ANNUAL REPORT 2021
Year 3 Report for
Horse Creek Stream Relocation Monitoring Plan

TIP Project No. I-4729A – Interchange Improvements at I-26 and US 74
USACE Action ID No. **SAW-2017-01737**
NCDWR Project No. **2017-01737**
Polk County, NC

Prepared By:

Vaughn & Melton Consulting Engineers, Inc.
40 Colonial Square
Sylva, NC 28779
(828) 477-4993

Date: May 2021

Prepared for:

North Carolina Department of Transportation
Division of Highways – Division 14
253 Webster Road
Sylva, NC 28779

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SUMMARY

The following report summarizes the Year 3 stream monitoring activities that have occurred during 2021 at the Horse Creek Mitigation Site in Polk County. The stream relocation was completed in April 2018 by the North Carolina Department of Transportation (NCDOT). The site was designed as stream mitigation for impacts associated with construction of TIP Project No. I-4729A (I-26/US 74 Interchange Improvement Project) near Columbus, Polk County, North Carolina. This report provides Year 3 results for the third formal year of monitoring (2021). The Year 2021 monitoring period is the third of seven scheduled years of monitoring (See Success Criteria in the I-4729A Stream Relocation Monitoring Report ver. 1.2). Monitoring data collected at the Site will include reference photos, plant survival analysis, and channel stability analysis and will be reported in the format specified by RGL 08-03.

Based on the review of the 2020 monitoring data, the channel was showing signs of widening, downcutting and scouring of pools, and considerable streambank erosion in the area of cross-section 1 (XS-1) mainly due to extreme weather conditions (excessive rainfall and flooding) that continues to occur in Polk County since the inception of this project. Stream channel modifications and/or repairs were designed and implemented by NCDOT personnel and were completed in October 2020. Methods of repair included boulder toe protection and the construction of a 150-foot long boulder wall along the eroded streambank, slight adjustment of the cross-vane below the RCBC, hardening and shallowing up of the deeply scoured pools and the removal of a beaver dam on the southern reach of the stream channel. The reconstructed areas were seeded with appropriated vegetation and stabilized with coir fiber matting. These disturbed areas were replanted with live stakes and bare root seedlings in March 2021, to provide long-term stabilization.

Based on review of the 2021 monitoring data following the October 2020 repairs, visual inspection, and photographs, the Horse Creek Mitigation Site has met the required monitoring protocols for the third formal year of monitoring. Based on visual assessment and comparisons of the As-Built to the Year 3 monitoring data following repairs, the channel appears to be stable and is more in line with the As-Build cross-sectional data and longitudinal profile data collected in 2018/2019, than the dramatic increases is bankfull width near Cross Section 1 (XS-1) and the various pool depths (scouring) along the longitudinal profile that occurred in the 2020 data. Additional survey data will be required to fully assess the stream channel repairs made in October 2020. Storm systems and high water events continue to affect this area of Polk County.

The streambank is well vegetated with live stakes for the third year of monitoring. The stream buffer planting is exceeding the required planting vegetation success criteria at the present time.

NCDOT will continue stream and vegetation monitoring at the Horse Creek Mitigation Site in 2022.

1.0 INTRODUCTION

1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during 2021 at the Horse Creek Mitigation Site. The site is situated in the center of the I-26 and US 74 interchange (see Figure 1). The site was constructed to provide mitigation for stream impacts associated with construction of TIP Project No. I-4729A. The site is composed of one reach of Horse Creek.

The mitigation project includes 742 linear feet of onsite stream relocation in the center of the I-26/US 74 interchange resulting from a fill slope that is required to elevate the newly added US 74 eastbound flyover ramp/bridge over the existing lanes within the interchange. Construction began in late November 2017. Following completion of the reinforced concrete box culvert, final channel work, buffer grading and removal of the temporary flow diversion, the stream relocation was completed in April 2018. The stream relocation included instream grade control structures, root wads for aquatic habitat, live staking of the streambanks, and planting of bareroot seedlings in the 30-foot disturbed riparian buffer along the western side of Horse Creek.

1.2 Purpose

For a mitigation site to be considered successful, the site must meet the success criteria. This report details the monitoring in **2021-3** at the Horse Creek Mitigation Site. The monitoring schedule may be modified from the original schedule due to the repairs of the eroded streambank in October 2020 at the request of NCDOT. The current monitoring schedule is highlighted in blue in the table below (Table 1).

Table 1. Monitoring Schedule

Resource	Year (2018 – 2025)						
	1	2	3	4	5	6	7
Stream Channel Monitoring							
Vegetation Monitoring							
Visual Assessment							
Report Submittal							

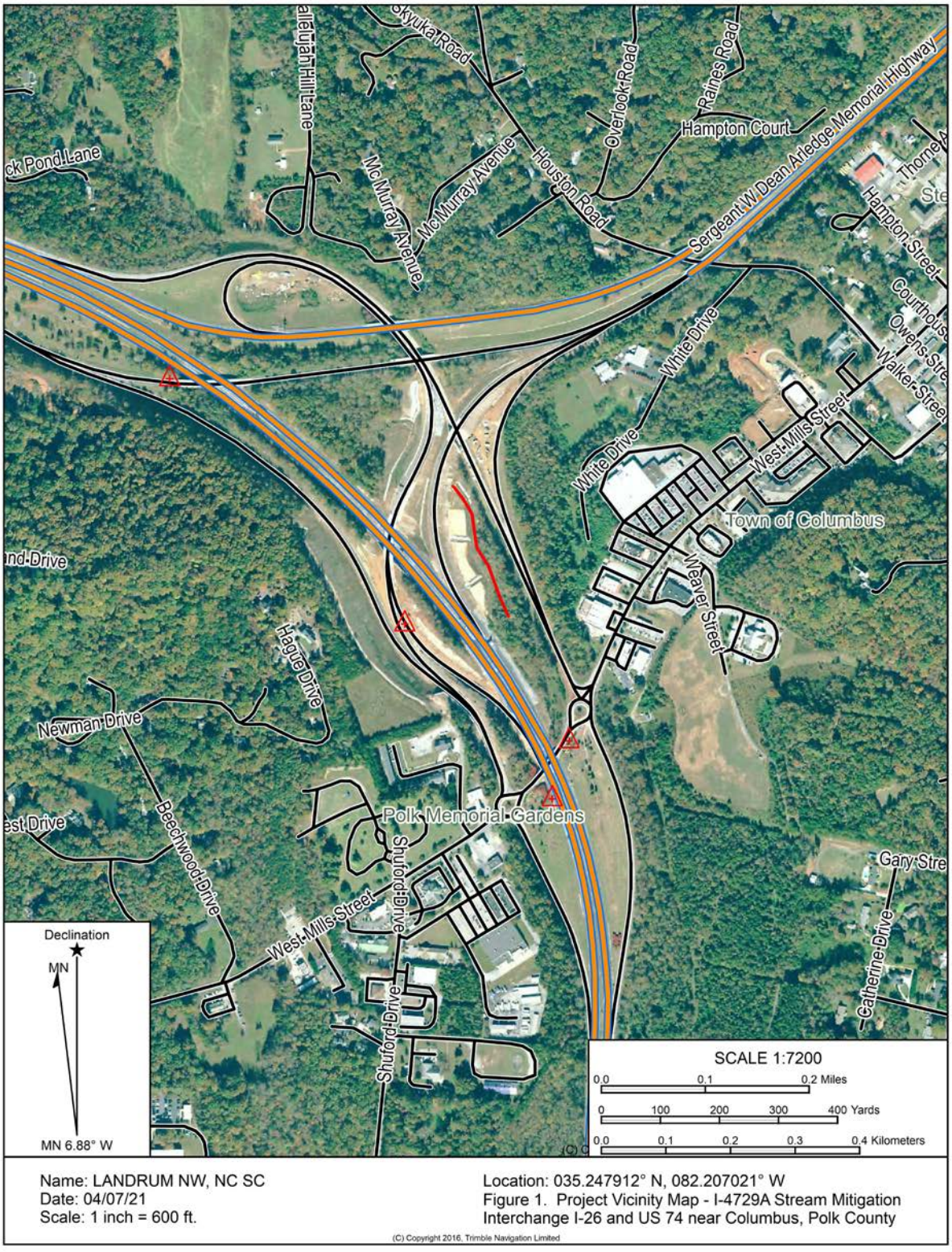
1.3 Project History

April 2018	As-Built Stream Reforestation Completed
April 2018	As-Built Stream Survey Completed
July 2018	As-Built Vegetation Monitoring
April 2019	Year 1 Stream Survey Completed
April 2019	Year 1 Vegetation Monitoring – Type II Supplemental Planting of Floodplain
April 2020	Year 2 Stream Survey Completed
April 2020	Year 2 Vegetation Monitoring
April 2020	Recommend Stabilization/Repairs of Eroded Streambank and Stream Channel
October 2020	NCDOT Personnel Completed Repairs to Eroded Streambank and Stream Channel
March 2021	Type I & II Supplemental Planting of Streambank Repair and Riparian Area
April 2021	Year 3 Stream Survey Completed (Following Fall 2020 Repairs)
April 2021	Year 3 Vegetation Monitoring

1.4 Debit Ledger

The US Army Corps of Engineers General Permit 31 for the Horse Creek stream relocation indicates the loss of 795 linear feet of stream channel. Fifty-three (53) linear feet of stream channel will be a total loss and is mitigated at a 2:1 ratio. The remaining 742 linear feet of channel relocation will be mitigated at a 1:1 ration for the I-4729A project to compensate for unavoidable stream impacts.

Figure 1. Project Vicinity Map – Revised 2021



2.0 STREAM ASSESSMENT

2.1 Success Criteria

The stream mitigation site shall be monitored for seven 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 three permanent cross sections (two riffles and one pool) and a longitudinal profile. Annual photographs showing both banks and upstream and downstream views will be taken from permanent, mapped photo points. The entire length of the stream relocation will be investigated for channel stability. Any evidence of channel instability will be identified, mapped and photographed. Pebble counts shall not be conducted. The monitoring shall be conducted annually for a minimum of seven (7) years after final planting with measurements completed in years 1-3, year 5, and year 7. The results of visual monitoring will be reported in all monitoring reports as well as the specified measurements of performance measures (vegetative success, etc.) Monitoring reports for years 4 and 6 will include photo documentation of stream stability. If monitoring demonstrates the Site is successful by year 5 and no concerns have been identified, NCDOT may propose in writing to terminate monitoring (Year 6 & 7) at the site. The US Army Corps of Engineers (USACE) will provide written approval to NCDOT if monitoring criteria is acceptable following Year 5 reporting and the final site visit and "close out" by the various resource agencies. The monitoring results shall be submitted to the USACE and NCDWR in a final report within sixty (60) days after completing monitoring.

Vegetation Success

The success of vegetation and plantings will be measured through stem counts. Two permanent plots will be used to sample vegetation success in the riparian buffer. Survival of the live stakes will be determined by visual observation throughout the seven-year monitoring period. Bare root vegetation will be evaluated using two staked survival plots, which will be 30-feet by 30-feet (0.02 Acres) in size. All flagged stems will be counted in those plots. Success will be defined as 320 planted stems per acre after Year 3, 260 planted stems per acre in year 5, and 210 planted stems per acre in Year 7. Since the site is in the mountains, planted vegetation must reach an average height of 8-feet in each plot at Year 7. Volunteer stems of "native plants" will be considered in determining overall vegetation success; however, (1) volunteer stems will be counted separately from planted stems and (2) volunteer stems must be species from the approved planting list included in the monitoring plan. All vegetation monitoring will be conducted during the growing season (July 1 through leaf drop) to characterize species composition and density. Visual observations of the percent cover of shrub and herbaceous species will also be documented by photograph.

2.2 Stream Description

2.2.1 Post-Construction Conditions

The mitigation project covers approximately 742 linear feet of stream relocation in the center of the I-26/US 74 interchange. A portion of Horse Creek was relocated in March/April 2018 by NCDOT. Stream relocation involved the installation of grade control structures (cross vanes, log vanes) meanders, riffle/pool complexes, root wads for aquatic habitat, live staking of streambanks, and planting of bareroot seedlings in the disturbed 30-foot buffer zone along the western side of Horse Creek. The riparian zone along the eastern side of Horse Creek is forested and was basically undisturbed during construction.

2.2.2 Monitoring Conditions

The objective of the I-4729A stream relocation was to offset stream impacts associated with the interchange improvement project. The relocation of Horse Creek should improve channel stability, sediment transport, water quality, as well as, terrestrial and aquatic habitats along this stream reach, which was previously disturbed during the construction of the existing interchange in the 1970's. For this report, three cross sections were used in the comparison of channel morphology (Table 2). The cross sections are highlighted for easier comparison (XS 1, XS 2, XS 3).

Table 2. Abbreviated Morphological Summary – Horse Creek – Cross Sections #1, #2, and #3

Variable	As-Built – 2018			Monitoring Year 1 – 2019			Monitoring Year 2 – 2020		
	XS 1	XS 2	XS 3	XS 1	XS 2	XS 3	XS 1	XS 2	XS 3
Drainage Area (mi²)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Bankfull width (ft)	10.87	10.35	11.83	11.61	10.91	11.75	19.20	11.43	12.79
Bankfull Mean Depth (ft)	0.62	1.16	0.71	0.86	1.07	0.91	0.47	1.60	1.04
Bank Height (ft)	7.70	8.21	7.94	7.41	7.74	7.98	7.64	9.39	7.80
Width/Depth Ratio	17.53	8.92	16.66	13.50	10.20	12.91	40.85	7.14	12.30
Bankfull Cross Sectional Area (ft²)	6.71	12.07	8.41	8.45	11.72	10.70	9.01	18.29	13.36
Maximum Bankfull Depth (ft)	0.95	1.79	1.12	1.27	1.70	1.40	1.33	2.96	1.52
Floodprone Area (ft²)	19.62	42.43	24.09	27.78	38.89	31.28	36.99	73.74	37.65
Entrenchment Ratio	2.92	3.51	1.37	1.61	1.82	1.51	1.21	2.21	1.50
Bank Height Ratio (ft/ft)	8.11	4.59	7.09	5.83	4.55	5.70	5.74	3.17	5.13

Variable	Monitoring Year 3 – 2021			Monitoring Year 4 - 2022		
	XS 1	XS 2	XS 3	XS 1	XS 2	XS 3
Drainage Area (mi²)	1.2	1.2	1.2			
Bankfull width (ft)	13.14	12.52	11.60			
Bankfull Mean Depth (ft)	0.76	1.46	0.73			
Bank Height (ft)	7.84	8.69	8.09			
Width/Depth Ratio	17.29	8.57	15.89			
Bankfull Cross Sectional Area (ft²)	9.97	18.26	8.43			
Maximum Bankfull Depth (ft)	1.14	2.75	1.09			
Floodprone Area (ft²)	27.83	69.25	23.31			
Entrenchment Ratio	1.36	1.96	1.36			
Bank Height Ratio (ft/ft)	6.88	3.16	7.43			

*Floodprone Width and Slope are average values only.
*Riffle values are used for classification purposes.

2.3 Results of the Stream Assessment

2.3.1 Site Data

The site assessment included the survey of 3 cross sections along the 742-linear foot Horse Creek stream relocation following construction. The three cross sections were established during the 2018 as-built survey/monitoring evaluation. Cross sections were established at locations where they would represent the various channel dimensions that exist along the new alignment so that they could be monitored for stability. The locations of the cross sections are presented below and shown in Appendix C.

- Cross Section 1 (XS 1): Horse Creek (most upstream below RCBC), midpoint of riffle
- Cross Section 2 (XS 2): Horse Creek, middle of pool
- Cross Section 3 (XS 3): Horse Creek, (most downstream), midpoint of riffle

Based on the review of the 2020 monitoring data, the channel was showing signs of widening, downcutting and scouring of pools, and considerable streambank erosion in the area of cross-section 1 (XS-1) mainly due to extreme weather conditions (excessive rainfall and flooding) that continues to occur in Polk County since the inception of this project. Stream channel modifications and/or repairs were designed and implemented by NCDOT personnel and were completed in October 2020. Methods of repair included boulder toe protection and the construction of a 150-foot long boulder wall along the eroded streambank, slight adjustment of the cross-vane below the RCBC, hardening and shallowing up of the deeply scoured pools and the removal of a beaver dam on the southern reach of the stream channel. The reconstructed areas were reseeded with appropriated vegetation and stabilized with coir fiber matting. These disturbed areas were replanted with live stakes and bare root seedlings in March 2021, to provide long-term stabilization.

Based on review of the 2021 monitoring data following the October 2020 repairs, visual inspection, and photographs, the Horse Creek Mitigation Site has met the required monitoring protocols for the third formal year of monitoring. Based on visual assessment and comparisons of the As-Built to the Year 3 monitoring data following repairs, the channel now appears stable and is more in line with the As-Build cross-sectional data and longitudinal profile data collected in 2018/2019, than the dramatic increases is bankfull width at Cross Section 1 (XS-1) and the scouring of pools along the longitudinal profile that occurred in the 2020 data. Following repairs, Cross Section 1 (XS-1) now shows a decrease in bankfull width of approximately 6.06 feet and an increase in bankfull mean depth since the channel was narrowed up in relation to the streambank repairs. Cross Section 2 (XS-2) shows an increase in bankfull width of 1.09 feet due to some minor scour along the toe of slope and a slight decrease in bankfull mean depth of 0.14 feet. Cross Section 3 (XS-3) is the most stable of the three cross sections over the past three years of monitoring. The data shows only slight variation in the parameters measured since the inception of this project.

Following the October 2020 repairs, the longitudinal profile shows some degradation (downcutting) along the thalweg, especially in the upper reaches of the stream channel near XS-1. The deeply scoured pool areas near XS-1 and XS-2 were filled-in to some degree and hardened to prevent further scouring and deepening of the pools. The installation of the 150 linear foot boulder wall along the eastern streambank probably attributed to the establishment of the new deeper thalweg in 2021. Additional survey data will be required to fully assess the stream channel repairs made in October 2020.

Graphs of the cross sections and longitudinal profile are presented in Appendix B. Site photographs are presented in Appendix C. Pebble counts were not required per the permit conditions or the monitoring plan; therefore, were not completed. All other monitoring activities will continue to be completed by NCDOT-Division 14 throughout the seven-year monitoring period.

3.0 VEGETATION: HORSE CREEK MITIGATION SITE (YEAR 3 MONITORING)

3.1 Success Criteria

Mitigation Plan: Success for vegetation monitoring within the riparian buffer is based on the survival of at least 320 planted stems per acre in Years 1-3; 290 planted stems per acre in Year 4; and 260 planted stems per acre in Year 5. Vegetation monitoring will consist of counts of planted stems within the two 30-foot x 30-foot plots (0.02 acres) established within the disturbed riparian buffer along the western side of Horse Creek.

3.2 Description of Species

The following live stake species were planted in the Streambank Enhancement Area (**Type I**):

(*Cornus* amomum), Silky Dogwood
(*Salix nigra*), Black Willow

The following tree species were planted in the Buffer Enhancement Area (**Type II**):

(*Platanus occidentalis*), American Sycamore
(*Liriodendron tulipifera*), Yellow Poplar
(*Fraxinus pennsylvanica*), Green Ash
(*Betula nigra*), River Birch

3.3 Results of Vegetation Monitoring

Plot counts were conducted in late April 2021 resulting in higher survival densities for Plot 1. Plot 2 came in with a slightly lower density per acre; however, the average tree density per acre for both plots came in with a much higher survival density of 847 trees per acre, which far exceeds the success criteria of 320 stems per acre for Years 1-3. In addition, there are various volunteer species such as red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), and Virginia pine (*Pinus virginiana*) sprouting throughout the vegetation plots, as well as, the previously disturbed riparian area along the western side of Horse Creek.

Table 3. Average Density of Tree Species – As Built/Year 3 – 2021

Plot Number	American Sycamore	Yellow Poplar	Green Ash	River Birch	Total (Year 3)	Total (At Planting)	Density (Tree/Acre)
***1**	6	-	4	2	-	12	**600**
***2**	4	-	5	2	-	11	**600**
1	12	0	8	3	23	12	**1,150**
2	6	0	3	1	10	11	**545**
As-Built Average Density (Trees/Acre)							**600**
Year 1 Average Density (Trees/Acre)							**803**
Year 2 Average Density (Trees/Acre)							**722**
Year 3 Average Density (Trees/Acre)							**847**

*Initial Planting Density = 600 Trees/Acre
*Plot Size (30' x 30') = 0.02 Acres
*Equation: # trees at survey ÷ # trees at planting x 600 = Trees/Acre

3.4 Live Stake Evaluation

The live stakes that were planted along the streambank and noted in the monitoring evaluation are surviving and becoming well established. The area of extensive streambank erosion below the RCBC in the vicinity of XS-1 was repaired by NCDOT in October 2020 and replanted with live stakes and bare root seedlings in March 2021 (see attached photos Appendix C).

3.5 Conclusions

There are 2 vegetation monitoring plots established within the 30-foot buffer zone. The 2018 As-Built vegetation monitoring of the site revealed an average tree density of 600 trees per acre. The 2019 (Year 1) vegetation monitoring of the site revealed an average tree density of 803 trees per acre due to some supplemental planting in the winter of 2019. The 2020 (Year 2) vegetation monitoring of the site revealed an average tree density of 722 trees per acre. The **2021 (Year 3)** vegetation monitoring of the site revealed an average tree density of 847 trees per acre. This average is well above the minimum success criteria of 320 trees per acre for monitoring Year 3. Photo Points 1 and 2 and vegetation plots presented in Appendix C show steady growth of herbaceous and woody vegetation, as well as, additional volunteer species sprouting throughout the riparian area.

4.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Based on the review of the 2020 monitoring data, the channel was showing signs of widening, downcutting and scouring of pools, and considerable streambank erosion in the area of cross-section 1 (XS-1) mainly due to extreme weather conditions (excessive rainfall and flooding) that continues to occur in Polk County since the inception of this project. Stream channel modifications and/or repairs were designed and implemented by NCDOT personnel and were completed in October 2020. Methods of repair included boulder toe protection and the construction of a 150-foot long boulder wall along the eroded streambank, slight adjustment of the cross-vane below the RCBC, hardening and shallowing up of the deeply scoured pools and the removal of a beaver dam on the southern reach of the stream channel. The reconstructed areas were seeded with appropriated vegetation and stabilized with coir fiber matting. These disturbed areas were replanted with live stakes and bare root seedlings in March 2021, to provide long-term stabilization.

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The streambank is well vegetated with live stakes for the third year of monitoring. The stream buffer planting is exceeding the required planting vegetation success criteria at present. NCDOT will continue stream and vegetation monitoring at the Horse Creek Mitigation Site in 2022.

5.0 REFERENCES

I-4729A Stream Relocation Monitoring Plan, Horse Creek, Polk County. Version 1.2, NCDOT Division 14, August 17, 2017.

On-Site Stream Mitigation Plan, Interchange at I-26 and US 74 near Columbus; Polk County, NC, T.I.P. Number I-4729A, WBS No: 34243.1.3, August 17, 2017.

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 Quality.

6.0 QUALIFICATIONS

The field surveys and preparation of the Stream Monitoring Report was conducted by Mark S. Davis, Environmental Specialist, Jan Gay, LSS, Ecologist, and Mark Parris, PLS, of Vaughn and Melton Consulting Engineers, Inc.

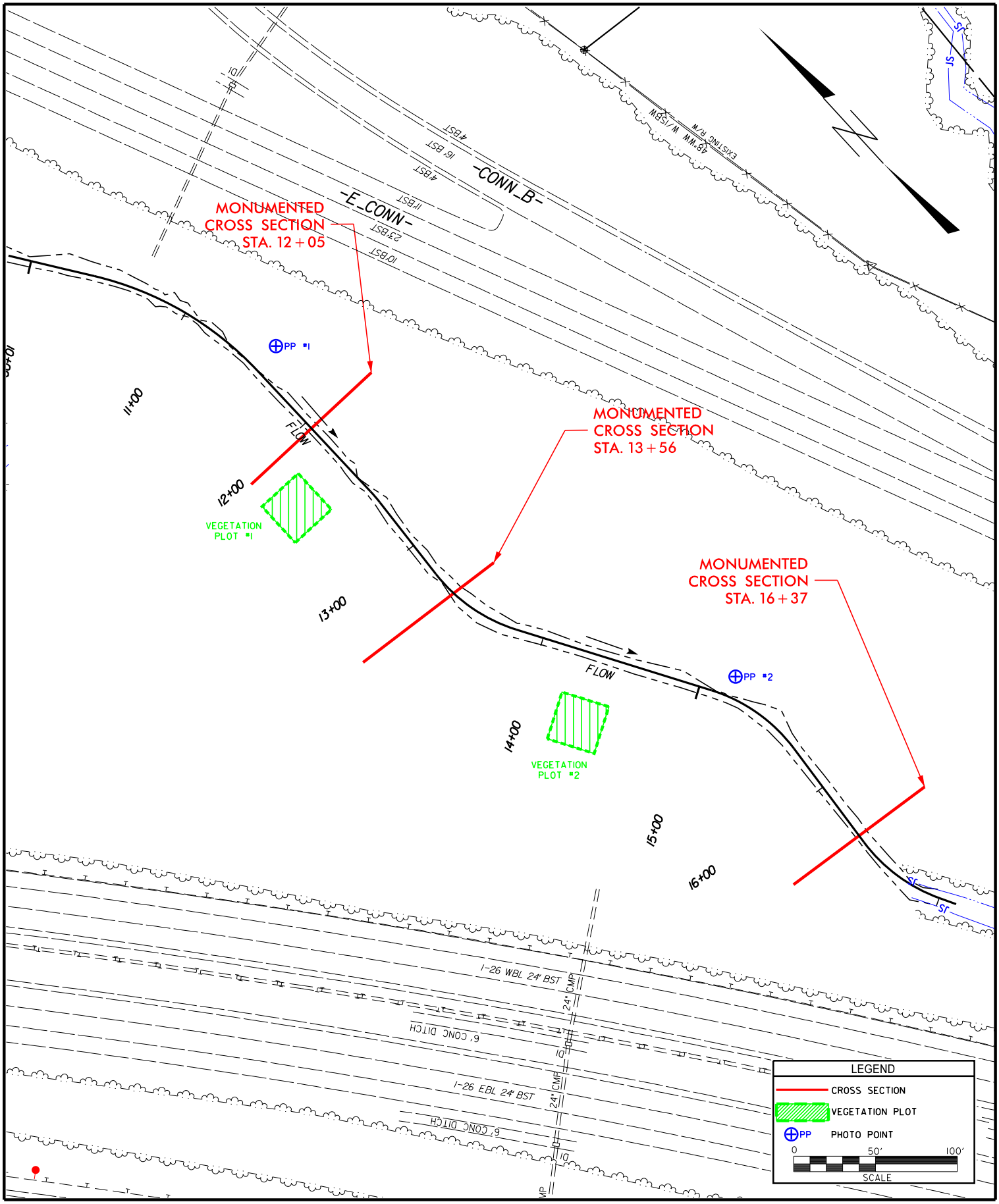
Investigator: Mark S. Davis, Environmental Specialist, Vaughn & Melton Consulting Engineers
Education: BS Fishery Science, North Carolina State University, 1978
Experience: Environmental Specialist, Vaughn & Melton Consulting Engineers, 2016-Present
Environmental Supervisor, NCDOT Division 14, 2000-2016
Mountain Region Hab/Con Coordinator, NC Wildlife Resources Commission, 1996-2000
Fishery Biologist/Technician, NC Wildlife Resources Commission, 1987-1996
Research Technician, US Forest Service, Coweeta Hydrologic Laboratory, 1980-1985
Biological Technician, US Fish & Wildlife Service, 1978-1979
Responsibilities: Wetland and stream delineations, habitat assessments, T&E species assessments and surveys, SHPO requests, 404/401 and TVA 26a Permit Applications, NEPA/SEPA document preparation.

Investigator: Jan Gay, LSS, CNRP, Ecologist, Vaughn and Melton Consulting Engineers
Education: MS Landscape Classification and Ecosystem Modeling, Clemson University, 1992
Experience: Environmental Specialist, Vaughn & Melton Consulting Engineers, 2011-Present
Forensic Ecologist, Cardno-Entrix, Deep Water Horizon, Houma Louisiana, 2010
Office Manager, Environmental Services, Inc., Asheville, NC, 1995-2010
Research Scientist, US Forest Service, Savannah River Site, Aiken, SC, 1992-1995
Responsibilities: Jurisdictional wetland/stream delineation, Terrestrial habitat assessment, T&E species assessments and surveys, stream channel and vegetation assessments.

Surveyor: Mark Parris, PLS, Survey Manager, Vaughn and Melton Consulting Engineers
Education: AS, Surveying Technology, Asheville-Buncombe Community College, 2003
Experience: He has extensive experience in boundary surveys, topographical surveys and construction staking surveys since 1999. V&M Survey Manager, 2015 to Present
Responsibilities: In charge of QA/QC, technical review, staffing, scheduling, and project budgets for V&M in the Carolinas.

APPENDIX A

CROSS SECTION, VEGETATION PLOT & PHOTO POINT LOCATIONS



Vaughn & Melton
Consulting Engineers

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

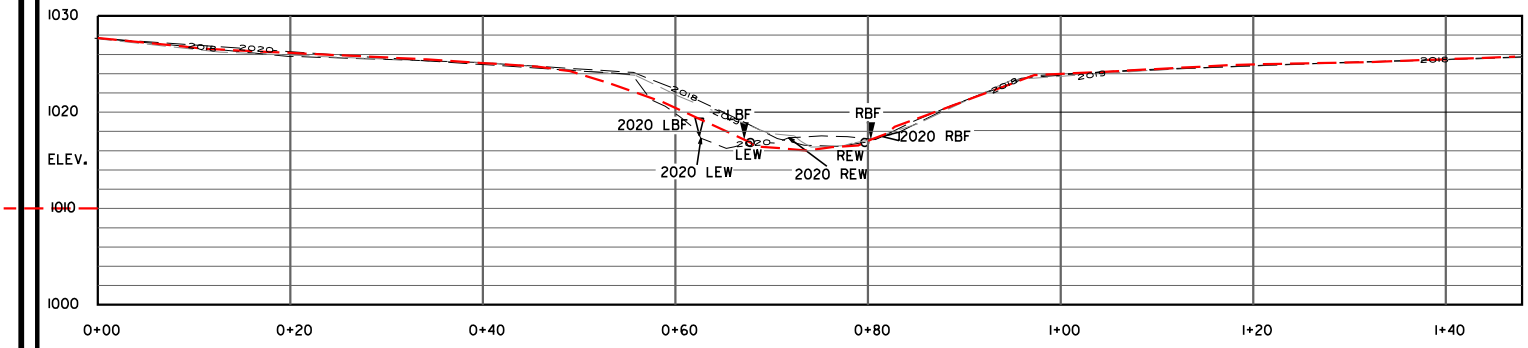
CROSS SECTIONS, VEGETATION PLOTS, & PHOTO POINT LOCATIONS

I-4729A
I-26 AND US 74 INTERCHANGE IMPROVEMENTS
STREAM RELOCATION
POLK CO., NORTH CAROLINA

PROJECT:	31732-05
DATE:	FEB. 2019
DWN./CHKD.:	SN/JG
FIGURE:	C1

APPENDIX B

CROSS SECTION COMPARISONS
&
LONGTITUDINAL PROFILE



LEGEND
▼ LBF (LEFT BANK FULL) / RBF (RIGHT BANK FULL)
○ LEW (LEFT EDGE WATER) / REW (RIGHT EDGE WATER)

CROSS SECTION #1 - STA. 12+05				
	AS BUILT	2019	2020	2021
BANKFULL WIDTH (FT.)	10.87	11.61	19.20	13.14
BANKFULL MEAN DEPTH (FT.)	0.62	0.86	0.47	0.76
BANK HEIGHT (FT.)	7.70	7.41	7.64	7.84
WIDTH/DEPTH RATIO	17.53	13.50	40.85	17.29
BANKFULL CROSS SECTIONAL AREA (SQ. FT.)	6.71	8.45	9.01	9.97
MAXIMUM BANKFULL DEPTH (FT.)	0.95	1.27	1.33	1.14
FLOODPRONE AREA (SQ FT.)	19.62	27.78	36.99	27.83
ENTRENCHMENT RATIO	2.92	1.61	1.21	1.36
BANK HEIGHT RATIO (FT./FT.)	8.11	5.83	5.74	6.88

LEGEND
2021 CROSS SECTION
2020 2020 CROSS SECTION
2019 2019 CROSS SECTION
2018 2018 INFORMATION

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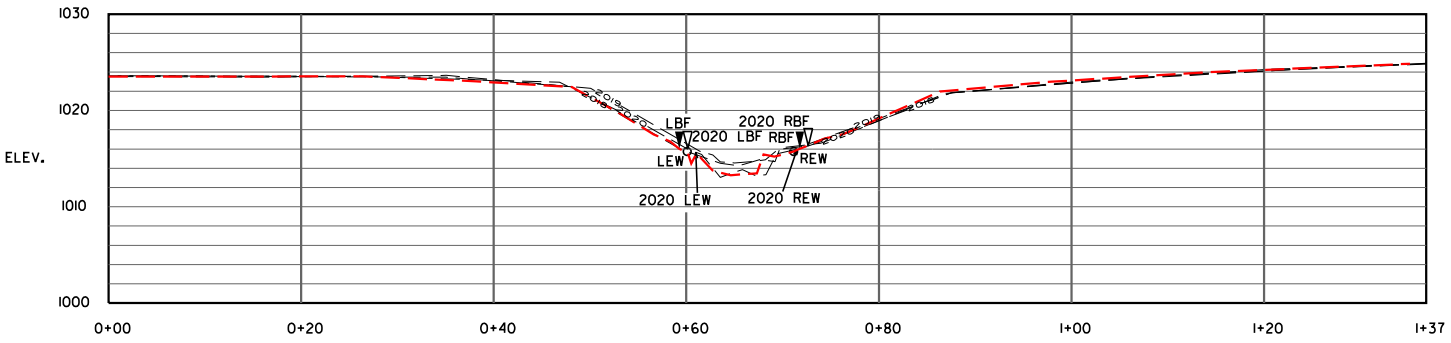
Consulting Engineers

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

RIFFLE CROSS-SECTION - STA. 12+05

I-4729A
I-26 AND US 74 INTERCHANGE IMPROVEMENTS
STREAM RELOCATION
POLK CO., NORTH CAROLINA

PROJECT: 31732-05
DATE: APR. 2021
DWN./CHKD.: SN/JG
FIGURE: A1



LEGEND
▼ LBF (LEFT BANK FULL) / RBF (RIGHT BANK FULL)
○ LEW (LEFT EDGE WATER) / REW (RIGHT EDGE WATER)

CROSS SECTION #2 - STA. 13+56				
	AS BUILT	2019	2020	2021
BANKFULL WIDTH (FT.)	10.35	10.91	11.43	12.52
BANKFULL MEAN DEPTH (FT.)	1.16	1.07	1.60	1.46
BANK HEIGHT (FT.)	8.21	7.74	9.39	8.69
WIDTH/DEPTH RATIO	8.92	10.20	7.14	8.57
BANKFULL CROSS SECTIONAL AREA (SQ. FT.)	12.07	11.72	18.29	18.26
MAXIMUM BANKFULL DEPTH (FT.)	1.79	1.70	2.96	2.75
FLOODPRONE AREA (SQ. FT.)	42.43	38.89	73.24	69.25
ENTRENCHMENT RATIO	3.51	1.82	2.21	1.96
BANK HEIGHT RATIO (FT./FT.)	4.59	4.55	3.17	3.16

LEGEND
2021 CROSS SECTION
2020 2020 CROSS SECTION
2019 2019 CROSS SECTION
2018 2018 INFORMATION

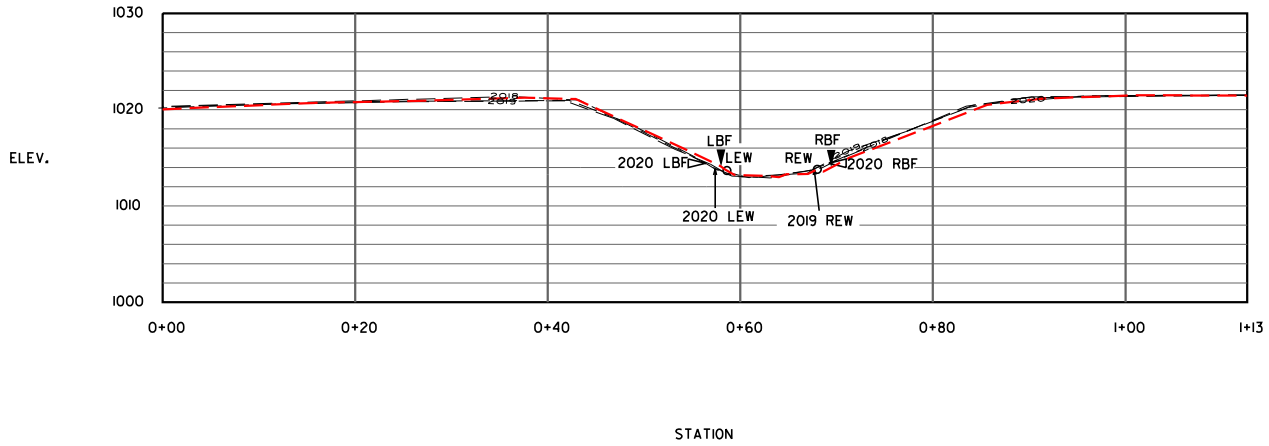
Vaughn & Melton
Consulting Engineers

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

POOL CROSS-SECTION - STA. 13+56

I-4729A
I-26 AND US 74 INTERCHANGE IMPROVEMENTS
STREAM RELOCATION
POLK CO., NORTH CAROLINA

PROJECT: 31732-05
DATE: APR. 2021
DWN./CHKD.: SN/JG
FIGURE: A2



LEGEND
▼ LBF (LEFT BANK FULL) / RBF (RIGHT BANK FULL)
o LEW (LEFT EDGE WATER) / REW (RIGHT EDGE WATER)

CROSS SECTION #3 - STA. 16+37				
	AS BUILT	2019	2020	2021
BANKFULL WIDTH (FT.)	11.83	11.75	12.79	11.60
BANKFULL MEAN DEPTH (FT.)	0.71	0.91	1.04	0.73
BANK HEIGHT (FT.)	7.94	7.98	7.80	8.09
WIDTH/DEPTH RATIO	16.66	12.91	12.30	15.89
BANKFULL CROSS SECTIONAL AREA (SQ. FT.)	8.41	10.70	13.36	8.43
MAXIMUM BANKFULL DEPTH (FT.)	1.12	1.40	1.52	1.09
FLOODPRONE AREA (SQ. FT.)	24.09	31.28	37.65	23.31
ENTRENCHMENT RATIO	1.37	1.51	1.50	1.36
BANK HEIGHT RATIO (FT./FT.)	7.09	5.70	5.13	7.43

LEGEND
2021 CROSS SECTION
2020 2020 CROSS SECTION
2019 2019 CROSS SECTION
2018 2018 INFORMATION

Vaughn & Melton
Consulting Engineers

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

RIFFLE CROSS-SECTION - STA. 16+37

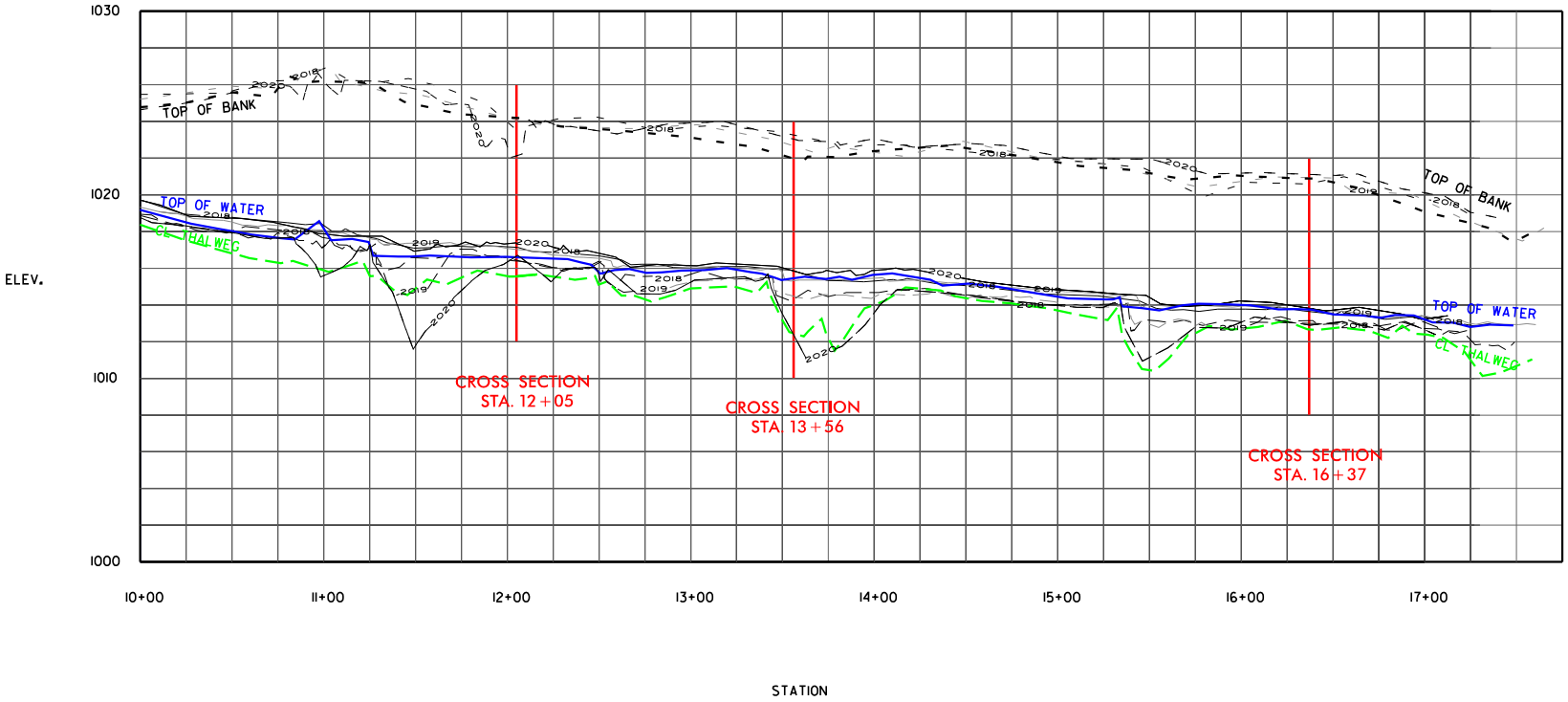
I-4729A
I-26 AND US 74 INTERCHANGE IMPROVEMENTS
STREAM RELOCATION
POLK CO., NORTH CAROLINA

PROJECT: 31732-05
DATE: APR. 2021
DWN./CHKD.: SN/JG
FIGURE: A3

Vaughn & Mellon
Consulting Engineers

STREAM LONGITUDINAL PROFILE

I-4729A
I-26 AND US 74 INTERCHANGE IMPROVEMENTS
STREAM RELOCATION
POLK CO., NORTH CAROLINA



LEGEND

- 2021 TOP OF BANK
- 2021 TOP OF WATER
- 2021 CL THALWEG
- 2020 INFORMATION
- 2019 INFORMATION
- 2018 INFORMATION

PROJECT: 31732-05
DATE: APR. 2021
DWN./CHKD.: SN/JG
FIGURE: A4

APPENDIX C

SITE PHOTOGRAPHS

I-4729A – Horse Creek Mitigation Site – Polk County
Photo Point 1A – 2021

Looking Upstream After Repairs – 4-2-2021

Looking Downstream After Repairs – 4-2-2021

I-4729A – Horse Creek Mitigation Site – Polk County
Photo Point 1A – 2021

Looking Across Stream from Point 1A After Repairs – 4-2-2021

I-4729A – Horse Creek Mitigation Site – Polk County
Photo Point 2 – 2021

Looking Upstream – 4-2-2021

Looking Downstream – 4-2-2021

I-4729A – Horse Creek Mitigation Site – Polk County
Photo Point 2 – 2021

Looking Across Stream from Point 2 – 4-2-2021

I-4729A – Horse Creek Mitigation Site – Polk County
Vegetation Plot Photos 2021

Plot 1 – Looking Northwest from Southeast Corner – 4/25/21

Plot 1 – Looking Northeast from Southwest Corner – 4/25/21

I-4729A – Horse Creek Mitigation Site – Polk County
Vegetation Plot Photos 2021

Plot 1 – Looking Southeast from Northwest Corner – 4/25/21

Plot 1 – Looking Southwest from Northeast Corner – 4/25/21

I-4729A – Horse Creek Mitigation Site – Polk County
Vegetation Plot Photos 2021

Plot 2 – Looking Northwest from Southeast Corner – 4/25/21

Plot 2 – Looking Northeast from Southwest Corner – 4/25/21

I-4729A – Horse Creek Mitigation Site – Polk County
Vegetation Plot Photos 2021

Plot 2 – Looking Southeast from Northwest Corner – 4/25/21

Plot 2 – Looking Southwest from Northeast Corner – 4/25/21

I-4729A – Horse Creek Mitigation Site – Polk County
Stream Destabilization Photos April 2020 and April 2021 Repairs

Looking East at Upper End of Streambank Destabilization April 2020

Looking East at Upper End of Streambank Repairs April 2021

I-4729A – Horse Creek Mitigation Site – Polk County
Stream Destabilization Photos April 2020 and April 2021 Repairs

Looking East at Middle of Streambank Destabilization April 2020

Looking East at Middle of Streambank Repairs April 2021

I-4729A – Horse Creek Mitigation Site – Polk County
Stream Destabilization Photos April 2020 and April 2021 Repairs

Looking East at Lower End of Streambank Destabilization April 2020

Looking East at Lower End of Streambank Repairs April 2021

I-4729A – Horse Creek Mitigation Site – Polk County
Minor Stream Destabilization Photos - 2021

Minor Streambank Scour North of New Boulder Wall

Minor Toe Scour on West Bank of Cross Vane 1

I-4729A – Horse Creek Mitigation Site – Polk County
Minor Stream Destabilization Photos - 2021

Minor Toe Scour on East Bank Below New Boulder Wall