



## Final MYO Monitoring Report

Owen Farms Mitigation Site  
Transylvania County, NC

NCDMS Project No. 100064  
NCDMS Contract No. 7532  
NCDMS RFP No. 16-007334  
(Issued 9/8/2017)

USACE ID: SAW-2018-01165

DWR ID: 20181033

French Broad River Basin  
Cataloging Unit 06010105

June 7, 2021

Data Collected: February, 2021

**Prepared for:**



**NC Department of Environmental Quality**  
**Division of Mitigation Services**  
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This As-Built Baseline Monitoring Report has been written in conformance with the requirements of the following:

- Federal rule for compensatory mitigation project sites as described in the Federal Register, Title 33 Navigation and Navigable Waters, Volume 3, Chapter 2, Section § 332.8, paragraphs (c)(2) through (c)(14).
- NCDEQ Division of Mitigation Services IN-Lieu Fee instrument signed and dated July 28, 2010.



May 31, 2021

Paul Wiesner  
Western Regional Supervisor  
NCDEQ – Division of Mitigation Services  
5 Ravenscroft Dr., Suite 102  
Asheville, North Carolina 28801

Re: MY0 As-Built Baseline Monitoring Report Comments  
Owen Farms Stream and Wetland Mitigation Site  
French Broad River Basin; CU# 06010105 – Transylvania County  
DMS Project ID No. 100064  
Contract No. 7532

Mr. Wiesner,

As per your letter dated May 21, 2021, we have reviewed and addressed the Department of Mitigation Services' (DMS) review comments as follows:

1. Report Cover: Please include the project's DWR# on the report cover: DWR# 20181033. Please also include the issuance date of the RFP on the report cover: RFP 16-007334 Issued 9/8/2017).  
*RE: Comply. The DWR number and RFP number has been added to the cover.*
2. General; Monitoring; Monitoring Photo Points: Per recent IRT discussion, DMS recommends adding photo points at each crossing location within the project to document crossing stability and function during the monitoring term.  
*RE: Comply. Photo points have been added at all crossings and will be monitored throughout the monitoring period.*
3. General; Section 1.3.1 - Project Structure; Table 4 Project Assets: The draft report notes that as-built stream lengths shown in Table 4 were produced using the thalweg generated in the as-built survey. As-built stream lengths should be based on the centerline of the restored or enhancement streams generated from the as-built survey data. Please revise the report and table accordingly. In the report text (Section 1.3.1 or Section 5.0), please update and describe/explain any differences from the IRT approved mitigation plan centerline lengths and the as-built centerline lengths provided.  
*RE: Comply. The As-Built centerlines and stationing produced by the PLS who conducted the survey have been utilized to calculate credits. Table 4 has been updated to reflect that the As-Built centerline lengths match the lengths and stationing proposed in the Mitigation Plan. Sections 1.3.1 and Section 5.0 no longer mention any discrepancies in stream lengths.*
4. Section 1.3 Project Structure, Restoration Type and Approach: In the report text, please also note the type of fencing installed to exclude livestock from the conservation easement.  
*RE: Comply. Section 1.3 now includes text that describes the type of fencing utilized and that it is compliant with NRCS cattle fencing specifications.*

5. Section 5.0 As-Built State: In the report text, please document and discuss any monitoring feature updates or locations that have changed from what was presented in the IRT approved mitigation plan.  
*RE: Comply. All monitoring feature location changes have been outlined in Section 5.1 and 5.2.*
6. Section 5.0 As-Built State/ Section 5.2 Verification of planting: Based on a review of the planting record drawings, several species were eliminated from the IRT approved mitigation plan and several species amounts (% composition) were changed. Please discuss the planting changes in the report text and explain why the changes were made (ie. availability, site conditions, etc.).  
*RE: Comply. Discussion has been added to Section 5.2 regarding the planting composition changes. Table 4. As-Built Planting Changes Summary has also been added to outline all changes and planting substitutions.*
7. Appendix A – Table 4\_Project Mitigation Quantities and Credits: Total project stream credits in the table should be updated to 5,043.893 SMUs so the report matches the DMS accounting system and project credit ledger. Total wetland credits currently match the DMS accounting system and credit ledger.  
*RE: Comply. Table 4 Project Mitigation Quantities and Credits now reflects 5,043.893 SMUs.*
8. Appendix A – Table 4\_Project Mitigation Quantities and Credits: West Fork French Broad River (EII section) indicates 705' for the Mitigation Plan length and 658' for the as-built length. This section is an EII section where no stream work was conducted other than two soil lifts. The 47' difference between the Mitigation Plan and as-built lengths leads the reader to believe that there was a change in pattern or loss in stream length in this section when this did not occur. This may be attributed to the as-built lengths generated from the thalweg as-built data. As noted in the earlier comment, please review and update the as-built lengths and table as necessary.  
*RE: The EII length for WFFBR now reflects the correct length based on the As-Built centerline stationing which now matches the 705' outlined in the Mitigation Plan.*
9. Appendix A – Table 4\_Project Mitigation Quantities and Credits: DMS recommends adding a note to Table 4 indicating that all crossings and utility easements have been removed from credit calculations or adding table comments for the applicable reaches.  
*RE: Comply. The note has been added to Table 5 (updated table number).*
10. Appendix A – Table 4\_Project Mitigation Quantities and Credits: UT 1 and UT 5 show an “ \* ” but no footnote is included. Please remove or include the applicable footnote/s.  
*RE: Comply. Footnote has been added (see response to Comment 9).*
11. Appendix A – Table 6: Please update the Completion/ Delivery date for the As-built (Year 0 Monitoring-Baseline) report.  
*RE: Comply. Completion/Delivery data has been updated.*
12. Appendix A – All Figures: The IRT has requested that the mapping legend asset colors and symbols remain consistent throughout the life of the project. The mapping legend asset colors and symbols in the draft MY0 report differ from what is presented in the IRT approved mitigation plan. If HDR believes that the mapping legend asset colors and symbols presented in the draft MY0 report better represent the project, please briefly discuss and note the change in the report

text. The mapping legend asset colors and symbols should remain consistent in all future monitoring reports.

*RE: Comply. The colors of the assets in Figures 2 & 3 have been updated to be consistent with what was presented in the Asset Map of the Mitigation Plan.*

13. Appendix A – All Figures: DMS recommends showing non-credit areas (utility line ROWs & crossings) as a separate color (no credit). A majority of the small crossings show a break while the crossing on the mainstem shows the stream within the crossing. Please be consistent and revise as necessary.

*RE: Comply. Non-credited areas are now shown on Figures 2 & 3 in orange.*

14. Appendix A – All Figures: As specified in Table 4, UT4 has a mitigation ratio of 2.5:1 and is mislabeled/ colored in the figures. Please QA/ QC all figures to confirm that they are consistent with Table 4 and the IRT approved mitigation plan.

*RE: Comply. UT 4 is now reflected as having a mitigation ratio of 2.5:1 in Figures 2.0 & 3.1-3.9*

15. Appendix A – Figure 2.0 Project Asset Map & As-Built Monitoring Plan View: Please label all project streams and wetland assets on the Project Asset Map to identify the stream segments and wetland areas presented in Table 4 (Project Mitigation Quantities and Credits). Project reaches and wetlands areas should also be labeled on figure 3.1.

Please also review the as-built monitoring plan view maps to confirm that all project streams and wetland assets areas are labeled. As an example, UT7 is not labeled on figure 3.5. Asset labeling should also be utilized in all future monitoring report figures.

*RE: Comply. All assets have been labeled in Figures 2.0 & 3.1 – 3.9.*

16. Appendix A – As-Built Monitoring Plan View Figures: Please review and confirm that the stationing shown on the as-built monitoring plan view maps is accurate and matches the longitudinal profiles provided. There appears to be minor discrepancies for UT3; UT4; and UT6. Please review all stationing shown on the maps & record drawings to confirm they are consistent with the longitudinal profiles and cross sections provided in the report. Please update as necessary.

*RE: Comply. The longitudinal profile stationing has been updated to match the plan view figures for UT3, UT4, and UT6.*

17. Appendix B – Table 9: Cross Section Morphology Monitoring Summary: Two (1&2) footnote references are included in the table but no footnotes are included. Please remove or include the applicable footnote/s.

*RE: Comply. Footnote references have been removed from Table 9.*

18. Appendix B – Longitudinal Profiles: Please include the longitudinal profile for the applicable portions of UT7 (restoration). It is missing in the draft MY0 report provided.

*RE: Comply. The UT 7 longitudinal profile is now included as Figure 4.12.*

19. Record Drawings: Please show the utility lines/ utility easements on the record drawings.

*RE: Comply. Utility lines and utility easements are now shown on the record drawings.*

20. Record Drawings: A majority of the project conservation easement is fenced and the installed fencing is shown on the record drawings. Please also include any as-built witness post/easement marking locations on the Record Drawings where fencing was not installed along the conservation easement.

*RE: Comply. Witness Post locations are now represented in the Record Drawings.*

**Digital Support File Comments:**

21. The feature for Wetland Group 1 has an area of 1.412 compared to the reported area of 1.540 acres. Please review and address this difference. Please update the digital support files as necessary.

*RE: The shapefile for Wetland Group 1 has been replaced and has an area of 1.54 acres.*

22. Please organize the stream asset features so that individual records in the attribute table reflect individual records in the asset table and include reach names in the submitted shapefile. It appears that there may be differences in feature lengths relative to lengths reported in the asset table (e.g. UT2A, feature length of 589 ft vs asset table length of 546 ft). Please review and address any differences.

*RE: The shapefile for Streams has been replaced and UT2A now has a feature length of 546 ft.*

23. It looks like the profile figure for UT7 was not included in the report but was included in the profiles and cross sections spreadsheet. Please update as necessary.

*RE: Comply. The profile figure for UT 7 has been included in the report.*

24. Please note that the color formatting of the cells in Table 10 differ from DMS template which was approved by the IRT and selected to meet ADA requirements for colorblindness. Please refer to the most recent monitoring report template and update the report and digital support files as necessary.

*RE: Comply. Table 11 (updated table number) now matches the DMS template.*

25. Please review the mitigation plan stream features for UT2A, which has a feature length of 615 ft compared to the asset table length of 546 ft. The mitigation plan feature for Wetland Group 1 also has an area of 1.412 vs the reported area of 1.540. GIS stream and wetland asset shapefile features should match the creditable footages/ acreages reported in the project asset table.

*RE: Comply. See responses to Comment 21 & 22.*

26. If available, please include existing conditions features in the revised digital submittal.

*RE: Comply. A MicroStation drawing containing the pre-construction alignments and wetland boundaries has been included in the folder titled 'Pre-Construction DGNs'.*

27. Please provide PDFs of any permits or associated permit correspondence acquired during design development that wasn't submitted during the Mitigation Plan development (i.e. FEMA Floodplain Compliance permit; DEQ Land Quality permit; etc.). This should be included in a separate "Project Permits" folder in the final digital submittal.



*RE: Comply. PDFs of all permits has been included in the digital submittal under the 'Permits' folder.*

28. Please provide the stand alone as-built .pdf and .dwg files with the final electronic submittal. This as-built survey should bear a Professional Land Surveyor (PLS) seal. The .pdf is included; however, the .dwg file/s are missing. Please review and update as necessary.

*RE: Comply. The .dwg files provided by Kee Surveying and Mapping have been included in the folder titled 'As-Built Plansheets'.*

29. Please provide the final standalone HDR design plan .pdf and .dwg files with the final digital submittal. The design plan should bear a Professional Engineer's seal.

*RE: The standalone HDR Mitigation Plansheets as submitted in the approved Mitigation Plan as a PDF in the folder titled 'Mitigation Plans'. A DGN containing the design file has been included in the same folder.*

If you have any questions or need additional information, please do not hesitate to give me a call (843.830.1536).

Sincerely,  
Land Management Group

A handwritten signature in blue ink, appearing to read 'Alex DiGeronimo', followed by a horizontal line ending in a small circle.

Alex DiGeronimo



## Executive Summary

The North Carolina Department of Environmental Quality Division of Mitigation Services (DMS) contracted HDR to restore, enhance, and preserve 8,565 linear feet (pre-construction length) of stream including the West Fork French Broad River (WFFBR, Index # 6-5-(0.5)) and 14 (fourteen) unnamed headwater tributaries, as well as restore 1.32 acres of wetland and enhance 1.54 acres of wetland within the Owen Farms Mitigation Site (hereafter referred to as the “Site”) to assist in fulfilling stream and wetland mitigation needs in the watershed. The Site is located approximately 3 miles north of Lake Toxaway in Transylvania County, NC. The Site is located within the 06010105010020 14-digit Hydrologic Unit (HUC), of the French Broad River Basin (8-digit HUC 06010105). The North Carolina Department of Environmental Quality (NCDEQ) classifies the WFFBR as a Class B; Trout water as it flows through the Site. WFFBR receives a designation of High Quality Waters (HQW) approximately three miles downstream of the Site.

The Site is comprised of one property owned by Troy Owen Farms, LLLP (PIN # 8524-24-1875-000). The Natural Heritage Program (NHP) has identified the Big Pisgah Mountain/Dismal Falls natural area as a Significant Natural Heritage Area located approximately 1.5 miles from the Site. The Site is also immediately adjacent by the Pisgah National Forest. Based on a review of records from the North Carolina State Historic Preservation Office (NCSHPO), there are no properties listed on the National Register within one mile of the Site. NCSHPO determined the project as proposed will not have an effect on any historic structures (HDR 2020).

Primary goals for the Site, are detailed in the Owen Farms Mitigation Site Mitigation Plan (HDR 2020) and outlined in Table 1 of this report.

### **Monitoring Components and Duration**

The first year monitoring report will be submitted in December 2021. Monitoring will continue for seven years or until agreed upon success criteria is achieved, with a report submitted at the beginning of December for each monitoring year. Annual monitoring in years 1, 2, 3, 5, and 7 include surveys of morphological conditions for the restored stream, representative surveys of vegetation, data collection of static groundwater levels throughout the Site, and an annual monitoring report that compiles and analyzes data to determine success levels. Annual monitoring in years 4 and 6 includes visual assessment of streams, wetlands, and riparian buffers, collection of groundwater data, and an annual monitoring report that summarizes visual assessments and groundwater data.



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*Figure 2. Project Asset Map (Appendix A)*

*Figures 3.1 - 3.9 As-Built Monitoring Plan View (Appendix A)*

*Figures 4.1 – 4.12 As-Built Profile Plots (Appendix B)*

*Figures 5.1 – 5.14 Monitoring Cross Section Plots (Appendix B)*

*Figures 6.1 – 6.28 Vegetation Plot Photographs and Site Aerial Photographs (Appendix C)*

## Tables

*Table 1. Project Goals and Objectives (Section 1.2)*

*Table 2. Monitoring Plan (Section 3.2)*

*Table 3. Monitoring Plan Components (Section 3.2)*

*Table 4. As-Built Planting Changes Summary (Section 5.2.1)*

*Table 5. Project Mitigation Quantities and Credits (Appendix A)*

*Table 6. Project Attributes (Appendix A)*

*Table 7. Project Activity and Reporting History (Appendix A)*

*Table 8. Project Contacts Table (Appendix A)*

*Table 9. Baseline Stream Data Summary (Appendix B)*

*Table 10. Cross Section Morphology Monitoring Summary (Appendix B)*

*Table 11. Vegetation Plot Data (Appendix C)*

## Appendices

Appendix A – General Tables and Figures

Appendix B – Morphological Summary Data and Plots

Appendix C – Vegetation Plot Data

Appendix D – Record Drawings



## 1.0 Project Goals, Background, and Attributes

### 1.1 Location and Setting

The Site is located approximately 3 miles north of Lake Toxaway in Transylvania County, NC (Figure 1).

#### Directions from Asheville, NC:

From Asheville, NC: Travel on I-26 east to exit 40 (NC-280 W/Airport Road) and merge on to NC-280 W, continue for 15.9 miles; continue straight onto US-64 W (NC-280 W becomes US-64 W), go 3.9 miles; turn right to stay on US-64 W; continue on US-64 W for 14.9 miles; turn right on Blue Ridge Road, continue for 5.4 miles and the Site entrance will be on the left.

The Site is located in the Blue Ridge Belt Physiographic Province of North Carolina.

### 1.2 Project Goals and Objectives

The Site provides many ecological functional uplifts within the French Broad River Basin. Project goals were established based on the French Broad RBRP (NCEEP 2009), and on-site data collected during the existing conditions survey. Site specific goals and objectives were developed to provide the highest practical potential for functional uplift based on NC SAM and NC WAM analyses of streams and wetlands on-site. Table 1 summarizes the functions targeted for uplift and the goals and objectives that were achieved to provide the proposed uplift.



Table 1. Project Goals and Objectives

Targeted Functions	Goals	Objectives
<b>(1) Hydrology</b>		
(2) Flood Flow	<ul style="list-style-type: none"> <li>Provide/enhance flood attenuation</li> <li>Restore riparian habitat</li> </ul>	<ul style="list-style-type: none"> <li>Restore UT 5, UT 7, and UT 8 as primarily a Priority I restoration where bankfull and larger flows can access the floodplain</li> <li>Restore WFFBR as Priority II with a floodplain bench ranging from 15' to 100' wide on each side of the channel</li> <li>Restore/enhance wetlands</li> <li>Plant native vegetation along stream banks and adjacent riparian corridor (including wetlands)</li> </ul>
(3) Streamside Area Attenuation		
(4) Floodplain Access		
(4) Wooded Riparian Buffer		
(4) Microtopography		
(3) Stream Stability	<ul style="list-style-type: none"> <li>Restore/enhance streams within the Site so that they are neither aggrading nor degrading.</li> </ul>	<ul style="list-style-type: none"> <li>Construct stable dimension, pattern, and profile on WFFBR, UT 5, UT 7, and UT 8</li> <li>Install fencing to exclude cattle from streams, wetlands, and riparian corridors</li> <li>Plant native vegetation along stream banks and adjacent riparian corridor (including wetlands)</li> <li>Seed newly constructed channels with native substrate harvested from the existing channels</li> </ul>
(4) Channel Stability		
(4) Sediment Transport		
(4) Stream Geomorphology		
Wetland Surface Storage and Retention	<ul style="list-style-type: none"> <li>Restore/enhance wetlands within the Site to remove hydrologic impairments</li> </ul>	<ul style="list-style-type: none"> <li>Restore wetland hydrology by raising the inverts of adjacent, incised tributaries</li> <li>Remove spoil and overburden from relic wetland areas</li> <li>Plant native vegetation in wetlands</li> </ul>
Wetland Sub-Surface Storage and Retention		



Targeted Functions	Goals	Objectives
<b>(1) Water Quality</b>		
(2) Streamside Area Vegetation	<ul style="list-style-type: none"> <li>• Reduce sediment, nutrient and other pollutant sources that affect water quality</li> <li>• Restore riparian habitat</li> </ul>	<ul style="list-style-type: none"> <li>• Plant native vegetation along stream banks and adjacent riparian corridor (including wetlands)</li> <li>• Install fencing to exclude cattle from streams, wetlands, and riparian corridors</li> <li>• Restore/enhance wetlands</li> <li>• Restore UT 5, UT 7, and UT 8 as primarily a Priority I restoration where bankfull and larger flows can access the floodplain, allowing adjacent wetlands to treat nutrients and filter sediment</li> <li>• Restore WFFBR as Priority II with a floodplain bench ranging from 15' to 100' wide on each side of the channel</li> <li>• Remove agricultural equipment from streams by converting existing fords on UT 1 and UT 2A to culverted crossings</li> </ul>
(3) Upland Pollutant Filtration		
(3) Thermoregulation		
(2) Indicators of Stressors		
Wetland Pathogen Change, Particulate Change, and Soluble Change		
<b>(1) Habitat</b>		
(2) In-stream Habitat	<ul style="list-style-type: none"> <li>• Restoring and enhancing aquatic, semi-aquatic, and riparian habitat</li> <li>• Restoring and connecting riparian habitat with adjacent natural habitats</li> <li>• Permanently protecting the Site from undesirable uses</li> </ul>	<ul style="list-style-type: none"> <li>• Plant native vegetation along stream banks and adjacent riparian corridor (including wetlands)</li> <li>• Construct rock habitat structures for Eastern hellbender</li> <li>• Restore/enhance wetlands and create floodplain pools in abandoned channel of WFFBR</li> <li>• Protect riparian buffers with a perpetual conservation easement</li> <li>• Introduce woody material through toe wood and log sills on restored channels</li> <li>• Restore sinuous gravel bed channels that promote riffles and pools</li> </ul>
(3) Stream Stability		
(3) In-stream Habitat		
(2) Stream-side Habitat		
(3) Stream-side Habitat		
(3) Thermoregulation		
Wetland Physical Structure, Landscape Patch Structure and Vegetation Composition		



## 1.3 Project Structure, Restoration Type and Approach

### 1.3.1. Project Structure

Approximately 3,180 linear feet (post-construction length) of stream has been restored, 5,172 linear feet of stream has been enhanced (125 linear feet of Enhancement I; 5,047 linear feet of Enhancement II), and 423 linear feet of stream has been preserved at the Site. 1.40 acres of wetlands has been enhanced, 0.35 acres of wetlands have been re-established, and 0.97 acres of wetlands have been rehabilitated at the Site. Table 5 provides a summary of project components and mitigation credits (Appendix A). The constructed alignment of each restored channel followed the alignment proposed in the Mitigation Plan. Locations of each Site component are depicted in Figure 2 (Appendix A).

### 1.3.2. WFFBR Restoration and Enhancement

Priority II restoration of pattern, profile, dimension, and riparian buffer was conducted for 1,799 linear feet of WFFBR (127 feet that flows through a powerline easement and 60 feet that flows through a ford crossing have been excluded from this total). Prior to restoration, WFFBR routinely experienced bank erosion leading to deposition of sediment and nutrient loading to on-site and downstream receiving waters. Restoration efforts consisted of restoring bank height ratios to 1.0; stabilizing channel banks by restoring a more natural and stable dimension and plan form while maintaining portions of the existing alignment where feasible; meandering the channel back to the low point of the valley; providing overbank flood relief through the creation of bankfull benches through excavation (benches) and fill (abandoned channel areas); installation of wood and rock structures for grade control and habitat improvement; seeding riffles with existing, native channel material for immediate restoration of the hyporheic zone; restoration of a vegetated riparian buffer; and removal of agricultural operations from the channel and riparian buffer through fencing. The proposed channel was designed as a moderate width to depth ratio, C4-type channel that conveys a bankfull discharge of approximately 300 cfs.

Fencing along the easement of the restored WFFBR limits agricultural operation crossing to the installed ford at station (STA) 23+90. The ford crossing is not contained within the conservation easement.

A combination of woven wire and four strand barbed wire exclusionary fencing was installed along the easement boundary to exclude cattle and clearly demarcate the easement boundary for the landowners. All fencing installed as part of project construction is in accordance with NRCS woven wire and barbed wire fencing specifications. A riparian buffer populated with native vegetative species was planted within the proposed conservation easement. HDR had all trees 12 inches and greater within the buffer surveyed. The survey was used during stream channel design to ensure that mature tree disturbance is limited to the greatest practical extent possible during construction. Any portion of the existing buffer that was removed to facilitate restoration of WFFBR was replanted with native vegetation.

Hellbender habitat was installed throughout the restored reach of WFFBR. Five (5) in channel habitat rock structures were installed in runs and glides of WFFBR. Habitat was also incorporated into the installed toewood along the channel by using large logs to create pockets within the brush that could be used as cover by hellbenders.

Bedrock along the channel invert between STA 21+83 and 22+50 necessitated the need to modify the designed channel. Bedrock elevation through this portion of WFFBR averaged approximately one foot



higher than the proposed riffle elevation. Boulder toes and soil lifts were utilized to stabilize stream banks where bedrock directed concentrated flow along the left toe of the channel. The channel was also widened slightly from design width to compensate for bankfull cross sectional area lost along the channel invert. Revised bankfull widths through this section of WFFBR resulted from tying the new channel into sections of stable bank throughout the bedrock area along the pre-construction alignment. Downstream, bedrock along the pool invert between STA 25+95 and 26+19 is directing concentrated flow along the left bank.

WFFBR was enhanced from STA 29+86 to 36+91 by installing soil lifts with toewood to stabilize eroding banks along the left side of the channel. Exclusionary fencing was also installed to remove cattle from the stream and adjacent riparian buffer. The buffer along the left overbank area was restored by planting native vegetation. The downstream 705 linear feet of WFFBR received Enhancement II. This portion of WFFBR is relatively stable with the exception of portions of the left bank which were stabilized using soil lifts with toe wood. WFFBR was also enhanced by installing exclusionary fencing to remove cattle from the stream channel and the adjacent riparian buffer. The buffer along the left overbank area was restored by planting native vegetation.

### **Repairs**

Earthwork was completed and the Site was demobilized October 7<sup>th</sup>, 2020. After construction was completed, two 10-year storm events took place in the month of October (October 10<sup>th</sup> and October 29<sup>th</sup>, 2020). Rack lines indicated that flow overtopped the banks by more than 3 feet. WFFBR suffered substantial bank loss between STA 10+00 and 16+50, and severe floodplain scour along the inside of meander bends between STA 10+00 and 28+50. In December of 2020, the Contractor re-mobilized to the Site to complete repair work and add additional stabilization measures. Soil lifts were installed along the right bank of WFFBR from STA 10+67 to 11+35, and along the left bank from STA 12+59 to 13+25 and from STA 15+28 to 16+31. As part of Site repairs, the floodplain bench was widened between STA 10+00 and 19+10 to decrease shear stress along the channel during high flow events. Cut material from floodplain widening was utilized to build soil lifts and fill in areas that experienced floodplain scour. Throughout the inside of meander bends, coir fiber matting was installed along the floodplain bench to provide additional stabilization until native grasses are able to establish. At the upstream extent of the project, fencing that originally crossed WFFBR was removed to prevent debris jams. The fencing immediately upstream and downstream of the ford crossing was also replaced with sections that can easily rip away and be replaced to prevent debris jams from causing bank or floodplain erosion. Repair items can be seen in the Record Drawings (Appendix D).

### **1.3.3. UT 5 Restoration**

Stream channel restoration of pattern, profile, dimension, and riparian buffer was constructed for approximately 827 linear feet of UT 5 (72 linear feet that flows under a powerline easement has been excluded from this total). Prior to construction UT 5 had been ponded immediately downstream of a culverted road crossing. Downstream of the pond the stream had been straightened and channelized which created a relatively uniform plan and bed form. Bankfull flows were entrenched in the existing channel and were abandoned from the historic floodplain. Restoration activities on UT 5 included draining of the pond, dam removal, and meandering the channel back to the low point of the valley through Priority I restoration. Bankfull flows are now able to access the historic floodplain and adjacent wetlands.



The channel was designed as a moderate width to depth ratio C4-type channel through a relatively steep valley (0.027 ft/ft). Short pool to pool spacing (averaging near 4.2 bankfull widths) and grade control structures are utilized throughout the restored channel in an attempt to dissipate energy (through pools) and maintain a relatively low bankfull slope of 0.006 ft/ft between drops. The low bankfull slope is required to transport sediment and flow such that, over time, the stream neither aggrades nor degrades.

No crossings are located on UT 5 within the conservation easement, ensuring stability of UT 5 to its confluence with WFFBR within the conservation easement.

The denuded and regularly maintained riparian buffer was restored by planting native vegetation within the conservation easement. Restoration of the riparian buffer promotes terrestrial, aquatic, and semiaquatic foraging, propagation, and cover habitat. Additionally, the restored buffer connects UT 5's riparian corridor with WFFBR's restored wooded riparian buffer and enhances the floodplain's ability to uptake nutrients and settle other pollutants from high flow events.

#### 1.3.4. UT 7 Restoration and Enhancement

Stream channel pattern, profile, dimension, and riparian buffer was restored for approximately 417 linear feet of UT 7. The downstream extent of the channel had been modified and relocated from its natural valley position to a point at which it flowed adjacent to an existing hill slope. UT 7 has been restored through Priority I restoration away from its previous location back through the low point of its natural valley which was utilized as pasture. Mitigation activities also included stabilizing channel banks, restoring a more natural and stable plan form, installation of wood and rock structures for grade control and habitat improvement, restoration of a vegetated riparian buffer, and removal of agricultural operations from the channel and riparian buffer through fencing.

Approximately 439 linear feet of UT 7 was enhanced (Enhancement II), beginning at the easement boundary, and extending to the beginning of restoration. Woven wire fencing was installed along the easement boundary to exclude cattle from the channel and clearly demarcate the easement boundary for the landowners. The existing, degraded buffer was planted with native vegetative species to restore natural vegetative structure and composition. Following enhancement activities, UT 7 now exhibits a minimum riparian buffer between 50 feet and 75 feet wide off of the left and right banks throughout the majority of the enhancement reach.

#### 1.3.5. UT 8 Restoration

Stream channel restoration of pattern, profile, dimension, and riparian buffer was constructed for approximately 137 linear feet of UT 8. WFFBR has been diverted away from its pre-construction alignment, which required the extension of UT 8 to converge with WFFBR. The extended channel now flows through a filled portion of the abandoned WFFBR until the point of their new convergence within WFFBR's constructed floodplain. Channel pattern, profile, and dimension were designed to ensure that the channel will convey flow and transport sediment in a way where the channel will neither aggrade nor degrade. Additional mitigation activities included installation of wood and rock structures for grade control and habitat improvement, and restoration of a vegetated riparian buffer.

#### 1.3.6. Other Unnamed Tributaries Enhancement

UT 1 - Approximately 764 feet of UT 1 (excluding 25 feet that flows through an agricultural crossing) has been enhanced (Enhancement II) as part of mitigation activities. Prior to construction, a mature riparian buffer averaging 10 to 20 feet wide already existed, but cattle had full access to UT 1. Woven wire fencing



was installed along the easement boundary to exclude cattle from UT 1 and clearly demarcate the easement boundary for the landowners. Native vegetative species were planted from the edge of the existing wooded buffer to the easement boundary. Following enhancement activities, UT 1 now exhibits a minimum riparian buffer 30 to 50 feet wide off of the left and right banks throughout the easement. The existing ford crossing on UT 1 was replaced with a culvert crossing. A single 24 inch Corrugated Metal Pipe (CMP) was installed at the culvert crossing.

UT 2, UT 2A, and UT 2B – Approximately 923 feet of UT 2 (excluding 20 feet that flows through an agricultural crossing), 546 feet of UT 2A (excluding 24 feet that flows through an agricultural crossing), and 75 feet of UT 2B has been enhanced (Enhancement II) as part of mitigation activities. Prior to construction cattle would routinely access this area of the Site for water and shade, which resulted in frequent inputs of nutrients and fecal matter, and degradation of the riparian buffer. Woven wire fencing was installed along the easement boundary to exclude cattle from UT 2, UT 2A, and UT 2B, and clearly demarcate the easement boundary for the landowners. The buffer has been planted with native vegetative species to restore natural vegetative structure and composition. Following enhancement activities, UT 2, UT 2A, and UT 2B now exhibit a minimum riparian buffer 30 to 50 feet wide off of the left and right banks throughout the easement. Portions of the buffer along UT 2 and UT 2A exceed 50 feet in width. The ford on UT 2A has been replaced with a culvert crossing and the previous culvert crossing on UT 2 has been replaced with a new culvert crossing. A single 24 inch CMP has been installed at each crossing.

UT 3 – Approximately 125 feet of UT 3 has been enhanced (Enhancement I) as part of mitigation activities. Enhancement measures consisted of grading stream bed and banks and installing a rock step structure to stabilize UT 3 as it converges with WFFBR. Woven wire fencing was installed along the easement boundary to exclude cattle from UT 3 and clearly demarcate the easement boundary for the landowner. A riparian buffer has been planted with native vegetative species on both sides of UT 3. UT 3 now exhibits a minimum riparian buffer 30 to 50 feet wide off of the left and right banks.

UT 4 – Approximately 809 linear feet of UT 4 (excluding 30 feet that flows through an agricultural crossing) has been enhanced (Enhancement II) as part of mitigation activities. Prior to construction cattle routinely accessed UT 4 for water and shade, which resulted in frequent inputs of nutrients and fecal matter, and degradation of the narrow riparian area adjacent to the stream. The riparian buffer in some areas along UT 4 consisted of a single tree buffer before planting. In addition, WFFBR was diverted away from its original alignment, which required the extension of UT 4 to converge with WFFBR. Approximately 146 linear feet of UT 4 was constructed with stable dimension, pattern, and profile to connect UT 4 with WFFBR. Woven wire fencing was installed along the easement boundary to exclude cattle from UT 4 and clearly demarcate the easement boundary for the landowner. A riparian buffer populated with native vegetative species has been planted on both sides of UT 4. Following enhancement activities, UT 4 now exhibits a minimum riparian buffer 30 to 50 feet wide off of the left and right banks. The existing culvert crossing on UT 4 has been replaced with a new culvert crossing. A single 36 inch CMP has been installed at the crossing.

UT 4A – Approximately 472 linear feet of UT 4A was enhanced (Enhancement II) as part of mitigation activities. Prior to construction cattle routinely accessed UT 4A for water and shade, which resulted in frequent inputs of nutrients and fecal matter, and degradation of the riparian area adjacent to the stream. Woven wire fencing has been installed along the easement boundary to exclude cattle from UT 4A and



clearly demarcate the easement boundary for the landowner. Additionally, approximately 72 linear feet of UT 4A were stabilized with rock step structures near the convergence with UT 4. A riparian buffer populated with native vegetative species has been planted on the left side of UT 4A. Following enhancement activities, UT 4A now exhibits a minimum riparian buffer 30 to 50 feet wide off of the left bank and 50 to 75 feet wide off of the right bank.

UT 4B – Approximately 178 linear feet of UT 4B was enhanced (Enhancement II) as part of the mitigation activities. A mature riparian buffer is present on both sides of the channel however prior to construction cattle had full access to UT 4B. Woven wire fencing has been installed along the easement boundary to exclude cattle from UT 4B and clearly demarcate the easement boundary for the landowner. Following enhancement activities, UT 4B exhibits a minimum riparian buffer 30 to 50 feet wide off of both sides of the channel.

UT 7B - Approximately 136 linear feet of UT 7B was enhanced (Enhancement II) as part of the mitigation activities. A riparian buffer has been planted through the reach and woven wire fencing has been installed along the easement boundary to exclude cattle from the channel and clearly demarcate the easement for the landowner. Following enhancement activities, UT 7B exhibits a minimum riparian buffer 30 to 50 feet wide off of both sides of the channel.

#### 1.3.7. Other Unnamed Tributaries Preservation

Approximately 114 linear feet of UT 6, 206 linear feet of UT 6A, 103 linear feet of UT 7A have been preserved within the Site's boundaries. All of the preserved streams are fully functional and were in danger of disturbance from agricultural practices if not protected.

#### 1.3.8. Wetland Rehabilitation and Re-establishment

Approximately 0.17 acres adjacent to W3 (excluding 0.10 acres of relic wetland within the powerline easement) and 0.18 acres adjacent to W5A/B were re-established and reconnected to the existing wetlands (Figure 2). Re-establishment of these relic wetlands included removing spoil piles and overburden material, restoring wetland hydrology by raising the inverts of adjacent, previously incised tributaries, and replanting with native vegetative species.

Approximately 0.97 acres (excluding 0.22 acres of relic wetland within the powerline easement) of W3 that previously served as part of the cattle pasture has been rehabilitated at the Site. Rehabilitation activities included planting the wetland with native vegetation, installation of exclusionary cattle fencing, and restoration of UT 5 which has increased the frequency of floodwaters reaching W3.

#### 1.3.9. Wetland Enhancement

W1, W2, W4, and W5A/B through W9 were enhanced via the installation of exclusionary cattle fencing and planting of native hydrophytic vegetation. In the As-Built state approximately 1.40 acres of wetland has been enhanced across the Site. The reduction in Wetland Group 1 is a result of a mistake at the Mitigation Plan stage that did not account for the UT 2 and UT 3 top of banks through the wetland areas, and a miscalculation of enhancement area along the left bank near STA 22+00 of WFFBR. The corrected enhancement area is reflected in the As-Built column of Table 5 and Figures 2 and 3.1 – 3.9 (Appendix A).

### 1.4 Project History, Contacts and Attribute Data

HDR provided engineering and design services for the Site. Land Management Group was contracted to provide construction oversight services for the Site. Construction began on June 8<sup>th</sup>, 2020 and earthwork

was completed and the Site was demobilized October 7<sup>th</sup>, 2020. The Site experienced two, 10 year storm events, once on October 10<sup>th</sup> and again on October 29<sup>th</sup>, 2020. Repair activities were completed on January 15<sup>th</sup>, 2021. Site planting was completed on January 22, 2021. Baseline monitoring field data collection occurred in February of 2021.

Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 6 through 8 (Appendix A).

## 2.0 Success Criteria

Site performance standards and required remediation actions are based on the Wilmington District Stream and Wetland Compensatory Mitigation Update (USACE et al. 2016). Performance standards for stream morphology, hydrology, and vegetation are discussed below. Installed project monitoring features are depicted on the As-Built Monitoring Plan View maps (Figures 3.1 – 3.9, Appendix A).

### 2.1 Streams

Restored stream reaches will be monitored for geomorphic activity. Annual fall/winter monitoring will include development of channel cross-sections on riffles and pools (Monitoring Years 1, 2, 3, 5 & 7) in addition to visual observation of channel stability (Monitoring Years 1 through 7).

#### 2.1.1. Stream Dimension

A stable cross-section and hydrologic access to the floodplain throughout the monitoring period will generally represent success in dimensional stability. Riffle cross-sections should remain stable and show little change in bankfull area, bank-height ratio, and width to depth ratio. Some changes in dimension (such as lowering of bankfull width-to-depth ratio) should be expected. Riffle sections should generally maintain a Bank Height Ratio (BHR) approaching 1.0 – 1.2, with some variation in this ratio naturally occurring, and display an entrenchment ratio of no less than 2.2. Both ratios should display no more than 10 percent change from year-to-year. Based on current DMS guidance regarding BHR, years that exhibit deposition in the channel may yield BHR ratios that are less than 1.0. Pool sections naturally adjust based on recent flows and time between flows. No individual measurements should exceed 15 percent variance over as-built conditions over the monitoring time frame.

#### 2.1.2. Stream Pattern and Profile

Pattern features should show little adjustment over the standard 7 year monitoring period. The profile should not demonstrate significant trends towards degradation or aggradation over a significant portion of a reach. Visual assessment and photo documentation will be used to indicate that streams are remaining stable and do not indicate a trend toward vertical or lateral instability. Longitudinal profile survey will be conducted during the as-built survey but will not be conducted during the seven-year monitoring period unless a trend towards vertical or lateral instability is observed.

#### 2.1.3. Substrate and Sediment Transport

There should be an absence of any significant trend in the aggradational or depositional potential of the channel.

#### 2.1.4. Hydraulics

All stream channels will maintain an ordinary high water mark (OHWM) through monitoring. Continuous surface water flow within tributaries must be documented to occur every year for at least 30 consecutive



days during the prescribed monitoring period. A minimum of four bankfull events must be documented within the 7 year monitoring period. The four bankfull events shall occur within separate years.

## 2.2 Vegetation

Vegetation requirements state that there must be a minimum of 320 planted stems per acre surviving after year three, 260 stems per acre after year five, and 210 stems per acre after year seven. Trees should average 6 feet in height at year five and 8 feet in height at year seven. Bog Complex communities may exhibit areas with low stem density that are dominated by herbaceous species, which is acceptable for this community type. In addition, Bog Complex communities will be planted with a high percentage of shrub species, which are not expected to reach the height requirements listed above for trees. Volunteers must be present for a minimum of two growing seasons before being included in performance standards in Year 5 and Year 7. For any tree stem to count toward success, it may be either planted or volunteer, but it must be a species from the approved planting list included in the Mitigation Plan. Other species not included on the planting list or in the stated documentation may be considered by the IRT on a case-by-case basis. Additionally, any single species can only account for up to 50% of the required number of stems within any vegetation plot. Should the performance criteria outlined above not be met during the monitoring period, HDR will provide DMS with an Adaptive Management Plan, detailing corrective actions and/or maintenance actions proposed and an implementation schedule for said actions, planned to meet the criteria. Upon review and approval of said corrective measures by DMS and the IRT, HDR will implement the necessary corrective measures.

## 2.3 Wetlands

Final performance criteria for wetland hydrology will be a groundwater level within 12 inches of the soil surface for a minimum of 12% (25 consecutive days) of the growing season (April 7 through October 30, 206 days). Wetland hydrology performance standards are based on the Lake Toxaway WETS table and the wetland saturation range for Ela soils as presented in the Wetland Saturation Threshold Table. Ela soils were used to determine the wetland saturation range because soil borings taken on-site showed a hydric soil with the associated taxonomic subgroup Fluvaquentic Humaquept, which corresponds to the Ela soil series. Both tables are provided in the Site's mitigation plan (HDR 2020). In the event of non-typical years of climatic conditions, groundwater monitoring data may be compared to on-site reference groundwater data; however, reference gauge data will not be tied to success criteria.

## 3.0 Monitoring Plan Guidelines

### 3.1 As-Built Monitoring

As-built surveys have been conducted upon completion of channel construction to document baseline conditions. The as-built surveys include all measurements typically documented during subsequent channel geomorphological surveys. A longitudinal profile of the thalweg, water surface, bankfull, and top of bank, were collected during the as-built survey of the constructed channel to compare with future geomorphological data, if necessary. Longitudinal profiles will not be required during routine channel stability monitoring (years 1 through 7) unless the monitoring efforts demonstrate channel bank or bed instability, in which case additional longitudinal profiles may be required along channel reaches of concern to track changes in the channel and demonstrate stability.

Vegetation data has been collected as part of the baseline monitoring and recorded in accordance with the NCDMS Annual Monitoring Report Format, Data, and Content Requirements (NCDMS 2020).



Seventeen permanent vegetation plots and three random vegetation plots have been established throughout the Site.

### 3.2 Annual Monitoring Plan Components

Annual monitoring reports will be produced and submitted to DMS by December 1st of the year for which monitoring was conducted. The Site will be monitored annually for a duration of 7 years. The seventh year monitoring report will include a Closeout Report that provides an assessment of monitoring data collected from the entire monitoring period. Fixed cross-sections and vegetation plots will be used as permanent photo points throughout the monitoring period. Tables 2 and 3 outline all of the monitoring components, methods, quantity, and frequency of data to be collected for the Site. A visual representation of all monitoring devices can be found in the As-Built Monitoring Plan View maps (Figure 3, Appendix A).



Table 2. Monitoring Plan

Goal	Treatment	Performance Standards	Monitoring Metric	Outcome	Functional Uplift
Restore/enhance streams within the Site so that they are neither aggrading nor degrading	Restore a stable dimension, pattern, and profile. Install fencing to exclude cattle.	Entrenchment Ratios should be $\geq 2.2$ . BHR should not exceed 1.2. BHR should not change more than 10% in any given monitoring interval. Riffle section W/D ratios should remain within the range of the appropriate stream type.	Cross-section monitoring and visual inspections.	Stable stream channels with entrenchment ratios over 2.2 and BHRs below 1.2.	Reduction of nutrients and sediment to downstream locations, reduction of shear stress, and improved hydraulic function.
Provide/ enhance flood attenuation.	Restore several existing streams as primarily a Priority I restoration where bankfull and larger flows can access the floodplain. Construct floodplain bench on WFFBR.	Four bankfull events in separate monitoring years.	Flow gauges (Pressure transducers), and visual inspection.	Bankfull events within monitoring period.	Increase attenuation of floodwaters, increase biogeochemical cycling and recharge riparian wetlands.
Restore/enhance aquatic, semi-aquatic, and riparian habitat.	Restore native vegetation to the stream channel banks, wetlands, and the adjacent riparian corridor.	Minimum of 320 stems/ac present at MY-3. Minimum of 260 stems/ac present at MY-5. Minimum of 210 stems/ac present at MY-7. Trees should average 6 feet in height at MY-5 and 8 feet in height at MY-7. Bog Complex communities may exhibit lower stem density and height.	Vegetation plots will be monitored annually between July 1st and leaf fall using the CVS protocol.	Planted stems meet density and vigor requirements in MY7, with volunteer trees also growing on site.	Treatment of nutrient enriched surface runoff from adjacent pastureland, increased bank stability and increased habitat.
Restore/Enhance Wetlands within the Site to remove hydrologic impairments	Reconstruct above bankfull stream channel flows to riparian wetlands and re-grade topography to remove spoil and overburden material.	Groundwater elevation within 12 inches of the ground surface for at least 12% of the growing season (April 7 - October 30).	Groundwater monitoring gauges.	Wetlands meeting criteria	Restoration of riparian habitat, treatment of nutrient enriched runoff from adjacent pastureland, increased flood attenuation.
Restore and connect riparian habitat with adjacent natural communities.	Conservation easement establishment.	Prevent Easement Encroachment.	Visual inspection.	No encroachment into the conservation easement.	Protect Site from encroachment in conservation easement.



Table 3. Monitoring Plan Components

Parameter	Monitoring Method	Quantity	Frequency	Notes
Dimension	Riffle Cross Sections	UT 5 (2) UT 7 (1) UT 8 (1) WFFBR (4)	Years 1, 2, 3, 5 & 7	
	Pool Cross Sections	UT 5 (2) UT 7 (1) UT 8 (1) WFFBR (2)	Years 1, 2, 3, 5 & 7	Bank pins may be installed in areas of concern.
Pattern	Visual	None	twice per year	Bank pins may be installed in areas of concern
Profile	Visual	None	twice per year	Additional profile measurements may be required if problems are identified during the monitoring period
Substrate	Visual	None	Annual	There should be an absence of any significant trend in the aggradational or depositional potential of the channel
Surface Water Hydrology	Flow Gage (Pressure Transducer)	UT 5 (1) UT 7 (1) UT 8 (1) WFFBR (1)	twice per year	Measuring devices will be inspected/downloaded at each site visit to document occurrence of bankfull events and ensure device function
Groundwater Hydrology	Groundwater Gages	5 Site gauges, 2 Reference Gauges	Annual	Data will be downloaded at each site visit.
Vegetation	CVS Level 2	Vegetation plots will be placed on ~2% of the planted area (17 permanent, 10x10 meter plots; 3 random plots of equal size)	Years 1, 2, 3, 5 & 7	Vegetation will be monitored using the Carolina Vegetation Survey (CVS) protocols. GPS coordinates and orientation of random plots will be provided in the annual monitoring reports and plot locations will be depicted on the Current Condition Plan View maps.
Invasive and nuisance vegetation	Visual		twice per year	Locations of exotic and nuisance vegetation and the occurrence of beaver dams and approximate inundation limits will be mapped
Project Boundary	Visual		twice per year	Fence damage, vegetation damage, boundary encroachments, etc. will be mapped
Culverts and Crossings	Visual		Twice per year	Blockages and/or erosion around culverts and crossings will be mapped and noted in monitoring reports.

## 4.0 Maintenance and Adaptive Management Plans

In the event the mitigation site or a component of the mitigation Site fails to achieve the necessary performance standards, HDR will notify DMS and work with DMS to develop contingency plans and remedial actions. Although all pre-existing beaver dams at the Site appeared inactive and have since been removed, potential beaver activity will be closely monitored. A beaver control plan will be developed and implemented if hydrologic modification from beaver dams jeopardizes Site success.

## 5.0 As-Built State

This section documents the as-built/baseline condition. Appendices B and C include Tables 9, 10, and 11 which detail specific geomorphic and vegetative data in relation to the as-built conditions. As-built/baseline record drawings are included in Appendix D.

### 5.1 Morphological State of the Channel

Upon completion of grading and structure installation, a baseline survey was performed for the entire restored length of stream and included 14 cross-sections. Overall, the majority of the cross sections were installed in the locations proposed in the Mitigation Plan except for five of the fourteen cross sections. The cross sections moved are as follows: Cross Section 10 was moved approximately 56 feet downstream to STA 13+81 (UT 5); Cross Section 11 was moved approximately 74 feet upstream to STA 16+26 (UT 5); Cross Section 12 was moved approximately 48 feet upstream to STA 17+51 (UT 5); Cross Section 13 was moved approximately 109 feet downstream to STA 11+84 (UT 7); and Cross Section 14 was moved approximately 67 feet downstream to STA 12+85 (UT 7). Baseline morphologic data is summarized in Table 9 and Table 10 in Appendix B. Plots of the profiles are shown in Figure 4 of Appendix B. Cross-section plots and photos can also be found in Appendix B. Cross-section photos were taken facing the downstream direction.

### 5.2 Verification of Plantings

An initial evaluation of planted stems was performed per guidelines established in NCDMS Annual Monitoring Report Format, Data, and Content Requirements (NCDMS 2020) to verify planting methods were successful and to determine species composition and density. Seventeen permanent vegetation plots were established across the Site and 3 random vegetation plots will be sampled each year. Overall, the majority of the permanent vegetation plots were installed as proposed in the Mitigation Plan except for five of the seventeen plots. The changes are as follows: Vegetation Plots 1 and 2 were installed as 5 by 20 meter plots to fit within the planted area along the buffer; Vegetation Plot 12 was moved immediately across UT 5 approximately 10 feet from the right top of bank; Vegetation Plot 18 was moved across UT 7 approximately 10 feet from the left top of bank of WFFBR; and Vegetation Plot 20 was installed approximately 180 feet south into the planted area along UT 7. Vegetation plot locations can be found in Figure 3 of Appendix A. Baseline vegetation plot data can be found in Table 11 in Appendix C. Plot photos are also located in Appendix C. Initial stem count measurements indicate an average of 698 planted stems per acre (excluding live stakes) across the Site. In addition, each individual plot met success criteria based on planted stems alone.

The As-Built planting list varies slightly from the list proposed in the Mitigation Plan due to limited availability of certain species. A summary of the planting list revisions can be found in the table below. The final As-Built Planting List can be found in Appendix C.



Table 4. As-Built Planting Changes Summary

<u>Species</u>	<u>Planting Revision</u>	<u>Reason for Revision</u>	<u>Net Change (%)</u>
<b>Zone 1: Streamside Assemblage</b>			
Tag Alder ( <i>Alnus serrulata</i> )	Reduced	Limited Species Availability	-10%
Elderberry ( <i>Sambucus canadensis</i> )	Added	Replaced Reduced Tag alder Quantity	+10%
<b>Zone 2: Piedmont/ Mountain Bottomland Forest</b>			
Mountain silverbell ( <i>Halesia tetraptera</i> )	Removed	Species Unavailable	-5%
Flowering Dogwood ( <i>Cornus florida</i> )	Increased	Replace Mountain silverbell quantity	+5%
<b>Zone 3: Swamp Forest-Bog Complex</b>			
Tag Alder ( <i>Alnus serrulata</i> )	Reduced	Limited Species Availability	-10%
Possumhaw viburnum ( <i>Viburnum nudum</i> )	Removed	Species Unavailable	-20%
Mountain holly ( <i>Ilex montana</i> )	Removed	Species Unavailable	-10%
Swamp rose ( <i>Rosa palustris</i> )	Removed	Species Unavailable	-5%
Buttonbush ( <i>Cephalanthus occidentalis</i> )	Added	Replace reduced/removed quantity	+20%
Spicebush ( <i>Lindera benzoin</i> )	Added	Replace reduced/removed quantity	+15%
Elderberry ( <i>Sambucus canadensis</i> )	Added	Replace reduced/removed quantity	+10%
<b>Zone 4: Montane Alluvial Forest</b>			
Sweet birch ( <i>Betula lenta</i> )	Removed	Species Unavailable	-10%
All remaining species in Zone 4	Increased by ~1.6%	Replaced Reduced Sweet birch Quantity	+10%

### 5.3 Stream and Wetland Gauges

Four pressure transducer flow gauges have been installed across the Site, one in each restoration reach (UT 5, UT 7, UT 8, and WFFBR). Measuring devices will be inspected/downloaded at each site visit to document occurrence of bankfull events and ensure device function. Flow gauge and groundwater gauge locations are documented in the As-Built Monitoring Plan View located in Appendix A.

Five groundwater gauges have been installed across the Site. One groundwater gauge was installed in Wetland Group 1, two groundwater gauges have been installed in Wetland Group 2, and two groundwater gauges have been installed in Wetland Group 3. Groundwater gauges will be inspected/downloaded at each site visit to document wetland hydrology and ensure device function.



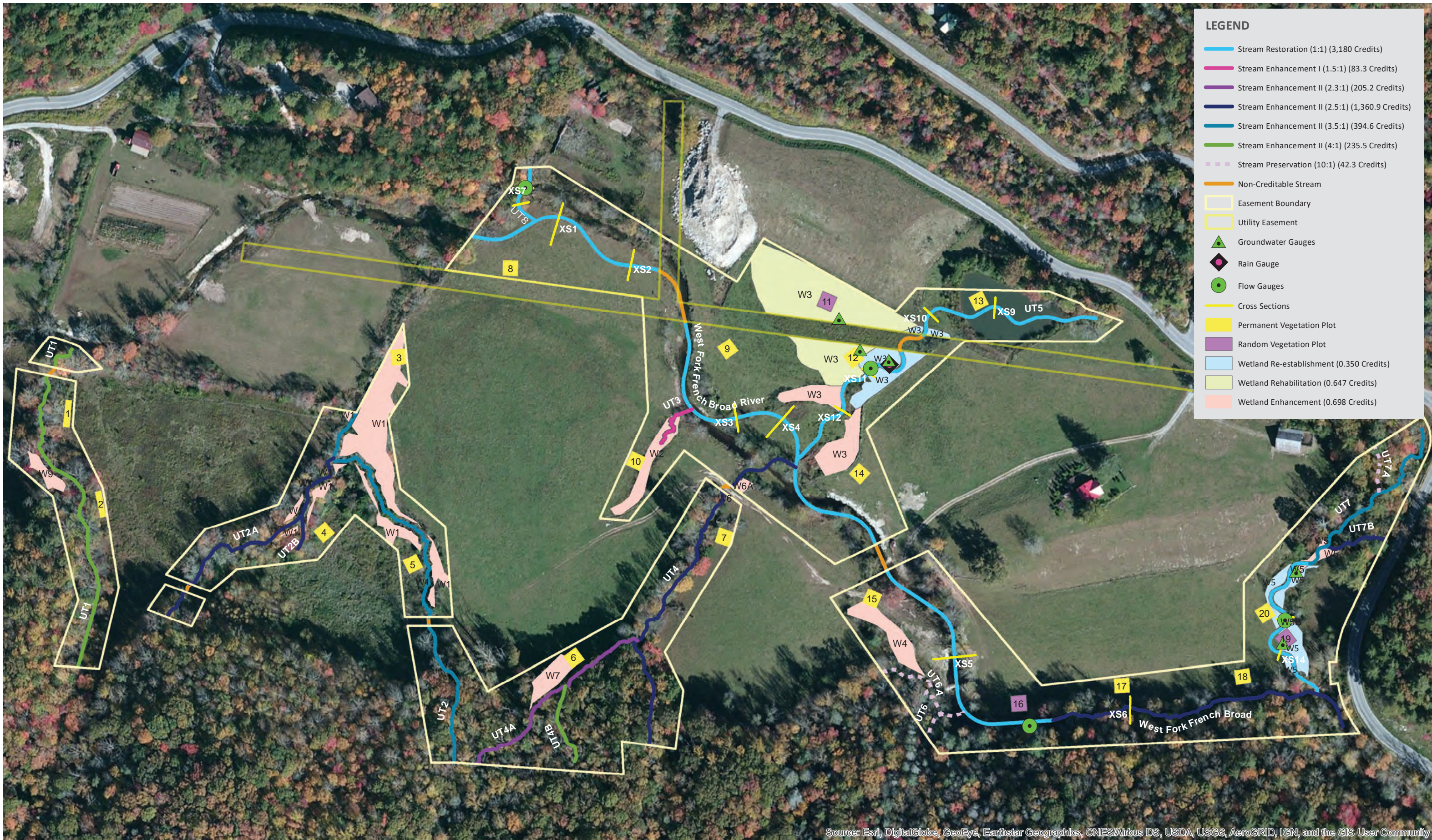


## 6.0 References

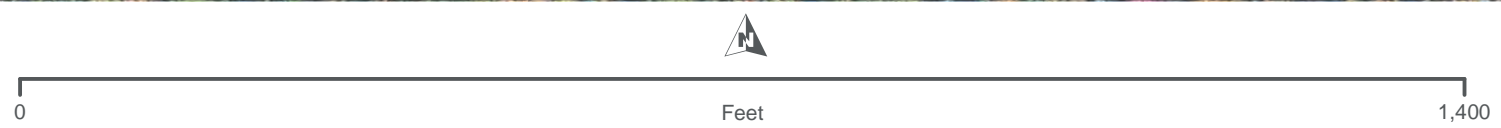
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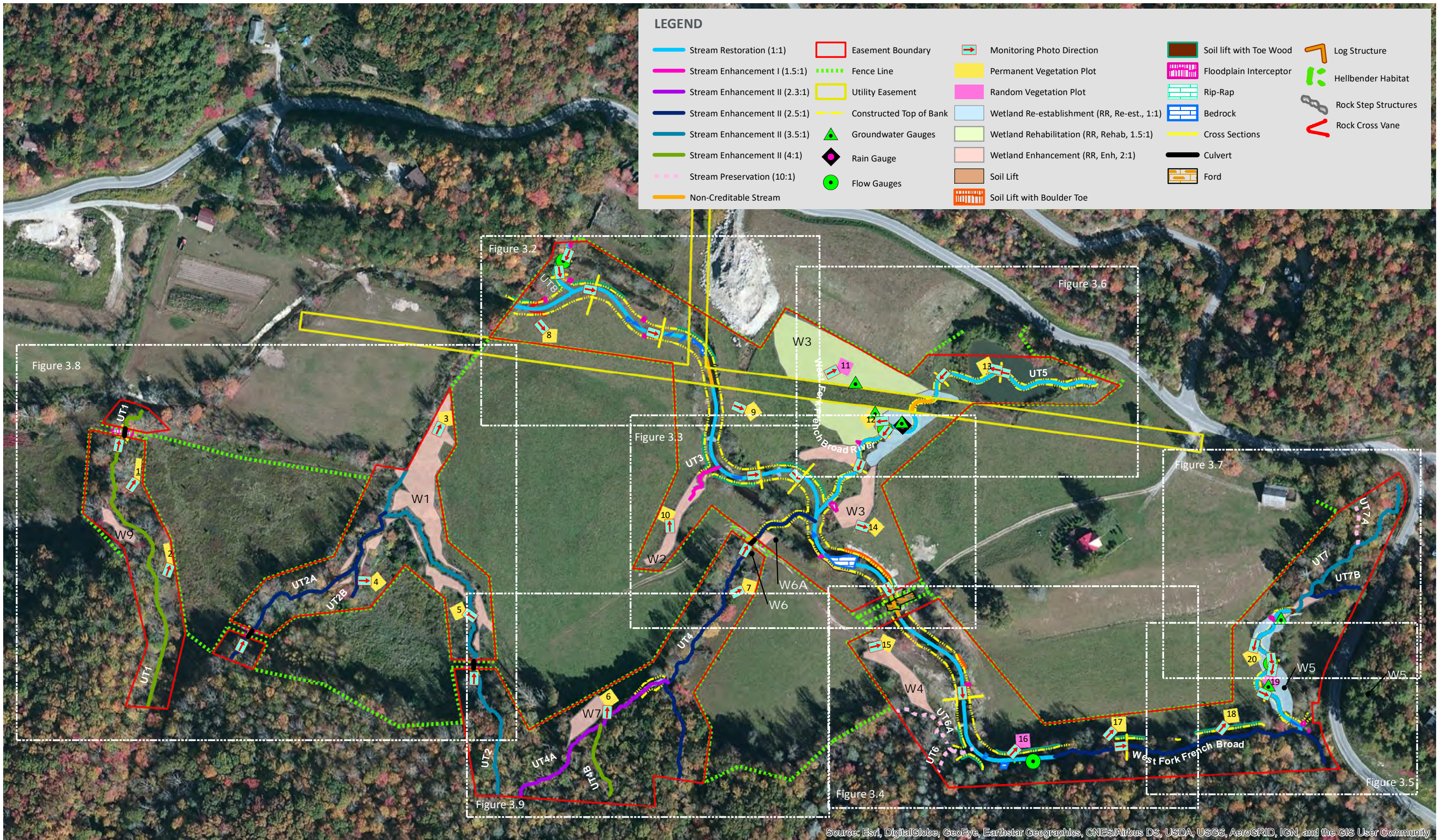
## Appendix A – General Tables and Figures



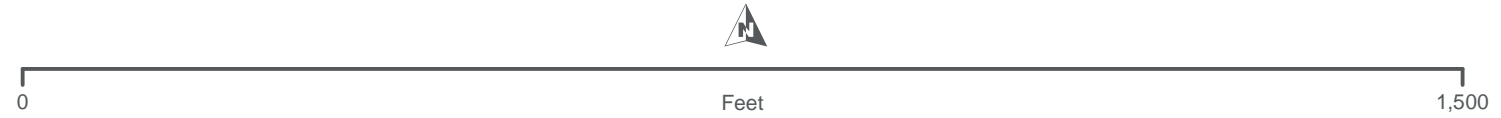
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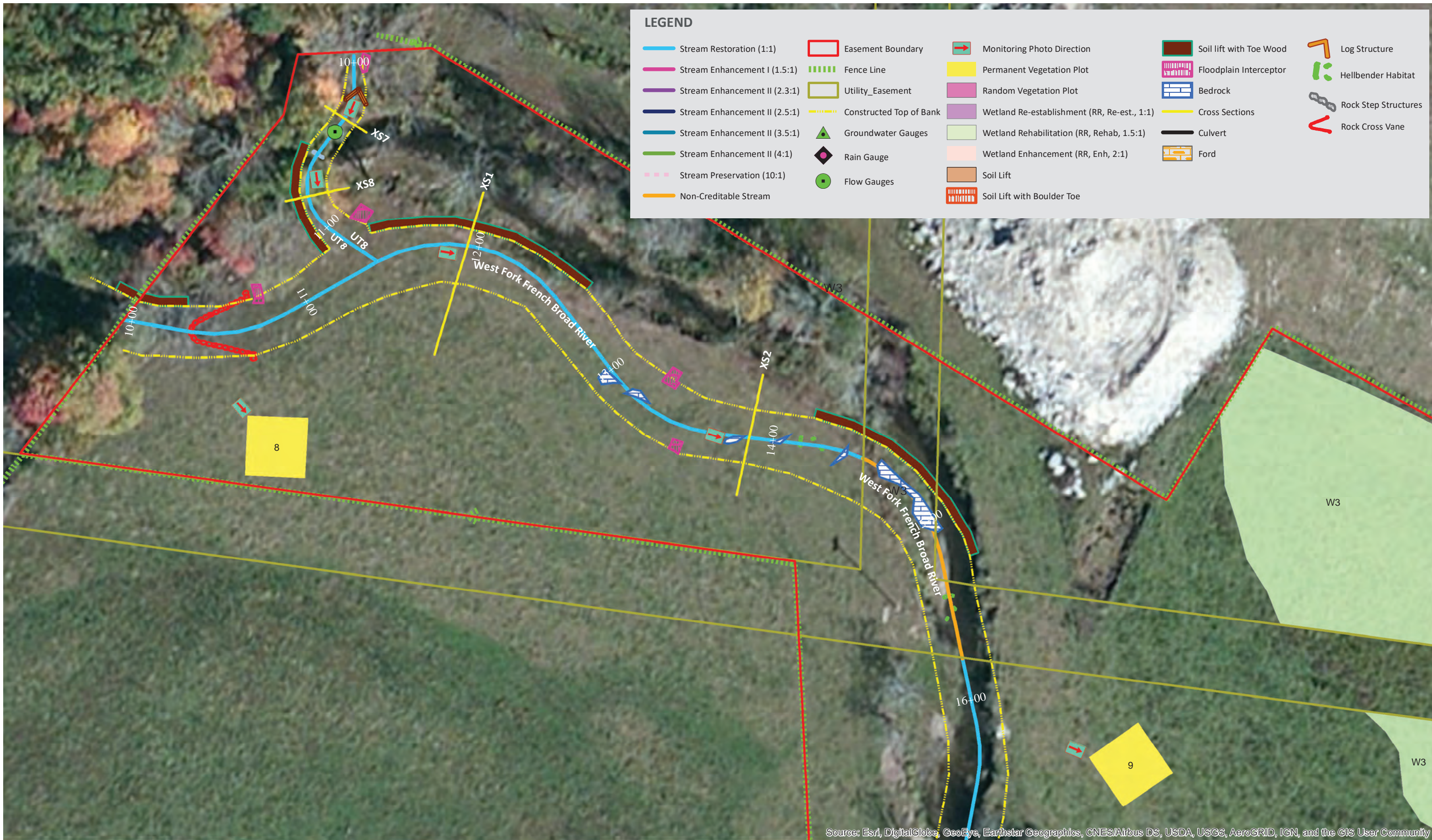
**PROJECT ASSET MAP**  
**OWEN FARMS MITIGATION SITE**  
 FIGURE 2.0  
 OWEN FARMS AS-BUILT REPORT

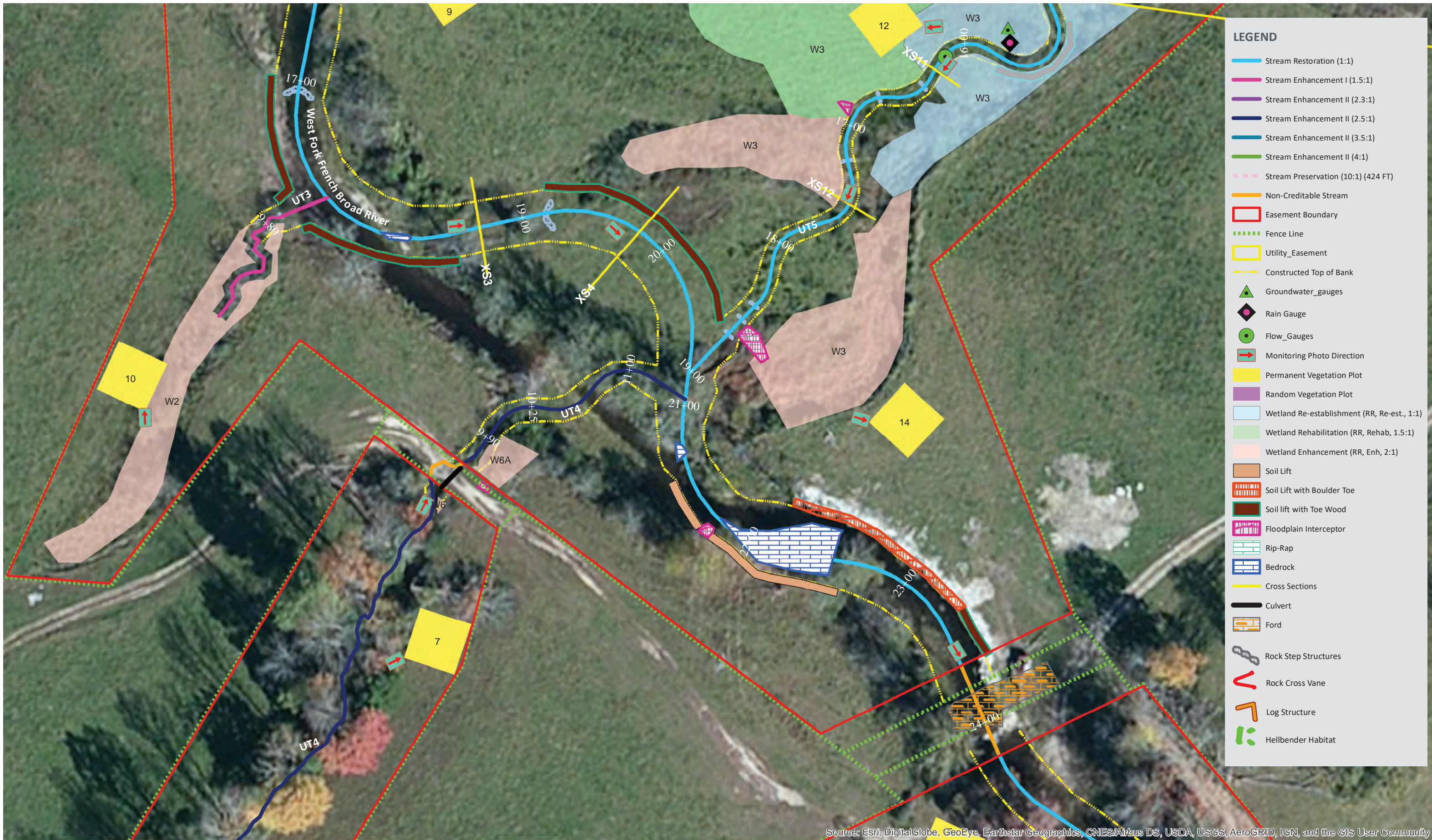


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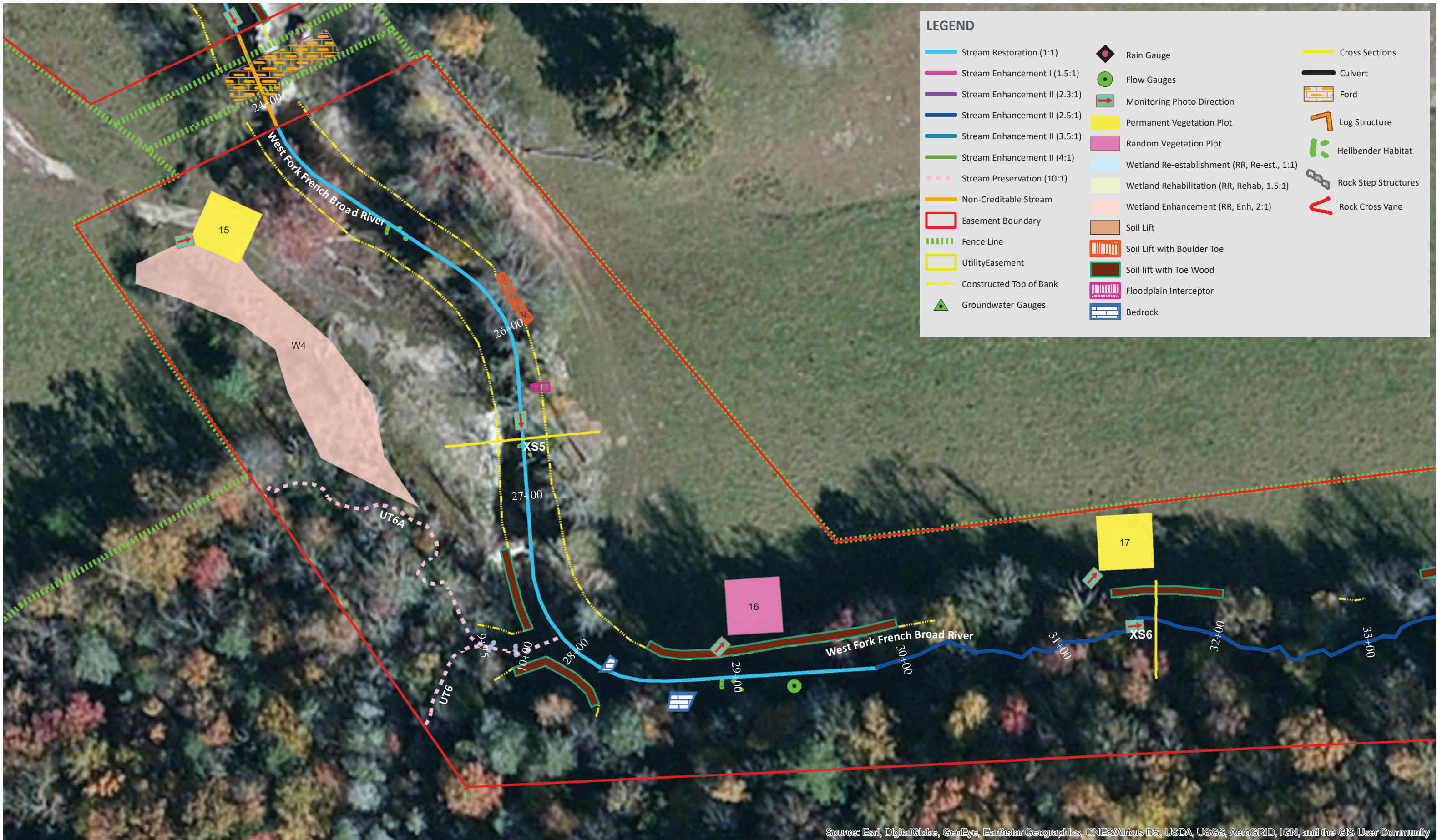
**AS-BUILT MONITORING PLAN VIEW**  
**OWEN FARMS MITIGATION SITE**  
 FIGURE 3.1  
 OWEN FARMS AS-BUILT REPORT





- LEGEND**
- Stream Restoration (1:1)
  - Stream Enhancement I (1.5:1)
  - Stream Enhancement II (2.3:1)
  - Stream Enhancement II (2.5:1)
  - Stream Enhancement II (3.5:1)
  - Stream Enhancement II (4:1)
  - - - Stream Preservation (10:1) (424 FT)
  - Non-Creditable Stream
  - Easement Boundary
  - Fence Line
  - Utility\_Easement
  - - - Constructed Top of Bank
  - ▲ Groundwater\_gauges
  - ◆ Rain Gauge
  - Flow\_Gauges
  - Monitoring Photo Direction
  - Permanent Vegetation Plot
  - Random Vegetation Plot
  - Wetland Re-establishment (RR, Re-est., 1:1)
  - Wetland Rehabilitation (RR, Rehab, 1.5:1)
  - Wetland Enhancement (RR, Enh, 2:1)
  - Soil Lift
  - Soil Lift with Boulder Toe
  - Soil lift with Toe Wood
  - Floodplain Interceptor
  - Rip-Rap
  - Bedrock
  - Cross Sections
  - Culvert
  - Ford
  - Rock Step Structures
  - Rock Cross Vane
  - Log Structure
  - Hellbender Habitat

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



**AS-BUILT MONITORING PLAN VIEW**  
**OWEN FARMS MITIGATION SITE**  
 FIGURE 3.4  
 OWEN FARMS AS-BUILT REPORT



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND	
	Stream Restoration (1:1)
	Stream Enhancement I (1.5:1)
	Enhancement II (2.3:1)
	Stream Enhancement II (2.5:1)
	Stream Enhancement II (3.5:1)
	Enhancement II (4:1)
	Stream Preservation (10:1)
	Non-Creditable Stream
	Easement Boundary
	Fence Line
	Utility Easement
	Constructed Top of Bank
	Groundwater Gauges
	Flow Gauges
	Rain Gauge
	Permanent Vegetation Plot
	Random Vegetation Plot
	Monitoring Photo Direction
	Wetland Re-establishment (RR, Re-est., 1:1)
	Wetland Rehabilitation (RR, Rehab, 1.5:1)
	Wetland Enhancement (RR, Enh, 2:1)
	Soil Lift
	Soil Lift with Boulder Toe
	Soil lift with Toe Wood
	Floodplain Interceptor
	Bedrock
	Cross Sections
	Culvert
	Ford
	Log Structure
	Hellbender Habitat
	Rock Step Structures
	Rock Cross Vane

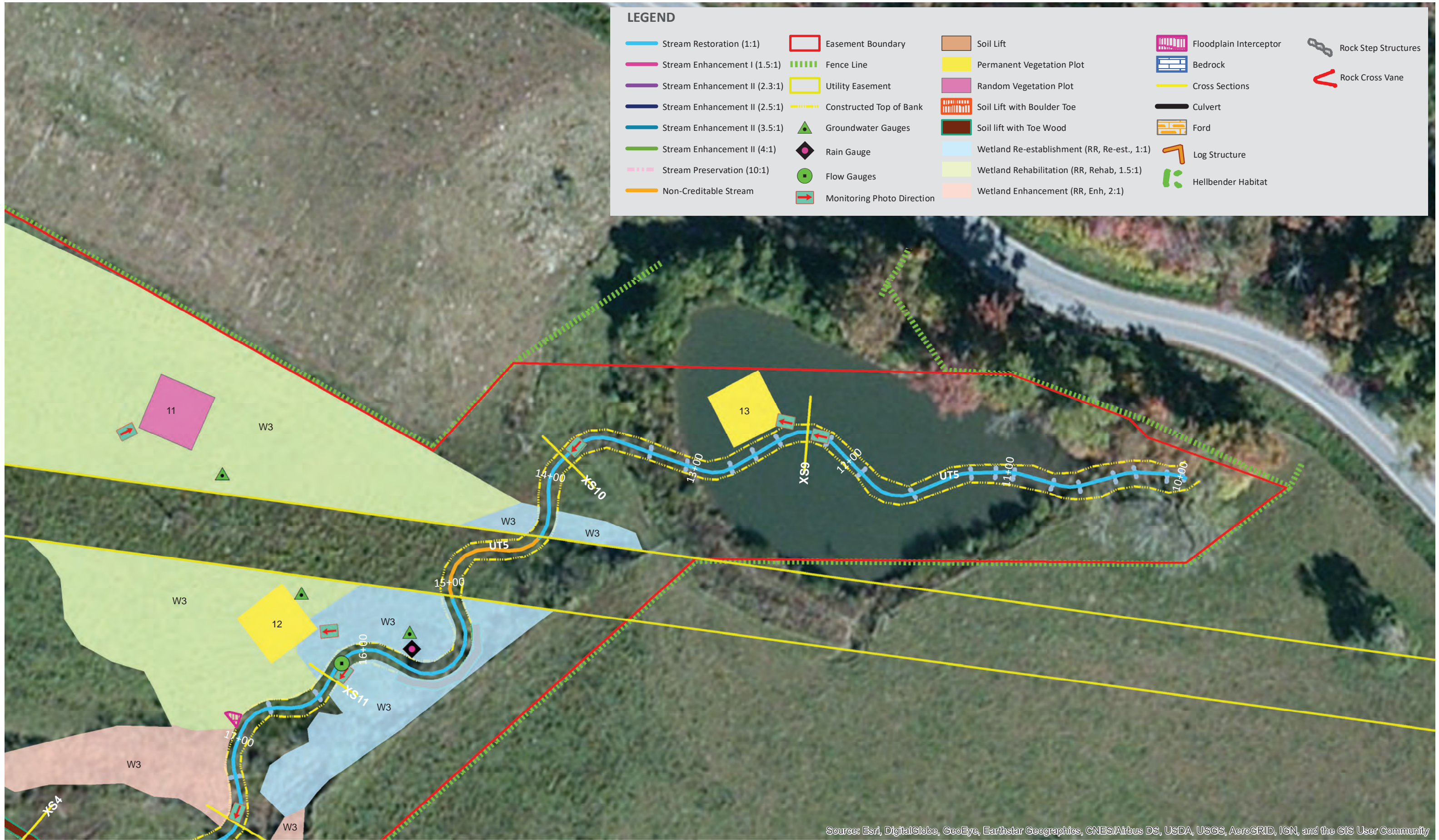


**AS-BUILT MONITORING PLAN VIEW**  
**OWEN FARMS MITIGATION SITE**  
 FIGURE 3.5  
 OWEN FARMS AS-BUILT REPORT



**LEGEND**

Stream Restoration (1:1)	Easement Boundary	Soil Lift	Floodplain Interceptor	Rock Step Structures
Stream Enhancement I (1.5:1)	Fence Line	Permanent Vegetation Plot	Bedrock	Rock Cross Vane
Stream Enhancement II (2.3:1)	Utility Easement	Random Vegetation Plot	Cross Sections	Culvert
Stream Enhancement II (2.5:1)	Constructed Top of Bank	Soil Lift with Boulder Toe	Ford	Log Structure
Stream Enhancement II (3.5:1)	Groundwater Gauges	Soil lift with Toe Wood	Hellbender Habitat	
Stream Enhancement II (4:1)	Rain Gauge	Wetland Re-establishment (RR, Re-est., 1:1)		
Stream Preservation (10:1)	Flow Gauges	Wetland Rehabilitation (RR, Rehab, 1.5:1)		
Non-Creditable Stream	Monitoring Photo Direction	Wetland Enhancement (RR, Enh, 2:1)		



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

**LEGEND**

- Stream Restoration (1:1)
- Stream Enhancement I (1.5:1)
- Stream Enhancement II (2.3:1)
- Stream Enhancement II (2.5:1)
- Stream Enhancement II (3.5:1)
- Stream Enhancement II (4:1)
- Stream Preservation (10:1)
- Non-Creditable Stream
- Easement Boundary
- Fence Line
- Utility Easement
- Constructed Top of Bank
- ▲ Groundwater Gauges
- ◆ Rain Gauge
- Flow Gauges
- Monitoring Photo Direction
- Permanent Vegetation Plot
- Random Vegetation Plot
- Soil Lift
- Soil Lift with Boulder Toe
- Soil lift with Toe Wood
- Wetland Re-establishment (RR, Re-est., 1:1)
- Wetland Rehabilitation (RR, Rehab, 1.5:1)
- Wetland Enhancement (RR, Enh, 2:1)
- Floodplain Interceptor
- Bedrock
- Cross Sections
- Culvert
- Ford
- Rock Step Structures
- ~ Rock Cross Vane
- L Log Structure
- ~ Hellbender Habitat

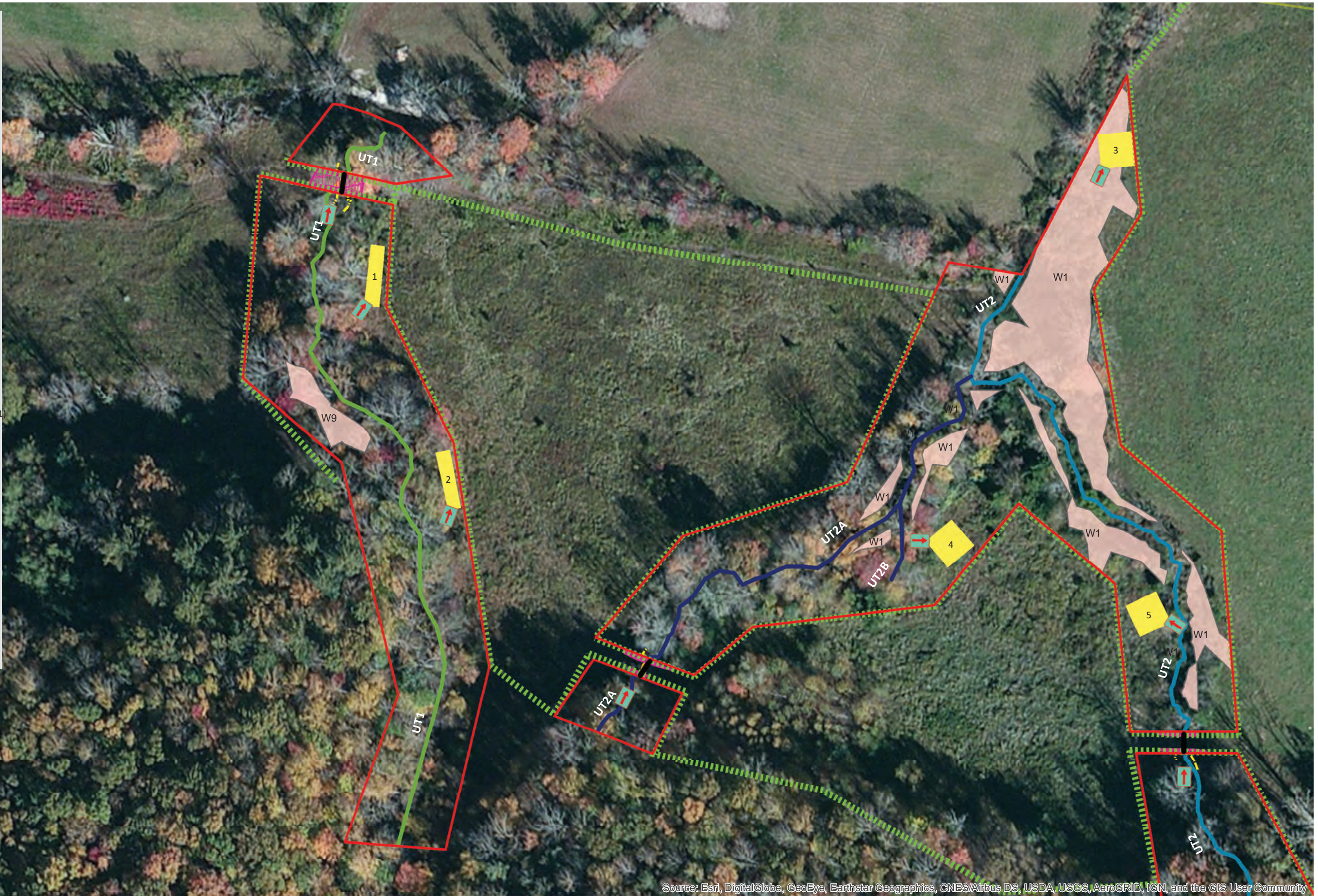


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



**AS-BUILT MONITORING PLAN VIEW**  
**OWEN FARMS MITIGATION SITE**  
 FIGURE 3.7  
 OWEN FARMS AS-BUILT REPORT

- LEGEND**
- Stream Restoration (1:1)
  - Stream Enhancement I (1.5:1)
  - Stream Enhancement II (2.3:1)
  - Stream Enhancement II (2.5:1)
  - Stream Enhancement II (3.5:1)
  - Stream Enhancement II (4:1)
  - Stream Preservation (10:1)
  - Non-Creditable Stream
  - Easement Boundary
  - Fence Line
  - Utility Easement
  - Constructed Top of Bank
  - ▲ Groundwater Gauges
  - ◆ Rain Gauge & Baro Troll
  - Flow Gauges
  - Permanent Vegetation Plot
  - Random Vegetation Plot
  - Monitoring Photo Direction
  - Soil Lift
  - Soil Lift with Boulder Toe
  - Soil lift with Toe Wood
  - Wetland Re-establishment (RR, Re-est. 1:1)
  - Wetland Rehabilitation (RR, Rehab, 1.5:1)
  - Wetland Enhancement (RR, Enh 2:1)
  - Floodplain Interceptor
  - Bedrock
  - Cross Sections
  - Culvert
  - Ford
  - Rock Step Structures
  - ~ Rock Cross Vane
  - Log Structure
  - Hellbender Habitat



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



**AS-BUILT MONITORING PLAN VIEW**  
**OWEN FARMS MITIGATION SITE**  
 FIGURE 3.8  
 OWEN FARMS AS-BUILT REPORT



Table 5. Owen Farms Mitigation Site (DMS Project No. 100064) Project Mitigation Quantities and Credits

Project Segment	Original Mitigation Plan Ft/Ac	As-Built Ft/Ac	Original Mitigation Category	Original Restoration Level	Original Mitigation Ratio (X:1)	Credits	Comments
<b>Stream</b>							
West Fork French Broad River (WFFBR)*	1799.000	1799.000	Cold	R	1.00000	1,799.000	Full channel Restoration, buffer planting, livestock exclusion, permanent easement
West Fork French Broad River (WFFBR)	705.000	705.000	Cold	EII	2.50000	282.000	Bank stabilization along the left bank, buffer planting, livestock exclusion, and permanent easement
UT 1*	764.000	764.000	Cold	EII	4.00000	191.000	Buffer planting, livestock exclusion, and permanent easement
UT 2	923.000	923.000	Cold	EII	3.50000	263.714	Buffer planting, livestock exclusion, and permanent easement
UT 2A*	546.000	546.000	Cold	EII	2.50000	218.400	Buffer planting, livestock exclusion, and permanent easement
UT 2B	75.000	75.000	Cold	EII	2.50000	30.000	Buffer planting, livestock exclusion, and permanent easement
UT 3	125.000	125.000	Cold	EI	1.50000	83.333	Stabilization of channel dimension and profile, buffer planting, livestock exclusion, and permanent easement
UT 4*	809.000	809.000	Cold	EII	2.50000	323.600	Buffer planting, livestock exclusion, and permanent easement
UT 4A	472.000	472.000	Cold	EII	2.30000	205.217	Stabilization of channel dimension and profile near confluence with UT 4, buffer planting, livestock exclusion, and permanent easement
UT 4B	178.000	178.000	Cold	EII	4.00000	44.500	Buffer planting, livestock exclusion, and permanent easement
UT 5*	827.000	827.000	Cold	R	1.00000	827.000	Full channel Restoration, buffer planting, livestock exclusion, permanent easement
UT 6	114.000	114.000	Cold	P	10.00000	11.400	Preservation
UT 6A	206.000	206.000	Cold	P	10.00000	20.600	Preservation
UT 7	417.000	417.000	Cold	R	1.00000	417.000	Full channel Restoration, buffer planting, livestock exclusion, permanent easement
UT 7	439.000	439.000	Cold	EII	3.50000	125.429	Buffer planting, livestock exclusion, and permanent easement
UT 7A	103.000	103.000	Cold	P	10.00000	10.300	Preservation
UT 7B	136.000	136.000	Cold	EII	2.50000	54.400	Buffer planting, livestock exclusion, and permanent easement
UT 8	137.000	137.000	Cold	R	1.00000	137.000	Full channel Restoration near confluence with WFFBR, buffer planting, livestock exclusion, permanent easement
					<b>Total:</b>	<b>5,043.893</b>	
<b>Wetland</b>							
Wetland Group 1 (W1-W9)	1.540	1.396	R	E	2.00000	0.770	Planting, livestock exclusion, permanent easement
Wetland Group 2 (W3 and W5)	0.350	0.350	R	REE	1.00000	0.350	Raising invert of adjacent tributaries and filling abandoned channels; livestock exclusion, planting, and removal of spoil
Wetland Group 3 (W3)	0.970	0.970	R	RH	1.50000	0.647	Planting, livestock exclusion, permanent easement; restoring adjacent tributaries to increase frequency of floodwaters accessing wetland
					<b>Total:</b>	<b>1.767</b>	

\*Length of streams flowing through utility easements or agricultural crossings has been deducted from As-Built and Original Mitigation Plan footage and credits

**Project Credits**

Restoration Level	Stream			Riparian	Non-Rip	Coastal
	Warm	Cool	Cold	Wetland	Wetland	Marsh
Restoration	N/A	N/A	3,180.000	N/A	N/A	N/A
Re-establishment				0.350	N/A	N/A
Rehabilitation				0.647	N/A	N/A
Enhancement				0.770	N/A	N/A
Enhancement I	N/A	N/A	83.333			
Enhancement II	N/A	N/A	1,738.260			
Creation				N/A	N/A	N/A
Preservation	N/A	N/A	42.300	N/A	N/A	N/A
<b>Totals</b>	<b>N/A</b>	<b>N/A</b>	<b>5,043.893</b>	<b>1.767</b>	<b>N/A</b>	<b>N/A</b>

Total Stream Credit 5,043.893  
Total Wetland Credit 1.767



Table 6. Project Attributes

Project Attribute Table					
Project Name		Owen Farms Mitigation Site			
County		Transylvania			
Project Area (acres)		25			
Project Coordinates (latitude and longitude decimal degrees)		35.183902, -82.937970			
Project Watershed Summary Information					
Physiographic Province		Blue Ridge Mountains			
River Basin		French Broad			
USGS Hydrologic Unit 8-digit	06010105	USGS Hydrologic Unit 14-digit	06010105010020		
DWR Sub-basin		0601010501			
Project Drainage Area (acres)		3,795			
Project Drainage Area Percentage of Impervious Area		2			
Land Use Classification		Agricultural/Pasture			
Reach Summary Information					
Parameters		WFFB	UT 4	UT 5	UT 6
Pre-project length (feet)		1,975	731	652	114
Post-project (feet)		1,799	809	827	114
Valley confinement (Confined, moderately confined, unconfined)		Unconfined	Confined	Confined	Confined
Drainage area (acres)		3,795	30.6	44.8	21.7
Perennial, Intermittent, Ephemeral		Perennial	Perennial	Perennial	Perennial
NCDWR Water Quality Classification		B; Tr	B	B	B
Dominant Stream Classification (existing)		B4	B4	B4	B4
Dominant Stream Classification (proposed)		C4	C4	C4	C4
Dominant Evolutionary class (Simon) if applicable					
Reach Summary Information Continued					
Parameters		UT 7		UT 8	
Pre-project length (feet)		372		49	
Post-project (feet)		417		137	
Valley confinement (Confined, moderately confined, unconfined)		Confined		Confined	
Drainage area (acres)		41		198	
Perennial, Intermittent, Ephemeral		Perennial		Perennial	
NCDWR Water Quality Classification		B		B	
Dominant Stream Classification (existing)		B4		B4	
Dominant Stream Classification (proposed)		C4		C4	
Dominant Evolutionary class (Simon) if applicable					
Wetland Summary Information					
Parameters		Wetland Group 1 (W1-W9)	Wetland Group 2 (W3 & W5)	Wetland Group 3 (W3)	
Pre-project (acres)		1.54	0.35	0.97	
Post-project (acres)		1.40	0.35	0.97	
Wetland Type (non-riparian, riparian)		Riparian Riverine	Riparian Riverine	Riparian Riverine	
Mapped Soil Series		Ela	Ela	Ela	
Soil Hydric Status		A7, F3, F6	F3, F6	F3, F6	
Regulatory Considerations					
Parameters		Applicable?	Resolved?	Supporting Docs?	
Water of the United States - Section 404		Yes	Yes	PCN	
Water of the United States - Section 401		Yes	Yes	PCN	
Endangered Species Act		Yes	Yes	CE	
Historic Preservation Act		Yes	Yes	CE	
Coastal Zone Management Act (CZMA or CAMA)		No	N/A	N/A	
Essential Fisheries Habitat		No	N/A	N/A	

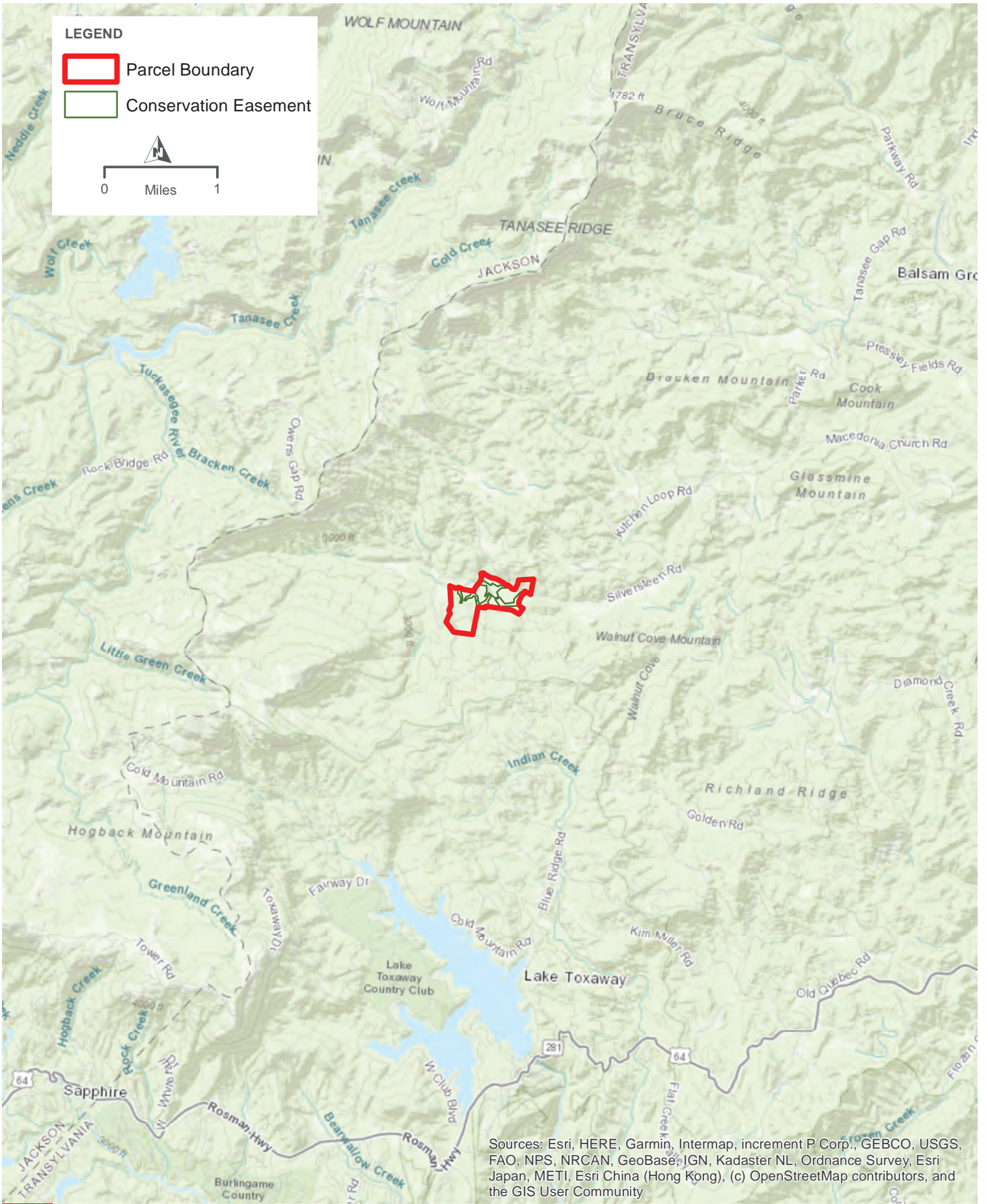


**Table 7. Project Activity and Reporting History**

Activity or Report	Data Collection Complete	Completion or Delivery
Mitigation Plan	January 2020	January 2020
Final Design – Planting and Construction Plans	January 2020	February 2020
Construction	---	October 7, 2020
Repair Activities Complete	---	January 15, 2021
Bare Root and Livestake Plantings for Entire Project Area	---	January 22, 2021
Mitigation Plan/As-built (Year 0 Monitoring-Baseline)	February 25, 2021	June 7, 2021
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		


**Table 8. Project Contacts Table**

<b>Designer</b>	HDR Engineering 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601-3034
Primary project design POC	Vickie Miller (919) 232-6600
<b>Construction Contractor</b>	Land Mechanics Design, Inc. 126 Circle G Lane Willow Spring, NC 27592
Construction Contractor POC	Lloyd Glover (919) 639-6132
<b>Planting Contractor</b>	Land Mechanics Design, Inc. 126 Circle G Lane Willow Spring, NC 27592
Planting Contractor POC	Lloyd Glover (919) 639-6132
<b>Monitoring Performers</b>	Land Management Group, Inc 3101 Poplarwood Court Raleigh, North Carolina 27604
Stream Monitoring POC	Land Management Group, Inc 3101 Poplarwood Court Raleigh, North Carolina 27604 Alex DiGeronimo (843) 830-1536
Vegetation Monitoring POC	Land Management Group, Inc 3101 Poplarwood Court Raleigh, North Carolina 27604 Alex DiGeronimo (843) 830-1536



**LEGEND**

- Parcel Boundary
- Conservation Easement



0 Miles 1

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, JGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



**LOCATION MAP**  
**OWEN FARMS MITIGATION SITE**  
**FIGURE 1**



## Appendix B – Morphological Summary Data and Plots





Table 9. Baseline Stream Data Summary

Parameter	West Fork French Broad River										UT 5									
	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)			Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
	Min	Mean	Med	Max	n	Min	Max	Min	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
<b>Riffle Only</b>																				
Bankfull Width (ft)	28.78	38.38	38.47	47.90	3	30.00	30.00	27.52	39.11	4	4.38	4.38	4.38	4.38	1	8.50	8.50	8.94	10.08	2
Floodprone Width (ft)	47.89	56.15	51.56	69.00	3	93.00	93.00	96.35	430.60	4	8.00	8.00	8.00	8.00	1	100.00	100.00	60.41	491.41	2
Bankfull Mean Depth (ft)	1.89	2.12	2.07	2.41	3	2.14	2.14	1.81	3.54	4	0.66	0.66	0.66	0.66	1	0.63	0.63	0.43	0.53	2
Bankfull Max Depth (ft)	2.93	3.14	3.20	3.28	3	2.63	2.63	2.43	4.76	4	0.95	0.95	0.95	0.95	1	0.76	0.76	0.81	0.81	2
Bankfull Cross Sectional Area (ft <sup>2</sup> )	69.31	79.83	79.56	90.63	3	69.60	69.60	49.82	138.26	4	2.90	2.90	2.90	2.90	1	5.00	5.00	4.37	4.75	2
Width/Depth Ratio	11.94	18.62	18.58	25.34	3	14.00	14.00	11.05	15.20	4	6.64	6.64	6.64	6.64	1	13.50	13.50	16.87	23.44	2
Entrenchment Ratio	1.25	1.49	1.44	1.79	3	3.10	3.10	3.50	14.23	4	1.83	1.83	1.83	1.83	1	11.80	11.80	5.99	54.94	2
Bank Height Ratio	1.70	1.90	1.80	2.19	3	1.00	1.00	1.00	1.00	4	1.20	1.20	1.20	1.20	1	1.00	1.00	1.00	1.00	2
Max part size (mm) mobilized at bankfull	83					83		83			40					40		40		
Rosgen Classification	B4 / F4					C4		C4			B4					C4		C4		
Bankfull Discharge (cfs)	300					300		300			10					10		10		
Sinuosity (ft)	1.06					1.12		1.14			1.08					1.14		1.14		
Water Surface Slope (Channel) (ft/ft)	0.0034					0.0034		0.0036			0.012					0.006		0.007		
Parameter	UT 7										UT 8									
	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)			Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
	Min	Mean	Med	Max	n	Min	Max	Min	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
<b>Riffle Only</b>																				
Bankfull Width (ft)	4.71	4.71	4.71	4.71	1	9.00	9.00	0.00	0.00	1	11.60	11.60	11.60	11.60	1	12.00	12.00	0.00	0.00	1
Floodprone Width (ft)	12.80	12.80	12.80	12.80	1	130.00	130.00	0.00	0.00	1	17.00	17.00	17.00	17.00	1	30.00	30.00	0.00	0.00	1
Bankfull Mean Depth (ft)	0.57	0.57	0.57	0.57	1	0.67	0.67	0.00	0.00	1	0.70	0.70	0.70	0.70	1	0.92	0.92	0.00	0.00	1
Bankfull Max Depth (ft)	0.74	0.74	0.74	0.74	1	0.80	0.80	0.00	0.00	1	0.97	0.97	0.97	0.97	1	1.11	1.11	0.00	0.00	1
Bankfull Cross Sectional Area (ft <sup>2</sup> )	2.69	2.69	2.69	2.69	1	5.60	5.60	0.00	0.00	1	8.19	8.19	8.19	8.19	1	10.30	10.30	0.00	0.00	1
Width/Depth Ratio	8.26	8.26	8.26	8.26	1	13.50	13.50	0.00	0.00	1	16.30	16.30	16.30	16.30	1	13.00	13.00	0.00	0.00	1
Entrenchment Ratio	2.71	2.71	2.71	2.71	1	14.40	14.40	0.00	0.00	1	1.47	1.47	1.47	1.47	1	2.50	2.50	0.00	0.00	1
Bank Height Ratio	3.40	3.40	3.40	3.40	1	1.00	1.00	0.00	0.00	1	2.79	2.79	2.79	2.79	1	1.00	1.00	0.00	0.00	1
Max part size (mm) mobilized at bankfull	61.7					61.7		61.7			76.8					76.8		76.8		
Rosgen Classification	B4					C4		C4			B4					C4		C4		
Bankfull Discharge (cfs)	13					13		13			45					45		45		
Sinuosity (ft)	1.00					1.24		1.26			1.03					1.09		1.10		
Water Surface Slope (Channel) (ft/ft)	0.0246					0.0054		0.0057			0.0379					0.0110		0.0112		

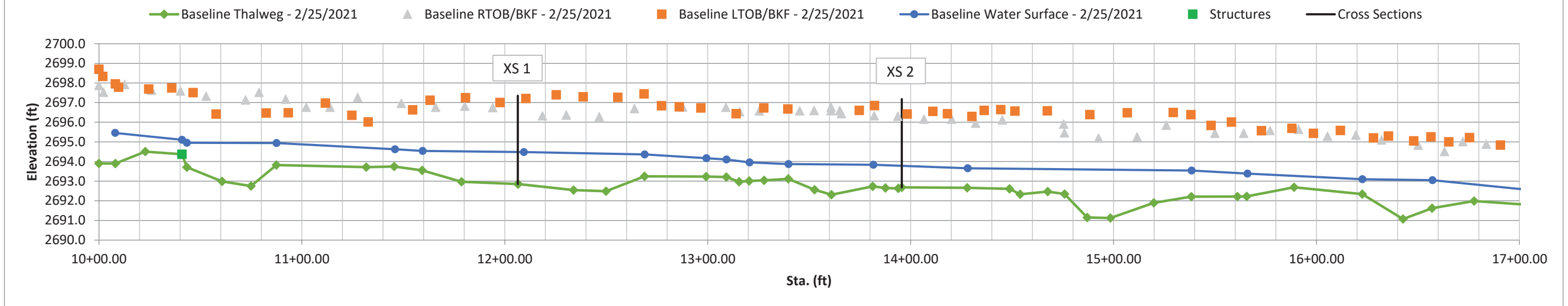


Table 10. Cross Section Morphology Monitoring Summary

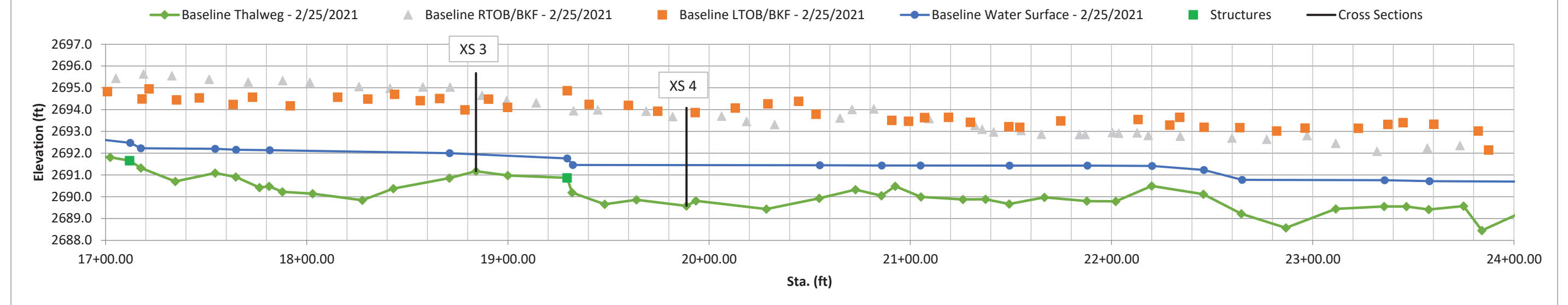
Owen Farms Mitigation Site / DMS: 100064 - West Fork French Broad River (WFFBR), UT 5, UT 7, UT 8																																				
	Cross Section 1 (Pool - WFFBR)							Cross Section 2 (Riffle - WFFBR)							Cross Section 3 (Riffle - WFFBR)							Cross Section 4 (Pool - WFFBR)							Cross Section 5 (Riffle - WFFBR)							
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	
Bankfull Elevation (ft) - Based on AB-Bankfull Area								2696.15							2694.46															2690.79						
Bank Height Ratio_Based on AB Bankfull Area								1.00							1.00															1.00						
Thalweg Elevation	2692.85							2692.68							2691.17								2689.58							2688.36						
LTOB Elevation	2696.45							2696.15							2694.46								2693.64							2690.79						
LTOB Max Depth (ft)	3.60							3.47							3.29								4.06							2.43						
LTOB Cross Sectional Area (ft <sup>2</sup> )	58.72							61.32							65.45								71.83							49.82						
	Cross Section 6 (Riffle - WFFBR)							Cross Section 7 (Riffle - UT 8)							Cross Section 8 (Pool - UT 8)							Cross Section 9 (Pool - UT 5)							Cross Section 10 (Riffle - UT 5)							
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	2691.20							2696.64															2705.97							2702.02						
Bank Height Ratio_Based on AB Bankfull Area	1.00							1.00															1.00							1.00						
Thalweg Elevation	2686.44							2695.39							2694.42								2703.98							2701.21						
LTOB Elevation	2691.20							2696.64							2696.50								2705.97							2702.02						
LTOB Max Depth (ft)	4.76							1.25							2.08								1.99							0.81						
LTOB Cross Sectional Area (ft <sup>2</sup> )	138.26							8.14							14.19								10.89							4.37						
	Cross Section 11 (Pool - UT 5)							Cross Section 12 (Riffle - UT 5)							Cross Section 13 (Pool - UT 7)							Cross Section 14 (Riffle - UT 7)														
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+								
Bankfull Elevation (ft) - Based on AB-Bankfull Area	2697.47							2694.13															2689.90													
Bank Height Ratio_Based on AB Bankfull Area	1.00							1.00															1.00													
Thalweg Elevation	2696.66							2692.78							2689.68								2689.18													
LTOB Elevation	2697.47							2694.13							2691.25								2689.90													
LTOB Max Depth (ft)	0.81							1.35							1.57								0.72													
LTOB Cross Sectional Area (ft <sup>2</sup> )	4.75							7.83							8.77								4.56													



### Figure 4.1 West Fork French Broad River - Longitudinal Profile

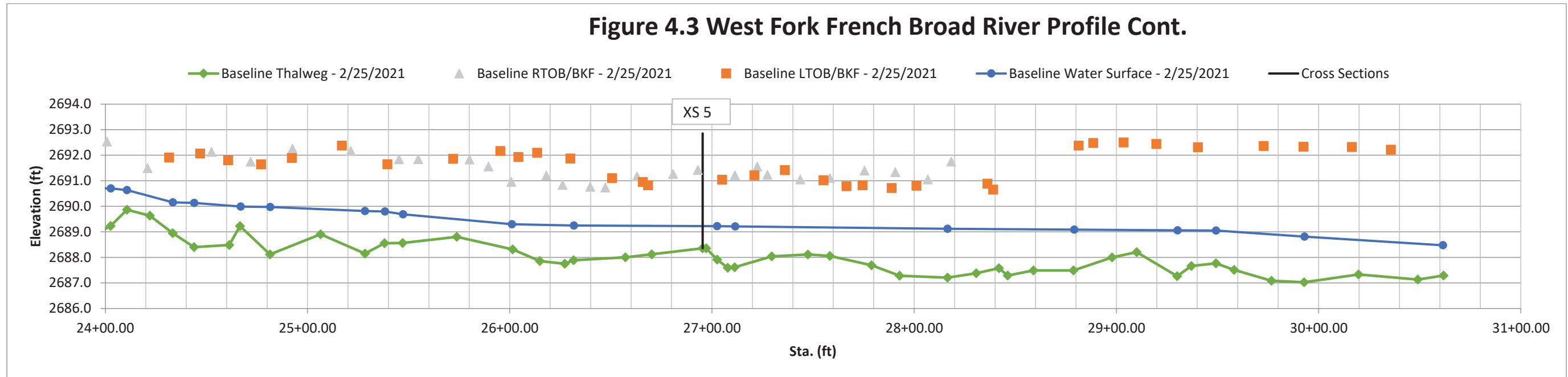


### Figure 4.2 West Fork French Broad River - Longitudinal Profile Cont.

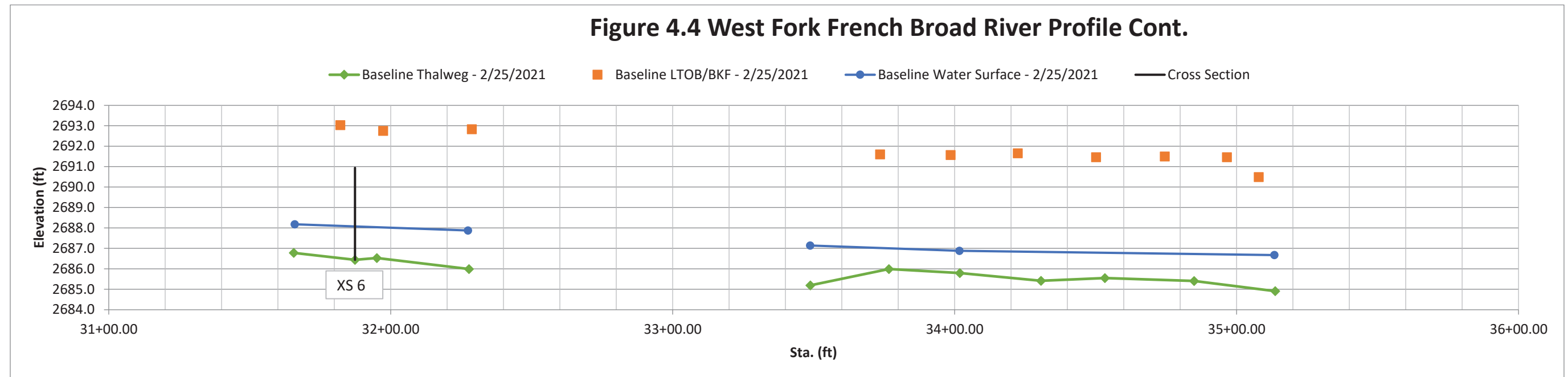




### Figure 4.3 West Fork French Broad River Profile Cont.

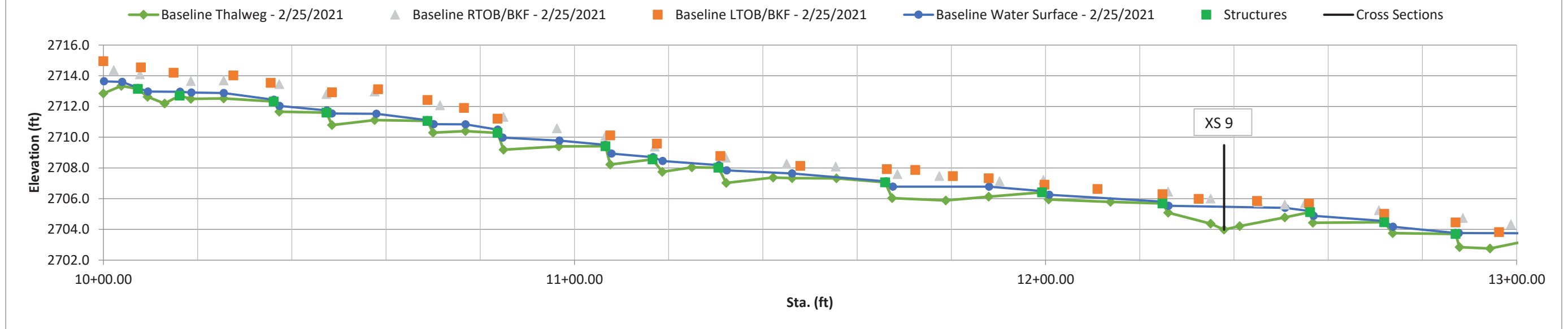


### Figure 4.4 West Fork French Broad River Profile Cont.

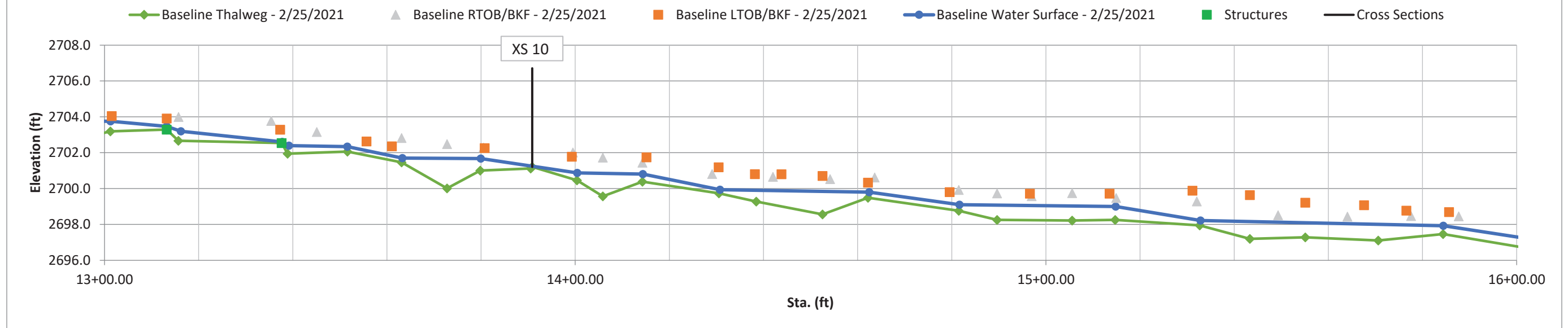




### Figure 4.5 UT 5 - Longitudinal Profile

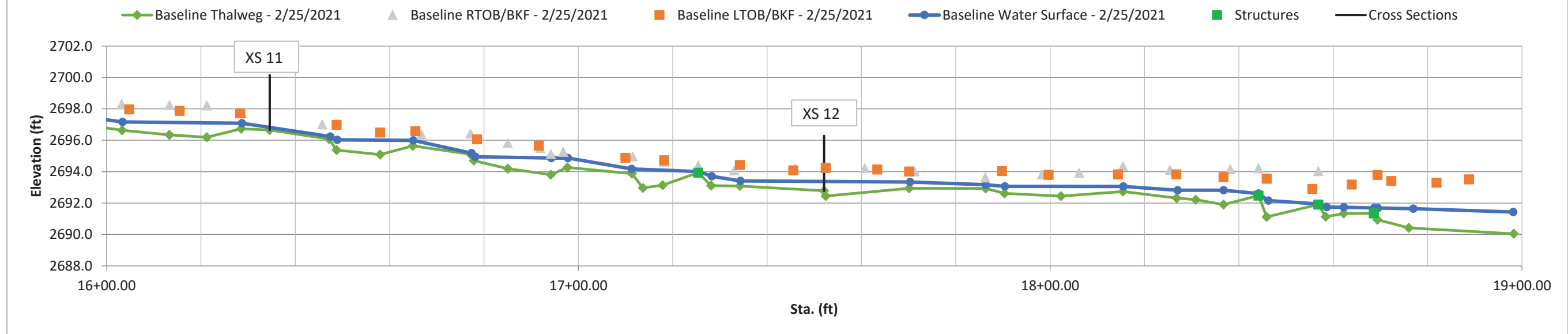


### Figure 4.6 UT 5 - Longitudinal Profile Cont.

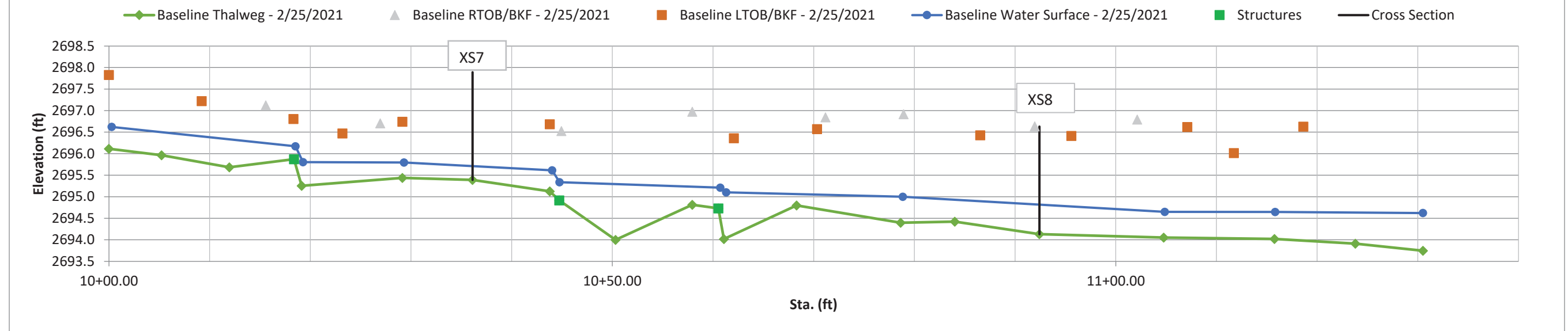




### Figure 4.7 UT 5 - Longitudinal Profile Cont.

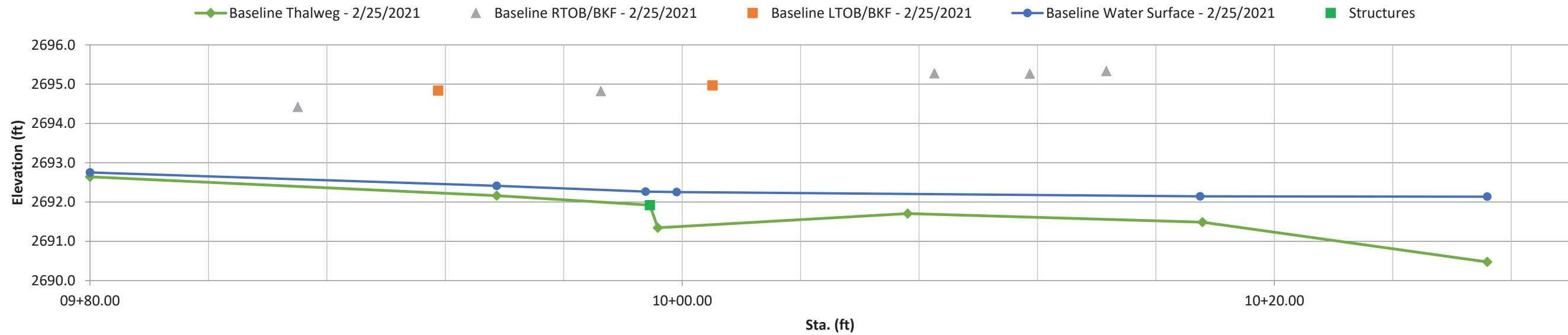


### Figure 4.8 UT 8 - Longitudinal Profile

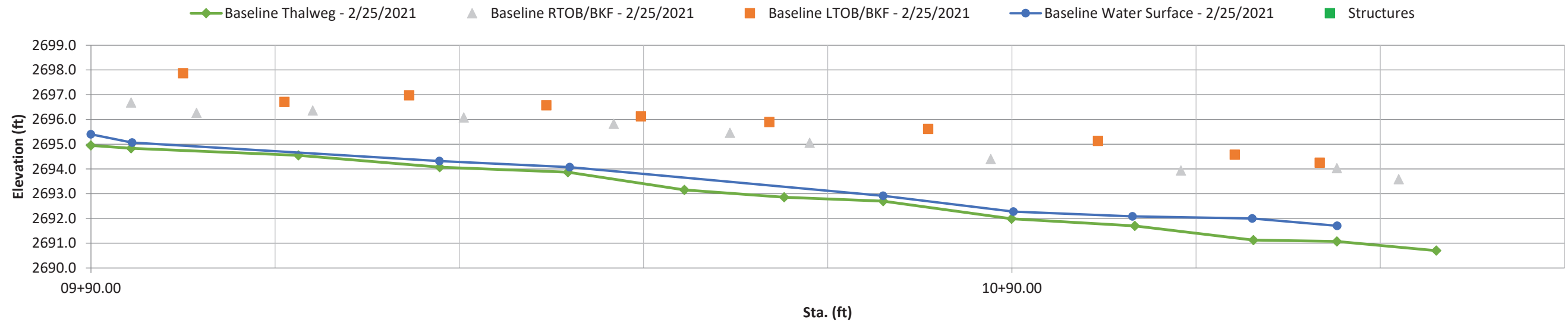




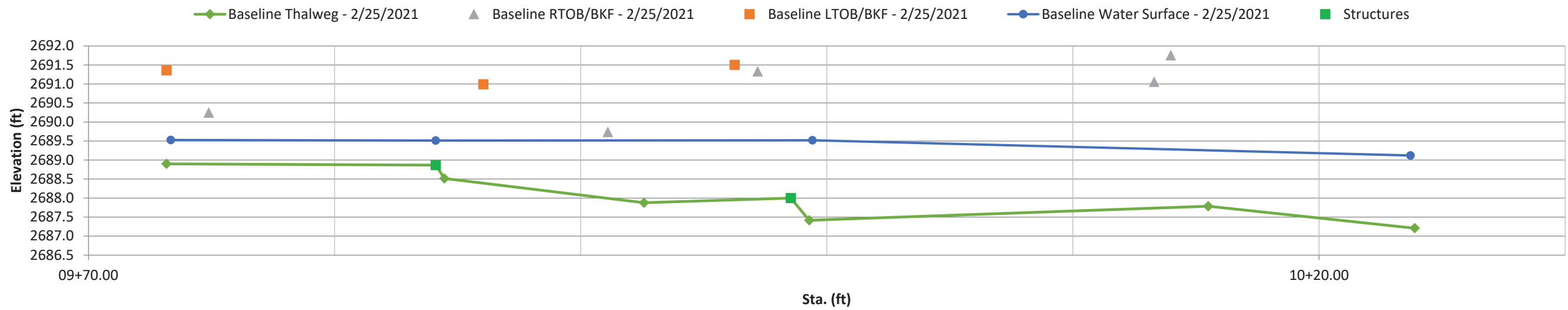
### Figure 4.9 UT 3 - Longitudinal Profile



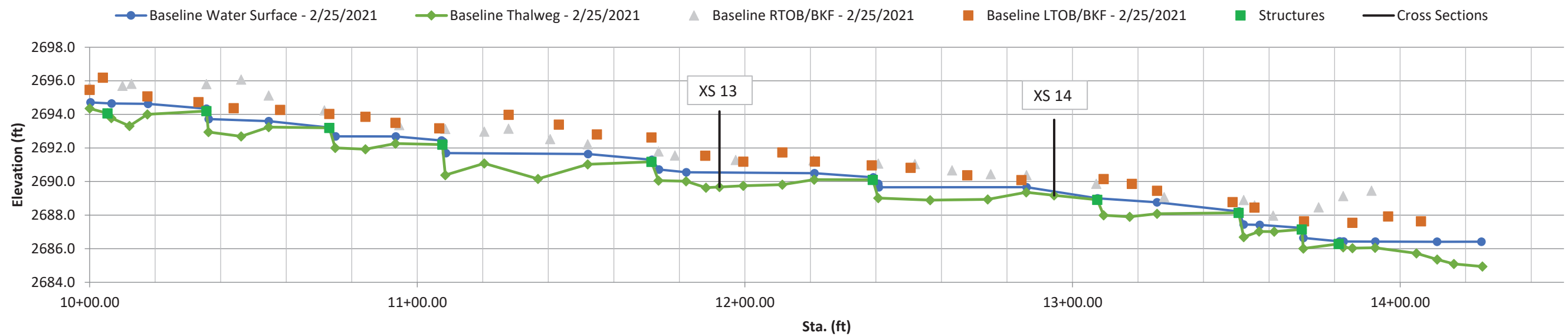
### Figure 4.10 UT 4 - Longitudinal Profile



### Figure 4.11 UT 6 - Longitudinal Profile



### Figure 4.12 UT 7 - Longitudinal Profile







Figures 5.1 – 5.14 Monitoring Cross Section Plots

Figure 5.1 Cross Section 1

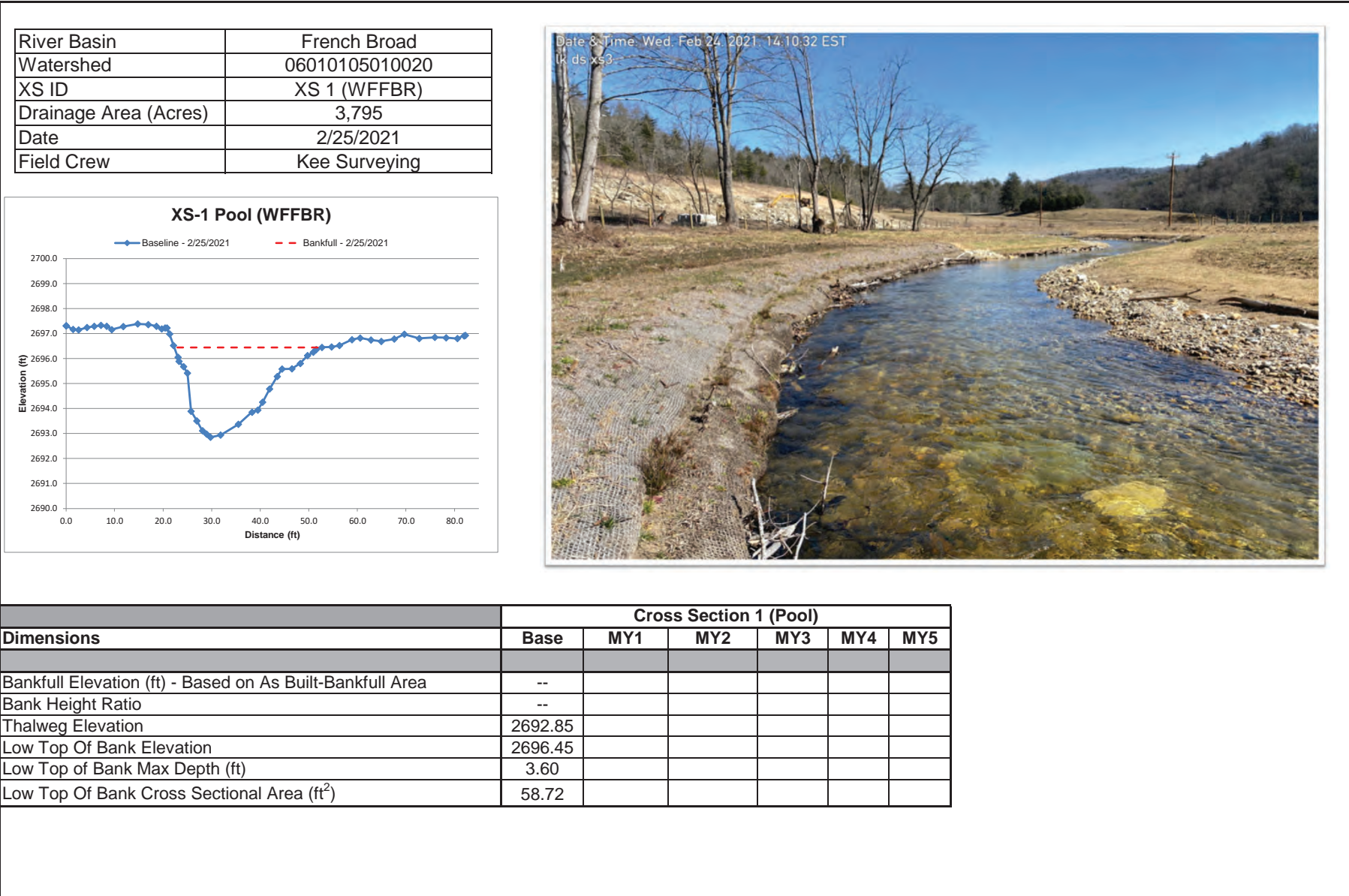




Figure 5.2 Cross Section 2

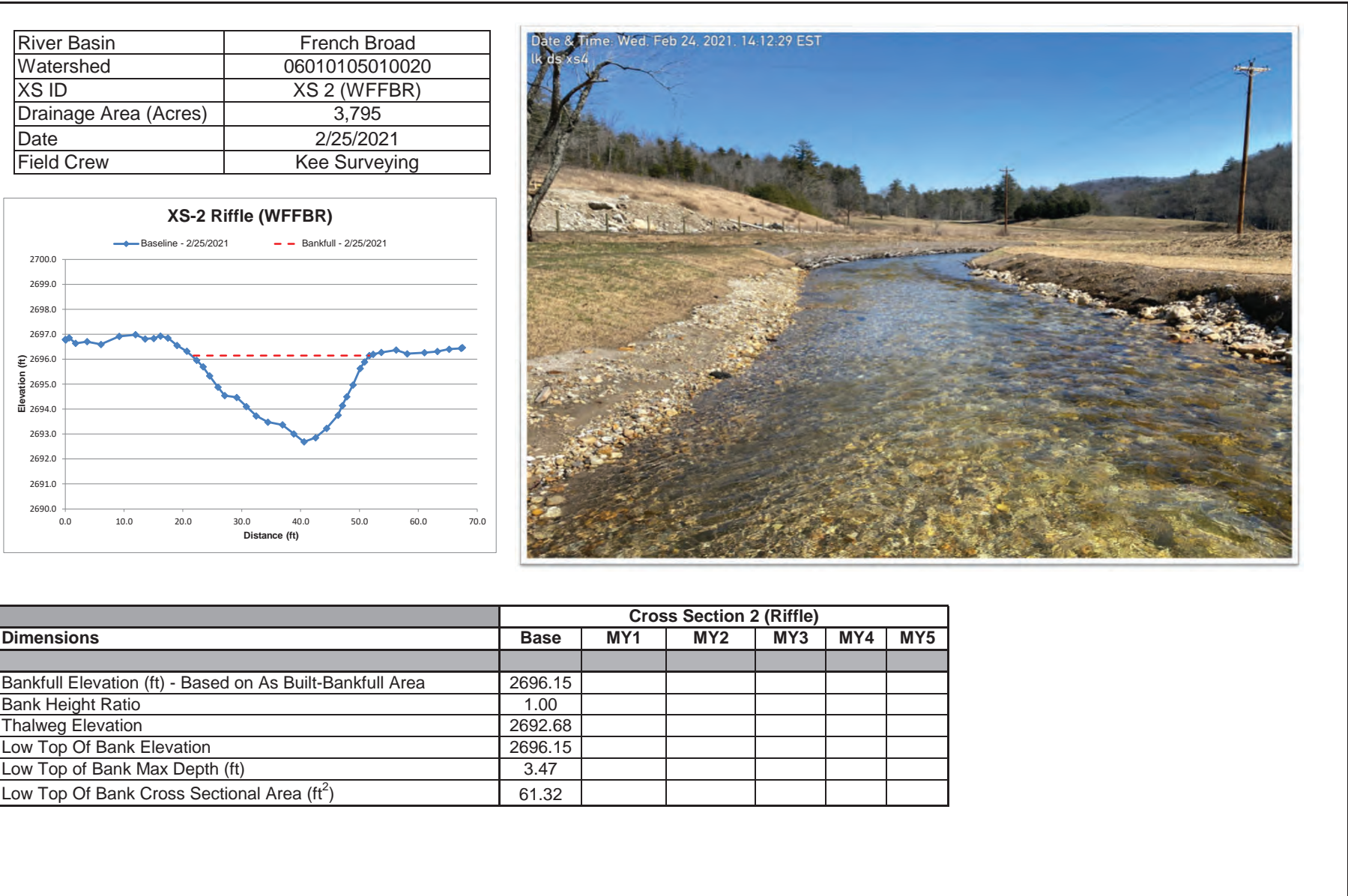




Figure 5.3 Cross Section 3

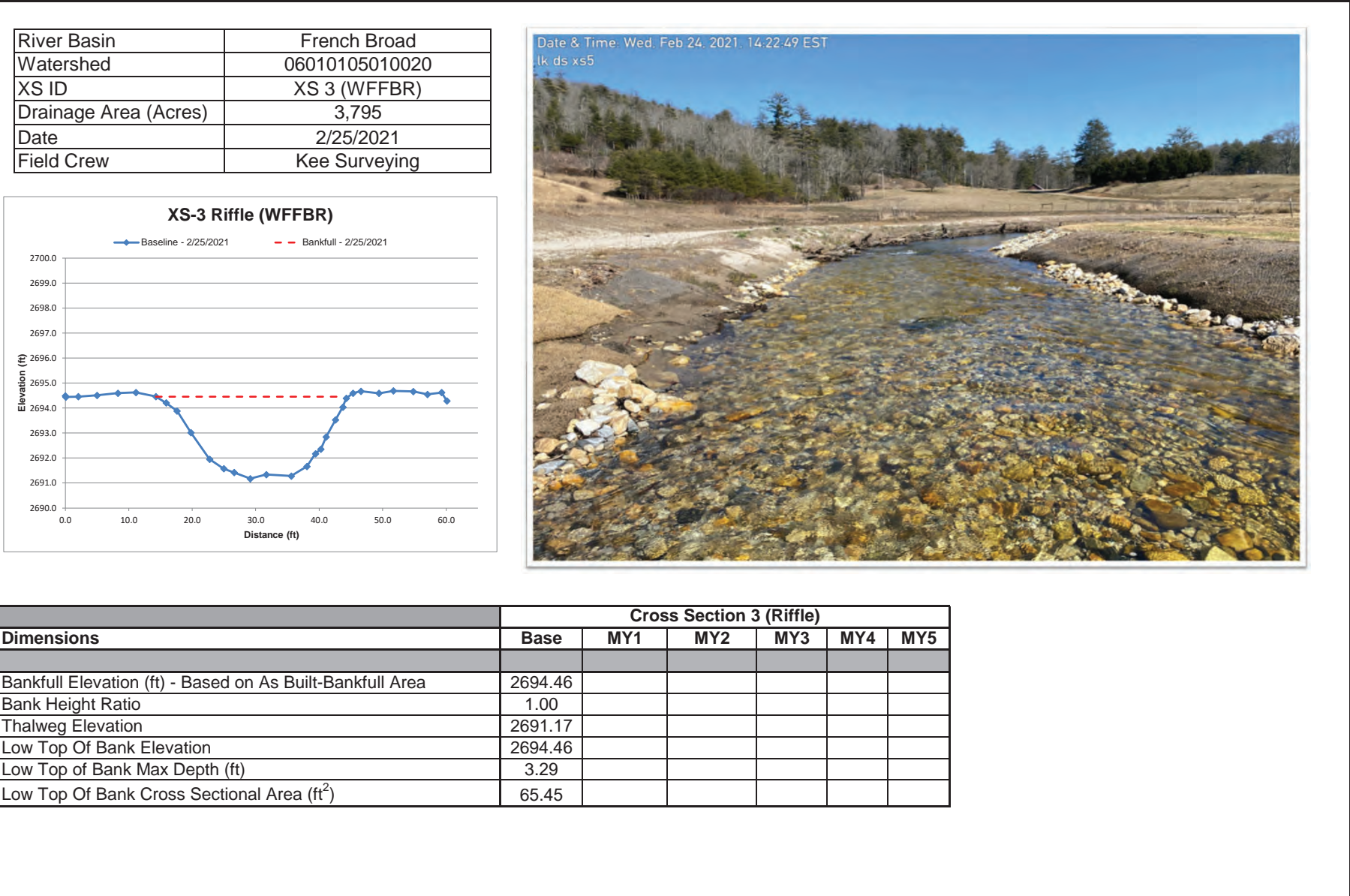




Figure 5.4 Cross Section 4

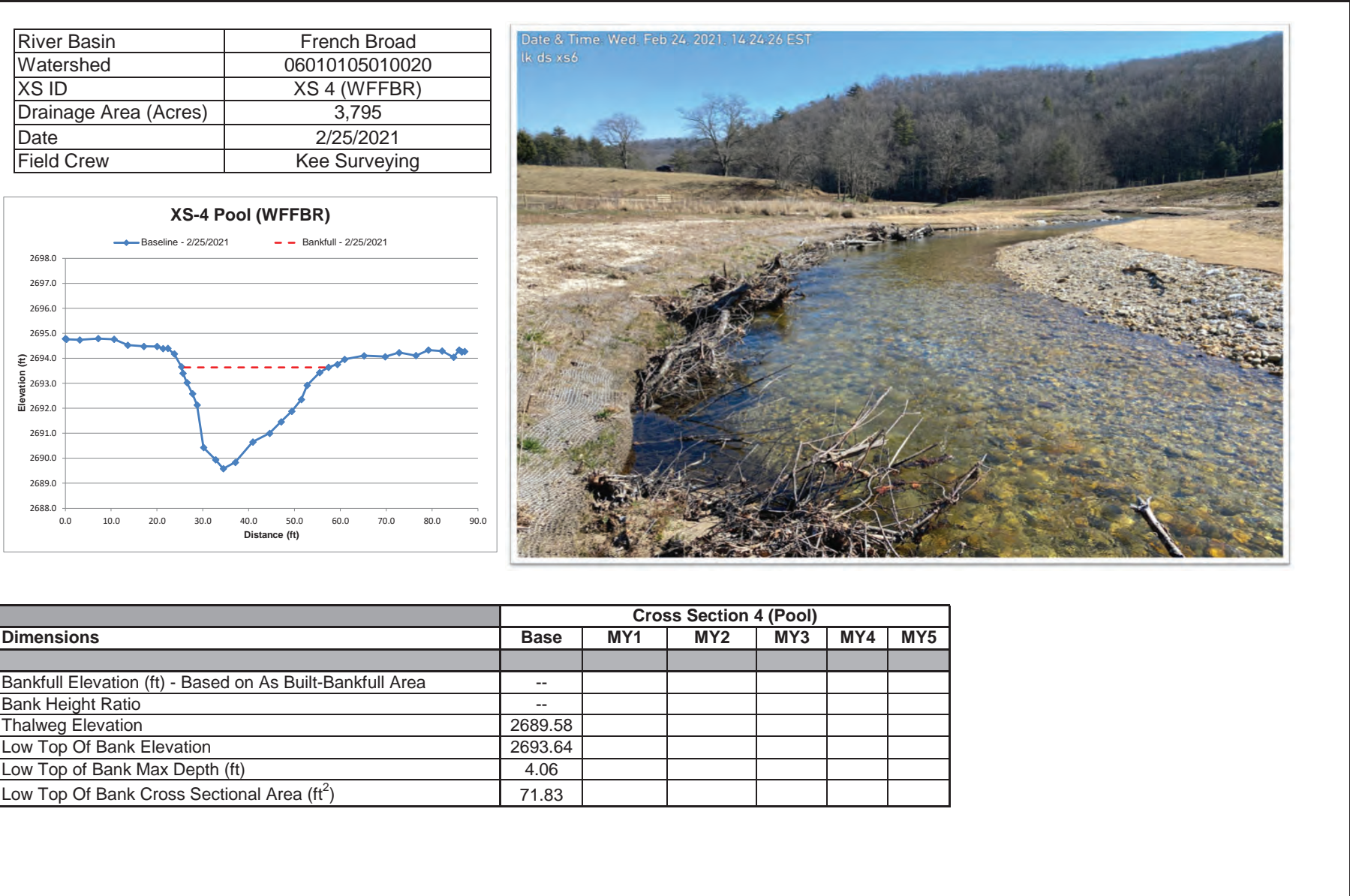




Figure 5.5 Cross Section 5

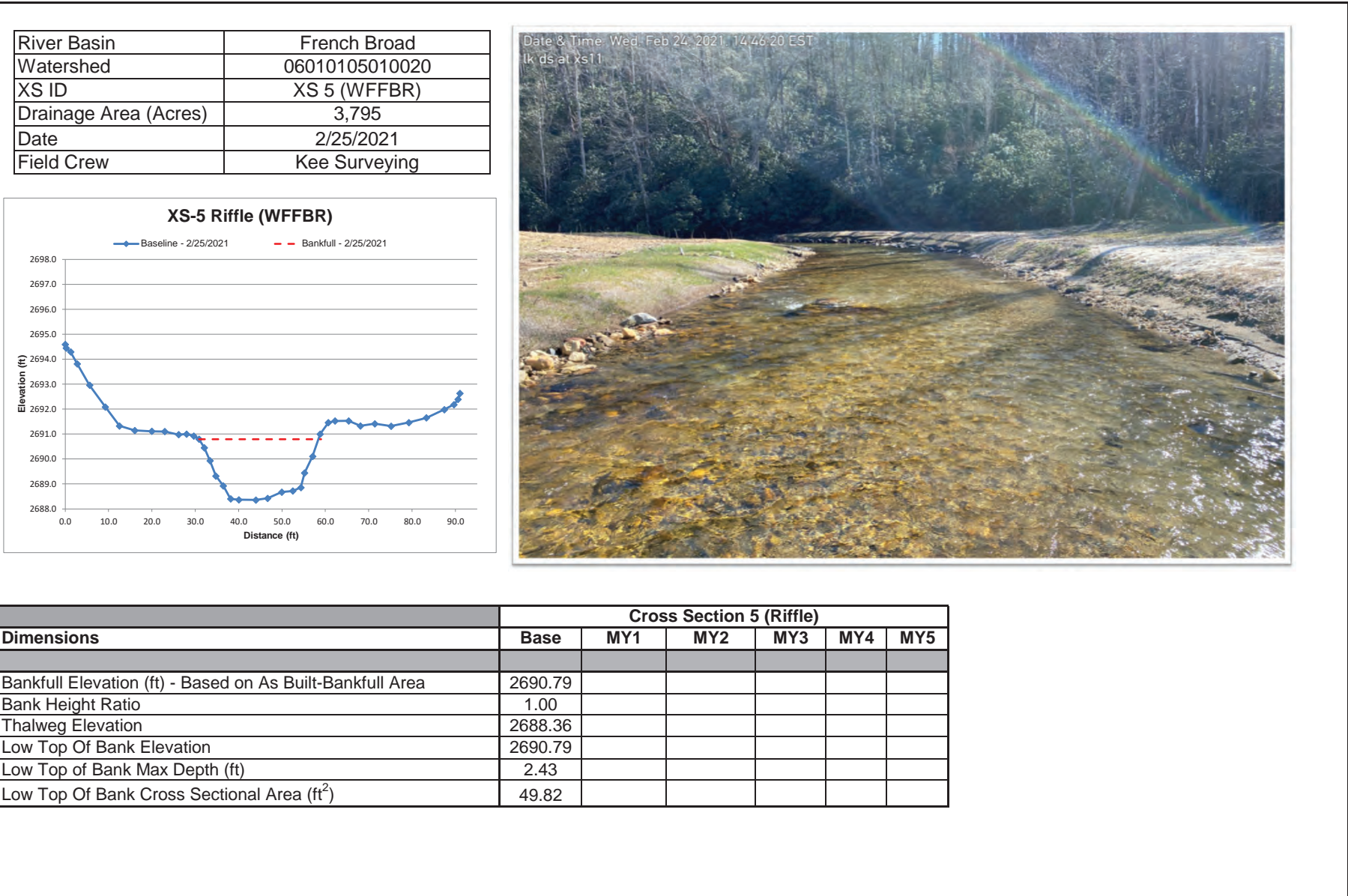




Figure 5.6 Cross Section 6

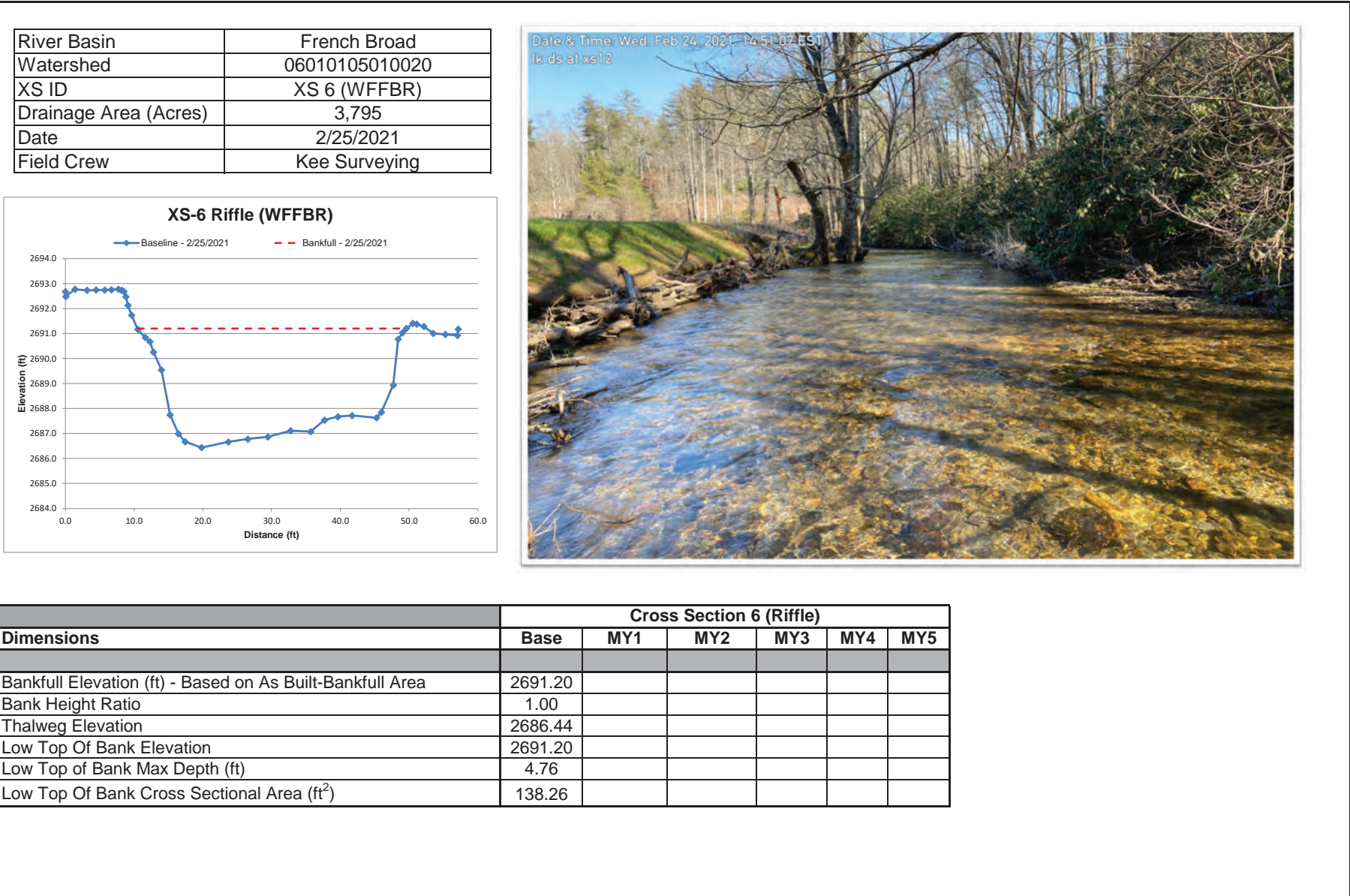




Figure 5.7 Cross Section 7

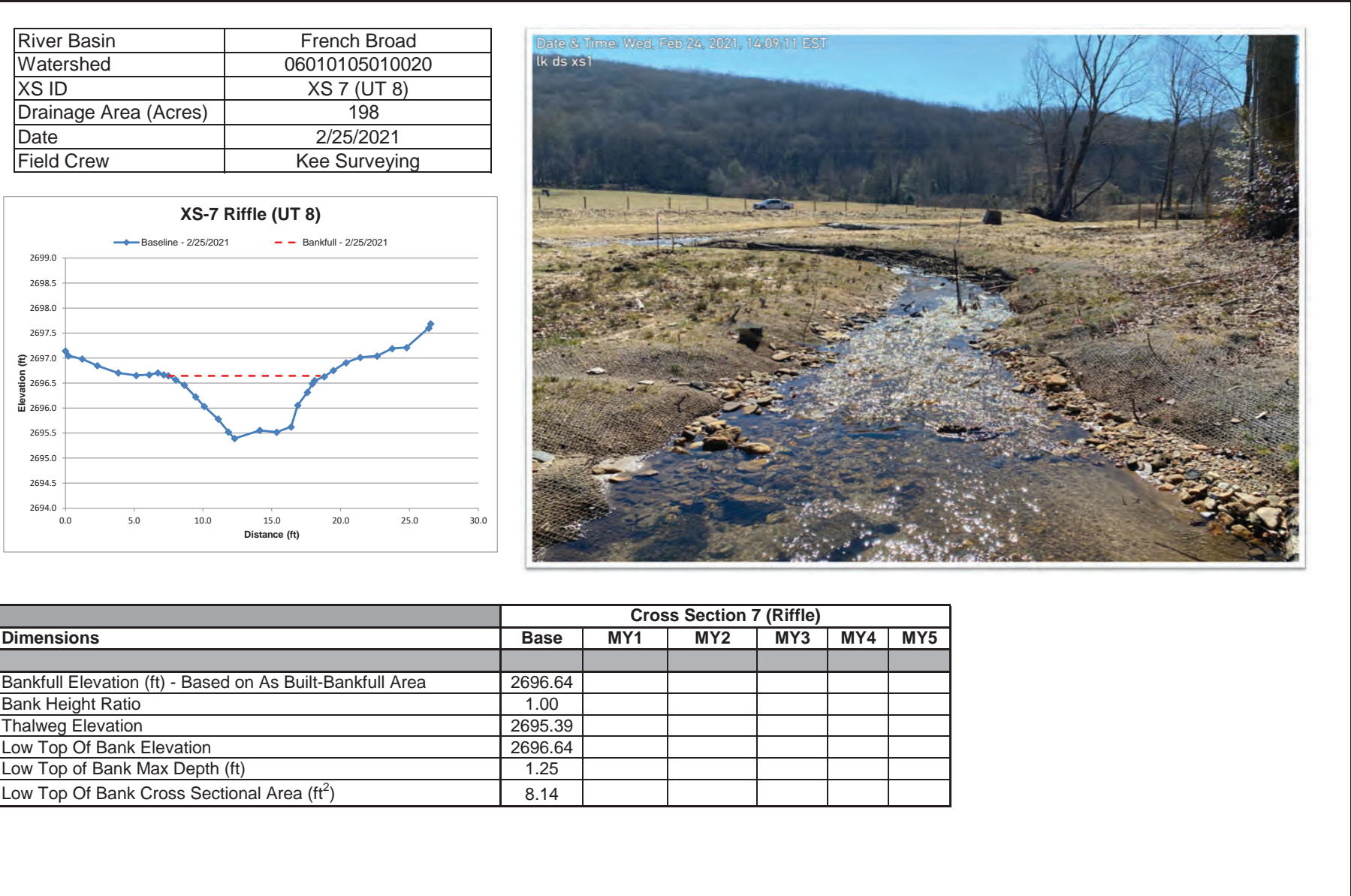




Figure 5.8 Cross Section 8

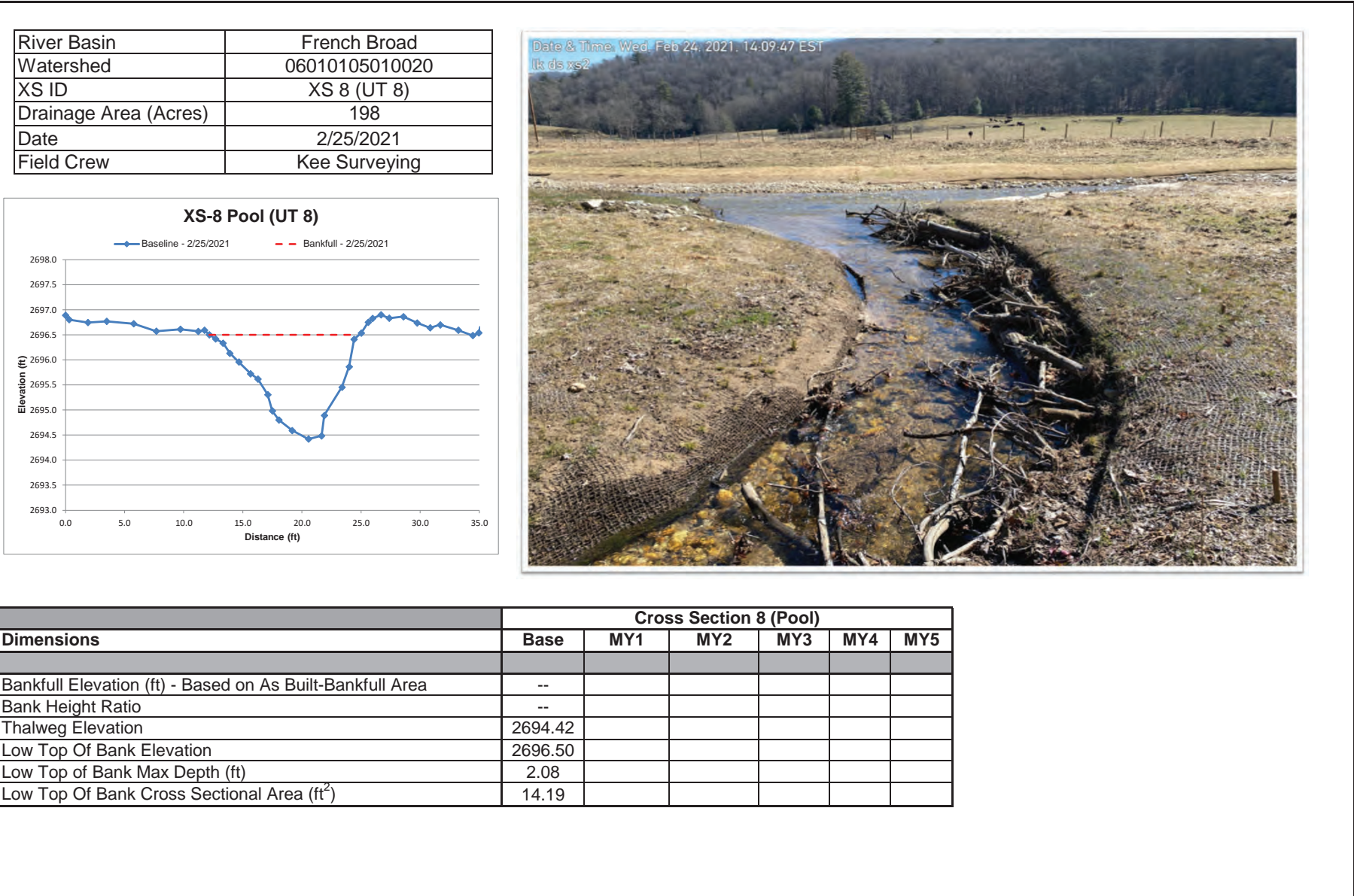






Figure 5.9 Cross Section 9

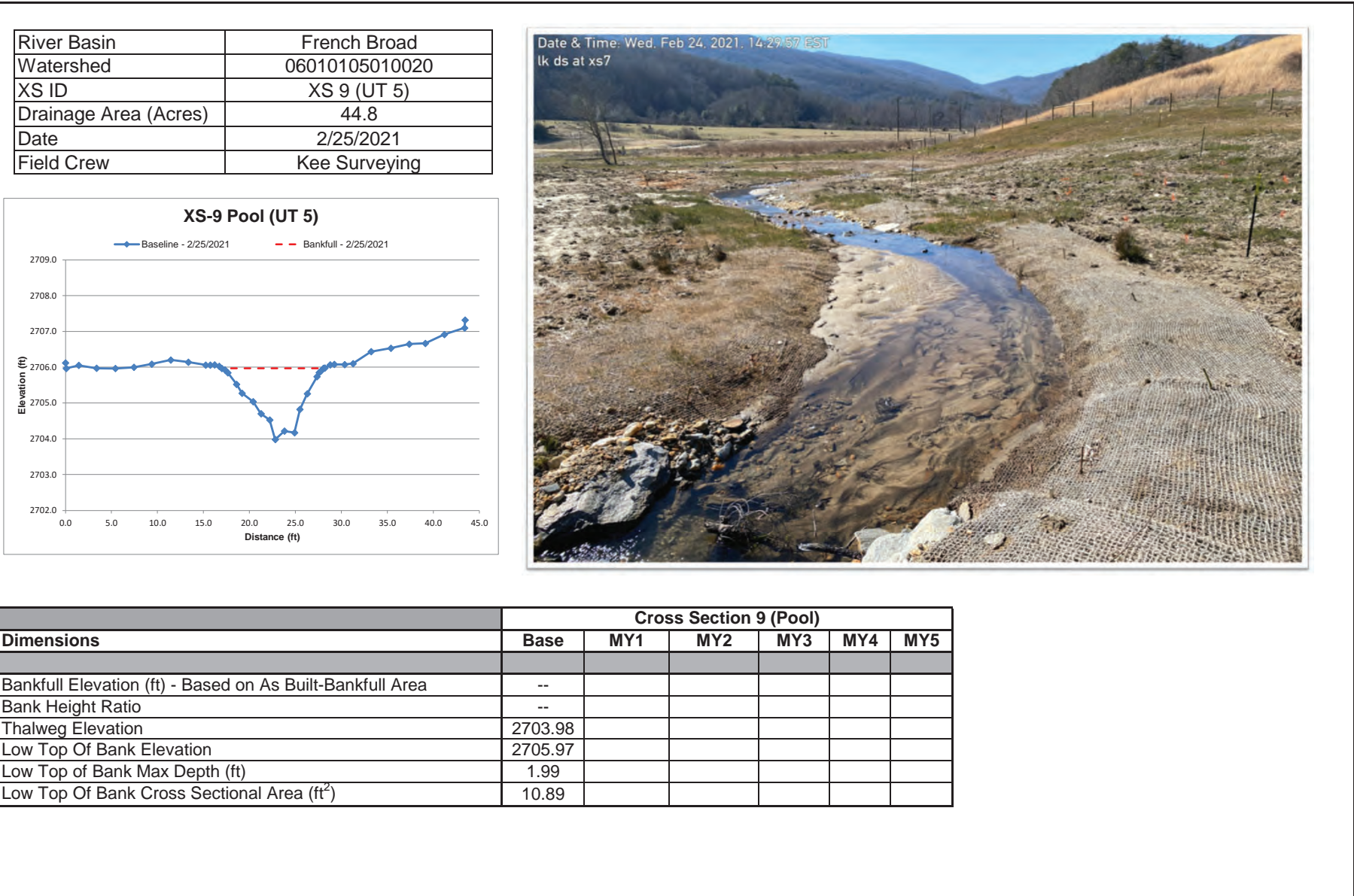




Figure 5.10 Cross Section 10

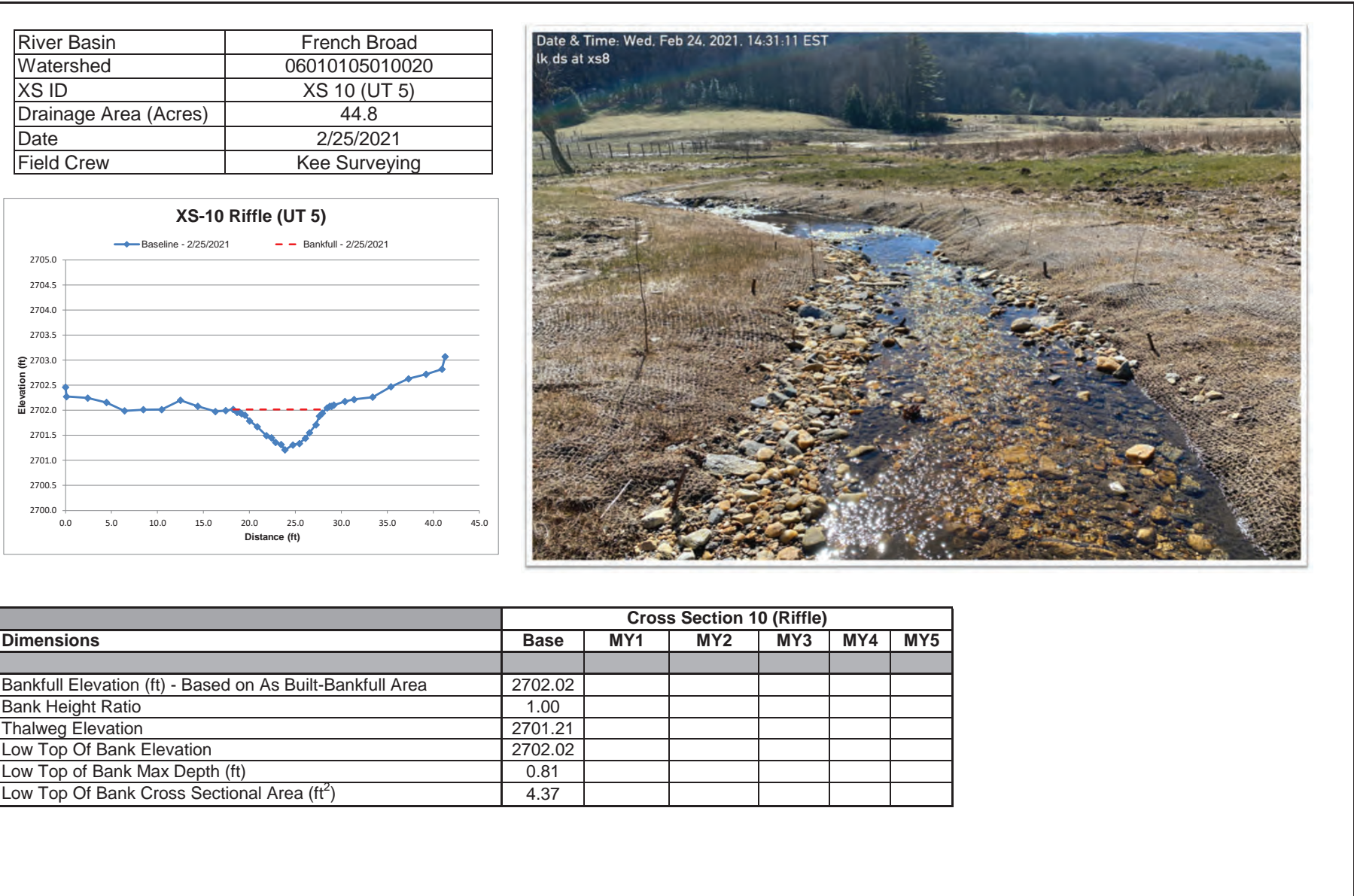




Figure 5.11 Cross Section 11

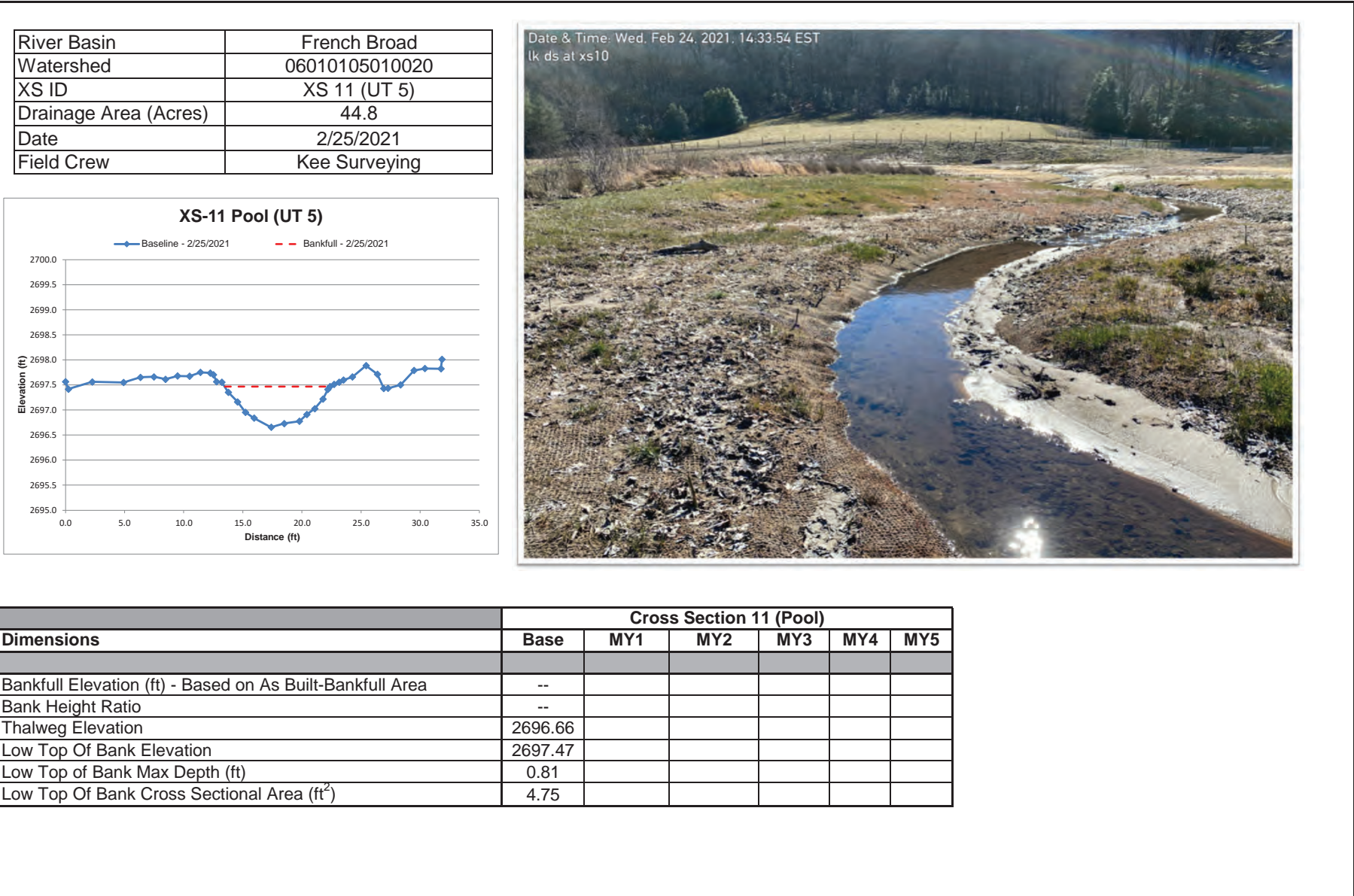




Figure 5.12 Cross Section 12

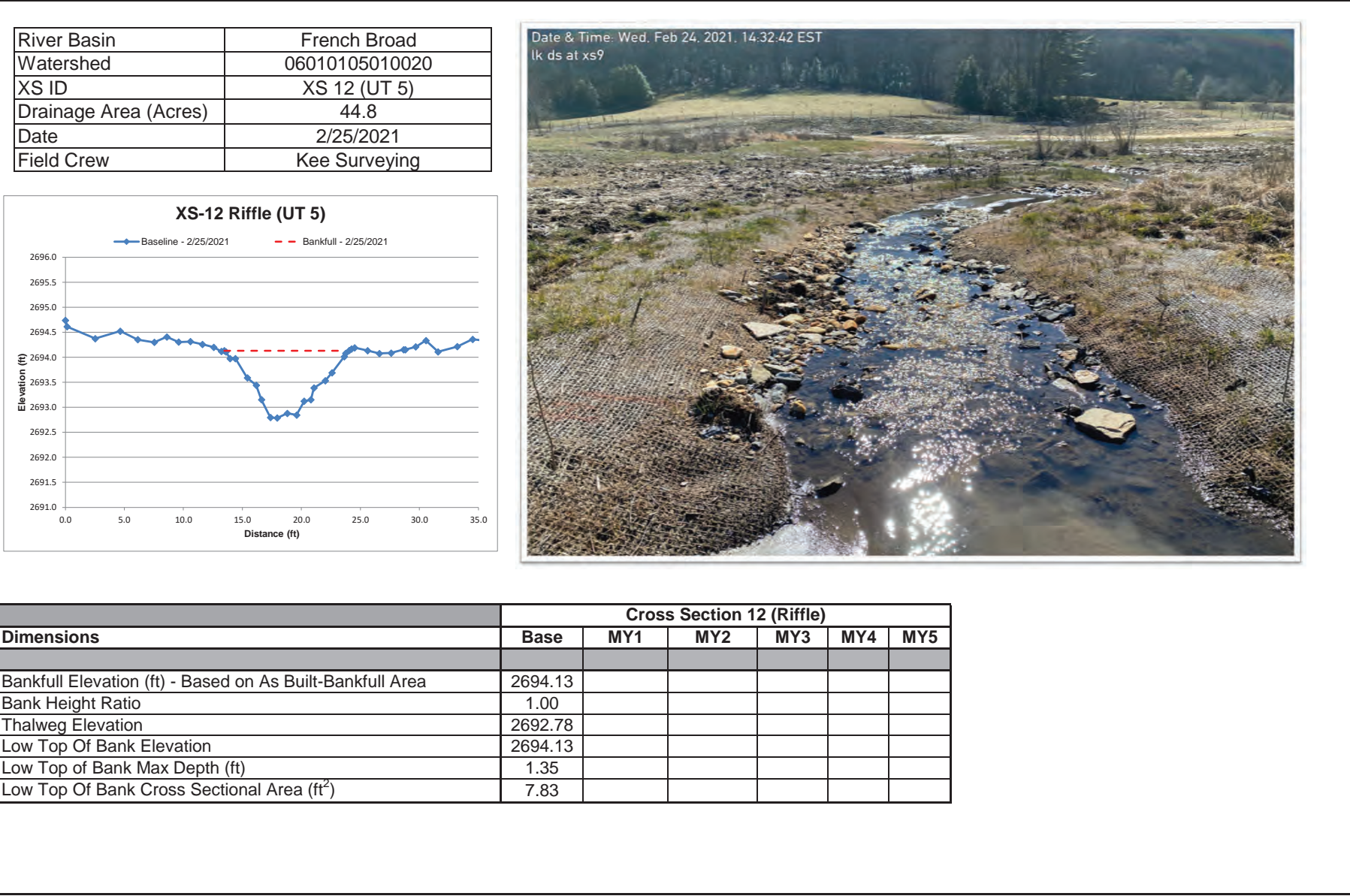




Figure 5.13 Cross Section 13

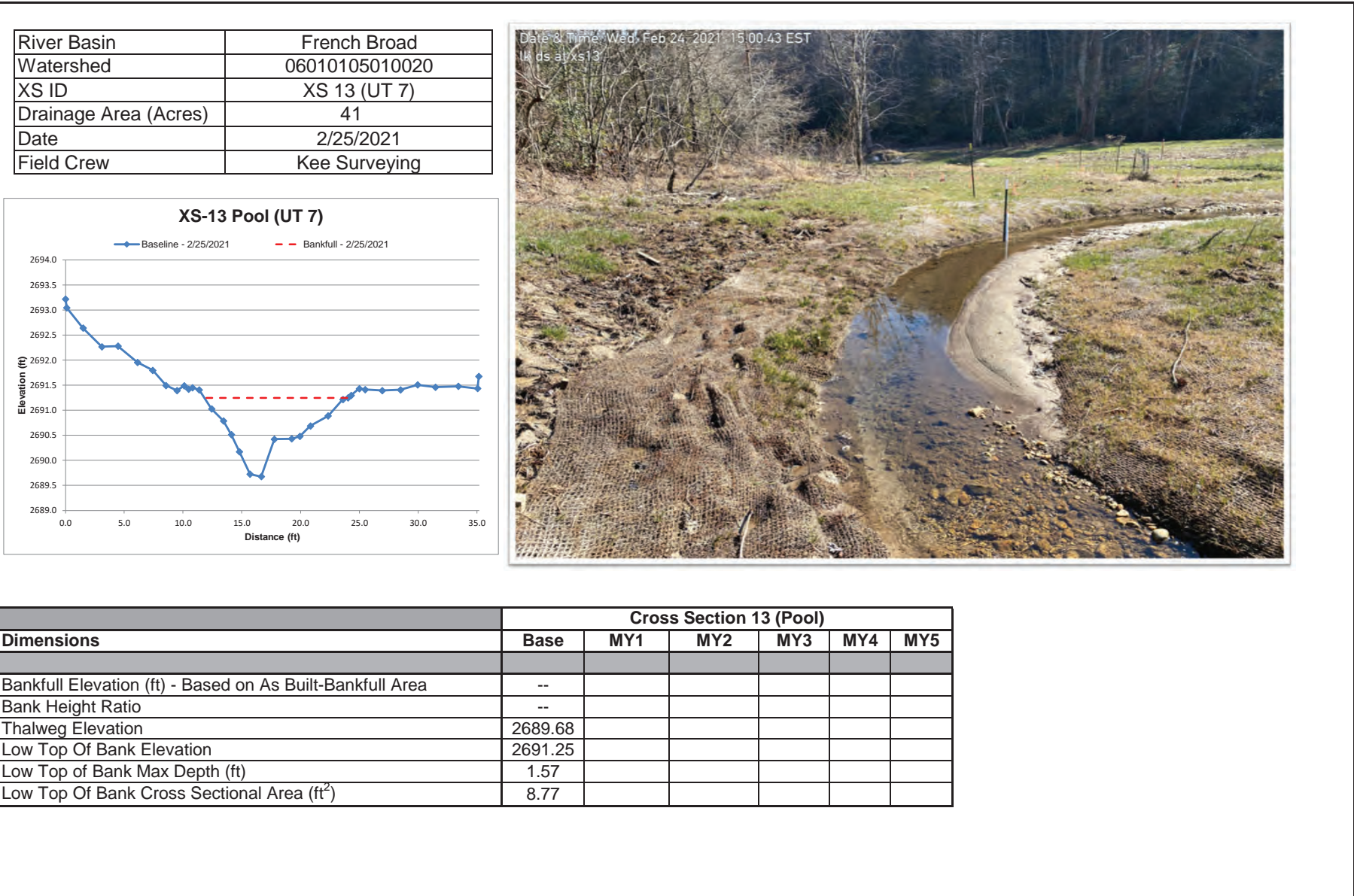
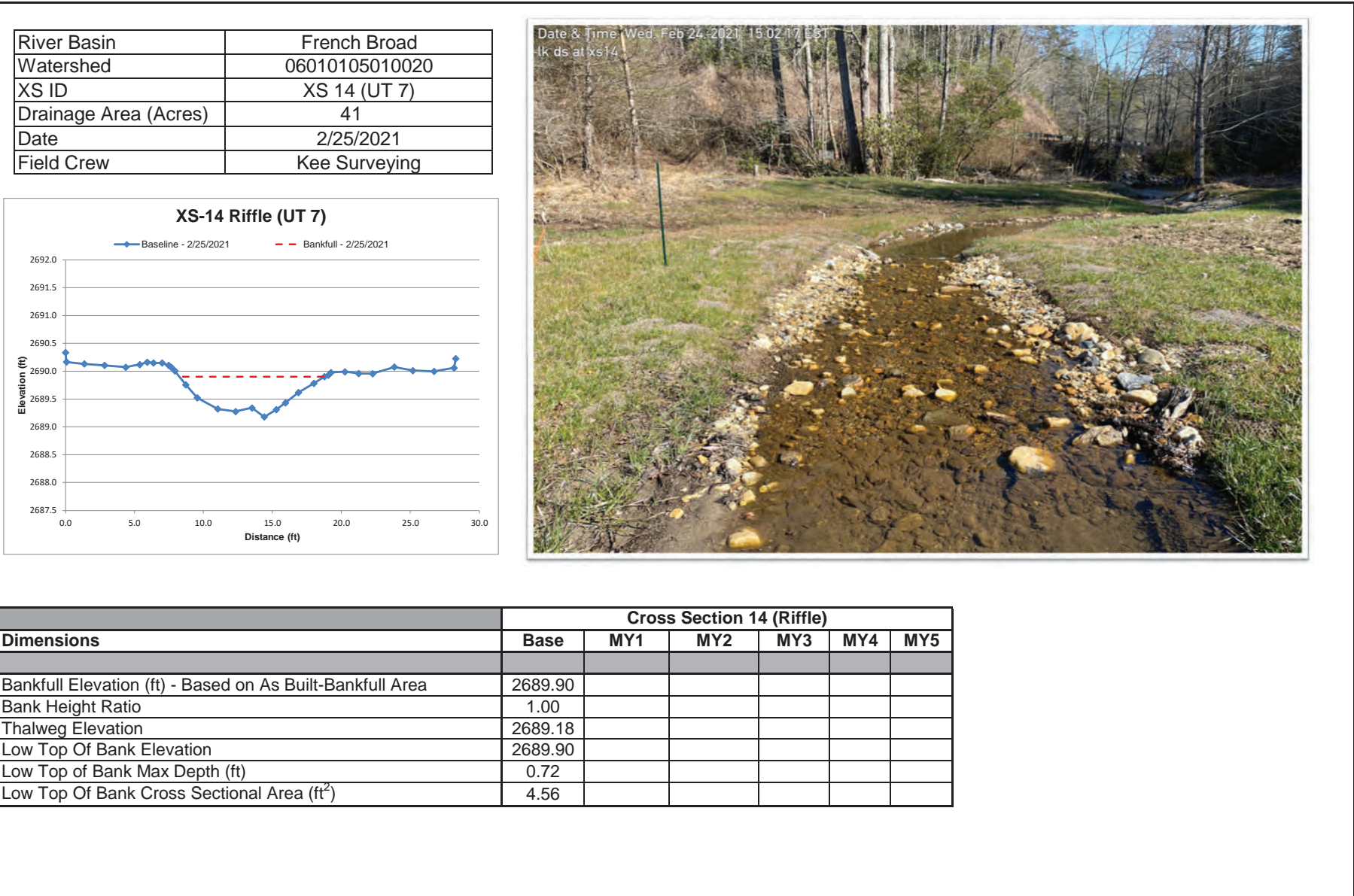




Figure 5.14 Cross Section 14





## Appendix C – Vegetation Plot Data



Table 11. Vegetation Plot Data

Planted Acreage	14.26
Date of Initial Plant	2021-01-22
Date(s) of Supplemental Plant(s)	#N/A
Date(s) Mowing	#N/A
Date of Current Survey	2021-02-23
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/ Shrub	Indicator Status	Veg Plot 1 F		Veg Plot 2 F		Veg Plot 3 F		Veg Plot 4 F		Veg Plot 5 F		Veg Plot 6 F		Veg Plot 7 F		Veg Plot 8 F		Veg Plot 9 F		Veg Plot 10 F		Veg Plot 12 F		Veg Plot 13 F		Veg Plot 14 F		Veg Plot 15 F		Veg Plot 17 F		Veg Plot 18 F		Veg Plot 20 F		Veg Plot 11 R	Veg Plot 16 R	Veg Plot 19 R					
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total				
Species Included in Approved Mitigation Plan	Alnus serrulata	hazel alder	Tree	OBL																					4	4														2						
	Aronia arbutifolia	red chokeberry	Shrub	FACW																					4	4															1					
	Betula alleghaniensis	yellow birch	Tree	FAC	1	1			2	2	1	1			1	1	4	4					2	2			6	6	2	2	2	3	3	4	4	2	2			6	6					
	Betula nigra	river birch	Tree	FACW	3	3	3	3	2	2	2	2	1	1			3	3	6	6	3	3					6	6	2	2	3	3														
	Carya cordiformis	bitternut hickory	Tree	FACU														2	2	5	5							6	6																	
	Carya ovata	shagbark hickory	Tree	FACU	1	1					2	2							1	1	3	3							1	1	6	6									1					
	Cephalanthus occidentalis	common buttonbush	Shrub	OBL																					3	3															3					
	Cornus amomum	silky dogwood	Shrub	FACW														1	1										1	1	1	1														
	Cornus florida	flowering dogwood	Tree	FACU														2	2	3	3								4	4												2				
	Hamamelis virginiana	American witchhazel	Tree	FACU	1	1	3	3	2	2	4	4	1	1	4	4	1	1																										2		
	Lindera benzoin	northern spicebush	Tree	FAC																					4	4																		3		
	Liriodendron tulipifera	tuliptree	Tree	FACU	2	2	6	6	3	3	5	5	3	3	2	2	2	2	1	1	2	2	2	2			2	2	4	4	1	1	3	3	6	6									7	4
	Platanus occidentalis	American sycamore	Tree	FACW	2	2	1	1	3	3			6	6	5	5	4	4	4	4	3	3	2	2					2	2	7	7	2	2	5	5	5	5							7	2
	Quercus alba	white oak	Tree	FACU	2	2	1	1	5	5	2	2	5	5	6	6	4	4											5	5														5	5	
	Sambucus canadensis	American black elderberry	Tree																						2	2																		4		
Ulmus americana	American elm	Tree	FACW									1	1																															1		
Sum	Performance Standard				13	13	17	17	17	17	17	17	16	16	18	18	18	17	17	19	19	18	18	17	17	19	19	22	22	19	19	16	16	18	18	17	17	13	13	18	18	16				
Mitigation Plan Performance Standard	Current Year Stem Count				13		17		17		17		16		18		18		17		19		18		17		19		22		19		16		18		17		13		18		16			
	Stems/Acre				526		688		688		688		648		729		729		688		769		729		688		769		891		769		648		729		688		526		729		648			
	Species Count				8		6		7		7		5		5		6		7		6		5		5		4		8		6		5		6		4		5		5		4			
	Dominant Species Composition (%)				23		35		29		29		38		33		22		35		26		50		24		32		27		37		25		33		35		31		39		56			
	Average Plot Height				2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2			
% Invasives				0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		
Post Mitigation Plan Performance Standard	Current Year Stem Count				13		17		17		17		16		18		18		17		19		18		17		19		22		19		16		18		17		13		18		16			
	Stems/Acre				526		688		688		688		648		729		729		688		769		729		688		769		891		769		648		729		688		526		729		648			
	Species Count				8		6		7		7		5		5		6		7		6		5		5		4		8		6		5		6		4		5		5		4			
	Dominant Species Composition (%)				23		35		29		29		38		33		22		35		26		50		24		32		27		37		25		33		35		31		39		56			
	Average Plot Height				2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2		2			
% Invasives				0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		0		

Meeting Success Criteria  
Not Meeting Success Criteria





*Figures 6.1 – 6.28 Vegetation Plot Photographs and Site Aerial Photographs*



**6.1 Vegetation Plot 1**



**6.2 Vegetation Plot 2**



**6.3 Vegetation Plot 3**



**6.4 Vegetation Plot 4**



**6.5 Vegetation Plot 5**



**6.6 Vegetation Plot 6**



**6.7 Vegetation Plot**



**6.8 Vegetation Plot 8**



**6.9 Vegetation Plot 9**



**6.10 Vegetation Plot 10**



**6.11 Vegetation Plot 11**



**6.12 Vegetation Plot 12**



**6.13 Vegetation Plot 13**



**6.14 Vegetation Plot 14**



**6.15 Vegetation Plot 15**



**6.16 Vegetation Plot 16**



**6.17 Vegetation Plot 17**



**6.18 Vegetation Plot 18**



**6.19 Vegetation Plot 19**



**6.20 Vegetation Plot 20**



**6.21 Aerial overview looking downstream West Fork French Broad River**



**6.22 Aerial overview of UT 3, UT4, and UT5 West Fork French Broad River confluence**



**6.23 Aerial overview of UT3 and UT5 West Fork French Broad confluence**



**6.24 Aerial overview of UT4, looking upstream**



**6.25 Aerial overview of UT5, looking downstream**



**6.26 Downstream view of ford crossing on West Fork French Broad River**



**6.27 Aerial overview of UT 7, looking downstream**



**6.28 Aerial overview of UT8, looking upstream**



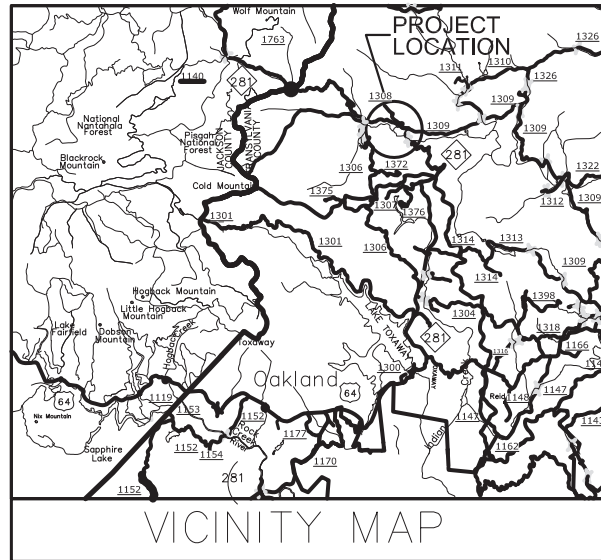
## Appendix D – Record Drawings

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CONTRACT: OWEN FARMS MITIGATION SITE

# RECORD DRAWING OWEN FARMS MITIGATION SITE

STATE N.C.	WEST FORK FRENCH BROAD RIVER	SHEET NO. 1
---------------	---------------------------------	----------------



LOCATION: TRANSYLVANIA COUNTY, NORTH CAROLINA

LAT: 35.183611 LONG: -82.9413889

35 11' 04.89" -82 56' 34.97"

TYPE OF WORK: RECORD DRAWINGS

## LEGEND

- 1/2" RBC (CROSS-SECTION REBAR)
- GAUGE (AS NOTED)
- ROCK STEP STRUCTURE W/ RIP RAP
- LOG SILL
- ROCK STEP STRUCTURE W/ BOULDERS AND HELLBENDER HABITAT
- ROCK CROSS VANE W/ HELLBENDER HABITAT
- HELLBENDER HABITAT
- UTILITY POLE
- GUY ANCHOR
- SOIL LIFT
- SOIL LIFT W/ BOULDER TOE
- SOIL LIFT W/ TOE WOOD
- CE CONSERVATION EASEMENT
- AS-BUILT CENTERLINE
- AS-BUILT TOP OF BANK
- DESIGN CENTERLINE
- DESIGN TOP OF BANK
- OW OVERHEAD WIRE
- FENCE
- GRAVEL
- BEDROCK
- RIP RAP
- EXISTING WETLANDS
- KISSING GATE
- CONSERVATION EASEMENT WITNESS POST

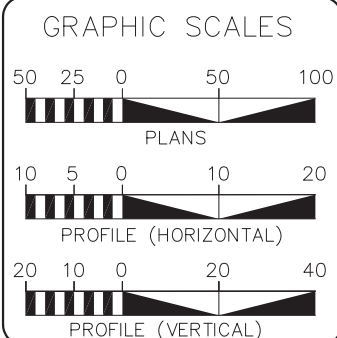
INDEX OF SHEETS

TITLE SHEET.....	1
RECORD DRAWINGS.....	2 THRU 16

RECORD DRAWINGS  
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SURVEY PREPARED BY:

KEE MAPPING & SURVEYING  
P.O. BOX 2566  
ASHEVILLE, NC 28802  
(828) 575-9021



WEST FORK FRENCH BROAD RIVER	DESIGN DATA		
	UT 5	UT 7	UT 8
DESIGN STREAM TYPE = C4	DESIGN STREAM TYPE = C4	DESIGN STREAM TYPE = C4	DESIGN STREAM TYPE = C4
BANKFULL AREA (FT <sup>2</sup> ) = 64.29	BANKFULL AREA (FT <sup>2</sup> ) = 5.35	BANKFULL AREA (FT <sup>2</sup> ) = 6.0	BANKFULL AREA (FT <sup>2</sup> ) = 11.08
BANKFULL WIDTH (FT) = 30.0	BANKFULL WIDTH (FT) = 8.5	BANKFULL WIDTH (FT) = 9.0	BANKFULL WIDTH (FT) = 12.0
MAX DEPTH (FT) = 2.68	MAX DEPTH (FT) = 0.76	MAX DEPTH (FT) = 0.80	MAX DEPTH (FT) = 1.11
WIDTH / DEPTH RATIO = 14.0	WIDTH / DEPTH RATIO = 13.5	WIDTH / DEPTH RATIO = 13.5	WIDTH / DEPTH RATIO = 13.0
DRAINAGE AREA (MI <sup>2</sup> ) = 5.50	DRAINAGE AREA (MI <sup>2</sup> ) = 0.07	DRAINAGE AREA (MI <sup>2</sup> ) = 0.06	DRAINAGE AREA (MI <sup>2</sup> ) = 0.31
BANKFULL SLOPE(FT/FT) = 0.00353	BANKFULL SLOPE(FT/FT) = 0.00569	BANKFULL SLOPE(FT/FT) = 0.00539	BANKFULL SLOPE(FT/FT) = 0.01096

CHRISTOPHER L. SMITH  
PROJECT DESIGNER / ENGINEER

PROJECT LENGTH	STREAM LENGTH	
	EXISTING	PROPOSED DESIGN
WEST FORK FRENCH BROAD RIVER	2,859.55 FT	2,691.02 FT
-UT4-	1,133.30 FT	136.08 FT
-UT4A-	471.56 FT	71.56 FT
-UT5-	652.00 FT	899.09 FT
-UT7-	811.00 FT	417.41 FT
-UT8-	49.00 FT	136.80 FT

Prepared in the Office of:

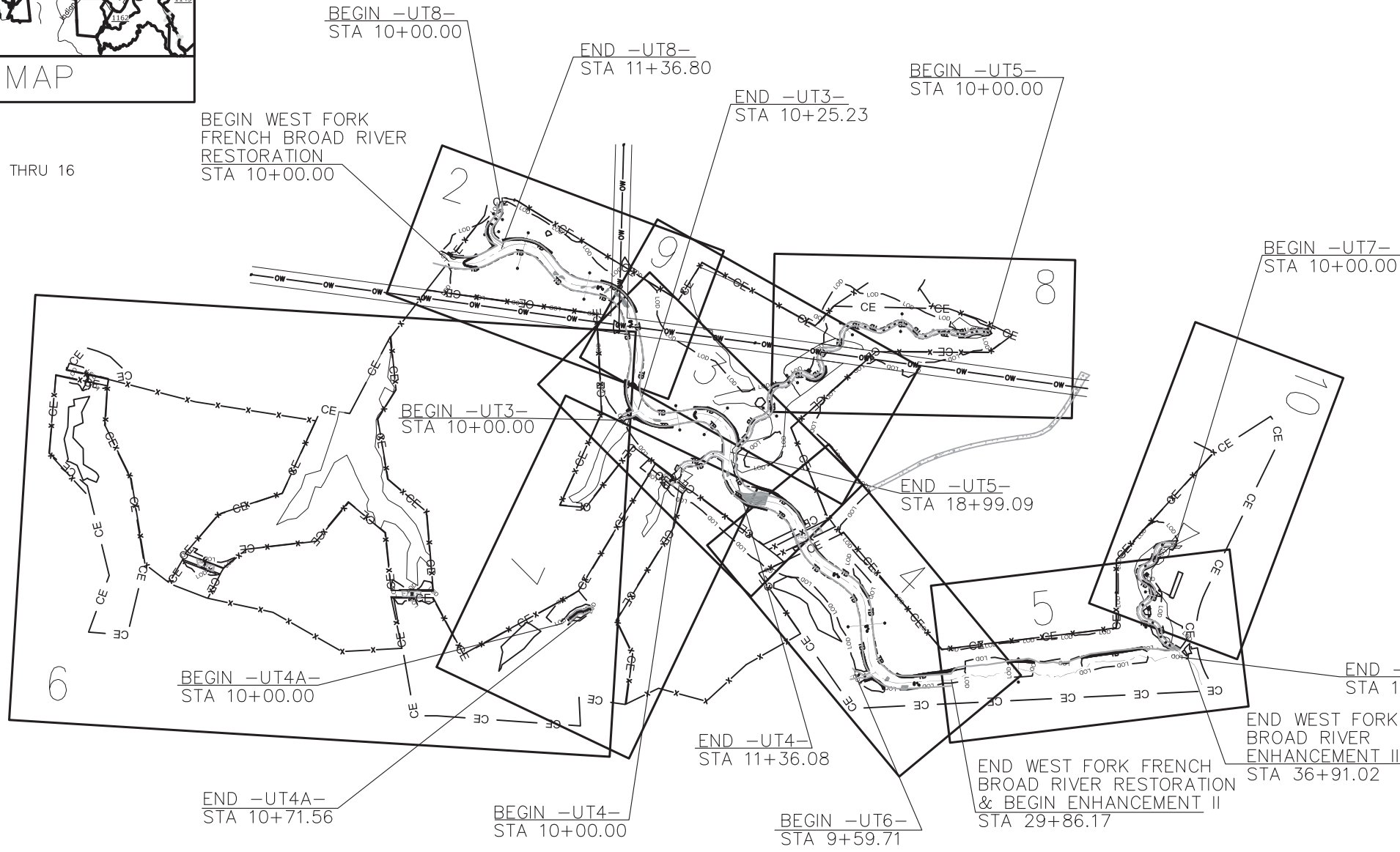
a DAVEY company

for

HDR Engineering, Inc. of the Carolinas  
555 Fayetteville St, Suite 900 Raleigh, N.C. 27601  
N.C.B.E.L.S. License Number: F-0116

DWR # 18-1033  
DMS ID # 100064  
DMS CONTRACT 7532  
USACE-SAW-2018-01165

DRG Services, P.C.  
3101 Poplarwood Ct.  
Raleigh N.C. 27604  
License No. C-4174



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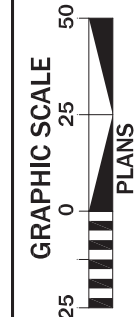
PREPARED IN THE OFFICE OF



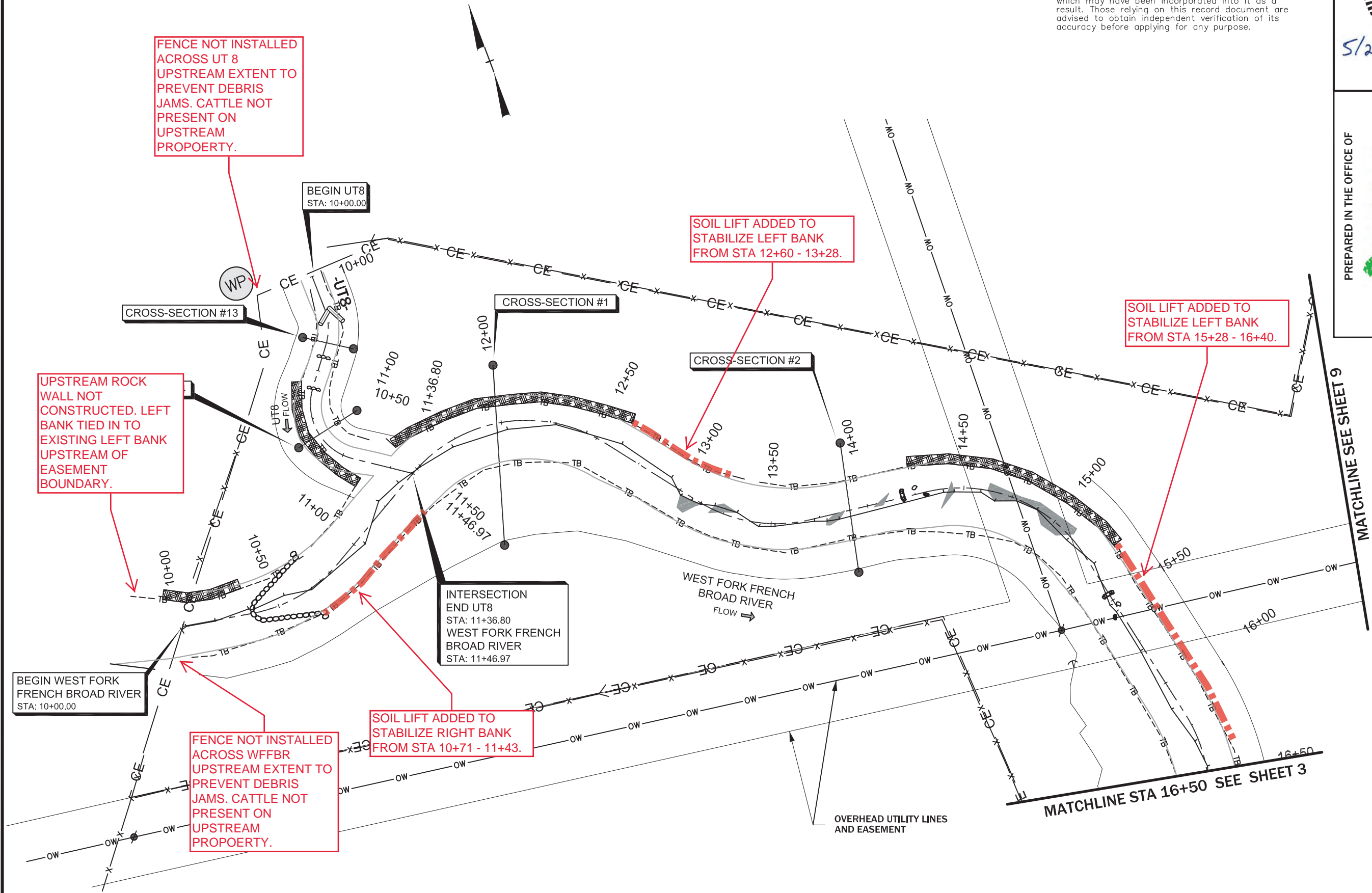
FOR  
 HDR Engineering, Inc. of the Carolinas  
 556 Fayetteville St., Suite 900 Raleigh, N.C. 27601  
 N.C.B.E.L.S. License Number: F-0116



OWEN FARMS MITIGATION SITE  
 STREAM & WETLAND RESTORATION PROJECT  
 TRANSYLVANIA COUNTY, NORTH CAROLINA  
 WEST FORK FRENCH BROAD RIVER STA. 10+00 - STA. 16+50  
 -UT8- STA. 10+00 - 11+47



DATE: 03-11-2021  
 RECORD DRAWING  
 SHEET 2  
 DMS ID # 100064



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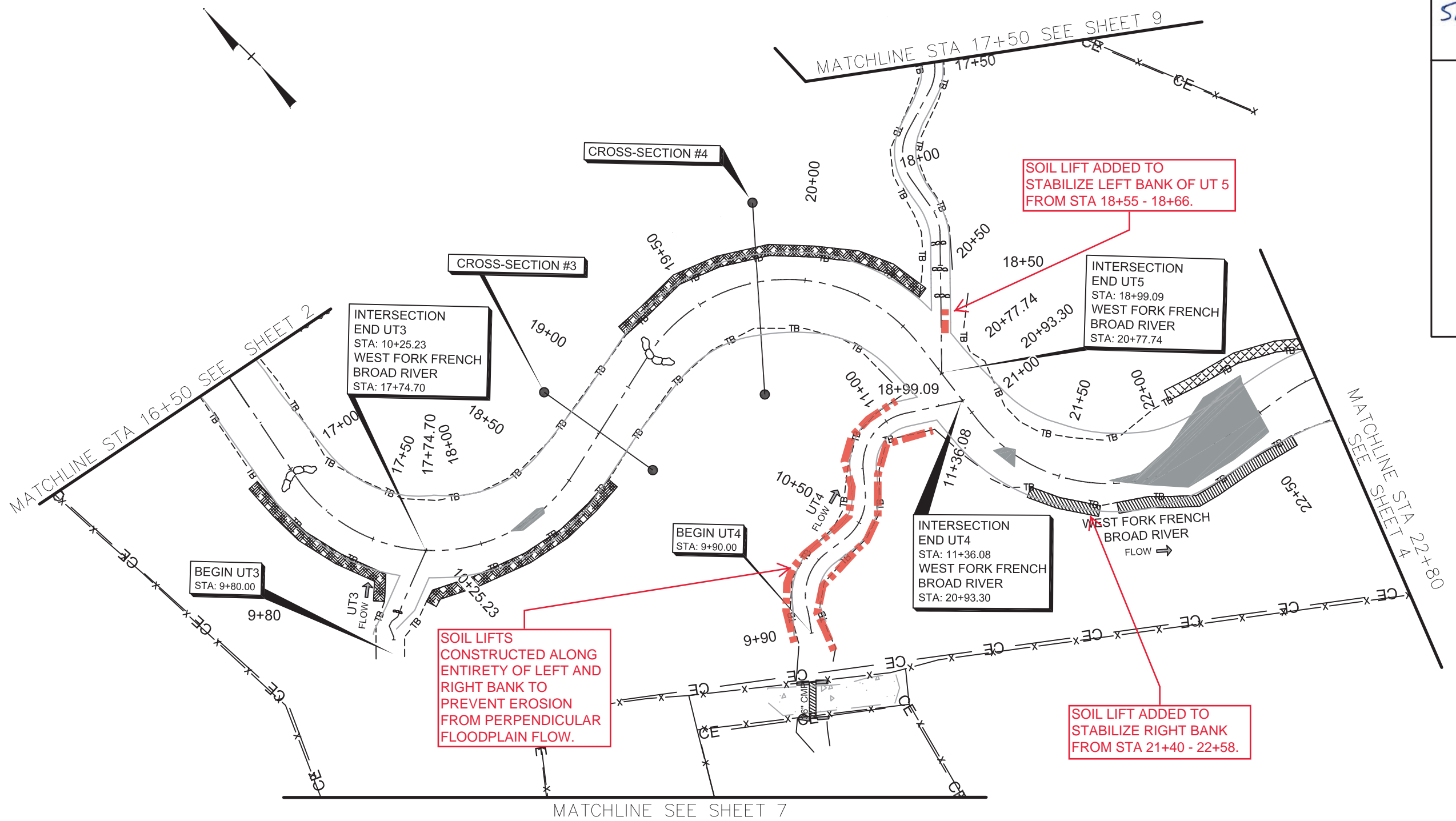


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FOR  
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 555 Fayetteville St., Suite 900 Raleigh, N.C. 27601  
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OWEN FARMS MITIGATION SITE  
 STREAM & WETLAND RESTORATION PROJECT  
 TRANSYLVANIA COUNTY, NORTH CAROLINA  
 WEST FORK FRENCH BROAD STA 16+50 - STA 22+80  
 -UT3- STA 9+80 - 10+25.24  
 -UT4- STA 9+90 - 11+36.08  
 -UT5- 17+50 - 18+99.09



DATE:  
 03-11-2021

RECORD  
 DRAWING

SHEET  
 3

DMS ID #  
 100064

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# RECORD DRAWING

## RECORD DRAWINGS

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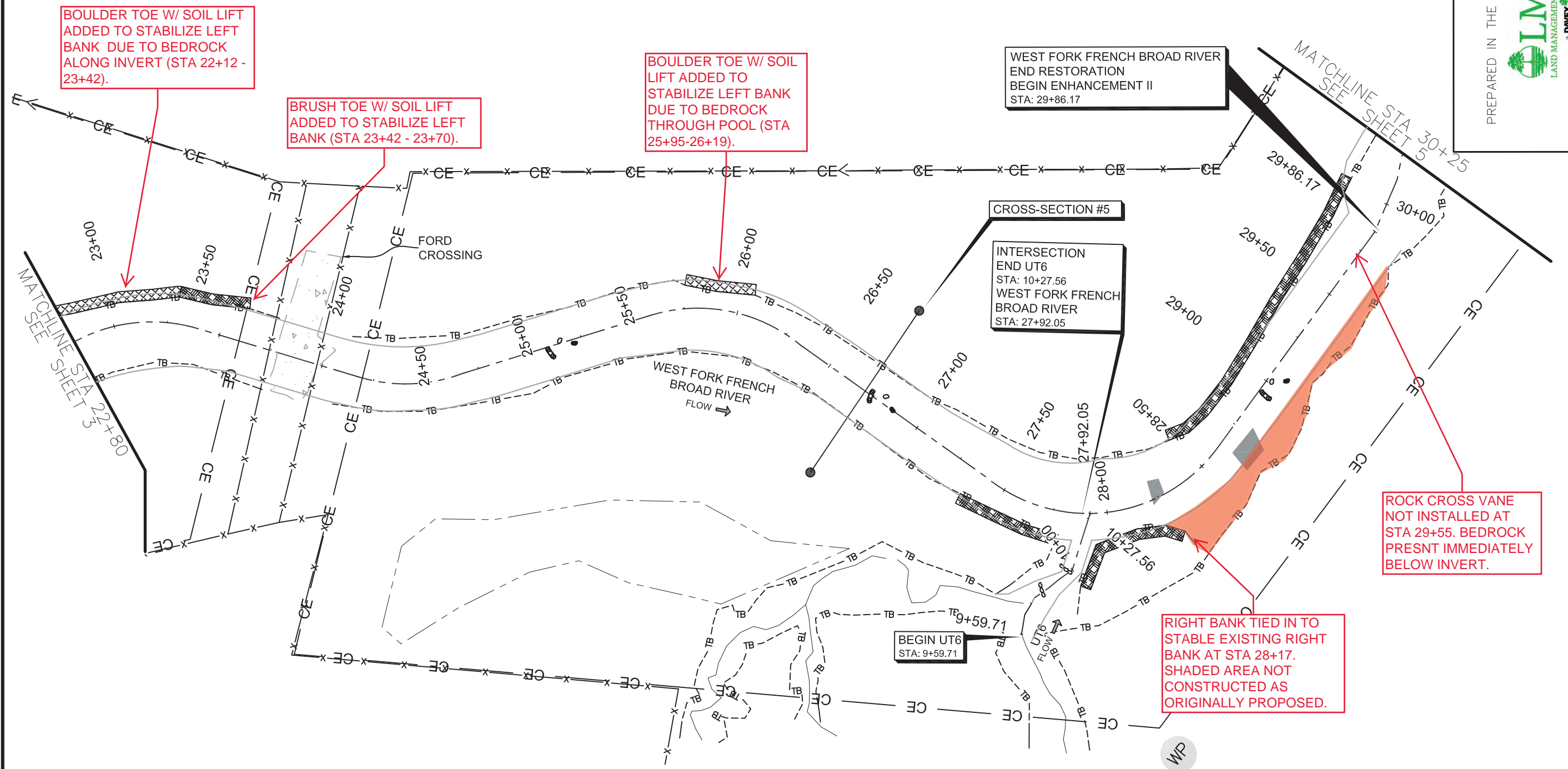
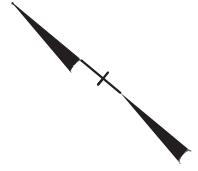


FOR  
HDR Engineering, Inc. of the Carolinas  
555 Fayetteville St, Suite 900 Raleigh, N.C. 27601  
N.C.B.E.L.S. License Number: F-0116

OWEN FARMS MITIGATION SITE  
STREAM & WETLAND RESTORATION PROJECT  
TRANSYLVANIA COUNTY, NORTH CAROLINA  
WEST FORK FRENCH BROAD RIVER STA 22+80 - STA 30+25  
-UT6- STA 9+60 - 27+92.05



DATE: 03-11-2021  
RECORD DRAWING  
SHEET 4  
DMS ID # 100064

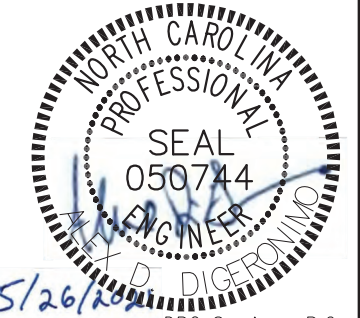


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# RECORD DRAWING

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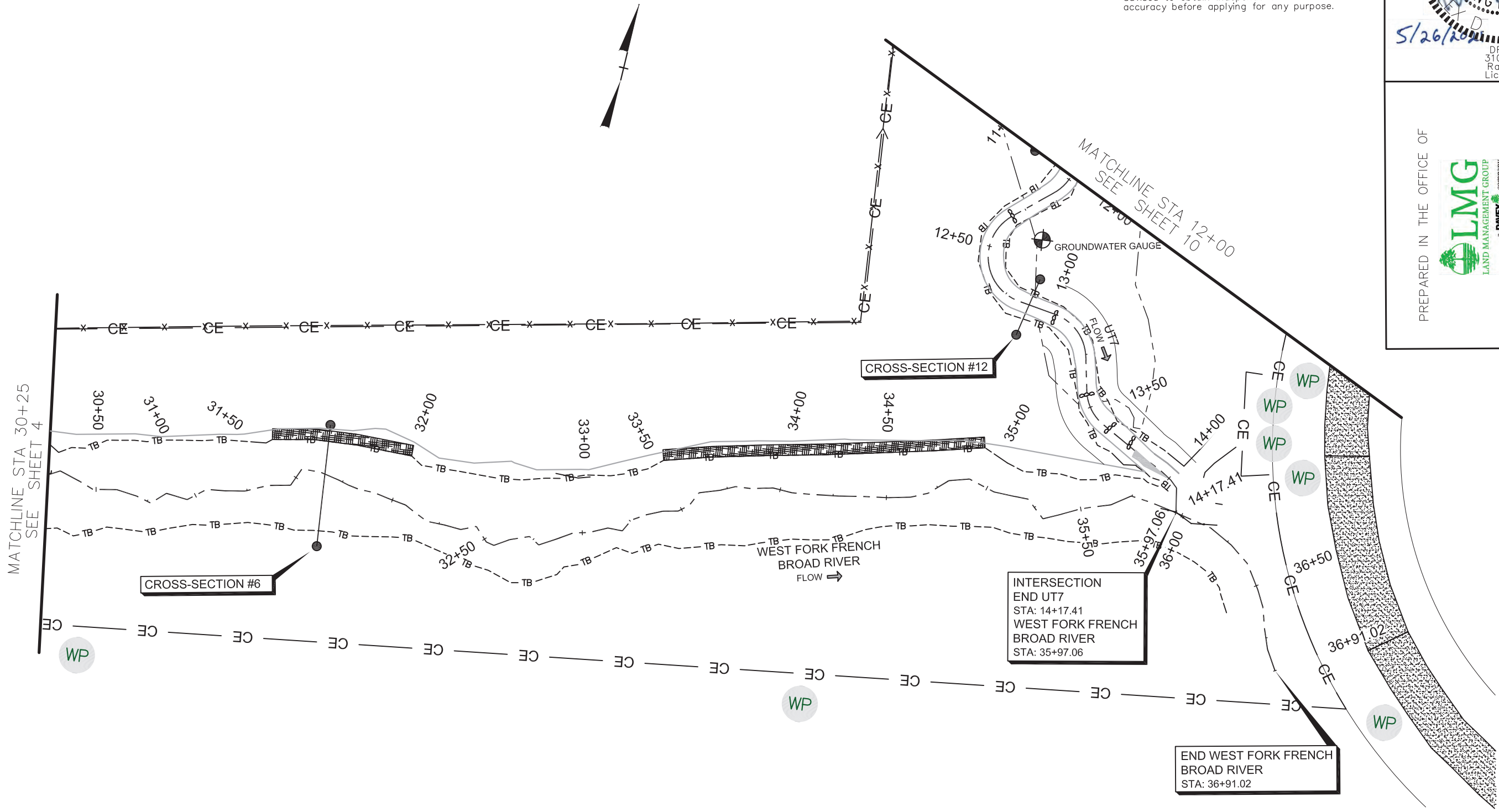


DRG Services, P.C.  
3101 Poplarwood Ct.  
Raleigh, N.C. 27604  
License No. C-4174

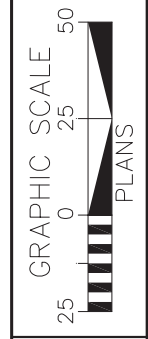
PREPARED IN THE OFFICE OF

FOR

HDR Engineering, Inc. of the Carolinas  
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N.C.B.E.L.S. License Number: F-0116



OWEN FARMS MITIGATION SITE  
STREAM & WETLAND RESTORATION PROJECT  
TRANSYLVANIA COUNTY, NORTH CAROLINA  
WEST FORK FRENCH BROAD STA 30+25 - 35+97.06  
-UT7- STA 12+00 - 14+17.41

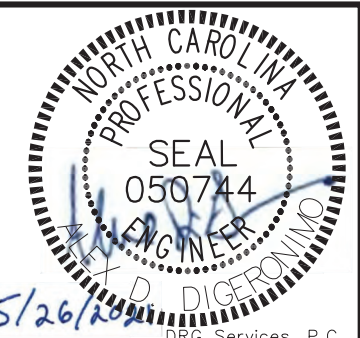


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RECORD DRAWING	
SHEET	5
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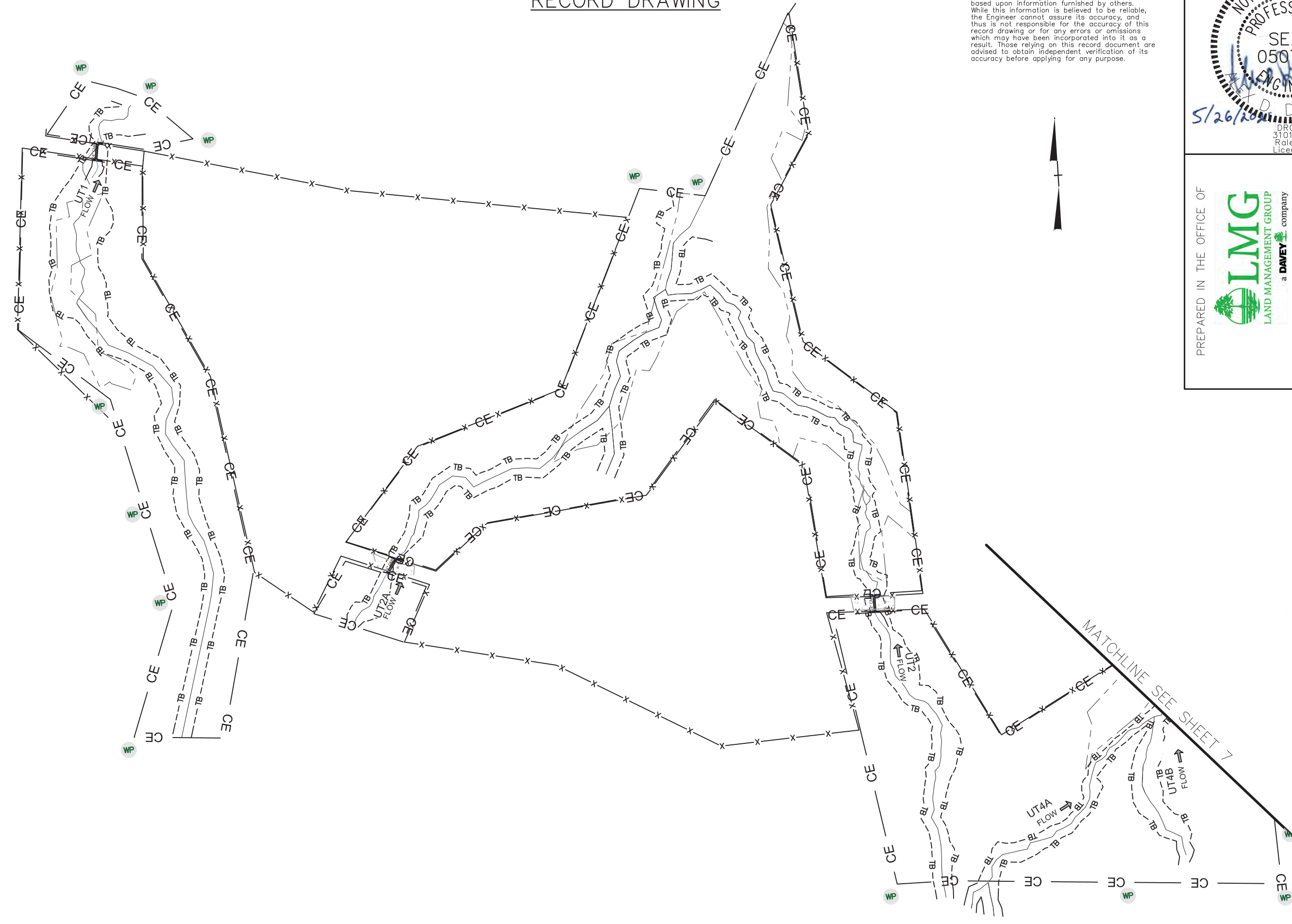
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OWEN FARMS MITIGATION SITE  
STREAM & WETLAND RESTORATION PROJECT  
TRANSYLVANIA COUNTY, NORTH CAROLINA

-UT1-, -UT2-, -UT2A-  
-UT2B-, -UT4A-, -UT4B-



DATE:  
03-11-2021

RECORD  
DRAWING

SHEET  
6

DMS ID #  
100064

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# RECORD DRAWING

## RECORD DRAWINGS

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OWEN FARMS MITIGATION SITE  
STREAM & WETLAND RESTORATION PROJECT  
TRANSYLVANIA COUNTY, NORTH CAROLINA

-UT4- &  
-UT4A- STA 10+00 - 10+71.56

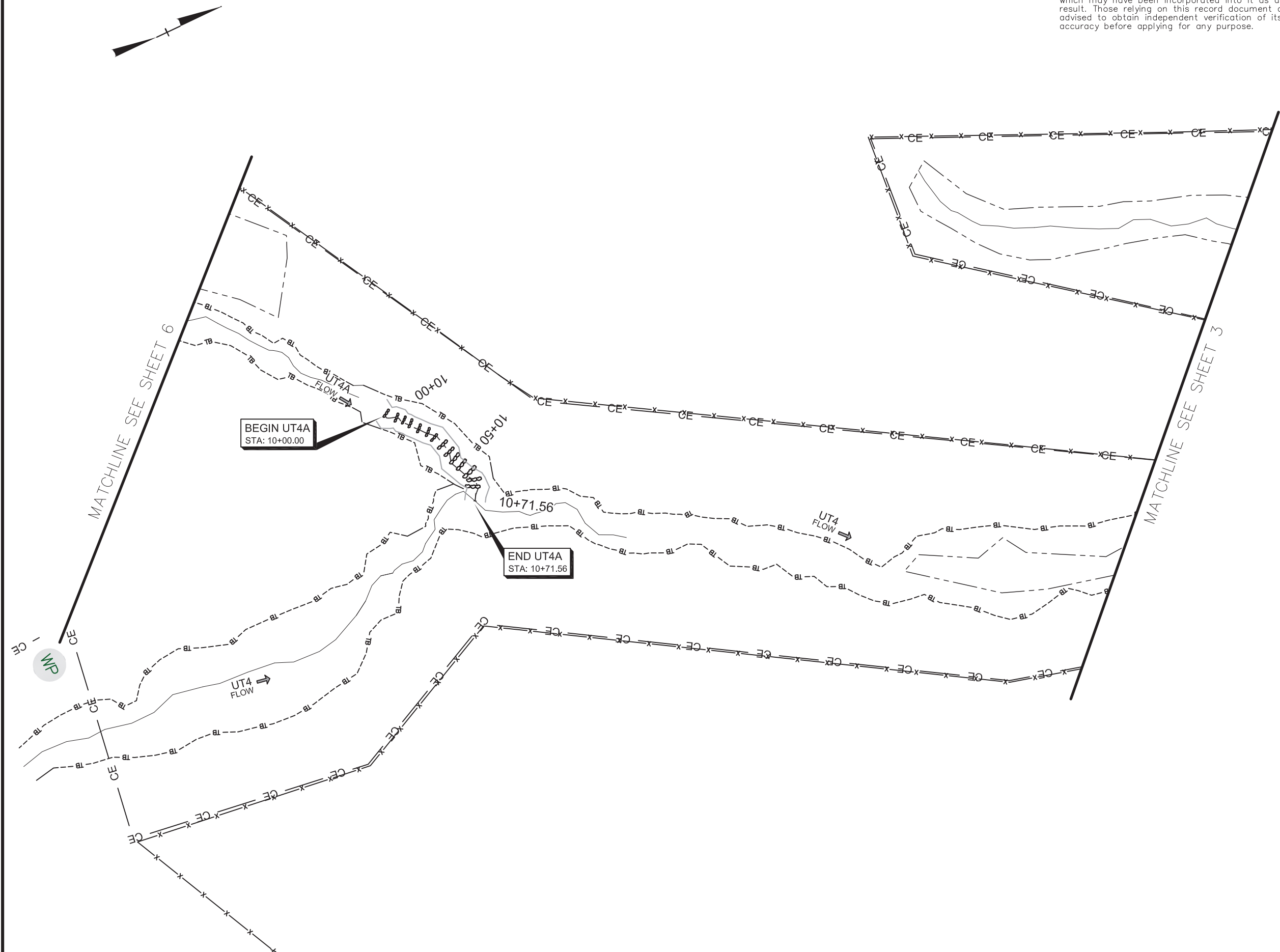


DATE:  
03-11-2021

RECORD  
DRAWING

SHEET  
7

DMS ID #  
100064



# RECORD DRAWING

RECORD DRAWINGS  
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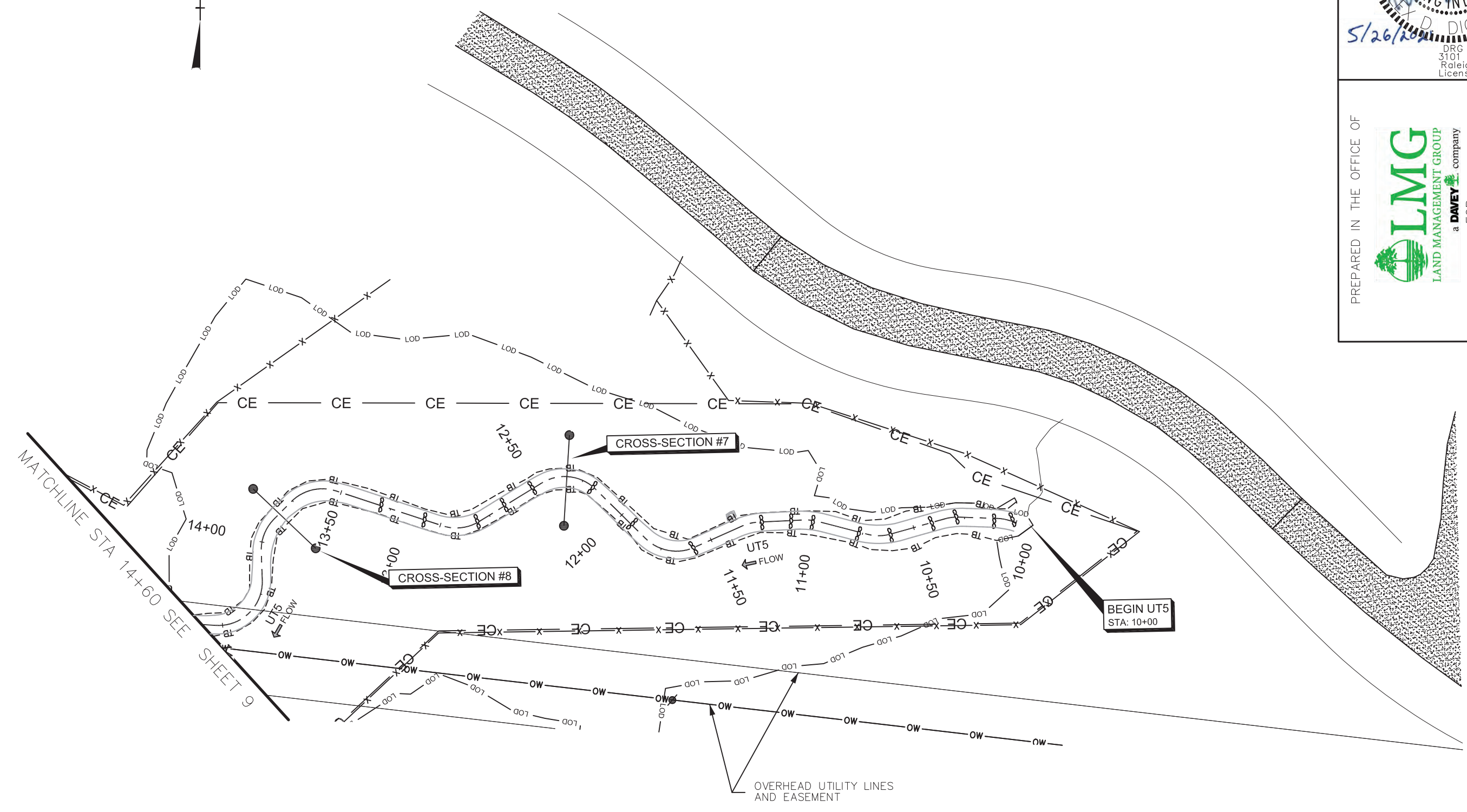


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OWEN FARMS MITIGATION SITE  
 STREAM & WETLAND RESTORATION PROJECT  
 TRANSYLVANIA COUNTY, NORTH CAROLINA



DATE:  
 03-15-2021

RECORD  
 DRAWING

SHEET  
 8

DMS ID #  
 100064

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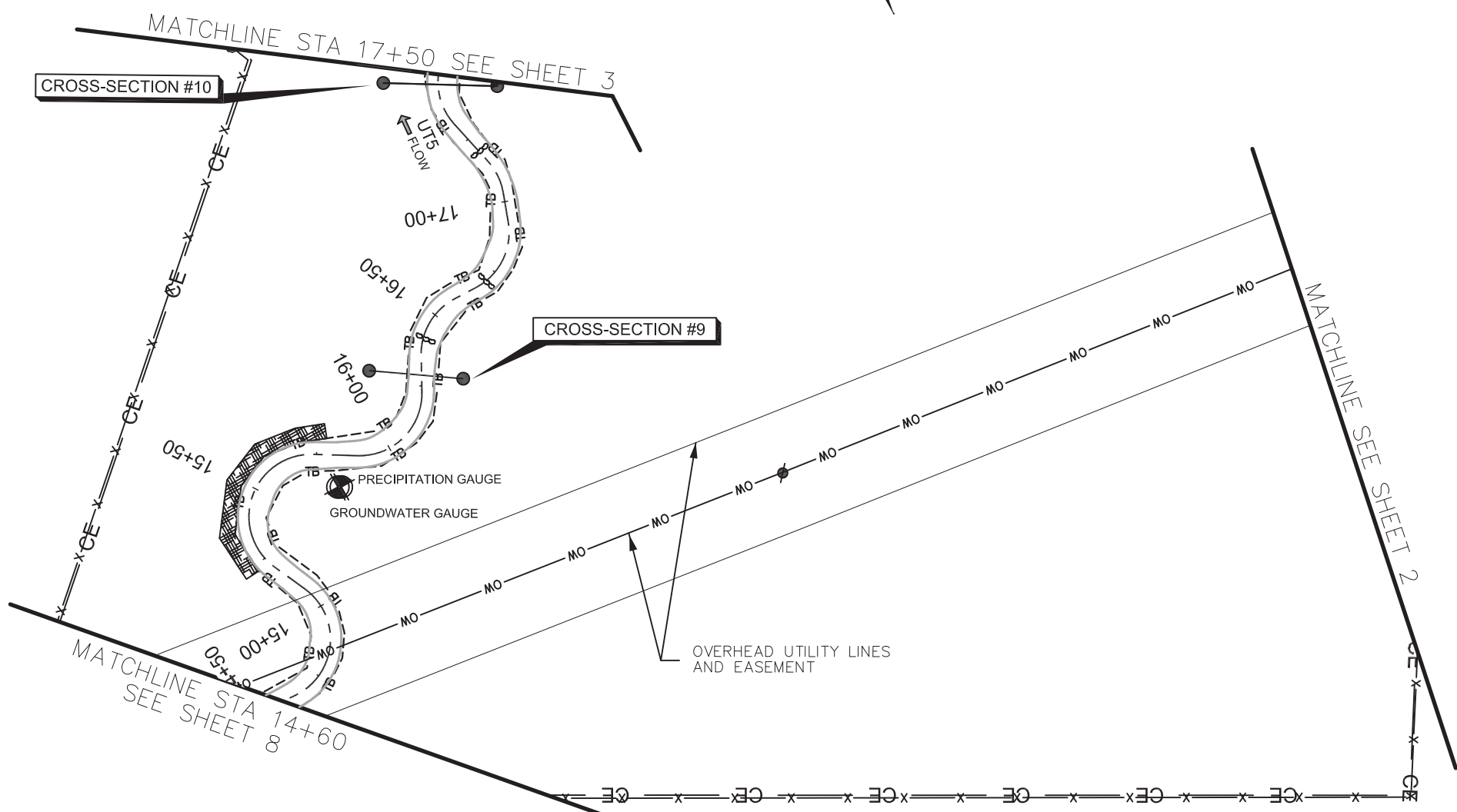
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RECORD DRAWINGS  
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5/26/2021

**PROFESSIONAL SEAL**  
 050744  
 ALEX D. DIGERONIMO  
 ENGINEER



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OWEN FARMS MITIGATION SITE  
 STREAM & WETLAND RESTORATION PROJECT  
 TRANSYLVANIA COUNTY, NORTH CAROLINA



DATE:	03-15-2021
RECORD DRAWING	
SHEET	9
DMS ID #	100064

-UT5- 14+60 - 17+50

# RECORD DRAWING

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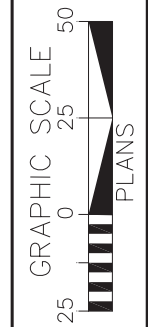


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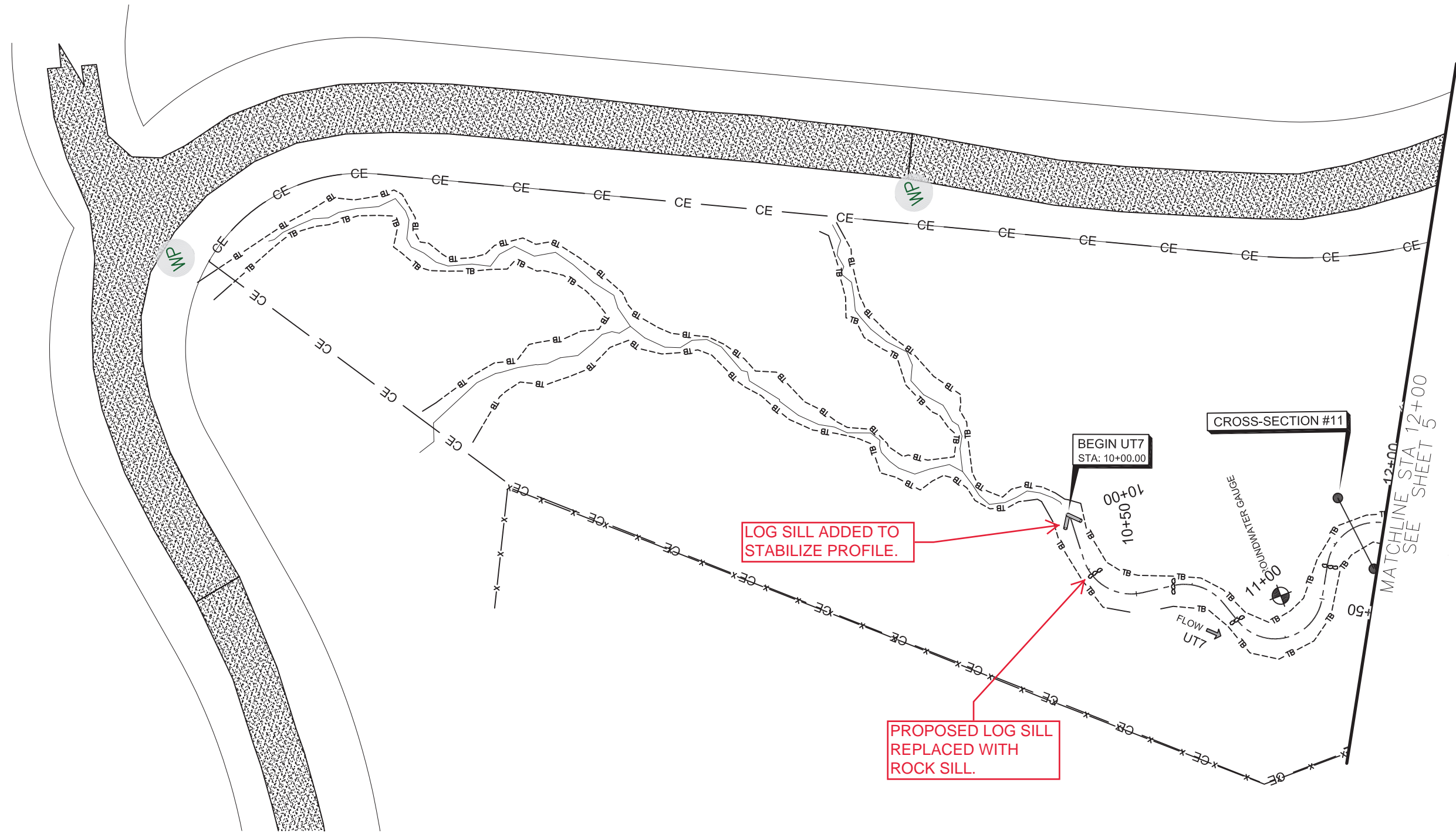
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OWEN FARMS MITIGATION SITE  
 STREAM & WETLAND RESTORATION PROJECT  
 TRANSYLVANIA COUNTY, NORTH CAROLINA  
 -UT7- STA 10+00 - 12+00  
 -UT7A-, -UT7B-



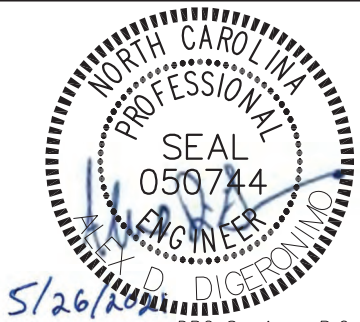
DATE:  
 03-15-2021  
 ASBUILT  
 PLAN  
 SHEET  
 10  
 DMS ID #  
 100064





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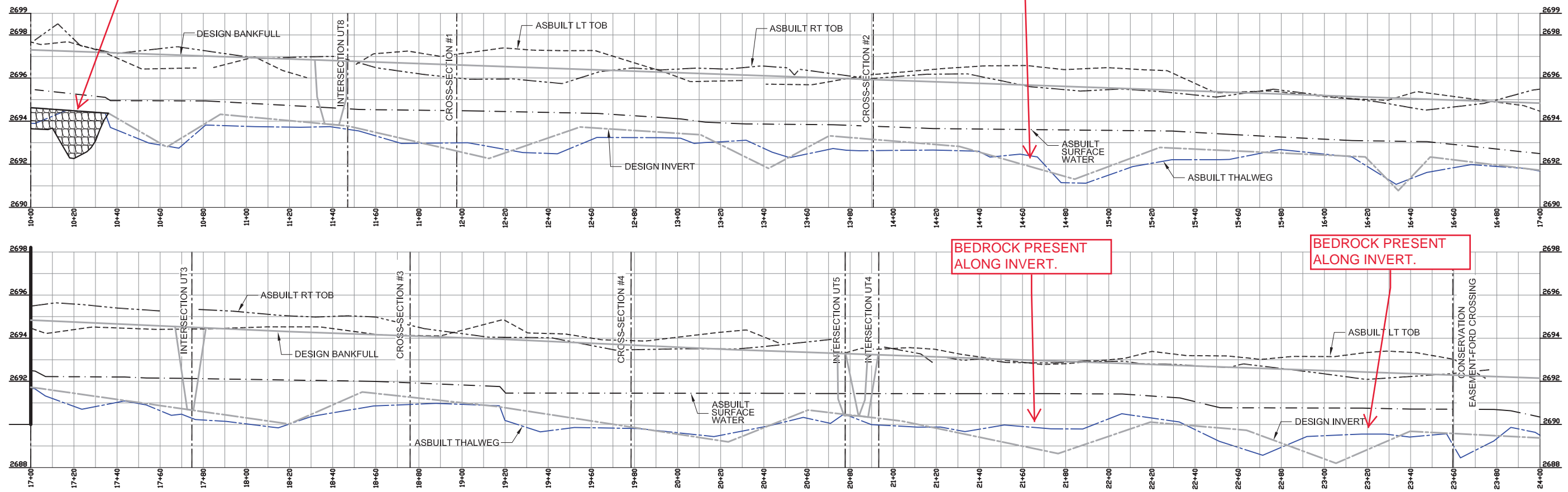


ROCK WALL NOT  
 INSTALLED AT  
 UPSTREAM EXTENT.  
 CHANNEL PROFILE  
 TIED IN WITH EXISTING  
 PROFILE UPSTREAM  
 OF PROJECT  
 BOUNDARY.

BEDROCK PRESENT  
 ALONG INVERT.

BEDROCK PRESENT  
 ALONG INVERT.

BEDROCK PRESENT  
 ALONG INVERT.



**LONGITUDINAL PROFILE- WEST FORK FRENCH BROAD**  
 HORIZONTAL SCALE: 1" = 20' FULL SIZE, 1" = 40' HALF SIZE  
 VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE

OWEN FARMS MITIGATION SITE  
 STREAM & WETLAND RESTORATION PROJECT  
 TRANSYLVANIA COUNTY, NORTH CAROLINA  
 WEST FORK FRENCH BROAD RIVER PROFILES



DATE: 03-15-2021  
 RECORD DRAWING  
 SHEET 11  
 DMS ID # 100064

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# RECORD DRAWING

## RECORD DRAWINGS

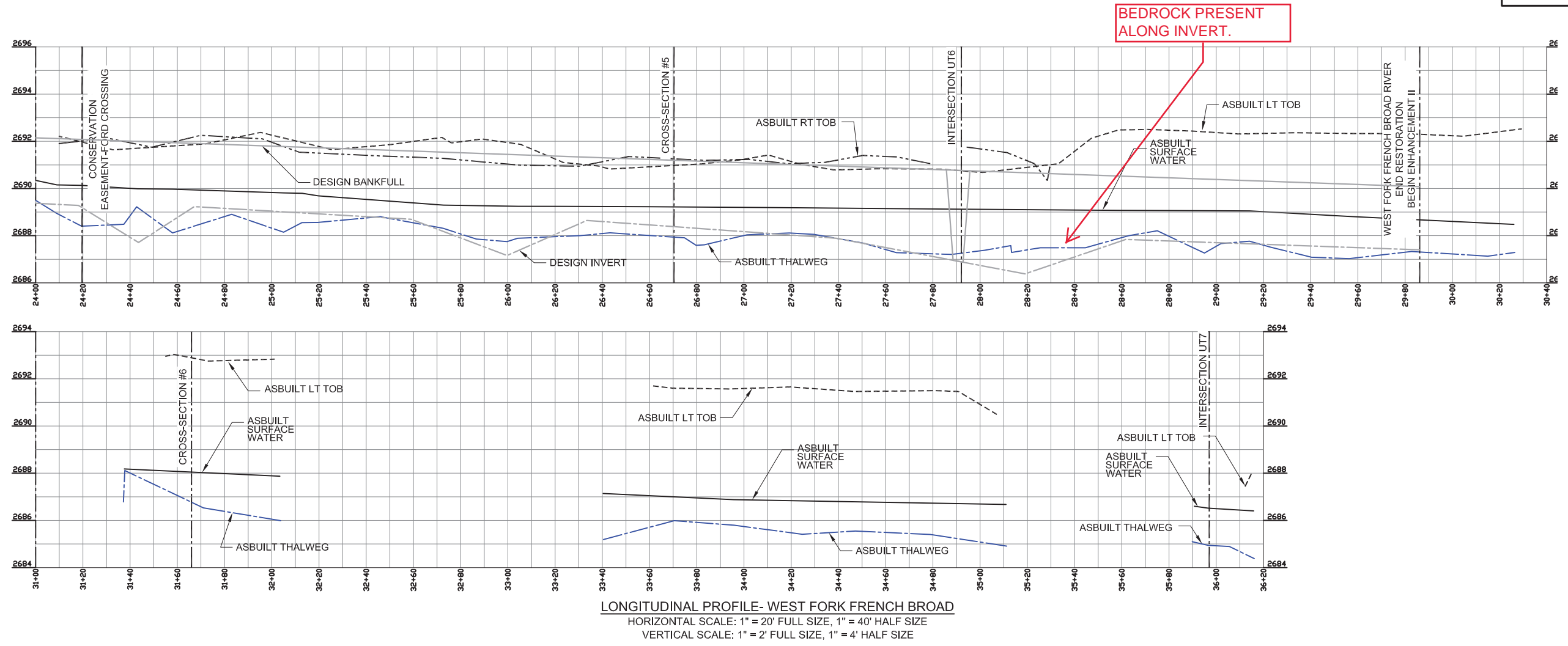
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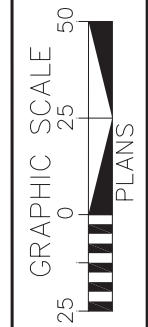
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OWEN FARMS MITIGATION SITE  
STREAM & WETLAND RESTORATION PROJECT  
TRANSYLVANIA COUNTY, NORTH CAROLINA  
WEST FORK FRENCH BROAD RIVER PROFILES



DATE: 03-15-2021  
RECORD DRAWING  
SHEET 12  
DMS ID # 100064

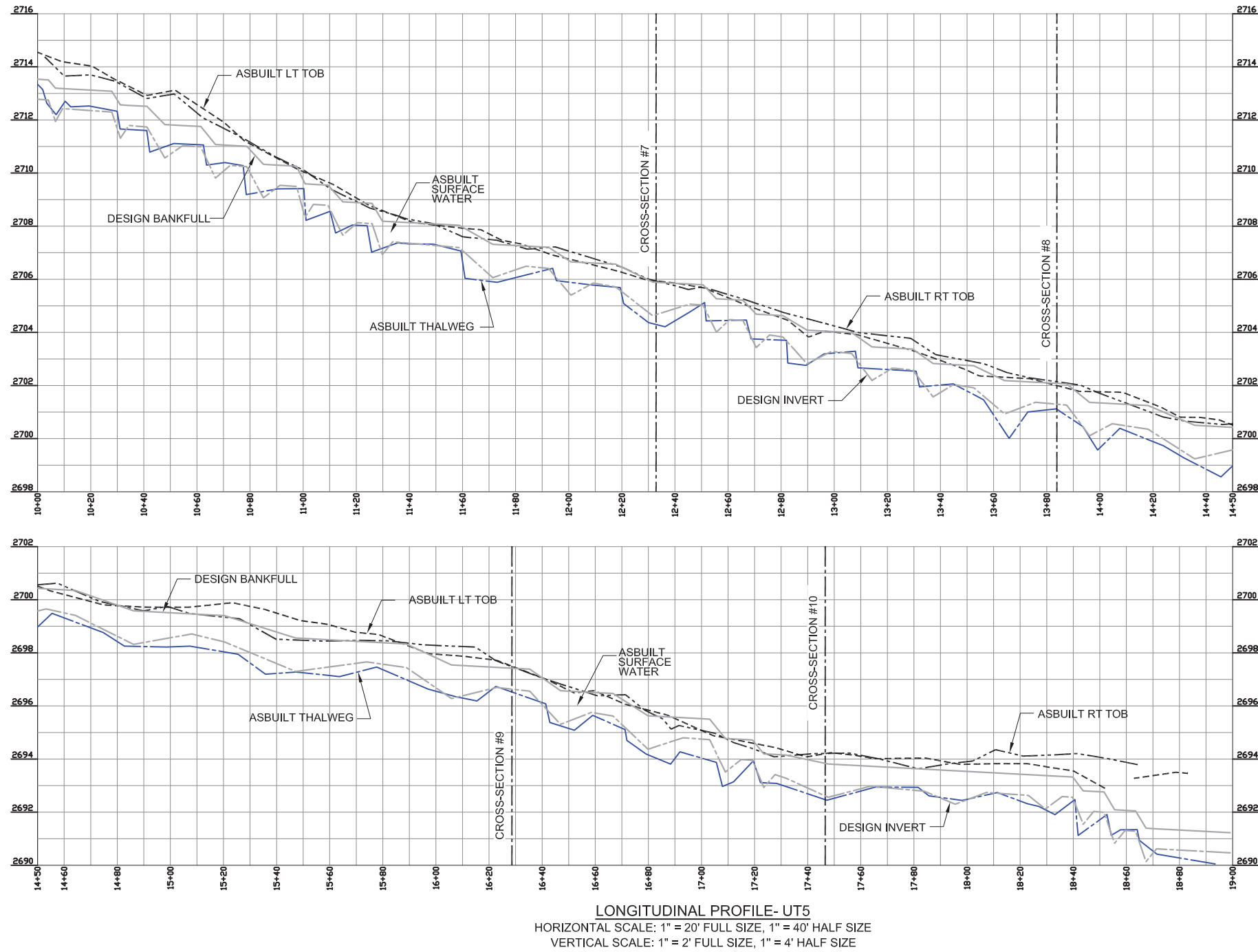
# RECORD DRAWING

## RECORD DRAWINGS

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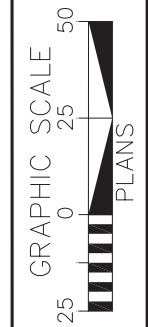


FOR

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OWEN FARMS MITIGATION SITE  
STREAM & WETLAND RESTORATION PROJECT  
TRANSYLVANIA COUNTY, NORTH CAROLINA

UTT 5 PROFILE



DATE:	03-15-2021
RECORD DRAWING	
SHEET	13
DMS ID #	100064

# RECORD DRAWING

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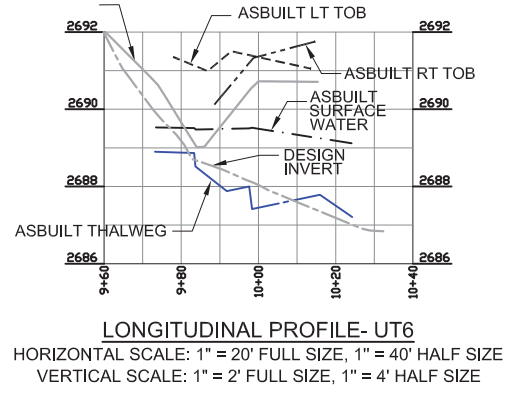
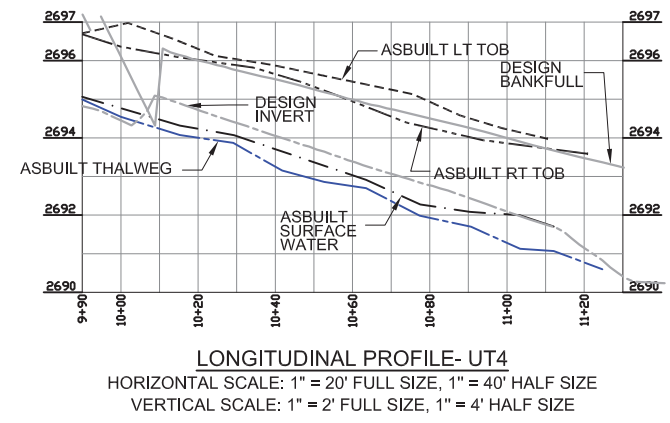
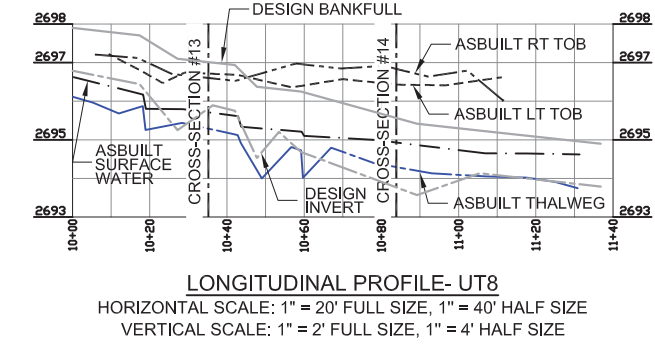
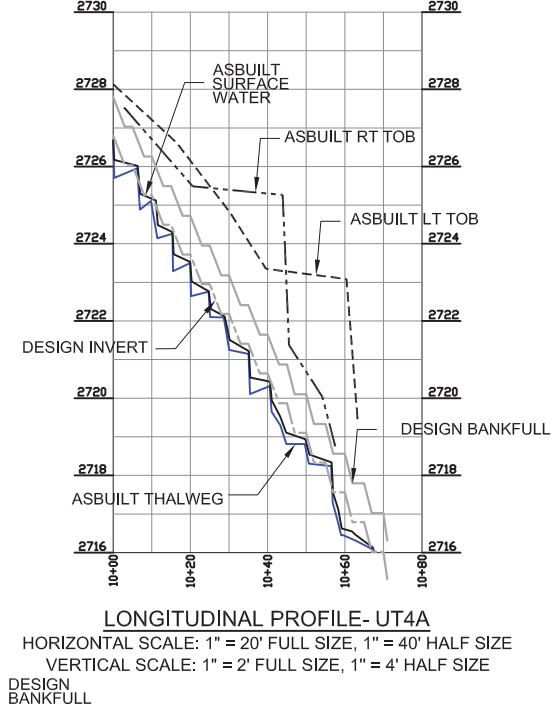
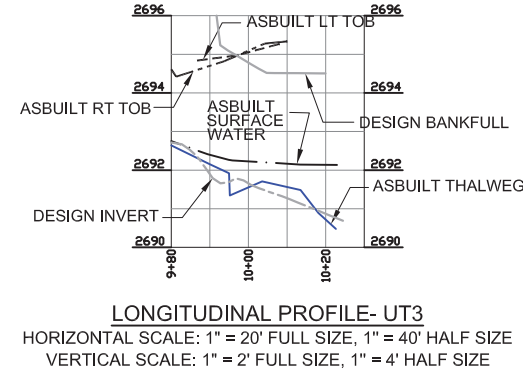


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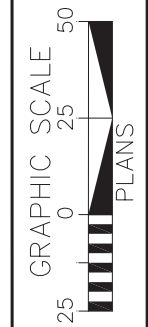
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OWEN FARMS MITIGATION SITE  
STREAM & WETLAND RESTORATION PROJECT  
TRANSYLVANIA COUNTY, NORTH CAROLINA



DATE:	03-15-2021
RECORD DRAWING	
SHEET	14
DMS ID #	100064

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UT 3, UT 4, UT 4A, UT 6 AND UT 8

# RECORD DRAWING

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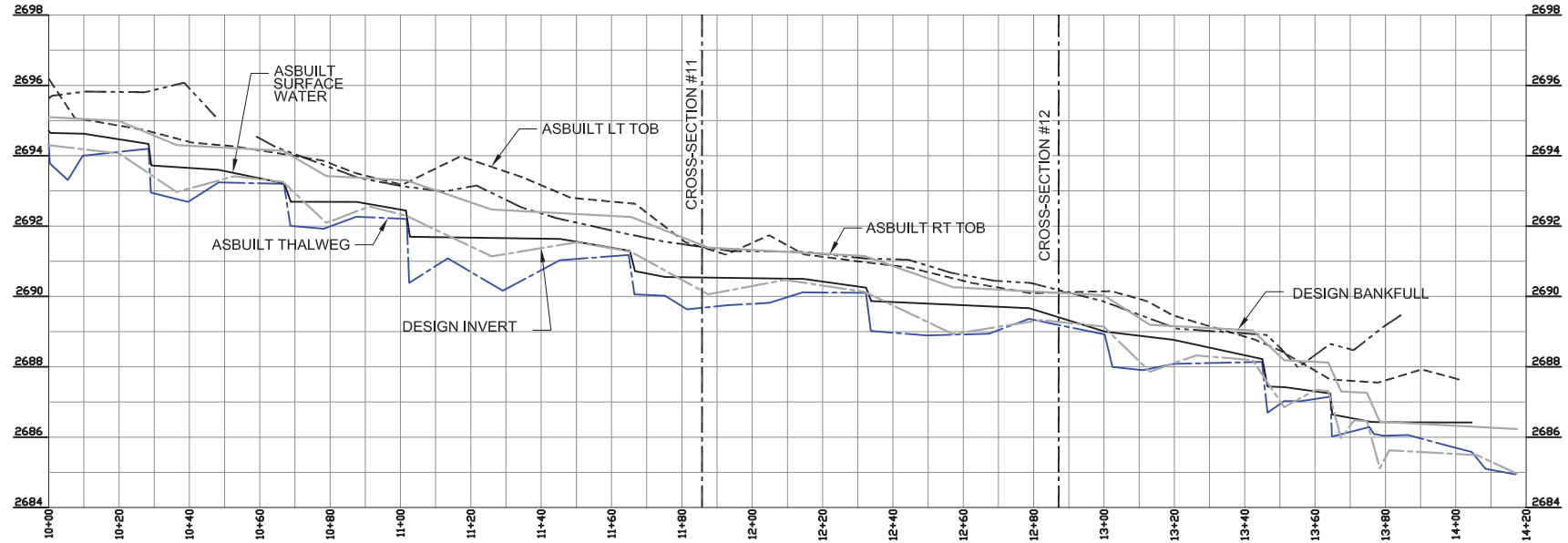


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**LONGITUDINAL PROFILE- UT7**  
HORIZONTAL SCALE: 1" = 20' FULL SIZE, 1" = 40' HALF SIZE  
VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE

OWEN FARMS MITIGATION SITE  
STREAM & WETLAND RESTORATION PROJECT  
TRANSYLVANIA COUNTY, NORTH CAROLINA

UT 7 PROFILE



DATE: 03-15-2021

RECORD DRAWING

SHEET 15

DMS ID #

100064

# RECORD DRAWING

## RECORD DRAWINGS

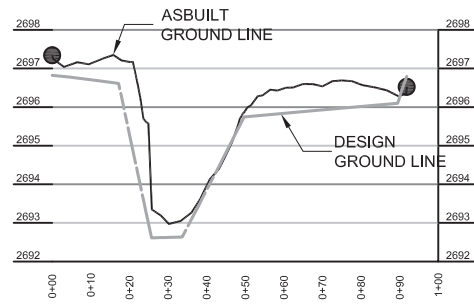
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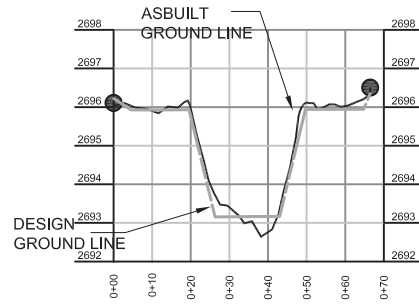
DRG Services, P.C.  
3101 Poplarwood Ct.  
Raleigh, N.C. 27604  
License No. C-4174

## LEGEND

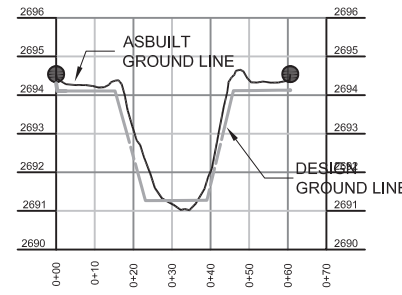
● CROSS-SECTION REBAR



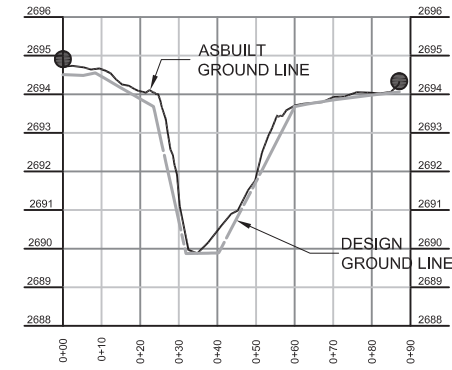
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HORIZONTAL SCALE: 1" = 20' FULL SIZE, 1" = 40' HALF SIZE  
VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



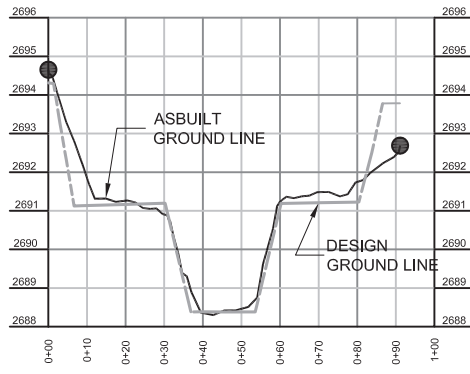
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VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



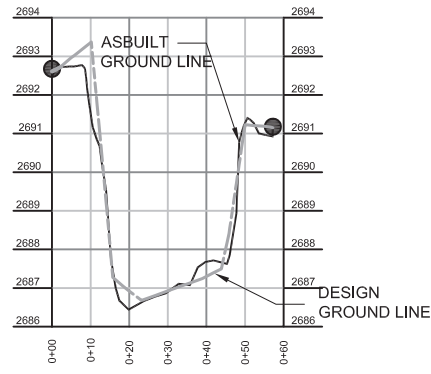
**CROSS-SECTION #3- WEST FORK FRENCH BROAD**  
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VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



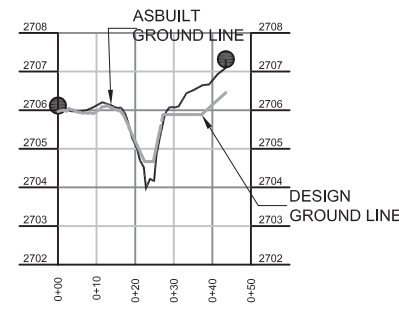
**CROSS-SECTION #4- WEST FORK FRENCH BROAD**  
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VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



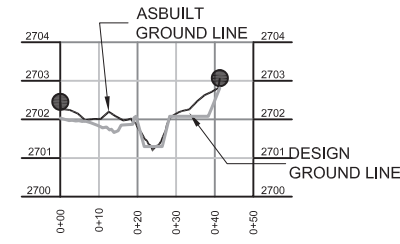
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VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



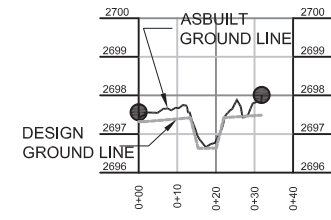
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VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



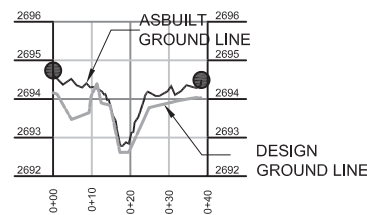
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VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



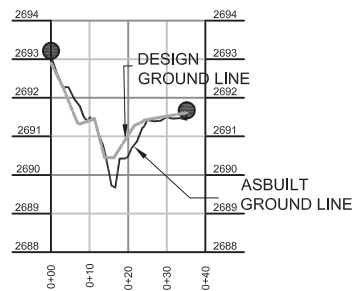
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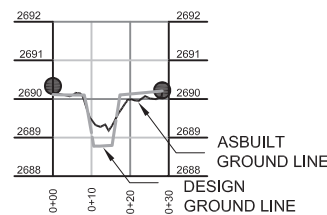
**CROSS-SECTION #9- UT5**  
HORIZONTAL SCALE: 1" = 20' FULL SIZE, 1" = 40' HALF SIZE  
VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



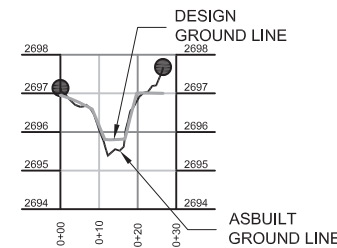
**CROSS-SECTION #10- UT5**  
HORIZONTAL SCALE: 1" = 20' FULL SIZE, 1" = 40' HALF SIZE  
VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



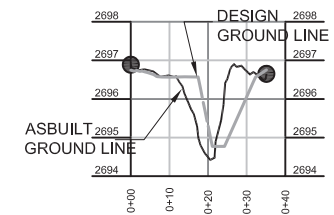
**CROSS-SECTION #11- UT7**  
HORIZONTAL SCALE: 1" = 20' FULL SIZE, 1" = 40' HALF SIZE  
VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



**CROSS-SECTION #12- UT7**  
HORIZONTAL SCALE: 1" = 20' FULL SIZE, 1" = 40' HALF SIZE  
VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



**CROSS-SECTION #13- UT8**  
HORIZONTAL SCALE: 1" = 20' FULL SIZE, 1" = 40' HALF SIZE  
VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE



**CROSS-SECTION #14- UT8**  
HORIZONTAL SCALE: 1" = 20' FULL SIZE, 1" = 40' HALF SIZE  
VERTICAL SCALE: 1" = 2' FULL SIZE, 1" = 4' HALF SIZE

PREPARED IN THE OFFICE OF



FOR  
HDR Engineering, Inc. of the Carolinas  
555 Fayetteville St., Suite 900 Raleigh, N.C. 27601  
N.C.B.E.L.S. License Number: F-0116



OWEN FARMS MITIGATION SITE  
STREAM & WETLAND RESTORATION PROJECT  
TRANSYLVANIA COUNTY, NORTH CAROLINA

RECORD DRAWING CROSS SECTIONS



DATE: 03-15-2021

RECORD DRAWING

SHEET 16

DMS ID #

100064

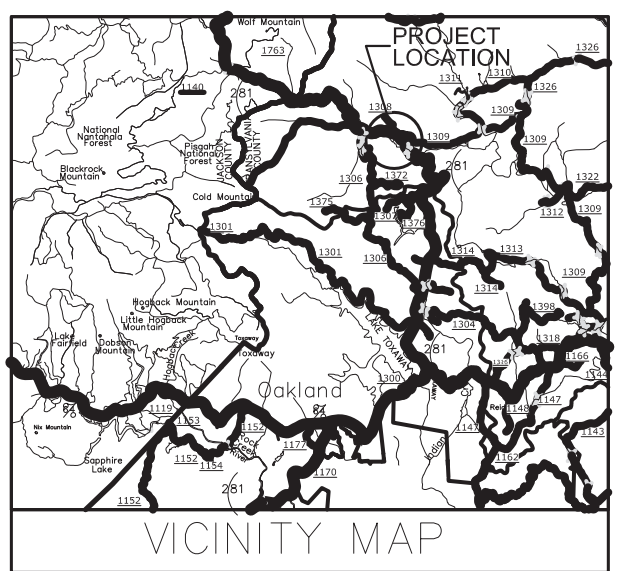
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CONTRACT: OWEN FARMS MITIGATION SITE

STATE N.C.	WEST FORK FRENCH BROAD RIVER	SHEET NO. PL-1
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# PLANTING RECORD DRAWINGS OWEN FARMS MITIGATION SITE

LOCATION: TRANSYLVANIA COUNTY, NORTH CAROLINA  
 LAT: 35.183611      LONG: -82.9413889  
 35 11' 04.89"      -82 56' 34.97"  
 TYPE OF WORK: RECORD DRAWINGS



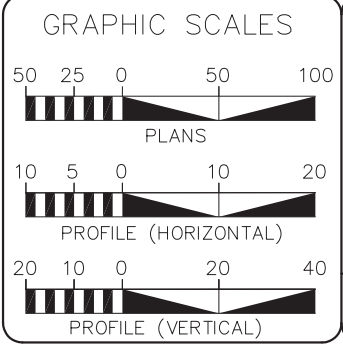
### LEGEND

- STREAMSIDE ASSEMBLAGE 7.813 LF
- PIEDMONT/MOUNTAIN BOTTOMLAND HARDWOOD 7.21 AC
- SWAMP FOREST/BOG COMPLEX 1.99 AC
- MONTANE ALLUVIAL FOREST 5.06 AC
- EXISTING WETLANDS

INDEX OF SHEETS  
 TITLE SHEET.....PL-1  
 RECORD DRAWINGS.....PL-2

**RECORD DRAWINGS**  
 This record drawing has been prepared in part, based upon information furnished by others. While this information is believed to be reliable, the Engineer cannot assure its accuracy, and thus is not responsible for the accuracy of this record drawing or for any errors or omissions which may have been incorporated into it as a result. Those relying on this record document are advised to obtain independent verification of its accuracy before applying for any purpose.

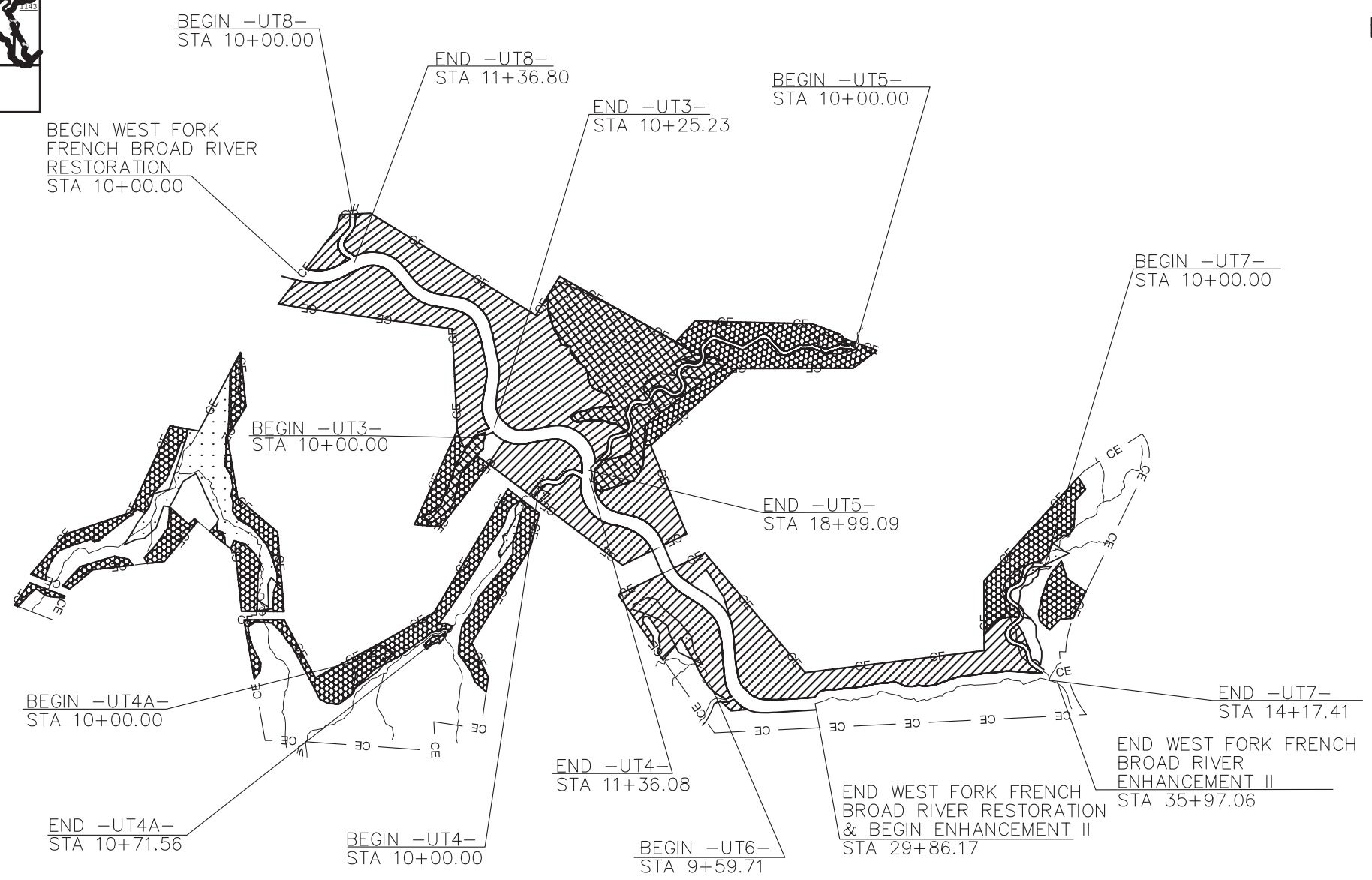
**PLANTING COMPLETED BY:**  
 KEE MAPPING & SURVEYING  
 P.O. BOX 2566  
 ASHEVILLE, NC 28802  
 (828) 575-9021



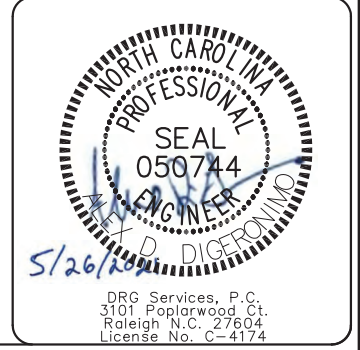
WEST FORK FRENCH BROAD RIVER	DESIGN DATA		
	UT 5	UT 7	UT 8
DESIGN STREAM TYPE = C4	DESIGN STREAM TYPE = C4	DESIGN STREAM TYPE = C4	DESIGN STREAM TYPE = C4
BANKFULL AREA (FT <sup>2</sup> ) CROSS-SECTIONED = 64.29	BANKFULL AREA (FT <sup>2</sup> ) CROSS-SECTIONED = 5.35	BANKFULL AREA (FT <sup>2</sup> ) CROSS-SECTIONED = 6.0	BANKFULL AREA (FT <sup>2</sup> ) CROSS-SECTIONED = 11.08
BANKFULL WIDTH (FT) = 30.0	BANKFULL WIDTH (FT) = 8.5	BANKFULL WIDTH (FT) = 9.0	BANKFULL WIDTH (FT) = 12.0
MAX DEPTH (FT) = 2.68	MAX DEPTH (FT) = 0.76	MAX DEPTH (FT) = 0.80	MAX DEPTH (FT) = 1.11
WIDTH / DEPTH RATIO = 14.0	WIDTH / DEPTH RATIO = 13.5	WIDTH / DEPTH RATIO = 13.5	WIDTH / DEPTH RATIO = 13.0
DRAINAGE AREA (MI <sup>2</sup> ) = 5.50	DRAINAGE AREA (MI <sup>2</sup> ) = 0.07	DRAINAGE AREA (MI <sup>2</sup> ) = 0.06	DRAINAGE AREA (MI <sup>2</sup> ) = 0.31
BANKFULL SLOPE(FT/FT) = 0.00353	BANKFULL SLOPE(FT/FT) = 0.00569	BANKFULL SLOPE(FT/FT) = 0.00539	BANKFULL SLOPE(FT/FT) = 0.01096

CHRISTOPHER L. SMITH  
PROJECT DESIGNER / ENGINEER

PROJECT LENGTH	DESIGN STREAM LENGTH	
	EXISTING	PROPOSED
WEST FORK FRENCH BROAD RIVER	2,859.55 FT	2,691.02 FT
-UT4-	1,133.30 FT	136.08 FT
-UT4A-	471.56 FT	71.56 FT
-UT5-	652.00 FT	899.09 FT
-UT7-	811.00 FT	417.41 FT
-UT8-	49.00 FT	136.80 FT



DWR # 18-1033  
 DMS ID # 100064  
 DMS CONTRACT 7532  
 USACE-SAW-2018-01165



DRG Services, P.C.  
 3101 Poplarwood Ct.  
 Raleigh N.C. 27604  
 License No. C-4174

Prepared in the Office of:



# RECORD DRAWING



DRG Services, P.C.  
3101 Poplarwood Ct.  
Raleigh N.C. 27604  
License No. C-4174



FOR  
HDR Engineering, Inc. of the Carolinas  
556 Fayetteville St., Suite 900 Raleigh, N.C. 27601  
N.C.B.E.L.S. License Number: F-0116

PREPARED IN THE OFFICE OF

Zone 1: Streamside Assemblage		Feet of Stream Bank	Unit Type*	Plant Spacing	
		7,813 ft		4 ft	
Common Name	Scientific Name		% Composition	# Planted	
Black willow	<i>Salix nigra</i>	L	25	489	
Tag alder	<i>Alnus serrulata</i>	L	<del>25</del> 15	<del>489</del>	293
Silky dogwood	<i>Cornus amomum</i>	L	25	489	
Elderberry	<i>Sambucus canadensis</i>	R	10	196	
Sycamore	<i>Platanus occidentalis</i>	R	25	489	
TOTAL				1,956	
Zone 2: Piedmont/Mountain Bottomland Forest		Area		Plant Spacing	
		7.21 ac		8 ft	
Common Name	Scientific Name		% Composition	# Planted	
Tulip tree	<i>Liriodendron tulipifera</i>	R	15	737	
River birch	<i>Betula nigra</i>	R	15	737	
Sycamore	<i>Platanus occidentalis</i>	R	20	982	
Shagbark hickory	<i>Carya ovata</i>	R	15	737	
American elm	<i>Ulmus Americana</i>	R	10	491	
Flowering dogwood	<i>Cornus florida</i>	R	<del>5</del> 10	<del>246</del>	491
Bitternut hickory	<i>Carya cordiformis</i>	R	15	737	
<del>Mountain silverbell</del>	<del><i>Halesia tetrapetala</i></del>	<del>R</del>	<del>5</del>	<del>246</del>	
TOTAL				4,913	
Zone 3: Swamp Forest-Bog Complex		Area		Plant Spacing	
		1.99 ac		8 ft	
Common Name	Scientific Name		% Composition	# Planted	
Silky willow	<i>Salix sericea</i>	R	15	204	
Tag alder	<i>Alnus serrulata</i>	R	<del>20</del> 10	<del>271</del>	136
<del>Possumhaw viburnum</del>	<del><i>Viburnum nudum</i></del>	<del>R</del>	<del>20</del>	<del>271</del>	
Red chokeberry	<i>Aronia arbutifolia</i>	R	15	204	
Silky dogwood	<i>Cornus amomum</i>	R	15	204	
<del>Mountain holly</del>	<del><i>Ilex montana</i></del>	<del>R</del>	<del>10</del>	<del>136</del>	
<del>Swamp rose</del>	<del><i>Rosa palustris</i></del>	<del>R</del>	<del>5</del>	<del>68</del>	
Buttonbush	<i>Cephalanthus occidentalis</i>	R	20	271	
Spicebush	<i>Lindera benzoin</i>	R	15	204	
Elderberry	<i>Sambucus canadensis</i>	R	10	136	
TOTAL				1,358	
Zone 4: Montane Alluvial Forest		Area		Plant Spacing	
		5.06 ac		8 ft	
Common Name	Scientific Name		% Composition	# Planted	
Sycamore	<i>Platanus occidentalis</i>	R	<del>15</del> 16.6	<del>517</del>	575
Yellow birch	<i>Betula alleghaniensis</i>	R	<del>15</del> 16.6	<del>517</del>	575
White oak	<i>Quercus alba</i>	R	<del>20</del> 21.6	<del>689</del>	744
Tulip tree	<i>Liriodendron tulipifera</i>	R	<del>15</del> 16.6	<del>517</del>	575
<del>Sweet birch</del>	<del><i>Betula lenta</i></del>	<del>R</del>	<del>10</del>	<del>345</del>	
River birch	<i>Betula nigra</i>	R	<del>15</del> 16.6	<del>517</del>	575
Witch hazel	<i>Hamamelis virginiana</i>	R	<del>10</del> 12	<del>345</del>	403
TOTAL				3,447	

\* Live Stake (L), Bare Root (R)

### NOTES:

- PLACE ONE LIVE STAKE AT TOP OF BANKFULL CHANNEL AND THEN THE NEXT LIVE STAKE AT THE TOE OF BANKFULL CHANNEL IN AN ALTERNATING PATTERN.
- LIVE STAKES SHALL BE EVENLY SPACED 4 FT. APART.
- LIVE STAKES SHALL BE DRIVEN UNTIL APPROXIMATELY 7/8 OF LIVE STAKE IS WITHIN GROUND.
- IF STARTER HOLE IS NEEDED, MINIMIZE AIR POCKET.
- UTILIZE ALL ON SITE TRANSPLANT MATERIALS MADE AVAILABLE BY THE OWNER. ONCE SOURCE OF TRANSPLANT MATERIAL HAS BEEN HARVESTED, THEN UTILIZE LIVE STAKING.

### LIVE STAKE DETAIL

SCALE: NTS

NOTE: STAKING MAY BE REQUIRED THROUGH MATTING, ROCK OR COMPACTED SOILS. A STARTER HOLE MAY BE REQUIRED.

### BANK STABILIZATION W/ LIVE STAKES

### PLANTING DETAILS

#### SEEDLING / LINER BAREROOT PLANTING DETAIL

##### HEALING IN

- LOCATE A HEALING-IN SITE IN A SHADY, WELL PROTECTED AREA.
- EXCAVATE A FLAT BOTTOM TRENCH 12IN. DEEP AND PROVIDE DRAINAGE.
- BACKFILL THE TRENCH WITH 2IN. OF COMPOST. PLACE A 2IN. LAYER OF COMPOST AT A SLOPING ANGLE AT ONE END OF THE TRENCH.
- PLACE A SINGLE LAYER OF PLANTS AGAINST THE SLOPING END SO THAT THE ROOT COLLAR IS AT GROUND LEVEL.
- PLACE A 2IN. LAYER OF COMPOST OVER THE ROOTS MAINTAINING A SLOPING ANGLE.
- REPEAT LAYERS OF PLANTS AND COMPOST AS NECESSARY AND WATER THOROUGHLY.

##### PLANTING METHOD USING A SHOVEL

- DIG HOLE WITH SHOVEL TO APPROPRIATE DEPTH AND WIDTH FOR SEEDLING.
- REMOVE SOIL FROM HOLE WITH SHOVEL. HOLE SHALL NOT BE MADE BY COMPACTING SOIL AWAY FROM THE HOLE.
- REMOVE SHOVEL AND PLACE SEEDLING AT CORRECT DEPTH.
- FILL HOLE WITH SOIL. TAMP SOIL TO REMOVE AIR POCKETS. WATER THOROUGHLY.

##### PLANTING NOTES:

PLANTING BAG DURING PLANTING, SEEDLINGS SHALL BE KEPT IN A MOIST CANVAS BAG OR SIMILAR CONTAINER TO PREVENT THE ROOT SYSTEMS FROM DRYING.

ROOT PRUNING ALL SEEDLINGS SHALL BE ROOT PRUNED, IF NECESSARY, SO THAT NO ROOTS EXTEND MORE THAN 24INCHES (24IN.) BELOW THE ROOT COLLAR.

TREE REFORESTATION SHALL BE PLANTED 8' ON CENTER, RANDOM SPACING, APPROXIMATELY 260 PLANTS PER ACRE.

OWEN FARMS MITIGATION SITE  
STREAM & WETLAND RESTORATION PROJECT  
PENNSYLVANIA COUNTY, NORTH CAROLINA



DATE: 03-11-2021  
RECORD DRAWING  
SHEET PL-2  
DMS ID # 100064