MONITORING YEAR 3 ANNUAL REPORT

Final

MARTIN DAIRY MITIGATION SITE

Orange County, NC
NCDEQ Contract No. 006831
DMS Project No. 97087
USACE Action ID No. 2016-00874
NCDWR Project No. 2016-0366

Data Collection Period: January – October 2020
Draft Submission Date: November 9, 2020
Final Submission Date: December 14, 2020

PREPARED FOR:

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

Mitigation Project Name	**Martin Dairy Mitigation Site-Option 2**	**USACE Action ID**	**2016-00874**
DMS ID	**97087**	**DWR Permit**	**2016-0366**
River Basin	**Neuse**	**Date Project Instituted**	**3/22/2016**
Cataloging Unit	**03020201**	**Date Prepared**	**4/20/2020**
County	**Orange**	**Stream/Wet. Service Area**	**Neuse 03020201**

Signature & Date of Official Approving Credit Release

1 - For NCDMS, no credits are released during the first milestone
2 - For NCDMS projects, the initial credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the IRT by posting it to the DMS portal, provided the following have been met:
1) Approved of Final Mitigation Plan
2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property.
3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan.
4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.
3 - A 10% reserve of credits is to be held back until the bankfull event performance standard has been met.

Credit Release Milestone	**Warm Stream Credits**						
Project Credits	**Scheduled Releases %**	**Proposed Releases %**	**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%	30.00%	640.500	0.000	640.500	2018	3/12/2018
3 - Year 1 Monitoring	10.00%	10.00%	213.500	0.000	213.500	2019	4/26/2019
4 - Year 2 Monitoring	10.00%	10.00%	213.500	0.000	213.500	2020	4/20/2020
5 - Year 3 Monitoring	10.00%					2021	
6 - Year 4 Monitoring	5.00%					2022	
7 - Year 5 Monitoring	10.00%					2023	
8 - Year 6 Monitoring	5.00%					2024	
9 - Year 7 Monitoring	10.00%					2025	
Stream Bankfull Standard	10.00%	10.00%	213.500	0.000	213.500	2020	4/20/2020
			Totals	0.000	1,281.000		

Total Gross Credits	2,135.000
Total Unrealized Credits to Date	0.000
Total Released Credits to Date	1,281.000
Total Percentage Released	60.00%
Remaining Unreleased Credits	854.000

Notes

Contingencies (if any)

Project Quantities

Mitigation Type	**Restoration Type**	**Physical Quantity**
Warm Stream	Restoration	2,135.000

Mitigation Project Name	**Martin Dairy Mitigation Site-Option 2**	**USACE Action ID**	**2016-00874**
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Cataloging Unit	**03020201**	**Date Prepared**	**4/20/2020**
County	**Orange**	**Stream/Wet. Service Area**	**Neuse 03020201**

Debits							**Stream Restoration Credits**
Beginning Balance (mitigation credits)							**2,135.000**
Released Credits							**1,281.000**
Unrealized Credits							**0.000**
Owning Program	**Req. Id**	**TIP #**	**Project Name**	**USACE Permit #**	**DCM Permit #**	**DWR Permit #**	
Statewide Stream & Wetland ILF Program	REQ-003175		Wendell Falls	2006-20100-292		2006-1617	213.500
Statewide Stream & Wetland ILF Program	REQ-003919		Donation - Heritage Subdivision			1999-1241	228.590
Statewide Stream & Wetland ILF Program	REQ-004270	R-2547 R-2641	DOT - Knightdale Bypass	2002-20819		2001-1689	411.910
Total Credits Debited							**854.000**
Remaining Available balance (Released credits)							**427.000**
Remaining balance (Unreleased credits)							**854.000**

December 14, 2020

Jeremiah Dow
N.C. Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

RE: Monitoring Year 3 Report Martin Dairy Mitigation Site, DMS ID# 97087
Neuse River Basin – CU# 03020201
Orange County, North Carolina
Contract No. 6831

Dear Mr. Dow,

We have reviewed the comments on the Monitoring Year 3 Report for the above referenced project dated December 10, 2020 and have revised the report based on these comments. The revised documents are submitted with this letter. Below are responses to each of your comments. For your convenience, the comments are reprinted with our response in italics.

MY3 Report – Stream Mitigation

1. Section 1.2.1 – Second paragraph discusses counting volunteers toward vegetative success criteria and lists Sweet Gum when listing desirable volunteers. Sweet Gum should not be counted toward vegetative success.

Sweet Gum were removed from the list of volunteers counted in vegetative success.

2. Figure 3 – Recommend using a different aerial image. The image is largely devoid of any features including roads and structures.

Aerial imagery in Figure 3 was updated.

MY3 Report – Riparian Buffer Mitigation

3. Table 1 – Please change Final Credit Ratio for Martin Dairy 101-200 from 3.00000 to 3.03030. Take all Riparian Buffer Credits (BMU) to 3 decimal places. Please change the BMUs for Martin Dairy 101-200 to 30,776.478 and the total credits to 379,169.358

The Final Credit Ratio for Martin Dairy 101-200 was changed from 3.00000 to 3.03030. Riparian Buffer Credits (BMU) were calculated to 3 decimal places. The BMUs for Martin Dairy 101-200 were changed to 30,776.478 and the total credits to 379,169.358

Overall

4. As required by contract, specifically RFP#16-006477, Wildlands must submit an updated Monitoring Phase Performance Bond (MPPB) for Monitoring Year 4 (Task 10) to Jeff Jurek for his approval before DMS approves this deliverable and the associated payment.

An updated Monitoring Phase Performance Bond (MPPB) for Monitoring Year 4 (Task 10) was submitted.

If you have any questions, please contact me by phone (919) 851-9986, or by email (jlorch@wildlandseng.com).

Sincerely,

Jason Lorch, *Monitoring Coordinator*

PREPARED BY:

WILDLANDS
ENGINEERING

312 West Millbrook Road, Suite 225
Raleigh, NC 27609

Jason Lorch
jlorch@wildlandseng.com
Phone: 919.851.9986

EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (Wildlands) implemented a full delivery project at the Martin Dairy Mitigation Project (Site) for the North Carolina Department of Environmental Quality Division of Mitigation Services (DMS) to restore a total of 2,135 linear feet (LF) of perennial streams in Orange County, NC. The Site is expected to generate 2,135 stream mitigation units (SMUs). All stream lengths were measured along the stream centerline for SMU calculations. The Site is located approximately eight miles northeast of Hillsborough, NC and eight miles south of Caldwell, NC (Figure 1) in the Neuse River Basin 8-Digit Hydrologic Unit Code 03020201. The project is located within the Neuse River Basin Hydrologic Unit Code 03020201030030 and NC Division of Water Resources (DWR) Subbasin 03-04-01. There are two unnamed streams on the Site, Martin Dairy Creek and UT1 with a downstream drainage area of 526 acres. The downstream drainage area of the Site is 526 acres. The Site drains to the Eno River which flows to Falls Lake and is classified as water supply waters (WS-IV). The 11.155-acre Site is protected with a permanent conservation easement.

The Site is located within the Neuse River Targeted Local Watershed as presented in the 2010 Neuse River Basin Restoration Priorities (RBRP) (Breeding, 2010), which highlights the importance of riparian buffers for stream restoration projects. The Site was an active dairy farm until 2014 when livestock were removed.

The project goals established in the Mitigation Plan (Wildlands, 2017) were developed considering the goals and objectives listed in the Neuse River RBRP plan. The project goals include:

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

The project will contribute to achieving the goals for the watershed listed 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, reduced nutrient and sediment loading have farther reaching effects. In addition, planned and implemented projects in the same watershed and basin as this Site will realize cumulative benefits.

The Site construction and as-built surveys were completed between July 2017 and January 2018. Monitoring Year 3 (MY3) assessments and site visits were completed between January and October 2020 to assess the conditions of the project. Overall, the Site has met the required vegetation and stream success criteria for MY3. The overall average stem density for the Site is 359 planted stems per acre, exceeding the MY3 interim requirement of 320 stems per acre. Vegetation plots 6, 7, and 8 did not meet the MY3 interim requirement of 320 stems per acre; however, the planted stems per acre for each of the three plots remains above the MY7 requirement of 210. When accounting for volunteers in the stem totals each of these plots are well above the stem requirements for MY3. A total of 6.6 acres of the Site received supplemental planting. All restored streams are stable and functioning as designed. Bankfull and geomorphically significant events were recorded on each restoration reach during MY3. Bankfull events were documented on each reach during both previous monitoring years, thus the stream hydrology success criteria has been met.

MARTIN DAIRY MITIGATION SITE

Monitoring Year 3 Annual Report

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APPENDICES

Section 1: PROJECT OVERVIEW

The Martin Dairy Mitigation Site (Site) is located in central Orange County, approximately eight miles northeast of Hillsborough, NC and eight miles south of Caldwell, NC off of Schley Road (Figure 1). The Site is located in the Neuse River Basin and within the Falls Lake Water Supply Watershed, which has been designated a Nutrient Sensitive Water. The project streams drain to the Eno River and eventually to the Falls Lake Reservoir. The Site is within Hydrologic Unit Code 03020201030030, which is a Targeted Local Watershed (Figure 1) as identified in the 2010 Neuse River Basin Restoration Priorities (RBRP) (Breeding, 2010). The Site is in in the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). The project watershed consists primarily of agricultural and wooded land and the drainage area for project site is 526 acres (0.82 square miles).

The project streams consist of Martin Dairy Creek and one unnamed tributary (UT1). Mitigation work within the Site included restoration of 2,135 linear feet (LF) of perennial stream channels. The riparian areas were planted with native vegetation to improve habitat and protect water quality. The final Mitigation Plan (Wildlands, 2017) was submitted to and accepted by DMS in March 2017. Construction activities were completed by Land Mechanic Designs, Inc. in July 2017. Planting and seeding activities were completed by Bruton Natural Systems, Inc. in December 2017. Baseline monitoring (MY0) was conducted between August 2017 and January 2018. Monitoring Year 3 was conducted in 2020. Annual monitoring will occur for seven years with the close-out anticipated to occur in 2025 given the success criteria are met. Appendix 1 provides additional details on project activity, history, contact information, and watershed/background information for the Site.

The Site is located on two tracts under the ownership of Ted H. Martin (PIN 9896-83-0483 & 9896-83-9111). A conservation easement was recorded on 11.155 acres (Deed Book 6218, Pages 270 - 289). The project is expected to provide 2,135 stream mitigation units (SMUs) by closeout.

A project vicinity map and directions are provided in Figure 1 and project components/assets are illustrated in Figure 2.

1.1 Project Goals and Objectives

Prior to construction activities, the primary degradation at the Site was the clearing of vegetation and channelization of Martin Dairy Creek and UT1. Channelization, as indicated by dredge spoil in the floodplain, involved straightening and deepening of the stream. Historic livestock grazing and hay cultivation on the Site further contributed to degradation of the riparian corridor and stream channel. Table 4 in Appendix 1 and Tables 10a and 10b in Appendix 4 present the pre-restoration conditions in detail.

The project is intended to provide numerous ecological benefits within the Neuse River Basin. While benefits such as habitat improvement and geomorphic stability are limited to the project site, reduced nutrient and sediment loading have farther reaching effects. The table below, describes expected outcomes to water quality and ecological processes are provided with project goals and objectives. The project goals and objectives were developed as part of the Mitigation Plan considering the goals and objectives listed in the Neuse River RBRP plan and strive to maximize ecological and water quality uplift within the watershed.

The following project goals and related objectives established in the Mitigation Plan (Wildlands, 2017) include:

Goal	Objective	Expected Outcomes
Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime.	Reconstruct stream channels with designed bankfull dimensions and depth based on reference reach data. Remove existing dredge spoil to reconnect 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.	Reduce sediment inputs from bank erosion. Reduce shear stress on channel boundary. Support all stream functions above hydrology.
Restore and enhance native floodplain and streambank vegetation.	Plant native tree and understory species in riparian zones and plant native shrub and herbaceous species on streambanks.	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 the streams. Support all stream functions.
Improve instream habitat.	Install habitat features such as constructed riffles, lunker logs, and brush toes into restored 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 the streams.
Permanently protect the Site from harmful uses.	Establish a conservation easement on the Site.	Protect the Site from encroachment on the riparian corridor and direct impact to streams and wetlands. Support all stream functions.

1.2 Monitoring Year 3 Data Assessment

Annual monitoring and site visits were conducted during MY3 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.

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). A total of eight standard 10-meter by 10-meter vegetation plots were established during the baseline monitoring within the project easement area.

The final vegetative success criteria are the survival of 210 planted stems per acre at the end of MY7. The interim measure of vegetative success is the survival of at least 320 planted stems per acre at the end of MY3 and at least 260 stems per acre at the end of MY5. Planted vegetation must average 10 feet in height at the end of MY7.

The MY3 vegetative survey was completed in September 2020. The 2020 vegetation monitoring resulted in an average stem density of 359 planted stems per acre, which is above the interim requirement of 320 stems per acre required at MY3 and 40% less than the baseline density recorded in January 2018 (597 stems per acre). There is an average of 9 stems per plot in MY3 compared to 14 stems per plot in MY0. Vegetation plots 6, 7, and 8 were below the interim requirement of 320 stems per acre, with respective planted stems per acre of 243, 283, and 243. Mortality of planted stems in these three plots is primarily due to competition with two native herbaceous species: tearthumb (*Persicaria sagittate)* and blackberry (*Rubus canadensis*). Despite the mortality of planted stems in these plots the number of volunteer species remains high. When accounting for volunteers each of these plots meets the MY3 interim success criteria with the number of stems per acre totaling 1,214, 890, and 3,035. Volunteer species include sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), flowering dogwood (*Cornus florida*), green ash (*Fraxinus pennsylvanica*), black gum (*Nyssa sylvatica*), and slippery elm (*Ulmus rubra*).

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

UT1 was a priority II restoration reach and the floodplain was graded during construction leaving poor soil conditions for vegetation growth. Tree vigor and vegetative cover along UT1 has improved since MY2 but is still not performing as well as the rest of the Site. Container trees and tublings were planted in the 0.5 acre low growth area along UT1 at a stem density of 140 stems per acre, and soil amendments were added to further promote vegetative growth. An additional 6.11 acres of the Site also received light supplemental planting at a stem density of 70 stems per acre to increase species diversity. Supplemental planting and low growth areas are shown in the Current Condition Plan View (CCPV) map in Appendix 2, and a list of supplemental species can be found in Table 9a. If deemed necessary, remedial actions will be taken in subsequent monitoring years to promote tree growth. Additionally, existing trees throughout the site received ring sprays to reduce competition with herbaceous vegetation and promote tree growth.

1.2.3 Stream Assessment

Morphological surveys for MY3 were conducted in March 2020. All streams within the Site are stable and functioning as designed. In general, cross-sections at the Site show little to no change in the bankfull area, maximum depth ratio, or width-to-depth ratio. Bank height ratios are less than 1.1. Substrate materials indicate the maintenance of coarser materials in the riffle reaches and finer particles in the pools. Longitudinal profile surveys are not required on the project unless visual inspection indicates reach wide vertical instability. Refer to Appendix 2 for the visual stability assessment table, CCPV 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 MY3.

1.2.5 Hydrology Assessment

At the end of the seven-year monitoring period, two or more bankfull events must have occurred in separate years within the restoration reaches. Also, two geomorphically significant events must be documented during the monitoring period. Bankfull events and multiple geomorphically significant events were recorded on all restoration reaches during MY1, MY2, and MY3 resulting in attainment of the stream hydrology success criteria. Refer to Appendix 5 for hydrologic data.

1.2.6 Maintenance Plan

The low vegetative growth area mentioned in Section 1.2.2 will continued to be assessed for further supplemental needs.

1.3 Monitoring Year 3 Summary

Five of the eight vegetation plots have met the MY3 interim requirement of 320 planted stems per acre, and all eight plots are on track to meet the final success criteria of 210 stems per acre. When counting volunteer species, all vegetation plots exceed the interim success criteria for MY3. Despite the mortality of planted stems in vegetation plots 6, 7, and 8 the total number of stems per acre and species diversity in each of the plots remains high. All streams within the Site are stable and functioning as designed. Bankfull and geomorphically significant events during two separate years have been documented on all stream reaches, resulting in fulfillment of the stream hydrology success criteria.

Summary information and data related to the performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Mitigation Plan 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). All Integrated Current Condition Mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcGIS. Crest gages 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 Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008).

Section 3: REFERENCES

Breeding, R. 2010. Neuse River Basin Restoration Priorities 2010. NCEEP, NC

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

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

Lee, M.T., Peet, R.K., S.D., Wentworth, T.R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Retrieved from http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-5.pdf.

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

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

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

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

Wildlands Engineering, Inc. 2018. Martin Dairy Mitigation Site Baseline Monitoring Document and As-Built Baseline Report. DMS, Raleigh, NC.

Wildlands Engineering, Inc. 2017. Martin Dairy Mitigation Project Mitigation Plan. DMS, Raleigh, NC.

APPENDIX 1. General Figures and Tables

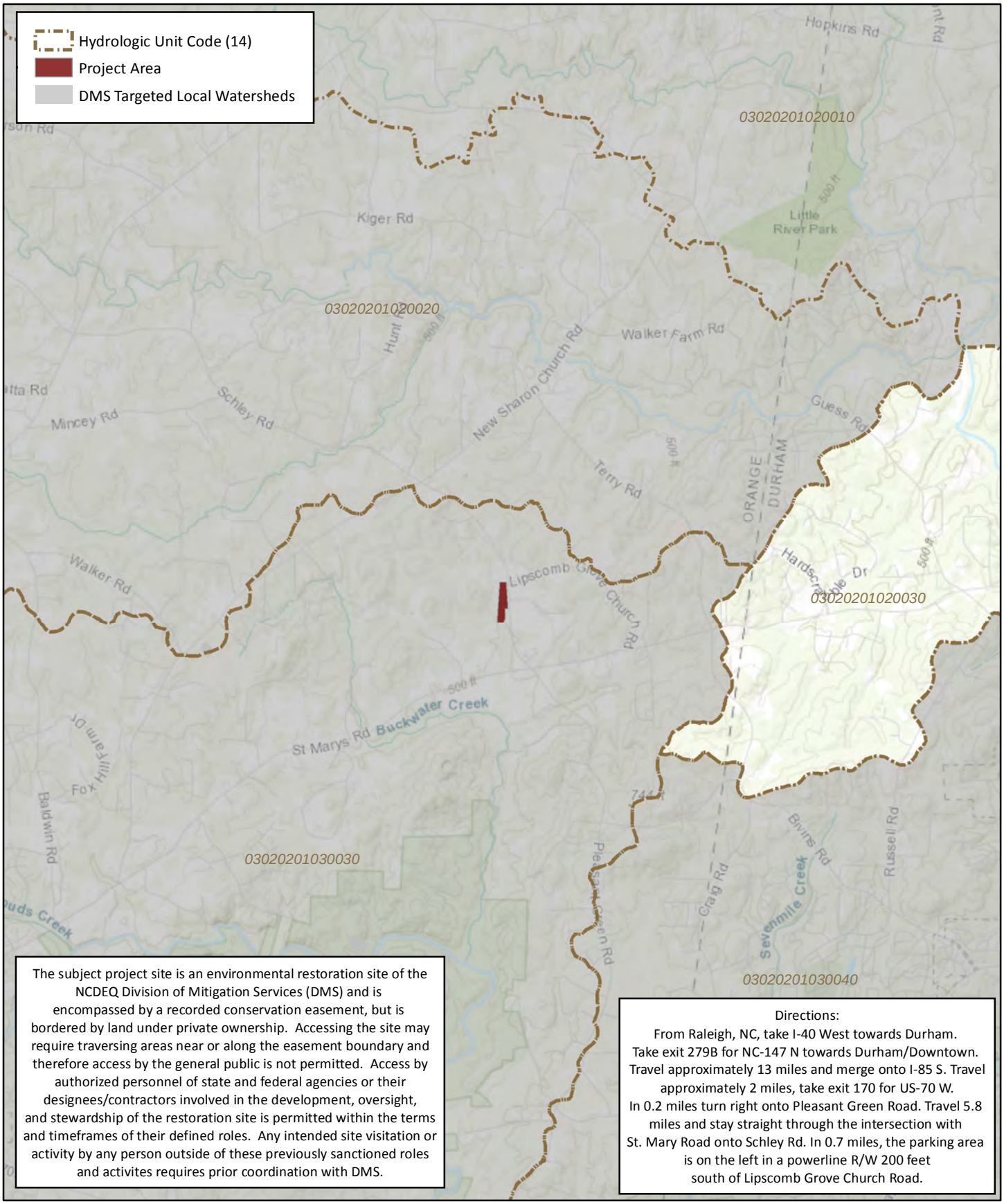
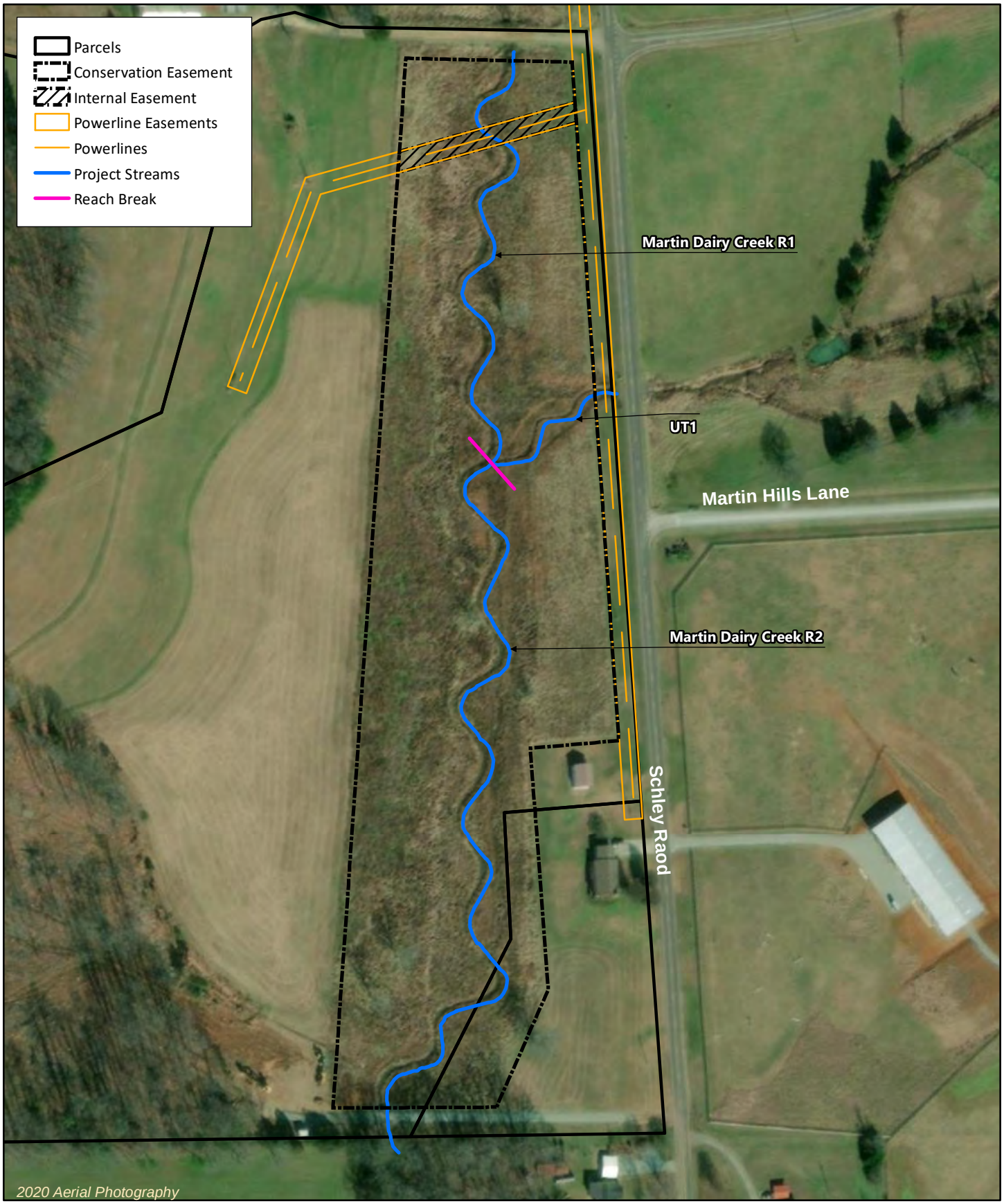


Figure 1. Project Vicinity Map
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020
Orange County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

N

Figure 2. Project Component/Asset Map
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020
Orange County, NC

Table 1. Project Components and Mitigation Credits
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

MITIGATION CREDITS										
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset	
Type	R	RE	R	RE	R	RE				
Totals	2,135	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

PROJECT COMPONENTS								
Reach ID	Centerline Stationing	Existing Footage	Approach	Restoration or Restoration Equivalent	Restoration Footage (LF)*	As-Built Thalweg Footage (LF)	Mitigation Ratio	Credits (SMU / WMU)
STREAMS								
Martin Dairy R1	100+13 - 101+38, 101+78 - 107+61	503	P1	Restoration	708	721	1	708
Martin Dairy R2	107+61 - 119+71	1,173	P1	Restoration	1,210	1,258	1	1,210
UT1	200+33 - 202+50	138	PII	Restoration	217	214	1	217

COMPONENT SUMMATION						
Restoration Level	Stream (LF)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (acres)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	2,135	-	-	-	-	-
Enhancement		-	-	-	-	-
Enhancement I	-					
Enhancement II	-					
Creation		-	-	-		
Preservation	-	-	-	-		-
High Quality Preservation	-	-	-	-		-

N/A: not applicable

*Linear footage calculated along stream centerline.

Table 2. Project Activity and Reporting History
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Activity or Report		Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan		March 2017	March 2017
Final Design - Construction Plans		March 2017	March 2017
Construction		June 2017 - July 2017	July 2017
Temporary S&E mix applied to entire project area[1]		June 2017 - July 2017	July 2017
Permanent seed mix applied to reach/segments[1]		June 2017 - July 2017	July 2017
Bare root and live stake plantings for reach/segments		December 2017	December 2017
Baseline Monitoring Document (Year 0)	Stream Survey	August 2017	January 2018
	Vegetation Survey	January 2018	
Year 1 Monitoring	Stream Survey	June 2018	December 2018
	Vegetation Survey	September 2018	
Year 2 Monitoring	Stream Survey	May 2019	December 2019
	Vegetation Survey	September 2019	
Supplemental Planting			January 2020
Year 3 Monitoring	Stream Survey	March 2020	December 2020
	Vegetation Survey	September 2020	
Year 4 Monitoring			December 2021
Year 5 Monitoring	Stream Survey	2022	December 2022
	Vegetation Survey	2022	
Year 6 Monitoring			December 2023
Year 7 Monitoring	Stream Survey	2024	December 2024
	Vegetation Survey	2024	

[1]Seed and mulch is added as each section of construction is completed.

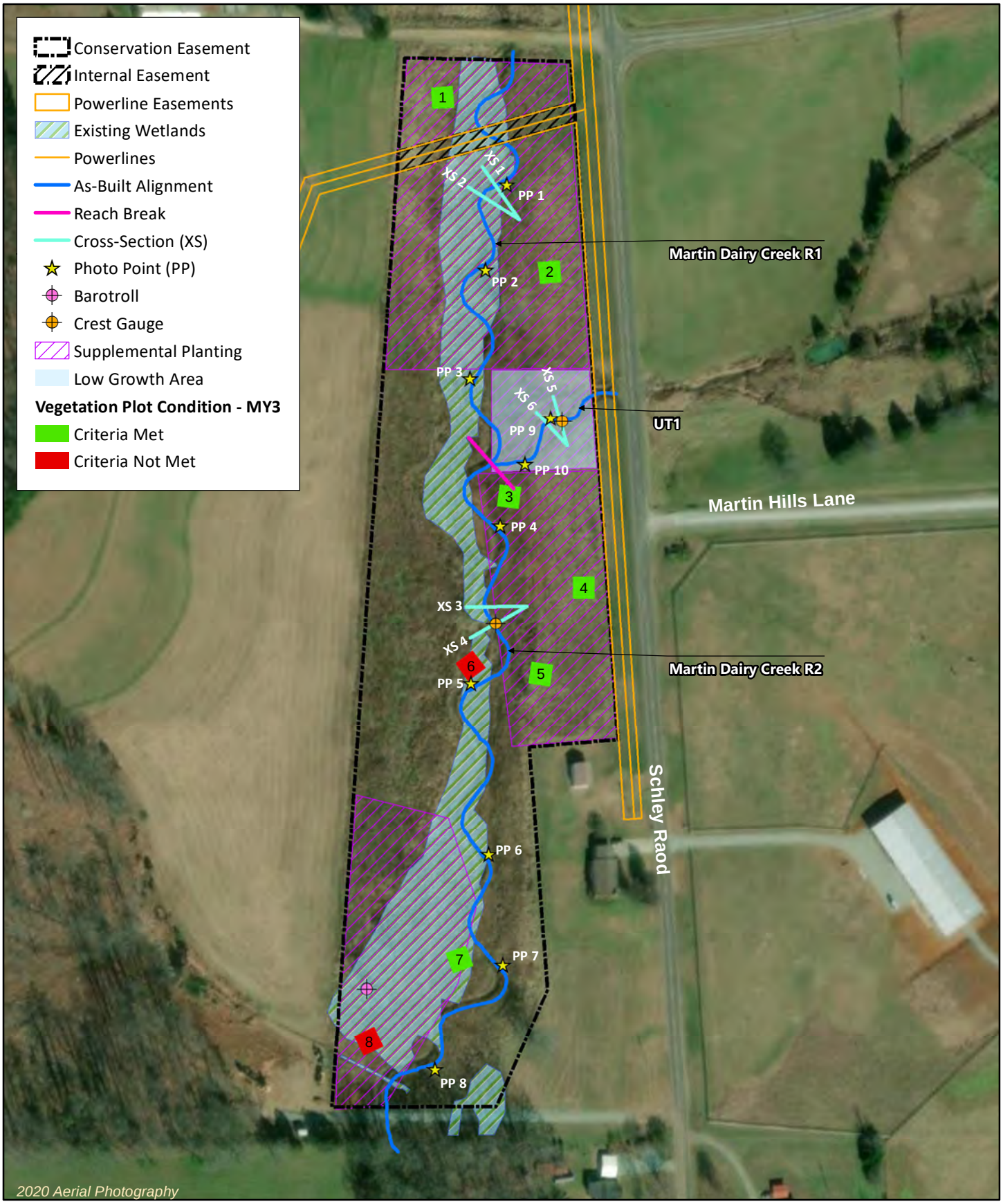
Table 3. Project Contact Table
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Designer Angela Allen, PE	**Wildlands Engineering, Inc.** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
Planting Contractor	**Bruton Natural Systems, Inc** P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
Seed Mix Sources	**Green Resource, LLC**
Nursery Stock Suppliers **Bare Roots**	**Dykes and Sons Nursery and Greenhouse**
Live Stakes	**Bruton Natural Systems, Inc**
Monitoring Performers	**Wildlands Engineering, Inc.**
Monitoring, POC	Jason Lorch 919.851.9986

Table 4. Project Information and Attributes
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

PROJECT INFORMATION			
Project Name	Martin Dairy Mitigation Site		
County	Orange County		
Project Area (acres)	11.155		
Planted Area (acres)	10.139		
Project Coordinates (latitude and longitude)	36° 7' 25.76" N, 79° 0' 14.26" W		
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	03020201030030		
DWR Sub-basin	03-04-01		
Project Drainiage Area (acres)	526		
Project Drainage Area Percentage of Impervious Area	0.4%		
CGIA Land Use Classification	59.0% forested, 40.6% cultivated, 0.4% impervious		
REACH SUMMARY INFORMATION			
Parameters	**Martin Dairy**	**UT1**	
Length of Reach (linear feet) - Post-Restoration	1,918	217	
Drainage Area (acres)	526	141	
NCDWR Stream Identification Score	36.75	30.75	
NCDWR Water Quality Classification	WS-IV		
Morphological Desription (stream type)	Perennial		
Evolutionary Trend (Simon's Model) - Pre-Restoration	IV: Degradation and Widening		
Underlying Mapped Soils	Chewacla loam, Herndon silt loam, Tatum silt loam		
Drainage Class	-	-	
Soil Hydric Status	-	-	
Slope	-	-	
FEMA Classification	N/A		
Native Vegetation Community	Piedmont Bottomland Forest		
Percent Composition Exotic Invasive Vegetation - Post-Restoration	0%		
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. 4087.
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	Martin Diary Mitigation Plan; Wildlands determined "no effect" on Orange County listed endangered species. The USFWS responded on June 3, 2016 and concurred with NCWRC stating that "the proposed action 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 June 3, 2016 indicating they were not aware of any historic resources that 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	N/A	N/A	N/A
Essential Fisheries Habitat	N/A	N/A	N/A

APPENDIX 2. Visual Assessment Data



WILDLANDS ENGINEERING

0 100 200 Feet

N

Figure 3. Intergrated Current Condition Plan View
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020
Orange County, NC

Table 5a. Visual Stream Morphology Stability Assessment Table
Martin Dairy Mitigation Project
DMS Project No. 97087
Monitoring Year 3 - 2020

Martin Dairy Reach 1

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	8	8			100%			
	3. Meander Pool Condition	Depth Sufficient	9	9			100%			
		Length Appropriate	9	9			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	8	8			100%			
		Thalweg centering at downstream of meander bend (Glide)	9	9			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.	5	5			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	5	5			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	5	5			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	6	6			100%			

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

Table 5b. Visual Stream Morphology Stability Assessment Table
Martin Dairy Mitigation Project
DMS Project No. 97087
Monitoring Year 3 - 2020

Martin Dairy 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	13	13			100%			
	3. Meander Pool Condition	Depth Sufficient	13	13			100%			
		Length Appropriate	13	13			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	13	13			100%			
		Thalweg centering at downstream of meander bend (Glide)	13	13			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.	8	8			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	8	8			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 5c. Visual Stream Morphology Stability Assessment Table
Martin Dairy Mitigation Project
DMS Project No. 97087
Monitoring Year 3 - 2020

UT1

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	4	4			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.	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%.	1	1			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 6. Vegetation Condition Assessment Table

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Planted Acreage **10.139**

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	1	0.52	5%
		Cumulative Total	**1**	**0.52**	**5%**

Easement Acreage **11.155**

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 Martin Dairy R1 – upstream *(3/19/2020)*

PHOTO POINT 1 Martin Dairy R1 – downstream *(3/19/2020)*

PHOTO POINT 2 Martin Dairy R1 – upstream *(3/19/2020)*

PHOTO POINT 2 Martin Dairy R1 – downstream *(3/19/2020)*

PHOTO POINT 3 Martin Dairy R1 – upstream *(3/19/2020)*

PHOTO POINT 3 Martin Dairy R1 – downstream *(3/19/2020)*

PHOTO POINT 4 Martin Dairy R2 – upstream *(3/19/2020)*

PHOTO POINT 4 Martin Dairy R2 – downstream *(3/19/2020)*

PHOTO POINT 5 Martin Dairy R2 – upstream *(3/19/2020)*

PHOTO POINT 5 Martin Dairy R2 – downstream *(3/19/2020)*

PHOTO POINT 6 Martin Dairy R2 – upstream *(3/19/2020)*

PHOTO POINT 6 Martin Dairy R2 – downstream *(3/19/2020)*

PHOTO POINT 7 Martin Dairy R2 – upstream *(3/19/2020)*

PHOTO POINT 7 Martin Dairy R2 – downstream *(3/19/2020)*

PHOTO POINT 8 Martin Dairy R2 – upstream *(3/19/2020)*

PHOTO POINT 8 Martin Dairy R2 – downstream *(3/19/2020)*

PHOTO POINT 9 UT1 – upstream *(3/19/2020)*

PHOTO POINT 9 UT1 – downstream *(3/19/2020)*

	
PHOTO POINT 10 UT1 – upstream *(3/19/2020)*	**PHOTO POINT 10 UT1 –** downstream *(3/19/2020)*

VEGETATION PLOT PHOTOGRAPHS

VEG PLOT 1 *(09/22/2020)*

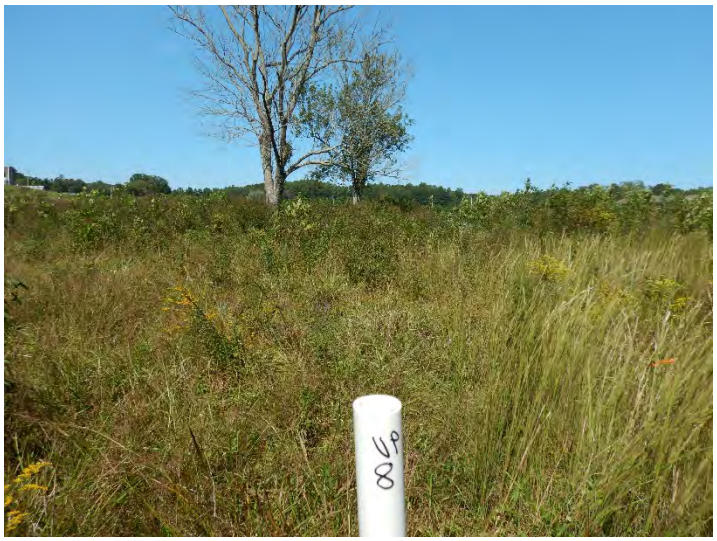
VEG PLOT 2 *(09/22/2020)*

VEG PLOT 3 *(09/22/2020)*

VEG PLOT 4 *(09/22/2020)*

VEG PLOT 5 *(09/22/2020)*

VEG PLOT 6 *(09/22/2020)*

	
VEG PLOT 7 *(09/22/2020)*	**VEG PLOT 8** *(09/22/2020)*

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Table

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Plot	Success Criteria Met	Tract Mean
1	Yes	63%
2	Yes	
3	Yes	
4	Yes	
5	Yes	
6	No*	
7	No*	
8	No*	

*Vegetation Plots 6, 7, and 8 do not meet MY3 interim success criteria of 310 planted stems per acre. However, when including volunteers Vegetation Plots 6, 7, and 8 exceeds the MY3 success criteria.

Table 8. CVS Vegetation Tables - Metadata
Martin Dairy Mitigation Project
DMS Project No. 97087
Monitoring Year 3 - 2020

Report Prepared By	Jason Lorch
Date Prepared	9/23/2020 9:18
Database Name	Martin Dairy- cvs-v2.5.0.- MY3.mdb
Database Location	F:\Projects\005-02158 Martin Dairy\Monitoring\Monitoring Year 3 - 2020\Vegetation Assessment
Computer Name	KAITLYN2020
File Size	51679232
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	97087
Project Name	Martin Dairy
Description	Stream Restoration Project
Sampled Plots	8

Table 9. Planted and Total Stem Counts

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

			Current Plot Data (MY3 2020)											
			VP1			VP2			VP3			VP4		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	River Birch	Tree	1	1	1	2	2	2	3	3	3	1	1	1
Carya	Hickory	Tree												1
Cephalanthus occidentalis	Buttonbush	Shrub Tree												
Cercis canadensis	Eastern Redbud	Shrub Tree												
Cornus florida	Flowering Dogwood	Shrub Tree												
Fraxinus pennsylvanica	Green Ash	Tree	2	2	2	3	3	3	2	2	3	3	3	3
Ligustrum sinense	Chinese Privet	Exotic									1			
Liquidambar styraciflua	Sweet Gum	Tree			1			1			3			1
Liriodendron tulipifera	Tulip Poplar	Tree	3	3	3							1	1	1
Nyssa sylvatica	Black Gum	Tree												
Platanus occidentalis	Sycamore	Tree	2	2	2	2	2	2	2	2	2	2	2	3
Pyrus calleryana	Bradford Pear	Exotic						1						
Quercus palustris	Pin Oak	Tree				1	1	1				2	2	2
Quercus phellos	Willow Oak	Tree	3	3	3	3	3	3	4	4	4	2	2	2
Quercus rubra	Northern Red Oak	Tree			1									
Salix nigra	Black Willow	Tree												
Ulmus	Elm	Tree												
Ulmus rubra	Slippery Elm	Tree			1			3						
		Stem count	11	11	13	11	11	14	11	11	12	11	11	13
		size (ares)	1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02		
		Species count	5	5	8	5	5	8	4	4	6	6	6	8
		Stems per ACRE	445	445	526	445	445	567	445	445	486	445	445	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%
Volunteers

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9. Planted and Total Stem Counts

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

			Current Plot Data (MY3 2020)											
			VP5			VP6			VP7			VP8		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	River Birch	Tree	2	2	3	1	1	1	1	1	3	1	1	4
Carya	Hickory	Tree												
Cephalanthus occidentalis	Buttonbush	Shrub Tree												
Cercis canadensis	Eastern Redbud	Shrub Tree												
Cornus florida	Flowering Dogwood	Shrub Tree									4			
Fraxinus pennsylvanica	Green Ash	Tree	1	1	1	1	1	1	1	1	8	2	2	62
Ligustrum sinense	Chinese Privet	Exotic												
Liquidambar styraciflua	Sweet Gum	Tree												3
Liriodendron tulipifera	Tulip Poplar	Tree												
Nyssa sylvatica	Black Gum	Tree						24						
Platanus occidentalis	Sycamore	Tree	4	4	4	4	4	4	4	4	6	2	2	6
Pyrus calleryana	Bradford Pear	Exotic			1									
Quercus palustris	Pin Oak	Tree												
Quercus phellos	Willow Oak	Tree	1	1	1				1	1	1	1	1	1
Quercus rubra	Northern Red Oak	Tree												
Salix nigra	Black Willow	Tree			2									
Ulmus	Elm	Tree												
Ulmus rubra	Slippery Elm	Tree												2
		Stem count	8	8	11	6	6	30	7	7	22	6	6	75
		size (ares)	1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02		
		Species count	4	4	6	3	3	4	4	4	5	4	4	6
		Stems per ACRE	324	324	445	243	243	1,214	283	283	890	243	243	3,035

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%
Volunteers

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9. Planted and Total Stem Counts

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

			Annual Means											
			MY3 (2020)			MY2 (2019)			MY1 (2018)			MY0 (2018)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	River Birch	Tree	12	12	18	14	14	14	16	16	16	17	17	17
Carya	Hickory	Tree			1									
Cephalanthus occidentalis	Buttonbush	Shrub Tree						12			8			
Cercis canadensis	Eastern Redbud	Shrub Tree							1	1	1	3	3	3
Cornus florida	Flowering Dogwood	Shrub Tree			4				2	2	2	2	2	2
Fraxinus pennsylvanica	Green Ash	Tree	15	15	83	15	15	45	17	17	29	18	18	18
Ligustrum sinense	Chinese Privet	Exotic			1									
Liquidambar styraciflua	Sweet Gum	Tree			9			9			2			
Liriodendron tulipifera	Tulip Poplar	Tree	4	4	4	5	5	7	7	7	7	19	19	19
Nyssa sylvatica	Black Gum	Tree			24									
Platanus occidentalis	Sycamore	Tree	22	22	29	22	22	27	24	24	25	25	25	25
Pyrus calleryana	Bradford Pear	Exotic			2			3						
Quercus palustris	Pin Oak	Tree	3	3	3	12	12	12	16	16	16	20	20	20
Quercus phellos	Willow Oak	Tree	15	15	15	12	12	12	14	14	14	14	14	14
Quercus rubra	Northern Red Oak	Tree			1									
Salix nigra	Black Willow	Tree			2									
Ulmus	Elm	Tree						2			1			
Ulmus rubra	Slippery Elm	Tree			6									
		Stem count	71	71	190	80	80	140	97	97	121	118	118	118
		size (ares)		8			8			8			8	
		size (ACRES)		0.20			0.20			0.20			0.20	
		Species count	6	6	15	6	6	10	8	8	11	8	8	8
		Stems per ACRE	359	359	961	405	405	708	491	491	612	597	597	597

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%
Volunteers

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total Stems

Table 9a. Supplemental Planting Tree Species

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Scientific Name	Common Name	Number	Type
Betula nigra	River birch	100	Container Plants (50), Tublings (50)
Platanus occidentalis	Sycamore	100	Container Plants (50) , Tublings (50)
Prunus serotina	Black cherry	35	Container Plants
Quercus lyrata	Overcup oak	15	Container Plants
Quercus phellos	Willow oak	75	Container Plants (25), Tublings (50)
Quercus rubra	Northern red oak	45	Container Plants (20), Tublings (25)
Quercus shumardii	Shumard's oak	30	Container Plants (20), Tublings (10)
Ulmus americana	American elm	25	Container Plants
Quercus alba	White oak	10	Tublings
Alnus serrulata	Tag alder	15	Tublings
Asimina triloba	Pawpaw	15	Tublings
Cornus amommum	Silky dogwood	15	Tublings
Oxydendrum arboreum	Sourwood	10	Tublings

*A total area of 6.61 acres were supplemeted with trees. Areas are shown in Figure 3.

APPENDIX 4. Morphological Summary Data and Plots

Table 10a. Baseline Stream Data Summary
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Martin Dairy

		PRE-RESTORATION CONDITION				REFERENCE REACH DATA						DESIGN				AS-BUILT/BASELINE			
Parameter	Gage	Martin Dairy Reach 1		Martin Dairy Reach 2		Long Branch		Spencer Creek 2		Foust Creek		Martin Dairy Reach 1		Martin Dairy Reach 2		Martin Dairy Reach 1		Martin Dairy Reach 2	
						Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																			
Bankfull Width (ft)	N/A	8.6		14.0		14.8	18.6	10.7	11.2	18.5	19.4	15.0		16.2		14.8		12.8	
Floodprone Width (ft)		121		200		50		60	114	49	63	33	75	36	81	150		200	
Bankfull Mean Depth		1.2		1.2		1.3	2.1	1.6	1.8	1.3	1.4	1.1		1.2		0.9		1.1	
Bankfull Max Depth		2.1		2.4		1.9	2.9	2.1	2.6	1.8	2.1	1.3	1.7	1.4	1.8	1.4		1.8	
Bankfull Cross-Sectional Area (ft^2)		10.0		16.1		25.0	34.6	17.8	19.7	23.9	24.1	16.8		20.0		13.2		14.2	
Width/Depth Ratio		7.3		12.2		7.9	13.8	5.8	7.1	13.9	14.2	13.4		13.2		16.7		11.6	
Entrenchment Ratio		14.2		14.3		3		5.5	10.2	2.6	3.4	2.2-5		2.2-5		10.1		15.6	
Bank Height Ratio		1.5		1.4		1.2-1.5		1.0		1.0		1.0		1.0		1.0		1.0	
D50 (mm)		2.6		11.0		---		---		---		10.6		10.6		13.1		10.2	
Profile																			
Riffle Length (ft)	N/A	---		---		---		---		---		---		---		12.0	35.9	16.7	51.0
Riffle Slope (ft/ft)		---		---		0.0130	0.0120	0.0130		0.0150	0.0350	0.0060	0.0180	0.0060	0.0190	0.0039	0.0193	0.0166	0.0266
Pool Length (ft)		---		---		---		---		---		---		---		38.2	77.4	36.1	83.1
Pool Max Depth (ft)		---		---		2.2		3.3		2.5	2.9	1.3	3.3	1.4	3.6	1.4	2.5	1.1	1.9
Pool Spacing (ft)		16	91	22	108	50	105	71		49	91	60	105	65	113	41	101	55	111
Pool Volume (ft^3)																			
Pattern																			
Channel Beltwidth (ft)	N/A	15	20	17	28	60		38	41	N/A		36	75	39	81	36	75	39	81
Radius of Curvature (ft)		11	32	7	46	16	87	11	15	N/A		27	75	29	81	27	75	29	81
Rc:Bankfull Width (ft/ft)		1.3	3.7	0.5	3.3	1.1	4.7	1.3	1.4	N/A		1.8	5.0	1.8	5.0	1.8	5.0	1.8	5.0
Meander Length (ft)		46	74	46	114	66.0	191	46.0	48.0	N/A		60	225	65	243	60	225	65	243
Meander Width Ratio		1.7	2.3	1.2	2.0	3.2	4.1	3.4	3.6	N/A		2.4	5.0	2.4	5.0	2.4	5.0	2.4	5.0
Substrate, Bed and Transport Parameters																			
Ri%/Ru%/P%/G%/S%	N/A																		
SC%/Sa%/G%/C%/B%/Be%																			
d16/d35/d50/d84/d95/d100		0.13/1.3/2.6/4.6/77/77/-/-		2.4/8.1/11/15/33/54/-/-		---		---		<0.063/3/8.8/42/90/-		---		---		SC/0.45/2.8/21.8/45.0/128.0		0.11/1.10/5.0/27.6/	
Reach Shear Stress (Competency) lb/ft^2		0.33		0.41								0.25		0.38		0.23		0.49	
Max part size (mm) mobilized at bankfull																			
Stream Power (Capacity) W/m^2																			
Additional Reach Parameters																			
Drainage Area (SM)	N/A	0.54		0.82		1.49		0.96		1.38		0.54		0.82		0.54		0.82	
Watershed Impervious Cover Estimate (%)		0.4%		0.4%								0.4%		0.4%		0.4%		0.4%	
Rosgen Classification		C4/E4		C4/E4		C4/E4		E4		C4		C4/E4		C4/E4		C4/E4		C4/E4	
Bankfull Velocity (fps)		5.0		3.8		3.6 - 4.0		4.9 - 5.4		2.9 - 3.7		2.8		3.2		2.2		3.3	
Bankfull Discharge (cfs)		---		---		101-124		97.0		88.0		47.0		63.0		41.0		56.0	
Q-NFF regression																			
Q-USGS extrapolation																			
Q-Mannings																			
Valley Length (ft)		---		---		---		---		---		607		1,043		607		1,043	
Channel Thalweg Length (ft)		---		---		---		---		---		---		---		776		1,258	
Sinuosity		1.05		1.09		1.30		2.30		1.10		1.25		1.28		1.27		1.22	
Water Surface Slope ($ft/ft)^2$		---		---		---		---		---		---		---		0.0046		0.0072	
Bankfull Slope (ft/ft)		0.009		0.007		0.004		0.005		0.009		---		---		0.005		0.007	

(---): Data was not provided

Table 10b. Baseline Stream Data Summary
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

UT1

		PRE-RESTORATION		REFERENCE REACH DATA						DESIGN		AS-BUILT/BASELINE	
Parameter	**Gage**	**UT1**		**Agony Acres UT1-Reach 3**		**UT to Polecat Creek**		**UT to Varnals Creek**		**UT1**		**UT1**	
				Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle													
Bankfull Width (ft)	N/A	5.7		9.1	10.4	5.3	10.9	9.3	10.5	9.4		9.2	
Floodprone Width (ft)		12.7		36		25	65	20	64	21	47	65	
Bankfull Mean Depth		1.0		1.0	1.2	1.0	1.1	1.1	1.2	0.7		0.7	
Bankfull Max Depth		1.4		1.8		1.4	1.7	1.5	1.7	0.8	1.3	1.4	
Bankfull Cross-Sectional Area (ft^2)		5.7		10.7	11.3	5.4	12.4	10.3	12.3	6.7		6.3	
Width/Depth Ratio		5.7		7.3	10.1	5.2	9.6	8.1	9.3	13.2		13.3	
Entrenchment Ratio		2.2		3.9		3.2	8.3	1.9	6.1	2.2	5.0	7.1	
Bank Height Ratio		2.1		1.0		1.0	1.1	0.9	1.0	1.0	1.0	1.0	
D50 (mm)		5.1		---		---		---		---		7.4	
Profile													
Riffle Length (ft)	N/A	---		---		---		---		---		4	28
Riffle Slope (ft/ft)		---		---		0.004	0.047	0.024	0.057	0.006	0.024	0.009	0.016
Pool Length (ft)		---		---		---		---		---		4.2	34.9
Pool Max Depth (ft)		2.0		2.5		1.8		2.5	2.6	0.8	2.2	0.4	1.3
Pool Spacing (ft)		---		---		34	52	8	82	38	56	30	73
Pool Volume (ft^3)													
Pattern													
Channel Beltwidth (ft)	N/A	9	19	21	93	28	50	15	45	23	66	23	66
Radius of Curvature (ft)		4	13	14	60	19	50	8	47	17	52	17	52
Rc:Bankfull Width (ft/ft)		0.7	2.3	14.0	60.0	2.0	5.3	0.6	3.2	1.8	5.5	1.8	5.5
Meander Length (ft)		35	47	121	171	--	--	--	--	56	155	56	155
Meander Width Ratio		1.6	3.3	2.3	8.9	3.0	5.3	1.0	3.0	2.4	7.0	2.4	7.0
Substrate, Bed and Transport Parameters													
Ri%/Ru%/P%/G%/S%	N/A												
SC%/Sa%/G%/C%/B%/Be%													
d16/d35/d50/d84/d95/d100		0.048/3/5.1/6.7/8.9/13/-/-		---		---		---		---		0.07/0.28/7.3/20.1/37.9/64.0	
Reach Shear Stress (Competency) lb/ft^2		0.6		---		---		---		0.2		0.3	
Max part size (mm) mobilized at bankfull													
Stream Power (Capacity) W/m^2													
Additional Reach Parameters													
Drainage Area (SM)	N/A	0.22		0.30		0.41		0.41		0.22		0.22	
Watershed Impervious Cover Estimate (%)		0.4%		---		---		---		0.4%		0.4%	
Rosgen Classification		C4/E4		E4		E4		E4		C4/E4		C4/E4	
Bankfull Velocity (fps)		4.7		2.2	2.4	2.2	3.5	4.4	5.2	3.6		2.5	
Bankfull Discharge (cfs)		---		25.0		20.3		54.0		24.0		21.0	
Q-NFF regression													
Q-USGS extrapolation													
Q-Mannings													
Valley Length (ft)		---		---		---		---		186		186	
Channel Thalweg Length (ft)		---		---		---		---		213		213	
Sinuosity		1.1		1.4		1.4		1.2		1.1		1.1	
Water Surface Slope $(ft/ft)^2$		---		---		---		---		---		0.0072	
Bankfull Slope (ft/ft)		0.0160		0.0039	0.0280	0.0120		0.0170		---		0.0103	

(---): Data was not provided

Table 11. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 3 - 2020

	Martin Dairy Reach 1											
	Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	505.8	505.9	506.1	506.0			505.7	505.9	505.8	505.9		
Low Bank Elevation (ft)	505.8	506.1	506.1	506.0			505.7	505.8	505.8	505.9		
Bankfull Width (ft)	14.8	15.0	14.5	14.9			20.0	22.5	19.5	19.1		
Floodprone Width (ft)	150	150	150	150			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	0.9	0.9	1.0	0.9			1.5	1.3	1.5	1.5		
Bankfull Max Depth (ft)	1.4	1.6	1.7	1.6			3.0	2.7	3.0	2.9		
Bankfull Cross-Sectional Area (ft^2)	13.2	13.2	13.8	14.0			29.4	29.4	28.6	28.1		
Bankfull Width/Depth Ratio	16.7	16.9	15.2	15.8			13.6	17.2	13.3	13.1		
Entrenchment Ratio[1]	10.1	10.0	10.4	10.1			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio[2]	1.0	1.1	1.0	1.0			N/A	N/A	N/A	N/A		
	Martin Dairy Reach 2											
	Cross-Section 3 (Pool)						Cross-Section 4 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	501.8	501.8	501.8	501.9			501.5	501.4	501.5	501.4		
Low Bank Elevation (ft)	501.8	501.8	501.8	501.9			501.5	501.4	501.5	501.4		
Bankfull Width (ft)	20.8	21.3	21.0	22.5			12.8	12.4	13.0	12.7		
Floodprone Width (ft)	N/A	N/A	N/A	N/A			200	200	200	200		
Bankfull Mean Depth (ft)	1.7	1.6	1.9	2.0			1.1	1.1	1.2	1.3		
Bankfull Max Depth (ft)	3.5	3.5	3.8	4.0			1.8	1.9	2.1	2.1		
Bankfull Cross-Sectional Area (ft^2)	34.9	34.9	39.2	44.9			14.2	14.2	15.7	15.9		
Bankfull Width/Depth Ratio	12.4	13.1	11.2	11.3			11.6	10.9	10.8	10.1		
Entrenchment Ratio[1]	N/A	N/A	N/A	N/A			15.6	16.1	15.3	15.8		
Bankfull Bank Height Ratio[2]	N/A	N/A	N/A	N/A			1.0	1.0	1.1	1.1		
	UT1											
	Cross-Section 5 (Riffle)						Cross-Section 6 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	504.0	503.9	503.9	503.9			504.1	504.1	504.1	504.0		
Low Bank Elevation (ft)	504.0	504.0	503.9	503.9			504.1	504.1	504.1	504.0		
Bankfull Width (ft)	9.2	9.5	9.7	10.1			11.5	11.9	12.3	11.3		
Floodprone Width (ft)	65	65	65	65			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	0.7	0.7	0.6	0.6			1.0	1.0	1.0	1.0		
Bankfull Max Depth (ft)	1.4	1.4	1.4	1.3			2.0	2.2	2.2	2.1		
Bankfull Cross-Sectional Area (ft^2)	6.3	6.3	5.8	5.6			11.8	11.8	12.5	11.0		
Bankfull Width/Depth Ratio	13.3	14.3	16.1	18.4			11.3	12.1	12.1	11.7		
Entrenchment Ratio[1]	7.1	6.8	6.7	6.4			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio[2]	1.0	1.1	<1.0	1.0			N/A	N/A	N/A	N/A		

[1]Entrenchment Ratio is calculated using the method specified in the Industry Technical Workgroup Memorandum

[2]Bank Height Ratio is calculated using the method specified in the Industry Technical Workgroup Memorandum

Table 12a. Monitoring Data - Stream Reach Data Summary

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 3 - 2020

Martin Dairy Reach 1

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)	14.8		15.0		14.5		14.9					
Floodprone Width (ft)	150		150		150		150					
Bankfull Mean Depth	0.9		0.9		1.0		0.9					
Bankfull Max Depth	1.4		1.6		1.7		1.6					
Bankfull Cross-Sectional Area (ft^2)	13.2		13.2		13.8		14.0					
Width/Depth Ratio	16.7		16.9		15.2		15.8					
Entrenchment Ratio	10.1		10.0		10.4		10.1					
Bank Height Ratio	1.0		1.1		1.0		1.0					
D50 (mm)	13.1		20.6		32.0		42.5					
Profile												
Riffle Length (ft)	12.0	35.9										
Riffle Slope (ft/ft)	0.0039	0.0193										
Pool Length (ft)	38.2	77.4										
Pool Max Depth (ft)	1.4	2.5										
Pool Spacing (ft)	41	101										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	36	75										
Radius of Curvature (ft)	27	75										
Rc:Bankfull Width (ft/ft)	1.8	5.0										
Meander Wave Length (ft)	60	225										
Meander Width Ratio	2.4	5.0										
Additional Reach Parameters												
Rosgen Classification	C4/E4											
Channel Thalweg Length (ft)	776											
Sinuosity (ft)	1.27											
Water Surface Slope (ft/ft)	0.0046											
Bankfull Slope (ft/ft)	0.005											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/0.45/2.8/21.8/ 45.0/128.0		SC/0.18/14.6/45.0 68.5/128.0		SC/1.0/6.8/37.9/69.7/ 180		0.30/2.57/17.1/78.1 165.3/512.0					
% of Reach with Eroding Banks	0%		0%		0%		0%					

Table 12b. Monitoring Data - Stream Reach Data Summary

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 3 - 2020

Martin Dairy 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)	12.8		12.4		13.0		12.7					
Floodprone Width (ft)	200		200		200		200					
Bankfull Mean Depth	1.1		1.1		1.2		1.3					
Bankfull Max Depth	1.8		1.9		2.1		2.1					
Bankfull Cross-Sectional Area (ft^2)	14.2		14.2		15.7		15.9					
Width/Depth Ratio	11.6		10.9		10.8		10.1					
Entrenchment Ratio	15.6		16.1		15.3		15.8					
Bank Height Ratio	1.0		1.0		1.1		1.1					
D50 (mm)	10.2		38.7		40.8		45.9					
Profile												
Riffle Length (ft)	16.7	51.0										
Riffle Slope (ft/ft)	0.0166	0.0266										
Pool Length (ft)	36.1	83.1										
Pool Max Depth (ft)	1.1	1.9										
Pool Spacing (ft)	55	111										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	39	81										
Radius of Curvature (ft)	29	81										
Rc:Bankfull Width (ft/ft)	1.8	5.0										
Meander Wave Length (ft)	65	243										
Meander Width Ratio	2.4	5.0										
Additional Reach Parameters												
Rosgen Classification	C4/E4											
Channel Thalweg Length (ft)	1,258											
Sinuosity (ft)	1.22											
Water Surface Slope (ft/ft)	0.0072											
Bankfull Slope (ft/ft)	0.007											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.11/1.10/5.0/27.6/ 64.0/512.0		0.55/13.27/24.7/68.5/ 104.7/180.0		0.16/4.58/10.5/84.1/ 160.7/512.0		SC/3.55/19.7/85.7 180.0/362.0					
% of Reach with Eroding Banks	0%		0%		0%		0%					

Table 12c. Monitoring Data - Stream Reach Data Summary

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 3 - 2020

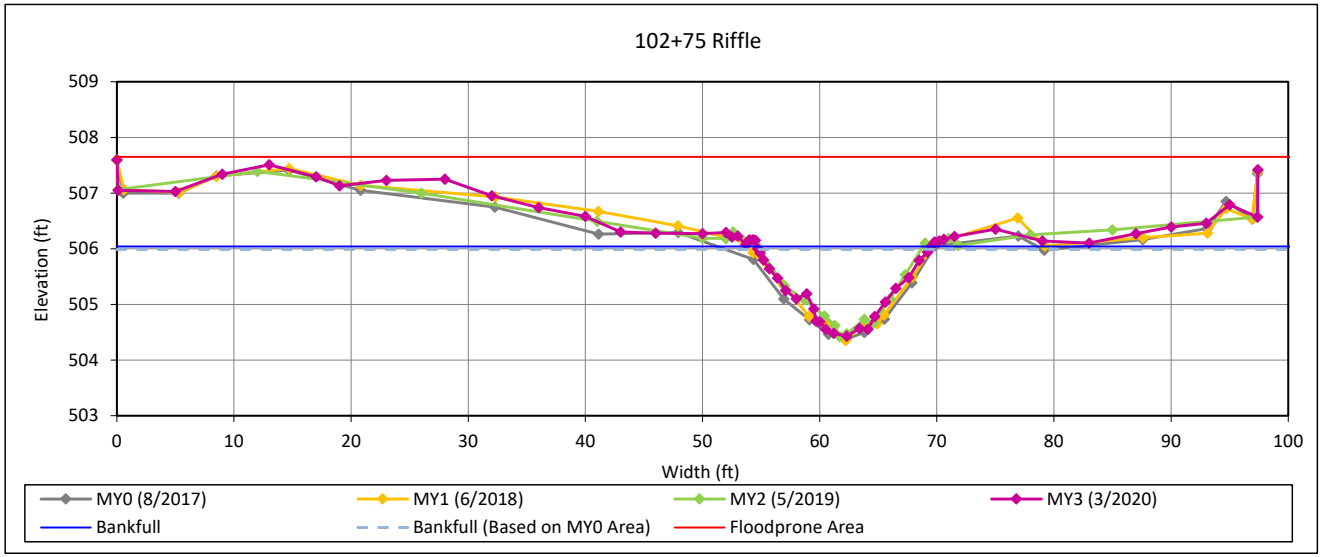
UT1

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)	9.2		9.5		9.7		10.1					
Floodprone Width (ft)	65		65		65		65					
Bankfull Mean Depth	0.7		0.7		0.6		0.6					
Bankfull Max Depth	1.4		1.4		1.4		1.3					
Bankfull Cross-Sectional Area (ft^2)	6.3		6.3		5.8		5.6					
Width/Depth Ratio	13.3		14.3		16.1		18.4					
Entrenchment Ratio	7.1		6.8		6.7		6.4					
Bank Height Ratio	1.0		1.1		<1.0		1.0					
D50 (mm)	7.4		72.1		14.6		20.3					
Profile												
Riffle Length (ft)	4	28										
Riffle Slope (ft/ft)	0.009	0.016										
Pool Length (ft)	4.2	34.9										
Pool Max Depth (ft)	0.4	1.3										
Pool Spacing (ft)	30	73										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	23	66										
Radius of Curvature (ft)	17	52										
Rc:Bankfull Width (ft/ft)	1.8	5.5										
Meander Wave Length (ft)	56	155										
Meander Width Ratio	2.4	7.0										
Additional Reach Parameters												
Rosgen Classification	C4/E4											
Channel Thalweg Length (ft)	213											
Sinuosity (ft)	1.1											
Water Surface Slope (ft/ft)	0.0072											
Bankfull Slope (ft/ft)	0.0103											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.07/0.28/7.3/20.1/ 37.9/64.0		SC/9.38/21.5/75.9/ 128.0/256.0		SC/0.09/4.3/21.1/50.6/ 90.0		SC/0.79/6.1/33.9 64.0/256.0					
% of Reach with Eroding Banks	0%		0%		0%		0%					

Cross-Section Plots

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Cross-Section 1 Martin Dairy Reach 1



Bankfull Dimensions	
14.0	x-section area (ft.sq.)
14.9	width (ft)
0.9	mean depth (ft)
1.6	max depth (ft)
15.4	wetted perimeter (ft)
0.9	hydraulic radius (ft)
15.8	width-depth ratio
150.0	W flood prone area (ft)
10.1	entrenchment ratio
1.0	low bank height ratio

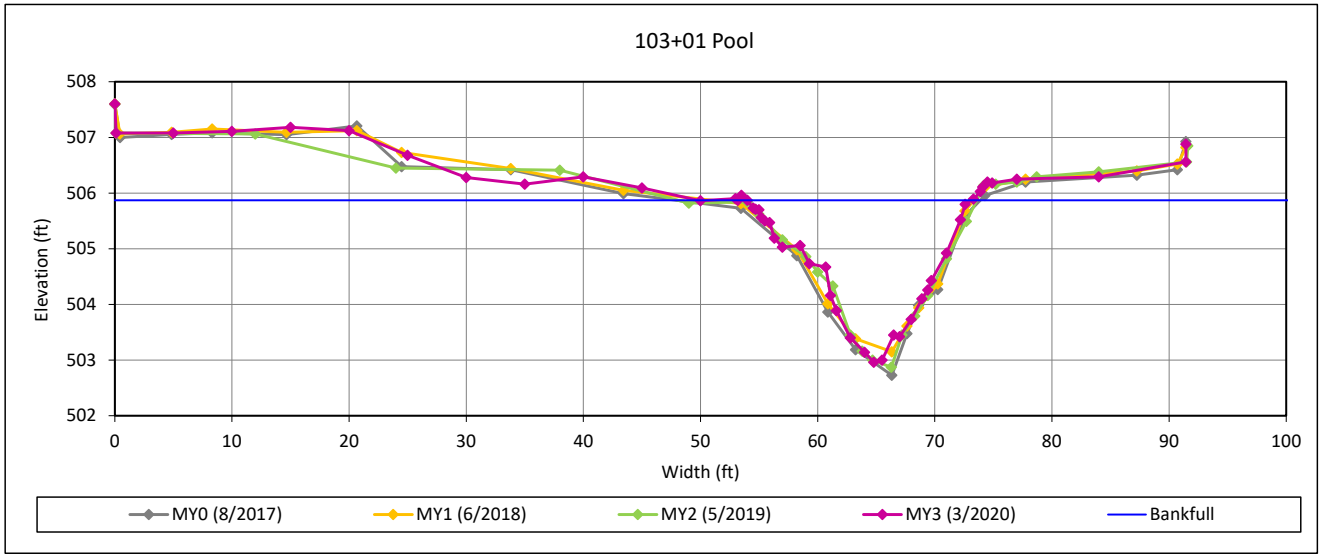
Survey Date: 3/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Cross-Section 2 Martin Dairy Reach 1



Bankfull Dimensions	
28.1	x-section area (ft.sq.)
19.1	width (ft)
1.5	mean depth (ft)
2.9	max depth (ft)
20.5	wetted perimeter (ft)
1.4	hydraulic radius (ft)
13.1	width-depth ratio

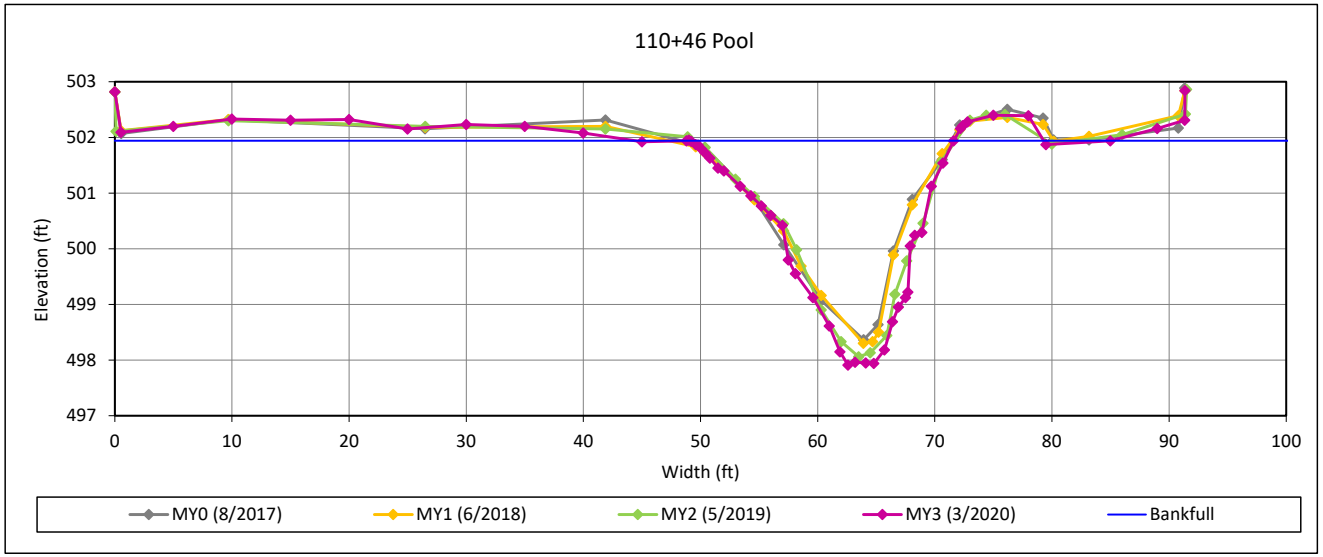
Survey Date: 3/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Cross-Section 3 Martin Dairy Reach 2



Bankfull Dimensions	
44.9	x-section area (ft.sq.)
22.5	width (ft)
2.0	mean depth (ft)
4.0	max depth (ft)
24.8	wetted perimeter (ft)
1.8	hydraulic radius (ft)
11.3	width-depth ratio

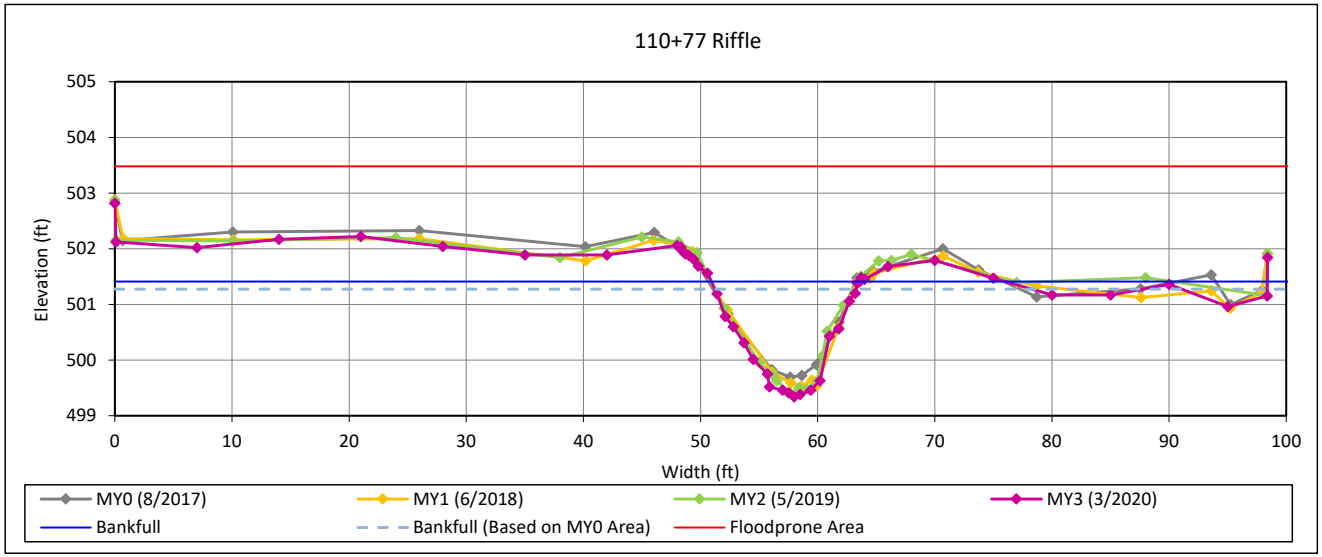
Survey Date: 3/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Cross-Section 4 Martin Dairy Reach 2



Bankfull Dimensions	
15.9	x-section area (ft.sq.)
12.7	width (ft)
1.3	mean depth (ft)
2.1	max depth (ft)
13.7	wetted perimeter (ft)
1.2	hydraulic radius (ft)
10.1	width-depth ratio
200.0	W flood prone area (ft)
15.8	entrenchment ratio
1.1	low bank height ratio

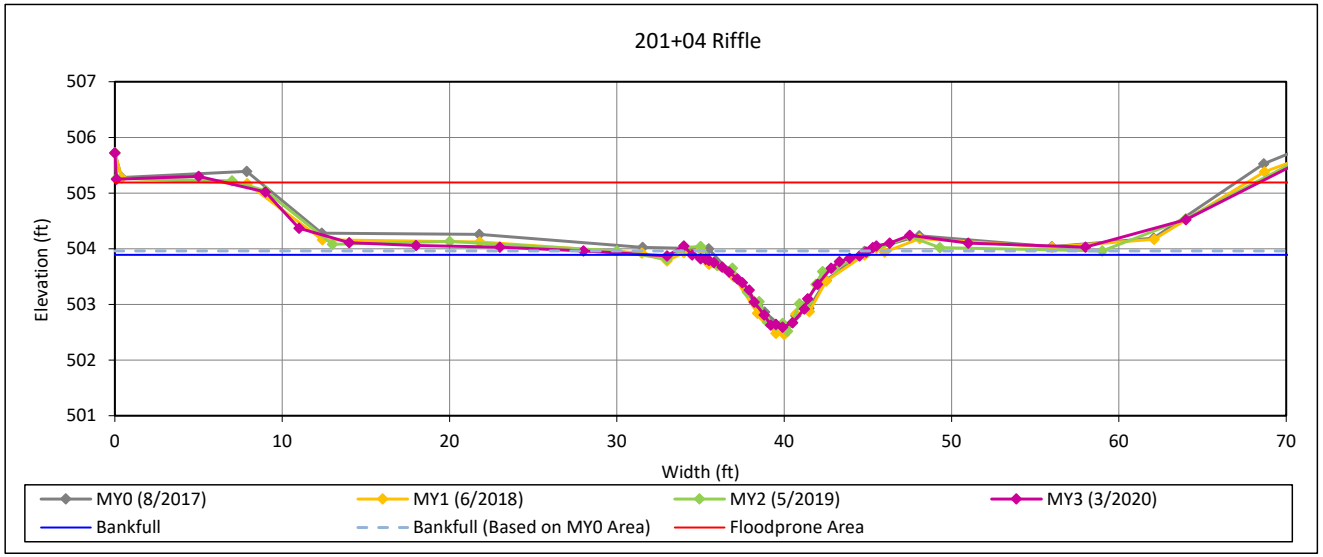
Survey Date: 3/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Cross-Section 5 UT1



Bankfull Dimensions	
5.6	x-section area (ft.sq.)
10.1	width (ft)
0.6	mean depth (ft)
1.3	max depth (ft)
10.6	wetted perimeter (ft)
0.5	hydraulic radius (ft)
18.4	width-depth ratio
65.0	W flood prone area (ft)
6.4	entrenchment ratio
< 1.0	low bank height ratio

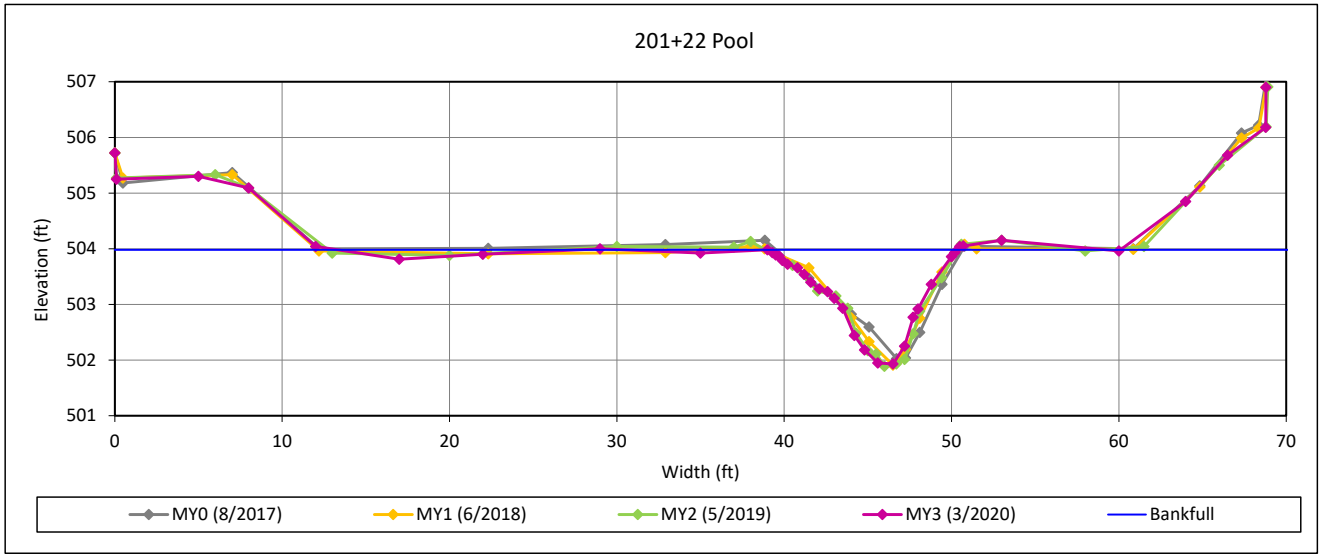
Survey Date: 3/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Cross-Section 6 UT1



Bankfull Dimensions	
11.0	x-section area (ft.sq.)
11.3	width (ft)
1.0	mean depth (ft)
2.1	max depth (ft)
12.3	wetted perimeter (ft)
0.9	hydraulic radius (ft)
11.7	width-depth ratio

Survey Date: 3/2020
Field Crew: Wildlands Engineering

View Downstream

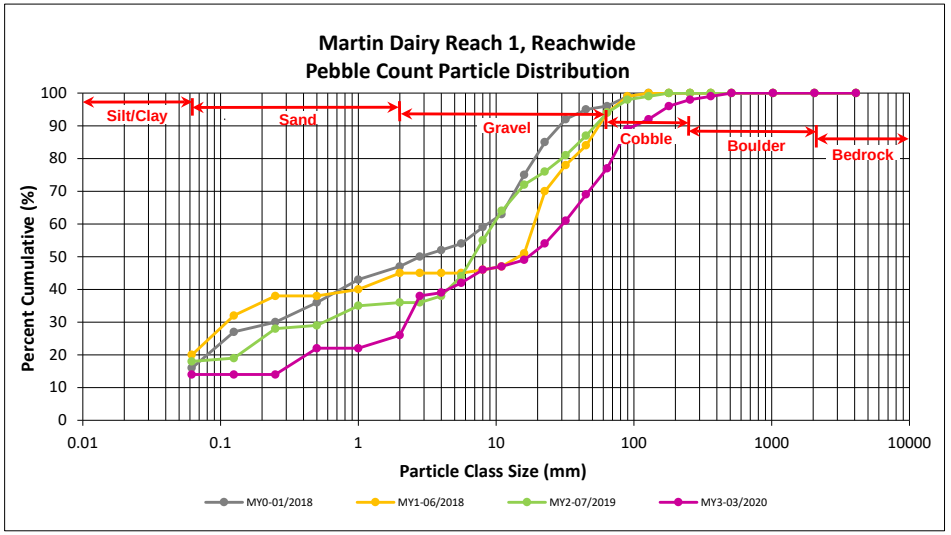
Reachwide and Cross-Section Pebble Count Plots

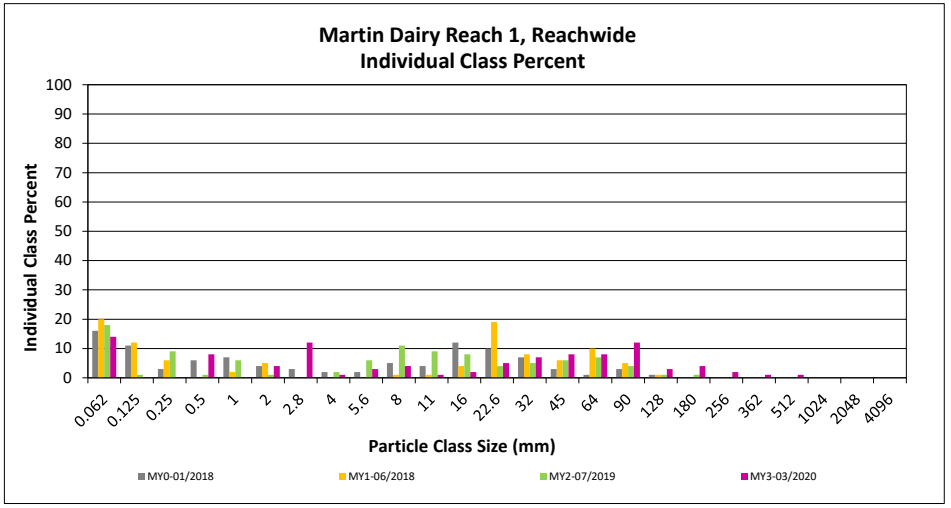
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Martin Dairy 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	2	12	14	14	14
SAND	Very fine	0.062	0.125					14
	Fine	0.125	0.250					14
	Medium	0.25	0.50		8	8	8	22
	Coarse	0.5	1.0					22
	Very Coarse	1.0	2.0		4	4	4	26
GRAVEL	Very Fine	2.0	2.8	1	11	12	12	38
	Very Fine	2.8	4.0		1	1	1	39
	Fine	4.0	5.6	1	2	3	3	42
	Fine	5.6	8.0	1	3	4	4	46
	Medium	8.0	11.0		1	1	1	47
	Medium	11.0	16.0	2		2	2	49
	Coarse	16.0	22.6	3	2	5	5	54
	Coarse	22.6	32	4	3	7	7	61
	Very Coarse	32	45	6	2	8	8	69
	Very Coarse	45	64	8		8	8	77
COBBLE	Small	64	90	11	1	12	12	89
	Small	90	128	3		3	3	92
	Large	128	180	4		4	4	96
	Large	180	256	2		2	2	98
BOULDER	Small	256	362	1		1	1	99
	Small	362	512	1		1	1	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} =	0.30
D_{35} =	2.57
D_{50} =	17.1
D_{84} =	78.1
D_{95} =	165.3
D_{100} =	512.0





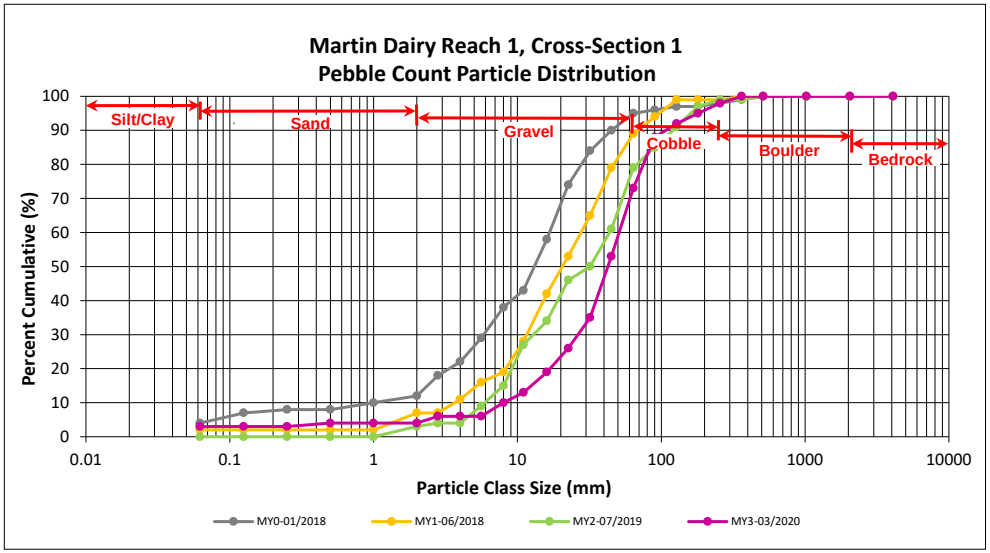
Reachwide and Cross-Section Pebble Count Plots

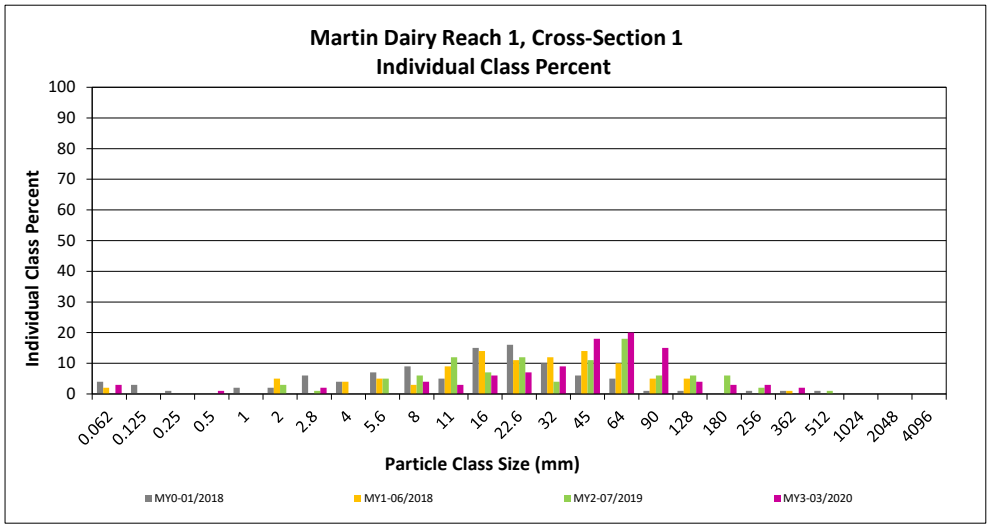
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Martin Dairy Reach 1, Cross-Section 1

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	3	3	3
SAND	Very fine	0.062	0.125			3
	Fine	0.125	0.250			3
	Medium	0.25	0.50	1	1	4
	Coarse	0.5	1.0			4
	Very Coarse	1.0	2.0			4
GRAVEL	Very Fine	2.0	2.8	2	2	6
	Very Fine	2.8	4.0			6
	Fine	4.0	5.6			6
	Fine	5.6	8.0	4	4	10
	Medium	8.0	11.0	3	3	13
	Medium	11.0	16.0	6	6	19
	Coarse	16.0	22.6	7	7	26
	Coarse	22.6	32	9	9	35
	Very Coarse	32	45	18	18	53
	Very Coarse	45	64	20	20	73
COBBLE	Small	64	90	15	15	88
	Small	90	128	4	4	92
	Large	128	180	3	3	95
	Large	180	256	3	3	98
BOULDER	Small	256	362	2	2	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross-Section 1	
Channel materials (mm)	
D_{16} =	13.27
D_{35} =	32.00
D_{50} =	42.5
D_{84} =	82.2
D_{95} =	180.0
D_{100} =	362.0





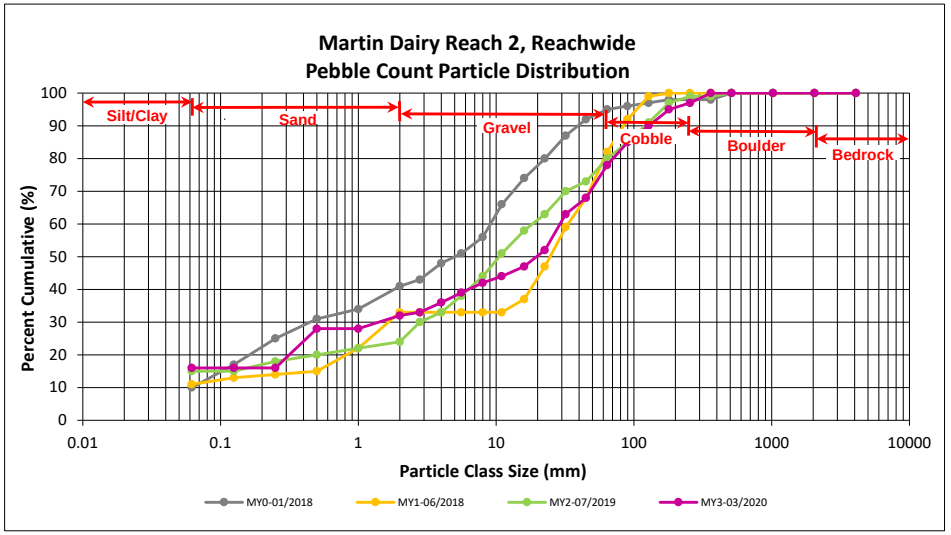
Reachwide and Cross-Section Pebble Count Plots

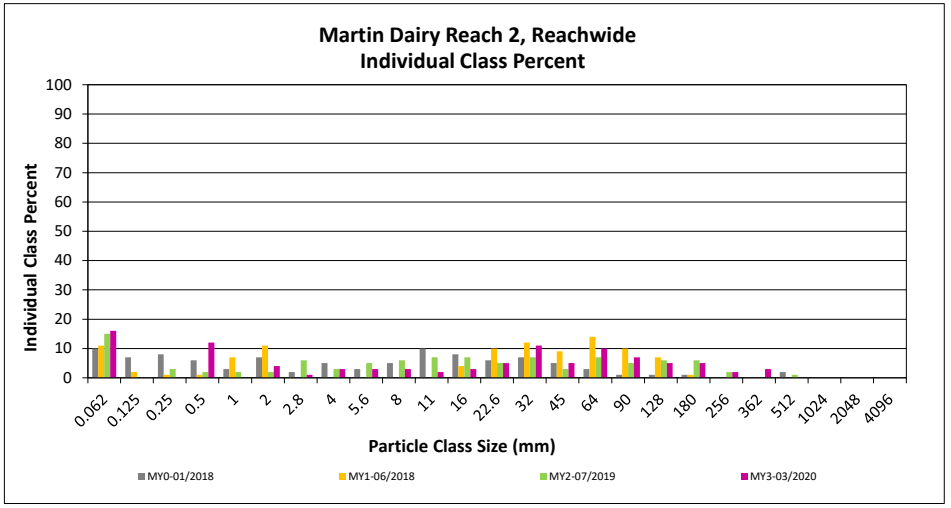
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Martin Dairy 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		16	16	16	16
SAND	Very fine	0.062	0.125					16
	Fine	0.125	0.250					16
	Medium	0.25	0.50		12	12	12	28
	Coarse	0.5	1.0					28
	Very Coarse	1.0	2.0		4	4	4	32
GRAVEL	Very Fine	2.0	2.8		1	1	1	33
	Very Fine	2.8	4.0	1	2	3	3	36
	Fine	4.0	5.6	1	2	3	3	39
	Fine	5.6	8.0	1	2	3	3	42
	Medium	8.0	11.0	1	1	2	2	44
	Medium	11.0	16.0		3	3	3	47
	Coarse	16.0	22.6	3	2	5	5	52
	Coarse	22.6	32	7	4	11	11	63
	Very Coarse	32	45	4	1	5	5	68
	Very Coarse	45	64	10		10	10	78
COBBLE	Small	64	90	7		7	7	85
	Small	90	128	5		5	5	90
	Large	128	180	5		5	5	95
	Large	180	256	2		2	2	97
BOULDER	Small	256	362	3		3	3	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} =	3.55
D_{50} =	19.7
D_{84} =	85.7
D_{95} =	180.0
D_{100} =	362.0





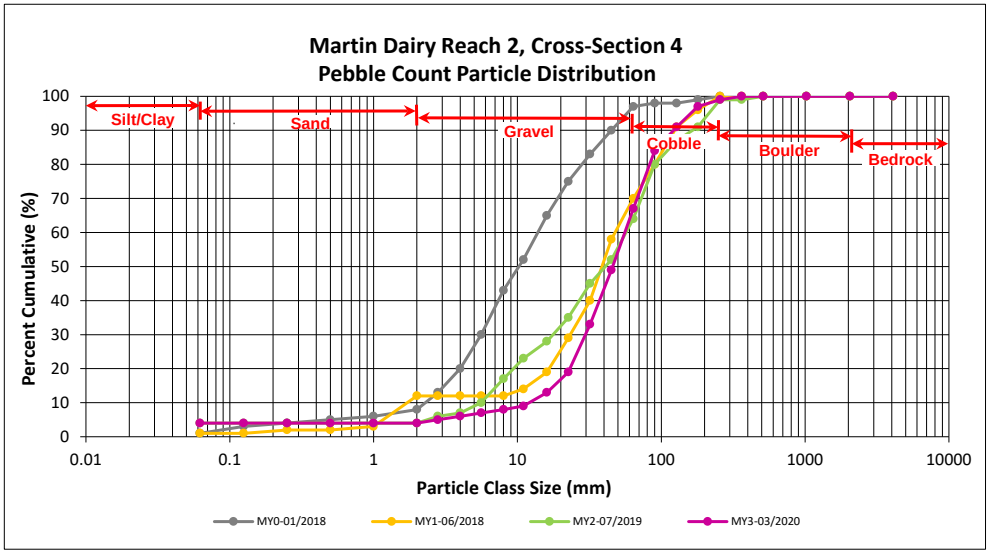
Reachwide and Cross-Section Pebble Count Plots

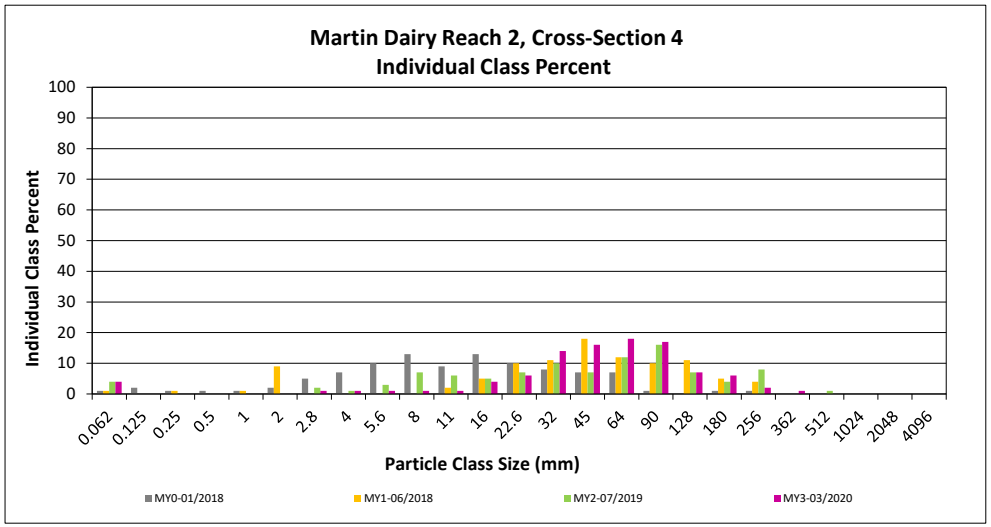
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

Martin Dairy Reach 2, Cross-Section 4

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	4	4
SAND	Very fine	0.062	0.125			4
	Fine	0.125	0.250			4
	Medium	0.25	0.50			4
	Coarse	0.5	1.0			4
	Very Coarse	1.0	2.0			4
GRAVEL	Very Fine	2.0	2.8	1	1	5
	Very Fine	2.8	4.0	1	1	6
	Fine	4.0	5.6	1	1	7
	Fine	5.6	8.0	1	1	8
	Medium	8.0	11.0	1	1	9
	Medium	11.0	16.0	4	4	13
	Coarse	16.0	22.6	6	6	19
	Coarse	22.6	32	14	14	33
	Very Coarse	32	45	16	16	49
	Very Coarse	45	64	18	18	67
COBBLE	Small	64	90	17	17	84
	Small	90	128	7	7	91
	Large	128	180	6	6	97
	Large	180	256	2	2	99
BOULDER	Small	256	362	1	1	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross-Section 4	
Channel materials (mm)	
D_{16} =	19.02
D_{35} =	33.39
D_{50} =	45.9
D_{84} =	90.0
D_{95} =	160.7
D_{100} =	362.0





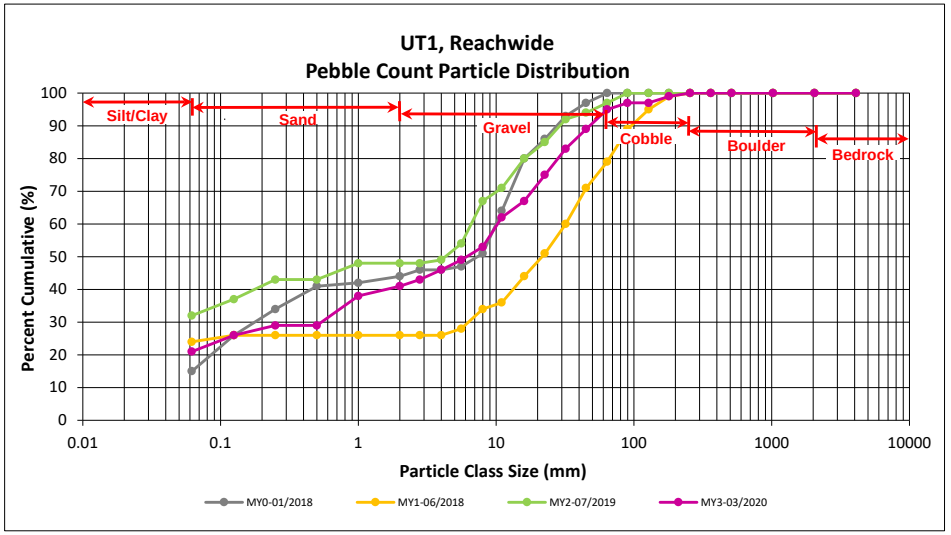
Reachwide and Cross-Section Pebble Count Plots

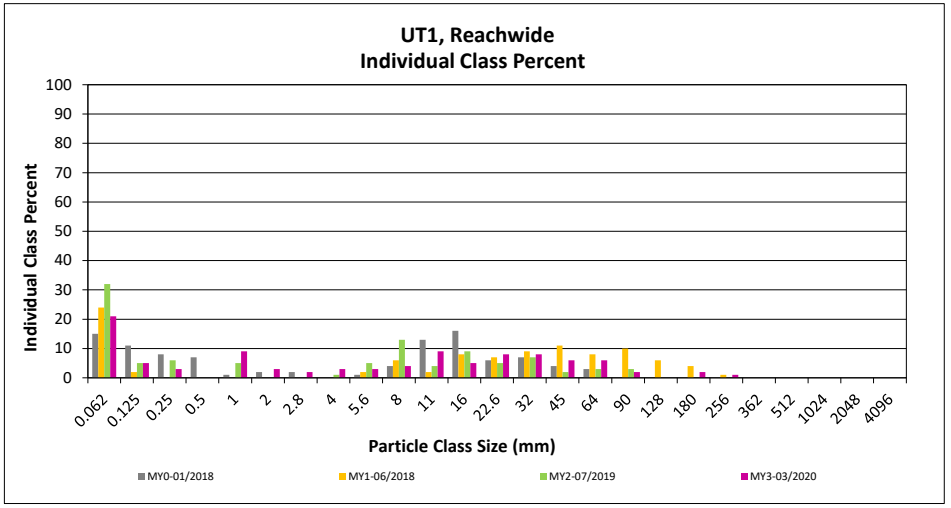
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

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		21	21	21	21
SAND	Very fine	0.062	0.125		5	5	5	26
	Fine	0.125	0.250		3	3	3	29
	Medium	0.25	0.50					29
	Coarse	0.5	1.0		9	9	9	38
	Very Coarse	1.0	2.0		3	3	3	41
GRAVEL	Very Fine	2.0	2.8		2	2	2	43
	Very Fine	2.8	4.0		3	3	3	46
	Fine	4.0	5.6	2	1	3	3	49
	Fine	5.6	8.0	4		4	4	53
	Medium	8.0	11.0	7	2	9	9	62
	Medium	11.0	16.0	4	1	5	5	67
	Coarse	16.0	22.6	8		8	8	75
	Coarse	22.6	32	8		8	8	83
	Very Coarse	32	45	6		6	6	89
	Very Coarse	45	64	6		6	6	95
COBBLE	Small	64	90	2		2	2	97
	Small	90	128					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} =	Silt/Clay
D_{35} =	0.79
D_{50} =	6.1
D_{84} =	33.9
D_{95} =	64.0
D_{100} =	256.0





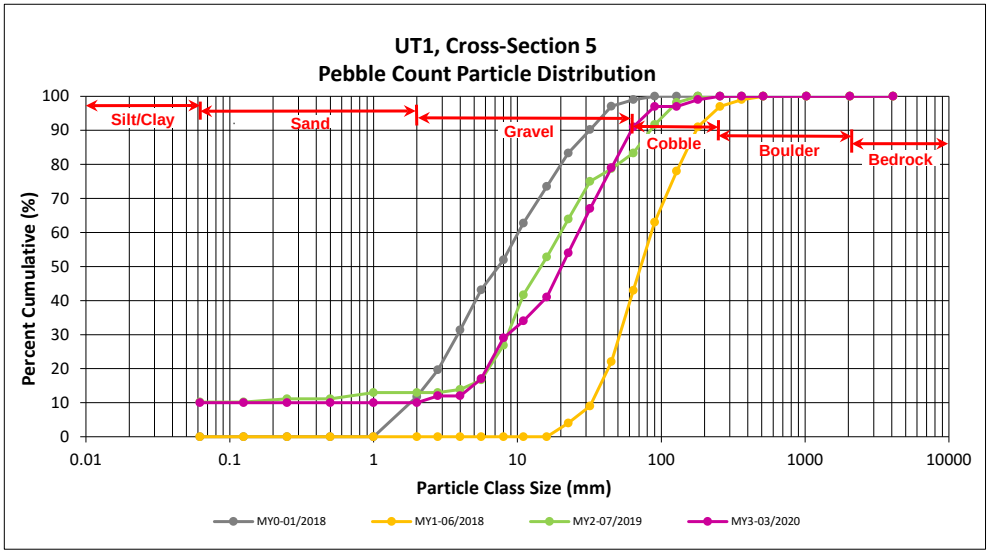
Reachwide and Cross-Section Pebble Count Plots

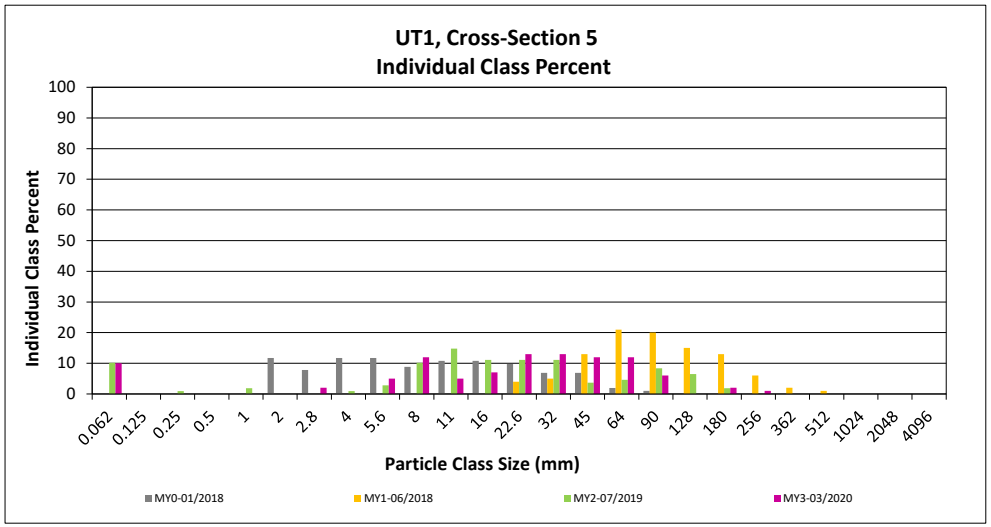
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

UT1, Cross-Section 5

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	10	10	10
SAND	Very fine	0.062	0.125			10
	Fine	0.125	0.250			10
	Medium	0.25	0.50			10
	Coarse	0.5	1.0			10
	Very Coarse	1.0	2.0			10
GRAVEL	Very Fine	2.0	2.8	2	2	12
	Very Fine	2.8	4.0			12
	Fine	4.0	5.6	5	5	17
	Fine	5.6	8.0	12	12	29
	Medium	8.0	11.0	5	5	34
	Medium	11.0	16.0	7	7	41
	Coarse	16.0	22.6	13	13	54
	Coarse	22.6	32	13	13	67
	Very Coarse	32	45	12	12	79
	Very Coarse	45	64	12	12	91
COBBLE	Small	64	90	6	6	97
	Small	90	128			97
	Large	128	180	2	2	99
	Large	180	256	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	**100**	**100**	**100**

Cross-Section 5	
Channel materials (mm)	
D_{16} =	5.24
D_{35} =	11.60
D_{50} =	20.3
D_{84} =	52.1
D_{95} =	80.3
D_{100} =	256.0





APPENDIX 5. Hydrology Summary Data

Table 13. Verification of Bankfull Events

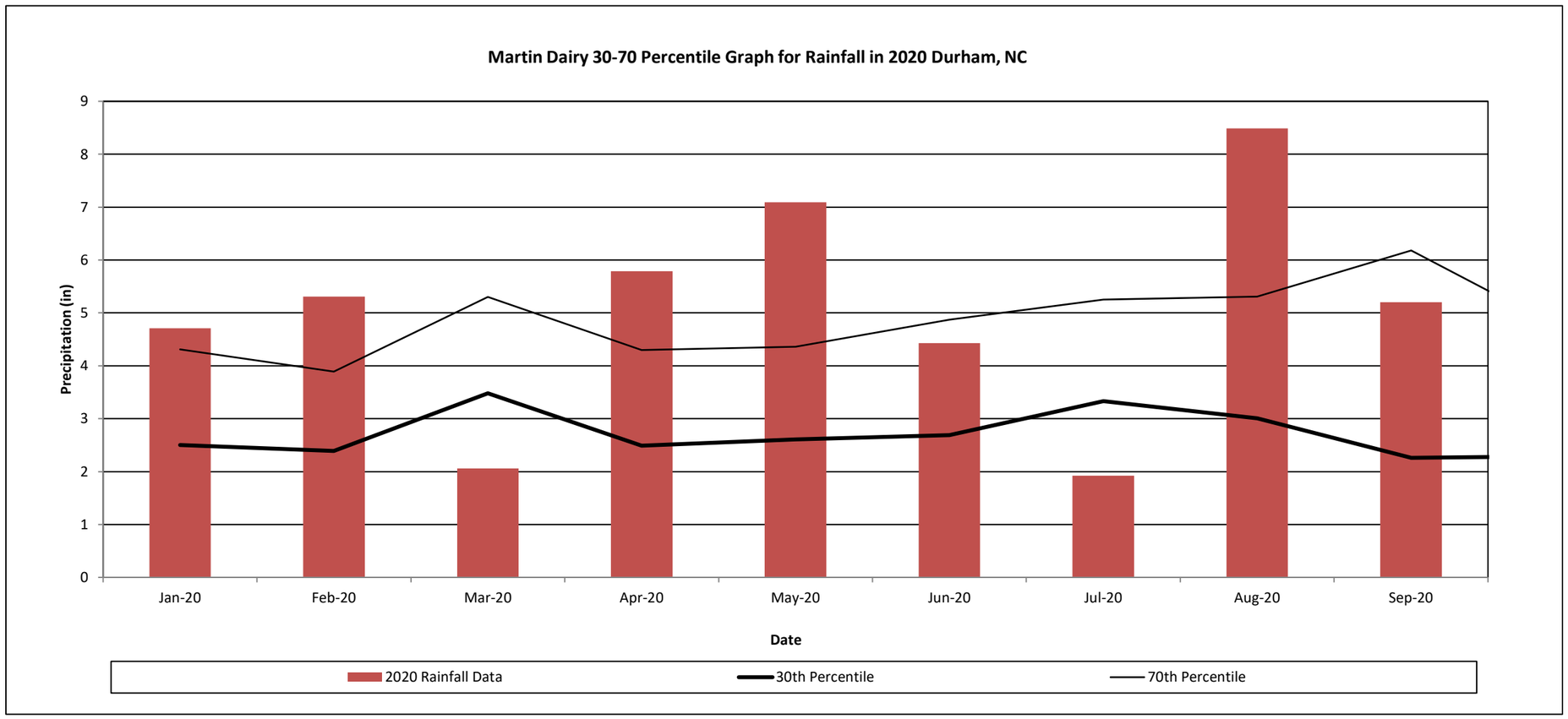
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020

	MY1	MY2	MY3	
Reach	**Date of Occurrence**	**Date of Occurrence**	**Date of Occurrence**	**Method**
Martin Dairy	4/15/2018	4/13/2019	1/24/2020	Crest Gage/ Pressure Transducer
	9/17/2018*	6/19/2019	2/6/2020	
UT1	4/15/2018	3/24/2019	1/24/2020	
	9/17/2018*	4/13/2019	2/6/2020	
		6/19/2019	6/11/2020	

*Hurricane Florence

Monthly Rainfall Data

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 3 - 2020



[1] 2020 monthly rainfall from USDA Station Durham 11 W

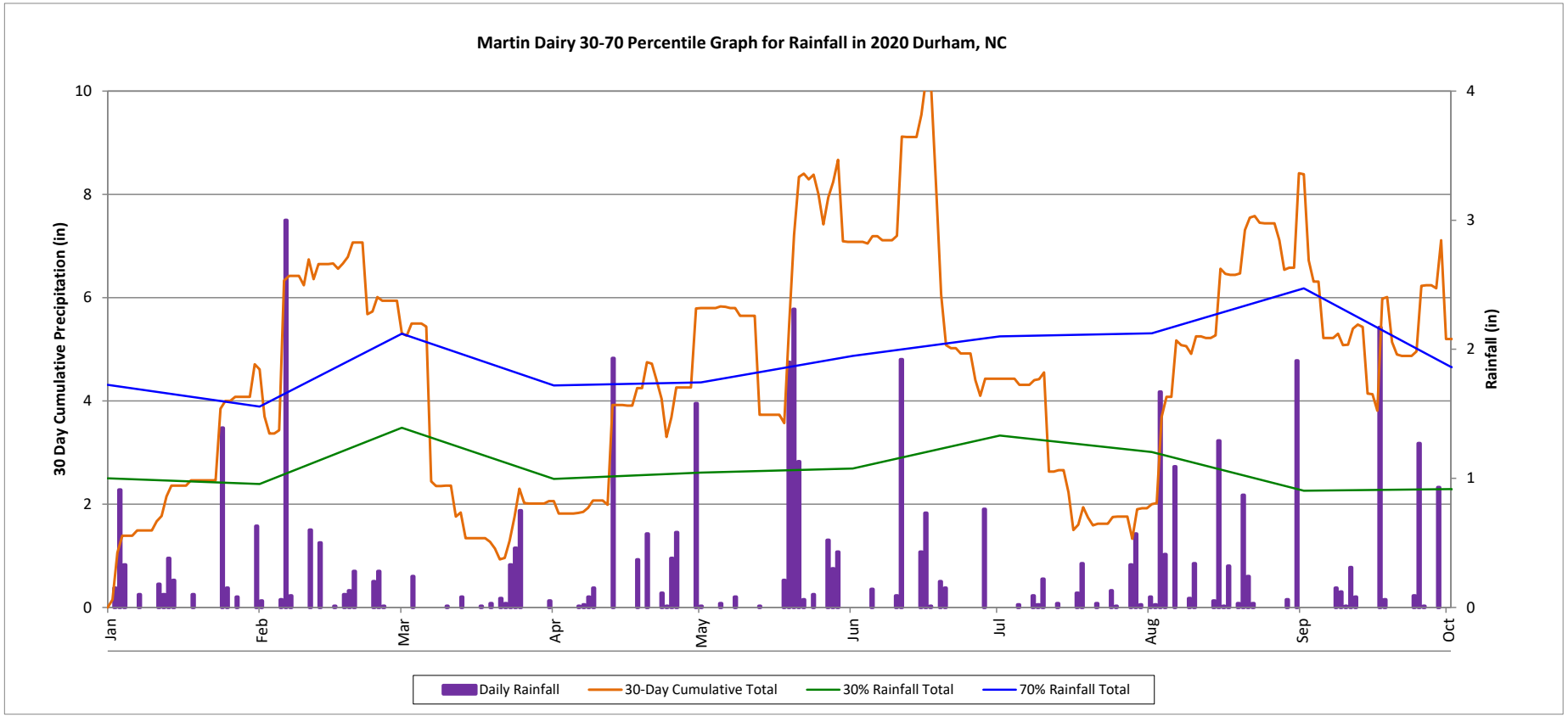
[2] 30th and 70th percentile rainfall data collected from weather station Chapel Hill 2 W, NC (USDA, 2020).

30-Day Cumulative Total Rainfall Data

Martin Dairy Mitigation Project

DMS Project No. 97087

Monitoring Year 3 - 2020



[1] 2020 monthly rainfall from USDA Station Durham 11 W.

[2] 30th and 70th percentile rainfall data collected from weather station Chapel Hill 2 W, NC (USDA, 2020).