

FINAL
AS-BUILT BASELINE
MONITORING REPORT
MUD LICK CREEK MITIGATION SITE
Chatham County, North Carolina

NCDMS Project No. 93482
Contract No. 7683
USACE Action ID No. SAW-2014-00736 & DWR Project No 2014-1127
SCO No. 1209857-01
Data Collection: July 2018
Submission: September 2018



PREPARED FOR:

N.C. DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
1601 MAIL SERVICE CENTER
RALEIGH, NORTH CAROLINA 27699-1601

FINAL
AS-BUILT BASELINE
MONITORING REPORT
MUD LICK CREEK MITIGATION SITE
Chatham County, North Carolina

NCDMS Project No. 93482
Contract No. 7683
USACE Action ID No. SAW-2014-00736 & DWR Project No 2014-1127.
SCO No. 1209857-01
Data Collection: July 2018
Submission: September 2018



PREPARED BY:
AXIOM ENVIRONMENTAL, INC.
218 SNOW AVENUE
RALEIGH, NORTH CAROLINA 27603

From: [Haupt, Mac](#)
To: [Tugwell, Todd J CIV USARMY CESA W \(US\)](#); [Schaffer, Jeff](#)
Cc: [andrea.w.hughes@usace.army.mil](#); [Kim Browning](#)
Subject: RE: [External] RE: Mud Lick Creek (DMS #93482) As-Built Baseline-Mitigation Plan Amendment Reuest
Date: Thursday, November 01, 2018 10:13:07 AM

Fine with me...

-----Original Message-----

From: Tugwell, Todd J CIV USARMY CESA W (US) [<mailto:Todd.J.Tugwell@usace.army.mil>]
Sent: Thursday, November 1, 2018 10:07 AM
To: Schaffer, Jeff <jeff.schaffer@ncdenr.gov>; Haupt, Mac <mac.haupt@ncdenr.gov>
Cc: andrea.w.hughes@usace.army.mil; Kim Browning <Kimberly.D.Browning@usace.army.mil>
Subject: RE: [External] RE: Mud Lick Creek (DMS #93482) As-Built Baseline-Mitigation Plan Amendment Reuest

CAUTION: External email. Do not click links or open attachments unless verified. Send all suspicious email as an attachment to Report Spam.<<mailto:report.spam@nc.gov>>

OK, sounds good.
Thanks

-----Original Message-----

From: Schaffer, Jeff [<mailto:jeff.schaffer@ncdenr.gov>]
Sent: Thursday, November 01, 2018 10:06 AM
To: Tugwell, Todd J CIV USARMY CESA W (US) <Todd.J.Tugwell@usace.army.mil>; Haupt, Mac <mac.haupt@ncdenr.gov>
Cc: Hughes, Andrea W CIV USARMY CESA W (US) <Andrea.W.Hughes@usace.army.mil>; Browning, Kimberly D CIV USARMY CESA W (US) <Kimberly.D.Browning@usace.army.mil>
Subject: [Non-DoD Source] RE: [External] RE: Mud Lick Creek (DMS #93482) As-Built Baseline-Mitigation Plan Amendment Reuest

Todd,

Thank you for getting back to me on this. Here are my responses to your questions:

1. Reductions made to channel leaving the easement? No, the easement boundaries were not changed from approved mitigation plan to as-built/baseline. For some unexplained reason, during their design Wildlands carried the channel measurements outside the easement and that was not discovered until the as-built survey was done.
2. Additional culvert added? No, there are only 2 crossings, both of which were shown in the approved mitigation plan, but the linear footage was not removed from the credit calculations by Wildlands. I did misstate in my memo in item 2d that the culvert was realigned on East Branch Reach 2 when the culvert is actually on North Branch Reach 3 (formerly North Branch Reach 2).
3. Updating of the approved mitigation plan - I have updated maps and an updated asset table that are included in the As-built Baseline Report (prepared by Axiom) and are based upon the as-built survey done by North State (contractor) and approved by Wildlands. The asset table in the As-built Baseline Report shows the mitigation plan assets (linear footage) as well as the as-built baseline assets and the differences are explained in footnotes and comments. I will also add a copy the DMS request memo and this email that documents the IRT concurrence with the requested changes behind the cover page of the As-built Baseline Report.

Based on this email and if you are in agreement with my responses, I will update the assets in our database and have the As-built Credit ledger prepared, and provide hardcopies of the As-built Baseline Report to both you and Mac.

Jeff Schaffer

Eastern Supervisor, Project Management
Division of Mitigation Services (Blocked<https://deq.nc.gov/about/divisions/mitigation-services>)
NC Department of Environmental Quality (NCDEQ)

(919) 707-8308 office
(919) 812-2634 mobile
Jeff.Schaffer@ncdenr.gov

217 West Jones St., Suite 3000A
1652 Mail Service Center
Raleigh, NC 27699-1652

Email correspondence to and from this address is subject to the North Carolina Public Records Law and may be disclosed to third parties.

-----Original Message-----

From: Tugwell, Todd J CIV USARMY CESAW (US) <Todd.J.Tugwell@usace.army.mil>
Sent: Thursday, November 01, 2018 9:03 AM
To: Schaffer, Jeff <jeff.schaffer@ncdenr.gov>; Haupt, Mac <mac.haupt@ncdenr.gov>
Cc: andrea.w.hughes@usace.army.mil; Kim Browning <Kimberly.D.Browning@usace.army.mil>
Subject: [External] RE: Mud Lick Creek (DMS #93482) As-Built Baseline-Mitigation Plan Amendment Reuest

CAUTION: External email. Do not click links or open attachments unless verified. Send all suspicious email as an attachment to Report Spam. <<mailto:report.spam@nc.gov>>

Jeff,

Mac and I discussed this yesterday. We don't necessarily have any problems with the changes you discuss, but it was not clear why were the reductions made for the channel leaving the easement - were the easement boundaries changed, and was an additional crossing added? We also need to make sure that we get the approved mit plan updated. Specifically, we need to make sure that we have updated maps and changes made to the credit determination (table 12 in the approved mitigation plan). I guess in this case these changes can be made in the as-built report, but we need to make sure that they are memorialized somewhere so when we get around to future credit releases, it is clear. I would also add a copy of this email, which concurs with the requested changes, to the record for the site.

Thanks,

Todd Tugwell
Mitigation Project Manager
Wilmington District, US Army Corps of Engineers
3331 Heritage Trade Drive, Suite 105
Wake Forest, North Carolina 27587
(919) 554-4884 ext. 58

-----Original Message-----

From: Schaffer, Jeff [<mailto:jeff.schaffer@ncdenr.gov>]
Sent: Wednesday, October 31, 2018 9:41 AM
To: Haupt, Mac <mac.haupt@ncdenr.gov>; Tugwell, Todd J CIV USARMY CESAW (US) <Todd.J.Tugwell@usace.army.mil>
Cc: Hughes, Andrea W CIV USARMY CESAW (US) <Andrea.W.Hughes@usace.army.mil>
Subject: [Non-DoD Source] RE: Mud Lick Creek (DMS #93482) As-Built Baseline-Mitigation Plan Amendment Reuest

My original email sent on 9/27/18 had an amendment request letter attached. To save you all from hunting for the original email, please see the attached.

Jeff Schaffer

Eastern Supervisor, Project Management
Division of Mitigation Services (BlockedBlocked<https://deq.nc.gov/about/divisions/mitigation-services>)
NC Department of Environmental Quality (NCDEQ)
(919) 707-8308 office
(919) 812-2634 mobile
Jeff.Schaffer@ncdenr.gov <<mailto:Jeff.Schaffer@ncdenr.gov>>

217 West Jones St., Suite 3000A
1652 Mail Service Center
Raleigh, NC 27699-1652

Email correspondence to and from this address is subject to the North Carolina Public Records Law and may be disclosed to third parties.

From: Haupt, Mac
Sent: Wednesday, October 31, 2018 9:34 AM
To: Schaffer, Jeff <jeff.schaffer@ncdenr.gov>; Todd Tugwell <todd.tugwell@usace.army.mil>
Cc: andrea.w.hughes@usace.army.mil
Subject: RE: Mud Lick Creek (DMS #93482) As-Built Baseline-Mitigation Plan Amendment Reuest

Jeff,

What was the reason for the reduction? There was nothing to really review other than your email, correct?

Thanks,

Mac

From: Schaffer, Jeff
Sent: Thursday, September 27, 2018 8:15 AM
To: Todd Tugwell <Todd.Tugwell@usace.army.mil <<mailto:Todd.Tugwell@usace.army.mil>> >
Cc: andrea.w.hughes@usace.army.mil <<mailto:andrea.w.hughes@usace.army.mil>> ; Haupt, Mac <mac.haupt@ncdenr.gov <<mailto:mac.haupt@ncdenr.gov>> >
Subject: Mud Lick Creek (DMS #93482) As-Built Baseline-Mitigation Plan Amendment Reuest

Todd,

This email is to notify you of changes in assets from Approved Mitigation Plan to As-Built Baseline for which I am seeking IRT approval to amend the mitigation plan in accordance with your October 5, 2017 correspondence regarding Mitigation Credit Calculation. Overall there is a reduction of stream credit from 2,938 at approved mitigation plan to +/-2,832 at as-built (rounded). Once I receive IRT approval, I will post the As-Built Baseline Report with the approved changes.

Please let me know if you have any questions or need to discuss this further.

Thanks!

Jeff Schaffer
Eastern Supervisor, Project Management
Division of Mitigation Services (<https://deq.nc.gov/about/divisions/mitigation-services>>)
NC Department of Environmental Quality (NCDEQ)



ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

September 27, 2018

MEMORANDUM

TO: Todd Tugwell, USACE; Chairman of IRT

FROM: Jeff Schaffer, DMS, Eastern Supervisor/Project Manager

SUBJECT: Amendment to Approved Mitigation Plan
Mud Lick Creek – DMS #93482
Cape Fear 03030003; Chatham County

The assets/credits have changed from Approved Mitigation Plan to As-Built Baseline on the Mud Lick Creek project. In keeping with the October 5, 2017 correspondence regarding Mitigation Credit Calculation, DMS is requesting IRT approval to amend the approved mitigation plan for the subject project.

1. All measurements are based on center of the wetted perimeter of the stream channel in accordance with the October 5, 2017 memorandum.
2. Specific changes are:
 - a. Decrease of credits on North Branch R1 due to footage removal of stream lengths that were outside the conservation easement.
 - b. Increase of credits on North Branch Reach 2 due to channel realignment due to bedrock identified during construction.
 - c. Decrease of credits on North Branch Reach 3 due to channel realignment due to bedrock and removal of 20 lf/credit to account for an easement break for a crossing.
 - d. Increase of credits on East Branch Reach 2 due to minor stream channel and culvert realignment because of bedrock identified during construction.
 - e. Decrease of credits on East Branch R1 due to footage removal of stream lengths that were outside the conservation easement.
 - f. Decrease of credits on Mud Lick Creek R1 due to footage removal of stream lengths that were outside the conservation easement.
 - g. Decrease of credits on Mud Lick Creek R2 due to removal of 31 lf/credit to account for an easement break for a crossing.
 - h. Decrease of credits on Mud Lick Creek R3 due to footage removal of stream lengths that were outside the conservation easement.
3. Overall there is a reduction of stream credit from 2,938 at approved mitigation plan to $\pm 2,832$ at as-built (rounded). This is a reduction of ± 106 stream credits.

DMS looks forward to your approval to amend the approved mitigation plan for the Mud Lick Creek project. Please let me know if you need any additional information or if you would like to discuss this further. I can be reached at (919) 707-8308, or via email at jeff.schaffer@ncdenr.gov.

cc: Andrea Hughes, USACE
Mac Haupt, DWR
File



Axiom Environmental, Inc.

218 Snow Avenue, Raleigh, NC 27603 919-215-1693

September 19, 2018

Mr. Jeff Schaffer
North Carolina Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

RE: Mud Lick Creek (DMS Project # 93482, Contract #7683)
Final Asbuilt Baseline Monitoring Report

12-004.22

Dear Jeff:

Axiom Environmental, Inc. (AXE) is pleased to provide you with 3 hardcopies and 1 CD of digital files for the Final Mud Lick Creek Asbuilt Baseline Monitoring Report. Axiom received your additional comment letter dated September 18, 2018 and have addressed them as follows:

1. Digital files:
 - a. GIS files: Change geographic reference for MudLickGraded from GCS_NAD_1983_CORS96 to Geographic Coordinate System, NAD 1983 State Plane North Carolina (US Feet).
The geographic referenced was changed for this shapefile.
2. Appendix B, Figure 2: Please identify all reaches as named in the **revised** Table 1. (3 reaches on North Branch and 2 reaches on East Branch)
Figure 2 was updated to match the revised Table 1. The centerline shapefile was also updated to reflect the correct reach breaks.
3. Appendix D: Please have a look at the stream type for the baseline in table 7a. It seems that based on the W/D ratios it should be a E/C type as the pre-con assessment indicated.
The Rosgen Classification in Table 7a was changed to indicate an E/C type channel.

Please let me know if you have any questions or comments regarding any component of this submittal. Thank you for the opportunity to continue to assist the Division of Mitigation Services with this important project.

Sincerely,
AXIOM ENVIRONMENTAL, INC.

Kenan R. Jernigan
Project Scientist

Attachments: 3 hard copies Final Mud Lick Creek MY0 Baseline Monitoring Report & CD with electronic copy and digital support files



Axiom Environmental, Inc.

218 Snow Avenue, Raleigh, NC 27603 919-215-1693

September 10, 2018

Mr. Jeff Schaffer
North Carolina Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

RE: Mud Lick Creek (DMS Project # 93482, Contract #7683)
Final Asbuilt Baseline Monitoring Report

12-004.22

Dear Jeff:

Axiom Environmental, Inc. (AXE) is pleased to provide you with an electronic copy of the revised document and digital files for the Final Mud Lick Creek Asbuilt Baseline Monitoring Report. Axiom received your comments dated August 31, 2018 and have addressed them as follows:

1. Digital files:

- a. GIS files: Ensure that all data sources are using the correct Geographic Coordinate System, NAD 1983 State Plane North Carolina (US Feet). (CVS_Plot, Invasives, Monitoring_XS, Origins, SAC & Structures using GCS_NAD1983_2011; Fish_Benthics using GCS_NAD_1983_CORS96). Please also make sure that the stream centerlines are properly segmented to reflect reach breaks, break in the easement and/or any specialized credit ratios in the shapefile. Attributing these features with reach IDs, restoration level, and lengths is required. *All shapefiles are now using the correct coordinate system. The stream centerline shapefile is now segmented and attributed to indicate reach ID, restoration level, and length.*
- b. Spatial Data Reference missing for MLC_Stationing and MLD_Station Ticks. *Spatial data has been updated to NAD 1983 State Plane North Carolina (US feet) for these shapefiles.*
- c. Crest gauges and their locations are not included in the digital/GIS files. *A shapefile depicting Crest Gauge locations has been included in the digital submittal.*
- d. Per your contract the information for Warranty Transects is to be included in the MY1 report not the Baseline Report. When you submit with MY 1, please include GIS shapefiles and show on CCPV. *Warranty transect information will be submitted with the MY1 report.*

2. Cover Sheets: Please just list the Axiom Monitoring Contract number since this deliverable is specific to your contract only. *The contract number was changed on the cover sheets to 7683.*

3. Project Summary, page i: insert CU: 03030003 and 14-digit HUC 03030003070010. *These were added to the first paragraph of page i.*

4. Page ii after Visual Assessments: Please insert the following text “As per sections 7.2 and 12.4 of the Mitigation Plan, physico-chemical and biological parameters may have been included as part of specialized monitoring, depending on the data that could be obtained during the baseline period. Monitoring of these parameters was for investigative purposes only and not tied to mitigation success or credit. The sample size and variability of the pre-con physico-chemical data was inadequate for the purposes of post-construction

comparison and therefore these will not be monitored moving forward. However, fish and macro-benthos will be monitored at the stations indicated in the asset and monitoring features map.” *This was added to the text.*

5. Monitoring Summary Table, page 1:

- a. Streams: The morphological parameters that will be tallied should include BHR (Calculated by holding the As-built XSA constant and comparing to subsequent year) and the ER. *This was added in the stream monitoring section of the text.*
- b. Vegetation Monitoring: Would say vegetation monitoring will be completed after most of the growing season has passed. *This was changed in the vegetation monitoring section of the text.*

6. Appendix A, Table 1:

- a. North Branch R1: revise reach IDs to differentiate between the Enhancement II and Restoration sections of this reach (i.e. North Branch R1a and North Branch R1b) or break North Branch into three reaches. *These were broken out into North Branch R1, R2, and R3.*
- b. East Branch: revise reach IDs to differentiate between the Enhancement II and Restoration sections of this reach (i.e. East Branch R1 and East Branch R2). *These were broken out into East Branch R1 and R2.*
- c. Show credits out to 3 decimals. *Credits are shown to 3 decimal places.*

7. Appendix A, Table 3: make the following changes: add the following contact information:

- a. Add Michael Anderson (336) 725-2010 to contact for Construction Contractor. *The contact was added.*
- b. Add Stephen Joyce (336) 725-2010 to contact for Planting Contractor. *The contact was added.*
- c. Delete Turner Land Surveying from As-built Surveyors. They did survey for original construction plans that were the basis of the redline (record) drawings. Turner had nothing to do with As-builts. *Turner Land Surveying was deleted from the table.*

8. Appendix B, Figure 2:

- a. Please identify all reaches as named in Table 1. *All reaches were labeled on the figure to match Table 1.*
- b. Please show locations of the three crest gauges installed at the site. Also make sure that these are included in the digital/GIS files (see comment 1.c. above). *These have been added to Figure 2 and the shapefiles are included in the digital submittal.*
- c. Color code vegetation plots to differentiate between those that are above and below success criteria. *Plots were color coded based on success criteria on the CCVP.*
- d. A stream area of concern is shown on Mud Lick Creek Reach 2, but there are no photographs as described in the Project Boundaries & Visual Assessments section on page 2. *Unfortunately, a photograph of the stream area of concern could not be found. A brief description of the area was added to the Stream discussion on page 1 of the report. Photographs of all areas of concern will be provided during all subsequent monitoring years.*
- e. Please symbolize the sections of Mud Lick mainstem that were graded *A layer was added to show the sections of Mud Lick Creek that were graded.*

9. Appendix B, Table 5:

- a. Verify this list against the list on sheet 2.1 of the Record Drawings (see next to last page in Appendix E). There appear to be some differences between the two. *The list was verified to be the same; however, the order of the species listed was different so it was reordered to match the record drawings order.*
- b. Correct spelling for Eastern Hophornbeam. *This was corrected.*

10. Appendix B, Table 6:

- a. Boxelder, red maple, hazel alder, sugarberry, and willow oak are listed as a planted species in various plots but are not listed in Table 5 which is the list of planted species provided by the planting contractor. Explain why these show up in Table 6 as planted. *Bare root stems found during asbuilt monitoring were identified as accurately as possible. Generally, planted stems are easily discernable due to the grid-like*

pattern in which they are planted, and in many cases during asbuilt monitoring, the signs of planting (dibble bar holes, etc.) are obvious. Therefore, when this evidence is observed at a woody stem, it is catalogued as a planted stem, regardless of whether the species was found on the planting list or not. Additionally, the red maple and box elder were changed from planted stems to natural recruits.

b. American elm, Eastern hophornbeam, Elderberry, Witch hazel, Swamp tupelo and Tulip poplar are listed among the planted stems in Table 5 but do not appear in Table 6. Please explain. *These species were not found in any of the vegetation plots during monitoring. The dense herbaceous layer was an important factor to consider during asbuilt vegetation monitoring, as it was performed in late summer. Each monitoring year, all plots are thoroughly searched for stems, and it is possible some of these species were covered/ hidden and will be found during subsequent monitoring years.*

c. Explain why there are two lines for sweet gum. *The species was not listed for one of the sweetgum entries in the CVS database that generates this table. The species was added to this entry which corrected the issue.*

d. Verify if the “unknown” planted stems could be one or more of the missing planted stems in comment 8.b. *The unknown planted stems could certainly be one or more of the missing planted stem species, however these stems were very small, in some cases leafless, and they could not be identified with confidence.*

e. For consistency between Tables 5 and 6, change American hornbeam to Ironwood. *This has been changed in the table.*

11. Appendix D: Need to re-evaluate the bankfull cross-sectional areas for Mud Lick mainstem in the context of the designer's calls. It was acknowledged that the bank height ratios for this reach were not going to be 1 in many places. They would be 1.2, 1.3 in many places, but it was proposed that since the reach had found its pattern and beltwidth, that an intensive EII with areas of bank reshaping would be pursued. The designer identified the bankfull XSA for this reach in the 40-50 SF range. The bankfull area calls should probably better approximate those even if it makes for BHRs of 1.2 or so. This was not a full restoration reach. Re-examine/ Recalculate in the context of this discussion the XS parameters for Mud Lick mainstem and update table 7a for Mud Lick *The Mud Lick mainstem cross-sections were updated with consideration for the design approach and where possible were adjusted to the 40-50 sq ft range.*

XS 10 seems to be outright incorrect for its XSA calculation. *This was incorrect; the correct data was input and updated throughout.*

Also, for Table 7a-c the baseline distribution should be restricted to riffle cross sections. *Baseline data is limited to riffle cross-sections.*

Please let me know if you have any questions or comments regarding any component of this submittal. Thank you for the opportunity to continue to assist the Division of Mitigation Services with this important project.

Sincerely,
AXIOM ENVIRONMENTAL, INC.



Kenan R. Jernigan
Project Scientist

Attachments: electronic copy Final Mud Lick Creek MY0 Baseline Monitoring Report & digital support files

PROJECT SUMMARY

The North Carolina Division of Mitigation Services (NCDMS) has established the Mud Lick Creek Mitigation Site (Site) located within the Cape Fear River Basin Cataloging Unit (CU) 03030003 in the Upper Rocky River local watershed planning (LWP) area and 14-digit HUC 03030003070010. The Site was identified as a priority mitigation project in the *Detailed Assessment and Targeting of Management Report* (Tetra Tech 2005). The main stressors to aquatic resources identified during the watershed assessments described in the LWP documents include the following.

- Nutrient (nitrogen and phosphorous) loading from farming;
- Sediment loading from overland runoff, disturbed surfaces, and streambank erosion;
- Cattle access to streams increasing bank erosion and fecal coliform contamination; and
- Insufficient bank vegetation.

The project will contribute to meeting management recommendations to offset these stressors as described above for the LWP area by accomplishing the following primary goals.

- Control and reduce nutrient sources from the Site;
- Reduce sediment loads from disturbed areas on the Site and from eroding stream banks;
- Increased aeration of flows within the project extent promoting increases in dissolved oxygen concentrations;
- Reduce sources of fecal coliform pollution;
- Improve instream habitat;
- Reduce thermal loadings;
- Reconnect channels with floodplains and raise local water table; and
- Restore riparian habitat.

These goals will be accomplished through the following objectives:

- Restore riparian vegetation on the Site and thereby reduce sediment loads to streams from stream banks and existing pastures, increase on-Site retention of sediment and nutrients, create riparian habitat, and provide shade for streams to reduce thermal loadings;
- Stabilize eroding streambanks to reduce sediment inputs;
- Install fencing around the perimeter of the conservation easement to eliminate livestock access to streams, thereby reducing sediment, nutrient, and fecal coliform inputs;
- Plant restored and stabilized streambanks with native species to improve stability and habitat;
- Install instream structures to improve stability, create habitat, and help aerate stream flows;
- Raise streambeds to reconnect restored channels to floodplains and raise local water tables; and
- Restore streams and vegetation so the Site looks natural and aesthetically pleasing.

Stream Success Criteria: The stream restoration performance criteria for the Site will follow approved performance criteria presented in the 2015 *Mud Lick Creek Mitigation Site Final Mitigation Plan* as described below.

Stream Dimension: Riffle cross-sections on the restoration reaches and enhancement II reaches, where banks were re-graded (three reaches of Mud Lick Creek), should be stable and should show little change in bankfull area, maximum depth, and width-to-depth ratio. Bank-height-ratios shall not exceed 1.2 and entrenchment ratios shall be at least 2.2 for restored channels to be considered stable. All riffle cross-sections should fall within the parameters defined for channels of the appropriate stream type. If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Indicators of instability include a vertically incising thalweg or eroding channel banks. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in

the width-to-depth ratio in meandering channels or an increase in pool depth. Remedial action would not be taken if channel changes indicate a movement toward stability.

Stream Pattern and Profile: The as-built survey will include a longitudinal profile for the baseline monitoring report. Longitudinal profile surveys will not be conducted during the seven-year monitoring period unless other indicators during the annual monitoring indicate a trend toward vertical and lateral instability.

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

Hydraulics: Two bankfull flow events, in separate monitoring years, must be documented on the restoration reaches and enhancement II reaches where banks were re-graded (three reaches of Mud Lick Creek) within the seven-year monitoring period.

Vegetation Success Criteria: The final vegetative success criteria will be the survival of 210 planted stems per acre in the riparian corridor along restored and enhanced reaches at the end of the required monitoring period (year seven). The interim measure of vegetative success for the Site will be the survival of at least 320 planted stems per acre at the end of the third monitoring year and at least 260 stems per acre at the end of the fifth year of monitoring. If this performance standard is met by year five and stem density is trending towards success (i.e., no less than 260 five year old stems/acre), monitoring of vegetation on the Site may be terminated with written approval by the USACE in consultation with the NC Interagency Review Team. The extent of invasive species coverage will also be monitored and controlled as necessary throughout the required monitoring period (seven years).

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

Visual Assessments: Visual assessments should support performance standards as described above.

As per Sections 7.2 and 12.4 of the Mitigation Plan, physio-chemical and biological parameters may have been included as part of specialized monitoring, depending on the data that could be obtained during the baseline period. Monitoring of these parameters was for investigative purposes only and not tied to mitigation success or credit. The sample size and variability of the pre-construction physio-chemical data was inadequate for the purposes of post-construction comparison and therefore, these will not be monitored moving forward. However, fish and macrobenthos will be monitored at the stations indicated in the asset and monitoring features map (Figure 2, Appendix B).

Site Background: The Site is located in northwestern Chatham County, north of Siler City and northwest of Silk Hope (Figure 1, Appendix B). The Site is located within the United States Geological Survey (USGS) Hydrologic Unit and Targeted Local Watershed 03030003070010 (North Carolina Division of Water Quality Subbasin 03-06-12) of the Cape Fear River Basin. Prior to construction, the Site was used for agricultural livestock production. The proposed project will improve water quality as well as provide numerous ecological benefits within the Cape Fear River Basin. The project will help meet management recommendations of the *Upper Rocky River Local Watershed Plan* by restoring a vegetated riparian buffer zone, stabilizing eroding stream banks, and removing livestock from streams and riparian zones. These activities will result in reduced nutrient, sediment, and fecal coliform inputs; improved aquatic and riparian habitat, and other ecological benefits.

Mitigation Components: Project mitigation efforts will generate 2832 Stream Mitigation Units (SMUs) as the result of the following.

- Restoration of 1215 linear feet of Site streams
- Enhancement (Level II) of 2426 linear feet of Site streams

Site design was completed in June 2015. Site construction occurred May 24–August 25, 2017 (final walkthrough) and the Site was planted in February 2018. Completed project activities, reporting history, completion dates, project contacts, and project attributes are summarized in Tables 1-4 (Appendix A).

TABLE OF CONTENTS

1.0	METHODS	1
2.0	REFERENCES	3

APPENDICES

Appendix A. Background Tables

- Table 1. Project Components and Mitigation Units
- Table 2. Project Activity and Reporting History
- Table 3. Project Contacts Table
- Table 4. Project Attributes Table

Appendix B. Visual Assessment Data

- Figure 1. Site Location
- Figure 2. Current Conditions Plan View
- Vegetation Plot Photographs

Appendix C. Vegetation Data

- Table 5. Planted Bare Root Woody Vegetation
- Table 6. Total Stems by Plot and Species

Appendix D. Stream Measurement and Geomorphology Data

- Cross-section Plots
- Tables 7A-7C. Baseline Morphology and Hydraulic Summary
- Tables 8A-8F. Morphology and Hydraulic Monitoring Summary

Appendix E. As-built Plan Sheets

1.0 METHODS

Monitoring of restoration efforts will be performed for seven years, or until success criteria are fulfilled. Monitoring is proposed for the stream channel and vegetation. In general, the restoration success criteria, and required remediation actions, are based on the *Stream Mitigation Guidelines* (USACE et al. 2003). Monitoring features are summarized in the following table and described below; monitoring features are depicted on Figure 2 (Appendix B).

Monitoring Summary

Parameter	Monitoring Feature	Quantity	Frequency
Streams			
Dimension	Cross-sections	7 riffles & 3 pools	annually
Substrate	Pebble counts	3 riffles	annually
Hydrology	Crest gauges	3	annually
Vegetation	Vegetation Plots	12	annually
	Warranty Plots	10	MY1
Visual assessments		Entire Site	biannually
Exotic & nuisance species		Entire Site	annually
Project boundary		Entire Site	annually
Reference photographs		22	annually
Supplemental Monitoring			
Biological	Macrobenthos	5 sites (Preconstruction only) 3 sites (MY3, MY5, & MY7)	
	Fish	3 sites (Preconstruction only) 2 sites (MY4 & MY7)	

Streams

The restored stream reaches are proposed to be monitored for geometric activity as follows.

- 7 permanent riffle cross-sections
- 3 permanent pool cross-sections
- 3 riffle pebble count samples for substrate analysis
- 3 stream crest gauges

The data will be presented in graphic and tabular format. Data to be presented will include 1) cross-sectional area, 2) bankfull width, 3) average depth, 4) maximum depth, and 5) width-to-depth ratio. Substrate analysis will be evaluated through pebble counts at three riffle cross-sections and data presented as a D50 for stream classification and tracking purposes. The stream will subsequently be classified according to stream geometry and substrate (Rosgen 1996). Significant changes in channel morphology including bank-height-ratios and entrenchment ratios will be tracked and reported by comparing data to asbuilt measurements in addition to each successive monitoring year. Annual photographs will include 22 fixed station photographs (12 vegetation plots and 10 cross-sections) (Appendix B). In addition, the Site contains three stream crest gauges to assist with documentation of bankfull events.

One stream area of concern was observed along a large bend in Mud Lick Creek Reach 2 (Figure 2, Appendix B). Approximately 50 feet of the right bank and 20 feet of the left bank have eroded to the point of bank sloughing. This area currently appears relatively unstable, and it will be closely monitored during year 1.

Vegetation

Restoration monitoring procedures for vegetation will monitor plant survival and species diversity. Planting occurred within the entire Site. After planting of the area was completed, 12 vegetation plots were installed and monitored at the Site; baseline results can be found in Appendix C. Annual measurements of vegetation will consist of the following.

- 10 plant warranty inspection plots (only MY1)
- 12 CVS vegetation plots

A photographic record of plant growth should be included in each annual monitoring report; baseline photographs are included in Appendix B. During the first year, vegetation will receive a cursory, visual evaluation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species. Subsequently, quantitative sampling of vegetation will be performed as outlined in the *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008) in late fall/early winter of the first monitoring year and annually toward the end of the growing for the remainder of the monitoring period until vegetation success criteria are achieved.

Locations of exotic and nuisance vegetation will be recorded using a GPS and included on mapping.

Project Boundaries & Visual Assessments

Locations of any fence damage, vegetation damage, boundary encroachments, etc. will be recorded using a GPS and included on mapping.

Visual assessments will be performed along all streams on a bi-annual basis during the seven year monitoring period. Problem areas will be noted such as channel instability (i.e. lateral and/or vertical instability, in-stream structure failure/instability and/or piping, headcuts), vegetated buffer health (i.e. low stem density, vegetation mortality, invasive species or encroachment), beaver activity, or livestock access. Areas of concern will be mapped and photographed accompanied by a written description in the annual report. Problem areas will be re-evaluated during each subsequent visual assessment.

Supplementary Monitoring

Supplemental monitoring will include biological monitoring in the Spring as follows.

- 3 benthos sampling sites (MY3, MY5, & MY7)
- 2 fish sampling sites (MY4 & MY7)

These parameters are being monitored for analytical purposes and are not tied to mitigation success and associated credit releases. The primary criteria for indication of improvement for the benthos and fish will be an increase of at least one bioclassification between the pre-con assessment and the post-con monitoring. Richness and EPT metrics will be analyzed as well.

2.0 REFERENCES

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.

North Carolina Division of Mitigation Services (NCDMS) 2015. Mud Lick Creek Mitigation Site Final Mitigation Plan.

Rosgen D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

Tetra Tech, 2005. Upper Rocky River Local Watershed Plan Preliminary Findings Report. Prepared for the North Carolina Ecosystem Enhancement Program.

United States Army Corps of Engineers (USACE), United States Environmental Protection Agency (USEPA), North Carolina Wildlife Resources Commission (NCWRC), Natural Resources Conservation Service (NRCS), and North Carolina Division of Water Quality (NCDWQ). 2003. Stream Mitigation Guidelines. State of North Carolina.

Appendix A.
Background Tables

- Table 1. Project Mitigation Components
Table 2. Project Activity and Reporting History
Table 3. Project Contacts Table
Table 4. Project Attributes Table

Table 1. Mud Lick Creek (ID-93482) - Mitigation Assets and Components

Project Component (reach ID, etc.)	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
North Branch R1		318	100+10 - 103+28	327	318	EII	-	1.5	212.000	Planting, fencing
North Branch R2		522	103+28 - 108+66	520	538	R	PI	1	538.000	
North Branch R3		351	108+66 - 111+51	303	265	R	P2	1	265.000	20 LF of restoration was removed from North Branch Reach 3 in order to account for an easement break
East Branch R1		165	200+05 - 201+69	168	164	EII	-	1.5	109.333	Planting, fencing
East Branch R2		315	201+69 - 205+81	409	412	R	P2	1	412.000	
Mud Lick Creek R1		525	300+72 - 306+23	623	551	EII	-	1.5	367.333	Planting, fencing, bank repairs
Mud Lick Creek R2		718	306+23 - 313+14	693	660	EII	-	1.5	440.000	Planting, fencing, bank repairs; 31 LF of enhancement II was removed from Mud Lick Creek Reach 2 in order to account for an easement break
Mud Lick Creek R3		733	313+14 - 320+47	748	733	EII	-	1.5	488.667	Planting, fencing, bank repairs

*Reach start and end stationing may differ slightly from the mitigation plan due to removal of stream lengths that are outside the conservation easement. The upstream ends of Mud Lick Creek, North Branch, and East Branch experienced footage reductions of 72', 10', and 5' respectively, while the downstream end of Mud Lick Creek experienced a footage reduction of 17'.

Length and Area Summations by Mitigation Category

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)
		Riverine	Non-Riverine	
Restoration	1215			
Enhancement				
Enhancement I				
Enhancement II	2426			
Creation				
Preservation				
High Quality Pres				

Overall Assets Summary

Asset Category	Overall Credits
Stream	2,832.333

Table 2. Project Activity and Reporting History
Mud Lick Creek (ID-93482)

Elapsed Time Since Grading Complete: 1 year 1 month

Elapsed Time Since Planting Complete: 5 months

Number of Reporting Years: 0

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Project Institution	--	February 13, 2013
Mitigation Plan	--	December 2015
404 Permit Date	--	March 25, 2016
Final Design – Construction Plans	--	June 2015
Construction	--	August 25, 2017
Bare Root; Containerized; and B&B Plantings for the Entire Project Site	February 2018	February 2018
Baseline Monitoring Document (Year 0 Monitoring Baseline)	July 2018	August 2018

Table 3. Project Contact Table

Mud Lick Creek (ID-93482)

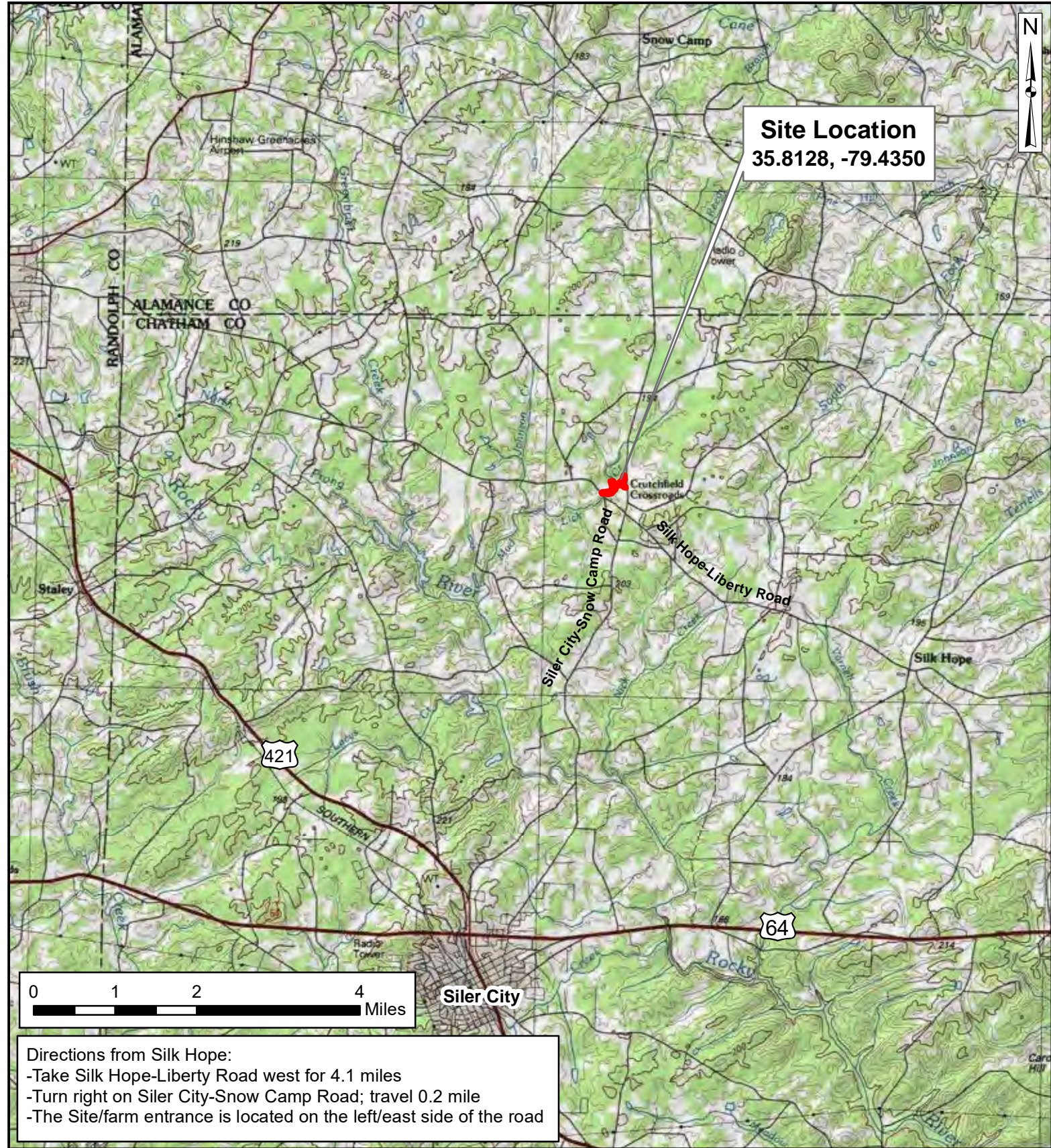
Designer	Wildlands Engineering, Inc. (License No. F-0831) 312 West Millbrook Rd, Suite 225 Raleigh, NC 27609 Angela N. Allen, PE (919) 851-9986
Construction Plans and Sediment and Erosion Control Plans	Wildlands Engineering, Inc. (License No. F-0831) 312 West Millbrook Rd, Suite 225 Raleigh, NC 27609 Angela N. Allen, PE (919) 851-9986
Construction Contractor	North State Environmental, Inc. 2889 Lowery Street Winston Salem, NC 27101 Michael Anderson (336) 725-2010
Planting Contractor	North State Environmental, Inc. 2889 Lowery Street Winston Salem, NC 27101 Stephen Joyce (336) 725-2010
As-built Surveyors	Allied Associates, PA 4720 Kester Mill Road Winston Salem, NC 27103 David Alley (336) 765-2377
Baseline Data Collection	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis (919) 215-1693

Table 4. Project Baseline Information and Attributes**Mud Lick Creek (ID-93482)**

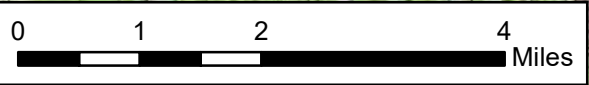
Project Information						
Project name	Mud Lick Creek Mitigation Site					
Project county	Chatham County, North Carolina					
Project area (Acres)	11.2					
Project coordinates (lat/long)	35.8128°N, 79.4350°W					
Planted Acres	9.6					
Project Watershed Summary Information						
Physiographic region	Carolina Slate Belt of the Piedmont Physiographic Province					
Project river basin	Cape Fear River Basin					
USGS hydrologic unit (8 digit/14-digit)	03030003/03030003070010					
NCDWR Sub-basin	03-06-12					
Project drainage area (mi ²)	3.64					
% Drainage area impervious	< 1%					
CGIA land use classification	Developed, Forested/Scrubland, Agriculture/Managed Herb., Open Water					
Reach Summary Information						
Parameters	Mud Lick Creek – R1	Mud Lick Creek – R2	Mud Lick Creek – R3	North Branch – R1	North Branch – R2	East Branch
Restored length (linear feet)	551	660	733	856	265	576
Valley confinement	Slightly confined - unconfined					
Drainage area (acres/mi ²)	1747/2.73	2170/3.39	2330/3.64	236.8/0.37	416/0.65	172.8/0.27
Perennial (P), Intermittent (I)	P	P	P	P	P	P
NCDWR water quality classification	WS-III, CA					
Stream Classification (existing)	E4	C4	E4	E4	B4c	B4c
Stream Classification (proposed)	E4	C4	E4	C4	C4	C4
Evolutionary trend (Simon & Hupp)	IV/V	IV/V	IV/V	IV	IV	IV
FEMA classification	AE	AE	AE	AE	AE	AE
Regulatory Considerations						
Regulation	Applicable?	Resolved?		Supporting Documentation		
Waters of the US – Section 404	Yes	Yes		SAW-2014-00736		
Waters of the US – Section 401	Yes	Yes		SAW-2014-00736		
Endangered Species Act	Yes	Yes		No Effect – CE Document		
Historic Preservation Act	No	NA		CE Document		
Coastal Zone Management Act (CZMA/CAMA)	No	NA		NA		
FEMA Floodplain Compliance	Yes	Yes		Chatham County Floodplain Development Permit #14-001		
Essential Fisheries Habitat	No	NA		NA		

Appendix B
Visual Assessment Data

Figure 1. Site Location
Figure 2. Current Conditions Plan View
Vegetation Plot Photos



Site Location
35.8128, -79.4350



Directions from Silk Hope:
 -Take Silk Hope-Liberty Road west for 4.1 miles
 -Turn right on Siler City-Snow Camp Road; travel 0.2 mile
 -The Site/farm entrance is located on the left/east side of the road



Axiom Environmental
 218 Snow Avenue
 Raleigh, NC 27603
 (919) 215-1693

Axiom Environmental, Inc.

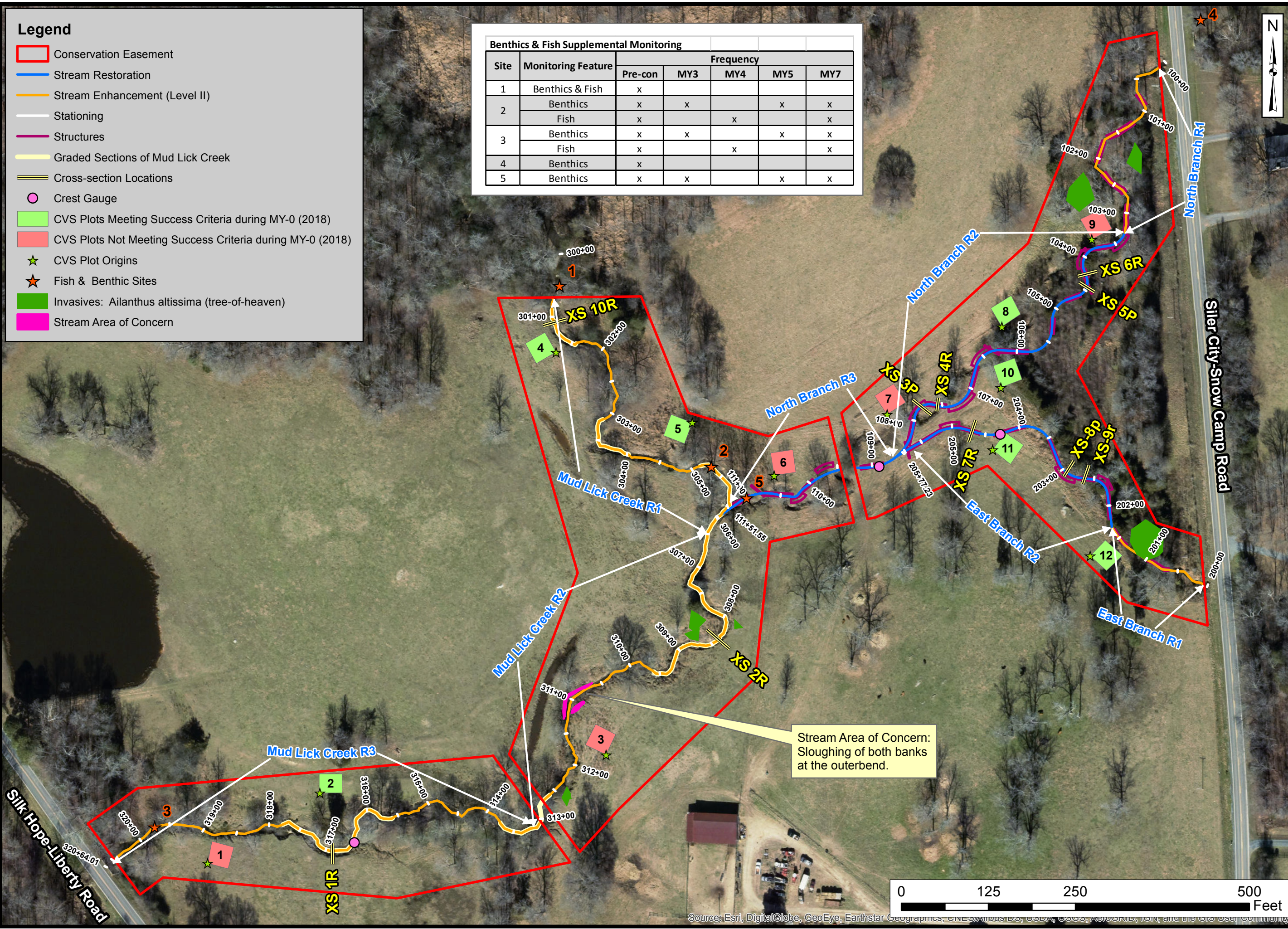
SITE LOCATION
MUD LICK CREEK MITIGATION SITE
DMS PROJECT NUMBER 93482
Chatham County, North Carolina

Dwn. by:	CLF	FIGURE 1
Date:	July 2018	
Project:	12-004.22	

Legend

- Conservation Easement
- Stream Restoration
- Stream Enhancement (Level II)
- Stationing
- Structures
- Graded Sections of Mud Lick Creek
- Cross-section Locations
- Crest Gauge
- CVS Plots Meeting Success Criteria during MY-0 (2018)
- CVS Plots Not Meeting Success Criteria during MY-0 (2018)
- ★ CVS Plot Origins
- ★ Fish & Benthic Sites
- Invasives: *Ailanthus altissima* (tree-of-heaven)
- Stream Area of Concern

Benthics & Fish Supplemental Monitoring						
Site	Monitoring Feature	Frequency				
		Pre-con	MY3	MY4	MY5	MY7
1	Benthics & Fish	x				
2	Benthics	x	x		x	x
	Fish	x		x		x
3	Benthics	x	x		x	x
	Fish	x		x		x
4	Benthics	x				
5	Benthics	x	x		x	x



Axiom Environmental, Inc.

Prepared for:
 North Carolina
 Department of
 Environmental
 Quality
 Division of
 Mitigation Services

Project:
MUD LICK CREEK MITIGATION SITE
 DMS Project
 Number 93482
 Chatham County, NC

Title:
CURRENT CONDITIONS PLAN VIEW

Drawn by:
 PHP, CLF

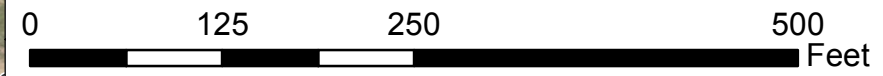
Date:
 Sept 2018

Scale:
 1:1,500

Project No.:
 12-004.22

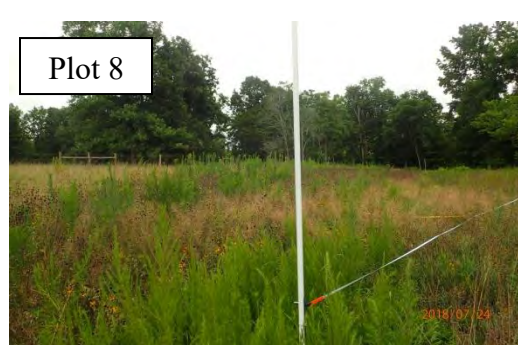
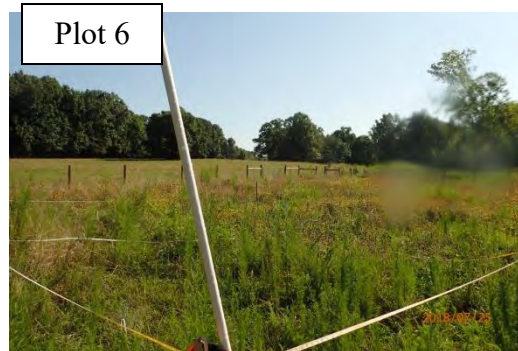
FIGURE

2

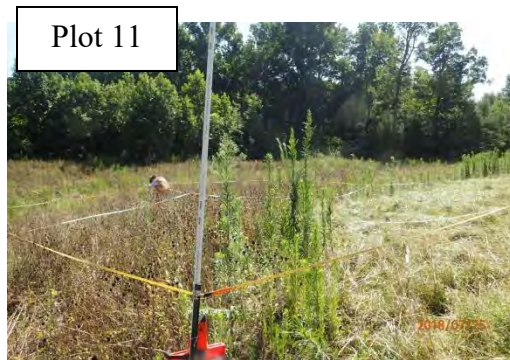
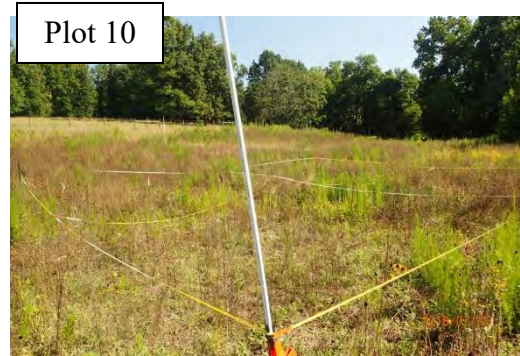


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

**Mud Lick Creek Stream Restoration Site
Baseline Vegetation Monitoring Photographs
Taken July 2018**



**Mud Lick Creek Stream Restoration Site
Baseline Vegetation Monitoring Photographs
Taken July 2018**



**Appendix C.
Vegetation Plot Data**

Table 5. Planted Bare Root Woody Vegetation

Table 6. Total Stems by Plot and Species

**Table 5. Planted Bare Root Woody Vegetation
Mud Lick Creek (ID-93482)**

Species	Quantity
Green Ash (<i>Fraxinus pennsylvanica</i>)	300
Sycamore (<i>Platanus occidentalis</i>)	400
Eastern Redbud (<i>Cercis canadensis</i>)	400
Cottonwood (<i>Populus deltoides</i>)	300
River birch (<i>Betula nigra</i>)	300
Hackberry (<i>Celtis occidentalis</i>)	300
Black Gum (<i>Nyssa sylvatica</i>)	300
American Elm (<i>Ulmus americana</i>)	300
Eastern Hophornbeam (<i>Ostrya virginica</i>)	300
Elderberry (<i>Sambucus spp.</i>)	300
Black Locust (<i>Robinia psuedoaccia</i>)	300
Silky Dogwood (<i>Cornus ammomum</i>)	300
Witch Hazel (<i>Hamamelis virginica</i>)	550
Buttonbush (<i>Cephalanthus occidentalis</i>)	300
Persimmon (<i>Diospyros virginiana</i>)	300
Ironwood (<i>Carpinus caroliniana</i>)	400
Swamp Tupelo (<i>Nyssa biflora</i>)	100
Swamp Chestnut oak (<i>Quercus michauxii</i>)	100
Water oak (<i>Quercus nigra</i>)	100
Tulip Poplar (<i>Liridendron tulipifera</i>)	300
TOTAL	5950

Appendix D.
Stream Measurements and Geomorphology Data

Cross Section Plots

Tables 7A-7C. Baseline Stream Data Summary

Tables 8A-8F. Monitoring Data-Dimensional Data Summary

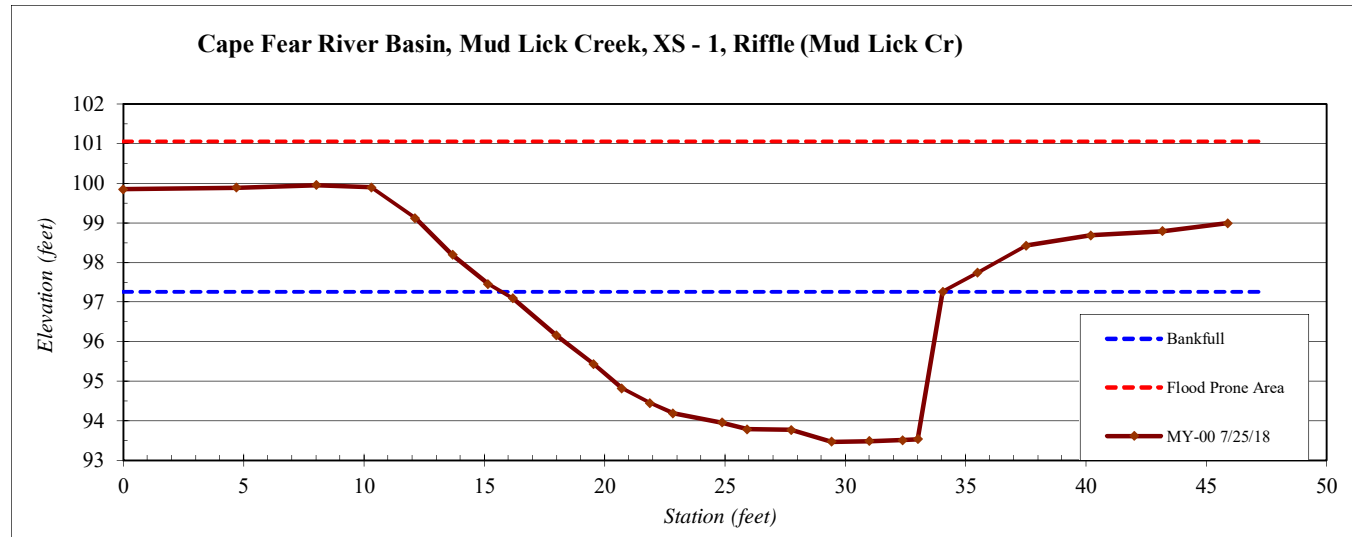
River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 1, Riffle (Mud Lick Cr)
Drainage Area (sq mi):	3.64
Date:	7/25/2018
Field Crew:	Perkinson, Smith



Station	Elevation
0.00	99.85
4.71	99.89
8.04	99.95
10.30	99.90
12.12	99.12
13.68	98.19
15.15	97.45
16.19	97.09
18.00	96.16
19.55	95.43
20.72	94.82
21.88	94.45
22.83	94.19
24.88	93.96
25.93	93.79
27.76	93.77
29.45	93.47
31.00	93.48
32.39	93.51
33.02	93.54
34.05	97.26
35.49	97.74
37.53	98.43
40.21	98.69
43.17	98.79
45.90	99.00
47.39	99.09

SUMMARY DATA	
Bankfull Elevation:	97.3
Bankfull Cross-Sectional Area:	49.8
Bankfull Width:	18.3
Flood Prone Area Elevation:	101.1
Flood Prone Width:	100.0
Max Depth at Bankfull:	3.8
Mean Depth at Bankfull:	2.7
W / D Ratio:	6.7
Entrenchment Ratio:	5.5
Bank Height Ratio:	1.3

Stream Type	E
--------------------	---



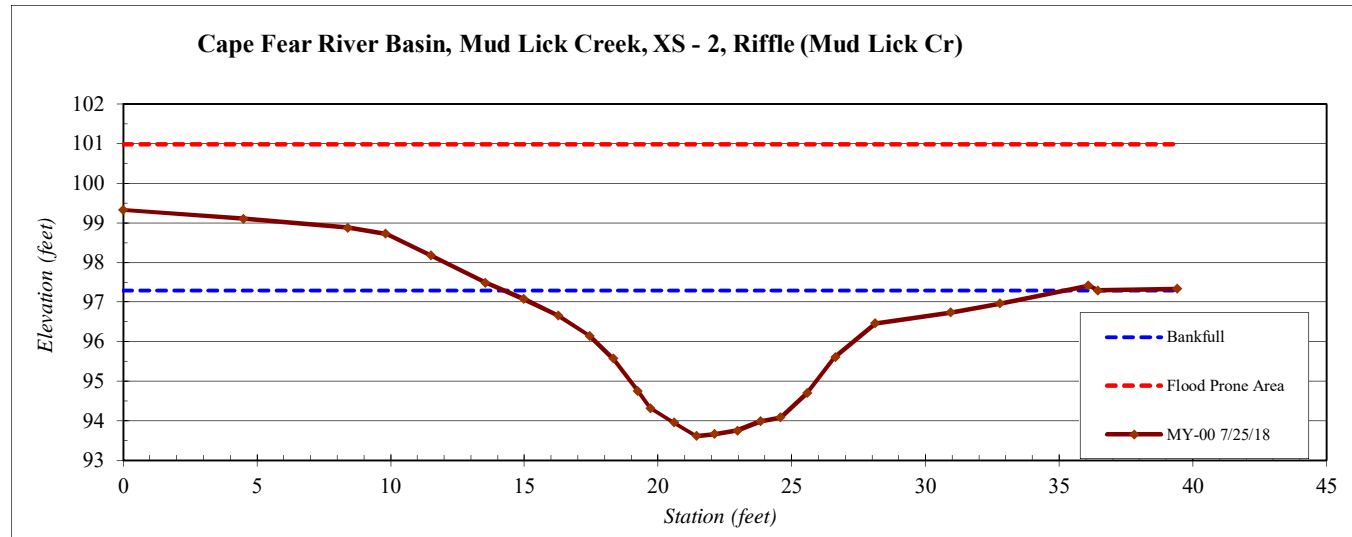
River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 2, Riffle (Mud Lick Cr)
Drainage Area (sq mi):	3.64
Date:	7/25/2018
Field Crew:	Perkinson, Smith

Station	Elevation
0.00	99.33
4.49	99.11
8.40	98.88
9.81	98.72
11.51	98.18
13.54	97.49
14.98	97.07
16.26	96.66
17.44	96.15
18.32	95.58
19.24	94.75
19.71	94.32
20.59	93.96
21.44	93.61
22.12	93.67
22.96	93.75
23.83	93.99
24.58	94.09
25.58	94.71
26.63	95.61
28.13	96.46
30.95	96.73
32.79	96.96
36.10	97.42
36.44	97.29
39.40	97.34

SUMMARY DATA	
Bankfull Elevation:	97.3
Bankfull Cross-Sectional Area:	33.0
Bankfull Width:	21.0
Flood Prone Area Elevation:	101.0
Flood Prone Width:	100.0
Max Depth at Bankfull:	3.7
Mean Depth at Bankfull:	1.6
W / D Ratio:	13.3
Entrenchment Ratio:	4.8
Bank Height Ratio:	1.0



Stream Type	E
--------------------	---



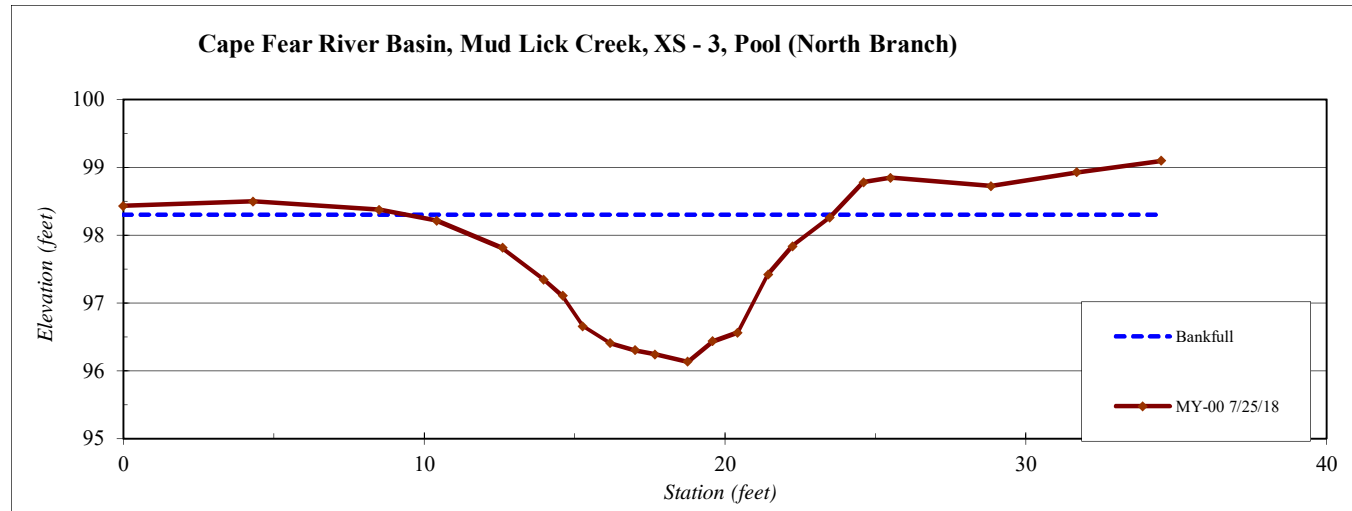
River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 3, Pool (North Branch)
Drainage Area (sq mi):	0.65
Date:	7/25/2018
Field Crew:	Perkinson, Smith



Station	Elevation
0.00	98.43
4.32	98.50
8.51	98.38
10.42	98.21
12.60	97.81
13.98	97.34
14.61	97.10
15.27	96.66
16.19	96.41
17.01	96.30
17.68	96.24
18.77	96.13
19.60	96.44
20.43	96.56
21.44	97.42
22.24	97.84
23.48	98.26
24.60	98.78
25.51	98.85
28.85	98.72
31.70	98.92
34.51	99.10

SUMMARY DATA	
Bankfull Elevation:	98.3
Bankfull Cross-Sectional Area:	15.5
Bankfull Width:	14.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.2
Mean Depth at Bankfull:	1.1
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	E
--------------------	---



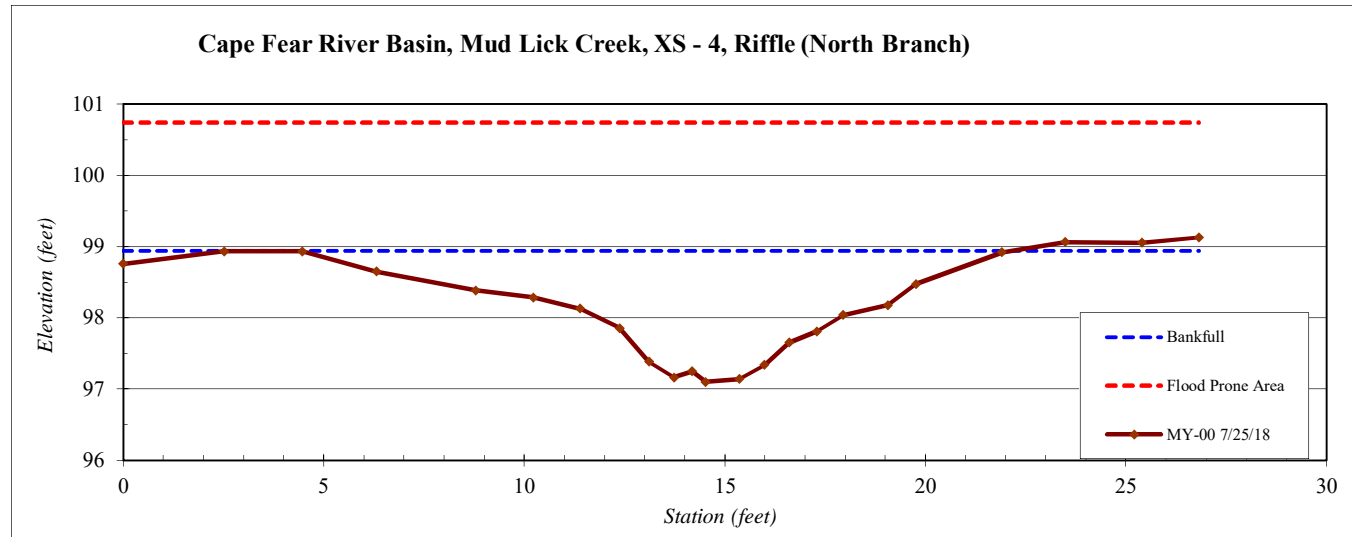
River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 4, Riffle (North Branch)
Drainage Area (sq mi):	0.65
Date:	7/25/2018
Field Crew:	Perkinson, Smith



Station	Elevation
0.00	98.76
2.51	98.93
4.46	98.94
6.31	98.65
8.79	98.38
10.22	98.28
11.38	98.13
12.37	97.86
13.11	97.38
13.73	97.17
14.19	97.25
14.52	97.10
15.36	97.14
15.99	97.34
16.60	97.65
17.30	97.81
17.95	98.04
19.07	98.18
19.77	98.48
21.91	98.92
23.48	99.07
25.39	99.05
26.82	99.13

SUMMARY DATA	
Bankfull Elevation:	98.9
Bankfull Cross-Sectional Area:	14.2
Bankfull Width:	17.7
Flood Prone Area Elevation:	100.7
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	0.8
W / D Ratio:	22.1
Entrenchment Ratio:	5.6
Bank Height Ratio:	1.0

Stream Type C



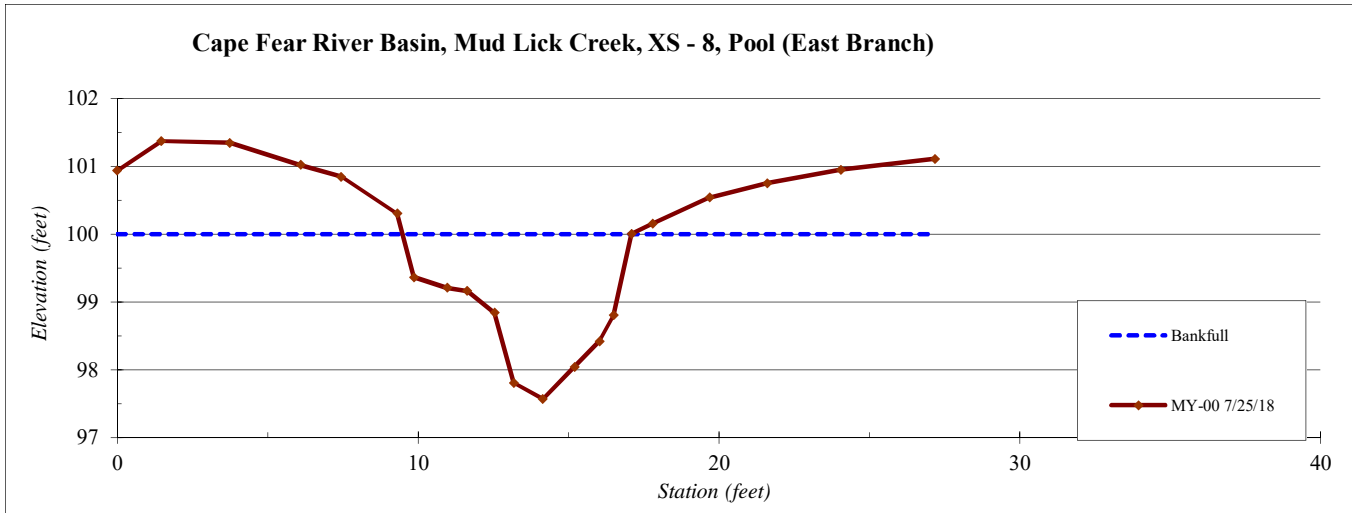
River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 8, Pool (East Branch)
Drainage Area (sq mi):	0.27
Date:	7/25/2018
Field Crew:	Perkinson, Smith

Station	Elevation
0.00	100.94
1.47	101.37
3.75	101.35
6.10	101.02
7.45	100.85
9.30	100.30
9.86	99.36
10.96	99.21
11.64	99.16
12.54	98.84
13.18	97.81
14.15	97.57
15.20	98.04
16.03	98.42
16.50	98.80
17.10	100.00
17.80	100.15
19.69	100.54
21.62	100.75
24.06	100.95
27.19	101.11

SUMMARY DATA	
Bankfull Elevation:	100.0
Bankfull Cross-Sectional Area:	10.5
Bankfull Width:	7.6
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.4
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0



Stream Type	C
--------------------	---



River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 10, Riffle (Mud Lick Cr)
Drainage Area (sq mi):	3.64
Date:	7/25/2018
Field Crew:	Perkinson, Smith



Station	Elevation
0.00	97.79
3.09	97.60
4.21	97.87
5.48	97.66
7.11	97.01
8.13	96.25
9.24	95.54
10.74	95.22
11.50	94.66
12.73	94.40
13.79	94.49
14.96	94.14
15.78	93.98
17.46	94.04
18.50	95.06
19.75	95.63
21.13	96.19
22.88	96.55
25.29	97.55
26.80	98.23
28.27	98.75
29.41	99.04
30.75	99.55
32.96	99.42
34.80	99.38

SUMMARY DATA	
Bankfull Elevation:	97.6
Bankfull Cross-Sectional Area:	40.4
Bankfull Width:	19.8
Flood Prone Area Elevation:	101.2
Flood Prone Width:	100.0
Max Depth at Bankfull:	3.6
Mean Depth at Bankfull:	2.0
W / D Ratio:	9.7
Entrenchment Ratio:	5.1
Bank Height Ratio:	1.0

Stream Type	E
--------------------	---

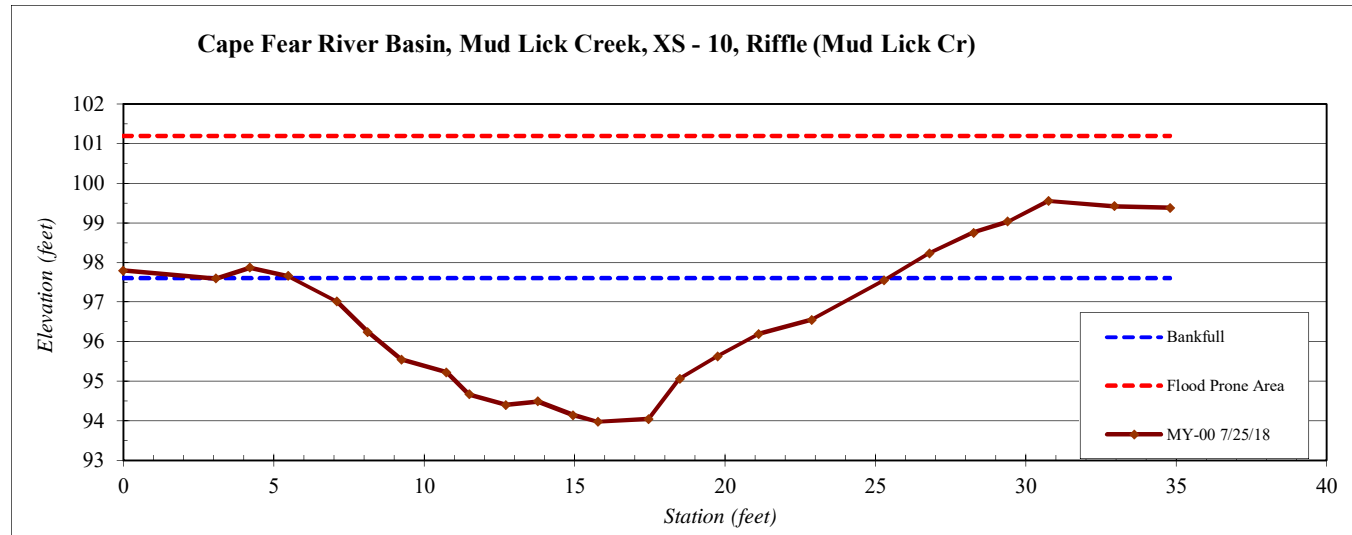


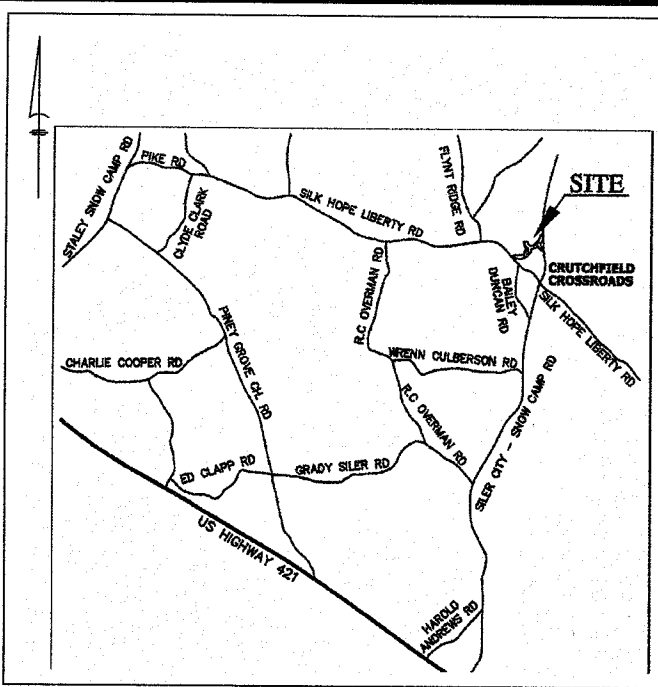
Table 7a. Baseline Stream Data Summary (Mud Lick Creek)
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

Parameter	Gauge	Regional Curve			Pre-Existing Condition (Mud Lick Creek)					Reference Reach(es) Data					Design (Mud Lick Creek)			Monitoring Baseline (Mud Lick Creek)				
		LL	UL	Eq.	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD	Min	Max	Med	Min	Mean	Med	Max	SD
Dimension and Substrate - Riffle Only																						
BF Width (ft)					18.2		22.0	24.6		5.3		10.8	12.3				18.3		19.8	21		3
Floodprone Width (ft)					250.0		306.0	378.0		14		60	125				100		100	100		3
BF Mean Depth (ft)					1.9		2.1	2.3		0.8		1.0	1.8				1.6		2.0	2.7		3
BF Max Depth (ft)					3.0		4.0	4.2		1.0		1.5	2.6				3.6		3.7	3.8		3
BF Cross Sectional Area (ft ²)					41.3		46.3	47.5		5.4		10.6	19.7				33.0		40.4	49.8		3
Width/Depth Ratio					8.0		10.5	12.8		5.2		8.6	14.4				6.8		9.9	13.1		3
Entrenchment Ratio					12.4		13.7	17.2		1.7		4.3	>10.2				4.8		5.1	5.5		3
Bank Height Ratio					1.1		1.2	1.2		1.0		1.0	1.1				1.0		1.0	1.3		3
Profile																						
Riffle length (ft)																						
Riffle slope (ft/ft)										0.0040		0.0188	0.0704									
Pool length (ft)																						
Pool Max depth (ft)					3.7		4.4	5.2		1.2		1.8	3.3									
Pool spacing (ft)										9.0		46.0	73.0									
Pattern																						
Channel Beltwidth (ft)					26.1		52.9	69.9		10		41	102									
Radius of Curvature (ft)					9.9		24.8	58.8		11		21	85									
Rc:Bankfull width (ft/ft)					0.5		1.1	2.39		1.3		2	9.1									
Meander Wavelength (ft)					59.9		159.6	244.4		-		-	-									
Meander Width ratio					1.4		2.2	3.8		1.6		4.4	8.9									
Transport parameters																						
Reach Shear Stress (competency) lbs/ft ²																						
Max part size (mm) mobilized at bankfull																						
Stream Power (transport capacity) W/m ²																						
Additional Reach Parameters																						
Rosgen Classification					E/C4					E/C4					E/C-type							
Bankfull Velocity (fps)					3.0 - 3.4					2.2 - 5.6												
Bankfull Discharge (cfs)					123.9 - 157.42					20 -97												
Valley Length (ft)																						
Channel Thalweg Length (ft)																						
Sinuosity					1.20 - 1.37					1.0 - 2.3												
Water Surface Slope (ft/ft)																						
BF slope (ft/ft)																						
Bankfull Floodplain Area (acres)																						
% of Reach with Eroding Banks																						
Channel Stability or Habitat Metric																						
Biological or Other																						

Table 7b. Baseline Stream Data Summary (North Branch)
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

Parameter	Gauge	Regional Curve			Pre-Existing Condition (North Branch)					Reference Reach(es) Data					Design (North Branch)			Monitoring Baseline (North Branch)					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD	Min	Max	Med	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle Only																							
BF Width (ft)					8.3			10.4		5.3		10.8	12.3		13.8	14.0		14.6		16.2	17.7		2
Floodprone Width (ft)					33.3			80.0		14		60	125		30	70		100		100	100		2
BF Mean Depth (ft)					0.7			1.5		0.8		1.0	1.8		1.0	1.2		0.8		0.9	1.0		2
BF Max Depth (ft)					1.5			2.3		1.0		1.5	2.6		1.3	2.0		1.8		1.8	1.8		2
BF Cross Sectional Area (ft ²)					7.7			12.7		5.4		10.6	19.7		14.4	16.3		14.2		14.4	14.5		2
Width/Depth Ratio					5.4			14.0		5.2		8.6	14.4		12.0	13.0		14.6		18.4	22.1		2
Entrenchment Ratio					1.9			10.1		1.7		4.3	>10.2		2.2	5.0		5.6		6.2	6.8		2
Bank Height Ratio					1.7			2.0		1.0		1.0	1.1		1.0	1.0		1.0		1.0	1.0		2
Profile																							
Riffle length (ft)																							
Riffle slope (ft/ft)										0.0040		0.0188	0.0704		0.0060	0.0340							
Pool length (ft)																							
Pool Max depth (ft)					2.1			2.7		1.2		1.8	3.3		1.3	4.7							
Pool spacing (ft)										9.0		46.0	73.0		19.0	92.0							
Pattern																							
Channel Beltwidth (ft)					11		26	38.5		10		41	102		41	125							
Radius of Curvature (ft)					6.1		17	37		11		21	85		25	42							
Rc:Bankfull width (ft/ft)					0.73		1.6	4.46		1.3		2	9.1		1.8	3							
Meander Wavelength (ft)					37.9		64.1	100.6		-		-	-		41	168							
Meander Width ratio					1.1		2.8	4.6		1.6		4.4	8.9		3	15							
Transport parameters																							
Reach Shear Stress (competency) lbs/ft ²																							
Max part size (mm) mobilized at bankfull																							
Stream Power (transport capacity) W/m ²																							
Additional Reach Parameters																							
Rosgen Classification					E5/B5c					E/C4					C4			C-type					
Bankfull Velocity (fps)					3.3 - 3.5					2.2 - 5.6					2.4 - 4.3								
Bankfull Discharge (cfs)					25.41 - 44.45					20 -97					34.6 - 70.1								
Valley Length (ft)																							
Channel Thalweg Length (ft)																							
Sinuosity					1.22 - 1.32					1.0 - 2.3					1.2 - 1.3								
Water Surface Slope (ft/ft)																							
BF slope (ft/ft)																							
Bankfull Floodplain Area (acres)																							
% of Reach with Eroding Banks																							
Channel Stability or Habitat Metric																							
Biological or Other																							

Appendix E.
As-built Plan Sheets



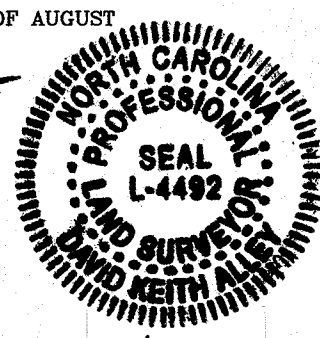
VICINITY MAP NOT TO SCALE

CERTIFICATE OF ACCURACY OF MAPPING

I, DAVID K. ALLEY, CERTIFY THAT THIS PROJECT WAS COMPLETED UNDER MY DIRECT AND RESPONSIBLE CHARGE FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION; THAT THIS TOPOGRAPHIC SURVEY WAS PERFORMED AT THE 98 PERCENT CONFIDENCE LEVEL TO MEET THE FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS; THAT THIS SURVEY WAS PERFORMED TO MEET THE REQUIREMENTS FOR A TOPOGRAPHIC/PLANIMETRIC SURVEY TO THE ACCURACY OF CLASS AA AND VERTICAL ACCURACY WHEN APPLICABLE TO THE CLASS A STANDARD, AND THAT THE ORIGINAL DATA WAS OBTAINED ON FEBRUARY 19, 2015; THAT THE SURVEY WAS COMPLETED ON FEBRUARY 20, 2015; AND ALL COORDINATES ARE BASED ON NCGS VRS-NETWORK NAD83 (2011) AND ALL ELEVATIONS ARE BASED ON NCGS VRS-NETWORK NAVD 88 AND THAT THIS MAP WAS PREPARED IN ACCORDANCE WITH THE STANDARDS AND PRACTICE FOR LAND SURVEYING AS OUTLINED BY THE NC ADMINISTRATION CODE TITLE 21, CHAPTER 56.

WITNESS MY HAND AND OFFICIAL SEAL THIS 10th DAY OF AUGUST 2017.
 L-4492
 LICENSE NO.

David K. Alley
 PROFESSIONAL LAND SURVEYOR



NOTES:

1. RAW ERROR OF CLOSURE 1:10,000+, MIS-CLOSURE WAS DISTRIBUTED BY COMPASS RULE.
2. AREA DETERMINED BY COORDINATE COMPUTATIONS.
3. DISTANCES SHOWN ARE HORIZONTAL GROUND DISTANCES UNLESS NOTED OTHERWISE.
4. CONTOUR INTERVAL = 1 FOOT
5. THE HORIZONTAL (NAD 83/2011) AND VERTICAL (NAVD 88) DATUM WAS ESTABLISHED BY OTHERS. SEE REFERENCE'S SHOWN HEREON.
6. THIS SURVEY IS SUBJECT TO ANY AND ALL FACTS THAT MY BE DISCLOSED BY A FULL TITLE SEARCH, WHICH HAS NOT BEEN FURNISHED TO SURVEYOR AS OF THIS DATE.
7. THE EXISTING CONTOURS SHOWN HEREON IN COLOR WERE PROVIDED BY OTHERS AND ARE SUBJECT TO THE ACCURACY THEREOF.
8. THE FIELD WORK WAS PERFORMED FROM JULY 17-18, 2017.

REFERENCES:

1. PLAT ENTITLED "FINAL PLAT MUD LICK CREEK (EEP 939495, SPO 19-1D) ADDITIONAL ACREAGE TO NCDOT PROJECT U-2524WM, PROPERTY OF GRAYSON C. THOMAS HEIRS" RECORDED NOVEMBER 13, 2015 IN PLAT SLIDE 2015-285 & 286, CHATHAM COUNTY REGISTRY.
2. PLAT ENTITLED "CONSERVATION PROJECT U-2524WM THOMAS TRACT" RECORDED DECEMBER 2, 2014 IN PLAT SLIDE 2014-389 & 394, CHATHAM COUNTY REGISTRY.
3. ALL DEEDS AND MAPS SHOWN HEREON.

PROJECT CONTROL
 NCDOT "THOMAS 1" (NAD83/NAVD 88)
 NORTHING-751,100.7723'
 EASTING-1,869,878.4481'
 ELEVATION-610.85'

LEGEND

- EXISTING IRON PIN
- EXISTING REBAR
- NO POINT SET
- IRON REBAR SET
- CABLE PEDESTAL
- TELEPHONE MANHOLE
- TELEPHONE PEDESTAL
- FLOOD LIGHT
- GUY WIRE
- LIGHT POLE
- ELECTRIC MANHOLE
- ELECTRIC METER
- ELECTRIC TRANSFORMER
- UTILITY POLE
- BOLLARD
- GAS METER
- GAS VALVE
- SEWER CLEAN OUT
- SEWER MANHOLE
- SIGN
- CATCH BASIN
- CURB INLET
- DROP \ YARD INLET
- FLARED END SECTION
- STORM MANHOLE
- HANDICAP
- FIRE HYDRANT
- WATER MANHOLE
- WATER METER
- WATER VALVE
- WELL
- MANHOLE
- PRESSURE INDICATOR VALVE
- TREE
- RIGHT-OF-WAY
- PROPERTY LINE
- PARCEL IDENTIFICATION NO.
- CONCRETE MONUMENT
- CHORD
- SIGHT EASEMENT
- DEED BOOK
- PLAT BOOK
- CURB AND GUTTER
- REINFORCED CONC PIPE
- CORRUGATED METAL PIPE
- CORRUGATED PLASTIC PIPE
- BOUNDARY LINE
- RIGHT-OF-WAY LINE
- UNSURVEYED PROPERTY LINE
- CONSERVATION EASEMENT
- FENCE (WIRE) LINE
- FENCE (WOOD) LINE
- BANKFULL
- THALWEG
- EDGE OF GRAVEL
- EDGE OF PAVEMENT
- GRADING LIMITS
- OVERHEAD UTILITY
- TIE LINE
- MAJOR CONTOUR LINE
- MINOR CONTOUR LINE
- WATER LINE
- WETLAND ZONE LINE
- CONSTRUCTED RIFFLE
- LOG VANE
- BRUSH TOE

PROJECT CONTROL
 NCDOT "THOMAS 2" (NAD83/NAVD 88)
 NORTHING-750,346.4685'
 EASTING-1,870,442.8109'
 ELEVATION-600.80'

SHEET 2

SHEET 3

SHEET 4

SHEET 6

SHEET 5

SHEET 1 OF 7

AS BUILT SURVEY
FOR: NORTH STATE ENVIRONMENTAL, INC

OF: "MUD LICK CREEK STREAM RESTORATION"

OWNER:
 GRAYSON C. THOMAS, HEIRS
 319 AUGUSTA DRIVE
 STATESVILLE, NC 28625

TAX PIN: 8775-12-3214.000
 DEED BOOK US, PAGE 143

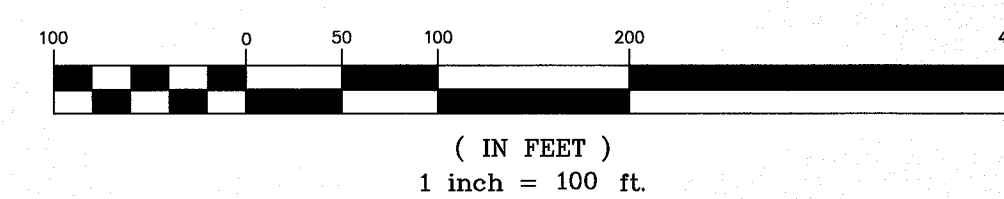
TAX PIN: 8775-01-6345.000
 DEED BOOK 411, PAGE 846

N/A ACRES +/- (TOTAL)

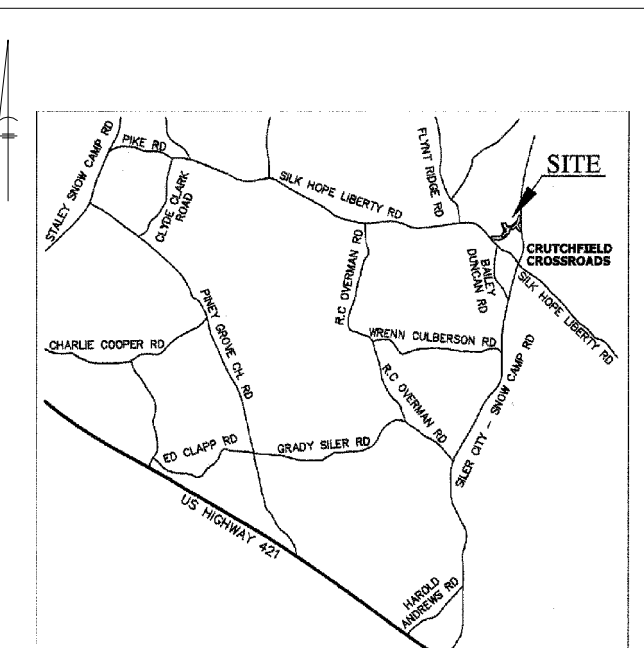
Allied Associates, P.A.
 4720 KESTER MILL ROAD PHONE (336) 785-2377
 WINSTON-SALEM, N.C. 27103
 www.alliedaps.com NC LICENSE #C-2198

SCALE	TOWNSHIP	COUNTY	STATE	DATE
1" = 100'	ALBRIGHT	CHATHAM	NORTH CAROLINA	08/01/17
SURVEYED:	MAPPED:	JOB NO.	MAP NO.	TDS
PJ TR	DA	PA170611	MLC.dwg	MLC

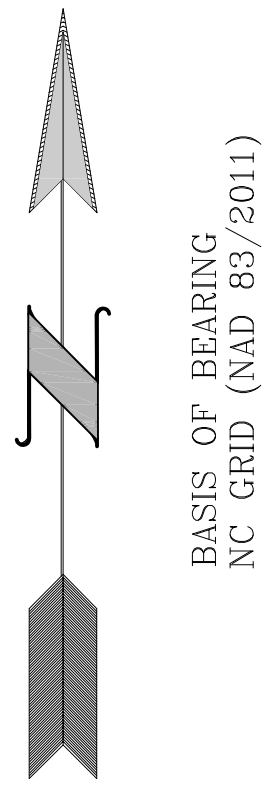
GRAPHIC SCALE



BASIS OF BEARING
 NC GRID (NAD 83/2011)



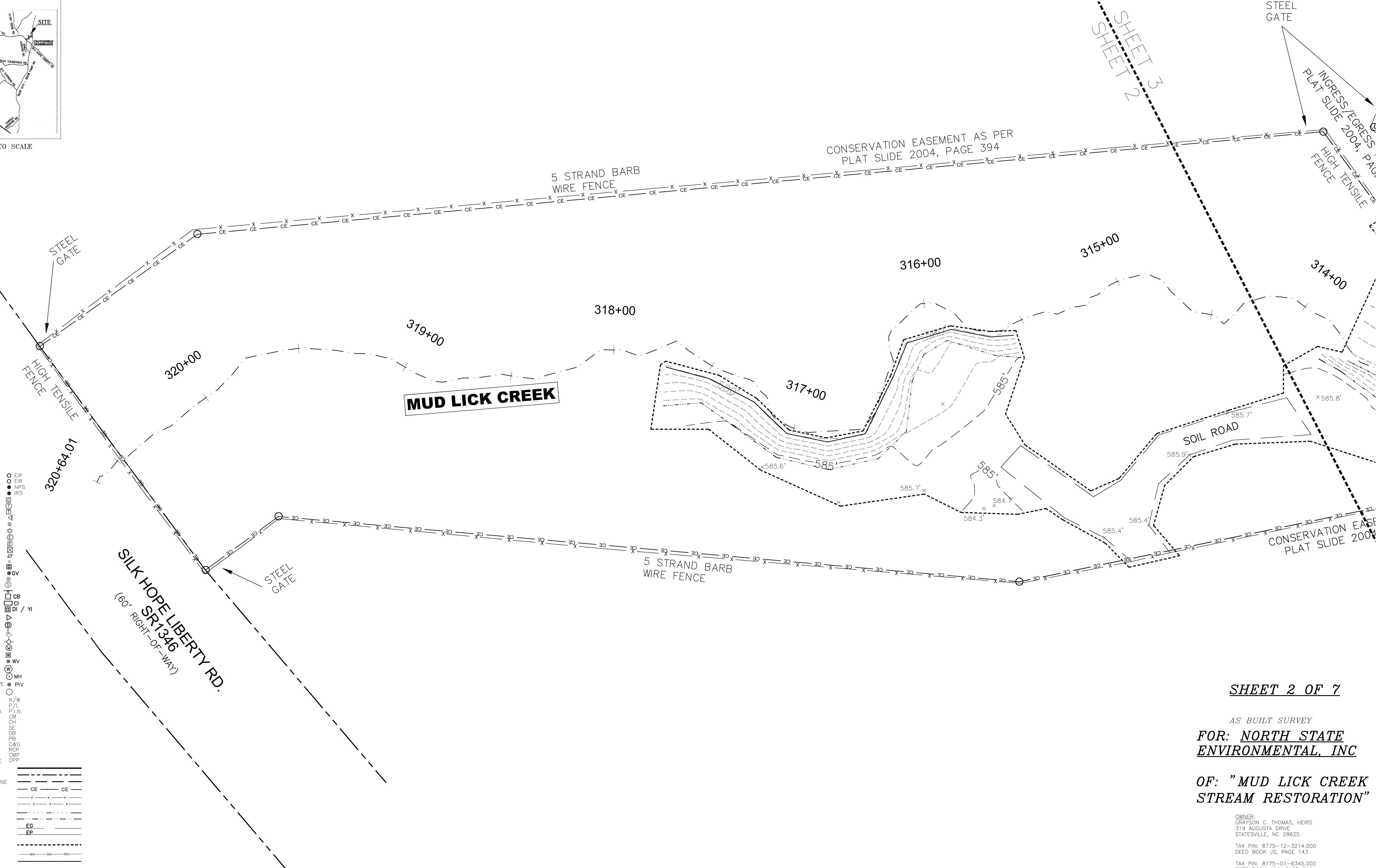
VICINITY MAP NOT TO SCALE



BASIS OF BEARING
NC GRID (NAD 83/2011)

LEGEND

EXISTING IRON PIN	○	EIP
EXISTING REBAR	○	EIR
NO POINT SET	○	NPS
IRON REBAR SET	●	IRS
CABLE PEDESTAL	○	CP
TELEPHONE MANHOLE	○	TMH
TELEPHONE PEDESTAL	○	TPD
FLOOD LIGHT	○	FL
GUY WIRE	○	GW
LIGHT POLE	○	LP
ELECTRIC MANHOLE	○	EMH
ELECTRIC METER	○	EM
ELECTRIC TRANSFORMER	○	ET
UTILITY POLE	○	UP
BOLLARD	○	B
GAS METER	○	GM
GAS VALVE	○	GV
SEWER CLEAN OUT	○	SCO
SEWER MANHOLE	○	SMH
SIGN	○	S
CATCH BASIN	○	CB
CURB INLET	○	CI
DROP \ YARD INLET	○	DI
FLARED END SECTION	○	FES
STORM MANHOLE	○	SM
HANDICAP	○	H
FIRE HYDRANT	○	FH
WATER MANHOLE	○	WMH
WATER METER	○	WM
WATER VALVE	○	WV
WELL	○	W
MANHOLE	○	MH
PRESSURE INDICATOR VALVE	○	PIV
TREE	○	T
RIGHT-OF-WAY	---	R/W
PROPERTY LINE	---	P/L
PARCEL IDENTIFICATION NO.	---	P.I.N.
CONCRETE MONUMENT	---	CM
CHORD	---	CH
SIGHT EASEMENT	---	SE
DEED BOOK	---	DB
PLAT BOOK	---	PB
CURB AND GUTTER	---	C&G
REINFORCED CONC PIPE	---	RCP
CORRUGATED METAL PIPE	---	CMP
CORRUGATED PLASTIC PIPE	---	CPP
BOUNDARY LINE	---	B
RIGHT-OF-WAY LINE	---	R/W
UNSURVEYED PROPERTY LINE	---	UPL
CONSERVATION EASEMENT	---	CE
FENCE (WIRE) LINE	---	F
FENCE (WOOD) LINE	---	F
BANKFULL	---	B
THALWEG	---	T
EDGE OF GRAVEL	---	EG
EDGE OF PAVEMENT	---	EP
GRADING LIMITS	---	G
OVERHEAD UTILITY	---	O
TIE LINE	---	T
MAJOR CONTOUR LINE	---	M
MINOR CONTOUR LINE	---	M
WATER LINE	---	W
WETLAND ZONE LINE	---	W
CONSTRUCTED RIFFLE	---	C
LOG VANE	---	L
BRUSH TOE	---	B



SHEET 2
SHEET 3

CONSERVATION EASEMENT AS PER
PLAT SLIDE 2004, PAGE 394

STEEL GATE
INGRESS/EGRESS
PLAT SLIDE 2004, PAGE 394
HIGH TENSILE FENCE

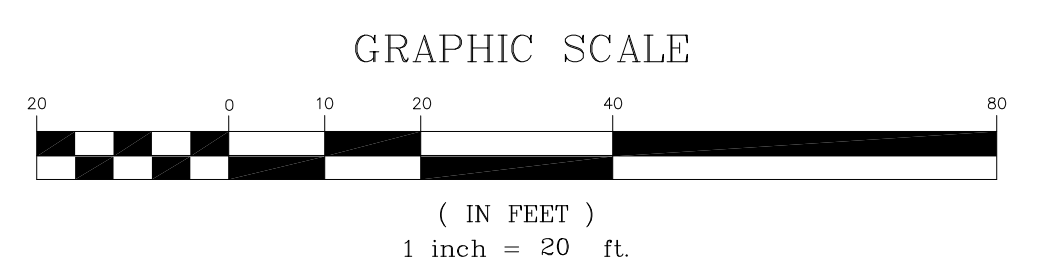
SILK HOPE LIBERTY RD.
(60' RIGHT-OF-WAY)
SR 1346

SHEET 2 OF 7

AS BUILT SURVEY
FOR: NORTH STATE ENVIRONMENTAL, INC

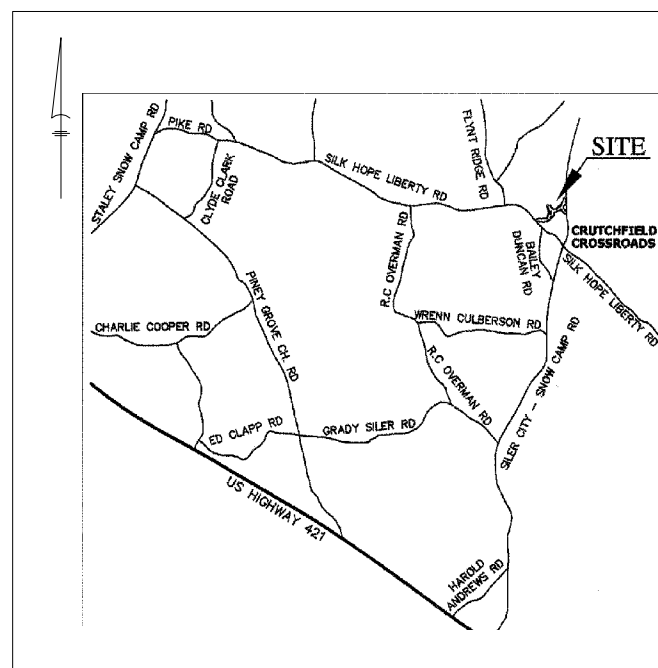
OF: "MUD LICK CREEK STREAM RESTORATION"

OWNER:
GRAYSON C. THOMAS, HEIRS
319 AUGUSTA DRIVE
STATESVILLE, NC 28625
TAX PIN: 8775-12-3214.000
DEED BOOK JS, PAGE 143
TAX PIN: 8775-01-6345.000
DEED BOOK 411, PAGE 846
N/A ACRES +/- (TOTAL)



Allied Associates, P.A.
4720 KESTER MILL ROAD PHONE (336) 765-2377
WINSTON-SALEM, N.C. 27103 FAX 760-8866
www.alliedappa.com NC LICENSE #C-2198

SCALE	TOWNSHIP	COUNTY	STATE	DATE
1" = 20'	ALBRIGHT	CHATHAM	NORTH CAROLINA	08/01/17
SURVEYED:	MAPPED:	JOB NO.	MAP NO.	TITLE
FJ TR	DA	PA170611	MLC.dwg	MLC

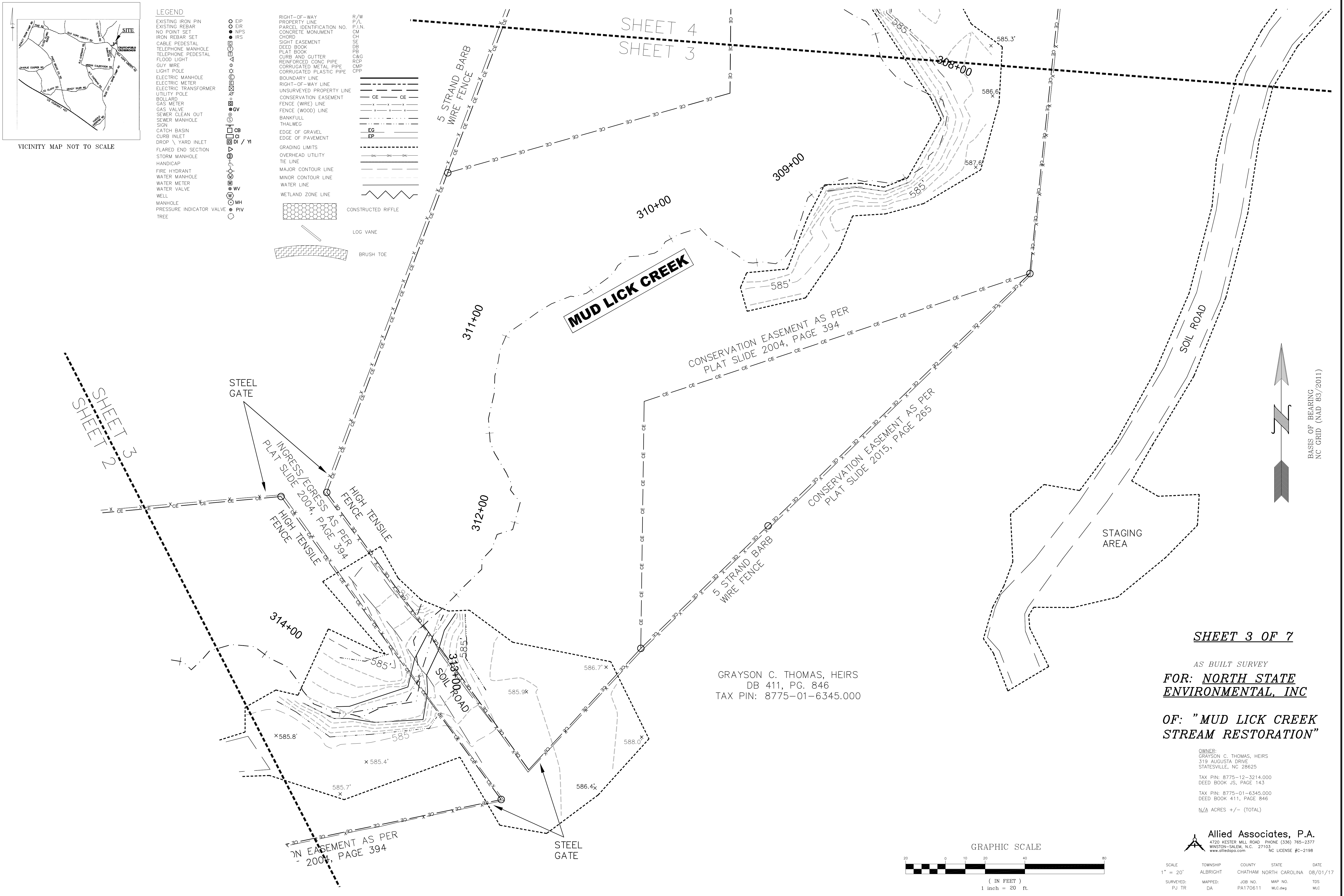


VICINITY MAP NOT TO SCALE

LEGEND

- EXISTING IRON PIN
- EXISTING REBAR
- NO POINT SET
- IRON REBAR SET
- CABLE PEDESTAL
- TELEPHONE MANHOLE
- TELEPHONE PEDESTAL
- FLOOD LIGHT
- GUY WIRE
- LIGHT POLE
- ELECTRIC MANHOLE
- ELECTRIC METER
- ELECTRIC TRANSFORMER
- UTILITY POLE
- BOLLARD
- GAS METER
- GAS VALVE
- SEWER CLEAN OUT
- SEWER MANHOLE
- SIGN
- CATCH BASIN
- CURB INLET
- DROP \ YARD INLET
- FLARED END SECTION
- STORM MANHOLE
- HANDICAP
- FIRE HYDRANT
- WATER MANHOLE
- WATER METER
- WATER VALVE
- WELL
- MANHOLE
- PRESSURE INDICATOR VALVE
- TREE

- RIGHT-OF-WAY
- PROPERTY LINE
- PARCEL IDENTIFICATION NO.
- CONCRETE MONUMENT
- CHORD
- SIGHT EASEMENT
- DEED BOOK
- PLAT BOOK
- CURB AND GUTTER
- REINFORCED CONC PIPE
- CORRUGATED METAL PIPE
- CORRUGATED PLASTIC PIPE
- BOUNDARY LINE
- RIGHT-OF-WAY LINE
- UNSURVEYED PROPERTY LINE
- CONSERVATION EASEMENT
- FENCE (WIRE) LINE
- FENCE (WOOD) LINE
- BANKFULL
- THALWEG
- EDGE OF GRAVEL
- EDGE OF PAVEMENT
- GRADING LIMITS
- OVERHEAD UTILITY
- TIE LINE
- MAJOR CONTOUR LINE
- MINOR CONTOUR LINE
- WATER LINE
- WETLAND ZONE LINE
- CONSTRUCTED RIFFLE
- LOG VANE
- BRUSH TOE



SHEET 4
SHEET 3

SHEET 2
SHEET 3

MUD LICK CREEK

SOIL ROAD

STAGING AREA

CONSERVATION EASEMENT AS PER
PLAT SLIDE 2004, PAGE 394

CONSERVATION EASEMENT AS PER
PLAT SLIDE 2015, PAGE 265

CONSERVATION EASEMENT AS PER
PLAT SLIDE 2004, PAGE 394

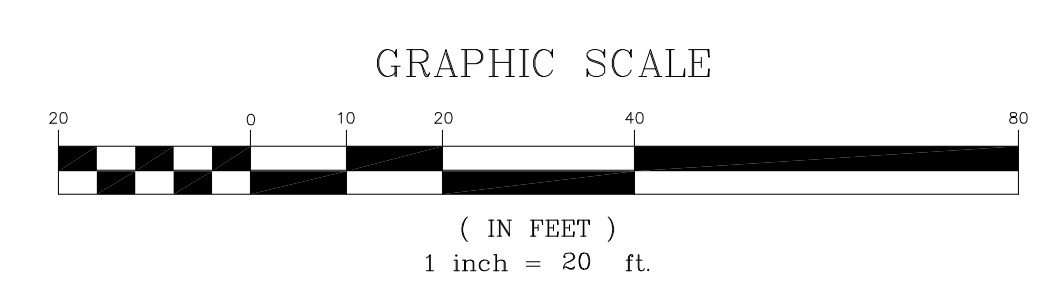
GRAYSON C. THOMAS, HEIRS
DB 411, PG. 846
TAX PIN: 8775-01-6345.000

SHEET 3 OF 7

AS BUILT SURVEY
FOR: NORTH STATE ENVIRONMENTAL, INC

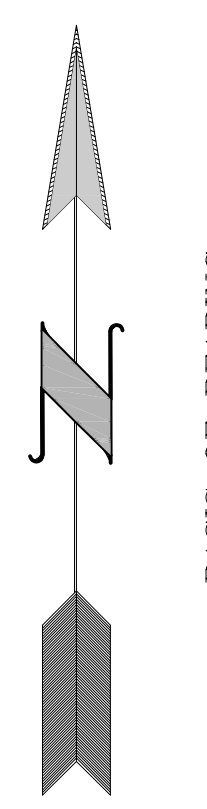
OF: "MUD LICK CREEK STREAM RESTORATION"

OWNER:
GRAYSON C. THOMAS, HEIRS
319 AUGUSTA DRIVE
STATESVILLE, NC 28625
TAX PIN: 8775-12-3214.000
DEED BOOK JS, PAGE 143
TAX PIN: 8775-01-6345.000
DEED BOOK 411, PAGE 846
N/A ACRES +/- (TOTAL)

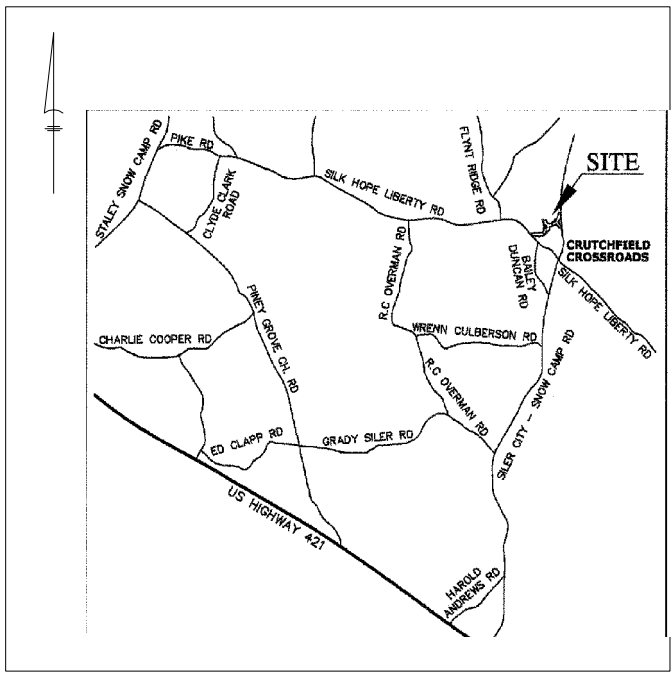


Allied Associates, P.A.
4720 KESTER MILL ROAD, PHONE (336) 765-2377
WINSTON-SALEM, N.C. 27103
www.alliedpa.com NC LICENSE #C-2198

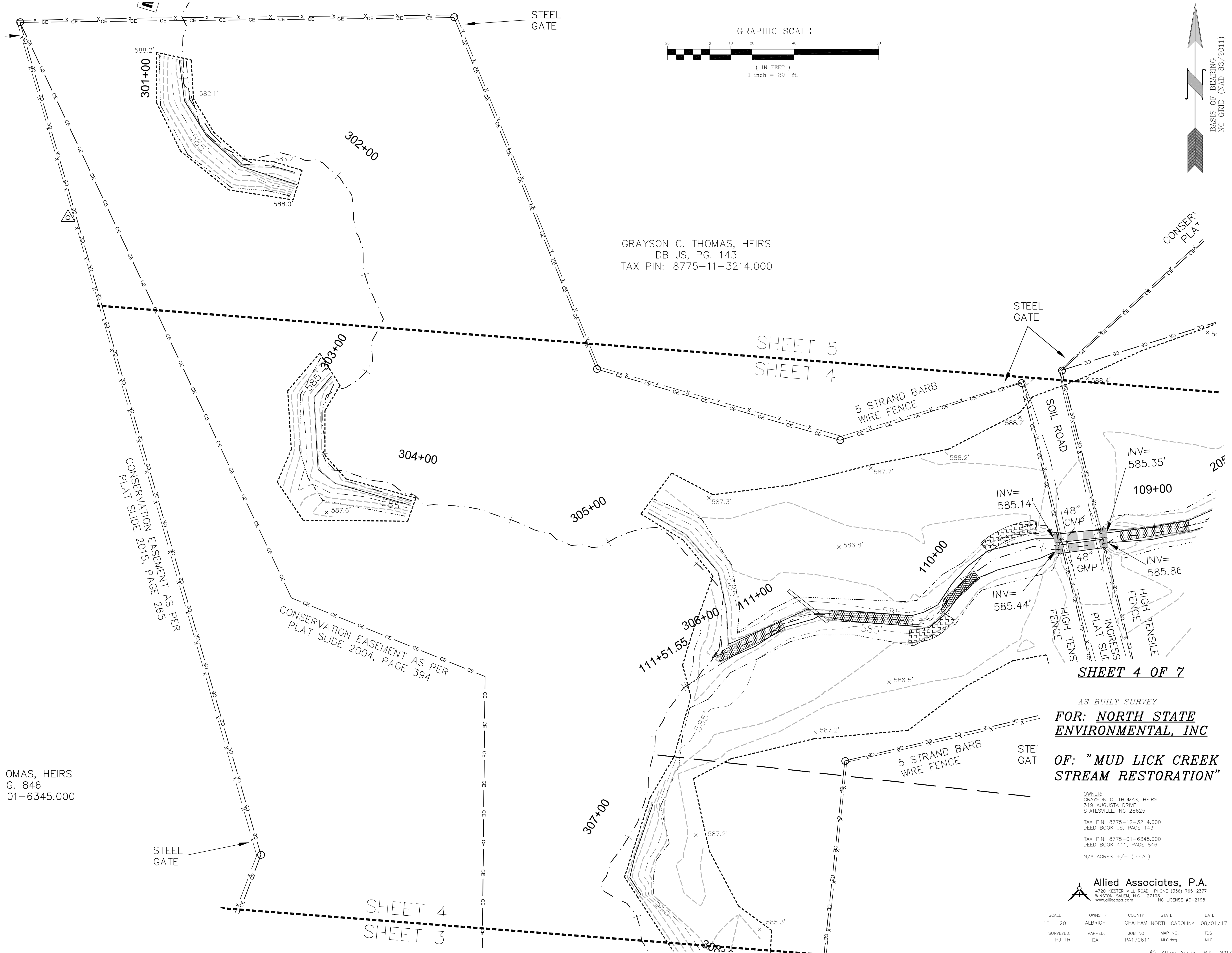
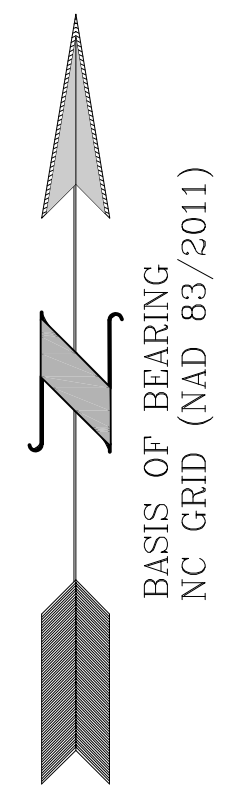
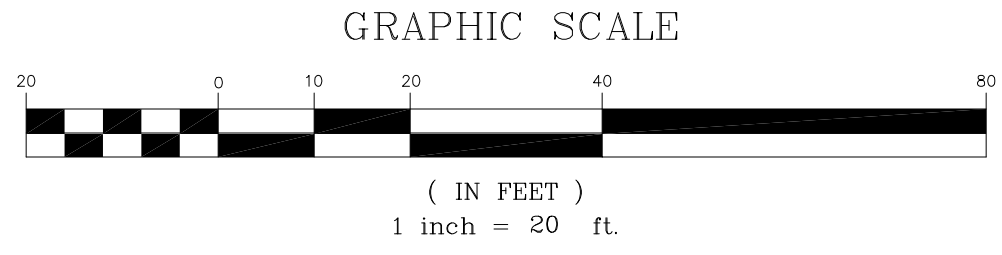
SCALE	TOWNSHIP	COUNTY	STATE	DATE
1" = 20'	ALBRIGHT	CHATHAM	NORTH CAROLINA	08/01/17
SURVEYED:	MAPPED:	JOB NO.	MAP NO.	TDS
PJ TR	DA	PA170611	MLC.dwg	MLC



BASIS OF BEARING
NC GRID (NAD 83/2011)



VICINITY MAP NOT TO SCALE



GRAYSON C. THOMAS, HEIRS
DB JS, PG. 143
TAX PIN: 8775-11-3214.000

SHEET 5
SHEET 4

SHEET 4 OF 7

AS BUILT SURVEY
FOR: NORTH STATE ENVIRONMENTAL, INC

OF: "MUD LICK CREEK STREAM RESTORATION"

OWNER:
GRAYSON C. THOMAS, HEIRS
319 AUGUSTA DRIVE
STATESVILLE, NC 28625
TAX PIN: 8775-12-3214.000
DEED BOOK JS, PAGE 143
TAX PIN: 8775-01-6345.000
DEED BOOK 411, PAGE 846
N/A ACRES +/- (TOTAL)

Allied Associates, P.A.
4720 WESTER HILL ROAD PHONE (336) 765-2377
WINSTON-SALEM, N.C. 27103
www.alliedpa.com NC LICENSE #C-2198

SCALE	TOWNSHIP	COUNTY	STATE	DATE
1" = 20'	ALBRIGHT	CHATHAM	NORTH CAROLINA	06/01/17
SURVEYED:	MAPPED:	JOB NO.	MAP NO.	TDS
PJ TR	DA	PA170611	MLC.dwg	MLC

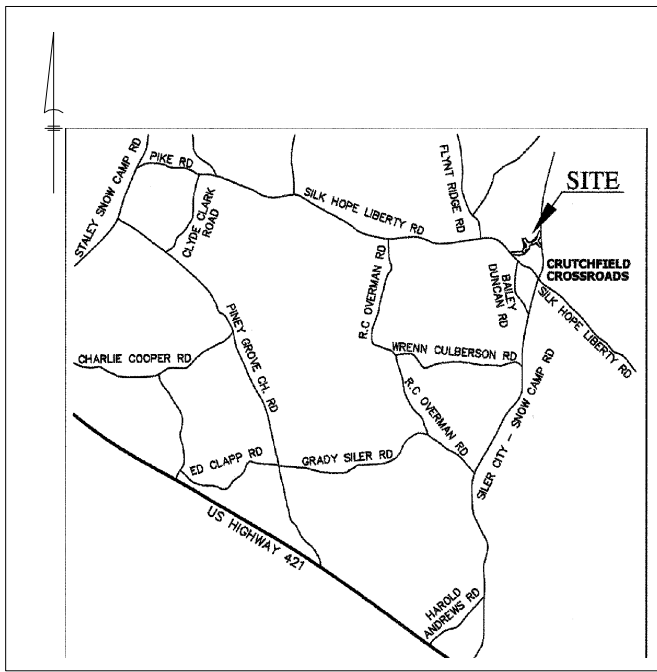
- LEGEND**
- EXISTING IRON PIN
 - EXISTING REBAR
 - NO POINT SET
 - IRON REBAR SET
 - CABLE PEDESTAL
 - TELEPHONE MANHOLE
 - TELEPHONE PEDESTAL
 - FLOOD LIGHT
 - GUY WIRE
 - LIGHT POLE
 - ELECTRIC MANHOLE
 - ELECTRIC METER
 - ELECTRIC TRANSFORMER
 - UTILITY POLE
 - BOLLARD
 - GAS METER
 - GAS VALVE
 - SEWER CLEAN OUT
 - SEWER MANHOLE
 - SIGN
 - CATCH BASIN
 - CURB INLET
 - DROP \ YARD INLET
 - FLARED END SECTION
 - STORM MANHOLE
 - HANDICAP
 - FIRE HYDRANT
 - WATER MANHOLE
 - WATER METER
 - WATER VALVE
 - WELL
 - MANHOLE
 - PRESSURE INDICATOR VALVE
 - PIV
 - TREE
 - RIGHT-OF-WAY
 - PROPERTY LINE
 - PARCEL IDENTIFICATION NO.
 - CONCRETE MONUMENT
 - CHORD
 - SIGHT EASEMENT
 - DEED BOOK
 - PLAT BOOK
 - CURB AND GUTTER
 - REINFORCED CONC PIPE
 - CORRUGATED METAL PIPE
 - CORRUGATED PLASTIC PIPE
 - BOUNDARY LINE
 - RIGHT-OF-WAY LINE
 - UNSURVEYED PROPERTY LINE
 - CONSERVATION EASEMENT
 - FENCE (WIRE) LINE
 - FENCE (WOOD) LINE
 - BANKFULL
 - THALWEG
 - EDGE OF GRAVEL
 - EDGE OF PAVEMENT
 - GRADING LIMITS
 - OVERHEAD UTILITY
 - TIE LINE
 - MAJOR CONTOUR LINE
 - MINOR CONTOUR LINE
 - WATER LINE
 - WETLAND ZONE LINE
 - CONSTRUCTED RIFFLE
 - LOG VANE
 - BRUSH TOE

OMAS, HEIRS
G. 846
01-6345.000

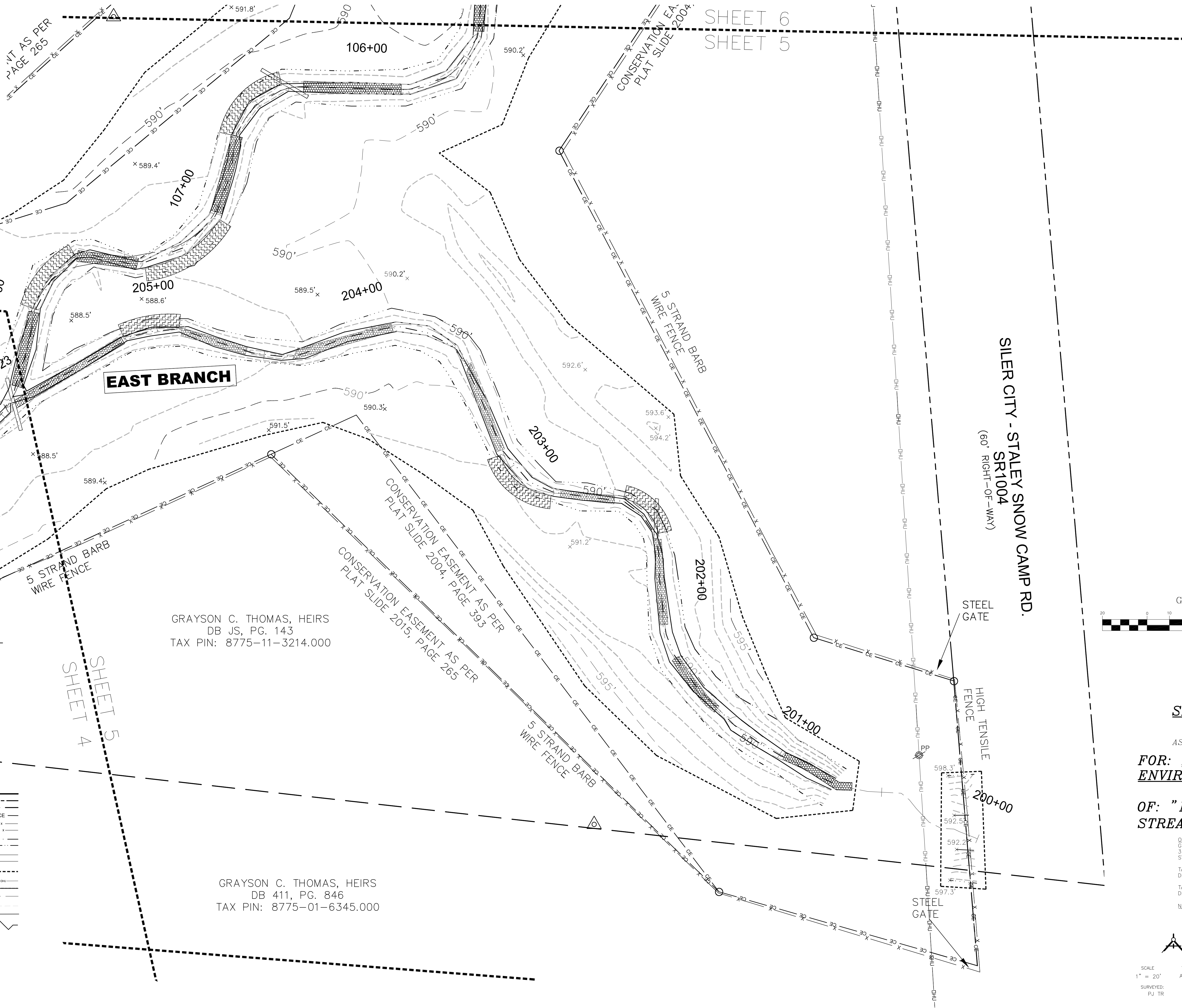
CONSERVATION EASEMENT AS PER
PLAT SLIDE 2004, PAGE 394

CONSERVATION EASEMENT AS PER
PLAT SLIDE 2015, PAGE 265

SHEET 4
SHEET 3



VICINITY MAP NOT TO SCALE



- LEGEND**
- EXISTING IRON PIN
 - EXISTING REBAR
 - NO POINT SET
 - IRON REBAR SET
 - CABLE PEDESTAL
 - TELEPHONE MANHOLE
 - TELEPHONE PEDESTAL
 - FLOOD LIGHT
 - GUY WIRE
 - LIGHT POLE
 - ELECTRIC MANHOLE
 - ELECTRIC METER
 - ELECTRIC TRANSFORMER
 - UTILITY POLE
 - BOLLARD
 - GAS METER
 - GAS VALVE
 - SEWER CLEAN OUT
 - SEWER MANHOLE
 - SIGN
 - CATCH BASIN
 - CURB INLET
 - DROP YARD INLET
 - FLARED END SECTION
 - STORM MANHOLE
 - HANDICAP
 - FIRE HYDRANT
 - WATER MANHOLE
 - WATER METER
 - WATER VALVE
 - WELL
 - MANHOLE
 - PRESSURE INDICATOR VALVE
 - TREE
 - RIGHT-OF-WAY
 - PROPERTY LINE
 - PARCEL IDENTIFICATION NO.
 - CONCRETE MONUMENT
 - CHORD
 - SIGHT EASEMENT
 - DEED BOOK
 - PLAT BOOK
 - CURB AND GUTTER
 - REINFORCED CONC PIPE
 - CORRUGATED METAL PIPE
 - CORRUGATED PLASTIC PIPE
 - BOUNDARY LINE
 - RIGHT-OF-WAY LINE
 - UNSURVEYED PROPERTY LINE
 - CONSERVATION EASEMENT
 - FENCE (WIRE) LINE
 - FENCE (WOOD) LINE
 - BANKFULL
 - THALWEG
 - EDGE OF GRAVEL
 - EDGE OF PAVEMENT
 - GRADING LIMITS
 - OVERHEAD UTILITY
 - TIE LINE
 - MAJOR CONTOUR LINE
 - MINOR CONTOUR LINE
 - WATER LINE
 - WETLAND ZONE LINE
 - CONSTRUCTED RIFFLE
 - LOG VANE
 - BRUSH TOE

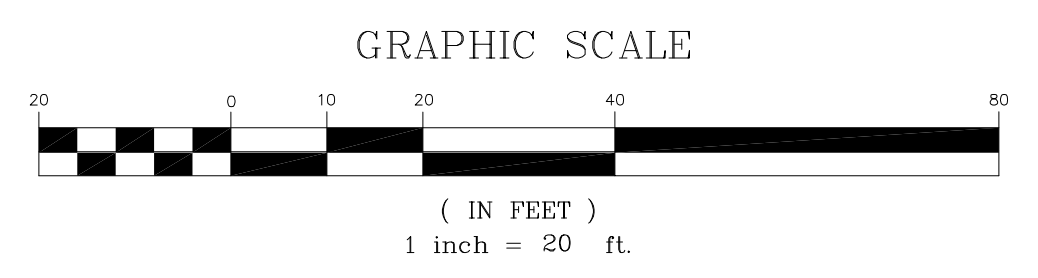
GRAYSON C. THOMAS, HEIRS
DB JS, PG. 143
TAX PIN: 8775-11-3214.000

GRAYSON C. THOMAS, HEIRS
DB 411, PG. 846
TAX PIN: 8775-01-6345.000

SHEET 6
SHEET 5

SHEET 4
SHEET 5

SILER CITY - STALEY SNOW CAMP RD.
(60' RIGHT-OF-WAY)
SR1004



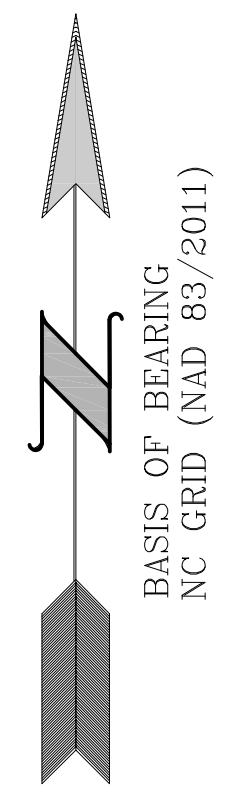
SHEET 5 OF 7

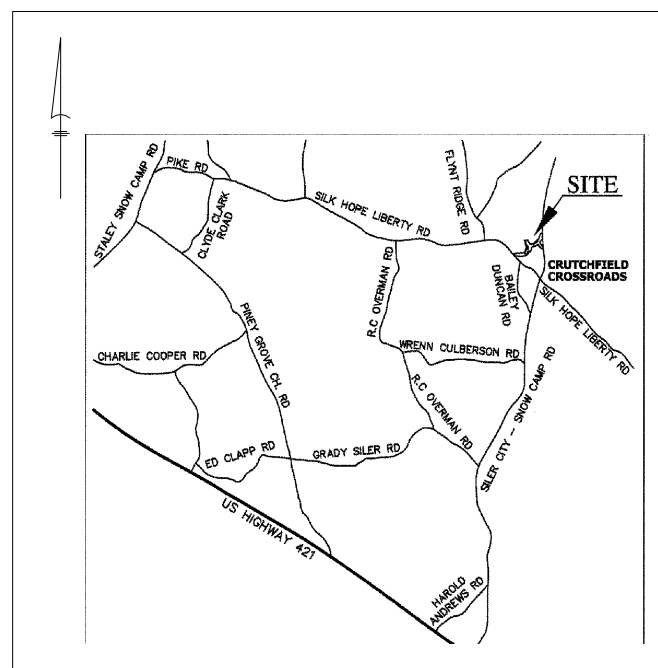
AS BUILT SURVEY
FOR: NORTH STATE ENVIRONMENTAL, INC
OF: "MUD LICK CREEK STREAM RESTORATION"

OWNER:
GRAYSON C. THOMAS, HEIRS
319 AUGUSTA DRIVE
STATESVILLE, NC 28625
TAX PIN: 8775-12-3214.000
DEED BOOK JS, PAGE 143
TAX PIN: 8775-01-6345.000
DEED BOOK 411, PAGE 846
N/A ACRES +/- (TOTAL)

Allied Associates, P.A.
4720 WESTER MILL ROAD PHONE (336) 765-2377
WINSTON-SALEM, N.C. 27103
www.alliedpa.com NC LICENSE #C-2198

SCALE	TOWNSHIP	COUNTY	STATE	DATE
1" = 20'	ALBRIGHT	CHATHAM	NORTH CAROLINA	06/01/17
SURVEYED:	MAPPED:	JOB NO.	MAP NO.	TDS
PJ TR	DA	PA170611	MLC.dwg	MLC





VICINITY MAP NOT TO SCALE

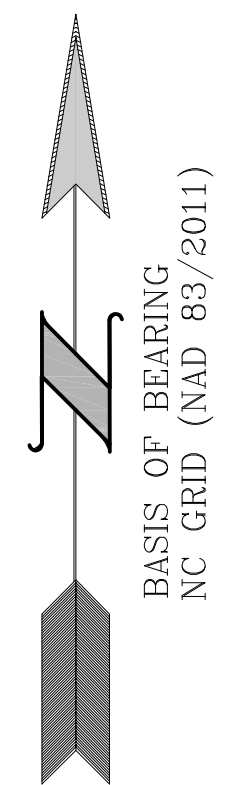
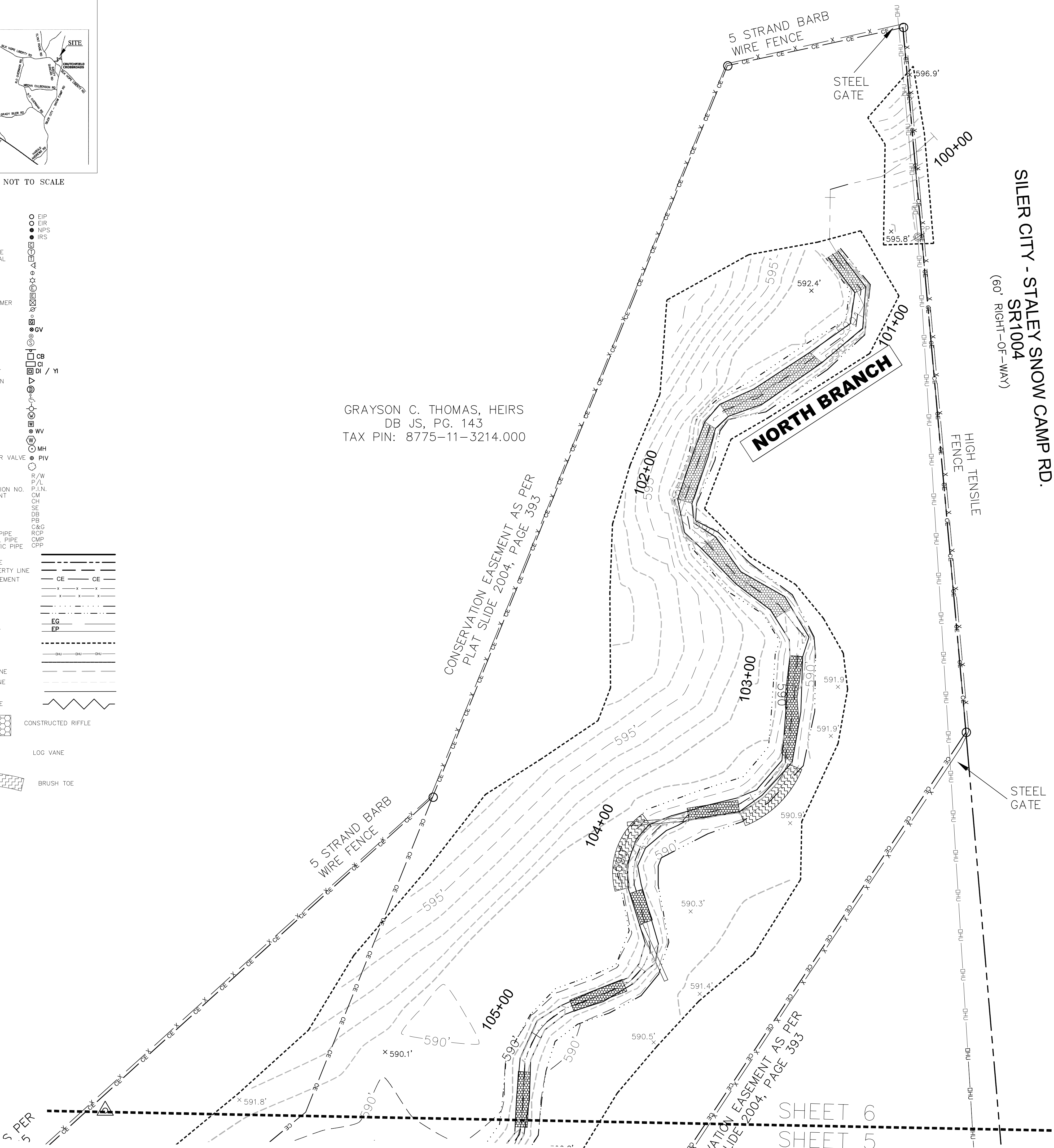
LEGEND

EXISTING IRON PIN	○	EIP
EXISTING REBAR	●	EIR
NO POINT SET	○	NPS
IRON REBAR SET	●	IRS
CABLE PEDESTAL	○	CP
TELEPHONE MANHOLE	⊗	TMH
TELEPHONE PEDESTAL	⊗	TPD
FLOOD LIGHT	○	FL
GUY WIRE	—	GW
LIGHT POLE	⊗	LP
ELECTRIC MANHOLE	⊗	EMH
ELECTRIC METER	⊗	EM
ELECTRIC TRANSFORMER	⊗	ET
UTILITY POLE	⊗	UP
BOLLARD	○	B
GAS METER	⊗	GM
GAS VALVE	⊗	GV
SEWER CLEAN OUT	⊗	SCO
SEWER MANHOLE	⊗	SMH
SIGN	⊗	S
CATCH BASIN	⊗	CB
CURB INLET	⊗	CI
DROP \ YARD INLET	⊗	DI
FLARED END SECTION	⊗	FES
STORM MANHOLE	⊗	SM
HANDICAP	⊗	H
FIRE HYDRANT	⊗	FH
WATER MANHOLE	⊗	WMH
WATER METER	⊗	WM
WATER VALVE	⊗	WV
WELL	⊗	W
MANHOLE	⊗	MH
PRESSURE INDICATOR VALVE	⊗	PIV
TREE	○	T
RIGHT-OF-WAY	—	R/W
PROPERTY LINE	—	P/L
PARCEL IDENTIFICATION NO.	—	P.I.N.
CONCRETE MONUMENT	—	CM
CHORD	—	CH
SIGHT EASEMENT	—	SE
DEED BOOK	—	DB
PLAT BOOK	—	PB
CURB AND GUTTER	—	C&G
REINFORCED CONC PIPE	—	RCP
CORRUGATED METAL PIPE	—	CMP
CORRUGATED PLASTIC PIPE	—	CPP
BOUNDARY LINE	—	B
RIGHT-OF-WAY LINE	—	R/W
UNSURVEYED PROPERTY LINE	—	UPL
CONSERVATION EASEMENT	—	CE
FENCE (WIRE) LINE	—	F
FENCE (WOOD) LINE	—	F
BANKFULL	—	B
THALWEG	—	T
EDGE OF GRAVEL	—	EG
EDGE OF PAVEMENT	—	EP
GRADING LIMITS	—	G
OVERHEAD UTILITY	—	O
TIE LINE	—	T
MAJOR CONTOUR LINE	—	M
MINOR CONTOUR LINE	—	M
WATER LINE	—	W
WETLAND ZONE LINE	—	W
CONSTRUCTED RIFFLE	—	C
LOG VANE	—	L
BRUSH TOE	—	B

GRAYSON C. THOMAS, HEIRS
DB JS, PG. 143
TAX PIN: 8775-11-3214.000

CONSERVATION EASEMENT AS PER
PLAT SLIDE 2004, PAGE 393

CONSERVATION EASEMENT AS PER
PLAT SLIDE 2004, PAGE 393

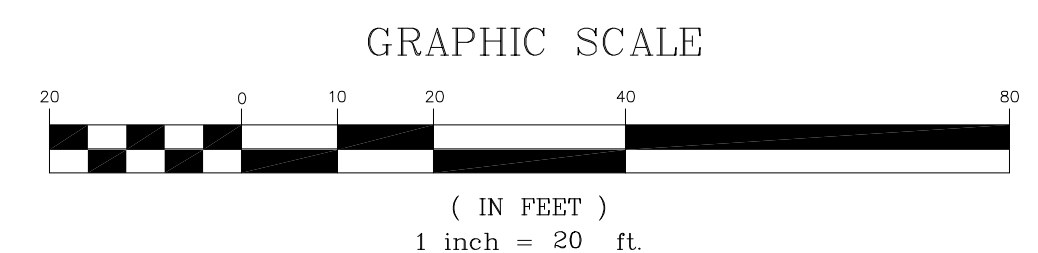


SHEET 6 OF 7

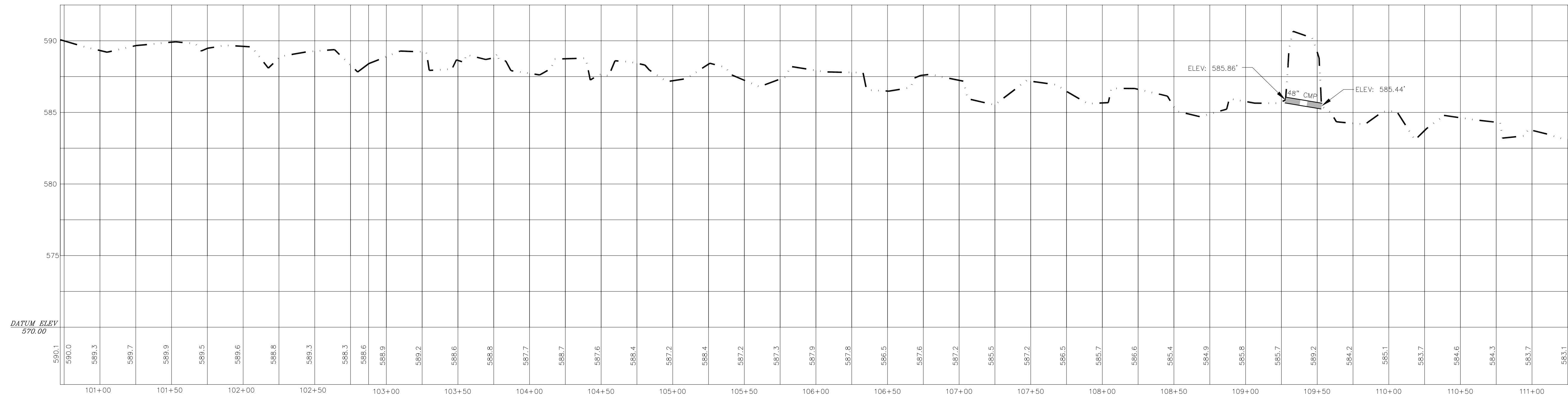
AS BUILT SURVEY
FOR: NORTH STATE ENVIRONMENTAL, INC
OF: "MUD LICK CREEK STREAM RESTORATION"

OWNER:
GRAYSON C. THOMAS, HEIRS
319 AUGUSTA DRIVE
STATESVILLE, NC 28625
TAX PIN: 8775-12-3214.000
DEED BOOK JS, PAGE 143
TAX PIN: 8775-01-6345.000
DEED BOOK 411, PAGE 846
N/A ACRES +/- (TOTAL)

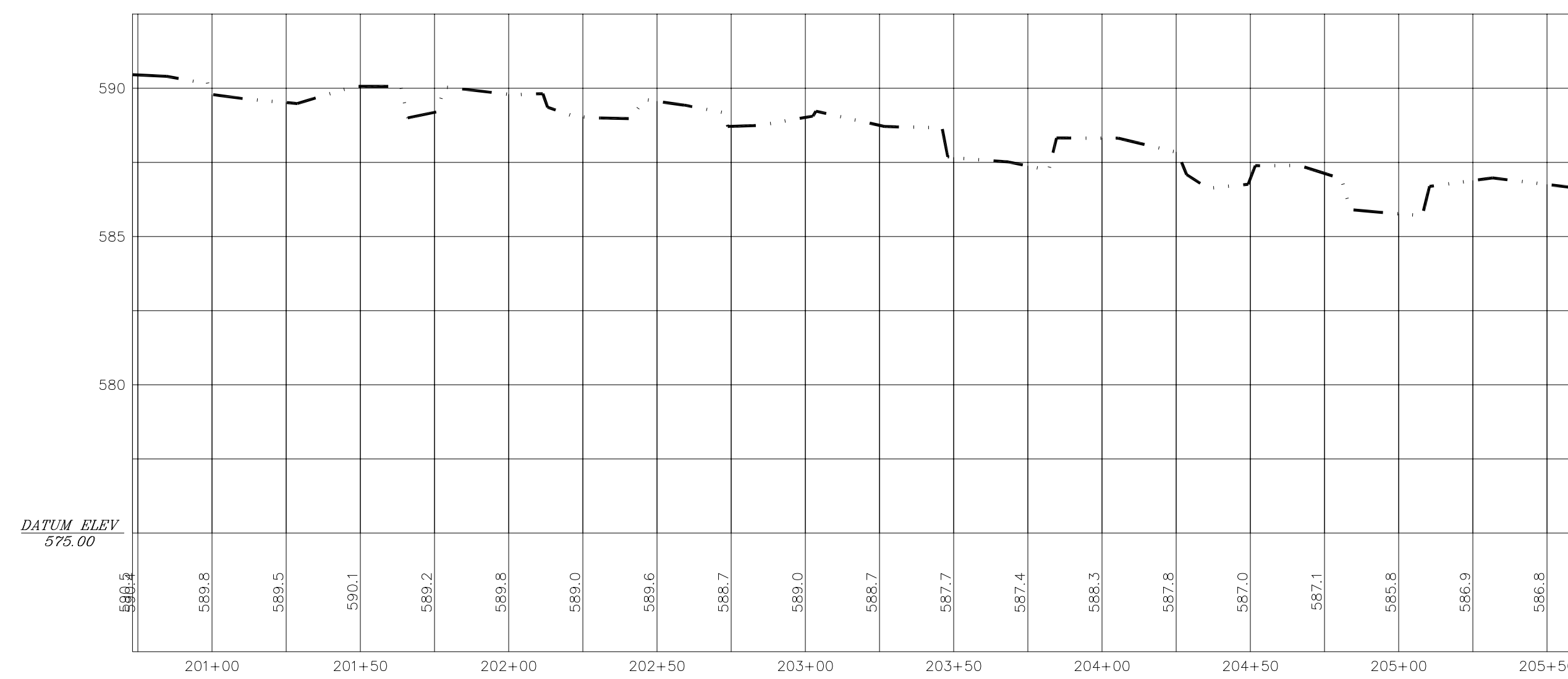
Allied Associates, P.A.
4720 WESTER MILL ROAD PHONE (336) 765-2377
WINSTON-SALEM, N.C. 27103
www.alliedpa.com NC LICENSE #C-2198



SCALE	TOWNSHIP	COUNTY	STATE	DATE
1" = 20'	ALBRIGHT	CHATHAM	NORTH CAROLINA	06/01/17
SURVEYED:	MAPPED:	JOB NO.	MAP NO.	TDS
PJ TR	DA	PA170611	MLC.dwg	MLC



NORTH BRANCH



EAST BRANCH

SHEET 7 OF 7

AS BUILT SURVEY
FOR: NORTH STATE ENVIRONMENTAL, INC

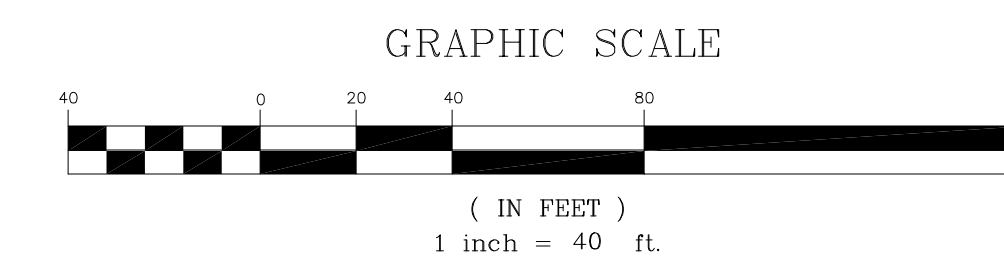
OF: "MUD LICK CREEK STREAM RESTORATION"

OWNER:
 GRAYSON C. THOMAS, HEIRS
 319 AUGUSTA DRIVE
 STATESVILLE, NC 28625

TAX PIN: 8775-12-3214.000
 DEED BOOK JS, PAGE 143

TAX PIN: 8775-01-6345.000
 DEED BOOK 411, PAGE 846

N/A ACRES +/- (TOTAL)



Allied Associates, P.A.
 4720 KESTER MILL ROAD, PHONE (336) 765-2377
 WINSTON-SALEM, N.C. 27103, FAX: 760-8886
 www.alliedpa.com NC LICENSE #C-2198

SCALE	TOWNSHIP	COUNTY	STATE	DATE
1" = 40'	ALBRIGHT	CHATHAM	NORTH CAROLINA	08/01/17
SURVEYED:	MAPPED:	JOB NO.	MAP NO.	TDS
FJ TR	DA	PA170611	MLC.dwg	MLC

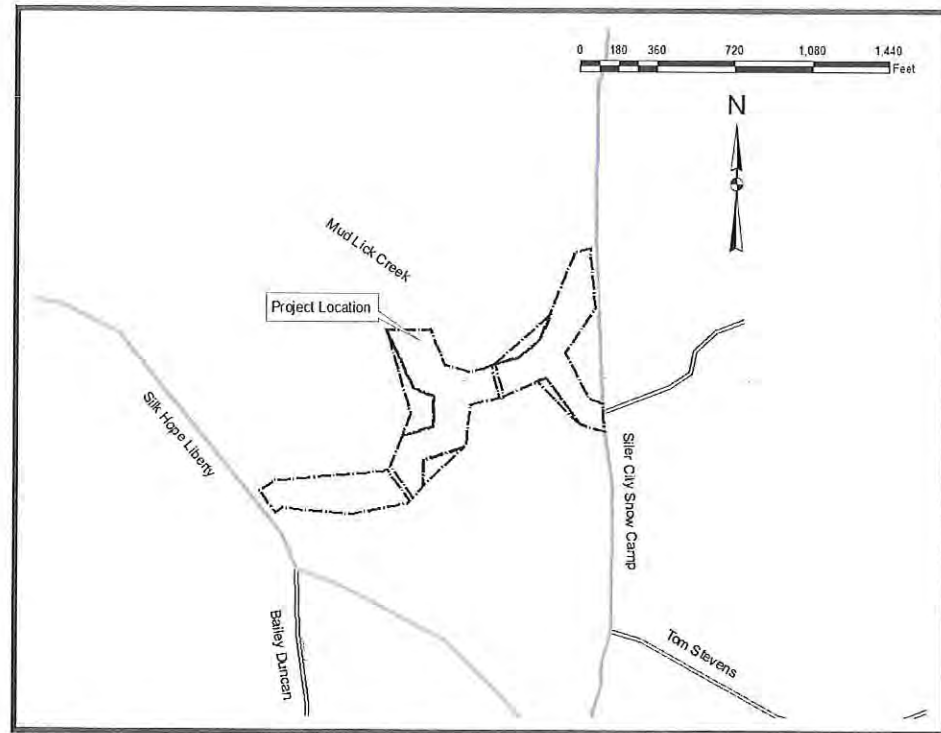
Mud Lick Creek Mitigation Site

Cape Fear River Basin 03030003

Chatham County, North Carolina

for

NCDEQ Division of
Mitigation Services



Vicinity Map
Not to Scale



FINAL RECORD DRAWINGS
Issued June 2018
Revised 06.12.2018

Stream Origins		
Stream	Latitude	Longitude
North Branch	N 35° 48' 53.73"	W 79° 25' 56.95"
East Branch	N 35° 48' 46.31"	W 79° 25' 56.17"
Mud Lick Creek	N 35° 48' 50.97"	W 79° 26' 07.48"

Sheet Index

Title Sheet	0.1
Legend	0.2
Stream Overlay Overview	0.3
Stream Overlay Plans	1.1-1.10
Planting Plan	2.1
Fencing Plan	3.1

Project Directory

Surveying: Turner Land Surveying, PLLC P.O. Box 41023 Raleigh, NC 27629 David S. Turner, PLS 919-875-1378	Owner: NCDEQ Division of Mitigation Services 1652 Mail Service Center Raleigh, NC 27699-1652 Jeff Schaffer 919-707-8976 DEQ Contract No. D14001i DMS ID No. 93482 SCO No. 1209857-01
Engineering: Wildlands Engineering, Inc License No. F-0831 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 Angela N. Allen, PE 919-851-9986	



Mud Lick Creek Mitigation Site
Chatham County, North Carolina

Title Sheet

Record Drawing

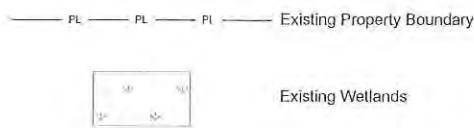
Date	06.12.2018
Job Number	09502912
Project Engineer	ANA
Drawn By	CLM
Checked By	JNK

0.1

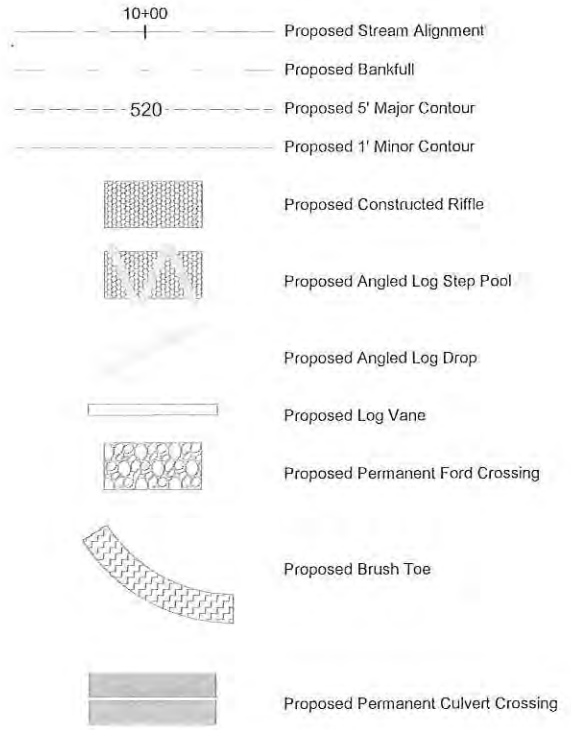
Sheet

June 1, 2018
 F:\Projects\061218_Mud Lick Creek\Drawings\Record Drawings\0112-01-01-Title Sheet.dwg

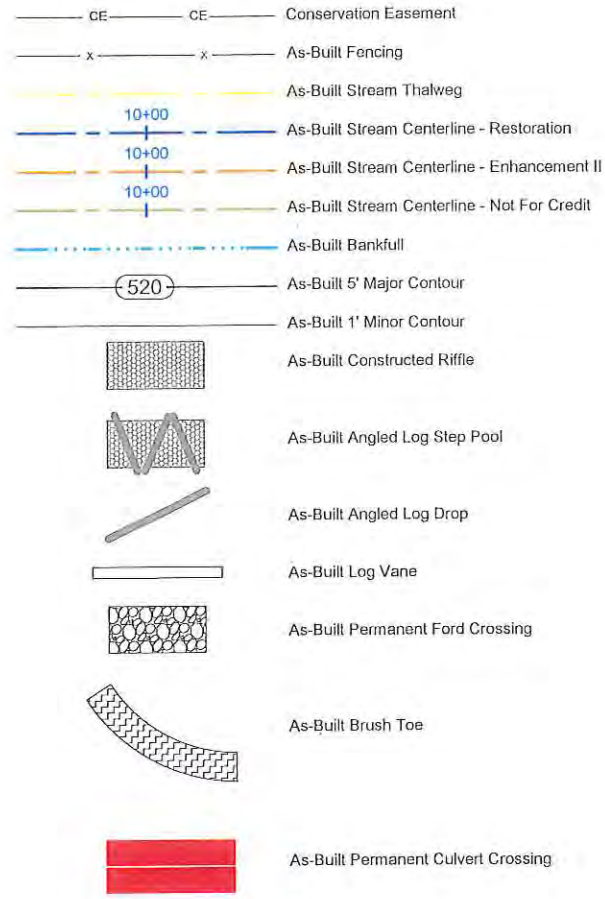
Existing Features



Proposed Features



As-Built Features



NOTE: FEATURES IN RED INDICATE DEVIATION FROM FINAL CONSTRUCTION PLANS.



Mud Lick Creek Mitigation Site
Chatham County, North Carolina

Legend

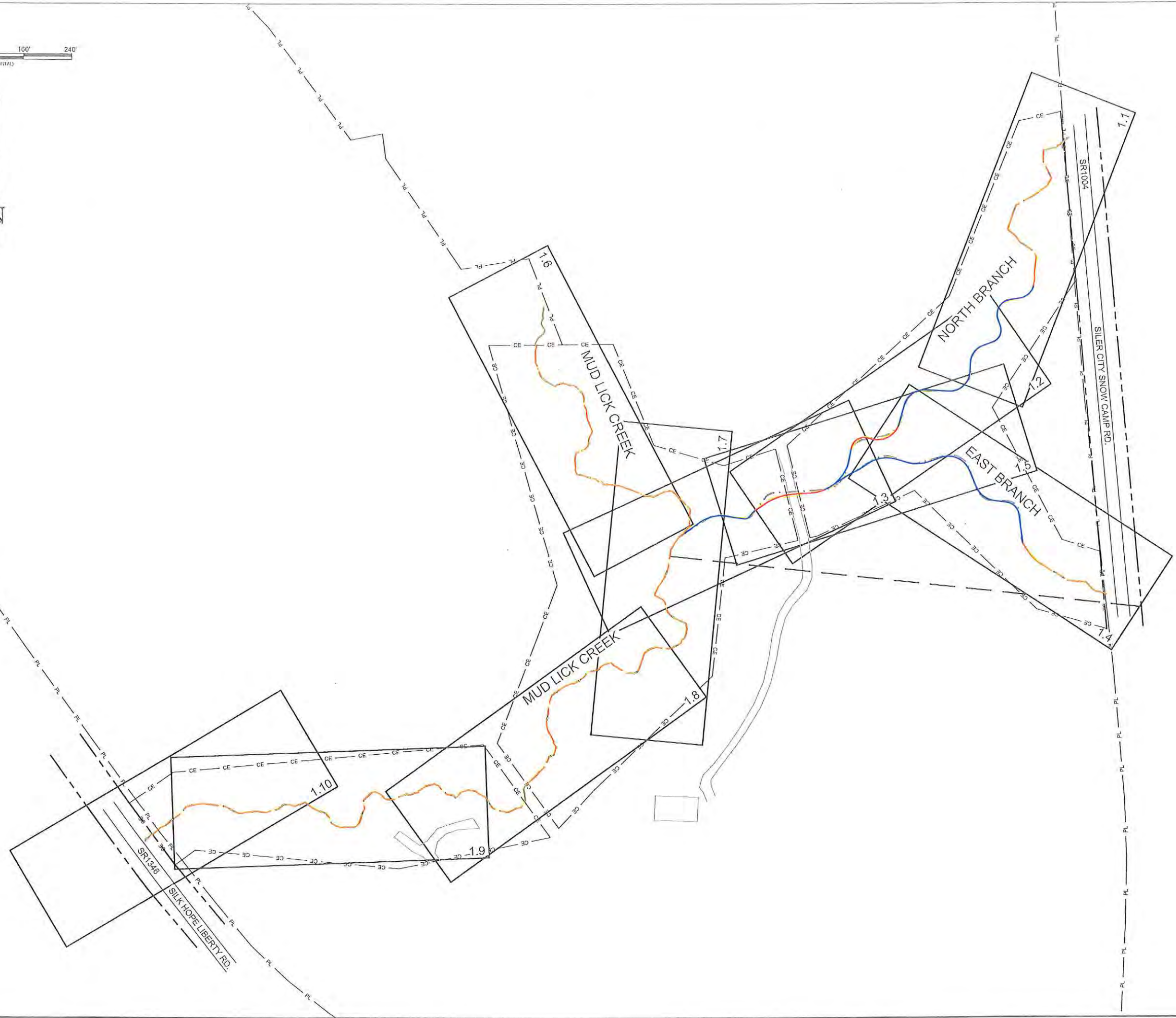
Record Drawing

Date	Revised By	Description
6/12/2018	ANA	001-0212
	ANA	
	CLM	
	JNK	

0.2

Sheet

06/12/2018
P:\Projects\061218_Mud Lick Creek\Civil\Plan\Stream Overlay\Stream Overlay.dwg



Record Drawing

Date:	06/12/2018
Job Number:	DPS-0212
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNS

0.3

Sheet

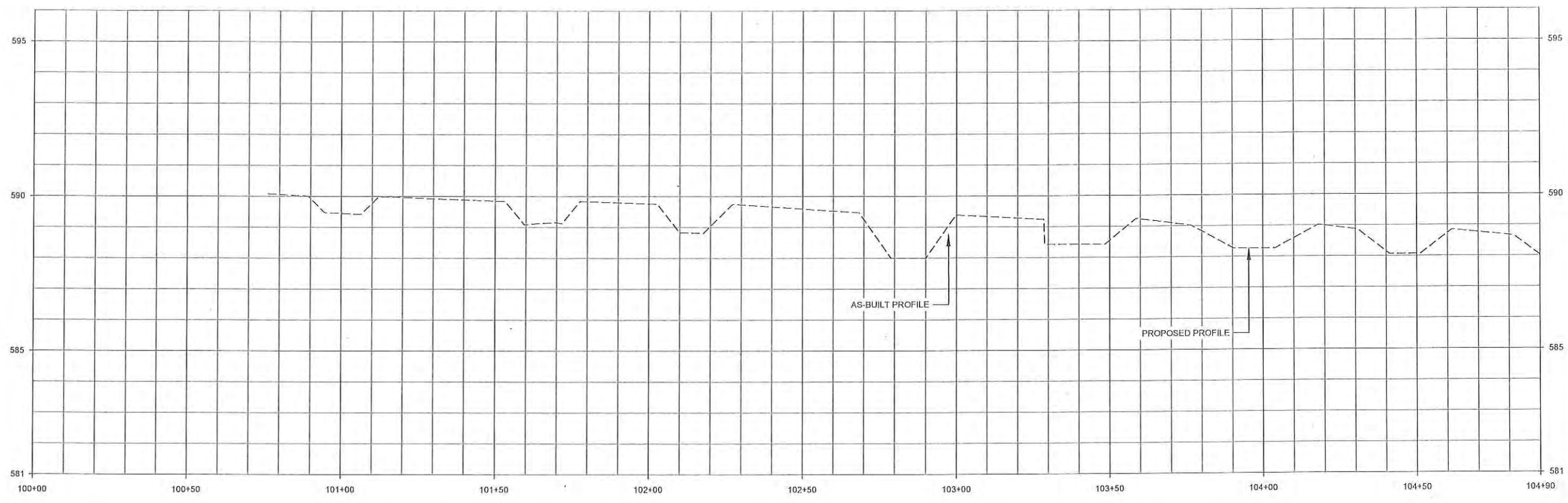
Mud Lick Creek Mitigation Site
Chatham County, North Carolina

Stream Overlay Overview

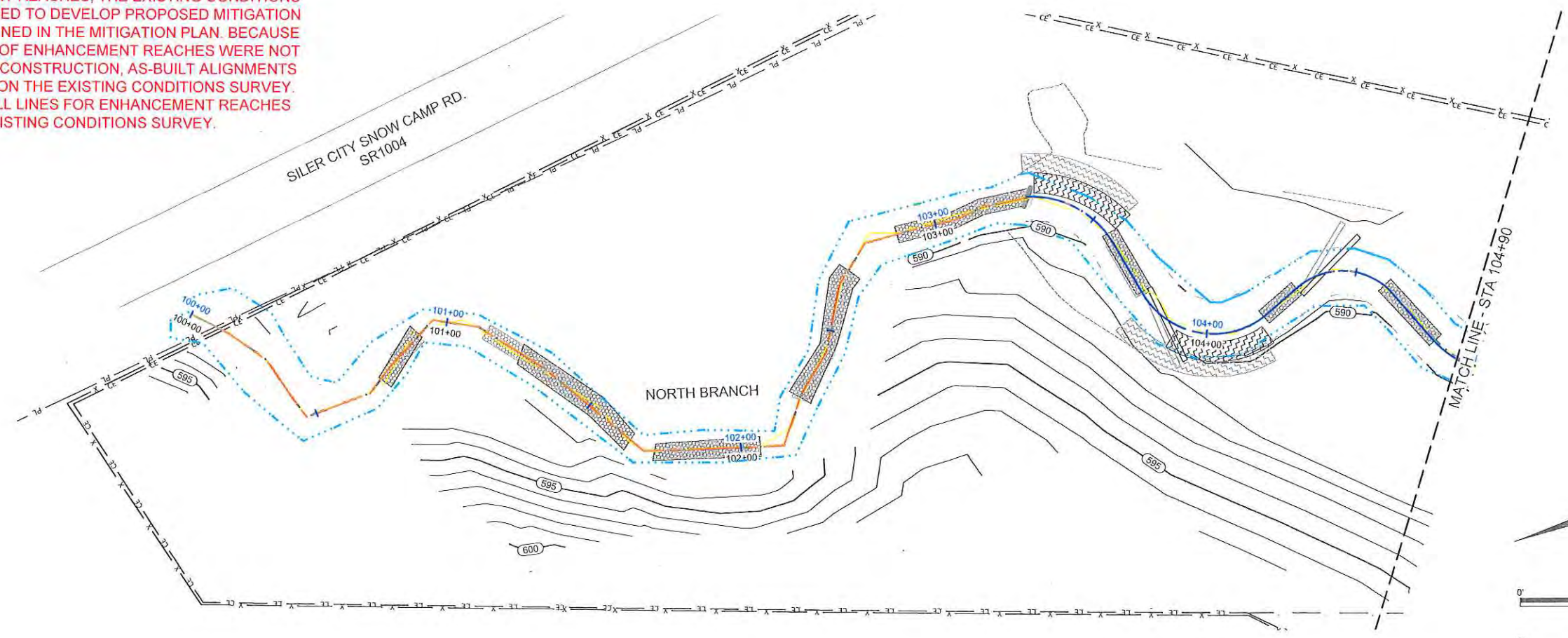


WILDLANDS
ENGINEERING
812 W. Millbrook Road, Ste 225
Waynesville, NC 27586
Tel: 919.951.9896
Firm License No. F-0831

Date: 06/12/2018
 Job Number: 005-0212
 Project Engineer: ANA
 Drawn By: CLM
 Checked By: JNK
 File Path: \\P:\Projects\005-0212\Mud Lick Creek\CD\Plan\03-Stream Overlay Plans.dwg



- NOTES:**
- FOR ENHANCEMENT REACHES, THE EXISTING CONDITIONS THALWEG WAS USED TO DEVELOP PROPOSED MITIGATION CREDITS AS OUTLINED IN THE MITIGATION PLAN. BECAUSE THE ALIGNMENTS OF ENHANCEMENT REACHES WERE NOT ALTERED DURING CONSTRUCTION, AS-BUILT ALIGNMENTS ARE ALSO BASED ON THE EXISTING CONDITIONS SURVEY.
 - AS-BUILT BANKFULL LINES FOR ENHANCEMENT REACHES ARE BASED ON EXISTING CONDITIONS SURVEY.



Record Drawing

Date:	06/12/2018
Job Number:	005-0212
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

1.1

Sheet

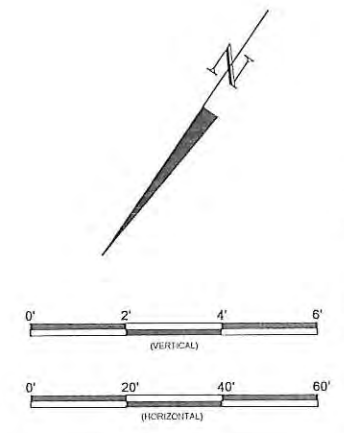
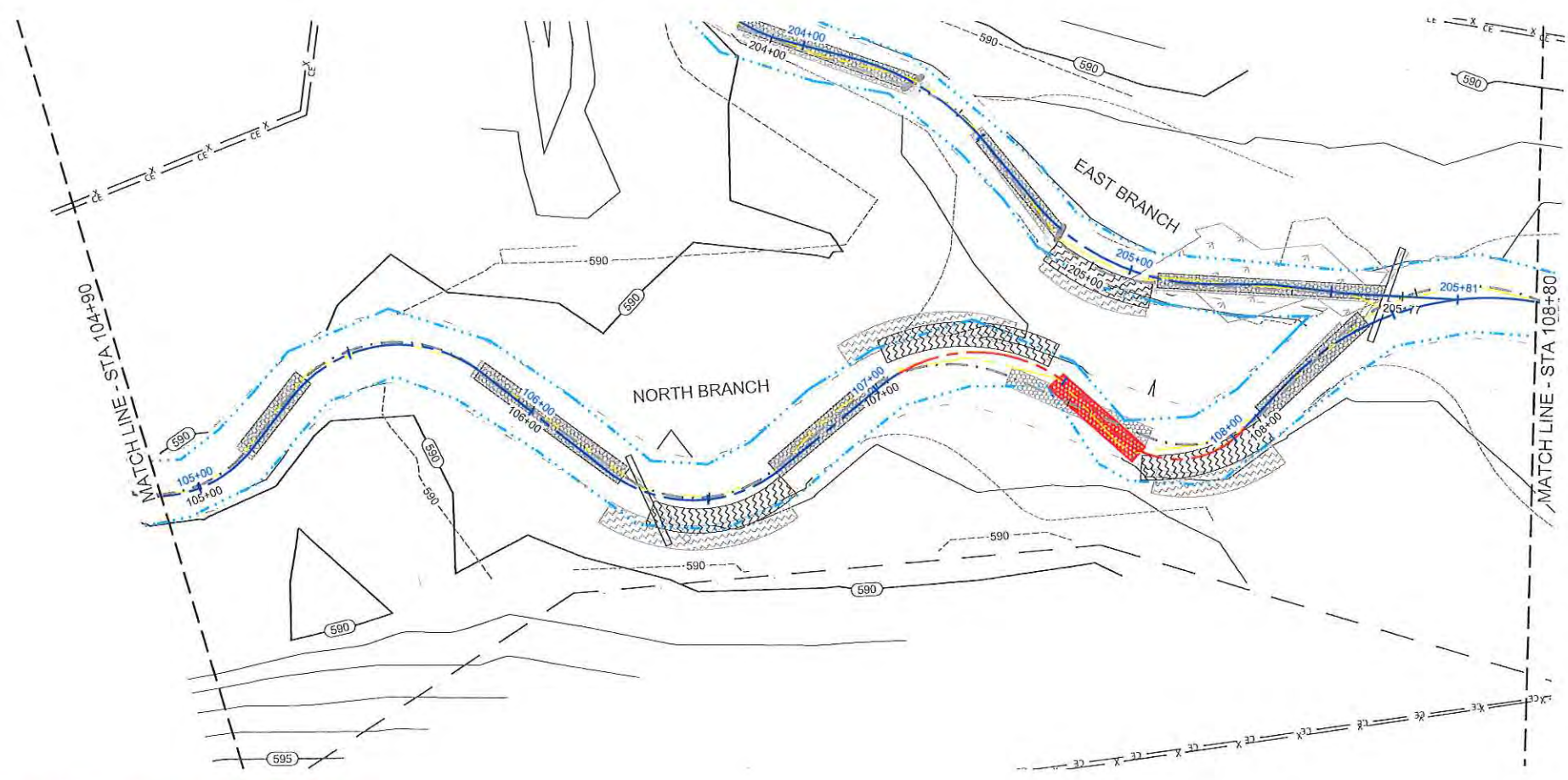
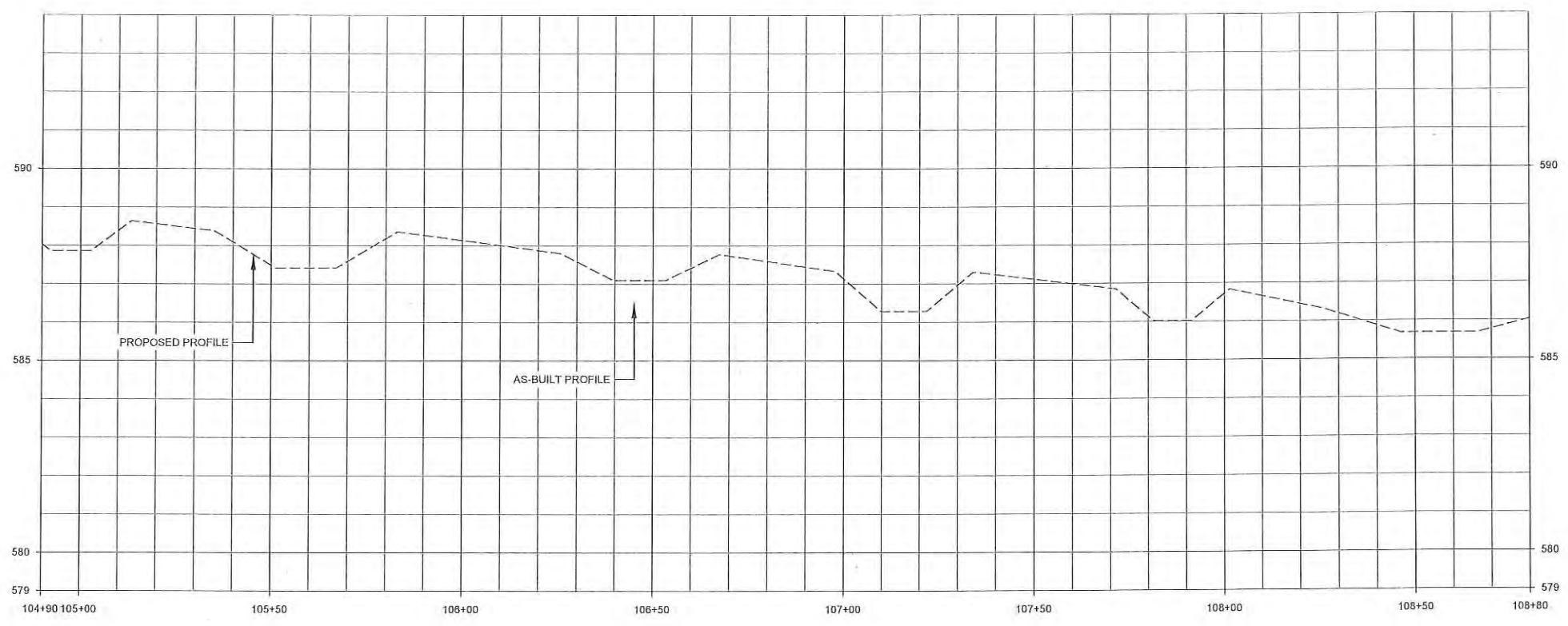
Mud Lick Creek Mitigation Site
 Chatham County, North Carolina
 North Branch Reach 1
 Stream Overlay Plans



WILDLANDS
 ENGINEERING
 312 W. Millbrook Road, Ste 225
 Raleigh, NC 27609
 Tel: 919.851.9955
 Firm License No. F-0831

June 17, 2018

F:\Projects\001670114_Mud_Lick_Creek\Civil\Plan\01670114-AS-Stream Overlay Plans.dwg



NOTE: FROM NORTH BRANCH STA. 107+55 TO STA. 107+86, PROPOSED STREAM ALIGNMENT REALIGNED IN ORDER TO AVOID EXISTING BEDROCK.

Record Drawing

Date:	06/12/2018
Job Number:	008-02112
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNS

1.2

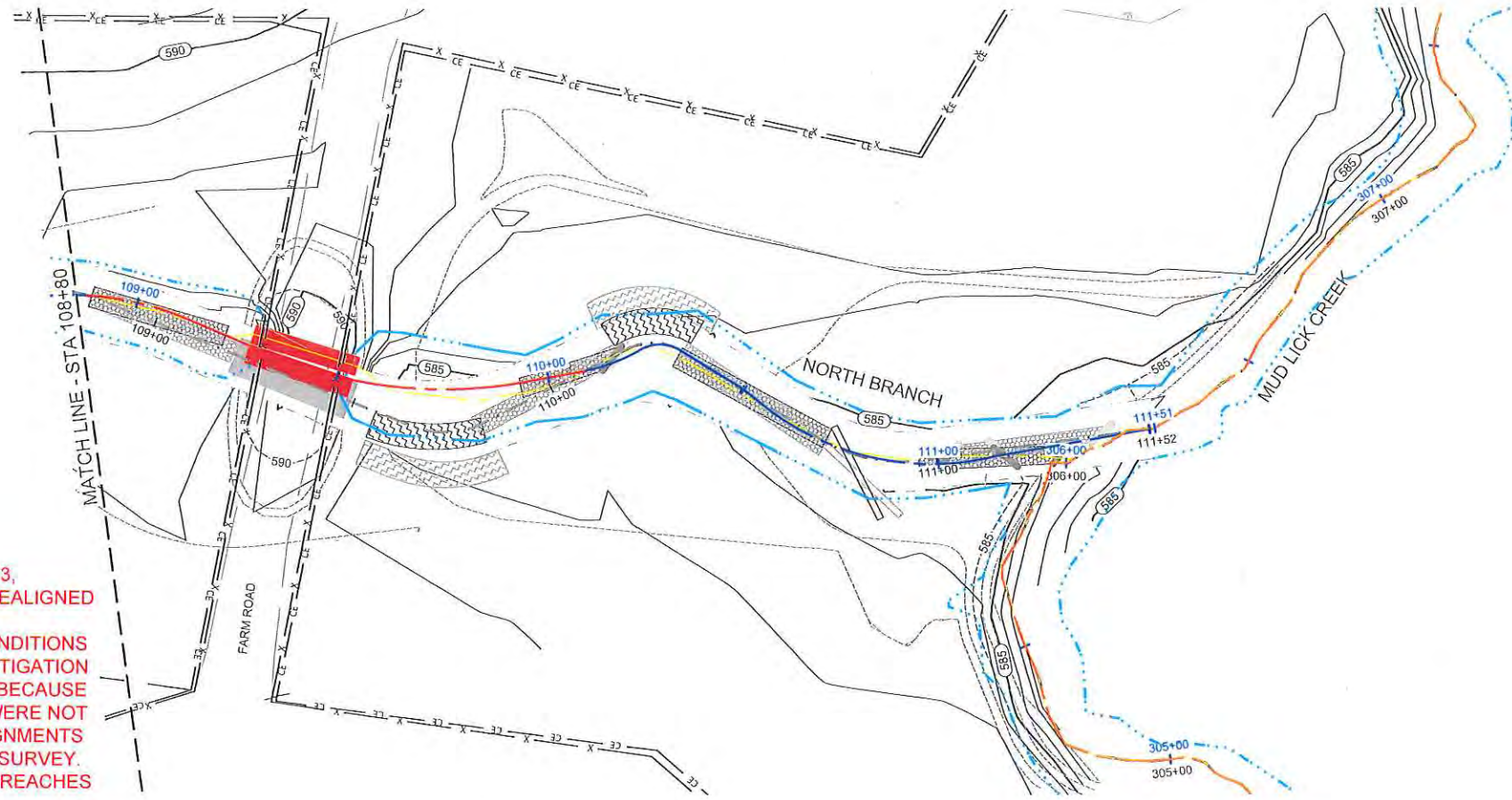
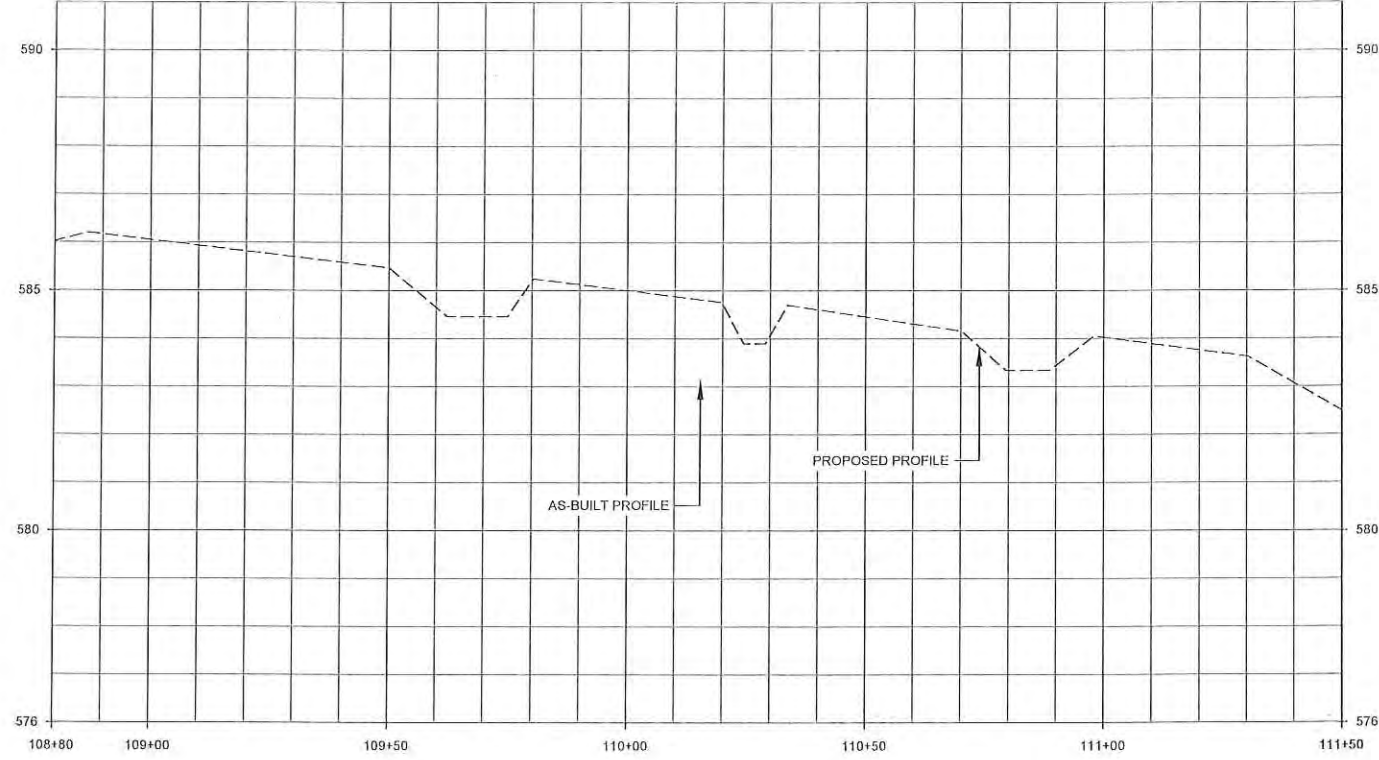
Sheet

Mud Lick Creek Mitigation Site
Chatham County, North Carolina
North Branch Reaches 1 & 2
Stream Overlay Plans

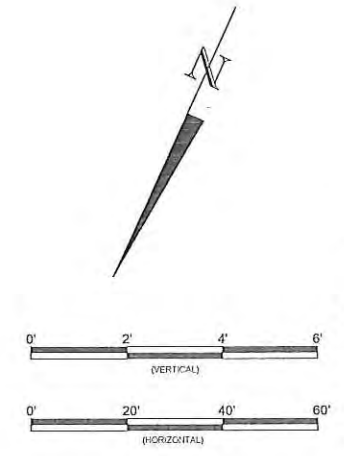


WILDLANDS
ENGINEERING
312 W. Millbrook Road, Ste 215
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831

File Path: \\s0112102\Mud Lick_Creek\CD\Plan\As-Built\Record_Drawing\02142_2A1B_Stream_Overlay_Plan.dwg
 Date: 06/12/2018 09:42:02



- NOTES:**
1. FROM NORTH BRANCH STA. 108+82 TO STA. 110+03, PROPOSED STREAM ALIGNMENT AND CULVERT REALIGNED IN ORDER TO AVOID EXISTING BEDROCK.
 2. FOR ENHANCEMENT REACHES, THE EXISTING CONDITIONS THALWEG WAS USED TO DEVELOP PROPOSED MITIGATION CREDITS AS OUTLINED IN THE MITIGATION PLAN. BECAUSE THE ALIGNMENTS OF ENHANCEMENT REACHES WERE NOT ALTERED DURING CONSTRUCTION, AS-BUILT ALIGNMENTS ARE ALSO BASED ON THE EXISTING CONDITIONS SURVEY.
 3. AS-BUILT BANKFULL LINES FOR ENHANCEMENT II REACHES ARE BASED ON EXISTING CONDITIONS SURVEY.



Record Drawing

Date:	06/12/2018
Job Number:	098-0262
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

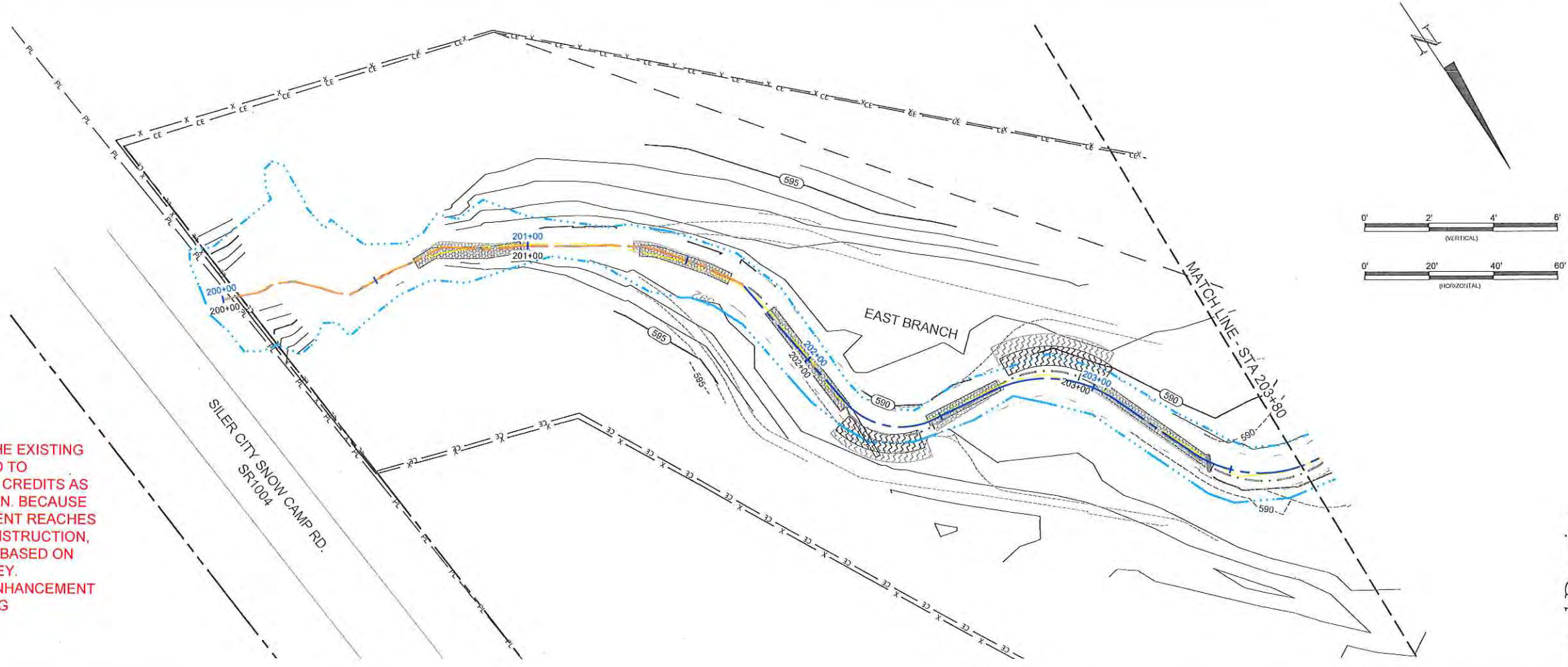
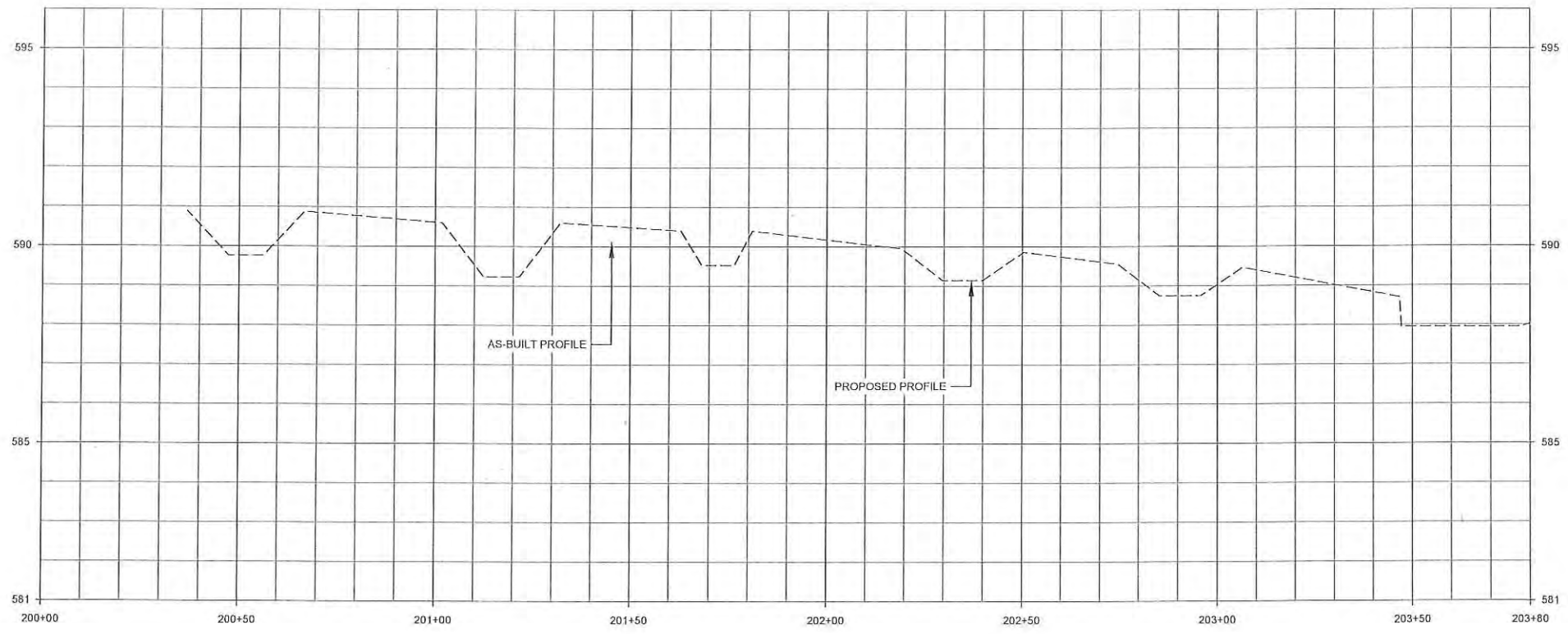
1.3

Sheet

Mud Lick Creek Mitigation Site
 Chatham County, North Carolina
 North Branch Reach 2
 Stream Overlay Plans



WILDLANDS
 ENGINEERING
 312 W. Millbrook Road, Ste 225
 Raleigh, NC 27609
 Tel: 919.851.9986
 Firm License No. F-0831



- NOTES:**
- FOR ENHANCEMENT REACHES, THE EXISTING CONDITIONS THALWEG WAS USED TO DEVELOP PROPOSED MITIGATION CREDITS AS OUTLINED IN THE MITIGATION PLAN. BECAUSE THE ALIGNMENTS OF ENHANCEMENT REACHES WERE NOT ALTERED DURING CONSTRUCTION, AS-BUILT ALIGNMENTS ARE ALSO BASED ON THE EXISTING CONDITIONS SURVEY.
 - AS-BUILT BANKFULL LINES FOR ENHANCEMENT REACHES ARE BASED ON EXISTING CONDITIONS SURVEY.

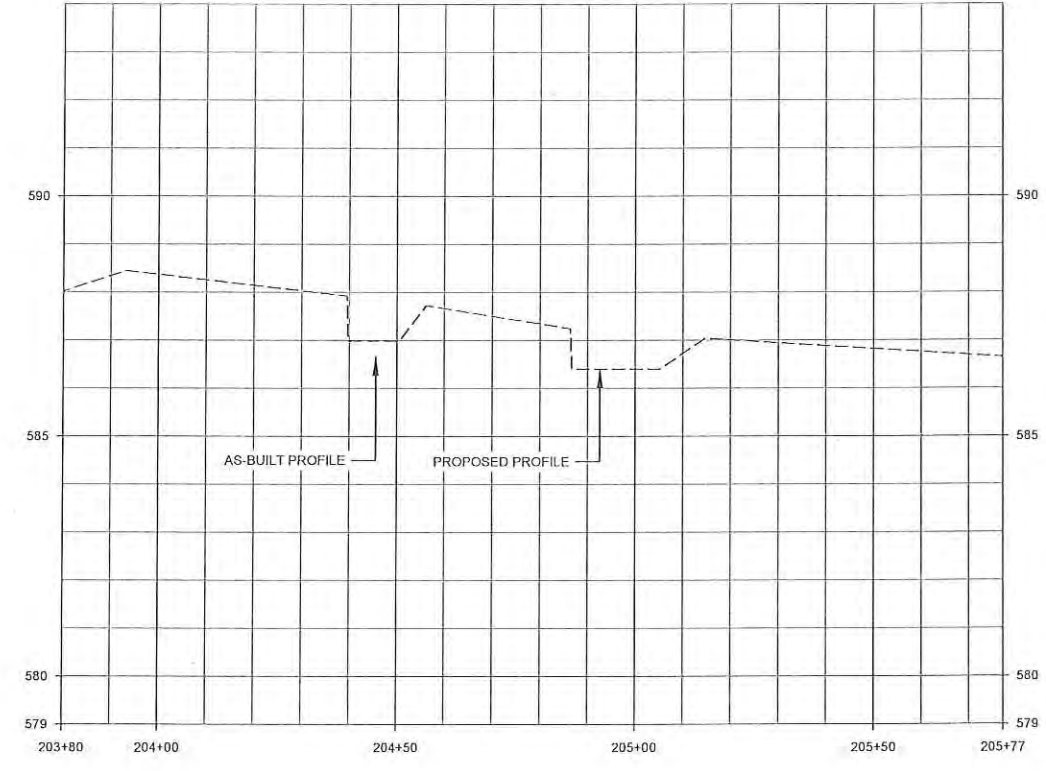
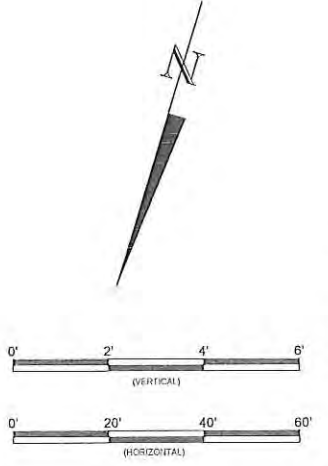
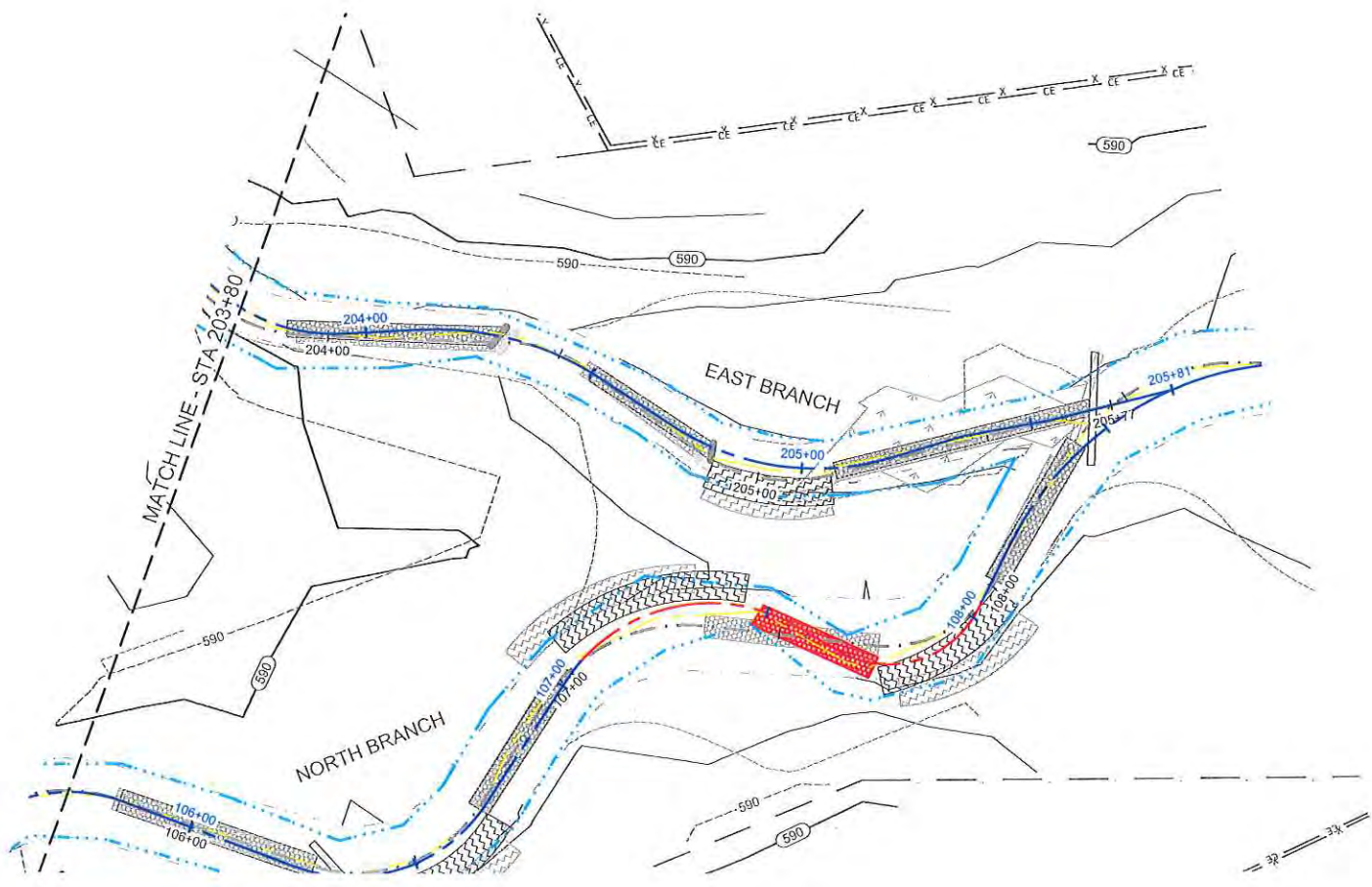


Mud Lick Creek Mitigation Site
Chatham County, North Carolina
East Branch
Stream Overlay Plans

Record Drawing

Date:	06.12.2018
Job Number:	051612142
Project Engineer:	ANJ
Drawn By:	CLM
Checked By:	JNK

Revisions: Beneficial symbology on this East Branch enhancement reach was revised to be more consistent with other reaches.



Record Drawing

Date:	06/12/2018
Job Number:	005-0212
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

1.5

Sheet

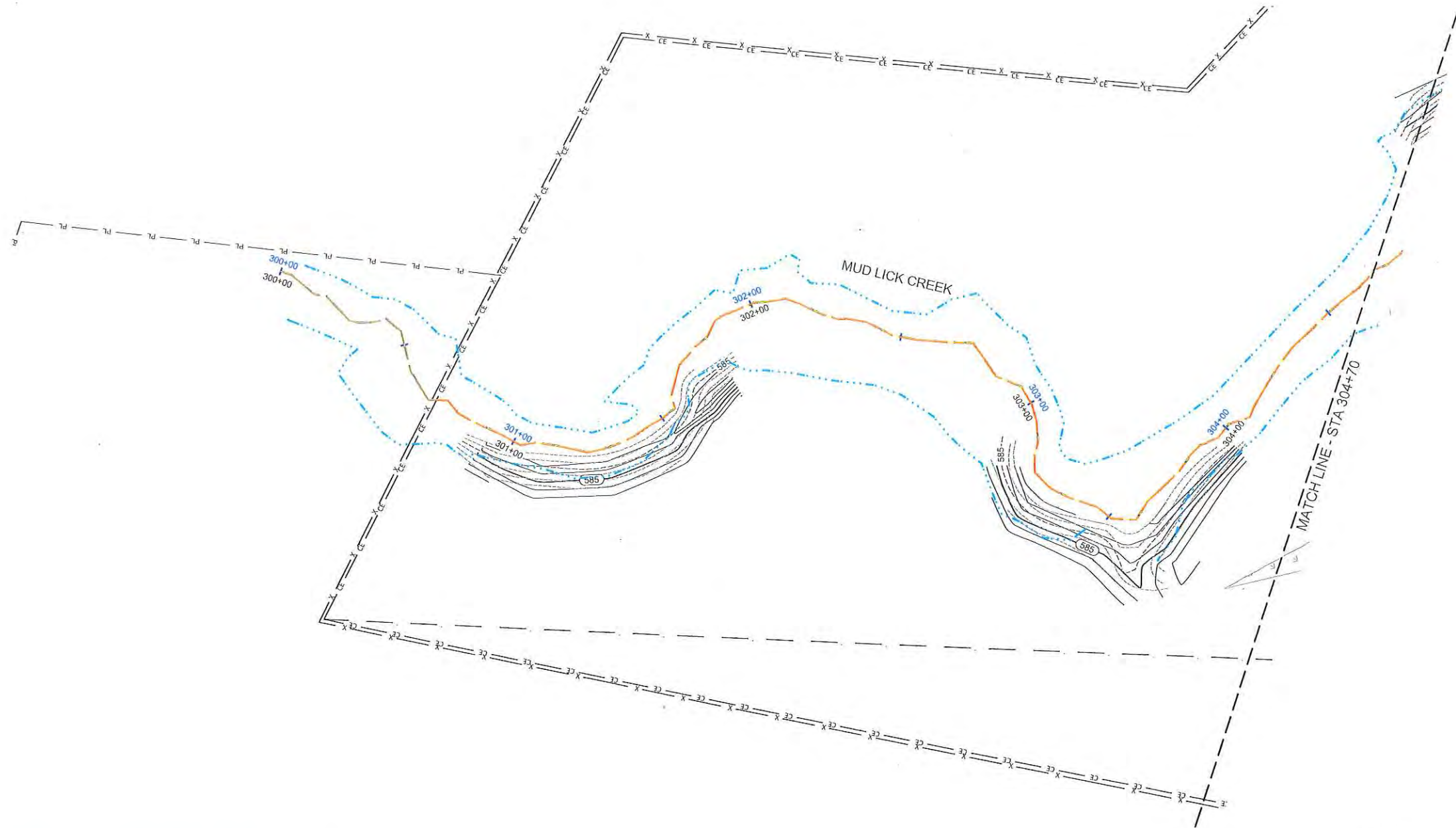
Mud Lick Creek Mitigation Site
 Chatham County, North Carolina

East Branch
 Stream Overlay Plans

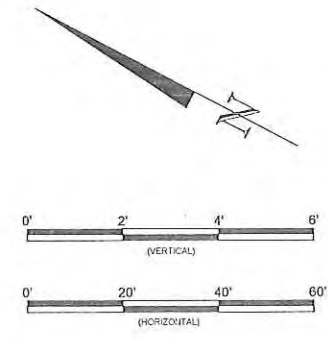


WILDLANDS
 ENGINEERING
 312 W. Millbrook Road, Ste. 225
 Raleigh, NC 27609
 Tel: 919.851.9986
 Firm License No. F-0831

I:\Projects\051212 Mud Lick Creek\CAD\Plan\051212_01_Stream Overlay Plans.dwg



- NOTES:**
- FOR ENHANCEMENT REACHES, THE EXISTING CONDITIONS THALWEG WAS USED TO DEVELOP PROPOSED MITIGATION CREDITS AS OUTLINED IN THE MITIGATION PLAN. BECAUSE THE ALIGNMENTS OF ENHANCEMENT REACHES WERE NOT ALTERED DURING CONSTRUCTION, AS-BUILT ALIGNMENTS ARE ALSO BASED ON THE EXISTING CONDITIONS SURVEY.
 - AS-BUILT BANKFULL LINES FOR ENHANCEMENT REACHES ARE BASED ON EXISTING CONDITIONS SURVEY.



Record Drawing

Date:	06/12/2018
Job Number:	091-02142
Project Engineer:	ANL
Drawn By:	CLM
Checked By:	JNK

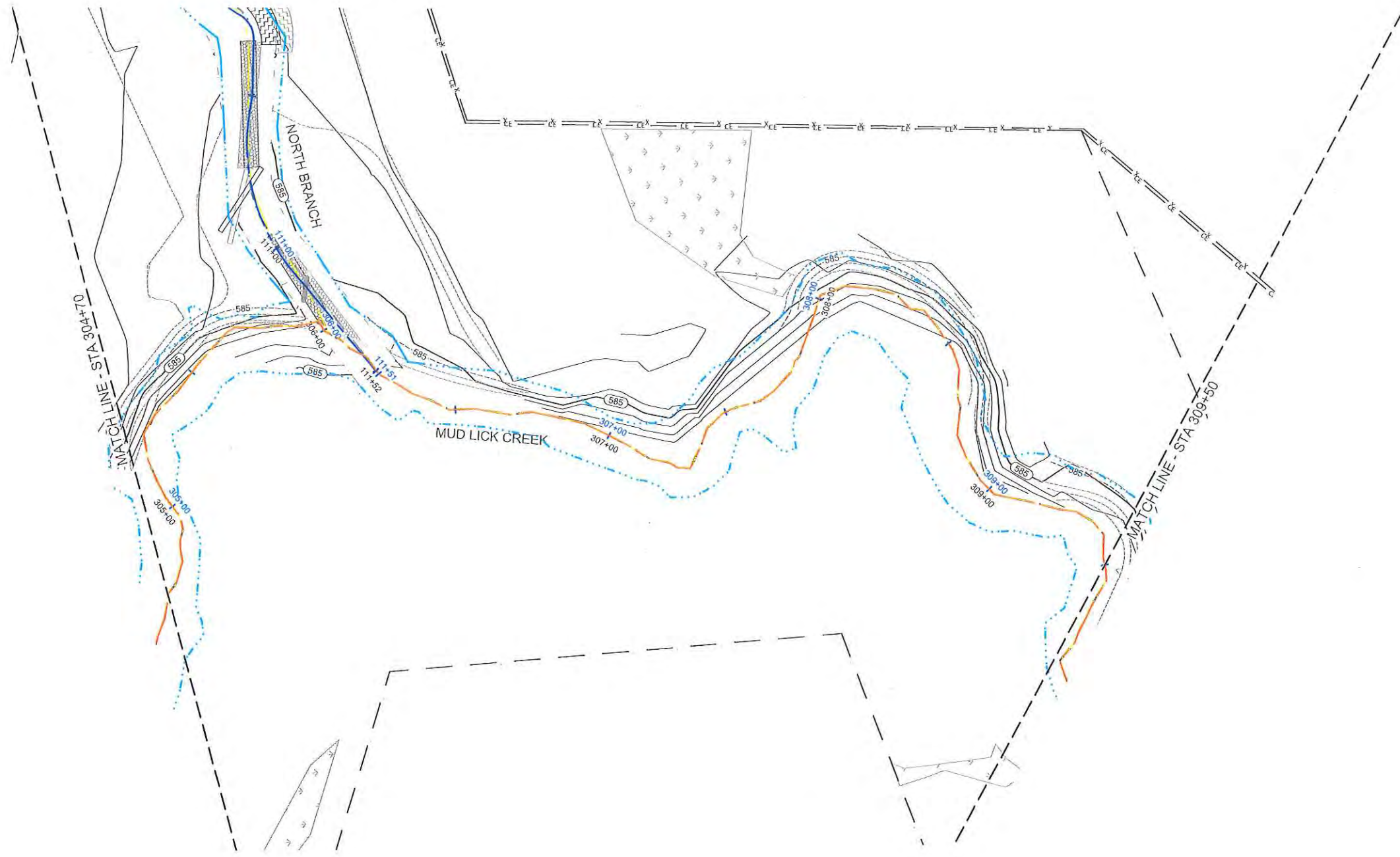
1.6

Sheet

Mud Lick Creek Mitigation Site
 Chatham County, North Carolina
 Mud Lick Creek Reach 1
 Stream Overlay Plans

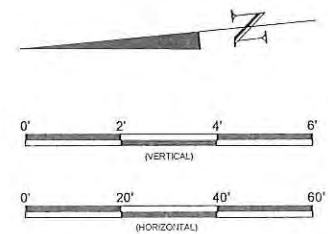


WILDLANDS
 ENGINEERING
 312 W. Millbrook Road, Ste 225
 Raleigh, NC 27608
 Tel: 919.851.9886
 Firm License No. F-0831



NOTES:

1. FOR ENHANCEMENT REACHES, THE EXISTING CONDITIONS THALWEG WAS USED TO DEVELOP PROPOSED MITIGATION CREDITS AS OUTLINED IN THE MITIGATION PLAN. BECAUSE THE ALIGNMENTS OF ENHANCEMENT REACHES WERE NOT ALTERED DURING CONSTRUCTION, AS-BUILT ALIGNMENTS ARE ALSO BASED ON THE EXISTING CONDITIONS SURVEY.
2. AS-BUILT BANKFULL LINES FOR ENHANCEMENT REACHES ARE BASED ON EXISTING CONDITIONS SURVEY.



Record Drawing

Date:	06.12.2018
Job Number:	095-02142
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

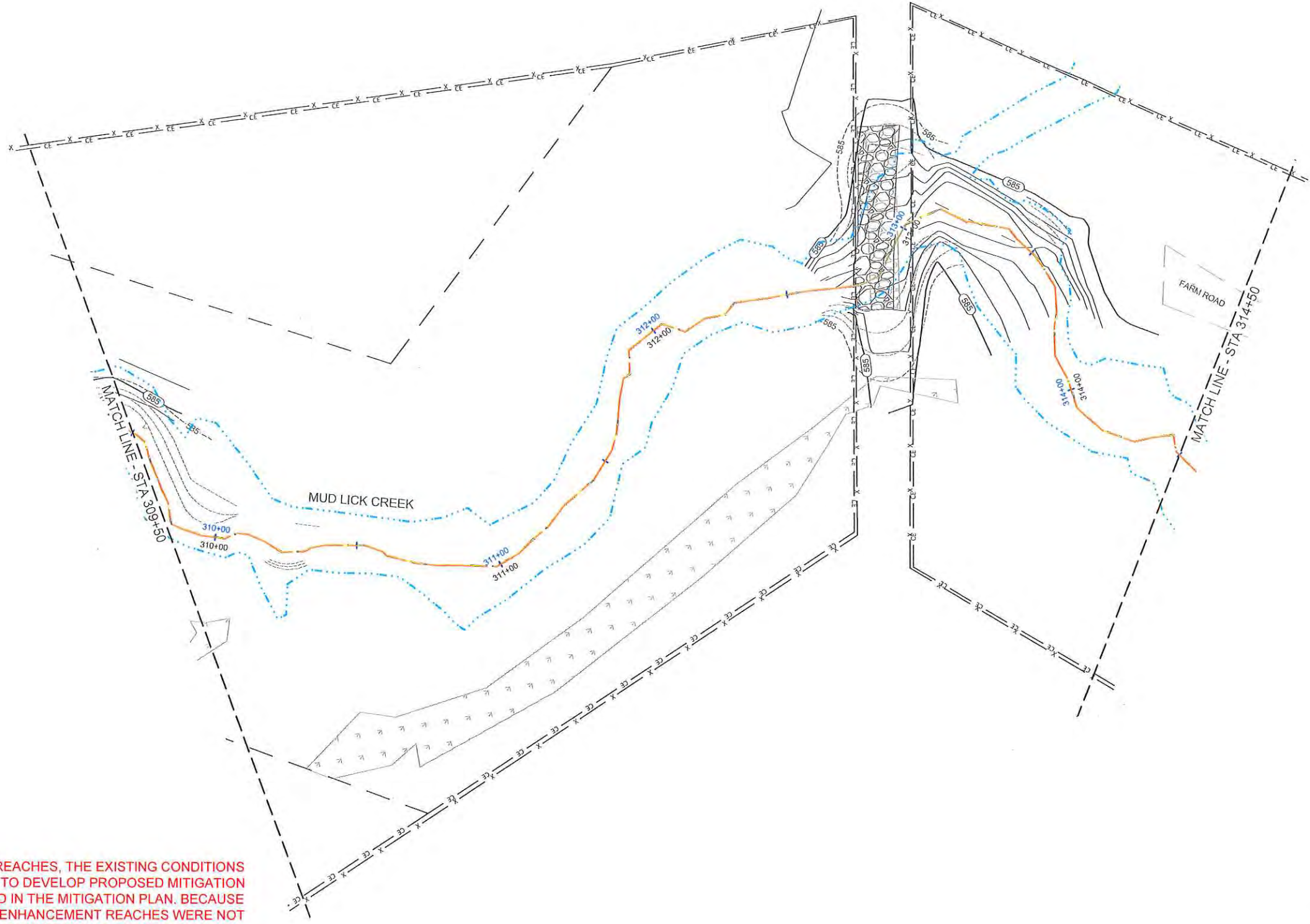
1.7

Sheet

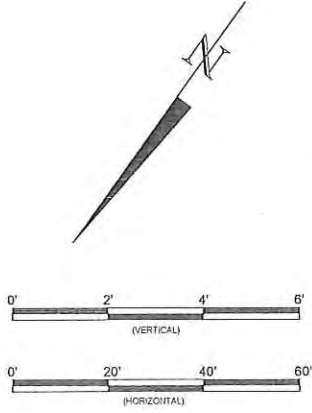
Mud Lick Creek Mitigation Site
 Chatham County, North Carolina
 Mud Lick Creek Reaches 1 & 2
 Stream Overlay Plans



WILDLANDS
 ENGINEERING
 312 W. Millbrook Road, Ste 225
 Raleigh, NC 27609
 Tel: 919.851.5500
 Firm License No. P-0831



- NOTES:**
1. FOR ENHANCEMENT REACHES, THE EXISTING CONDITIONS THALWEG WAS USED TO DEVELOP PROPOSED MITIGATION CREDITS AS OUTLINED IN THE MITIGATION PLAN. BECAUSE THE ALIGNMENTS OF ENHANCEMENT REACHES WERE NOT ALTERED DURING CONSTRUCTION, AS-BUILT ALIGNMENTS ARE ALSO BASED ON THE EXISTING CONDITIONS SURVEY.
 2. AS-BUILT BANKFULL LINES FOR ENHANCEMENT REACHES ARE BASED ON EXISTING CONDITIONS SURVEY.



Record Drawing

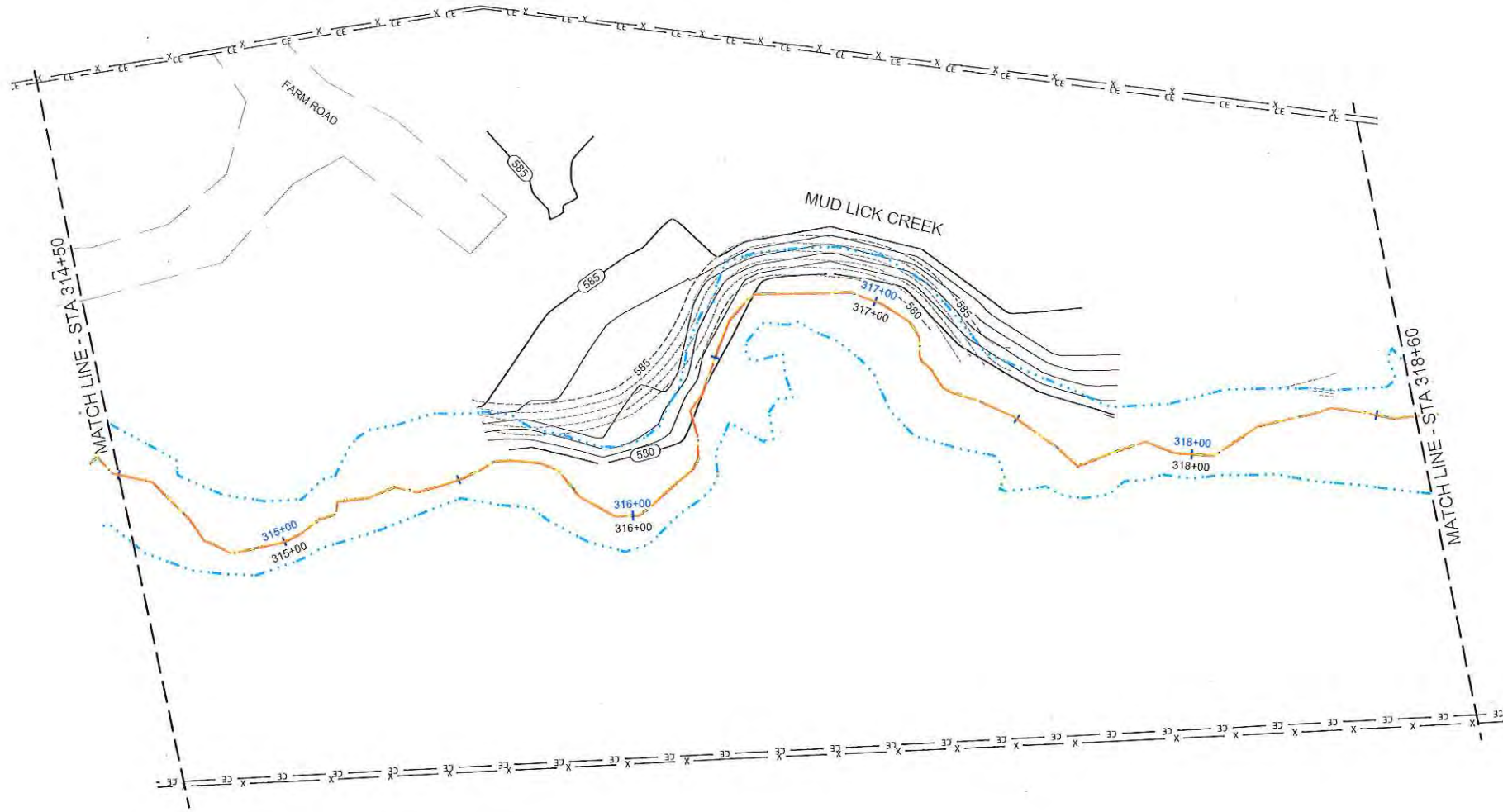
Date:	06.12.2018
Job Number:	09162143
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

1.8

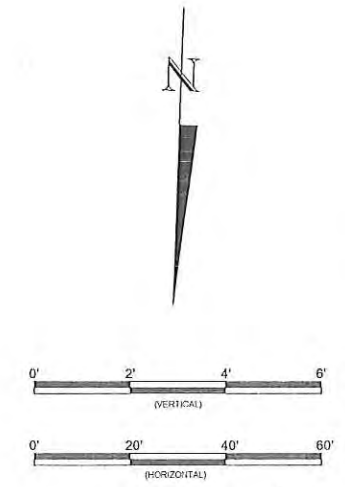
Sheet

Mud Lick Creek Mitigation Site
 Chatham County, North Carolina
 Mud Lick Creek Reaches 2 & 3
 Stream Overlay Plans





- NOTES:**
1. FOR ENHANCEMENT REACHES, THE EXISTING CONDITIONS THALWEG WAS USED TO DEVELOP PROPOSED MITIGATION CREDITS AS OUTLINED IN THE MITIGATION PLAN. BECAUSE THE ALIGNMENTS OF ENHANCEMENT REACHES WERE NOT ALTERED DURING CONSTRUCTION, AS-BUILT ALIGNMENTS ARE ALSO BASED ON THE EXISTING CONDITIONS SURVEY.
 2. AS-BUILT BANKFULL LINES FOR ENHANCEMENT REACHES ARE BASED ON EXISTING CONDITIONS SURVEY.



Record Drawing

Date:	06/12/2018
Job Number:	095-02142
Project Engineer:	ANA
Drawn By:	CLAN
Checked By:	JNK
Revisions:	

1.9

Sheet

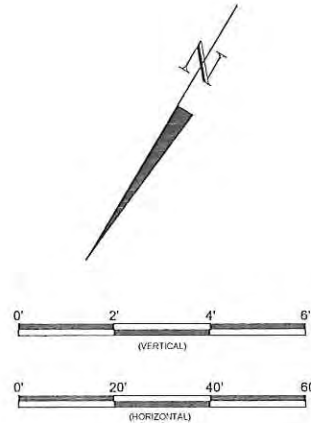
Mud Lick Creek Mitigation Site
 Chatham County, North Carolina
 Mud Lick Creek Reach 3
 Stream Overlay Plans





NOTES:

1. FOR ENHANCEMENT REACHES, THE EXISTING CONDITIONS THALWEG WAS USED TO DEVELOP PROPOSED MITIGATION CREDITS AS OUTLINED IN THE MITIGATION PLAN. BECAUSE THE ALIGNMENTS OF ENHANCEMENT REACHES WERE NOT ALTERED DURING CONSTRUCTION, AS-BUILT ALIGNMENTS ARE ALSO BASED ON THE EXISTING CONDITIONS SURVEY.
2. AS-BUILT BANKFULL LINES FOR ENHANCEMENT REACHES ARE BASED ON EXISTING CONDITIONS SURVEY.



Record Drawing

Revisions:

Date: 06/12/2018
 DSS Number: 085/0212
 Project Engineer: ANS
 Drawn By: CLR
 Checked By: JNK

1.10

Sheet

Mud Lick Creek Mitigation Site
 Chatham County, North Carolina
 Mud Lick Creek Reach 3
 Stream Overlay Plans



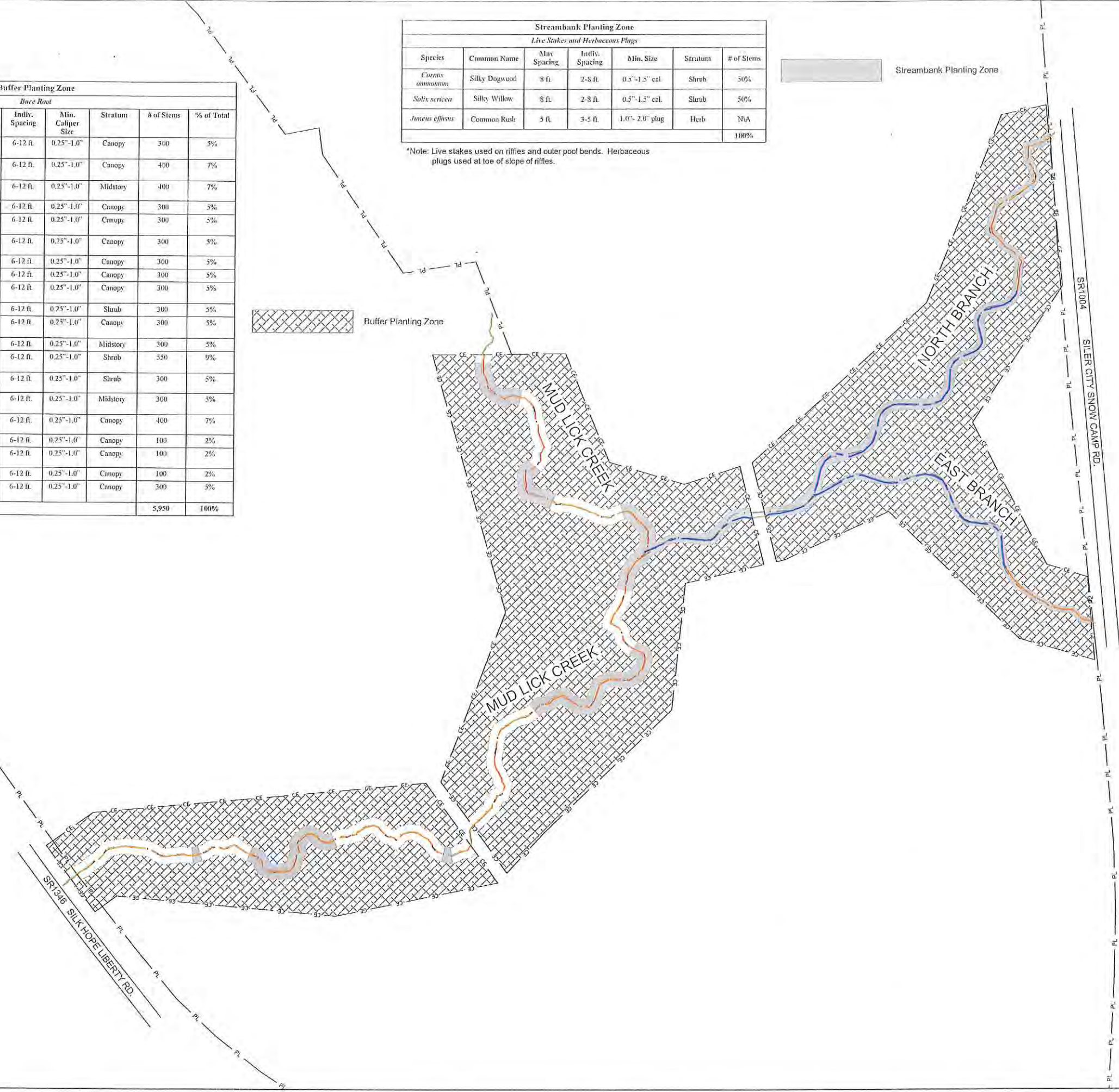
WILDLANDS
 ENGINEERING
 312 W. Millbrook Road, Ste. 225
 Raleigh, NC 27609
 Tel: 919.851.9986
 Firm License No. F-0831

Buffer Planting Zone							
Bare Root							
Species	Common Name	Max Spacing	Indiv. Spacing	Min. Caliper Size	Stratum	# of Stems	% of Total
<i>Fraxinus pennsylvanica</i>	Green Ash	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	300	5%
<i>Platanus occidentalis</i>	Sycamore	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	400	7%
<i>Cercis canadensis</i>	Redbud	12 ft.	6-12 ft.	0.25"-1.0"	Midstory	400	7%
<i>Populus deltoides</i>	Cottonwood	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	300	5%
<i>Betula nigra</i>	River Birch	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	300	5%
<i>Celtis occidentalis</i>	Hackberry	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	300	5%
<i>Nyssa sylvatica</i>	Black Gum	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	300	5%
<i>Ulmus americana</i>	American Elm	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	300	5%
<i>Ostrya virginiana</i>	Eastern Hophornbeam	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	300	5%
<i>Sambucus spp.</i>	Elderberry	12 ft.	6-12 ft.	0.25"-1.0"	Shrub	300	5%
<i>Robinia pseudoacacia</i>	Black Locust	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	300	5%
<i>Cornus amomum</i>	Silky Dogwood	12 ft.	6-12 ft.	0.25"-1.0"	Midstory	300	5%
<i>Hamamelis virginiana</i>	Witch hazel	12 ft.	6-12 ft.	0.25"-1.0"	Shrub	550	9%
<i>Cephalanthus occidentalis</i>	Buttonbush	12 ft.	6-12 ft.	0.25"-1.0"	Shrub	300	5%
<i>Diospyros virginiana</i>	Persimmon	12 ft.	6-12 ft.	0.25"-1.0"	Midstory	300	5%
<i>Carpinus caroliniana</i>	Ironwood	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	400	7%
<i>Nyssa biflora</i>	Swamp Tupelo	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	100	2%
<i>Quercus michauxii</i>	Swamp Chestnut Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	100	2%
<i>Quercus nigra</i>	Water Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	100	2%
<i>Liriodendron tulipifera</i>	Tulip Poplar	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	300	5%
						5,950	100%

*Area for bare root planting = 9.6 acres

Streambank Planting Zone						
Live Stakes and Herbaceous Plugs						
Species	Common Name	Max Spacing	Indiv. Spacing	Min. Size	Stratum	# of Stems
<i>Cornus amomum</i>	Silky Dogwood	8 ft.	2-8 ft.	0.5"-1.5" cal.	Shrub	50%
<i>Salix sericea</i>	Silky Willow	8 ft.	2-8 ft.	0.5"-1.5" cal.	Shrub	50%
<i>Juncus effusus</i>	Common Rush	5 ft.	3-5 ft.	1.0"- 2.0" plug	Herb	MA
						100%

*Note: Live stakes used on riffles and outer pool bends. Herbaceous plugs used at toe of slope of riffles.



WILD LANDS
ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27602
Tel: 919.876.8888
Firm License No. F-6981



Mud Lick Creek Mitigation Site
Chatham County, North Carolina

Planting Plan

Revisions: Buffer planting species list was revised to reflect as-built conditions.

Date: 06.12.2018
Job Number: 005-02112
Project Engineer: ANA
Drawn By: CLM
Checked By: JSK

2.1

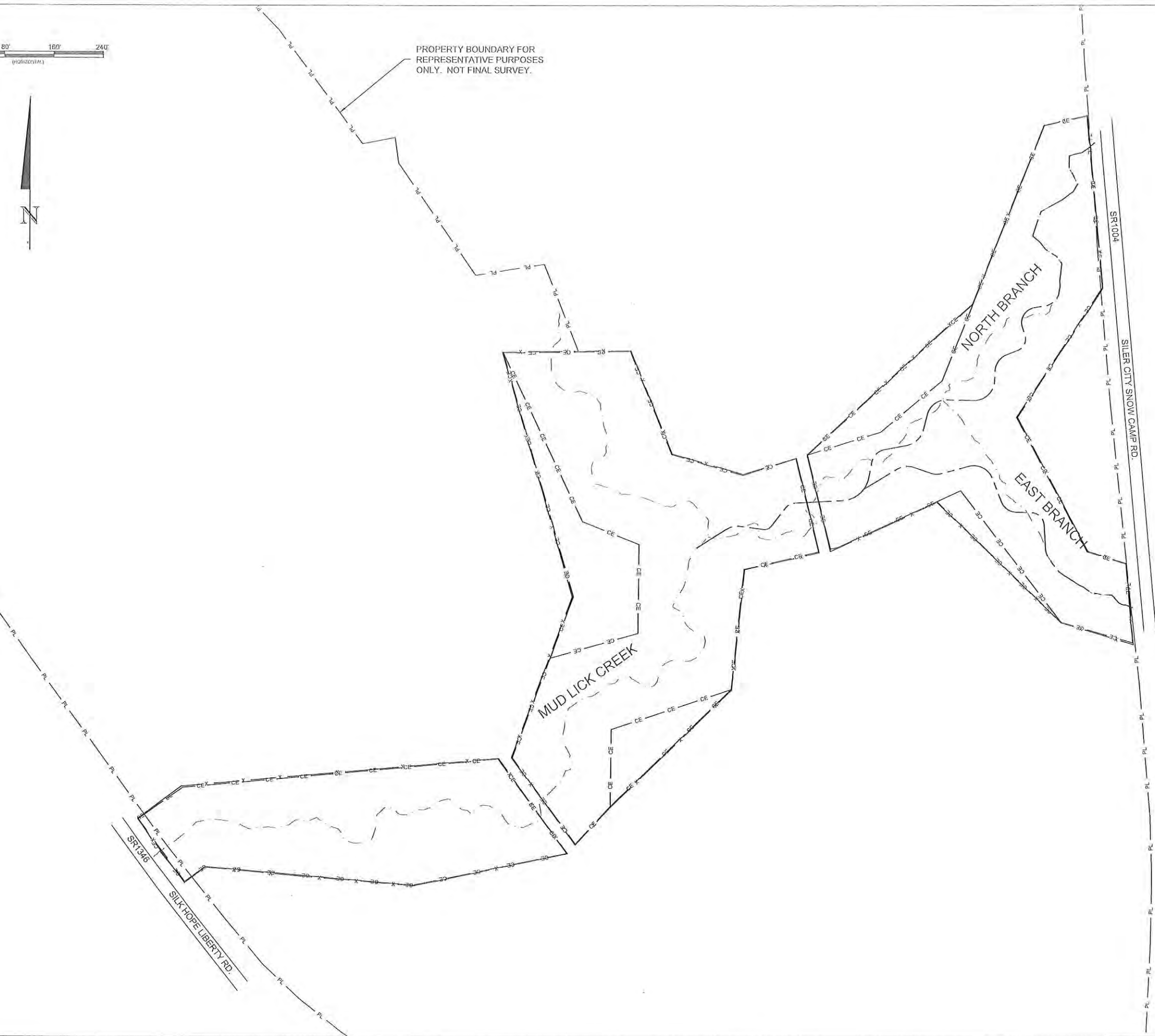
Record Drawing

FP:\pfiles\00512112\Mud Lick Creek\CM\Plan\03\Plan\Record Drawing\0212_1B_Fencing Plan.dwg

June 13, 2018



PROPERTY BOUNDARY FOR REPRESENTATIVE PURPOSES ONLY. NOT FINAL SURVEY.



Record Drawing

Date:	06/12/2018
Job Number:	095-02112
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNS

3.1

Sheet

Mud Lick Creek Mitigation Site
Chatham County, North Carolina

Fencing Plan



6-12-18

WILDLANDS
ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27606
Tel: 919.877.9988
Firm License No. F-08831