RESTORATION SYSTEMS | LLC
Natural Resource
Restoration & Conservation

22 October 2014

Mr. David Bailey
U.S. Army Corps of Engineers
Regulatory Field Office
Wilmington District
3331 Heritage Trade Drive, Suite 105
Wake Forest, North Carolina 27587

RE: FINAL PROSPECTUS FOR CAPE FEAR 02 UMBRELLA STREAM MITIGATION BANK

Dear Mr. Bailey,

It is with great pleasure that Restoration Systems LLC submits the accompanying Final Prospectus ("Prospectus") for the Cape Fear 02 Umbrella Stream Mitigation Bank ("Bank"). The Bank is proposed as a multi-phase project: eight sites constitute "Phase I"; all future phases will consist of sites that have not yet been secured or identified. The accompanying Prospectus provides preliminary descriptions of existing and proposed conditions at all Phase I sites. In addition, the Prospectus discusses a series of general provisions and requirements of the proposed umbrella banking instrument.

We recognize that an umbrella stream mitigation bank is an uncommon occurrence in the Wilmington District. We have therefore attempted to provide as much information as possible at this stage in the process. We hope that you find the Prospectus's contents adequate and complete.

We are prepared to assist you in coordinating site visits for our Phase I properties. Please keep in mind that there are eight Phase I sites; therefore the field visits will likely require two days. Please reach out to us with suggested dates at your earliest convenience.

Finally, hardcopies of the Prospectus have been shipped directly to each project IRT member copied at the bottom of this letter. Please contact Adam Riggsbee (512-970-3062) or Worth Creech (919-389-3888) to make field site visit arrangements and any other needs relating to the Prospectus that you may have. Thank you in advance for your consideration of our Prospectus. We look forward to receiving IRT comments in approximately 90-days.

Sincerely,

John Preyer
President

Enclosure

cc: Ms. Jean Gibby, USACE
Mr. Todd Bowers, EPA
Ms. Cindy Karoly, NCDWR
Ms. Kathy Matthews, FWS
Mr. Travis Wilson, NCWRC
Mr. Fritz Rohde, NOAA
Ms. Renee Gledhill-Earley, SHPO
Mr. Worth Creech, Restoration Systems LLC
Dr. Adam Riggsbee, RiverBank Consultants LLC

CAPE FEAR 02 UMBRELLA MITIGATION BANK
FINAL PROSPECTUS

OCTOBER 2014

Sponsored by:

RESTORATION SYSTEMS LLC

Prepared by:

Axiom Environmental Inc and RiverBank Consultants LLC

CAPE FEAR 02 UMBRELLA MITIGATION BANK PROSPECTUS

OCTOBER 2014

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1 INTRODUCTION

Restoration Systems, LLC ("the Sponsor") is pleased to propose the Cape Fear 03030002 (Cape Fear 02) Umbrella Mitigation Bank ("the Bank"). The proposed umbrella structure of the Bank is designed to initially permit the establishment of eight stream mitigation sites (collectively referred to as "Phase I"), while enabling the establishment of future mitigation sites not yet identified. All Phase I sites are located in North Carolina and consist of the following: 1) Motes Creek in Alamance County, 2) Benton Branch in Caswell County, 3) Orphan Creek in Alamance County, 4) Chico Branch in Rockingham County, 5) Maple Hill Farm in Alamance County, 6) Major Hill in Alamance County, 7) Rocky Top in Alamance County, and 8) Slingshot Creek in Rockingham County (Figure 1; Table 1).

Table 1: Phase I Site Summary

Stream Site	Hydro Status*	Existing Length (LF)	Mitigation Type	Approx. Final Length (LF)
Motes Creek	Per	5,746	Restoration, Enhancement	6,693
Benton Branch	Per/Int	8,843	Restoration, Enhancement	10,343
Orphan Creek	Per/Int	2,668	Restoration, Enhancement	3,081
Chico Branch	Per/Int	2,295	Restoration	2,805
Major Hill	Per/Int	2,410	Restoration, Enhancement	3,160
Maple Hill Farm	Per/Int	3,990	Restoration, Enhancement	4,493
Rocky Top	Per	1,214	Restoration, Enhancement	1,273
Slingshot Creek	Per	3,907	Restoration, Enhancement	4,777
Totals		**31,073**		**36,625**

* Per = perennial; Int = intermittent

The Phase I sites, and all future sites, are located in the Upper Cape Fear River basin ("Cape Fear 02"; Figure 2). Motes Creek is located approximately 8 miles southeast of Burlington. Benton Branch is located approximately 4 miles north of Burlington. Orphan Creek is located approximately 2 miles north of Saxapahaw and 7 miles

southeast of Graham. Chico Branch is located approximately 6 miles south of Reidsville. Major Hill is located approximately 5 miles southwest of Saxapahaw and 3 miles east of Snow Camp. Maple Hill Farm is located approximately 4 miles west of Saxapahaw and 9 miles south of Graham. Rocky Top is located approximately 6 miles southwest of Saxapahaw and 2 miles east of Snow Camp. Slingshot Creek is located approximately 2 miles west of Reidsville.

1.1 Project Objectives

The overall objectives of the Bank are to restore or otherwise improve the following functions: 1) hydrological, 2) water quality, and 3) habitat. Tables 2-4 provide an overview of the Bank's objectives and the specific actions proposed to accomplish them.

Table 2: Hydrological Function Objectives and Proposed Actions

Functional Improvement Objectives	Proposed Actions
Floodplain Connectivity	Reconnect channels with historic floodplains
Floodplain Resistance	Plant woody riparian buffers; increase microtopography
Stream Stability & Sediment Transport	Reconstruct stream channels, sized to convey bankfull discharges and watershed sediment supplies
Surface and Subsurface Storage and Retention	Channels constructed or raised to historic floodplain elevations; increased floodplain hydraulic resistance by planting woody vegetation and increasing microtopography

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Table 3: Water Quality Function Objectives and Proposed Actions

Functional Improvement Objectives	Proposed Actions
Remove Pollutant Sources	Cattle exclusion
Upland Pollutant Filtration	Plant woody riparian buffers; construct marsh treatment features intercepting overland flows
Floodplain Biogeochemical Processing	Increase floodplain connectivity, plant woody riparian buffers; increase microtopography; construct marsh treatment areas
Thermal Regulation	Plant woody riparian buffers to provide shade

Table 4: Habitat Function Objectives and Proposed Actions

Functional Improvement Objectives	Proposed Actions
In-channel Habitat	Construct stable channels, geomorphology designed to increase hydraulic and bedform habitat heterogeneity
Riparian Habitat and Structure	Plant native, woody riparian buffers providing foraging, nesting and cover for terrestrial species as well as refugia for aquatic species

1.2 Bank Sponsor and Contact Information

Restoration Systems, LLC
John Preyer
1101 Haynes Street, Suite 211
Raleigh, NC 27604
jpreyer@restorationsystems.com
919.755.9490

2 ESTABLISHMENT AND OPERATION

2.1 Umbrella Mitigation Banking Instrument

The Sponsor is proposing to permit the Bank using an umbrella mitigation banking instrument ("UMBI"). As proposed, the UMBI would allow for the establishment and operation of multiple phases. Phase I is described in this prospectus and, if

approved, will serve as the Bank's first source of mitigation credit. The Sponsor also proposes the incorporation into the Bank of additional sites not yet identified (within the Geographic Service Area described in the next section), following Interagency Review Team ("IRT") review and approval.

2.2 Credit Determination

Credit for Phase I, and all additional phases, shall be based on the U.S. Army Corps of Engineers (USACE) most current mitigation credit determination methodology. Presently, the USACE is utilizing the *Stream Mitigation Guidelines* (USACE 2003) to quantify mitigation project credit potential. If other methods are released and become de facto requirements for stream mitigation projects in the USACE, future phases will utilize these methods as appropriate.

2.3 Riparian Buffer and Nutrient Offset Credits

In April 2013, the Sponsor and the North Carolina Department of Environment and Natural Resources ("NCDENR") entered into an *Agreement to Establish an Umbrella Mitigation Banking Instrument in the Cape Fear River Basin for Riparian Buffer and Nutrient Offset Mitigation Credits Pursuant to the Jordan Lake Nutrient Strategy* ("Buffer UMBI"). The Sponsor may choose to generate and sell buffer or nutrient credits from any site(s) permitted under the UMBI proposed here. Such generation and sale of buffer or nutrient credits must be approved by NCDENR, and shall be pursuant to all terms and conditions of the Sponsor's Buffer UMBI.

2.4 Credit Release Schedule

Credits generated by actions described and approved in the Bank's final UMBI shall be released in predetermined increments according to the milestones agreed to by the Sponsor and the IRT in the UMBI's credit release schedule. The Sponsor will use the credit release schedule detailed for stream mitigation banks in USACE (2013).

3 GEOGRAPHIC SERVICE AREA AND USE OF CREDITS

Located within the Piedmont level III ecoregion and the Upper Cape Fear River basin, the Bank's geographic service area ("GSA") is defined by the United States Geological Survey (USGS) 8-digit Hydrological Unit Code ("HUC") within which the Bank's sites are located, the Cape Fear 02 (Figure 3).

The Bank's credits are proposed to be used to offset unavoidable, permitted impacts within the Bank's GSA. Use of the Bank's credits outside of its GSA may be permissible with approval by the USACE, which will be considered on a case-by-case basis.

4 WATERSHED CONSIDERATIONS

4.1 Watershed Environmental Concerns and Mitigation Needs

The Cape Fear River basin is one of four rivers in North Carolina completely contained within the state's boundaries. Comprised of five major drainages—Haw River, Deep River, Northeast Cape Fear River, Black River and the Cape Fear River—the basin drains portions of 26 counties and 115 municipalities with a total of 6,386 stream miles. The most populated portions of the basin are located in the Triad, the Triangle, Fayetteville, and Wilmington (NCDWQ 2005).

Nearly all of the Cape Fear 02 drains into B. Everett Jordan Lake ("Jordan Lake"), which is designated as impaired due to excessive levels of chlorophyll *a* according to state water quality standards. Stressors to Jordan Lake's water quality are associated with nitrogen and phosphorus inputs from point sources, especially municipal wastewater, and non-point sources such as urban stormwater runoff and rural agricultural runoff. Most of the impaired streams in the Cape Fear 02 are located in heavily urbanized areas.

Between the 2000 and 2010 censuses, the Cape Fear 02 population increased approximately 17 percent (Table 5). The general trend of population growth appears to be continuing according to recent population estimates, which indicate Guilford, Orange, Chatham and Durham counties are all growing at faster annual rates than the state's 1.02 percent (USCB 2013). These data suggest land development activities will increase in frequency, as will aquatic ecosystem impacts related to such development. Therefore, there is an immediate and prolonged need for compensatory stream mitigation in the watershed. Of further benefit, aquatic ecosystem restoration projects are capable of reducing nutrient loading in sensitive downstream receiving waters such as Jordan Lake.

Table 5: Population Growth in Cape Fear 02

Municipality	2000 Population	2010 Population	Percent Increase
Greensboro	223,891	269,666	20
Burlington	44,917	49,963	11
Chapel Hill	48,715	57,233	17
Durham*	187,035	228,330	22
Rest of Guilford County	421,048	488,406	11
Rest of Alamance County	130,800	151,131	18
Rest of Orange County	118,227	133,801	10
Chatham County	49,329	63,505	29
Rest of Durham County*	223,314	267,587	8
Totals	**942,718**	**1,104,430**	**17**

*Some portions of Durham (city) and Durham County are located in the Cape Fear 02; the majority of these areas are located in the Neuse River basin.

Historically, the Cape Fear 02 has experienced relatively high stream mitigation demand. Bass Mountain and Cripple Creek are the only active stream mitigation banks in the watershed. Current stream mitigation credit inventory relative to North

Carolina Ecosystem Enhancement Program (NCEEP) demand is exceptionally low. Since 2002, the NCEEP has requested 155,000 Stream Mitigation Units (SMUs) in the Cape Fear 02 (Table 6). Available inventory is approximately 482 SMUs.

Table 6: NCEEP Stream Mitigation Requests for Proposals in Cape Fear 02

Request For Proposals	SMUs Requested
October 26, 2005	90,000
November 22, 2006	17,000
November 24, 2009	5,000
October 30, 2013	43,000
Total	**155,000**

4.2 Bank Site Selection

Based on the analysis presented in Section 4.1, the Cape Fear 02 was targeted as a watershed in need of stream mitigation. The Sponsor and its consultant, Axiom Environmental, Inc. (Axiom), conducted a search for sites possessing stream restoration and enhancement opportunities. Identified sites were prioritized based on geomorphic condition and land use, and the necessary landowners were contacted to gauge their interest in participating in a stream mitigation project. Sites with willing landowners were then pursued further. As real estate in the area is generally well subdivided, many of the identified opportunities are not currently feasible because such sites require the cooperation of several landowners in order to achieve sufficient ecological and economic scale. Therefore, selection of the Phase I properties was based on a combination of geomorphic condition, land use, and the willingness of landowners to participate.

5 OWNERSHIP AND LONG-TERM MANAGEMENT

The Phase I properties are an assemblage of portions of larger holdings currently owned by the following people, or organizations:

Motes Creek – Thomas, Roger, and Patricia Dodson of Alamance County;
Benton Branch – Dennis Simmons of Caswell County;
Orphan Creek – Mr. and Mrs. Williamson of Alamance County;
Chico Branch – Billingsley & Associates of Rockingham County;
Major Hill – Jim Lamm of Alamance County;
Maple Hill Farm – Joe and Tish Murray of Alamance County;
Rocky Top – Jim Lamm of Alamance County; and
Slingshot Creek – Robert Wheless of Rockingham County.

Hereafter, these owners will collectively be referred to as "the Landowners."

The Sponsor and the Landowners have executed separate *Agreements for Purchase and Sale of Conservation Easements* covering approximately 19-acres along Motes Creek, 30-acres along Benton Branch, 14.5-acres along Orphan Branch, 8-acres

along Chico Creek, 11.1-acres along Maple Hill Farm, 10-acres along Major Hill, 5.2-acres along Rocky Top, and 13-acres along Slingshot Creek. Following USACE approval of the UMBI and the Phase I Mitigation Plan, the Sponsor will exercise its rights provided under the above-referenced agreements.

The Phase I properties will be protected in perpetuity by conservation easements approved by the USACE. At a minimum, conservation easements will be written to prohibit incompatible uses that might jeopardize objectives of the Bank. During the operational period of each site, the Sponsor may hold the conservation easements. Once a Bank site is closed out, easements will be transferred to a qualified land trust, such as the North Carolina Wildlife Habitat Foundation, to be held in perpetuity. The Sponsor will provide the land trust with a financial sum, in an amount agreeable to both parties, appropriate for the long-term stewardship of the sites.

During the operational period of a Bank site, the Sponsor will be responsible for management actions. Following Bank close out, the Landowners will serve as long-term managers of the sites, and the land trust holding conservation easements will routinely monitor the sites to ensure the Bank's conservation easement terms are not violated. Other long-term management responsibilities will include protecting the sites from encroachment, trespass, clearing, and other violations that interfere with conservation purposes. Fencing, suitable to prevent livestock grazing within easement boundaries, will be constructed as necessary. Conservation easement boundaries will be clearly marked prior to transfer.

6 QUALIFICATIONS OF SPONSOR

Restoration Systems is an environmental restoration, mitigation banking and full-delivery mitigation firm founded in 1998. The firm was formed to improve the quality of environmental restoration and mitigation by locating and acquiring the best available sites, planning restoration using proven science, and constructing sites with the most qualified contractors. Restoration Systems' staff has been involved in environmental mitigation and mitigation banking since 1992. Project managers have more than 80 years of experience in resource evaluation, environmental restoration, and mitigation implementation. The company employs 9 permanent staff members based in Raleigh, North Carolina.

Corporate experience with the principals began with completion of the state's full-delivery mitigation project in 1997, the Barra Farms Mitigation Bank (623-acres), the subsequent Bear Creek—Mill Branch Mitigation Bank in 2001 (450-acres), and Sleepy Creek Mitigation Site (550-acres). The firm then performed all of the off-site mitigation (7500-LF of stream restoration and 10-acres of wetland restoration) for the Piedmont Triad International Airport Authority.

Restoration Systems has implemented projects for the NCEEP, formerly the North Carolina Wetland Restoration Program; including the removal of the Carbonton and

Lowell Mill dams in the Cape Fear and Neuse River basins (132,000-LF), the Haw River Wetland Restoration Site (34-acres, Cape Fear), the Elk Shoals Stream Restoration Site (6,00-LF, Catawba), the Lick Creek Stream Site (10,000-LF, Cape Fear), Gatlin Swamp Wetland Restoration Site (125-acres, Roanoke), and a number of buffer restoration projects, including Casey Dairy, Walnut Creek, Big Bull, Brogden Road, and Little Buffalo.

Restoration Systems' Cripple Creek Stream & Wetland Mitigation Bank in the Cape Fear 02 River basin is the first compensatory wetland and stream bank in North Carolina under the 2008 Federal Compensatory Mitigation Rule. Additional mitigation banking projects are underway in North Carolina, including the Pancho Site, and throughout the southern United States.

7 ECOLOGICAL SUITABILITY OF SITES

Primary considerations for selecting the Phase I sites included the potential for protection/improvement of water quality within a region of North Carolina under heavy development and livestock/agricultural pressure. More specifically, considerations included desired aquatic resource functions, hydrologic conditions, soil characteristics, aquatic habitat diversity, habitat connectivity, compatibility with adjacent land uses, reasonably foreseeable effects the mitigation projects will have on ecologically important aquatic and terrestrial resources, and potential development trends and land use changes.

As all Phase I sites are located in Cape Fear 02, the current agricultural land uses at these sites may contribute nutrients to Jordan Lake (NCDWQ 2005). Restoration and enhancement work proposed in the Restoration Plan (Section 10) will reduce existing nutrient and sediment loads to downstream waters. In addition, restoration work will improve in-channel aquatic and riparian habitats.

8 FINANCIAL ASSURANCES

The Sponsor will provide financial assurances in a form acceptable to the IRT, sufficient to assure completion of all mitigation work, required reporting and monitoring, and any remedial work that may be required pursuant to the final UMBI.

Prior to the first credit release, for the Phase I sites proposed here as well as all additional sites permitted under the proposed UMBI, the Sponsor shall furnish a financial assurance instrument covering all reasonably anticipated costs relating to construction, operation, monitoring, maintenance and any remedial measures associated with the Bank. This instrument shall consist of either a Performance Bond underwritten by a surety company licensed to do business in North Carolina with a Best's current rating of not less than "A-," or a casualty insurance policy in an appropriate form to be approved by the USACE in compliance with current USACE policy and guidance documents. The total value of such a bond or policy will be

based on reasonably expected costs associated with approved Mitigation Plans, plus a reasonable contingency, which collectively shall be sufficient to ensure the project will be successfully completed in accordance with applicable performance standards.

If performance bonds are utilized, the initial performance bond shall be replaced following completion of construction and USACE approval of the Phase I as-built reports. The Sponsor shall then furnish a replacement performance bond, to be valued based on reasonably anticipated costs associated with project monitoring and maintenance. Once all performance standards have been met, the Sponsor may withdraw monies from or otherwise terminate the financial assurance instrument described in this paragraph.

9 EXISTING CONDITIONS

9.1 Motes Creek

The Motes Creek site is characterized by disturbed forest and agricultural land used for livestock grazing and hay production (Photo 1). The main hydrologic features include Motes Creek, three unnamed tributaries (UT) to Motes Creek, and adjacent floodplains. The proposed conservation easement area contains approximately 19-acres (Figure 4A).

9.1.1 Physiography, Topography, and Land Use

The Motes Creek site is located in the Carolina Slate Belt. Dissected, irregular plains characterize regional physiography with moderate to steep slopes and low- to moderate-gradient streams over boulder- and cobble-dominated substrate (Griffith et al. 2002). On-site elevations range from a high of 600-feet National Geodetic Vertical Datum ("NGVD") at the upper reach of UT 1 to a low of approximately 568-feet NGVD at the site outfall (Figure 4B).

This site drains an approximately 0.71-square mile (455-acres) watershed (Figure 4C). The watershed is dominated by pasture, agricultural land, forest, and sparse residential property. Impervious surfaces account for less than five-percent of the upstream land surface.

Land use at the site is characterized by disturbed forest, hay fields, and livestock pasture. Riparian zones and wetland areas are primarily composed of herbaceous vegetation that is sparse and disturbed due to livestock grazing, bush hogging, and regular land-management activities.

9.1.2 Water Quality

Motes Creek is located within USGS 14-digit HUC 030002050040 (Figure 2) and North Carolina Division of Water Resources (NCDWR) Subbasin 03-06-04. Topographic features of the Motes Creek site drain to Motes Creek (Stream Index Number 16-5), which has been assigned a Best Usage Classification of **C, NSW**

(NCDWR 2013). Streams with a C designation are protected for uses such as aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes wading, boating, and other uses not involving human body contact with waters on an organized or frequent basis. The NSW designation denotes nutrient sensitive waters, which include areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment.

NCDWR has assembled a list of impaired waterbodies according to the Clean Water Act Section 303(d) and 40 CFR 130.7, which is a comprehensive public accounting of all impaired waterbodies. An impaired waterbody is one that does not meet state standards, including designated uses, numeric and narrative criteria, and anti-degradation requirements defined in 40 CFR 131. Motes Creek, within and adjacent to the site discussed here, is not listed on the final 2012 or draft 2014 303(d) lists (NCDWQ 2012 and NCDENR 2014).

9.1.3 Vegetation

The Motes Creek site is characterized primarily by agricultural land, including livestock pasture and hay fields, and some areas of disturbed forest. Fields are dominated by fescue (*Festuca* sp.) with sparse natural recruits including dog fennel (*Eupatorium capillifolium*), clover (*Trifolium* sp.), cocklebur (*Xanthium strumarium*), as well as other opportunistic herbaceous species. Small wetted areas located within pastures are dominated by rushes (*Juncus* spp.) and sedges (*Carex* spp.) and sweetgum (*Liquidambar styraciflua*) with scattered Chinese privet (*Ligustrum sinense*), winged elm (*Ulmus alata*), Virginia pine (*Pinus virginiana*), persimmon (*Diospyros virginiana*), dog fennel, and broomsedge (*Andropogon* sp.).

9.1.4 Soils

Based on Web Soil Survey mapping (USDA 2014), proposed conservation easement areas associated with the Motes Creek site contain five soil series (Figure 4D and Table 7): Chewacla fine sandy loam (*Fluvaquentic Dystrudepts*), Efland silt loam (*Typic Hapludults*), Herndon silt loam (*Typic Kanhapludults*), local alluvial land, and Orange silt loam (*Albaquic Hapludalfs*).

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Table 7: Motes Creek Site Soils

Map Unit Symbol	Map Unit Name	Hydric Status	Description
Cd	Chewacla fine sandy loam	Non-hydric, may contain minor inclusions	This series consists of nearly level, somewhat poorly drained soils on floodplains that are frequently flooded. The seasonal high water table occurs at a depth of 0.5-2.0 feet.
EaB2, EaC2	Efland silt loam	Non-hydric	This series consists of well-drained soils found along slopes. Slopes range from 2-6 percent for EAB2 soils and 6-10 percent for EAC2 soils. This series is thin and can be associated with large rock outcrops. It is derived from parent material of the Carolina slate belt.
HdD	Herndon silt loam	Non-hydric	The series consists of well-drained soils found on steep slopes and uplands. Slopes range from 10-15 percent. This series is derived from parent material of the Carolina slate belt.
Lc	Local alluvial land, poorly drained	Hydric	This series consists of nearly level, poorly drained soils adjacent to streams and sloughs. This series developed from alluvial sediments washed from adjacent uplands and is not consistent in sequence, development, or arrangement of layers.
ObC2	Orange silt loam	Non-hydric	This series consists of moderately well-drained soils on smooth uplands near or on the top of slopes (2-6 percent). This series developed from igneous and metamorphic parent materials and has poor runoff and slow internal drainage.

9.1.5 Hydrology

Motes Creek site streams are mapped as intermittent by USGS (Figure 4B) and are not mapped by the National Wetlands Inventory (NWI). However, on-site investigations—including benthic macroinvertebrate sampling and NCDWQ stream forms (Table 8)—suggest Motes Creek and its tributaries are perennial.

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Table 8: Motes Creek Existing Stream Flow Regime

Stream	Stream Length	Stream Order	USGS Stream Classification	In-field Stream Classification
Motes Creek	1831	2nd	Intermittent	Perennial
UT 1	1272	1st	Intermittent	Perennial
UT 2	2098	1st	Intermittent	Perennial
UT 3	545	1st	Not mapped	Perennial
Total	**5,746**			

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging 43.7-inches per year (based on data provided by NOAA 2014). Site discharge is dominated by a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Harman et al. 1999), the bankfull discharge for a 0.71-square mile watershed is expected to average 70-cubic feet per second (CFS). Based on empirical evidence a bankfull discharge of 70-CFS is expected to occur approximately every 1.3 to 1.5 years (Rosgen 1996, Leopold 1994).

9.1.6 Fluvial Geomorphology

Currently, channels targeted for restoration are characterized as entrenched and/or incised G-type or C-type channels with little to no sinuosity, little to no riffle-pool morphology, oversized cross-sectional areas, and no access to floodplains during high discharge events (Bank Height Ratio (BHR) range > 1.3 to 2.4). Sinuosity was measured at 1.05 from topographic surveys, aerial photography, and visual observation during field surveys.

In general, sediment and nutrient inputs, channel incision and straightening, livestock trampling, removal of cobble substrate, aggradation of silt and sand, and removal of woody vegetation have impacted Motes Creek site streams.

9.1.7 FEMA

Inspection of the FEMA Flood Insurance Rate Map 3710981100J, Panel 9811, effective September 6, 2006, indicates that Motes Creek streams are not located in a Special Flood Hazard Area, and the project should not alter FEMA flood zones. Therefore, a "Conditional Letter of Map Revision" (CLOMR) is not necessary for this site.

9.2 Benton Branch

The Benton Branch site is characterized by disturbed forest and agricultural land used for livestock grazing and hay production (Photo 2). The main hydrological features include Benton Branch and six UTs to Benton Branch. Several of these streams have impoundments in the headwaters reducing the frequency and

duration of channel-forming discharges. The proposed conservation easement area contains approximately 30-acres (Figure 5A).

9.2.1 Physiography, Topography, and Land Use

The Benton Branch site is located in the Southern Outer Piedmont. Dissected irregular plains, low rounded hills and ridges, and low- to moderate-gradient streams with mostly cobble, gravel, and sandy substrates characterize regional physiography. On-site elevations range from a high of 645-feet NGVD at the upper reaches of UT 3 to a low of approximately 620-feet NGVD at the site outfall (Figure 5B).

This site drains an approximately 9.1-square mile watershed at the outfall with smaller drainage areas ranging from 0.03 to 1.24-square miles (Figure 5C). The watershed is primarily composed of pasture, with sparse residential areas along state-maintained roads, and forestland in the upper headwaters. Impervious surfaces account for less than five-percent of the upstream land surface.

Land use at the site is characterized by disturbed forest, hay fields, and livestock pasture. Riparian zones and wetland areas are primarily composed of herbaceous vegetation that is sparse and disturbed due to livestock grazing, bush hogging, and regular land-management activities.

9.2.2 Water Quality

The site is located within the Cape Fear River Basin in USGS 14-digit HUC 03030002030030 (Figure 2) and NCDWR Subbasin number 03-06-02. Benton Branch has been assigned Stream Index Number 16-14-3 and a Best Usage Classification of **WS-II, HQW, NSW**. WS-II streams are protected as water supplies for drinking, culinary, or food-processing purposes. These waters are also protected for Class C uses, such as aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes wading, boating, and other uses not involving human body contact with waters on an organized or frequent basis. All WS-II waters are HQW (High Quality Waters) by supplemental classification. The designation NSW includes areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment. Site streams are not included on the 2012 Final, or draft 2014 303(d) lists of impaired waterbodies (NCDWQ 2012 and NCDENR 2014).

9.2.3 Vegetation

The Benton Branch site is characterized primarily by agricultural land utilized for beef cattle production and scattered disturbed forest. Agricultural land is maintained for livestock grazing and has been planted with fescue (*Festuca* sp.). Natural recruits of dog fennel (*Eupatorium capillifolium*), clover (*Trifolium* sp.), nightshade (*Solanum carolinense*), as well as other opportunistic herbaceous species have recolonized the site. Several pockets of wetland occur in the site, which are characterized by rushes (*Juncus* spp.) and sedges (*Carex* spp.). Disturbed forest is largely cleared of understory species due to livestock pruning and is composed of

sweetgum (*Liquidambar styraciflua*), Chinese privet (*Ligustrum sinense*), winged elm (*Ulmus alata*), Virginia pine (*Pinus virginiana*), persimmon (*Diospyros virginiana*), dog fennel, and broomsedge (*Andropogon* sp.).

9.2.4 Soils

Detailed soil mapping by NRCS has not been completed for Caswell County. The most recent published soil survey for Caswell County is dated 1908, with general soil mapping conducted countywide; therefore a map of the site's soils is not provided here. The countywide NRCS map depicts the site as being underlain by Cecil sandy loam in floodplains and low-lying areas, with Cecil sandy clay and Iredell sandy loam in the adjacent uplands (Table 9).

Table 9: Benton Branch Site Soils

Map Unit Symbol	Map Unit Name	Hydric Status	Description
Cs and Cc	Cecil sandy loam and Cecil sandy clay	Non-hydric	The Cecil series consists of very deep, well-drained, moderately permeable soils on ridges and side slopes of Piedmont uplands. This series formed in residuum weathered from felsic, igneous and high-grade metamorphic rocks of the Piedmont uplands. Slopes range from 0 to 25 percent.
Is	Iredell sandy loam	Non-hydric	The Iredell series is brownish-gray or very dark brown, moderately well drained, medium acid soils of the Piedmont Plateau. This series occurs wherever the geologic formation contains basic dikes. These soils are important to agriculture.

A North Carolina Licensed Soil Scientist identified a portion of the Benton Branch Site as containing hydric soil. The only hydric soils listed as occurring in Caswell County are soils of the Codorus and/or Hatboro soil series. On-site hydric soils are grey to gley in color and are compacted and pockmarked by livestock trampling and agricultural activities. Livestock grazing, annual mowing for hay harvest, and clearing of timber have resulted in an herbaceous vegetative community. Groundwater springs and surface runoff contribute hydrology to these areas. At this time, no detailed soil mapping has been conducted at the site.

9.2.5 Hydrology

Benton Branch site streams are mapped as perennial and intermittent by the USGS (Table 10; Figures 5B) and are not mapped by the NWI.

Table 10: Benton Branch Existing Stream Flow Regime

Stream	Stream Length	Stream Order	USGS Stream Classification	In-field Stream Classification
Benton Br	2054	4th	Perennial	Perennial
UT1	1232	1st	Intermittent	Perennial
UT2	244	1st	Not Mapped	Perennial
UT3	1395	1st	Not Mapped	Perennial
UT4	1413	1st	Intermittent	Perennial
UT5	1466	2nd	Intermittent	Perennial
UT6	1039	3rd	Intermittent	Perennial
Total	**8,843**			

With the exception of Benton Branch, the site's tributaries are depicted as intermittent on the USGS 7.5-minute topographic quadrangle. However, UT 4, UT 5, and UT 6 exhibit field characteristics of perennial streams. These tributaries have drainage areas encompassing 0.13, 0.68, and 1.24-square miles, respectively, and the channels are well defined with cobble substrate. In addition, benthic macroinvertebrate samples collected in the upper reaches of UT 4 using the Qual-4 technique support a perennial flow regime designation (stonefly larvae).

UT 2 and UT 3 are not mapped by the USGS; however, field evidence—including benthic macroinvertebrate samples, NCDWQ Stream Identification Form [v4.11] scores, and evidence of stream flow during field visits—indicates the channels are intermittent to perennial. UT 1, UT 2, and UT 3 all exhibit characteristics of perennial flow in the upper reaches. However, ponds upstream from the stream origin point, low slope of floodplain, livestock impacts to channels, and antropogenic alterations to the floodplain and channels have resulted in loss of stream channel morphology in the downstream reaches.

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging 43.4-inches per year (based on data provided by NOAA 2014). Site discharge is dominated by a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves, the bankfull discharge for a 0.3-square mile and 9.1-square mile watershed are expected to average 7.8 and 439-CFS, respectively (Harman et al. 1999). A bankfull discharge is expected to occur approximately every 1.3 to 1.5-years (Rosgen 1996, Leopold 1994).

9.2.6 Fluvial Geomorphology

Currently, two distinct stream types characterize channels targeted for restoration. One is an entrenched and/or incised G-type or F-type channel with sinuosity affected by bank erosion and hoof shear. Riffle-pool morphology has been compromised by sedimentation and bank collapse due to a lack of deep-rooted vegetation. These channels are oversized with no access to floodplains during high-discharge events (BHR = 3.6).

A second stream type includes streams without existing channels due to aggradation resulting from livestock trampling, vegetative clearing, removal of channel substrate, and channel rerouting. Headwater ponds further affect some of the channels in this category. Ponds in the upper reaches of UT 1, UT 2, and UT 3 appear to attenuate storm flows, thereby reducing sediment mobilization. Reduced sediment transport and intensive trampling of channel bed and banks by livestock has produced aggraded channels characterized as wide, compacted sloughs without defined beds or banks.

9.2.7 FEMA

Inspection of the FEMA Flood Insurance Rate Map 371089600K, Panel 8960, effective September 28, 2007, indicates that Benton Branch, UT 3, and associated floodplains are located within a Zone AE flood area. Therefore, a HEC-RAS analysis will be completed on the existing and proposed conditions of Benton Branch and its tributaries that enter the Benton Branch floodplain to assess hydraulic performance. As per N.C. Floodplain Mapping requirements, a Conditional Letter of Map Revision (CLOMR) will need to be prepared for the site.

The CLOMR includes written documentation of modeling, preparation of topographic work maps, annotated FIRM or Floodway Maps, FIRM Flood Profiles and Data Tables. The CLOMR will be sent to Caswell County for approval and signature, and then the CLOMR will be sent to FEMA for review and approval. The CLOMR approval process will take 3-6 months. The CLOMR should be prepared, submitted and approved prior to construction. A requirement of the CLOMR is to prepare and submit a Letter of Map Revision (LOMR) once construction is complete.

9.3 Orphan Creek

The Orphan Creek site is characterized by agricultural land used for livestock grazing and hay production (Photo 3). The main hydrologic features include five-UTs to Meadow Creek (Main Channel, UT 1A, UT 1B, UT 2, and UT 3) and adjacent floodplains. The proposed conservation easement area contains approximately 14.5-acres (Figure 6A).

9.3.1 Physiography, Topography and Land Use

The Orphan Creek site is located in the Carolina Slate Belt. Dissected, irregular plains characterize regional physiography with moderate to steep slopes and low- to moderate-gradient streams over boulder and cobble-dominated substrate (Griffith et al. 2002). On-site elevations range from a high of 570-feet NGVD at the upper

reaches of UT 1A to a low of approximately 540-feet NGVD at the site outfall (Figure 6B).

This site drains an approximately 0.2-square mile (127-acre) watershed (Figure 5C). The watershed is dominated by pasture, agricultural land, disturbed forest, and sparse residential property. Impervious surfaces account for less than five-percent of the upstream land surface.

Land use at the site is characterized by hay fields and livestock pasture. Livestock have unrestricted access to site streams. A narrow riparian fringe has developed on the stream margins composed of opportunistic species and a few mature trees.

9.3.2 Water Quality

Orphan Creek is located within USGS 14-digit HUC 03030002050010 (Figure 2) and NCDWR Subbasin 03-06-02. Topographic features of the Orphan Creek site drain off site to Meadow Creek (Stream Index Number 16-23), which has been assigned a Best Usage Classification of **WS-V, NSW** (NCDWR 2013). WS-V streams are protected as water supplies that are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or as waters formerly used as water supply. These waters are also protected for Class C uses such as aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes wading, boating, and other uses not involving human body contact with waters on an organized or frequent basis. The NSW designation denotes nutrient sensitive waters, which include areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment. Meadow Creek, the receiver of site tributaries, is not listed on the final 2012 or draft 2014 303(d) lists (NCDWQ 2012 and NCDWR 2014).

9.3.3 Vegetation

The Orphan Creek site is characterized primarily by agricultural land, including pasture, hay fields, and some areas of disturbed forest. Fields are dominated by fescue (*Festuca* sp.) with sparse natural recruits including dog fennel (*Eupatorium capillifolium*), nightshade (*Solanum* sp.), blackberry (*Rubus argutus*), dandelion (*Taraxacum* sp.), as well as other opportunistic herbaceous species. Scattered trees located adjacent to site tributaries include Chinese privet (*Ligustrum sinense*), winged elm (*Ulmus alata*), loblolly pine (*Pinus taeda*), persimmon (*Diospyros virginiana*), red maple (*Acer rubrum*), Russian olive (*Elaeganus angustifolia*), eastern red cedar (*Juniperus virginiana*), black walnut (*Juglans nigra*), shagbark hickory (*Carya ovata*), sweetgum (*Liquidambar styraciflua*), and poison ivy (*Toxicodendron radicans*).

9.3.4 Soils

Based on Web Soil Survey mapping (USDA 2014), the proposed conservation easement areas associated with the Orphan Creek site contain four soil series (Figure 6D and Table 11): Efland silt loam (*Typic Hapludults*), local alluvial land,

Orange silt loam (*Albaquic Hapludalfs*), and Tirzah silt loam and silty clay loam (*Typic Kanhapludults*).

Table 11: Orphan Creek Site Soils

Map Unit Symbol	Map Unit Name	Hydric Status	Description
EaB2	Efland silt loam	Non-hydric	This series consists of well-drained soils found along 2-6 percent slopes. This series is thin, can be associated with large rock outcrops, and is derived from parent material of the Carolina slate belt.
Lc	Local alluvial land, poorly drained	Hydric	This series consists of nearly level, poorly drained soils adjacent to streams and sloughs. This series developed from alluvial sediments washed from adjacent uplands and is not consistent in sequence, development, or arrangement of layers.
ObB2	Orange silt loam	Non-hydric	This series consists of moderately well-drained soils on smooth uplands near or on the top of 2-6 percent slopes. This series developed from igneous and metamorphic parent materials and has poor runoff and slow internal drainage.
TaB2, TaC2, TbC3, TbD3	Tirzah silt loam and silty clay loam	Non-hydric	The series consists of well-drained soils found on ridges and side slopes. Slopes range from 2-6 percent for TaB2 (eroded), 6-10 percent for TaC2 (eroded) and TaC3 (severely eroded), and 10-15 percent for TbD3 (severely eroded). This series is derived from parent material of the Carolina slate belt.

9.3.5 Hydrology

The Main Channel at the Orphan Creek site is mapped by USGS as intermittent; however UT 1A, UT 2 and UT 3 are not mapped (Figure 6B). The NWI does not map any channels at the Orphan Creek site. On-site investigations, however, suggest all channels are either perennial or intermittent. Benthic macroinvertebrate samples were collected in the upper reaches of the Main Channel and UT 2 using the Qual-4 technique. The results suggest the Main Channel, UT 1A and UT 2 are perennial; and UT 1B and UT 3 are intermittent (Table 12).

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Table 12: Orphan Creek Existing Stream Flow Regime

Stream	Stream Length	Stream Order	USGS Stream Classification	In-field Stream Classification
Main Channel	1181	2nd	Intermittent	Perennial
UT 1A	278	1st	Not mapped	Perennial
UT 1B	232	1st	Not mapped	Intermittent
UT 2	382	1st	Not mapped	Perennial
UT 3	595	1st	Not mapped	Intermittent
Total	**2668**			

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging 43.7-inches per year (based on data provided by NOAA 2014). Site discharge is dominated by a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Harman et al. 1999), the bankfull discharge for a 0.2-square mile watershed is expected to average 27.7-CFS. A bankfull discharge event is expected to occur approximately every 1.3 to 1.5-years (Rosgen 1996, Leopold 1994).

9.3.6 Fluvial Geomorphology

Currently, channels targeted for restoration are characterized as entrenched and/or incised G-type or F-type channels with little to no sinuosity, little to no riffle-pool morphology, oversized channel cross-sectional areas, and no access to floodplains during high discharge events (BHR range > 2.2 to 2.7). Sinuosity was measured at 1.02 using topographic surveys, aerial photography, and visual observation during field surveys.

In general, the streams comprising the Orphan Creek site have been impacted by excavation of a straightened channel, excessive sediment and nutrient inputs, channel incision, livestock trampling, removal of cobble substrate, aggradation of silt and sand, and removal of woody vegetation.

9.3.7 FEMA

Inspection of the FEMA Flood Insurance Rate Map 3710980100J, Panel 8901, effective September 6, 2006, indicates that Orphan Creek streams are not located in a Special Flood Hazard Area, and the project should not alter FEMA flood zones. Therefore, a "Conditional Letter of Map Revision" (CLOMR) is not necessary for this site.

9.4 Chico Branch

The Chico Branch site is characterized by disturbed forest and agricultural land used for livestock grazing and hay production (Photo 4). The main hydrologic features include two unnamed tributaries to Troublesome Creek (UT 1 and UT 2) and

adjacent floodplains. The proposed conservation easement area contains approximately 8-acres (Figure 7A).

9.4.1 Physiography, Topography and Land Use

The Chico Branch site is located in the Northern Inner Piedmont. Dissected, irregular plains, low to high hills, ridges, and isolated monadnocks characterize regional physiography with low to moderate-gradient streams over cobble, gravel, and sand-dominated substrate (Griffith et al. 2002). On-site elevations range from a high of 720-feet NGVD at the upper reach of UT 1 to a low of approximately 690-feet NGVD at the site outfall (Figure 7B).

This site drains an approximately 0.1-square mile (61-acre) watershed (Figure 7C). The watershed is dominated by pasture, agricultural land, sparse forest, and rural residential property. Impervious surfaces account for less than five-percent of the upstream land surface.

Land use at the site is characterized by disturbed forest, hay fields, and livestock pasture. Riparian zones and wetland areas primarily support herbaceous vegetation that is sparse and disturbed due to livestock grazing, bush hogging, and regular land management activities.

9.4.2 Water Quality

Chico Branch is located within USGS 14-digit HUC 0303000201001 (Figure 2) and NCDWR Subbasin 03-06-01. Topographic features of the Chico Branch site drain to Troublesome Creek (Stream Index Number 16-6-(3)), which has been assigned a Best Usage Classification of **WS-V, NSW** (NCDWR 2013). WS-V streams are protected as water supplies, which are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or as waters formerly used as water supply. These waters are also protected for Class C uses such as aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes wading, boating, and other uses not involving human body contact with waters on an organized or frequent basis. The NSW designation denotes nutrient sensitive waters, which include areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment. Troublesome Creek, immediately downstream of the site, is listed on the final 2012 or draft 2014 303(d) lists for low levels of dissolved oxygen (NCDWQ 2012 and NCDENR 2014).

9.4.3 Vegetation

The Chico Branch site is characterized primarily by agricultural land, including pasture and hay fields, and some areas of disturbed forest in the downstream reaches. Fields are dominated by fescue (*Festuca* sp.) with sparse natural recruits including dog fennel (*Eupatorium capillifolium*), nightshade (*Solanum* sp.), clover (*Trifolium* sp.), blackberry (*Rubus argutus*), dandelion (*Taraxacum* sp.), as well as other opportunistic herbaceous species. Stream channels have been trampled by livestock and are characterized by wetter species such as rushes (*Juncus* spp.) and

sedges (*Carex* spp.). Disturbed forest occurs in the downstream portions of the site, which serves as the headwaters for an agriculture pond. Tree species include loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), eastern red cedar (*Juniperus virginiana*), and sweetgum (*Liquidambar styraciflua*).

9.4.4 Soils

Based on Web Soil Survey mapping (USDA 2014), the proposed conservation easement areas associated with the Chico Branch site contain two soil series (Figure 7D and Table 13): Clifford sandy clay loam (*Typic Kanhapludults*) and Fairview-Poplar Forest complex (*Typic Kanhapludults*).

Table 13: Chico Branch Site Soils

Map Unit Symbol	Map Unit Name	Hydric Status	Description
CgB2	Clifford sandy clay loam	Non-hydric	This series consists of well-drained, moderately eroded soils found along 2-8 percent slopes. The parent material is saprolite derived from schist and/or gneiss.
FrD2	Fairview-Poplar complex	Non-hydric	This series consists of well-drained, moderately eroded soils found on 8-15 percent hill slopes on ridges. The parent material is saprolite derived from schist and/or gneiss.

A North Carolina Licensed Soil Scientist identified a portion of the Chico Branch site as containing hydric soil. Hydric soils are located in floodplain portions of the site and are likely soils of the Wehadkee and/or Worsham series. On-site hydric soils are grey to gley in color and are cleared of forest vegetation and accessible by livestock. Livestock grazing, annual mowing for harvest of hay, and clearing of timber have resulted in an herbaceous vegetative community. At this time, no detailed soil mapping has been conducted at the site.

9.4.5 Hydrology

Chico Branch site streams are not mapped by USGS or NWI. However, on site investigations—including benthic macroinvertebrate collections in an adjacent, similarly sized reference reach underlain by the same soil series—suggest the streams would be intermittent to perennial without existing land-use impacts (Table 14).

Table 14: Chico Branch Existing Stream Flow Regime

Stream	Stream Length	Stream Order	USGS Stream Classification	In-field Stream Classification
UT1	1447	1st	Not mapped	Intermittent/Perennial
UT2	848	1st	Not mapped	Intermittent/Perennial
Total	**2295**			

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging 41.7 inches per year (USDA 1992). Site discharge consists of a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Harman et al. 1999), the bankfull discharge for a 0.1-square mile watershed is expected to average 16.9-CFS. A bankfull discharge event is expected to occur approximately every 1.3 to 1.5-years (Rosgen 1996, Leopold 1994).

9.4.6 Fluvial Geomorphology

Livestock trampling has aggraded channels targeted for restoration. These channels are discontinuous with pockmarked soils and adjacent compaction resulting in accelerated overland runoff. In addition, small impoundments within the channels result in an alternating pattern of aggradation and scour. A lack of deep-rooted vegetation and removal of stream substrate, combined with heavy stocking rates of livestock with unrestricted access to the channels, results in shallow depressions devoid of any discernable geometry.

An adjacent reference stream, not impacted by livestock, exhibits channel morphology of an E-type channel with natural sinuosity. The reference channel appears slightly smaller than regional curves; however, dimension, pattern, and profile appear suitable as a reference for the Chico Branch site.

9.4.7 FEMA

Inspection of the FEMA Flood Insurance Rate Map 3710891200J, Panel 8912, effective July 3, 2007, indicates that Chico Branch streams are not located in a Special Flood Hazard Area, and the project should not alter FEMA flood zones. Therefore, a "Conditional Letter of Map Revision" (CLOMR) is not necessary for this site.

9.5 Major Hill

The Major Hill site is characterized by disturbed forest and agricultural land used for livestock grazing and hay production (Photo 5). The main hydrologic features include two unnamed tributaries to Pine Hill Branch (UT 1 and UT 2) and adjacent floodplains. The proposed conservation easement area contains approximately 10-acres (Figure 8A).

9.5.1 Physiography, Topography and Land Use

The Major Hill site is located in the Carolina Slate Belt. Dissected, irregular plains characterize regional physiography with moderate to steep slopes and low to moderate-gradient streams over boulder and cobble-dominated substrate (Griffith et al. 2002). On-site elevations range from a high of 560-feet NGVD at the upper reach of UT 1 to a low of approximately 510-feet NGVD at the site outfall (Figure 8B).

This site drains an approximately 0.09-square mile (60.4-acre) watershed (Figure 8C). The watershed is dominated by pasture, agricultural land, sparse forest, and sparse residential property. Impervious surfaces account for less than five-percent of the upstream land surface.

Land use at the site is characterized by hay fields, livestock pasture, row crop production, and disturbed forest. Row crops were soybeans at the time of the initial site visit; however, the landowner is converting the property back into livestock pasture in the near future. Riparian zones in the lower half of UT 1 and all of UT 2 are comprised of disturbed hardwood forest that are accessible by livestock.

9.5.2 Water Quality

Major Hill is located within USGS 14-digit HUC 03030002050050 (Figure 2) and NCDWR Subbasin 03-06-04 (Figure 2). Topographic features of the Major Hill site drain off site to Pine Hill Branch (Stream Index Number 16-28-5-1), which has been assigned a Best Usage Classification of **WS-V, NSW** (NCDWR 2013). WS-V streams are protected as water supplies that are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or as waters formerly used as water supply. These waters are also protected for Class C uses such as aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes wading, boating, and other uses not involving human body contact with waters on an organized or frequent basis. The NSW designation denotes nutrient sensitive waters, which include areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment. Pine Hill Branch, adjacent to the site discussed here, is not listed on the final 2012 or draft 2014 303(d) lists (NCDWQ 2012 and NCDENR 2014).

9.5.3 Vegetation

The Major Hill site is characterized primarily by agricultural land, including pasture and hay fields and some areas of disturbed forest. Fields are dominated by fescue (*Festuca* sp.) planted for livestock. Stocking rates appear high leading to opportunistic natural recruits of aggressive species including curly dock (*Rumex crispus*), cocklebur (*Xanthium strumarium*), dog fennel (*Eupatorium capillifolium*), nightshade (*Solanum* sp.), and dandelion (*Taraxacum* sp.). Disturbed forest is characterized by hardwood species such as willow oak (*Quercus phellos)*, post oak *(Quercus stellata),* white oak (*Quercus alba*), hickory *(Carya* sp.*),* red maple (*Acer rubrum*), red cedar *(Juniperos virginiana),* and sweetgum (*Liquidambar styraciflua*),

with extensive invasive species such as Russian olive (*Elaeganus angustifolia*), Chinese privet (*Ligustrum sinense*), and rose (*Rosa* sp.).

9.5.4 Soils

Based on Web Soil Survey mapping (USDA 2014), the proposed conservation easement areas associated with the Major Hill site contain five soil series (Figure 8D and Table 15): Efland silt loam (*Typic Hapludults*), Georgeville silt loam (*Typic Kanhapludalts*), Herndon silt loam (*Typic Kanhapludalts*), local alluvial land, and Orange silt loam (*Albaquic Hapludalfs*).

Table 15: Major Hill Site Soils

Map Unit Symbol	Map Unit Name	Hydric Status	Description
EaC	Efland silt loam	Non-hydric	This series consists of well-drained soils found along 6-10 percent slopes. This series is thin, can be associated with large rock outcrops, and is derived from parent material of the Carolina slate belt.
GaC2	Georgeville silt loam	Non-hydric	This series consists of well-drained soils on 6-10 percent hillslopes on ridges. This series is formed in residuum weathered from metavolcanics and/or argilite.
HdC	Herndon silt loam	Non-hydric	This series consists of well-drained soils on 6-10 percent hillslopes on ridges. This series is formed in residuum weathered from metavolcanics and/or argilite.
Lc	Local alluvial land, poorly drained	Hydric	This series consists of nearly level, poorly drained soils on floodplains and is developed from loamy alluvial sediments derived from igneous and metamorphic rock. This series is not consistent in sequence, development, or arrangement of layers.
ObC	Orange silt loam	Non-hydric	This series consists of moderately well-drained soils on 6-10 percent hill slopes on ridges. This series is formed in residuum weathered from metavolcanics and/or argilite.

9.5.5 Hydrology

The USGS maps UT 1 as intermittent, while UT 2 is unmapped. The NWI does not map any of the site's channels. However, on-site investigations—including benthic macroinvertebrate samples collected in the upper reaches of UT 1 using the Qual-4 technique—suggest UT 1 is perennial. UT 2 appears to be intermittent and was dry during summer field investigations (Table 16).

Table 16: Major Hill Existing Stream Flow Regime

Stream	Stream Length	Stream Order	USGS Stream Classification	In-field Stream Classification
Tributary 1	1552	1st/2nd	Intermittent	Perennial
Tributary 2	858	1st	Not mapped	Intermittent
Total	**2410**			

It should be noted that an agriculture pond has impounded the upper reach of UT 1. Benthic macroinvertebrate measurements collected upstream of the influence of this pond indicate the channel is perennial leading into the pond. Attenuation and storage of stream flow appear to have resulted in a loss of channel forming/maintenance flows below the pond. This, coupled with dense herbaceous vegetation and livestock trampling, has resulted in a completely aggraded channel below the pond.

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging 43.7-inches per year (based on data provided by NOAA 2014). Site discharge consists of a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Harman et al. 1999), the bankfull discharge for a 0.09-square mile watershed is expected to average 16.2-CFS. A bankfull discharge event is expected to occur approximately every 1.3 to 1.5-years (Rosgen 1996, Leopold 1994).

9.5.6 Fluvial Geomorphology

Currently, channels targeted for restoration are characterized as entrenched and/or incised G-type or E-type incised channels with oversized cross-sectional areas, little to no riffle-pool morphology, and no access to floodplains during high discharge events (BHR range > 1.6 to 1.8). Sinuosity appears to be relatively normal in the lower reaches, measuring 1.2; however, channel erosion has resulted in migrating channels, mass wasting, and tight meander radii.

The upper reach of UT 1 has been impounded and aggraded by livestock trampling. A lack of deep-rooted vegetation and removal of stream substrate, combined with intensive livestock access to the channel results in no measurable channel characteristics.

In general, the Major Hill site streams have been impacted by land clearing, impoundment, sediment and nutrient inputs, channel incision and straightening, livestock trampling, removal of cobble substrate, aggradation of silt and sand, and removal of woody vegetation.

9.5.7 FEMA

Inspection of the FEMA Flood Insurance Rate Map 3710879700J, Panel 8797, effective September 6, 2006, indicates that Major Hill streams are not located in a Special Flood Hazard Area, and the project should not alter FEMA flood zones. Therefore, a "Conditional Letter of Map Revision" (CLOMR) is not necessary for this site.

9.6 Maple Hill Farm

Pasture, fallow fields, and mature forest characterize the Maple Hill Farm site. Historically, the property was used for livestock grazing, including beef cattle and horses (Photo 6). Within the past few years, livestock have been removed and pastures maintained for hay production. The main hydrologic features include four UTs to Marys Creek (UT 1, UT 2A, UT 2B, and UT 3) and adjacent floodplains. The primary restoration feature (UT 1) has been rerouted across the property, bypassing its historic floodplain. The proposed conservation easement area, including the historic UT 1 floodplain, encompasses approximately 11.1-acres (Figure 9A).

9.6.1 Physiography, Topography and Land Use

Maple Hill Farm is located in the Carolina Slate Belt. Dissected, irregular plains characterize regional physiography with moderate to steep slopes and low to moderate-gradient streams over boulder and cobble-dominated substrate (Griffith et al. 2002). On-site elevations range from a high of 620-feet NGVD at the upper reach of UT 1 to a low of approximately 580-feet NGVD at the outfall of site tributaries (Figure 9B).

This site cumulatively drains an approximately 0.26-square mile (162-acres) watershed amongst three individual drainage basins (UT 1, UT 2, and UT 3; Figure 9C). The watershed is dominated by pasture, agricultural land, and forest. Impervious surfaces account for less than one-percent of the upstream land surface.

Land use at the site is characterized by hay fields and disturbed forest. The property was intensively grazed by beef cattle. Currently, no livestock occupy the property, but future land-management objectives include the reintroduction of livestock. Riparian zones are composed of a thin forest fringe characterized by a thick understory of vines and invasive shrubs.

9.6.2 Water Quality

Maple Hill Farm is located within USGS 14-digit HUC 03030002050020 (Figure 2) and NCDWR Subbasin 03-06-04. Topographic features of Maple Hill Farm drain to Marys Creek (Stream Index Number 16-26), which has been assigned a Best Usage Classification of **WS-V, NSW** (NCDWR 2013). WS-V streams are protected as water supplies that are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or as waters formerly used as water supply. These waters are also protected for Class C uses such as aquatic life propagation and survival, fishing, wildlife, secondary recreation, and

agriculture. Secondary recreation includes wading, boating, and other uses not involving human body contact with waters on an organized or frequent basis. The NSW designation denotes nutrient sensitive waters, which include areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment. Marys Creek, adjacent to the site, is not listed on the final 2012 or draft 2014 303(d) lists (NCDWQ 2012 and NCDENR 2014); however, it was historically listed for habitat degradation and impaired biological integrity, most likely due to agriculture.

9.6.3 Vegetation

Primarily hay fields and some areas of disturbed forest characterize Maple Hill Farm. Fields are dominated by fescue (*Festuca* sp.) with sparse natural recruits including dog fennel (*Eupatorium capillifolium*), nightshade (*Solanum* sp.), blackberry (*Rubus argutus*), dandelion (*Taraxacum* sp.), as well as other opportunistic herbaceous species. Scattered trees located adjacent to site tributaries include Chinese privet (*Ligustrum sinense*), winged elm (*Ulmus alata*), pines (*Pinus* spp.), persimmon (*Diospyros virginiana*), red maple (*Acer rubrum*), eastern red cedar (*Juniperus virginiana*), black walnut (*Juglans nigra*), white oak (*Quercus alba*), sweetgum (*Liquidambar styraciflua*), and poison ivy (*Toxicodendron radicans*).

9.6.4 Soils

Based on Web Soil Survey mapping (USDA 2014), the proposed conservation easement areas associated with Maple Hill Farm contain four soil series (Figure 9D and Table 17): Georgeville silt loam (*Typic Kanhapludalts*), Herndon silt loam (*Typic Kanhapludalts*), local alluvial land, and Orange silt loam (*Albaquic Hapludalfs*).

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Table 17: Maple Hill Farm Site Soils

Map Unit Symbol	Map Unit Name	Hydric Status	Description
GaB2	Georgeville silt loam	Non-hydric	This series consists of well-drained soils on 2-6 percent hillslopes on ridges. This series is formed in residuum weathered from metavolcanics and/or argilite.
HdB2, HdD	Herndon silt loam	Non-hydric	This series consists of very deep, well-drained, moderately permeable soils on 2-6 percent (HdB2) gently sloping to 10-15 percent (HdD) steep uplands. This series is formed in material mostly weathered from fine-grained metavolcanic rocks of the Carolina Slate Belt.
Lc	Local alluvial land, poorly drained	Hydric	This series consists of nearly level, poorly drained soils on floodplains and is developed from loamy alluvial sediments derived from igneous and metamorphic rock. This series is not consistent in sequence, development, or arrangement of layers.
ObB2, ObC2	Orange silt loam	Non-hydric	This series consists of moderately well drained soils on smooth uplands near or on the top slopes. Slopes range from 2-6 percent (ObB2) and 6-10 percent (ObC2). This series is developed from igneous and metamorphic parent materials and has poor runoff and slow internal drainage.

9.6.5 Hydrology

UT 1 and UT 3 are mapped as intermittent by the USGS[1] (Figure 9B). None of the site channels is mapped by the NWI. UT 1 and UT 3 exhibit perennial characteristics in the field. UT 2A and UT 2B are not mapped; however, on-site investigations—including a field review and NCDWQ stream forms—suggest UT 2A and UT 2B are intermittent (Table 18).

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[1] The best available resolution (240k) of USGS topographic data used in GIS to create Figure 9B does not map UT 3. However, the channel is clearly mapped as intermittent on 24k USGS quad sheets.

Table 18: Maple Hill Farm Existing Stream Flow Regime

Stream	Stream Length	Stream Order	USGS Stream Classification	In-field Stream Classification
Tributary 1	1312	1st	Intermittent	Perennial
Tributary 2A	711	1st	Not mapped	Intermittent
Tributary 2B	1090	1st	Not mapped	Intermittent
Tributary 3	877	1st	Intermittent	Perennial
Total	**3990**			

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging 43.7-inches per year (based on data provided by NOAA 2014). Site discharge consists of a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Harman et al. 1999), the bankfull discharge for a 0.06 to 0.1-square mile watershed is expected to average 11.7 and 16.9-CFS, respectively. A bankfull discharge event is expected to occur approximately every 1.3 to 1.5-years (Rosgen 1996, Leopold 1994).

9.6.6 Fluvial Geomorphology

The primary restoration feature at the Maple Hill Farm is UT 1, which has been rerouted across pasture, bypassing the floodplain. The stream is located on the side slope, at a higher elevation than the floodplain, resulting in a low-slope, straight channel, with poor substrate and no riffle-pool morphology. At the lower reaches of the stream, the slope becomes excessive, and scour along the channel banks is prevalent. The historic channel, across the floodplain has been filled and planted with grass. An approximately 1.1-acre area of hydric soils straddles the historic channel. Hydric soils have been ditched to drain surface water off the pasture.

In general, Maple Hill Farm streams are proposed for enhancement by fencing livestock, removing invasive species, and planting native hardwood vegetation. The primary restoration feature, UT 1, has been dredged/straightened and bypasses the historic floodplain. The Sponsor proposes to relocate this channel to its natural location in the floodplain.

9.6.7 FEMA

Inspection of the FEMA Flood Insurance Rate Map 3710878900J, Panel 8789, effective September 6, 2006, indicates that Maple Hill streams are not located in a Special Flood Hazard Area, and the project should not alter FEMA flood zones. Therefore, a “Conditional Letter of Map Revision” (CLOMR) is not necessary for this site.

9.7 Rocky Top

The Rocky Top site is characterized by disturbed forest and agricultural land used for livestock grazing and hay production (Photo 7). The main hydrologic features include two UTs to Reedy Branch (UT 1 and UT 2) and adjacent floodplains. The proposed conservation easement area contains approximately 5.2-acres (Figure 10A).

9.7.1 Physiography, Topography and Land Use

The Rocky Top site is located in the Carolina Slate Belt. Dissected, irregular plains characterize regional physiography with moderate to steep slopes and low to moderate-gradient streams over boulder and cobble-dominated substrate (Griffith et al. 2002). On-site elevations range from a high of 660-feet NGVD at the upper reach of UT 1 to a low of approximately 610-feet NGVD at the site outfall (Figure 10B).

This site drains an approximately 0.07-square mile (42-acres) watershed (Figure 10C). The watershed is dominated by pasture and forest. Impervious surfaces account for less than one-percent of the upstream land surface.

Land use at the site is characterized by disturbed forest, hay fields, and livestock pasture. Riparian zones and wetland areas are primarily composed of disturbed forest. Forest areas are accessible to livestock and have a thin understory with compacted soils. Multiple, active springs are located along the margins of the stream. These areas have primarily been cleared of forest vegetation and are characterized by herbaceous vegetation that is sparse and disturbed due to livestock grazing, bush hogging, and regular land management activities.

9.7.2 Water Quality

Rocky Top is located within USGS 14-digit HUC 03030002050050 (Figure 2) and NCDWR Subbasin 03-06-04. Topographic features of the Rocky Top site drain to Reedy Branch (Stream Index Number 16-28-3), which has been assigned a Best Usage Classification of **WS-V, NSW** (NCDWR 2013). WS-V streams are protected as water supplies that are generally upstream and draining to Class WS-IV waters or waters used by industry to supply their employees with drinking water or as waters formerly used as water supplies. These waters are also protected for Class C uses such as aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes wading, boating, and other uses not involving human body contact with waters on an organized or frequent basis. The NSW designation denotes nutrient sensitive waters, which include areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment. Reedy Branch, adjacent to the site, is not listed on the final 2012 or draft 2014 303(d) lists (NCDWQ 2012 and NCDWR 2014).

9.7.3 Vegetation

The Rocky Top site is characterized primarily by agricultural land including pasture, hay fields, and disturbed forest. Fields are dominated by fescue (*Festuca* sp.) with

sparse natural recruits including knotweed (*Polygonum* spp.), dog fennel (*Eupatorium capillifolium*), curly dock (*Rumex crispus*), cranesbill (*Geranium carolinianum*), clover (*Trifolium repens*), and nightshade (*Solanum* sp.), as well as other opportunistic herbaceous species. Scattered trees located adjacent to site tributaries include Chinese privet (*Ligustrum sinense*), winged elm (*Ulmus alata*), red maple (*Acer rubrum*), eastern red cedar (*Juniperus virginiana*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), and poison ivy (*Toxicodendron radicans*).

9.7.4 Soils

Based on Web Soil Survey mapping (USDA 2014), the proposed conservation easement areas associated with the Rocky Top site contain one soil series (Figure 9D and Table 19): Goldston channery silt loam (*Typic Dystrudepts*).

Table 19: Rocky Top Site Soils

Map Unit Symbol	Map Unit Name	Hydric Status	Description
GcD	Goldston channery silt loam	Non-hydric	This series consists of well drained soils on 10-15 percent hill slopes on ridges. This series formed from residuum weathered from metavolcanics and/or argillite.

Site jurisdictional wetlands/hydric soils were delineated in the field following guidelines set forth in the USACE Wetlands Delineation Manual (Environmental Laboratory 1987) and subsequent regional supplements (USACE 2012), and located using GPS technology with reported sub-meter accuracy. David Bailey of the USACE approved jurisdictional delineations during a field visit on May 29, 2014.

9.7.5 Hydrology

Rocky Top site streams are not mapped by either the USGS or the NWI. However, on-site investigations—including NCDWQ stream identification forms and benthic macroinvertebrate sampling collected using the Qual-4 technique—suggest that site streams are perennial (Table 20).

Table 20: Rocky Top Existing Stream Flow Regime

Stream	Stream Length	Stream Order	USGS Stream Classification	In-field Stream Classification
Tributary 1	944	1st	Not mapped	Perennial
Tributary 2	270	1st/2nd	Not mapped	Perennial
Total	**1214**			

This region is characterized by moderate rainfall with precipitation averaging 43.7-inches per year (based on data provided by NOAA 2014). Site discharge consists of a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Harman et al. 1999), the bankfull discharge for a 0.07-square mile watershed is expected to average 13.0-CFS. A bankfull discharge event is expected to occur approximately every 1.3 to 1.5-years (Rosgen 1996, Leopold 1994).

9.7.6 Fluvial Geomorphology

Currently, channels targeted for restoration are characterized as entrenched and/or incised G-type or F-type channels with little to no riffle-pool morphology, oversized channel cross-sectional areas, and no access to floodplains during high discharge events (BHR range > 2). UT 2 originates from a springhead and has been ditched along the margins of the floodplain, resulting in a sinuosity of 1.02. UT 1 retains a reasonable sinuosity (approximately 1.2); however, the loss of forest vegetation and hoof shear has destabilized some outer bends, resulting in a loss of pattern including tight meander radii, shoot cutoffs, extended pools, and a loss of suitable channel substrate.

In general, sediment and nutrient inputs, channel incision and manipulation, livestock trampling, removal of cobble substrate, aggradation of silt and sand, as well as removal of woody vegetation have impacted Rocky Top site streams.

9.7.7 FEMA

Inspection of the FEMA Flood Insurance Rate Map 3710878700J, Panel 8787, effective September 6, 2006, indicates that Rocky Top streams are not located in a Special Flood Hazard Area, and the project should not alter FEMA flood zones. Therefore, a "Conditional Letter of Map Revision" (CLOMR) is not necessary for this site.

9.8 Slingshot Creek

The Slingshot Creek site is characterized by livestock pasture and disturbed forest (Photo 8). The main hydrologic features include three unnamed tributaries to Lake Hunt (Main Channel and Unnamed Tributaries (UT) 1 and 2) and adjacent floodplains. Site streams are accessible by livestock and have been heavily disturbed. The proposed conservation easement area encompasses approximately 13 acres (Figure 11A).

9.8.1 Physiography, Topography and Land Use

Slingshot Creek is located in the Carolina Slate Belt. Dissected, irregular plains characterize regional physiography with moderate to steep slopes and low- to moderate-gradient streams over boulder- and cobble-dominated substrate (Griffith et al. 2002). On-site elevations range from a high of 780 feet NGVD at the upper reach of the Main Channel to a low of approximately 740 feet NGVD at the site outfall (Figure 11B).

This site cumulatively drains an approximately 0.4-square mile (284-acre) watershed (Figure 11C). The watershed is dominated by pasture, agricultural land, and sparse residential development on the outskirts of Reidsville. Impervious surfaces account for less than 5 percent of the upstream land surface.

Land use at the site is characterized by livestock pasture, hay fields, and disturbed forest. Livestock have unrestricted access to site streams. A narrow riparian fringe has developed on the stream margins that is composed of opportunistic species, invasive species, and a few mature tree species.

9.8.2 Water Quality

Slingshot Creek is located within USGS 14-digit HUC 03030002010010 (Figure 2) and NCDWR Subbasin 03-06-01. Topographic features of Slingshot Creek drain to Hunt Lake and ultimately to Troublesome Creek (Stream Index Number 16-6-2-(1)), which has been assigned a Best Usage Classification of **WS-III&B, NSW** (NCDWR 2013). WS-III streams are protected as water supplies for drinking, culinary, or food processing purposes where a more protective WS-I or II classification is not feasible. The supplemental Classification of **B** includes Waters protected for all Class C uses in addition to primary recreation. Primary recreational activities include swimming, skin diving, water skiing, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis. WS-III waters are generally in low to moderately developed watersheds. The NSW designation denotes nutrient sensitive waters, which include areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment.

Troublesome Creek (Stream Index Number 16-6-(3)) downstream from the site and is listed on both the final 2012 and draft 2014 303(d) lists (NCDWQ 2012 and NCDENR 2014) for low dissolved oxygen, most likely due to agricultural pollution.

9.8.3 Vegetation

Slingshot Creek is characterized primarily by livestock pasture and disturbed forest. Pasture is dominated by fescue (*Festuca* sp.) and Bermuda grass (*Cynodon dactylon*) with opportunistic recruits including dog fennel (*Eupatorium capillifolium*), nightshade (*Solanum* sp.), blackberry (*Rubus argutus*), polygonum (*Polygonum* sp.), as well as other herbaceous species. Scattered trees located adjacent to site tributaries include Chinese privet (*Ligustrum sinense*), green ash (*fraxinus pennsylvanica*), American sycamore (*platanus occidentalis*.), persimmon (*Diospyros virginiana*), red maple (*Acer rubrum*), eastern red cedar (*Juniperus virginiana*), tag alder (*alnus serrulata*), white oak (*Quercus alba*), sweetgum (*Liquidambar styraciflua*), and catbrier (*Smilax rotundifolia*).

9.8.4 Soils

Based on Web Soil Survey mapping (USDA 2014), the proposed conservation easement areas associated with Slingshot Creek contain six soil series (Figure 11D and Table 21): Clifford sandy clay loam (*Typic Kanhapludults*) Codorus loam

(*Fluvaquentic Dystrudepts*), Davie sandy loam (*Aquultic Hapludalfs*), Fairview-Poplar Forest complex (*Typic Kanhapludults*), Nathalie sandy loam (*Typic Fragiudults*), and Poplar Forest sandy clay loam (*Typic Kanhapludults*).

Table 21: Slingshot Creek Site Soils

Map Unit Symbol	Map Unit Name	Hydric Status	Description
CgB2	Clifford sandy clay loam	Non-hydric	This series consists of well-drained, moderately eroded soils found along 2-8 percent slopes. The parent material is saprolite derived from schist and/or gneiss.
CsA	Codorus loam	Non-hydric	This series consists of moderately well-drained and somewhat poorly drained soils found on 0-2 percent slopes in floodplains. The parent material is alluvium derived from schist, gneiss, phyllite, and other metamorphic rocks.
DcB	Davie sandy loam	Non-hydric	This series consists of somewhat poorly-drained soils found along 2-8 percent slopes. The parent material is residuum from intermediate or mafic metamorphic or igneous rock.
FrE2	Fairview-Poplar complex	Non-hydric	This series consists of well-drained, moderately eroded soils found on 15-25 percent hill slopes on ridges. The parent material is saprolite derived from schist and/or gneiss.
NaB	Nathalie sandy loam	Non-hydric	This series consists of well-drained soils found along 2-8 percent slopes. The parent material is residuum from felsic igneous or metamorphic rock.
PpD2	Poplar Forest sandy clay loam	Non-hydric	This series consists of well-drained soils found along 8-15 percent slopes. The parent material is residuum from felsic or intermediate, high-grade metamorphic or igneous rocks high in mica content.

9.8.5 Hydrology

Slingshot Creek streams (Main Channel, UT 1 and UT 2) are mapped as intermittent by the USGS (Figure 11B) and not represented in the NWI. Site streams exhibited characteristics of perennial flow during field review (Table 22).

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Table 22: Slingshot Creek Existing Stream Flow Regime

Stream	Stream Length	Stream Order	USGS Stream Classification	In-field Stream Classification
Main Channel	1809	1st and 2nd	Intermittent	Perennial
UT 1	1968	1st	Intermittent	Perennial
UT 2	130	1st	Intermittent	Perennial
Total	**3907**			

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging 41.7 inches per year (USDA 1992). Site discharge consists of a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Harman et al. 1999), the bankfull discharge for a 0.4-square mile watershed is expected to average 48.4 CFS. Current research also estimates a bankfull discharge of 48.4 CFS is expected to occur approximately every 1.3-1.5-years (Rosgen 1996, Leopold 1994).

9.8.6 Fluvial Geomorphology

Currently, channels targeted for restoration are characterized as entrenched and/or incised G-type or F-type channels with little to no sinuosity, little to no riffle-pool morphology, oversized channel cross-sectional areas, and no access to floodplains during high discharge events (BHR range > 2.2 to 2.7). Sinuosity was measured at 1.07 using topographic surveys, aerial photography, and visual observation during field surveys.

In general, the streams comprising the Slingshot Creek site have been impacted by livestock hoof shear, excessive sediment and nutrient inputs, channel incision, aggradation of silt and sand, and removal of woody vegetation.

9.8.7 FEMA

Inspection of the FEMA Flood Insurance Rate Map 3710798400J, Panels 7984 and 7994, effective September 3, 2007, indicates that Slingshot Creek streams are not located in a Special Flood Hazard Area, and the project should not alter FEMA flood zones. Therefore, a "Conditional Letter of Map Revision" (CLOMR) is not necessary for this site.

10 RESTORATION PLAN

The primary goals of the Phase I mitigation plan include: 1) reducing and/or eliminating non-point source pollution associated with heavy livestock and agricultural activities; 2) improving water quality functions by restoring native, woody riparian vegetation adjacent to Phase I channels; 3) improving floodplain function by increasing hydraulic resistance to floodwaters; 4) improving aquatic habitat through channel stabilization and increased habitat heterogeneity; and 5)

improving near-channel habitat for terrestrial species and refugia for aquatic species through restoration of native, woody riparian vegetation.

10.1 Reference Data

10.1.1 Stream Reference

At this time, site-specific reference streams have not been identified for all sites. However, relatively undisturbed sections of stream have been identified at Chico Branch, Maple Hill Farm, Rocky Top, and Major Hill sites. Data collected at these reference reaches, including cross sectional data, benthic macroinvertebrate collections, and hardwood forest composition, were utilized to approximate mitigation potential on these sites. These reference reaches have been compared to a database of reference sites compiled by Axiom for other restoration sites in the area (Cedarock Park, Causey Farm Mitigation Site, and Bass Mountain Mitigation Site). Reference data, used in conjunction with appropriate regional curves for the Piedmont of North Carolina (Harman *et al* 1999), allowed for comparison of existing, disturbed conditions to relatively undisturbed reference conditions at the proposed mitigation sites.

10.1.2 Reference Forest Ecosystem

According to Mitigation Site Classification ("MiST") guidelines (USEPA 1990), Reference Forest Ecosystems ("RFEs") must be established for restoration sites. RFEs are forested areas used to model restoration efforts at each site in relation to soils, hydrology, and vegetation. RFEs should be ecologically stable climax communities and should represent believed historical conditions of the restoration site. Data describing plant community composition and structure are collected at the RFEs and subsequently applied as reference data for design of each restoration site.

Reference vegetation communities for each site have not been identified at this time. During detailed restoration planning, a site-specific reference forest will be located and tree and shrub species identified in this area will be utilized, in addition to other relevant species to supplement community descriptions for Piedmont Low Mountain Alluvial Forest and Dry-Mesic Oak-Hickory Forest (Schafale and Weakley 1990). Species that may occur in these vegetative communities are listed in Table 23.

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Table 23: Reference Forest Ecosystem Species

Piedmont Alluvial Forest (Floodplains and Slopes)		Dry-Mesic Oak-Hickory Forest (Upland Side Slopes)	
Canopy Species	**Understory Species**	**Canopy Species**	**Understory Species**
Acer rubrum	*Acer rubrum*	*Acer rubrum*	*Acer rubrum*
Liquidambar styraciflua	*Betula nigra*	*Carya alba/tomentosa/glabra*	*Carpinus caroliniana*
Liridendrum tulipifera	*Carpinus caroliniana*	*Liriodendron tulipifera*	*Diospyros viginiana*
Pinus taeda	*Liriodendron tulipifera*	*Pinus taeda*	*Ilex opaca*
Platanus occidentalis		*Pinus virginiana*	*Juniperus virginiana*
Quercus phellos		*Quercus alba*	*Pinus taeda*
Quercus shumbardii		*Quercus falcata*	*Cornus florida*
3Ulmus americana		*Quercus rubra*	
Celtis laevigata			
Fraxinus pennsylvanica			

10.2 Site Work Plans

This section contains preliminary descriptions of proposed work plans. All final stream lengths presented here are approximate and will be adjusted following the completion of the sites' 60% design. Design sheets and reports will be adequate to accurately determine the appropriate length of each restored channel, which will serve as the basis of credit determination for the UMBI.

10.2.1 Motes Creek

A summary of the restorative actions proposed at Motes Creek is provided in Table 24 and on Figure 12A. In general, proposed activities involve Stream Restoration, Stream Enhancement II, upgrading an existing pond outfall, the construction of a marsh treatment area below the pond outfall, and riparian community restoration.

Table 24: Motes Creek Work Plan Summary

Stream Reach	Approx. Final Length (LF)	Mitigation Activity
Motes Creek	2,212	Stream Restoration, Riparian Restoration
UT 1	1,531	Stream Restoration, Riparian Restoration, Enhancement II
UT 2	2,362	Stream Restoration, Riparian Restoration, Enhancement II
UT 3	588	Enhancement II
Total	**6,693**	

10.2.2 Benton Branch

A summary of the proposed restorative actions at Benton Branch is provided in Table 25 and on Figure 12B. In general, proposed stream restoration activities include pond removal in the upper reaches of UT 1, UT 2, and UT 3, as well as channel excavation and stabilization, and channel bankfill. Proposed Stream Enhancement I activities include restoring dimension and profile to reaches in UT 2, UT 4, and UT 6 affected by livestock grazing and riparian clearing. Proposed Stream Enhancement II activities include removal of invasive species, fencing, and planting of native hardwood species along reaches of Benton Branch, UT 5, and UT 6.

Table 25: Benton Branch Work Plan Summary

Stream Reach	Approx. Final Length (LF)	Mitigation Activity
Benton Branch	2,009	Enhancement II
UT 1	828	Stream Restoration, Riparian Restoration
UT 2	2,212	Stream Restoration, Riparian Restoration, Enhancement I
UT 3	1,385	Stream Restoration, Riparian Restoration, Enhancement II
UT 4	1,392	Stream Restoration, Riparian Restoration, Enhancement I & II
UT 5	1,478	Stream Restoration, Enhancement I)
UT 6	1,039	Enhancement I & II
Total	**10,343**	

10.2.3 Orphan Creek

A summary of the proposed restorative actions at Orphan Creek is provided in Table 26 and on Figure 12C. In general, proposed stream restoration activities include channel excavation and stabilization, and channel backfill. Proposed Stream Enhancement II activities include removal of invasive species, fencing, and planting of native hardwood species along UT 3.

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Table 26: Orphan Creek Work Plan Summary

Stream Reach	Approx. Final Length (LF)	Mitigation Activity
Main Channel	1,463	Stream Restoration
UT 1A	309	Stream Restoration
UT 1B	265	Stream Restoration
UT 2	394	Stream Restoration
UT 3	650	Stream Enhancement II
Total	**3,081**	

10.2.4 Chico Branch

A summary of the proposed restorative actions at Chico Branch is provided in Table 27 and on Figure 12D. In general, proposed stream and wetland restoration activities include channel excavation and stabilization, and channel backfill.

Table 27: Chico Branch Work Plan Summary

Stream Reach/Feature	Approx. Final Length (LF)	Mitigation Activity
UT 1	1,785	Stream Restoration
UT 2	1020	Stream Restoration
Total	**2,805**	

10.2.5 Major Hill

A summary of the proposed restorative actions at Major Hill is provided in Table 28 and on Figure 12E. In general, proposed stream restoration activities include channel excavation and stabilization, and channel backfill. Proposed Stream Enhancement (Level II) activities include removal of invasive species, fencing, and planting of native hardwood species along UT 2 and a portion of UT 1.

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Table 28: Major Hill Work Plan Summary

Stream Reach	Proposed Length (LF)	Mitigation Activity
UT 1	2,281	Stream Restoration, Stream Enhancement Level II
UT 2	879	Stream Enhancement Level II
Total	**3,160**	

10.2.6 Maple Hill Farm

A summary of the proposed restorative actions at Maple Hill Farm is provided in Table 29 and on Figure 12F. In general, proposed stream restoration activities include channel excavation and stabilization, and channel backfill. Proposed Stream Enhancement II activities include removal of invasive species, fencing, and planting of native hardwood species along UT 2A, UT 2B, and UT 3.

Table 29: Maple Hill Farm Work Plan Summary

Stream Reach	Proposed Length (LF)	Mitigation Activity
UT 1	1,815	Stream Restoration
UT 2A	711	Stream Enhancement II
UT 2B	1,090	Stream Enhancement II
UT 3	877	Stream Enhancement II
Total	**4,493**	

10.2.7 Rocky Top

A summary of the proposed restorative actions at Rocky Top is provided in Table 30 and on Figure 12G. In general, proposed stream restoration activities include channel excavation and stabilization, and channel backfill. Proposed Stream Enhancement II activities include removal of invasive species, fencing, and planting of native hardwood species along a portion of Tributary 1.

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Table 30: Rocky Top Work Plan Summary

Stream Reach	Proposed Length (LF)	Mitigation Activity
Tributary 1	1,028	Stream Restoration, Stream Enhancement (Level II)
Tributary 2	245	Stream Restoration
Total	**1,273**	

10.2.8 Slingshot Creek

A summary of the proposed restorative actions at Slingshot Creek is provided in Table 31 and on Figure 12H. In general, proposed stream restoration activities include channel excavation and stabilization, and channel backfill. Proposed Stream Enhancement I activities include restoring dimension and profile to reaches in the Main Channel and UT 1 affected by livestock grazing and riparian clearing. Proposed Stream Enhancement II activities include removal of invasive species, fencing, and planting of native hardwood species along UT 1.

Table 31: Slingshot Creek Work Plan Summary

Stream Reach	Proposed Length (LF)	Mitigation Activity
Main Channel	3,490	Stream Restoration/Enhancement I
UT 1	1,122	Stream Restoration/Enhancement I and II
UT 2	165	Stream Restoration
Total	**4,777**	

10.3 Stream Restoration

Stream Restoration efforts are intended to restore a stable, meandering stream at new locations, improving floodplain connectivity while using reference streams and appropriate regional curves to design and construct natural hydrodynamics, stream geometry, and local microtopography. Primary activities designed to restore Phase I channels include: belt-width preparation and grading, channel excavation, installation of channel plugs, backfilling of abandoned channels, installation of piped channel crossings, and vegetative planting.

10.3.1 Belt-width Preparation and Grading

Care will be taken to avoid the removal of existing, deeply rooted vegetation within the belt-width corridor, which often provides channel stability. Material excavated during grading will be stockpiled immediately adjacent to channel segments to be abandoned and backfilled following stream diversion.

Spoil material may be placed to stabilize temporary access roads and to minimize compaction of the underlying floodplain. However, all spoil will be removed from floodplain surfaces upon completion of construction activities.

After preparation of the corridor, the design channels and updated profile surveys will be developed, and the locations of each meander wavelength will be plotted and staked along the profile. Pool locations and other channel features may be modified in the field based on local variations in the floodplain profile.

10.3.2 Channel Excavations

Channels will be constructed within the range of values developed during detailed restoration planning. Regional curves and/or reference stream reaches (see Section 10.1.1) will be used to develop various stream geometry attributes.

Stream banks and local belt-width areas of constructed channels will be immediately planted with shrub and herbaceous vegetation to initiate stability, preventing unintended erosion. Deposition of shrub and woody debris into and/or overhanging the constructed channels will be used to further increase each channel's resistance to shear stress. Particular attention will be directed toward providing vegetative cover and root growth along the outer bends of each stream meander. Live willow stakes will be purchased and/or collected on-site and inserted through the root/erosion mat into underlying soils.

10.3.3 Channel Plugs

Impermeable plugs will be installed along abandoned channel segments. The plugs will consist of low-permeability materials or hardened structures designed to be of sufficient strength to withstand the erosive energy of surface flow events across each site. Dense clays, which may be imported from off-site if necessary, will be compacted within each channel for plug construction. Each plug will be of sufficient width and depth to form an imbedded overlap in the existing banks and bed.

10.3.4 Channel Backfilling

After impermeable plugs have been installed, abandoned channels will be backfilled. Stockpiled materials will be pushed into abandoned channels. Suitable material used for backfilling may be derived from on-site or off-site sources. Vegetation debris (e.g., root mats, top soils, shrubs, woody debris, etc.) will be redistributed across the backfill area upon completion.

10.3.5 Piped Stream Crossing

Landowner uses will sometimes necessitate the installation of piped channel crossings to allow access to portions of the property otherwise isolated by stream restoration activities. Piped crossings will be constructed with pipes sized to adequately pass anticipated stormwater flows with hydraulically stable riprap or other suitable rock. Pipes will be large enough to handle the weight of anticipated vehicular traffic. Approach grades will be at an approximate 10:1 slope and

constructed on hard, scour-resistant crushed rock or other permeable material free of fines.

10.3.6 In-stream Structures

The use of in-stream structures for grade control and habitat are essential for successful stream restoration. In-stream structures may be placed in the channel to elevate local water surface profiles, potentially flattening the water energy slope or gradient. The structures will likely consist of log/rock cross-vanes or log/rock j-hook vanes designed primarily to direct stream energy into the center of the channel and away from banks. In addition, structures will be placed in relatively straight reaches to provide secondary (perpendicular) flow cells during bankfull events.

Log vanes may also be used to direct high-velocity flows during bankfull events toward the center of constructed channels. Log vanes will be constructed utilizing large tree trunks harvested on-site or imported from off-site as necessary. Tree stems harvested for a log cross-vane arm must be long enough to be embedded into the stream channel and extend several feet into the floodplain. Logs will create an arm that slopes from the center of the channel upward to each stream bank at an angle or 20 to 30-degrees. A trench will be dug into the stream channel that is deep enough for the head of the log to be at or below the channel invert. The trench is then extended into the floodplain and the log is set into the trench such that the log arm is below the floodplain elevation. If the log is not of sufficient size to completely block stream flow (gaps occur between the log and channel bed), a footer log will be installed beneath the header log. Support pilings will then be situated at the base of the log and at the head of the log to hold the log in place. Once these vanes are in place, filter fabric is toed into a trench on the upstream side of the vane and draped over the structure to force water over the vane. The upstream side of the structure is then backfilled with suitable material.

Drop structures will be necessary at the outfalls of some constructed channels to match preconstruction elevations. Drop structures will be constructed out of TerraCell, or other suitable materials, depending upon anticipated scour from the restored stream channels. The structures will be constructed to resist erosive forces associated with hydraulic drops. TerraCell is a lightweight, flexible mat made of high-density, polyethylene strips. The strips are bonded together to form a honeycomb configuration. The honeycomb mat is fixed in place and filled with gravel or sand. Material in the TerraCell structure may be planted with grasses and shrubs for additional erosion protection. The TerraCell structure will form a nickpoint that approximates geologic controls in streambeds.

10.4 Riparian Restoration

Restoration of floodplain forest and streamside habitat allows for development and expansion of characteristic species across the landscape. Ecotonal changes between community types contribute to diversity and provide secondary benefits, such as

enhanced feeding and nesting opportunities for mammals, birds, amphibians, and other wildlife.

Planted streamside trees and shrubs will include species with high value for sediment stabilization, rapid growth rates, and the ability to withstand hydraulic forces associated with bankfull and overbank flow events. Streamside trees and shrubs will be planted within 15-feet of the channel throughout the meander beltwidth. Shrub elements will be planted along reconstructed stream banks, concentrated along outer bends.

Deeply rooted riparian vegetation will be restored as needed at all Phase I and future sites. Planting vegetation on cleared stream banks is proposed to reestablish native/historic community patterns within the stream corridor as well as associated side slopes and transition areas. Revegetating floodplains and stream banks will provide overall system stability, shade, and wildlife habitat. In addition, viable riparian communities will improve system biogeochemical function by filtering pollutants from overland and shallow subsurface flows and providing organic materials to adjacent stream channels.

Variations in vegetative planting will occur based on topography and hydraulic condition of soils. Vegetative species composition will be based on RFEs, site-specific features, and community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990). Community associations to be utilized include: 1) Piedmont/Low Mountain Alluvial Forest, 2) Dry-Mesic Oak-Hickory Forest and 3) Streamside Assemblage. A list of species organized by Schafale and Weakley (1990) communities is presented below. This list is for planning purposes only. Final planting may include some or all of the species below. In addition, other species may be added if appropriate and available.

Piedmont Alluvial Forest

1. Sycamore (*Platanus occidentalis*)
2. American elm (*Ulmus americana*)
3. Hackberry (*Celtis laevigata*)
4. Green ash (*Fraxinus pennsylvanica*)
5. Shagbark hickory (*Carya ovata*)
6. Willow oak (*Quercus phellos*)
7. Schumard oak (*Quercus schumardii*)
8. River birch (*Betula nigra*)
9. Silky dogwood (*Cornus amomum*)
10. Pawpaw (*Asimina triloba*)

Dry-Mesic Oak-Hickory Forest

1. White oak (*Quercus alba*)
2. Northern red oak (*Quercus rubra*)
3. Pignut hickory (*Carya glabra*)
4. Mockernut hickory (*Carya alba/tomentosa*)
5. Black gum (*Nyssa sylvatica* var. *sylvatica*)
6. Flowering dogwood (*Cornus florida*)
7. Eastern red cedar (*Juniperus virginiana*)

8. Persimmon (*Diospyros virginiana*)
9. Ironwood (*Carpinus caroliniana*)

Stream-Side Assemblage

1. Black willow (*Salix nigra*)
2. Tag alder (*Alnus serrulata*)
3. Buttonbush (*Cephalanthus occidentalis*)

10.5 Stream Enhancement I & II

In portions of the Phase I sites and future sites, the use of restoration may not be necessary to improve a system's ecological function. In such cases, enhancement activities will be implemented. For the purposes of the UMBI, Stream Enhancement I and Stream Enhancement II are defined per USACE (2003).

10.5.1 Stream Enhancement I

Stream Enhancement I is expected to include cessation of agricultural activities (including row crop production, hay production, and/or livestock grazing), removal of invasive species, raising the channel bed elevation to reconnect bankfull stream flows to the abandoned floodplain, and planting with native, woody species. Stream Enhancement I will generally entail the alteration of stream channel dimension and profile, as the channel is lifted to the historic floodplain elevation. These measures are expected to facilitate stream dynamics associated with a natural, relatively undisturbed stream in the Piedmont of North Carolina.

10.5.2 Stream Enhancement II

Stream Enhancement II is expected to include the cessation of agricultural activities (including row crop production, hay production, and/or livestock grazing), removal of invasive species, and supplemental planting with native, woody tree species. Stream enhancement II will extend a minimum distance of 50-feet from the top of stream banks. These measures are expected to facilitate stream recovery and prevent further degradation of the streams.

11 MONITORING PLAN

The Bank's performance standards and monitoring plan will be based on the USACE (2013) guidance document titled, *Monitoring Requirements and Performance Standards for Compensatory Mitigation in North Carolina*. In general, the monitoring program will be implemented for 7 years with an opportunity for an early termination after 5 years if a site's performance standards, as set forth in USACE (2013), are met. Additional monitoring of each site, aside from the Bank's performance standards, will occur to identify areas to be treated by the Adaptive Management and Remedial Measures Plan (see Section 12).

11.1 Stream Monitoring

Stream monitoring protocols will be developed for all reaches involving Stream Restoration, Enhancement II, and Enhancement I with in-channel work. Protocols will include collection of the following: longitudinal profile (collected as part of a

sites' as-built surveys), permanent channel cross-sections, bank pins on predetermined outside meander bends, and crest gauges to monitor frequency and magnitude of bankfull events. Visual assessments will be conducted by walking the length of each channel. Preconstruction and post-construction photographs will be compiled.

11.2 Vegetation Monitoring

Restoration monitoring procedures for vegetation are designed in accordance with *CVS-EEP Protocol for Recording Vegetation Level 1-2 Plot Sampling Only (Version 4.2*) (Lee et al. 2008).

After planting has been completed in winter or early spring, an initial evaluation will be performed to verify planting methods and to determine initial species composition and density. Supplemental planting and additional site modification will be implemented if necessary.

During the first year, vegetation will receive visual observation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species, and quantitative sampling will occur between September 1 and September 30. Subsequently, quantitative sampling of vegetation will be performed between July 1 and leaf drop for each growing season until vegetation success criteria are achieved.

During quantitative sampling in early fall of the first year, a minimum of 4 plots (10 meters square) or approximately 2 percent of a site's easement area, whichever is greater, will be randomly placed across each site. In each sample plot, vegetation parameters to be monitored and reported include species, count, height, date of planting, and grid location of each planted stem. Volunteer species encountered during monitoring will be counted, identified to species level, measured, and recorded.

11.3 Visual Monitoring

Visual monitoring of general site conditions that may or may not be part of stream and vegetation monitoring protocols will be conducted at least twice during each monitoring year. One visual inspection can be completed during stream and/or vegetation monitoring. The other inspection will occur independently and must be separated by at least 5 months. Monitoring will be conducted by traversing the entire site to identify and document areas of low stem density, poor plant vigor, prolonged inundation, native and exotic invasive species, beaver activity, excessive herbivory, easement encroachment, indicators of livestock access, and other areas of concern.

11.4 Water Quality and Macroinvertebrate Monitoring

Per USACE (2013), water quality and macroinvertebrate monitoring will be conducted as appropriate for each site to document fluctuations in various water quality parameters and macroinvertebrate communities. Protocols for water quality and macroinvertebrate monitoring will be developed for all reaches involving

Stream Restoration, Enhancement I, and Enhancement II with in-channel work. As streams are products of their watersheds, and upstream pollution and land use can negatively affect a site's water quality, the results of this particular part of the Monitoring Plan may not demonstrate ecological improvements at a given site. Therefore, these data will not be tied directly to the UMBI's performance standards. However, positive results could be useful in determining if a particular site has met its goals and objectives.

11.4.1 Water Quality Monitoring

Water quality monitoring will be conducted once to establish baseline conditions and at least twice during each monitoring year. Monitoring should be repeated at the same times and during normal flow conditions each year to limit seasonal and hydrological variability. Each bi-annual monitoring event will be separated by 5 or more months. Water quality parameters to be sampled include pH, temperature, dissolved oxygen, and conductivity, which will be sampled at two locations in each tributary exceeding 500-LF in order to capture channel-specific input and output values.

11.4.2 Macroinvertebrate Monitoring

Macroinvertebrate sampling will be conducted once before construction (baseline conditions) and once during monitoring years 3, 5, and 7. Sampling will be conducted according to the "Qual 4" method described in *Standard Operating Procedures for Collection and Analysis of Benthic Macroinvertebrates* (NCDWQ 2012). In addition, sampling should occur during the "index period" referenced in *Small Streams Biocriteria Development* (NCDWQ 2009). Results will be presented on a site-by-site basis and will include a list of taxa collected, an enumeration of *Ephemeroptera*, *Plecoptera*, and *Tricoptera* taxa, and Biotic Index values.

12 ADAPTIVE MANAGMENT AND REMEDIAL MEASURES

An adaptive management plan will be developed for each site and for the UMBI in general. In the event monitoring results indicate a site will not meet one or more of its performance standards, remedial actions will be implemented following notification of the UMBI's USACE project manager. Adaptive management and remedial measures are discussed in general below and will be developed further in the UMBI's Final Mitigation Plan.

12.1 Stream Instability

If stream monitoring and/or visual monitoring identify stream stability problems that worsen or otherwise threaten other portions of a mitigation site, repairs will be made as necessary. Persistent problems will be evaluated to determine if design or construction are contributing factors. Should such systemic problems be identified and reasonably determined to be unfixable, the IRT may decide to adjust a site's mitigation credit potential.

12.2 Vegetation

Vegetation mortality remedial actions may include replanting, and, if needed, corrective measures will be based on a determination of potential reasons for mortality (e.g., portions of site too wet for planted species). Low vegetation vigor remedial actions may include but are not limited to deep ripping, replanting (same or similar species), mowing, herbicide application, fertilization, and replanting with other species possessing condition-specific tolerance.

12.3 Invasive Species

In the event that invasive or otherwise undesirable species—as defined in an appendix to the NC SAM Users Manual (NC SFAT 2014)—reasonable efforts will be made to eradicate or otherwise control growth and distribution of the species across the mitigation site. Such efforts may involve herbicide applications, mechanical, and/or hand removal, or prescribed burns.

13 HISTORICAL AND ARCHEOLOGICAL INVESTIGATIONS

Field visits were conducted at all Phase I sites during the winter, spring, and summer of 2014 to ascertain the presence of structures or other features that may be eligible for inclusion on the National Register of Historic Places. No structures were identified within proposed easement boundaries; however, coordination with State Historic Preservation Office will occur prior to construction activities to determine if any significant cultural resources are present.

14 ENDANGERED AND PROTECTED SPECIES

14.1 Motes Creek, Orphan Creek, and Maple Hill Farm

The United States Fish and Wildlife Service does not list any protected species as occurring in Alamance County (USFWS 2014). However, six species are designated as Federal Species of Concern (Table 32). If present, these species are likely to benefit from the restoration efforts.

Table 32: Federal Species of Concern, Alamance County, NC

Common Name	Scientific Name	Potential Habitat Present
American Eel	*Anguilla rostrata*	No
Carolina Darter	*Etheostoma collis lepidinion*	No
Carolina Creekshell	*Villosa vaughaniana*	No
Yellow Lampmussel	*Lampsilis cariosa*	No
Buttercup Phacelia	*Phacelia covellei*	No
Sweet Pinesap	*Monotropsis odorata*	No

14.2 Benton Branch

Two federally protected species are listed as occurring in Caswell County (USFWS 2014): the James spinymussel (*Pleurobema collina*) and the Roanoke logperch (*Percina rex*). Both species are listed as Endangered.

14.2.1.1 James Spinymussel

This freshwater mussel is limited to the James River drainage and the Dan/Mayo River drainage with the Roanoke River basin in Virginia, North Carolina, and West Virginia. This species' range does not include the Benton Branch site, which is located in the Upper Cape Fear River drainage.

14.2.1.2 Roanoke Logperch

In North Carolina, the species is found in the Dan and Mayo rivers, as well as Big Beaver Island Creek. This species' range does not include the Benton Branch site, which is located in the Upper Cape Fear River drainage.

14.2.1.3 Preliminary Biological Conclusions

Neither of these species' ranges includes the site. Therefore, this project will have no effect on these federally protected species.

14.3 Chico Branch and Slingshot Creek

Three federally protected species are listed as occurring in Rockingham County (USFWS 2014): the James spinymussel (*Pleurobema collina*), the Roanoke logperch (*Percina rex*), and smooth coneflower (*Echinacea laevigata*). These species are listed as Endangered.

14.3.1.1 James Spinymussel

This freshwater mussel is limited to the James River drainage and the Dan/Mayo River drainage with the Roanoke River basin in Virginia, North Carolina, and West Virginia. This species' range does not include the Chico Branch or Slingshot Creek site, which is located in the Upper Cape Fear River drainage.

14.3.1.2 Roanoke Logperch

In North Carolina, the species is found in the Dan and Mayo rivers, as well as Big Beaver Island Creek. This species' range does not include the Chico Branch or Slingshot Creek site, which is located in the Upper Cape Fear River drainage.

14.3.1.3 Smooth Coneflower

This species grows in calcareous, basic, or circumneutral soils on roadsides, clear cuts, and power line right-of-ways where there is abundant light and little herbaceous competition. Fire-maintained woodlands also appear to provide potential habitat for the coneflower. Shading of roadsides by adjacent forest trees and routine mowing reduce the suitability of roadsides within the study corridor for this species.

Chico Creek is characterized by disturbed areas that are regularly maintained, providing little or no opportunity for growing of this species. No specimens were noted during field surveys.

Slingshot Creek is characterized by agriculture fields and disturbed forest which may provide suitable habitat for this species. Detailed surveys for this species may be required prior to land disturbing activities associated with stream restoration at this site.

14.3.1.4 Preliminary Biological Conclusions

Neither the James spineymussel nor the Roanoke logperch have ranges extending to the site. Suitable habitat for the smooth coneflower does not exist at the Chico Creek site. However, suitable habitat for smooth coneflower may exist at the Slingshot Creek site and this project may effect on this federally protected species.

15 CONCLUSIONS

Restoration Systems, LLC is pleased to offer the Cape Fear 02 Umbrella Mitigation Bank ("the Bank"). The proposed umbrella structure of the Bank is designed to initially permit the establishment of eight stream mitigation sites, comprising Phase I, while enabling the establishment of future mitigation sites not yet identified. Phase I consists of the following sites: 1) Motes Creek in Alamance County; 2) Benton Branch in Caswell County; 3) Orphan Creek in Alamance County; 4) Chico Branch in Alamance County, 5) Major Hill in Alamance County, 6) Maple Hill in Alamance County, 7) Rocky Top in Alamance County, and 8) Slingshot Creek in Rockingham County. (Figure 1; Table 33).

Table 33: Phase I Site Summary

Stream Site	Hydro Status*	Existing Length (LF)	Mitigation Type	Approx. Final Length (LF)
Motes Creek	Per	5,746	Restoration, Enhancement	6,693
Benton Branch	Per/Int	8,843	Restoration, Enhancement	10,343
Orphan Creek	Per/Int	2,668	Restoration, Enhancement	3,081
Chico Branch	Per/Int	2,295	Restoration	2,805
Major Hill	Per/Int	2,410	Restoration, Enhancement	3,160
Maple Hill Farm	Per/Int	3,990	Restoration, Enhancement	4,493
Rocky Top	Per	1,214	Restoration, Enhancement	1,273
Slingshot Creek	Per	3,907	Restoration, Enhancement	4,777
Totals		**31,073**		**36,625**

* Per = perennial; Int = intermittent

16 REFERENCES

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. United States Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Griffith, G.E., J.M. Omernik, J.A. Comstock, M.P. Schafale, W.H. McNab, D.R. Lenat, T.F. MacPherson, J.B. Glover, and V.B. Shelbourne. 2002. Ecoregions of North Carolina and South Carolina. U.S. Geological Survey, Reston, Virginia.

Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.A. O'Hara, A. Jessup, R. Everhart. 1999. Bankfull Hydraulic Geometry Relationships for North Carolina Streams. N.C. State University, Raleigh, North Carolina.

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.

Leopold, L.B. 1994. A View of the River. Harvard University Press. Cambridge, MA. 298 pp.

National Oceanic and Atmospheric Administration (NOAA). 2014. National Climate Data Center's (NCDC) Climate Data Online (CDO). http://www.ncdc.noaa.gov/cdo-web/

North Carolina Department of Environment and Natural Resources (NCDENR). 2012. Water Quality Data Assessment (2012 Final 303(d) List) (online). Available: http://portal.ncdenr.org/c/document_library/get_file?uuid=9d45b3b4-d066-4619-82e6-ea8ea0e01930&groupId=38364

North Carolina Division of Water Quality (NCDWQ). 2005. Cape Fear River Basinwide Water Quality Plan. (online). Available: http://portal.ncdenr.org/web/wq/ps/bpu/basin/capefear/2005

North Carolina Division of Water Quality (NCDWQ). 2012. Standard Operating Procedures for Collection and Analysis of Benthic Macroinvertebrates. (online). Available: http://portal.ncdenr.org/c/document_library/get_file?uuid=f3cfa483-16de-4c18-95b7-93684c1b64aa&groupId=38364

North Carolina Division of Water Quality (NCDWQ). 2009. Small Streams Biocriteria Development. Available: http://portal.ncdenr.org/c/document_library/get_file?uuid=2d54ad23-0345-4d6e-82fd-04005f48eaa7&groupId=38364

North Carolina Department of Environment and Natural Resources (NCDENR). 2014. Water Quality Data Assessment (2014 Draft 303(d) List) (online). Available: http://portal.ncdenr.org/c/document_library/get_file?uuid=d61a8974-6af6-4edb-829f-e658935e3341&groupId=38364

North Carolina Division of Water Resources (NCDWR). 2013. North Carolina Water Bodies Report (online). Available: http://portal.ncdenr.org/c/document_library/get_file?uuid=10c60296-dcc8-439f-a41c-d475ea7ad1fa&groupId=38364

North Carolina Stream Functional Assessment Team (NC SFAT). 2014. N.C. Stream Assessment Method (NC SAM) User Manual (Version 2). 178 pp.

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

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, North Ccarolina Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

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.

United States Army Corps of Engineers (USACE). 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region, ed. J.S. Weakely, R.W. Lichvar, and C.V. Noble. ERDC/EL TR-10-XX. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

United States Army Corps of Engineers (USACE). 2013. Monitoring Requirements and Performance Standards for Compensatory Mitigation in North Carolina.

United States Department of Agriculture (USDA). 1960. Soil Survey of Alamance County, North Carolina. Soil Conservation Service.

United States Department of Agriculture (USDA). 1992. Soil Survey of Rockingham County, North Carolina. Soil Conservation Service.

United States Department of Agriculture (USDA). 2014. Web Soil Survey (online). Available: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx [August 2014].

United States Census Bureau (USCB). 2013. Population estimates V.2013. http://quickfacts.census.gov/qfd/states/37000.html

United States Environmental Protection Agency (USEPA). 1990. Mitigation Site Type Classification (MiST). EPA Workshop, August 13-15, 1989. EPA Region IV and Hardwood Research Cooperative, NCSU, Raleigh, North Carolina.

Slingshot Creek
36.333480, -79.715103

Chico Branch
36.279342, -79.634140

Benton Branch
36.273108, -79.425701

Orphan Creek
35.979398, -79.315874

Motes Creek
35.988548, -79.285166

Maple Hill Farm
35.939228, -79.389729

Rocky Top
35.886591, -79.387578

Major Hill
35.875167, -79.359061

Reidsville
Summerfield
Greensboro
High Point
Pleasant Garden
Ossipee
Burlington
Graham
Mebane
Hillsborough
Saxapahaw
Chapel Hill
Carrboro
Snow Camp

158 29 220 87 62 119 49 61 40 85 70 54 421 86

N

Legend
Mitigation Bank Easements

5 2.5 0 5 10 15
Miles

FIGURE 1

Drawn by: SGD
Date: OCT 2014
Project No.: 13-004

PHASE I SITE LOCATIONS MAP

Upper Cape Fear Umbrella Mitigation Bank

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

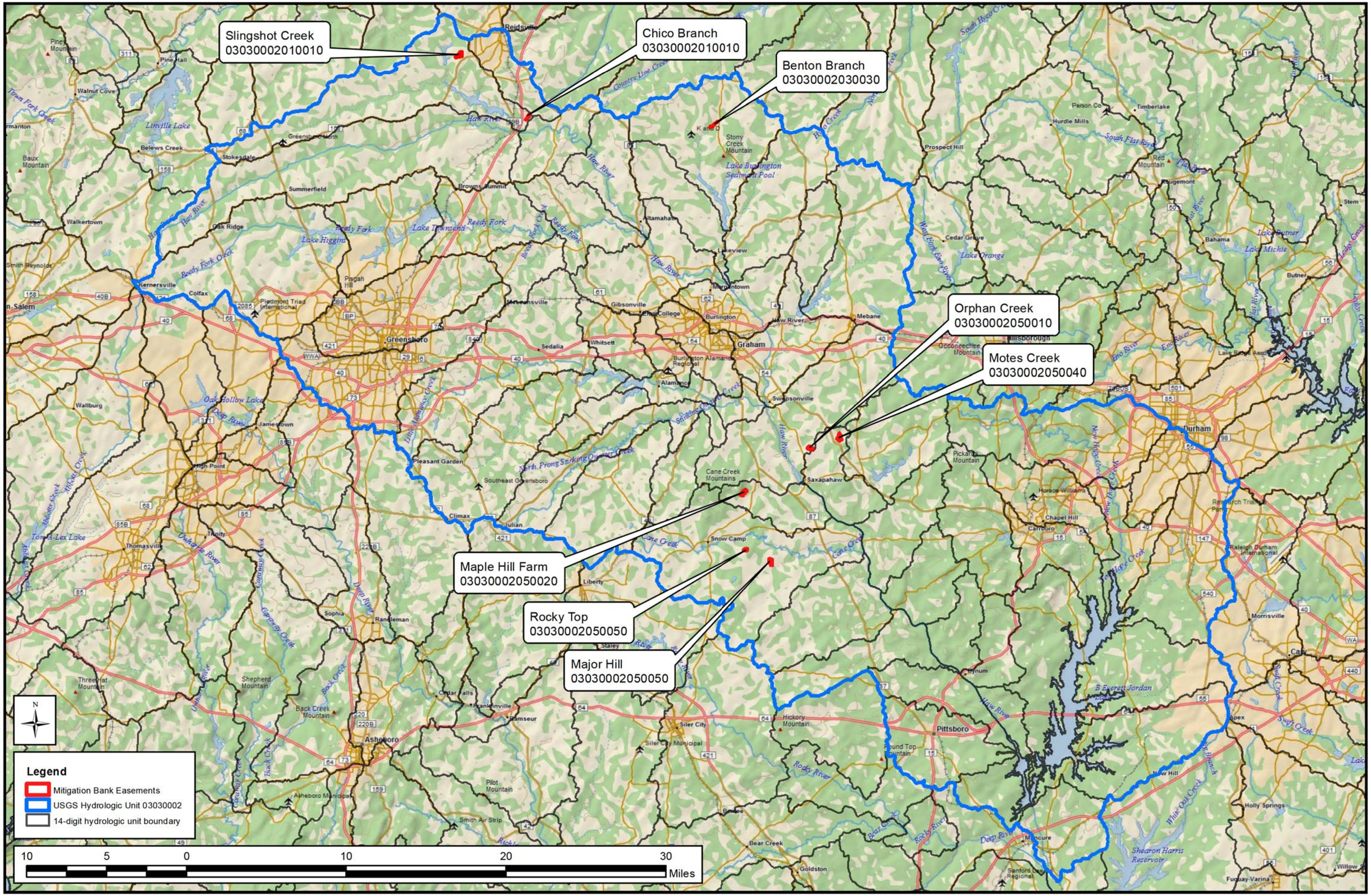


FIGURE 2

Drawn by: SGD
Date: OCT 2014
Project No.: 13-004

HYDROLOGIC UNIT MAP
Upper Cape Fear Umbrella Mitigation Bank

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

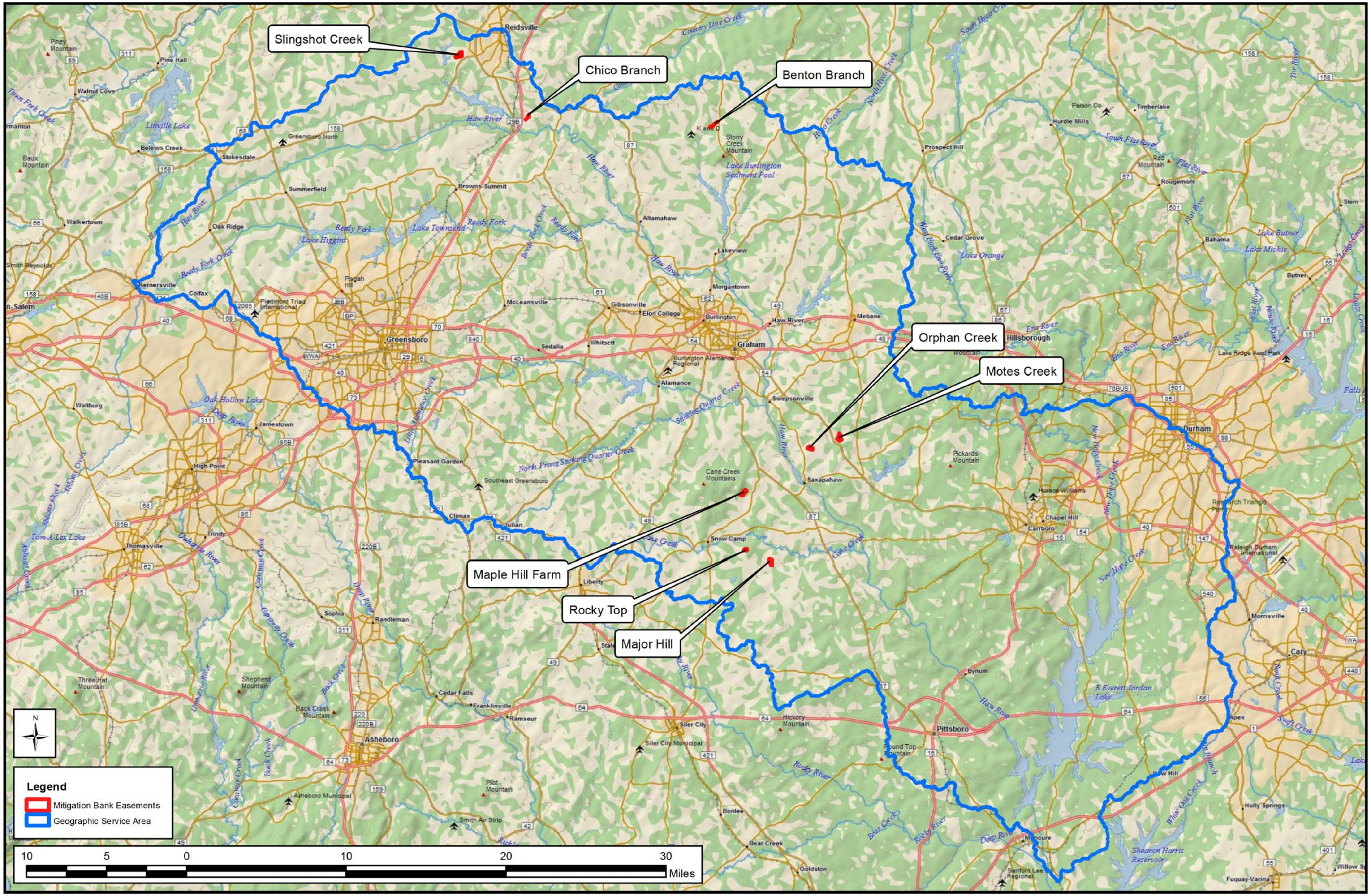


FIGURE 3

Drawn by: SGD
Date: OCT 2014
Project No.: 13-004

GEOGRAPHIC SERVICE AREA

Upper Cape Fear Umbrella Mitigation Bank

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

Figure 4A: Motes Creek Site Features

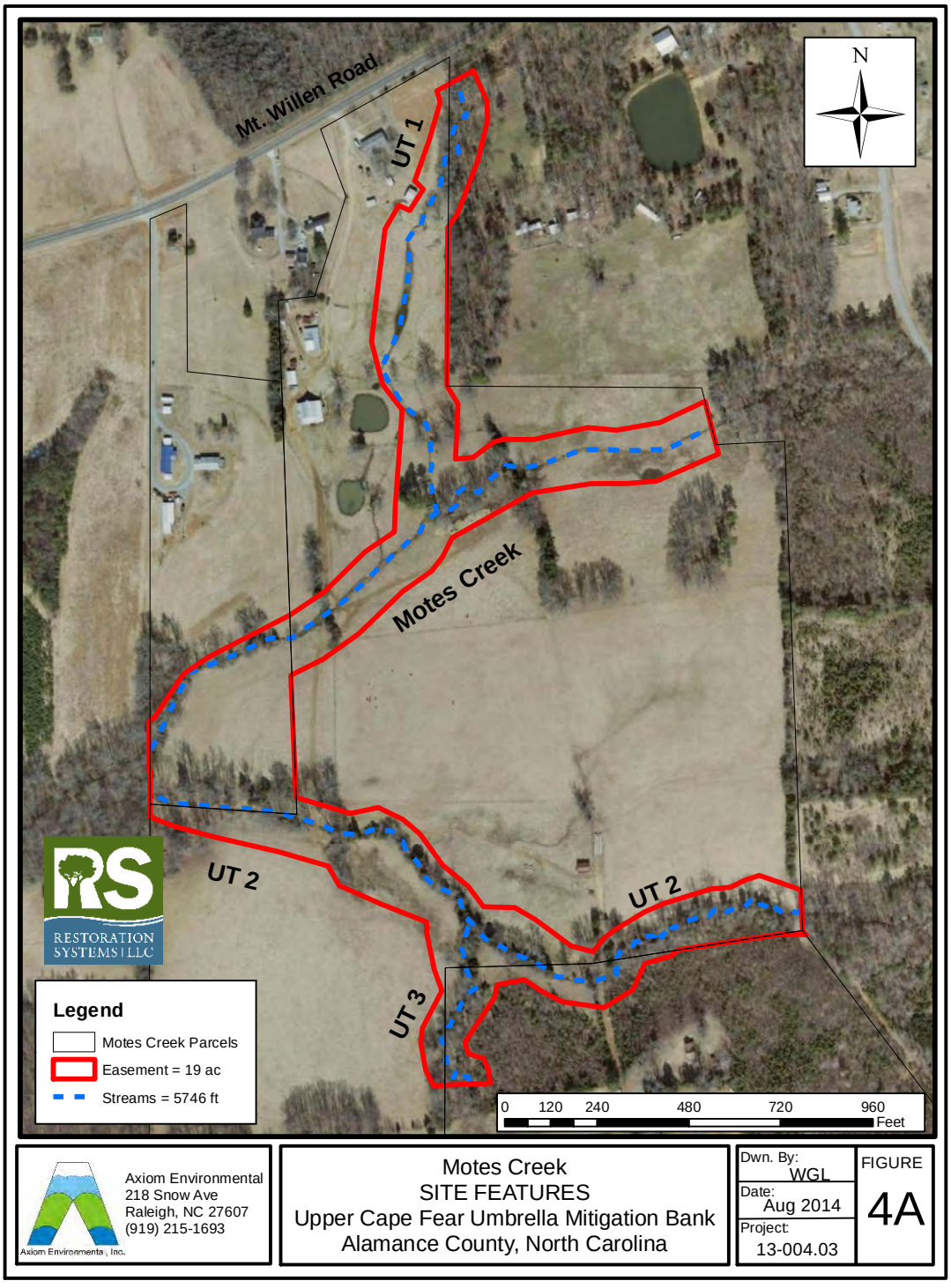


Figure 4B: Motes Creek Topography

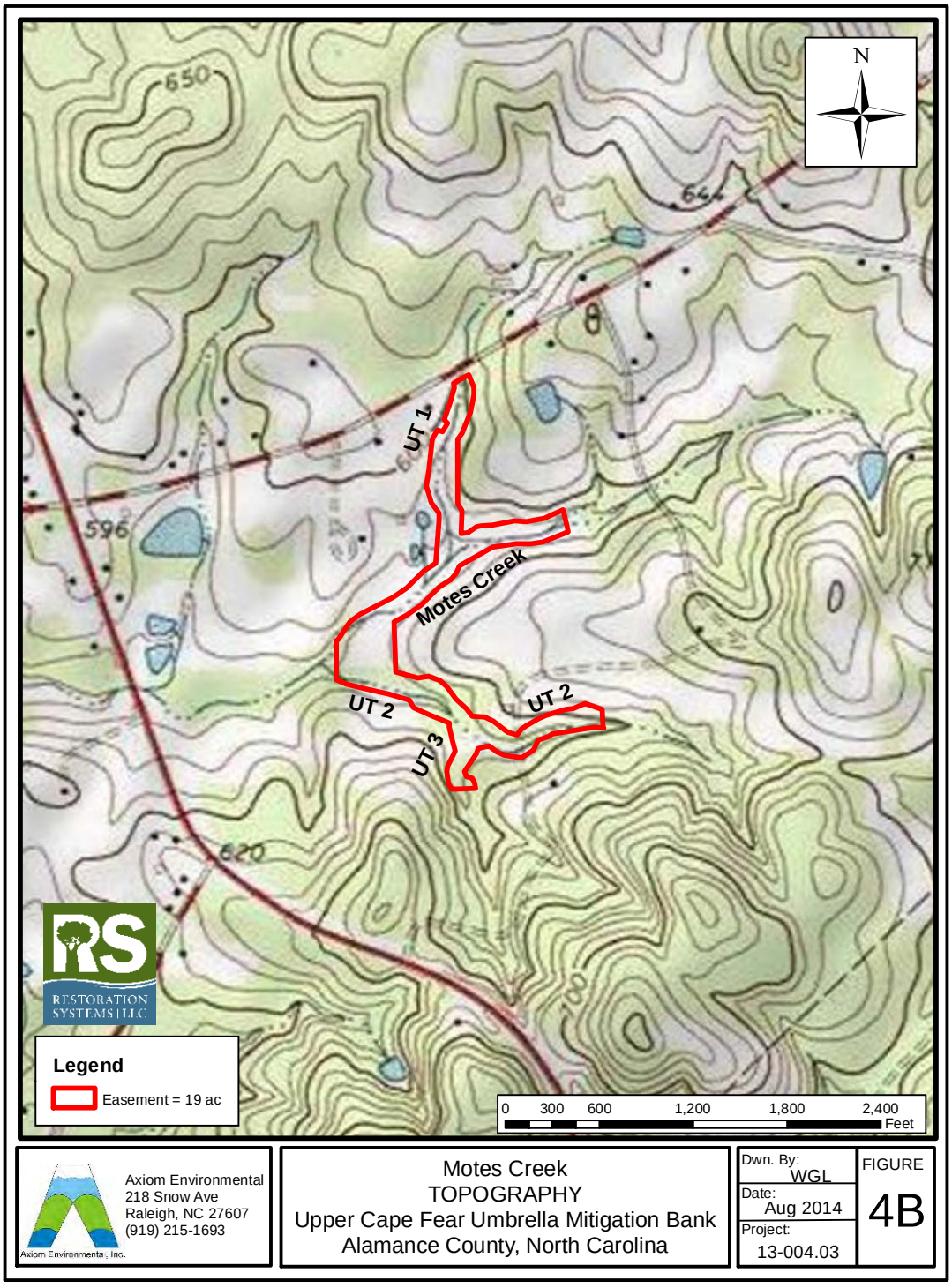
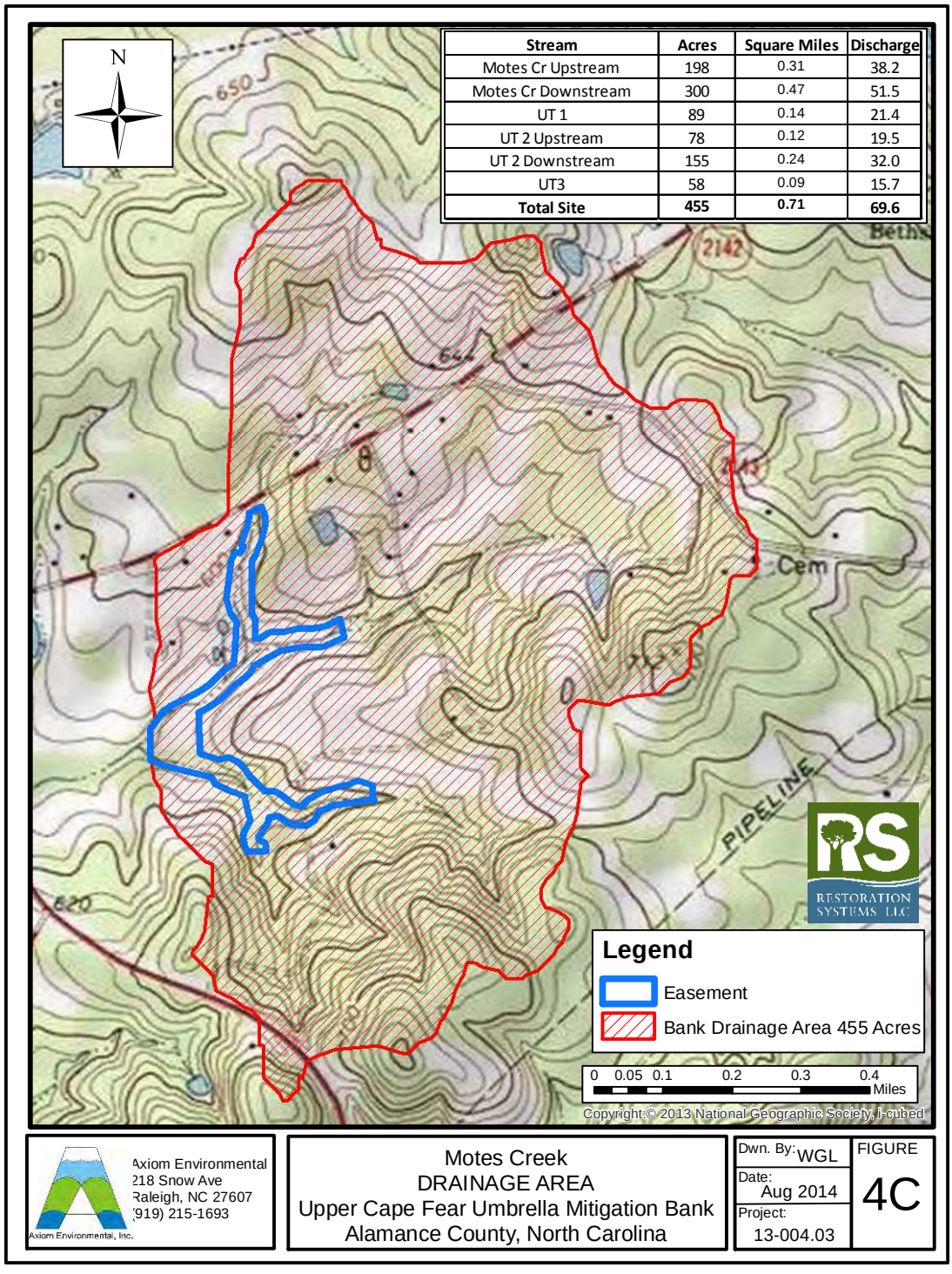
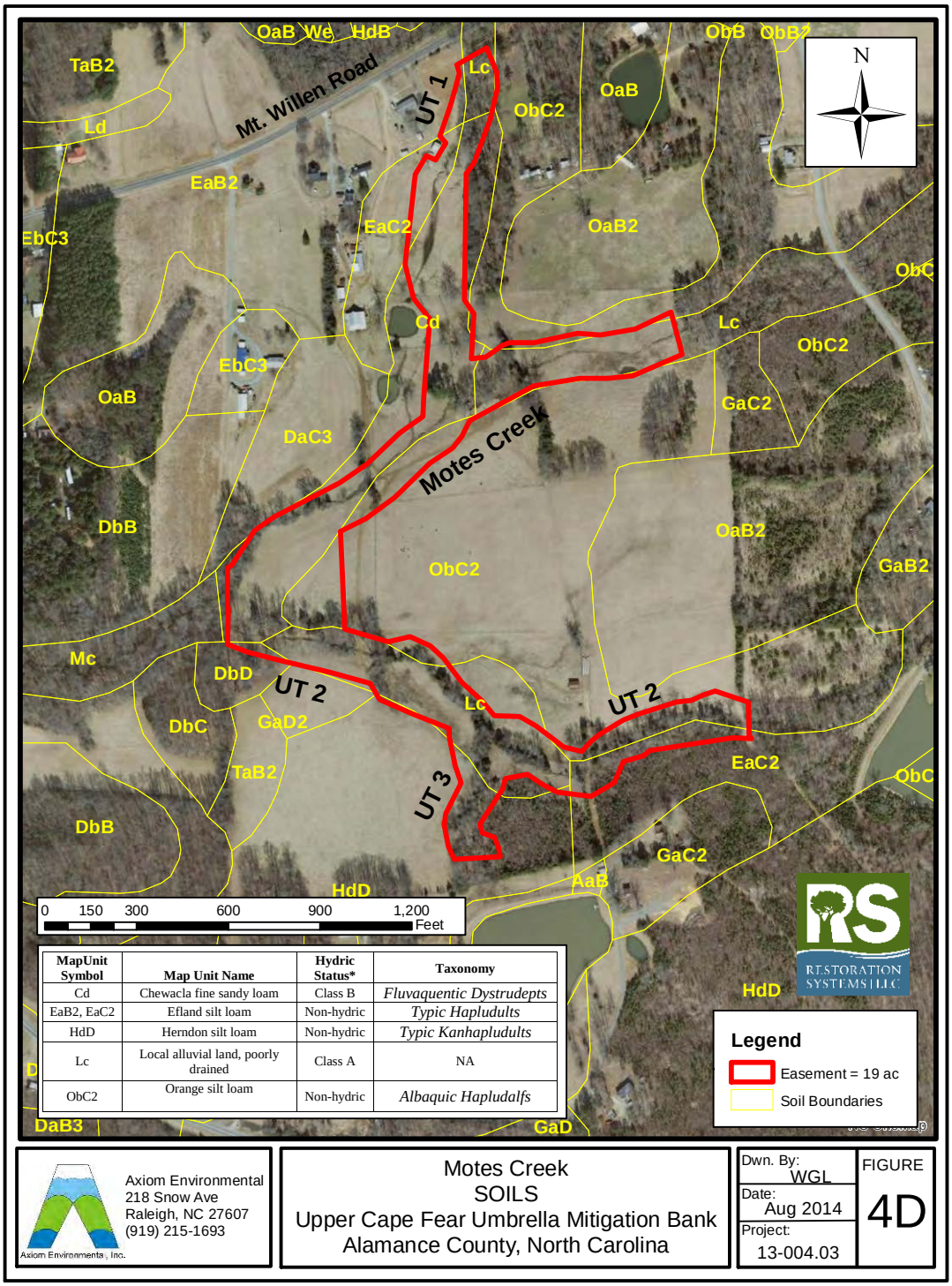


Figure 4C: Motes Creek Drainage Area



Stream	Acres	Square Miles	Discharge
Motes Cr Upstream	198	0.31	38.2
Motes Cr Downstream	300	0.47	51.5
UT 1	89	0.14	21.4
UT 2 Upstream	78	0.12	19.5
UT 2 Downstream	155	0.24	32.0
UT3	58	0.09	15.7
Total Site	**455**	**0.71**	**69.6**

Figure 4D: Motes Creek Soils



MapUnit Symbol	Map Unit Name	Hydric Status*	Taxonomy
Cd	Chewacla fine sandy loam	Class B	*Fluvaquentic Dystrudepts*
EaB2, EaC2	Efland silt loam	Non-hydric	*Typic Hapludults*
HdD	Herndon silt loam	Non-hydric	*Typic Kanhapludults*
Lc	Local alluvial land, poorly drained	Class A	NA
ObC2	Orange silt loam	Non-hydric	*Albaquic Hapludalfs*

Axiom Environmental
218 Snow Ave
Raleigh, NC 27607
(919) 215-1693

Motes Creek
SOILS
Upper Cape Fear Umbrella Mitigation Bank
Alamance County, North Carolina

Dwn. By: WGL
Date: Aug 2014
Project: 13-004.03
FIGURE 4D

Figure 5A: Benton Branch Site Features

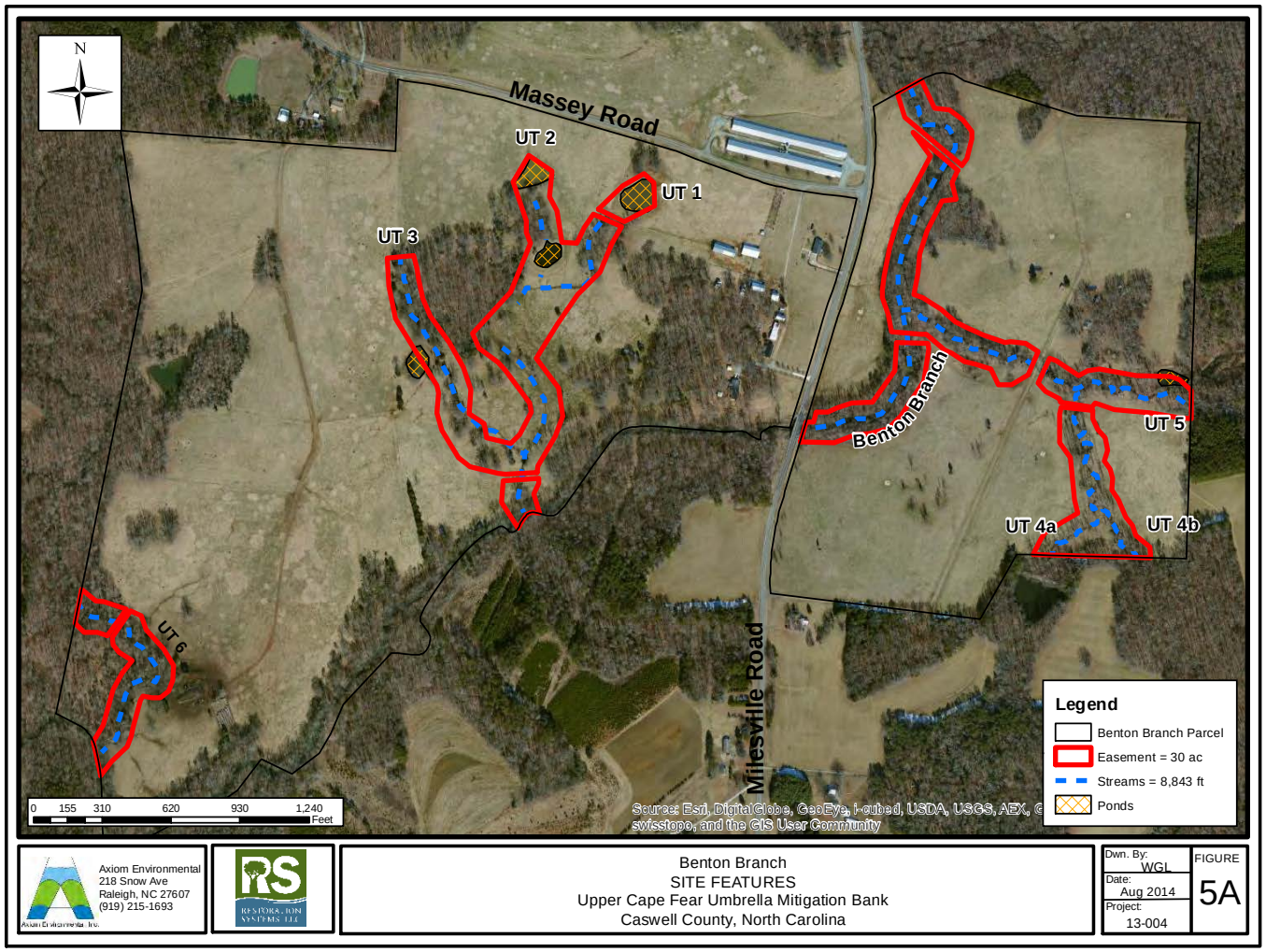


Figure 5B: Benton Branch Topography

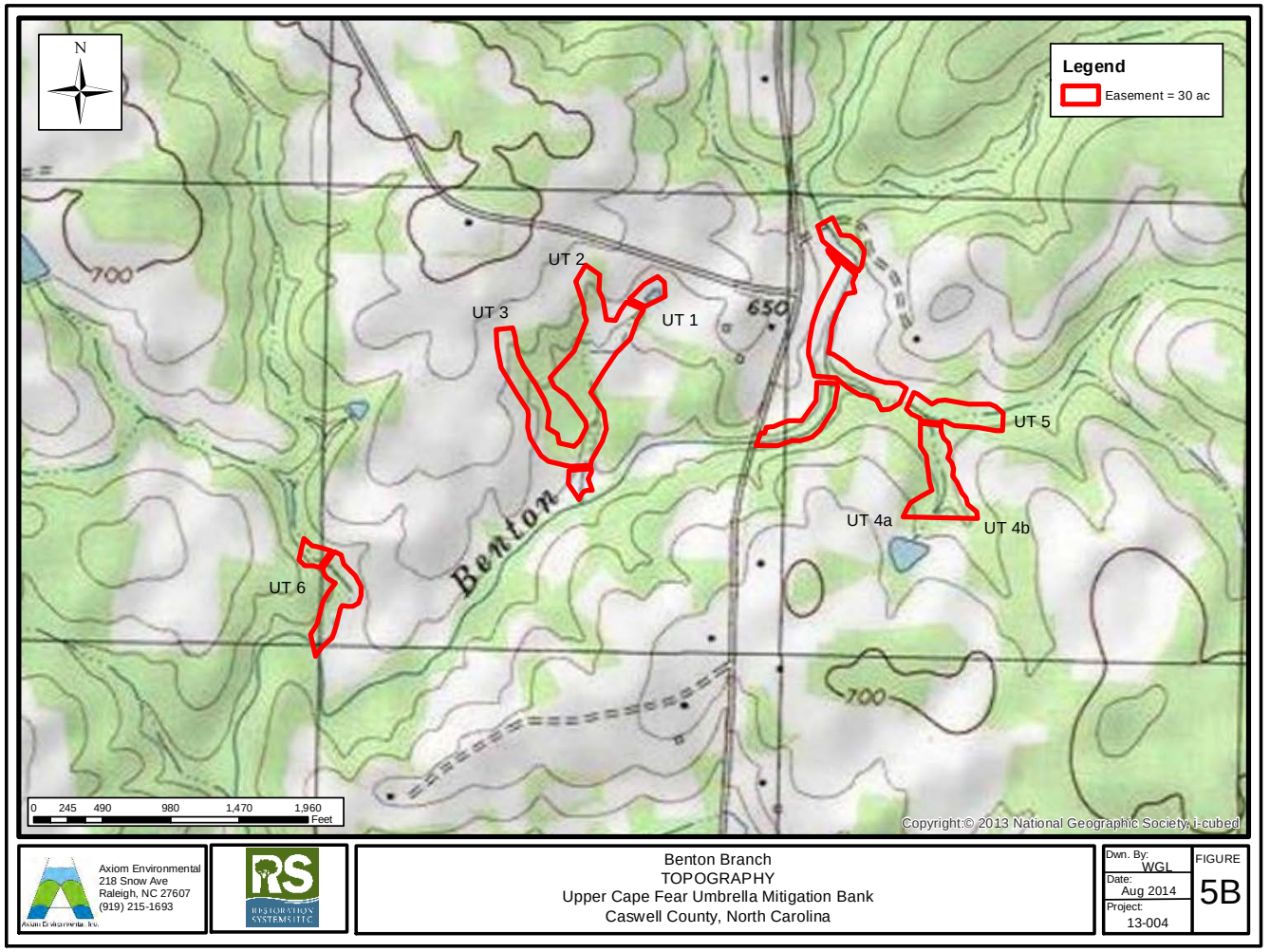


Figure 5C: Benton Branch Drainage Area

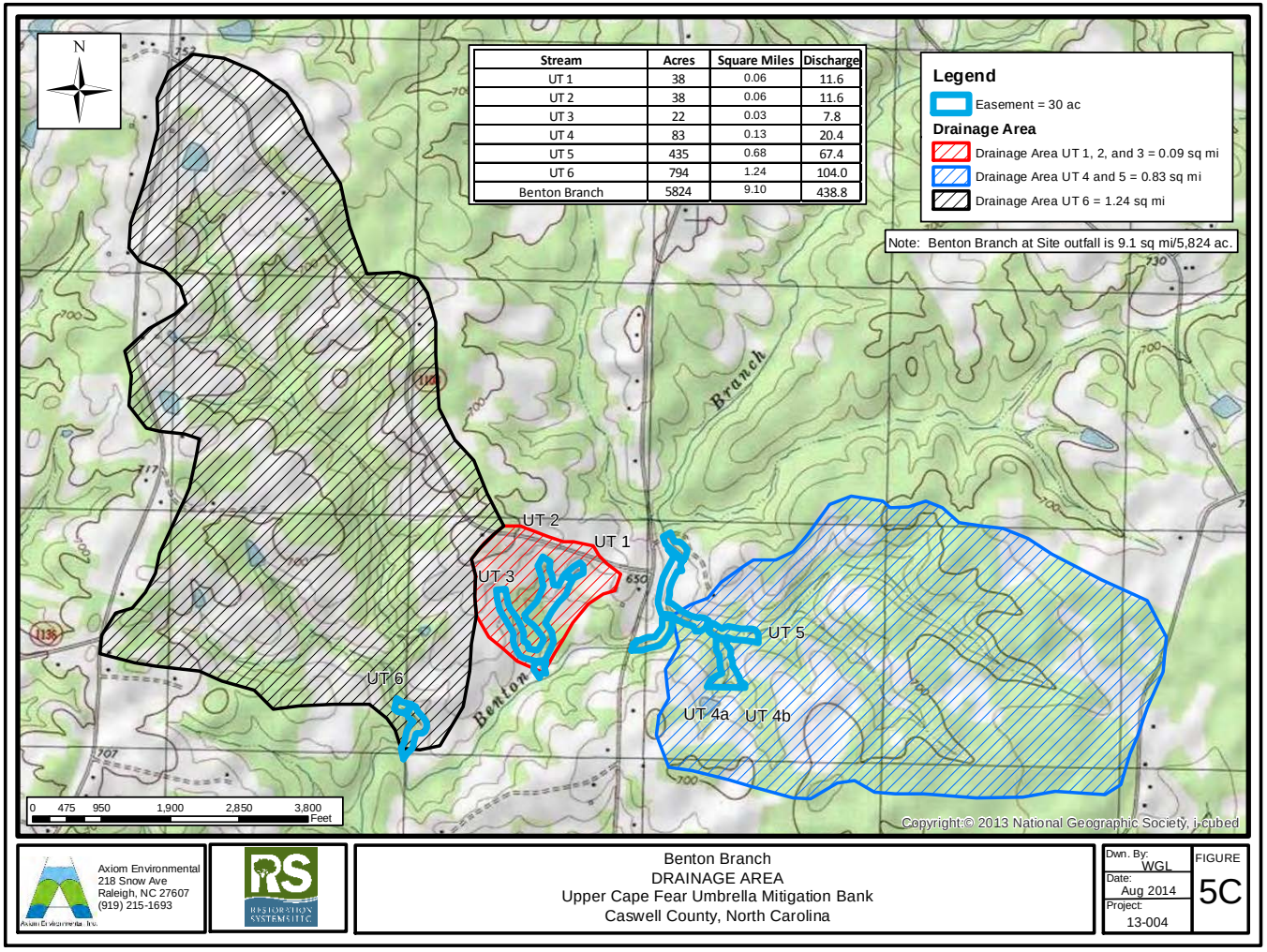


Figure 6A: Orphan Creek Site Features

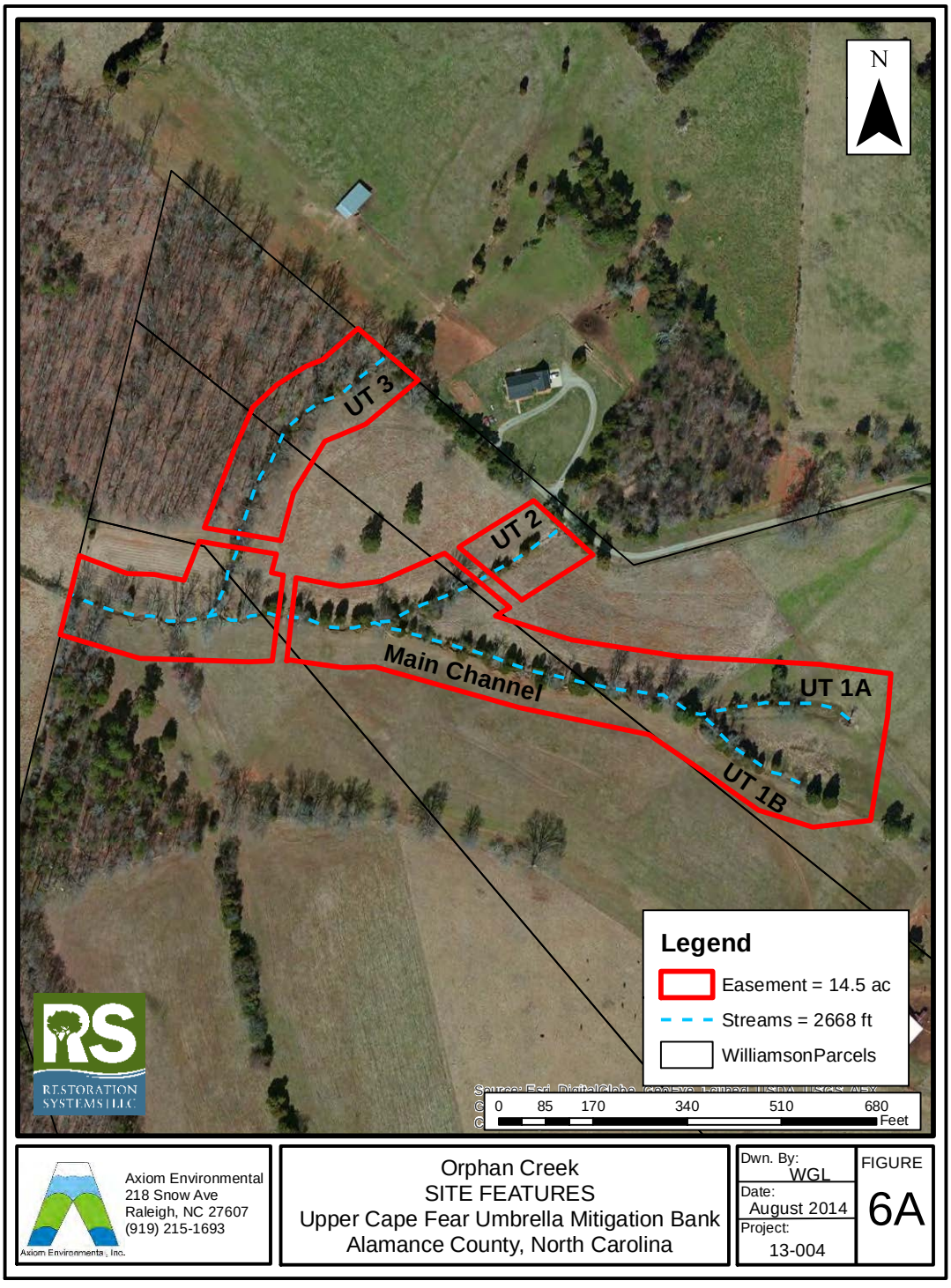


Figure 6B: Orphan Creek Topography

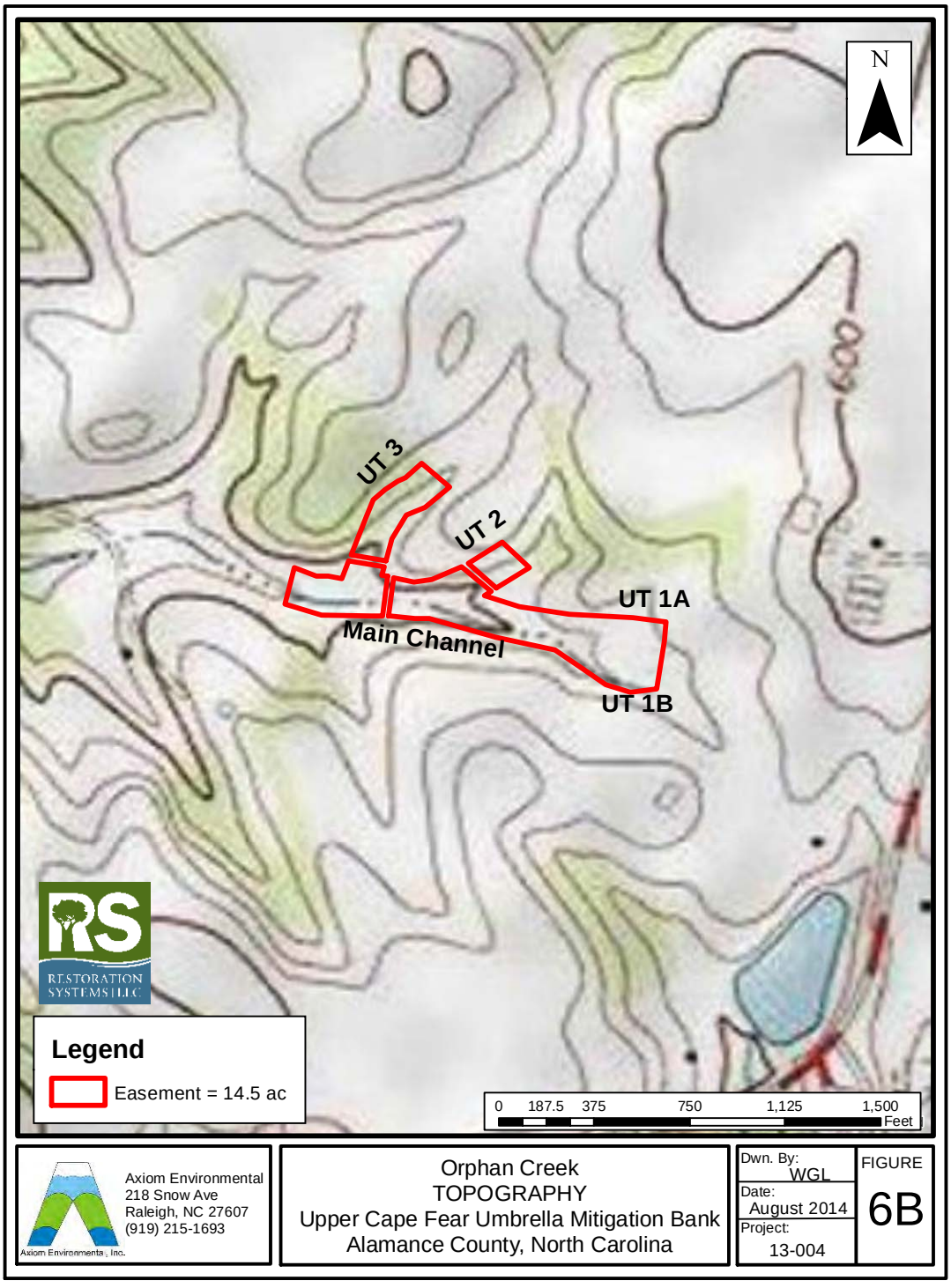


Figure 6C: Orphan Creek Drainage Area

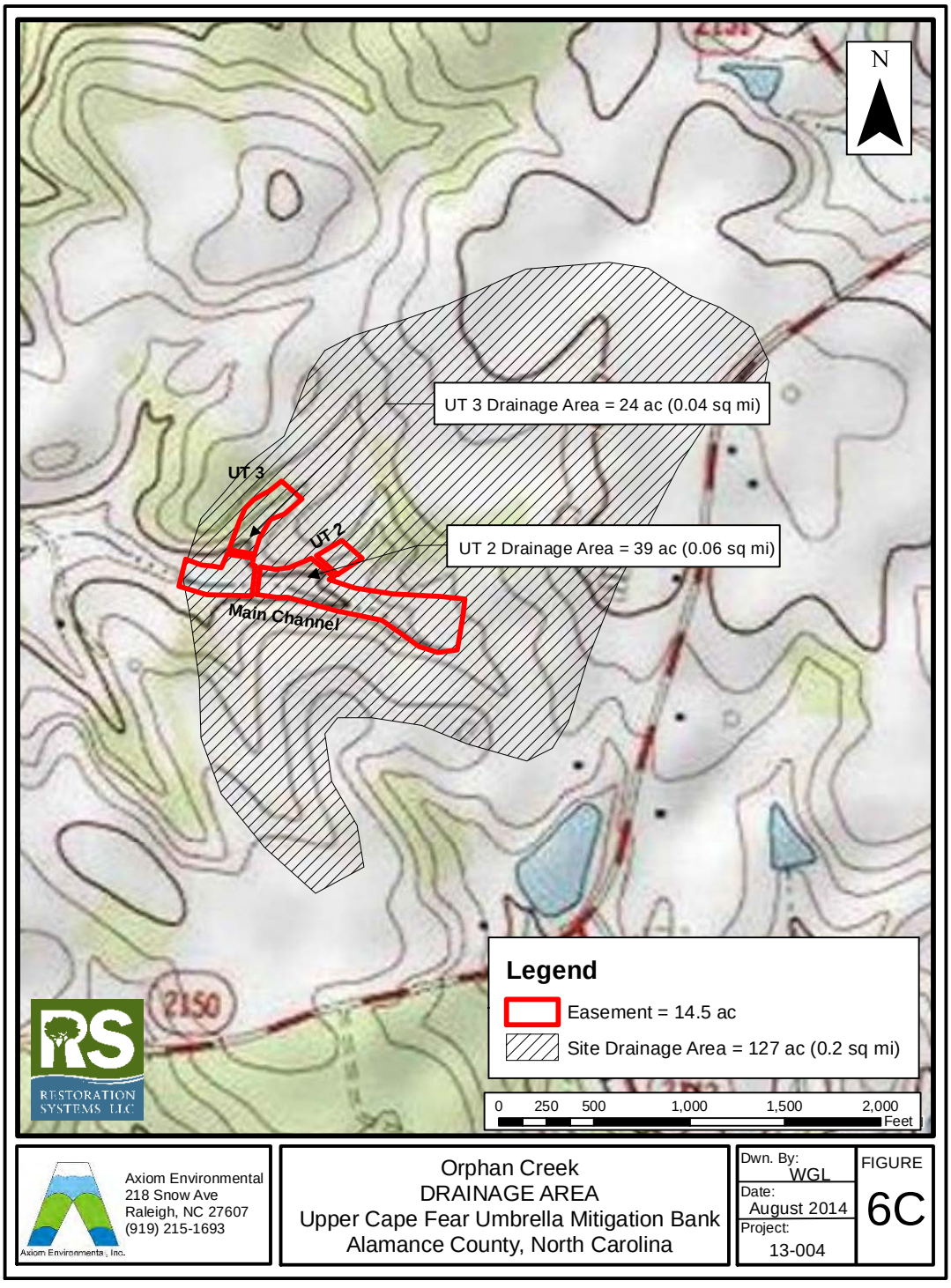


Figure 6D: Orphan Creek Soils

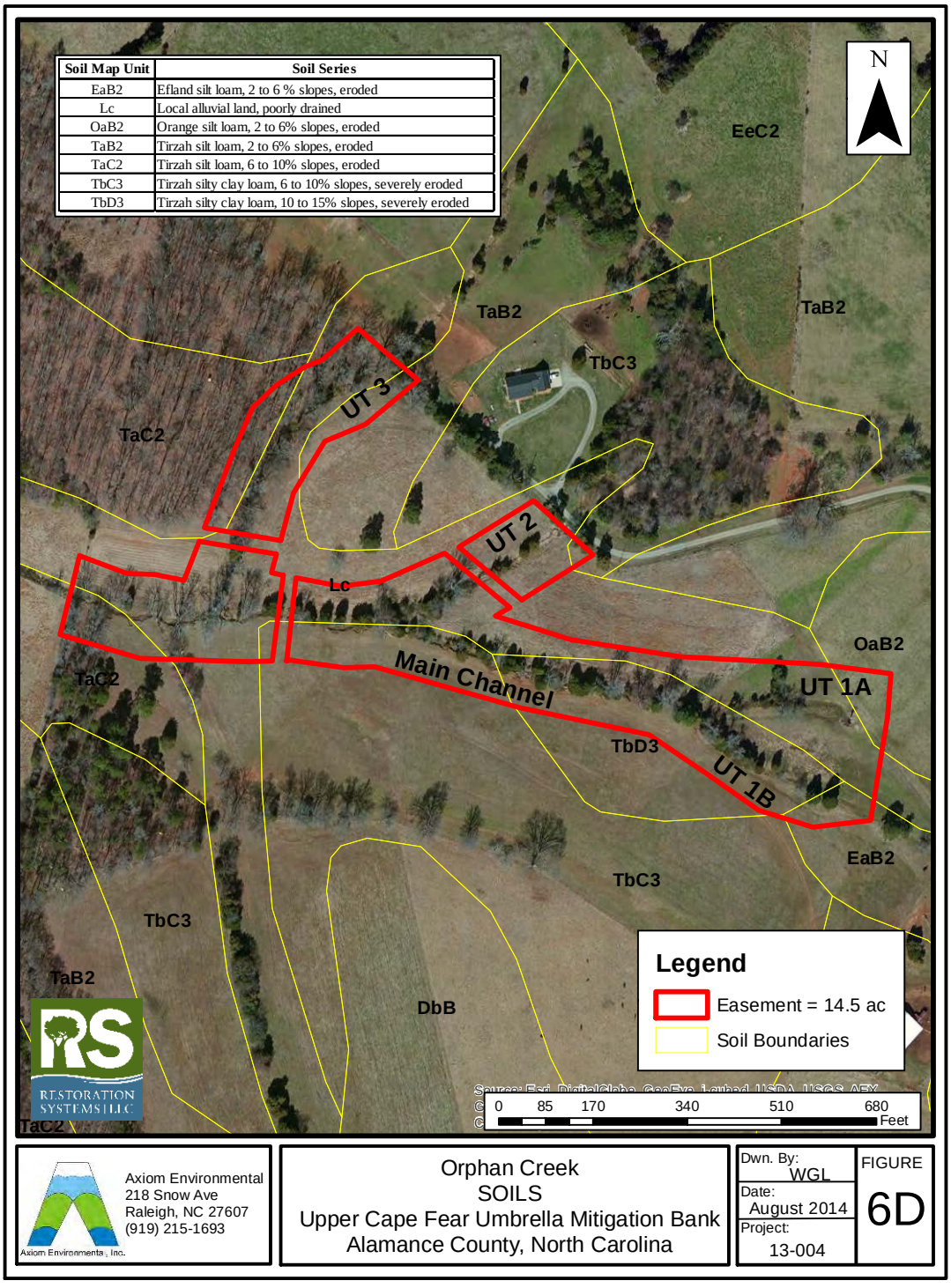


Figure 7A: Chico Branch Site Features

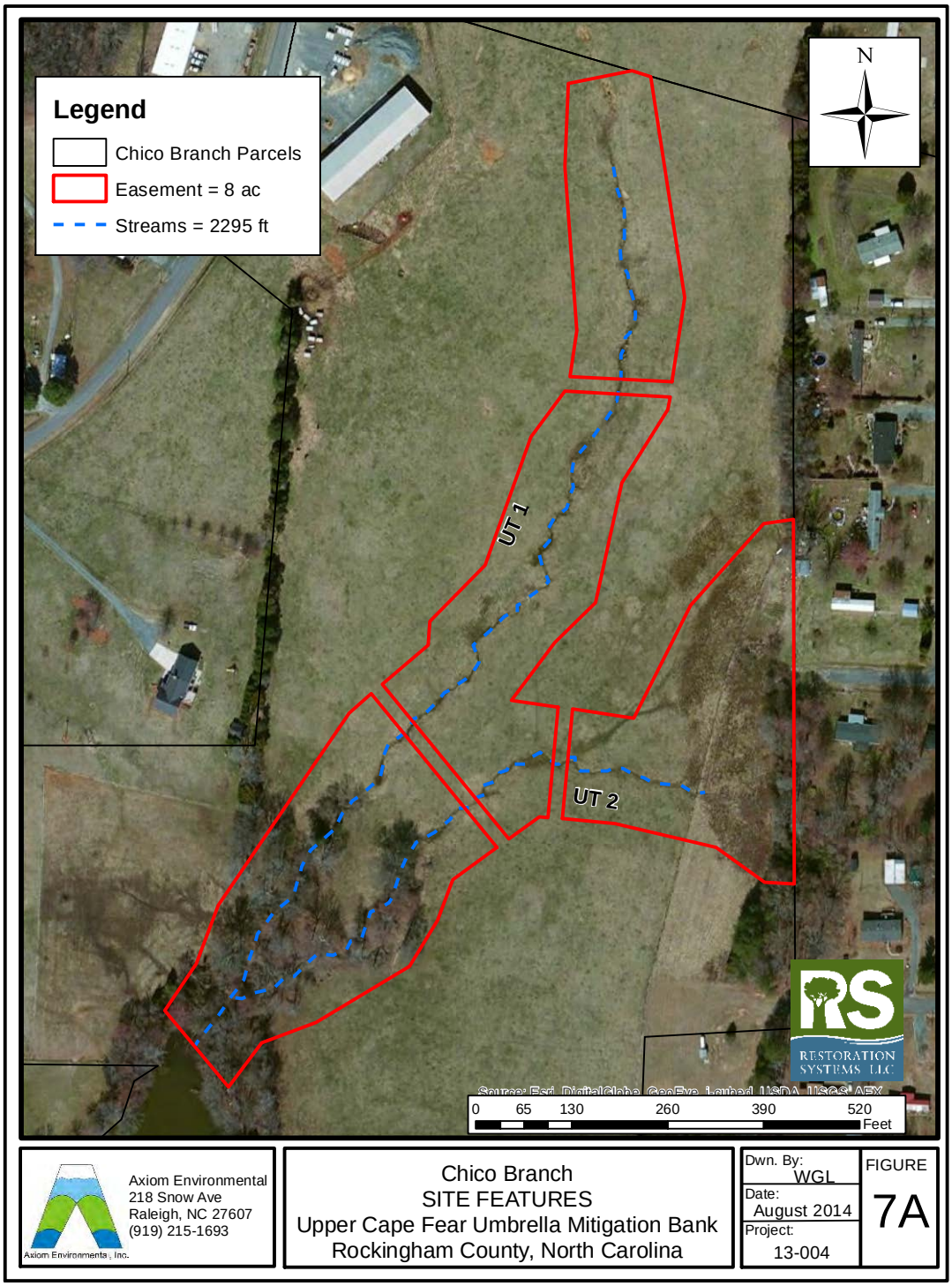


Figure 7B: Chico Branch Topography

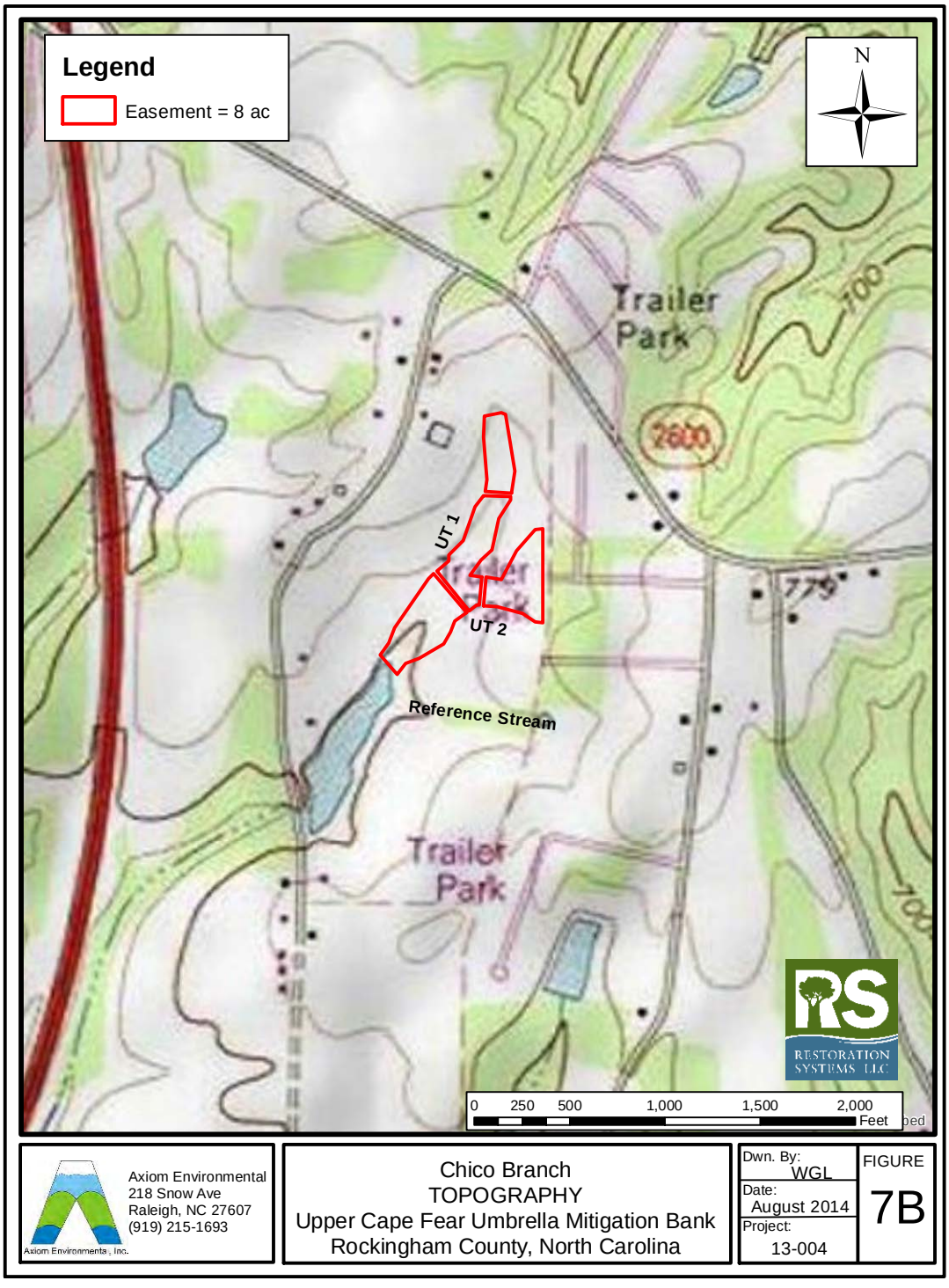


Figure 7C: Chico Branch Drainage Area

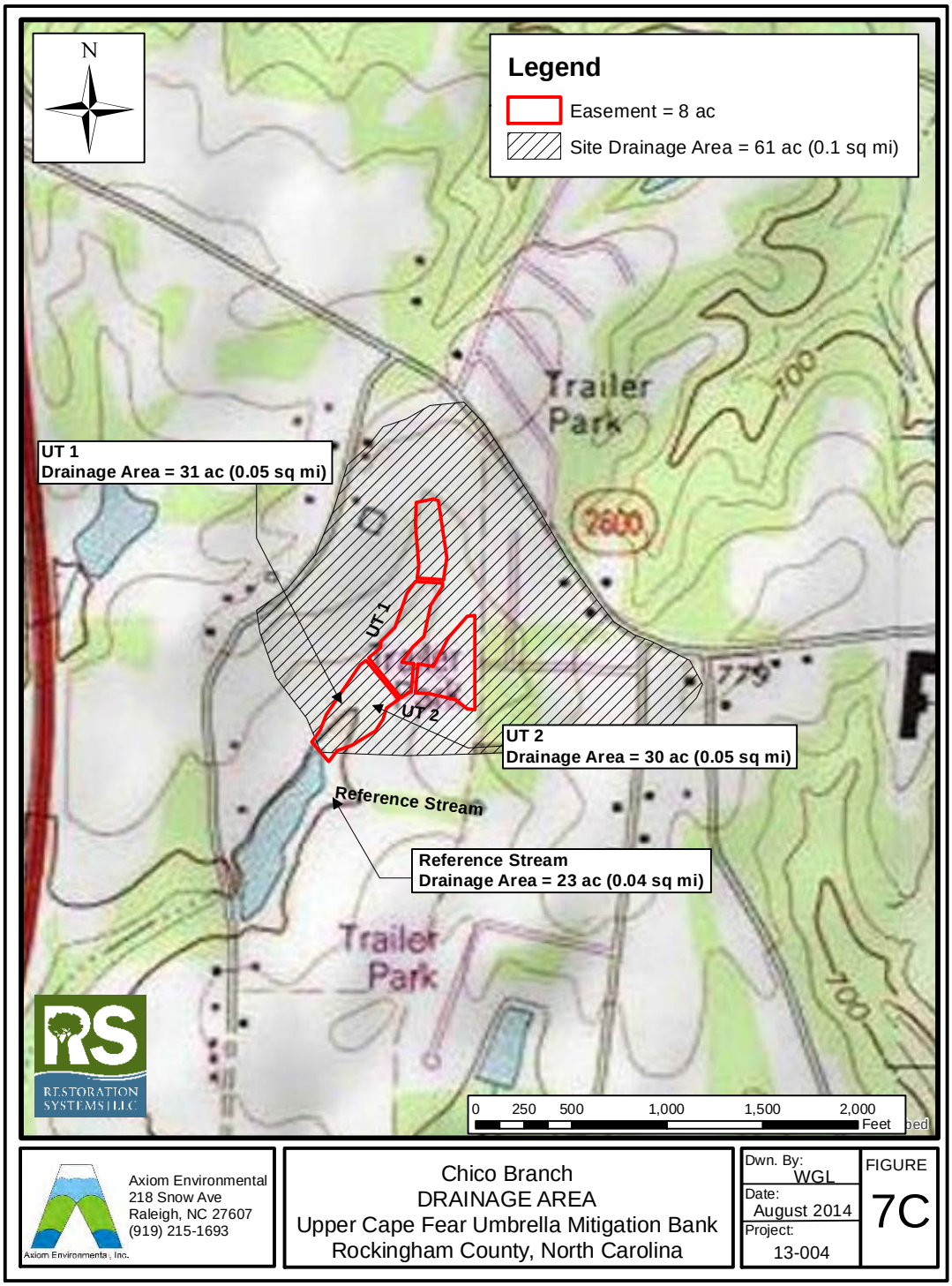


Figure 7D: Chico Branch Soils

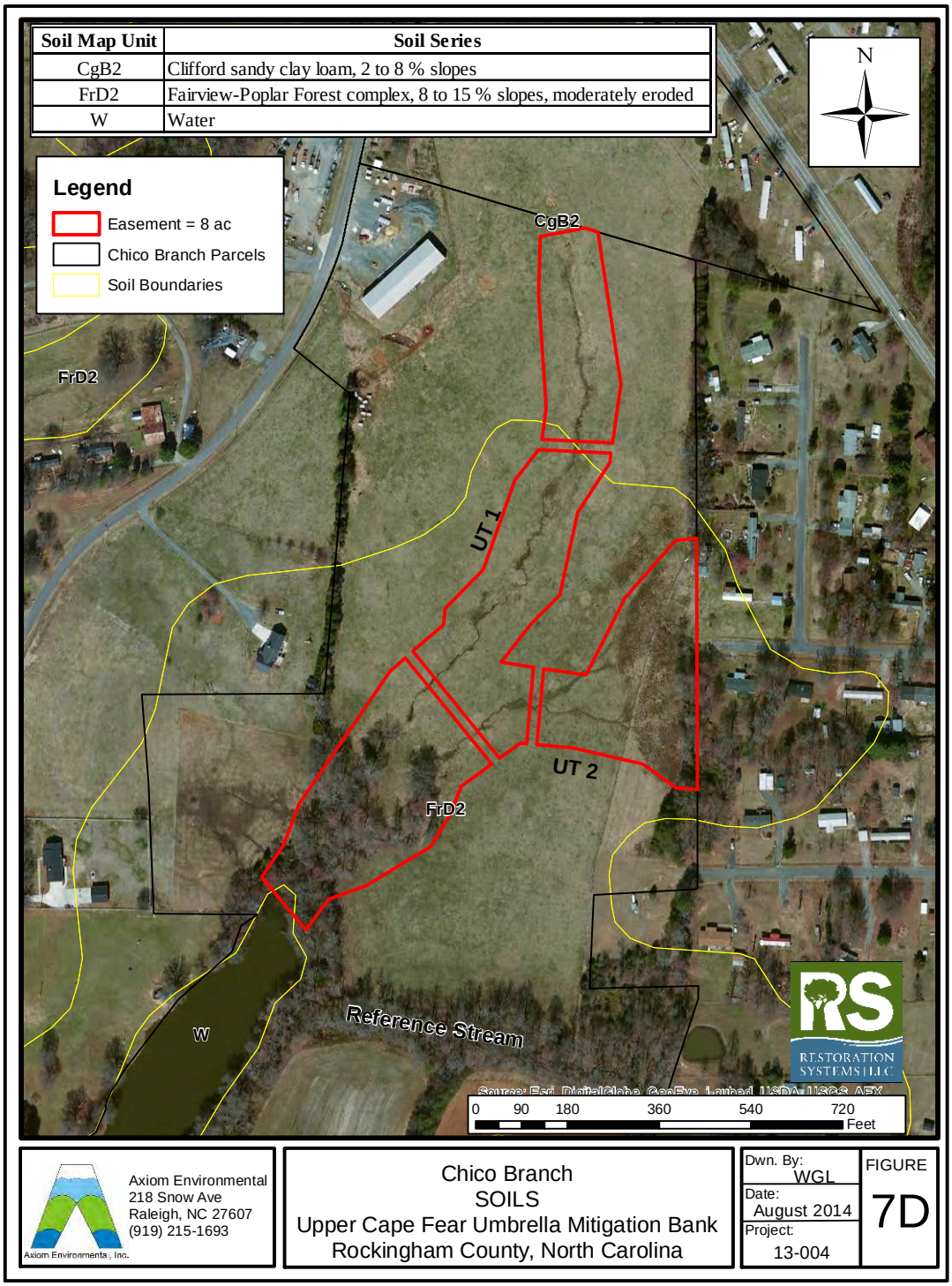


Figure 8A: Major Hill Site Features

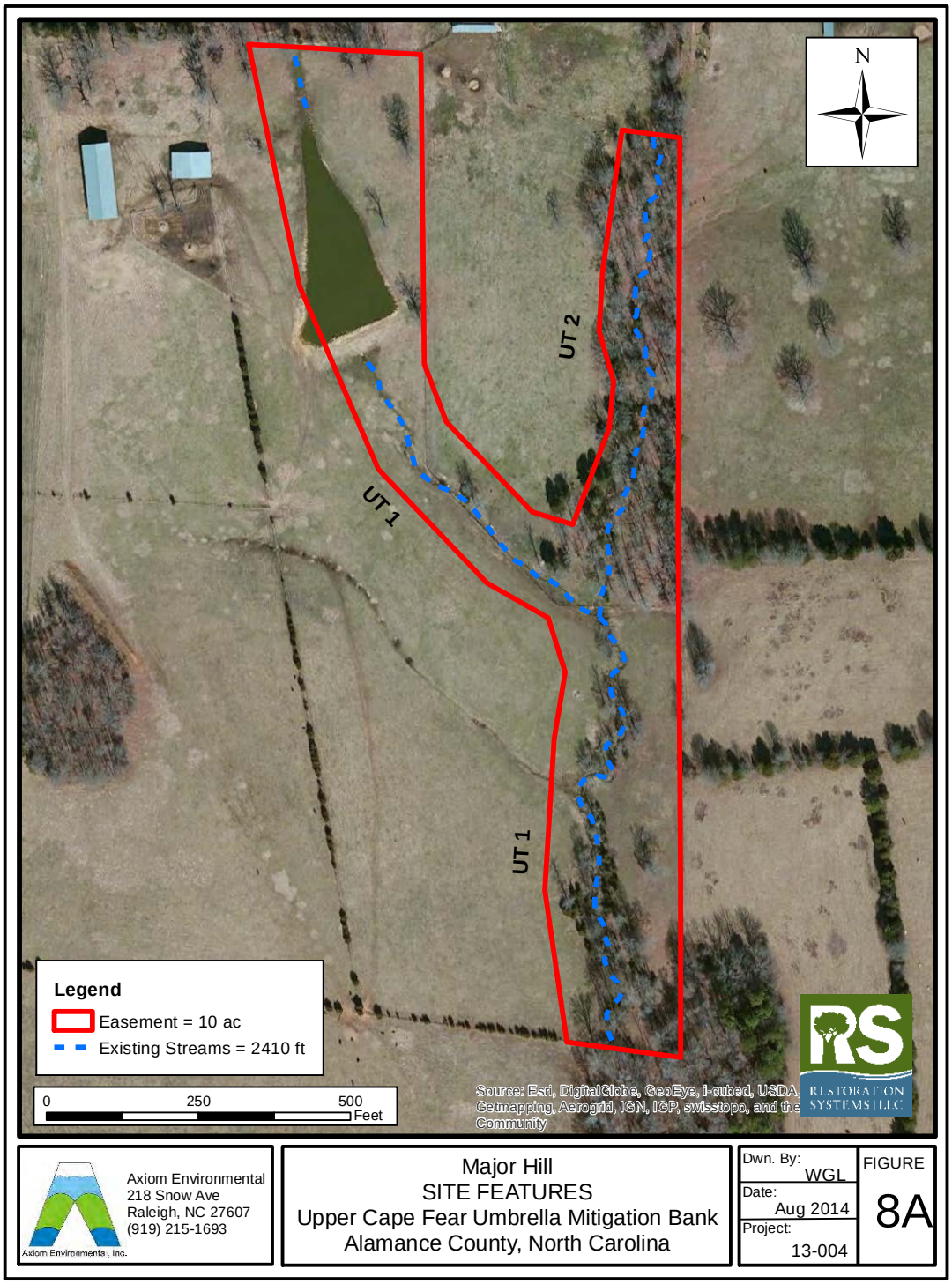


Figure 8B: Major Hill Topography

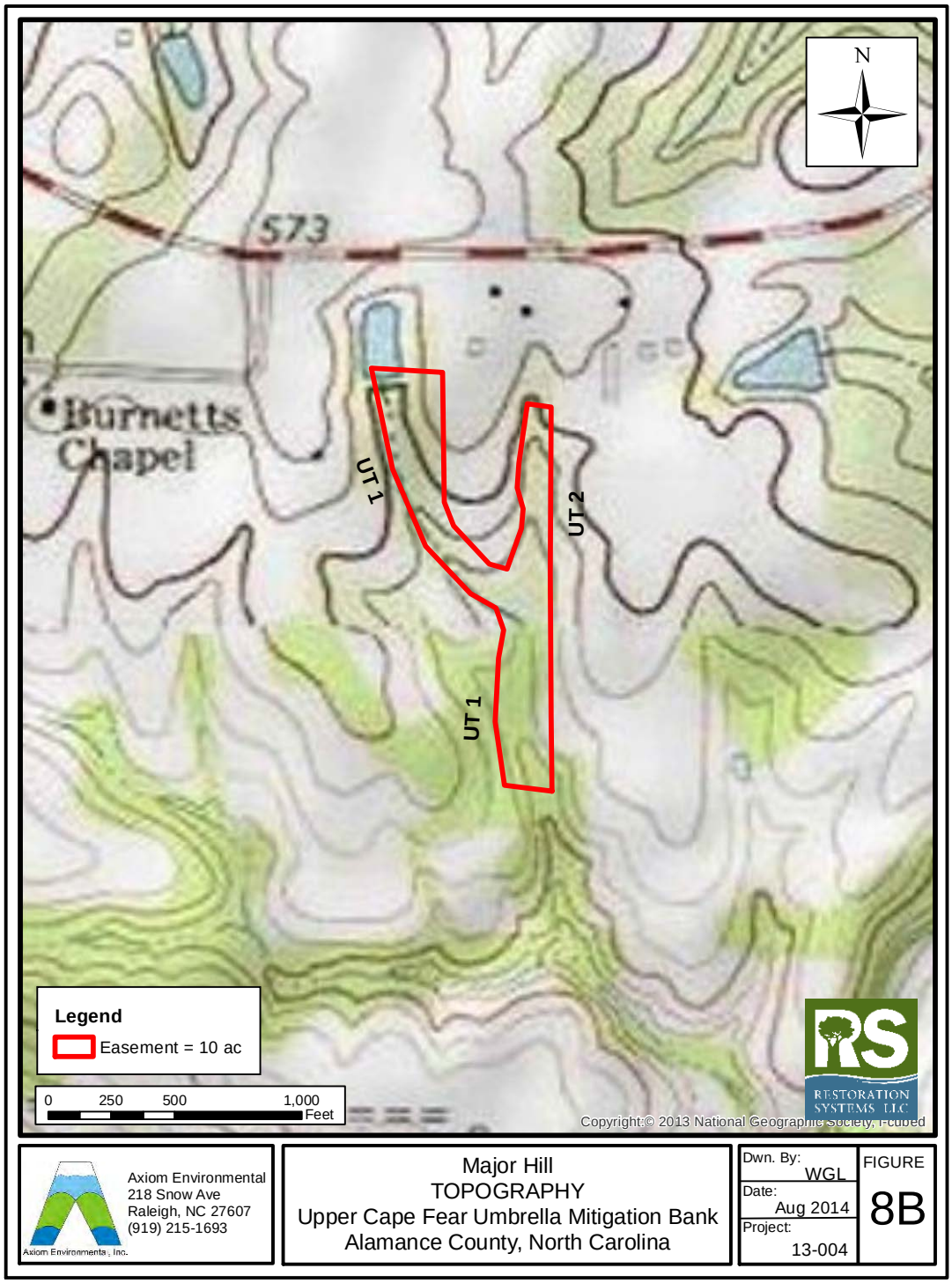


Figure 8C: Major Hill Drainage Area

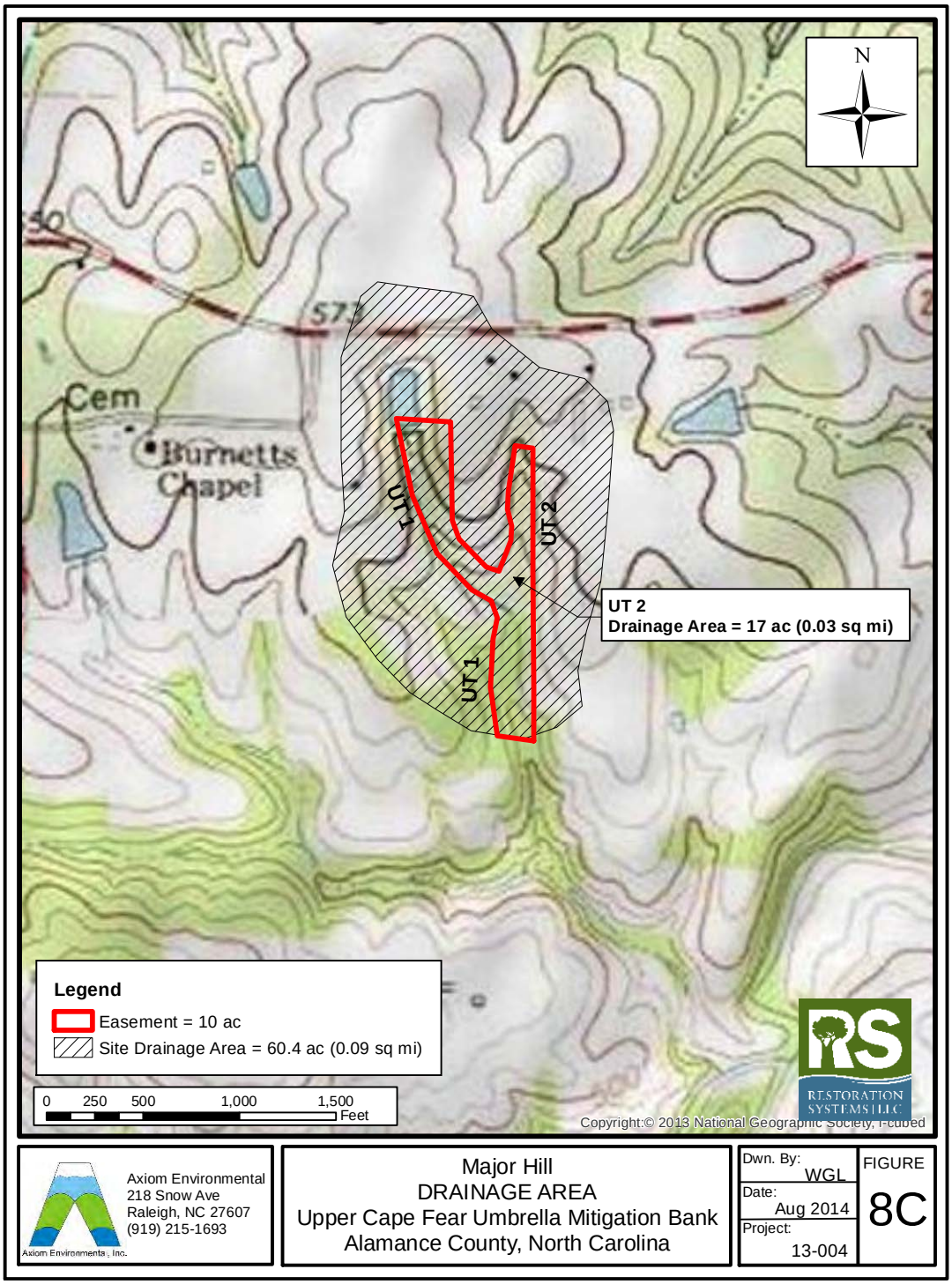


Figure 8D: Major Hill Soils

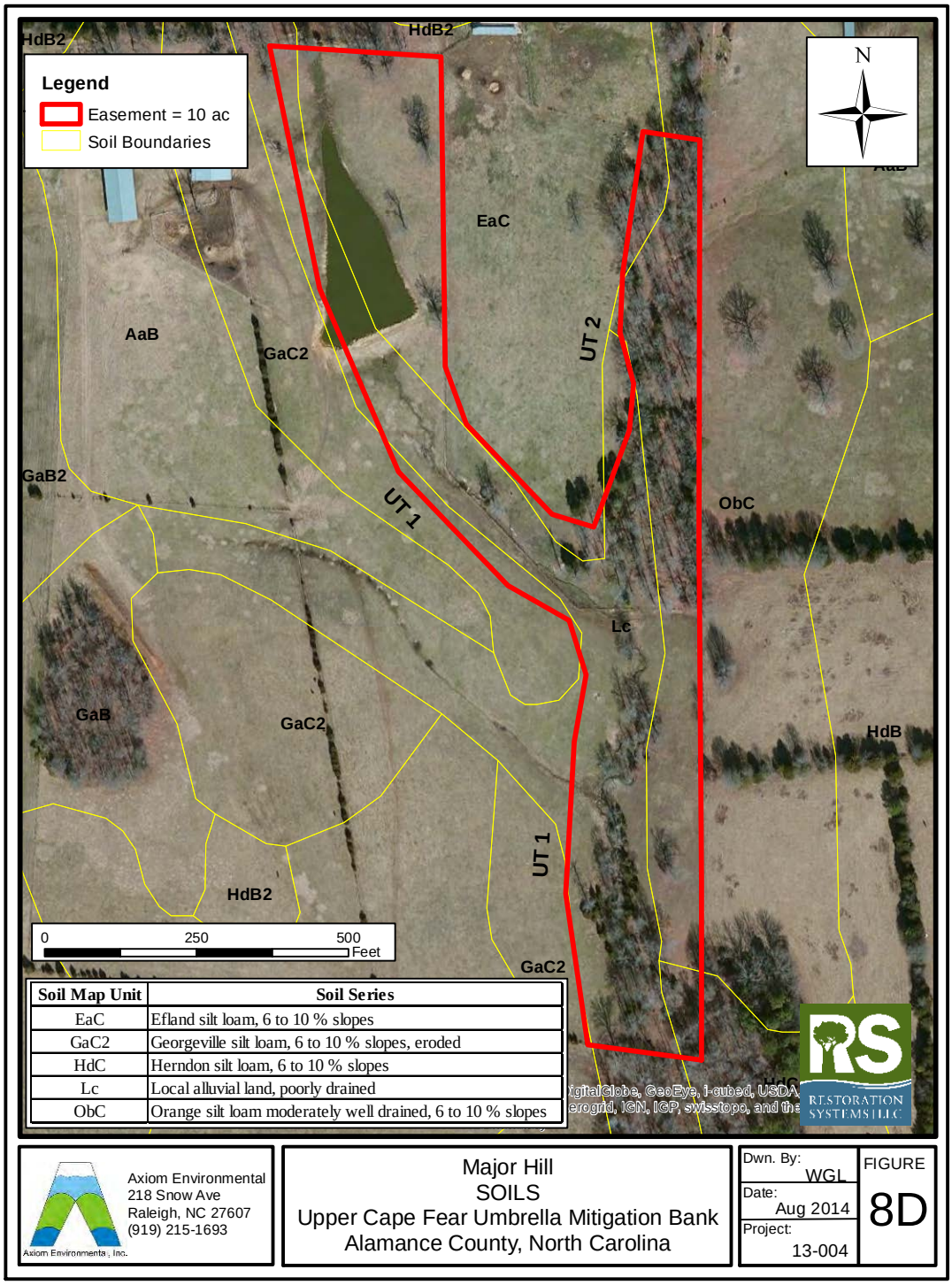


Figure 9A: Maple Hill Farm Site Features

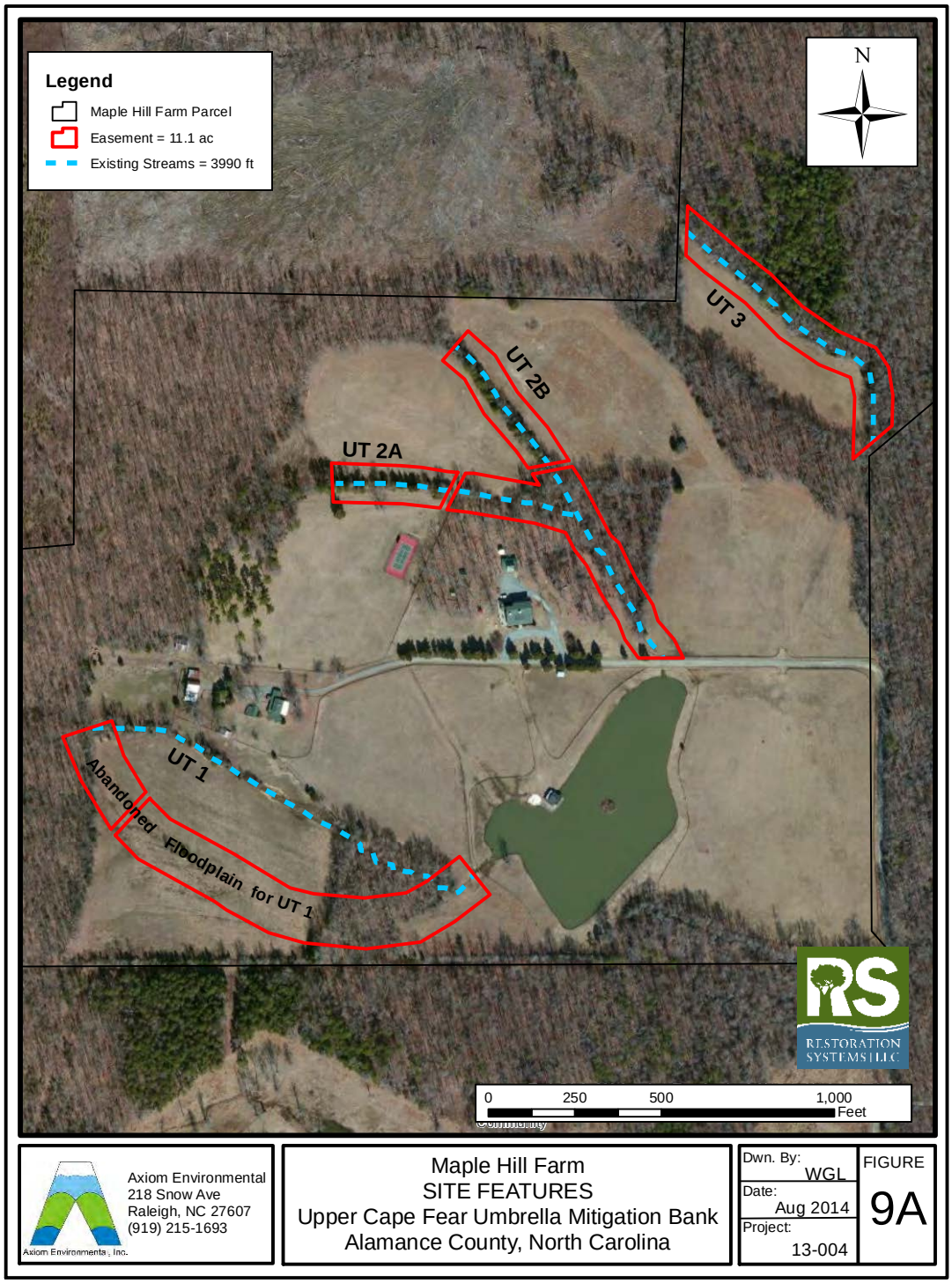


Figure 9B: Maple Hill Farm Topography

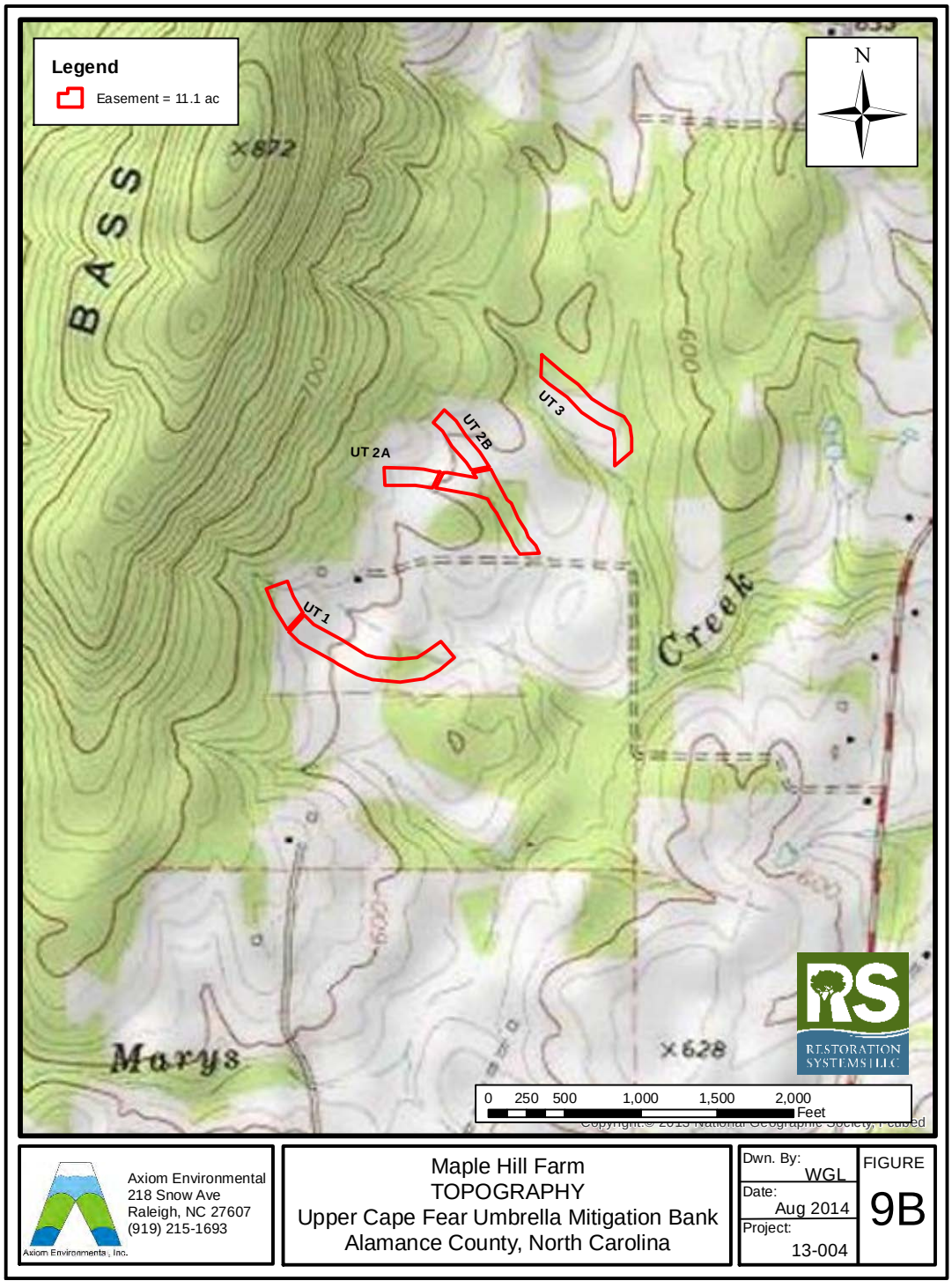


Figure 9C: Maple Hill Farm Drainage Area

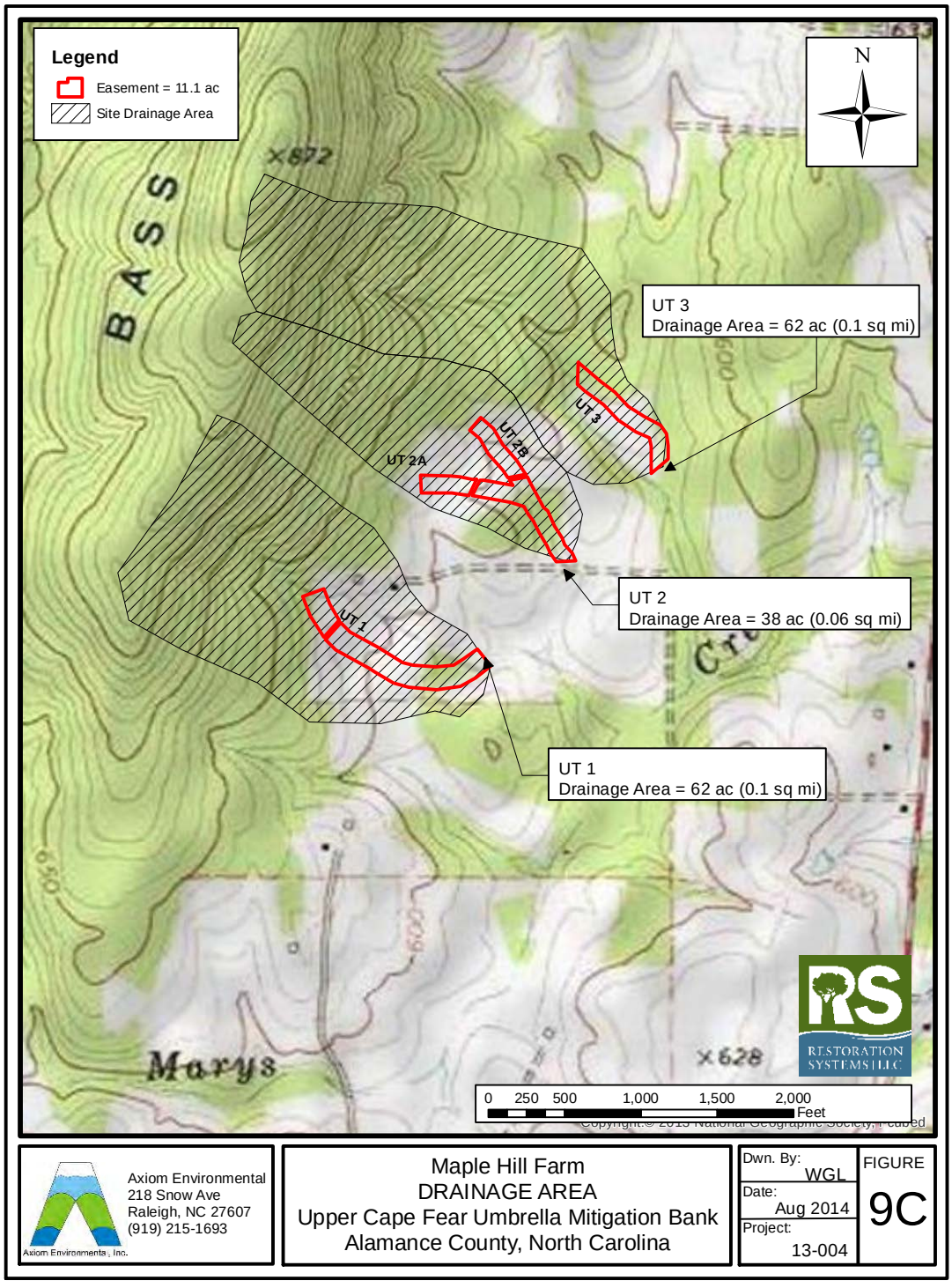


Figure 9D: Maple Hill Farm Soils

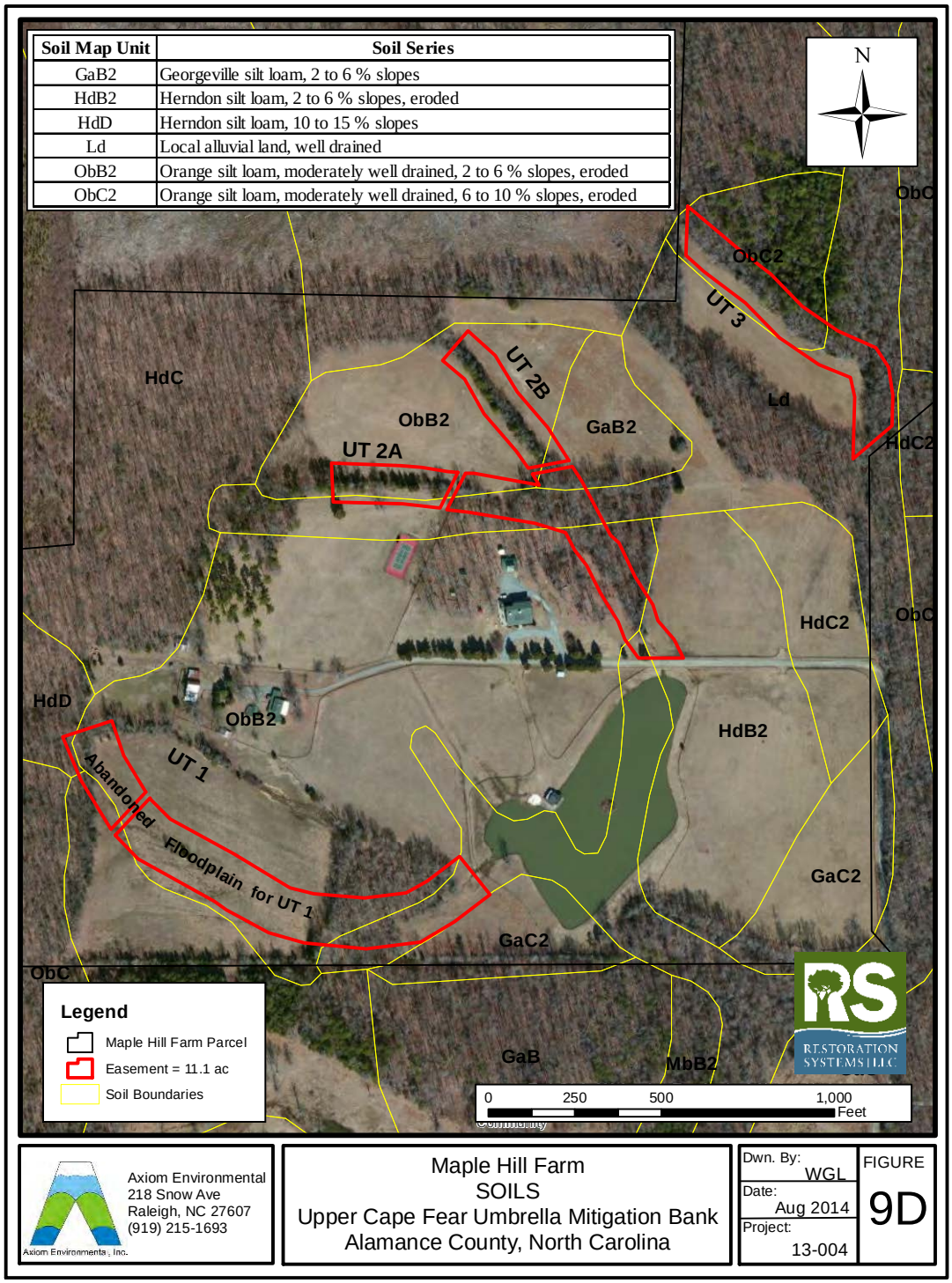


Figure 10A: Rocky Top Site Features

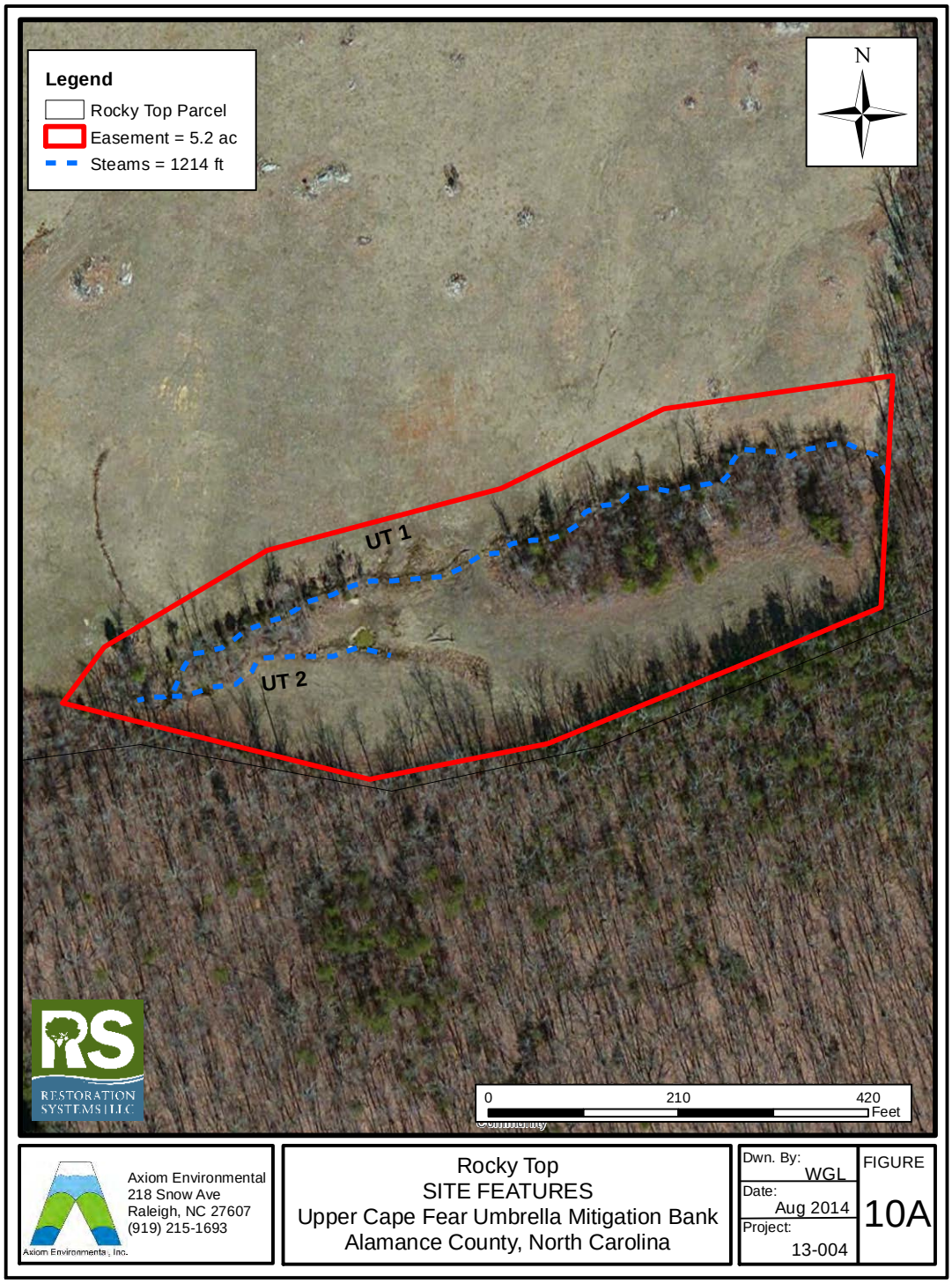


Figure 10B: Rocky Top Topography

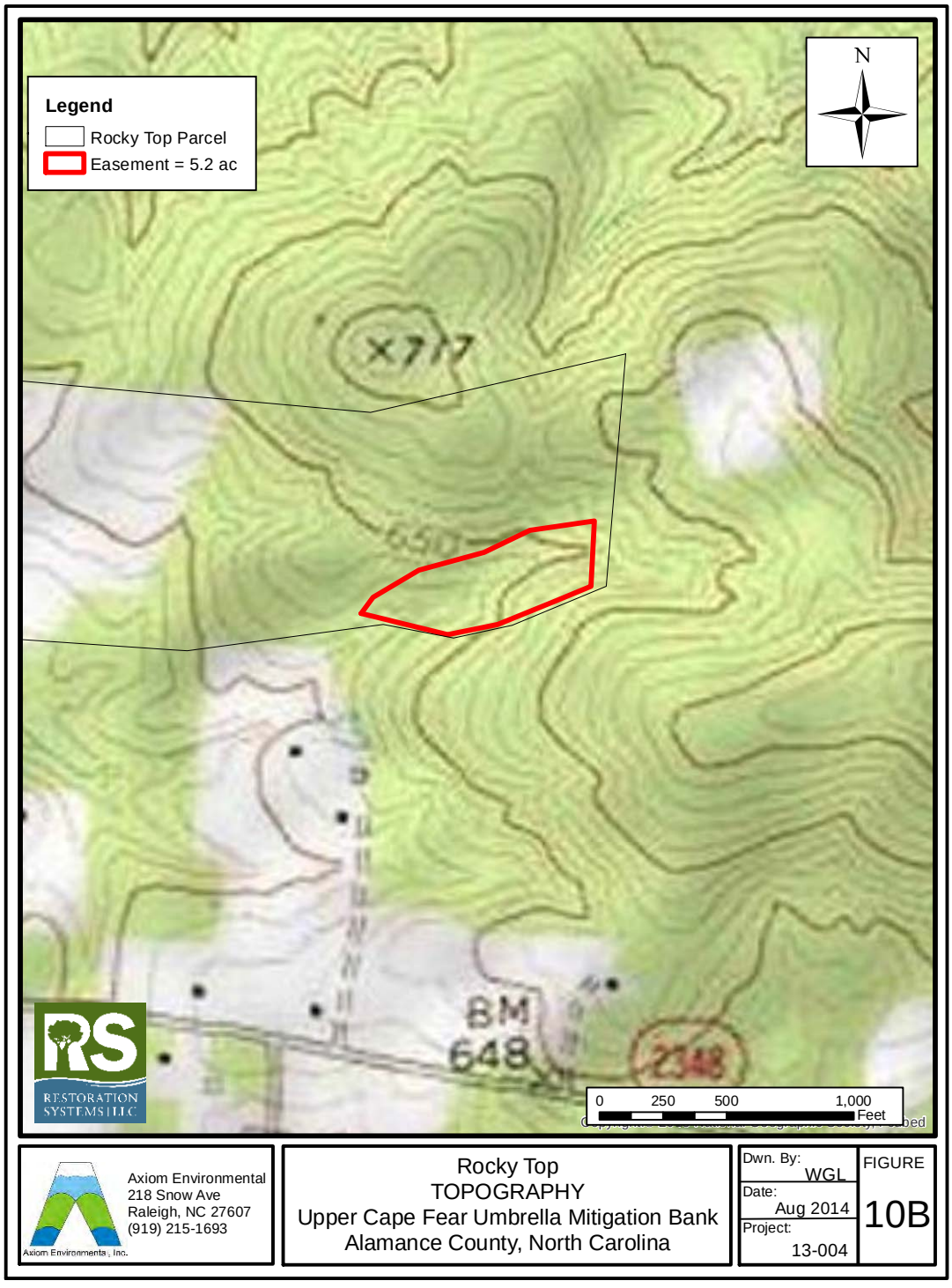


Figure 10C: Rocky Top Drainage Area

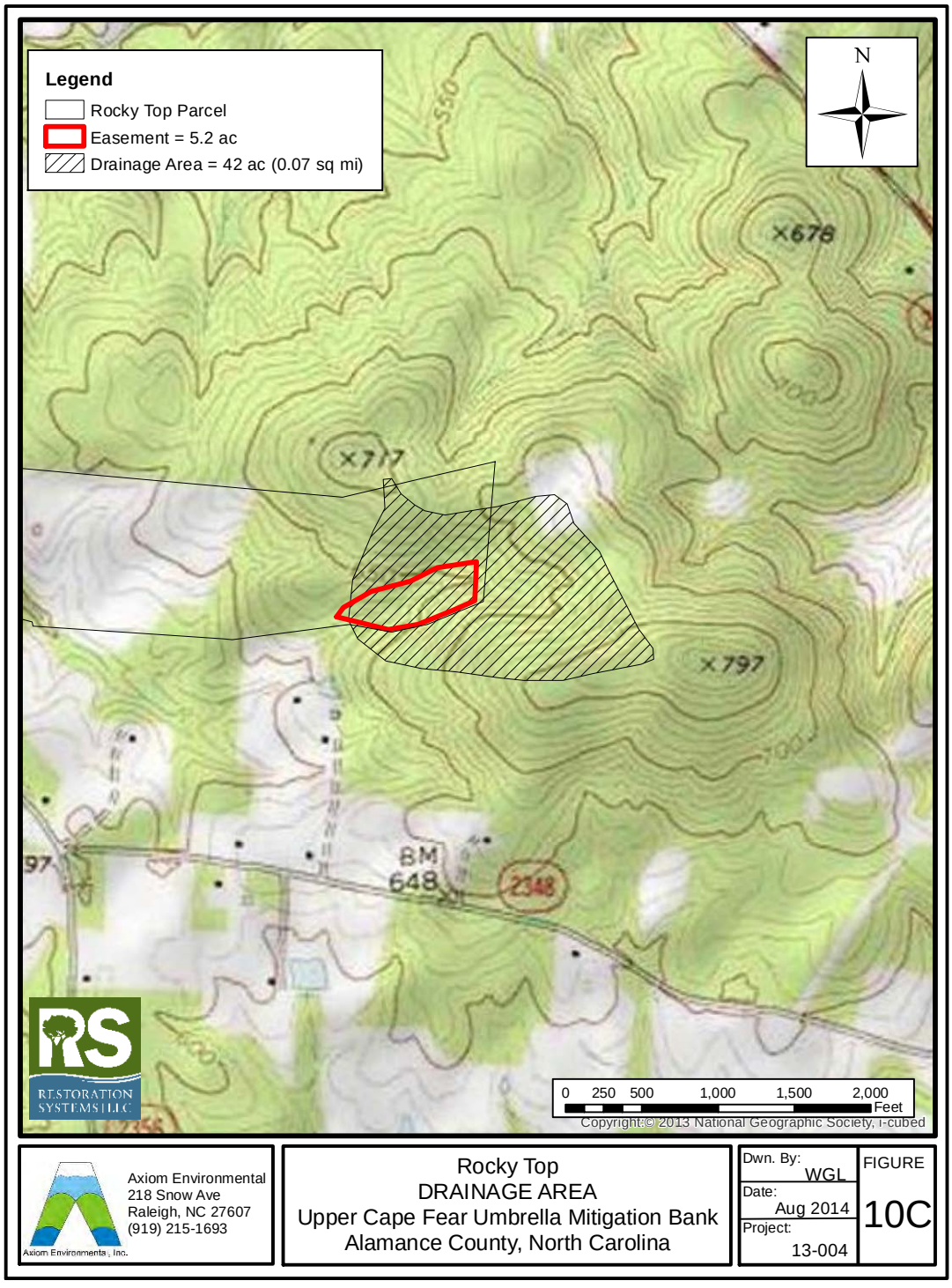


Figure 10D: Rocky Top Soils

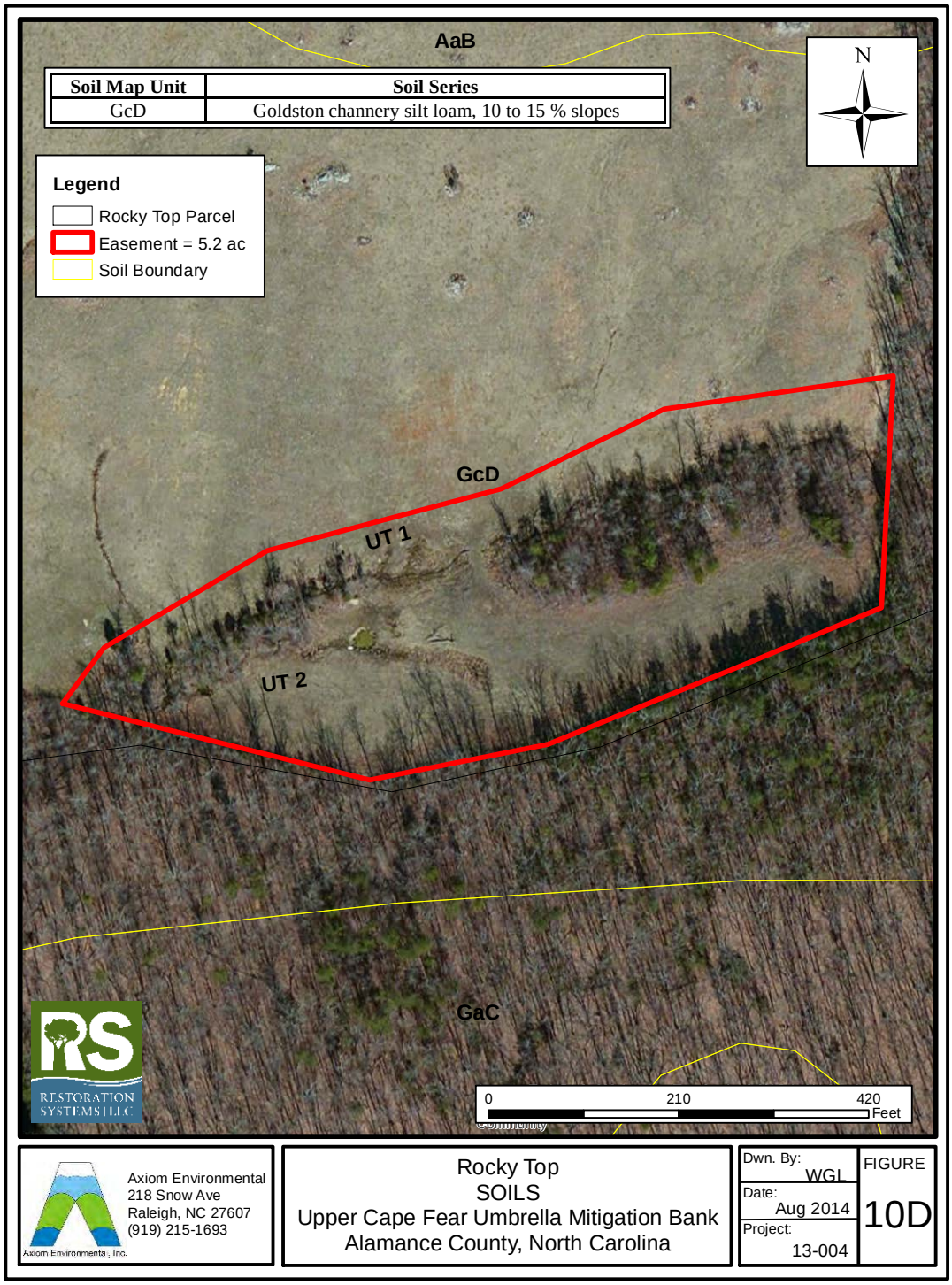
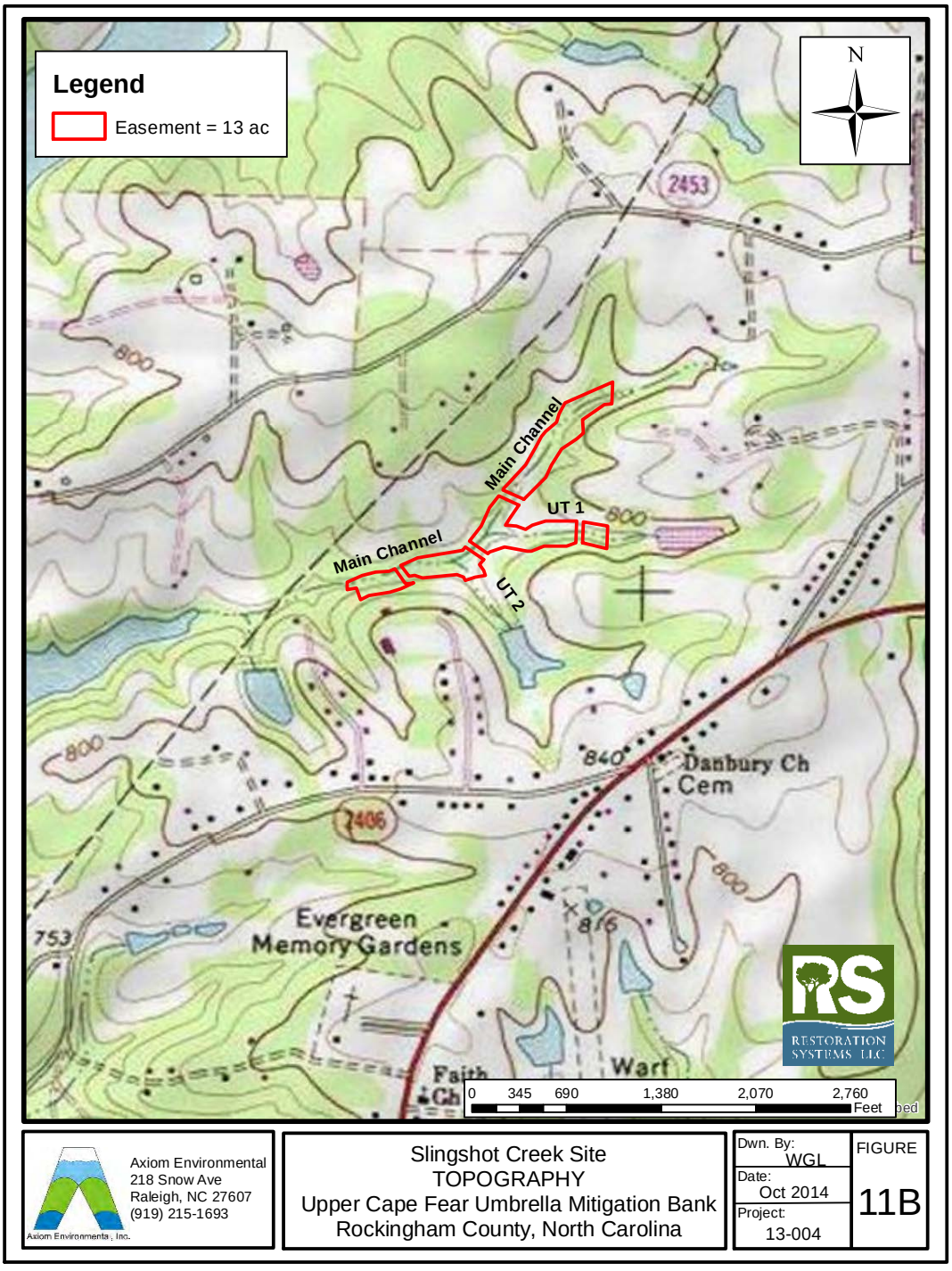


Figure 11A: Slingshot Creek Site Features

Figure 11B: Slingshot Creek Topography



Axiom Environmental 218 Snow Ave Raleigh, NC 27607 (919) 215-1693	Slingshot Creek Site TOPOGRAPHY Upper Cape Fear Umbrella Mitigation Bank Rockingham County, North Carolina	Dwn. By: WGL Date: Oct 2014 Project: 13-004	FIGURE 11B

Figure 11C: Slingshot Creek Drainage Area

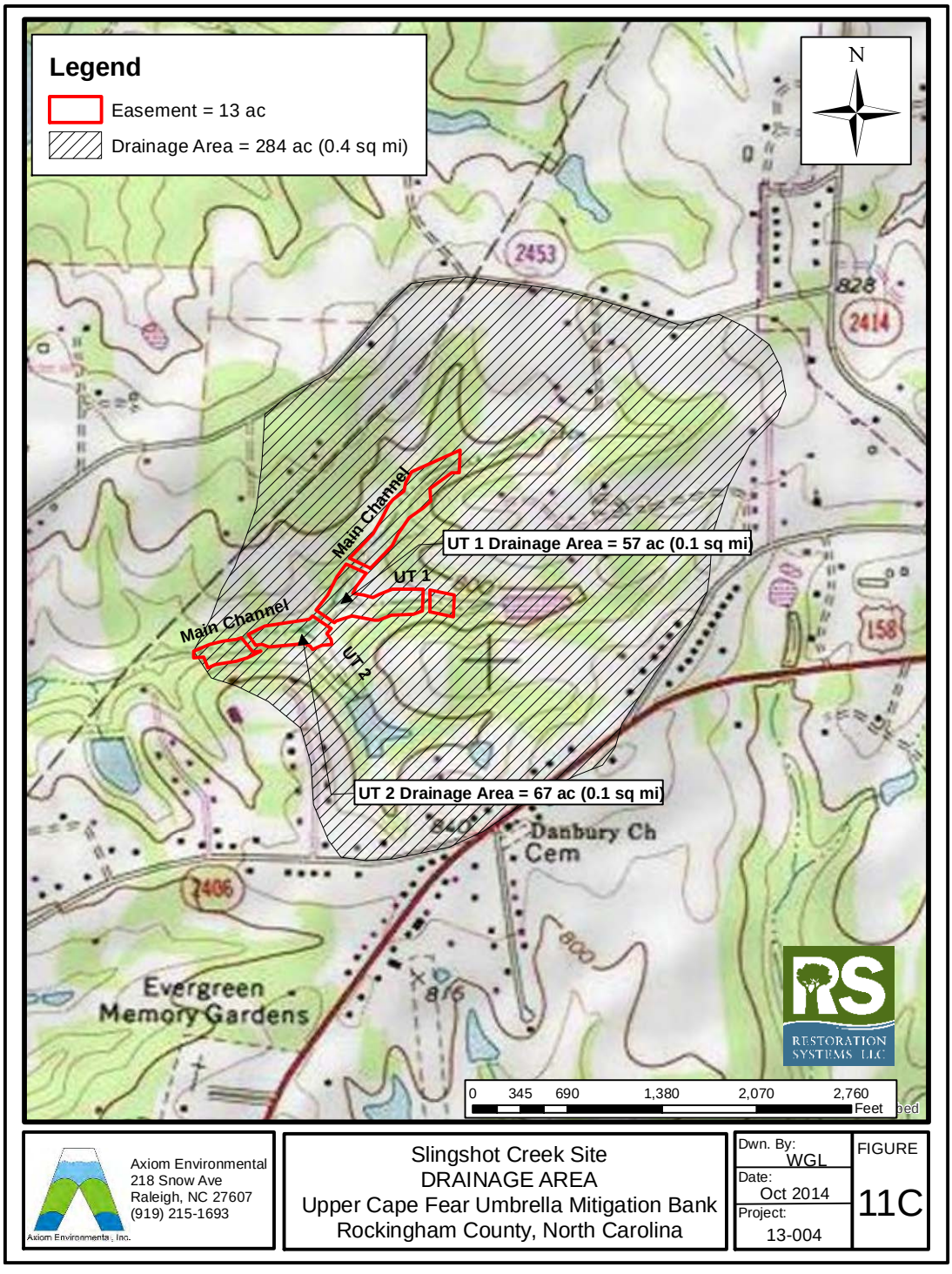


Figure 11D: Slingshot Creek Soils

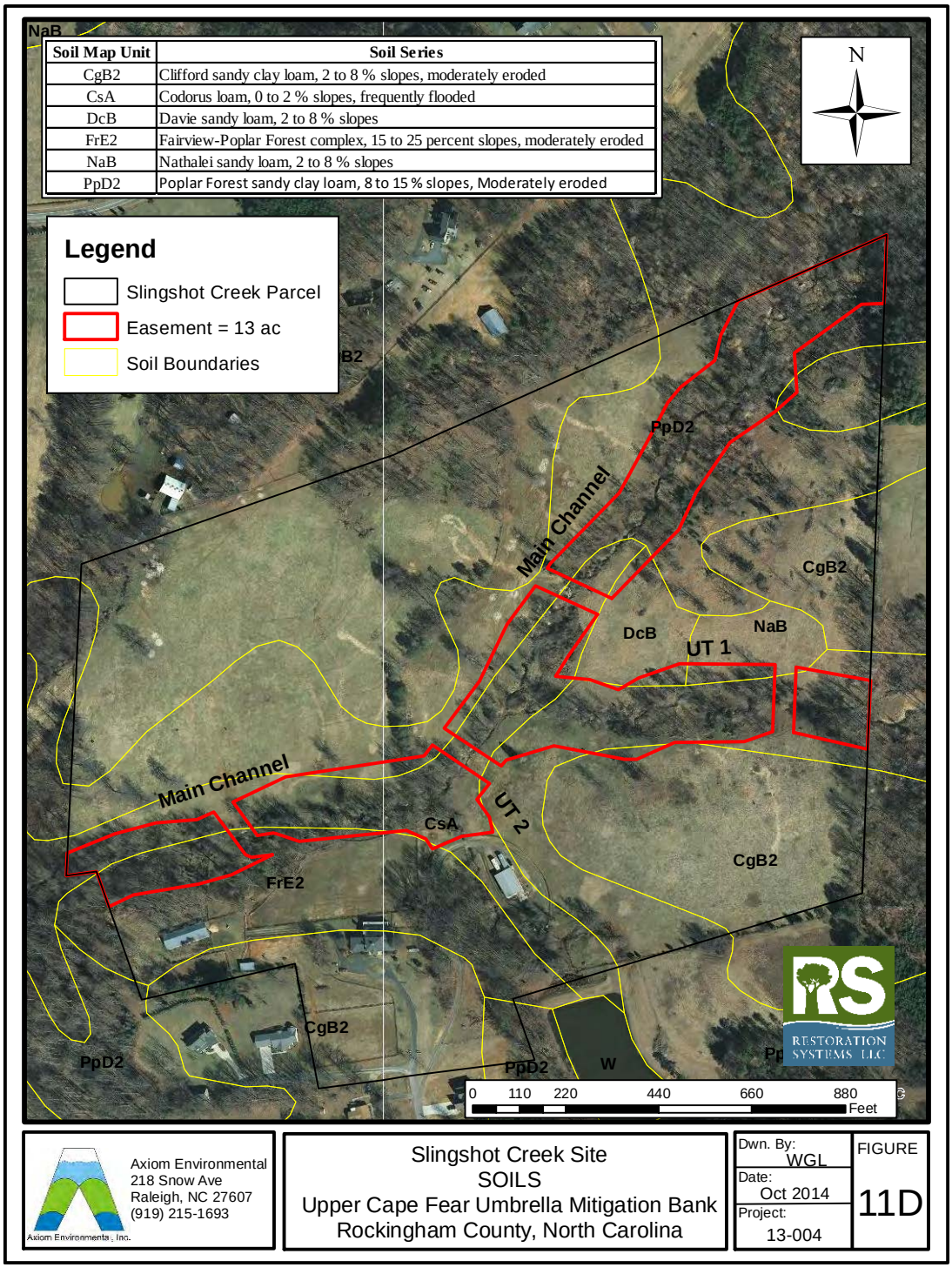


Figure 12A: Motes Creek Restoration Plan

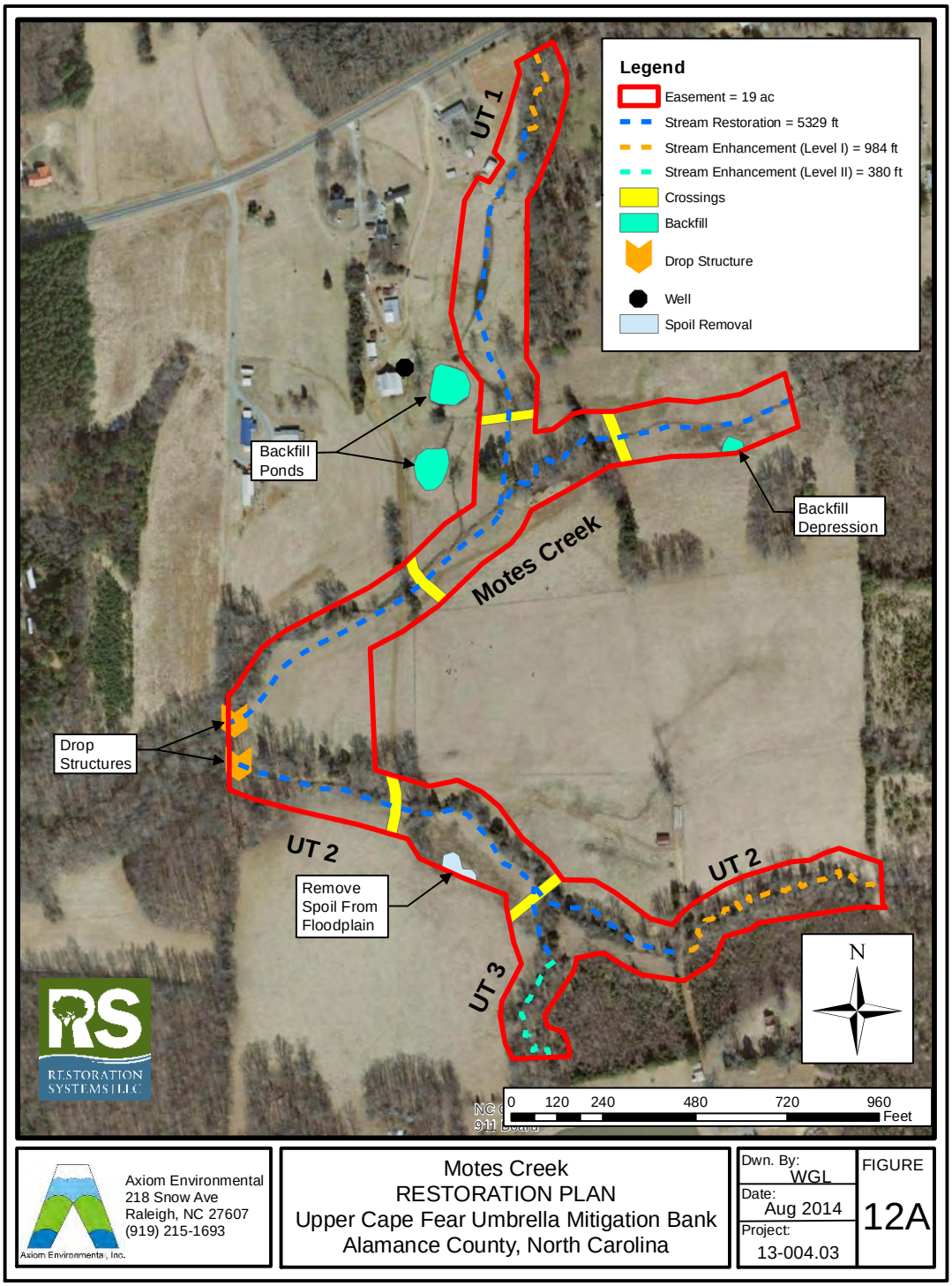


Figure 12B: Benton Branch Restoration Plan

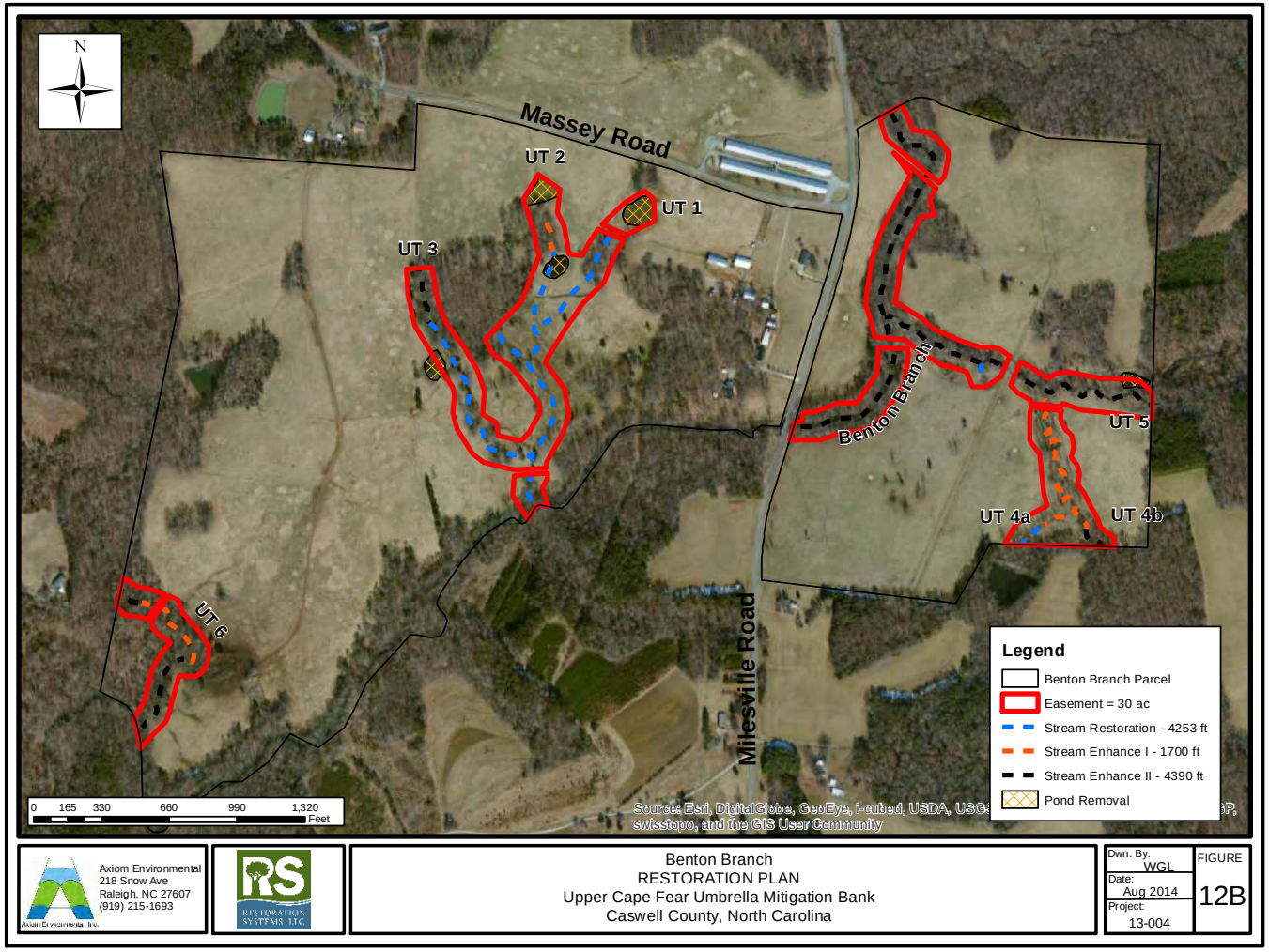


Figure 12C: Orphan Creek Restoration Plan

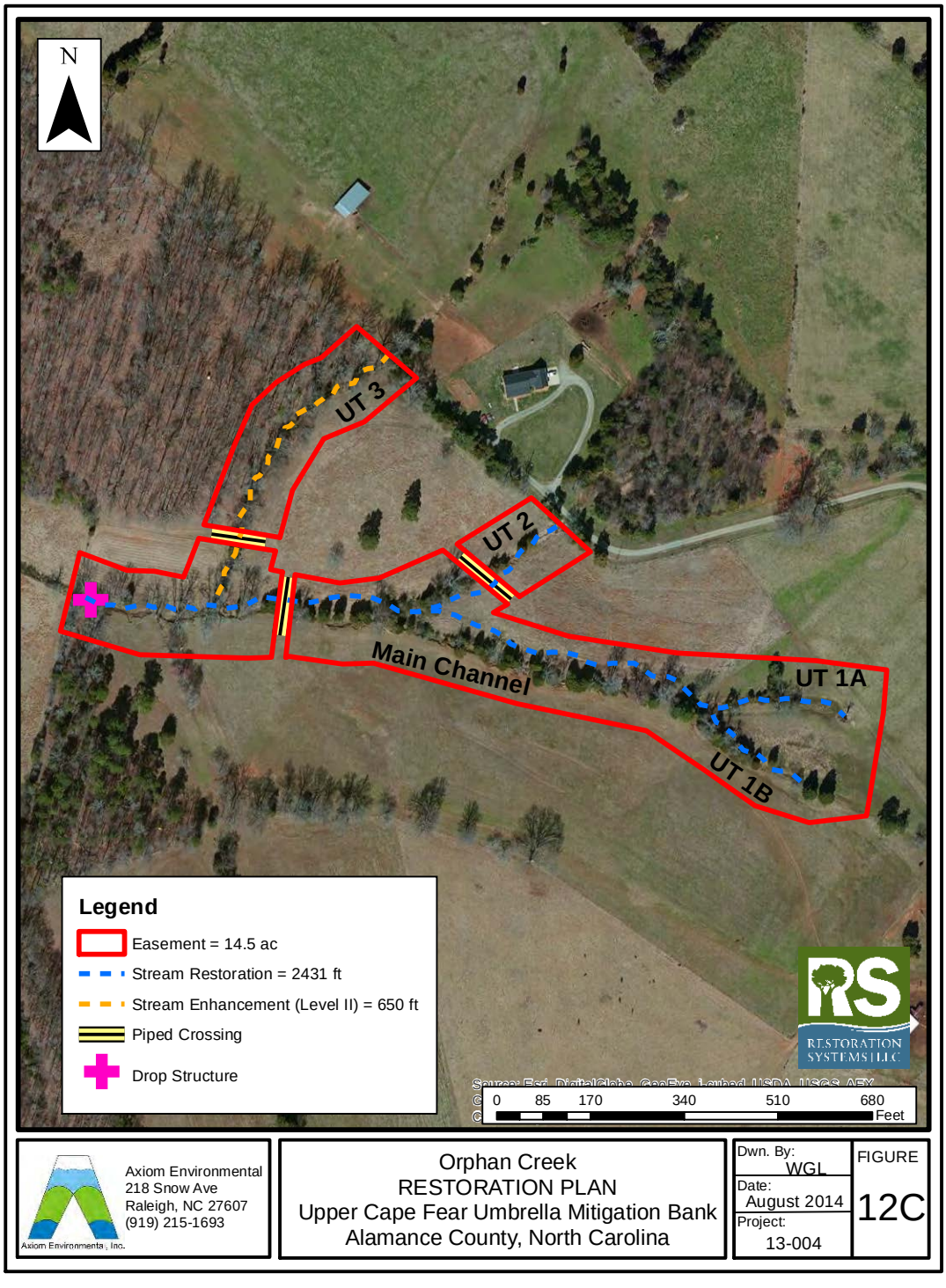


Figure 12D: Chico Branch Restoration Plan

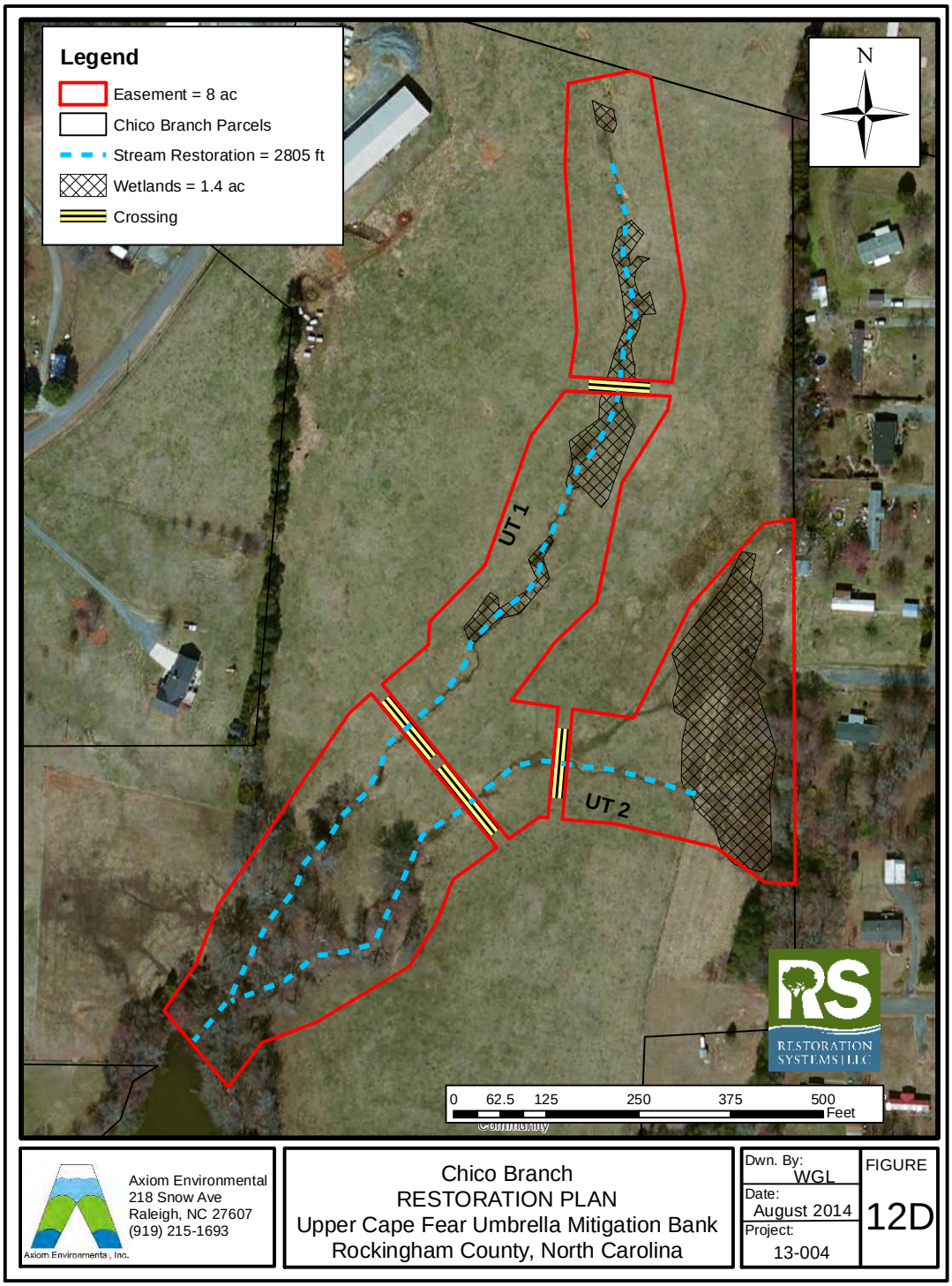


Figure 12E: Major Hill Restoration Plan

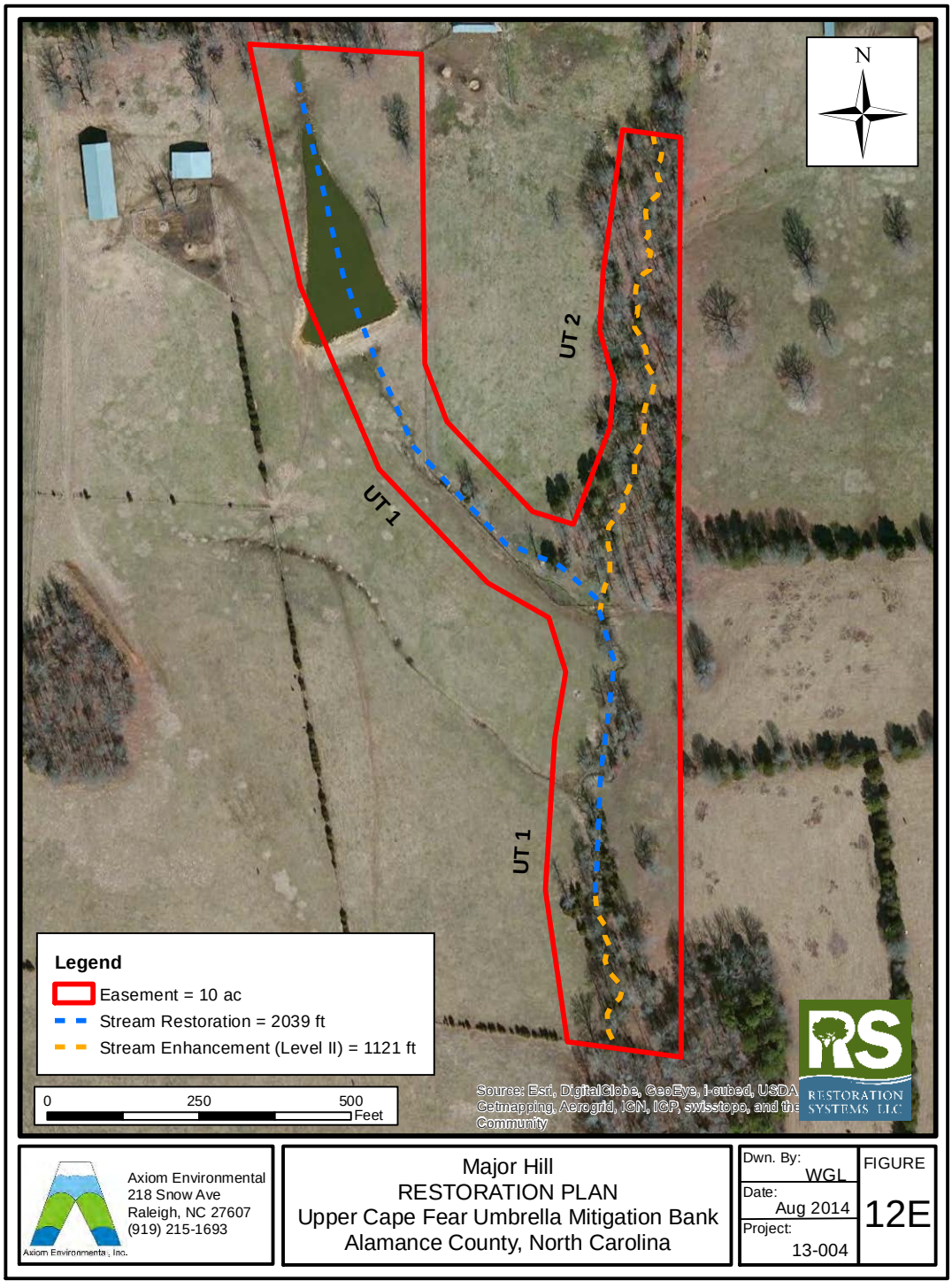


Figure 12F: Maple Hill Restoration Plan

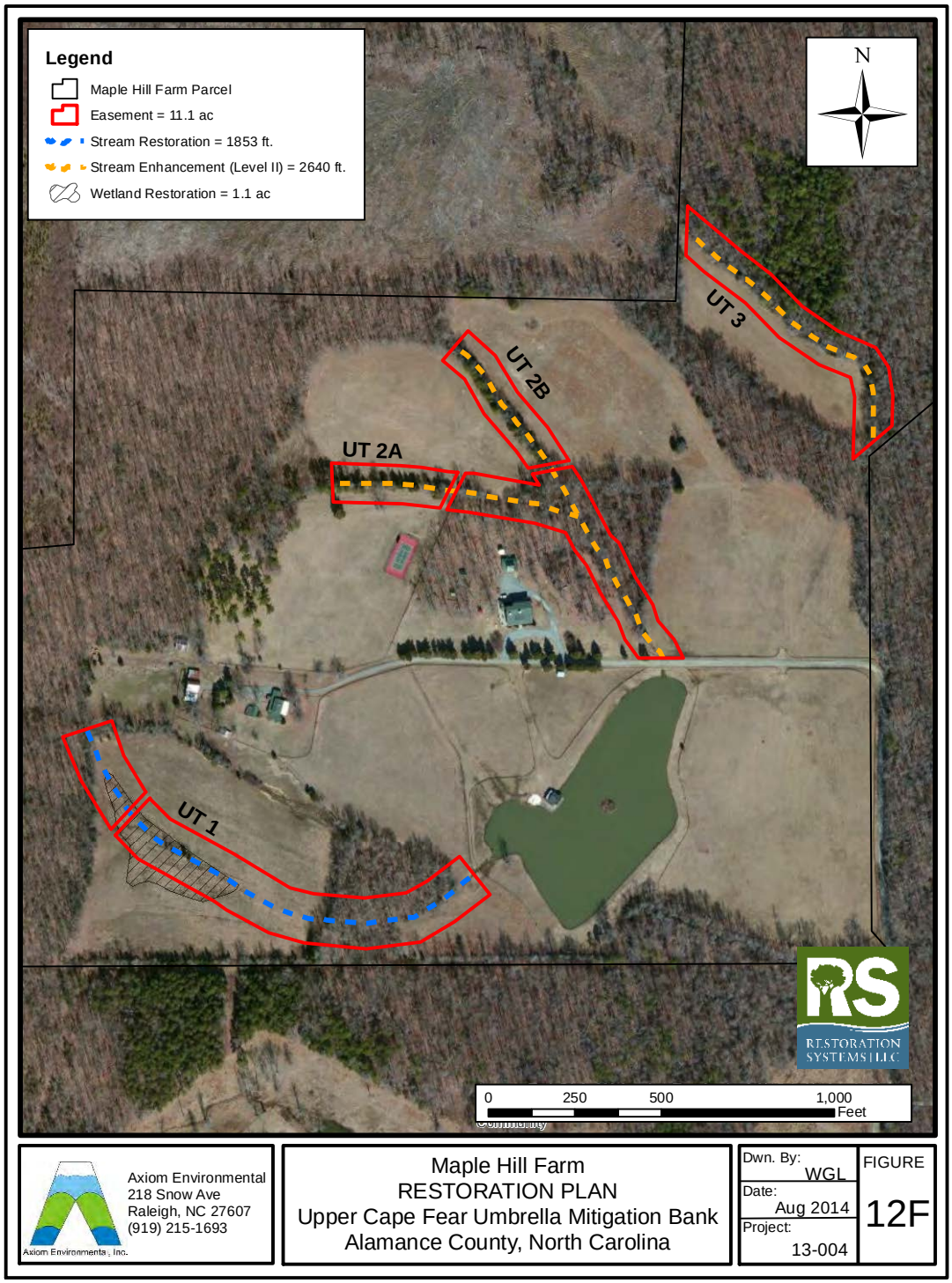


Figure 12 G: Rocky Top Restoration Plan

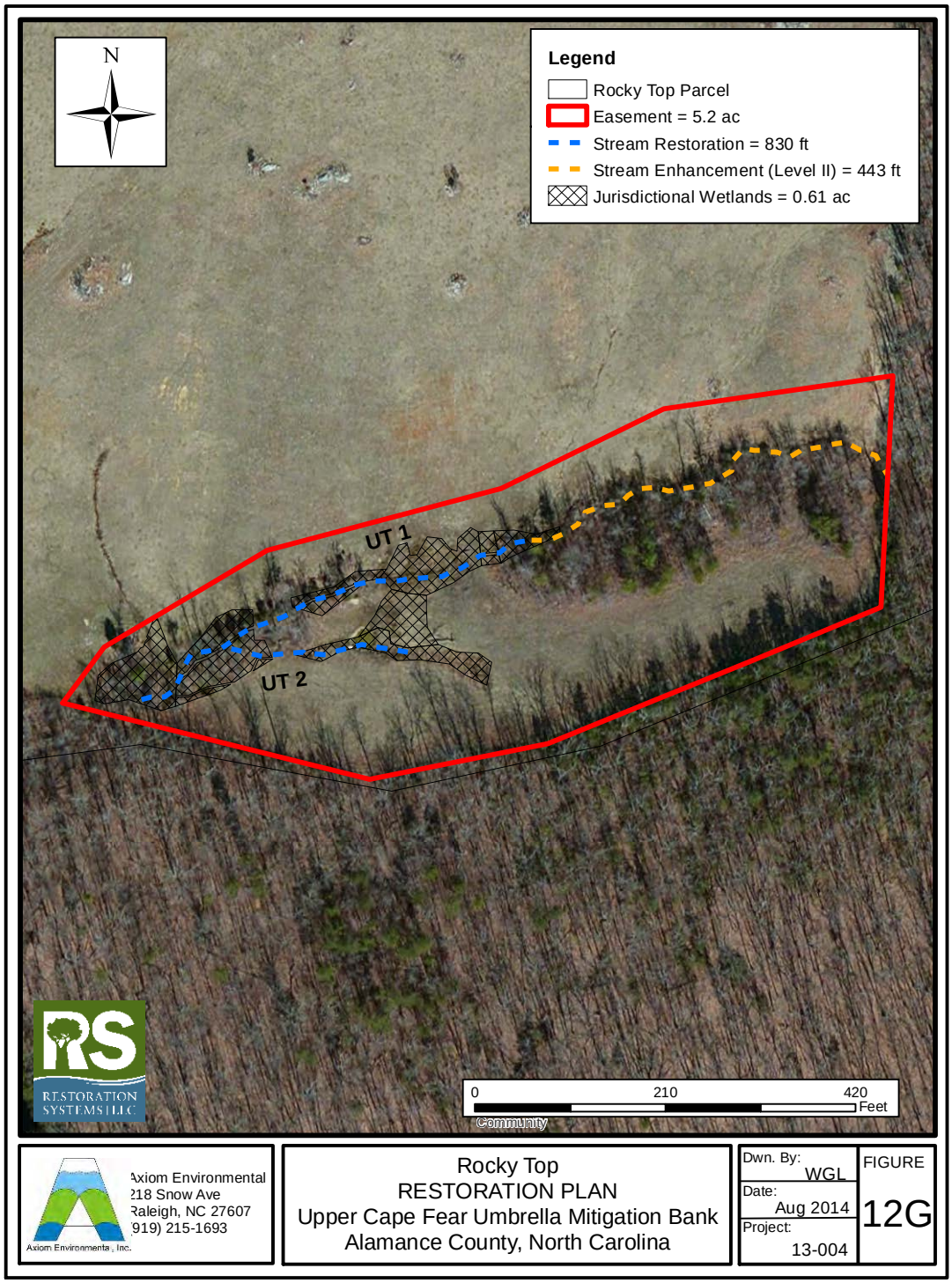


Figure 12H: Slingshot Creek Restoration Plan

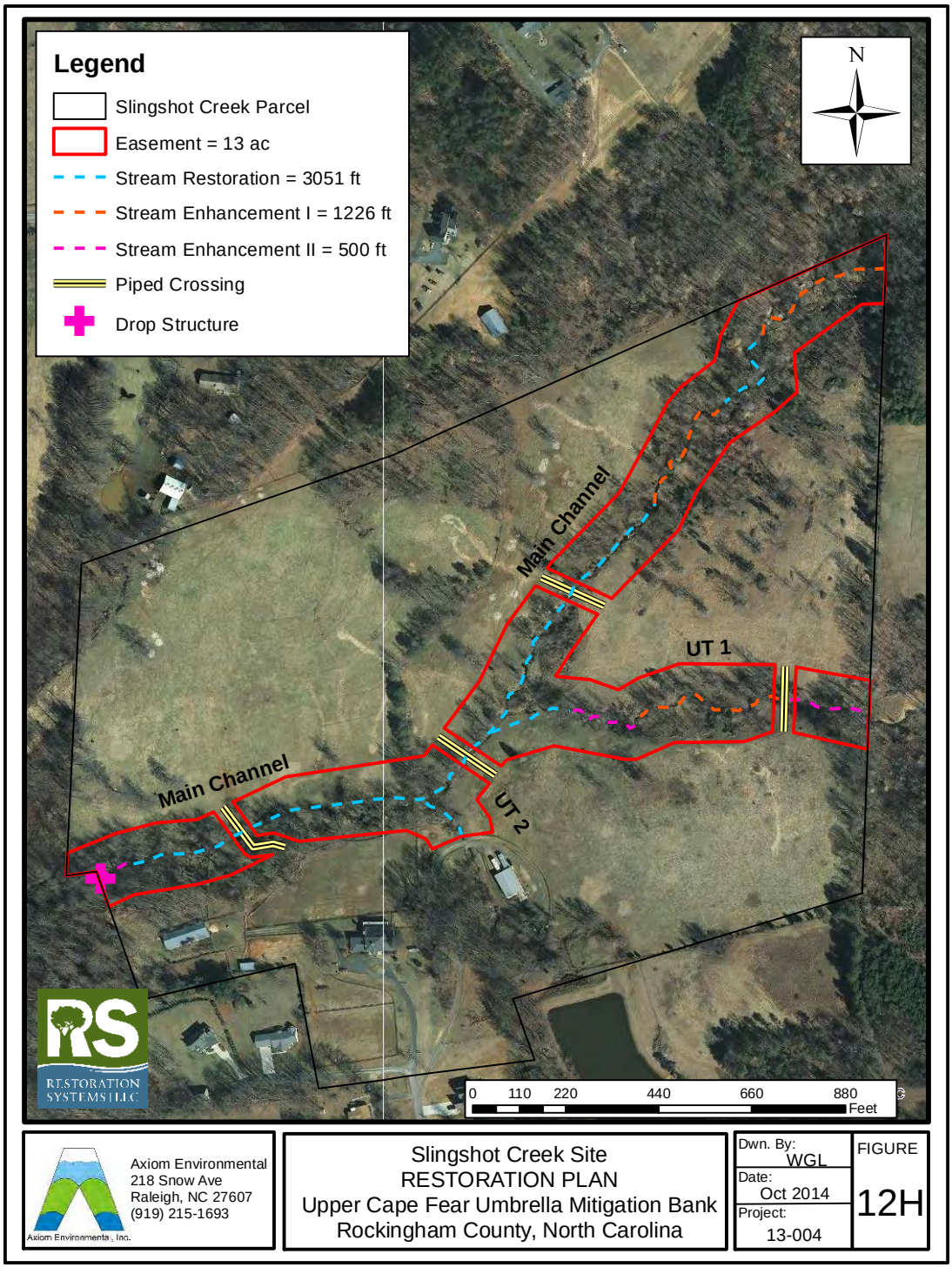


Photo 1: Motes Creek

Photo 1: Upper reaches of Motes Creek facing downstream at livestock trampled channel.

Photo 2: Benton Branch

Photo 2: Incised UT 3, looking upstream

Photo 3: Orphan Creek

Photo 3: View of incised channel below confluence of UT 1A and UT 1B

Photo 4: Chico Branch

Photo 4: UT 2, looking upstream at headwater wetlands

Photo 5: Major Hill

Photo 5: Cattle have full access to Major Hill's channels.

Photo 6: Maple Hill Farm

Photo 6: UT 1, abandoned floodplain with relict channel depression

Photo 7: Rocky Top

Photo 7: Rocky Top restoration reach, looking downstream

Photo 8: Slingshot Creek

Photo 8: Channel incision in upper reaches of Slingshot Creek