Monitoring Report Year 2
FINAL

Bowman
(Mt. Pleasant Creek Restoration Project)
DMS Project Number 44
401: DWR 07-2252v2
404: SAW-2008-01382

Randolph County, North Carolina

Prepared by:
NCDMS, 1652 Mail Service Center, Raleigh, NC 27699-1652

Mitigation Services
ENVIRONMENTAL QUALITY

Monitoring Data Collected: July-October 2018

TABLE OF CONTENTS

Appendix A – Background Tables

Appendix B – Visual Assessment Data

Appendix C – Vegetation Plot Data

Appendix D – Stream Measurement and Geomorphology Data

PROJECT SUMMARY

Project work at the Mt. Pleasant Creek Restoration Project, Bowman Property ("Bowman") was completed in February 2017, and included construction, planting, invasive treatment, and fence installation. Through this project work, a total of 1,866 linear feet of stream were enhanced or preserved, and 358,604 sf of buffer were protected, enhanced, or restored. The project stream is perennial and drains a 5.2-acre watershed in the Cape Fear River Basin (03030003 8-digit cataloging unit) of Randolph County, North Carolina. The Bowman site has a history of unrestricted livestock access, leading to bank erosion, compaction, and discontinuity between the stream and its associated floodplain. The completed project will reduce sediment inputs from failing banks, reduce nutrients and bacteria entering the stream from livestock and will enhance the forested corridor along the stream floodplain.

The project is protected by a 9.61-acre permanent conservation easement, held by the NC Department of Transportation. Bowman is located off Whites Chapel Road, approximately 5 miles southwest of Liberty, North Carolina. The project site is bounded by interspersed pastureland and forested land to the east, forest to the south, pasture and forest to the north, and agricultural land and forest to the west. Bowman is within a parent parcel involved with agricultural production for cattle, chicken houses, goats, and hay pasture.

GOALS & OBJECTIVES

The 2009 Cape Fear River Basin RBRP identified HUC 03030003020010 (Sandy Creek) as a Targeted Local Watershed, of which the project site is a part (NCEEP 2009). The project goals are in line with the following basin priorities:

- Reduce sources of sediment and nutrients by enhancing riparian buffer vegetation, excluding livestock, and enhancing stream and buffer function.

The goals for the project are to:

- Restore long term stability to exposed banks and reduce susceptibility to scour.
- Eliminate stream bacteria and nutrient exposure from animal waste and wallow.
- Restore a contiguous riparian buffer that connects to the surrounding forested mature buffer.

The project goals will be addressed through the following objectives:

- Conduct Enhancement I level stream restoration on 530 linear feet of stream by repairing actively eroding banks and re-establishing the stream pattern where there has been excessive sediment deposition.
- Conduct Enhancement II level stream restoration on 1,046 linear feet of stream through a permanent conservation easement and removing cattle access.
- Install Preservation on an additional 290 linear feet of stream by putting the stream in a permanent conservation easement.
- Riparian buffer restoration, enhancement, and preservation throughout the stream corridor.

DESIGN APPROACH & IMPLEMENTATION

To implement these objectives, project work was completed in February 2017 per the Mitigation Plan. The as-built and baseline surveys found that the stream was constructed as designed and all structures were installed as planned. Stream work included installation of 7 soil lifts fortified with live willow whips, a ford crossing, and constructed riffle in the Enhancement I credit area. Bio-engineering with live staking, temporary and permanent seeding occurred along all exposed banks, and sloped banks; and transplants were installed where possible. Invasive treatment occurred throughout the entire easement, using a stump herbicide treatment method. The site was constructed as designed. The only modification during construction was the extension of the stone on both sides of the ford crossing.

On March 9, 2017, 1.23-acres of riparian buffer was planted per the Mitigation Plan specifications. Five species of trees were installed at a density of approximately 600 trees per acre. There were two substitutions from the Mitigation Plan species due to availability and vigor of trees (*Nyssa sylvatica* and *Quercus nigra*). Also in March following planting, 3-strand high tensile electric fencing was installed in the crossing area.

MONITORING

The monitoring components were installed in March 2017 per the Mitigation Plan monitoring specifications. Three permanent cross-sections were established at stations 12+12 (XS2), 15+25 (XS3) and 17+00 (XS4). Two of these cross-sections (12+12 and 17+00) were established at location where previous, pre-construction cross-sections were installed for comparison. The third cross-section (15+25) was placed across the newly constructed riffle. A crest gauge was installed to record the occurrence of bankfull events.

For vegetation monitoring, one permanent and two random 10 m^2 vegetation monitoring plots were established. The location of the planted stems relative to the origin within the permanent plot, as well as the species in all plots, was recorded by size. Volunteers were recorded by species and size separately from planted stems. Six permanent photo reference points were established and will be taken annually.

SUCCESS CRITERION

Stream performance standards are based on 2003 Stream Mitigation Guidelines for determination of channel stability and vegetative success. Stream stability will be documented through 1) annual visual assessment 2) demonstration of bankfull events, 3) stream photo points and 4) monitoring three cross sections (for the Enhancement I section only). A minimum of two bankfull events in separate years must be recorded during the five-year monitoring period to meet success.

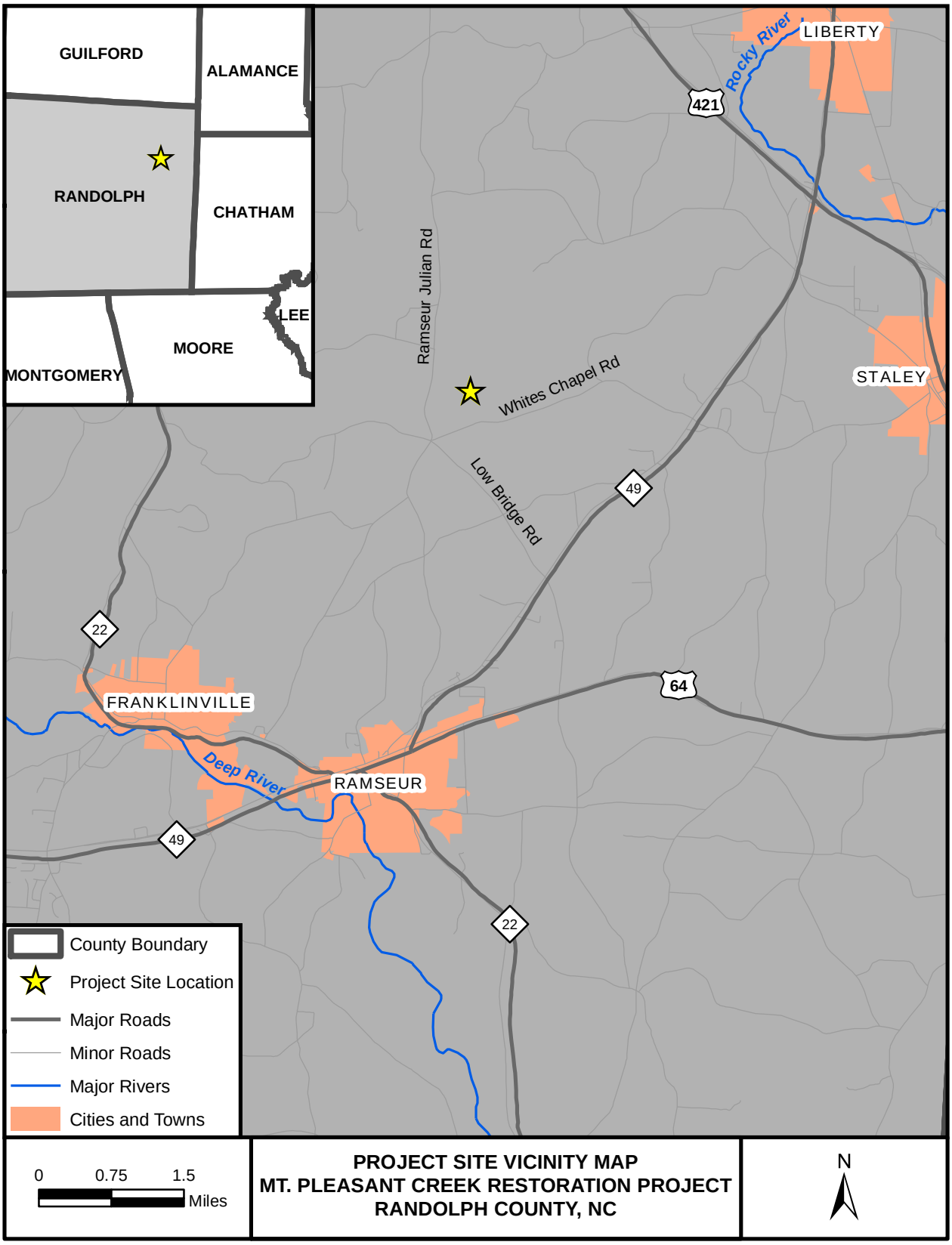
Vegetative success criterion is in accordance with North Carolina Division of Water Resources Administrative Code 15A NCAC 02B.0295 (NCDWR 2014 Temporary Rule). After five years of monitoring, an average density of 260 woody stems per acre must be surviving and diffuse flow maintained.

MONITORING YEAR 2 RESULTS

Vegetative monitoring and visual assessments occurred on July 16, 2018; cross-sections were measured July 16 and October 16. Vegetation monitoring, visual assessments, and cross-sectional surveys results are summarized in tables below. The one permanent and two random vegetation plots all met success criteria (Table 5). Walnut volunteers continue to thrive on the planted areas of the site, as there are many "parent" walnut trees that are large and mast producing. Invasive treatment occurred in spring and fall in 2018 and will be on-going throughout the monitoring period. Privet sprouting was noted by the invasive contractor and during visual assessment, but it is being managed well.

There were numerous bankfull events during 2018, at least visually documented twice in the monitoring year (Table 7). There were several very large trees lifted into the floodplain, evidence of significant rack and debris, and establishment of some benching. Despite large climatological events, including Hurricane Florence and Matthew, which brought high winds and 4" and 2.5" of rain respectively, the stream banks held. Willow whip live stakes are vigorous and have established a strong bank foothold.

During the MY2 site visit, staff noticed some isolated areas of bank scour and mechanical failure in the enhancement II area, which may have previously been obscured by dense privet in these areas. Due to these concerns, staff resurveyed a stream cross-section and compared it to a 2007 survey (Cross-sections, page 23) and looked at pre-conditions. These comparisons showed no significant deviation from pre-conditions, and staff professionals think it likely due to the large drainage area and natural geomorphological processes, and that these banks looked like this all along.


GUILFORD
ALAMANCE
RANDOLPH
CHATHAM
LEE
MOORE
MONTGOMERY
LIBERTY
Rocky River
421
Ramseur Julian Rd
Whites Chapel Rd
STALEY
Low Bridge Rd
49
22
64
FRANKLINVILLE
Deep River
RAMSEUR
49
22
County Boundary
Project Site Location
Major Roads
Minor Roads
Major Rivers
Cities and Towns
0
0.75
1.5
Miles
PROJECT SITE VICINITY MAP
MT. PLEASANT CREEK RESTORATION PROJECT
RANDOLPH COUNTY, NC
N

Bowman Site (Mount Pleasant Creek), DMS ID #44
Asset Map

0 75 150 300 Feet

N W E S

REFERENCES

NCDENR, Ecosystem Enhancement Program. 2009. Cape Fear River Basin Restoration Priorities 2009. Raleigh, NC. Last accessed 1/2016 at: http://portal.ncdenr.org/c/document_library/get_file?uuid=705d1b58-cb91-451e-aa58-4ef128b1e5ab&groupId=60329

NCDENR, Ecosystem Enhancement Program. 2014. NCDENR, Ecosystem Enhancement Program. 2014.
Stream and Wetland Mitigation Monitoring Guidelines. Last accessed 1/2016 at: http://portal.ncdenr.org/c/document_library/get_file?p_l_id=60409&folderId=18877169&n ame=DLFE-86604.pdf

NCDENR, Ecosystem Enhancement Program. 2014. Stream and Wetland Mitigation Monitoring Guidelines. Last accessed 6/2015 at: http://portal.ncdenr.org/c/document_library/get_file?p_l_id=60409&folderId=18877169&n ame=DLFE-86606.pdf

APPENDIX A

Background Tables

Table 1. Project Components and Mitigation Credits
Mt. Pleasant Creek Restoration Project-Bowman Property, DMS Project #44
Mitigation Credits

	Stream		Riparian Buffer	
Type	R	RE	R	E
Size (ft/sf)	1,576	290	37,474	321,130
Credits (SMU/BMU)	772	58	33,359	144,090
TOTAL CREDITS		830		177,448

STREAM MITIGATION

Project Component	Location	Existing Length (ft)	Approach	Mitigation Ratio (x: 1)	Restoration Length (ft)	Credits (SMU)
Mount Pleasant Creek	10 + 00 to 11+75	175	Enhancement II	2.5	175	70
	11+75 to 14+91 15+11 to 17+25	530	Enhancement I	1.5	530	353
	17 + 25 to 25 + 96	871	Enhancement II	2.5	871	348
	25 + 96 to 28 + 86	290	Preservation	5	290	58

RIPARIAN BUFFER MITIGATION: Randleman Lake Water Supply Watershed

Project Component	Proximity to TOB (ft)	Existing Area (sqft)	Approach	Mitigation Ratio (x: 1)	Eligible Restoration Area (sqft)	Credits (BMU)
A	0-100	16,404	Restoration	1	16,404	16,404
E1	0-100	5,222	Restoration	1	5,222	5,222
E1	100-200	3,091	Restoration	2	3,091	1,546
E2	0-100	7,617	Restoration	1	7,617	7,617
E2	100-200	5,140	Restoration	2	5,140	2,570
B	0-100	19,982	Enhancement	2	19,982	9,991
B	100-200	6,611	Enhancement	4	6,611	1,653
C1, C2, C3 & D	0-100	246,962	Alt. Enhancement	2	246,962	123,481
C1, C2, C3 & D*	100-200	47,575	Alt. Enhancement	4	35,860	8,965
SUM		**358,604**			**346,889**	**177,448**
SUBTOTAL	0-100		Restoration	1	29,243	29,243
SUBTOTAL	100-200		Restoration	2	8,231	4,116
SUBTOTAL	0-100		Enhancement	2	266,944	133,472
SUBTOTAL	100-200		Enhancement	4	42,471	10,618

*Area greater than 100' from TOB must be no greater than 10% of total mitigation. Eligible area was reduced from Mitigation plan to reflect this.
Ratios taken from Temporary Rule 15A NCAC 02B .0295 (i) and (m) as prescribed in 3/1/2016 DWR Viability Letter.
All Stream on Project Site has greater than 30' buffer throughout project.
Alt. Enhancement for grazing (m)(2)(F) is proven through project documentation of unrestricted livestock access and attesting landowner letter.

Table 2. Project Activity & Reporting History Mt. Pleasant Creek Restoration Project-Bowman Property, DMS Project #44		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan		March 16
Final Design - Construction Plans		June 16
Construction & Invasive Trtmt		Feb 17
Planting		March 17
Baseline Monitoring/Report	March 17	April 17
Invasive Trtmt		All Fall & Spring
Year 1 Monitoring	October 9, 2017	November 17
Year 2 Monitoring	July 23 & October 23, 2018	November 18

Table 3. Project Contacts Mt. Pleasant Creek Restoration Project-Bowman Property, DMS Project #44	
Design Firm	KCI Associates of North Carolina, PC 4505 Falls of Neuse Road, Suite 400 Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
Construction Contractor	Cole Land and Timber, LLC PO Box 97 Southmont, NC 27351 Contact: Brooks Cole Phone: (336)239-4039
Invasive Treatment Contractor (Initial)	Bruton Natural Systems, Inc. P.O. Box 1197 Fremont, NC 27830 Contact: Charlie Bruton Phone: (919) 242-6555
Planting Contractor (Long-term Invasive Treatment)	Carolina Silvics 1600 Olive Chapel Rd, Suite 232 Apex, NC 27502 Contact: Mary Margaret McKenney Phone: (252) 482-8491
Monitoring Performers	
MY0 **MY1-5**	KCI Associates of North Carolina, PC (Spiller) DMS (Crocker, Haywood)

Table 4. Project Information Mt. Pleasant Creek Restoration Project-Bowman Property, DMS Project #44			
Project Name	Mt. Pleasant Creek Restoration Project		
County	Randolph County		
Project Area (acres)	9.61 acres		
Project Coordinates (lat. and long.)	35.7938° N, - 79.6363° W		
Project Watershed Summary Information			
Physiographic Province	Piedmont		
River Basin	Cape Fear		
USGS Hydrologic Unit 8-digit	03030003	**USGS Hydrologic Unit 14-digit**	03030003020010
DWQ Sub-basin	03-06-09		
Project Drainage Area (acres)	3,354 acres		
Project Drainage Area Percentage of Impervious Area	1%		
CGIA Land Use Classification	Piedmont Alluvial Forest 21% (3.4 ac), Dry-Mesic-Oak-Hickory Forest 42% (6.6 ac), Pasture/Disturbed Community 37% (5.8 ac)		

Existing Reach Summary Information		
Parameters	**Mt. Pleasant Creek**	**UT to Mt. Pleasant Creek**
Length of reach (linear feet)	1,866	236
Valley classification	3,354 acres	33 acres
Drainage area (acres)	WS-III	WS-III
NCDWQ Water Quality Classification	C4/1	B4/1
Morphological Description (stream type)	Stage VI	N/A
Evolutionary trend	Georgeville silt loam	Georgeville silt loam
Mapped Soil Series	Well drained	Well drained
Drainage class	Non-hydric	Non-hydric
Soil Hydric status	0.7%	0-2%
Slope	Zone AE	Zone AE
FEMA classification	Piedmont Alluvial Forest	Piedmont Alluvial Forest
Existing vegetation community	5%	5%
Percent composition of exotic invasive vegetation		

Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	NWP 27
Waters of the United States – Section 401	Yes	Yes	NWP 27
Endangered Species Act	No	N/A	N/A
Historic Preservation Act	No	N/A	N/A
Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	N/A
Essential Fisheries Habitat	No	N/A	N/A

APPENDIX B

Visual Assessment Data

Table 5 Visual Assessment

Stream Stability

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody	Footage with Stabilizing Woody	Adjusted % for Woody Vegetation
Bank	Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			2	95	100%	0	0	100%
	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.			1	100	100%	0	0	100%
	Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	3	195	100%	0	0	100%
Engineered Structures	Overall Integrity	Structures physically intact with no dislodged boulders or logs.	7	7			100%			
	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	7	7			100%			
	Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	0	0			N/A			

Vegetative Condition		Planted Acreage	1.23				
	Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
	Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Pattern and Color	0	0.00	0.0%
	Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
				Total	0	0.00	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 acres	Pattern and Color	0	0.00	0.0%
				Cumulative Total	0	0.00	0.0%
	Invasive Areas of Concern[4]	Areas or points (if too small to render as polygons at map scale).	1000 SF	Pattern and Color	0	0.00	0.0%
	Easement Encroachment Areas[3]	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%

Bowman Site (Mount Pleasant Creek), DMS ID #44
Current Condition Plan View: MY2 2018

0 75 150 300 Feet

N W E S

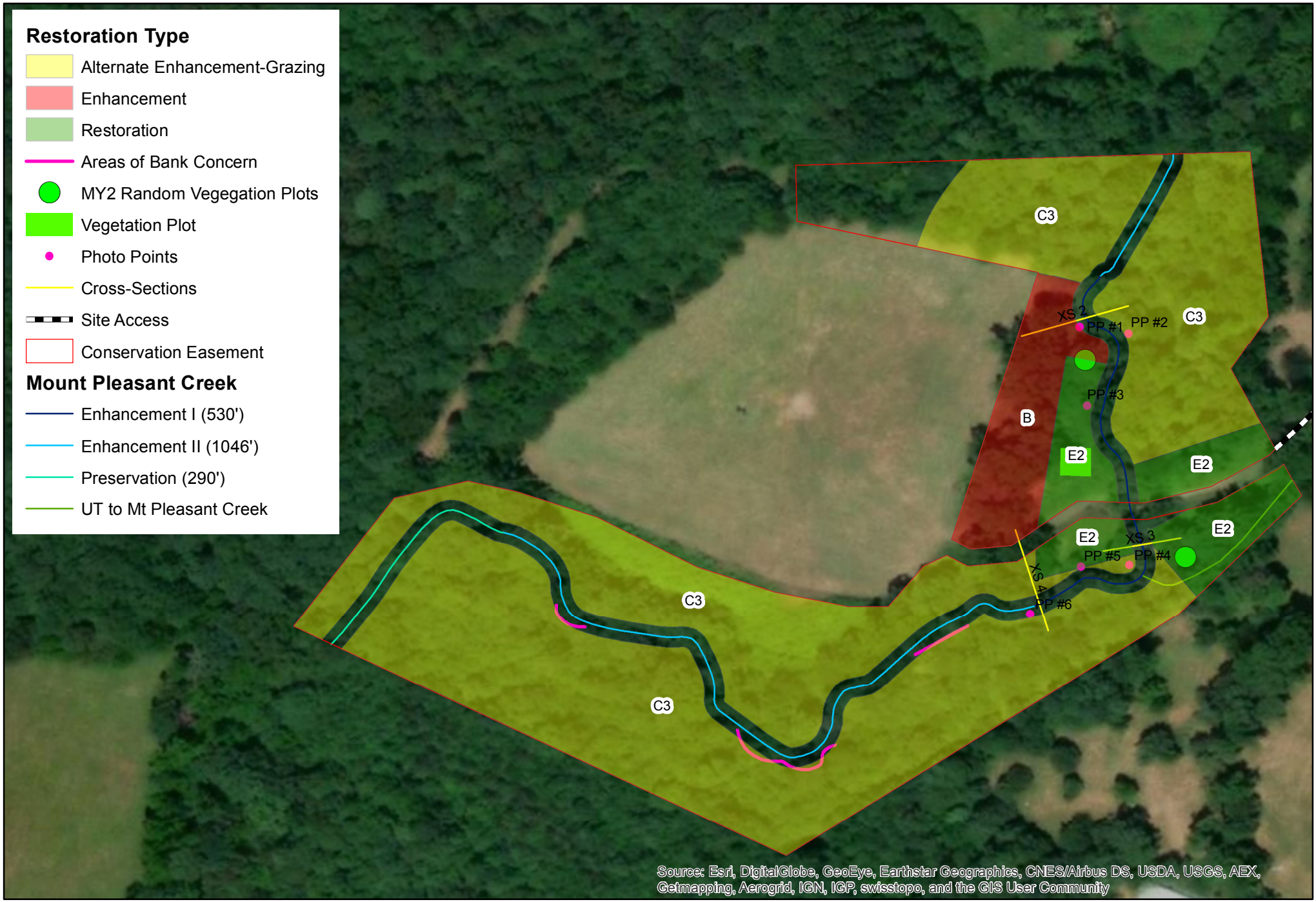


Photo Reference Photos

PP1 – MY-00 – 3/30/17

PP1 – MY-01 – 11/9/17

PP2 – MY-01 – 2018 (taken in June)

PP2 – MY-00 – 3/30/17

PP2 – MY-01 – 11/9/17

PP2 – MY-02 – 2018

PP3 – MY-00 – 3/30/17

PP3 – MY-01 – 11/9/17

PP3 – MY-02 –2018

P4 – MY-00 – 3/30/17

PP4 – MY-01 – 11/9/17

PP4 –MY-2 – 2018

PP5– MY-00 – 3/30/17

PP5– MY-01 – 11/9/17

PP5 –MY-2 – 2018

PP6– MY-00 – 3/30/17

PP6– MY-01 – 11/9/17

PP6 –MY-2 – 2018

Vegetation Monitoring Plot Photos

Permanent Vegetation Plot 1 (10/16/18)–

Other Photos

10/16/18. Large wood picked up during a storm and distributed on floodplain.

10/16/18. Depositional sediment bar forming in stream.

10/16/18. Wrack piling up from storms. See backround image of exposed bank as typical on Enhancement II section.

APPENDIX C

Vegetation Plot Data

Table 6. Tree Planting Mt. Pleasant Creek Restoration Project-Bowman Property, DMS Project #44			
Species	**Quantity**	**Type**	**Nursery**
Cornus ammomum	200	tubelings	Mellow Marsh Farm
Liriodendron tulipifera	200	bare roots	Superior Trees
Nyssa sylvatica	200	bare roots	Superior Trees
Platanus occidentalis	40	tubelings	Mellow Marsh Farm
Quercus nigra	200	bare roots	Superior Trees

Table 7. Stem Count by Plot and Species
Bowman (Mt. Pleasant Creek), DMS Project #44

Species	Current Plot Data (MY2 2018)						Annual Means MY0 (2017)		Annual Means MY1 (2017)		Annual Means MY2 (2018)	
	Plot P1		Plot T1		Plot T2							
	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
American Sycamore (*Platanus occidentalis*)	2	2	1	1			18	18	6	6	3	3
Blackgum (*Nyssa sylvatica*)	3	3	5	5	7	7	9	9	4	4	15	15
Silky dogwood (*Cornus amomum*)	2	2	4	4	5	5	13	13	14	14	11	11
Tulip Poplar (*Liriodendron tulipifera*)	2	2	2	2	5	5	12	12	11	11	9	9
Water Oak (*Quercus nigra*)	1	1					14	14	7	7	1	1
Black Walnut (*Juglans nigra*)		1		2		3		1		1		6
Persimmon (*Diospyros virginiana*)		2										2
Green Ash (*Fraxinus pennsylvanica*)		1										1
Stem count	10	14	12	14	17	20	66	67	42	43	39	48
Number of plots	1		1		1		3		3		3	
size (acres)	0.025		0.025		0.025		0.075		0.075		0.075	
Species count	5	8	4	5	3	4	5	6	5	6	5	8
Stems per ACRE	400	560	480	560	680	800	890	904	560	573	520	640
Meets Success Criteria												

APPENDIX D

Stream Measurement and Geomorphology Data

Table 8. Bankfull Events

Bowman (Mount Pleasant Creek, DMS Project #44

Date of Bankfull Event	Evidence
5/25/2017	Rack, sorting in the bed, deposition on banks
6/27/2017	Rack, sorting in the bed, deposition on banks, large logs moved in the stream and floodplain
7/16/2018	Rack and debris on stream banks (possibly below bankfull line)
10/23/2018	Large debris, rack lines in floodplain and on bankfull benches

Bankfull Pictures

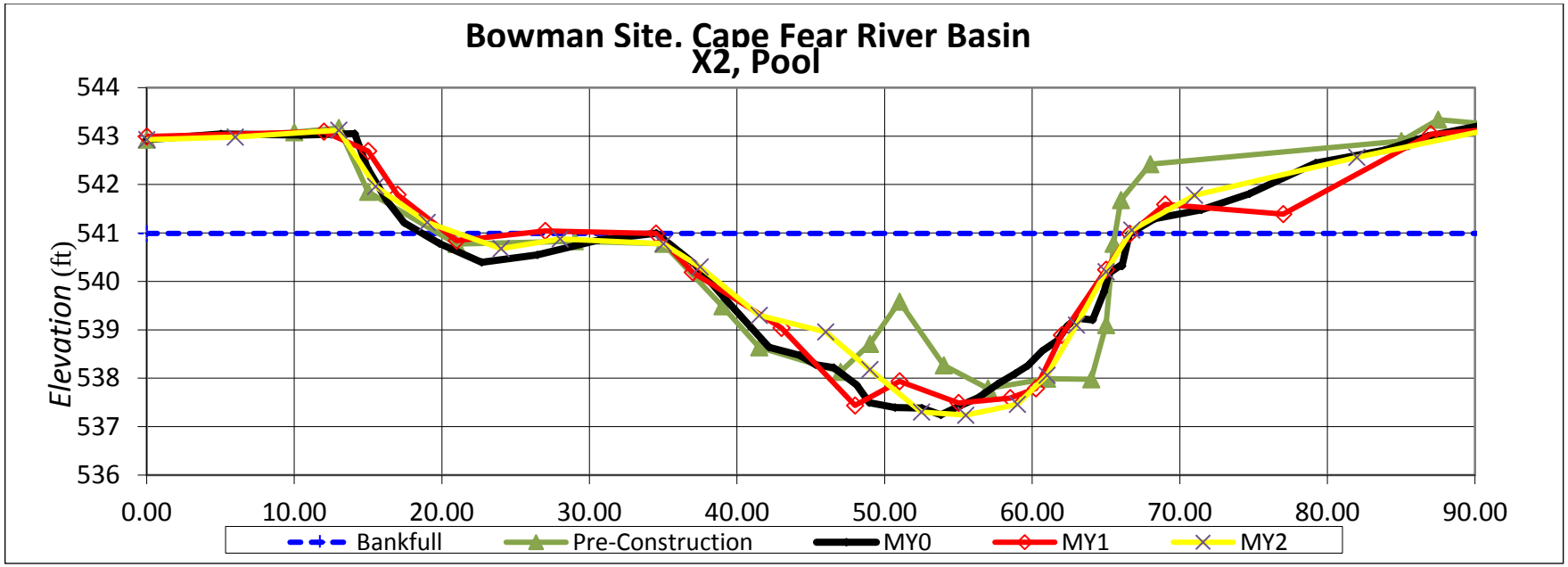
Evidence of wrack on the banks and sorting, 10/16/18

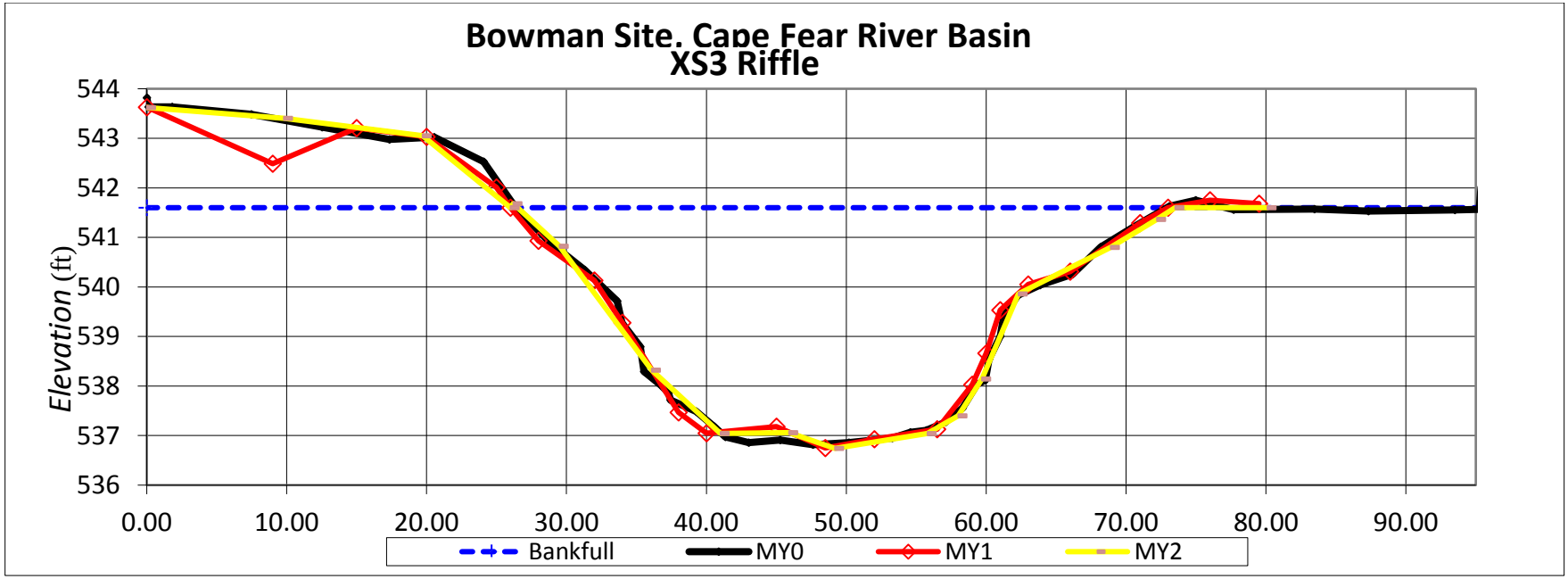
Table 9. Cross-Section Morphology Data Tables

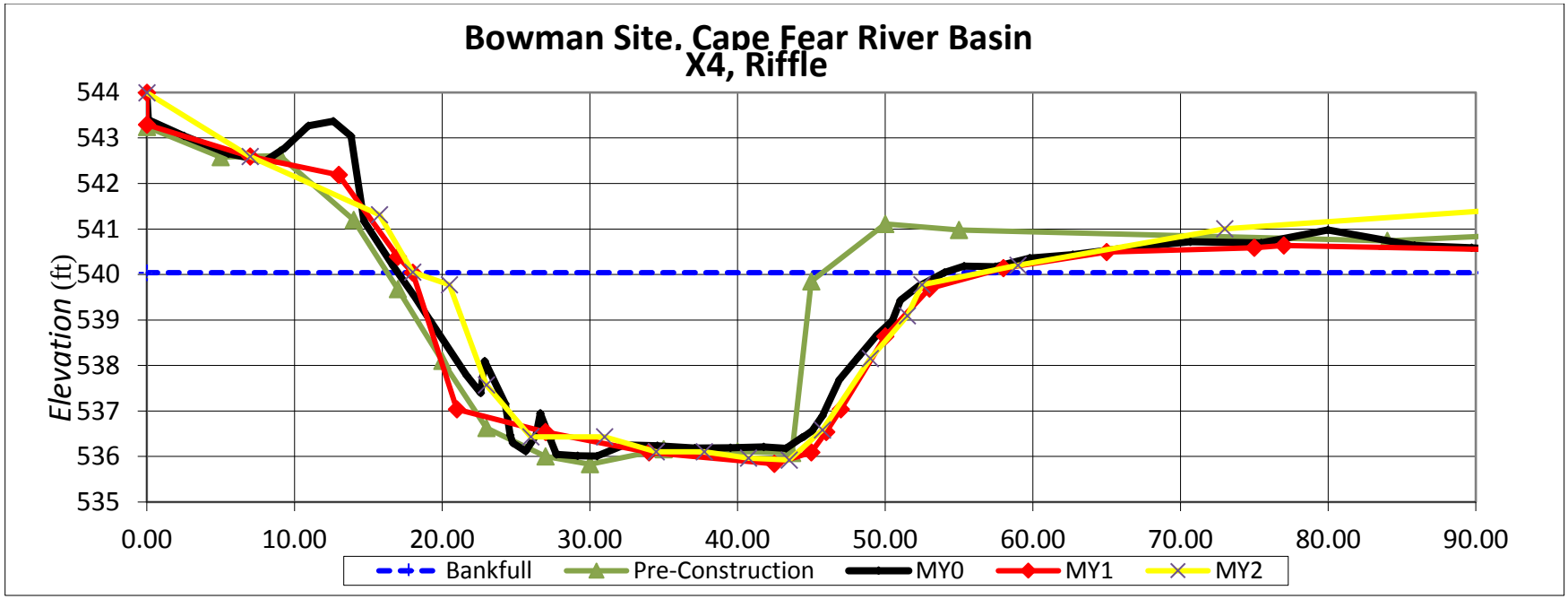
Bowman (Mount Pleasant Creek), DMS Project #44

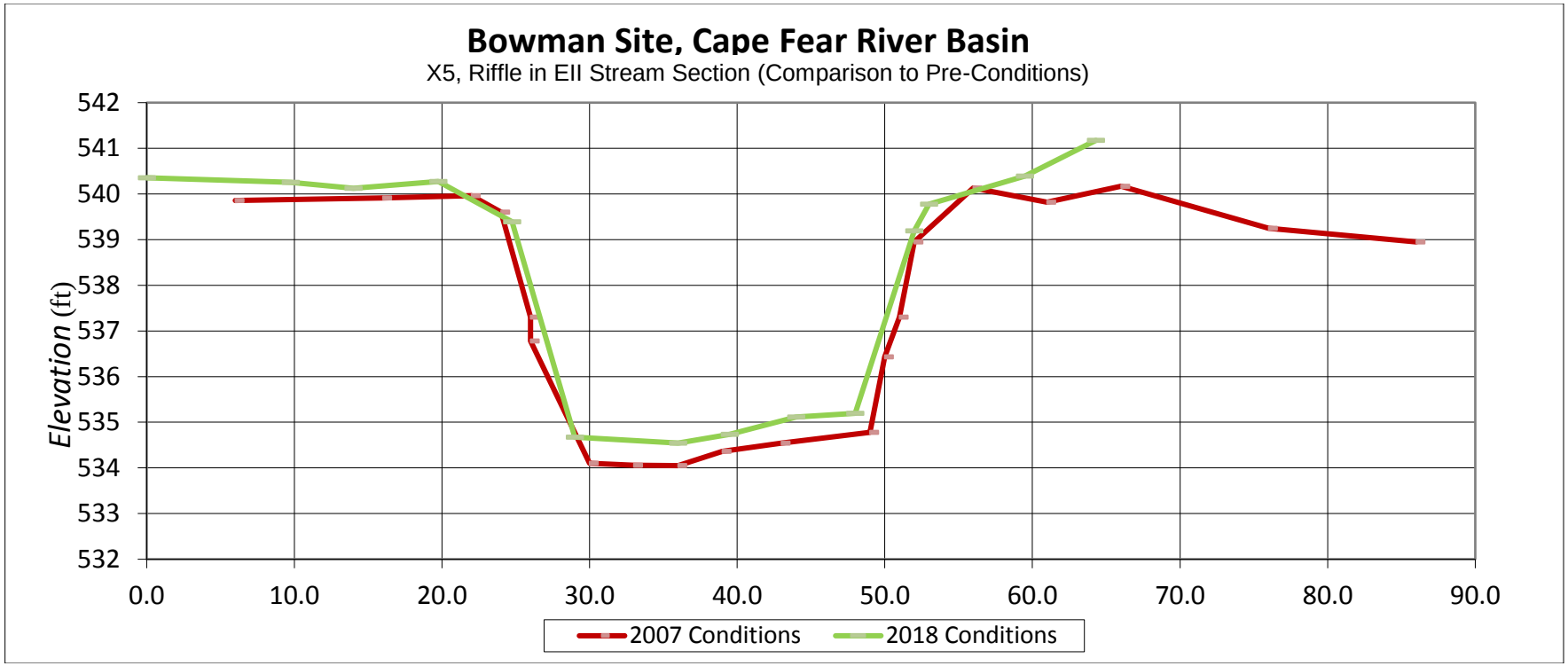
Dimension and Substrate	Cross-Section 2 (Pool), Station 12+12							Cross-Section 3 (Riffle), Station 15+25						
Based on fixed baseline elevation	Pre	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	30.5	32.1	32.1	31.8				46.7	47.0	47.5				
Floodprone Width (ft)	-	-	-	-				>100	>100	>100				
Bankfull Mean Depth (ft)	2.1	2.5	2.3	2.0				2.9	2.8	2.9				
Bankfull Max Depth (ft)	3	3.7	3.6	3.5				4.8	4.9	4.9				
Bankfull Cross-Sectional Area (ft^2)	64.5	80.4	73.7	64.7				136.5	133.3	135.7				
Bankfull Width/Depth Ratio	-	-	-	-				16.0	16.6	16.6				
Bankfull Entrenchment Ratio	-	-	-	-				2.0	2.1	2.1				
Bankfull Bank Height Ratio	-	-	-	-				1.0	1.0	1.0				

		Cross-Section 4 (Riffle), Station 17+25					
Based on fixed baseline elevation	Pre	Base	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	28	37.4	40.0	41.0			
Floodprone Width (ft)	>100	>100	>100	>100			
Bankfull Mean Depth (ft)	3	2.9	2.8	2.5			
Bankfull Max Depth (ft)	3.9	4.2	4.2	4.1			
Bankfull Cross-Sectional Area (ft^2)	83.5	109.5	111.1	102.0			
Bankfull Width/Depth Ratio	9.4	12.8	14.4	16.5			
Bankfull Entrenchment Ratio	1.1	3.3	3.1	3.0			
Bankfull Bank Height Ratio	1.4	1.1	1.1	0.8			

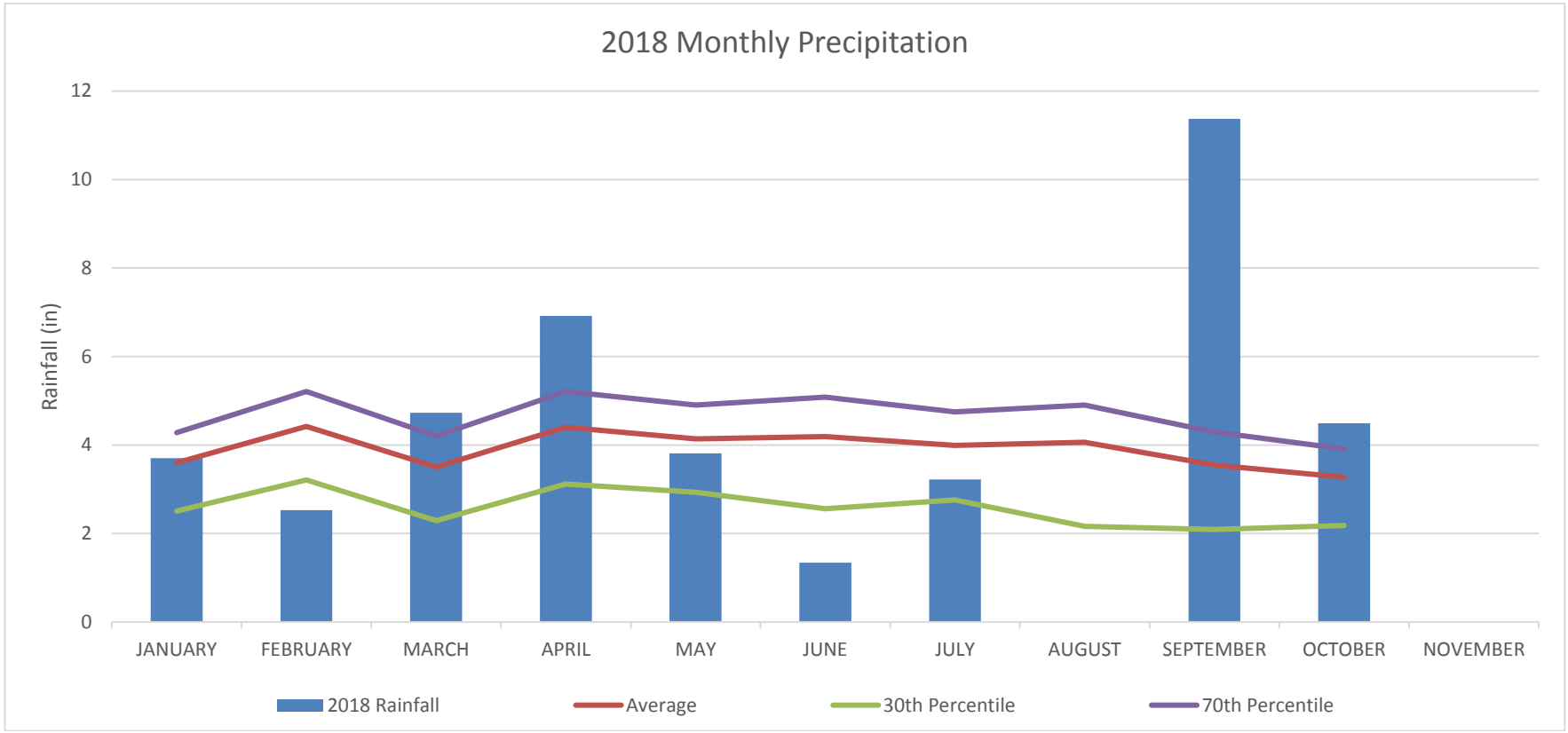

Bowman Site. Cape Fear River Basin
X2, Pool
Elevation (ft)
544
543
542
541
540
539
538
537
536
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
Bankfull
Pre-Construction
MY0
MY1
MY2


Bowman Site. Cape Fear River Basin
XS3 Riffle
Elevation (ft)
544
543
542
541
540
539
538
537
536
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
Bankfull
MY0
MY1
MY2


Bowman Site. Cape Fear River Basin
X4, Riffle
Elevation (ft)
544
543
542
541
540
539
538
537
536
535
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
Bankfull
Pre-Construction
MY0
MY1
MY2



Picture of XS5 10/16/18



- Historic and Observed Data from Randleman, NC Station AgACIS
- Note: Precipitation from August and November were missing for this station.