Moccasin Creek Riparian Buffer Restoration
Johnston County, North Carolina

RESTORATION PLAN

Ecosystem Enhancement PROGRAM

GES

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1.0. INTRODUCTION

On 21 October 2004 the North Carolina Department of Environment and Natural Resources' Ecosystem Enhancement Program (EEP) and the division of Purchase and Services published a full delivery Request for Proposal (RFP 16-D05015) for up to 175 Buffer Mitigation Units (BMU) in the Upper Neuse Basin (CU 03020201). On 17 February 2005 Greene Environmental Services, LLC (GES) submitted a proposal for 20.2 BMUs. The proposal was accepted by EEP on 27 June 2005. The project, Moccasin Creek Riparian Buffer Restoration, was planted in early February 2006 and has restored 20.2 acres of riparian buffer along 4,552 feet of intermittent and perennial first and second order tributaries to Moccasin Creek (Figure 1). Pursuant to the RFP's definitions, all project acreage qualifies as "restoration" because tree density is below the 100 stems per acre threshold.

A conservation easement was recorded in Johnston County on 17 October 2005 between GES (grantor) and the state of North Carolina (grantee) and the land is protected from development in perpetuity. GES will monitor the restoration area and perform necessary maintenance for five years to ensure planting success. When monitoring has indicated five consecutive years of planted stem density of greater than 320 stems per acre, the state of North Carolina will assume maintenance and management responsibilities, in accordance with the terms of the conservation easement.

2.0. GOALS AND OBJECTIVES

Reestablishing native hardwoods within riparian buffers has been successful in nutrient attenuation, storage, and removal, especially when agricultural inputs are present (Gilliam et al. 1997, and Lowrance, et al. 1995a). Lowrance, et al. (1995b) estimated that 74.3 percent reduction in nitrate-nitrogen, a 70.0 percent reduction in phosphorous and a 89.9 percent reduction in sediments was achieved in 19 meter wide riparian buffers in a Chesapeake Bay watershed. Nitrogen removal occurs primarily via vegetation uptake and storage, and the microbial denitrification process in saturated and organic soils.

Tree roots in natural drainages penetrate more deeply into the soil than roots of herbaceous vegetation. This increased contact with nitrogen in shallow groundwater provides more effective nitrogen removal than herbaceous vegetation alone (Kuenzler, et al. 1977 and Lowrance, et al. 1984 and 1995a). Fallen trees and branches, leaf litter, and tree roots add carbon, which is essential to the denitrification process in the upper soil profile. Gilliam, et al. (1978) demonstrated that denitrification more effectively removes nitrogen in soils that are greater than ten percent organic.

The Moccasin Creek riparian buffer restoration project's primary goal is to improve water quality in the upper Neuse River watershed by reducing agricultural nutrient inputs into the systems. Establishing, maintaining, and protecting the 20.2 acre buffer will enhance microbial denitrification in shallow surface water and ground water that is currently entering local streams, sequester nutrients (chiefly nitrogen and phosphorous) in woody biomass as the buffer matures, and trap nutrient laden sediments before they enter local streams.

A number of secondary benefits will be realized as the buffer matures. As leaf litter and other organic material in the upper soil profile increases, flood attenuation and storage will become important functions. A growing canopy that shades the stream will decrease water temperature and algal blooms, which will increase dissolved oxygen levels. As stream banks stabilize and water quality improves, native terrestrial and aquatic organisms will colonize the restoration area.

3.0. LOCATION INFORMATION

The project area is in southeastern Johnston County, approximately 2.75 miles south of Princeton along Moccasin Creek's western bank. The unnamed tributary that the buffer surrounds confluences Moccasin Creek immediately to the southesast of the restoration site, approximately 7.5 stream miles north of its confluence with the Neuse River (Figure 1). The entire project lies on the Danny Kornegay Farm in USGS Hydrologic Unit 03020201160010 (Figure 2). Hay fields and cattle pastures adjacent to the buffers receive liquid hog waste from the farm and typically have 65 cow/calf pairs rotating between fields (Figure 3).

Danny Kornegay Farms is a diversified agricultural enterprise that has been in operation since 1953. The farm typically cultivates 1,500 acres of cotton, 1,500 acres of soy beans, 600 acres of sweet potatoes, 250 acres of tobacco, and 200 acres of various produce. The farm also grows hay on approximately 58 acres immediately adjacent to the proposed buffer areas. Liquid hog waste is applied to these hay fields at the rates specified in the farm's approved waste utilization plan. The liquid hog waste application and pasture that currently occupy the proposed buffer and adjacent fields are significant contributors to local nutrient loading. The farm "finishes" approximately 7,200 hogs per year using four 720 animal "parlors" and a 1.5 acre lagoon. Approximately 65 "brood" cows on the farm each produce one calf per year that is sold as a yearling (Photos 1 - 4).

4.0. GENERAL WATERSHED INFORMATION

4.1. Drainage Area

The entire project lies within the Moccasin Creek drainage basin (USGS HU 03020201160010), which has a 37.21 square mile drainage area and is classified by DWQ as WS-IV from 0.6 mile downstream from Holts Dam (approximately 2.5 miles upstream of the project area) to its confluence with the Neuse River. The unnamed tributary that the Moccasin Creek buffer restoration site surrounds receives drainage from approximately one square mile. Cataloguing Unit (CU) 03020201 drains 2,405.65 square miles from its headwaters in Person and Orange counties to just upstream of Stoney Creek in Goldsboro (Wane County). The restoration site is in the downstream quarter of the CU (Figure2)

4.2. Land Use

Agriculture is the dominant land use in the project area's immediate watershed and its 14-digit HU. Some of the most densly developed urban, industrial, and residential land uses in North Carolina occupy large portions of the CU in Durham and Wake counties, upstream of the site.

Because of the intensive agricultural use of upland areas in the project vicinity for the last century, mature forests generally occupy floodplains and other areas with low topographic position that are too wet to farm. Aerial photography from 1976, 1998, and 2004 indicates that little change to land use has occurred in the project vicinity during the last three decades. A few scattered forest stands have been converted to agricultural use.

Agricultural practices provide the primary nitrogen inputs entering surface waters on the site. Aerial application of hog waste contributes nitrates to groundwater, delivers nutrient loaded sediment to streams, and releases ammonia-nitrogen into the air. Mr. Kornegay has developed the required Waste Management Plans for land application of the liquid hog waste.

The approved Waste Utilization Plan for the farm indicates that nearly all of project is located in fields included in the Plan. Since the execution of the conservation easement, these areas have been removed from the Plan. Of the acreage that will remain in the Plan, approximately 58 acres are immediately adjacent to the restoration site (Figure 3). The average Plant Available Nitrogen (PAN) for the fields included in the Plan is 275.63 pounds/acre/year, based on local soil and crop types (Pettus, 1999). This translates to average annual inputs of 15,984 pounds of PAN in the immediately adjacent fields.

Use of adjacent fields as cow pasture provides additional nutrient inputs. Using manure production and nutrient content rates from the *2005 North Carolina Agricultural Chemicals Manual* (Shaffer), the 65 cow/calf pairs that graze adjacent to the proposed buffers produce 8,256 pounds of nitrogen per year.

Considering liquid waste application and manure and urine, total nitrogen applied to fields adjacent to the proposed project buffers totals 24,240 pounds per year. Other nutrient inputs (e.g. phosphorus and potassium) from these sources are also significant.

5.0. DESCRIPTION OF EXISTING CONDITIONS

The Moccasin Creek buffer restoration project has restored 20.2 acres of riparian buffer along approximately 4,552 feet of intermittent and perennial streams on an active farm in southeastern Johnston County. The restoration areas are geographically contiguous and receive nutrient inputs from an on-site hog farm (Figures *** and ***). The restored buffer tracts are on fields that were previously used for growing hay and as cow pastures. They all received liquid hog waste. During February the existing electric fences were moved, prior to planting. The remaining, immediately adjacent fields occupy nearly three times the restoration area (~58 acres). They remain cow pastures and hay fields that receive liquid hog waste.

5.1. Vegetation

The project site was characterized using topographic and photographic analysis and limited quantitative vegetation and qualitative soil and hydrologic surveys. To facilitate planning and maintenance, the project site was divided into four tracts (A, B, C, and D).

Vegetation at the site has been modified by farming and drainage for decades. Remnant tree stands with individuals at least five inches in diameter at breast height (dbh) exist along narrow strips immediately adjacent to the stream channels in portions of tracts C and D. All trees at least five inches dbh were counted in the project area. The highest tree density (number of trees ≥ five inches dbh/(50 /per side of stream buffered x linear feet of stream reach/43560)= number of trees per acre) was measured was 77 trees per acre in Tract D. The number of trees per acre for the entire project is 19. Tree densities in all tracts were within the allowable limit of no more than100 trees per acre considered eligible for inclusion as riparian buffer restoration, rather than enhancement.

Table 1. Pre-restoration land use in the Phase 3 riparian buffer.

Land Use	Acres	Buffer Percentage	Tract
Hayfield and pasture	19.32	96	A, B, C, and D
Woodland remnant	0.88	4	C and D
Total	**20.2**	**100**	

Acreage is approximated from interpretation of 1998 infrared aerial photography and on-site observation.

Throughout the project area hay feild and pasture extend up to or within a few feet of stream banks. A mix of native and nonnative shrubs and herbaceous vegetation occupies portions of the zone between stream banks and fields in portions of tracts C and D. Liquid hog waste is applied to these fields to enhance hay and forage production, pursuant to the farm's waste management plan.

Prior to conversion to agriculture, the project site was likely to have been a mixture of upland forest and swamp forest. Based on the community classification system developed by Schafale and Weakley (1990), the plant communities likely to have been present were *Coastal Plain Bottomland Hardwoods (Brownwater Subtype)* along streams and *Coastal Plain Small Stream Swamp (Brownwater Subtype)* on stream banks. These communities likely graded into *Mesic Mixed Hardwood Forest (Coastal Plain Subtype)* and/or *Mesic Pine Flats* upslope on more well drained soils at the outer edge of the buffer restoration zone.

5.2. Soils

The Soil Survey for Johnston County, North Carolina indicates five soil series mapped at the project site (USDA-SCS 1994) (Table 2 and Figure 4). One of these soil series underlies four-fifths of the project area; Pantego (80 percent). All series mapped on the project site, except Uchee (less than one percent of the project area), are classified as hydric soils because of presence of extensive hydric inclusions (Table 2). The inclusions occur especially in narrow flats adjacent to the steam. Generally, the soils within 50 feet of the stream are of lower chroma and higher organic content than the soils greater than 50 feet from the stream. Soil Leaching Potential (SLP) is a measure of a soil's susceptibility to leaching, especially the leaching of pesticides, based on organic content, texture and pH (NC Cooperative Extension Service 1994). Ten percent of soils in the project area have high to very high SLP, which may indicate the potential for the leaching of nitrogen into groundwater from surface application. Site suitability for hardwoods was rated fair to good (Table 2).

Table 2. Soils series at the Moccasin Creek Riparian Buffer Restoration Project identified in the Soil Survey of Johnston County, NC (USDA-SCS 1994).

Soil Series	Texture	Hydric Status	SLP+	Acres (percent of total)	Common Trees-Site Index	Seedling Mortality	Hardwood potential
Pantego (Pn)	Loam	Hydric; very poorly drained	15	16.14 (79.9)	loblolly pine-91, sweetgum-91, bald cypress--, black gum--, water oak--	severe	fair
Lynchburg (Ly)	Sandy loam	Hydric inclusions; somewhat poorly drained	44	1.91 (9.5)	loblolly pine-86, longleaf pine-74, yellow-poplar-92, sweetgum-90, yellow-poplar-92, southern red oak--, white oak--, black gum--	slight	good
Goldsboro (GoA)	Sandy loam	Hydric inclusions; moderately well drained	70	1.69 (8.4)	loblolly pine-90, longleaf pine-66, sweetgum-90, southern red oak--, white oak--	slight	good
Bibb (Bb)	Sandy loam	Hydric; poorly drained	77	0.42 (2.1)	loblolly pine-90, sweetgum-90, water oak-90, black gum--, yellow poplar--, willow oak--	severe	fair
Uchee (UcB)	Loamy course sand	Non-hydric; well drained	-	0.03 (<1)	loblolly pine-82, longleaf pine-67, hickory--, black oak--	moderate	fair

+Soil Leaching Potential; ranging from lowest leaching potential (1) to highest leaching potential (100).

5.3. Hydrology

The proposed project will restore 20.2 acres of riparian buffer along 4,552 feet of unnamed intermittent and perennial first and second order tributaries to Moccasin Creek (Figure 2). These streams discharge into Moccasin Creek approximately 7.5 stream miles north it's confluence with the Neuse River (Figure 1).

Streams in the project area have been channelized, straightened, and realigned as part of agricultural activities. The USGS Princeton topographic quadrangle, which is based on 1973 aerial photography, shows the main perennial stream that crosses all project tracts with a significantly different alignment than the 1980 aerial photographs included in the county soil survey (SCS, 1999). These photos show the stream in its current alignment, as do the 1998 aerial photos presented in Figures 3 and 4.

No quantitative data for stream hydrology are available, but groundwater discharges to the main stream maintained flow, even during the 2002 drought of record. All stream and ditch reaches were evaluated using DWQ's Stream Evaluation Form and all were determined to be at least intermittent.

Water enters the streams via sheet flow from adjacent fields (58 acres of fields bordering the buffers are used for liquid hog waste disposal and cow pasture) and concentrated flow in lateral farm ditches and roadway ditches.

West of the farm access road that separates most of Tract A from Tract B, the stream is incised one to three feet, probably due to the steeper slope and construction and maintenance of the hog waste lagoon. The remaining stream and ditch banks in the project area have been maintained during farming operations and have slopes measuring 4:1 and shallower. Their channels are not incised (less than two feet). Mature trees have root zones extending into and stabilizing stream banks in portions of tracts C and D.

5.3.1. Depth to Water Table and Local Topography

An assessment of depth to water table was made during January 2005. The purpose of the assessment was to correlate approximate local topography to water table depth then determine which stream reaches were most suitable for inclusion as riparian buffer restoration. EEP's Guidelines for Riparian Buffer Restoration (2004) require water tables within three to four feet of the surface for restoration sites.

Water table elevation (top of the surficial aquifer) is not static; it is influenced by season, evapotranspiration, precipitation, soil infiltration rates, proximity of streams and anthropogenic drainage and land alteration.

Soil samples were taken at 11 sites throughout the project area using a power auger and a Dutch auger (Table 3). Water table contact was determined by the presence of saturated soils, often in coarse sand or organic loamy sands. Above the water table, however, the presence of low chroma soils, mottled clays and reducing conditions indicated that the water table is periodically higher, probably during spring and winter or during years of normal or above normal rainfall.

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Table 3. Depth to Groundwater Sample Results

Tract	Sample Number	Depth to Saturation		Profile	
		cm	ft	depth (cm)	Munsell color
A	1	20	0.66	0-20	10YR 3/1
	2	75	2.46	0-10	2.5Y 4/4
				10-75	2.5Y 7/4
	3	115	3.77	0-30	2.5Y 3/2
				20-85	10YR 5/6
				5-115	2.5Y 7/1
	4	Surface	0		10YR 2/1
B	1	20	0.66	0-20	10YR 2/1
	2	Surface	0		10YR 2/1
	3	15	0.49	0-15	10YR 4/1
C	1	16	0.52	0-16	10YR 4/2
	2	23	0.75	0-15	10YR 5/2
				15-23	2.5Y 5/3
D	1	25	0.82	0-15	2.5Y 4/2
				15-25	10YR 6/6
	2	40	1.31	0-40	2.5Y 4/2
				40-60	2.5Y 5/4

5.4. Tract Descriptions

The project proposes to restore 20.2 acres of riparian buffer along approximately 4,552 feet of intermittent and perennial streams on an active farm. The restoration areas have been divided into four tracts that all lie in USGS hydrologic unit 03020201160010 in the Upper Neuse Basin (CU 03020201), are geographically and hydrologically contiguous, and receive nutrient inputs from the on-site hog and cattle operations. (Figures 2 and 3).

Depth to water table, hydrology, soils, topographic position, position in the watershed, and existing vegetation were evaluated in each tract to determine appropriate buffer width and location. Detailed descriptions of these parameters follow for each tract.

All native trees greater than five inches diameter at breast height (dbh) were counted in each tract and totaled 120 for the entire project. Tree density for each tract is reported below and was calculated on a per acre basis pursuant to the RFP's Buffer Restoration definition. Using this measure, tree density for all tracts combined measured 19 trees per acre. This calculation assumes a 50 foot wide buffer that produces a total project area of 6.3 acres. Much wider buffers were appropriate for restoration in all tracts. If density calculations were based on the actual restoration area (20.2 acres), total density for the entire project would be six trees per acre.

5.4.1. Tract A (Photo 5)

Tract A measures 2.74 acres and provides buffer along 1,445 feet of stream in the most upstream portion of the project. One stream in Tract A drains southeast into Tract B and the other drains east into Moccasin Creek. The easternmost stream drains within 70 feet of the 1.5 acre hog waste lagoon, northeast of Tract A. This lagoon receives waste from four hog parlors, which house the 7,200 "feeder to finish" hogs produced annually on the farm.

Based on the USGS Princeton topographic quadrangle (1973) and 1980 aerial photography presented in the Johnston County Soil Survey (SCS, 1994), it appears that Tract A's stream course was modified during the 1970s. The stream presently drains east-southeast from the farm access road, across the Tract C field, as indicated by the Johnston County Soil Survey and 1998 color infrared aerial photography presented in figures 4 and 5. Historically, based on the Princeton quad, the stream turned north where it currently passes under the farm access road. It then flowed north-northeast for approximately 1,000 feet and discharged into Moccasin Creek's lateral swamp. The easternmost portion of Tract A buffers a channelized stream, which may have been part of the original stream channel that appears on the Princeton quad.

Tract A's northern stream reach, which begins at a headcut west of the hog operation, scored a 21.25 on the DWQ Stream Classification Form, the southern reach scored a 65.5, and the easternmost stream draining into Moccasin Creek scored a 19.

There are no trees in Tract A.

Soil series in Tract A included Pantego loam (99 percent), and Uchee loamy coarse sand (one percent). Soil samples indicated water at the surface in 1 of the 4 sample locations with all locations having saturated soil within 115 cm of the surface (less than 3.8 feet). Almost all samples had hydric soils in the upper meter, as evidenced by low soil matrix chromas and redoxomorphic features in horizons above saturated soils. Fifty foot wide buffers are appropriate in Tract A's upper (western) reaches and a 150 foot wide buffer is appropriate the lower (eastern) portion, based on depth to water table, soils, and topography.

5.4.2. Tract B (Photo 6)

Tract B is downstream of Tract A and measures 6.09 acres along 778 feet of stream, which is shown in its current location in the Johnston County Soil Survey, but not on the Princeton topographic quadrangle, as described in Tract A. The stream in Tract B scored a 37.5 on the DWQ Stream Classification Form. Approximately 15 acres of hay field/pasture border Tract B to the north and south.

There are no trees in Tract B.

Soils series in Tract B include Pantego loam (68 percent), and Lynchburg sandy loam (32 percent). Soil samples indicated water at the surface in some locations and saturated soil no deeper than 20 cm (less than 1 foot) in Tract B. All samples had hydric soils in the upper meter, as evidenced by low soil matrix chromas and redoxomorphic features in horizons above saturated soils. Buffers widths between 150 and 200 feet wide are appropriate in Tract B, based on depth to water table, soils, and topography.

5.4.3. Tract C (Photo 7)

Tract C measures 6.41 acres along 885 feet of the stream draining Tract B and 831 along an agricultural ditch. The ditch is shallow and was likely cut to drain the seep that discharges groundwater at the toe of the slope to the tract's west. Bullrush (*Juncus effuses*) replaces pasture grasses in the area between the creek and ditch, where standing water persists throughout much of the year.

Approximately 11 acres of hay field/pasture border Tract C to the south. Remnant woodland occurs along the ditch in the southern portion of Tract C. The 12 trees in Tract C equate to eight trees per acre according the RFP definition and two trees per acre if the entire tract is included.

Soils in Tract C include Pantego loam (90 percent), and Goldsboro sandy loam (10 percent). Soil samples at the outer boundaries indicated saturated soil within 23 cm (0.75 feet) of the surface. Hydric soil was observed throughout Tract C. Buffers between 100 and 200 feet wide were appropriate in Tract C, based on depth to water table, hydrology and topography.

5.4.4. Tract D (Photo 8)

Tract D totals 4.96 acres and will restore buffers along 612 feet of the wetland-draining ditch described in Tract C. Tract D's eastern boundary borders perennially inundated areas that border Moccasin Creek and the relocated channel described above. The reach flowing through the center of Tract D scored 34.5 on the DWQ Stream Classification Form.

A large (50 acre) hay field/pasture borders Tract D to the west. Remnant woodland (mostly hardwood) exists along the Tract D central reach. The 108 trees in Tract D equate to 77 trees per acre according to the RFP definition and 22 trees per acre if the entire tract is included.

Soils series in Tract D include Pantego loam (70 percent), Goldsboro sandy loam (22 percent), and Bibb sandy loam (8 percent). Soil samples indicated saturated soil within 60 cm of the surface (1.3 feet). All samples had hydric soils in the upper meter, as evidenced by low soil matrix chromas and redoxomorphic features in horizons above saturated soils. Buffers widths between 100 and 200 feet wide are appropriate in Tract D, based on depth to water table, soils, and topography.

6.0. RIPARIAN BUFFER RESTORATION STUDIES

Depth to water table, hydrology, soils, topographic position, position in the watershed, and existing vegetation were evaluated in each tract to determine appropriate buffer width and location. Detailed descriptions of these parameters for each tract are in the preceding section.

An assessment of depth to water table was made during January 2005. The purpose of the assessment was to correlate approximate local topography to water table depth then determine which stream reaches were most suitable for inclusion as riparian buffer restoration. NC-WRP's *Guidelines for Riparian Buffer Restoration* (2001) require water tables within three to four feet of the surface for restoration sites.

Water table elevation (top of the surficial aquifer) is not static; it is influenced by season, evapotranspiration, precipitation, soil infiltration rates, proximity of streams and anthropogenic drainage and land alteration.

Soil samples were taken at 11 sites throughout the project area using a Dutch auger (Table 3). Water table contact was determined by the presence of saturated soils, often in coarse sand or organic loamy sands. Above the water table, however, the presence of low chroma soils, mottled clays and reducing conditions indicated that the water table was periodically higher, probably during spring and winter or during years of normal or above normal rainfall.

Generally, within 50 feet of streams, the soils were probably former floodplain and highly organic, relic Pantego soils or similar soils exhibiting indicators of an active hydrologic regime. Beyond the 50-foot zone, topography varied from nearly level to a rise of up to 6 feet, 150 feet from the streambank. Low chroma, organic soil conditions, that are indicative of an active hydrologic regime, often persisted up to 2 feet above the elevation of the 50-foot zone.

Precipitation and stream gauge data indicate that near normal hydrologic conditions were evident at the time water table depth measurements were taken. These data were used to determine buffer width and alignment to insure groundwater contact in the root zone.

7.0. RESTORATION PLAN

7.1. Site Preparation

Since nearly the entire project area (96 percent, Table 1) is active hay field/pasture with no debris or unwanted vegetation and all channels have stable banks with little erosion, little site preparation is needed prior to planting. The only significant preparation for planting the buffer is to move existing fences to keep livestock out of the restoration areas.

7.2. Implementation

Approximately 9,300 bare root hardwood saplings of six species and 2,000 bald cypress saplings were planted in the restoration area during February 2006 (Table 4). Between and within rows, saplings were planted between eight and nine feet apart. The approximate average density after planting is 560. This planting density was selected to allow up to 40 percent mortality while meeting the 320 stems per acre targeted density. In addition to the bare root saplings, black willow (Salix nigra) stakes were planted at the top and on the sides of stream banks in erosion-prone reaches. The stakes were harvested from local trees and trimmed to two foot lengths, approximately one half inch in diameter.

Most of the tree species are suitable for the range of soil moisture conditions found at the site, but some species (e.g. green ash, bald cypress, water tupelo, and black gum) are best suited for the more hydric soils nearest the stream and in other low-lying areas. Other species (e.g. sycamore and yellow poplar) should be more successful on the more well-drained soils. Two planting zones were established based on soil hydroperiod. Zone boundaries were determined based on field evaluation and soil sampling results (Figure 3). Generally, the wetter zone (zone one) extends outward 20-50 feet from the streambank and is planted with species tolerant of poorly-drained soils. The wet zone was significantly expanded where soil moisture warranted (e.g. tracts C and D, Figure 3). Similarly, where a drier soil moisture regime prevailed, species suitable for more well-drained conditions were planted in the drier zone (zone two).

Applying glyphosate herbicide with a concentration of 0.25% will be used to control competing grasses and herbaceous vegetation. The herbicide will be applied to actively growing plant tissue in May through July and as necessary. Backpack sprayers will be used to apply herbicide concentrating in a 3-foot radius around and in between saplings. Existing native vegetation that is stabilizing the stream bank will be avoided. Naturally colonizing tree species, especially sweetgum and loblolly pine, will be removed if they appear to be out-competing planted seedlings. Native species that are allowed to persist will be noted in stem density measurements and separate calculations for total density and planted density will be provided.

Table 4. Trees Planted in the Riparian Buffer Restoration Project (February 2006)

Species	Common Name	Number Planted	(Percent of Total)	Soil Drainage Suitability
Fraxinus pennsylvanica	green ash	2,000	18	mesic, hydric
Liriodendron tulipifera	yellow poplar	3,000	27	mesic, hydric
Nyssa aquatica	water tupelo	800	7	hydric
Nyssa sylvantica	black gum	500	4	hydirc
Platanus occidentalis	coastal sycamore	3,000	27	mesic
Taxodium distichum	Bald cypress	2,000	18	hydric
	TOTAL	**11,300**	**(559/acre)**	

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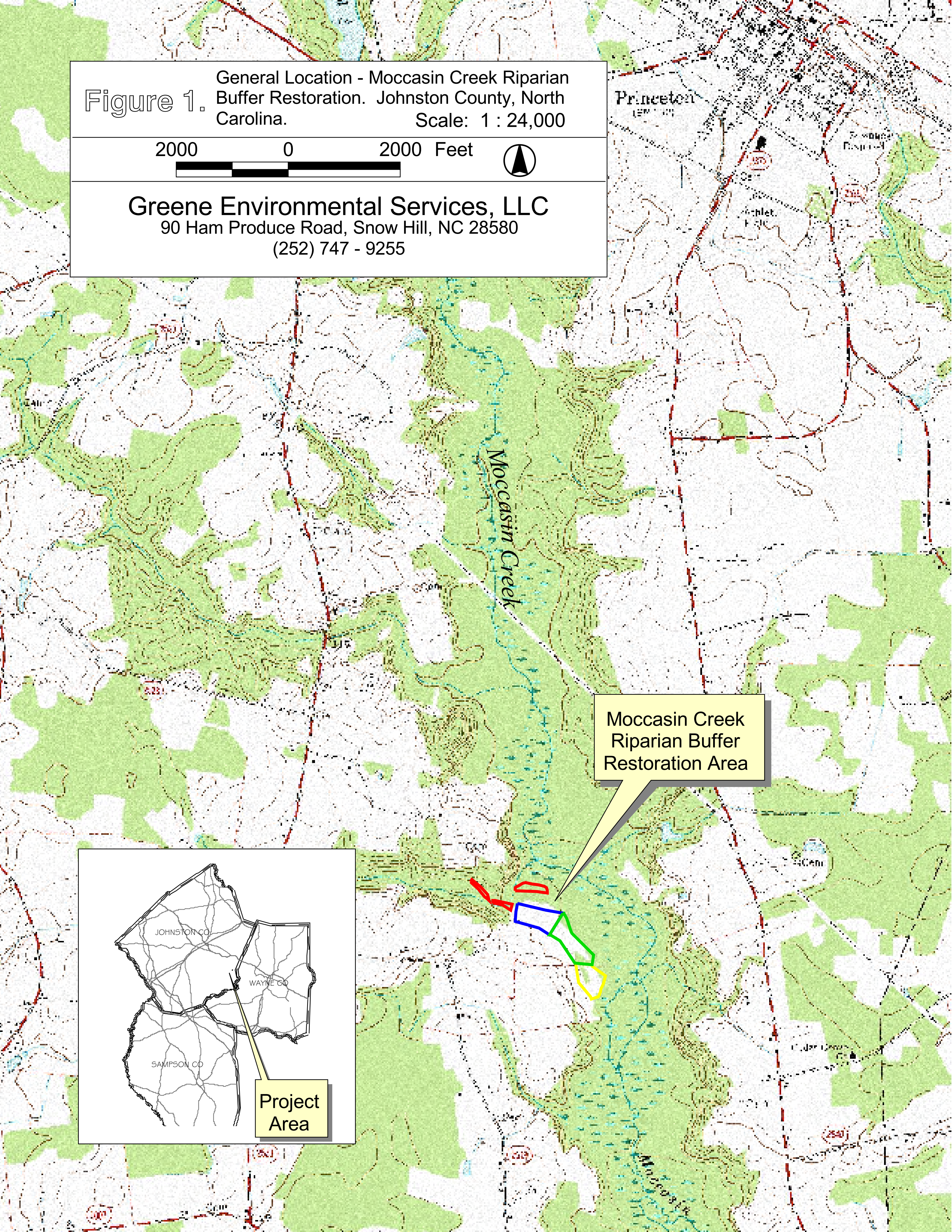

Figure 1. General Location - Moccasin Creek Riparian Buffer Restoration. Johnston County, North Carolina.

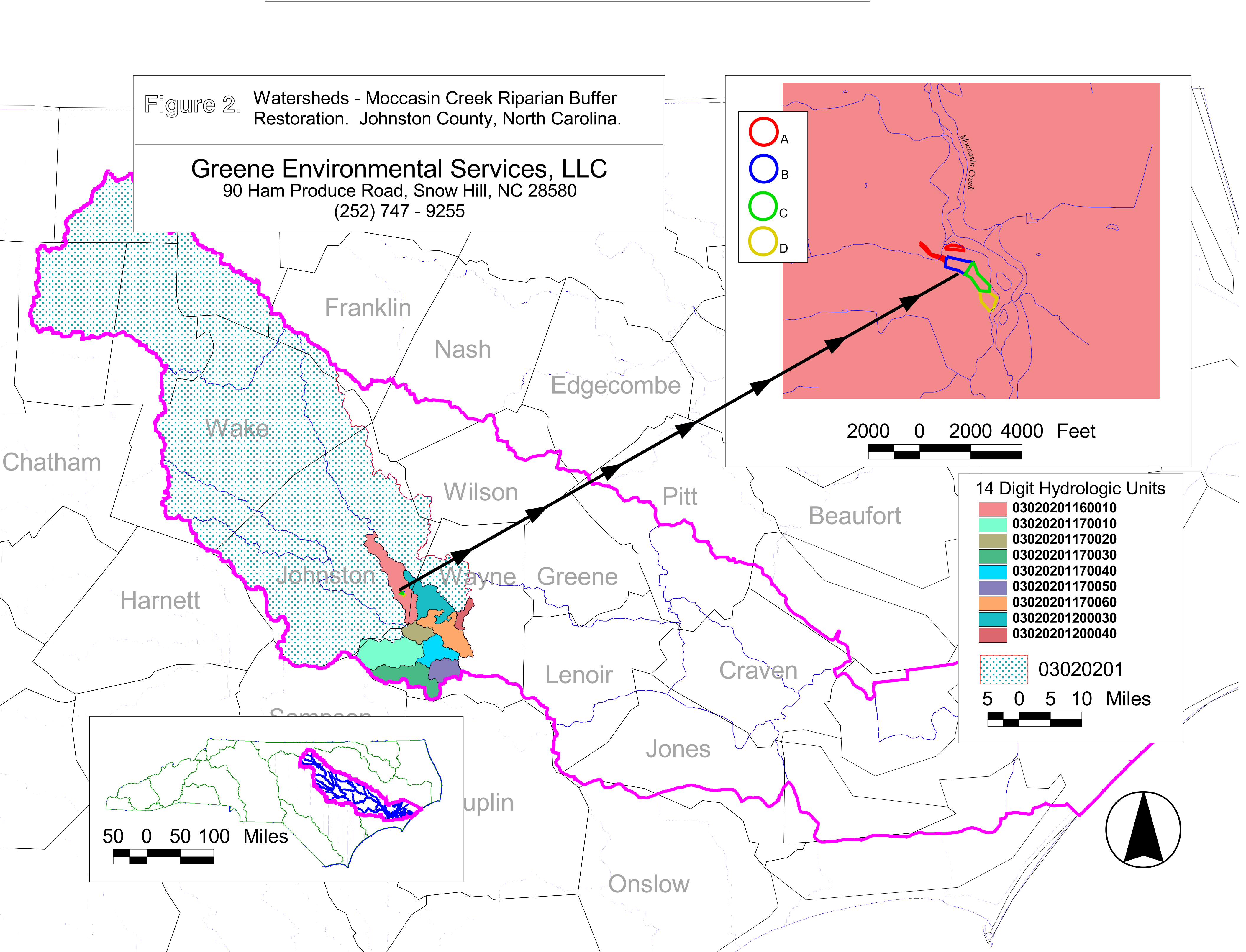
Figure 2. Watersheds - Moccasin Creek Riparian Buffer Restoration. Johnston County, North Carolina.
Greene Environmental Services, LLC
90 Ham Produce Road, Snow Hill, NC 28580
(252) 747 - 9255
A
B
C
D
Moccasin Creek
2000 0 2000 4000 Feet
14 Digit Hydrologic Units
03020201160010
03020201170010
03020201170020
03020201170030
03020201170040
03020201170050
03020201170060
03020201200030
03020201200040
03020201
5 0 5 10 Miles
Franklin
Nash
Edgecombe
Wake
Chatham
Wilson
Pitt
Beaufort
Johnston
Wayne
Greene
Harnett
Lenoir
Craven
Jones
Onslow
50 0 50 100 Miles

Figure 3.
Land Application Sites and Planting Zones -
Moccasin Creek Riparian Buffer Restoration.
Johnston County, North Carolina.
Greene Environmental Services, LLC
90 Ham Produce Road, Snow Hill, NC 28580
(252) 747 - 9255
Confined Hog Operation
LEGEND
Moccasin Creek Riparian
Buffer Restoration
A
B
C
D
Liquid Hog
Waste Application
Planting Zone 1
(Hydric)
Planting Zone 2
(Mesic)
200
0
200
400
Feet

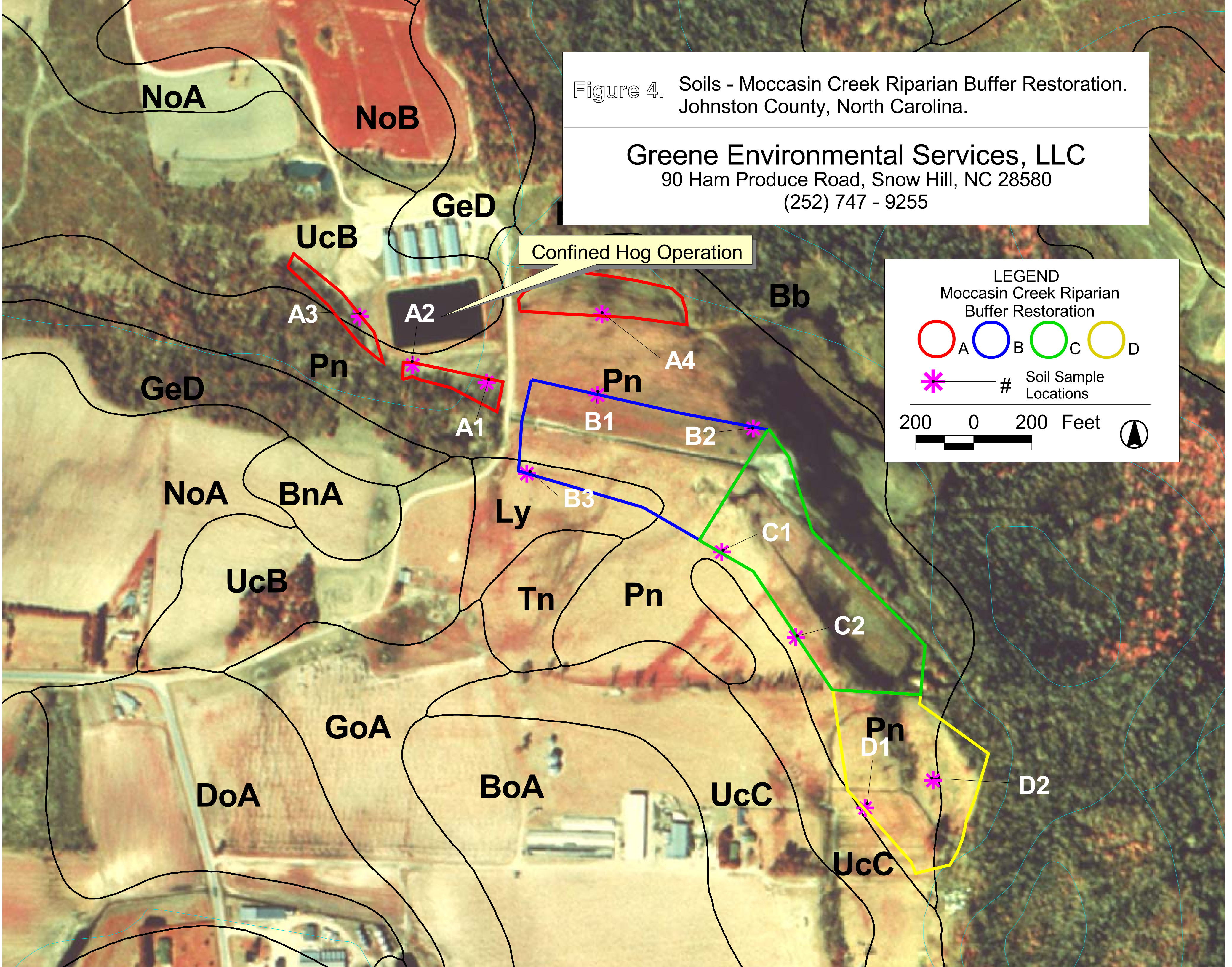

Figure 4. Soils - Moccasin Creek Riparian Buffer Restoration.
Johnston County, North Carolina.
Greene Environmental Services, LLC
90 Ham Produce Road, Snow Hill, NC 28580
(252) 747 - 9255
Confined Hog Operation
LEGEND
Moccasin Creek Riparian
Buffer Restoration
A
B
C
D
#
Soil Sample
Locations
200
0
200
Feet
NoA
NoB
GeD
UcB
Pn
GeD
Bb
NoA
BnA
Ly
UcB
Tn
Pn
Pn
GoA
DoA
BoA
UcC
UcC
A1
A2
A3
A4
B1
B2
B3
C1
C2
D1
D2

Photo 1. Danny Kornegay Farm


Photo 2. Danny Kornegay Farm


Photo 3. Danny Kornegay Farm pasture


Photo 4. Danny Kornegay Farm hog parlors


Photo 5. Tract A


Photo 6. Tract B


Photo 7. Tract C


Photo 8. Tract D