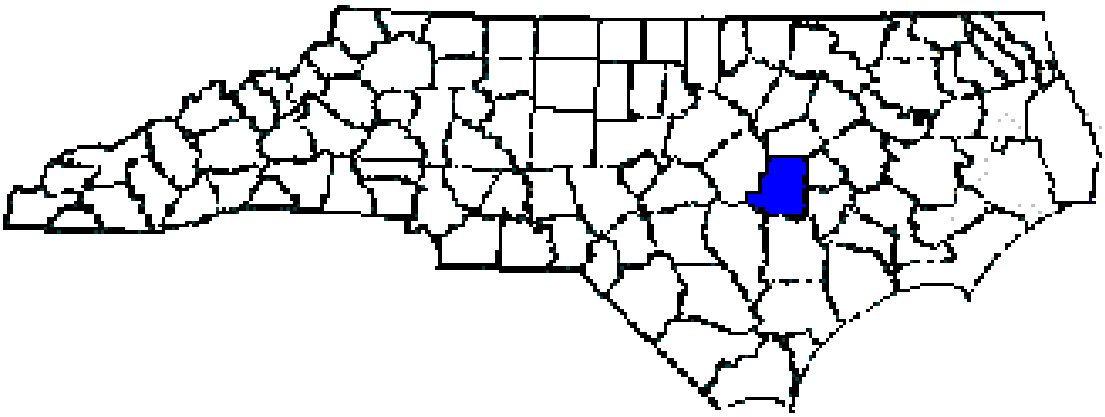
ANNUAL REPORT FOR 2020



Mark Edwards Site
Wayne County
TIP No. R-2554BB
USACE Action ID: SAW-2008-00252
DWR Project # 20080570

Prepared By:
Roadside Environmental Unit & Environmental Analysis Unit
North Carolina Department of Transportation
November 2020

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SUMMARY

The following report summarizes the stream monitoring activities that have occurred during 2020 at the Mark Edwards Mitigation Site in Wayne County. The site was constructed during 2014 by the North Carolina Department of Transportation (NCDOT). This report provides the monitoring results for the fifth formal year of monitoring (Year 2020). The Year 2020 monitoring period is the fifth of five scheduled years for monitoring on Mark Edwards Site (See Success Criteria Section 2.1).

Based on the overall conclusions of monitoring along Mark Edwards Site, the site has met the required monitoring protocols for the fifth formal year of monitoring. Based on comparing the fifth year of monitoring data to the as-built data, the channel is stable throughout the stream at this time. The streambank and buffer are meeting planted vegetation success criteria for the fifth year of monitoring.

NCDOT proposes to discontinue stream and vegetation monitoring at the Mark Edwards Mitigation Site.

1.0 INTRODUCTION

1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during 2020 at the Mark Edwards Mitigation Site. The site is located along the US 70 Bypass approximately 1.2 miles west of Parkstown Road near Goldsboro, NC (Figure 1). The Mark Edwards Mitigation Site was constructed to provide mitigation for stream impacts associated with Transportation Improvement Program (TIP) number R-2554BB in Wayne County.

The mitigation project covers approximately 1,322 linear feet of stream restoration. Construction was completed in July 2014 by NCDOT. Stream restoration involved the installation of log cross vanes, log vanes with root wads, construction of a new stream channel and construction of the floodplain to allow for overbank flooding. It also included the installation of coir fiber matting and live stakes along the streambank and bareroot seedlings in the buffer area.

1.2 Purpose

In order for a mitigation site to be considered successful, the site must meet the success criteria. This report details the monitoring in 2020 at the Mark Edwards Mitigation Site. Hydrologic monitoring was not required for the site.

1.3 Project History

July 2014	Site Construction Completed
January 2015	As-Built Survey Completed
March 2015	Streambank Reforestation Completed
May 2016	Supplemental Planting
July 2016	Vegetation Monitoring (Year 1)
November 2016	Stream Channel Monitoring (Year 1)
January 2017	Supplemental Live Staking
June 2017	Vegetation Monitoring (Year 2)
October 2017	Onsite Agency Meeting
December 2017	Stream Channel Monitoring (Year 2)
June 2018	Vegetation Monitoring (Year 3)
November 2018	Stream Channel Monitoring (Year 3)
June 2019	Vegetation Monitoring (Year 4)
November 2019	Stream Channel Monitoring (Year 4)

August 2020	Vegetation Monitoring (Year 5)
November 2020	Stream Channel Monitoring (Year 5)

1.4 Debit Ledger

The entire Mark Edwards Mitigation Site was used at a 1:1 ratio for the R-2554BB project to compensate for unavoidable stream impacts.

Figure 1. Site Location Map

2.0 STREAM ASSESSMENT

2.1 Success Criteria

The stream mitigation site shall be monitored for five years or until success criteria are satisfied. Monitoring protocols shall follow the Monitoring Level I outlined in the Stream Mitigation Guidelines, April 2003. NCDOT will evaluate the success of the stream relocation project based on guidance provided by the Stream Mitigation Guidelines disseminated by the United States Army Corps of Engineers-Wilmington District. The survey of channel dimension will consist of permanent cross sections placed at approximately nine cross sections (five riffles and four pools). Annual photographs showing both banks and upstream and downstream views will be taken from permanent, mapped photo points. The survey of the longitudinal profile will represent distinct areas of the stream and will cover a cumulative total of 1,322 linear feet of channel. The entire restored length of stream will be investigated for channel stability and in-stream structure functionality. Any evidence of channel instability will be identified, mapped and photographed.

Vegetation Success

For the onsite buffer mitigation sites, the permittee shall monitor the sites for five years. An annual report shall be submitted to the DWR for a period of 5 years showing monitoring results, survival rate, success of tree and vegetation establishment, and that diffuse flow through the riparian buffer has been maintained. The first annual report shall be submitted within one year of final planting. Failure to achieve a buffer density of 320 trees per acre after 5 years will require the annual report to provide appropriate remedial actions to be implemented and a schedule for implementation. Approval of the final annual report, and a formal “close out” of the mitigation site by the DWR is required. The success of vegetation plantings will be measured through stem counts. Permanent quadrants will be used to sample the riparian buffer. Survival of the live stakes will be determined by visual observation throughout the 5 year monitoring period.

Bareroot vegetation will be evaluated using 3 staked survival plots. Plots will be 50 ft. by 50 ft. and flagged stems will be counted in these plots. Success will be defined as 320 stems per acre after 5 years. All vegetation monitoring will be conducted during the growing season.

2.2 Stream Description

2.2.1 Post-Construction Conditions

The mitigation project covers approximately 1,322 linear feet of stream restoration. Construction was completed in July 2014 by NCDOT. Stream

restoration involved the installation of log cross vanes, log vanes with root wads, construction of a new stream channel and construction of the floodplain to allow for overbank flooding. It also included the installation of coir fiber matting and live stakes along the streambank and bareroot seedlings in the buffer area.

2.2.2 Monitoring Conditions

The objective of the Mark Edwards Site Mitigation Site relocation was to build a C/E5 stream type as identified in the Rosgen's Applied River Morphology. A total of nine cross sections (five in a riffle, four in a pool) were surveyed. For this report, only cross sections containing riffles were used in the comparison of channel morphology in Table 1.

Table 1. Abbreviated Morphological Summary (Mark Edwards Site - Cross Sections #2, #3, #4, #7 and #9)							
Variable	**Proposed**	**Cross Section #2 (Riffle)**	**Cross Section #3 (Riffle)**	**Cross Section #4 (Riffle)**	**Cross Section #7 (Riffle)**	**Cross Section #9 (Riffle)**	**Min. - Max Values (Riffle Sections Only)**
		2020	**2020**	**2020**	**2020**	**2020**	**2020**
Drainage Area (sq. mi)	**0.29**	0.29	0.29	0.29	0.29	0.29	0.29
Bankfull Width (ft)	**7.0**	7	11	7	7	7.5	7 – 11
Bankfull Mean Depth (ft)	**0.58**	0.42	0.4	0.58	0.56	0.45	0.4 – 0.58
Width/Depth Ratio	**12.0**	16.67	27.5	12.07	12.5	16.67	12.07 – 27.5
Bankfull Cross Sectional Area (ft^2)	**3.90**	2.94	4.43	4.06	3.92	3.38	2.94 – 4.43
Maximum Bankfull Depth (ft)	**0.90**	0.75	1.06	1.02	1.16	1.06	0.75 – 1.16
Floodprone Area (ft)	**75.0**	43	55	55	56	43	43 – 56
Entrenchment Ratio	**10.71**	6.14	5	7.86	8	5.73	5 – 8

*Drainage Area, Floodprone Width, and Slope are averaged values only.
*Riffle values are used for classification purposes.

2.3 Results of the Stream Assessment

2.3.1 Site Data

The assessment included the survey of six cross sections and the longitudinal profile of Mark Edwards Mitigation Site established by the NCDOT after construction. The length of the profile along Mark Edwards Site was approximately 1,038 linear feet. Six cross sections were established during the as-built. Cross section locations were subsequently based on the stationing of the longitudinal profile and are presented below. The location of the cross sections are shown in Appendix A.

- Cross Section #1. Mark Edwards Site, Station 122+00 linear feet, upper reach midpoint of pool
- Cross Section #2. Mark Edwards Site, Station 148+00 linear feet, upper reach midpoint of riffle
- Cross Section #3. Mark Edwards Site, Station 127+00 linear feet, middle reach midpoint of riffle
- Cross Section #4. Mark Edwards Site, Station 196+00 linear feet, middle reach midpoint of riffle
- Cross Section #5. Mark Edwards Site, Station 310+05 linear feet, middle reach midpoint of pool
- Cross Section #6. Mark Edwards Site, Station 552+00 linear feet, middle reach midpoint of pool
- Cross Section #7. Mark Edwards Site, Station 583+00 linear feet, middle reach midpoint of riffle
- Cross Section #8. Mark Edwards Site, Station 95+50 linear feet, lower reach midpoint of pool
- Cross Section #9. Mark Edwards Site, Station 136+50 linear feet, lower reach midpoint of riffle

Based on comparisons of the as-built to 2020 monitoring data, all nine cross sections appear stable with little or no active bank erosion. Graphs of the cross sections are presented in Appendix A. Future survey data will vary depending on actual location of rod placement and alignment; however this information should remain similar in appearance. The 2020 longitudinal profile was not completed but, a visual inspection was completed in lieu of the profile and the stream was noted as highly stable throughout the length of the stream. The stream remains stable at the pipe inlet along the Upper Reach at the time of monitoring. See Appendix B for photos of this area. Regulatory Agencies approved discontinuing the longitudinal profile prior to the 2019 stream monitoring. All other monitoring activities will continue throughout the 5-year monitoring period.

Bankfull Events	
Date	**Determined by**
10-09-16	Wrack Line
11-26-18	Wrack Line

2.4 Results of Stream and Buffer Vegetation

2.4.1 Description of Species

The following live stake species were planted on the streambank:

Cephalanthus occidentalis, Buttonbush

Cornus amomum, Silky Dogwood

Salix sericea, Silky Willow

The following tree species were planted in the buffer area:

Betula nigra, River Birch

Fraxinus pennsylvanica, Green Ash

Nyssa sylvatica var. *biflora*, Swamp Blackgum

Platanus occidentalis, American Sycamore

Quercus lyrata, Overcup Oak

Quercus michauxii, Swamp Chestnut Oak

2.4.2 Results of Vegetation Monitoring

Buffer Vegetation: Three 50 ft. x 50 ft. vegetation plots were set to determine the trees per acre in the buffer area.

Table 2. Vegetation Monitoring Results

Plot #	River Birch	Green Ash	Swamp Blackgum	Sycamore	Overcup Oak	Swamp Chestnut Oak	Total (Year 5)	Total (at planting)	Density (Trees/Acre)
1	10	2	5	5	6	2	30	39	523
2	7	8	3	4	2	0	24	39	418
3	9	18	1	2	2	2	34	39	593
Year 5 Average Density (Tree/Acre)									**511**
Year 4 Average Density (Tree/Acre)									**506**
Year 3 Average Density (Tree/Acre)									**517**
Year 2 Average Density (Tree/Acre)									**570**
Year 1 Average Density (Tree/Acre)									**575**

Site Notes: The buttonbush, silky willow, and silky dogwood live stakes were surviving along the streambank. Other vegetation noted included woolgrass, soft rush, sweetgum, pine, *Baccharis* sp., cattail, black willow, morning glory vine, blackberry, briars, tear-thumb, and various grasses.

2.4.3 Conclusions

There were three vegetation monitoring plots established throughout the buffer area. The 2020 vegetation monitoring of the site revealed an average tree density of 511 trees per acre. This average is well above the minimum success criteria of 320 trees per acre after the fifth year of monitoring. NCDOT proposes to discontinue monitoring the vegetation at the Mark Edwards Mitigation Site.

3.0 OVERALL CONCLUSIONS/RECOMMENDATIONS

The Mark Edwards Mitigation Site has met the required monitoring protocols for the fifth formal year of monitoring. The channel and structures throughout the stream are stable at this time. The streambank and buffer are meeting planted vegetation success criteria for the fifth year of monitoring.

NCDOT proposes to discontinue stream and vegetation monitoring at the Mark Edwards Mitigation Site.

4.0 REFERENCES

NSD Site 9 (Mark Edwards Site) Onsite Stream Mitigation Plan for US Highway 70 Goldsboro Bypass Construction. Wayne County, NC, October 30, 2012.

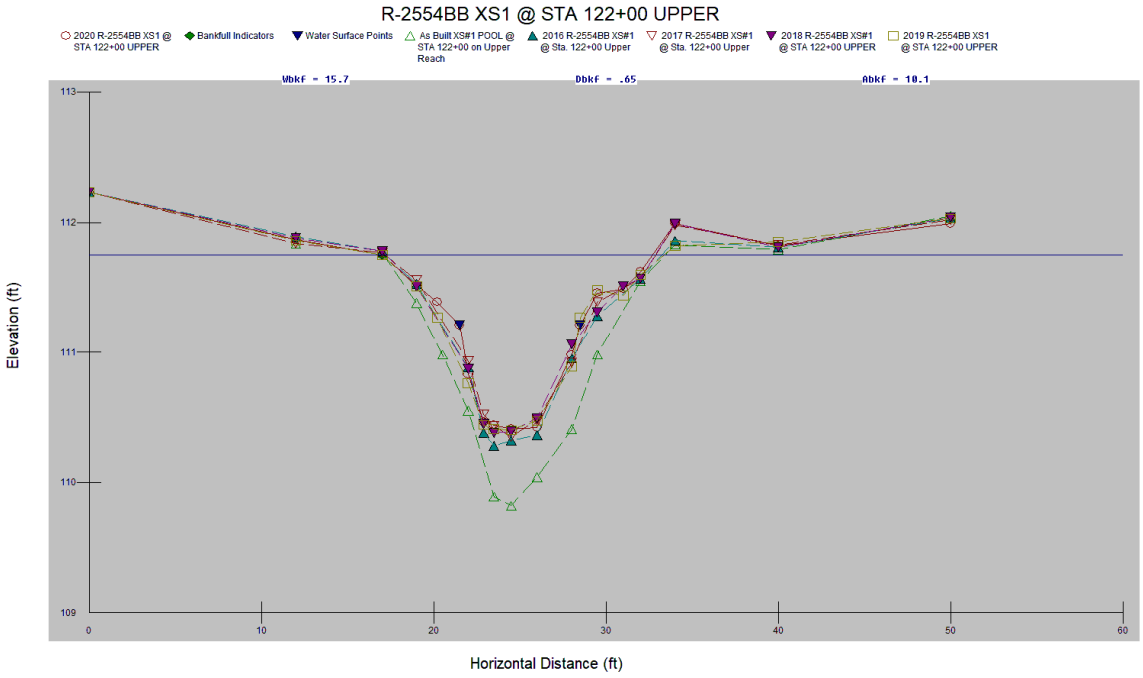
As-Built Report for Stream Relocation on R-2554C Mark Edwards Site, Wayne County, NC, August 11, 2016.

Rosgen, D.L, 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

US Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. Prepared with cooperation from the US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Resources.

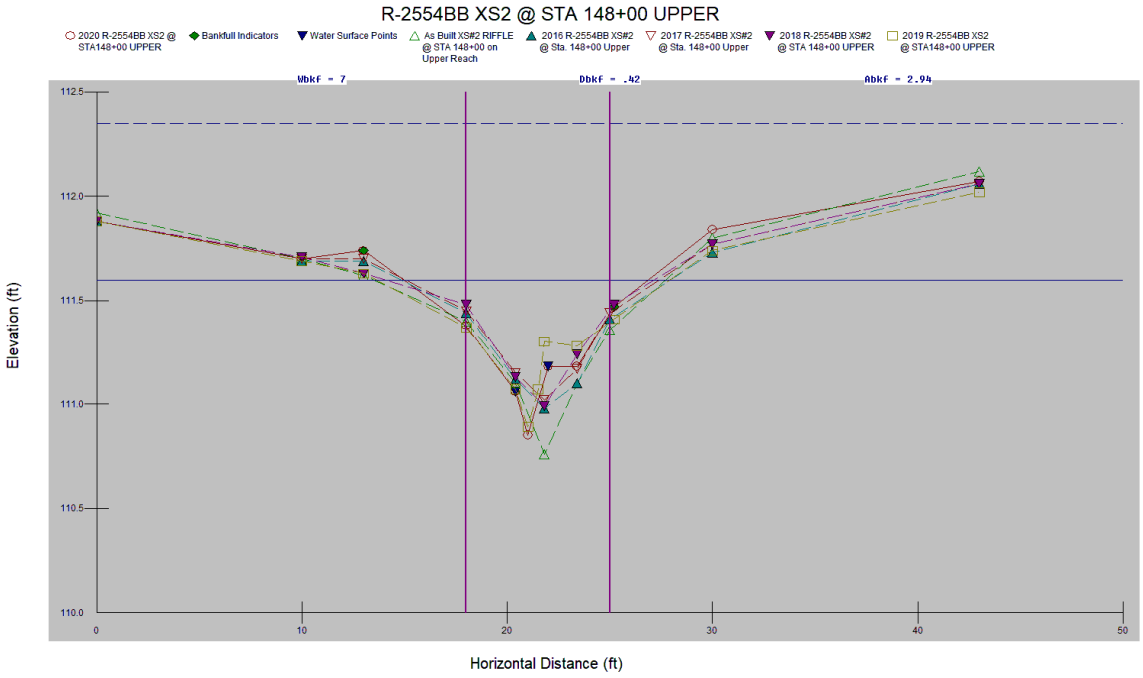
APPENDIX A

CROSS SECTION COMPARISONS

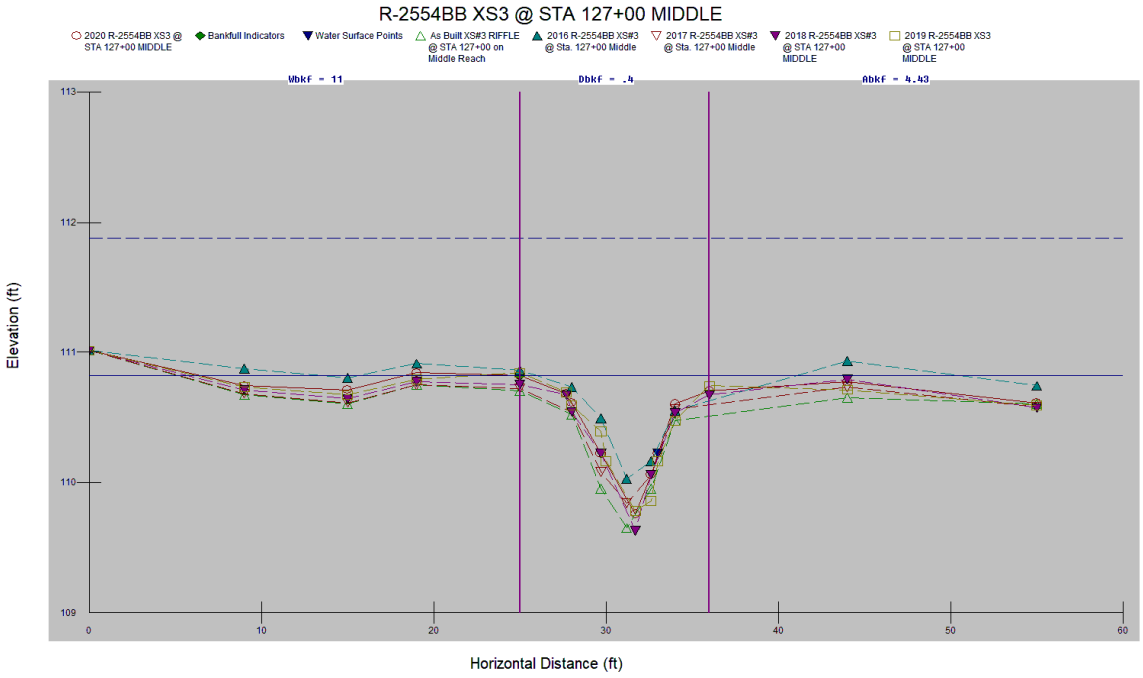


Cross-Section #1 (Pool) Abbreviated Morphological Summary*					
	2016	2017	2018	2019	2020
Bankfull Cross Sectional Area (ft^2)	11.81	10.8	11.07	10.76	10.13
Maximum Bankfull Depth (ft.)	1.50	1.42	1.4	1.35	1.34
Bankfull Mean Depth (ft.)	0.72	0.68	0.69	0.66	0.65
Bankfull Width (ft.)	16.45	15.98	16	16.36	15.7

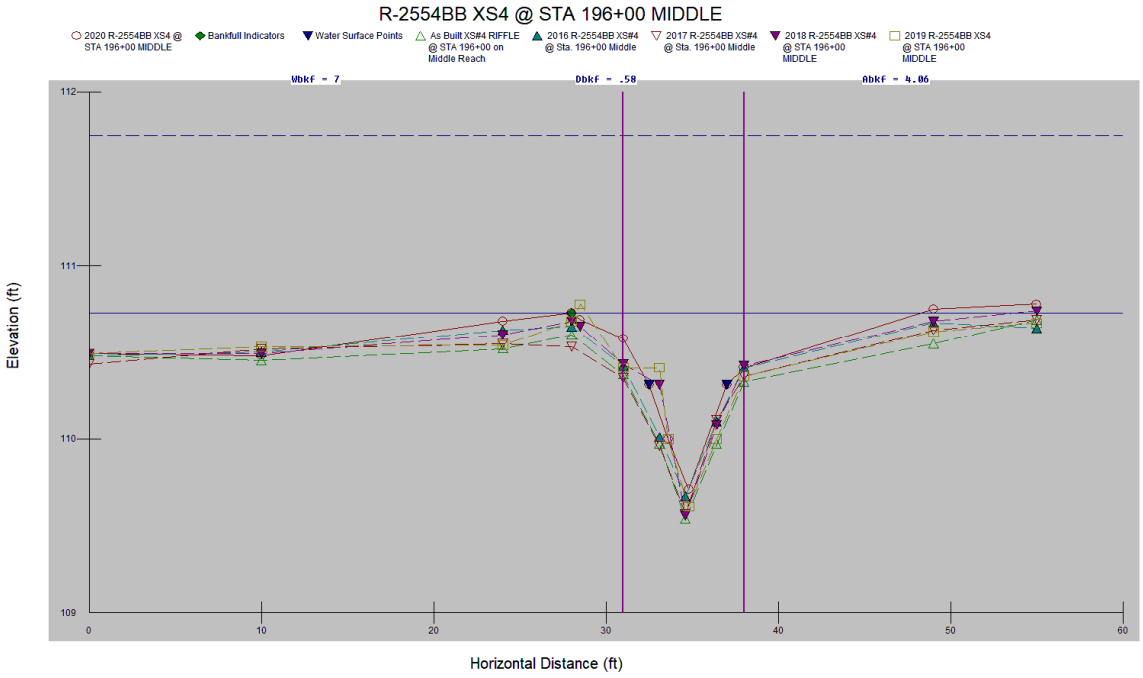
* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.



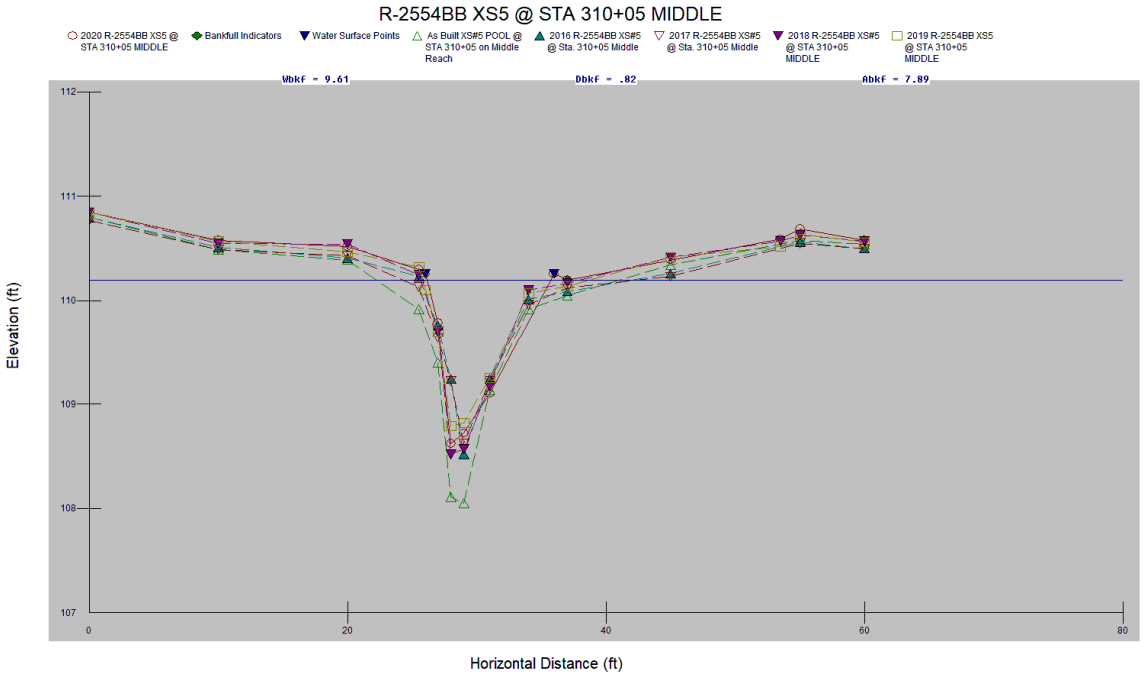
Cross-Section #2 (Riffle) Abbreviated Morphological Summary					
	2016	2017	2018	2019	2020
Bankfull Width (ft.)	7.0	7	7.2	7.2	7
Bankfull Mean Depth (ft.)	0.52	0.49	0.4	0.4	0.42
Width/Depth Ratio	13.46	14.29	18	18	16.67
Bankfull Cross Sectional Area (ft^2)	3.62	3.42	2.89	2.89	2.94
Maximum Bankfull Depth (ft.)	0.71	0.68	0.64	0.74	0.75
Width of the Floodprone Area (ft.)	43.0	43	43	43	43
Entrenchment Ratio	6.14	6.14	5.97	5.97	6.14



Cross-Section #3 (Riffle) Abbreviated Morphological Summary					
	2016	2017	2018	2019	2020
Bankfull Width (ft.)	9.0	9	11	11	11
Bankfull Mean Depth (ft.)	0.37	0.42	0.38	0.43	0.4
Width/Depth Ratio	24.32	21.43	28.95	25.58	27.5
Bankfull Cross Sectional Area (ft^2)	3.3	3.76	4.18	4.75	4.43
Maximum Bankfull Depth (ft.)	0.83	0.88	1.12	1.06	1.06
Width of the Floodprone Area (ft.)	55.0	55	55	55	55
Entrenchment Ratio	6.11	6.11	5	5	5

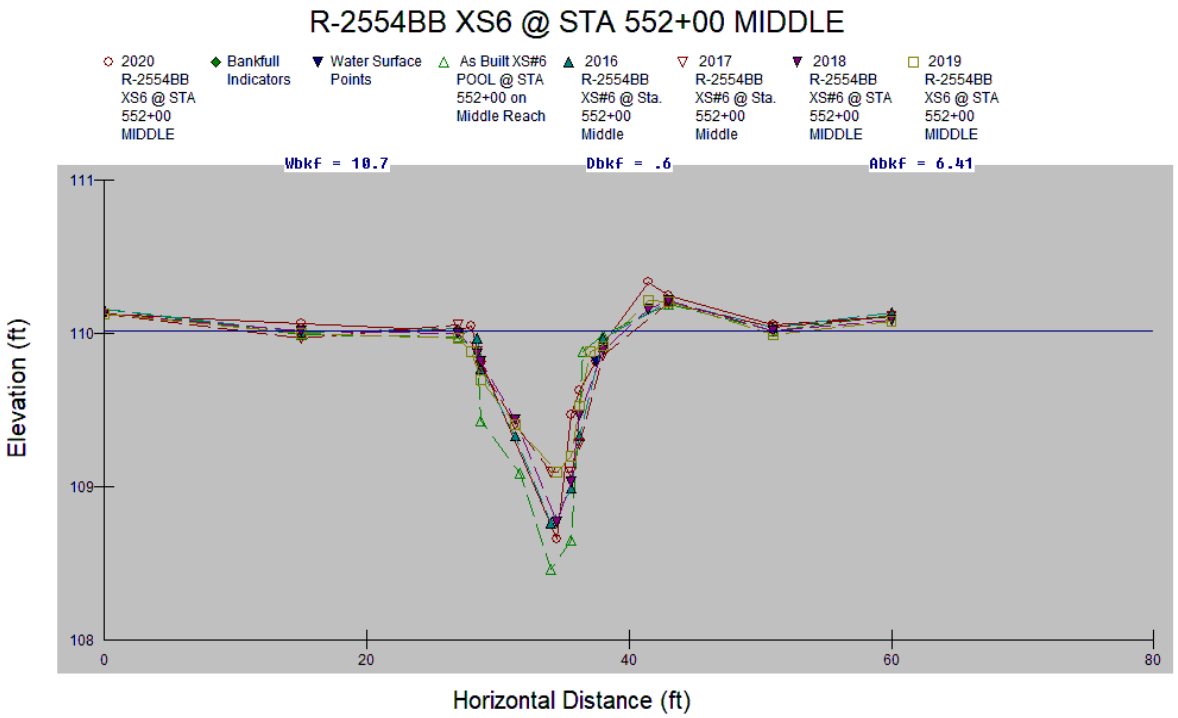


Cross-Section #4 (Riffle) Abbreviated Morphological Summary					
	2016	2017	2018	2019	2020
Bankfull Width (ft.)	7.0	7	7	7	7
Bankfull Mean Depth (ft.)	0.59	0.52	0.57	0.58	0.58
Width/Depth Ratio	11.86	13.46	12.28	12.07	12.07
Bankfull Cross Sectional Area (ft^2)	4.14	3.65	4	4.05	4.06
Maximum Bankfull Depth (ft.)	0.98	0.96	1.12	1.07	1.02
Width of the Floodprone Area (ft.)	55.0	55	55	55	55
Entrenchment Ratio	7.86	7.86	7.86	7.86	7.86



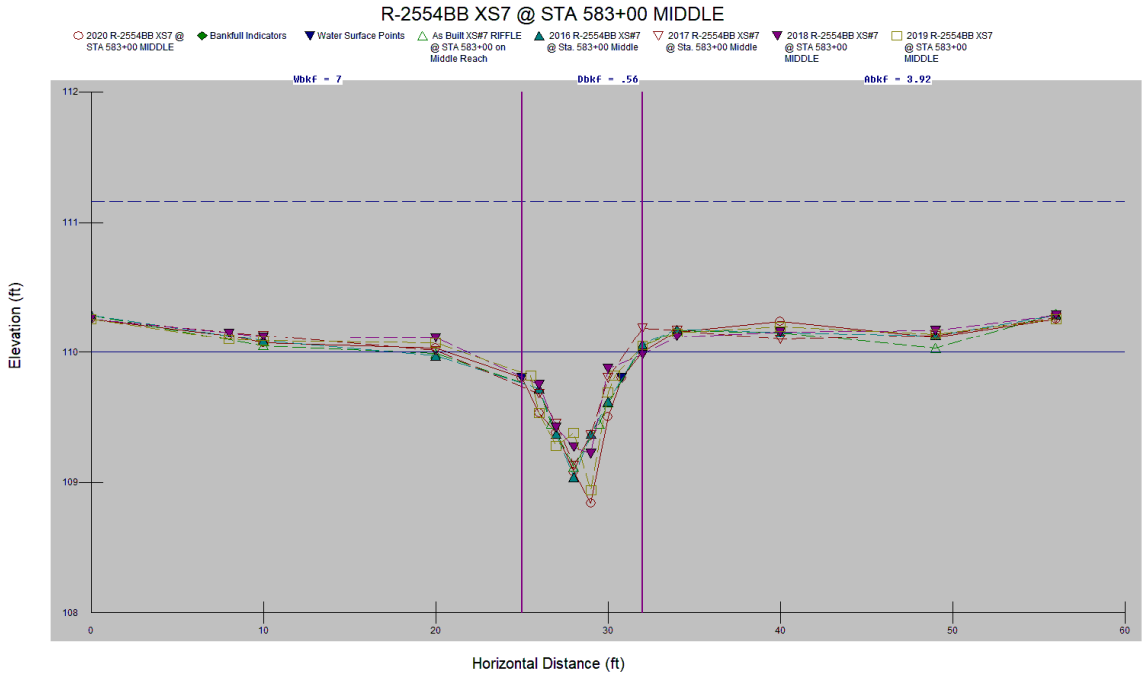
Cross-Section #5 (Pool) Abbreviated Morphological Summary*					
	2016	2017	2018	2019	2020
Bankfull Cross Sectional Area (ft^2)	5.91	6.47	7.28	6.23	7.89
Maximum Bankfull Depth (ft.)	1.57	1.5	1.65	1.35	1.58
Bankfull Mean Depth (ft.)	0.53	0.56	0.65	0.56	0.82
Bankfull Width (ft.)	11.05	11.47	11.28	11.09	9.61

* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.

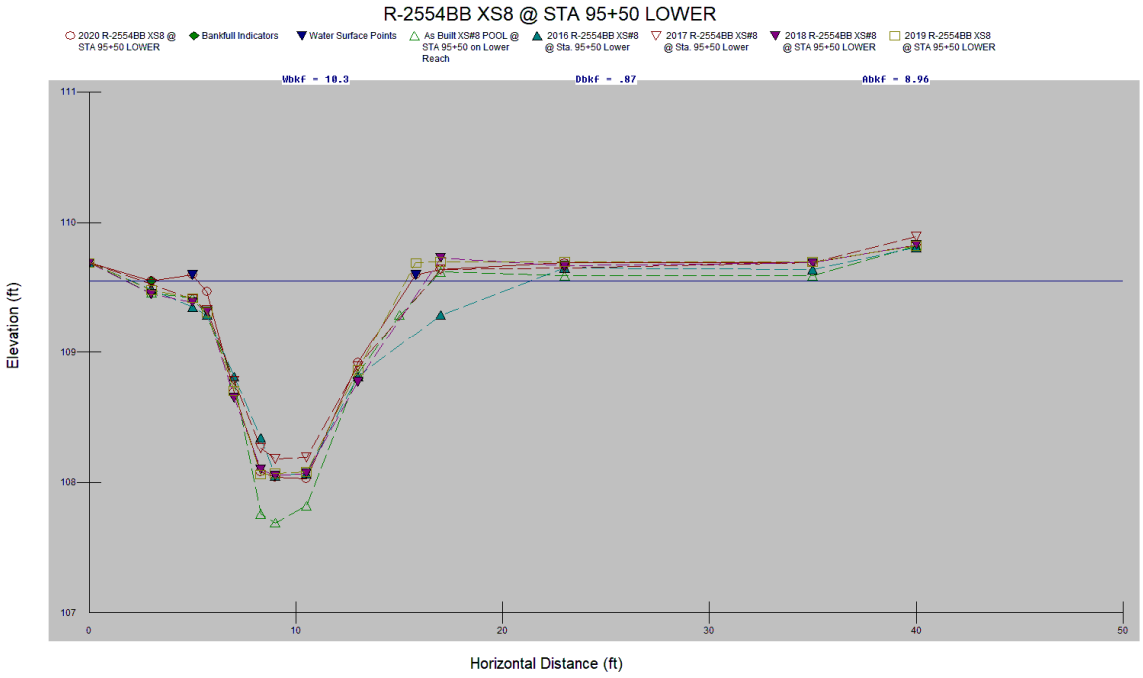


Cross-Section #6 (Pool) Abbreviated Morphological Summary*					
	2016	2017	2018	2019	2020
Bankfull Cross Sectional Area (ft^2)	7.09	6.8	6.28	5.1	6.41
Maximum Bankfull Depth (ft.)	1.27	0.96	1.23	0.87	1.36
Bankfull Mean Depth (ft.)	0.58	0.49	0.51	0.44	0.6
Bankfull Width (ft.)	12.25	13.94	12.43	11.58	10.68

* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.

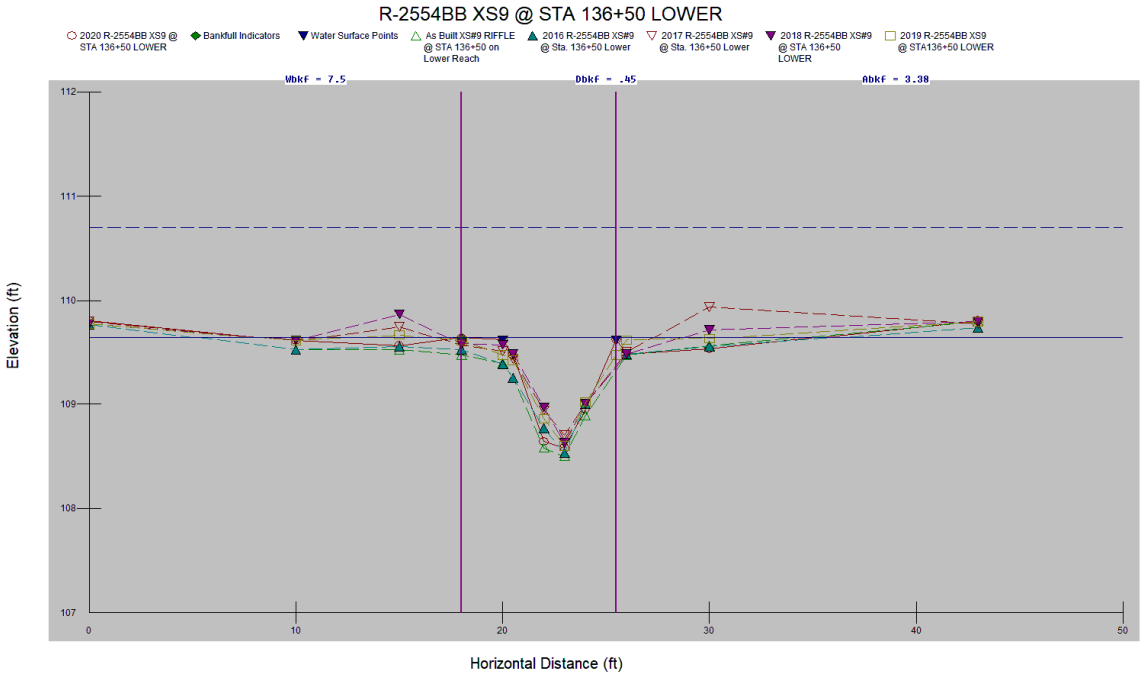


Cross-Section #7 (Riffle) Abbreviated Morphological Summary					
	2016	2017	2018	2019	2020
Bankfull Width (ft.)	6.0	6	6	6.5	7
Bankfull Mean Depth (ft.)	0.66	0.58	0.39	0.54	0.56
Width/Depth Ratio	9.09	10.34	15.38	12.04	12.5
Bankfull Cross Sectional Area (ft^2)	3.95	3.47	2.31	3.48	3.92
Maximum Bankfull Depth (ft.)	1.14	1.06	0.76	1.11	1.16
Width of the Floodprone Area (ft.)	56.0	56	56	56	56
Entrenchment Ratio	9.33	9.33	9.33	8.62	8



Cross-Section #8 (Pool) Abbreviated Morphological Summary*					
	2016	2017	2018	2019	2020
Bankfull Cross Sectional Area (ft^2)	9.79	8.66	8.71	8.46	8.96
Maximum Bankfull Depth (ft.)	1.44	1.35	1.4	1.42	1.52
Bankfull Mean Depth (ft.)	0.56	0.65	0.68	0.7	0.87
Bankfull Width (ft.)	17.33	13.41	12.83	12.09	10.32

* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.



Cross-Section #9 (Riffle) Abbreviated Morphological Summary					
	2016	2017	2018	2019	2020
Bankfull Width (ft.)	8.0	8	8	7.97	7.5
Bankfull Mean Depth (ft.)	0.43	0.53	0.64	0.4	0.45
Width/Depth Ratio	18.6	15.09	12.5	19.92	16.67
Bankfull Cross Sectional Area (ft^2)	3.43	4.24	5.12	3.19	3.38
Maximum Bankfull Depth (ft.)	1.02	1.05	1.24	1.01	1.06
Width of the Floodprone Area (ft.)	43.0	43	43	43	43
Entrenchment Ratio	5.38	5.38	5.38	5.4	5.73

APPENDIX B

SITE PHOTOGRAPHS, CROSS SECTION AND PHOTO POINT LOCATIONS, AND STREAMBANK REFORESTATION PLAN

Mark Edwards Site

Vegetation Overview of Upper Reach


Vegetation Overview of Middle Reach


Vegetation Overview of Lower Reach

August 2020

Mark Edwards Site

Photo Point #1 (Upstream)

Photo Point #1 (Downstream)

Photo Point #2 (Upstream)

Photo Point #2 (Downstream)

Photo Point #3 (Upstream)

Photo Point #3 (Downstream)

November 2020

Mark Edwards Site

Photo Point #4 (Upstream)

Photo Point #4 (Downstream)

Photo Point #5 (Upstream)

Photo Point #5 (Downstream)

Photo Point #6 (Upstream)

Photo Point #6 (Downstream)

November 2020

Mark Edwards Site

Photo Point #7 (Upstream)

Photo Point #7 (Downstream)

Photo Point #8 (Upstream)

Photo Point #8 (Downstream)

Photo Point #9 (Upstream)

Photo Point #9 (Downstream)

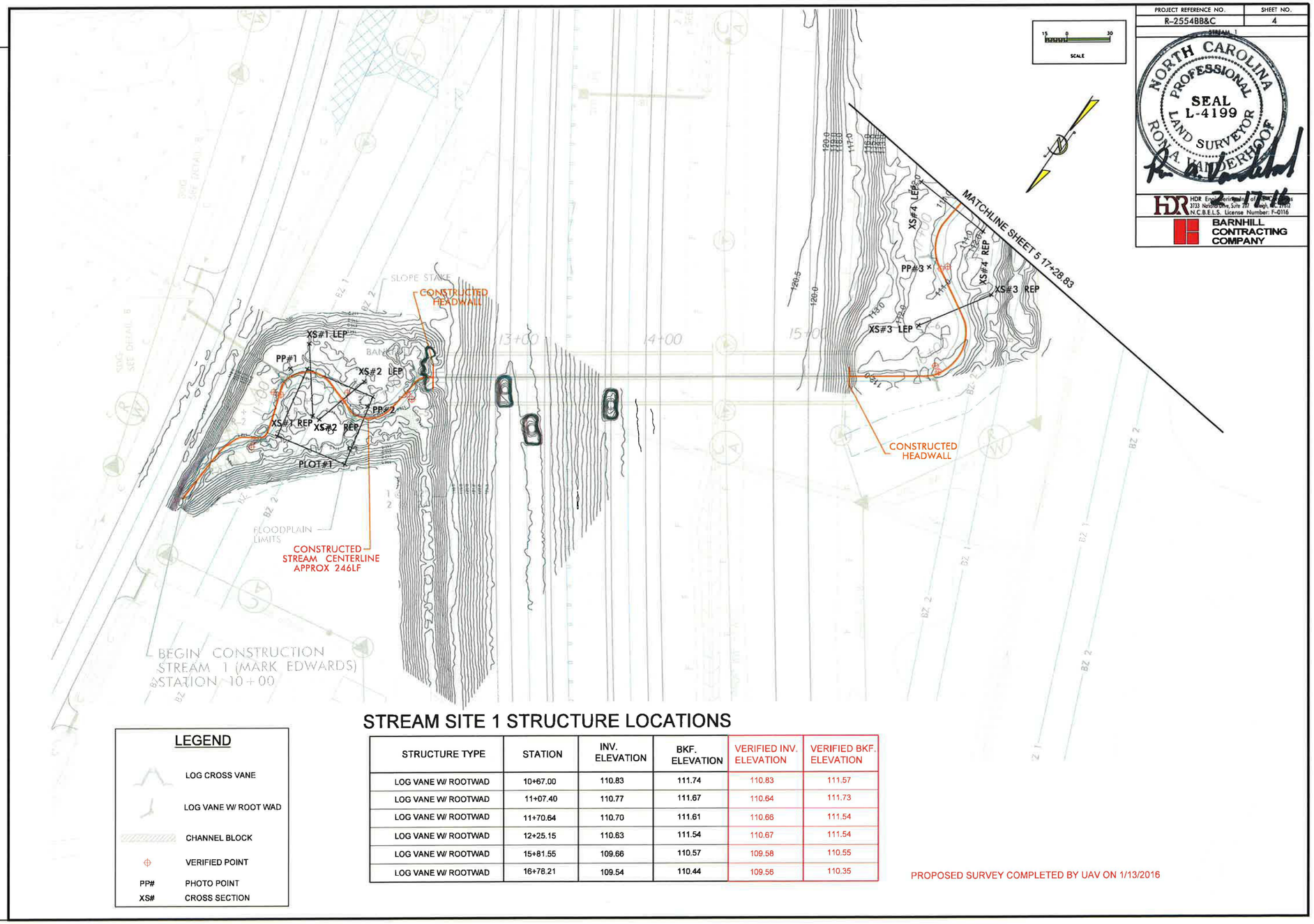
November 2020

Mark Edwards Site

Upper stream at pipe inlet looking upstream

Upper stream looking downstream at pipe inlet

November 2020



LEGEND

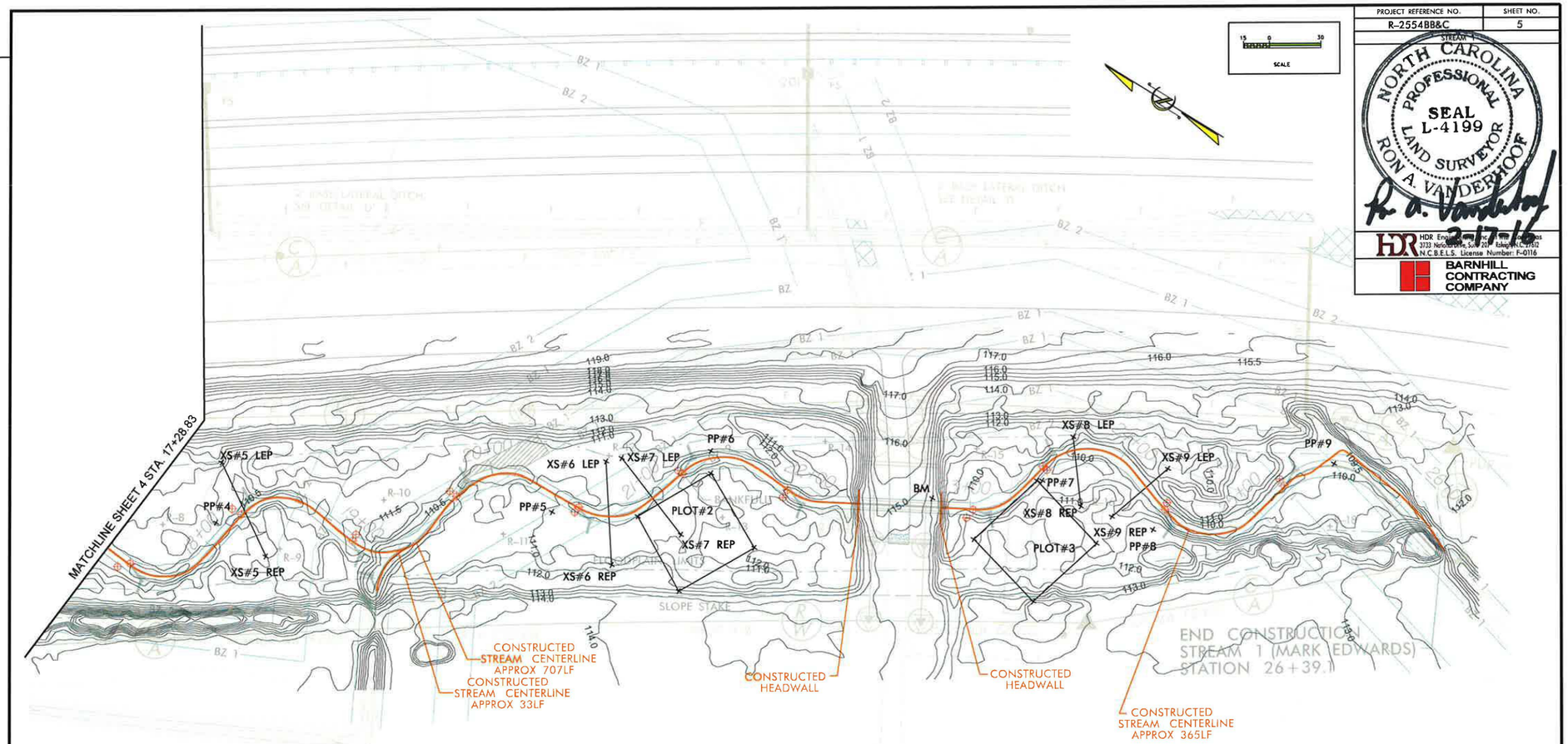
- LOG CROSS VANE
- LOG VANE W/ ROOT WAD
- CHANNEL BLOCK
- VERIFIED POINT
- PP# PHOTO POINT
- XS# CROSS SECTION

STREAM SITE 1 STRUCTURE LOCATIONS

STRUCTURE TYPE	STATION	INV. ELEVATION	BKF. ELEVATION	VERIFIED INV. ELEVATION	VERIFIED BKF. ELEVATION
LOG VANE W/ ROOTWAD	10+67.00	110.83	111.74	110.83	111.57
LOG VANE W/ ROOTWAD	11+07.40	110.77	111.67	110.64	111.73
LOG VANE W/ ROOTWAD	11+70.64	110.70	111.61	110.66	111.54
LOG VANE W/ ROOTWAD	12+25.15	110.63	111.54	110.67	111.54
LOG VANE W/ ROOTWAD	15+81.55	109.66	110.57	109.58	110.55
LOG VANE W/ ROOTWAD	16+78.21	109.54	110.44	109.56	110.35

PROPOSED SURVEY COMPLETED BY UAV ON 1/13/2016

Photo Point, Cross Section, and Vegetation Plot Locations
R-2554BB Mark Edwards Site
Wayne County, North Carolina



PROJECT REFERENCE NO.	SHEET NO.
R-2554BB&C	5

REVISIONS

PLOT DRIVER: $PLTDRVS$ PENTABLE: $PENTBLS$
USER: $USER$ DATE: 2/11/2016 TIME: 3:00:55 PM
FILE: $PWVARVAULTPATHDESC$

STREAM SITE 1 STRUCTURE LOCATIONS

STRUCTURE TYPE	STATION	INV. ELEVATION	BKF. ELEVATION	VERIFIED INV. ELEVATION	VERIFIED BKF. ELEVATION
LOG VANE W/ ROOTWAD	17+46.08	109.42	110.33	109.40	110.35
LOG VANE W/ ROOTWAD	18+25.37	109.30	110.21	109.28	110.22
LOG VANE W/ ROOTWAD	18+99.46	109.20	110.11	109.22	110.14
LOG VANE W/ ROOTWAD	19+76.72	109.11	110.02	109.15	110.02
LOG VANE W/ ROOTWAD	20+54.86	109.02	109.93	108.95	109.96
LOG VANE W/ ROOTWAD	21+24.77	108.94	109.84	108.89	109.85
LOG VANE W/ ROOTWAD	21+94.87	108.87	109.77	108.80	109.76
LOG VANE W/ ROOTWAD	23+02.88	108.56	109.51	108.58	109.54
LOG VANE W/ ROOTWAD	23+51.62	108.54	109.45	108.50	109.41
LOG VANE W/ ROOTWAD	24+39.93	108.45	109.36	108.48	109.41
LOG VANE W/ ROOTWAD	25+25.67	108.37	109.28	108.33	109.30

LEGEND

- LOG CROSS VANE
- LOG VANE W/ ROOT WAD
- CHANNEL BLOCK
- VERIFIED POINT
- PP# PHOTO POINT
- XS# CROSS SECTION

PROPOSED SURVEY COMPLETED BY UAV ON 1/13/2016

Photo Point, Cross Section, and Vegetation Plot Locations
R-2554BB Mark Edwards Site
Wayne County, North Carolina

STREAM 1 (MARK EDWARDS) PLANTING OVERVIEW

PROJECT REFERENCE NO.	SHEET NO.
R-2554BB&C	PL-4
STREAM 1	

SCALE 25 0 50

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE 2/17/16

HDR HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 202 Raleigh, N.C. 27612
N.C.B.E.L.S. License Number: F-0116

BARNHILL CONTRACTING COMPANY

BEGIN CONSTRUCTION
STREAM 1 (MARK EDWARDS)
STATION 10+00

END CONSTRUCTION
STREAM 1 (MARK EDWARDS)
STATION 26+39.1

BEGIN CONSTRUCTION
STREAM 1 (MARK EDWARDS)
STATION 10+00

LEGEND

ZONE 1

ZONE 2

REVISIONS

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Streambank Reforestation Plan
R-2554BBMark Edwards Site
Wayne County, North Carolina