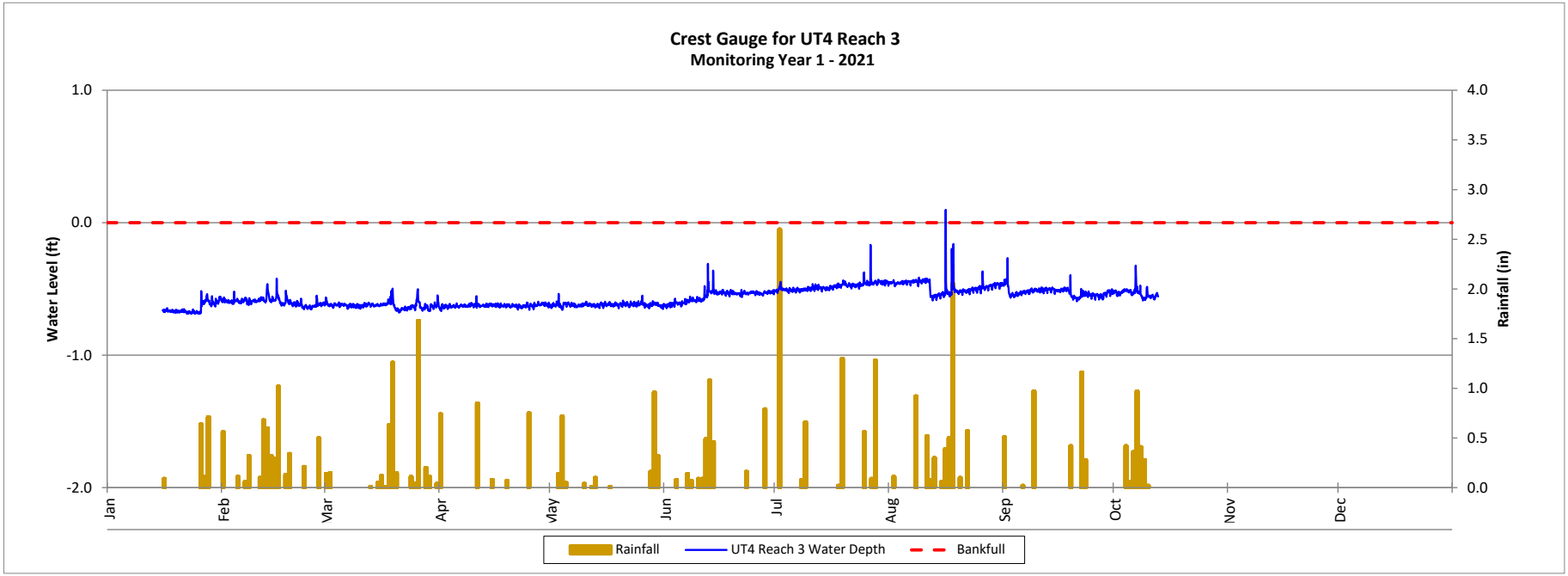
Recorded Bankfull Event Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021



Recorded Bankfull Event Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021



Recorded Bankfull Event Plots

Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

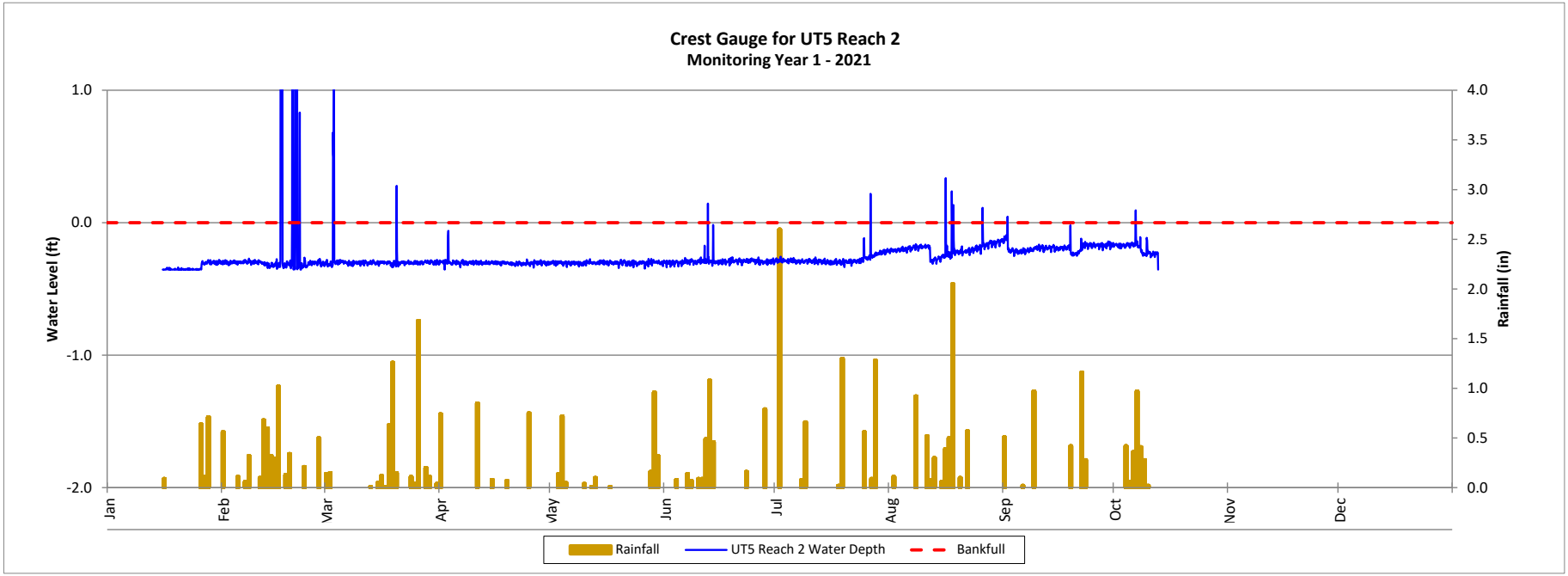


Table 12. Recorded In-Stream Flow Events Summary

Lyon Hills Mitigation Site
DMS Project No. 100085
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)
UT4 Reach 1	259 Days/ 259 Days						

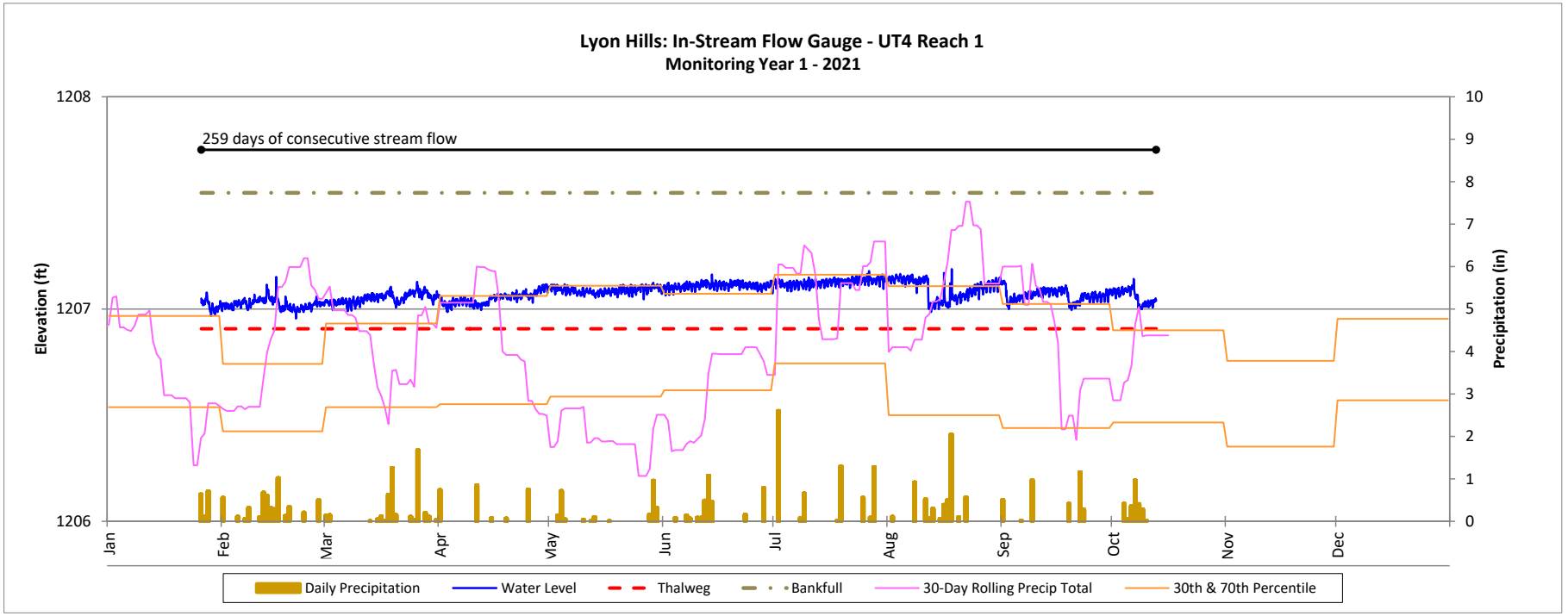
*Success criteria is 30 consecutive days of flow.
**Data colleted through October 16, 2021.

Recorded In-Stream Flow Events Plot

Lyon Hills Mitigation Site

DMS Project No. 100085

Monitoring Year 1 - 2021



APPENDIX E. Project Timeline and Contact Info

Table 13. Project Activity and Reporting History
Lyon Hills Mitigation Site
DMS Project No. 100085
Monitoring Year 1 - 2021

Activity or Deliverable		Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted		NA	June 2018
Mitigation Plan Approved		July 2020	July 2020
Construction (Grading) Completed		NA	January 2021
Planting Completed		NA	March 2021
As-Built Survey Completed		Febuary 2021	Febuary 2021
Baseline Monitoring Document (Year 0)	Stream Survey	February 2021	June 2021
	Vegetation Survey	March 2021	
Year 1 Monitoring	Stream Survey	September 2021	December 2021
	Vegetation Survey	September 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
Lyon Hills Mitigation Site
DMS Project No. 100085
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

November 23, 2021

Ms. Kimberly Browning
Wilmington District, Regulatory Division
U.S. Army Corps of Engineers
11405 Falls of Neuse Road
Wake Forest, NC 27587

Subject: IRT Comments on Lyon Hills Mitigation Site
As-Built Monitoring Report (MY0) and Record Drawings
Yadkin River Basin – CU# 03040101, Wilkes County
DMS Project ID No. 100085, Contract No. 7620

Dear Ms. Browning,

On October 13, 2021, Wildlands Engineering received comments from the North Carolina Interagency Review Team (NCIRT) regarding the As-Built Baseline Report dated July 28, 2021. The following letter documents NCIRT feedback and Wildlands' corresponding responses.

USACE Comments, Casey Haywood:

Section 2.2 : "Vegetative performance for riparian buffers associated with the stream restoration component of the project (buffer widths 0 – 30ft) will be in accordance with the Stream Mitigation Guidelines" Should this be 0-50ft? The mitigation plan indicates that all buffers on the project meet the minimum 50-foot requirement. Please adjust in future reports.

Response: Lyon Hills is located in Wilkes County which is a mountain county. The buffer width for mountain counties is 0-30ft. This was a mistake in the Mitigation Plan.

Culvert photos: UT1 looking upstream appears to have a significant amount of rock in the channel. Is Wildlands concerned with how the rock is placed in the channel and in front of the culvert? Was this meant to be a constructed riffle with embedded material?

Response: Wildlands is not concerned with rock placement in the channel and in front of the culvert. This was not meant to be a constructed riffle; however we do anticipate riffle material transporting through the system at higher flow events.

USEPA Comments, Todd Bowers:

I have performed a cursory review of the As-Built/MY0 Report for the Lyon Hills mitigation site dated September 2021. At this time I have no site-specific comments for corrective action at the Lyon Hills site. I have noted the discrepancies noted in the report namely the perched culvert at the Hanks Branch crossing and the three areas of fencing that required adjustment and Wildland's actions to repair and monitor these areas appears sufficient. I concur with the proposed plan to monitor the crossing at Sparks Creek that currently is without fencing due to the desire to avoid frequent repairs.

NCDWR Comments, Erin Davis:

DWR appreciates the level of detail provided in the Section 5 narrative and the redline drawings. Also, thank you for including culvert crossing photos.

Response: Thank you.

There were multiple additional rock outlets installed. Were other non-hardening options considered? Were live stakes or herbaceous plugs planted within outlet areas? What stone size was used? As discussed at the WEI's Key Mill site, large stone created voids can become wildlife traps.

Response: A/B stone was used for the outlets. With the large amount of concentrated flow that was occurring, Wildlands was unsure if proper vegetation would be able to establish fast enough to prevent rills and headcuts. Future sediment will cover the rocks and native vegetation will become established to avoid wildlife traps.

Looking at the photos, DWR was glad to see coir logs were utilized as a temporary sediment and erosion control measure in steep slope areas.

Response: Thank you.

In photo point 9 upstream, is that a monitoring device behind the tree?

Response: This was a drum barrel leftover from the landowner. Wildlands plans to remove it within the year.

With the additional rock outlet installations and new sections of stream realignments, please confirm that you did not go over the project's 401 approved wetland impact total.

Response: The stream realignments did not impact any additional wetlands beyond the permitted wetland impacts, however the additional rock outlet on Hanks Branch Reach 1 did impact part of a wetland by an extra 0.0088 acres (384 sq. ft.). This rock outlet was installed to prevent future bank erosion along Hanks Branch Reach 1. Since cattle have been removed from wetlands along the project streams and wetlands have been replanted, it is believed that the wetlands on site are higher quality than before construction and provide improved wetland functions.

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*