MONITORING YEAR 1 ANNUAL REPORT

FINAL

CATFISH POND MITIGATION SITE

Durham County, NC
NCDEQ Contract No. 007424
DMS Project No. 100039
USACE Action ID No. 2018-00424
NCDWR Project No. 2018-0196

Data Collection Period: April-December 2020
Draft Submission Date: December 8, 2020
Final Submission Date: February 2, 2021

PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
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Mitigation Project Name	**Catfish Pond Mitigation Site**	**USACE Action ID**	**2018-00424**
DMS ID	**100039**	**DWR Permit**	**2018-0196**
River Basin	**Neuse**	**Date Project Instituted**	**1/10/2018**
Cataloging Unit	**03020201**	**Stream/Wet. Service Area**	**Neuse 03020201**
County	**Durham**	**Date Printed**	**7/27/2020**

BROWNING.KIMBERLY.DANIELLE.1527683510 Digitally signed by BROWNING.KIMBERLY.DANIELLE.1527683510
Date: 2020.08.26 11:00:49 -04'00'

Signature of Official Approving Credit Release

Credit Release Milestone	**Warm Stream Credits**						
Project Credits	**Scheduled Releases %**	**Estimated Scheduled Release #**	**Proposed Released #**	**Not Approved # Releases**	**Approved Credits**	**Anticipated Release Year**	**Actual Release Date**
1 - Site Establishment	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 - Year 0 / As-Built	30.00%	1,124.640	1,124.640	0.000	1,124.640	2020	7/27/2020
3 - Year 1 Monitoring	10.00%	374.880				2021	
4 - Year 2 Monitoring	10.00%	374.880				2022	
5 - Year 3 Monitoring	10.00%	374.880				2023	
6 - Year 4 Monitoring	5.00%	187.440				2024	
7 - Year 5 Monitoring	10.00%	374.880				2025	
8 - Year 6 Monitoring	5.00%	187.440				2026	
9 - Year 7 Monitoring	10.00%	374.880				2027	
Stream Bankfull Standard	10.00%	374.880				2022	
			Totals		1,124.640		

Total Gross Credits	3,748.800
Total Unrealized Credits to Date	0.000
Total Released Credits to Date	1,124.640
Total Percentage Released	30.00%
Remaining Unreleased Credits	2,624.160

Notes

Contingencies (if any)

Project Quantities

Mitigation Type	**Restoration Type**	**Physical Quantity**
Warm Stream	Restoration	1,492.000
Warm Stream	Enhancement II	5,642.000

EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (Wildlands) implemented a full delivery project at the Catfish Pond Mitigation Site (Site) for the North Carolina Department of Environmental Quality Division of Mitigation Services (DMS). A total of 7,140 linear feet of perennial and intermittent streams were restored and enhanced in Durham County, NC. The Site is expected to generate 3,748.800 stream mitigation units when calculated along stream centerlines. The Site is located approximately 12 miles north of the City of Durham and approximately 3 miles east of the Orange/Durham County border (Figure 1). The Site is in the Neuse River Basin 8-Digit Hydrologic Unit Code 03020201 and NC Division of Water Resources (NCDWR) Subbasin 03-04-01. The Site contains Catfish Creek and 3 unnamed tributaries. The streams drain to Mountain Creek, which flows into Little River, the Eno River, and then Falls Lake. Falls Lake is classified as Water Supply Waters (WS-IV) and Nutrient Sensitive Waters (NSW). The 20.73-acre Site is protected with a permanent conservation easement.

The Site is located within a DMS Targeted Local Watershed as discussed in the 2010 Neuse River Basin Restoration Priorities (RBRP), which highlights the importance of riparian buffers for stream restoration projects (Breeding, 2010). Current and past degradation at the Site includes an in-line pond, extensive logging, farm road crossings, stream channelization, and livestock access to streams and buffers.

The project goals established in the Catfish Pond Site Mitigation Plan (Mitigation Plan) (Wildlands, 2019) were completed with consideration of goals and objectives described in the Neuse River RBRP. The project goals established include:

- Exclude cattle from project streams;
- Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime;
- Improve the stability of stream channels;
- Improve instream habitat;
- Restore and enhance native floodplain and streambank vegetation; and
- Permanently protect the Site from harmful uses.

The project will contribute to achieving goals for the watershed discussed in the Neuse River RBRP and provide ecological benefits within the Neuse River Basin. While benefits such as habitat improvement and geomorphic stability are limited to the Site, others, such as reduced pollutant and sediment loading, have farther reaching effects.

Site construction, seeding, and tree planting were completed in March and April 2020. As-built surveys were conducted in March and April 2020. Monitoring Year 1 (MY1) assessments and site visits were completed in October and November 2020 to assess the conditions of the project.

Overall, the Site has met the required vegetation and stream success criteria for MY1. The average vegetation plot stem density for the Site is 544 planted stems per acre and is therefore on track to meet the MY3 interim requirement of 320 planted stems per acre. Sporadic populations of multiflora rose (*Rosa multiflora*), Chinese privet (*Ligustrum sinense*), and Japanese honeysuckle (*Lonicera japonica*), along with scattered stems of princess tree (*Paulownia tomentosa*) and tree of heaven (*Ailanthus altissima*) were treated with various herbicide application approaches in May and September 2020. Follow up treatments are scheduled for winter 2020/2021. Project streams are stable and functioning. Cross-sections show slight deviations from as-built due to sediment deposition and the establishment of vegetation. A bankfull event was documented on both Catfish Creek Reach 6 and UT1 Reach 2 during MY1.

CATFISH POND MITIGATION SITE

Monitoring Year 1 Annual Report

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APPENDICES

Section 1: PROJECT OVERVIEW

The Catfish Pond Mitigation Site (Site) is located in Durham County approximately 12 miles north of the City of Durham and approximately 3 miles east of the Orange/Durham County border (Figure 1). The Site is located within the Falls Lake Water Supply Watershed, which is within the Neuse River Basin. Both the Neuse River and Falls Lake have been designated as Nutrient Sensitive Water. The Site is within Hydrologic Unit Code 03020201020040 and is located within the Neuse River Targeted Local Watershed (Figure 1) as identified in the 2010 Neuse River Basin Priorities (RBRP) (Breeding, 2010). The Site is in the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). The project watershed consists primarily of agricultural and forested land. Approximately 197 acres drain to the downstream end of Catfish Creek and 30 acres drain to Mountain Tributary for a total Site drainage area of 227 acres.

The project streams consist of Catfish Creek and three unnamed tributaries (UT1, UT2, and Mountain Tributary). Mitigation work within the Site included restoration and enhancement II of 7,140 linear feet of intermittent and perennial stream channels (Figure 2 and Table 1). The riparian areas were planted with native vegetation to improve habitat and protect water quality. The final Mitigation Plan (Wildlands, 2019) was submitted to and accepted by the North Carolina Department of Environmental Quality Division of Mitigation Services (DMS) in July 2019. Construction activities were completed by Main Stream Earthwork, Inc. in March 2020. Planting and seeding activities were completed by Bruton Natural Systems, Inc. and Canady's Landscaping and Erosion in March and April 2020. Baseline monitoring (MY0) was conducted in March and April 2020. Annual monitoring will occur for seven years with the closeout anticipated to commence in 2027 provided the success criteria are met. Appendix 1 provides additional details on project activity, history, contact information, and background information for the Site.

The Site is located on 2 parcels under single ownership. A conservation easement was recorded on 20.73 acres. The project is expected to provide 3,748.800 stream mitigation units (SMU) at closeout. A Project Vicinity Map and directions are provided in Figure 1 and a Project Component/Asset Map is illustrated in Figure 2.

1.1 Project Goals and Objectives

Prior to construction activities, one of the primary causes of degradation on the Site was the creation of an in-line pond on Catfish Creek Reach 6 sometime between 1940 and 1955. During that same time extensive logging and farm road construction took place at the Site. In 1972, aerial photographs suggest that portions of UT1 had been straightened for agricultural purposes. Catfish Creek above and below the pond, UT2, and Mountain Tributary showed few signs of channel manipulation, but were impaired due to historical livestock access. Table 4 in Appendix 1 and Tables 10a-b in Appendix 4 present additional information on pre-restoration conditions.

The project is intended to provide numerous ecological benefits helping achieve goals for the watershed discussed in the Neuse River RBRP. While benefits such as habitat improvement and geomorphic stability are limited to the Site, reduced nutrient and sediment loading have farther reaching effects. The table below describes expected outcomes to water quality and ecological processes and provides project goals and objectives. The project goals and objectives were developed as part of the Mitigation Plan (Wildlands, 2019) considering the goals and objectives listed in the Neuse River RBRP and strive to maximize ecological and water quality uplift within the watershed.

Goals	Objectives	Expected Outcomes
Exclude cattle from project streams.	Install fencing around conservation easements adjacent to cattle pastures to remove livestock.	Reduce and control sediment inputs; reduce and manage nutrient inputs; reduce and manage fecal coliform inputs. Contribute to protection of or improvement to a Water Supply Waterbody.
Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime.	Reconstruct stream channels for bankfull dimensions and depth relative to the existing floodplain. Remove existing berms to re-connect channel with adjacent wetlands.	Raise water table and hydrate riparian wetlands. Allow more frequent flood flows to disperse on the floodplain. Support geomorphology and higher-level functions.
Improve the stability of stream channels.	Construct stream channels that will maintain stable cross-sections, patterns, and profiles over time.	Significantly reduce sediment inputs from bank erosion. Reduce shear stress on channel boundary. Support all stream functions above hydrology.
Improve instream habitat.	Install habitat features such as constructed riffles, cover/lunker logs, and brush toes into restored/enhanced streams. Add woody materials to channel beds. Construct pools of varying depth.	Increase and diversify available habitats for macroinvertebrates, fish, and amphibians leading to colonization and increase in biodiversity over time. Add complexity including LWD to streams.
Restore and enhance native floodplain and streambank vegetation.	Plant native tree and understory species in riparian zone and plant appropriate species on streambank.	Reduce sediment inputs from bank erosion and runoff. Increase nutrient cycling and storage in floodplain. Provide riparian habitat. Add a source of LWD and organic material to stream. Support all stream functions.
Permanently protect the project Site from harmful uses.	Establish conservation easements on the Site.	Protect Site from encroachment on the riparian corridor and direct impact to streams and wetlands. Support all stream functions.

1.2 Monitoring Year 1 Data Assessment

Annual monitoring and site visits were conducted during Monitoring Year 1 (MY1) to assess the condition of the project. The vegetation, stream, and hydrology success criteria for the Site follow the approved success criteria presented in the Mitigation Plan (Wildlands, 2019).

1.2.1 Vegetative Assessment

Planted woody vegetation is being monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008). During baseline monitoring (MY0) a total of six standard 10-meter by 10-meter vegetation plots and one 5-meter by 20-meter vegetation plot were established within the project easement area. An additional two random vegetation plots are monitored annually, in which a new center point is arbitrarily chosen each year within the conservation easement.

The final vegetation success criteria at the end of MY7 are the survival of 210 planted stems per acre averaging 10 feet in height. Interim success criteria are the survival of 320 planted stems per acre at the

end of MY3 and 260 planted stems per acre with an average stem height of 7 feet at the end of MY5. No one species shall account for more than 50% of the required number of stems within any vegetation plot at the end of MY7.

The MY1 vegetative survey was completed in October 2020. Vegetation monitoring resulted in an average stem density of 544 planted stems per acre, which is well above the interim success criteria of 320 stems per acre required at MY3. There is an average of 13 stems per plot. All 9 vegetation plots individually met the interim success criteria and are on track to meet the final success criteria required for MY7. Refer to Appendix 2 for vegetation plot photographs and the vegetation condition assessment table and Appendix 3 for vegetation data tables.

1.2.2 Vegetation Areas of Concern

Before construction, the Site had sporadic areas of multiflora rose (*Rosa multiflora*), Chinese privet (*Ligustrum sinense*), and Japanese honeysuckle (*Lonicera japonica*). There were also a few scattered stems of princess tree (*Paulownia tomentosa*) and tree of heaven (*Ailanthus altissima*). Multiflora rose was treated throughout the Site in May 2020 using a foliar application of triclopyr. The scattered princess tree and tree of heaven individuals were treated in September 2020 using a stem injection of imazapyr. The remaining Chinese privet on the site will be treated during the winter of 2020/2021 using a combination of methods including foliar and cut stump applications. Herbicide application for Japanese honeysuckle treatment is also scheduled for MY2. While invasive species have been greatly reduced, Wildlands recognizes that multiple treatments are typically needed for effective invasive plant control and will likely conduct follow up treatments in subsequent monitoring years as necessary.

Areas along the edge of the easement adjacent to the livestock pastures were dominated by pasture grasses such as tall fescue (*Festuca arundinacea*). These areas received a broadcast application of glyphosate and were seeded with the permanent native seed mix prior to planting. Wildlands completed ring sprays around the base of trees in most of the remaining areas dominated by tall fescue. These ring sprays were completed soon after tree planting and significantly reduced tall fescue cover in an 18”-30” radius around each tree. A few small areas were left untreated by ring sprays for comparison.

1.2.3 Stream Assessment

Morphological surveys for MY1 were conducted in October 2020. Streams within the Site are stable and functioning as designed. All cross-sections at the Site show minimal change in the bankfull cross-sectional area and width-to-depth ratio. Bank height ratios are 1.0 or less. Entrenchment ratios are over 1.4 for B channels and 2.2 for C channels. Cross-section graphs show slight deviations from as-built due to sediment deposition and establishment of vegetation. Some sediment deposition in pools is natural and expected. Reachwide substrate measurements indicate the maintenance of coarser materials in the riffle reaches and finer particles in the pools. Visual inspection does not indicate reachwide vertical instability so longitudinal profile surveys are not required. Refer to Appendix 2 for the visual stability assessment table, Integrated Current Condition Plan View map, and stream photographs. Refer to Appendix 4 for the morphological data and plots.

1.2.4 Stream Areas of Concern

No stream areas of concern were identified during MY1.

1.2.5 Hydrology Assessment

By the end of MY7, four or more bankfull events must have occurred in separate years within the restoration reaches. One bankfull event was recorded on Catfish Creek Reach 6 and one was recorded on UT1 Reach 2. Refer to Appendix 5 for hydrologic data.

1.2.6 Wetland Assessment

As requested by NCDWR, four groundwater wells with pressure transducers were installed and monitored within the existing wetlands zones (one along Catfish Creek Reach 4 and three along UT1 Reach 2). The purpose of these gauges is to assess potential effects to wetland hydrology from the construction of the restored stream channels. The monitoring results are not tied to performance standards. All gauges are downloaded and maintained quarterly.

The measured hydroperiod ranged from 5.3% (14 days) to 41.0% (109 days) of the growing season. Groundwater gauges were not installed until mid-March after construction completion, resulting in a data gap during the first 18 days of the growing season. Refer to Appendix 5 for wetland hydrology data.

1.2.7 Adaptive Management Plan

From construction completion through MY1, sporadic areas of invasive species were treated via various forms of herbicide applications. Both the scattered Chinese privet and Japanese honeysuckle are scheduled for herbicide treatment in MY2. Wildlands will continue to monitor and control invasive species at the Site during subsequent monitoring years.

Trees planted in areas of competition with tall fescue are being observed closely. Based on current conditions, no additional treatment is necessary at this time.

1.3 Monitoring Year 1 Summary

All vegetation plots met the MY3 interim requirement of 320 planted stems per acre. Sporadic invasive vegetation was treated in May and September 2020 and follow up treatments are scheduled for winter 2020/2021. Project streams are stable and functioning as designed. Cross-sections show limited deviations from as-built due to sediment deposition and vegetation establishment. A bankfull event was documented on both Catfish Creek Reach 6 and UT1 Reach 2 during MY1.

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. Narrative background and supporting information formerly found in these reports can be found in the Mitigation Plan (Wildlands, 2019) available on DMS's website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

Section 2: 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). Integrated Current Condition View mapping for MY1 was recorded using a Garmin GLO receiver with 3-meter accuracy and processed using ArcGIS. Pressure transducers were installed in riffle cross-sections to measure bankfull events and were monitored throughout the year. Hydraulic monitoring instrument installation and monitoring methods are in accordance with the Wilmington District Stream and Wetland Compensatory Mitigation Update, released by the North Carolina Interagency Review Team (NCIRT, 2016). Vegetation monitoring protocols followed the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008).

Section 3: REFERENCES

Breeding, R. 2010. Neuse River Basin Restoration Priorities. North Carolina Ecosystem Enhancement Program. Accessed at: https://files.nc.gov/ncdeq/Mitigation%20Services/Watershed_Planning/Neuse_River_Basin/FINAL%20RBRP%20Neuse%202010_%2020111207%20CORRECTED.pdf

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, John 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. Accessed at: https://www.fs.fed.us/biology/nsaec/fishxing/fplibrary/Harrelson_1994_Stream_Channel_Reference_Sites_An_Illustrated.pdf

Lee, M.T., Peet, R.K., Roberts, S.D., & Wentworth, T.R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Accessed at: http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-2.pdf

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

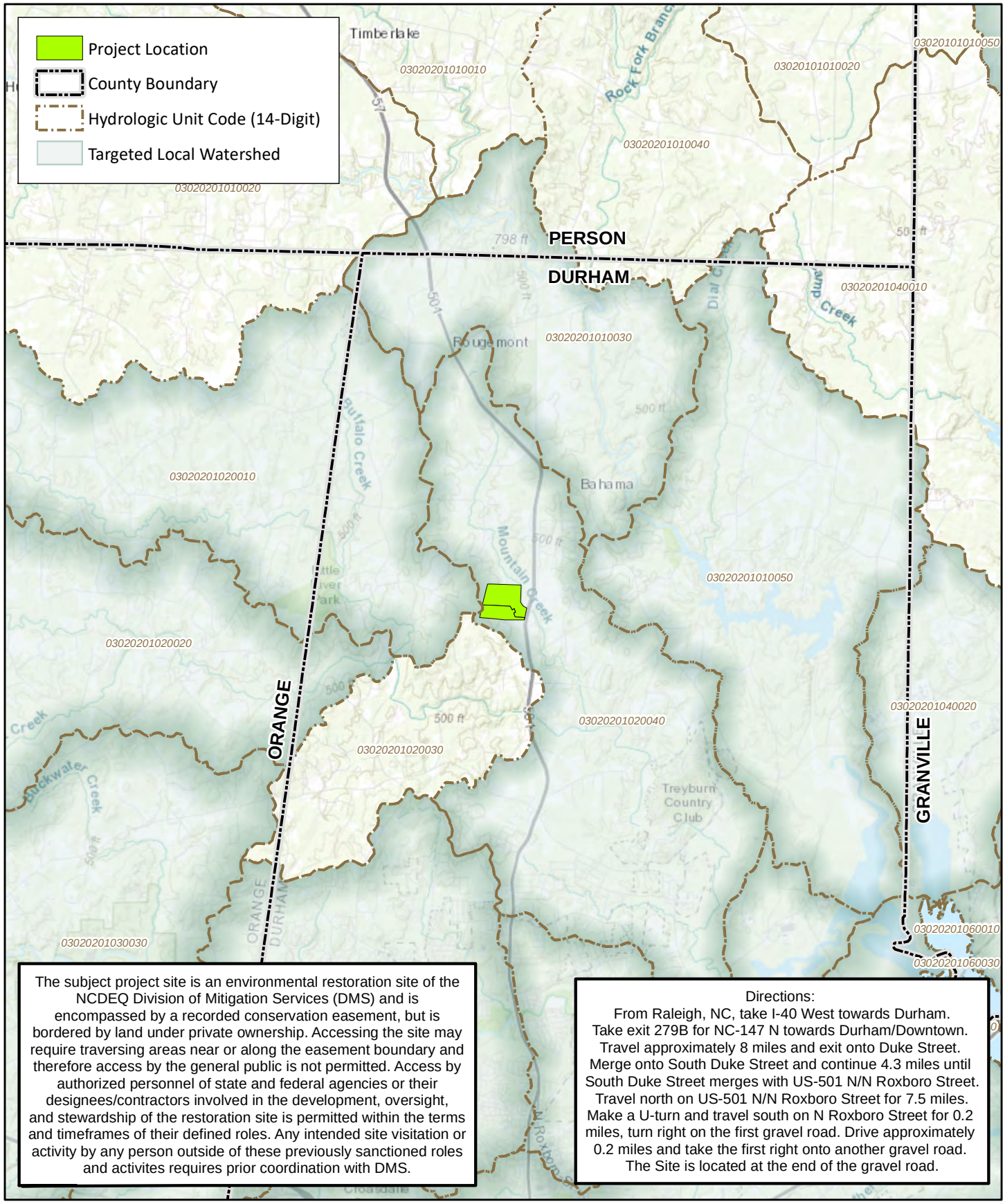
Rosgen, D.L. 1994. A classification of natural rivers. *Catena* 22:169-199.

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

United States Geological Survey. 1998. North Carolina Geology. Accessed at: http://www.geology.enr.state.nc.us/usgs/carolina.htm

Wildlands Engineering, Inc. 2019. Catfish Pond Mitigation Site Mitigation Plan. DMS, Raleigh, NC.

APPENDIX 1. General Figures and Tables



The subject project site is an environmental restoration site of the NCDEQ Division of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight, and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activites requires prior coordination with DMS.

Directions:
From Raleigh, NC, take I-40 West towards Durham. Take exit 279B for NC-147 N towards Durham/Downtown. Travel approximately 8 miles and exit onto Duke Street. Merge onto South Duke Street and continue 4.3 miles until South Duke Street merges with US-501 N/N Roxboro Street. Travel north on US-501 N/N Roxboro Street for 7.5 miles. Make a U-turn and travel south on N Roxboro Street for 0.2 miles, turn right on the first gravel road. Drive approximately 0.2 miles and take the first right onto another gravel road. The Site is located at the end of the gravel road.

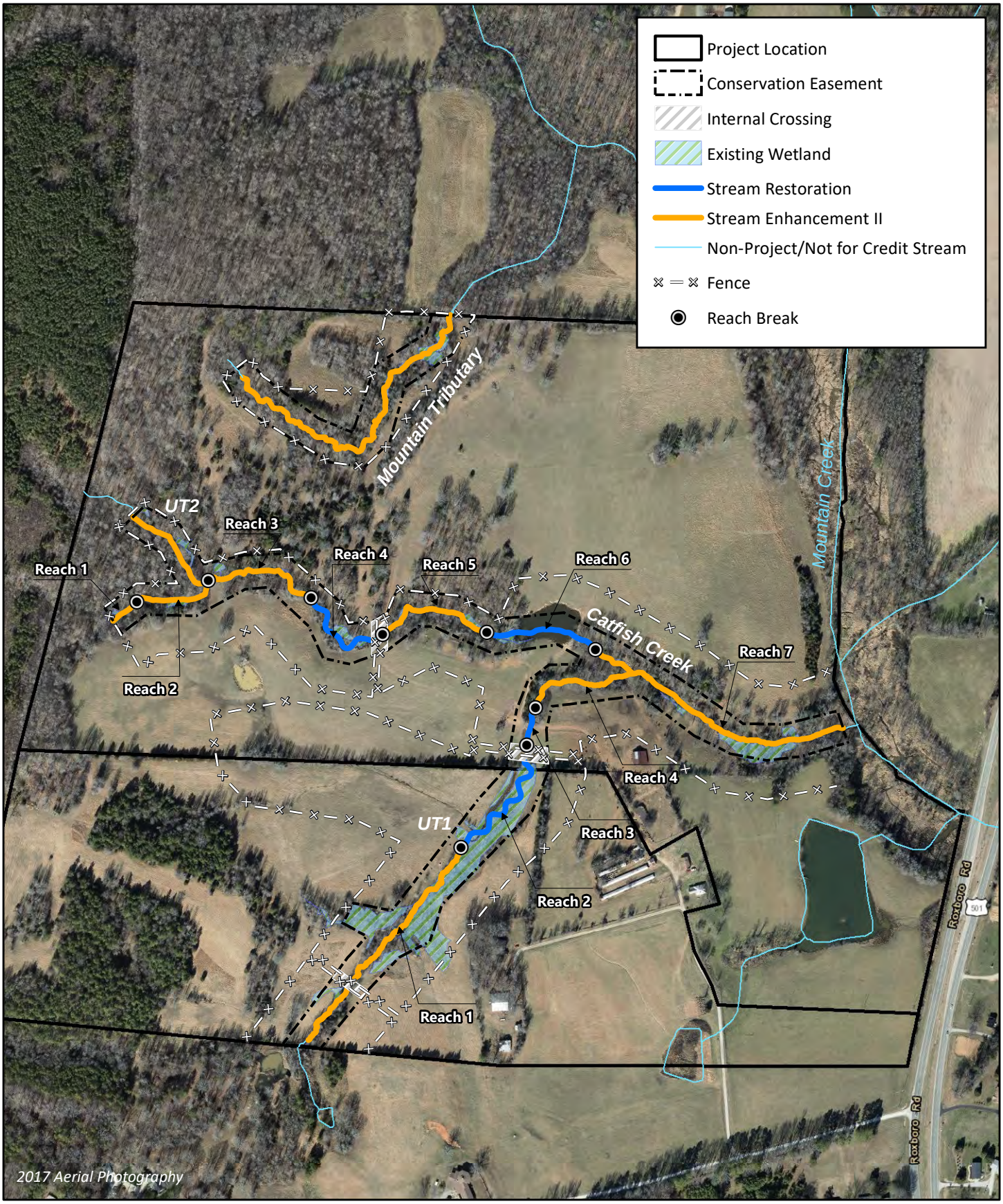
WILDLANDS ENGINEERING

0 1 2 Miles

N

Figure 1. Project Vicinity Map
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 – 2020

Durham County, NC



WILDLANDS ENGINEERING

0 250 500 Feet

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Figure 2. Project Component/Asset Map
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 – 2020

Durham County, NC

Table 1. Mitigation Assets and Components
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

PROJECT COMPONENTS									
Reach ID	**Existing Footage**	**Mitigation Plan Footage**	**Mitigation Category**	**Restoration Level**	**Priority Level**	**Mitigation Ratio (X:1)**	**As-Built Footage**	**Credits (SMU)**	**Comments**
STREAMS									
Catfish Creek Reach 1	115	115	Warm	EII	N/A	2.5	115	46.000	Invasive Control, Conservation Easement
Catfish Creek Reach 2	323	323	Warm	EII	N/A	2.5	323	129.200	Invasive Control, Grade Control Structures, Planted Buffer, Livestock Exclusion
Catfish Creek Reach 3	474	473	Warm	EII	N/A	2.5	474	189.200	Invasive Control, Grade Control Structures, Planted Buffer, Livestock Exclusion
Catfish Creek Reach 4	369	374	Warm	R	P1	1.0	373	374.000	Full Channel Restoration, Planted Buffer, Livestock Exclusion
	65	72	N/A	N/A	N/A	0.0	72	0.000	Culvert Crossing
Catfish Creek Reach 5	459	460	Warm	EII	N/A	2.5	460	184.000	Grade Control Structures, Planted Buffer, Livestock Exclusion, Conservation Easement
Catfish Creek Reach 6	466	454*	Warm	R	P1	1.0	444	454.000	Full Channel Restoration, Planted Buffer, Livestock Exclusion, Farm Pond Drained
Catfish Creek Reach 7	1,087	1,071*	Warm	EII	N/A	2.5	1,087	428.400	Invasive Control, Grade Control Structures, Planted Buffer, Livestock Exclusion
UT1 Reach 1	307	263	Warm	EII	N/A	2.5	263	105.200	Invasive Control, Planted Buffer, Livestock Exclusion
	42	42	N/A	N/A	N/A	0.0	42	0.000	Culvert Crossing
	717	717	Warm	EII	N/A	2.5	711	286.800	Invasive Control, Planted Buffer, Livestock Exclusion
UT1 Reach 2	430	515	Warm	R	P1	1.0	520	515.000	Full Channel Restoration, Planted Buffer, Livestock Exclusion
	60	60	N/A	N/A	N/A	0.0	61	0.000	Culvert Crossing
UT1 Reach 3	154	149	Warm	R	P2	1.0	149	149.000	Full Channel Restoration, Planted Buffer, Livestock Exclusion
UT1 Reach 4	447	446	Warm	EII	N/A	2.5	446	178.400	Invasive Control, Planted Buffer, Livestock Exclusion
UT2	412	412	Warm	EII	N/A	2.5	412	164.800	Invasive Control, Grade Control Structures, Livestock Exclusion
Mountain Tributary	1,362	1,362	Warm	EII	N/A	2.5	1,362	544.800	Invasive Control, Grade Control Structures, Planted Buffer, Livestock Exclusion

*Due to a stationing error in the Mitigation Plan, linear feet and associated credits were overestimated on Catfish Creek Reach 6 and underestimated on Reach 7 for a net overage of 10.6 SMUs. Stream credits were calculated using Mitigation Plan footage because the 10.6 SMUs represent only 0.28% of the total stream credits.

PROJECT CREDITS							
Restoration Level	**Stream**			**Riparian Wetland**		**Non-Riparian Wetland**	**Coastal Marsh**
	Warm	**Cool**	**Cold**	**Riverine**	**Non-Riverine**		
Restoration	1,492.000						
Enhancement I							
Enhancement II	2,256.800						
Preservation							
Re-Establishment							
Rehabilitation							
Enhancement							
Creation							
Total^	**3,748.800**						

^Credits have been adjusted to include changes in stream alignment on Catfish Creek Reach 6 due to bedrock in the floodplain.

Table 2. Project Activity and Reporting History

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Activity or Report		Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan		July 2019	July 2019
Final Design - Construction Plans		August 2019	August 2019
Construction		February-March 2020	March 2020
Temporary S&E mix applied to entire project area[1]		March 2020	March 2020
Permanent seed mix applied to reach/segments[1]		April 2020	April 2020
Bare root and live stake plantings for reach/segments		March 2020	March 2020
Baseline Monitoring Document (Year 0)	Stream Survey	March-April 2020	June 2020
	Vegetation Survey	March 2020	
Competitive Vegetation Treatment[2]			April-May 2020
Invasive Vegetation Treatment			May & September 2020
Year 1 Monitoring	Stream Survey	October 2020	December 2020
	Vegetation Survey	October 2020	
Year 2 Monitoring	Stream Survey	2021	December 2021
	Vegetation Survey	2021	
Year 3 Monitoring	Stream Survey	2022	December 2022
	Vegetation Survey	2022	
Year 4 Monitoring			December 2023
Year 5 Monitoring	Stream Survey	2024	December 2024
	Vegetation Survey	2024	
Year 6 Monitoring			December 2025
Year 7 Monitoring	Stream Survey	2026	December 2026
	Vegetation Survey	2026	

[1]Seed and mulch is added as each section of construction is completed.
[2]Herbicide ring sprays around the base of planted stems.

Table 3. Project Contact Table

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Designer Daniel Johnson, PE	**Wildlands Engineering, Inc.** 497 Bramson Ct, Suite 104 Mt. Pleasant, SC 29464 843.277.6221
Construction Crew	**Main Stream Earthwork, Inc.** 631 Camp Dan Valley Rd Reidsville, NC 27320
Planting Contractor	**Bruton Natural Systems, Inc** P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	**Canady's Landscaping & Erosion** 256 Fairview Acres Rd Lexington, NC 27295
Seed Mix Sources	**Garrett Wildflower Seed Farm** 1591 Cleveland Rd Smithfield, NC 27577
	Ernst Conservation Seeds, Inc. 8884 Mercer Pike Meadville, PA 16335
Nursery Stock Suppliers **Bare Roots**	**Dykes and Sons Nursery and Greenhouse** 825 Maude Etter Rd McMinnville, TN 37110
Live Stakes	**Bruton Natural Systems, Inc**
	Foggy Mountain Nursery 797 Helton Creek Rd Lansing, NC 28643
Monitoring Performers Monitoring, POC	**Wildlands Engineering, Inc.** Jason Lorch 919.851.9986

Table 4. Project Information and Attributes
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

PROJECT INFORMATION	
Project Name	Catfish Pond Mitigation Site
County	Durham County
Project Coordinates (latitude and longitude)	36° 9' 48.03" N, 78° 54' 37.66" W
Project Area (acres)	20.73
Planted Acreage (acres of woody stems planted)	8.00

PROJECT WATERSHED SUMMARY INFORMATION	
Physiographic Province	Carolina Slate Belt of the Piedmont Physiographic Province
River Basin	Neuse River
USGS Hydrologic Unit 8-digit	03020201
USGS Hydrologic Unit 14-digit	03020201020040
DWR Sub-basin	03-04-01
Project Drainiage Area (acres)	227 (Catfish Creek - 197, Mountain Tributary - 30)
Project Drainage Area Percentage of Impervious Area	0.0%
CGIA Land Use Classification	45.6% forested, 54.2% cultivated, 0.2% wetland

REACH SUMMARY INFORMATION

Parameters	Catfish Creek						
	R1	R2	R3	R4	R5	R6	R7
Length of Reach (linear feet) - Post-Restoration	115	323	474	373	460	444	1,087
Valley Confinement (confined, moderately confined, unconfined)	Confined	Confined	Confined	Unconfined	Moderately Confined	Moderately Confined	Moderately Confined
Drainage Area (acres)	17	17	53	56	61	70	197
Perennial, Intermittent, Ephemeral	I	P	P	P	P	P	P
NCDWR Stream Identification Score	35.00	---	30.00	45.25	---	---	---
NCDWR Water Quality Classification	WS-II/HQW/NSW						
Morphological Description (stream type) - Pre-Restoration	E5b/E4b	E5b/E4b	E4	Incised E6	C4b	N/A	C4b
Morphological Description (stream type) - Post-Restoration	E5b/E4b	E5b/E4b	E4	C4	C4b	B4a	C4b
Evolutionary Trend (Simon's Model) - Pre-Restoration	IV	IV	IV	IV	IV	N/A	V
FEMA Classification	None						Zone AE

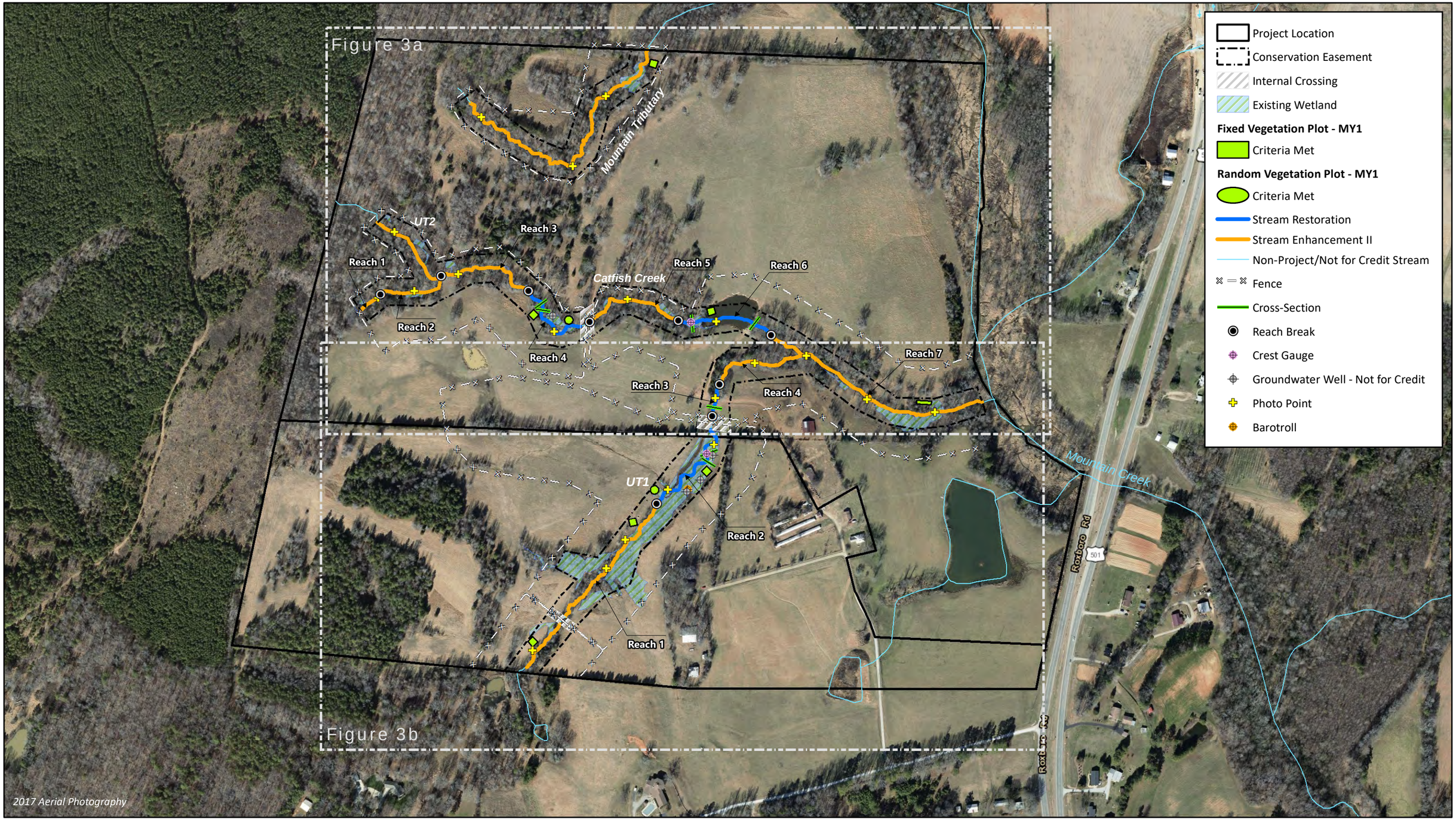
Parameters	UT1				UT2	Mountain Tributary
	R1	R2	R3	R4		
Length of Reach (linear feet) - Post-Restoration	974	520	149	446	412	1,362
Valley Confinement (confined, moderately confined, unconfined)	Unconfined	Moderately Confined	Moderately Confined	Confined	Confined	Moderately Confined
Drainage Area (acres)	75	105	107	108	32	30
Perennial, Intermittent, Ephemeral	P	P	P	P	I	I
NCDWR Stream Identification Score	31.50				26.00	26.00
NCDWR Water Quality Classification	WS-II/HQW/NSW					
Morphological Description (stream type) - Pre-Restoration	E4	C6	E4b	E4b	C3b/C4b	E4b
Morphological Description (stream type) - Post-Restoration	E4	C4	B4a	E4b	C3b/C4b	E4b
Evolutionary Trend (Simon's Model) - Pre-Restoration	IV	V	IV	IV	IV	IV
FEMA Classification	None					

REGULATORY CONSIDERATIONS

Regulation	Applicable	Resolved	Supporting Documentation
Waters of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No. 27 and DWQ 401 Water Quality Certification No. 4134.
Waters of the United States - Section 401	Yes	Yes	
Division of Land Quality (Dam Safety)	N/A	N/A	N/A
Endangered Species Act	Yes	Yes	Catfish Pond Mitigation Plan; per the Categorical Exclusion research and response by US Fish and Wildlife Service the "proposed action [in this project] is not likely to adversely affect any federally listed endangered or threatened species, their formally designated critical habitat, or species currently proposed for listing under the Act."
Historic Preservation Act	Yes	Yes	Correspondence from SHPO on March 5, 2018 stated they were aware of "no historic resources which would be affected by the project."
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	Durham County Floodplain Development Permit No. 19800041 was obtained on October 7, 2019.
Essential Fisheries Habitat	N/A	N/A	N/A

(---): Data was not provided.

APPENDIX 2. Visual Assessment Data



WILDLANDS ENGINEERING

0 400 800 Feet

N

Figure 3. Integrated Current Condition Plan View Map Key
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 – 2020

Durham County, NC

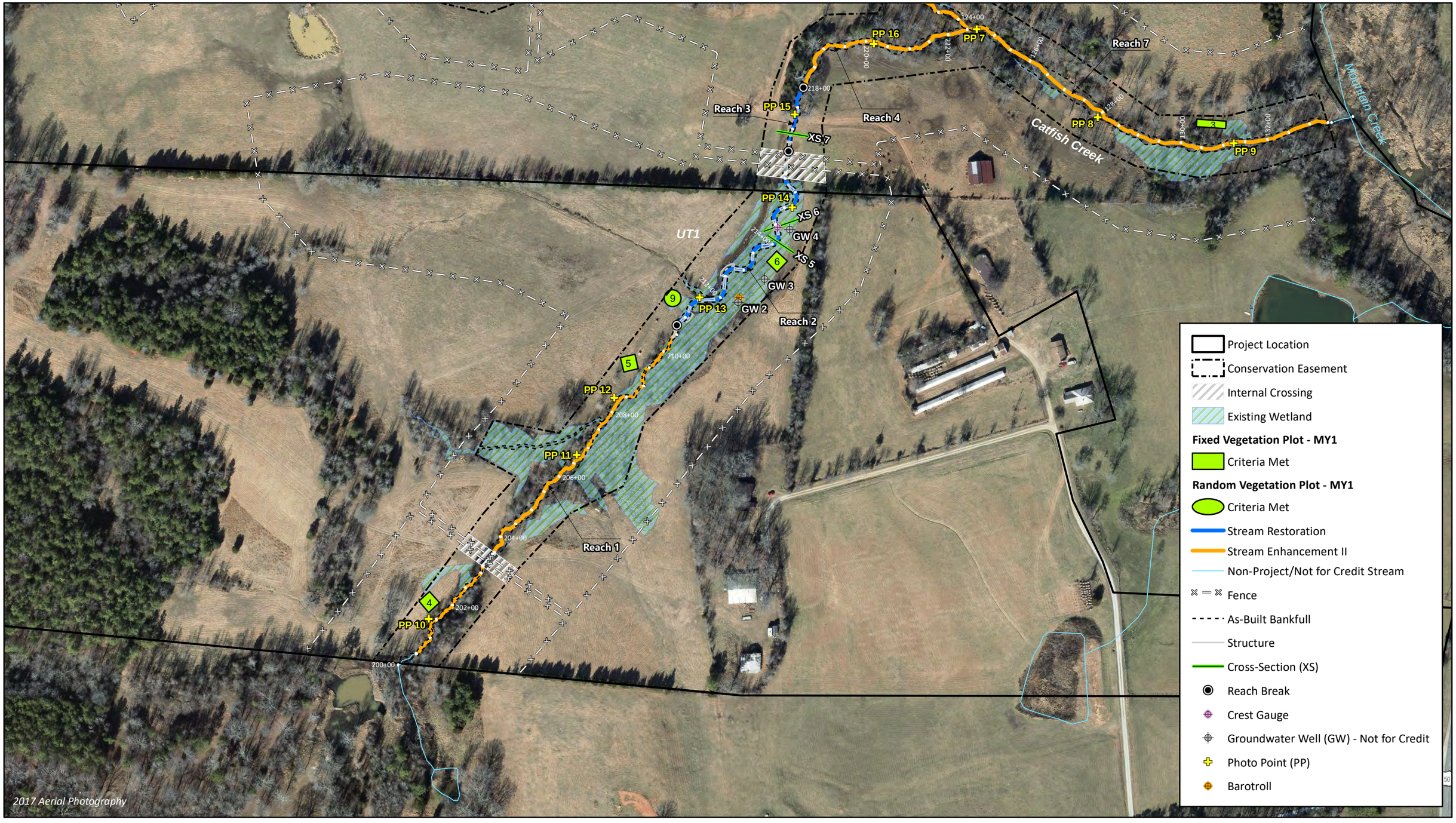
WILDLANDS ENGINEERING

0 200 400 Feet

N

Figure 3a. Integrated Current Condition Plan View Map
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 – 2020

Durham County, NC



WILDLANDS ENGINEERING

0 200 400 Feet

N

Figure 3b. Integrated Current Condition Plan View Map
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 – 2020
Durham County, NC

Table 5a. Visual Stream Morphology Stability Assessment Table
Catfish Pond Mitigation Project
DMS Project No. 100039
Monitoring Year 1 - 2020

Catfish Creek Reach 4

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability (Riffle and Run Units)**	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	7	7			100%			
	3. Meander Pool Condition	Depth Sufficient	7	7			100%			
		Length Appropriate	7	7			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	7	7			100%			
		Thalweg centering at downstream of meander bend (Glide)	7	7			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse.			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	0	0			N/A			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	4	4			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	4	4			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 5b. Visual Stream Morphology Stability Assessment Table
Catfish Pond Mitigation Project
DMS Project No. 100039
Monitoring Year 1 - 2020

Catfish Creek Reach 6

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability (Riffle and Run Units)**	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	14	14			100%			
	3. Meander Pool Condition	Depth Sufficient	15	15			100%			
		Length Appropriate	15	15			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	14	14			100%			
		Thalweg centering at downstream of meander bend (Glide)	15	15			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	1	1			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	1	1			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	1	1			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	0	0			N/A			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	0	0			N/A			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 5c. Visual Stream Morphology Stability Assessment Table
Catfish Pond Mitigation Project
DMS Project No. 100039
Monitoring Year 1 - 2020

UT1 Reach 2

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability (Riffle and Run Units)**	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	10	10			100%			
	3. Meander Pool Condition	Depth Sufficient	10	10			100%			
		Length Appropriate	10	10			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	10	10			100%			
		Thalweg centering at downstream of meander bend (Glide)	10	10			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	0	0			N/A			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	2	2			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	2	2			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 5d. Visual Stream Morphology Stability Assessment Table
Catfish Pond Mitigation Project
DMS Project No. 100039
Monitoring Year 1 - 2020

UT1 Reach 3

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability (Riffle and Run Units)**	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	3	3			100%			
	3. Meander Pool Condition	Depth Sufficient	4	4			100%			
		Length Appropriate	4	4			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	4	4			100%			
		Thalweg centering at downstream of meander bend (Glide)	4	4			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	0	0			N/A			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	0	0			N/A			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	0	0			N/A			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6. Vegetation Condition Assessment Table

Catfish Pond Mitigation Project
DMS Project No. 100039
Monitoring Year 1 - 2020

Planted Acreage **8.00**

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

Easement Acreage **20.73**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale).	1,000	0	0	0%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0%

STREAM PHOTOGRAPHS

	
PHOTO POINT 1 Catfish Creek R1 – upstream *(10/22/2020)*	**PHOTO POINT 1 Catfish Creek R1 – downstream *(10/22/2020)***
	
PHOTO POINT 2 Catfish Creek R2 – upstream *(10/22/2020)*	**PHOTO POINT 2 Catfish Creek R2 – downstream *(10/22/2020)***
	
PHOTO POINT 3 Catfish Creek R3 – upstream *(10/22/2020)*	**PHOTO POINT 3 Catfish Creek R3 – downstream *(10/22/2020)***

PHOTO POINT 4 Catfish Creek R4 – upstream *(10/22/2020)*

PHOTO POINT 4 Catfish Creek R4 – downstream *(10/22/2020)*

PHOTO POINT 5 Catfish Creek R5 – upstream *(10/22/2020)*

PHOTO POINT 5 Catfish Creek R5 – downstream *(10/22/2020)*

PHOTO POINT 6 Catfish Creek R6 – upstream *(10/22/2020)*

PHOTO POINT 6 Catfish Creek R6 – downstream *(10/22/2020)*

	
PHOTO POINT 7 Catfish Creek R7 – upstream *(10/22/2020)*	**PHOTO POINT 7 Catfish Creek R7 – downstream *(10/22/2020)***
	
PHOTO POINT 8 Catfish Creek R7 – upstream *(10/22/2020)*	**PHOTO POINT 8 Catfish Creek R7 – downstream *(10/22/2020)***
	
PHOTO POINT 9 Catfish Creek R7 – upstream *(10/22/2020)*	**PHOTO POINT 9 Catfish Creek R7 – downstream *(10/22/2020)***

	
PHOTO POINT 10 UT1 R1 – upstream *(10/22/2020)*	**PHOTO POINT 10 UT1 R1 – downstream *(10/22/2020)***
	
PHOTO POINT 11 UT1 R1 – upstream *(10/22/2020)*	**PHOTO POINT 11 UT1 R1 – downstream *(10/22/2020)***
	
PHOTO POINT 12 UT1 R1 – upstream *(10/22/2020)*	**PHOTO POINT 12 UT1 R1 – downstream *(10/22/2020)***

PHOTO POINT 13 UT1 R2 – upstream *(10/22/2020)*

PHOTO POINT 13 UT1 R2 – downstream *(10/22/2020)*

PHOTO POINT 14 UT1 R2 – upstream *(10/22/2020)*

PHOTO POINT 14 UT1 R2 – downstream *(10/22/2020)*

PHOTO POINT 15 UT1 R3 – upstream *(10/22/2020)*

PHOTO POINT 15 UT1 R3 – downstream *(10/22/2020)*

	
PHOTO POINT 16 UT1 R4 – upstream *(10/22/2020)*	**PHOTO POINT 16 UT1 R4 – downstream *(10/22/2020)***
	
PHOTO POINT 17 UT2 – upstream *(10/22/2020)*	**PHOTO POINT 17 UT2 – downstream *(10/22/2020)***
	
PHOTO POINT 18 Mountain Trib – upstream *(10/22/2020)*	**PHOTO POINT 18 Mountain Trib – downstream *(10/22/2020)***

	
PHOTO POINT 19 Mountain Trib – upstream *(10/22/2020)*	**PHOTO POINT 19 Mountain Trib – downstream *(10/22/2020)***
	
PHOTO POINT 20 Mountain Trib – upstream *(10/22/2020)*	**PHOTO POINT 20 Mountain Trib – downstream *(10/22/2020)***

VEGETATION PLOT PHOTOGRAPHS

FIXED VEG PLOT 1 *(10/06/2020)*

FIXED VEG PLOT 2 *(10/06/2020)*

FIXED VEG PLOT 3 *(10/06/2020)*

FIXED VEG PLOT 4 *(10/06/2020)*

FIXED VEG PLOT 5 *(10/06/2020)*

FIXED VEG PLOT 6 *(10/06/2020)*

FIXED VEG PLOT 7 *(10/06/2020)*

RANDOM VEG PLOT 8 *(10/06/2020)*

RANDOM VEG PLOT 9 *(10/06/2020)*

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Table

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Plot	Success Criteria Met*	Tract Mean
Fixed Veg Plot 1	Yes	100%
Fixed Veg Plot 2	Yes	
Fixed Veg Plot 3	Yes	
Fixed Veg Plot 4	Yes	
Fixed Veg Plot 5	Yes	
Fixed Veg Plot 6	Yes	
Fixed Veg Plot 7	Yes	
Random Veg Plot 8	Yes	
Random Veg Plot 9	Yes	

*Based on the interim target stem density for MY3 of 320 planted stems per acre.

Table 8. CVS Vegetation Tables - Metadata
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Report Prepared By	Tasha King
Date Prepared	10/30/2020 9:37
Database Name	CatfishPond_MY1_cvs-v2.5.0.mdb
Database Location	F:\Monitoring\Catfish Pond\MY1 - 2020
Computer Name	CHARLOTTEINTERN
File Size	84144128
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Project Planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Project Total Stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and Spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	100039
Project Name	Catfish Pond Mitigation Site
Description	Stream and Buffer Restoration Project
Sampled Plots	7

Table 9a. Fixed Plots: Planted and Total Stem Counts

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

			Current Plot Data (MY1 2020)														
			VP 1			VP 2			VP 3			VP 4			VP 5		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Aesculus flava	Yellow Buckeye	Shrub Tree	1	1	1												
Betula nigra	River Birch	Tree				1	1	1	1	1	1						
Diospyros virginiana	American Persimmon	Tree									12						
Fraxinus pennsylvanica	Green Ash	Tree				2	2	2						1	3	3	3
Liquidambar styraciflua	Sweet Gum	Tree															
Platanus occidentalis	Sycamore	Tree	4	4	4	7	7	7	3	3	3	8	8	8	2	2	2
Quercus alba	White Oak	Tree				2	2	2									
Quercus lyrata	Overcup Oak	Tree							2	2	2	1	1	1			
Quercus michauxii	Swamp Chestnut Oak	Tree	2	2	2	1	1	1	2	2	2	1	1	1	3	3	3
Quercus phellos	Willow Oak	Tree	5	5	5				3	3	3	1	1	1	3	3	3
Quercus shumardii	Shumard Oak	Tree	2	2	2	2	2	2	1	1	1	1	1	1	2	2	2
	Unknown Species	Tree															
		Stem count	14	14	14	15	15	15	12	12	12	12	12	12	13	13	13
		size (ares)	1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02		
		Species count	5	5	5	6	6	6	6	6	7	5	5	6	5	5	5
		Stems per ACRE	567	567	567	607	607	607	486	486	486	486	486	486	526	526	526

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS - Planted Stems Excluding Live Stakes

P-all - All Planted Stems

T - All Woody Stems

Table 9a. Fixed Plots: Planted and Total Stem Counts

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

			Current Plot Data (MY1 2020)						Annual Means					
			VP 6			VP 7			MY1 (2020)			MY0 (2020)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Aesculus flava	Yellow Buckeye	Shrub Tree							1	1	1	1	1	1
Betula nigra	River Birch	Tree				7	7	7	9	9	9	9	9	9
Diospyros virginiana	American Persimmon	Tree						1			13			
Fraxinus pennsylvanica	Green Ash	Tree	1	1	1	1	1	1	7	7	8	7	7	7
Liquidambar styraciflua	Sweet Gum	Tree						2			2			
Platanus occidentalis	Sycamore	Tree	6	6	6	6	6	6	36	36	36	36	36	36
Quercus alba	White Oak	Tree				1	1	1	3	3	3	3	3	3
Quercus lyrata	Overcup Oak	Tree							3	3	3	3	3	3
Quercus michauxii	Swamp Chestnut Oak	Tree	2	2	2				11	11	11	11	11	11
Quercus phellos	Willow Oak	Tree	3	3	3				15	15	15	15	15	15
Quercus shumardii	Shumard Oak	Tree	2	2	2	1	1	1	11	11	11	11	11	11
	Unknown Species	Tree										1	1	1
		Stem count	14	14	14	16	16	16	96	96	96	97	97	97
		size (ares)	1			1			7			7		
		size (ACRES)	0.02			0.02			0.17			0.17		
		Species count	5	5	5	5	5	7	9	9	11	10	10	10
		Stems per ACRE	567	567	567	647	647	647	555	555	555	561	561	561

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS - Planted Stems Excluding Live Stakes

P-all - All Planted Stems

T - All Woody Stems

Table 9b. Random Plots: Planted and Total Stem Counts

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

			Current Plot Data (MY1 2020)				Annual Means			
			VP 8		VP 9		MY1 (2020)		MY0 (2020)	
Scientific Name	Common Name	Species Type	Te	Total	Te	Total	Te	Total	Te	Total
Aesculus flava	Yellow Buckeye	Shrub Tree							3	3
Betula nigra	River Birch	Tree	1	1	1	1	2	2	4	4
Fraxinus pennsylvanica	Green Ash	Tree	3	3	3	3	6	6	1	1
Liquidambar styraciflua	Sweetgum	Tree	3	3			3	3		
Platanus occidentalis	Sycamore	Tree	5	5	2	2	7	7	7	7
Quercus alba	White Oak	Tree	1	1			1	1	1	1
Quercus lyrata	Overcup Oak	Tree							1	1
Quercus michauxii	Swamp Chestnut Oak	Tree	1	1	5	5	6	6	2	2
Quercus phellos	Willow Oak	Tree			1	1	1	1	4	4
Quescus shumardii	Shumard Oak	Tree	1	1	1	1	2	2	2	2
Salix nigra	Black Willow	Tree			3	3	3	3		
Ulmus	Elm	Tree	1	1			1	1		
Viburnum dentatum	Arrowwood Viburnum	Shrub Tree							1	1
		Stem count	16	12	16	13	32	25	26	26
		size (ares)	1		1		2		2	
		size (ACRES)	0.02		0.02		0.05		0.05	
		Species count	8	8	7	7	10	10	10	10
		Stems per ACRE	647	486	647	526	647	506	526	526

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

Te - Number of stems including exotic species

Total - Number of stems excluding exotic species

APPENDIX 4. Morphological Summary Data and Plots

Table 10a. Baseline Stream Data Summary
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Catfish Creek Reach 4 & UT1 Reach 2

		PRE-RESTORATION CONDITION				REFERENCE REACH DATA						DESIGN				AS-BUILT/BASELINE			
Parameter	Gage	Catfish Creek Reach 4		UT1 Reach 2		UT4 (UT to Cedar Creek)		UT to Wells Creek		UT to Varnals Creek		Catfish Creek Reach 4		UT1 Reach 2		Catfish Creek Reach 4		UT1 Reach 2	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																			
Bankfull Width (ft)	N/A	7.0		16.7		7.3		6.2	8.6	9.3	10.5	8.5		11.5		8.1		10.0	
Floodprone Width (ft)[1]		12.0		22.0		20.1		16.0	22.0	60.0	100.0	19.0		25.0	58.0	200.0		200.0	
Bankfull Mean Depth		0.9		0.4		0.6		0.6	1.0	1.5	1.7	0.7		0.9		0.8		0.8	
Bankfull Max Depth		1.3		0.9		1.1		0.9	1.4	1.5	1.7	0.9	1.2	1.0	1.3	1.2		1.5	
Bankfull Cross Sectional Area (ft^2)		6.4		7.1		4.2		3.9	6.3	10.3	12.3	5.8		9.9		6.4		8.0	
Width/Depth Ratio		7.7		39.5		12.6		6.1	12.6	8.1	9.3	12.6		13.4		10.2		12.4	
Entrenchment Ratio[1]		1.7		1.3		2.7		1.9	4.1	5.7	10.0	>2.2		2.2	5.0	24.6		20.1	
Bank Height Ratio		2.2		2.4		1.0		1.0	1.8	1.0		1.0		1.0		1.0		1.0	
D50 (mm)		---		---		---		---		---		---		---		28.5		37.5	
Profile																			
Riffle Length (ft)	N/A																		
Riffle Slope (ft/ft)		---		---		0.006	0.049	0.017	0.078	0.024	0.057	0.016	0.026	0.007	0.012	0.011	0.042	0.004	0.027
Pool Length (ft)																			
Pool Max Depth (ft)		1.4		---		1.4	1.5	1.6	1.9	2.5	2.6	2.3		2.6		1.9	2.2	2.1	2.8
Pool Spacing (ft)		---		---		17.6	24.1	17.0	63.0	7.8	82.0	48.0	61.0	36.0	64.0	35.0	78.0	30.0	71.0
Pool Volume (ft^3)																			
Pattern																			
Channel Beltwidth (ft)	N/A	---		---		3.2	5.7	10.0	35.0	15.0	45.0	21.0	38.0	33.0	48.0	21.0	38.0	33.0	48.0
Radius of Curvature (ft)		---		---		5.3	12.6	2.3	32.0	8.3	47.3	21.0	35.0	18.0	26.0	21.0	35.0	18.0	26.0
Rc:Bankfull Width (ft/ft)		---		---		0.7	1.7	0.3	4.0	0.6	3.2	2.5	4.1	1.6	2.3	2.5	4.1	1.6	2.3
Meander Length (ft)		---		---		10.2	17.0	---		---		109.0	120.0	93.0	125.0	109.0	120.0	93.0	125.0
Meander Width Ratio		---		---		0.4	0.8	1.3	4.4	1.0	3.0	2.5	4.5	2.9	4.2	2.5	4.5	2.9	4.2
Substrate, Bed and Transport Parameters																			
Ri%/Ru%/P%/G%/S%	N/A																		
SC%/Sa%/G%/C%/B%/Be%																			
d16/d35/d50/d84/d95/d100		---		---		---		0.1/0.6/4.5/53/ 96/x		2.9/9.2/15.0/56.0/ 88.0		---		---		SC/6.69/16.0/ 60.9/107.3/>2048		SC/SC/0.5/ 56.9/107.3/256	
Reach Shear Stress (Competency) lb/ft^2		0.56		0.26		---		---		---		---		---		0.65		0.13	
Max part size (mm) mobilized at bankfull																			
Stream Power (Capacity) W/m^2																			
Additional Reach Parameters																			
Drainage Area (SM)	N/A	0.09		0.16		0.11		0.13		0.41		0.09		0.16		0.09		0.16	
Watershed Impervious Cover Estimate (%)		0.0%				---		---		---		0.0%				0.0%			
Rosgen Classification		E6		C6		C4		C4		C4/E4		C4		C4		C4		C4	
Bankfull Velocity (fps)		2.8		3.0		5.2	6.1	3.8		4.4	5.2	3.0		2.1		3.2		1.1	
Bankfull Discharge (cfs)		18.0		21.0		21.7	25.8	15.0		54.0		17.0		20.6		20.6		9.6	
Q-NFF regression																			
Q-USGS extrapolation																			
Q-Mannings																			
Valley Length (ft)		---		---		---		---		---		---		---		---		---	
Channel Thalweg Length (ft)		369 (65 crossing)		430 (60 crossing)		---		---		---		374 (72 crossing)		515 (60 crossing)		373 (72 crossing)		520 (61 crossing)	
Sinuosity		1.07		1.06		1.05		1.41		1.20		1.18		1.23		1.18		1.23	
Bankfull Slope (ft/ft)		0.016		0.020		0.016		0.020		0.020		0.014		0.005		0.014		0.005	

[1] Differences between Design and As-Built/Baseline calculations are due to the ranges used in Design and field surveyed measurements used in As-Built/Baseline.
(---): Data was not provided.

Table 10b. Baseline Stream Data Summary
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Catfish Reach 6 & UT1 Reach 3

		PRE-RESTORATION CONDITION				REFERENCE REACH DATA				DESIGN				AS-BUILT/BASELINE			
Parameter	Gage	Catfish Creek Reach 6		UT1 Reach 3 (Reach 4 XS)		UT to Henry Fork		Agony Acres		Catfish Creek Reach 6		UT1 Reach 3		Catfish Creek Reach 6		UT1 Reach 3	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																	
Bankfull Width (ft)	N/A	N/A[1]		6.2	8.1	3.2	7.7	11.1		8.5		8.0		7.7	9.0	6.5	
Floodprone Width (ft)[2]		N/A[1]		22.0		6.3	13.3	25.2		12.0	21.0	11.0	20.0	30.0	100.0	60.0	
Bankfull Mean Depth		N/A[1]		0.7	0.8	0.5	0.6	0.7		0.6		0.6		0.7	0.8	0.8	
Bankfull Max Depth		N/A[1]		0.9	1.1	0.8	0.7	1.0		0.9	1.1	0.9	1.1	1.2	1.3	1.5	
Bankfull Cross Sectional Area (ft^2)		N/A[1]		4.2	6.2	1.3	3.6	7.4		5.3		4.9		5.7	7.0	5.4	
Width/Depth Ratio		N/A[1]		9.2	10.5	5.2	16.4	16.6		13.8		13.0		10.2	11.6	7.8	
Entrenchment Ratio[2]		N/A[1]		2.8	3.6	1.7	2.0	2.3		1.4	2.5	1.4	2.5	3.3	13.1	9.3	
Bank Height Ratio		N/A[1]		1.2	1.5	1.0	1.3	1.0		1.0		1.0		1.0		1.0	
D50 (mm)		N/A[1]		---		34.0		50.6		---		---		34.4	40.6	34.1	
Profile																	
Riffle Length (ft)	N/A																
Riffle Slope (ft/ft)		N/A[1]		---		0.050	0.070	---		0.031	0.045	0.049	0.055	0.005	0.059	0.040	0.093
Pool Length (ft)																	
Pool Max Depth (ft)		N/A[1]		---		---		1.6		2.3		3.0		1.5	2.4	1.8	2.6
Pool Spacing (ft)		N/A[1]		---		14.1	24.9	---		13.0	51.0	11.0	28.0	7.9	142.1	19.0	32.0
Pool Volume (ft^3)																	
Pattern																	
Channel Beltwidth (ft)	N/A	N/A[3]		---		N/A[3]		N/A[3]		N/A[3]		N/A[3]		N/A[3]		N/A[3]	
Radius of Curvature (ft)		N/A[3]		---		N/A[3]		N/A[3]		N/A[3]		N/A[3]		N/A[3]		N/A[3]	
Rc:Bankfull Width (ft/ft)		N/A[3]		---		N/A[3]		N/A[3]		N/A[3]		N/A[3]		N/A[3]		N/A[3]	
Meander Length (ft)		N/A[3]		---		N/A[3]		N/A[3]		N/A[3]		N/A[3]		N/A[3]		N/A[3]	
Meander Width Ratio		N/A[3]		---		N/A[3]		N/A[3]		N/A[3]		N/A[3]		N/A[3]		N/A[3]	
Substrate, Bed and Transport Parameters																	
Ri%/Ru%/P%/G%/S%	N/A																
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100		---		---		---		2.0/12.9/50.6/ 168.1/>2048.1		---		---		16.56/32.92/50.6/ 2580.3/3545.2/>2048		SC/7.10/23.2/ 71.7/120.7/>2048	
Reach Shear Stress (Competency) lb/ft^2		1.52		1.89		---		---		---		---		1.86		1.89	
Max part size (mm) mobilized at bankfull																	
Stream Power (Capacity) W/m^2																	
Additional Reach Parameters																	
Drainage Area (SM)	N/A	0.11		0.16		0.05		0.15		0.11		0.16		0.11		0.16	
Watershed Impervious Cover Estimate (%)		0.0%				---		---		0.0%				0.0%			
Rosgen Classification		---		E4b		B4a		B3		B4a		B4a		B4a		B4a	
Bankfull Velocity (fps)		---		5.1		3.8	5.4	4.9		4.0		4.4		4.9		3.5	
Bankfull Discharge (cfs)		---		21.0		12.0		37.0		20.9		21.8		28.4		20.1	
Q-NFF regression																	
Q-USGS extrapolation																	
Q-Mannings																	
Valley Length (ft)		---		---		---		---		---		---		---		---	
Channel Thalweg Length (ft)		466		154		---		---		454		149		444		149	
Sinuosity		---		1.10		1.10		1.04		1.04		1.02		1.05		1.02	
Bankfull Slope (ft/ft)		---		0.038		0.042		0.050		0.043		0.054		0.043		0.061	

[1] Catfish Creek Reach 6 was an embankment pond and thus had no existing channel characteristics.

[2] Differences between Design and As-Built/Baseline calculations are due to the ranges used in Design and field surveyed measurements used in As-Built/Baseline.

[3] Pattern data is not applicable for B-type channels.

(---): Data was not provided.

N/A: Not Applicable

Table 11. Cross-Section Morphology Monitoring Summary

Catfish Pond Mitigation Site

DMS Project No. 100039

Monitoring Year 1 - 2020

	Catfish Creek Reach 4												Catfish Creek Reach 6											
	Cross-Section 1 (Pool)						Cross-Section 2 (Riffle)						Cross-Section 3 (Riffle)						Cross-Section 4 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	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	467.55	N/A					466.93	467.08					444.72	444.80					432.39	432.41				
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A					1.0	<1.0					1.0	<1.0					1.0	1.0				
Thalweg Elevation	465.36	465.65					465.71	465.90					443.45	443.53					431.20	431.24				
LTOB[2] Elevation	467.55	467.56					466.93	466.95					444.72	444.70					432.39	432.40				
LTOB[2] Max Depth (ft)	2.2	1.9					1.2	1.0					1.0	1.2					1.2	1.2				
LTOB[2] Cross-Sectional Area (ft^2)	14.4	12.3					6.4	5.3					5.7	4.9					7.0	6.9				
	UT1 Reach 2												UT1 Reach 3											
	Cross-Section 5 (Pool)						Cross-Section 6 (Riffle)						Cross-Section 7 (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	446.13	N/A					445.98	446.05					442.36	442.40										
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A					1.0	1.0					1.0	1.0										
Thalweg Elevation	443.44	443.52					444.52	444.73					440.83	440.87										
LTOB[2] Elevation	446.13	446.19					445.98	446.01					442.36	442.34										
LTOB[2] Max Depth (ft)	2.7	2.7					1.5	1.3					1.5	1.5										
LTOB[2] Cross-Sectional Area (ft^2)	20.1	19.5					8.0	7.5					5.4	5.0										

[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 12a. Monitoring Data - Stream Reach Data Summary
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Catfish Creek Reach 4

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY5		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	8.1		7.9									
Floodprone Width (ft)	200		200									
Bankfull Mean Depth	0.8		0.7									
Bankfull Max Depth	1.2		1.0									
Bankfull Cross-Sectional Area (ft^2)	6.4		5.3									
Width/Depth Ratio	10.2		11.7									
Entrenchment Ratio	24.6		25.4									
Bank Height Ratio	1.0		<1.0									
Profile												
Riffle Length (ft)												
Riffle Slope (ft/ft)	0.0110	0.0420										
Pool Length (ft)												
Pool Max Depth (ft)	1.9	2.2										
Pool Spacing (ft)	35.0	78.0										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	21	38										
Radius of Curvature (ft)	21	35										
Rc:Bankfull Width (ft/ft)	2.5	4.1										
Meander Wave Length (ft)	109.0	120.0										
Meander Width Ratio	2.5	4.5										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	373 (72 crossing)											
Sinuosity (ft)	1.18											
Water Surface Slope (ft/ft)												
Bankfull Slope (ft/ft)	0.014											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/6.69/16.0/ 60.9/107.3/>2048		0.08/1.41/11.4/ 54.7/107.3/256									
% of Reach with Eroding Banks	0%		0%									

*Morphological survey and analysis not required for MY4 and MY6.

Table 12b. Monitoring Data - Stream Reach Data Summary
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Catfish Creek Reach 6

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY5		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	7.7	9.0	7.2	9.4								
Floodprone Width (ft)	30	100	30	100								
Bankfull Mean Depth	0.7	0.8	0.7									
Bankfull Max Depth	1.2	1.3	1.2									
Bankfull Cross-Sectional Area (ft^2)	5.7	7.0	4.9	6.9								
Width/Depth Ratio	10.2	11.6	10.7	12.8								
Entrenchment Ratio	3.3	13.1	3.2	13.8								
Bank Height Ratio	1.0		<1.0	1.0								
Profile												
Riffle Length (ft)												
Riffle Slope (ft/ft)	0.005	0.059										
Pool Length (ft)												
Pool Max Depth (ft)	1.5	2.4										
Pool Spacing (ft)	8	142										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	N/A[1]											
Radius of Curvature (ft)	N/A[1]											
Rc:Bankfull Width (ft/ft)	N/A[1]											
Meander Wave Length (ft)	N/A[1]											
Meander Width Ratio	N/A[1]											
Additional Reach Parameters												
Rosgen Classification	B4a											
Channel Thalweg Length (ft)	444											
Sinuosity (ft)	1.05											
Water Surface Slope (ft/ft)												
Bankfull Slope (ft/ft)	0.043											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	16.56/32.92/50.6/ 2580.3/3545.2/>2048		9.38/27.57/51.2/ 113.8/207.2/362									
% of Reach with Eroding Banks	0%		0%									

[1] Pattern data is not applicable for B-type channels.
*Morphological survey and analysis not required for MY4 and MY6.
N/A: Not Applicable

Table 12c. Monitoring Data - Stream Reach Data Summary
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

UT1 Reach 2

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY5		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	10.0		10.1									
Floodprone Width (ft)	200		200									
Bankfull Mean Depth	0.8		0.7									
Bankfull Max Depth	1.5		1.3									
Bankfull Cross-Sectional Area (ft^2)	8.0		7.5									
Width/Depth Ratio	12.4		13.5									
Entrenchment Ratio	20.1		19.8									
Bank Height Ratio	1.0		1.0									
Profile												
Riffle Length (ft)												
Riffle Slope (ft/ft)	0.004	0.027										
Pool Length (ft)												
Pool Max Depth (ft)	2.1	2.8										
Pool Spacing (ft)	30.0	71.0										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	33.0	48.0										
Radius of Curvature (ft)	18.0	26.0										
Rc:Bankfull Width (ft/ft)	1.6	2.3										
Meander Wave Length (ft)	93.0	125.0										
Meander Width Ratio	2.9	4.2										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	520 (61 crossing)											
Sinuosity (ft)	1.23											
Water Surface Slope (ft/ft)												
Bankfull Slope (ft/ft)	0.005											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/SC/0.5/56.9/ 107.3/256		SC/0.27/16/95.4/ 190.9/256									
% of Reach with Eroding Banks	0%		0%									

*Morphological survey and analysis not required for MY4 and MY6.

Table 12d. Monitoring Data - Stream Reach Data Summary
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

UT1 Reach 3

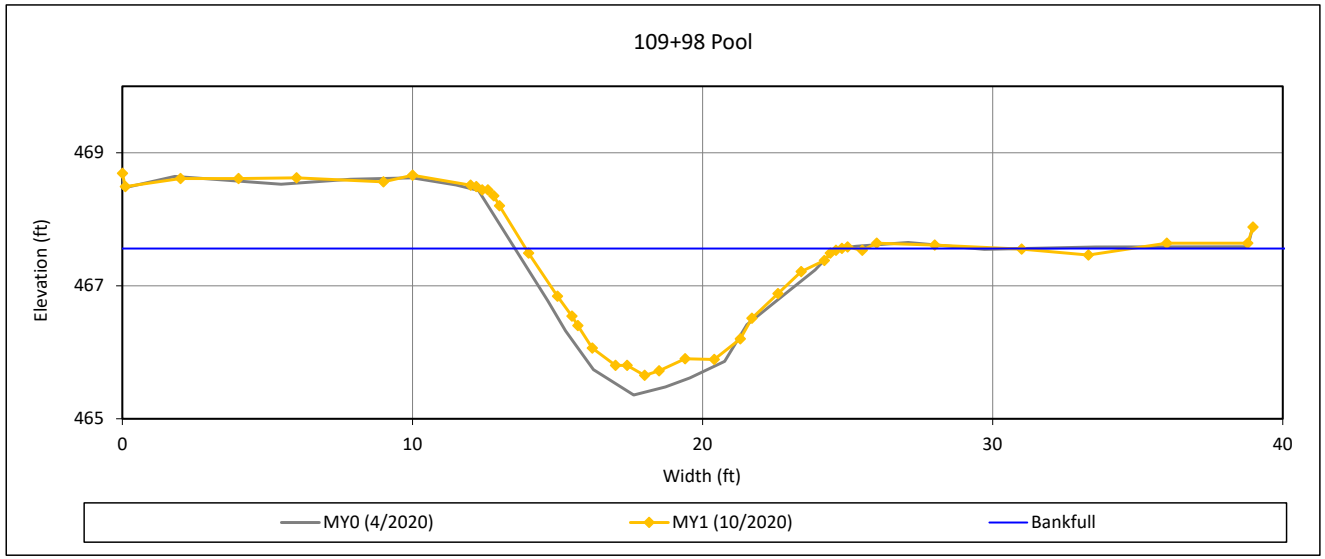
Parameter	As-Built/Baseline		MY1		MY2		MY3		MY5		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	6.5		6.0									
Floodprone Width (ft)	60		60									
Bankfull Mean Depth	0.8		0.8									
Bankfull Max Depth	1.5		1.5									
Bankfull Cross-Sectional Area (ft^2)	5.4		5.0									
Width/Depth Ratio	7.8		7.1									
Entrenchment Ratio	9.3		10.0									
Bank Height Ratio	1.0		1.0									
Profile												
Riffle Length (ft)												
Riffle Slope (ft/ft)	0.040	0.093										
Pool Length (ft)												
Pool Max Depth (ft)	1.8	2.6										
Pool Spacing (ft)	19.0	32.0										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	N/A[1]											
Radius of Curvature (ft)	N/A[1]											
Rc:Bankfull Width (ft/ft)	N/A[1]											
Meander Wave Length (ft)	N/A[1]											
Meander Width Ratio	N/A[1]											
Additional Reach Parameters												
Rosgen Classification	B4a											
Channel Thalweg Length (ft)	149											
Sinuosity (ft)	1.02											
Water Surface Slope (ft/ft)												
Bankfull Slope (ft/ft)	0.061											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/7.10/23.2/71.7/ 120.7/>2048		SC/16/47.7/227.6/ 3197.8/>2048									
% of Reach with Eroding Banks	0%		0%									

[1] Pattern data is not applicable for B-type channels.
*Morphological survey and analysis not required for MY4 and MY6.
N/A: Not Applicable

Cross-Section Plots

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Cross-Section 1 - Catfish Creek Reach 4



Bankfull Dimensions	
12.3	x-section area (ft.sq.)
10.9	width (ft)
1.1	mean depth (ft)
1.9	max depth (ft)
11.8	wetted perimeter (ft)
1.0	hydraulic radius (ft)
9.7	width-depth ratio

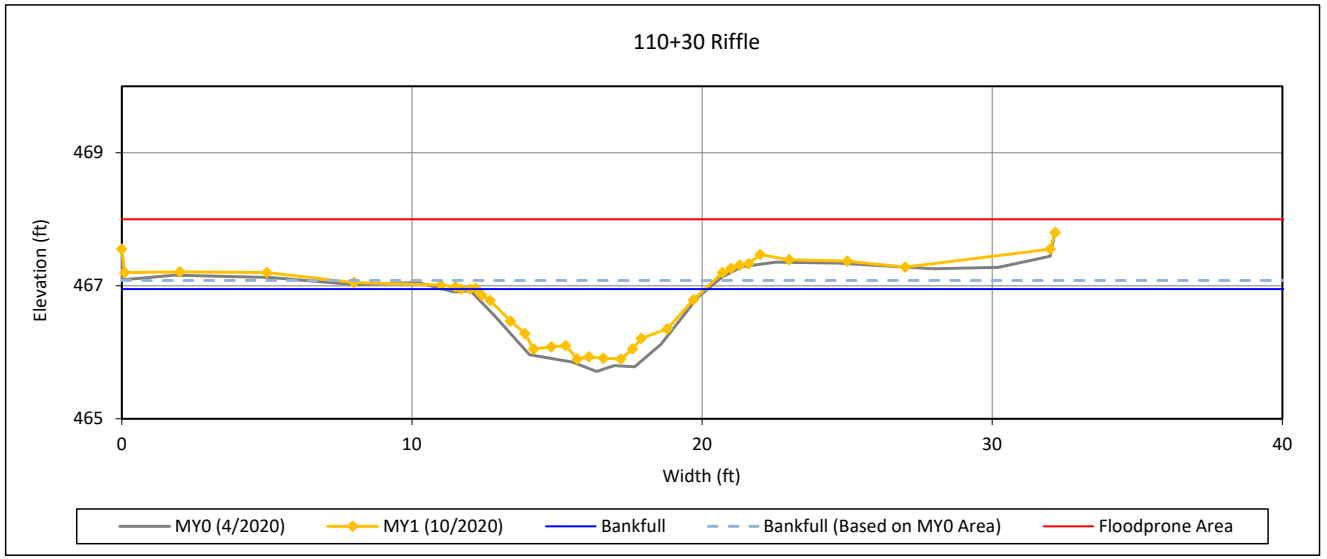
Survey Date: 10/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Cross-Section 2 - Catfish Creek Reach 4



Bankfull Dimensions	
5.3	x-section area (ft.sq.)
7.9	width (ft)
0.7	mean depth (ft)
1.0	max depth (ft)
8.3	wetted perimeter (ft)
0.6	hydraulic radius (ft)
11.7	width-depth ratio
200.0	W flood prone area (ft)
25.4	entrenchment ratio
< 1.0	low bank height ratio

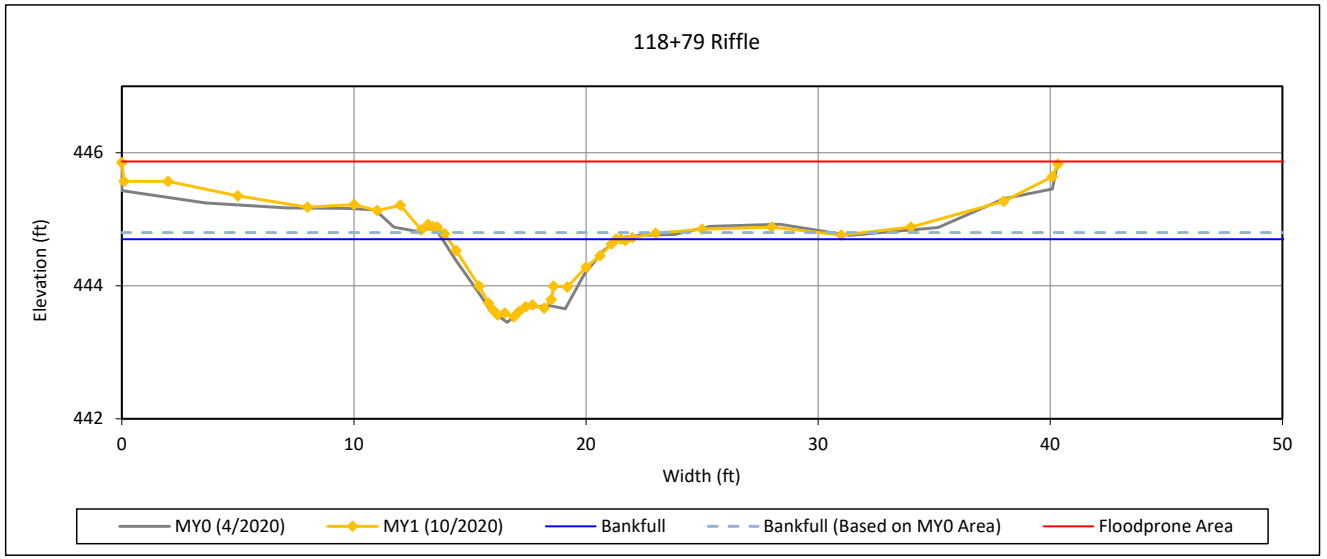
Survey Date: 10/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Cross-Section 3 - Catfish Creek Reach 6



Bankfull Dimensions	
4.9	x-section area (ft.sq.)
7.2	width (ft)
0.7	mean depth (ft)
1.2	max depth (ft)
7.8	wetted perimeter (ft)
0.6	hydraulic radius (ft)
10.7	width-depth ratio
100.0	W flood prone area (ft)
13.8	entrenchment ratio
< 1.0	low bank height ratio

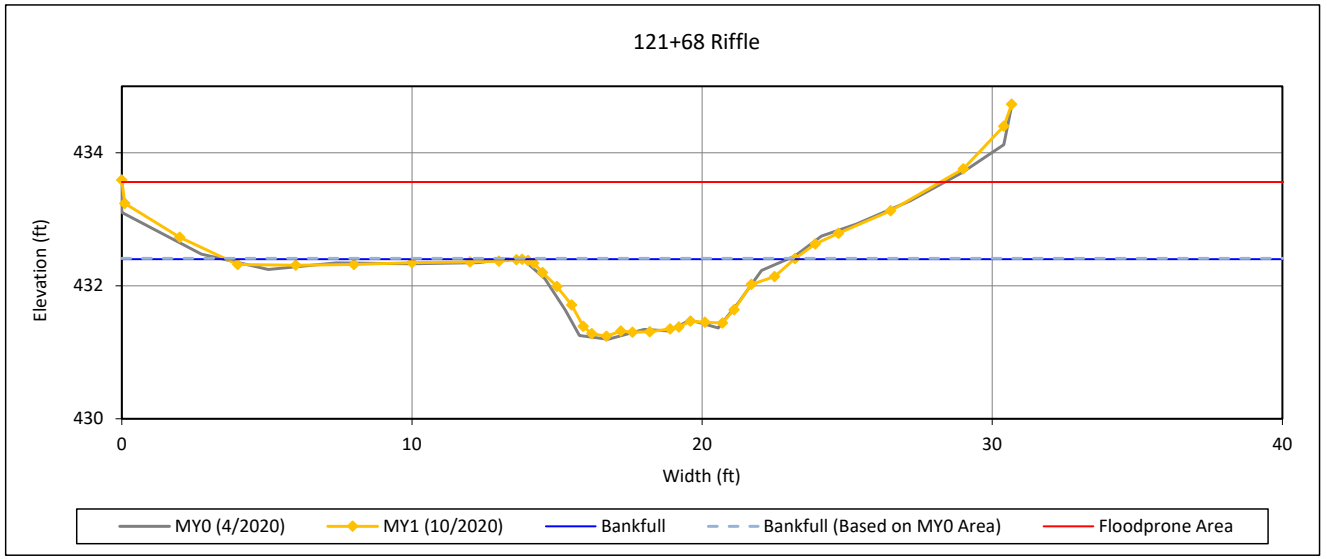
Survey Date: 10/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Cross-Section 4 - Catfish Creek Reach 6



Bankfull Dimensions	
6.9	x-section area (ft.sq.)
9.4	width (ft)
0.7	mean depth (ft)
1.2	max depth (ft)
9.9	wetted perimeter (ft)
0.7	hydraulic radius (ft)
12.8	width-depth ratio
30.0	W flood prone area (ft)
3.2	entrenchment ratio
1.0	low bank height ratio

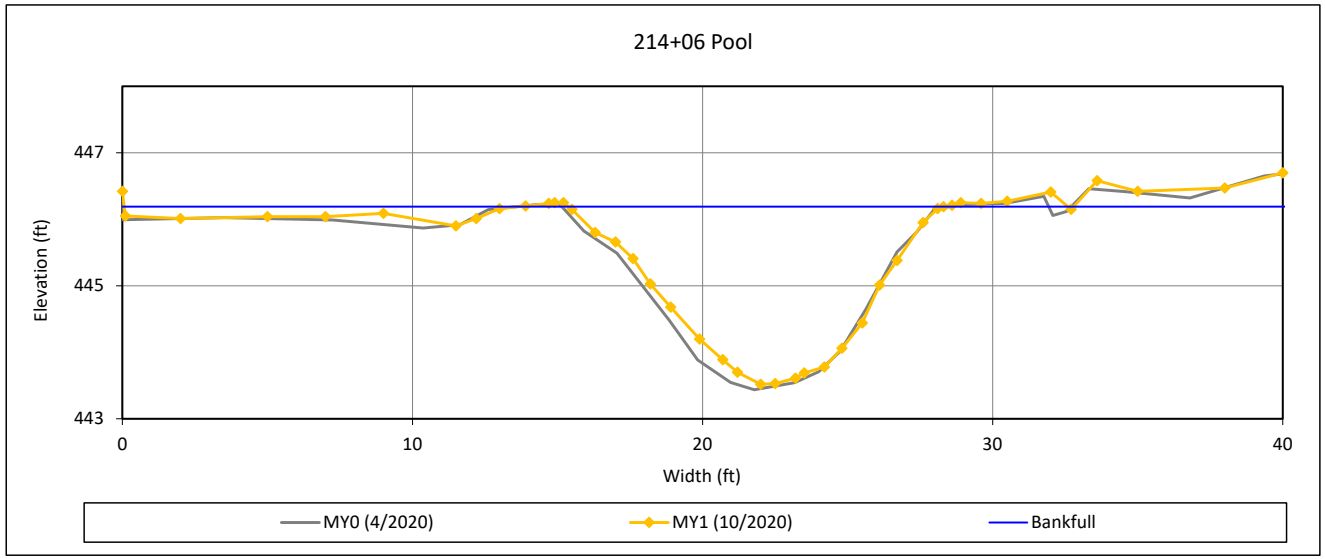
Survey Date: 10/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Cross-Section 5 - UT1 Reach 2



Bankfull Dimensions	
19.5	x-section area (ft.sq.)
12.9	width (ft)
1.5	mean depth (ft)
2.7	max depth (ft)
14.2	wetted perimeter (ft)
1.4	hydraulic radius (ft)
8.5	width-depth ratio

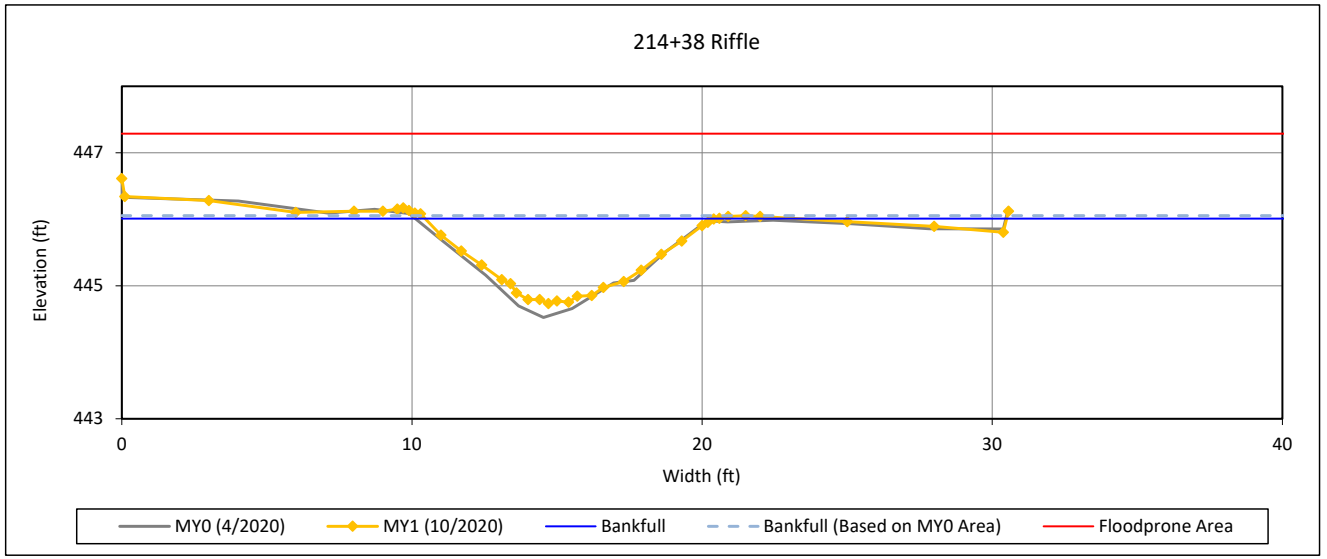
Survey Date: 10/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Cross-Section 6 - UT1 Reach 2



Bankfull Dimensions	
7.5	x-section area (ft.sq.)
10.1	width (ft)
0.7	mean depth (ft)
1.3	max depth (ft)
10.5	wetted perimeter (ft)
0.7	hydraulic radius (ft)
13.5	width-depth ratio
200.0	W flood prone area (ft)
19.8	entrenchment ratio
1.0	low bank height ratio

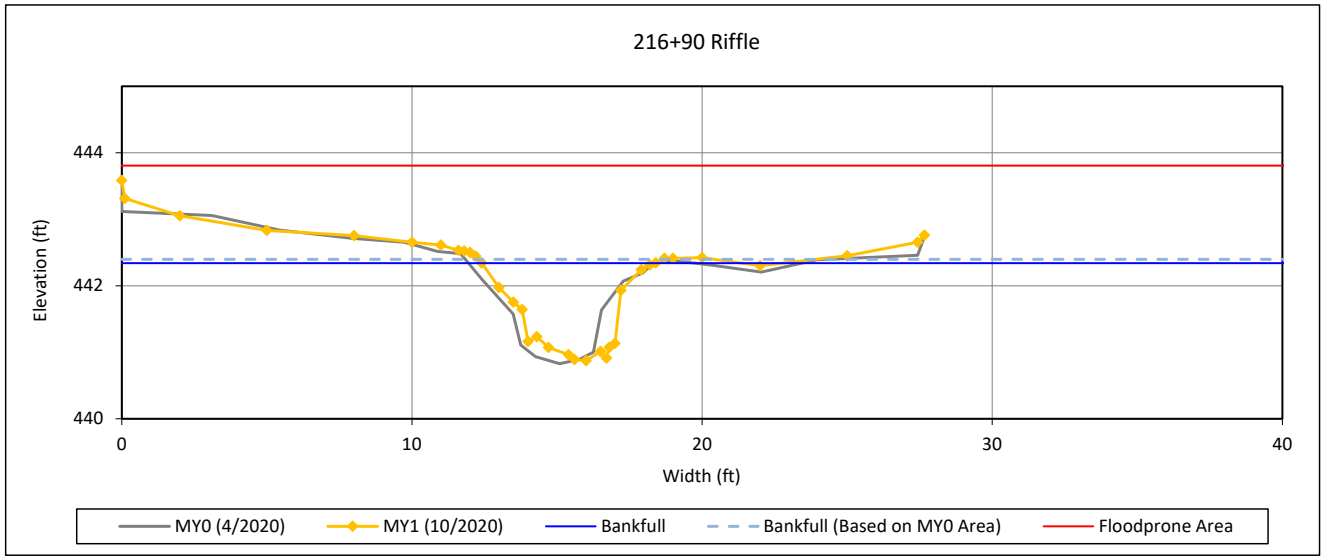
Survey Date: 10/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Cross-Section 7 - UT1 Reach 3



Bankfull Dimensions	
5.0	x-section area (ft.sq.)
6.0	width (ft)
0.8	mean depth (ft)
1.5	max depth (ft)
7.4	wetted perimeter (ft)
0.7	hydraulic radius (ft)
7.1	width-depth ratio
60.0	W flood prone area (ft)
10.0	entrenchment ratio
1.0	low bank height ratio

Survey Date: 10/2020
Field Crew: Wildlands Engineering

View Downstream

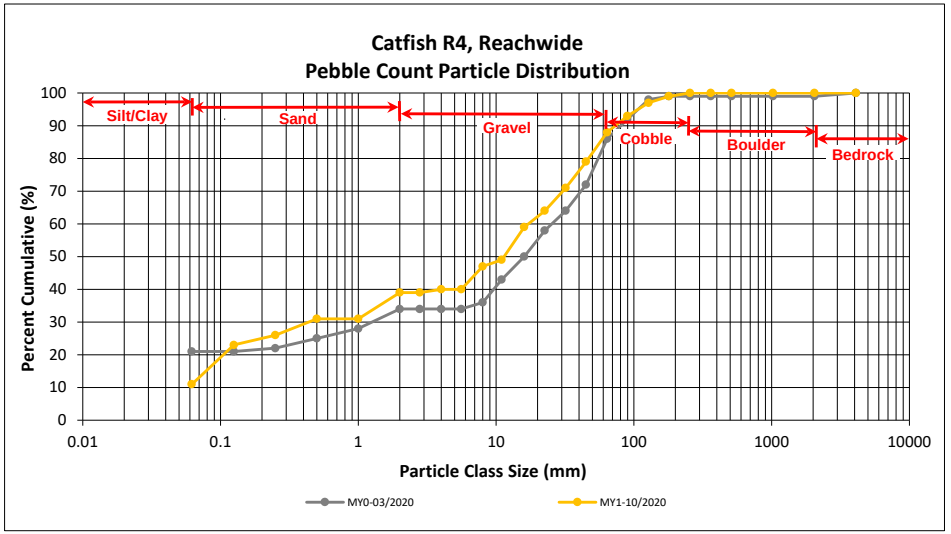
Reachwide Pebble Count Plots

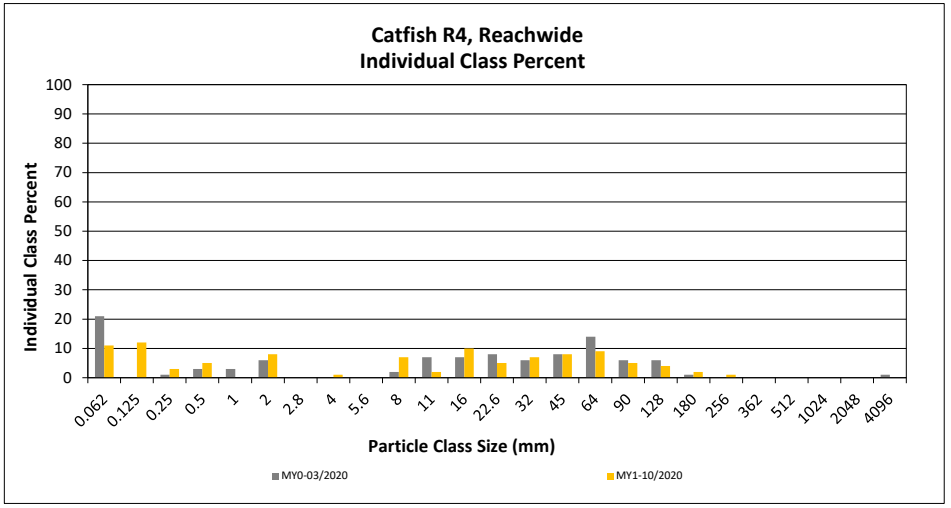
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Catfish R4, 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	2	9	11	11	11
SAND	Very fine	0.062	0.125	1	11	12	12	23
	Fine	0.125	0.250	1	2	3	3	26
	Medium	0.25	0.50	1	4	5	5	31
	Coarse	0.5	1.0					31
	Very Coarse	1.0	2.0	3	5	8	8	39
GRAVEL	Very Fine	2.0	2.8					39
	Very Fine	2.8	4.0		1	1	1	40
	Fine	4.0	5.6					40
	Fine	5.6	8.0	2	5	7	7	47
	Medium	8.0	11.0		2	2	2	49
	Medium	11.0	16.0	4	6	10	10	59
	Coarse	16.0	22.6	3	2	5	5	64
	Coarse	22.6	32	6	1	7	7	71
	Very Coarse	32	45	8		8	8	79
	Very Coarse	45	64	9		9	9	88
COBBLE	Small	64	90	5		5	5	93
	Small	90	128	3	1	4	4	97
	Large	128	180	2		2	2	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	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.08
D_{35} =	1.41
D_{50} =	11.4
D_{84} =	54.7
D_{95} =	107.3
D_{100} =	256.0





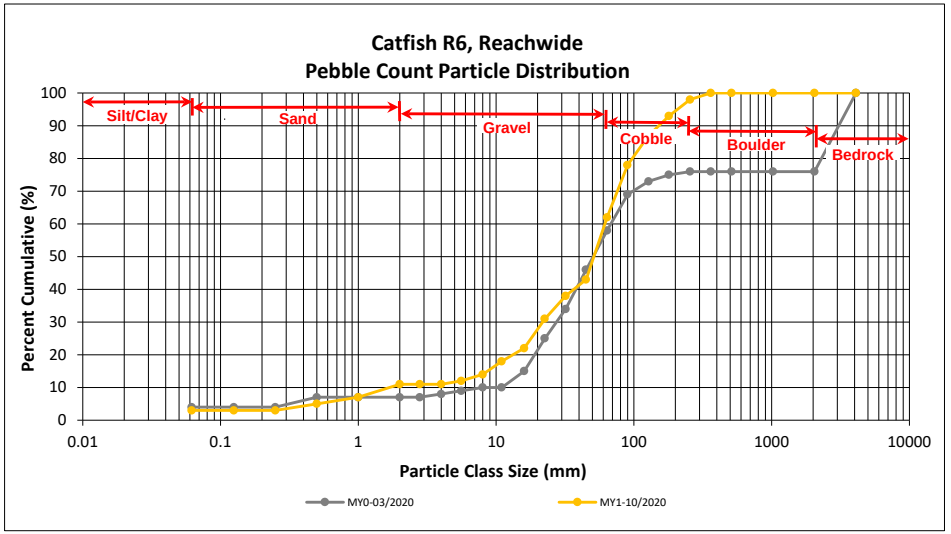
Reachwide Pebble Count Plots

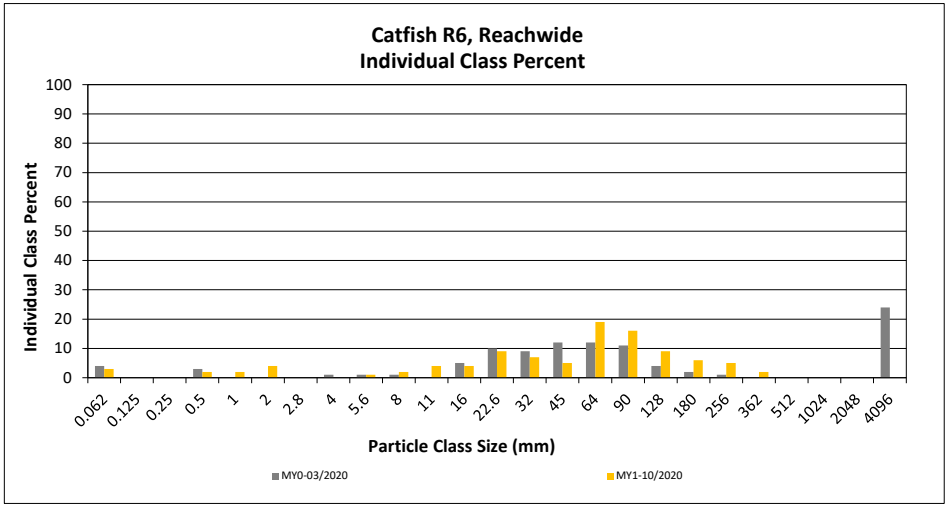
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

Catfish R6, 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	1	2	3	3	3
SAND	Very fine	0.062	0.125					3
	Fine	0.125	0.250					3
	Medium	0.25	0.50	1	1	2	2	5
	Coarse	0.5	1.0		2	2	2	7
	Very Coarse	1.0	2.0	2	2	4	4	11
GRAVEL	Very Fine	2.0	2.8					11
	Very Fine	2.8	4.0					11
	Fine	4.0	5.6		1	1	1	12
	Fine	5.6	8.0		2	2	2	14
	Medium	8.0	11.0	1	3	4	4	18
	Medium	11.0	16.0	3	1	4	4	22
	Coarse	16.0	22.6	8	1	9	9	31
	Coarse	22.6	32	5	2	7	7	38
	Very Coarse	32	45	4	1	5	5	43
	Very Coarse	45	64	15	4	19	19	62
COBBLE	Small	64	90	11	5	16	16	78
	Small	90	128	8	1	9	9	87
	Large	128	180	6		6	6	93
	Large	180	256	3	2	5	5	98
BOULDER	Small	256	362	2		2	2	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} =	9.38
D_{35} =	27.57
D_{50} =	51.2
D_{84} =	113.8
D_{95} =	207.2
D_{100} =	362.0





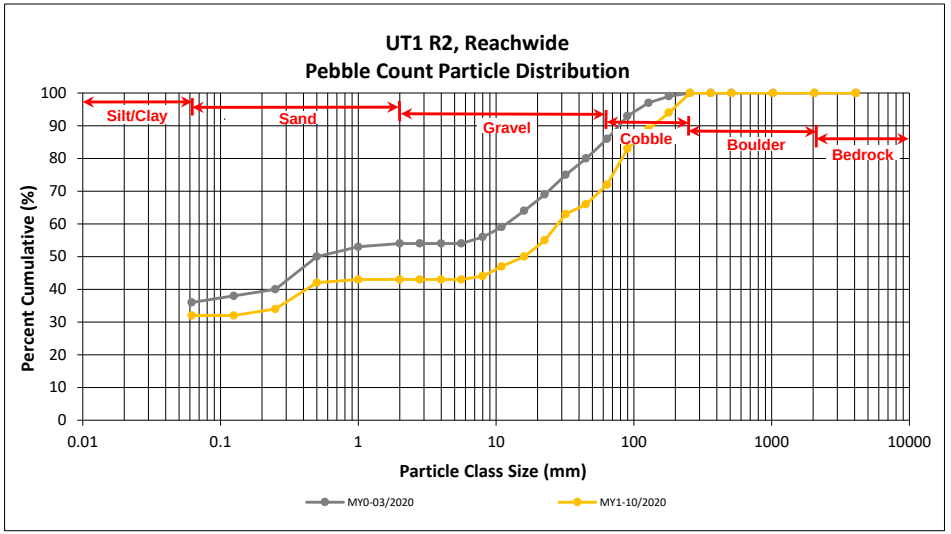
Reachwide Pebble Count Plots

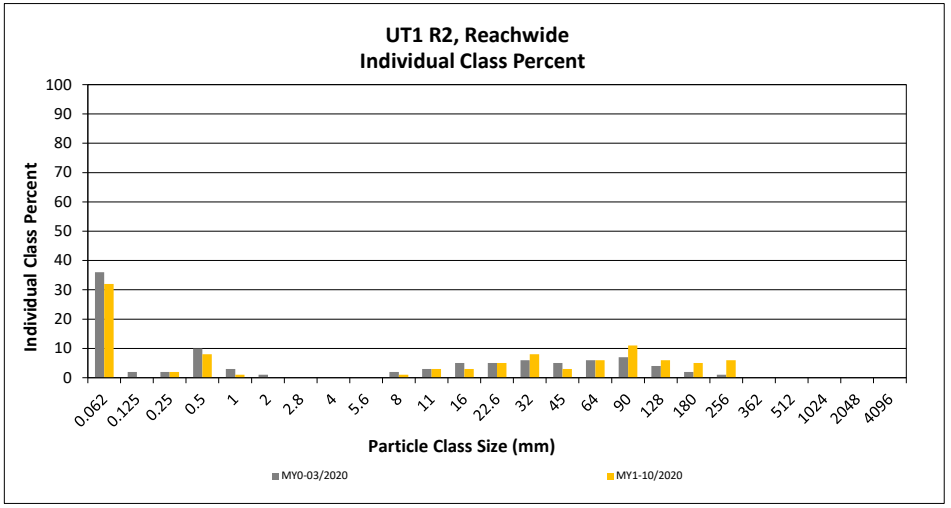
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

UT1 R2, 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	28	32	32	32
SAND	Very fine	0.062	0.125					32
	Fine	0.125	0.250		2	2	2	34
	Medium	0.25	0.50		8	8	8	42
	Coarse	0.5	1.0		1	1	1	43
	Very Coarse	1.0	2.0					43
GRAVEL	Very Fine	2.0	2.8					43
	Very Fine	2.8	4.0					43
	Fine	4.0	5.6					43
	Fine	5.6	8.0		1	1	1	44
	Medium	8.0	11.0	1	2	3	3	47
	Medium	11.0	16.0		3	3	3	50
	Coarse	16.0	22.6	5		5	5	55
	Coarse	22.6	32	3	5	8	8	63
	Very Coarse	32	45	3		3	3	66
	Very Coarse	45	64	6		6	6	72
COBBLE	Small	64	90	11		11	11	83
	Small	90	128	6		6	6	89
	Large	128	180	5		5	5	94
	Large	180	256	6		6	6	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} =	0.27
D_{50} =	16.0
D_{84} =	95.4
D_{95} =	190.9
D_{100} =	256.0





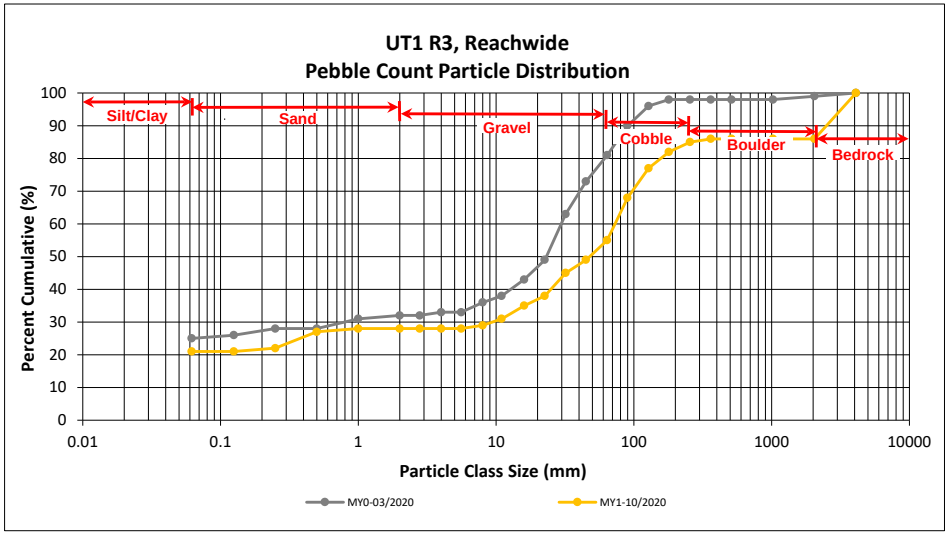
Reachwide Pebble Count Plots

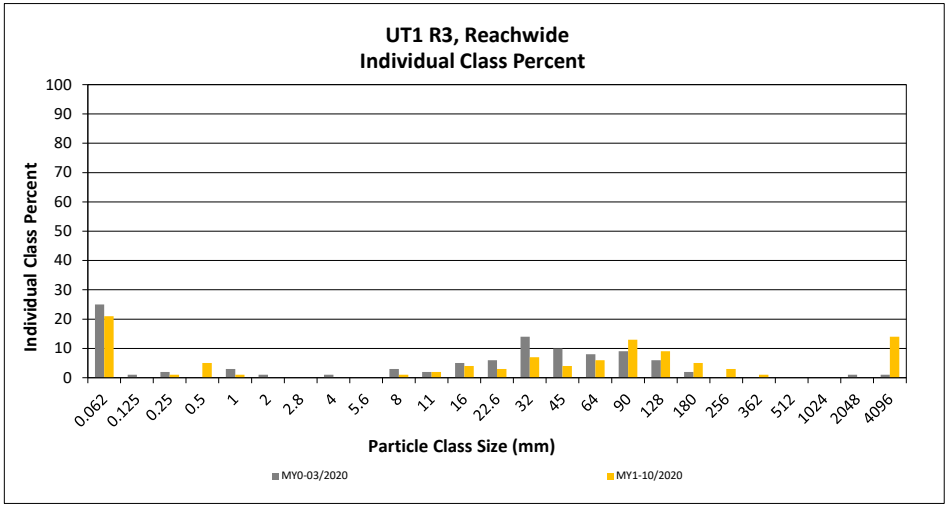
Catfish Pond Mitigation Site
DMS Project No. 100039
Monitoring Year 1 - 2020

UT1 R3, 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	3	18	21	21	21
SAND	Very fine	0.062	0.125					21
	Fine	0.125	0.250	1		1	1	22
	Medium	0.25	0.50	1	4	5	5	27
	Coarse	0.5	1.0		1	1	1	28
	Very Coarse	1.0	2.0					28
GRAVEL	Very Fine	2.0	2.8					28
	Very Fine	2.8	4.0					28
	Fine	4.0	5.6					28
	Fine	5.6	8.0		1	1	1	29
	Medium	8.0	11.0	2		2	2	31
	Medium	11.0	16.0	1	3	4	4	35
	Coarse	16.0	22.6	2	1	3	3	38
	Coarse	22.6	32	5	2	7	7	45
	Very Coarse	32	45	3	1	4	4	49
	Very Coarse	45	64	4	2	6	6	55
COBBLE	Small	64	90	11	2	13	13	68
	Small	90	128	6	3	9	9	77
	Large	128	180	3	2	5	5	82
	Large	180	256	3		3	3	85
BOULDER	Small	256	362	1		1	1	86
	Small	362	512					86
	Medium	512	1024					86
	Large/Very Large	1024	2048					86
BEDROCK	Bedrock	2048	>2048	4	10	14	14	100
			Total	50	50	100	100	100

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	16.00
D_{50} =	47.7
D_{84} =	227.6
D_{95} =	3197.8
D_{100} =	>2048





APPENDIX 5. Hydrology Summary Data

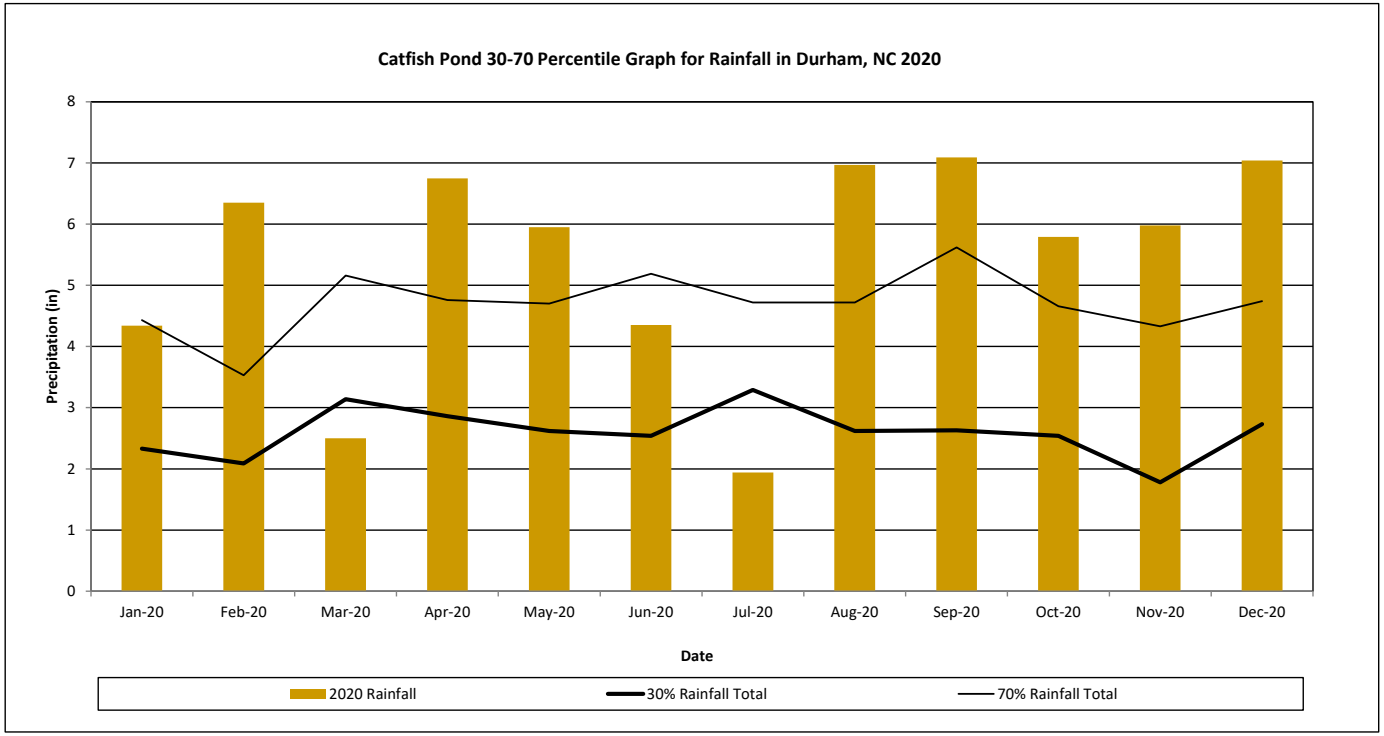
Table 13. Verification of Bankfull Events

Catfish Pond Mitigation Project
DMS Project No. 100039
Monitoring Year 1 - 2020

Summary of Recorded Bankfull Events for Monitoring Years 1 through 7								
Reach	**Date of Occurrence**							
	MY1 (2020)	**MY2 (2021)**	**MY3 (2022)**	**MY4 (2023)**	**MY5 (2024)**	**MY6 (2025)**	**MY7 (2026)**	**Method**
Catfish Creek Reach 6	10/11/2020							Pressure Transducer
UT1 Reach 2	12/14/2020							

Monthly Rainfall Data

Catfish Pond Mitigation Project
DMS Project No. 100039
Monitoring Year 1 - 2020



[1] 2020 monthly rainfall from USDA Station Durham 10.7 NNE.

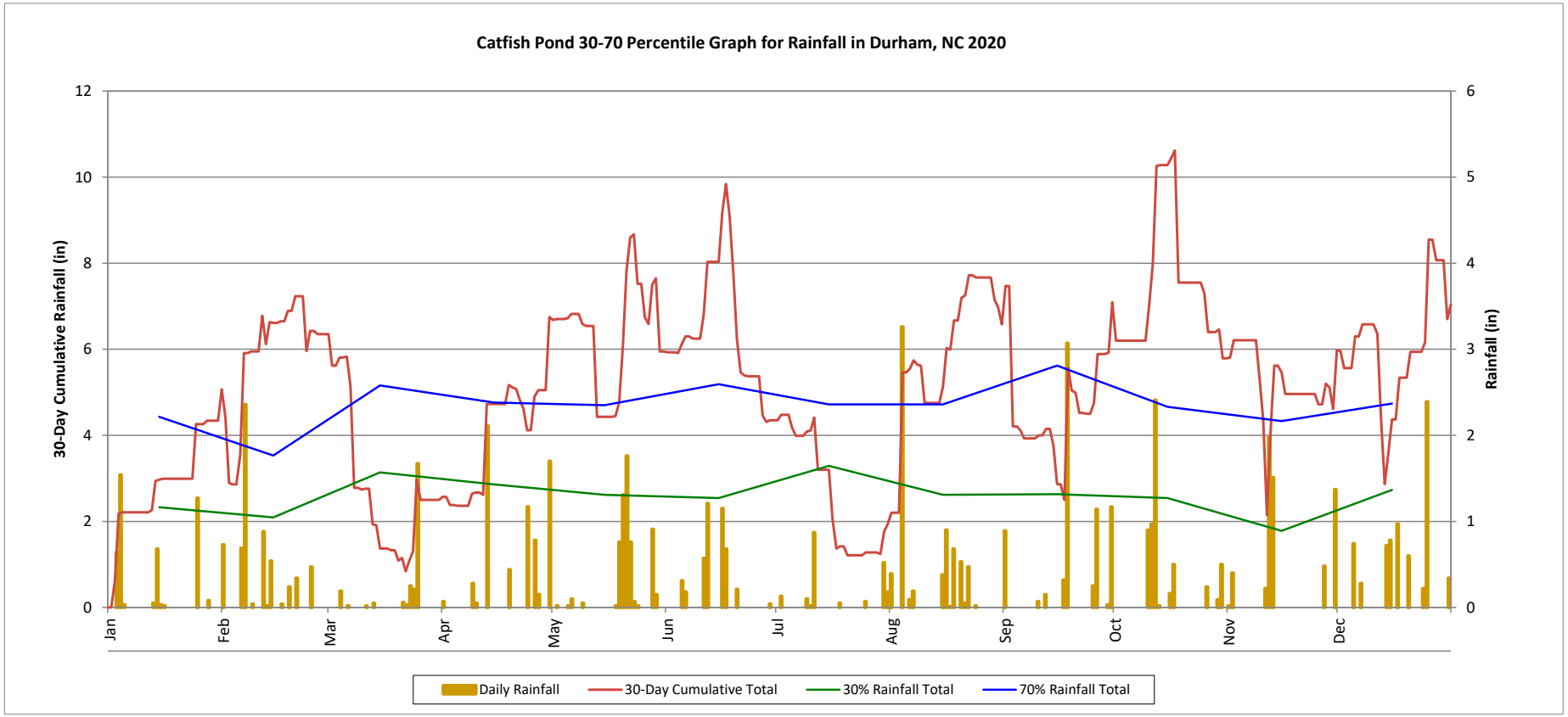
[2] 30th and 70th percentile rainfall data collected from weather station Roxboro 7 ESE, NC (USDA, 2020).

30-Day Cumulative Total Rainfall Data

Catfish Pond Mitigation Site

DMS Project No. 100039

Monitoring Year 1 - 2020



[1] 2020 monthly rainfall from USDA Station Durham 10.7 NNE.

[2] 30th and 70th percentile rainfall data collected from weather station Roxboro 7 ESE, NC (USDA, 2020).

Table 14. Wetland Gauge Summary

Catfish Pond Mitigation Project
DMS Project No. 100039
Monitoring Year 1 - 2020

Summary of Groundwater Gauge Results for Monitoring Years 1 through 7*							
Gauge	Max Consecutive Days During Growing Season (Percentage)						
	MY1 (2020)	MY2 (2021)	MY3 (2022)	MY4 (2023)	MY5 (2024)	MY6 (2025)	MY7 (2026)
1	**14 Days (5.3%)**						
2	**100 Days (37.6%)**						
3	**109 Days (41.0%)**						
4	**59 Days (22.2%)**						

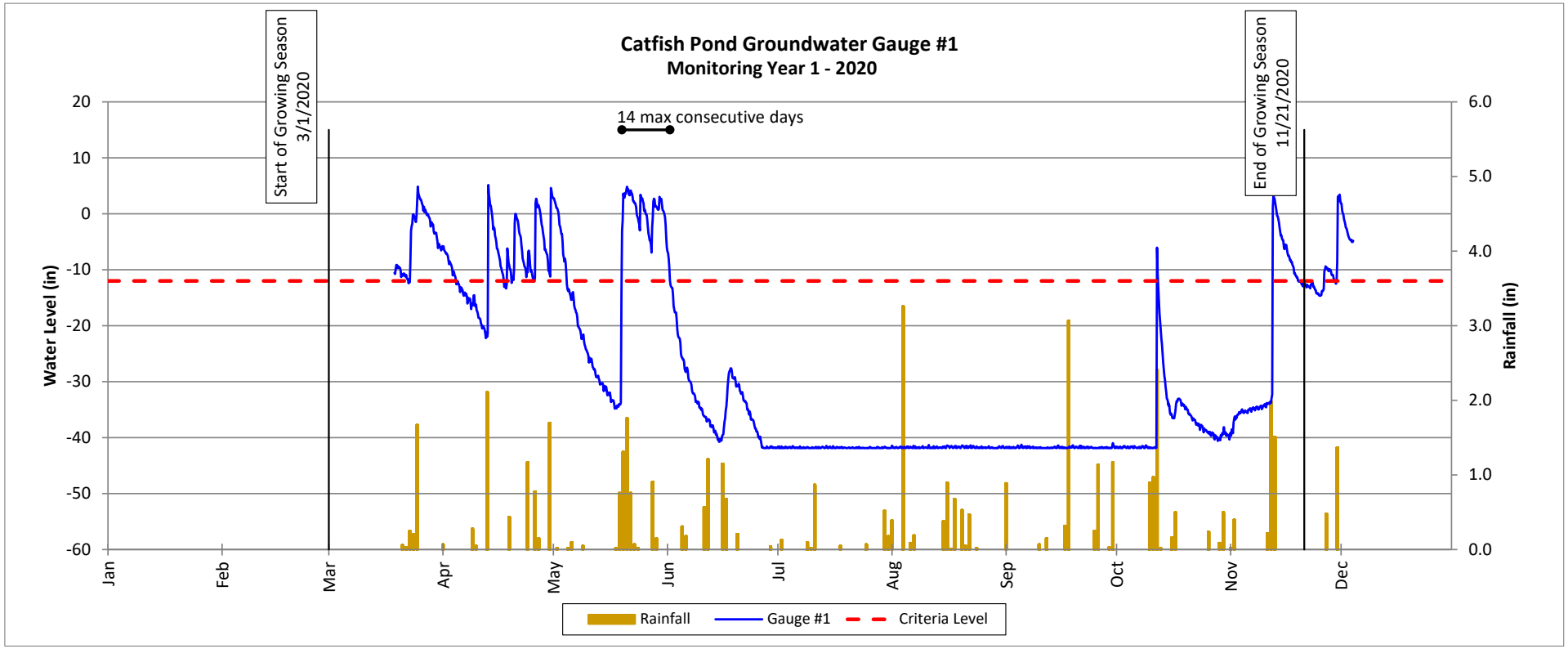
*Data collected for informational purposes only, no success criteria is associated with the wetland areas.

Groundwater Gauge Plots

Catfish Pond Mitigation Site

DMS Project No. 100039

Monitoring Year 1 - 2020

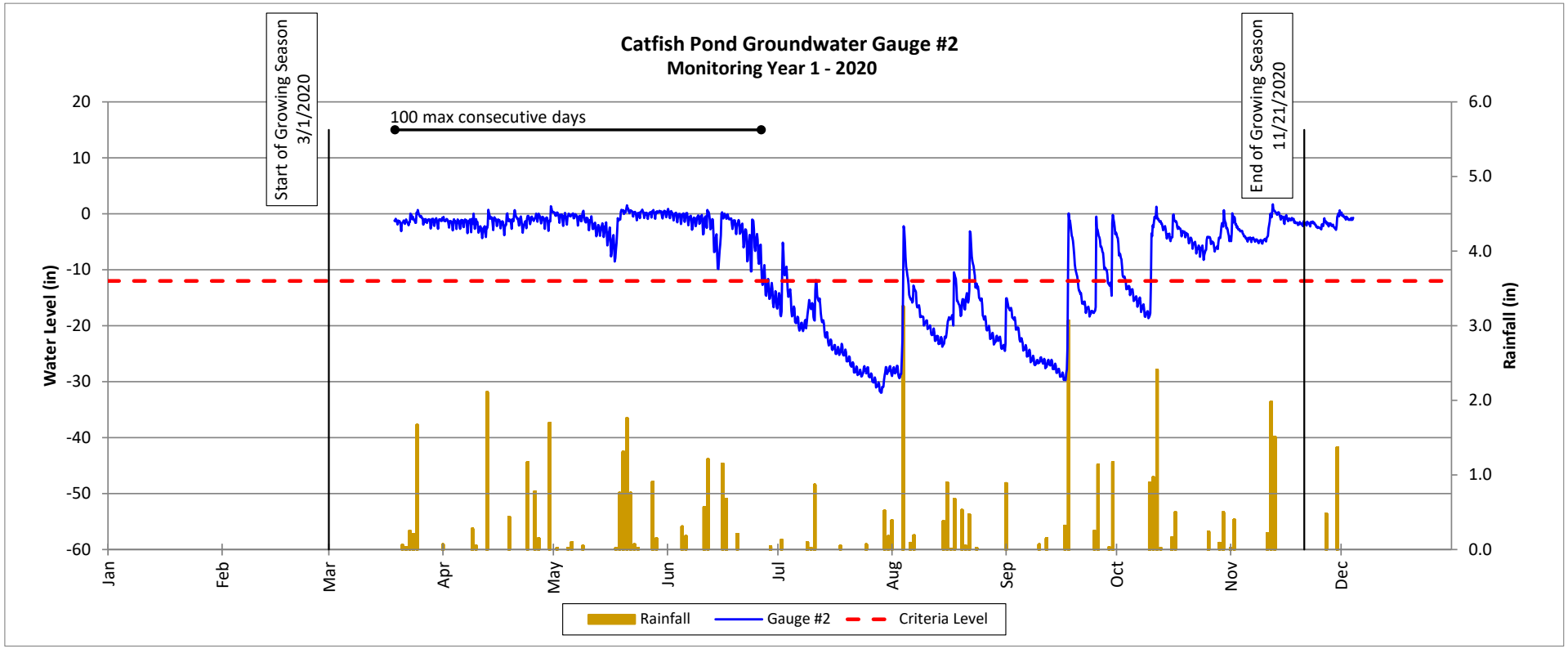


Groundwater Gauge Plots

Catfish Pond Mitigation Site

DMS Project No. 100039

Monitoring Year 1 - 2020

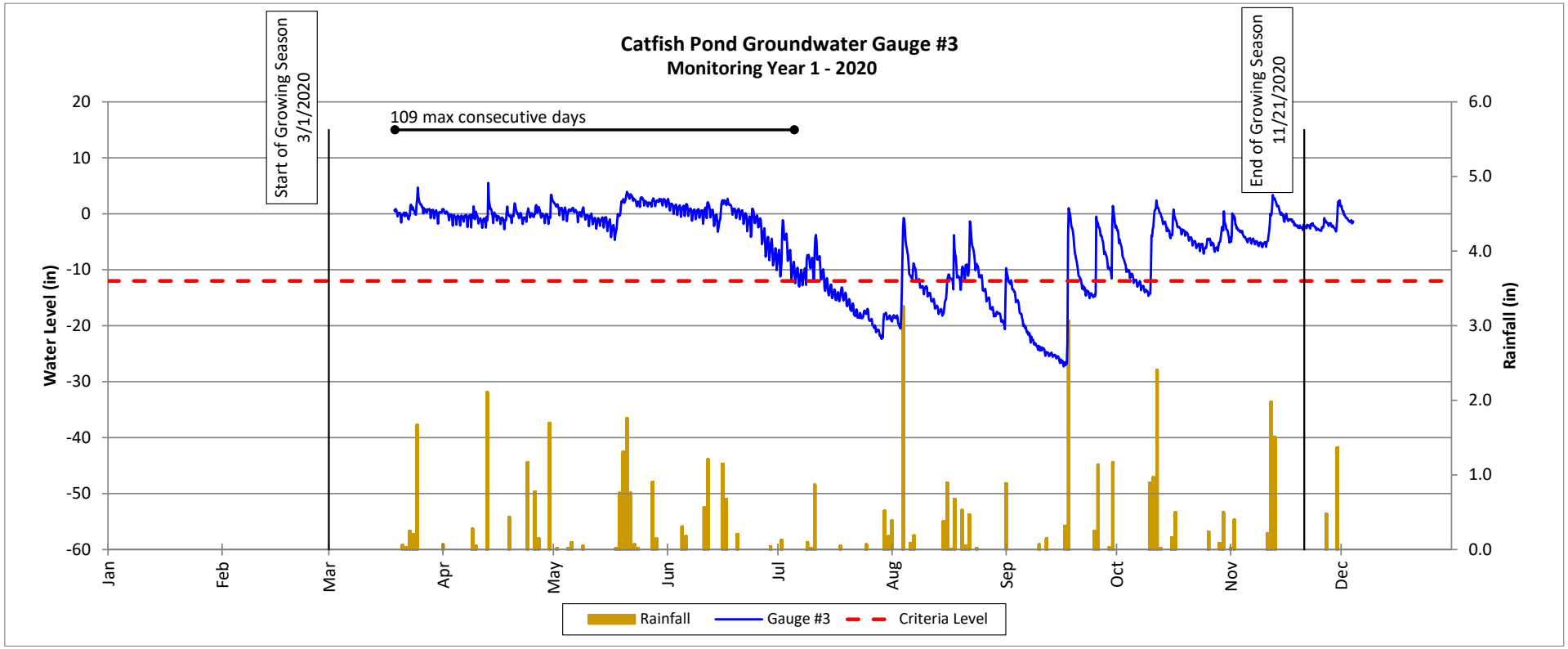


Groundwater Gauge Plots

Catfish Pond Mitigation Site

DMS Project No. 100039

Monitoring Year 1 - 2020



Groundwater Gauge Plots

Catfish Pond Mitigation Site

DMS Project No. 100039

Monitoring Year 1 - 2020