

**AS-BUILT BASELINE MONITORING REPORT
Tributaries of Wicker Branch Stream Restoration
Union County, North Carolina
DMS Project Number: 95022
Contract No: 003982
USACE Action Id No: SAW 2013-01680**

**Yadkin River
03040105**



Prepared for:

**NC Department of Environment and Natural Resources
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652**

Data Collection Period May – June 2015

January 2016

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January 2016

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EXECUTIVE SUMMARY

The Tributaries of Wicker Branch Stream Restoration Project is located in Union County, North Carolina in the Yadkin River Basin, (HUC 03040105081010), and within a North Carolina Department of Environment and Natural Resources (NCDENR) Division of Mitigation Services (DMS) Targeted Local Watershed (TLW). It is also located within the watershed of Lanes Creek, a 303d-listed stream and Water Supply Watershed.

The project site consists of four headwater stream channels that flow through agricultural land and prior to restoration efforts were devoid of riparian vegetation. Past and present agricultural use of the land had severely impacted and degraded the channels. The project goals address stressors identified in the TLW and include the following:

- Improved water quality in Wicker Branch.
- Improve aquatic habitat in the tributary channels.
- Provide aesthetic value, wildlife habitat, and bank stability through the creation of a riparian zone.
- Create a contiguous wildlife corridor, with connection of some isolated adjacent natural habitats to larger downstream forested tracts.
- Provide shading and biomass input to the stream and mast for wildlife when vegetation is mature.

These objectives were achieved through restoring, enhancing, and preserving 4021 feet of perennial and intermittent stream channel. The riparian areas were also planted with native vegetation to improve habitat and protect water quality. The project reaches consist of Tributary 1A (Priority 1 Restoration), Tributary 1B (Preservation and invasive species control), Tributary 2 (Preservation), Tributary 3 (Enhancement Levels I and II), and Tributary 4 (Enhancement Level II)(See **Table 1** in **Appendix A** and **Figure 2** in **Appendix B**).

Project design was completed in December 2013 and the project constructed in September and October 2014. Planting was complete in March 2015 (See **Table 2** in **Appendix A**). Tributary 1A was constructed as designed. Several log sills were not installed on Tributary 3. These primarily were sills that were to be placed on the upper reach between the wetland areas the channel to help maintain stability. This area had developed significant vegetation following the establishment of the Conservation Easement and had already stabilized. Therefore, the log sills were determined to be unnecessary.

This report documents the completion of the restoration construction activities and presents As-built monitoring data for the post-construction monitoring period.

1.0 PROJECT GOALS, BACKGROUND AND ATTRIBUTES

1.1 LOCATION AND SETTING

The Tributaries of Wicker Branch Stream Restoration project is located in southeastern Union County approximately 8.5 miles southeast of the city of Monroe (**Appendix A, Figure 1**). The project site is located in the Carolina Slate Belt ecoregion (Griffith *et. al*, 2002).

The project site consists of four stream channels that currently flow through active agricultural land and prior to restoration efforts were devoid of riparian vegetation (**Appendix B, Figure 2**). Tributary 1 enters the tract as a first order stream and is joined by first order Tributary 2 becoming a second order stream. Tributary 3 and 4 are both first order tributaries in their entirety within the project site. Tributary 1 originates from an outfall and spillway from an upstream pond, while Tributary 2 originates from roadway runoff. Tributary 3 originates from seepage arising from the dam of the upstream pond, and lastly Tributary 4 starts from the outfall and spillway from another upstream pond, located to the northeast of the project site.

The primary adjacent land use throughout the project watershed consists of active agricultural land containing annual crops, small scattered rural residential areas, and forested land. Past and present agricultural use of the land severely impacted and degraded the channels. Farm equipment driven through the channels has created instability in bedform and loss of channel definition in several locations. Row crops are planted immediately up to the streambanks.

1.2 DIRECTIONS

To get to the project site from Raleigh, take I-40 West to US 1 South. Follow US 1 South 91 miles to US 74 West towards Monroe. Follow US 74 West 47 miles to US Highway 601. Take US Highway 601 South 6.3 miles to Griffin Cemetery Road. Turn left onto Griffin Cemetery Road. Follow Griffin Cemetery Road approximately 0.7 miles and turn right onto gravel drive. Follow gravel drive to farm field and to the head of Tributary 1A.

To get to the project site from Charlotte, take US 74 East approximately 24 miles to US Highway 601. Take US Highway 601 South 6.3 miles to Griffin Cemetery Road. Turn left onto Griffin Cemetery Road. Follow Griffin Cemetery Road approximately 0.7 miles and turn right onto gravel drive. Follow gravel drive to farm field and to the head of Tributary 1A.

1.3 PROJECT GOALS AND OBJECTIVES

The DMS develops River Basin Restoration Priorities (RBRPs) to guide its restoration activities within each of the state's 54 cataloging units. RBRPs delineate specific watersheds that exhibit both the need and opportunity for wetland, stream and riparian buffer restoration. These watersheds are called Targeted Local Watersheds (TLWs) and receive priority for DMS planning and restoration project funds.

The 2009 Lower Yadkin Pee Dee RBRP identified HUC 03040105081010 (Upper Lanes Creek) as a Targeted Local Watershed (NCDENR 2009). The Upper Lanes Creek watershed, which is approximately 33 square miles in size, consists of approximately 50% agricultural land and 34% forest, with approximately 0.6% impervious cover. There are over 30 animal operations in the watershed. Approximately 9% of the streams are classified as impaired due to the poor health of the aquatic community and are likely being impaired by point and non-point source pollutants

such as wastewater and runoff (NCDENR 2009). Urban land use, if following current trends, is projected to increase by over 350% in Union County by 2030.

The 2009 RBRP identified agricultural practices and development impacts as major stressors within this TLW. The Tributaries of Wicker Branch Stream Restoration Project was identified as a stream restoration opportunity to improve water quality within the TLW, and to protect several reaches of streams heavily impacted by agricultural practices.

The project goals address stressors identified in the TLW and include the following:

- Improved water quality in Wicker Branch.
- Improve aquatic habitat in the tributary channels.
- Provide aesthetic value, wildlife habitat, and bank stability through the creation of a riparian zone.
- Create a contiguous wildlife corridor, with connection of some isolated adjacent natural habitats to larger downstream forested tracts.
- Provide shading and biomass input to the stream and mast for wildlife when vegetation is mature.

The project goals will be addressed through the following project objectives:

- Restoration and enhancement of stream channels to stabilize channels to reduce erosion and improve aquatic habitat.
- Remove nutrients and sediment influx from surrounding agricultural fields.
- Establishment of a riparian buffer on project streams to reduce nutrients and sedimentation from agricultural processes, and connect adjacent isolated habitats to larger contiguous downstream habitats.
- Improve aquatic habitat in the tributary channels by removing excess sediment, providing a variety of habitat (pools and riffles), and a riparian buffer.

2.0 PROJECT STRUCTURE, RESTORATION TYPE AND APPROACH

2.1 PROJECT COMPONENTS AND RESTORATION APPROACH

The project site consists of four stream channels, Tributaries 1 through 4, which flow through active agricultural land and at the time of the restoration activities were devoid of riparian vegetation.

Tributary 1

The upper reach of Tributary 1 (aka Tributary 1A) underwent full restoration by constructing a new single thread channel in the adjacent floodplain. Instream structures, consisting of log sills, were incorporated into the design to provide grade control and pool formation. Bed material was placed in all riffles.

The lower reach of Tributary 1 (Tributary 1B) is within a wooded area. Work consistent with Enhancement Level II mitigation was performed on this portion of the tributary. Spot stabilization on areas of intermittent erosion and incision was performed in four areas. Areas with incision and headcuts had “rock ramps” installed at a 3:1 or a 4:1 slope to repair the headcuts. Areas with bank erosion had the banks sloped back slightly to reduce bank angle. Exotic invasive

plants, namely Chinese privet (*Ligustrum sinense*), were removed from the easement area to allow for the natural establishment of native vegetation. Because of the existing mature hardwood overstory, no additional planting along Tributary 1B was performed.

Tributary 2

Originally proposed for enhancement, this reach was determined to be unsuitable for mitigation credits during a site visit with the US Army Corps of Engineers (USACE) in August 2011. It was requested by the USACE that a 30 foot buffer and conservation easement be acquired to provide riparian habitat connectivity between the restored segments of Tributary 1A and upstream wooded areas.

Tributary 3

Two wetlands are present in the existing stream channel of Tributary 3, and are separated by approximately 260 feet of stream channel. The restoration of Tributary 3 began just downstream of the most upstream wetland. During a site visit with the USACE in August, 2011, it was suggested that the stream reach between the two wetlands could remain as-is with no modifications.

The restoration work conducted on Tributary 3 was consistent with Enhancement Level I and Enhancement Level II mitigation. The Enhancement Level I reach restored two of the three morphological parameters (profile and cross-section), while the Enhancement Level II reach restored the riparian area and stabilized the channel to prevent bank erosion or headcuts. The channel remained in its current alignment. A bankfull bench will be established along both sides of the channel to aid in reducing the energy of flows during above-bankfull events and allows for floodwaters to collect within the restored floodplain, thereby increasing the treatment of the water and providing overall stability to the channel itself. Log sills were installed to help control grade and provide instream pool habitat.

Adjacent rill erosion occurring along Tributary 3 will be controlled with wood sill level spreaders to ensure that only diffuse flow occurs through the easement.

Tributary 4

Tributary 4 had a level of work consistent with Enhancement Level II mitigation. There was no bank erosion present on this channel and the channel form was not incised. Several log notched sills were placed in the channel to help establish pool habitat in an otherwise uniform bedform. A 20-foot pipe at an old road crossing was removed at the head of this stream. A riparian buffer was established to help protect the stream.

2.2 PROJECT HISTORY, CONTACTS, AND ATTRIBUTE DATA

The project was selected by DMS as a Full Delivery site in July 2011. Following field studies, the Restoration Plan was finalized and approved in December 2013. Design was completed in December 2013 and all permits were secured by the summer of 2014. Construction occurred in

September and October 2014 and planting was completed in March 2015. **Tables 2** through **4** in **Appendix A** provide more information regarding the project.

3.0 PERFORMANCE STANDARDS

The following section outlines the performance standards for the proposed mitigation. The performance standards are consistent with the requirements described in the Federal rule for compensatory mitigation project sites as described in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.5 paragraphs (a) and (b).

3.1 STREAMS

Post-restoration monitoring of channel stability will include dimension (cross-sections), pattern and profile (longitudinal profile), and photo documentation of the project. Success criteria for the stream restoration also include substrate analysis and the frequency of bankfull events. The success criteria are described below for each parameter.

3.1.1 Dimension

Riffle cross-sections on the restoration reaches should remain relatively stable; however, due to the sand/silt nature of the substrate throughout the restoration reaches, fluctuations of the riffle bed elevation over time are expected. These fluctuations should be temporary and will likely correspond to storm events. Riffle cross-sectional ratios (width-to-depth, depth ratio, and bank height ratio) should fall within the parameters defined for channels of the appropriate Rosgen stream type. If persistent changes are observed, these changes will be evaluated to assess whether the stream channel is showing signs of long term instability. Indicators of instability include a vertically incising thalweg or eroding channel banks. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in the width-to-depth ratio in meandering channels or an increase in pool depth. Remedial action would not be taken if channel changes indicate a movement toward stability.

3.1.2 Pattern and Profile

Longitudinal profile data for the restoration reaches should show that the bedform features are remaining stable. The riffles should be steeper and shallower than the pools, while the pools should be deep with flat water surface slopes. The relative percentage of riffles and pools should not change significantly from the design parameters. Adjustments in length and slope of run and glide features are expected and will not be considered a sign of instability. The longitudinal profile should show that the bank height ratio remains very near to 1.0 for the majority of the restoration reaches.

3.1.3 Photo Documentation

Photographs should illustrate the project site's vegetation and morphological stability on an annual basis. Cross-section photos should demonstrate no excessive erosion or degradation of the banks. Longitudinal photos should indicate the absence of persistent bars within the channel

or vertical incision. Grade control structures should remain stable. Reference photos will also be taken for each of the vegetation plots.

3.1.4 Substrate

Substrate materials in the restoration reaches should indicate a progression towards or the maintenance of coarser materials in the riffle features and smaller particles in the pool features.

3.1.5 Bankfull Events

Two bankfull flow events in separate years must be documented on the project within the five-year monitoring period. Bankfull events will be documented using a crest gage, photographs, and visual assessments such as debris lines.

3.2 VEGETATION

Success will be determined by survival of planted species within the sample plots. A minimum of 260 planted stems/acre must survive for at least five years after initial planting. At least six different representative tree and shrub species should be present on the entire site. If the vegetative success criteria are not met, the cause of failure will be determined and an appropriate corrective action will be taken.

The criteria for vegetative success will be as follows:

- A minimum survival rate of 320 planted trees per acre in the riparian buffer at the end of three years.
- A minimum survival rate of 260 planted trees per acre in the conservation easement at the end of five years.
- The species composition in the riparian buffer meets the diversity criteria established at the beginning of the project.

4.0 MONITORING PLAN

The monitoring report will follow the most recent DMS guidelines at the time monitoring is initiated. The report will discuss the current years' results and will include a discussion of any changes that have occurred at the project site. The relative significance of these changes will be discussed in detail and a maintenance plan will be recommended if applicable. The monitoring report will include the current monitoring year's data overlain on the previous monitoring years and design data for the plan, profile, and cross-section. In addition, a photo log showing successive conditions at established photo points will also be included.

4.1 STREAMS

Monitoring of the stability of the channel will occur after the first growing season and will continue annually for a period of five years or until two bankfull events have been documented. Bankfull events must be documented during separate monitoring years.

The following characteristics will be monitored with respect to stream channels on site.

4.1.1 Dimension

In order to monitor the channel dimension, a minimum of two permanent cross-sections were installed per 1,000 linear feet of stream restoration work, with riffle and pool sections in accordance with DMS guidance. Each cross-section was permanently marked with pins to establish its location. An annual cross-section survey will include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg. Cross-sections were established as follows:

- Tributary 1A (1,390 feet) – 4 riffle and 3 pool cross-sections
- Tributary 3 (640 feet) – 2 riffle and 1 pool cross-sections
- Tributary 4 (631 feet) – 2 riffle cross-sections

4.1.2 Pattern and Profile

A longitudinal profile will be completed for the restoration reaches of the project each year of the monitoring period. Per USACE and NCDWQ Stream Mitigation Guidance, for reaches less than 3,000 feet in length, the profile will be completed for the entire reach length. Measurements will include thalweg, water surface, bankfull, and top of low bank. These profile measurements will be taken at the head of each riffle, run, pool, and glide, as well as at the maximum pool depth. The survey will be tied to a permanent benchmark and NC State Plane coordinates.

4.1.3 Photo Documentation

Photographs will be taken once a year to visually document stability for five years following construction. Permanent markers will be established so that the same locations and view directions on the site are monitored each year. Photos will be used to monitor restoration and enhancement stream reaches as well as vegetation plots. Lateral reference photos should show a stable cross-section with no excessive erosion or degradation of the banks. The reference photo transects will be taken of both banks at each permanent cross-section. A survey tape pulled across the section will be centered in the photographs of the bank. The photographer will make every effort to maintain the same area in each photo over time. Photographs will be taken at representative grade control structures along the restored stream. The photographer will make every effort to consistently maintain the same area in each photo over time.

4.1.4 Substrate

A pebble count will be performed at each surveyed riffle and pool cross-section.

4.1.5 Bankfull Events

Bankfull events will be documented using a crest gauge and photographs. The crest gauge will be installed along the channel bank of Tributary 1A at a central site location. The gauge will be checked at each site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition.

4.1.6 Bank Stability Assessments

Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) assessments will be performed in year five of the project monitoring. The entire project length will be classified into the BEHI

erosion hazard categories and will include a NBS assessment. The data will be compared to the preconstruction BEHI and NBS assessment results.

4.2 VEGETATION

Eleven vegetation plots were established and assessed for the baseline vegetation monitoring. Monitoring of vegetation will follow protocols established in the most recent version of the Carolina Vegetative Survey-EEP Protocol. The baseline vegetation monitoring was conducted at a Level 1: Inventory of Planted Stems. Beginning in year one and continuing throughout the rest of the monitoring period, the site will be monitored using the Level 2 protocol (volunteer stems will be identified and counted). A baseline of 680 stems per acre were planted.

5.0 BASELINE CONDITIONS

The project was built as designed with the following changes based upon conditions encountered during construction:

- Upper reach of Tributary 3 between the two existing wetlands. Log sills at 10+00, 10+50, 11+03, and 12+13 were not installed as the channel was quite stable. The adjacent areas appeared to be developing into vegetated wetlands following establishment of the Conservation Easement and the elimination of farm equipment.
- Lower reach of Tributary 3 log sills at 16+15, 16+70, 19+38 and 20+89 were not installed.

A baseline survey was performed post construction by AECOM in May 2015 and is provided in **Appendix D**. The baseline survey of the longitudinal profile shows that the as-built channel closely reflects the design conditions.

6.0 MAINTENANCE AND CONTINGENCY PLANS

Problem areas at the Tributaries to Wickers Branch Stream Restoration Site will be dealt with accordingly based on the severity of the problem. Site maintenance may include reinstallation of coir matting, repairs to floodplain scouring, removal of sediment from the level spreaders, or adjustments in stream structures. All maintenance activities will be documented in the yearly monitoring reports.

7.0 REFERENCES

Griffith, G.E., J.M. Omernik, J.A. Comstock, M.P. Shafale, W.H. McNab, D.R. Lenat, J.B. Glover, and V.B. Shelburne. 2002. Ecoregions of North Carolina and South Carolina. (2 sided color poster with map, descriptive text, summary tables, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:1,500,000.

North Carolina Department of Environment and Natural Resources. 2009. Lower Yadkin Pee-Dee River Basin Restoration Priorities. <http://portal.ncdenr.org/web/eep/rbrps/yadkin>.

APPENDIX A – BACKGROUND TABLES

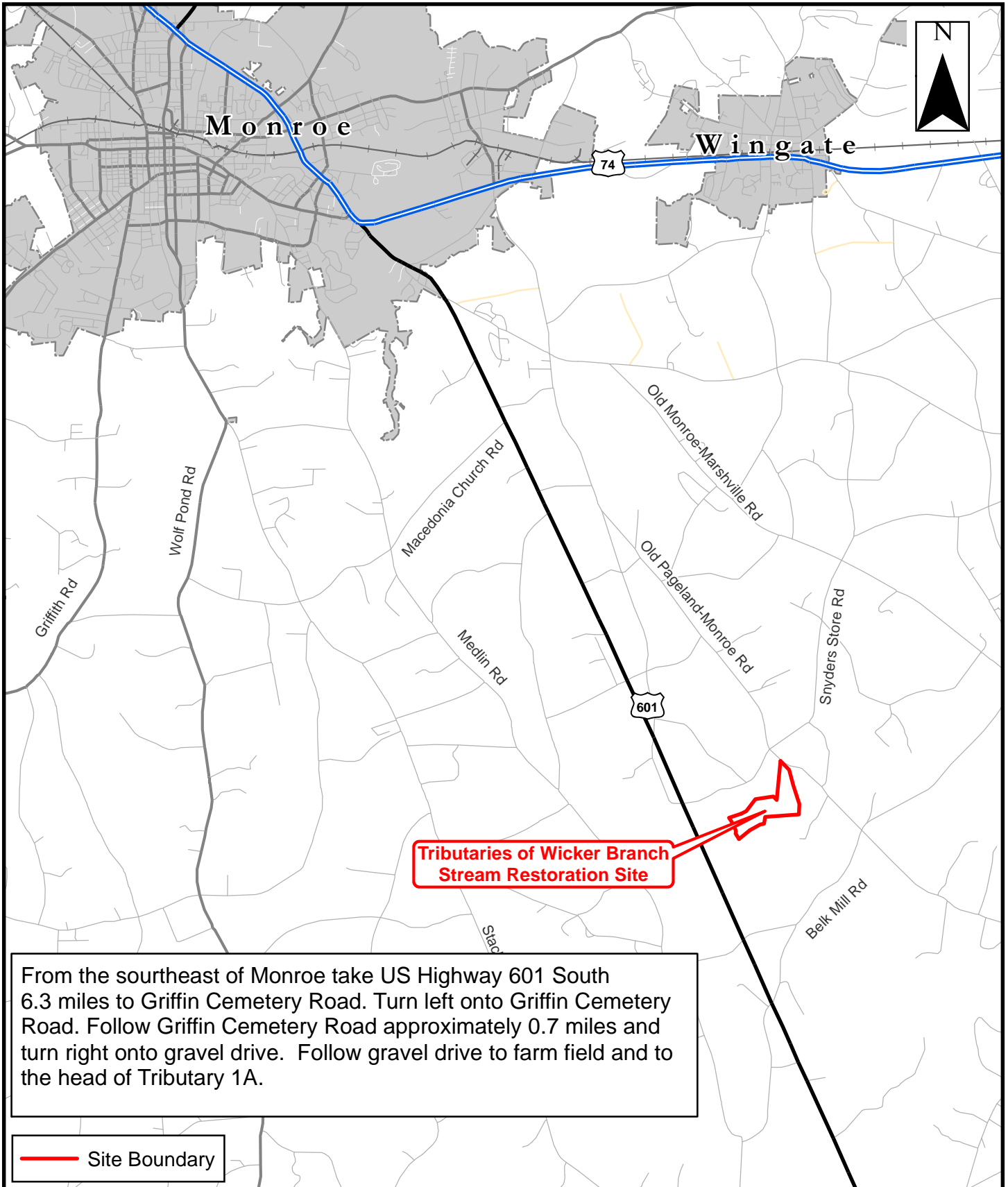
Figure 1: Vicinity Map

Table 1: Project Mitigation Components

Table 2: Project Activity and Reporting History

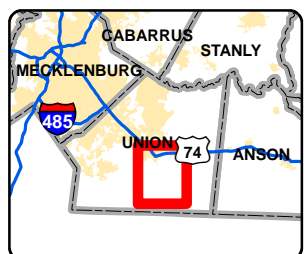
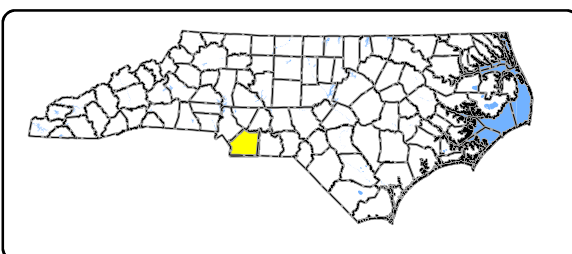
Table 3: Project Contact Table

Table 4: Project Attribute Table



From the southeast of Monroe take US Highway 601 South 6.3 miles to Griffin Cemetery Road. Turn left onto Griffin Cemetery Road. Follow Griffin Cemetery Road approximately 0.7 miles and turn right onto gravel drive. Follow gravel drive to farm field and to the head of Tributary 1A.

— Site Boundary



1. Vicinity Map
 Tributaries of Wicker Branch
 Stream Restoration Site (DMS No. 95022)
 Union County, NC



**Table 2. Project Activity and Reporting History
Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	Dec-13	Dec-13
Final Design – Construction Plans	Mar-14	Mar-14
Construction	Nov-14	Nov-14
Permanent seed applied to entire site	Nov-14	Nov-14
Plantings for entire site	Mar-15	Mar-15
Mitigation Plan (Year 0 Monitoring – baseline)	May-15	Jan-16
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		

Table 3. Project Contact Table
Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022

<p>Owner</p> <p>NCDENR - Division of Mitigation Services</p>	<p>Harry Tsomides NCDENR - Division of Mitigation Services 5 Ravenscroft Drive, Suite 102 Asheville, NC 28801</p> <p>(828) 545-7057</p>
<p>Designer</p> <p>AECOM of North Carolina, Inc.</p>	<p>Ron Johnson, Project Manager 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607 (919) 854-6210</p>
<p>Landowner</p> <p>Richard Simpson</p>	<p>3308 Old Pageland Monroe Rd. Monroe, NC 28112 704-506-5184</p>
<p>Construction Contractor</p>	<p>Riverworks 6105 Chapel Hill Road Raleigh, NC 27607</p>
<p>Planting Contractor</p>	<p>Efird's Landscaping 42759 Greenview Drive Albemarle, NC 38001 (704) 985-6559</p>
<p>Seeding Contractor</p>	<p>Riverworks</p>
<p>Monitoring Performer</p> <p>AECOM of North Carolina, Inc.</p>	<p>701 Corporate Center Drive, Suite 475 Raleigh, NC 27607 919-760-4000</p>

**Table 4. Project Baseline Information and Attributes
Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

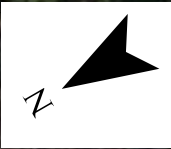
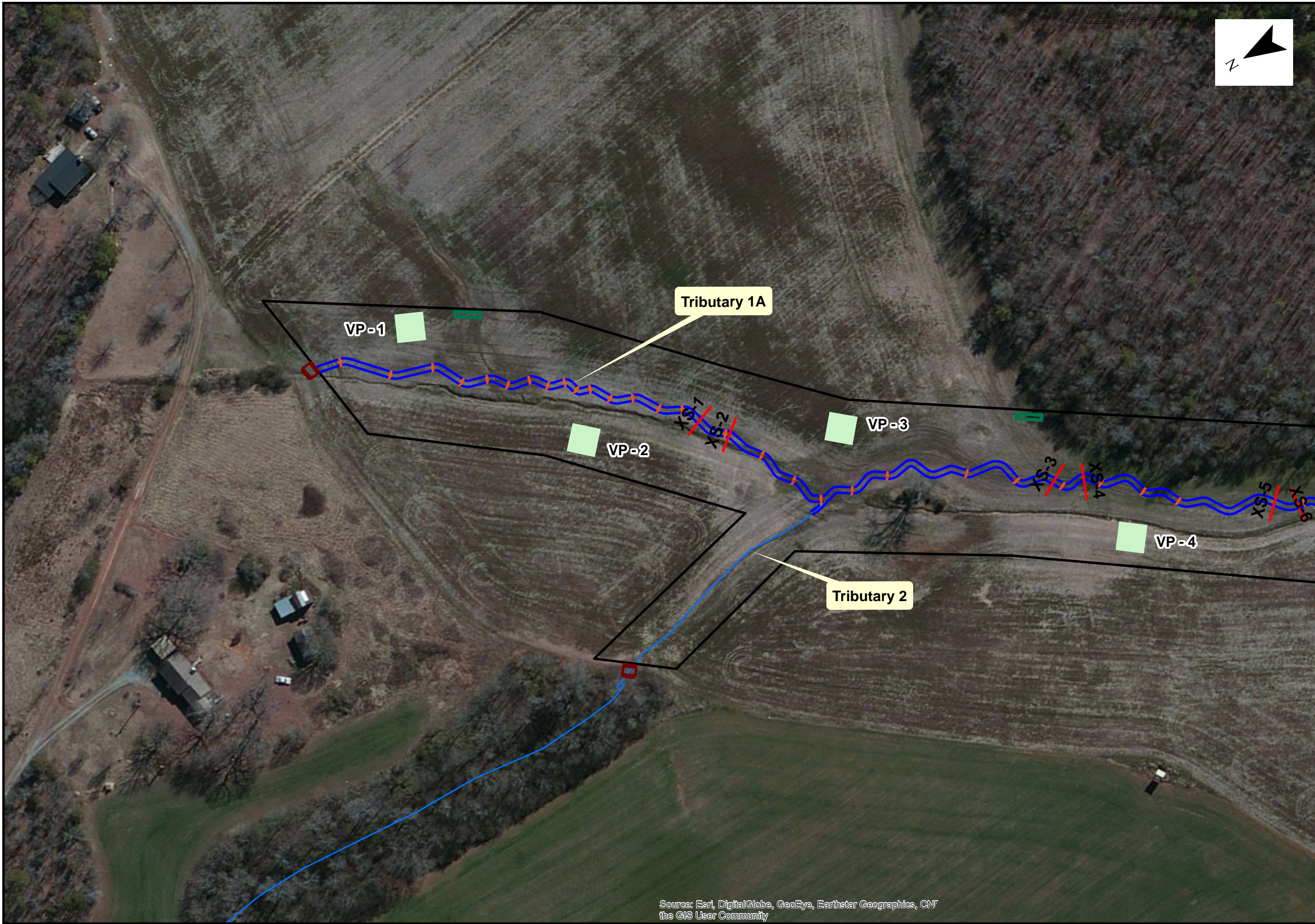
Project Information					
Project Name	Tributaries of Wicker Branch				
Project County	Union				
Project Area (acres)	15.49				
Project Coordinates (lat/long)	34.8946849, -80.4472082				
Project Watershed Summary					
Physiographic Province	Carolina Slate Belt - Piedmont				
Project River Basin	Yadkin-Pee Dee				
USGS HUC for Project	3040105081010				
NCDWQ Sub-basin for Project	3/7/2014				
Project Drainage Area (acres)	173				
Project Drainage Area Percentage of Impervious Area	2% to 3%				
CGIA Land Use Classification	Cultivated/Managed Herbaceous Cover				
Reach Summary Information (Pre-restoration)					
Parameters	Trib 1A	Trib 1B	Trib 2	Trib 3	Trib 4
Length of Reach (feet)	1293	1095	330	1184	631
Valley Classification	Type II	Type II	Type II	Type II	Type II
Drainage area (acres)	71.5	94.5	17.6	32.7	29.8
NCDWQ Stream ID Score	38.5	38.5	27	43	31.5
NCDWQ Water Quality Classification	WS-V	WS-V	WS-V	WS-V	WS-V
Morphological Description	B4c, G4c, F4	C4/F4	N/A	F/B6c/F6	N/A*
Evolutionary Trend	G→F→C	N/A	N/A	G→F→C	N/A
Underlying Mapped Soils	Cid channery silt loam	Chewacla silt loam	Cid channery silt loam, Badin channery silt loam	Cid channery silt loam	Cid channery silt loam, Goldston-Badin complex
Drainage Class	Moderately well drained/ somewhat poorly drained	Somewhat poorly drained	Moderately well drained/ somewhat poorly drained, well drained	Moderately well drained/ somewhat poorly drained	Somewhat poorly drained to excessively drained
Soil Hydric Status	No	Yes	No	No	No
Slope	1.30%	1.00%	1.70%	1.40%	1.00%
FEMA Classification	Zone X	Zone X	Zone X	Zone X	Zone X
Native Vegetation	None	Mesic Mixed Hardwoods	None	None	None
Percent Composition of Exotic Invasive Vegetation	0	50 % Understory	0	0	0
Regulatory Considerations					
Regulation	Applicable			Resolved	
Waters of the US – Section 404	Yes			Yes	
Waters of the US – Section 401	Yes			Yes	
Endangered Species Act	Yes			Yes	
Historic Preservation Act	No			N/A	
CZMA/CAMA	No			N/A	
FEMA Floodplain Compliance	No			N/A	
Essential Fisheries Habitat	No			N/A	

APPENDIX B – VISUAL ASSESSMENT DATA









Figure 2: Current Condition Plan View

Photos: Vegetation Plots

Photos: Stream Stations



Legend

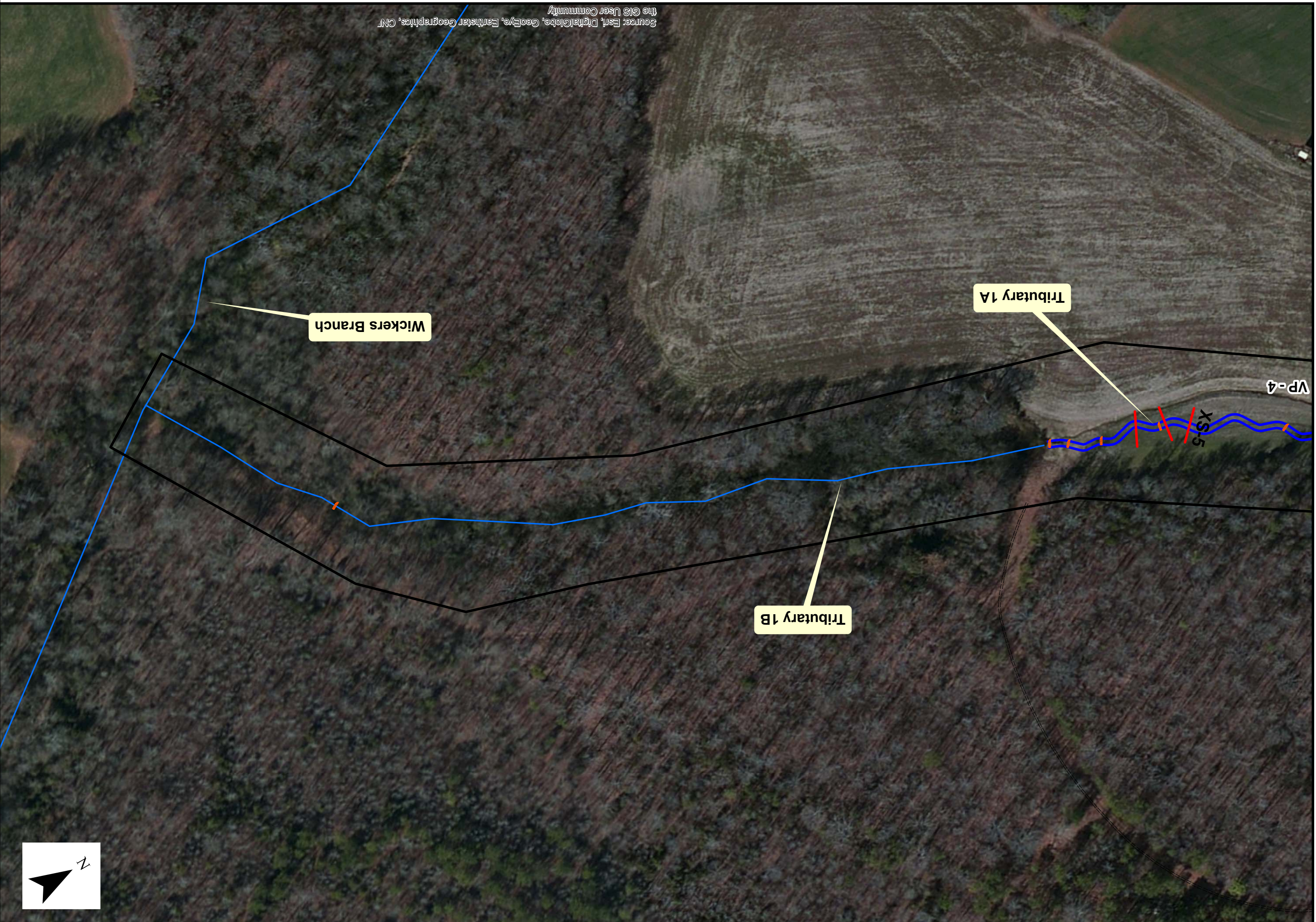
-  Existing Wetlands
-  Vegetation Plots
-  Level Spreader
-  Stream
-  Easement Boundary
-  Equipment Crossing
-  Log Sill
-  Cross Sections



Existing Condition Plan View
 Tributaries of Wicker Branch Stream Restoration
 Union County, NC
 DMS Project No. 95022

FIGURE 2a

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNF the GIS User Community



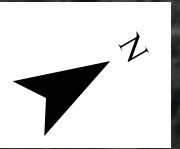
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNR
the GIS User Community

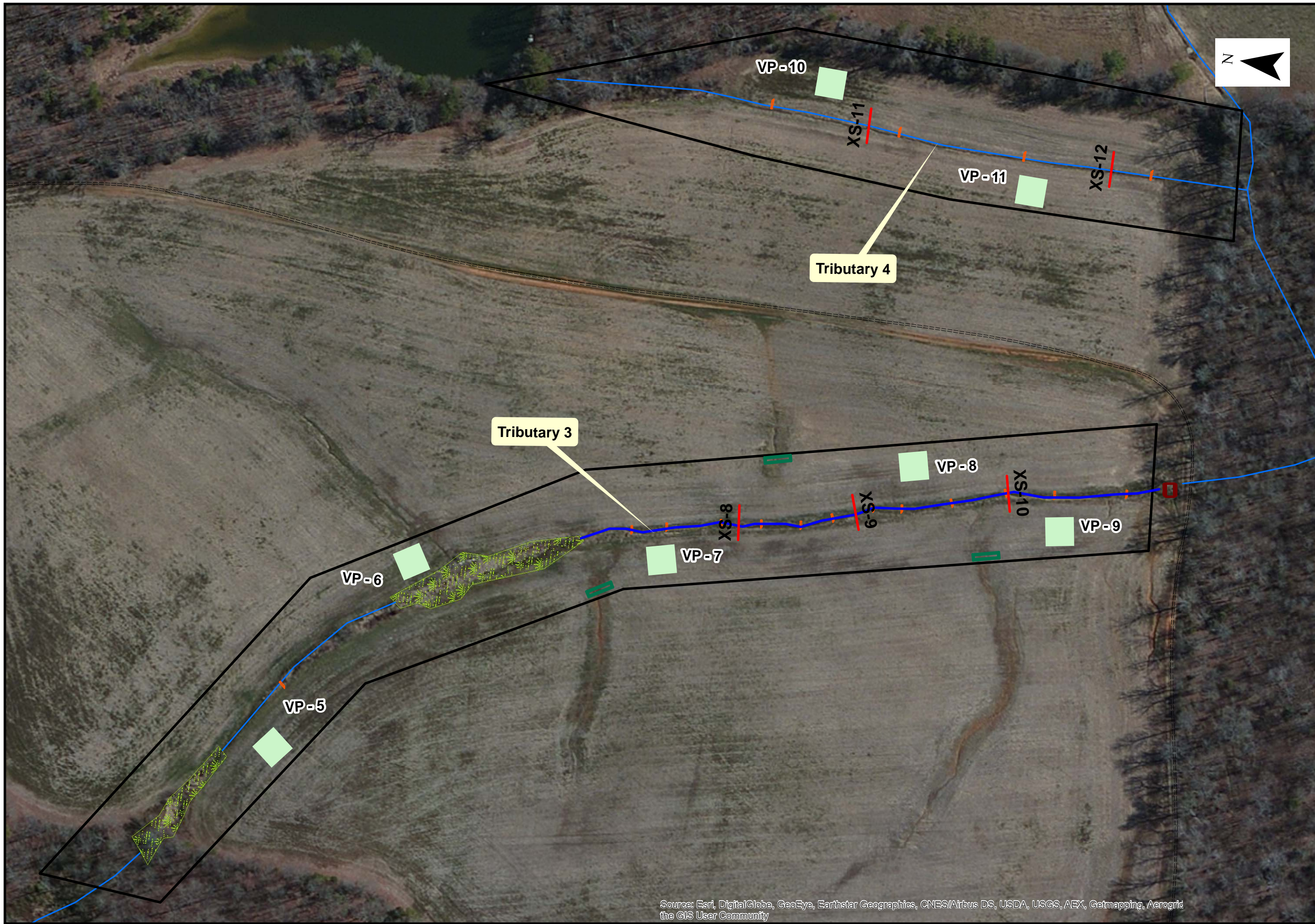
FIGURE
2b

Existing Condition Plan View
Tributaries of Wicker Branch Stream Restoration
Union County, NC
DMS Project No. 95022

0 50 100
Scale in Feet

- Legend**
- Equipment Crossing
 - Level Spreader
 - Log Sill
 - Stream
 - Easement Boundary
 - Existing Wetlands
 - Vegetation Plots
 - Cross Sections





Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid
the GIS User Community

Existing Condition Plan View
Tributaries of Wicker Branch Stream Restoration
Union County, NC
DMS Project No. 95022

Legend

- Existing Wetlands
- Vegetation Plots
- Level Spreader
- Stream
- Equipment Crossing
- Log Sill
- Easement Boundary
- Cross Sections



Vegetation Monitoring Plot 1 – 5/7/15



Vegetation Monitoring Plot 4 – 5/7/15



Vegetation Monitoring Plot 2 – 5/7/15



Vegetation Monitoring Plot 5 – 5/7/15



Vegetation Monitoring Plot 3 – 5/7/15



Vegetation Monitoring Plot 6 – 5/7/15



Vegetation Monitoring Plot 7 – 5/7/15



Vegetation Monitoring Plot 10 – 5/7/15



Vegetation Monitoring Plot 8 – 5/7/15



Vegetation Monitoring Plot 11 – 5/7/15



Vegetation Monitoring Plot 9 – 5/7/15



Cross Section 1 (looking upstream) – 6/5/15



Cross Section 4 (looking upstream) – 6/5/15



Cross Section 2 (looking upstream) – 6/5/15



Cross Section 5 (looking upstream) – 6/5/15



Cross Section 3 (looking upstream) – 6/5/15



Cross Section 6 (looking upstream) – 6/5/15



Cross Section 7 (looking upstream) – 6/5/15



Cross Section 10 (looking upstream) – 6/5/15



Cross Section 8 (looking upstream) – 6/5/15



Cross Section 11 (looking upstream) – 6/5/15



Cross Section 9 (looking upstream) – 6/5/15



Cross Section 12 (looking upstream) – 6/5/15

APPENDIX C: VEGETATION PLOT DATA

Table 5: Baseline Vegetation – As-built Stem Counts

**Table 5. Vegetation Plot Stem Count Summary
Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

Species		Plots*											MY5 Totals	MY4 Totals	MY3 Totals	MY2 Totals	MY1 Totals	Baseline Totals
Scientific Name	Common Name	01	02	03	04	05	06	07	08	09	10	11						
<i>Cercis canadensis</i>	Eastern redbud	1	2	3	6	2		3	1	5	2	1						26
<i>Cornus amomum</i>	Silky dogwood	5	1		2	3		2	1		5	2						21
<i>Diospyros virginiana</i>	Common persimmon	1	1	1					4									7
<i>Liriodendron tulipifera</i>	Tuliptree	2	6	5	6	4	4	3	3	4		1						38
<i>Quercus</i>	Oak	2																2
<i>Quercus alba</i>	White oak	5	2	4		7	6	5	4	3	1	4						41
<i>Quercus falcata</i>	Southern red oak	4	1	3	2		3	2	2		3							20
<i>Robinia pseudoacacia</i>	Black locust	1	1				1	4		1	1							9
<i>Salix nigra</i>	Black willow				1													1
<i>Sambucus canadensis</i>	Common elderberry	5	3	3	1		2		1		3	3						21
<i>Unknown</i>												1						1
TABLE SUMMARY	Plot area (acres)	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025						0.28
	Species count	9	8	4	6	4	5	6	7	4	6	6						
	Stem count	26	17	19	18	16	16	19	16	13	15	12						187
	Total stems per acre	1040	680	760	720	640	640	760	640	520	600	480						680

APPENDIX D: STREAM MEASUREMENT AND GEOMORPHOLOGY DATA

Appendix D – Stream Measurement and Geomorphology Data

Baseline Cross-Sections

Baseline Longitudinal Profiles

Baseline Pebble Counts

Table 6: Baseline Stream Data Summary

Table 7: Cross-Section Morphology Data

Table 8: Stream Reach Morphology Data

Cross-section Plot Exhibit

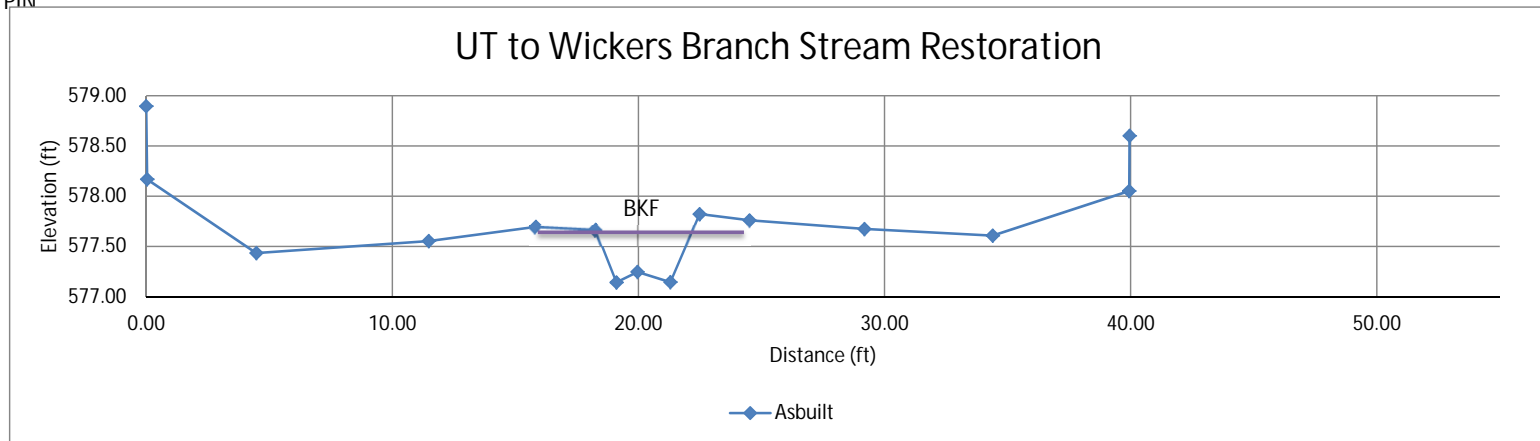
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	1
Feature	Riffle
Drainage Area (sq mi)	0.15
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0.00	578.89	LTPIN
0.04	578.17	LBPIN
4.47	577.43	GR
11.48	577.55	GR
15.84	577.70	GR
18.26	577.67	BKF
19.11	577.14	TOE
19.96	577.25	TW
21.30	577.14	TOE
22.49	577.82	TOB
24.51	577.76	GR
29.19	577.67	GR
34.40	577.61	GR
39.94	578.05	RBPIN
39.96	578.60	RTPIN

Summary Data	
Bankfull Elevation	577.67
Bankfull Width (ft)	3.97
Floodprone Width (ft)	50
Bankfull Mean Depth (ft)	0.38
Bankfull Max Depth (ft)	0.53
Bankfull Cross Sectional Area (ft ²)	1.51
Bankfull Width/Depth Ratio	10.45
Bankfull Entrenchment Ratio	10.06



Photo: Cross-section 1 looking upstream



Cross-section Plot Exhibit

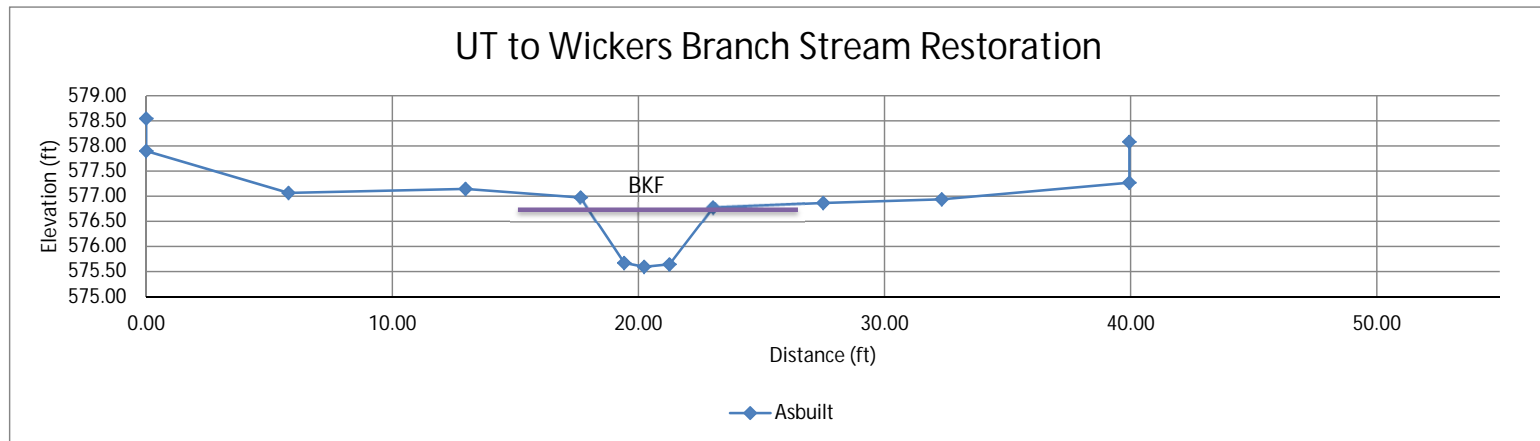
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	2
Feature	Pool
Drainage Area (sq mi)	0.15
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0.00	578.54	LTPIN
0.00	577.90	LBPIN
5.78	577.07	GR
12.98	577.14	GR
17.65	576.97	TOB
19.42	575.67	TOE
20.23	575.59	TW
21.26	575.64	TOE
23.04	576.78	BKF
27.51	576.86	GR
32.33	576.94	GR
39.95	577.27	RBPIN
39.95	578.08	RTPIN

Summary Data	
Bankfull Elevation	576.78
Bankfull Width (ft)	5.13
Floodprone Width (ft)	50
Bankfull Mean Depth (ft)	0.78
Bankfull Max Depth (ft)	1.19
Bankfull Cross Sectional Area (ft ²)	3.98
Bankfull Width/Depth Ratio	6.58
Bankfull Entrenchment Ratio	7.79



Photo: Cross-section 2 looking upstream



Cross-section Plot Exhibit

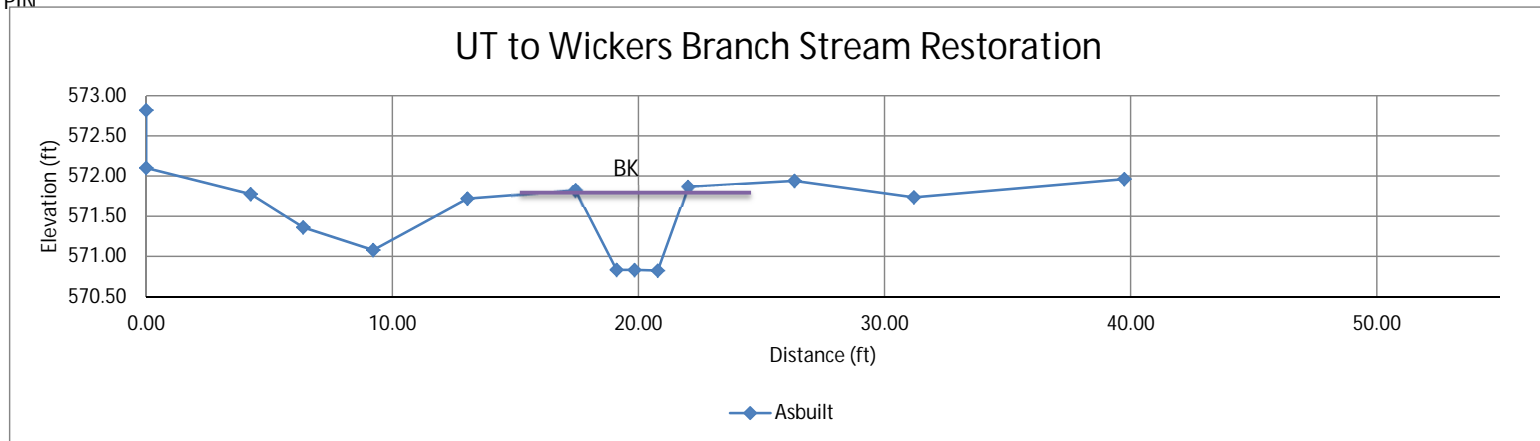
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	3
Feature	Riffle
Drainage Area (sq mi)	0.15
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0.00	572.82	LTPIN
0.00	572.10	LBPIN
4.25	571.77	GR
6.38	571.36	GR
9.22	571.08	GR
13.05	571.72	GR
17.45	571.82	BKF
19.11	570.83	TOE
19.84	570.83	TW
20.79	570.82	TOE
22.01	571.86	TOB
26.34	571.94	GR
31.19	571.74	GR
39.75	571.96	RBPIN
39.93	572.62	RTPIN

Summary Data	
Bankfull Elevation	571.82
Bankfull Width (ft)	4.51
Floodprone Width (ft)	50
Bankfull Mean Depth (ft)	0.68
Bankfull Max Depth (ft)	1
Bankfull Cross Sectional Area (ft ²)	3.08
Bankfull Width/Depth Ratio	6.63
Bankfull Entrenchment Ratio	11.1



Photo: Cross-section 3 looking upstream



Cross-section Plot Exhibit

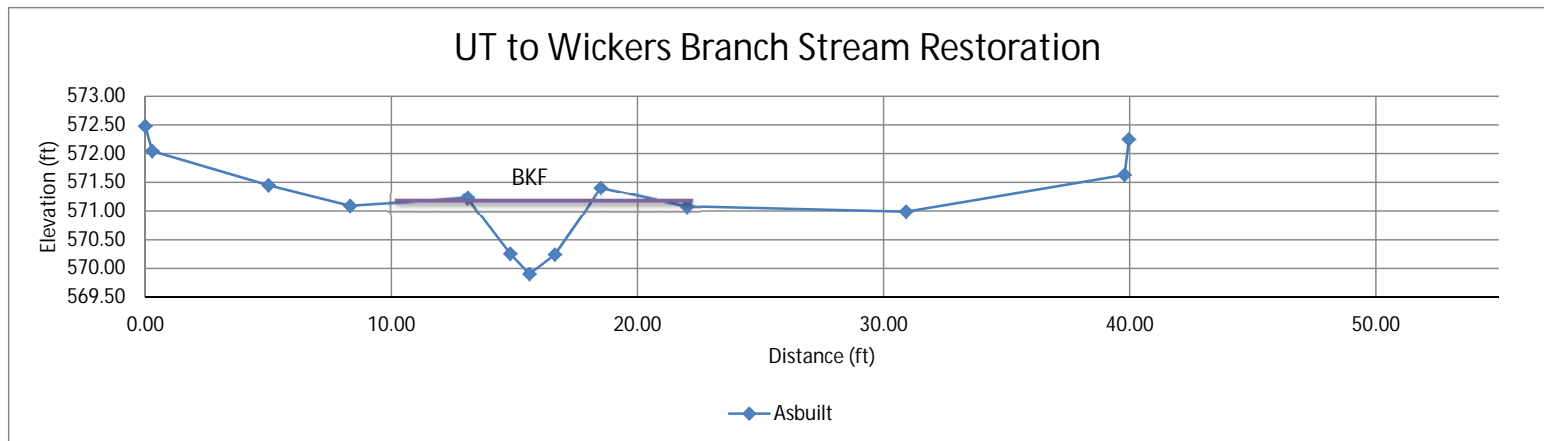
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	4
Feature	Pool
Drainage Area (sq mi)	0.15
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0.00	572.48	LTPIN
0.28	572.04	LBPIN
5.01	571.45	GR
8.33	571.09	GR
13.11	571.23	BKF
14.84	570.26	TOE
15.61	569.90	TW
16.65	570.24	TOE
18.51	571.40	TOB
22.01	571.08	GR
30.92	570.99	GR
39.79	571.63	RBPIN
39.97	572.25	RTPIN

Summary Data	
Bankfull Elevation	571.23
Bankfull Width (ft)	5.14
Floodprone Width (ft)	50
Bankfull Mean Depth (ft)	0.72
Bankfull Max Depth (ft)	1.33
Bankfull Cross Sectional Area (ft ²)	3.72
Bankfull Width/Depth Ratio	7.14
Bankfull Entrenchment Ratio	9.7



Photo: Cross-section 4 looking upstream



Cross-section Plot Exhibit

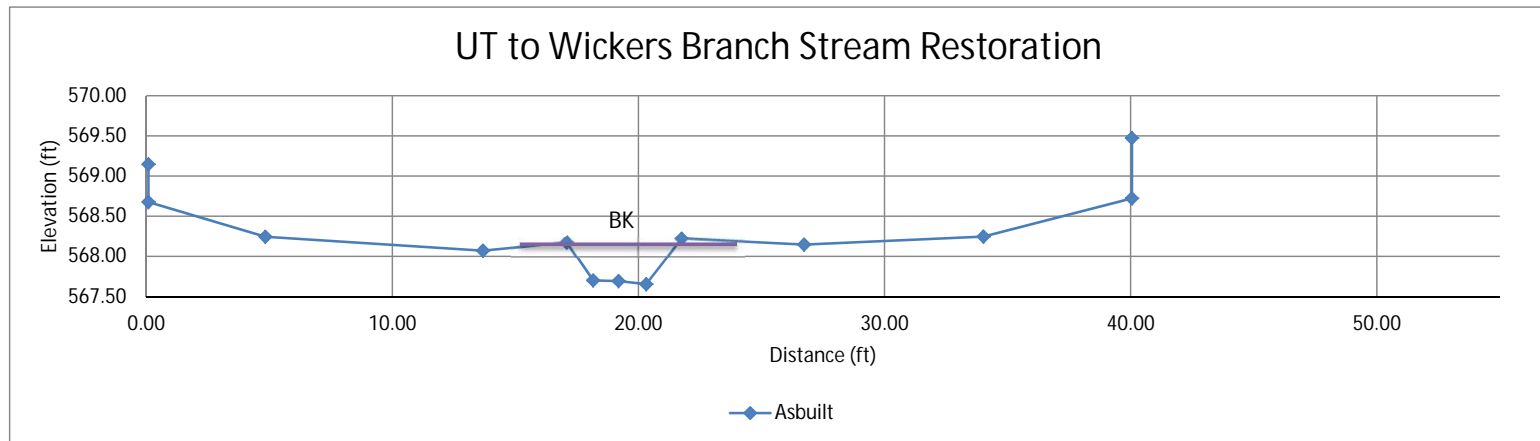
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	5
Feature	Riffle
Drainage Area (sq mi)	0.15
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0.09	569.15	LTPIN
0.09	568.68	LBPIN
4.84	568.24	GR
13.68	568.07	GR
17.11	568.17	BKF
18.16	567.70	TOE
19.20	567.69	TW
20.32	567.66	TOE
21.76	568.22	TOB
26.73	568.15	GR
34.02	568.25	GR
40.05	568.72	RBPIN
40.05	569.47	RTPIN

Summary Data	
Bankfull Elevation	568.17
Bankfull Width (ft)	4.76
Floodprone Width (ft)	50
Bankfull Mean Depth (ft)	0.32
Bankfull Max Depth (ft)	0.79
Bankfull Cross Sectional Area (ft ²)	1.54
Bankfull Width/Depth Ratio	14.87
Bankfull Entrenchment Ratio	10.5



Photo: Cross-section 5 looking upstream



Cross-section Plot Exhibit

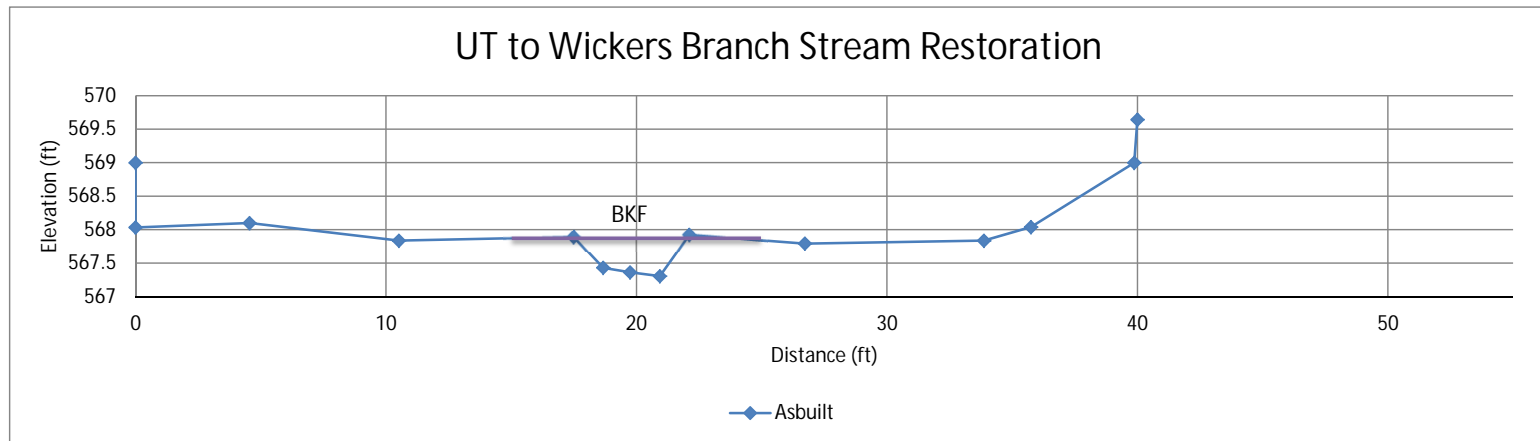
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	6
Feature	Riffle
Drainage Area (sq mi)	0.15
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0	568.996	LTPIN
0	568.032	LBPIN
4.553744	568.098	GR
10.51411	567.835	GR
17.51345	567.891	BKF
18.67151	567.431	TOE
19.74526	567.362	TW
20.93414	567.305	TOE
22.10403	567.922	TOB
26.72096	567.791	GR
33.87075	567.835	GR
35.75084	568.038	GR
39.87134	568.996	RBPIN
40	569.641	RTPIN

Summary Data	
Bankfull Elevation	567.89
Bankfull Width (ft)	4.39
Floodprone Width (ft)	50
Bankfull Mean Depth (ft)	0.39
Bankfull Max Depth (ft)	0.58
Bankfull Cross Sectional Area (ft ²)	1.72
Bankfull Width/Depth Ratio	11.26
Bankfull Entrenchment Ratio	11.4



Photo: Cross-section 6 looking upstream



Cross-section Plot Exhibit

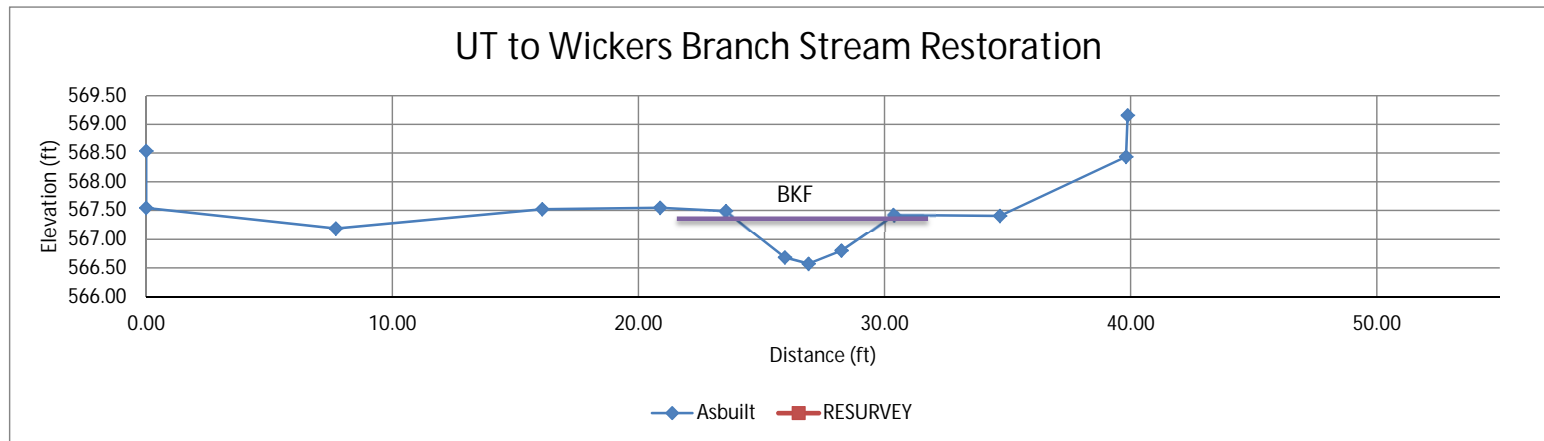
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	7
Feature	Pool
Dranage Area (sq mi)	0.15
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0.00	568.54	LTPIN
0.00	567.54	LBPIN
7.71	567.18	GR
16.09	567.52	GR
20.88	567.55	GR
23.56	567.49	TOB
25.95	566.68	TOE
26.92	566.57	TW
28.25	566.80	TOE
30.36	567.42	BKF
34.69	567.41	GR
39.81	568.44	RBPIN
39.88	569.16	RTPIN

Summary Data	
Bankfull Elevation	567.42
Bankfull Width (ft)	6.59
Floodprone Width (ft)	40
Bankfull Mean Depth (ft)	0.49
Bankfull Max Depth (ft)	0.85
Bankfull Cross Sectional Area (ft ²)	3.21
Bankfull Width/Depth Ratio	13.45
Bankfull Entrenchment Ratio	6.1



Photo: Cross-section 7 looking upstream



Cross-section Plot Exhibit

River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	8
Feature	Riffle
Drainage Area (sq mi)	0.05
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

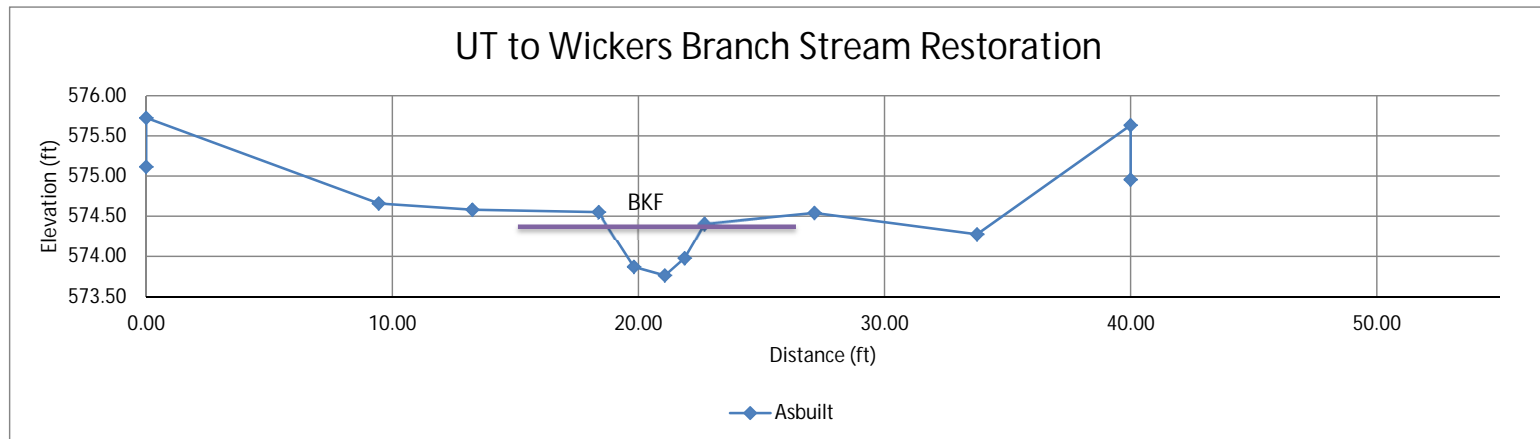
Station	Elevation	
0.00	575.11	LBPIN
0.00	575.72	LTPIN
9.45	574.66	GR
13.25	574.58	GR
18.39	574.55	TOB
19.82	573.87	TOE
21.07	573.76	TW
21.88	573.98	TOE
22.69	574.41	BKF
27.15	574.54	GR
33.76	574.28	GR
40.00	575.63	RTPIN
40.00	574.96	RBPIN

Summary Data

Bankfull Elevation	574.41
Bankfull Width (ft)	4
Floodprone Width (ft)	32
Bankfull Mean Depth (ft)	0.41
Bankfull Max Depth (ft)	0.65
Bankfull Cross Sectional Area (ft ²)	1.66
Bankfull Width/Depth Ratio	9.78
Bankfull Entrenchment Ratio	7.9



Photo: Cross-section 8 looking downstream



Cross-section Plot Exhibit

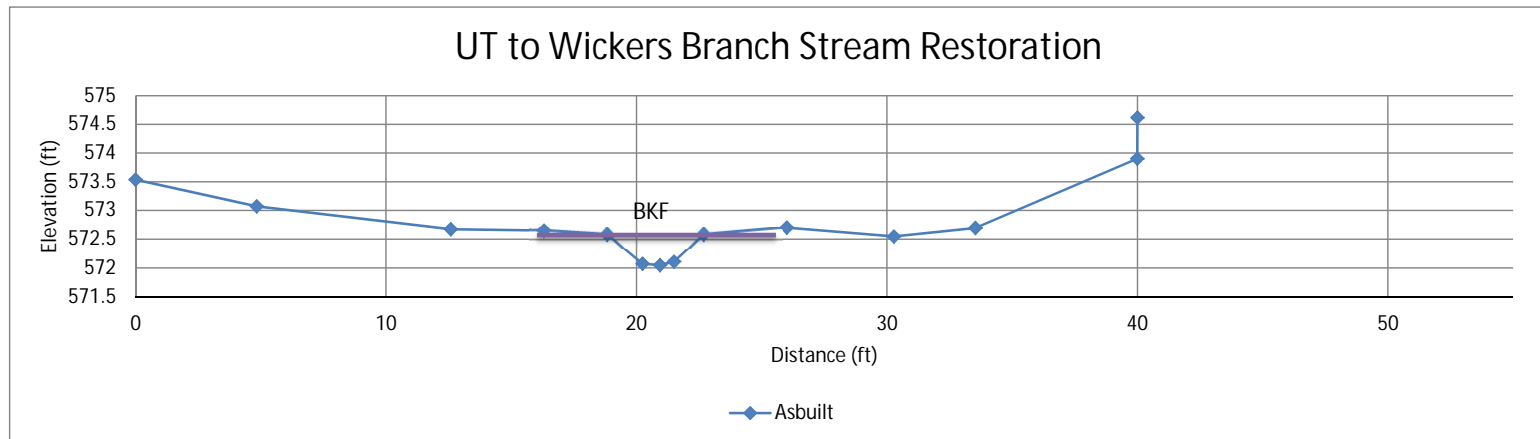
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	9
Feature	Riffle
Drainage Area (sq mi)	0.05
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0	573.537	LBPIN
4.840279	573.071	GR
12.58982	572.674	GR
16.30894	572.65	GR
18.83274	572.586	BKF
20.24403	572.074	TOE
20.93613	572.049	TW
21.49827	572.112	TOE
22.67417	572.587	TOB
25.99985	572.702	GR
30.27965	572.547	GR
33.53438	572.695	GR
39.99435	573.901	RBPIN
40	574.619	RTPIN

Summary Data	
Bankfull Elevation	572.58
Bankfull Width (ft)	3.58
Floodprone Width (ft)	31
Bankfull Mean Depth (ft)	0.32
Bankfull Max Depth (ft)	0.49
Bankfull Cross Sectional Area (ft ²)	1.16
Bankfull Width/Depth Ratio	11.19
Bankfull Entrenchment Ratio	8.6



Photo: Cross-section 9 looking upstream



Cross-section Plot Exhibit

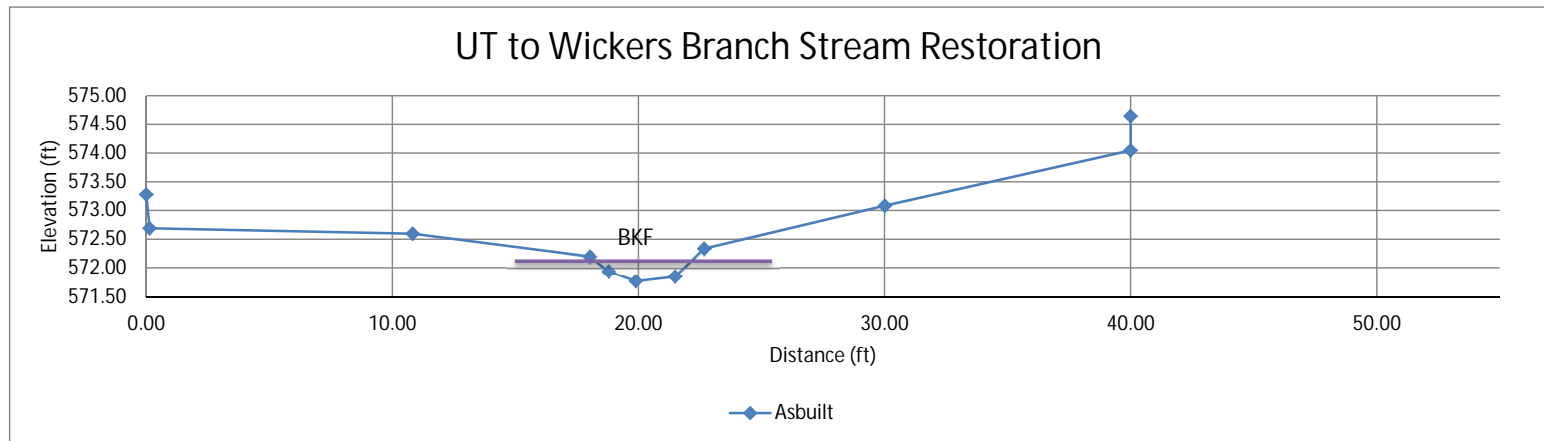
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	12
Feature	Riffle
Drainage Area (sq mi)	0.05
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0.00	573.28	LTPIN
0.14	572.69	LBPIN
10.83	572.60	GR
18.04	572.20	BKF
18.80	571.94	TOE
19.90	571.77	TW
21.49	571.86	TOE
22.68	572.34	TOB
30.01	573.08	GR
40.00	574.05	RBPIN
40.00	574.64	RTPIN

Summary Data	
Bankfull Elevation	572.2
Bankfull Width (ft)	4.29
Floodprone Width (ft)	18.3
Bankfull Mean Depth (ft)	0.29
Bankfull Max Depth (ft)	0.43
Bankfull Cross Sectional Area (ft ²)	1.23
Bankfull Width/Depth Ratio	14.79
Bankfull Entrenchment Ratio	4.26



Photo: Cross-section 12 looking upstream



Cross-section Plot Exhibit

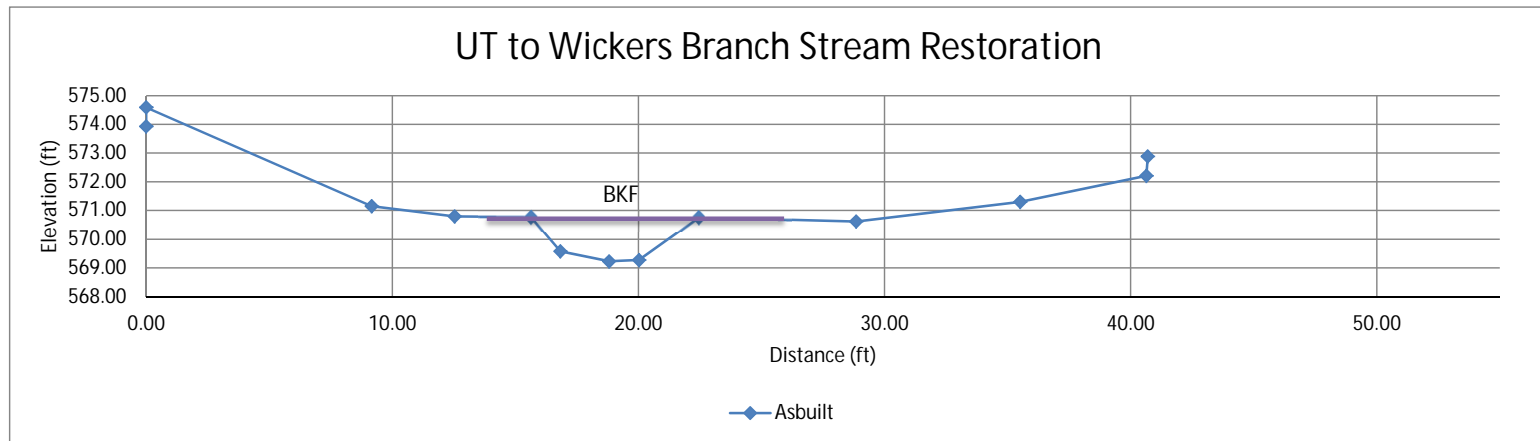
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	10
Feature	Pool
Drainage Area (sq mi)	0.05
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0.00	573.93	LBPIN
0.00	574.59	LTPIN
9.16	571.15	GR
12.53	570.79	GR
15.65	570.77	TOB
16.83	569.58	TOE
18.81	569.23	TW
20.02	569.28	TOE
22.44	570.76	BKF
28.85	570.62	GR
35.52	571.30	GR
40.64	572.21	RBPIN
40.70	572.89	RTPIN

Summary Data	
Bankfull Elevation	570.76
Bankfull Width (ft)	6.74
Floodprone Width (ft)	35
Bankfull Mean Depth (ft)	1.04
Bankfull Max Depth (ft)	1.53
Bankfull Cross Sectional Area (ft ²)	6.98
Bankfull Width/Depth Ratio	6.48
Bankfull Entrenchment Ratio	5.12



Photo: Cross-section 10 looking upstream



Cross-section Plot Exhibit

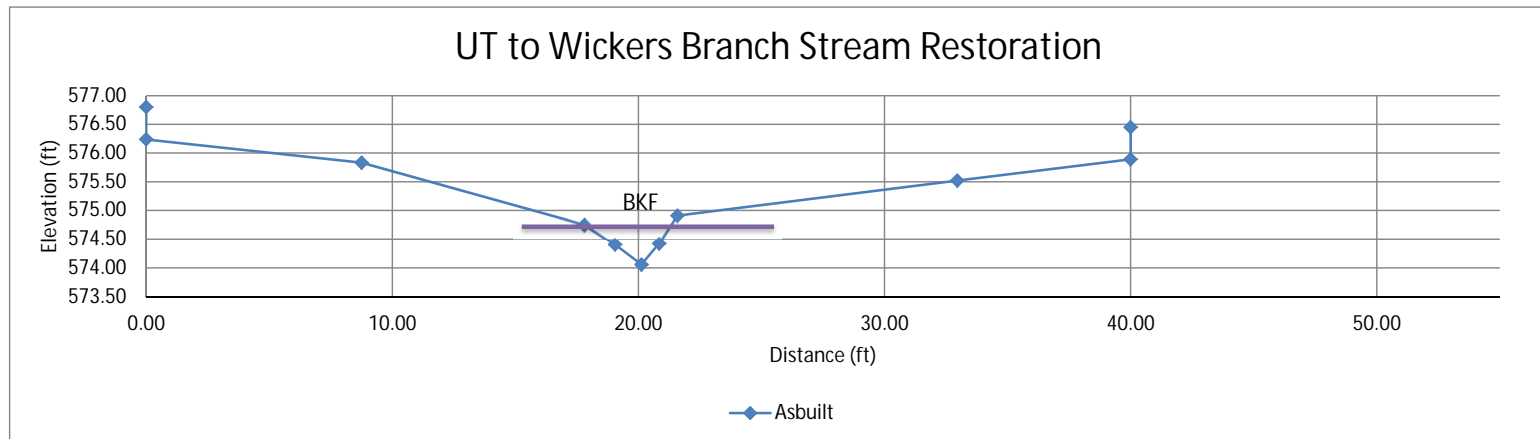
River Basin	Yadkin-Pee Dee
Watershed	Wickers Branch
X-Sec ID	11
Feature	Riffle
Drainage Area (sq mi)	0.05
Date	5/7/2015
Field Crew	Steven Pires, Ron Johnson

Station	Elevation	
0.00	576.80	RTPIN
0.00	576.24	RBPIN
8.75	575.83	GR
17.81	574.75	BKF
19.05	574.41	TOE
20.12	574.06	TW
20.85	574.43	TOE
21.58	574.91	TOB
32.95	575.52	GR
40.00	575.89	RBPIN
40.00	576.45	RTPIN

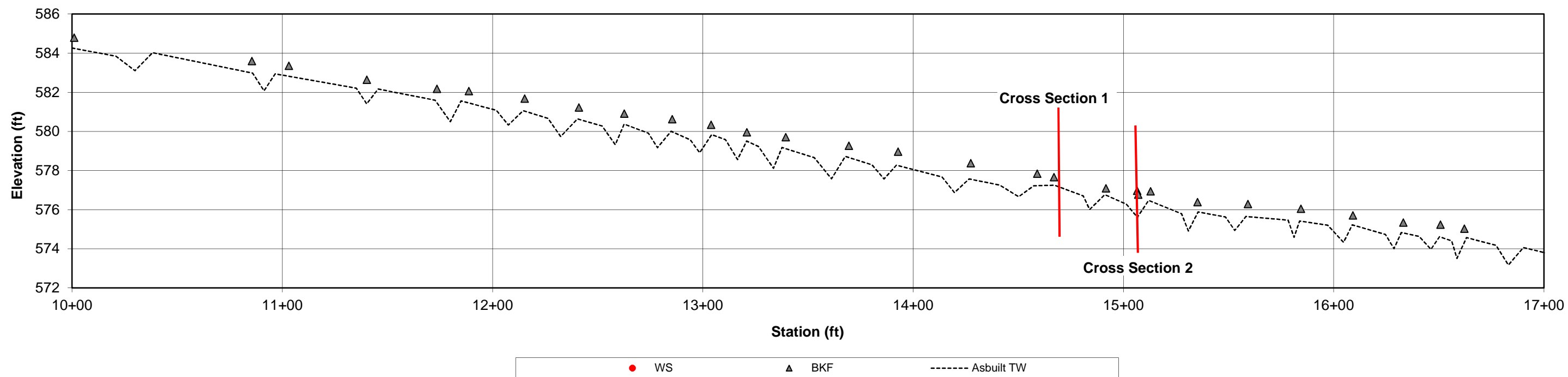
Summary Data	
Bankfull Elevation	574.75
Bankfull Width (ft)	3.53
Floodprone Width (ft)	19.5
Bankfull Mean Depth (ft)	0.34
Bankfull Max Depth (ft)	0.69
Bankfull Cross Sectional Area (ft ²)	1.21
Bankfull Width/Depth Ratio	10.38
Bankfull Entrenchment Ratio	5.5



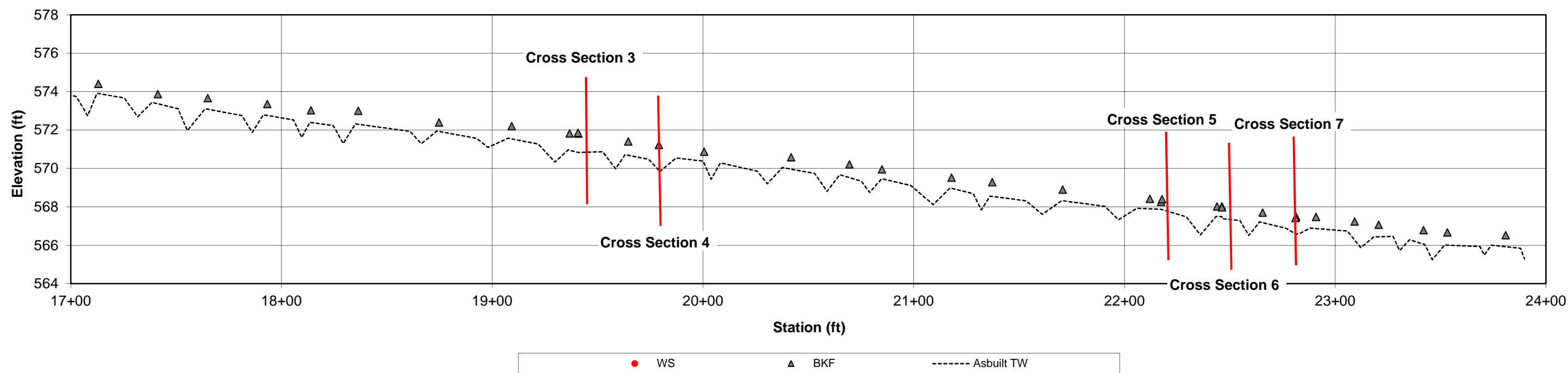
Photo: Cross-section 11 looking upstream



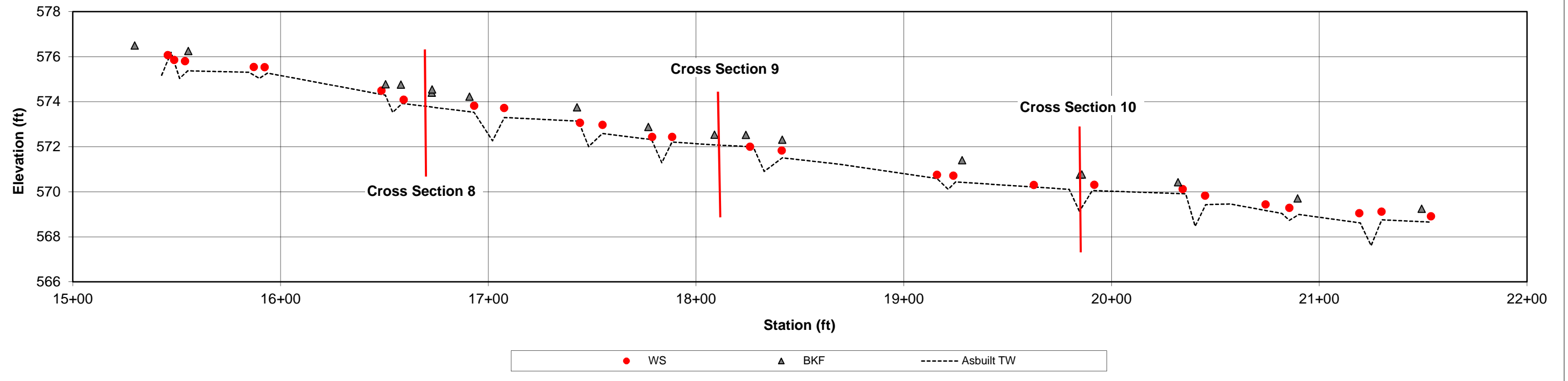
Tributaries to Wickers Branch - Trib 1A Long Profile



Tributaries to Wickers Branch - Trib 1A Long Profile



Tributaries to Wickers Branch - Trib 3 Long Profile



Tributaries to Wickers Branch - Trib 4 Long Profile

