



MONITORING YEAR 2 ANNUAL REPORT

Final

MARTIN DAIRY MITIGATION SITE

Orange County, NC

NCDEQ Contract No. 006831

DMS Project Number 97087

USACE Action ID Number 2016-00874

NCDWR Project Number 2016-0366

Data Collection Period: March - October 2019

Draft Submission Date: October 21, 2019

Final Submission Date: December 17, 2019

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
 DMS ID 97087
 River Basin Neuse
 Cataloging Unit 03020201

County Orange
 Date Project Instituted 3/22/2016
 Date Prepared 7/15/2019

USACE Action ID 2016-01702
 NCDWR Permit No 2016-0366

Credit Release Milestone	Stream Credits						Wetland Credits							
	Scheduled Releases (Stream)	Warm	Cool	Cold	Anticipated Release Year (Stream)	Actual Release Date (Stream)	Scheduled Releases (Forested)	Riparian Riverine	Riparian Non-riverine	Non-riparian	Scheduled Releases (Coastal)	Coastal	Anticipated Release Year (Wetland)	Actual Release Date (Wetland)
Potential Credits (Mitigation Plan)		2,135.000												
Potential Credits (As-Built Survey)		2,135.000												
1 (Site Establishment)	N/A				N/A	N/A	N/A				N/A			
2 (Year 0 / As-Built)	30%	640.500			2018	3/12/2018	N/A				N/A			
3 (Year 1 Monitoring)	10%	213.500			2019	4/26/2019	N/A				N/A			
4 (Year 2 Monitoring)	10%				2020		N/A				N/A			
5 (Year 3 Monitoring)	10%				2021		N/A				N/A			
6 (Year 4 Monitoring)	5%				2022		N/A				N/A			
7 (Year 5 Monitoring)	10%				2023		N/A				N/A			
8 (Year 6 Monitoring)	5%				2024		N/A				N/A			
9 (Year 7 Monitoring)	10%				2025		N/A				N/A			
Stream Bankfull Standard	10%						N/A				N/A			
Total Credits Released to Date		854.000												

NOTES:

CONTINGENCIES:


 Signature of Wilmington District Official Approving Credit Release

27 Sept 2019
 Date

- 1 - For NCDMS, no credits are released during the first milestone
- 2 - For NCDMS projects, the second credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the NCIRT by posting it to the NCDMS Portal, provided the following criteria have been met:
 - 1) Approval of the 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



December 17, 2019

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

RE: Monitoring Year 2 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 2 Report for the above referenced project dated December 12, 2019 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.

MY2 Report – Stream Mitigation

1. Section 1, 2nd paragraph: In the 8th sentence the date should be changed from “January 2017” to “January 2018.”

The date had now been changed to January 2018.

2. Section 1.2.2 – Concern regarding stem survival along parts of UT1 was discussed during the site visit on 11/21. We recommend a sentence briefly detailing vegetation observations on UT1, and what action was taken in MY2 or may be considered in the future.

A few sentences have been added discussing the stem survival along UT1.

3. Appendix 3, Table 9 – Vegetation Plot 7 planted stem density should be colored red as it is not on track to meet the interim success criteria for MY3 of 320 planted stems per acre.

Vegetation Plot 7 has now been updated to red in Table 9.

MY2 Report – Riparian Buffer Mitigation

1. See comment 2 above. Please consider adding a brief discussion where appropriate.

A section has been added discussing the stem survival along UT1.



Overall

1. As required by contract, specifically RFP#16-006477, Wildlands must submit an updated Monitoring Phase Performance Bond (MPPB) for Monitoring Year 3 (Task 9) to Jeff Jurek for his approval before DMS approves this deliverable and the associated payment.

A draft Monitoring Phase Performance Bond will be submitted.

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

Sincerely,

A handwritten signature in black ink, appearing to read "JLorch".

Jason Lorch, *Monitoring Coordinator*

PREPARED BY:



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 (HUC) 03020201. The project is located within a DMS targeted watershed for the Neuse River Basin Hydrologic Unit Code (HUC) 03020201030030 and NC Division of Water Resources (DWR) Subbasin 03-04-01. There are two unnamed tributaries on the Site, Martin Dairy Creek and UT1. 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 (TLW) 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, and the Site land use became hay cultivation.

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 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 2 (MY2) assessments and site visits were completed between May and September 2019 to assess the conditions of the project. Overall, the Site has met the required vegetation and stream success criteria for MY2. The overall average stem density for the Site is 405 stems per acre and is therefore on track to meet the MY3 interim requirement of 320 stems per acre. A significant die-off occurred in Vegetation Plot 7 causing the plot to not meet the MY3 interim requirement of 320 stems per acre; however, it is still above the MY7 final success criteria of 210 stems per acre. All restored streams are stable and functioning as designed. Hydrologic monitoring stations with crest gages and pressure transducers were installed on the Site to document bankfull events on the restoration reaches. Bankfull and geomorphically significant events were recorded on each restoration reach during the 2019 annual monitoring period. Since the Site also achieved these events during the 2018 annual monitoring period, the stream hydrology success criteria for bankfull events have been met.



MARTIN DAIRY MITIGATION SITE
Monitoring Year 2 Annual Report

TABLE OF CONTENTS

Section 1: PROJECT OVERVIEW1-1

 1.1 Project Goals and Objectives 1-1

 1.2 Monitoring Year 2 Data Assessment..... 1-2

 1.2.1 Vegetative Assessment 1-2

 1.2.2 Vegetation Areas of Concern 1-3

 1.2.3 Stream Assessment..... 1-3

 1.2.4 Stream Areas of Concern 1-3

 1.2.5 Hydrology Assessment..... 1-3

 1.2.6 Maintenance Plan 1-3

 1.3 Monitoring Year 2 Summary 1-4

Section 2: METHODOLOGY2-1

Section 3: REFERENCES.....3-1

APPENDICES

Appendix 1	General Figures and Tables
Figure 1	Project Vicinity Map
Figure 2	Project Component/Asset Map
Table 1	Project Components and Mitigation Credits
Table 2	Project Activity and Reporting History
Table 3	Project Contact Table
Table 4	Project Information and Attributes
Appendix 2	Visual Assessment Data
Figure 3	Integrated Current Condition Plan View
Table 5a-c	Visual Stream Morphology Stability Assessment Table
Table 6	Vegetation Condition Assessment Table
	Stream Photographs
	Vegetation Photographs
Appendix 3	Vegetation Plot Data
Table 7	Vegetation Plot Criteria Attainment Table
Table 8	CVS Vegetation Tables - Metadata
Table 9	Planted and Total Stem Counts
Appendix 4	Morphological Summary Data and Plots
Table 10a-b	Baseline Stream Data Summary
Table 11	Morphology and Hydraulic Summary (Dimensional Parameters – Cross-Section)
Table 12a-c	Monitoring Data – Stream Reach Data Summary
	Cross-Section Plots
	Reachwide and Cross-Section Pebble Count Plots
Appendix 5	Hydrology Summary Data
Table 13	Verification of Bankfull Events
	Monthly Rainfall Data

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 Rd (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 (HUC) 03020201030030, which is a Targeted Local Watershed (TLW) (Figure 1) as identified in the 2010 Neuse River Basin Restoration 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 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. Stream restoration reaches included Reaches 1 and 2 of Martin Dairy Creek and 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 the 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 1 was conducted in 2018. 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. Livestock grazing 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 stream. Support all stream functions.
Improve instream habitat.	Install habitat features such as constructed riffles, lunger 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 2 Data Assessment

Annual monitoring and site visits were conducted during MY2 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 is the survival of 210 planted stems per acre at the end of the seven-year monitoring period (MY7). The interim measure of vegetative success is the survival of at least 320 planted stems per acre at the end of year three of the monitoring period (MY3) and at least 260 stems per acre at the end of the fifth year of monitoring (MY5). Planted vegetation must average 10 feet in height at the end of MY7.

The MY2 vegetative survey was completed in September 2019. The 2019 vegetation monitoring resulted in an average stem density of 405 stems per acre, which is well above the interim requirement of 320 stems per acre required at MY3 and 32% less than the baseline density recorded (597 stems per acre). There is an average of 10 stems per plot in MY2 compared to 14 stems per plot in MY0. With 283 planted stems per acre, Vegetation Plot 7 is not on track to meet the interim requirement of 320 stems per acre but it is still above the final vegetative success criteria of 210 planted stems per acre. The reason for Vegetation Plot 7's tree mortality is that Alligator weed (*Alternanthera philoxeroides*) has formed a thick herbaceous understory that has out competed the planted trees. However, several volunteer species including green ash (*Fraxinus pennsylvanica*) and buttonbush (*Cephalanthus occidentalis*) were recorded in the plot, increasing the total stems per acre to 405. Thus, all eight of the plots are on track to meet the 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

Vegetation Plot 7 had a higher planted tree mortality rate than the rest of the vegetation plots on Site due to competition from Alligator weed. Even with a dense herbaceous layer, volunteers are surviving, increasing the stems per acres to 405. Due to the success of the volunteer trees, remedial action will not be taken in MY3 but monitoring will continue to assess tree mortality rates.

Tree vigor along UT1 was good but is not performing as well as the rest of the Site. This is likely due to floodplain grading during construction. Approximately 100 pounds of biochar, rock phosphate, azomite, and humic acid was added to the floodplain to promote tree growth during MY2. Remedial action will be taken as necessary in subsequent monitoring years to promote tree growth.

1.2.3 Stream Assessment

Morphological surveys for MY2 were conducted in May 2019. 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, Current Condition Plan View (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 MY2.

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 and MY2, resulting in attainment of the stream hydrology success criteria. Refer to Appendix 5 for hydrologic data.

1.2.6 Maintenance Plan

No maintenance plan is necessary at this time.



1.3 Monitoring Year 2 Summary

Seven of the eight vegetation plots are on track to meet the MY3 interim requirement of 320 planted stems per acre. Vegetation Plot 7 had significant tree mortality due to competition from alligator weed but is still above the final success requirement of 210 planted stems per acre. When counting volunteer trees, vegetation plot 7 is above the MY3 interim requirement. 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

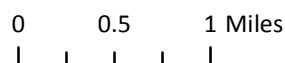
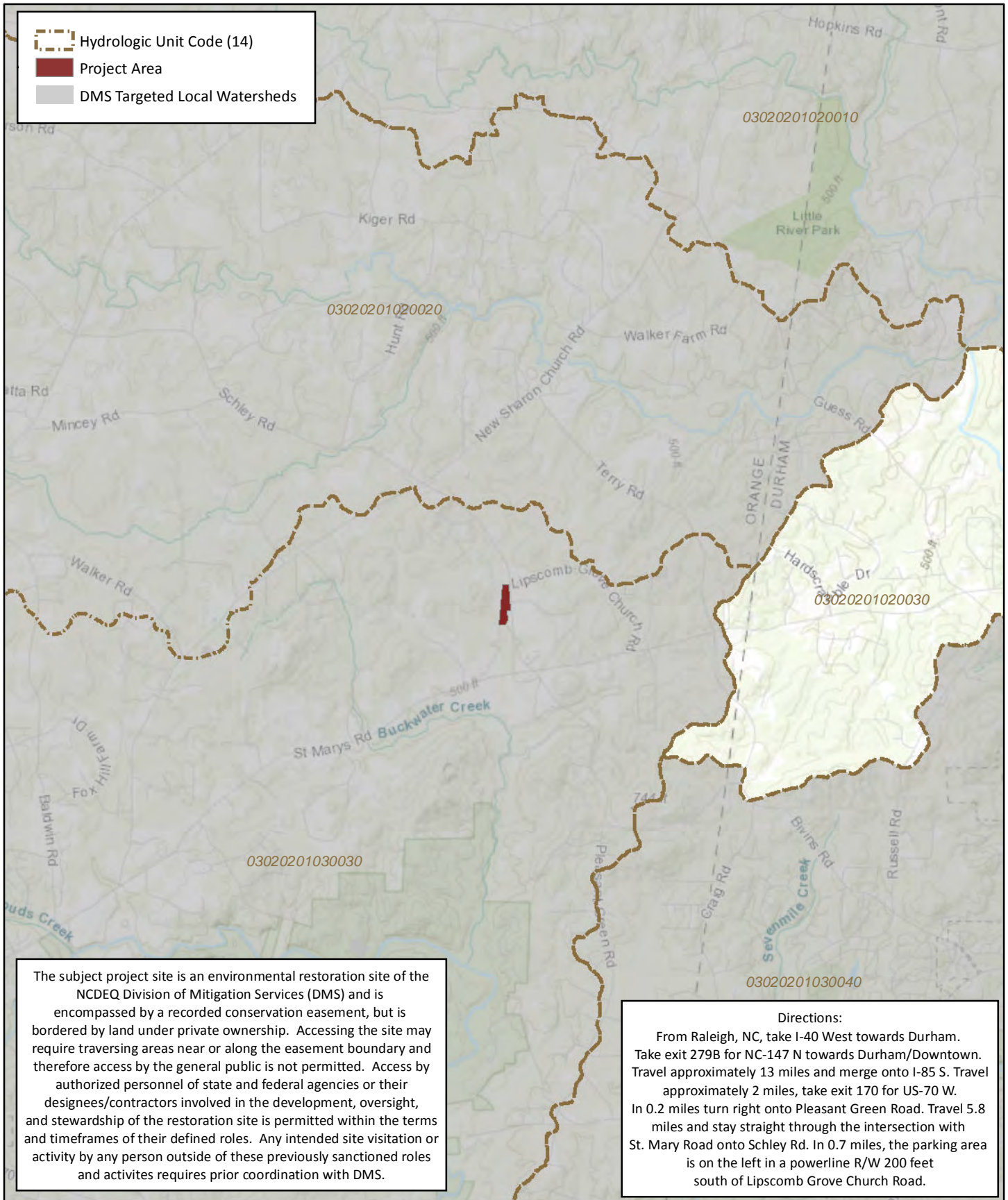


Figure 1. Project Vicinity Map
 Martin Dairy Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019
 Orange County, NC

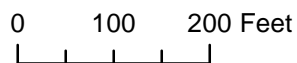
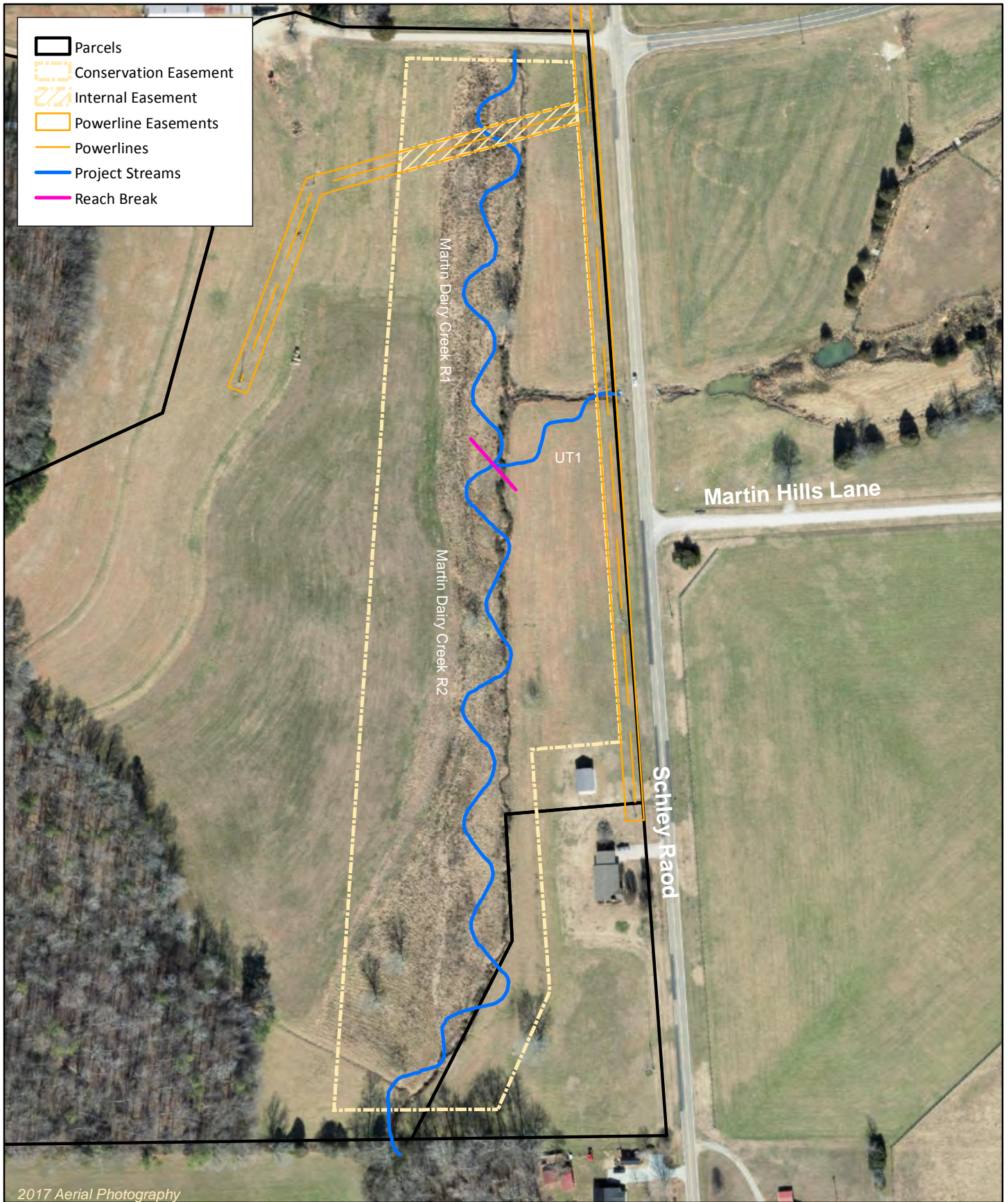


Figure 2. Project Component/Asset Map
 Martin Dairy Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019
 Orange County, NC

Table 1. Project Components and Mitigation Credits
 Martin Dairy Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019

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	P1I	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 2 - 2019

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	
Year 3 Monitoring	Stream Survey	2020	December 2020
	Vegetation Survey	2020	
Year 4 Monitoring	Stream Survey	2021	December 2021
	Vegetation Survey	2021	
Year 5 Monitoring	Stream Survey	2022	December 2022
	Vegetation Survey	2022	
Year 6 Monitoring	Stream Survey	2023	December 2023
	Vegetation Survey	2023	
Year 7 Monitoring	Stream Survey	2024	December 2024
	Vegetation Survey	2024	

¹Seed 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 2 - 2019

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	Dykes and Sons Nursery and Greenhouse
Bare Roots	
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 2 - 2019

PROJECT INFORMATION			
Project Name	Martin Dairy Mitigation Site		
County	Orange County		
Project Area (acres)	11.155		
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 Drainage 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 Description (stream type)	Perennial	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. N/A
Waters of the United States - Section 401	Yes	Yes	
Division of Land Quality (Dam Safety)	N/A	N/A	
Endangered Species Act	Yes	Yes	Martin Dairy 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

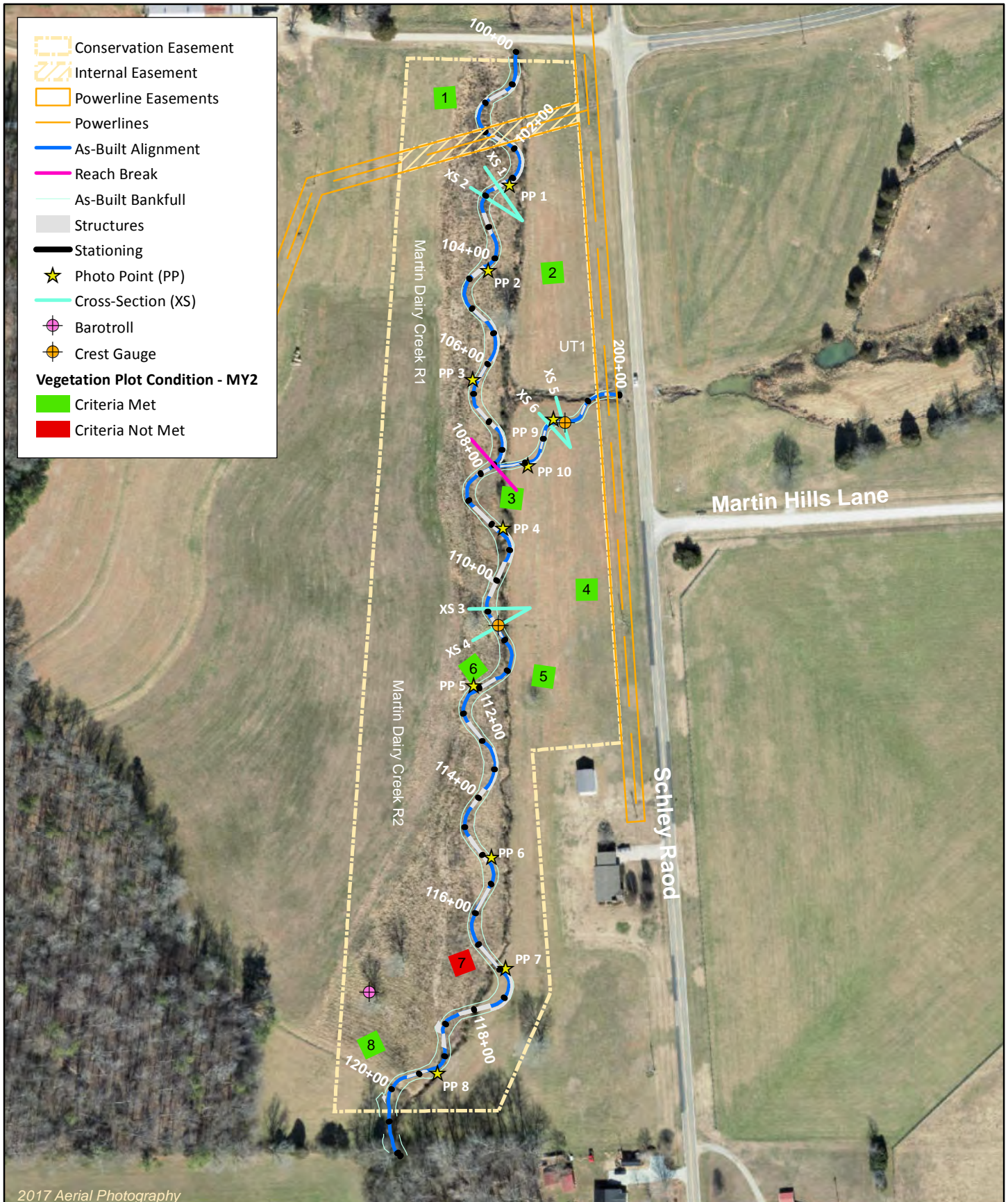


Table 5a. Visual Stream Morphology Stability Assessment Table

Martin Dairy Mitigation Project
 DMS Project No. 97087
 Monitoring Year 2 - 2019

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%			
Totals					0	0	100%	n/a	n/a	n/a
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
3. Engineered Structures¹	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%			

¹Excludes 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 2 - 2019

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%			
Totals					0	0	100%	n/a	n/a	n/a
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
3. Engineered Structures¹	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%			

¹Excludes 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 2 - 2019

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%			
Totals					0	0	100%	n/a	n/a	n/a
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 Structures¹	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%			

¹Excludes 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 2 - 2019

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	0	0	0%
Cumulative Total			0	0.0	0%

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 (5/8/2019)



PHOTO POINT 1 Martin Dairy R1 – downstream (5/8/2019)



PHOTO POINT 2 Martin Dairy R1 – upstream (5/8/2019)



PHOTO POINT 2 Martin Dairy R1 – downstream (5/8/2019)



PHOTO POINT 3 Martin Dairy R1 – upstream (5/8/2019)



PHOTO POINT 3 Martin Dairy R1 – downstream (5/8/2019)



PHOTO POINT 4 Martin Dairy R2 – upstream (5/8/2019)



PHOTO POINT 4 Martin Dairy R2 – downstream (5/8/2019)



PHOTO POINT 5 Martin Dairy R2 – upstream (5/8/2019)



PHOTO POINT 5 Martin Dairy R2 – downstream (5/8/2019)



PHOTO POINT 6 Martin Dairy R2 – upstream (5/8/2019)



PHOTO POINT 6 Martin Dairy R2 – downstream (5/8/2019)



PHOTO POINT 7 Martin Dairy R2 – upstream (5/8/2019)



PHOTO POINT 7 Martin Dairy R2 – downstream (5/8/2019)



PHOTO POINT 8 Martin Dairy R2 – upstream (5/8/2019)



PHOTO POINT 8 Martin Dairy R2 – downstream (5/8/2019)



PHOTO POINT 9 UT1 – upstream (5/8/2019)



PHOTO POINT 9 UT1 – downstream (5/8/2019)



PHOTO POINT 10 UT1 – upstream (5/8/2019)



PHOTO POINT 10 UT1 – downstream (5/8/2019)

VEGETATION PLOT PHOTOGRAPHS



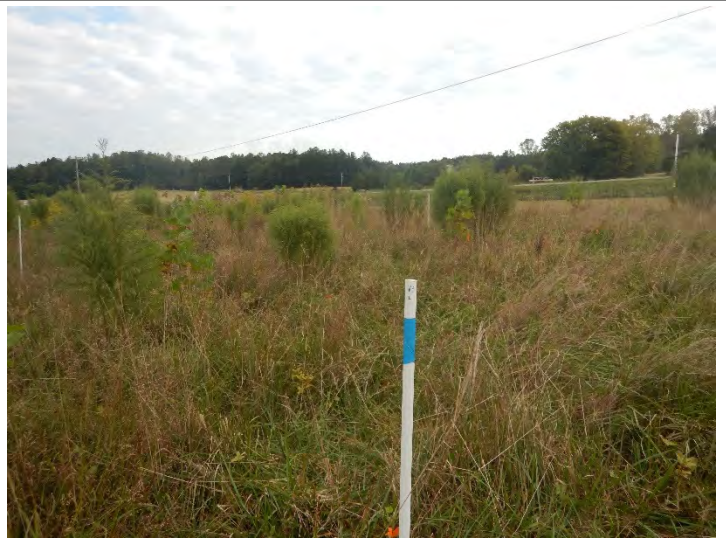
VEG PLOT 1 (09/18/2019)



VEG PLOT 2 (09/18/2019)



VEG PLOT 3 (09/18/2019)



VEG PLOT 4 (09/18/2019)



VEG PLOT 5 (09/18/2019)



VEG PLOT 6 (09/18/2019)



VEG PLOT 7 (09/18/2019)



VEG PLOT 8 (09/18/2019)

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Table

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Plot	MY2 Success Criteria Met	Tract Mean
1	Yes	88%
2	Yes	
3	Yes	
4	Yes	
5	Yes	
6	Yes	
7	No*	
8	Yes	

*Vegetation Plot 7 is not going to meet interim success criteria for MY3 of 310 planted stems per acre. However, when including volunteers Vegetation Plot 7 is on track to meet interim success criteria for MY3 and is on track to meet interim success criteria for MY5 of 260 planted stems per acre.

Table 8. CVS Vegetation Tables - Metadata

Martin Dairy Mitigation Project
 DMS Project No. 97087
 Monitoring Year 2 - 2019

Report Prepared By	Jason Lorch
Date Prepared	9/20/2019 14:12
Database Name	Martin Dairy- cvs-v2.5.0.- MY2.mdb
Database Location	F:\Projects\005-02158 Martin Dairy\Monitoring\Monitoring Year 2\Vegetation Assessment
Computer Name	CARLYNN-PC
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 2 - 2019

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2019)														
			VP 1			VP 2			VP 3			VP 4			VP 5		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Betula nigra</i>	River Birch	Tree	1	1	1	2	2	2	3	3	3	1	1	1	3	3	3
<i>Cephalanthus occidentalis</i>	Buttonbush	Shrub Tree															
<i>Cercis canadensis</i>	Red Bud	Shrub Tree															
<i>Cornus florida</i>	Flowering Dogwood	Shrub Tree															
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree	2	2	2	3	3	3	2	2	2	3	3	3	1	1	1
<i>Liquidambar styraciflua</i>	Sweet Gum	Tree									4			1			
<i>Liriodendron tulipifera</i>	Tulip Poplar	Tree	3	3	3							1	1	1			
<i>Platanus occidentalis</i>	Sycamore	Tree	2	2	2	2	2	2	2	2	2	2	2	2	4	4	4
<i>Pyrus calleryana</i>	Bradford Pear	Tree			1												2
<i>Quercus palustris</i>	Pin Oak	Tree				2	2	2	2	2	2	3	3	3			
<i>Quercus phellos</i>	Willow Oak	Tree	3	3	3	2	2	2	1	1	1	2	2	2	2	2	2
<i>Ulmus</i>	Elm	Tree												1			
Stem count			11	11	11	11	11	11	10	10	14	12	12	14	10	10	10
size (ares)			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			5	5	5	5	5	5	5	5	6	6	6	8	4	4	4
Stems per ACRE			445	445	445	445	445	445	405	405	567	486	486	567	405	405	405

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 2 - 2019

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2019)									Annual Means								
			VP 6			VP 7			VP 8			MY2 (2019)			MY1 (2018)			MY0 (2018)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Betula nigra</i>	River Birch	Tree	2	2	2	1	1	1	1	1	1	14	14	14	16	16	16	17	17	17
<i>Cephalanthus occidentalis</i>	Buttonbush	Shrub Tree			11			1						12			8			
<i>Cercis canadensis</i>	Red Bud	Shrub Tree													1	1	1	3	3	3
<i>Cornus florida</i>	Flowering Dogwood	Shrub Tree													2	2	2	2	2	2
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree	1	1	1	1	1	3	2	2	30	15	15	45	17	17	29	18	18	18
<i>Liquidambar styraciflua</i>	Sweet Gum	Tree									4			9			2			
<i>Liriodendron tulipifera</i>	Tulip Poplar	Tree							1	1	3	5	5	7	7	7	7	19	19	19
<i>Platanus occidentalis</i>	Sycamore	Tree	4	4	4	4	4	4	2	2	7	22	22	27	24	24	25	25	25	25
<i>Pyrus calleryana</i>	Bradford Pear	Tree												3						
<i>Quercus palustris</i>	Pin Oak	Tree	2	2	2	1	1	1	2	2	2	12	12	12	16	16	16	20	20	20
<i>Quercus phellos</i>	Willow Oak	Tree	1	1	1				1	1	1	12	12	12	14	14	14	14	14	14
<i>Ulmus</i>	Elm	Tree									1			2			1			
Stem count			10	10	21	7	7	10	9	9	49	80	80	140	97	97	121	118	118	118
size (ares)			1			1			1			8			8			8		
size (ACRES)			0.02			0.02			0.02			0.20			0.20			0.20		
Species count			5	5	6	4	4	5	6	6	8	6	6	9	8	8	11	8	8	8
Stems per ACRE			405	405	850	283	283	405	364	364	1983	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

APPENDIX 4. Morphological Summary Data and Plots

Table 10a. Baseline Stream Data Summary

Martin Dairy Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019

Martin Dairy

Parameter	Gage	PRE-RESTORATION CONDITION		REFERENCE REACH DATA						DESIGN				AS-BUILT/BASELINE					
		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)		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)	N/A	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)		---	---	---		---		---		---		---		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)		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																			
R _i %/R _u %/P ₃ %/G ₅ %/S ₉ %																			
SC ₃ %/Sa ₅ %/G ₅ %/C ₇ %/B ₆ %/Be ₆ %																			
d ₁₆ /d ₃₅ /d ₅₀ /d ₈₄ /d ₉₅ /d ₁₀₀	N/A	0.13/1.3/2.6/4.6/7.7/77/-/-	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		0.11/1.10/5.0/27.6/64.0/512.0			
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)		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%		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
 N/A: Not Applicable

Table 10b. Baseline Stream Data Summary

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

UT1

Parameter	Gage	PRE-RESTORATION	REFERENCE REACH DATA						DESIGN		AS-BUILT/BASELINE		
		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

N/A: Not Applicable

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

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

	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				505.7	505.9	505.8			
Low Bank Elevation (ft)	505.8	506.1	506.1				505.7	505.8	505.8			
Bankfull Width (ft)	14.8	15.0	14.5				20.0	22.5	19.5			
Floodprone Width (ft)	150	150	150				N/A	N/A	N/A			
Bankfull Mean Depth (ft)	0.9	0.9	1.0				1.5	1.3	1.5			
Bankfull Max Depth (ft)	1.4	1.6	1.7				3.0	2.7	3.0			
Bankfull Cross-Sectional Area (ft ²)	13.2	13.2	13.8				29.4	29.4	28.6			
Bankfull Width/Depth Ratio	16.7	16.9	15.2				13.6	17.2	13.3			
Entrenchment Ratio ¹	10.1	10.0	10.4				N/A	N/A	N/A			
Bankfull Bank Height Ratio ²	1.0	1.1	1.0				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				501.5	501.4	501.5			
Low Bank Elevation (ft)	501.8	501.8	501.8				501.5	501.4	501.5			
Bankfull Width (ft)	20.8	21.3	21.0				12.8	12.4	13.0			
Floodprone Width (ft)	N/A	N/A	N/A				200	200	200			
Bankfull Mean Depth (ft)	1.7	1.6	1.9				1.1	1.1	1.2			
Bankfull Max Depth (ft)	3.5	3.5	3.8				1.8	1.9	2.1			
Bankfull Cross-Sectional Area (ft ²)	34.9	34.9	39.2				14.2	14.2	15.7			
Bankfull Width/Depth Ratio	12.4	13.1	11.2				11.6	10.9	10.8			
Entrenchment Ratio ¹	N/A	N/A	N/A				15.6	16.1	15.3			
Bankfull Bank Height Ratio ²	N/A	N/A	N/A				1.0	1.0	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				504.1	504.1	504.1			
Low Bank Elevation (ft)	504.0	504.0	503.9				504.1	504.1	504.1			
Bankfull Width (ft)	9.2	9.5	9.7				11.5	11.9	12.3			
Floodprone Width (ft)	65	65	65				N/A	N/A	N/A			
Bankfull Mean Depth (ft)	0.7	0.7	0.6				1.0	1.0	1.0			
Bankfull Max Depth (ft)	1.4	1.4	1.4				2.0	2.2	2.2			
Bankfull Cross-Sectional Area (ft ²)	6.3	6.3	5.8				11.8	11.8	12.5			
Bankfull Width/Depth Ratio	13.3	14.3	16.1				11.3	12.1	12.1			
Entrenchment Ratio ¹	7.1	6.8	6.7				N/A	N/A	N/A			
Bankfull Bank Height Ratio ²	1.0	1.1	<1.0				N/A	N/A	N/A			

¹Entrenchment Ratio is the flood prone width divided by the bankfull width

²Bank Height Ratio is the bank height divided by the max depth of the bankfull channel

*Morphological survey and analysis not required for MY4 and MY6

Table 12a. Monitoring Data - Stream Reach Data Summary

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

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							
Floodprone Width (ft)	150		150		150							
Bankfull Mean Depth	0.9		0.9		1.0							
Bankfull Max Depth	1.4		1.6		1.7							
Bankfull Cross-Sectional Area (ft ²)	13.2		13.2		13.8							
Width/Depth Ratio	16.7		16.9		15.2							
Entrenchment Ratio	10.1		10.0		10.4							
Bank Height Ratio	1.0		1.1		1.0							
D50 (mm)	13.1		20.6		32.0							
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							
% of Reach with Eroding Banks	0%		0%		0%							

(--): Data was not provided

*Morphological survey and analysis not required during MY4 and MY6

Table 12b. Monitoring Data - Stream Reach Data Summary

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

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							
Floodprone Width (ft)	200		200		200							
Bankfull Mean Depth	1.1		1.1		1.2							
Bankfull Max Depth	1.8		1.9		2.1							
Bankfull Cross-Sectional Area (ft ²)	14.2		14.2		15.7							
Width/Depth Ratio	11.6		10.9		10.8							
Entrenchment Ratio	15.6		16.1		15.3							
Bank Height Ratio	1.0		1.0		1.1							
D50 (mm)	10.2		38.7		40.8							
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							
% of Reach with Eroding Banks	0%		0%		0%							

(--): Data was not provided

*Morphological survey and analysis not required during MY4 and MY6

Table 12c. Monitoring Data - Stream Reach Data Summary

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

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							
Floodprone Width (ft)	65		65		65							
Bankfull Mean Depth	0.7		0.7		0.6							
Bankfull Max Depth	1.4		1.4		1.4							
Bankfull Cross-Sectional Area (ft ²)	6.3		6.3		5.8							
Width/Depth Ratio	13.3		14.3		16.1							
Entrenchment Ratio	7.1		6.8		6.7							
Bank Height Ratio	1.0		1.1		<1.0							
D50 (mm)	7.4		72.1		14.6							
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							
% of Reach with Eroding Banks	0%		0%		0%							

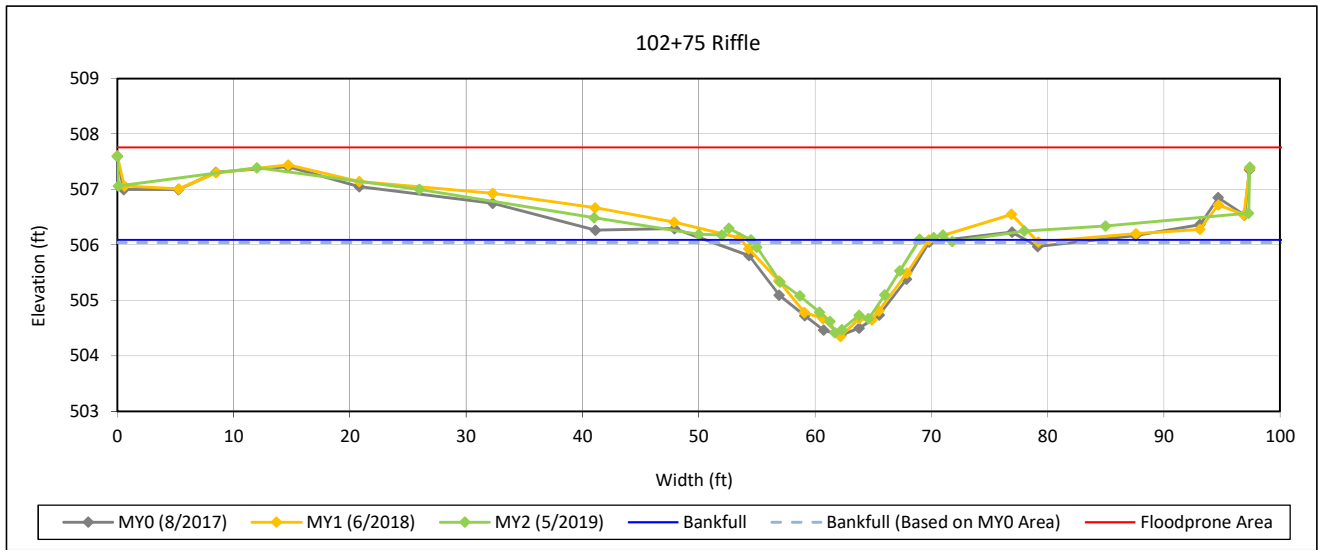
(--): Data was not provided

*Morphological survey and analysis not required during MY4 and MY6

Cross-Section Plots

Martin Dairy Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019

Cross-Section 1 Martin Dairy Reach 1



Bankfull Dimensions

13.8	x-section area (ft.sq.)
14.5	width (ft)
1.0	mean depth (ft)
1.7	max depth (ft)
14.9	wetted perimeter (ft)
0.9	hydraulic radius (ft)
15.2	width-depth ratio
150.0	W flood prone area (ft)
10.4	entrenchment ratio
1.0	low bank height ratio

Survey Date: 5/2019

Field Crew: Wildlands Engineering



View Downstream

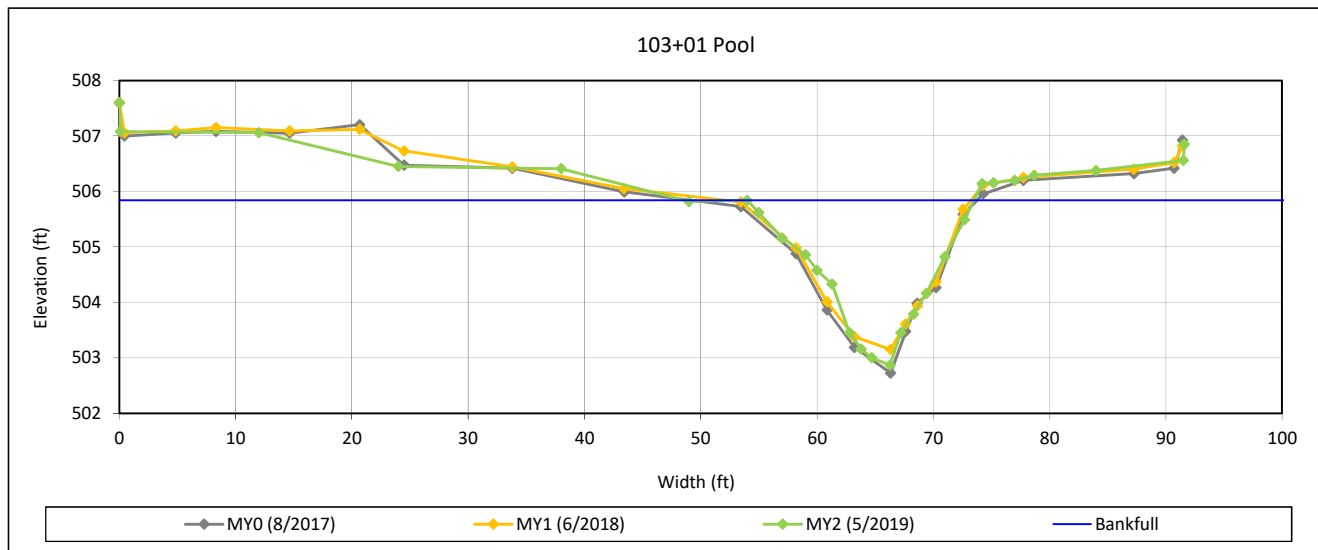
Cross-Section Plots

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Cross-Section 2 Martin Dairy Reach 1



Bankfull Dimensions

28.6	x-section area (ft.sq.)
19.5	width (ft)
1.5	mean depth (ft)
3.0	max depth (ft)
20.6	wetted perimeter (ft)
1.4	hydraulic radius (ft)
13.3	width-depth ratio

Survey Date: 5/2019

Field Crew: Wildlands Engineering



View Downstream

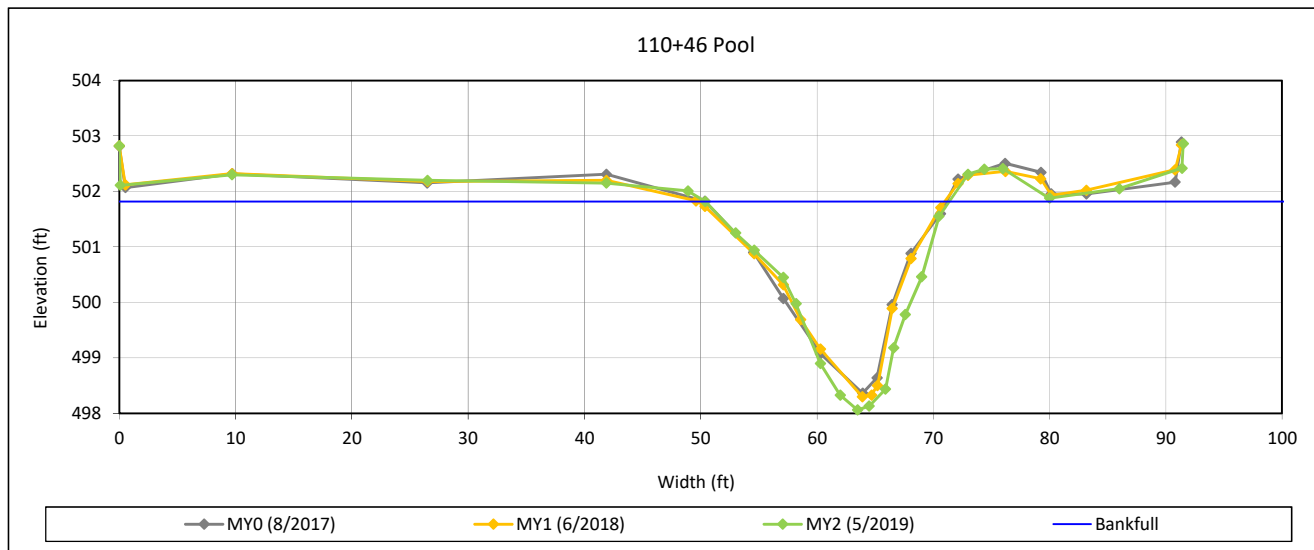
Cross-Section Plots

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Cross-Section 3 Martin Dairy Reach 2



Bankfull Dimensions

39.2	x-section area (ft.sq.)
21.0	width (ft)
1.9	mean depth (ft)
3.8	max depth (ft)
22.7	wetted perimeter (ft)
1.7	hydraulic radius (ft)
11.2	width-depth ratio

Survey Date: 5/2019

Field Crew: Wildlands Engineering

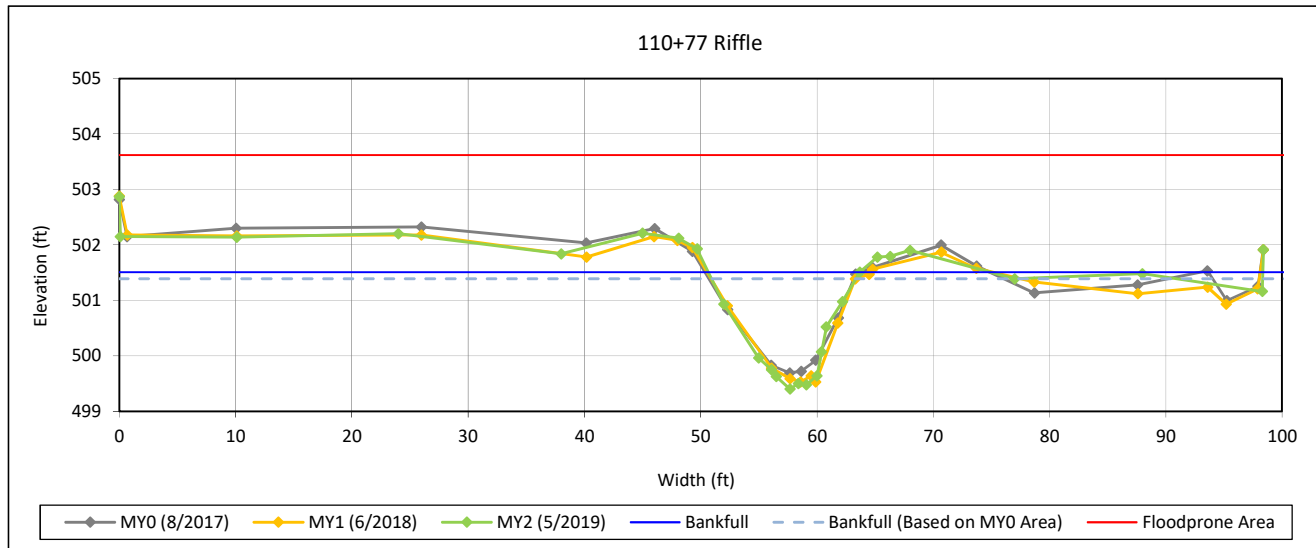


View Downstream

Cross-Section Plots

Martin Dairy Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019

Cross-Section 4 Martin Dairy Reach 2



Bankfull Dimensions

15.7	x-section area (ft.sq.)
13.0	width (ft)
1.2	mean depth (ft)
2.1	max depth (ft)
13.9	wetted perimeter (ft)
1.1	hydraulic radius (ft)
10.8	width-depth ratio
200.0	W flood prone area (ft)
15.3	entrenchment ratio
1.1	low bank height ratio

Survey Date: 5/2019
 Field Crew: Wildlands Engineering

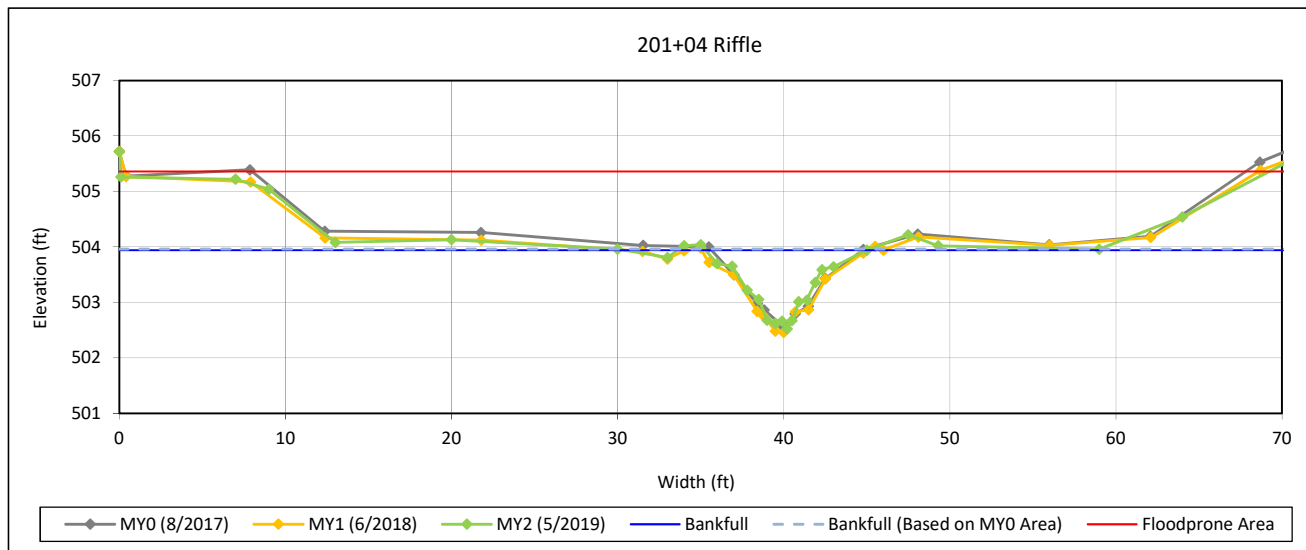


View Downstream

Cross-Section Plots

Martin Dairy Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019

Cross-Section 5 UT1



Bankfull Dimensions

5.8	x-section area (ft.sq.)
9.7	width (ft)
0.6	mean depth (ft)
1.4	max depth (ft)
10.4	wetted perimeter (ft)
0.6	hydraulic radius (ft)
16.1	width-depth ratio
65.0	W flood prone area (ft)
6.7	entrenchment ratio
< 1.0	low bank height ratio

Survey Date: 5/2019
 Field Crew: Wildlands Engineering



View Downstream

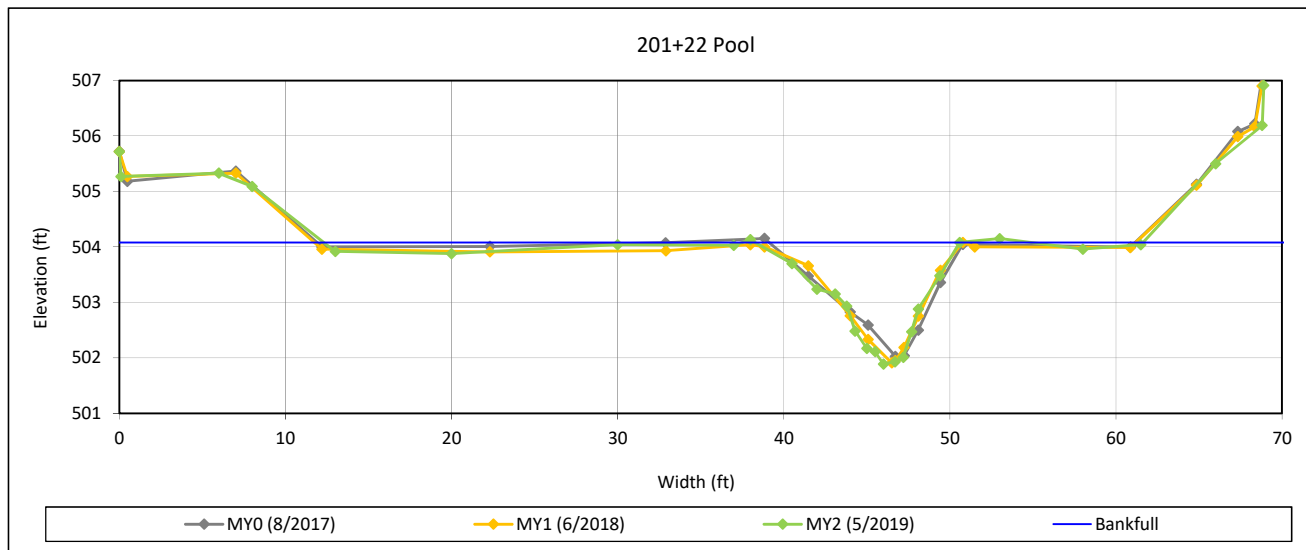
Cross-Section Plots

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Cross-Section 6 UT1



Bankfull Dimensions

12.5	x-section area (ft.sq.)
12.3	width (ft)
1.0	mean depth (ft)
2.2	max depth (ft)
13.4	wetted perimeter (ft)
0.9	hydraulic radius (ft)
12.1	width-depth ratio

Survey Date: 5/2019

Field Crew: Wildlands Engineering



View Downstream

Reachwide and Cross-Section Pebble Count Plots

Martin Dairy Mitigation Site

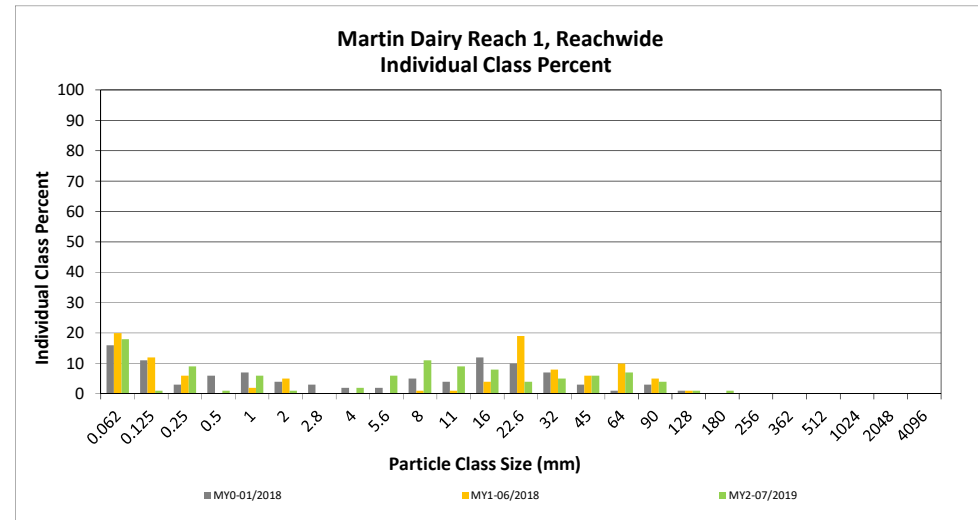
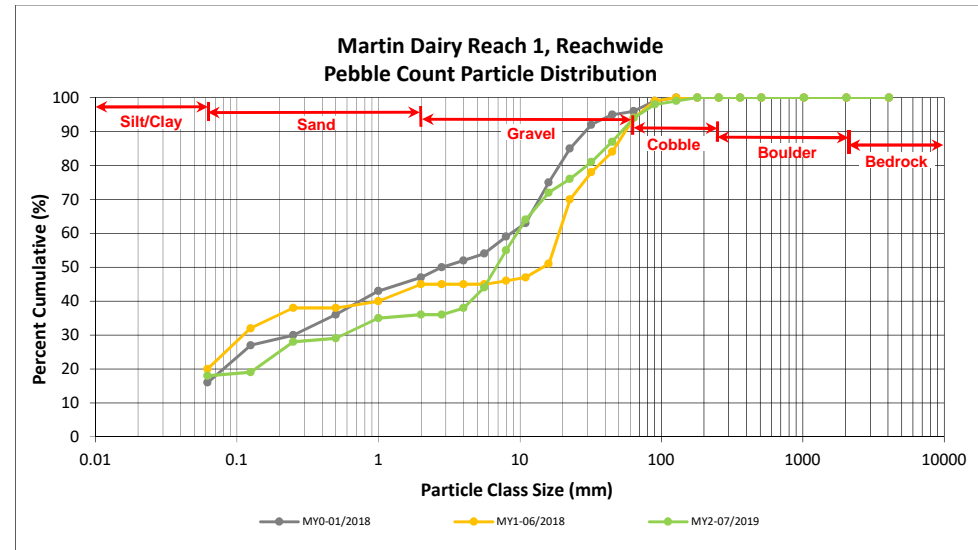
DMS Project No. 97087

Monitoring Year 2 - 2019

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		18	18	18	18
SAND	Very fine	0.062	0.125		1	1	1	19
	Fine	0.125	0.250		9	9	9	28
	Medium	0.25	0.50		1	1	1	29
	Coarse	0.5	1.0		6	6	6	35
	Very Coarse	1.0	2.0	1		1	1	36
GRAVEL	Very Fine	2.0	2.8					36
	Very Fine	2.8	4.0		2	2	2	38
	Fine	4.0	5.6	5	1	6	6	44
	Fine	5.6	8.0	7	4	11	11	55
	Medium	8.0	11.0	9		9	9	64
	Medium	11.0	16.0	7	1	8	8	72
	Coarse	16.0	22.6	3	1	4	4	76
	Coarse	22.6	32	3	2	5	5	81
	Very Coarse	32	45	6		6	6	87
	Very Coarse	45	64	5	2	7	7	94
COBBLE	Small	64	90	3	1	4	4	98
	Small	90	128		1	1	1	99
	Large	128	180	1		1	1	100
BOULDER	Large	180	256					100
	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
BEDROCK	Bedrock	1024	2048					100
Total				50	50	100	100	100

Reachwide Channel materials (mm)	
D ₁₆ =	Silt/Clay
D ₃₅ =	1.00
D ₅₀ =	6.8
D ₈₄ =	37.9
D ₉₅ =	69.7
D ₁₀₀ =	180.0



Reachwide and Cross-Section Pebble Count Plots

Martin Dairy Mitigation Site

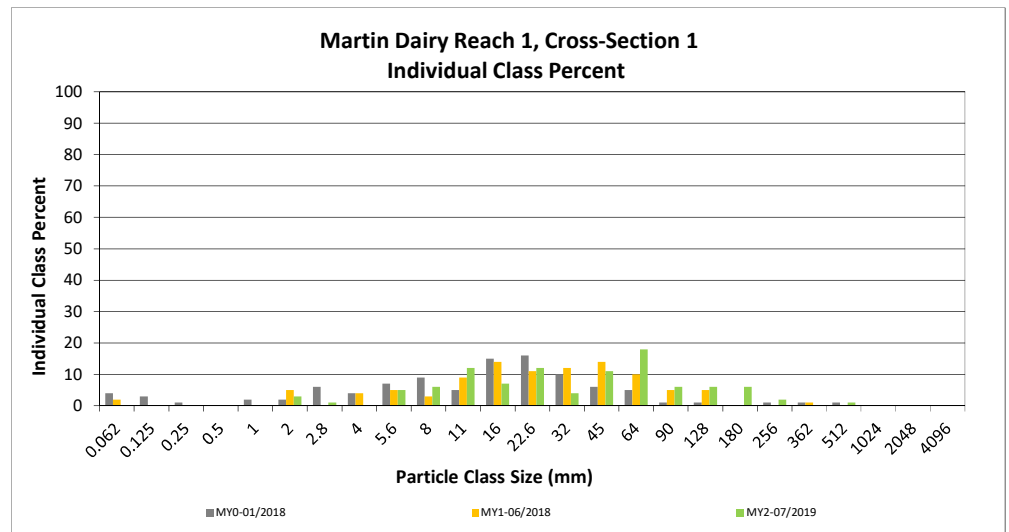
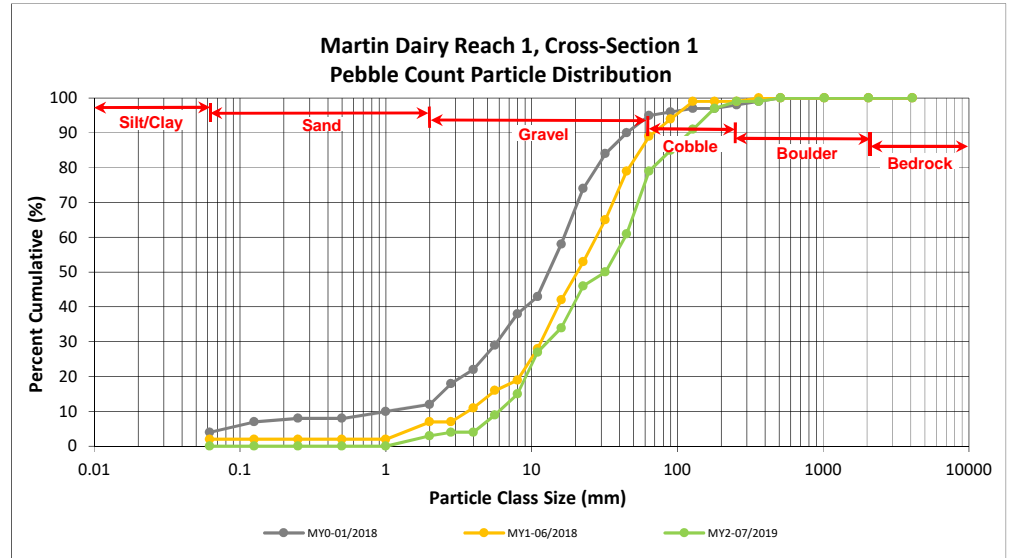
DMS Project No. 97087

Monitoring Year 2 - 2019

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			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.25	0.50			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0	3	3	3
GRAVEL	Very Fine	2.0	2.8	1	1	4
	Very Fine	2.8	4.0			4
	Fine	4.0	5.6	5	5	9
	Fine	5.6	8.0	6	6	15
	Medium	8.0	11.0	12	12	27
	Medium	11.0	16.0	7	7	34
	Coarse	16.0	22.6	12	12	46
	Coarse	22.6	32	4	4	50
	Very Coarse	32	45	11	11	61
	Very Coarse	45	64	18	18	79
COBBLE	Small	64	90	6	6	85
	Small	90	128	6	6	91
	Large	128	180	6	6	97
	Large	180	256	2	2	99
BOULDER	Small	256	362			99
	Small	362	512	1	1	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 =	8.22
D ₃₅ =	16.47
D ₅₀ =	32.0
D ₈₄ =	85.0
D ₉₅ =	160.7
D ₁₀₀ =	512.0



Reachwide and Cross-Section Pebble Count Plots

Martin Dairy Mitigation Site

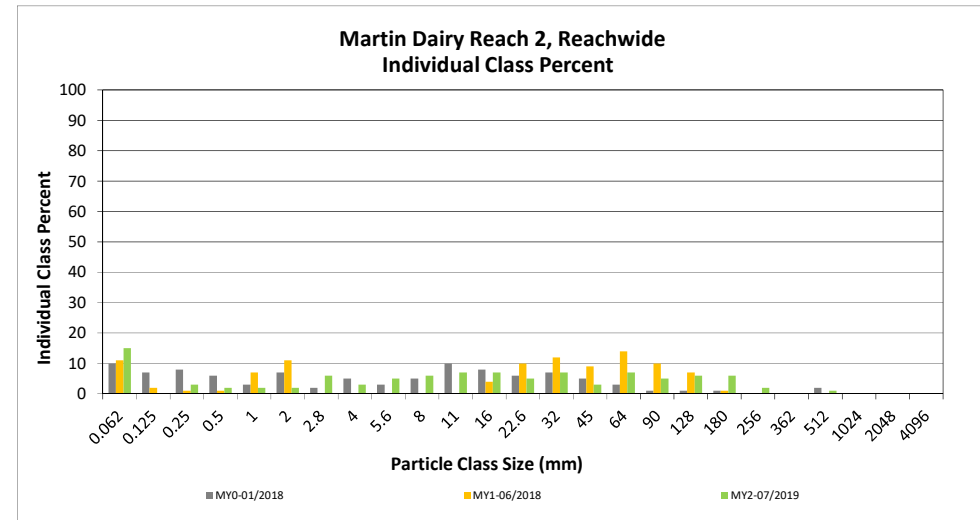
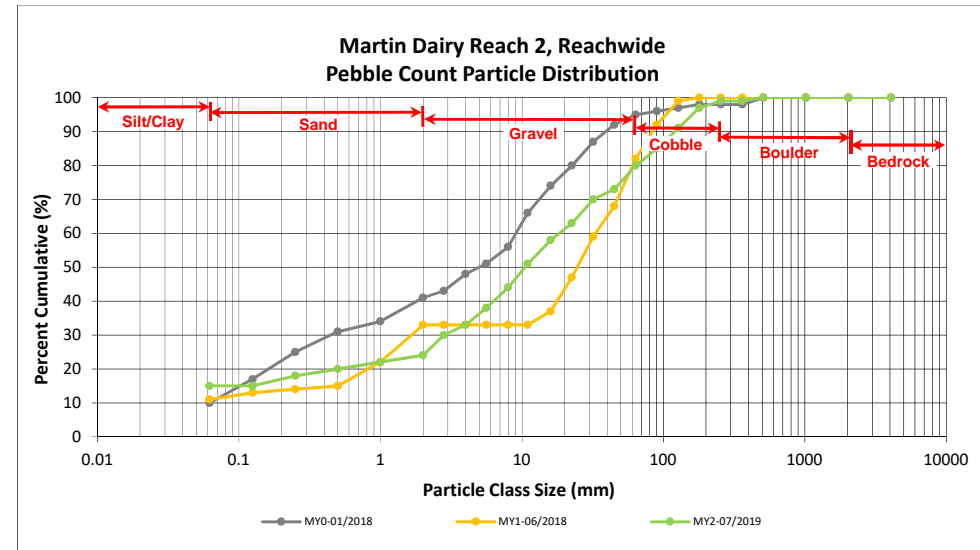
DMS Project No. 97087

Monitoring Year 2 - 2019

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	1	14	15	15	15
SAND	Very fine	0.062	0.125					15
	Fine	0.125	0.250		3	3	3	18
	Medium	0.25	0.50	1	1	2	2	20
	Coarse	0.5	1.0		2	2	2	22
	Very Coarse	1.0	2.0		2	2	2	24
GRAVEL	Very Fine	2.0	2.8	2	4	6	6	30
	Very Fine	2.8	4.0		3	3	3	33
	Fine	4.0	5.6	1	4	5	5	38
	Fine	5.6	8.0	3	3	6	6	44
	Medium	8.0	11.0	2	5	7	7	51
	Medium	11.0	16.0	5	2	7	7	58
	Coarse	16.0	22.6	4	1	5	5	63
	Coarse	22.6	32	3	4	7	7	70
	Very Coarse	32	45	2	1	3	3	73
	Very Coarse	45	64	7		7	7	80
COBBLE	Small	64	90	5		5	5	85
	Small	90	128	5	1	6	6	91
	Large	128	180	6		6	6	97
	Large	180	256	2		2	2	99
BOULDER	Small	256	362					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 =	0.16
D ₃₅ =	4.58
D ₅₀ =	10.5
D ₈₄ =	84.1
D ₉₅ =	160.7
D ₁₀₀ =	512.0



Reachwide and Cross-Section Pebble Count Plots

Martin Dairy Mitigation Site

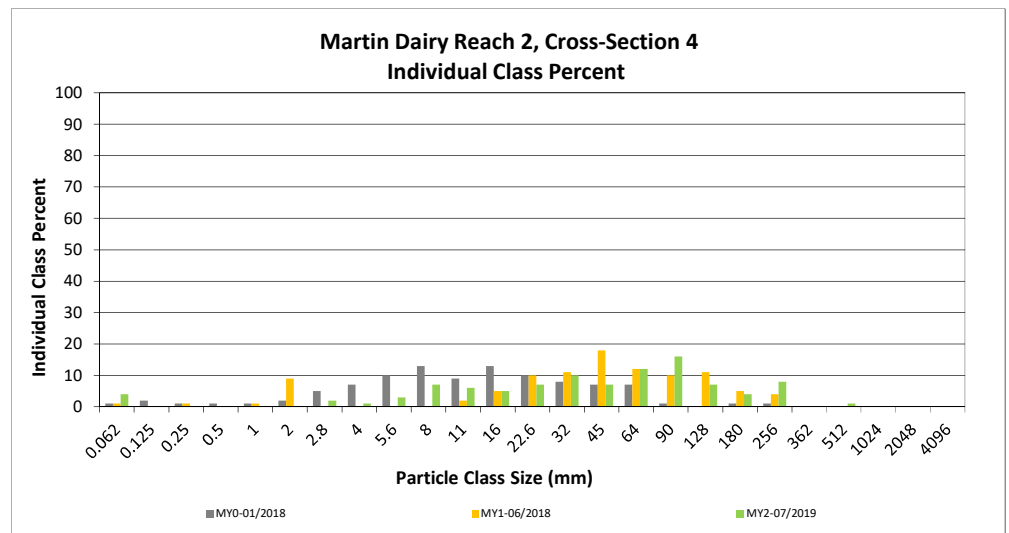
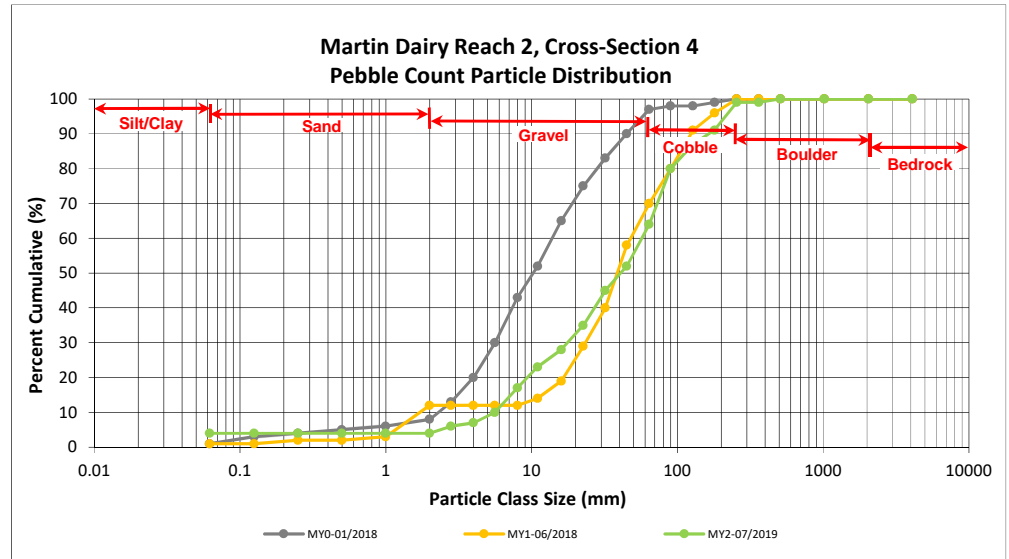
DMS Project No. 97087

Monitoring Year 2 - 2019

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	2	2	6
	Very Fine	2.8	4.0	1	1	7
	Fine	4.0	5.6	3	3	10
	Fine	5.6	8.0	7	7	17
	Medium	8.0	11.0	6	6	23
	Medium	11.0	16.0	5	5	28
	Coarse	16.0	22.6	7	7	35
	Coarse	22.6	32	10	10	45
	Very Coarse	32	45	7	7	52
Very Coarse	45	64	12	12	64	
COBBLE	Small	64	90	16	16	80
	Small	90	128	7	7	87
	Large	128	180	4	4	91
	Large	180	256	8	8	99
BOULDER	Small	256	362			99
	Small	362	512	1	1	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 =	7.60
D ₃₅ =	22.60
D ₅₀ =	40.8
D ₈₄ =	110.1
D ₉₅ =	214.7
D ₁₀₀ =	512.0



Reachwide and Cross-Section Pebble Count Plots

Martin Dairy Mitigation Site

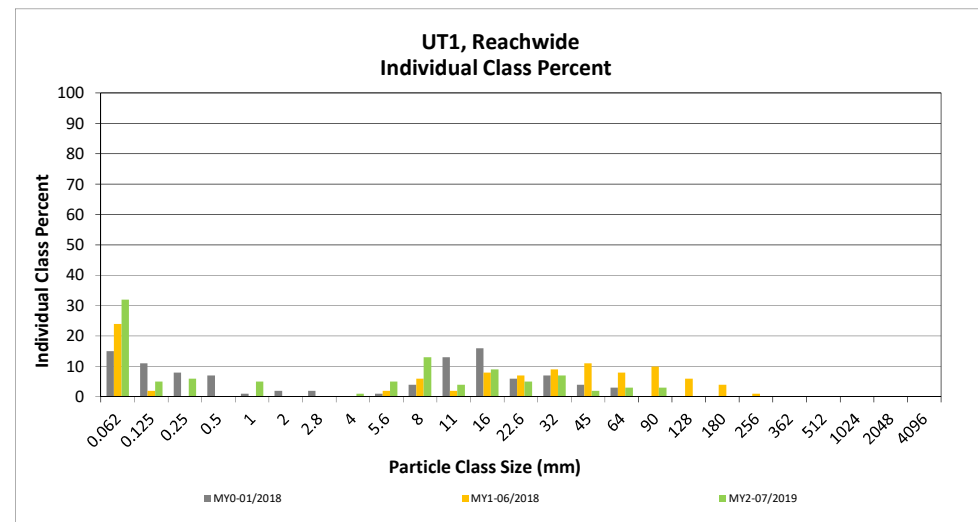
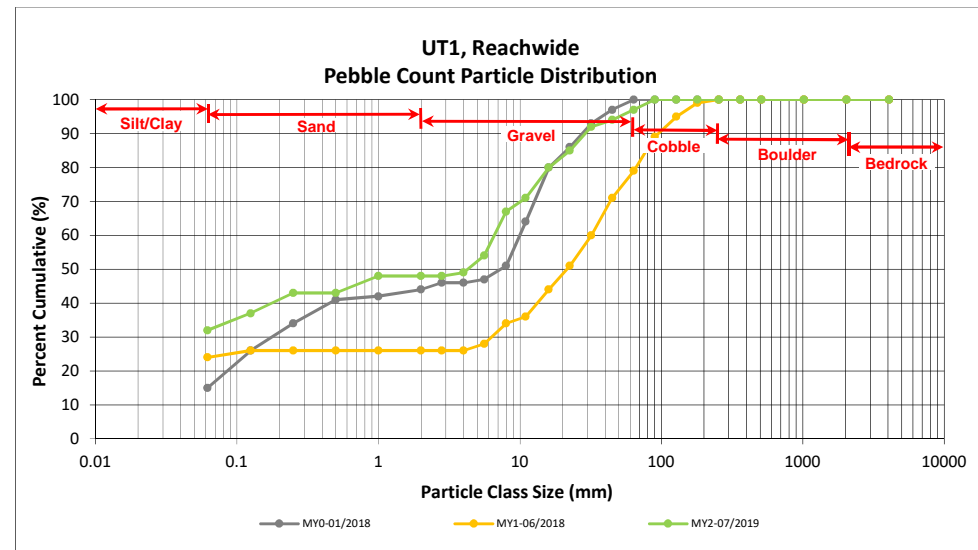
DMS Project No. 97087

Monitoring Year 2 - 2019

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	1	31	32	32	32
SAND	Very fine	0.062	0.125		5	5	5	37
	Fine	0.125	0.250	2	4	6	6	43
	Medium	0.25	0.50					43
	Coarse	0.5	1.0	1	4	5	5	48
	Very Coarse	1.0	2.0					48
GRAVEL	Very Fine	2.0	2.8					48
	Very Fine	2.8	4.0		1	1	1	49
	Fine	4.0	5.6	3	2	5	5	54
	Fine	5.6	8.0	10	3	13	13	67
	Medium	8.0	11.0	4		4	4	71
	Medium	11.0	16.0	9		9	9	80
	Coarse	16.0	22.6	5		5	5	85
	Coarse	22.6	32	7		7	7	92
	Very Coarse	32	45	2		2	2	94
	Very Coarse	45	64	3		3	3	97
COBBLE	Small	64	90	3		3	3	100
	Small	90	128					100
	Large	128	180					100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
Total				50	50	100	100	100

Reachwide Channel materials (mm)	
D ₁₆ =	Silt/Clay
D ₃₅ =	0.09
D ₅₀ =	4.3
D ₈₄ =	21.1
D ₉₅ =	50.6
D ₁₀₀ =	90.0



Reachwide and Cross-Section Pebble Count Plots

Martin Dairy Mitigation Site

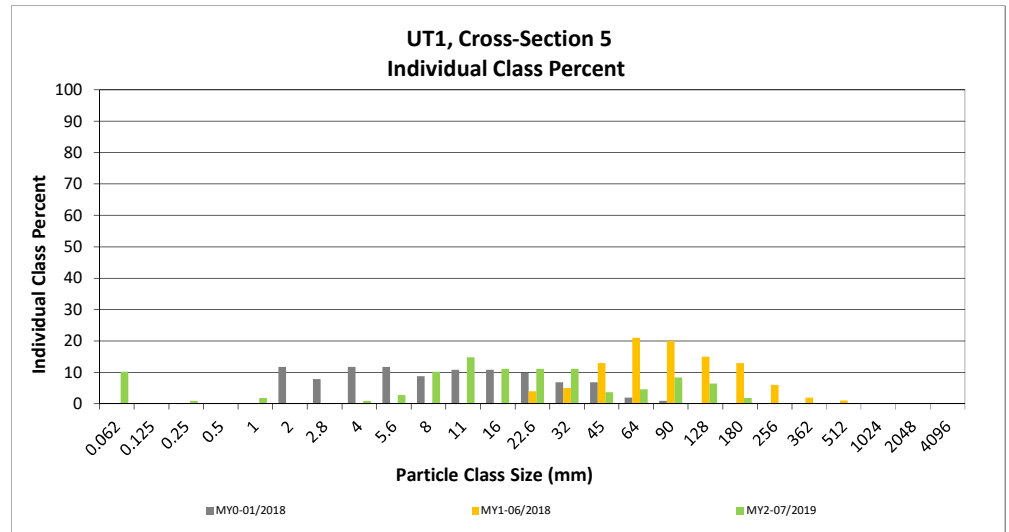
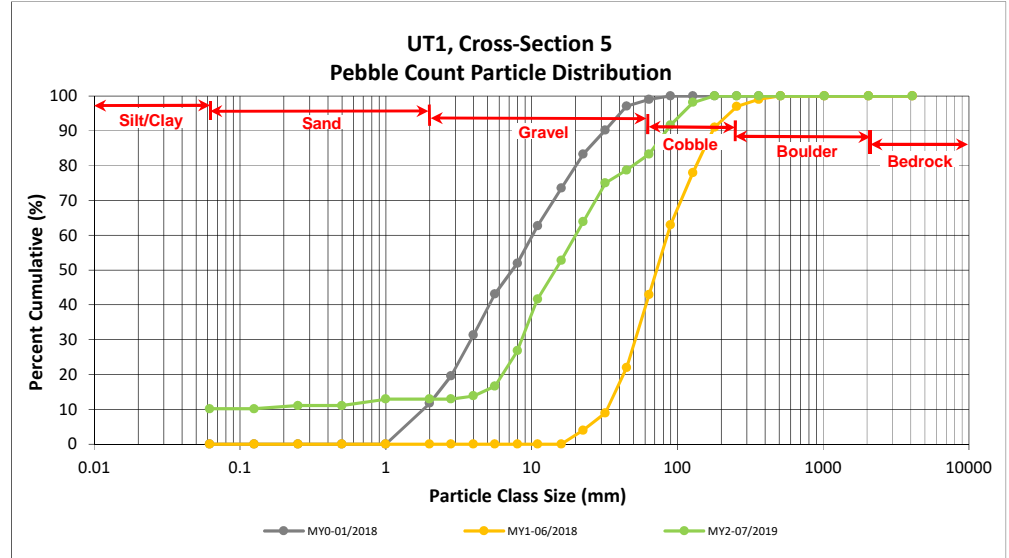
DMS Project No. 97087

Monitoring Year 2 - 2019

UT1, Cross-Section 5

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	11	10	10
SAND	Very fine	0.062	0.125			10
	Fine	0.125	0.250	1	1	11
	Medium	0.25	0.50			11
	Coarse	0.5	1.0	2	2	13
	Very Coarse	1.0	2.0			13
GRAVEL	Very Fine	2.0	2.8			13
	Very Fine	2.8	4.0	1	1	14
	Fine	4.0	5.6	3	3	17
	Fine	5.6	8.0	11	10	27
	Medium	8.0	11.0	16	15	42
	Medium	11.0	16.0	12	11	53
	Coarse	16.0	22.6	12	11	64
	Coarse	22.6	32	12	11	75
	Very Coarse	32	45	4	4	79
Very Coarse	45	64	5	5	83	
COBBLE	Small	64	90	9	8	92
	Small	90	128	7	6	98
	Large	128	180	2	2	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
Total				108	100	100

Cross-Section 5 Channel materials (mm)	
D ₁₆ =	5.17
D ₃₅ =	9.53
D ₅₀ =	14.6
D ₈₄ =	65.8
D ₉₅ =	107.9
D ₁₀₀ =	180.0



APPENDIX 5. Hydrology Summary Data

Table 13. Verification of Bankfull Events

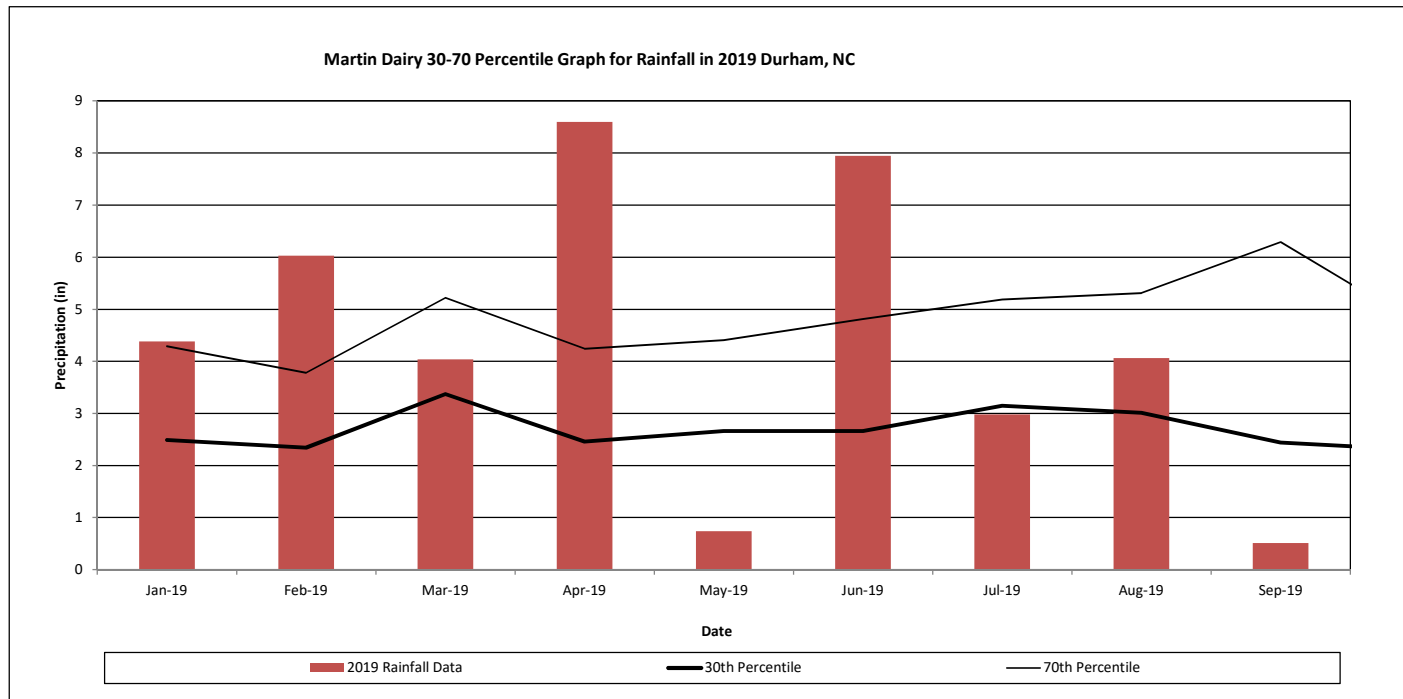
Martin Dairy Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019

Reach	MY1		MY2		Method
	Date of Data Collection	Date of Occurrence	Date of Data Collection	Date of Occurrence	
Martin Diary	6/6/2018	4/15/2018	7/18/2019	4/13/2019	Crest Gage/ Pressure Transducer
	10/17/2018	9/17/2018*		6/19/2019	
UT1	6/6/2018	4/15/2018	7/18/2019	3/24/2019	
	10/17/2018	7/6/2018		4/12/2019	
		9/17/2018*		6/19/2019	

*Hurricane Florence

Monthly Rainfall Data

Martin Dairy Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019



¹ 2019 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, 2019).



**MONITORING YEAR 2
ANNUAL REPORT
Final**

MARTIN DAIRY BUFFER MITIGATION SITE

Orange County, NC
NCDEQ Contract No. 006831
DMS Project Number 97087
NCDWR Project Number 2016-0366

Data Collection Period: September 2019
Draft Submission Date: October 21, 2019
Final Submission Date: December 17, 2019

PREPARED FOR:



**NC Department of Environmental Quality
Division of Mitigation Services**
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PREPARED BY:



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Phone: (919) 851-9986

MARTIN DAIRY BUFFER MITIGATION SITE
Monitoring Year 2 Report

TABLE OF CONTENTS

Section 1: PROJECT OVERVIEW	2
1.1 Project Summary.....	2
1.2 Project Goals and Objectives	2
1.3 Monitoring Year 2 Data Assessment.....	2
1.3.1 Vegetative Assessment	3
1.4 Monitoring Year 2 Summary	3
Section 2: METHODOLOGY.....	4
Section 3: REFERENCES	4

APPENDICES

Appendix 1	General Figures and Tables
Figure 1	Project Vicinity Map
Figure 2	Service Area
Figure 3	Project Component / Asset Map
Table 1	Project Components and Mitigation Credits
Table 2	Project Activity and Reporting History
Table 3	Project Contact Table
Table 4	Project Information and Attributes
Table 5	Adjacent Forested Areas Existing Tree and Shrub Species
Table 6	Planted Tree Species
Appendix 2	Visual Assessment Data
Figure 4	Monitoring Plan View
Table 7	Vegetation Condition Assessment Table Vegetation Plot Photographs
Appendix 3	Vegetation Plot Data
Table 8	Vegetation Plot Criteria Attainment Table
Table 9	CVS Vegetation Tables - Metadata
Table 10	Planted and Total Stem Counts
Appendix 4	Overview Photos



Section 1: PROJECT OVERVIEW

1.1 Project Summary

Wildlands Engineering, Inc. (Wildlands) implemented a full delivery project at the Martin Dairy Mitigation Site (“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 included the restoration of two unnamed tributaries (Martin Dairy Creek and UT1). The project also restored 10.139 acres (441,654.84 ft²) of riparian buffer at the Site, which will provide 379,169.330 Riparian Buffer Credits. The project Site was planned, designed, and constructed on land surrounding Martin Dairy Creek and its tributaries. 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 (HUC) 03020201. The project is located within a DMS targeted watershed for the Neuse River Basin Hydrologic Unit Code (HUC) 03020201030030 and NC Division of Water Resources (DWR) Subbasin 03-04-01. The Site drains to Buckwater Creek, which flows to Falls Lake, which is classified as water supply waters (WS-IV) and nutrient sensitive waters (NSW). The 11.155 acre site is protected with a permanent conservation easement.

The project has been planned, designed and constructed per the Martin Dairy Mitigation Plan (2017) and the Consolidated Buffer Mitigation Rule 15A NCAC 02B .0295 (effective November 1, 2015). The purpose of the riparian buffer restoration is to provide riparian buffer credits to compensate for buffer impacts within the Hydrologic Unit Code 03020201 and the Falls Lake Watershed. The service area for the Riparian Buffer Credits is depicted in Figure 2. The mitigation credits generated from this Site are listed in Table 1 and shown in Figure 3.

1.2 Project Goals and Objectives

Prior to construction activities, the primary degradation on the Site was the original clearing of the Site and channelization of Martin Dairy Creek and UT1. The channelization involved straightening and deepening of the stream (as indicated by the amount of dredge spoil in the floodplain). In the past livestock were grazed on the Site, which contributed to bank sloughing. Table 4 in Appendix 1 presents the pre-restoration conditions in more detail. The restored riparian buffer areas within the Site will aid in protecting water quality.

The main objective of the project was to reduce nitrogen and phosphorus loading to the Neuse River tributaries by establishing a forested riparian buffer on land previously used for agricultural purposes. The riparian buffer will immobilize nutrients, reducing quantities available to downstream aquatic ecosystems in the Neuse River Basin.

11.115 acres of land were protected with a conservation easement. Out of the 11.155 acres, 10.139 acres were restored for Neuse River buffer credit and 1.017 acres will not generate buffer mitigation credit. In general, riparian buffer restoration area widths on streams extend out to 200 feet from top of bank for Neuse River buffer credits. Maps detailing the credit generation are provided in Figure 3.

1.3 Monitoring Year 2 Data Assessment

The final mitigation plan was submitted and accepted by DMS in March 2017. Construction activities were completed by Land Mechanic Designs, Inc in July 2017. The planting was completed by Bruton Natural Systems, Inc. in December 2017. The baseline as-built survey for the stream mitigation work was completed by Turner Land Surveying in August 2017 and for the buffer mitigation component in January 2018. Monitoring Year 1 vegetation survey was completed September 2018. Refer to Appendix 1 for detailed project activity, history, contact information, and watershed/site background information.



Vegetative performance for buffer restoration areas will be in accordance with 15A NCAC 02B .0295(n)(2)(B), and (n)(4) (effective November 1, 2015). To meet success criteria, areas generating buffer mitigation credits shall include a minimum of four native hardwood tree species or four native hardwood tree and native shrub species, where no one species is greater than 50 percent of stems, and have a survival of 260 planted stems per acre at the end of the required monitoring period (MY5) (no interim success criteria required). In order for the monitoring to be terminated, DWR must provide a written approval of vegetation success of buffer restoration areas generating buffer credit. Annual monitoring was conducted to assess the condition of the vegetation in September 2019.

1.3.1 Vegetative Assessment

The quantity of monitoring vegetation plots was determined in accordance with the Carolina Vegetative Sampling Protocol (CVS Levels II) such that at least two (2) percent of the Site is encompassed in monitoring plots. A total of eight (8) vegetation plots (10 meters by 10 meters) were randomly established between the conservation easement boundaries and five feet from the top of stream banks. The plot corners have been marked and are recoverable either through field identification or with the use of a GPS unit. Reference photographs will be taken at the origin looking diagonally across the plot to the opposite corner on an annual basis. Species composition, density, and survival rates will be evaluated on an annual basis by plot and for the entire site. The extent of invasive species coverage will also be monitored and controlled as necessary.

The Monitoring Year 2 (MY2 of 5) vegetative survey was completed in September 2019. The 2019 annual vegetation monitoring resulted in an average survivability of 405 stems per acre, which is greater than the final requirement of 260 stems per acre, but approximately 32% less than the baseline density recorded (597 stems/acre) in January 2018. There was an average of 10 stems per plot compared to 14 stems per plot in MY0. Vegetation Plot 7 had an increased tree mortality rate from MY0 to MY2 due to herbaceous competition from Alligator Weed (*Alternanthera philoxeroides*). Vegetation Plot 7 is on track to meet the MY5 success criteria of 260 stems per acre but exceeds requirements by less than 10 percent with 283 planted stems per acre. Even with herbaceous competition, several volunteers were assessed in the plot including green ash (*Fraxinus pennsylvanica*) and buttonbush (*Cephalanthus occidentalis*), bringing the total stems per acre to 405, exceeding the success requirements by more than 10 percent. The Site is on track to meet its final success criteria. Please refer to Appendix 3 for vegetation plot criteria attainment data, CVS vegetation plot metadata, and vegetation summary tables and Appendix 2 for vegetation plot photographs, vegetation condition assessment table, and monitoring plan view.

Tree vigor along UT1 was good but is not performing as well as the rest of the Site. This is likely due to floodplain grading during construction. Approximately 100 pounds of biochar, rock phosphate, azomite, and humic acid was added to the floodplain to promote tree growth during MY2. Remedial action will be taken as necessary in subsequent monitoring years to promote tree growth.

1.4 Monitoring Year 2 Summary

Overall, the Site has met the required vegetation success criteria for MY2. All the vegetation plots met the MY2 success criteria as seen in the monitoring components map. While tree mortality rate in Vegetation Plot 7 increased, it is still meeting the success criteria and with volunteers is on track to exceed the success criteria with 405 stems per acre. At this time no remedial actions are proposed.

Summary information/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 documents available on DMS's website. All raw data supporting the tables and figures in the appendices is available from DMS upon request.

Section 2: METHODOLOGY

Planted woody vegetation was monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2006). A total of eight standard 10 meter by 10-meter vegetation plots were established within the project easement area.

Section 3: REFERENCES

- Breeding, R. 2010. Neuse River Basin Restoration Priorities. North Carolina Ecosystem Enhancement Program.
- Guidelines for Riparian Buffer Restoration. NC Department of Environment and Natural Resources, Ecosystem Enhancement Program. October 2004.
- Lee, Michael T., Peet, Robert K., Steven D., Wentworth, Thomas R. 2006. CVS-EEP Protocol for Recording Vegetation Version 4.0. Retrieved from <http://www.nceep.net/business/monitoring/veg/datasheets.htm>.
- Peet, R.K., T.R. Wentworth and P.S. White. 1998. A flexible, multipurpose method for recording vegetation composition and structure. *Castanea* 63:262-274. <http://cvs.bio.unc.edu/methods.htm>
- Schafale, M.P. and Weakley, A.S. 1990. A Classification of the Natural Communities of North Carolina, Third Approximation.
- Wildlands Engineering (2017). Martin Dairy Mitigation Site. NCDWR, Raleigh NC. <http://portal.ncdenr.org/web/wq/nutrientbufferbanks>



APPENDIX 1. General Figures and Tables

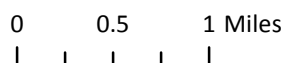
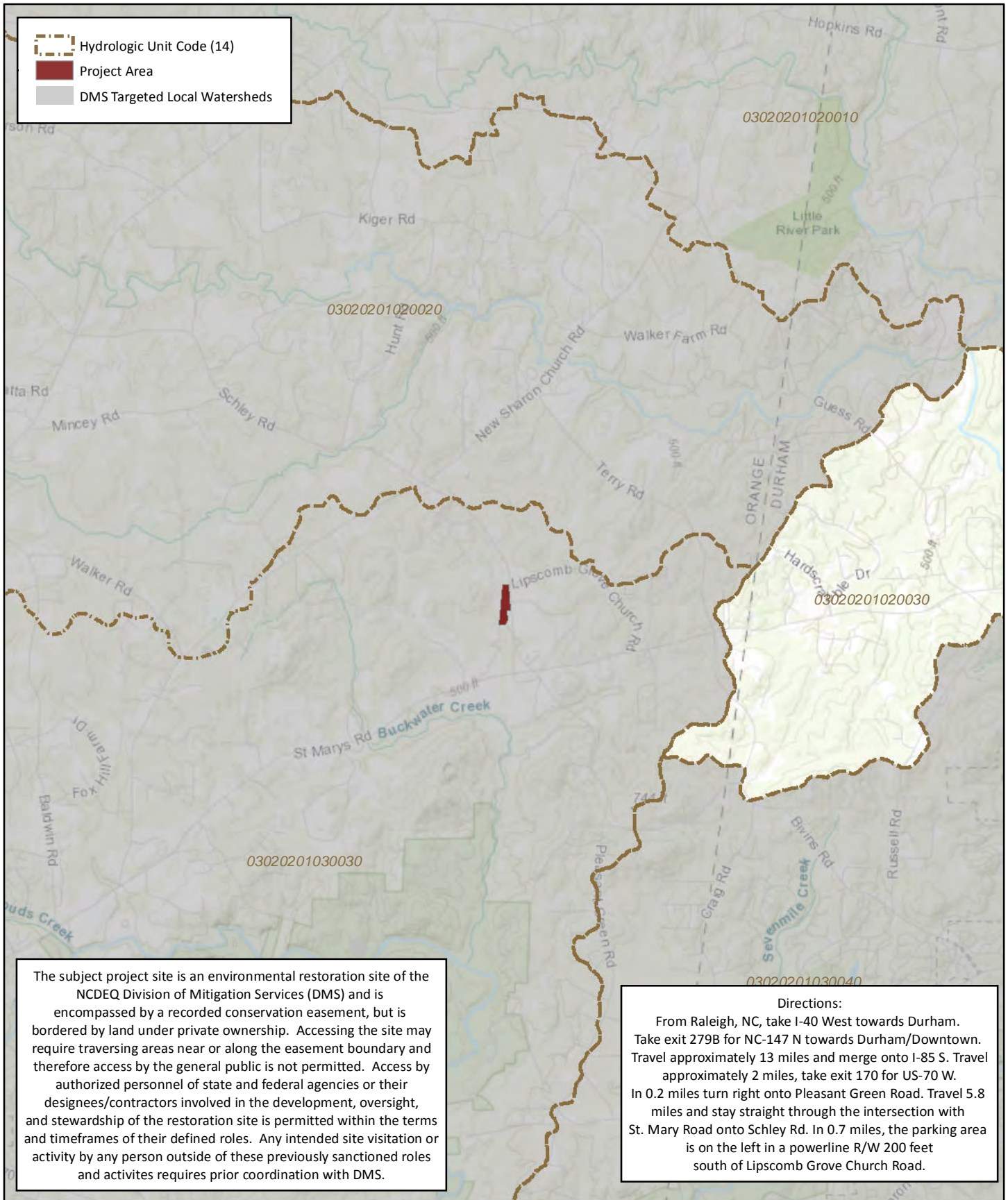


Figure 1. Project Vicinity Map
 Martin Dairy Buffer Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019
 Orange County, NC

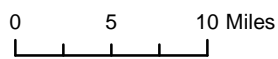
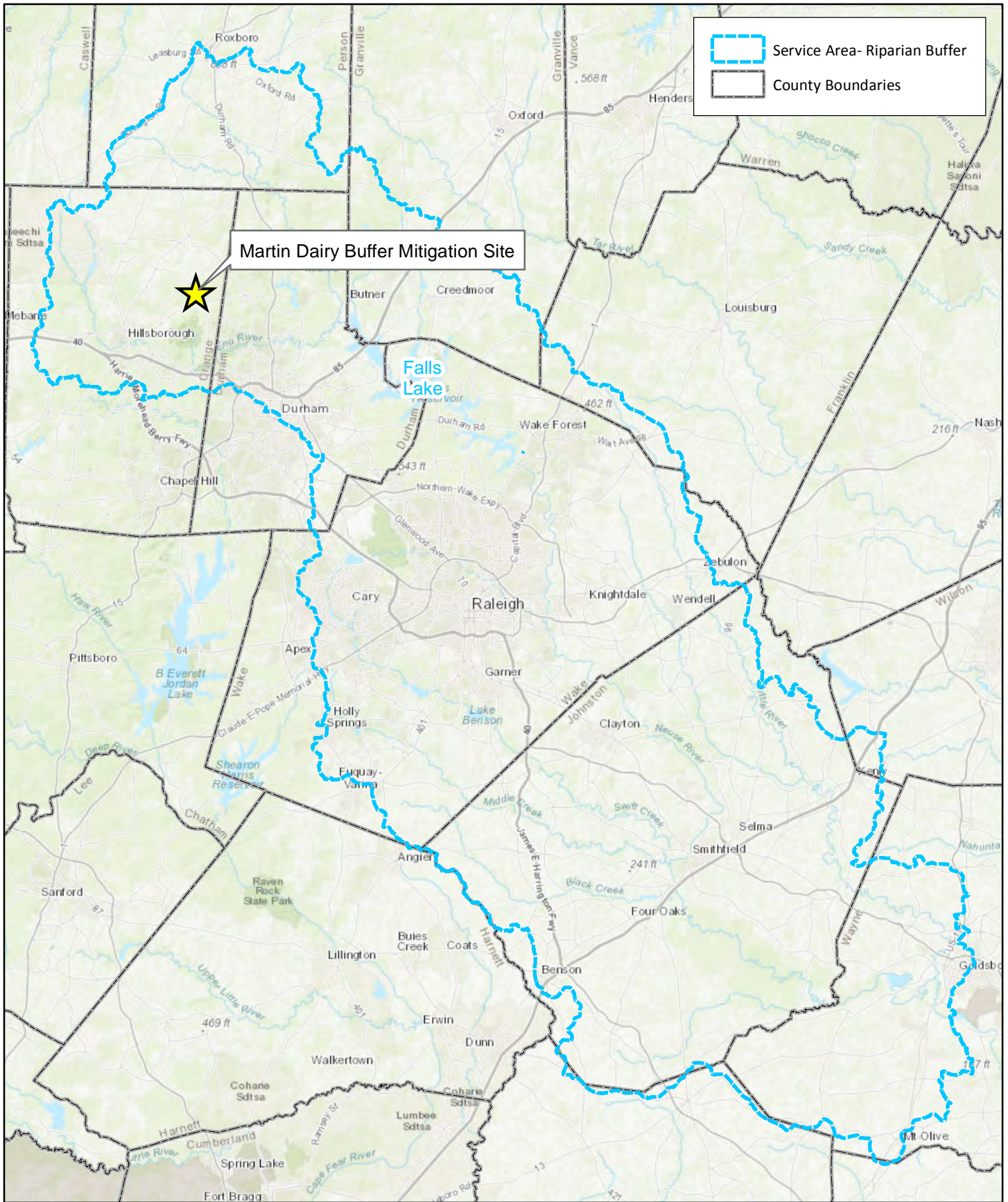


Figure 2. Service Area
Martin Dairy Buffer Mitigation Site
DMS Project No. 97087
Monitoring Year 2 - 2019

Orange County, NC

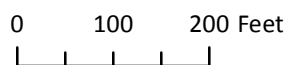
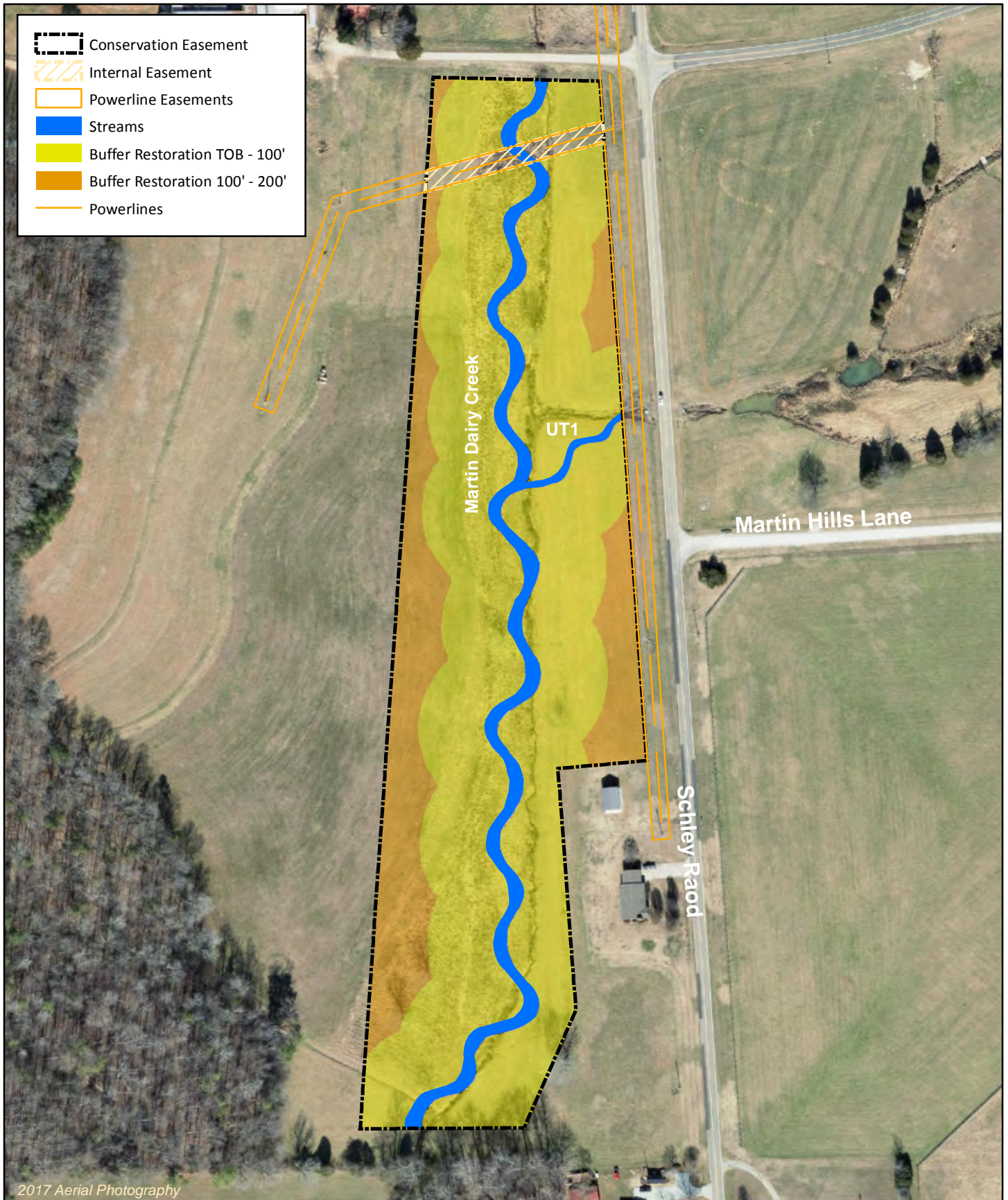


Figure 3. Project Component / Asset Map
 Martin Dairy Buffer Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019
 Orange County, NC

Table 1. Project Components and Mitigation Credits

Martin Dairy Buffer Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

MITIGATION CREDITS												
Riparian Buffer (15A NCAC 02B.0295)											If Converted to Nutrient Offset	
Location	Jurisdictional Streams	Restoration Type	Reach ID /Component	Buffer Width (ft)	Creditable Area (square feet)	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits (BMU)	Convertible to Nutrient Offset (Yes or No*)	Nutrient Offset: N (lbs)	Nutrient Offset: P (lbs)
Rural	Subject	Restoration	Martin Dairy	0-100	348,392.88	1	100%	1.00000	348,392.88	No	0.000	0.000
			Martin Dairy	101-200	93,261.96		33%	3.00000	30,776.45	No	0.000	0.000
SUBTOTALS					441,654.84				379,169.33		0.000	0.000

*Riparian buffer credits are not convertible to nutrient offset because the site was used for hay production and livestock have been removed.

Table 2. Project Activity and Reporting History

Martin Dairy Buffer Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Activity or Report	Date Collection Complete	Completion or Scheduled Delivery
Conservation Easement	N/A	November 2016
Mitigation Plan	March 2017	March 2017
Bare Root Planting	N/A	December 2017
As-Built & Baseline Monitoring Document	January 2018	January 2018
Year 1 Monitoring	September 2018	December 2018
Year 2 Monitoring	September 2019	December 2019
Year 3 Monitoring	2020	December 2020
Year 4 Monitoring	2021	December 2021
Year 5 Monitoring	2022	December 2022

Table 3. Project Contact Table

Martin Dairy Buffer Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Designer Angela Allen, PE	Wildlands Engineering, Inc. 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Planting Contractor	Bruton Natural Systems, Inc P.O. Box 1197 Fremont, NC 27830
Nursery Stock Suppliers	Dykes and Son Nursery
Monitoring Performers Monitoring, POC	Wildlands Engineering, Inc. Jason Lorch 919.851.9986, ext. 107

Table 4. Project Information and Attributes

Martin Dairy Buffer Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

PROJECT INFORMATION	
Project Name	Martin Dairy Buffer Mitigation Site
County	Orange County
Project Area (acres)	11.155
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
USGS Hydrologic Unit 8-digit	03020201
USGS Hydrologic Unit 14-digit	03020201030030
DWR Sub-basin	03-04-01
Project Drainage Area (acres)	526.0
Project Drainage Area Percentage of Impervious	0.4%
CGIA Land Use Classification	59.0% forested, 40.6% cultivated, 0.40% impervious

Table 5. Adjacent Forested Areas Existing Tree and Shrub Species

Martin Dairy Buffer Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Common Name	Scientific Name	Wetland Indicator Status
Red Maple	<i>Acer rubrum</i>	FAC
Water Hickory	<i>Carya aquatica</i>	OBL
Sugarberry	<i>Celtis laevigata</i>	FACW
Sweet Pepperbush	<i>Clethra alnifolia</i>	FACW
Swamp Titi	<i>Cyrilla racemiflora</i>	FACW
Persimmon	<i>Diospyros virginiana</i>	FAC
Water Ash	<i>Fraxinus caroliniana</i>	OBL
Deciduous Holly	<i>Ilex decidua</i>	FACW-
Virginia Sweetspire	<i>Itea virginica</i>	FACW+
Eastern Red Cedar	<i>Juniperus virginiana</i>	FACU-
Sweetgum	<i>Liquidambar styraciflua</i>	FAC+
Yellow Poplar	<i>Liriodendron tulipifera</i>	FAC
Water Tupelo	<i>Nyssa aquatica</i>	OBL
Blackgum	<i>Nyssa sylvatica</i>	FAC
Loblolly Pine	<i>Pinus taeda</i>	FAC
American Sycamore	<i>Platanus occidentalis</i>	FACW-
Willow Oak	<i>Quercus phellos</i>	FACW-
Red Oak	<i>Quercus rubra</i>	FACU
Shumard Oak	<i>Quercus shumardii</i>	FACW-
Black Willow	<i>Salix nigra</i>	OBL

Table 6. Planted Tree Species

Martin Dairy Buffer Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Common Name	Scientific Name	Number Planted	% of Total
River Birch	<i>Betula nigra</i>	926	16%
Eastern Redbud	<i>Cercis canadensis</i>	58	1%
Flowering Dogwood	<i>Comus florida</i>	58	1%
Green Ash	<i>Fraxinus pennsylvanica</i>	1,042	18%
Tulip Poplar	<i>Liriodendron tulipifera</i>	926	16%
Sycamore	<i>Platanus occidentalis</i>	1,274	22%
Pin Oak	<i>Quercus palustris</i>	811	14%
Willow Oak	<i>Quercus phellos</i>	695	12%
Total		5,790	100%

APPENDIX 2. Visual Assessment Data

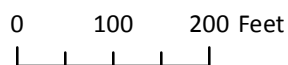
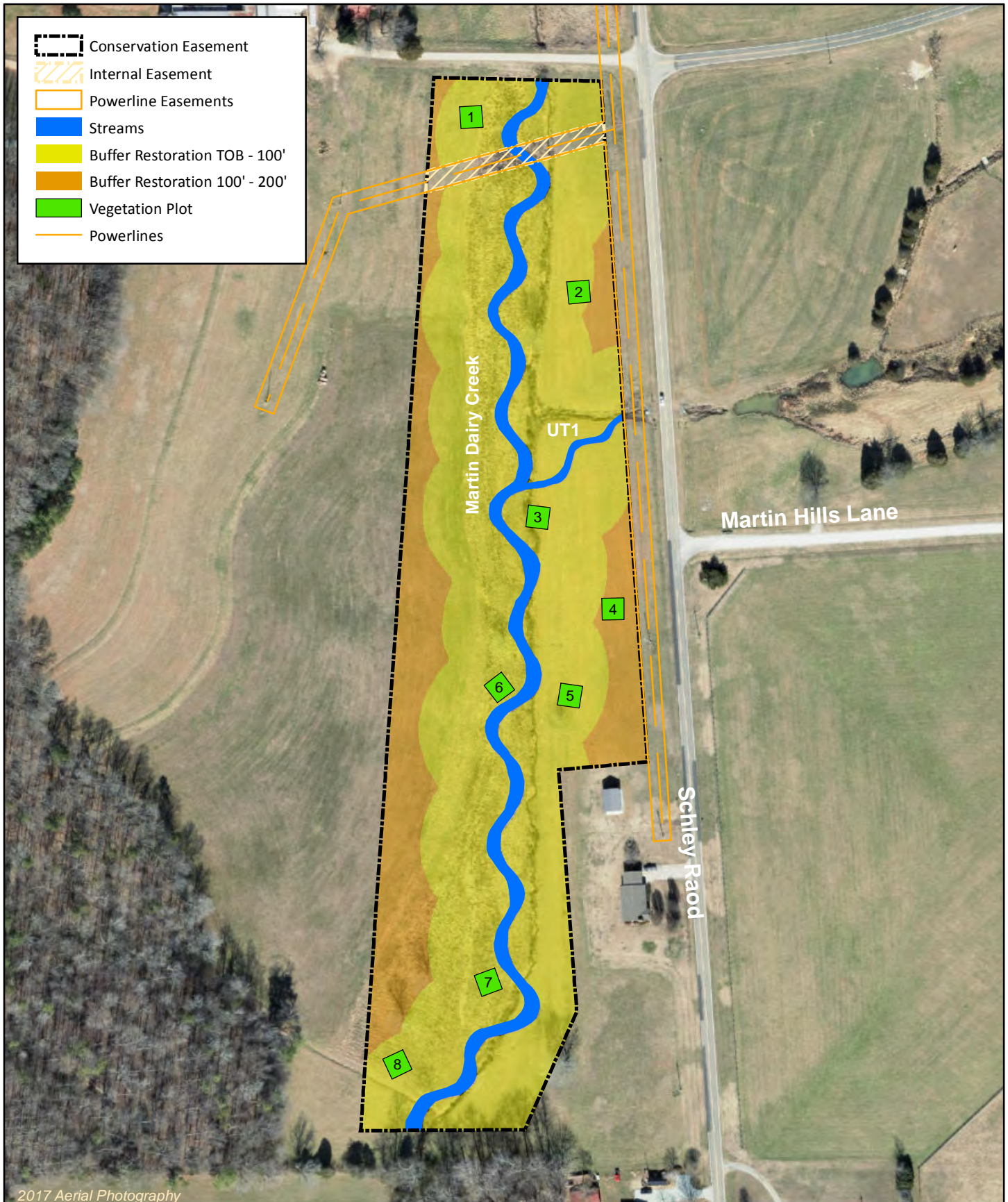


Figure 4. Monitoring Plan View
 Martin Dairy Buffer Mitigation Site
 DMS Project No. 97087
 Monitoring Year 2 - 2019
 Orange County, NC

Table 7. Vegetation Condition Assessment Table

Martin Dairy Buffer Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

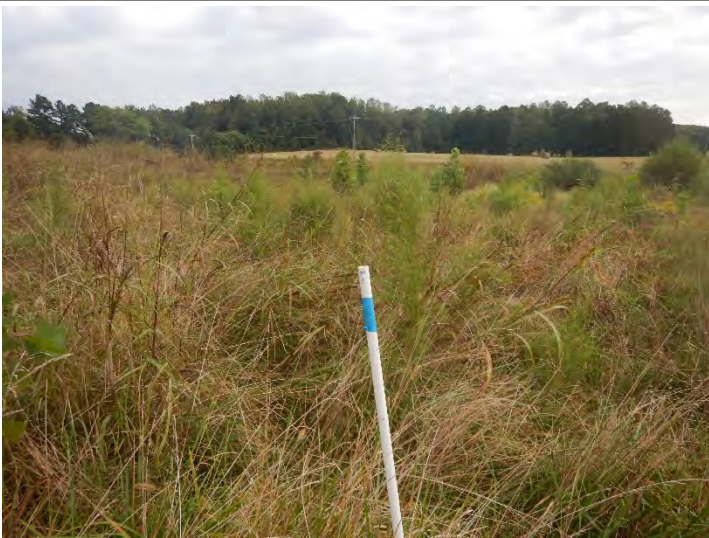
Planted Acreage 10.139

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	0	0	0%
Cumulative Total			0	0.0	0%

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%

VEGETATION PLOT PHOTOGRAPHS



VEG PLOT 1 (09/18/2019)



VEG PLOT 2 (09/18/2019)



VEG PLOT 3 (09/18/2019)



VEG PLOT 4 (09/18/2019)



VEG PLOT 5 (09/18/2019)



VEG PLOT 6 (09/18/2019)



VEG PLOT 7 (09/18/2019)



VEG PLOT 8 (09/18/2019)

APPENDIX 3. Vegetation Plot Data

Table 8. Vegetation Plot Criteria Attainment Table

Martin Dairy Buffer Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Plot	Met Success Criteria	Tract Mean
1	Yes	100%
2	Yes	
3	Yes	
4	Yes	
5	Yes	
6	Yes	
7	Yes	
8	Yes	

Table 9 CVS Vegetation Tables - Metadata

Martin Dairy Buffer Mitigation Project
 DMS Project No.97087
Monitoring Year 2 - 2019

Report Prepared By	Jason Lorch
Date Prepared	9/20/2019 14:12
Database Name	Martin Dairy- cvs-v2.5.0.- MY2.mdb
Database Location	F:\Projects\005-02158 Martin Dairy\Monitoring\Monitoring Year 2\Vegetation Assessment
Computer Name	CARLYNN-PC
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 10. Planted and Total Stem Counts

Martin Dairy Buffer Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2019)														
			VP 1			VP 2			VP 3			VP 4			VP 5		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Betula nigra</i>	River Birch	Tree	1	1	1	2	2	2	3	3	3	1	1	1	3	3	3
<i>Cephalanthus occidentalis</i>	Buttonbush	Shrub Tree															
<i>Cercis canadensis</i>	Red Bud	Shrub Tree															
<i>Cornus florida</i>	Flowering Dogwood	Shrub Tree															
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree	2	2	2	3	3	3	2	2	2	3	3	3	1	1	1
<i>Liquidambar styraciflua</i>	Sweet Gum	Tree									4			1			
<i>Liriodendron tulipifera</i>	Tulip Poplar	Tree	3	3	3							1	1	1			
<i>Platanus occidentalis</i>	Sycamore	Tree	2	2	2	2	2	2	2	2	2	2	2	2	4	4	4
<i>Pyrus calleryana</i>	Bradford Pear	Tree			1												2
<i>Quercus palustris</i>	Pin Oak	Tree				2	2	2	2	2	2	3	3	3			
<i>Quercus phellos</i>	Willow Oak	Tree	3	3	3	2	2	2	1	1	1	2	2	2	2	2	2
<i>Ulmus</i>	Elm	Tree												1			
Stem count			11	11	11	11	11	11	10	10	14	12	12	14	10	10	10
size (ares)			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			5	5	5	5	5	5	5	5	6	6	6	8	4	4	4
Stems per ACRE			445	445	445	445	445	445	405	405	567	486	486	567	405	405	405

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 10. Planted and Total Stem Counts

Martin Dairy Buffer Mitigation Site

DMS Project No. 97087

Monitoring Year 2 - 2019

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2019)									Annual Means								
			VP 6			VP 7			VP 8			MY2 (2019)			MY1 (2018)			MY0 (2018)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Betula nigra</i>	River Birch	Tree	2	2	2	1	1	1	1	1	1	14	14	14	16	16	16	17	17	17
<i>Cephalanthus occidentalis</i>	Buttonbush	Shrub Tree			11			1						12			8			
<i>Cercis canadensis</i>	Red Bud	Shrub Tree													1	1	1	3	3	3
<i>Cornus florida</i>	Flowering Dogwood	Shrub Tree													2	2	2	2	2	2
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree	1	1	1	1	1	3	2	2	30	15	15	45	17	17	29	18	18	18
<i>Liquidambar styraciflua</i>	Sweet Gum	Tree									4			9			2			
<i>Liriodendron tulipifera</i>	Tulip Poplar	Tree							1	1	3	5	5	7	7	7	7	19	19	19
<i>Platanus occidentalis</i>	Sycamore	Tree	4	4	4	4	4	4	2	2	7	22	22	27	24	24	25	25	25	25
<i>Pyrus calleryana</i>	Bradford Pear	Tree												3						
<i>Quercus palustris</i>	Pin Oak	Tree	2	2	2	1	1	1	2	2	2	12	12	12	16	16	16	20	20	20
<i>Quercus phellos</i>	Willow Oak	Tree	1	1	1				1	1	1	12	12	12	14	14	14	14	14	14
<i>Ulmus</i>	Elm	Tree									1			2			1			
Stem count			10	10	21	7	7	10	9	9	49	80	80	140	97	97	121	118	118	118
size (ares)			1			1			1			8			8			8		
size (ACRES)			0.02			0.02			0.02			0.20			0.20			0.20		
Species count			5	5	6	4	4	5	6	6	8	6	6	9	8	8	11	8	8	8
Stems per ACRE			405	405	850	283	283	405	364	364	1983	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

APPENDIX 4. Overview Photos



