



MONITORING YEAR 1 ANNUAL REPORT

Final

Mangum Homestead Mitigation Site

Orange County, NC
NCDEQ Contract No. 7859
DMS ID No. 100107
DWR No. 2019-0645

Jordan Lake-Upper New Hope
Cape Fear River Basin
HUC 03030002

RFP #: 16-007702

Data Collection Period: September - October 2020
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PREPARED FOR:



**NC Department of Environmental Quality,
Division of Mitigation Services**
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Mangum Homestead Mitigation Site
Monitoring Year 1 Annual Report

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Section 1: PROJECT OVERVIEW

1.1 Project Description

The Mangum Homestead Mitigation Site (Site) is located in Orange County approximately three miles northwest of the Town of Carrboro (Figure 1). The Site involved riparian area restoration, enhancement, and preservation on four unnamed tributaries and three ephemeral channels that flow to New Hope Creek upstream of Jordan Lake. The Site was completed for buffer mitigation credit and nutrient offset credit in the Cape Fear River Basin HUC 03030002, Upper New Hope Watershed of Jordan Lake in accordance with the Consolidated Buffer Mitigation Rules (15A NCAC 02B .0295), the Jordan Water Supply Nutrient Strategy (15A NCAC 02B .0262) and the Nutrient Offset Payments Rule (15A NCAC 02B .0240). See Figure 2 for the Service Area of the Site. The Site is expected to generate 36,933.600 riparian buffer credits, 19,985.729 Nitrogen offset credits, and 1,259.783 Phosphorous Offset credits.

The project is located within the Cape Fear River Basin Hydrologic Unit Code (HUC) 03030002060110, Upper New Hope – Jordan Lake Sub-watershed, and NCDWR Subbasin 03-06-05. Project streams flow approximately one mile to the confluence with New Hope Creek, which is classified as Nutrient Sensitive Waters (NSW) by the North Carolina Division of Water Resources (NCDWR). The project supports specific goals identified in the 2009 Cape Fear River Basin Restoration Priorities Plan (RBRP) by addressing nutrient reductions through buffer restoration and improving habitat for the native mussel species present in the HUC.

This nutrient offset and buffer restoration project is reducing sediment and nutrient loading and improving terrestrial habitat. The area surrounding the streams prior to restoration was primarily open agricultural fields used for hay production. The restored vegetative riparian areas up to 200 feet from the streams are removing sediment and fertilizer inputs within the project area. The full establishment of riparian areas will create shading to minimize thermal pollution. Finally, invasive vegetation will be treated within the project area as needed and the planted native vegetation provides cover and food for wildlife.

Tables 2 and 4 in Appendix 1 provide more detailed watershed and Site background information for this project.

1.2 Project Goals and Objectives

The major goals of the nutrient offset and buffer restoration project are to provide ecological and water quality enhancements to Jordan Lake in the Cape Fear River Basin by creating a functional riparian corridor and restoring the riparian area.



| Goals | Objectives |
|--|--|
| Decrease nutrient levels | Nutrient input will be decreased by filtering runoff from the agricultural fields through restored native buffer zones. The off-site nutrient input will also be absorbed on-site by dispersing flood flows through native vegetation. |
| Decrease sediment input | Sediment from off-site sources will be deposited on restored floodplain areas where native vegetation will slow overland flow velocities. |
| Reduce thermal pollution | Water temperature will decrease, and dissolved oxygen concentrations will increase with the establishment and maintenance of riparian areas creating additional long-term shading of the channel flow. |
| Reduce peak flows | Establishment of a riparian area that will slow flood flows and allows for greater infiltration, reducing peak flows downstream. |
| Create appropriate terrestrial habitat | Buffer areas will be restored by removing invasive vegetation and planting native vegetation. |
| Permanently protect the Site from harmful uses | Establish a conservation easement on the Site. |

1.3 Project History

On July 19, 2019, NCDWR conducted on-site determinations to review features and land use within the project boundary. The resulting NCDWR site viability letter and map confirming the Site as suitable for riparian buffer mitigation is located in Appendix 1. NCDWR also approved the seven project reaches as appropriate for buffer mitigation as related to the rules set forth in the Jordan Riparian Area Protection Rules (15A NCAC 02B .0267). The on-site determination approval letter from NCDWR is also included in Appendix 1.

The final mitigation plan was submitted and accepted by the NC Department of Mitigation Services (NCDMS) in January 2020. Planting activities were completed by Bruton Natural Systems, Inc. in April 2020. The baseline monitoring and as-built survey were completed in June 2020. There were no significant deviations reported in the project elements in comparison to the design plans. Tables 2 and 3 in Appendix 1 provide more detailed project activity, history, and contact information for this project.

1.4 Project Location

The Site is located (Center of project 35.59795 N and -79.87855 W) in Orange County, NC approximately three miles northwest of the Town of Carrboro within the Cape Fear River Basin (HUC 03030002) and the NCDWR Sub-basin 03-06-05. Directions to the project are as follows: Traveling west on I-40W from Raleigh, take exit 263 (28.7 miles). Turn left onto New Hope Church Road. Continue onto Arthur Minnis Road (2.1 miles). The site will be on the right (Foggy Bottom Lane). Enter the Site via the gravel driveway. The property location is depicted on the Vicinity Map (Figure 1), which is located in Appendix 1.

1.5 Project Design

The Wildlands Team restored high quality riparian areas along several unnamed tributaries on the Site. The project design ensured that no adverse impacts to wetlands or existing riparian buffers occurred. Figure 3 illustrates buffer zones for the Site. General site and buffer overview photographs are included in Appendix 2.

1.5.1 Riparian Area Restoration Activities

Prior to planting, the buffer restoration area was used as agricultural fields., Disturbed areas were tilled with a chisel plow to reduce soil compaction. The Site's ephemeral channels were located fully within the conservation easement area and were completely buffered as part of the project; therefore, no land disturbance to maintain diffuse flow was required.

The revegetation plan for the buffer restoration area included permanent seeding in select areas and planting bare root trees. These revegetation efforts were coupled with the select treatment of invasive species to control their population. The specific species composition planted was selected based on the desired community type, observation of occurrence of species in riparian buffers adjacent to the Site, and best professional judgement on species establishment and anticipated site conditions in the early years following project implementation. The total number of tree species planted across the buffer areas were as follows: Schumard Oak (*Quercus shumardii*) 1800 stems, Willow Oak (*Quercus phellos*) 1100 stems, American Sycamore (*Platanus occidentalis*) 2800 stems, River Birch (*Betula nigra*) 2300 stems, American Persimmon (*Diospuros virginiana*) 1000 stems, Boxelder (*Acer negundo*) 660 stems, and Swamp Chestnut Oak (*Quercus michauxii*) 450 stems. Eastern Cottonwood (*Populus deltoides*) was originally planned for planting however scarcity of the tree led to substituting Swamp Chestnut Oak in its place. In total, 10,110 stems were planted across the restored areas of the site.

Trees were planted at a density sufficient to meet the performance standards outlined in the Rule 15A NCAC 02B .0295 of 260 trees per acre at the end of five years. No one tree species planted was greater than 50% of the established stems. An appropriate seed mix was applied as necessary to provide temporary ground cover for soil stabilization and reduction of sediment loss during rain events in disturbed areas. This was followed by an appropriate permanent seed mixture. Planting was completed on April 16, 2020. Ring sprays were implemented around all planted trees.

1.5.2 Riparian Area Enhancement Activities

The revegetation plan for the buffer enhancement areas under 15A NCAC 02B .0295(n) included planting supplemental bare root trees and controlling invasive species growth.

1.5.3 Riparian Area Preservation Activities

No work was done in the buffer preservation areas, as allowed under 15A NCAC 02B .0295(o). The preservation area is protected in perpetuity under a conservation easement.



Section 2: DETERMINATION OF CREDITS

In addition to buffer restoration and enhancement on subject streams, per the Consolidated Buffer Mitigation Rules (15A NCAC 02B 0.0295 (o)), alternative mitigation was completed on the Site in the form of buffer restoration on ephemeral channels and preservation of forested buffer on subject streams. The proposed project is in compliance with these rules in the following ways:

Buffer Restoration on Ephemeral Channels (15A NCAC 02B 0.0295(o)(7)):

- NCDWR performed an evaluation of the Site and identified the perennial, intermittent, and ephemeral channels on the property.
- The mitigation area on the Site's ephemeral channels is located completely within their drainage areas.
- The ephemeral channels are directly connected to intermittent or perennial stream channels and will be protected under the same contiguous easement boundary.
- The mitigation area on the ephemeral channels is less than 25% of the total buffer mitigation area on the Site (Table 1, Appendix 1).

Preservation on Subject Streams (15A NCAC 02B .0295 (o)(5):

- The buffer width is at least 30 feet from the stream.
- The area meets the requirements of 15A NCAC 02R 0.0403(c)(7), (8), and (11) with no known structures, infrastructure, hazardous substances, solid waste, or encumbrances within the mitigation boundary.
- Preservation mitigation is being requested on no more than 25% of the total buffer mitigation area (Table 1, Appendix 1).

Mitigation credits are presented in Table 1 and Figure 3 in Appendix 1 and are based upon the as-built survey included in the Mangum Homestead Baseline Monitoring Report (2020).

Section 3: PERFORMANCE CRITERIA AND MONITORING PROTOCOLS

The performance criteria for the Site follows approved performance criteria presented in the Mangum Homestead Mitigation Site Mitigation Plan (Wildlands Engineering, Inc., 2020), the NC DMS Riparian Buffer and Nutrient Offset Buffer Baseline & Annual Monitoring Report Template, Version 2.0 (May 2017) and the Consolidated Buffer Rule (15A NCAC 02B .0295).

The nutrient offset and buffer restoration project has been assigned specific performance criteria components for vegetation. Performance criteria will be evaluated throughout the five-year post-construction monitoring. The monitoring period will extend for five years beyond the completion of construction or until performance criteria have been met. An outline of the performance criteria and monitoring components are described below.

3.1 Annual Monitoring and Reporting

Annual monitoring and semi-annual site visits are being conducted to assess the condition of the project. The extent of invasive species coverage will also be monitored and treated as necessary throughout the required monitoring period (five years). Complete monitoring reports will be prepared in the fall of each monitoring year and submitted to DMS. Annual monitoring reports will be based on the above referenced DMS Template (May 2017).

3.2 Vegetation Success Criteria and Monitoring Protocol

The final vegetative success criteria will be the survival of 260 planted stems per acre in the riparian corridor at the end of the required monitoring period (Monitoring Year (MY) 5). The final performance standard shall include a minimum of four native hardwood tree species or four native hardwood tree and native shrub species, where no one species is greater than 50 percent of stems. Native hardwood and native shrub volunteer species may be included to meet the final performance standard of 260 stems per acre. Performance criteria will be evaluated throughout the five-year post-construction monitoring or until performance criteria have been met. Annual vegetation monitoring will follow the CVS-EEP Level 1 & 2 Protocol for Recording Vegetation (2008).

A total of thirteen (13) vegetation monitoring quadrants were established within the project easement area using 12 standard 10 meter by 10 meter vegetation monitoring plots and one 20 meter by 5 meter plot. Plots were randomly established within planted portions of the riparian buffer areas to capture the heterogeneity of the designed vegetative communities. The plot corners have been marked and are recoverable either through field identification or with the use of a GPS unit. Reference photographs of the vegetation plots will be taken annually from the origin looking diagonally across the plot to the opposite corner.

Vegetation plot locations are depicted on the Integrated Current Conditions Plan View (CCPV) Map (Figure 4) in Appendix 2. Photos depicting the current conditions of the vegetation plots for MY1 are also presented in Appendix 2.

3.3 Overview Photographs

Photographs will be taken of the project area once a year to visually document vegetation growth for five years following construction. A drone will be used to document the project's overall vegetative growth and ground cover. Overview photographs are shown in Appendix 2.

3.4 Visual Assessments

Visual assessments should support the specific performance standards for each metric as described



above. Visual assessments will continue to be performed within the Site on a semi-annual basis during the five-year monitoring period. Problem areas with vegetative health will be noted (e.g. low stem density, vegetation mortality, invasive species, and/or encroachment). Areas of concern will be mapped, photographed, and accompanied by a written description in the annual monitoring report. Problem areas will be re-evaluated during each subsequent visual assessment.



Section 4: Results of Year 1 Monitoring

The MY1 vegetation monitoring resulted in an average stem density of 529 planted stems per acre, which is approximately 92% of the baseline (MY0) density recorded (573 stems per acre) in the Baseline Monitoring Report submitted in June 2020. Stem densities in individual monitoring plots range from 364 to 688 planted stems per acre with stem counts in individual plots ranging from 9 to 17 stems with an average of 13 planted stems per plot. The number of different species planted per plot range from four to six with a Site average of five; the Site had a total of seven different species. All vegetation plots (VPs) are on track to meet the final stem density success criteria of 260 stems per acre for MY5. See Table 9 in Appendix 3 for additional information.

One small area (0.06 acres) along the left side of E3 was mowed shortly after planting. Additional easement signage and horse tape was added along the conservation easement boundary to better mark the boundary. The area is now healthy and growing quickly. Since this is such a small area, no additional planting is needed at this time. Wildlands will continue to monitor this area for emergence of woody species and any signs of easement encroachment.

Refer to Appendix 2 for visual assessment data and Appendix 3 for vegetation plot data and vegetation plot photographs.

4.1 Parcel Maintenance

Ring sprays were conducted shortly after planting in May 2020 to reduce competition that could hinder growth from the planted stems. Additional adaptive measures will be developed, or appropriate remedial actions will be implemented in the event that the Site or a specific component of the Site fails to achieve the success criteria outlined in the Mitigation Plan. Site maintenance will be performed to correct any identified problems on the Site that have a high likelihood of affecting project success. Such items include but are not limited to excess tree mortality caused by fire, flooding, drought, or insects. Any actions implemented will be designed to achieve the success criteria and will include a work schedule and updated monitoring criteria.

4.2 Conclusions

The 2020 vegetation monitoring data reflects that the Site is on trajectory to achieve the final vegetative success criteria by the end of Monitoring Year Five. These criteria include both a stem density of 260 stems per acre and a species diversity of at least four native species for the Site. The small easement encroachment from MY0 along E3 has been properly posted. Replanting is not necessary at this time. No major problems were identified, such as invasive species or excessive tree mortality, during Monitoring Year 1. Therefore, no corrective actions are required at this time.






Section 5: References

- Lee, Michael T., Peet, Robert K., Steven D., Wentworth, Thomas R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Retrieved from <http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-5.pdf>
- North Carolina Ecosystem Enhancement Program. 2009. Cape Fear River Basin Restoration Priorities 2009. http://www.nceep.net/services/lwps/cape_fear/RBRP%20Cape%20Fear%202008.pdf
- North Carolina Division of Mitigation Services (DMS). 2017. Riparian Buffer and Nutrient Offset Buffer Baseline & Annual monitoring Report Template (Version 2.0, 05-2017). Raleigh, North Carolina. https://ncdenr.s3.amazonaws.com/s3fs-public/Mitigation%20Services/Document%20Management%20Library/Guidance%20and%20Template%20Documents/RB_NO_Base_Mon_Template_2.0_2017_5.pdf
- North Carolina Interagency Review Team. 2016. Wilmington District Stream and Wetland Compensatory Mitigation Update. October 24, 2016.
- Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina, 3rd approx. North Carolina Natural Heritage Program, Raleigh, North Carolina.
- United States Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.
- Wildlands Engineering, Inc. 2020. Mangum Homestead Mitigation Plan. DMS, Raleigh, NC. January, 2020.
- Wildlands Engineering, Inc. 2020. Mangum Homestead Baseline Monitoring Report. DMS, Raleigh, NC. June, 2020.



APPENDIX 1. General Tables and Figures

**Directions: Traveling west on I-40W from Raleigh.
 Take exit 263 (28.7 miles).
 Turn left onto New Hope Church Road.
 Continue onto Arthur Minnis Road (2.1 miles).
 The site will be on the right (Foggy Bottom Lane).
 Enter the Site via the gravel driveway.**

-  Project Location
-  Conservation Easement Boundary
-  Mangum Homestead Mitigation Site Location

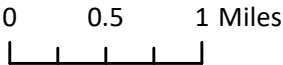
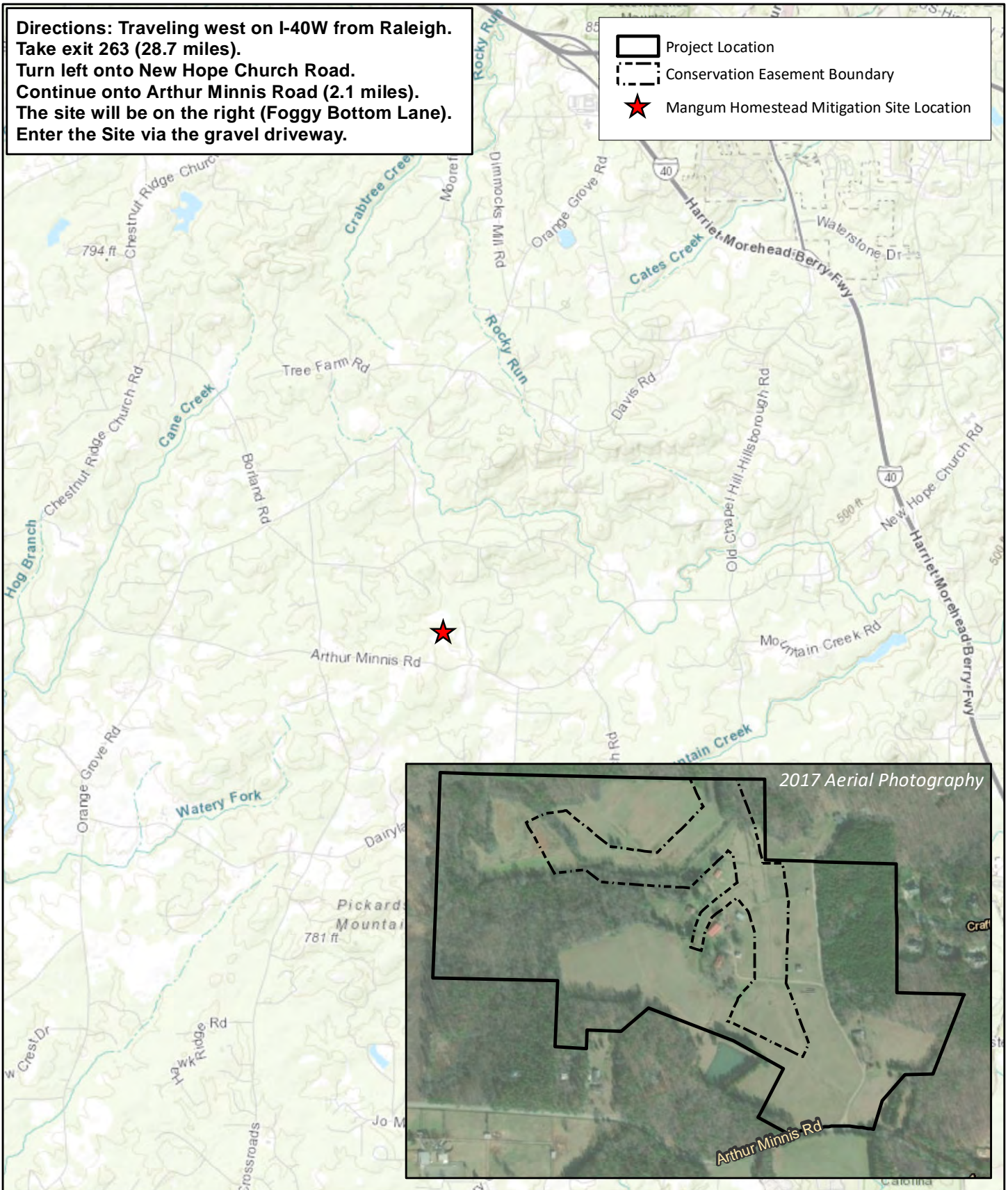


Figure 1 Vicinity Map
 Mangum Homestead Mitigation Site
 Monitoring Year 1 Report
 Cape Fear River Basin (03030002)
 Orange County, NC

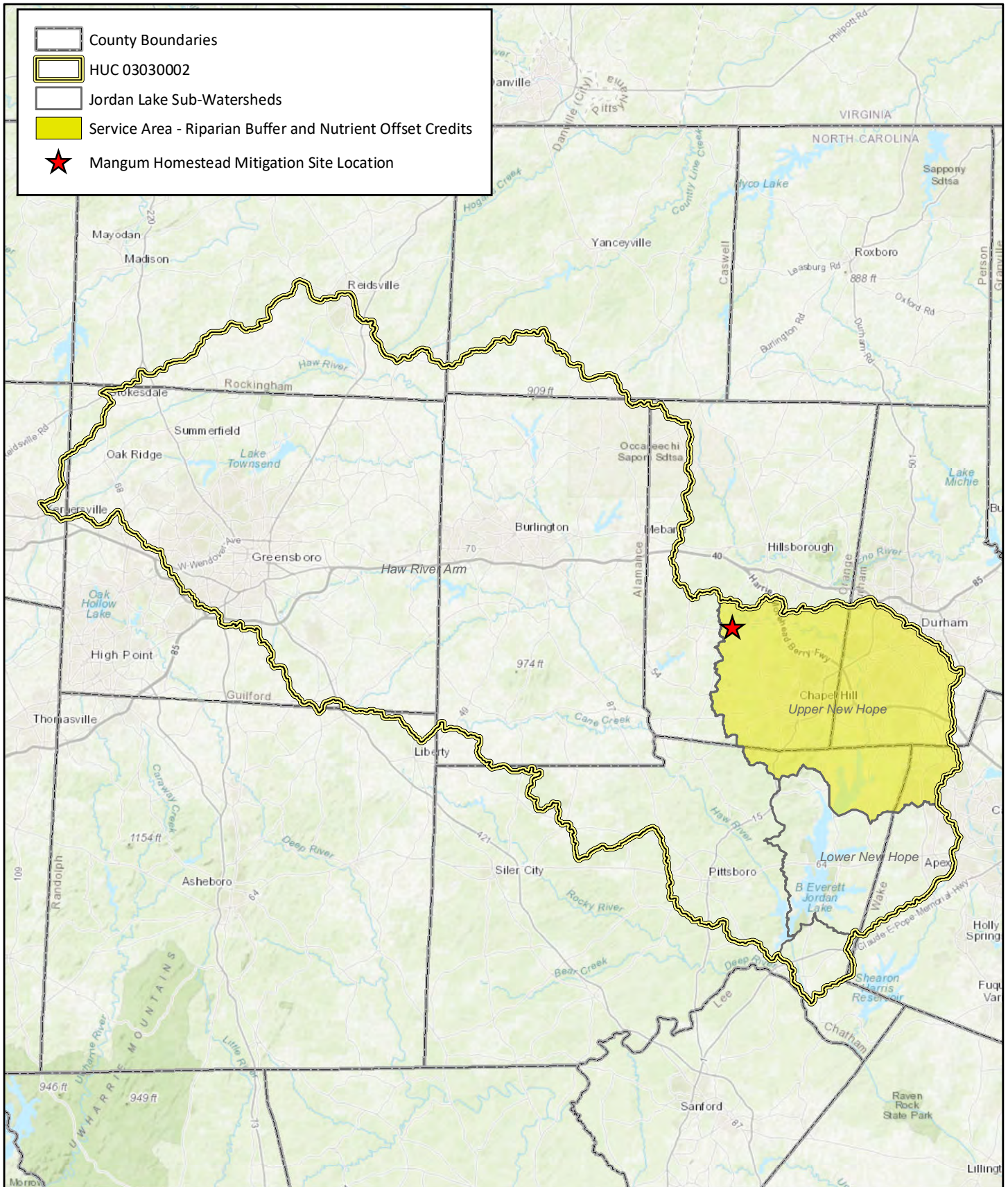
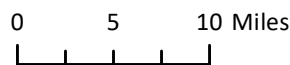


Figure 2 Service Area Map
 Mangum Homestead Mitigation Site
 Monitoring Year 1 Report
 Cape Fear River Basin (03030002)
 Orange County, NC



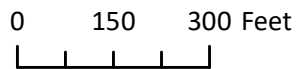
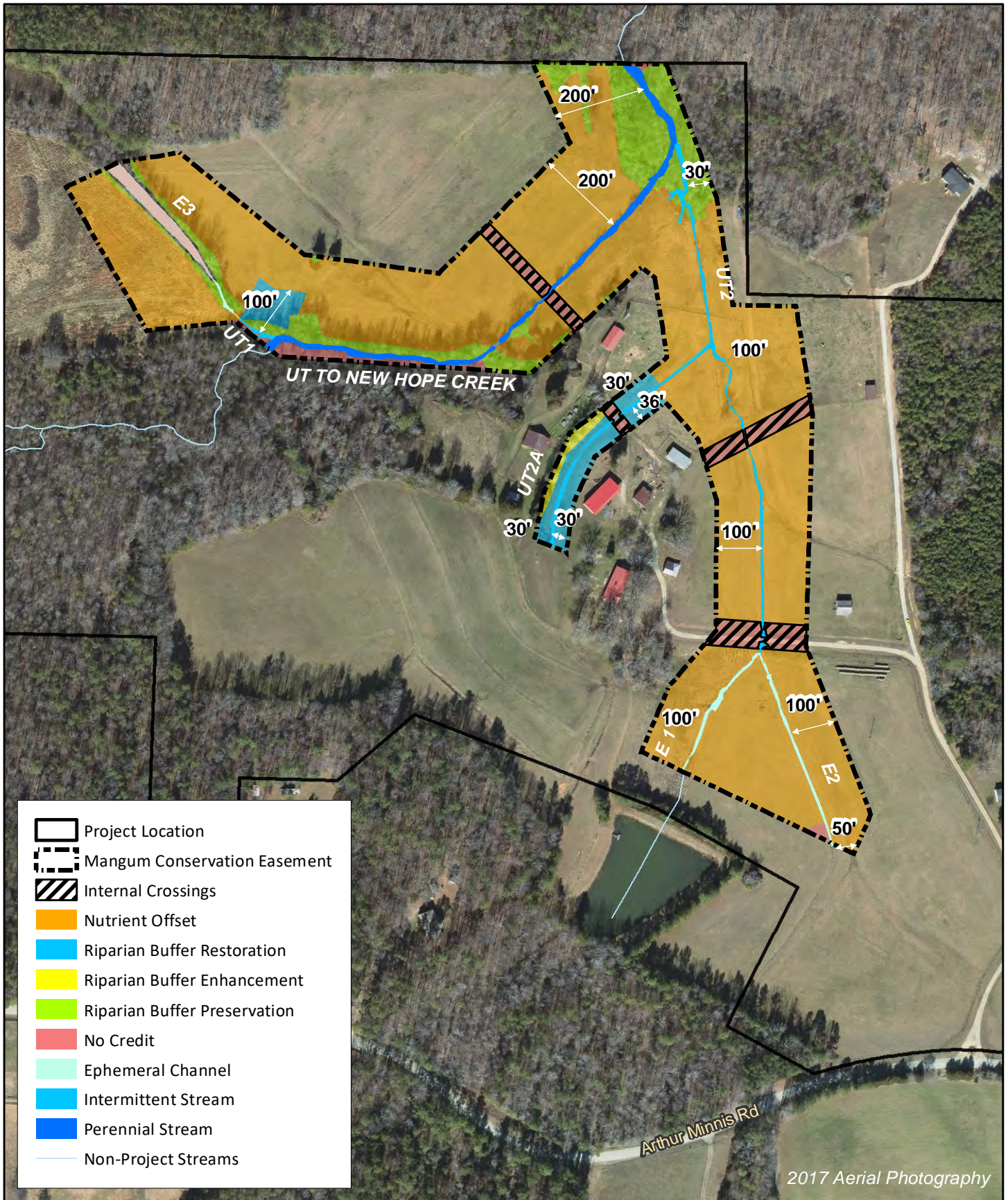


Figure 3 Project Component/Asset Map
 Mangum Homestead Mitigation Site
 Monitoring Year 1 Report
 Cape Fear River Basin (03030002)
 Orange County, NC

Table 1. Buffer Project Areas and Assets

Mangum Homestead Mitigation Site

DMS Project No. 100107

Monitoring Year 1 - 2020

| Cape Fear - Jordan Upper New Hope 03030002060110 | | Project Area | | | | | | | | | | | | | | |
|--|----------|--|--------------|---------------------|---------------------------|---------------------------------------|-------------------------------|---|----------------------------|---------------|--------------------------|---------------------------------|-------------------------|---------------------------------|------------------------------------|------------------------------------|
| 32.91899 | | N Credit Conversion Ratio (ft ² /pound) | | | | | | | | | | | | | | |
| 522.2408 | | P Credit Conversion Ratio (ft ² /pound) | | | | | | | | | | | | | | |
| Credit Type | Location | Subject? (enter NO if ephemeral or ditch ¹) | Feature Type | Mitigation Activity | Min-Max Buffer Width (ft) | Feature Name | Total Area (ft ²) | Total (Creditable) Area of Buffer Mitigation (ft ²) | Initial Credit Ratio (x:1) | % Full Credit | Final Credit Ratio (x:1) | Convertible to Riparian Buffer? | Riparian Buffer Credits | Convertible to Nutrient Offset? | Delivered Nutrient Offset: N (lbs) | Delivered Nutrient Offset: P (lbs) |
| Buffer | Rural | Yes | I / P | Restoration | 0-50 | UT2A | 23,810 | 23,810 | 1 | 100% | 1.00000 | Yes | 23,810.000 | No | — | — |
| Buffer | Rural | Yes | I / P | Restoration | 0-100 | UT1 | 9,445 | 9,445 | 1 | 100% | 1.00000 | Yes | 9,445.000 | Yes | 286.916 | 18.086 |
| Buffer | Rural | Yes | I / P | Enhancement | 0-100 | UT2A | 4,819 | 4,819 | 2 | 100% | 2.00000 | Yes | 2,409.500 | No | — | — |
| Nutrient Offset | Rural | No | Ephemeral | Restoration | 0-100 | UT to New Hope Creek, UT2, E1, E2, E3 | 503,726 | 503,726 | 1 | 100% | 1.00000 | Yes | 503,726.000 | Yes | 15,301.988 | 964.547 |
| Nutrient Offset | Rural | No | Ephemeral | Restoration | 101-200 | UT to New Hope Creek, UT2, E1, E2, E3 | 154,184 | 154,184 | 1 | 33% | 3.03030 | Yes | 50,880.771 | Yes | 4,683.740 | 295.235 |
| Totals: | | | | | | | 695,984 | 695,984 | | | | | | | | |

Enter Preservation Credits Below

| | | | | | | | | Eligible for Preservation (ft ²): | | | | | | |
|-------------|----------|----------|--------------|---------------------|---------------------------|---------------------------|-----------------|--|----------------------------|---------------|--------------------------|-------------------------|---|--|
| Credit Type | Location | Subject? | Feature Type | Mitigation Activity | Min-Max Buffer Width (ft) | Feature Name | Total Area (sf) | Total (Creditable) Area for Buffer Mitigation (ft ²) | Initial Credit Ratio (x:1) | % Full Credit | Final Credit Ratio (x:1) | Riparian Buffer Credits | | |
| Buffer | Rural | Yes | I / P | Preservation | 0-100 | UT to New Hope Creek, UT2 | 74,537 | 12,691 | 10 | 100% | 10.00000 | 1,269.100 | | |
| | Rural | Yes | I / P | | 101-200 | UT to New Hope Creek | 4,922 | | 10 | 33% | | — | | |
| | | | | | | | | | | | | | — | |
| | | | | | | | | | | | | | — | |
| | | | | | | | | | | | | | — | |

Preservation Area Subtotal (ft²): 12,691
 Preservation as % Total Area of Buffer Mitigation: 25.0%
 Ephemeral Reaches as % Total Area of Buffer Mitigation: 0.0%

| TOTAL AREA OF BUFFER MITIGATION (TABM) | | |
|--|---------------|-------------------|
| Mitigation Totals | Square Feet | Credits |
| Restoration: | 33,255 | 33,255.000 |
| Enhancement: | 4,819 | 2,409.500 |
| Preservation: | 12,691 | 1,269.100 |
| Total Riparian Buffer: | 50,765 | 36,933.600 |
| TOTAL NUTRIENT OFFSET MITIGATION | | |
| Mitigation Totals | Square Feet | Credits |
| Nutrient Offset: | | |
| Nitrogen: | 657,910 | 19,985.729 |
| Phosphorus: | | 1,259.783 |

Table 2. Project Activity and Reporting History

Mangum Homestead Mitigation Site

DMS Project No. 100107

Monitoring Year 1 - 2020

| Activity or Report | Data Collection Complete | Completion or Scheduled Delivery |
|---|---------------------------------|---|
| Mitigation Plan Date | - | January 2020 |
| Bare Roots Planting | - | April 2020 |
| As-Built & Baseline Monitoring Document | April 2020 | June 2020 |
| Competitive Vegetation Treatment ¹ | | May 2020 |
| Year 1 Monitoring Report Date | October 2020 | December 2020 |
| Year 2 Monitoring Report Date | 2021 | December 2021 |
| Year 3 Monitoring Report Date | 2022 | December 2022 |
| Year 4 Monitoring Report Date | 2023 | December 2023 |
| Year 5 Monitoring Report Date | 2024 | December 2024 |

¹Ring sprays conducted around planted stems

Table 3. Project Contact Table

Mangum Homestead Mitigation Site

DMS Project No. 100107

Monitoring Year 1 - 2020

| | |
|--------------------------------|---|
| Designers | Wildlands Engineering, LLC 1430 South Mint Street, Suite 104 Charlotte, NC 28203 704.332.7754 |
| Planting Contractor | Bruton Natural Systems, Inc P.O. Box 1197 Fremont, NC 27830 |
| Nursery Stock Suppliers | Dykes and Son Nursery |
| Monitoring Performers | Wildlands Engineering, Inc. Jason Lorch 919.851.9986, ext. 107 |

Table 4. Project Information and Attributes

Mangum Homestead Mitigation Site

DMS Project No. 100107

Monitoring Year 1 - 2020

| PROJECT INFORMATION | |
|--|-------------------------------------|
| Project Name | Mangum Homestead Mitigation Site |
| USGS Hydrologic Unit 14-digit | 03030002060110 |
| River Basin | Cape Fear - Jordan Upper New Hope |
| Project Coordinates (latitude and longitude) | 35° 59' 49.23'' N, 79° 8' 44.77'' W |
| Total Credits (BMU) | 36,933.600 |
| Total Credits (Nitrogen Offset) | 19,985.729 |
| Total Credits (Phosphorous Offset) | 1,259.783 |
| Types of Credits | Riparian Buffer & Nutrient Offset |

Table 5. Monitoring Components Summary

Mangum Homestead Mitigation Site

DMS Project No. 100107

Monitoring Year 1 - 2020

| Parameter | Monitoring Feature | Quantity/Length By Reach | | | | | | | Frequency |
|--------------------------------|-----------------------|--------------------------|-----|-----|-----|----|----|--------|--------------|
| | | UT to New Hope Creek | UT1 | UT2 | UT3 | E1 | E2 | E3 | |
| Vegetation | CVS Level 1 | 13 | | | | | | | Annual |
| Visual Assessment | Y | Y | Y | Y | Y | Y | Y | Y | Semi- Annual |
| Exotic and Nuisance Vegetation | Y | Y | Y | Y | Y | Y | Y | Y | Semi- Annual |
| Project Boundary | Y | Y | Y | Y | Y | Y | Y | Y | Semi- Annual |
| Reference Photographs | Over View Photographs | | | | | | | Annual | |

ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

LINDA CULPEPPER
Director



NORTH CAROLINA
Environmental Quality

September 4, 2019

Andrea Eckardt
Wildlands Engineering, Inc
1430 S. Mint St, Suite 104
Charlotte, NC 28203
(via electronic mail: aekardt@wildlandseng.com)

DWR# 2019-0645
Orange County

Re: Site Viability for Buffer Mitigation & Nutrient Offset – Mangum Homestead Site
Located at 1449 Foggy Bottom Ln, Hillsborough, NC
Upper New Hope of Jordan Lake Watershed

Dear Ms. Eckardt,

On May 14, 2019, Katie Merritt, with the Division of Water Resources (DWR), received a request from Wildlands Engineering, Inc. (Wildlands) for an onsite mitigation determination near the above-referenced site (Site). The Site is located within the Upper New Hope sub-watershed of Jordan Lake in the Cape Fear River Basin. The Site is being proposed as part of a full-delivery riparian buffer mitigation and nutrient offset project for the Division of Mitigation Services (RFP #16-007702). On July 19, 2019, Ms. Merritt performed an onsite assessment of riparian land uses adjacent to streams and channels onsite, which are shown on the attached map labeled "Site Map". Staff from the Division of Mitigation Services were also present onsite.

Ms. Merritt's evaluation of the features onsite and their associated mitigation determination for the riparian areas are provided in the table below. This evaluation was made from Top of Bank (TOB) and landward 200' from each feature for buffer mitigation pursuant to 15A NCAC 02B .0295 (effective November 1, 2015) and for nutrient offset credits pursuant to 15A NCAC 02B .0240.



North Carolina Department of Environmental Quality | Division of Water Resources
512 North Salisbury Street | 1617 Mall Service Center | Raleigh, North Carolina 27699-1617
919.707.9000

| <u>Feature</u> | <u>Classification onsite</u> | <u>¹Subject to Buffer Rule</u> | <u>Riparian Land uses adjacent to Feature (0-200')</u> | <u>Buffer Credit Viable</u> | <u>²Nutrient Offset Viable</u> | <u>⁵Mitigation Type Determination w/in riparian areas</u> |
|----------------------|------------------------------|---|--|-----------------------------|---|---|
| E1 | Ephemeral | No | Non-forested hay field | ⁴ Yes | Yes | Restoration Site per 15A NCAC 02B .0295 (o)(7) |
| E2 | Ephemeral | No | Non-forested hay field | ⁴ Yes | Yes | Restoration Site per 15A NCAC 02B .0295 (o)(7) |
| UT2 | Stream | Yes | Mostly non-forested hay field with some forested areas downstream | ³ Yes | Yes (<i>non-forested areas only</i>) | Non-forested areas - Restoration Site per 15A NCAC 02B .0295 (n) Forested Areas - Preservation Site per 15A NCAC 02B .0295 (o)(5) |
| UT2A | Stream | No | Mostly non-forested grassed lawn with some trees along fence line | Yes | No | Restoration Site per 15A NCAC 02B .0295 (o)(3) Tree line - Enhancement Site per 15A NCAC 02B .0295 (o)(3) |
| E3 | Ephemeral | No | Combination of forested areas mostly along the channel and non-forested hay fields | ^{3,4} Yes | Yes (<i>non-forested areas only</i>) | Non-forested areas - Restoration Site per 15A NCAC 02B .0295 (o)(7) Forested Areas - Preservation Site per 15A NCAC 02B .0295 (o)(7) |
| UT1 (at DWR flag) | Stream | Yes | Combination of forested areas mostly along the channel and non-forested hay fields | ³ Yes | Yes (<i>non-forested areas only</i>) | Non-forested areas - Restoration Site per 15A NCAC 02B .0295 (n) Forested Areas - Preservation Site per 15A NCAC 02B .0295 (o)(5) |
| UT to New Hope Creek | Stream | Yes | Combination of forested areas mostly along the channel and non-forested hay fields | ³ Yes | Yes (<i>non-forested areas only</i>) | Non-forested areas - Restoration Site per 15A NCAC 02B .0295 (n) Forested Areas - Preservation Site per 15A NCAC 02B .0295 (o)(5) |

¹Subjectivity calls for the features were determined by DWR in correspondence dated August 27, 2019 using the 1:24,000 scale quadrangle topographic map prepared by USGS and the most recent printed version of the soil survey map prepared by the NRCS .

² NC Division of Water Resources - Methodology and Calculations for determining Nutrient Reductions associated with Riparian Buffer Establishment. Nitrogen and Phosphorus are calculated differently in the Jordan Lake Watershed.

³The area of preservation credit within a buffer mitigation site shall comprise of no more than 25 percent (25%) of the total area of buffer mitigation per 15A NCAC 0295 (o)(5) and 15A NCAC 0295 (o)(4). Site cannot be a Preservation Only site to comply with this rule.

⁴The area of the mitigation site on ephemeral channels shall comprise no more than 25 percent (25%) of the total area of buffer mitigation per 15A NCAC 02B .0295 (o)(7).

⁵All features proposed for buffer mitigation or nutrient offset, must have a conservation easement established that includes the tops of channel banks when being measured perpendicular and landward from the channel, even when no credit is viable within the 50' riparian area.

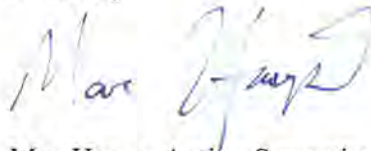
The site map attached to this letter was prepared by Wildlands and edited by DWR to match this correspondence. This letter does not constitute an approval of this site to generate mitigation credits. Pursuant to 15A NCAC 02B .0295, a mitigation proposal and a mitigation plan shall be submitted to DWR for written approval **prior** to conducting any mitigation activities in riparian areas and/or surface waters for buffer mitigation credit. Pursuant to 15A NCAC 02B .0240, a proposal regarding a

proposed nutrient load-reducing measure for nutrient offset credit shall be submitted to DWR for approval prior to any mitigation activities in riparian areas and/or surface waters.

All vegetative plantings, performance criteria and other mitigation requirements for riparian restoration, enhancement and preservation must follow the requirements in 15A NCAC 02B .0295 to be eligible for buffer and/or nutrient offset mitigation credits. For any areas depicted as not being viable for nutrient offset credit above, one could propose a different measure, along with supporting calculations and sufficient detail to support estimates of load reduction, for review by the DWR to determine viability for nutrient offset in accordance with 15A NCAC 02B .0240.

This viability assessment will expire on September 4, 2021 or upon the submittal of an As-Built Report to the DWR, whichever comes first. **This letter should be provided in all stream and wetland, buffer and/or nutrient offset mitigation plans for this Site.**

Sincerely,

A handwritten signature in blue ink that reads "Mac Haupt". The signature is stylized and written in a cursive-like font.

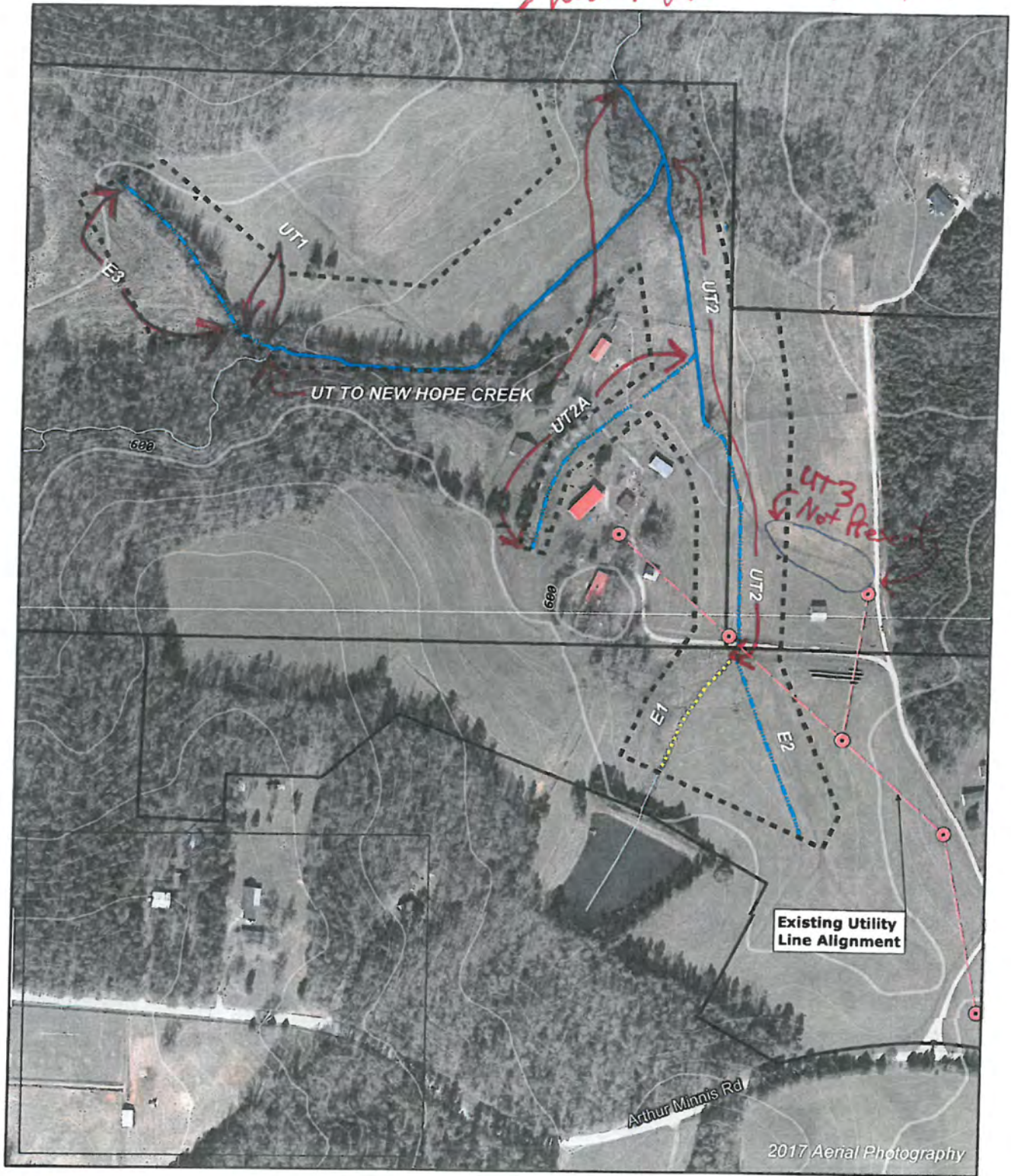
Mac Haupt, Acting Supervisor
401 and Buffer Permitting Branch

MH/km

Attachments: Site Map

cc: File Copy (Katie Merritt)
Lindsay Crocker- DMS (via electronic mail)

Shubert 8/26/19



0 150 300 Feet

Handwritten signature and date: 9/4/19

Site Map
Mangum Homestead Mitigation Site
Cape Fear River Basin (03030002)
Orange County, NC

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
LINDA CULPEPPER
Director



August 27, 2019

DWR Project # 2019-0645 V2
Orange County

Andrea Eckardt
Wildlands Engineering Inc.
1430 S. Mint Street, Suite 104
Charlotte, NC 28203

Subject: On-Site Determination for Applicability to the Jordan Buffer Rules (15A NCAC 02B .0267)

Project Name: Mangum Homestead Mitigation Site

Parcel ID Numbers: 9851671991, 9851778621, 9851763367

Address/ Location: 1449 Foggy Bottom Lane, Hillsborough, Orange County, NC

Stream(s) Evaluated: Unnamed Tributaries to New Hope Creek, Classified as WS-V; NSW

Determination Date: 7/19/2019

Staff: DWR, Shelton Sullivan

Dear Andrea,

On July 19, 2019, Shelton Sullivan of the Division of Water Resources (DWR) Central Office conducted an on-site review of features located on the subject property at the request of Wildlands Engineering Inc. The purpose of the review was to determine the applicability to the Jordan Riparian Area Protection Rules (15A NCAC 02B .0267) and perform stream determinations within the proposed project easement.

The enclosed site map indicates the features evaluated and this information is also summarized in the table below. Streams that are "Subject" are shown on the most recently published NRCS Soil Survey of Orange County and/or the most recent copy of the USGS Topographic (at 1:24,000 scale) maps, have been located on the ground at the site, and possess characteristics that qualify them to be at least intermittent streams. Features that are "Not Subject" are not depicted on the required maps, not present on the property, or have been determined to not be at least intermittent.

Please note that there may be other surface waters located on the property that may be subject to the Jordan Riparian Area Protection Rules, considered jurisdictional according to the US Army Corps of Engineers, and subject to the Clean Water Act.



North Carolina Department of Environmental Quality | Division of Water Resources
512 North Salisbury Street | 1617 Mail Service Center | Raleigh, North Carolina 27699-1617
919.707.9000

See the following table for the features rated during the DWR site visit:

| Feature ID | *E/I/P/ Other | Subject to Buffer Rules | Start @ | Stop @ | Depicted on Soil Survey | Depicted on USGS Topo |
|-------------------------|------------------|-------------------------------|--|--|----------------------------|--------------------------|
| E3 | "E" | No | Northwest project easement | Downstream of the pipe at flag and UT1 Start | Yes | No |
| UT1 | "I" | Yes | Downstream of the pipe at flag and UT1 Start | Confluence of UT1 and UT to New Hope Creek | Yes | No |
| UT to New Hope Creek | "P" | Yes | Project easement | Continues throughout | Yes | Yes |
| E1 | "E" | No | Southern project easement below pond. | Continues downstream to confluence with E2 | Yes | Yes |
| E2 | "E" | No | Southern project easement. | Continues downstream to confluence with E1 | Yes | No |
| UT2 | "I" | Yes | Confluence of E1 and E2, just upstream of culvert | Continues downstream to confluence of UT to New Hope Creek | Yes | Yes |
| **UT2A | "I" | No | Project easement. | Continues downstream to confluence with UT2 | No | No |
| UT3 | Not Present | No | Shown on aerials on east side of project easement | N/A | Yes | No |

*Ephemeral, I: Intermittent, P: Perennial

**Please note that UT2A has an installed corrugated pipe that is impeding the stream flow to the downstream portion UT2A.

This on-site determination shall expire five (5) years from the date of this letter. Landowners or affected parties that dispute a determination made by the DWR may request a determination by the Director. An appeal request must be made within sixty (60) calendar days of the date of this letter to the Director in writing.


If sending via U.S. Postal Service:
DWR 401 & Buffer Permitting Branch
Supervisor
1617 Mail Service Center
Raleigh, NC 27699-1617

If sending via delivery service (UPS, FedEx, etc.)
DWR 401 & Buffer Permitting Branch
Supervisor
512 N Salisbury St.
Raleigh, NC 27604

This determination is final and binding as detailed above, unless an appeal is requested **within sixty (60) calendar days**.

This letter only addresses the features on the subject property and within the proposed project easement and does not approve any activity within buffers or within waters of the state. If you have any additional questions or require additional information, please call Shelton Sullivan at (919) 707-3636. This determination is subject to review as provided in Articles 3 & 4 of G.S. 150B.

Sincerely,



for

Mac Haupt, Acting Supervisor
401 & Buffer Permitting Branch

Enclosures: Photographs, Site Map, Soil Survey, USGS Topographical Map

cc: Andrea Eckardt, Wildlands Engineering Inc. via email
Robert and Janie Mangum, 1449 Foggy Bottom Lane, Hillsborough, NC 27278
401 & Buffer Permitting Branch files



Pic 1. E3 Ephemeral



Pic. 2 UT1 Intermittent Start

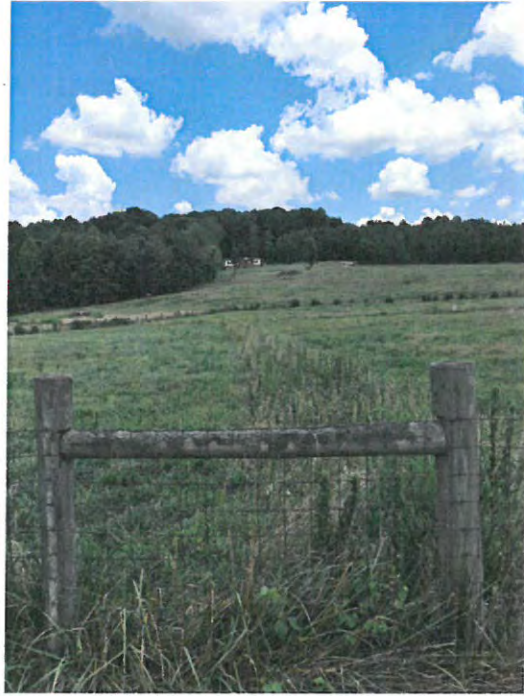


Pic 3. Confluence of UT1 and UT to New Hope Creek

Photographs 7-19-2019 (continued)



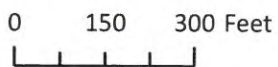
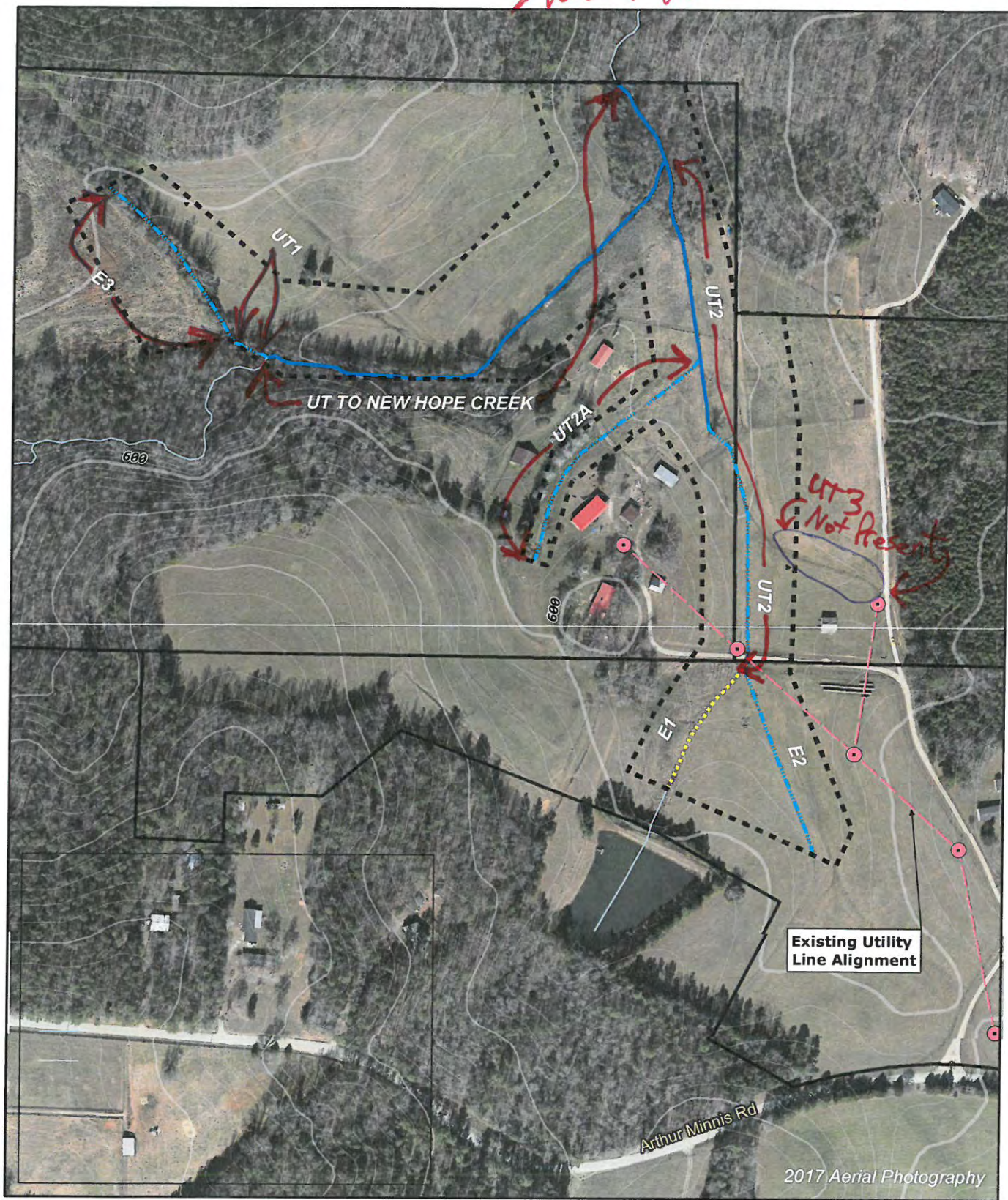
UT2A looking upstream from path



UT2A looking downstream from path

No photographs of UT2 or UT3

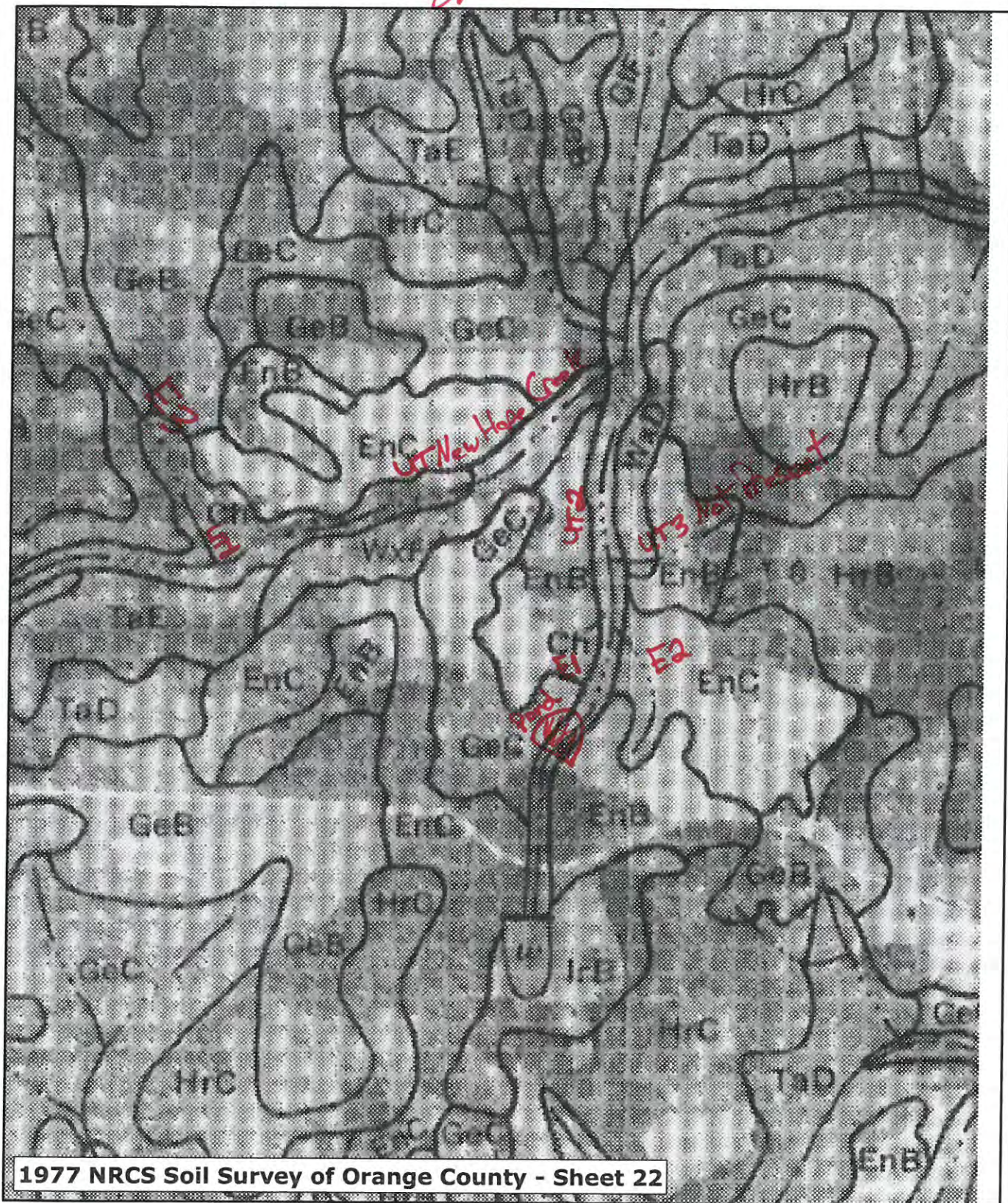
Shelbyville 8/26/19



Site Map
Mangum Homestead Mitigation Site
Cape Fear River Basin (03030002)

Orange County, NC

Submittal 8/26/19



0 275 550 Feet

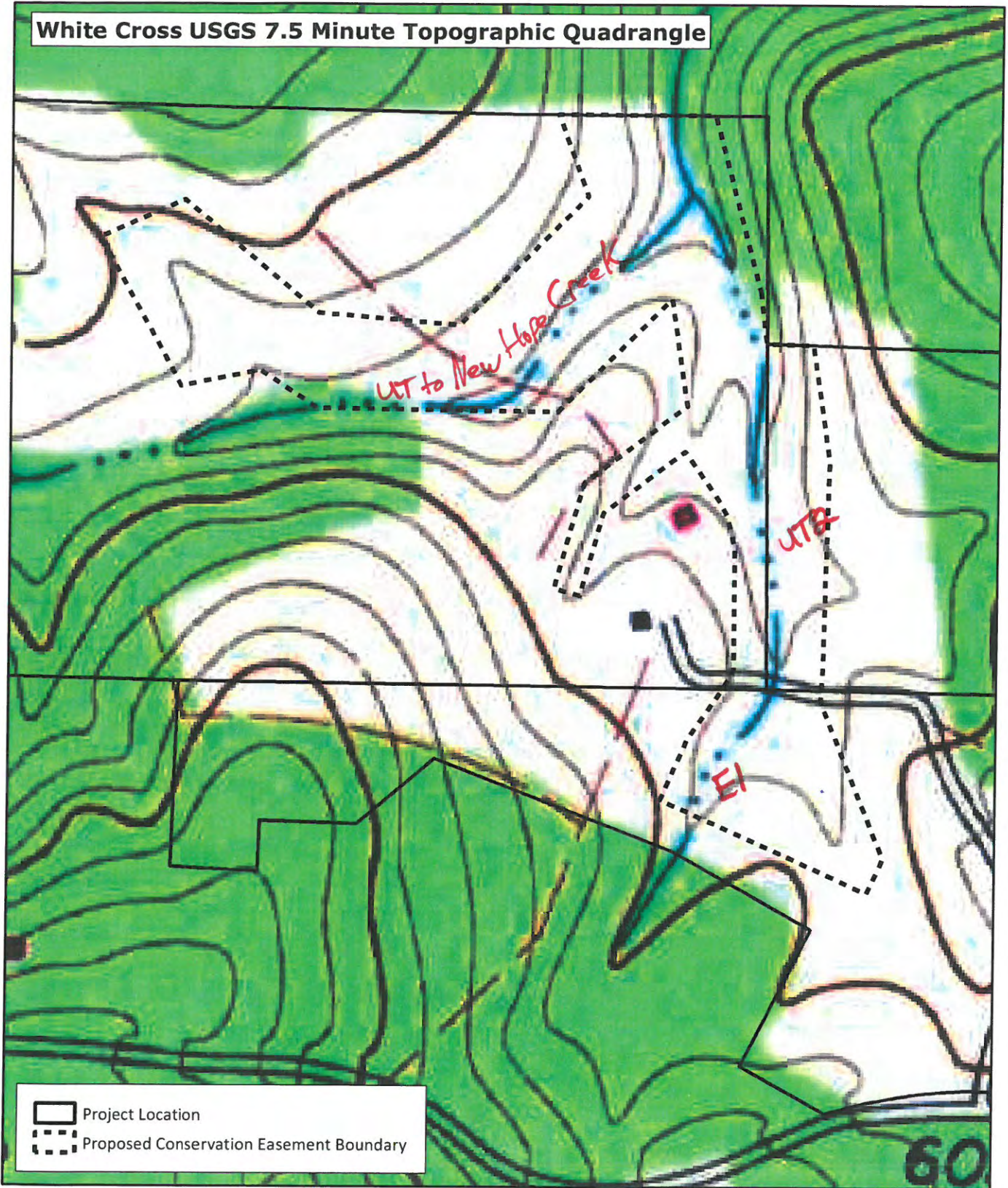


1977 NRCS Soil Survey Map
Mangum Homestead Mitigation Site
Cape Fear River Basin (03030002)

Orange County, NC

Shelby Miller 8/26/19

White Cross USGS 7.5 Minute Topographic Quadrangle



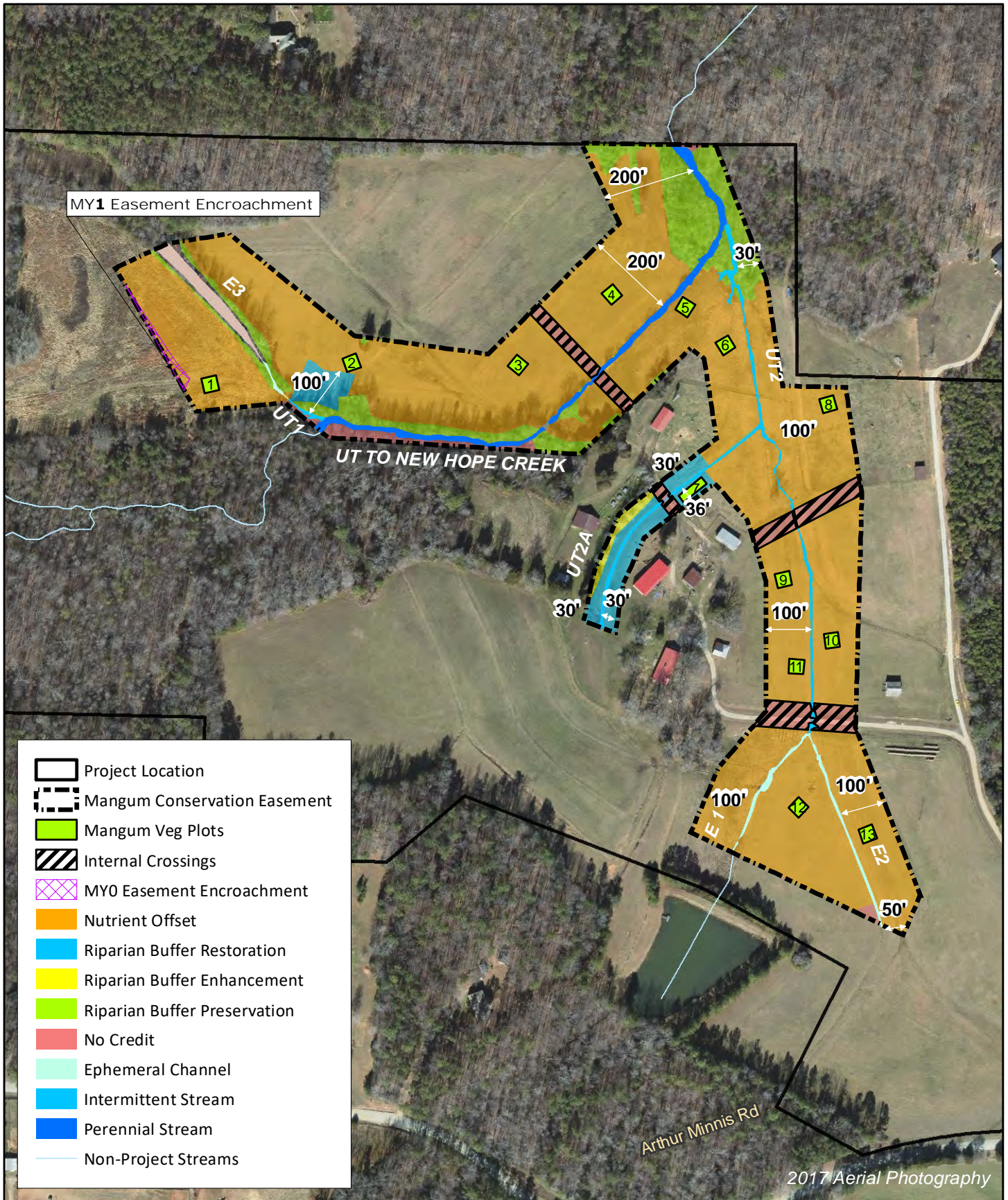
0 150 300 Feet



USGS Topographic Map
Mangum Homestead Mitigation Site
Cape Fear River Basin (03030002)

Orange County, NC

APPENDIX 2. Visual Assessment Data



WILDLANDS
ENGINEERING

0 150 300 Feet



Figure 4 Integrated Current Condition Plan View
Mangum Homestead Mitigation Site
Monitoring Year 1 Report
Cape Fear River Basin (03030002)
Orange County, NC

Table 6. Vegetation Condition Assessment Table

Mangum Homestead Mitigation Site

DMS Project No. 100107

Monitoring Year 1 - 2020**Planted Acreage 17.14**

| Vegetation Category | Definitions | Mapping Threshold (Ac) | Number of Polygons | Combined Acreage | % of Planted Acreage |
|--|---|------------------------|--------------------|------------------|----------------------|
| Bare Areas | Very limited cover of both woody and herbaceous material | 0.1 | 0 | 0 | 0% |
| Low Stem Density Areas | Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria. | 0.1 | 0 | 0 | 0% |
| Total | | | 0 | 0 | 0% |
| Areas of Poor Growth Rates or Vigor | Areas with woody stems of a size class that are obviously small given the monitoring year. | 0.25 Ac | 0 | 0 | 0% |
| Cumulative Total | | | 0 | 0.0 | 0% |

Easement Acreage 19.89

| Vegetation Category | Definitions | Mapping Threshold (SF) | Number of Polygons | Combined Acreage | % of Easement Acreage |
|------------------------------------|--|------------------------|--------------------|------------------|-----------------------|
| Invasive Areas of Concern | Areas of points (if too small to render as polygons at map scale). | 1,000 | 0 | 0 | 0% |
| Easement Encroachment Areas | Areas of points (if too small to render as polygons at map scale). | none | 1 | 0.06 | 0.3% |

OVERVIEW PHOTOGRAPHS





VEGETATION PLOT PHOTOGRAPHS



VEG PLOT 1 (10/2/2020)



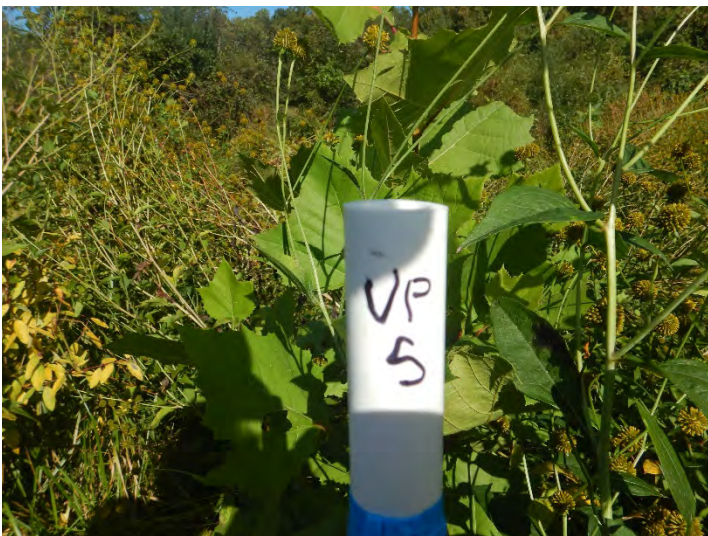
VEG PLOT 2 (10/2/2020)



VEG PLOT 3 (10/2/2020)



VEG PLOT 4 (10/2/2020)



VEG PLOT 5 (10/2/2020)



VEG PLOT 6 (10/2/2020)





VEG PLOT 7 (10/2/2020)



VEG PLOT 8 (10/2/2020)



VEG PLOT 9 (10/2/2020)



VEG PLOT 10 (10/2/2020)



VEG PLOT 11 (10/2/2020)



VEG PLOT 12 (10/2/2020)





VEG PLOT 13 (10/2/2020)



APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Table

Mangum Homestead Mitigation Site

DMS Project No. 100107

Monitoring Year 1 - 2020

| Plot | Success Criteria | Tract Mean |
|------|------------------|------------|
| 1 | Yes | 100% |
| 2 | Yes | |
| 3 | Yes | |
| 4 | Yes | |
| 5 | Yes | |
| 6 | Yes | |
| 7 | Yes | |
| 8 | Yes | |
| 9 | Yes | |
| 10 | Yes | |
| 11 | Yes | |
| 12 | Yes | |
| 13 | Yes | |

Table 8. CVS Vegetation Tables - Metadata

Mangum Homestead Mitigation Site
 DMS Project No.100107
Monitoring Year 1 - 2020

| | |
|--|---|
| Report Prepared By | Daniel Dixon |
| Date Prepared | 10/2/2020 15:03 |
| Database Name | Mangum- CVS v2.5.0- MY1.mdb |
| Database Location | F:\Monitoring\Mangum\MY1 |
| Computer Name | DDIXON2020 |
| File Size | 77819904 |
| DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----- | |
| Metadata | Description of database file, the report worksheets, and a summary of project(s) and project data. |
| Project Planted | Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes. |
| Project Total Stems | Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems. |
| Plots | List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.). |
| Vigor | Frequency distribution of vigor classes for stems for all plots. |
| Vigor by Spp | Frequency distribution of vigor classes listed by species. |
| Damage | List of most frequent damage classes with number of occurrences and percent of total stems impacted by each. |
| Damage by Spp | Damage values tallied by type for each species. |
| Damage by Plot | Damage values tallied by type for each plot. |
| Planted Stems by Plot and Spp | A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded. |
| ALL Stems by Plot and Spp | A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded. |
| PROJECT SUMMARY----- | |
| Project Code | 100107 |
| Project Name | Mangum Homestead |
| Description | Stream Restoration Site |
| Sampled Plots | 13 |

Table 9. Planted and Total Stem Counts

Mangum Homestead Mitigation Site

DMS Project No. 100107

Monitoring Year 1 - 2020

| | | | Current Plot Data (MY1 2020) | | | | | | | | | | | | | | | | | | | | |
|------------------------------|--------------------|--------------|------------------------------|-------|-----|-------|-------|-----|-------|-------|-----|-------|-------|-----|-------|-------|-----|-------|-------|-----|-------|-------|-----|
| Scientific Name | Common Name | Species Type | VP 1 | | | VP 2 | | | VP 3 | | | VP 4 | | | VP 5 | | | VP 6 | | | VP 7 | | |
| | | | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T |
| <i>Acer negundo</i> | Box Elder | Tree | 1 | 1 | 1 | 3 | 3 | 3 | | | | 1 | 1 | 1 | | | | 1 | 1 | 1 | | | |
| <i>Betula nigra</i> | River Birch | Tree | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 5 | 5 | 5 | 5 | 5 | 5 |
| <i>Diospyros virginiana</i> | American Persimmon | Tree | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | | | | | | | 1 | 1 | 5 | 4 | 4 | 4 |
| <i>Platanus occidentalis</i> | Sycamore | Tree | 5 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 5 | 5 | 5 | 7 | 7 | 7 | 5 | 5 | 5 | 3 | 3 | 3 |
| <i>Quercus michauxii</i> | Swamp Chestnut Oak | Tree | | | | 2 | 2 | 2 | 3 | 3 | 3 | 5 | 5 | 5 | | | | | | | 1 | 1 | 1 |
| <i>Quercus phellos</i> | Willow Oak | Tree | 2 | 2 | 2 | 1 | 1 | 1 | 4 | 4 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 |
| <i>Quercus shumardii</i> | Shumard Oak | Shrub Tree | | | | | | | | | | | | | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| Stem count | | | 12 | 12 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 11 | 11 | 11 | 13 | 13 | 17 | 17 | 17 | 17 |
| size (ares) | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | |
| size (ACRES) | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | |
| Species count | | | 5 | 5 | 5 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 6 | 6 | 6 |
| Stems per ACRE | | | 486 | 486 | 526 | 526 | 526 | 526 | 526 | 526 | 526 | 526 | 526 | 526 | 445 | 445 | 445 | 526 | 526 | 688 | 688 | 688 | 688 |

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Volunteers

PnoLS - Planted Stems Excluding Live Stakes

P-all - All Planted Stems

T - All Woody Stems

Table 9. Planted and Total Stem Counts

Mangum Homestead Mitigation Site
 DMS Project No. 100107
 Monitoring Year 1 - 2020

| Scientific Name | Common Name | Species Type | Current Plot Data (MY1 2020) | | | | | | | | | | | | | | | Annual Means | | | | | | | | |
|------------------------------|--------------------|--------------|------------------------------|-------|-----|-------|-------|-----|-------|-------|-----|-------|-------|-----|-------|-------|-----|--------------|-------|-----|------------|-------|-----|------------|-------|-----|
| | | | VP 8 | | | VP 9 | | | VP 10 | | | VP 11 | | | VP 12 | | | VP 13 | | | MY1 (2020) | | | MY0 (2020) | | |
| | | | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T |
| <i>Acer negundo</i> | Box Elder | Tree | 1 | 1 | 1 | 3 | 3 | 3 | 2 | 2 | 2 | | | | | | | 12 | 12 | 12 | 14 | 14 | 14 | | | |
| <i>Betula nigra</i> | River Birch | Tree | 1 | 1 | 1 | | | | 5 | 5 | 5 | 4 | 4 | 4 | 5 | 5 | 5 | 3 | 3 | 3 | 40 | 40 | 40 | 45 | 45 | 45 |
| <i>Diospyros virginiana</i> | American Persimmon | Tree | 3 | 3 | 3 | 4 | 4 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | | | | 20 | 20 | 25 | 18 | 18 | 18 |
| <i>Platanus occidentalis</i> | Sycamore | Tree | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | | | | 5 | 5 | 5 | 5 | 5 | 5 | 47 | 47 | 47 | 48 | 48 | 48 |
| <i>Quercus michauxii</i> | Swamp Chestnut Oak | Tree | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | | | | 3 | 3 | 3 | 21 | 21 | 21 | 23 | 23 | 23 |
| <i>Quercus phellos</i> | Willow Oak | Tree | | | | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | | | | | | | 20 | 20 | 20 | 26 | 26 | 26 |
| <i>Quercus shumardii</i> | Shumard Oak | Shrub Tree | 2 | 2 | 2 | | | | | | | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 10 | 10 | 10 | 10 | 10 | 10 |
| Stem count | | | 11 | 11 | 11 | 15 | 15 | 15 | 15 | 15 | 15 | 9 | 9 | 9 | 14 | 14 | 14 | 14 | 14 | 14 | 170 | 170 | 175 | 184 | 184 | 184 |
| size (ares) | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | | 1 | | | 13 | | | 13 | | |
| size (ACRES) | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.02 | | | 0.32 | | | 0.32 | | |
| Species count | | | 6 | 6 | 6 | 5 | 5 | 5 | 6 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 7 | 7 | 7 | 7 | 7 | 7 |
| Stems per ACRE | | | 445 | 445 | 445 | 607 | 607 | 607 | 607 | 607 | 607 | 364 | 364 | 364 | 567 | 567 | 567 | 567 | 567 | 567 | 529 | 529 | 545 | 573 | 573 | 573 |

Color for Density

- Exceeds requirements by 10%
- Exceeds requirements, but by less than 10%
- Fails to meet requirements, by less than 10%
- Fails to meet requirements by more than 10%
- Volunteers

PnoLS - Planted Stems Excluding Live Stakes

P-all - All Planted Stems

T - All Woody Stems