MITIGATION PLAN

Final

March 29, 2019

SHAKE RAG MITIGATION SITE

Madison County, NC
NCDEQ Contract No. 7190
DMS ID No. 100018

French Broad River Basin
HUC 06010105

USACE Action ID No. SAW-2017-01570
RFP #: 16-006991

PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

REPLY TO
ATTENTION OF:

CESAW-RG/Browning March 14, 2019

MEMORANDUM FOR RECORD

SUBJECT: Shake Rag Mitigation Site - NCIRT Comments during 30-day Mitigation Plan Review

PURPOSE: The comments listed below were posted to the NCDMS Mitigation Plan Review Portal during the 30-day comment period in accordance with Section 332.8(g) of the 2008 Mitigation Rule.

NCDMS Project Name: Shake Rage Mitigation site, Madison County, NC

USACE AID#: SAW-2017-01570

NCDMS #: 100018

30-Day Comment Deadline: March 1, 2019

Mac Haupt, NCDWR:

1. DWR would like to be notified when construction begins, specifically, would like to be present when construction is about half way through reach 3 for Shake Rag Branch (and UT3, UT4).
2. DWR noted there was some pre-construction monitoring of macrobenthos, however; there does not appear to be any macrobenthic monitoring post stream construction. Given the fact that a number of these stream were buried, it may be interesting to see the macrobenthos recovery trajectory for these reaches.
3. Table 9 shows a permanent impact to 0.22 acres of wetlands, please address how you intend to maintain the functional level of wetlands on site.
4. Table 23- given the amount of planting that is planned for reaches UT1, UT2, UT5 and UT6, DWR requests several vegetation plots (either fixed or random) be planned for these reaches throughout the monitoring period.
5. Design sheet 2.1.8- is there an existing pipe or just subterranean flow above UT8? Interesting to start the stream reach at a headwall in the middle of a pasture in no apparent crenulation.
6. Given the slope and design of the structures, there will be a lot of rock needed for this site. Does WEI plan to mine the rock on-site or go off site to obtain the rock?
7. Design sheet 2.1.13- Does WEI/DMS have any concerns about maintenance of flow for this reach (UT3 reach 2) given that it appears to be moved upslope away from the crenulation and the wetland?

Kim Browning, USACE:

1. It's recommended to place a veg plot on the south side of UT3 in the vicinity of wetland F.
2. There appears to be two crossings planned in close proximity to each other on reach 5 of Shake Rag Branch. Is it possible to combine these into one crossing?

3. Even though there are no wetland credits being sought, and existing wetlands are fairly small, there will be permanent impacts to these wetlands during construction. It is anticipated that overall wetland function will improve from increased hydrology from stream restoration activities; however, it is recommended that wetland gauges be installed and monitored in order to demonstrate no functional loss and/or acreage loss of wetlands with this project.
4. A step-pool stormwater BMP is planned on UT4. Please provide a brief narrative of any maintenance required for the BMP, if any.
5. Please make sure to include a statement regarding the existing outhouse located within the easement.
6. Section 8 – Performance Standards: The RFP date is 09/16/16, but regardless of the date, it's recommended to use the Wilmington District Mitigation Guidance from Oct 2016, rather than the 2003 guidance (this is referenced in several sections of Section 8). Associated with that, there should be 4 bankful events in the performance standards and credit release schedule, and monitoring should occur for 7 years.
    a. Section 8.2: monitoring should occur for seven years, and the vigor standards should be 7' high at year 5 and 10'high at year 7.
    b. It would be helpful to see the location of the photo reference stations on the monitoring map, figure 9.
7. If cattle are going to be present on site and have use of the crossings, maintenance of these crossings should be addressed. Perhaps adding this to the Monitoring section and the long-term management section would be beneficial. In addition, will the water lines that cross UT5 and UT6 require maintenance or replacement at some point?
8. Please notify the Corps when construction begins for this project.

Kim Browning
Mitigation Project Manager
Regulatory Division

WILDLANDS
ENGINEERING

MEMORANDUM

TO: Matthew Reid, NC DMS

FROM: Jacob McLean, PE

DATE: March 25, 2019

RE: Shake Rag Mitigation Site
Madison County, NC
USACE AID#: SAW-2017-01570, NCDMS #: 100018
FINAL Mitigation Plan – IRT Comment Response

This memo documents NCIRT's Mitigation Plan review comments (*in italics*) received from Kim Browning's letter dated 3/14/19, the project team's responses, and where the revisions have been included in the final Mitigation Plan.

Mac Haupt, NCDWR

1. *DWR would like to be notified when construction begins, specifically, would like to be present when construction is about half way through reach 3 for Shake Rag Branch (and UT3, UT4)*

    a. Wildlands will let DWR know when construction commences and will make available the construction schedule for Shake Rag Branch Reach 3, UT3, and UT4 for DWR.

2. *DWR noted there was some pre-construction monitoring of macrobenthos, however; there does not appear to be any macrobenthic monitoring post stream construction. Given the fact that a number of these stream were buried, it may be interesting to see the macrobenthos recovery trajectory for these reaches.*

    a. While Wildlands agrees that this would be of interest, no macrobenthic monitoring component is proposed as part of regulatory compliance or success criteria.

3. *Table 9 shows a permanent impact to 0.22 acres of wetlands, please address how you intend to maintain the functional level of wetlands on site.*

    a. Of the 0.22 acres, 0.09 acres are associated with a manmade pond (Wetland C & Open Water 1). The remainder (Wetlands H, I, & J) are associated with buried streams, and typically seem to be the result of prior manmade manipulation, and failing subsurface manmade drainage features. We anticipate that stream restoration efforts, as well as the removal of artificial drainage features (pipes, rock conduits) as proposed, are likely to result in new linear wetland features within the restoration area with similar characteristics as the existing wetlands H, I & J, although it is not possible to say where and to what extent these will occur. We maintain that the loss of these wetland features would also result naturally, if maintenance of the buried streams was halted and streams cut down to redevelop their historic channels.

Furthermore, the site has multiple natural seep areas, many of which Wildlands has made extra land purchases to include within the conservation easement (notably Wetlands F & K) in order to enhance and ensure permanent protection of their functions, including the protection of downstream water quality. We also anticipate that the functions of Wetland G will be enhanced by proposed activities within the easement. Given the nature of the impacts, and the efforts to enhance other on-site areas as described above, Wildlands does not propose additional efforts or monitoring.

4. *Table 23- given the amount of planting that is planned for reaches UT1, UT2, UT5 and UT6, DWR requests several vegetation plots (either fixed or random) be planned for these reaches throughout the monitoring period.*

    a. Wildlands was already proposing one permanent plot for UT1 & UT2 which should be representative of performance in the open planting area for both of those streams. We will add one random vegetation plot within in the UT1 & UT2 easement area to track planting of other areas within the easement. Similar to as described below, many of the areas proposed for planting in the UT1 & UT2 stream corridors are presently in partial canopy and may be better suited for visual assessment rather than stem count and height metrics. Within the UT5 & UT6 corridors, Wildlands is anticipating that the majority of the planting will be supplemental to existing canopy and consist primarily of understory plantings. Table 23 of the mitigation plan states in footnote 4 that, "Planted shaded areas will be visually assessed with permanent vegetation photo points along UT5 and UT6". We believe that visual assessment is a suitable metric given that height criteria would not be applicable for understory planting areas, and that visual assessment can be used to identify a lack of understory woody species establishment and can be used to conduct adaptive management and replanting as necessary.

5. *Design sheet 2.1.8- is there an existing pipe or just subterranean flow above UT8? Interesting to start the stream reach at a headwall in the middle of a pasture in no apparent crenulation.*

    a. As with other stream valleys on the site, UT8's valley has been modified. Wildlands describes our assessment of historic manipulation in Section 3.2.1 (page 6) of the mitigation plan and in Section 3.4.1 (page 12), where our understanding is stated that "UT8 is buried either in a pipe or manmade rock conduit". The broad valley bottom is understood to be the result of prior manipulation. Wildlands is proposing to gage UT8 for the purpose of demonstrating consecutive flow requirements stated in the Wilmington Mitigation Guidance (2016).

6. *Given the slope and design of the structures, there will be a lot of rock needed for this site. Does WEI plan to mine the rock on-site or go off site to obtain the rock?*

    a. WEI anticipates that rock will come from both on-site and off-site to meet the needs of the project. On-site rock will be used as much as possible, and where off-site rock is imported, it will be capped with on-site rock material.

7. *Design sheet 2.1.13- Does WEI/DMS have any concerns about maintenance of flow for this reach (UT3 reach 2) given that it appears to be moved upslope away from the crenulation and the wetland?*

    a. As stated in mitigation plan Section 3.4.1 (page 11), UT3 Reach 2 "is ditched across the valley slope to the right edge of the adjacent valley". This is the location of wetlands G & F which are in large part the result of this prior ditching of Reach 2's flow outside of its natural valley. The proposed approach is to return it to its natural valley. Test pits along the proposed stream alignment have indicated subsurface flow which will support the hydrology of Reach 2 along with the return of its surface water baseflow to its original valley.

Kim Browning, USACE:

1. *It's recommended to place a veg plot on the south side of UT3 in the vicinity of wetland F.*
    a. Wildlands decided to protect wetland F as an ancillary activity to stream restoration efforts in order to exclude direct impacts from cattle. While we propose to plant this area, a vegetation plot is already proposed for the north side of UT3 in this vicinity. Wildlands proposes that at our discretion this plot may be designated as one of the three proposed mobile plots, and that as such, the plot could be placed on the south side of UT3 for one or more sampling events. The south side of UT3 also has some tree canopy in the area of wetland F.

2. *There appears to be two crossings planned in close proximity to each other on reach 5 of Shake Rag Branch. Is it possible to combine these into one crossing?*
    a. This crossing configuration was proposed in the initial concept submitted and reviewed as part of the IRT site walk at the onset of the project. Each landowner requested a crossing on their parcel which was the impetus for having two crossings instead of one. For this reason it is not possible to combine the two crossings.

3. *Even though there are no wetland credits being sought, and existing wetlands are fairly small, there will be permanent impacts to these wetlands during construction. It is anticipated that overall wetland function will improve from increased hydrology from stream restoration activities; however, it is recommended that wetland gauges be installed and monitored in order to demonstrate no functional loss and/or acreage loss of wetlands with this project.*
    a. Wildlands refers the reader to the response to Mac Haupt's comment #3 within this response letter. Wildlands does not think that it would be reasonable to use groundwater gaging for such small wetlands and for future wetlands that develop as a result of proposed activities.

4. *A step-pool stormwater BMP is planned on UT4. Please provide a brief narrative of any maintenance required for the BMP, if any.*
    a. No regular maintenance is anticipated for this BMP. We have included in Section 8.0 that visual assessment will include assessment of BMP stability and remedial action as required. This feature will be constructed as a self-maintaining vegetated channel.

5. *Please make sure to include a statement regarding the existing outhouse located within the easement.*
    a. It is already stated in mitigation plan Section 3.4.2 (page 14), that the "outhouse … will be removed as part of the project".

6. *Section 8 – Performance Standards: The RFP date is 09/16/16, but regardless of the date, it's recommended to use the Wilmington District Mitigation Guidance from Oct 2016, rather than the 2003 guidance (this is referenced in several sections of Section 8). Associated with that, there should be 4 bankfull events in the performance standards and credit release schedule, and monitoring should occur for 7 years.*
    a. *Section 8.2: monitoring should occur for seven years, and the vigor standards should be 7' high at year 5 and 10'high at year 7.*
    b. *It would be helpful to see the location of the photo reference stations on the monitoring map, figure*

       (response to initial paragraph) - Wildlands has updated the bankfull event performance standard to 4 bankfull events over 7 years, occurring in separate years. We have updated Section 8.1.4 to reflect guidance requirements, and this section and footnote 4 in Table 22 to clarify to clarify that bankfull performance standards are not applicable to UT8, which is less than 300 feet in length, but that consecutive flow requirements will be monitored with gaging or other suitable methods.

    a. (response to comment "a") - The comment refers to the requirements for Coastal and Piedmont sites; however, Shake Rag is a Mountain site and the height requirements stated in Section 8.2 are consistent with those required in the 2016 guidance for Mountain counties.

    b. (response to comment "b") - Photo reference stations will be provided on annual monitoring report maps but are typically not included as part of the mitigation plan monitoring map.

7. *If cattle are going to be present on site and have use of the crossings, maintenance of these crossings should be addressed. Perhaps adding this to the Monitoring section and the long-term management section would be beneficial. In addition, will the water lines that cross UT5 and UT6 require maintenance or replacement at some point?*
    a. Section 10.0 of the mitigation plan states that, "maintenance of the proposed fencing and permanent crossings will be the responsibility of the landowner". Some of the crossings are for cattle use, but many are not. Additionally, cattle use of cattle crossings is anticipated to be infrequent. Wildlands has also added to Section 8.0 that visual assessment of stream crossings will be part of semi-annual visual assessment in order to ensure that crossings become well established stable components of the project.
    b. The water line crossing UT6 has been in existence for several years. The owner has indicated that water lines constructed with similar materials have been in existence on the farm for several decades with no maintenance or replacement required to date. The purpose of the easement is to provide access to the water lines in such case that future maintenance or replacement becomes necessary. The standard waterline material on the farm consists of 2" PVC and does not require significant disturbance to install (it is typically placed at 12-24" depth).

8. *Please notify the Corps when construction begins for this project.*
    a. Wildlands will notify the Corps when construction begins.

FINAL MITIGATION PLAN

SHAKE RAG MITIGATION SITE

Madison County, NC
NCDEQ Contract No. 7190
DMS ID No. 100018
French Broad River Basin
HUC 06010105

USACE Action ID No. SAW 2017-01570

PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

PREPARED BY:

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Charlotte, NC 28203
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This mitigation plan 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.

These documents govern DMS operations and procedures for the delivery of compensatory mitigation.

Contributing Staff:

Jake McLean, PE, CFM, *Project Manager, Design*
Shawn Wilkerson, *Principal in Charge*
Ian Eckardt, PWS, *Wetland Delineations*
Scott Gregory, GISP, PLS, *Mitigation Plan Development, Design*
Mimi Caddell, *Environmental Scientist*
Jacob Wiseman, EI, *Design, Construction Documents*
Emily Reinicker, PE, CFM, *Lead Quality Assurance*

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APPENDICES

1.0 Introduction

The Shake Rag Mitigation Site (Site) is in Madison County approximately 19 miles north of Asheville and 4 miles northeast of the town of Mars Hill (Figure 1). The Site is within the NC Division of Mitigation Services (DMS) targeted watershed for the French Broad River Basin Hydrologic Unit Code (HUC) 06010105110020 and the NC Division of Water Resources (DWR) Subbasin 04-03-04, and will provide stream mitigation credits in the French Broad River Basin HUC 06010105 (French Broad 05).

The Site contains Shake Rag Branch and nine unnamed tributaries which all flow to Middle Fork Little Ivy Creek. Middle Fork Little Ivy Creek joins California Creek to form Little Ivy Creek in the Beech Glen community. Shake Rag Branch and Middle Fork Little Ivy Creek are noted in the 2014 North Carolina Integrated Report as WS-II (Water Supply Watershed) and HQW (High Quality Waters).

In general, the Site encompasses three primary drainage areas that are comprised of smaller valleys. The three primary drainage areas are Shake Rag Branch, UT1, and UT6 (Table 2 and Figure 3). All project stream reaches within these drainages originate from steep, forested headwater valleys before transitioning to open pastureland situated in wider valley bottoms further downstream. Shake Rag Branch's valley begins as a steep, colluvial, V-shaped valley, which gradually widens and gains an alluvial bottom moving downstream. UT1A, UT3, UT4, and UT8 have steep valleys with much broader valley bottoms, while UT1, UT2, UT5, UT6, and UT7 flow through steep, colluvial, V-shaped valleys for their entire length in the project area.

The Site is currently in hay production in the valley bottom, with cattle grazing occurring up the main and tributary valleys, then transitioning to wooded as valleys steepen, with cattle access to portions of wooded areas as well. Riparian buffers are absent except high in the steepest portions of the site. The streams throughout the Site are in various stages of impairment related to the current and historical agricultural uses. Many of the streams were buried in rock-lined channels or pipes approximately 50 years ago. The project proposes to restore, enhance, and preserve 9,273 linear feet (LF) of streams. One Best management practice (BMP) is proposed to treat grazed cattle areas upstream of their confluence into the jurisdictional portion of the stream. The existing streams are presented in Figure 2. The work proposed on the Site will provide 6,655.6 stream credits and will be protected in perpetuity by an 18-acre conservation easement. The Site Protection Instrument detailing the proposed terms and restrictions of the conservation easement is in Appendix 1.

Table 1: Project Attribute Table Part 1 – *Shake Rag Mitigation Site*

Project Information	
Project Name	Shake Rag Mitigation Site
County	Madison
Project Area (acres)	18
Project Coordinates (latitude and longitude)	35° 52' 41"N 82° 29' 47"W
Planted Acreage (acres of woody stems planted)	13.8

2.0 Watershed Approach and Site Selection

The Site was selected based on its potential to support the objectives and goals of multiple conservation and watershed planning documents, outlined below.

- Shake Rag Branch and Middle Fork Little Ivy Creek are noted in the 2014 North Carolina Integrated Report as WS-II (Water Supply Watershed) and HQW (High Quality Water).

- Little Ivy Creek and Ivy Creek, which are receiving waters for the Site, are on the 2016 draft 303 (d) list for exceeding criteria for fecal coliform.
- The 2009 French Broad River Basin Restoration Priorities (RBRP) listed major stressors in the basin as excess fecal coliform bacteria, nutrient enrichment, habitat fragmentation from impoundments, and habitat degradation associated with sedimentation, streambed scour, and streambank erosion. Additionally, the RBRP lists toxic impacts from point sources and agricultural related non-point sources as significantly impacting biological communities.
- The French Broad River basin is discussed in the 2005 North Carolina Wildlife Resource Commission's (NCWRC) Wildlife Action Plan (WAP). In the report, it is noted that habitat degradation resulting from non-point source pollution is the most widespread problem within the basin. The WAP discusses the importance of habitat conservation and restoration to address current problems affecting species and habitats.

Restoration of the Site streams will directly and indirectly address stressors identified in the RBRP and the WAP by protecting stable headwater streams, uncapping streams buried by man, reducing or eliminating agricultural non-point source pollution through cattle exclusion, restoring a forest to agriculturally maintained buffer areas, and removing an inline impoundment. These actions will reduce fecal, nutrient, and sediment inputs to project streams, and ultimately to Little Ivy Creek and Ivy Creek, as well as reconnect instream and terrestrial habitats on the Site. Restoration of the Site is directly in line with recommended management strategies outlined in the French Broad RBRP. Approximately 18 acres of land will be placed under permanent conservation easement to protect the Site in perpetuity.

3.0 Baseline and Existing Conditions

The Site watershed is in the northeastern portion of the French Broad 05 river basin. It is situated in the rural mountain countryside in Madison County near Mars Hill, NC. The following sections describe the existing conditions of the Site, watershed, and watershed processes, including disturbance and response.

Table 2: Project Attribute Table Part 2 – *Shake Rag Mitigation Site*

Project Watershed Summary Information			
Physiographic Province	Blue Ridge		
Ecoregion	Southern Crystalline Ridges and Mountains		
River Basin	French Broad River		
USGS HUC (8 digit, 14 digit)	06010105, 06010105110020		
NCDWR Sub-basin	04-03-04		
Project Drainage Area (acres)	70 (UT1), 163 (Shake Rag Branch), 43 (UT6)		
Project Drainage Area Percentage of Impervious Area	< 1%		
2011 NLCD Land Use Classification	UT1 Drainage	Shake Rag Branch Drainage	UT6 Drainage
Forest	95%	49%	99%
Pasture/Hay	5%	49%	1%
Shrubland	0%	1%	0%
Urban	0%	1%	0%

3.1 Landscape Characteristics

3.1.1 Physiography and Topography

The Site is located in the Blue Ridge Belt of the Blue Ridge physiographic province. The Blue Ridge Province is characterized as a mountainous area with steep ridges and valleys and elevations ranging from 1,500 to over 6,000 feet above sea level. The Site topography, as indicated on the Bald Creek, Sams Gap, Mars Hill, and Barnardsville, NC USGS 7.5 minute topographic quadrangles, shows steeply sloped valleys generally running northwest to southeast throughout the Site (Figure 3). The Site topography and relief are typical for the region, as illustrated in Figure 4.

3.1.2 Geology and Soils

The Blue Ridge Belt contains a combination of igneous, sedimentary, and metamorphic rocks that have been repeatedly heated and deformed through such processes as folding, faulting, and fracturing. The underlying geology of the Site is mapped as middle Proterozoic age (1.2 billion years in age) migmatitic biotite-hornblende gneisses (Ymg). The unit is described as layered biotite-granite gneiss, biotite-hornblende gneiss, amphibolite, and calc-silicate rock that locally contains relict granulite facies rock (NCGS, 1985).

Soil mapping units are based on the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Soil Survey for Madison County. Soils in the project area flood-prone areas and adjacent uplands are mapped as Buladean-Chestnut complex (BnE & BnF), Evard-Cowee complex (EvD2 & EvE2), Toecane-Tusquitee complex (TsD & TsE), and Tusquitee-Whiteside complex (TwC). All soils listed are characterized as well drained soils and are described below in Table 3; a soils map is provided in Figure 5.

Table 3: Project Soil Types – *Shake Rag Mitigation Site*

Soil Name	Description
Buladean-Chestnut complex, 30 to 50 percent slopes, stony	These soils are well drained and deep to moderately deep. Slopes of 30 – 50%. Shrink-swell potential is low and is located on summits and side slopes. Consists of 50% Buladean soil, 40% Chestnut soil, and 10% dissimilar inclusions.
Buladean-Chestnut complex, 50 to 95 percent slopes, stony	These soils are well drained and deep to moderately deep. Slopes of 50 – 95%. Shrink-swell potential is low and is located on side slopes. Consists of 50% Buladean soil, 40% Chestnut soil, and 10% dissimilar inclusions.
Evard-Cowee complex, 15 to 30 percent slopes, moderately eroded	Found on the summits and upper side slopes of ridges and mountain slopes, these soils are generally well drained and moderately eroded. Slopes of 15-30%. Consists of 55% Evard, 35% Cowee, and 10% dissimilar inclusions. They are loamy soils with low shrink swell potential.
Evard-Cowee complex, 30 to 50 percent slopes, moderately eroded	Found on the summits and back slopes of ridges and mountain slopes, these soils are generally well drained and moderately eroded. Slopes of 30-50%. Consists of 55% Evard, 35% Cowee, and 10% dissimilar inclusions. They are loamy soils with low shrink swell potential.
Toecane-Tusquitee complex, 15 to 30 percent slopes, very bouldery	These soils are located on head, foot, and toe slopes of low and intermediate mountains. The soils are very deep and well drained with slopes of 15-30%. They are composed of 45% Toecane, 45% Tusquitee, and 10% dissimilar inclusions.
Toecane-Tusquitee complex, 30 to 50 percent slopes, very bouldery	These soils are located on head and foot slopes of low to intermediate mountains. They are well drained and have slopes of 30-50%. Composition is 55% Toecane, 35% Tusquitee, and 10% dissimilar inclusions. Shrink-swell potential is low.
Tusquitee-Whiteside complex, 8 to 15 percent slopes	These soils are located in mountain valleys of intermountain hills and low mountains and are very deep, loamy, and moderately to well drained. Shrink-swell potential is low and slopes are 8-15%. Composition is 55% Tusquitee, 35% Whiteside, and 10% dissimilar inclusions.

3.2 Land Use/Land Cover

Land use and land cover, both past and present, were investigated throughout the Site and its watershed using historical aerials from 1956 to 2016, and through the watershed reconnaissance survey conducted between February and September 2018. Future land use potential was examined by reviewing the Madison County zoning boundaries and the Madison County Comprehensive Plan, which is a guide to future growth and development approved by the county in May 2010 (Madison County, 2010). Historic aerials are presented in Appendix 4.

3.2.1 Historical Aerial Review

Land uses draining to the project reaches are primarily forest within the upstream project limits, and pasture and hay fields in the lower portions of the valleys. The review of historic aerials revealed that the valley bottoms and lower valley side slopes of the Site have been in agricultural production (either hay or pasture) since at least 1956 with relatively little change in land use configuration to date. However, changes to hydrology and riparian corridors in these lower valley open areas over time has diminished the extent and function of aquatic resources of project stream reaches on Site.

Specific impacts to hydrology and riparian corridors include the relocation, burying, piping, and impounding of streams, the clearing of streamside native riparian vegetation, and increased cattle access to streams. UT4, and a large portion of Reach 3 of Shake Rag Branch, were buried in rock-lined trenches, or pipes, by the landowner's father over 50 years ago (R. Thomas, personal communication, December 29, 2017). In addition, during this time period, UT3 was ditched across to the adjacent valley at the bottom of Reach 1. A large portion of the downstream length of UT3 Reach 2 was buried, including its confluence with Shake Rag Branch. UT3 is being returned to its historic alignment down the center of the valley where the proposed alignment is shown (in Figures 6a and 6b).

UT8 – original channel alignment and confluence with Shake Rag Branch in 1965

Prior to 1988, UT8 flowed into Shake Rag Branch (Reach 3) approximately 300 LF upstream of its confluence with UT3 (Reach 2). Historical aerials between 1956 and 1976 show that the channel was bordered by a house located just down valley from the current location of the pond in the left terrace of UT8. UT8 was impounded between 1988 and 1989, and piped across and down an adjacent valley to where it currently outlets today (between Reaches 4 and 5 of Shake Rag). According to the land owner, multiple repairs have been made to the buried conveyance over the years which is evident on the 2014 aerial imagery base map used in Figures 2 and 6.

Historical aerials suggest, and the land owner verified, that a wet area used to occupy the right terrace of Shake Rag Branch (Reach 5) at the confluence of UT4. During this time, UT4 was bordered by a narrow, fragmented buffer and flowed past a small structure (likely a springhouse) located alongside the right valley wall before entering a broad saturated area in the right terrace of Shake Rag Branch. The wet area widened as it approached Shake Rag Branch, and was situated between the existing crossing on Reach 5 of the mainstem and a pre-existing home site located downstream. It appears that a portion of Shake Rag Branch Reach 5 was shifted away from the low point of the valley into the right terrace to accommodate a level site to build the home. The house has since been removed and the channel has been realigned alongside the gravel road which has afforded access through the center of the Shake Rag valley for over 60 years. The springhouse structure has also been removed, but the former terrace wet

area now drains to Shake Rag Branch via three conveyances: a short section of open channel and two small PVC pipes (from which one is connected to a spring box).

In 1956 the riparian buffer along the entire length of Reaches 2, 3, and 4 of Shake Rag Branch, and UT3 Reach 2, was moderately wide and intact. By 1965, the buffer narrowed considerably within the upper Shake Rag Branch valley to accommodate additional pasture area within the upstream limits of Reach 3 and downstream limits of Reach 2. By 1981, most of the riparian corridor along these two reaches was devoid of vegetation. Between 1956 and 1965, the ridge and valley slope along the left terrace of UT8 was clear cut of vegetation, and the entire valley bottom between UT8 and Shake Rag Branch was graded and converted for hay production; additional hay fields were also created further down valley along the left terrace of the mainstem and up its valley wall.

Pre-existing house and terrace wetland area in 1965 at the confluence of UT4 and Shake Rag Branch

Agricultural land use practices on Site appeared to be most intensive between 1989 and 1993. Logging roads within the upper forested valleys of all three drainages of the Site appeared well-maintained and in high use. The majority of the mid to lower valley of the Shake Rag drainage was denuded of riparian vegetation except for the mature cluster of trees that currently sit atop the ridge along the right bank of Reach 4 of Shake Rag Branch. In 1993, it's evident that cattle were frequently using Reaches 3 (upper reach) and 4 of Shake Rag Branch for wallowing areas.

Land use change involving impacts to hydrology and riparian areas was not as widespread in drainages UT1 and UT6 compared to that of tributaries comprising the Shake Rag Branch drainage. Beyond the clearing of small patches of forest between 1965 and 1989, riparian buffers for these two drainages remained fairly intact. By 1965, the lower valley bottom of UT2 (Reach 2) was cleared in proximity to its confluence with UT1. Between 1965 and 1989, clearings for additional pasture area within the UT5 watershed continued to expand further up valley, especially along the left valley wall and left terrace.

3.2.2 Current Land Use

As previously mentioned, the Site is located in a Water Supply Watershed (WS-II) which is predominantly undeveloped. The Site is currently located on three parcels owned by members of the Thomas family that are zoned as R-A, or Residential—Agricultural. The Thomas family leases the land to a tenant farmer who grows hay in the valley bottoms and maintains the valley side slopes for cattle pasture. Higher in the valleys, above the maintained cattle pastures, the valleys are steep and forested. Cattle have free roam of the woods and pastures, and are currently only restricted from accessing the hay fields and a fenced area of an existing United States Department of Agriculture (USDA) Conservation Reserve Enhancement Program (CREP) easement downstream of the project stream reaches. Immediately upstream of the UT1/UT1A confluence in the right terrace of UT1, is an old log cabin occasionally used by family members as a vacation retreat. Dense tree canopy within historical aerial images made it difficult to discern when this structure was built.

3.2.3 Future Land Use

The Site is located less than a mile from the US 19 Highway corridor which underwent widening within the past five years and is proposed as a 'Mixed Use Commercial Corridor' zone in the future land use plan for Madison County (2010). However, several reaches of Middle Fork Little Ivy Creek which parallel this highway corridor in proximity to Shake Rag Branch Road are protected by conservation easements from NCDOT on-site stream mitigation in response to the recent improvements to the transportation

corridor. These easement areas are protected from development in perpetuity and would thus limit the extent and density of mixed use commercial development proposed along this highway corridor. Low density residential development potential exists in the lower portions of the valley but would have minimal or no effect on the Site streams; the landowner is also considering other conservation options which could enhance site protection.

3.3 Existing Vegetation

Riparian buffers are largely absent from Site streams in the wider valley bottoms and consist of pasture grass species in the cattle pastures and sown hay in the hay fields. Some invasive species are present at the fringe between forested areas and pasture including: tree-of-heaven (*Ailanthus altissima*), princess tree (*Paulownia tomentosa*), multiflora rose (*Rosa multiflora*), wineberry (*Rubus phoenicolasius*), Chinese silvergrass (*Miscanthus sinensis*), Chinese privet (*Ligustrum sinense*), creeping Charlie (*Glechoma hederacea*), Japanese honeysuckle (*Lonicera japonica*), and English Ivy (*Hedera helix*). In the forested areas, the canopy is primarily American beech (*Fagus grandifolia*), green ash (*Fraxinus pennsylvanica*), northern red oak (*Quercus rubra*), and black walnut (*Juglans nigra*). The understory contains spicebush (*Lindera* sp.), black cherry (*Prunus serotine*), and sapling species of tulip poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), and American beech. Herbaceous species include jewelweed (*Impatiens capensis*), poison ivy (*Toxicodendron radicans*), Christmas fern (*Polystichum acrostichoides*), Japanese stiltgrass (*Microstegium vimineum*), and false nettle (*Boehmeria cylindrical*).

3.4 Project Resources

Wildlands investigated on-site jurisdictional waters of the United States (US) within the proposed project area. Potential jurisdictional areas were delineated using the US Army Corps of Engineers (USACE) Routine On-Site Determination Method. This method is defined by the 1987 Corps of Engineers Wetlands Delineation Manual and the subsequent Eastern Mountains and Piedmont Regional Supplement. Streams were classified using North Carolina Division of Water Resources (NCDWR) Classification Forms. Jurisdictional waters of the US were surveyed for inclusion on plans and figures. NCDWR stream identification forms are in Appendix 3. Wetland determination forms representative of on-site jurisdictional areas as well as non-jurisdictional upland areas are included in Appendix 2.

The results of the on-site field investigation indicate there are 10 potential jurisdictional streams located within the proposed project area: Shake Rag Branch and nine unnamed tributaries (UT1, UT1A, UT2, UT3, UT4, UT5, UT6, UT7, and UT8). In addition to streams, 11 potential wetlands (A – K) and one open water (pond) were also delineated.

Shake Rag Branch is the primary drainage and flows south through the center of the Site. Four of its headwater tributaries (UT3, UT4, UT7, and UT8) join Shake Rag Branch within the Site limits. The UT1 drainage area includes UT1, UT1A, and UT2. UT1A and UT2 join UT1 within the Site limits on the northern portion of the Site and flow southeast off the Site to join Middle Fork Little Ivy Creek. The UT6 drainage area consists of UT6 and UT5. UT5 joins UT6 within the project limits before flowing east into a USDA CREP easement to Shake Rag Branch downstream of the Site. Shake Rag Branch continues to flow south below this confluence to join Middle Fork Little Ivy Creek. There are multiple NC Department of Transportation (DOT) mitigation sites on Middle Fork Little Ivy Creek that are located both upstream and downstream of the Shake Rag Branch confluence near US Highway 19 (Figure 1).

These resources are discussed below by their location within the Site. Tables 4 through 7 provide a summary of water resources within the project limits. Existing conditions of the Site are also illustrated in Figure 2. Reach specific cross sections and geomorphic summaries for stream reaches proposed for restoration and enhancement are provided in Appendix 4.

3.4.1 Resources within the Shake Rag Branch Drainage

Project reaches from the Shake Rag Branch (SRB) drainage generally emanate from valleys that are forested, V-shaped, and colluvial. Overall valley slopes of these reaches range from 7% to 30% between the valley bottom and headwaters, respectively. Wetlands F, G, H, and I are located within the Shake Rag Branch drainage and are summarized in Table 7 of section 3.4.4.

SRB Reach 1

SRB Reach 1 is the headwaters of the mainstem and emanates from a steep, confined, wooded valley. The upstream project reach limits begin approximately 150 LF downstream of an unpaved forest road. The channel exhibits a stable step-pool morphology. The channel is characterized by a succession of bedrock and boulder cascades until its confluence with UT7 which constitutes the upstream reach limits for SBR Reach 2.

SRB Reach 2

SRB Reach 2 originates in a confined, wooded valley at the confluence of UT7 and SRB Reach 1, where the valley slope decreases from 30% to 23% and channel substrate transitions to a mix of boulders, large cobble, and gravel. The forested portion of the reach is geomorphically stable and classifies as a Rosgen A4a+ type stream per Cross Section 11 (XS11). Halfway downstream along the project reach, the channel enters a maintained pasture with a wider and flatter valley (15% slope) and becomes moderately unstable vertically. Within the pasture, channel profile and dimension are impacted from past cattle trampling and the placement of woody debris in the channel by the land owner—the channel narrows, becomes shallow, and much less entrenched; bed and banks become less defined, and channel flow becomes diffuse and multi-threaded in some areas. The woody debris disposal area covers the downstream half of the reach, extending from within the forested area to the pasture downstream. The downstream half of the project reach is bordered by an unpaved forest road located approximately 25 feet from the left top of bank. Invasive vegetation, such as tree of heaven, is widespread within this short project reach especially in proximity to the wood-line.

SRB Reach 3

SRB Reach 3 originates from within the woody debris pile covering the channel and flows through the pasture before intersecting an existing fence that separates the pasture from the hay field downstream. Flow through the pasture is subsurface in some areas including a portion of the channel which flows through wetland H and under two additional piles of woody debris upstream of the fence line. Within the pasture, the stream drops over a succession of several active headcuts (one to two-feet in height) and alternates between incision with vertical banks followed by aggraded sections of channel with low but trampled banks. Wetland H coincides with a cattle wallowing area where sediment fines have settled out and aggraded over time due to backwater conditions caused by constricted flow at the fence line where the channel drops into a buried, rock-lined conduit before continuing downstream through the hay field. The valley slope of Reach 3 gradually decreases from 13% from within the upstream pasture to 10% at the downstream project reach limits within the hay field. Cross Section 10 (XS10) was collected in the pasture upstream from wetland H. The reach generally classifies as a Rosgen A4a+ stream type but exhibits a high entrenchment ratio of 7.5 due to cattle trampling and valley grading.

The majority of SRB Reach 3 flows through the hay field and is buried. Topography contours from the recent field survey indicate that the buried conduit is aligned due south from the pasture and into the hay field for approximately 130 LF. The conduit then outlets beyond the fence bordering the hay field and into a short, 180 LF section of open channel nestled alongside the right edge of the valley (wetland I). Flow for the remainder of the reach returns subsurface through another buried conduit until it outlets downstream of the UT3 confluence through a series of three RCPs which constitute the downstream limits of Reach 3. Rill erosion has formed a new channel in some spots above the buried stream

upstream of the culverts. The concrete culverts were placed in the channel in preparation for continuing the buried condition of the stream. The pipes were never joined and backfilled, and the stream eroded around the pipes. Stream banks are relatively stable with only a few areas of scour despite the presence of the pipes in the center of the channel. However, the pipes prevent the formation of appropriate bed features and likely function as a barrier to aquatic species passage.

During saturated soil conditions, seeps were observed in the left terrace, emanating from the middle of the hillside located southwest of the pond impounding UT8. These seeps drain to the Shake Rag mainstem channel via a grassy, swale-like conveyance, or pond overflow channel, that cuts across the subwatershed boundary located between UT8 and the mainstem. Historical aerials from 1955 through 1965 suggest that UT8 was originally aligned with this overflow channel, connecting to the mainstem approximately 350 LF upstream of the UT3 confluence before it was impounded and piped down valley. This pond overflow channel also appears to serve as a light-duty farm road.

Numerous sinkholes (or groundhog borings as reported per the landowner) are evident within the lower half of the reach within the hay field upstream and downstream of the UT3 confluence. Stream flow was field-verified at four of these sinkholes based on visual or audible evidence and are shown on Figure 2. These four sinkholes are clustered together consecutively along the (buried) Reach 3 corridor upstream of the UT3 confluence just downstream of where UT8 originally appeared to empty into the mainstem.

SRB Reach 4

SRB Reach 4 originates at the outlet of the downstream most culvert of SRB Reach 3 and terminates just upstream of the (buried) UT8 confluence. Downstream of the culvert outlet, the channel continues to flow alongside the steep hillslope on the right edge of the valley for most of the reach. Historical aerial photos from the early 1990's suggest this reach is a remnant cattle wallow area which is evident from the extensive trampling along the bed and banks, variability in channel dimension, and sections of subsurface flow. Per Cross Section 9 (XS9), the channel classifies as a Rosgen A4/B4a type stream; but like Reach 3 further upstream, Reach 4 exhibits a high entrenchment ratio (2.9) due to prior alteration of the valley. In many areas channel width and depth narrow considerably, and flow becomes subsurface and multi-threaded through macropores. The channel flows through a moderately confined alluvial valley with a higher sinuosity than other reaches on Site (1.07) as the valley slope has decreased (to 10%) and the channel has more access to its flood-prone area. The profile contains a few long and vertically unstable steep riffle sections that are indicative of ongoing channel adjustment. The tall, steep hillslope along the right bank faces northeast, and along with a mature vegetated canopy from atop the ridge, provide ample channel shading throughout most of the day.

Reach 4 contains a few seeps that originate from the left bank or flood-prone area and are shown Figure 2. These seeps are most likely a combination of remnant voids or macropores from prior iterations of channel and terrace alteration for UT8 and the mainstem over time.

SRB Reach 5 – channel incision and bank erosion downstream of UT4 confluence

SRB Reach 5

SRB Reach 5 begins at the UT8 confluence and extends to the lower project limits of the Site, downstream of the UT4 confluence. The channel has been shifted up against the valley wall for most of its length. It is located alongside the right valley wall upstream of UT4 and alongside the left valley wall downstream of UT4. A gravel road borders the top of left bank for the entire reach length and traces of gravel and fines from the road are

present in the channel. An overhead electric utility easement intersects the proposed easement boundary within the downstream reach limits.

Unlike Reach 4, which has a moderate flood-prone width just upstream, Reach 5 is confined between the road and valley wall throughout its length and increasingly becomes more incised further down valley. Vertical and lateral channel instability become especially apparent immediately downstream of a ford that crosses Shake Rag Branch above the UT4 confluence. Cross Section 8 (XS8) was collected downstream of the ford and reported a bank height ratio of 3.1. The channel classifies as an unstable Rosgen A4 type stream. Vertical, eroding banks and small active headcuts are observed throughout the remainder of the reach downstream of the ford.

UT3 Reach 1

UT3 Reach 1 originates as a perennial stream about 250 LF downstream of a forest road crossing. Approximately 100 LF downstream of its upper project limits, UT3 Reach 1 appears to have been pushed against the left edge of the valley sometime in the past, likely from landslide activity which is evident through surface expressions. The channel is confined within a V-shaped, colluvial valley and has an overall valley slope of 18%. The stream exhibits stable banks and step-pool morphology with small gravel and cobble substrate and isolated boulders or bedrock in the bed and banks. Riparian vegetation consists of a mix of forest and pasture. The understory and mid-canopy vegetation are very minimal due to past cattle grazing especially along the right terrace. The project reach classifies as a Rosgen A4a+/B4a stream type. The high width-to-depth ratio (16.3) reported by Cross Section 14 (XS14) is most likely due to combination of cattle trampling and recent tree or large woody debris removal from the channel.

UT3 Reach 2

UT3 Reach 2 begins where the vegetation transitions from a mix of forest and pasture to entirely pasture and the valley gradually widens. The stream is ditched across the valley slope to the right edge of the adjacent valley and continues flowing alongside the right valley wall until its confluence with SRB Reach 3. As part of this ditching, a berm was constructed off the left bank.

Two small linear wetlands, G and F, were mapped within the upper half of the reach. Both wetland areas are located outside of the proposed easement boundary. Wetland F extends between Reaches 1 and 2 of UT3, beyond the right terrace, in a small, adjacent valley where the channel was bermed and ditched across the valley. Wetland F emerges from below a relict landslide feature and may have been a previous alignment of the Reach 1 channel. Wetland G is located further downstream where the ditched channel outlets into the adjacent valley, or the right edge of the UT3 valley. Flow in the channel becomes diffuse and eventually subsurface as it flows through wetland G and the wetland area broadens down valley. Surface flow returns approximately 130 LF downstream of wetland G where its existing and original valley converge, and discernable bed and bank channel features become re-established.

Ditching of UT3 Reach 2 across the valley

For the next 330 LF downstream, the channel becomes very incised with vertical, eroding banks. Cross Section 13 (XS13) reported a bank height ratio of 2.7 and the project reach classifies as a Rosgen A4a+ stream type. Grade control, to help minimize the upstream migration of the numerous active headcuts observed throughout this subreach, was scarce. Pools were typically narrower in width than riffles and silted in with eroded sediment.

Three sinkholes mapped along UT3 Reach 2 were verified to contain subsurface stream flow. One is located midreach and is centered in the low point of the original valley. The other two are located immediately upstream of the confluence with the Shake Rag Branch. Baseflow abruptly ends and returns subsurface at one of the sinkholes located in the existing channel approximately 100 LF above UT3's confluence with Shake Rag Branch; surface flow within this section of channel has been observed during saturated conditions where rill erosion has formed a new channel in some spots above the buried stream. There is one cattle drinker located near the confluence of UT3 and the mainstem within the center of the valley where the terraces of both reaches converge.

UT4

UT4 originates from a springhead in a small pasture at the base of several small converging valleys. The stream is buried in a rock-lined trench through a hay field to the stream's confluence with SRB Reach 5. UT4 flows through approximately 30 LF of incised, open channel before its confluence with Reach 5 (approximately 100 LF downstream of the existing crossing on SRB Reach 5). The valley of UT4 has a broad bottom, is approximately 200 feet wide, and has an overall slope of 13%.

UT4 - piped

At least six sinkholes were mapped within the project limits of UT4. All the sinkholes were centered within the low point of the valley and most were located within 300 LF from the confluence with the mainstem (SRB Reach 5). About 200 LF downstream of the SRB Reach 5 and UT4 confluence, there are two 4-inch PVC pipes that drain the shared terraces between Reach 5 and UT4. The pipe further upstream flows from an old spring box that appears to convey flow from the UT4 drainage area. Halfway up the valley of UT4, a 1 ¼ inch metal pipe that conveys flow from a springhead extends from the valley toe along the right terrace. There is one cattle drinker located in the upper valley pasture just outside of the proposed easement boundary.

A cross section could not be collected to evaluate UT4 since it is buried.

UT7

UT7 is a small, headwater stream nestled in a narrow, wooded valley within the upper valley of the Shake Rag Branch drainage. The upstream project reach limits begin approximately 35 LF downstream of an unpaved forest road. Like SRB Reach 1, UT7 exhibits a steep, stable step-pool channel morphology comprised of bedrock and boulder cascades and rock slides. It flows into Shake Rag Branch at the Reach 1/Reach 2 break.

UT8

Most of UT8's flow originates from an upstream pond where its narrow headwater valley begins to broaden adjacent to the Shake Rag Branch mainstem valley. UT8 is buried either in a pipe or a man-made rock lined conduit from the base of the pond down to the valley bottom at the stream's confluence between SRB Reaches 4 and 5. UT8's valley has a broad bottom and is primarily in a hay field. The overall slope of the valley bottom is 9%.

A few sinkholes and seeps were identified that drain subsurface flow from the shared terraces between UT8 and Shake Rag Branch to Reaches 3 and 4 of Shake Rag Branch. These subsurface flow conveyance features are most likely a combination of remnant voids or macropores from prior iterations of channel

alteration within which flow from the UT8 buried channel has leaked over time. As previously mentioned, multiple repairs have been made to the buried conveyance by the land owner over the years due to piping (leaks).

A cross section could not be collected to evaluate UT8 since it is buried.

Table 4: Shake Rag Branch Drainage Project Attribute Table Part 3 – *Shake Rag Mitigation Site*

Reach Summary Information						
Parameter		**SRB Reach 1**	**SRB Reach 2**	**SRB Reach 3**	**SRB Reach 4**	**SRB Reach 5**
Existing Length of Reach (LF)		312	175	1,451[2]	385	1,216
Valley Confinement (confined, moderately confined, unconfined)		Confined	Moderately Confined	Moderately Confined	Moderately Confined	Moderately Confined
Existing Drainage Area (acres)		10	26	76	77	163
Perennial, Intermittent, Ephemeral		P	P	P	P	P
NCDWR Water Quality Classification		WS-II; HQW				
Stream Classification[1]	**Existing**	Not classified, preservation only	A4a+	A4a+	A4/B4a	A4
	Proposed		No proposed change in stream classification	A4a+/B4a	A4/B4a	A4/B4a
Evolutionary Trend (Simon)[1]		I	VI	II/III	V/VI	III/IV/V
FEMA Classification		None				

Reach Summary Information (continued)						
Parameter		**UT3 R1**	**UT3 R2**	**UT4**	**UT7**	**UT8**
Existing Length of Reach (LF)		426	1,387[2]	910[2]	428	210[2]
Valley Confinement (confined, moderately confined, unconfined)		Confined	Confined	N/A	Confined	N/A
Existing Drainage Area (acres)		12	38	32	13	19
Perennial, Intermittent, Ephemeral		P	P	P	P	P
NCDWR Water Quality Classification		WS-II; HQW				
Stream Classification[1]	**Existing**	A4a+/B4a	A4a+	Not classified, channel is piped	Not classified, preservation only	Not classified, channel is piped
	Proposed	No proposed change in stream classification	A4a+/B4a	A4a+/B4a		A4/B4a
Evolutionary Trend (Simon)[1]		VI	II/III/IV	II	I	II
FEMA Classification		None				

1. These channels have been heavily manipulated by man and may not precisely fit the classification category developed for natural streams using the Rosgen classification system (Rosgen, 1994). Results of the Rosgen stream classification system and the Simon Channel Evolution Model (Simon, 1989) are both provided for illustrative purposes only. Project stream reaches that are piped are categorized as Stage II in the channel evolution model to indicate that these channels have been disturbed or modified (channelized).
2. Some or all of SRB Reach 3, UT3 Reach 2, UT4, and UT8 have been buried in rock-lined channels or pipes. Reported lengths are estimates based upon land owner communication, remote sensing, and field verification to approximate the subsurface location and alignment.

3.4.2 Resources within UT1 Drainage

All three tributaries within the UT1 drainage originate in steep, colluvial, V-shaped valleys and transition to a wider valley bottom further downstream into what may be an inactive alluvial fan near their confluence. Overall valley slopes of these reaches range from 11% and 33% between the valley bottom and headwaters, respectively. Wetlands A, B, C, J, and Open Water 1 are located within the UT1 drainage and are summarized in Table 7 of section 3.4.4.

UT1 Reach 1

This reach is geomorphically stable and classifies as a Rosgen A4a+ stream type. Cattle access to the stream channel is evident from a few overwide aggraded areas within the channel (wallow areas), isolated areas of bank trampling, and narrow cattle trails observed along portions of the bank. Like UT3 Reach 1, UT1 Reach 1 reported a high width-to-depth ratio (15.8) for an A type channel as a result of cattle trampling. Upstream of an existing culvert crossing, an unpaved road borders the left bank of the stream. The culvert crossing is overwide, trampled, and aggraded with sediment originating from rill erosion and gullying of the adjacent unpaved road. The riparian vegetation in the upper third of the project reach is proliferated with invasive vegetation, namely tree-of-heaven, princess tree, and wineberry. Wetland B is located midreach in a clearing within the left terrace where two unpaved roads come together. Most of Wetland B is located outside of the proposed easement boundary.

Below the existing culvert crossing and upstream of the UT1/UT1A confluence, is an old log cabin and cookhouse (Figure 2). This log cabin is used as a vacation retreat by family members and is rarely occupied. An existing wooden footbridge across UT1 provides access from the cabin to the cookhouse. The cabin, cookhouse, and wooden footbridge, including the length of stream bordering these structures on UT1 Reach 1 and UT1A, are all excluded from the project easement as shown in Figures 2 and 6. The old outhouse located in the right terrace near the culvert crossing will be removed as part of the project. Downstream of the proposed easement break, UT1 Reach 1 flows alongside the forested left valley wall and the right terrace which continues as open pasture.

UT1 Reach 2

UT1 Reach 2 begins approximately 40 LF upstream of the old farm pond (open water 1) and wetland C. UT1 Reach 2's channel profile flattens from aggraded material impounded by the pond over time. UT2 joins UT1 with the pond. The pond is drained by a 24-inch CMP through the pond embankment that doubles as a farm road. The farm road continues down valley beyond the left terrace. The drainage area for UT1 Reach 2 doubles downstream of the pond with the addition of UT2's drainage, as do channel dimensions to accommodate additional discharge.

Like the upstream reach, UT1 Reach 2 classifies as a Rosgen A4a+ stream type and generally exhibits stable banks and step-pool morphology throughout most of its lengths. Downstream of the pond, the stream is less confined along the left bank and terrace (entrenchment ratio of 3 per Cross Section 2); the channel appears to have been pushed against the right valley wall and trampled by cattle in the past. As a result, most of the right bank is steep and actively eroding, especially at the outside of a few tight meander bends that are eroding into the right valley wall.

UT1A

UT1A originates from a springhead at the base of a small, broad, and forested valley. Minimal understory vegetation is present due to past cattle grazing activities. Young herbaceous species, various shrubs, and spricebush was observed. The riparian buffer was also impacted in the past from various activities associated with the old log cabin. Just upstream of the spring, outside of the proposed easement boundary, is wetland A, downstream of which perennial flow through defined channel bed and bank features originate. UT1A exhibits stable banks and step-pool morphology throughout the reach and classifies as a Rosgen A4a+ stream type. As previously mentioned, the last 30 LF of the stream

will be excluded from the proposed project easement due to the close proximity of structures associated with the old log cabin.

UT2 Reach 1

UT2 Reach 1 originates beyond the proposed easement boundary as a forested step-pool channel confined between the right valley wall and an embankment of an unpaved road on the left bank. It appears that the channel was relocated to the right valley wall in the past to accommodate the unpaved forest road and the pasture within the left terrace further downstream. Within the project limits, the channel becomes much less confined and entrenched due to past cattle trampling of the bed and banks. UT2 Reach 1 re-established a stable dimension and profile over time. Due to ample access to its flood-prone area with an entrenchment ratio of 2.8 and a moderate width to depth ratio of 12.9, the reach classifies as a Rosgen A4a+/B4a stream type. UT2 Reach 1 is well-shaded by a mature tree canopy. Understory vegetation is fairly sparse especially along the left terrace.

UT2 Reach 2

UT2 Reach 2 suffers from cattle impacts and exhibits trampled bed and banks, and profile instability. The geomorphic condition along this reach is very similar to portions of Reach 3 of Shake Rag Branch in the upper pasture area upstream of the hay field. At least nine active headcuts, greater the one foot in depth, were observed on UT2 Reach 2. Grade control is lacking throughout this reach which would help contain these active headcuts from migrating further upstream and causing widespread channel incision. Cross Section 5 (XS5) reported a bankfull area of 1.6 square feet, or half the bankfull area of UT2 Reach 1 which shares the same drainage area and is located just upstream. Compared to Reach 1, UT2 Reach 2 is typically deeper but much narrower (half the channel width), from cattle impacts. This stream most closely classifies as an unstable Rosgen A4a+ type stream. The channel exhibits ample access to a flood-prone area with an entrenchment ratio of 7.0, is generally undersized, and is prone to avulsion as evidenced by a few lengths of multi-threaded channel. The channel flows through a 12-inch CMP at the existing crossing downstream before outletting to wetland C which transitions into the pond.

Table 5: UT1 Drainage Project Attribute Table Part 3 – *Shake Rag Mitigation Site*

Reach Summary Information						
Parameter		**UT1 R1**	**UT1 R2**	**UT1A**	**UT2 R1**	**UT2 R2**
Existing Length of Reach (LF)		934	255	100	164	296
Valley Confinement (confined, moderately confined, unconfined)		Confined	Moderately confined	Confined	Moderately Confined	Confined
Existing Drainage Area (acres)		38	70	6	29	31
Perennial, Intermittent, Ephemeral		P	P	P	P	P
NCDWR Water Quality Classification		WS-II; HQW				
Stream Classification[1]	**Existing**	A4a+	A4a+	A4a+	A4a+/B4a	A4a+
	Proposed	No proposed change in stream classification	A4a+/B4a	No proposed change in stream classification	No proposed change in stream classification	A4a+/B4a
Evolutionary Trend (Simon)[1]		VI	V/VI	I	VI	II/III
FEMA Classification		None				

1. These channels have been heavily manipulated by man and may not precisely fit the classification category developed for natural streams using the Rosgen classification system (Rosgen, 1994). Results of the Rosgen stream classification system and the Simon Channel Evolution Model (Simon, 1989) are both provided for illustrative purposes only.

3.4.3 Resources within the UT6 Drainage

Project resources within the UT6 drainage include UT5 and UT6. Both reaches are perennial streams that flow through steep, colluvial, V-shaped valleys for their entire length. Overall valley slopes range between 10 to 12 percent. Both reaches are intersected by an existing culvert crossing of an unpaved farm road that extends up into the headwaters of UT6. UT5 and UT6 both, exhibit stable banks and step-pool morphology, and classify as Rosgen B4a type streams. Wetlands K, D, and E are located within the UT6 drainage and are summarized in section 3.4.4 in Table 7.

UT5

UT5 originates from wetland D, a small linear wetland located just upstream of the proposed easement boundary, and terminates at its confluence with UT6 downstream of an existing culvert crossing. The project stream reach is bordered by active cattle pasture along both banks beyond a narrow, vegetated buffer. The channel appears to have been relocated against the left valley wall in the past to accommodate pastureland in the right terrace. The entire valley wall beyond the left terrace also consists of open pasture. Watering troughs for cattle are located within the upstream and downstream limits of the reach in the right terrace. The upstream trough outlets to a buried 4-inch PVC pipe, or waterline, that intersects the UT5 channel and continues into the left terrace; the downstream trough outlets into the UT6 channel via a 4-inch PVC pipe.

Portions of the channel within the upstream and downstream limits are overwide and aggraded with sediment from cattle access. Midreach, UT5 is incised as the channel becomes confined between the left valley wall and a bermed right top of bank where bank height ratio measures 4.9. There is ample grade control throughout the reach in the form of boulders, large cobble, hearty root mass from trees, and woody debris. Coarse substrate and diverse bedforms are frequent but are often covered by fines from the trampling of bed and banks by cattle. The channel narrows and becomes mucky with silt within the downstream third of the reach as it approaches the culvert crossing.

UT6

UT6 originates as a jurisdictional channel at the outlet of a 12-inch pipe outlet below an existing culvert crossing located just upstream of the proposed conservation easement area. This channel flows through a small linear wetland (K) and becomes subsurface in some areas of the subsequent 175 LF before exhibiting surface flow for the remainder of its stream length. The perennial channel origin constitutes UT6's upstream project reach limits and the downstream reach limits is at the confluence with UT5. Stream credit is not being pursued for the upper 175 LF because this area was originally questioned by regulatory agencies as being more of a seep feature, and agencies requested a starting point further downstream than where the jurisdictional boundary was ultimately set.

UT6 - stable cobble bed stream

UT6's valley is fairly broader toward the upstream project limits where a subcatchment enters from the right terrace but becomes pinched downstream of this ephemeral channel confluence with a steep valley sidewall on the right terrace immediately to the right of the gravel road. It again opens up, this time along the left terrace downstream of the culvert crossing, where the valley broadens due to the UT5 subcatchment. UT6 appears to have been pushed up against the left valley wall in the past to accommodate the farm road on the right terrace. This farm road crosses the channel at a culverted crossing midreach. Upstream of the crossing, the channel is located within 20-25 feet of the road and is

bermed along the right top of bank by stone piles that have been placed by the land owner for future use. A wide, forested buffer exists along the left bank upstream of the culvert crossing, and on the right bank downstream of the crossing. Despite a lack of buffer on one side of the stream, it is well-shaded from a mature tree canopy.

An existing waterline (2-inch PVC pipe), originating from a small ditch in the right terrace, intersects UT6 and conveys water across the valley to the watering trough in UT5's upper valley. Wetland E is a small, linear feature that coincides with this waterline crossing location between the road and the UT6 channel.

Table 6: UT6 Drainage Project Attribute Table Part 3 – *Shake Rag Mitigation Site*

Reach Summary Information			
Parameter		**UT5**	**UT6**
Existing Length of Reach (LF)		483	707
Valley Confinement (confined, moderately confined, unconfined)		Moderately Confined	Moderately Confined
Existing Drainage Area (acres)		18	25[2]
Perennial, Intermittent, Ephemeral		P	P
NCDWR Water Quality Classification		WS-II; HQW	
Stream Classification[1]	**Existing**	B4a	B4a
	Proposed	No proposed change in stream classification	
Evolutionary Trend (Simon)[1]		VI	VI
FEMA Classification		None	

1. These channels have been heavily manipulated by man and may not precisely fit the classification category developed for natural streams using the Rosgen classification system (Rosgen, 1994). Results of the Rosgen stream classification system and the Simon Channel Evolution Model (Simon, 1989) are both provided for illustrative purposes only.
2. Drainage area as measured upstream of the confluence with UT5

3.4.4 Project Site Wetland/Open Waters

There are eleven wetlands and one open water feature located within or immediately adjacent to the project area (wetlands A – K, and open water 1). Refer to Figure 2 for resource locations. The wetland features are classified as headwater forest and seep wetland types using the North Carolina Wetland Assessment Method (NCWAM) classification key and best professional judgement. The wetlands occur on the side slopes and terraces that drain to on-site stream channels. The features exhibit one or more of the following wetland hydrology indicators: drift deposits, saturation within the upper 12 inches of the soil profile, and water-stained leaves. Soils within on-site wetlands have a low chroma (depleted) matrix. Common hydrophytic vegetation includes common rush (Juncus effusus) and shallow sedge (Carex lurida). Vegetation within the majority of the wetlands is impaired due to livestock grazing and mowing. The one open water feature is a small (0.04 acres), online farm pond along UT1. Wetland and open water features are summarized in Table 7. Wetland determination forms are provided in Appendix 2.

Table 7: Wetland/Open Water Project Attribute Table Part 3 – *Shake Rag Mitigation Site*

Resource Summary Information						
Parameter	**A (Wetland)**	**B (Wetland)**	**C (Wetland)**	**D (Wetland)**	**E (Wetland)**	
Size of Wetland (acres)	0.01	0.02	0.05	0.01	0.01	
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian Non-Riverine					
Mapped Soil Series	Buladean-Chestnut		Toecane-Tusquitee	Buladean-Chestnut	Toecane-Tusquitee	
Drainage Class	Well Drained					
Soil Hydric Status	No					
Source of Hydrology	Groundwater					
Restoration or enhancement method (hydrologic, vegetative, etc.)[1]	N/A					
Resource Summary Information						
Parameter	**F (Wetland)**	**G (Wetland)**	**H (Wetland)**	**I (Wetland)**	**J (Wetland)**	**K (Wetland)**
Size of Wetland (acres)	0.05	0.09	0.06	0.05	0.04	0.01
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian Non-Riverine					
Mapped Soil Series	Toecane-Tusquitee	Evard-Cowee/Toecane-Tusquitee	Tocane-Tusquitee		Evard-Cowee/Toecane-Tusquitee	Buladean-Chestnut/ Toecane-Tusquitee
Drainage Class	Well Drained					
Soil Hydric Status	No					
Source of Hydrology	Groundwater					
Restoration or enhancement method (hydrologic, vegetative, etc.)[1]	N/A					
Resource Summary Information						
Parameter	**Open Water 1**					
Size of Wetland (acres)	0.04					
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian Non-Riverine					
Mapped Soil Series	Toecane-Tusquitee					
Drainage Class	Well Drained					
Soil Hydric Status	No					
Source of Hydrology	Stream impoundment					
Restoration or enhancement method (hydrologic, vegetative, etc.)[1]	N/A					

1. Wetland areas are not proposed for restoration or enhancement credit.

4.0 Functional Uplift Potential

The potential for functional uplift is described in this section by area per the Stream Functions Pyramid (Harman, 2012). The Stream Functions Pyramid describes a hierarchy of five stream functions, each of which supports the functions above it on the pyramid (and sometimes reinforces those below it). The five functions in order from bottom to top are hydrology, hydraulics, geomorphology, physicochemical, and biology.

4.1 Functional Uplift

4.1.1 Hydrology

Site watersheds have been subject to intensive agriculture which lead to the burial and piping of many of the project stream segments. Other stream segments have been impounded, straightened, relocated, and in some cases plugged with woody debris. Within the project limits, lower valley bottoms are used for hay, mid-elevation valleys are used for livestock grazing, and upper elevation areas are typically wooded but allow some livestock access. The alteration in land cover which facilitates this land management typically results in less rainfall interception and evapotranspiration which leads to runoff and water yield increases (Dunne and Leopold, 1978) producing elevated peak flows and reduced base flow. The majority of the upper watersheds have been wooded for many decades, but have been deforested in the past. The management of the riparian corridors with conservation easements and planting, as well as preservation of the high elevation stream channels, will improve natural hydrologic conditions that buffer against flooding and drought. Because the streams are all headwater drainages, the implementation of the project will improve downstream hydrology in the immediate project area and downstream before the project size is overshadowed by inputs from other subwatersheds. Easements provide reasonable buffers against future forestry practices and a proposed stormwater BMP protects UT4, the primary drainage that is still subject to a considerable degree of upstream grazing.

4.1.2 Hydraulics

The majority of project streams proposed for restoration are hydraulically impaired due to prior burial and piping, channelization, and the resulting loss of stream morphology influenced by cattle trampling and natural hydraulic processes. Daylighting the buried streams and creating a stable dimension and profile within these steep step-pool systems, will restore hydrology, help establish a bankfull channel that is free-to-form through the transport of sediment and wood, and help establish diverse bedforms. The reduction in bankfull and greater flow velocities and channel shear stresses will help to provide a lift in hydraulic function.

4.1.3 Channel Geomorphology

The past channelization, capping, incision, and bank erosion place most of the stream reaches on the Site in Stages II, III, and IV of the Simon Channel Evolution Model. Bedform diversity of most stream reaches throughout the Site is extremely poor from long term cattle access impacts and loss of hydrology from flow alterations involving piping and impounding streams. Overall, the existing geomorphology function on project design reaches ranges from moderate where bedform diversity has formed (UT2 Reach 1) despite prior alteration, to very poor where bedform is silted in from bed and bank erosion (UT3 Reach 2).

There is a significant opportunity to improve the geomorphology function. Several project stream reaches will be daylighted and have their valleys, dimension, and profiles restored. LWD will be added to the system through construction of instream structures and bank revetments and a riparian buffer will be planted, resulting in lifted geomorphic function.

4.1.4 Physicochemical

No water quality sampling has been conducted on the project site, and no water quality monitoring stations exist within the Shake Rag watershed. The 2009 French Broad RBRP noted the importance of reducing sediment and nutrient input from farming operations. Examples of sediment and nutrient impacts evident on the site include eroding banks and trampled streams from grazing, manure and associated bacterial and nutrient runoff to streams, sediment contributions from unpaved roads, and stream bank erosion and pasture erosion (sinkhole formation) resulting from prior stream manipulation. In addition, burial of project streams removes physicochemical functions brought on through atmospheric reactions (e.g. oxygenation through aeration).

The proposed project will significantly reduce the stressors identified. The reduction of sediment and nutrient inputs from on-going farming operations will be achieved through easement establishment, cattle exclusion fencing, buffer planting, and through implementation of a BMP to treat concentrated flow from grazing areas upstream of the project easement on UT4. Wildlands is obtaining easement acreage in areas which are outside of the required buffer in order to protect seeps that would otherwise remain accessible to livestock, and is routing overland flow into protected buffers as high as possible to avoid runoff through livestock use areas. The design streams will be restored to minimize bank erosion and profile instability. Daylighting streams will increase the aeration of the surface water. Trees planted in the riparian zone will create shade to reduce thermal impacts. In addition, t removal of the in-line pond (open water 1) from the UT1 corridor will eliminate a riser structure which drains warmer surface water from the top of the water column.

Physicochemical improvements will not be explicitly monitored for success, although visual observations should show that the improvements are in place and achieving the benefits described above.

4.1.5 Biology

Pre-project macroinvertebrate data was collected by Penrose Environmental in June, 2018. Six locations were sampled, three on Shake Rag Branch mainstem (1, 2, & 3 in order from upstream to downstream) and one on each Tributary, UT3, UT1/UT2 - below their confluence, and UT5/6 - below their confluence. The sample on UT3 was in actively grazed pasture; Shake Rag Branch Site 1 was accessible to cattle but just above the active pasture at the wood-line; all other locations were outside of areas accessible to cattle. Of all locations sampled, UT3 and Shake Rag Branch Site 2 have the greatest percentage of contributing drainage area from grazed areas. UT1/UT2 and UT5/UT6 have the lowest contributing area from actively grazed areas although cattle have periodic access within these subwatersheds. UT1/2, UT5/6, and Shake Rag Site 1, were selected to be most likely to reflect reference conditions. The findings are provided below, but any potential conclusions are presented with due caution due to the limited sample size.

Biological data showed that the sample on UT3 had much lower EPT taxa richness values and abundance values compared to other sampling locations and was dominated by blackflies. UT3 had the highest biotic index of sampled locations (generally, the lower the biotic index, the better the water quality). The mid-reach sample on Shake Rag (near the Reach 4/5 reach break) had a lower abundance of stoneflies and caddisflies as compared to the upstream and downstream sampling locations. This may be indicative of greater impacts from grazing. UT5/UT6 and UT1/UT2 samples contained a larger number of EPT and intolerant taxa than all other sites which is consistent with land use-based assessments that these would be the least impacted of the sampled sites. While this sampling effort provides only a small dataset, there is reason to suggest that proposed restoration efforts, including cattle exclusion, may result in functional lift to stream biology and intolerant benthic stream organisms in particular.

The in-line pond (open water 1) is a stagnant, manmade feature that is not typical of this position on the landscape and is at risk of long-term failure which could adversely affect downstream biology. The pond also likely experiences algal blooms and low dissolved oxygen from agricultural nutrient inputs which limits its value to aquatic species. The pond and outlet structure are a barrier to aquatic organism passage between Reaches 1 and 2 of UT1 and to UT2, and its removal will restore stream continuity between its two reaches and UT2.

Improvements to biological function will create benefits that are realized on various time scales and the benefit to in-stream biology may be slow and unconducive to short-term monitoring. Biological response of the streams to the project will not be explicitly monitored, but its (biological) function is expected to improve based on the expected uplift of the other primary functional categories.

4.2 Overall Functional Uplift Potential

Overall, the Shake Rag Site has great functional uplift potential, owing to the headwater landscape position of the project streams, lack of stream functions present in existing buried streams, and the adverse impact of cattle grazing within the current stream corridors. Physicochemical and biological improvements are a likely result of the project. However, there is no existing basis for classifying the existing condition of these functions, and further, the likely improvements will occur gradually after construction resulting in long term benefits that may not be easily documented during short term monitoring. The biological benefits of long-term restoration of a forested land use and cattle exclusion are supported by the conclusions from the limited macroinvertebrate data collected during pre-project evaluation.

4.3 Site Constraints to Functional Uplift

There are no known Site constraints that will affect the functional uplift of the project. Steep valley slopes on the Site will allow for the development of profile and dimensions to restore stable, functioning streams. The degree to which the physicochemical and biology functions can improve on the Site is limited by the watershed conditions beyond the project limits, upstream water quality, and the presence of source communities upstream and downstream of the Site.

5.0 Regulatory Considerations

Table 8 is a summary of regulatory considerations for the Site. These considerations are expanded upon in Sections 5.1-5.3.

Table 8: Project Attribute Table Part 4 – *Shake Rag Mitigation Site*

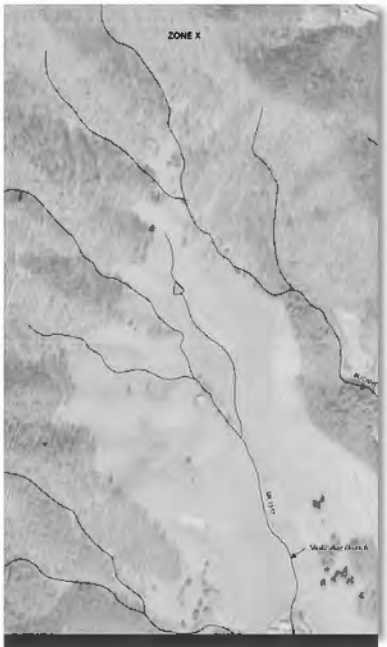
Regulatory Considerations			
Parameters	**Applicable?**	**Resolved?**	**Supporting Docs?**
Water of the United States - Section 404	Yes	No	PCN (Appendix 2)
Water of the United States - Section 401	Yes	No	PCN (Appendix 2)
Endangered Species Act	Yes	Yes	Appendix 5
Historic Preservation Act	Yes	Yes	Appendix 5
Coastal Zone Management Act	No	N/A	N/A
FEMA Floodplain Compliance	No	N/A	N/A
Essential Fisheries Habitat	No	N/A	N/A

5.1 Biological and Cultural Resources

A Categorical Exclusion for the Shake Rag Mitigation Site was approved on December 4, 2017. This document included investigation into the presence of threatened and endangered species on Site protected under The Endangered Species Act of 1973, as well as any historical resources protected under The National Historic Preservation Act of 1966. The biological conclusion for the Site, per the Categorical Exclusion research and response by US Fish and Wildlife Service, is that "any incidental take that may results from the associated activities [from the project] is exempt under the 4(d) rule." All correspondence with USFWS and a list of Threatened and Endangered Species in Madison County, NC is included in Appendix 5. The conclusion for cultural resources per the Categorical Exclusion research and response by the State Historic Preservation Office is that there are no historic resources that would be affected by this project. For additional information and regulatory communications please refer to the Categorical Exclusion document in Appendix 5.

5.2 FEMA Floodplain Compliance and Hydrologic Trespass

The Site is represented on the Madison County Flood Insurance Rate Map Panel 9769. Shake Rag Branch and the unnamed tributaries are mapped Zone X, meaning they are outside the Special Flood Hazard Area; therefore, compliance with FEMA is not required for implementation of the proposed stream design approaches.



FIRM Panel 9769

5.3 401/404

As discussed in Section 3.4, the results of the on-site delineation of jurisdictional waters of the US indicates ten jurisdictional stream channels including Shake Rag Branch within the proposed project area. In addition, 11 potential wetland areas (A - K) and one open water (pond) were also delineated within the proposed project area, totaling 0.44 acres. Tables 4 through 7 summarize existing project waters. The USACE completed a preliminary jurisdictional determination site walk on November 7, 2018. Wetland jurisdictional forms, the approved preliminary jurisdictional determination package, and the Pre-Construction Notification form (PCN) are included in Appendix 2.

Impacts to jurisdictional streams will be necessary for restoration and enhancement activities but this project will result in an uplift of aquatic resources that have been historically impacted by agricultural practices. Wildlands evaluated existing stream stability and functionality to develop appropriate levels of intervention. Project streams with less instability and partial stream functionality (UT1 Reach 2 and Shake Rag Branch Reach 4) are proposed for stream enhancement, which will involve bank stabilization and in-stream structure installation. Project streams that are buried or that have greater instability and less functionality (like Shake Rag Branch Reach 5, UT3 Reach 2, and UT2 Reach 2), are proposed for restoration which will involve the construction of new stream channels. As previously mentioned, the removal of open water 1 will likely provide uplift to most of the pyramid stream functions. Most of the wetlands found on Site are remnant cattle wallowing areas devoid of woody vegetation, and are often located in small linear sloughs, or depressional areas, within inactive alluvial fans at the junction of two valleys. Wetland areas J and H are within the low point of a steep valley and directly coincide with the proposed design stream alignments. These wetlands will likely be impacted through a combination of channel and upland grading. Even though wetland mitigation credit is not being sought for this project, portions of these wetlands will be protected to the extent possible, during construction, and enhanced where applicable by minor grading and the planting

of appropriate native wetland vegetation. Table 9 estimates the anticipated impacts to existing streams on this project.

Table 9: Estimated Impacts to Aquatic Resources – *Shake Rag Mitigation Site*

Jurisdictional Feature	Classification	Existing		Permanent (P) Impact		Temporary (T) Impact	
		Length (LF)	Acreage (AC)	Type of Activity	Impacts (LF/AC)	Type of Activity	Impacts (LF/AC)
Shake Rag Branch	Perennial[1]	3,539	-	Restoration (R)	2,667	Enhancement (E2)	175
				Enhancement (E1)	385		
UT1	Perennial	1,189	-	Enhancement (E1) & (E2 Crossing)	315	Enhancement (E2)	220
UT1A	Perennial	100	-	N/A	0	N/A	0
UT2	Perennial	460	-	Restoration (R)	296		
UT3	Perennial[1]	1,813	-	Restoration (R)	1,387		
UT4	Perennial[1]	910	-	Restoration (R)	910		
UT5	Perennial	483	-	Enhancement (E2 Crossing)	44		
UT6	Perennial	707	-	Enhancement (E2 Crossing)	34		
UT7	Perennial	428	-	N/A	0	N/A	0
UT8	Perennial[1]	210	-	Restoration (R)	210		
Wetland A	Seep	-	0.01	N/A	0	N/A	0
Wetland B	Seep	-	0.02	N/A	0	N/A	0
Wetland C	Headwater Forest	-	0.05	Channel and Adjacent Upland Grading for Restoration (R) and Enhancement (E1) after Pond Removal	0.05		
Wetland D	Seep	-	0.01	N/A	0	N/A	0
Wetland E	Seep	-	0.01	N/A	0	Upland Grading	0.01
Wetland F	Seep	-	0.05	N/A	0	N/A	0
Wetland G	Headwater Forest	-	0.09	N/A	0	N/A	0
Wetland H	Headwater Forest	-	0.06	Channel and Adjacent Upland Grading for Restoration (R)	0.05	Channel and Adjacent Upland Grading for Restoration (R)	0.01
Wetland I	Headwater Forest	-	0.05	Channel and Adjacent Upland	0.05		

Jurisdictional Feature	Classification	Existing		Permanent (P) Impact		Temporary (T) Impact	
		Length (LF)	Acreage (AC)	Type of Activity	Impacts (LF/AC)	Type of Activity	Impacts (LF/AC)
				Grading for Restoration (R)			
Wetland J	Headwater Forest	-	0.04	Channel and Adjacent Upland Grading for Restoration (R)	0.03	Channel and Adjacent Upland Grading for Restoration (R)	0.01
Wetland K	Seep	-	0.01	N/A	0	N/A	0
Open Water 1	Pond	-	0.04	Pond Removal	0.04		
				Total P Impact	**6,248 LF and 0.22 AC**	**Total T Impact**	**395LF and 0.03 AC**

1. Some or all of SRB Reach 3, UT3 Reach 2, UT4, and UT8 have been buried in rock-lined channels or pipes. Reported lengths are estimates based upon land owner communication, remote sensing, and field verification to approximate the subsurface location and alignment.

6.0 Mitigation Site Goals and Objectives

The major goals of the proposed stream mitigation project are to provide ecological and water quality enhancements to the French Broad River Basin while creating functional riparian corridors at the site level. The project will improve stream functions as described in Section 4 through protecting stable headwater streams, uncapping streams buried by man, stream restoration, reducing or eliminating agricultural non-point source pollution through cattle exclusion, restoring a forest to agriculturally maintained buffer areas, and removing an inline impoundment. Project goals are desired project outcomes and are verifiable through measurement and/or visual assessment. Objectives are activities that will result in the accomplishment of goals. The project will be monitored after construction to evaluate performance as described in Section 8 of this report. The project goals and related objectives are described in Table 10.

Table 10: Mitigation Goals and Objectives – *Shake Rag Mitigation Site*

Goal	Objective	Expected Outcomes CU-Wide and RBRP Objectives Supported	Functions Supported
Improve the stability of stream channels.	Reconstruct stream channels slated for restoration with stable dimensions and appropriate depth relative to the existing flood-prone area. Add bank revetments and in-stream structures to protect restored/ enhanced streams.	Reduce sediment inputs from bed and bank erosion; Stabilize stream banks; Restore aquatic habitat.	Hydraulic, Geomorphology, Physicochemical, Biology
Exclude livestock from stream channels.	Install livestock fencing and watering systems as needed to exclude livestock from stream channels and riparian areas.	Reduce sediment inputs; Reduce fecal coliform inputs; Implement agricultural BMPs.	Geomorphology, Physicochemical, Biology
Reconstruct channels and flood-prone areas with appropriate geomorphology.	Daylight buried or piped streams, remove man-made impoundments, and restore historic valley profiles. Reconstruct stream channels with bankfull dimensions and construct flood-prone areas consistent with reference reach findings.	Allow a natural range of flows to flow within the bankfull channel and to flow on to the flood-prone area; support formation of channel diversity and habitat features; provide flood relief at	Hydraulic, Geomorphology, Physicochemical, Biology

Goal	Objective	Expected Outcomes CU-Wide and RBRP Objectives Supported	Functions Supported
		the bankfull stage and mimic headwater entrenchment ratios and flood-prone area function.	
Improve instream habitat.	Install habitat features such as cascading riffle-pool sequences, lunker logs, and brush toes on restored reaches. Add woody materials to channel beds. Construct pools of varying depth. Remove online farm pond.	Restore aquatic habitat; Reduce habitat fragmentation from impoundment and agricultural land uses.	Hydraulic, Geomorphology, Biology
Reduce sediment and nutrient input from adjacent cattle grazing areas and unpaved roads	Construct one step-pool conveyance BMP to treat contributing 17-acre drainage area that is subject to nutrient and fecal coliform loading from cattle. Relocate unpaved roads outside of riparian corridor. Grade and plant forested buffer with native vegetation.	Reduce agricultural and sediment inputs to the project, which will reduce likelihood of accumulated fines and excessive algal blooms from nutrients.	Hydrology, Hydraulic, Geomorphology, Physicochemical, Biology
Restore and enhance native riparian and upland vegetation.	Convert active hay fields and cattle pasture to forested riparian buffers along all Site streams, which will slow and treat runoff from adjacent agriculture before entering streams. Protect and enhance existing forested riparian buffers. Treat invasive species.	Reduce sediment inputs; Reduce nutrient inputs; Restore riparian buffers.	Hydrology (local), Hydraulic, Physicochemical, Biology
Permanently protect the Site from harmful uses.	Establish a conservation easement on the Site. Exclude livestock from Site streams.	Permanently protect the Site from harmful uses.	Hydraulic, Geomorphology, Physicochemical, Biology

7.0 Design Approach and Mitigation Work Plan

7.1 Design Approach Overview

The design approach for this Site was developed to meet the goals and objectives described in Section 6 which were formulated based on the potential for uplift described in Section 4. The design is also intended to provide the expected outcomes in Section 6, though these are not tied to performance criteria. The project streams proposed for restoration on the Site will be reconnected to an adjacent flood-prone area, or bankfull bench, and the channels will be reconstructed with stable dimension, pattern, and profile that will transport the water and sediment delivered to the system. The riparian buffer will be planted with native tree species. Instream structures will be constructed in the channels to help maintain stable channel morphology and improve aquatic habitat. The entire project area will be protected in perpetuity by a conservation easement.

The design approach for this Site utilized a combination of analog and analytical approaches for stream restoration, and also relies on empirical data and prior experiences and observations. Reference reaches were identified to serve as the basis for design parameters. Channels were sized based on design discharge hydrologic analysis which uses a combination of empirical and analytical data as described within this report. Designs were then verified and/or modified based on sediment transport analysis. These design approaches have been used on many successful mountain restoration projects and is appropriate for the goals and objectives for this Site.

7.2 Reference Streams

Reference streams provide geomorphic parameters of a stable system, which can be used to inform design of stable channels of similar stream types in similar landscapes and watersheds. Six reference reaches were identified for this Site and used to support the design of streams (Figure 7). Most of these reference reaches were chosen because of their similarities to the Site streams including drainage area, valley slope, morphology, and bed material. Ironwood Tributary and UT to South Fork Fishing Creek are small, high gradient sand bed channels located outside of Wilkesboro in the foothills of North Carolina. Despite being located in a different physiographic province (western piedmont) and being characterized by a finer channel substrate (coarse to very coarse sand) than project streams on the Site, these two steep reaches function more like step-pool channels, dissipating energy over a series of boulder steps, bedrock slides, and cobble riffles that cascade into plunge pools; and thus warranted inclusion as reference reaches for this project. Geomorphic parameters for all reference reaches are summarized in Appendix 4. The references to be used for the specific streams are shown in Table 11. A description of each reference reach is included below.

Table 11: Stream Reference Data Used in Development of Design Parameters – *Shake Rag Mitigation Site*

	Design Stream	Shake Rag Branch			UT1	UT2	UT3	UT4	UT8
	Reach	3	4	5	2	2	2		
Reference Stream	Stream Type								
UT to Hampton Creek	A4/B4a			x					
Ironwood Tributary	A5a+	x			x	x		x	x
UT to Gap Branch	A4/B4a						x		
UT to South Fork Fishing Creek	B5a							x	x
UT to Austin Branch (upstream)	A4/B4a		x		x	x			
UT to Austin Branch (downstream)	A4/B4a		x		x	x			

7.2.1 UT to Gap Branch

UT to Gap Branch is located in the Box Creek Wilderness in Union Mills, NC. This stream flows through a confined valley with an alluvial bottom, much like UT1 Reach 2. The overall stream slope is 6.8% and the width to depth ratio is 10.1. The entrenchment ratio is 3.4, and Rosgen classification for this reach unclear: this reach could be classified either as a slightly entrenched B4a or a slightly entrenched A4. Available habitats at UT to Gap Branch include boulder/cobble steps, pools, rock riffles, runs, root mats, and undercut banks.

7.2.2 UT to South Fork Fishing Creek

UT to South Fork Fishing Creek reference reach is a small, locally steep (8.2%) B5a channel. It has a drainage area of approximately 0.02 square miles. UT to South Fork Fishing Creek is surrounded by a forested land cover. The bedform consists of bedrock slides and boulder steps at the tail of riffles that cascade into pools. The channel is confined so the banks are relatively high but well-vegetated.

7.2.3 UT to Hampton Creek

UT to Hampton Creek is located in Cherokee National Forest, near the North Carolina/Tennessee state line in northern Madison County, North Carolina (approximately five miles from the Site). The reference reach is a small, steep (6.5%) A4/B4a channel with a drainage area of approximately 0.25 square miles. Its entire watershed is forested with rhododendron, mountain laurel, American holly and various mature hardwoods (tulip poplar, white oak, bitternut hickory). The width to depth ratio is 10, the stream is

moderately entrenched with an entrenchment ratio of 1.7, and sinuosity is 1.15. Habitats identified in UT to Hampton Creek include large cobble riffles, boulder/cobble steps, and plunge pools.

7.2.4 Ironwood Tributary

The Ironwood Tributary reference reach is approximately 175 ft in length and is located outside of Wilkesboro, NC in the foothills. The reach is geomorphically described as a steep (11.4%) step-pool system and classifies as an A5a+ channel. It has a drainage area of 0.03 square miles and is surrounded by heavy canopy coverage. It has a channel sinuosity of 1.19 which is considerably high for a high gradient stream. Several long gravel/cobble riffles were observed that cascaded into pools over root mass, woody debris, or a boulder step at the tail of the riffles.

7.2.5 UT to Austin Branch (upstream)

Located in Buncombe County on the West Range of the Biltmore property, this reference reach is drained by a small forested watershed (0.12 square miles) that empties into Austin Branch which flows directly into the French Broad River. Most of the watershed is wooded except for narrow patches of open, lightly used pastureland located around the upper periphery of the watershed. Surrounding plant communities included various mature hardwoods (white oak, tulip poplar) and understory shrubs (rhododendron, American holly). UT to Austin Branch is a step-pool channel; it classifies as an A4/B4a stream with a channel slope of approximately 9.9%, a low sinuosity of 1.0, and a width to depth ratio of 12.8. The stream exhibited adequate access to its flood-prone area with an entrenchment ratio 2.6. Habitats identified in UT to Austin Branch include cobble riffles, boulder/cobble steps, and plunge pools.

7.2.6 UT to Austin Branch (downstream)

UT to Austin Branch (downstream) is located approximately 100 feet downstream of the UT to Austin Branch (upstream) step-pool reference reach previously described. The increase in drainage area is nominal compared to the upstream reach, but the valley of this downstream reach becomes flatter, broader, and less confined. As a result, the channel transitions to more of meander pool system than a step-pool system. Channel slope decreases to 4%, or half that of the upstream reach, and sinuosity increases to 1.2. Land use is uniform with that from the upstream reach of UT to Austin Branch. This lower reach of UT to Austin Branch classifies as an A4/B4a type channel with a width to depth ratio of 8.8. Stream access to its adjacent flood-prone area is ample reporting an entrenchment ratio of 4.3. Habitats identified in UT to Austin Branch (downstream) include cobble riffles, boulder/cobble steps, plunge pools, and meander pools.

7.3 Design Channel Morphological Parameters

Reference reaches were a primary source of information to develop dimension and profile design parameters for the streams. Due to the steep, confined valleys of proposed design reaches on Site, stream pattern parameters were not developed. Proposed channel slopes for design reaches range between 6 and 17 percent. Step-pool channels, classified as A4a+/B4a or A4/Ba, are proposed for all design reaches. Proposed design parameters for channel dimension and profile were developed within the reference reach parameter ranges with some exceptions based on best professional judgement and knowledge from previous projects. Pool depths were designed to be between 2 and 3.5 times deeper than riffles to provide habitat variation. Cross-section parameters such as area, depth, and width were designed based on the design discharge and stable bank slopes. In some cases, the width to depth ratio was increased beyond reference parameters to provide stable bank slopes prior to the development of a fully vegetated streambank. Key morphological parameters for the Site are listed in Tables 12-16 for all design project reaches. Complete morphological tables for existing, reference, and proposed conditions are in Appendix 4.

Table 12: Summary of Morphological Parameters – *Shake Rag Mitigation Site*

Parameter	SRB Reach 3			SRB Reach 4			
	Existing	Reference: Ironwood Tributary	Proposed	Existing	Reference: UT to Austin Branch (US)	Reference: UT to Austin Branch (DS)	Proposed[1]
Valley Width (ft)	20-30	N/A	20-30	20-25	N/A	N/A	20-25
Contributing Drainage Area (acres)	76	19	76	77	77	77	77
Channel/Reach Classification	A4a+	A5a+	A4a+/B4a	A4/B4a	A4/B4a	A4/B4a	A4/B4a
Design Discharge Width (ft)	3.3	5.0	5.8	5.1	6.7	6.2	8.8
Design Discharge Depth (ft)	0.5	0.6	0.4	0.6	0.5	0.7	0.6
Design Discharge Area (ft^2)	1.7	2.7	2.4	2.9	3.6	4.4	5.1
Design Discharge Velocity (ft/s)	9.6	4.9	7.1	8.1	7.3	6.2	6.6
Design Discharge (cfs)	16	13	17	24	26	27	34
Water Surface Slope (ft/ft)	0.1317	0.1139	0.1360	0.0913	0.0986	0.0400	0.0770
Sinuosity	1.03	1.2	1.03	1.07	1.0	1.20	1.08
Width/Depth Ratio	6.2	9.1	14.0	9.0	12.8	8.8	15.0
Bank Height Ratio	1.1	1.3	1.0	1.0	1.0	1.0	1.0
Entrenchment Ratio	7.5	2.1	1.4 – 2.2	2.9	2.6	4.3	1.4 – 2.2

1. Proposed typical cross section for SRB Reach 5 is applied to SRB Reach 4 through channel grading of subsurface channel segments.

Table 13: Summary of Morphological Parameters – *Shake Rag Mitigation Site*

Parameter	SRB Reach 5			UT3 Reach 2		
	Existing	Reference: UT to Hampton Creek	Proposed	Existing	Reference: UT to Gap Branch	Proposed
Valley Width (ft)	50-60	N/A	50-60	10-20	N/A	10-20
Contributing Drainage Area (acres)	163	160	163	38	26	38
Channel/Reach Classification	A4	A4/B4a	A4/B4a	A4a+	A4/B4a	A4a+/B4a
Design Discharge Width (ft)	6.7	6.8	8.8	4.5	6.2	5.9
Design Discharge Depth (ft)	0.7	0.7	0.6	0.5	0.6	0.4
Design Discharge Area (ft^2)	5.0	4.6	5.1	2.3	3.8	2.3
Design Discharge Velocity (ft/s)	6.8	6.6	6.6	8.3	5.0	8.1
Design Discharge (cfs)	34	31	34	19	19	19
Water Surface Slope (ft/ft)	0.0685	0.0650	0.0660	0.1757	0.0680	0.1650
Sinuosity	1.04	1.15	1.01	1.03	1.2	1.05
Width/Depth Ratio	9.0	10	15.0	9.1	10.1	15.0
Bank Height Ratio	3.1	1.0	1.0	2.7	1.0	1.0
Entrenchment Ratio	1.3	1.7	1.4 – 2.2	1.6	3.4	1.4 – 2.2

Table 14: Summary of Morphological Parameters – *Shake Rag Mitigation Site*

Parameter	UT4				UT8			
	Existing[1]	Reference: Ironwood Tributary	Reference: UT to South Fork Fishing Creek	Proposed	Existing[1]	Reference: Ironwood Tributary	Reference: UT to South Fork Fishing Creek	Proposed
Valley Width (ft)	N/A	N/A	N/A	10-20	N/A	N/A	N/A	10-20
Contributing Drainage Area (acres)	32	19	12.8	32	19	19	12.8	19
Channel/Reach Classification	N/A	A5a+	B5a	A4a+/B4a	N/A	A5a+	B5a	A4/B4a
Design Discharge Width (ft)	N/A	5.0	4.1	6.1	N/A	5.0	4.1	5.2
Design Discharge Depth (ft)	N/A	0.6	0.4	0.4	N/A	0.6	0.4	0.4
Design Discharge Area (ft^2)	N/A	2.7	1.8	2.4	N/A	2.7	1.8	1.9
Design Discharge Velocity (ft/s)	N/A	4.9	4.1	6.7	N/A	4.9	4.1	5.5
Design Discharge (cfs)	N/A	13	8	16	N/A	13	8	10
Water Surface Slope (ft/ft)	N/A	0.1139	0.0815	0.1080	N/A	0.1139	0.0815	0.0850
Sinuosity	N/A	1.2	1.25	1.02	N/A	1.2	1.25	1.06
Width/Depth Ratio	N/A	9.1	9.3	15.0	N/A	9.1	9.3	15.0
Bank Height Ratio	N/A	1.3	1.0	1.0	N/A	1.3	1.0	1.0
Entrenchment Ratio	N/A	2.1	1.7	1.4 – 2.2	N/A	2.1	1.7	1.4 – 2.2

1: Cross sections for UT4 and UT8 could not be collected since the majority of these channels have been buried in rock-lined channels or pipes.

Table 15: Summary of Morphological Parameters – *Shake Rag Mitigation Site*

Parameter	UT1 Reach 2				
	Existing[1]	Reference: Ironwood Tributary	Reference: UT to Austin Branch (US)	Reference: UT to Austin Branch (DS)	Proposed[2]
Valley Width (ft)	15-60	N/A	N/A	N/A	15-30
Contributing Drainage Area (acres)	70	19	77	77	38
Channel/Reach Classification	A4a+	A5a+	A4/B4a	A4/B4a	A4a+/B4a
Design Discharge Width (ft)	5.3	5.0	6.7	6.2	5.5
Design Discharge Depth (ft)	0.8	0.6	0.5	0.7	0.4
Design Discharge Area (ft^2)	4.3	2.7	3.6	4.4	2.0
Design Discharge Velocity (ft/s)	8.1	4.9	7.3	6.2	6.4
Design Discharge (cfs)	44	13	26	27	13
Water Surface Slope (ft/ft)	0.1200	0.1139	0.0986	0.0400	0.1130
Sinuosity	1.05	1.2	1.0	1.20	1.03
Width/Depth Ratio	6.4	9.1	12.8	8.8	15.0
Bank Height Ratio	1.0	1.3	1.0	1.0	1.0
Entrenchment Ratio	3.0	2.1	2.6	4.3	1.4 – 2.2

1: Existing cross section data shown was collected downstream of the UT2 confluence (downstream of the pond).
2: Constructing the restored channel through the removed pond will mostly occur upstream of the UT2 confluence which drains half the area (38 acres) of the existing condition data reported, and is thus reflected in the proposed condition design parameters.

Table 16: Summary of Morphological Parameters – *Shake Rag Mitigation Site*

Parameter	UT2 Reach 2				
	Existing	Reference: Ironwood Tributary	Reference: UT to Austin Branch (US)	Reference: UT to Austin Branch (DS)	Proposed
Valley Width (ft)	15-60	N/A	N/A	N/A	15-30
Contributing Drainage Area (acres)	31	19	77	77	31
Channel/Reach Classification	A4a+	A5a+	A4/B4a	A4/B4a	A4a+/B4a
Design Discharge Width (ft)	3.1	5.0	6.7	6.2	5.5
Design Discharge Depth (ft)	0.5	0.6	0.5	0.7	0.4
Design Discharge Area (ft^2)	1.6	2.7	3.6	4.4	2.0
Design Discharge Velocity (ft/s)	7.4	4.9	7.3	6.2	7.2
Design Discharge (cfs)	12	13	26	27	14
Water Surface Slope (ft/ft)	0.1500	0.1139	0.0986	0.0400	0.1550
Sinuosity	1.01	1.2	1.0	1.20	1.07
Width/Depth Ratio	6.0	9.1	12.8	8.8	15.0
Bank Height Ratio	1.0	1.3	1.0	1.0	1.0
Entrenchment Ratio	7.0	2.1	2.6	4.3	1.4 – 2.2

7.4 Design Discharge Analysis

Multiple methods were used to develop bankfull discharge estimates for each of the project restoration reaches: the NC Mountain regional curve (Harman et al., 2000), NC Piedmont/Mountain regional curve (Walker, unpublished), a site-specific reference reach curve, existing bankfull indicators using Manning's equation, and data from previous successful design projects. The resulting values were compared and best professional judgment was used to determine the specific design discharge for each restoration reach. Each data source is plotted on Figure 8 to show the relationship of the data to the design discharge selections.

7.4.1 Regional Curve Data

Discharge was estimated using the published NC Mountain Curve (Mountain Streams on Figure 8) as well as the updated curve for rural Piedmont and Mountain streams, shown as the Alan Walker Curve on Figure 8.

7.4.2 Site Specific Reference Reach Curve

Six reference reaches were identified for this project. Each reference reach was surveyed to develop information for analyzing drainage area-discharge relationships as well as development of design parameters. Stable cross-sectional dimensions and channel slopes were used to compute a bankfull discharge with the Manning's equation for each reference reach. The resulting discharge values were plotted with drainage area on Figure 8 (Reference Reach Curve) and compared the other discharge estimation methods.

7.4.3 Bankfull Discharge (Manning's Equation)

A riffle cross-section was surveyed on each design reach on the Site. Bankfull indicators were field identified throughout Site streams and used for estimating a bankfull discharge. Manning's equation was used to calculate a discharge associated with the field identified bankfull indicators for all project streams. Stream slope was calculated from the surveyed channel slope and roughness was estimated

using guidelines from Chow (1959). The corresponding discharge was plotted on Figure 8 (Qbkf – Existing Site Streams) and considered as potential bankfull discharge values throughout the Site.

7.4.4 Design Discharge Analysis Summary

Main design goals at Shake Rag include reconnecting streams with their natural valleys and reconstructing channels with stable bankfull dimensions and flood-prone areas consistent with reference reach findings. Bankfull discharges calculated for surveyed riffle cross sections using Manning's equation generally exceeded those predicted by the NC Mountain Curve, and at a greater magnitude, exceeded those predicted by the Alan Walker Curve. Drainage areas and channel slope of stream reaches from these two regional curves are not entirely representative of the very small and steep headwater streams found throughout the Site; stream reaches from these curves have much less slope and drainage areas orders of magnitude larger than those found on Site, and thus tend to under predict bankfull discharge when using these curves. Therefore, proposed bankfull discharges for all design streams on the Site were selected primarily within the range of values predicted by Manning's equation and the reference reach curve. Tables 17 and 18 give a summary of the discharge analysis, while Figure 8 illustrates the design discharge data.

Table 17: Summary of Design Discharge Analysis – *Shake Rag Mitigation Site*

	Shake Rag Branch			UT1
	Reach 3[1]	Reach 4	Reach 5	Reach 2[2]
DA (acres)	36	77	163	38
DA (sq. mi.)	0.06	0.12	0.25	0.06
Mountain Regional Curve (cfs)	11	20	34	12
Alan Walker Curve (cfs)	6	11	19	6
Site Specific Reference Reach Curve	16	25	38	17
Bankfull Q from Manning's Eq. from XS survey (cfs)	16	24	34	N/A[2]
Final Design Q (cfs)	17	24	34	13

1: Drainage area and bankfull discharge for SRB Reach 3 were calculated upstream of the UT3 confluence.
2: Drainage area and bankfull discharge for UT1 Reach 2 were calculated upstream of the pond and UT2 confluence. No existing cross section was collected above the pond.

Table 18: Summary of Design Discharge Analysis – *Shake Rag Mitigation Site*

	UT2 Reach 2	UT3 Reach 2	UT4	UT8
DA (acres)	31	38	32	19
DA (sq. mi.)	0.05	0.06	0.05	0.03
Mountain Regional Curve (cfs)	10	12	10	7
Alan Walker Curve (cfs)	5	6	5	3
Site Specific Reference Reach Curve	15	17	15	11
Bankfull Q from Manning's Eq. from XS survey (cfs)	12	19	N/A[1]	N/A[1]
Final Design Q (cfs)	14	19	16	10

1: Cross sections for UT4 and UT8 could not be collected since the majority of these channels have been buried in rock-lined channels or pipes.

7.5 Sediment Transport Analysis

The majority of the reaches on the Shake Rag project site will involve uncovering and reestablishing buried streams. Sediment samples in existing stream channels and observations from excavated transects along buried reaches indicate that these headwater streams have bed material that is a mix of gravel, cobble and small boulders including fines within the matrix. Hillslope processes, including landslides and debris flows, have contributed both immobile and mobile sediment that have redistributed throughout the historic streams.

Where daylit streams are relocated on their old streambeds, which is expected to be the norm, it is anticipated that appropriately-sized bed material will be encountered in-situ. Where it is not present, supplemental material will be applied to form restored stream beds with limited mobility of the larger size fraction of particles. To establish a target design for bed material on project streams, an assessment of existing and reference reach conditions, and calculation of sediment transport competency for a range of flows were performed. The design intent is to re-creating low-mobility bedforms that persist for long periods of time, and to use a range of particle sizes and bed features that mimic habitat conditions in reference reaches.

7.5.1 Competence Analysis

Competence analyses were performed during design for each of the restoration reaches by comparing shear stress associated with the design bankfull discharge, proposed channel dimensions, and proposed channel slopes with the size distribution of the existing bed load. The analysis utilized standard equations based on a methodology using the Shields curve (Leopold et al., 1964) and Andrews equation described by Rosgen (2001). Material size ranges specified for riffles and grade control features were adjusted to the design competence. The results of the analysis are shown in Tables 19 and 20.

UT1 Reach 2 below the pond is a stable project reach with reference quality streambed composition used to help guide the design streambed matrix on similar streams within the project site

Table 19: Results of UT1 and UT2 Existing Conditions Sediment Sampling and Competence Analyses – *Shake Rag Mitigation Site*

	UT1	UT2
	Reach 2	**Reach 2**
Dbkf (ft)	0.36	0.36
Channel Slope (Schan) (ft/ft)	0.12	0.15
Bankfull Shear Stress, t (lb/sq ft)	2.6	3.3
Dmax Bar or Subpavement sample (mm)	1400	250
Calculated movable particle size, Shields Curve (mm)	214 (8.5 inches)	271 (10.7 inches)
Existing conditions particle sizes D16 / D30 / D50 / D84 /D100 (mm)	0.5 / 15-20 / 100 / 300-400 / >1400	0.25 / 0.7 / 5.5 / 15 / 250
Design bed material (equivalent quarry stone size)	Class A/B to constitute 50% or greater of mix (150 – 300 mm)	Class A/B to constitute 50% or greater of mix (150 – 300 mm)

As a discussion of the above Table 19, UT1 Reach 2 and UT2 Reach 2 have similar drainage areas and slopes before they confluence, and the predictions of the competency analyses reflect this. Where-as UT2 Reach 2 has been previously manipulated, conditions in UT1 are more representative of a reference condition and exhibit greater stability (as evident in comparison of the stream profiles for the two tributaries). Therefore, similar size D30 and larger particle sizes as UT1 will be incorporated into the bed mix for both tributaries. Based on the results of the competency analyses, six to 12-inch particles (the equivalent of Class A & B stone sizes), will be incorporated into the bed material at a ratio of approximately 50 percent of the cascading riffle mix, allowing for the remaining material to contain sufficient gravel and sand size particles to maintain flow at the surface of the bed.

Table 20: Results of UT3, UT4 and Shake Rag Branch Existing Conditions Sediment Sampling and Competence Analyses – *Shake Rag Mitigation Site*

	UT3	UT4	Shake Rag Branch	
	Reach 2		Reach 3	Reach 5
Dbkf (ft)	0.40	0.40	0.41	0.58
Channel Slope (Schan) (ft/ft)	0.170	0.114	0.1275	0.0679
Bankfull Shear Stress, t (lb/sq ft)	4.1	2.8	3.2	2.4
Dmax Bar or Subpavement sample (mm)	270	N/A[1]	N/A[1]	45
Calculated movable particle size, Shields Curve (mm)	214 (8.5 inches)	271 (10.7 inches)	260 (10.3 inches)	192 (7.6 inches)
Existing conditions particle sizes D16 / D30 / D50 / D84 /D100 (mm)	20-25 / 45 / 75 / 150 / 270	N/A (Buried)	N/A (Buried)	1-2 / 8-9 / 10-20 / 90-100 / 180
Design bed material (equivalent quarry stone size)	Class A/B to constitute 50% or greater of mix (150 – 300 mm)	Class A/B to constitute 50% or greater of mix (150 – 300 mm)	Class A/B to constitute 50% or greater of mix (150 – 300 mm)	Class A/B to constitute 50% or greater of mix (150 – 300 mm)

As a discussion of the above Table 19, the existing conditions sediment sample for UT3 Reach 2 is in a highly manipulated setting with existing head-cutting and bank erosion along steep, exposed banks. The bed design and rationale are comparable to UT1 & UT2.

UT4 was not sampled during existing conditions due to it being buried. Excavated transects, or test digging, along the proposed alignment for UT4 confirmed the presence of small boulders, cobble, gravels, and sand in-situ. The competency analysis for UT4 indicates that the bed should be designed with a similar range and distribution of particles as the reaches previously discussed.

Shake Rag Branch Reach 3 is highly manipulated, and to a large extent buried; it was also not sampled. The competency analysis for Shake Rag Branch Reach 3 indicates that the bed should be designed with a similar range and distribution of particles as the reaches previously mentioned. Enhancement efforts along Shake

Test pit to excavate subsurface rock drain in UT4, exposing natural bed materials

Rag Branch Reach 4 will use sediment transport findings from Reach 3 which is of similar channel dimension and slope. Reach 5 is not as steep but has a larger proposed depth and has a similar bed design for this reason.

For all designed reaches, transport competency was also assessed for episodic high flows in the 10 to 100-year range of recurrence interval. The predicted shear stresses are in the four to 6.5 lb/ft^2 range and capable of moving particles 18-24 inches in size according to Shields Curve. To create greater bed stability, 18 to 24-inch (450-600 mm) size material will be incorporated into bed and structure design in sufficient quantity so as to provide protection against catastrophic flooding that could adversely impact the design streams. Some movement under infrequent high flows should be viewed as acceptable as particles reorient and redistribute, so long as overall vertical stability is not be compromised.

In summary, the project streams all experience a very similar range of shear stress based on their size and slope. There are good reference bed conditions present on-site which support an analogous design approach. This approach has been supported through sediment competency analyses to identify the range of particle size mobility to be expected in each design reach. Where suitable material is not encountered in-situ, bed material will be supplemented with the size fractions of material that are absent from the desired bed mix.

7.6 Project Implementation

Currently, the streams throughout the Site are heavily impacted by agricultural activities. The primary stressors to Site streams are livestock trampling and fecal coliform inputs, active scour, the lack of stabilizing stream bank and riparian vegetation, ditching and/or piping, and incision.

Wildlands' approach to restoring, enhancing, and protecting stream resources on the Site includes a multi-tiered approach including Enhancement 1 and 2, Priority 1 restoration, and preservation. The watershed scale of this project makes it especially valuable for improving and protecting water quality because the proposed conservation easement reaches up toward the headwaters of the tributaries on the Site and a large portion of the Shake Rag Branch watershed will be protected in perpetuity.

Proposed design reaches will include various types of in-stream structures: cascading riffles, cascading riffle-pool sequences, log steps, rock drops, lunker logs, and brush toe. The structures will reinforce channel stability and serve as habitat features. Rock drops and cascading riffles will be comprised of excavated on-site material from the existing channel bed and adjacent hillslopes where possible; some quarry stone may be used to supplement onsite material. The daylighting of buried channels from rock-lined trenches is expected to yield material for use in grade control structures. The riffles will incorporate woody brush material and logs. The diverse range of constructed riffle types will provide grade control, diversity of habitat, and will create varied flow vectors.

For buried project stream reaches (Shake Rag Branch Reach 3, UT3 Reach 2, UT4, and UT8), proposed alignments generally followed the low point of the valley which was often difficult to discern due to widespread landscape alterations from past agricultural activities. Wildlands used local survey data to generate a flow direction and accumulation model in GIS to help identify low points in the valley and guide the proposed alignment layout process. An overlay of sinkholes (with field verified subsurface flow) with the model provided additional evidence as to the most suitable locations for the proposed channel alignments. On the Site, multiple transects were excavated perpendicular to the valley and in proximity to these low points along these reaches to provide an additional converging line of evidence for aligning the proposed channel. Modeled flow lines (low points) from GIS largely intersected sinkholes and excavated transects located in the field. Subsurface flow was uncovered at each of the transects at depths ranging between 2 to 3 feet from the existing ground surface. Most of these subsurface flows or seeps flowed over top a gravel bed layer underlaid by clay. Proposed alignments for Shake Rag Branch

Reach 3, UT3 Reach 2, UT4, and UT8 coincide with the aforementioned modeled and field verified hydrology features. Sinkholes are illustrated on Figure 2, proposed alignments for all stream reaches are shown on the concept plan in Figure 6a, and Figure 6b provides an overlay of existing and proposed stream alignments for reference.

7.6.1 Shake Rag Branch Drainage

The primary stressors to streams within the Shake Rag Branch drainage include the channelization, relocation, burying, piping, and impounding of streams (UT8), the clearing of streamside native riparian vegetation, and increased cattle access to the channel. Such stressors have resulted in channel incision on many (unburied) channels and an extensive lack of bedform diversity.

Shake Rag Branch Reach 2 and UT3 Reach 1 are both proposed for Enhancement 2 involving the removal of invasive vegetation, native buffer plantings, and cattle exclusion. Woody debris, currently covering most of Shake Rag Branch Reach 2, will also be removed. After the woody debris is removed from Reach 2, the channel thalweg will be re-established and the banks reshaped as necessary in trampled or flattened areas to contain and convey flows downstream; grade control will be installed as necessary in a few select areas along the channel profile. The existing unpaved road, that currently parallels the majority of Shake Rag Branch Reach 2 within 25 LF from the left top of bank, will be decommissioned. In preparation for buffer planting, the floodplain terrace pasture area and surface of the abandoned road will be scarified and the soil amended as necessary to ensure proper germination of applied native seed and plantings.

Shake Rag Branch Reach 4 is proposed for Enhancement 1 involving the removal of invasive vegetation, native buffer plantings, decommissioning of an adjacent farm road in the left terrace, and the re-establishment of stable channel dimension and profile in selected reach segments.

Restoration level practices are proposed on Shake Rag Branch Reaches 3 and 5, UT3 Reach 2, UT4, and UT8. On Shake Rag Branch, restoration practices will include re-establishment of stable dimension, pattern, and profile within the active pasture upstream of the existing fence, through the ditched and buried middle reach between the pasture and the upstream ford, and along the incised and badly eroding downstream reach along the main farm road. A Priority 1 approach is proposed for each of these segments. A short length of Priority 2 restoration may be needed at the downstream tie-in for Reach 5 of Shake Rag Branch in order to transition the stream from the Priority 1 elevation back down to the existing channel. The farm road bordering the left bank of Shake Rag Branch Reach 5 will be relocated to the east, outside of the easement. An existing power pole on the west side of Reach 5 will also be relocated east of the easement so that the overhead power line will not interfere with proposed conservation practices. Culvert crossings indicated on Figure 6a provide livestock access in pasture areas and equipment access in hay fields.

Restoration practices proposed for UT3 Reach 2 include establishment of a new channel through the low point of the its original valley and abandonment of the ditched diversion channel. A Priority 1 approach is proposed. A portion of the downstream reach of UT3 Reach 2 flows underground in either a pipe or a rock-lined conduit, so some of the restoration effort will be focused on daylighting this ditch and re-establishing an appropriately sized channel. An existing cattle waterer near the confluence of UT3 and Shake Rag Branch will be relocated outside of the easement; plumbing associated with this waterer ties to a spring head that is already located outside of the proposed easement.

The restoration approach for UT4 and UT8 is similar to that described for UT3 Reach 2. The streams currently flow through a rock-lined trench and the restoration effort will be focused on establishing open channels that will meander with the low point of the valley using a Priority 1 approach. Valley topography will largely dictate the restoration pattern.

A step pool stormwater conveyance (SPSC) agricultural BMP will be constructed in the upper drainage area of UT4 (approximately 200 LF upstream of the existing fence line). This SPSC will treat the contributing 17-acre drainage area that is subject to nutrient and fecal coliform loading from cattle grazing usage. No mitigation credit is proposed for this SPSC BMP.

Preservation is proposed on Reach 1 of Shake Rag Branch and UT7 to protect these headwaters, consistent with DEQ's recommendations for this HQW designation.

7.6.2 UT1 Drainage

Reach 1 of UT1 and UT2 are both proposed for Enhancement 2 involving the removal of invasive vegetation, native buffer plantings, cattle exclusion, and the decommissioning of an adjacent farm road in the left terrace. The culvert crossing, located midreach along UT1 Reach 1, will be stabilized with a permanent culvert replacement, and the nearby outhouse will be removed from the proposed easement area. Downstream of UT1's crossing, a portion of UT1 will be excluded from the proposed easement area along with the old log cabin, footbridge over UT1, and cookhouse. A similar approach of Enhancement 2 is proposed for UT1A which also excludes the downstream channel limits at its confluence with UT1 in proximity to the cabin and cookhouse.

Enhancement Level 1 activities for UT1 Reach 2 will include draining the upstream pond and excavating a new and steeper valley through the pond bed, impoundment, and further downstream that supports more of a step-pool channel morphology and matches the natural valley. The step-pool channel will be restored as a Priority 1 A4a+/B4a type stream according to the Rosgen classification system and will dissipate flows vertically. The proposed channel profile proposed through the drained pond bed will have a consistent slope with the downstream channel to help maintain hydrology through the transition of the newly created valley. The Priority 1 design approach for UT1 Reach 2 is proposed through the drained pond bed and will tie into the existing channel downstream. The existing channel downstream exhibits a stable geometry and intact in-stream habitat but appears to have been pushed against the right valley wall and trampled by cattle in the past. As a result, most of the right bank is steep and actively eroding, especially at the outside of a few tight meander bends that are eroding into the right valley wall. The proposed channel will be shifted toward the left terrace to relocate it to the natural low point of the valley and the right bank will be stabilized through a combination of bank grading and live-stake planting.

The primary stressors to UT2 Reach 2 are confinement against the valley wall, active stream incision and head cutting, and lack of bedform and stabilizing streamside vegetation due to agriculture practices. Wildlands' approach to restoring UT2 Reach 2 will focus on returning the stream to the center of its valley, reconstructing a stable bankfull channel with adjacent flood-prone area interaction, and stabilizing active headcuts. Due to the lack of entrenchment in such a steep valley from a combination of past cattle wallowing and sediment aggradation, portions of the existing channel are prone to avulsion as evidenced by a few lengths of muti-threaded channel observed on this reach. Priority 1 restoration involves reconnecting the channel to a more natural valley bottom by constructing a moderately entrenched but stable step-pool channel profile within the altered valley corridor. Full restoration is proposed instead of enhancement on this reach since the proposed design approach will address channel instability related to dimension and profile while reconfiguring the valley form throughout the entire reach corridor. The proposed channel alignment will be shifted offline away from the right valley wall to the valley low point, conveyed through a 25-foot wide internal culvert crossing, and oriented more directly down valley toward the existing pond.

Valley slope for UT2 Reach 2 is over 15% and the stream is designed as a Rosgen A4a+/B4a with energy dissipated vertically over steps. Steps will be intermixed with cascade riffles modeled after the steep riffles observed on the reference stream UT to Austin Branch. Step spacing was guided by

measurements from UT to Austin Branch, Ironwood Tributary, and by the step pool geometric scaling documented in Chartrand and other's paper on step-pools (Chartrand et. al, 2011). Although designed as an A4a+/B4a-type stream, which generally exists within a V-shaped valley, UT2's valley provided some space to accommodate a narrow flood-prone area, or small floodplain bench, the likes of which can be seen along the existing channel for UT2 Reach 1 further upstream. Thus, a floodplain bench was provided consistently along UT2 Reach 2's proposed design length.

7.6.3 UT6 Drainage

UT5 and UT6 are both proposed for Enhancement 2 involving the removal of invasive vegetation, native buffer plantings, and cattle exclusion. Enhancement activities for UT6 also include the removal of streamside spoil piles from the right top of bank and relocation of an unpaved road from the easement.

The existing unpaved road currently parallels the right bank in the upper half of UT6 and will be relocated outside of the easement along the right valley wall. Due to the confined nature of the valley, the road could not be relocated far enough away from the top of bank to provide a full 30-foot wide easement. Decommissioning the road was not an option, and the long term risks of erosion and slope instability were sufficient, to both water quality and owner safety, so as to recommend a narrower easement in this portion of the corridor along UT6. The relocation will vary from minimal to about half of the road width in order to remove the road from the easement and allow a few feet of clearance to the proposed fence to maintain user safety. The minimum easement width held through this corridor is approximately 20 feet. Two 25-foot wide internal culvert crossings are proposed where the existing crossings are currently located, one on UT6 midreach and one within the downstream limits of UT5. A 6-foot wide internal crossing is proposed for the buried waterline toward the upstream limits of UT5 and UT6. In preparation for buffer planting, the floodplain terrace area and surface of the abandoned road will be scarified and the soil amended as necessary to ensure proper germination of applied native seed and buffer plantings. In order to offset for the narrower buffer, Wildlands has included within the conservation easement a 175 linear foot segment of UT6 upstream of the credited project limits; IRT staff indicated where they wanted the project to begin based off of their interpretation of stream hydrology during an August site walk, although this segment subsequentially was accepted by the Corps as jurisdictional based on a subsequent site review walk for the purpose of jurisdictional determination.

7.7 Vegetation and Planting Plan

The objective of the planting plan is to establish, over time, a thriving riparian buffer composed of native tree species. This restored buffer will improve riparian habitat, help the restored streams stay stable, shade the streams, and provide a source for large woody debris (LWD) and organic material to the streams. Non-forested areas within the conservation easement will be planted, which includes additional buffer areas far beyond the minimum 30-foot requirement from top of bank as illustrated in the plans enclosed in Appendix 6. Riparian buffers will be seeded and planted with early successional native vegetation chosen to develop species diversity consistent with Rich Cove and Mesic Oak-Hickory Forest characteristics (Schafale, 2012). The specific species composition to be planted was selected based on the community type, observation of occurrence of species in riparian buffers adjacent to the Site, and best professional judgement on species establishment and anticipated Site conditions in the early years following project implementation. Species chosen for the planting plan are listed on Sheet 3.1 of the Draft Plans located in Appendix 6.

The riparian buffer will be planted with bare root seedlings. In addition, the stream banks will be planted with live stakes and the channel toe will be planted with multiple herbaceous species. Permanent herbaceous seed will be spread on streambanks, floodplain terrace areas, and disturbed areas within the project easement.

Invasive species within the riparian buffers of restoration reaches will be treated at the time of construction. The extent of invasive species coverage will be monitored, mapped, and controlled as necessary throughout the required monitoring period. Please refer to Appendix 7 for the invasive species plan. Additional monitoring and maintenance issues regarding vegetation are in Sections 8 and 9 and Appendix 8.

7.8 Project Risk and Uncertainties

In general, this project is low risk. Anytime buried streams are uncovered or constructed as a Priority 1 restoration, there is some risk of flow submergence; Wildlands will utilize subsurface channel plugging to limit this risk.

Due to the rural nature of the area, the potential for urban development is low. The land use surrounding the majority of the project stream reaches is currently being utilized for hay and cattle production. Following construction, cattle will be precluded from accessing the restored stream and buffer. The Site is in a Water Supply Watershed (WS-II) which is predominantly undeveloped. A large portion of the Shake Rag Branch watershed will be protected in perpetuity since the proposed conservation easement encompasses the headwaters of the tributaries on the Site. The headwaters of Shake Rag Branch is currently zoned as R-A, or Residential – Agricultural.

8.0 Performance Standards

The stream performance standards for the project have been developed based on guidance presented in the DMS Stream and Wetland Mitigation Plan Template and Guidance (June 2017), the Annual Monitoring Template (June 2017), and the Wilmington District Mitigation Guidance from October 2016.

Annual monitoring and semi-annual site visits will be conducted to assess the condition of the completed project. The stream restoration sections of the project will be assigned specific performance criteria components for hydrology, vegetation, and geomorphology. The stream Enhancement 2 reaches will be assigned specific performance criteria components for vegetation only. Performance criteria will be evaluated throughout the (up to) seven years of post-construction monitoring. Site monitoring must occur for seven years post-construction, unless the District, in consultation with the IRT, agrees that monitoring or components of monitoring may be terminated early. An outline of the performance criteria components follows.

8.1 Streams

8.1.1 Dimension

Riffle cross sections on the restoration reaches should be stable and should show little change in bankfull area, maximum depth ratio, and width-to-depth ratio. Bank height ratios should not exceed 1.2 and entrenchment ratios shall be within the range of 1.4-2.2 for restored B-type channels to be considered stable. All riffle cross sections should fall within the parameters defined for channels of the appropriate stream type. If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in the width-to-depth ratio in meandering channels or an increase in pool depth. Remedial action would not be taken if channel changes indicate a movement toward stability.

Example of a cross section survey

In order to assess channel dimension performance, permanent cross sections will be installed per DMS Stream and Wetland Monitoring Guidelines (June 2017). Each cross section will be permanently marked with pins to establish its location. Cross section surveys will include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg. Cross section and bank pin surveys (if applicable) will be conducted in monitoring years one, two, three, five, and seven.

Riffle cross-sections on the restoration reaches should be stable and should show little change in bankfull area, maximum depth ratio, and width-to-depth ratio. All riffle cross-sections should fall within the parameters defined for the designated stream type. If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Indicators of instability include a vertically incising thalweg or eroding channel banks. Remedial action would not be taken if channel changes indicate a movement toward stability. Please note that Shake Rag Branch Reach 5 due to existing landforms, is expected to have a wider flood-prone width and an entrenchment ratio greater than 2.2.

8.1.2 Pattern and Profile

Longitudinal profile surveys will not be conducted during the seven-year monitoring period unless other indicators during the annual monitoring indicate a trend toward vertical and lateral instability. If a longitudinal profile is deemed necessary, monitoring will follow standards as described in the DMS Stream and Wetland Monitoring Guidelines (June 2017) and the Wilmington District Mitigation Guidance from October 2016 for the necessary reaches.

8.1.3 Substrate

A reach-wide pebble count will be performed in each restoration reach each year for classification purposes. A wetted pebble count will be performed at surveyed riffles to characterize the pavement during as-built.

Substrate materials in the restoration reaches should indicate a progression towards or the maintenance of coarser materials in the riffle features and smaller particles in the pool features. However, natural variations in pool and riffle substrate is expected as a result of sediment transport processes in steeper sloped channels.

8.1.4 Hydrology

Per the Wilmington Mitigation Guidance (2016), one gage must be installed for every 5000 feet on tributaries greater than 1000 feet. On these streams, four bankfull flow events, occurring in separate years, must be documented within the seven-year monitoring period. In addition, there were requests by the IRT at the pre-design site visit to demonstrate consecutive stream flow in buried streams. Where applicable, flow will be monitored mid-reach using gaging or alternative proven methods (e.g. game camera) to demonstrate at least 30 consecutive days of flow in every year within the monitoring period, unless permission for early termination is granted. Flow in UT8, which is less than 300 feet in length, will be monitored mid-reach for consecutive flow only.

Where required by the guidance, bankfull events will be documented with either a crest gage or a pressure transducer, as appropriate for Site conditions, and supported with photographic evidence when possible. The selected measurement device will be installed in the stream within a surveyed riffle cross section. The device will be checked at each site visit to determine if a bankfull event has occurred. Photographs will also be used to document the occurrence of debris lines and sediment deposition.

8.2 Vegetation

The final vegetative success criteria will be the survival of 210 planted stems per acre in the riparian corridors at the end of the required monitoring period (year seven). The interim measure of vegetative success for the site will be the survival of at least 320 native species stems per acre at the end of the

third monitoring year and at least 260 stems per acre at the end of the fifth year of monitoring. If this performance standard is met by year five and stem density is trending towards success (i.e., vigor), and invasive species are not threatening ecological success, monitoring of vegetation on the Site may be terminated with written approval by the USACE in consultation with the IRT. In NC Mountain counties, planted vegetation must average 6 feet in height in each plot at the end of the fifth year of monitoring and 8 feet in height at Year 7. The extent of invasive species coverage will also be monitored and controlled as necessary throughout the required monitoring period.

Vegetation monitoring quadrants will be installed across the Site to measure the survival of the planted trees. The number of monitoring quadrants required and frequency of monitoring will be based on the DMS monitoring guidance documents. Vegetation monitoring will occur in the summer and will follow the CVS-EEP Protocol for Recording Vegetation (2008) or another DMS approved protocol.

8.3 Other Parameters

Photo Reference Stations

Photographs should illustrate the Site's vegetation and morphological stability on an annual basis. Cross section photos should demonstrate no excessive erosion or degradation of the banks. Longitudinal photos should indicate the absence of persistent mid-channel bars within the channel or vertical incision. Grade control structures should remain stable. Deposition of sediment on the bank side of vane arms is preferable. Maintenance of scour pools on the channel side of vane arms is expected.

Photographs will be taken once a year to visually document stability for seven years following construction. Permanent markers will be established and located with GPS equipment so that the same locations and view directions on the Site are photographed each year. Photos will be used to monitor restoration and enhancement areas as well as vegetation plots.

Longitudinal reference photos will be established at regular intervals along the channel by taking a photo looking upstream and downstream. Cross sectional photos will be taken of each permanent cross section looking upstream and downstream. Reference photos will also be taken for each of the vegetation plots. Representative digital photos of each permanent photo point, cross section, and vegetation plot will be taken on the same day the stream and vegetation assessments are conducted. The photographer will make every effort to consistently maintain the same area in each photo over time.

Visual Assessments

Visual monitoring will adhere to the DMS Stream and Wetland Monitoring Guidelines (June 2017) for visual stream and vegetation assessments, and should support the specific performance standards for each metric as described above.

Visual assessments will be performed along stream reaches on a semi-annual basis during the seven-year monitoring period. Problem areas such as channel instability (e.g. lateral and/or vertical instability, instream structure failure/instability and/or piping, headcuts), vegetation health (e.g. low stem density, vegetation mortality, invasive species, or encroachment), beaver activity, or livestock access will be noted. Wildlands will also visually assess stability of internal stream crossings and the stability of the proposed stormwater BMP above UT4. Areas of concern will be mapped and photographed and will be accompanied by a written description in the annual report. Problem areas with be re-evaluated during each subsequent visual assessment. Should remedial actions be required, a plan of action will be provided in the annual monitoring report.

9.0 Monitoring Plan

Using the DMS Baseline Monitoring Report Template (June 2017), a baseline monitoring document and as-built record drawings of the project will be developed for the constructed Site. Complete monitoring reports will be prepared in the fall of monitoring year one, two, three, five, and seven and submitted to DMS. In monitoring years four and six, a brief summary of the site conditions along with photos, current condition plan view (CCPV) map, and applicable hydrology data will be prepared and submitted to DMS. Annual monitoring reports will be based on the DMS Annual Monitoring Report Template (April 2015). The monitoring period will extend seven years beyond completion of construction or until performance criteria have been met.

The Site monitoring plan has been developed to ensure that the required performance standards are met and project goals and objectives are achieved. The monitoring report shall provide project data chronology that will facilitate an understanding of project status and trends, ease population of DMS databases for analysis and research purposes, and assist in close-out decision making.

Using the DMS Baseline Monitoring Report Template (June 2017), a baseline monitoring document and as-built record drawings of the project will be developed following the planting completion and monitoring installation on the restored site. Complete monitoring reports will be prepared in the fall of monitoring year one, two, three, five, and seven and submitted to DMS. In monitoring years four and six, a brief summary of the site conditions along with photos, current condition plan view (CCPV) map, and applicable hydrology data will be prepared and submitted to DMS. Annual monitoring reports will be based on the DMS Annual Monitoring Report Template (June 2017) and Closeout Report Template (January 2016). The monitoring period will extend seven years beyond completion of construction or until performance criteria have been met. If all performance criteria have been successfully met and at least two bankfull events have occurred during separate years, Wildlands may propose to terminate stream and/or vegetation monitoring after five years.

Table 21, below, describes how the monitoring plan is set up to verify that project goals and objectives have been achieved.

Table 21: Monitoring Plan – *Shake Rag Mitigation Site*

Goal	Treatment	Performance Standards	Monitoring Metric	Outcome	Likely Functional Uplift
Improve stream channel stability.	Restore stream channels with bankfull channel dimension and pattern suited to the valley type.	Bank height ratios stay below 1.2. Visual assessments showing progression towards stability.	Cross-section monitoring and Visual assessment.	Stable stream channels with bank height ratios below 1.2.	Reduction in sediment inputs from bank erosion, reduction of shear stress, and improved overall hydraulic function.
Exclude livestock from stream channels.	Install livestock fencing and watering systems as needed to exclude livestock from stream channels and riparian areas.	Prevent easement encroachment.	Visual assessment	Eliminate cattle access to buffer areas and stream.	Reduction in pollutant loads to streams caused by cattle access.

Goal	Treatment	Performance Standards	Monitoring Metric	Outcome	Likely Functional Uplift
Reconstruct channels with flood-prone areas with appropriate geomorphology.	Restore stream channels with bankfull dimensions and construct flood-prone areas consistent with reference reach findings.	Streams: Stream profile and pattern must remain stable (note description of stability in Section 8.1).	Cross-section monitoring, Visual assessment	Stable stream channels with entrenchment ratios between 1.4-2.2 and bank height ratios below 1.2.[1]	Reduction in bankfull and greater flow velocities and channel shear stresses by allowing a natural range of flows to flow within the bankfull channel and on to the flood-prone area.
Improve instream habitat.	Install habitat features such as constructed riffles, cover logs, and brush toes into restored streams. Add woody materials to channel beds. Construct pools of varying depth. Remove online farm pond.	There is no required performance standard for this metric.	Visual assessment	The visual inspection of instream aquatic habitat would progress, showing increase complexity over time.	Increase in available habitat niches for macroinvertebrates and fish leading to an increase in biodiversity over time.
Reduce sediment and nutrient input from adjacent cattle grazing areas and unpaved roads	Construct one step pool stormwater conveyance to treat runoff from cattle grazing areas before entering Site streams. Relocate unpaved roads outside of riparian corridor, grade and plant forested buffer with native vegetation.	There is no required performance standard for this metric.	None	Stormwater conveyance remain functional, trap sediment and treat agricultural runoff.	Reduction in floodplain terrace sediment inputs from runoff, improved aquatic habitat and water quality.
Restore and enhance native floodplain terrace vegetation.	Plant native tree and understory species in open and shaded riparian areas where currently insufficient. Treat invasive species.	In open areas planted; Survival of 210 planted stems per acre at MY7. Interim survival of at least 320 planted stems at MY3 and at least 260 planted stems per acre at MY5. No success criteria is associated with shaded area planting.	Permanent and mobile 100 square meter vegetation plots within planted open areas. Shaded areas planted will be visual assessed.	Planted open area stem densities will be at or above 210 planted stems per acre at MY7.	Reduction in floodplain terrace sediment inputs from runoff, increased bank stability, increased LWD and organic material in streams, and improved riparian habitat.
Permanently protect the project site from harmful uses.	Establish a conservation easement on the Site. Exclude livestock from Site streams.	Record and close conservation easement prior to implementation.	Visual assessment	Site remains protected by conservation easement in perpetuity.	Protection of the Site from encroachment into the conservation easement and direct impact to streams. Supports all functions.

[1] Due to existing landforms, Shake Rag Branch Reach 5 is expected to have a wider flood-prone width and an entrenchment ratio greater than 2.2.

9.1 Monitoring Components

Project monitoring components are listed in more detail in Table 22 and 23. Approximate locations of the proposed vegetation plots stream gage monitoring components are illustrated in Figure 8.

Table 22: Monitoring Components (Shake Rag Branch, UT3, UT4, UT8, and UT7) – *Shake Rag Mitigation Site*

Parameter	Monitoring Feature	Quantity/Length by Reach										Frequency	Notes
		Shake Rag Reach 1	Shake Rag Reach 2	Shake Rag Reach 3	Shake Rag Reach 4	Shake Rag Reach 5	UT3 Reach 1	UT3 Reach 2	UT4	UT8	UT7		
Dimension	Riffle Cross-sections	N/A	N/A	2	1	1	N/A	1	1	1	N/A	Year 1, 2, 3, 5, and 7	1
	Pool Cross-sections	N/A	N/A	1	0	1	N/A	1	1	0	N/A		
Pattern	Pattern	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Substrate	Reach wide (RW) Pebble Count	N/A	N/A	1 RW	1 RW	1 RW	N/A	1 RW	1 RW	1 RW	N/A	Year 1, 2, 3, 5, and 7	3
Hydrology	Crest Gage (CG) and/or Transducer (SG)	N/A	N/A	1			N/A	1	1	1 (see note 4)	N/A	Semi-Annual	4
Vegetation	CVS Level 2/Mobile Plots	N/A	N/A	7 (4 permanent, 3 mobile)							N/A	Year 1, 2, 3, 5, and 7	5
Visual Assessment		N/A	Y	Y	Y	Y	Y	Y	Y	Y	N/A	Semi-Annual	
Exotic and nuisance vegetation												Semi-Annual	6
Project Boundary												Semi-Annual	7
Reference Photos	Photographs	21										Annual	

1. Cross-sections will be permanently marked with rebar to establish location. Surveys will include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg.
2. Pattern and profile will be assessed visually during semi-annual site visits. Longitudinal profile will be collected during as-built baseline monitoring survey only, unless observations indicate widespread lack of vertical stability (greater than 10% of reach is affected) and profile survey is warranted in additional years to monitor adjustments or survey repair work.
3. Riffle 100-count substrate sampling will be collected during the baseline monitoring only. Substrate assessments in subsequent monitoring years will consist of reachwide substrate monitoring.
4. Crest gages and/or transducers will be inspected quarterly or semi-annually; evidence of bankfull events or consecutive flow will be documented with a photo when possible. Transducers, if used, will be set to record stage once every 2 hours, or at a shorter interval if necessary. The proposed gage on UT8 will be used for the sole purpose of demonstrating consecutive flow – an alternative proven method (e.g. game camera) may be used if agreed by IRT to be sufficient to demonstrate this requirement.
5. Both mobile and permanent vegetation plots will be utilized to evaluate the vegetation performance for the open areas planted. 2% of the open planted acreage will be monitored with permanent plots and mobile plots. Permanent vegetation monitoring plot assessments will follow CVS Level 2 protocols. Mobile vegetation monitoring plot assessments will document number of planted stems and species using a circular or 100 m^2 square/rectangular plot. Planted shaded areas will be visually assessed.
6. Locations of exotic and nuisance vegetation will be mapped
7. Locations of vegetation damage, boundary encroachments, etc. will be mapped.

Table 23: Monitoring Components (UT1, UT1A, UT2, UT5, and UT6) – *Shake Rag Mitigation Site*

Parameter	Monitoring Feature	Quantity/Length by Reach							Frequency	Notes
		UT1 Reach 1	UT1 Reach 2	UT1A	UT2 Reach 1	UT2 Reach 2	UT5	UT6		
Dimension	Riffle Cross-sections	N/A	1	N/A	N/A	1	N/A	N/A	Year 1, 2, 3, 5, and 7	1
	Pool Cross-sections	N/A	0	N/A	N/A	0	N/A	N/A		
Pattern	Pattern	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Substrate	Reach wide (RW) Pebble Count	N/A	1 RW	N/A	N/A	1 RW	N/A	N/A	Year 1, 2, 3, 5, and 7	3
Hydrology	Crest Gage (CG) and/or Transducer (SG)	N/A	1	N/A	N/A	1	N/A	N/A	Semi-Annual	4
Vegetation	CVS Level 2/Mobile Plots	2 (1 permanent, 1 mobile)					N/A	N/A	Year 1, 2, 3, 5, and 7	5
Visual Assessment		Y	Y	Y	Y	Y	Y	Y	Semi-Annual	
Exotic and nuisance vegetation									Semi-Annual	6
Project Boundary									Semi-Annual	7
Reference Photos	Photographs	9							Annual	

1. Cross-sections will be permanently marked with rebar to establish location. Surveys will include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg.
2. Pattern and profile will be assessed visually during semi-annual site visits. Longitudinal profile will be collected during as-built baseline monitoring survey only, unless observations indicate widespread lack of vertical stability (greater than 10% of reach is affected) and profile survey is warranted in additional years to monitor adjustments or survey repair work.
3. Riffle 100-count substrate sampling will be collected during the baseline monitoring only. Substrate assessments in subsequent monitoring years will consist of reachwide substrate monitoring.
4. Crest gages and/or transducers will be inspected quarterly or semi-annually, evidence of bankfull events will be documented with a photo when possible. Transducers, if used, will be set to record stage once every 2 hours. The transducer will be inspected and downloaded semi-annually.
5. Both mobile and permanent vegetation plots will be utilized to evaluate the vegetation performance for the open areas planted. 2% of the open planted acreage will be monitored with permanent plots and mobile plots. Permanent vegetation monitoring plot assessments will follow CVS Level 2 protocols. Mobile vegetation monitoring plot assessments will document number of planted stems and species using a circular or 100 m^2 square/rectangular plot. Planted shaded areas will be visually assessed with permanent vegetation photo points along UT5 and UT6.
6. Locations of exotic and nuisance vegetation will be mapped
7. Locations of vegetation damage, boundary encroachments, etc. will be mapped.

10.0 Long-Term Management Plan

The Site will be transferred to the North Carolina Department of Environmental Quality (NCDEQ) Stewardship Program. This party shall serve as conservation easement holder and long-term steward for the property and will conduct periodic inspection of the site to ensure that restrictions required in the conservation easement are upheld. The NCDEQ Stewardship Program is developing an endowment system within the non-reverting, interest-bearing Conservation Lands Conservation Fund Account. The use of funds from the Endowment Account will be governed by North Carolina General Statue GS 113A-232(d)(3). Interest gained by the endowment fund may be used for stewardship, monitoring, stewardship administration, and land transaction costs, if applicable.

The Stewardship Program will periodically install signage as needed to identify boundary markings as needed. Maintenance of the proposed fencing and permanent crossings will be the responsibility of the landowner and not NCDEQ. The Site Protection Instrument associated with this project can be found in Appendix 1.

Table 24: Long-term Management Plan – *Shake Rag Mitigation Site*

Long-Term Management Activity	Long-Term Manager Responsibility	Landowner Responsibility
Signage will be installed and maintained along the Site boundary to denote the area protected by the recorded conservation easement.	The long-term steward will be responsible for inspecting the Site boundary and for maintaining or replacing signage to ensure that the conservation easement area is clearly marked.	The landowner shall report damaged or missing signs to the long-term manager, as well as contact the long-term manager if a boundary needs to be marked, or clarification is needed regarding a boundary location. If land use changes in the future and fencing is required to protect the easement, the landowner is responsible for installing appropriate approved fencing.
The Site will be protected in its entirety and managed under the terms outlined in the recorded conservation easement.	The long-term manager will be responsible for conducting annual inspections and for undertaking actions that are reasonably calculated to swiftly correct the conditions constituting a breach. The USACE, and their authorized agents, shall have the right to enter and inspect the Site and to take actions necessary to verify compliance with the conservation easement.	The landowner shall contact the long-term manager if clarification is needed regarding the restrictions associated with the recorded conservation easement.

11.0 Adaptive Management Plan

Upon completion of Site construction, Wildlands will implement the post-construction monitoring defined in Sections 8 and 9. Project maintenance will be performed during the monitoring years to address minor issues as necessary (Appendix 8). If, during annual monitoring it is determined the Site's ability to achieve Site performance standards are jeopardized, Wildlands will notify the members of the IRT and work with the IRT to develop contingency plans and remedial actions.

12.0 Determination of Credits

Mitigation credits presented in Table 25 are projections based upon the proposed design. The Site is submitted for mitigation credit in the French Broad 06010105. Credit adjustments at the as-built stage cannot be made unless there is a significant change in the as-built. All design alignments should be based on stream centerline. This Site contains 12 internal easement crossings, two of which are for the buried water line intersecting UT5 and UT6. The affected length of stream within the crossings are excluded from the restored footage and proposed stream credit values in the table below. Note, per a special condition of RFP 16-006993, no more than 10% of the total LF of stream offered for mitigation can be stream preservation. Buffers proposed throughout the Site meet the minimum required 30-foot standard width for Mountain streams, and in most cases, far exceed it. Appendix 9 contains the credit release schedule for the Site.

Table 25: Project Asset Table – *Shake Rag Mitigation Site*

Mitigation Credits								
	Stream		Riparian Wetland		Non-Riparian Wetland		Riparian Buffer	
Type	R	RE	R	RE	R	RE	R	RE
Totals	6,581.6	74	N/A	N/A	N/A	N/A	N/A	N/A
Project Components								
Project Component or Reach ID	**Existing Footage/ Acreage**	**Proposed Stationing Location**	**Approach (P1, P2, etc.)**	**Restoration (R) or Restoration Equivalent (RE)**	**Restoration Footage/ Acreage[1]**	**Mitigation Ratio**	**Proposed Credit**	
Shake Rag Branch R1	312	903+88 – 907+00	Preservation	RE	312	10	31.2	
Shake Rag Branch R2	175	907+00 – 908+75	E2	R	175	2.5	70	
Shake Rag Branch R3	1,451[1]	908+75 – 923+18	P1	R	1,393	1	1,393	
Shake Rag Branch R4	385	923+18 – 927+03	E1	R	385	1.5	256.7	
Shake Rag Branch R5	1,216	927+03 – 938+88	P1, P2	R	1,134	1	1,134	
UT1 R1	934	100+53 – 110+90	E2	R	907	2.5	362.8	
UT1 R2	255	110+90 – 113+68	E1	R	278	1.5	185.3	
UT1A	100	150+18 – 151+18	E2	R	100	2.5	40	
UT2 R1	164	200+86 – 202+50	E2	R	164	2.5	65.6	
UT2 R2	296	202+50 – 205+80	P1	R	304	1	304	
UT3 R1	426	300+00 – 304+26	E2	R	426	2.5	170.4	
UT3 R2	1,387[1]	304+26 – 314+70	P1	R	1,019	1	1,019	
UT4	910[1]	400+00 – 409+56	P1	R	930	1	930	
UT5	483	500+00 – 504+83	E2	R	439	2.5	175.6	
UT6	707	601+87 – 608+94	E2	R	673	2.5	269.2	
UT7	428	72+72 – 77+00	Preservation	RE	428	10	42.8	
UT8	210[1]	800+00 – 802+06	P1	R	206	1	206	

Component Summation					
Restoration Level	**Proposed Stream (LF)**	**Riparian Wetland (Acres)**	**Non-Riparian Wetland (AC)**	**Buffer (sq.ft.)**	**Upland (AC)**
Restoration	4,986	N/A	N/A	N/A	N/A
Enhancement	3,547	N/A	N/A	N/A	N/A
Preservation	740	N/A	N/A	N/A	N/A

1. Some or all of SRB Reach 3, UT3 Reach 2, UT4, and UT8 have been buried in rock-lined channels or pipes. Reported lengths are estimates based upon land owner communication, remote sensing, and field verification to approximate the subsurface location and alignment.
2. The Site contains 12 internal easement crossings. This value excludes the affected length of proposed stream centerline within each crossing.

13.0 References

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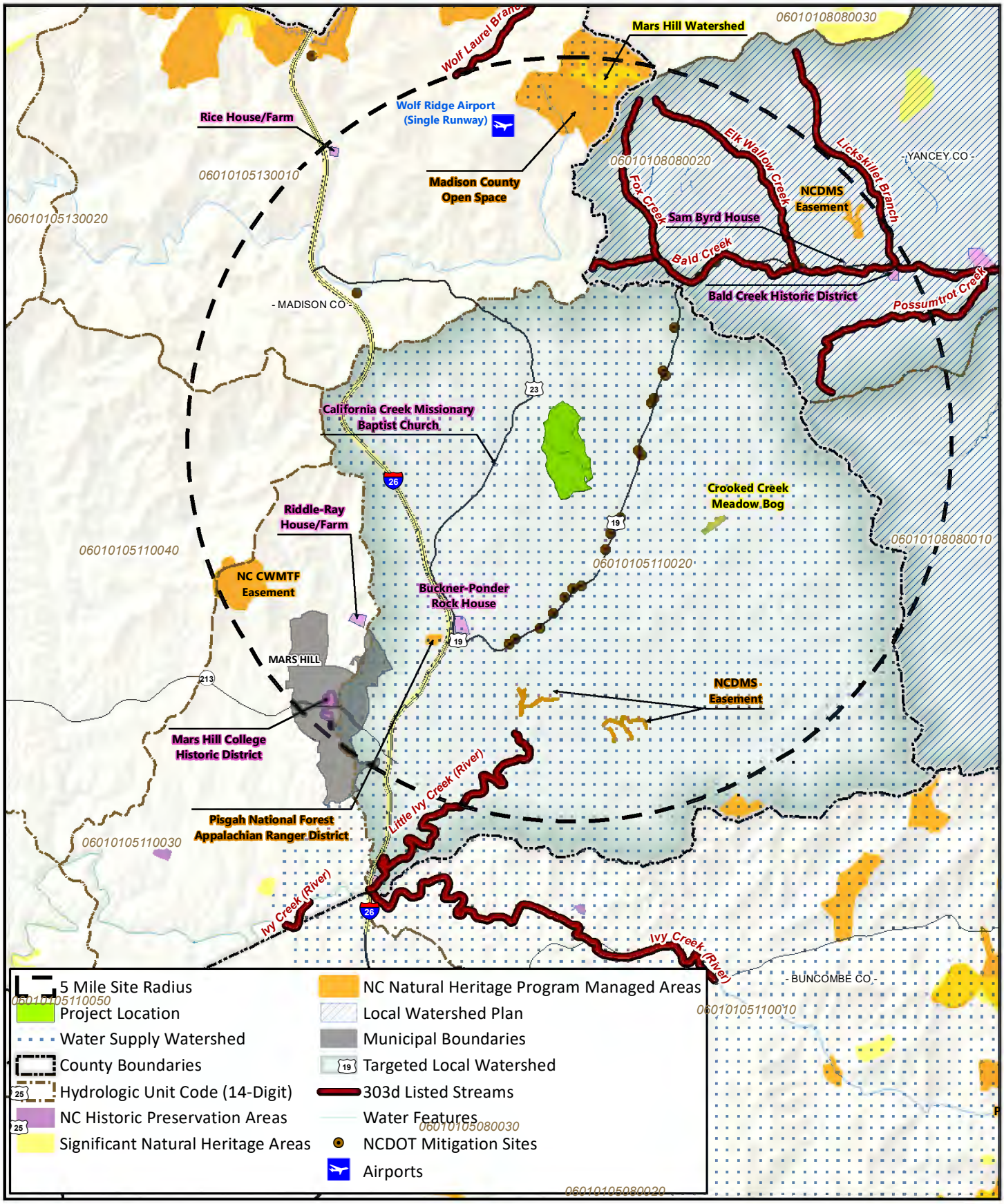
FIGURES



WILDLANDS ENGINEERING

0 1 2 Miles

N

Figure 1 Vicinity Map
Shake Rag Mitigation Site
French Broad River Basin 06010105

Madison County, NC

Project Location
Proposed Conservation Easement
Existing Wetlands
Open Water (Pond)
Woody Debris Pile
Project Streams
Perennial
Perennial - Buried (approximate location)
Non-Project Streams
Cross Sections
Existing Power Line
Unpaved Roads
Existing Fence to Remain
Existing CREP Fence
Existing Power Pole
Existing Structures
Reach Breaks
Stream Classification Points (SCP #)
Sinkholes/Seeps (Field Verified Subsurface Flow)
Existing Culverts/Pipes

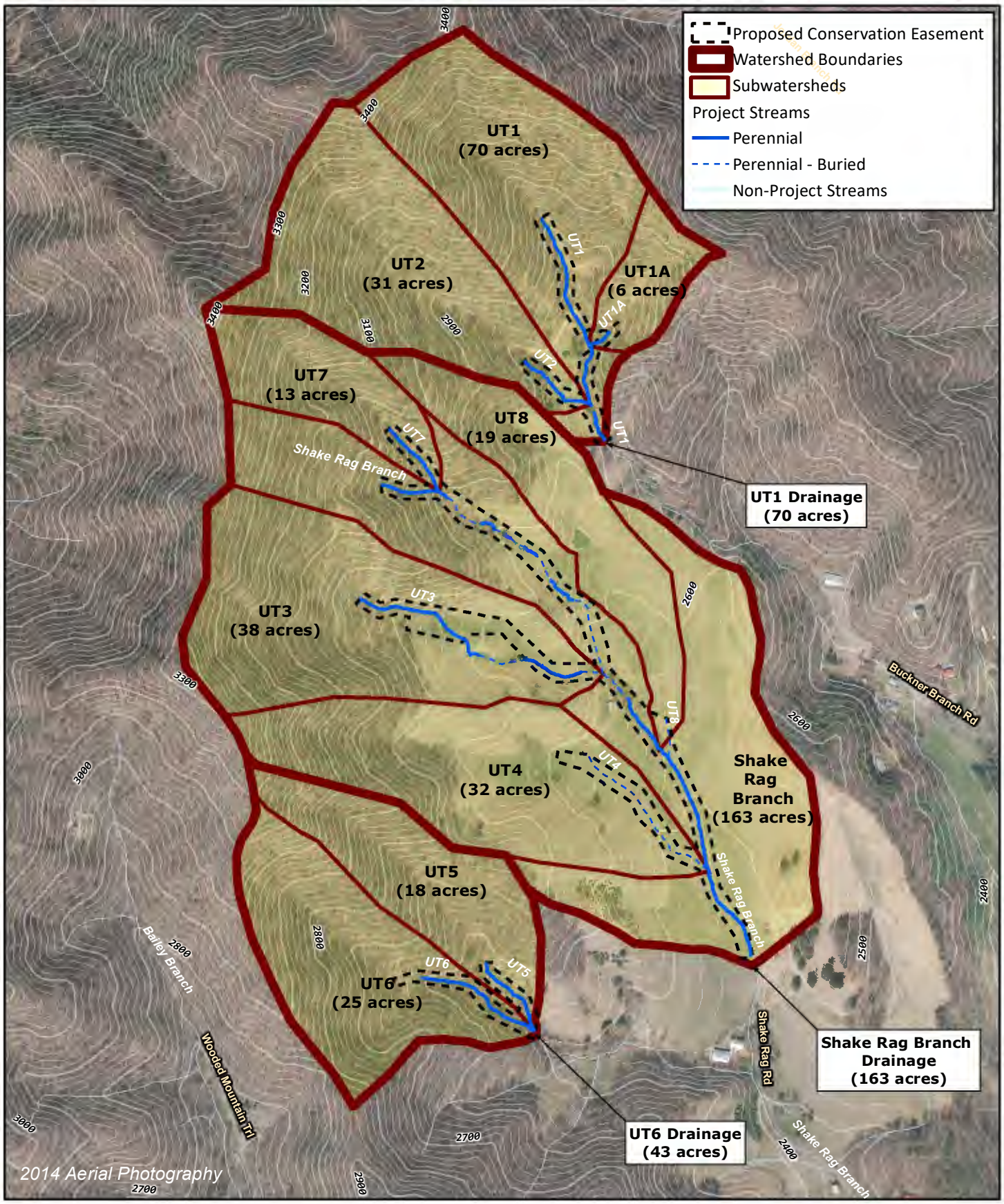
0 600 Feet

N

2014 Aerial Photography

WILDLANDS ENGINEERING

Figure 2 Site Map
Shake Rag Mitigation Site
French Broad River Basin 06010105
Madison County, NC



WILDLANDS ENGINEERING

0 700 1,400 Feet

N

Figure 3 Watershed Map
Shake Rag Mitigation Site
French Broad River Basin 06010105

Madison County, NC

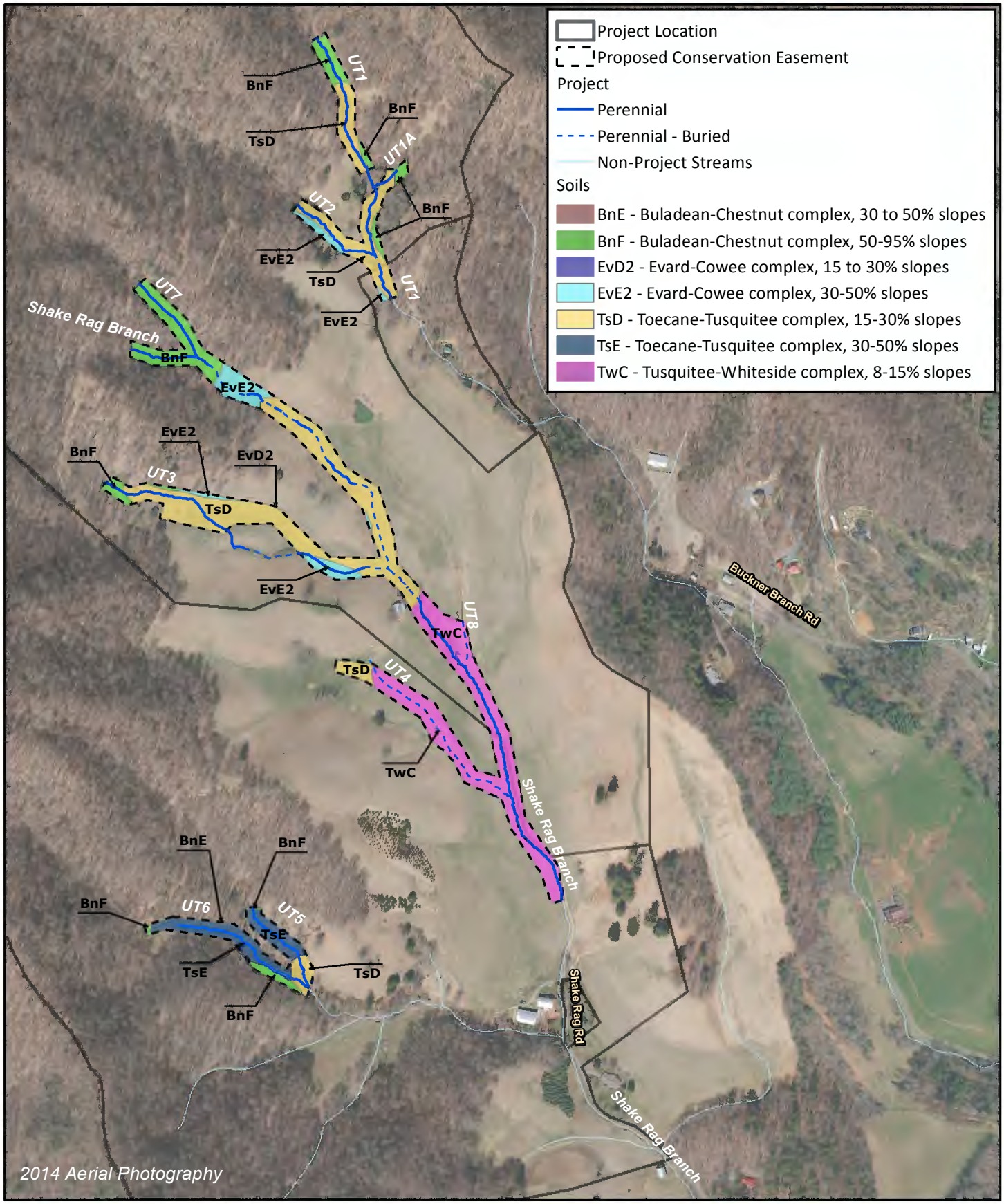
WILDLANDS ENGINEERING

0 1,000 Feet

N

Figure 4 USGS Topographic Map
Shake Rag Mitigation Site
French Broad River Basin 06010105

Madison County, NC



WILDLANDS ENGINEERING

0 600 1,200 Feet

N

Figure 5 Soils Map
Shake Rag Mitigation Site
French Broad River Basin 06010105

Madison County, NC

Reach 1
Existing Farm Road Within Easement to be Abandoned and Planted
UT1
Outhouse to be Removed
Existing Cabin 1
Cookhouse
UT1A
Pond and Associated Culverts to be Removed
UT2
Reach 1
Reach 2
Reach 2
UT1
Existing Cabin 2
UT7
Shake Rag Branch
Reach 2
Reach 1
Shake Rag Branch
Reach 3
Tie Proposed Fence to Existing Fence
UT3
Reach 1
Reach 2
Remove Failing Concrete Pipes and Other Debris from Stream Channel
Reach 4
UT8
Existing Farm Road Within Easement to be Relocated Outside of Easement
UT4
Install Step-Pool Stormwater Control Measure BMP
Reach 5
Shake Rag Branch
6' Internal Buried Water Line Crossing
Existing Power Line and Power Pole to be Relocated Outside of Conservation Easement
Tie Proposed Fence to Existing CREP Fence
UT6
UT5
Shake Rag Rd
2014 Aerial Photography
3000
3300
3400
3100
2900
3200
2800
2600
2700
2500

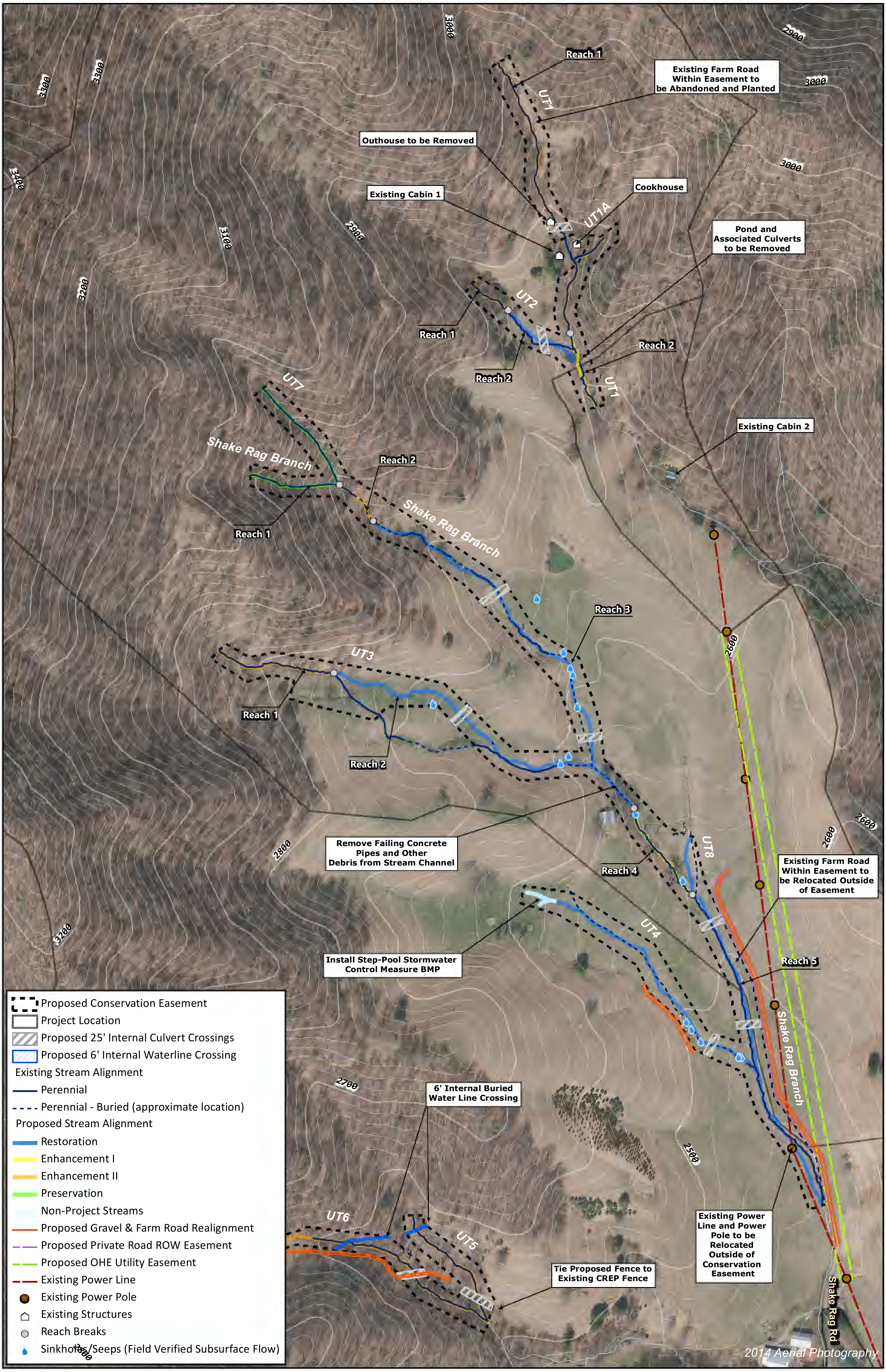
- Proposed Conservation Easement
- Project Location
- Proposed 25' Internal Culvert Crossings
- Proposed 6' Internal Waterline Crossing
- Restoration
- Enhancement I
- Enhancement II
- Preservation
- Non-Project Streams
- Existing Fence to Remain
- Existing CREP Fence
- Existing Fence to be Removed
- Proposed Fencing
- Proposed Gravel & Farm Road Realignment
- Proposed Private Road ROW Easement
- Proposed OHE Utility Easement
- Existing Power Line
- Existing Power Pole
- Existing Structures
- Reach Breaks

WILDLANDS ENGINEERING

0 600 Feet

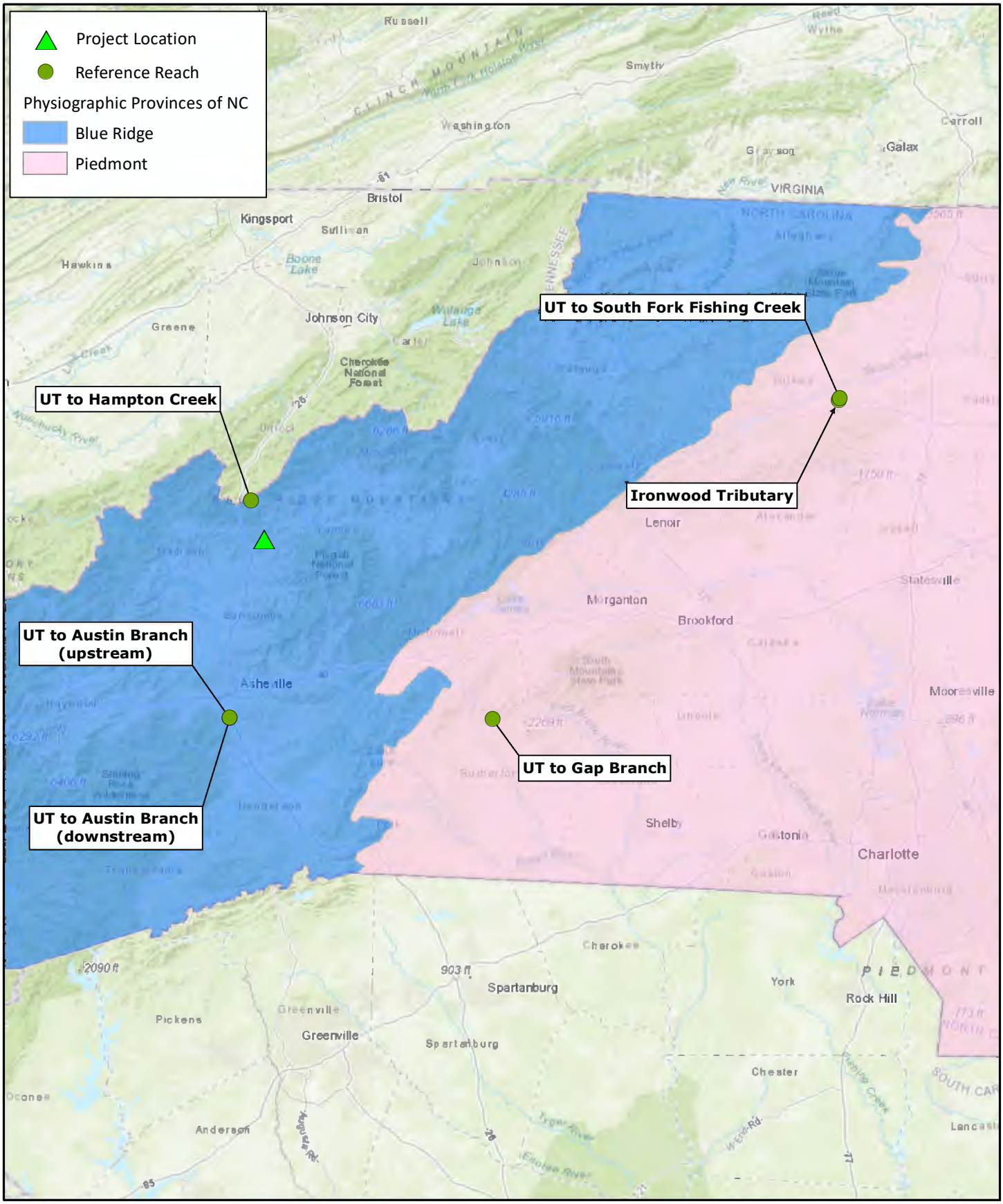
N

Figure 6a Concept Design Map
Shake Rag Mitigation Site
French Broad River Basin 06010105
Madison County, NC


Reach 1
Existing Farm Road Within Easement to be Abandoned and Planted
UT1
Outhouse to be Removed
Existing Cabin 1
Cookhouse
UT1A
Pond and Associated Culverts to be Removed
UT2
Reach 1
Reach 2
Reach 2
UT1
Existing Cabin 2
UT7
Shake Rag Branch
Reach 2
Reach 1
Shake Rag Branch
Reach 3
UT3
Reach 1
Reach 2
Remove Failing Concrete Pipes and Other Debris from Stream Channel
UT8
Reach 4
Existing Farm Road Within Easement to be Relocated Outside of Easement
UT4
Install Step-Pool Stormwater Control Measure BMP
Reach 5
Shake Rag Branch
6' Internal Buried Water Line Crossing
UT6
UT5
Tie Proposed Fence to Existing CREP Fence
Existing Power Line and Power Pole to be Relocated Outside of Conservation Easement
Shake Rag Rd
2014 Aerial Photography
3300
3300
3400
3200
3100
2900
3000
2900
3000
3000
2600
2600
2600
2800
3200
2700
2500
Proposed Conservation Easement
Project Location
Proposed 25' Internal Culvert Crossings
Proposed 6' Internal Waterline Crossing
Existing Stream Alignment
Perennial
Perennial - Buried (approximate location)
Proposed Stream Alignment
Restoration
Enhancement I
Enhancement II
Preservation
Non-Project Streams
Proposed Gravel & Farm Road Realignment
Proposed Private Road ROW Easement
Proposed OHE Utility Easement
Existing Power Line
Existing Power Pole
Existing Structures
Reach Breaks
Sinkholes/Seeps (Field Verified Subsurface Flow)
0
600 Feet
N

WILDLANDS ENGINEERING

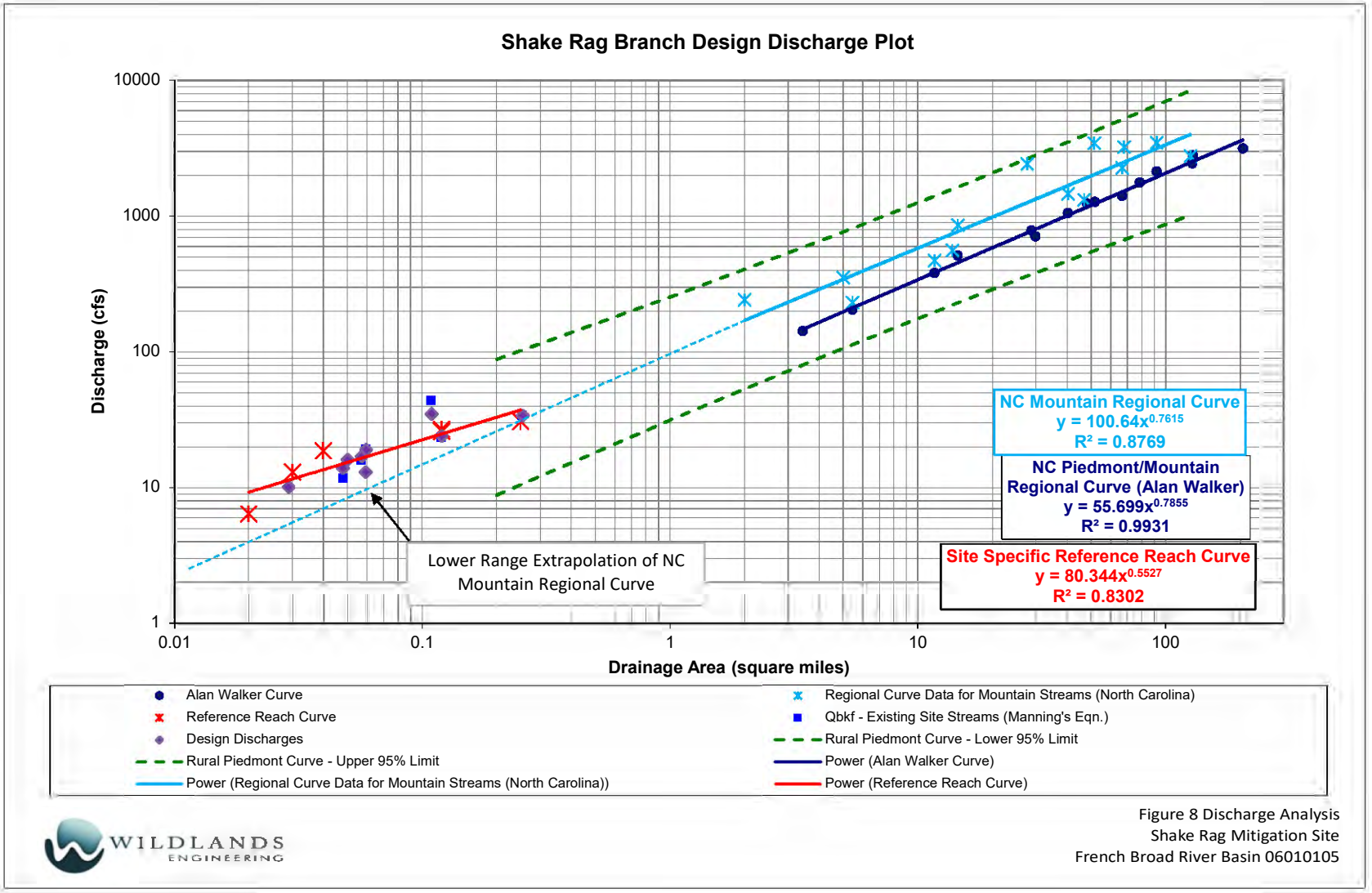
Figure 6b Overlay of Existing and Proposed Stream Alignments
Shake Rag Mitigation Site
French Broad River Basin 06010105
Madison County, NC



WILDLANDS ENGINEERING

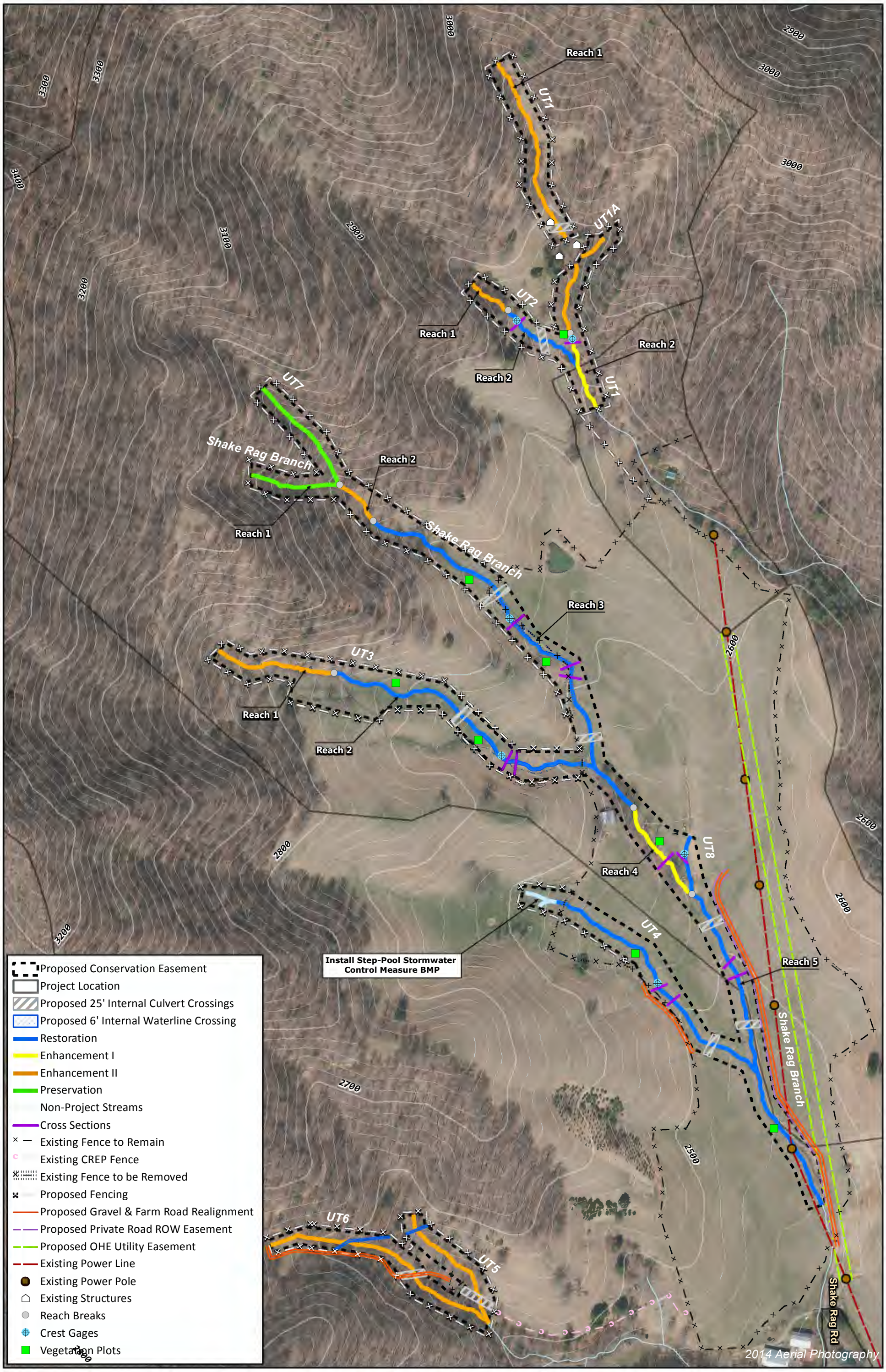
Figure 7 Reference Reach Vicinity Map
Shake Rag Mitigation Site
French Broad River Basin 06010105

Madison County, NC



WILDLANDS ENGINEERING

Figure 8 Discharge Analysis
Shake Rag Mitigation Site
French Broad River Basin 06010105



WILDLANDS ENGINEERING

0 600 Feet

Figure 9 Monitoring Plan Map
Shake Rag Mitigation Site
French Broad River Basin 06010105
Madison County, NC

APPENDIX 1
SITE PROTECTION INSTRUMENT

Appendix 1 Site Protection Instrument

The land required for construction, management, and stewardship of this mitigation project includes portions of the parcels listed in Table 1. All parcels are optioned for purchase by Wildlands Engineering, Inc. (Wildlands). Upon transfer of lands to Wildlands, a conservation easement will be recorded on the parcels and includes streams and wetlands being restored and preserved along with their corresponding riparian buffers.

Table 1: Site Protection Instrument – *Shake Rag Mitigation Site*

Current Landowner	PIN	County	Under Option to Purchase by Wildlands?	Memorandum of Option/Temporary Access and Conservation Easement Deed Book (DB) and Page Number (PG)	Acreage to be Protected
James Ronald Thomas	9769401483	Madison	Yes	DB: 611 PG: 7-11	4.99
Nancy and Gary Wilde	9769336376 9769438371	Madison	Yes	DB: 611 PG: 1-6	12.78

The conservation easement template that will be used for recordation is included in this appendix. All site protection instruments require 60-day advance notification to the USACE and or DMS prior to any action to void, amend, or modify the document. No such action shall take place unless approved by the State.

STATE OF NORTH CAROLINA

DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT

MADISON COUNTY

SPO File Numbers: _____
DMS Project Number: 100018

Prepared by: Office of the Attorney General
Property Control Section
Return to: NC Department of Administration
State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

THIS DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS, made this__day of_____, 201_, by _____, ("**Grantor**"), whose mailing address is _____ to the State of North Carolina, ("**Grantee**"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations of Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. § 143-214.8 et seq., the State of North Carolina has established the Division of Mitigation Services (formerly known as the Ecosystem Enhancement Program and Wetlands Restoration Program) within the Department of Environmental Quality for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the

protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between **Wildlands Engineering, Inc.** and the North Carolina Department of Environmental Quality, to provide stream, wetland and/or buffer mitigation pursuant to the North Carolina Department of Environment and Natural Resources Purchase and Services Contract Number **7190**.

WHEREAS, The State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Understanding, (MOU) duly executed by all parties on November 4, 1998. This MOU recognized that the Wetlands Restoration Program was to provide effective compensatory mitigation for authorized impacts to wetlands, streams and other aquatic resources by restoring, enhancing and preserving the wetland and riparian areas of the State; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (MOA) duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Division of Mitigation Services (formerly Ecosystem Enhancement Program) is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the Department of Environment and Natural Resources, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the North Carolina Wildlife Resources Commission, the North Carolina Division of Water Quality, the North Carolina Division of Coastal Management, and the National Marine Fisheries Service entered into an agreement to continue the In-Lieu Fee operations of the North Carolina Department of Natural Resources' Division of Mitigation Services (formerly Ecosystem Enhancement Program) with an effective date of 28 July, 2010, which supersedes and replaces the previously effective MOA and MOU referenced above; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Division of Mitigation Services in the Department of Environmental Quality, which has been delegated the authority authorized by the Governor and Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple certain real properties situated, lying, and being in _____ Township, Madison County, North Carolina (the "**Property**"), and being more particularly described as that certain parcels of land containing approximately _____ acres and being conveyed to the Grantor by deed as recorded in **Deed Book _____, Page _____** of the Madison County Registry, North Carolina; and

WHEREAS, Grantor is willing to grant a Conservation Easement and Right of Access over the herein described areas of the Property, thereby restricting and limiting the use of the areas of the Property subject to the Conservation Easement to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept said Easement and Access Rights. The Conservation Easement shall be for the protection and benefit of the waters of unnamed tributaries to Shake Rag Branch.

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement along with a general Right of Access.

The Conservation Easement Area consists of the following:

Easement Areas _____ containing a total of _____ acres as shown on the plats of survey entitled "A Conservation Easement Survey for the State of North Carolina NCDEQ: Division of Mitigation Services, Shake Rag Mitigation Site, SPO File No. ____, DMS Project Site No. 100018, Property of _____, dated _____ Nolan R. Carmack PLS Number L-5076 and recorded in the Madison County, North Carolina Register of Deeds at Plat Book _____ Page_____.

See attached "**Exhibit A**", Legal Description of area of the Property hereinafter referred to as the "Conservation Easement Area"

The purposes of this Conservation Easement are to maintain, restore, enhance, construct, create and preserve wetland and/or riparian resources in the Conservation Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Conservation Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with, and be a continuing restriction upon the use of, the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, agents, lessees, and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Conservation Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Conservation Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. Recreational Uses. Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Conservation Easement Area for the purposes thereof.

B. Motorized Vehicle Use. Motorized vehicle use in the Conservation Easement Area is prohibited except within a Crossing Area(s) or Road or Trail as shown on the recorded survey plat**.**

C. Educational Uses. The Grantor reserves the right to engage in and permit others to engage in educational uses in the Conservation Easement Area not inconsistent with this Conservation Easement, and the right of access to the Conservation Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the property shall not alter vegetation, hydrology or topography of the site.

D. **Damage to Vegetation.** Except within Crossing Area(s) as shown on the recorded survey plat and as related to the removal of non-native plants, diseased or damaged trees, or vegetation that destabilizes or renders unsafe the Conservation Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Conservation Easement Area is prohibited.

E. Industrial, Residential and Commercial Uses. All industrial, residential and commercial uses are prohibited in the Conservation Easement Area.

F. Agricultural Use. All agricultural uses are prohibited within the Conservation Easement Area including any use for cropland, waste lagoons, or pastureland.

G. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Conservation Easement Area.

H. Roads and Trails. There shall be no construction or maintenance of new roads, trails, walkways, or paving in the Conservation Easement.

All existing roads, trails and crossings within the Conservation Easement Area shall be shown on the recorded survey plat.

I. Signs. No signs shall be permitted in the Conservation Easement Area except interpretive signs describing restoration activities and the conservation values of the Conservation Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, signs giving directions, or signs prescribing rules and regulations for the use of the Conservation Easement Area.

J. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or any other material in the Conservation Easement Area is prohibited.

K. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, drilling, hydraulic fracturing; removal of topsoil, sand, gravel, rock, peat, minerals, or other materials.

L. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water in the Conservation Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored, enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticide or biocides in the Conservation Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Conservation Easement Area may temporarily be withdrawn for good cause shown as needed for the survival of livestock on the Property.

M. Subdivision and Conveyance. Grantor voluntarily agrees that no further subdivision, partitioning, or dividing of the Conservation Easement Area portion of the Property owned by the Grantor in fee simple ("fee") that is subject to this Conservation Easement is allowed. Any future transfer of the Property shall be subject to this Conservation Easement and Right of Access and to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Conservation Easement Area for the purposes set forth herein.

N. Development Rights. All development rights are permanently removed from the Conservation Easement Area and are non-transferrable.

O. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Conservation Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is not inconsistent with the purposes of this Conservation Easement, and the Grantor obtains advance written approval from the Division of Mitigation Services, 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. Right of Access, Construction, and Inspection. The Grantee, its employees and agents, successors and assigns, receive a perpetual Right of Access to the Conservation Easement Area over the Property at reasonable times to undertake any activities to restore, construct, manage, maintain, enhance, protect, and monitor the stream, wetland and any other riparian resources in the Conservation Easement Area, in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. Signs. The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities within the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. Fences. Conservation Easements are purchased to protect the investments by the State (Grantee) in natural resources. Livestock within conservations easements damages the investment and can result in reductions in natural resource value and mitigation credits which would cause financial harm to the State. Therefore, Landowners (Grantor) with livestock are required to restrict livestock access to the Conservation Easement area.

E. Crossing Area(s). The Grantee is not responsible for maintenance of crossing area(s), however, the Grantee, its employees and agents, successors or assigns, reserve the right to repair crossing area(s), at its sole discretion and to recover the cost of such repairs from the Grantor if such repairs are needed as a result of activities of the Grantor, his successors or assigns.

IV. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Conservation Easement Area that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features in the Conservation Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor in writing of such breach and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the

power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Conservation Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Conservation Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury or change in the Conservation Easement Area caused by third parties, resulting from causes beyond the Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life or damage to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring expenses, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor, including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. No Waiver. Enforcement of this Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the

obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown herein or to other addresses as either party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed is subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in writing signed by all parties hereto, or their successors or assigns, if such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the State Property Office and the U.S. Army Corps of Engineers in writing sixty (60) days prior to the initiation of any transfer of all or any part of the Property or of any request to void or modify this Conservation Easement. Such notifications and modification requests shall be addressed to:

Division of Mitigation Services Program Manager
NC State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

and

General Counsel
US Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Conservation Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Conservation Easement Area, and the right of quiet enjoyment of the Conservation Easement Area,

TO HAVE AND TO HOLD, the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes,

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same is free from encumbrances and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever.

IN TESTIMONY WHEREOF, the Grantor has hereunto set his hand and seal, the day and year first above written.

_____ (SEAL)

NORTH CAROLINA
COUNTY OF _____

I,_____, a Notary Public in and for the County and State aforesaid, do hereby certify that_____, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the _____ day of _____, 20 .

_____
Notary Public

My commission expires:

_____

EXHIBIT A

Legal Description

APPENDIX 2
WETLAND JD FORMS
& PCN

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Shake Rag Mitigation Site City/County: Madison County Sampling Date: 2/13/2018

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: DP1 - Wetland C

Investigator(s): I. Eckardt Section, Township, Range:

Landform (hillside, terrace, etc.): Pond edge Local relief (concave, convex, none): Concave Slope (%):

Subregion (LRR or MLRA): LRR N Lat: 35.880505 Long: -82.496098 Datum:

Soil Map Unit Name: Toecane-Tusquitee complex (TsD) NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	**Is the Sampled Area within a Wetland?** **Yes** X **No**
Hydric Soil Present?	Yes X	No	
Wetland Hydrology Present?	Yes X	No	

Remarks:
Sampling point taken on the edge of small farm pond.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 6

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP1 - Wetland C

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size: 5)			
1. *Juncus effusus*	50	Yes	FACW
2. *Carex lurida*	30	Yes	OBL
3. *Festuca rubra*	10	No	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	90 =Total Cover		
50% of total cover: 45	20% of total cover: 18		
Woody Vine Stratum (Plot size: 5)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	30	x 1 =	30
FACW species	50	x 2 =	100
FAC species	0	x 3 =	0
FACU species	10	x 4 =	40
UPL species	0	x 5 =	0
Column Totals:	90 (A)		170 (B)

Prevalence Index = B/A = 1.89

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: P1 - Wetland

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1	10YR 2/2	100					Loamy/Clayey	
1-5	10YR 3/2	100					Sandy	
5-8	10YR 3/1	100					Sandy	
8-14	10YR 4/1	95	7.5YR 4/6	5	C	PL	Sandy	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- X Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Mucky Mineral (F1) **(MLRA 136)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 122, 136)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Shake Rag Mitigation Site City/County: Mars Hill/Madison Sampling Date: 2/13/18

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: DP2 - Upland C

Investigator(s): Ian Eckardt Section, Township, Range:

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): none Slope (%):

Subregion (LRR or MLRA): LRR N Lat: 35.880471 Long: -82.496291 Datum:

Soil Map Unit Name: Toecane-Tusquitee complex (TsD) NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation X, Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present? Yes No X

Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	**Is the Sampled Area within a Wetland?** **Yes** **No X**
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks:
Sampling point is within a grazed pasture where the vegetation has been converted from forest to grass.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes	No	Depth (inches):
Water Table Present?	Yes	No	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes	No	Depth (inches):

Wetland Hydrology Present? **Yes** **No X**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP2 - Upland C

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size: 5)			
1. *Festuca rubra*	95	Yes	FACU
2. *Andropogon virginicus*	5	No	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100 =Total Cover		
50% of total cover: 50	20% of total cover: 20		
Woody Vine Stratum (Plot size: 5)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	100	x 4 =	400
UPL species	0	x 5 =	0
Column Totals:	100 (A)		400 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: P2 - Upland

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	10YR 3/3	100					Loamy/Clayey	
2-14	10YR 4/4	100					Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Mucky Mineral (F1) **(MLRA 136)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 122, 136)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Shake Rag Mitigation Site City/County: Mars Hill/Madison Sampling Date: 5/9/2018

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: DP3 - Wetland D

Investigator(s): Ian Eckardt Section, Township, Range:

Landform (hillside, terrace, etc.): Hillside seep Local relief (concave, convex, none): concave Slope (%):

Subregion (LRR or MLRA): LRR N Lat: 35.872441 Long: -82.497565 Datum:

Soil Map Unit Name: Buladean-Chestnut complex (BnF) NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No	**within a Wetland?** **Yes** X **No**
Wetland Hydrology Present?	Yes X	No	

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- X Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP3 - Wetland D

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size: 15)			
1. *Lindera benzoin*	60	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	60 =Total Cover		
50% of total cover: 30	20% of total cover: 12		
Herb Stratum (Plot size: 5)			
1. *Microstegium vimineum*	20	Yes	FAC
2. *Galax*	5	Yes	
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	25 =Total Cover		
50% of total cover: 13	20% of total cover: 5		
Woody Vine Stratum (Plot size: 5)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	80	x 3 =	240
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	80 (A)		240 (B)

Prevalence Index = B/A = 3.00

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: P3 - Wetland

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 4/2	80	5YR 4/6	20	C	PL	Loamy/Clayey	Prominent redox concentrations
8-14	10YR 4/2	60	5YR 4/6	40	C	PL	Loamy/Clayey	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Mucky Mineral (F1) **(MLRA 136)**
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 122, 136)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Shake Rag Mitigation Site City/County: Mars Hill/Madison Sampling Date: 5/9/2018

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: DP4 - Upland D

Investigator(s): Ian Eckardt Section, Township, Range:

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): none Slope (%):

Subregion (LRR or MLRA): LRR N Lat: 35.872404 Long: -82.497618 Datum:

Soil Map Unit Name: Buladean-Chestnut complex (BnF) NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation X, Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present? Yes No X

Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	**Is the Sampled Area within a Wetland?** **Yes** **No X**
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks:
Areas is actively grazed and forested vegetation has been replaced with pasture grasses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes	No	Depth (inches):
Water Table Present?	Yes	No	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes	No	Depth (inches):

Wetland Hydrology Present? **Yes** **No X**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP4 - Upland D

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Liriodendron tulipifera*	50	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
	50	=Total Cover	
50% of total cover: 25		20% of total cover: 10	
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
		=Total Cover	
50% of total cover:		20% of total cover:	
Herb Stratum (Plot size: 5)			
1. *Festuca rubra*	80	Yes	FACU
2. *Galax*	10	No	
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	90	=Total Cover	
50% of total cover: 45		20% of total cover: 18	
Woody Vine Stratum (Plot size: 5)			
1.			
2.			
3.			
4.			
5.			
		=Total Cover	
50% of total cover:		20% of total cover:	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	130	x 4 =	520
UPL species	0	x 5 =	0
Column Totals:	130 (A)		520 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: P4 - Upland

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR 3/4	100					Loamy/Clayey	
3-14	10YR 4/4	100					Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Mucky Mineral (F1) **(MLRA 136)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 122, 136)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Shake Rag Mitigation Site City/County: Mars Hill/Madison Sampling Date: 5/9/2018

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: DP5 - Wetland G

Investigator(s): Ian Eckardt Section, Township, Range:

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): concave Slope (%):

Subregion (LRR or MLRA): LRR N Lat: 35.876756 Long: -82.497684 Datum:

Soil Map Unit Name: Evard-Cowee complex (EvE2) NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation X, Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present? Yes No X

Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	**Is the Sampled Area within a Wetland?** **Yes** X **No**
Hydric Soil Present?	Yes X	No	
Wetland Hydrology Present?	Yes X	No	

Remarks:
Grazed hillside. Native vegetation has been replaced with pasture grasses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- Surface Water (A1)
- High Water Table (A2)
- X Saturation (A3)
- Water Marks (B1)
- Sediment Deposits (B2)
- Drift Deposits (B3)
- Algal Mat or Crust (B4)
- Iron Deposits (B5)
- Inundation Visible on Aerial Imagery (B7)
- Water-Stained Leaves (B9)
- Aquatic Fauna (B13)
- True Aquatic Plants (B14)
- Hydrogen Sulfide Odor (C1)
- Oxidized Rhizospheres on Living Roots (C3)
- Presence of Reduced Iron (C4)
- Recent Iron Reduction in Tilled Soils (C6)
- Thin Muck Surface (C7)
- Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- Surface Soil Cracks (B6)
- Sparsely Vegetated Concave Surface (B8)
- X Drainage Patterns (B10)
- Moss Trim Lines (B16)
- Dry-Season Water Table (C2)
- Crayfish Burrows (C8)
- X Saturation Visible on Aerial Imagery (C9)
- Stunted or Stressed Plants (D1)
- Geomorphic Position (D2)
- Shallow Aquitard (D3)
- Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes	No X	Depth (inches):
Water Table Present?	Yes	No X	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes X	No	Depth (inches): 6

Wetland Hydrology Present? **Yes** X **No**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP5 - Wetland C

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size: 5)			
1. *Festuca rubra*	50	Yes	FACU
2. *Juncus effusus*	20	Yes	FACW
3. *Carex lurida*	20	Yes	OBL
4. *Ranunculus*	2	No	
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	92 =Total Cover		
50% of total cover: 46	20% of total cover:	19	
Woody Vine Stratum (Plot size: 5)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	20	x 1 =	20
FACW species	20	x 2 =	40
FAC species	0	x 3 =	0
FACU species	50	x 4 =	200
UPL species	0	x 5 =	0
Column Totals:	90 (A)		260 (B)

Prevalence Index = B/A = 2.89

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: P5 - Wetland

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 4/2	90	5YR 4/6	10	C	PL	Loamy/Clayey	Prominent redox concentrations
5-10	7.5YR 3/4	100					Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Mucky Mineral (F1) **(MLRA 136)**
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 122, 136)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Shake Rag Mitigation Site City/County: Mars Hill/Madison Sampling Date: 5/9/2018

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: DP6 - Upland G

Investigator(s): Ian Eckardt Section, Township, Range:

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): none Slope (%):

Subregion (LRR or MLRA): LRR N Lat: 35.876805 Long: -82.497602 Datum:

Soil Map Unit Name: Toecane-Tusquitee complex (TsD) NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation X, Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present? Yes No X

Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes	No X	**Is the Sampled Area within a Wetland?** **Yes** **No X**
Hydric Soil Present?	Yes	No X	
Wetland Hydrology Present?	Yes	No X	

Remarks:
Sample point on a grazed hillside. Native vegetation has been removed and replaced with pasture grasses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes	No X	Depth (inches):
Water Table Present?	Yes	No X	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes	No X	Depth (inches):

Wetland Hydrology Present? **Yes** **No X**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP6 - Upland G

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size: 5)			
1. *Festuca rubra*	90	Yes	FACU
2. *Trifolium repens*	7	No	FACU
3. *Ranunculus*	3	No	
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100 =Total Cover		
50% of total cover: 50	20% of total cover: 20		
Woody Vine Stratum (Plot size: 5)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	97	x 4 =	388
UPL species	0	x 5 =	0
Column Totals:	97 (A)		388 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: P6 - Upland

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-14	7.5YR 4/4	100					Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Mucky Mineral (F1) **(MLRA 136)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 122, 136)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Shake Rag Mitigation Site City/County: Mars Hill/Madison Sampling Date: 5/9/2018

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: DP7 - Wetland J

Investigator(s): Ian Eckardt Section, Township, Range:

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): concave Slope (%):

Subregion (LRR or MLRA): LRR N Lat: 35.880634 Long: -82.496643 Datum:

Soil Map Unit Name: Evard-Cowee complex (EvE2) NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)

Are Vegetation X, Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present? Yes No X

Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	**Is the Sampled Area**
Hydric Soil Present?	Yes X	No	**within a Wetland?** **Yes** X **No**
Wetland Hydrology Present?	Yes X	No	

Remarks:
Sampling location is in a grazed hillside. Native vegetation has been removed and replaced with pasture grasses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- Surface Water (A1)
- High Water Table (A2)
- X Saturation (A3)
- Water Marks (B1)
- Sediment Deposits (B2)
- Drift Deposits (B3)
- Algal Mat or Crust (B4)
- Iron Deposits (B5)
- Inundation Visible on Aerial Imagery (B7)
- Water-Stained Leaves (B9)
- Aquatic Fauna (B13)
- True Aquatic Plants (B14)
- Hydrogen Sulfide Odor (C1)
- Oxidized Rhizospheres on Living Roots (C3)
- Presence of Reduced Iron (C4)
- Recent Iron Reduction in Tilled Soils (C6)
- Thin Muck Surface (C7)
- Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- Surface Soil Cracks (B6)
- Sparsely Vegetated Concave Surface (B8)
- Drainage Patterns (B10)
- Moss Trim Lines (B16)
- Dry-Season Water Table (C2)
- Crayfish Burrows (C8)
- Saturation Visible on Aerial Imagery (C9)
- Stunted or Stressed Plants (D1)
- Geomorphic Position (D2)
- Shallow Aquitard (D3)
- X Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes	No X	Depth (inches):
Water Table Present?	Yes	No X	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes X	No	Depth (inches): 2

Wetland Hydrology Present? **Yes** X **No**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP7 - Wetland

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size: 5)			
1. *Carex lurida*	50	Yes	OBL
2. *Juncus effusus*	40	Yes	FACW
3. *Galax sp.*	10	No	
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100 =Total Cover		
50% of total cover: 50	20% of total cover: 20		
Woody Vine Stratum (Plot size: 5)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	50	x 1 =	50
FACW species	40	x 2 =	80
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	90 (A)		130 (B)

Prevalence Index = B/A = 1.44

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: P7 - Wetland

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR 2/2	100					Loamy/Clayey	
3-6	2.5Y 3/2	98	7.5YR 4/4	2	C	PL	Loamy/Clayey	Prominent redox concentrations
6-10	10YR 4/1	90	7.5YR 4/6	10	C	PL	Loamy/Clayey	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- X Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Mucky Mineral (F1) **(MLRA 136)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 122, 136)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Rock

Depth (inches): 10

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Shake Rag Mitigation Site City/County: Mars Hill/Madison Sampling Date: 5/9/2018

Applicant/Owner: Wildlands Engineering State: NC Sampling Point: DP8 - Upland

Investigator(s): Ian Eckardt Section, Township, Range:

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR or MLRA): LRR N Lat: 35.880701 Long: -82.496580 Datum:

Soil Map Unit Name: Toecane-Tusquitee complex (TsD) NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation X, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes ____ No X

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____	No X	
Wetland Hydrology Present?	Yes ____	No X	

Remarks:
Sampling locations is within a grazed hillside where native vegetaiton has been removed and replaced with pasture grasses.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): ____

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: DP8 - Upland

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Sapling/Shrub Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	=Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size: 5)			
1. *Festuca rubra*	100	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100 =Total Cover		
50% of total cover: 50	20% of total cover: 20		
Woody Vine Stratum (Plot size: 5)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	100	x 4 =	400
UPL species	0	x 5 =	0
Column Totals:	100 (A)		400 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

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Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP8 - Upland

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-14	10YR 4/4	100					Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Mucky Mineral (F1) **(MLRA 136)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 122, 136)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action ID: **SAW-2017-01570** County: **Madison** U.S.G.S. Quad: **Bald Creek and Barnardsville**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Property Owner: **Wildlands Engineering, Inc. / Attn.: Ian Eckardt**
Address: **1430 S. Mint Street, Suite 104**
Charlotte, NC 28203
Telephone Number: **704-332-7754**

Size (acres): **20** Nearest Town: **Mars Hill**
Nearest Waterway: **UTs Shake Rag Branch, Shake Rag Branch, and UTs Middle Fork Ivy Gap Branch** Coordinates: **35.87805 N, 82.49638 W**
River Basin/ HUC: **Upper French Broad (06010105)**

Location description: **The proposed project site is an approximately 20 acres portion of larger adjoining tracts of land (PINs 9769-43-8371, 9767-33-6376, and 9769-40-1438) at 788 and 856 Shake Rag Road in Mars Hill, Madison County, North Carolina.**

Indicate Which of the Following Apply:

A. Preliminary Determination

X There are waters, including wetlands, on the above described project area, that may be subject to Section 404 of the Clean Water Act (CWA)(33 USC § 1344) and/or Section 10 of the Rivers and Harbors Act (RHA) (33 USC § 403). The waters, including wetlands, have been delineated, and the delineation has been verified by the Corps to be sufficiently accurate and reliable. Therefore this preliminary jurisdiction determination may be used in the permit evaluation process, including determining compensatory mitigation. For purposes of computation of impacts, compensatory mitigation requirements, and other resource protection measures, a permit decision made on the basis of a preliminary JD will treat all waters and wetlands that would be affected in any way by the permitted activity on the site as if they are jurisdictional waters of the U.S. This preliminary determination is not an appealable action under the Regulatory Program Administrative Appeal Process (Reference 33 CFR Part 331). However, you may request an approved JD, which is an appealable action, by contacting the Corps district for further instruction.

_ There are wetlands on the above described property, that may be subject to Section 404 of the Clean Water Act (CWA)(33 USC § 1344) and/or Section 10 of the Rivers and Harbors Act (RHA) (33 USC § 403). However, since the waters, including wetlands, have not been properly delineated, this preliminary jurisdiction determination may not be used in the permit evaluation process. Without a verified wetland delineation, this preliminary determination is merely an effective presumption of CWA/RHA jurisdiction over all of the waters, including wetlands, at the project area, which is not sufficiently accurate and reliable to support an enforceable permit decision. We recommend that you have the waters of the U.S. on your property delineated. As the Corps may not be able to accomplish this wetland delineation in a timely manner, you may wish to obtain a consultant to conduct a delineation that can be verified by the Corps.

B. Approved Determination

_ There are Navigable Waters of the United States within the above described property subject to the permit requirements of Section 10 of the Rivers and Harbors Act (RHA) (33 USC § 403) and Section 404 of the Clean Water Act (CWA)(33 USC § 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ There are waters of the U.S. including wetlands on the above described property subject to the permit requirements of Section 404 of the Clean Water Act (CWA)(33 USC § 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ We recommend you have the waters of the U.S. on your property delineated. As the Corps may not be able to accomplish this wetland delineation in a timely manner, you may wish to obtain a consultant to conduct a delineation that can be verified by the Corps.

_ The waters of the U.S. including wetlands on your project area have been delineated and the delineation has been verified by the Corps. If you wish to have the delineation surveyed, the Corps can review and verify the survey upon completion. Once verified, this survey will provide an accurate depiction of all areas subject to CWA and/or RHA jurisdiction on your property which, provided there is no change in the law or our published regulations, may be relied upon for a period not to exceed five years.

_ The waters of the U.S. including wetlands have been delineated and surveyed and are accurately depicted on the plat signed by the Corps Regulatory Official identified below on_____. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ There are no waters of the U.S., to include wetlands, present on the above described project area which are subject to the permit requirements of Section 404 of the Clean Water Act (33 USC 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ The property is located in one of the 20 Coastal Counties subject to regulation under the Coastal Area Management Act (CAMA). You should contact the Division of Coastal Management to determine their requirements.

Placement of dredged or fill material within waters of the US and/or wetlands without a Department of the Army permit may constitute a violation of Section 301 of the Clean Water Act (33 USC § 1311). Placement of dredged or fill material, construction or placement of structures, or work within navigable waters of the United States without a Department of the Army permit may constitute a violation of Sections 9 and/or 10 of the Rivers and Harbors Act (33 USC § 401 and/or 403). If you have any questions regarding this determination and/or the Corps regulatory program, please contact **David Brown** at **828-271-7980, ext. 4232** or **david.w.brown@usace.army.mil.**

C. Basis for Determination:

See attached preliminary jurisdictional determination form.

D. Remarks:

The potential waters of the U.S., at this site, were verified on-site by the Corps on November 7, 2018, and are as approximately depicted on the attached Delineation Maps 3.0 - 3.4 submitted by Wildlands Engineering, Inc.

E. Attention USDA Program Participants

This delineation/determination has been conducted to identify the limits of Corps' Clean Water Act jurisdiction for the particular site identified in this request. The delineation/determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985. If you or your tenant are USDA Program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service, prior to starting work.

F. Appeals Information (This information applies only to approved jurisdictional determinations as indicated in B. above)

This correspondence constitutes an approved jurisdictional determination for the above described site. If you object to this determination, you may request an administrative appeal under Corps regulations at 33 CFR Part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and request for appeal (RFA) form. If you request to appeal this determination you must submit a completed RFA form to the following address:

US Army Corps of Engineers
South Atlantic Division
Attn: Jason Steele, Review Officer
60 Forsyth Street SW, Room 10M15
Atlanta, Georgia 30303-8801

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR part 331.5, and that it has been received by the Division Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be received at the above address by, N/A (Preliminary-JD).

It is not necessary to submit an RFA form to the Division Office if you do not object to the determination in this correspondence.

Corps Regulatory Official: _____
David Brown

Issue Date of JD: **November 30, 2018** Expiration Date: N/A Preliminary JD

The Wilmington District is committed to providing the highest level of support to the public. To help us ensure we continue to do so, please complete our Customer Satisfaction Survey, located online at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0.

Copy furnished:
James R. Thomas, 788 Shake Rag Road, Mars Hill, NC 28754

Nancy Wilde, P.O. Box 1531, Weaverville, NC 28787

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NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL		
Applicant: **Wildlands Engineering, Inc. / Attn.: Ian Eckardt**	File Number: **SAW-2017-01570**	Date: **November 30, 2018**

Attached is:	See Section below
☐ INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
☐ PROFFERED PERMIT (Standard Permit or Letter of permission)	B
☐ PERMIT DENIAL	C
☐ APPROVED JURISDICTIONAL DETERMINATION	D
☒ PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits.aspx or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the district engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:	If you only have questions regarding the appeal process you may also contact:
District Engineer, Wilmington Regulatory Division, **Attn: David Brown** **151 Patton Avenue, Room 208** **Asheville, North Carolina 28801-5006** **828-271-7980, ext. 4232**	Mr. Jason Steele, Administrative Appeal Review Officer CESAD-PDO U.S. Army Corps of Engineers, South Atlantic Division 60 Forsyth Street, Room 10M15 Atlanta, Georgia 30303-8801 Phone: (404) 562-5137

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

	Date:	Telephone number:
_____ Signature of appellant or agent.		

For appeals on Initial Proffered Permits send this form to:

District Engineer, Wilmington Regulatory Division, Attn.: David Brown, 69 Darlington Avenue, Wilmington, North Carolina 28403

For Permit denials, Proffered Permits and approved Jurisdictional Determinations send this form to:

Division Engineer, Commander, U.S. Army Engineer Division, South Atlantic, Attn: Mr. Jason Steele, Administrative Appeal Officer, CESAD-PDO, 60 Forsyth Street, Room 10M15, Atlanta, Georgia 30303-8801 Phone: (404) 562-5137

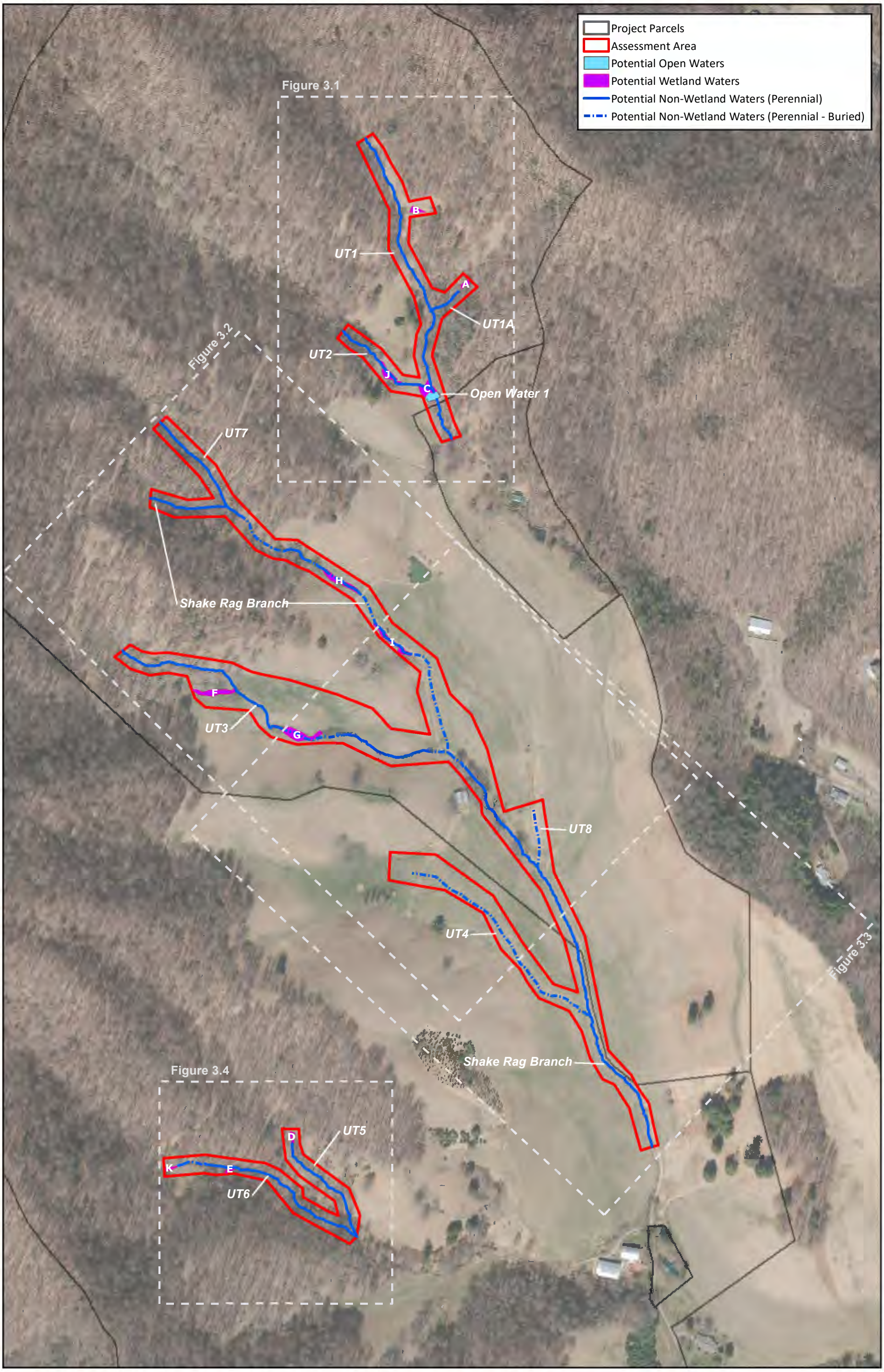

Figure 3.0: Delineation Overview Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105

Madison County, NC

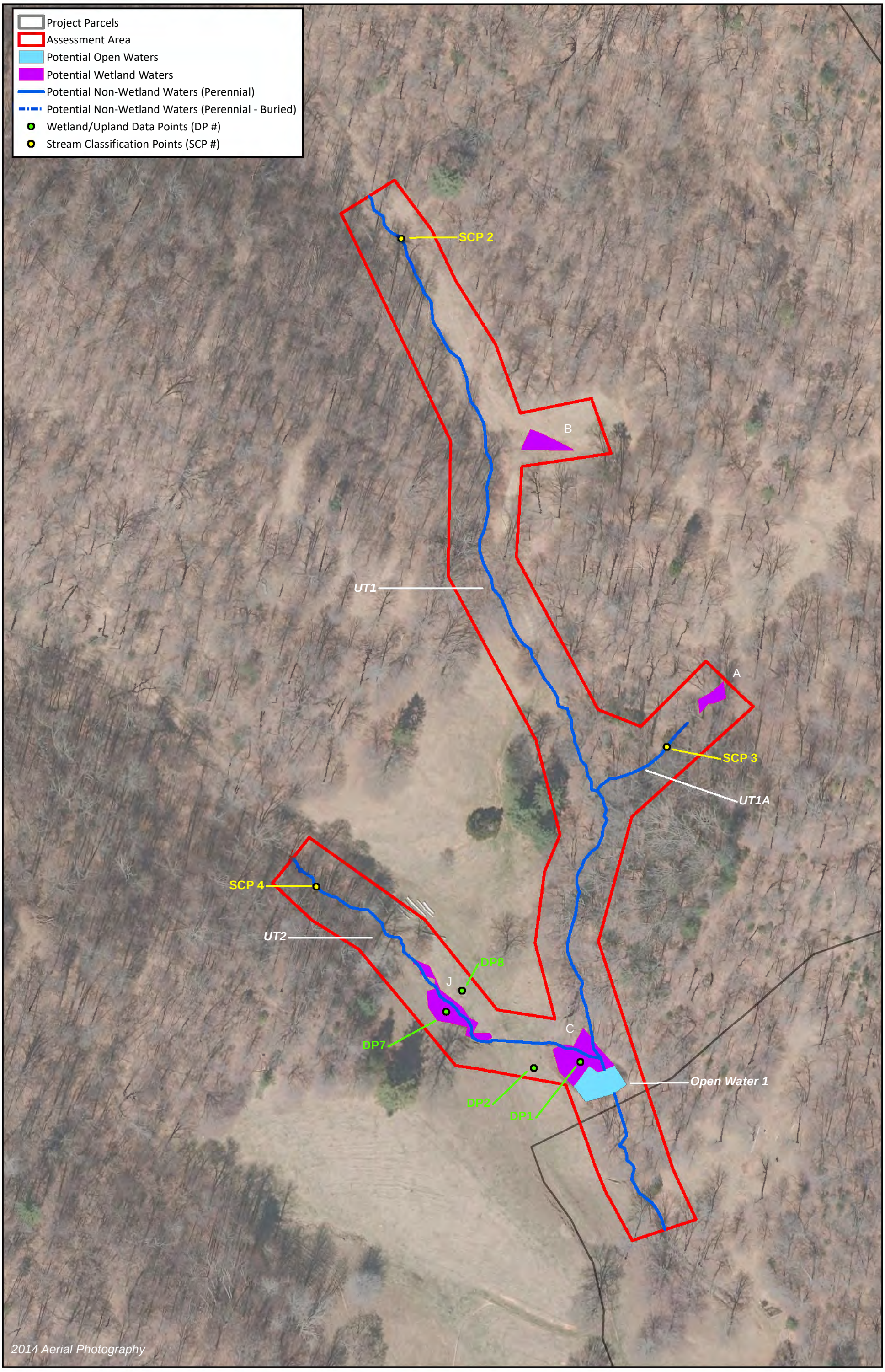

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Figure 3.1: Delineation Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC

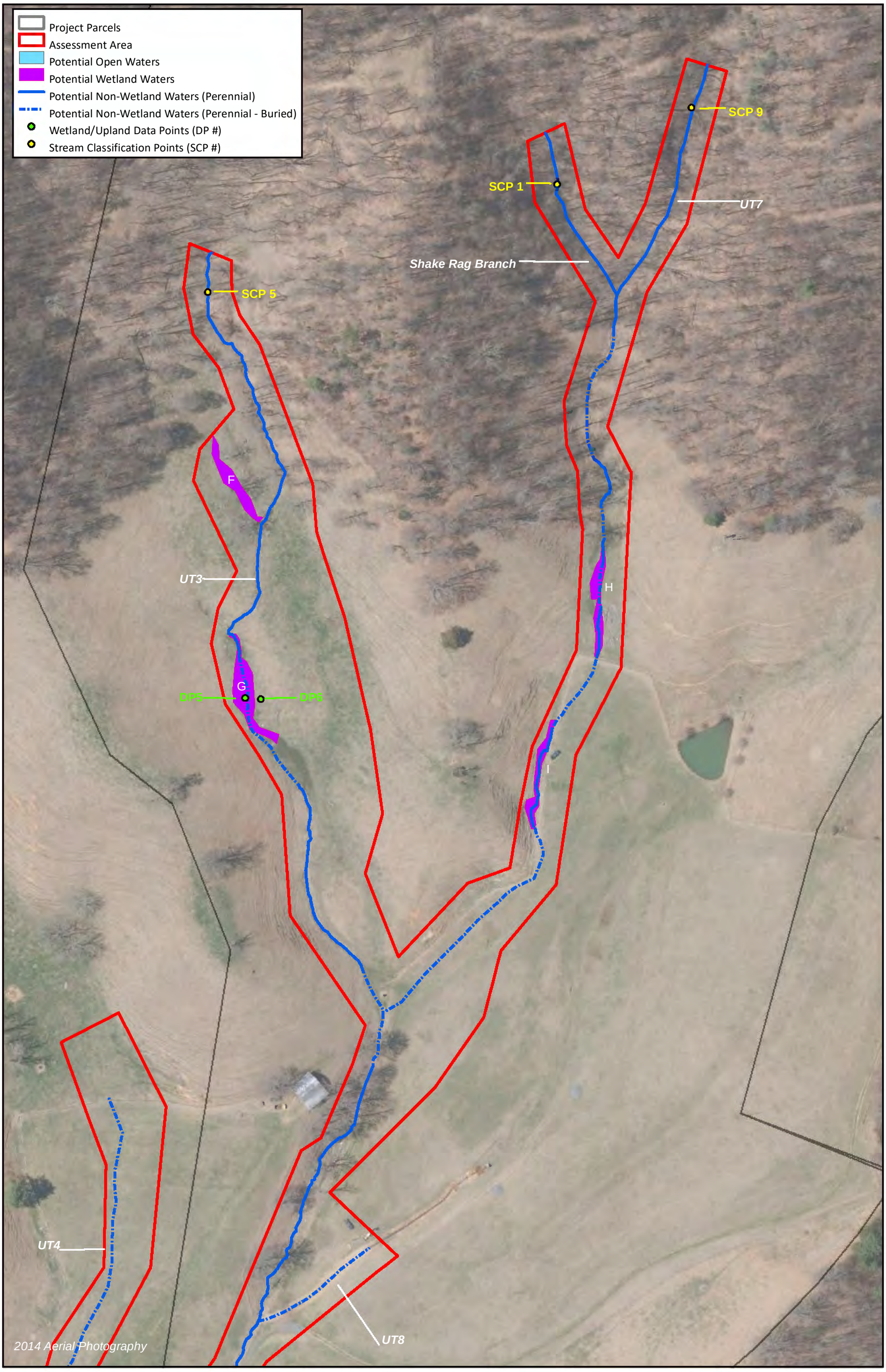

Figure 3.2: Delineation Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC

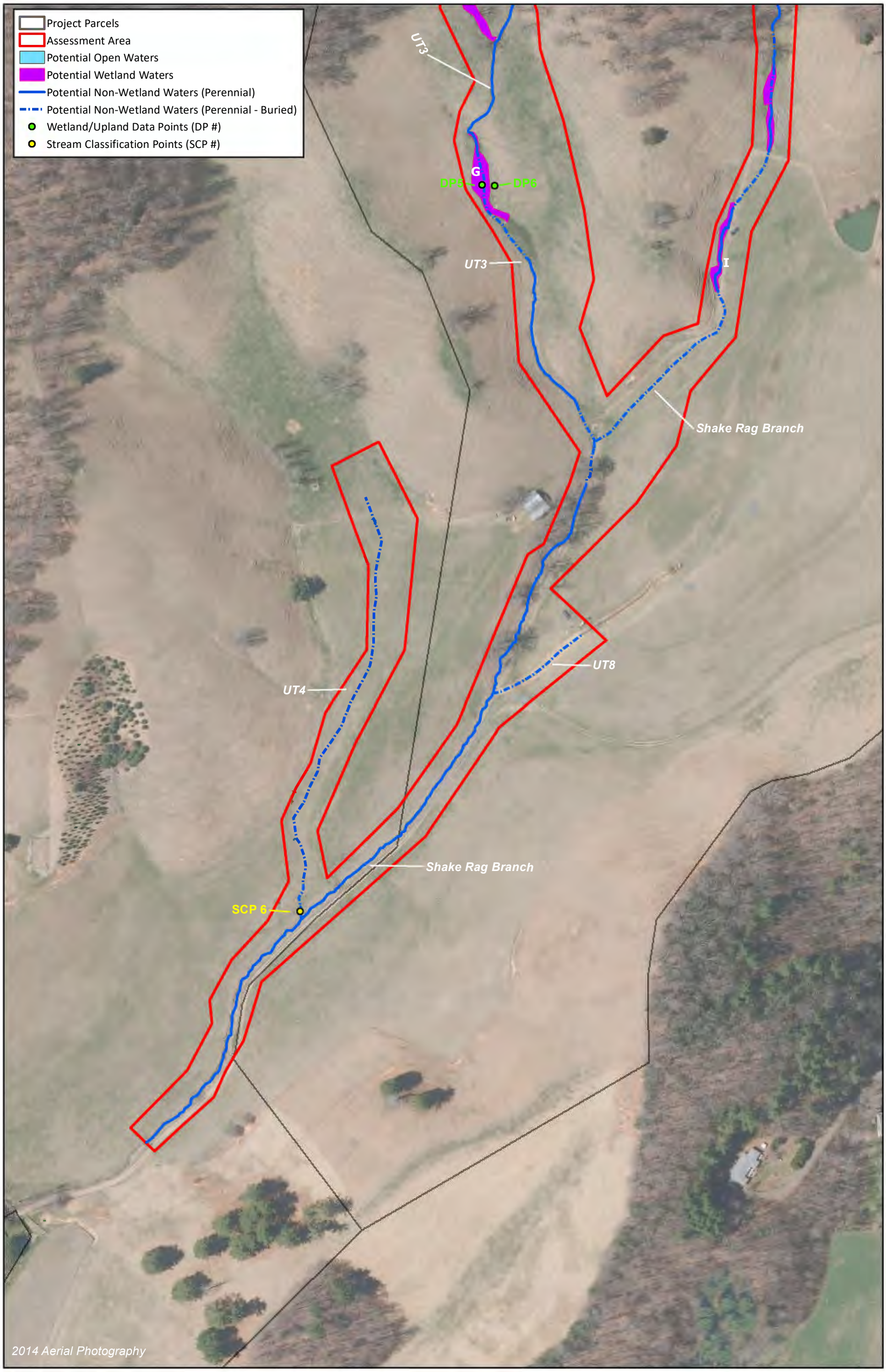

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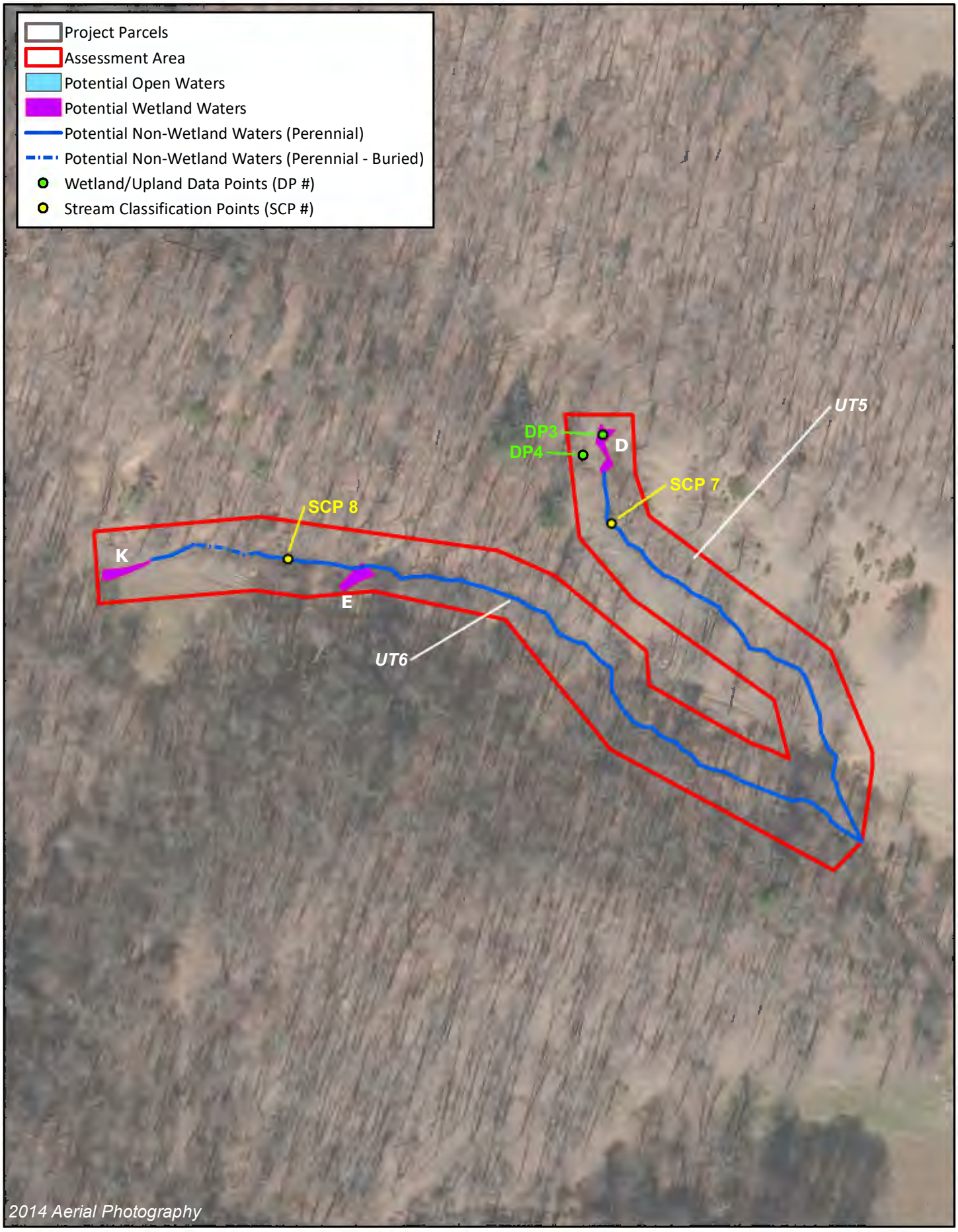
Figure 3.3: Delineation Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC



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N

Figure 3.4: Delineation Overview Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC

PRELIMINARY JURISDICTIONAL DETERMINATION (JD) FORM
U.S. Army Corps of Engineers

BACKGROUND INFORMATION

A. **REPORT COMPLETION DATE FOR PRELIMINARY JD:** November 30, 2018

B. **NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:**
Wildlands Engineering, Inc. / Attn.: Ian Eckardt
1430 S. Mint Street, Suite 104
Charlotte, NC 28203

C. **DISTRICT OFFICE, FILE NAME, AND NUMBER:**
CESAW-RG-A, SAW-2017-01570, NCDMS ILF – Shake Rag Branch Mitigation Site

D. **PROJECT LOCATION(S) AND BACKGROUND INFORMATION:**
The proposed project site is an approximately 20 acres portion of larger adjoining tracts of land (PINs 9769-43-8371, 9767-33-6376, and 9769-40-1438) at 788 and 856 Shake Rag Road in Mars Hill, Madison County, North Carolina.

State: **NC** County/parish/borough: **Madison** City: **Mars Hill**
Center coordinates of site (lat/long in degree decimal format): **35.87805 N, 82.49638 W**
Universal Transverse Mercator: **N/A**
Name of nearest waterbody: **UTs Shake Rag Branch, Shake Rag Branch, and UTs Middle Fork Ivy Gap Branch**

E. **REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):**
☒ Office (Desk) Determination. Date: **November 30, 2018**
☒ Field Determination. Date(s): **November 7, 2018**

Use the table below to document aquatic resources and/or aquatic resources at different sites

TABLE OF AQUATIC RESOURCES IN REVIEW AREA WHICH "MAY BE" SUBJECT TO REGULATORY JURISDICTION

Site Number	Centered Coordinates (decimal degrees)		Estimated Amount of Aquatic Resource in Review Area (linear feet or acre)	Type of Aquatic Resources	Geographic Authority to Which Aquatic Resource "May Be" Subject
	Latitude	Longitude			
Shake Rag Branch	35.880373	-82.500015	3,594 LF	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
UT1 (UT Middle Fork Ivy Gap Branch)	35.883470	-82.497554	1,292 LF	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
UT1A (UT Middle Fork Ivy Gap Branch)	35.881458	-82.495839	133 LF	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
UT2 (UT Middle Fork Ivy Gap Branch)	35.881802	-82.498590	460 LF	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404

UT3 (UT Shake Rag Branch)	35.877360	-82.499757	1,475 LF	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
UT4 (UT Shake Rag Branch)	35.874772	-82.494958	941 LF	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
UT5 (UT Shake Rag Branch)	35.808176	-82.392356	483 LF	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
UT6 (UT Shake Rag Branch)	35.872073	-82.498604	815 LF	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
UT7 (UT Shake Rag Branch)	35.879371	-82.498729	467 LF	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
UT8 (UT Shake Rag Branch)	35.875758	-82.494456	229 LF	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland A	35.881646	-82.495667	0.01 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland B	35.882435	-82.496357	0.02 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland C	35.880505	-82.496098	0.05 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland D	35.872441	-82.497565	0.01 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland E	35.872058	-82.498354	0.01 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland F	35.877169	-82.498804	0.05 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland G	35.876756	-82.497684	0.09 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland H	35.878442	-82.497277	0.06 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland I	35.877707	-82.496330	0.05 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland J	35.880634	-82.496643	0.04 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Wetland K	35.872037	-82.499163	0.01 AC	☒ Wetland ☐ Non-wetland Waters	☒ Section 404 ☐ Section 10/404
Open Water 1	35.880426	-82.496039	0.04 AC	☐ Wetland ☒ Non-wetland Waters	☒ Section 404 ☐ Section 10/404

1. The Corps of Engineers believes that there may be jurisdictional aquatic resources in the review area, and the requestor of this PJD is hereby advised of his or her option to request and obtain an approved JD (AJD) for that review area based on an informed decision after having discussed the

various types of JDs and their characteristics and circumstances when they may be appropriate.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre- construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an AJD for the activity, the permit applicant is hereby made aware that: (1) the permit applicant has elected to seek a permit authorization based on a PJD, which does not make an official determination of jurisdictional aquatic resources; (2) the applicant has the option to request an AJD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an AJD could possibly result in less compensatory mitigation being required or different special conditions; (3) the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) undertaking any activity in reliance upon the subject permit authorization without requesting an AJD constitutes the applicant's acceptance of the use of the PJD; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a PJD constitutes agreement that all aquatic resources in the review area affected in any way by that activity will be treated as jurisdictional, and waives any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an AJD or a PJD, the JD will be processed as soon as practicable. Further, an AJD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331. If, during an administrative appeal, it becomes appropriate to make an official determination whether geographic jurisdiction exists over aquatic resources in the review area, or to provide an official delineation of jurisdictional aquatic resources in the review area, the Corps will provide an AJD to accomplish that result, as soon as is practicable. This PJD finds that there *"may be"* waters of the U.S. and/or that there *"may be"* navigable waters of the U.S. on the subject review area, and identifies all aquatic features in the review area that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA

Data reviewed for preliminary JD (check all that apply) - Checked items should be included in subject file. Appropriately reference sources below where indicated for all checked items:

☒ Maps, plans, plots or plat submitted by or on behalf of preliminary JD requester: **Wildlands Engineering, Inc.**
☒ Data sheets prepared/submitted by or on behalf of preliminary JD requester. **Wildlands Engineering, Inc.**
  ☒ Office concurs with data sheets/delineation report.
  ☐ Office does not concur with data sheets/delineation report. Rational:
☐ Data sheets prepared by the Corps:
☐ Corps navigable waters' study:
☐ U.S. Geological Survey (USGS) Hydrologic Atlas:
  ☐ USGS NHD data.
  ☐ USGS 8 and 12 digit HUC maps.
☒ USGS map(s). Cite scale & quad name: **Bald Creek and Barnardsville.**
☒ Natural Resources Conservation Service (NRCS) Soil Survey.
  Citation: **Madison County, NC**
☐ National wetlands inventory (NWI) map(s). Cite name:
☐ State/Local wetland inventory map(s):
☒ Federal Emergency Management Agency (FEMA) / Flood Insurance Rate Map (FIRM) maps: **Map No. 3700976900J, effective date June 2, 2009**
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date): **Google Earth Pro, Oct. 2015, Nov. 2013, Oct. 2010, May 2009, Jun. 2005, Apr. 1998, and Mar. 1994**
  or ☐ Other (Name & Date):

☐ Previous determination(s). File no. and date of response letter:
☐ Applicable/supporting scientific literature:
☒ Other information (please specify): **The site contains wetlands as determined by the *1987 Corps of Engineers Wetland Delineation Manual* and the *Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Eastern Mountain and Piedmont Region (Version 2.0)*. These wetlands are abutting to stream channels located at the site and flow into the channels. Wetland hydrology is enhanced with the abutting stream channel via normal down gradient flows and periods of high water.**

The site also contains open water (impoundment) that abuts wetlands and a stream channel at the site. The impoundment receives waters and/or flow directly into associated abutting wetlands and/or stream. The open water is an impoundment of a UT Middle Fork Ivy Gap Branch.

The streams on the property are UTs Shake Rag Branch, Shake Rag Branch, and UTs Middle Fork Ivy Gap Branch all exhibit physical ordinary high water mark (OHWM) indicators including, break in slope; developed bed and bank; changes in sediment texture and soil character; natural line impressed on the bank; shelving; absence of vegetation; leaf litter washed away; sediment deposition and sorting; presence of other aquatic life; water staining; presence of debris; and scour. Most of the streams are depicted as solid blue lines on the USGS 7.5 minute quadrangle map Bald Creek and Barnardsville and the most current Natural Resource Conservation Service Soil Survey for Madison County. Solid blue line features on these mapping conventions typically represent perennial streams.

The UTs Shake Rag Branch flow into Shake Rag Branch, which flows into Middle Fork Ivy Gap Branch. UTs Middle Fork Ivy Gap Branch flow into Middle Fork Ivy Gap Branch, which flows into California Creek, and then into Little Ivy Creek. Little Ivy Creek flows into Ivy Creek, which flows into the French Broad River, a traditional navigable river and designated Section 10 water. The French Broad River merges with the Holston River to form the Tennessee River. The Tennessee River flows into the Ohio River then to the Mississippi River before entering the Gulf of Mexico.

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

David Brown, November 30, 2018
Signature and date of Regulatory staff member completing preliminary JD

Wildlands Engineering, Inc.
(per Agent Authorization)
Signature and date of person requesting preliminary JD (REQUIRED, unless obtaining the signature is impracticable)

Two copies of this Preliminary JD Form have been provided. Please sign both copies. Keep one signed copy for your record and return a signed copy to the Asheville Regulatory Field Office by mail or e-mail.

US Army Corps of Engineers-Wilmington District
Asheville Regulatory Field Office
151 Patton Avenue, Room 208
Asheville, NC 28801-5006

[1] Districts may establish timeframes for requester to return signed PJD forms. If the requester does not respond within the established time frame, the district may presume concurrence and no additional follow up is necessary prior to finalizing an action.

Corps Submittal Cover Sheet

Please provide the following info:

1. Project Name Shake Rag Mitigation Project
2. Name of Property Owner/Applicant: City of Hendersonville - Brent Detwiler
3. Name of Consultant/Agent: Jordan Hessler

   *Agent authorization needs to be attached.
4. Related/Previous Action ID number(s): N/A
5. Site Address: 788 and 856 Shake Rag Road
6. Subdivision Name: N/A
7. City: Mars Hill
8. County: Madison
9. Lat: 35.878056 Long: -82.496389 (Decimal Degrees *Please*)
10. Quadrangle Name: Bald Creek and Barnardsville
11. Waterway: Shake Rag Branch
12. Watershed: Upper French Broad: 06010105
13. Requested Action:

    X Nationwide Permit # 27

    ___ General Permit # _____

    ___ Jurisdictional Determination Request

    ___ Pre-Application Request

The following information will be completed by Corps office:

AID: _____

_____ Prepare File Folder ____ Assign number in ORM _____ Begin Date

Authorization: ____ Section 10 ____ Section 404

Project Description/ Nature of Activity/ Project Purpose:

_____

Site/Waters Name: _____

Keywords: _____

Office Use Only:
Corps action ID no. _____
DWQ project no. _____
Form Version 1.3 Dec 10 2008

Pre-Construction Notification (PCN) Form

A. Applicant Information

1. Processing

1a. Type(s) of approval sought from the Corps:	☒ Section 404 Permit ☐ Section 10 Permit	
1b. Specify Nationwide Permit (NWP) number:	or General Permit (GP) number:	
1c. Has the NWP or GP number been verified by the Corps?	☐ Yes	☒ No

1d. Type(s) of approval sought from the DWQ (check all that apply):

☒ 401 Water Quality Certification – Regular ☐ Non-404 Jurisdictional General Permit

☐ 401 Water Quality Certification – Express ☐ Riparian Buffer Authorization

1e. Is this notification solely for the record because written approval is not required?	For the record only for DWQ 401 Certification: ☐ Yes ☒ No	For the record only for Corps Permit: ☐ Yes ☒ No
1f. Is payment into a mitigation bank or in-lieu fee program proposed for mitigation of impacts? If so, attach the acceptance letter from mitigation bank or in-lieu fee program.		☐ Yes ☒ No
1g. Is the project located in any of NC's twenty coastal counties? If yes, answer 1h below.		☐ Yes ☒ No
1h. Is the project located within a NC DCM Area of Environmental Concern (AEC)?		☐ Yes ☒ No

2. Project Information

2a. Name of project:	Shake Rag Mitigation Site
2b. County:	Madison
2c. Nearest municipality / town:	Mars Hill
2d. Subdivision name:	N/A
2e. NCDOT only, T.I.P. or state project no:	

3. Owner Information

3a. Name(s) on Recorded Deed:	1.) Nancy Wilde & Gary Wilde 2.) Nancy Wilde & Gary Wilde 3.) James Ronald Thomas
3b. Deed Book and Page No.	1.) DB 296 PG 515 2.) DB 568 PG 530 3.) DB 578 PG 512
3c. Responsible Party (for LLC if applicable):	North Carolina Department of Environmental Quality (NCDEQ) – Division of Mitigation Services (DMS) Contact: Lin Xu, Project Review Coordinator
3d. Street address:	217 West Jones Street, Suite 3000A
3e. City, state, zip:	Raleigh, NC 27603
3f. Telephone no.:	919-707-8319
3g. Fax no.:	
3h. Email address:	lin.xu@ncdenr.gov

4. Applicant Information (if different from owner)	
4a. Applicant is:	☐ Agent ☒ Other, specify: State agency
4b. Name:	Lin Xu
4c. Business name (if applicable):	NCDEQ - DMS
4d. Street address:	217 W. Jones St, Suite 3000A
4e. City, state, zip:	Raleigh, NC 27603
4f. Telephone no.:	919-707-8319
4g. Fax no.:	
4h. Email address:	lin.xu@ncdenr.gov
5. Agent/Consultant Information (if applicable)	
5a. Name:	Jordan Hessler
5b. Business name (if applicable):	Wildlands Engineering, Inc.
5c. Street address:	167-B Haywood Road
5d. City, state, zip:	Asheville, NC 28806
5e. Telephone no.:	828-774-5547 x106
5f. Fax no.:	
5g. Email address:	jhessler@wildlandseng.com

B. Project Information and Prior Project History	
1. Property Identification	
1a. Property identification no. (tax PIN or parcel ID):	PIN #'s 1.) 9769438371 2.) 9769336376 3.) 9769401483
1b. Site coordinates (in decimal degrees):	Latitude: 35.878056° N/ Longitude: -82.496389° W
1c. Property size:	20 Acres
2. Surface Waters	
2a. Name of nearest body of water (stream, river, etc.) to proposed project:	Shake Rag Branch
2b. Water Quality Classification of nearest receiving water:	Class WS-II
2c. River basin:	French Broad River Basin: 06010105

3. Project Description

3a. Describe the existing conditions on the site and the general land use in the vicinity of the project at the time of this application: The project area is located within a rural watershed in Madison County, NC. Land use in and immediate adjacent to the project area is primarily pasture and forest.

3b. List the total estimated acreage of all existing wetlands on the property:

Approximately 0.35 acres of wetlands and open waters within the project area.

3c. List the total estimated linear feet of all existing streams (intermittent and perennial) on the property:

Approximately 9,755 linear feet (LF) of perennial channel within the project area.

3d. Explain the purpose of the proposed project:

The project proposes to restore, enhance, and preserve 9,273 LF of stream channel involving 8 unnamed tributaries to Shake Rag Branch. The project will generate stream mitigation units for the North Carolina Department of Environmental Quality Division of Mitigation Services.

3e. Describe the overall project in detail, including the type of equipment to be used:

The project proposes 4,986 LF of stream restoration, 3,547 LF of stream Enhancement, and 740 LF of stream preservation. Stream restoration will be achieved through natural channel design. Stream restoration activities include Priority 1 and Priority 2 approaches. Priority 1 restoration will involve the excavation of new channels within existing floodplain and Priority 2 will involve the excavation of new channel and floodplain. Both approaches will include installation of in-stream structures including constructed riffles, rock sills, log sills, lunker logs, and log vanes. Post-construction the project area will be planted with native riparian buffer species. Excavators will be used for channel and floodplain excavation as well as for bank grading, while articulated and track trucks will be used for hauling soil. Small equipment such as mini excavators and skid steers may also be used during grading activities. A conservation easement has been recorded on the project area.

4. Jurisdictional Determinations

4a. Have jurisdictional wetland or stream determinations by the Corps or State been requested or obtained for this property / project (including all prior phases) in the past? Comments:	☒ Yes ☐ No ☐ Unknown
4b. If the Corps made the jurisdictional determination, what type of determination was made?	☒ Preliminary ☐ Final
4c. If yes, who delineated the jurisdictional areas? Name (if known): Ian Eckardt	Agency/Consultant Company: Wildlands Engineering Inc.

4d. If yes, list the dates of the Corps jurisdictional determinations or State determinations and attach documentation.

November 30, 2018

5. Project History

5a. Have permits or certifications been requested or obtained for this project (including all prior phases) in the past?	☐ Yes ☒ No ☐ Unknown

5b. If yes, explain in detail according to “help file” instructions.

6. Future Project Plans

6a. Is this a phased project?	☐ Yes ☒ No

6b. If yes, explain.

C. Proposed Impacts Inventory

1. Impacts Summary

1a. Which sections were completed below for your project (check all that apply):

☒ Wetlands ☒ Streams - tributaries ☐ Buffers

☒ Open Waters ☐ Pond Construction

2. Wetland Impacts

If there are wetland impacts proposed on the site, then complete this question for each wetland area impacted.

2a. Wetland impact number – Permanent (P) or Temporary (T)	2b. Type of impact	2c. Type of wetland (if known)	2d. Forested	2e. Type of jurisdiction (Corps - 404, 10 DWQ – non-404, other)	2f. Area of impact (acres)
W1 – Wetland C ☒ P ☒ T	Excavation – stream restoration	Headwater Forest	☒ Yes ☐ No	☒ Corps ☒ DWQ	0.05
W2 – Wetland E ☐ P ☒ T	Excavation – stream restoration	Seep	☒ Yes ☐ No	☒ Corps ☒ DWQ	0.01
W3 – Wetland H ☒ P ☒ T	Excavation – stream restoration	Headwater Forest	☒ Yes ☐ No	☒ Corps ☒ DWQ	0.06
W4 – Wetland I ☒ P ☐ T	Excavation – stream restoration	Headwater Forest	☐ Yes ☒ No	☒ Corps ☒ DWQ	0.05
W5 – Wetland J ☒ P ☒ T	Excavation – stream restoration	Headwater Forest	☐ Yes ☒ No	☒ Corps ☒ DWQ	0.04
				2g. **Total wetland impacts**	0.21

2h. Comments:

3. Stream Impacts

If there are perennial or intermittent stream impacts (including temporary impacts) proposed on the site, then complete this question for all stream sites impacted.

3a. Stream impact number -Permanent (P) or Temporary (T)	3b. Type of impact	3c. Stream name	3d. Perennial (PER) or intermittent (INT)?	3e. Type of jurisdiction (Corps - 404, 10 DWQ – non-404, other)	3f. Average stream width (feet)	3g. Impact length (linear feet)
S1 ☒ P ☒ T	Relocation/Fill, stabilization	Shake Rag Branch	☒ PER ☐ INT	☒ Corps ☒ DWQ	-	3,227
S2 ☒ P ☒ T	Stabilization (Bank grading & structures)	UT1	☒ PER ☐ INT	☒ Corps ☒ DWQ	-	535
S3 ☒ P ☐ T	Stabilization (Bank grading & structures)	UT2	☒ PER ☐ INT	☒ Corps ☒ DWQ	-	296
S4 ☒ P ☐ T	Stabilization (Bank grading & structures	UT3	☒ PER ☐ INT	☒ Corps ☒ DWQ	-	1,387
S5 ☒ P ☐ T	Stabilization (Bank grading & structures	UT4	☒ PER ☐ INT	☒ Corps ☒ DWQ	-	910
S6 ☒ P ☐ T	Stabilization (Bank grading	UT5	☒ PER ☐ INT	☒ Corps ☒ DWQ	-	44

	& structures					
S7 ☒ P ☐ T	Stabilization (Bank grading & structures	UT6	☒ PER ☐ INT	☒ Corps ☒ DWQ	-	34
S8 ☒ P ☐ T	Relocation/Fill	UT8	☒ PER ☐ INT	☒ Corps ☒ DWQ	-	210
				3h. **Total stream and tributary impacts**		6,643

3i. Comments: Impacts are restoration and stabilization activities that will result in an increase in resource function.

4. Open Water Impacts

If there are proposed impacts to lakes, ponds, estuaries, tributaries, sounds, the Atlantic Ocean, or any other open water of the U.S. then individually list all open water impacts below.

4a. Open water impact number – Permanent (P) or Temporary (T)	4b. Name of waterbody (if applicable)	4c. Type of impact	4d. Waterbody type	4e. Area of impact (acres)
O1 ☒ P ☐ T	Open Water 1	Fill – Stream Restoration	Ag. field ditch	0.03
			4f. Total open water impacts	0.03

4g. Comments:

5. Pond or Lake Construction

If pond or lake construction proposed, then complete the chart below.

5a. Pond ID number	5b. Proposed use or purpose of pond	5c. Wetland Impacts (acres)			5d. Stream Impacts (feet)			5e. Upland (acres)
		Flooded	Filled	Excavated	Flooded	Filled	Excavated	Flooded
P1								
P2								
	5f. Total							

5g. Comments:

5h. Is a dam high hazard permit required?	☐ Yes ☐ No If yes, permit ID no:
5i. Expected pond surface area (acres):	
5j. Size of pond watershed (acres):	
5k. Method of construction:	

6. Buffer Impacts (for DWQ)

If project will impact a protected riparian buffer, then complete the chart below. If yes, then individually list all buffer impacts below. If any impacts require mitigation, then you **MUST** fill out Section D of this form.

6a. Project is in which protected basin?	☐ Neuse ☐ Tar-Pamlico ☐ Other: ☐ Catawba ☐ Randleman				
6b. Buffer impact number – Permanent (P) or Temporary (T)	6c. Reason for impact	6d. Stream name	6e. Buffer mitigation required?	6f. Zone 1 impact (square feet)	6g. Zone 2 impact (square feet)
B1 ☐ P ☐ T			☐ Yes ☐ No		
B2 ☐ P ☐ T			☐ Yes ☐ No		
B3 ☐ P ☐ T			☐ Yes ☐ No		
		6h. **Total buffer impacts**			
6i. Comments:					

D. Impact Justification and Mitigation

1. Avoidance and Minimization

1a. Specifically describe measures taken to avoid or minimize the proposed impacts in designing project.

Due to the nature of mitigation projects, impacts to on-site streams and wetlands are necessary. The project will use natural channel design techniques throughout to have an overall positive impact restoring stream function and habitat by improving bed features in the streams and establishing flood storage. Impacts will be minimized or avoided along relatively stable projects reaches designated for preservation.

1b. Specifically describe measures taken to avoid or minimize the proposed impacts through construction techniques.

Project Construction will be done in the dry as much as possible through offline construction in areas of Priority 1 restoration and pumping around when working in existing online channels. Newly constructed channel banks will be stabilized using biodegradable coir fiber matting, seeding, and planted with native riparian species. During construction, a follow guideline from the NC Erosion and Sediment Control Planning and Design Manual. See plans for impacts for specific streams, wetlands, and open waters.

2. Compensatory Mitigation for Impacts to Waters of the U.S. or Waters of the State

2a. Does the project require Compensatory Mitigation for impacts to Waters of the U.S. or Waters of the State?	☐ Yes ☒ No
2b. If yes, mitigation is required by (check all that apply):	☐ DWQ ☐ Corps
2c. If yes, which mitigation option will be used for this project?	☐ Mitigation bank ☐ Payment to in-lieu fee program ☐ Permittee Responsible Mitigation

3. Complete if Using a Mitigation Bank

3a. Name of Mitigation Bank:

3b. Credits Purchased (attach receipt and letter)	Type	Quantity

3c. Comments:

4. Complete if Making a Payment to In-lieu Fee Program

4a. Approval letter from in-lieu fee program is attached.	☐ Yes
4b. Stream mitigation requested:	linear feet
4c. If using stream mitigation, stream temperature:	☐ warm ☐ cool ☐ cold
4d. Buffer mitigation requested (DWQ only):	square feet
4e. Riparian wetland mitigation requested:	acres
4f. Non-riparian wetland mitigation requested:	acres
4g. Coastal (tidal) wetland mitigation requested:	acres

4h. Comments:

5. Complete if Using a Permittee Responsible Mitigation Plan

5a. If using a permittee responsible mitigation plan, provide a description of the proposed mitigation plan.

6. Buffer Mitigation (State Regulated Riparian Buffer Rules) – required by DWQ

6a. Will the project result in an impact within a protected riparian buffer that requires buffer mitigation?	☐ Yes ☒ No

6b. If yes, then identify the square feet of impact to each zone of the riparian buffer that requires mitigation. Calculate the amount of mitigation required.

Zone	6c. Reason for impact	6d. Total impact (square feet)	Multiplier	6e. Required mitigation (square feet)
Zone 1				
Zone 2				
	6f. **Total buffer mitigation required:**			

6g. If buffer mitigation is required, discuss what type of mitigation is proposed (e.g., payment to private mitigation bank, permittee responsible riparian buffer restoration, payment into an approved in-lieu fee fund).

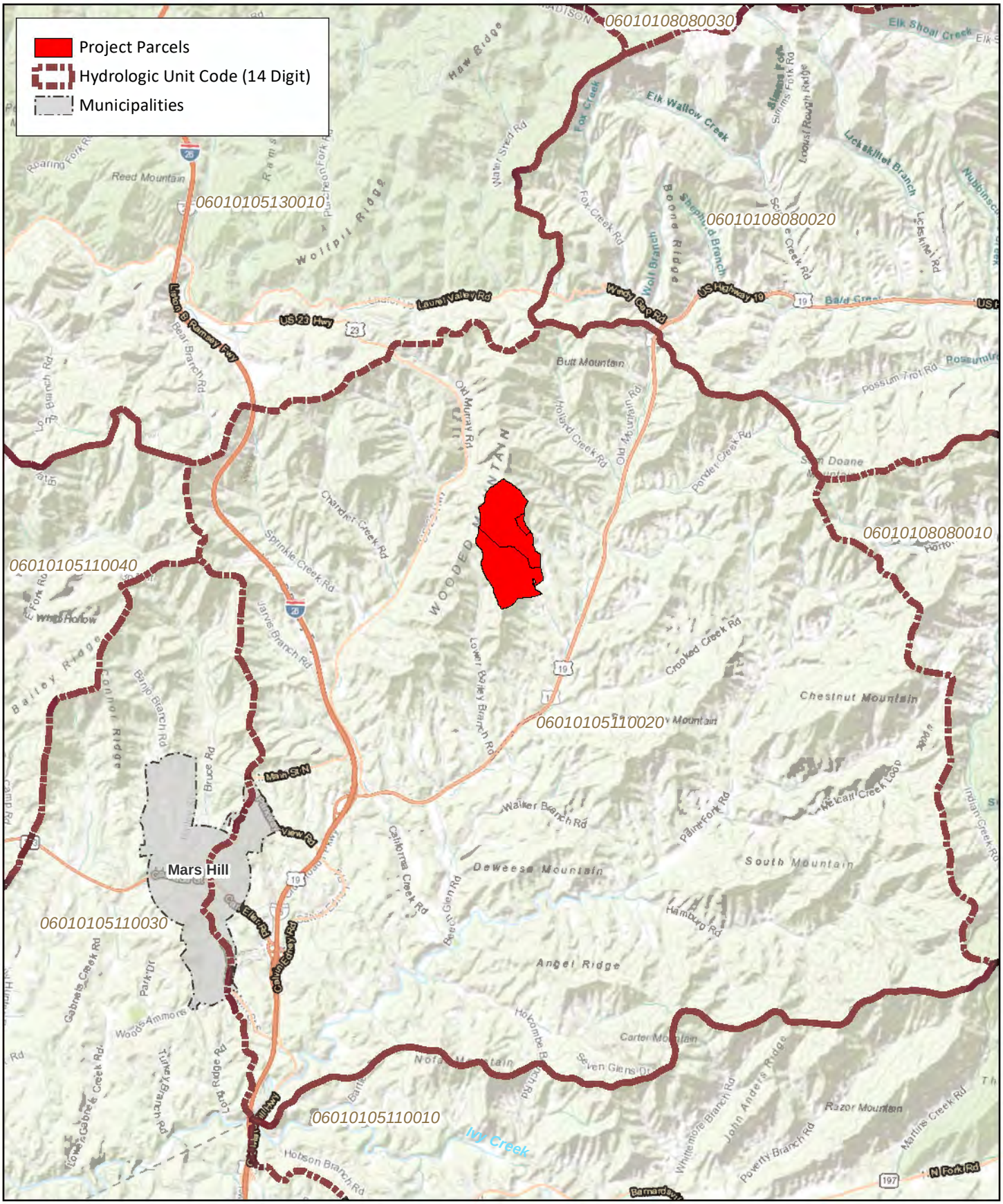
6h. Comments:

E. Stormwater Management and Diffuse Flow Plan (required by DWQ)	
1. Diffuse Flow Plan	
1a. Does the project include or is it adjacent to protected riparian buffers identified within one of the NC Riparian Buffer Protection Rules?	☐ Yes ☒ No
1b. If yes, then is a diffuse flow plan included? If no, explain why. Comments:	☐ Yes ☐ No
2. Stormwater Management Plan	
2a. What is the overall percent imperviousness of this project?	0%
2b. Does this project require a Stormwater Management Plan?	☐ Yes ☒ No
2c. If this project DOES NOT require a Stormwater Management Plan, explain why: This project involves the restoration and preservation of on-site jurisdictional streams and wetlands.	
2d. If this project DOES require a Stormwater Management Plan, then provide a brief, narrative description of the plan:	
2e. Who will be responsible for the review of the Stormwater Management Plan?	☐ Certified Local Government ☐ DWQ Stormwater Program ☐ DWQ 401 Unit
3. Certified Local Government Stormwater Review	
3a. In which local government's jurisdiction is this project?	N/A
3b. Which of the following locally-implemented stormwater management programs apply (check all that apply):	☐ Phase II ☐ NSW ☐ USMP ☐ Water Supply Watershed ☐ Other:
3c. Has the approved Stormwater Management Plan with proof of approval been attached?	☐ Yes ☐ No
4. DWQ Stormwater Program Review	
4a. Which of the following state-implemented stormwater management programs apply (check all that apply):	☐ Coastal counties ☐ HQW ☐ ORW ☐ Session Law 2006-246 ☐ Other:
4b. Has the approved Stormwater Management Plan with proof of approval been attached?	☐ Yes ☐ No
5. DWQ 401 Unit Stormwater Review	
5a. Does the Stormwater Management Plan meet the appropriate requirements?	☐ Yes ☐ No
5b. Have all of the 401 Unit submittal requirements been met?	☐ Yes ☐ No

F. Supplementary Information		
1. Environmental Documentation (DWQ Requirement)		
1a. Does the project involve an expenditure of public (federal/state/local) funds or the use of public (federal/state) land?	☒ Yes	☐ No
1b. If you answered "yes" to the above, does the project require preparation of an environmental document pursuant to the requirements of the National or State (North Carolina) Environmental Policy Act (NEPA/SEPA)?	☒ Yes	☐ No
1c. If you answered "yes" to the above, has the document review been finalized by the State Clearing House? (If so, attach a copy of the NEPA or SEPA final approval letter.) Comments: The approved Categorical Exclusion is attached in Appendix 5 of the mitigation plan.	☒ Yes	☐ No
2. Violations (DWQ Requirement)		
2a. Is the site in violation of DWQ Wetland Rules (15A NCAC 2H .0500), Isolated Wetland Rules (15A NCAC 2H .1300), DWQ Surface Water or Wetland Standards, or Riparian Buffer Rules (15A NCAC 2B .0200)?	☐ Yes	☒ No
2b. Is this an after-the-fact permit application?	☐ Yes	☒ No
2c. If you answered "yes" to one or both of the above questions, provide an explanation of the violation(s):		
3. Cumulative Impacts (DWQ Requirement)		
3a. Will this project (based on past and reasonably anticipated future impacts) result in additional development, which could impact nearby downstream water quality?	☐ Yes	☒ No
3b. If you answered "yes" to the above, submit a qualitative or quantitative cumulative impact analysis in accordance with the most recent DWQ policy. If you answered "no," provide a short narrative description. This is a stream and wetland mitigation project and will not cause an increase in development nor will it negatively impact downstream water quality. The project area will be protected in perpetuity from future development through a conservation easement.		
4. Sewage Disposal (DWQ Requirement)		
4a. Clearly detail the ultimate treatment methods and disposition (non-discharge or discharge) of wastewater generated from the proposed project, or available capacity of the subject facility.		

5. Endangered Species and Designated Critical Habitat (Corps Requirement)		
5a. Will this project occur in or near an area with federally protected species or habitat?	☒ Yes	☐ No
5b. Have you checked with the USFWS concerning Endangered Species Act impacts?	☒ Yes	☐ No
5c. If yes, indicate the USFWS Field Office you have contacted.	☐ Raleigh ☒ Asheville	
5d. What data sources did you use to determine whether your site would impact Endangered Species or Designated Critical Habitat? Utilized the U.S. Fish and Wildlife Service (USFWS) database in order to identify federally listed Threatened and Endangered plant and animal species for Madison County, NC.		
6. Essential Fish Habitat (Corps Requirement)		
6a. Will this project occur in or near an area designated as essential fish habitat?	☐ Yes	☒ No
6b. What data sources did you use to determine whether your site would impact Essential Fish Habitat? The NCWRC and USFWS were contacted for comment related to fish and wildlife issues associated with the proposed stream mitigation project. Neither agency anticipates the project to result in significant adverse impacts to aquatic or terrestrial wildlife resources (see correspondence in Appendix 5 of the mitigation plan).		
7. Historic or Prehistoric Cultural Resources (Corps Requirement)		
7a. Will this project occur in or near an area that the state, federal or tribal governments have designated as having historic or cultural preservation status (e.g., National Historic Trust designation or properties significant in North Carolina history and archaeology)?	☐ Yes	☒ No
7b. What data sources did you use to determine whether your site would impact historic or archeological resources? The NC Department of Natural and Cultural Resources was contacted for comment related to historic and archeological resources associated with the proposed stream mitigation project. The agency's aware of no historic resources which would be affected by the project. (see correspondence in Appendix 5 of the mitigation plan).		
8. Flood Zone Designation (Corps Requirement)		
8a. Will this project occur in a FEMA-designated 100-year floodplain?	☐ Yes	☒ No
8b. If yes, explain how project meets FEMA requirements:		
8c. What source(s) did you use to make the floodplain determination?		

Lin Xu Project Review Coordinator, NCDEQ - DMS Applicant/Agent's Printed Name	_____ Applicant/Agent's Signature (Agent's signature is valid only if an authorization letter from the applicant is provided.)	Date



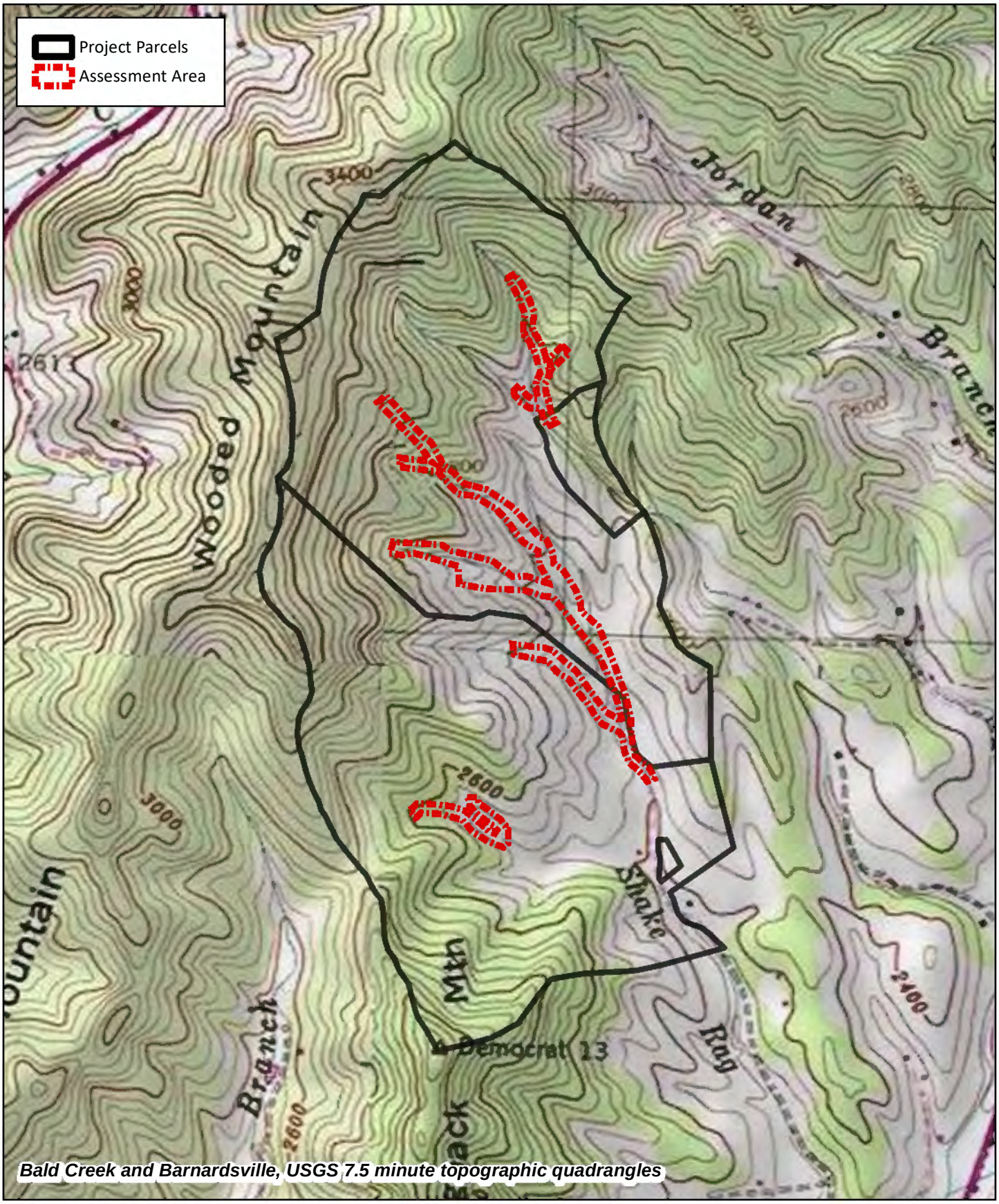
WILDLANDS ENGINEERING

0 1 2 Miles

N

Figure 1 Vicinity Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105

Madison County, NC



WILDLANDS ENGINEERING

0 1,000 Feet

N

Figure 2 USGS Topographic Map
Shake Rag Mitigation Site
French Broad River Basin (06010105)

Madison County, NC

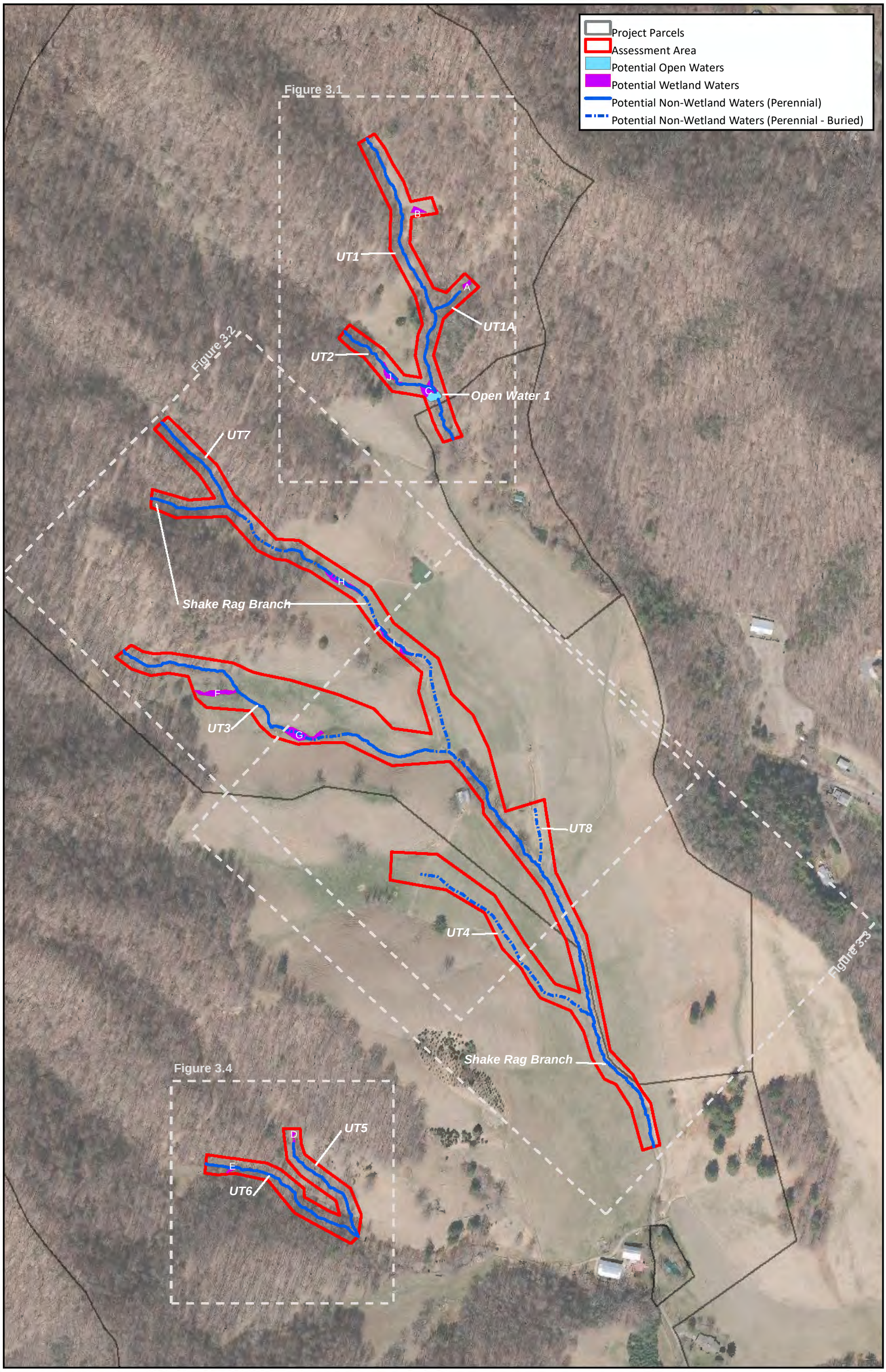


Figure 3.0: Delineation Overview Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105

Madison County, NC

Project Parcels
Assessment Area
Potential Open Waters
Potential Wetland Waters
Potential Non-Wetland Waters (Perennial)
Potential Non-Wetland Waters (Perennial - Buried)
Wetland/Upland Data Points (DP #)
Stream Classification Points (SCP #)

SCP 2
B
UT1
A
SCP 3
UT1A
SCP 4
UT2
DP8
J
C
DP7
Open Water 1
DP2
DP1

2014 Aerial Photography

0 200 Feet

N

Figure 3.1: Delineation Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC

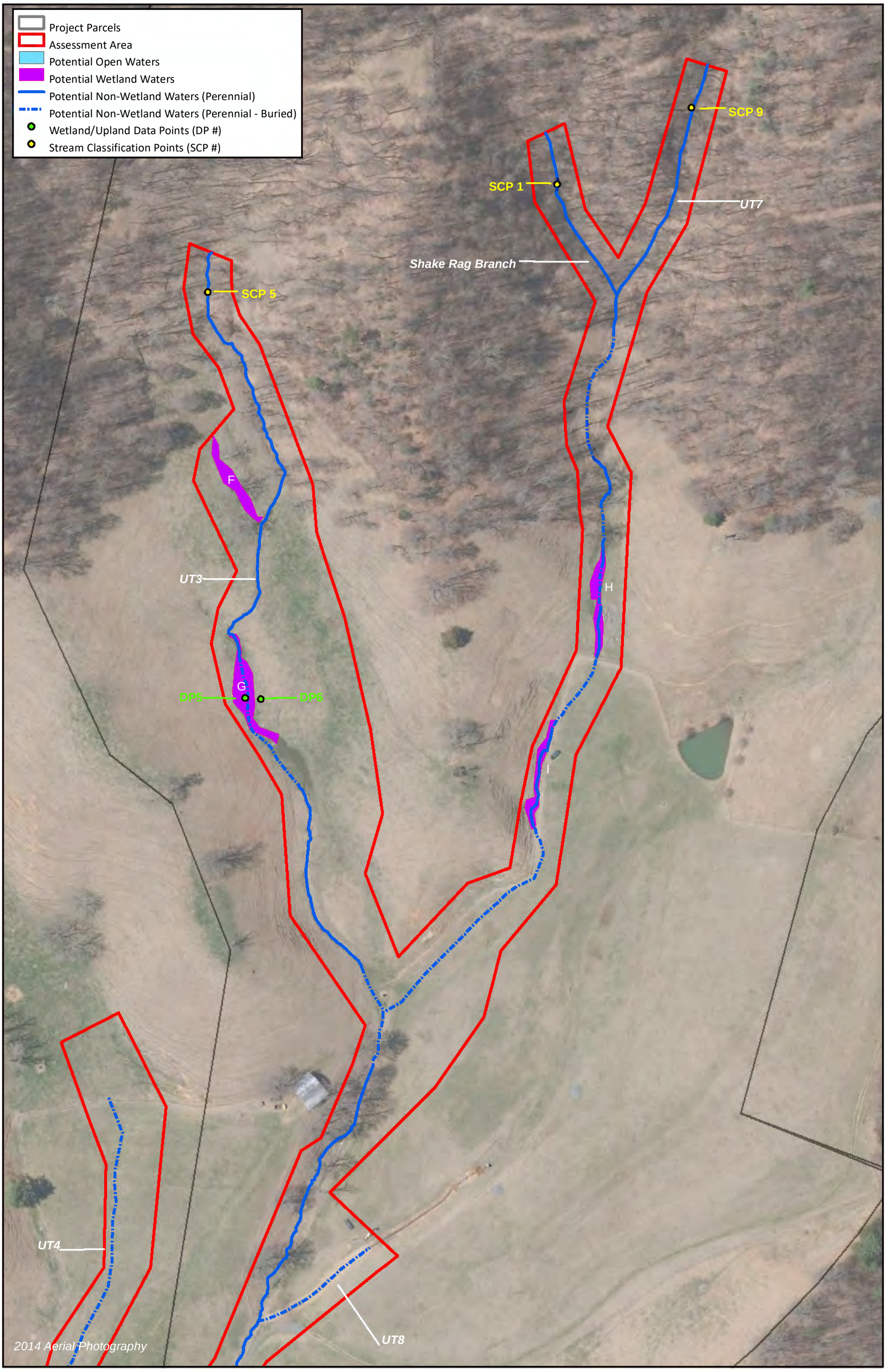
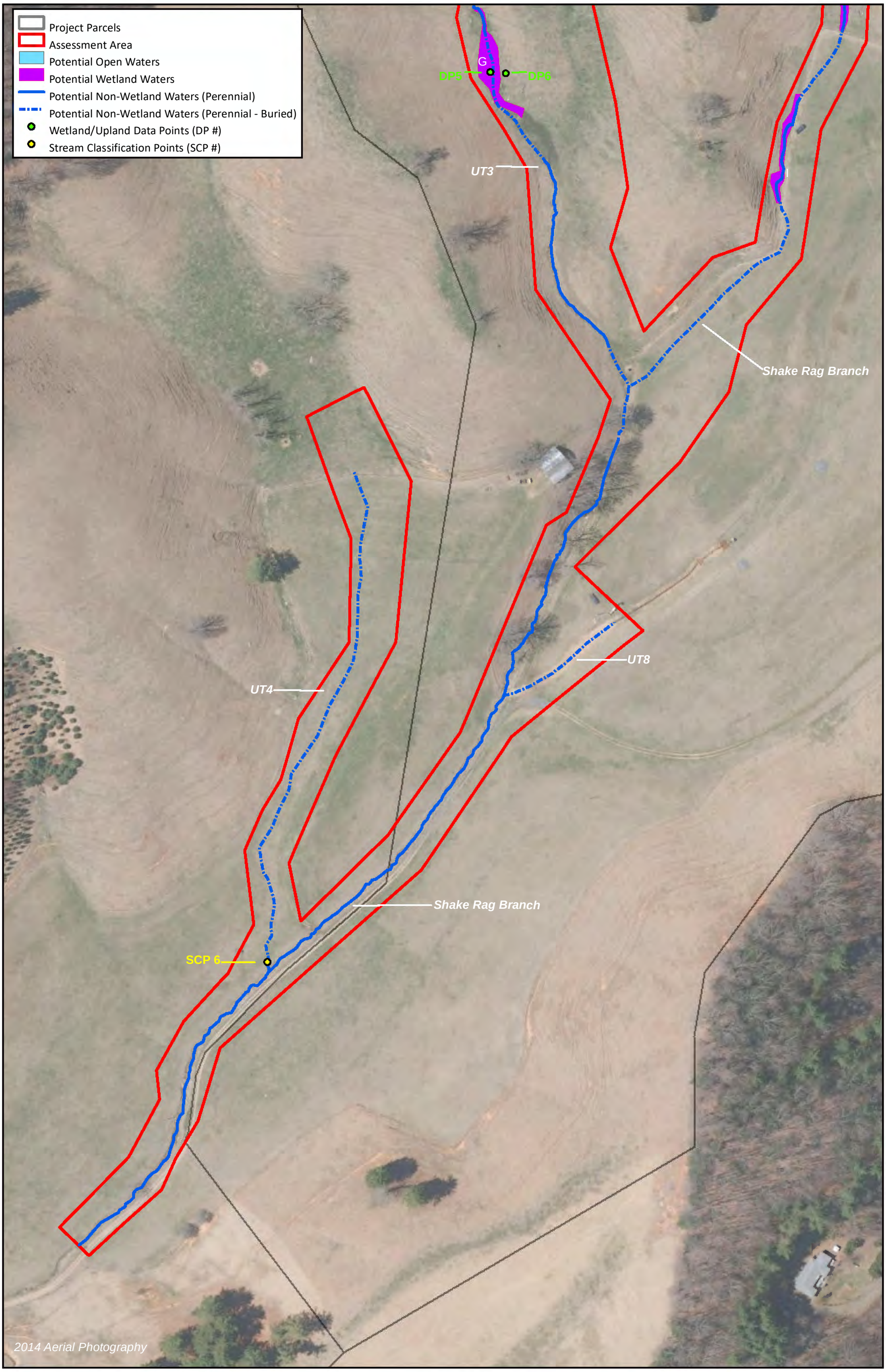
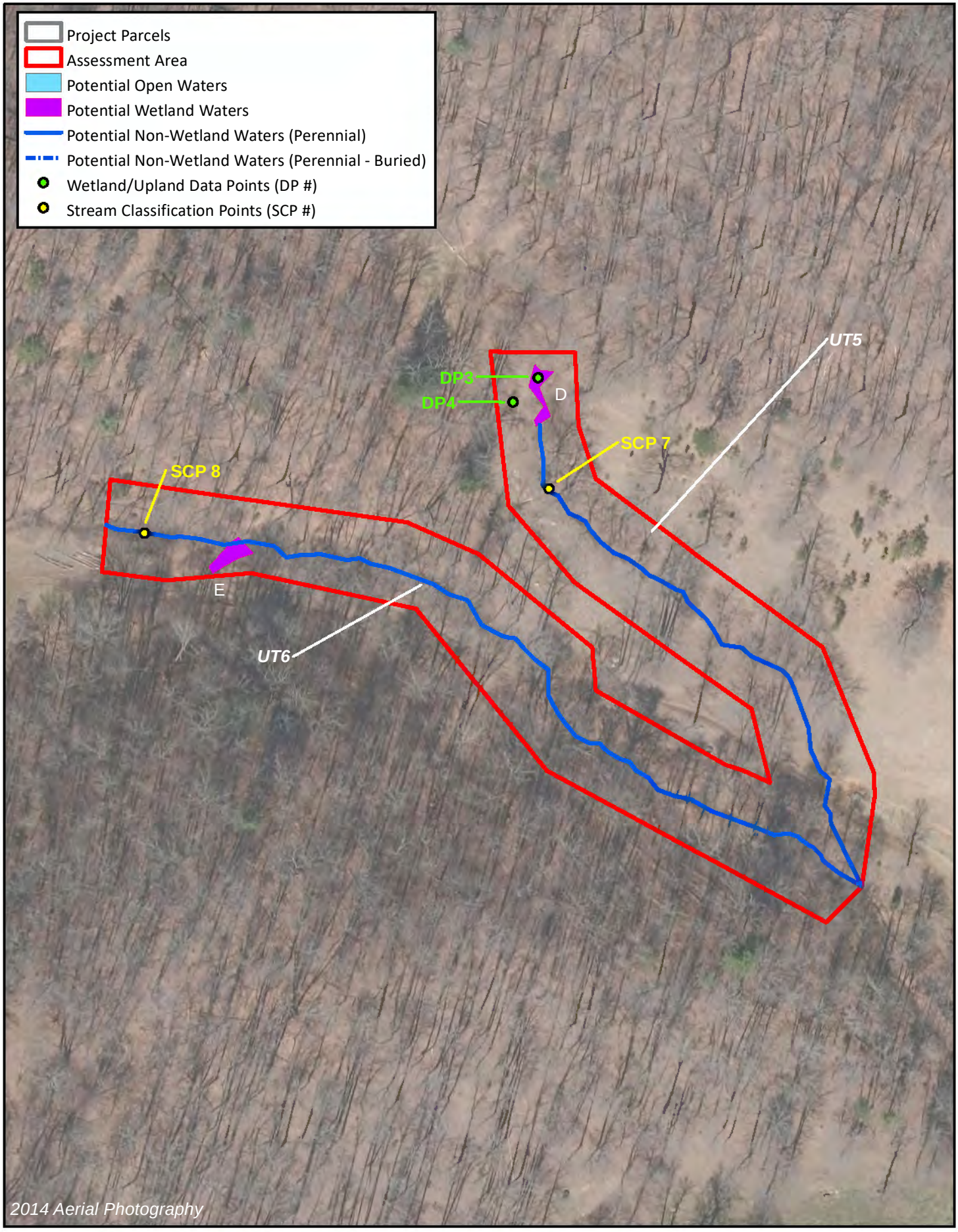


Figure 3.2: Delineation Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC



0 300 Feet

Figure 3.3: Delineation Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC



0 100 Feet

N

Figure 3.4: Delineation Overview Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC

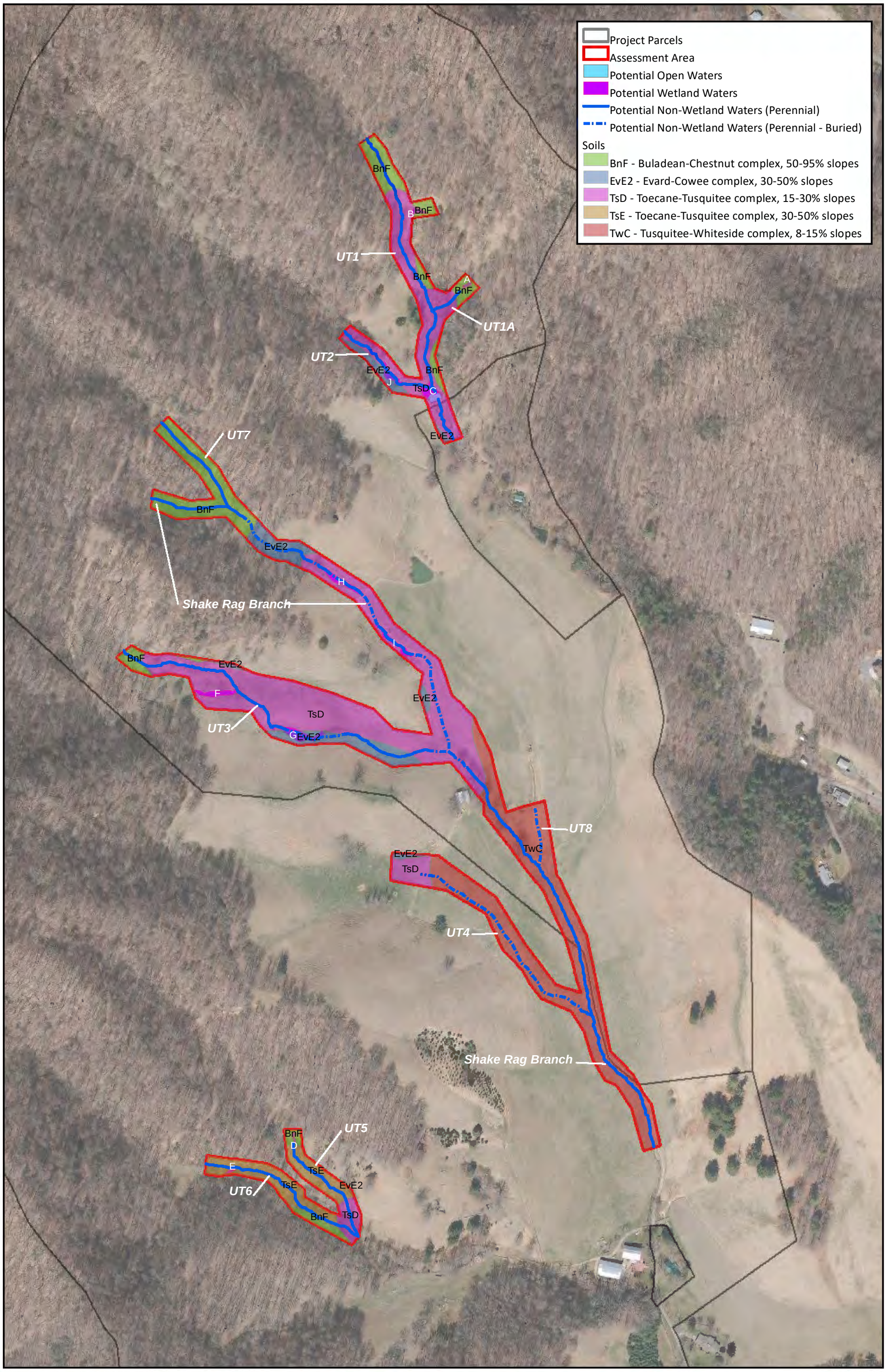


Figure 4: Soils Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105

Madison County, NC

APPENDIX 3
DWR STREAM IDENTIFICATION FORMS

SCP1

NC DWQ Stream Identification Form Version 4.11

Date: 6-1-16	**Project/Site:** Shake Rag Mitigation Site	**Latitude:** 35.879155 °N
Evaluator: I. Eckardt	**County:** Madison	**Longitude:** -82.499387 °W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 32.75	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** Shake Rag Branch *e.g. Quad Name:* (near u/s end project)

A. Geomorphology (Subtotal = 13)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain (steep, narrow valley)	(0)	1	2	3
6. Depositional bars or benches	(0)	1	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	0.5	1	(1.5)
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 11.25)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	(2)	3
21. Aquatic Mollusks	0	(1)	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	1	(1.5)
25. Algae	0	0.5	1	1.5
26. Wetland plants in streambed (jewelweed)	(FACW = 0.75; OBL = 1.5 Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Abundant salamanders (20+)
Few caddisflies (outside casing) and few mayflies

Sketch:

SCP2

NC DWQ Stream Identification Form Version 4.11

Date: 6-1-16	**Project/Site:** Shake Rag Mitigation Site	**Latitude:** 35.883017°N
Evaluator: JEckardt	**County:** Madison	**Longitude:** -82.496929
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 34.75	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** UT1 *e.g. Quad Name:*

A. Geomorphology (Subtotal = 14)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, (step-pool), ripple-pool sequence	0	1	2	(3)
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain (narrow, steep valley)	(0)	1	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	0.5	1	(1.5)
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 12.25)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	0	1	2	(3)
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	1	(1.5)
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed (jewelweed)	(FACW = 0.75; OBL = 1.5 Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: 5 salamanders 20+ right handed snails
2 caddisfly casings

Sketch:

SCP 3

NC DWQ Stream Identification Form Version 4.11

Date: 6-1-16	Project/Site: Shake Rag Branch FOP	Latitude: 35.881458°N
Evaluator: T. Eckardt	County: Madison	Longitude: -82.495839°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 28*	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other UT1A *e.g. Quad Name:*

A. Geomorphology (Subtotal = 12)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	(0)	1	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 8)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	(2)	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	(1)	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0) none			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: 7 caddisfly casings
2 salamanders

Sketch: Based on the present of EPT species (caddisfly) and salamanders observer believes reach has weak perennial flow. There is a short section of trampled seep above the stream call which occurs at the base of a boulder. Flow w/i seep area is not consistent.

SCP 4

NC DWQ Stream Identification Form Version 4.11

Date: 5-31-16	**Project/Site:** Shake Rag Mitigation Site	**Latitude:** 35.880999°N
Evaluator: JEckardt	**County:** Madison	**Longitude:** -82.497143
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 33.75	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** UT2 - below crossing *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 11.75)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	0	1	2	(3)
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	(1)	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed (Jewelweed)	(FACW = 0.75; OBL = 1.5 Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Abundant right handed snails
Observed very small benthic (1) but too small to identify.

Sketch:

SCP5

NC DWQ Stream Identification Form Version 4.11

Date: 5-31-16	Project/Site: Shake Rag Branch FOP	Latitude: 35.877360°N
Evaluator: J. Eckardt	County: Madison	Longitude: -82.499757°W
Total Points: 33.5 *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30**	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other UT3 *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 9.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 10.5)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	3	(2)	1	0
20. Macrobenthos (note diversity and abundance)	0	1	(2)	3
21. Aquatic Mollusks	0	1	2	(3)
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	(1)	1.5
25. Algae	0	(0.5)	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0) none			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Observed 2 salamanders, 7 mayflies under piece of large quartz, 10+ right handed snails

Sketch:

SCP 6

NC DWQ Stream Identification Form Version 4.11

Date: 5/9/18	Project/Site Shake Rag	Latitude: 35.873860°N
Evaluator: J. Eckardt	County: Madison	Longitude: -82.493727°W
Total Points: 30.25 *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30**	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other UT41 - D/S (20') e.g. Quad Name: open channel

A. Geomorphology (Subtotal = 10.5)	Absent	Weak	Moderate	Strong
1[3] Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	(0)	1	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	(No = 0)		Yes = 3	

[3] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 7.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	(0)	0.5	1	1.5
16. Organic debris lines or piles	(0)	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 12.25)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance) 1 stonefly	0	(1)	2	3
21. Aquatic Mollusks 30+ right handed snails	0	1	2	(3)
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians 3 salamanders	0	0.5	(1)	1.5
25. Algae	0	(0.5)	1	1.5
26. Wetland plants in streambed Juncus effusus	(FACW = 0.75; OBL = 1.5 Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

SCP 7

NC DWQ Stream Identification Form Version 4.11

Date: 5/31/16	**Project/Site:** Snake Ray mitigation Site	**Latitude:** 35.872217°N
Evaluator: J Eckardt	**County:** Madison	**Longitude:** -82.497518 °W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 36.25	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** UTS *e.g. Quad Name:*

A. Geomorphology (Subtotal = 15)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	0.5	1	(1.5)
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 12.75)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	(2)	3
21. Aquatic Mollusks	0	1	2	(3)
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	(1)	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed (jewelweed)	(FACW = 0.75; OBL = 1.5 Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Observed 3 salamanders, 20+ right handed snails, 3 caddis fly casings

Sketch:

SCP 8

NC DWQ Stream Identification Form Version 4.11

Date: 5-31-16	Project/Site: Shake Rag Branch EDP	Latitude: 35.872073°N
Evaluator: T Eckardt	County: Madison	Longitude: -82.498604°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 34.25	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other UT6 *e.g. Quad Name:*

A. Geomorphology (Subtotal = 14.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 11.75)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks - abundant right handed snails	0	1	2	(3)
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians 2 salamanders	0	0.5	(1)	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed (jewelweed)	(FACW = 0.75) OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Observed a couple caddisfly casings & 1 mayfly

Sketch:

SCP 9

NC DWQ Stream Identification Form Version 4.11

Date: 6-1-16	**Project/Site:** Shake Rag Mitigation Site	**Latitude:** 35.879848°N
Evaluator: J. Eckardt	**County:** Madison	**Longitude:** -82.499373°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 32.75	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** UT 7 *e.g. Quad Name:*

A. Geomorphology (Subtotal = 14)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	(3)
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain (narrow, steep valley)	(0)	1	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	0.5	1	(1.5)
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 10.25)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	0	0.5	(1)	1.5
24. Amphibians (lot salamanders)	0	0.5	1	(1.5)
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed (jewelweed)	(FACW = 0.75); OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Observed 3 caddisfly casings.

Sketch:

APPENDIX 4
DATA, ANALYSIS, SUPPLEMENTARY INFORMATION, FIGURES AND MAPS

Existing Conditions Geomorphic Parameters										
Parameter	**Notation**	**Units**	**UT1 Reach 1**	**UT1 Reach 2**		**UT1A**		**UT2 Reach 1**	**UT2 Reach 2**	
				max	**max**	**min**	**max**		**min**	**max**
stream type			A4a+	A4a+		A4a+		A4a+/B4a	A4a+	
drainage area	DA	sq mi	0.06	0.11		0.01		0.05	0.05	
bankfull cross-sectional area	A_{bkf}	SF	1.4	4.3		1.2		2.9	1.6	
avg velocity during bankfull event	v_{bkf}	fps	7.2	8.1		6.7		8.4	7.4	
width at bankfull	w_{bkf}	feet	4.6	5.3		2.9		6.1	3.1	
maximum depth at bankfull	d_{max}	feet	0.4	1.0		0.7		0.7	1.3	
mean depth at bankfull	d_{bkf}	feet	0.3	0.8		0.4		0.5	0.5	
bankfull width to depth ratio	w_{bkf}/d_{bkf}		15.8	6.4		6.9		12.9	6.0	
low bank height		feet	0.8	1.0		0.7		0.8	1.3	
bank height ratio	BHR		2	1.0		1.0		1.1	1.0	
floodprone area width	w_{fpa}	feet	5.6	15.7		9.9		17.1	21.6	
entrenchment ratio	ER		1.2	3.0		3.5		2.8	7.0	
max pool depth at bankfull	d_{pool}	feet	N/A	1.4		N/A		N/A	N/A	
pool depth ratio	d_{pool}/d_{bkf}		N/A	1.8		N/A		N/A	N/A	
pool width at bankfull	w_{pool}	feet	N/A	5.1		N/A		N/A	N/A	
pool width ratio	w_{pool}/w_{bkf}		N/A	1.0		N/A		N/A	N/A	
Bkf pool cross-sectional area	A_{pool}	SF	N/A	4.7		N/A		N/A	N/A	
pool area ratio	A_{pool}/A_{bkf}		N/A	1.1		N/A		N/A	N/A	
pool-pool pacing	p-p	feet	N/A	9	28	N/A		N/A	N/A	
pool-pool spacing ratio	p-p/W_{bkf}		N/A	1.7	5.3	N/A		N/A	N/A	
valley slope	S_{valley}	feet/foot	0.2152	0.1262		0.1147		0.1343	0.1520	
channel slope	$S_{channel}$	feet/foot	0.2013	0.1200		0.1100		0.1291	0.1500	
sinuosity	K		1.07	1.05		1.04		1.04	1.01	

Note: Stream pattern parameters other than sinuosity not reported due to limited channel pattern inherent of stream types (step-pool morphology) located within steep valleys.

N/A - Channelized stream channel with limited bed form profile variability. Stream profile parameters not reported for Enhancement II reaches.

Existing Conditions Geomorphic Parameters										
Parameter	**Notation**	**Units**	**SRB Reach 2**		**SRB Reach 3**		**SRB Reach 4**		**SRB Reach 5**	
			min	**max**	**min**	**max**	**min**	**max**	**min**	**max**
stream type			A4a+		A4a+		A4/B4a		A4	
drainage area	DA	sq mi	0.04		0.06		0.12		0.24	
bankfull cross-sectional area	A_{bkf}	SF	1.2		1.7		2.9		5.0	
avg velocity during bankfull event	v_{bkf}	fps	8.5		9.6		8.1		6.8	
width at bankfull	w_{bkf}	feet	3.7		3.3		5.1		6.7	
maximum depth at bankfull	d_{max}	feet	0.5		0.9		0.9		1.5	
mean depth at bankfull	d_{bkf}	feet	0.3		0.5		0.6		0.7	
bankfull width to depth ratio	w_{bkf}/d_{bkf}		11.6		6.2		9.0		9	
low bank height		feet	0.5		1.0		0.9		4.7	
bank height ratio	BHR		1.0		1.1		1.0		3.1	
floodprone area width	w_{fpa}	feet	6.7		24.6		14.6		8.6	
entrenchment ratio	ER		1.8		7.5		2.9		1.3	
max pool depth at bankfull	d_{pool}	feet	N/A		N/A		N/A		1.8	
pool depth ratio	d_{pool}/d_{bkf}		N/A		N/A		N/A		2.6	
pool width at bankfull	w_{pool}	feet	N/A		N/A		N/A		6.3	
pool width ratio	w_{pool}/w_{bkf}		N/A		N/A		N/A		0.9	
Bkf pool cross-sectional area	A_{pool}	SF	N/A		N/A		N/A		7.5	
pool area ratio	A_{pool}/A_{bkf}		N/A		N/A		N/A		1.5	
pool-pool pacing	p-p	feet	N/A		N/A		N/A		7	18
pool-pool spacing ratio	$p\text{-}p/W_{bkf}$		N/A		N/A		N/A		1.0	2.7
valley slope	S_{valley}	feet/foot	0.2339		0.1317		0.0976		0.0685	
channel slope	$S_{channel}$	feet/foot	0.2323		0.1275		0.0913		0.0659	
sinuosity	K		1.01		1.03		1.07		1.04	

Note: Stream pattern parameters other than sinuosity not reported due to limited channel pattern inherent of stream types (step-pool morphology) located within steep valleys.

N/A - Channelized stream channel with limited bed form profile variability. Stream profile parameters not reported for Enhancement II reaches.

Existing Conditions Geomorphic Parameters						
Parameter	**Notation**	**Units**	**UT3 Reach 1**		**UT3 Reach 2**	
			min	**max**	**min**	**max**
stream type			A4a+/B4a		A4a+	
drainage area	DA	sq mi	0.04		0.06	
bankfull cross-sectional area	A_{bkf}	SF	1		2.3	
avg velocity during bankfull event	v_{bkf}	fps	6.0		8.3	
width at bankfull	w_{bkf}	feet	4.0		4.5	
maximum depth at bankfull	d_{max}	feet	0.5		1.0	
mean depth at bankfull	d_{bkf}	feet	0.2		0.5	
bankfull width to depth ratio	w_{bkf}/d_{bkf}		16.3		9.1	
low bank height		feet	0.5		2.8	
bank height ratio	BHR		1.0		2.7	
floodprone area width	w_{fpa}	feet	5.6		7.2	
entrenchment ratio	ER		1.4		1.6	
max pool depth at bankfull	d_{pool}	feet	N/A		1.2	
pool depth ratio	d_{pool}/d_{bkf}		N/A		2.4	
pool width at bankfull	w_{pool}	feet	N/A		3.3	
pool width ratio	w_{pool}/w_{bkf}		N/A		0.7	
Bkf pool cross-sectional area	A_{pool}	SF	N/A		2.9	
pool area ratio	A_{pool}/A_{bkf}		N/A		1.3	
pool-pool pacing	p-p	feet	N/A		8	16
pool-pool spacing ratio	$p\text{-}p/W_{bkf}$		N/A		1.8	3.6
valley slope	S_{valley}	feet/foot	0.1784		0.1757	
channel slope	$S_{channel}$	feet/foot	0.1700		0.1700	
sinuosity	K		1.05		1.03	

Note: Stream pattern parameters other than sinuosity not reported due to limited channel pattern inherent of stream types (step-pool morphology) located within steep valleys.

N/A - Channelized stream channel with limited bed form profile variability. Stream profile parameters not reported for Enhancement II reaches.

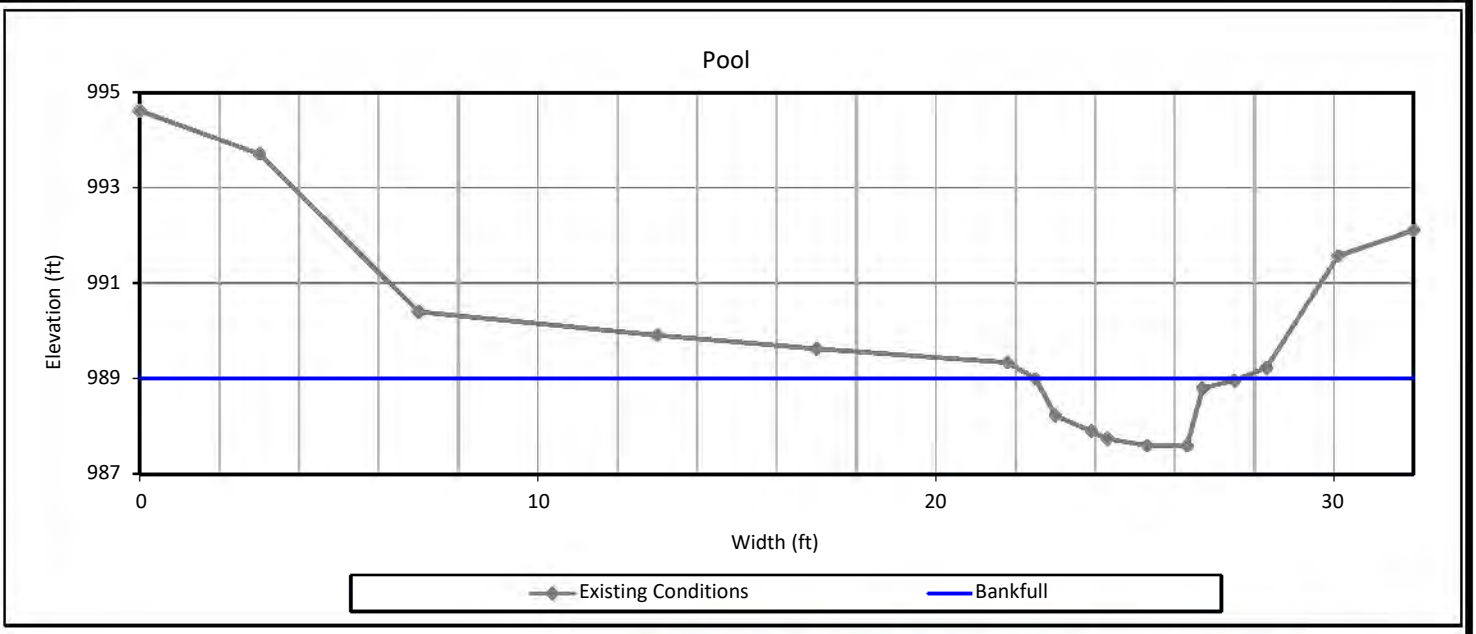
Existing Conditions Geomorphic Parameters						
Parameter	**Notation**	**Units**	**UT5**		**UT6**	
			min	**max**	**min**	**max**
stream type			B4a		B4a	
drainage area	DA	sq mi	0.03		0.04	
bankfull cross-sectional area	A_{bkf}	SF	1.8		2.7	
avg velocity during bankfull event	v_{bkf}	fps	5.2		6.6	
width at bankfull	w_{bkf}	feet	6.4		6.1	
maximum depth at bankfull	d_{max}	feet	0.4		0.6	
mean depth at bankfull	d_{bkf}	feet	0.3		0.4	
bankfull width to depth ratio	w_{bkf}/d_{bkf}		22.7		13.7	
low bank height		feet	2.0		1.88	
bank height ratio	BHR		4.5		2.9	
floodprone area width	w_{fpa}	feet	9.6		11.4	
entrenchment ratio	ER		1.5		1.9	
max pool depth at bankfull	d_{pool}	feet	N/A		N/A	
pool depth ratio	d_{pool}/d_{bkf}		N/A		N/A	
pool width at bankfull	w_{pool}	feet	N/A		N/A	
pool width ratio	w_{pool}/w_{bkf}		N/A		N/A	
Bkf pool cross-sectional area	A_{pool}	SF	N/A		N/A	
pool area ratio	A_{pool}/A_{bkf}		N/A		N/A	
pool-pool pacing	p-p	feet	N/A		N/A	
pool-pool spacing ratio	p-p/W_{bkf}		N/A		N/A	
valley slope	S_{valley}	feet/foot	0.1029		0.1118	
channel slope	$S_{channel}$	feet/foot	0.0989		0.1065	
sinuosity	K		1.04		1.05	

Note: Stream pattern parameters other than sinuosity not reported due to limited channel pattern inherent of stream types (step-pool morphology) located within steep valleys.

N/A - Channelized stream channel with limited bed form profile variability. Stream profile parameters not reported for Enhancement II reaches.

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 1, UT1 Reach 2

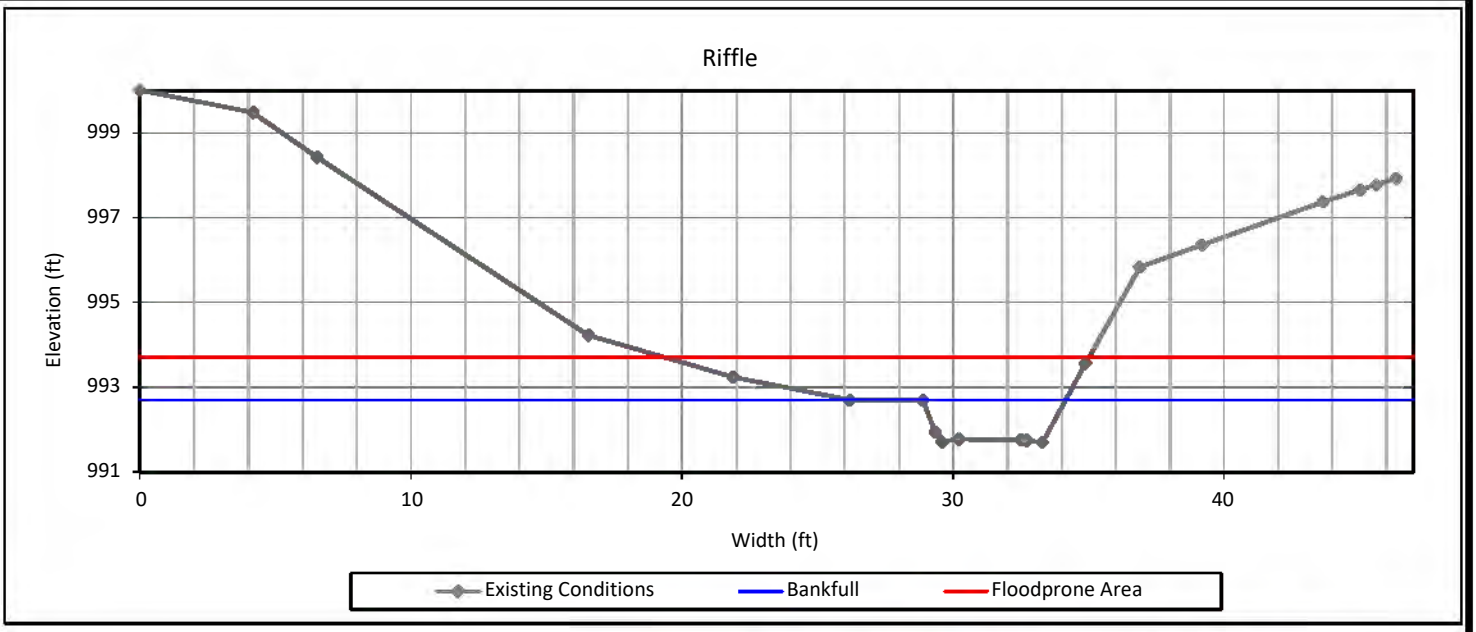


Bankfull Dimensions	
4.7	x-section area (ft.sq.)
5.1	width (ft)
0.9	mean depth (ft)
1.4	max depth (ft)
6.5	wetted perimeter (ft)
0.7	hyd radi (ft)
5.6	width-depth ratio
15.7	W flood prone area (ft)
3.1	entrenchment ratio
1.0	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 2, UT1 Reach 2

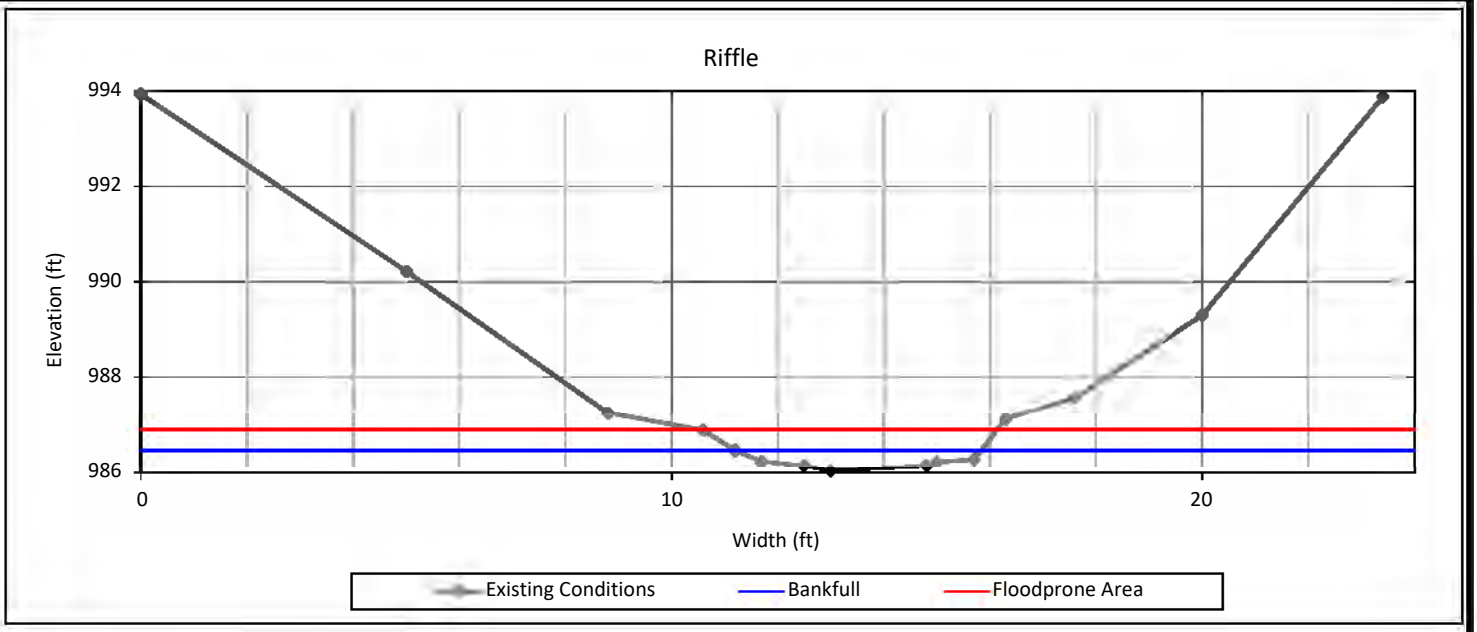


Bankfull Dimensions	
4.3	x-section area (ft.sq.)
5.3	width (ft)
0.8	mean depth (ft)
1.0	max depth (ft)
6.2	wetted perimeter (ft)
0.7	hyd radi (ft)
6.4	width-depth ratio
15.7	W flood prone area (ft)
3.0	entrenchment ratio
1.0	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 3, UT1 Reach 1



Bankfull Dimensions	
1.4	x-section area (ft.sq.)
4.6	width (ft)
0.3	mean depth (ft)
0.4	max depth (ft)
4.8	wetted perimeter (ft)
0.3	hyd radi (ft)
15.8	width-depth ratio
5.6	W flood prone area (ft)
1.2	entrenchment ratio
2.0	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

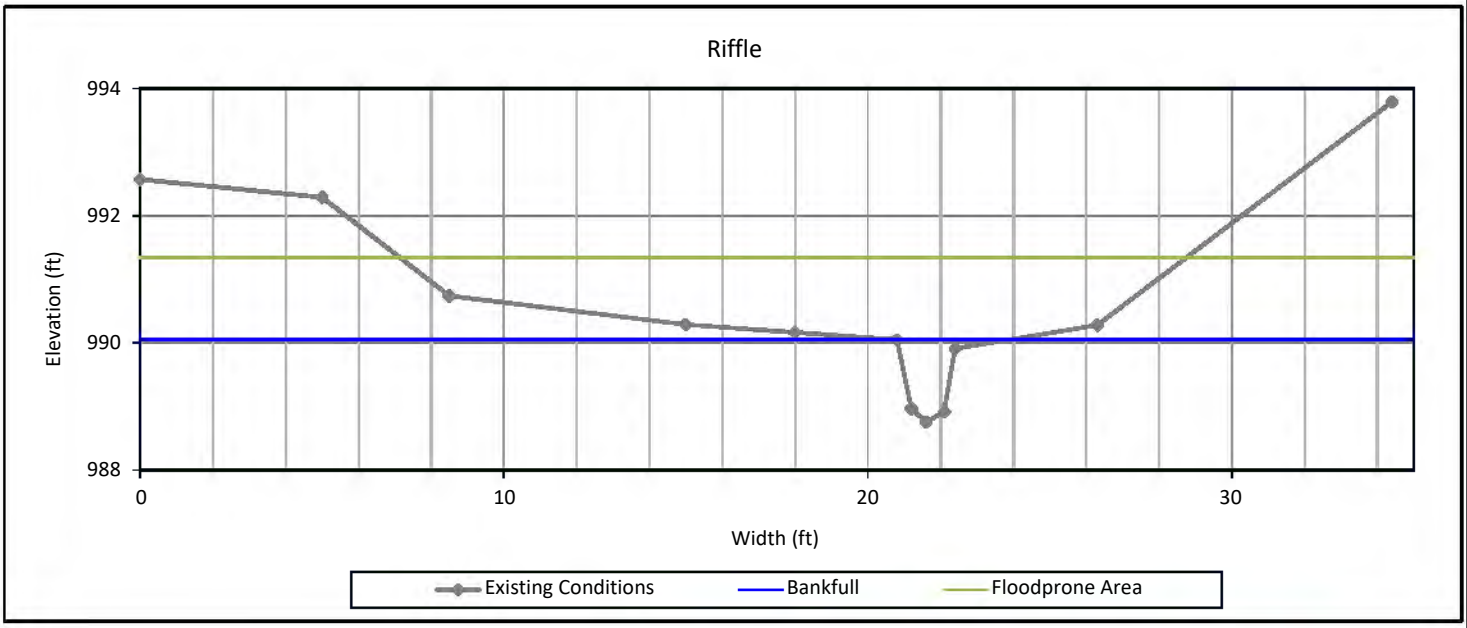
Cross Section 4, UT1A

Bankfull Dimensions	
1.2	x-section area (ft.sq.)
2.9	width (ft)
0.4	mean depth (ft)
0.7	max depth (ft)
3.3	wetted perimeter (ft)
0.4	hyd radi (ft)
6.9	width-depth ratio
9.9	W flood prone area (ft)
3.5	entrenchment ratio
1.0	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 5, UT2 Reach 2

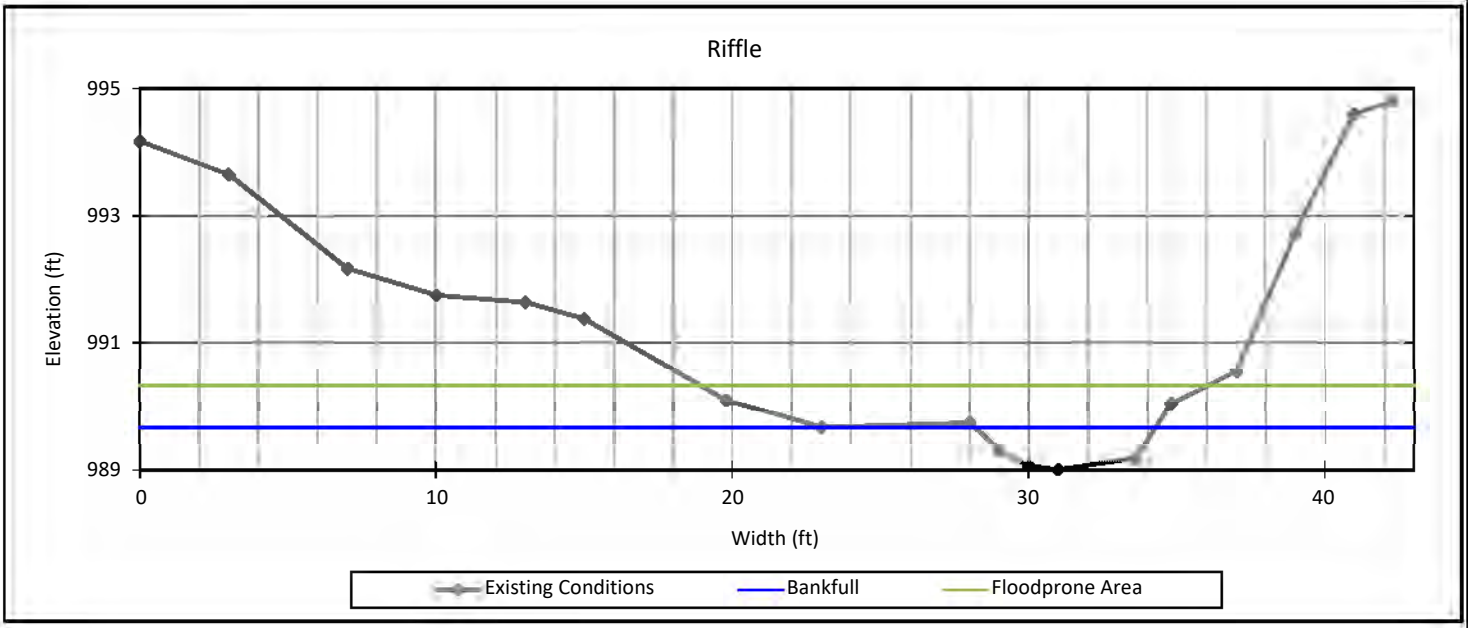


Bankfull Dimensions	
1.6	x-section area (ft.sq.)
3.1	width (ft)
0.5	mean depth (ft)
1.3	max depth (ft)
4.6	wetted perimeter (ft)
0.3	hyd radi (ft)
6.0	width-depth ratio
21.6	W flood prone area (ft)
7.0	entrenchment ratio
1.0	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 6, UT2 Reach 1

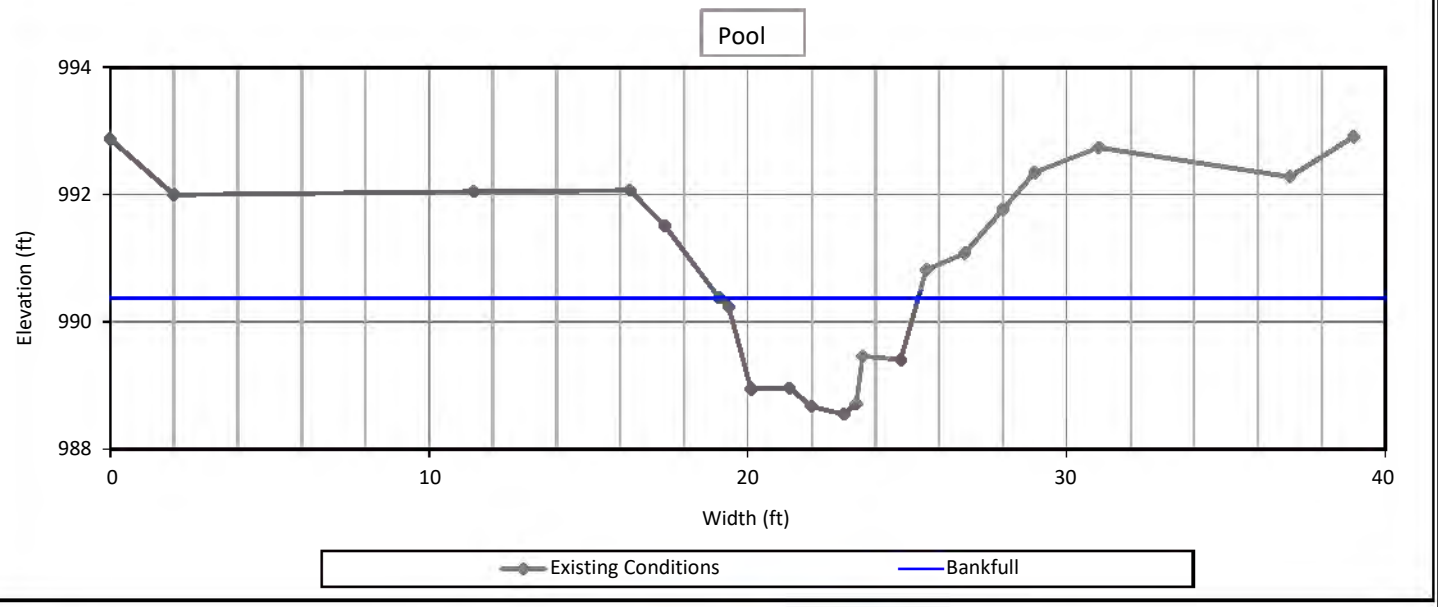


Bankfull Dimensions	
2.9	x-section area (ft.sq.)
6.1	width (ft)
0.5	mean depth (ft)
0.7	max depth (ft)
6.4	wetted perimeter (ft)
0.5	hyd radi (ft)
12.9	width-depth ratio
17.1	W flood prone area (ft)
2.8	entrenchment ratio
1.1	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 7, Shake Rag Branch Reach 5

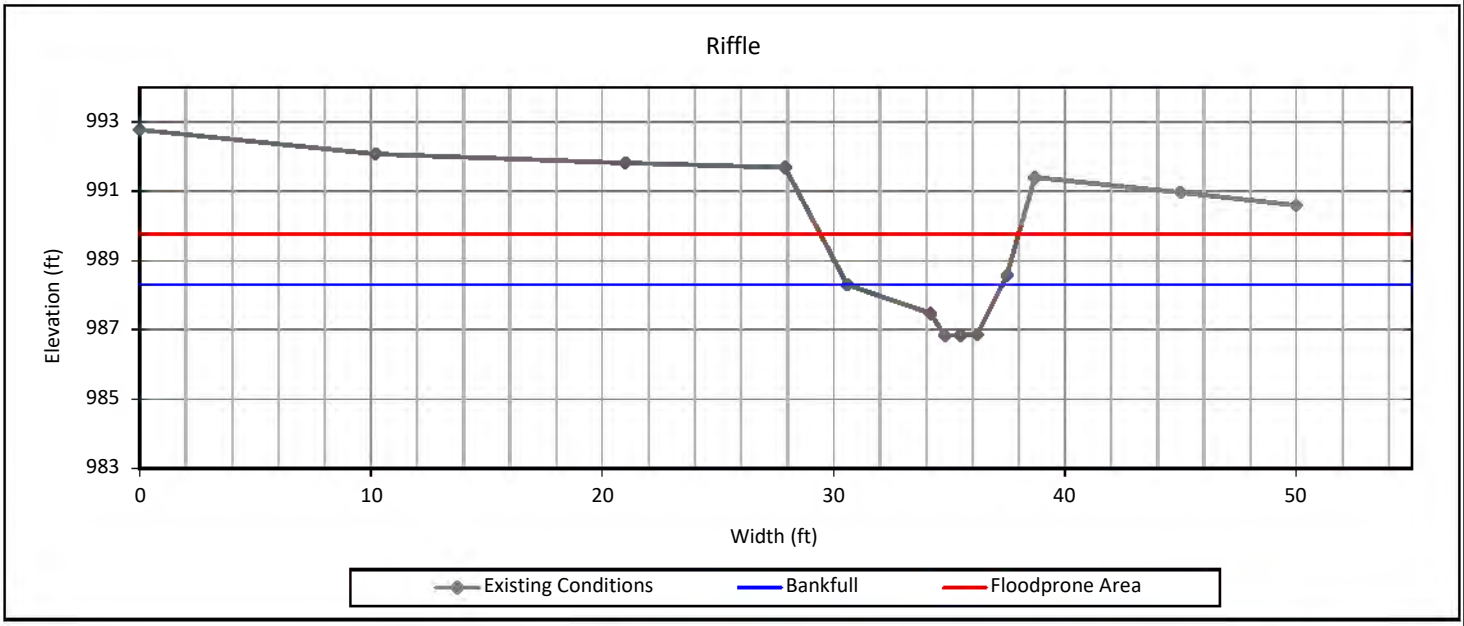


Bankfull Dimensions	
7.5	x-section area (ft.sq.)
6.3	width (ft)
1.2	mean depth (ft)
1.8	max depth (ft)
8.3	wetted perimeter (ft)
0.9	hyd radi (ft)
5.2	width-depth ratio
27.2	W flood prone area (ft)
4.4	entrenchment ratio
1.9	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 8, Shake Rag Branch Reach 5

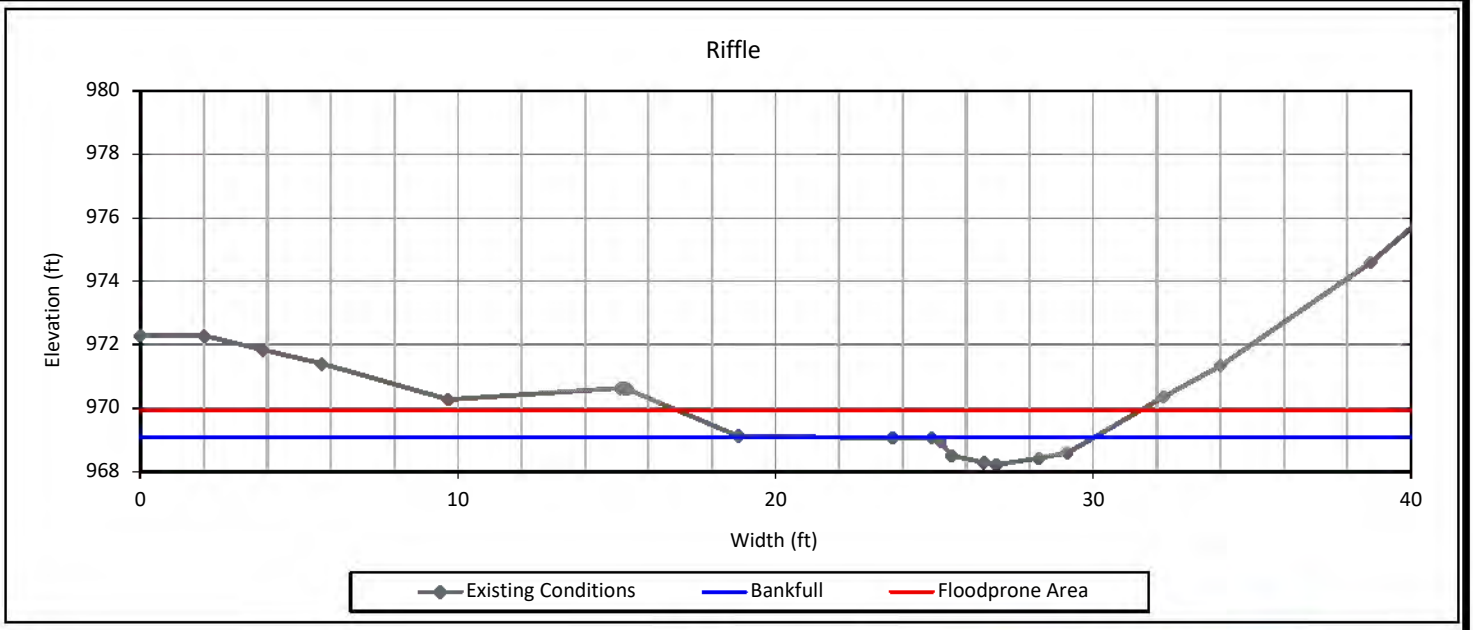


Bankfull Dimensions	
5.0	x-section area (ft.sq.)
6.7	width (ft)
0.7	mean depth (ft)
1.5	max depth (ft)
7.8	wetted perimeter (ft)
0.6	hyd radi (ft)
9.0	width-depth ratio
8.6	W flood prone area (ft)
1.3	entrenchment ratio
3.1	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 9, Shake Rag Branch Reach 4

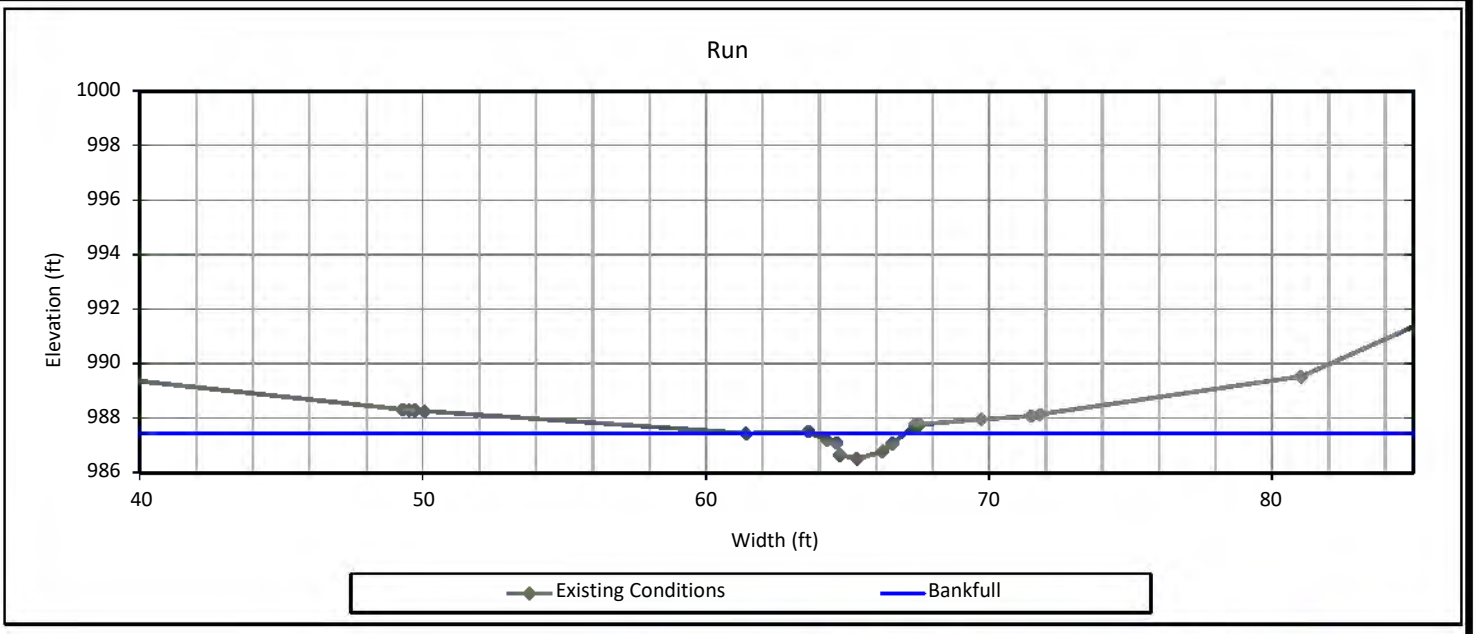


Bankfull Dimensions	
2.9	x-section area (ft.sq.)
5.1	width (ft)
0.6	mean depth (ft)
0.9	max depth (ft)
5.6	wetted perimeter (ft)
0.5	hyd radi (ft)
9.0	width-depth ratio
14.6	W flood prone area (ft)
2.9	entrenchment ratio
1.0	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 10, Shake Rag Branch Reach 3

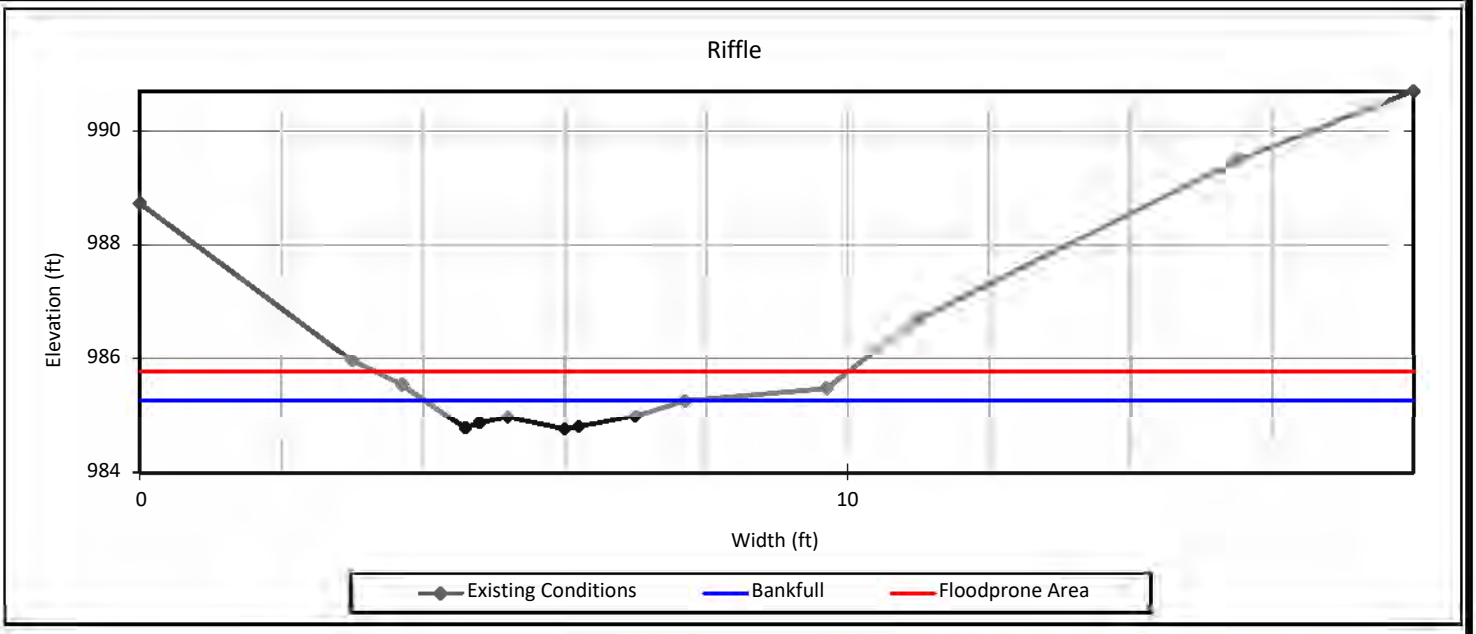


Bankfull Dimensions	
1.7	x-section area (ft.sq.)
3.3	width (ft)
0.5	mean depth (ft)
0.9	max depth (ft)
4.0	wetted perimeter (ft)
0.4	hyd radi (ft)
6.2	width-depth ratio
24.6	W flood prone area (ft)
7.5	entrenchment ratio
1.1	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 11, Shake Rag Branch Reach 2

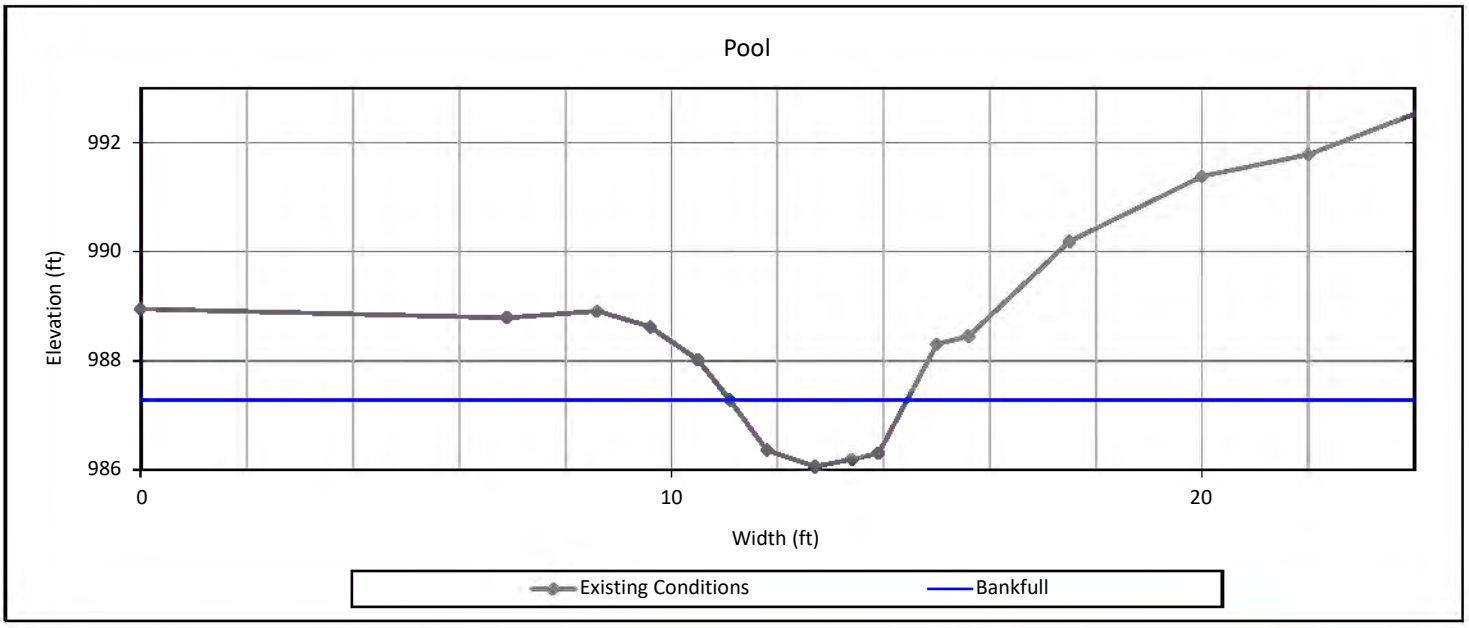


Bankfull Dimensions	
1.2	x-section area (ft.sq.)
3.7	width (ft)
0.3	mean depth (ft)
0.5	max depth (ft)
4.0	wetted perimeter (ft)
0.3	hyd radi (ft)
11.6	width-depth ratio
6.7	W flood prone area (ft)
1.8	entrenchment ratio
1.0	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 12, UT3 Reach 2

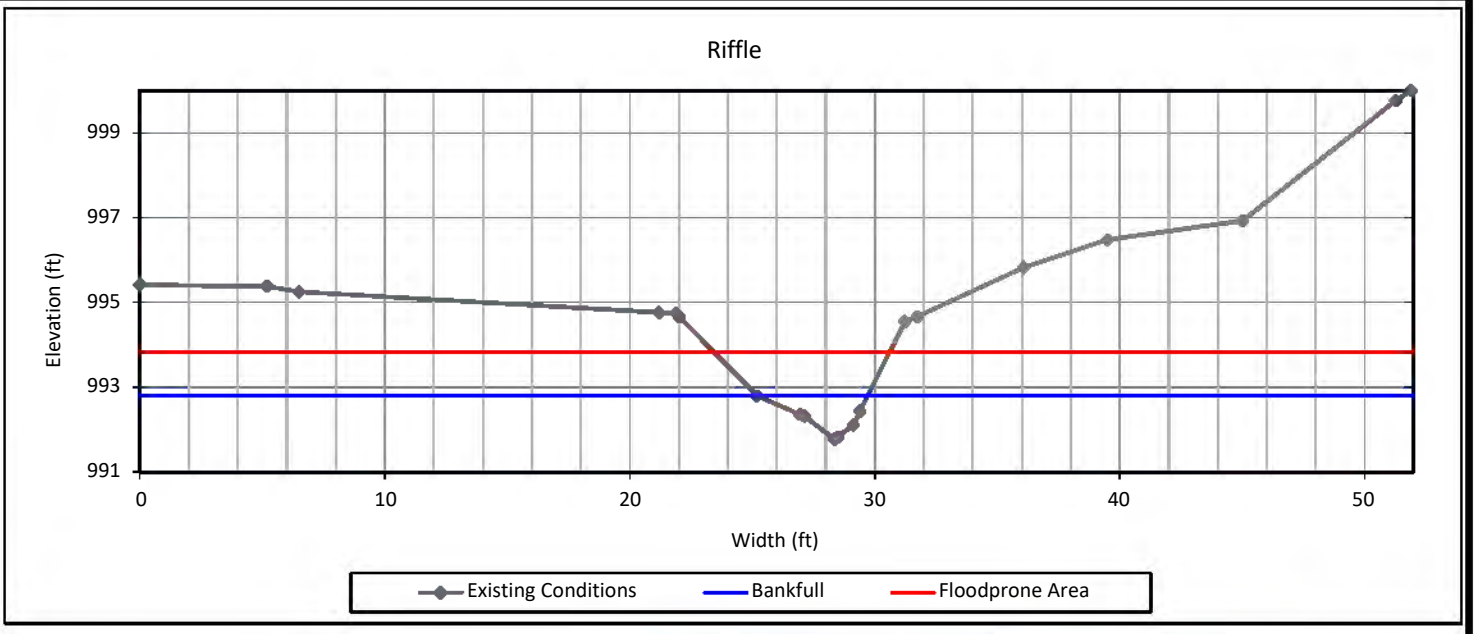


Bankfull Dimensions	
2.9	x-section area (ft.sq.)
3.3	width (ft)
0.9	mean depth (ft)
1.2	max depth (ft)
4.4	wetted perimeter (ft)
0.6	hyd radi (ft)
3.9	width-depth ratio
5.9	W flood prone area (ft)
1.8	entrenchment ratio
4.4	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 13, UT3 Reach 2

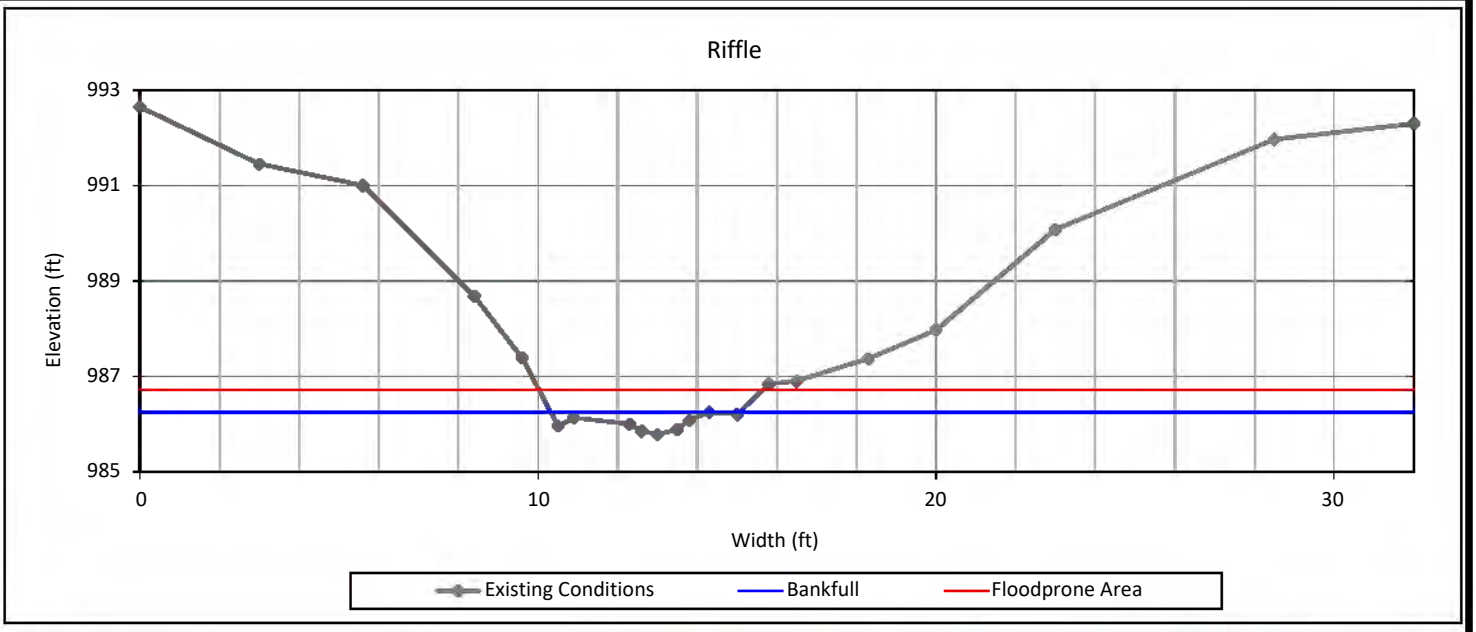


Bankfull Dimensions	
2.3	x-section area (ft.sq.)
4.5	width (ft)
0.5	mean depth (ft)
1.0	max depth (ft)
5.1	wetted perimeter (ft)
0.4	hyd radi (ft)
9.1	width-depth ratio
7.2	W flood prone area (ft)
1.6	entrenchment ratio
2.7	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 14, UT3 Reach 1

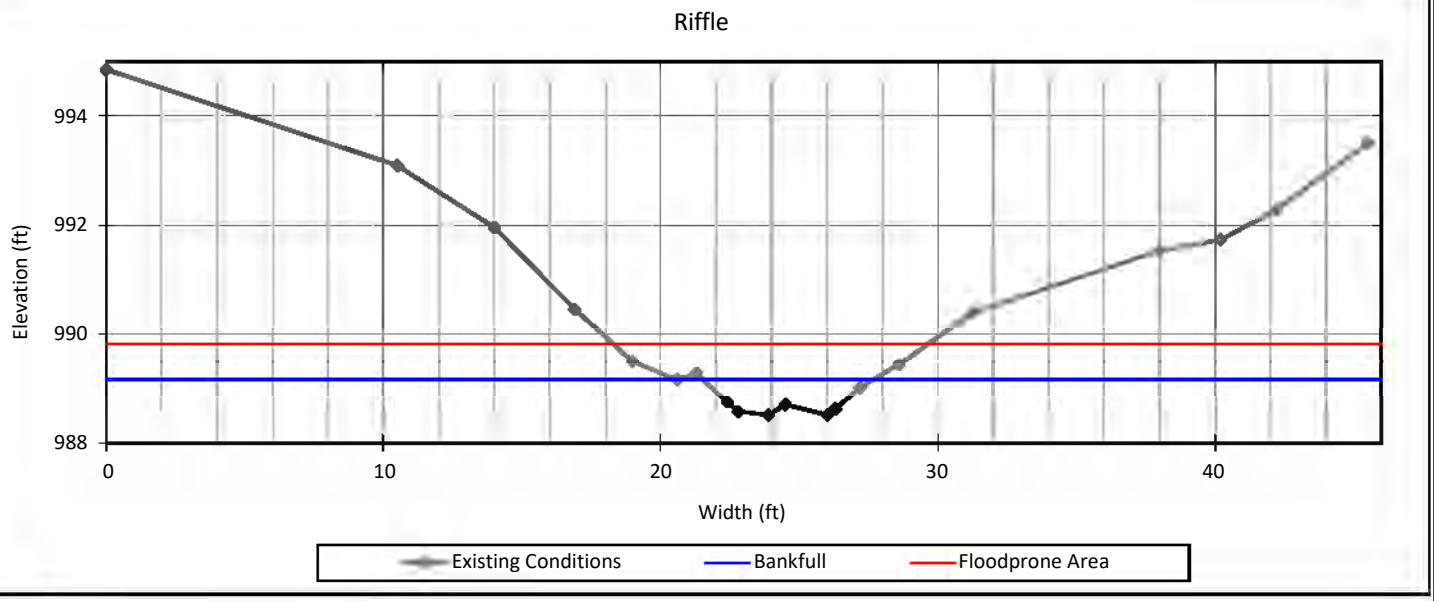


Bankfull Dimensions	
1.0	x-section area (ft.sq.)
4.0	width (ft)
0.2	mean depth (ft)
0.5	max depth (ft)
4.3	wetted perimeter (ft)
0.2	hyd radi (ft)
16.3	width-depth ratio
5.6	W flood prone area (ft)
1.4	entrenchment ratio
1.0	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

Cross Section 15, UT6

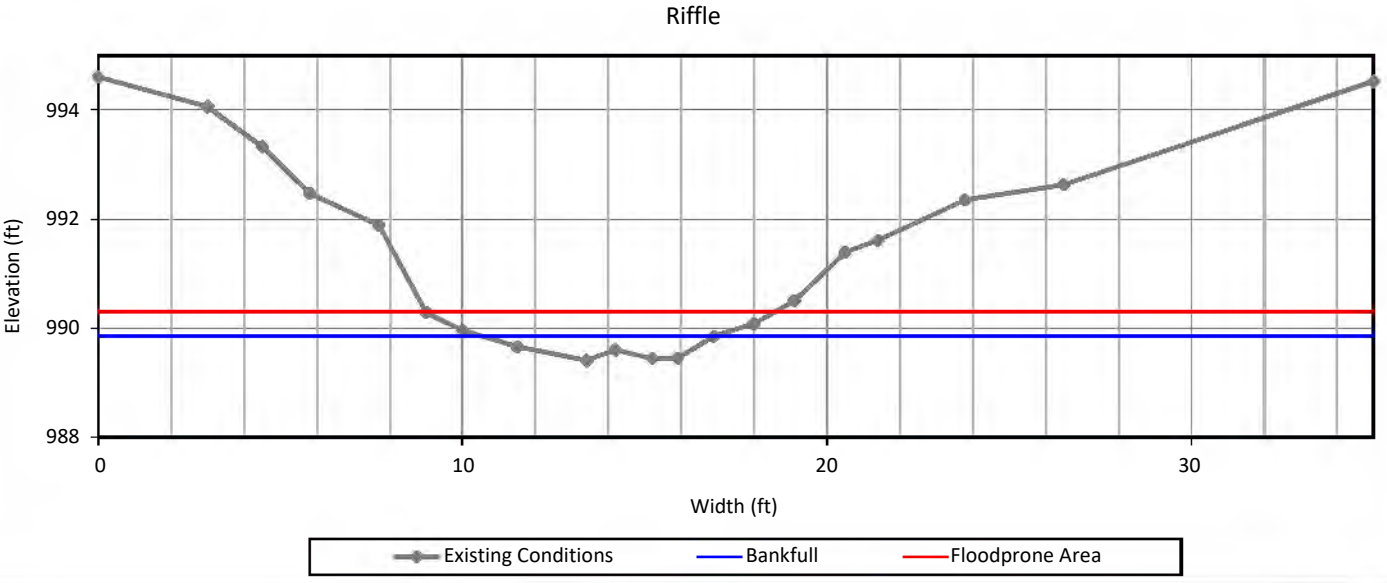


Bankfull Dimensions	
2.7	x-section area (ft.sq.)
6.1	width (ft)
0.4	mean depth (ft)
0.6	max depth (ft)
6.4	wetted perimeter (ft)
0.4	hyd radi (ft)
13.7	width-depth ratio
11.4	W flood prone area (ft)
1.9	entrenchment ratio
2.9	low bank height ratio

View Downstream

Cross Section Plots
Shake Rag Mitigation Site (DMS Project No. 100018)
Existing Conditions

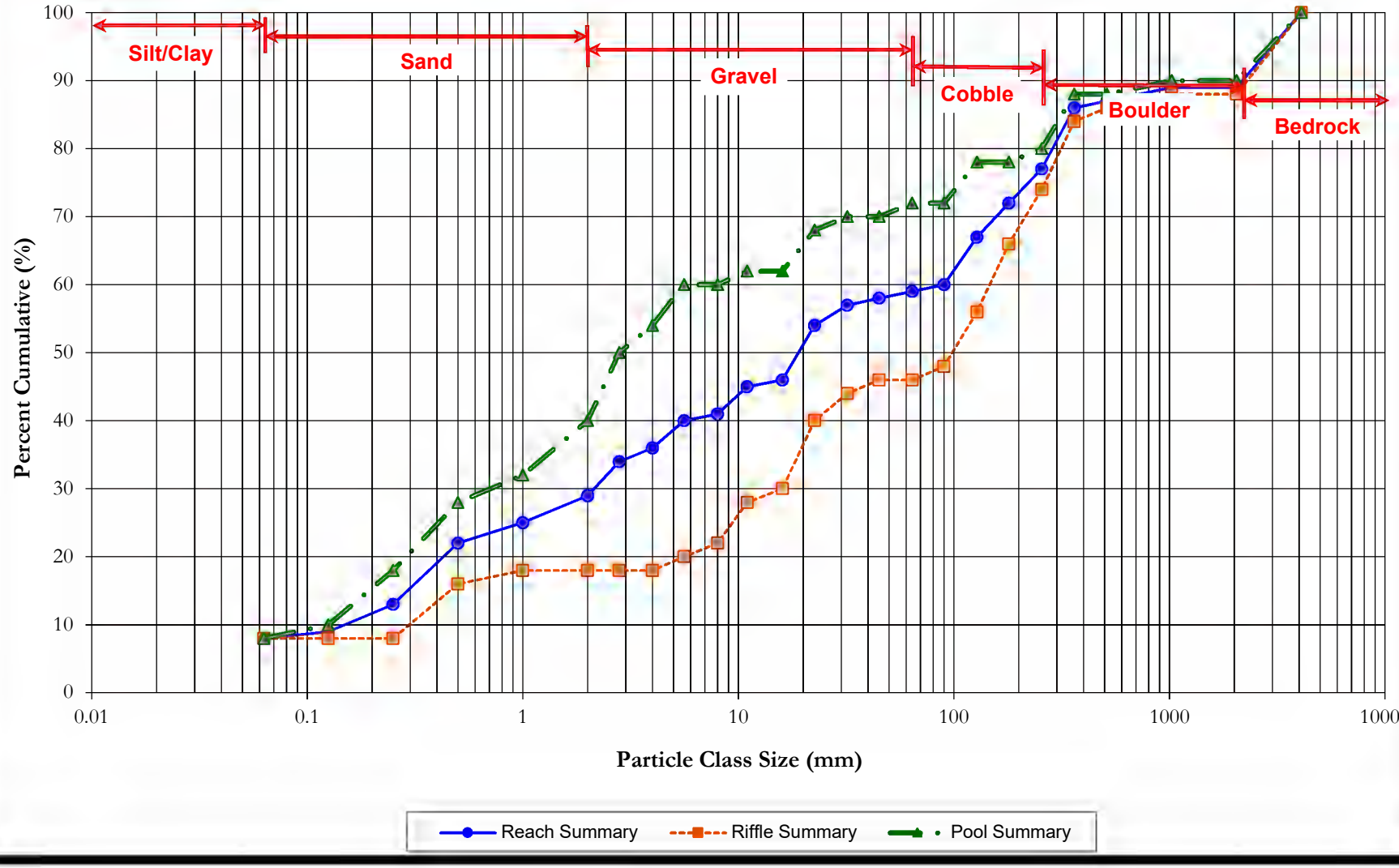
Cross Section 16, UT5



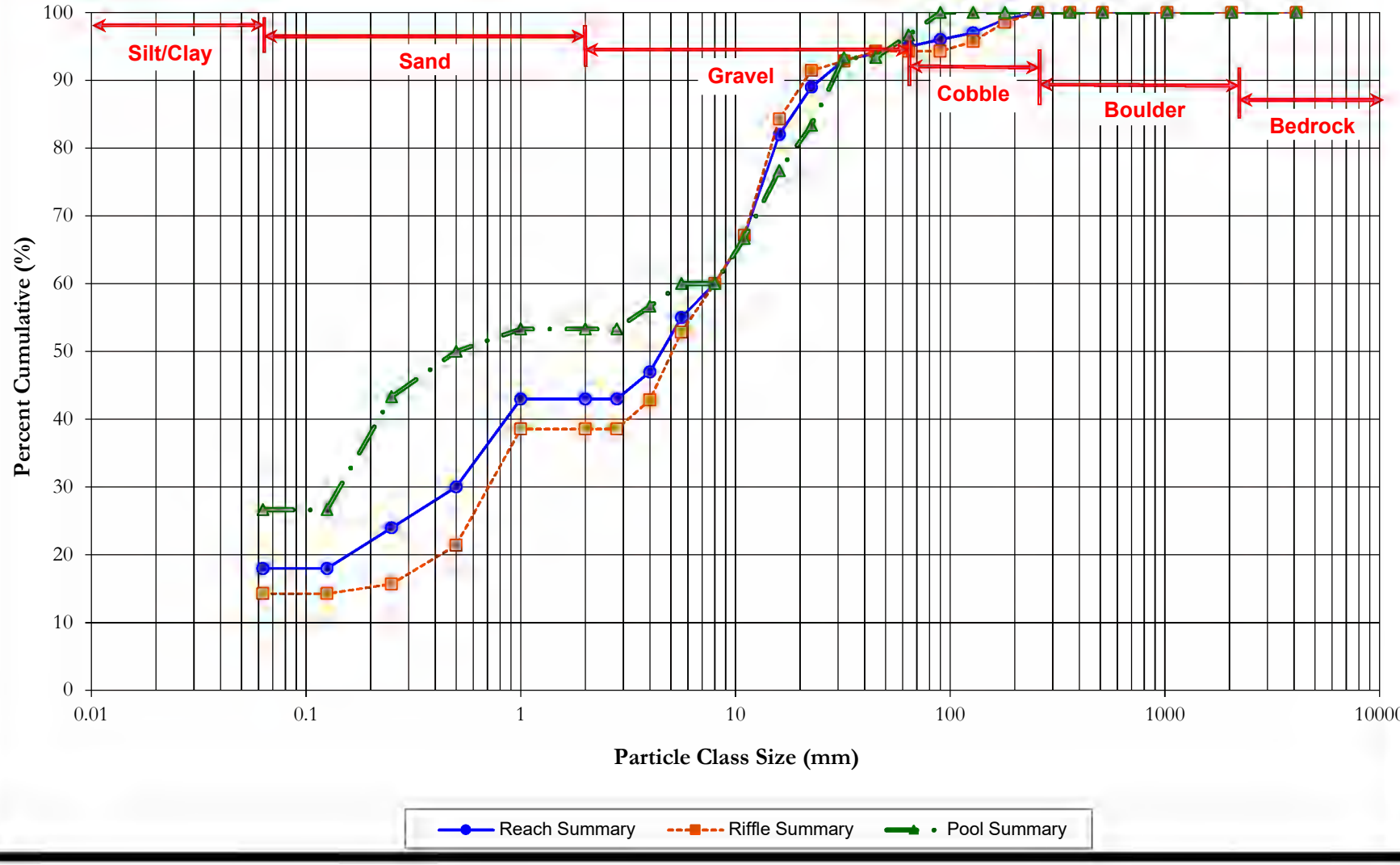
Bankfull Dimensions	
1.8	x-section area (ft.sq.)
6.4	width (ft)
0.3	mean depth (ft)
0.4	max depth (ft)
6.5	wetted perimeter (ft)
0.3	hyd radi (ft)
22.7	width-depth ratio
9.6	W flood prone area (ft)
1.5	entrenchment ratio
4.5	low bank height ratio

View Downstream

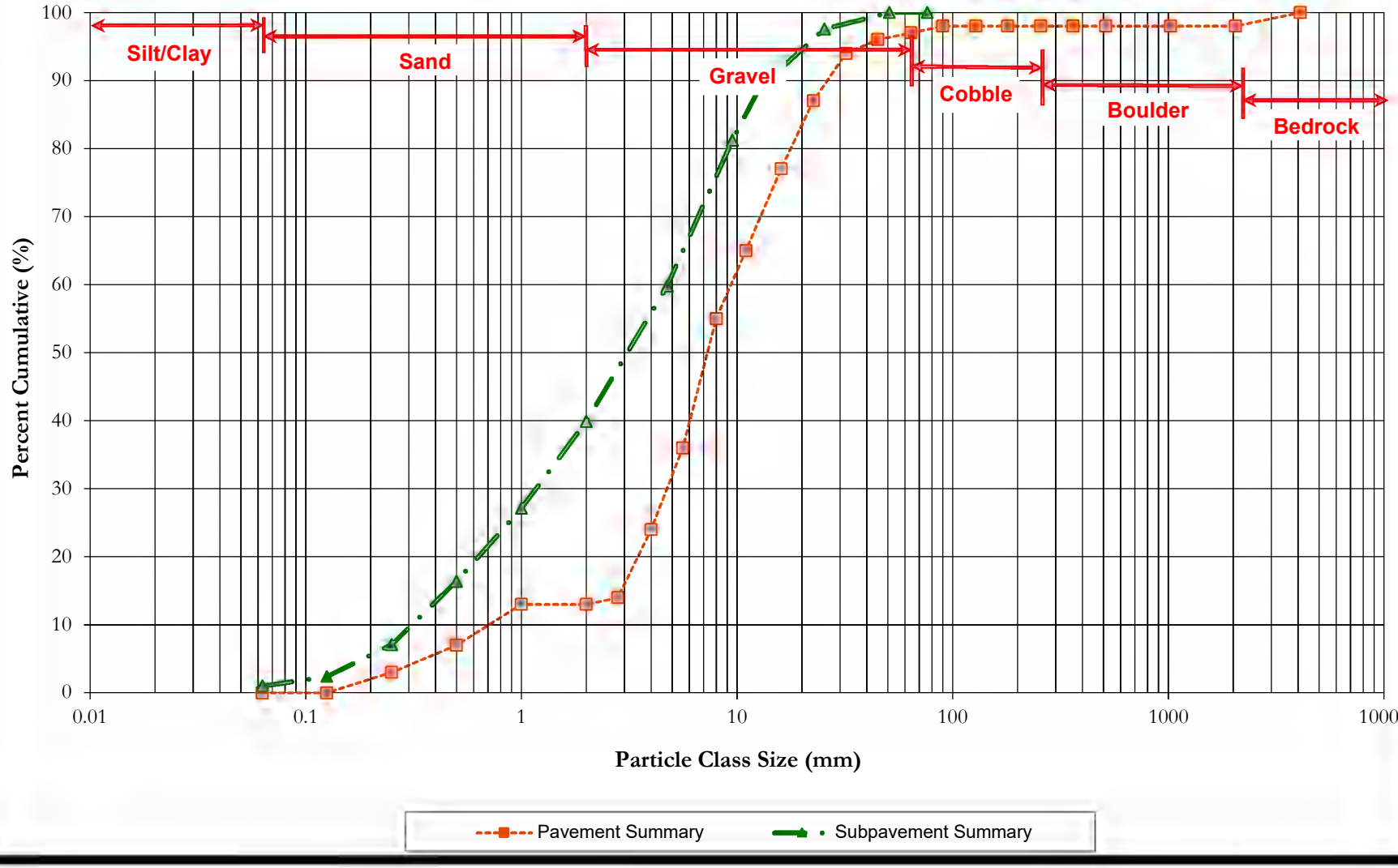
Shake Rag Branch - UT1 (Reaches 1 and 2)
Reachwide Pebble Count Particle Distribution



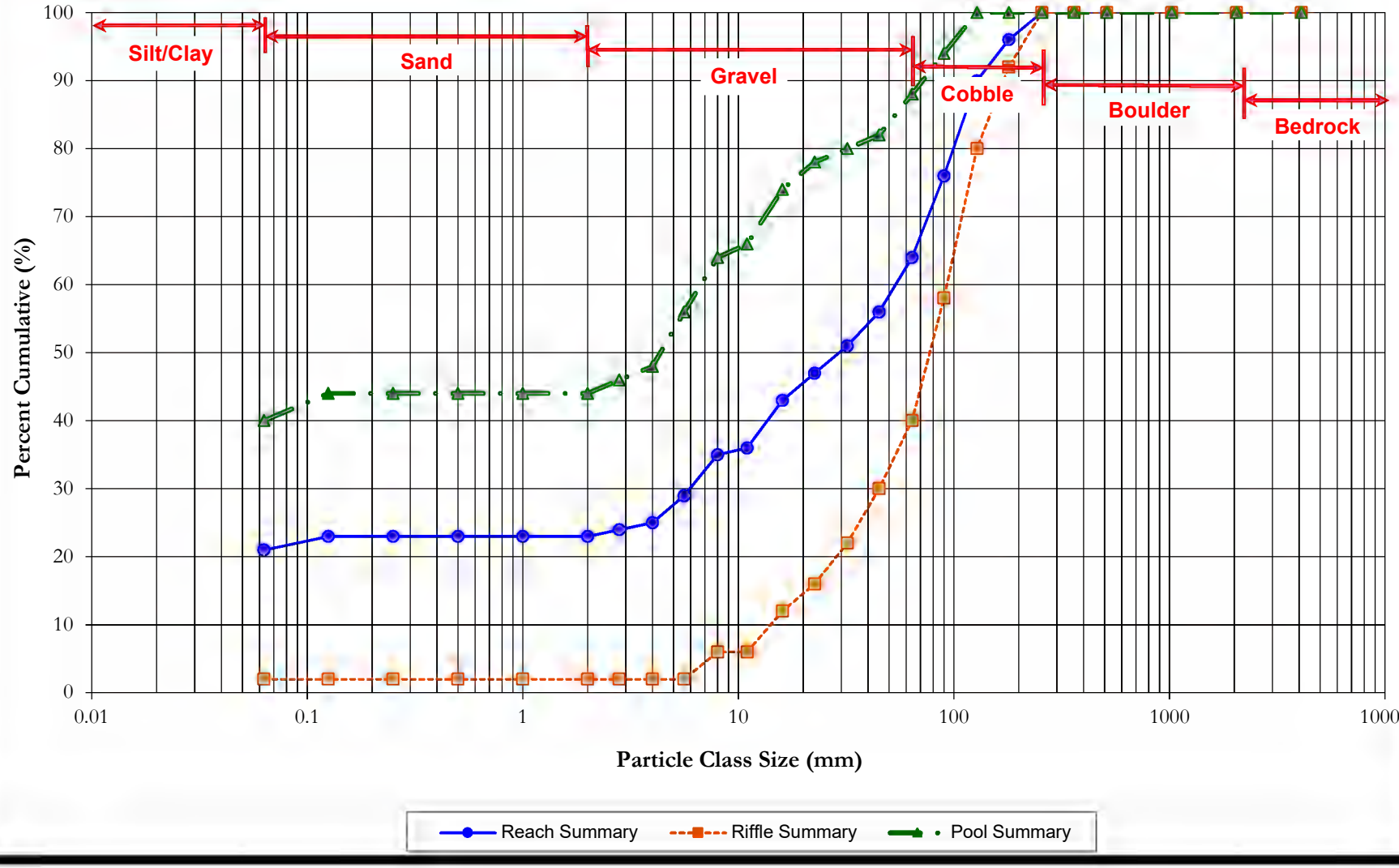
Shake Rag Branch - UT2 (Reach 2)
Reachwide Pebble Count Particle Distribution



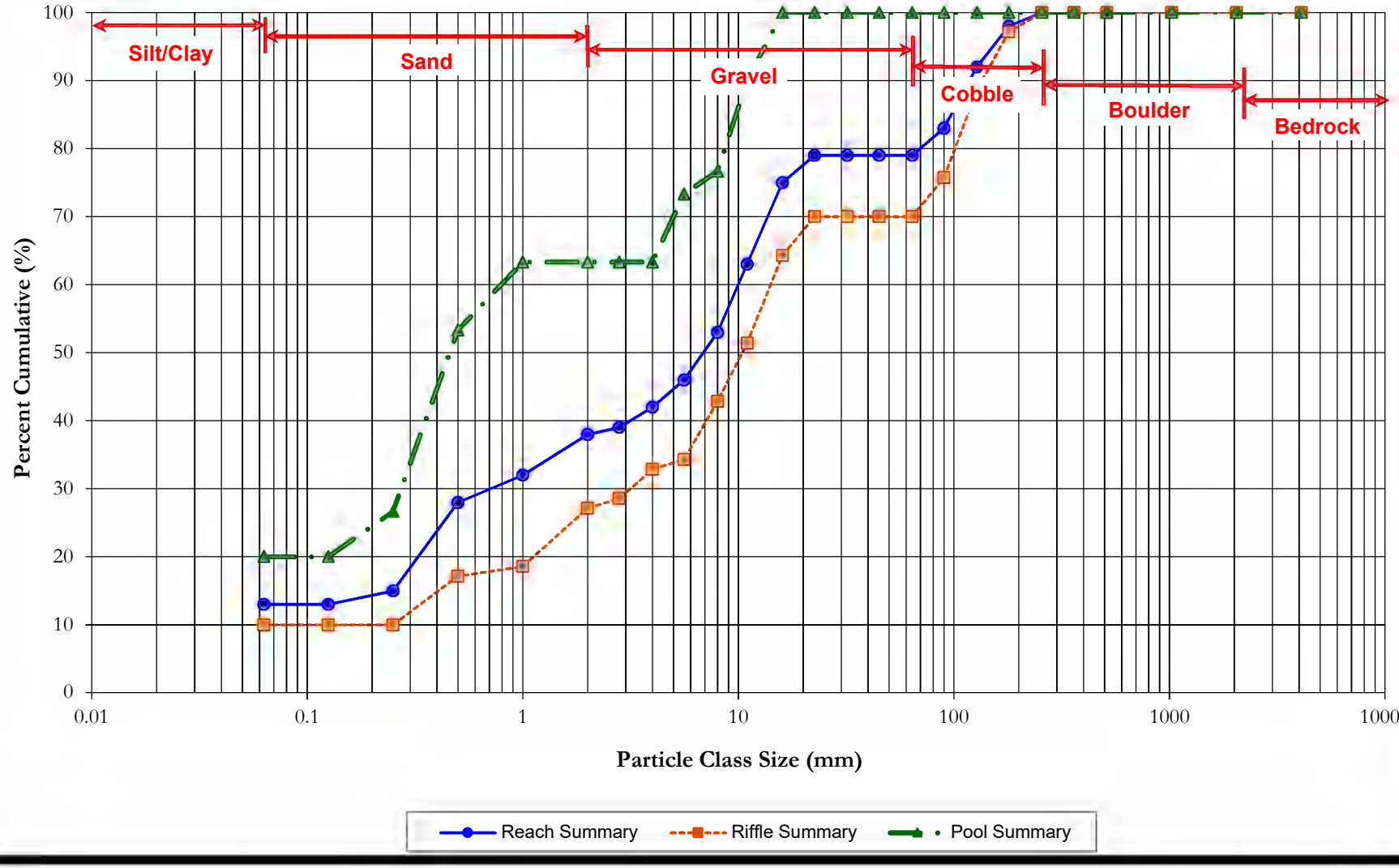
Shake Rag Branch - UT2 Reach 2 (XS5 Riffle)
Pavement-Subpavement Particle Distribution



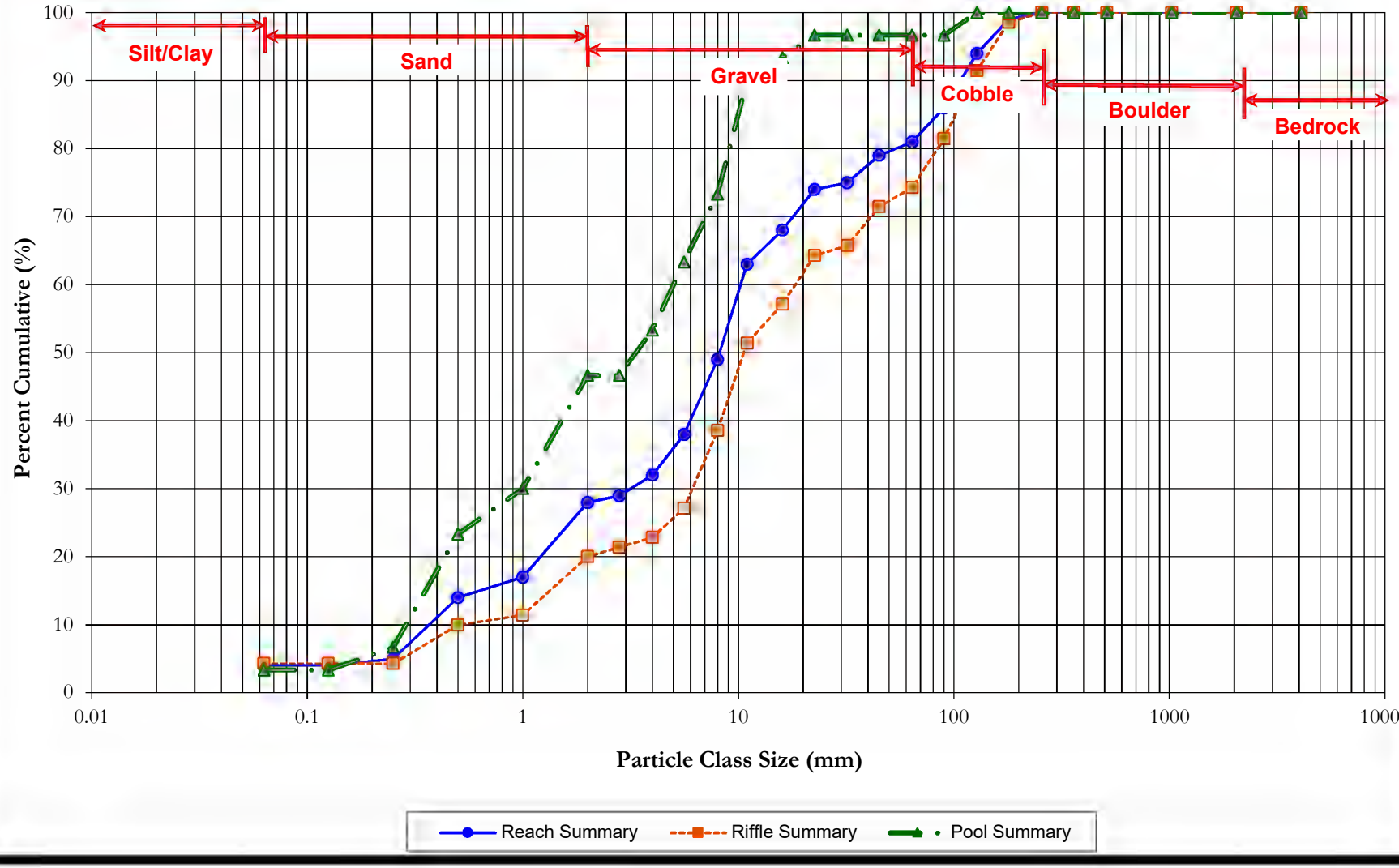
Shake Rag Branch - UT3 Reach 2
Reachwide Pebble Count Particle Distribution



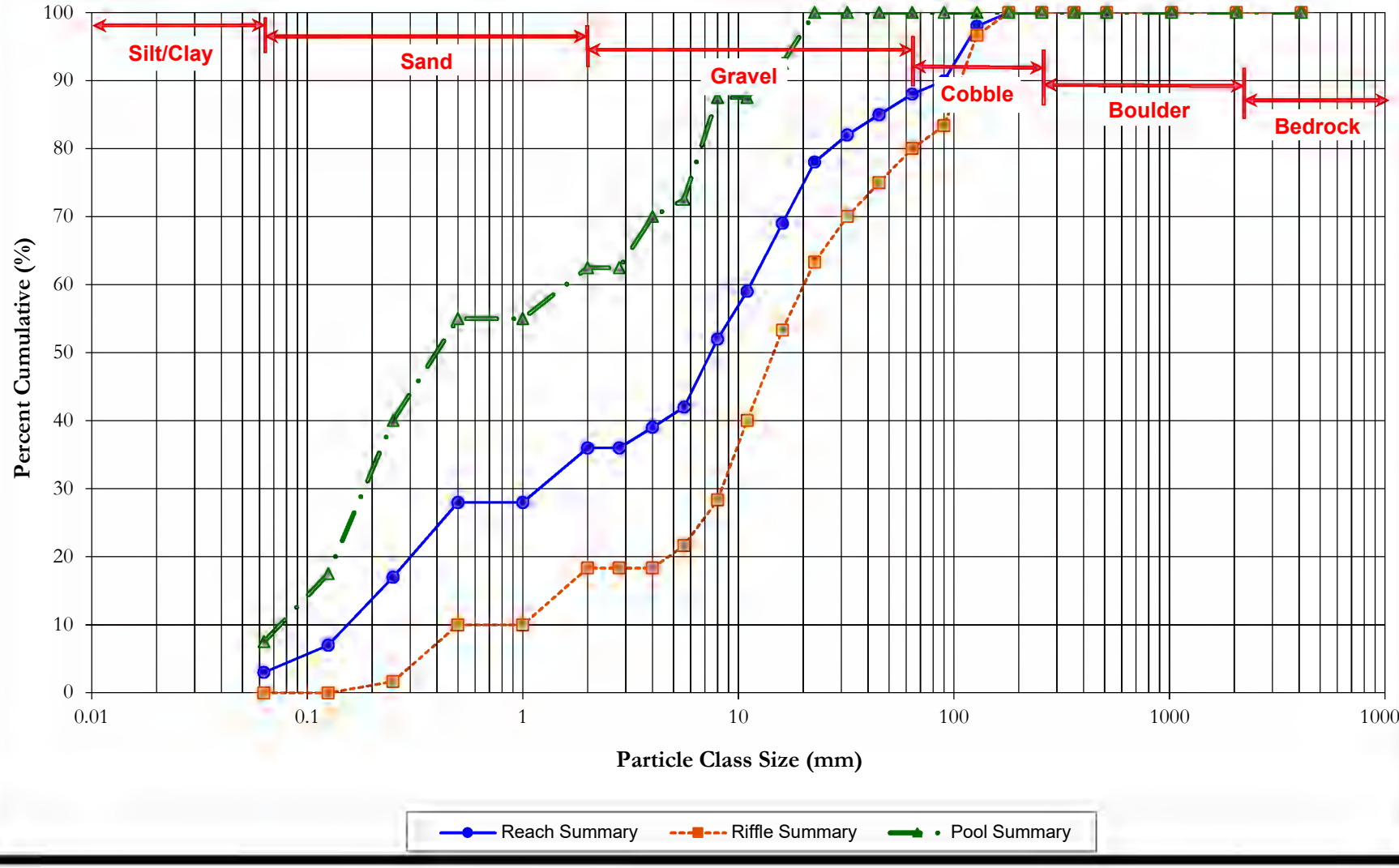
Shake Rag Branch - UT5
Reachwide Pebble Count Particle Distribution



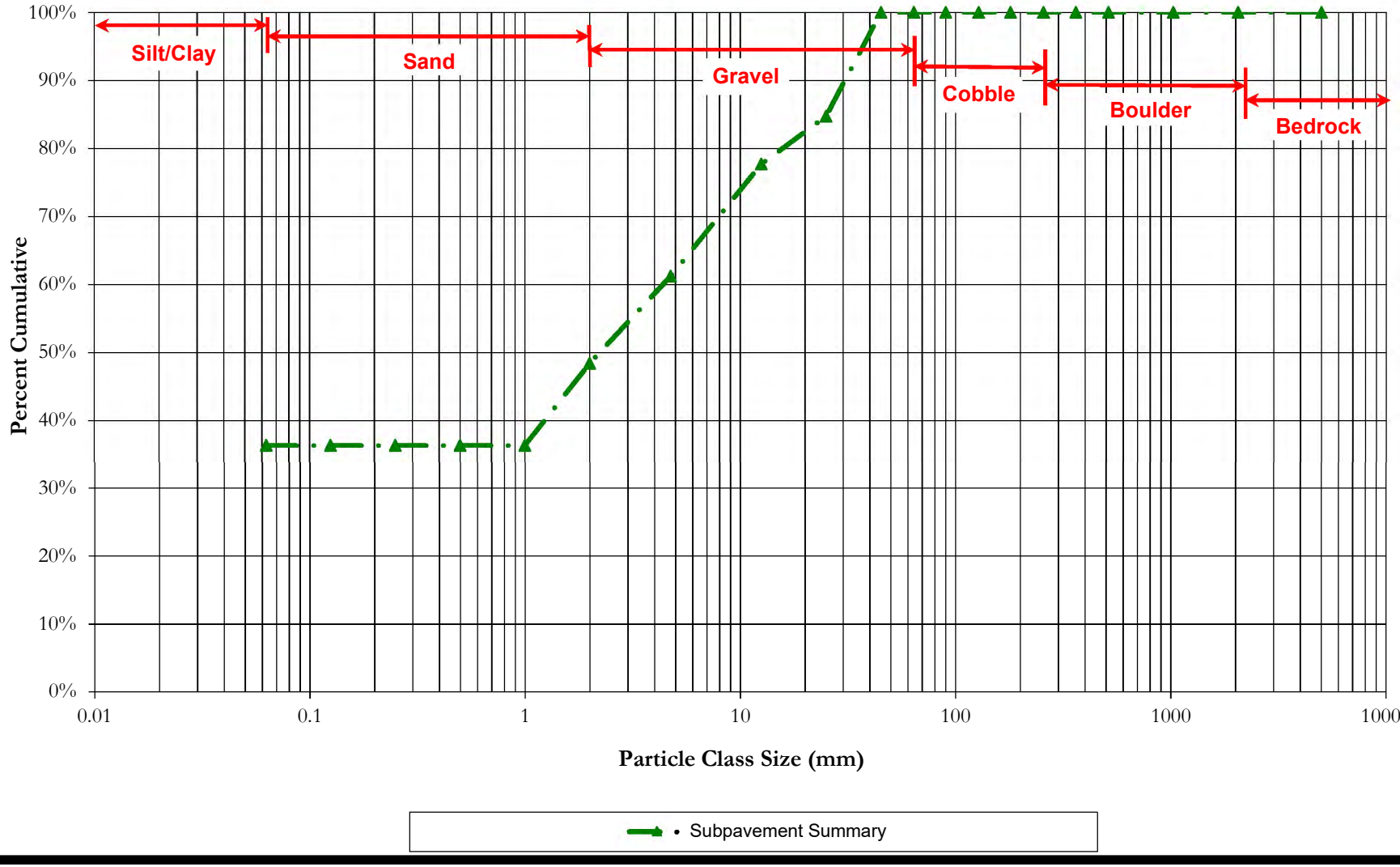
Shake Rag Branch - UT6
Reachwide Pebble Count Particle Distribution



Shake Rag Branch - Shake Rag Branch (Reach 5)
Reachwide Pebble Count Particle Distribution



Shake Rag Branch - Shake Rag Branch (Reach 5)
Subpavement Particle Distribution

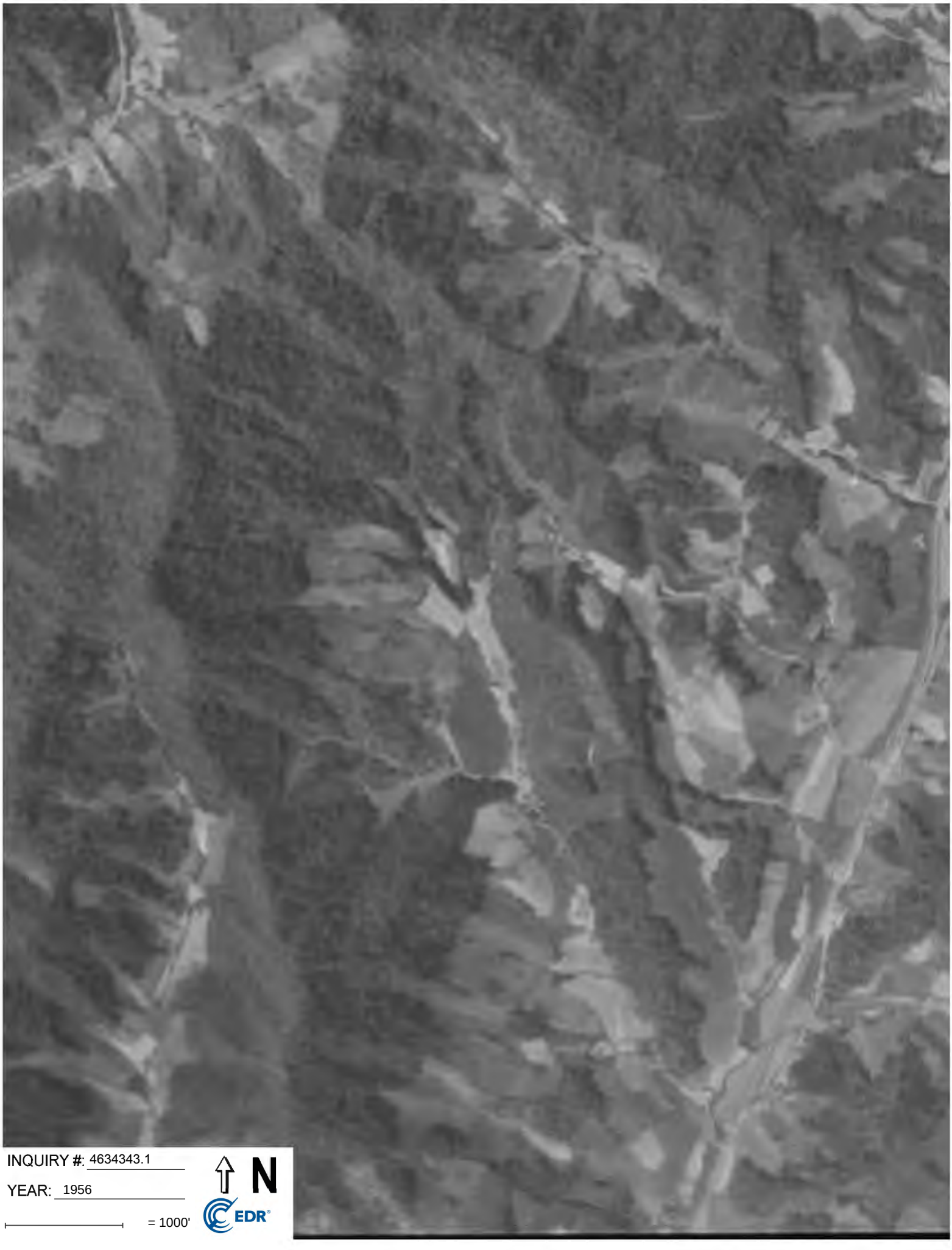


REFERENCE REACHES																
			Ironwood Tributary		UT to South Fork Fishing Creek		UT to Austin Branch (upstream)		UT to Austin Branch (downstream)		UT to Gap Branch		UT to Hampton Creek	
Description	Notation	Units	min	max	min	max	min	max	min	max	min	max	min	max
stream type			A5a+		B5a		A4/B4a		A4/B4a		A4/B4a		A4/B4a	
drainage area	DA	sq mi	0.03		0.02		0.12		0.12		0.04		0.25	
bankfull discharge	Q_{bkf}	cfs	13		8		26		27		19		31	
bankfull cross-sectional area	A_{bkf}	SF	2.7		1.8		3.6		4.4		3.8		4.6	
average bankfull velocity	v_{bkf}	fps	4.9		4.1		7.3		6.2		5.0		6.6	
width at bankfull	w_{bkf}	feet	5.0		4.1		6.7		6.2		6.2		6.8	
maximum depth at bankfull	d_{max}	feet	0.8		0.7		0.8		1.2		1.0		1.0	
mean depth at bankfull	d_{bkf}	feet	0.6		0.4		0.5		0.7		0.6		0.7	
bankfull width to depth ratio	w_{bkf}/d_{bkf}		9.1		9.3		12.8		8.8		10.1		10.0	
depth ratio	d_{max}/d_{bkf}		1.3		1.8		1.6		1.7		1.7		1.4	
low bank height			1.0		0.7		0.8		1.2		1.0		1.0	
bank height ratio	BHR		1.3		1.0		1.0		1.0		1.0		1.0	
floodprone area width	w_{fpa}	feet	10.3		7.0		18		27		21		12	
entrenchment ratio	ER		2.1		1.7		2.6		4.3		3.4		1.7	
sinuosity	K		1.2		1.25		1		1.2		NA		1.1	1.2
belt width	w_{blt}	feet	NA		NA		NA		NA		NA		NA	
meander width ratio	w_{blt}/w_{bkf}		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
meander length	L_m	feet	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
meander length ratio	L_m/w_{bkf}		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
radius of curvature	R_c	feet	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
radius of curvature ratio	R_c/w_{bkf}		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
valley slope	S_{valley}	feet/ foot	0.1418		0.1025		0.1000		0.0480		NA		0.0840	
channel slope	$S_{channel}$	feet/ foot	0.1139		0.0815		0.0986		0.0400		0.0680		0.0650	
riffle slope	S_{riffle}	feet/ foot	NA		0.0240	0.2000	0.0810	0.2900	0.0250	0.0730	0.0110	0.1400	0.0500	0.1000
riffle slope ratio	$S_{riffle}/S_{channel}$		NA		0.3	2.5	0.8	2.9	0.6	1.8	0.2	2.1	0.7	1.5
pool slope	S_{pool}	feet/ foot	NA		0.000	0.170	0.000	0.170	0.000	0.015	0.004	0.061	0.010	0.030
pool slope ratio	$S_{pool}/S_{channel}$		NA		0.00	2.09	0.00	1.70	0.00	0.40	0.06	0.90	0.20	0.40
pool-to-pool spacing	L_{p-p}	feet	NA		6	32	10	17	14	31	18	27	11	19
pool spacing ratio	L_{p-p}/w_{bkf}		NA		1.5	7.8	1.5	2.5	2.2	4.9	3.0	4.4	1.1	1.9
maximum pool depth at bankfull	d_{pool}	feet	NA		NA		1.7		1.7		1.6		1.3	
pool depth ratio	d_{pool}/d_{bkf}		NA		NA		3.2		2.4		2.5		1.9	
pool width at bankfull	w_{pool}	feet	NA		NA		8.8		8.8		6.1		7.0	
pool width ratio	w_{pool}/w_{bkf}		NA		NA		1.3		1.4		1.0		1.0	
pool bankfull cross-sectional area	A_{pool}	SF	NA		NA		9.4		9.4		7.1		5.9	
pool area ratio	A_{pool}/A_{bkf}		NA		NA		2.6		2.1		1.9		1.3	
Particle Size Distribution from			Reachwide Count		Reachwide Count		Riffle Count		Riffle Count		Reachwide Count		Reachwide Count	
		d_{50}	Coarse Sand		Very Coarse Sand		Very Coarse Gravel		Very Coarse Gravel		Coarse Gravel		Coarse Gravel	
	d_{16}	mm	0.26		0.1		11.0		11.0		0.4		NA	
	d_{35}	mm	0.5		0.3		42.0		42.0		8.0		NA	
	d_{50}	mm	0.91		1.2		59.0		59.0		19.0		NA	
	d_{84}	mm	19		11.0		130.0		130.0		102.3		NA	
	d_{95}	mm	97		24.0		170.0		170.0		257.0		NA	
	d_{99}	mm	128		64.0		256.0		256.0		>2048		NA	

Design Morphologic Parameters
Shake Rag Mitigation Site

	Notation	Units	Shake Rag Branch Reach 3			Shake Rag Branch Reach 4			Shake Rag Branch Reach 5			UT1 Reach 2 (Upstream of Pond)			UT1 Reach 2 (Downstream of Pond)			UT2 Reach 2			UT3 Reach 2			UT4			UT8		
			Typical Section Values	Min	Max	Typical Section Values	Min	Max	Typical Section Values	Min	Max	Typical Section Values	Min	Max	Typical Section Values	Min	Max	Typical Section Values	Min	Max	Typical Section Values	Min	Max	Typical Section Values	Min	Max	Typical Section Values	Min	Max
stream type			A4a+/B4a			A4/B4a			A4/B4a			A4a+/B4a			A4a+/B4a			A4a+/B4a			A4a+/B4a			A4a+/B4a			A4/B4a		
drainage area	DA	sq mi	0.06			0.12			0.24			0.06			0.11			0.05			0.06			0.05			0.03		
design discharge	Q	cfs	17			24			34			13			28			14			19			16			10		
bankfull cross-sectional area	A_{bkf}	SF	2.4			3.6			5.1			2.0			3.5			2.0			2.3			2.4			1.9		
average velocity during bankfull event	v_{bkf}	fps	7.1			6.8			6.6			6.4			8.0			7.2			8.1			6.7			5.5		
Cross-Section																													
width at bankfull	w_{bkf}	feet	5.8			7.2			8.8			5.5			6.9			5.5			5.9			6.1			5.2		
maximum depth at bankfull	d_{max}	feet	0.60			0.70			0.80			0.50			0.80			0.50			0.60			0.60			0.50		
mean depth at bankfull	d_{bkf}	feet	0.4			0.5			0.6			0.4			0.5			0.4			0.4			0.4			0.4		
maximum depth ratio	d_{max}/d_{avg}		1.5			1.4			1.4			1.4			1.5			1.4			1.4			1.4			1.4		
bankfull width to depth ratio	w_{bkf}/d_{bkf}		14.0			15.0			15.0			15.0			14.0			15.0			15.0			15.0			15.0		
low bank height		feet	0.60			0.70			0.80			0.50			0.80			0.50			0.60			0.60			0.50		
bank height ratio	BHR		1.0			1.0			1.0			1.0			1.0			1.0			1.0			1.0			1.0		
floodprone area width	w_{fpa}	feet		8.0	13.0		10.0	16.0		12.0	19.0		8.0	12.0		8.0	15.0		8.0	12.0		8.0	13.0		9.0	13.0		7.0	11.0
entrenchment ratio	ER			1.4	2.2		1.4	2.2		1.4	22.0		1.4	2.2		1.4	2.2		1.4	2.2		1.4	2.2		1.4	2.2		1.4	2.2
Slope																													
valley slope	S_{valley}	feet/ foot		0.1523			0.0832			0.0685			0.1164			0.1164			0.1659			0.176			0.1102			0.0901		
channel slope	S_{chnl}	feet/ foot		0.136			0.077			0.066			0.113			0.113			0.155			0.165			0.108			0.085		
riffle slope	S_{riffle}	feet/ foot		0.064	0.166		0.065	0.120		0.040	0.123		0.096	0.252		0.096	0.252		0.063	0.152		0.043	0.176		0.057	0.171		0.045	0.161
riffle slope ratio	S_{riffle}/S_{chnl}			0.5	1.3		0.8	1.8		0.7	1.8		0.8	2		0.8	2.0		0.5	1		0.5	1		0.5	1.5		0.5	1.8
pool slope	S_p	feet/ foot		0.000	0.038		0.000	0.036		0.000	0.027		0.000	0.013		0.0020	0.0126		0.000	0.300		0.000	0.053		0.000	0.034		0.000	0.027
pool slope ratio	S_p/S_{chnl}			0.5	1.3		0.0	0.3		0.0	0.4		0.0	0.1		0.0	0.1		0.5	1.0		0.0	0.3		0.0	0.3		0.0	0.3
pool-to-pool spacing	L_{p-p}	feet		9	17		11	25		11	31		8	14		10	17		6	14		6	15		9	18		8	18
pool spacing ratio	L_{p-p}/w_{bkf}			1.5	3.0		1.5	3.5		1.3	3.5		1.5	2.5		1.5	2.5		1	2.5		1	2.5		1.5	3		1.5	3.5
pool cross-sectional area		SF		3.1	4.8		5.4	7.2		6.6	10.2		3.3	5.5	16.7	5.3	8.8		2.6	4.0		3.0	4.6		3.1	4.8		2.5	3.8
pool area ratio				1.3	2.0		1.5	2.0		1.3	2.0		1.5	2.5	1.9	1.5	2.5		1.3	2.0		1.3	2.0		1.3	2.0		1.3	2.0
maximum pool depth		feet		0.8	1.4		1.0	1.8		1.2	2.0		0.8	1.4	2.2	1.0	1.8		0.7	1.3		0.8	1.4		0.8	1.4		0.7	1.3
pool depth ratio				2.0	3.5		2.0	3.5		2.0	3.5		2.0	3.5	2.6	2.0	3.5		2.0	3.5		2.0	3.5		2.0	3.5		2.0	3.5
pool width at bankfull		feet		5.8	7.5		7.2	9.4		8.8	11.4		5.5	8.3	15.2	6.9	10.4		5.5	6.6		5.9	7.1		6.1	7.9		5.2	6.8
pool width ratio				1.0	1.3		1.0	1.3		1.0	1.3		1.0	1.5	1.5	1.0	1.5		1.0	1.2		1.0	1.2		1.0	1.3		1.0	1.3
Pattern																													
sinuosity	K			1.03			1.08			1.01			1.03			1.03			1.07			1.05			1.02			1.06	

Note: Stream pattern parameters other than sinuosity not reported due to limited channel pattern inherent of stream types (step-pool morphology) located within steep valleys.



INQUIRY #: 4634343.1

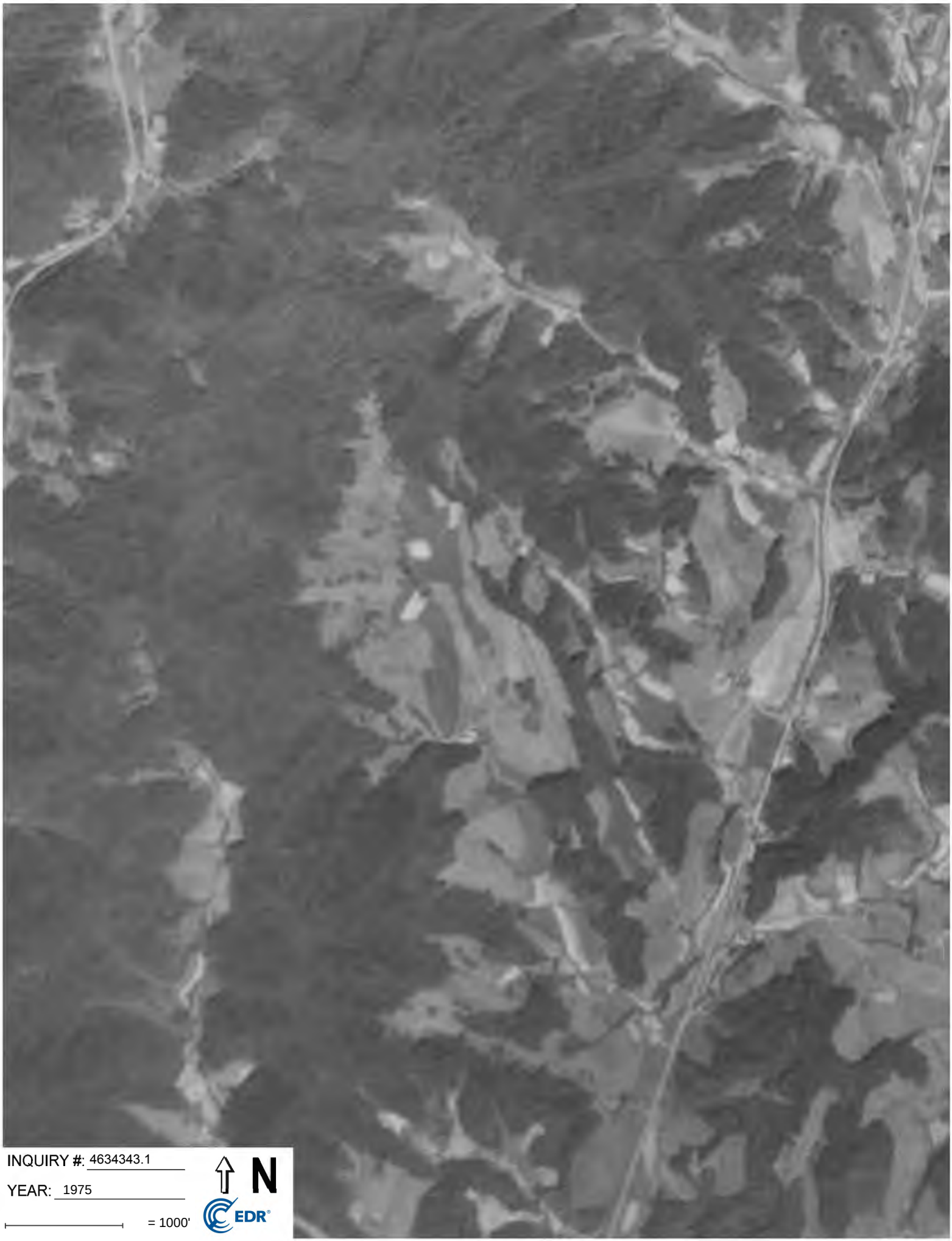
YEAR: 1956

= 1000'

N

EDR

1965 aerial image from USGS Earth Explorer



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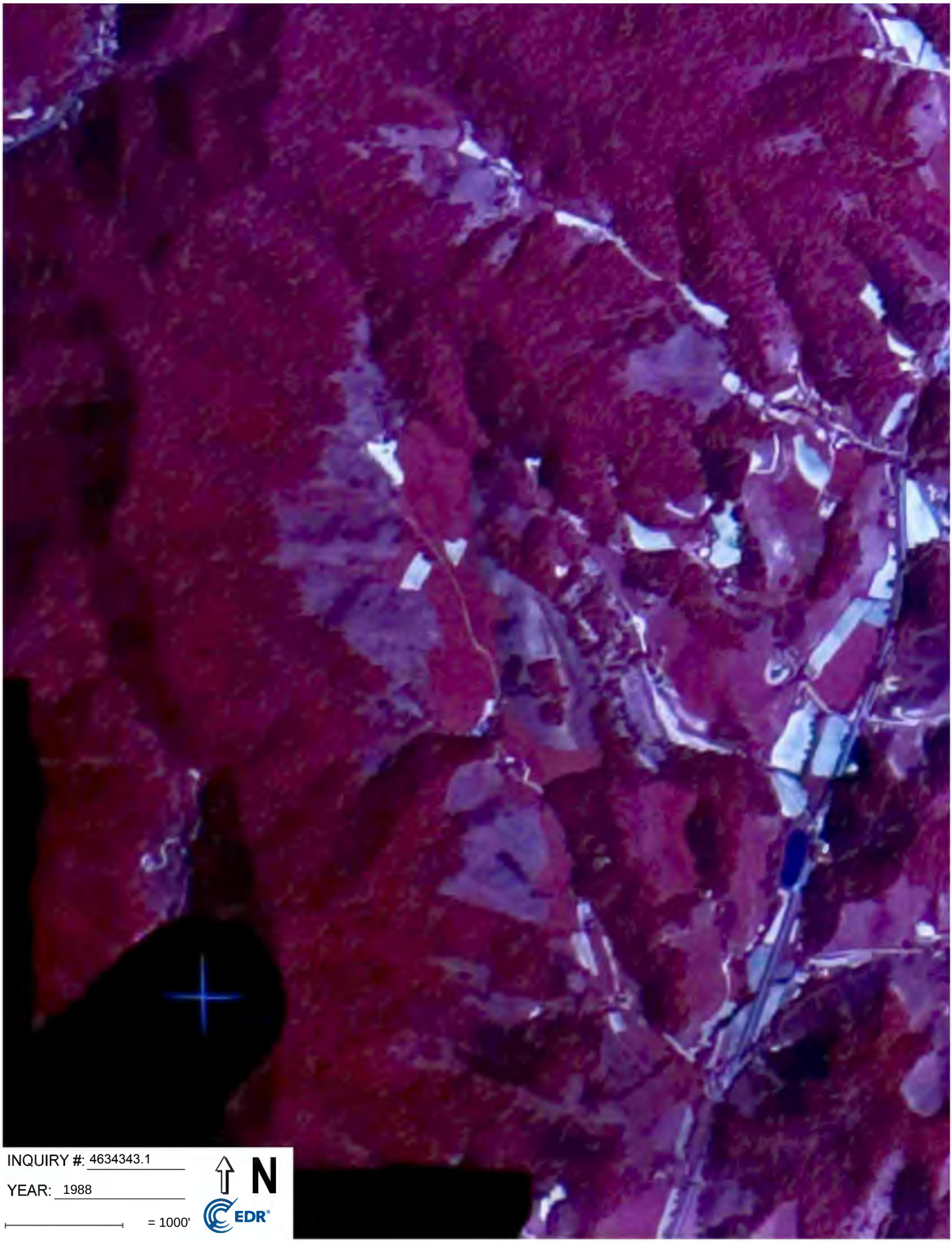
1976 aerial image from NCDOT Division of Highways Photogrammetry Unit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YEAR: 1988
= 1000'
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1989 aerial image from NCDOT Division of Highways Photogrammetry Unit

INQUIRY #: 4634343.1

YEAR: 1993

= 500'

N

EDR

INQUIRY #: 4634343.1

YEAR: 2005

= 500'

N

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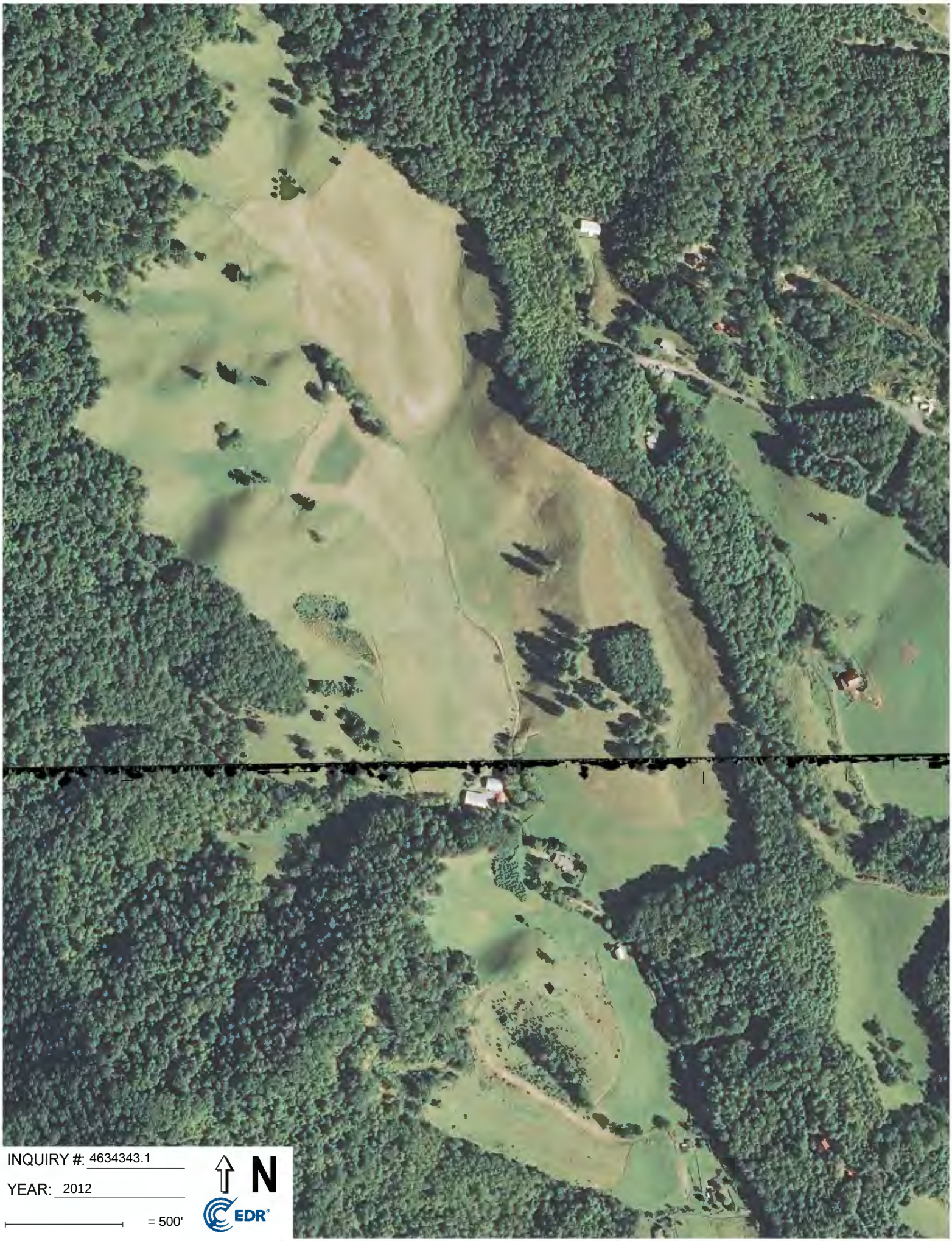
INQUIRY #: 4634343.1
YEAR: 2012
= 500'
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WILDLANDS
ENGINEERING

MEETING NOTES

MEETING:	Post-Contract IRT Site Walk **SHAKE RAG Mitigation Site** French Broad 06010105; Madison County, NC DEQ Contract No. 7190 DMS Project No. 100018 Wildlands Project No. 005-02164
DATE:	*On-site Meeting*: Tuesday, August 29, 2017 *Final Meeting Notes Distributed*: Monday, September 11, 2017
LOCATION:	Shake Rag Rd Burnsville, NC

Attendees

Todd Tugwell, USACE	Marella Buncick, USFWS	Matthew Reid, DMS
Steve Kichefski, USACE	Mac Haupt, DWR	Shawn Wilkerson, Wildlands
Kimberly Browning, USACE	Zan Price, DWR	Jake McLean, Wildlands
Andrea Leslie, NCWRC	Paul Wiesner, DMS	

Materials

- Wildlands Engineering Technical Proposal dated 2/15/2017 in response to DMS RFP 16-006991

Meeting Notes

The meeting began at 9 am and concluded around noon. Maps and a brief overview of the project were presented by Wildlands at the parking area adjacent to the barn. From there, the group proceeded to walk the site, in the order presented below following the general discussion topics.

General

- Due to the small drainage areas of the project streams, it was noted by IRT members that demonstration of flow would be a critical component of success criteria during monitoring. Flow gaging

- It was discussed that approximately 50-60 years ago, the father of the current owners buried several of the project streams using rock lined underground channels. Wildlands pointed out that this method of stream burial is present on UT4, UT3, and Shake Rag Branch starting just below and extending above UT3.
- Project stream preservation, enhancement or restoration will be taken up to, or as close as to practicable, to the stream's jurisdictional point. In some cases, preservation, enhancement or restoration will break off before this point at some other reasonable stopping point (e.g. road crossing) or where road encroachment doesn't allow for mitigation.

- A question of how/if fescue would be treated was asked. Shawn responded that Wildlands' current best practice is to treat fescue in place and not remove due to the loss of topsoil and ground cover. There was no objection to this approach.
- The jurisdictional determination can be sent to Steve Kichefski (USACE) for approval.

Shake Rag Branch (Lower, below UT8)

- Wildlands noted that there is a utility pole to be relocated near bottom of branch and that the road will also be relocated, as necessary, outside of the proposed easement.
- Wildlands indicated that the branch will be relocated slightly away from the gravel road.
- Wildlands noted that the weather has been dry and that the timing of this late summer visit means that both flow and bank erosion is more difficult to view, given the lack of rain and also the heavy vegetation at this time of year. Wildlands pointed out that incision and historic manipulation was evident.

UT4

- Participants observed flow from man-made rock lined conduit (method used to bury several of on-site streams) which Wildlands indicated was unearthed by the landowner at the bottom of UT4 where it confluences with Shake Rag. Several other small sinkholes were observed along the fall line of the valley where the stream was buried. At the fence line (the upstream limits of restoration), a second small hole had been excavated to show the presence of flow and continued presence of the man-made rock conduit continuing upgradient. Flow was present.
- It was discussed, that where possible and applicable, previously diverted ephemeral and intermittent drainage pathways should be reconnected to the project streams in a fashion as close to original as possible. An ephemeral drainage is ditched along the hillslope south of UT4 and should be reconnected into the project if possible.

Shake Rag Branch (Upper, above UT8)

- Immediately above UT8, the branch is located against the hillslope. The IRT commented that if restoration was only going to relocate the channel but not involve other significant work, that the present channel was fairly stable and enhancement (leaving the channel in place) may be preferable. Wildlands was proposing to continue restoration along Shake Rag through this segment, since the predominant (upstream and downstream) approach is restoration. (See similar approach taken with Enhancement II approach proposed for UT2 pond and culvert removal). Wildlands indicated that they will reconsider the proposed design approach (restoration) in favor of Enhancement for this portion of the channel which would involve planting and fencing cattle out for the full easement width. If full restoration is proposed for this reach, it will be clearly justified in the mitigation plan.
- Wildlands indicated that the upper portion of the Shake Rag restoration reach has been piped underground using man-made rock lined conduit as with other reaches.

UT3

- UT3 was walked to the top of the enhancement reach. There was discussion that the enhancement II reach could be extended upstream to encompass additional intermittent and perennial footage and this will be explored.
- The group observed that UT3 has been ditched across the valley near the start of the restoration reach. Wildlands indicated that restoration of UT3 will start at the beginning of the diversion and that the preferred approach is to return UT3 to its natural topographic valley.

UT7 & Preservation Reach of Shake Rag Branch

- The group accessed a farm road from UT3, which lead around and above UT7 and passed by the start of the Shake Rag Preservation reach. Wildlands indicated that Shake Rag Preservation will begin below the farm road. • Steve Kichefski (USACE) identified that the I-P break should be located roughly 40-50' upstream of road

  crossing on Shake Rag. Starting the project below the road was agreed upon as suitable – the following bullets were part of that discussion.
- There was some concern about the long-term stability of road at Shake Rag crossing. The road as evidence of prior overtopping. Wildlands agreed to evaluate what could be done to armor the road knowing that future overtopping events are likely, and in the interest of preventing failure at the top of this reach. Wildlands pointed out that large boulders are present on the lower portion of the downstream embankment.
- Concern about logging of the parcel was brought up in the context of preservation activities. The credit ratio of preservation was discussed, given that buffers on preservation are the minimum allowed. Wildlands explained that preservation reach buffers are what landowner was willing to grant, and that they are being proposed at the lowest ratio (10:1) for preservation. There was consensus by the group that preservation will be helpful in protecting and buffering the project, that forestry was not an immediate concern and that preservation should be kept as proposed.

UT8

- Wildlands indicated that UT8, similar to other streams, has been buried and will be unearthed within the easement area as part of the project.

UT1, 1A, and 2

- It was explained that UT2 was starting down lower below the intermittent-perennial break because of the need to keep the existing farm road on the left floodplain, which would have impinged on the required buffer and the fact that in prior discussions there was double about whether cattle would access the stream due to steep topography adjacent to UT2.
- Wildlands indicated that the existing culvert on UT2 and pond on UT1 will be removed. Wildlands explained that in the proposal, Enhancement II credit was requested in an attempt to lump areas by their predominant approach.
- A side conservation about the treatment of the upper portion of UT1 resulted in the suggestion that Wildlands break out UT1 into separate reaches, as necessary, to explain and present the uplift presented between existing and proposed conditions (incorporating such conditions as cattle access, planting and road treatment, etc.). This suggestion will be used when preparing the mitigation approach and used to guide justification in the mitigation plan.
- Shawn indicated to the IRT that, in our agreement with the landowner, there is the requirement that a segment of fence be added to connect the downstream terminus of the UT1 easement (right floodplain side) with an existing fence. This is shown on the attached map.

UT5 and 6

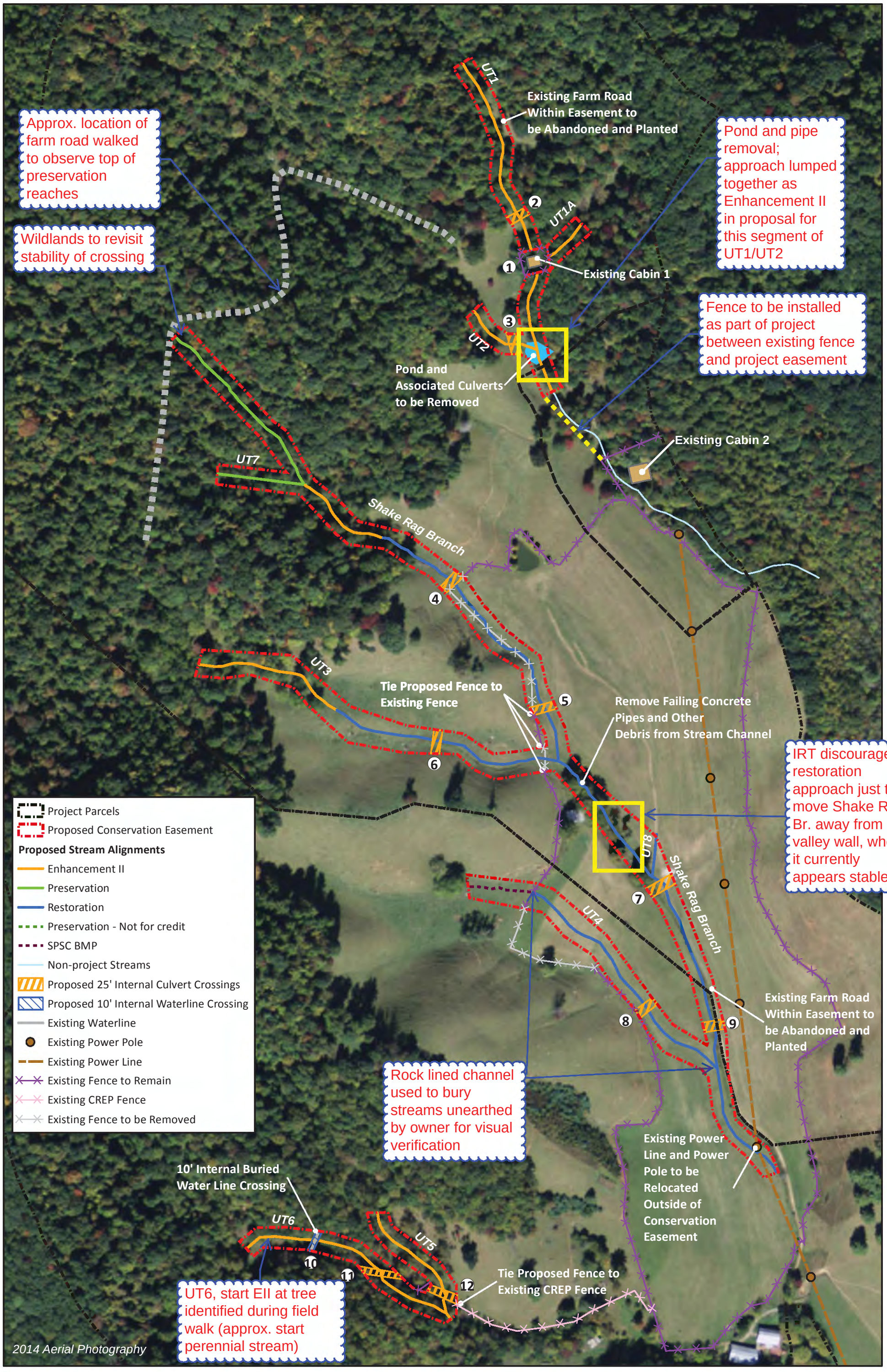
- IRT members observed that this portion of the project ends at an existing reach which is fenced and under agreement for maintenance as part of the CREP program.
- It was agreed that the beginning of UT6 (EII) would be moved downstream for crediting purposes because a portion of the top of UT6 is what the Corps considers a problem area (it would likely be a jurisdictional wetland instead of stream). The start of the stream enhancement was agreed to be set at

a distinct damaged tree on the left bank immediately adjacent to the stream (also adjacent to the 2nd rock pile from the top). This approximate location is identified on the attached map.

- The IRT questioned whether the internal crossings could be reoriented at all. Wildlands agreed to review options to improve the configuration in order to identify the most efficient configuration that can still meet the landowner's requirements.

All Attendees listed have been copied by email. These meeting minutes were prepared by Jake McLean and reviewed by Shawn Wilkerson on September 8, 2017, and represent the authors' interpretation of events. Please report and discrepancies or corrections within 5 business days of receipt of these minutes.

Concept Map with 8/29/17 IRT Fieldwalk Notes



WILDLANDS ENGINEERING

0 300 Feet

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Figure 6 Concept Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC

APPENDIX 5
APPROVED FHWA CATEGORICAL EXLUSION FORM

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

Note: Only Appendix A should to be submitted (along with any supporting documentation) as the environmental document.

Part 1: General Project Information	
Project Name:	Shake Rag Branch Mitigation Site
County Name:	Madison County
EEP Number:	100018
Project Sponsor:	Wildlands Engineering, Inc
Project Contact Name:	Andrea S. Eckardt
Project Contact Address:	1430 South Mint Street, Suite 104, Charlotte, NC 28203
Project Contact E-mail:	aeckardt@wildlandseng.com
EEP Project Manager:	Matthew Reid

Project Description

The Shake Rag Branch Mitigation Site is a stream mitigation project located approximately 19 miles north of Asheville and four miles northeast of Mars Hill in Madison County, NC. The project includes Shake Rag Branch and nine unnamed tributaries, all of which flow to Middle Fork Little Ivy Creek for a total of 9,636 linear feet of stream. Historically the site has been used for cattle and other agricultural uses. The site is currently used for hay production and for cattle pasture. The project will provide stream mitigation units to the Division of Mitigation Services in the French Broad River Basin (06010105).

For Official Use Only

Reviewed By:

12/4/2017
Date

EEP Project Manager

Conditional Approved By:

Date

For Division Administrator
FHWA

☐ **Check this box if there are outstanding issues**

Final Approval By:

12-4-17
Date

For Division Administrator
FHWA

Part 2: All Projects Regulation/Question	Response
Coastal Zone Management Act (CZMA)	
1. Is the project located in a CAMA county?	☐ Yes ☑ No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?	☐ Yes ☐ No ☑ N/A
3. Has a CAMA permit been secured?	☐ Yes ☐ No ☑ N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?	☐ Yes ☐ No ☑ N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?	☐ Yes ☑ No ☐ N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☑ No ☐ N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☐ No ☑ N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?	☐ Yes ☐ No ☑ N/A
6. Is there an approved hazardous mitigation plan?	☐ Yes ☐ No ☑ N/A
National Historic Preservation Act (Section 106)	
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?	☐ Yes ☑ No
2. Does the project affect such properties and does the SHPO/THPO concur?	☐ Yes ☐ No ☑ N/A
3. If the effects are adverse, have they been resolved?	☐ Yes ☐ No ☑ N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Does the project require the acquisition of real estate?	☑ Yes ☐ No ☐ N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	☐ Yes ☑ No ☐ N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	☑ Yes ☐ No ☐ N/A

Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☑ Yes ☐ No
2. Is the site of religious importance to American Indians?	☐ Yes ☑ No ☐ N/A
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	☐ Yes ☐ No ☑ N/A
4. Have the effects of the project on this site been considered?	☐ Yes ☐ No ☑ N/A
Antiquities Act (AA)	
1. Is the project located on Federal lands?	☐ Yes ☑ No
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Archaeological Resources Protection Act (ARPA)	
1. Is the project located on federal or Indian lands (reservation)?	☐ Yes ☑ No
2. Will there be a loss or destruction of archaeological resources?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	☑ Yes ☐ No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	☑ Yes ☐ No ☐ N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	☐ Yes ☑ No ☐ N/A
4. Is the project "likely to adversely affect" the species and/or "likely to adversely modify" Designated Critical Habitat?	☐ Yes ☐ No ☑ N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	☐ Yes ☐ No ☑ N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	☐ Yes ☐ No ☑ N/A

Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	☐ Yes ☑ No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	☐ Yes ☐ No ☑ N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	☐ Yes ☐ No ☑ N/A
Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	☑ Yes ☐ No
2. Has NRCS determined that the project contains prime, unique, statewide or locally important farmland?	☑ Yes ☐ No ☐ N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	☑ Yes ☐ No ☐ N/A
Fish and Wildlife Coordination Act (FWCA)	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	☑ Yes ☐ No
2. Have the USFWS and the NCWRC been consulted?	☑ Yes ☐ No ☐ N/A
Land and Water Conservation Fund Act (Section 6(f))	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	☐ Yes ☑ No
2. Has the NPS approved of the conversion?	☐ Yes ☐ No ☑ N/A
Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)	
1. Is the project located in an estuarine system?	☐ Yes ☑ No
2. Is suitable habitat present for EFH-protected species?	☐ Yes ☐ No ☑ N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	☐ Yes ☐ No ☑ N/A
4. Will the project adversely affect EFH?	☐ Yes ☐ No ☑ N/A
5. Has consultation with NOAA-Fisheries occurred?	☐ Yes ☐ No ☑ N/A
Migratory Bird Treaty Act (MBTA)	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	☐ Yes ☑ No
2. Have the USFWS recommendations been incorporated?	☐ Yes ☐ No ☑ N/A
Wilderness Act	
1. Is the project in a Wilderness area?	☐ Yes ☑ No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	☐ Yes ☐ No ☑ N/A

Shake Rag Branch Mitigation Site
Categorical Exclusion

SUMMARY

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides a Federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and Shake Rag Branch Mitigation Site is a full-delivery project; an EDR Radius Map Report with Geocheck was ordered for the site through Environmental Data Resources, Inc on May 25, 2017. Neither the target property nor the adjacent properties were listed in any of the Federal, State, or Tribal environmental databases searched by the EDR. The assessment revealed no evidence of any "recognized environmental conditions" in connection with the target property. The Executive Summary of the EDR report is included in the Appendix. The full report is available if needed.

National Historic Preservation Act (Section 106)

The National Historic Preservation Act declares a national policy of historic preservation to protect, rehabilitate, restore, and reuse districts, sites, buildings, structures, and objects significant in American architecture, history, archaeology, and culture, and Section 106 mandates that federal agencies take into account the effect of an undertaking on a property that is included in, or is eligible for inclusion in, the National Register of Historic Places.

Wildlands Engineering, Inc. (Wildlands) requested review and comment from the State Historic Preservation Office (SHPO) with respect to any archeological and architectural resources related to the Shake Rag Mitigation Site on October 3, 2017. SHPO responded on October 17, 2017 and stated they were aware of "no historic resources which would be affected by the project" and would have no further comment. All correspondence related to Section 106 is included in the Appendix.

American Indian Religious Freedom Act (AIRFA)

The American Indian Religious Freedom Act provides for the protection and preservation of places of religious importance to American Indians, Eskimos, and Native Hawaiians.

Wildlands requested review and comment from the Eastern Band of Cherokee Indians Tribal Historic Preservation Office (THPO) with respect to any archeological or religious resources related to the Shake Rag Mitigation Site on October 3, 2017. At this time there has been no response from the THPO. All correspondence related to AIRFA is included in the Appendix.

Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)

These acts, collectively known as the Uniform Act, provide for uniform and equitable treatment of persons displaced from their homes, businesses, non-profit associations, or farms by federal and federally-assisted programs, and establish uniform and equitable land acquisition policies.

Shake Rag Branch Mitigation Site is a full-delivery project that includes land acquisition. Notification of the fair market value of the project property and the lack of condemnation authority by Wildlands was included in the signed Option Agreements for the project properties. A copy of the relevant section of the Option Agreements is included in the Appendix.

Endangered Species Act (ESA)

Section 7 of the ESA requires federal agencies, in consultation with and with the assistance of the Secretary of the Interior or of Commerce, as appropriate, to ensure that actions they authorize, fund or carry out are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat for these species.

The Madison County listed endangered species includes the gray bat (*Myotis grisescens*) and the Northern long-eared bat (NLEB) (*Myotis septentrionalis*). The USFWS does not currently list any Critical Habitat Designations for the Federally-listed species within Madison County nor are there any known occurrences of the NLEB documented within the County (https://www.fws.gov/asheville/htmls/project_review/NLEB_in_WNC.html). The project site is over six miles from the nearest known 12-digit Hydrologic Unit Code with known hibernaculum and/or maternity sites for the NLEB.

Pedestrian surveys conducted on May 31 and June 1, 2016, indicated that the Site provides suitable habitat for the NLEB, but not the gray bat. No individual species were identified on the site. Therefore, due to the lack of species or suitable habitat present for the gray bat, Wildlands has determined the project has "no effect" on that federally protected species. Due to the presence of suitable habitat but absence of the species on the site, Wildlands has determined that the project "may effect" the NLEB.

Wildlands requested review and comment from the United States Fish and Wildlife Service (USFWS) on October 3, 2017 in respect to the Shake Rag Branch Mitigation Site and its potential impacts on threatened or endangered species. Federal Highway Administration has submitted a completed NLEB 4(d) Rule Streamlined Consultation Form to USFWS as well. USFWS has not responded at this time. All documents submitted to the USFWS are included in the Appendix.

Farmland Protection Policy Act (FPPA)

The FPPA requires that, before taking or approving any federal action that would result in conversion of farmland, the agency must examine the effects of the action using the criteria set forth in the FPPA, and, if there are adverse effects, must consider alternatives to lessen them.

The Shake Rag Branch Mitigation Site includes the conversion of prime farmland. As such, Form AD-1006 has been completed and submitted to the Natural Resources Conservation Service (NRCS). The completed form and correspondence documenting its submittal is included in the Appendix.

Fish and Wildlife Coordination Act (FWCA)

The FWCA requires consultation with the USFWS and the appropriate state wildlife agency on projects that alter or modify a water body. Reports and recommendations prepared by these agencies document project effects on wildlife and identify measures that may be adopted to prevent loss or damage to wildlife resources.

The Shake Rag Branch Mitigation Site includes stream restoration. Wildlands requested comment on the project from both the USFWS and the North Carolina Wildlife Resources Commission (NCWRC) on October 3, 2017. NCWRC responded on October 31, 2017 and recommended riparian buffer be reestablished as wide as possible. USFWS has not responded at this time. All correspondence with the two agencies is included in the Appendix.

Migratory Bird Treaty Act (MBTA)

The MBTA makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird. The indirect killing of birds by destroying their nests and eggs is covered by the MBTA, so construction in nesting areas during nesting seasons can constitute a taking.

Wildlands requested comment on the Shake Rag Branch Stream Mitigation Site from the USFWS in regards to migratory birds on October 3, 2017. The USFWS has not responded at this time. All correspondence with USFWS is included in the Appendix.

Shake Rag Branch Mitigation Site
Categorical Exclusion

APPENDIX

Shake Rag
788 Shake Rag Road
Mars Hill, NC 28754

Inquiry Number: 4947603.2s
May 25, 2017

The EDR Radius Map™ Report with GeoCheck®

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-13) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

788 SHAKE RAG ROAD
MARS HILL, NC 28754

COORDINATES

Latitude (North):	35.8738210 - 35˚ 52' 25.75''
Longitude (West):	82.4940080 - 82˚ 29' 38.42''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	365126.4
UTM Y (Meters):	3970784.0
Elevation:	2458 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	5948464 BARNARDSVILLE, NC
Version Date:	2013
Northeast Map:	5948462 BALD CREEK, NC
Version Date:	2013
Southwest Map:	5948494 MARS HILL, NC
Version Date:	2013
Northwest Map:	5948516 SAMS GAP, NC
Version Date:	2013

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20141009
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
788 SHAKE RAG ROAD
MARS HILL, NC 28754

Click on Map ID to see full detail.

MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft. & mi.) DIRECTION

NO MAPPED SITES FOUND

EXECUTIVE SUMMARY

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL ---------- National Priority List
Proposed NPL ---------- Proposed National Priority List Sites
NPL LIENS ---------- Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ---------- National Priority List Deletions

Federal CERCLIS list

FEDERAL FACILITY ---------- Federal Facility Site Information listing
SEMS ---------- Superfund Enterprise Management System

Federal CERCLIS NFRAP site list

SEMS-ARCHIVE ---------- Superfund Enterprise Management System Archive

Federal RCRA CORRACTS facilities list

CORRACTS ---------- Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF ---------- RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG ---------- RCRA - Large Quantity Generators
RCRA-SQG ---------- RCRA - Small Quantity Generators
RCRA-CESQG ---------- RCRA - Conditionally Exempt Small Quantity Generator

Federal institutional controls / engineering controls registries

LUCIS ---------- Land Use Control Information System
US ENG CONTROLS ---------- Engineering Controls Sites List

US INST CONTROL---------- Sites with Institutional Controls

Federal ERNS list

ERNS---------- Emergency Response Notification System

State- and tribal - equivalent NPL

NC HSDS---------- Hazardous Substance Disposal Site

State- and tribal - equivalent CERCLIS

SHWS---------- Inactive Hazardous Sites Inventory

State and tribal landfill and/or solid waste disposal site lists

SWF/LF---------- List of Solid Waste Facilities
OLI---------- Old Landfill Inventory

State and tribal leaking storage tank lists

LUST---------- Regional UST Database
LAST---------- Leaking Aboveground Storage Tanks
INDIAN LUST---------- Leaking Underground Storage Tanks on Indian Land
LUST TRUST---------- State Trust Fund Database

State and tribal registered storage tank lists

FEMA UST---------- Underground Storage Tank Listing
UST---------- Petroleum Underground Storage Tank Database
AST---------- AST Database
INDIAN UST---------- Underground Storage Tanks on Indian Land

State and tribal institutional control / engineering control registries

INST CONTROL---------- No Further Action Sites With Land Use Restrictions Monitoring

State and tribal voluntary cleanup sites

INDIAN VCP---------- Voluntary Cleanup Priority Listing
VCP---------- Responsible Party Voluntary Action Sites

State and tribal Brownfields sites

BROWNFIELDS---------- Brownfields Projects Inventory

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS---------- A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

HIST LF---------- Solid Waste Facility Listing

SWRCY	Recycling Center Listing
INDIAN ODI	Report on the Status of Open Dumps on Indian Lands
DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations
ODI	Open Dump Inventory
IHS OPEN DUMPS	Open Dumps on Indian Land

Local Lists of Hazardous waste / Contaminated Sites

US HIST CDL	Delisted National Clandestine Laboratory Register
US CDL	National Clandestine Laboratory Register

Local Land Records

LIENS 2	CERCLA Lien Information

Records of Emergency Release Reports

HMIRS	Hazardous Materials Information Reporting System
SPILLS	Spills Incident Listing
IMD	Incident Management Database
SPILLS 90	SPILLS 90 data from FirstSearch
SPILLS 80	SPILLS 80 data from FirstSearch

Other Ascertainable Records

RCRA NonGen / NLR	RCRA - Non Generators / No Longer Regulated
FUDS	Formerly Used Defense Sites
DOD	Department of Defense Sites
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
US FIN ASSUR	Financial Assurance Information
EPA WATCH LIST	EPA WATCH LIST
2020 COR ACTION	2020 Corrective Action Program List
TSCA	Toxic Substances Control Act
TRIS	Toxic Chemical Release Inventory System
SSTS	Section 7 Tracking Systems
ROD	Records Of Decision
RMP	Risk Management Plans
RAATS	RCRA Administrative Action Tracking System
PRP	Potentially Responsible Parties
PADS	PCB Activity Database System
ICIS	Integrated Compliance Information System
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
MLTS	Material Licensing Tracking System
COAL ASH DOE	Steam-Electric Plant Operation Data
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER	PCB Transformer Registration Database
RADINFO	Radiation Information Database
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
DOT OPS	Incident and Accident Data
CONSENT	Superfund (CERCLA) Consent Decrees
INDIAN RESERV	Indian Reservations
FUSRAP	Formerly Utilized Sites Remedial Action Program
UMTRA	Uranium Mill Tailings Sites
LEAD SMELTERS	Lead Smelter Sites

EXECUTIVE SUMMARY

US AIRS ---------- Aerometric Information Retrieval System Facility Subsystem
US MINES ---------- Mines Master Index File
ABANDONED MINES ---------- Abandoned Mines
FINDS ---------- Facility Index System/Facility Registry System
DOCKET HWC ---------- Hazardous Waste Compliance Docket Listing
UXO ---------- Unexploded Ordnance Sites
ECHO ---------- Enforcement & Compliance History Information
FUELS PROGRAM ---------- EPA Fuels Program Registered Listing
COAL ASH ---------- Coal Ash Disposal Sites
DRYCLEANERS ---------- Drycleaning Sites
Financial Assurance ---------- Financial Assurance Information Listing
NPDES ---------- NPDES Facility Location Listing
UIC ---------- Underground Injection Wells Listing

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP ---------- EDR Proprietary Manufactured Gas Plants
EDR Hist Auto ---------- EDR Exclusive Historic Gas Stations
EDR Hist Cleaner ---------- EDR Exclusive Historic Dry Cleaners

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

RGA HWS ---------- Recovered Government Archive State Hazardous Waste Facilities List
RGA LF ---------- Recovered Government Archive Solid Waste Facilities List
RGA LUST ---------- Recovered Government Archive Leaking Underground Storage Tank

SURROUNDING SITES: SEARCH RESULTS

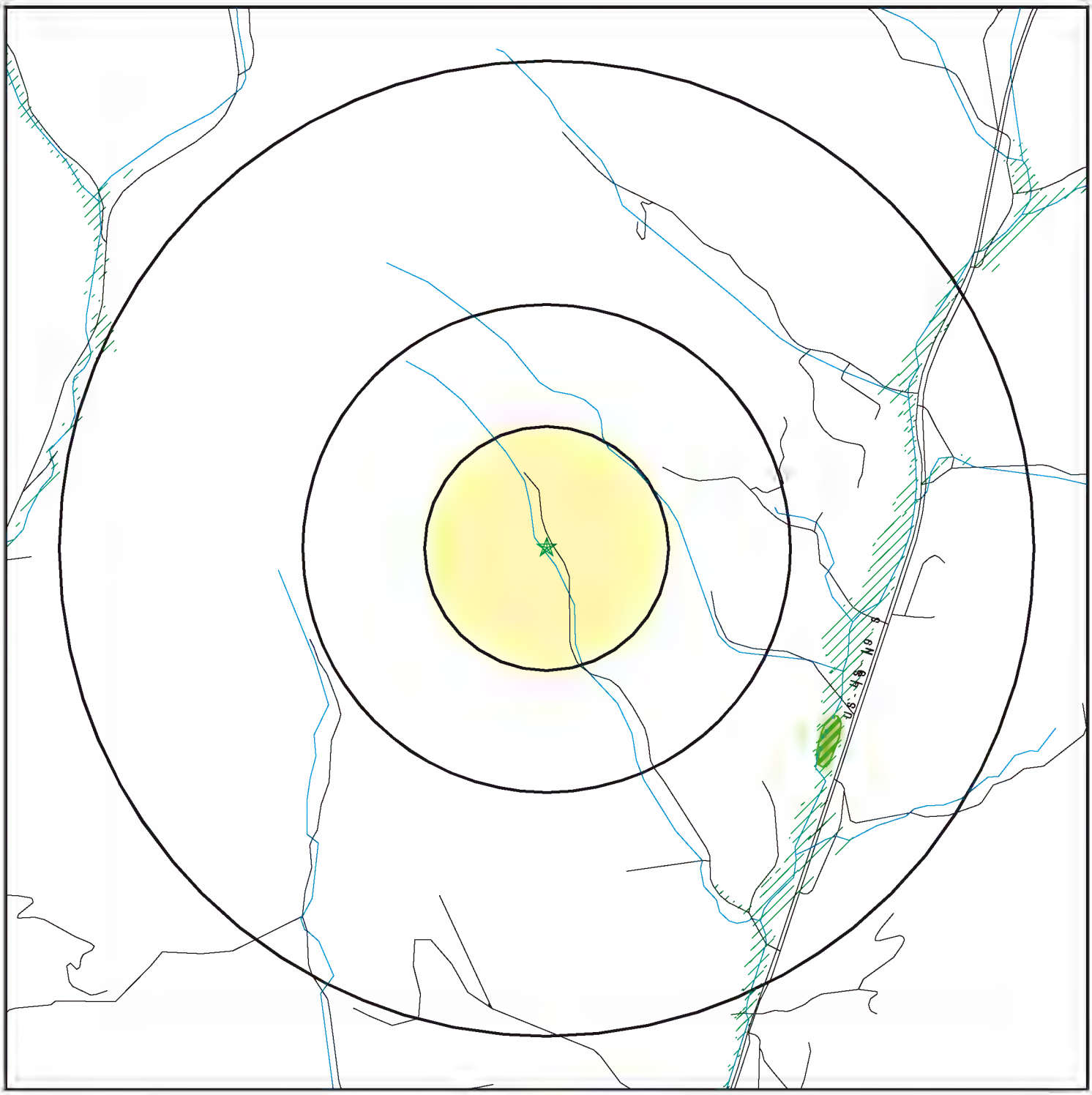
Surrounding sites were not identified.

Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

There were no unmapped sites in this report.

OVERVIEW MAP - 4947603.2S

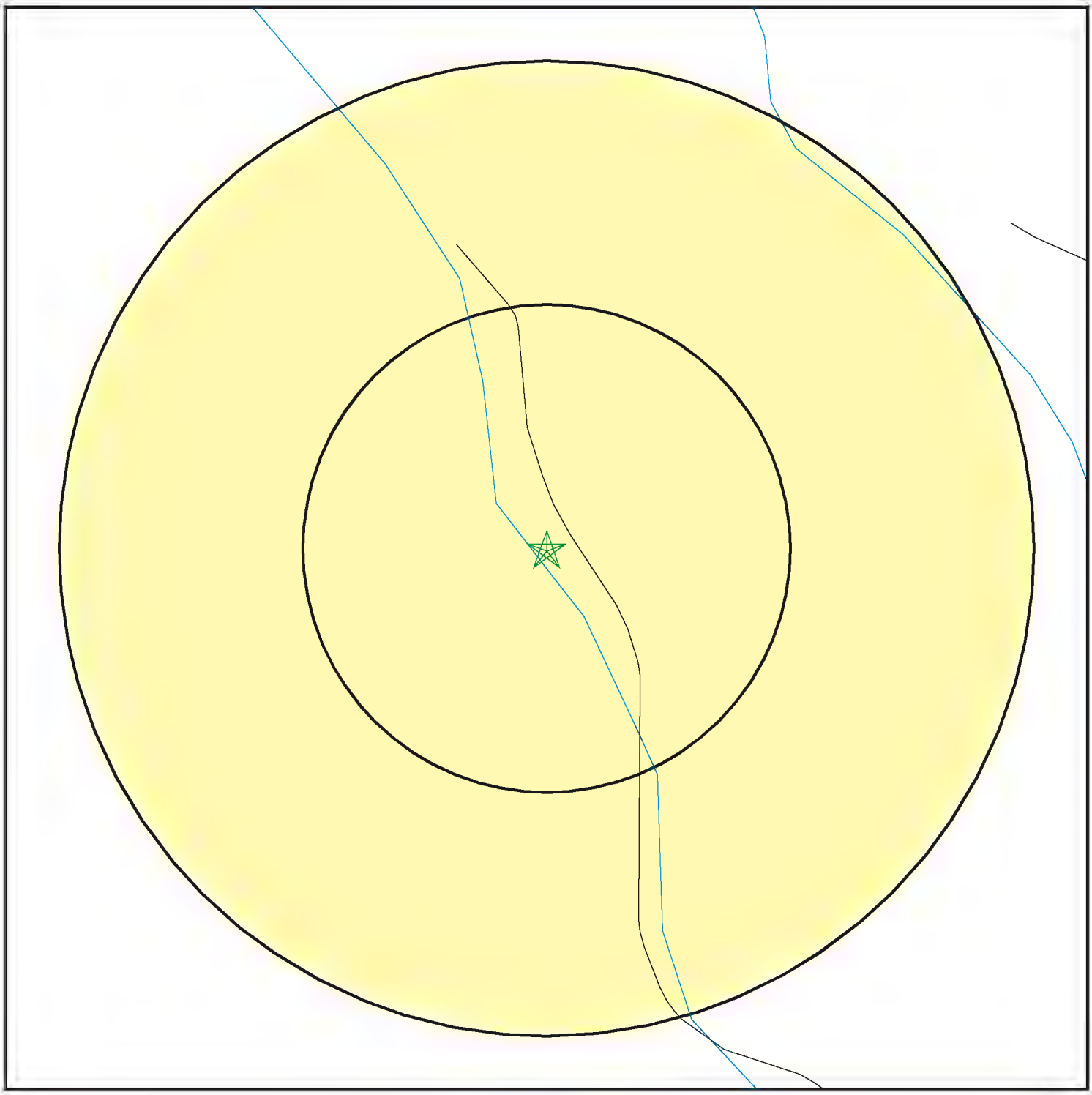


- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Shake Rag	CLIENT: Wildlands Eng, Inc.
ADDRESS: 788 Shake Rag Road Mars Hill NC 28754	CONTACT: Andrea Eckardt
LAT/LONG: 35.873821 / 82.494008	INQUIRY #: 4947603.2s DATE: May 25, 2017 8:58 am

DETAIL MAP - 4947603.2S



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites

0 1/16 1/8 1/4 Miles

Indian Reservations BIA

Hazardous Substance Disposal Sites

N

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Shake Rag	CLIENT: Wildlands Eng, Inc.
ADDRESS: 788 Shake Rag Road Mars Hill NC 28754	CONTACT: Andrea Eckardt
LAT/LONG: 35.873821 / 82.494008	INQUIRY #: 4947603.2s DATE: May 25, 2017 8:59 am

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL	1.000		0	0	0	0	NR	0
Proposed NPL	1.000		0	0	0	0	NR	0
NPL LIENS	TP		NR	NR	NR	NR	NR	0
Federal Delisted NPL site list								
Delisted NPL	1.000		0	0	0	0	NR	0
Federal CERCLIS list								
FEDERAL FACILITY	0.500		0	0	0	NR	NR	0
SEMS	0.500		0	0	0	NR	NR	0
Federal CERCLIS NFRAP site list								
SEMS-ARCHIVE	0.500		0	0	0	NR	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS	1.000		0	0	0	0	NR	0
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF	0.500		0	0	0	NR	NR	0
Federal RCRA generators list								
RCRA-LQG	0.250		0	0	NR	NR	NR	0
RCRA-SQG	0.250		0	0	NR	NR	NR	0
RCRA-CESQG	0.250		0	0	NR	NR	NR	0
Federal institutional controls / engineering controls registries								
LUCIS	0.500		0	0	0	NR	NR	0
US ENG CONTROLS	0.500		0	0	0	NR	NR	0
US INST CONTROL	0.500		0	0	0	NR	NR	0
Federal ERNS list								
ERNS	TP		NR	NR	NR	NR	NR	0
State- and tribal - equivalent NPL								
NC HSDS	1.000		0	0	0	0	NR	0
State- and tribal - equivalent CERCLIS								
SHWS	1.000		0	0	0	0	NR	0
State and tribal landfill and/or solid waste disposal site lists								
SWF/LF	0.500		0	0	0	NR	NR	0
OLI	0.500		0	0	0	NR	NR	0
State and tribal leaking storage tank lists								
LUST	0.500		0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
LAST	0.500		0	0	0	NR	NR	0
INDIAN LUST	0.500		0	0	0	NR	NR	0
LUST TRUST	0.500		0	0	0	NR	NR	0
State and tribal registered storage tank lists								
FEMA UST	0.250		0	0	NR	NR	NR	0
UST	0.250		0	0	NR	NR	NR	0
AST	0.250		0	0	NR	NR	NR	0
INDIAN UST	0.250		0	0	NR	NR	NR	0
State and tribal institutional control / engineering control registries								
INST CONTROL	0.500		0	0	0	NR	NR	0
State and tribal voluntary cleanup sites								
INDIAN VCP	0.500		0	0	0	NR	NR	0
VCP	0.500		0	0	0	NR	NR	0
State and tribal Brownfields sites								
BROWNFIELDS	0.500		0	0	0	NR	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS	0.500		0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
HIST LF	0.500		0	0	0	NR	NR	0
SWRCY	0.500		0	0	0	NR	NR	0
INDIAN ODI	0.500		0	0	0	NR	NR	0
DEBRIS REGION 9	0.500		0	0	0	NR	NR	0
ODI	0.500		0	0	0	NR	NR	0
IHS OPEN DUMPS	0.500		0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
US HIST CDL	TP		NR	NR	NR	NR	NR	0
US CDL	TP		NR	NR	NR	NR	NR	0
Local Land Records								
LIENS 2	TP		NR	NR	NR	NR	NR	0
Records of Emergency Release Reports								
HMIRS	TP		NR	NR	NR	NR	NR	0
SPILLS	TP		NR	NR	NR	NR	NR	0
IMD	0.500		0	0	0	NR	NR	0
SPILLS 90	TP		NR	NR	NR	NR	NR	0
SPILLS 80	TP		NR	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA NonGen / NLR	0.250		0	0	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
FUDS	1.000		0	0	0	0	NR	0
DOD	1.000		0	0	0	0	NR	0
SCRD DRYCLEANERS	0.500		0	0	0	NR	NR	0
US FIN ASSUR	TP		NR	NR	NR	NR	NR	0
EPA WATCH LIST	TP		NR	NR	NR	NR	NR	0
2020 COR ACTION	0.250		0	0	NR	NR	NR	0
TSCA	TP		NR	NR	NR	NR	NR	0
TRIS	TP		NR	NR	NR	NR	NR	0
SSTS	TP		NR	NR	NR	NR	NR	0
ROD	1.000		0	0	0	0	NR	0
RMP	TP		NR	NR	NR	NR	NR	0
RAATS	TP		NR	NR	NR	NR	NR	0
PRP	TP		NR	NR	NR	NR	NR	0
PADS	TP		NR	NR	NR	NR	NR	0
ICIS	TP		NR	NR	NR	NR	NR	0
FTTS	TP		NR	NR	NR	NR	NR	0
MLTS	TP		NR	NR	NR	NR	NR	0
COAL ASH DOE	TP		NR	NR	NR	NR	NR	0
COAL ASH EPA	0.500		0	0	0	NR	NR	0
PCB TRANSFORMER	TP		NR	NR	NR	NR	NR	0
RADINFO	TP		NR	NR	NR	NR	NR	0
HIST FTTS	TP		NR	NR	NR	NR	NR	0
DOT OPS	TP		NR	NR	NR	NR	NR	0
CONSENT	1.000		0	0	0	0	NR	0
INDIAN RESERV	1.000		0	0	0	0	NR	0
FUSRAP	1.000		0	0	0	0	NR	0
UMTRA	0.500		0	0	0	NR	NR	0
LEAD SMELTERS	TP		NR	NR	NR	NR	NR	0
US AIRS	TP		NR	NR	NR	NR	NR	0
US MINES	0.250		0	0	NR	NR	NR	0
ABANDONED MINES	0.500		0	0	0	NR	NR	0
FINDS	TP		NR	NR	NR	NR	NR	0
DOCKET HWC	TP		NR	NR	NR	NR	NR	0
UXO	1.000		0	0	0	0	NR	0
ECHO	TP		NR	NR	NR	NR	NR	0
FUELS PROGRAM	0.250		0	0	NR	NR	NR	0
COAL ASH	0.500		0	0	0	NR	NR	0
DRYCLEANERS	0.250		0	0	NR	NR	NR	0
Financial Assurance	TP		NR	NR	NR	NR	NR	0
NPDES	TP		NR	NR	NR	NR	NR	0
UIC	TP		NR	NR	NR	NR	NR	0
EDR HIGH RISK HISTORICAL RECORDS								
EDR Exclusive Records								
EDR MGP	1.000		0	0	0	0	NR	0
EDR Hist Auto	0.125		0	NR	NR	NR	NR	0
EDR Hist Cleaner	0.125		0	NR	NR	NR	NR	0
EDR RECOVERED GOVERNMENT ARCHIVES								
Exclusive Recovered Govt. Archives								
RGA HWS	TP		NR	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
RGA LF	TP		NR	NR	NR	NR	NR	0
RGA LUST	TP		NR	NR	NR	NR	NR	0
- Totals --		0	0	0	0	0	0	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

WILDLANDS
ENGINEERING

October 3, 2017

Renee Gledhill-Earley
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617

Subject: Shake Rag Branch Mitigation Site
Madison County, North Carolina

Dear Ms. Gledhill-Earley,

Wildlands Engineering, Inc. requests review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with the Shake Rag Mitigation Site. A Site Map and USGS Topographic Map with approximate project areas are enclosed. The topographic figure was prepared from the Bald Creek and Barnardsville, 7.5-Minute USGS Topographic Quadrangles.

The Shake Rag Branch Mitigation Site is being developed to provide in-kind mitigation for unavoidable stream channel impacts. Several sections of channel have been identified as significantly degraded. The project will include stream restoration on Shake Rag Branch and several unnamed tributaries all which flow to Middle Fork Little Ivy Creek. The site has historically been disturbed due to agricultural use, including both cattle and crops. Much of these streams proposed for restoration were buried in rock-lined trenches or pipes approximately 50 years ago. There are no existing structures within the project area, other than an old outhouse located off the right bank of UT1, that will be removed as part of the project. Furthermore, no archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes.

We ask that you review this site based on the attached information to determine the presence of any historic properties.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the project.

Sincerely,

Andrea S. Eckardt

Andrea S. Eckardt
Senior Environmental Scientist

Attachment:
Figure 1 Site Map
Figure 2 USGS Topographic Map

North Carolina Department of Natural and Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Roy Cooper
Secretary Susi H. Hamilton

Office of Archives and History
Deputy Secretary Kevin Cherry

October 17, 2017

Kimberly Browning
US Army Corps of Engineers
Wilmington District

Kimberly.D.Browning@usace.army.mil

Re: Shake Rag Branch Mitigation Site, Madison County, ER 17-1785

Dear Ms. Browning:

Thank you for your public notice of September 14, 2017, concerning the above project.

We have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or renee.gledhill-earley@ncdcr.gov. In all future communication concerning this project, please cite the above-referenced tracking number.

Sincerely,

Ramona M. Bartos

Andrea Eckardt

From: Andrea Eckardt
Sent: Tuesday, October 03, 2017 2:15 PM
To: 'russtown@nc-cherokee.com'; 'hollymaustin94@gmail.com'
Cc: 'Brew, Donnie (FHWA)'; 'Reid, Matthew'
Subject: Shake Rag Mitigation Site - Request for Review
Attachments: Shake Rag Mitigation Site - Scoping Package.pdf

Mr. Townsend-
Wildlands Engineering, Inc is contracted with the NC Division of Mitigation Services to conduct stream restoration, enhancement and preservation activities on the Shake Rag Mitigation Site, located in Madison County.

As such, I am requesting your office review and comment on any possible issues with respect to archeological or cultural resources associated with the proposed project. Attached is a package providing additional project details and maps of the Shake Rag Mitigation Site.

Thank you for your time and please let me know if you have any questions or need additional information about the project.

Andrea S. Eckardt | *Senior Environmental Scientist*
704.332.7754 x101

Wildlands Engineering, Inc.
1430 S. Mint St, Suite 104
Charlotte, NC 28203

WILDLANDS
ENGINEERING

October 3, 2017

Mr. Russell Townsend
Tribal Historic Preservation Officer
Eastern Band of Cherokee Indians
PO Box 455
Cherokee, NC 28719

Subject: Shake Rag Branch Mitigation Site - Madison County, North Carolina

Dear Mr. Townsend,

Wildlands Engineering, Inc. is contracted by the North Carolina Division of Mitigation Services (NCDMS) to conduct stream restoration, enhancement and preservation activities for the above-referenced project. We are requesting your office review and comment on any possible issues that may emerge with respect to archeological or cultural resources associated with this proposed stream mitigation project. Included in this package are a site map and USGS Topographic map with approximate project areas. The topographic figure was prepared from the Bald Creek and Barnardsville, 7.5-Minute USGS Topographic Quadrangles.

The Shake Rag Branch Mitigation Site is being developed to provide in-kind mitigation for unavoidable stream channel impacts. The project includes portions of Shake Rag Branch and nine unnamed tributaries, all which flow to Middle Fork Little Ivy Creek. The project includes approximately 4,842 feet of stream restoration, 3,836 feet of stream enhancement, and 958 linear feet of stream preservation. The streams proposed for restoration are located within the non-forested areas, which have historically and currently been managed for cattle and hay production. Much of these streams proposed for restoration were buried in rock-lined trenches or pipes approximately 50 years ago.

There are no existing structures within the project area, other than an old outhouse located off the right bank of UT1, that will be removed as part of the project. Furthermore, no archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes.

We appreciate your timely attention to this matter. Please feel free to contact us if you have any questions regarding this project or the extent of proposed disturbance.

Sincerely,

Andrea S. Eckardt

Andrea S. Eckardt
Senior Environmental Scientist

cc: via email
Ms. Holly Austin, Federal Cultural Resource Law Liaison, EBCI Tribal Historic Preservation Office
Mr. Donnie Brew, Federal Highway Administration
Mr. Matthew Reid, Division of Mitigation Services

TO BUYER: Wildlands Engineering, Inc.
1430 S. Mint Street, Suite 104
Charlotte, North Carolina 28203
Attention: Robert W. Bugg
e-mail: rbugg@wildlandseng.com

TO SELLER: Nancy and Gary Wilde
P.O. Box 1531
Weaverville, N.C. 28787
e-mail:g.wilde@dryridgeappraisal.com

Notice of change of address shall be given by written notice in the manner described in this paragraph.

3.3 **Assignment.** Buyer has the right to assign this agreement without the consent of Seller. No assignment shall be effective unless the assignee has delivered to Seller a written assumption of Buyer's obligations under this agreement. Seller hereby releases Buyer from any obligations under this agreement arising after the effective date of any assignment of this agreement by Buyer.

3.4 **Value of Conservation Easement; No Power of Eminent Domain.** In accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Buyer hereby notifies Seller that: (i) Buyer believes that the fair market value of the Conservation Easement is an amount equal to the Purchase Price; and (ii) Buyer does not have the power of eminent domain.

3.5 **Modification; Waiver.** No amendment of this agreement will be effective unless it is in writing and signed by the parties. No waiver of satisfaction of a condition or failure to comply with an obligation under this agreement will be effective unless it is in writing and signed by the party granting the waiver, and no such waiver will constitute a waiver of satisfaction of any other condition or failure to comply with any other obligation.

3.6 **Attorneys' Fees.** If either party commences an action against the other to interpret or enforce any of the terms of this agreement or because of the breach by the other party of any of the terms of this agreement, the losing party shall pay to the prevailing party reasonable attorneys' fees, expenses, court costs, litigation costs and any other expenses incurred in connection with the prosecution or defense of such action, whether or not the action is prosecuted to a final judgment.

3.7 **Memorandum of Option Agreement.** Concurrently with the signing of this agreement, Buyer and Seller agree to sign a Memorandum of Option that will be recorded against the Property in the Register of Deeds in the County stated in paragraph A within five days after the Effective Date.

3.8 **Tax Deferred Exchange**. If Seller desires to effect a tax-deferred exchange (the "**Exchange**") in connection with Buyer's purchase of the Conservation Easement, the parties agree to cooperate in effecting the Exchange. Seller is responsible for all additional costs associated with the Exchange and Buyer shall not have any additional liability with respect to the Exchange. The parties will execute any additional documents required for the Exchange at no cost to Buyer.

Buyer
Seller Seller

registered or certified mail, postage prepaid, with a return receipt requested; (c) one business day after the notice has been deposited with either FedEx or United Parcel Service to be delivered by overnight delivery; or (d) if sent by email, upon receipt of an acknowledgement email sent to the sender's email address in which the party receiving the email notice acknowledges having received that email. An automatic "read receipt" is not acknowledgement for purposes of this section 3.2. The addresses of the parties to receive notices are as follows:

TO BUYER:
Wildlands Engineering, Inc.
1430 S. Mint Street, Suite 104
Charlotte, North Carolina 28203
Attention: Robert W. Bugg
e-mail: rbugg@wildlandseng.com

TO SELLER:
James Ronald Thomas
788 Shake Rag Road
Mars Hill, NC 28754
e-mail: jrt188@gmail.com

Notice of change of address shall be given by written notice in the manner described in this paragraph.

3.3 **Assignment.** Buyer has the right to assign this agreement without the consent of Seller. No assignment shall be effective unless the assignee has delivered to Seller a written assumption of Buyer's obligations under this agreement. Seller hereby releases Buyer from any obligations under this agreement arising after the effective date of any assignment of this agreement by Buyer.

3.4 **Value of Conservation Easement; No Power of Eminent Domain.** In accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Buyer hereby notifies Seller that: (i) Buyer believes that the fair market value of the Conservation Easement is an amount equal to the Purchase Price; and (ii) Buyer does not have the power of eminent domain.

3.5 **Modification; Waiver.** No amendment of this agreement will be effective unless it is in writing and signed by the parties. No waiver of satisfaction of a condition or failure to comply with an obligation under this agreement will be effective unless it is in writing and signed by the party granting the waiver, and no such waiver will constitute a waiver of satisfaction of any other condition or failure to comply with any other obligation.

3.6 **Attorneys' Fees.** If either party commences an action against the other to interpret or enforce any of the terms of this agreement or because of the breach by the other party of any of the terms of this agreement, the losing party shall pay to the prevailing party reasonable attorneys' fees, expenses, court costs, litigation costs and any other expenses incurred in connection with the prosecution or defense of such action, whether or not the action is prosecuted to a final judgment.

3.7 **Memorandum of Option Agreement.** Concurrently with the signing of this agreement, Buyer and Seller agree to sign a Memorandum of Option that will be recorded against the Property in the Register of Deeds in the County stated in paragraph A within five days after the Effective Date.

Buyer
Seller

WILDLANDS
ENGINEERING

October 3, 2017

Marella Buncick
US Fish and Wildlife Service
Asheville Field Office
160 Zillicoa Street
Asheville, NC 28801

Subject: Shake Rag Branch Mitigation Site
Madison County, North Carolina

Dear Ms. Buncick,

Wildlands Engineering, Inc. requests review and comment on any possible issues that might emerge with respect to endangered species, migratory birds, or other trust resources associated with the proposed Shake Rag Branch Mitigation Site. A USGS Topographic Map and an Overview Site Map showing the approximate project area are enclosed. The topographic figure was prepared from the Bald Creek and Barnardsville, 7.5-Minute USGS Topographic Quadrangles.

The Shake Rag Branch Mitigation Site is being developed to provide in-kind mitigation for unavoidable stream channel impacts. Several sections of channel have been identified as significantly degraded. The project will include stream restoration on Shake Rag Branch and several unnamed tributaries all which flow to Middle Fork Little Ivy Creek. The site has historically been disturbed due to agricultural use, including both cattle and crops.

According to your website (https://www.fws.gov/raleigh/species/cntylist/madison.html) the threatened or endangered species for Madison County are: the gray bat (*Myotis grisescens*) and the Northern long-eared bat (*Myotis septentrionalis*). If we have not heard from you in 30 days, we will assume that you do not have any comments regarding associated laws and that you do not have any information relevant to this project at the current time.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning this project.

Sincerely,

Andrea S. Eckardt

Andrea S. Eckardt
Senior Environmental Scientist

Attachment:
Figure 1 Site Map
Figure 2 USGS Topographic Map

Andrea Eckardt

From: Brew, Donnie (FHWA) <Donnie.Brew@dot.gov>
Sent: Tuesday, October 10, 2017 9:48 AM
To: Marella_Buncick@fws.gov
Cc: Andrea Eckardt
Subject: Shake Rag Branch site NLEB 4(d) rule consultation
Attachments: Shake Rag Branch Site NLEB 4(d) Rule Streamlined Consultation Form.pdf; Figure 1 Shake Rag SIte Map.pdf; Figure 2 Shake Rag USGS.pdf

Good morning Marella,

The purpose of this message is to notify your office that FHWA will use the streamlined consultation framework for the Shake Rag Branch Mitigation Site in Madison County, NC.

Attached is a completed NLEB 4(d) Rule Streamlined Consultation form, including site maps.

Thank you and have a great week,

Donnie

Notifying the Service Under the Framework

Northern Long-Eared Bat 4(d) Rule Streamlined Consultation Form

Federal agencies (or designated non-federal representatives) should use the Northern Long-Eared Bat 4(d) Rule Streamlined Consultation form to notify the Service of their project and meet the requirements of the framework.

Northern Long-Eared Bat 4(d) Rule Streamlined Consultation Form (Word document)

Information requested in the Northern Long-Eared Bat 4(d) Rule Streamlined Consultation Form serves to

(1) notify the field office that an action agency will use the streamlined framework;

(2) describe the project with sufficient detail to support the required determination; and

(3) enable the USFWS to track effects and determine if reinitiation of consultation for the 4(d) rule is required. This form requests the minimum amount of information required for the Service to be able to track this information.

Providing information in the Streamlined Consultation Form does not address section 7(a)(2) compliance for any other listed species.

Donnie Brew
Preconstruction & Environment Engineer
Federal Highway Administration

Northern Long-Eared Bat 4(d) Rule Streamlined Consultation Form

Federal agencies should use this form for the optional streamlined consultation framework for the northern long-eared bat (NLEB). This framework allows federal agencies to rely upon the U.S. Fish and Wildlife Service's (USFWS) January 5, 2016, intra-Service Programmatic Biological Opinion (BO) on the final 4(d) rule for the NLEB for section 7(a)(2) compliance by: (1) notifying the USFWS that an action agency will use the streamlined framework; (2) describing the project with sufficient detail to support the required determination; and (3) enabling the USFWS to track effects and determine if reinitiation of consultation is required per 50 CFR 402.16.

This form is not necessary if an agency determines that a proposed action will have no effect to the NLEB or if the USFWS has concurred in writing with an agency's determination that a proposed action may affect, but is not likely to adversely affect the NLEB (i.e., the standard informal consultation process). Actions that may cause prohibited incidental take require separate formal consultation. Providing this information does not address section 7(a)(2) compliance for any other listed species.

Information to Determine 4(d) Rule Compliance:	**YES**	**NO**
1. Does the project occur wholly outside of the WNS Zone[1]?	☐	X
2. Have you contacted the appropriate agency[2] to determine if your project is near known hibernacula or maternity roost trees?	X	☐
3. Could the project disturb hibernating NLEBs in a known hibernaculum?	☐	X
4. Could the project alter the entrance or interior environment of a known hibernaculum?	☐	X
5. Does the project remove any trees within 0.25 miles of a known hibernaculum at any time of year?	☐	X
6. Would the project cut or destroy known occupied maternity roost trees, or any other trees within a 150-foot radius from the maternity roost tree from June 1 through July 31.	☐	X

You are eligible to use this form if you have answered yes to question #1 **or** yes to question #2 **and** no to questions 3, 4, 5 and 6. The remainder of the form will be used by the USFWS to track our assumptions in the BO.

Agency and Applicant[3] (Name, Email, Phone No.): Donnie Brew, Federal Highway Administration, donnie.brew@dot.gov, 919-747-7017 and Wildlands Engineering, Inc., aeckardt@wildlandseng.com; 704-332-7754 ext. 101

Project Name: Shake Rag Branch Mitigation Site.

Project Location (include coordinates if known): 19 miles north of Asheville and four miles northeast of Mars Hill in Madison County, NC

Basic Project Description (provide narrative below or attach additional information): The project includes Shake Rag Branch and nine unnamed tributaries, all of which flow to Middle Fork Little Ivy Creek. Approximately 4,842 feet of stream restoration, 3,836 feet of stream enhancement, and 958 linear feet of stream preservation. In addition, approximately 0.5 acres will involve tree clearing in the forested area. The streams proposed for restoration are located within the non-forested areas, which have historically and currently been managed for cattle and hay production. Much of these streams proposed for restoration were buried in rock-lined trenches or pipes approximately 50 years ago. The project will provide stream mitigation units to the Division of Mitigation Services in the French Broad River Basin (06010105).

[1] http://www.fws.gov/midwest/endangered/mammals/nleb/pdf/WNSZone.pdf

General Project Information

	YES	NO
Does the project occur within 0.25 miles of a known hibernaculum?	☐	X
Does the project occur within 150 feet of a known maternity roost tree?	☐	X
Does the project include forest conversion[4]? (if yes, report acreage below)	X	☐
Estimated total acres of forest conversion	0.5 ac	
If known, estimated acres[5] of forest conversion from April 1 to October 31		
If known, estimated acres of forest conversion from June 1 to July 31[6]		
Does the project include timber harvest? (if yes, report acreage below)	☐	X
Estimated total acres of timber harvest		
If known, estimated acres of timber harvest from April 1 to October 31		
If known, estimated acres of timber harvest from June 1 to July 31		
Does the project include prescribed fire? (if yes, report acreage below)	☐	X
Estimated total acres of prescribed fire		
If known, estimated acres of prescribed fire from April 1 to October 31		
If known, estimated acres of prescribed fire from June 1 to July 31		
Does the project install new wind turbines? (if yes, report capacity in MW below)	☐	X
Estimated wind capacity (MW)		

Agency Determination:

By signing this form, the action agency determines that this project may affect the NLEB, but that any resulting incidental take of the NLEB is not prohibited by the final 4(d) rule.

If the USFWS does not respond within 30 days from submittal of this form, the action agency may presume that its determination is informed by the best available information and that its project responsibilities under 7(a)(2) with respect to the NLEB are fulfilled through the USFWS January 5, 2016, Programmatic BO. The action agency will update this determination annually for multi-year activities.

The action agency understands that the USFWS presumes that all activities are implemented as described herein. The action agency will promptly report any departures from the described activities to the appropriate USFWS Field Office. The action agency will provide the appropriate USFWS Field Office with the results of any surveys conducted for the NLEB. Involved parties will promptly notify the appropriate USFWS Field Office upon finding a dead, injured, or sick NLEB.

Signature: _____ Date Submitted: 10-10-17

[4] Any activity that temporarily or permanently removes suitable forested habitat, including, but not limited to, tree removal from development, energy production and transmission, mining, agriculture, etc. (see page 48 of the BO).
[5] If the project removes less than 10 trees and the acreage is unknown, report the acreage as less than 0.1 acre.
[6] If the activity includes tree clearing in June and July, also include those acreage in April to October.

Andrea Eckardt

From: Andrea Eckardt
Sent: Friday, December 01, 2017 10:26 AM
To: 'Cortes, Milton - NRCS, Raleigh, NC'
Subject: RE: Shake Rag Mitigation Site
Attachments: AD1006_ShakeRag_Madison.pdf

Milton-
Attached is the fully completed AD1006 form for the Shake Rag Mitigation Site for your files.

Thank you for your time.

Andrea

Andrea S. Eckardt | *Senior Environmental Planner*
704.332.7754 x101

From: Cortes, Milton - NRCS, Raleigh, NC [mailto:Milton.Cortes@nc.usda.gov]
Sent: Monday, November 13, 2017 12:21 PM
To: Andrea Eckardt <aeckardt@wildlandseng.com>
Subject: RE: Shake Rag Mitigation Site
Importance: High

Andrea:

Please find attached the Farmland Conversion Impact Rating evaluation for the Shake Rag Mitigation Site Stream Restoration.

If we can be of further assistance please let us know.

Cordially;

Milton Cortes
Assistant State Soil Scientist
USDA Natural Resources Conservation Service
4407 Bland Rd, Suite 117
Raleigh, NC 27609
Phone: 919-873-2171
milton.cortes@nc.usda.gov

From: Andrea Eckardt [mailto:aeckardt@wildlandseng.com]
Sent: Monday, October 09, 2017 1:33 PM
To: Cortes, Milton - NRCS, Raleigh, NC <Milton.Cortes@nc.usda.gov>
Subject: Shake Rag Mitigation Site

Milton-

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*		Date Of Land Evaluation Request 10/9/2017	
Name of Project Shake Rag Mitigation Site		Federal Agency Involved NC Division of Mitigation Services	
Proposed Land Use Stream Restoration		County and State Madison County, NC	
PART II *(To be completed by NRCS)*		Date Request Received By NRCS	Person Completing Form: Milton Cortes NRCS NC
Does the site contain Prime, Unique, Statewide or Local Important Farmland? *(If no, the FPPA does not apply - do not complete additional parts of this form)*	YES ☐ NO ☐	Acres Irrigated none	Average Farm Size 78 acres
Major Crop(s) CORN	Farmable Land In Govt. Jurisdiction Acres: 24 % 68,421 acres	Amount of Farmland As Defined in FPPA Acres: 2 % 5,995 acres	
Name of Land Evaluation System Used Madison Co. NC LESA	Name of State or Local Site Assessment System N/A	Date Land Evaluation Returned by NRCS November 13, 2017	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	16.2			
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	16.2	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	0			
B. Total Acres Statewide Important or Local Important Farmland	4.3			
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted	0.0139			
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value	44.9 %			
PART V (To be completed by NRCS) Land Evaluation Criterion Relative Value of Farmland To Be Converted (Scale of 0 to 100 Points)	26			

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(Criteria are explained in 7 CFR 658.5 b. For Corridor project use form NRCS-CPA-106)*	**Maximum Points**	Site A	Site B	Site C	Site D
1. Area In Non-urban Use	(15)	15			
2. Perimeter In Non-urban Use	(10)	10			
3. Percent Of Site Being Farmed	(20)	5			
4. Protection Provided By State and Local Government	(20)	20			
5. Distance From Urban Built-up Area	(15)	15			
6. Distance To Urban Support Services	(15)	10			
7. Size Of Present Farm Unit Compared To Average	(10)	10			
8. Creation Of Non-farmable Farmland	(10)	0			
9. Availability Of Farm Support Services	(5)	4			
10. On-Farm Investments	(20)	5			
11. Effects Of Conversion On Farm Support Services	(10)	0			
12. Compatibility With Existing Agricultural Use	(10)	0			
TOTAL SITE ASSESSMENT POINTS	160	94	0	0	0
PART VII ***(To be completed by Federal Agency)***					
Relative Value Of Farmland *(From Part V)*	100	26	0	0	0
Total Site Assessment *(From Part VI above or local site assessment)*	160	94	0	0	0
TOTAL POINTS ***(Total of above 2 lines)***	260	120	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? YES ☐ NO ☐

Reason For Selection:

Name of Federal agency representative completing this form:	Date:

(See Instructions on reverse side) **Form AD-1006 (03-02)**

WILDLANDS
ENGINEERING

October 3, 2017

Shannon Deaton
North Carolina Wildlife Resource Commission
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699

Subject: Shake Rag Branch Mitigation Site
Madison County, North Carolina

Dear Ms. Deaton,

Wildlands Engineering, Inc. requests review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with the proposed Shake Rag Branch Mitigation Site. A USGS Topographic Map and an Overview Site Map showing the approximate project area are enclosed. The topographic figure was prepared from the Bald Creek and Barnardsville, 7.5-Minute USGS Topographic Quadrangles.

The Shake Rag Branch Mitigation Site is being developed to provide in-kind mitigation for unavoidable stream channel impacts. Several sections of channel have been identified as significantly degraded. The project will include stream restoration on Shake Rag Branch and several unnamed tributaries all which flow to Middle Fork Little Ivy Creek. The site has historically been disturbed due to agricultural use, including both cattle and crops.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning this project.

Sincerely,

Andrea S. Eckardt

Andrea S. Eckardt
Senior Environmental Scientist

Attachment:
Figure 1 Site Map
Figure 2 USGS Topographic Map

Andrea Eckardt

From: Leslie, Andrea J <andrea.leslie@ncwildlife.org>
Sent: Tuesday, October 31, 2017 4:29 PM
To: Andrea Eckardt
Subject: Shake Rag Branch Mitigation Site - NCWRC comments
Attachments: ShakeRagBranchMitigationSite_ShakeRagBr&UTs_Madison_WRCComments.pdf

Hi Andrea,

Attached are NCWRC's comments on the Shake Rag Branch Mitigation Site.

Andrea

Andrea Leslie
Mountain Habitat Conservation Coordinator
NC Wildlife Resources Commission
645 Fish Hatchery Rd.
Marion, NC 28752
828-400-4223
www.ncwildlife.org

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

September 13, 2017

Andrea Eckardt
Wildlands Engineering
1430 Mint Street, Suite 104
Charlotte, NC 28203

SUBJECT: Shake Rag Mitigation Site

Dear Ms. Eckardt:

Biologists with the North Carolina Wildlife Resources Commission (NCWRC) received your October 3, 2017 letter regarding plans for a stream restoration project on Shake Rag Branch and unnamed tributaries in Madison County. You requested review and comment on the project. Our comments on this project are offered for your consideration under provisions of the Clean Water Act of 1977 (33 U.S.C. 466 et. seq.) and Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667d).

The project will involve the restoration of approximately 9,000 feet of degraded streams. This project should not impact wild trout resources.

We recommend that riparian buffers that are to be reestablished be as wide as possible, given site constraints and landowner needs. NCWRC generally recommends a woody buffer of 100 feet on perennial streams to maximize the benefits of buffers, including bank stability, stream shading, treatment of overland runoff, and wildlife habitat.

Thank you for the opportunity to review and comment on this project. Please contact me at (828) 400-4223 if you have any questions about these comments.

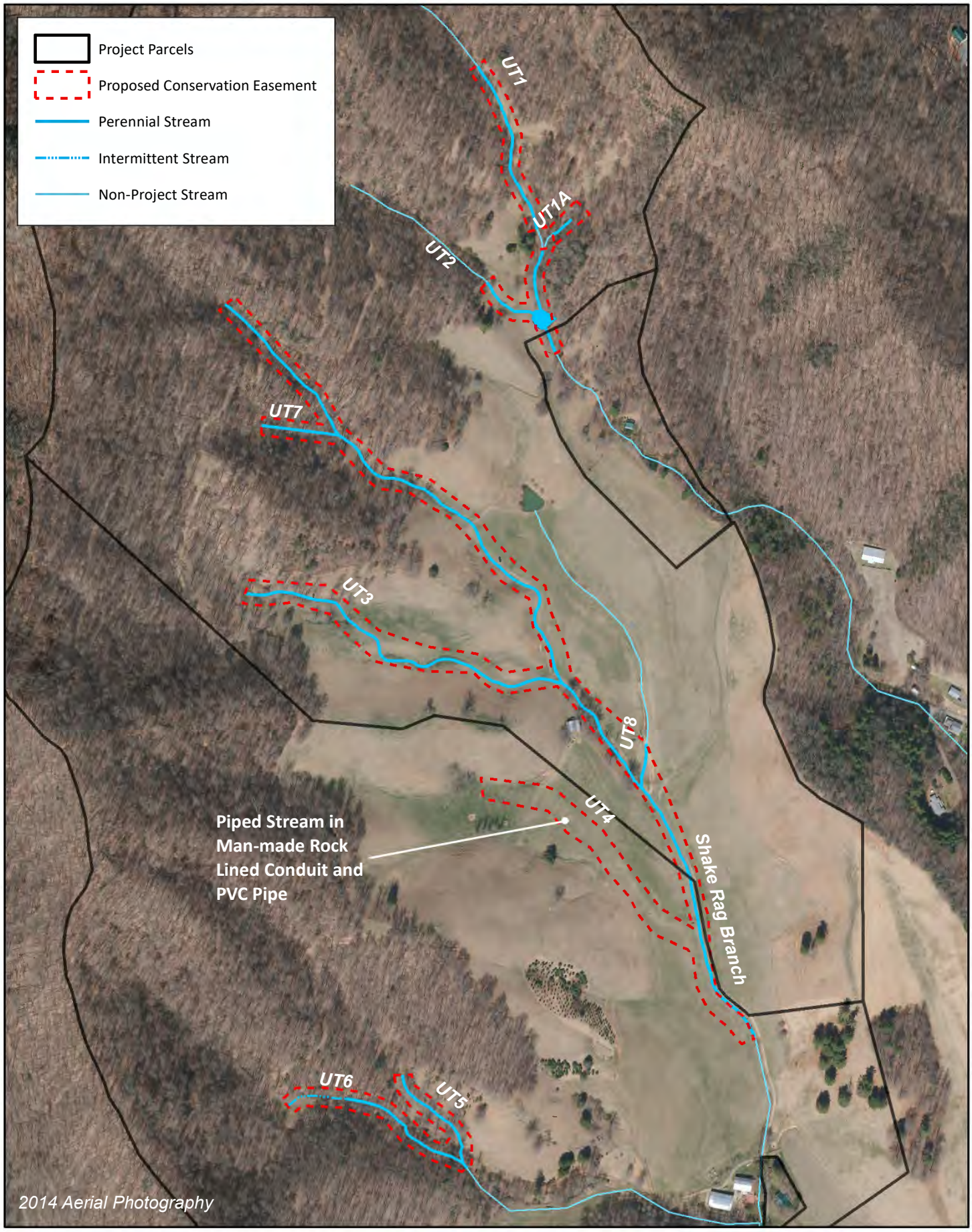
Sincerely,

Andrea Leslie
Mountain Region Coordinator
Habitat Conservation Program

Mailing Address: Habitat Conservation • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

Shake Rag Branch Mitigation Site
Categorical Exclusion

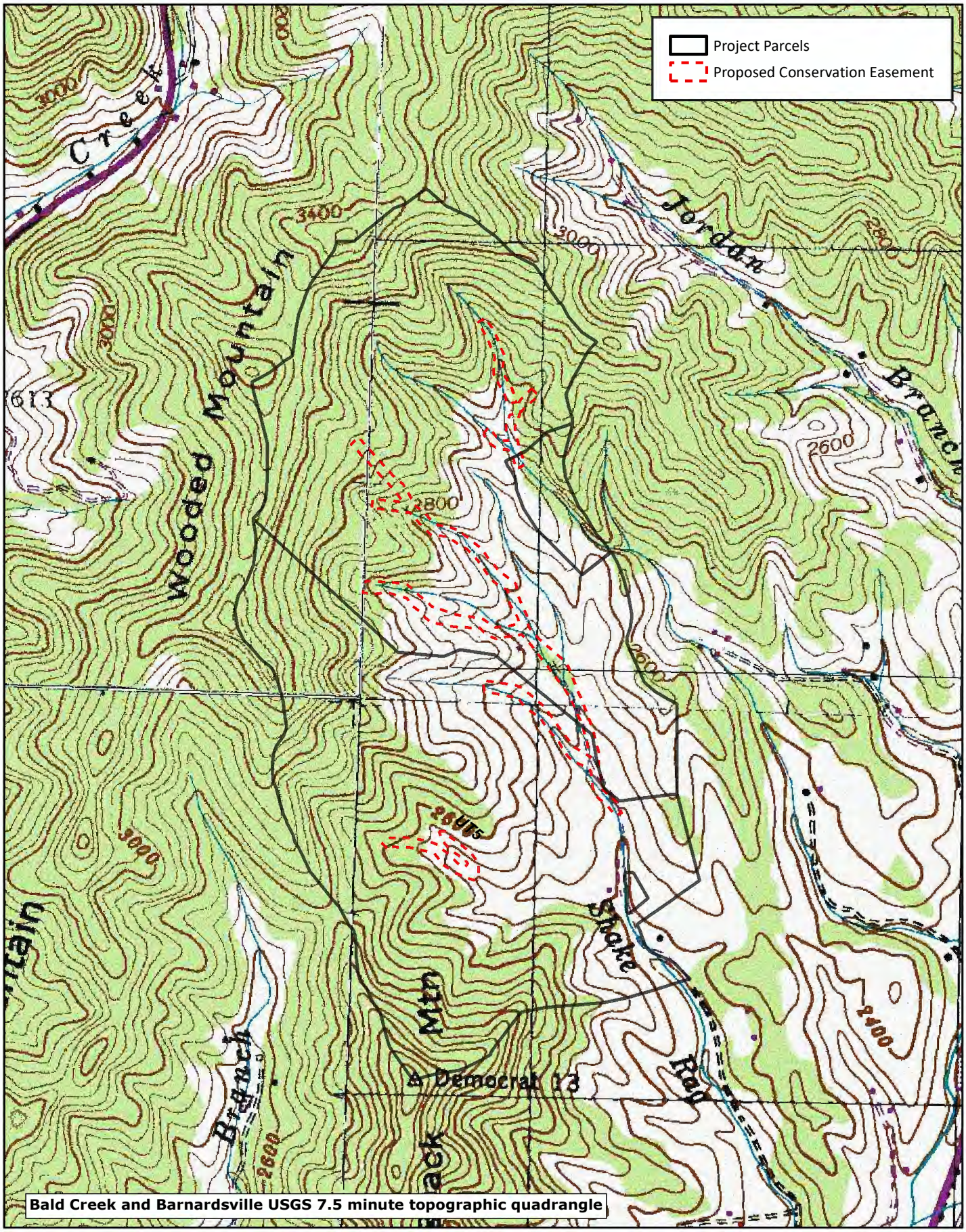
FIGURES



WILDLANDS ENGINEERING

0 250 500 Feet

Figure 1 Site Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC



WILDLANDS ENGINEERING

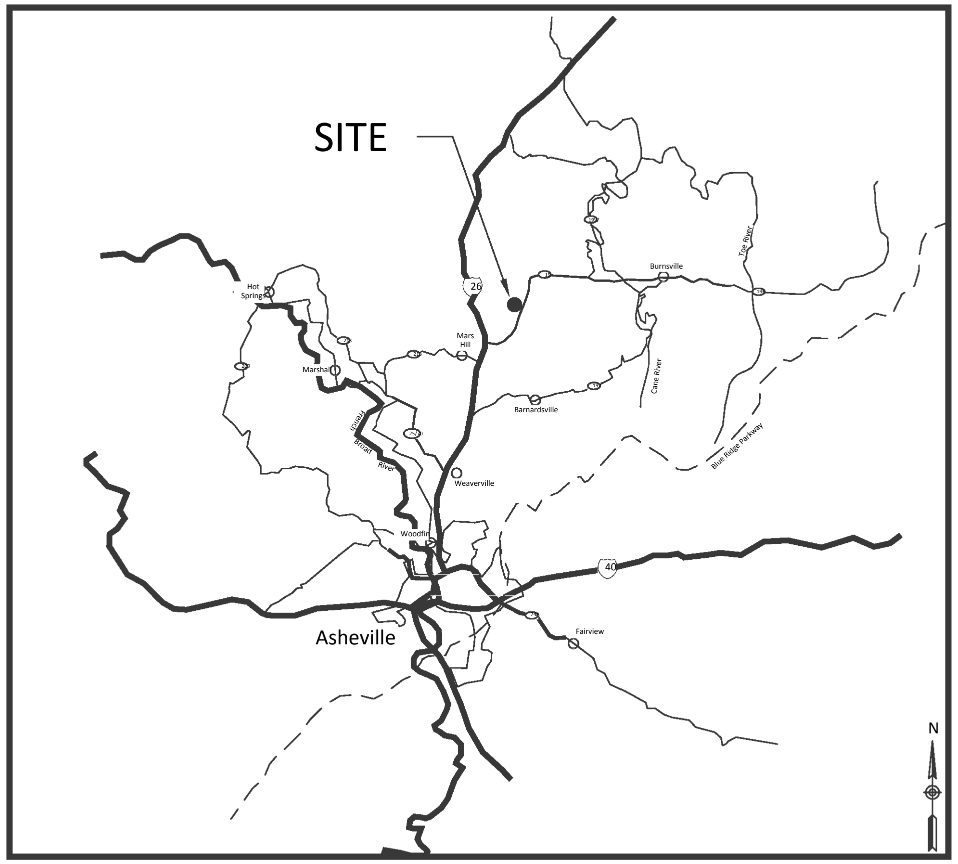
0 500 1,000 Feet

N

Figure 2 USGS Topographic Map
Shake Rag Branch Mitigation Site
French Broad River Basin 06010105
Madison County, NC

APPENDIX 6
PLAN SHEETS

Shake Rag Branch Mitigation Site
Madison County, North Carolina
for
NCDEQ
Division of Mitigation Services



Vicinity Map
Not to Scale

BEFORE YOU DIG!
CALL 1-800-632-4949
N.C. ONE-CALL CENTER
IT'S THE LAW!

DRAFT PLANS FOR IRT
MITIGATION PLAN REVIEW
ISSUED NOVEMBER 6, 2018

Sheet Index

Project Directory

Engineering:
Wildlands Engineering, Inc
License No. F-0831
167-B Haywood Road
Asheville, NC 28806
Jake Mclean, PE
828.774.5547

Surveying:
Kee Mapping and Surveying
P.O. Box 2566
Asheville, NC 28802
Bradley Kee, PLS
828-575-9021

Owner:
NCDEQ
Division of Mitigation Services
5 Ravenscroft Drive, Ste 102
Asheville, NC 28801
Matthew Reid
828-273-1673

DMS Project No. 100018

French Broad River Basin
HUC 06010105

WILDLANDS
ENGINEERING
167-B Haywood Road
Asheville, NC 28806
Tel: 828.774.5547
Fax: 704.332.3306
Firm License No. F-0831

PRELIMINARY
DO NOT
USE FOR
CONSTRUCTION

Shake Rag Branch Mitigation Site
Madison County, North Carolina

Title Sheet

Revisions:

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
Checked By: CB

Sheet 0.1

Construction Sequence:

The anticipated construction sequence is listed below.

Initial Site Preparation

1. Contact North Carolina "One Call" Center (1.800.632.4949) before any excavation.
2. Contact Division of Energy, Mineral and Land Resources (252-946-6481) before any work begins on the project and notify them of the start date.
3. Mobilize equipment and materials to the site.
4. Identify and establish construction entrance, staging and stockpile areas, haul roads, silt fence, tree protection fencing, safety fencing, and temporary stream crossings as indicated on the plans for work areas.
5. All haul roads shall be monitored for sediment loss daily. In the event of sediment loss, silt fence or other acceptable sediment and erosion control practices, such as straw wattles, shall be installed.
6. Set up temporary facilities, locate equipment within the staging area, and stockpile materials needed for the initial stages of construction within the stockpile area(s).
7. Install and maintain an onsite rain gauge and log book to record the rainfall amounts and dates. Complete the self-inspection as required by NCDEQ permit.

Stream Construction

8. Perform any necessary clearing and grubbing in phases as work progresses. Bank vegetation and vegetation immediately adjacent to live channels shall be left undisturbed as long as possible. On a reach by reach basis, remove all non-native and invasive vegetation within limits of grading prior to beginning the channel construction for the reach.
9. Construction of all channels are to be done in the dry. Construction should generally progress from upstream to downstream to prevent sediment runoff from upstream construction affecting completed downstream reaches. Use a pump around as shown on the plans and discussed in the Erosion Control Notes. Existing channels or ditches or diversion may also be used to route stream flow in lieu of pump-around.
10. Construction of all channels are to be done in the dry. Construction should generally progress from upstream to downstream to prevent upstream construction affecting completed downstream reaches. Use a pump around as shown on the plans and discussed in the General Notes.
11. Where feasible, more than one offline section may be constructed concurrently. Offline sections shall be tied online sequentially from downstream to upstream.
12. As work progresses, remove and stockpile the top three inches of soil from the active grading area. Stockpiled topsoil shall be kept separate for onsite replacement prior to floodplain seeding.
13. Construct the proposed stream channel to the grade specified in the cross-sections and profile.
14. Grade the adjacent floodplain area according to grades shown on the plan.
15. Various types of constructed riffles are specified on the plans. Contractor shall build the specific types of constructed riffles at locations shown on the plans. Changes in constructed riffle type must be approved by the Designer.
16. Install in-stream structures (riffles, angled log sill, log sill with root wad, double log drops,and in-bank bioengineering such as brush toe and sod mats after channel grading is completed according to details and specifications. Sod mats should be used in lieu of coir fiber matting, where available, to stabilize all stream banks on site as the preferential stabilization method. Coir fiber matting may be used where sod mats are not available or if coir fiber matting is preferred at the discretion of the Designer.
17. Seed (with specified temporary and permanent seed mix) and straw mulch areas where the coir fiber matting is to be installed.
18. Install coir fiber matting according to plans and specifications.
19. Backfill abandoned channel sections with stockpiled soil according to the grades shown on the plans. Non-native and invasive vegetation (e.g. Chinese privet) shall be removed from the existing channel prior to backfilling.
20. Prepare floodplain for seeding by applying stockpiled topsoil to any areas of floodplain that have been cut below the topsoil horizon between bankfull (top of bank) and the top of terrace or grading limits, ripping, and raking/smoothing. Seed with specified temporary and permanent seed mix and mulch. Any areas within the conservation easement that have not been graded shall be treated according to the planting plan.
21. If at any time circumstances should arise where water has been turned into the new channel and additional work must be done on the floodplain, erosion control devices will be installed to protect the new channel from sedimentation.
22. Once all phases of channel and floodplain construction are complete, prepare the floodplain areas for planting per the specifications.

Construction Sequence (continued):

Construction Demobilization

25. Remove temporary stream crossings.
24. Install livestakes and herbaceous plugs along the stream banks according to the plans and specifications or as directed by designer.
25. The Contractor shall ensure that the site is free of trash and leftover materials prior to demobilization of equipment from the site.
26. Complete the removal of any additional stockpiled material from the site.
27. Demobilize grading equipment from the site.
28. All rock and other stockpiled materials must be removed from the limits of disturbance and conservation easement. All areas outside the conservation easement shall be returned to pre-project conditions or better.
29. Seed, mulch, and stabilize staging areas, stockpile areas, haul roads, and construction entrances. Pasture seed mix is to be applied to areas of disturbance outside of the conservation easement.

Existing Features

- Existing Property Boundary
- Existing 5' Major Contour (100)
- Existing 1' Minor Contour (101)
- Existing Thalweg
- Existing Right of Way (R/W)
- Existing Overhead Electric Line (OHE)
- Existing Top of Bank (TB)
- Existing Fence
- Existing Waterline
- Existing Overhead Electric Pole
- Existing Wetlands
- Existing Treeline
- Existing Tree
- Survey Control Point
- Existing Ditch / Channel
- Existing Pipe
- Existing Bedrock
- Existing Wood Debris
- Existing Pond / Spring
- Existing Roads
- Existing Gravel Roads

Proposed Features

- Proposed Conservation Easement (CE)
- Proposed Private Road Easement (R/W)
- Proposed Overhead Electric Utility Easement (R/W)
- Proposed Stream Alignment (10+00)
- Proposed Bankfull
- Proposed Concept Grading 5' Major (Select Locations) (100)
- Proposed 1' Minor Contour (Select Locations) (101)
- Proposed 25' Internal Easement (Farm Crossing) (CE-XS)
- Proposed Fence (X)
- Proposed 6' Internal Easement (Waterline)
- Proposed Cascading Riffle
- Proposed Cascading Riffle-Pool Sequence
- Proposed Log Step
- Proposed Rock Step
- Proposed Culvert
- Proposed Swale
- Proposed Rock Drop
- Proposed Brush Toe
- Proposed Lunker Log
- Proposed Rock Toe
- Proposed Step Pool Conveyance BMP
- Proposed Tree Removal
- Proposed Tree Save (SAF)
- Proposed Safety Fence (SAF)
- Proposed Gravel Farm Road
- Proposed Compacted Soil Farm Road with Grass
- Proposed Demolition of Existing Fence
- Proposed Rock Slide

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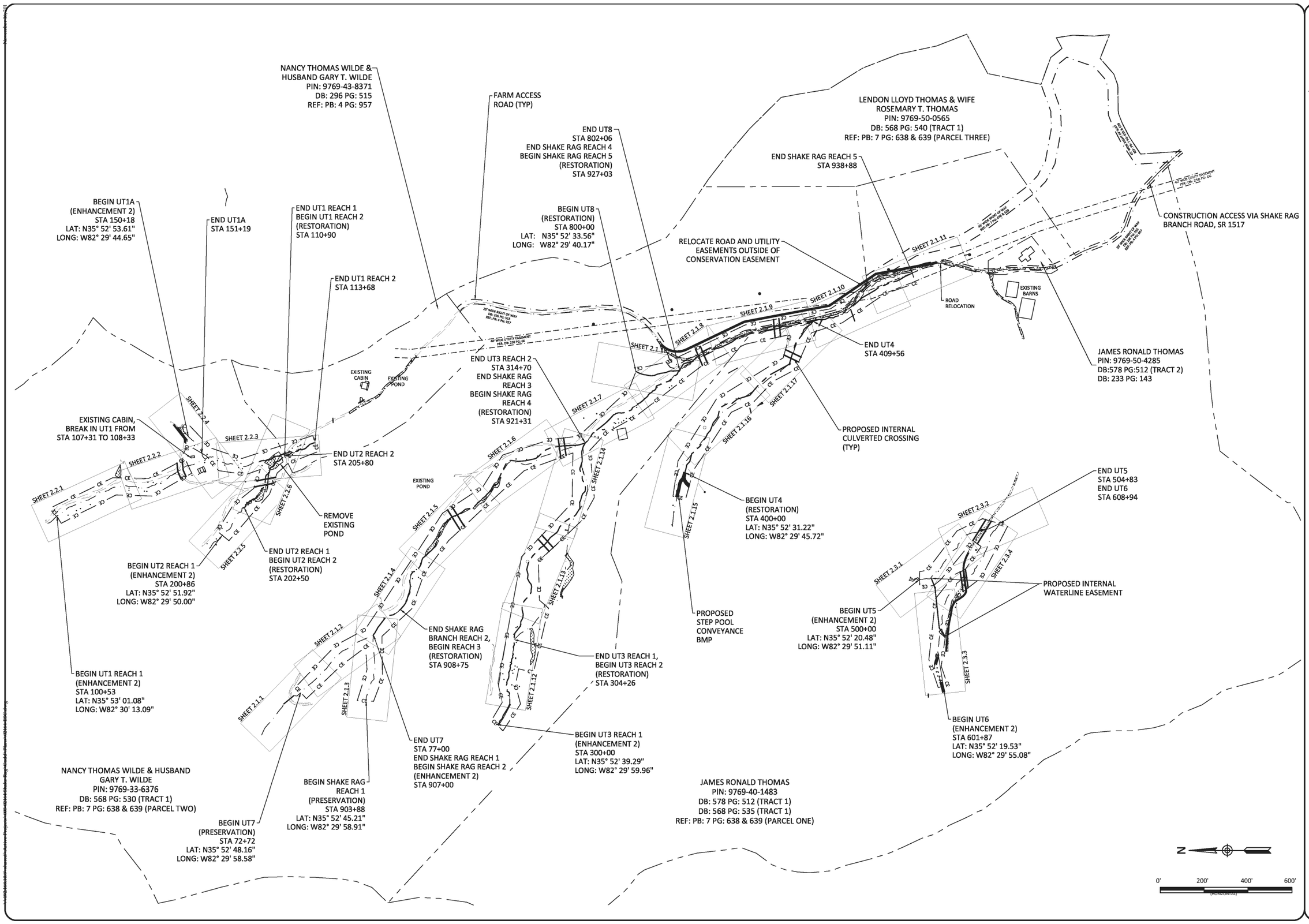
Shake Rag Branch Mitigation Site
Madison County, North Carolina

General Notes and Symbols

Revisions:

Date: November 06, 2018
Task/Number: 100542164
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 0.2



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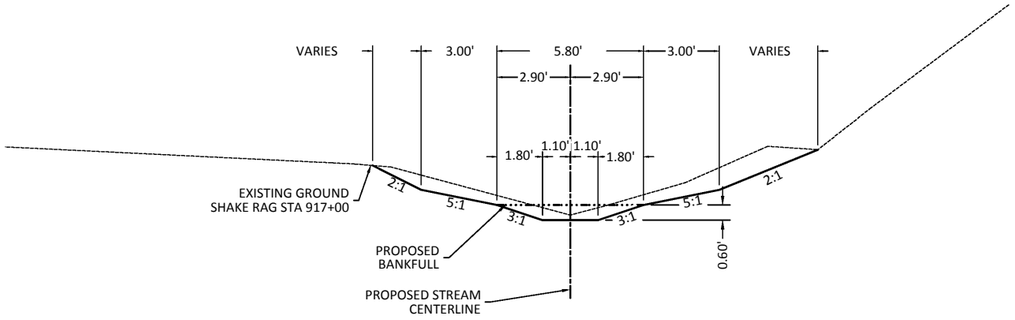
Madison County, North Carolina

Project Overview

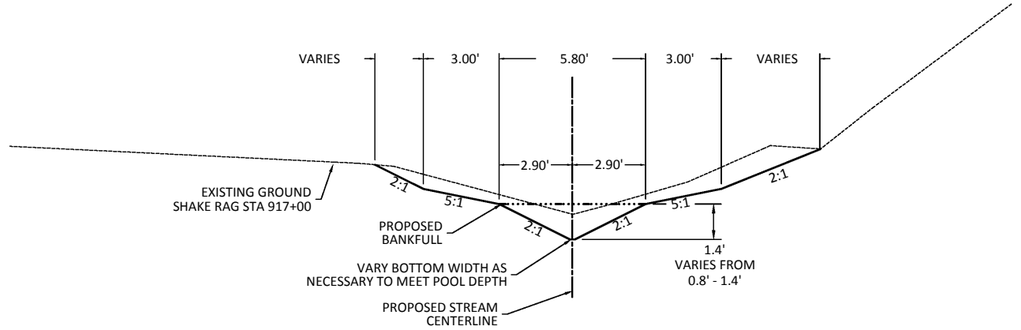
Revisions:

Date: November 06, 2018
7631 Number: 00542165
Project Engineer: JM
Drawn by: JDW
Checked By: CB

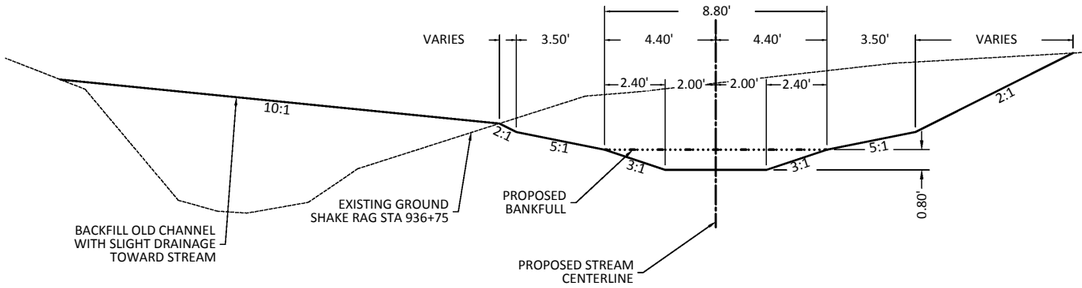
Sheet 0.3



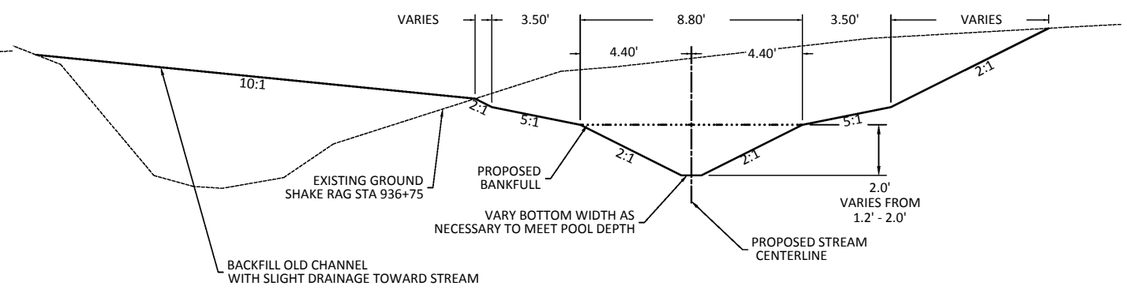
Shake Rag Branch Reach 3 - Typical Section: Riffle
STA 908+75 TO 921+31



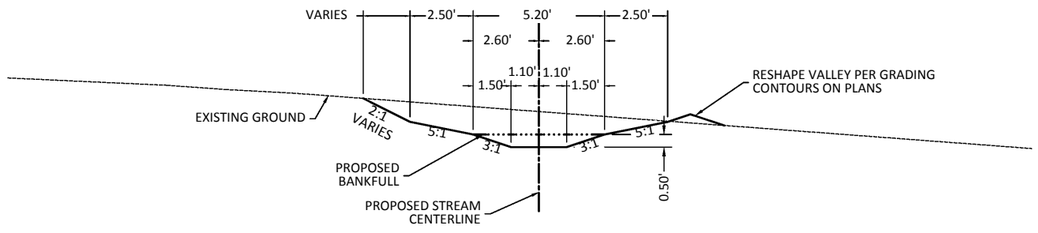
Shake Rag Branch Reach 3 - Typical Section: Pool
STA 908+75 TO 921+31



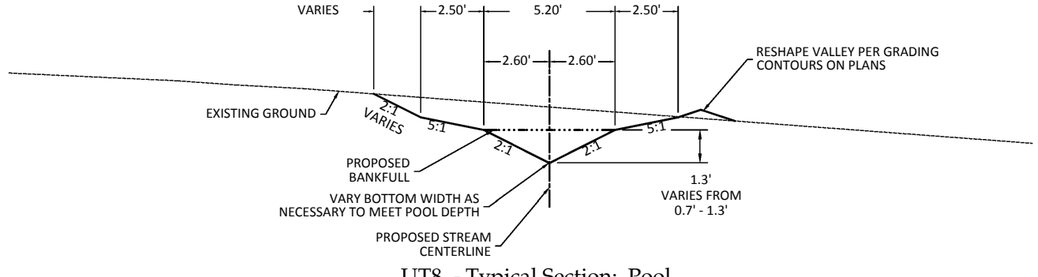
Shake Rag Branch Reach 4 and 5 - Typical Section: Riffle
STA 923+18 TO 927+03 &
STA 927+03 TO 938+88



Shake Rag Branch Reach 4 and 5 - Typical Section: Pool
STA 923+18 TO 927+03 &
STA 927+03 TO 938+88



UT8 - Typical Section: Riffle
STA 800+00 TO 802+06



UT8 - Typical Section: Pool
STA 800+00 TO 802+06

0' 3' 6' 9'

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Shake Rag Branch Mitigation Site
Madison County, North Carolina

Typical Sections

Revisions:

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
Checked By: CB

Sheet 1.1

November 16, 2018

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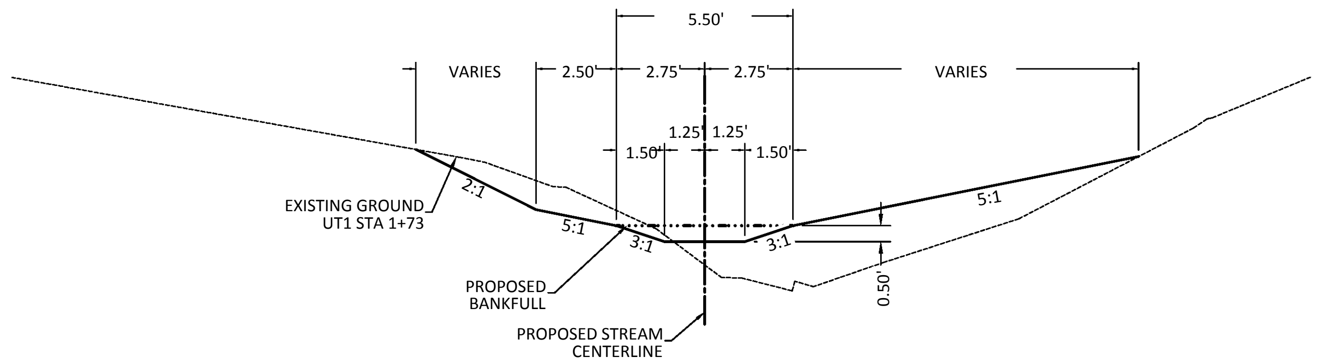

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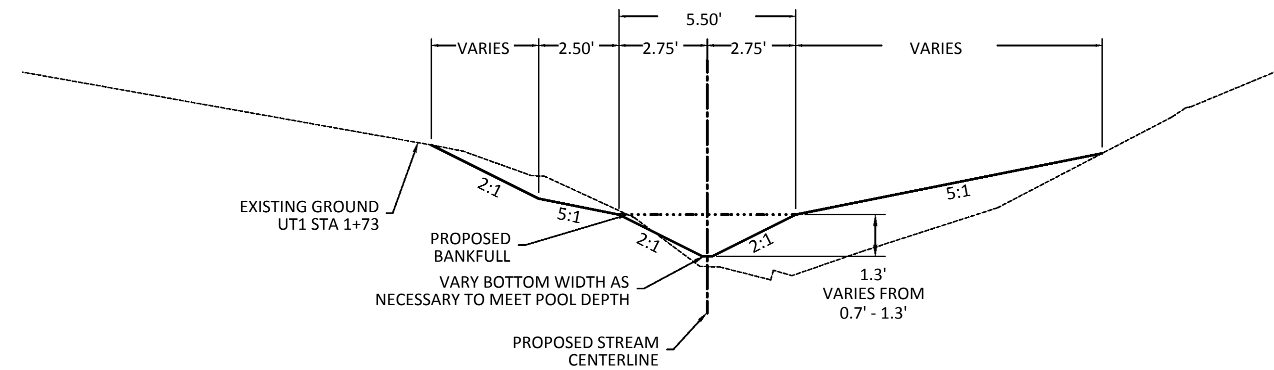
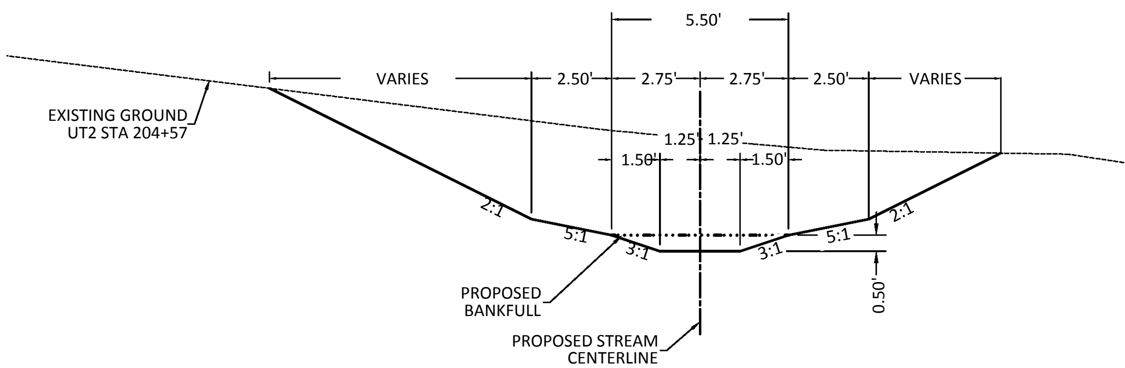
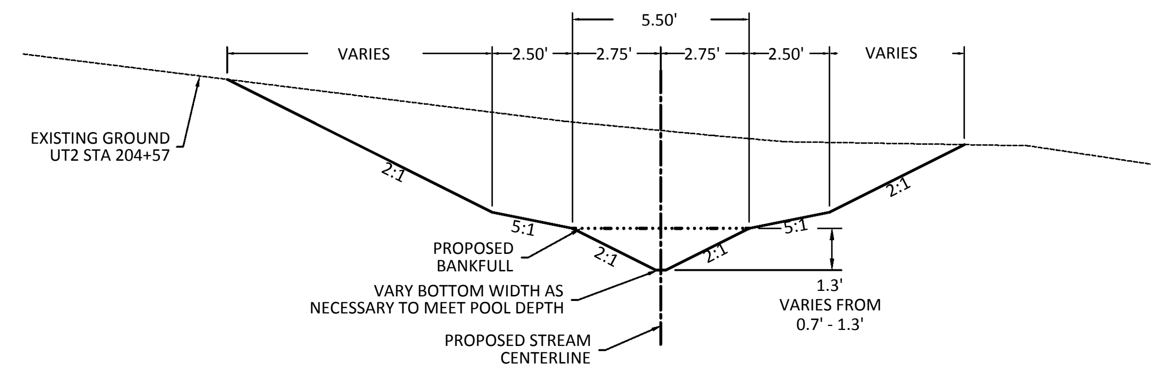
STA 100+53 TO 113+68



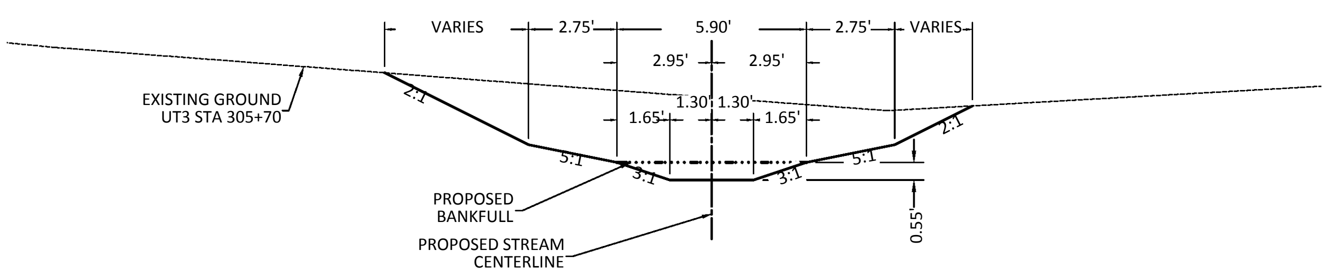
UT1 - Typical Section: Pool
STA 100+53 TO 113+68



UT2 - Typical Section: Riffle
STA 200+86 TO 205+80



UT2 - Typical Section: Pool
STA 200+86 TO 205+80



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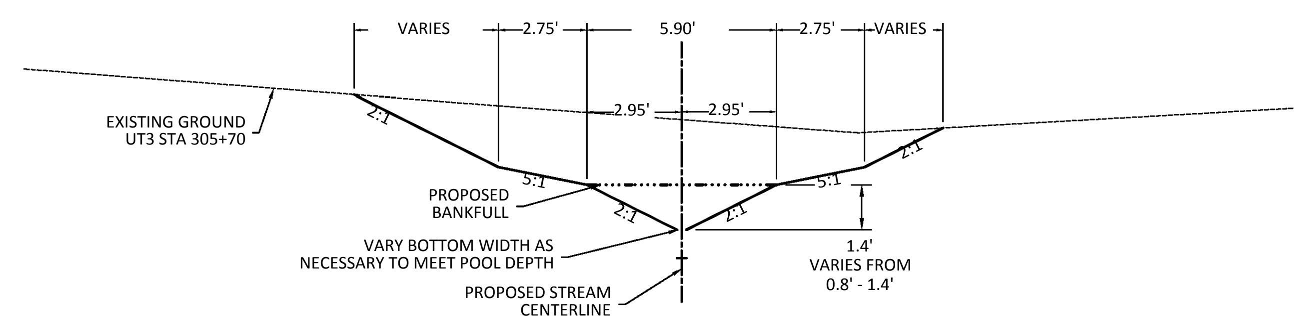
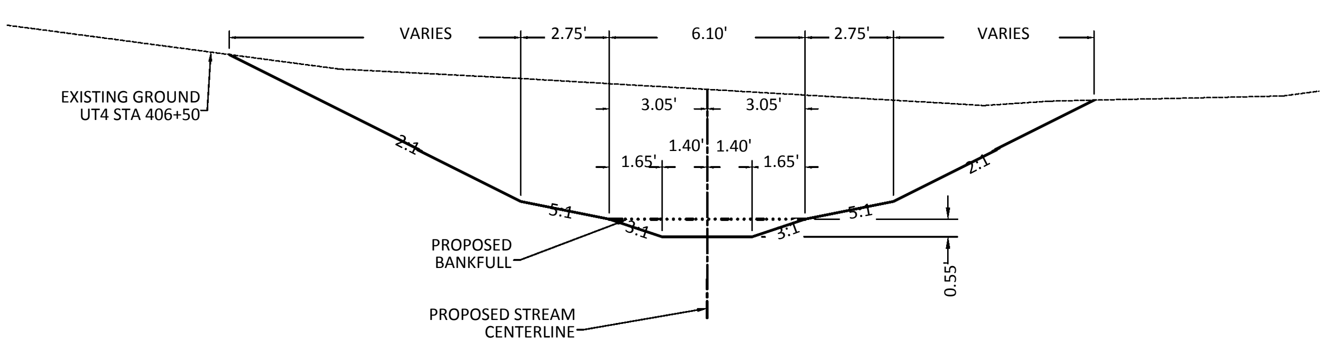
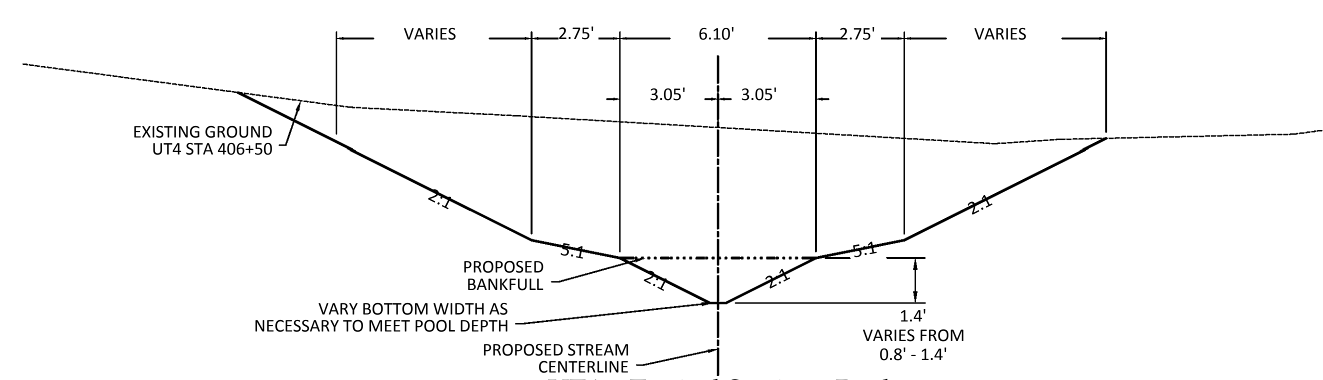
STA 300+00 TO 314+70



UT3 - Typical Section: Pool
STA 300+00 TO 314+70



UT4 - Typical Section: Riffle
STA 400+00 TO 409+56



UT4 - Typical Section: Pool
STA 400+00 TO 409+56

0' 3' 6' 9'

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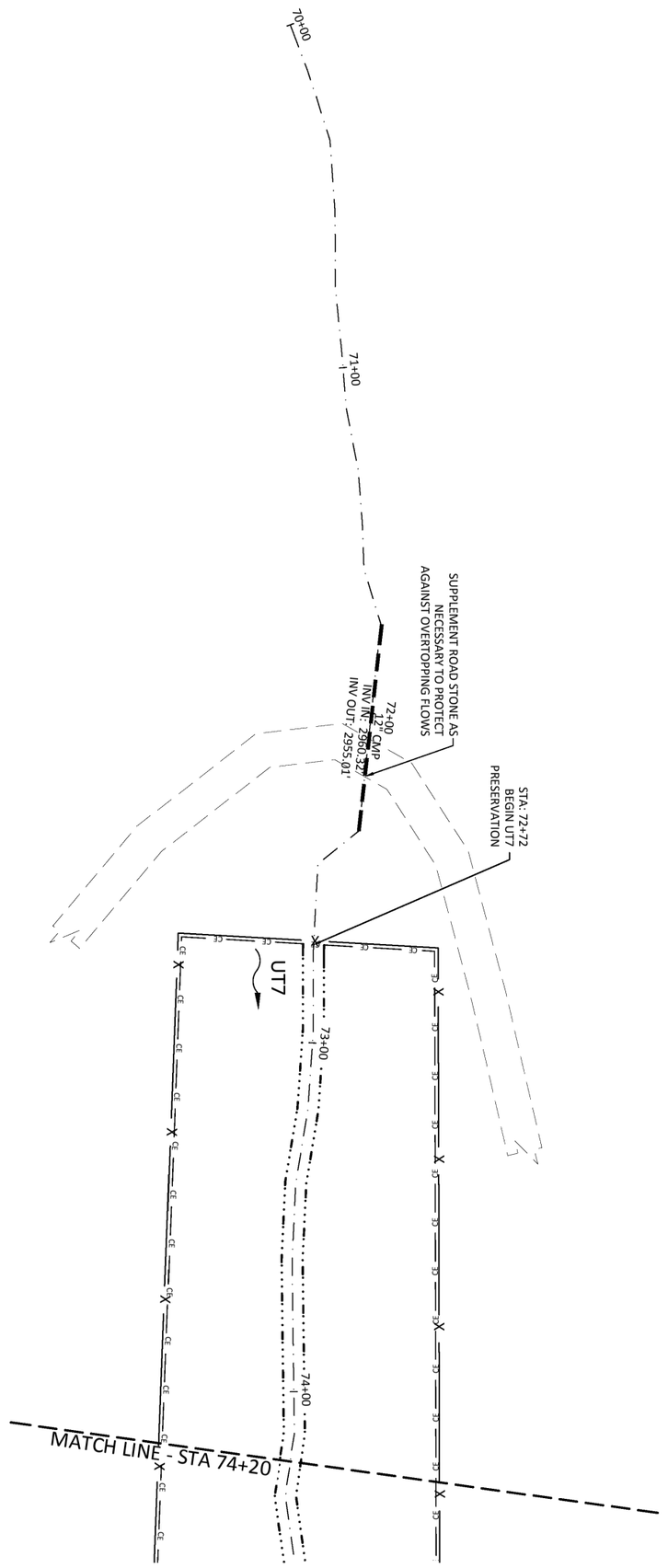
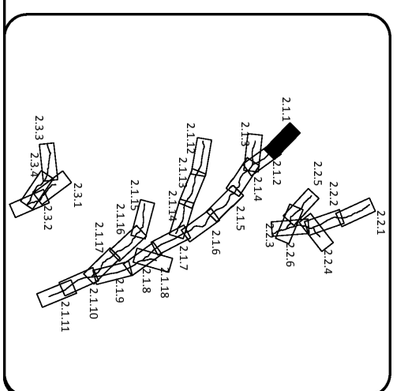
Typical Sections

Revisions:

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
Checked By: CB

1.2
Sheet





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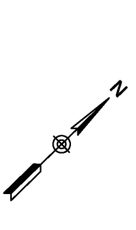

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
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2.1.1
Sheet

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Shake Rag Branch Mitigation Site
Madison County, North Carolina

UT7 Preservation
Stream Plan and Profile

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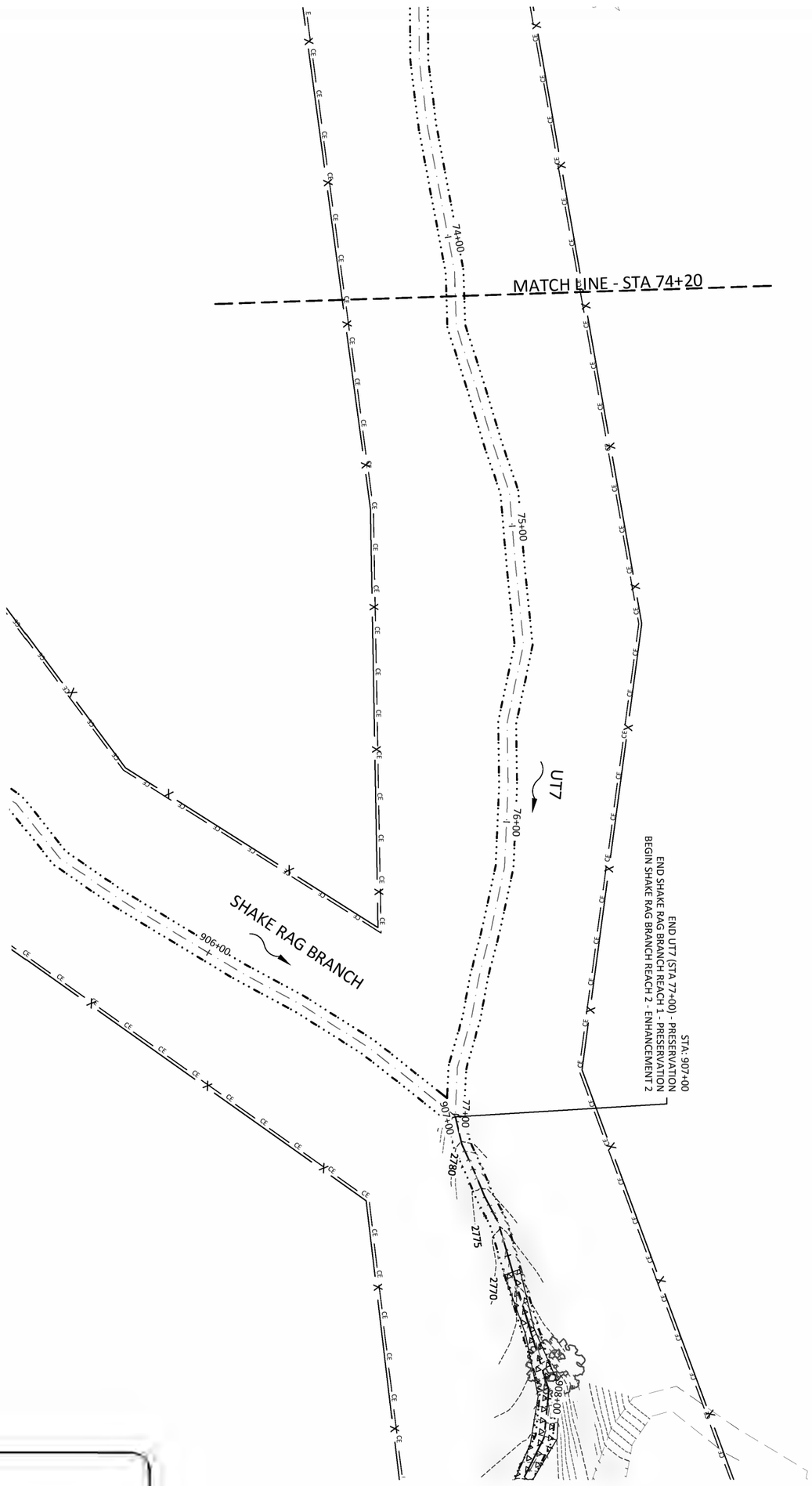

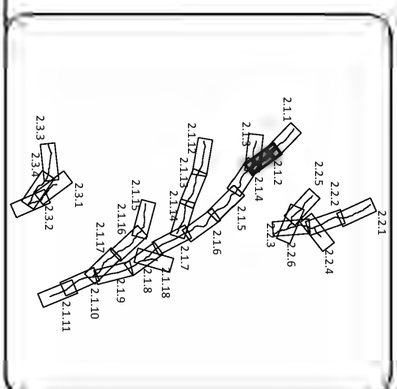

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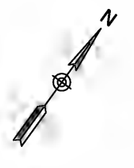

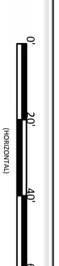

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
Checked By: CB

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2.1.2
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Shake Rag Branch Mitigation Site
Madison County, North Carolina

UT7 Preservation
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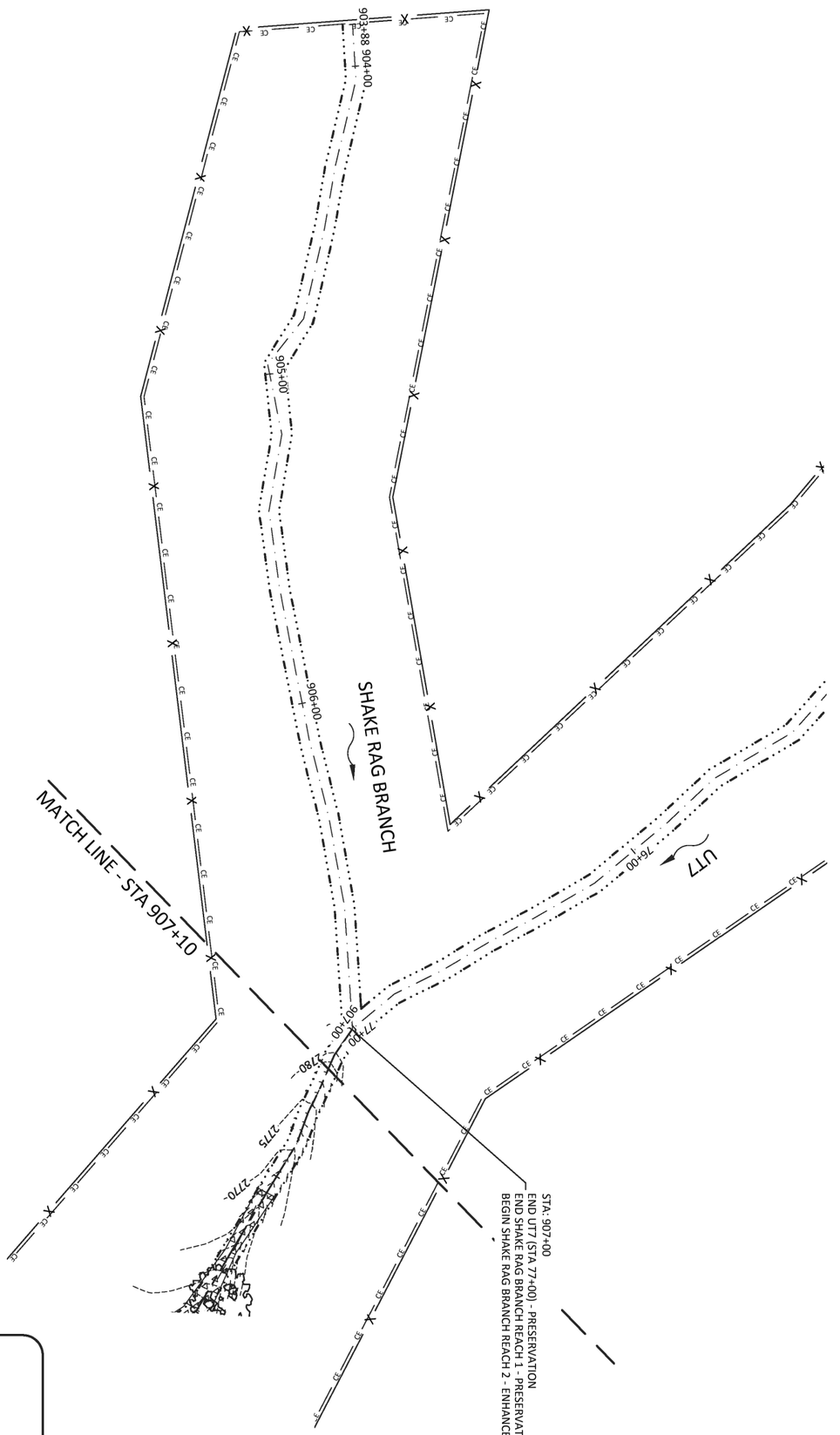

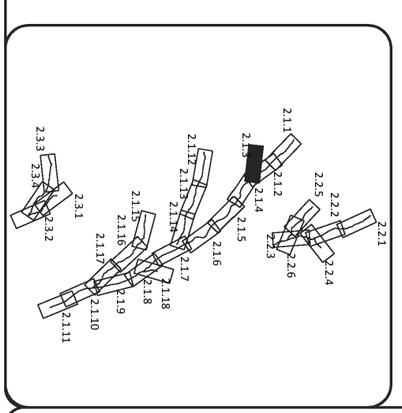

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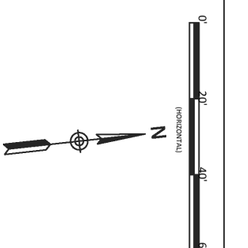

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
Checked By: CB

2.1.3
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Revisions:

Shake Rag Branch Mitigation Site
Madison County, North Carolina

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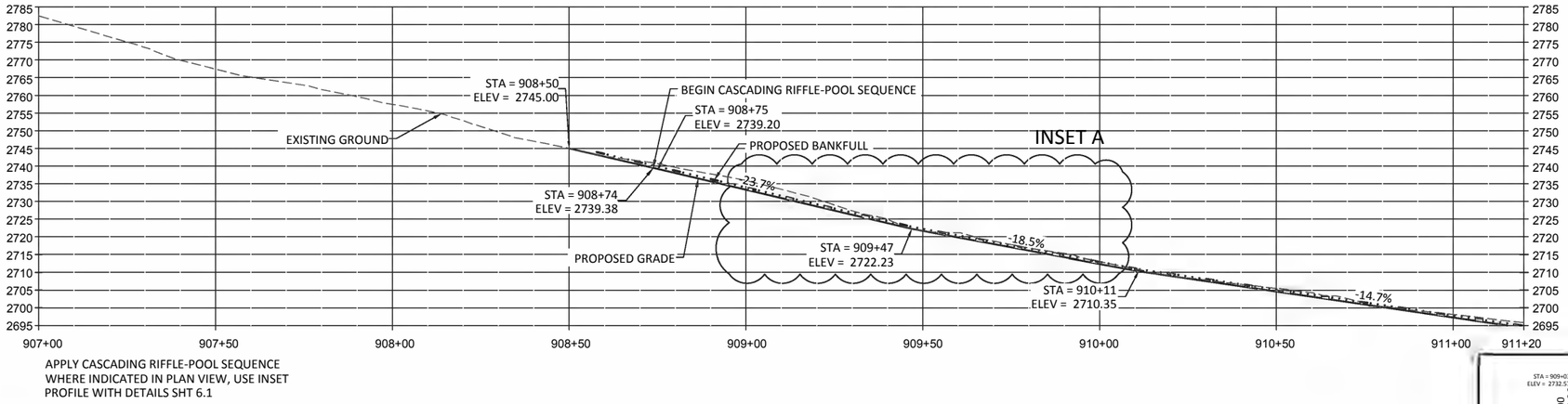
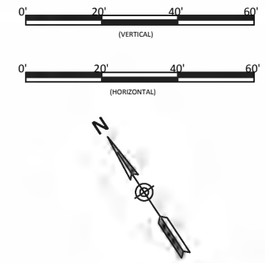
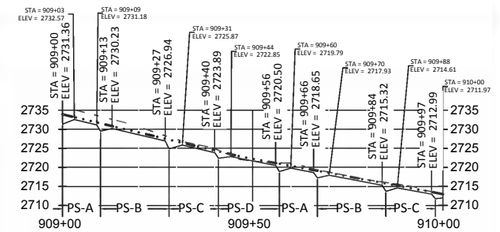
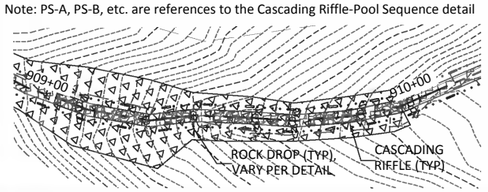


APPLY CASCADING RIFFLE-POOL SEQUENCE WHERE INDICATED IN PLAN VIEW, USE INSET PROFILE WITH DETAILS SHT 6.1

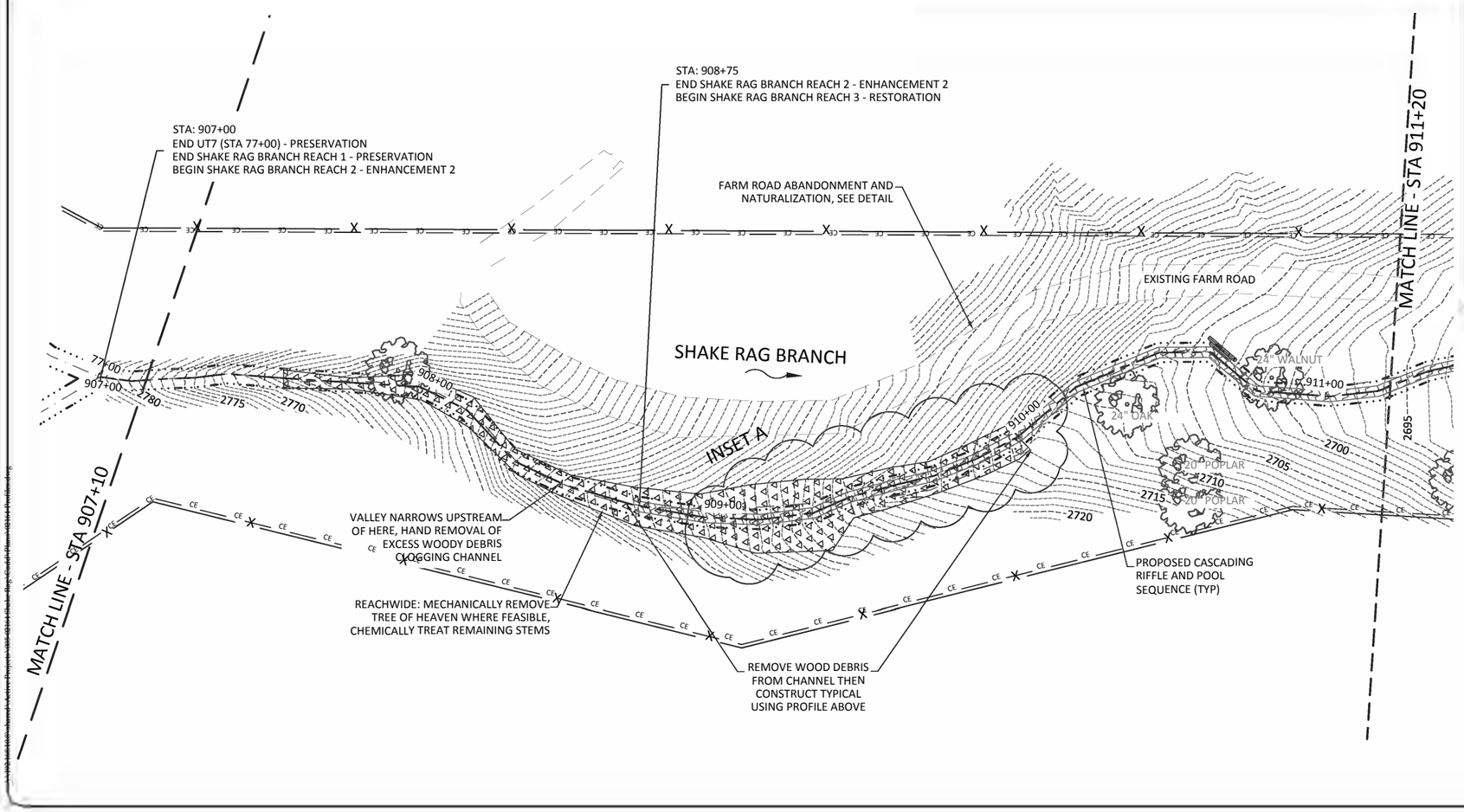




Note: PS-A, PS-B, etc. are references to the Cascading Riffle-Pool Sequence detail



INSET A: Plan and Profile Details



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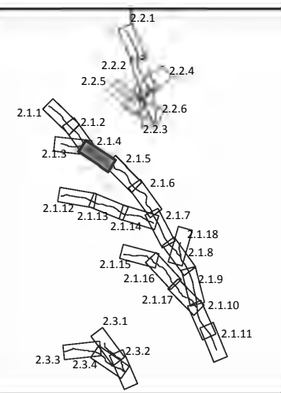

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Shake Rag Branch Mitigation Site
Madison County, North Carolina

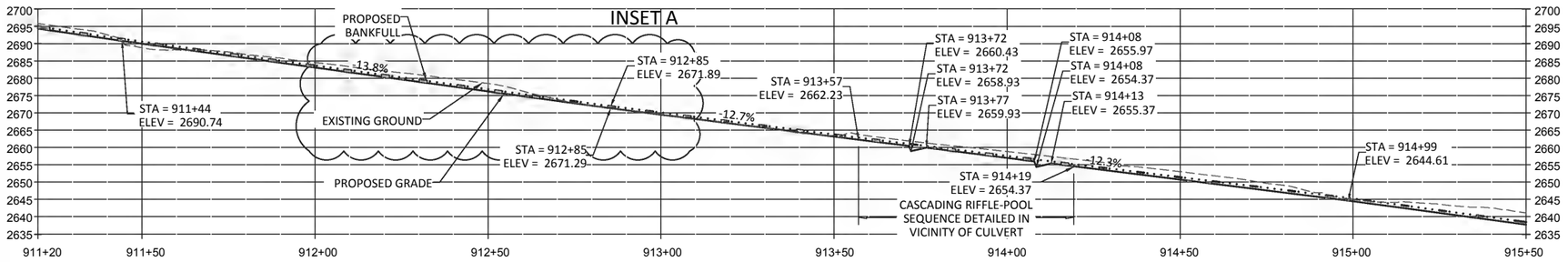
Shake Rag Branch
Stream Plan and Profile

Revisions:

Date: November 06, 2018
DMS Number: 005-02165
Project Engineer: JM
Drawn by: JDW
Checked By: CB

2.1.4
Sheet

November 06, 2018

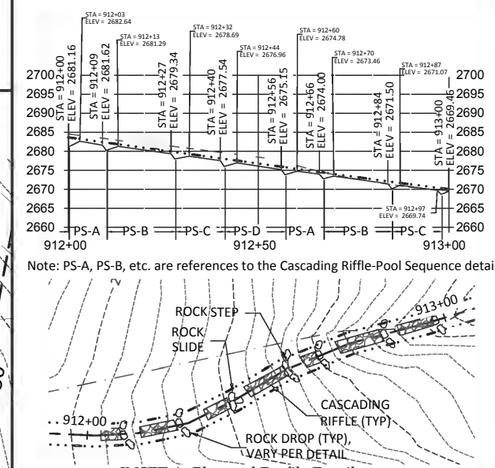


APPLY CASCADING RIFFLE-POOL SEQUENCE WHERE INDICATED IN PLAN VIEW, USE INSET PROFILE WITH DETAILS SHT 6.1

0' 20' 40' 60' (VERTICAL)

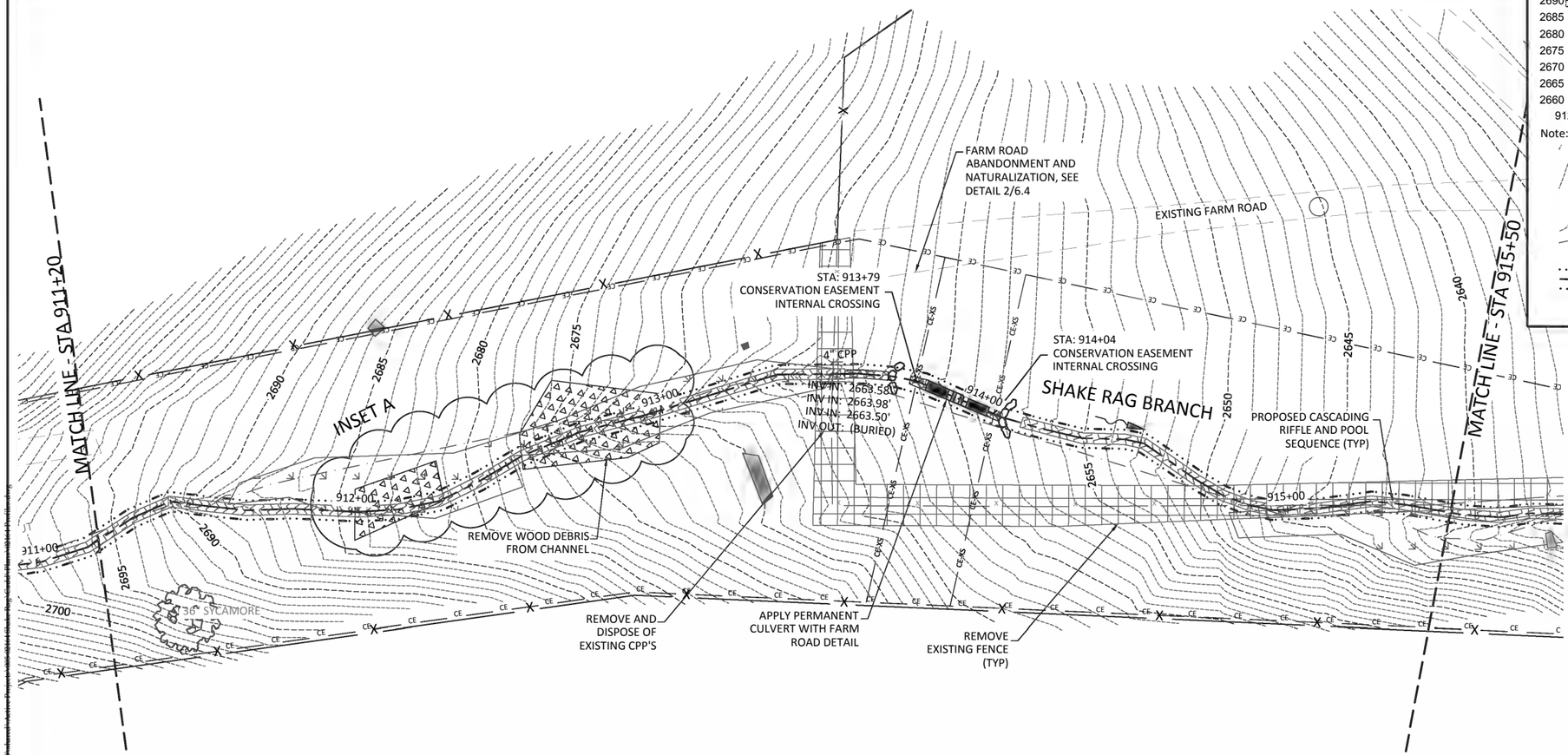
0' 20' 40' 60' (HORIZONTAL)

N

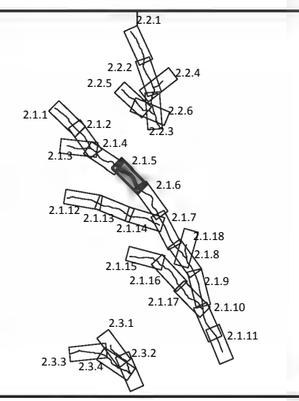


Note: PS-A, PS-B, etc. are references to the Cascading Riffle-Pool Sequence detail

INSET A: Plan and Profile Details



Sheet Index



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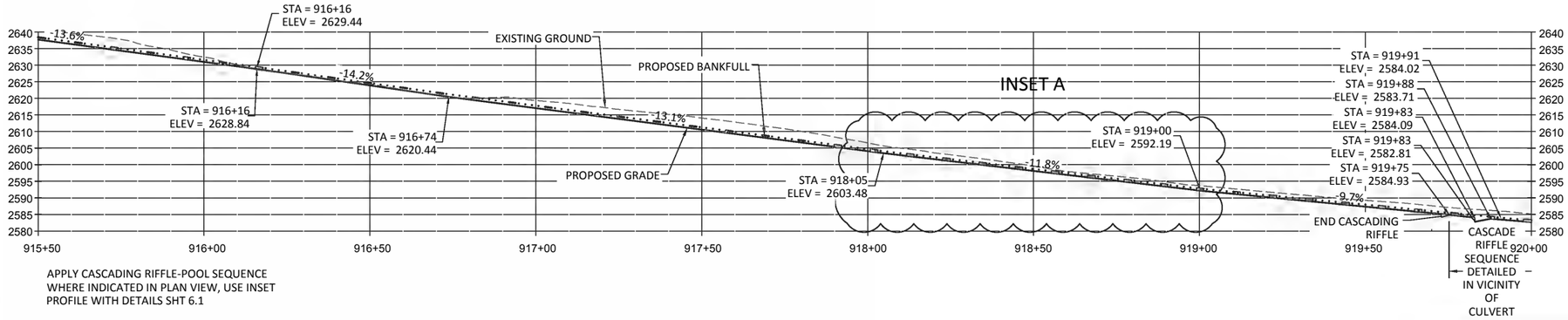
Shake Rag Branch Mitigation Site
Madison County, North Carolina

Shake Rag Branch
Stream Plan and Profile

Revisions:

Date: November 06, 2018
Job Number: 005-02166
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 2.1.5

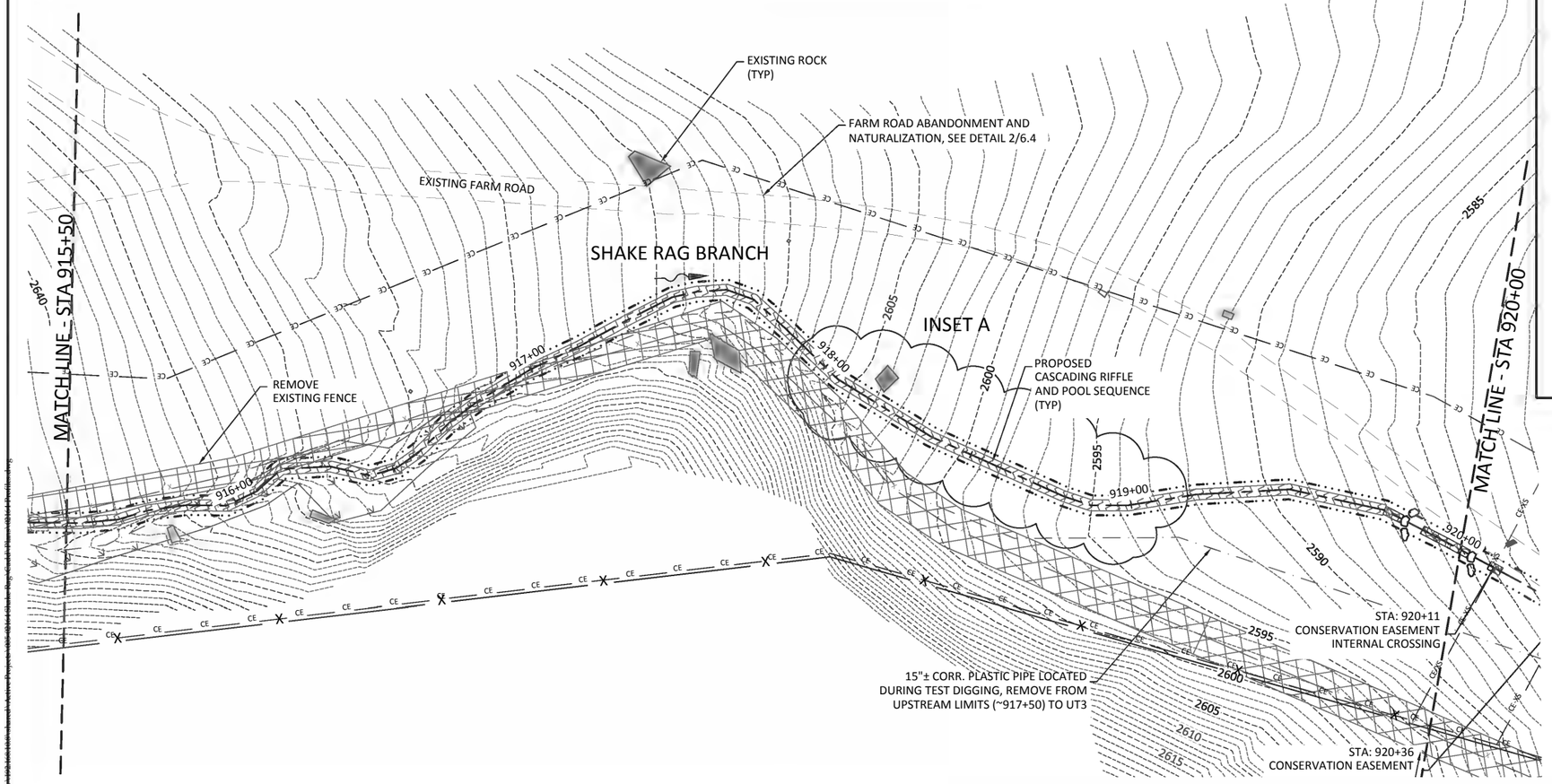


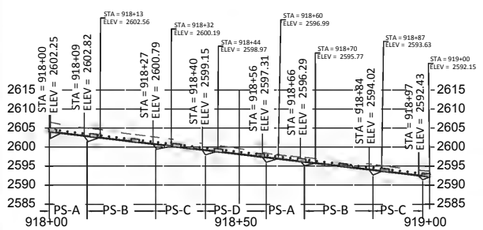
APPLY CASCADING RIFFLE-POOL SEQUENCE WHERE INDICATED IN PLAN VIEW, USE INSET PROFILE WITH DETAILS SHT 6.1

0' 20' 40' 60' (VERTICAL)

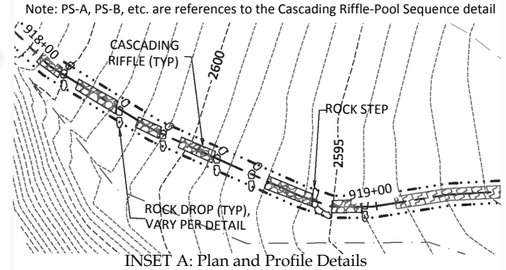
0' 20' 40' 60' (HORIZONTAL)

N





Note: PS-A, PS-B, etc. are references to the Cascading Riffle-Pool Sequence detail



INSET A: Plan and Profile Details

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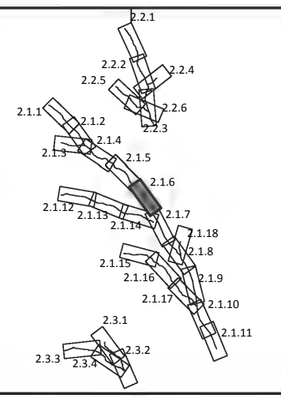

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PRELIMINARY DO NOT USE FOR CONSTRUCTION

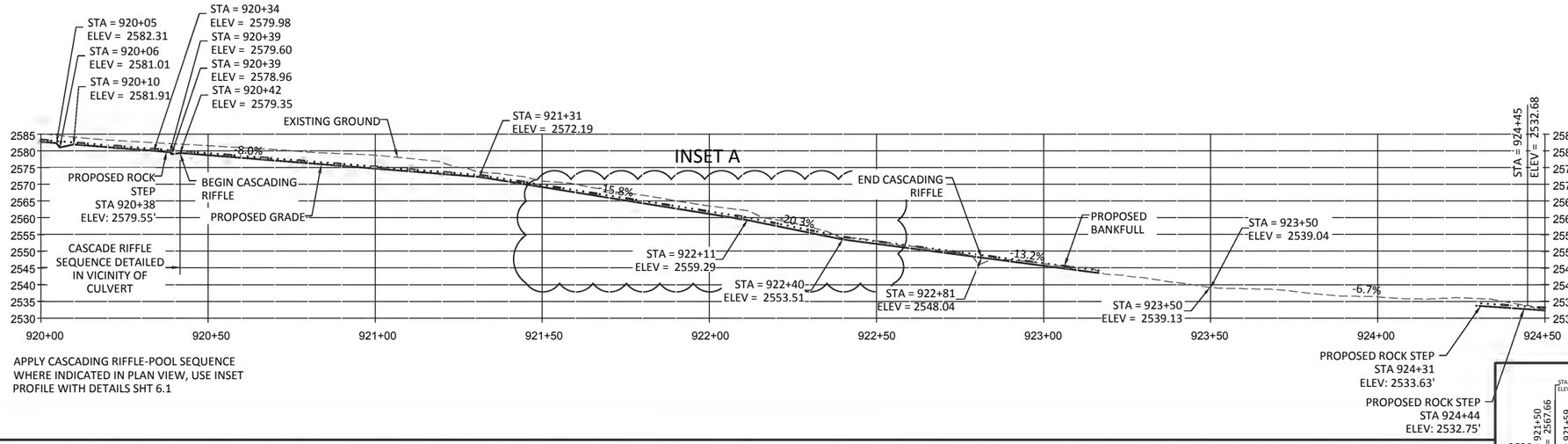
Shake Rag Branch Mitigation Site
Madison County, North Carolina

Shake Rag Branch
Stream Plan and Profile

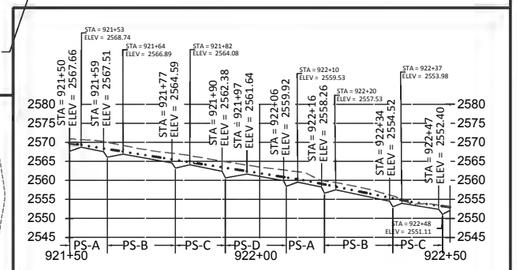
Revisions:

Date: November 06, 2018
DMS Number: 100542
Project Engineer: JM
Drawn by: JDW
Checked by: CB

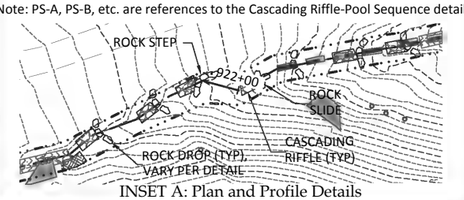
Sheet 2.1.6



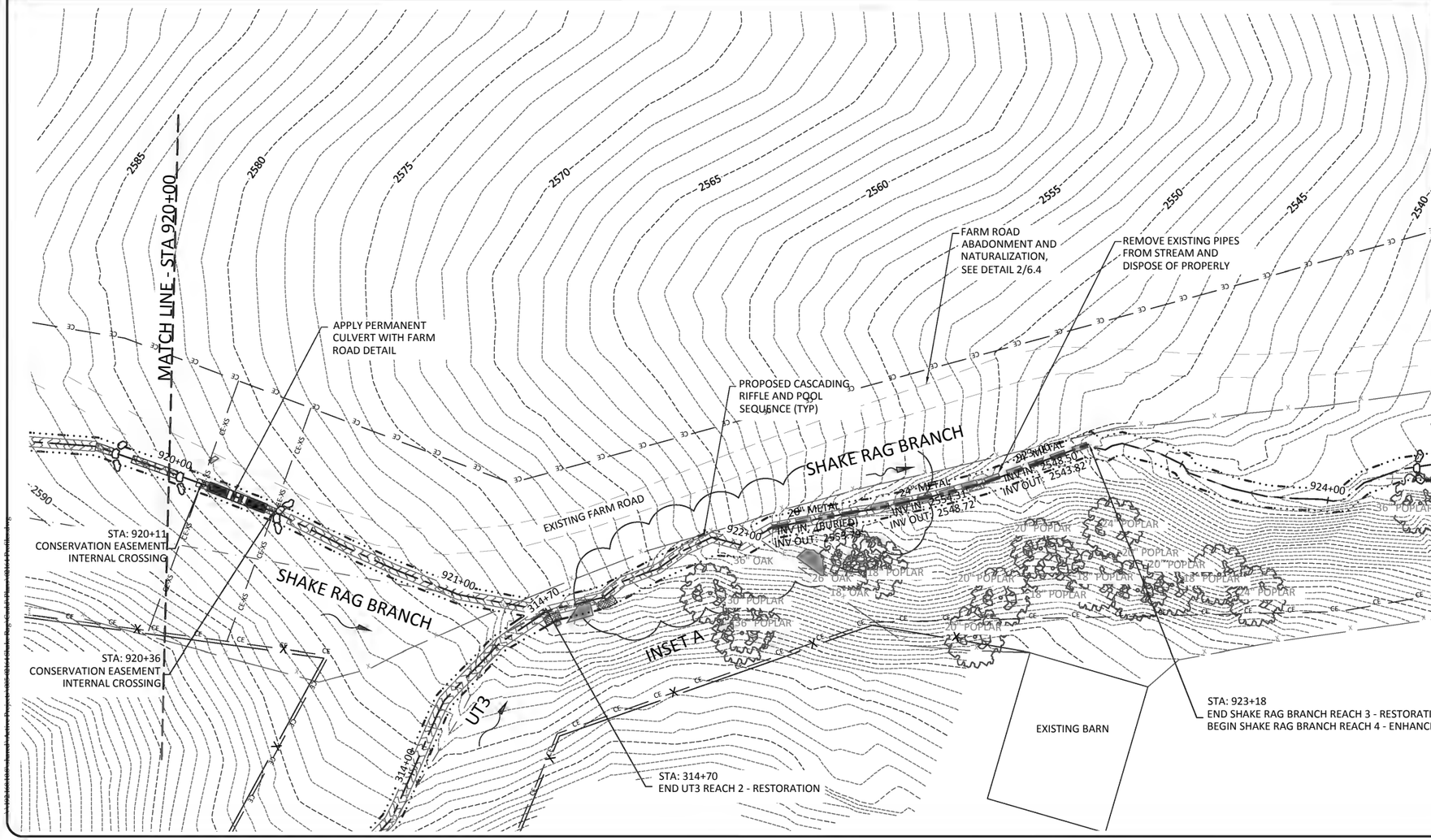
APPLY CASCADING RIFFLE-POOL SEQUENCE WHERE INDICATED IN PLAN VIEW, USE INSET PROFILE WITH DETAILS SHT 6.1



Note: PS-A, PS-B, etc. are references to the Cascading Riffle-Pool Sequence detail



INSET A: Plan and Profile Details



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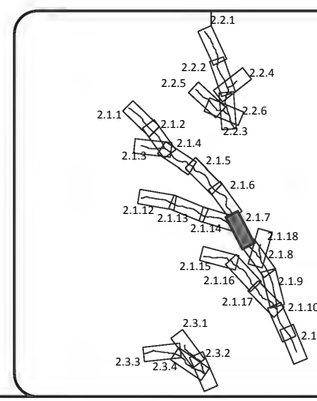

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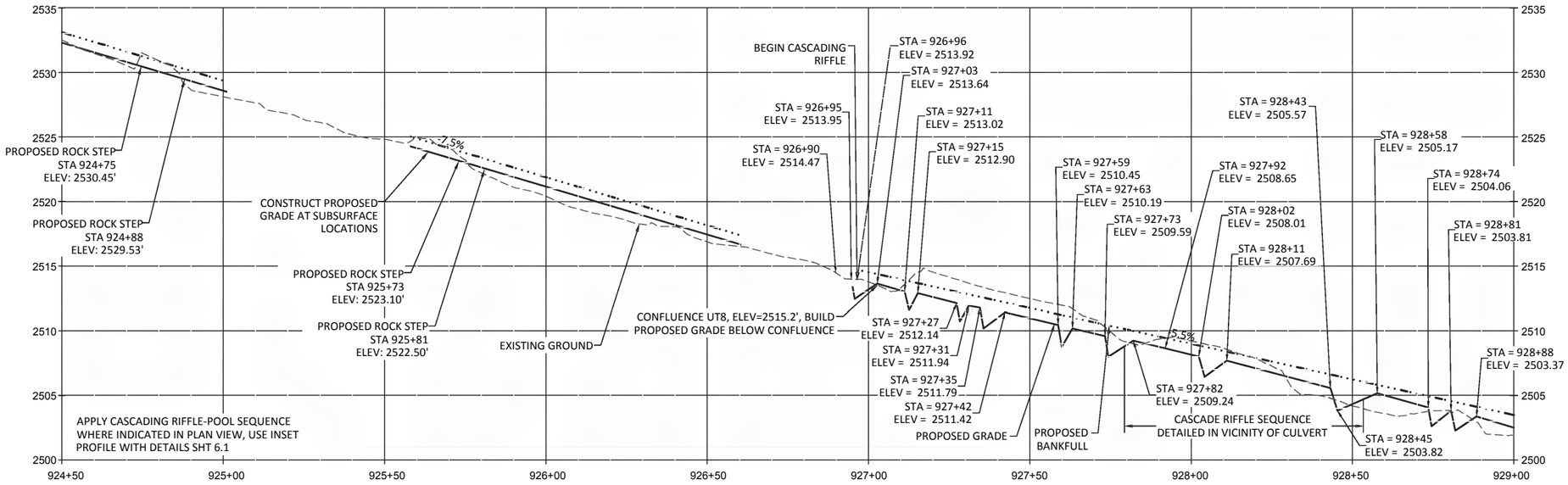
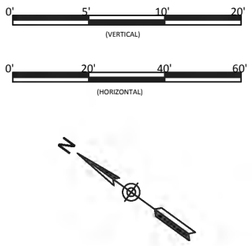
Shake Rag Branch
Stream Plan and Profile

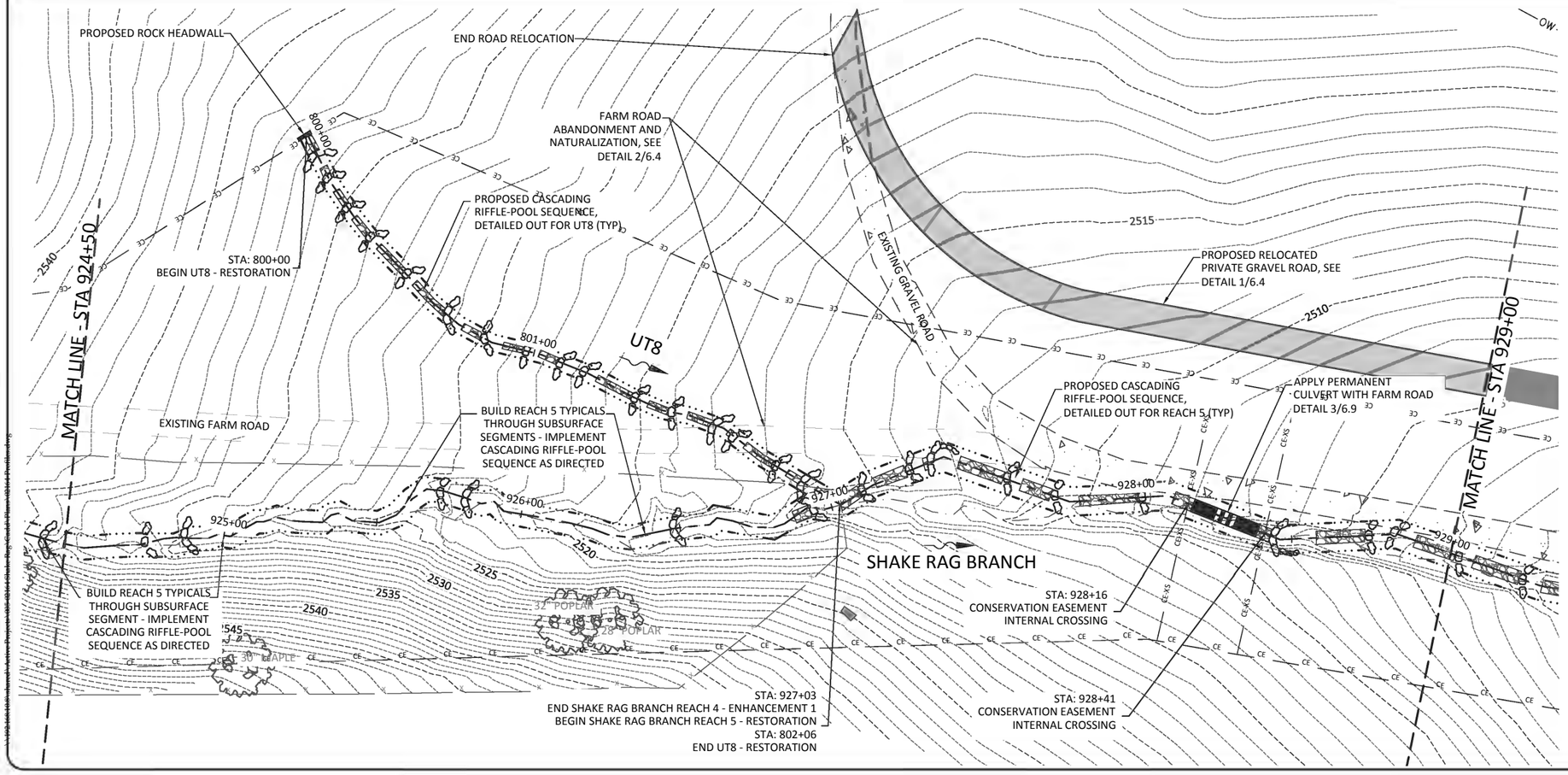
Revisions:

Date: November 06, 2018
703 Number: 005-02165
Project Engineer: TM
Drawn by: JDW
Checked by: CB

Sheet 2.1.7







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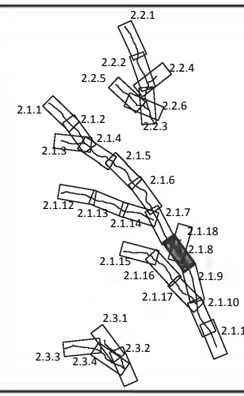

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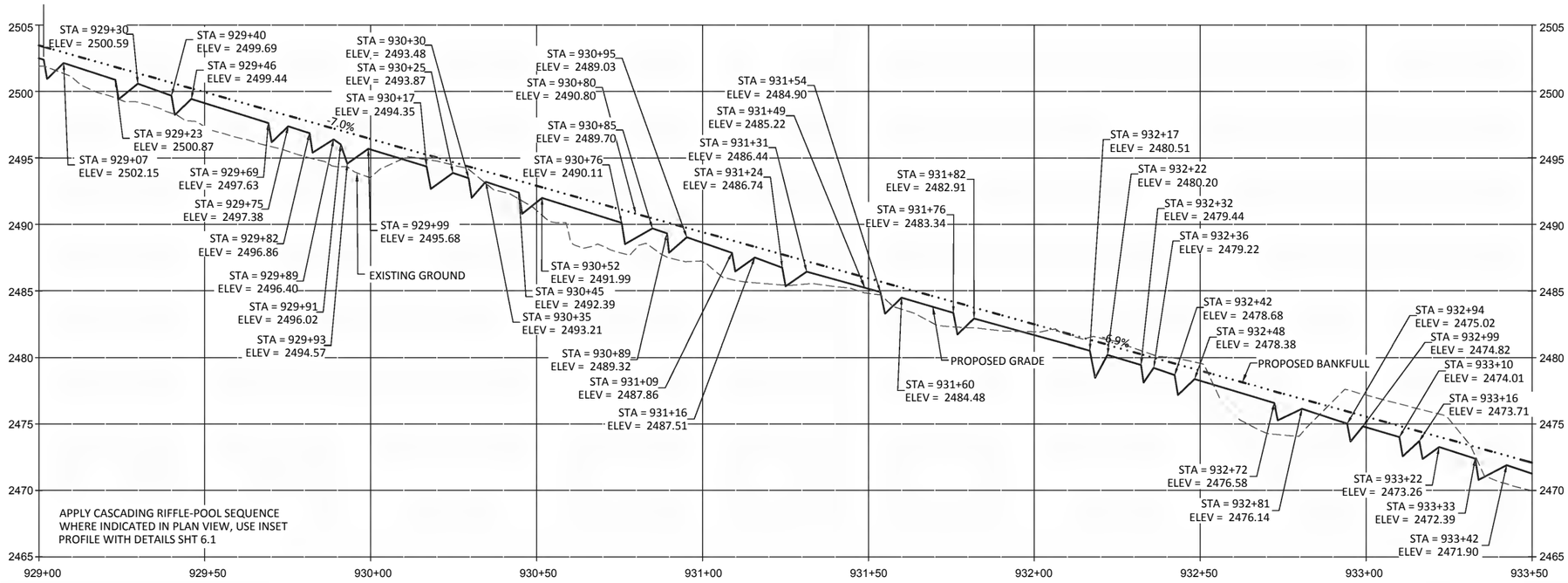
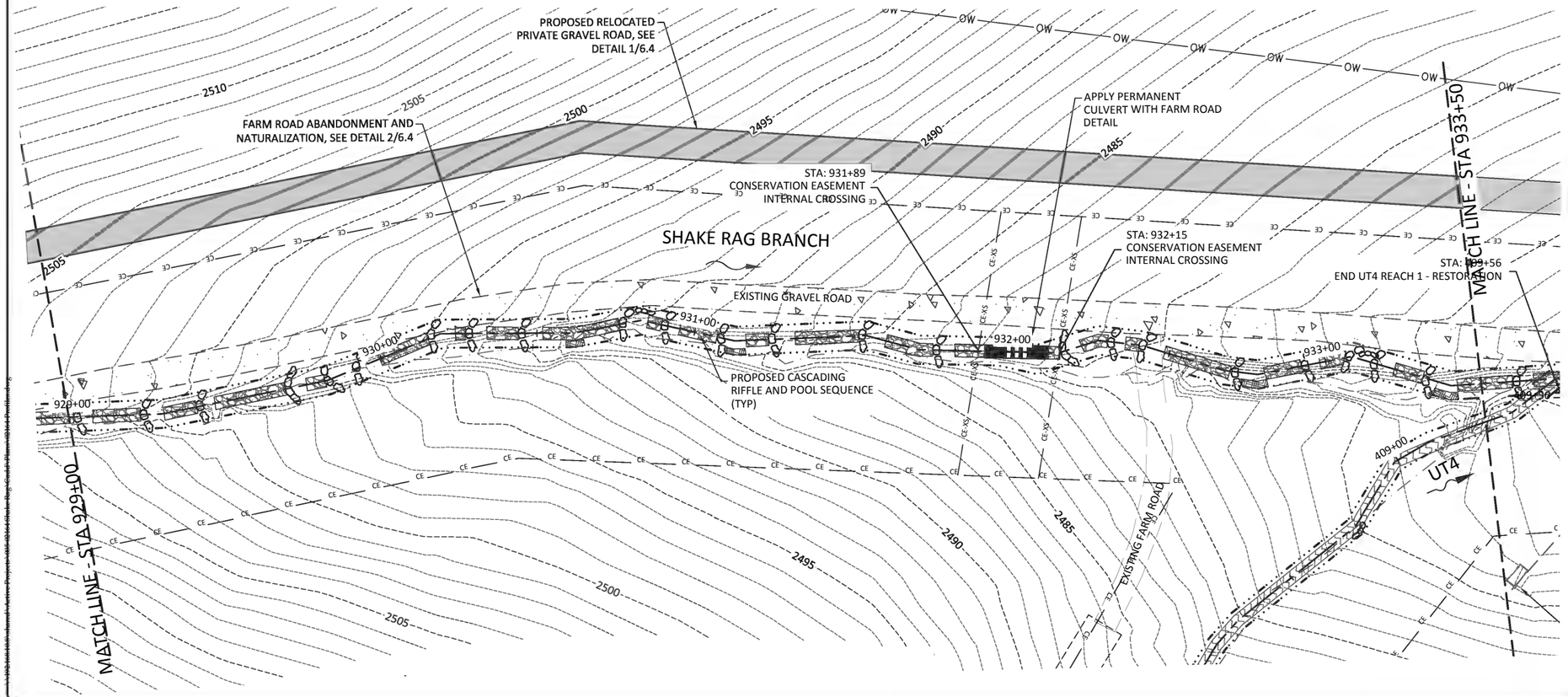
Shake Rag Branch
Stream Plan and Profile

Revisions:

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 2.1.8





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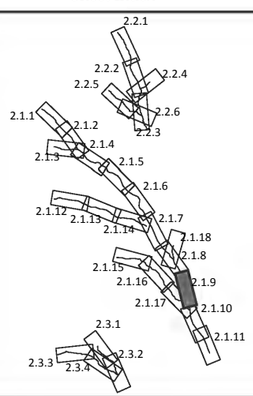

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Revisions:

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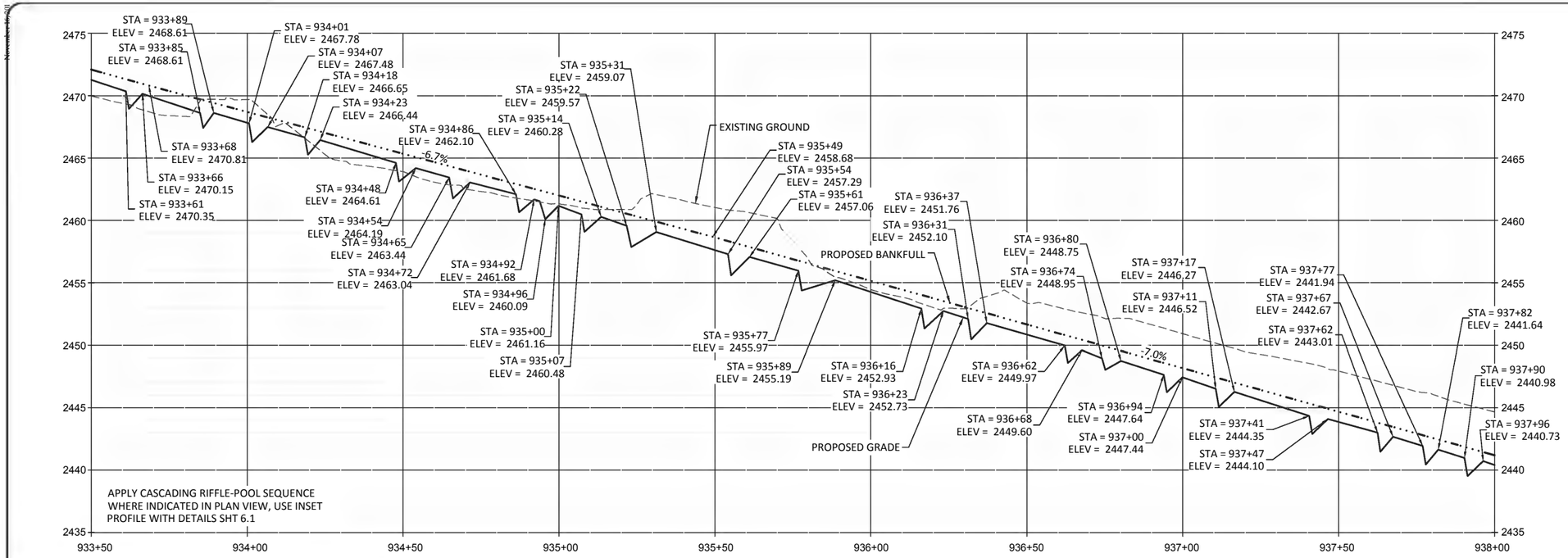
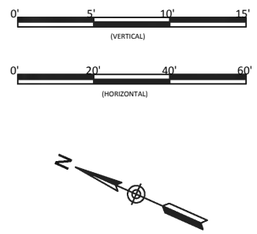
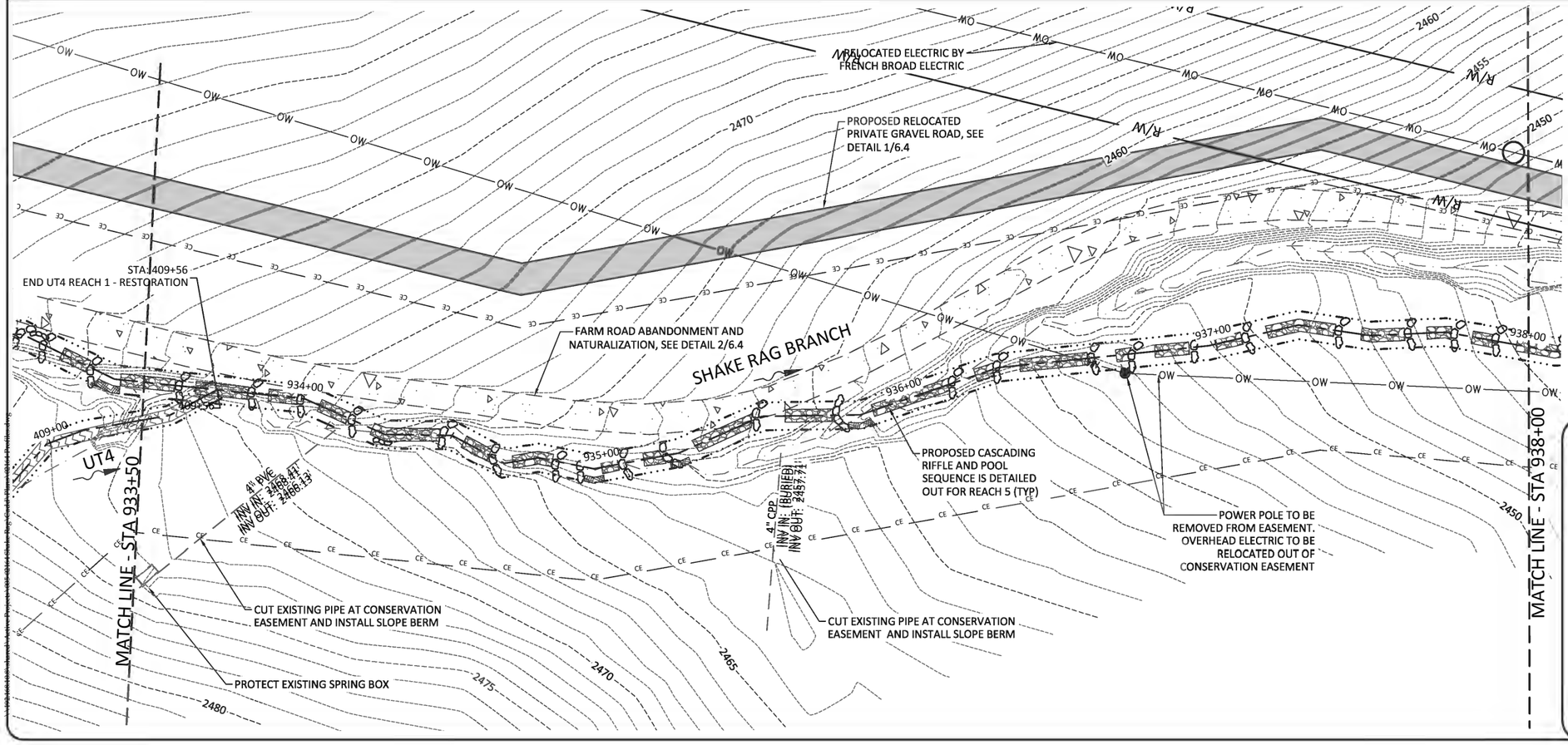
WS Number: 005-02164
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 2.1.9







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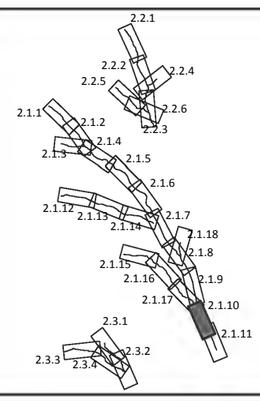

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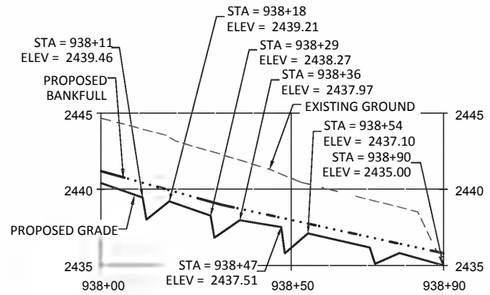
Shake Rag Branch
Stream Plan and Profile

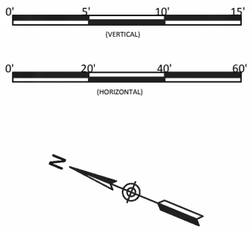
Revisions:

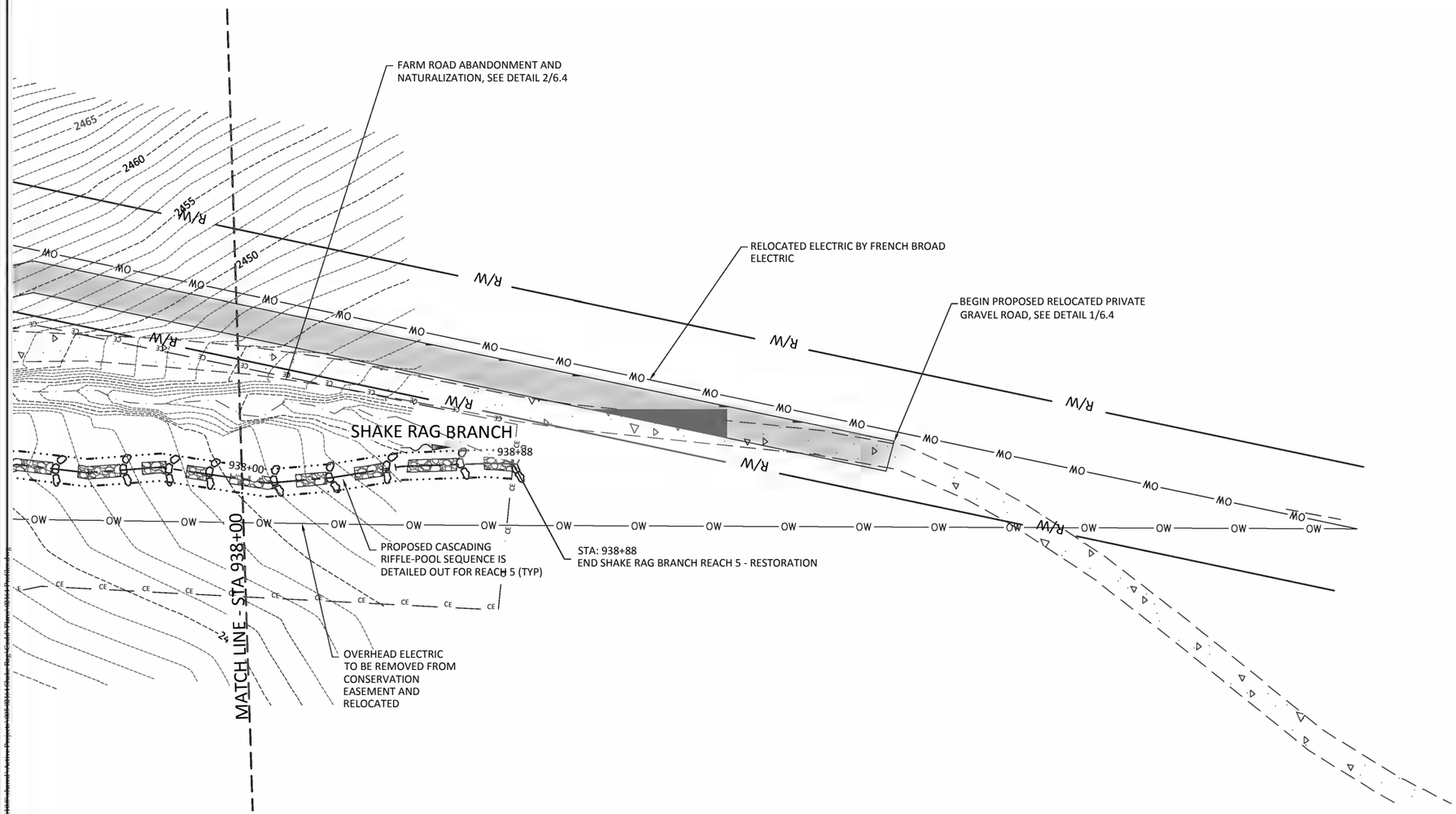
Date: November 06, 2018
EEP Number: 005421[illegible]
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 2.1.10



PROFILE FOR CASCADING RIFFLE-POOL SEQUENCE DETAILED OUT FOR UT8 - CONTRACTOR SHALL IMPLEMENT PER DETAILS SHT 6.1





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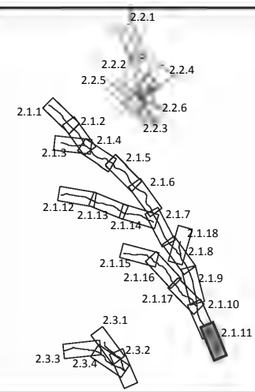

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Date: November 06, 2018
WB Number: 005-02164
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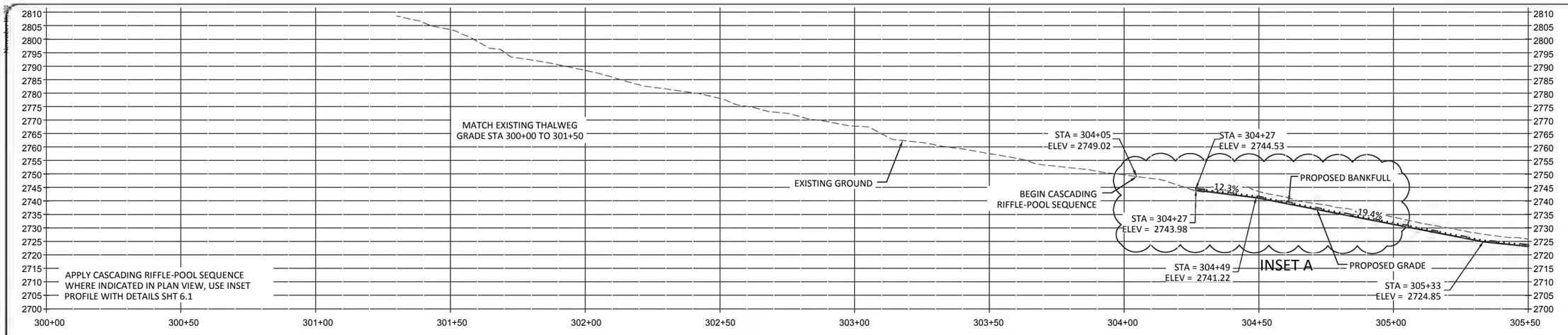
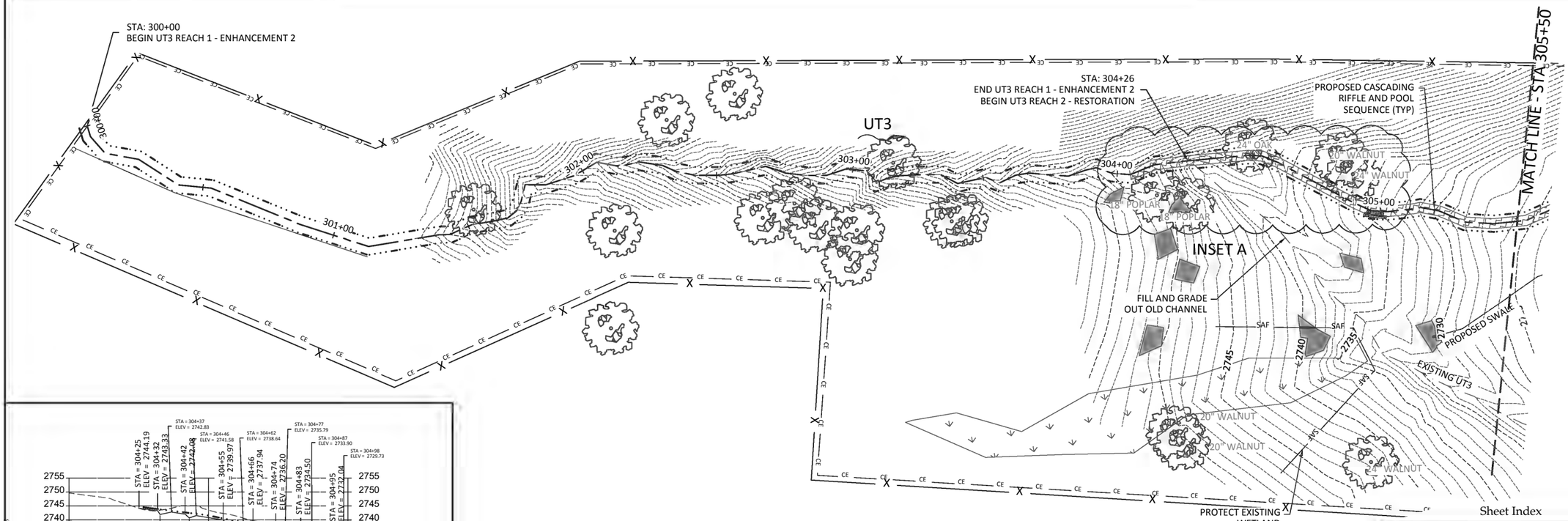
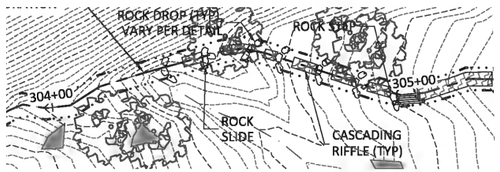
Checked by: CB

Sheet 2.1.11





Note: PS-A, PS-B, etc. are references to the Cascading Riffle-Pool Sequence detail



INSET A: Plan and Profile Details

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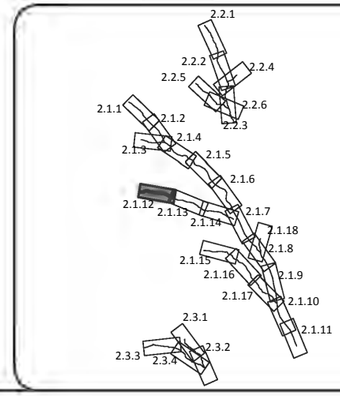

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UT3
Stream Plan and Profile

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319 Number: 005-02161
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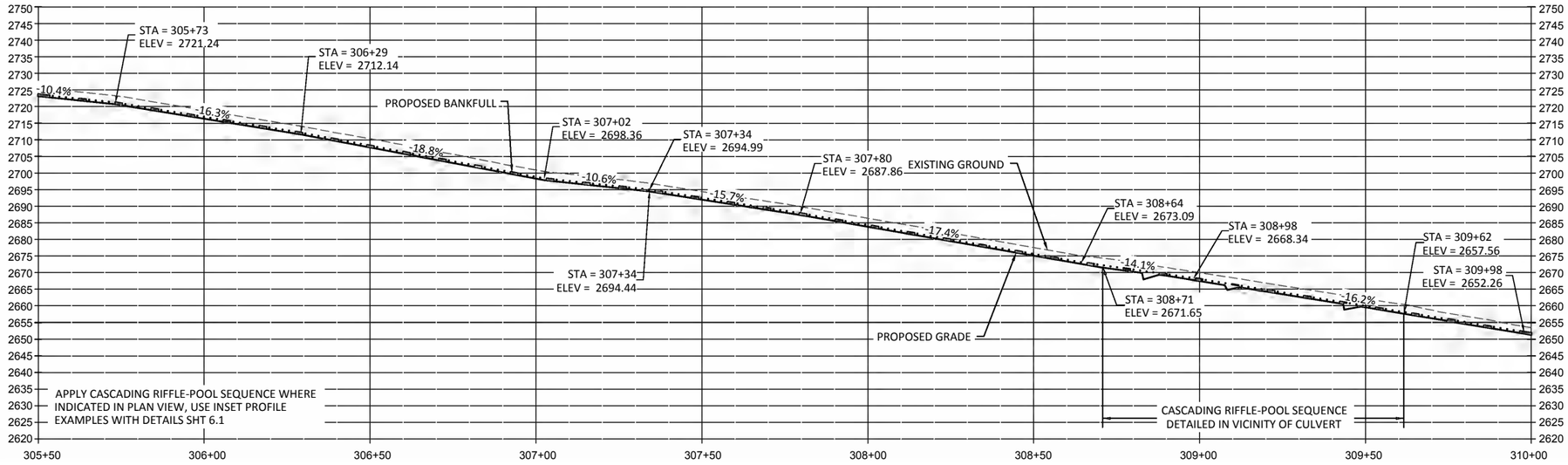
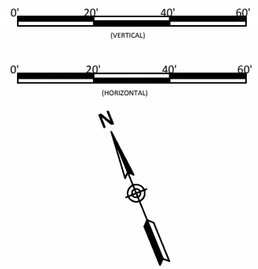
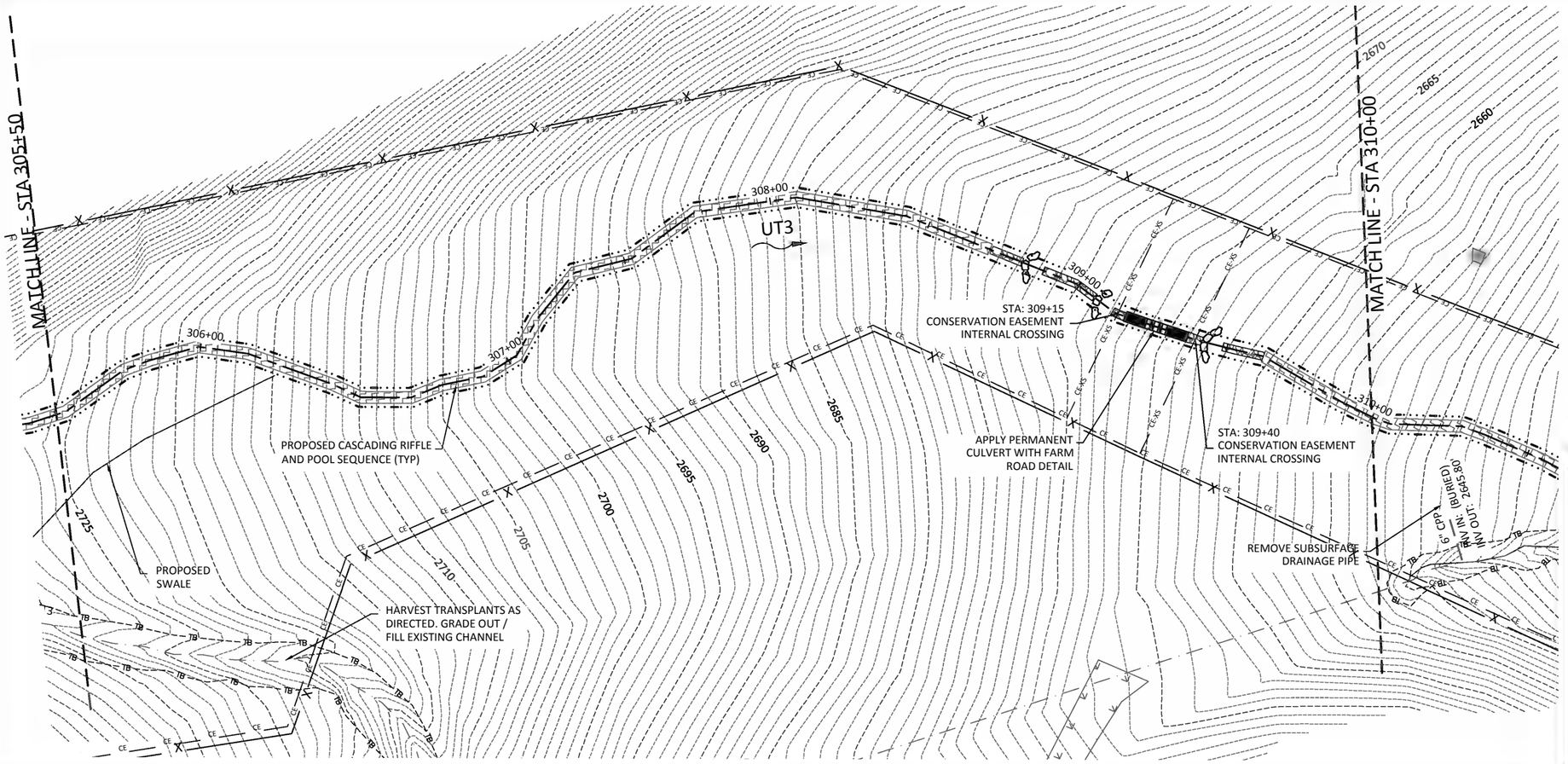
Sheet 2.1.12





INSUFFICIENT SPACE TO SHOW INSET. USE PREVIOUS AND NEXT SHEET AS EXAMPLES FOR APPLYING CASCADING RIFFLE-POOL SEQUENCE.



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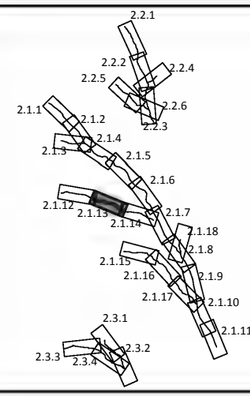

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Stream Plan and Profile

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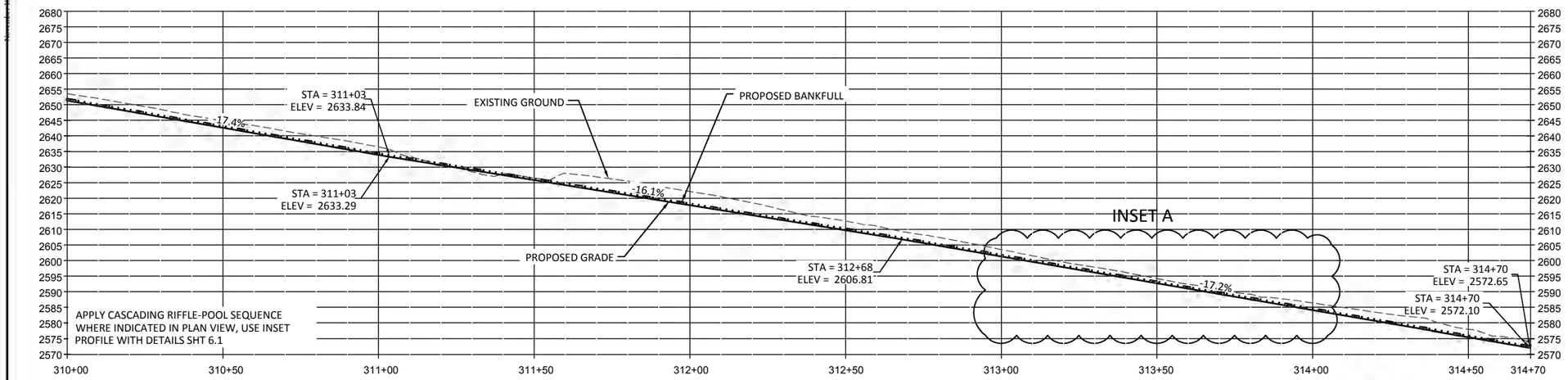
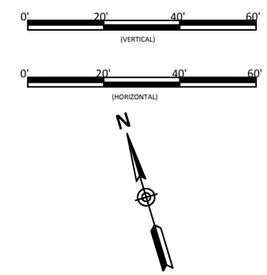
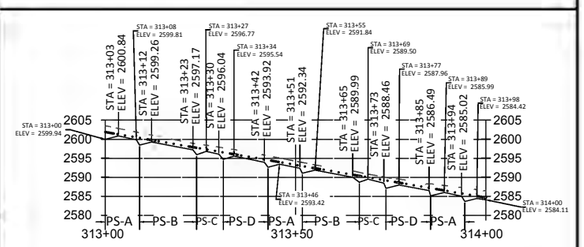
Sheet 2.1.13

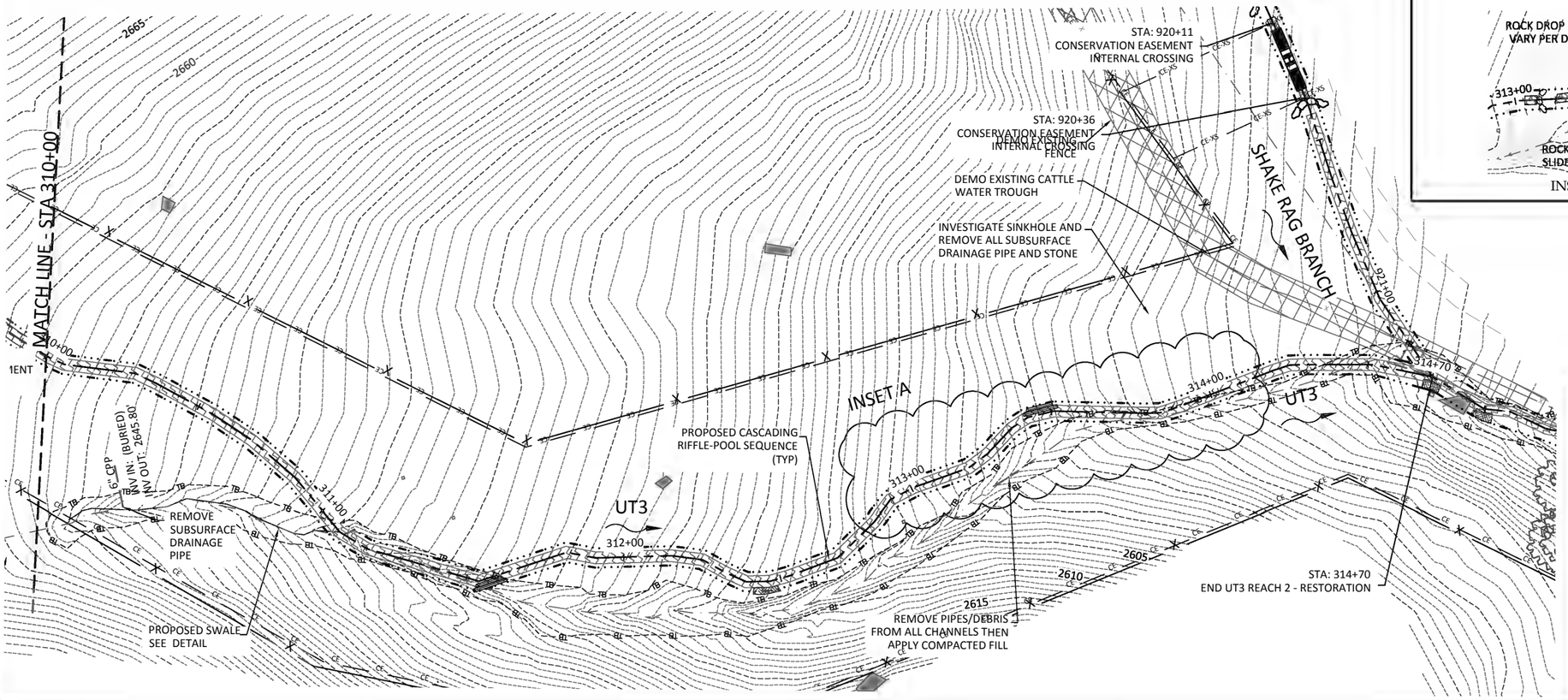






Note: PS-A, PS-B, etc. are references to the Cascade-Pool Sequence detail

INSET A: Plan and Profile Details



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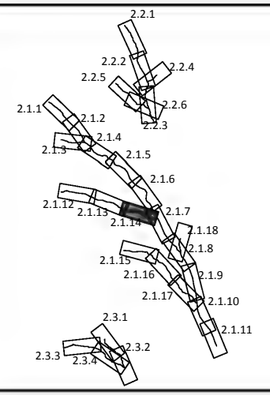

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Sheet 2.1.14

Shake Rag Branch Mitigation Site
Madison County, North Carolina
UT4
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Project Engineer: JM
Drawn By: JDW
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Revisions:

Sheet
2.1.15

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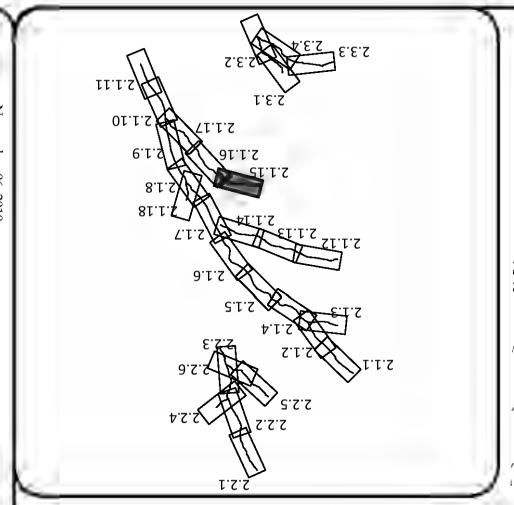
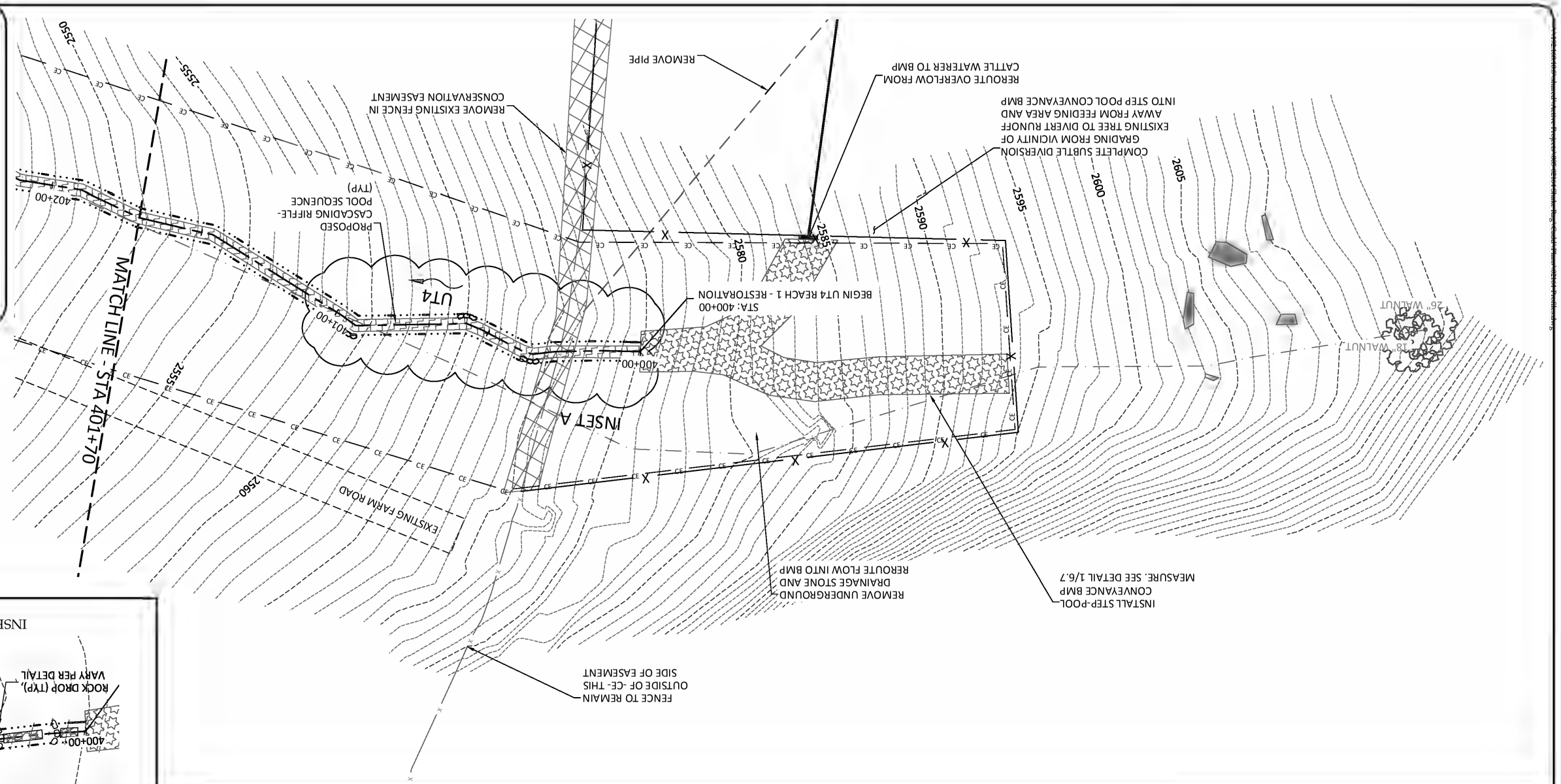
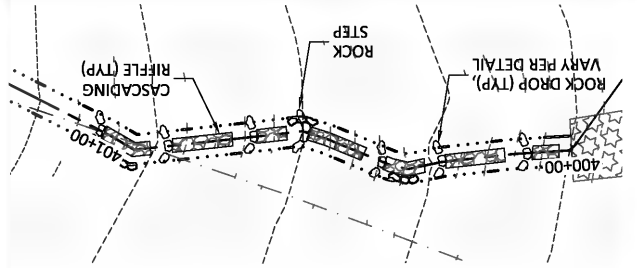
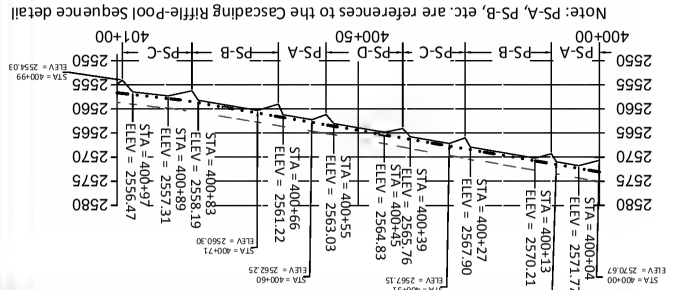
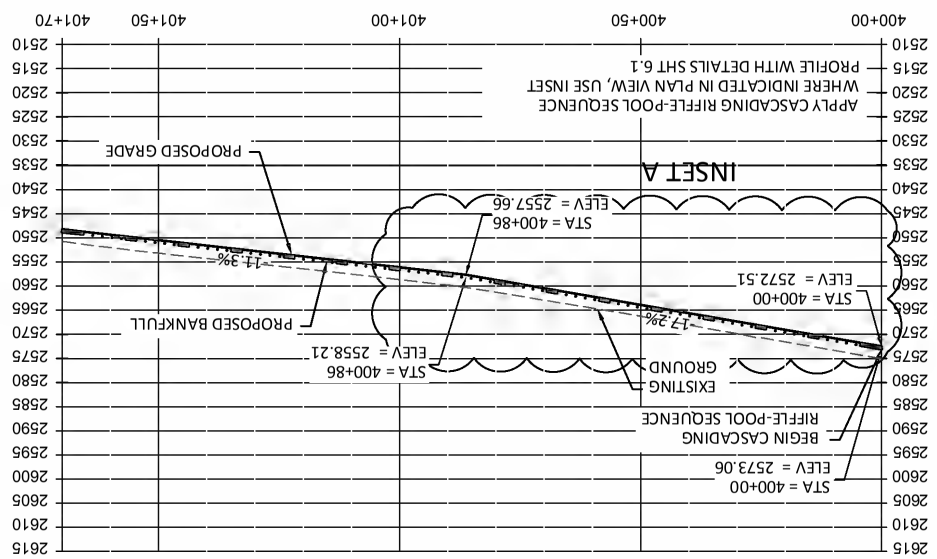
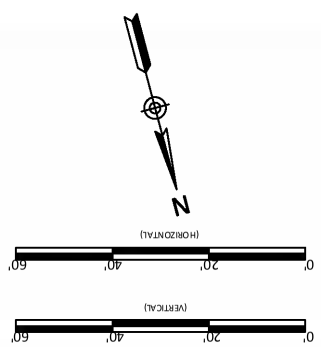


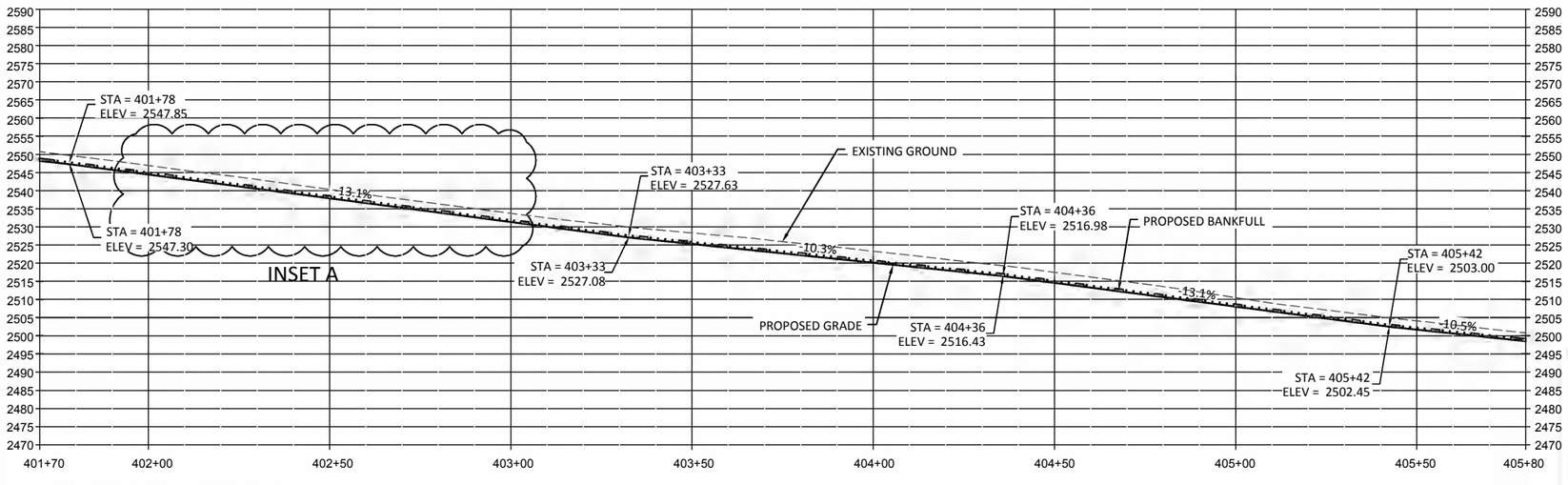




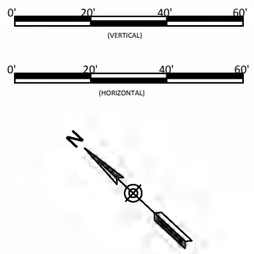


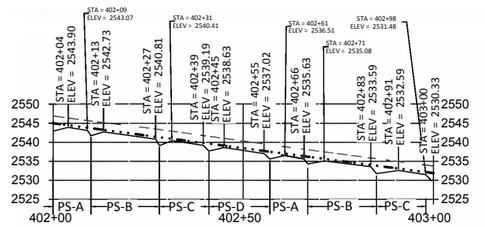




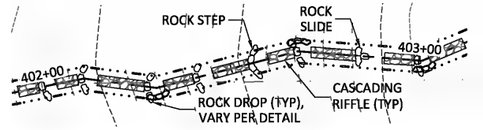


APPLY CASCADING RIFFLE-POOL SEQUENCE WHERE INDICATED IN PLAN VIEW, USE INSET PROFILE WITH DETAILS SHT 6.1

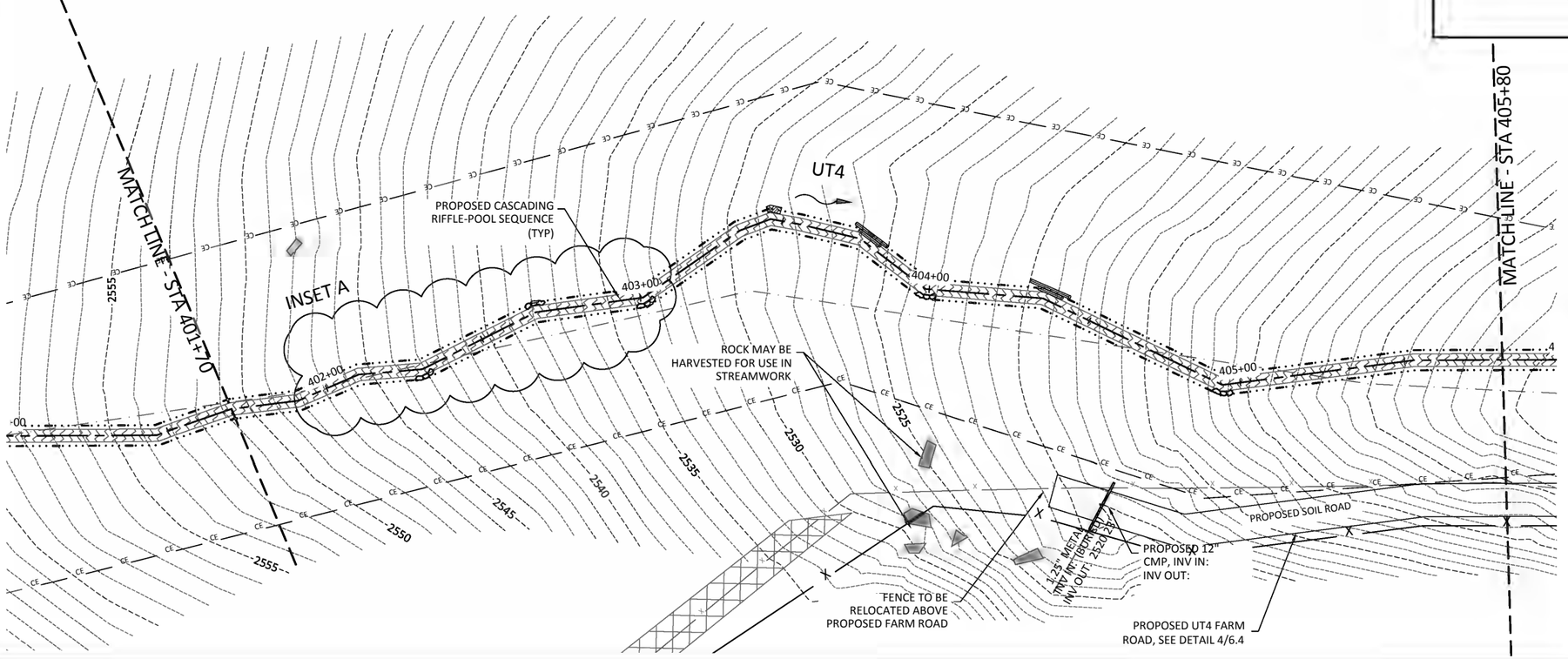




Note: PS-A, PS-B, etc. are references to the Cascading Riffle-Pool Sequence detail



INSET A: Plan and Profile Details



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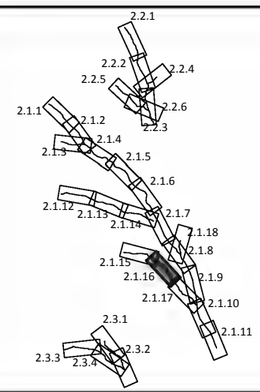

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Drawn by: JDW
Checked by: CB

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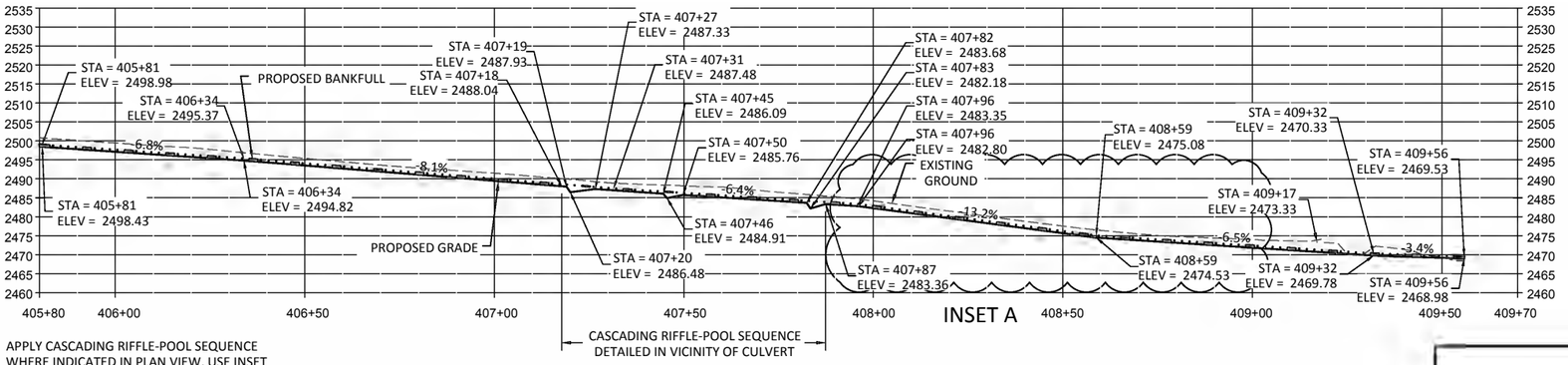
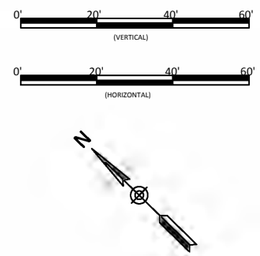
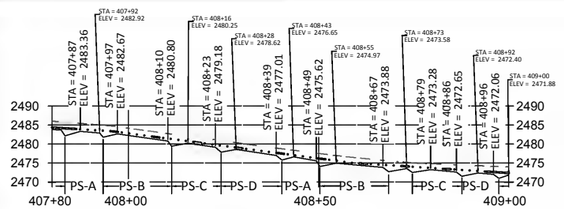
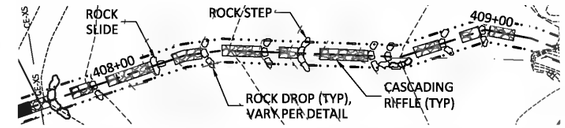


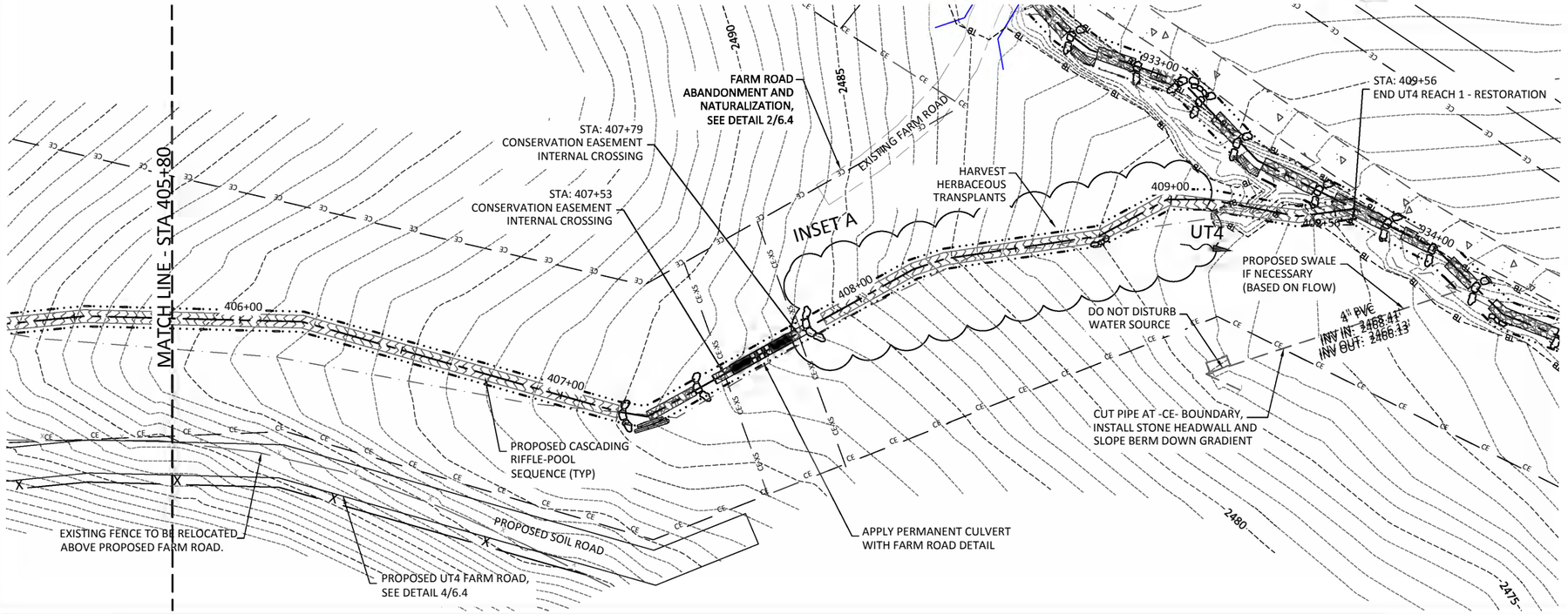




Note: PS-A, PS-B, etc. are references to the Cascading Riffle-Pool Sequence detail



INSET A: Plan and Profile Details



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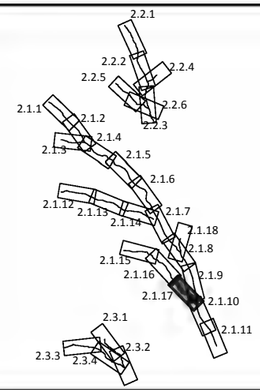

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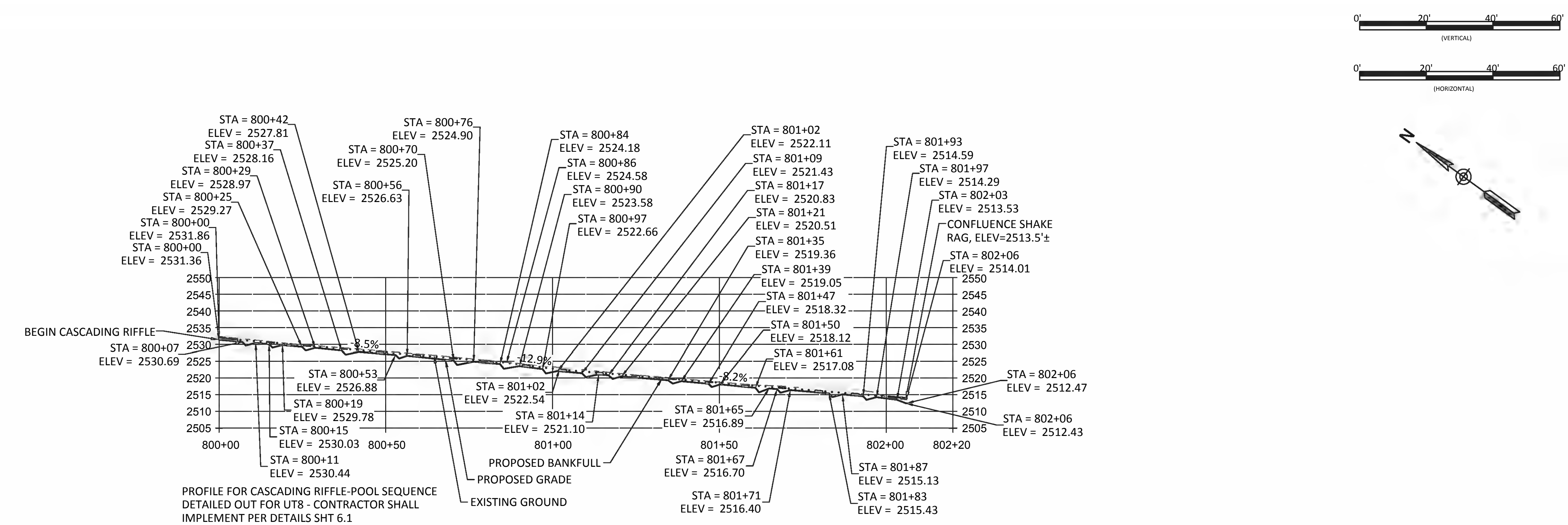
Madison County, North Carolina

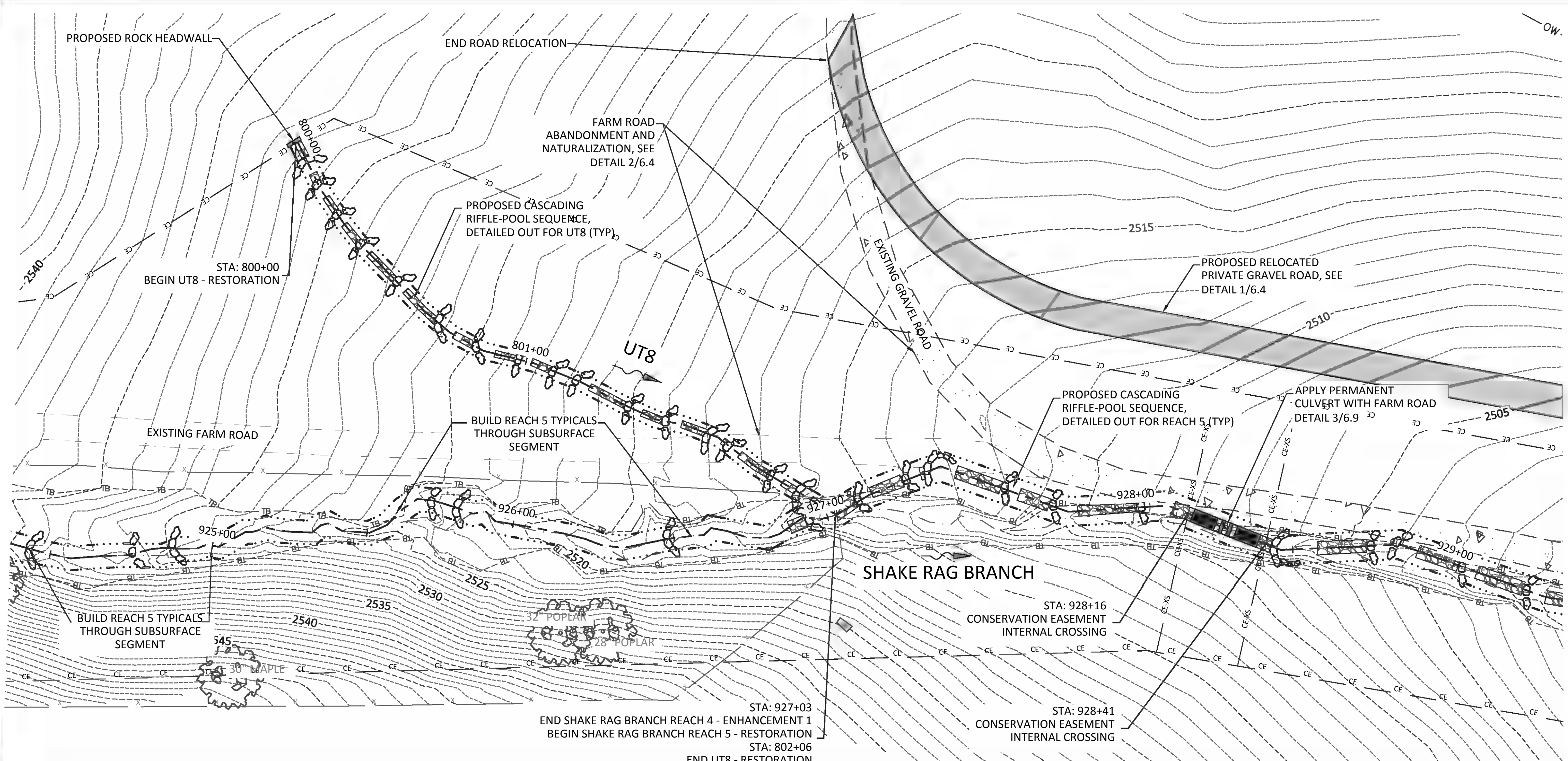
UT4
Stream Plan and Profile

Revisions:

Date: November 06, 2018
Job Number: 005-02166
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 2.1.17





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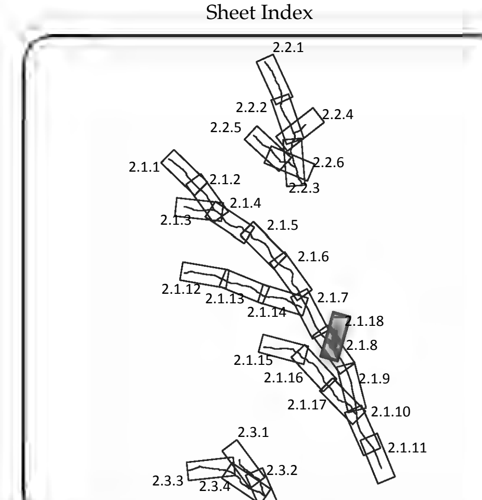

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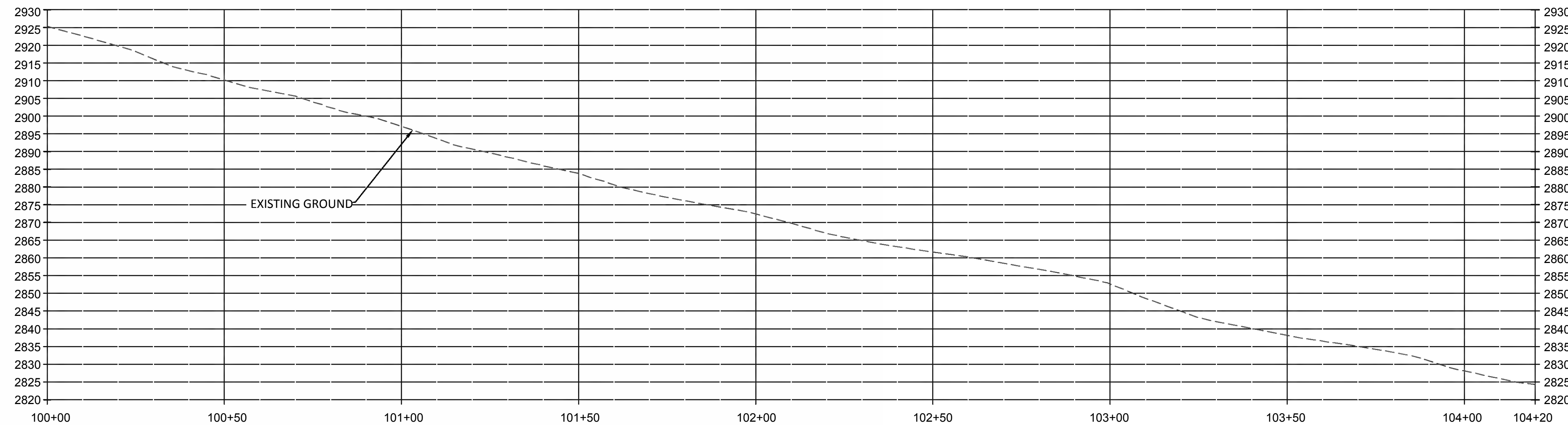
UT8
Stream Plan and Profile

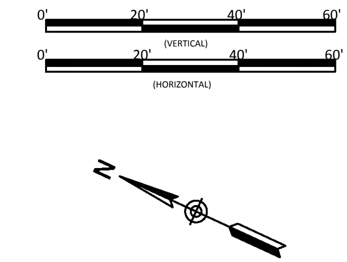
Revisions:

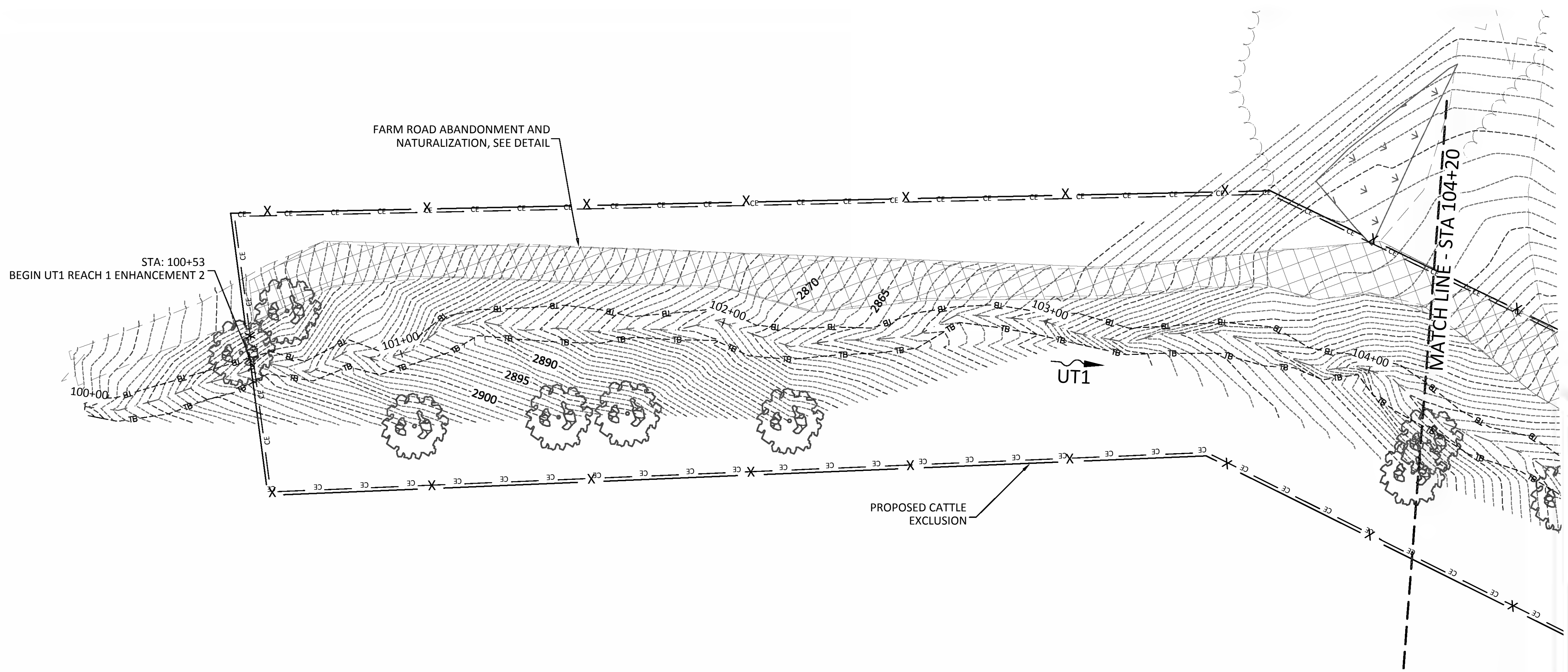
Date:	November 06, 2018
300 Number:	005-02164
Project Engineer:	JM
Drawn By:	JDW
Checked By:	CB

2.1.18

Sheet







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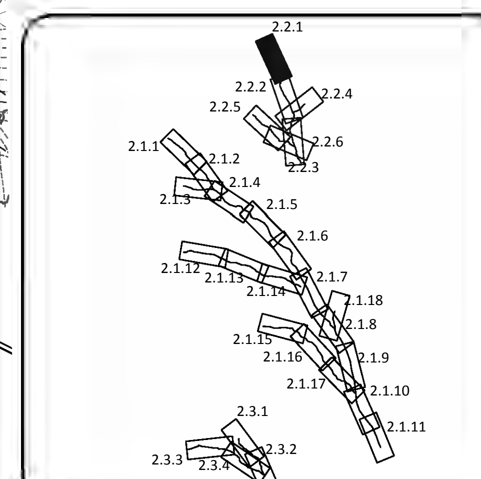

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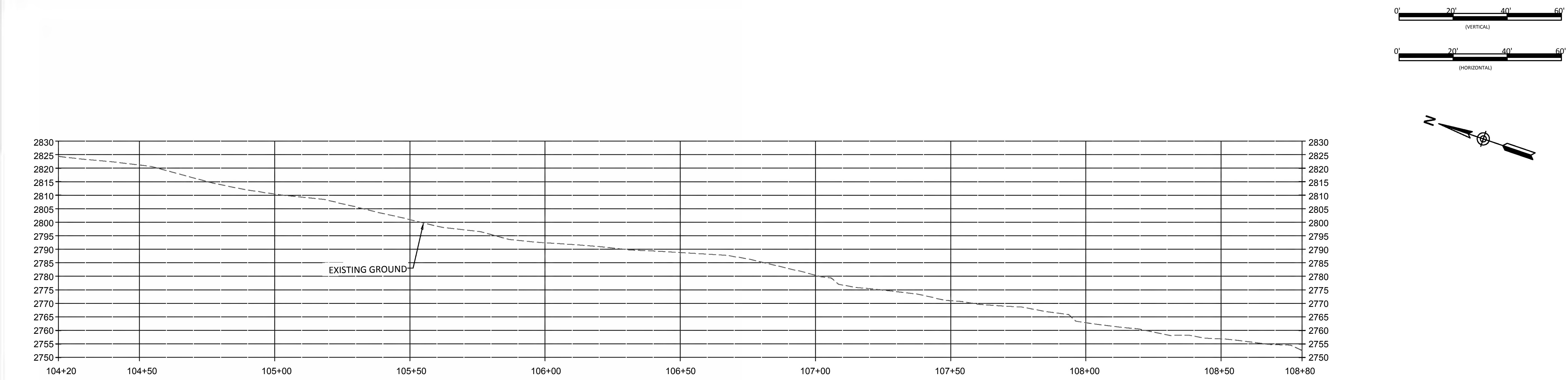
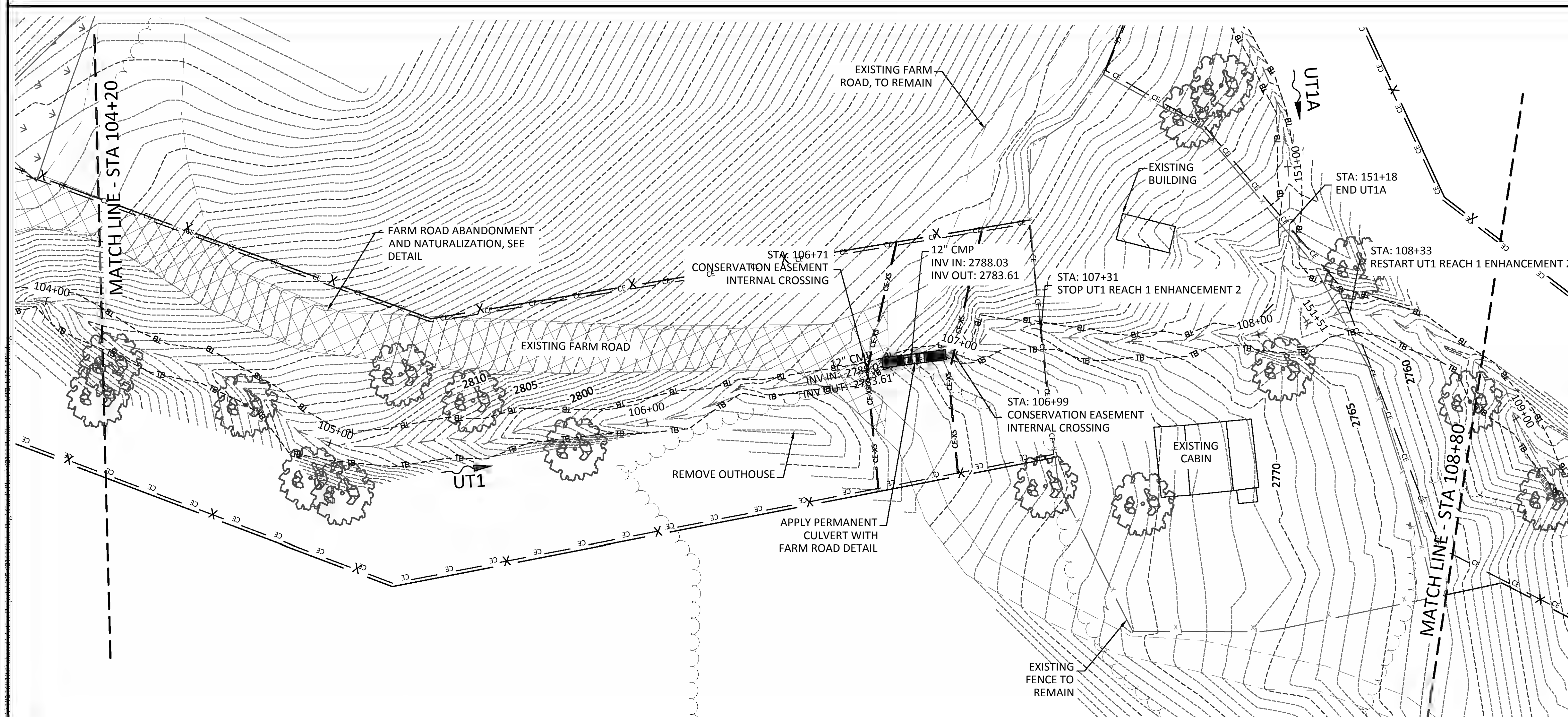
UT1
Stream Plan and Profile

Revisions:

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
Checked By: CB

Sheet 2.2.1





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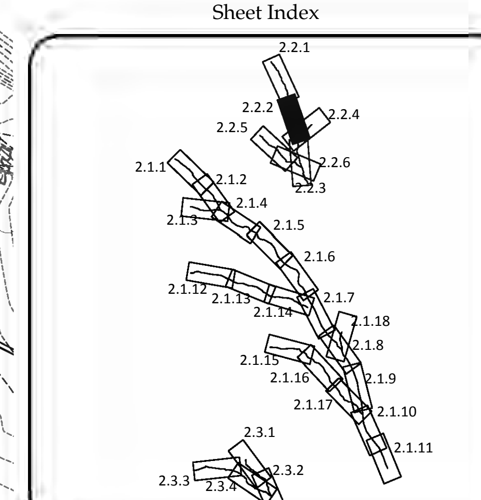

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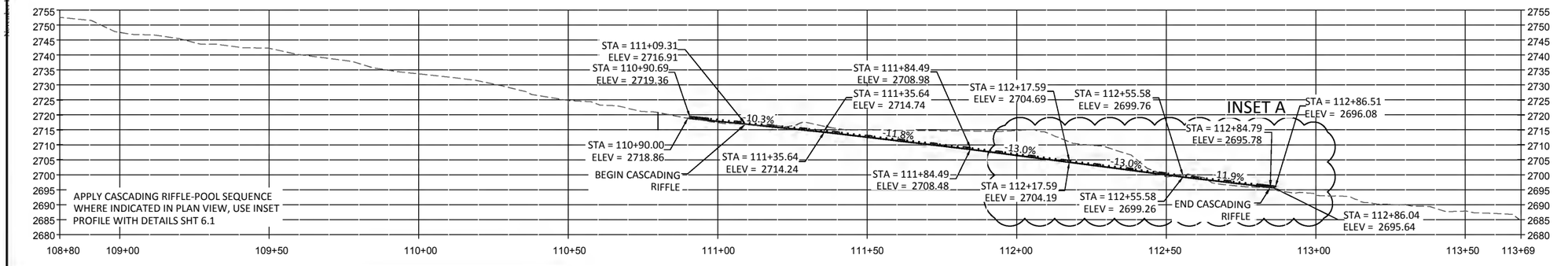
UT1
Stream Plan and Profile

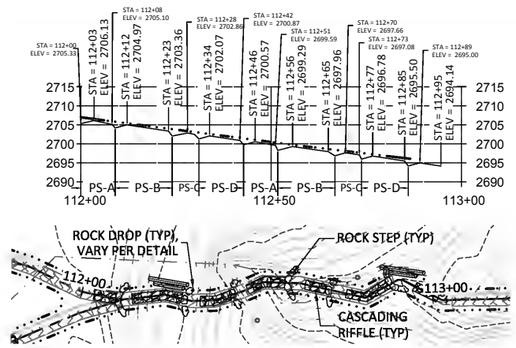
Revisions:

Date:	November 06, 2018
Job Number:	005-02164
Project Engineer:	JM
Drawn By:	JDW
Checked By:	CB

2.2.2

Sheet





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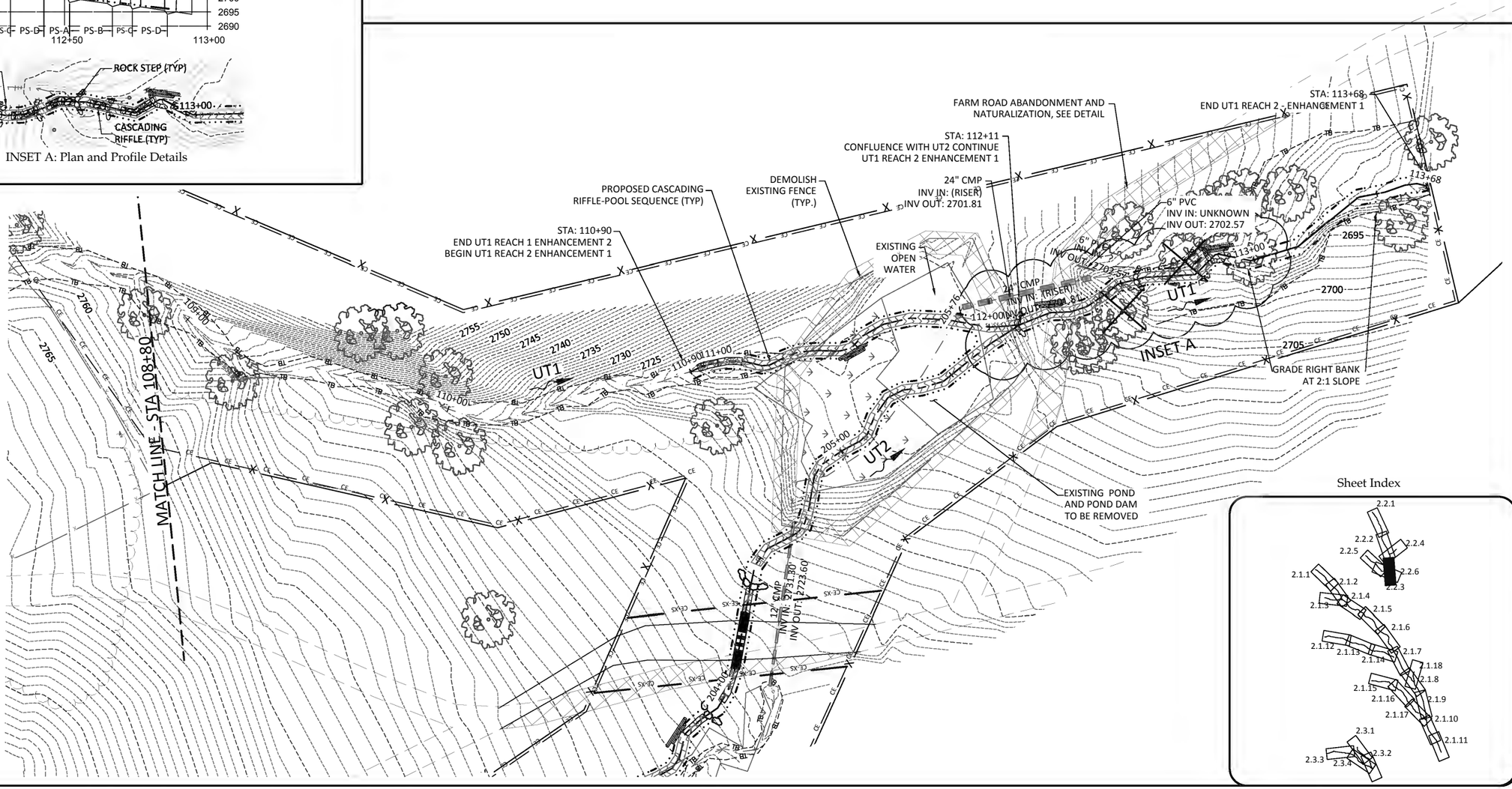

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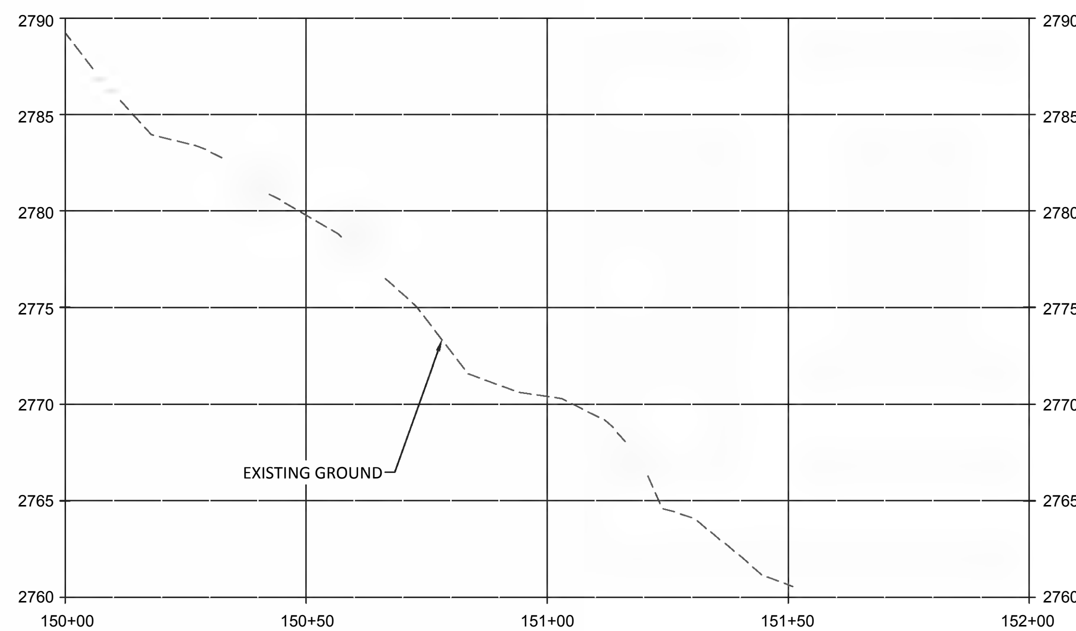
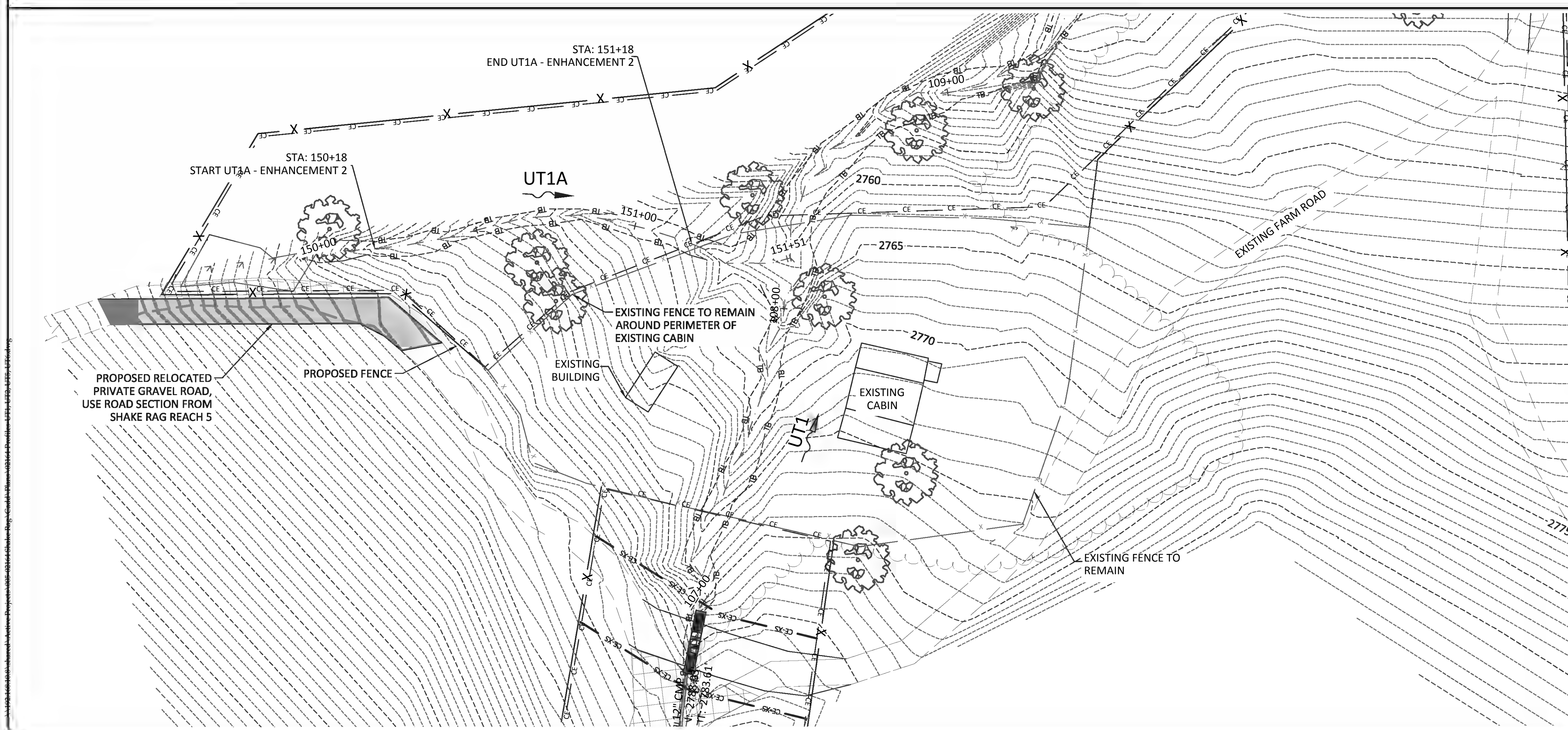
UT1
Stream Plan and Profile

Revisions:

Date: November 06, 2018
Task Number: 005-02165
Project Engineer: JM
Drawn by: JDW
Checked By: CB

Sheet 2.2.3





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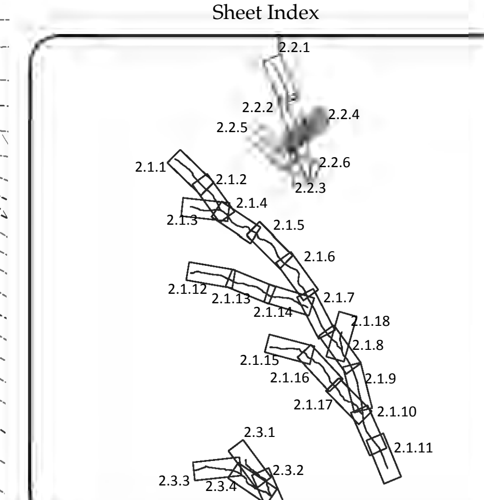

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Shake Rag Branch Mitigation Site
Madison County, North Carolina

UT1A
Stream Plan and Profile

Date:	November 06, 2018
Job Number:	005-02164
Project Engineer:	JDM
Drawn By:	JDW
Checked By:	CB

Revisions:

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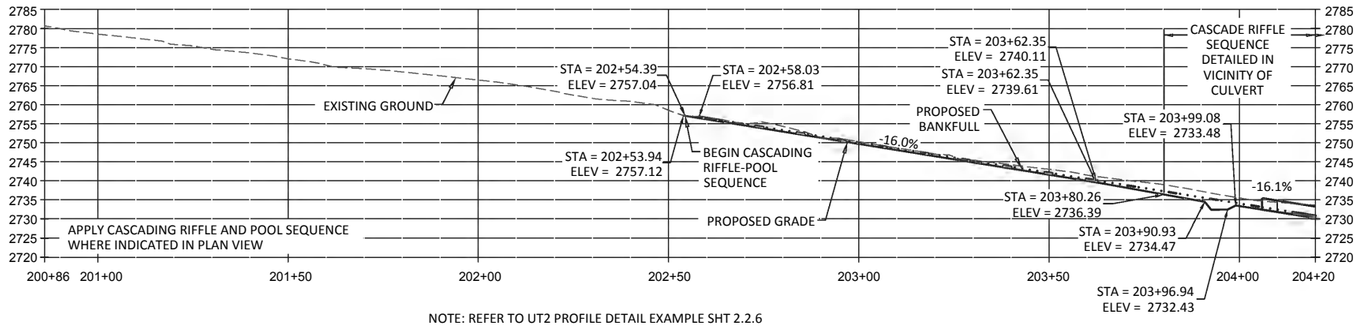
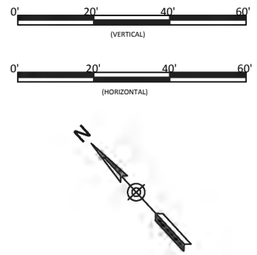
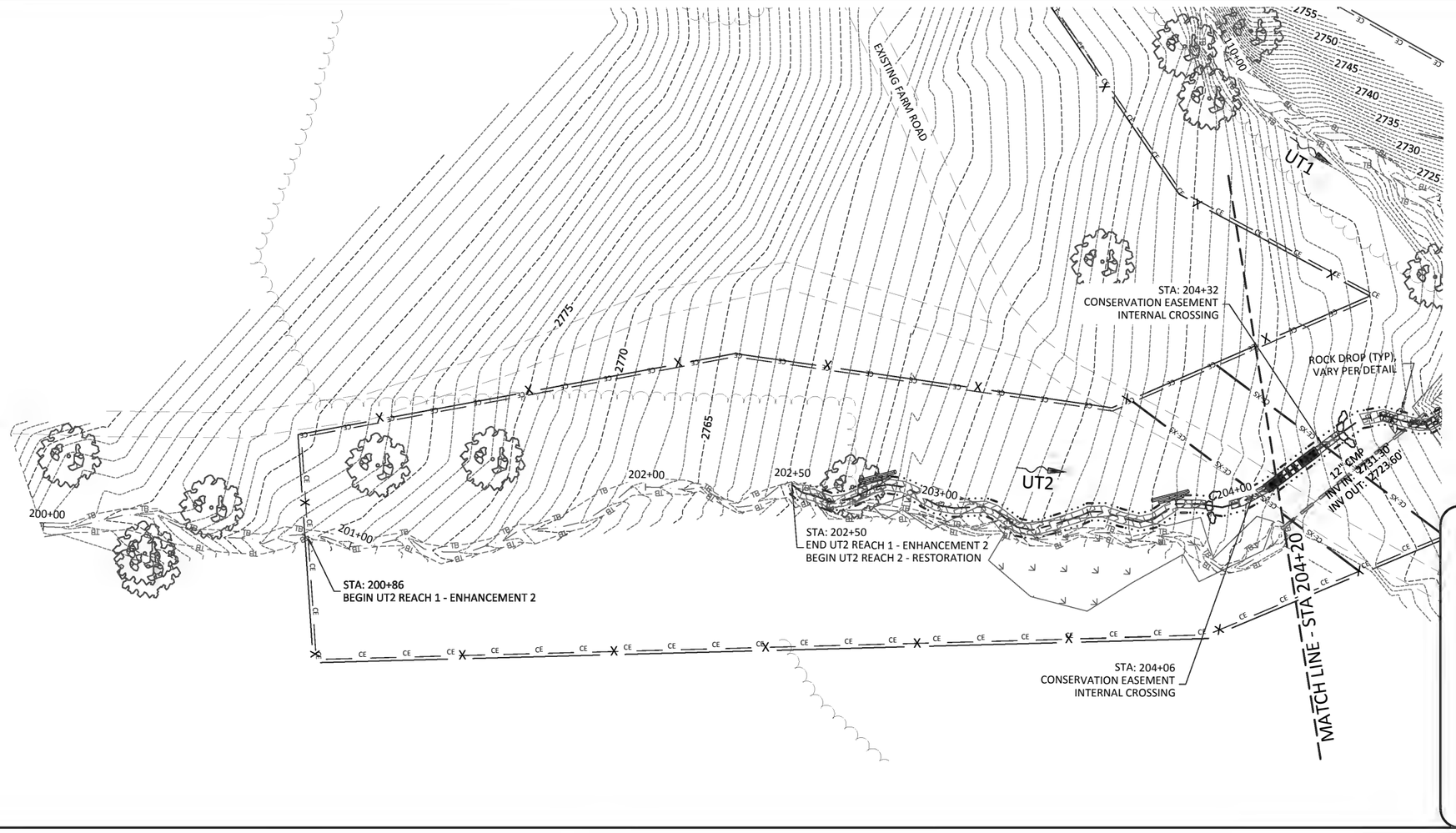


NOTE: REFER TO UT2 PROFILE DETAIL EXAMPLE SHT 2.2.6





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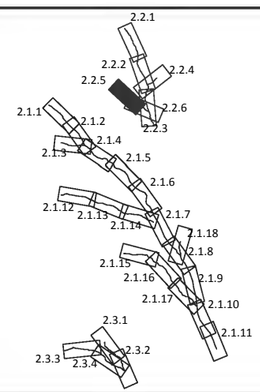

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UT2
Stream Plan and Profile

Revisions:

Date: November 06, 2018
Job Number: 005-02165
Project Engineer: JM
Drawn By: JDW
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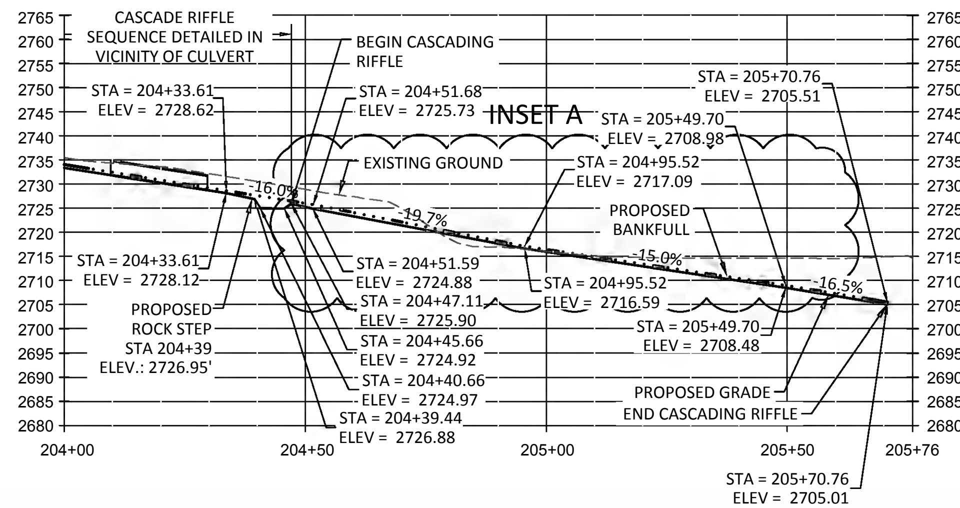
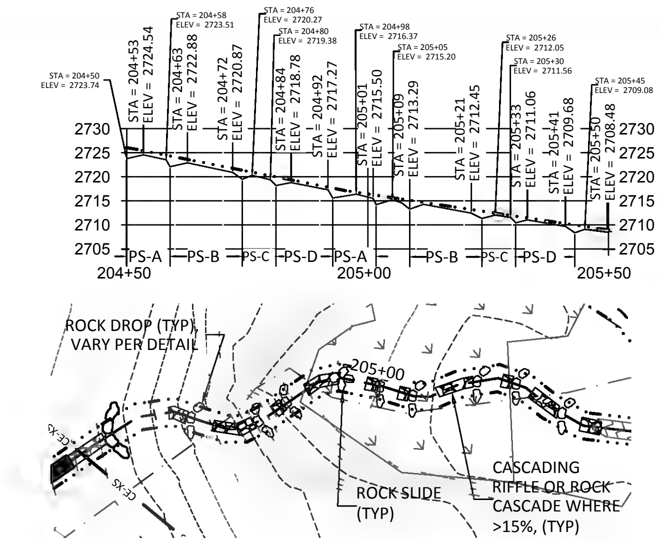
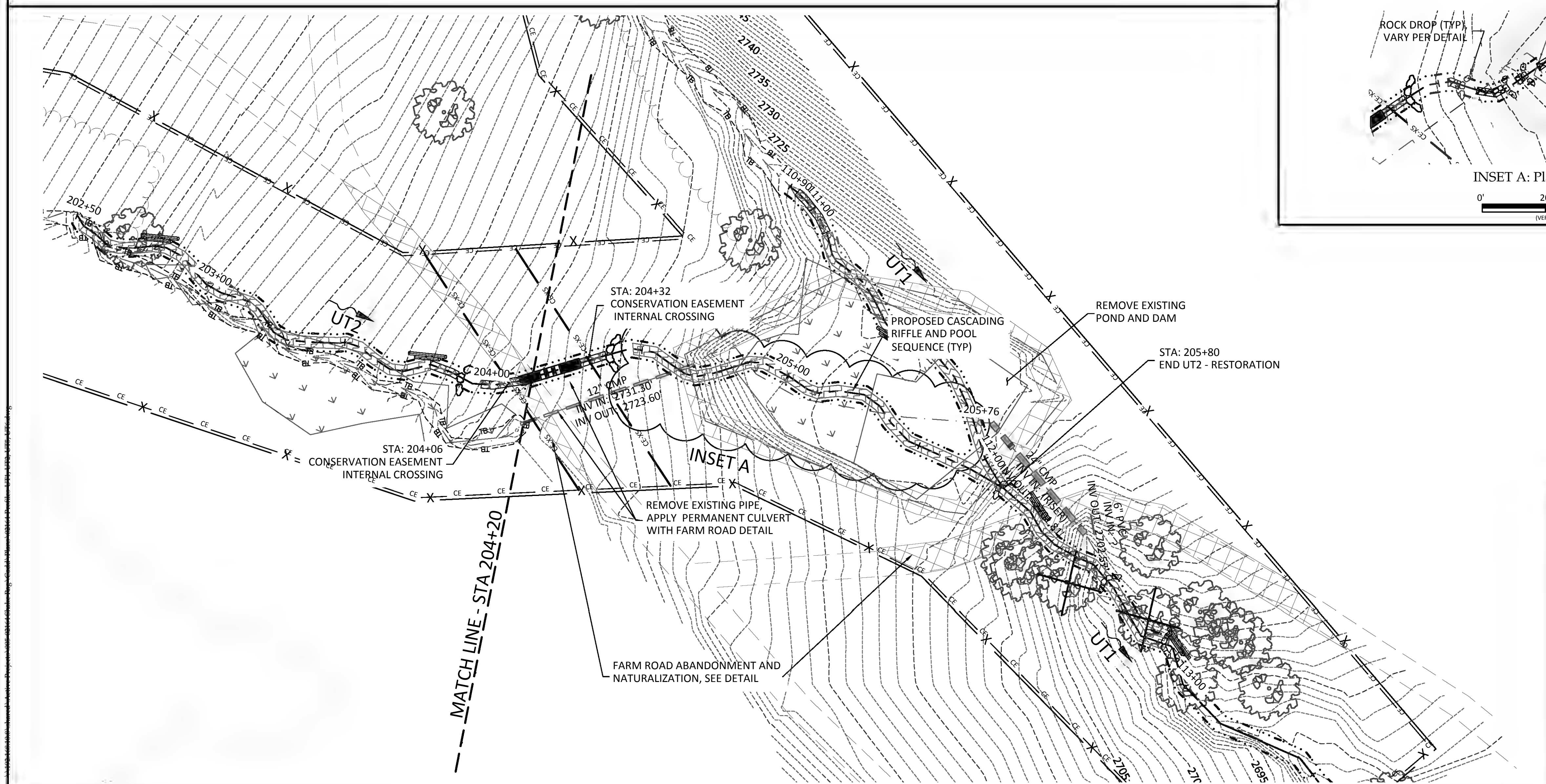


APPLY CASCADING RIFFLE AND POOL SEQUENCE WHERE INDICATED IN PLAN VIEW



INSET A: Plan and Profile Details



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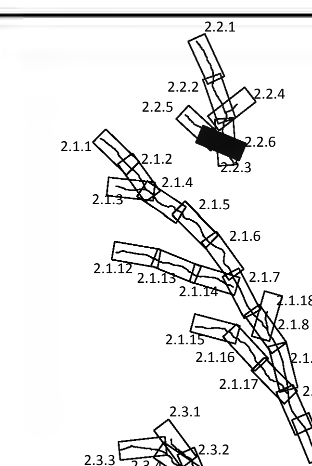

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UT2
Stream Plan and Profile

Revisions:

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
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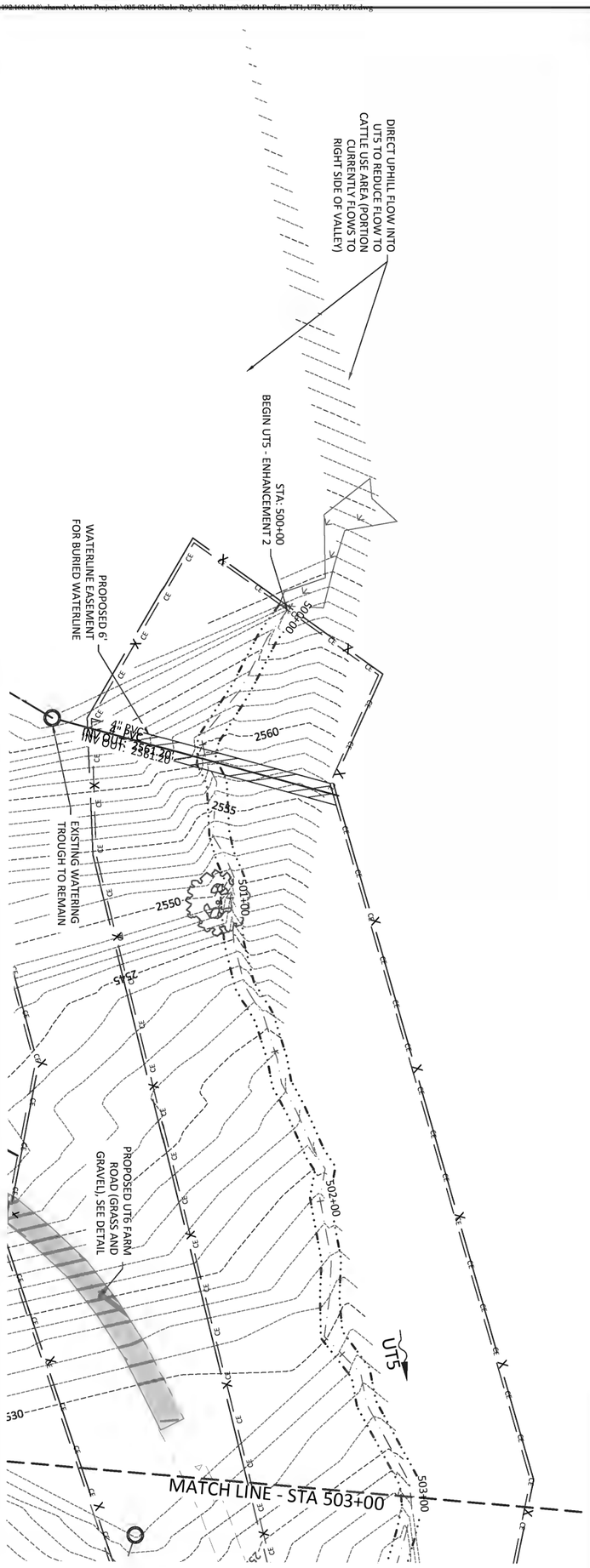

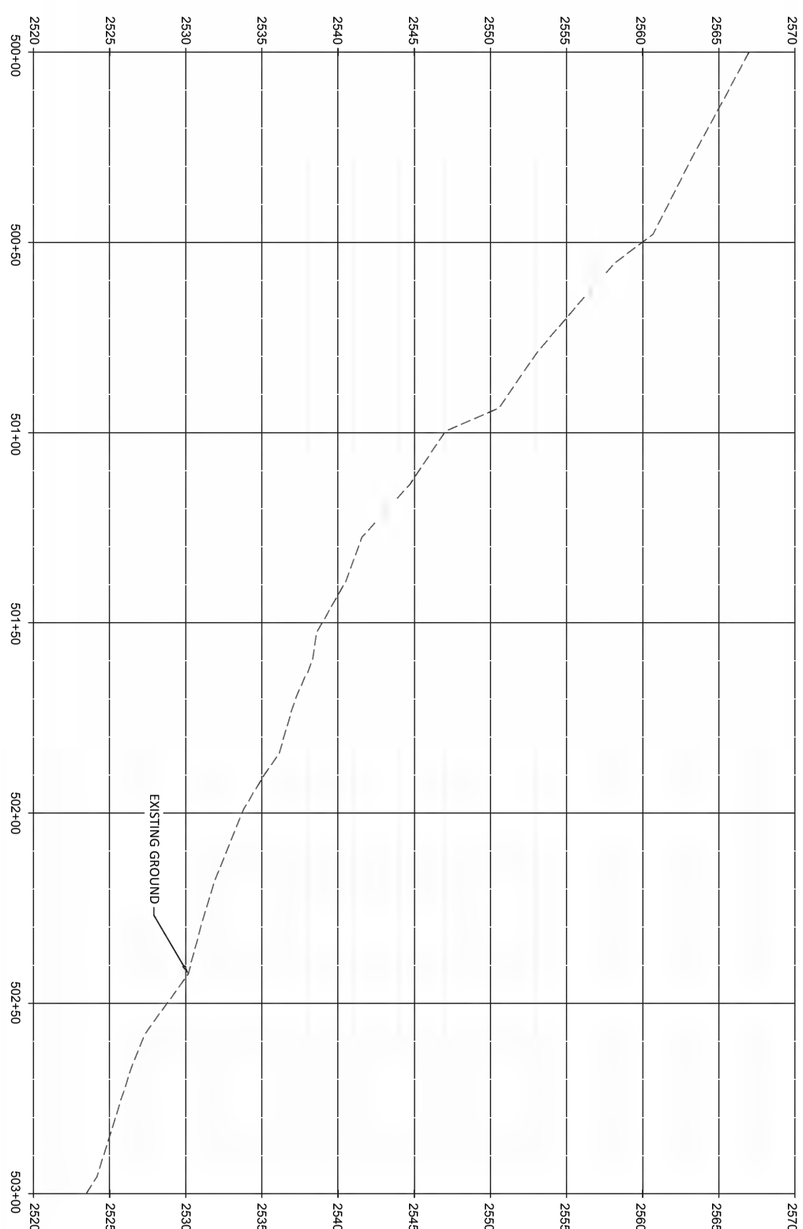

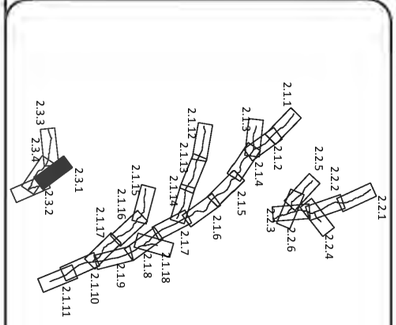

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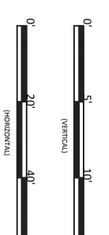

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
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Revisions:

2.3.1
Sheet

Shake Rag Branch Mitigation Site
Madison County, North Carolina

UT5
Stream Plan and Profile

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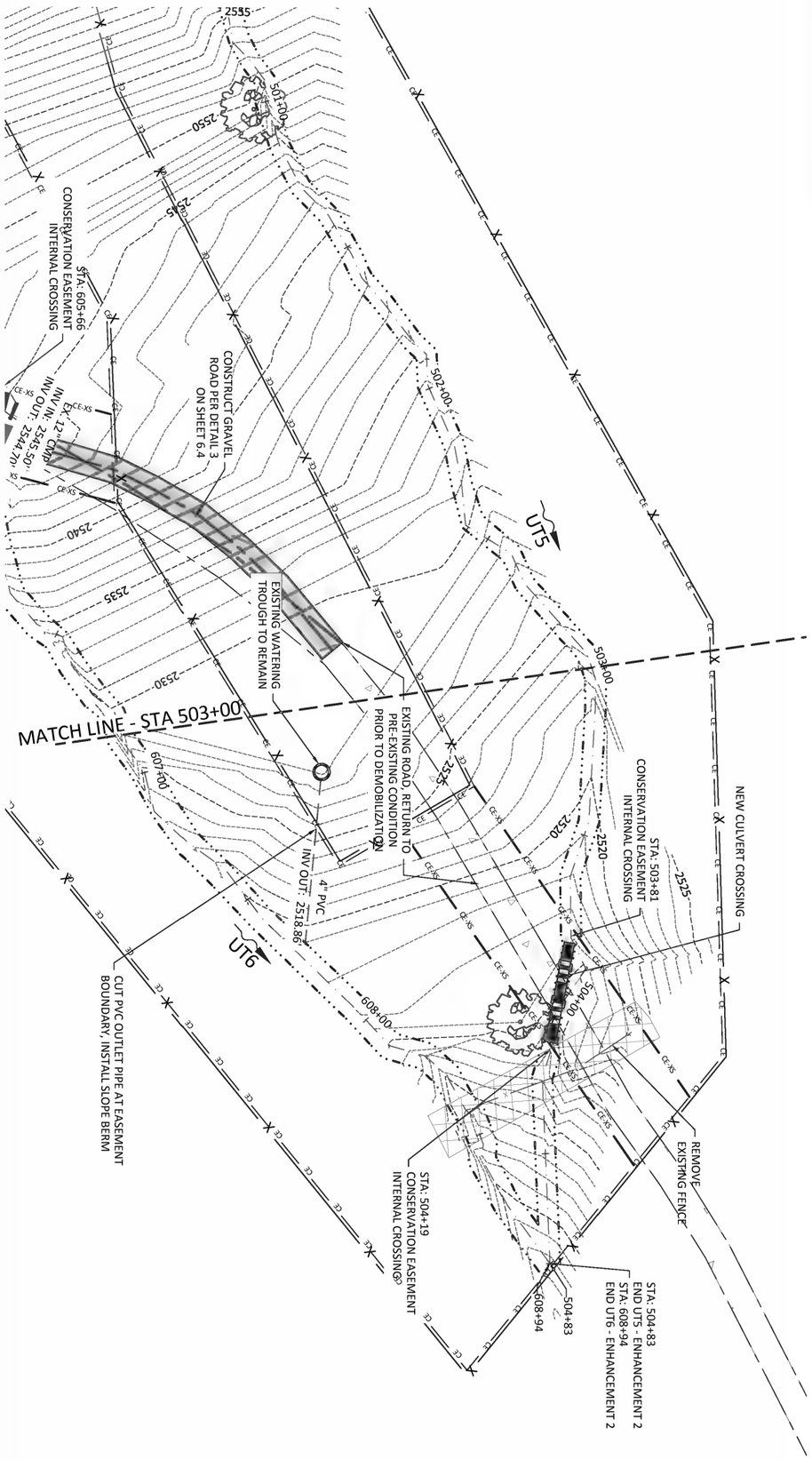

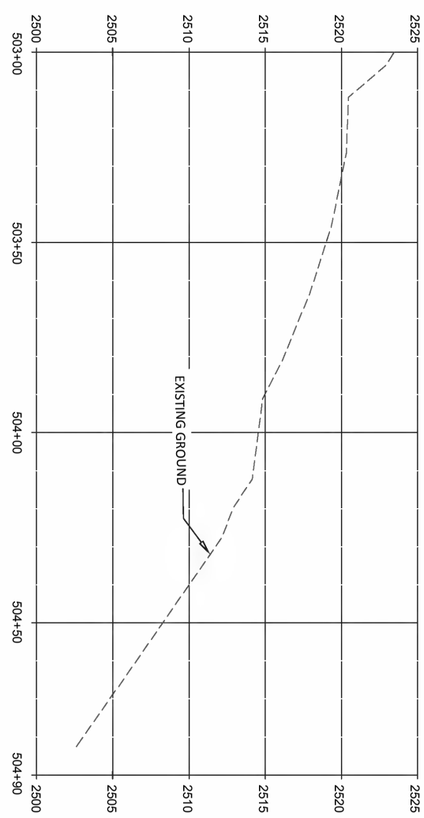

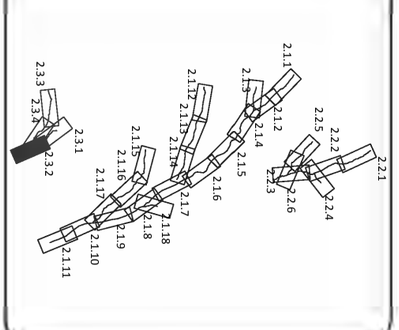

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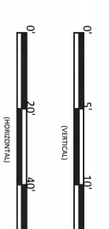

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
Checked By: CB

Revisions:

2.3.2
Sheet

Shake Rag Branch Mitigation Site
Madison County, North Carolina

UT5
Stream Plan and Profile

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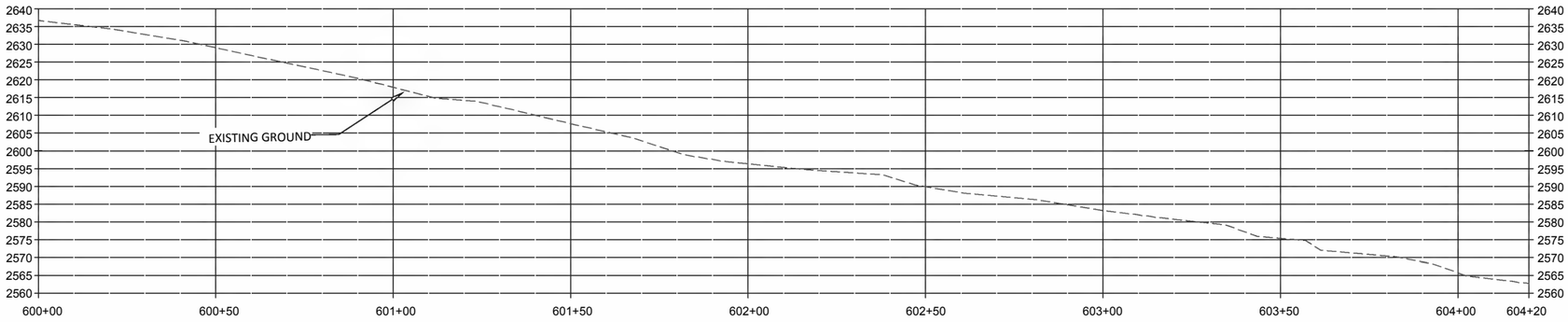

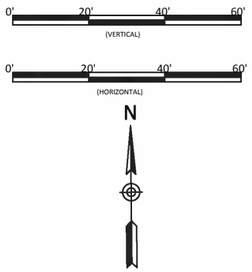

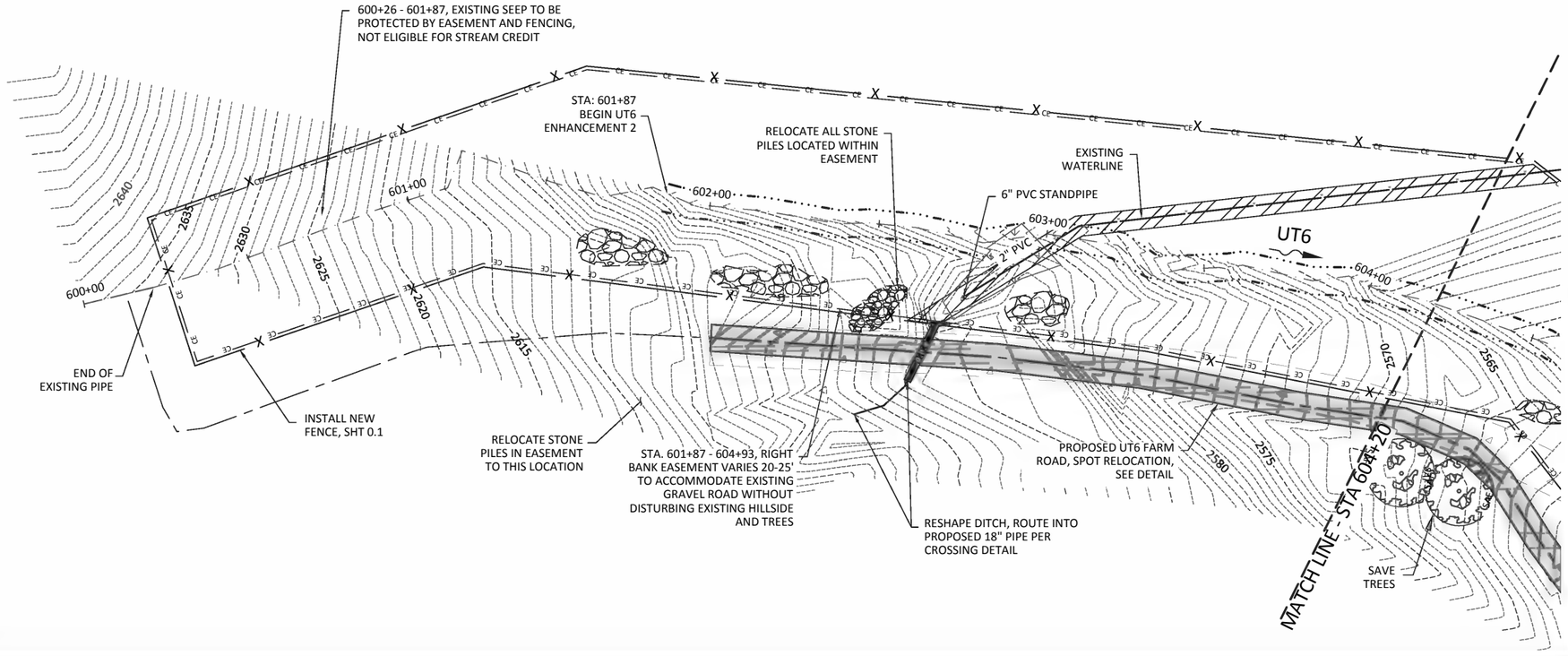

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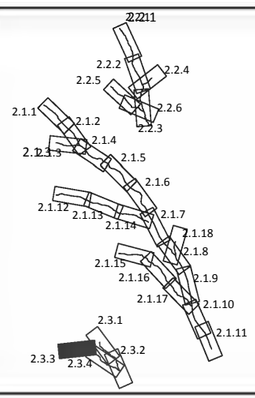

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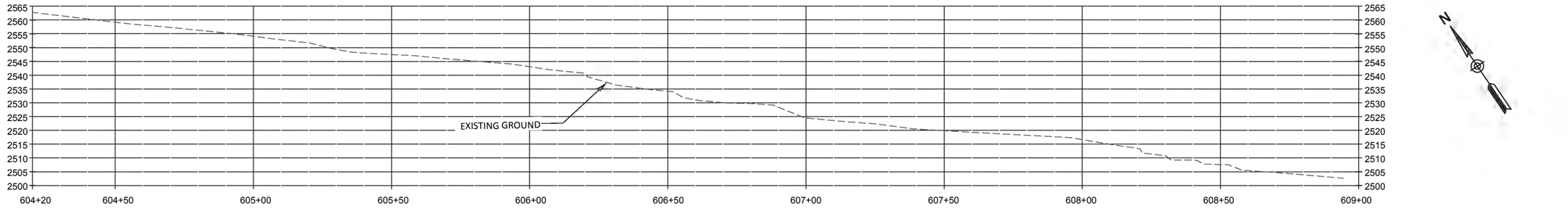
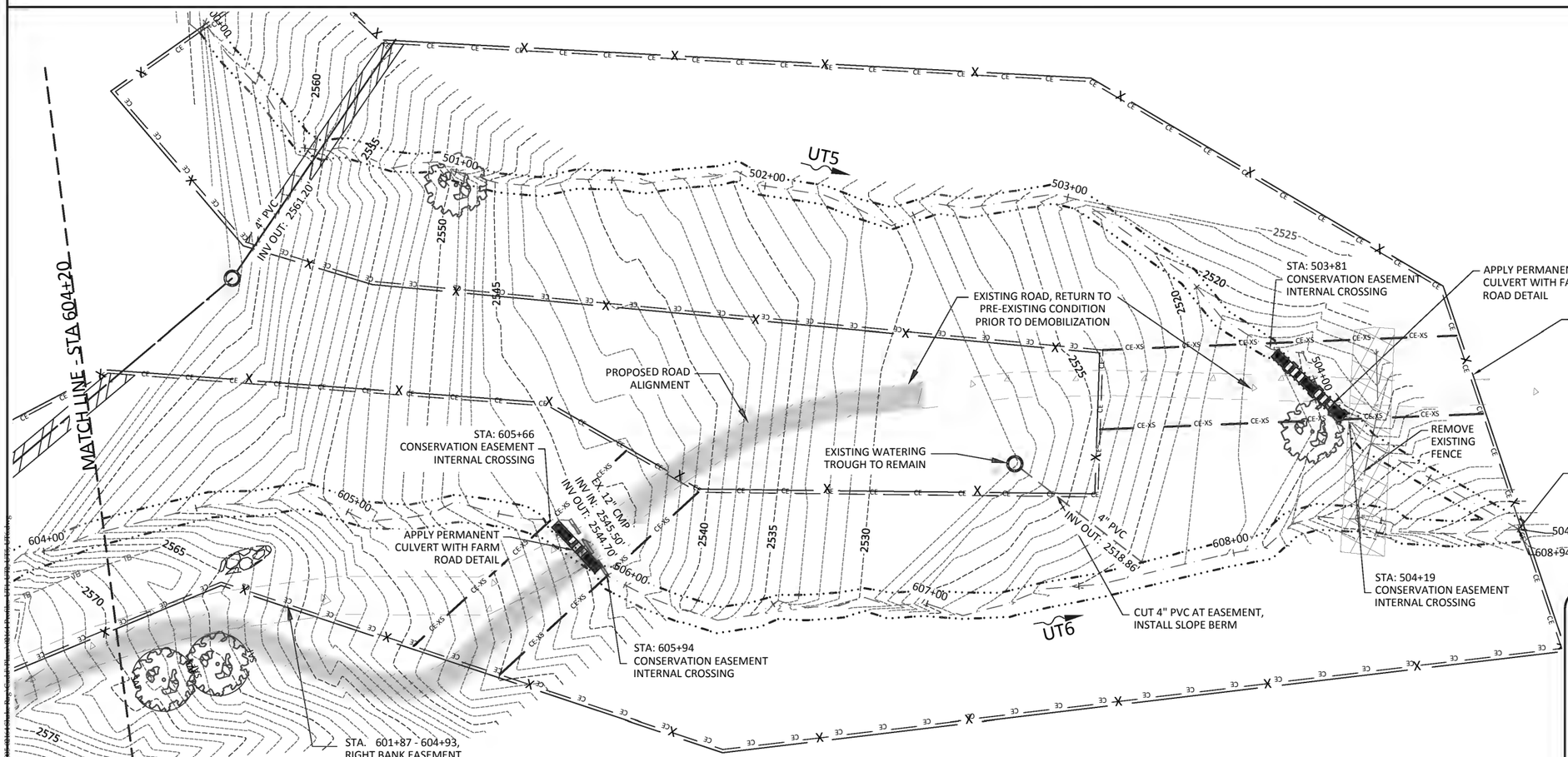
UT6
Stream Plan and Profile

Revisions:

Date: November 06, 2018
205 Number: 005-02164
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 2.3.3





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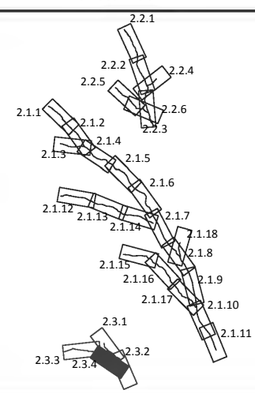

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UT6
Stream Plan and Profile

Revisions:

Date: November 06, 2018
EEP Number: 005-02164
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 2.3.4

Open Areas

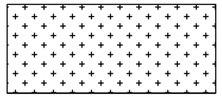
70% Trees
30% Small Trees / Shrubs
-Density 640 stems per acre or as
adjusted to meet planting benchmarks

Open Area Buffer Planting

Open Buffer Planting Zone Trees						
Bare Root						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Caliper Size**	**Stratum**	**# of Stems**
Quercus phellos	Willow Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
Platanus occidentalis	Sycamore	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
Betula nigra	River Birch	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	15%
Liriodendron tulipifera	Tulip Poplar	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
Fraxinus pennsylvanica	Green Ash	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	5%
					Total	**70%**
Alternates						
Alnus serrulata	Tag Alder	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
Quercus pagoda	Cherrybark Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
Quercus michauxii	Swamp Chestnut Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
					Total	0%
Open Buffer Planting Zone Small Trees / Shrubs						
Bare Root						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Caliper Size**	**Stratum**	**# of Stems**
Acer pensylvanicum	Striped Maple	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	5%
Hamamelis virginiana	Witch Hazel	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
Cornus florida	Flowering Dogwood	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	5%
Lindera benzoin	Spicebush	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
Aesculus sylvatica	Painted Buckeye	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	3%
Amelanchier lavis	Serviceberry	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	2%
					Total	**30%**
Alternates						
Acer Spicatum	Mountain Maple	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
Cornus alternifolia	Alternate leaf Dogwood	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
Prunus Pensylvanica	Fire Cherry	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
					Total	0%

Notes:
Transplants from on-site to be used at Designer's discretion for streambank and floodplain planting.
Percentages of each species may be varied at Designer's discretion but shall not exceed 20% per each species.
Designer may substitute container plantings or other plantings for bare roots.

Partially Vegetated Areas



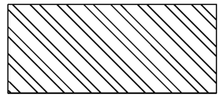
30% Trees
70% Small Trees / Shrubs
-Density varies to supplement existing

Partially Vegetated Area Buffer Planting

Partially Vegetaded Buffer Planting Zone Trees						
Bare Root						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Caliper Size**	**Stratum**	**# of Stems**
Quercus phellos	Willow Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	5%
Platanus occidentalis	Sycamore	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	5%
Betula nigra	River Birch	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	5%
Liriodendron tulipifera	Tulip Poplar	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
Fraxinus pennsylvanica	Green Ash	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	5%
					Total	**30%**
Alternates						
Alnus serrulata	Tag Alder	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
Quercus pagoda	Cherrybark Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
Quercus michauxii	Swamp Chestnut Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
					Total	0%
Partially Vegetated Buffer Planting Zone Small Trees / Shrubs						
Bare Root						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Caliper Size**	**Stratum**	**# of Stems**
Acer pensylvanicum	Striped Maple	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
Hamamelis virginiana	Witch Hazel	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	15%
Cornus florida	Flowering Dogwood	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
Lindera benzoin	Spicebush	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	15%
Aesculus sylvatica	Painted Buckeye	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
Amelanchier lavis	Serviceberry	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
					Total	**70%**
Alternates						
Acer Spicatum	Mountain Maple	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
Cornus alternifolia	Alternate leaf Dogwood	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
Prunus Pensylvanica	Fire Cherry	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	0%
					Total	0%

Notes:
Transplants from on-site to be used at Designer's discretion for streambank and floodplain planting.
Percentages of each species may be varied at Designer's discretion but shall not exceed 20% per each species.
Designer may substitute container plantings or other plantings for bare roots.

Riparian Corridor Planting



Riparian Corridor Planting (Streambanks)

Streambank Planting Zone						
Live Stakes						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Size**	**Stratum**	**% of Stems**
Salix nigra	Black Willow	8 ft.	6-8 ft.	0.5"-1.5" cal.	Shrub	10%
Cornus amomum	Silky Dogwood	8 ft.	6-8 ft.	0.5"-1.5" cal.	Shrub	25%
Salix sericea	Silky Willow	8 ft.	6-8 ft.	0.5"-1.5" cal.	Shrub	30%
Physocarpos opulifolius	Ninebark	8 ft.	6-8 ft.	0.5"-1.5" cal.	Shrub	15%
Cephalathus occidentalis	Buttonbush	8 ft.	6-8 ft.	0.5"-1.5" cal.	Shrub	10%
Rosa palustris	Swamp Rose	8 ft.	6-8 ft.	0.5"-1.5" cal.	Shrub	10%
					Total	**100%**
Herbaceous Plugs						
Juncus effusus	Common Rush	5 ft.	3-5 ft.	1.0"- 2.0" plug	Herb	45%
Carex alata	Broadwing Sedge	5 ft.	3-5 ft.	1.0"- 2.0" plug	Herb	45%
Panicum virgatum	Switchgrass	5 ft.	3-5 ft.	1.0"- 2.0" plug	Herb	10%
					Total	**100%**

Note: See detail for Live Staking instructions on streambanks.

Permanent Seeding

Riparian Seeding - Open Canopy				
Pure Live Seed (20 lbs/ acre)				
Approved Date	**Species Name**	**Common Name**	**Stratum**	**Density (lbs/acre)**
All Year	*Panicum rigidulum*	Redtop Panicgrass	Herb	1.5
All Year	*Agrostis hyemalis*	Winter Bentgrass	Herb	4.0
All Year	*Chasmanthium latifolium*	River Oats	Herb	2.0
All Year	*Rudbeckia hirta*	Blackeyed Susan	Herb	1.0
All Year	*Coreopsis lanceolata*	Lanceleaf Coreopsis	Herb	1.0
All Year	*Carex vulpinoidea*	Fox Sedge	Herb	3.0
All Year	*Panicum clandestinum*	Deertongue	Herb	3.5
All Year	*Elymus virginicus*	Virginia Wild Rye	Herb	2.0
All Year	*Asclepias syrica*	Common Milkweed	Herb	0.2
All Year	*Baptisia australis*	Blue False Indigo	Herb	0.2
All Year	*Gaillardia pulchella*	Annual Gaillardia	Herb	1.0
All Year	*Echinacea purpurea*	Pale Purple Coneflower	Herb	0.6

Notes:
~~Apply~~ Permanent Riparian seeding in all disturbed areas within Conservation Easement.
Apply Permanent seeding in all other disturbed areas per specification.

Pasture Seeding

Pasture Seeding		
Pure Live Seed (35 lbs/ac)		
Species Name	**Common Name**	**lbs/acre**
Festuca arundinacea	Fescue	20
Avena sativa	Oats	10
Trifolium repens	Clover	5

Notes:
~~Apply~~ Pasture Seeding for grading outside Conservation Easement, utility easements, and stream crossings.
Install temporary seed and mulch with all permanent seed.

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PRELIMINARY
DO NOT
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CONSTRUCTION

Shake Rag Branch Mitigation Site
Madison County, North Carolina
Planting Lists

Revisions:

Date: November 06, 2018
DMS Number: 100542164
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 3.1

PRESERVATION AREA NO PLANTING PROPOSED

UT7

SHAKE RAG BRANCH

SHAKE RAG BRANCH

UT3

SHAKE RAG BRANCH

ROAD TO CABINS AND UT1 & 2.

PERMANENT CROSSING (TYP)

PROPOSED GRAVEL ROAD

UT4

SHAKE RAG BRANCH

ROAD TO BARNS AND SHAKE RAG ROAD

ACREAGE SUMMARY

OPEN AREAS - 8.13 ACRES

PARTIALLY VEGETATED AREAS - 1.35 ACRES

RIPARIAN CORRIDORS - 1.25 ACRES

NOTE:

ALL GRAVEL ROADS TO BE ABANDONED WITHIN EASEMENT. USE NATURALIZATION DETAIL (FARM ROAD ABANDONMENT AND NATURALIZATION 2/6.4) AND PLANTING APPLIED.

N

0' 100' 200' 300'

(HORIZONTAL)

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Shake Rag Branch Mitigation Site
Madison County, North Carolina

Overview
Planting

Revisions:

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168 Number: 005-02216
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 3.2

ACREAGE SUMMARY

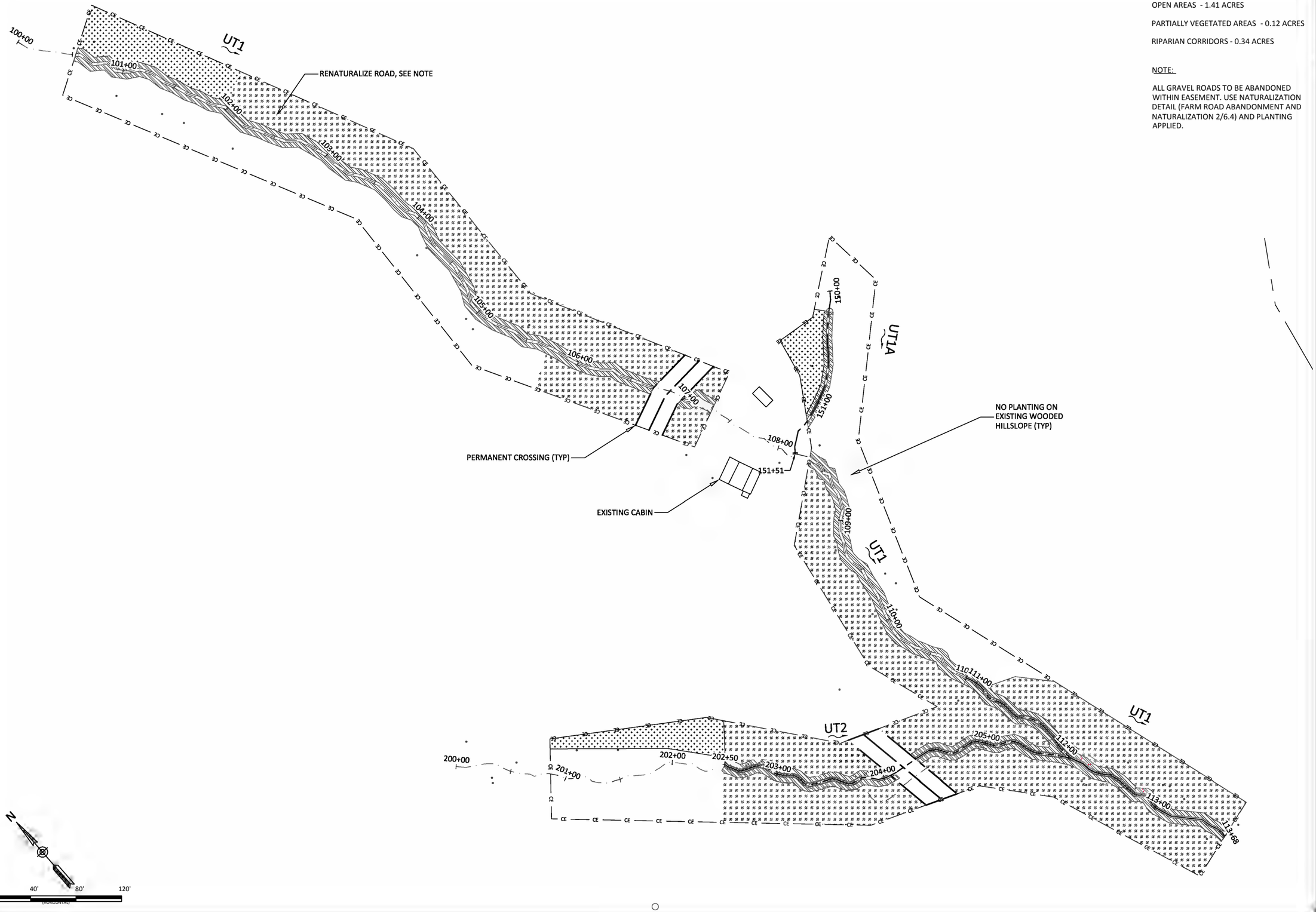
OPEN AREAS - 1.41 ACRES

PARTIALLY VEGETATED AREAS - 0.12 ACRES

RIPARIAN CORRIDORS - 0.34 ACRES

NOTE:

ALL GRAVEL ROADS TO BE ABANDONED WITHIN EASEMENT. USE NATURALIZATION DETAIL (FARM ROAD ABANDONMENT AND NATURALIZATION 2/6.4) AND PLANTING APPLIED.



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Shake Rag Branch Mitigation Site
Madison County, North Carolina

UT1-UT2 Overview
Planting

Revisions:

Date: November 06, 2018
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Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 3.3

ACREAGE SUMMARY

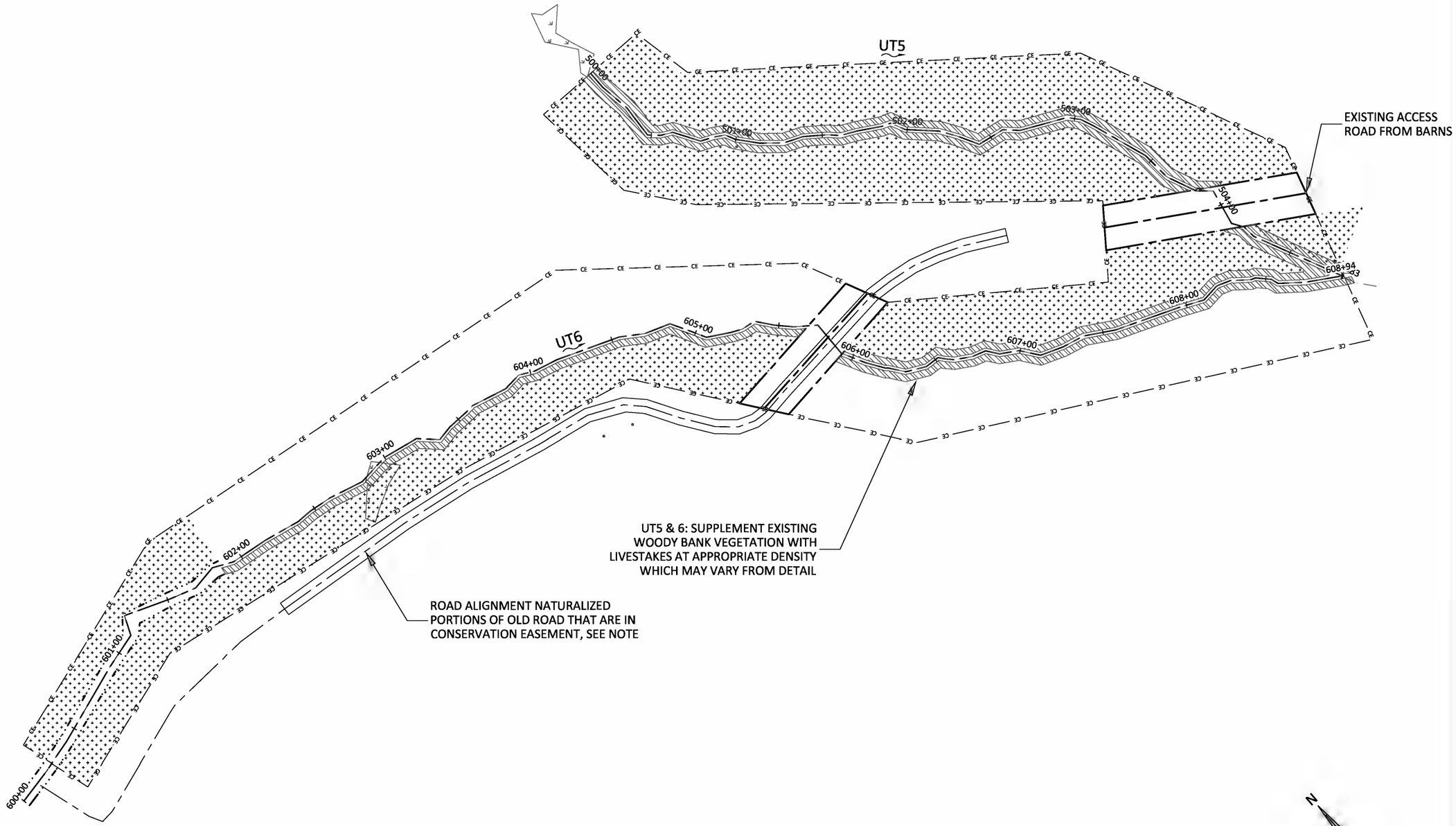
OPEN AREAS - N/A

PARTIALLY VEGETATED AREAS - 1.06 ACRES

RIPARIAN CORRIDORS - 0.17 ACRES

NOTE:

ALL GRAVEL ROADS TO BE ABANDONED WITHIN EASEMENT. USE NATURALIZATION DETAIL (FARM ROAD ABANDONMENT AND NATURALIZATION 2/6.4) AND PLANTING APPLIED.



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PRELIMINARY DO NOT USE FOR CONSTRUCTION

Shake Rag Branch Mitigation Site
Madison County, North Carolina

UT5-UT6 Overview
Planting

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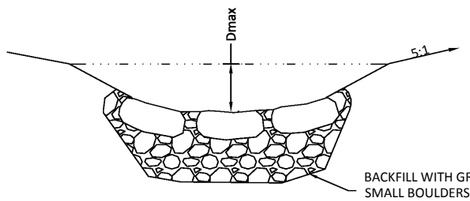
Project Engineer: JM
Drawn by: JDW
Checked By: CB

3.4

Sheet



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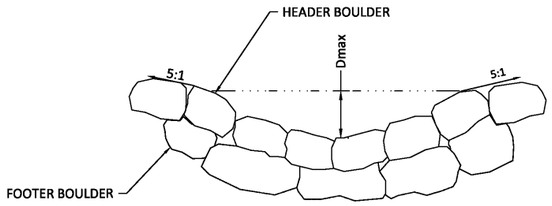

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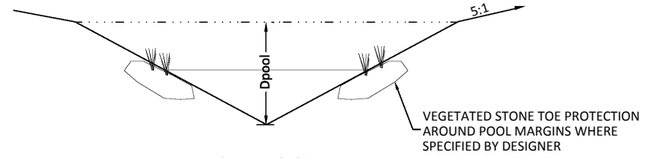

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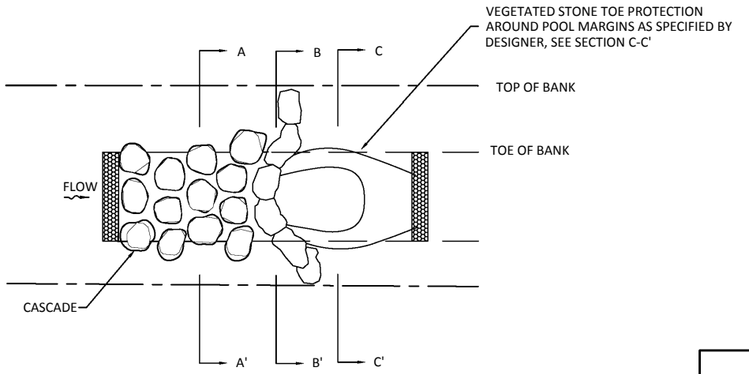
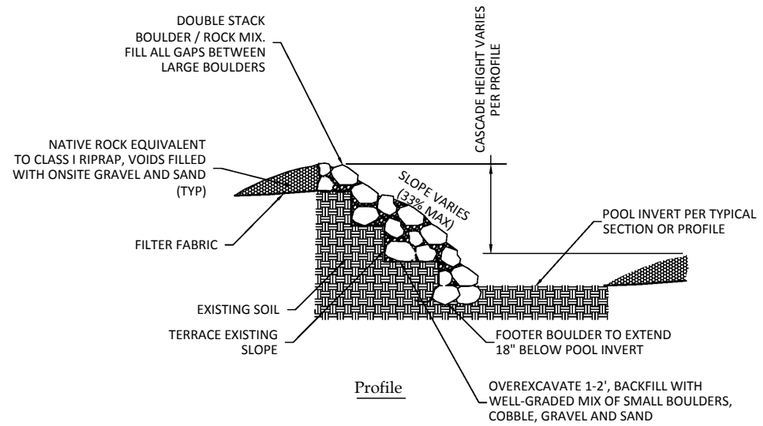


Riffle Sequence Plan View

NOTES:

- USE AS DIRECTED WITH DETAIL 3/6.1 IN LIEU OF CASCADING RIFFLES WHERE AVERAGE SLOPE EXCEEDS 15-20% (ROCK SLIDE MAY ALSO BE USED FOR THIS SCENARIO).
- MINIMUM SIZE FOR BOULDERS SHALL BE 2' x 2' x 1'.
- VOID SPACES BETWEEN BOULDERS ON CASCADE SHALL BE FILLED WITH SMALLER NATIVE ROCK WHERE AVAILABLE.
- IF NATIVE ROCK IS NOT AVAILABLE, QUARRIED ROCK MAY BE SUBSTITUTED IN THE SAME SIZES.
- ALL SMALLER ROCK SHALL BE HETEROGENEOUS AND WELL MIXED.

1/6.1 Rock Cascade
Not to Scale

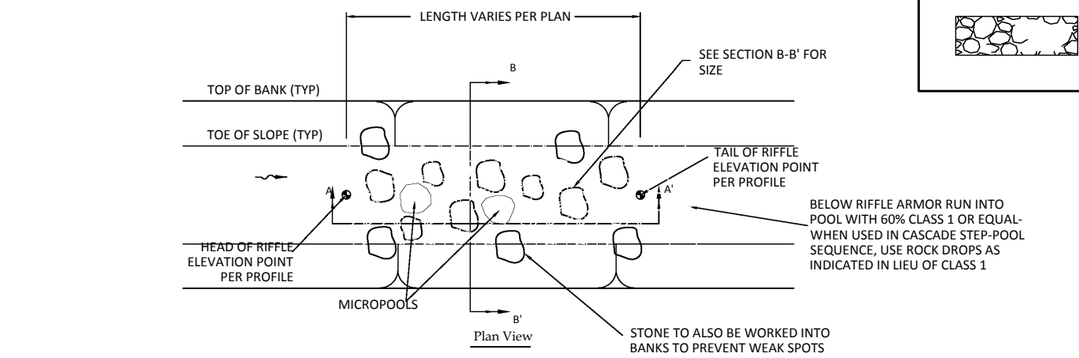


Profile

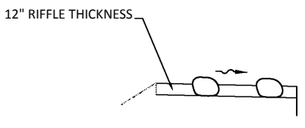
NOTE ABOUT DETAILS:
DETAILS 1/6.1, 2/6.1, 1/6.3, 2/6.3 ARE TO BE USED TO CONSTRUCT SEQUENCES SHOWN IN 3/6.1.

DESIGNER MAY INCORPORATE OTHER GRADE CONTROL STRUCTURES.

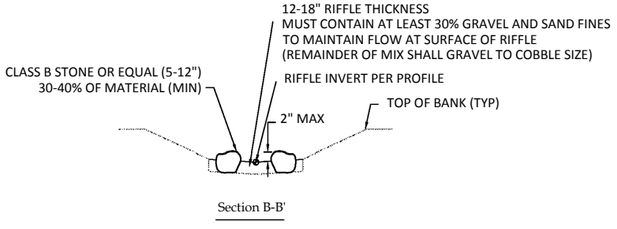
AROUND CULVERTS AND IN ENHANCEMENT REACHES, THE INDIVIDUAL STRUCTURES MAY BE SHOWN TO DICTATE THE SPECIFIC PLACEMENTS IN THOSE AREAS.



Plan View

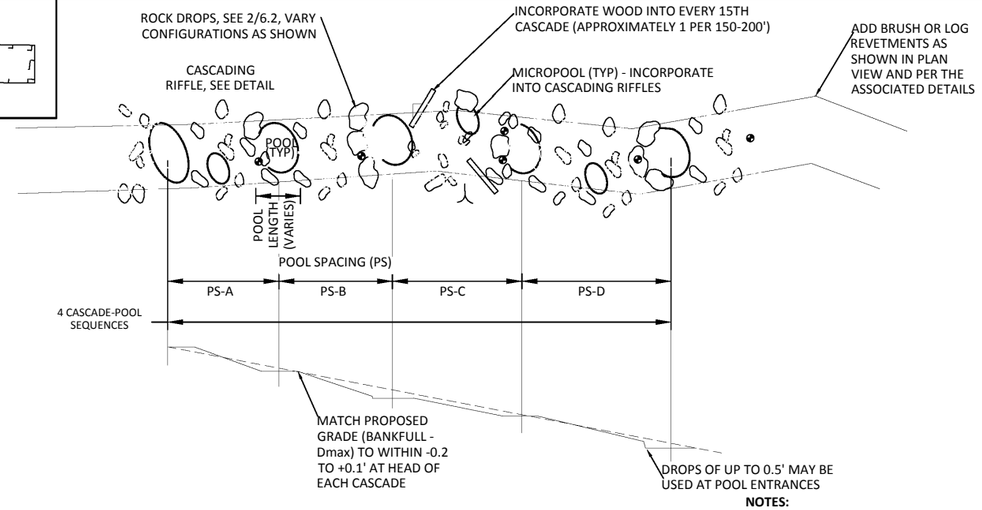


Section A-A'



Section B-B'

2/6.1 Cascading Riffle (Riffle)
Not to Scale



Cascade / Step-Pool Spacing Table

Species Name	POOL SPACING (PS) RANGE	PS-A	PS-B	PS-C	PS-D	SEQUENCE LENGTH A+B+C+D	POOL LENGTH	CASCADE SLOPE RANGE[1]
Shake Rag - Reach 3	9-18'	10'	18'	13'	16'	57'	3-5'	6-16%
Shake Rag - Reach 4[2]	11-25'	12'	17'	14'	25'	68'	3-7'	6-22%
Shake Rag - Reach 5	11-31'	12'	22'	15'	30'	69'	4-8'	6-22%
UT4	9-18'	10'	18'	13'	16'	57'	3-6'	6-22%
UT3	6-15'	9'	15'	7'	12'	47'	3-6'	4-18%
UT2/UT1	6-15'	9'	15'	7'	12'	47'	3-6'	4-18%

[1] Low and high ranges to be used sparingly, individual segments may exceed high range in which case rock cascade and/or rock slide details shall apply
[2] Reach 4 is Enhancement, use where indicated on plans

3/6.1 Cascading Riffle-Pool Sequence
Not to Scale

NOTES:

- CONTRACTOR MAY VARY POOL SPACING BUT SHALL COMPLETE SEQUENCES TOTALING TO SEQUENCE LENGTH PROVIDED IN TABLE
- ROCK CASCADE OR ROCK SLIDE STRUCTURES SHALL BE USED INSTEAD OF CASCADING RIFFLES FOR SLOPES >15-20%
- INCORPORATE LOG OR ROCK STEPS (FOOTERED STRUCTURES) FROM SHEET 6.2 AS DIRECTED
- SEQUENCES ARE DETAILED OUT ON THE PLANS FOR UT8 AND REACH 5 OF SHAKE RAG BRANCH- CHANGES TO THESE REACHES MUST BE APPROVED BY DESIGNER

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Shake Rag Branch Mitigation Site
Madison County, North Carolina

Details

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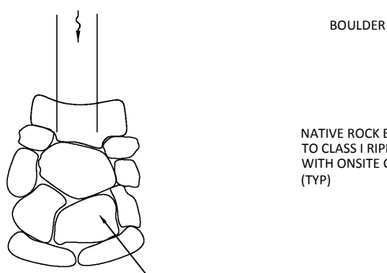
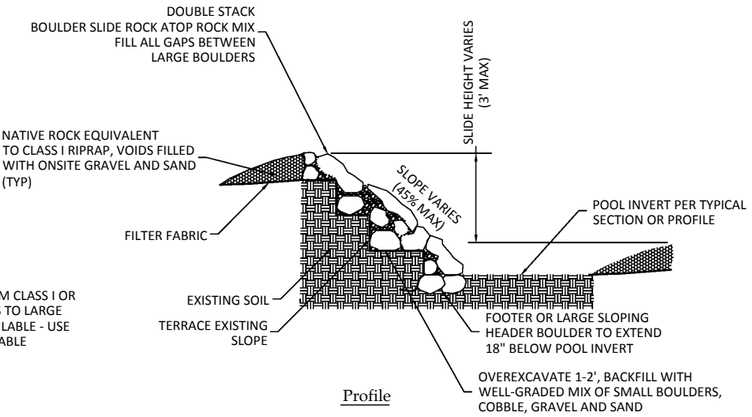
Project Engineer: JM
Drawn by: JDW
Checked by: CB

Sheet 6.1



MATERIAL VARIES FROM CLASS I OR II STONE TO BOULDERS TO LARGE ON-SITE STONE IF AVAILABLE - USE LARGEST STONE AVAILABLE

Plan View

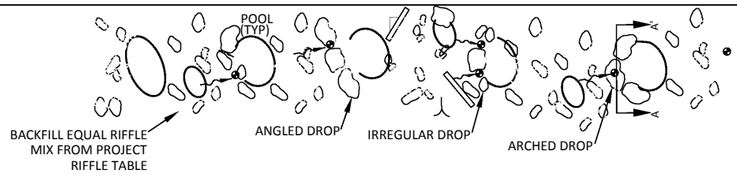


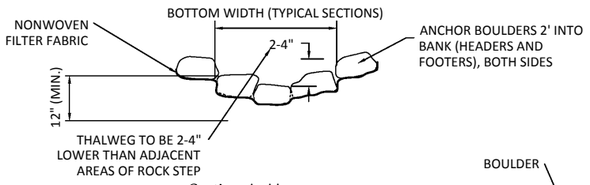
Profile

NOTES:

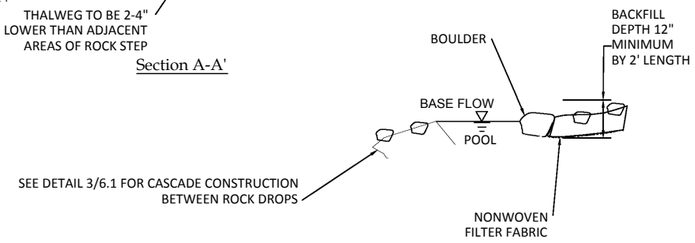
- USE AS DIRECTED WITH DETAIL 3/6.1 IN LIEU OF CASCADING RIFFLES WHERE AVERAGE SLOPE EXCEEDS 15-20% (ROCK CASCADE MAY ALSO BE USED FOR THIS SCENARIO).
- MINIMUM SIZE FOR BOULDERS SHALL BE 4' x 2' x 1'.
- VOID SPACES BETWEEN BOULDERS ON SLIDE SHALL BE FILLED WITH SMALLER NATIVE ROCK WHERE AVAILABLE.
- IF NATIVE ROCK IS NOT AVAILABLE, QUARRIED ROCK MAY BE SUBSTITUTED IN THE SAME SIZES.
- ALL SMALLER ROCK SHALL BE HETEROGENEOUS AND WELL MIXED.

1 6.2 Rock Slide
Not to Scale

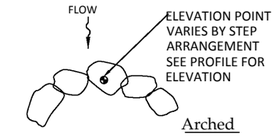


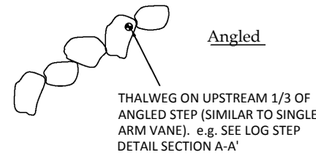


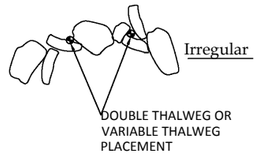
Section A-A'



Profile View





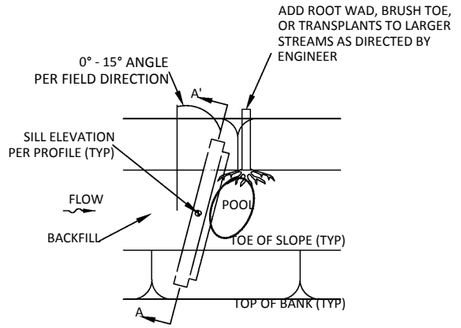


Types of Step Configurations

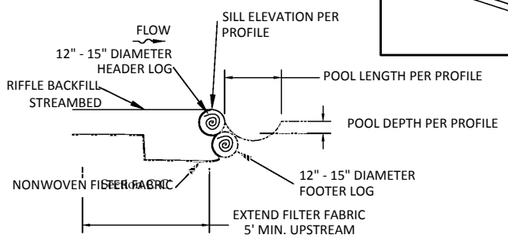
NOTES:

- DROP TYPE MAY BE VARIED IN THE FIELD BY DESIGNER. IN GENERAL, VARY DROP TYPE OFTEN WITH ROUGHLY EQUAL NUMBERS OF EACH DROP TYPE WITHIN A REACH.
- DETAILED TO BE APPLIED IN CONJUCTION WITH DETAIL 3/6.1 (CASCADING RIFFLE-POOL SEQUENCE)
- SECTION VIEWS REPRESENT ARCHED ROCK DROP VARIATION. MODIFY SECTIONS AS NEEDED TO ACCOMMODATE OTHER VARIATIONS
- BOULDER SIZE TABLES PER REACH TO BE ADDED TO 100% PLANS

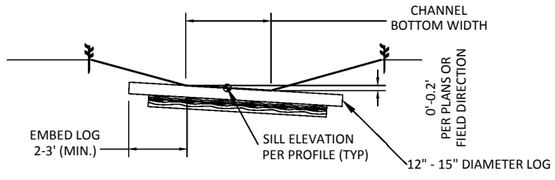
2 6.2 Rock Drop
Not to Scale



Plan View



Profile View

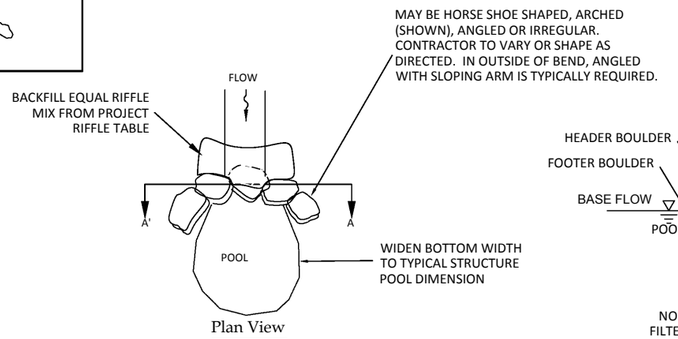


Section A - A'

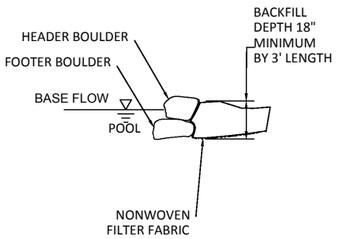
NOTE:

1. FOOTER LOG TO BE ADDED IF DROP IS MORE THAN HEADER LOG DIAMETER.

3 6.2 Log Step
Not to Scale



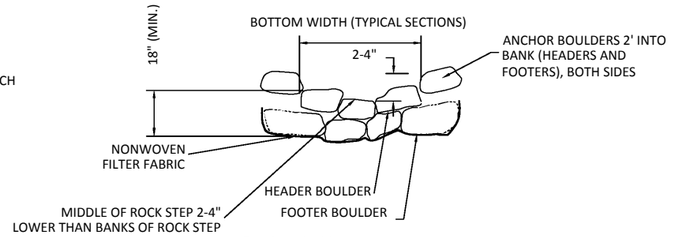
Plan View



Profile View

NOTE:

- BOULDER SIZE TABLES PER REACH TO BE ADDED TO 100% PLANS



Section A-A'

4 6.2 Rock Step
Not to Scale

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Madison County, North Carolina

Details

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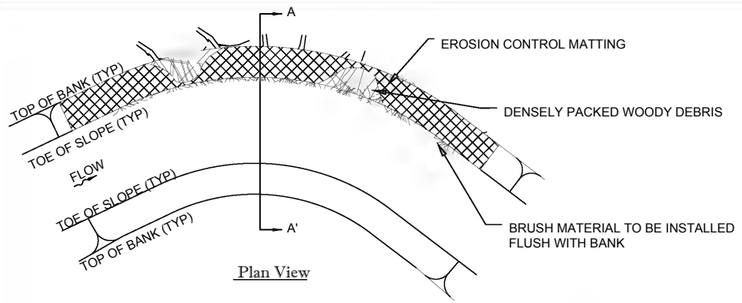
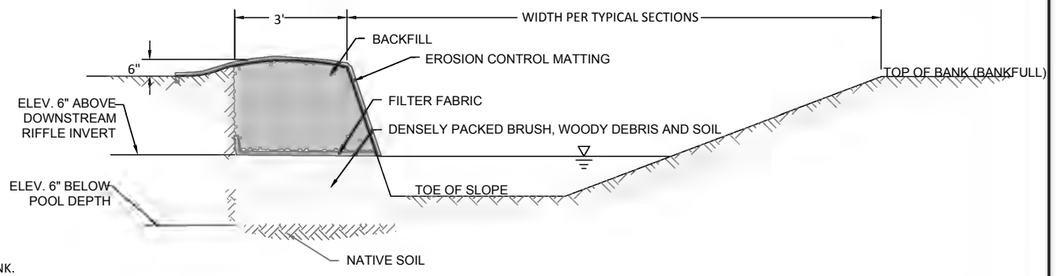
6.2
Sheet



Plan View

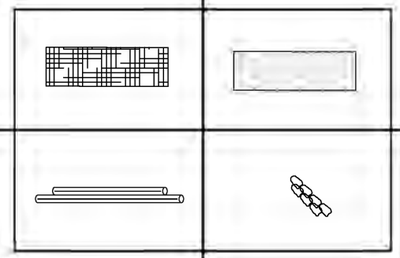


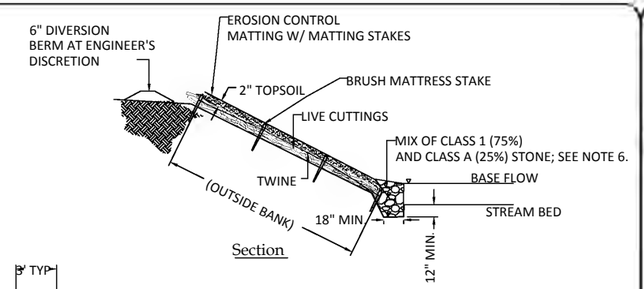
Section A-A'

NOTES:

- OVEREXCAVATE 2-3' BEYOND TOE OF BANK.
- INSTALL A DENSE LAYER OF BRUSH/WOODY DEBRIS, WHICH SHALL CONSIST OF SMALL BRANCHES AND ROOTS COLLECTED ON-SITE AND SOIL TO FILL ANY VOID SPACE. LIGHTLY COMPACT BRUSH/WOODY DEBRIS LAYER.
- BRUSH SHOULD BE ALIGNED SO STEMS ARE ROUGHLY PARALLEL AND IS INSTALLED POINTING SLIGHTLY UPSTREAM.
- INSTALL FILTER FABRIC OVER BRUSH/WOODY DEBRIS.
- INSTALL EARTH BACKFILL OVER BRUSH/WOODY LAYER ACCORDING TO TYPICAL SECTION DIMENSIONS.
- SEED, MULCH AND INSTALL EROSION CONTROL MATTING AND BANK STABILIZATION PER PLANS.

1 / 6.3 Brush Toe
Not to Scale





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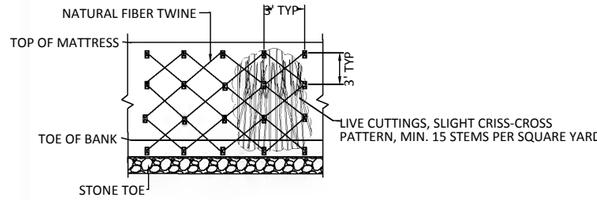

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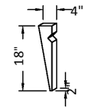
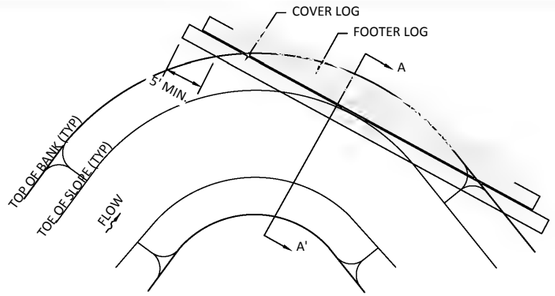


Brush Mattress Stake

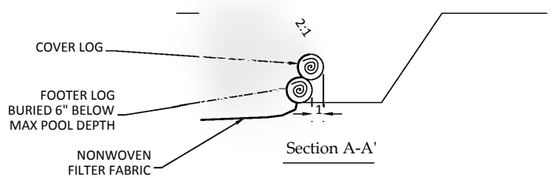
NOTES:

- PLACE LIVE CUTTINGS ON GRADED BANK WITH BUTT ENDS EXTENDING TO BASE FLOW WATER SURFACE.
- DRIVE STAKES HALFWAY INTO BANK BETWEEN CUTTINGS. WRAP TWINE AROUND STAKES AND OVER CUTTINGS TIGHTLY. DRIVE STAKES FURTHER TO TIGHTEN TWINE AND SECURE CUTTINGS TO SLOPE.
- FILL VOIDS BETWEEN CUTTINGS WITH LOOSE TOPSOIL. SEED AND MULCH SURFACE.
- INSTALL EROSION CONTROL MATTING OVER TOPSOIL, USING 18" LONG MATTING STAKES.
- PLACE STONE TOE OVER END OF MATTRESS AND MATTING.
- ON-SITE COBBLE AND GRAVEL MEETING STONE SPECS MAY BE SUBSTITUTED FOR IMPORTED STONE .
- BRUSH CUTTINGS TO BE SAME SPECIES AS LIVE STAKES

2 / 6.3 Brush Mattress
Not to Scale



Plan View

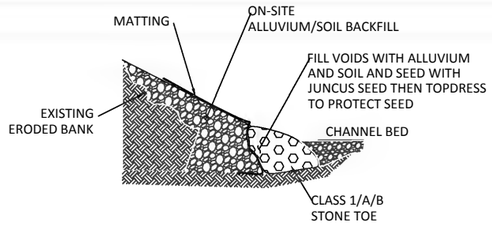


Section A-A'

NOTE:

- ROCK TOE MAY BE USED WHEN WOOD IS NOT AVAILABLE

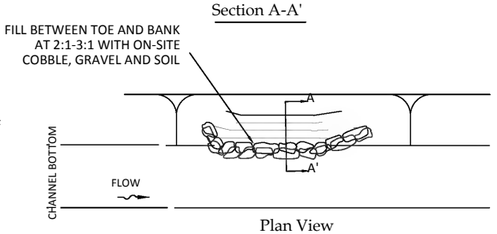
3 / 6.3 Lunker Log
Not to Scale



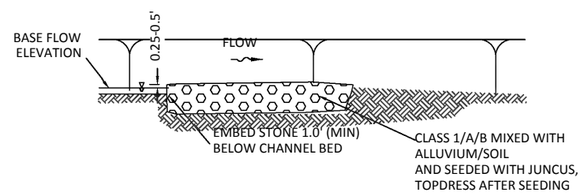
Section A-A'

SUBSTITUTE NOTE:

- ENGINEER MAY SPECIFY THAT COIR WATTLE/LOG ALTERNATE BE USED INSTEAD OF VEGETATED STONE TOE PROTECTION. COIR SHALL MEET PROJECT SPECIFICATION IN EROSION CONTROL SECTION AND BE STAKED PER MANUFACTURER RECOMMENDATIONS.



Plan View



Profile View

4 / 6.3 Vegetated Stone Toe Protection
Not to Scale

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PRELIMINARY DO NOT USE FOR CONSTRUCTION

Shake Rag Branch Mitigation Site
Madison County, North Carolina

Details

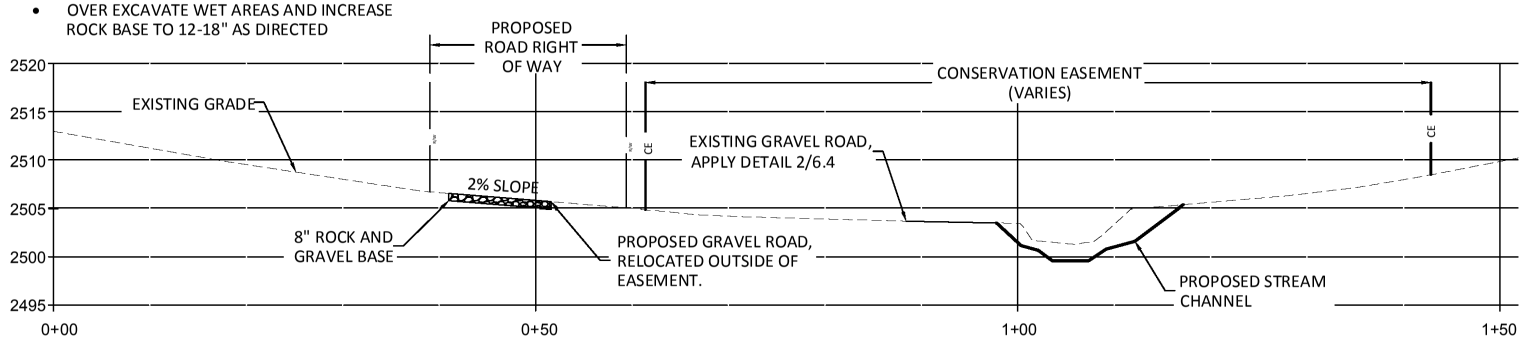
Revisions:

Date: November 06, 2018
Task Number: 005-02165
Project Engineer: JM
Drawn by: JDW
Checked By: CB

Sheet 6.3

NOTES:

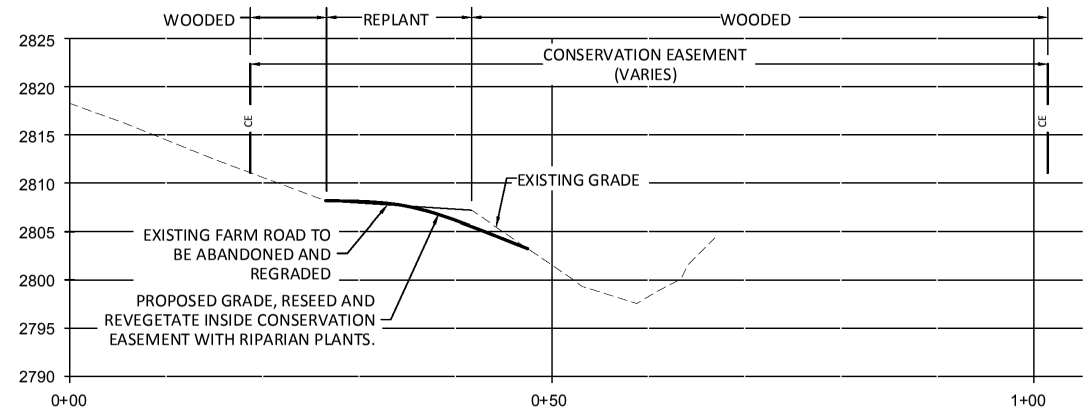
- AS APPLICABLE, HARVEST EXISTING ROAD BASE FOR REUSE.
- OVER EXCAVATE WET AREAS AND INCREASE ROCK BASE TO 12-18" AS DIRECTED



1/6.4 Private Gravel Road Along Shake Rag Branch, Reach 5
Not To Scale

NOTES:

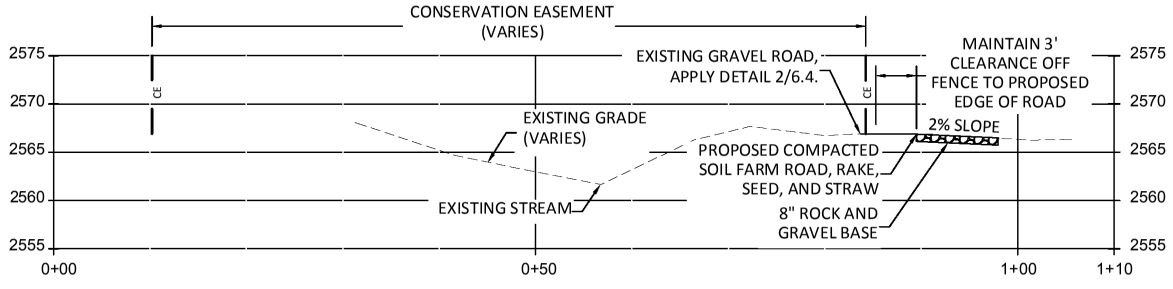
- EXISTING WOODS TO BE TREATED FOR INVASIVE SPECIES
- TYPICAL MAX SLOPE 2:1, LIMITED AREAS HAVE MAX SLOPE 1.5:1 AND SHALL BE SUPPLEMENTED WITH RIP-RAP THAT IS MIXED WITH SOIL AND REVEGETATED



2/6.4 Farm Road Abandonment and Naturalization
Not To Scale

NOTES:

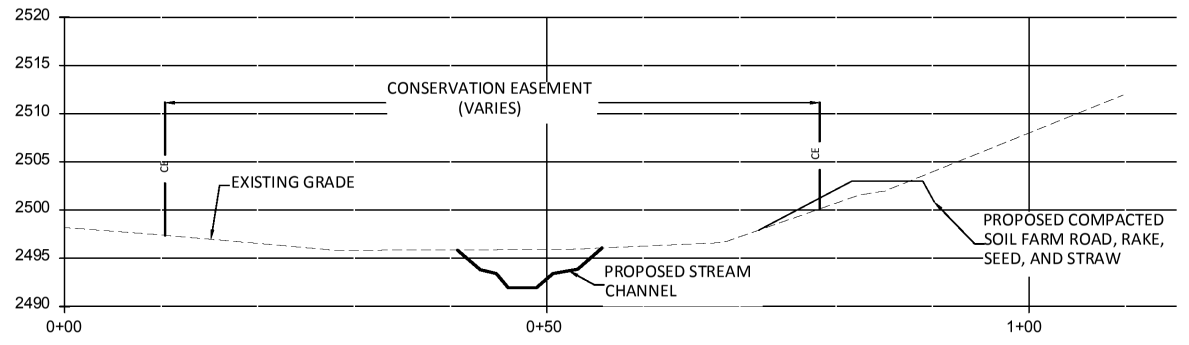
- AS APPLICABLE, HARVEST EXISTING ROAD BASE FOR REUSE.
- OVER EXCAVATE WET AREAS AND INCREASE ROCK BASE TO 12-18" AS DIRECTED.
- EXISTING GRADE ADJACENT TO ROAD VARIES. CONTRACTOR TO CONSTRUCT CROSS SLOPE AND GRADE TO DRAIN - MAY REQUIRE ROCK SWALE IN SOME AREAS



3/6.4 Ut6 Proposed Farm Road
Not To Scale

NOTES:

- AS APPLICABLE, HARVEST EXISTING ROAD BASE FOR REUSE.
- OVER EXCAVATE WET AREAS AND INCREASE ROCK BASE TO 12-18" AS DIRECTED.



4/6.4 Ut4 Proposed Farm Road
Not To Scale

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PRELIMINARY DO NOT USE FOR CONSTRUCTION

Shake Rag Branch Mitigation Site
Madison County, North Carolina

Details

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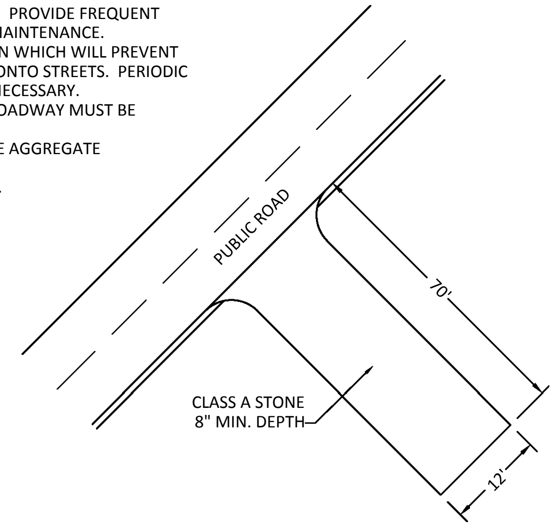
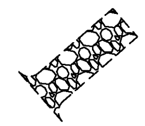
Date: November 06, 2018
768 Number: 005-02164
Project Engineer: JM
Drawn by: JDW
Checked by: CB

6.4
Sheet

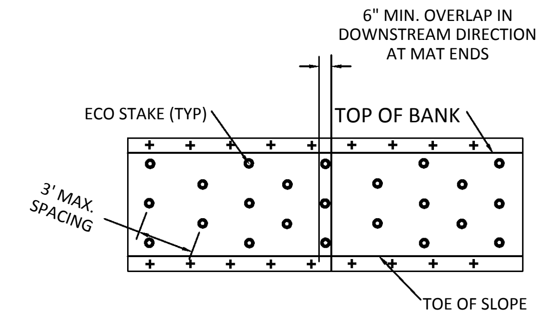
NOTES:

- PROVIDE TURNING RADIUS SUFFICIENT TO ACCOMMODATE LARGE TRUCKS.
- LOCATE CONSTRUCTION ENTRANCE AT ALL POINTS OF INGRESS AND EGRESS UNTIL SITE IS STABILIZED. PROVIDE FREQUENT CHECKS OF THE DEVICE AND TIMELY MAINTENANCE.
- MUST BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR DIRECT FLOW OF MUD ONTO STREETS. PERIODIC TOP DRESSING WITH STONE WILL BE NECESSARY.
- ANY MATERIAL TRACKED ONTO THE ROADWAY MUST BE CLEANED IMMEDIATELY.
- USE CLASS A STONE OR OTHER COARSE AGGREGATE APPROVED BY THE ENGINEER.
- PLACE FILTER FABRIC BENEATH STONE.

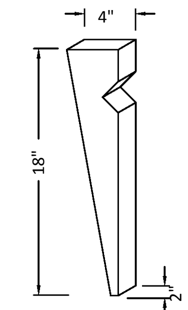




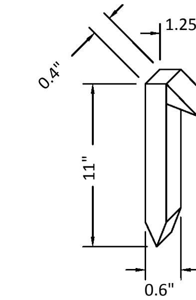
1/6.5 Construction Entrance
Not to Scale



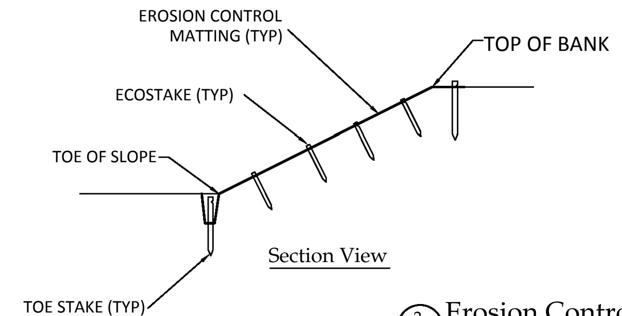
Plan View



Toe Stake +



Eco Stake

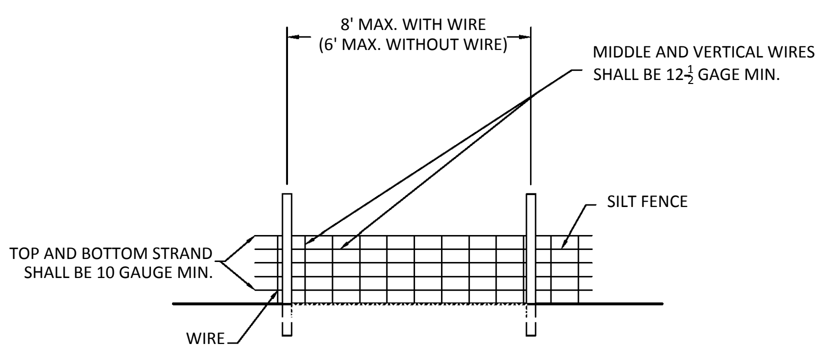


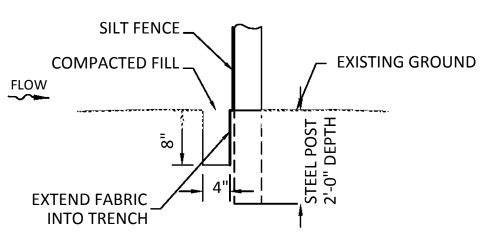
Section View

MAINTENANCE NOTES:

- ALL EROSION CONTROL MATTING SHOULD BE INSPECTED AT LEAST ONCE WEEKLY OR AFTER 0.25" OF PRECIPITATION WITHIN 24 HOURS.
- ANY MATTING FAILURES SHOULD BE REPAIRED WITHIN 24 HOURS.
- TENTING (EROSION OCCURRING UNDERNEATH INSTALLED MATTING) WILL REQUIRE PEELING BACK MATTING, REPAIRING ANY RILLS, AND REAPPLYING THE MATTING.
- USE 780 g/m^2 DENSITY COIR MATTING

2/6.5 Erosion Control Matting
Not to Scale

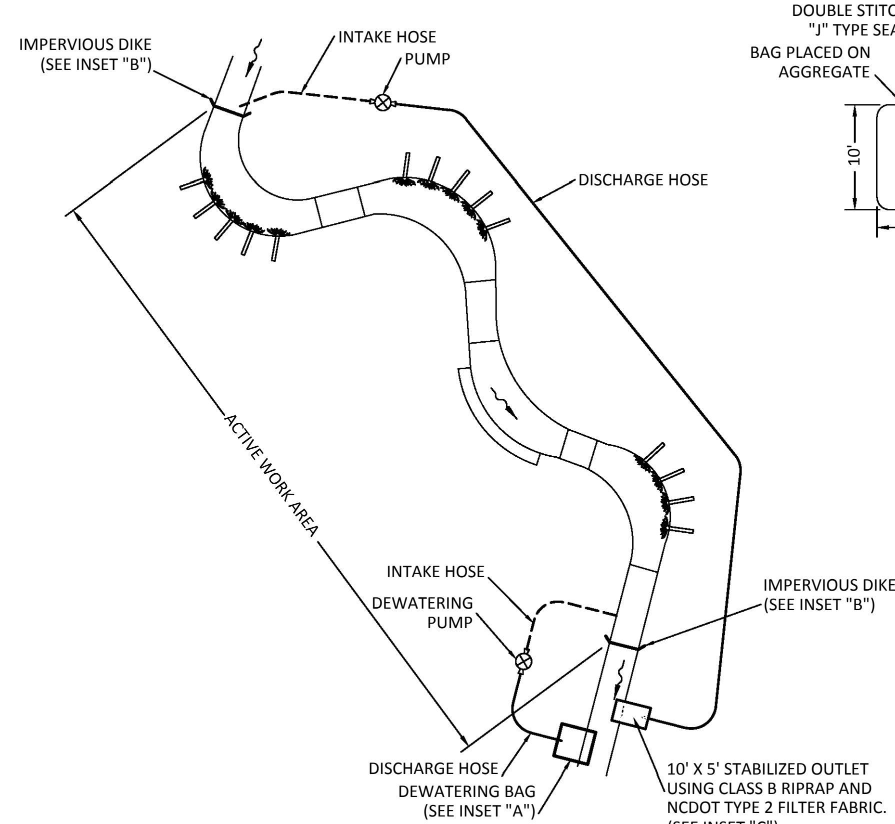




NOTES:

- USE WIRE A MINIUM OF 32" IN WIDTH AND WITH A MINIMUM OF 6 LINES OF WIRES WITH 12" STAY SPACING.
- USE SILT FENCE A MINIMUM OF 36" IN WIDTH AND FASTEN ADEQUATELY TO THE WIRES AS DIRECTED BY THE ENGINEER.
- PROVIDE 5' STEEL POST OF THE SELF-FASTENER ANGLE STEEL TYPE. ANGLE STEEL TYPE.

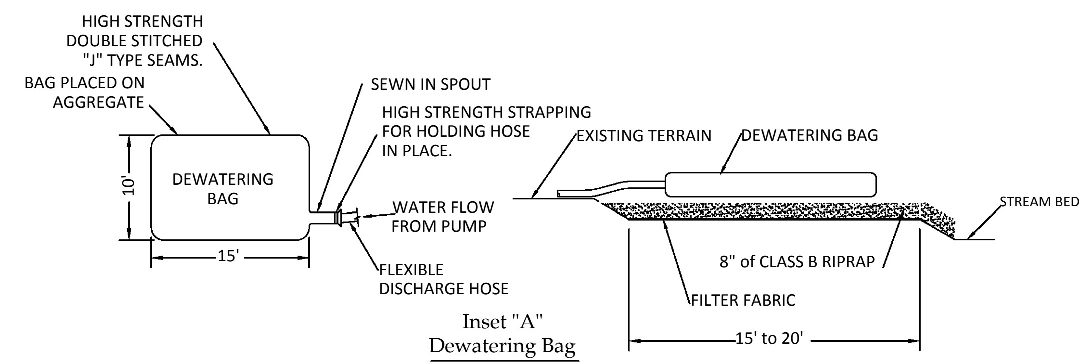
3/6.5 Temporary Silt Fence
Not to Scale



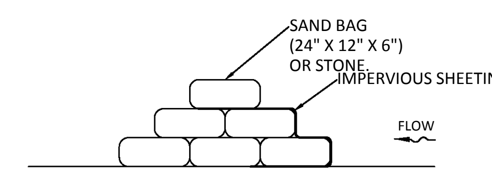
Plan View

NOTE:

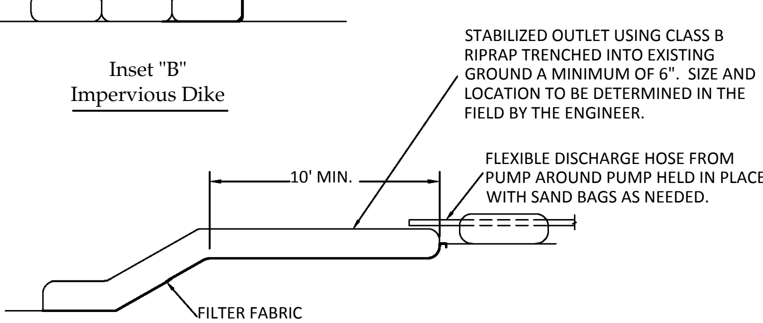
- PROVIDE STABILIZED OUTLET TO STREAMBED.



Inset "A"
Dewatering Bag



Inset "B"
Impervious Dike



Inset "C"
Stabilized Outlet

4/6.5 Pump Around System
Not to Scale

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PRELIMINARY DO NOT USE FOR CONSTRUCTION

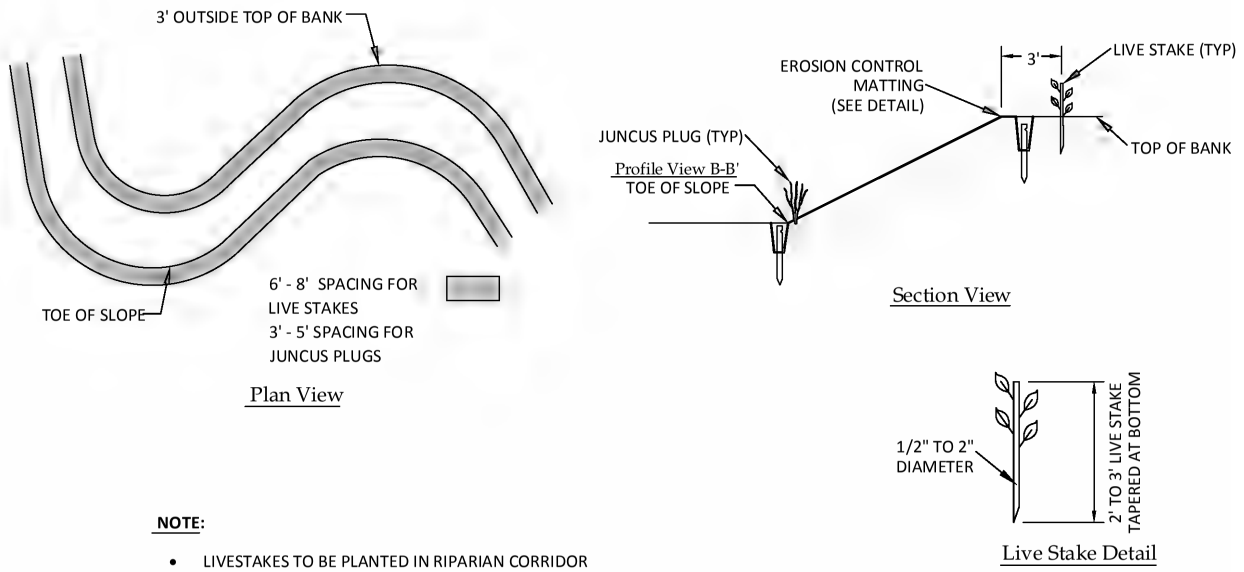
Shake Rag Branch Mitigation Site
Madison County, North Carolina

Details

Revisions:

Date: November 06, 2018
Job Number: 005-02164
Project Engineer: JM
Drawn By: JDW
Checked By: CB

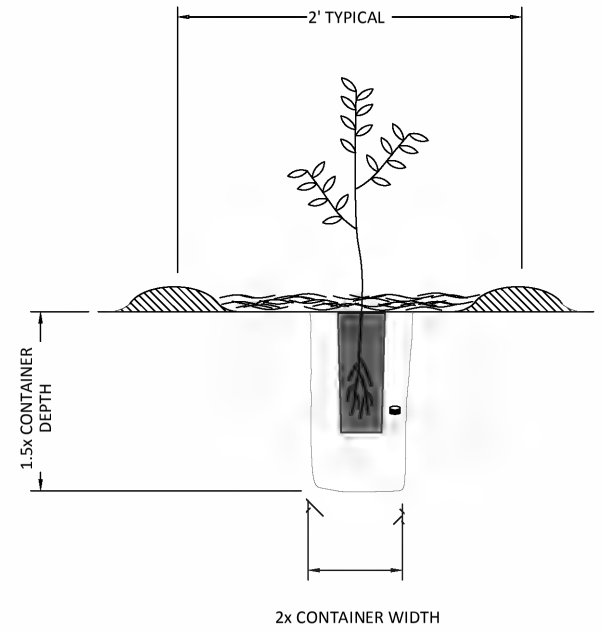
Sheet 6.5



NOTE:

- LIVESTAKES TO BE PLANTED IN RIPARIAN CORRIDOR PLANTING ZONES DESIGNATED ON PLANTING PLAN
- PLUGS TO BE PLANTED ON RESTORATION REACHES ONLY UNLESS DIRECTED OTHERWISE
- IN ENHANCEMENT AREAS, LIVESTAKES ONE OR BOTH BANKS AS DIRECTED BY DESIGNER - NO LIVESTAKING UT2 REACH 1

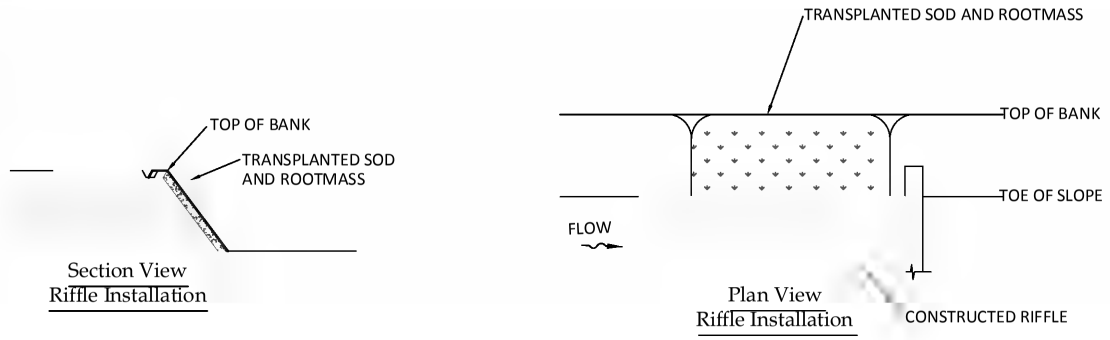
1 / 6.6 Live Staking & Juncus Plugs
Not to Scale



2 / 6.6 Containerized Planting
Not to Scale

This space reserved for details

3 / 6.6 Reserved
Not to Scale



NOTES:

- PREPARE THE BANK WHERE THE SOD MAT WILL BE TRANSPLANTED BY RAKING & FERTILIZING.
- EXCAVATE TRANSPLANT SOD MATS WITH A WIDE BUCKET AND AS MUCH ADDITIONAL SOIL MATERIAL AS POSSIBLE.
- PLACE TRANSPLANT ON THE BANK TO BE STABILIZED.
- SECURE WITH SOD STAPLES.
- FILL IN ANY HOLES AROUND THE TRANSPLANT AND COMPACT.
- ANY LOOSE SOIL LEFT IN THE STREAM SHOULD BE REMOVED.
- PLACE MULTIPLE TRANSPLANTS CLOSE TOGETHER SUCH THAT THEY TOUCH.

4 / 6.6 Transplanted Sod Mats
Not to Scale

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Shake Rag Branch Mitigation Site
Madison County, North Carolina

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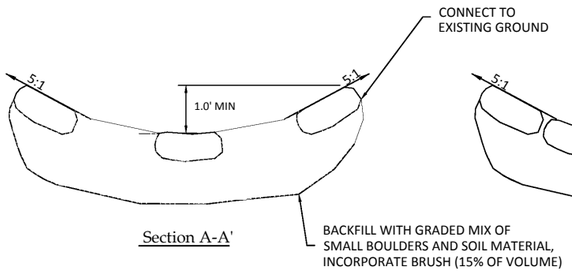
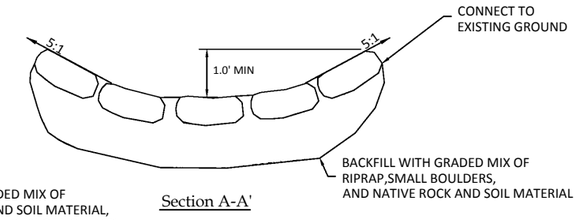
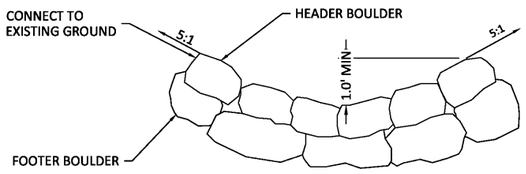
6.6
Sheet



Section A-A'



Section A-A'



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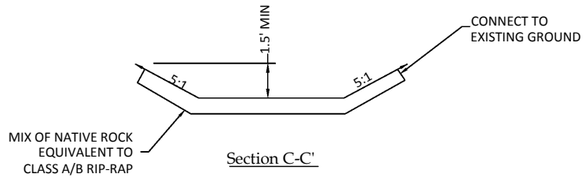

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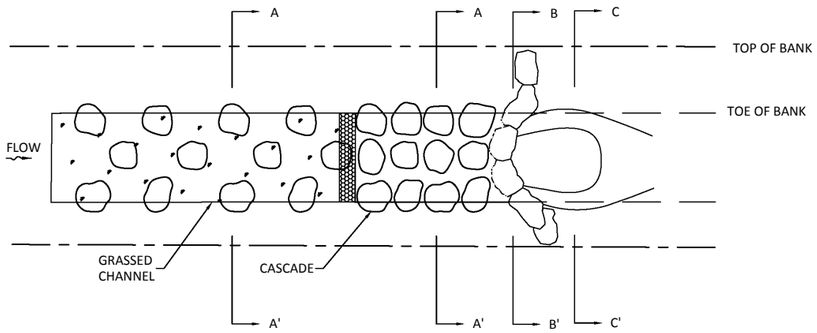
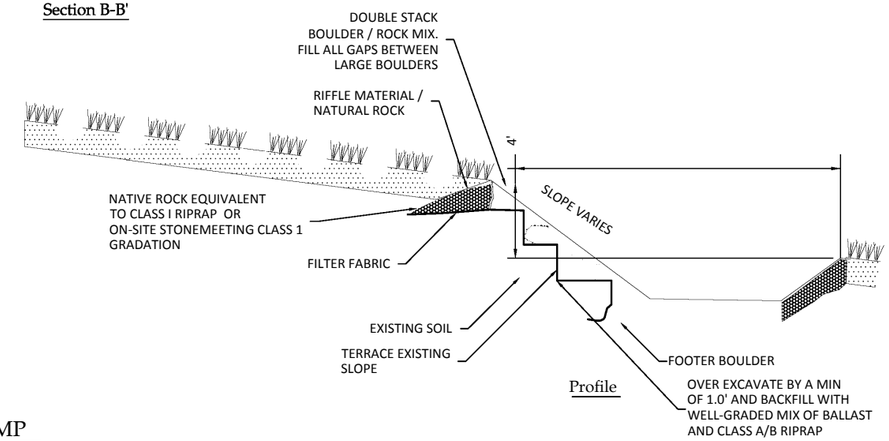


Riffle Sequence Plan View

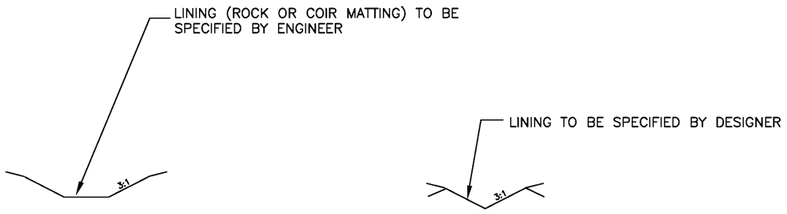
NOTES:

- MINIMUM SIZE FOR BOULDERS SHALL BE 2' x 2' x 1'.
- VOID SPACES BETWEEN BOULDERS ON CASCADE SHALL BE FILLED WITH SMALLER NATIVE ROCK.
- IF NATIVE ROCK IS NOT AVAILABLE, QUARRIED ROCK MAY BE SUBSTITUTED IN THE SAME SIZES.
- ALL SMALLER ROCK SHALL BE HETEROGENEOUS AND WELL MIXED.



Profile

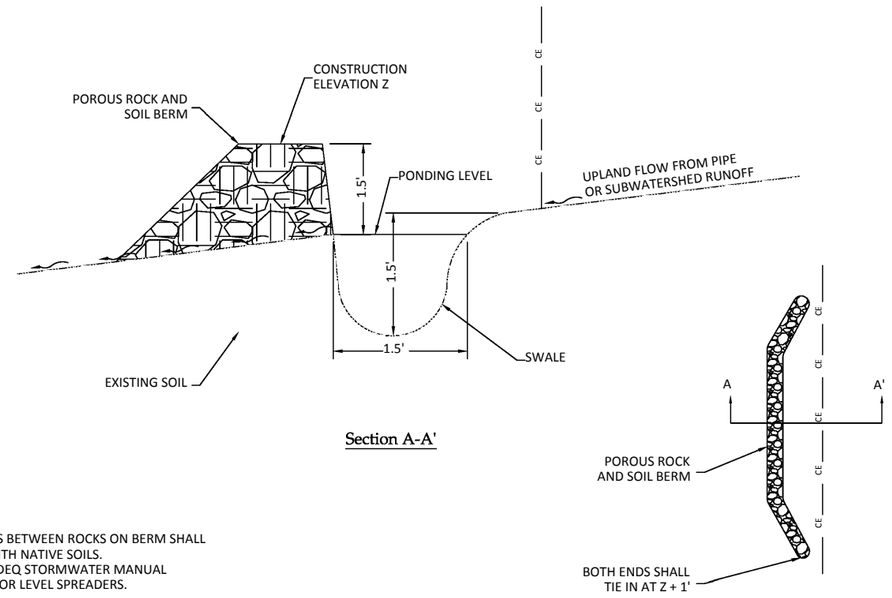
1 / 6.7 Step Pool Conveyance BMP
Not to Scale



NOTES FOR TYPICAL SWALES AND MICROSWALES:

- WIDTH AND DEPTH VARY, TO BE SPECIFIED ON FINAL PLANS.
- WIDTH SHALL BE AS BROAD AS POSSIBLE AND WHERE VALLEY ALLOWS, FLOW DISPERSION SHALL OCCUR AS CLOSE TO EASEMENT BOUNDARY AS POSSIBLE TO ALLOW BUFFER TO FUNCTION AS INTENDED.
- SHAPE AND GRADE TO PROVIDE DRAINAGE.
- APPLY TEMPORARY AND PERMANENT NATIVE SEED MIX
- APPLY MATTING AND VEGETATED RIPRAP CHECK DAMS WHERE DICTATED IN FIELD.

2 / 6.7 Proposed Swale
Not to Scale



Section A-A'

PLAN VIEW

NOTES:

- VOID SPACES BETWEEN ROCKS ON BERM SHALL BE FILLED WITH NATIVE SOILS.
- SIZE PER NCDEQ STORMWATER MANUAL GUIDANCE FOR LEVEL SPREADERS.

3 / 6.7 Slope Berm
Not to Scale

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Madison County, North Carolina

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Job Number: 005-02161
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Drawn by: JDW
Checked by: CB

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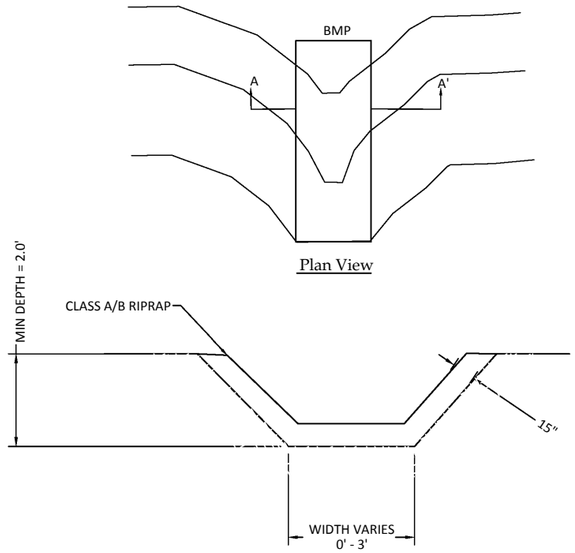
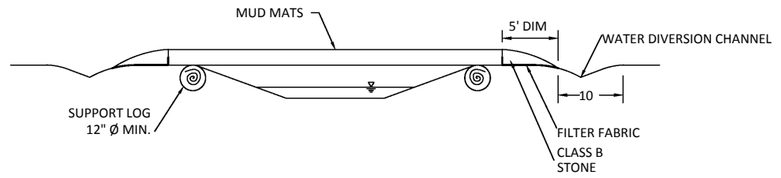


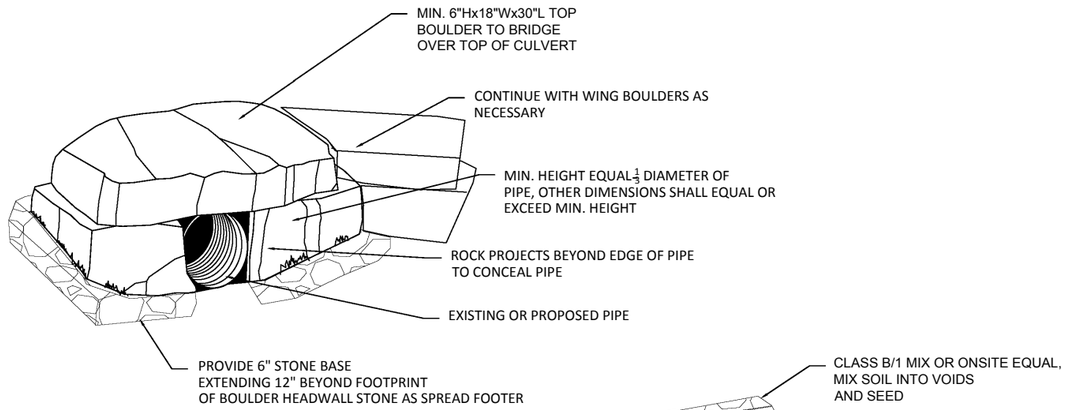
1 / 6.8 Stabilized Inlet
Not to Scale



2 / 6.8 Temporary Stream Crossing - Mud Mat
Not to Scale

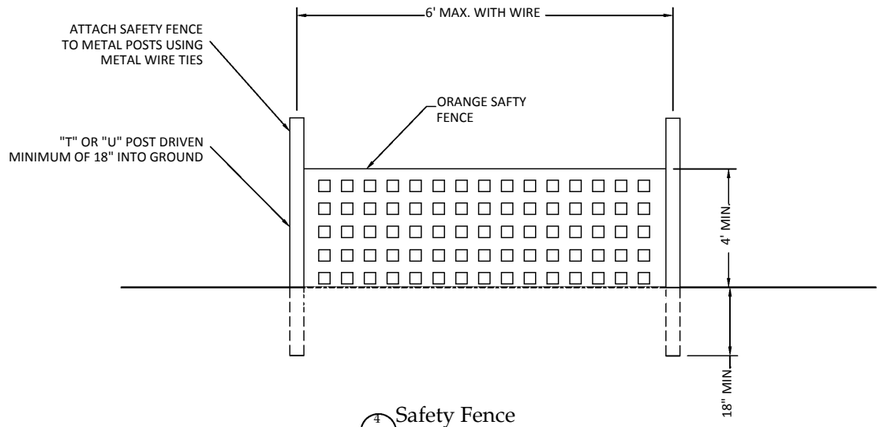
NOTES:

- CONSTRUCT STREAM CROSSING WHEN FLOW IS AT NORMAL BASEFLOW.
- MINIMIZE CLEARING AND EXCAVATION OF STREAMBANKS. DO NOT EXCAVATE CHANNEL BOTTOM.
- INSTALL STREAM CROSSING PERPENDICULAR TO THE FLOW.
- MAINTAIN CROSSING SO THAT RUNOFF IN THE CONSTRUCTION ROAD DOES NOT ENTER EXISTING CHANNEL.
- STABILIZE AN ACCESS RAMP OF CLASS B STONE TO THE EDGE OF THE MUD MAT.
- CONTRACTOR SHALL DETERMINE AN APPROPRIATE RAMP ANGLE ACCORDING TO EQUIPMENT UTILIZED.



3 / 6.8 Rock Headwall
Not to Scale

MATERIAL SPECIFICATIONS		
PHYSICAL PROPERTY	TESTS	REQUIREMENTS
MATERIAL	N/A	POLYETHYLENE
RECOMENDED COLOR	N/A	"INTERNATIONAL ORANGE"
TENSILE YIELD	ASTM D638	AVE. 2000 LBS. PER 4' WIDE
ULTIMATE TENSILE STRENGTH	ASTM D638	AVE. 2900 LBS. PER 4' WIDE
ELONGATION AT BREAK (%)	ASTM D638	GREATER THAN 1000%
CHEMICAL RESISTANCE	N/A	INERT TO MOST CHEMICALS AND ACIDS



4 / 6.8 Safety Fence
Not to Scale

WILDLANDS ENGINEERING
167-B Haywood Road
Asheville, NC 28806
Tel: 828.774.3547
Fax: 704.332.3306
Firm License No. F-0831

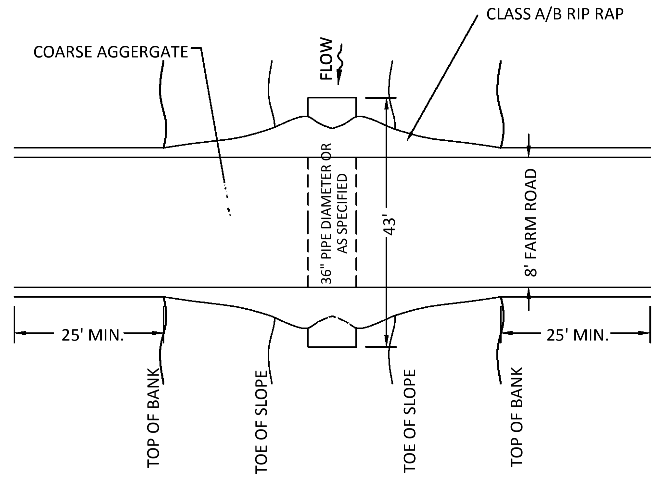
PRELIMINARY
DO NOT
USE FOR
CONSTRUCTION

Shake Rag Branch Mitigation Site
Madison County, North Carolina
Details

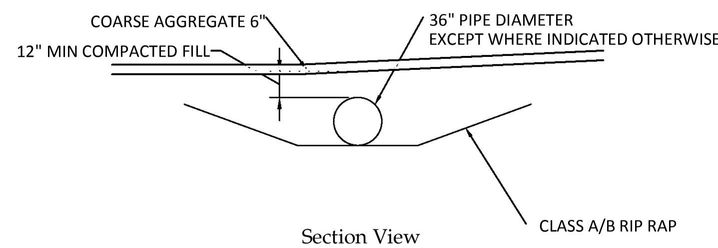
Revisions:

Date: November 06, 2018
319 Number: 005-02158
Project Engineer: JW
Drawn by: JDW
Checked by: CB

6.8
Sheet



Plan View



Section View

NOTES:

- THIS TYPE OF CROSSING CAN BE INSTALLED IN BOTH A WET OR DRY WEATHER STREAM CONDITION WHERE THE DRAINAGE AREA EXCEEDS 10 ACRES.

3 / 6.9 Permanent Culvert with Farm Road
Not to Scale

This space reserved for details

2 / 6.9 Reserved
Not to Scale

This space reserved for details

3 / 6.9 Reserved for Fencing Detail
Not to Scale

This space reserved for details

4 / 6.9 Reserved
Not to Scale

WILDLANDS ENGINEERING
167-B Haywood Road
Asheville, NC 28806
Tel: 828.774.5547
Fax: 704.332.3306
Firm License No. F-0831

PRELIMINARY DO NOT USE FOR CONSTRUCTION

Shake Rag Branch Mitigation Site
Madison County, North Carolina

Details

Revisions:

Date:	November 06, 2018
Job Number:	005-02164
Project Engineer:	JM
Drawn By:	JDW
Checked By:	CB

6.9

Sheet

APPENDIX 7
INVASIVE SPECIES PLAN

Appendix 7 Invasive Species Plan

Annual monitoring and semi-annual site visits will be conducted to assess the condition of the finished project. These site inspections may identify the presence of invasive vegetation. If, during the monitoring period, invasive species threaten the survivability of planted woody vegetation in an area that exceeds 1% of the planted easement acreage, the invasive species shall be treated. Smaller areas may be treated at the discretion of the project engineer and biologist, if deemed in the best interest of the Site. Generally, the treatment plan shall follow the below guidelines in Table 1 for common invasive species found in riparian areas; however, the treatment may be changed based on the professional judgement of the project engineer and biologist. For invasive species not listed in the below table that threaten the survivability of the planted woody vegetation, Wildlands shall notify DMS of the invasive species observed and the plan for treatment prior to treating the species. All invasive species treatment will be reported in the following year's monitoring plan.

Table 1. Invasive Species Treatment – *Shake Rag Mitigation Site*

Invasive Species	Recommended Removal Technique
Honeysuckle (*Lonicera japonica*)	Small infestations of *L. japonica* can be pulled by hand. Monitor to remove any re-sprouts. Care should be taken to bag and remove the plants, including mature fruits to prevent re-establishment. Large infestations of *L. japonica* will usually require a combination of cut stump and foliar herbicide treatments. Where vines have grown into the tree canopy, cut each stem as close to the ground as possible. Treat the freshly cut surface of the rooted stem with a 25 percent solution of glyphosate or triclopyr. Remove the twining vines to prevent them from girdling and killing desirable vegetation. Groundcovers of *L. japonica* can be treated with a foliar solution of 2 percent glyphosate or triclopyr plus a 0.5 percent non-ionic surfactant to thoroughly wet all the leaves.
Chinese Privet (*Ligustrum sinense*)	Thoroughly wet all leaves with one of the following herbicides in water with a surfactant: a glyphosate herbicide as a 3-percent solution (12 ounces per 3-gallon mix) in the late fall or early winter when safety to surrounding vegetation is desired, or elsewhere, Arsenal AC* as a 1-percent solution (4 ounces per 3-gallon mix). Backpack mist blowers can broadcast glyphosate as a 3-percent solution (12 ounces per 3-gallon mix) or Escort XP* at 1 ounce per acre (0.2 dry ounces per 3-gallon mix and 10 gallons per acre) during winter for safety to dormant hardwoods. Summer applications of glyphosate may not be as effective as other times and require a higher percent solution. The best time for Arsenal AC* and Escort XP* is summer to fall. For stems too tall for foliar sprays and when safety to surrounding vegetation is desired, apply a basal spray of Garlon 4 as a 20-percent solution (5 pints per 3-gallon mix) in a labeled basal oil product, vegetable oil or mineral oil with a penetrant, or fuel oil or diesel fuel (where permitted); or undiluted Pathfinder II. Elsewhere, apply Stalker* as a 6- to 9-percent solution (1.5 to 2 pints per 3-gallon mix) in a labeled basal oil product, vegetable oil or mineral oil with a penetrant, or fuel oil or diesel fuel (where permitted) to young bark as a basal spray making certain to treat all stems in a clump; or cut and immediately treat the stump tops with Arsenal AC* as a 5-percent solution (20 ounces per 3-gallon mix) or Velpar L* as a 10-percent solution in water (1 quart per 3-gallon mix) with a surfactant. When safety to surrounding vegetation is desired, immediately treat stump tops and sides with Garlon 3A or with a glyphosate herbicide as a 20-percent solution (5 pints per 3-gallon mix) in water with a surfactant. ORTHO Brush-B-Gon and Enforcer Brush Killer are effective undiluted for treating cut-stumps and available in retail garden stores (safe to surrounding plants). For large stems, make stem injections using Arsenal AC* or when safety to surrounding vegetation is desired, Garlon 3A or a glyphosate herbicide using dilutions and cut-spacings specified on the herbicide label

Invasive Species	Recommended Removal Technique
	(anytime except March and April). An EZ-Ject tree injector can help to reach the lower part of the main stem; otherwise, every branching trunk must be hack-and-squirt injected.
Tree of Heaven (*Ailanthus altissima*)	Foliar Spray Method: This method should be considered for large thickets of seedlings and small saplings where risk to nontarget species is minimal. Air temperature should be above 65Â°F to ensure absorption of herbicides. Glyphosate: Apply a 2% solution of glyphosate or triclopyr and water plus a 0.5% non-ionic surfactant to thoroughly wet all leaves. Use a low pressure and coarse spray pattern to reduce spray drift damage to non-target species. Glyphosate is a non-selective systemic herbicide that may kill non-target partially-sprayed plants. Cut Stump Method: This control method should be considered when treating individual trees or where the presence of desirable species precludes foliar application. Stump treatments can be used if the ground is not frozen. Triclopyr: Horizontally cut stems at or near ground level. Immediately apply a 25% solution of triclopyr and water to the cut stump making sure to cover the outer 20% of the stump. Hack and Squirt and Stem Injection Methods: To effectively treat larger saplings to mature trees using the hack and squirt methods, make cuts to the cambium spaced 1" apart and arranged horizontally around the stem. Immediately apply a 50% solution of triclopyr or 25% solution of glyphosate into the cuts. An EZ-Ject tree injector or other similar tool can be used to treat saplings to mature trees. These treatments should occur from mid-late summer to late fall.
Princess Tree (*Paulownia tomentosa*)	Foliar Spray Method: This method should be considered for large thickets of paulownia seedlings where risk to non-target species is minimal. Air temperature should be above 65Â°F to ensure absorption of herbicides. Glyphosate: Apply a 2% solution of glyphosate and water plus a 0.5% non-ionic surfactant to thoroughly wet all leaves. Use a low pressure and coarse spray pattern to reduce spray drift damage to non-target species. Glyphosate is a non-selective systemic herbicide that may kill non-target partially-sprayed plants. Triclopyr: Apply a 2% solution of triclopyr and water plus a 0.5% non-ionic sur-factant to thoroughly wet all leaves. Use a low pressure and coarse spray pattern to reduce spray drift damage to non-target species. Triclopyr is a selective herbicide for broadleaf species. In areas where desirable grasses are growing under or around paulownia, triclopyr can be used without non-target damage. Cut Stump Method: This control method should be considered when treating individual trees or where the presence of desirable species precludes foliar application. Stump treatments can be used if the ground is not frozen. Glyphosate: Horizontally cut stems at or near ground level. Immediately apply a 25% solution of glyphosate and water to the cut stump making sure to cover the outer 50% of the stump. Triclopyr: Horizontally cut stems at or near ground level. Immediately apply a 50% solution of triclopyr and water to the cut stump making sure to cover the outer 20% of the stump. Hack and Squirt and Stem Injection Methods: To effectively treat larger saplings to mature trees using the hack and squirt methods, make cuts to the cambium spaced 1" apart and arranged horizontally around the stem. Immediately apply a 50% solution of triclopyr or 25% solution of glyphosate into the cuts. An EZ-Ject tree injector or other similar tool can be used to treat saplings to mature trees. These treatments should occur from mid-late summer to late fall. https://www.se-eppc.org/manual/princess.html

Invasive Species	Recommended Removal Technique
English ivy (*Hedera helix*)	Small infestations of *Hedera helix* can be pulled by hand. Monitor to remove any re-sprouts. Care should be taken to bag and remove the plants, including mature fruits to prevent re-establishment. Foliar Spray Method: Thoroughly wet all leaves (until runoff) with one of the following herbicides in water with a surfactant (July to October for successive years): Garlon 3A or Garlon 4 as a 3- to 5-percent solution (12 to 20 ounces per 3-gallon mix) or a glyphosate herbicide as a 4-percent solution (1 pint per 3-gallon mix). Use a string trimmer to reduce growth layers and injure leaves for improved herbicide uptake. Or apply basal sprays of Garlon 4 as a 20-percent solution in a labeled basal oil product, vegetable oil, kerosene, or diesel fuel (where permitted) (5 pints per 3-gallon mix); or apply undiluted Pathfinder II to large vines, avoiding the bark of desirable trees. Or for extensive and dense infestation where damage to hardwood trees, shrubs, and other plants is not a concern apply Escort XP* at 1 ounce per acre (0.2 dry ounces per 3-gallon mix and 10 gallons per acre). Cut Stump Method: Cut large vines and immediately apply a 50% solution of triclopyr or 25% solution of glyphosate.
Wineberry (*Rubus phoenicolasius*)	Small wineberry populations with young plants can be hand pulled or dug due to its small root system. Special care must be taken to remove the entire root and to bag and remove plants. Foliar Spray Method: Spray plants until runoff with a 2-3% solution of triclopyr (Garlon 3a or Vastlan) with a 0.5% solution of non-ionic surfactant. Treatments are most effective in fall after fruit has set and nutrients begin to flow towards the root systems.
creeping charlie, ground ivy (*Glechoma hederacea*)	*Glechoma hederacea* is a difficult to control weed that tolerates shade and poor compact soils. Hand pulling can be effective for small early detected populations. Providing competition to *G. hederacea*, typically in the form of a robust turf layer, can also be effective at limiting its spread. Herbicide applications are necessary for meaningful treatment of larger populations. Foliar Spray Method: Apply herbicide products containing metsulfuron, triclopyr, fluroxypyr, quinclorac, or 2,4-D at label rates in late fall. Plant injury from application may not appear until spring. Multiple years of treatment are likely necessary for effective control.
Chinese silvergrass (*Miscanthus sinensis*)	Chinese silvergrass is a disturbance specialist that spreads via robust rhizomes and seed. Remove prior plantings taking special care to remove entire rhizome, and control sprouts and seedlings. Bag and dispose of plants and seed heads in a dumpster or burn. Sterile cultivars most commonly planted are not a problem. Minimize disturbance within miles of where fertile plants occur, and anticipate wider occupation if plants are present or adjacent before disturbance. Do not mow when there are seed heads. Disking rhizomes can provide control in large populations. Chinese silvergrass should be treated before seeds appear on plants. Foliar Spray Method: Thoroughly wet all leaves with one of the following herbicides in water with a surfactant (September or October with multiple applications to regrowth): Arsenal AC* as a 1-percent solution (4 ounces per 3-gallon mix). When safety to surrounding vegetation is desired, a glyphosate herbicide as a 4-percent solution (1 pint per 3-gallon mix) only to the target plants; or a combination of the two herbicides, Arsenal AC* as a 0.5-percent solution (2 ounces per 3-gallon mix) plus a glyphosate herbicide as a 4-percent solution (2 ounces plus 1 pint per 3-gallon mix). Repeat applications when new growth reaches 2 feet (60 cm) in height.

APPENDIX 8
MAINTENANCE PLAN

Appendix 8 Maintenance Plan

The site shall be visited semi-annually and a physical inspection of the site shall be conducted a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include the following:

Table 1. Maintenance Plan – *Shake Rag Mitigation Site*

Component/ Feature	Maintenance through project close-out
Stream	Routine channel maintenance and repair activities may include chinking of in-stream structures to prevent piping, securing of loose coir matting, and supplemental installations of live stakes and other target vegetation along the channel – these shall be conducted where success criteria are threatened or at the discretion of the Designer. Areas where storm water and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting. Beaver activity will be monitored and beaver dams on project streams will typically be removed, at the discretion of the Designer, during the monitoring period to allow for bank stabilization and stream development outside of this type of influence.
Vegetation	Vegetation shall be maintained to ensure the health and vigor of the targeted community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species requiring treatment per the Invasive Species Treatment Plan (Appendix 9) shall be treated in accordance with that plan and with NC Department of Agriculture (NCDA) rules and regulations.
Site boundary	Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree-blazing, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as-needed basis.

APPENDIX 9
CREDITING INFORMATION

Appendix 9 - Credit Release Schedule

All credit releases will be based on the total credit generated as reported by the as-built survey of the mitigation site. Under no circumstances shall any mitigation project be debited until the necessary Department of the Army (DA) authorization has been received for its construction or the District Engineer (DE) has otherwise provided written approval for the project in the case where no DA authorization is required for construction of the mitigation project. The DE, in consultation with the Interagency Review Team (IRT), will determine if performance standards have been satisfied sufficiently to meet the requirements of the release schedules below. In cases where some performance standards have not been met, credits may still be released depending on the specifics of the case. Monitoring may be required to restart or be extended, depending on the extent to which the site fails to meet the specified performance standard. The release of project credits will be subject to the criteria described as follows:

Table A: Credit Release Schedule – Stream Credits – *Shake Rag Mitigation Site*

Monitoring Year	Credit Release Activity	Interim Release	Total Released
0	Initial Allocation – see requirements below	30%	30%
1	First year monitoring report demonstrates performance standards are being met	10%	40%
2	Second year monitoring report demonstrates performance standards are being met (additional 10% released at second bankfull event in a separate year)	10%	50% (60%)
3	Third year monitoring report demonstrates performance standards are being met	10%	60% (70%)
4	Fourth year monitoring report demonstrates performance standards are being met	5%	65% (75%)
5	Fifth year monitoring report demonstrates performance standards are being met	10%	75% (85%)
6	Sixth year monitoring report demonstrates performance standards are being met	5%	80% (90%)
7	Seventh year monitoring report demonstrates performance standards are being met and project has received closeout approval	10%	90% (100%)

1.1 Initial Allocation of Released Credits

The initial allocation of released credits, as specified in the mitigation plan can be released by DMS without prior written approval of the DE upon satisfactory completion of the following activities:

a. Approval of the final Mitigation Plan.
b. Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property.
c. Completion of project construction (the initial physical and biological improvements to the mitigation site) pursuant to the mitigation plan; per the DMS Instrument, construction means that a mitigation site has been constructed in its entirety, to include planting, and an as-built report has been produced. As-built reports must be sealed by an engineer prior to project closeout, if appropriate but not prior to the initial allocation of released credits.

d. Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

1.2 Subsequent Credit Releases

All subsequent credit releases must be approved by the DE, in consultation with the IRT, based on a determination that required performance standards have been achieved. For stream projects a reserve of 10% of a site's total stream credits shall be released after two bankfull events have occurred, in separate years, provided the channel is stable and all other performance standards are met. In the event that less than two bankfull events occur during the monitoring period, release of these reserve credits shall be at the discretion of the IRT. As projects approach milestones associated with credit release, the DMS will submit a request for credit release to the DE along with documentation substantiating achievement of criteria required for release to occur. This documentation will be included with the annual monitoring report.

APPENDIX 10
FINANCIAL ASSURANCE

Appendix 10 Financial Assurances

Pursuant to Section IV H and Appendix III of the Division of Mitigation Service's In-Lieu Fee Instrument dated July 28, 2010, the North Carolina Department of Environment and Natural Resources has provided the US Army Corps of Engineers Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by DMS. This commitment provides financial assurance for all mitigation projects implemented by the program.