FINAL MITIGATION PLAN

Mockingbird Site
Davie County, North Carolina

Yadkin River Basin
HUC 03040101

DMS Project #: 100021
Contract #: 7185
USACE Action ID #: SAW-2017-01505
DWR Project #: 20171040
RFP #: 16-006993

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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For Environmental Banc & Exchange, LLC
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919-209-1052

November 2018

"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 NCDMS operations and procedures for the delivery of compensatory mitigation."

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

November 6, 2018

Regulatory Division

Re: NCIRT Review and USACE Approval of the Mockingbird Site Mitigation Plan; SAW-2017-01505; NCDMS Project # 100021

Mr. Tim Baumgartner
North Carolina Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Dear Mr. Baumgartner:

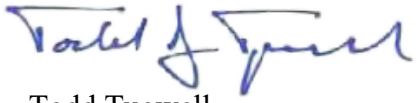
The purpose of this letter is to provide the North Carolina Division of Mitigation Services (NCDMS) with all comments generated by the North Carolina Interagency Review Team (NCIRT) during the 30-day comment period for the Mockingbird Site Mitigation Plan, which closed on October 5, 2018. These comments are attached for your review.

Based on our review of these comments, we have determined that no major concerns have been identified with the Draft Mitigation Plan, which is considered approved with this correspondence. However, several minor issues were identified, as described in the attached comment memo, which must be addressed in the Final Mitigation Plan.

The Final Mitigation Plan is to be submitted with the Preconstruction Notification (PCN) Application for Nationwide permit approval of the project along with a copy of this letter. Issues identified above must be addressed in the Final Mitigation Plan. All changes made to the Final Mitigation Plan should be summarized in an errata sheet included at the beginning of the document. If it is determined that the project does not require a Department of the Army permit, you must still provide a copy of the Final Mitigation Plan, along with a copy of this letter, to the appropriate USACE field office at least 30 days in advance of beginning construction of the project. Please note that this approval does not preclude the inclusion of permit conditions in the permit authorization for the project, particularly if issues mentioned above are not satisfactorily addressed. Additionally, this letter provides initial approval for the Mitigation Plan, but this does not guarantee that the project will generate the requested amount of mitigation credit. As you are aware, unforeseen issues may arise during construction or monitoring of the project that may require maintenance or reconstruction that may lead to reduced credit.

Thank you for your prompt attention to this matter, and if you have any questions regarding this letter, the mitigation plan review process, or the requirements of the Mitigation Rule, please call me at 919-554-4884.

Sincerely,



Todd Tugwell
Mitigation Project Manager

Enclosures

Electronic Copies Furnished:

NCIRT Distribution List
Paul Wiesner – NCDMS
Harry Tsomides – NCDMS

M E M O R A N D U M

302 Jefferson Street, Suite 110 Raleigh, North Carolina 27605 919.209.1052 tel. 919.829.9913 fax

TO: NCIRT and NCDMS

FROM: Cara Conder - RES

DATE: November 12, 2018

RE: Response to Mockingbird Site NCIRT Comments during 30-day Mitigation Plan Review
DMS Project ID No. 100021, Contract #7185, USACE Action ID #SAW-2017-01505

Mac Haupt, NCDWR:

1. DWR noted DMS's comment in their letter to you regarding reach NM5. Your response (memo, August 30, 2018) indicated that HC1 will displace the jurisdictional length, however, HC1 appears to cross over NM5 and not completely displace it. In addition, in Appendix G, your Table shows reach NM5 as intermittent as per the DWR stream form (23.5).
   The majority of NM5 will be displaced by the restoration of HC1 due to plugging NM5 at the confluence of the existing location of HC1 and filling in that abandoned channel. NM5 is an intermittent channel and 'ephemeral' in the design reach sections on page 30 has been changed to intermittent.

2. DWR needs to see consistency in the labeling of reaches. On Figure 8c reach HC2-C is labeled in one location and on Figure 10b is labeled in another location. This is confusing when reading the existing channel morphology summaries and not knowing which reach is being described. For example, what I was looking for was a description that included existing wetlands in reach HC2-B and HC2-C, but did not see any mention of existing wetlands. Initially I was focusing on reach HC2-B, and that when I became confused with the labeling.
   Figure 8c (existing conditions) has been updated to better show which reach is being labeled. Also, wetland acreage has been added to the appropriate reaches in the existing conditions section (Reaches HC2-A, HC2-B, TP2 and TP3).

3. Section 6.2- Design Approach- in reading the paragraph for reach HC2-B there was mention of existing wetlands, however, no mention on increasing the function of these adjacent wetlands. However, wetlands were mentioned in Table 11 (reference Hydrology and "maintaining a stable water table in riparian wetlands"). The increase in wetland function was stated in Section 6.4 in the last paragraph.
   Section 6.2 has been revised to better address increasing the function of the adjacent wetlands, specifically the paragraph before the design reach descriptions and Reach HC2-B.

4. Section 7 Performance Standards- DWR would like to stress that the flow metric stated in the Surface Flow paragraph should only be referring to intermittent channels (NM1, NM4, TP2, and TP3).
Understood that the surface flow section only applies to intermittent reaches and we have those reaches listed (NM1, NM4, TP2, and TP3).

5. DWR would like to see a groundwater gauge placed in the adjacent wetlands on stream right at or near station 24+75.
This groundwater gauge has been added to the monitoring plan on the design sheet, the monitoring plan figure, and the language has also been added to Reach HC2-B in Section 6.2.

6. DWR believes there is a significant opportunity to enhance/create/restore wetlands in the channel backfill portions of reaches HC2-B and HC1.
RES agrees and has updated Section 6.2 for design reach descriptions for HC1 and HC2-B.

7. DWR notes that the typical for channel backfill referred to on Design sheet MB5 is actually on sheet D2 and not sheet D3.
Callout has been adjusted on sheets MB4 and MB5 to reflect correct detail sheet. Callout has also been added to other applicable sheets where backfill/abandonment occurs.

8. DWR likes the format of the RES Design Sheets.
Thanks!

9. DWR also likes the proposal to install a couple of detention basins at the top of a couple of reaches. However, DWR would like to see less rock in these detention bases. DWR requests that RES go back and look at some other designs that would incorporate less rock, perhaps some vegetation on the edges or other more natural approaches that would be designed to be subject to vegetative succession.
Dry sediment basin detail has been replaced with sediment trap detail to incorporate less rock and add more vegetation.

10. It appears that the detention basin planned for reach TP3 may be in a jurisdictional wetland. RES may either want to redesign this basin or consider not incorporating a basin at this location.
Dry Detention Basin has been replaced with Sediment Trap in order to avoid adding rock to a jurisdictional wetland.

11. Design Sheets MB12 and MB13- there are two linear features on these sheets that appear to be streams or stream-like. On sheet MB13, the feature appears to be NM5, if this is the case then the design for HC1 simply crosses NM5 and does not actually displace the reach. On sheet MB12, another feature is running parallel to the existing channel, and the design channel does somewhat "displace" the parallel feature. Therefore, from a permitting standpoint, it looks as though NM5 will largely be filled and the other feature will largely be incorporated into the new design channel.
This is correct, and Section 6.2 has been revised, specially Reach NM5. The other feature is actually just a low spot and the blue hatching on the plans has been removed for this feature.

Kimberly Browning, USACE:

1. Table 11, Functional Benefits and Improvements—Highly Functioning (HF) is not a recognized category in the Stream Functional Pyramid Framework.
   a. Please include the data collection sheets associated with determining the existing and projected functional levels if this data is going to be used to justify functional uplift. The USACE Stream Quality Assessment Forms included in Appendix H can be used to document existing conditions.
   All references to Highly Functioning have been removed – we have made this change in other mitigation plans as well. Also, the functional pyramid is not being used to justify uplift and the following sentence has been added to Section 4: Neither the Stream Functions Pyramid nor the Quantification Tool are proposed to determine success of the mitigation site.

2. Section 7.1—The Entrenchment Ratio (ER) must be above 2.2 for all measured riffle cross-sections on a given reach (for C and E streams), not 1.4. Please correct this in Table 17, as well.
   Section 7.1 and Table 17 have been revised to say that for C/E channels entrenchment ratio shall be no less than 2.2 within restored reaches, and for B channels the entrenchment ratio shall be no less than 1.4 within restored reaches.

3. Figure 8C—The wetland maps indicate there are potential jurisdictional wetlands at the top of reach TP3 where a BMP is planned. BMPs will need to be placed outside of jurisdictional waters. Additionally, since the dry detention basin areas are located within the stream buffers, the mitigation plan should include a performance standard for the marsh areas tied to vegetation success.
   The BMP on Reach TP3 has been revised to a sediment trap which incorporates woody debris and live stakes and should not impact the potential wetland areas. This is not a permanent structure that is being placed in the jurisdictional wetland and is all wood. Also, the treatment on TP3 is enhancement II, so this will not increase or affect the wetland hydrology on Wetland A. Wetland A is mostly outside the easement area (0.26 acres in easement vs. 0.83 acres in total for WA). Since the dry detention basin has been revised to the sediment trap and the treatment is enhancement II, there are not any additional performance standards for this "marsh area". All planted areas will be monitored for success and we have moved the vegetation plot upstream on TP3 to be in/near the wetland area.

4. Please include a monitoring map which includes the location of veg plots, flow gauges, photo locations, and crest gauges, similar to sheet M1.
   Figure 11 has been added.

5. Even though there are no wetland credits being sought, 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.
   Only Reach HC2-B is being restored through a jurisdictional wetland. Reaches TP3, TP2, and HC2-A are enhancement II with a treatment of riparian buffer planting, invasive species treatment, and cattle exclusion. Per DWR's comment, a wetland gauge is being added to Reach HC2-B near station 24+75 on the right floodplain.

M E M O R A N D U M

302 Jefferson Street, Suite 110 Raleigh, North Carolina 27605 919.209.1052 tel. 919.829.9913 fax

TO: **North Carolina Division of Mitigation Services**

FROM: **Cara Conder - RES**

DATE: **August 30, 2018**

RE: **Response to Mockingbird Site Draft Mitigation Plan Comments**
DMS Project ID No. 100021, Contract #7185

Cover Page/General/Formatting

The project was contracted and now being tracked as "Mockingbird Site". Please title the document and refer to the project accordingly, rather than "Mockingbird Stream Mitigation Site".
Mitigation Plan updated to reflect this language.

Please confirm that RES has followed the DMS mitigation plan guidance or have explained where and why any of the guidelines may not have been followed.
Confirming that RES has followed the June 2017 DMS mitigation plan guidance.

Please add tabs for sections, appendices, etc. for the distribution hard copies. Spiral bound is preferred over 3-ring binder.
Tabs have been added to the hard copies. Noted about the spiral bound and we'll provide this if possible, but size of these plans has limited us to 3-ring binders (CE document was very large).

Executive Summary

Paragraph 3 – Please elaborate that the DMS Hauser Creek site closed out in 2017, and is now in NCDEQ Stewardship.
This has been added to executive summary and Section 3.3

Please indicate that a contracting meeting was held on 9/29/2017 among RES, DMS and IRT, and the meeting minutes can be found in Appendix B.
Added to paragraph 1

It would be good to note, while referencing Figure 1 (Vicinity Map), the total linear feet along Hauser Creek from the top part of Reach HC2 down to the lower end of the DMS Hauser Creek project, and the percentage therein protected by conservation easement with the three combined projects (Mockingbird, Scout, and Hauser).
We have added the following information to Section 1 and the Executive Summary: the total linear feet protected by all three projects on Hauser Creek is 10,407 LF and this is 60% of Hauser Creek

proper in an easement. About 80% of Hauser Creek starting at Reach HC2 to the end of the DMS Hauser Creek project is in an easement.

Section 2.0 Watershed Approach

You have listed bulleted goals from the 2009 RBRP; however the 2017 guidance indicates to "Describe connections to DMS River Basin Restoration Priorities, DMS Watershed Plans and/or other watershed evaluations. The goals of the project should be linked to the Compensation Planning Framework (CPF) at the highest resolution plan available and should advance the improvement of identified issues." Please describe specifically how the project will help address planning-identified stressors and watershed concerns.
Section 2 does list specific goals from the RBRP and Sections 2.1 and 5 discuss how the project will address those goals specifically. This section has been revised to contain more information about how the stressors will be addressed.

Provide a project watershed map with watershed planning priority boundaries (e.g., Local Watershed Plan, Targeted Local Watershed, Targeted Resource Area, Regional Watershed Plan) as applicable, and easement boundaries.
This figure has been edited to better show the planning boundaries.

Site selection / landowner information (2.1) – Please indicate in the mitigation plan and conservation easement that landowners will be responsible for fence maintenance and repairs to exclude livestock from the conservation easement; this was discussed at the IRT meeting.
This language has been added.

In Table 2, only six of the seven parcels are listed (5853144949 is not shown); please add.
Added

Section 3.0 Baseline and Existing Conditions

3.1 Drainage Area and Land Use - How did you observe excess nutrient inputs? Please explain.
This section of the paragraph has been removed per the comment about Section 3.5 Reach Summary. This type of information is better suited for Section 3.5 and is already in that section. Excess nutrient language has been removed since there were no measurements taken to quantify "excess".

3.2 Landscape Characteristics - Please include a citation for this paragraph. If phrases were taken directly from a source document, please add quotation marks and citation.
Citation has been added to the References and this paragraph (Griffith et. al 2002).

3.2 Landscape Characteristics - While existing geomorphology, geology, vegetation etc. are adequately described, please describe in more detail per the 2017 guidance how landscape character will influence the project site. For example: How does the hydrologic regime relate to stream condition and function, e.g., discharge and flow frequency? How does the landscape position relate to sources of wetland hydrology? Use maps and/or tables with captions as appropriate to illustrate the major points [link is provided to examples].
Section 3.2 has been revised

3.2 Geology - Please provide further discussion on the geology section; if you are not able to interpret how geology influences the landscape, controls grain-size distribution, or affects the project in any way, please remove this section.
This section has been revised and combined with the Soils section.

3.2 Geology - Indicate if bedrock is visible at the site and if it is a controlling factor on the site streams. If design considerations are expected due to bedrock, please add discussion.
Note – there is minimal bedrock within upper half of project along the EII reaches and is not affecting design. No bedrock was observed in the restoration reaches.

Section 3.3 is titled land use as well as this one. Please avoid repetition if at all possible.
Section 3.1 has been changed to 'Drainage Area and Land Cover' and Section 3.3 remains 'Land Use – Historic, Current, and Future.'

3.3 Land Use - Include a statement identifying any site improvements such as BMPs and buffer that are expected to provide future uplift and minimize impacts from ongoing agricultural uses outside the conservation easement.
The language has been added and was also in Section 5.

3.4 Constraints - Please address culvert and crossing maintenance responsibilities, both pre- and post-close out.
This language has been added: All crossing and culvert maintenance will be the responsibility of RES through completion of monitoring. Once the Project has completed monitoring and the Project is closed out, the crossings and culverts will be the responsibility of the landowner(s).

3.5 Reach Summary - Paragraph beginning with "In general" contains the same information as stated in section 3.1. Please avoid repetition.
The repetitive information from Section 3.1 has been removed.

Section 3.5 - Channel Classification paragraph adds no value to the mitigation plan. Please remove or provide relevant information, table or map.
A summary table has been added to show each reach's hydrology status, stream determination score, and existing length.

Section 3.5 - Discharge: It is indicated, "Estimating flows are difficult due to…[etc.]"; Do you mean bank full flows? Why is this general info under reach summary section?
This section was removed from the report.

Page 17, Bankfull verification: Why is RES having so much trouble estimating discharge and determining a design discharge? Please clarify.
Bankfull indicators (point bars, benches, etc.) are generally absent along reaches that are heavily impacted from agricultural activities; and therefore, it is difficult to identify bankfull using only these indicators. To avoid confusion, this section was removed from the report.

Section 6.0 Mitigation Work Plan

Table 16 indicates HC2-B as 595 LF of Restoration Reach at 1:1; however the IRT meeting minutes (9/29/2017) indicate this was an EII-justified reach at 2.5:1, and the technical proposal and Task 1 deliverable (ERTR) indicate and describe an E2 approach. Please clarify and discuss in the narrative how the approach evolved from E2 to R, or please revert back to E2. The existing conditions (page 14) describes this reach: *"Reach HC2-B is a gravel/cobble stream that flows in a northerly direction between Reaches HC2-A and HC2-C. The channel is slightly incised in some areas and exhibits irregular banks due to cattle access and hoof shear. The riparian buffer is in fair condition with much of the buffer being intact and wooded;however, there are areas of invasive species (privet). The buffer is also comprised of several wetland patches."*
Reach HC2-B in the mitigation plan was Reach HC2-C in the proposal and ERTR. In the proposal this reach was proposed as Enhancement I, however DWR suggested restoration might be more appropriate based on the level of impairment. Post data collection and detailed survey, the Reach HC2-B was found to be better suited for restoration. Just an FYI, Reach HC2-A in the mitigation plan was Reach HC2-B in the proposal and this treatment is still Enhancement II.

Also, we had the incorrect existing conditions description for Reach HC2-B (due to the mix-up of reach label changes) and this has been updated to the actual existing conditions for what is Reach HC2-B in the mitigation plan. "Reach HC2-B is a sand/gravel/cobble stream that flows in a northerly direction between Reaches HC2-A and HC2-C. The channel is incised, has irregular banks due to cattle access and exhibits little bedform diversity. Livestock have direct access to the channel, and the resulting hoof shear has severely degraded the channel banks. The riparian buffer is in poor condition being comprised of an active pasture with some mature trees located along the top of banks."

Plan-generated SMUs on the project total 6,427 while the technical proposal listed 6,047 SMU. Please explain and justify in the plan narrative the additional 380 SMU to the project, versus the technical proposal and contracting stage.
The design reach lengths and treatments are justified in the mitigation plan already; however, there is no discussion of contracted SMUs.

The additional SMUs come from a couple design changes and actual surveyed linear footage of the channels. Reach HC2-B was enhancement I in the proposal, but is now restoration and this is 296 more SMUs than in the proposal. Reach NM2 (a restoration reach) is 91 more linear feet post detailed survey. Reaches HC2-A and HC2-C are more linear feet than in the proposal as well. Reach HC2-C was originally part of HC2-D in the proposal and this section has changed to enhancement I due to this section of the channel being incised and degraded; this is roughly 87 more SMUs than in the proposal.

Also, some reaches did "lose" length from the proposal, notably NM1, NM4, and TP1; however, the proposed easement was not decreased. The treatment on these reaches is EII. The decrease in reach length is due to detailed survey and the restoration alignment does impact a portion of these reaches. Also, it appears Reach TP1 in the proposal might have had an incorrect length. Reach TP1 stops at the fence line, NM1 stops at the farm path, and NM4 stops near the crossing (same as the proposal). The landowner is not interested in additional easement, but we will continue discussions with them.

Summary table of notable changes:

Proposal Reach	Mitigation Plan Reach	Proposal Mitigation Type	Mitigation Plan Mitigation Type	Proposal Length	Mitigation Plan Length	Proposal SMU	Mitigation Plan SMU
HC2-A	**HC2-A**	Enhancement II	**Enhancement II**	868	**2018**	347	**807**
HC2-B		Enhancement II		857		343	
HC2-C	**HC2-B**	Enhancement I	**Restoration**	449	**595**	299	**595**
HC2-D	**HC2-C**	Enhancement I	**Enhancement I**	119	**155**	79	**103**
HC2-D	**HC2-D**	Preservation	**Preservation**	462	**407**	46	**41**
NM2	**NM2**	Restoration	**Restoration**	1277	**1368**	1277	**1368**
			Total	**4032**	**4543**	**2391**	**2914**

Proposal Reach	Mitigation Plan Reach	Proposal Mitigation Type	Mitigation Plan Mitigation Type	Proposal Length	Mitigation Plan Length	Proposal SMU	Mitigation Plan SMU
NM1	**NM1**	Enhancement II	**Enhancement II**	383	**229**	153	**92**
NM4	**NM4**	Enhancement II	**Enhancement II**	314	**286**	126	**114**
TP1	**TP1**	Enhancement II	**Enhancement II**	265	**157**	106	**63**
			Total	**962**	**672**	**385**	**269**

6.1 Reference Stream - Include photos and any surveyed cross-sections in the appendix.
This has been added to Appendix B.

6.3 Vegetation and Planting Plan - Please indicate that vegetation planting/replanting will be conducted between November 15 and March 15, per 10/24/2016 USACE / NCIRT monitoring guidance.
This has been added: It is anticipated that the vegetation planting/replanting will be conducted between November 15 and March 15, per the October 2016 USACE/NCIRT monitoring guidance. If the Project completes construction after March 15, but before May 31, the site will be planted immediately following construction so that there is 180 days prior to the initiation of the first year of monitoring.

Section 7.0 Performance Standards

Please state that performance standards reflect the 10/24/2016 USACE / NCIRT monitoring guidance, or indicate where they do not.
This has been updated to reflect the October 2016 guidance is being followed.

Section 8.0 Monitoring Plan

Please state that monitoring will follow the 10/24/2016 USACE / NCIRT monitoring guidance, or indicate where they will not.
This has been updated to reflect the October 2016 guidance is being followed.

Tables

Table 1 – List SMUs to nearest tenths
Done

Table 8 – NM5 is listed as a reach however it does not appear on any project maps. Please clarify.
Realignment of Reach HC1 will displace the jurisdictional length of NM5 in its entirety. A small portion of ephemeral channel will be protected within the easement, but will receive no credit. This is noted under Section 6.2.

Table 16 – Format should follow most recent guidance, see example attached to this email; comments / notes column should address any crossings, utility cutouts etc. and other relevant items; all three parts of the guidance example should be part of Table 16.
Table updated to reflect format.

Appendix B

DMS has concerns over the proposed channel geometries which propose construction of a low width/depth ratio channel. The proposed geometries appear consistent with the reference analogs but the reference data are compiled from short reach lengths where the streambanks likely benefit from substantial root reinforcement that cannot be established in the short term. Were the constructed channel geometries of the nearby mitigation site reviewed during your design and was the channel response to the applied geometries and construction methods considered? Please review these factors and provide discussion supporting the final design proposal.
The proposed width/depth ratios range between 9 and 11, which is on the higher side for E-type channels and where the higher W/D ratios are associated with the larger channels. The mitigation site located downstream of Mockingbird used a design W/D ratio of 13, and the associated reference reach had a W/D ratio of 12; neither of which are significantly higher than ratios used for Mockingbird.

Plan Sheets
Add riffle and pool facets to the profiles.
Profiles along restoration reaches revised per comment.

MB11 – Include label for NM2.
Sheet MB11 reaches revised per comment.

D7 - Consider extending the filter fabric partially onto the header log to minimize potential for piping through gaps between the logs
Detail revised per comment.

EXECUTIVE SUMMARY

The Mockingbird Site (the "Project") is located in Davie County, North Carolina, approximately eight miles west of Clemmons and five miles northwest of Bermuda Run. Water quality stressors currently affecting the Project include livestock production, agricultural production, and lack of riparian buffer. The Project presents 8,998 linear feet of stream restoration, enhancement, and preservation generating 6,427 Warm Stream Mitigation Units (SMU) along Hauser Creek and eight unnamed tributaries. A contracting meeting was held on 9/29/17 among RES, DMS, and IRT, and the meeting minutes can be found in Appendix B.

The Project is located in the Yadkin River Basin within Cataloging Unit 03040101, Target Local Watershed (TLW) 03040101160010, and NC Division of Water Resources (DWR) subbasin 03-07-02. The current State classification for Hauser Creek is Water Supply IV (WS-IV). WS-IV waters are sources of water supply for drinking, culinary, or food processing purposes where a WS-I, II or III classification is not feasible. These waters are also protected for Class C uses (NCDWQ 2011).

Consisting of agricultural fields, cattle pastures and wooded areas, the Project's total easement area is 27.46 acres within the overall drainage area of 1,540 acres. The Project has two separate portions along Hauser Creek and in between those portions is the Scout Mitigation Bank. While each site could be developed independently of the other, the combined easements will result in greater continuity of protected corridors along the main stem of Hauser Creek. The downstream end of the Project connects to the DMS Hauser Creek Mitigation Site, which closed out in 2017 and is now in NCDEQ stewardship. All easements combined total approximately 49.33 acres and 14,605 linear feet of stream that will be protected in perpetuity. Approximately 10,400 LF of Hauser Creek is protected by these three projects and this is 60% of Hauser Creek's total length (Figure 1).

Goals for the Project include an increase to hydrological function and restoration to ecological function within the existing stream and riparian corridor, and to protect these features in perpetuity. These will be accomplished by returning the existing streams to stable conditions by constructing an E/C type stream with appropriate dimensions and pattern, reconnecting the channel to the floodplain, and bank stabilization throughout. In-stream structures will be installed for vertical stability and to improve habitat, where necessary. Buffer improvements will filter runoff from the surrounding pasture lands, thereby reducing nutrient and sediment loads to the channel. Livestock exclusion fence will be installed along the easement boundary or livestock will be removed. The widening and restoration of the riparian areas will also provide wildlife corridors throughout the Project area. Benefits to be accrued from these activities include improved water quality and terrestrial and aquatic habitat.

The stream design approach for the Project is to combine the analog method of natural channel design with analytical methods to evaluate stream flows and hydraulic performance of the channel and floodplain. The analog method involves the use of a reference reach, or "template" stream, adjacent to, nearby, or previously in the same location as the design reach. The template parameters of the analog reach are replicated to create the features of the design reach. The analog approach is useful when watershed and boundary conditions are similar between the design and analog reaches (Skidmore et al., 2001). Hydraulic geometry is developed using analytical methods to identify the design discharge.

After completion of all construction and planting activities, the Project will be monitored on a regular basis throughout the seven-year post-construction monitoring period, or until performance standards are met. The Project will be transferred to the 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. Funding will be supplied by the responsible party on a yearly basis until such time an endowment is established.

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1 PROJECT INTRODUCTION

1.1 Project Components

The Mockingbird Site ("Project") is located within a rural watershed in Davie County, North Carolina approximately eight miles west of Clemmons and five miles northwest of Bermuda Run. The Project lies within the Yadkin River Basin, North Carolina Department of Water Resources (NCDWR) sub-basin 03-07-02 and United States Geological Survey (USGS) 14-digit hydrologic unit code (HUC) 03040101160010 (**Figure 1**). The Project proposes to restore 4,849 linear feet (LF), enhance 3,742 LF, preserve 407 LF, and provide water quality benefit for 1,540 acres of drainage area. The Project is in the Southern Outer Piedmont Level IV ecoregion.

The Project area is comprised of two sections (north and south) involving Hauser Creek and nine unnamed tributaries, totaling 8,812 existing LF, which eventually drain into the Yadkin River. The southern easement area is separated from the northern area by over 4,500 feet of Hauser Creek. Over 2,500 feet of this easement break is the Scout Mitigation Bank, which connects to the upstream end of the northern Mockingbird easement area. The downstream end of the Project connects to the DMS Hauser Creek Mitigation Site. All easements combined total approximately 49 acres and 14,605 LF of stream that will be protected in perpetuity. Approximately 10,407 LF of Hauser Creek is protected by these three projects combined, which accounts for about 60% of Hauser Creek. The stream mitigation components are summarized in **Table 1** and **Figures 10, 10a, and 10b**. The northern easement is accessible from Spillman Road where Hauser Creek passes under the road at the downstream end of the Project. The southern easement is accessible through pasture land further south along Spillman Road, across from Triple H Trail. Coordinates for the Project areas are as follow: northern portion (36.038433, -80.516410); southern portion (36.028029, -80.502333).

1.2 Project Outcomes

The streams proposed for restoration have been significantly impacted by livestock production, agricultural practices, and a lack of riparian buffer. Proposed improvements to the Project will meet the river basin needs expressed in the 2009 Upper Yadkin Pee-Dee River Basin Restoration Priorities (RBRP) as well as ecological improvements to riparian corridor within the easement.

Through stream restoration, enhancement, and preservation, the Project presents 8,998 LF of proposed stream, generating 6,427 Warm Stream Mitigation Units (SMU) (**Table 1**). This mitigation plan is consistent with the September 29, 2017 Post Contract IRT Meeting Minutes and IRT response emails (**Appendix B**).

Table 1. Mockingbird Project Components Summary

Mitigation Approach	Linear Feet	Ratio	Warm SMU
Restoration	4,849	1	4,849
Enhancement I	155	1.5	103.3
Enhancement II	3,587	2.5	1,434.8
Preservation	407	10	40.7
Total	**8,998**		**6,427.8**

2 WATERSHED APPROACH

The Project was selected based on its potential to support the objectives and goals of the DMS 2009 Upper Yadkin Pee-Dee RBRP. The Upper Yadkin Pee-Dee RBRP identified several restoration needs for the entire Yadkin River Basin, as well as for HUC 03040101. Thirteen counties are included in the Upper Yadkin River Basin, including the towns of Wilkesboro, Elkin, Yadkinville, and Winston-Salem. As of the 2000 census, approximately 660,000 people live in this area. The Project watershed was identified as a Target Local Watershed (TLW) (HUC 03040101160010, Turner and Hauser Creeks TLW), a watershed that exhibits both the need and opportunity for stream, wetland, and riparian buffer restoration. Approximately 39% of this TLW is agricultural lands and over 90% of the watershed is classified as water supply watershed (WSW) designated waters. More specifically, goals outlined in the 2009 RBRP for the watershed include:

1. *Restoration of water quality and aquatic habitat in impaired stream segments;*

2. *Protection of high-resource value waters, including HQW, ORW, and WSW designated waters and those containing large numbers of rare and endangered species (NHEOs);*

3. *Continuation of existing watershed restoration and protection initiatives and projects, including efforts funded by Clean Water Management Trust Fund (CWMTF), DWQ's 319 Program, NC EEP, Ag Cost Share Program (ACSP) and Community Conservation Assistance Program (CCAP);*

4. *Collaborative efforts with local resource agencies, land trusts and willing landowners to implement new stream, riparian buffer and wetland restoration, enhancement and preservation projects within TLWs;*

5. *Improved management of stormwater runoff (including the implementation of stormwater BMP projects), especially in urban and suburban areas contributing to downstream degradation of stream habitat and impairment of water quality; and*

6. *Implementation of agricultural BMPs in order to limit inputs of sediment, nutrients, and fecal coliform to streams from active farming operations.*

Approximately 240 miles of streams in this HUC are affected by habitat degradation, with primary stressors being erodible soils; sediment and erosion from road construction and agriculture; and stormwater flow off impervious surfaces (NCEEP, 2009). Nonexistent or degraded riparian buffers are a significant contributing factor to water quality impairment and habitat degradation in this watershed and the Project will help address these identified stressors as described in Section 2.1.

2.1 Site Selection

Currently the Project area has an absence of riparian buffers, bank erosion, sediment deposition, channel incision, cattle access the streams, and the historic land use has led to channelization. The Project will directly and indirectly address stressors identified in the RBRP by stabilizing eroding stream banks, reconnecting incised streams to their floodplains, installing BMPs to treat areas of concentrated agricultural inputs, and restoring forested buffers on the stream channels. These actions will reduce nutrient and sediment inputs to the Project streams, provide stream stability, improve instream habitat, and improve overall hydrology. Project-specific goals and objectives will be addressed further in **Section 5**. A project watershed map with the Project's drainage areas is shown on **Figure 2** and watershed planning priority boundaries are shown on **Figure 1.**

The Project will address four of the six goals outlined in the 2009 Upper Yadkin Pee-Dee RBRP. By establishing a conservation easement, WSW designated waters will be protected in perpetuity (RBRP Goal 2). Continuation of the project and easement area on Hauser Creek will provide additional protection to Hauser Creek and protect additional WSW waters (RBRP Goal 3). Collaborative efforts have been made with local and willing landowners to implement new stream and enhancement projects within the Turner and Hauser Creeks TLW (03040101160010) (RBRP Goal 4), thereby addressing erosion, sedimentation, and habitat degradation issues due to current agricultural land-use. The Project will include the use of agricultural Best Management Practices (BMPs) to limit inputs of sediment, nutrients, and fecal coliform to streams from active farming operations (RBRP Goal 6). Establishing riparian buffers, instream structures, and increasing bedform diversity will help address RBRP Goal 1, but achievement will not be quantified.

The land required for the construction, management, and stewardship of this Project includes portions of seven parcels in Davie County with the following ownership in **Table 2 & Figure 3**. Once finalized, a copy of the land protection instruments will be included in **Appendix C**. The DMS Conservation Easement model template will be utilized to draft the site protection instruments. The landowners will be responsible for any fence maintenance and repairs to exclude livestock from the conservation easement, and the conservation easement document will include the applicable language.

Table 2. Project Parcel and Landowner Information

Owner of Record	PIN Or Tax Parcel ID#	Stream Reach
Teresa S. Phifer	5852594790 5853514536 (Davie County)	TP1, TP2, & TP3
The Wilson W. and Katherine S. Sparks Living Trust, Dated December 03, 2015	5853416631 (Davie County)	HC2-A, HC2-B, HC2-C, & HC2-D
The Sparks Family Trust, Dated July 26, 2005	5853164843 5853173894 (Davie County)	JS1
Michael A. Miller and Nancy S. Miller	5853153934 5853144949 (Davie County)	HC1, NM1, NM2, NM3, NM4, & NM5

3 BASELINE AND EXISTING CONDITIONS

3.1 Watershed Summary Information

Drainage Area and Land Cover

The Project area is comprised of Hauser Creek and nine unnamed tributaries that flow south to north, and eventually drain into the Yadkin River. The total drainage area for the Project is 1,540 acres (2.41 square miles). Primary land use within the rural watershed consists of approximately 46% forest, 42% agricultural land, and 9% residential. Impervious surface covers two percent of the total watershed (**Table 3** & **Figure 4**). Historic and current land-use within the immediate Project area have allowed cattle direct access to the streams. These activities have negatively impacted both water quality and streambank stability along the Project streams and their tributaries.

Table 3. Project Watershed Summary Information

Level IV Ecoregion	45b-Southern Outer Piedmont
River Basin	Yadkin
USGS Hydrologic Unit 8-digit	03040101
USGS Hydrologic Unit 14-digit	03040101160010
DWR Sub-basin	03-07-02
Project Drainage Area (acres)	1,540
Percent Impervious Area	2%

Surface Water Classification

Hauser Creek has been classified as a Class C waterway and a Water Supply-IV classification (WS-IV) (NCDWQ 2011).

Class C waters are protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner (NCDWQ 2011).

Waters classified as WSW are water supply watersheds and these classifications protect the water supplies. Water Supply IV (WS-IV) provide water supply for drinking, culinary, or food processing purposes where a WS-I, II, or III classification is not feasible and are generally located in moderately to highly developed watersheds or protected areas.

3.2 Landscape Characteristics

Physiography and Topography

The Project is located in the Southern Outer Piedmont Level IV ecoregion, which is characterized by lower elevations, less relief, and less precipitation than the Southern Inner Piedmont (Griffith et al. 2002). Elevations within the Piedmont physiographic region range from 300 to 1,500 feet above mean sea level; while elevations through the project watershed range from 704 to 854 feet. The valley along the primary project reach transitions from a moderately confined valley with a slope of 1.5% to 2% to a broad, alluvial floodplain with a 0.4% slope at the downstream end.

The primary project reach is typical of a Piedmont stream characterized by a moderate bedload and low sediment supply, largely attributed to wooded buffers and few agricultural impacts. The channel substrate is dominated by gravel and cobble with periodic boulder/bedrock outcrops and maintains a coarse bed

within the upper half of the project. As the channel transitions to a broader alluvial floodplain within the bottom of the project, bed materials become finer (mix of sand and gravel) and the sediment supply becomes moderate to high as livestock access and agricultural practices become more significant within riparian areas.

Geology and Soils

According to geology data from the North Carolina Geologic Survey, published in 1985, the Project is in the Charlotte and Milton belts. The underlying geology of the Site is mapped as the Permian period (300 million to 250 million years in age) and metamorphosed mafic rock. The rock type is described as intrusive rocks, such as metagabbro, metadiorate, and mafic plutonic-volcanic complexes.

The existing soil information from the Natural Resource Conservation Service (NRCS) shows the property is located within the Gaston-Mocksville-Mecklenburg soil association. This association is made of gently sloping to steep, well drained soils that have a loamy surface layer and a clayey or loamy subsoil with a low or moderate shrink-swell potential. They formed in material weathered from mafic and intermediate crystalline rocks on uplands. They are found on broad to narrow ridges and side slopes in the northeastern, central, and southwestern parts of the county.

The Davie County Soil Survey shows several mapping units across the Project. Map units include seven soil series. The soil series found on the Project are described below and summarized in **Table 4**.

Project soils are mapped by the NRCS within the easement as Banister fine sandy loam, Codorus loam, Davie sandy loam, Mocksville sandy loam, Oak level clay loam, Rasalo fine sandy loam and Tomlin clay loam (**Figure 5**). Codorus loam makes up about 64% of the easement, Banister fine sandy loam makes up about 18%, Rasalo fine sandy loam occurs in 6%, Oak level clay loam occurs in 4%, Tomlin clay loam occurs in 6.6%, Davie sandy loam occurs in 0.6%, Mocksville sandy loam occurs in 0.8% of the easement.

Table 4. Mapped Soil Series

Map Unit Symbol	Map Unit Name	Percent Hydric	Drainage Class	Hydrologic Soil Group	Landscape Setting
BaB	Banister fine sandy loam, 0-6% slopes	2%	Moderately well	C	Flats on stream terraces
CoA	Codorus loam, 0-2% slopes	5%	Somewhat poor	B/D	Floodplains
DkB	Davie sandy loam, 1-6% slopes	3%	Moderately well	C/D	Ridges
MsC	Mocksville sandy loam, 8-15% slopes	0%	Well	B	Hillslopes on ridges
OkB2	Oak level clay loam, 2-8% slopes	0%	Well	C	Interfluves
RaB	Rasalo fine sandy loam, 2-8% slopes	0%	Well	C	Interfluves
RaC	Rasalo fine sandy loam, 8-15% slopes	0%	Well	C	Hillslopes on ridges

Map Unit Symbol	Map Unit Name	Percent Hydric	Drainage Class	Hydrologic Soil Group	Landscape Setting
ToC2	Tomlin clay loam, 8-15% slopes	0%	Well	B	Hillslopes on ridges

Existing Vegetation

Vegetation around the unbuffered reaches of Hauser Creek and its tributaries are primarily composed of herbaceous vegetation and scattered trees. In general, these riparian zones are disturbed due to regular land management activities. On April 3, 2018 three 100-meter squared plots were surveyed along the floodplain of Hauser Creek to categorize the existing vegetation communities. Forested riparian areas along the majority of Hauser creek and its tributaries have been intermittently cattle-grazed and lack a well-developed understory and shrub strata, while short reaches of enhancement and preservation represent more natural community assemblages. For this reason, representative plots were surveyed along reach HC1, HC2-A and HC2-D (**Appendix B**). Within each vegetation plot, all trees greater than or equal to five inches (12.7 centimeters) diameter at breast height (DBH) were identified, measured, and used to calculate both basal area and stems per acre. Trees greater than or equal to 54 inches (137 centimeters) in height were used to quantify tree species diversity. Canopy species data was calculated to quantify the existing natural community (Schafale, 2012) **(Table 5)**. Shrub species and herbaceous species were also identified, and the percent cover was estimated.

Table 5. Mockingbird Vegetation Plot Summary

Plot	Basal Area (m^2/ha)	Avg. DBH (cm)	Trees per Acre	Total Tree Species	Natural Community
1	0	0	0	0	Pasture
2	23.6	21.9	202.4	10	Piedmont Alluvial Forest
3	76.2	38.9	283.3	8	Disturbed Piedmont Headwater Stream Forest
AVG	**33.3**	**20.3**	**161.9**	**6**	

Dominant canopy species across the site included honey locust (*Gleditisia triacanthos*), sweetgum (*Liquidambar styraciflua*), black walnut (*Juglans nigra*), red maple (*Acer rubrum*), boxelder (*Acer negundo*), white oak (*Quercus alba*), willow oak (*Quercus phellos*), and sugarberry (*Celtis laevigate*). Sub-canopy species included eastern red cedar (*Juniperus virginiana*), winged elm (*Ulmus alata*), flowering dogwood (*Cornus florida*), eastern redbud (*Cercis canadensis*), musclewood (*Carpinus caroliniana*), and sawtooth blackberry (*Rubus argutus*). Invasive species were also found within the vegetation survey plots and in the vicinity of the site, including: Bradford pear (*Pyrus calleryana*), Chinese privet (*Ligustrum sinense*), multiflora rose (*Rosa multiflora*), and Japanese honeysuckle (*Lonicera japonica*).

3.3 Land Use – Historic, Current, and Future

Historic aerial imagery indicates that the Project and adjacent Scout Mitigation Bank has been used extensively for agricultural purposes, and that the location of the streams has not changed in over 50 years (**Figure 6)**. The agricultural footprint shows minimal change over this time. The area remains in an agricultural community with some neighboring forested property. Several watershed characteristics, such as groundwater, vegetation, surface drainage, and potentially soil parameters have been modified. Soil structure and surface texture have been altered from intensive agricultural operations.

The Project and adjacent Scout Mitigation Bank is currently still in agricultural use, and is being used as pasture for cattle. Livestock have full access to the project reaches, and these reaches remain heavily impacted. The tributaries to Hauser Creek now have sparse canopy cover, but livestock impact to the understory remains. Outside the Project area is also still in agricultural use and remains partially forested. The downstream end of the Project connects to the DMS Hauser Creek Mitigation Site, north of Spillman Road. The DMS Hauser Creek Mitigation Site closed out in 2017 and is now in NCDEQ stewardship.

The future land use for the Project and adjacent Scout Mitigation Bank will include 40.68 acres of conservation easement, that will be protected in perpetuity. The combined conservation easements, including the Hauser Creek Mitigation Site, encompass 49.79 acres and 14,605 linear feet of high functioning streams, a minimum 50-foot riparian buffer, and will exclude livestock with fencing or livestock removal. A combination of agricultural BMPs will be used on site; riparian buffer planting, bank stabilization, stream restoration, livestock exclusions, and livestock watering facilities. This combination of BMPs will ultimately lead to the functional uplift of the site by minimizing sedimentation, nutrient input, and fecal coliform input from ongoing livestock and agricultural production outside of the conservation easement. Additionally, installation of two sediment traps will regulate upstream runoff coming into TP2 and TP3.

3.4 Regulatory Considerations

Federal Emergency Management Agency (FEMA)/ Hydrologic Trespass

The Project includes a mapped FEMA 100-year floodplain (1% annual chance of flooding) present on seven of the proposed reaches (HC1, JS1, NM1, NM2, NM3, NM4, & NM5) (**Figure 7**). The design and permitting of the mitigation work will include coordination with the Davie County Floodplain Administrator and permitting a FEMA No-Rise Certification or CLOMR/LOMR. Hydraulic modeling will be required to determine that restoration activities will have no effect on 100-year flood elevations downstream. No hydrologic trespass will be permitted to adjacent properties upstream or downstream of the Project.

Environmental Screening and Documentation

To ensure that a project meets the "Categorical Exclusion" criteria, the Federal Highways Administration (FHWA) and DMS have developed a categorical exclusion (CE) checklist that is included as part of each mitigation project's Environmental Resources Technical Report (ERTR). The approved CE Form for the Mockingbird Project is included in **Appendix K** and was approved by DMS and FHWA in December 2017.

Threatened and Endangered Species

Plants and animals with a federal classification of endangered or threatened are protected under provisions of Sections 7 and 9 of the Endangered Species Act of 1973, as amended. The USFWS database (2017) lists two endangered species that may occur in proximity to the Project: Michaux's sumac (*Rhus michauxii*) and Northern long-eared bat (*Myotis septentrionalis*). Species and species habitat listed in the USFWS database were inspected during the field investigation to determine whether they occur at the Project. No individual species or habitats were identified on site. Potential impacts to species and species habitat off site, downstream, and within the vicinity of the Project were also considered. A letter was sent to the USFWS on October 20, 2017 requesting review and comment of possible issues with respect to threatened and endangered species on the Project. USFWS responded on November 20, 2017 and stated that besides the Northern long-eared bat (NLEB), there is no record of other federally protected species in the project vicinity. Incidental take of the NLEB is exempt, but the USFWS encourages to avoid tree cutting from May 15 – August 15 if possible. Documentation of this correspondence is included in **Appendix K**.

To comply with the NLEB 4(d) streamlined rule for federal agencies, the required consultation form was submitted by the FHWA to the USFWS as part of the CE process for DMS projects. Federally protected species met the Categorical Exclusion Criteria for FHWA and DMS projects and documentation is included in **Appendix K**.

The Fish and Wildlife Coordination Act requires consultation with state fish and wildlife agencies when "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted…or otherwise controlled or modified." A letter was sent to the North Carolina Wildlife Resources Commission (NCWRC) on October 20, 2017 requesting review and comment of possible issues with respect to fish and wildlife resources on the Project. A response was received on December 01, 2017 and NCWRC indicated that there are no records for any listed aquatic species in the vicinity of this Project. Documentation is included in **Appendix K.**

Cultural Resources

A letter was sent to the North Carolina Department of Cultural Resources, State Historic Preservation Office (SHPO), on October 20, 2017. The letter described the Project and requested a review and comment of potential cultural resources occurring within the vicinity of the Project. SHPO responded on November 3, 2017 stating that there will be no effect on historic resources. Documentation of this correspondence is found in **Appendix K**. Cultural Resources met the Categorical Exclusion Criteria for FHWA and DMS projects and documentation is included in **Appendix K**.

Table 6. Regulatory Considerations

Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States - Section 404	Yes	No	Appendix K
Waters of the United States - Section 401	Yes	No	Appendix K
Endangered Species Act	Yes	Yes	Appendix K
National Historic Preservation Act	Yes	Yes	Appendix K
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	No	Appendix L
Magnuson Stevens Act - Essential Fisheries Habitat	No	N/A	N/A

3.5 Reach Summary Information

The Project area is comprised of two sections (north and south) along Hauser Creek and nine unnamed tributaries. The easement areas are separated by 4,500 feet of Hauser Creek; however, over 2,500 feet of that separation is the proposed Scout Mitigation Bank, which connects to the upstream end of the north Mockingbird easement area. There are eight easement breaks on the Project along reaches HC1, HC2-B, HC2-C/D, NM2, and above reaches HC2-A, NM3, NM4, and TP2. The Project is split into 13 reaches based on proposed treatment type (**Figure 10, Figure 10a,** and **Figure 10b**). Results of the preliminary data collections are presented in **Table 7**.

In general, all or portions of the Project reaches, except Reach HC2-D, do not function to their full potential. Current conditions demonstrate significant habitat degradation due to impacts from agriculture, livestock production, and lack of riparian buffer. Being heavily eroded and incised, some of the streams do not access their floodplains as frequently as they naturally would have prior to agricultural operations. In many cases, the riparian buffer is in poor condition where much of the riparian buffer is devoid of trees or shrubs and row crops are present up to the edge of the existing channel. Habitat along the much of the restoration

reaches is poor in that there is little woody debris or overhanging vegetation for fish cover or protection for other aquatic species. Reach HC2-D is functioning at a moderate level. While the channel has been impacted by heavy sediment and nutrient loads, the riparian buffer is in good condition and livestock have been historically excluded from the reach. Morphological parameters are located in **Appendix B.**

Table 7. Summary of Existing Channel Characteristics

Reach	Drainage Area (ac)	ABKF[1] (ft^2)	Width (ft)	Mean Depth (ft)	Width:Depth Ratio	Sinuosity	Slope (ft/ft)
HC1	1,319	40	20	2	10.1	1.11	0.0028
HC2-A	55	6	11.7	0.5	22.9	1.16	0.0170
HC2-B	151	4.5	10	0.5	22.2	1.15	0.0092
HC2-C	194	15.7	17	0.9	18.4	1.17	0.0139
HC2-D	207	12.1	12.2	1	12.2	1.48	0.0102
JS1	221	2.2	4.7	1	4.5	0.99	0.0065
NM1	20	16.9	10.6	1.6	6.6	1.00	0.0128
NM2	330	17.8	10	1.8	5.6	1.12	0.0076
NM3	74	3.9	6.7	0.6	11.4	1.04	0.0250
NM4	27	2.7	4.8	0.6	8.5	1.10	0.0289
NM5	24	11.7	12.6	0.9	8.5	1.03	0.0256
TP1	45	3.6	9.3	0.4	24.1	1.27	0.0167
TP2	20	3	6.1	0.5	12.2	1.04	0.0357
TP3	20	3.1	8	0.4	21	1.11	0.0257

[1]ABKF= cross-sectional area (measured at approximate bankfull stage as estimated using existing conditions data and NC Regional Curve equations where field indicators were not present)

Channel Classification

The streams have been classified as intermittent and perennial streams using the NCDWR Stream Identification Form version 4.11 and are E-, B-, C-, and F-stream types as classified using the Rosgen stream classification system (Rosgen, 1994). **Table 8** summarizes these stream parameters and the stream determination scores can be found in **Appendix G**. Stream determinations have been verified by the USACE.

Table 8. Summary of Stream Parameters

Reach	Hydrology Status	Stream Determination Score	Reach Length (LF)	Rosgen Stream Classification
HC1	Perennial	41	2,135	E5
HC2-A	Perennial	33	2,018	B3c
HC2-B	Perennial	33	568	F3/C3
HC2-C & HC2-D	Perennial	33	563	C3
JS1	Perennial	34.5	465	E5
NM1	Intermittent	25.25	229	E4
NM2	Perennial	33.5	1,219	E4
NM3	Perennial	31	197	C4
NM4	Intermittent	19.25	286	E6b

Reach	Hydrology Status	Stream Determination Score	Reach Length (LF)	Rosgen Stream Classification
NM5	Intermittent	23.25	101	E6b
TP1	Perennial	36	157	B3c
TP2	Intermittent	22.75	450	C6b
TP3	Intermittent	22	525	B6

Existing Channel Morphology

Reach HC1 (Hauser Creek)
Reach HC1, along Hauser Creek proper, is a sand/gravel channel with a moderate sediment load that flows in a northerly direction. The reach is contiguous to the DMS Hauser Creek Project that begins just downstream of Spillman Road. This incised channel has been historically straightened, has a slope of less than one percent, and flows through a broad alluvial valley. The buffers are impacted with active pastures within the eastern riparian areas and agricultural fields to the west.

Reach NM1

Reach NM1 is a headwater system that flows in a westerly direction into the upper third of Reach HC1. The majority of the riparian buffer is forested; however, while the reach is stable, the downstream section is oversized and has been historically ditched.

Reach NM2

Reach NM2 is an incised gravel and cobble bed stream that flows northeast through an agricultural crossing before meeting at a confluence with HC1. There is a low to moderate sediment load and a channel slope of less than one percent. The valley transitions from a width of approximately 50 feet just upstream of the project boundary to a broader alluvial valley that ties into the western floodplain of HC1.

Reach NM3

Reach NM3 is an incised sand/gravel bed stream with a relatively low sediment load and a channel slope of one percent to two percent. The channel is relatively stable and has historically been channelized and ditched. The channel flows in an easterly direction through an active agricultural field down to Reach HC1.

Reach NM4

Reach NM4 is a headwater system that flows in an easterly direction into the downstream end of Reach HC1. The downstream section of the channel has been historically ditched and is oversized. The buffers are comprised of pasture grasses with some woody vegetation along the banks at the confluence with HC1.

Reach NM5

Reach NM5 is a headwater system that flows in a westerly direction into the downstream end of Reach HC1. The channel has been historically ditched and no longer has proper bedform or structure. The buffers are compromised by livestock access and vegetation is sparse. Moving upstream from the confluence, the channel becomes decreasingly defined until is it lost altogether towards the edge of the pasture and upland tree line.

Reach JS1

Reach JS1 is an incised sand/gravel/cobble bed stream with a moderate sediment load and a channel slope of less than one percent. The channel exhibits irregular banks and moderate erosion as the reach is actively impacted by cattle. The channel flows to the west, through a pasture with no riparian buffer, down to the confluence with the DMS Hauser Creek Project.

Reach HC2 (Hauser Creek)

Reach HC2-A at the upstream end is a slightly oversized and stable, cobble bed stream that flows in a northerly direction. The bed profile appears stable and is controlled by root grade controls, boulder outcrops and cobble riffles. The channel appears to be managing its low sediment load and the banks exhibit little to no erosion. The riparian buffer is fully intact along the right bank; while widths vary from 15 to 30 feet along the left. An active cattle pasture is adjacent to the channel along the west side, and cattle have access to the channel throughout the reach. Further down the reach after the proposed easement break, it is gravel/cobble stream. The channel is slightly incised in some areas and exhibits irregular banks due to cattle access and hoof shear. The riparian buffer is in fair condition with much of the buffer being intact and wooded; however, there are areas of invasive species (privet). Jurisdictional wetlands are in the floodplain of this reach; WC is approximately 0.13 acres in size (upstream end and right bank), WE is approximately 0.36 acres in size with 0.26 acres in the proposed easement (downstream and right bank), WF is approximately 0.05 acres in size (downstream and left bank), and WG is approximately 0.23 acres in size (downstream and right bank).

Reach HC2-B is a sand/gravel/cobble stream that flows in a northerly direction between Reaches HC2-A and HC2-C. The channel is incised, has irregular banks due to cattle access and exhibits little bedform diversity. Livestock have direct access to the channel, and the resulting hoof shear has severely degraded the channel banks. The riparian buffer is in poor condition being comprised of an active pasture with some mature trees located along the top of banks. Jurisdictional wetlands are located in the floodplain on the right bank; WH is approximately 0.75 acres in size with 0.59 acres being in the proposed easement.

Reach HC2-C is a sand/gravel/cobble stream that flows in a northerly direction between Reaches HC2-B and HC2-D. The channel is incised, has irregular banks due to cattle access and exhibits little bedform diversity. Livestock have direct access to the channel, and the resulting hoof shear has severely degraded the channel banks. The riparian buffer is in poor condition being comprised of an active pasture with some mature trees located along the top of banks.

Reach HC2-D is a slightly incised, gravel/cobble bed stream that flows in a northerly direction. The bed profile appears stable and is controlled by cobble riffles. The channel appears to be managing its moderate sediment load and the banks are generally stable with some areas of localized erosion and cut banks along some meander bends. The riparian buffer is in good condition and comprised of mature forest with few invasive species present.

Reach TP1

Reach TP1 is a slightly oversized gravel/cobble bed stream with a low sediment load and channel slopes ranging from one to three percent. The channel appears to be managing its low sediment load and the banks exhibit little to no erosion. The riparian buffer is fully intact throughout and comprised of hardwoods and little understory. Cattle have direct access to the channel and buffers throughout the reach.

Reach TP2

Reach TP2 is a channelized ditch that flows to the west into the upstream end of Reach HC2-B. The channel is oversized, and incision increases as the channel approaches the confluence with reach HC2-B. The riparian buffer is in poor condition and is primarily comprised of pasture grasses. Livestock have direct access to the channel and associated buffers. Jurisdictional wetlands are in the floodplain of the left bank; WB is approximately 0.08 acres in size.

Reach TP3

Reach TP3, a historically ditched channel, flows southwest through an active pasture and into the downstream end of Reach HC2-C. Channel incision increases as the channel approaches the confluence with reach HC2-C. The channel exhibits localized areas of minor erosion and the streambed is comprised

of gravel and sand. The riparian buffer is in poor condition due to cattle access and is a mix of pasture grasses and some hardwoods, and shrubby vegetation along the top of banks. The reach originates in Wetland WA (0.83 acres with 0.26 acres in easement), which extends beyond the easement boundary and is also heavily impacted by cattle access.

Channel Stability Assessment

A modified version of the channel stability assessment method (CSA) provided in "Assessing Stream Channel Stability at Bridges in Physiographic Regions" by Johnson (2006) was used to assess channel stability for the Project's existing channels. This method may be rapidly applied on a variety of stream types in different physiographic regions having a range of bed and bank materials.

The original channel assessment method was designed to evaluate 13 stability indicators in the field. These parameters are: watershed characteristics (frequency of watershed disturbances such as agricultural activities, urbanization, etc.), flow habit, channel pattern, entrenchment/channel confinement, bed material, bar development, presence of obstructions/debris jams, bank soil texture and coherence, average bank angle, bank vegetation/protection, bank cutting, mass wasting/bank failure, and upstream distance to bridge. See **Appendix B** for a detailed description of the stability indicators. As this method was initially developed to assess stability at bridges, a few minor adjustments were made to remove indicators that contradict stability characteristics of natural channels in favor of providing hydraulic efficiency at bridges. First, the "channel pattern" indicator was altered such that naturally meandering channels scored low as opposed to straightened/engineered channels that are favorable for stability near bridges. Secondly, the last indicator, "upstream distance to bridge", was removed from the assessment as bridges are not a focus of channel stability for this project. The 12 indicators were then scored in the field, and a rating of excellent, good, fair, or poor was assigned to each project reach based on the total score.

The channel assessment results (scores and ratings) for the Project are provided in **Table 9.** Seven of the fourteen project stream reaches received "Fair" ratings, while five reaches received "Good" ratings. Reach HC2-A received an "Excellent" rating, and Reach HC1 received a "Poor" rating. Most Project streams were observed to have relatively high bank angles and many were found to be actively eroding. All of the channels have been impacted by farming practices or livestock production, and most are slightly entrenched. These characteristics are reflected in the higher channel assessment scores for average bank angle and bank vegetation/protection. Most reaches also scored poorly for watershed characteristics since the surrounding land use is dominated by agriculture activities.

Table 9. Channel Stability Assessment Results

		HC1	NM1	NM2	NM3	NM4	NM5	JS1	HC2-A	HC2-B	HC2-C	HC2-D	TP1	TP2	TP3	UT to Grassy Creek (Reference Reach)	UT to Hauser Creek (Reference Reach)
1	**Watershed characteristics**	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	5
2	**Flow habit**	8	5	8	7	3	4	6	3	4	6	6	4	4	4	2	4
3	**Channel pattern**	9	9	8	6	5	9	3	3	4	6	2	2	6	6	2	1
4	**Entrenchment/channel confinement**	10	6	11	12	3	3	7	1	3	3	7	3	4	3	2	2
5	**Bed material**	12	10	11	10	9	10	6	1	2	5	6	2	11	9	3	6
6	**Bar development**	10	2	2	3	3	2	4	2	7	6	3	3	10	8	5	2
7	**Obstructions/debris jams**	7	6	4	5	6	9	2	1	5	3	3	3	9	2	2	3
8	**Bank soil texture and coherence**	8	5	9	7	5	7	5	5	5	7	6	6	9	6	3	5
9	**Average bank angle**	10	7	10	11	4	3	10	2	6	6	8	4	6	5	5	2
10	**Bank vegetation/protection**	9	8	10	11	10	9	12	5	6	4	1	2	11	9	2	1
11	**Bank cutting**	11	5	9	9	6	6	11	2	4	4	8	4	5	6	2	1
12	**Mass wasting/bank failure**	9	4	8	9	7	9	9	1	4	5	8	2	8	8	2	1
13	**Upstream distance to bridge**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Score	**111**	**75**	**98**	**98**	**69**	**79**	**83**	**34**	**55**	**63**	**66**	**43**	**91**	**74**	**37**	**33**
	Rating*	**Poor**	**Fair**	**Fair**	**Fair**	**Good**	**Fair**	**Fair**	**Excellent**	**Good**	**Good**	**Good**	**Good**	**Fair**	**Fair**	**Good**	**Excellent**

***** Excellent (0 < Score <= 36), Good (36 < Score <= 72), Fair (72 < Score <= 108), Poor (108 < Score <= 144)

3.6 Existing Wetlands

A survey of existing wetlands was performed on October 3, 2017. Wetland boundaries were delineated using current methodology outlined in the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987). Soils were characterized and classified using the Field Indicators of Hydric Soils in the United States, Version 7.0 (USDA-NRCS 2010). Within the boundaries of the proposed Project, seven jurisdictional wetlands are present. Wetland A (WA) forms above the origin of Reach TP3, continuing outside of the easement boundary. Wetland B (WB) is a small riparian wetland on the left bank of Reach TP2. Wetland C (WC) occurs at the top of HC2-A and continues partially outside of the easement. Wetland E (WE) occurs along the right bank floodplain of HC2-A and extends into the surrounding pasture outside of the easement boundary. Wetland F (WF) is a small oxbow-type wetland that occurs on the bank of HC2-C, opposite of WE. Wetland G (WG) occurs on the right bank of HC2-C, upstream of WE. Wetland H (WH) is a large wetland near the confluence of HC2-B and TP3, extending beyond the easement boundary (**Figure 8** & **Table 10**). Livestock have full access to all on-site wetlands.

Vegetation within the wetland areas is made up of black willow (*Salix nigra*), green ash (*Fraxinus pennsylvanica*), winged elm (*Ulmus alata*), red cedar, blackberry, multiflora rose, common rush (*Juncus effusus*), broom sedge (*Carex scoparia*), tearthumb (*Persicaria sagittata*), dogfennel (*Eupatorium capillifolium*), Pennsylvania smartweed (*Persicaria pensylvanica*), and tall fescue (*Festuca arundinacea*). Outside of the easement and wetland areas, cattle are actively managed for, and fescue is the predominant forage.

A preliminary jurisdictional determination (PJD) request was sent to the USACE on October 27, 2017 and a final PJD was received on March 26, 2018. Wetland forms are included in **Appendix I**.

The US Fish and Wildlife Service (USFWS) National Wetland Inventory Map (NWI) does not depict any additional wetland areas within the Project (**Figure 9**).

Table 10. Wetland Summary Information

Wetland Summary Information				
Parameters	**Wetland WA**	**Wetland WB**	**Wetland WC**	**Wetland WE**
Size of Wetland (acres)	0.83	0.08	0.13	0.36
Wetland Type	PFO	Upland	PFO	PFO
Mapped Soil Series	Codorus loam	Codorus loam	Banister fine sandy loam	Codorus loam
Drainage Class	Somewhat poorly	Somewhat poorly	Moderately well	Somewhat poorly
Soil Hydric Status	Yes	No	Yes	Yes
Source of Hydrology	Groundwater	N/A	Groundwater	Groundwater
	Surface Hydrology		Surface Hydrology	Surface Hydrology
Hydrologic Impairment	Incised channel	Lack of vegetation	Ditching	Incised channel
Native vegetation community	Forest	Pasture	Forest	Forest/Pasture
Percent composition of exotic invasive vegetation	<5%	<1%	40%	10%

Parameters	**Wetland WF**	**Wetland WG**	**Wetland WH**
Size of Wetland (acres)	0.05	0.23	0.75
Wetland Type	PFO	PFO	PFO
Mapped Soil Series	Codorus loam	Codorus loam	Codorus loam
Drainage Class	Somewhat pooly	Somewhat pooly	Somewhat pooly
Soil Hydric Status	Yes	Yes	Yes
Source of Hydrology	Groundwater	Groundwater	Groundwater
	Surface Hydrology	Surface Hydrology	Surface Hydrology
Hydrologic Impairment	Incised Channel	Incised Channel	Lack of vegetation/Incised channel
Native vegetation community	Forest	Forest	Pasture
Percent composition of exotic invasive vegetation	30%	20%	<5%

3.7 Site Photographs

Reach JS1 looking upstream from driveway
04/03/2018

Looking downstream at confluence of HC1 and NM4, towards culvert under Spillman Rd.
04/03/2018

Looking upstream on Reach NM4
04/03/2018

Top of Reach NM5
04/03/2018

Looking downstream at bottom of Reach NM2
04/03/2018

Culvert on Reach NM2
04/03/2018

Looking upstream on Reach NM1
04/03/2018

Looking upstream on Reach HC1 above NM1 confluence
04/03/2018

Looking downstream from culvert on NM3
04/03/2018

Preservation Reach HC2-D
04/03/2018

On TP3, looking downstream at HC2-C confluence
04/03/2018

Reach TP3 origin/Wetland A
04/03/2018

Looking downstream on Reach HC2-B, Wetland G on right bank
04/03/2018

Looking upstream on HC2-C
04/03/2018

Looking upstream on Reach TP2
04/03/2018

Looking downstream on TP1
04/03/2018

Looking upstream on HC2-A
04/03/2018

Looking downstream on HC2-A
04/03/2018

4 FUNCTIONAL UPLIFT POTENTIAL

The Stream Functions Pyramid Framework (Harman et. al. 2012) uses stream functions to describe project objectives, existing condition assessments and monitoring, performance metrics, and design criteria. The Framework separates stream functions into five categories, ordered into a hierarchy, which communicate the interrelations among functions and illustrate the dependence of higher level functions (biology, physiochemical and geomorpholgy) on lower level functions (hydrology and hydraulics). Functions that affect the greatest number of other functions are illustrated at the base of the Pyramid, while functions that have the least effect on other functions are illustrated below **Chart 1**.

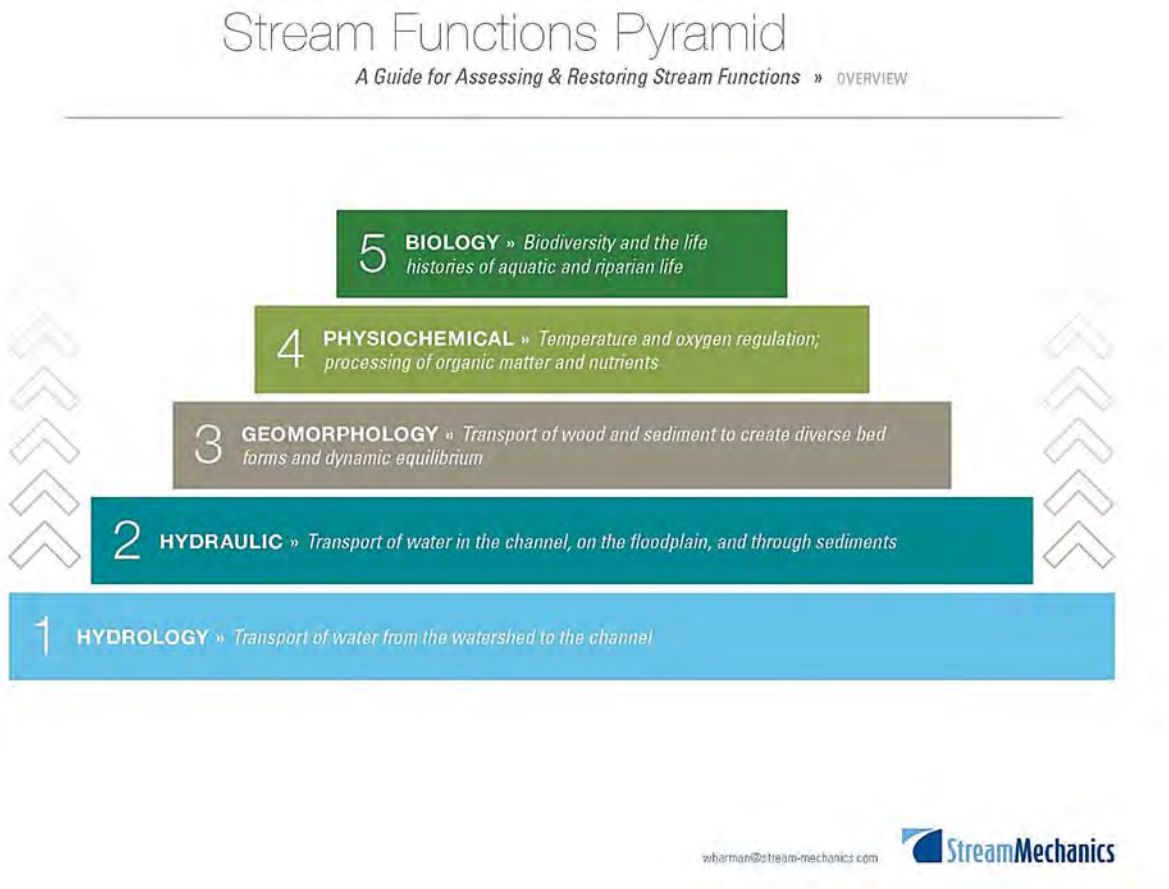

Chart 1. Stream Functions Framework

Fischenich (2006) found that the most critical functions include those that address hydrodynamic processes, sediment transport processes, stream stability and riparian buffer restoration. By addressing these fundamental functions and processes, a restored stream and riparian system are capable of supporting more dependent functions that typically require time to establish, such as diverse biological communities, chemical and nutrient processes, diverse habitats and improved water and soil quality. The objectives of this Project will address the most critical functional objectives that will allow for a more restored stream and riparian over time.

While traditional mitigation approaches have generally relied on surrogate measures of success (i.e. linear feet of restoration) for determining SMU credit yields, a function-based approach provides a more objective and flexible approach to quantify the expected ecological benefits of a mitigation design. Additionally, a

functional based approach broadens the reach-scale goals of a restoration project by contextualizing the functional uplift to the watershed scale. The proposed Project will provide numerous ecological and water quality benefits within the Yadkin River Basin by applying an ecosystem restoration approach. The restoration approach at the reach scale of this Project will have the greatest effect on the hydraulic and geomorphology function of the system but will benefit the upper-level functions (physiochemical and biology) over time and in combination with other Projects within the watershed. Anticipated functional benefits and improvements within the Project area, as based on the Function-Based Framework are outlined in **Table 10.** Neither the Stream Functions Pyramid nor the Quantification Tool are proposed to determine success of the mitigation site.

4.1 Anticipated Functional Benefits and Improvements

Hydrology

According to the Stream Functions Pyramid Framework, hydrology is defined as the transport of water from the watershed to the channel. Therefore, the Project intends to make significant improvements to the already functioning hydrology. Much of the improvement will come from altering land use within these reaches' small catchment areas. By converting land use for a significant percentage of the catchment area from pasture to riparian forest, curve numbers will decrease and reach runoff will improve. Additionally, installation of two sediment traps will regulate upstream runoff coming into TP2 and TP3.

Hydraulic

The hydraulic function of the Pyramid is defined as transport of water in the channel, on the floodplain, and through sediments. Perhaps the greatest potential uplift at the Project will be achieved through establishing healthy floodplain connectivity. Reaches in the Project do not have functioning floodplain connectivity or stable flow dynamics. Reaches where floodplain connectivity is not-functioning or functioning-at-risk will be improved to functioning by reducing bank height ratios and increasing entrenchment ratios. Reaches in which stable flow dynamics are not-functioning or functioning-at-risk will be improved to functioning by constructing a new channel that is geometrically stable based on the Project's hydrology inputs. Additionally, instream structures will be installed to address the energy and erosive power of the water so that a stable base flow is achieved post-project.

Geomorphology

Geomorphology, as defined within the Pyramid Framework, is the transport of wood and sediment to create bed forms and dynamic equilibrium. Sediment transport will be improved in reaches that currently function-at-risk or not-functioning by designing channels on restoration reaches that are sinuous and sized so that water velocities are maintained in a stable manor that allows for sediment to move efficiently through the system. Large Woody Debris Transport and Storage will be improved through the addition of woody debris to the system by installing in-stream structures on restoration reaches such as log vanes, root wads, log weirs, and log toes. Some of these woody structures will also deliver functional uplift by providing aquatic habitat. The restoration reaches are also designed to accumulate woody debris by having defined shallow riffles where cobble catches and holds woody debris and leaf packs. In reaches proposed for restoration, lateral stability is not functioning. To achieve functioning lateral stability, sinuous channels will be constructed with grade-control structures, graded banks, and live-stake planted banks that will significantly reduce erosion rates compared to existing conditions. Existing riparian vegetation is either functioning-at-risk or not-functioning in Project reaches. Therefore, riparian buffers will be planted out to a minimum of 50 feet to improve the riparian vegetation to functioning levels, while also providing terrestrial habitat. Bed form diversity will be improved in restoration reaches by designing natural riffle-pool sequences in constructed channels based on reference reach conditions. This bed form diversity will also further improve aquatic habitat. All of these functional parameters are interconnected and ultimately depend on each other

in order to function properly. Therefore, by focusing improvements to these parameters, the restored channels will achieve dynamic equilibrium and provide maximum geomorphic functional uplift.

Physiochemical

The Pyramid Framework defines the physicochemical category as temperature and oxygen regulation and the processing of organic matter and nutrients. Although this project would support the overarching goal in the Yadkin Pee-Dee River Basin Priorities to promote nutrient and sediment reduction in agricultural areas, it is difficult to measure nutrient and sediment reduction at this project level because they can be affected by so many variables. However, several restoration actions are known to help reduce nutrients and sediment even though they may not be measurable at the project level. These activities include filtering of runoff through buffer areas, the conversion of active farm fields to forested buffers, and improved denitrification and nutrient uptake through buffer zones. Additional benefits may also come from functional uplift of the lower level stream functions (hydraulics and geomorphology), which will reduce sediment and nutrients in the system through bank stabilization and reforesting. Temperature regulation will also be improved through the restoration of canopy tree species to the stream buffer areas. Oxygen regulation will occur through two actions: first, the temperature of the water directly impacts the amount of gas held by the water. Therefore, through planting the buffer to shade the channel the temperature is decreased dissolved oxygen is increased. Second, the log structures placed in the stream create mixing zones where oxygen dissolves much faster than the standard exchange rate of oxygen to dissolved oxygen. The processing of organic matter will be improved once healthy riffles are shallow enough to catch twigs and branches that then retain leaves. Many of these physiochemical benefits occur slowly over time and are dependent on multiple variables within the stream ecosystem. Therefore, it is not practical or feasible to directly measure these parameters within the monitoring time-frame of this project. With that said, it is logical to use existing riparian buffer and visual performance standards to demonstrate the positive correlation between geomorphic parameters and physicochemical parameters. For example, as riparian buffer trees grow, as represented in annual monitoring reports, it is anticipated that canopy cover is actively shading the stream channel and reducing water temperature. This is not a substitute for direct physicochemical monitoring, but it is a useful tool to help project the long-term benefits of the Project in terms of its functional uplift.

Biology

The highest category of the Pyramid is biology and is defined as the biodiversity and life histories of aquatic and terrestrial life, specifically referring to animals. As mentioned for the physiochemical stream function, it will be difficult to measure the functional uplift of the biological functions at this site within the monitoring period of the project. However, since the life histories of many species likely to benefit from stream and wetland restoration are depending on all the lower-level functions, the functional uplift from the hydraulic and geomorphic levels would have a positive effect to the biology over time and in combination with other projects within the watershed is anticipated. Again, there is no substitute for direct biological monitoring, but it is important to understand the hierarchy of the Stream Functions Pyramid Framework in order to help project long-term benefits of the Project though only categories two and three (hydraulics and geomorphology) will be directly measured during the seven-year monitoring period.

4.2 Potential Constraints

The Project restoration reaches will primarily be Priority I restoration, but the upper portion of reach NM2 will be Priority II due to elevation constraints coupled with low valley slope. The Priority II restoration will comply with IRT and DMS design guidelines regarding bench width, soil stockpiling, and valley planform. The downstream end of the Hauser Creek restoration must tie-in with the existing DOT culvert elevation and downstream legacy project. The downstream end of reach JS1 restoration must tie-in with the existing culvert which passes under a residential driveway. An existing barn on the right bank of the top of JS1 will also be removed during construction. No overhead or underground easements conflict with the proposed Project. No General Aviation or Commercial airports are located within five miles of the proposed Project.

The Project is located within five miles of two privately owned and operated airstrips. One privately owned public use air transport facility (Sugar Valley Airport) is located approximately four miles south of the Project. Construction access is not constrained throughout the Project area. While existing mature trees are generally not threatened, a tree survey has been conducted to design the mitigation measures and access to minimize impacts to significant specimen trees.

Several existing stream crossings and fords will be either maintained or enhanced within proposed easement breaks. There are four planned crossings within the Project. These crossings will occur at easement breaks, and will allow landowners to continue current land-use and access as needed. One existing 40-foot culvert crossing will be maintained in the north easement portion and one 40-foot double culvert crossing will be constructed at the upstream end of reach HC1 at the boundary with the Scout Mitigation Site. Two existing fords to be upgraded occur at the juncture of reaches HC2-B and HC2-C and on HC2-A. Both crossings on the southern easement portion will be 30-foot crossings. All crossing and culvert maintenance will be the responsibility of RES through completion of monitoring. Once the Project has completed monitoring and the Project is closed out, the crossings and culverts will be the responsibility of the landowner(s).

5 MITIGATION PROJECT GOALS AND OBJECTIVES

Through the comprehensive analysis of the Project's maximum functional uplift using the Stream Functions Pyramid Framework, specific, attainable goals and objectives will be realized by the Project. These goals clearly address the degraded water quality and nutrient input from farming that were identified as major watershed stressors in the 2009 Upper Yadkin Pee-Dee River RBRP. The Project will address outlined RBRP Goals 2, 3, 4, and 6 (listed in **Section 2**).

The Project goals are:

- Improve water transport from watershed to the channel in a non-erosive manner in a stable channel;
- Improve flood flow attenuation on site and downstream by allowing for overbanks flows and connection to the active floodplain;
- Improve instream habitat;
- Restore and enhance native floodplain vegetation;
- Indirectly support the goals of the 2009 Upper Yadkin Pee-Dee RBRP to improve water quality and to reduce sediment and nutrient loads; and
- Protect Water Supply Watersheds (WSW).

The Project objectives to address the goals are:

- Design and reconstruct stream channels sized to convey bankfull flows that will maintain a stable dimension, profile, and planform based on modeling watershed conditions, and reference reach conditions;
- Permanently exclude livestock from stream channels and their associated buffers;
- Add in-stream structures and bank stabilization measures to protect restored and enhanced streams;
- Install habitat features such as brush toes, constructed riffles, woody materials, and pools of varying depths to restored and enhanced streams;
- Reduce bank height ratios and increase entrenchment ratios to reference reach conditions;
- Increase forested riparian buffers to at least 50 feet on both sides of the channel along the Project reaches with a hardwood riparian plant community;
- Implement two sediment traps in order to limit inputs of sediment, nutrients, and fecal coliform to streams from surrounding farming operations;
- Treat exotic invasive species; and
- Establish a permanent conservation easement on the Project.

Anticipated functional uplift, benefits, and improvements within the Project area, as based on the Function Based Framework are outlined in **Table 11.**

Limitations to achieving these watershed goals arise by remaining constrained to our project boundaries. While we are restoring habitat and streams to stable and effective conditions that achieve our goals within the project parcels, we are unable to influence the effect of poor riparian buffers and livestock impact in other areas within the watershed. However, through this Project's connectivity with other projects in the watershed and responsible stewardship of current restoration projects, overall watershed functionality and health will improve to meet the RBRP goals.

Best Management Practices (BMPs)

A suite of agricultural BMPs will be utilized for the Project to reduce direct effluent inputs, pollutant contamination, and sediment loading. The combination of the following agricultural BMPs: riparian buffer planting, bank stabilization, stream restoration, livestock exclusion, and livestock watering facilities will

ultimately lead to the functional uplift of the site, while still allowing livestock production to persist through the installation of alternative water sources or relocation.

The riparian buffer will be restored along all project reaches, except the preservation reaches. Restored riparian buffers are established adjacent to and up-gradient from watercourses of water bodies to improve water quality. The main advantages of the restored riparian buffer will be to provide water quality treatment, erosion control, and water temperature benefits. Moreover, there will be significant reductions in sedimentation, nutrient input, and fecal coliform input.

Approximately 3,200 linear feet of livestock exclusion fencing will be installed along one easement boundary and other easement areas with current livestock will have the livestock removed permanently. Therefore, livestock will no longer have stream access and the conservation easement will permanently exclude them. To account for eliminating livestock water access, the landowner will be provided an alternate water source. A total of three watering facilities will be installed to provide high quality drinking water to livestock.

Two sediment traps will be installed on TP2 and TP3. The structures will be installed within the conservation easement so that the structure is protected. Failure or maintenance of the structure is not anticipated as this structure will be installed in a low-gradient area, and the area proposed to diffuse flow will be well vegetated and matted.

Stormwater management issues resulting from future development of adjacent properties will be governed by the applicable state and local ordinances and regulations. It is recommended that any future stormwater entering the Project maintain pre-development peak flow. Any future stormwater diverted into the project should be done in a manner as to prevent erosion, adverse conditions, or degradation of the project in any way.

Table 11. Functional Benefits and Improvements

Level	Function	Goal	Functional Parameter	Existing Rating/Projected Rating (Reach)	Objective	Measurement Method
1	***Hydrology***° *Transport of water from the watershed to the channel*	to transport water from the watershed to the channel in a non-erosive manner and maintain a stable water table in riparian wetlands	Channel-Forming Discharge Catchment Hydrology Precipitation/Runoff Relationship Reach Runoff Flow Duration Baseflow Alteration Flood Frequency	**F/F** (All Reaches)	Convert land-use of streams and their headwaters from pasture to riparian forest Install two sediment traps to regulate upstream runoff and coming into the reach. (TP2 & TP3)	Percent Project drainage area converted to riparian forest (indirect measurement) Visually monitor integrity of runoff attenuation structure
2	***Hydraulic*** *Transport of water in the channel, on the floodplain, and through the sediments*	to transport water in a stable non-erosive manner	Flood Bank Connectivity Flow Dynamics Groundwater/Surface water exchange	**NF/F** (HC1, NM2, NM3, NM4, TP2) **FAR/F** (NM1, HC2-B, HC2-C, TP3) **F/F** (HC2-A, HC2-D, TP1)	Improve flood bank connectivity by reducing bank height ratios and increase entrenchment ratios	Cross sections Crest gauges Bank Height Ratio Entrenchment Ratio
3	**Geomorphology** *Transport of wood and sediment to create diverse bedforms and dynamic equilibrium*	to create a diverse bedform to achieve dynamic equilibrium	Sediment Transport Large Woody Debris Transport & Storage Lateral Stability Channel Evolution Channel Sinuosity Bedform Diversity Bed Material Riparian Buffer	**NF/F** (HC1, NM2, NM3, NM4, TP2) **FAR/F** (NM1, HC2-B, HC2-C, TP3) **F/F** (HC2-A, HC2-D, TP1)	Reduce erosion rates and channel stability to reference reach conditions Improve bedform diversity (pool spacing, percent riffles, etc.) Increase buffer width to 50 feet	As-built stream profile Cross sections Visual monitoring Stream walks Vegetation plots
4	**Physiochemical** ° *Temperature and oxygen regulation; processing of organic matter and nutrients*	to achieve appropriate levels for water temperature, dissolved oxygen concentration, and other important nutrients including but not limited to Nitrogen and Phosphorus	Water Temperature Nutrient load Organic Carbon Bacteria Water Quality	**NF/F** (HC1, NM2, NM3, NM4, TP2) **FAR/F** (NM1, HC2-B, HC2-C, TP3) **F/F** (HC2-A, HC2-D, TP1)	Improve stream temperature regulation through introduction of canopy Decrease nutrient loading through filtration of planted riparian buffer, and removing livestock from the riparian areas	Vegetation plots (indirect measurement) Established fencing and/or perpetual conservation easement (indirect measurement)
5	**Biology** * *Biodiversity and life histories of aquatic life histories and riparian life*	to achieve functionality in levels 1-4 to support the life histories of aquatic and riparian plants and animals	Microbial Communities Macrophyte Communities Benthic Macroinvertebrate Communities Fish Communities Landscape Connectivity	**NF/F** (HC1, NM2, NM3, NM4, TP2) **FAR/F** (NM1, HC2-B, HC2-C, TP3) **F/F** (HC2-A, HC2-D, TP1)	Improve aquatic habitat through the installation of habitat features, construction of pools at varying depths, and planting the riparian buffer	Vegetation plots (indirect measurement)
Not Measured (NM); Not Functioning (NF); Functioning-at-risk (FAR); Functioning (F) ° *These categories are measured indirectly; *These categories are not quantifiably measured*						

6 MITIGATION WORK PLAN

6.1 Reference Stream

The restoration portions of the Project are currently characterized by agricultural and livestock practices. Physical parameters of the Project were used, as well as other reference materials, to determine the target stream type. The "Classification of the Natural Communities of North Carolina" was also used to narrow the potential community types that would have existed at the Project (Schafale, 2012). An iterative process was used to develop the final information for the Project design.

Targeted reference conditions included the following:

- Located within the Physiographic Region and ecoregion,
- Similar watershed size,
- Similar land use on site and in the watershed,
- Similar soil types on site and in the watershed,
- Ideal, undisturbed habitat – several types of woody debris present,
- Similar topography,
- Similar slope,
- Pattern common among Piedmont streams, and
- Minimal presence of invasive species.

Obtaining property owner information and owner authorization for access was another factor in locating suitable reference sites for the Project. There was no predetermined amount of reference sites needed as long as the site was suitable and met the parameters. Many streams in this watershed are impacted by cattle and agricultural practices, having a minimal riparian buffer, making it difficult to find an ideal reference for the Project site. Two reference streams were used for this Project. The reference reach used for Reach HC1 is located north of the Mockingbird Site, across Spillman road, and connects to Hauser Creek. The other reference is part of an unnamed tributary (UT) to Grassy Creek in Union County, NC. This stream site is ideal in both geomorphology and size for the smaller reaches of Hauser Creek and its unnamed, first-order tributaries.

Reference Watershed Characterization

The first reference stream is an unnamed tributary to Hauser Creek that flows west to east and connects to Hauser Creek below the Hauser Creek Mitigation Site. The portion of this reference reach that was surveyed and analyzed is approximately 185 feet long. The drainage area for the reach is 0.11 square miles (70.4 acres). The second reference reach, UT to Grassy Creek, is located within the Yadkin Pee-Dee River Basin in Union County. This reach is 320 feet in length, with a drainage area of 0.67 square miles (427 acres). The land use in both watersheds is characterized by mostly agricultural, with mixed pines and hardwoods, and a small amount of residential.

Reference Discharge

Several hydrologic models/methods were used to develop a bankfull discharge for the reference site. Existing drainage area, land use, slope, roughness, and cross-sectional area were all factors considered when performing the calculations. Using a combination of Piedmont Regional Curves, in-house spreadsheet tools, and a project specific regional flood frequency analysis; the existing discharge for UT to Grassy Creek was calculated to be approximately 50 cubic feet per second (ft^3/s). The existing bankfull discharge for the reference portion of UT to Hauser Creek was calculated to be approximately 7.6 cubic feet per second (ft^3/s). See **Section 6.2** for a more detailed description of the hydrologic analyses performed for this project.

Reference Channel Morphology

In comparison to the restoration reaches, both UT to Grassy Creek and the UT to Hauser Creek reaches are smaller than the designed restoration reaches when comparing pattern, dimension and profile, which is the reason for using a scaling factor for the design. The scaling factor is based on the difference in bankfull area of the reference channel. The designed reach would then have the necessary dimensions of either a smaller or larger stream corresponding to differences in drainage area. For UT to Hauser Creek, the reach was typically 5.2 feet wide and 0.6 feet deep. The cross sectional area was typically around 3.0 square feet with a width to depth ratio around 8.9. The UT to Grassy Creek was typically 13.6 feet wide and 1.4 feet deep. The cross sectional area was typically around 18.1 square feet with a width to depth ratio around 9.8

Reference Channel Stability Assessment

Both reference reaches UT to Grassy Creek and UT to Hauser Creek are stable and show no evidence of incision or erosion in the portion that was surveyed and analyzed. The streams appear to maintain slope and have sufficient amounts of vegetation to secure the banks. Riparian buffer widths exceed 50 feet on each side. The reference reaches received a "Good" rating as the channels each demonstrate a stable meandering pattern and a well-vegetated riparian buffer.

Reference Riparian Vegetation

The UT to Grassy Creek reference reach riparian community is characteristic of a Mesic Mixed Hardwood Forest-Piedmont Subtype. This community is approximately 20 to 25 years old, as evidenced by the representative DBH measurements and historical aerial photography. Tree communities were categorized in 10 transects spanning both left and right banks of the channel. Dominant canopy species present include northern red oak (*Quercus rubra*), southern red oak (*Quercus falcata*), white oak (*Quercus alba*), water oak (*Quercus nigra*), shagbark hickory (*Carya ovata*), sweetgum, eastern redcedar, southern magnolia (*Magnolia grandiflora*), American holly (*Ilex opaca*), tulip-poplar, and longleaf pine (*Pinus palustris*). Percent coverage over the channel ranges from 70 to 90 percent with average DBH ranging from four to 12 inches.

The UT to Hauser Creek reference reach riparian community is characteristic of a Piedmont Alluvial Forest. Basal areas for the plots were 12.5 m^2/hectare (ha) and 49.6m^2/ha and stems per acre was 81 for both plots. Dominant canopy species across the reference reach included sweetgum, tulip-poplar, American beech (*Fagus grandifolia*), pignut hickory (*Carya glabra*), eastern redcedar, green ash, red maple, and boxelder. Sub-canopy species included musclewood, sourwood (*Oxydendron arboreum*), and sawtooth blackberry.

Invasive species were also found within the vegetation survey plots and in the vicinity of the reach, including: multiflora rose (*Rosa multiflora*), and Japanese honeysuckle. Non-native species included Japanese stiltgrass (*Microstegium vimineum*), common chickweed (*Stellaria media*), buttercup, wooly mullein (*Verbascum thapsus*), and onion grass (*Allium vineale*).

It is anticipated that a local seed source for high dispersal species is present upstream at the Project and will disperse across much of the Project area. These species are often found in early successional communities and quickly fill disturbance gaps. Because many of these high dispersal species often become aggressive in these sites, they are not included in the Restoration Planting List (**Section 6.3**). Hardwood species typical of the target community were observed in adjacent and nearby communities, and were judged to be more appropriate for this site.

6.2 Design Parameters

Stream Restoration Approach

Stream restoration efforts along the tributaries of the Project will be accomplished through analyses of geomorphic conditions and watershed characteristics. The design approach applies a combination of analytical and reference reach based design methods that meet objectives commensurate with both ecological and geomorphic improvements. Proposed treatment activities may range from minor bank grading and planting to re-establishing stable planform and hydraulic geometry. For reaches requiring full restoration, natural design concepts have been applied and verified through rigorous engineering analyses and modeling. The objective of this approach is to design a geomorphically stable channel that provides habitat improvements and ties into the existing landscape.

The Project will include Priority I Restoration, Priority II Restoration, Enhancement Levels I and II, and Preservation. Stream restoration will incorporate the design of a single-thread meandering channel, with parameters based on data taken from reference sites, published empirical relationships, regional curves developed from existing project streams, and NC Regional Curves. Analytical design techniques will also be a crucial element of the project and will be used to determine the design discharge and to verify the design as a whole. Conceptual plan views are provided in **Figure 10.**

Current stream conditions along the proposed restoration reaches exhibit habitat degradation as a result of impacts from livestock and channelization performed to promote agricultural activities. Additionally, the riparian buffer is in poor condition throughout most of the Project area, where much of it is devoid of trees or shrubs, and active pasture is present up to the edge of the existing channel.

The Project design approach began with a thorough study of existing conditions, including the on-site streams, valleys, and watershed. Design parameters, including active channel, habitat and floodplain features were developed from analyses performed on the reference site data. Analytical design techniques were used to determine the design discharge and to verify the design as a whole.

Engineering analysis will be performed using various hydrologic and hydraulic models to verify the reference reach based design. A combination of methods will be used to estimate bankfull flows, and flows corresponding to other significant storm events. A HEC-RAS model will then be used to simulate water surface elevations of flows generated by the hydrologic analysis. The development of the HEC model is an important component to the design; therefore, model input parameters are field verified when possible. Through this hydrologic analysis, the design discharge (typically referenced as bankfull or dominant discharge) will be determined. The subsequent design will be based on this calculated discharge. As part of the design process, a qualitative analysis of sediment supply will be performed by characterizing watershed conditions. A combination of windshield surveys, existing land use data, and historical aerial photography, followed up by ground truthing, will be analyzed to assess existing and past watershed conditions and to determine if any changes occurred that would significantly impact sediment supply. Design parameters developed through the analyses of reference reach data, watershed characterizations, and hydrologic and hydraulic modeling will be confirmed using the Stable Channel Design function and/or the Sediment Transport Analysis components within HEC-RAS in conjunction with shear stress and velocity analyses.

Geomorphic and habitat studies will be performed concurrently with the engineering analyses. While stream design will be verified by simulations of hydrology and fluvial processes, analogs of desirable habitat features will be derived from reference sites and integrated into the project design. Both in-stream and riparian habitat features will be designed. In-stream structures will be used throughout the project to act as grade control and for bank stabilization by dissipating and redirecting the stream's energy. Bank

stability may further be enhanced through the installation of brush mattresses, live stakes and cuttings bundles.

Sections of abandoned stream channel will be backfilled with material excavated from onsite to the elevation of the floodplain in areas adjacent to the new channel, installing channel plugs where necessary. Due to the Priority II approach on some reaches, excess cut material is expected. RES has performed a preliminary quantity estimate and has developed an onsite disposal plan that will satisfy landowner requirements. The floodplain will be planted with native species creating a vegetated buffer, which will provide numerous water quality and ecological benefits. Stream banks will be stabilized using a combination of grading, erosion control matting, bare-root plantings, native material revetment techniques (i.e., bioengineering), structure placement, and sod transplants where possible. The stream and adjacent riparian areas will be protected by a minimum 50-foot conservation easement which will be fenced to exclude livestock as needed. In conjunction with the stream restoration, adjacent wetland hydrology will be enhanced through raising the channel bed. No wetland mitigation credits will be generated from the enhancement of these wetland areas; however, the enhancement and protection of these currently degraded wetlands will store excess water during flood events, prevent erosion of stream banks, and reduce in-stream sedimentation and nutrients.

The Project has been broken into the following design reaches:

Reach HC1 – Reach HC1 begins at the upstream end of the northern portion of the project and at the downstream limits of the proposed Scout Mitigation Bank. A 40-foot easement break is proposed between the two projects that will coincide with a culvert crossing and include 24 LF of 48-inch double barrel RCP. The reach totals 2,083 LF of Priority I Restoration to address historic channelization and livestock impacts. Priority I Restoration provides higher functional uplift and less risk of failure when connected to the restoration on upstream Reach HC3. The left bank is crop land while the right bank is active pasture, contributing to significant disturbance on both banks. Restoration activities will include constructing a new channel within the natural valley with appropriate dimensions and pattern, adding channel plugs where necessary and backfilling the abandoned channel. Backfilling the abandoned stream channel presents an opportunity to create wetlands in the ephemeral pool areas. In-stream structures such as log sills, brush toes, rock cross vanes, and rock/wood constructed riffles will be installed for channel stability and to improve habitat. A minimum 50-foot buffer is proposed along each side of the channel. Buffer activities will improve riparian areas that will filter runoff from adjacent pastures, thereby reducing nutrient and sediment loads to the channel.

Reach NM1 – Historically channelized reach NM1 begins at the ephemeral/intermittent break on the right bank near the top of HC1 and flows west to a confluence with HC1. Active pasture surrounds this reach. The reach totals 229 linear feet of Enhancement II, and enhancement activities will include buffer plantings and the treatment of invasive species. This reach treatment ends at the farm path.

Reach NM2 – Reach NM2 begins on the west side of Reach HC1 and flows east to the confluence with HC1 near it's midpoint. The reach totals 637 linear feet of Priority I Restoration and 731 Priority II Restoration. Due to elevation and slope constraints, Priority II Restoration will be utilized at the top of the reach, blending into Priority I as it nears the HC1 floodplain. Active crop land surrounds this reach as well as limited cattle exposure. A 40-foot easement break is proposed for a culvert crossing where an existing 72-inch CMP will be removed and replaced with 24 LF of a double barrel 48-inch RCP. Restoration activities will include constructing a new channel within the natural valley with appropriate dimensions and pattern, adding channel plugs where necessary and backfilling the abandoned channel. In-stream structures such as log sills, brush toes, log cross vanes, and rock/wood constructed riffles will be installed for channel stability and to improve habitat. A minimum 50-foot buffer will be maintained

along on each side of the channel. Buffer activities will improve riparian areas that will filter runoff from adjacent fields, thereby reducing nutrient and sediment loads to the channel.

Reach NM3 – Reach NM3 begins at a culvert on the west side of Reach HC1, near the downstream end of the Project, and flows east to a confluence with HC1. The reach totals 280 LF of Priority I Restoration to address historic channelization and excess deposition due to agricultural practices. The incised reach is surrounded by active fields of row crops and lacks a protective buffer. Restoration activities will include constructing a new channel with appropriate dimensions and pattern, adding channel plugs where necessary and backfilling the abandoned channel. In-stream structures such as log sills, brush toes, rock cross vanes, and constructed riffles will be installed for channel stability and to improve habitat. A minimum of 50 feet of buffer on each side of the channel is proposed. Buffer activities will improve riparian areas that will filter runoff from adjacent fields, reducing nutrient and sediment loads to the channel.

Reach NM4 – NM4 is a headwater reach that forms from the hills on the east side of HC1 near the downstream portion of the Project. Active pasture surrounds this reach. This reach totals 253 LF of Enhancement II. Treatment includes removing an existing crossing at a 15-inch RCP, establishing a minimum 50-foot riparian buffer, and instream structures such as rock cross vane and log sills to provide channel stability.

Reach NM5 – NM5 is a headwater reach that forms within the eastern floodplain of Reach HC1, just upstream of Reach NM4, and flows west to a confluence with HC1. Realignment of Reach HC1 will displace the majority of NM5 due to plugging this channel at its confluence with the existing HC1 and filling in that abandoned channel. A small portion of intermittent channel will be protected within the easement, but will receive no credit. Active pasture surrounds this reach.

Reach JS1 – Reach JS1 begins in an active pasture, north of Spillman Road, and flows east into the existing DMS Hauser Creek Mitigation Site that exists downstream from the Project. This incised reach totals 523 LF of Priority I Restoration to address historic channelization, livestock impacts and erosion. Restoration activities will include removing an existing ford, constructing a new channel within the natural valley, backfilling the abandoned channel, and reconnecting to the floodplain for frequent inundation. In-stream structures such as log sills, brush toes, log cross vanes, rock cross vanes, and constructed riffles will be installed for channel stability and to improve habitat. A minimum of 50 feet of buffer on each side of the channel is proposed. Buffer activities will improve riparian areas that will filter runoff from adjacent pastures, thereby reducing nutrient and sediment loads to the channel. The channel will tie back into the existing location in order to connect to the 72-inch CMP under the landowner's gravel driveway.

Reach HC2-A – Reach HC2-A begins at the upstream end of the Project (the southern portion of the project), and flows north to Reach HC2-B. The reach totals 2,018 linear feet of Enhancement II. Agricultural fields and bottomland hardwood forests are located adjacent to the reach. Enhancement activities will include the re-establishment of a riparian buffer along the channel (buffers will extend a minimum of 50 feet from the top of each bank) and invasive species treatment as needed. Buffer improvements will filter runoff from adjacent pastures, thereby reducing nutrient and sediment loads to the channel. Additional habitat improvements will be gained through livestock exclusion. A 31-foot easement break is proposed to maintain an existing ford crossing within the bottom third of this reach.

Reach HC2-B – Reach HC2-B begins immediately downstream of Reach HC2-A and flows north to Reach HC2-C. The reach totals 595 LF of Priority I Restoration to address historic channelization and cattle exposure. The incised reach is surround by active pasture and the downstream portion is surrounded by disturbed bottomland hardwood forests and riparian wetlands. Restoration activities will

include constructing a new channel within the natural valley with appropriate dimensions and pattern, adding channel plugs where necessary and backfilling the abandoned channel. In-stream structures such as log sills, brush toes, cross vanes, rock A-vanes, and constructed riffles will be installed for channel stability and to improve habitat. A minimum of 50 feet of buffer on each side of the channel is proposed. Buffer activities will improve riparian areas that will filter runoff from adjacent pastures, thereby reducing nutrient and sediment loads to the channel. Reach TP3 ties into HC2-B prior to a proposed 35-foot easement break and ford crossing, before transitioning into Reach HC2-C. Also, the reach will be built through part of a jurisdictional wetland that is currently on the right bank floodplain and degraded from cattle access and pasture-use. While this project is not claiming any wetland credit, the raised channel bed should enhance the wetlands' hydrology by reconnecting the floodplain wetlands to the stream. Also, backfilling the abandoned stream channel presents an opportunity to create additional wetlands in the ephemeral pool areas. A gauge will be installed on the right floodplain to monitor the wetland hydrology and will be reported in the yearly monitoring reports.

Reach HC2-C – This incised, degraded reach begins at the downstream end of HC2-B and flows north from a ford crossing to the upstream end of HC2-D. Although cattle have been historically excluded from this reach, upstream pasture activity and travel across the existing ford have resulted in bed and bank erosion and sedimentation. The reach totals 155 LF of Enhancement I, and enhancement activities will include laying back and/or benching the left bank and installing coir matting and live stakes to provide channel stabilization. Bottomland hardwoods are located adjacent to the reach.

Reach HC2-D – Reach begins immediately downstream of Reach HC2-C and flows north to the downstream boundary of the southern portion of the easement. The reach totals 407 linear feet of preservation with minimum 50-foot buffers. Bottomland hardwoods surround this reach.

Reach TP1 – Reach TP1 begins on the east side of Reach HC2-A in headwater Piedmont forest, and flows west to a confluence with Reach HC1-A. Lightly disturbed forest surrounds this reach. The reach totals 146 LF of Enhancement II, where cattle exclusion and supplemental planting of the riparian buffer is proposed. This reach treatment ends at the fence line.

Reach TP2 - This channelized reach begins on the east side of Reach HC2-A, just downstream of the confluence of TP1 with HC2-A, and flows southwest to a confluence with Hauser Creek. The reach totals 471 LF of Enhancement II. The reach is surrounded by active pasture and a small wetland occurs near the stream origin. Enhancement activities include reestablishing the riparian buffer with native vegetation and cattle exclusion. A sediment trap will be installed upstream of ephemeral/intermittent stream break to provide sediment and nutrient control from upland agricultural practices.

Reach TP3 – This mildly incised, historically channelized reach begins to the east of Reach HC2-B and flows southwest to a confluence with HC2-B upstream of a proposed easement break. The reach totals 470 linear feet of Enhancement II. The reach is surrounding by active pasture and forms out of a headwater wetland. A sediment trap (made from woody debris and livestakes) is proposed at the upper end of the reach to provide sediment and nutrient control from upland agricultural practices.

Design Methods

There are three primary methods that have demonstrated success in stream restoration: analog, empirical, and analytical. All three methods have advantages and limitations, and it is often best to utilize more than one method to address site-specific conditions or to verify the applicability of design elements. This is particularly true in developed watersheds where existing conditions do not always reflect current inputs and events, and sediment and hydrologic inputs may remain unstable for some time. Combinations of analytical and analog methods were used to develop the stream designs for the Project.

Analytical Approach
Analytical design is based on principles and processes considered universal to all streams, and can entail many traditional engineering techniques. The analytical approach utilizes continuity, roughness equations, hydrologic and hydraulic models, and sediment transport functions to derive equilibrium conditions. Since the project is located within a rural watershed, restoration designs are based on hydrologic and hydraulic analyses, including rainfall-runoff models to determine design discharges coupled with reference reach techniques.

Analog Approach
The analog method of natural channel design involves the use of a "template" or reference stream located near the design reach, and is particularly useful when watershed and boundary conditions are similar between the design and analog reaches (Skidmore et al., 2001). In an analog approach, the planform pattern, cross sectional shape, longitudinal profile, and frequency and locations of woody debris along the analog reaches are mimicked when developing the design parameters for the subject stream.

Empirical Approach
Empirical design is based on regional mathematical relationships among measured channel variables. The flood frequency analysis and regional curve evaluation described above are examples of empirical design methods to select a range of channel forming discharges for a given watershed area.

Typical Design Sections
Typical cross sections for riffles and pools are shown on the design plan sheets in **Appendix A**. The cross-section dimensions were developed for the four design reaches by using an in-house spreadsheet described in **Section 6.2** of this report. The cross sections were altered slightly to facilitate constructability; however, the cross sectional area, width to depth ratio, and side slopes were preserved. Typical pool sections include pools located on straight reaches and pools on meander bends.

Meander Pattern
The design plans showing the proposed channel alignment are provided in **Appendix A**. The meander pattern was derived directly from the analog reach and was altered in some locations to provide variability in pattern, to avoid on site constraints, to follow the valley pattern, and to make the channel more constructible. The morphologic parameters summarized in the **Appendix B** were applied wherever these deviations occurred.

Longitudinal Profiles
The design profiles are presented in **Appendix A**. These profiles extend throughout the entire project for the proposed channel alignment. The profiles were designed using the analog reach bed features that were sized with the scaling factors. The bed slopes and bankfull energy gradients were determined for each design reach based on the existing valley slope and the sinuosity of the design reach. Log structures will be utilized in the design to control grade, divert flows, and provide additional habitat diversity and stability.

In-Stream Structures
Structures will be incorporated into the channel design to provide additional stability and improve aquatic habitat. Native materials and vegetation will be used for revetments and grade control structures where applicable. Additionally, rock structures will be utilized intermittently along the restoration reaches to provide increased stability and habitat. Typical rock structures that will protect the channel bed and/or banks will include riffle grade controls and cross-vanes.

Woody debris will be placed throughout the channel at locations and at a frequency that is similar to those observed in the analog reaches. Woody habitat features installed will include dead brush, root wads, brush toes, and log vanes. To provide additional bank stability, sod mats harvested onsite will be installed along

stream banks during construction if and when feasible. Sod mats will only be harvested and used if comprised of appropriate vegetation. The use of sod mats that include aggressive turf grasses will be avoided. Sod mats are natural sections of vegetation taken from the banks when they were cut during construction, and are about nine inches thick. Before installation, proposed banks are graded lower than specified to accommodate the thickness of the mat. The mats are placed on top of the bank to act as a natural stabilizer of native species, and they grow much faster than the combination of coir fiber matting and seeding. Other bank stability measures include the installation of live stakes, log sills, brush toes, log vanes, and log toes. Typical details for proposed in-stream structures and revetments are in **Appendix A**.

Data Analysis

Stream Hydrologic Analysis

Hydrologic evaluations were performed for the design reaches using multiple methods to determine and validate the design bankfull discharge and channel geometry required to provide regular floodplain inundation. The use of various methods allows for comparison of results and eliminates reliance on a single model. Peak flows (**Table 12**) and corresponding channel cross sectional areas were determined for comparison to design parameters using the following methods:

- Regional Flood Frequency Analysis,
- AutoCAD's Hydraflow Hydrographs,
- NC and VA Regional Curves for the Rural Piedmont, and
- USGS regional regression equations for rural conditions in the Blue Ridge-Piedmont.

Regional Flood Frequency Analysis

A flood frequency analysis was completed for the study region using historic gauge data on all nearby USGS gauges with drainage areas less than 6,400 acres (10 mi^2) which passed the Dalrymple homogeneity test (Dalrymple, 1960). This is a subset of gauges used for USGS regression equations. Regional flood frequency equations were developed for the 1.1-, 1.5-, and 2-year peak discharges based on the gauge data. Discharges were then computed for the design reach. These discharges were compared to those predicted by the discharge regional curve and USGS regional regression 2-year discharge equations.

Regional Curve Regression Equations

The North Carolina Piedmont regional curves by Harman et al. (1999) and Doll et al. (2002) and the Virginia Rural Piedmont regional curves by Lotspeich (2009) for discharge were used to predict the bankfull discharge for the Project. The NC regional curves predicted flows that are similar to those predicted by the 1.1-year flood frequency, while the VA curves are much lower, closer to the flows predicted by the Hydraflow Hydrographs. The regional curve equations for NC discharges by Doll et al. (2002):

(1) $Q_{bkf}=89.04*(DA)^{0.73}$ (Harman et al., 1999)
(2) $Q_{bkf}=91.62*(DA)^{0.71}$ (Doll et al., 2002)
(3) $Q_{bkf}= 43.895*(DA)^{0.9472}$ (Lotspeich, 2009)

Where Q_{bkf}=bankfull discharge (ft^3/s) and DA=drainage area (mi^2).

USGS Regional Regression Equations

USGS regression equations estimate the magnitude and frequency of flood-peak discharges. The regression equations were developed from gauge data in different physiographic regions of the Southeastern United States. For this analysis, there was only concern for the 2-year return interval. The equation for the rural Piedmont/Foothills (Hydrologic Region 1) (4) is:

(4) $Q_2=158*(DA)^{0.649}$ (Weaver et al., 2009)

Table 12. Peak Flow Comparison

Reach	Drainage Area (Ac)	FFQ $Q_{1.1}$	FFQ $Q_{1.5}$	NC Regional Curve Q (1)	NC Regional Curve Q (2)	VA Regional Curve Q (3)	Regional Regression Eqns. Q_2 (4)	Design/ Calculated Q
HC1	1,324	125	204	154	151	87	253	145
HC2-B	194	43	68	39	37	14	73	43
JS1	220	47	73	43	41	16	79	40
NM2	330	58	92	57	55	23	103	50
NM3	74	26	39	20	18	6	39	11

Design Discharge

Based upon the hydrologic analyses described above, design discharges were selected that typically fall between model results for the 1.1-year and 1.5-year flood frequency analysis for each reach but closer to the 1.1-year. The design discharge values are similar to the Hydraflow Hyrdograph outputs for the 1- and 2-year storms at a 6-hour duration. The design flows are all slightly higher than the Rational Method calculated flows. The selected flows, in cubic feet per second (cfs), for the restoration reaches are 145 for HC1, 43 for HC2-B, 40 for JS1, 50 for NM2 and 11 for reach NM3. These discharges will provide frequent inundation of the adjacent floodplain.

Sediment Transport Analysis

An erosion and sedimentation analysis was performed to confirm that the restoration design creates a stable gravel bed channel that neither aggrades nor degrades over time. Typically, sediment transport is assessed to determine a stream's ability to move a specific grain size at specified flows. Various sediment transport equations are applied when estimating entrainment for sand and gravel bed streams found in the Piedmont. The US Army Corps of Engineers (USACE) report, *Stability Thresholds for Stream Restoration Materials* (Fischenich, 2001), was used to obtain permissible shear stresses and velocities. Data found in this document was obtained from multiple sources using different testing conditions. The following methods and published documents were utilized during the sediment transport analysis:

- Permissible Shear Stress Approach, and
- Permissible Velocity Approach.

Shear Stress Approach

Shear stress is a commonly used tool for assessing channel stability. Allowable channel shear stresses are a function of bed slope, channel shape, flows, bed material (shape, size, and gradation), cohesiveness of bank materials, vegetative cover, and incoming sediment load. The shear stress approach compares calculated shear stresses to those found in the literature. Shear stress is the force exerted on a boundary during the resistance of motion as calculated using the following formula:

(1) $\tau = \gamma RS$

τ = shear stress (lb/ft^2)

γ = specific gravity of water (62.4 lb/ft^3)

R = hydraulic radius (ft)

S = average channel slope (ft/ft)

Table 13. Comparison of Allowable and Proposed Shear Stresses

Reach	Proposed Shear Stress at Bankfull Stage (lbs/ft^2)	Critical Shear Stress (lbs/ft^2)	Permissible Shear Stress[1]		
			Sand/Silt/Clay (lbs/ft^2)	Coarse Gravel (lbs/ft^2)	Vegetation (lbs/ft^2)
HC1	0.38	>0.54	0.03 to 0.26	0.33 to 0.67	0.7 to 1.7
HC2-B	0.38	>0.54	0.03 to 0.26	0.33 to 0.67	0.7 to 1.7
JS1	0.30	>0.54	0.03 to 0.26	0.33 to 0.67	0.7 to 1.7
NM2	0.24	>0.54	0.03 to 0.26	0.33 to 0.67	0.7 to 1.7
NM3	0.55	>0.54	0.03 to 0.26	0.33 to 0.67	0.7 to 1.7

[1](Fischenich, 2001)

Review of the above table shows that the proposed shear stresses for the Project design reaches fall between the critical shear stress (shear stress required to initiate motion) and the allowable limits. Therefore, the proposed channel should remain stable.

Velocity Approach

Published data are readily available that provide entrainment velocities for different bed and bank materials. A comparison of calculated velocities to these permissible velocities is a simple method to aid in the verification of channel stability. **Table 14** compares the proposed velocities calculated using Manning's equation with the permissible velocities.

Table 14. Comparison of Permissible and Proposed Velocities

Reach	Manning's "n" value	Design Velocity (ft/s)	Bed Material	Permissible Velocity[1] (ft/sec)
HC1	0.05	2.7	Coarse gravel to cobble	2.5 - 7.5
HC2-B	0.05	2.4-2.9	Coarse gravel to cobble	2.5 - 7.5
JS1	0.05	1.3-2.5	Sand to coarse gravel	1.75 - 6.0
NM2	0.05	1.8-2.1	Sand to coarse gravel	1.75 - 6.0
NM3	0.05	1.9-2.1	Coarse gravel to cobble	2.5 - 7.5

[1](Fischenich, 2001)

Sediment Supply

In addition to the stability assessment, a qualitative analysis of sediment supply was performed by characterizing watershed conditions. A combination of field reconnaissance and windshield surveys, existing land use data, and historical aerial photography were analyzed to assess existing and past watershed conditions to determine if any changes occurred that would significantly impact sediment supply. As discussed in **Section 3.3**, the land use throughout the site has changed little since 1960. Much of the Project area has been used primarily for agricultural purposes over the past 60 years. Most of the existing stream channels are unforested. Land use has remained relatively constant within this rural watershed, and significant land disturbing activities are not anticipated for the future.

There are several areas of instability and erosion along the channels, which appear to be a result of historic cattle activity and agricultural activities occurring up to and along channel banks and not from watershed activities. It is anticipated that sediment supply from agricultural land adjacent to the project will decrease

as buffers are enhanced and widened, and flow from existing agricultural ditches will be diffused before entering the proposed channel.

Since observed areas of degradation can be attributed to farming practices adjacent to the channel and watershed activities, a threshold channel design approach was used. This approach assumes minimal movement (vertical or lateral migration) of the channel boundary during design flow conditions, and that the channel is not sensitive to sediment supply. Additionally, grade controls have been integrated throughout the design to provide vertical stability in the event scour should occur.

6.3 Vegetation and Planting Plan

Plant Community Restoration

The restoration of the plant communities is an important aspect of the restoration Project. The selection of plant species is based on what was observed at the reference reach, species present in the forest surrounding the restoration Project, and what is typically native to the area. Several sources of information were used to determine the most appropriate species for the restoration project. While two reference streams were used during design, only UT to Hauser Creek is used as a vegetation community reference due to close proximity to the Project.

A Piedmont Alluvial Forest will be the target community along Hauser Creek, JS1, NM1, NM2, NM3, and NM4. A Piedmont Headwater Stream Forest will be the target community along HC2-A, TP1, TP2, and TP3. The target community will be used for the planting areas within the Project, shown in **Appendix A**. The plant species list has been developed and can be found in **Table 15**. Although there is one planting zone, certain targeted species will be planted in the appropriate target community location (**Table 16**). Species with high dispersal rates are not included because of local occurrence, adjacent seed sources, and the high potential for natural regeneration. The high dispersal species include red maple and sweetgum.

The restoration of plant communities along the Project will provide stabilization and diversity. For rapid stabilization of the stream banks (primarily outside meanders), silky dogwood (*Cornus amomum*) and black willow (*Salix nigra*) were chosen for live stakes along the restored channel because of their rapid growth patterns and high success rates. Willows grow at a faster rate than the species planted around them, and they stabilize the stream banks. Willows will also be quicker to contribute organic matter to the channel. When the other species are bigger, the black willows will slowly stop growing or die out because the other species would outgrow them and create shade that the willows do not tolerate. The live stake species will be planted along the outside of the meander bends three feet from the top of bank, creating a three-foot section along the top of bank. The live stakes will be spaced one per linear foot with alternate spacing vertically.

It is anticipated that the vegetation planting/replanting will be conducted between November 15 and March 15, per the October 2016 USACE/NCIRT monitoring guidance. If the Project completes construction after March 15, but before May 31, the site will be planted immediately following construction so that there is 180 days prior to the initiation of the first year of monitoring.

Table 15. Proposed Plant List

Bare Root Planting Tree Species				
Species	**Common Name**	**Spacing (ft)**	**Unit Type**	**% of Total Species Composition**
Quercus nigra	Water Oak	9X6	Bare Root	15
Quercus phellos	Willow Oak	9X6	Bare Root	15
Betula nigra	River birch	9X6	Bare Root	15
Platanus occidentalis	American Sycamore	9X6	Bare Root	15
Quercus rubra	Northern Red Oak	9X6	Bare Root	10
Fraxinus pennsylvanica	Green Ash	9X6	Bare Root	10
Liriodendron tulipifera	Yellow Poplar	9X6	Bare Root	10
Diospyros virginiana	Persimmon	9X6	Bare Root	5
Nyssa sylvatica	Black Gum	9X6	Bare Root	5

Live Staking and Live Cuttings Bundle Tree Species		
Species	**Common Name**	**% of Total Species Composition**
Salix nigra	Black willow	60
Cornus ammomum	Silky dogwood	40

On-Site Invasive Species Management

Treatment for invasive species will be required within all grading limits associated with stream restoration. Invasive species will require different and multiple treatment methods, depending on plant phenology and the location of the species being treated. All treatment will be conducted as to maximize its effectiveness and reduce chances of detriment to surrounding native vegetation. Treatment methods will include mechanical (cutting with loppers, clippers, or chain saw) and chemical (foliar spray, cut stump, and hack and squirt techniques). Plants containing mature, viable seeds will be removed from the Project and properly disposed. All herbicide applicators will be supervised by a certified ground pesticide applicator with a North Carolina Department of Agriculture and Consumer Services (NCDA&CS) license and adhere to all legal and safety requirements according to herbicide labels, and NC and Federal laws. Management records will be kept on the plant species treated, type of treatment employed, type of herbicide used, application technique, and herbicide concentration and quantities used. These records will be included in all reporting documents.

Soil Restoration

After construction activities, the subsoil will be scarified and any compaction will be deep tilled before the topsoil is placed back over the Project. Any topsoil that is removed during construction will be stockpiled and placed over the Project during final soil preparation. This process should provide favorable soil conditions for plant growth. Rapid establishment of vegetation will provide natural stabilization for the Project.

6.4 Mitigation Summary

Natural channel design techniques have been used to develop the restoration designs described in this document. The combination of the analog and analytical design methods was determined to be appropriate for this Project because the watershed is rural, the causes of disturbance are known and have been abated, and there are minimal infrastructure constraints. The original design parameters were developed from the

measured analog/reference reach data and applied to the subject stream. The parameters were then analyzed and adjusted through an iterative process using analytical tools and numerical simulations of fluvial processes. The designs presented in this report provide for the restoration of natural Piedmont cobble/gravel-bed channel features and stream bed diversity to improve benthic habitat. The proposed design will allow flows that exceed the design bankfull stage to spread out over the floodplain.

A large portion of the existing stream will be filled using material excavated from the restoration channel. However, many segments will be left partially filled to provide habitat diversity and flood storage. Native woody material will be installed throughout the restored reach to reduce bank stress, provide grade control, and increase habitat diversity.

Forested riparian buffers of at least 50 feet on both sides of the channel will be established along the Project reaches. An appropriate riparian plant community (Piedmont Alluvial Forest along HC1, HC2-B/C, JS1, NM1, NM2, NM3, NM4; Piedmont Headwater Stream Forest along HC2-A left bank, TP2, TP3) will be established to include a diverse mix of species. The plant species list has been developed and can be found in **Table 15**. Although there is one planting zone, certain targeted species will be planted in the appropriate target community location. Replanting of native species will occur where the existing buffer is impacted during construction. Replanting of native species will occur where the existing buffer is impacted during construction.

Due to the nature of the project, complete avoidance of stream and wetland impacts is not possible. Proposed stream impacts, including stream relocation and culverts, will be replaced on site. Wetland impacts associated with restoration and enhancement efforts will only temporarily impact wetlands and will provide an overall increase in wetland function with the addition of native trees and shrubs along the stream banks, and restored hydrology. All stream impacts will be accounted for in the Pre-Construction Notification (PCN) form.

6.5 Determination of Credits

Mitigation credits presented in **Table 16** are projections based upon site design (**Figure 10**, **Figure 10a**, and **Figure 10b**). Upon completion of site construction, the project components and credits data will only be revised to be consistent with the as-built condition if there is a large discrepancy and with an approved mitigation plan addendum. This will be approved by the USACE.

Table 16. Mockingbird Site (ID-100021) - Mitigation Components

Project Component (reach ID)	Wetland Position and HydroType	Existing Footage	Stationing	Mitigation Plan Footage	As-Built Footage	Restoration Level	Approach Priority Level	Mitigation Ratio (X:1)	Mitigation Credits	Notes/Comments
HC2-A		1,345	0+74 to 14+19	1,345	TBD	EII	-	2.5	538.0	Riparian and supplemental planting, livestock exclusion, invasives treatment (Stream crossing: STA 14+19 to STA 14+50)
HC2-A		673	14+50 to 21+23	673	TBD	EII	-	2.5	269.2	Riparian and supplemental planting, livestock exclusion, invasives treatment
HC2-B		568	21+23 to 27+18	595	TBD	R	PI	1	595.0	Channel restoration, riparian planting, livestock exclusion (Stream crossing: STA 27+18 to STA 27+53)
HC2-C		155	27+53 to 29+08	155	TBD	EI	PIII	1.5	103.3	Bank grading and stabilzation, supplemental planting, conservation easement
HC2-D		408	29+08 to 33+15	407	TBD	P	-	10	40.7	Conservation Easement
HC1		2,135	27+79 to 48+62	2,083	TBD	R	PI	1	2,083.0	Channel restoration, riparian planting, livestock exclusion
TP1		157	1+19 to 2+65	146	TBD	EII	-	2.5	58.4	Riparian planting, livestock exclusion
TP2		450	0+0 to 4+71	471	TBD	EII	-	2.5	188.4	Riparian planting, livestock exclusion
TP3		525	1+18 to 5+88	470	TBD	EII	-	2.5	188.0	Riparian planting, livestock exclusion
NM1		229	1+44 to 3+73	229	TBD	EII	-	2.5	91.6	Riparian planting, livestock exclusion
NM2		889	0+59 to 10+56	997	TBD	R	PI/PII	1	997.0	Channel restoration, riparian planting, livestock exclusion (Stream crossing: STA 10+56 to STA 10+96)
NM2		330	10+96 to 14+67	371	TBD	R	PI	1	371.0	Channel restoration, riparian planting, livestock exclusion
NM3		197	1+36 to 4+16	280	TBD	R	PI	1	280.0	Channel restoration, riparian planting
NM4		286	0+82 to 3+35	253	TBD	EII	-	2.5	101.2	Riparian planting, livestock exclusion
JS1		465	0+47 to 5+70	523	TBD	R	PI	1	523.0	Channel restoration, riparian planting, livestock exclusion
No Wetland Mitigation										

Table 16 Continued. Mockingbird Site (ID-100021) - Mitigation Components

Length and Area Summations by Mitigation Category

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)
		Riverine	Non-Riverine	
Restoration	4,849			
Enhancement				
Enhancement I	155			
Enhancement II	3,587			
Creation				
Preservation	407			
High Quality Pres				

Overall Assets Summary

Asset Category	Overall Credits
Stream	**6,427.8**
RP Wetland	**NA**
NR Wetland	**NA**

7 PERFORMANCE STANDARDS

The success criteria for the Project will follow the 2016 USACE Wilmington District Stream and Wetland Compensatory Mitigation Update and subsequent agency guidance. Specific success criteria components are presented below.

7.1 Stream Restoration Success Criteria

Bankfull Events

Channel stability should be demonstrated through a minimum of four bankfull events documented in the seven-year monitoring period. The bankfull events must occur in separate years. Otherwise, the stream monitoring will continue until four bankfull events have been documented in separate years. Crest gauges will be installed on the bottom of Reach HC1 and Reach NM2.

Cross Sections

There should be little change in as-built cross sections. If changes do take place, they should be evaluated to determine if they represent a movement toward a less stable condition (for example down-cutting or erosion), or are minor changes that represent an increase in stability (for example settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross sections shall be classified using the Rosgen stream classification method, and all monitored cross sections should fall within the quantitative parameters defined for channels of the design stream type. For C/E channels, bank height ratio shall not exceed 1.2, and the entrenchment ratio shall be no less than 2.2 within restored reaches. For B channels, bank height ratio shall not exceed 1.2, and the entrenchment ratio shall be no less than 1.4 within restored reaches. Channel stability should be demonstrated through a minimum of four bankfull events documented in the seven-year monitoring period.

Digital Image Stations

Digital images will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures. Longitudinal images should not indicate the absence of developing bars within the channel or an excessive increase in channel depth. Lateral images should not indicate excessive erosion or continuing degradation of the banks over time. A series of images over time should indicate successional maturation of riparian vegetation.

Surface Flow

Stream restoration reaches will be monitored to document intermittent or seasonal surface flow. This will be accomplished through direct observation and the use of hydraulic pressure transducers with data loggers. Intermittent reaches must demonstrate a minimum of 30 consecutive days of flow. Flow gauges will be installed on Reaches NM1, NM4, TP2 and TP3.

7.2 Vegetation Success Criteria

Specific and measurable success criteria for plant density within the riparian buffers on the Project will follow IRT Guidance. The interim measures of vegetative success for the Project will be the survival of at least 320 planted three-year old trees per acre at the end of Year 3, five-year old trees at seven feet in height at the end of Year 5, and the final vegetative success criteria will be 210 trees per acre with an average height of ten feet at the end of Year 7. Volunteer trees will be counted, identified to species, and included in the yearly monitoring reports, but will not be counted towards the success criteria of total planted stems. Moreover, any single species can only account for up to 50 percent of the required number of stems within any vegetation plot. Any stems in excess of 50 percent will be shown in the monitoring table, but will not be used to demonstrate success.

8 MONITORING PLAN

Annual monitoring data will be reported using the DMS Monitoring Report Template dated June 2017 and NC IRT monitoring template. The monitoring report shall provide a project data chronology that will facilitate an understanding of project status and trends, research purposes, and assist in decision making regarding project close-out. Monitoring reports will be prepared annually and submitted to DMS. Monitoring of the Project will adhere to metrics and performance standards established by the USACE's April 2003 Wilmington District Stream Mitigation Guidelines and the NC IRT's October 2016 Wilmington District Stream and Wetland Compensatory Mitigation Update. **Table 17** outlines the links between project goals, objectives, and treatments and their associated monitoring metrics and performance standards within the context of functional uplift based on the Stream Functions Pyramid Framework. **Figure 11** is a monitoring map with locations for vegetation plots, flow gauges, crest gauges, and wetland gauges.

8.1 As-Built Survey

An as-built survey will be conducted following construction to document channel size, condition, and location. The survey will include a complete profile of thalweg, water surface, bankfull, and top of bank to compare with future geomorphic data. Longitudinal profiles will not be required in annual monitoring reports unless requested by USACE. Stream channel stationing will be marked with stakes placed near the top of bank every 200 feet.

8.2 Visual Monitoring

Visual monitoring of all mitigation areas will be conducted a minimum of twice per monitoring year by qualified individuals. The visual assessments will include vegetation density, vigor, invasive species, and easement encroachments. Visual assessments of stream stability will include a complete streamwalk and structure inspection. Digital images will be taken at fixed representative locations to record each monitoring event, as well as any noted problem areas or areas of concern. Results of visual monitoring will be presented in a plan view exhibit with a brief description of problem areas and digital images. Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures.

8.3 Hydrology Events

Crest gauges will be installed to document the occurrence of bankfull events. In accordance with the guidelines that a minimum of one gauge will be installed on each tributary that is greater than 1,000 feet a crest gauge will be installed on HC1 (**Appendix A**). Reaches with Priority 1 Restoration (designed to reconnect the stream to its floodplain), gauges will be capable of tracking the frequency and duration of overbank events. Where restoration or enhancement activities are proposed for intermittent streams, flow monitoring gauges should be installed to track the frequency and duration of stream flow events.

8.4 Cross Sections

Permanent cross sections will be installed at a minimum of one per 20 bankfull widths with half in pools and half in riffle on all Restoration and Enhancement I reaches. All cross-section measurements will include bank height ratio and entrenchment ratio. Cross sections will be monitored in Years 1, 2, 3, 5, and 7. There should be little change in as-built cross sections. If changes do take place, they should be evaluated to determine if they represent movement toward a less stable condition (for example down-cutting or erosion), or are minor changes that represent an increase in stability (for example settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio).

8.5 Vegetation Monitoring

Vegetation monitoring plots will be a minimum of 0.02 acres in size, and cover a minimum of two percent of the planted area. There will be 15 plots within the planted area (18.6 acres) (**Appendix A**). Plots will be a mixture of fixed and random plots. Planted area indicates all area in the easement that will be planted with trees. Existing wooded areas are not included in the planted area. The following data will be recorded for all trees in the fixed plots: species, height, planting date (or volunteer), and grid location. For random plots, species and height will be recorded for all woody stems. The location (GPS coordinates and orientation) of the random plots will be identified in the annual monitoring reports. Vegetation will be planted and plots established at least 180 days prior to the initiation of the first year of monitoring. Monitoring will occur in Years 1, 2, 3, 5, and 7 between July 1st and leaf drop. Invasive and noxious species will be monitored so that none become dominant or alter the desired community structure of the Project. If necessary, RES will develop a species-specific treatment plan.

8.6 Scheduling/Reporting

A baseline monitoring report and as-built drawings documenting stream restoration activities will be developed within 60 days of the planting completion on the Project. The report will include all information required by DMS mitigation plan guidelines, including elevations, photographs and sampling plot locations, gauge locations, and a description of initial species composition by community type. The report will also include a list of the species planted and the associated densities. Baseline vegetation monitoring will include species, height, date of planting, and grid location of each stem. The baseline report will follow DMS As-Built Baseline Monitoring Report Template June 2017, USACE guidelines, and the October 2017 Mitigation Credit Calculation Memo.

The monitoring program will be implemented to document system development and progress toward achieving the success criteria. The restored stream morphology will be assessed to determine the success of the mitigation. The monitoring program will be undertaken for seven years or until the final success criteria are achieved, whichever is longer.

Monitoring reports will be prepared in the fall of each year of monitoring and submitted to DMS. The monitoring reports will include all information, and be in the format required by USACE.

Table 17. Monitoring Requirements

Level	Goal	Treatment	Outcome	Monitoring Metric	Performance Standard
1 *Hydrology*	To transport water from the watershed to the channel in a non-erosive manner	Convert land-use of Project reaches from pasture to riparian forest Install two sediment traps to regulate floodplain runoff coming into the reach (TP2 & TP3)	Improve the transport of water from the watershed to the Project reaches in a non-erosive way	NA	NA
				Visually monitor integrity of runoff attenuation structure: Performed semiannually (*indirect measurement*)	Identify and document instability and/or flaws to the structure
2 *Hydraulic*	To transport water in a stable non-erosive manner	Reduce bank height ratios and increase entrenchment ratios by reconstructing channels to mimic reference reach conditions	Improve flood bank connectivity by reducing bank height ratios and increase entrenchment ratios	Crest gauges and/or pressure transducers: Inspected semiannually	Four bankfull events occurring in separate years
					At least 30 days of continuous flow each year
				Cross sections: Surveyed in Years 1, 2, 3, 5 and 7	Entrenchment ratio shall be no less than 2.2 within restored reaches
					Bank height ratio shall not exceed 1.2
3 *Geomorphology*	To create a diverse bedform To achieve dynamic equilibrium	Establish a riparian buffer to reduce erosion and sediment transport into project streams. Establish stable banks with livestakes, erosion control matting, and other in stream structures	Reduce erosion rates and channel stability to reference reach conditions Improve bedform diversity (pool spacing, percent riffles, etc. Increase buffer width to 50 feet	As-built stream profile	NA
				Cross sections: Surveyed in Years 1, 2, 3, 5 and 7	Entrenchment ratio shall be no less than 1.4 for B channels and no less than 2.2 for C/E channels (restored reaches)
				Visual monitoring	Bank height ratio shall not exceed 1.2
				Visual monitoring: Performed at least semiannually	Identify and document significant stream problem areas; i.e. erosion, degradation, aggradation, etc.
				Vegetation plots: Surveyed in Years 1, 2, 3, 5 and 7	MY 1-3: 320 trees/acre MY 5: 260 trees/acre (7 ft. tall) MY 7: 210 trees/acre (10 ft. tall)
4 *Physiochemical* °	To achieve appropriate levels for water temperature, dissolved oxygen concentration, and other important nutrients including but not limited to Nitrogen and Phosphorus	Exclude livestock from riparian areas with exclusion fence or conservation easement, and plant a riparian buffer	Improve stream temperature regulation through introduction of canopy Decrease nutrient loading through filtration of planted riparian buffer, and removing livestock from the riparian areas	Vegetation plots: Surveyed in Years 1, 2, 3, 5 and 7 (*indirect measurement*)	MY 1-3: 320 trees/acre MY 5: 260 trees/acre (7 ft. tall) MY 7: 210 trees/acre (10 ft. tall)
				Visual assessment of established fencing and conservation signage: Performed at least semiannually (*indirect measurement*)	Inspect fencing and signage. Identify and document any damaged or missing fencing and/or signs
5 *Biology* *	To achieve functionality in levels 1-4 to support the life histories of aquatic and riparian plants and animals	Plant a riparian buffer, install habitat features, and construct pools of varying depths	Improve aquatic habitat through the installation of habitat features, construction of pools at varying depths, and planting the riparian buffer	Visual monitoring of in-stream habitat features: Performed at least semiannually (*indirect measurement*)	Identify and document significant stream problem areas; i.e. degradation, aggradation, stressed or failed structures, etc.

*° These categories are measured indirectly; *These categories are not quantifiably measured*

9 ADAPTIVE MANAGEMENT PLAN

In the event the mitigation site or a specific component of the mitigation site fails to achieve the necessary performance standards as specified in the mitigation plan, the sponsor shall notify the members of the IRT and work with the IRT to develop contingency plans and remedial actions.

10 LONG-TERM MANAGEMENT PLAN

The site will be transferred to the NCDEQ Stewardship Program (or 3rd party if approved). 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. Funding will be supplied by the responsible party on a yearly basis until such time an endowment is established. The NCDEQ Stewardship Program is developing an endowment system within the nonreverting, interest-bearing Conservation Lands Conservation Fund Account. The use of funds from the Endowment Account will be governed by North Carolina General Statute GS 113A-232(d)(3). Interest gained by the endowment fund may be used for the purpose of 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. Any livestock or associated fencing or permanent crossings will be the responsibility the owner of the underlying fee to maintain.

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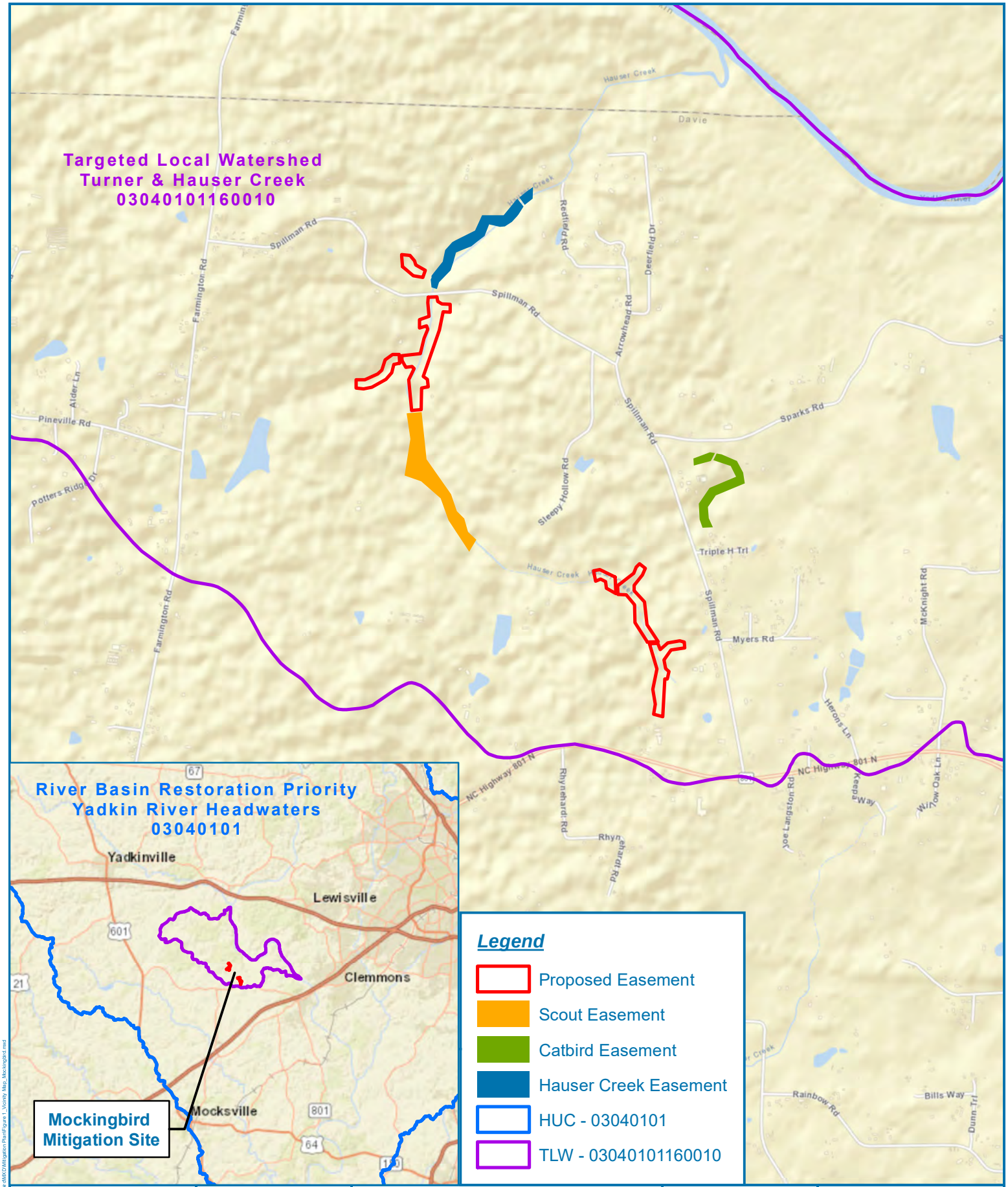


Figure 1 - Vicinity Map

Mockingbird Mitigation Site

Daive County, North Carolina

Date: 11/9/2018

Drawn by: MDE

Checked By: CSC

1 inch = 2,000 feet

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 1_Vicinity Map_Mockingbird.mxd

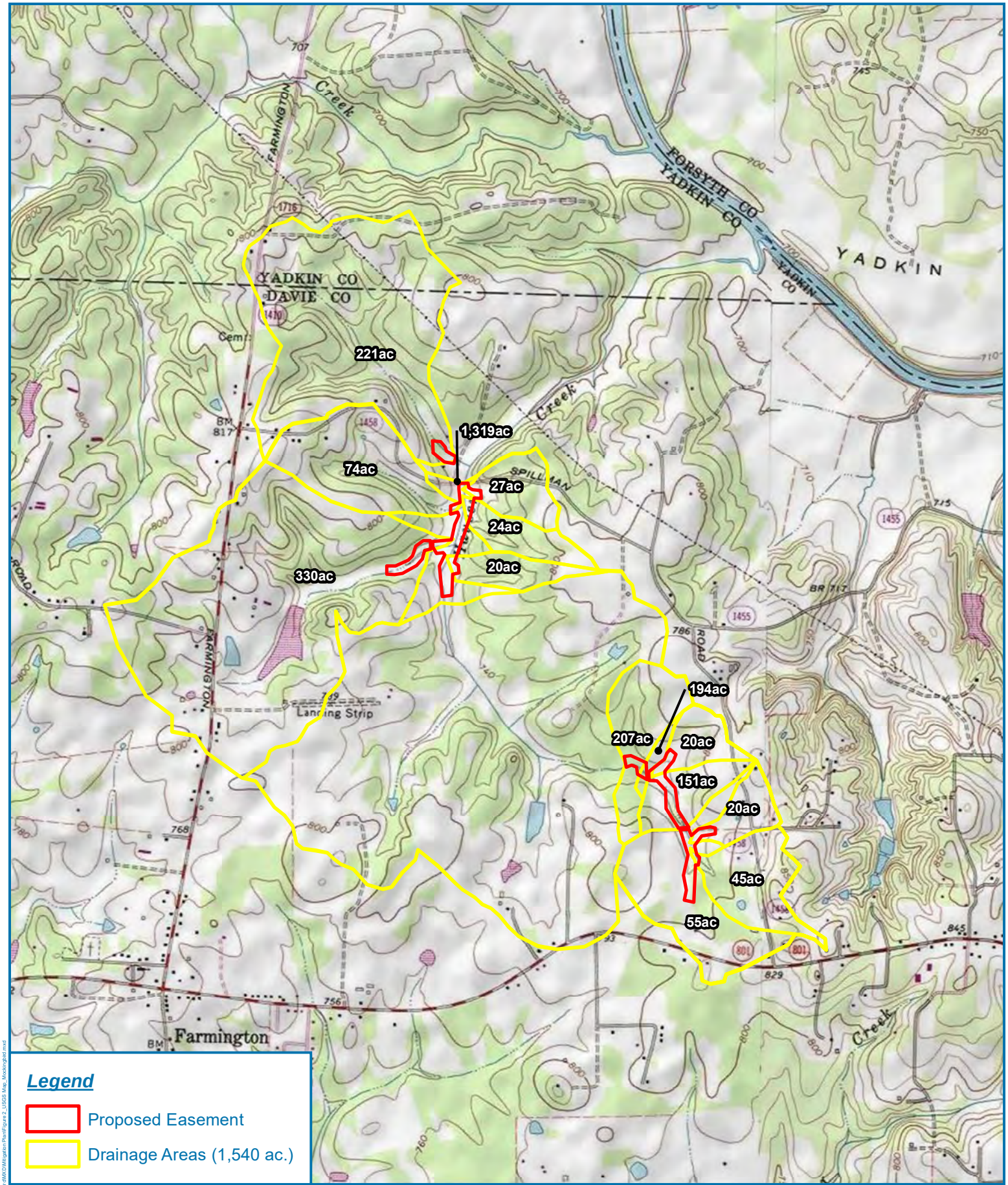


Figure 2 - USGS Map
(Farmington 1967)

Mockingbird Mitigation Site

Davie County, North Carolina

Date: 11/9/2018

Drawn by: EWT

1 inch = 2,000 feet

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 2_USGS Map_Mockingbird.mxd

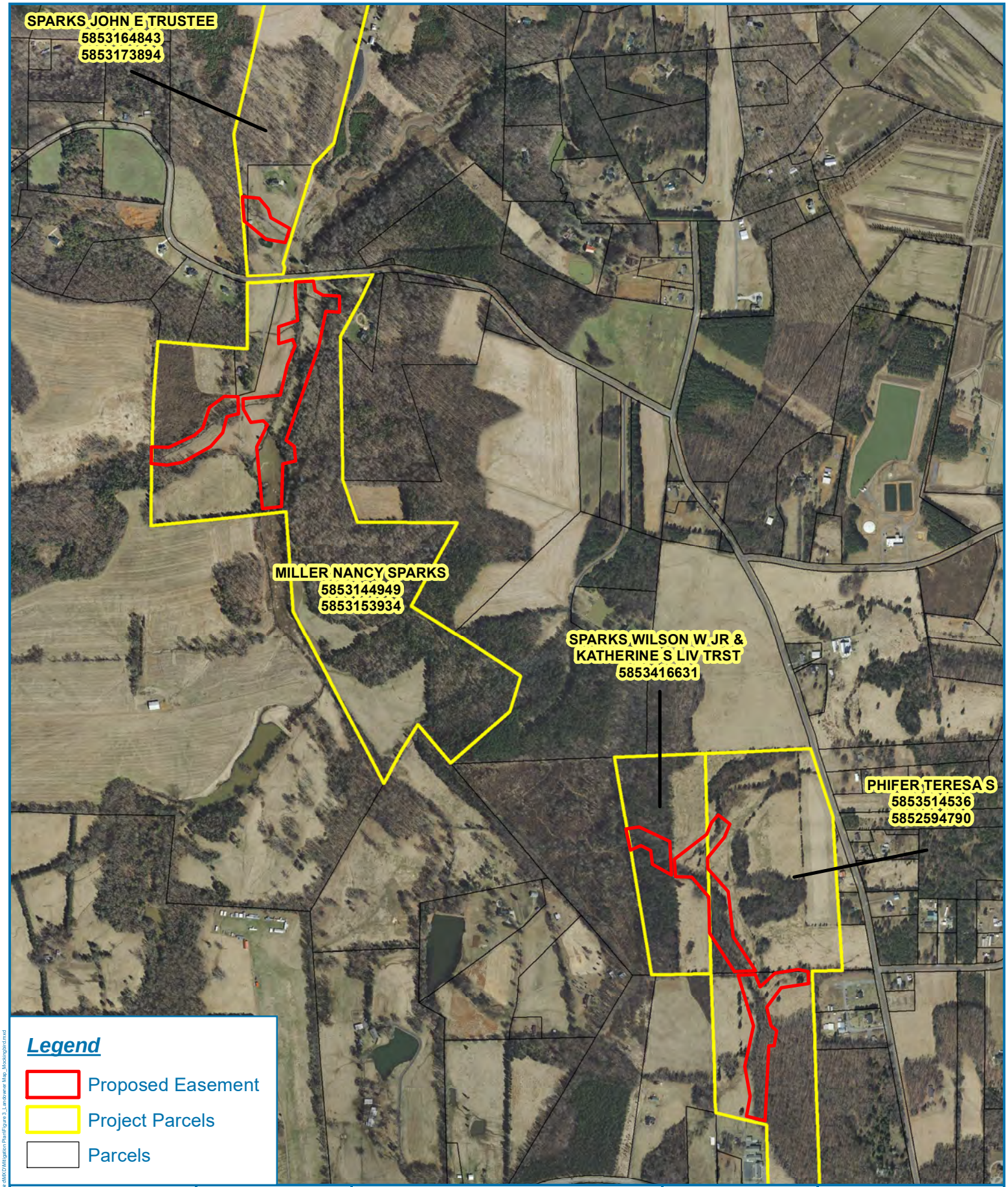


Figure 3 - Landowner Map

Mockingbird Mitigation Site

Davie County, North Carolina

Date: 11/9/2018

Drawn by: MDE

1 inch = 1,000 feet

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 3_Landowner Map_Mockingbird.mxd

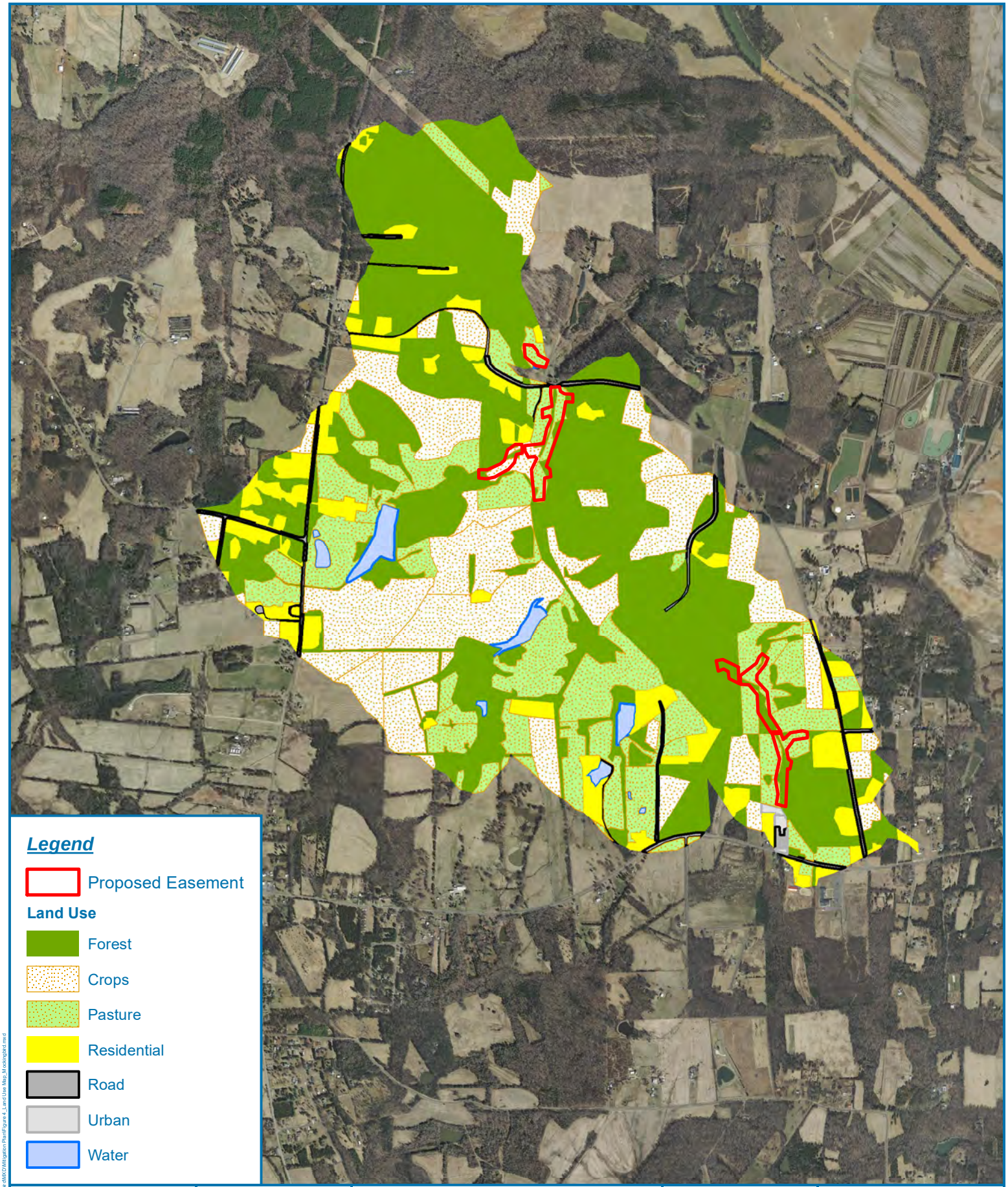


Figure 4 - Landuse Map

Mockingbird Mitigation Site

Davie County, North Carolina

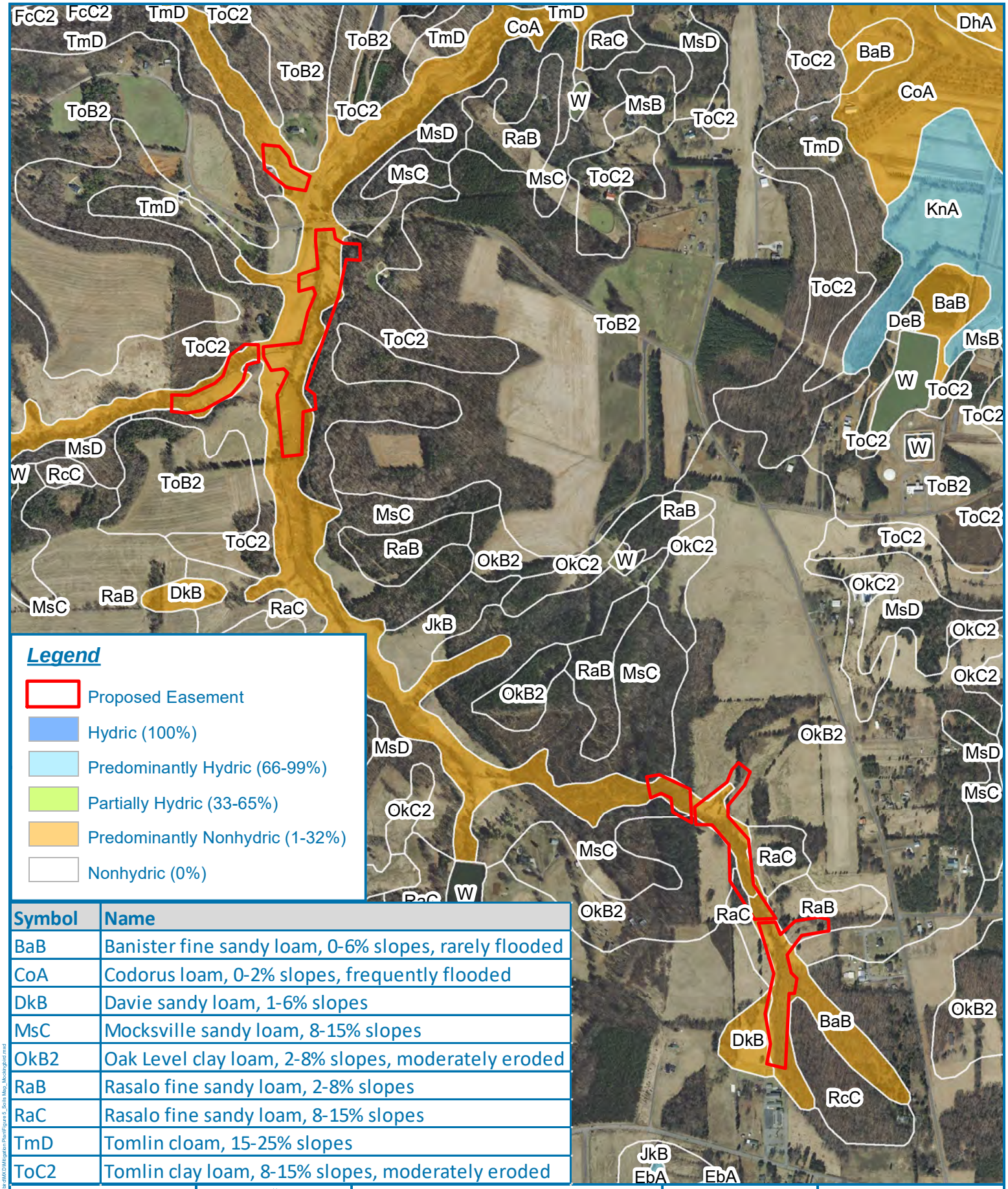
Date: 11/9/2018

Drawn by: MDE

1 inch = 2,000 feet

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 4_Land Use Map_Mockingbird.mxd



Legend

- Proposed Easement
- Hydric (100%)
- Predominantly Hydric (66-99%)
- Partially Hydric (33-65%)
- Predominantly Nonhydric (1-32%)
- Nonhydric (0%)

Symbol	Name
BaB	Banister fine sandy loam, 0-6% slopes, rarely flooded
CoA	Codorus loam, 0-2% slopes, frequently flooded
DkB	Davie sandy loam, 1-6% slopes
MsC	Mocksville sandy loam, 8-15% slopes
OkB2	Oak Level clay loam, 2-8% slopes, moderately eroded
RaB	Rasalo fine sandy loam, 2-8% slopes
RaC	Rasalo fine sandy loam, 8-15% slopes
TmD	Tomlin cloam, 15-25% slopes
ToC2	Tomlin clay loam, 8-15% slopes, moderately eroded

N W E S

0 500 1,000

Feet

Figure 5 - Soils Map

Mockingbird Mitigation Site

Davie County, North Carolina

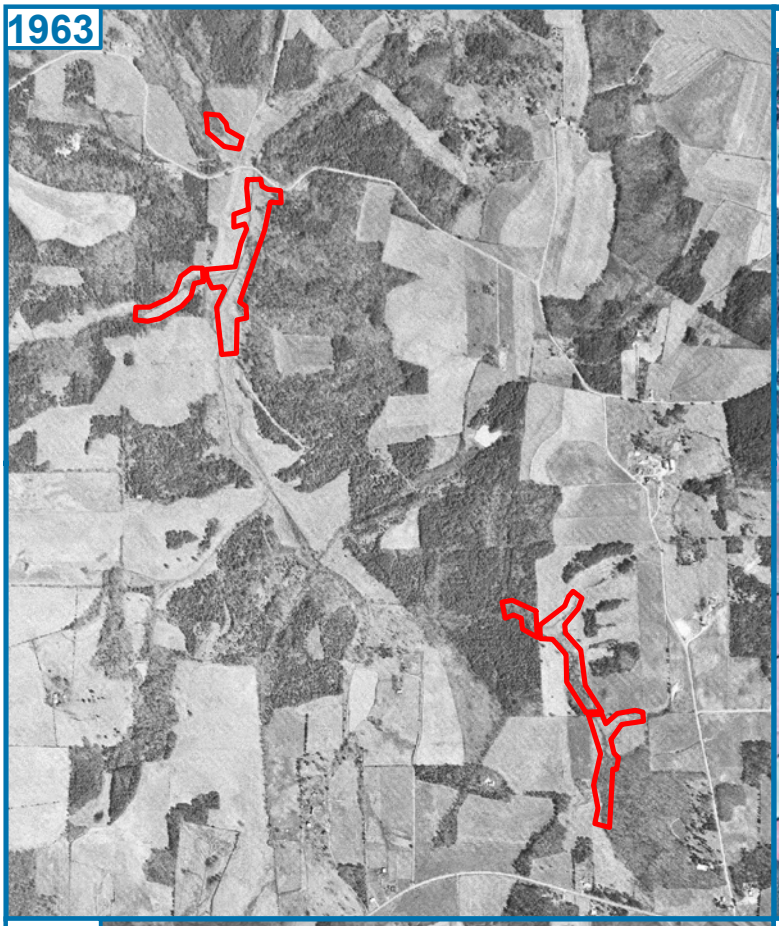
Date: 11/9/2018

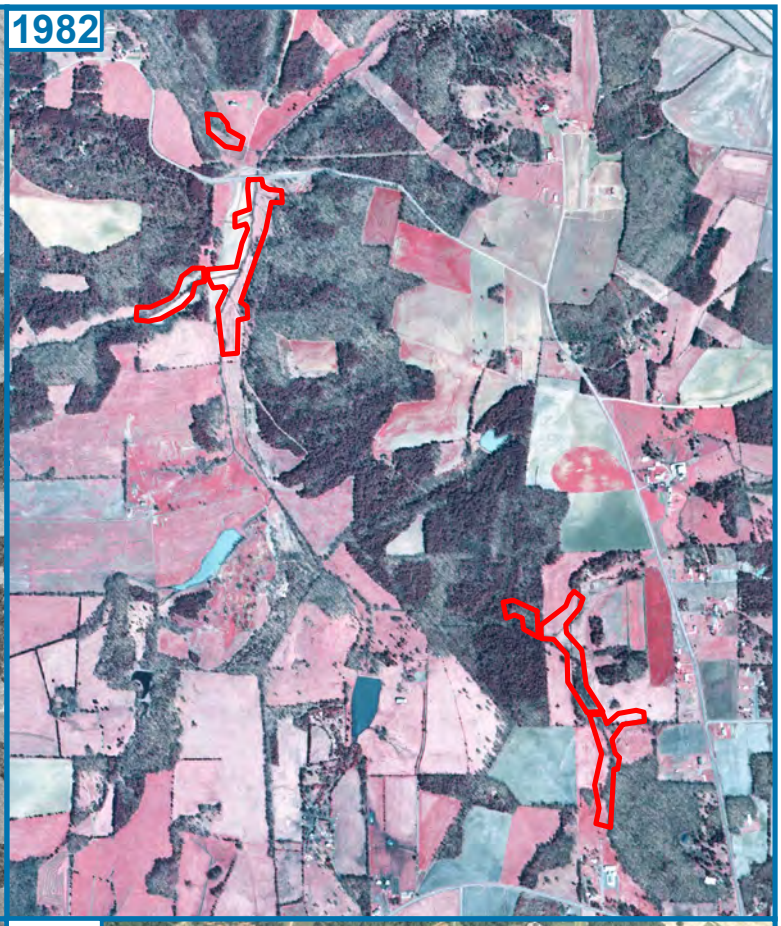
Drawn by: MDE

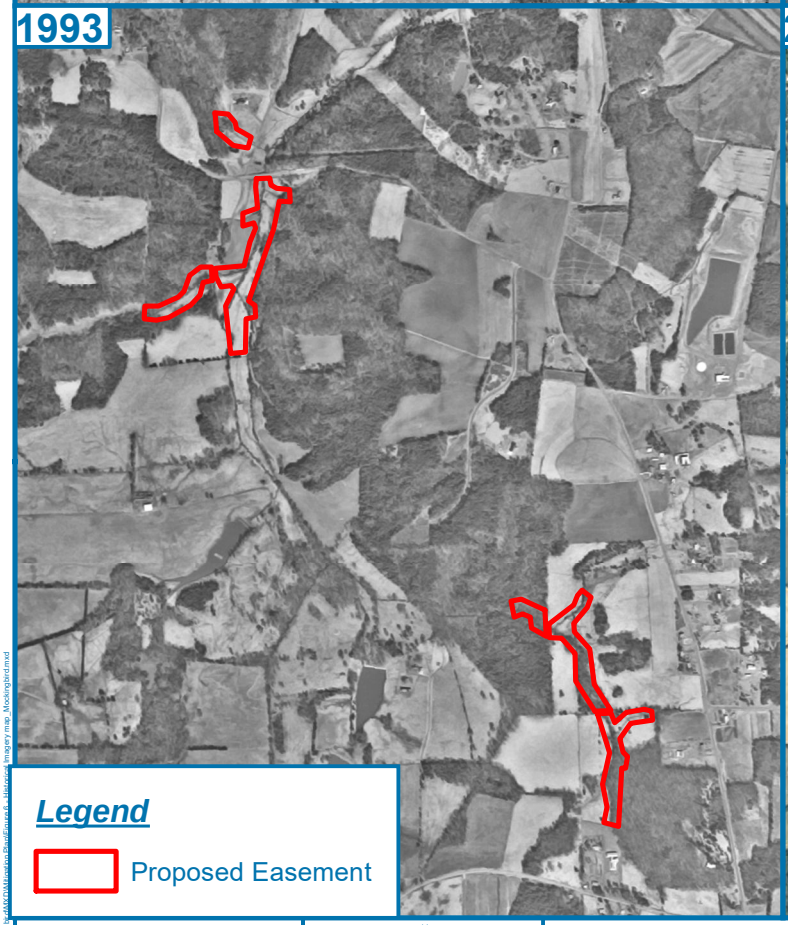
1 inch = 1,000 feet

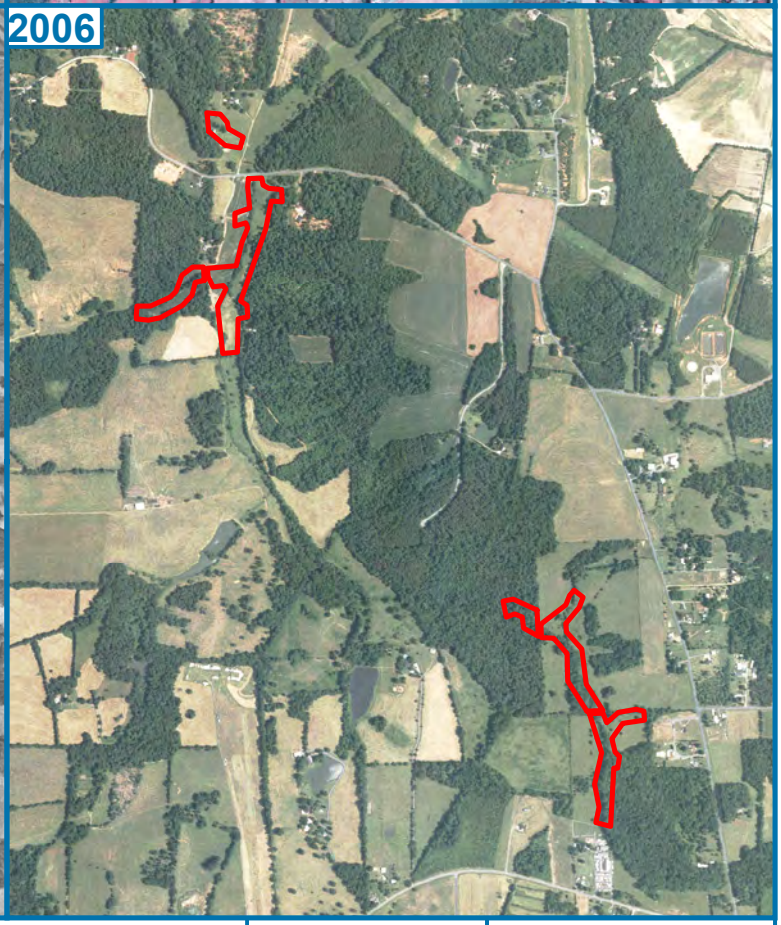
res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 5_Soils Map_Mockingbird.mxd



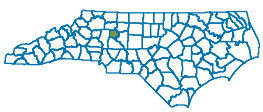






Legend

Proposed Easement



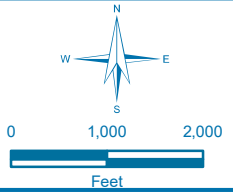


Figure 6 - Historical Aerials Map

Mockingbird Mitigation Site

Davie County, North Carolina

Date: 11/9/2018

Drawn by: MDE

1 inch = 2,000 feet

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Historical Imagery\Figure 6 - Historical Imagery map_Mockingbird.mxd

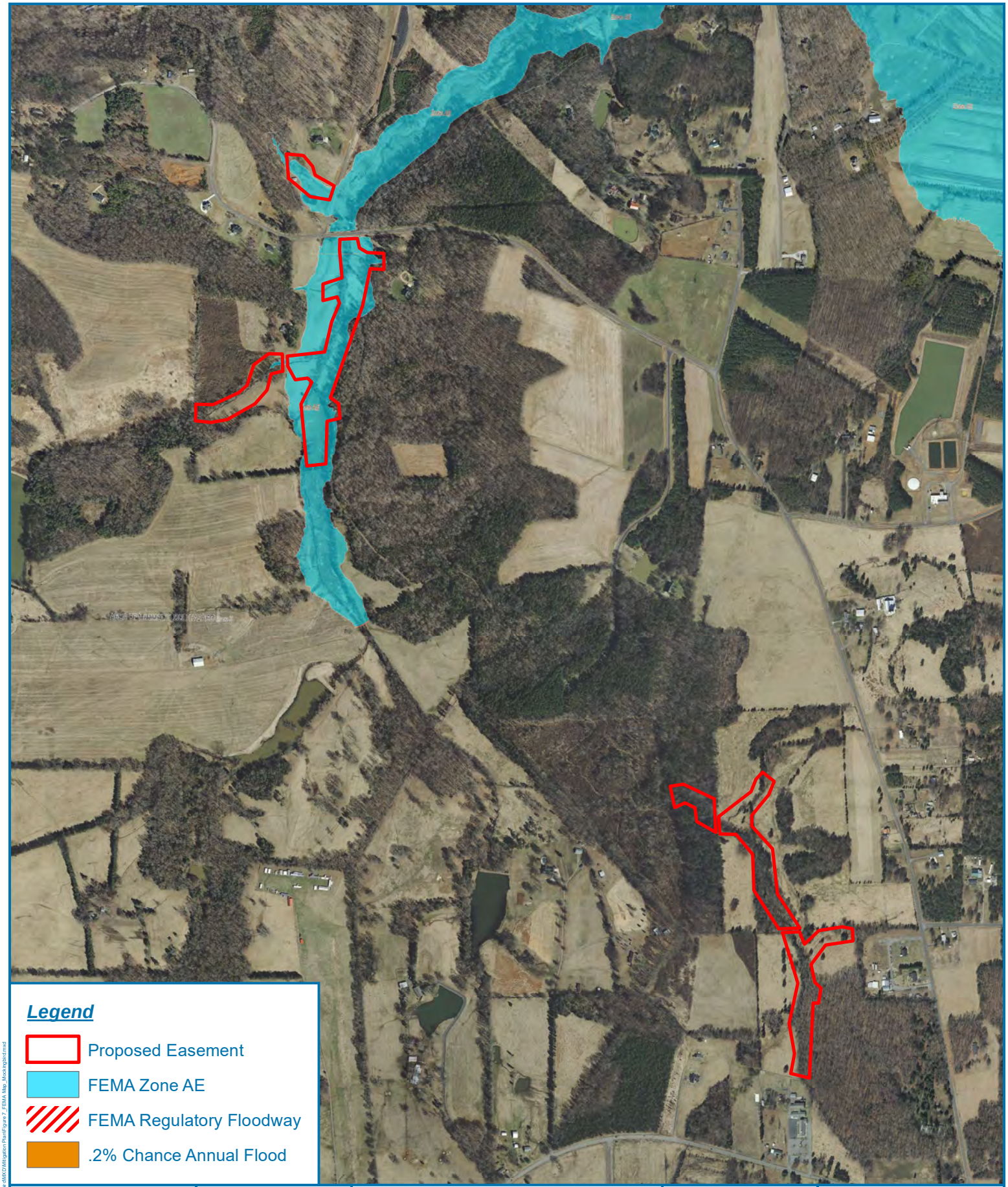


Figure 7 - FEMA Map
panel: 3710584200L eff: 05/18/2009

Mockingbird Mitigation Site

Davie County, North Carolina

Date: 11/9/2018

Drawn by: MDE

1 inch = 1,000 feet

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 7_FEMA Map_Mockingbird.mxd

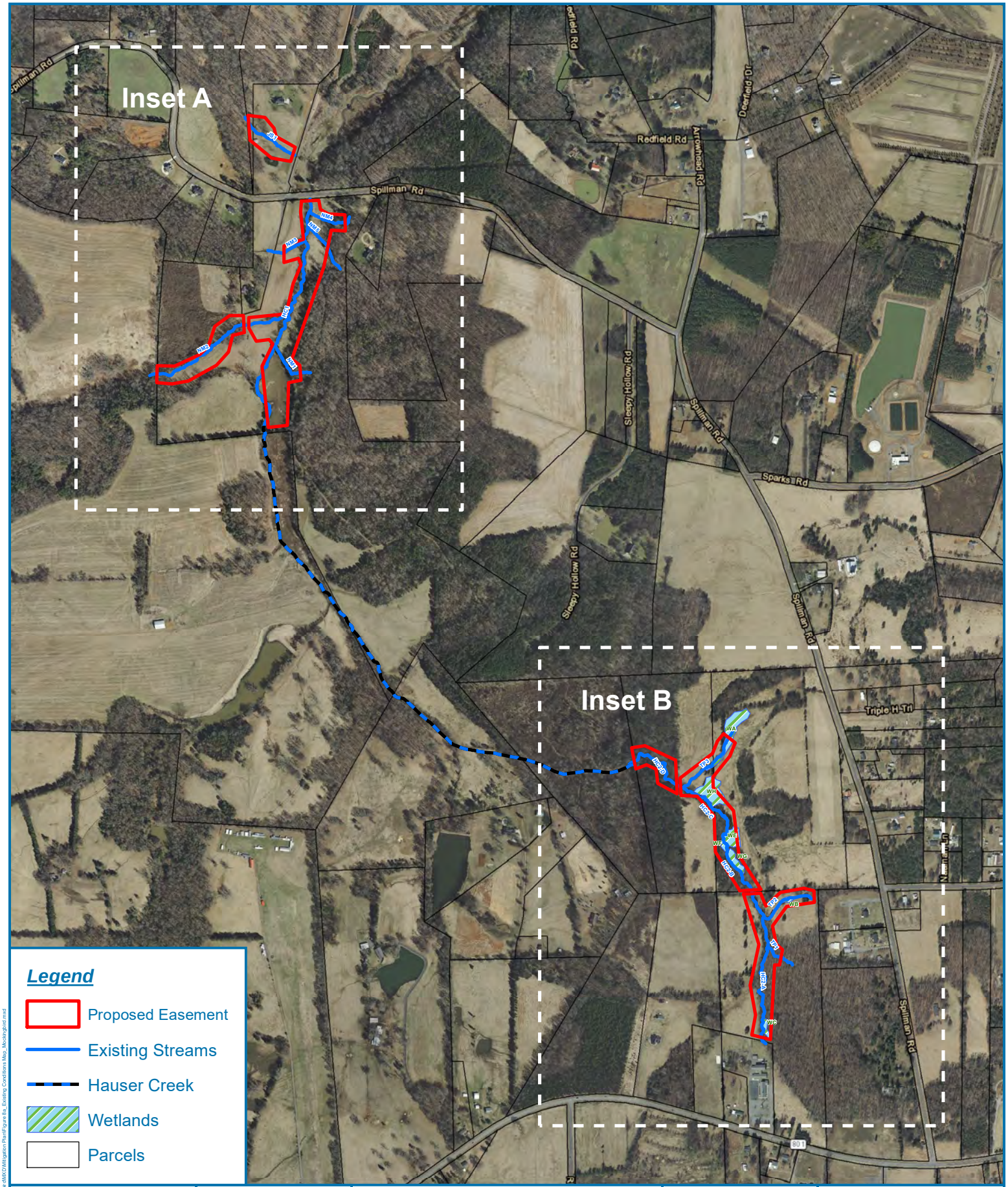


Figure 8a - Existing Conditions Map

Mockingbird Mitigation Site

Davie County, North Carolina

Date: 11/9/2018

Drawn by: MDE

1 inch = 1,000 feet

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 8a_Existing Conditions Map_Mockingbird.mxd

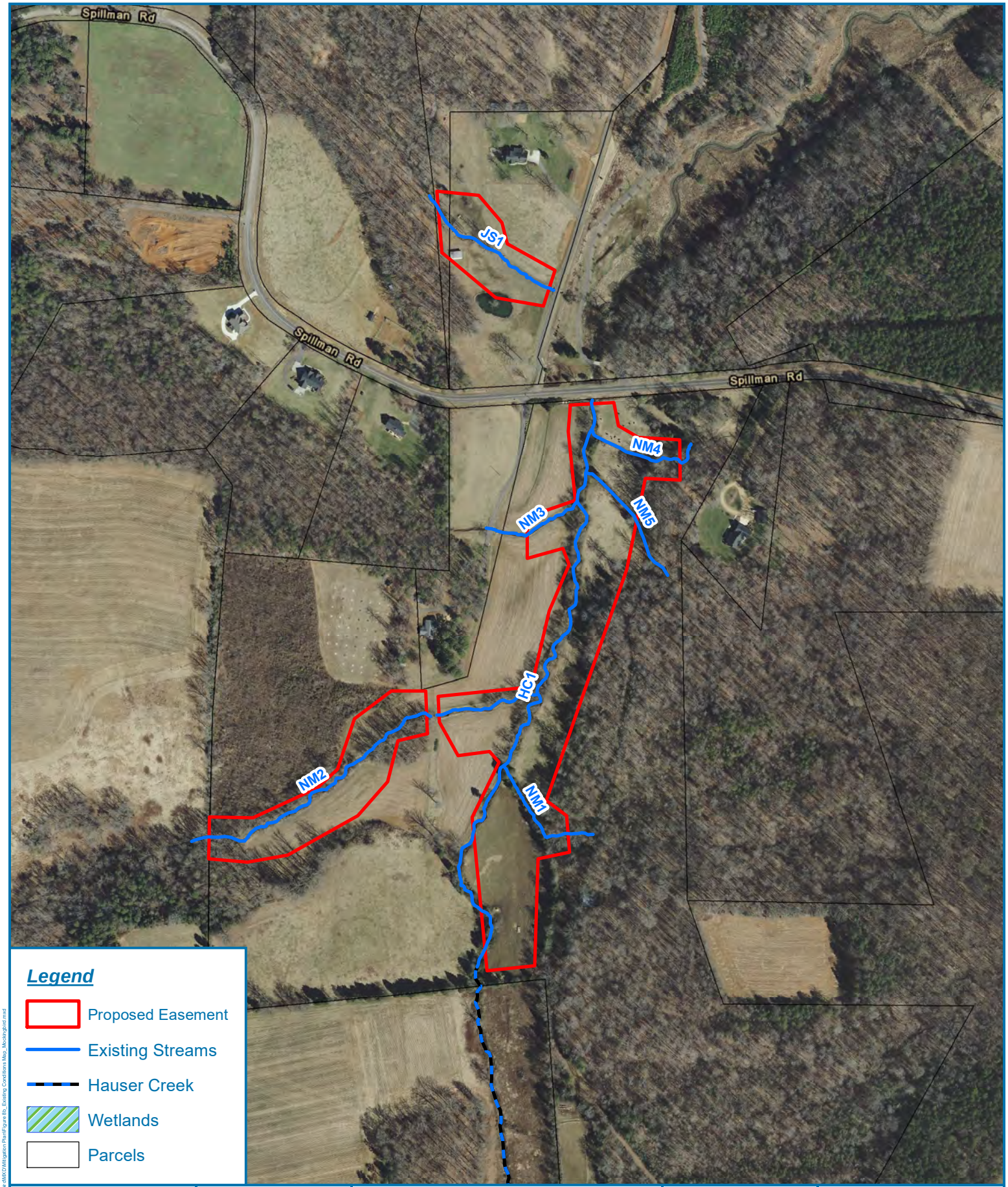


Figure 8b - Existing Conditions Map (North)

Mockingbird Mitigation Site

Davie County, North Carolina

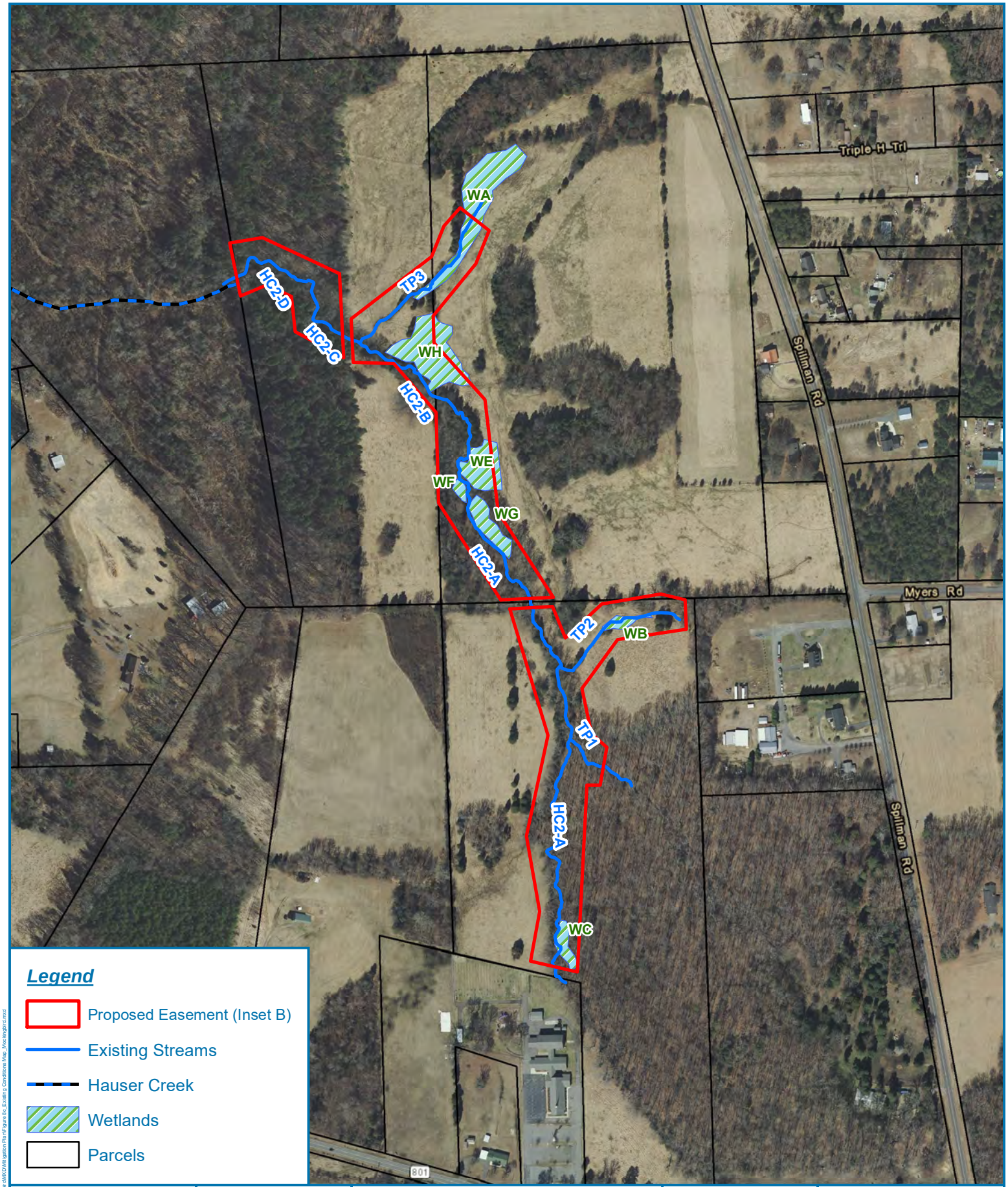
Date: 11/9/2018

Drawn by: MDE

1 inch = 400 feet

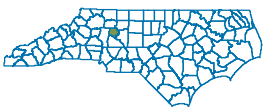
res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 8b. Existing Conditions Map_Mockingbird.mxd



Legend

- Proposed Easement (Inset B)
- Existing Streams
- Hauser Creek
- Wetlands
- Parcels



N
W E
S

0 200 400

Feet

Figure 8c - Existing Conditions Map (South)

Mockingbird Mitigation Site

Davie County, North Carolina

Date: 11/9/2018

Drawn by: MDE

1 inch = 400 feet

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 8c. Existing Conditions Map_Mockingbird.mxd

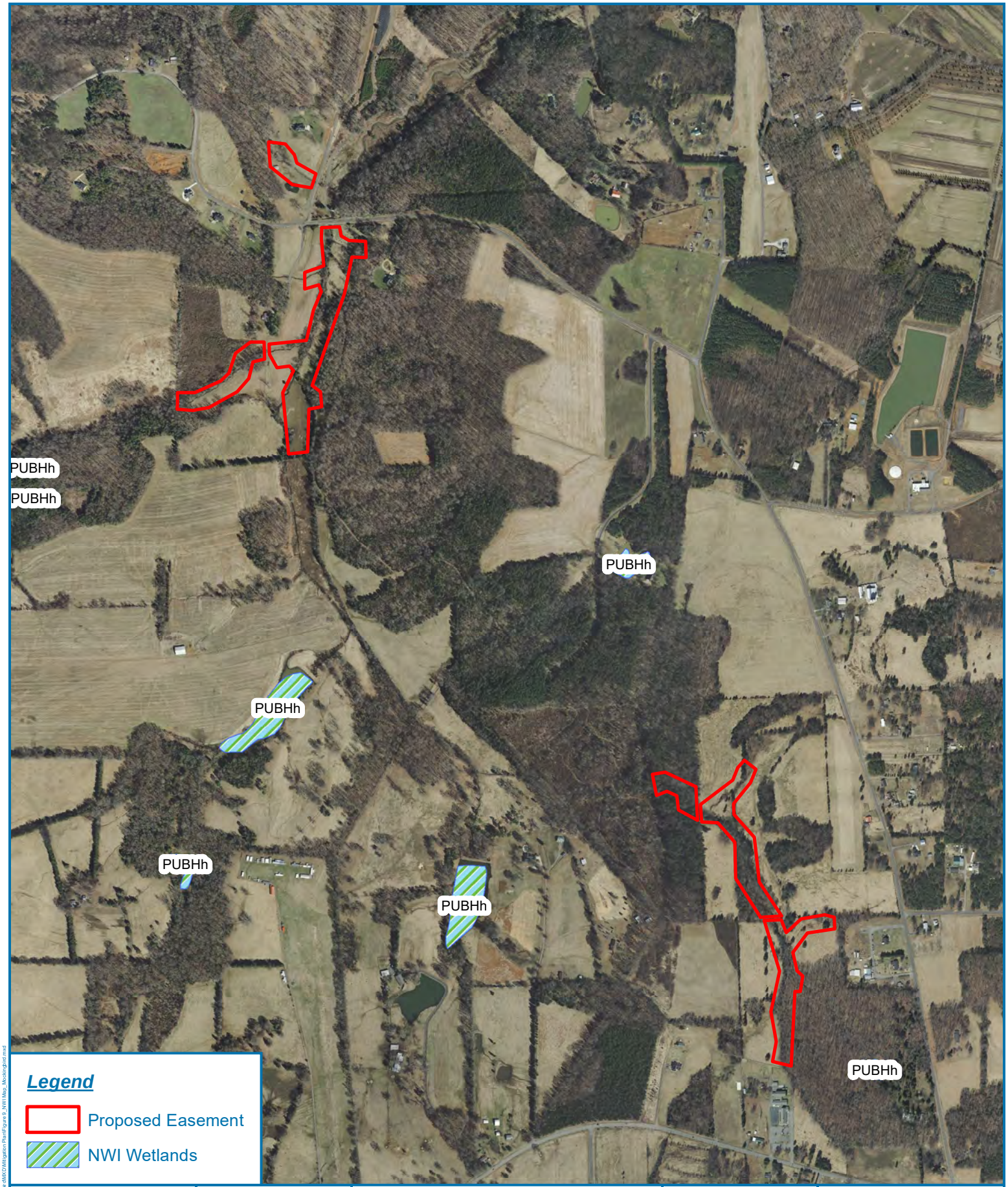


Figure 9 - NWI Map

Mockingbird Mitigation Site

Davie County, North Carolina

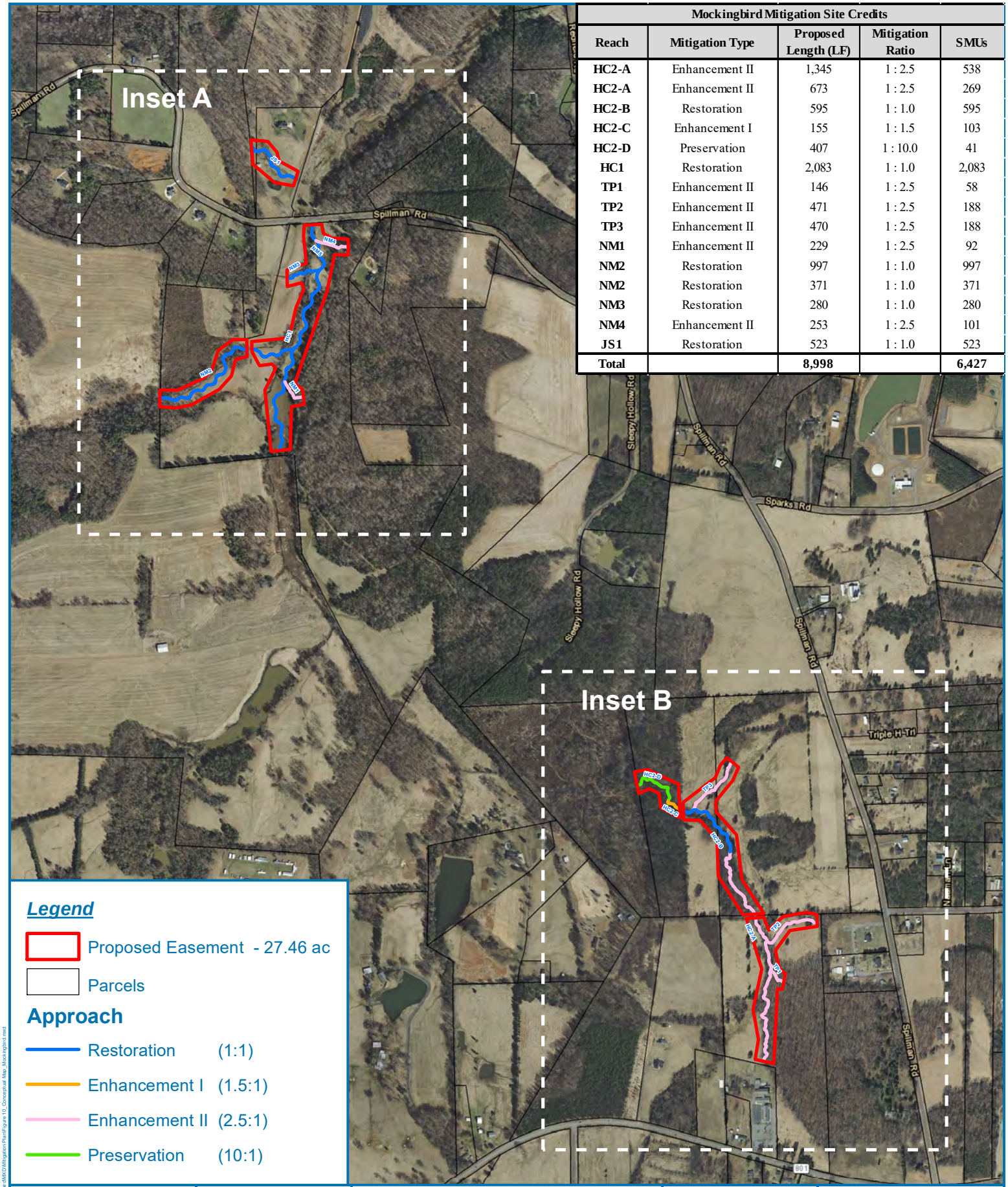
Date: 11/9/2018

Drawn by: EWT

1 inch = 1,000 feet

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 9_NWI Map_Mockingbird.mxd



Mockingbird Mitigation Site Credits

Reach	Mitigation Type	Proposed Length (LF)	Mitigation Ratio	SMUs
HC2-A	Enhancement II	1,345	1 : 2.5	538
HC2-A	Enhancement II	673	1 : 2.5	269
HC2-B	Restoration	595	1 : 1.0	595
HC2-C	Enhancement I	155	1 : 1.5	103
HC2-D	Preservation	407	1 : 10.0	41
HC1	Restoration	2,083	1 : 1.0	2,083
TP1	Enhancement II	146	1 : 2.5	58
TP2	Enhancement II	471	1 : 2.5	188
TP3	Enhancement II	470	1 : 2.5	188
NM1	Enhancement II	229	1 : 2.5	92
NM2	Restoration	997	1 : 1.0	997
NM2	Restoration	371	1 : 1.0	371
NM3	Restoration	280	1 : 1.0	280
NM4	Enhancement II	253	1 : 2.5	101
JS1	Restoration	523	1 : 1.0	523
Total		**8,998**		**6,427**

Legend

Proposed Easement - 27.46 ac

Parcels

Approach

- Restoration (1:1)
- Enhancement I (1.5:1)
- Enhancement II (2.5:1)
- Preservation (10:1)

N W E S

0 500 1,000

Feet

Figure 10 - Conceptual Map

Mockingbird Mitigation Site

Davie County, North Carolina

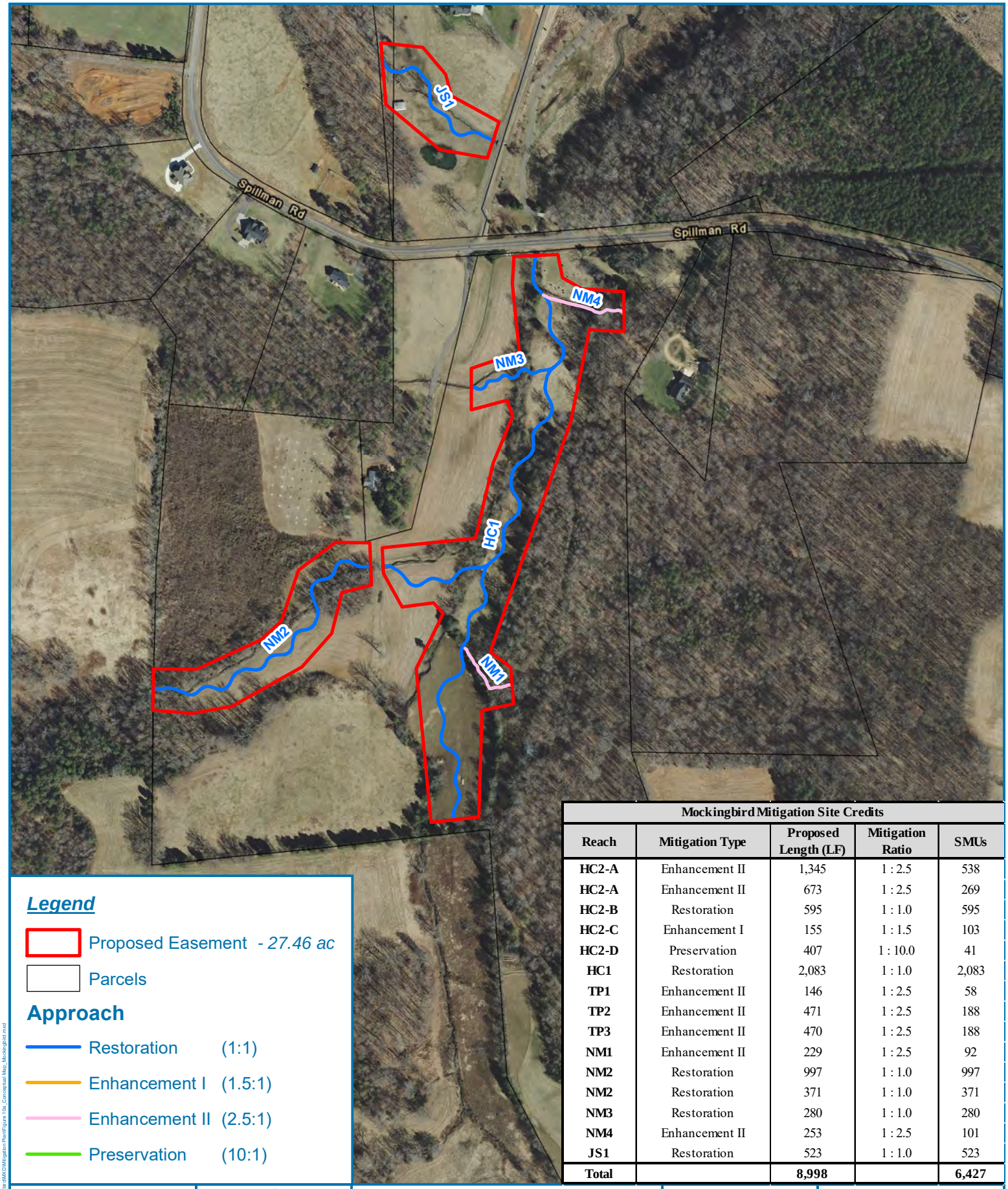
Date: 11/9/2018

Drawn by: MDE

1 inch = 1,000 feet

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 10_Conceptual Map_Mockingbird.mxd



Mockingbird Mitigation Site Credits

Reach	Mitigation Type	Proposed Length (LF)	Mitigation Ratio	SMUs
HC2-A	Enhancement II	1,345	1 : 2.5	538
HC2-A	Enhancement II	673	1 : 2.5	269
HC2-B	Restoration	595	1 : 1.0	595
HC2-C	Enhancement I	155	1 : 1.5	103
HC2-D	Preservation	407	1 : 10.0	41
HC1	Restoration	2,083	1 : 1.0	2,083
TP1	Enhancement II	146	1 : 2.5	58
TP2	Enhancement II	471	1 : 2.5	188
TP3	Enhancement II	470	1 : 2.5	188
NM1	Enhancement II	229	1 : 2.5	92
NM2	Restoration	997	1 : 1.0	997
NM2	Restoration	371	1 : 1.0	371
NM3	Restoration	280	1 : 1.0	280
NM4	Enhancement II	253	1 : 2.5	101
JS1	Restoration	523	1 : 1.0	523
Total		**8,998**		**6,427**

Legend

Proposed Easement - *27.46 ac*

Parcels

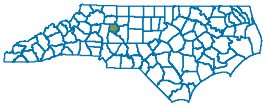
Approach

Restoration (1:1)

Enhancement I (1.5:1)

Enhancement II (2.5:1)

Preservation (10:1)



N W E S

0 200 400

Feet

Figure 10a - Conceptual Map (North)

Mockingbird Mitigation Site

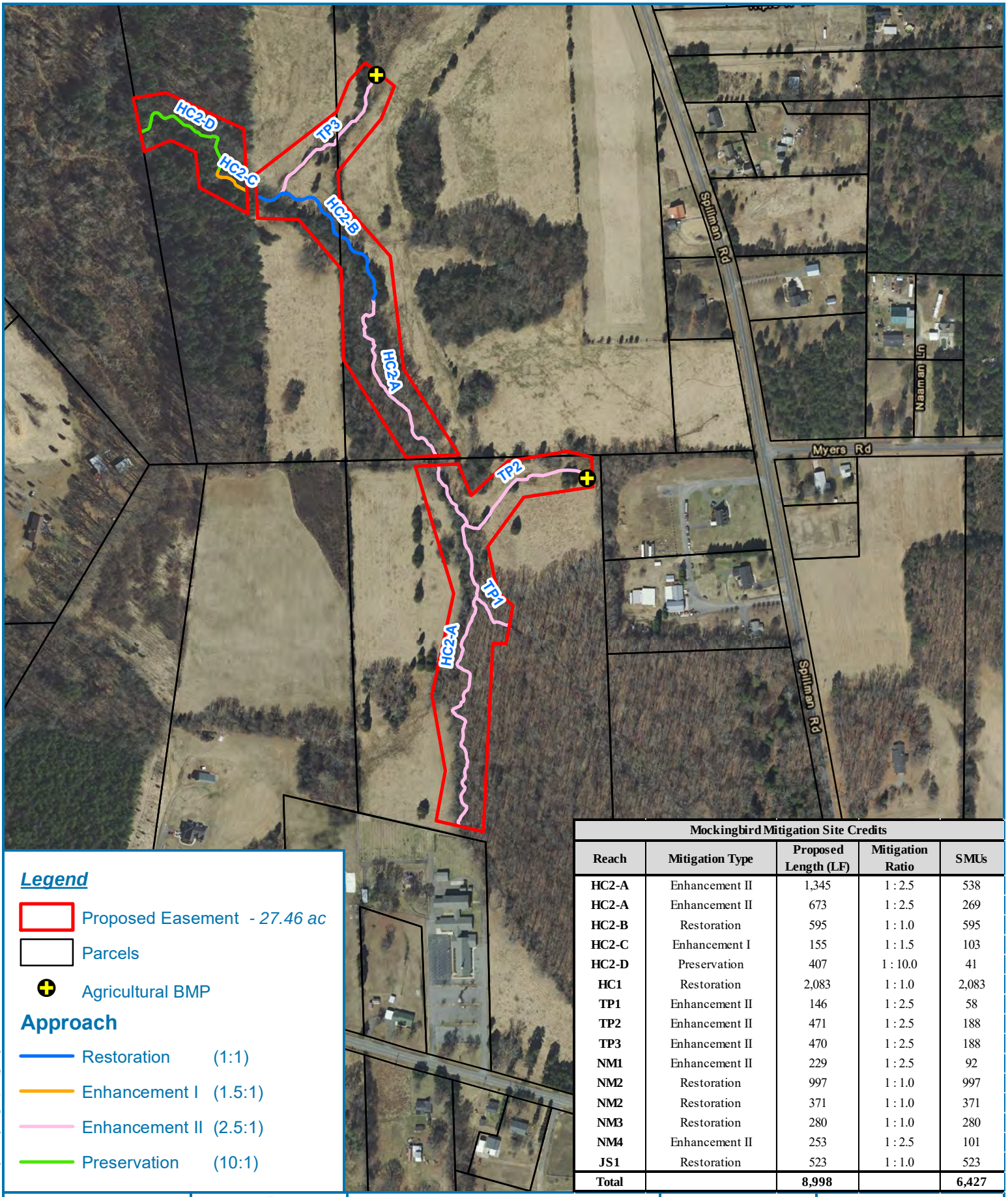
Davie County, North Carolina

Date: 11/9/2018

Drawn by: EWT

1 inch = 400 feet

res



Legend

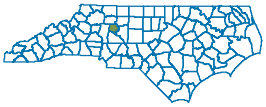
- Proposed Easement - *27.46 ac*
- Parcels
- Agricultural BMP

Approach

- Restoration (1:1)
- Enhancement I (1.5:1)
- Enhancement II (2.5:1)
- Preservation (10:1)

Mockingbird Mitigation Site Credits

Reach	Mitigation Type	Proposed Length (LF)	Mitigation Ratio	SMUs
HC2-A	Enhancement II	1,345	1 : 2.5	538
HC2-A	Enhancement II	673	1 : 2.5	269
HC2-B	Restoration	595	1 : 1.0	595
HC2-C	Enhancement I	155	1 : 1.5	103
HC2-D	Preservation	407	1 : 10.0	41
HC1	Restoration	2,083	1 : 1.0	2,083
TP1	Enhancement II	146	1 : 2.5	58
TP2	Enhancement II	471	1 : 2.5	188
TP3	Enhancement II	470	1 : 2.5	188
NM1	Enhancement II	229	1 : 2.5	92
NM2	Restoration	997	1 : 1.0	997
NM2	Restoration	371	1 : 1.0	371
NM3	Restoration	280	1 : 1.0	280
NM4	Enhancement II	253	1 : 2.5	101
JS1	Restoration	523	1 : 1.0	523
Total		**8,998**		**6,427**



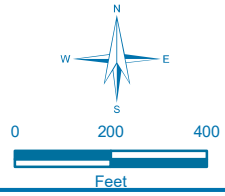


Figure 10b - Conceptual Map (South)

Mockingbird Mitigation Site

Davie County, North Carolina

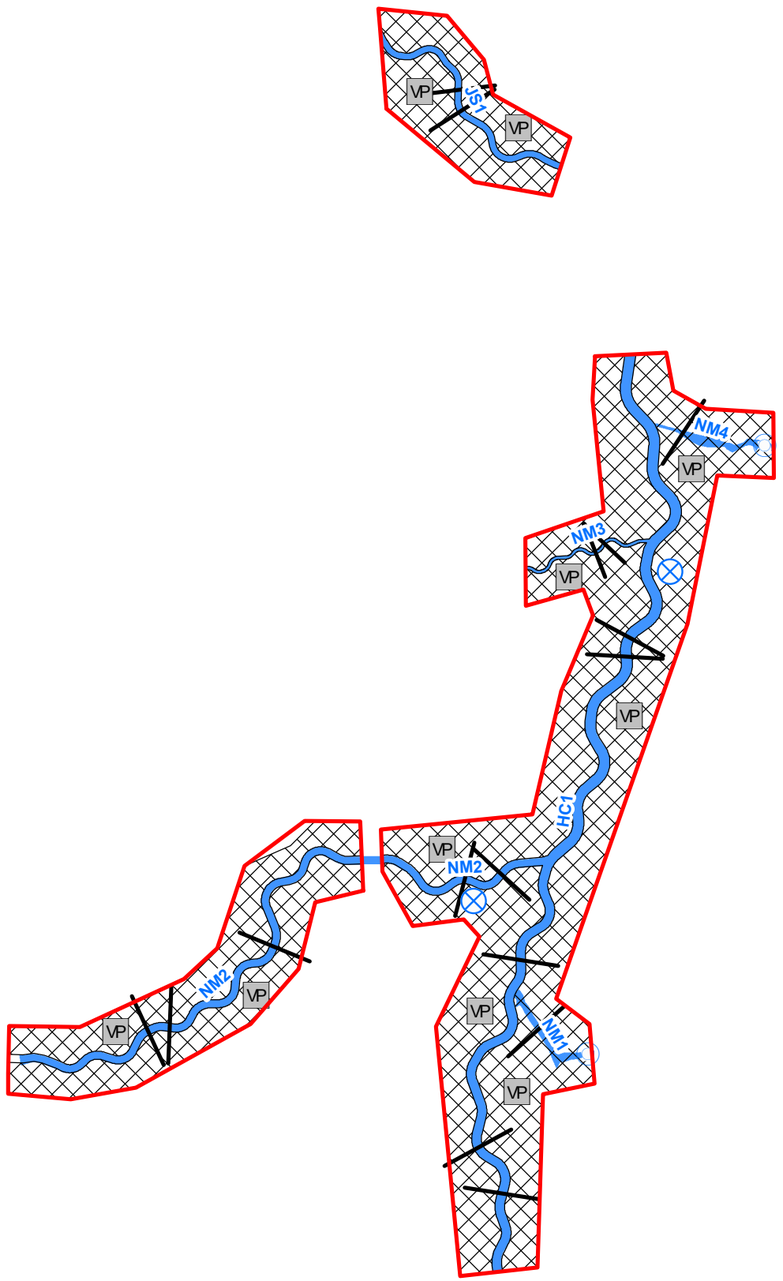
Date: 11/9/2018

Drawn by: EWT

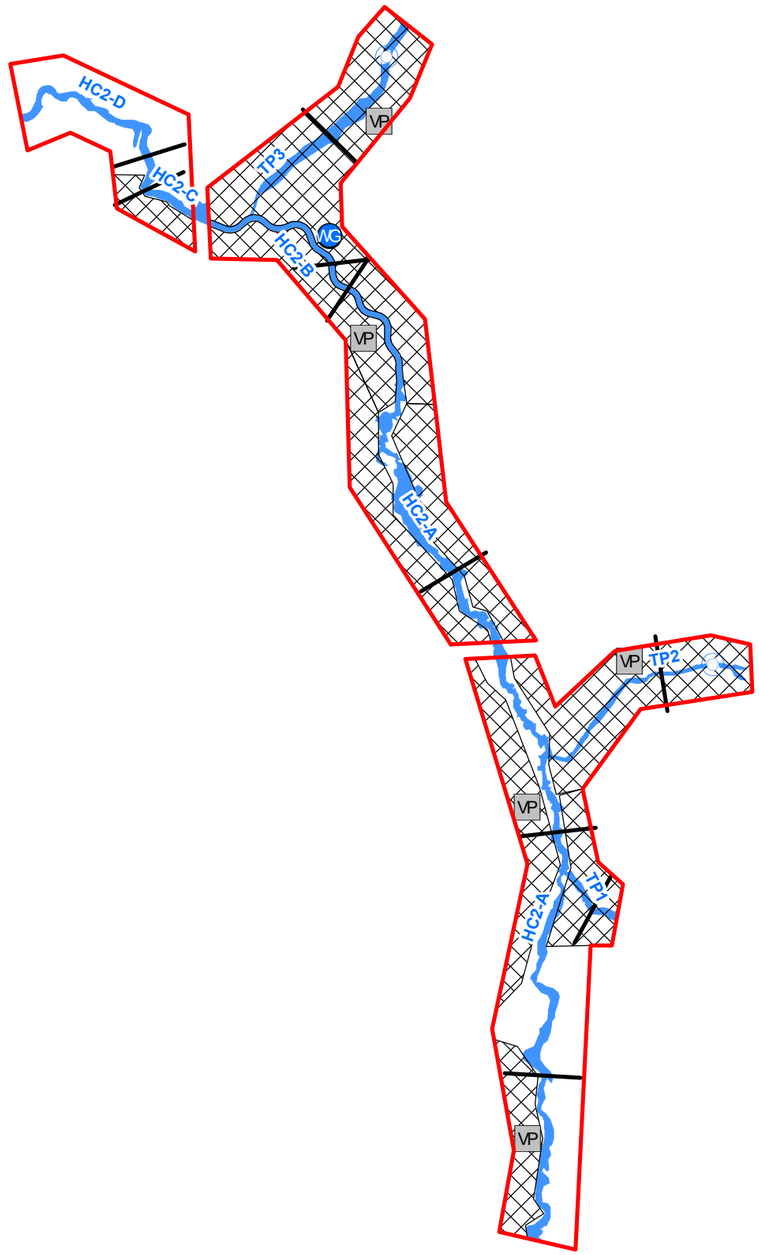
1 inch = 400 feet

res

Mockingbird North



Mockingbird South



res

N
W E
S

0 150 300
Feet

Figure 11 - Monitoring Plan Map

Mockingbird Mitigation Site

Davie County, North Carolina

Date: 11/12/2018	Drawn by: MDE
Checked by: JRM	1 in = 300 feet

Legend

- Proposed Easement
- Proposed Top of Bank
- Planting Area
- Flow Gauge
- Crest Gauge
- VP — Vegatation Plot
- WG — Wetland Gauge
- Proposed Cross Sections

REFERENCE

1) Horizontal Datum is NAD83 UTM Z15N.

2) Map Projection is NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet

Document Path: S:\@RES GIS Projects\NC\Mockingbird\MXD\MMitigation\Plan\Figure 11 - Monitoring Map.mxd

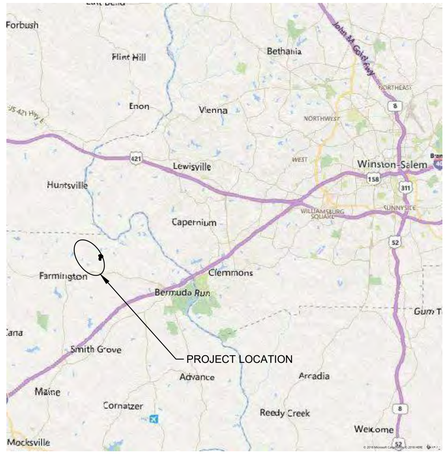
Appendix A - Plan Sheets

MOCKINGBIRD SITE

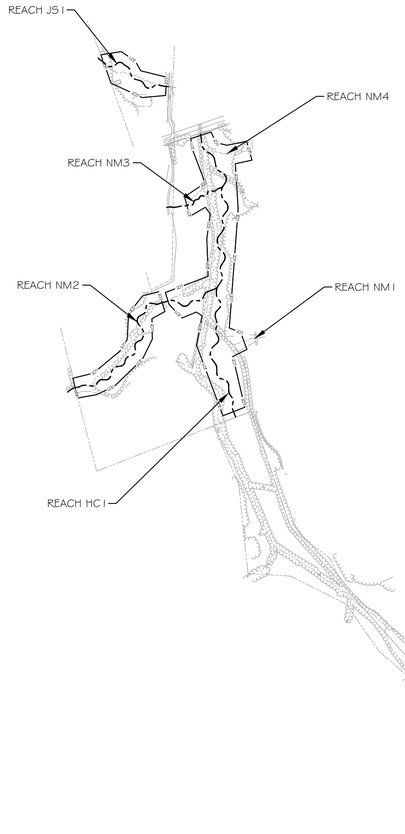
DAVIE COUNTY, NORTH CAROLINA

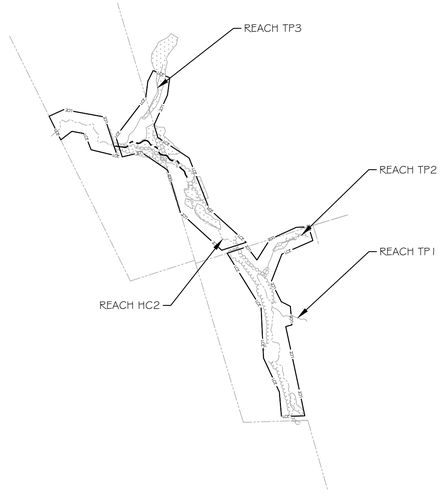
YADKIN 01 RIVER BASIN: HUC 03040101
NOVEMBER 2018

RESOURCE ENVIRONMENTAL SOLUTIONS, LLC
302 JEFFERSON ST, SUITE 110
RALEIGH, NC 27605



VICINITY MAP
NTS





SITE MAP

Sheet List Table	
Sheet Number	Sheet Title
-	COVER
A1	OVERALL AERIAL VIEW
E1	NOTES
E2	INDEX SHEET
E3	EXISTING CONDITIONS
MB1	REACH HC2
MB2	REACH HC2
MB3	REACH HC2
MB4	REACH HC2
MB5	REACH HC2
MB6	REACH HC2
MB7	REACH TP1
MB8	REACH TP2
MB9	REACH TP3
MB10	REACH HC1
MB11	REACH HC1
MB12	REACH HC1
MB13	REACH HC1
MB14	REACH NM1
MB15	REACH NM2
MB16	REACH NM2
MB17	REACH NM2
MB18	REACH NM3
MB19	REACH NM4
MB20	REACH JS1
P1	PLANTING PLAN
M1	MONITORING PLAN
D1	DETAILS
D2	DETAILS
D3	DETAILS
D4	DETAILS
D5	DETAILS
D6	DETAILS
D7	DETAILS

DMS PROJECT #: 100021
CONTRACT #: 7185
USACE ACTION ID #: SAW-2017-01505
RFP #: 16-006993

res
302 Jefferson Street, Suite 110
Raleigh, NC 27605
Main: 919.829.9909
Fax: 919.829.9913
www.res.us

SEAL

FULL SCALE: 1"=500

0 500 1000

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION

REVISIONS:

RELEASED FOR:
PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/9/2018

PROJECT NUMBER: 0381
PROJECT MANAGER: CSC
DESIGNED: AFM
DRAWN: TRS
CHECKED: AFM

SHEET NUMBER:
-

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_COVER.dwg SAVED BY: Tswartzfager

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_COVER.dwg SAVED BY: Tswartzfager

res
302 Jefferson Street, Suite 110
Raleigh, NC 27605
Main: 919.829.9909
Fax: 919.829.9913
www.res.us

SEAL

FULL SCALE: 1"=300

0 300 600

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION

REVISIONS:

RELEASED FOR:

PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
OVERALL AERIAL VIEW

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

A1

CONSTRUCTION NOTES:

1. INSTALL EROSION CONTROL MEASURES AS DESCRIBED IN THE EROSION CONTROL PLAN AND NOTES. EROSION CONTROL MEASURES MAY BE PHASED-IN TO THOSE AREAS OF THE PROJECT CURRENTLY BEING WORKED ON. THE CONTRACTOR MAY MODIFY OR RELOCATE EROSION CONTROL MEASURES TO MAKE ADJUSTMENTS FOR UNFORESEEN FIELD CONDITIONS SO LONG AS PROPER CONSTRUCTION IS MAINTAINED TO ENSURE THE INTEGRITY AND USEFULNESS OF THE PROPOSED MEASURES. ALL DISTURBED AREAS ALONG CHANNEL BANKS SHALL BE STABILIZED WITH TEMPORARY SEED AND MULCH AT THE END OF EACH DAY.
2. IN GENERAL, STREAM CONSTRUCTION SHALL PROCEED FROM AN UPSTREAM TO DOWNSTREAM DIRECTION.
3. EXISTING WETLANDS CANNOT BE ENCROACHED UPON UNDER ANY CIRCUMSTANCES IF NOT APPROVED AS DESIGNATED IMPACT AREAS. HIGH VISIBILITY FENCING MUST BE PLACED AROUND ALL EXISTING WETLANDS THAT ARE LOCATED ADJACENT TO CONSTRUCTION ACTIVITIES AND/OR ARE LOCATED WITHIN THE PROPOSED CONSERVATION EASEMENT.
4. DURING STREAM CONSTRUCTION ACTIVITIES, THE WORK AREA SHALL BE STABILIZED AT THE END OF EACH WORKING DAY.
5. UNLESS NOTED OTHERWISE, FILL MATERIAL GENERATED FROM CHANNEL EXCAVATION AND STABILIZATION SHALL BE PLACED INSIDE THE EXISTING CHANNEL TO BE ABANDONED AT AN ELEVATION THAT PROVIDES POSITIVE DRAINAGE TOWARDS THE PROPOSED CHANNEL.
6. STOCKPILE AREAS MAY BE RELOCATED UPON THE APPROVAL OF THE ENGINEER. SILT FENCING MUST BE INSTALLED AROUND ALL STOCKPILE AREAS.
7. CONTRACTOR SHALL NOT COMPACT SOIL AROUND ROOTS OR TREES TO REMAIN, AND SHALL NOT DAMAGE SUCH TREES IN ANY WAY. EXCAVATED OR OTHER MATERIAL SHALL NOT BE PLACED, PILED OR STORED WITHIN THE CRITICAL ROOT ZONE AREA OF THE TREES TO BE SAVED. ANY COMPROMISED TREES NOT USED IN CONSTRUCTION ARE TO BE REMOVED AND DISPOSED OF OFF SITE.
8. REMOVE AND STOCKPILE GRAVEL/COBBLE SUBSTRATE LOCATED WITHIN EXISTING CHANNELS TO BE ABANDONED. THIS MATERIAL SHALL BE INSTALLED ON THE PROPOSED BED OF SHALLOW CHANNEL SECTIONS.
9. IN-STREAM STRUCTURES PROPOSED ALONG THE OUTSIDE OF MEANDER BENDS (BRUSH TOES, LOG VANES, AND LOG TOES) MAY BE USED INTERCHANGEABLY THROUGHOUT THE PROJECT PER APPROVAL FROM DESIGNER.
10. THE WORK TO RESHAPE THE CHANNEL BANKS WILL BE PERFORMED USING EQUIPMENT WORKING FROM THE TOP OF THE EXISTING STREAM BANK, WHERE POSSIBLE.
11. CONSTRUCTION EQUIPMENT WILL NOT BE PLACED WITHIN THE ACTIVE CHANNEL TO PERFORM WORK IF POSSIBLE. PLATFORMS SHOULD BE USED TO CROSS CHANNEL WHERE ACCESS IS NOT POSSIBLE.
12. NO MORE CHANNEL SHALL BE DISTURBED THAN CAN BE STABILIZED BY THE END OF THE WORK DAY OR PRIOR TO RESTORING FLOW TO NEWLY CONSTRUCTED CHANNEL SEGMENTS.
13. CONTRACTOR SHALL REMOVE ALL TEMPORARY CONTROL DEVICES ONCE CONSTRUCTION IS COMPLETE AND THE SITE IS STABILIZED. A MAXIMUM OF 200 LINEAR FEET OF STREAM MAY BE DISTURBED AT ANY ONE TIME.
14. ALL EXCAVATED MATERIAL MUST BE PLACED WITHIN DESIGNATED STOCKPILE AREAS.
15. AT LOCATIONS IN WHICH THE EXISTING CHANNEL IS BEING MAINTAINED, TEMPORARY PUMP AROUND DAMS AND BYPASS PUMPING WILL BE USED TO DE-WATER THE WORK AREA AS DESCRIBED IN THE DETAILS.
16. WHEN THE PROPOSED CHANNEL HAS BEEN SUFFICIENTLY STABILIZED TO PREVENT EROSION, ALL TEMPORARY PUMP AROUND DAMS WILL BE REMOVED FROM THE ACTIVE STREAM CHANNEL AND NORMAL FLOW RESTORED. ACCUMULATED SEDIMENT SHALL BE DISPOSED OF IN DESIGNATED SPOILS AREAS PRIOR TO REMOVAL OF TEMPORARY PUMP AROUND DAM.
17. AT LOCATIONS IN WHICH ROCK STRUCTURES, BOULDER TOE STABILIZATION, AND LOG TOE STABILIZATION ARE CALLED FOR ON THE PLANS, TEMPORARY COFFER DAMS AND BYPASS PUMPING WILL BE USED TO DE-WATER THE WORK AREA, EXCEPT AT LOCATIONS IN WHICH THE NORMAL FLOW CAN BE DIVERTED AROUND THE WORK AREA WITH THE USE OF AN EXISTING CHANNEL. WHEN THE TOE HAS BEEN SUFFICIENTLY STABILIZED TO RESTRAIN EROSION ALL TEMPORARY COFFER DAMS WILL BE REMOVED FROM THE ACTIVE STREAM CHANNEL AND NORMAL FLOW RESTORED. ACCUMULATED SEDIMENT SHALL BE DISPOSED OF IN DESIGNATED SPOILS AREA PRIOR TO REMOVAL OF TEMPORARY COFFER DAM.
18. MATERIAL THAT IS REMOVED FROM THE STREAM WILL BE RE-DEPOSITED OUTSIDE OF THE ACTIVE CHANNEL AND ITS FLOODPLAIN.
19. TEMPORARY AND PERMANENT STABILIZATION OF ALL DISTURBED GRASSED AREAS AT THE TOP OF THE CHANNEL BANKS WILL BE IN ACCORDANCE WITH THE SEEDING AND MULCHING SPECIFICATION AS SHOWN ON PLANS.
20. RE-FERTILIZE AND RE-SEED DISTURBED AREAS IF NECESSARY.
21. TEMPORARY AND/OR PERMANENT IMPACTS TO EXISTING WETLANDS SHALL BE AVOIDED TO THE EXTENT POSSIBLE. HIGH VISIBILITY FENCING SHALL BE INSTALLED AROUND ALL EXISTING WETLANDS LOCATED WITHIN THE PROJECT AREA AND/OR ADJACENT TO ANY CONSTRUCTION ACTIVITIES.

STREAM CONSTRUCTION SEQUENCE:

1. CONDUCT PRE-CONSTRUCTION MEETING INCLUDING OWNER, ENGINEER, ASSOCIATED CONTRACTORS, NCDEQ EROSION CONTROL PERSONNEL, AND OTHER AFFECTED PARTIES. CONTACT NCDEQ EROSION CONTROL PERSONNEL AT 919-791-4200.
2. OBTAIN EROSION CONTROL PERMIT FROM NCDENR - LAND QUALITY SECTION AND ALL OTHER APPROVALS NECESSARY TO BEGIN AND COMPLETE THE PROJECT.
3. CONTRACTOR IS FULLY RESPONSIBLE FOR CONTACTING ALL APPROPRIATE PARTIES AND ASSURING THAT UTILITIES ARE LOCATED PRIOR TO THE COMMENCEMENT OF CONSTRUCTION. CALL NC ONE-CALL (PREVIOUSLY ULOCO) AT 1-800-632-4949 FOR UTILITY LOCATING SERVICES 48 HOURS PRIOR TO COMMENCEMENT OF ANY WORK. CONTRACTOR SHALL VERIFY LOCATION AND DEPTH OF ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION.
4. PRIOR TO CONSTRUCTION, STABILIZED GRAVEL ENTRANCE/EXIT AND ROUTES OF INGRESS AND EGRESS SHALL BE ESTABLISHED AS SHOWN ON THE PLANS AND DETAILS. MAINTAIN EXISTING DRIVEWAY OVERTOPPING ELEVATION / PROFILE.
5. PREPARE STAGING AND STOCKPILING AREAS IN LOCATIONS AS SHOWN ON THE CONSTRUCTION PLANS OR AS APPROVED BY THE ENGINEER. ANY EXCESS SPOIL FROM STREAM CONSTRUCTION SHALL BE USED TO CONSTRUCT CHANNEL PLUGS AS SHOWN ON PLANS.
6. INSTALL PUMP AROUND APPARATUS AND IMPERVIOUS DIKES AT UPSTREAM END OF PROJECT. AS CONSTRUCTION PROGRESSES, MOVE PUMP AROUND OPERATION DOWNSTREAM. (SEE DETAILS ON SHEET D1)
7. INSTALL SILT FENCE, TEMPORARY CROSSINGS AND ALL OTHER EROSION CONTROL MEASURES AS SHOWN ON PLANS.
8. CONSTRUCT UPSTREAM PORTION OF THE CHANNEL FIRST, WORKING IN AN UPSTREAM TO DOWNSTREAM DIRECTION.
9. ROUGH GRADING OF CHANNEL SHALL BE PERFORMED PRIOR TO INSTALLATION OF STRUCTURES.
10. INSTALL STRUCTURES AS SHOWN ON PLANS AND DETAILS. PRIOR TO FINE GRADING, OBTAIN APPROVAL OF THE ENGINEER ON INSTALLATION OF STRUCTURES.
11. UPON COMPLETION OF FINE GRADING, INSTALL EROSION CONTROL MATTING OR SOD MATS ALONG CHANNEL BANKS.
12. FILL AND STABILIZE ABANDONED SEGMENTS OF THE EXISTING CHANNEL PER DIRECTION OF THE ENGINEER.
13. ALL IMPERVIOUS DIKES AND PUMPING APPARATUS SHALL BE REMOVED FROM THE STREAM AT THE END OF EACH DAY TO RESTORE NORMAL FLOW BACK TO THE CHANNEL.
14. DURING STREAM CONSTRUCTION ACTIVITIES, THE WORK AREA SHALL BE STABILIZED AT THE END OF EACH WORKING DAY.
15. INSTALL LIVE STAKE, BARE ROOT, AND CONTAINERIZED PLANTINGS AS SPECIFIED ON PLANTING PLANS.

LEGEND

- EXISTING CONTOUR MAJOR — 50
- EXISTING CONTOUR MINOR — 46
- PROPOSED CONTOUR MAJOR — 50
- PROPOSED CONTOUR MINOR — 42
- EXISTING WETLAND
- EXISTING STREAM
- EXISTING TOP OF BANK — TB
- EXISTING BOTTOM OF BANK — BB
- EXISTING OVERHEAD ELECTRIC UTILITY LINE — OHE
- PROPERTY LINE
- EXISTING FENCELINE — x
- EXISTING TREELINE
- PROPOSED TOP OF BANK
- PROPOSED CENTERLINE OF CHANNEL
- LIMITS OF PROPOSED CONSERVATION EASEMENT — LCE
- PROPOSED CHANNEL PLUG (SEE DETAIL DWG D2)
- PROPOSED FILL AREA
- EXISTING TREE
- BRUSH TOE PROTECTION (SEE DETAIL D2)
- LOG SILL (SEE DETAIL D4)
- LOG CROSS VANE (SEE DETAIL D5)
- DOUBLE LOG DROP (SEE DETAIL D4)
- ROCK CROSS VANE (SEE DETAIL D5)
- ROCK A-VANE (SEE DETAIL D5)
- LOG VANE (SEE DETAIL D3)
- CONSTRUCTED RIFFLE (SEE DETAIL D6)
- SEDIMENT TRAP (SEE DETAIL D2)
- LOG SILL (PROFILE)
- LOG CROSS VANE (PROFILE)
- DOUBLE LOG DROP (PROFILE)
- ROCK CROSS VANE/A-VANE (PROFILE)

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SEAL

SCALE: AS SHOWN

PLOT DATE: 11/12/2018

MARK	DATE	DESCRIPTION
REVISIONS:		
RELEASED FOR:		

PRELIMINARY - NOT FOR CONSTRUCTION

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
NOTES

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
E1

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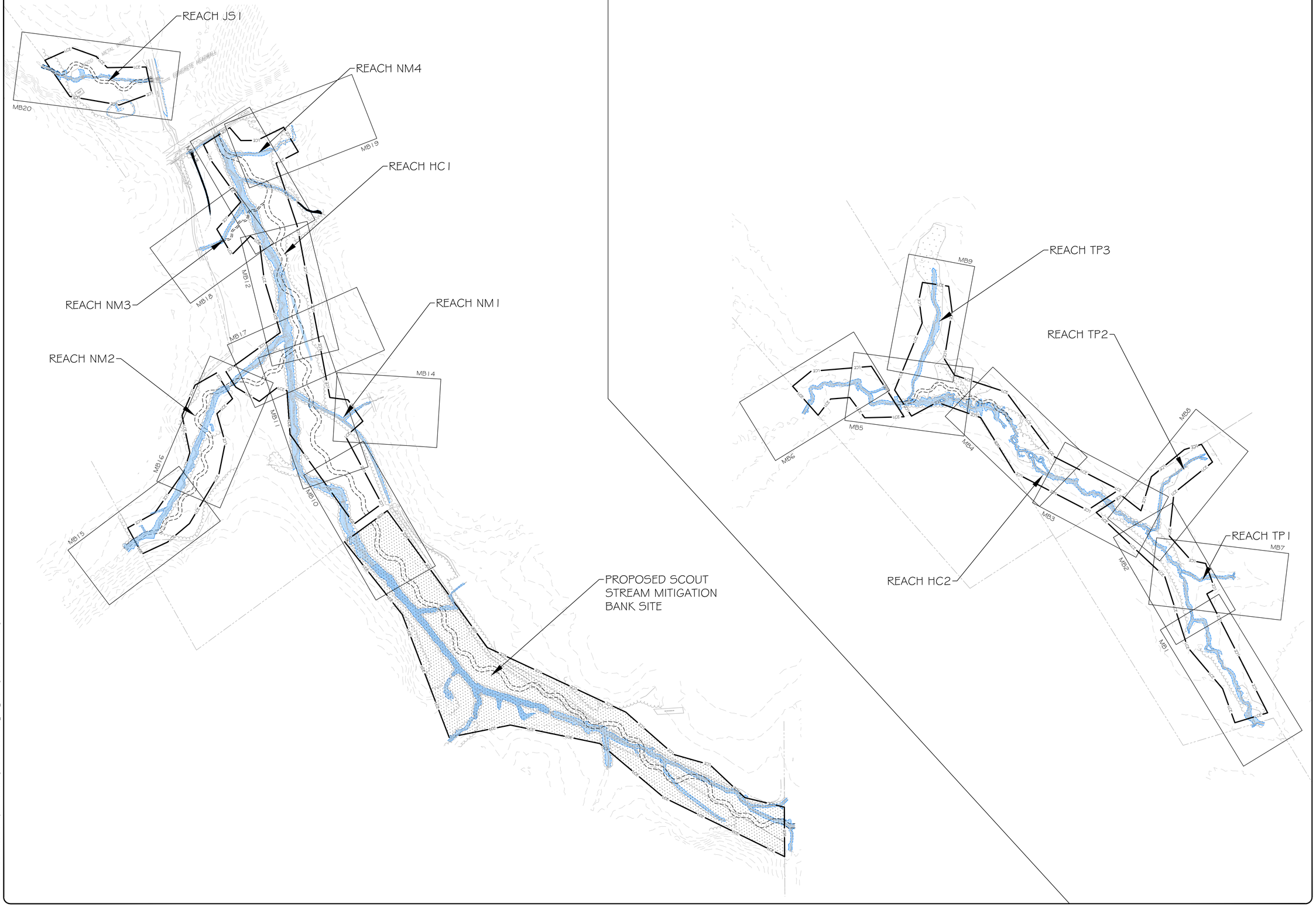

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SEAL

FULL SCALE: 1"=200

0 200 400

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		
RELEASED FOR:		PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
INDEX SHEET

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
E2

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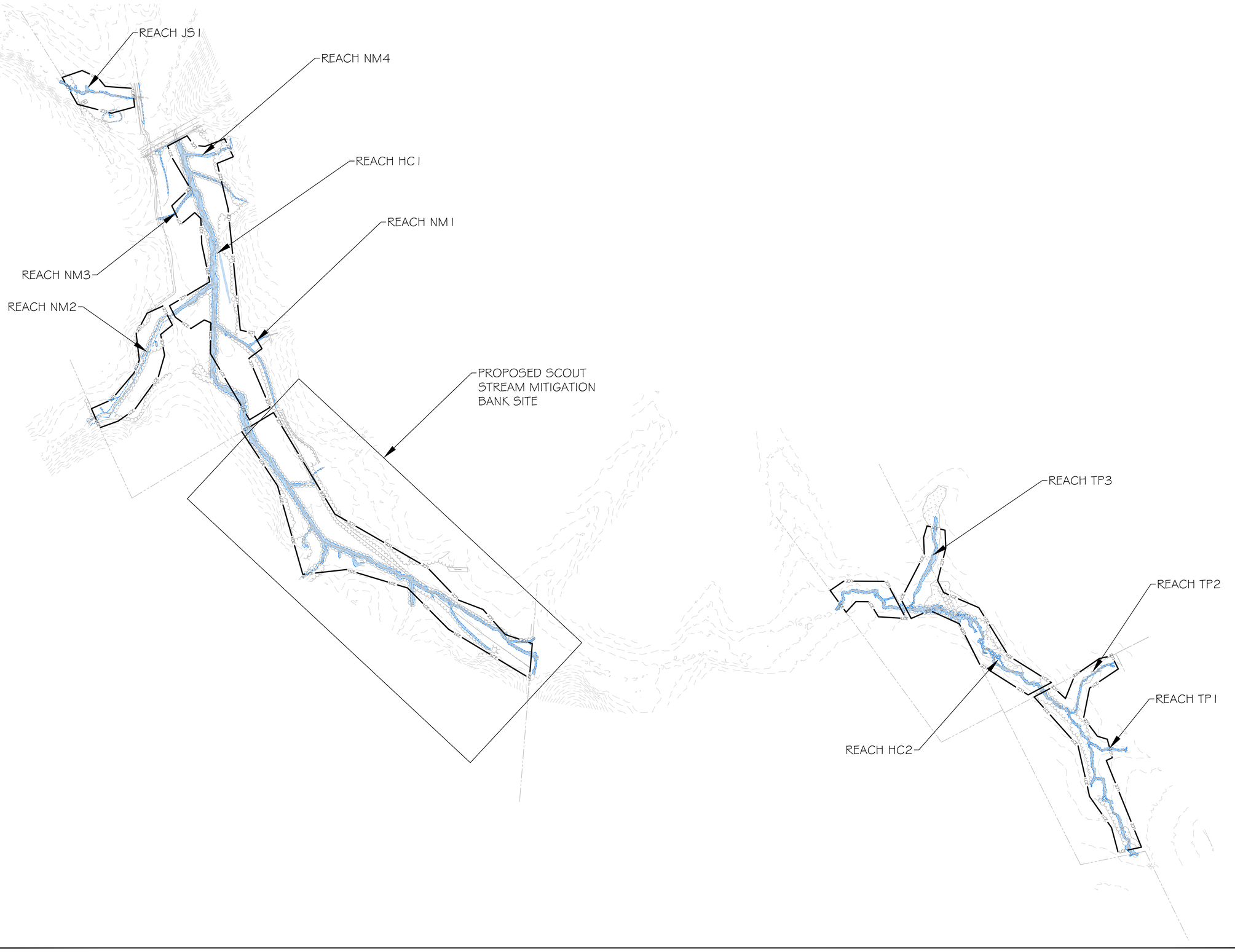

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SEAL

FULL SCALE: 1"=300

0 300 600

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		

RELEASED FOR:
PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

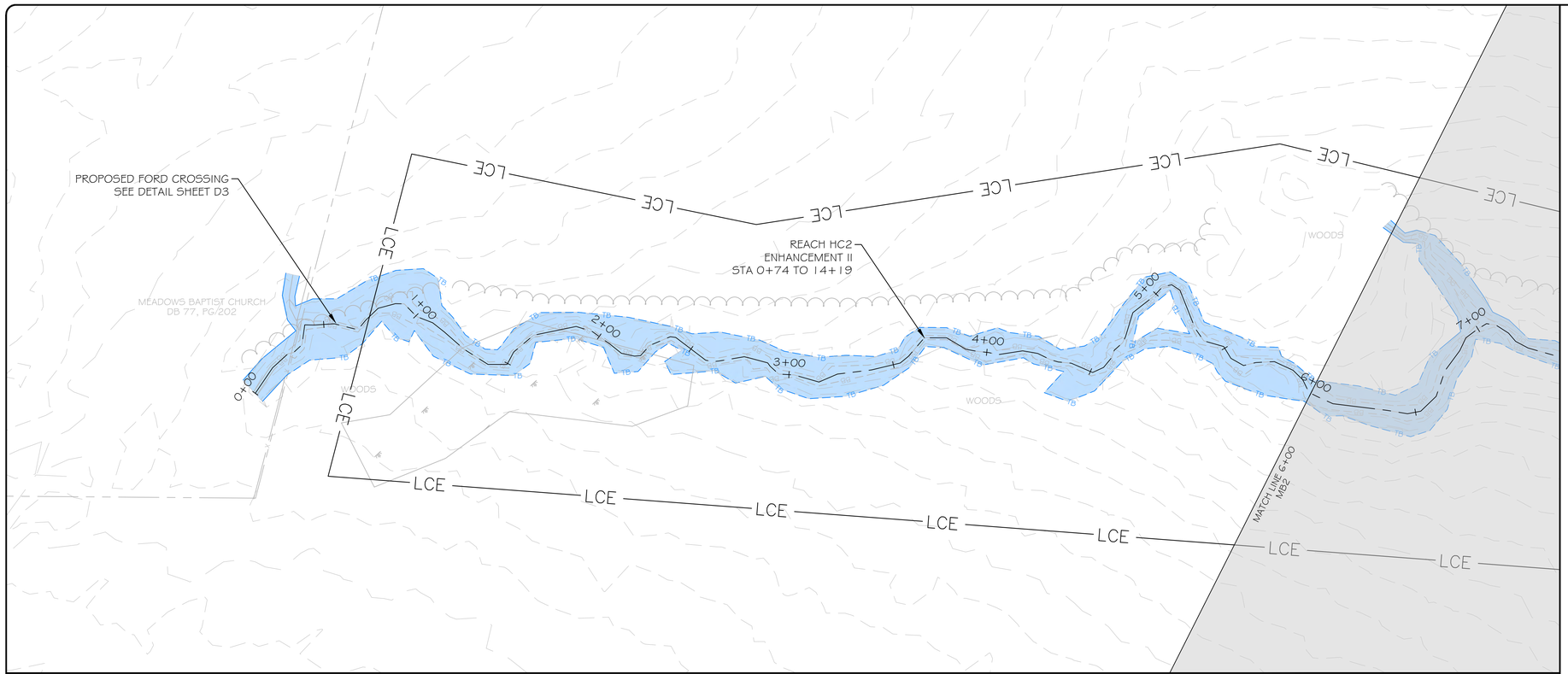
PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

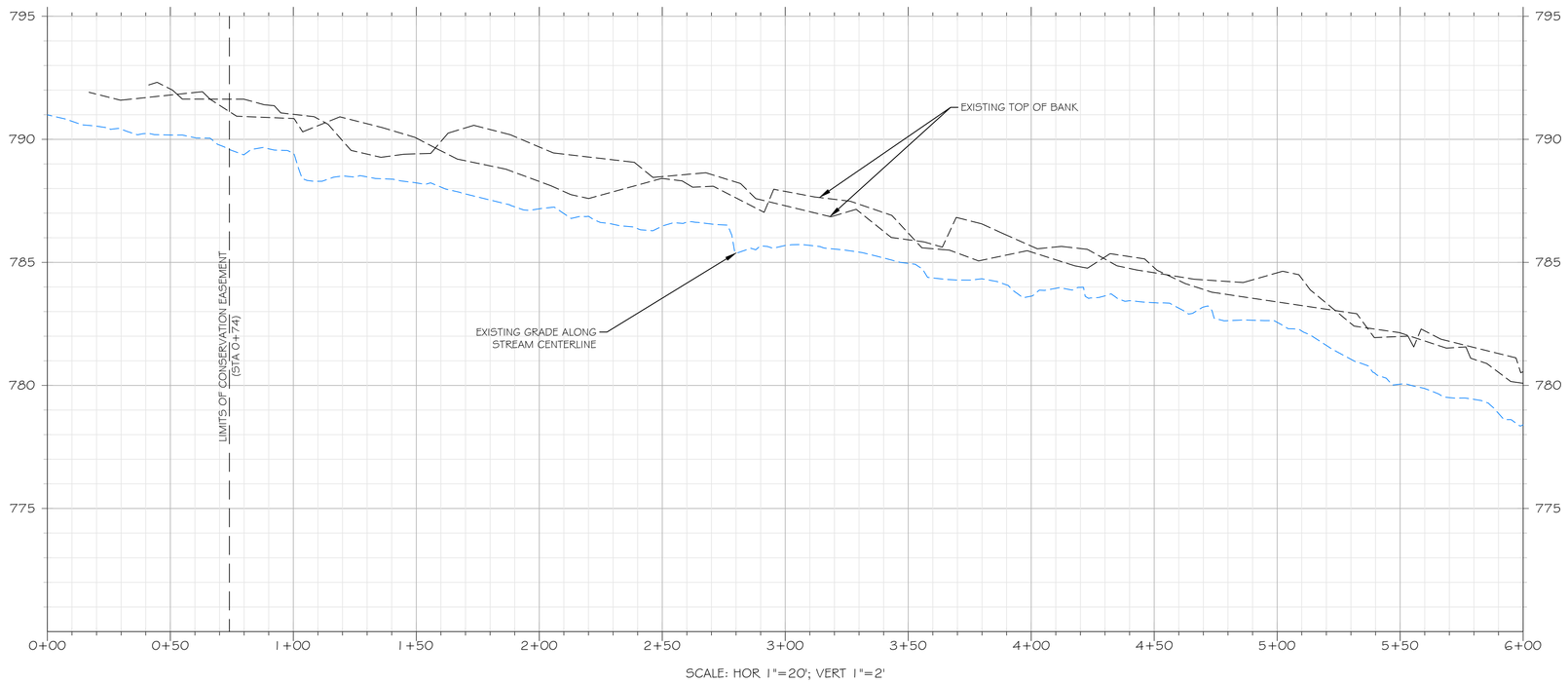
DRAWING TITLE:
EXISTING CONDITIONS

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

E3





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SEAL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION

REVISIONS:

RELEASED FOR: PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

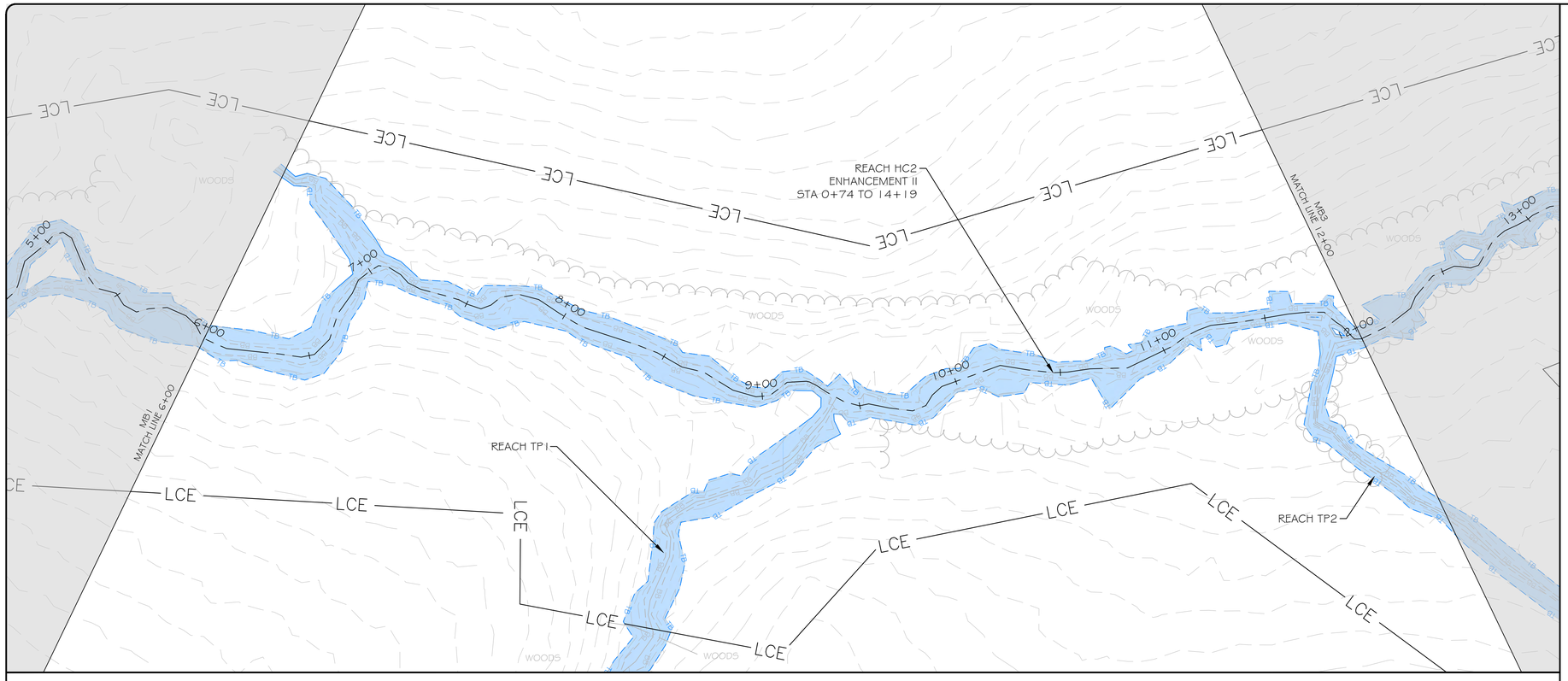
PROJECT NAME: MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

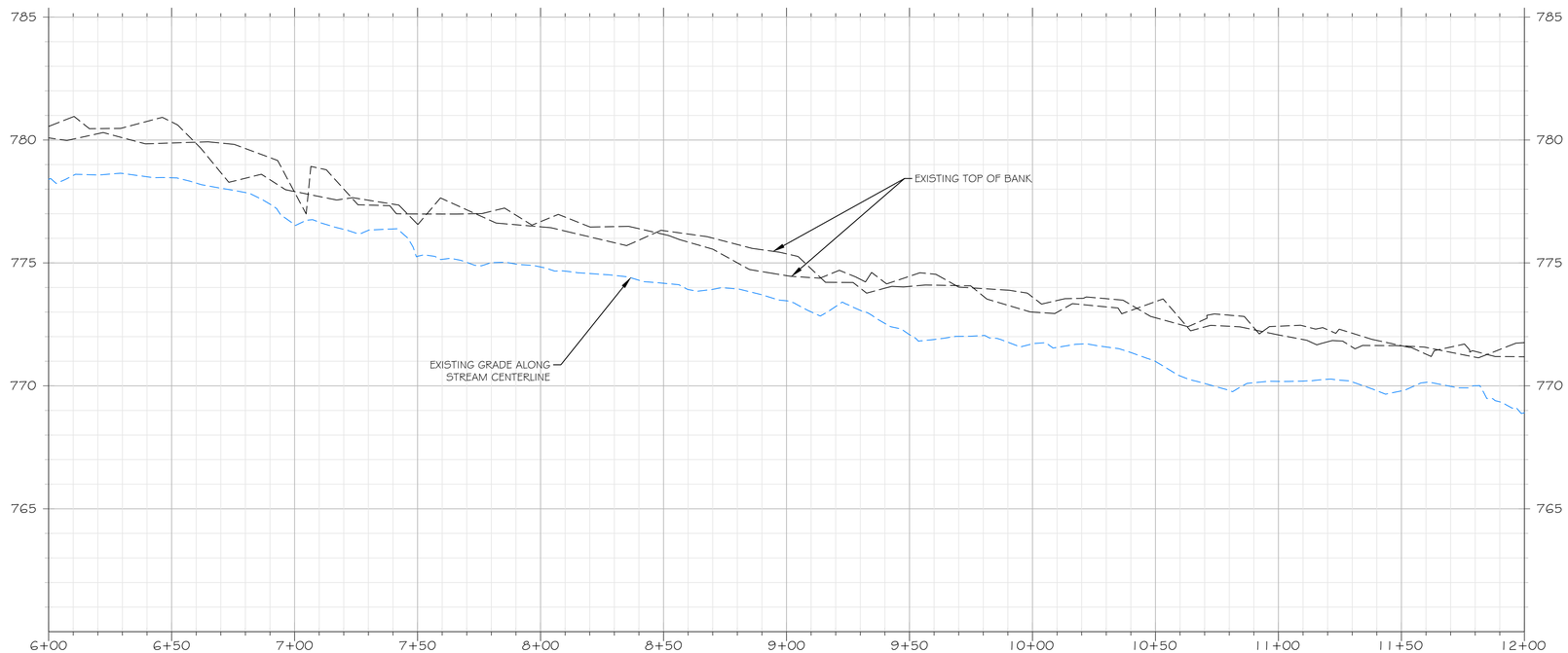
DRAWING TITLE: REACH HC2

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB1





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SEAL

FULL SCALE: 1"=30

0 30 60

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MARK	DATE	DESCRIPTION
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PLOT DATE: 11/12/2018

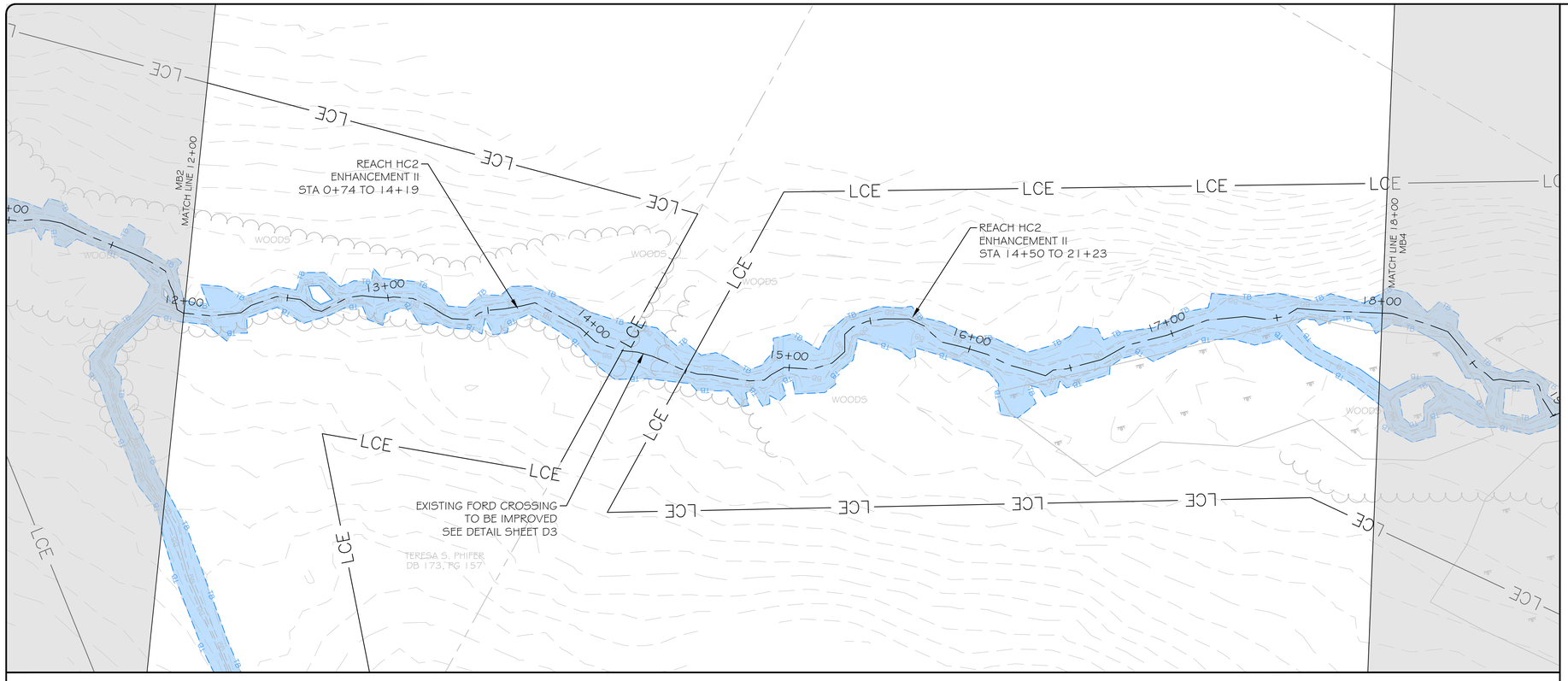
PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

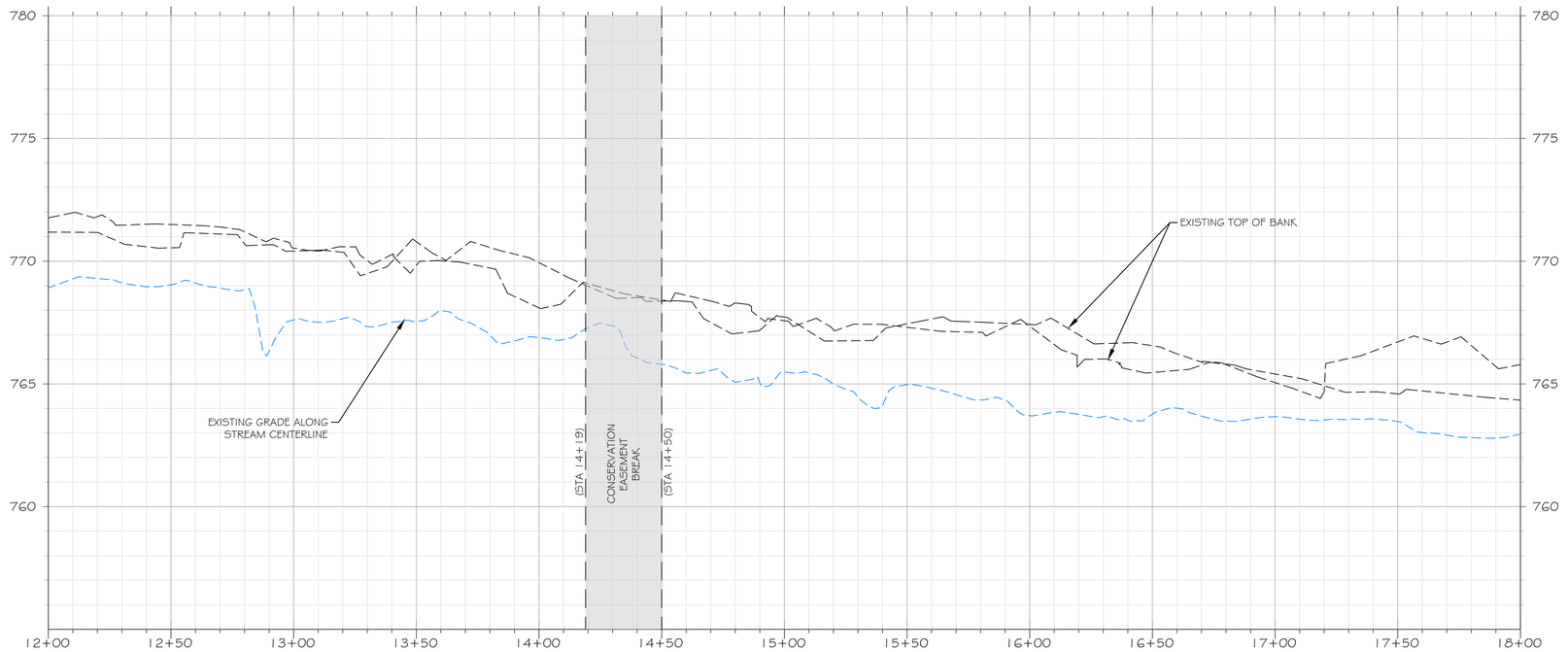
DRAWING TITLE:
REACH HC2

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB2





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SEAL

FULL SCALE: 1"=30

0 30 60

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MARK	DATE	DESCRIPTION
REVISIONS:		

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PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

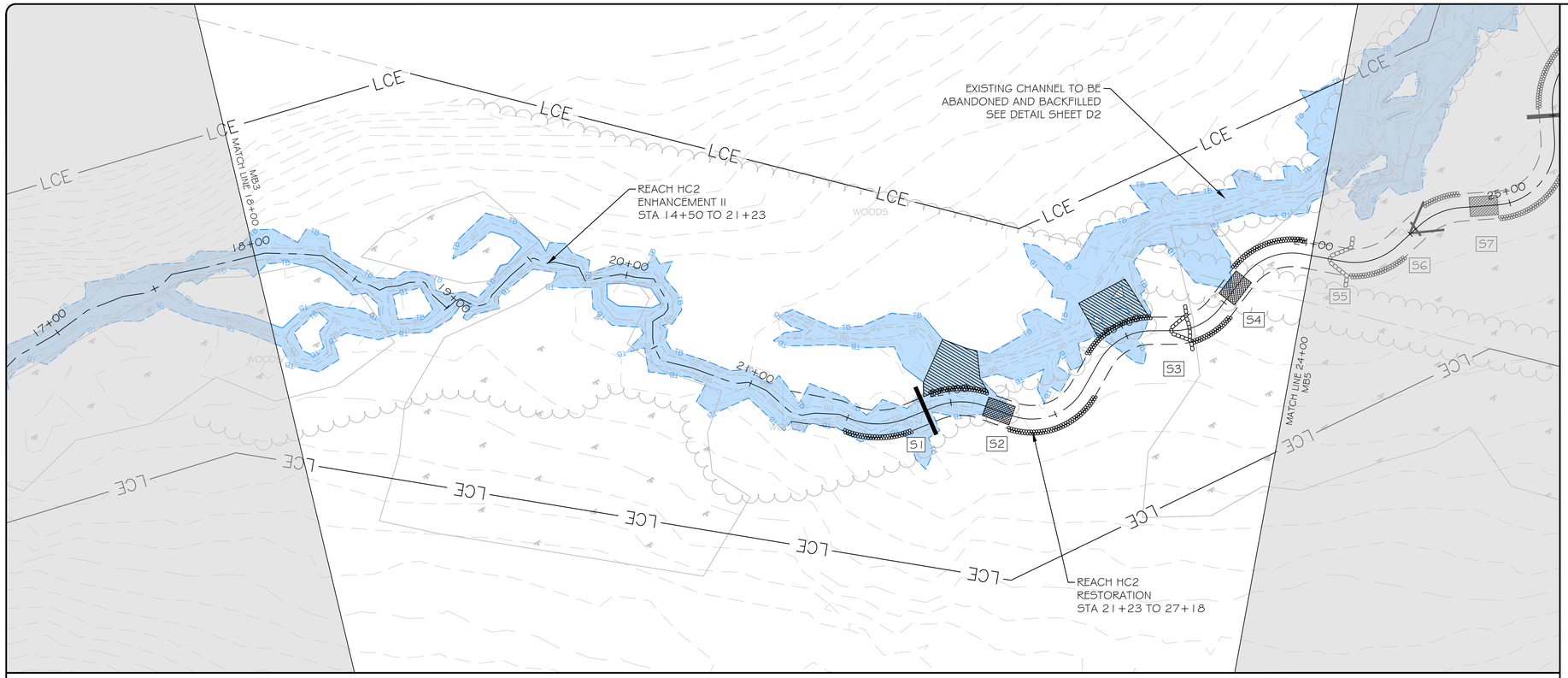
PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

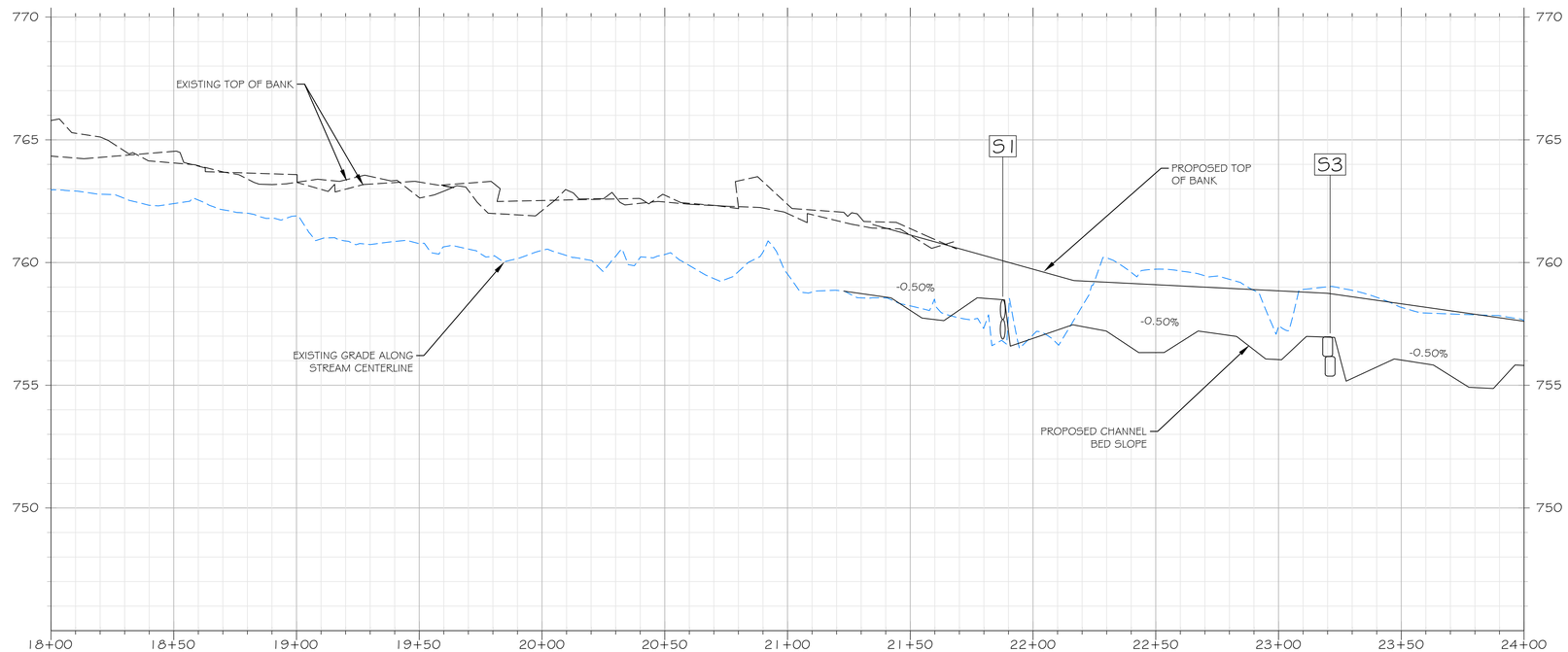
DRAWING TITLE:
REACH HC2

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB3





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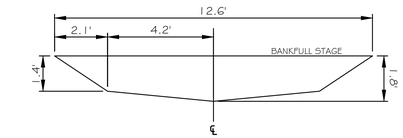
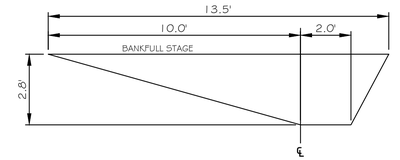
REACH HC2 STA 21+23 TO STA 27+18



TYPICAL RIFFLE CROSS SECTION



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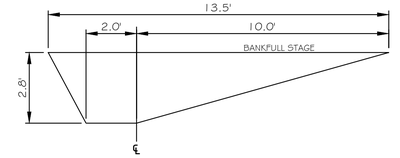

TYPICAL LEFT MEANDER CROSS SECTION

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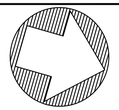
SEAL



FULL SCALE: 1"=30

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2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		

RELEASED FOR: PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME: MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE: REACH HC2

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB4

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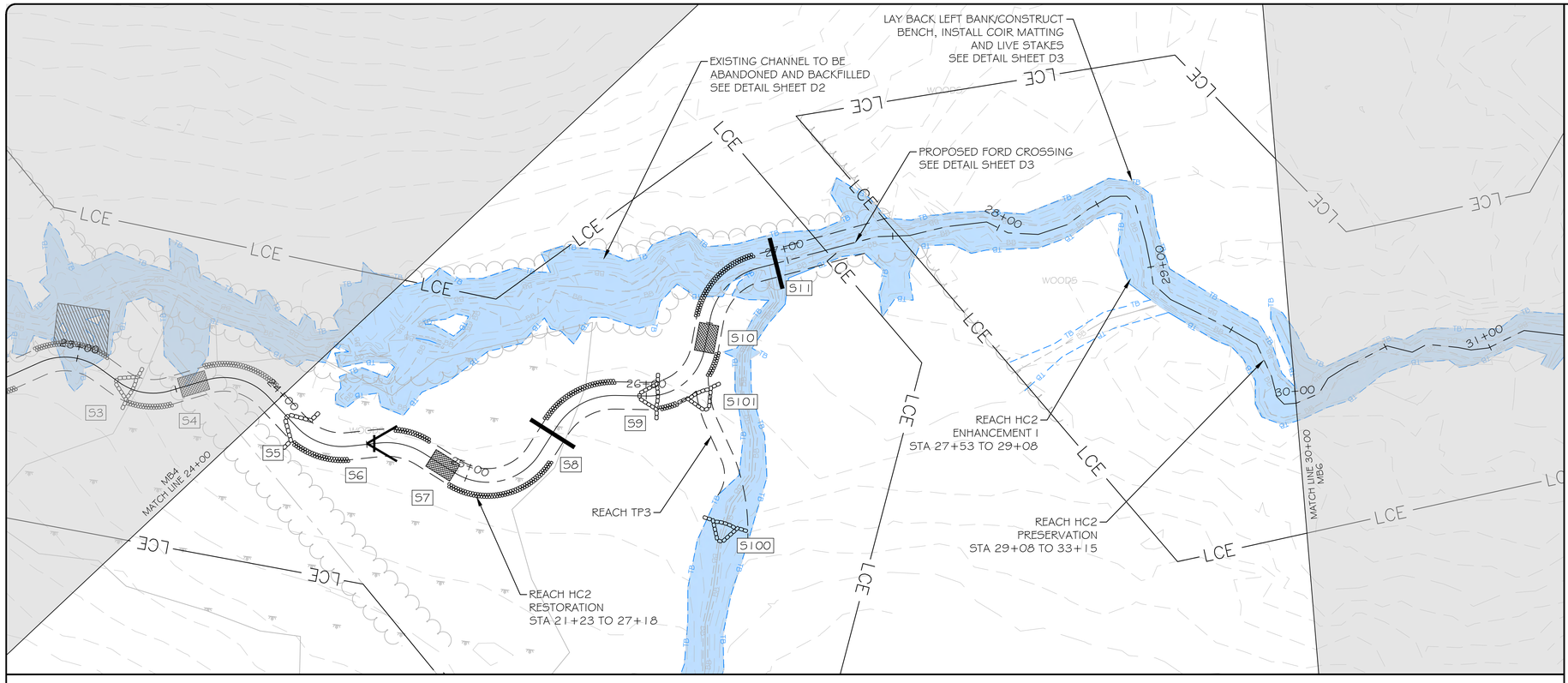
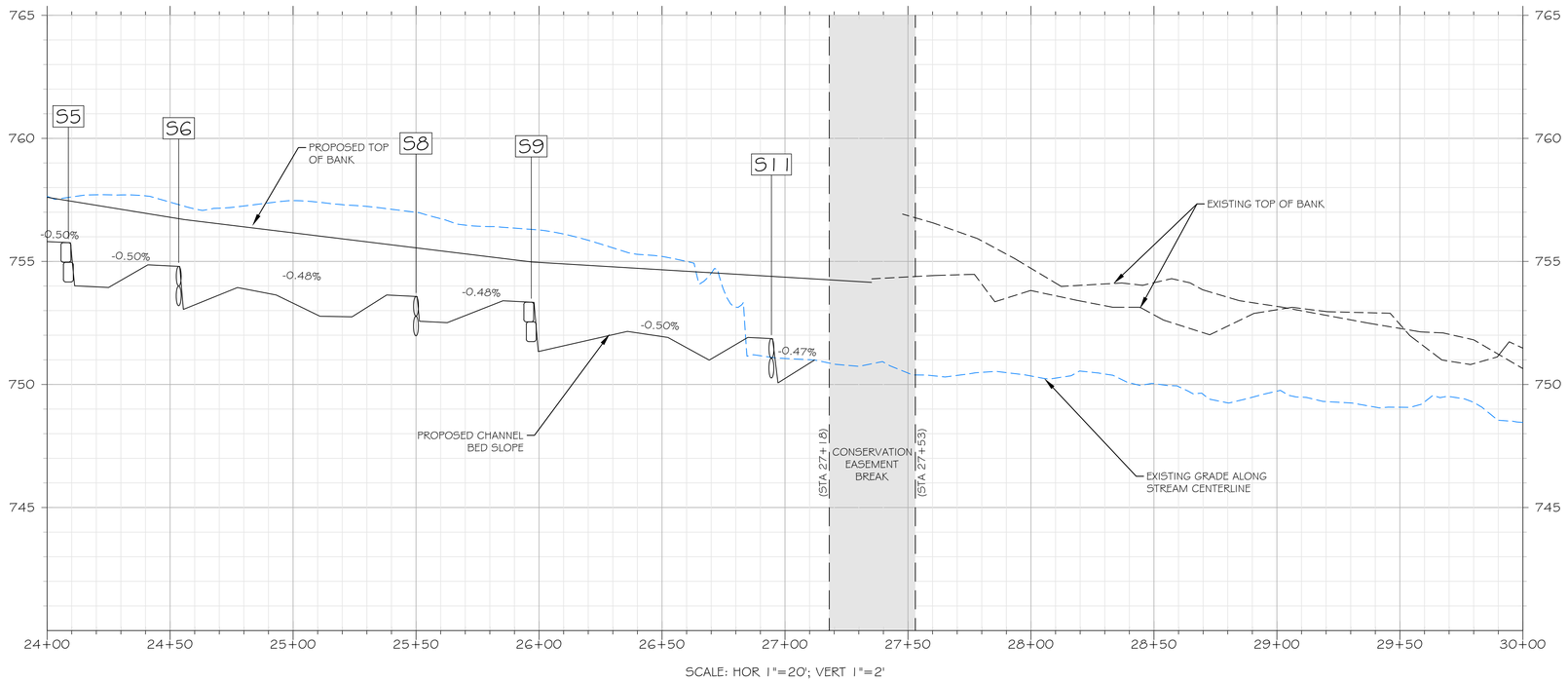
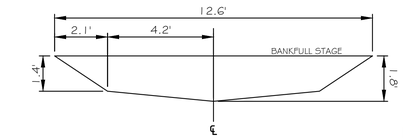




REACH HC2 STA 21+23 TO STA 27+18



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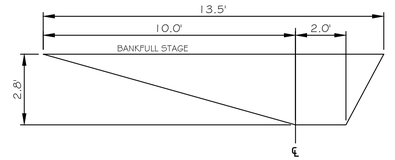

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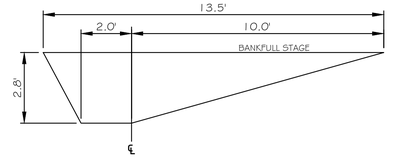

TYPICAL LEFT MEANDER CROSS SECTION

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SEAL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		

RELEASED FOR:
PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

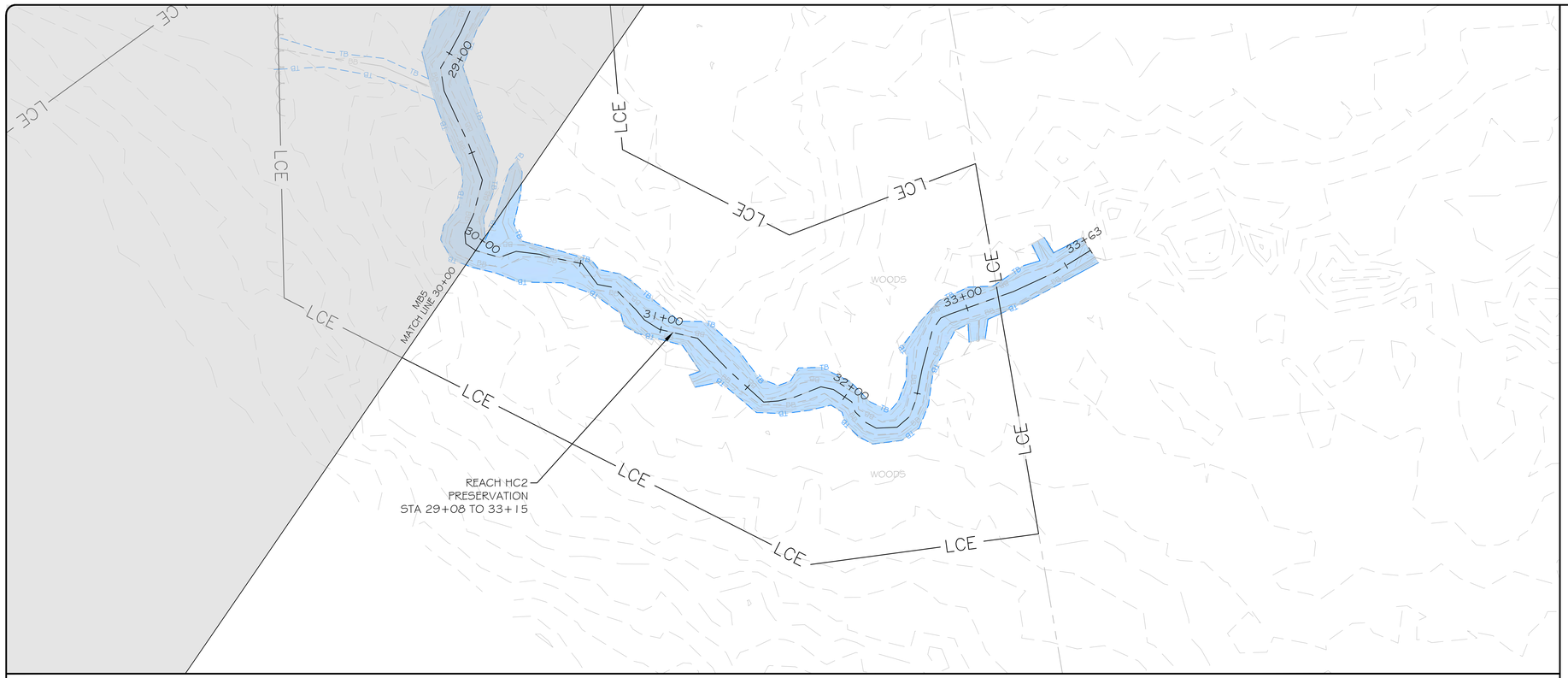
PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

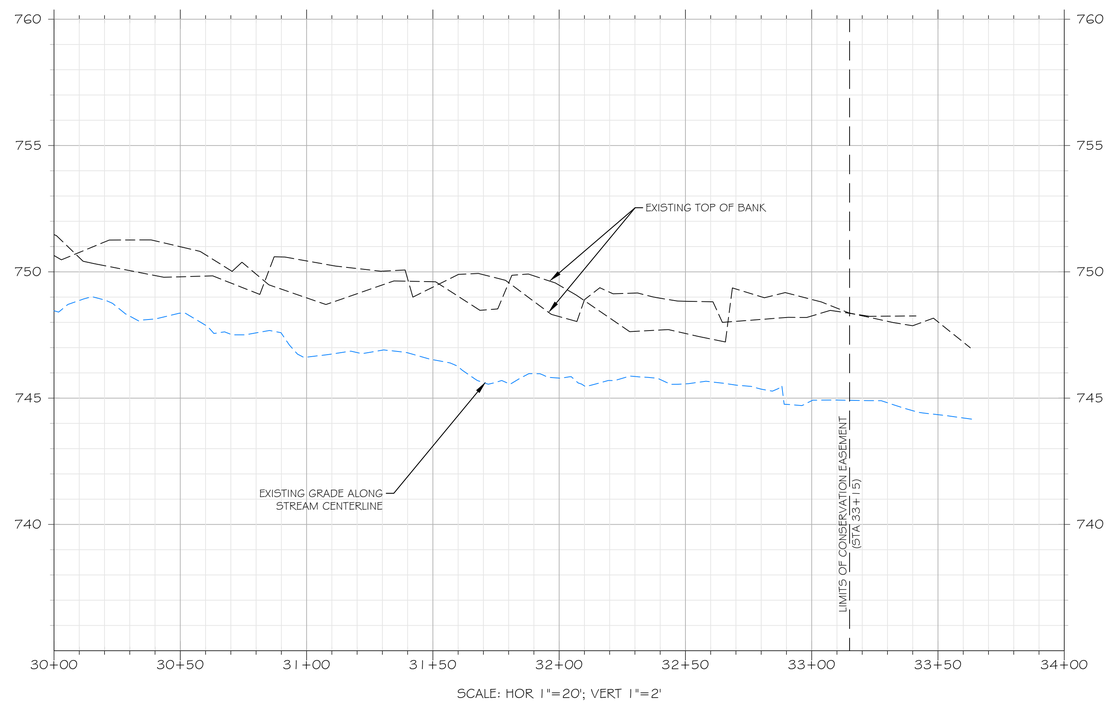
DRAWING TITLE:
REACH HC2

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
MB5

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_HC2.dwg SAVED BY: Tswartzfager





SCALE: HOR 1"=20'; VERT 1"=2'

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SEAL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
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MARK	DATE	DESCRIPTION
REVISIONS:		

RELEASED FOR:
PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE:
11/12/2018

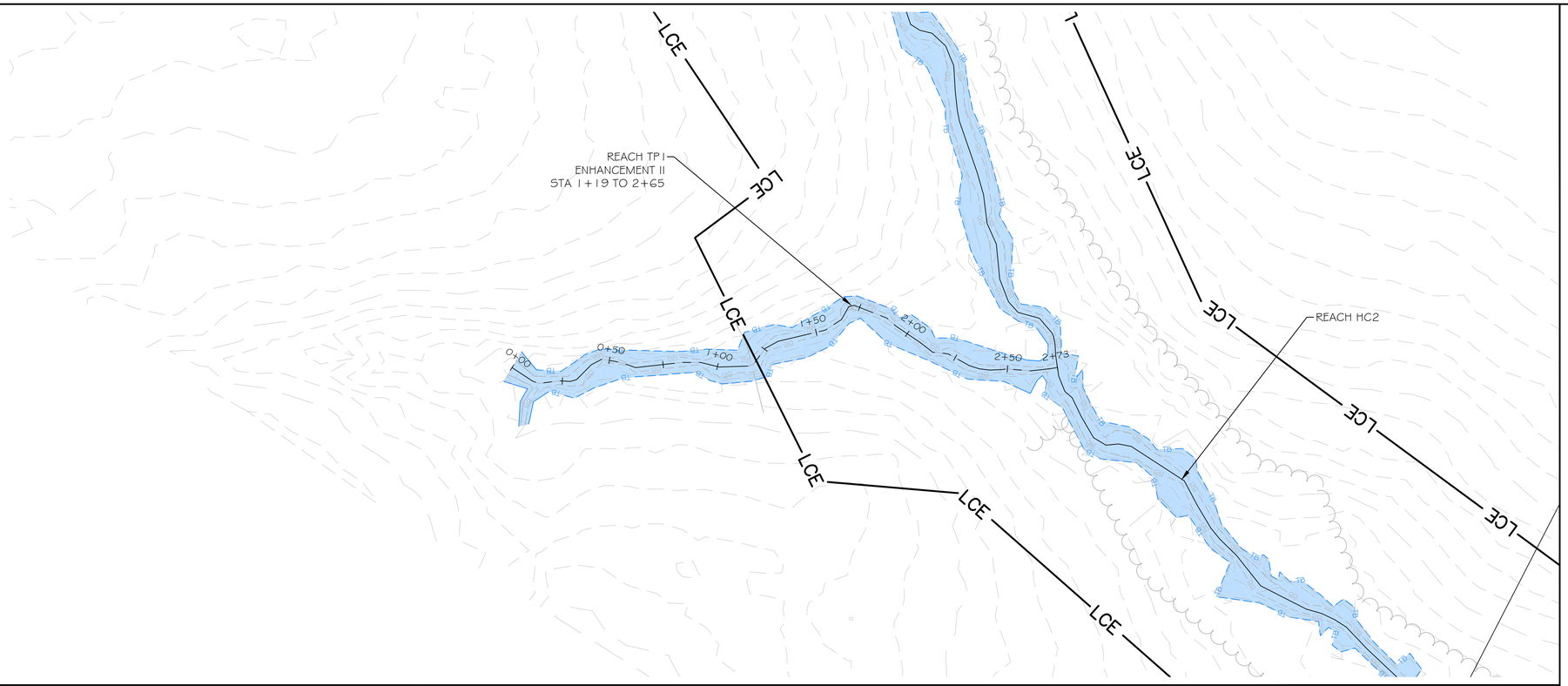
PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

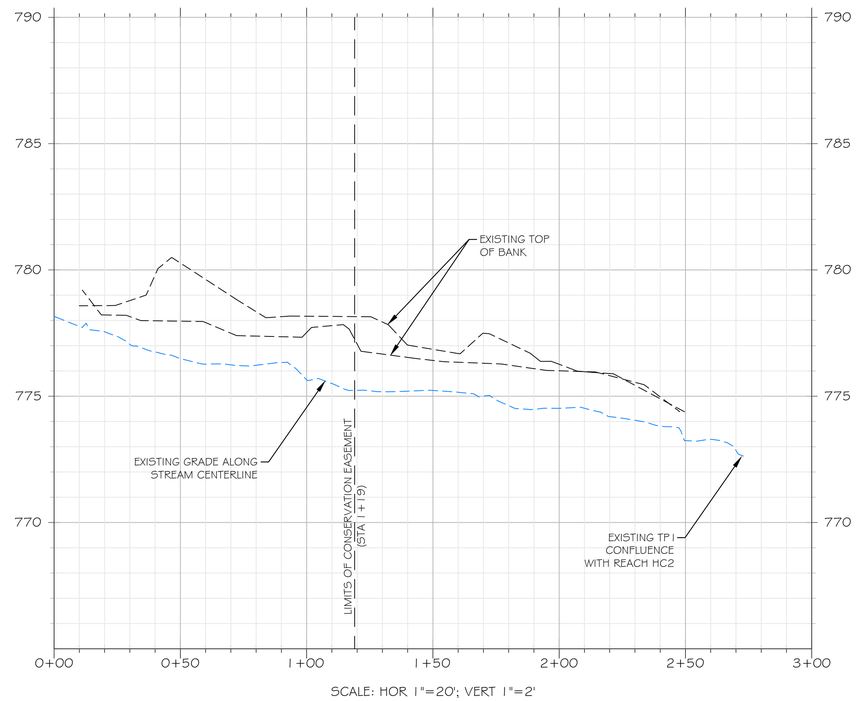
DRAWING TITLE:
REACH HC2

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
MB6

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_HC2.dwg SAVED BY: Tswartzfager





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SEAL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION

REVISIONS:

RELEASED FOR:

PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

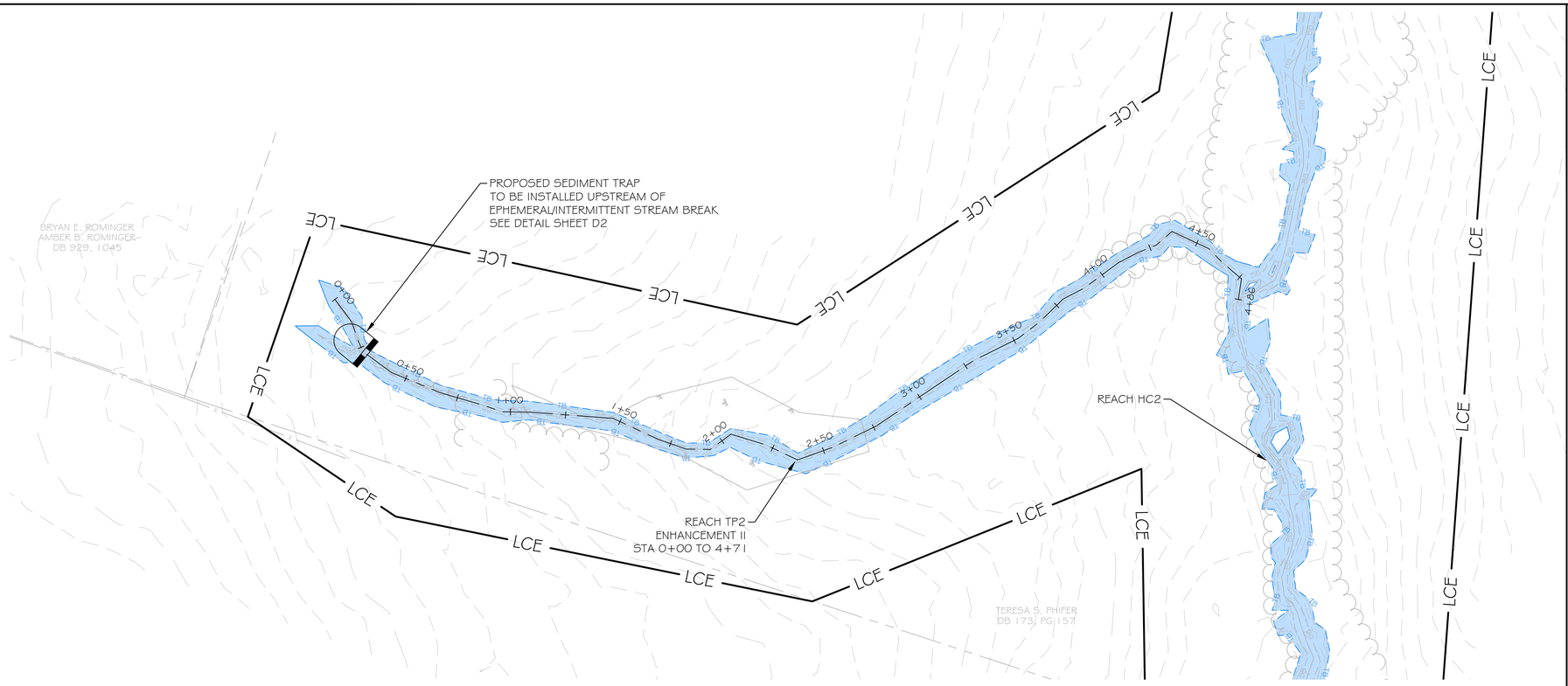
PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

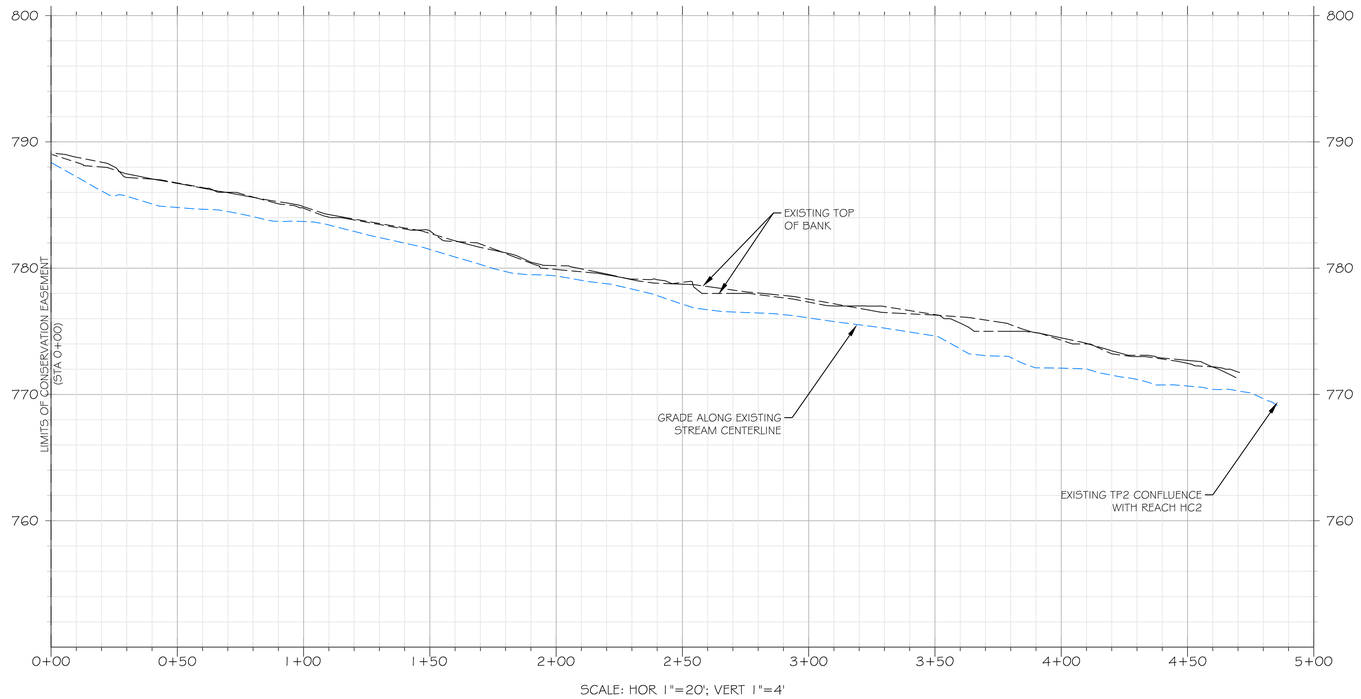
DRAWING TITLE:
REACH TP1

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB7





SCALE: HOR 1"=20'; VERT 1"=4'

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302 Jefferson Street, Suite 110
Raleigh, NC 27605
Main: 919.829.9909
Fax: 919.829.9913
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SEAL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION

REVISIONS:

RELEASED FOR:

PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

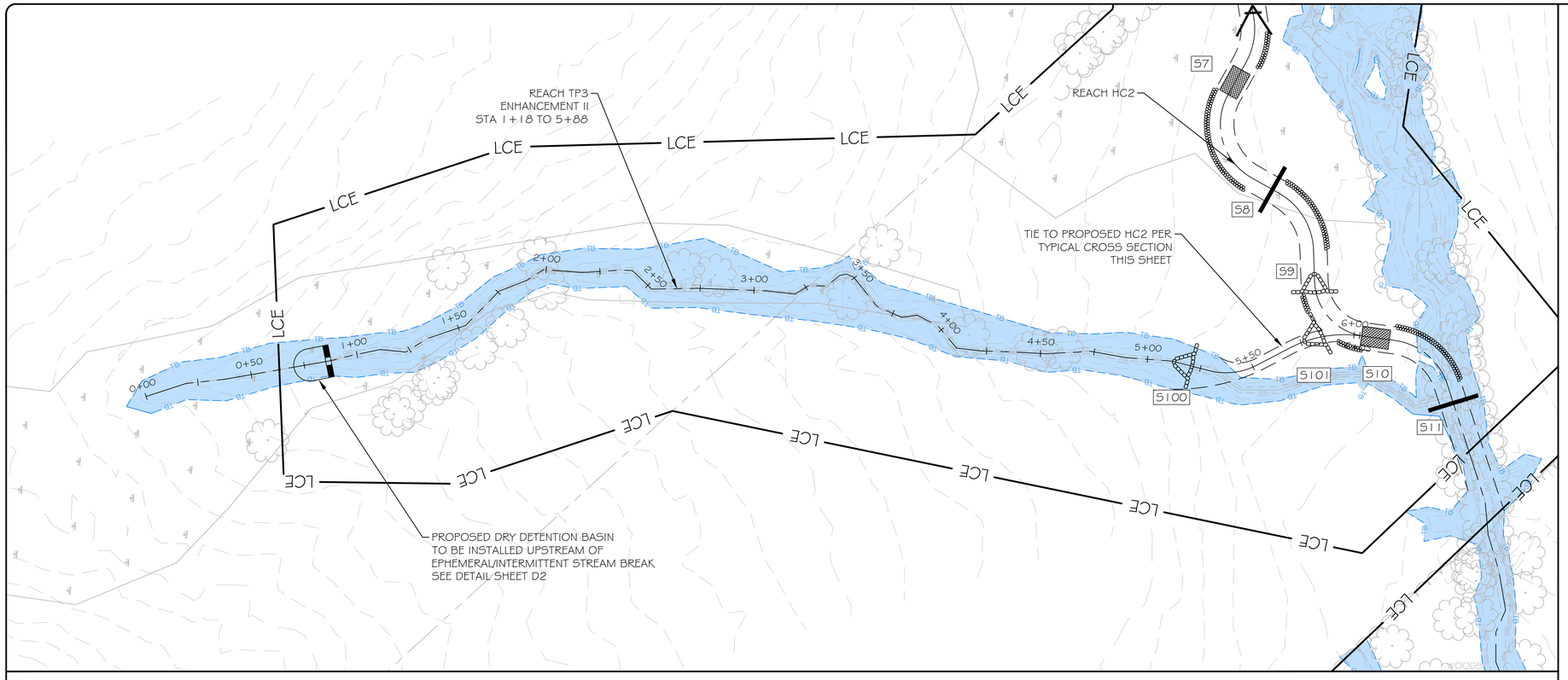
DRAWING TITLE:
REACH TP2

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

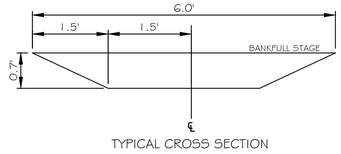
SHEET NUMBER:

MB8

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWGS\0312_SHT_TP2.dwg SAVED BY: Tswartzfager



REACH TP3 STA 5+30 TO STA 5+88



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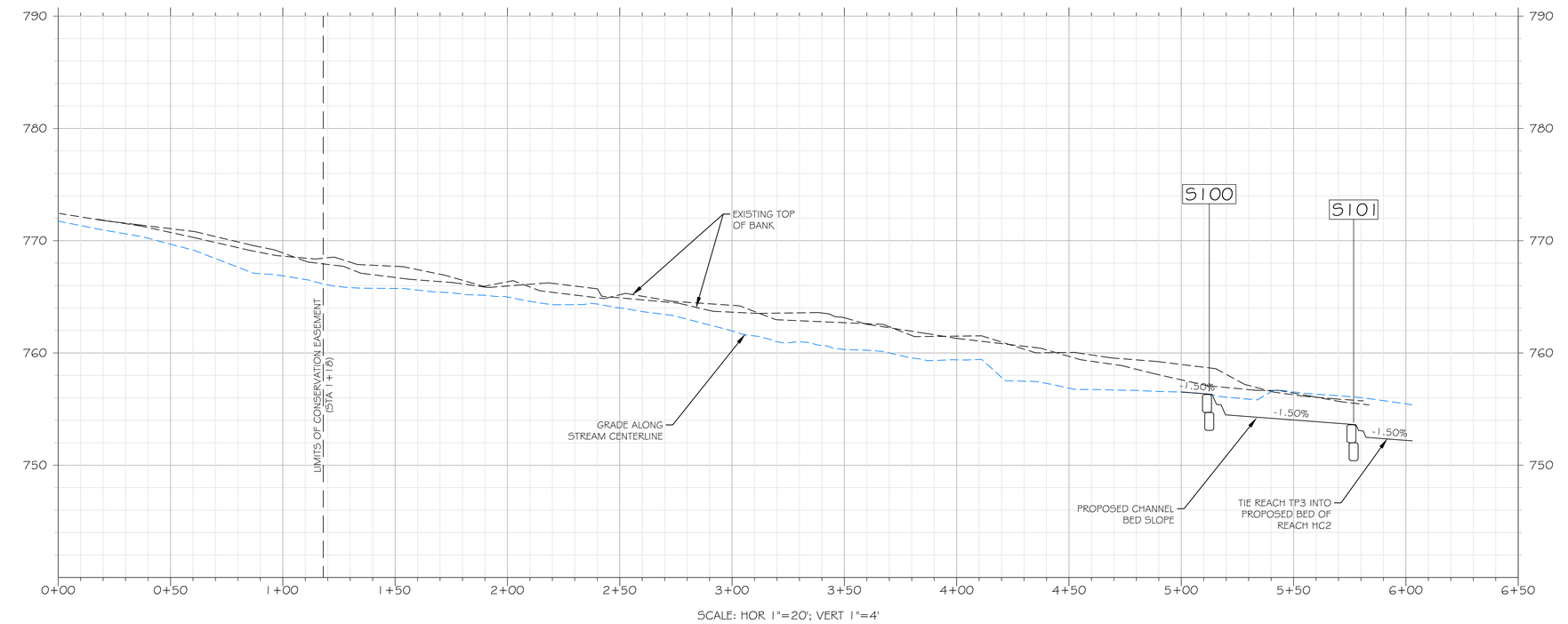

SCALE: HOR 1"=20'; VERT 1"=4'

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SEAL

FULL SCALE: 1"=30

0 30 60

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1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		

RELEASED FOR:
PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
REACH TP3

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
MB9

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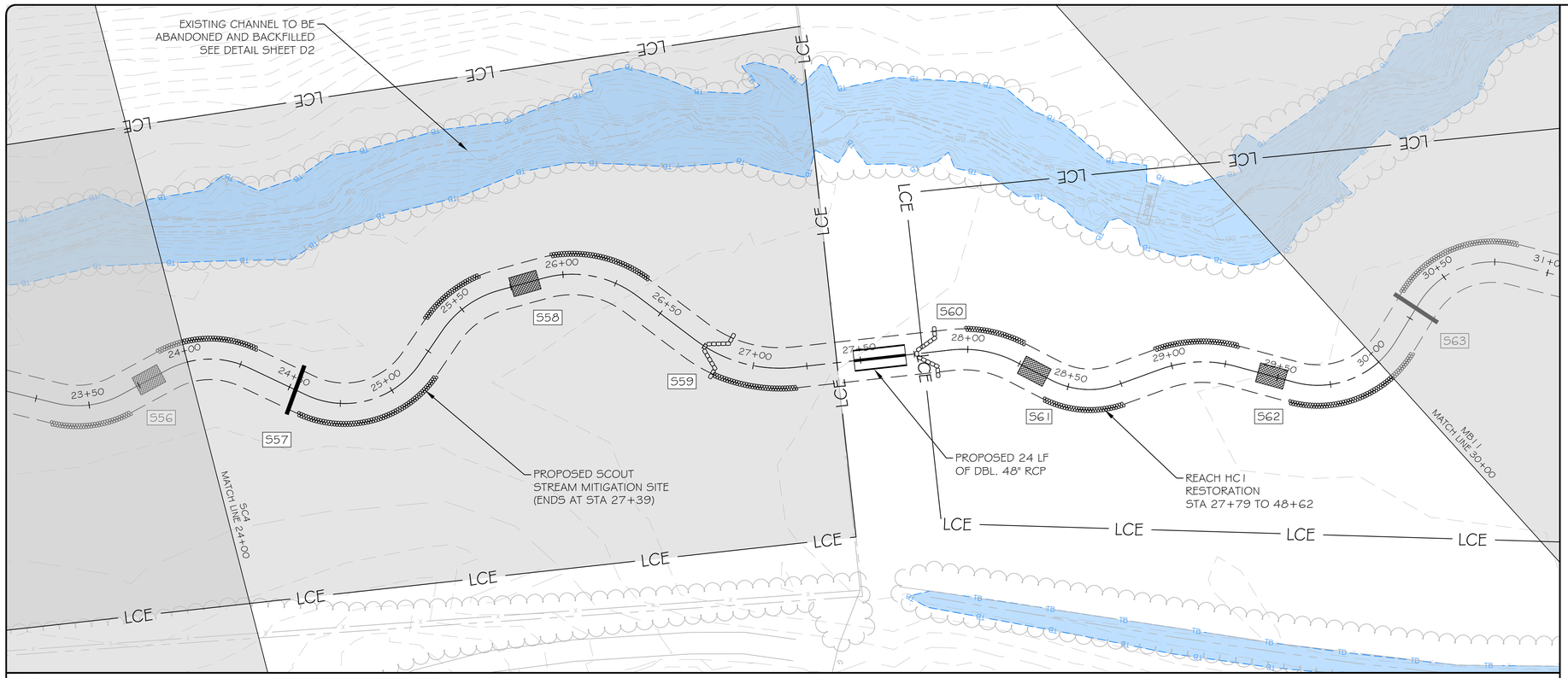
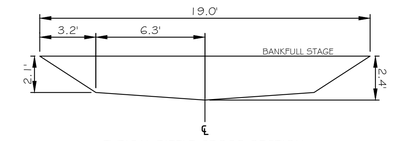


REACH HC1 STA 27+79 TO STA 37+10



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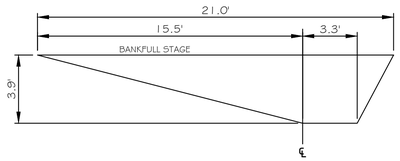

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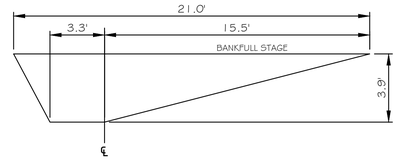
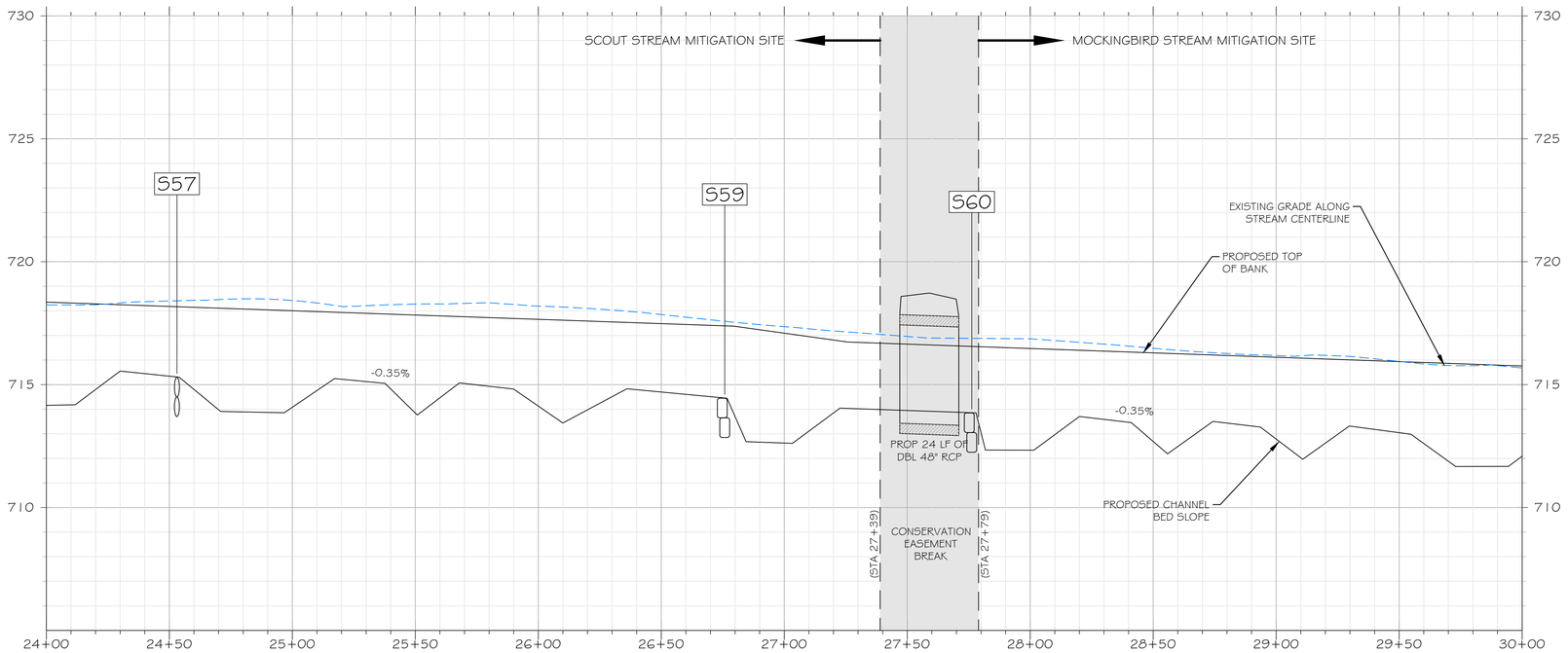


TYPICAL LEFT MEANDER CROSS SECTION



SCALE: HOR 1"=20'; VERT 1"=2'

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Main: 919.829.9909
Fax: 919.829.9913
www.res.us

SEAL

FULL SCALE: 1"=##

0 ## ##

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		

RELEASED FOR:
PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

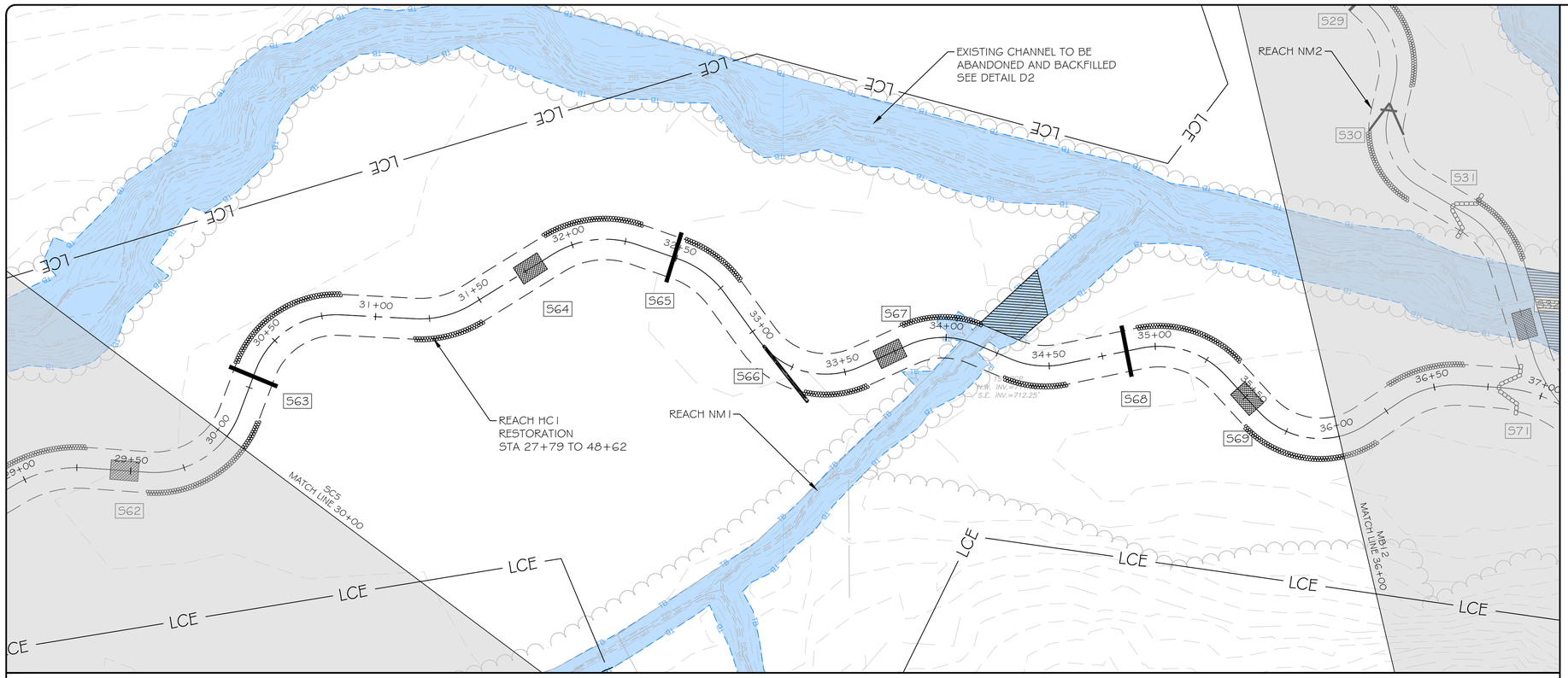
DRAWING TITLE:
REACH HC1

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

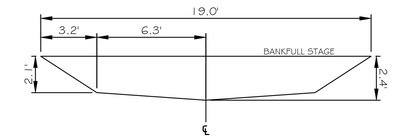
SHEET NUMBER:

MB10

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_HC1.dwg SAVED BY: Tswartzfager



REACH HC1 STA 27+79 TO STA 37+10



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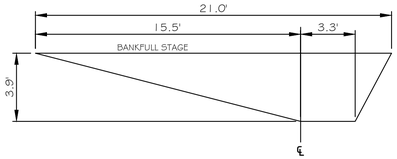

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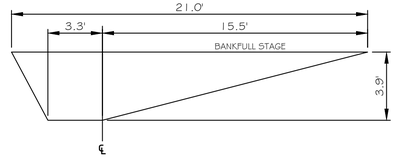
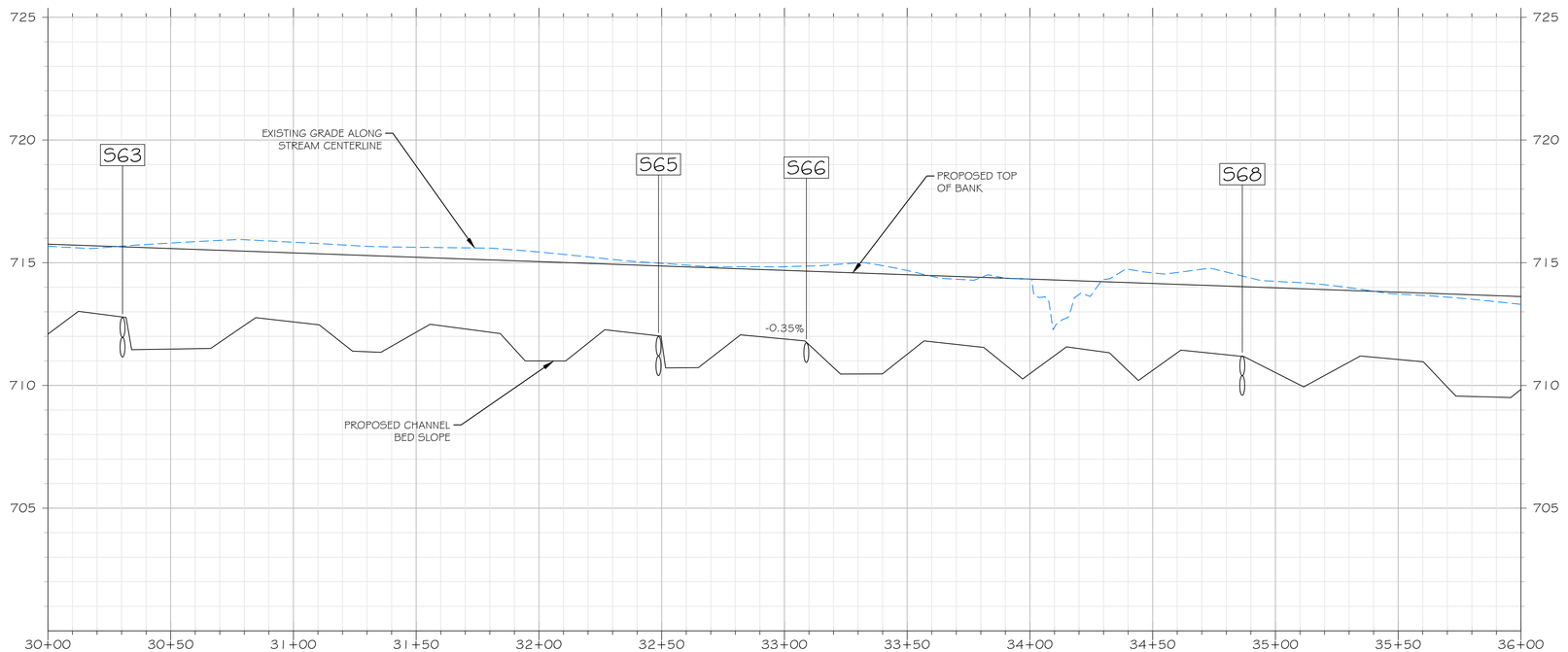


TYPICAL LEFT MEANDER CROSS SECTION



SCALE: HOR 1"=20'; VERT 1"=2'

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SEAL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		
RELEASED FOR:		PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

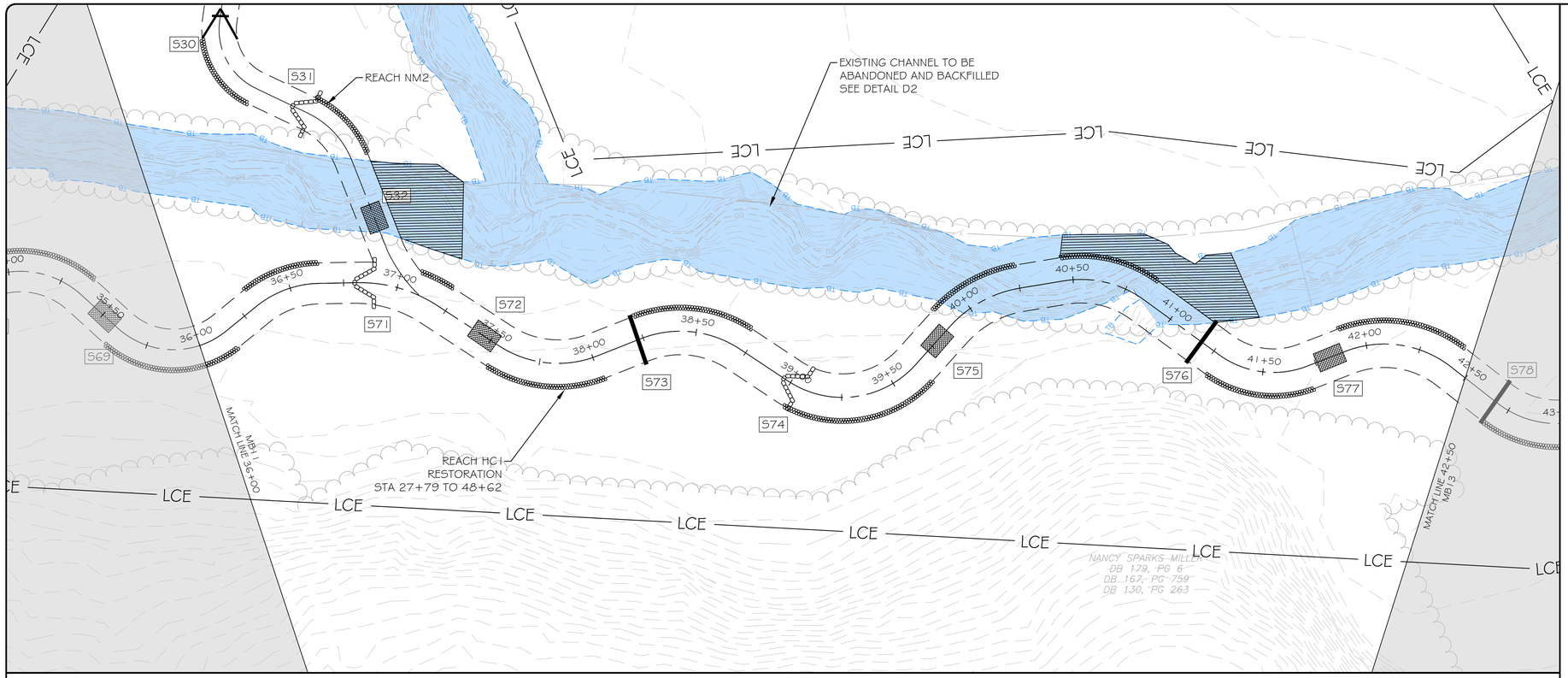
DRAWING TITLE:
REACH HC1

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

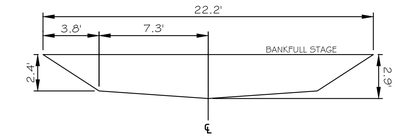
SHEET NUMBER:

MB11

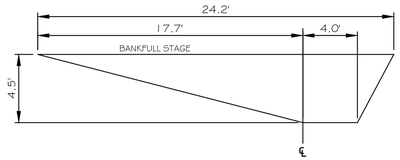
FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_HC1.dwg SAVED BY: Tswartzfager



REACH HC1 STA 37+10 TO STA 48+62



TYPICAL RIFFLE CROSS SECTION



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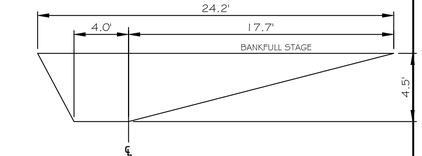
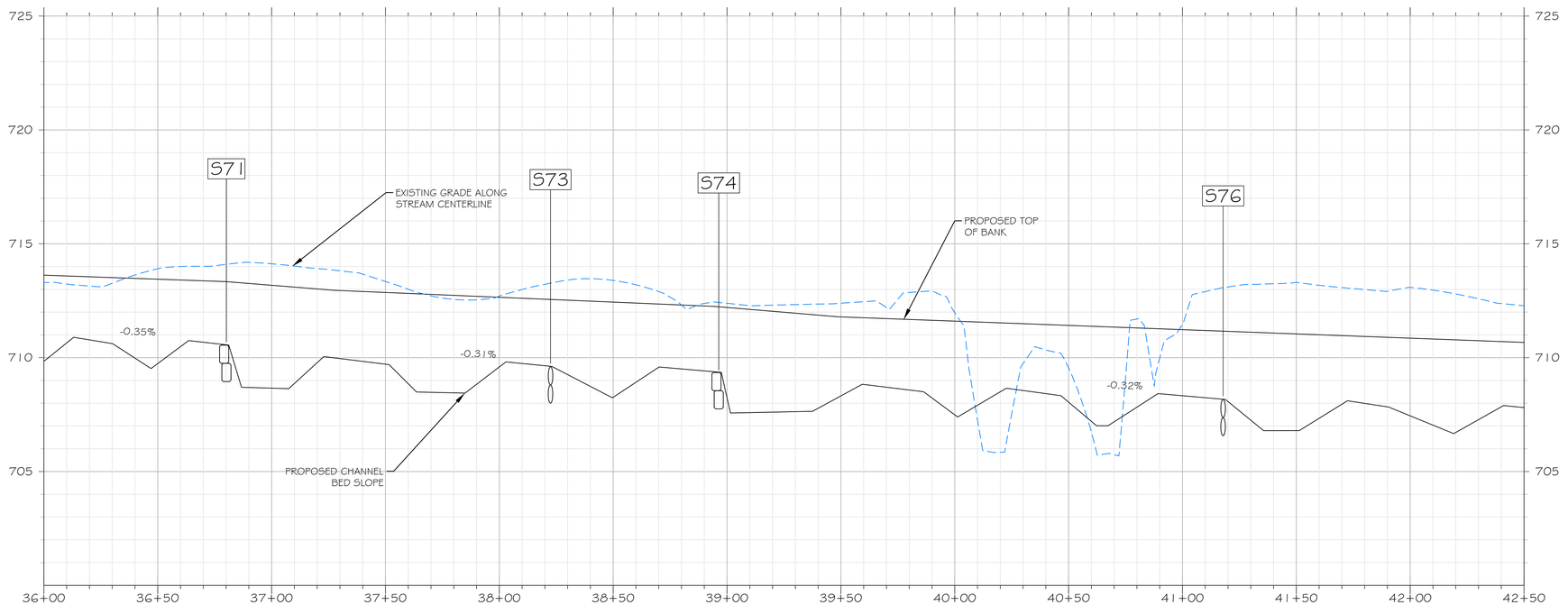


TYPICAL LEFT MEANDER CROSS SECTION



SCALE: HOR 1"=20'; VERT 1"=2'

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SEAL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		

RELEASED FOR:
PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

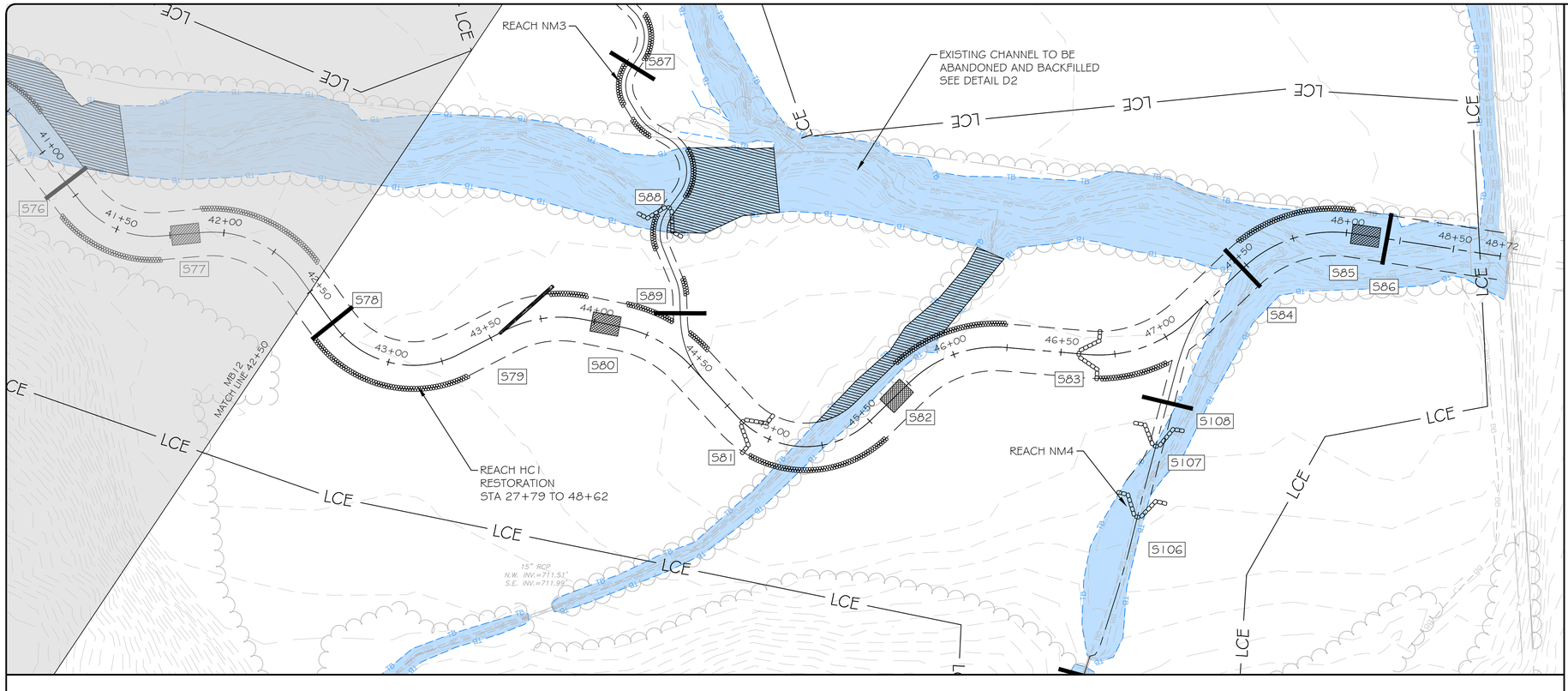
PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
REACH HC1

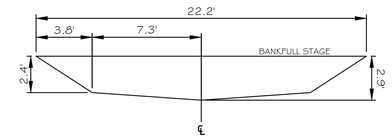
PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
MB12

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_HC1.dwg SAVED BY: Tswartzfager



REACH HC1 STA 37+10 TO STA 48+62



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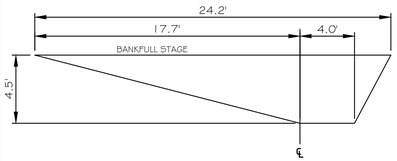
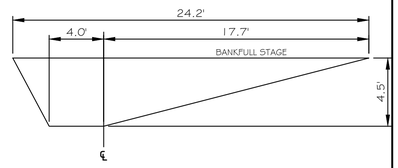
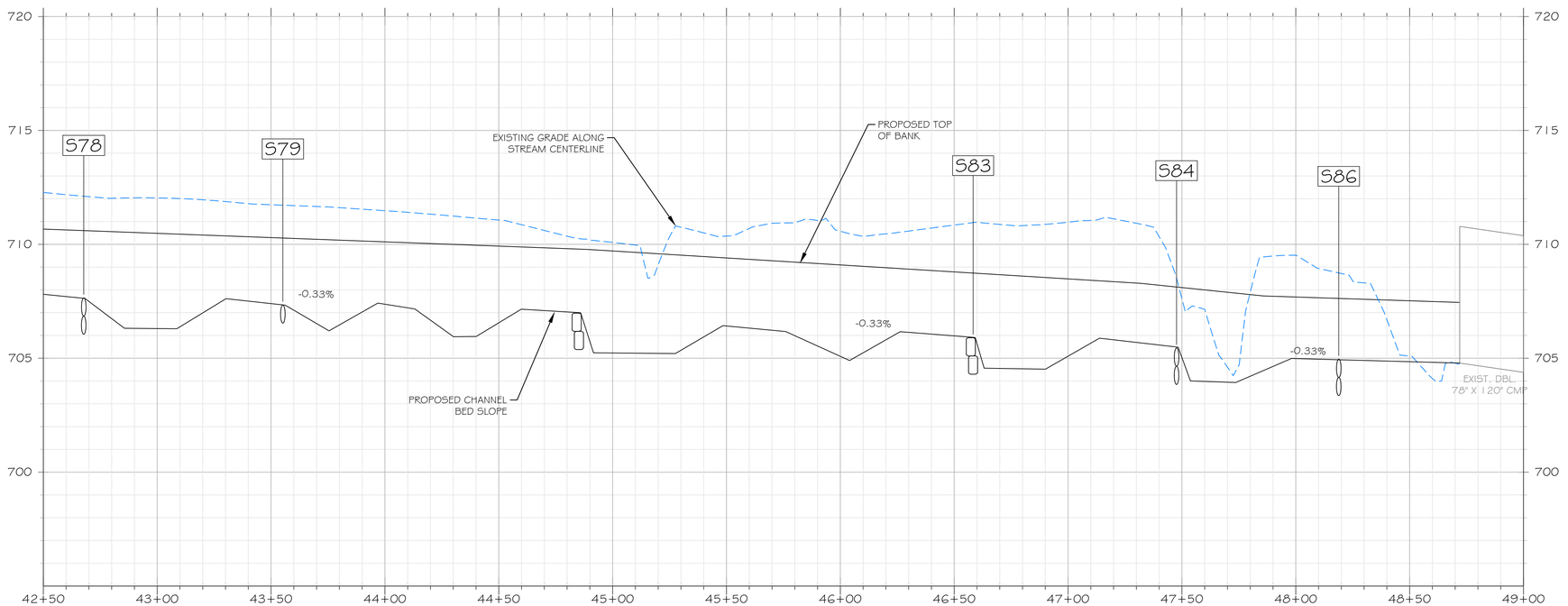


TYPICAL RIGHT MEANDER CROSS SECTION



TYPICAL LEFT MEANDER CROSS SECTION



SCALE: HOR 1"=20'; VERT 1"=2'

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SEAL

FULL SCALE: 1"=30

0 30 60

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		

RELEASED FOR: PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME: MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

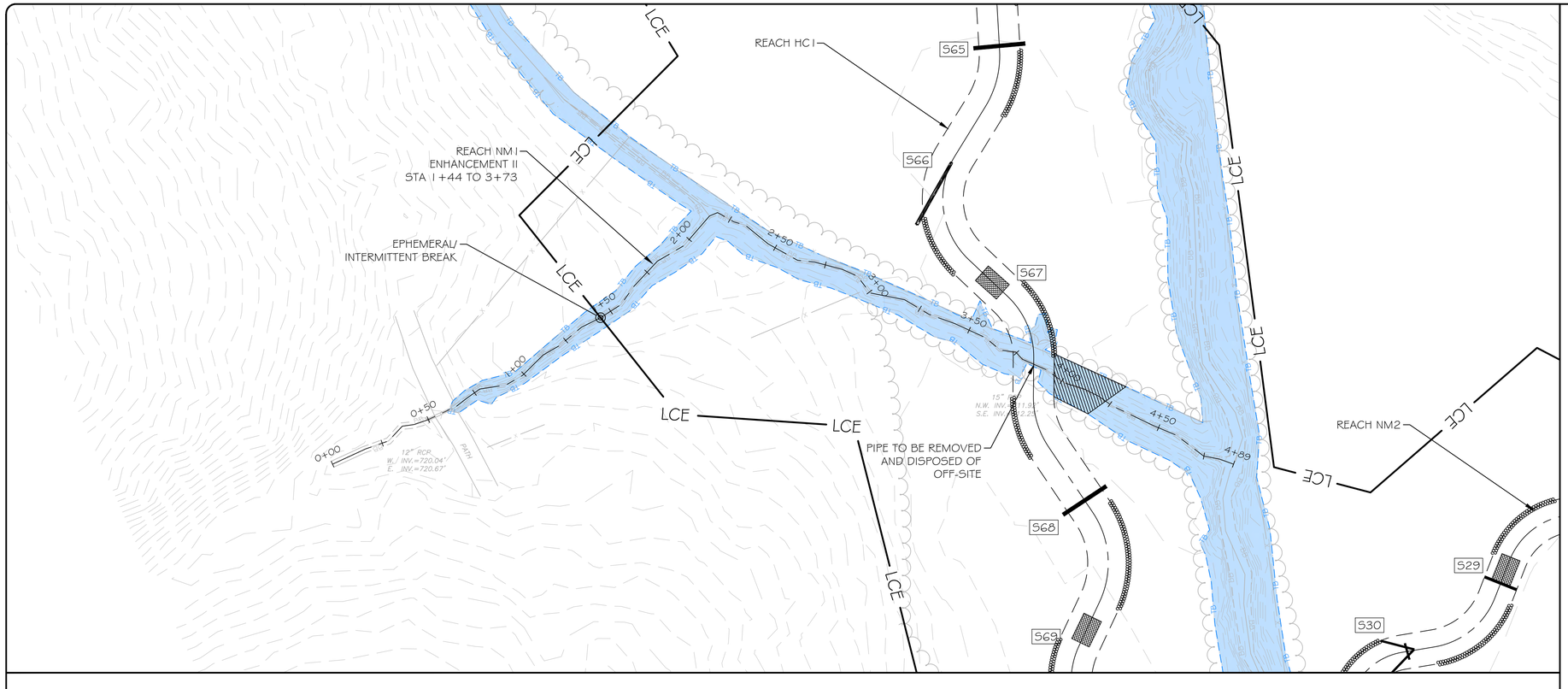
DRAWING TITLE: REACH HC1

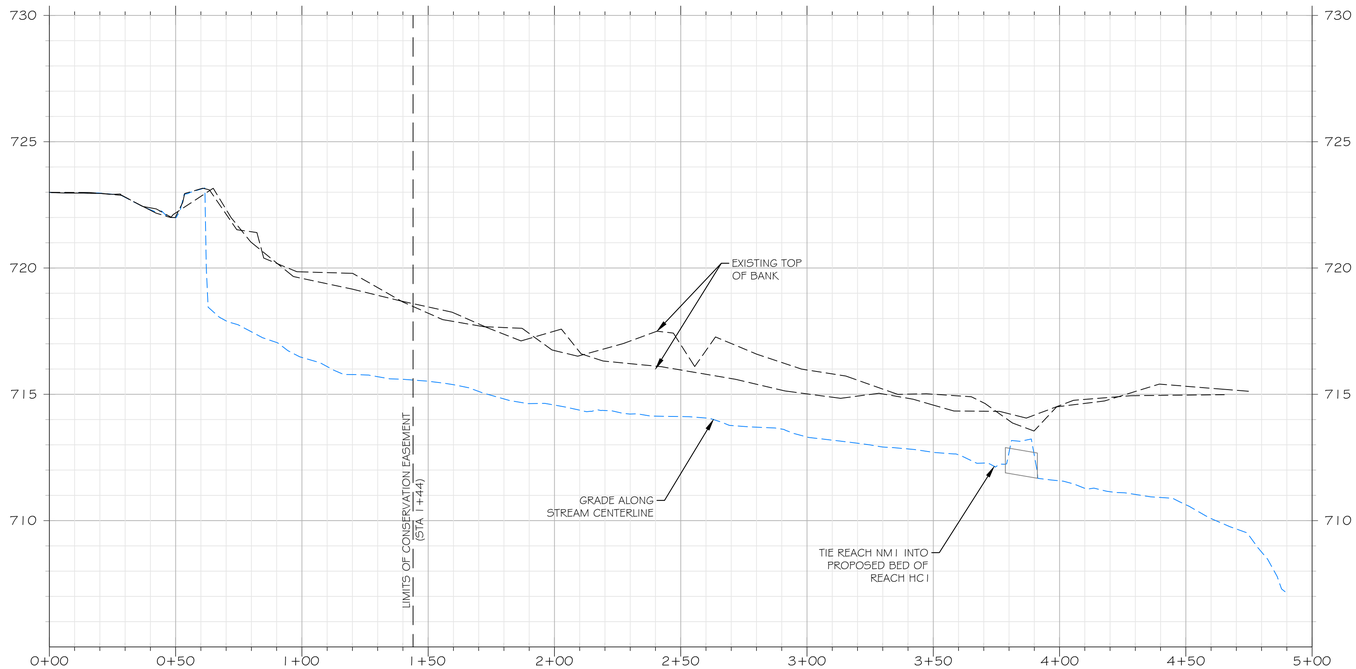
PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB13

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_HC1.dwg SAVED BY: Tswartzfager





SCALE: HOR 1"=20'; VERT 1"=2'

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SEAL

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0 30 60

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MARK	DATE	DESCRIPTION
REVISIONS:		

RELEASED FOR:
PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

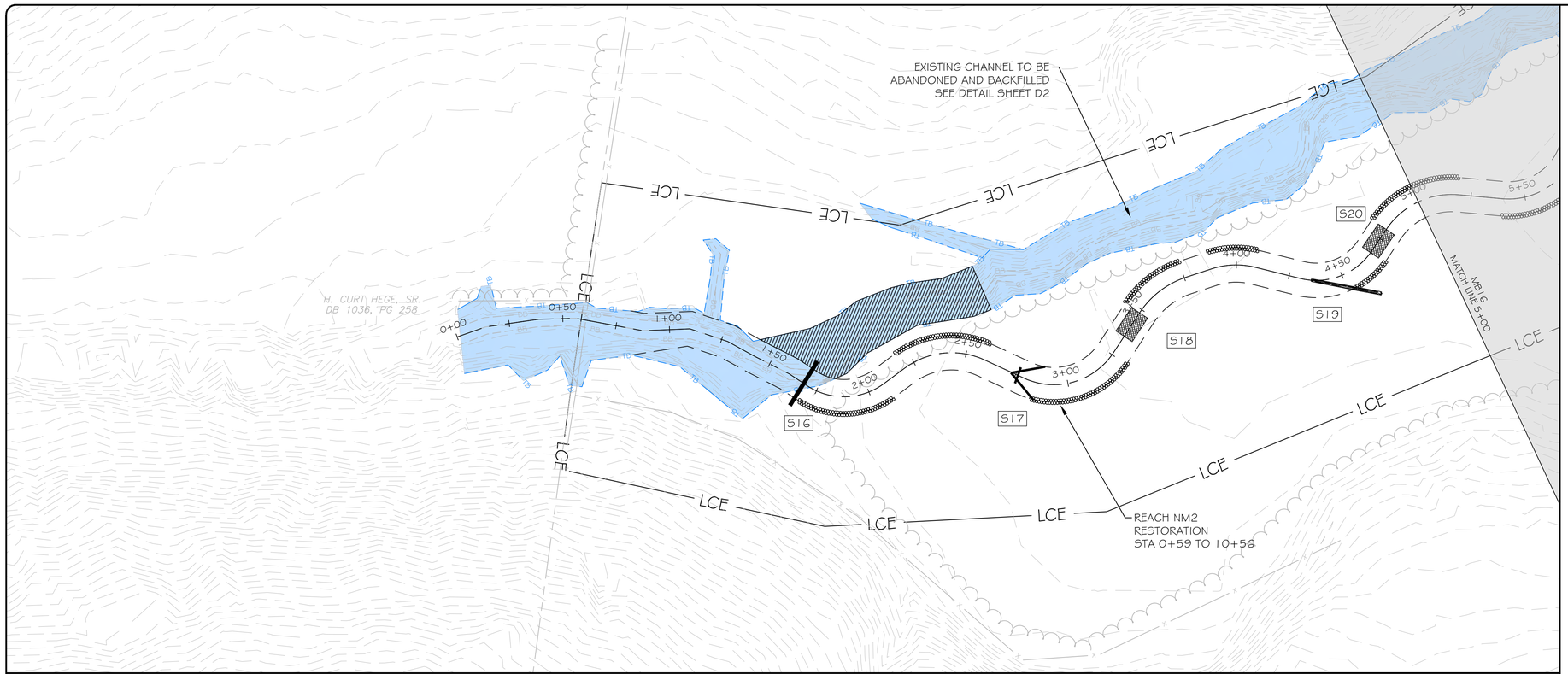
PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
REACH NM1

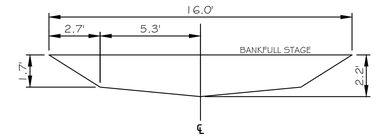
PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
MB14

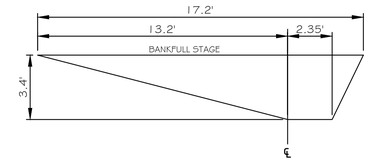
FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_NM1.dwg SAVED BY: Tswartzfager



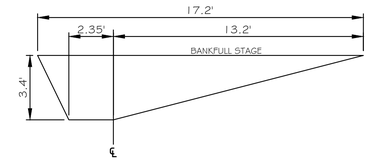
REACH NM2 STA 0+59 TO 14+67



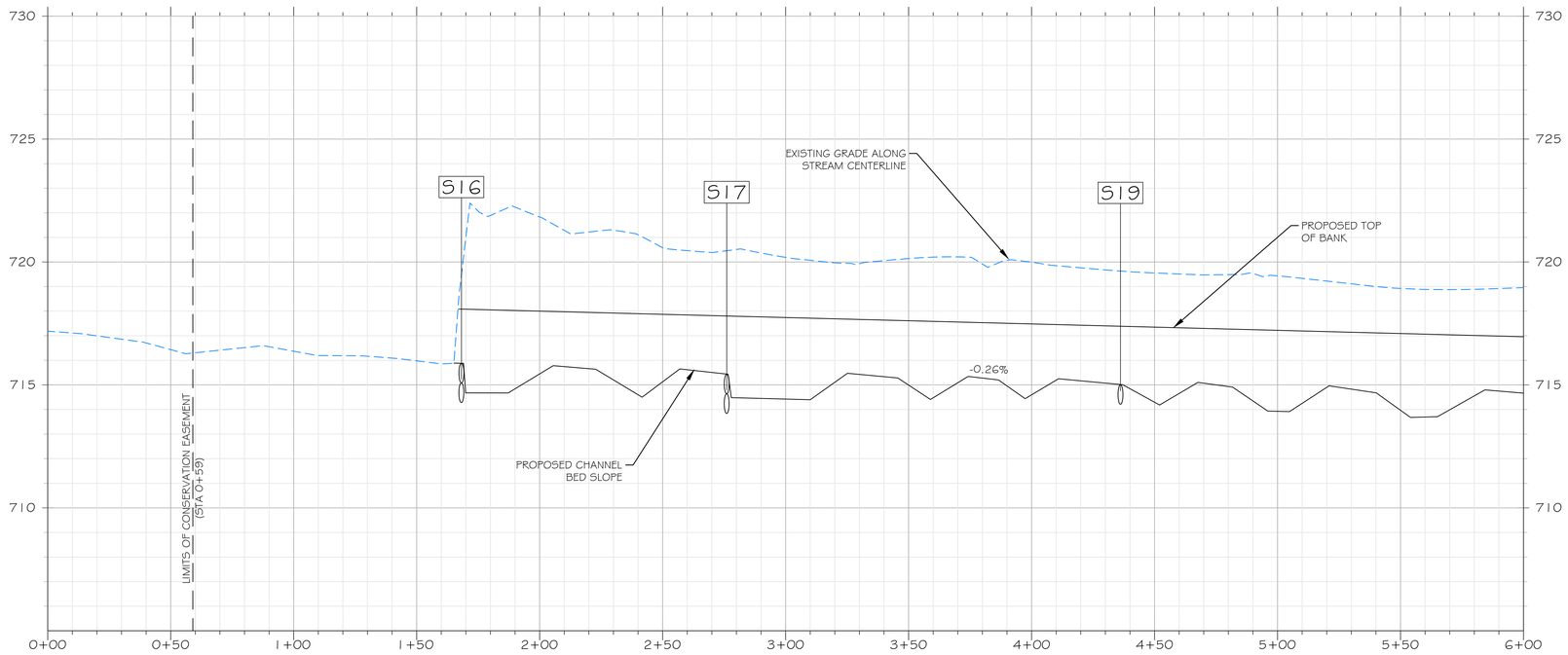
TYPICAL RIFFLE CROSS SECTION



TYPICAL RIGHT MEANDER CROSS SECTION



TYPICAL LEFT MEANDER CROSS SECTION



SCALE: HOR 1"=20'; VERT 1"=2'

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SEAL

FULL SCALE: 1"=30

0 30 60

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MARK	DATE	DESCRIPTION

REVISIONS:

RELEASED FOR: PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME: MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

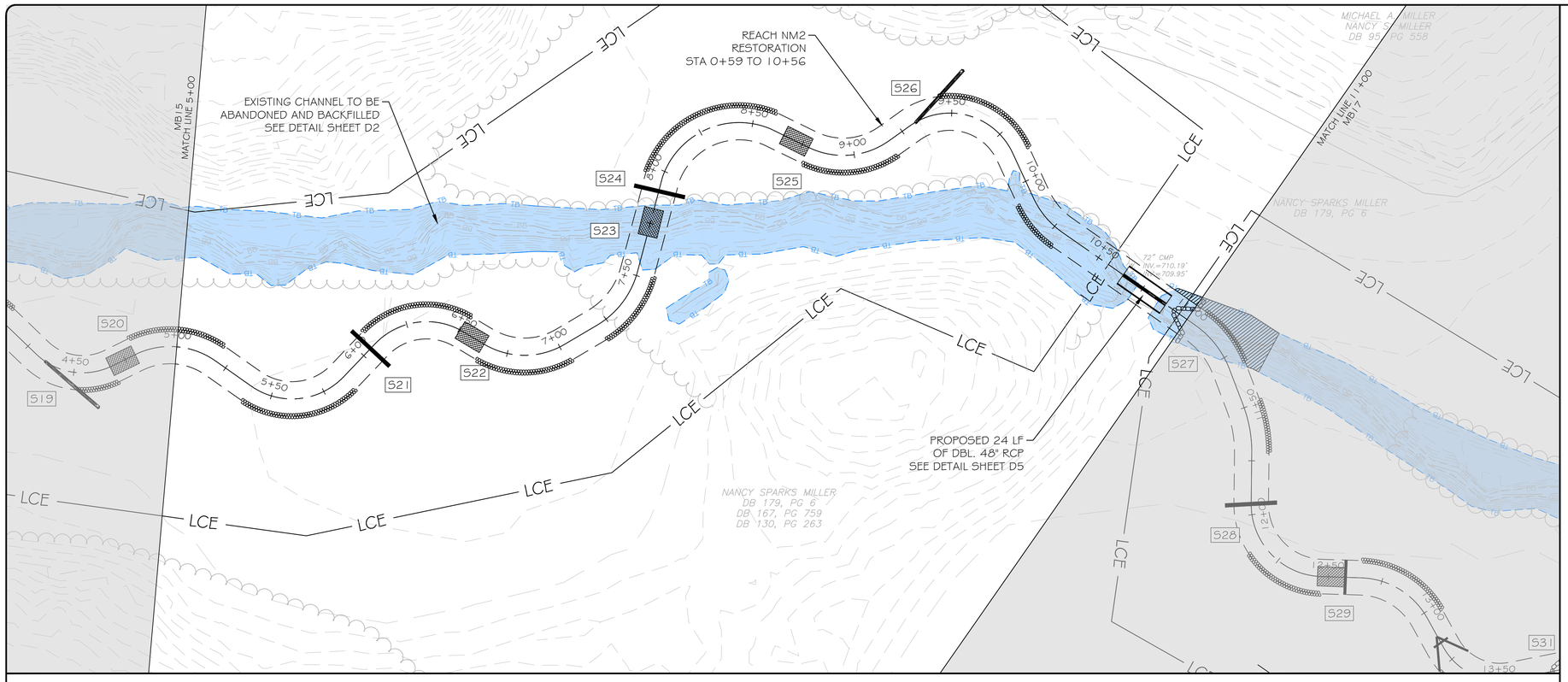
DRAWING TITLE: REACH NM2

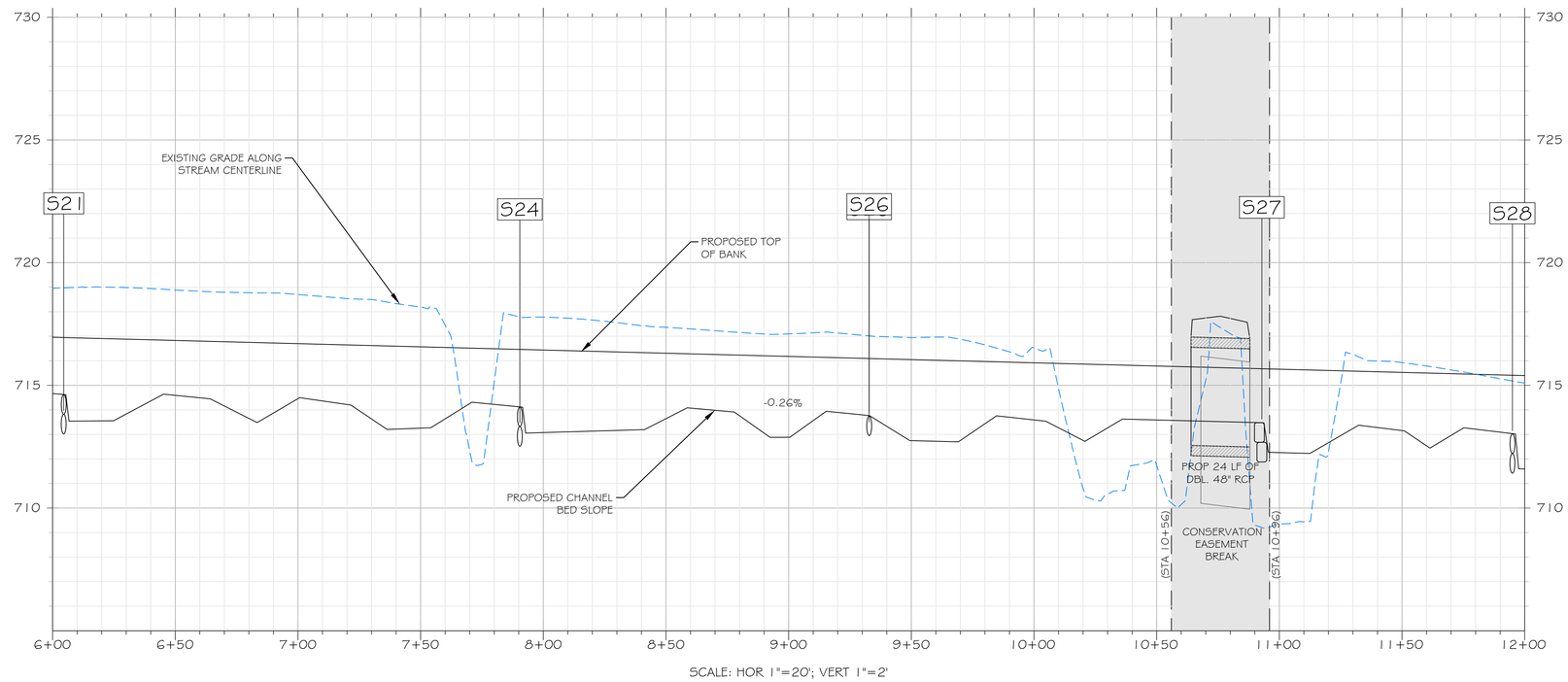
PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB15

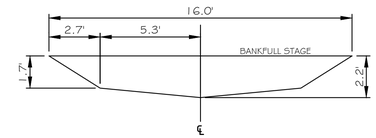
FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWGS\0312_SHT_NM2.dwg SAVED BY: Tswartzfeger



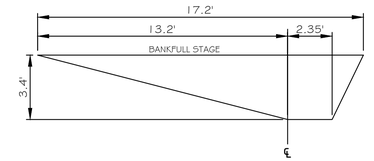


SCALE: HOR 1"=20'; VERT 1"=2'

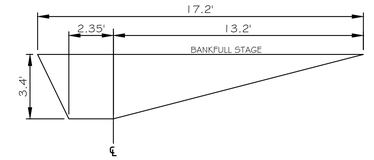
REACH NM2 STA 0+59 TO 14+67



TYPICAL RIFFLE CROSS SECTION



TYPICAL RIGHT MEANDER CROSS SECTION



TYPICAL LEFT MEANDER CROSS SECTION

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SEAL

FULL SCALE: 1"=30

0 30 60

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1" = HALF SCALE

MARK	DATE	DESCRIPTION

REVISIONS:

RELEASED FOR:

PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
REACH NM2

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB16

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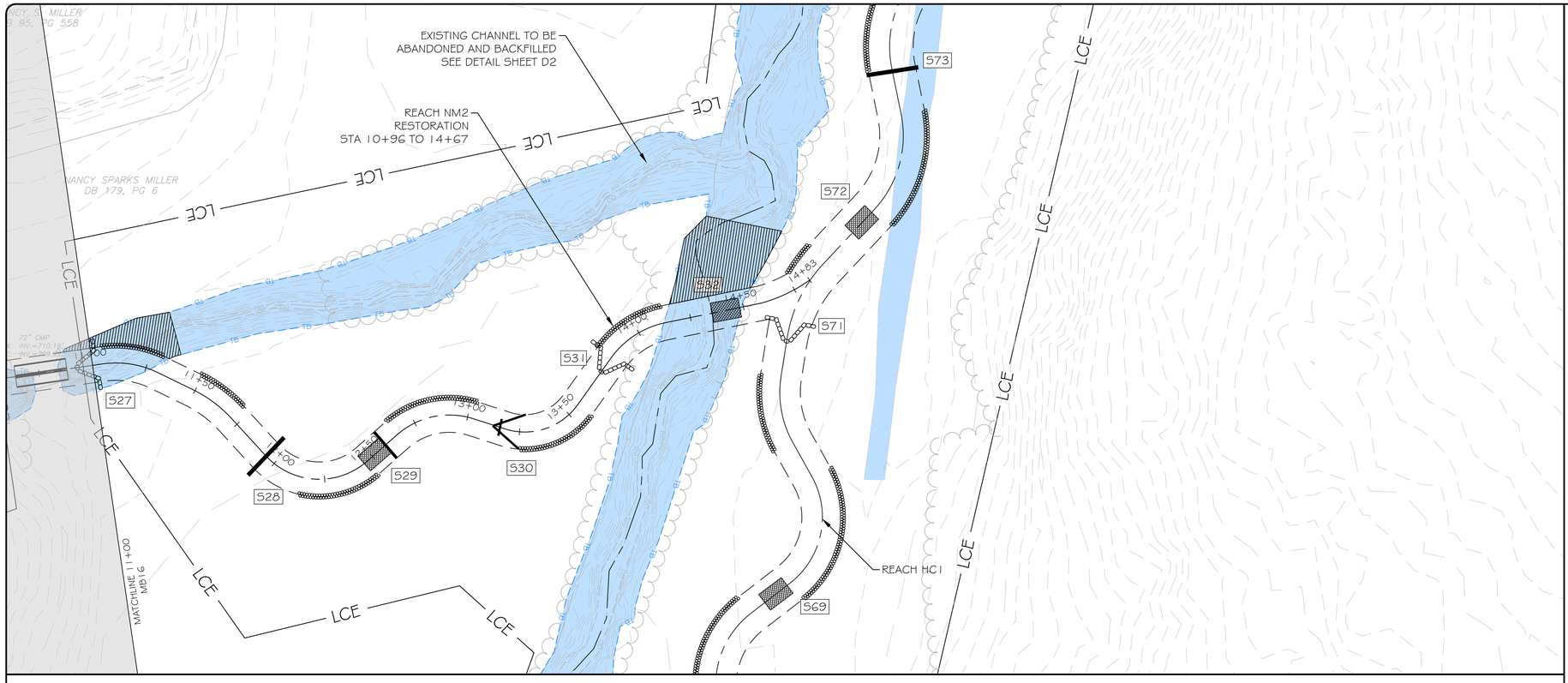
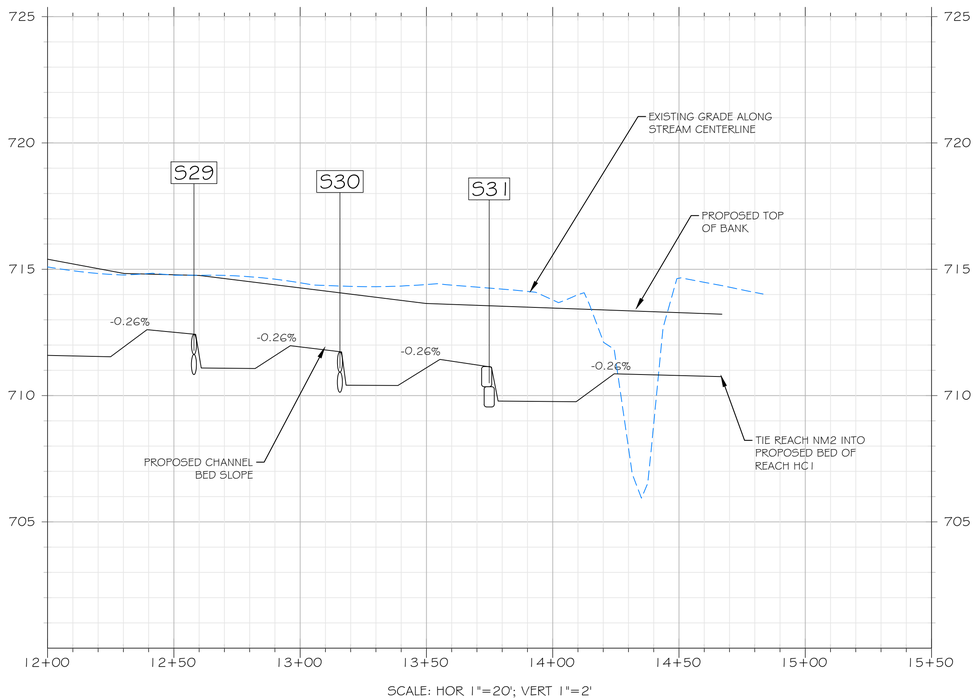
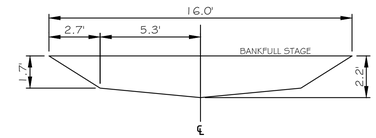


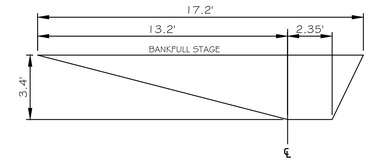


SCALE: HOR 1"=20'; VERT 1"=2'

REACH NM2 STA 0+59 TO 14+67



TYPICAL RIFFLE CROSS SECTION



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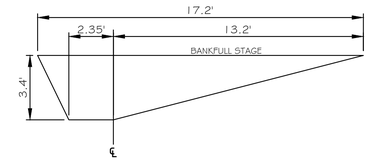

TYPICAL LEFT MEANDER CROSS SECTION

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0 30 60

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		

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PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
REACH NM2

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
MB17

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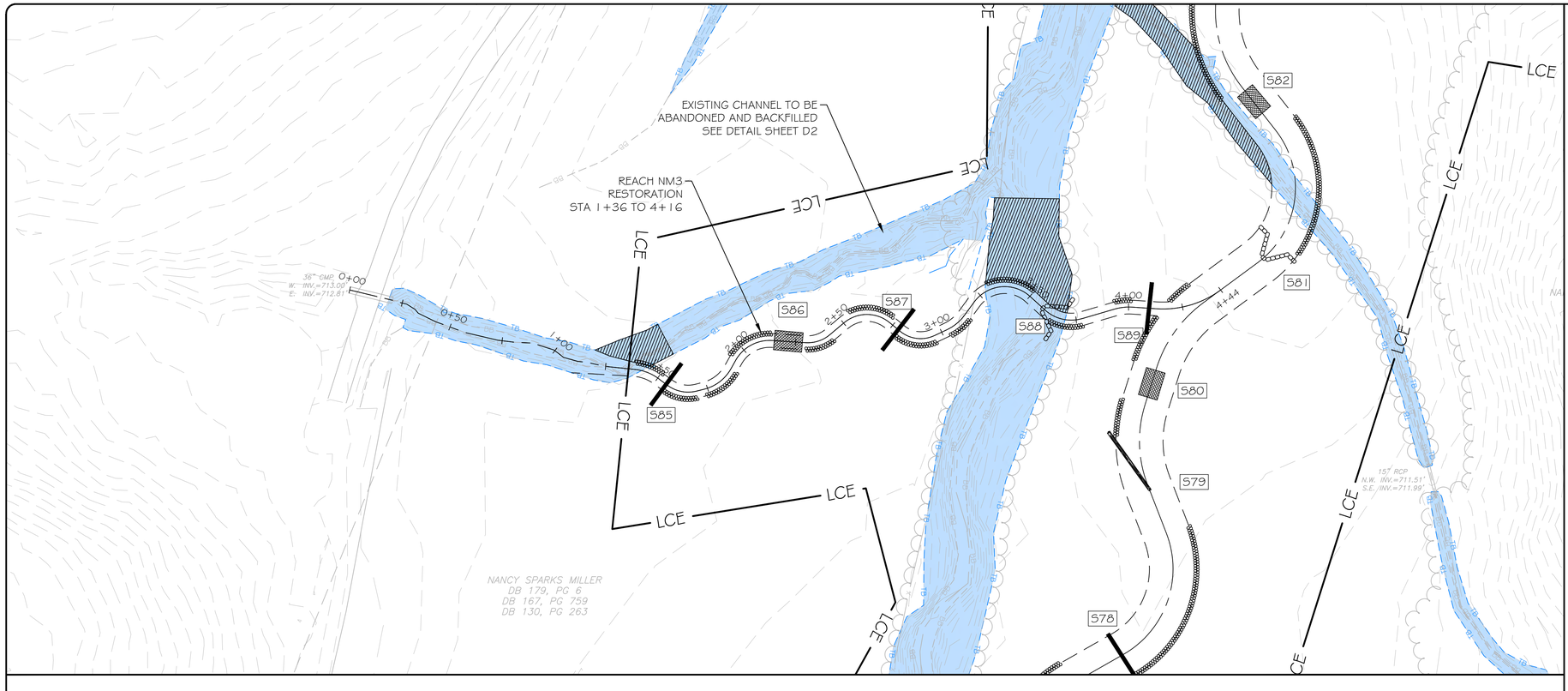
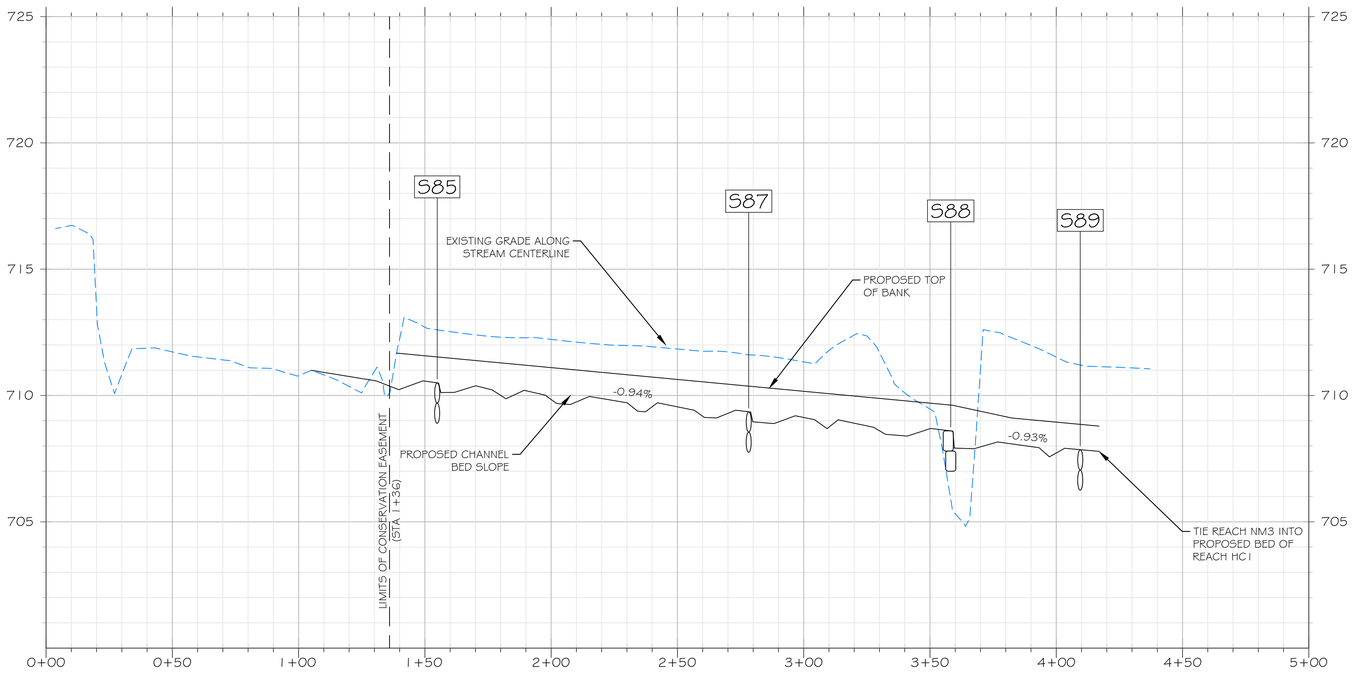
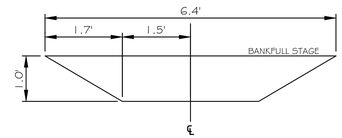




SCALE: HOR 1"=20'; VERT 1"=2'

REACH NM3 STA 1+36 TO STA 4+16



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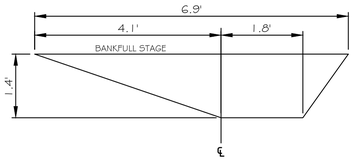

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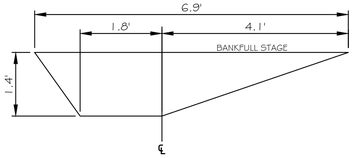

TYPICAL LEFT MEANDER CROSS SECTION

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0 30 60

2" = FULL SCALE
1" = HALF SCALE

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REVISIONS:		

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PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
REACH NM3

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB18

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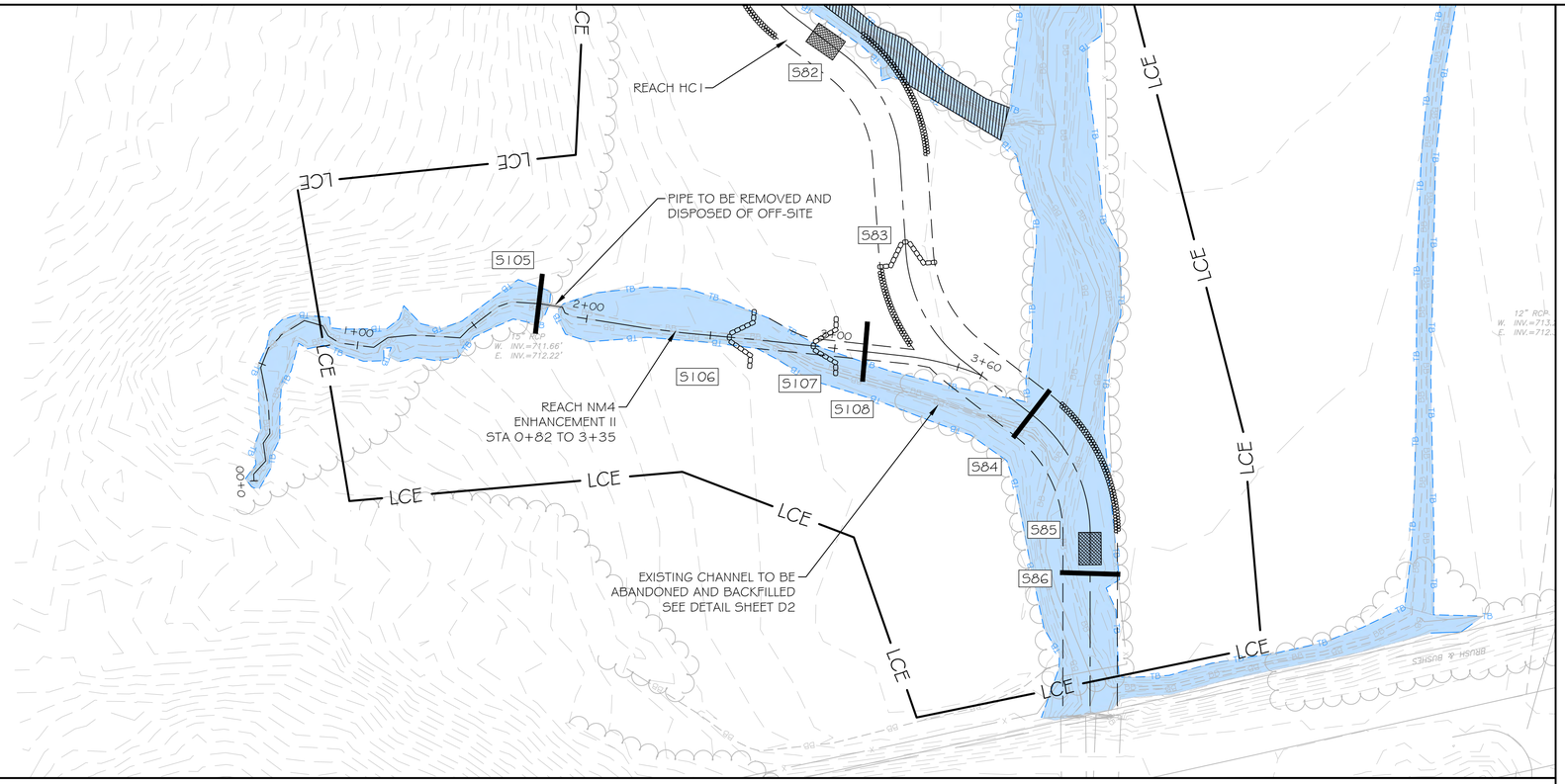
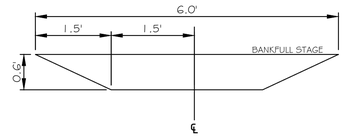


REACH NM4 STA 2+70 TO STA 3+35



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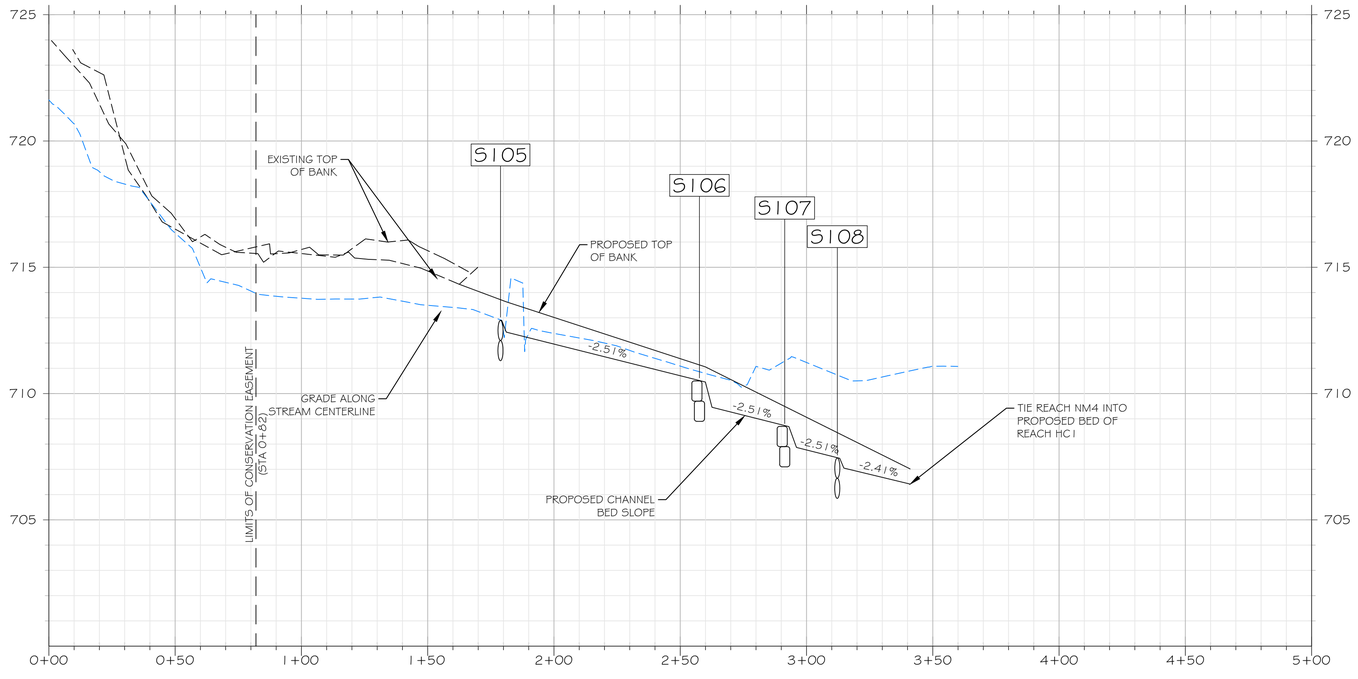

SCALE: HOR 1"=20'; VERT 1"=2'

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SEAL

FULL SCALE: 1"=30

0 30 60

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MARK	DATE	DESCRIPTION
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PLOT DATE: 11/12/2018

PROJECT NAME: MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

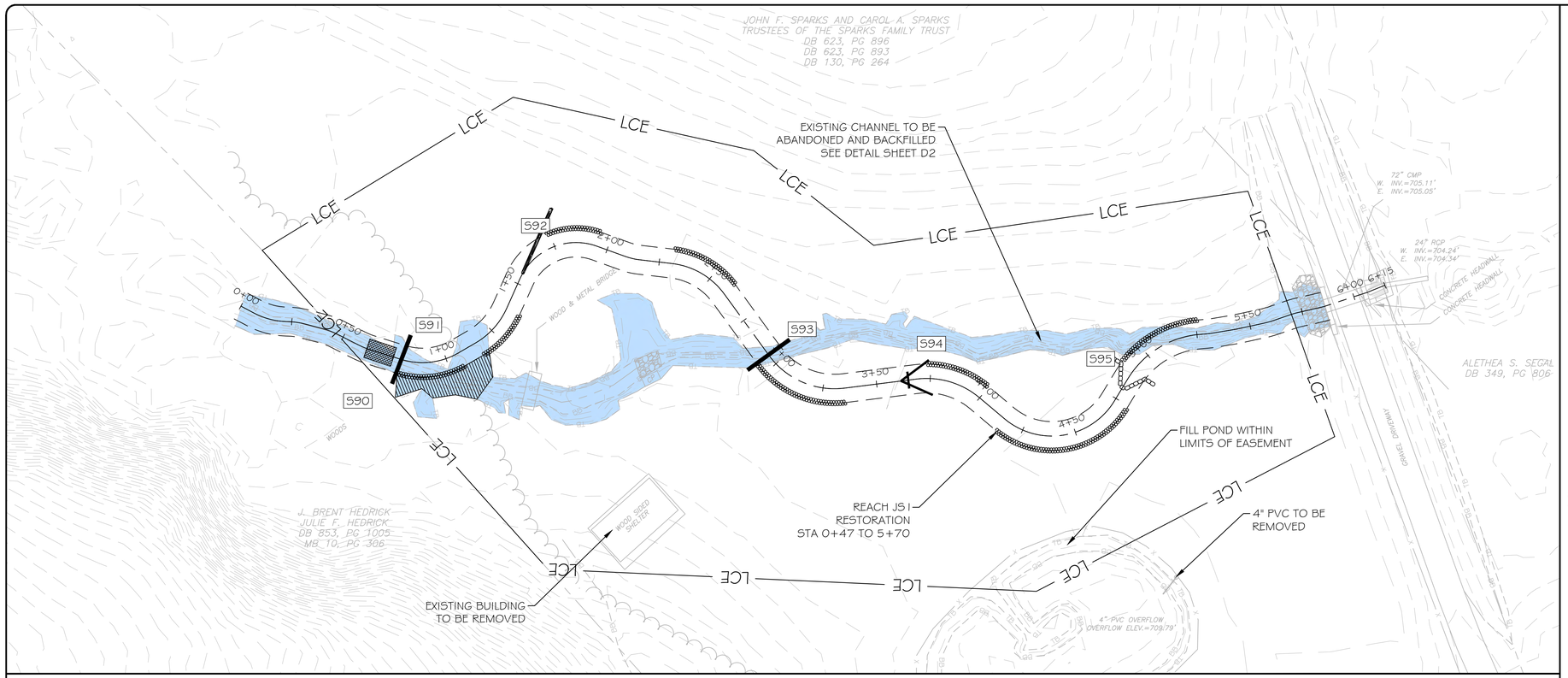
DRAWING TITLE: REACH NM4

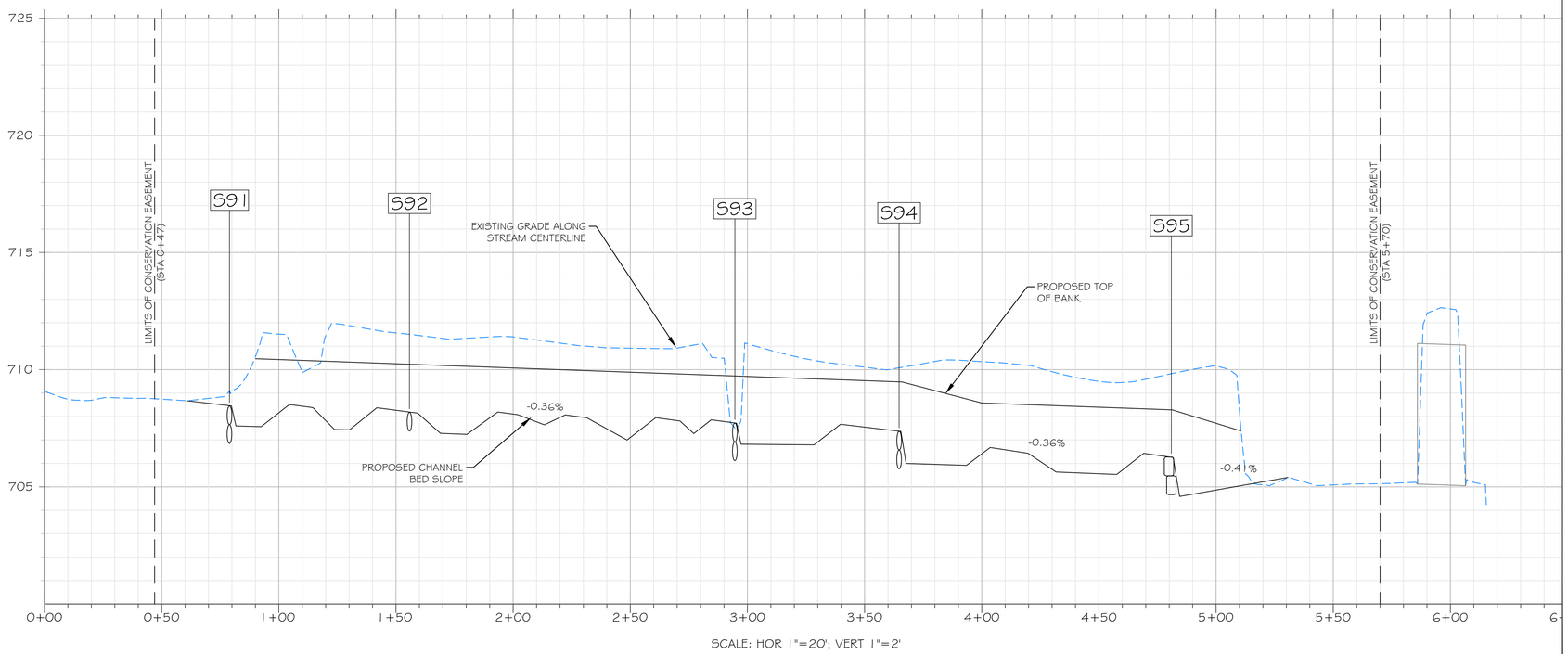
PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB19

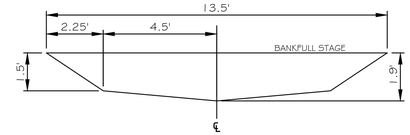
FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_NM4.dwg SAVED BY: Tswartzfager



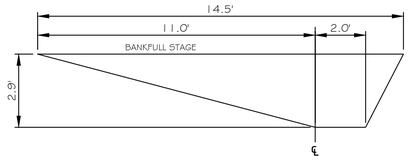


SCALE: HOR 1"=20'; VERT 1"=2'

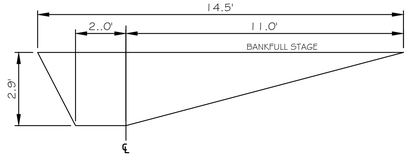
REACH JS1 STA 0+47 TO STA 5+70



TYPICAL RIFFLE CROSS SECTION



TYPICAL RIGHT MEANDER CROSS SECTION



TYPICAL LEFT MEANDER CROSS SECTION

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SEAL

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0 30 60

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION

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PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
REACH JS1

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

MB20

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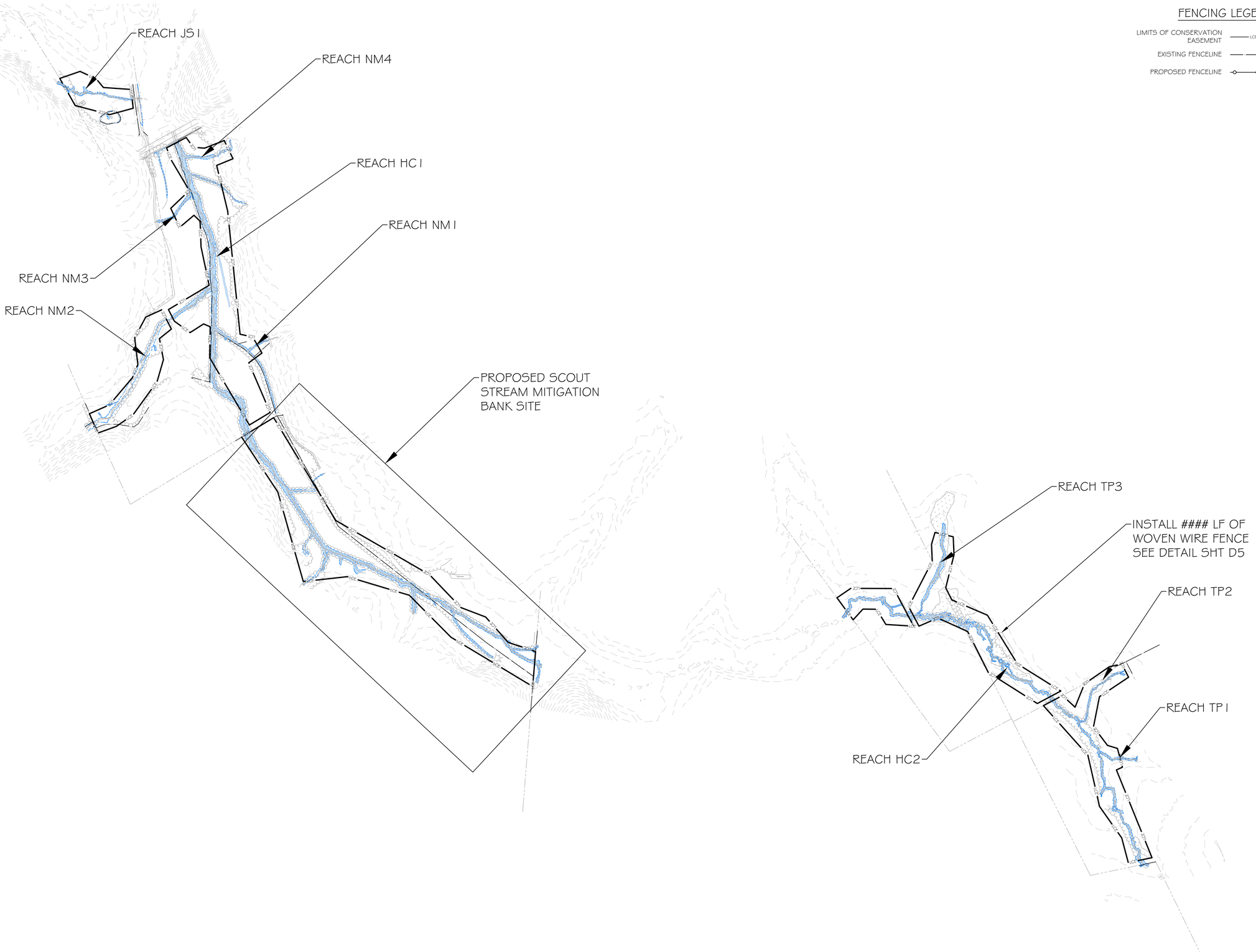

FENCING LEGEND

LIMITS OF CONSERVATION EASEMENT — LCE —

EXISTING FENCELINE — — —

PROPOSED FENCELINE —o—o—

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0 300 600

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
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PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
FENCING PLAN

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
F1

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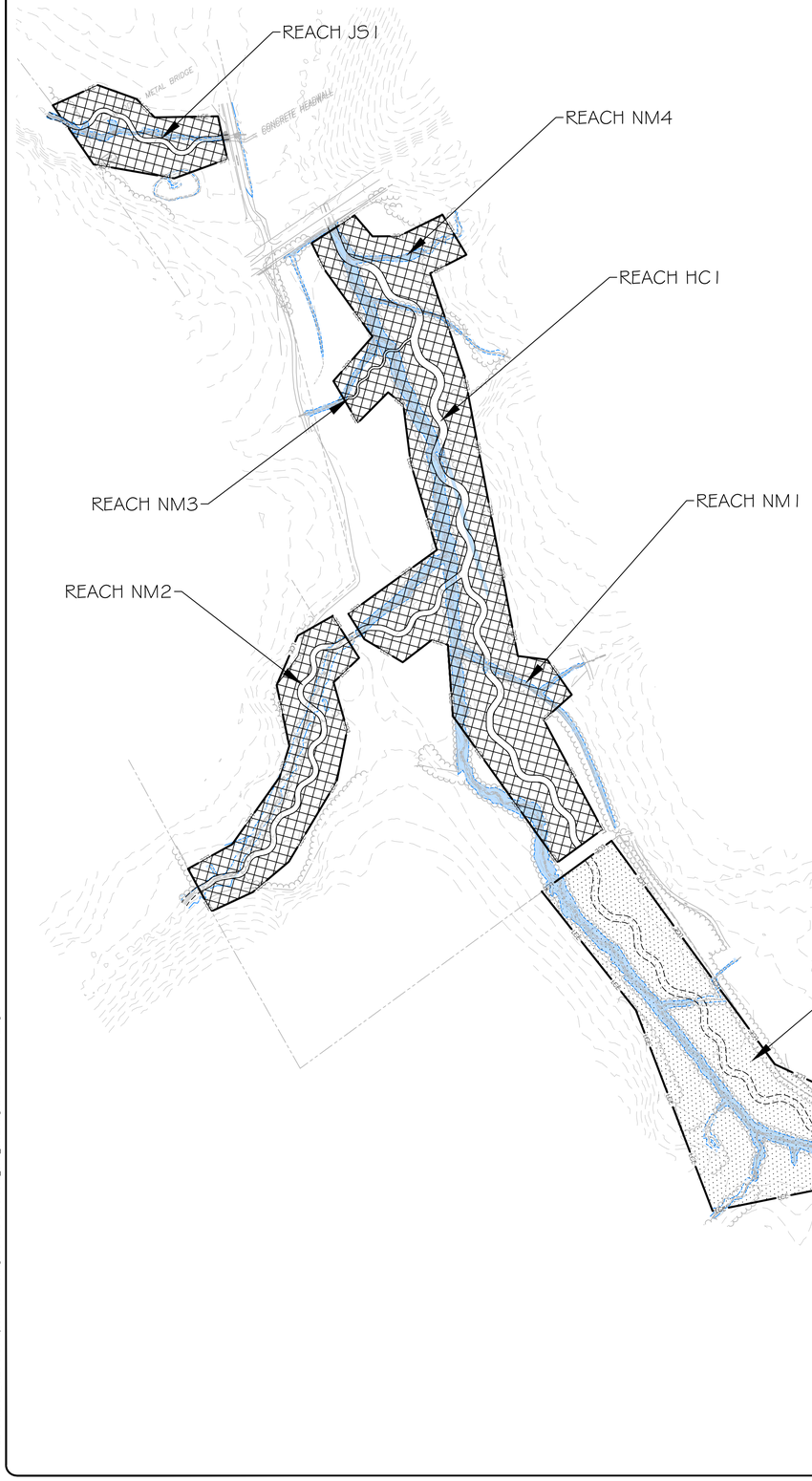


PLANTING LEGEND

LIMITS OF CONSERVATION EASEMENT — LCE —

EXISTING TREELINE

PROPERTY LINE

RIPARIAN PLANTING (TOTAL AREA: 19.4 AC)

SUPPLEMENTAL PLANTING/EVASIVES CONTROL (TOTAL AREA: 2.5 AC)

PLANTING TABLE

Permanent Riparian Seed Mix		
Common Name	Scientific Name	Percent Composition
Virginia Wildrye	*Elymus virginicus*	25%
Indian Grass	*Sorghastrum nutans*	25%
Little Blue Stem	*Schizachyrnum scoparium*	10%
Soft Rush	*Juncus effusus*	10%
Blackeyed susan	*Rudbeckia hirta*	10%
Deertongue	*Dichanthelium clandestinum*	10%
Common Milkweed	*Asclepias synaca*	5%
Showy Goldenrod	*Solidago erecta*	5%

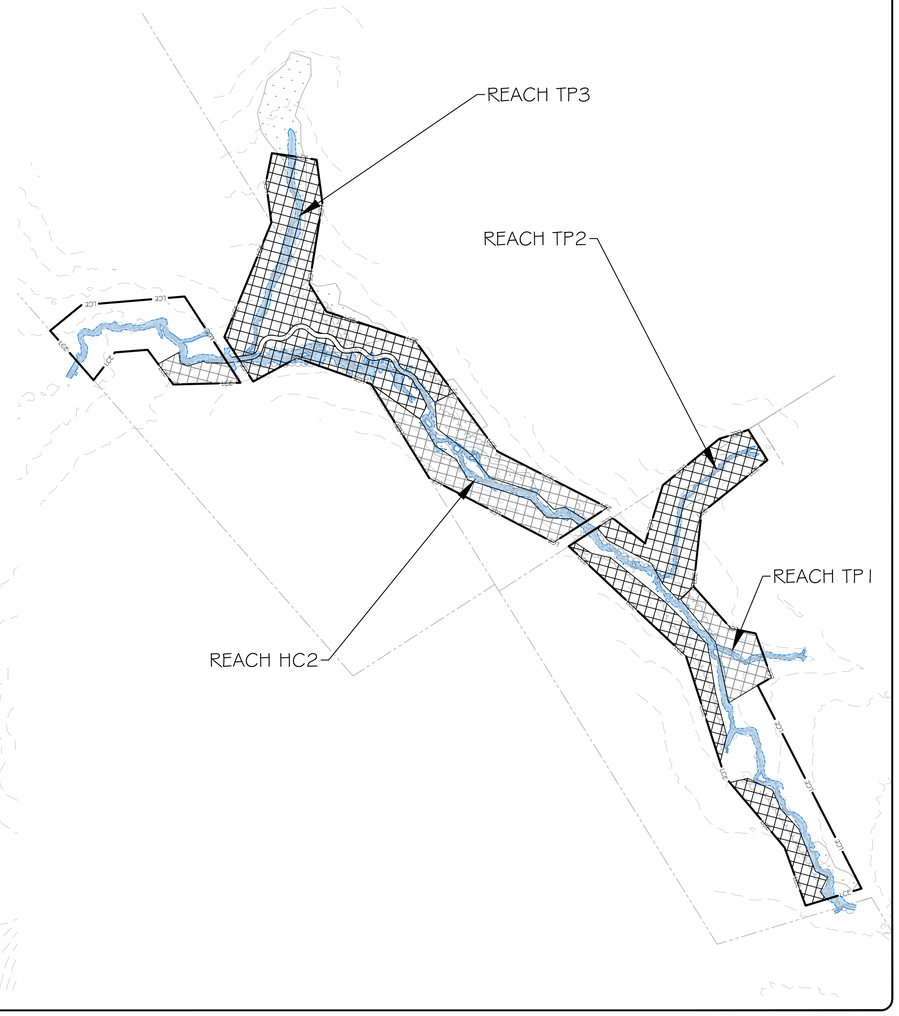
Live Staking and Live Cuttings Bundle Tree Species		
Common Name	Scientific Name	Percent Composition
Silky dogwood	*Cornus amomum*	40%
Black willow	*Salix nigra*	60%

Bare Root Planting Tree Species		
Common Name	Scientific Name	Percent Composition
Water Oak	*Quercus nigra*	15%
Willow Oak	*Quercus phellos*	15%
River Birch	*Betula nigra*	15%
American Sycamore	*Platanus occidentalis*	15%
Northern Red Oak	*Quercus rubra*	10%
Green Ash	*Fraxinus pennsylvanica*	10%
Yellow Poplar	*Liriodendron tulipifera*	10%
Persimmon	*Diospyros virginiana*	5%
Black Gum	*Nyssa biflora*	5%

PLANTING NOTES

ALL PLANTING AREAS

1. EROSION CONTROL MEASURES SHALL BE PROPERLY MAINTAINED UNTIL PERMANENT VEGETATION IS ESTABLISHED AND FINAL APPROVAL HAS BEEN ISSUED. THE CONTRACTOR SHALL INSPECT EROSION CONTROL MEASURES AT THE END OF EACH WORKING DAY TO ENSURE MEASURES ARE FUNCTIONING PROPERLY.
2. DISTURBED AREAS NOT AT FINAL GRADE SHALL BE TEMPORARILY VEGETATED WITHIN 10 WORKING DAYS. UPON COMPLETION OF FINAL GRADING, PERMANENT VEGETATION SHALL BE ESTABLISHED FOR ALL DISTURBED AREAS WITHIN 10 WORKING DAYS. SEEDING SHALL BE IN ACCORDANCE WITH EROSION CONTROL PLAN.
3. ALL DISTURBED AREAS SHALL BE PREPARED PRIOR TO PLANTING BY DISC OR SPRING-TOOTH CHISEL PLOW TO MINIMUM DEPTH OF 12 INCHES. MULTIPLE PASSES SHALL BE MADE ACROSS PLANTING AREAS WITH THE IMPLEMENT AND THE FINAL PASS SHALL FOLLOW TOPOGRAPHIC CONTOURS.
4. BARE ROOT PLANTINGS SHALL BE PLANTED ACCORDING TO DETAIL SHOWN ON SHEET D2. LIVE STAKES SHALL BE PLANTED ACCORDING TO DETAIL SHOWN ON SHEET D2.
5. TREATMENT/REMOVAL OF INVASIVE SPECIES, PINES AND SWEET GUMS LESS THAN 6" DBH SHALL BE PERFORMED THROUGHOUT THE PLANTED AREA.
6. SPECIES SHALL BE DISTRIBUTED SUCH THAT 3 TO 6 PLANTS OF THE SAME SPECIES ARE GROUPED TOGETHER.
7. BARE ROOT PLANTING DENSITY IS APPROXIMATELY 800 STEMS PER ACRE.
8. LIVE STAKES ARE PROPOSED ALONG THE OUTSIDE OF MEANDER BENDS AND ALONG BOTH BANKS OF STRAIGHT REACHES ADJACENT TO POOLS.
9. TEMPORARY SEED MIX SHALL BE APPLIED AT A RATE OF 150 LBS/ACRE TO ALL DISTURBED AREAS WITH SLOPES EQUAL TO OR STEEPER THAN 3:1.
10. PERMANENT RIPARIAN SEED MIX SHALL BE APPLIED TO ALL DISTURBED AREAS WITHIN THE CONSERVATION EASEMENT AT A RATE OF 15 LBS/ACRE.
11. PERMANENT HERB SEED MIX SHALL BE APPLIED TO ALL DISTURBED AREAS WITHIN THE CONSERVATION EASEMENT BREAKS AT A RATE OF 15 LBS/ACRE.



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SEAL

FULL SCALE: 1"=200

0 200 400

2" = FULL SCALE
1" = HALF SCALE

MARK	DATE	DESCRIPTION
REVISIONS:		

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PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

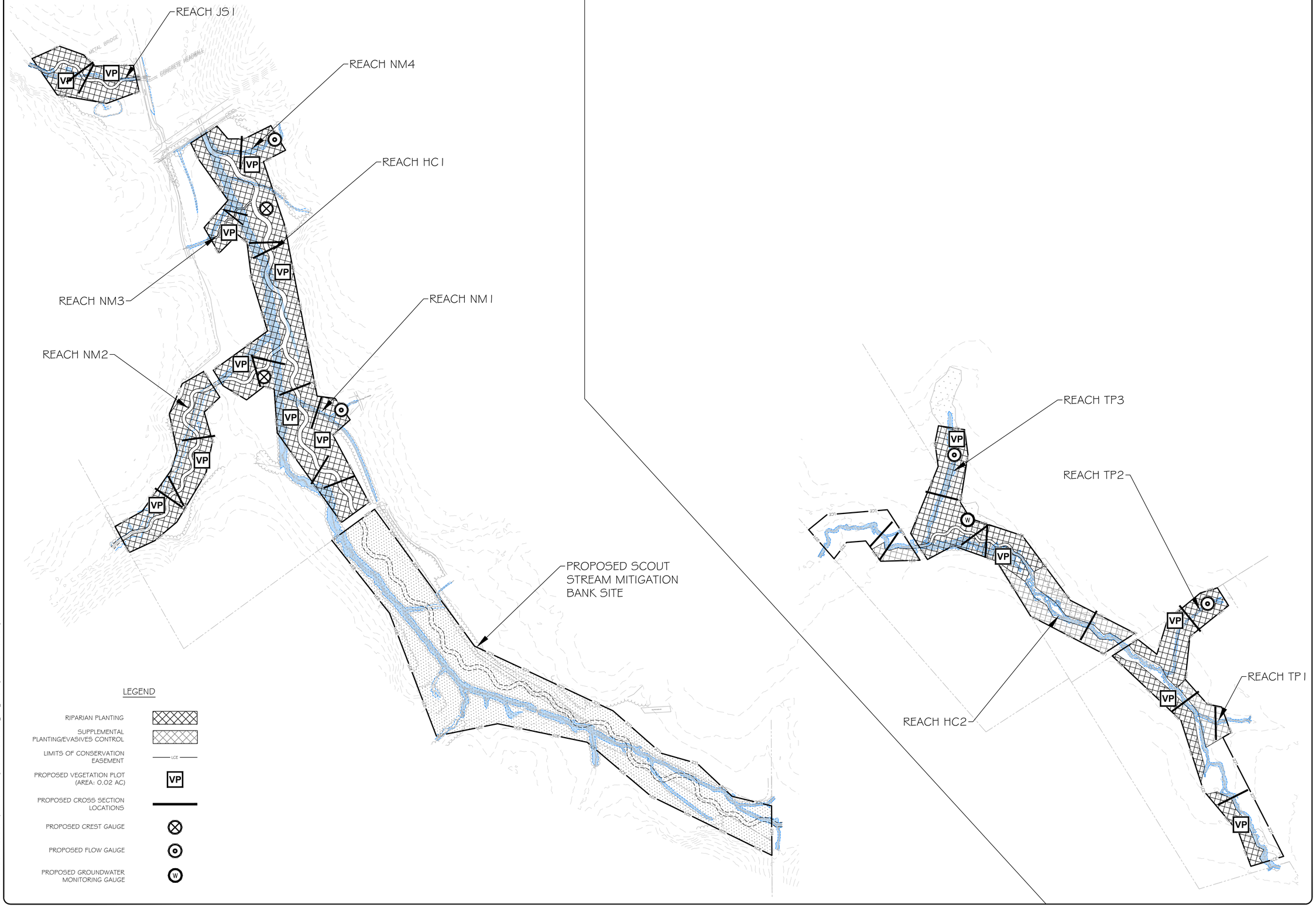
PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
PLANTING PLAN

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
P1

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_SITE.dwg SAVED BY: Tswartzfager



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FULL SCALE: 1"=200

0 200 400

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MARK	DATE	DESCRIPTION
REVISIONS:		

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PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
MONITORING PLAN

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
M1

WHEN AND WHERE TO USE IT
SILT FENCE IS APPLICABLE IN AREAS:

WHERE THE MAXIMUM SHEET OR OVERLAND FLOW PATH LENGTH TO THE FENCE IS 100-FEET.
WHERE THE MAXIMUM SLOPE STEEPNESS (NORMAL [PERPENDICULAR] TO FENCE LINE) IS 2H:1V.
THAT DO NOT RECEIVE CONCENTRATED FLOWS GREATER THAN 0.5 CFS.

DO NOT PLACE SILT FENCE ACROSS CHANNELS OR USE IT AS A VELOCITY CONTROL BMP.

CONSTRUCTION SPECIFICATIONS:

1. USE A SYNTHETIC FILTER FABRIC OF AT LEAST 95% BY WEIGHT OF POLYOLEFINS OR POLYESTER, WHICH IS CERTIFIED BY THE MANUFACTURER OR SUPPLIER AS CONFORMING TO THE REQUIREMENTS IN ASTM D 6461. SYNTHETIC FILTER FABRIC SHOULD CONTAIN ULTRAVIOLET RAY INHIBITORS AND STABILIZERS TO PROVIDE A MINIMUM OF 6 MONTHS OF EXPECTED USABLE CONSTRUCTION LIFE AT A TEMPERATURE RANGE OF 0° TO 120° F.
2. ENSURE THAT POSTS FOR SEDIMENT FENCES ARE 1.33 LB/LINEAR FT STEEL WITH A MINIMUM LENGTH OF 5 FEET. MAKE SURE THAT STEEL POSTS HAVE PROJECTIONS TO FACILITATE FASTENING THE FABRIC.

CONSTRUCTION:

1. CONSTRUCT THE SEDIMENT BARRIER OF EXTRA STRENGTH SYNTHETIC FILTER FABRICS.
2. ENSURE THAT THE HEIGHT OF THE SEDIMENT FENCE DOES NOT EXCEED 24 INCHES ABOVE THE GROUND SURFACE. (HIGHER FENCES MAY IMPOUND VOLUMES OF WATER SUFFICIENT TO CAUSE FAILURE OF THE STRUCTURE.)
3. CONSTRUCT THE FILTER FABRIC FROM A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID JOINTS. WHEN JOINTS ARE NECESSARY, SECURELY FASTEN THE FILTER CLOTH ONLY AT A SUPPORT POST WITH 4 FEET MINIMUM OVERLAP TO THE NEXT POST.
4. EXTRA STRENGTH FILTER FABRIC WITH 6 FEET POST SPACING DOES NOT REQUIRE WIRE MESH SUPPORT FENCE. SECURELY FASTEN THE FILTER FABRIC DIRECTLY TO POSTS. WIRE OR PLASTIC ZIP TIES SHOULD HAVE MINIMUM 50 POUND TENSILE STRENGTH.
5. EXCAVATE A TRENCH APPROXIMATELY 4 INCHES WIDE AND 8 INCHES DEEP ALONG THE PROPOSED LINE OF POSTS AND UPSLOPE FROM THE BARRIER.
6. PLACE 12 INCHES OF THE FABRIC ALONG THE BOTTOM AND SIDE OF THE TRENCH.
7. BACKFILL THE TRENCH WITH SOIL PLACED OVER THE FILTER FABRIC AND COMPACT. THOROUGH COMPACTION OF THE BACKFILL IS CRITICAL TO SILT FENCE PERFORMANCE.
8. DO NOT ATTACH FILTER FABRIC TO EXISTING TREES.

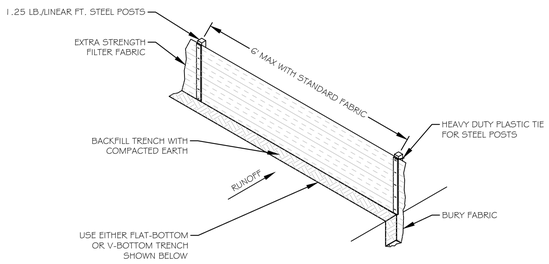
MAINTENANCE:

INSPECT SEDIMENT FENCES AT LEAST ONCE A WEEK AND AFTER EACH RAINFALL. MAKE ANY REQUIRED REPAIRS IMMEDIATELY.

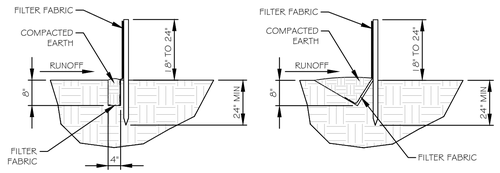
SHOULD THE FABRIC OF A SEDIMENT FENCE COLLAPSE, TEAR, DECOMPOSE OR BECOME INEFFECTIVE, REPLACE IT PROMPTLY.

REMOVE SEDIMENT DEPOSITS AS NECESSARY TO PROVIDE ADEQUATE STORAGE VOLUME FOR THE NEXT RAIN AND TO REDUCE PRESSURE ON THE FENCE. TAKE CARE TO AVOID UNDERMINING THE FENCE DURING CLEANOUT.

REMOVE ALL FENCING MATERIALS AND UNSTABLE SEDIMENT DEPOSITS AND BRING THE AREA TO GRADE AND STABILIZE IT AFTER THE CONTRIBUTING DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.



SILT FENCE INSTALLATION

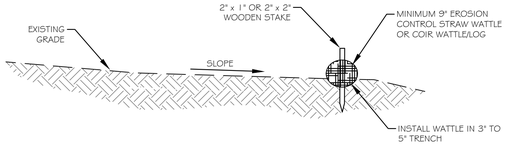


FLAT-BOTTOM TRENCH DETAIL

V-SHAPED TRENCH DETAIL

TEMPORARY SILT FENCE

NTS



NOTE:
EROSION CONTROL WATTLES OR COIR LOGS/WATTLES MAY BE USED IN PLACE OF SILT FENCE.

EROSION CONTROL WATTLE

NTS

INSTALLATION NOTES:

SITE PREPARATION

1. GRADE AND COMPACT AREA.
2. REMOVE ALL ROCKS, CLODS, VEGETATION, AND OBSTRUCTIONS SO THAT MATTING WILL HAVE DIRECT CONTACT WITH THE SOIL.
3. PREPARE SEEDBED BY LOOSENING 3 TO 4 INCHES OF TOPSOIL ABOVE FINAL GRADE.
4. TEST SOILS FOR ANY NUTRIENT DEFICIENCIES AND SUBMIT SOIL TEST RESULTS TO THE ENGINEER. APPLY ANY TREATMENT SUCH AS LIME OR FERTILIZERS TO THE SOIL IF NEEDED.

SEEDING

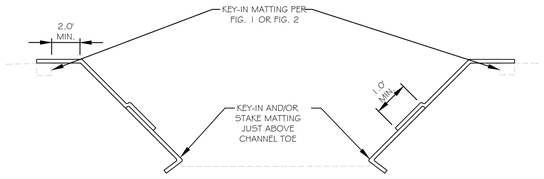
1. SEE PLANTING SHEETS FOR SEEDING REQUIREMENTS.
2. APPLY SEED TO SOIL BEFORE PLACING MATTING.

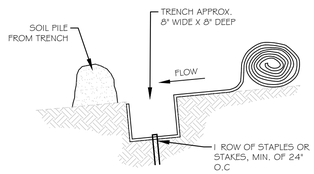
INSTALLATION - STREAM BANK

1. SEE GRADING NOTES ON PLAN AND PROFILE SHEETS AND DETAIL SHEETS FOR INFORMATION REGARDING WHAT AREAS ARE TO RECEIVE COIR MATTING.
2. OVERLAP ADJACENT MATS 3" (IN DIRECTION PARALLEL TO FLOW) AND ANCHOR EVERY 12" ACROSS THE OVERLAP. THE UPSTREAM MAT SHOULD BE PLACED OVER THE DOWNSTREAM MAT.
3. EDGES SHOULD BE SHINGLED AWAY FROM THE FLOW OF WATER.
4. LAY MAT LOOSE TO ALLOW CONTACT WITH SOIL. DO NOT STRETCH TIGHT.
5. ANCHOR MAT USING BIODEGRADABLE STAKES OR PINS.
6. CUT 8" x 8" TRENCH ALONG TOP OF BANK FOR MAT TERMINATION AS SHOWN IN FIGURES 1 & 2. EXTEND MAT 2 TO 3 FEET PAST TOP OF BANK.
7. PLACE ADJACENT ROLLS IN THE ANCHOR TRENCH WITH A MINIMUM OF 4" OVERLAP. SECURE WITH BIODEGRADABLE STAKES OR PINES, BACKFILL ANCHOR TRENCH, AND COMPACT SOIL.
8. STAPLE AT 12' INTERVALS ALONG OVERLAP.
9. STREAM BANK MATTING TO BE INSTALLED FROM TOE OF BANK TO A MINIMUM OF 2.0' PAST TOP OF BANK. SEE FIGURE 3 FOR TERMINATION AT TOP OF BANK.
10. IF MORE THAN ROLL IS REQUIRED TO COVER THE CHANNEL FROM THE TOP OF BANK DOWN TO THE TOE, THEN OVERLAP MATTING BY A MINIMUM OF 1'.

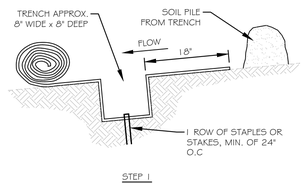
EROSION CONTROL MATTING MUST MEET OR EXCEED THE FOLLOWING REQUIREMENTS:

- 100 % COCONUT FIBER (COIR) TWINE WOVEN INTO A HIGH STRENGTH MATRIX.
- THICKNESS - 0.35 IN. MINIMUM.
- SHEAR STRESS – 5 LBS/SQFT
- FLOW VELOCITY- OBSERVED 16 FT/SEC
- WEIGHT - 29 OZ/SY
- OPEN AREA - 38%
- SLOPES – UP TO A MAXIMUM OF 1:1

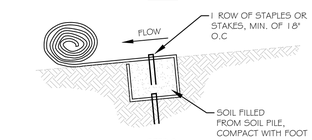




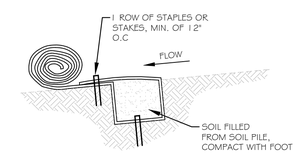
STEP 1



STEP 1



STEP 2



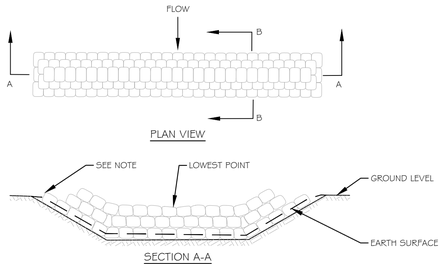
STEP 2

FIGURE 1

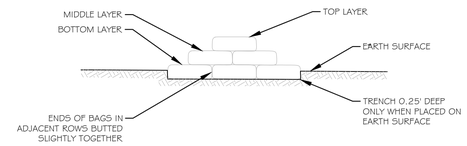
FIGURE 2

COIR MATTING

NTS



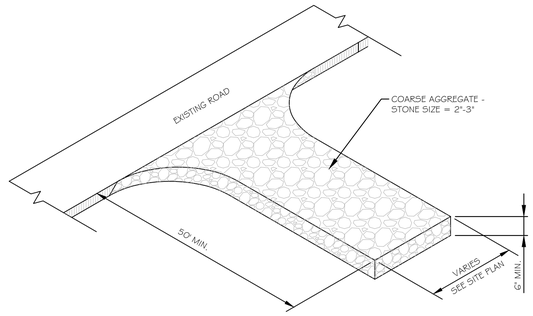
NOTE: END OF DIKE AT GROUND LEVEL TO BE HIGHER THAN THE LOWEST POINT OF FLOW CHECK. SUFFICIENT SANDBAGS ARE TO BE PLACED TO PREVENT SCOURING.



SANDBAG BARRIERS SHALL BE CONSTRUCTED OF THREE LAYERS OF SANDBAGS. THE BOTTOM LAYER SHALL CONSIST OF 3 ROWS OF BAGS, THE MIDDLE LAYER SHALL CONSIST OF 2 ROWS OF BAGS AND THE TOP LAYER SHALL CONSIST OF 1 ROW OF BAGS. THE RECOMMENDED DIMENSION OF A FILLED SANDBAG SHALL BE APPROXIMATELY 0.5 FT X 0.5 FT X 1.5 FT.

SANDBAG IMPERVIOUS DIKE

NTS



PURPOSE:

STABILIZED CONSTRUCTION ENTRANCES SHOULD BE USED AT ALL POINTS WHERE TRAFFIC WILL BE LEAVING A CONSTRUCTION SITE AND MOVING DIRECTLY ONTO A PUBLIC ROAD.

CONSTRUCTION SPECIFICATIONS:

1. CLEAR THE ENTRANCE AND EXIT AREA OF ALL VEGETATION, ROOTS, AND OTHER OBJECTIONABLE MATERIAL AND PROPERLY GRADE IT.
2. PLACE THE GRAVEL TO THE SPECIFIC GRADE AND DIMENSIONS SHOWN ON THE DETAIL, AND SMOOTH IT.
3. PROVIDE DRAINAGE TO CARRY WATER TO A SEDIMENT TRAP OR OTHER SUITABLE OUTLET.
4. USE GEOTEXTILE FABRICS BECAUSE THEY IMPROVE STABILITY OF THE FOUNDATION IN LOCATIONS SUBJECT TO SEEPAGE OR HIGH WATER TABLE.

MAINTENANCE:

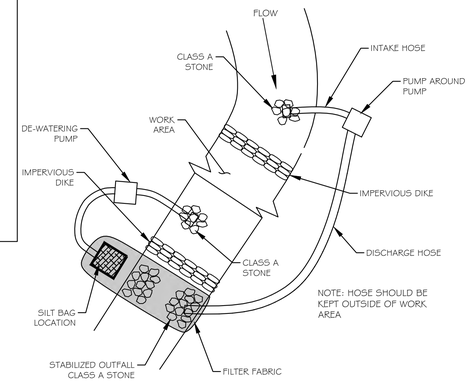
MAINTAIN THE GRAVEL PAD IN A CONDITION TO PREVENT MUD OR SEDIMENT FROM LEAVING THE CONSTRUCTION SITE. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH 2-INCH STONE. AFTER EACH RAINFALL, INSPECT ANY STRUCTURE USED TO TRAP SEDIMENT AND CLEAN IT OUT AS NECESSARY. IMMEDIATELY REMOVE ALL OBJECTIONABLE MATERIALS SPILLED, WASHED, OR TRACKED ONTO PUBLIC ROADWAYS, OR AIRFIELD PAVEMENTS.

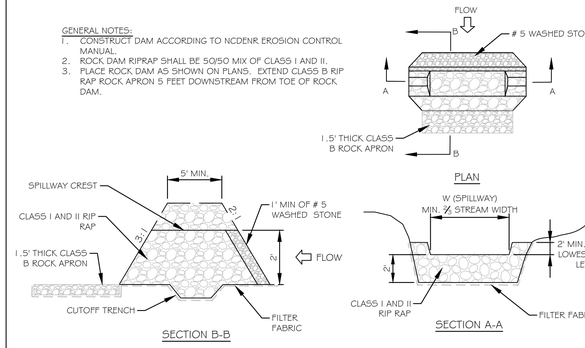
TEMPORARY GRAVEL CONSTRUCTION ENTRANCE

NTS

NOTES:
1. EXCAVATION SHALL BE PERFORMED ONLY IN DRY AND/OR ISOLATED SECTIONS OF CHANNEL.
2. IMPERVIOUS DIKES SHOULD BE USED TO ISOLATE WORK AREAS FROM STREAM FLOW.
3. THE CONTRACTOR SHALL NOT DISTURB MORE AREA THAN CAN BE STABILIZED IN ONE WORKING DAY. A MAXIMUM OF 200 FEET MAY BE DISTURBED AT ANY ONE TIME.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING PUMP SIZE SUFFICIENT TO PUMP BASE FLOW.
5. DIKE MUST BE CONSTRUCTED OF NON-ERODIBLE MATERIALS SUCH AS SANDBAGS.

SEQUENCE OF CONSTRUCTION:
1. INSTALL STILLING BASIN AND STABILIZED OUTFALL USING CLASS A RIP RAP AT THE DOWNSTREAM END OF THE DESIGNATED PROJECT WORKING AREA.
2. THE CONTRACTOR SHALL INSTALL THE PUMP AROUND PUMP AND THE TEMPORARY PIPING THAT WILL CONVEY THE BASE FLOW FROM UPSTREAM OF THE WORK AREA TO THE STABILIZED OUTFALL.
3. INSTALL UPSTREAM IMPERVIOUS DIKE AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.
4. INSTALL THE DOWNSTREAM IMPERVIOUS DIKE AND DEWATERING PUMPING APPARATUS IF NEEDED TO DEWATER THE ENTRAPPED AREA. THE PUMP AND HOSE FOR THIS PURPOSE SHALL BE OF SUFFICIENT SIZE TO DEWATER THE WORK AREA. THIS WATER WILL ALSO BE PUMPED TO AN OUTFALL STABILIZED WITH CLASS A RIP RAP.
5. THE CONTRACTOR SHALL EXCAVATE ANY ACCUMULATED SILT AND DEWATER BEFORE REMOVAL OF THE IMPERVIOUS DIKE. WHEN DEWATERING AREA, ALL DIRTY WATER MUST BE PUMPED THROUGH A SILT BAG. REMOVE IMPERVIOUS DIKES, PUMPS, AND TEMPORARY FLEXIBLE HOSE/PIPING STARTING WITH THE DOWNSTREAM DIKE FIRST.
6. ONCE THE WORKING AREA IS COMPLETED, REMOVE ALL RIP RAP AND IMPERVIOUS DIKES AND STABILIZE DISTURBED AREAS WITH SEED AND MULCH.
7. ALL WORK IN CHANNEL MUST BE COMPLETED BEFORE REMOVING IMPERVIOUS DIKE.

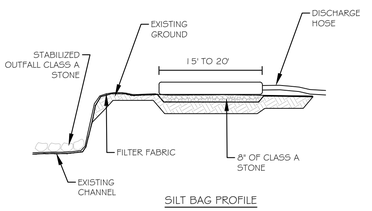




GENERAL NOTES:
1. CONSTRUCT DAM ACCORDING TO NCDENR EROSION CONTROL MANUAL.
2. ROCK DAM RIPRAP SHALL BE 50/50 MIX OF CLASS I AND II.
3. PLACE ROCK DAM AS SHOWN ON PLANS. EXTEND CLASS B RIP RAP ROCK APRON 5 FEET DOWNSTREAM FROM TOE OF ROCK DAM.

TEMPORARY ROCK CHECK DAM

NTS



SILT BAG PROFILE

PUMP AROUND & DEWATERING DETAIL

NTS

302 Jefferson Street, Suite 110
Raleigh, NC 27605
Main: 919.829.9909
Fax: 919.829.9913
www.res.us

SEAL

SCALE: AS SHOWN

MARK	DATE	REVISIONS: DESCRIPTION

RELEASED FOR: PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME: MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE: DETAILS

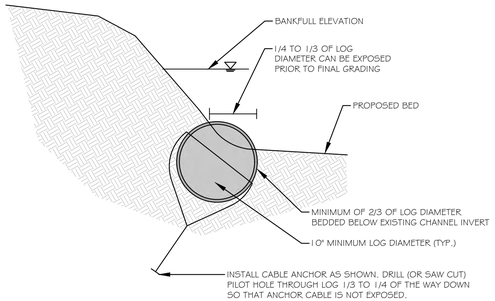
PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

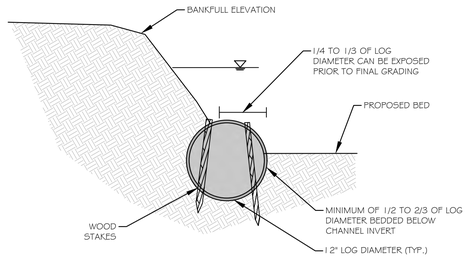
D1

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWGS\0312_SHT_DETAILS.dwg SAVED BY: Tswartzfager

NOTES:
1. LOGS SHOULD BE AT LEAST 10 INCHES IN DIAMETER, 5-8 FEET LONG, RELATIVELY STRAIGHT, AND HARDWOOD.
2. CABLE ANCHORS SHOULD BE PLACED 1' TO 3' FROM EACH END OF LOG. REBAR (5/8" MINIMUM DIAMETER 3' MIN. LENGTH TYPICAL) MAY BE USED AS A SUBSTITUTION FOR CABLE ANCHORS PER DIRECTION OF ENGINEER.
3. IF REBAR IS USED, PRE-DRILL HOLES WITH 5/8" DRILL BIT.

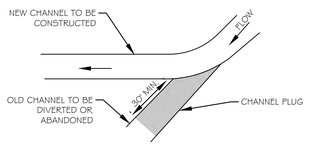


LOG TOE PROTECTION
NTS

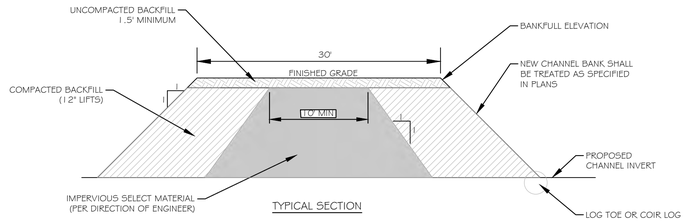


NOTES:
1. INSTALL STAKES ON 3' CENTERS ON EACH SIDE OF ROLL. TOP OF STAKE SHOULD NOT EXTEND ABOVE ROLL.
2. EXCAVATE A SMALL TRENCH (DEPTH APPROX 1/2 TO 2/3 OF LOG DIAM) FOR PLACEMENT OF ROLL.
3. COIR LOGS SHALL BE 10 FT LONG AND HAVE A DIAMETER OF 12 IN.

COIR LOG (TOE PROTECTION)
NTS

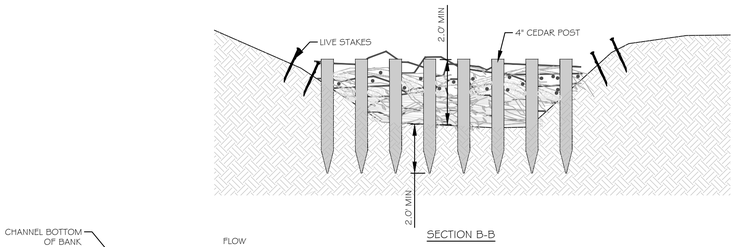


PLAN VIEW



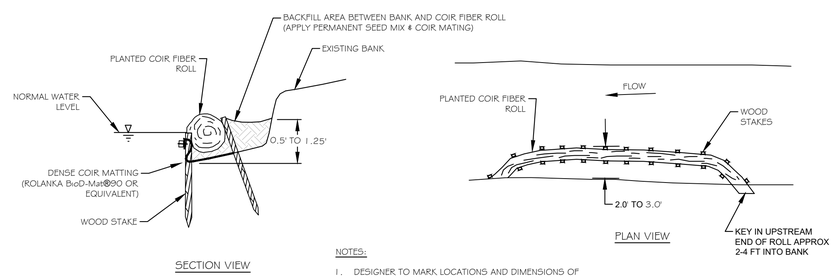
TYPICAL SECTION

CHANNEL PLUG
NTS



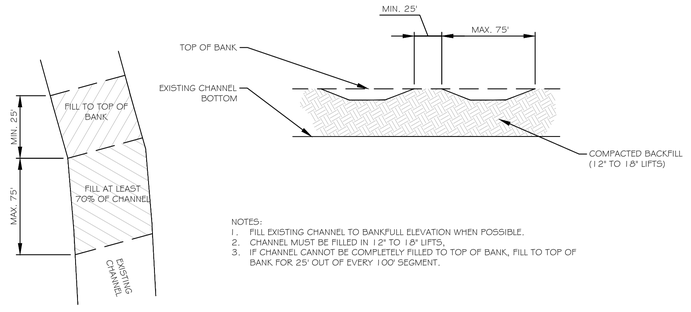
SEDIMENT TRAP
NTS

NOTES:
1. DRIVE 2 ROWS OF 4" CEDAR POSTS ON MINIMUN 3' CENTERS PAST MINIMUM DEPTH AS SHOWN.
2. FILL THE VOID BETWEEN POST ROWS W/ AN EVEN MIX OF HARDWOOD LOGS, LIMBS, AND BRUSH AS SHOWN.
3. REDUCE POST SPACING AS NEEDED TO IMPROVE STRUCTURE STABILITY.



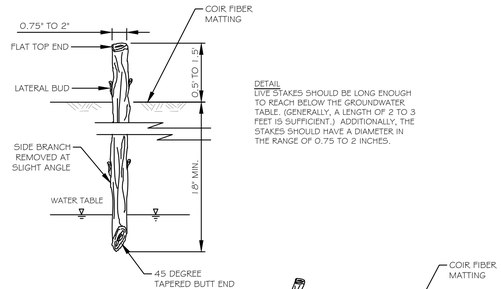
NOTES:
1. DESIGNER TO MARK LOCATIONS AND DIMENSIONS OF SILLS IN THE FIELD PRIOR TO CONSTRUCTION.
2. INSTALL STAKES ON 3' CENTERS ON EACH SIDE OF ROLL. TOP OF STAKE SHOULD NOT EXTEND ABOVE ROLL.
3. EXCAVATE A SMALL TRENCH (APPROX 2in DEEP) FOR PLACEMENT OF ROLL.

VEGETATED SILL DEFLECTOR
NTS

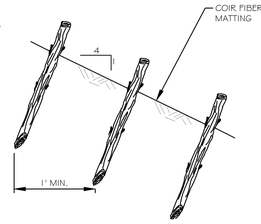


NOTES:
1. FILL EXISTING CHANNEL TO BANKFULL ELEVATION WHEN POSSIBLE.
2. CHANNEL MUST BE FILLED IN 12" TO 18" LIFTS.
3. IF CHANNEL CANNOT BE COMPLETELY FILLED TO TOP OF BANK, FILL TO TOP OF BANK FOR 25' OUT OF EVERY 100' SEGMENT.

CHANNEL BACKFILL
NTS



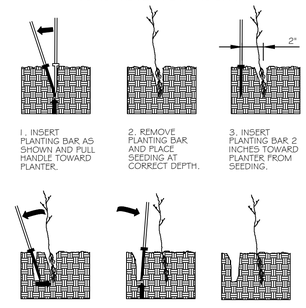
DETAIL
LIVE STAKES SHOULD BE LONG ENOUGH TO REACH BELOW THE GROUNDWATER TABLE. (GENERALLY, A LENGTH OF 2 TO 3 FEET IS SUFFICIENT.) ADDITIONALLY, THE STAKES SHOULD HAVE A DIAMETER IN THE RANGE OF 0.75 TO 2 INCHES.



NOTE:
1. ACCEPTABLE SPECIES INCLUDE BLACK WILLOW (SALIX NIGRA), SILKY WILLOW (SALIX SERICEA) AND SILKY DOGWOOD (CORNUS AMMOMUM).
2. LIVE STAKES SHALL BE PLANTED IN AN AREA EXTENDING 3 FEET OUT FROM TOP OF BANK TO JUST BELOW BANKFULL.
3. LIVE STAKES SHALL BE SPACED 3 FEET APART, ALTERNATE SPACING.

LIVE STAKE
NTS

DIBBLE PLANTING METHOD
USING THE KBC PLANTING BAR



PLANTING NOTES:

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

KBC PLANTING BAR
PLANTING BAR SHALL HAVE A BLADE WITH A TRIANGULAR CROSS SECTION, AND SHALL BE 12 INCHES LONG, 4 INCHES WIDE AND 1 INCH THICK AT CENTER.

ROOT PRUNING
ALL SEEDLINGS SHALL BE ROOT PRUNED, IF NECESSARY, SO THAT NO ROOTS EXTEND MORE THAN 10 INCHES BELOW THE ROOT COLLAR.

NOTES:
BARE ROOTS SHALL BE PLANTED 6 FT. TO 10 FT. ON CENTER, RANDOM SPACING, AVERAGING 8 FT. ON CENTER. APPROXIMATELY 680 PLANTS PER ACRE.

BARE ROOT PLANTING
NTS

res
302 Jefferson Street, Suite 110
Raleigh, NC 27605
Main: 919.829.9909
Fax: 919.829.9913
www.res.us

SEAL

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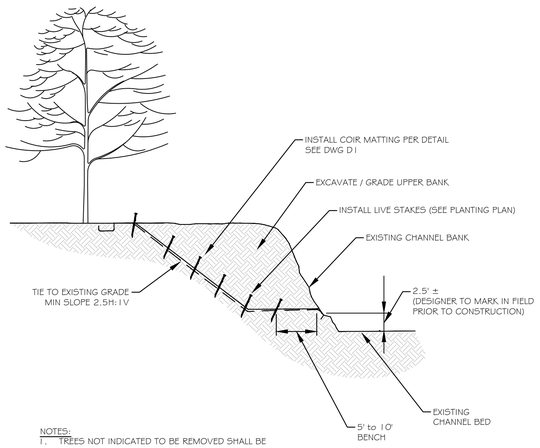
D2

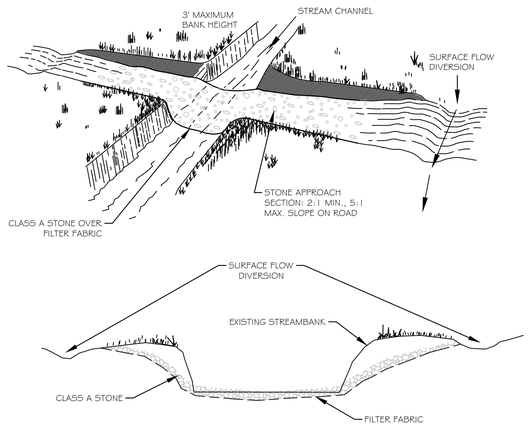
FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_DETAILS.dwg SAVED BY: Tswartzfager



NOTES:
1. TREES NOT INDICATED TO BE REMOVED SHALL BE PROTECTED DURING CONSTRUCTION IN ACCORDANCE WITH PLANS.
2. SEED AND MULCH ALL BANKS PRIOR TO INSTALLING COIR MATTING.

TYPICAL BANK GRADING

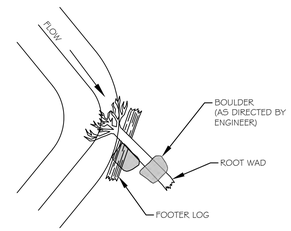
NTS



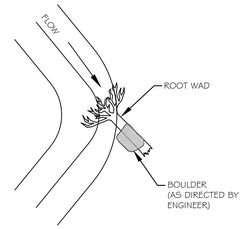
NOTES:
1. CONSTRUCT STREAM CROSSING WHEN FLOW IS LOW.
2. HAVE ALL NECESSARY MATERIALS AND EQUIPMENT ON-SITE BEFORE WORK BEGINS.
3. MINIMIZE CLEARING AND EXCAVATION OF STREAMBANKS. DO NOT EXCAVATE CHANNEL BOTTOM. COMPLETE ONE SIDE BEFORE STARTING ON THE OTHER SIDE.
4. INSTALL STREAM CROSSING PERPENDICULAR TO FLOW.
5. GRADE SLOPES TO A MINIMUM OF 2:1 SLOPE, MAXIMUM
6. MAINTAIN CROSSING SO THAT RUNOFF IN THE CONSTRUCTION ROAD DOES NOT ENTER EXISTING CHANNEL.
7. A STABILIZED PAD OF NATURAL CLASS A STONE, 6 TO 9 INCHES THICK, LINED WITH FILTER FABRIC SHALL BE USED OVER THE BERM AND ACCESS SLOPES.
8. FILTER FABRIC USED SHALL BE NCDOT TYPE 2 ENGINEERING FABRIC OR EQUIVALENT.
9. WIDTH OF THE CROSSING SHALL BE SUFFICIENT (8' MIN.) TO ACCOMMODATE THE LARGEST VEHICLE CROSSING THE CHANNEL.
10. CONTRACTOR SHALL DETERMINE AN APPROPRIATE RAMP ANGLE ACCORDING TO EQUIPMENT UTILIZED.
11. TEMPORARY CROSSINGS ARE TO BE ABANDONED IN PLACE.

FORD CROSSING

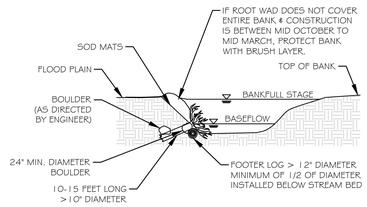
NTS



PLAN VIEW - TRENCHING METHOD



PLAN VIEW - DRIVE POINT METHOD



CROSS SECTION VIEW

DRIVE POINT METHOD:
SHARPEN THE END OF THE LOG WITH A CHAINSAW BEFORE "DRIVING" IT INTO THE BANK. ORIENT ROOT WADS UPSTREAM SO THAT THE STREAM FLOW MEETS THE ROOT WAD AT A 90-DEGREE ANGLE, DEFLECTING THE WATER AWAY FROM THE BANK. A TRANSPLANT OR BOULDER SHOULD BE PLACED ON THE DOWNSTREAM SIDE OF THE ROOT WAD IF A BACK EDDY IS FORMED BY THE ROOT WAD. THE BOULDER SHALL BE APPROXIMATELY 3' X 3' X 2'.

TRENCHING METHOD:
IF THE ROOT WAD CANNOT BE DRIVEN INTO THE BANK OR THE BANK NEEDS TO BE RECONSTRUCTED, THE TRENCHING METHOD SHOULD BE USED. THIS METHOD REQUIRES THAT A TRENCH BE EXCAVATED FOR THE LOG PORTION OF THE ROOT WAD. IN THIS CASE, A FOOTER LOG SHOULD BE INSTALLED UNDERNEATH THE ROOT WAD IN A TRENCH EXCAVATED PARALLEL TO THE BANK AND WELL BELOW THE STREAMBED. ONE-THIRD OF THE ROOT WAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS.

ROOTWAD

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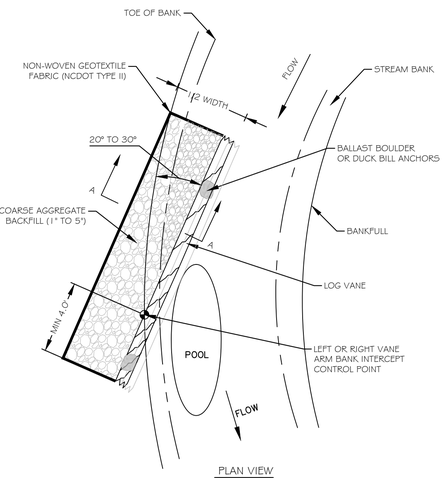
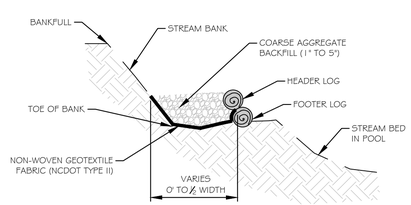


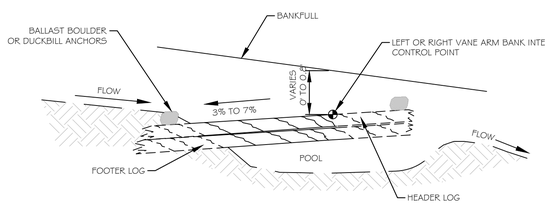
PLAN VIEW



SECTION A-A

NOTES:

1. LOG VANES SHALL BE CONSTRUCTED OF ONE OR MORE LOGS HELD IN PLACE BY EITHER BALLAST BOULDERS, DUCKBILL ANCHORS, OR REBAR. LOGS SHALL BE OF A LENGTH AND DIAMETER SPECIFIED BY THE DESIGNER AND BE RELATIVELY STRAIGHT HARDWOOD, RECENTLY HARVESTED. THE LENGTH SHALL BE SUCH THAT THE LOG IS BURIED INTO THE SOIL OF THE STREAM BANK (ON ONE END) AND STREAM BED (ON THE OTHER END) A MINIMUM DISTANCE OF 4.0'. FLAT-SIDED BALLAST BOULDERS SHALL BE OF SIZE 2' X 2' X 1.5' OR AS SPECIFIED BY THE DESIGNER.
2. THE VANE SHALL INTERCEPT THE STREAM BANK AT A HEIGHT EQUAL TO BETWEEN ½ BANKFULL STAGE AND BANKFULL STAGE. AN ELEVATION CONTROL POINT MAY BE ESTABLISHED AT THE LEFT OR RIGHT STREAM BANK/VANE INTERCEPT POINT. THE VANE INTERCEPT LOCATION MAY BE OTHERWISE DESCRIBED BY ITS RELATIONSHIP TO BANKFULL STAGE OR BY THE LENGTH AND SLOPE OF THE VANE ARM. BANKFULL IS NOT NECESSARILY THE TOP OF THE STREAM BANK SLOPE.
3. FILTER FABRIC SHALL BE USED TO SEAL THE GAPS BETWEEN THE LOGS AND UNDER THE COARSE BACKFILL MATERIAL OF THE VANE. THERE SHALL BE NO FILTER FABRIC VISIBLE IN THE FINISHED WORK; EDGES SHALL BE FOLDED TUCKED, OR TRIMMED AS NEEDED.
4. LOG VANES SHALL BE BUILT TYPICALLY AS FOLLOWS:
   A. OVER-EXCAVATE STREAM BED TO A DEPTH EQUAL TO THE TOTAL THICKNESS OF THE HEADER (AND FOOTER IF SPECIFIED) LOGS.
   B. PLACE FOOTER LOG OF THE VANE ARM IF SPECIFIED. THE SLOPE OF THE VANE ARM IS MEASURED ALONG THE VANE ARM WHICH IS INSTALLED AT AN ANGLE TO THE STREAM BANK AND PROFILE.
   C. INSTALL HEADER LOG OF THE VANE ARM ON TOP OF AND SLIGHTLY FORWARD OR BACK FROM THE FOOTER LOG.
   D. NAIL FILTER FABRIC TO THE HEADER LOG USING A GALVANIZED NAIL WITH A PLASTIC CAP. THE SIZE AND GAGE OF NAIL AND NAIL SPACING SHALL BE SPECIFIED BY THE DESIGNER.
   E. PLACE BALLAST BOULDERS OR DUCKBILL ANCHOR ON THE VANE.
   F. PLACE COARSE BACKFILL BEHIND LOGS ENSURING THAT ANY VOIDS BETWEEN THE LOGS ARE FILLED.
   G. BACKFILL REMAINDER OF VANE WITH PREVIOUSLY EXCAVATED MATERIAL.
5. IF ANY EROSION CONTROL MATTING IS SPECIFIED FOR USE IN THE VICINITY OF THE STREAM BANK/VANE INTERCEPT POINT THE MATTING EDGES SHALL BE NEATLY SECURED AROUND THE LOGS.



PROFILE VIEW

LOG VANE

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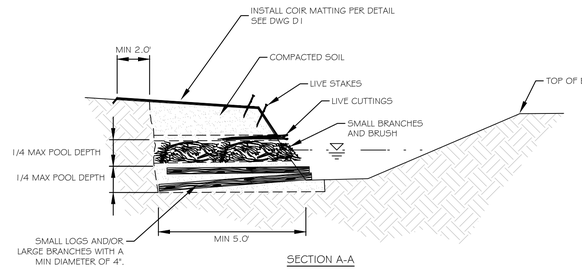
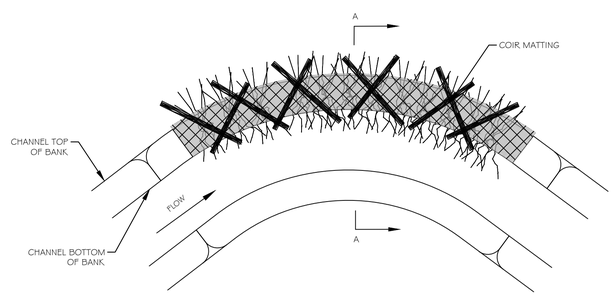


SECTION A-A

NOTES:

1. OVER EXCAVATE THE OUTSIDE BEND OF THE CHANNEL. PLACE LARGER BRANCHES AND LOGS IN A CRISS-CROSS PATTERN, LOCK IN PLACE WITH FILL COVERING 6 IN TO 18 IN OF THE LARGER BRANCHES/SMALL LOGS.
2. PLACE SMALLER BRANCHES AND BRUSH OVER THE LARGER BRANCHES/SMALL LOGS (HARDWOOD SPECIES ONLY) AND COMPACT LIGHTLY TOGETHER. BACKFILL AND COMPACT TO LOCK IN PLACE.
3. ACCEPTABLE LIVE CUTTINGS SPECIES A INCLUDE BLACK WILLOW (SALIX NIGRA) AND SILKY WILLOW (SALIX SERICEA). WILLOW CUTTINGS SHOULD BE RINSED AT CUTTING POINT TO ALLOW BETTER ROOTING.
4. INSTALL EROSION CONTROL (COIR) MATTING OVER COMPACTED SOIL PER DIRECTION OF ENGINEER.
5. INSTALL 1 TO 3 ROWS OF LIVE STAKES ABOVE THE LIVE CUTTINGS LAYER PER DIRECTION OF ENGINEER.



TYPICAL PLAN VIEW

BRUSH TOE

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SEAL

SCALE: AS SHOWN

MARK	DATE	DESCRIPTION
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PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
DETAILS

PROJECT NUMBER:	0381
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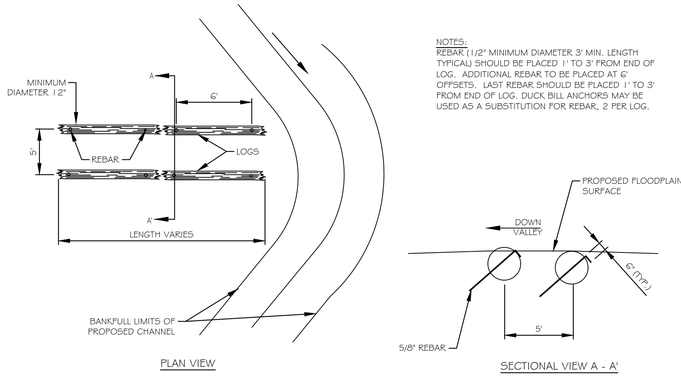
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:
D3

FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_DETAILS.dwg SAVED BY: Tswartzfager



PLAN VIEW

NOTES:
REBAR (1/2" MINIMUM DIAMETER 3' MIN. LENGTH TYPICAL) SHOULD BE PLACED 1' TO 3' FROM END OF LOG. ADDITIONAL REBAR TO BE PLACED AT 6' OFFSETS. LAST REBAR SHOULD BE PLACED 1' TO 3' FROM END OF LOG. DUCK BILL ANCHORS MAY BE USED AS A SUBSTITUTION FOR REBAR, 2 PER LOG.

SECTIONAL VIEW A - A'

FLOODPLAIN SILL

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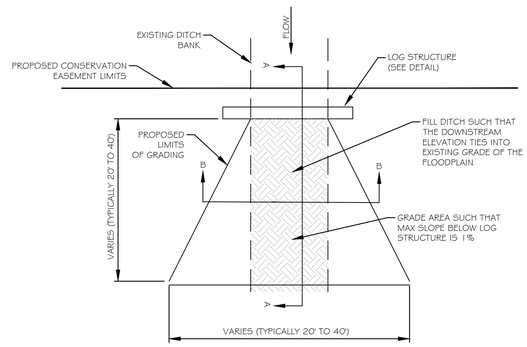
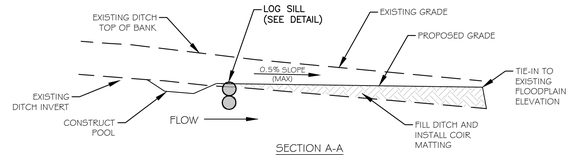
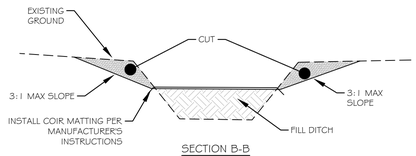


PLAN VIEW



SECTION A-A



SECTION B-B

NOTES:
1. NO FLOODPLAIN GRADING IS ALLOWED WITHIN 10 FT OF THE PROPOSED CHANNEL TOP OF BANK.
2. LOGS SHOULD BE AT LEAST 10'-20' LONG AND AT LEAST 8 INCHES IN DIAMETER, AND HARDWOOD.

DIFFUSE FLOW STRUCTURE

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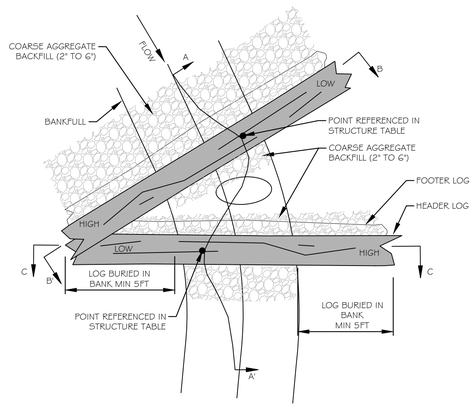
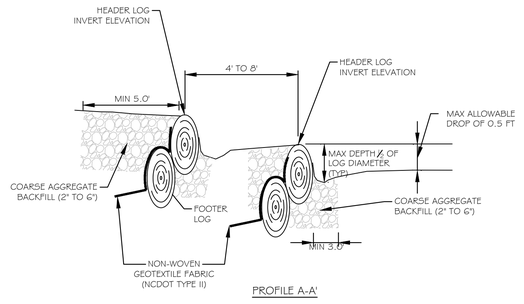
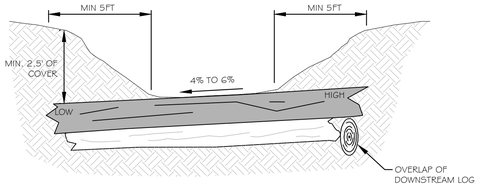


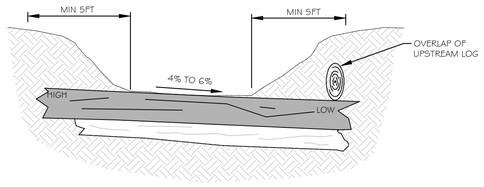
PLAN VIEW



PROFILE A-A'



PROFILE B-B'

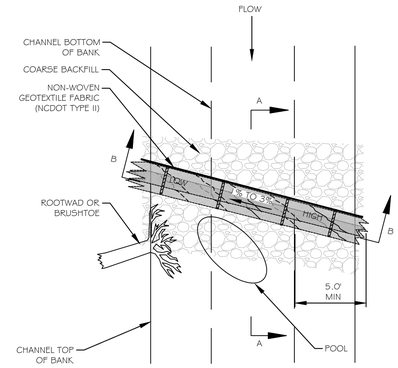


PROFILE C-C'

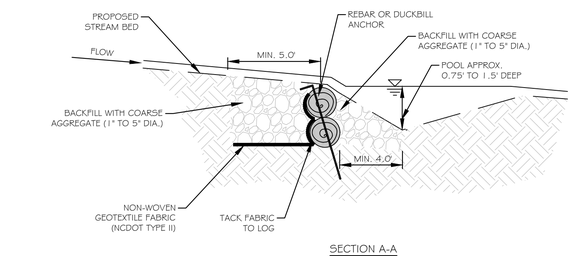
NOTES:
1. LOGS SHOULD BE RELATIVELY STRAIGHT HARDWOOD AND RECENTLY HARVESTED.
2. LOG DIMENSIONS:
   MIN DIAM. = 12", MIN LENGTH = 18'
3. NAIL FILTER FABRIC USING 3" 10D GALVANIZED COMMON NAIL EVERY 1.5' ALONG THE LOG

DOUBLE LOG DROP

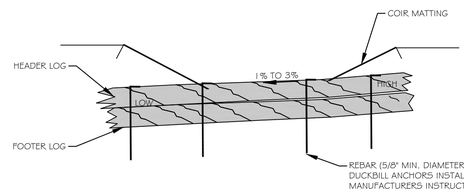
NTS



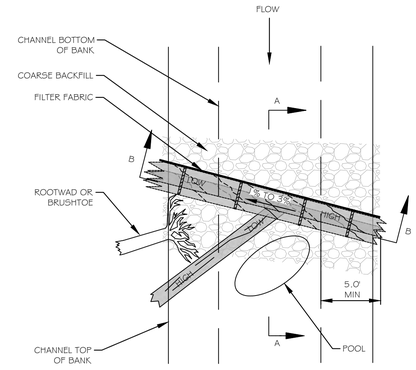
TYPICAL PLAN VIEW (OPT 1)



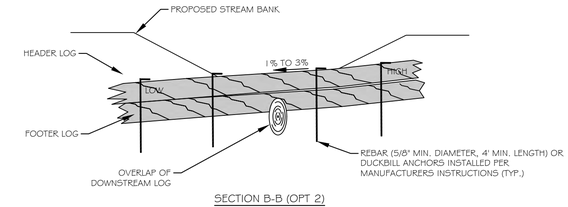
SECTION A-A



SECTION B-B (OPT 1)



TYPICAL PLAN VIEW (OPT 2)



SECTION B-B (OPT 2)

NOTES:
1. LOGS SHOULD BE RELATIVELY STRAIGHT HARDWOOD AND RECENTLY HARVESTED.
2. LOG DIMENSIONS:
   MIN DIAM. = 12", MIN LENGTH = 18'
   NAIL FILTER FABRIC USING 3" 10D GALVANIZED COMMON NAIL EVERY 1.5' ALONG THE LOG
3. DUCKBILL ANCHORS MAY BE USED IN PLACE OF REBAR.

LOG SILL

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SEAL

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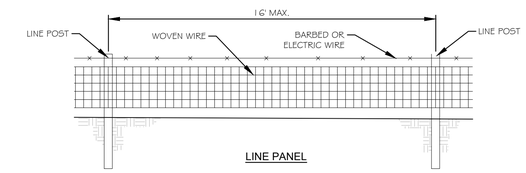
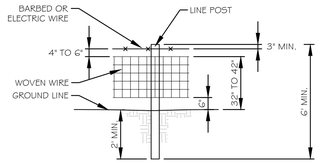
FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_DETAILS.dwg SAVED BY: Tswartzfager



LINE PANEL



WOVEN WIRE:
ASTM CLASS 3 GALVANIZED.
TOP AND BOTTOM WIRES MIN. 12 GAUGE.
INTERMEDIATE AND STAY WIRES MIN.
12 1/2 GAUGE.

WOVEN WIRE WITH ONE BARB DETAIL

NOTES:
1. LINE POSTS (WOODEN): MIN. 4 IN. DIAM. OR 4 IN. SQUARE.
2. LINE POSTS (STEEL): STUDDED OR PUNCHED T, U, OR Y SHAPED, WITH ANCHOR PLATES.
3. MIN. WEIGHT 1.3 LBS./FT. (EXCLUDING ANCHOR PLATE). POSTS SHALL BE DRIVEN A MINIMUM OF 1.6' DEEP AND MUST BE AT LEAST 5.5 FT IN LENGTH
4. SPECIES AND TREATMENT FOR ALL WOOD: USE UNTREATED DURABLE POSTS OF SPECIES SUCH AS RED CEDAR, BLACK LOCUST OR OSAGE-ORANGE WITH BARK REMOVED, OR NON-DURABLE WOOD THAT IS PRESERVATIVE PRESSURE TREATED (0.40 LBS./CUBIC FOOT CCA, OR EQUIVALENT NON-CCA TREATMENT). DO NOT USE RED PINE.

WOVEN WIRE FENCE (NRCS DETAIL 382A)

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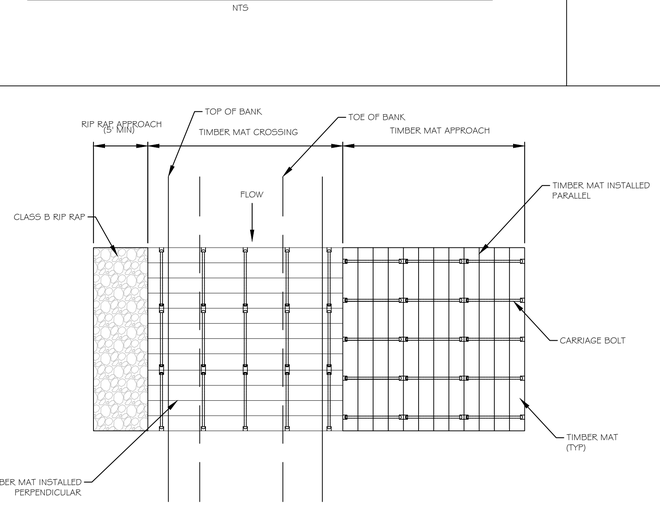
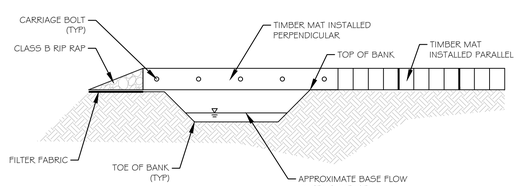


PLAN VIEW



SECTION VIEW

NOTES:
1. TIMBER MATS SHALL BE USED FOR TEMPORARY CONSTRUCTION ACCESS TO TRAVERSE WET AND/OR MUDDY ARES ADJACENT TO THE STREAM AND TO CROSS THE STREAM AND OTHER CONCENTRATED FLOW AREAS.
2. THE STREAM CROSSING SHALL BE INSTALLED WHEN FLOW IS LOW. THERE SHALL BE MINIMAL TO NO DISTURBANCE OF THE CHANNEL BED AND BANKS AS A RESULT OF INSTALLING THE APPROACHES OR CROSSING.
3. THE LENGTH OF TIMBER MAT REQUIRED TO CROSS THE STREAM OR CONCENTRATED FLOW AREAS SHALL BE SUCH THAT THE TIMBER MAT EXTENDS PAST THE TOP OF BANK ON EACH SIDE OF THE CROSSING A SUFFICIENT DISTANCE TO SUPPORT THE MAXIMUM EQUIPMENT SIZE USING THE CROSSING.
4. STREAM CROSSINGS SHALL BE INSTALLED WITH THE TIMBER MAT LENGTHS ORIENTED PERPENDICULAR TO THE TOPS OF THE STREAM BANKS. TIMBER MAT STREAM APPROACHES SHALL BE INSTALLED WITH THE TIMBER MAT LENGTHS ORIENTED PARALLEL TO THE TOPS OF THE STREAM BANKS.
5. STREAM CROSSING APPROACHES FROM DRY AREAS SHALL BE CONSTRUCTED USING CLASS B RIP RAP PLACED OVER FILTER FABRIC.
6. ALL TIMBER MATS, FILTER FABRIC, AND RIP RAP SHALL BE COMPLETELY REMOVED FROM THE SITE WHEN THE CROSSING IS REMOVED.

TIMBER MAT TEMPORARY CROSSING

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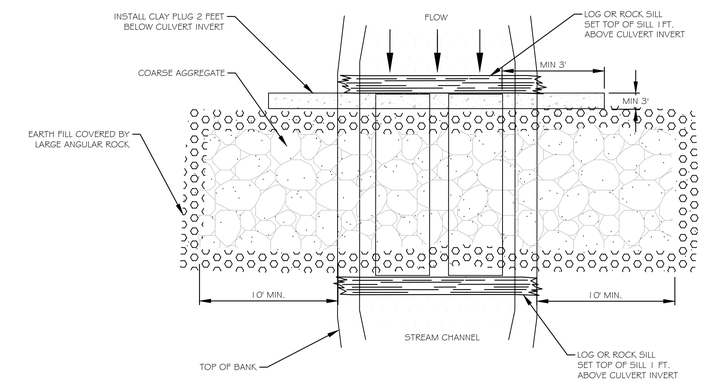
SECTION VIEW

NOTES:
1. CONSTRUCT STREAM CROSSING WHEN FLOW IS LOW.
2. INSTALL STREAM CROSSING PERPENDICULAR TO FLOW.
3. CONTRACTOR TO COORDINATE APPROPRIATE BEDDING MATERIAL WITH MANUFACTURER.
4. FILTER FABRIC USED SHALL BE NCDOT TYPE 2 ENGINEERING FABRIC OR EQUIVALENT.
5. WIDTH OF TYPICAL FARM CROSSINGS SHALL BE PER PLAN OR A MINIMUM OF 12'.
6. WHEN REQUIRED, CONTRACTOR TO ENSURE PIPE MATERIAL AND COVER MEET H-20 LOADING REQUIREMENTS.



PLAN VIEW

PROPOSED CULVERT CROSSING

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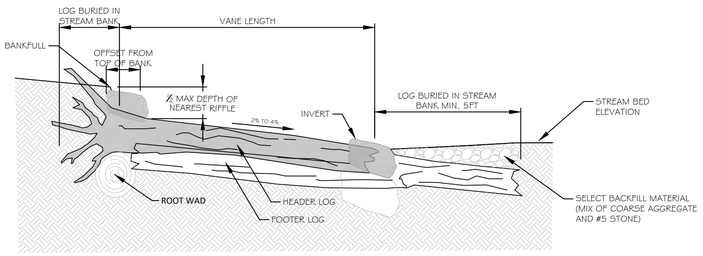
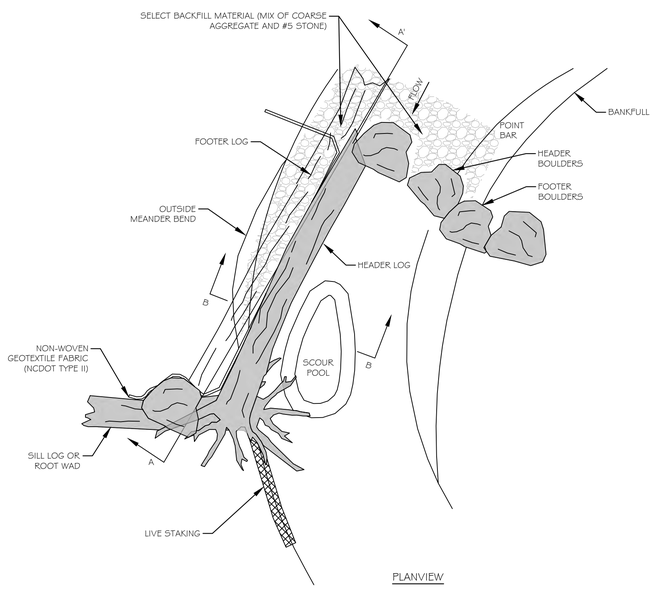


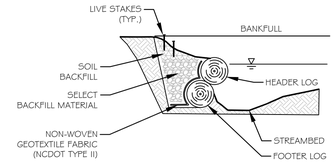
SECTION A-A'

NOTES:

1. LOGS SHALL HAVE MINIMUM DIMENSIONS AS FOLLOWS:
   MIN DIAM = 10"
   MIN LENGTH = 30'
2. ALL LOGS SHALL BE RELATIVELY STRAIGHT, HARDWOOD, AND LIMBS SHALL BE TRIMMED FLUSH.
3. FOOTER LOGS/BOULDERS ARE LOGS/BOULDER PLACED TO PROVIDE A FOUNDATION AND SCOUR PROTECTION FOR THE HEADER LOGS/BOULDERS.
4. HEADER LOGS/BOULDERS SHALL BE UNDERLAIN BY FOOTER LOGS/BOULDERS UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
5. HEADER LOGS ARE THE TOP MOST LOGS USED IN EACH LOG STRUCTURE. ALL HEADER LOGS CAN BE SEEN PROTRUDING FROM THE WATER SURFACE DURING EXTREMELY LOW FLOWS.
6. HEADER LOGS SHALL BE OFFSET SLIGHTLY DOWNSTREAM OF THE FOOTING LOGS WHERE SCOUR POOLS ARE ANTICIPATED TO FORM AS SHOWN IN THE DETAIL.
7. SILL LOGS SHALL BE PLACED PERPENDICULAR TO THE BANKFULL FLOW DIRECTION.
8. THE FOOTER LOGS SHALL EXTEND FROM THE SILL LOG TO THE END OF THE HEADER LOG TOWARD THE BANK.
9. HOOK BOULDERS SHALL EXTEND FROM THE HEADER LOG TO BEYOND BANKFULL WIDTH.
10. SET INVERTS AT ELEVATION SHOWN ON THE PLAN AND PROFILE SHEETS.
11. HEADER LOG SHALL TIE INTO THE STREAM BANK AT A MAXIMUM ELEVATION OF ½ DMAX (MEASURED AT THE NEXT DOWNSTREAM RIFFLE) BELOW BANKFULL ELEVATION AND A MINIMUM ELEVATION OF ½ DMAX (MEASURE AT THE NEXT DOWNSTREAM RIFFLE) BELOW BANKFULL ELEVATION UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
12. CUTTING OF THE SILL LOG ROOTWAD BAY BE REQUIRED TO PREVENT THE ROOTWAD FROM PROTRUDING ABOVE THE BANKFULL ELEVATION.
13. ALL GAPS/VOIDS LARGER THAN 1 INCH BETWEEN THE HEADER AND FOOTING LOGS SHALL BE CHINKED WITH LIMBS AND/OR BRUSH ON THE UPSTREAM SIDE PRIOR TO PLACEMENT OF THE GEOTEXTILE.
14. ALL GAPS/VOIDS LARGER THAN 1 INCH BETWEEN THE HEADER AND FOOTING BOULDERS SHALL BE CHINKED WITH GRAVEL AND COBBLES.
15. ON THE UPSTREAM SIDE OF THE LOGS AND/OR BOULDERS, NON-WOVEN GEOTEXTILE FABRIC SHALL BE PLACED AS SHOWN IN PLANVIEW AND IN SECTION B-B'. PLACE SELECT BACKFILL FOR THE ENTIRE LENGTH OF THE LOG AND BOULDER HOOK.
16. BACKFILL STRUCTURE WITH SELECT BACKFILL MATERIAL AS SHOWN SHOWN IN PLANVIEW AND IN SECTION B-B'.
17. SELECT BACKFILL AND SOIL BACKFILL MATERIAL SHALL BE COMPACTED SUCH THAT FUTURE SETTLEMENT OF THE MATERIAL IS KEPT TO A MINIMUM.
18. NAIL NON-WOVEN GEOTEXTILE USING 3" 10D GALVANIZED COMMON NAIL TO EDGE OF HEADER LOG AND BACKFILL AS SHOWN IN THE GEOTEXTILE PLACEMENT AND SELECT BACKFILL DETAIL.



PLANVIEW



SECTION B-B'

LOG J-HOOK

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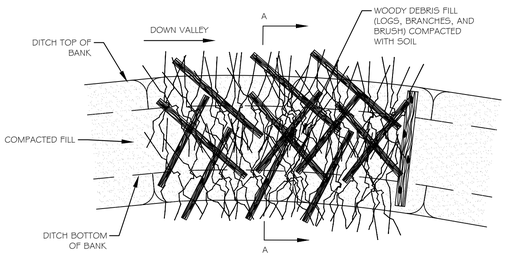
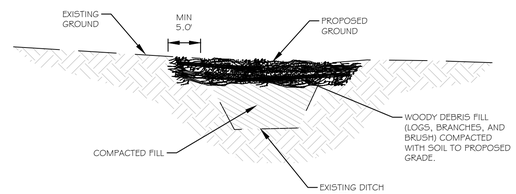
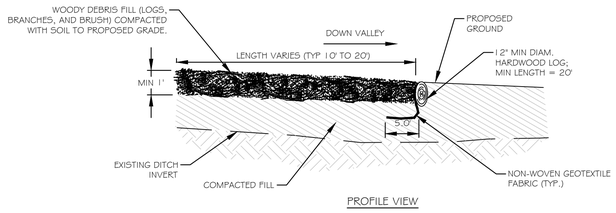


TYPICAL PLAN VIEW



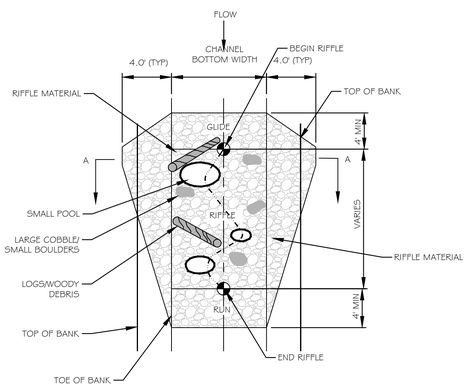
SECTION A-A



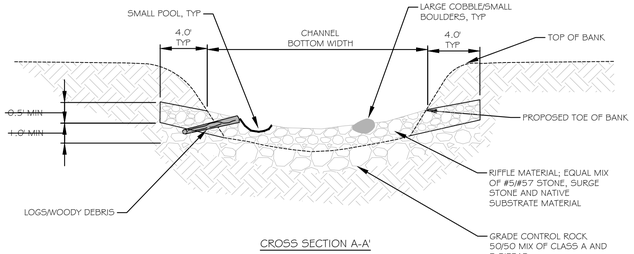
PROFILE VIEW

BRUSH BED SILL

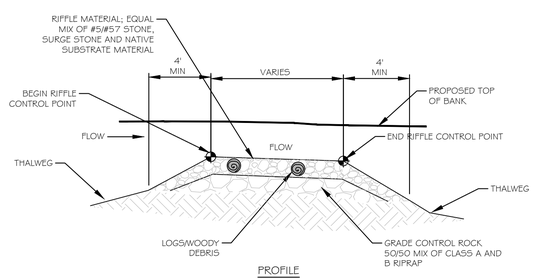
NTS



PLAN VIEW



CROSS SECTION A-A'



PROFILE

CONSTRUCTED RIFFLE

NTS

NOTES:

1. CONSTRUCTED RIFFLES SHALL BE INSTALLED IN NEWLY GRADED CHANNEL SECTIONS, AS SPECIFIED BY THE DESIGNER.
2. ELEVATION CONTROL POINTS SHALL BE DESIGNATED AT THE BEGINNING AND END OF RIFFLE POINTS TO ESTABLISH PART OF THE PROFILE OF THE CHANNEL. SURVEY OF CONTROL POINTS SHALL BE REQUIRED TO ESTABLISH ACCURATE RIFFLE INSTALLATION WITHIN A TOLERANCE OF ±0.2'.
3. GRADE CONTROL ROCK SHALL BE COMPRISED OF A 50/50 MIX OF CLASS A AND B RIPRAP. GRADE CONTROL ROCK SHALL BE PLACED SUCH THAT THE ADDITION OF THE SPECIFIED THICKNESS OF RIFFLE MATERIAL SHALL ACHIEVE THE DESIGNATED GRADES.
4. RIFFLE MATERIAL SHALL BE COMPRISED OF ROCKS AND WOOD. THE ROCK MATERIAL SHALL CONSIST OF AN EQUAL MIX OF #5 / #57 STONE, SURGE STONE AND NATIVE SUBSTRATE MATERIAL. RIFFLE MATERIAL SHALL BE EXCAVATED, STOCKPILED, AND RE-USED FROM ABANDONED CHANNEL SECTIONS. OTHERWISE ROCK RIFFLE MATERIAL SHALL BE SLIGHTLY ROUNDED, "RIVER-TYPE" ROCK, UNLESS OTHER ROCK CHARACTERISTICS ARE APPROPRIATE FOR THE CHANNEL. IN ADDITION, LOGS AND WOODY DEBRIS SHALL BE INCLUDED WITH THE ROCK MATERIAL AS SPECIFIED BY THE DESIGNER.
5. THE PLACEMENT OF GRADE CONTROL ROCK AND/OR RIFFLE MATERIAL SHALL BE DONE IN A MANNER TO CREATE A SMOOTH PROFILE, WITH NO ABRUPT "JUMP" (TRANSITION) BETWEEN THE UPSTREAM POOL-GLIDE AND THE RIFFLE, AND LIKEWISE NO ABRUPT "DROP" (TRANSITION) BETWEEN THE RIFFLE AND THE DOWNSTREAM RUN-POOL. THE FINISHED CROSS SECTION OF THE RIFFLE MATERIAL SHALL GENERALLY MATCH THE SHAPE AND DIMENSIONS SHOWN ON THE RIFFLE TYPICAL SECTION WITH SOME VARIABILITY OF THE THALWEG LOCATION AS A RESULT OF THE SMALL POOLS AND LOGS.
6. THE END OF RIFFLE CONTROL POINT MAY TIE IN TO ANOTHER IN-STREAM STRUCTURE (LOG SILL OR J-HOOK).
7. THE CONSTRUCTED RIFFLE SHALL BE KEYED IN TO THE STREAM BANKS AND/OR BED AS DESIGNATED BY THE DESIGNER. THE "KEY" SHALL EXTEND BEYOND THE TOP OF BANK AT THE BEGINNING (CREST) OF THE RIFFLE. WHERE PRESERVATION OF EXISTING STREAM BANK VEGETATION IS A PRIORITY A "KEY" MAY NOT BE USED (OR THE DIMENSIONS MAY BE ADJUSTED) TO LIMIT DISTURBANCE.

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SEAL

SCALE: AS SHOWN

MARK	DATE	DESCRIPTION

REVISIONS:

RELEASED FOR:

PRELIMINARY - NOT FOR CONSTRUCTION

PLOT DATE: 11/12/2018

PROJECT NAME:
MOCKINGBIRD SITE
DAVIE COUNTY, NORTH CAROLINA

DRAWING TITLE:
DETAILS

PROJECT NUMBER:	0381
PROJECT MANAGER:	CSC
DESIGNED:	AFM
DRAWN:	TRS
CHECKED:	AFM

SHEET NUMBER:

D6

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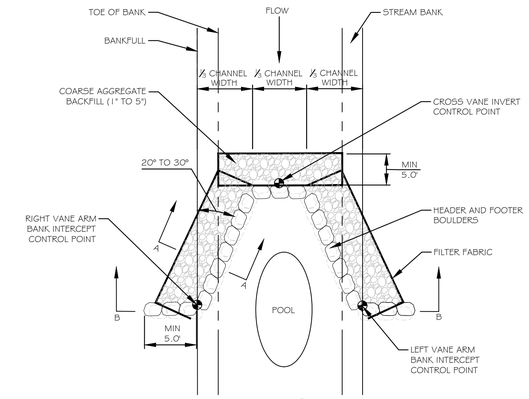
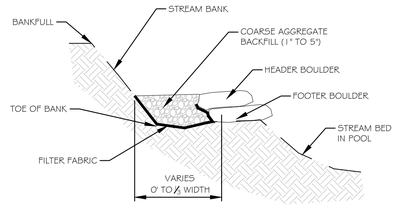
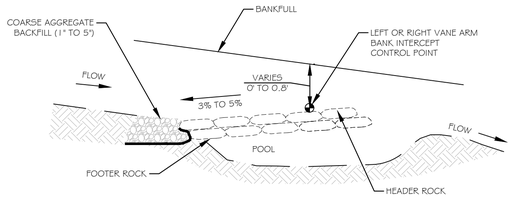


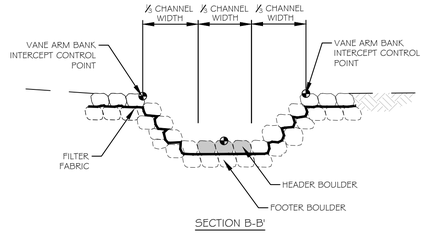
PLAN VIEW



SECTION A-A'



PROFILE VIEW



SECTION B-B'

ROCK CROSS VANE

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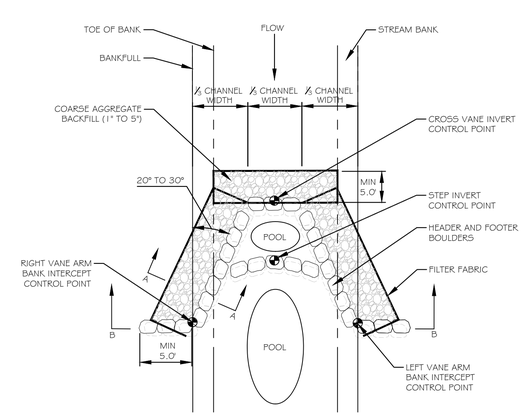
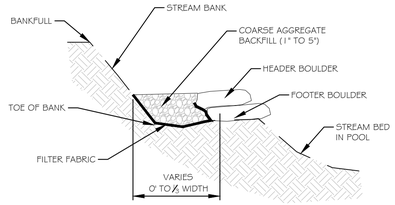
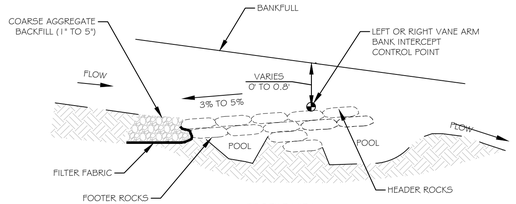


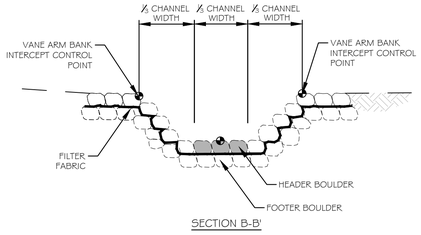
PLAN VIEW



SECTION A-A'



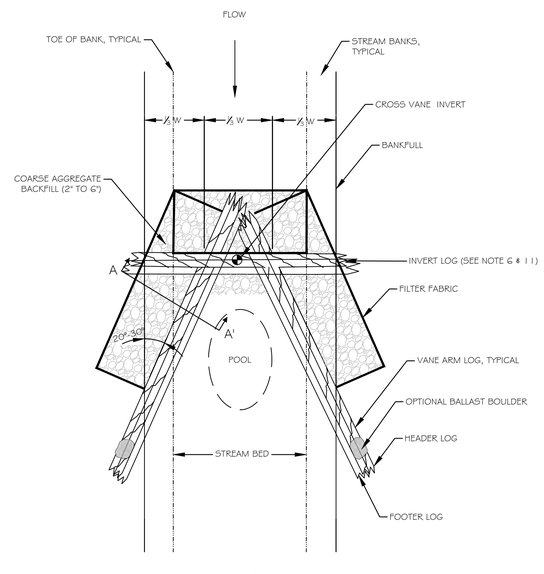
PROFILE VIEW



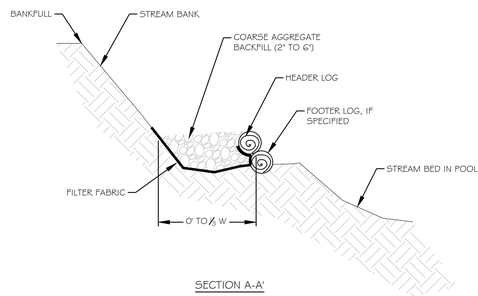
SECTION B-B'

ROCK A-VANE

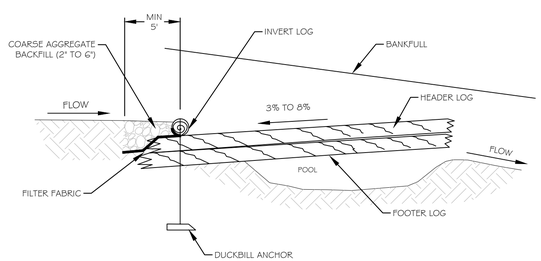
NTS



PLAN VIEW



SECTION A-A'



PROFILE VIEW

NOTES:
1. LOGS SHALL BE OF A MINIMUM OF 12' IN LENGTH AND 10" IN DIAMETER AND RELATIVELY STRAIGHT HARDWOOD, RECENTLY HARVESTED.
2. A SINGLE LOG MAY BE USED IN LIEU OF A HEADER/FOOTER LOG COMBINATION, PER DIRECTION OF DESIGNER.
3. FILTER FABRIC SHALL BE USED TO SEAL THE GAPS BETWEEN THE LOG(S) AND THE STREAM BED, UNDER THE COARSE BACKFILL MATERIAL. THERE SHALL BE NO FILTER FABRIC VISIBLE IN THE FINISHED WORK; EDGES SHALL BE FOLDED, TUCKED, OR TRIMMED AS NEEDED.
4. COARSE BACKFILL SHALL BE PLACED TO A THICKNESS EQUAL TO THE DEPTH OF THE HEADER (AND ANY FOOTER) LOGS AND SHALL EXTEND OUT FROM THE VANE ARMS TO THE STREAM BANK AND UPSTREAM.
5. AS AN OPTION, FLAT-SIDED BOULDERS MAY BE PLACED AS BALLAST ON TOP OF THE STREAM BANK SIDE OF THE EMBEDDED VANE ARMS. DUCK BILL ANCHORS MAY BE USED IN LIEU OF BALLAST BOULDERS.
6. DUCKBILL ANCHORS WITH GALVANIZED CABLE ATTACHED MAY BE USED TO SECURE LOGS INTO THE STREAM BED AND/OR BANKS. FLAT SIDED BOULDERS CAN BE USED IN LIEU OF THE LOG INVERT/DUCKBILL ANCHOR SYSTEM.

LOG CROSS VANE

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SEAL

SCALE: AS SHOWN

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DAVIE COUNTY, NORTH CAROLINA

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FILE NAME:S:\@RES GIS\Projects\NC\Mockingbird\CAD\DWG\0312_SHT_DETAILS.dwg SAVED BY: Tswartzfager

Appendix B –
Data/Analysis/Supplementary Information

IRT Meeting Notes

MEMORANDUM

Date: September 29, 2017

Re: Mockingbird Site Post-Contract IRT Site Visit Meeting Minutes
CU: 03040101
DMS Project No.: 100021
DEQ Contract No.: 7185
County: Davie
Location: 36.029909° N, -80.503020° W, Spillman Road
DMS Project Manager: Harry Tsomides

Meeting Summary
Date: August 15, 2017
RES Attendees: Daniel Ingram, Cara Conder, David Godley, Daniel Ramsay
DMS Attendees: Paul Wiesner, Harry Tsomides, Kirsten Ullman
IRT Attendees: Todd Tugwell (USACE), Mac Haupt (NCDWR), Olivia Munzer (NCWRC)

General Summary: IRT members generally agreed the Mockingbird Site is suitable to provide compensatory stream mitigation credits. IRT members also confirmed the technical approach, and ratios proposed as appropriate. No adjustment to contracted credit amounts are expected. IRT members requested any changes in technical approach between the proposal and mitigation plan be clearly communicated in the mitigation plan. Specific discussions related to each reach are discussed below.

Reaches TP1, TP2, TP3, HC2-A, and HC2-B: These reaches are proposed as Enhancement II within the upper portion of the project area. IRT members agreed with that approach and 2.5:1 credit ratio. IRT members requested flow monitoring gauges on headwater reaches to document 30 days of continuous flow, regardless of JD status. Cattle exclusion is being provided through landowner agreement. No fencing is proposed. Todd Tugwell expressed some concern for that approach long-term but did not object in principle regarding the Mockingbird project. Several small isolated wetland areas were discussed but are not expected to impact the project implementation.

Reach HC2-C: This reach was proposed as Enhancement I, however, Mac Haupt suggested Restoration may be more appropriate based on the level of impairment. RES will evaluate the final technical approach based on survey and detailed assessment data.

Reach HC2-D: IRT members discussed several potential approaches to this forested reach. Generally, the upper two meanders are incised and unstable on outside bends. Todd Tugwell suggested stabilizing these upper meanders could generate EI credit (1.5:1) and preservation is appropriate downstream. Another potential option is preservation on the entire reach, with wider

buffers, and photo documentation of stability in monitoring (10:1 ratio). RES will determine the final approach in design phase to maximize uplift and minimize damage to mature riparian forest. All IRT members agreed that including this reach in the project has value.

Reach HC1: This reach is proposed as Restoration. IRT members generally agreed with the restoration approach. P1 vs P2 approach was discussed in the context of the proposed RES Scout Bank Site located on Hauser Creek between HC1 and HC2-D. RES proposes to permit and construct the two sites in sequence to allow for a P1 approach on Reach HC1, providing higher functional lift and less risk of failures.

Reaches NM1 and NM4: Both of these reaches are proposed as EII. IRT members did not provide any direct feedback on these reaches but generally accepted their suitability for EII credit due to livestock exclusion and buffer plantings. Similar to other small headwater reached RES will provide flow duration monitoring tied to success criteria.

Reaches NM2, NM3, and JS1: These reaches are proposed as P1 restoration. IRT members generally agreed with the restoration approach. It was noted that the upstream limits may require a P2 approach blended into P1 at the confluence with Hauser Creek. No specific comments were provided by the IRT on these reaches.

Vegetation Survey

Protocol for Existing Conditions Vegetation Surveying

Plot Selection and Setup

Survey multiple plots on-site, which together are representative of all ecotypes present within the easement boundaries. Each plot is a 5m X 20m belt transect, positioned parallel to the channel in the floodplain or adjacent upland.

Take a GPS point at the origin and set the bounds with 5m as the "x-axis" and 20m as the "y-axis." Set the plot with the y-axis as the side parallel to the stream channel. Record the y-axis azimuth to allow for future resampling. Conclude selection and set-up with a representative photo of the plot taken from the origin.

Data Collection

Identify each plant in the plot to the species level. Sort and measure tree species by height class and diameter at breast height (DBH). Count seedlings <54in (137cm) in height into height categories 0-9cm, 10-50cm, 51-100cm, or 101-137cm. Count saplings >54in (137cm) in height into DBH categories 0-1cm, 1-2.5cm, 2.5-5cm, or 5-12.7cm. Measure the DBH of all trees ≥5in (12.7cm) DBH. Shrubs, vines, and herbaceous taxa receive an estimation of their percent cover over the substrate within the plot. If the personnel are unable to identify to the species level, collect voucher photos and/or specimen(s) for later identification. Record these on the data sheet as UNK-1, UNK-2, etc.

Data Processing

Begin processing collected data by identifying the unknown species observed from voucher photos and specimen(s) collected. When species present are sufficiently identified, use the dominant canopy species assemblages and ecological region to identify a habitat type from Schafale (2012).

Calculate both basal area and stems per acre for each plot surveyed using the formulas below. These metrics help to inform the existing conditions of the canopy on-site and inform the development of the project's planting plan.

Basal Area Formula:

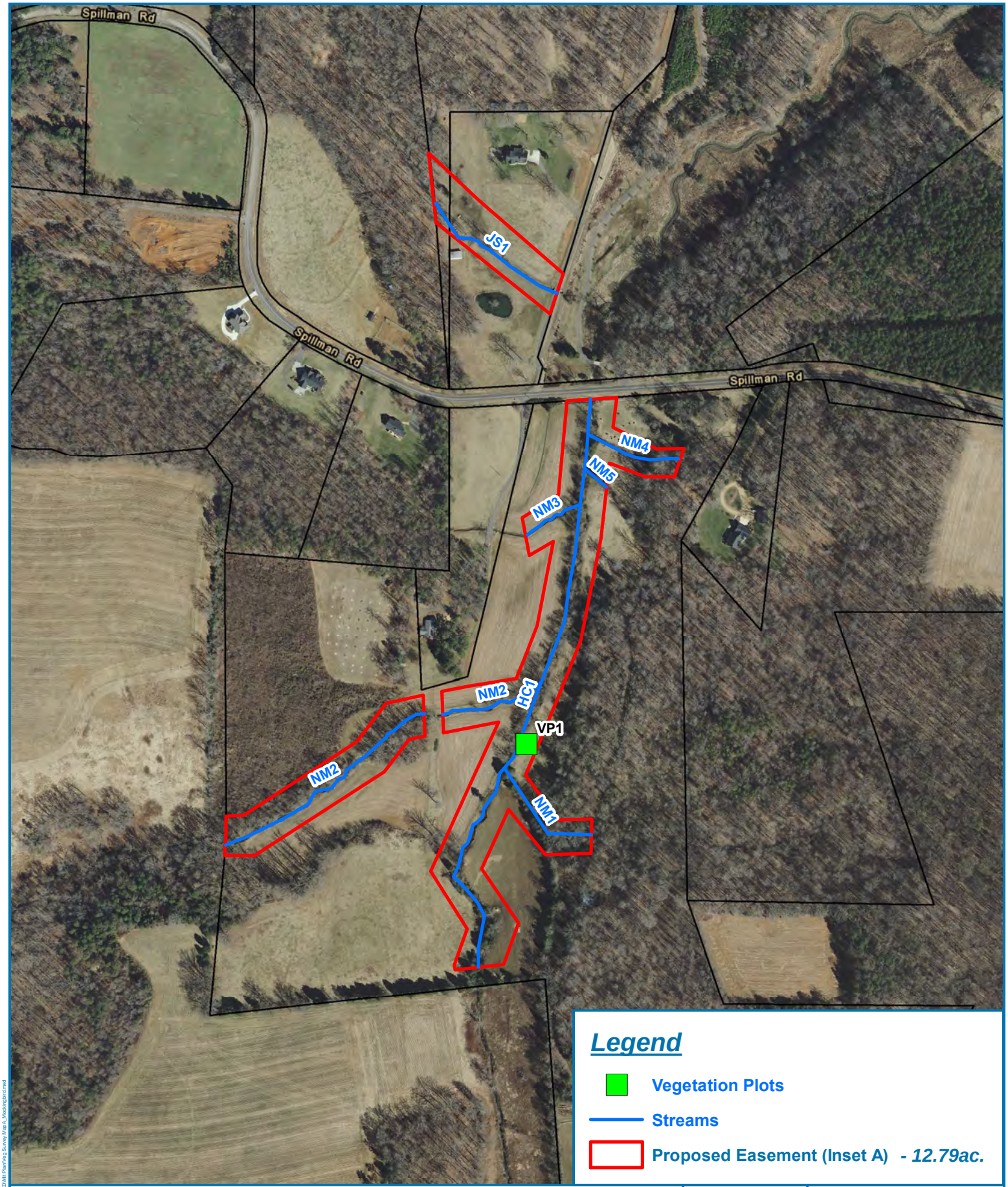
Basal area of each tree (m2) = 0.00007854 X (DBHcm)2

Basal area of plot (m2/ha) = (sum of basal areas for all trees in plot) X 100

- 100 is to scale up from our 0.01ha plot to 1ha

Stems per Acre Formula:

Stems/Acre = (# of stems)/0.02471



Legend

- Vegetation Plots
- Streams
- Proposed Easement (Inset A) - *12.79ac.*

0 200 400
Feet

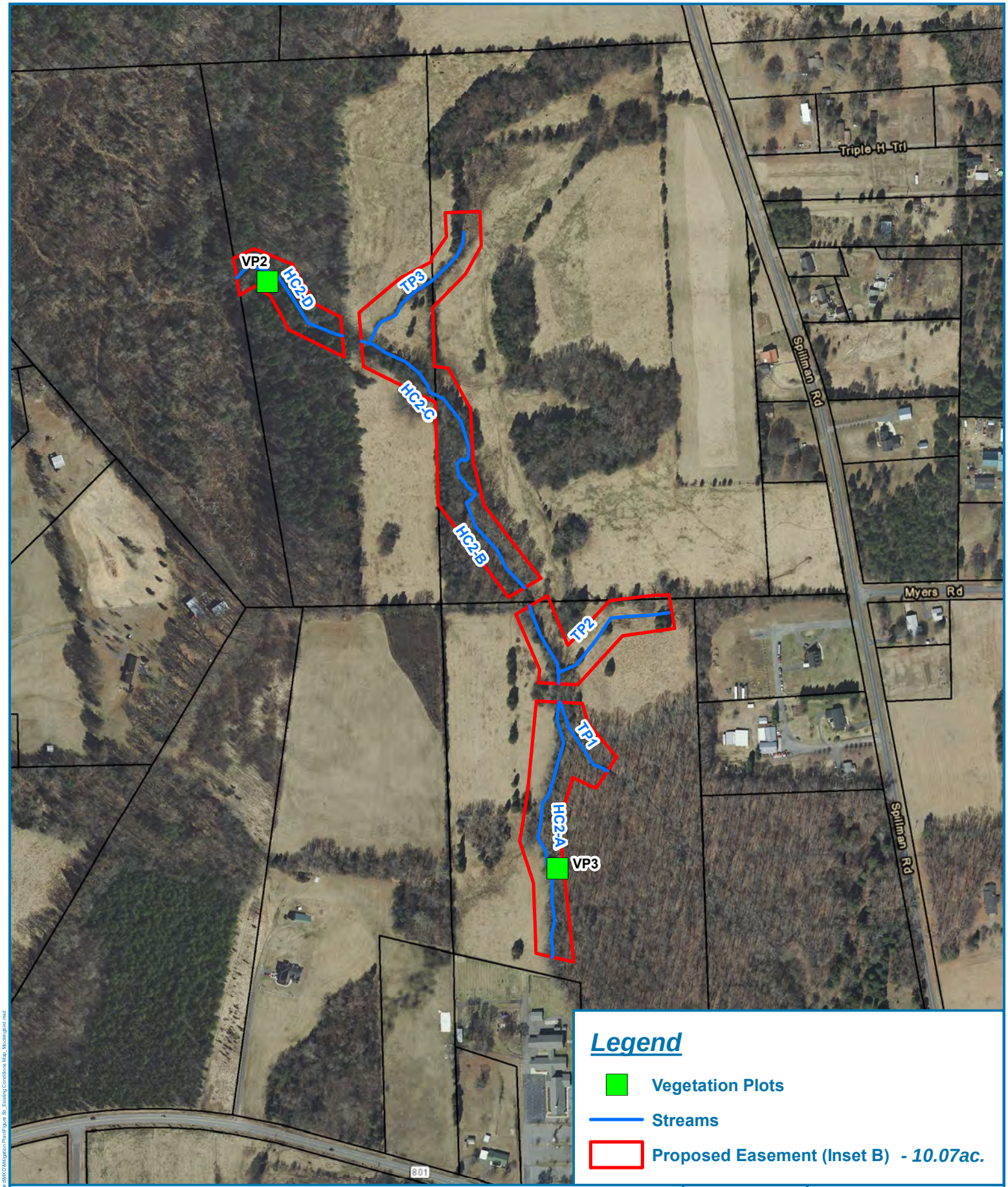
Existing Vegetation Survey Plot Locations (North)

Mockingbird Mitigation Site

Davie County, North Carolina

Date: 5/24/2018
Drawn by: EWT
Checked by: ATP

Document Path: S:\@RES GIS\Projects\NC\Scout\MXD\Mit Plan\Veg Survey Maps_Mockingbird.mxd



Legend

- Vegetation Plots
- Streams
- Proposed Easement (Inset B) - *10.07ac.*

N
W E
S

0 200 400
Feet

Existing Vegetation Survey Plot Locations (South)

Mockingbird Mitigation Site

Davie County, North Carolina

Date: 5/24/2018
Drawn by: EWT
Checked by: ATP

res

Document Path: S:\@RES GIS\Projects\NC\Mockingbird\MXD\Mitigation Plan\Figure 9b_ Existing Conditions Map_ Mockingbird.mxd

Existing Conditions Vegetation Survey	Date: 4/3/18	Latitude:	NOTES: NEXT TO HCI Basal area = 0m2/ha Stems per acre = 0
Site: **Mockingbird**	Plot: VP3	Longitude:	
Personnel: EWT, MDE		Azimuth: 10°	

Species	Form			SEEDLINGS - Height Classes				SAPLINGS - DBH		TREE - DBH						Est. % Cover
	T	S	H	0-9cm (0-3.5in)	10-50cm (3.6-19.7in)	51-100cm (19.8-39.4in)	101-137cm (39.5-54in)	0-1cm (0-0.4in)	1-2.5cm (0.5-1in)	2.5-5cm (1-2in)	5-12.7cm (2-5in)	>10cm = Measure Size (>5in)				Record 5% to 100% in increments of 5; <5% for anything below
Boxelder	X															
Black Walnut																60%
Privet		X														60%
Japanese Honeysuckle	Vine															5%
Plantain			X	Lamium amplexicaule & Lamium purpureum												<1%
Fescue	Grass															60%
Vetch			X	Vicia sativa												<1%
Unknown #1			X	Ranunculus repens												10%
Unknown mint			X	Cardmine flexuosa												<1%
Rubus		X														<1%
Bedstraw			X	Galium aparine												<1%
Speedwell			X	Veronica persica												<1%
Multiflora Rose		X														1%
Vitus			X													<1%
Strawberry Invas.			X	Duchesnea indica												<1%
geranium sp			X	Geranium carolinianum												

*List unidentified species starting with UNK-1; Take pics and/or pressings for later ID

Existing Conditions Vegetation Survey	Date: 4/3/18	Latitude:	NOTES: preservation area; HC2-D Basal area = 23.59m^2/ha Stems per acre = 202.35
Site: Mockingbird	Plot: 6	Longitude:	
Personnel: EAT MDE JRM		Azimuth: 340°	

Species	Form			SEEDLINGS - Height Classes				SAPLINGS - DBH		TREE - DBH						Est. % Cover
	T	S	H	0-9cm (0-3.5in)	10-50cm (3.6-19.7in)	51-100cm (19.8-39.4in)	101-137cm (39.5-54in)	0-1cm (0-0.4in)	1-2.5cm (0.5-1in)	2.5-5cm (1-2in)	5-12.7cm (2-5in)	>10cm = Measure Size (>5in)				Record 5% to 100% in increments of 5; <5% for anything below
Boxelder	✓			75 →		100				•						
Musclewood Carpinus caroliniana	✓			•••	•			•	•			8.3	6	6	5.7	
Bradford pear	✓			••		•										
red cedar	✓			•	••											
red maple	✓			•	•											
Flowering Dogwood	✓									••						
Southern Red oak	✓											17.1				
Red Bud	✓						•	••		•						
Sugar Berry	✓				•											
~~Sugar~~ Maple (?)	✓							•								
Japanese honeysuckle			✓													10%
crane fly orchid				Tipularia discolor												<1
onion grass chives				Allium vineale												5%
Bedstraw				Galium aparine												<1
unknown grass #3				Eragrostis sp.												2%
cinquefoil				Potentilla canadensis												<1
christmas tree fern																<1
unknown #6 VP #1				Ranunculus spp.												<1
partridge berry				Mitchella repens												<1
rattlesnake fern				Botrypus virginianus												<1

*List unidentified species starting with UNK-1; Take pics and/or pressings for later ID

unknown invasive #5 ground cover from little Sebastian rel (VP #1)	<1	Euonymus fortunei
unknown herb 2 (VP #1)	<1	Botrypus virginianus
Multiflora rose	<1	
Privet (shrub)	5%	
English Ivy	<1	
unknown herb #3 (VP #2)	<1	Geum canadense

Existing Conditions Vegetation Survey	Date: 4/3/18	Latitude:	NOTES: Basal area = 76.19m^2/ha Stems per acre = 283.29
Site: Mockingbird H2C-A	Plot: 7	Longitude:	
Personnel: EWT MDE JRM		Azimuth: 30	

Species	Form			SEEDLINGS - Height Classes				SAPLINGS - DBH		TREE - DBH						Est. % Cover
	T	S	H	0-9cm (0-3.5in)	10-50cm (3.6-19.7in)	51-100cm (19.8-39.4in)	101-137cm (39.5-54in)	0-1cm (0-0.4in)	1-2.5cm (0.5-1in)	2.5-5cm (1-2in)	5-12.7cm (2-5in)	>10cm = Measure Size (>5in)				Record 5% to 100% in increments of 5; <5% for anything below
Black Gum	✓									*		3.5				
Red Maple											*	5.4				
N Red oak												17.9				
willow oak												16.1	16.6			
- ?																
White Oak												18.7	13.8	8.9		
Winged elm / Ironwood				•					•	•• ••	•• ••					
Red Cedar	/			••	•	•										
MayApple			X	Podophyllum peltatum												2%
Japanese Honeysuckle			X													10%
Carex Tartia			X													1-2%
Multiflora rose																<1
Bradford pear	X			•												<1
Unknown Herb #1			X	Ranunculus arbortivus												<1
crane fly				Tipularia discolor												<1
Unknown Herb #3 VP2				Geum canadense												<1
																<1

*List unidentified species starting with UNK-1; Take pics and/or pressings for later ID

Morphological Parameters

Mockingbird **Morphological Parameters**

	Existing																							
	HC1			HC2A		HC2B		HC2C		HC2D	JS1		NM1	NM2		NM3	NM4	TP1		TP2		TP3	
Feature	Riffle			Riffle	Pool	Pool	Riffle	Riffle		Riffle	Riffle	Pool	Riffle	Riffle		Riffle	Riffle	Riffle	Pool	Riffle	Riffle	Riffle	Pool
Drainage Area (ac)	1319			55		151		194		207	221		20	330		74	27	45		20		20	
Drainage Area (mi^2)	2.06			0.09		0.24		0.30		0.32	0.35		0.03	0.52		0.12	0.04	0.07		0.03		0.03	
NC Regional Curve Discharge (cfs)[2]	150.9			14.8		31.0		37.3		39.1	41.0		7.1	54.9		18.4	8.8	12.8		7.1		7.1	
NC Regional Curve Discharge (cfs)[3]	153.1			16.0		32.9		39.3		41.1	43.1		7.8	57.2		19.8	9.7	13.9		7.8		7.8	
Design/Calculated Discharge (cfs)	-			-		-		-		-	-		-	-		-	-	-		-		-	
Dimension																							
BF Cross Sectional Area (ft^2)	40.0	23.0	38.0	6.0	10.0	18.9	11.9	14.0	11.6	12.1	14.4	14.7	16.9	17.8	23.0	3.9	2.7	3.6	3.2	3.0	3.1	4.3	
BF Width (ft)	20.0	11.9	15.4	11.7	10.7	18.3	11.7	16.9	12.6	12.2	8.8	8.6	10.6	10.0	9.3	6.7	4.8	9.3	5.3	6.1	8.0	14.7	
BF Mean Depth (ft)	2.0	1.9	2.5	0.5	0.9	1.0	1.0	0.8	0.9	1.0	1.6	1.7	1.6	1.8	2.5	0.6	0.6	0.4	0.6	0.5	0.4	0.3	
BF Max Depth (ft)	3.2	3.7	3.8	0.8	1.4	1.8	1.2	1.3	1.5	1.3	3.0	3.8	2.8	2.6	4.0	1.4	1.0	0.7	0.8	1.2	0.5	0.4	
Wetted Perimeter (ft)	22.3	14.4	18.3	12.0	12.1	18.9	12.5	17.9	13.2	13.1	12.0	12.8	12.4	12.2	12.7	7.4	5.4	9.8	6.0	6.7	8.2	14.8	
Hydraulic Radius (ft)	1.8	1.6	2.1	0.5	0.8	1.0	0.9	0.8	0.9	0.9	1.2	1.2	1.4	1.5	1.8	0.5	0.5	0.4	0.5	0.5	0.4	0.3	
Width/Depth Ratio	10.1	6.1	6.2	22.9	11.4	17.8	11.6	20.3	13.7	12.2	5.4	5.0	6.6	5.6	3.8	11.4	8.5	24.1	9.0	12.2	21.0	50.3	
Floodprone Width (ft)	27.4	30.0	50.0	19.0	11.9	25.0	15.0	21.4	30.0	28.0	10.7	15.7	>30	20.7	>30	21.9	17.0	15	11	15.0	11	24	
Entrenchment Ratio	1.4	2.5	3.2	1.6	1.1	1.4	1.3	1.3	2.4	0.0	1.2	1.8	>2.2	2.1	>2.2	3.3	3.5	1.6	2.1	2.5	1.4	1.6	
Bank Height Ratio	1.8	1.8	1.8	1.6	-	-	2.0	2.1	1.5	2.1	1.1	-	1.0	2.4	1.1	0.8	1.0	1.0	1.3	1.1	2.1	2.5	
Bed Material																							
Description (D50)	Silt/Sand			Cobble		Cobble		Cobble		Cobble	Sand		Sand/Gravel	Sand/Gravel		Gravel	Silt/Sand	Gravel/Cobble		Silt		Silt	
D16 (mm)	-			-		-		-		-	0.72		-	0.74		0.062	0.062	-		-		-	
D50 (mm)	-			-		-		-		-	1.3		-	2.3		1.7	0.062	-		-		-	
D84 (mm)	-			-		-		-		-	2		-	29		13	1.4	-		-		-	

Pattern	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Profile	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Shallow Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Run Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glide Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool -to-Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Additional Reach Parameters													
Valley Length (ft)	1925	1159	586	487	380	470	229	1089	190	260	124	433	473
Channel Length (ft)	2135	1344	673	569	563	465	229	1219	198	286	157	450	525
Sinuosity	1.11	1.16	1.15	1.17	1.48	0.99	1.00	1.12	1.04	1.10	1.27	1.04	1.11
Water Surface Slope (ft/ft)	0.0051	-	0.011	-	-	0.0095	-	0.0042	-	-	-	-	-
Channel Slope (ft/ft)	0.0028	0.0170	0.0092	0.0139	0.0102	0.0065	0.0128	0.0076	0.0250	0.0289	0.0167	0.0357	0.0257
Rosgen Classification	E5	B3c	F3	F3/C3	C3	E5	E4	E4	C4	E6b	B3c	C6b	B6

[1] Bankfull stage was estimated using NC Regional Curve equations and existing conditions data

[2] NC Regional Curve equations source: Doll et al. (2003)

[3] NC Regional Curve equations source: Sweet and Geratz (2003)

Mockingbird **Morphological Parameters**

	Reference Reach				Design									
	UT to Grassy Creek		UT to Hauser Creek		NM2		NM3		HC1		HC2B		JS1	
Feature	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool
Drainage Area (ac)	426		29		330		74		1324		194		220	
Drainage Area (mi^2)	0.67		0.05		0.52		0.12		2.07		0.30		0.34	
NC Regional Curve Discharge (cfs)[2]	66.2		9		54.9		18.4		151.4		37.3		40.8	
NC Regional Curve Discharge (cfs)[3]	68.6		10		57.2		19.8		153.5		39.3		42.9	
Design/Calculated Discharge (cfs)	**50**		**5-7**		**46-53**		**9-10**		**129**		**40-47**		**25-48**	
Dimension														
BF Cross Sectional Area (ft^2)	18.1	23.4	3.0	4.2	25.3	33.2	4.7	6.1	47.0	61.0	16.4	21.7	19.4	23.8
BF Width (ft)	13.7	15.0	5.2	5.6	16	17.2	6.4	6.9	21.8	23.5	12.6	13.5	13.5	14.4
BF Mean Depth (ft)	1.4	1.6	0.6	1.2	1.6	1.9	0.7	0.9	2.2	2.6	1.3	1.6	1.4	1.7
BF Max Depth (ft)	1.7	2.7	0.8	2.1	2.2	3.4	1.0	1.4	2.9	4.5	1.8	2.8	1.9	2.9
Wetted Perimeter (ft)	14.9	16.8	5.6	11.0	17.0	19.7	6.9	7.9	23.3	26.8	13.5	15.6	14.5	16.6
Hydraulic Radius (ft)	1.2	1.4	0.5	1.0	1.5	1.7	0.7	0.8	2.0	2.3	1.2	1.4	1.3	1.4
Width/Depth Ratio	9.8	9.6	8.9	7.5	10.1	8.9	8.7	7.8	10.1	9.1	9.7	8.4	9.4	8.7
Floodprone Width (ft)	>50	---	>30	---	50	26.5	30	30	50	26.5	50	26.5	50	26.5
Entrenchment Ratio	>2.2	---	>4	---	3.1	1.5	4.7	4.3	2.3	1.1	4.0	2.0	3.7	1.8
Bank Height Ratio	1.0	1.1	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Bed Material														
Description (D50)	Gravel		Gravel		Sand/Gravel		Cobble/Gravel		Cobble/Gravel		Cobble/Gravel		Sand/Gravel	
D16 (mm)	2.8		1.1		-		-		-		-		-	
D50 (mm)	11		3.7		-		-		-		-		-	
D84 (mm)	16		25		-		-		-		-		-	
Pattern														
	Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Channel Beltwidth (ft)	26.3	55.5	15.0	35.0	33	60	18	43	45	82	26	47	28	51
Radius of Curvature (ft)	13.5	103.3	6.0	17.0	28	75	7	21	38	103	22	59	24	64
Radius of Curvature Ratio	1.0	6.9	1.2	3.0	1.8	4.4	1.1	3.0	1.7	4.4	1.7	4.4	1.8	4.4
Meander Wavelength (ft)	49.4	66.0	23.0	43.0	69	91	28	53	95	123	55	71	59	76
Meander Width Ratio	3.6	4.4	4.4	7.7	2.1	3.5	4	6.2	2.1	3.5	4	3.5	2.1	5
Profile														
	Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Shallow Length (ft)	6	18	4	18	7	21	4	22	10	29	6	17	6	18
Run Length (ft)	7	16	2	8	8	19	4	10	11	26	6	15	7	16
Glide Length (ft)	5	13	3	8	6	15	3	10	8	21	5	12	5	13
Pool Length (ft)	5	42	3	10	6	49	4	12	8	67	5	39	5	42
Pool -to-Pool Spacing (ft)	18	64	12	35	21	75	15	43	29	103	17	59	18	64
Additional Reach Parameters														
Valley Length (ft)	279		146		1348		240		1925		487		470	
Channel Length (ft)	318		185		1366		280		2083		595		500	
Sinuosity	1.14		1.27		1.01		1.17		1.08		1.22		1.06	
Water Surface Slope (ft/ft)	0.004		1.69		0.0026		0.013		0.003		0.005		0.0036	
Channel Slope (ft/ft)	0.004		0.0130		0.0026		0.0130		0.0030		0.0050		0.0036	
Rosgen Classification	E4		E4		E4/E5		E3/E4		E3/E4		E3/E4		E4/E5	

[1] Bankfull stage was estimated using NC Regional Curve equations and existing conditions data

[2] NC Regional Curve equations source: Doll et al. (2003)

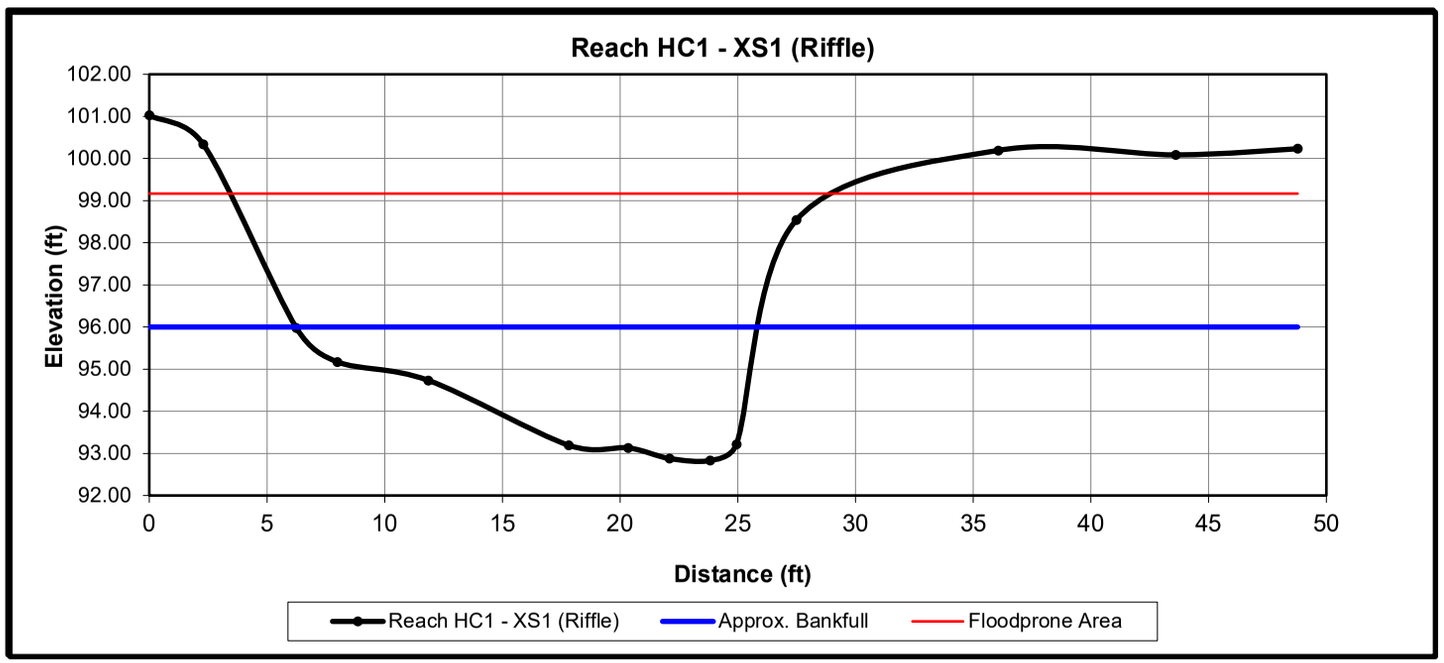
[3] NC Regional Curve equations source: Sweet and Geratz (2003)

Mocking Bird					
Reach	**HC1**	**HC2-B**	**JS1**	**NM2**	**NM3**
DA (ac)	1324	194	220	330	74
DA (sqmi)	2.07	0.30	0.34	0.52	0.12
Ex. Conds XSs					
~ Q_{BKF}	**129**	**40-47**	**25-48**	**46-53**	**9-10**
FFQ Analysis					
$Q_{1.1}$	125	43	47	58	26
$Q_{1.5}$	204	68	73	92	39
Q_{2}	257	88	95	119	52
Q_{10}	613	190	205	263	106
Piedmont Regional Curves					
NC-$Q_{BKF\ (1)}$	154	39	43	57	20
NC-$Q_{BKF\ (2)}$	151	37	41	55	18
VA-Q_{BKF}	87	14	16	23	6
SCS (Hydraflow Hydrographs with 6 hour duration and a PSF of 484)					
Q_{1}	97	33	7	23	3
Q_{2}	181	56	14	48	6
Q_{5}	350	100	37	100	18
Q_{10}	510	138	64	151	29
Q_{25}	758	195	111	228	48
SCS (Hydraflow Express with 24 hour duration and a PSF of 484)					
Q_{1}	357	112	43	115	22
Q_{2}	596	168	90	194	43
Q_{5}	1005	260	182	331	81
Q_{10}	1357	336	734	448	730
Q_{25}	1869	444	390	619	165
USGS RR Eqns (Region 1)					
$Q_{2(1996\ EQNS)}$	238	63	69	91	32
$Q_{2(2001\ EQNS)}$	225	58	64	85	30
Q_{2}	253	73	79	103	39
Q_{5}	465	140	151	195	76
Q_{10}	623	191	206	264	105
Q_{25}	834	261	281	359	145
Q_{50}	1022	323	348	444	181
Recommended Design Flows =					
$Q_{bnkfull}$	**145**	**43**	**40**	**50**	**11**
~ Q_{BKF} / FFQ $Q_{1.1}$	1.031	1.083	0.860	0.860	0.431
Hydraflow Avg	139	44	10	36	5
% FFQ $Q_{1.1}$	1.16	0.99	0.86	0.86	0.43
% RC	0.96	1.15	0.98	0.91	0.60

Cross Sections of Current Conditions & Reference Reaches

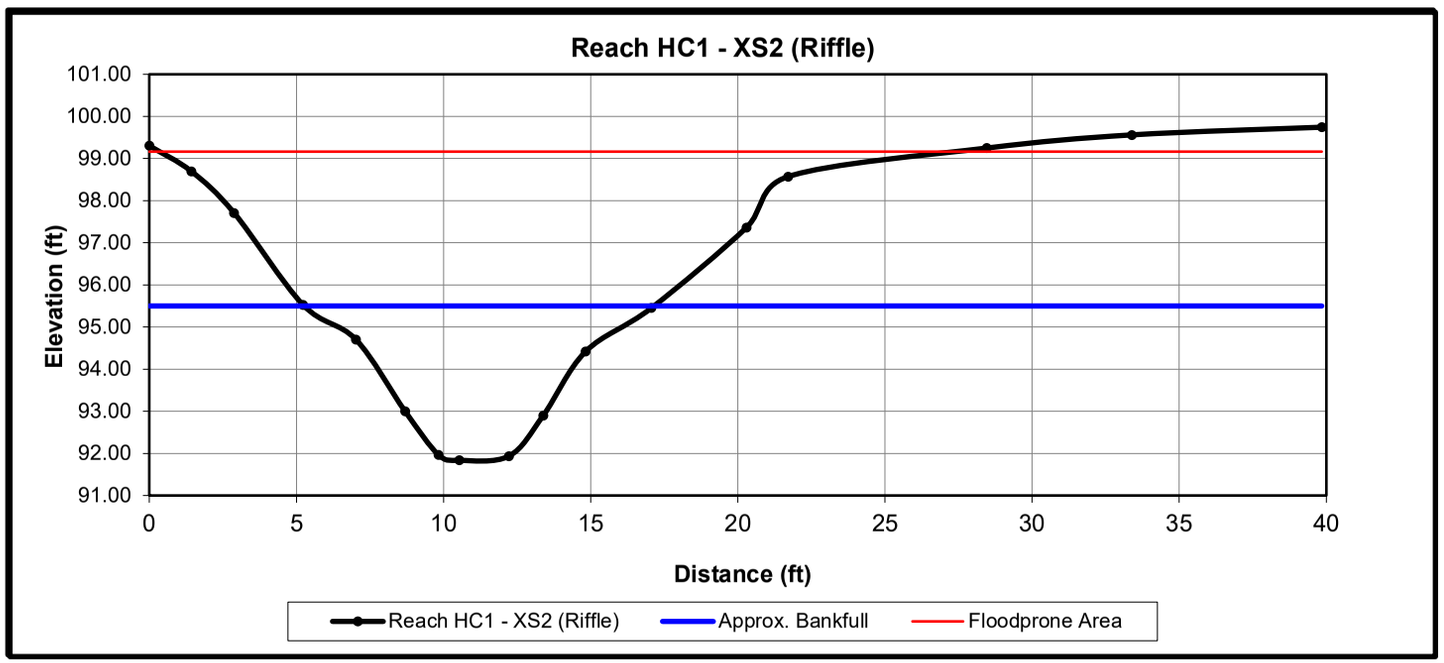
Right Bank

Downstream



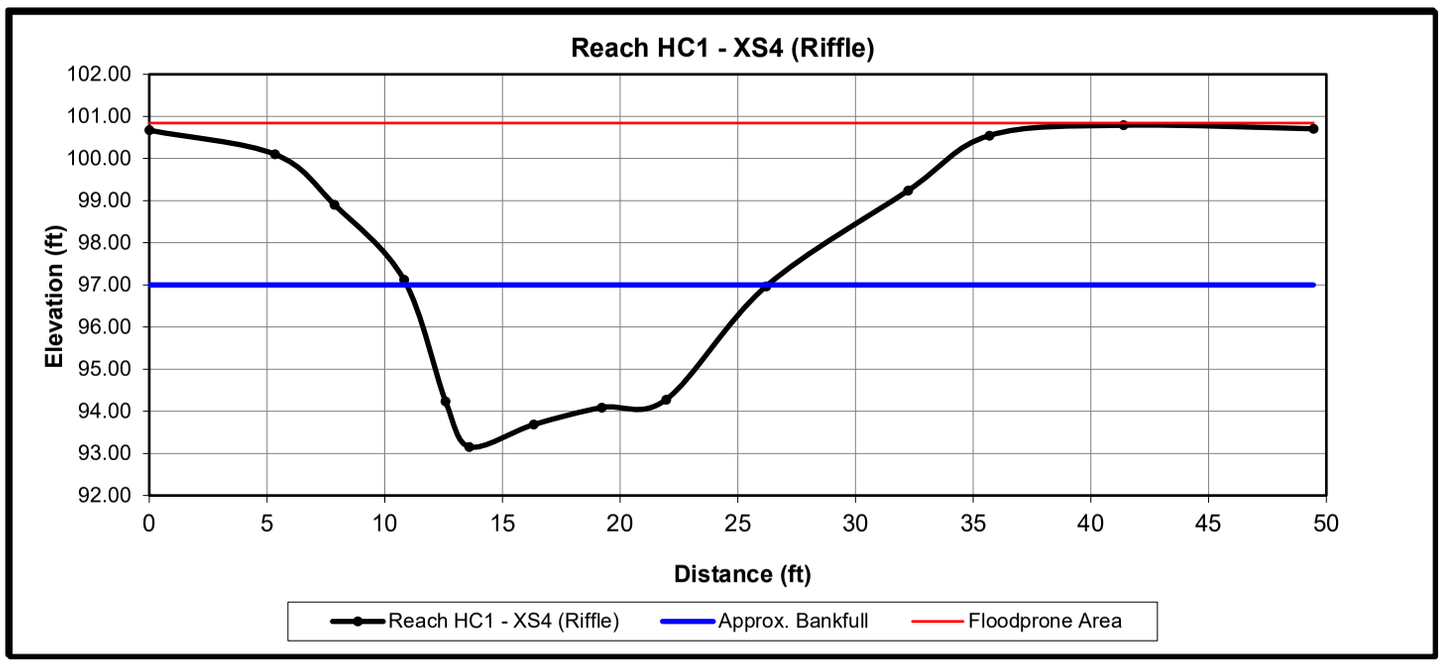
Upstream

Downstream



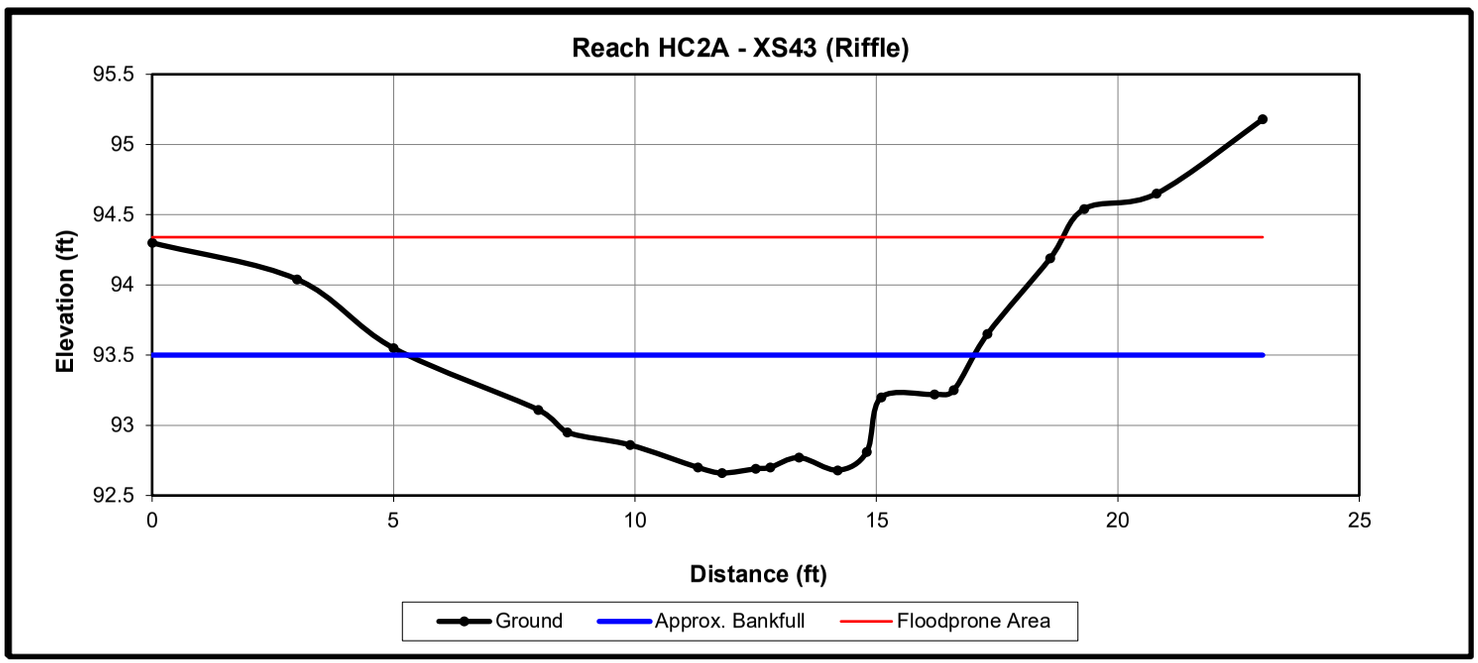
Upstream

Downstream



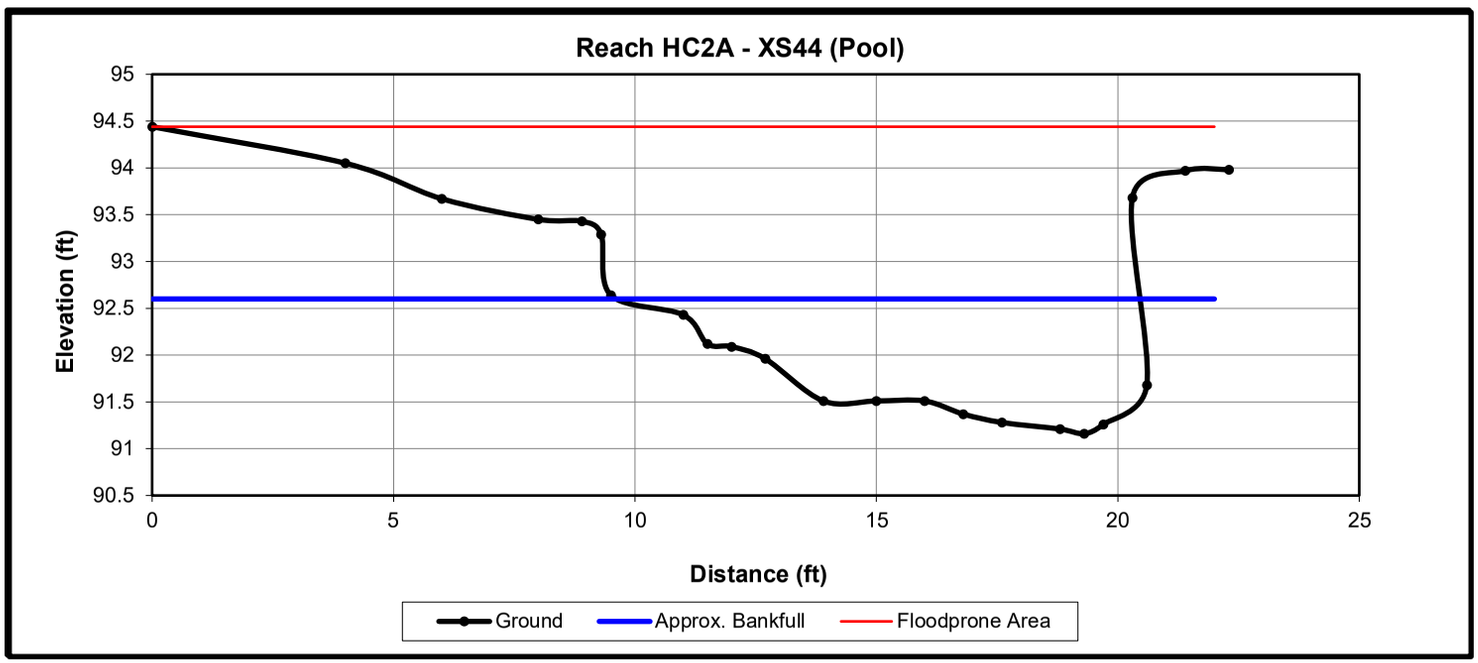
Upstream

Downstream



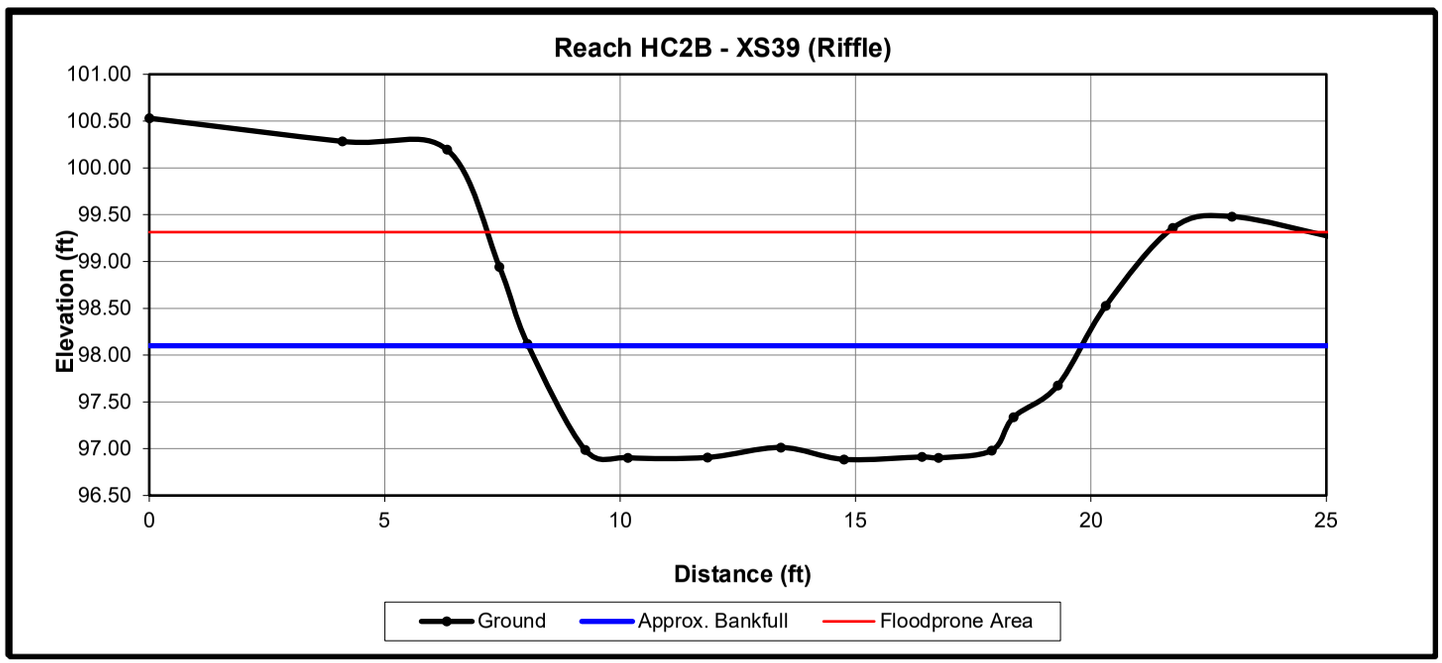
Upstream

Downstream



Upstream

Downstream



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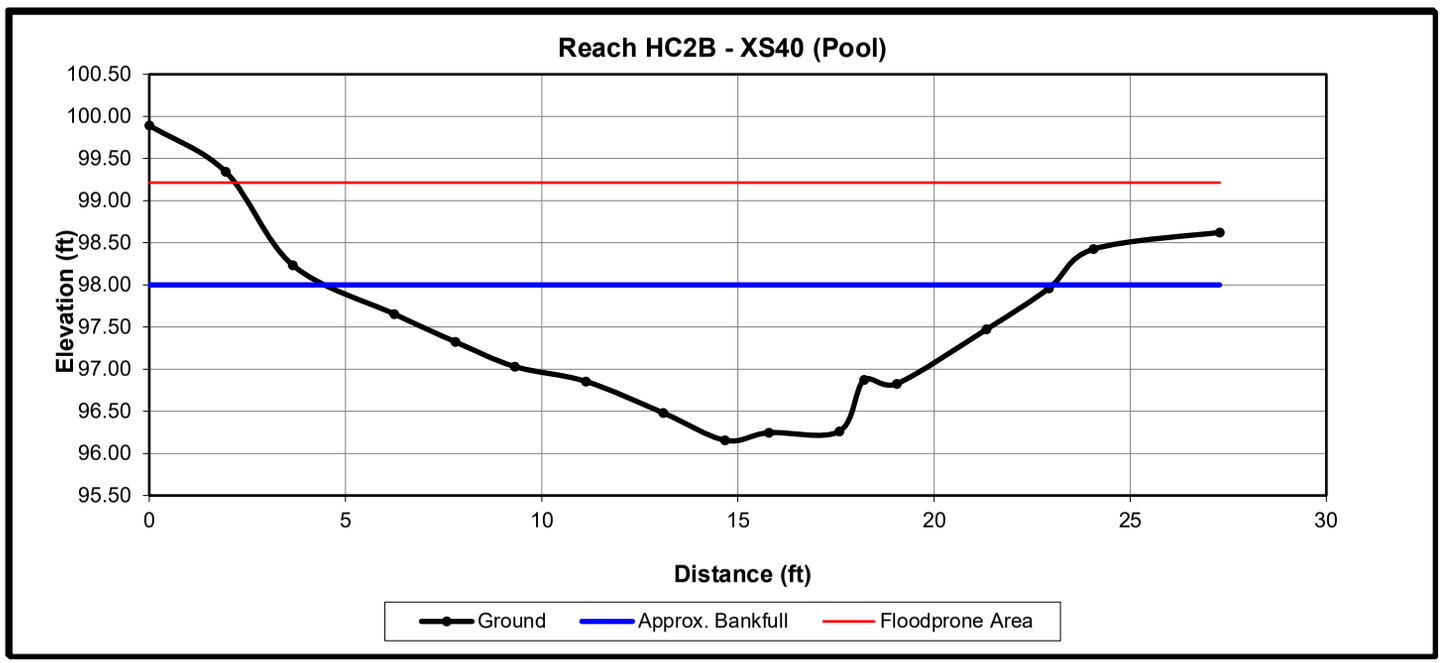
Downstream



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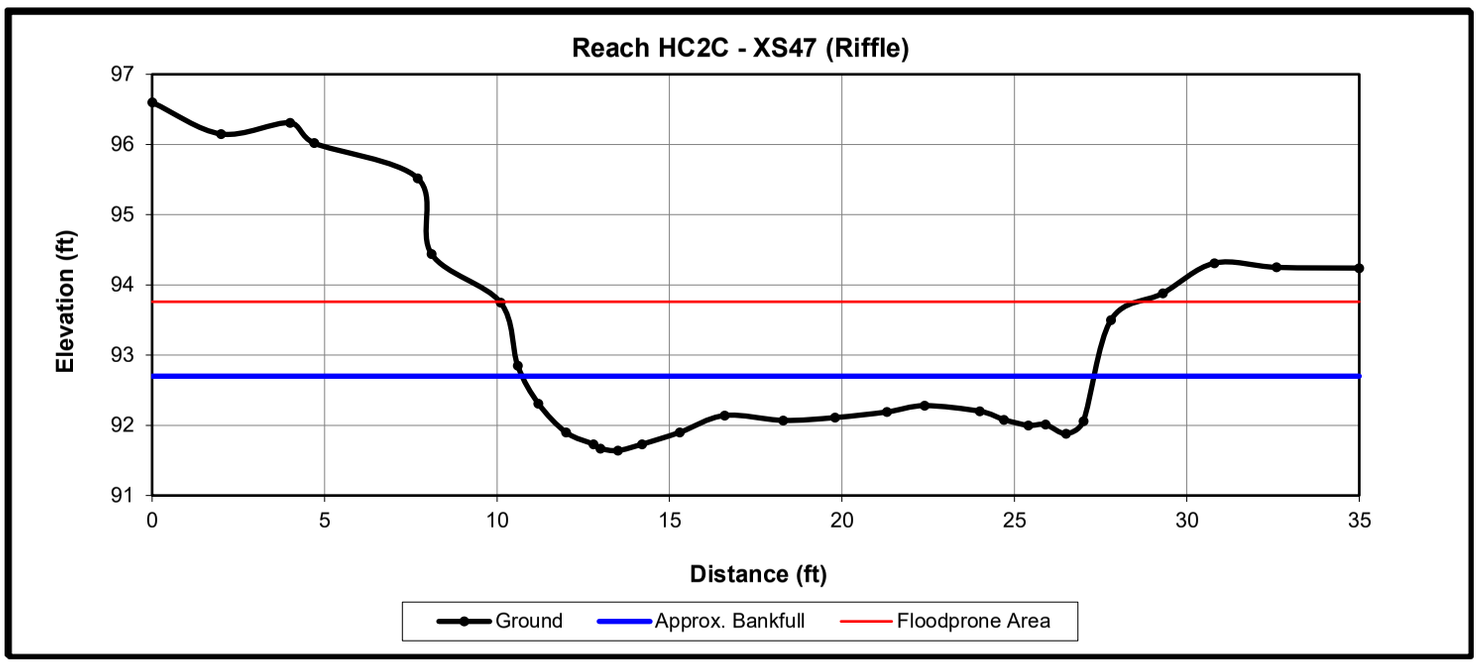

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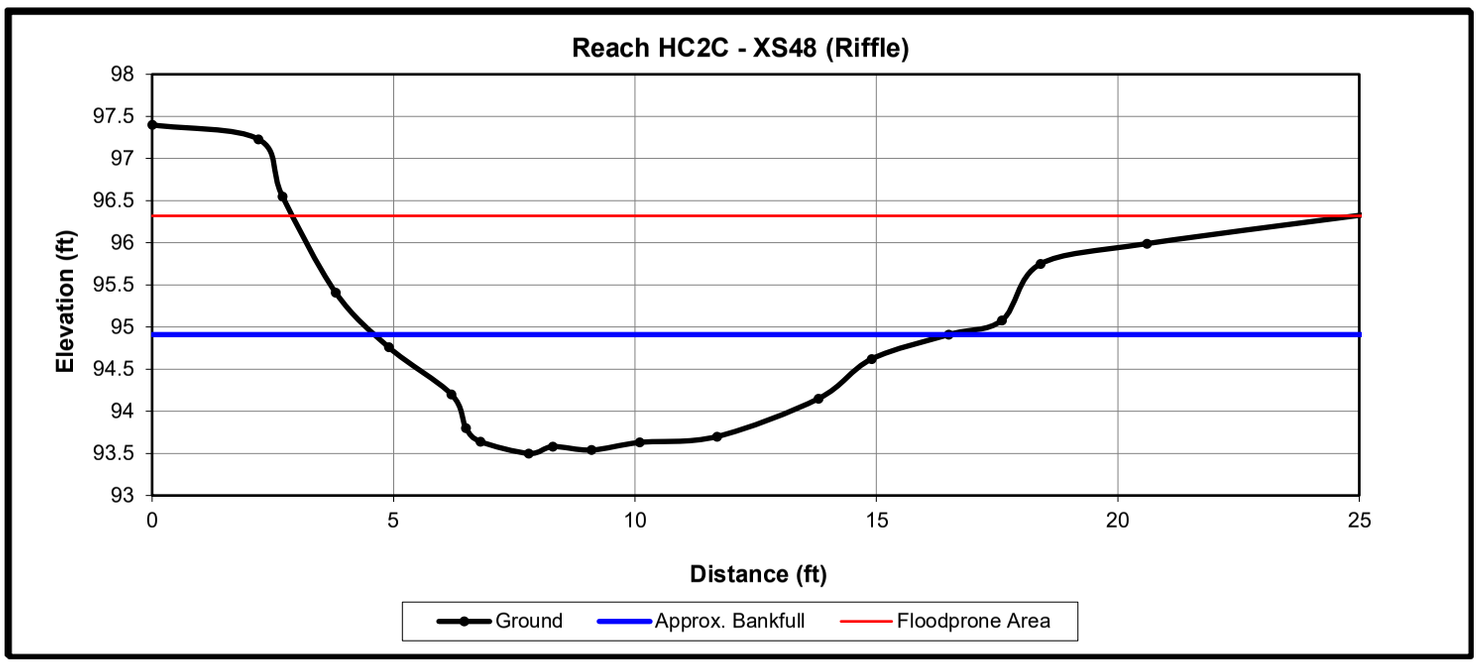

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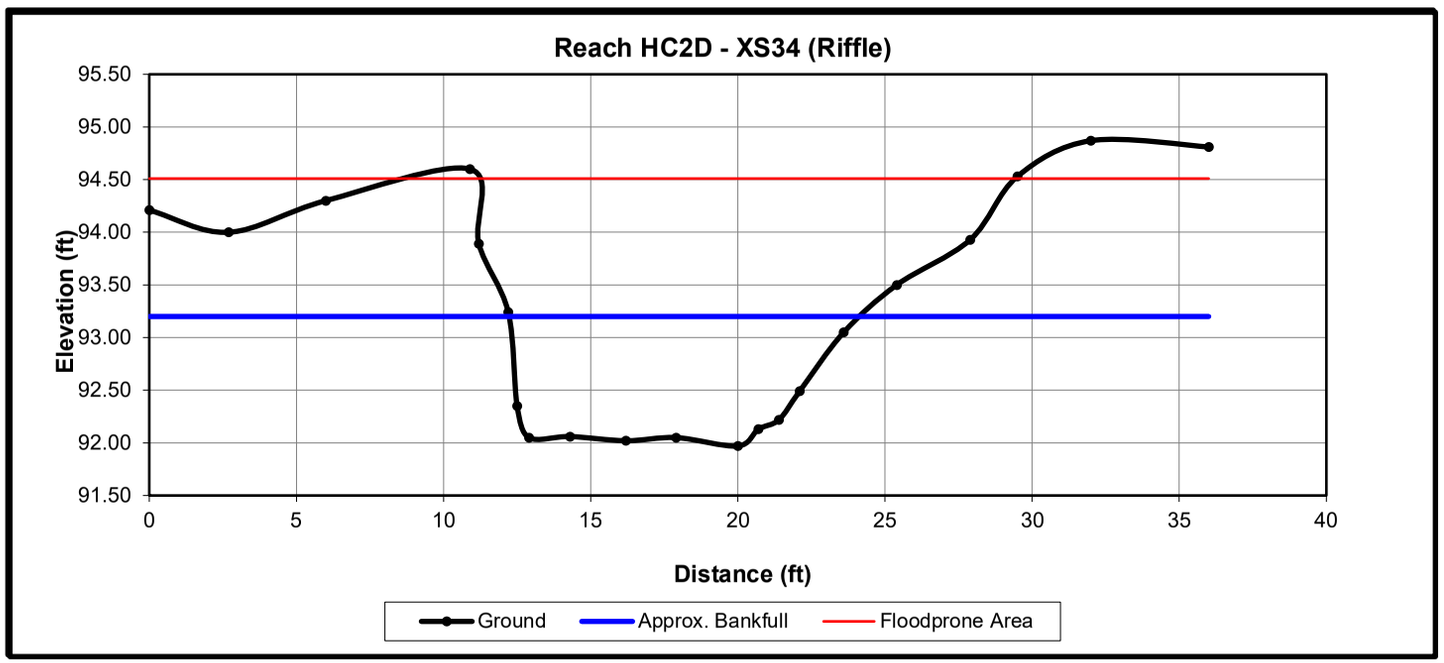

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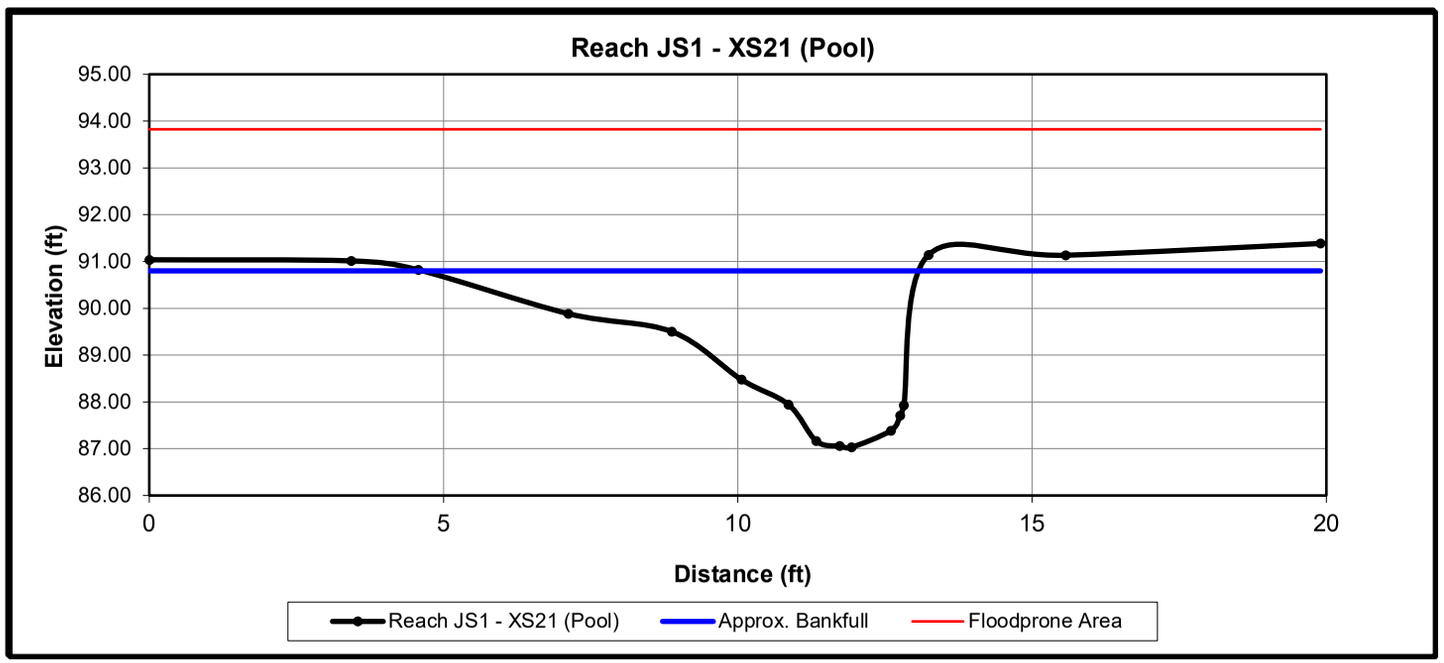
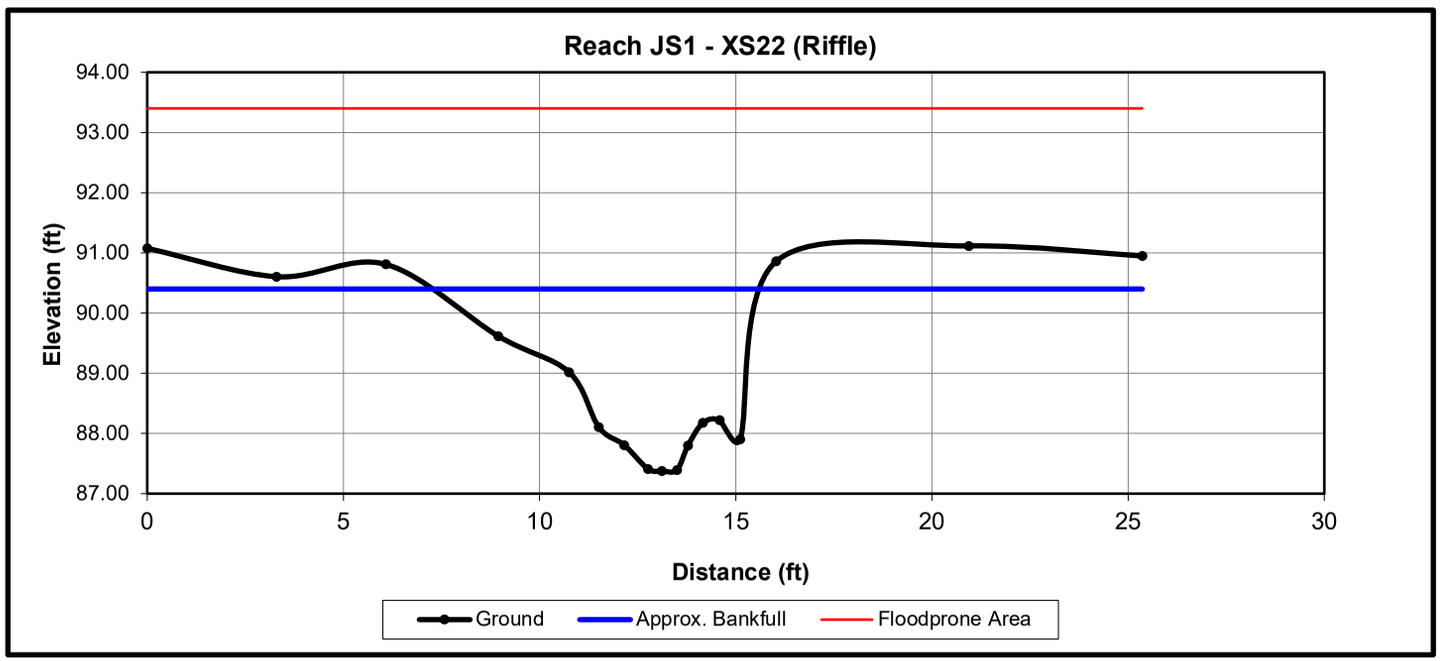


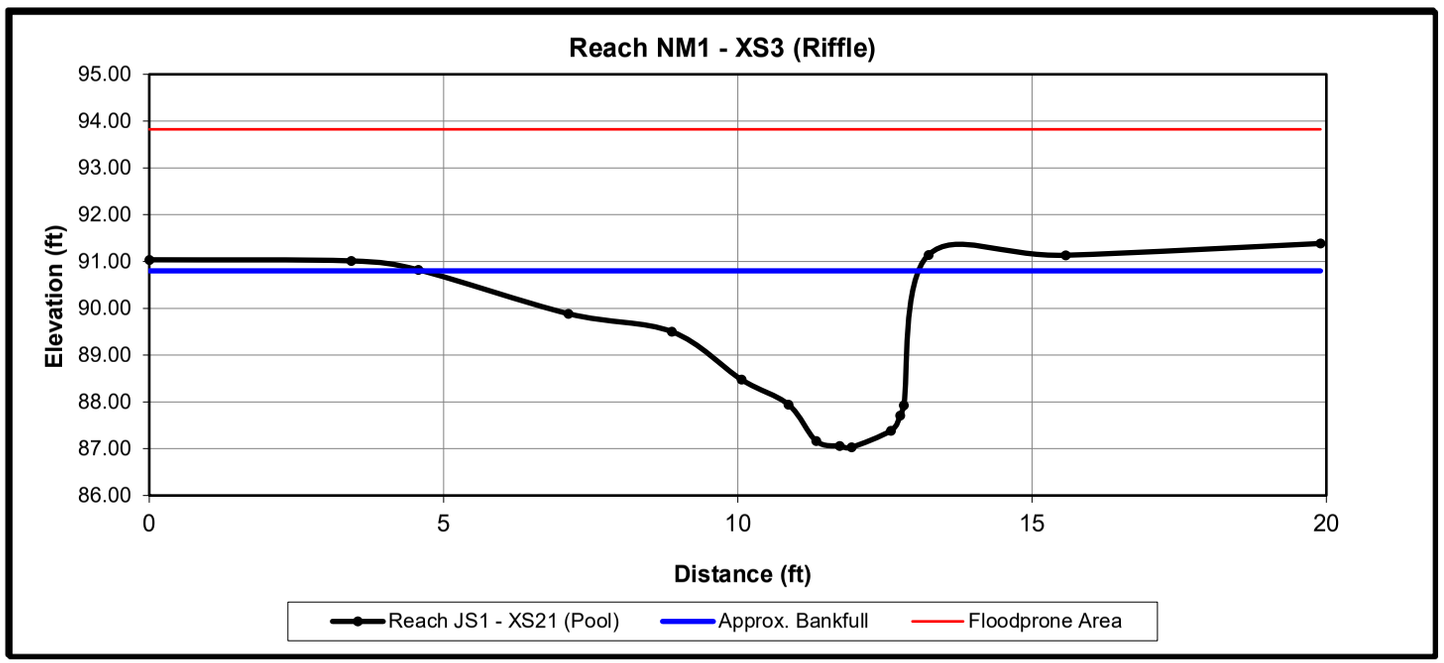
Upstream

Downstream



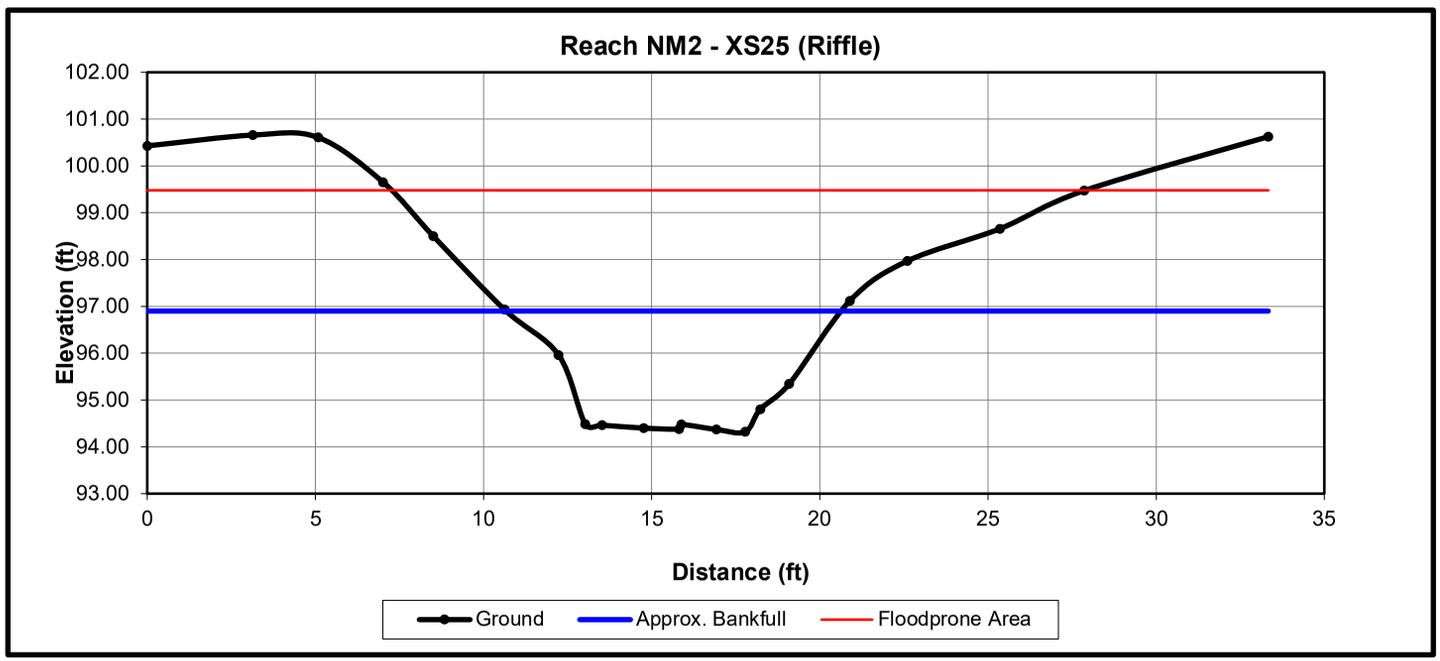
Upstream

Downstream



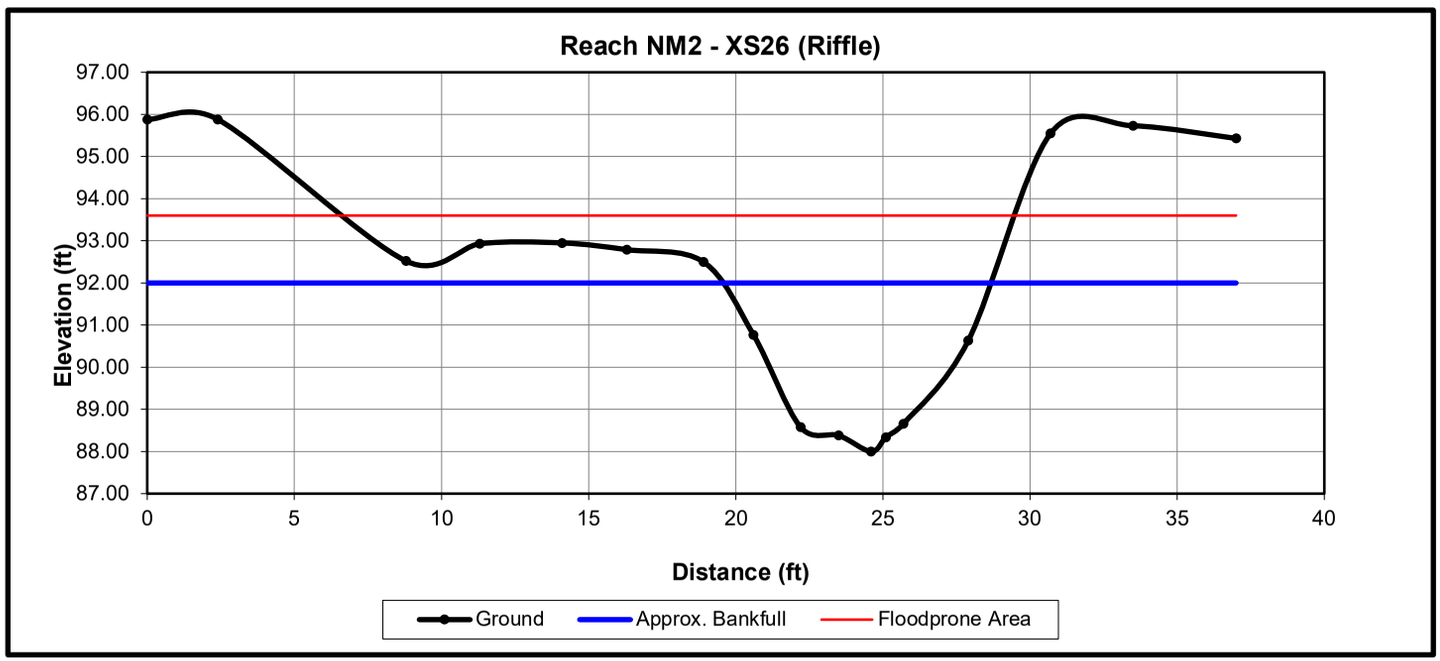
Upstream

Downstream



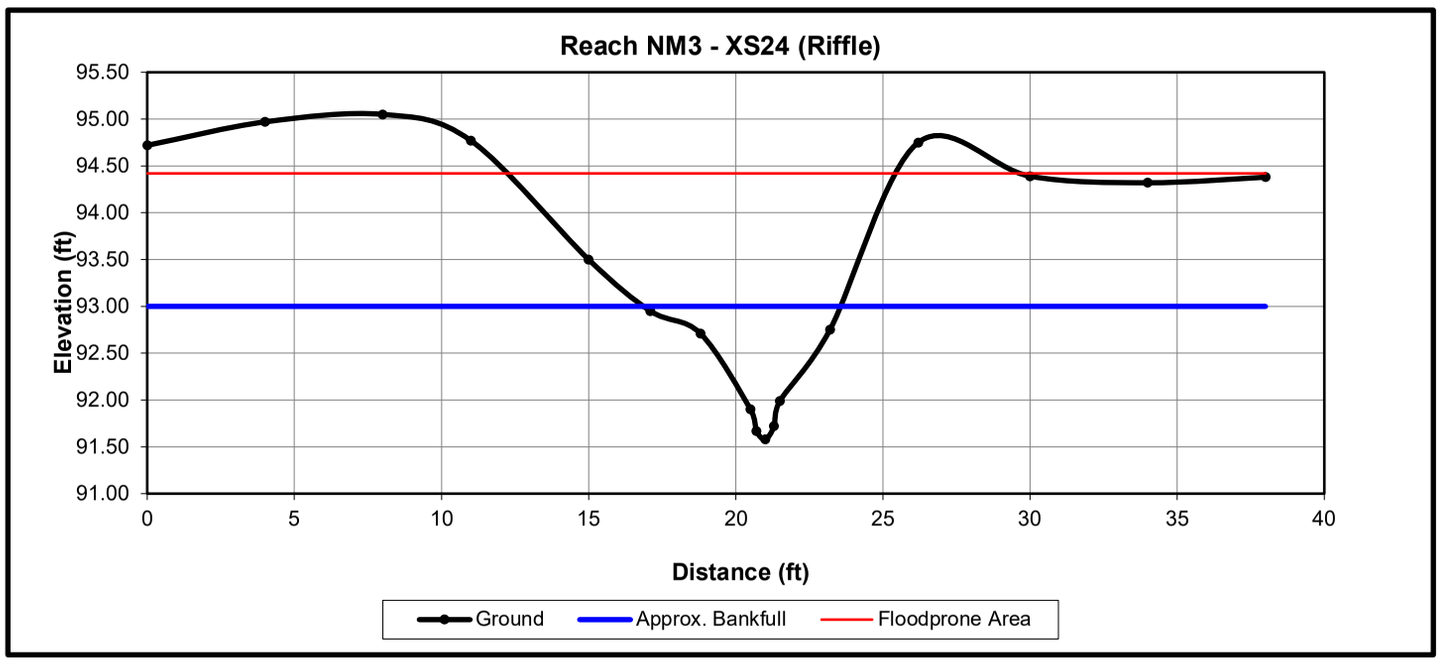
Upstream

Downstream



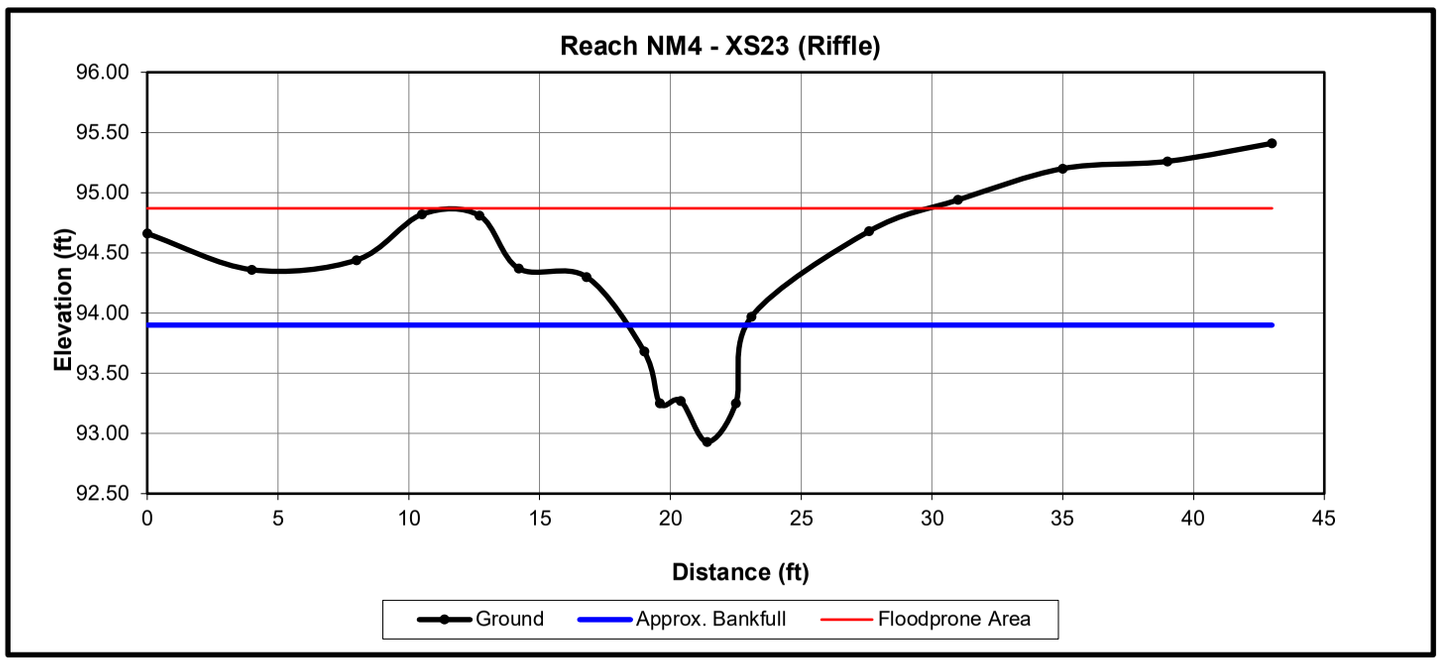
Upstream

Downstream



Upstream

Downstream



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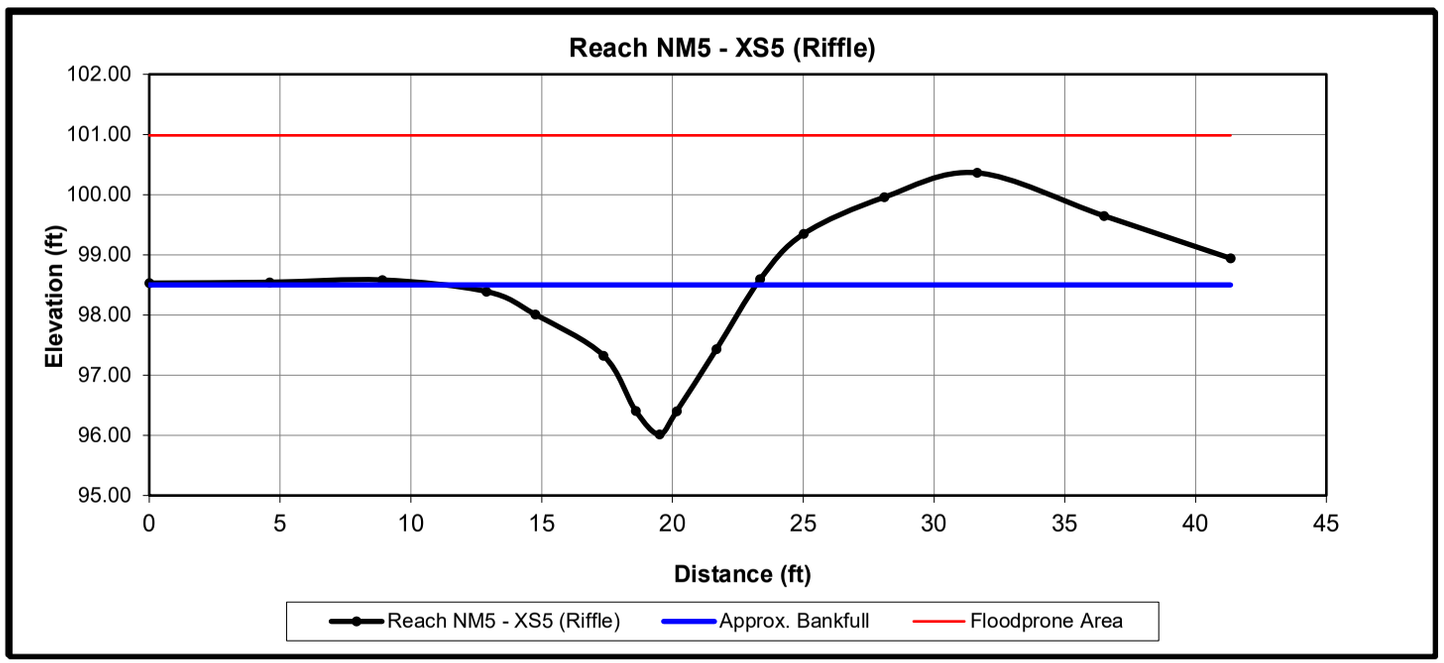
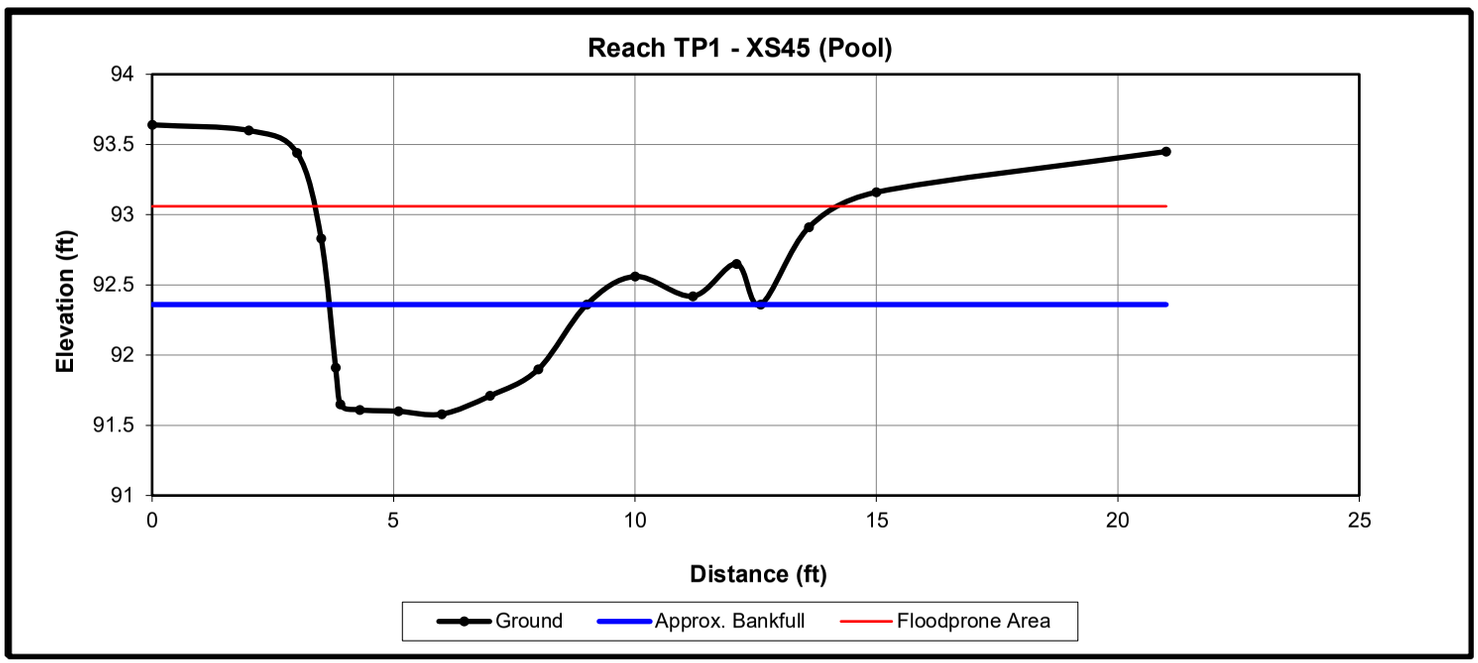
Downstream



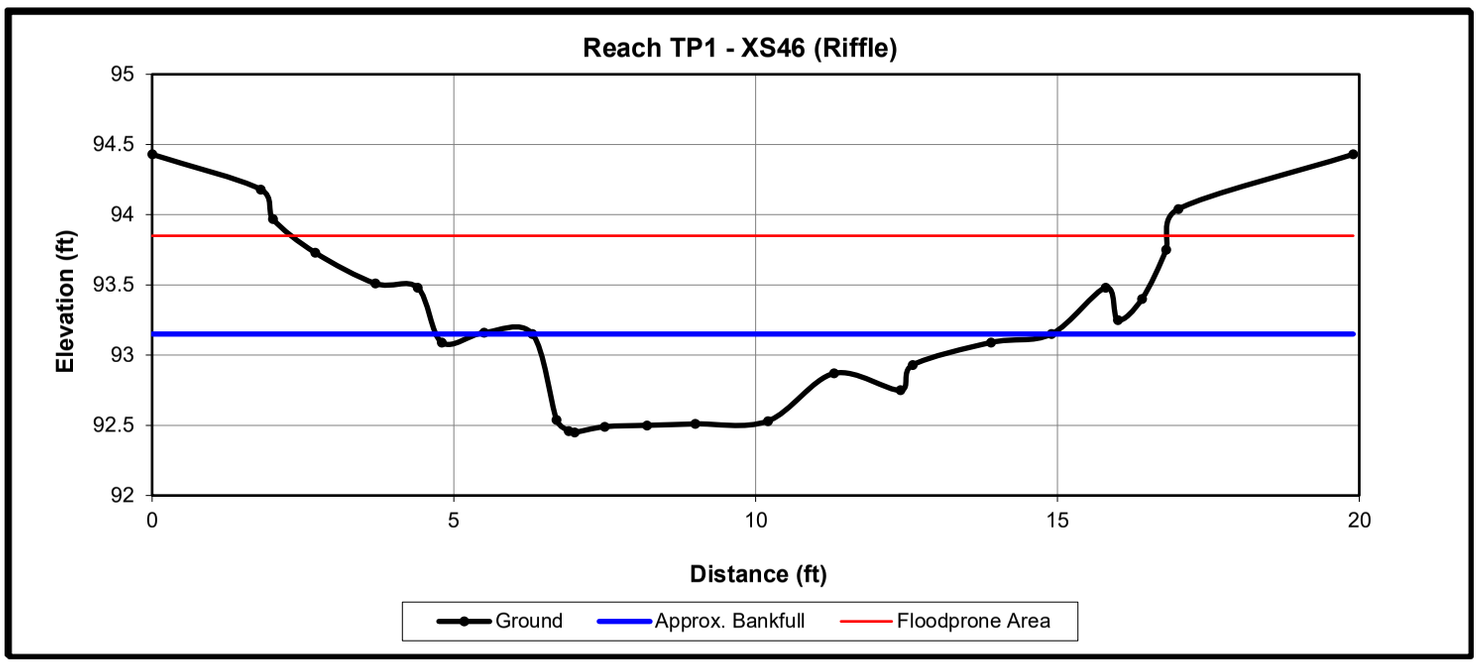
Upstream

Downstream



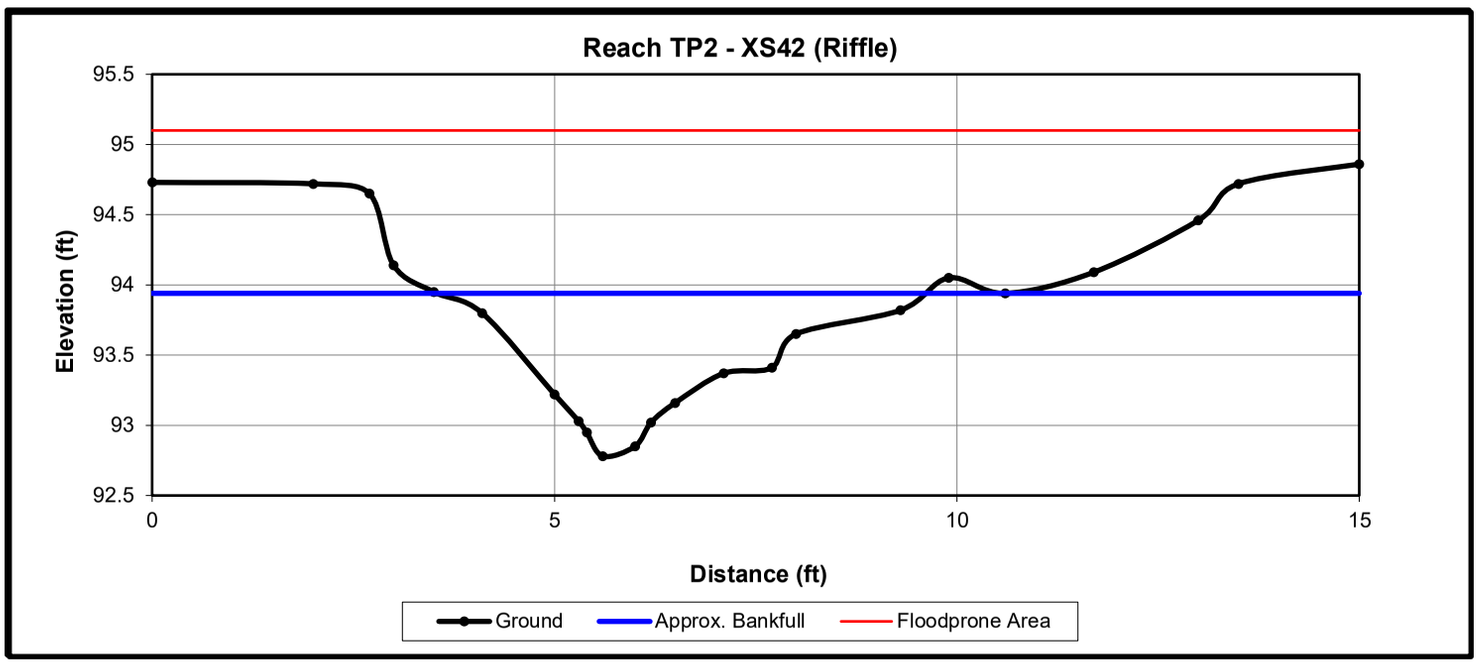
Upstream

Downstream



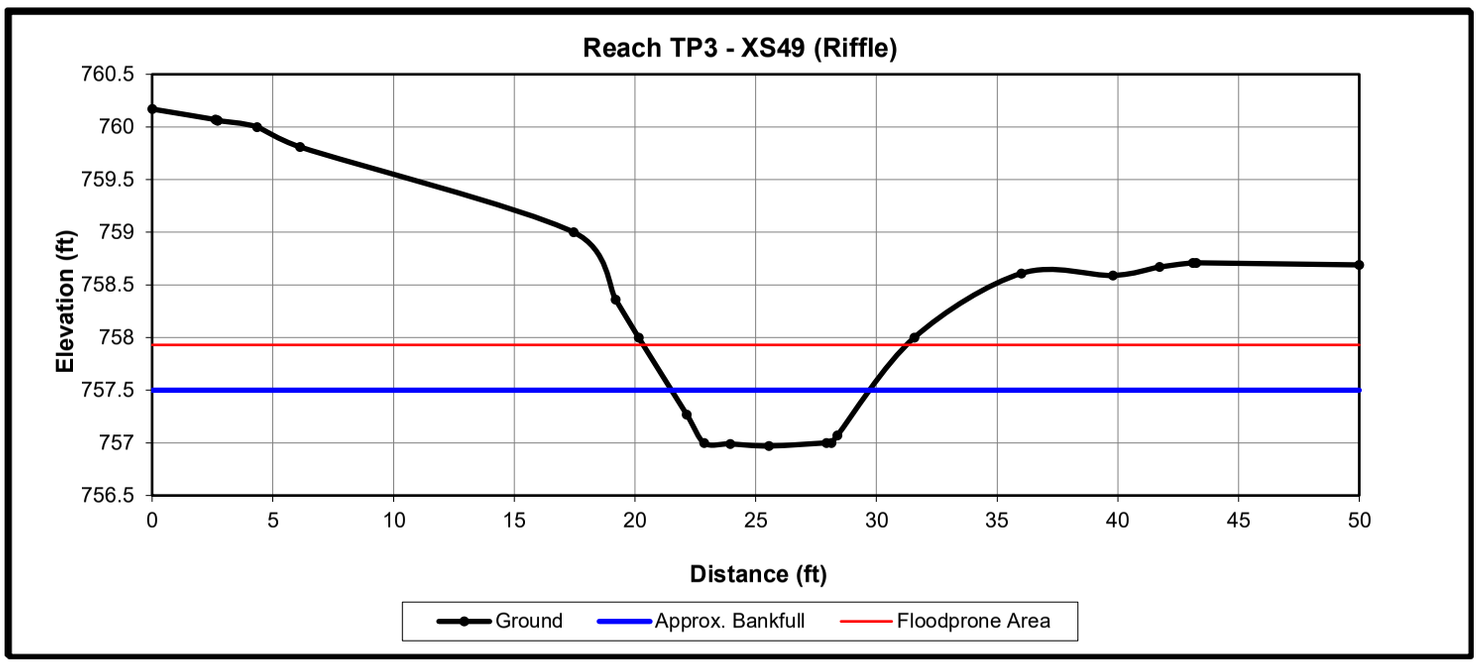
Upstream

Downstream



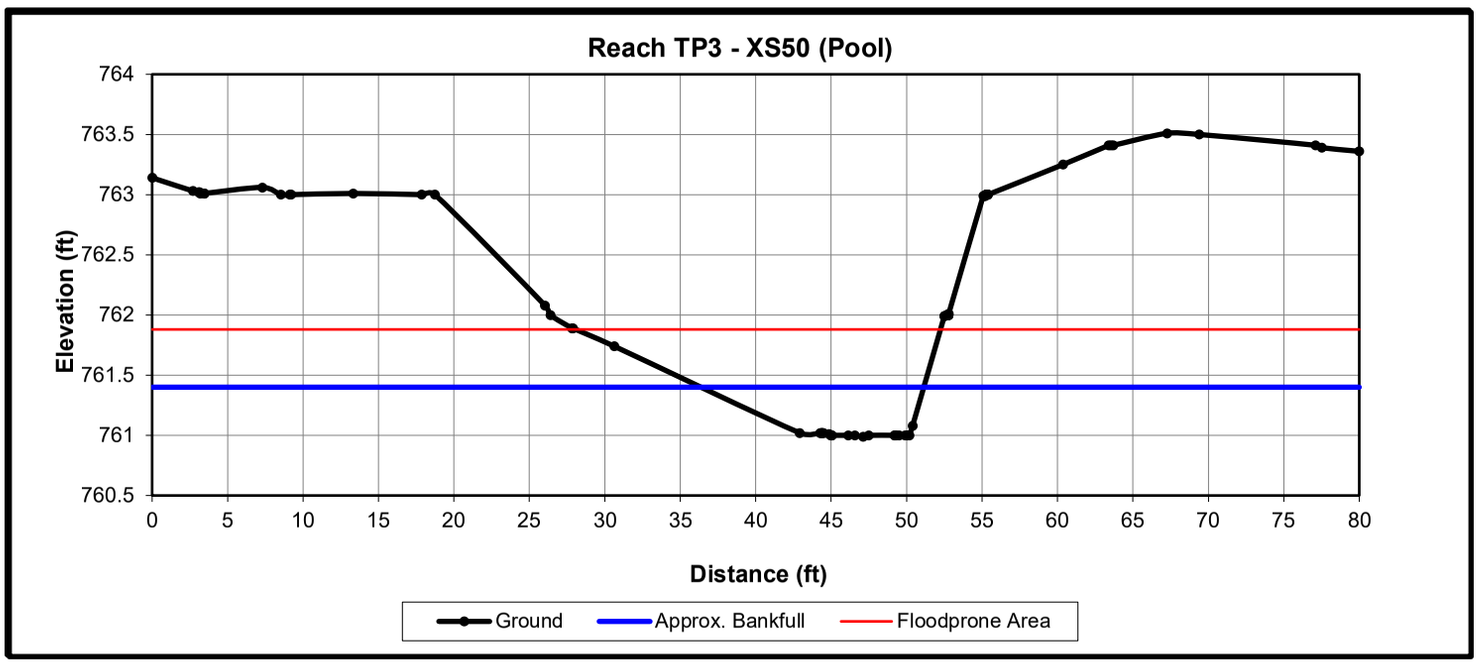
Upstream

Downstream



Upstream

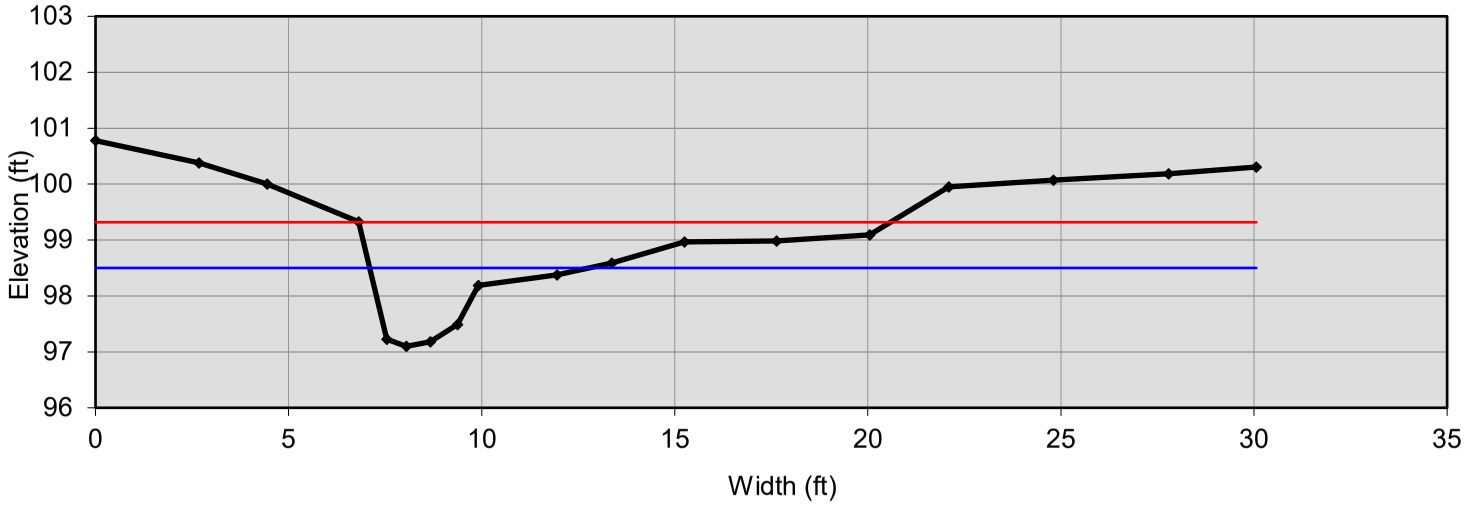
Downstream



Cross Section 1 – UT to Hauser Creek - Pool

Downstream

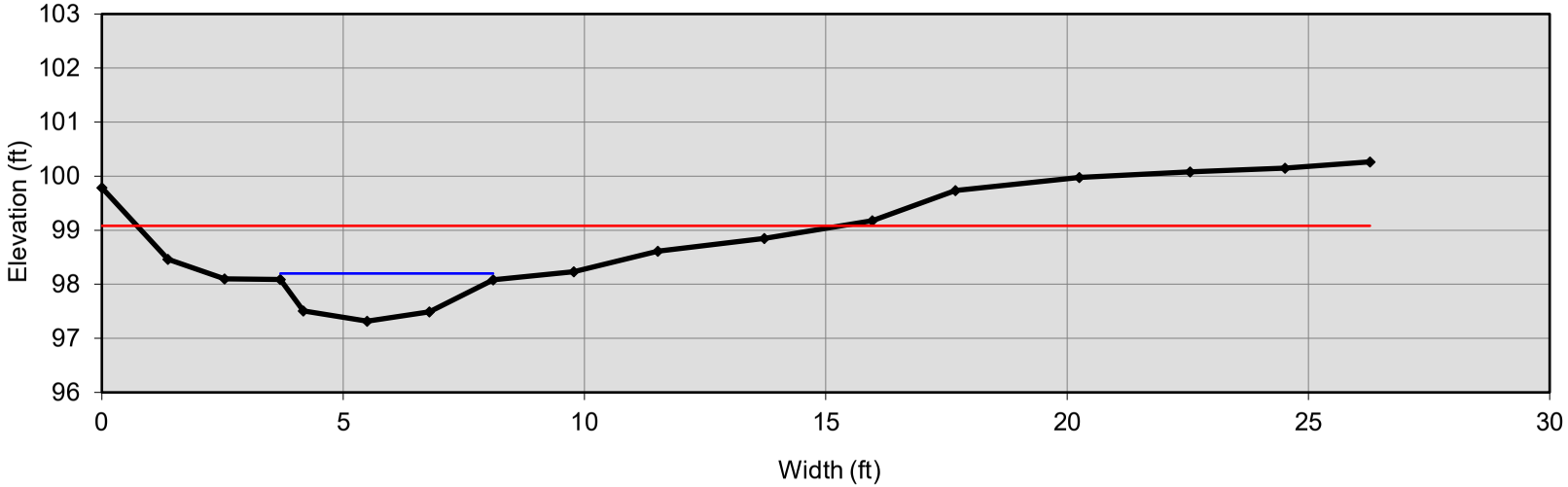
Upstream



Cross Section 2 – UT to Hauser Creek – Riffle

Downstream

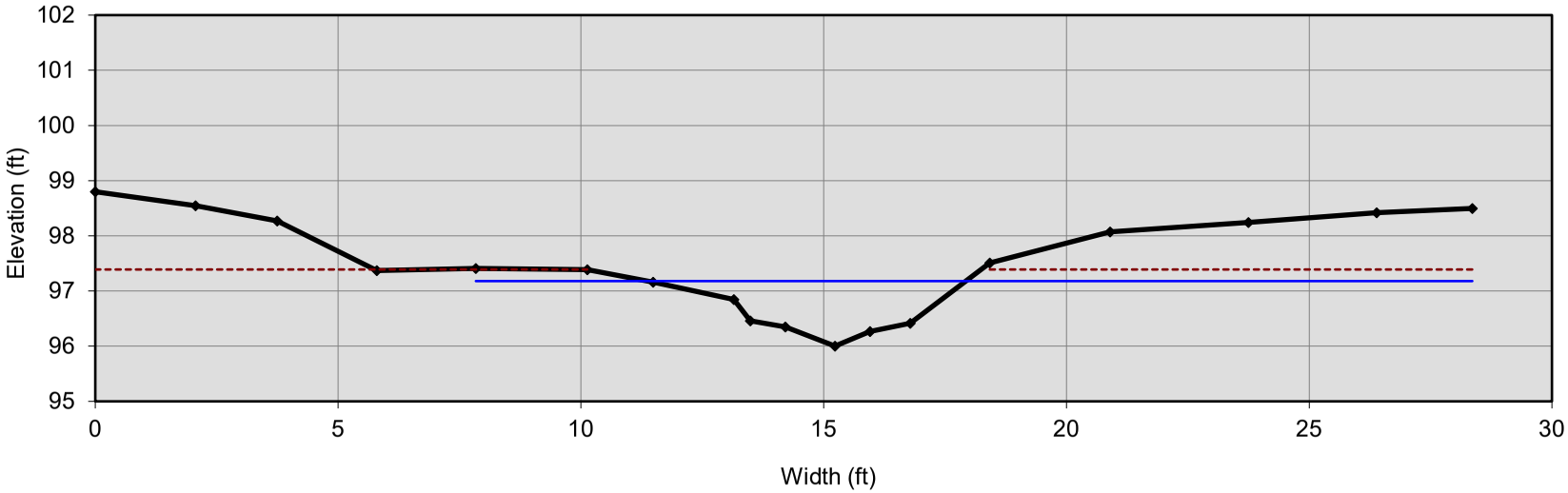
Upstream



Cross Section 3 – UT to Hauser Creek – Pool

Downstream

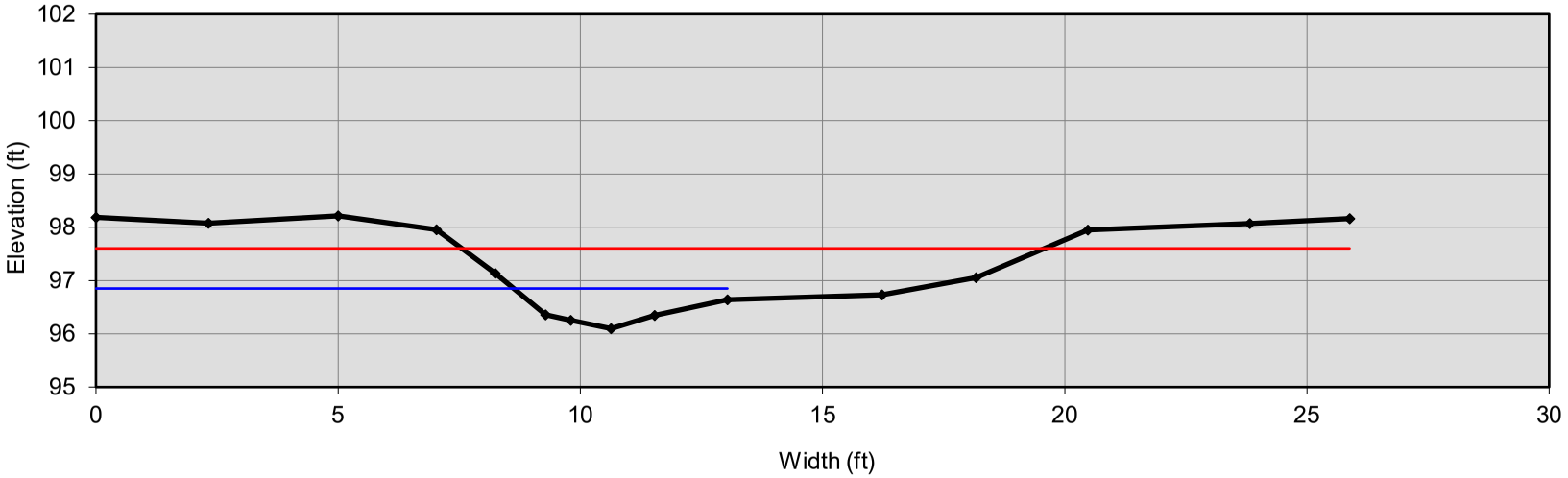
Upstream



Cross Section 4 – UT to Hauser Creek – Riffle

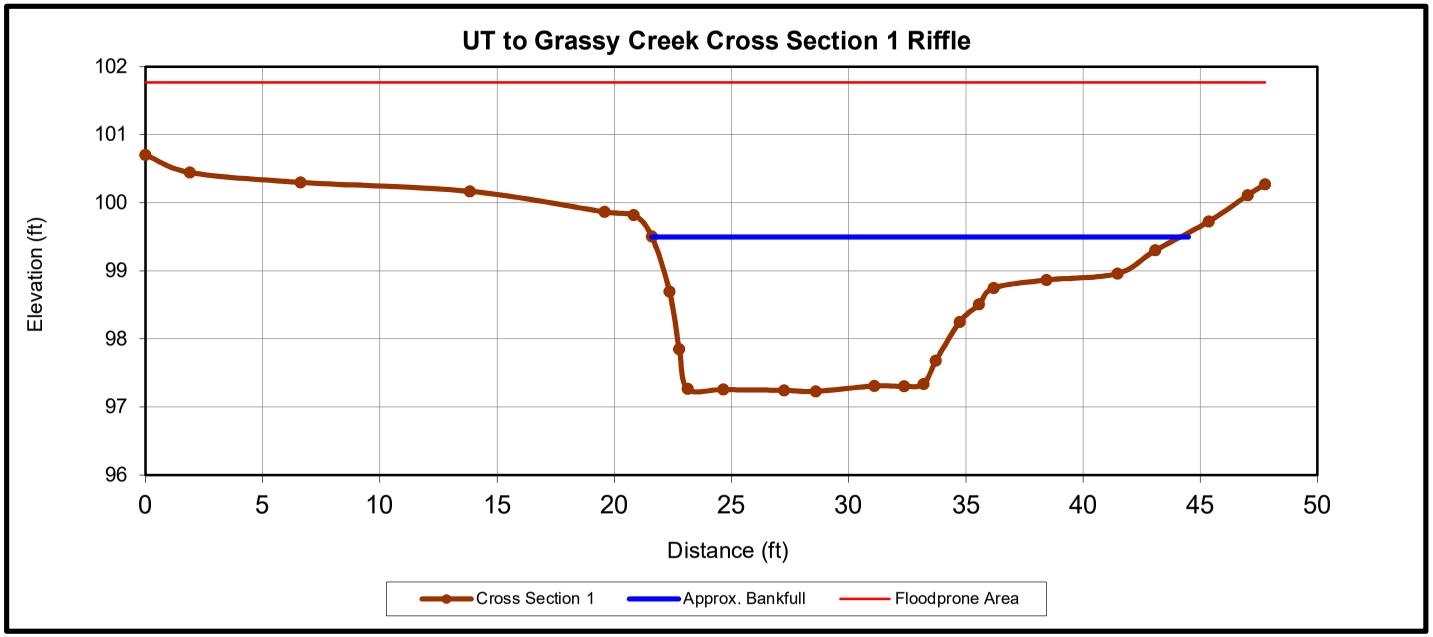
Downstream

Upstream



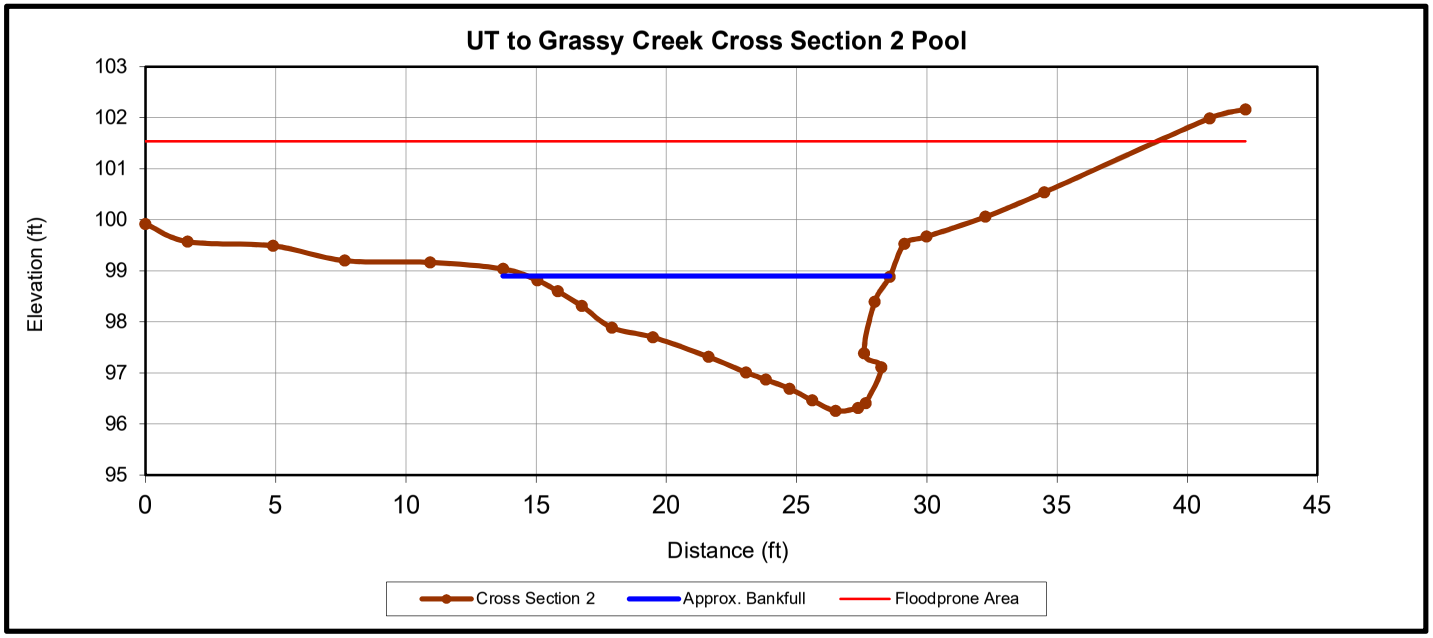
Upstream

Downstream



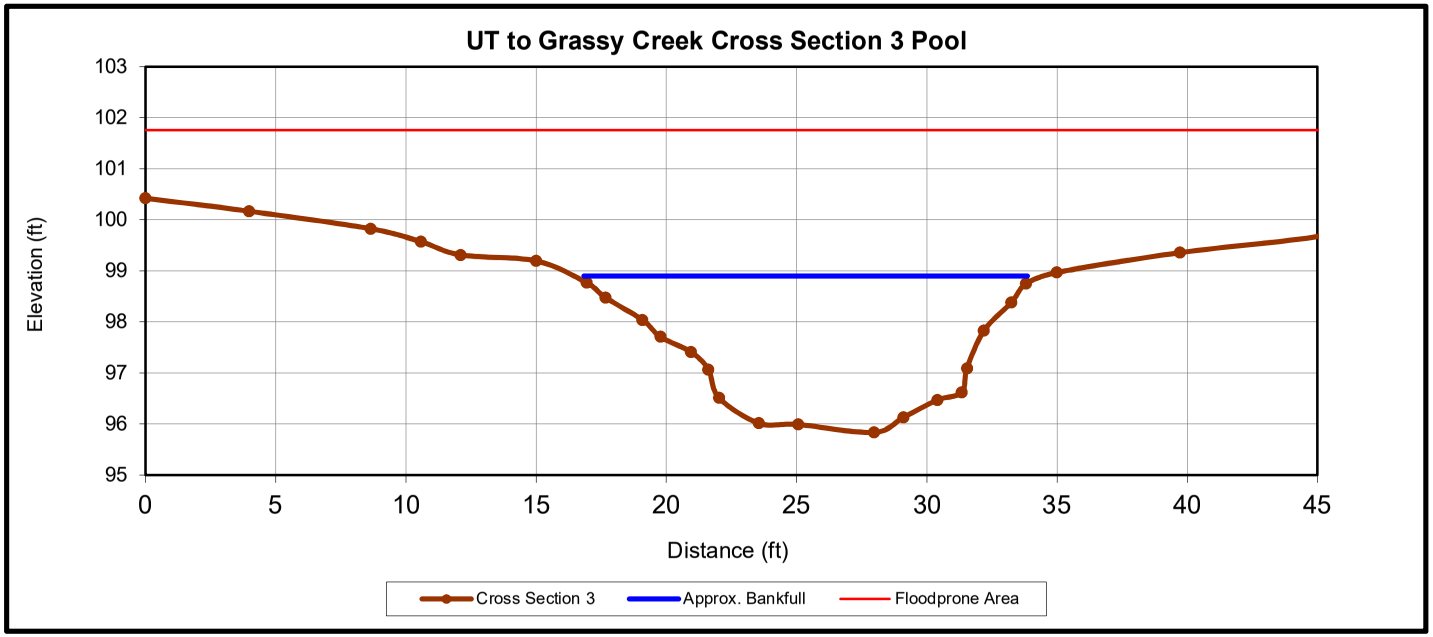
Upstream

Downstream



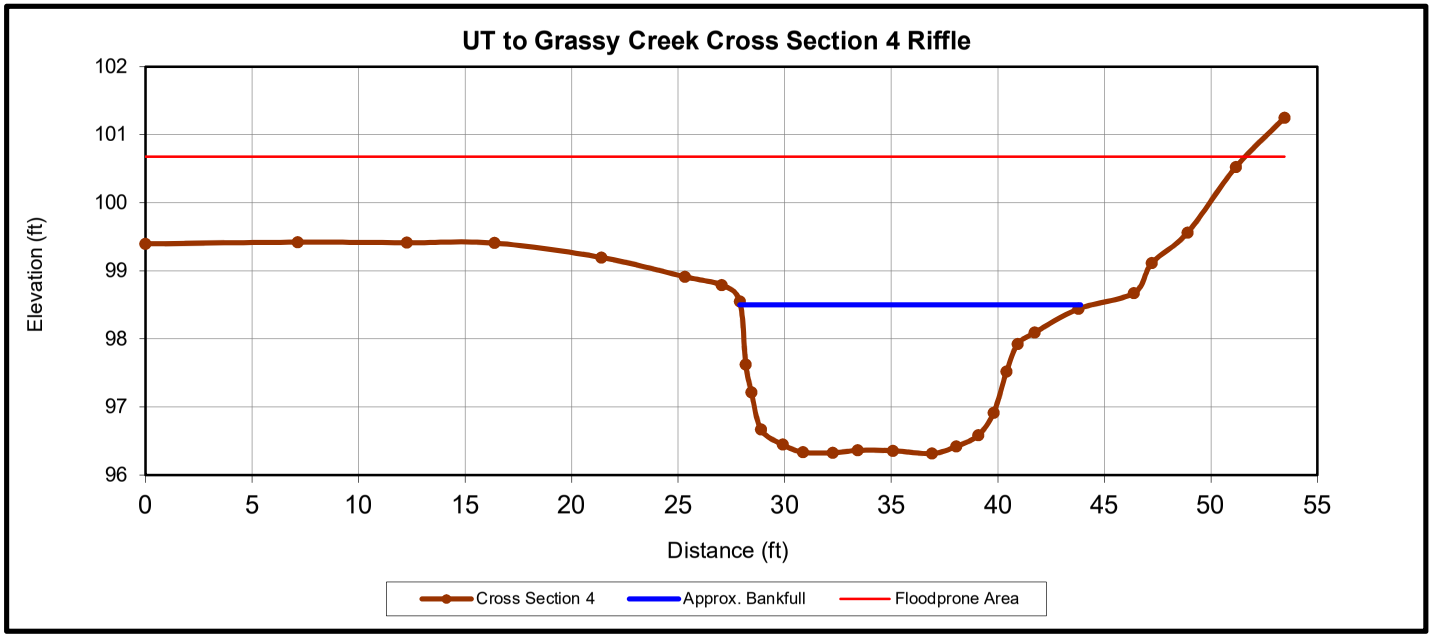
Upstream

Downstream



Upstream

Downstream



Channel Stability Assessment

Channel Stability Assessment Summary Table

		JS1	HC1	HC2-A	HC2-B	HC2-C	HC2-D (E)	HC2-D (P)	NM1	NM2	NM3	NM4	NM5	TP1	TP2	TP3
1	**Watershed characteristics**	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
2	**Flow habit**	6	8	3	4	6	6	6	5	8	7	3	4	4	4	4
3	**Channel pattern**	3	9	3	4	6	2	2	9	8	6	5	9	2	6	6
4	**Entrenchment/channel confinement**	7	10	1	3	3	7	7	6	11	12	3	3	3	4	3
5	**Bed material**	6	12	1	2	5	6	6	10	11	10	9	10	2	11	9
6	**Bar development**	4	10	2	7	6	3	3	2	2	3	3	2	3	10	8
7	**Obstructions/debris jams**	2	7	1	5	3	3	3	6	4	5	6	9	3	9	2
8	**Bank soil texture and coherence**	5	8	5	5	7	6	6	5	9	7	5	7	6	9	6
9	**Average bank angle**	10	10	2	6	6	8	8	7	10	11	4	3	4	6	5
10	**Bank vegetation/protection**	12	9	5	6	4	1	1	8	10	11	10	9	2	11	9
11	**Bank cutting**	11	11	2	4	4	8	8	5	9	9	6	6	4	5	6
12	**Mass wasting/bank failure**	9	9	1	4	5	8	8	4	8	9	7	9	2	8	8
13	**Upstream distance to bridge**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Score	**83**	**111**	**34**	**58**	**63**	**66**	**66**	**75**	**98**	**98**	**69**	**79**	**43**	**91**	**74**
	Rating*	**Fair**	**Poor**	**Excellent**	**Good**	**Good**	**Good**	**Good**	**Fair**	**Fair**	**Fair**	**Good**	**Fair**	**Good**	**Fair**	**Fair**

* Excellent (0 < Score <= 36), Good (36 < Score <= 72), Fair (72 < Score <= 108), Poor (108 < Score <= 144)

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	JS1	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 48F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	6
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	3
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	7
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	6
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	4
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	2

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	5
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	10
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50-70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	12
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	11
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	9
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 83

Stream:	Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	HC1	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 48F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	8
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	9
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	10
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	12
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	10
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	7

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	8
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	10
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	9
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	11
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	9
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 111

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	NM1	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 48F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	5
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	9
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	6
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	10
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	2
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	6

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	5
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	7
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	8
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	5
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	4
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 75

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	NM2	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 48F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	8
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	8
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	11
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	11
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	2
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	4

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	9
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	10
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	10
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	9
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	8
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 98

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	NM3	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 48F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	7
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	6
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	12
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	10
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	3
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	5

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	7
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	11
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	11
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	9
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	9
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 98

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	NM4	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 48F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	3
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	5
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	3
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	9
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	3
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	6

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	5
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	4
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	10
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	6
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	7
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 69

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	NM5	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 48F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	4
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	9
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	3
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	10
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	2
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	9

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	7
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	3
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	9
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	6
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	9
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 79

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	TP1	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 55F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	4
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	2
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	3
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	2
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	3
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	3

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	6
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	4
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	2
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	4
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	2
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 43

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	TP2	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 55F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	4
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	6
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	4
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	11
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	10
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	9

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	9
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	6
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	11
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	5
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	8
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 91

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	TP3	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 55F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	4
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	6
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	3
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	9
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	8
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	2

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	6
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	5
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	9
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	6
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	8
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 74

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	HC2-A	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 55F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	3
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	3
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	1
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	1
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	2
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	1

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	5
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	2
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	5
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	2
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	1
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 34

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	HC2-B	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 55F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	4
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	4
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	3
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	2
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	7
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	5

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	5
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	6
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	6
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	4
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	4
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 58

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	HC2-C	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 55F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	6
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	6
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	3
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	5
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	6
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	3

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	7
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	6
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	4
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	4
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	5
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 63

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	HC2-D (Enhancement)	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 55F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	6
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	2
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	7
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	6
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	3
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	3

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	6
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	8
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	1
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	8
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	8
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 66

Stream:	Trib to Hauser Creek	Observers:	EWT, MDE, JRM
Reach:	HC2-D (Preservation)	Project:	Mockingbird
Date:	4/3/2018	Drainage Area:	Yadkin Pee-Dee
Weather:	Overcast, 55F	Stream Type:	pool-riffle
Location:	Mocksville, NC		

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
1. Watershed and flood plain activity and characteristics	Stable, forested, undisturbed watershed	Occasional minor disturbances in the watershed, including cattle activity (grazing and/or access to stream), construction, logging, or other minor deforestation. Limited agricultural activities	Frequent disturbances in the watershed, including cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Urbanization over significant portion of watershed	Continual disturbances in the watershed. Significant cattle activity, landslides, channel sand or gravel mining, logging, farming, or construction of buildings, roads, or other infrastructure. Highly urbanized or rapidly urbanizing watershed	8
2. Flow habit	Perennial stream with no flashy behavior	Perennial stream or ephemeral first-order stream with slightly increased rate of flooding	Perennial or intermittent stream with flashy behavior	Extremely flashy; flash floods prevalent mode of discharge; ephemeral stream other than first-order stream	6
3. Channel pattern (revised)	No evidence of channelization. Meandering, stable channel or straight (step-pool system, narrow valley), stable channel.	Appears to have previously been channelized. Stream is relatively stable. Channel has some meanders due to previous channel adjustment.	Appears to have previously been channelized. Stream is actively adjusting (meandering); localized areas of instability and/or erosion around bends. Straightened, stable channel.	Appears to have previously been channelized. Stream is actively adjusting (laterally and/or vertically) with few bends. Straight, unstable reach.	2
4. Entrenchment/ channel confinement	Active flood plain exists at top of banks; no sign of undercutting infrastructure; no levees	Active flood plain abandoned, but is currently rebuilding; minimal channel confinement; infrastructure not exposed; levees are low and set well back from the river	Moderate confinement in valley or channel walls; some exposure of infrastructure; terraces exist; flood plain abandoned; levees are moderate in size and have minimal setback from the river	Knickpoints visible downstream; exposed water lines or other infrastructure; channel-width-to-top-of-banks ration small; deeply confined; no active flood plain; levees are high and along the channel edge	7
5. Bed material Fs = approximate portion of sand in the bed	Assorted sized tightly packed, overlapping, and possibly imbricated. Most material > 4 mm. Fs < 20%	Moderately packed with some overlapping. Very small amounts of material < 4 mm. 20 < Fs < 50%	Loose assortment with no apparent overlap. Small to medium amounts of material < 4 mm. 50 < Fs < 70%	Very loose assortment with no packing. Large amounts of material < 4 mm. Fs > 70%	6
6. Bar development	For S < 0.02 and w/y > 12, bars are mature, narrow relative to stream width at low flow, well-vegetated, and composed of coarse gravel to cobbles. For S > 0.02 and w/y are < 12, no bars are evident	For S < 0.02 and w/y > 12, bars may have vegetation and/or be composed of coarse gravel to cobbles, but minimal recent growth of bar evident by lack of vegetation on portions of the bar. For S > 0.02 and w/y <12, no bars are evident	For S < 0.02 and w/y > 12, bar widths tend to be wide and composed of newly deposited coarse sand to small cobbles and/or may be sparsely vegetated. Bars forming for S > 0.02 and w/y < 12	Bar widths are generally greater than 1/2 the stream width at low flow. Bars are composed of extensive deposits of fine particles up to coarse gravel with little to no vegetation. No bars for S < 0.02 and w/y > 12	3
7. Obstructions, including bedrock outcrops, armor layer, LWD jams, grade control, bridge bed paving, revetments, dikes or vanes, riprap	Rare or not present	Occasional, causing cross currents and minor bank and bottom erosion	Moderately frequent and occasionally unstable obstructions, cause noticeable erosion of the channel. Considerable sediment accumulation behind obstructions	Frequent and often unstable, causing a continual shift of sediment and flow. Traps are easily filled, causing channel to migrate and/or widen	3

Stability Indicator	Excellent (1 -3)	Good (4 - 6)	Fair (7 - 9)	Poor (10 - 12)	Score
8. Bank soil texture and coherence	Clay and silty clay; cohesive material	Clay loam to sandy clay loam; minor amounts of noncohesive or unconsolidated mixtures; layers may exist, but are cohesive materials	Sandy clay to sandy loam; unconsolidated mixtures of glacial or other materials; small layers and lenses of noncohesive or unconsolidated mixtures	Loamy sand to sand; noncohesive material; unconsolidated mixtures of glacial or other materials; layers of lenses that include noncohesive sands and gravels	6
9. Average bank slope angle (where 90° is a vertical bank)	Bank slopes < 3H:1V (18°) for noncohesive or unconsolidated materials to < 1:1 (45°) in clays on both sides	Bank slopes up to 2H:1V (27°) in noncohesive or unconsolidated materials to 0.8:1 (50°) in clays on one or occasionally both banks	Bank slopes to 1H:1V (45°) in noncohesive or unconsolidated materials to 0.6:1 (60°) in clays common on one or both banks	Bank slopes over 45° in noncohesive or unconsolidated materials or over 60° in clays common on one or both banks	8
10. Vegetative or engineered bank protection	Wide band of woody vegetation with at least 90% density and cover. Primarily hard wood, leafy, deciduous trees with mature, healthy, and diverse vegetation located on the bank. Woody vegetation oriented vertically. In absence of vegetation, both banks are lined or heavily armored	Medium band of woody vegetation with 70-90% plant density and cover. A majority of hard wood, leafy, deciduous trees with maturing, diverse vegetation located on the bank. Wood vegetation oriented 80-90% from horizontal with minimal root exposure. Partial lining or armoring of one or both banks	Small band of woody vegetation with 50 70% plant density and cover. A majority of soft wood, piney, coniferous trees with young or old vegetation lacking in diversity located on or near the top of bank. Woody vegetation oriented at 70-80% from horizontal, often with evident root exposure. No lining of banks, but some armoring may be in place on one bank	Woody vegetation band may vary depending on age and health with less than 50% plant density and cover. Primarily soft wood, piney, coniferous trees with very young, old and dying, and/or monostand vegetation located off of the bank. Woody vegetation oriented at less than 70% from horizontal with extensive root exposure. No lining or armoring of banks	1
11. Bank cutting	Little or none evident. Infrequent raw banks, insignificant percentage of total bank	Some intermittently along channel bends and at prominent constrictions. Raw banks comprise minor portion of bank in vertical direction	Significant and frequent on both banks. Raw banks comprise large portion of bank in vertical direction. Root mat overhangs	Almost continuous cuts on both banks, some extending over most of the banks. Undercutting and sod-root overhangs	8
12. Mass wasting or bank failure	No or little evidence of potential or very small amounts of mass wasting. Uniform channel width over the entire reach	Evidence of infrequent and/or minor mass wasting. Mostly healed over with vegetation. Relatively constant channel width and minimal scalloping of banks	Evidence of frequent and/or significant occurrences of mass wasting that can be aggravated by higher flows, which may cause undercutting and mass wasting of unstable banks. Channel width quite irregular, and scalloping of banks is evident	Frequent and extensive mass wasting. The potential for bank failure, as evidenced by tension cracks, massive undercuttings, and bank slumping is considerable. Channel width is highly irregular, and banks are scalloped	8
13. Upstream distance to bridge from meander impact point and alignment	More than 35 m; bridge is well-aligned with river flow	20-35 m; bridge is aligned with flow	10-20 m; bridge is skewed to flow, or flow alignment is otherwise not centered beneath bridge	Less than 10 m; bridge is poorly aligned with flow	

H = horizontal, V = vertical, Fs = fraction of sand, S = slope, w/y = width-to-depth ratio

Total Score 66

Appendix C – Site Protection Instrument

SITE PROTECTION INSTRUMENT

Site Protection Instrument(s) Summary Information

The land required for the construction, management, and stewardship of this mitigation project includes portions of the parcels listed below in Table C1. EBX (an entity of RES) has obtained a conservation easement from the current landowners for the project area. The easement deed and survey plat will be submitted to DMS and State Property Office (SPO) for approval and will be held by the State of North Carolina. The easement deed will follow the NCDMS Full Delivery Conservation Easement Template dated May 5, 2017 and included in this appendix. Once recorded, the secured easement will allow EBX to proceed with the project development and protect the mitigation assets in perpetuity. Once finalized, a copy of the land protection instrument(s) will be included in **Appendix C**.

Table C1. Project Parcel and Landowner Information

Owner of Record	PIN	County	Site Protection Instrument	Deed Book and Page Numbers	Acreage Protected
Teresa S. Phifer	5852594790 5853514536	Davie	Conservation Easement	--	9.10 ac
The Wilson W. and Katherine S. Sparks Living Trust, Dated December 03, 2015	5853416631	Davie	Conservation Easement	--	3.30 ac
The Sparks Family Trust, Dated July 26, 2005	5853164843	Davie	Conservation Easement	--	1.71 ac
Michael A. Miller and Nancy S. Miller	5853144949 5853153934	Davie	Conservation Easement	--	13.35 ac

STATE OF NORTH CAROLINA

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

_____ COUNTY

SPO File Number:
DMS Project Number:

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 _____, 20__, by _____ *Landowner name goes here* , ("**Grantor**"), whose mailing address is _____ *Landowner address goes here* _____, 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 Environment and Natural Resources 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 *(insert name and address of full delivery contract provider)* and the North Carolina Department of Environmental Quality, to provide stream, wetland and/or buffer mitigation pursuant to the North Carolina Department of Environmental Quality Purchase and Services Contract Number _____.

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 property situated, lying, and being in _____ Township, _____ County, North Carolina (the "**Property**"), and being more particularly described as that certain parcel of land containing approximately _____ acres and being conveyed to the Grantor by deed as recorded in **Deed Book _____ at Page ____** of the _____ 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 ***if known, insert name of stream, branch, river or waterway here***.

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:

Tracts Number _____ containing a total of _____ **acres** as shown on the plats of survey entitled "Final Plat, Conservation Easement for North Carolina Division of Mitigation Services, Project Name: _____, SPO File No._____, EEP Site No. _____, Property of _____," dated _____, 20__ by *name of surveyor*, PLS Number _____ and recorded in the _____ County, North Carolina Register of Deeds at **Plat Book _____ Pages _____.**

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 on the property 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. Repeated failure to do so may result in the State (Grantee) repairing or installing livestock exclusion devices (fences) within the conservation area for the purpose of restricting livestock access. In such cases, the landowner (Grantor) must provide access to the State (Grantee) to make repairs.

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

[INSERT LEGAL DESCRIPTION]

Appendix D – Credit Release Schedule

CREDIT RELEASE SCHEDULE

All credit releases will be based on the total credit generated as reported in the approved final mitigation plan, unless there are major discrepancies and then a mitigation plan addendum will be submitted. 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 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 be restarted 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 in **Table D1**.

Table D1. Stream Credit Release Schedule

Credit Release Milestone	Release Activity	Interim Release	Total Release
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	10%	50%
3	Third year monitoring report demonstrates performance standards are being met	10%	60%
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%**)

**Please note that vegetation data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the IRT.*

***10% reserve of credits to be held back until the bankfull event performance standard has been met.*

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:

1) Approval of the final Mitigation Plan.
2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property.
3) 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.

4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

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 four 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 four 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, 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 E – Financial Assurance

FINANCIAL ASSURANCE

Pursuant to Section IV H and Appendix III of the NCDEQ DMS (formerly Ecosystem Enhancement Program) In-Lieu Fee Instrument dated July 28, 2010, the North Carolina Department of Environmental Quality (NCDEQ) has provided the USACE-Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by NCDEQ DMS. This commitment provides financial assurance for all mitigation projects implemented by the program.

Appendix F – Maintenance Plan

MAINTENANCE PLAN

The site will be monitored on a regular basis and a physical inspection will 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:

F1. Maintenance Plan

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. Areas where stormwater and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting. Stream maintenance activities will be documented and reported in annual monitoring reports. Stream maintenance will continue through the monitoring period.
Wetland	N/A
Vegetation	Vegetation shall be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be treated by mechanical and/or chemical methods. Any vegetation requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations. Vegetation maintenance activities will be documented and reported in annual monitoring reports. Vegetation maintenance will continue through the monitoring period.
Site Boundary	Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries will be marked with signs identifying the property as a mitigation site, and will include the name of the long-term steward and a contact number. 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. Easement monitoring and staking/signage maintenance will continue in perpetuity as a stewardship activity.
Road Crossing	Road crossings within the site may be maintained only as allowed by conservation easement or existing easement, deed restrictions, rights of way, or corridor agreements. Crossings in easement breaks are the responsibility of the landowner to maintain.
Livestock Fencing	Livestock fencing is to be placed outside the easement limits. Maintenance of fencing is the responsibility of the landowner.
Beaver	Routine site visits and monitoring will be used to determine if beaver management is needed. If beaver activity poses a threat to project stability or vegetative success, RES will trap beavers and remove impoundments as needed. All beaver management activities will be documented and included in annual monitoring reports. Beaver monitoring and management will continue through the monitoring period.

Appendix G – DWR Stream ID Forms

NC DWQ Stream Identification Scores

	HC1	NM1	NM2	NM3	NM4	NM5	JS1	HC2-A	HC2-B	HC2-C	HC2-D	TP1	TP2	TP3
A. Geomorphology														
1. Continuity	3	3	3	3	2	1	3	3	3	3	3	3	1	1
2. Sinuosity	2	2	2	2	1	1	2	2	2	2	2	3	2	2
3. In-channel structure	2	2	3	2	2	0	2	2	2	2	2	2	1	1
4. Particle size	3	1	2	2	2	1	1	2	2	2	2	2	2	2
5. Floodplain	1	1	1	1	1	3	1	2	2	2	2	2	2	2
6. Depositional bars	3	1	1	1	0	0	2	2	2	2	2	1	1	1
7. Alluvial deposits	2	1	1	1	0	2	2	1	1	1	1	1	1	1
8. Headcuts	2	0	3	1	0	0	1	2	2	2	2	2	0	0
9. Grade control	1.5	0.5	1.5	1.5	1	0	1	1	1	1	1	1.5	1	1
10. Natural valley	1.5	1	1	1	0.5	0.5	1	1	1	1	1	1	1	1
11. Second order	3	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Hydrology														
12. Baseflow	3	2	3	3	2	1	3	2	2	2	2	3	2	2
13. Iron oxidizing bacteria	1	1	2	2	0	2	2	1	1	1	1	1	1	1
14. Leaf litter	1.5	0.5	1.5	1.5	1	1	1.5	1	1	1	1	1.5	1	1
15. Sediment	0.5	0	0.5	0.5	0	1	1	1	1	1	1	0.5	0	0
16. Organic debris	1	0.5	1	0.5	0	1	1	0	0	0	0	0.5	1	1
17. Hydric soil	3	3	0	3	3	3	3	3	3	3	3	3	3	3
C. Biology														
18. Fibrous roots	3	2	3	2	2	2	3	3	3	3	3	3	1	1
19. Rooted upland plants	3	2	3	2	1	2	3	3	3	3	3	3	1	1
20. Macrobenthos	1	1	1	1	0	1	1	1	1	1	1	2	0	0
21. Aquatic Mollusks	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22. Fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23. Crayfish	0	0	0	0	0	1	0	0	0	0	0	0	0	0
24. Amphibians	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25. Algae	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26. Wetland plants	0	0.75	0	0	0.75	0.75	0	0	0	0	0	0	0.75	0
Total	**41**	**25.25**	**33.5**	**31**	**19.25**	**23.25**	**34.5**	**33**	**33**	**33**	**33**	**36**	**22.75**	**22**

NC DWQ Stream Identification Form Version 4.11

Date:	Project/Site:	Latitude:
Evaluator:	County:	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30**	**Stream Determination (circle one)** **Ephemeral Intermittent Perennial**	**Other** *e.g. Quad Name*:

A. Geomorphology (Subtotal =_____)	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 = _____)				
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 = _____)				
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			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

Appendix H – USACE District Assessment Forms

Stream Quality Assessment Worksheet Summary

			JS1	HC1	HC2-A	HC2-B	HC2-C	HC2-D (E)	HC2-D (P)	NM1	NM2	NM3	NM4	NM5	TP1	TP2	TP3
Physical	1	Presence of flow / persistent pools in stream	3	4	3	4	4	4	4	2	3	3	3	2	3	2	3
	2	Evidence of past human alteration	1	1	4	3	3	5	5	2	1	0	1	1	5	2	2
	3	Riparian zone	0	1	3	3	1	4	5	1	1	0	1	1	4	0	1
	4	Evidence of nutrient or chemical discharges	0	0	3	2	1	2	3	0	1	0	1	1	3	1	0
	5	Groundwater discharge	0	0	3	4	4	0	0	1	0	0	0	0	2	4	4
	6	Presence of adjacent floodplain	4	4	4	3	4	4	4	4	3	3	4	3	3	4	4
	7	Entrenchment / floodplain access	1	0	4	3	1	1	3	2	0	0	3	3	3	2	3
	8	Presence of adjacent wetlands	0	0	3	4	4	0	0	0	0	0	0	0	2	4	4
	9	Channel sinuosity	1	1	3	3	2	2	4	0	1	1	1	1	3	1	1
	10	Sediment input	1	0	4	3	1	1	3	1	1	1	1	1	3	2	2
	11	Size & diversity of channel bed substrate	1	1	4	2	2	1	3	1	1	1	1	1	4	1	1
Stability	12	Evidence of channel incision or widening	1	0	3	2	1	1	2	2	0	0	2	2	3	2	2
	13	Presence of major bank failures	3	0	5	3	2	2	3	3	0	1	3	1	4	3	4
	14	Root depth and density on banks	0	1	4	3	2	3	3	1	1	0	1	2	4	1	1
	15	Impact by agriculture, livestock, or timber production	0	0	3	1	0	4	0	1	1	0	0	1	3	0	0
	16	Presence of riffle-pool/ripple-pool complexes	1	1	5	3	1	3	4	1	2	1	1	1	4	1	2
Habitat	17	Habitat complexity	2	2	5	4	2	3	5	2	3	1	2	2	5	2	3
	18	Canopy coverage over streambed	0	2	4	5	3	5	5	1	1	0	1	1	5	0	1
	19	Substrate embeddedness	1	1	3	2	1	2	2	1	1	1	1	1	3	1	1
Biology	20	Presence of stream invertebrates	1	1	4	3	1	2	3	1	1	1	1	1	4	2	2
	21	Presence of amphibians	0	1	4	1	1	1	2	1	1	0	0	0	2	1	0
	22	Presence of fish	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	23	Evidence of wildlife use	1	2	3	3	2	3	3	1	2	1	2	2	3	1	1

Total Score:	**22**	**23**	**81**	**64**	**43**	**53**	**67**	**29**	**25**	**15**	**30**	**28**	**75**	**37**	**42**

REACH JS1 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	0
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	0
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	0
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	1
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	1
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	0
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	0
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	1
Total Points Possible			100	100	100	22
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

REACH HC1 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	0
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	0
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	0
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	0
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	0
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	0
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	2
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	23
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

REACH NM1 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	2
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	2
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	0
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	1
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	2
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	0
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	1
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	1
Total Points Possible			100	100	100	29
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

NM2 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	0
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	3
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	0
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	0
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	0
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	1
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	3
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	25
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

NM3 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	0
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	0
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	0
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	3
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	0
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	0
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	1
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	0
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	1
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	0
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	1
Total Points Possible			100	100	100	15
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

NM4 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	0
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	30
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

NMS 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	2
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	0
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	3
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	1
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	2
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	1
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	28
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

HC2-A 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	4
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	3
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	3
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	4
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	3
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	3
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	4
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	4
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	3
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	5
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	4
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	3
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	5
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	5
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	4
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	3
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	4
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	~~0~~
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
Total Points Possible			100	100	100	81
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

HC2-B 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	3
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	3
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	2
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	3
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	3
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	3
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	2
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	3
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	1
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	3
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	5
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	2
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	3
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
Total Points Possible			100	100	100	64
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

HC2-C 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	3
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	1
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	.4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	2
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	2
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	1
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	2
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	2
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	3
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	43
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

HC2-D (ENHANCEMENT) 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	5
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	4
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	2
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	~~0~~
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	1
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	~~0~~
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	2
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	1
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	2
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	3
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	4
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	3
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	3
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	5
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	2
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	2
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	~~0~~
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
Total Points Possible			100	100	100	53
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

HC2-D (PRESERVATION) 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	5
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	5
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	3
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	~~0~~
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	~~0~~
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	4
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	3
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	3
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	3
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	~~0~~
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	4
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	5
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	5
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	2
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	3
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
Total Points Possible			100	100	100	67
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

TP1 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	5
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	4
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	3
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	2
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	3
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	2
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	3
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	3
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	4
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	3
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	4
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	4
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	3
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	4
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	5
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	5
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	3
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	4
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
Total Points Possible			100	100	100	75
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

TP2 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	2
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	2
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	~~0~~
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	2
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	~~0~~
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	~~0~~
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	2
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	~~0~~
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	1
Total Points Possible			100	100	100	37
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

TP3 4/3/18

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	2
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	0
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	4
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	3
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	2
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	1
Total Points Possible			100	100	100	42
TOTAL SCORE (also enter on first page)						

* These characteristics are not assessed in coastal streams.

Appendix I – Wetland JD Forms and Maps

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **SAW-2017-01469 and SAW-2017-01505** County: **Davie** U.S.G.S. Quad: **NC-Farmington**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Requestor: **North Carolina Department of Environmental Quality, Division of Mitigation Services**
Harry Tsomides
Address: **5 Ravenscroft Drive, Suite 102**
Asheville, NC 28801
Telephone Number: **828-545-7057**
E-mail: **harry.tsomides@ncdenr.gov**

Size (acres) **37.0**
Nearest Waterway **Yadkin River**
USGS HUC **03040101**
Nearest Town **Mocksville**
River Basin **Upper Pee Dee**
Coordinates Latitude: **36.0261**
Longitude: **-80.5050**

Location description: **The review areas are located on the west side of Spillman Road. PINs: 5853144949, 05853153934, 5843932576, 5853416631, 5852594790, 5853601920, 58535114536, 5853164843, and 5853173894. Reference review area description in Jurisdictional Determination Request Package entitled "Potential Wetland or Non-Wetland Waters of the U.S. Map" and Printed Date of 2/28/2018.**

Indicate Which of the Following Apply:

A. Preliminary Determination

☒ There appear to be **waters including wetlands,** on the above described project area/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). The **waters including wetlands,** have been delineated, and the delineation has been verified by the Corps to be sufficiently accurate and reliable. The approximate boundaries of these waters are shown on the enclosed delineation map dated **2/28/2018**. 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 appear to be **waters including wetlands,** on the above described project area/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 including wetlands,** on your project area/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 project area/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 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 including wetlands,** on the above described project area/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.

SAW-2017-01469 and SAW-2017-01505

☐ We recommend you have the **waters including wetlands,** on your project area/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 including wetlands,** on your project area/property have been delineated and the delineation has been verified by the Corps. The approximate boundaries of these waters are shown on the enclosed delineation map dated **MAP DATE**. 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 including wetlands,** have been delineated and surveyed and are accurately depicted on the plat signed by the Corps Regulatory Official identified below on **SURVEY SIGNED DATE**. 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/property 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 in **Morehead City, NC, at (252) 808-2808** to determine their requirements.

Placement of dredged or fill material within waters of the US, including 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 **Bryan Roden-Reynolds at 704-510-1440 or bryan.roden-reynolds@usace.army.mil**.

C. Basis For Determination: Basis For Determination: See the preliminary jurisdictional determination form dated 03/26/2018.

D. Remarks: None.

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

SAW-2017-01469 and SAW-2017-01505

Corps Regulatory Official: RODEN REYNOLDS.BRYAN.KENNETH.1263385574

Digitally signed by RODEN REYNOLDS.BRYAN.KENNETH.1263385574
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=RODEN REYNOLDS.BRYAN.KENNETH.1263385574
Date: 2018.03.26 14:25:37 -04'00'

Date of JD: **03/26/2018** Expiration Date of JD: **Not applicable**

SAW-2017-01469 and SAW-2017-01505

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 the Customer Satisfaction Survey located at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0

Copy furnished:

Agent:	**Resource Environmental Solutions**
	Jeremy Schmid
Address:	**302 Jefferson Street, Suite 110**
	Raleigh, NC 27605
Telephone Number:	**919-926-1473**
E-mail:	**jschmid@res.us**

SAW-2017-01469 and SAW-2017-01505

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: **North Carolina Department of Environmental Quality, Division of Mitigation Services, Harry Tsomides**	File Number: **SAW-2017-01469 and SAW-2017-01505**	Date: **03/26/2018**

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 or http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits.aspx or the 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.

SAW-2017-01469 and SAW-2017-01505

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: Bryan Roden-Reynolds** **Asheville Regulatory Office** **U.S Army Corps of Engineers** **151 Patton Avenue, Room 208** **Asheville, North Carolina 28801**	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: Bryan Roden-Reynolds , 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

PRELIMINARY JURISDICTIONAL DETERMINATION (PJD) FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PJD: 03/26/2018

B. NAME AND ADDRESS OF PERSON REQUESTING PJD: North Carolina Department of Environmental Quality, Division of Mitigation Services, Harry Tsomides, 5 Ravenscroft Drive, Suite 102, Asheville, NC 28801

C. DISTRICT OFFICE, FILE NAME, AND NUMBER: Wilmington District, Scout and Mockingbird Sites, SAW-2017-01469 and SAW-2017-01505

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION: The review areas are located on the west side of Spillman Road. PINs: 5853144949, 05853153934, 5843932576, 5853416631, 5852594790, 5853601920, 58535114536, 5853164843, and 5853173894. Reference review area description in Jurisdictional Determination Request Package entitled "Potential Wetland or Non-Wetland Waters of the U.S. Map" and Printed Date of 2/28/2018.

(USE THE TABLE BELOW TO DOCUMENT MULTIPLE AQUATIC RESOURCES AND/OR AQUATIC RESOURCES AT DIFFERENT SITES)

State: NC County: Davie City: Mocksville
Center coordinates of site (lat/long in degree decimal format): Latitude: 36.0261 Longitude: -80.5050

Universal Transverse Mercator:

Name of nearest waterbody: Yadkin River

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☐ Office (Desk) Determination. Date:
☒ Field Determination. Date(s): **10/03/17 and 02/15/18**

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

Site Number	Latitude (decimal degrees)	Longitude (decimal degrees)	Estimated amount of aquatic resources in review area (acreage and linear feet, if applicable	Type of aquatic resources (i.e., wetland vs. non-wetland waters)	Geographic authority to which the aquatic resource "may be" subject (i.e., Section 404 or Section 10/404)
Scout Site (SAW-2017-01469)					
Wetland WD	36.0028026	-80.5144835	0.75 acres	Wetland	404
Stream HC3	36.030105	-80.516072	2,428 linear feet	Non-wetland	404
Stream JD1	36.030583	-80.517263	238 linear feet	Non-wetland	404
Stream JD2	36.029308	-80.515734	77 linear feet	Non-wetland	404
Mockingbird Site (SAW-2017-01505)					
Wetland WA	36.026870	-80.504691	0.83 acres	Wetland	404
Wetland WB	36.023060	-80.503075	0.08 acres	Wetland	404
Wetland WC	36.020154	-80.503590	0.13 acres	Wetland	404
Wetland WE	36.024412	-80.504582	0.36 acres	Wetland	404
Wetland WF	36.024210	-80.504827	0.05 acres	Wetland	404
Wetland WG	36.023900	-80.504506	0.23 acres	Wetland	404
Wetland WH	36.025417	-80.505161	0.75 acres	Wetland	404
Stream HC1	36.036092	-80.516843	1,960 linear feet	Non-wetland	404
Stream HC2-A	36.021119	-80.503956	855 linear feet	Non-wetland	404
Stream HC2-B	36.023879	-80.504621	937 linear feet	Non-wetland	404
Stream HC2-C	36.025208	-80.505265	426 linear feet	Non-wetland	404

Stream HC2-D	36.025872	-80.506699	455 linear feet	Non-wetland	404
Stream JS1	36.039677	-80.517472	505 linear feet	Non-wetland	404
Stream NM1	36.034585	-80.516771	378 linear feet	Non-wetland	404
Stream NM2	36.035076	-80.518932	1,148 linear feet	Non-wetland	404
Stream NM3	36.037264	-80.516842	202 linear feet	Non-wetland	404
Stream NM4	36.037801	-80.515787	310 linear feet	Non-wetland	404
Stream NM5	36.037645	-80.516801	101 linear feet	Non-wetland	404
Stream TP1	36.021662	-80.503054	380 linear feet	Non-wetland	404
Stream TP2	36.023014	-80.503143	438 linear feet	Non-wetland	404
Stream TP3	36.026046	-80.505192	489 linear feet	Non-wetland	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 PJD (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 the PJD requestor:
Map: **Vicinity Map Dated 10/26/2017**

☒ Data sheets prepared/submitted by or on behalf of the PJD requestor.

☒ Office concurs with data sheets/delineation report.

☐ Office does not concur with data sheets/delineation report. Rationale:_____

☐ Data sheets prepared by the Corps:_____

☐ Corps navigable waters' study:_____

☐ U.S. Geological Survey Hydrologic Atlas:_____

☐ USGS NHD data.

☐ USGS 8 and 12 digit HUC maps.

☒ U.S. Geological Survey map(s). Cite scale & quad name: **USGS Map, 1:24,000 Farmington**

☒ Natural Resources Conservation Service Soil Survey. Citation: **Soils Map, Davie County Dated 10/26/2017**

☒ National wetlands inventory map(s). Cite name: **National Wetlands Inventory Map, USFWS NWI Mapper**

☐ State/local wetland inventory map(s):_____

☐ FEMA/FIRM maps:_____

☐ 100-year Floodplain Elevation is:_____ (National Geodetic Vertical Datum of 1929)

☒ Photographs: ☒ Aerial (Name & Date): **Potential Wetland or Non-Wetland Waters of the U.S. Map Dated 02/28/2018**

or ☐ Other (Name & Date):_____

☐ Previous determination(s). File no. and date of response letter:_____

☐ Other information (please specify):_____

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.

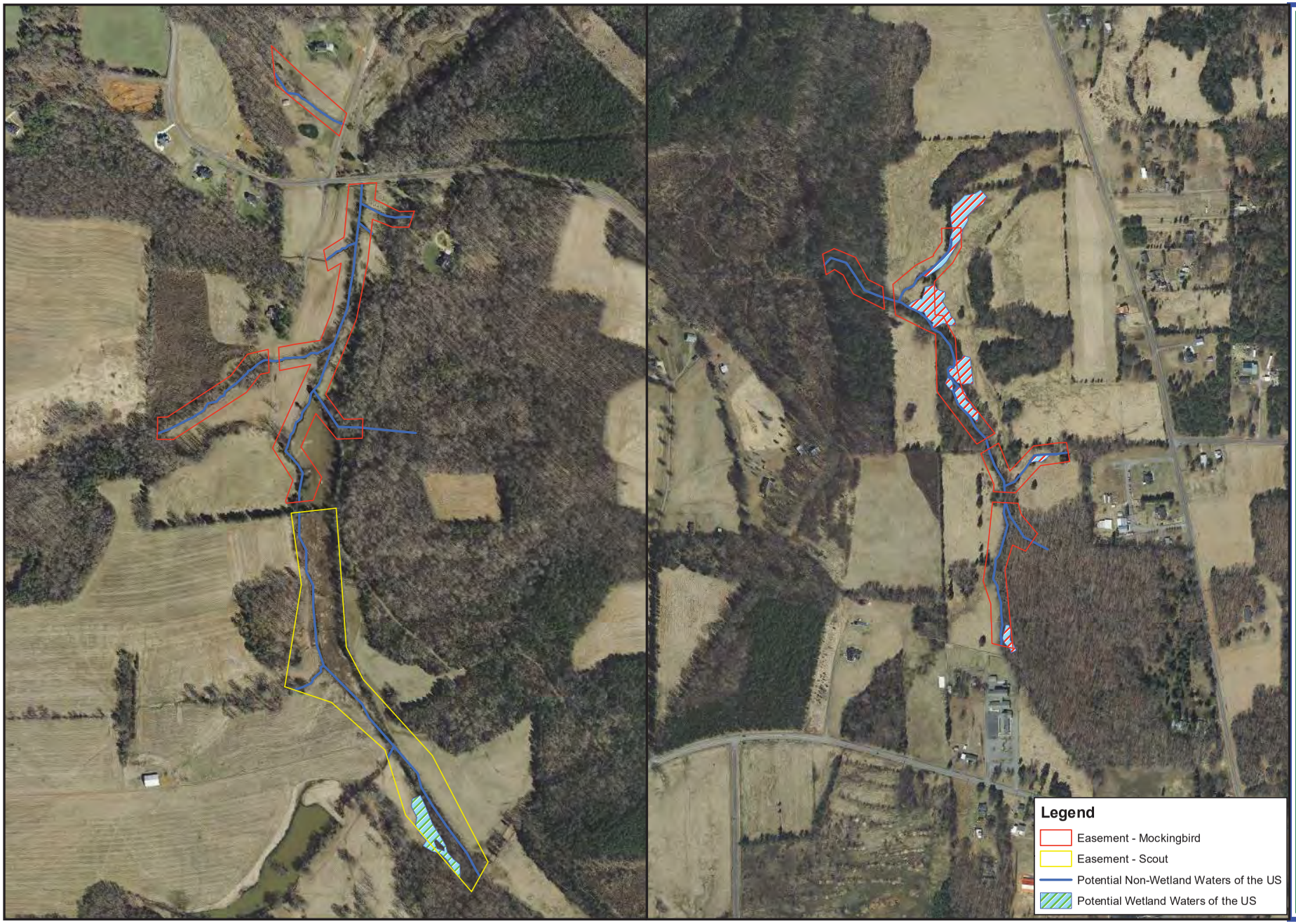
RODEN REYNOLDS.BRYAN.KENNETH.1263385574

Digitally signed by RODEN REYNOLDS.BRYAN.KENNETH.1263385574
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=RODEN REYNOLDS.BRYAN.KENNETH.1263385574
Date: 2018.03.26 14:25:58 -04'00'

Signature and date of Regulatory staff member completing PJD
03/26/2018

Signature and date of person requesting PJD (REQUIRED, unless obtaining the signature is impracticable)[1]

[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.



res

Potential Wetland or Non-Wetland Waters of the U.S. Map

Mockingbird and Scout Mitigation Sites

Davie County, North Carolina

N
W E
S

0 250 500
Feet

PROJECT MANAGER:	
DRAWN:	ATP
JOB NUMBER:	######
DATE:	09/29/2017
REVISIONS:	NONE

Potential Wetland or Non-Wetland Waters of the U.S. Map - Northern Section

Mockingbird and Scout Mitigation Sites

Davie County, North Carolina

Date: 2/28/2018

Drawn by: xxx

Checked by: xxxxxxxx

res

Potential Wetland or Non-Wetland Waters of the U.S. Map - Southern Section

Mockingbird and Scout Mitigation Sites

Davie County, North Carolina

Date: 2/28/2018

Drawn by: xxx

Checked by: xxxxxxxx

res

Appendix J – Invasive Species Plan

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. RES will treat invasive species vegetation within the project area and provide remedial action on a case by- case basis. Common invasive species vegetation, such as Chinese privet (*Ligustrum sinense*), multiflora rose (*Rosa multiflora*), tree-of-heaven (*Ailanthus altissima*), and Japanese honeysuckle (*Lonicera japonica*), will be treated to allow native plants to become established within the conservation easement. Invasive species vegetation will be treated by approved mechanical and/or chemical methods such that the percent composition of exotic/invasive species is less than 5% of the total riparian buffer area. Any control methods requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations. If areas of invasive species exist within the easement, they will be monitored yearly as part of the monitoring protocol, and treated if necessary. If required, problem areas will continue to be treated until the project easement shows overall trending towards meeting all monitoring requirements.

Appendix K – Approved FHWA Categorical Exclusion Form

Categorical Exclusion Form for Division of Mitigation Services Projects
Version 1.4

Part 1: General Project Information	
Project Name:	Mockingbird
County Name:	Davie
DMS ID Number:	100021
Project Sponsor:	Resource Environmental Solutions, LLC
Project Contact Name:	Cara Conder
Project Contact Address:	302 Jefferson Street Suite 110, Raleigh, NC 27605
Project Contact E-mail:	cconder@res.us
DMS Project Manager:	Harry Tsomides

Project Description

The Mockingbird site is a stream restoration site in the Turner and Hauser Creeks (Yadkin River: 03040101160010) watershed whose objectives are to restore or enhance 8,799 linear feet of a portion of Hauser Creek and seven unnamed tributaries. The project watershed is primarily forested and mixed agricultural land, and has historically served this purpose. Most project reaches are currently being impacted by livestock production, agricultural production, and lack of riparian buffer. A combination of stream restoration, enhancement, and preservation is proposed to increase hydrologic and ecological function and protect these natural features in perpetuity.

For Official Use Only

Reviewed By:

12/11/2017
Date

Harry Tsomides
DMS Project Manager

Conditional Approved By:

Date

For Division Administrator FHWA

☐ **Check this box if there are outstanding issues**

Final Approval By:

12-8-17
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 specie 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

Categorical Exclusion Summary

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, created a tax on the chemical and petroleum industries to clean up abandoned or uncontrolled hazardous waste sites.

As a part of the ERTR and CERCLA compliance, an EDR Radius Map Report with Geocheck was ordered for the Mockingbird Mitigation Site through Environmental Data Resources, Inc (EDR) on July 10, 2017. According to the EDR report, there were not listed sites located within 1 mile of the project site. In addition to the EDR search, a visual inspection of the Mockingbird site was conducted to assess the potential for the occurrence of recognized environmental conditions on the property that might not have been revealed in the EDR report. The inspection was conducted to locate and identify any obvious use, storage, or generation of hazardous materials. No hazardous storage containers or substances were observed.

Overall, the EDR assessment revealed no evidence of "recognized environmental conditions" in connection with the target property. The summary of the EDR report is included in the Appendix.

National Historical Preservation Act (Section 106)

The National Historical Preservation Act (NHPA) is legislation intended to preserve historical and archaeological sites in the United States of America. RES requested review and comment from the State Historic Preservation Office (SHPO) with respect to any archaeological and architectural resources related to the Mockingbird Mitigation Site on October 20th, 2017. SHPO responded on November 3, 2017 and had no objections to the Mockingbird Project. The correspondence SHPO can be found in the Appendix.

Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)

The Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act) provides important protections and assistance for those people affected by federally funded projects. The Uniform Act applies to the acquisition, rehabilitation, or demolition of real property for federally funded projects. The Mockingbird Mitigation Site is a full-delivery project that includes land acquisition. Notification of fair market value of the property and the lack of condemnation authority was completed by RES. The landowner was notified of fair market value and condemnation authority was listed in the option agreement.

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.

Davie County's list of threatened and endangered species include Michaux's Sumac (*Rhus michauxii*) and Northern Long Eared Bat (NLEB) (*Myotis septentrionalis*). Other than the NLEB, the Mockingbird Mitigation Site does not support any habitat related to any of the threatened or endangered species listed above.

During site visits performed by RES, no NLEB individuals were found to exist on the site. A completed NLEB 4(d) Rule Streamline Consultation Form will be submitted by the Federal Highways Administration to the USFWS is included in Appendix F. The NLEB 4(d) Rules states "that the project may affect the NLEB, but that any resulting incidental take of the NLEB is not prohibited by the final 4(d) rule." All correspondence with the USFWS is included in the Appendix.

Farmland Protection Policy Act (FPPA)

The Farmland Protection Policy Act (FPPA) is intended to minimize the impact federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. The Mockingbird Mitigation Site includes the conversion of prime farmland. As such, Form AD-1006 has been completed and submitted to the Natural Resource Conservation Service (NRCS). The completed form and correspondence is included in the Appendix.

Fish and Wildlife Coordination Act (FWCA)

The Fish and Wildlife Coordination Act (FWCA) of the United States was enacted to protect fish and wildlife when federal actions result in the control or modification of a natural stream or body of water. Since the Mockingbird Mitigation Site includes stream restoration RES requested comment from the North Carolina Fish and Wildlife Resource Commission (NCWRC). The NCWRC responded on December 1, 2017 and stated there are no records for any listed aquatic species in the vicinity of the project. All correspondence can be found in Appendix F.

Migratory Bird Treaty Act (MBTA)

The MBTA makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship import, or extort and 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 at taking.

RES requested comment on the Mockingbird Mitigation Site from the USFWS regarding migratory birds on October 20th, 2017. The USFWS responded on November 20, 2017 and stated that besides the Northern long-eared bat, there is no record of other federally protected species in the project vicinity. All correspondence with USFWS will be included in the Appendix.

October 20, 2017

Renee Gledhill-Earley
North Carolina State Historic Preservation Office
4617 Mail Service Center
Raleigh NC 27699-4617

Dear Ms. Gledhill-Earley,

The Mockingbird Site has been identified by Resource Environmental Solutions, LLC (RES) to provide compensatory mitigation for unavoidable stream impacts. The proposed project involves the restoration and enhancement of approximately 8,800 linear feet of stream.

RES requests review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential stream mitigation project on the Mockingbird Site (a USGS site map with approximate limits of conservation easement is attached).

A review of the N.C. State Historic Preservation Office (SHPO) HPOWEB GIS Service database (http://gis.ncdcr.gov/hpoweb/; accessed October 11, 2017) was performed as part of the site due diligence evaluation. The database did not reveal any listed or potentially eligible historic or archeological resources on the proposed properties. In addition, the majority of the site has historically been disturbed due to cattle grazing.

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. You may return the comment to my attention at the address below, or via email. Please feel free to contact me at mdeangelo@res.us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Matt DeAngelo
Ecologist

302 Jefferson St., Suite 110
Raleigh, NC 27605
Tel. 984.255.9133

10055 Red Run Blvd.
Suite 130
Owings Mills, MD
21117

412 N. 4th St.
Suite 300
Baton Rouge, LA
70802

100 Calhoun St.
Suite 320
Charleston, SC
29401

5020 Montrose Blvd.
Suite 650
Houston, TX
77006

1200 Camellia Blvd.
Suite 220
Lafayette, LA
70508

137½ East Main St.
Suite 210
Oak Hill, WV
25901

33 Terminal Way
Suite 431
Pittsburgh, PA
15219

302 Jefferson St.
Suite 110
Raleigh, NC
27605

1521 W. Main
2nd Floor
Richmond, VA
23220

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

November 3, 2017

Kim Browning
Mitigation Field Office
3331 Heritage Trade Drive, Suite 105
Wake Forest, NC 27587

Re: Mockingbird Mitigation Site, SAW 2017-01505, Davie County, ER 17-1790

Dear Ms. Browning:

We have received a public notice concerning the above project. We apologize for the delay in our response.

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, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

October 20, 2017

Mr. Vann Stancil
Habitat Conservation Biologist
North Carolina Wildlife Resources Commission
215 Jerusalem Church Road
Kenly, NC 27542

Subject: Project Scoping for Mockingbird Stream Mitigation Project in Davie County.

Dear Mr.Stancil,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to fish and wildlife associated with a potential stream restoration project on the attached site (USGS site maps with approximate property lines and areas of potential ground disturbance are enclosed). The Mockingbird Site has been identified by Resource Environmental Solutions, LLC (RES) to provide compensatory mitigation for unavoidable stream impacts. The proposed project involves the restoration and enhancement of approximately 8,800 linear feet of stream. The site is currently used for cattle grazing and the stream channels have been channelized and impounded.

We thank you in advance for your timely response and cooperation. You may return the comment to my attention at the address below. Please feel free to contact me at mddeangelo@res.us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Matt DeAngelo
Ecologist

302 Jefferson St., Suite 110
Raleigh, NC 27605
Tel. 984.255.9133

10055 Red Run Blvd.
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137½ East Main St.
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25901

33 Terminal Way
Suite 431
Pittsburgh, PA
15219

302 Jefferson St.
Suite 110
Raleigh, NC
27605

1521 W. Main
2nd Floor
Richmond, VA
23220

From: Stancil, Vann F <vann.stancil@ncwildlife.org>
Sent: Friday, December 1, 2017 1:17 PM
To: Matthew DeAngelo
Subject: RE: [External] Mockingbird Mitigation Site

Matt,

Thanks for the opportunity to review these 3 mitigation project for issues related to fish and wildlife.

The Mockingbird Stream Mitigation Site is located on Hauser Creek and its tributaries in Davie County. Hauser Creek is a direct tributary to the Yadkin River. There's an existing easement downstream of this new mitigation site. There are no records for any listed aquatic species in the vicinity of this project.

The Catbird Stream Mitigation Site appears to be located on an unnamed tributary to the Yadkin River located east of Hauser Creek in Davie County. There are no records for any listed aquatic species in the vicinity of this project.

The Little Sebastian Stream Mitigation Site is located in Surry County on Mill Creek and 3 of it's tributaries. Mill Creek is a tributary to the Mitchell River. While there are no records of listed aquatic species in Mill Creek, there are records for brook floater, *Alasmidonta varicosa*, in the Mitchell River upstream and downstream of the Mill Creek confluence. Brook floater is a state endangered species. I've consulted with our aquatic biologists about the possibility of brook floaters in Mill Creek. There are no records from Mill Creek, but we don't have any records of collection efforts there either. So brook floaters may inhabit Mill Creek, near the area proposed for restoration. Our biologist plan to investigate Mill Creek to see if there are brook floaters present or if the habitat there is likely to support them. If brook floaters, or another listed aquatic species is found, additional measures will be needed to protect these species if restoration efforts are likely to impact them. While restoration efforts are likely to improve habitat conditions in the long term in Mill Creek, and potentially improve conditions downstream in the Mitchell River as well, there may be short term impacts to aquatic species and habitats during restoration. Additional measures during restoration may be needed to minimize these short term impacts.

Regarding terrestrial species, the U.S. Fish and Wildlife Service (USFWS) recently listed the northern long-eared bat (*Myotis septentrionalis*) as threatened under the Endangered Species Act. Davie & Surry counties are within the range (https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/WNSZone.pdf) of the northern long-eared bat and may be present or in the vicinity of the project site. As such, consultation with the USFWS may be required. For more information, please see https://www.fws.gov/midwest/endangered/mammals/nleb/ or https://www.fws.gov/raleigh/NLEB_RFO.html or contact the Asheville office of the USFWS to ensure that potential issues related to this species are addressed.

Please let me know if I can assist further. Also, feel free to follow up on the results of survey efforts in Mill Creek if you have not yet heard from me.

Thanks,
Vann

From: Matthew DeAngelo [mailto:mdeangelo@res.us]
Sent: Friday, October 20, 2017 12:50 PM
To: Stancil, Vann F <vann.stancil@ncwildlife.org>
Cc: Brad Breslow <bbreslow@res.us>
Subject: [External] Mockingbird Mitigation Site

Dear Mr. Stancil,

The Mockingbird Stream Mitigation Site has been identified by Resource Environmental Solutions, LLC (RES) to provide compensatory mitigation for unavoidable stream and wetland impacts through the North Carolina Division of Mitigation Services. The purpose of this letter is to request, review, and comment on any possible issues that might emerge with respect to fish and wildlife associated with a potential stream restoration project on the attached site (USGS site maps with approximate property lines and areas of potential ground disturbance are enclosed along with a KMZ file). We thank you in advance for your timely response and cooperation. You may return the comment to my attention at the address below. Please feel free to contact me at mdeangelo@res.us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Matt DeAngelo
Ecologist
RES | res.us
Direct: 984.255.9133 | Mobile: 757.202.4471

October 20, 2017

Mrs. Janet Mizzi
US Fish and Wildlife Service
Asheville Field Office
160 Zillicoa Street
Asheville, NC 28801

Subject: Project Scoping for Mockingbird Mitigation Site in Davie County

Dear Mrs. Mizzi,

Resource Environmetal Solutions (RES) requests review and comment from the United States Fish and Wildlife Service (USFWS) on any possible concerns they may have with regards to the implementation of the Mockingbird Mitigation Project. Please note that this request is in support of the development of the Categorical Exclusion (CE) for the referenced project. The proposed project involves the restoration and enhancement of approximately 8,800 linear feet of stream The Site is currently in agricultural use, specifically as pasture and row crops.

The US Fish and Wildlife Service (USFWS) database (accessed 11 October 2017) lists one endangered species for Davie County, North Carolina: Michaux's sumac (*Rhus michauxii*). The database also lists the northern long-eared bat (*Myotis septentrionalis*) as a threatened species. No protected species or potential habitat for protected species was observed during preliminary site evaluations. A review of the NHP database indicates that there are no known occurrences of state threatened or endangered species within a one-mile radius of the project area. Based on initial site investigations, no impacts to federally protected species are anticipated as a result of the proposed project.

Please provide comments on any possible issues that might emerge with respect to endangered species, migratory birds, or other trust resources from the construction of a stream restoration project on the subject property. Maps showing the location and approximate limits of the conservation easement are enclosed.

We thank you in advance for your timely response and cooperation. You may return the comment to my attention at the address below. Please feel free to contact me at mdeangelo@res.us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Matt DeAngelo
Ecologist

302 Jefferson St., Suite 110
Raleigh, NC 27605
Tel. 984.255.9133

10055 Red Run Blvd.
Suite 130
Owings Mills, MD
21117

412 N. 4th St.
Suite 300
Baton Rouge, LA
70802

100 Calhoun St.
Suite 320
Charleston, SC
29401

5020 Montrose Blvd.
Suite 650
Houston, TX
77006

1200 Camellia Blvd.
Suite 220
Lafayette, LA
70508

137½ East Main St.
Suite 210
Oak Hill, WV
25901

33 Terminal Way
Suite 431
Pittsburgh, PA
15219

302 Jefferson St.
Suite 110
Raleigh, NC
27605

1521 W. Main
2nd Floor
Richmond, VA
23220

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Asheville Field Office
160 Zillicoa Street
Asheville, North Carolina 28801

November 20, 2017

Mr. Matt DeAngelo
Resource Environmental Solutions
302 Jefferson Street, Suite 110
Raleigh, North Carolina 27605

Dear Mr. DeAngelo:

Subject: Mockingbird Mitigation Site; Davie County, North Carolina
Log No. 4-2-18-027

The U.S. Fish and Wildlife Service (Service) has reviewed the information provided in your correspondence received via email dated October 20, 2017. We submit the following comments in accordance with the provisions of the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661-667e); the National Environmental Policy Act (42 U.S.C. §4321 et seq.); and section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543) (Act).

Project Description

According to your correspondence, you are seeking our scoping comments to inform a NEPA document for a proposed mitigation bank near Farmington, North Carolina. The proposed bank would entail restoration and enhancement of approximately 8,800 linear feet of Hauser Creek and its unnamed tributaries. Adjacent land use is dominated by pasture and row crops.

Federally Listed Endangered and Threatened Species

According to Service records, suitable summer roosting habitat may be present in the project area for the federally threatened northern long-eared bat (*Myotis septentrionalis*). However, the final 4(d) rule (effective as of February 16, 2016), exempts incidental take of northern long-eared bat associated with activities that occur greater than 0.25 miles from a known hibernation site, and greater than 150 feet from a known, occupied maternity roost during the pup season (June 1 – July 31). Based on the information provided, the project (which may or may not require tree clearing) would occur at a location where any incidental take that may result from associated activities is exempt under the 4(d) rule. **Although not required, we encourage you to avoid any associated tree clearing activities during the maternity roosting season from May 15 – August 15 if possible.**

The Service has record of no other federally protected species in the project vicinity.

We offer the following comments in the interest of protecting fish and wildlife resources:

Stream Channel and Bank Restoration

A natural, stable stream system is one that is able to transport a wide range of flows and associated bed load (sediment) while maintaining channel features and neither degrading

(accelerating the erosion of banks and scour of the channel bed) nor aggrading (accelerating the deposition of sediment within the channel). Alterations to the dimension (cross-sectional view of the channel), pattern (the sinuosity of the channel), or profile (longitudinal slope) of the stream channel as well as changes to streambank vegetation, floodplains, hydrology, or sediment input can significantly alter this equilibrium. Accordingly, we recommend the following:

1. Only the absolute minimum amount of work should be done within stream channels to accomplish necessary reconstruction. The amount of disturbance to in-stream and riparian areas should not exceed what can be stabilized by the end of the workday. Restoration plans should account for the constraints of the site and the opportunities to improve stream pattern, dimension, and profile with minimal disturbance.

2. All reconstruction work should follow natural channel design methodologies that are based on the bank-full, or channel-forming, stage of the stream. Bank-full stage maintains the natural channel dimensions and transports the bulk of sediment over time (Doll et al. 2003). Natural channel conditions should be identified using a reference reach (nearby stream reaches that exemplify restoration goals). Restoration design should match the pattern, dimension, and profile of the reference reach to ensure the project's success. The Service is available to assist with the identification of reference reaches.

3. All work in or adjacent to stream waters should be conducted in a dry work area to the extent possible. Sandbags, cofferdams, bladder dams, or other diversion structures should be used to prevent excavation in flowing water. These diversion structures should be removed as soon as the work area is stable. When practical, a pump-around operation shall be used to divert flow during construction.

4. Equipment should not be operated in the stream unless absolutely necessary. Machinery should be operated from the banks in a fashion that minimizes disturbance to woody vegetation. Equipment should be: (a) washed to remove any contaminant residue prior to project construction, (b) in good working order, and (c) checked to ensure there are no leaks of potential contaminants (such as oil or other lubricants) prior to and during construction.

5. Streambanks with deep-rooted woody vegetation are the most stable, and stream restoration efforts should incorporate the use of native vegetation adapted to the site conditions. Biodegradable erosion-control materials may be incorporated into bank-restoration design in order to stabilize soils as vegetation becomes established. Live dormant stakes (such as black willow) may be used to reestablish root structure in riparian areas. In areas where banks are severely undercut, high, and steep, whole-tree revetment or rock may be used as a stabilization treatment (small rock, gravel, sand, and dirt are not recommended due to their erosive nature), and it should not extend above the bank-full elevation (the elevation of the channel where the natural floodplain begins). Deep-rooting woody vegetation should be established along banks where any channel work is accomplished. Tree and shrub plantings should be spaced at intervals no greater

than 10 feet along banks. Vegetated riparian zone widths should be as wide as practical but should extend at least 30 feet from the stream channel.

6. Adequate measures to control sediment and erosion must be implemented prior to any ground-disturbing activities in order to minimize effects on downstream aquatic resources. In North Carolina, non-cohesive and erosion-prone soils are most common in the felsic-crystalline terrains of the mountain and upper piedmont regions (Miller and Kochel 2010). Therefore, reconstruction work should be staged such that disturbed areas would be stabilized with seeding, mulch, and/or biodegradable (coir) erosion-control matting prior to the end of each workday. No erosion-control matting or blankets should contain synthetic (netting) materials. Matting should be secured in place with staples; stakes; or, wherever possible, live stakes of native trees. If rain is expected prior to temporary seed establishment, additional measures should be implemented to protect water quality along slopes and overburden stockpiles (for example, stockpiles may be covered with plastic or other geotextile material).

7. Woody debris, detritus, and other vegetative materials are the main sources of nutrients and carbon necessary for primary productivity in stream ecosystems. Removal of this material can impact the production of higher trophic levels, including fish. The Service does not recommend the removal of woody debris within the stream channel or floodplain unless it is causing a debris blockage (logjam) or will affect the ability to achieve bank stability along a specific reach of stream. Woody debris that must be removed should be chipped on the site.

8. At each restoration site, cross-sections (at intervals based on restoration reach size), longitudinal profiles, and stream-pattern plans should be measured and mapped prior to and immediately following any channel work. In addition, photographs should be taken to document the condition of the project site prior to initiating the work and upon completion of the work. However, since a project's restoration success does not necessarily equate to biological success, the ecological goals of the project should be clearly defined and assessed for improvement after construction is completed (Palmer et al. 2005).

The Service appreciates the opportunity to provide these comments. Please contact Mr. Byron Hamstead of our staff at 828/258-3939, Ext. 225, if you have any questions. In any future correspondence concerning this project, please reference our Log Number 4-2-18-027.

Sincerely,

- - original signed - -

Janet Mizzi
Field Supervisor

References

Doll, B.A., G.L. Grabow, K.R. Hall, J. Halley, W.A. Harman, G.D. Jennings, and D.E. Wise. 2003. Stream Restoration: A Natural Channel Design Handbook. North Carolina Stream Restoration Institute, North Carolina State University. 128 pp.

Hall, K. 2003. Recommended Native Plant Species for Stream Restoration in North Carolina. Raleigh: North Carolina Stream Restoration Institute, North Carolina State University.

Miller, J.R., and Kochel, R.C. 2010. Assessment of channel dynamics, in-stream structures and post-project channel adjustments in North Carolina and its implications to effective stream restoration. Environmental Earth Sciences, 59(8), pp. 1681-1692.

Palmer, M.A., E.S. Bernhardt, J.D. Allan, P.S. Lake, G. Alexander, S. Brooks, J. Carr, S. Clayton, C.N. Dahm, J. Follstad Shah, and D.L. Galat. 2005. Standards for ecologically successful river restoration. Journal of Applied Ecology, 42(2), pp. 208-217.

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]?	☐	☒
2. Have you contacted the appropriate agency[2] to determine if your project is near known hibernacula or maternity roost trees?	☒	☐
3. Could the project disturb hibernating NLEBs in a known hibernaculum?	☐	☒
4. Could the project alter the entrance or interior environment of a known hibernaculum?	☐	☒
5. Does the project remove any trees within 0.25 miles of a known hibernaculum at any time of year?	☐	☒
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.	☐	☒

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, Donnie.brew@dot.gov, 919-747-7017
Federal Highway Administration

Cara Conder, cconder@res.us, 919-209-1052
Resource Environmental Solutions, LLC (EBX is an entity of RES)

[1] http://www.fws.gov/midwest/endangered/mammals/nleb/pdf/WNSZone.pdf
[2] See http://www.fws.gov/midwest/endangered/mammals/nleb/nhisites.html
[3] If applicable - only needed for federal actions with applicants (e.g., for a permit, etc.) who are party to the consultation.

Project Name: Mockingbird Stream Mitigation Site, DMS Project #100021

Project Location (include coordinates if known):

The Project is located in Davie County, approximately eight miles west of Clemmons and five miles northwest of Bermuda Run. From Raleigh, proceed west on I-40 towards Greensboro. Continue on I-40 West for 115 miles. Take exit 180B to merge onto NC-801. Stay on NC-801 for 4 miles. Take a right onto Spillman road and continue for approximately 1 mile and the project will be on the left. Coordinates for the site are as follows: 36.036000 N, -80.517000 W.

Basic Project Description (provide narrative below or attach additional information):

The Mockingbird Stream Mitigation Site is located in Davie County, approximately eight miles west of Clemmons and five miles northwest of Bermuda Run (Figure 1). The Project is located in the Yadkin River Basin within Cataloging Unit 03040101, TLW 03040101160010, and NC Division of Water Resources (DWR) subbasin 03-07-02. The Project area includes Hauser Creek and seven unnamed tributaries. The current State classification for Hauser Creek is Water Supply IV (WS-IV). WS-IV waters are sources of water supply for drinking, culinary, or food processing purposes where a WS-I, II or III classification is not feasible. Water quality stressors currently affecting the Project include livestock production, agricultural production, and lack of riparian buffer. Field evaluations determined all reaches to be either intermittent or perennial. A combination of stream restoration, enhancement, and preservation is proposed to increase hydrologic and ecological function and protect these features in perpetuity (Figure 2). Reaches proposed for the Project have minimum 50-foot buffers throughout and RES has the ability to protect larger buffers if necessary. Agricultural BMPs are proposed above intermittent enhancement reaches to capture and treat concentrated runoff from adjacent pasture.

The Site will include Priority II stream restoration, stream Enhancement Levels I and II, and stream preservation on 13 reaches (Figure 2; HC1, NM1, NM2, NM3, NM4. JS1, HC2-A, HC2-B, HC3-C, HC2-D, TP1, TP2, TP3). Priority II stream restoration will incorporate the design of a single-thread meandering channel, with parameters based on data taken from reference sites to be identified later, published empirical relationships, regional flood frequency analyses, NC Regional Curves, and analysis of the downstream Hauser Creek project design and performance. Analytical design techniques will also be an important element of the project and will be used to determine the design discharge and to verify the design as a whole.

Priority II Stream Restoration activities will include constructing an E/C type stream with appropriate dimensions and pattern, reconnecting the channel to the floodplain, and backfilling the abandoned channel. In-stream structures such as log sills and brush toes will be installed for vertical stability and to improve habitat. Buffer improvements will filter runoff from agricultural fields, thereby reducing nutrient and sediment loads to the channel. The widening and restoration of the riparian areas will also provide wildlife corridors throughout the project area.

Enhancement I activities will include bank grading and stabilization and the installation of log grade control structures, brush toes, and live stakes. Stabilization through in-stream structures and bank treatments will enhance hydrologic function and reduce sediment loads to downstream channels. Habitat will further be improved through buffer plantings and livestock exclusion. Livestock fencing will follow current NRCS standards and specifications. The widening and restoration of the riparian areas will provide wildlife corridors throughout the project area. The re-establishment of minimum 50-foot buffers will filter runoff from adjacent pastures, thereby reducing nutrient and sediment loads to the channel.

Enhancement II activities will include the re-establishment of a riparian buffer and live staking the channel banks with native vegetation. Proposed buffer activities will improve riparian areas that will filter runoff from adjacent agricultural areas, thereby reducing nutrient and sediment loads to the channel. The buffers will extend a minimum of 50 feet from the top of each bank.

Preservation activities include maintaining a 50-foot minimum buffer on each bank.

One agricultural BMP will be installed at the upper end of the reach (TP3, Figure 2) to provide nutrient/sediment control and flow attenuation from the adjacent pasture.

Any tree removal due to the construction of the stream mitigation site will be limited to the area along the channel banks. An effort will be made to conduct any tree cutting of suitable summer roosting tree species between August 1 and May 31, but will ultimately depend on the construction/contractor timeline.

The following objectives are proposed for accomplishing project goals:

a. The Project presents the opportunity to provide up to 6,047 warm stream mitigation units. These will be derived from 4,244 linear feet of Priority II Restoration, 449 linear feet of Enhancement I, 3,644 linear feet of Enhancement II, and 462 linear feet of Preservation (see table below).
b. Restore stable channel morphology and proper sediment transport capacity.
c. Create and improve stream bed form and improve aquatic and benthic macroinvertebrate habitat.
d. Construct a floodplain bench that is accessible at the proposed bankfull channel elevation.
e. Improve channel and stream bank stabilization by integrating in-stream structures and native bank vegetation.
f. Provide approximately 22.9 acres of riparian buffer restoration by establishing a native forested and herbaceous riparian buffer plant community with a minimum width of 50 feet from the edge of the restored channels. This new community will be established in conjunction with the eradication of any existing exotic or undesirable plant species.

		Proposed Mitigation		
Reach	**Restoration Level**	**Linear Feet**	**Mitigation Ratio**	**Stream Mitigation Units (SMUs)**
HC1	Restoration	2,181	1 : 1	2,181
JS1	Restoration	561	1 : 1	561
NM1	Enhancement II	383	2.5 : 1	153
NM2	Restoration	1,277	1 : 1	1,277
NM3	Restoration	225	1 : 1	225
NM4	Enhancement II	314	2.5 : 1	126
HC2-A	Enhancement II	868	2.5 : 1	347
HC2-B	Enhancement II	857	2.5 : 1	343
HC2-C	Enhancement I	449	1.5 : 1	299
HC2-D	Preservation	462	10 : 1	46
TP1	Enhancement II	265	2.5 : 1	106
TP2	Enhancement II	450	2.5 : 1	180
TP3	Enhancement II	507	2.5 : 1	203
	Stream Totals	**8,799**		**6,047**

General Project Information	YES	NO
Does the project occur within 0.25 miles of a known hibernaculum?	☐	☒
Does the project occur within 150 feet of a known maternity roost tree?	☐	☒
Does the project include forest conversion[4]? (if yes, report acreage below)	☒	☐
Estimated total acres of forest conversion	1.5 ac	
If known, estimated acres[5] of forest conversion from April 1 to October 31	1.5 ac	
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)	☐	☒
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)	☐	☒
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)	☐	☒
Estimated wind capacity (MW)		

Agency Determination:

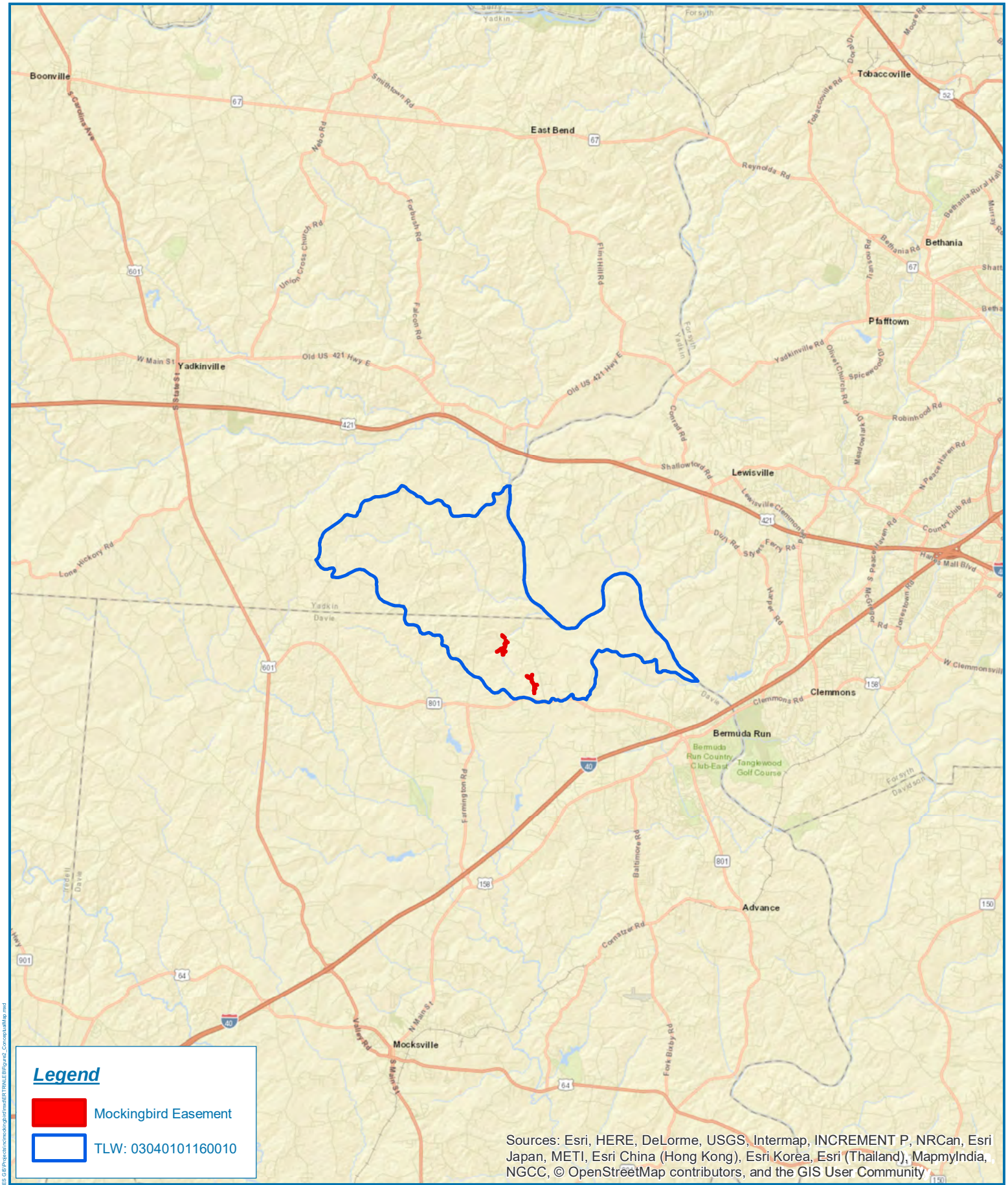
By signing this form, the action agency determines that this project may affect the NLEB, but that any resulting incidental take of the NLEB is not prohibited by the final 4(d) rule.

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: 12-4-17

[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.



Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

1 inch = 3 miles

0 1.5 3 6

Miles

Figure 1

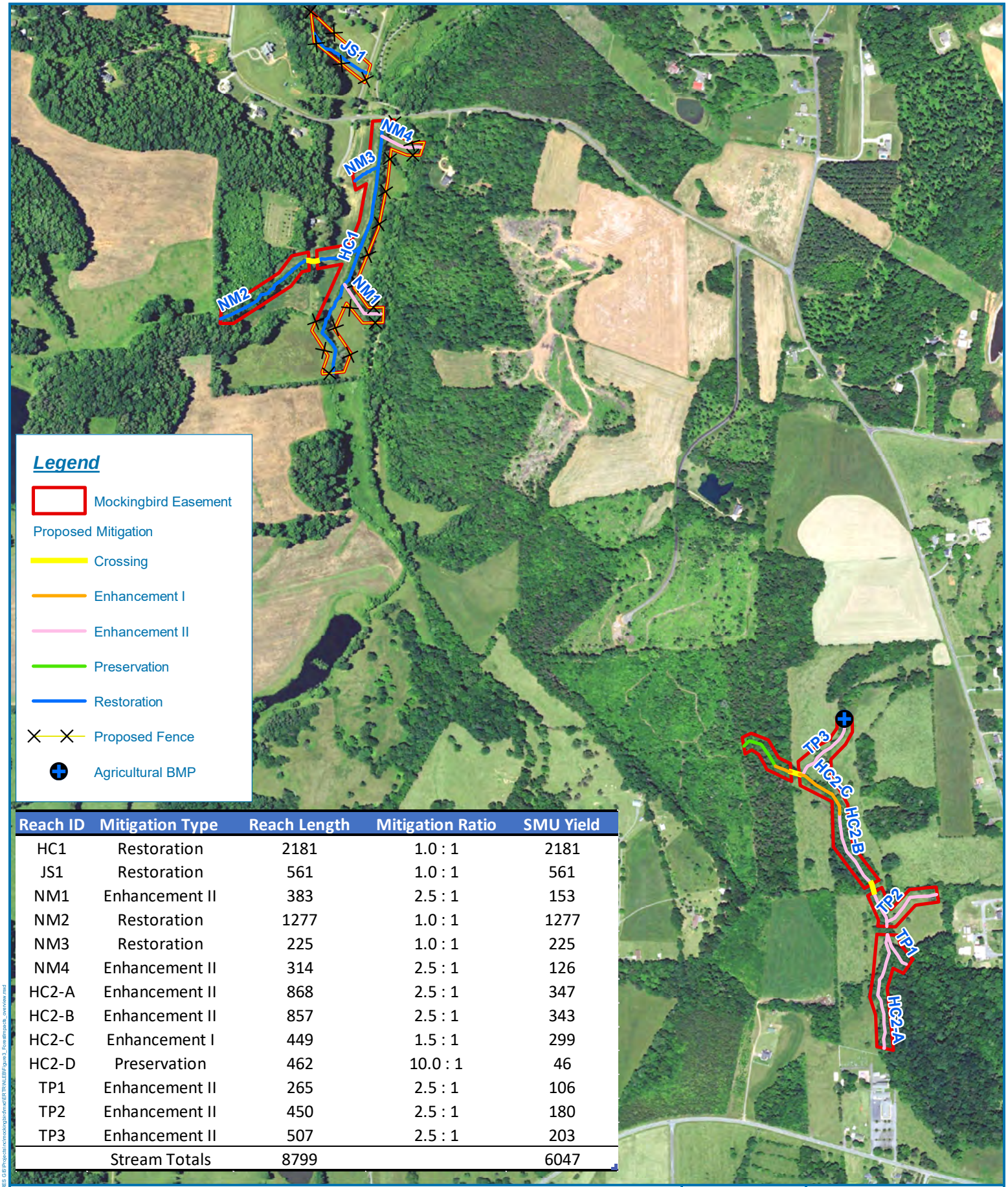
Watershed Map
Mockingbird Stream Site

Davie County, North Carolina

Date: 11/13/2017

Drawn by: MDE

Document Path: C:\Users\mmegill\Dropbox (RES)\@RES GIS\Projects\mcmdnghill\mxd\ERTRNLEB\Figure2_ConceptualMap.mxd



Reach ID	Mitigation Type	Reach Length	Mitigation Ratio	SMU Yield
HC1	Restoration	2181	1.0 : 1	2181
JS1	Restoration	561	1.0 : 1	561
NM1	Enhancement II	383	2.5 : 1	153
NM2	Restoration	1277	1.0 : 1	1277
NM3	Restoration	225	1.0 : 1	225
NM4	Enhancement II	314	2.5 : 1	126
HC2-A	Enhancement II	868	2.5 : 1	347
HC2-B	Enhancement II	857	2.5 : 1	343
HC2-C	Enhancement I	449	1.5 : 1	299
HC2-D	Preservation	462	10.0 : 1	46
TP1	Enhancement II	265	2.5 : 1	106
TP2	Enhancement II	450	2.5 : 1	180
TP3	Enhancement II	507	2.5 : 1	203
	Stream Totals	8799		6047

1 inch = 900 feet

0 450 900 1,800

Feet

Figure 2

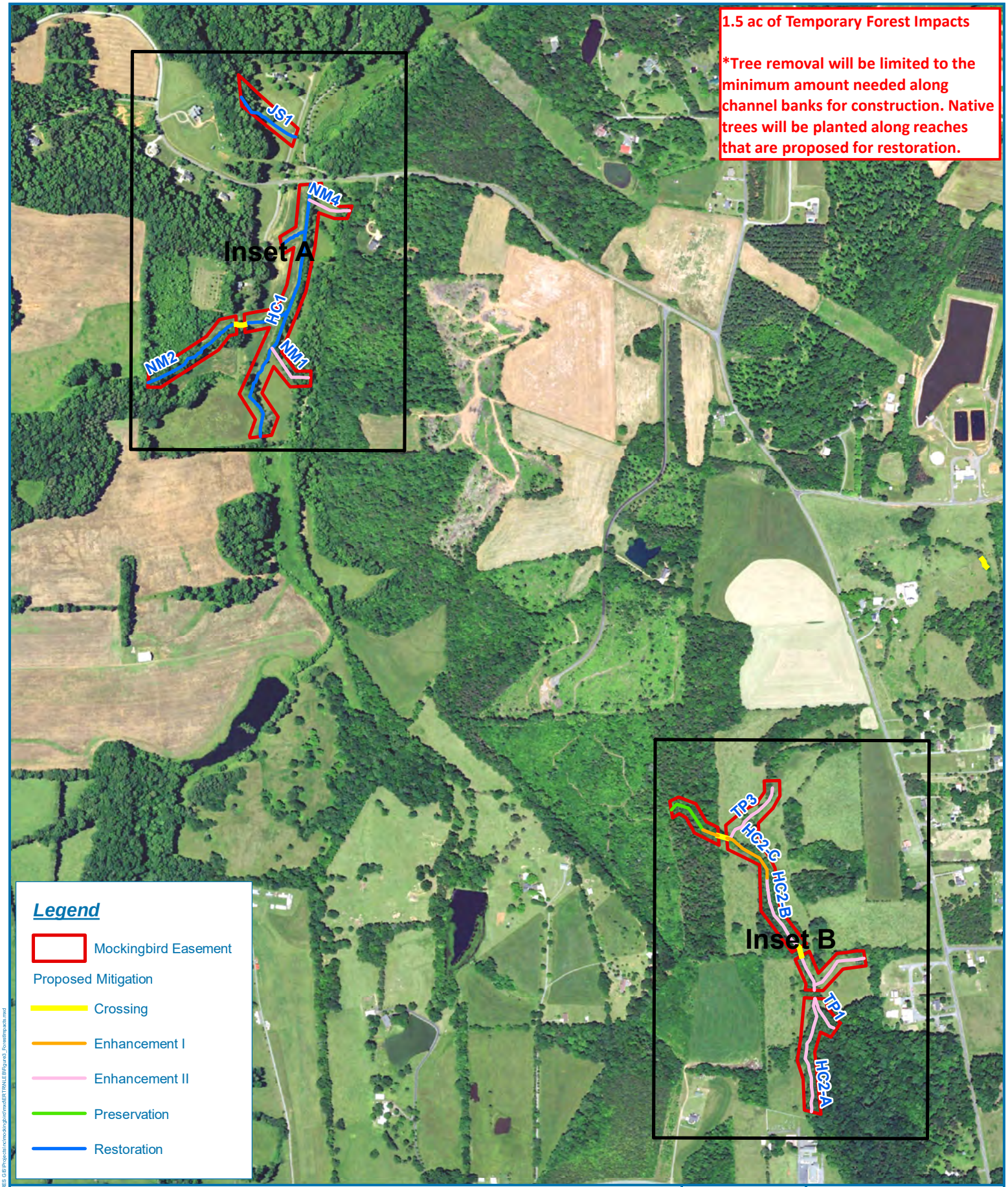
Conceptual Design Map
Mockingbird Stream Site

Davie County, North Carolina

Date: 11/13/2017

Drawn by: MDE

res



1 inch = 900 feet

0 450 900 1,800

Feet

Figure 3

Temporary Forest Impacts Map
Mockingbird Stream Site

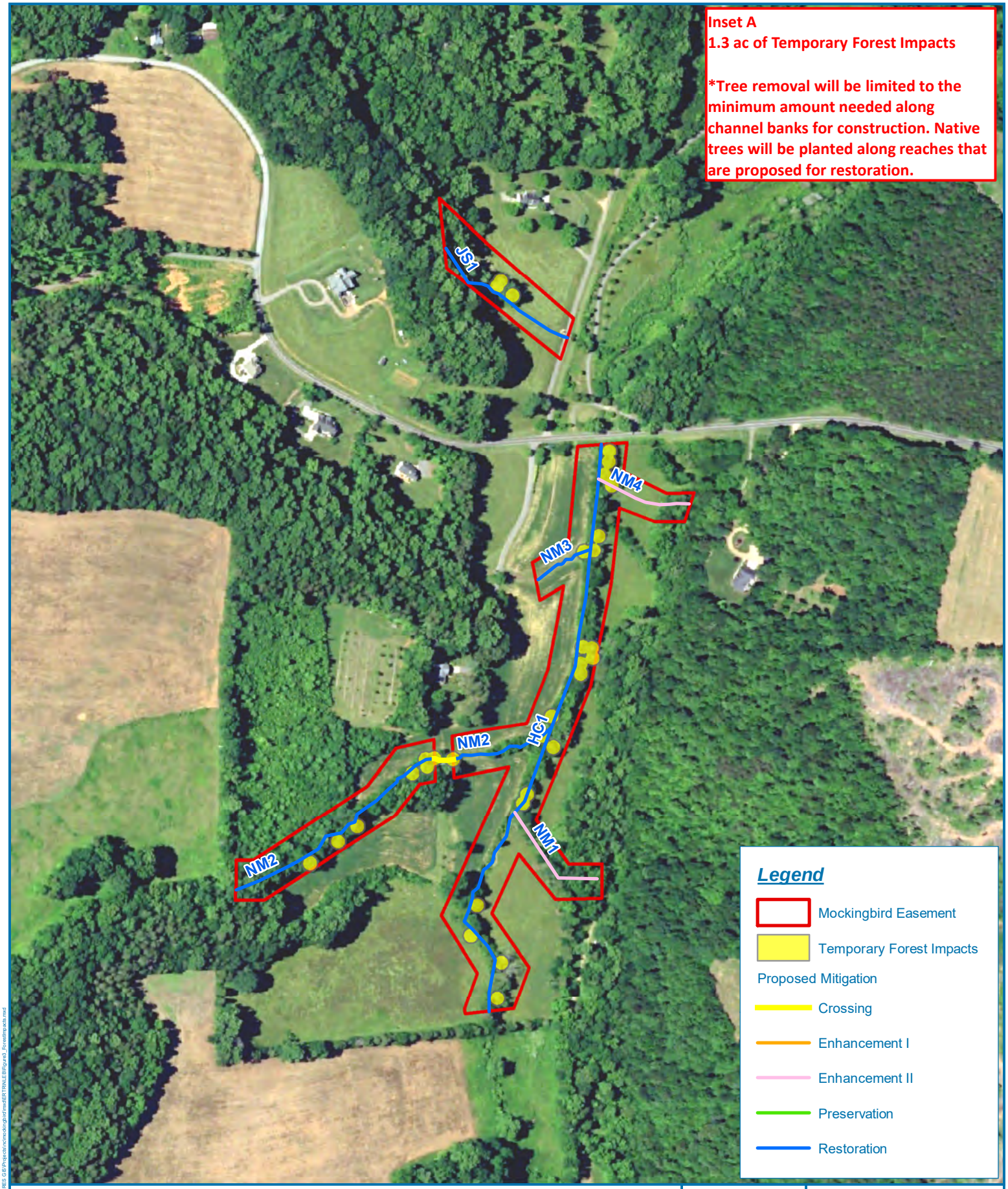
Davie County, North Carolina

Date: 11/13/2017

Drawn by: MDE

res

Document Path: C:\Users\mmegill\Dropbox (RES)\@RES GIS\Projects\mockingbird\mxd\ERTRNLE\Figure3_Forestimpacts.mxd



N
W E
S
1 inch = 400 feet
0 200 400 800
Feet

Figure 3 (Inset A)

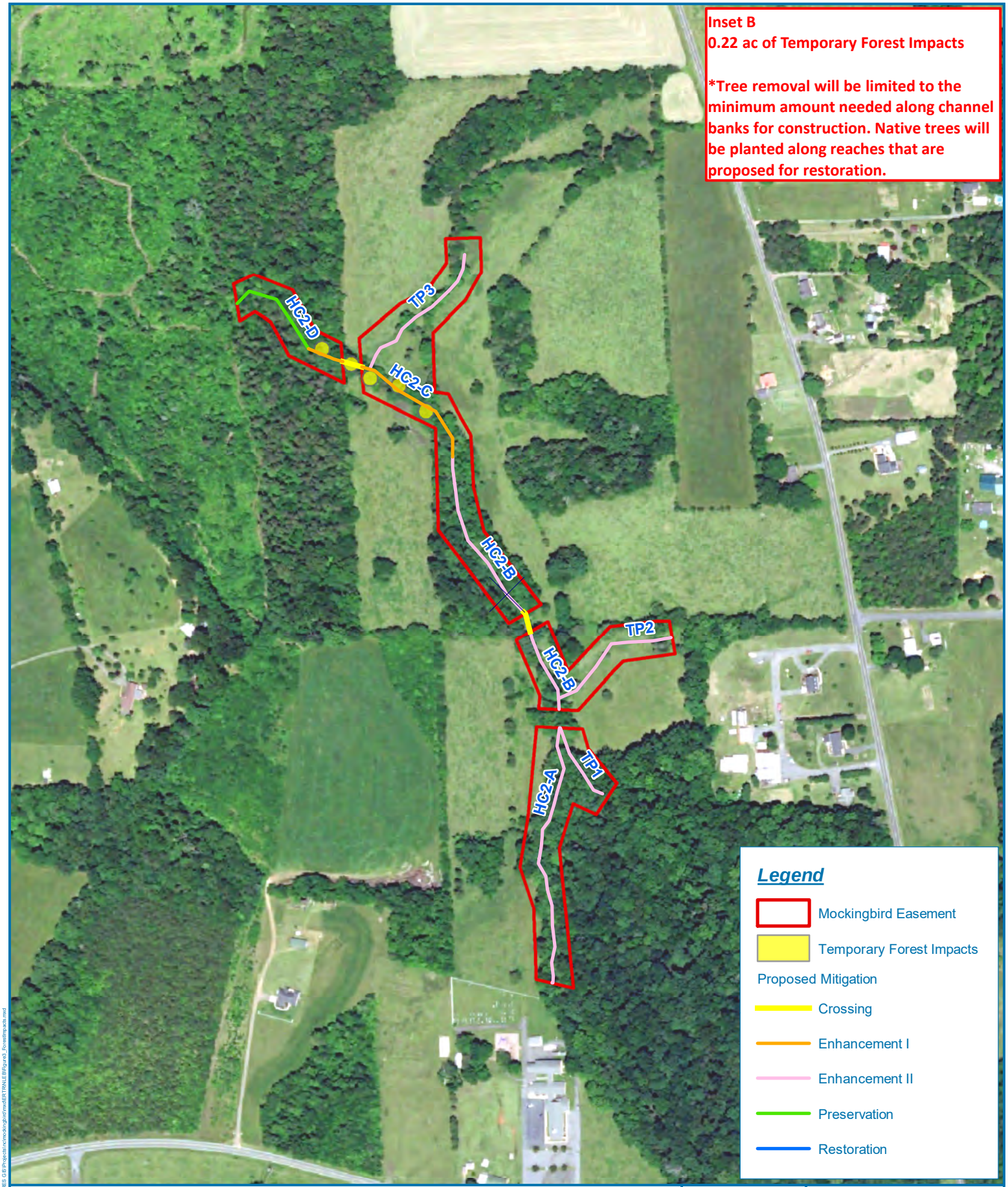
Temporary Forest Impacts Map
Mockingbird Stream Site

Davie County, North Carolina

Date: 11/13/2017

Drawn by: MDE

Document Path: C:\Users\mmegill\Dropbox (RES)\@RES GIS\Projects\mocksingbird\mxd\ERTRNLEB\Figure3_ForestImpacts.mxd



1 inch = 400 feet

0 200 400 800

Feet

Figure 3 (Inset B)

Temporary Forest Impacts Map
Mockingbird Stream Site

Davie County, North Carolina

Date: 11/13/2017

Drawn by: MDE

Document Path: C:\Users\mmegill\Dropbox (RES)\@RES GIS\Projects\mcmdingbird\mxd\EBTRNLEB\Figure3_ForestImpacts.mxd

October 20, 2017

Randy Blackwood
Natural Resources Conservation Service
301 E Center St.
Lexington, NC 27292-4107

Subject: AD-1006 Request for the Mockingbird Mitigation Site in Davie County

Dear Mr. Blackwoood,

Resource Environmental Solutions (RES) requests review and comment from the Natural Resources Conservation Service on any possible concerns that may emerge with respect to farmland resources including prime, unique, statewide or local important farmland associated with the Mockingbird stream mitigation project. This project is being developed for the North Carolina Division of Mitigation Services. Please note that this request is in support of the development of the Categorical Exclusion (CE) and an Environmental Resource Technical Report for the referenced project.

The Mockingbird Site has been identified for the purposes of providing mitigation for unavoidable stream channel impacts in the Yadkin River Basin. RES has been awarded the contract to design and implement the Mockingbird project. A requirement of the project is to prepare and Environmental Resource Technical Document that describes resources present on the project site.

The Project is located in the Turner and Hauser Creeks Watershed (03040101160010), a Targeted Local Watershed (TLW). The Project supports many of the Upper Yadkin River Basin Restoration Priorities (RBRP) goals and presents an opportunity to restore and enhance 8,800 linear feet of warm water stream and riparian corridor. The Project will provide numerous ecological and water quality benefits within the Yadkin River Basin. These benefits are not limited to the project area, but have more far-reaching effects throughout the Yadkin River Basin. The Project will provide improvements to water quality, hydrologic function, and habitat. Coordinates for the site are as follows: 36.036000 N, -80.517000 W.

An inventory of soils data was completed by RES utilizing Web Soil Survey to determine prime farmland classifications for the project area. Five soil map units in the project area are classified as prime farm land, making up approximately 20% of the site. Four soil map units in the project area are classified as farmland of state importance, making up approximately 6% of the site. One map soil unit in the project area is classified as Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season, making up approximately 75% of the site. One soil map unit in the project area is classified as not prime farmland, making up less than 1% of the site.

Enclosed is Form AD-1006 with Parts I and III Completed and maps of the Mockingbird Site. We ask that you review the site information and complete Parts II, IV, and V as required by NRCS. Please email (mengel@res.us), or mail your reply to the address below.

10055 Red Run Blvd.
Suite 130
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Suite 300
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100 Calhoun St.
Suite 320
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29401

5020 Montrose Blvd.
Suite 650
Houston, TX
77006

1200 Camellia Blvd.
Suite 220
Lafayette, LA
70508

137½ East Main St.
Suite 210
Oak Hill, WV
25901

33 Terminal Way
Suite 431
Pittsburgh, PA
15219

302 Jefferson St.
Suite 110
Raleigh, NC
27605

1521 W. Main
2nd Floor
Richmond, VA
23220

We thank you in advance for your timely response and cooperation. Please feel free to contact me with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Megan D Engel
Field Ecologist

302 Jefferson St., Suite 110
Raleigh, NC 27605
Tel. 919.209.1052
Fax: 919.829.9913

Attachements: Vicinity Map (Figure 1), USGS topographc Map (Figure 2), Conceptual Plan Maps (Figure 7, 7A, and 7B), & AD-1006

Megan Engel

From: Cortes, Milton - NRCS, Raleigh, NC <Milton.Cortes@nc.usda.gov>
Sent: Tuesday, November 14, 2017 2:57 PM
To: Megan Engel; Blackwood, Randy - NRCS, Asheboro, NC
Cc: Brad Breslow
Subject: Mockingbird Conservation Easement Project, Davie County, NC.
Attachments: AD1006_Mockingbird_Mitigation_DavieCo.pdf; Letter_Mockingbird_Mitigation_DavieCo.pdf

Importance: High

Megan:

Please, find attached the Farmland Conversion Impact Rating for the Mockingbird Conservation Easement Project, Davie County, NC.

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: Megan Engel [mailto:mengel@res.us]
Sent: Monday, October 23, 2017 10:52 AM
To: Cortes, Milton - NRCS, Raleigh, NC <Milton.Cortes@nc.usda.gov>; Blackwood, Randy - NRCS, Asheboro, NC <Randy.Blackwood@nc.usda.gov>
Cc: Brad Breslow <bbreslow@res.us>
Subject: RE: AD1006 requests, Davie County, NC

Milton,

Good morning, and thank you for providing me with the updated FY2018 FPPA guidance. I have attached the two AD-1006 requests for Davie County (Mockingbird and Catbird mitigation sites) and they now include the WSS maps as per your email below.

Please let me know if you need anything else, and have a great day.

Megan D Engel
Field Ecologist
RES | res.us
Mobile: 909.844.7122

From: Cortes, Milton - NRCS, Raleigh, NC [mailto:Milton.Cortes@nc.usda.gov]
Sent: Monday, October 23, 2017 10:29 AM
To: Megan Engel <mengel@res.us>
Cc: Blackwood, Randy - NRCS, Asheboro, NC <Randy.Blackwood@nc.usda.gov>
Subject: AD1006 requests, Davie County, NC
Importance: High

Hi Megan:

I received the attached Farmland Conversion Impact Rating Requests from Randy Blackwood, Supervisory Soil Conservationist, Team 9.

I have attached a document with some instructions on what it is required to complete this type of request. All I need, at this time, is the soils map as described in the included instructions. Now, an alternative would be to get the GIS boundary shape file in a zip file so that I can import the file to WSS and generate the map and the mapunit inventory I need to complete the farmland evaluation.

If you have any question, please let me 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

USDA
United States Department of Agriculture

Natural Resources
Conservation Service

North Carolina
State Office

4407 Bland Road
Suite 117
Raleigh, NC 27609
Voice 919-873-2171
Fax (844) 325-2156

November 14, 2017

Megan D Engel
Field Ecologist
Res
302 Jefferson St., Suite 110
Raleigh, NC 27605

Dear Megan D Engel:

Thank you for your letter dated October 25, 2017. Subject: Mockingbird Conservation Easement Project, Davie County, NC. The following guidance is provided for your information.

Projects are subject to the Farmland Protection Policy Act (FPPA) requirements if they may irreversibly convert farmland (directly or indirectly) to non-agricultural use and are completed by a federal agency or with assistance from a federal agency. Farmland means prime or unique farmlands as defined in section 1540(c)(1) of the FPPA or farmland that is determined by the appropriate state or unit of local government agency or agencies with concurrence of the Secretary of Agriculture to be farmland of statewide local importance.

For the purpose of FPPA, farmland includes prime farmland, unique farmland, and land of statewide or local importance. Farmland subject to FPPA requirements does not have to be currently used for cropland. It can be forestland, pastureland, cropland, or other land, but not water or urban built-up land.

Farmland does not include land already in or committed to urban development or water storage. Farmland *already in* urban development or water storage includes all such land with a density of 30 structures per 40-acre area. Farmland already in urban development also includes lands identified as *urbanized area* (UA) on the Census Bureau Map, or as urban area mapped with a *tint overprint* on the United States Geological Survey (USGS) topographical maps, or as *urban-built-up* on the United States Department of Agriculture (USDA) Important Farmland Maps.

The area in question meets one or more of the above criteria for Farmland. Farmland area will be affected or converted. Enclosed is the Farmland Conversion Impact Rating form AD1006 with PARTS II, IV and V completed by NRCS. The corresponding agency will need to complete the evaluation, according to the Code of Federal Regulation 7CFR 658, Farmland Protection Policy Act.

If you have any questions, please contact Milton Cortes, Assistant State Soil Scientist at 919-873-2171 or by email: milton.cortes@nc.usda.gov.

Again, thank you for inquiry. If we can be of further assistance, please do not hesitate to contact us.

Sincerely,

Milton Cortes
Assistant State Soil Scientist

cc:
Kent Clary, State Soil Scientist, NRCS, Raleigh, NC

November 20, 2017

John & Carol Sparks
900 Spillman Road
Mocksville, NC 27028

Re: Mockingbird Mitigation Project

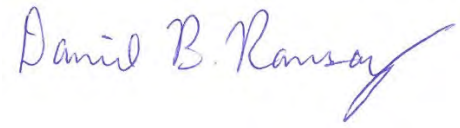
Dear John and Carol,

As part of the environmental documentation process in preparation for the stream mitigation project on your property, this letter is to inform you of provisions in the Federal Highway Administration Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, referred to as the Uniform Act.

The Uniform Act requires that we inform you in writing that this conservation easement transaction is voluntary and that the project is being developed by Environmental Banc & Exchange, LLC for the North Carolina Division of Mitigation Services (NCDMS). Neither EBX nor NCDMS have the authority to acquire the property by eminent domain. In addition, EBX believes that the agreed purchase price for the conservation easement area represents the fair market value.

This letter is for your information, and you do not need to respond. As always, please feel free to call me at 919-817-7378 with any questions.

Sincerely,



Daniel Ramsay
Land Representative

November 20, 2017

Michael & Nancy Miller
903 Spillman Road
Mocksville, NC 27028

Re: Mockingbird Mitigation Project

Dear Mike and Nancy,

As part of the environmental documentation process in preparation for the stream mitigation project on your property, this letter is to inform you of provisions in the Federal Highway Administration Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, referred to as the Uniform Act.

The Uniform Act requires that we inform you in writing that this conservation easement transaction is voluntary and that the project is being developed by Environmental Banc & Exchange, LLC for the North Carolina Division of Mitigation Services (NCDMS). Neither EBX nor NCDMS have the authority to acquire the property by eminent domain. In addition, EBX believes that the agreed purchase price for the conservation easement area represents the fair market value.

This letter is for your information, and you do not need to respond. As always, please feel free to call me at 919-817-7378 with any questions.

Sincerely,

Daniel Ramsay
Land Representative

November 20, 2017

Teresa Phifer
PO Box 971
Monroe, NC 28111

Re: Mockingbird Mitigation Project

Dear Teresa,

As part of the environmental documentation process in preparation for the stream mitigation project on your property, this letter is to inform you of provisions in the Federal Highway Administration Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, referred to as the Uniform Act.

The Uniform Act requires that we inform you in writing that this conservation easement transaction is voluntary and that the project is being developed by Environmental Banc & Exchange, LLC for the North Carolina Division of Mitigation Services (NCDMS). Neither EBX nor NCDMS have the authority to acquire the property by eminent domain. In addition, EBX believes that the agreed purchase price for the conservation easement area represents the fair market value.

This letter is for your information, and you do not need to respond. As always, please feel free to call me at 919-817-7378 with any questions.

Sincerely,

Daniel B. Ramsay

Daniel Ramsay
Land Representative

November 20, 2017

Wilson W. & Katherine S. Sparks
150 Herons Lane
Advance, NC 27006

Re: Mockingbird Mitigation Project

Dear Mr. and Mrs. Sparks,

As part of the environmental documentation process in preparation for the stream mitigation project on your property, this letter is to inform you of provisions in the Federal Highway Administration Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, referred to as the Uniform Act.

The Uniform Act requires that we inform you in writing that this conservation easement transaction is voluntary and that the project is being developed by Environmental Banc & Exchange, LLC for the North Carolina Division of Mitigation Services (NCDMS). Neither EBX nor NCDMS have the authority to acquire the property by eminent domain. In addition, EBX believes that the agreed purchase price for the conservation easement area represents the fair market value.

This letter is for your information, and you do not need to respond. As always, please feel free to call me at 919-817-7378 with any questions.

Sincerely,

Daniel B. Ramsay

Daniel Ramsay
Land Representative

Appendix L – DMS Floodplain Requirements Checklist

EEP Floodplain Requirements Checklist

This form was developed by the National Flood Insurance program, NC Floodplain Mapping program and Ecosystem Enhancement Program to be filled for all EEP projects. The form is intended to summarize the floodplain requirements during the design phase of the projects. The form should be submitted to the Local Floodplain Administrator with three copies submitted to NFIP (attn. State NFIP Engineer), NC Floodplain Mapping Unit (attn. State NFIP Coordinator) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	Mockingbird
Name if stream or feature:	Hauser Creek
County:	Davie County
Name of river basin:	Yadkin – Pee Dee River Basin
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Davie County
DFIRM panel number for entire site:	5842 (Map Number 3710584200L, Revised Date May 18, 2009)
Consultant name:	Resource Environmental Solutions
Phone number:	(919) 209-1052
Address:	302 Jefferson Street, Suite 110 Raleigh, NC 27605

Design Information

The Mockingbird Mitigation Site is located within a rural watershed in Davie County, within the Yadkin River Basin and USGS 14-digit HUC 03040101160010. The Project proposes to restore 4,849 linear feet (LF), enhance 3,742 LF, preserve 407 LF of stream, and provide water quality benefit for 27 acres of conservation easement. The Scout Mitigation Bank is nestled between two Project easement locations (north and south), involving Hauser Creek and eight unnamed tributaries. The stream mitigation components are summarized in the table below. The purpose of the Project is to meet water quality improvements addressed in the River Basin Restoration Priorities and improve overall stream health.

Reach	Length	Mitigation Type
HC1	2,083	Restoration
NM1	229	Enhancement II
NM2	1,368	Restoration
NM3	280	Restoration
NM4	253	Enhancement II
JS1	523	Restoration
HC2-A	2,018	Enhancement II
HC2-B	595	Restoration
HC2-C	155	Enhancement I
HC2-D	407	Preservation
TP1	146	Enhancement II
TP2	471	Enhancement II
TP3	470	Enhancement II

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?

◉ Yes ○ No

If project is located in a SFHA, check how it was determined:

☐ Redelineation

☐ Detailed Study

☑ Limited Detail Study

☐ Approximate Study

☐ Don't know

List flood zone designation: Zone AE

Check if applies:

☑ AE Zone

- ○ Floodway
- ○ Non-Encroachment
- ◉ None

☐ A Zone

- ○ Local Setbacks Required
- ○ No Local Setbacks Required

If local setbacks are required, list how many feet:

Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks?

○ Yes ◉ No

Land Acquisition (Check)

☐ State owned (fee simple)

☐ Conservation easment (Design Bid Build)

☑ Conservation Easement (Full Delivery Project)

Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)

Is community/county participating in the NFIP program?

Is community/county participating in the NFIP program?

☒ Yes ☐ No

Note: if community is not participating, then all requirements should be addressed to NFIP (attn: State NFIP Engineer, (919) 715-8000)

Name of Local Floodplain Administrator: Andrew Meadwell
Phone Number: (336)753-6050

Floodplain Requirements

This section to be filled by designer/applicant following verification with the LFPA

☐ No Action

☐ No Rise

☐ Letter of Map Revision

☐ Conditional Letter of Map Revision

☑ Other Requirements

List other requirements:

HEC-RAS modeling will take place, resulting in one of the above items.

Comments:

Name: Olivia L. Pilkington Signature: 

Title: Engineer II Date: 0 7.09.2018