Newtown Stream and Wetland Restoration Site

Union County, North Carolina

RFP 16-001117, SCO ID# 002025

Restoration Plan

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Prepared for:

Ecosystem Enhancement PROGRAM

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Executive Summary

The Newtown Stream and Wetland Restoration Site is located within the Catawba River Basin in Union County, North Carolina and contains Underwood Creek and one Unnamed Tributary to Underwood Creek. The restoration lengths of Underwood Creek and UT to Underwood Creek are 1331 and 3986 feet, respectively, for a total project length of 5317 feet. The area of riparian wetland to be restored is 3.38 acres and wetland preservation of 0.15 acres. The project site is owned by one property owner Mr. Frank W. Howey, Jr.

Existing Underwood Creek and UT to Underwood Creek are classified as degraded C4/E4 channels with actively eroding beds and banks. Some sections of the streams have degraded into a G type channel. The 1.5 square mile watershed contributing drainage to the stream restoration segment is located in a rural setting. The land adjacent to the project streams are primarily used for agricultural practices and single family development. The floodplain is more confined in the upper reach of the project and opens up to a broad width for the majority of the project length. The existing stream width ranges from 6 to 16 feet at the top of bank with steep side slopes undergoing erosion along the channel length. The channel has very low sinuosity and very little to no riparian buffer. The channel has incised throughout the reach 1 to 3 feet.

The project will also include 3.38 acres of wetland restoration and 0.15 acre of wetland preservation. Wetland vegetation typical of a Piedmont Alluvial Forest will be planted in the designated wetland restoration areas. Wetland hydrology is expected to increase through raising the stream bed elevation of Underwood Creek and UT to Underwood Creek as well as the removal of fill material within the floodplain. The restoration project will impact 0.03 acre (Wetland 1) of the existing wetland in the proposed conservation easement. These impacts consist of grading for a permanent stream crossing.

The restoration goals for this project are:

- Improve water quality with the construction of stable stream banks and the establishment of a protective buffer.
- Improve the stream function and habitat with the connection of the channelized and incised stream back to its floodplain.
- Improve wetland hydrology with the functional uplift of the proposed channel.
- Restore long-term stability with the restoration of channel pattern, profile and dimension.
- Improve in- stream habitat with the installation of root wads, constructed riffles and rock cross vanes to enhance pool depths.

The project objectives will include:

- The restoration of 4759 linear feet of Priority I and 558 feet of Priority II in order to raise the stream elevation, reconnect the floodplain, restore pattern, and re-establish channel dimension on Underwood Creek and UT to Underwood Creek.
- Restoration of 3.38 acres of wetlands through the functional uplift of the stream to improve wetland hydrology and the removal of 2-6 inches of depositional sediment from the wetland surface due to agricultural field soil wash.
- Preservation of 0.15 acres of existing jurisdictional wetlands.

- Establish a riparian buffer with native vegetation for a mean distance of 50 feet beyond the stream banks. Buffer enhancement on 16 acres along the stream length will be established with the planting of riparian vegetation.

Stream Summary		
Stream Reach	*Existing Length (feet)*	*Proposed Length (feet)*
Underwood Creek	1089	1331
UT to Underwood Creek	3977	3986
Total	5066	5317
Wetland Summary		
Wetland Mitigation	*Proposed Area (acre)*	
Restoration	3.38	
Preservation	0.15	
Total	3.53	

The total proposed stream length of the project is 5317 linear feet. The project will also include wetland restoration of 3.38 acres and preservation of 0.15 acres. The project is not located within a North Carolina Department of Water Quality Ecosystem Enhancement Program Local Watershed Plan.

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1.0 Introduction

Environmental Banc & Exchange (EBX) will complete a stream restoration project along Underwood Creek and an Unnamed Tributary of Underwood Creek, in Union County, North Carolina. The total length of the project is 5317 feet; with the 3986 feet of Priority I restoration of UT to Underwood Creek and 1331 feet of Underwood Creek; 773' Priority I and 558' Priority II. Along with the restoration of the main channel and tributary, 3.38 acres of wetland will be restored and 0.15 acres of wetlands preserved adjacent to the project streams.

1.1 Directions to Project Site

The Newtown Project Site is located approximately 5 miles west of Waxhaw and 7 miles south of Stallings in Union County, North Carolina. From Raleigh, take US-1 South 90 miles to Rockingham, North Carolina. Then take US-74 West for 42 miles to Monroe, North Carolina. Take the Concord Avenue exit, on the right, then turn left on Concord Avenue for 0.9 miles where it then turns into North Charlotte Avenue. Continue on North Charlotte Avenue for 0.5 miles. Next, turn right on NC-75 West/West Franklin Street and continue on NC-75 West for 3.5 miles. Next, turn right at Fletcher Broome Road for 0.2 miles. Then turn left onto Newtown Road for approximately 2 miles and arrive at the project site located on the right. The coordinates of this location are: 36° 58' 10" N and 80° 38' 47" W (Figure 1, Section 11).

1.2 USGS Hydrologic Unit Code

The United States Geological Survey (USGS) uses a multi-tiered system to divide and sub-divide the country's watersheds into successively smaller hydrological units. Each hydrologic unit is identified by a unique hydrologic unit code (HUC), consisting of various numbers of digits depending on the level of classification within the hydrologic unit system. Under the USGS system, the Catawba River basin has three 8-digit hydrologic units, the project site is located within the Lower Catawba and its HUC number is 03050103.

The 8-digit units are further sub-divided into smaller 14-digit hydrologic units that are used for smaller scale planning. The Newtown Stream and Wetland Restoration Project Site is located in the 14-digit HUC 03050103030020.

1.3 NCDWQ River Basin Designations

The North Carolina Division of Water Quality (NCDWQ) uses a two-tiered system to divide the state into watershed units. The state is divided into seventeen major river basins with each basin further subdivided into sub-basins (NCDWQ 6-digit sub-basins). The project area is located within the "Lower Catawba" sub-basin 03-08-38 of the Catawba River Basin (DWQ 2007). This area is part of USGS Hydrologic Unit 03050103 of the South Atlantic-Gulf Region. The "Lower Catawba" river basin covers 1,370 square miles (3,548 square kilometers).

1.4 Project Vicinity Map

The project vicinity map is Figure 1 in Section 11. An aerial vicinity map is included on Figure 2.

2.0 Watershed Characterization

2.1 Drainage Area

The drainage area for Underwood Creek is approximately 0.72 square miles at the downstream limit, where Underwood Creek crosses Newtown Road. The Unnamed Tributary to Underwood Creek has an approximate drainage area of 0.74 square miles. The combined watershed, 1.46 square miles, consists of 21% forested land, 66% cleared land for agricultural use (row crops), and 14% remaining land in single family residential use with 1 acre lots. The drainage area boundary is bound by Newtown Road (SR 1315) on the south, Potter Road (SR 1377) on the west, Weddington Road (SR 1334) on the north, and S. Rocky River Road (SR 1007) on the east (Figure 4 in Section 11).

2.2 Surface Water Classification / Water Quality

The project area is located within sub-basin 03-08-38 of the Catawba River Basin. This area is part of USGS Hydrologic Unit 03050103 (Lower Catawba Basin) of the South Atlantic-Gulf Region. The Lower Catawba River Basin covers 1,370 square miles (3,548 square kilometers). NCDWQ classifies Underwood Creek (DWQ Stream Index Number 11-138-2-3-1) as class **C**. The "**C**" classification indicates waters protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. After Underwood Creek leaves the project area, it flows into Little Twelvemile Creek approximately 1.0 river miles (RM) downstream. Little Twelvemile Creek flows into East Fork Twelvemile Creek, which flows into Twelvemile Creek. Twelvemile Creek crosses the North Carolina/South Carolina state line where it combines with the Catawba River.

2.3 Physiography, Geology and Soils

2.3.1 Physiography

The site is located within the Piedmont physiographic province which consists of gently rolling countryside frequently broken by well rounded hills and ridges. Due to the rapid growth in this province many of the farms and much of the rural areas are being replaced by suburbanization.

2.3.2 Geology

North Carolina is divided into a variety of geologic belts. The site is part of the Carolina Slate Belt soil system (Daniels, Buol, Kleiss, & Ditzler, 1999). The major rocks are volcanic argillites, basic and acid tuffs, breccias and flows. Volcanic igneous rocks rise above the surrounding slates as high rolling hills and small mountains. The topography of the Carolina Slate Belt has both similarities to and differences from the rest of the Piedmont. The interfluves are irregular, and sharp topographic breaks such as knolls and saddles are common. The valley sides are relatively short. Thick soils tend to occur on the smoother parts of the Slate Belt and thin soils occur on the broken or sharply irregular landscapes. Alluvial fills in the small streams draining the Slate Belt are narrow, shallow to hard rock, and contain an abundance of slate fragments. The small first and second order ephemeral streams or drainage ways are short and stubby with high angle junctions. Alignment of tributaries across the main stream is common

and probably related to the underlying rock structures. Right angle turns are also common in the main channels (Daniels, Buol, Kleiss, & Ditzler, 1999).

2.3.3 Soils

Most of the non-eroded or moderately eroded soils in the Carolina Slate Belt have silt loam surfaces and over 30 percent silt plus have fine sand in the B horizon. Soils formed in the Carolina Slate Belt have relatively high silt contents and overlie relatively thin saprolite compared to soils formed in the felsic crystalline areas. Soils in the Slate system have more slowly permeable B horizons and saprolite than their felsic crystalline counterparts. The major soil series identified within the project site according to the NRCS Web Soil Survey for Union are Badin, Chewacla, Cid, Mecklenburg, and Tarrus (Figure 6). These soils are discussed below.

Badin channery silt loam (Fine, mixed, semiactive, thermic Typic Hapludults ; 2-15% slope): The Badin series consists of moderately deep, well drained, moderately permeable soils that formed in residuum weathered from fine-grained metasedimentary and metavolcanic rocks of the Carolina Slate Belt. These soils are on gently sloping to steep uplands in the Piedmont. On this site, they are mapped south of UT to Underwood Creek. Classified as an Ultisol, this series is more mature than surrounding floodplain soils. Colors tend to display more red hues, and textures contain a high percentage of silt and clay (silt loam to silty clay), as well as the presence of channers (10-35% by volume). Erosion hazards are moderate in bare or unprotected areas. In Union County the land use within this soil series is mostly crops and pasture, with some wooded or in urban use.

Chewacla silt loam (Fine-loamy, mixed, active, thermic Fluvaquentic Dystrudepts; 0-2% slope): The Chewacla series consists of very deep, somewhat poorly drained, moderately permeable soils that formed in alluvium derived from rocks of the Carolina Slate Belt. They can found in Piedmont and Coastal Plain floodplains. On this site they closely follow the streams as would be expected. Classified as Inceptisols, these soils are generally younger, less developed than neighboring residual soils. These soils are frequently flooded for brief periods. Colors tend to display more yellow hues, and textures are loamy (silt loam to clay loam). Typical land use is wooded, but the soil also functions well as cropland.

Cid channery silt loam (Fine, mixed, semiactive, thermic Aquic Hapludults; 1-5 % slope): The Cid series consists of moderately deep, moderately well drained or somewhat poorly drained soils on Piedmont uplands. These soils formed in residuum weathered from argillite and other fine-grained metavolcanic rocks. On this site they occur frequently on side slopes adjacent to the floodplain. Classified as Ultisols like Badin, these soils are more developed and have exhibited stability over time. Colors tend to display in the yellow hues, and textures contain a high percentage of silt and clay (silt loam to silty clay). Typical land use is cropland, pasture and woodland.

Mecklenburg sandy clay loam (Fine, mixed, active, thermic Ultic Hapludalfs; 2-8% slope): The Mecklenburg series consists of very deep, well drained, slowly permeable soils that formed in residuum weathered from intermediate and mafic crystalline rocks of the Piedmont uplands. Located in a similar landscape position as Cid, this series is located east of Underwood Creek at this site. This series is classified as an Alfisol, which is similar in age to nearby Ultisols. The upper profile exhibits textures between loam and clay, while the subsoil is more sandy (sandy

clay loam). The soil has colors in the red hues of the spectrum. Erosion hazard is moderate for bare or unprotected areas. Typical land use is cropland, hayland, pasture, and woodland.

Tarrus gravelly silty clay loam (Fine, kaolinitic, thermic Typic Kanhapludults; 2-8% slope): Soils of the Tarrus series are deep and well drained. They have moderate permeability. They formed in residuum from argillite or other fine-grained metavolcanic rocks of the Carolina Slate Belt. These soils are on uplands of the Piedmont physiographic region. On the site, Tarrus often occupies upland positions, both adjacent to the floodplain as well as topographically high positions. Similar to other upland soils of the site, it is classified as an Ultisol. This series exhibits yellow hues and textures that range from silt loam to clay. Erosion hazard is moderate for bare or unprotected areas. Typical land use is cropland, hayland, pasture, and woodland.

2.4 Historical Land Use and Development Trends

Historic aerial photographs of the site were collected and examined. Photographs were available from 1951, 1993 and 2007.

The 1951 photograph is of poor quality but faintly shows Underwood Creek and the Unnamed Tributary to Underwood Creek. Underwood Creek had a wooded buffer for the entire length of the stream. UT to Underwood Creek had a wooded buffer on both sides of the stream from the downstream limit of the project area until approximately 1500 feet from where the stream crosses Clarence Secret Road (SR 1333). From that point, UT to Underwood creek maintains a wooded buffer along the north bank of the stream with the southern bank bordering agricultural land. UT to Underwood Creek returns to wooded buffers on both sides of the stream approximately 1000 feet east of its intersection with SR 1333 until the uppermost limits of the watershed area. Approximately 69% of the watershed area in 1951 was used for agricultural purposes with the other 31% being wooded.

The 1993 photograph shows a new single family development under construction in the watershed. UT to Underwood Creek has not noticeably migrated from its 1951 location. The wooded buffers for UT to Underwood Creek have changed very little from the 1951 photograph except for an additional loss of 1000 linear feet of stream buffer. The location of Underwood Creek does not appear to have changed significantly from the 1951 photograph. The stream buffer however has been significantly reduced to a thin strip of vegetation along the banks of the stream. Approximately 65% of the watershed area continues to be in agricultural use. Approximately 22% of the watershed area remains wooded with 13% of woodlands converted to single family residential development.

The 2007 photo of the watershed shows little change in land use from the 1993 photograph. The stream buffers remain consistent on UT to Underwood Creek, however significant changes have been made to the buffers on Underwood Creek. The buffers along this reach have been cleared entirely as crop production has been extended to the top of the stream bank. The residential development has become fully built out in 2007. The land use remains consistent with the 1993 photo in that 65% of the drainage area remains in agriculture, 22% wooded and 13% single family residential.

The watershed is rural and is currently comprised mainly of open grassy meadows and woods (Table 3, Section 10 and Figure 4, Section 11). The watershed will most likely continue to

develop with single family homes due to the close proximity to urban areas. The existing residential development has plans to expand in size over the next few years. This expansion will result in continued loss of wooded and agricultural lands.

2.5 Endangered/Threatened Species

Some populations of fauna and flora have been or are in the process of decline due to either natural forces or their inability to coexist with human activities. Federal law (under the provisions of the Endangered Species Act of 1973, as amended) requires that any action likely to adversely affect a species classified as federally protected, be subject to review by the USFWS or National Marine Fisheries. Other species may receive additional protection under separate state laws.

2.6 Federally Protected Species

2.6.1 Site Evaluation Methodology

A March 2, 2010, search of the North Carolina Natural Heritage Program (NCNHP) digital database of rare plants, animals, and natural areas for records of threatened and endangered species or federally designated habitat found within one mile (1.6 kilometers) of the project site resulted in two elemental occurrences, neither of which were federally protected species (Table 1 and Figure 8, Section 11). Neither of the occurrences was on the subject property nor are they likely to be affected by the proposed actions.

Table 1. NCNHP Elemental Occurrences within 1 mile of site.

Common Name	Scientific Name	Federal Status	State Status[a]
Notched Rainbow	*Villosa constricta*	-	SC
Smooth Coneflower	*Helianthus laevigatus*	-	SR-P

a: SR-P - Proposed Significantly Rare; SC – Special Concern

The USFWS website was consulted to obtain a listing of all threatened and endangered species for Union County.

Table 2. Federally Listed Species, Union County, North Carolina (11/15/2007)

Common Name	Scientific Name	Status*
Carolina Heelsplitter	*Lasmigona decorata*	E
Michaux's Sumac	*Rhus michauxii*	E
Schweinitz's sunflower	*Helianthus schweinitzii*	E

*Endangered

The entire site was then traversed to determine if any suitable habitat existed for these listed species.

2.6.2 Threatened and Endangered Species

Plants and animals with federal classifications of Endangered, Threatened, Proposed Endangered, and Proposed Threatened are protected under provisions of Sections 7 and 9 of the Endangered Species Act of 1973, as amended. There are three federally listed species listed for Union County (Table 2).

2.6.2.1 Species Description and Biological Conclusion

Carolina Heelsplitter (*Lasmigona decorata*)
Status: Endangered
Family: Unionidae
Listed: 06/30/93

The Carolina heelsplitter (*Lasmigona decorata*), originally described as *Unio decoratus* by (Lea 1852), synonymized with *Lasmigona subviridis* (Conrad 1835, Johnson 1970), and later separated as a distinct species (Clarke 1985), is a federally Endangered freshwater mussel, historically known from several locations within the Catawba and Pee Dee River systems in North Carolina and the Pee Dee, Savannah, and possibly the Saluda River systems in South Carolina.

The Carolina heelsplitter is characterized as having an ovate, trapezoid-shaped, unsculptured shell. The outer surface of the shell ranges from greenish brown to dark brown in color, with younger specimens often having faint greenish brown or black rays. The shell's nacre is often pearly white to bluish white, grading to orange in the area of the umbo (Keferl 1991). The hinge teeth are well developed and heavy and the beak sculpture is double looped (Keferl and Shelly 1988). Morphologically, the shell of the Carolina heelsplitter is very similar to the shell of the green floater (Clarke 1985), with the exception of a much larger size and thickness in the Carolina heelsplitter (Keferl and Shelly 1988).

Prior to collections in 1987 and 1990, by Keferl (1991), the Carolina heelsplitter had not been collected in the 20th century and was known only from shell characteristics. Because of its rarity, very little information of this species' biology, life history, and habitat requirements was known. Feeding strategy and reproductive cycle of the Carolina heelsplitter have not been documented, but are likely similar to other native freshwater mussels (USFWS 1996).

The feeding processes of freshwater mussels are specialized for the removal (filtering) of suspended microscopic food particles from the water column (Pennak 1989). Documented food sources for freshwater mussels include detritus, diatoms, phytoplankton, and zooplankton (USFWS 1996).

Freshwater mussels have complex reproductive cycles, which include a larval stage (glochidium) that is an obligatory parasite on a fish. The glochidia develop into juvenile mussels and detach from the "fish host" and sink to the stream bottom where they continue to develop, provided suitable substrate and water conditions are available (USFWS 1996). Many species of naiads require a particular species of fish to serve as the host. The host species(s) for the Carolina heelsplitter is unknown (USFWS 1996). McMahon and Bogan (2001) and Pennak (1989) should be consulted for a general overview of freshwater mussel reproductive biology.

Biological Conclusion: No Effect.

Suitable habitat for the Carolina Heelsplitter does not exist in the proposed conservation easement. A review of NCNHP records, updated March 2, 2010, indicates no known Carolina heelsplitter occurrence within the proposed conservation easement.

Schweinitz's Sunflower (*Helianthus schweinitzii*)
Status: Endangered
Family: Asteraceae
Listed: 05/07/91

Schweinitz's sunflower is a perennial herb endemic to the piedmont of North and South Carolina. The species can grow to six feet in height, but can be substantially shorter. The stem is usually unbranched in its lower portion, while the terminal one-third of the stem is freely branched. The stem is usually pubescent but can be nearly glabrous and it is often purple. The leaves are sessile to short-petiolate, lanceolate, 5 to 10 times as long as wide, scabrous above, with dense soft white hairs below. Schweinitz's sunflower has relatively small heads; the disk is 6 to 15 millimeters across and the flowers are yellow. Schweinitz's sunflower has thickened, tuberous rhizomes which store starch (USFWS 1994).

Schweinitz's sunflower is known to occur along roadsides, power line clearings, old pastures, woodland openings, and other sun-exposed areas. It is typically located on poor, clayey, or rocky soils, especially those derived from mafic parent materials. The species historically occurred in prairielike habitats or oak savannas maintained by fires. Fire suppression and urbanization have resulted in the species decline (USFWS 1994).

Schweinitz's sunflower is presently believed to occur only in the lower Piedmont of south-central North Carolina and north-central South Carolina. The species is currently known from Anson, Cabarrus, Davidson, Gaston, Mecklenburg, Montgomery, Randolph, Rowan, Stanly, Stokes, Surry and Union counties in North Carolina (USFWS 1994).

Biological Conclusion: No Effect
Suitable habitat for the Schweinitz's sunflower does not exist in the study area. Where open areas occur within the easement, they are not sufficient to provide suitable habitat. A review of NCNHP records, updated March 2, 2010, indicates no known Schweinitz's sunflower occurrence within the proposed conservation easement.

Smooth coneflower (*Echinacea laevigata*)
Family: Asteraceae
Endangered
Date Listed: October 8, 1992

Smooth coneflower is a rhizomatous perennial herb that grows up to 4.9 feet (1.5 meters) tall. The stem is smooth. Basal leaves are smooth to slightly rough and are the largest, reaching 7.9 inches (20 centimeters) in length and 2.9 inches (7.5 centimeters) in width. They have long stems, and are elliptical to broadly lanceolate, tapering to the base. Mid-stem leaves have shorter stems or no stems and are smaller in size than the basal leaves. Flower heads are usually solitary with drooping petals light pink to purplish in color and 1.9 to 3.1 inches (5 to 8 centimeters) long. Flowering occurs from May through July.

Smooth coneflower is usually found in open woods, cedar barrens, roadsides, clearcuts, dry limestone bluffs, and power line rights-of-way, usually on magnesium- and calcium-rich soils

associated with limestone (in Virginia), gabbro (in North Carolina and Virginia), diabase (in North Carolina and South Carolina), and marble (in South Carolina and Georgia). Smooth coneflower is found in areas with abundant sunlight and few competitors which are usually associated with periodic disturbances such as fire (USFWS 1995).

Biological Conclusion: No Effect

Suitable habitat for the smooth coneflower does not exist in the study area. Where open areas occur within the easement, they are not of sufficient to provide suitable habitat. A review of NCNHP records, updated March 2, 2010, indicates no known smooth coneflower occurrence within the conservation easement.

2.6.3 Federal Species of Concern

There are 10 Federal Species of Concern (FSC) and one candidate (C) species listed by the USFWS for Union County (Table 3). FSC and C species are not afforded federal protection under the Endangered Species Act of 1973, as amended, and are not subject to any of its provisions, including Section 7, until they are formally proposed or listed as Threatened or Endangered.

Table 3. Federal Species of Concern and Candidate Species, Union County, North Carolina

Common Name	Scientific name	Federal Status
Vertebrate:		
American Eel	*Aguilla rostrata*	FSC
Carolina Darter	*Etheostoma collis collis*	FSC
Invertebrate:		
Atlantic Pigtoe	*Fusconaia masoni*	FSC
Carolina Creekshell	*Villosa vaughaniana*	FSC
Savannah Lilliput	*Toxolasma pullus*	FSC
Yellow Lampmussel	*Lampsilis cariosa*	FSC
Vascular Plant:		
Dwarf Aster	*Eurybia myrabilis*	C
Georgia Aster	*Symphorotrichum georgianum*	FSC
Prairie birdsfoot-trefoil	*Lotus unifoliiatus* var. *helleri*	FSC
Shoals Spierlily	*Hymenocallis coronaria*	FSC
Virginia Quillwort	*Isoetes virginica*	FSC

2.7 Cultural Resources

A letter was sent to State Historic Preservation Office (SHPO) on October 20, 2009 requesting information concerning significant cultural resources on the project site. A response was received on November 3, 2009 stating that there were no known historic resources in the project area (Appendix 6).

2.8 Potential Constraints

2.8.1 Property Ownership and Boundary

Environmental Banc & Exchange (EBX) has entered into an Agreement for Purchase and Sale of Easement with the owner of the site. The conservation easement on the site exists on three

parcels of land that are owed by a single owner, Frank Howey. The Union County PIN numbers for the project site are 09408002, 09408004, and 09408005.

2.8.2 Site Access

Construction entry to the site will be taken from Newtown Road. It is not anticipated that there will be any site access issues.

2.8.3 Utilities

There are no utilities located on the project site.

2.8.4 FEMA/Hydrologic Trespass

Underwood Creek is designated as FEMA regulated and is shown on FIRM map number 3710540400, effective October 16, 2008 (Appendix 7). A No-Rise flood study has been completed for the design channel of Underwood Creek and there is no increase in water surface elevations (WSELs) as a result of the restoration design. Upon completion of the project a Letter of Map Revisions (LOMR) will be submitted to FEMA based on the As-built conditions of the project site.

3.0 Project Site Streams

3.1 Channel Classification

The project consists of two streams, Underwood Creek and an Unnamed Tributary to Underwood Creek. Underwood Creek runs from the northern property line approximately 1,250 linear feet to the existing culvert at Newtown Road. The tributary, UT to Underwood Creek enters the property at the eastern property line and flows west and south approximately 4,300 linear feet to the existing culvert at Newtown Road.

Underwood Creek classifies as a degraded C4/E4 channel. The “C” stream type is a meandering channel with sequential riffle and pool features. The “4” in the classification describes the channel further as a gravel bed stream. The “E” stream type is where the width to depth ratio of the channel decreases to a value less than 12. The stream has a broad floodplain currently under agricultural use, however bankful flows do not have full access due to its current entrenchment. The stream lacks vegetation through the reach except at the upstream and downstream ends where the land is not currently being farmed. The stream has very little pattern within the restoration reach and one culvert crossing is present at an existing farm road in the middle of the restoration reach.

UT to Underwood Creek classifies as an entrenched C4/E4 stream with some segments within the stream length that classify as a G4 stream type. The channel changes into a “G” stream type in areas throughout the stream length in which the channel becomes deeply entrenched. The upstream 700 feet of stream is contained in a wooded reach. The project stream restoration will begin 100 feet downstream of the property line. The first 100 feet of channel has not been impacted by the active incision. Well developed point bars extended through approximately 2/3 of the distance within the woods. As the channel begins to become incised in the downstream direction point bars are absent from the stream channel. The stream banks become more vertical. As the channel moves out of the wooded area and adjacent to the agricultural field the stream has widened and center bars have formed. Because of the over widening and excess sediment

deposition due to the lack of buffer, this segment of stream is filled with herbaceous vegetation in the stream banks and bottom. There are two locations in which the stream is directly adjacent to extremely high vertical terrace banks. Severe erosion is occurring at the toe and bank at the upper most location. At the second location a small relic floodplain still remains. Large trees at the toe of the slope have provided stability to the terrace and stream bank. The stream meanders through a second wooded area where some buffer has been maintained and then enters an area with agricultural fields located on both floodplain banks. A small strip of vegetation 5-10 feet is located through out this corridor. Two existing pipe crossings are located on the tributary. The stream incision increases on the down stream side of the second crossing.

3.2 Discharge

The drainage area to the end of the project limits is approximately 1.5 square miles and mainly consists of land in agricultural use and woods. A single family development is located just upstream of the restoration reach on UT to Underwood Creek. The floodplain in the project site is wide and well defined throughout the channel length. An existing wetland area is located in the middle of the tributary stream length on the north side of the stream.

Underwood creek has a drainage area of 0.72 square miles and an estimated bankfull discharge of approximately 55 cubic feet per second (cfs). The discharge was estimated from 11 field cross sections that were taken along the channel. Bankfull was located within the existing channel banks approximately 1.5 feet below the existing floodplain elevation along the entire reach. The bankfull areas were used along with the bankfull slope to determine the stream bankfull discharge.

UT to Underwood Creek has a drainage area of approximately 0.74 square miles. The estimated bankfull discharge is approximately 42 cubic feet per second (cfs). The discharge was estimated from 18 field cross sections taken along the channel. Bankfull was located approximately 1 to 3 feet below the existing floodplain elevation.

3.3 Channel Morphology

The morphological characteristics of the eleven cross sections on Underwood Creek and eighteen cross sections on UT to Underwood Creek are shown in Section 10, Table 4. Surveyed field cross-section locations are shown on the restoration plans Existing Conditions Plans Sheets EC1 through EC4. The morphologic tables, located within the table section of this report, show the existing and proposed Underwood Creek and UT to Underwood Creek conditions along with the morphological characteristics of the reference reach. UT to Underwood Creek located just upstream of the restoration reach.

The land within the project site is currently in agricultural use for row crop production. Underwood Creek has been straightened. The stream is entrenched throughout the reach. Incision along with lack of vegetation has caused most of the stream banks to eroded and become very steep. The stream cross sectional area is narrow at the top and entrenched through out the restoration stream length. The existing floodplain adjacent to the stream banks is void of woody vegetation except for an area just upstream of the existing farm road crossing adjacent to a pond and the downstream 200 foot segment at the bottom of the project adjacent to the existing culvert under Newtown Road.

UT to Underwood Creek has very little pattern. The stream profile is entrenched through out most of the restoration reach with the most severe entrenchment occurring as the stream joins with Underwood Creek. A portion of the upstream one half of the project site has been farmed up to the channel banks and is heavily impacted with sediment. The cross section is over wide with center bars and vegetative mats establishing within the channel bed. The stream channel narrows and deepens as it flows southwest through the project site. The floodplain adjacent to UT to Underwood Creek has a vegetated buffer at the top and bottom of the restoration reach with limited vegetation in between

3.4 Channel Stability Assessment

The channel stability assessment was based on observations made in evaluating bank erosion potential with the Rosgen method of completing a Bank Erosion Hazard Index (BEHI) (Section 10, Tables 5-6).

3.5 Bankfull Verification

Bankfull Verification on Underwood Creek and UT to Underwood Creek was completed with a comparison of field surveyed cross sections along the streams to typical bankfull width, area, depth, and discharge relationships. The watershed predicted discharges were compared with the bankfull channel capacities as well for verification. The Rural Piedmont Regional Curves developed by the North Carolina State University (NCSU) Water Quality Group were used to verify acceptable limits of morphological characteristics based on a hydro-physiographic region and drainage area. The average bankfull discharge, cross sectional area, width, and depth for Underwood Creek and UT to Underwood Creek fell within the confidence limits of the North Carolina Rural Regional curves.

3.6 Vegetation

Plant community classifications follow those presented by Schafale and Weakley (1990) where possible (Figure 9). The dominant flora observed, or likely to occur, in each community are described and discussed below. Due to the site visit being conducted

Scientific nomenclature and the common names (when applicable) are provided. Plant taxonomy typically follows Weakley (2008). All subsequent references to the same organism will include the common name only. Published range distributions and habitat analysis are used in estimating flora expected to be present within the project site. Piedmont Alluvial Forest and Agriculture Land were the community types observed in the project site (Figure 8).

3.6.1 Piedmont Alluvial Forest

The piedmont alluvial forest community is a fragmented vegetative community along Underwood Creek and UT to Underwood Creek. The canopy was very sparse to nearly absent throughout the project study area. Canopy species observed include green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), red elm (*Ulmus rubra*), black walnut (*Juglans nigra*), persimmon (*Diospyros virginiana*), black willow (*Salix nigra*), red maple (*Acer rubrum*), willow oak (*Quercus phellos*), sycamore (*Platanus occidentalis*), southern hackberry (*Celtis laevigata*), Princess tree (*Paulownia tomentosa*), and pecan (*Carya illinoinensis)*. The small tree and shrub layer was dominated by Chinese Privet (*Ligustrum sinense*) thoughout interspersed with red maple, sweet gum, and sycamore saplings. Other small trees observed

were black willow (*Salix nigra*), elderberry (*Sambucus canadensis*), multiflora rose (*Rosa multiflora*), silky dogwood (*Cornus amomum*), and Ironwood (*Carpinus carolinana*). The herbaceous layer was sparse to absent throughout with Japanese honeysuckle dominant in some areas among other less common species such as rush (*Juncus effusus*) and common greenbriar (*Smilax rotundifolia*).

3.6.2 Agriculture Land

The Agriculture Land community type was dominated with a graminoid cover crop with evidence of corn as the main crop during the previous growing season. This community occupies the majority of the proposed conservation easement.

4.0 Reference Stream

One reference reach was used for both Underwood Creek and UT to Underwood Creek since they are of similar watershed size and valley slope. The reference reach is located in an undisturbed segment of UT to Underwood Creek just above the restoration site. This area has remained wooded as far back as 1951 as evidenced by the aerial photograph that was obtained.

4.1 UT to Underwood Creek

One reference stream, UT to Underwood Creek, was used for the restoration design. The reference reach scored a 36.5 on the NCDWQ stream identification form (Appendix 2). The vegetative community buffering the stream is classified as a Piedmont Alluvial Forest.

4.1.1 Watershed Characterization

UT to Underwood Creek is located within the same watershed as the project restoration stream and therefore has the same watershed characterization as the project site.

4.1.2 Channel Classification

UT to Underwood Creek reference reach classifies as a E4/C4 stream type. The reference reach ranges that represent a “C” type channel will be used for the restoration design of Underwood and UT to Underwood Creeks. The "C" stream types are located in narrow to wide valleys, constructed from alluvial deposition. They have a well-developed floodplain that is slightly entrenched, are relatively sinuous with a channel slope of 2% or less and bedform morphology indicative of a riffle/pool configuration. The C-type streams also exhibit a sequencing of steps (riffles) and flats (pools) that are linked to the meander geometry of the river where the riffle/pool sequence or spacing is approximately 5-7 bankfull channel widths. The primary morphological features of the "C" stream type are the sinuous, low relief channel, the well developed floodplains built by the river, and characteristic "point bars" within the active channel. The channel aggradation/degradation and lateral extension processes, notably active in "C" stream types, are dependent on the natural stability of stream bank, the existing upstream watershed conditions and flow and sediment regime. These channels can be significantly altered and rapidly de-stabilized when the effects of imposed changes in bank stability, watershed conditions, or flow regime are combined to cause an exceedance of a channel stability threshold (Rosgen, 1996). The 4 in the classification system further identifies the stream as having a gravel bed.

4.1.3 Discharge

The drainage area at the downstream limit of the reference reach is approximately 0.43 square miles. The estimated bankfull discharge is approximately 40 cubic feet per second (cfs). The discharge was estimated from eleven (11) field cross sections taken along the channel. Bankfull was located at the top of the existing channel which is at the existing floodplain elevation.

4.1.4 Channel Morphology

The morphological characteristics from the UT to Underwood Creek Reference reach are shown in Section 10.0, Table 4. The channel has a high bankfull width/depth ratio range and a low bank height that allows floodwater to access the floodplain. The profile consists of a well developed riffle pool sequence located at the appropriate locations within the channel. The stream is located in the same physiographic region, the Carolina Slate Belt, as Underwood and UT to Underwood Creeks. While UT to Underwood Creek classifies as a "E4/C4" type channel, using the range of numbers from the morphological tables that are more closely associated with a "C" type channel, the proposed restoration channels will be designed to fall into that classification.

4.1.5 Channel Stability Assessment

Visual observations of UT to Underwood Creek reference reach show that the stream has adequate root depth and density, moderate bank slopes, low bank heights and good vegetative surface protection. This indicates that the creek has low bank erosion potential, degrades slowly and contributes little sediment to the stream waters.

4.1.6 Bankfull Verification

Bankfull verification on UT to Underwood Creek was completed with a comparison of field surveyed stream cross sections for typical bankfull width, area, depth, and discharge relationships. The watershed predicted discharges were compared with the bankfull channel capacities generated from field cross sections for verification. The Rural Piedmont Curves developed by the North Carolina State University (NCSU) Water Quality Group were used to verify acceptable limits of morphological characteristics based on a hydro-physiographic region and drainage area. UT to Underwood Creek's average cross sectional values for bankfull area, width, depth and discharge fell within the confidence limits on the North Carolina Rural Regional Curves.

4.1.7 Vegetation

4.1.7.1 Vegetative Communities for Underwood Creek and UT to Underwood Creek

Plant community classifications follow those presented by Schafale and Weakley (1990) where possible (Figure 8, Section 11). The dominant flora observed, or likely to occur, in each community are described and discussed.

Scientific nomenclature and the common names (when applicable) are provided. Plant taxonomy typically follows (Weakley 2008). All subsequent references to the same organism will include the common name only. Published range distributions and habitat analysis are used in estimating flora expected to be present within the project site.

4.1.7.1.1. Piedmont Alluvial Forest

Upstream of the restoration reach along UT to Underwood Creek is the reference reach used for both the UT to Underwood Creek and Underwood Creek. The vegetative community species composition is similar to that of the Piedmont Alluvial Forest located within the conservation easement. The canopy is composed of tree species including but not limited to green ash, sweetgum, red maple, red elm, and southern hackberry. Subcanopy and shrub species observed include ironwood (*Carpinus caroliniana*) saplings of red maple and sweetgum. This community has a dense shrub layer dominated by Chinese privet. Herbaceous species observed in this community include the invasive species, Japanese honeysuckle (*Lonicera japonica*).

5.0 Project Site Wetlands (Existing Conditions)

Jurisdictional delineations were performed using the three-parameter approach as prescribed in the *1987 Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratories 1987). Supplementary technical literature describing the parameters of hydrophytic vegetation, hydric soils, and hydrological indicators was also utilized. The USACE wetland routine determination forms are included (Appendix 1).

5.1 Jurisdictional Wetlands

Field teams used USGS topographic quadrangle mapping (7.5-minute) with the property boundary as a background file on Trimble global positioning system (GPS) handheld units with sub-meter accuracy for navigation and mapping. Wetland boundaries were flagged and surveyed using GPS equipment (Figure 7, Section 11).

One wetland (W1) was observed within the proposed conservation easement (Figure 7, Section 11). Regional indicator F3 was used to determine hydric soils. All three wetland parameters were observed in these wetland systems.

Wetland 1- Wetland 1 (80°38’ 28”W, 34° 58’ 17”N) is a riparian wetland approximately 0.92 acre that drains into UT to Underwood Creek. This wetland is a depression within a piedmont alluvial forest community. Vegetation is mostly herbaceous with some small trees and shrubs such as tag alder (*Alnus serrulata*), buttonbush (*Cephalanthus occidentalis*), common elderberry (*Sambucus canadensis*), black willow (*Salix nigra*), and the invasives Chinese privet and multiflora rose (*Rosa multiflora*) scattered throughout. Some larger trees were identified along the margin that consists of common persimmon (*Diospyros virginiana*), red elm, and eastern red cedar (*Juniperus virginiana*). Herbaceous vegetation consists of common rush (*Juncus effusus*), goldenrod (*Solidago* sp.), giant ironweed (*Vernonia gigantea*), sedges (*Carex* sp.), smartweed (Persicaria sp.), arrowleaf tearthumb (*Persicaria sagittata*), swithgrass (*Panicum* sp.), and orange jewelweed (*Impatiens capensis*).

5.1.1 Hydrological Characterization of Jurisdictional Wetlands

One Remote Data Systems (RDS) groundwater monitoring gauges (Gauge 4) was installed within the jurisdictional wetland on February 19, 2010 (Figure 7). These gauges record groundwater levels daily and the data is collected bi-monthly. . Utilizing the Draft Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region, it states for problematic sites [which of course, a restored wetland is since it will take time for the sites physical characteristics (soil porosity, structure,

organic matter, surface organic layer, and vegetation) to regain its historic conditions] the technical standard for monitoring hydrology is 14 or more consecutive days of flooding or ponding, or a water table 12 in. (30 cm) or less below the soil surface, during the growing season at a minimum frequency of 5 years in 10. The growing season is 221 day, from Mar 28 - Nov 3, therefore the hydrologic success criteria is defined by the groundwater levels within 12 inches of the soil surface for at least 6.3% of the growing season. These areas will be considered wetlands if the groundwater is within 12 inches for at least 6.3% of the growing season, the area supports hydrophytic vegetation, and it meets the hydric soil requirements. Data for a complete growing season has not been gathered to date for Gauges 1-7.

5.2 Non-Jurisdictional Wetlands

Non-jurisdictional wetlands include all of the areas within the project area contain hydric soils but do not exhibit wetland characteristics.

5.2.1 Hydrological Characterization of Non-Jurisdictional Wetlands

Six groundwater gauges (Gauge 1,2,3,5, 6, &7) were installed within non-jurisdictional wetland areas of the project area on February 19, 2010 (Figure 7). These gauges record a groundwater levels daily and the data is collected bi-monthly. Hydrologic regimes are monitored to determine if groundwater levels are within 12 inches of the soil surface for at least 6.3% of the growing season. These areas will be considered wetlands if the groundwater is within 12 inches for at least 6.3% of the growing season, the area supports hydrophytic vegetation, and it meets the hydric soil requirements. No groundwater data has been collected within a growing season to date.

5.3 Groundwater Modeling of Restoration Site

Groundwater modeling is not recommended for this project.

5.4 Surface Water Modeling at Restoration Site

Surface water modeling is not recommended for this project.

5.5 Hydrologic Budget for Restoration Site

A hydrologic budget is not anticipated for this project. Groundwater data will be analyzed to make a final determination as to the need for the hydrologic budget.

5.6 Soil Characterization of Existing Wetland

An overall site assessment, consisting mainly of a series of hand auger borings, was conducted by a licensed soil scientist. The most notable feature throughout the majority of the study area was a buried hydric soil horizon. The depth to this horizon ranged in depths from 4 to 12 inches. This feature is NOT noted in any of the county soils mapped by NRCS, as such, any associations with a particular mapped soil would be inappropriate. However, the presence of the fill material was located in the areas mapped as Chewacla by the NRCS.

The soil deposited on top of the buried horizon has begun to develop morphological features. These features were used to identify the current hydric/ non-hydric soil boundary. . This soil was classified as hydric by meeting field indicators F3 and/or F19 as noted in the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and

Northeast Region (USACOE, 2009) and the Field Indicators of Hydric Soils in the United States (USDA, NRCS 2006), which state:

F3. Depleted Matrix. *For use in all LRRs, except for W, X, and Y.* A layer that has a depleted matrix with 60 percent or more chroma of 2 or less and that has a maximum thickness of either:

a. 5 cm (2 inches) if the 5 cm is entirely within the upper 15 cm (6 inches) of the soil, or
b. 15 cm (6 inches), starting within 25 cm (10 inches) of the soil surface.

(USDA, NRCS 2006)

Two representative soil borings are provided below:

Table 4. Typical Floodplain Profile

Horizon name	Depth (in)	Soil Color*	Texture
Ap1	0-1	dark yellowish brown (10YR 3/4)	sandy loam
Ap2	1-5	dark yellowish brown (10YR 4/4) with many distinct strong light olive brown (2.5Y 5/3) concentrations and few distinct manganese masses	sandy loam
Bw	5-12	brownish yellow (10YR 6/8) with many prominent light yellowish brown (10YR 6/4) and common distinct reddish yellow (7.5YR 6/8) concentrations. Common prominent gray (10YR 6/1) depletions and few distinct manganese masses	clay loam
Bg1	12-19	gray (10YR 6/1) with many prominent light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/6) concentrations and few distinct manganese masses	sandy loam
Bg2	19-25	gray (10YR 6/1) with many prominent light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/8) concentrations	clay loam
Bg3	25-29	gray (10YR 6/1) with many prominent yellowish brown (10YR 5/6) concentrations	sandy clay loam
Cg	29-32	gray (10YR 6/1) with many prominent yellowish brown (10YR 5/6) concentrations and common distinct gray (N/6) depletions	sandy loam
Auger Refusal	32+		

*Munsell soil color notation

Table 5. Typical Wetland Profile

Horizon name	Depth (in)	Soil Color*	Texture
Ap	0-1	dark yellowish brown (10YR 3/4)	sandy loam
BE	1-6	light olive brown (2.5Y 5/3) with common distinct strong light brownish gray (2.5Y 6/2) depletions and few distinct oxidized rhizospheres	sandy loam
Bg1	6-11	grayish brown (2.5Y 5/2) with common distinct oxidized rhizospheres and few distinct manganese masses	sandy loam
Bg2	11-14	grayish brown (2.5Y 5/2) with common prominent light yellowish brown (10YR 5/4) concentrations and many prominent gray (2.5Y 6/1) depletions and few distinct manganese masses	sandy loam
Bg3	14-24	light brownish gray (10YR 6/2) with many prominent light yellowish brown (10YR 6/4) and common prominent yellowish brown (10YR 5/4) concentrations and many prominent manganese masses	clay loam
Bg4	24-31	gray (10YR 6/1) with many prominent yellowish brown (10YR 5/8) concentrations	clay loam
Bg5	31-43+	light brownish gray (10YR 6/2) with common prominent yellowish brown (10YR 5/6) concentrations and common prominent gray (N/6) depletions	clay loam

*Munsell soil color notation

See Section 2.3.3 for a description of soils mapped within the project site according to the Union County NRCS soil survey.

5.7 Soil Characterization of Non-Jurisdictional Wetland

See Section 5.6 for a typical non hydric profile of soils observed on site.

5.7.1 Taxonomic Classification of Wetlands and Non-Jurisdictional Wetlands

The NRCS Soil Survey for Union County has five soil types mapped within the study site: Badin, Chewacla, Cid, Mecklenburg, and Tarrus soil series. Badin soils (Subgroup- *Typic Hapludults*) are moderately deep, well drained, moderately permeable soils that formed in residuum weathered from fine-grained metasedimentary and metavolcanic rocks of the Carolina Slate Belt. Chewacla soils (Subgroup-*Fluvaquentic Dystrudepts*) consist of somewhat poorly drained, nearly level soils on flood plains that are subject to frequent flooding for brief periods. Cid soils (Subgroup- *Aquic Hapludults*) are moderately deep, moderately well drained or somewhat poorly drained soils on Piedmont uplands. These soils formed in residuum weathered from argillite and other fine-grained metavolcanic rocks. Mecklenburg soils (Subgroup- *Ultic Hapludalfs*) consist of very deep, well drained, slowly permeable soils that formed in residuum weathered from intermediate and mafic crystalline rocks of the Piedmont uplands. The Tarrus series (Subgroup-*Typic Kanhapludults*) is deep and well drained. They have moderate permeability and formed in residuum from argillite or other fine-grained metavolcanic rocks of the Carolina Slate Belt. All five series are dominated by cropland land use on this site, with some patches of woodland.

5.7.2 Soil Profile Descriptions

See Section 5.6 for a typical profile of soils observed on site.

5.7.3 Hydraulic Conductivity

No hydraulic conductivity tests are recommended for this project.

5.7.4 Organic Matter Content

In fertility testing performed by the NCDA, the organic matter content ranged from 0.66 to 1.02%. It is anticipated that this will increase once the stream is restored and plantings are established.

5.7.5 Bulk Density

Calculation of bulk density is not recommended for this project.

5.8 Plant Community Characterization

Wetland 1 is situated along a portion of the right descending bank on the north side of UT to Underwood Creek. See section 5.1 for a full description of the wetland vegetation observed.

6.0 Reference Wetlands

Wetland 1 will be used as the reference wetland. It is located on the north side of UT to Underwood Creek and 0.15 acres are proposed for wetland preservation. This wetland receives frequent flooding, and was deemed suitable as a reference site. It contains a mix of recently deposited soils with an herbaceous layer of hydrophytic plants. One RDS groundwater monitoring gauge (Gauge 4) was installed in February 19, 2010 and a routine wetland determination form was completed for the site (Appendix 1).

6.1 Hydrological Characterization

One groundwater monitoring gauge (Gauge 4) was installed within the reference Wetland 1 (Figure 7) to determine the current hydrologic regime.

6.1.1 Gauge Data Summary

Six groundwater gauges (Gauge 1,2,3,5, 6, &7) were installed within non-jurisdictional wetland areas of the project area on February 19, 2010 (Figure 7). These gauges record a groundwater levels daily and the data is collected bi-monthly. Hydrologic regimes are monitored to determine if groundwater levels are within 12 inches of the soil surface for at least 6.3% of the growing season. These areas will be considered wetlands if the groundwater is within 12 inches for at least 6.3% of the growing season, the area supports hydrophytic vegetation, and it meets the hydric soil requirements. No groundwater data has been collected within a growing season to date.

6.2 Soil Characterization

Wetland 1 is a riverine wetland associated with UT to Underwood Creek. In general, the soil meets field indicator F3 and/or F19 as noted the Field Indicators of Hydric Soils in the United States, which states:

> ***F3. Depleted Matrix.*** A layer that has a depleted matrix with 60 percent or more chroma of 2 or less and has a minimum thickness of either:
>
> a.) 2 inches entirely within the uppers 6 inches of the soil surface

OR

b.) 6 inches starting within 10 inches of the soil surface

F19. Piedmont Flood Plain Soils. On active floodplains, a layer that has a depleted matrix with 60 percent or more chroma less than 4 and 20 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings and has a minimum thickness of:

6.2.1 Taxonomic Classification

The NRCS Soil Survey for Union County has one soil series mapped within the wetland area of the study site: the Chewacla soil series. Chewacla soils (Subgroup-*Fluvaquentic Dystrudepts*) consist of somewhat poorly drained, nearly level soils on flood plains that are subject to frequent flooding for brief periods. Most of these soils have been cleared and are being utilized as cropland.

6.2.2 Profile Description

See section 5.6 for a typical soil profile description for hydric soils observed within jurisdictional wetlands on the project site.

6.2.3 Hydraulic Conductivity

No hydraulic conductivity tests are recommended for this project.

6.2.4 Organic Matter Content

Soil fertility samples were not taken within the reference wetland.

6.2.5 Bulk Density

Calculation of bulk density is not recommended for this project.

6.3 Plant Community Characterization

6.3.1 Community Description

Wetland 1 is situated along a portion of the right descending bank on the north side of UT to Underwood Creek. See Section 5.1 for a full description of the wetland vegetation observed.

6.3.2 Basal Area

Since the majority of the wetland is composed mostly of herbaceous vegetation, this data was not recorded during initial field investigations.

7.0 Project Site Restoration Plan

7.1 Restoration Project Goals and Objectives

The restoration plan for Underwood Creek and UT to Underwood Creek includes Priority I and Priority II stream restoration as well as wetland restoration and preservation. Underwood Creek within the project limits will have a restored stream length of 1331 feet and UT to Underwood

Creek restored length of 3986 feet. The total project restored stream length is 5317 linear feet. Approximately 3.38 acres of wetlands are to be restored and 0.15 acres preserved as a part of the project.

7.1.1 Designed Channel Classification

The proposed Underwood Creek and UT to Underwood Creek channels will be restored as C4 streams. The restoration will place meanders back into the straightened stream and will extend the existing stream length.

Through the restoration of the existing streams the stream pattern, profile, and dimension will be adjusted to allow the stream to efficiently transport its water and sediment load through a combination of changes to the channel dimension, pattern, and profile. The channel dimension will be modified to provide for a shallower and wider stream that is designed for the bankfull cross sectional area. The new stream channel will be reconnected to the floodplain for storm events greater than the bankfull return period. The pattern of the stream will also be adjusted to include an appropriate meander pattern.

To aid in long-term stabilization, the installation of structures and vegetation will be an important part of the restoration plan. Clay plugs will be installed in the old channel on either side of where the new channel passes through it in order to prevent future breaches. Single wing vanes and rootwads have been included into the design to assist in bank stabilization. Constructed riffles and cross vanes have been added to the project to reinforce the vertical stability of the new stream elevations.

Grading of the floodplain bench will provide additional flood capacity during the 100-year storm event to compensate for the change in channel configuration and elevations. The proposed grading is shown on the restoration plans Section 12, Sheets PP1-PP6.

Three existing farm crossings will be upgraded and incorporated into the restoration design at the existing crossing locations. Ephemeral pools will be provided at locations specified on the plans in areas of the abandoned channel.

7.1.2 Target Wetland Communities/Buffer Communities

Wetlands are proposed to be restored to typical piedmont alluvial forest wetland through the planting of wetland tree and shrub species and the removal of 2 to 6 inches of sediment wash from upland farm agricultural fields. The stream buffers of Underwood Creek and UT to Underwood Creek will be planted with tree and shrub species typical of a piedmont alluvial forest. Herbaceous vegetation will not be planted with the anticipation of present native species and volunteers giving rise from the seed bank. See Section 10, Table 7 for a list of tree and shrub species that will be planted within the proposed restoration area. The restoration planting plan is shown in Section 12, Sheets VP1-VP6.

7.2 Sediment Transport Analysis

7.2.1 Methodology

A stable stream has the capacity to move its sediment load without aggrading or degrading. The total load of sediment can be divided into wash load and bed load. Wash load is normally

composed of fine sands, silts and clay and transported in suspension at a rate that is determined by availability and not hydraulically controlled by the size and nature of the bed material and hydraulic conditions (Hey 1997).

The critical shear stress for the proposed channels has to be sufficient to move the particle size diameter value at the 84th percentile (D84) of the bed material. Shear stress was computed using the shear stress equation below and compared to the Shield's Curve of the threshold of grain diameter motion.

$$\mathcal{T} = \mathcal{Y}\mathbf{Rs}$$

Where:
$\mathcal{T}$ = shear stress (lb/sqft)
$\mathcal{Y}$ = specific gravity of water (62.4 lb/cubic ft.)
R = hydraulic radius (ft)
s = water surface slope (ft/ft)

Additional sediment transport analysis was completed using the Rosgen method of using bed materials and sub surface material D50 particle sizes to determine the critical dimensionless shear stress. The critical shear stress along with the channel slope and largest sub-pavement moving particle made available by the watershed as measured on a depositional feature were used to predict the mean depth for the design channel at bankfull. If the channel design depth is too small the channel sediment will be deposited. If the depth is too large the channel will need energy deposition.

$$\mathcal{Y}ci = 0.0834\left(\frac{di}{\mathcal{D}\hat{}50}\right)\hat{} -0.872$$

$$Depth = \frac{(Tci)\ 1.65\ (\mathcal{D})}{slope}$$

Where:
$\mathcal{T}ci$ = critical shear stress (lb/sqft)
di = D50 pavement bed material
$d\hat{}50$ = D50 sub-pavement
$\mathcal{D}$ = Largest sub-pavement particle (ft)
$Depth$ = Mean depth at bankfull (ft)
$Slope$ = Average water surface slope at bankfull (ft/ft)

7.2.2 Calculations and Discussion

The reference reach for this project is located directly upstream of the restoration reach. The reference reach is currently passing the watershed sediment efficiently and therefore the channel dimension and slope was carried through the restoration design.

The shear stress calculated for sediment samples in UT to Underwood Creek 0.28 lbs/sq ft when entered into Shield's Curve, predicted a range of particle motion of 1.5 inches very coarse gravel. The D84 in UT to Underwood Creek, 30-56 mm, is very course gravel and therefore will move

as a bed load. The Rosgen analysis showed that with the mean channel depth designed for UT to Underwood Creek, a D50 particle size of 19.3 mm, course gravel will pass through the system. This is consistent with the shields diagram analysis of the range of particle motion in the system. The bankfull depth of 0.98 feet for the proposed stream was designed to pass the course gravel sediment load that is moving through UT to Underwood Creek.

The shear stress calculated for sediment samples in Underwood Creek 0.43 lbs/sq ft when entered into Shield's Curve, predicted a range of particle motion of 2.36 inches very coarse gravel to small cobble. The D84 in Underwood Creek, 38-79 mm, is very coarse gravel to small cobble and therefore will move as a bed load. The Rosgen analysis showed that with the mean channel depth designed for Underwood Creek, a D50 particle size of 20.7 mm, course gravel will pass through the system. This is consistent with the shields diagram analysis of the range of particle motion in the system. The bankfull depth of 1.06 feet for the proposed stream was designed to pass the course gravel sediment load that is moving through Underwood Creek.

7.3 HEC-RAS Analysis

7.3.1 Hydrologic Trespass

Underwood Creek is listed as flood study was conducted using a HEC-RAS model to determine potential Hydrologic Trespass. Cross sections were located at 500 feet or less intervals along the stream with sections extending upstream and downstream of the project to determine off site impacts. Pre and post-project models were run and the predicted water surface elevations compared to determine the effects of the designed channel within the floodplain during selected storm events. There will be no hydrologic trespass with the planned restoration of Underwood Creek.

7.4 Soil Restoration

7.4.1 Narrative & Soil Preparation and Amendment

Chewacla soils are found throughout the stream floodplain along Underwood Creek and UT to Underwood Creek. These soils are on nearly level, flood plains in the upper reaches of watersheds in the Piedmont and have formed in recent alluvium. They are frequently flooded hydric soils that are somewhat poorly drained. Due to soil disturbing activities during construction and the removal of the sediment wash deposits from the adjacent agricultural fields, it is recommended that samples be collected post construction activities to ensure accurate soil amendment recommendations.

7.5 Natural Plant Community Restoration

7.5.1 Narrative & Plant Community Restoration

The goal of the riparian restoration is to provide long-term improvements to ecological functions of the existing forest community. The Restoration Plan Design Sheets have been developed to provide these functional uplifts through the re-establishment of targeted natural communities. The targeted natural communities were determined by comparing existing site conditions to established communities and verifying appropriate species in the proximate reference natural communities. Based on *Classification of the Natural Communities of North Carolina, Third Approximation* (Schafale and Weakley 1990), the site's riparian area most closely correlates to

piedmont alluvial forest community and the wetland community most closely correlates to riparian wetland associated with piedmont alluvial forests.

The goal of the planting scheme is to establish a riparian community consistent with the reference community, using an approach that accelerates the successional process and leads to a mature riparian community. The planting plan will use the reference plant communities discussed in the previous paragraph as a base for designing a planting scheme and developing a vegetation list. Recolonization of cleared riparian habitats characteristically begins with the invasion of a pioneer species that creates an environment (e.g. shading) suitable for species typically found in a mature community. To initialize the proposed riparian community, the restoration area will be planted with a mix of pioneer and climax species that have been selected and arranged to meet the following objectives:

- Establish mix of shade-intolerant canopy and shade-tolerant understory species
- Provide vegetative source of dominant species
- Establish local seed sources for those species less likely to migrate into the restoration area.
- Stabilize disturbed or high stress areas

Three planting zones have been developed considering site hydrology, soils, and disturbance regimes and are referenced to natural communities. Each zone has a unique environment that dictates species selection and community structure. A planting list has been developed for each zone to match the vegetation in the reference community and meet the objectives given above. The planting list only includes species that are readily available and have a reasonable expectation of survival. For a given zone and species, a plant source and planting type are recommended. Then, a planting schedule is developed so that site preparation and plant installation occur at the optimal time and season. After installation, the planting will be verified. Finally, a maintenance plan is developed to promote long-term success of the planting. The planting plan components are described below in more detail.

The restoration plan consists of three planting zones:

Zone 1 (1.87 Acre) Piedmont Alluvial Forest Stream Bank
Zone 2 (11.99 Acre) Piedmont Alluvial Forest Stream Buffer
Zone 3 (3.38 Acre) Piedmont Alluvial Forest Wetland Restoration

Zone 1 will consist of small trees and shrubs, live stakes and plugs that work well for planting along stream banks. Zone 2 will consist of canopy, subcanopy, and shrub species typical for a piedmont alluvial forest. Zone 3 will consist of a canopy, subcanopy, and shrub species typically found in wetland communities of a piedmont alluvial forest. A list of species for each zone is provided in Table 7. The herbaceous species seed mix specifications will be determined and provided in the construction plan.

7.5.2 On-site Invasive Species Management

There are some invasive exotic species found throughout the project site. There were three invasive exotic plant species observed throughout the project site; Chinese privet, multiflora

rose, and Japanese honeysuckle. Where ground disturbing activities occur, invasive exotic species management strategies will be conducted. Prior to construction, locations of invasive exotic plants that will be controlled will be flagged to ensure their removal from the site. Efforts will be made to eradicate fescue and invasive plants such as multiflora rose, Chinese privet, and Japanese honeysuckle. A permanent seed mix can be used after application of the pre-emergent, and woody planting can follow during the dormant season. Alternative management strategies that are species specific are presented below.

Chinese privet and Muiltflora Rose: Manual or mechanical removal should always be considered as the first method of control where feasible. Three other effective methods to control this shrub are foliar sprays, the basal bark spray method, and the cut stump method. A foliar spray application should be applied between August and December to plants small enough to ensure full foliar coverage. The basal bark spray method uses an herbicide-oil penetrant mixture that is applied to the basal area of plants with smooth juvenile bark on stems having a diameter less than 6 inches. The lower 12-20 inches of the plant base should be wetted on all sides of the woody stem. A modified streamline basal spray is an effective method for woody stemmed plants having a diameter up to 2 inches and can be applied during late winter and early spring before the leaves appear. Apply a stream of herbicide wetting the first 6 to 8 inches of the stems from the plant base. The cut stump method, which is most effective if conducted during the late winter and summer, is more appropriate for larger plants. This methods involves the application of an herbicide to the outer circumference of a freshly cut stump or on the entire surface of a smaller cut stems. Stumps can be cut with handsaws, chainsaws, or other variations of a cutting blade.

Japanese Honeysuckle: Manual or mechanical removal should always be considered as the first method of control where feasible. Japanese honeysuckle occurs as dense infestations along forest margins, rights-of-ways, and under canopies. This vine is shade tolerant and spreads from a large root stock, rooting at vine nodes, and from seeds dispersed by animals. Control procedures to consider should include broadcast spraying between June and October while avoiding desirable plants. For larger vines cut them just above the soil surface and immediately treat the freshly cut stem with an herbicide between the months of July and October.

8.0 Performance Criteria

To demonstrate mitigative success, baseline conditions will be established in the form of as-built drawings. The as-built drawings will include profile and plan views of the completed stream project. At the conclusion of the construction activities, the channel modifications and planted vegetation based on a 1.4 – 1.7 year bankfull return period will be monitored annually for a minimum of five years. Monitoring reports will be prepared at the end each year and made available to the resource agencies.

8.1 Streams

The proposed success criteria for stream mitigation will be based on the stability of the stream. The geomorphology of the stream will be monitored as follows:

- Dimension: Permanent cross sections (surveyed or GPS'd) will be established in the frequency of one for every 20 bankfull widths along the length of the reach. Cross

section sites will be selected such that approximately half are placed in riffles and half placed in pools. Measurements of W/D ratio, entrenchment ratio, and low bank height ratio will be monitored yearly.

- Pattern: Pattern measurements will include sinuosity and meander width ratio and will be performed yearly. Measurements of radius of curvature will be monitored on newly constructed meanders for the first year only.
- Profile: Longitudinal profile will be surveyed and measurements collected on slope (average, pool, riffle) and pool-to-pool spacing.
- Materials: Pebble counts in pools and riffles will be measured. The D50 and D84 particle size diameter percentiles will be monitored to assure an increase in coarseness in riffles and an increase in fineness in pools.
- Photo Reference Points: Photo reference points will be established at all cross sections showing banks and channel. Additional photos will be taken at selected structures on the project to monitor their structural stability.
- Vegetation: Vegetation plots will be established to monitor the plant survival in the planted areas of the conservation easement and stream bank. The vegetation plots will be 10 meters by 10 meters and will be established based on site conditions. Vegetative sampling will be undertaken on a yearly basis. The survival rate will be based on 260 stems/acre for trees after five years of planting.

During the annual review the entire stream reach will be evaluated for any potential problem areas and photographs taken to document the degree and severity. Potential problem areas may include bank instability, in-stream structure failure or unsuccessful vegetation establishment. If a failure area is noted, corrective actions will be evaluated to resolve the problem. Remedial actions will be undertaken considering any seasonal limitations. Any remedial actions will be documented on the as-built plans.

8.2 Wetlands

All the wetlands to be enhanced are riparian. Hydrology will be restored through stream restoration efforts that will raise the groundwater level coupled with removal of some of the soil that has covered the wetlands as a result of past land use practices. Utilizing the Draft Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region, it states for problematic sites [which of course, a restored wetland is since it will take time for the sites physical characteristics (soil porosity, structure, organic matter, surface organic layer, and vegetation) to regain its historic conditions] the technical standard for monitoring hydrology is 14 or more consecutive days of flooding or ponding, or a water table 12 in. (30 cm) or less below the soil surface, during the growing season at a minimum frequency of 5 years in 10. The growing season is 221 day, from Mar 28 - Nov 3, therefore efforts are anticipated to result in restoring wetland hydrology for at minimum 6.3% of the growing season. Wetland plants will be re-established in accordance with the planting plan.

8.3 Vegetation

The vegetation monitoring will be conducted according to the Carolina Vegetation Survey (CVS) – EEP protocol Version 4.2 (Lee et al 2008). Vegetation monitoring plots will be 100 square meters in size and will be conducted according to the Level I protocol which has a focus on planted stems only. The purpose of this level of monitoring is to determine the pattern of

installation of plant material with respect to species, spacing, density, and to monitor the survival and growth of those installed species. The success criteria for the preferred species in the restoration areas will be based on annual and cumulative survival and growth over five (5) years. Survival on preferred species must be at a minimum 320 stems/acre at the end of the three years of monitoring and 260 stems/acre after five years. Level II of the CVS protocol, which includes natural stems and planted stems, will be followed for the monitoring year 2 and subsequent years until the project close out year. The number of required plots is based on the mitigation category: stream enhancement, stream restoration, and wetland restoration. A spreadsheet is provided by EEP to calculate to necessary numbers of plots for streams (Lee et al 2008). The number of required wetland plots is determined on a case-by-case basis. We propose to establish a total of three plots within the restored wetlands. Seven plots will be required for the restored reach of UT to Underwood Creek. The restored reach of the Underwood Creek will have one plot.

8.4 Schedule/Reporting

The Underwood Creek Stream Restoration Project will be determined to be successful once vegetation success criteria have been met within the restoration and enhancement areas. During vegetation monitoring, planted and volunteer stem densities will be measured in addition to the relative abundance and diversity of herbaceous vegetation within the monitoring plots. Species will be listed and identified by wetland indicator status. Planting locations and methods will be completed in the first year Annual Report. Survival, numbers per acre by species, and tree height will be measured at the end of each growing season just prior to leaf fall.

Monitoring data will be collected for a period of five years or until all success criteria are achieved, whichever is longer. Annual Reports will be submitted to EEP prior to the end of each calendar year, documenting plant community conditions within the restoration areas and documenting hydrologic data within these areas and reference plots. The project areas will be photographed from permanent photo stations and changes in any of the above variables will be recorded and included in each annual report. The Annual Report will also include a proposed plan of action for the following year including maintenance activities.

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10.0 Tables

Table 1: Restoration Structure and Objectives

Restoration Segment ID	Station Range	Restoration Type	Priority Approach	Existing Linear Footage/Ac	Designed Linear Footage/Ac
Underwood Creek	5+00 to 10+58	Restoration	II	520	558
Underwood Creek	11+18 to 18+91	Restoration	I	625	773
UT to Underwood Creek	2+00 to 43+06	Restoration	I	3923	3986
Wetland	NA	Restoration	-	3.38 Ac	3.38 Ac
Wetland	NA	Preservation	-	0.15 Ac	0.15 Ac

Table 2: Drainage Areas

Stream	Drainage Area (Sq. Miles)
Underwood Creek	0.72
UT to Underwood Creek	0.74

Table 3: Land Use of the Underwood Creek Watershed

Land Use	Square Miles	Percentage
Agricultural	0.97	65%
Residential (1 Ac lots)	0.19	13 %
Woods (good)	0.33	22 %

Table 4: Morphological Table for Underwood and UT to Underwood Creek

Variables	Existing Underwood Creek Main Channel	Existing UT to Underwood Creek	Proposed Underwood Creek Underwood Creek	Proposed Reach UT to Underwood Creek	Reference Reach UT Underwood Creek
Stream type	Incised C4/E4	Incised C4/E4 with sections of G4	C4	C4	E4/C4
Drainage Area (Sq. Mile)	0.72	0.74	0.72	0.74	0.43
Bankfull width (Wbkf) (feet)	11.72 (8.3-16.3)	11.75 (6.3-16.0)	16	14.0	12.2 (10.0-14.3)
Bankfull mean depth (dbkf) (feet)	1.16 (0.93-1.29)	1.12 (0.73-1.56)	1.06	0.98	1.12 (0.92-1.34)
Width/depth ratio (Wbkf/dbkf)	10.42 (6.5-16.8)	11.21 (5.4-19.8)	15	14.3	11.3 (7.7-15.6)
Bankfull Cross Sectional Area (Abkf) (sq ft)	13.3 (10.5-19.6)	12.9 (7.3-18.8)	17	13.7	13 (12.2-13.4)

Bankfull Mean Velocity (Vbkf) (feet/second)	4.05 (3.65-4.34)	3.19 (1.95-4.64)	3.3	3.07	3.0 (2.8-3.2)
Bankfull Discharge, cfs (Qbkf) (cfs)	55	42	55	42.5	40 (38-42)
Bankfull Maximum depth (dmax) (feet)	1.58 (1.02-2.05)	1.92 (1.1-2.6)	1.6	1.4	1.6 (1.2-2.2)
Max driff/dbkf ratio	1.36 (1.01-1.68)	1.76 (1.3-2.8)	1.5	1.42	1.52 (1.0-1.9)
Low Bank Height (feet)	2.87 (1.61-2.28)	2.44 (1.1-3.8)	1.6	1.4	1.5 (1.1-1.7)
Ratio of Low bank Height to max dbkf	1.83 (1.61-2.28)	1.26 (1.31-1.99)	1.0	1.0	1.0 (0.9-1.2)
Width of flood prone area (Wfpa) (feet)	58 (12-107)	109 (19-352)	140 (130-250)	160 (95-220)	77 (42-110)
Entrenchment ratio (Wfpa/Wbkf)	4.65 (1.47-7.71)	9.04 (2.0-29.3)	9 (8-16)	11 (6.8-16)	6.5 (2.9-8.6)
Meander length (Lm) (feet)	113.57 (55-245)	126.5 (80-190)	112 (82-130)	98 (72-113)	85.5 (62-99)
Ratio of meander length to bankfull width (Lm/Wbkf)	5.98 (2.90-12.91)	5.41 (3.42-8.12)	7.0 (5.1-8.1)	7.0 (5.1-8.1)	7.0 (5.1-8.1)
Radius of Curvature (Rc) (feet)	47 (7-173)	23 (2.4-169)	41 (26-59)	36 (23-52)	31 (20-122)
Ratio of radius of curvature to bankfull width (Rc/Wbkf)	4.0 (0.6-14.8)	1.97 (0.2-14.4)	2.55 (1.6-3.7)	2.55 (1.6-3.7)	2.55 (1.6-3.7 Avg max) potential for max value 10
Belt width (Wblt) (feet)	47.80 (35-56)	43.75 (40-51)	53 (34-86)	46 (30-76)	40 (25-65)
Meander width ratio (Wblt/Wbkf)	2.52 (1.84-2.95)	1.87 (1.71-2.18)	3.3 (2.1-5.4)	3.3 (2.1-5.4)	3.3 (2.1-5.4)
Sinuosity (stream length /valley distance) (k)	1.04	1.17	1.3	1.3	Avg 1.20 Stream can support (k=1.34)

Valley slope (ft/ft)	0.0064	0.0063	0.0064	0.0063	0.0065
Average slope Savg= (Svalley / k)	0.0062	0.0056 (.0027-.0066)	0.0048	0.0048	0.0048
Pool Slope (Spool) (ft/ft)	0.0011 (0.0-.0034)	0.0009 (0.00-0.0030)	0.0006 (0-0.0009)	0.0007 (0-.0009)	0.0007 (0.0006-0.0009)
Ratio of pool slope to average slope (Spool/Sbkf)	0.19 (0.0-0.56)	0.17 (0.00-0.6)	0.146 (0.125-0.188)	0.146 (0.125-0.188)	0.146 (0.125 - 0.188)
Maximum pool depth (dpool) (feet)	2.31 (2.0-3.1)	2.57 (1.3-4.8)	3.5 (2.4-4.5)	2.8 (2.1-3.9)	2.47 (1.7-3.1)
Ratio of pool depth to average bankfull depth (dpool/dbkf)	1.99 (1.7-2.7)	2.29 (1.2-4.2)	2.2 (1.5-2.8)	2.0 (1.5-2.8)	2.20 (1.5-2.8)
Pool width (Wpool)(feet)	10.6 (8.4-14.9)	10.8 (10.3-11.2)	17 (16-24)	15 (14-21)	15.5 (11.8-18.0)
Ratio of pool width to bankfull width (Wpool/Wbkf)	0.9 (0.71-1.27)	0.92 (0.88-0.95)	1.2 (1.0-1.5)	1.2 (1.0-1.5)	1.2 (1.0-1.5)
Pool Cross Sectional Area (sq ft)	15.3 (12.4-19.6)	14.8 (13.4-17.0)	32* (26-29)	22.7* (21-23.5)	21.4 (20.6-22.9)
Ratio of pool area to bankfull area	1.14 (0.93-1.47)	1.15 (1.04-1.32)	1.88 (26-29)	1.66 (1.54-1.71)	1.6 (1.54-1.71)
Pool to pool spacing (p-p) (feet)	91 (34-245)	105 (8.5-752)	63 (37-110)	55 (32-97)	48 (29-84)
Ratio of p-p spacing to bankfull width (p-p/Wbkf)	7.8 (2.9-20.9)	8.9 (0.72-64)	3.9 (2.3-6.9)	3.9 (2.3-6.9)	3.9 (2.3-6.9)

* Pools will be over excavated and allowed to fill in after construction.

Table 5: BEHI/NBS and Sediment Export Estimate for Underwood Creek

Time Point	Linear Footage	Extreme		Very High		High		Moderate		Low		Very Low		Sediment Export
Pre-Construction		Ft.	%	Ft.	%	Ft.	%	Ft.	%	Ft.	%	Ft.	%	Ton/y
	1071	0	0	0	0	122	5.7	1180	55	841	39	0	0	8.4

Table 6: BEHI/NBS and Sediment Export Estimate for UT to Underwood Creek

Time Point	Linear Footage	Extreme		Very High		High		Moderate		Low		Very Low		Sediment Export
Pre-Construction		Ft.	%	Ft.	%	Ft.	%	Ft.	%	Ft.	%	Ft.	%	Ton/y
	3908	0	0	0	0	1072	13	5199	67	1546	20	0	0	68.3

Table 7. Planting Plan Species List

Planting Zone 1 (Piedmont Alluvial Forest Streambank)	
Cornus amomum	Silky dogwood
Hamamelis viginiana	Witch-hazel
Sambucus canadensis	Elderberry
Salix nigra	Black willow
Carpinus caroliniana	Ironwood
Alnus serrulata	Tag alder
Planting Zone 2 (Piedmont Alluvial Forest Riparian Buffer)	
Quercus phellos	Willow oak
Celtis laevigata	Soutehrn hackberry
Quercus michauxii	Swamp Chestnut Oak
Alnus serrulata	Tag alder
Asimina triloba	Common paw-paw
Fraxinus pennsylvanica	Green ash
Carpinus caroliniana	Ironwood
Planting Zone 3 (Piedmont Alluvial Forest Wetland Restoration)	
Alnus serrulata	Tag alder
Rosa palustris	Swamp rose
Cephalanthus occidentalis	Buttonbush
Salix nigra	Black willow
Sambucus canadensis	Common elderberry
Cornus amomum	Silky dogwood

Table 8. Particle Size Distribution – Underwood & UT to Underwood Creek

Materials:	Existing		Proposed		Reference
Particle Size distribution of channel material (mm)	**Underwood Creek**	**UT to Underwood Creek**	**Underwood Creek**	**UT to Underwood Creek**	**UT to Underwood Creek**
D16	5.0-11.3	9.9-15.5	12	12	9.7-13.5
D35	16-22.5	16.0-23.6	25	25	16.1-25.3
D50	20.7-34.8	19.3-29.7	35	35	20.4-38.1
D84	38.1-79.2	29.6-56.5	80	80	31.5-90
D95	51-159.2	38.5-82.5	125	125	40.5-125
Particle Size distribution of bar material (mm)					
D16	0.36	1.2	0.4	1.2	0.42
D35	0.9	2.4	0.9	2.4	1.3
D50	2.1	3.2	2	3.2	2.3
D84	10	11	10	11	7.9
D95	13.3	19	13	19	14
Largest size particle at the toe (lower third) of bar (inches)	2	1.7	2	1.7	2

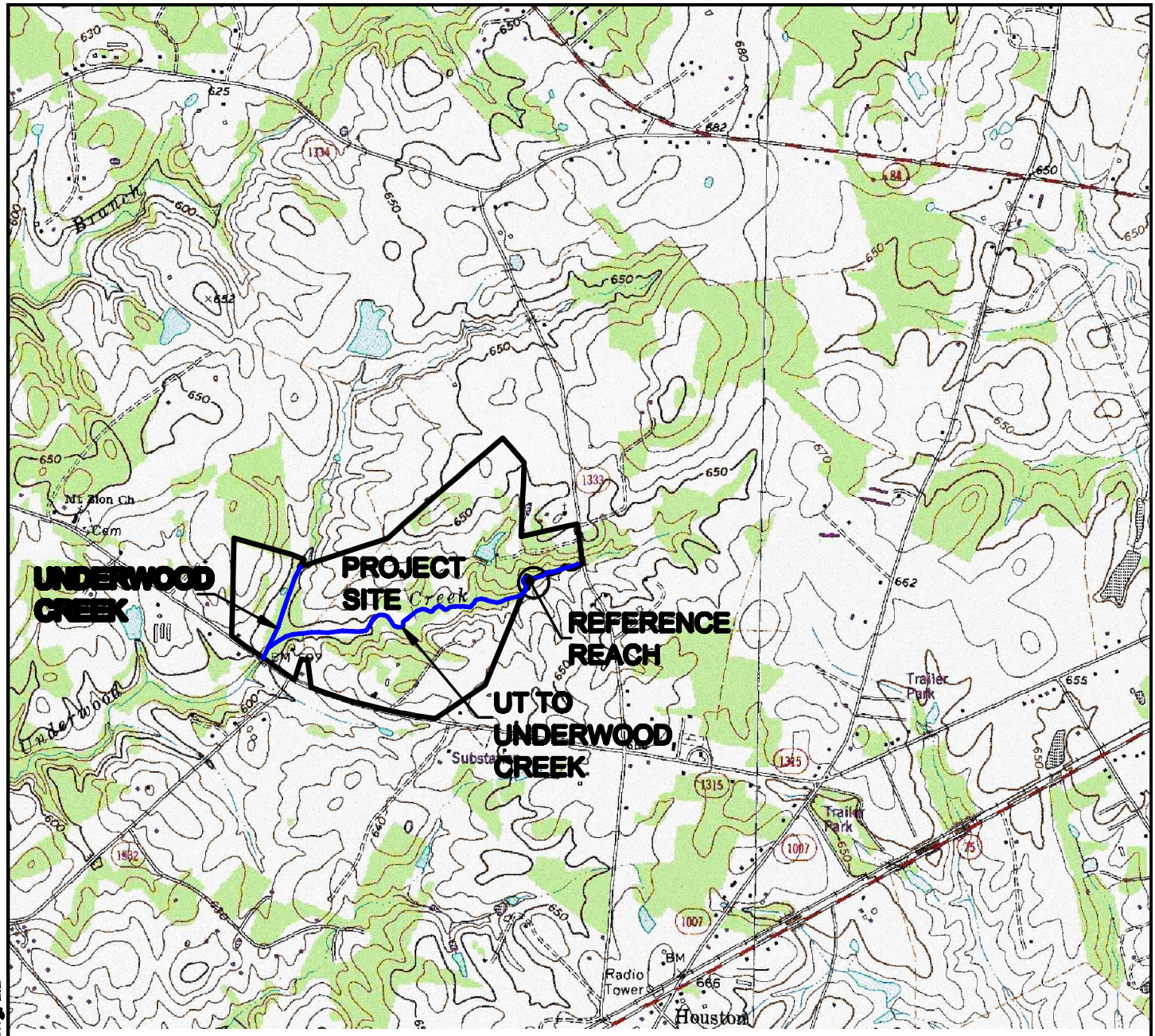
Table 9. Sediment Transport Validation Underwood Creek

Sediment Transport Validation Underwood Creek (Based on Bankfull shear Stress)	Existing	Proposed
Calculated Shear Stress (lbs/sq.ft.)	0.41	0.28
Value from Shield Diagram (lb/sq.ft.)	0.33	0.33
Critical dimensionless shear stress	0.0183	0.0183
Minimum mean dbkf calculated using critical dimensionless shear stress equations (feet)	0.90	0.98

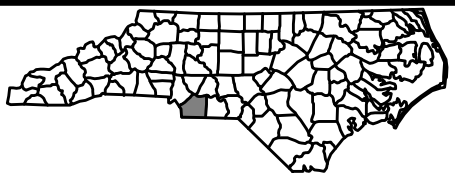
Table 10. Sediment Transport Validation UT to Underwood Creek

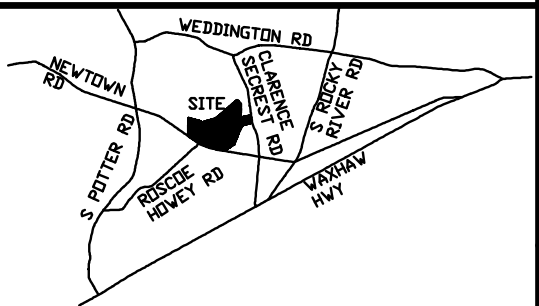
Sediment Transport Validation UT to Underwood Creek (Based on Bankfull shear Stress)	Existing	Proposed
Calculated Shear Stress (lbs/sq.ft.)	0.45	0.43
Value from Shield Diagram (lb/sq.ft.)	0.42	0.42
Critical dimensionless shear stress	0.0113	0.0113
Minimum mean dbkf calculated using critical dimensionless shear stress equations (feet)	1.05	1.06

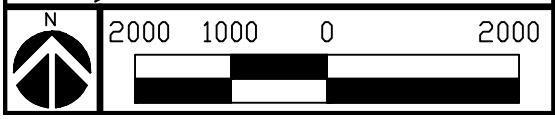
11.0 Figures



USGS Quadrangle Map Waxhaw, 1993







Ecosystem Enhancement PROGRAM

North Carolina - Ecosystem Enhancement Program

Newtown Stream and Wetland Restoration Site
Union County, North Carolina

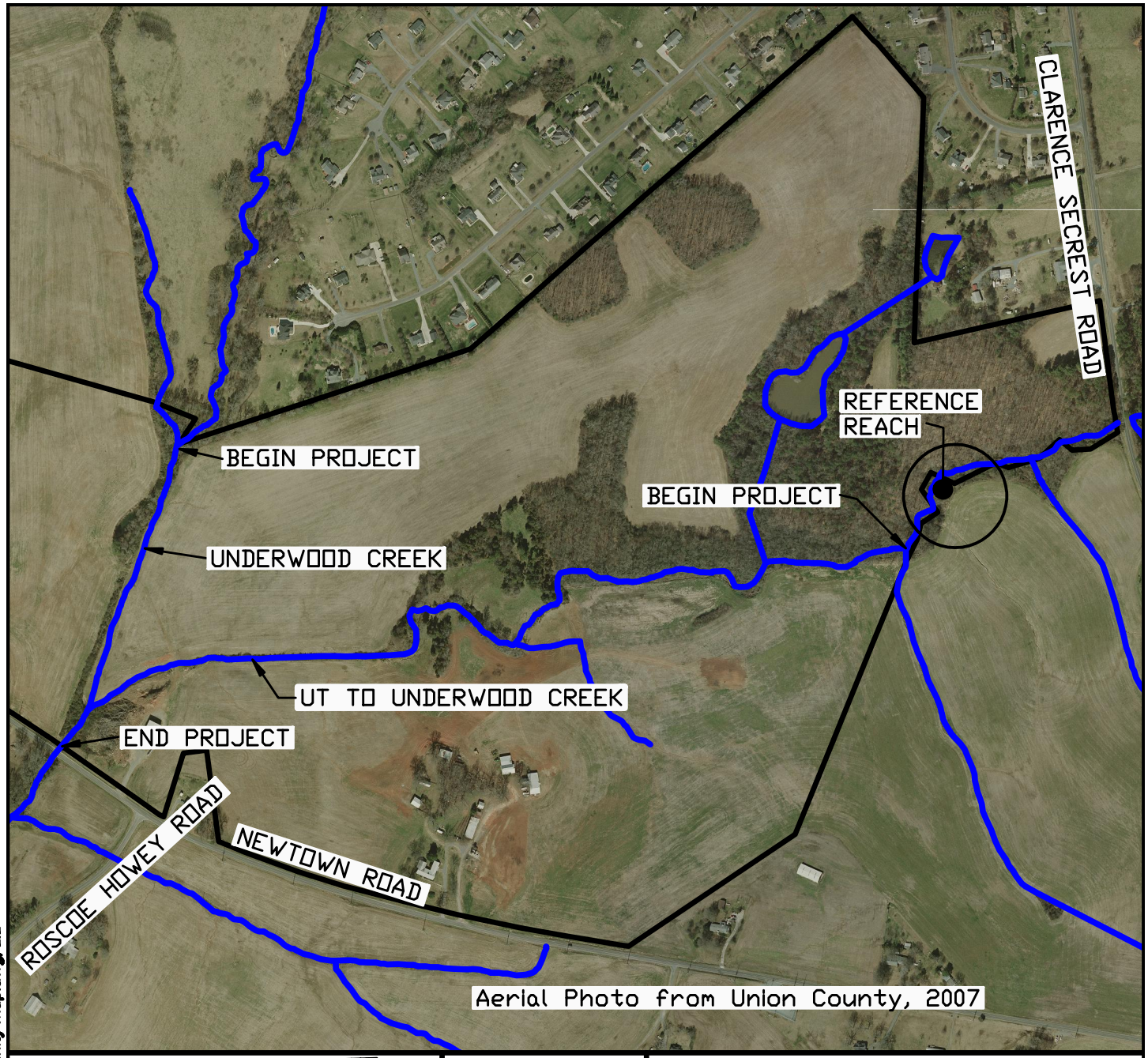
FIGURE 1
UNDERWOOD CREEK
VICINITY MAP

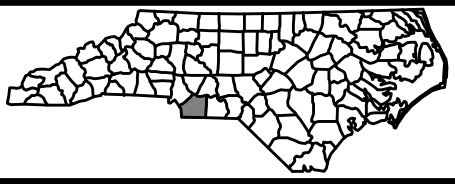
DATE: March 26, 2010

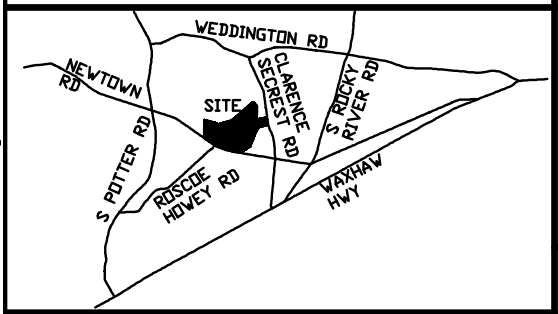
WARD CONSULTING ENGINEERS, PC

8368 Six Forks Rd. Suite 104 (919) 870-0526
Raleigh, NC 27615-5088 FAX (919) 870-5359

D:\CAD\New Town\DWG\Figures Restoration Plan\Vicinity Map.dwg, 1:1







North Carolina - Ecosystem Enhancement Program

Newtown Stream and Wetland Restoration Site
Union County, North Carolina

FIGURE 2
UNDERWOOD CREEK
AERIAL VICINITY MAP

DATE: March 28, 2010

WARD CONSULTING ENGINEERS, PC

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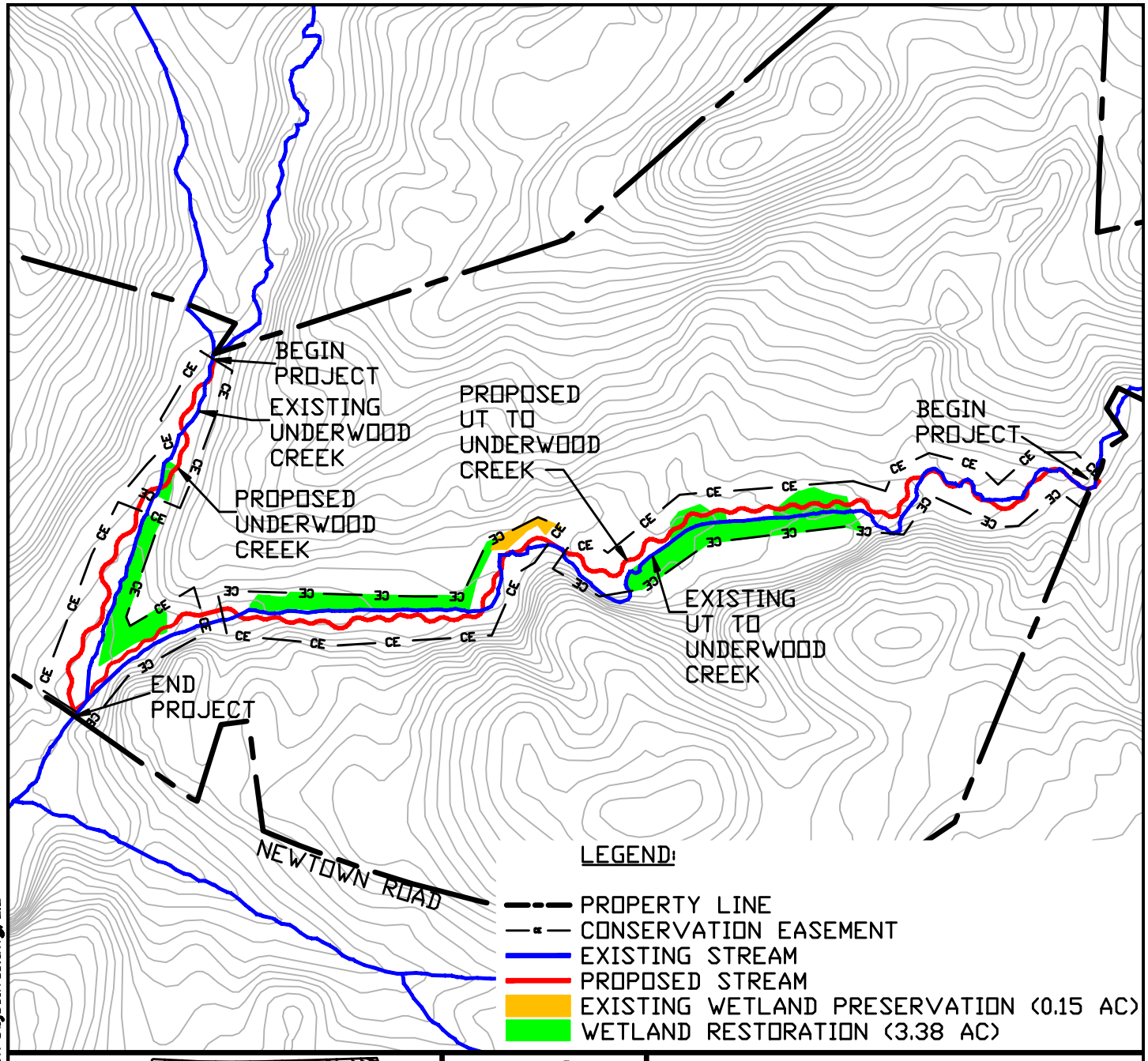

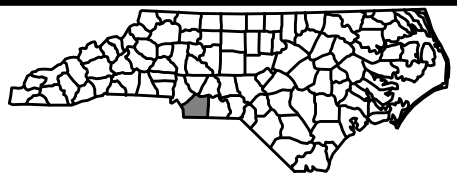

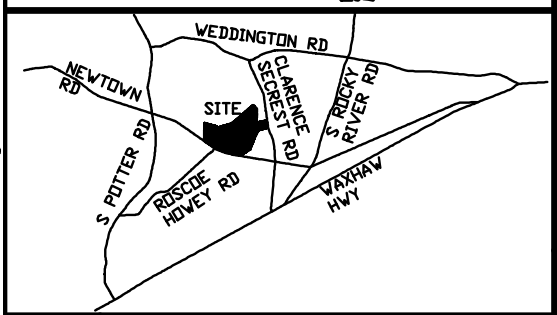

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Ecosystem Enhancement PROGRAM

North Carolina - Ecosystem Enhancement Program

Newtown Stream and Wetland Restoration Site
Union County, North Carolina

FIGURE 3
UNDERWOOD CREEK
RESTORATION OBJECTIVES

DATE: March 26, 2010

WARD CONSULTING ENGINEERS, PC

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Raleigh, NC 27615-5088 FAX (919) 870-5359

D:\CAD\New Town\DWG\Figures Restoration Plan\Restoration Objectives.dwg, 1:1

WEDDINGTON RD

CLARENCE SECREST RD

WAXHAW INDIAN TRAIL RD

UNDERWOOD CREEK
WATERSHED AREA
461.61 ACRES
0.72 SQ MILES

REFERENCE REACH
UT TO UNDERWOOD CREEK
WATERSHED AREA
275.12 ACRES
0.43 SQ MILES

PROJECT SITE

UT TO UNDERWOOD CREEK
WATERSHED AREA
473.64 ACRES
0.74 SQ MILES

REFERENCE
REACH

S ROCKY RIVER RD

ROSCOE HOWEY RD

NEWTOWN RD

WAXHAW HWY

D:\CAD\Projects\Town\DWG\Figures Restoration Plan\Watershed.dwg, 1:1

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Raleigh, NC 27615-5088 FAX (919) 870-5369

Ecosystem Enhancement PROGRAM

UNDERWOOD CREEK WATERSHED MAP

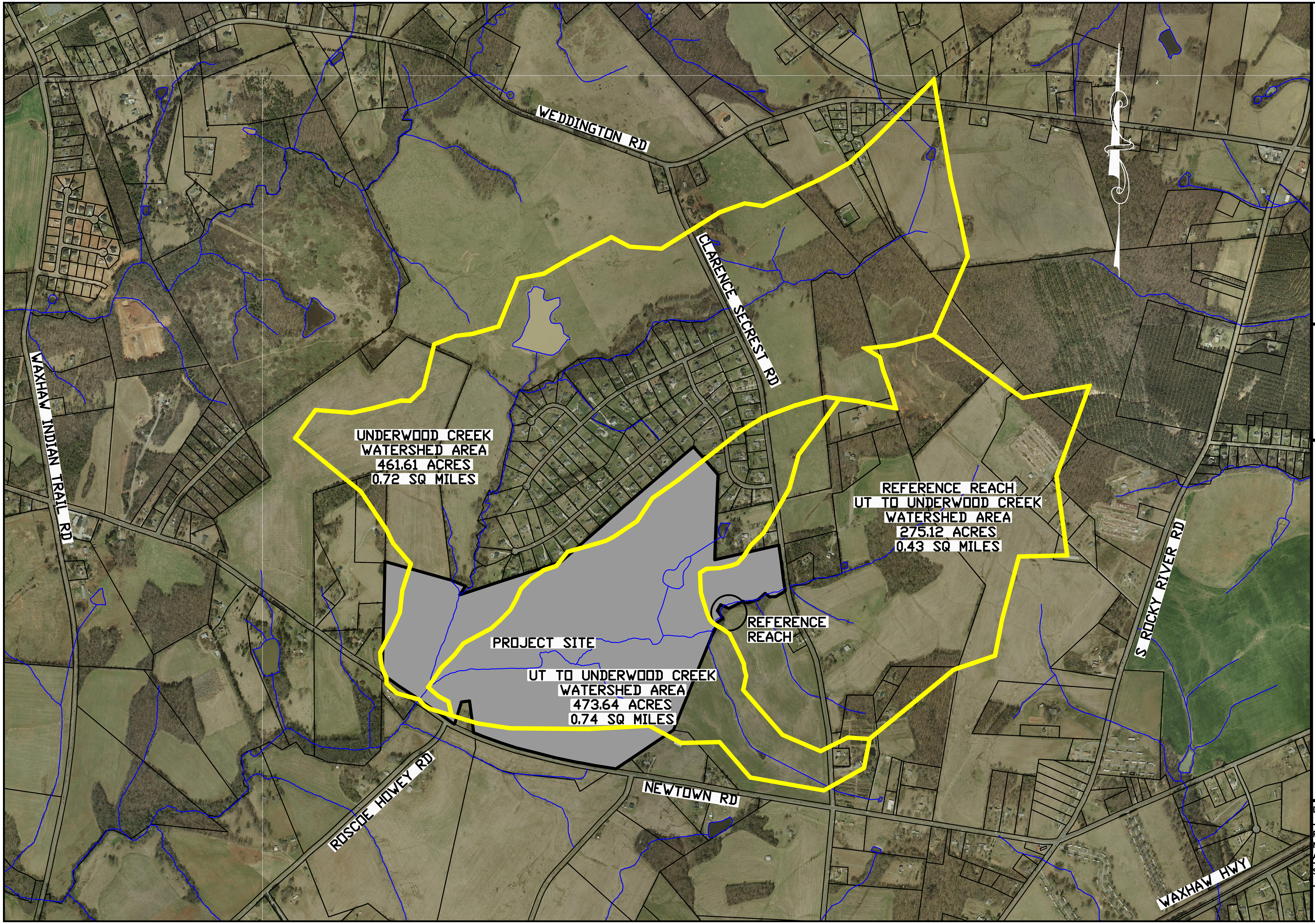
UNION COUNTY, NORTH CAROLINA

DATE: 03-26-10

PROJ./DWG. NAME: Newtown Watershed Map

SCALE: 1"=1000'

FIGURE 4



WARD CONSULTING ENGINEERS, PC
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Raleigh, NC 27615-5088 FAX (919) 870-5359

Ecosystem Enhancement PROGRAM

UNDERWOOD CREEK
AERIAL WATERSHED MAP

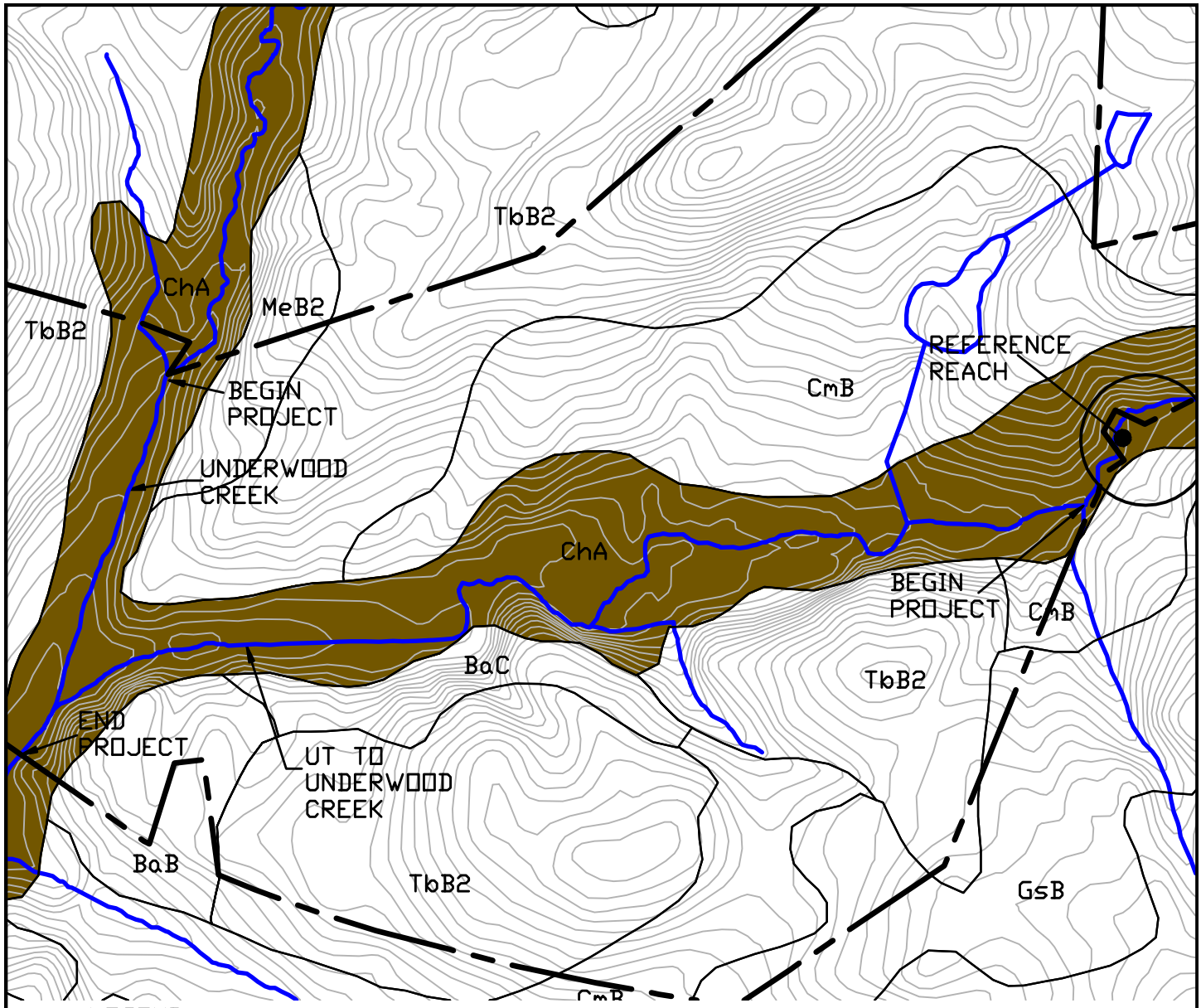
UNION COUNTY, NORTH CAROLINA

DATE: 03-26-10

PROJ./DWG. NAME: Newtown Aerial Watershed Map

SCALE: 1"=1000'

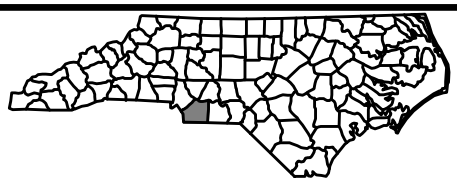
FIGURE 5

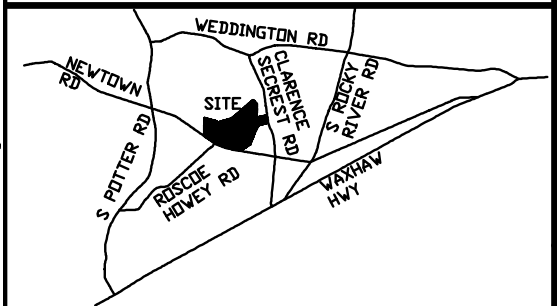


LEGEND:

PROPERTY LINE

ChA - CHEWACLA SILT LOAM, 1 TO 5 PERCENT SLOPES





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Ecosystem Enhancement PROGRAM

North Carolina - Ecosystem Enhancement Program

Newtown Stream and Wetland Restoration Site
Union County, North Carolina

FIGURE 6
UNDERWOOD CREEK
NRCS SOIL SURVEY

DATE: March 26, 2010

WARD CONSULTING ENGINEERS, PC

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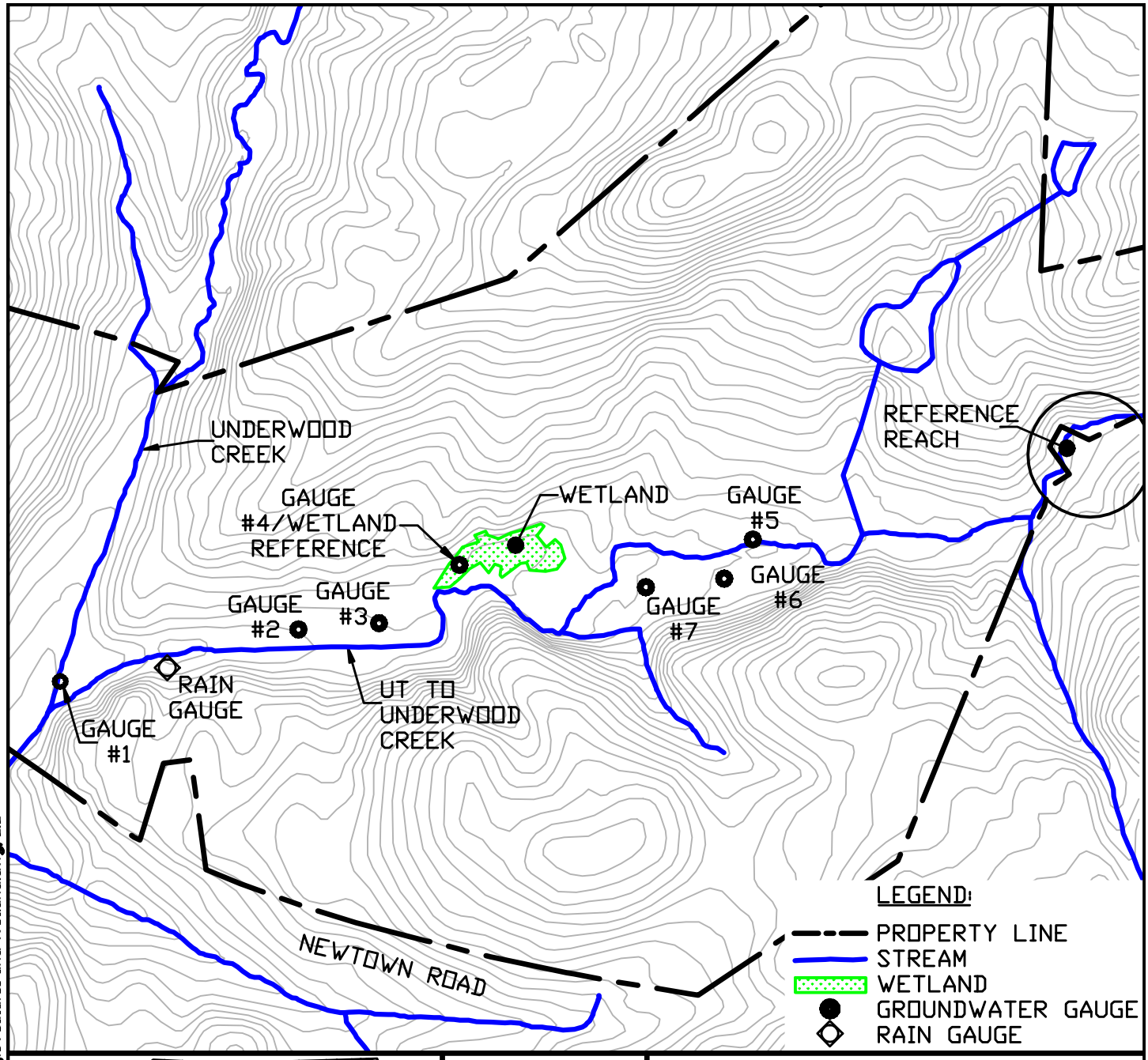

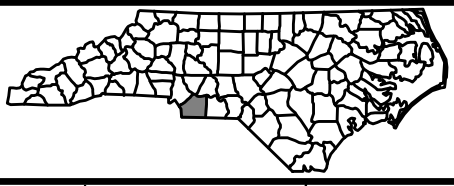

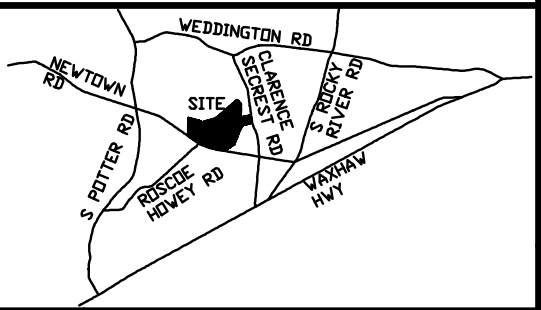

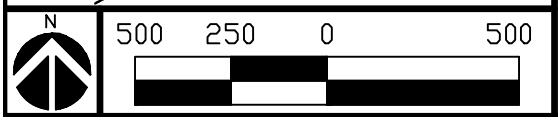

North Carolina - Ecosystem Enhancement Program

Newtown Stream and Wetland Restoration Site
Union County, North Carolina

FIGURE 7
UNDERWOOD CREEK HYDROLOGIC FEATURES AND WETLAND DELINEATION

DATE: March 26, 2010

WARD CONSULTING ENGINEERS, PC

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Raleigh, NC 27615-5088 FAX (919) 870-5359

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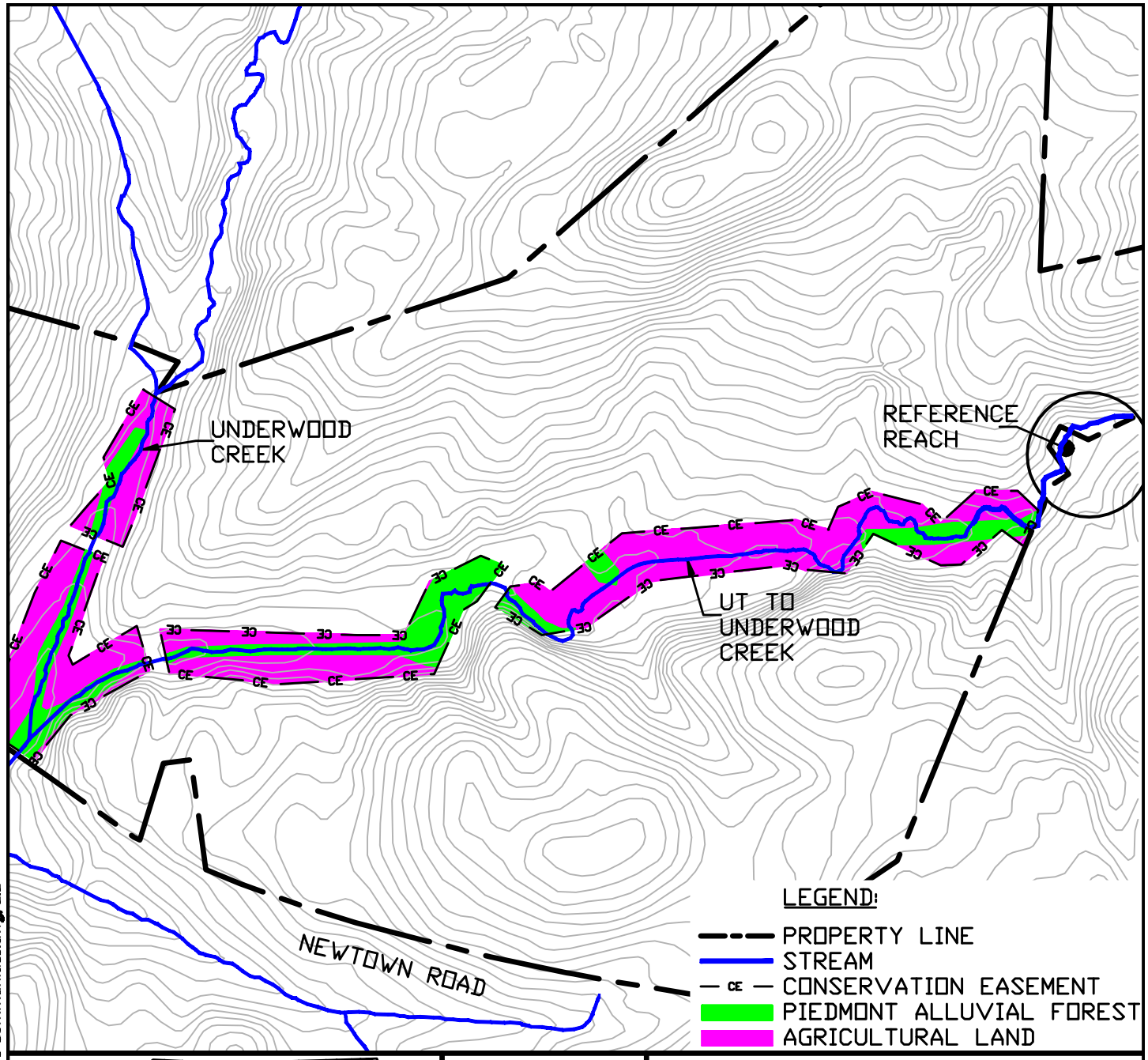

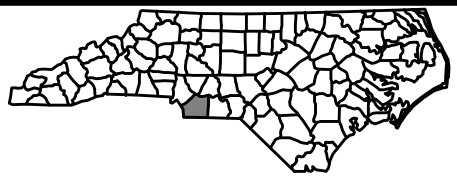

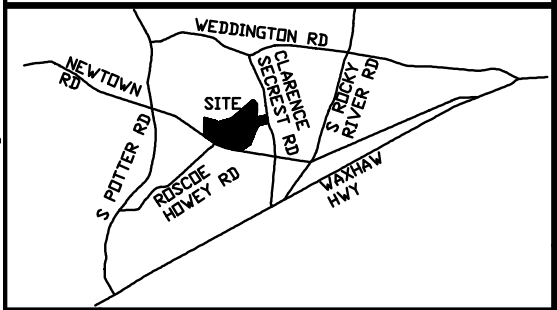

Ecosystem Enhancement PROGRAM

North Carolina - Ecosystem Enhancement Program

Newtown Stream and Wetland Restoration Site
Union County, North Carolina

FIGURE 8
UNDERWOOD CREEK
VEGETATIVE COMMUNITIES

DATE: March 26, 2010

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Raleigh, NC 27615-5088 FAX (919) 870-5359

D:\CAD\New Town\DWG\Figures Restoration Plan\Vegetative Communities.dwg, 1:1

12.0 Restoration Plans

T1: Title Sheet

CS1: Typical Cross Sections with Legends

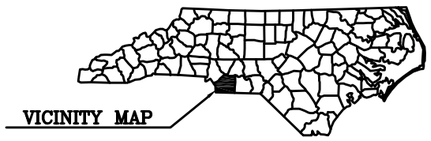
M1: Morphology Table

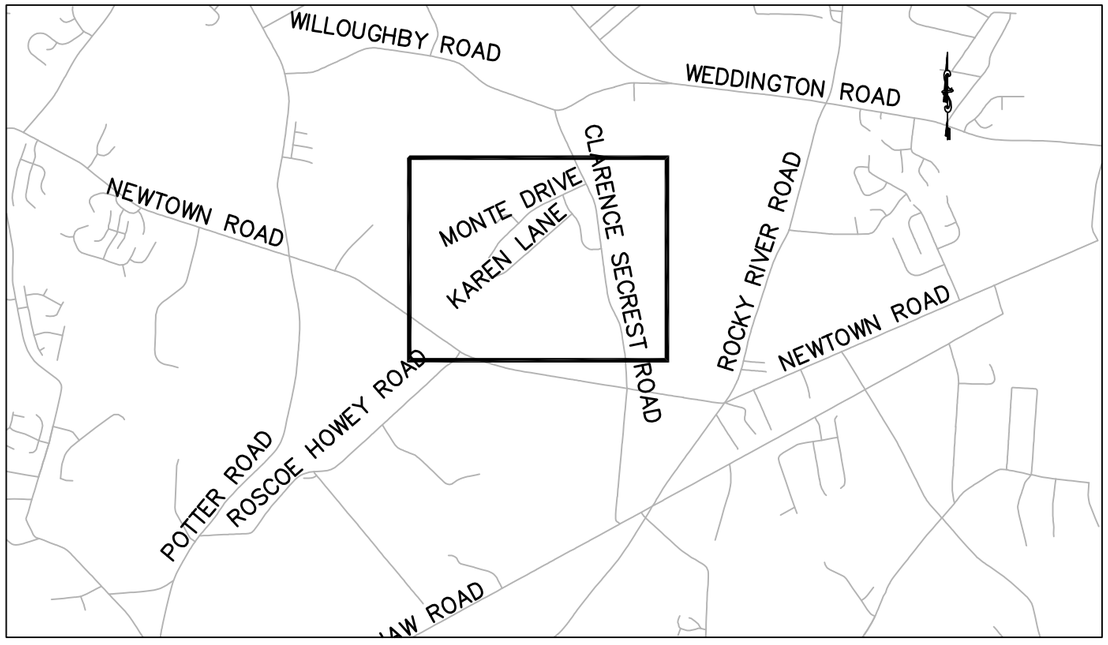
EC1-EC4: Existing Conditions

PP1-PP6: Plan and Profile

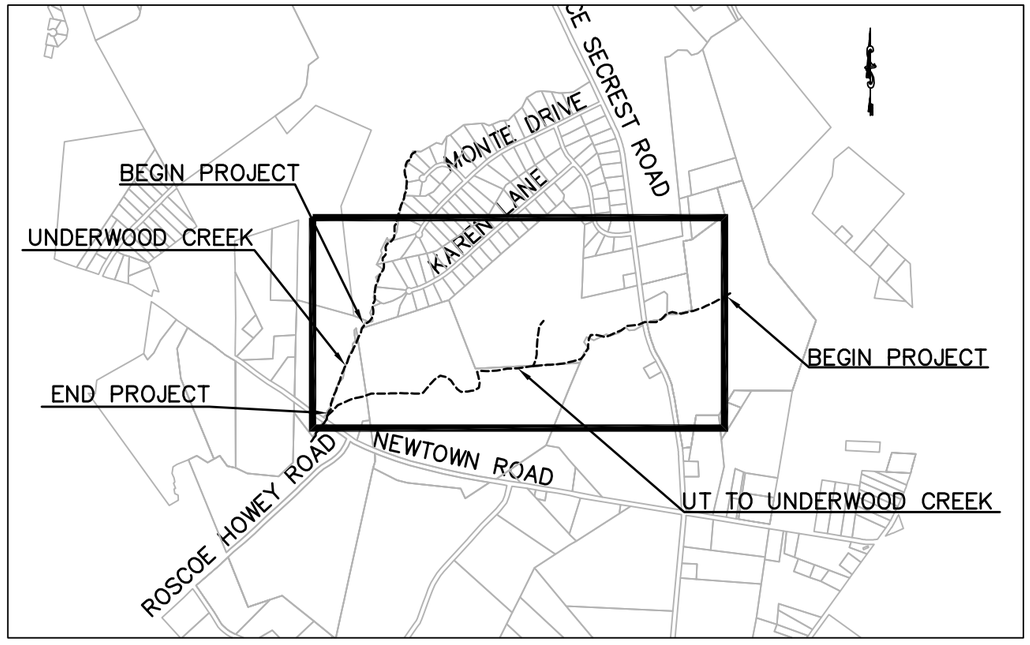
VP1-VP6: Planting Plan

NEWTOWN
STREAM AND WETLAND RESTORATION PROJECT
UNION COUNTY, NORTH CAROLINA
STATE CONTRACT NO:002025
RFP 16-001117





VICINITY MAP



LOCATION MAP

SURVEY DATA PROVIDED BY: R.B. Pharr & Associates
420 Hawthorne Lane
Charlotte NC 28204
PHONE: 704-376-2186
FAX: 704-333-8724

NATURAL SYSTEMS INVESTIGATION:

The Catena Group Inc.
410-B Millstone Drive
Hillsborough, NC 27278
PH: 919-732-1300
FAX: 919-732-1303

INDEX OF SHEETS

NCEEP CONTACT: GUY PEARCE (919) 715-1656
WARD CONSULTING ENGINEERS CONTACT: BECKY WARD, PE (919) 870-0526
ENVIRONMENTAL BANC AND EXCHANGE CONTACT: NORTON WEBSTER (919) 829-9909

Ward Consulting Engineers, P.C.
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Raleigh, NC 27615-5083 FAX (919) 870-5369
Environmental Banc & Exchange
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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

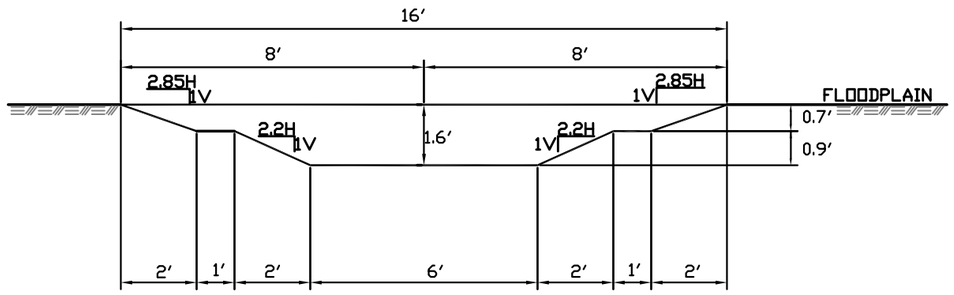
SEAL

NEWTOWN
TITLE SHEET
UNION COUNTY, NORTH CAROLINA

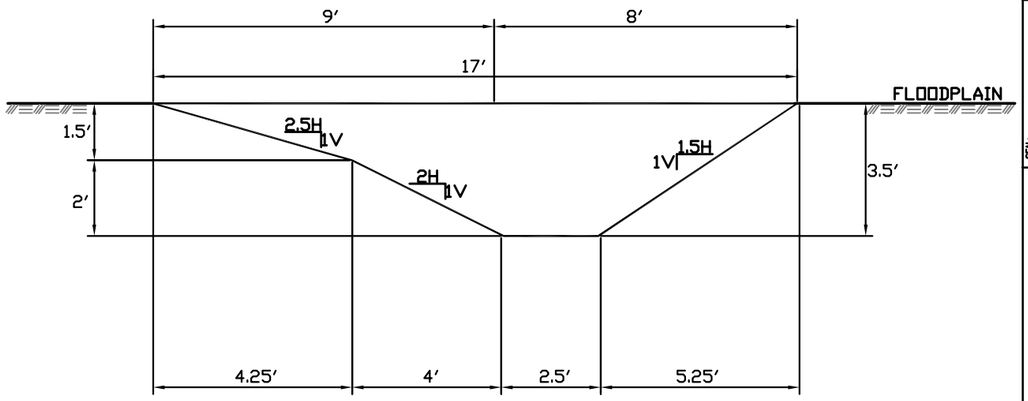
DATE: 01 MARCH 2010
REVISIONS:
PROJECT NAME: New Town Creek
DWG NAME: Restoration Cover Sheet
SCALE: NTS
PERMIT SET
SHEET NO. T1

LEGEND

- EXISTING CENTERLINE
- 599 EXISTING CONTOURS
- PROPOSED CENTERLINE
- PROPOSED TOP OF BANK
- 599 PROPOSED CONTOURS
- ROOT WAD
- FLOODPLAIN SILL
- ROCK CROSS VANE
- CONSTRUCTED RIFFLE
- GRADE TRANSITION
- PROPOSED CONSERVATION EASEMENT
- PROPERTY LINE
- LIMITS OF DISTURBANCE
- WETLAND RESTORATION
- WETLAND PRESERVATION
- TREE TO BE REMOVED
- MATCHLINE
- CLAY PLUG
- SINGLE WING ROCK VANE
- RV RIGHT OF WAY
- -E-E- OVERHEAD ELECTRIC



1 PROPOSED RIFFLE SECTION (UNDERWOOD CREEK MAIN CHANNEL)
SCALE: NOT TO SCALE



2 PROPOSED POOL SECTION (UNDERWOOD CREEK MAIN CHANNEL)
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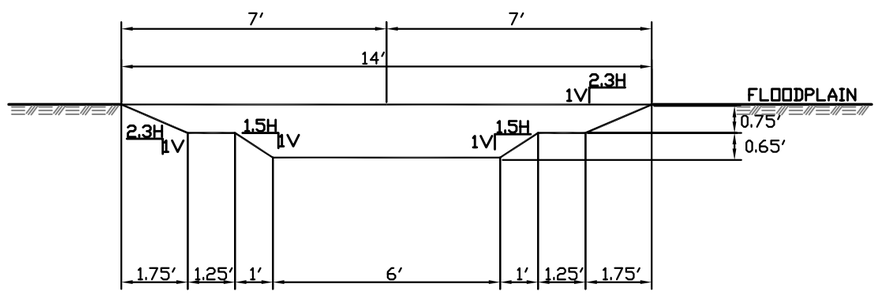

3 PROPOSED RIFFLE SECTION (UT-UNDERWOOD CREEK MAIN CHANNEL)
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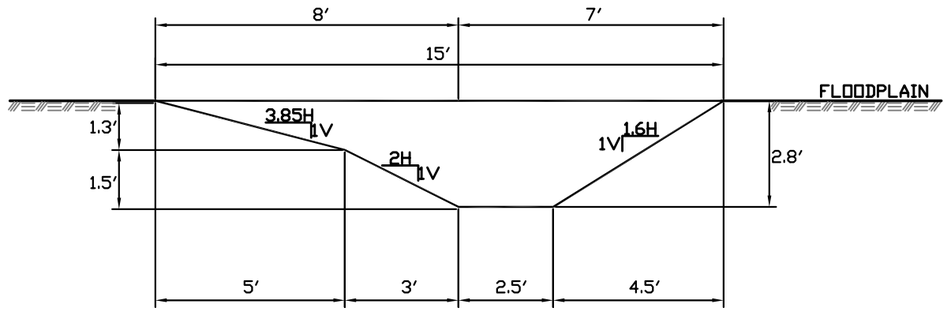

4 PROPOSED POOL SECTION (UT-UNDERWOOD CREEK MAIN CHANNEL)
SCALE: NOT TO SCALE

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Fax: (919) 229-9913

SEAL

NEWTOWN
TYPICAL CROSS SECTIONS WITH LEGENDS
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010
REVISIONS:
PROJECT NAME: New Town Creek
DWG NAME: Legends and Symbols
SCALE: NTS
PERMIT SET
SHEET NO.
CS1

Variables	Existing Underwood Creek Main Channel	Existing UT to Underwood Creek	Proposed Underwood Creek Underwood Creek	Proposed Reach UT to Underwood Creek	Reference Reach UT Underwood Creek
Stream type	Incised C4/E4	Incised C4/E4 with sections of G4	C4	C4	E4/C4
Drainage Area (Sq. Mile)	0.72	0.74	0.72	0.74	0.43
Bankfull width (Wbkf) feet	11.72 (8.3-16.3)	11.75 (6.3-16.0)	16	14.0	12.2 (10.0-14.3)
Bankfull mean depth (dbkf) feet	1.16 (0.93-1.29)	1.12 (0.73-1.56)	1.06	0.98	1.12 (0.92-1.34)
Width/depth ratio (Wbkf/dbkf)	10.42 (6.5-16.8)	11.21 (5.4-19.8)	15	14.3	11.3 (7.7-15.6)
Bankfull Cross Sectional Area (Abkf) (sq ft)	13.3 (10.5-19.6)	12.9 (7.3-18.8)	17	13.7	13 (12.2-13.4)
Bankfull Mean Velocity (Vbkf) feet/second	4.05 (3.65-4.34)	3.19 (1.95-4.64)	3.3	3.07	3.0 (2.8-3.2)
Bankfull Discharge, cfs (Qbkf) cfs	55	42	55	42.5	40 (38-42)
Bankfull Maximum depth (dmax) feet	1.58 (1.02-2.05)	1.92 (1.1-2.6)	1.6	1.4	1.6 (1.2-2.2)
Max driff/dbkf ratio	1.36 (1.01-1.68)	1.76 (1.3-2.8)	1.5	1.42	1.52 (1.0-1.9)
Entrenchment ratio (Wfpa/Wbkf)	4.65 (1.47-7.71)	9.04 (2.0-29.3)	9 (8-16)	11 (6.8-16)	6.5 (2.9-8.6)
Meander length (Lm) feet	113.57 (55-245)	126.5 (80-190)	112 (82-130)	98 (72-113)	85.5 (62-99)
Ratio of meander length to bankfull width (Lm/Wbkf)	5.98 (2.90-12.91)	5.41 (3.42-8.12)	7.0 (5.1-8.1)	7.0 (5.1-8.1)	7.0 (5.1-8.1)
Radius of Curvature (Rc) feet	47 (7-173)	23 (2.4-169)	41 (26-59)	36 (23-52)	31 (20-122)
Ratio of radius of curvature to bankfull width (Rc/Wbkf)	4.0 (0.6-14.8)	1.97 (0.2-14.4)	2.55 (1.6-3.7)	2.55 (1.6-3.7)	2.55 (1.6-3.7 Avg max) potential for max value 10
Belt width (Wblt) feet	47.80 (35-56)	43.75 (40-51)	53 (34-86)	46 (30-76)	40 (25-65)

Variables	Existing Underwood Creek Main Channel	Existing UT to Underwood Creek	Proposed Underwood Creek Underwood Creek	Proposed Reach UT to Underwood Creek	Reference Reach UT Underwood Creek
Meander width ratio (Wblt/Wbkf)	2.52 (1.84-2.95)	1.87 (1.71-2.18)	3.3 (2.1-5.4)	3.3 (2.1-5.4)	3.3 (2.1-5.4)
Sinuosity (stream length /valley distance) (k)	1.04	1.17	1.3	1.3	Avg 1.20 Stream can support (k=1.34)
Valley slope (ft/ft)	0.0064	0.0063	0.0064	0.0063	0.0065
Average slope Savg= (Svalley / k)	0.0062	0.0056 (.0027-.0066)	0.0048	0.0048	0.0048
Pool Slope (Spool) (ft/ft)	0.0011 (0.0-.0034)	0.0009 (0.00-0.0030)	0.0006 (0-0.0009)	0.0007 (0-.0009)	0.0007 (0.0006-0.0009)
Ratio of pool slope to average slope (Spool/Sbkf)	0.19 (0.0-0.56)	0.17 (0.00-0.6)	0.146 (0.125-0.188)	0.146 (0.125-0.188)	0.146 (0.125 - 0.188)
Maximum pool depth (dpool) feet	2.31 (2.0-3.1)	2.57 (1.3-4.8)	3.5 (2.4-4.5)	2.8 (2.1-3.9)	2.47 (1.7-3.1)
Ratio of pool depth to average bankfull depth (dpool/dbkf)	1.99 (1.7-2.7)	2.29 (1.2-4.2)	2.2 (1.5-2.8)	2.0 (1.5-2.8)	2.20 (1.5-2.8)
Pool width (Wpool) Feet	10.6 (8.4-14.9)	10.8 (10.3-11.2)	17 (16-24)	15 (14-21)	15.5 (11.8-18.0)
Ratio of pool width to bankfull width (Wpool/Wbkf)	0.9 (0.71-1.27)	0.92 (0.88-0.95)	1.2 (1.0-1.5)	1.2 (1.0-1.5)	1.2 (1.0-1.5)
Pool Cross Sectional Area (sq ft)	15.3 (12.4-19.6)	14.8 (13.4-17.0)	32* (26-29)	22.7* (21-23.5)	21.4 (20.6-22.9)
Ratio of pool area to bankfull area	1.14 (0.93-1.47)	1.15 (1.04-1.32)	1.88 (26-29)	1.66 (1.54-1.71)	1.6 (1.54-1.71)
Pool to pool spacing (p-p) feet	91 (34-245)	105 (8.5-752)	63 (37-110)	55 (32-97)	48 (29-84)
Ratio of p-p spacing to bankfull width (p-p/Wbkf)	7.8 (2.9-20.9)	8.9 (0.72-64)	3.9 (2.3-6.9)	3.9 (2.3-6.9)	3.9 (2.3-6.9)

* Pools will be over excavated and allowed to fill in after construction.

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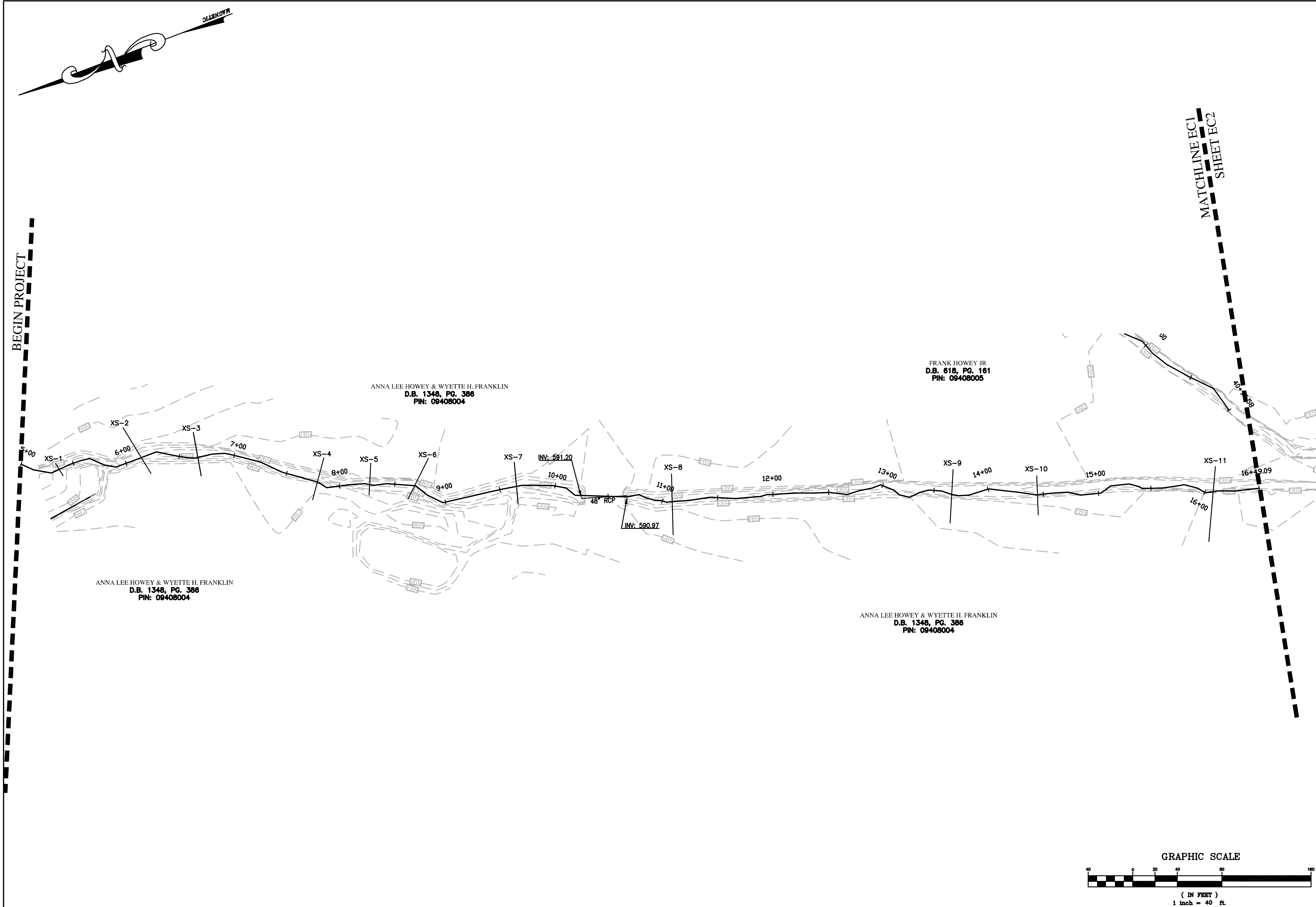
Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL:

NEWTOWN MORPHOLOGY TABLE UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010
REVISIONS:
PROJECT NAME: New Town Creek
DWG NAME: Morphology Table Sheet
SCALE: NTS
SHEET NO.

M1



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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL:
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 13344 BECKY LYNNE WARD

EXISTING CONDITIONS
UNDEROOD CREEK
STATION 5+00 TO 16+49
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

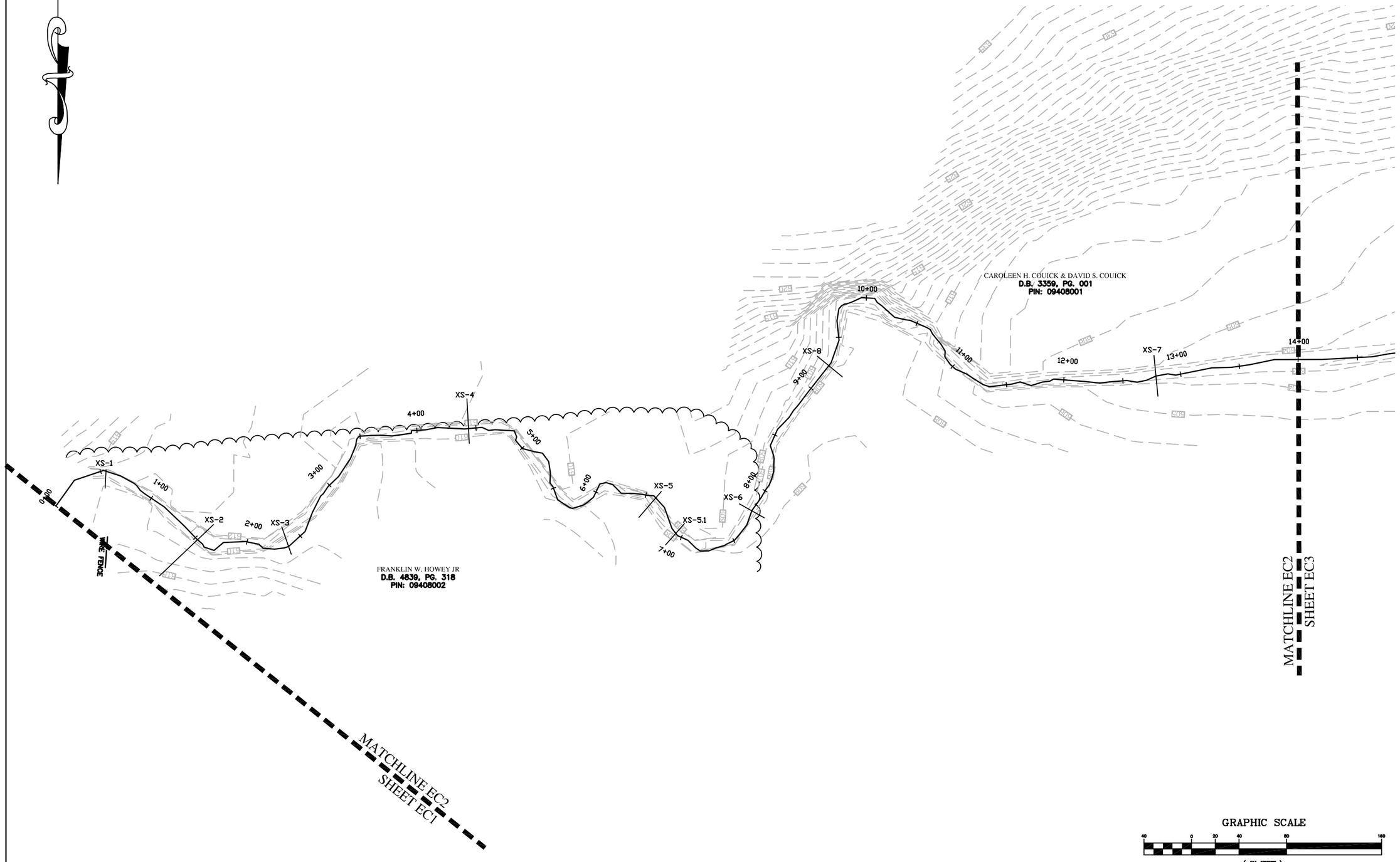
PROJECT NAME: New Town Creek

DWG NAME: Existing Conditions

SCALE: 1"=40'

PERMIT SET

SHEET NO. EC1



GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

Ward Consulting Engineers, P.C.

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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL:

EXISTING CONDITIONS
UT TO UNDERWOOD CREEK
STATION 0+00 TO 14+00
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

PROJECT NAME: New Town Creek

DWG NAME: Existing Conditions

SCALE: 1"=40'

PERMIT SET

SHEET NO.

EC2

MAGNETIC

ANNA LEE HOWEY & WYETTE H. FRANKLIN
D.B. 1348, PG. 386
PIN: 09408004

ANNA LEE HOWEY & WYETTE H. FRANKLIN
D.B. 1348, PG. 386
PIN: 09408004

ANNA LEE HOWEY & WYETTE H. FRANKLIN
D.B. 1348, PG. 386
PIN: 09408004

FRANKLIN W. HOWEY JR
D.B. 4839, PG. 318
PIN: 09408002

XS-9
XS-10
XS-11
XS-12
XS-13

14+00
15+00
16+00
17+00
18+00
19+00
20+00
21+00
22+00
23+00
24+00
25+00
26+00
27+00
28+00
29+00

INV: 598.06
42" RCP
INV: 598.03

MATCHLINE EC2
SEE SHEET EC3

SEE SHEET EC3
MATCHLINE EC4

GRAPHIC SCALE
40 0 20 40 80 160
(IN FEET)
1 inch = 40 ft.

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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 13344 BECKY L. WARD

SEAL:

EXISTING CONDITIONS
UT TO UNDERWOOD CREEK
STATION 14+00 TO 29+00
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

PROJECT NAME: New Town Creek

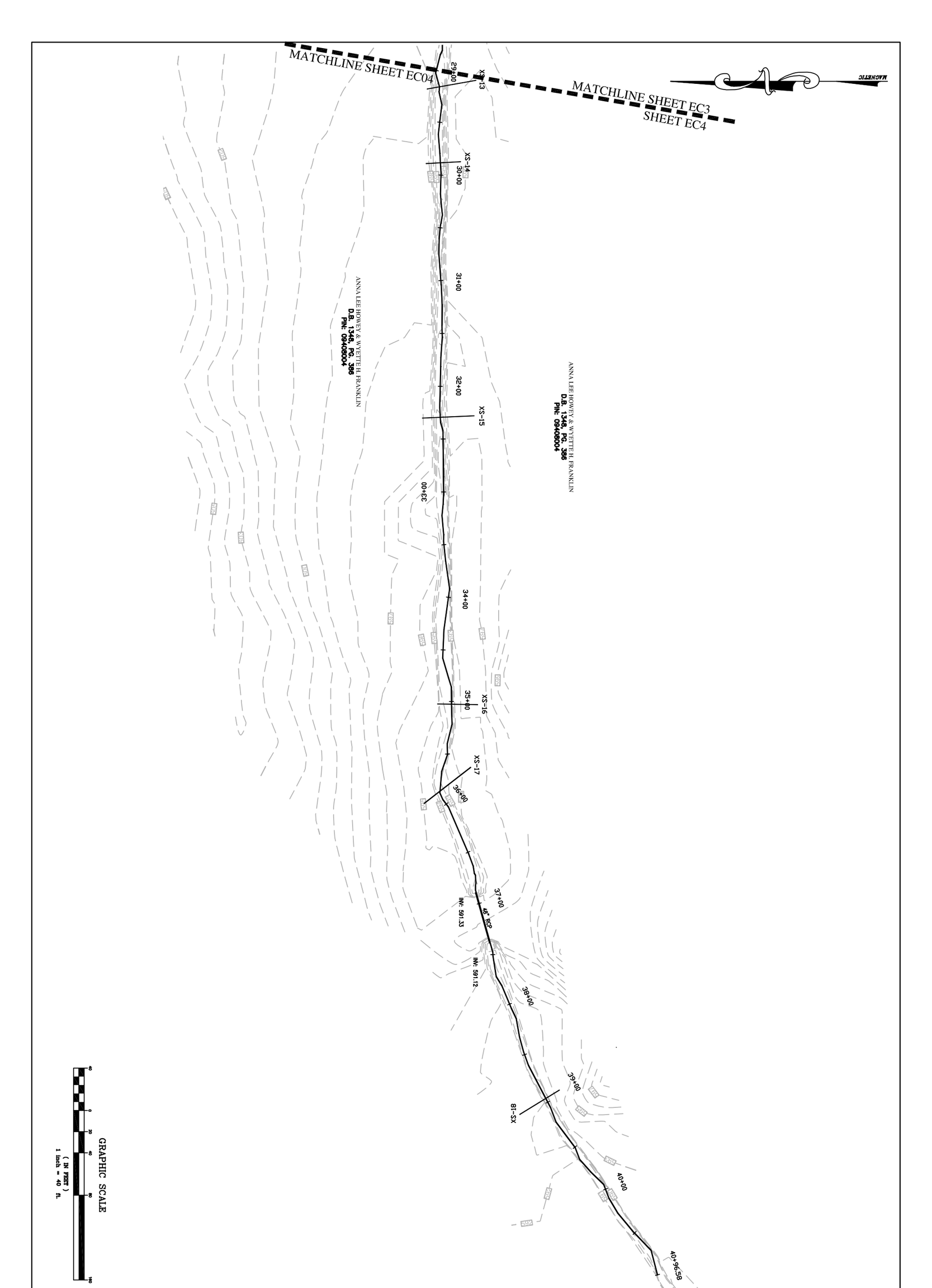
DWG NAME: Existing Conditions

SCALE: 1"=40'

PERMIT SET

SHEET NO.

EC3



EXISTING CONDITIONS
UT TO UNDERWOOD CREEK
STATION 29+00 TO 40+96
UNION COUNTY, NORTH CAROLINA

SEAL:

NORTH CAROLINA PROFESSIONAL SEAL 13344 ENGINEER BECKY LYNNE WARD

Ward Consulting Engineers, P.C.

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Environmental Banc & Exchange
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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

DATE: 01 MARCH 2010

REVISIONS:

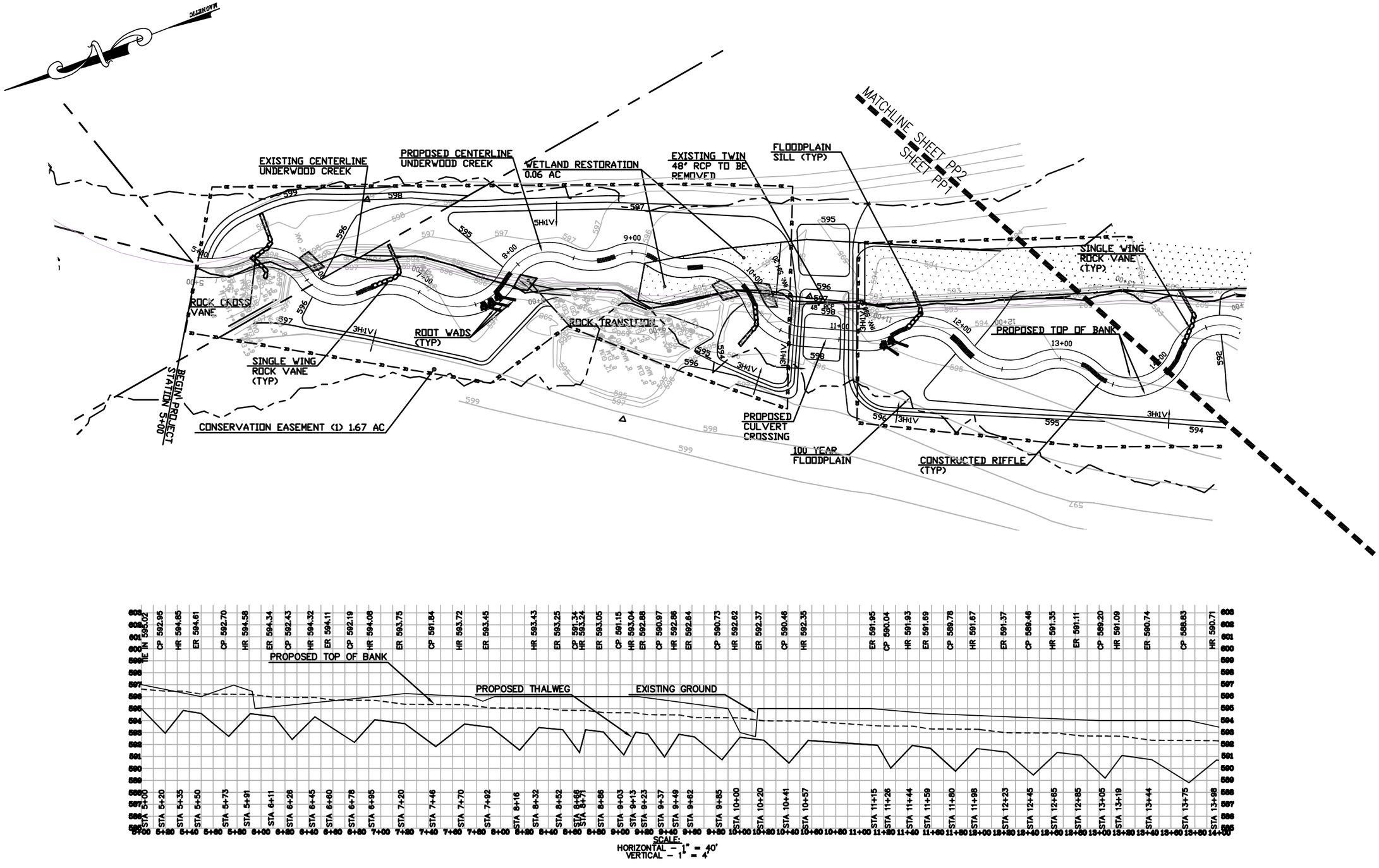
PROJECT NAME: New Town Creek

DWG NAME: Existing Conditions

SCALE: 1"=40'

PERMIT SET

SHEET NO.: EC4



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Environmental Banc & Exchange
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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL:

NEWTOWN PLAN AND PROFILE
STATION 5+00 TO 14+00
UNDERWOOD CREEK
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

PROJECT NAME: New Town Creek

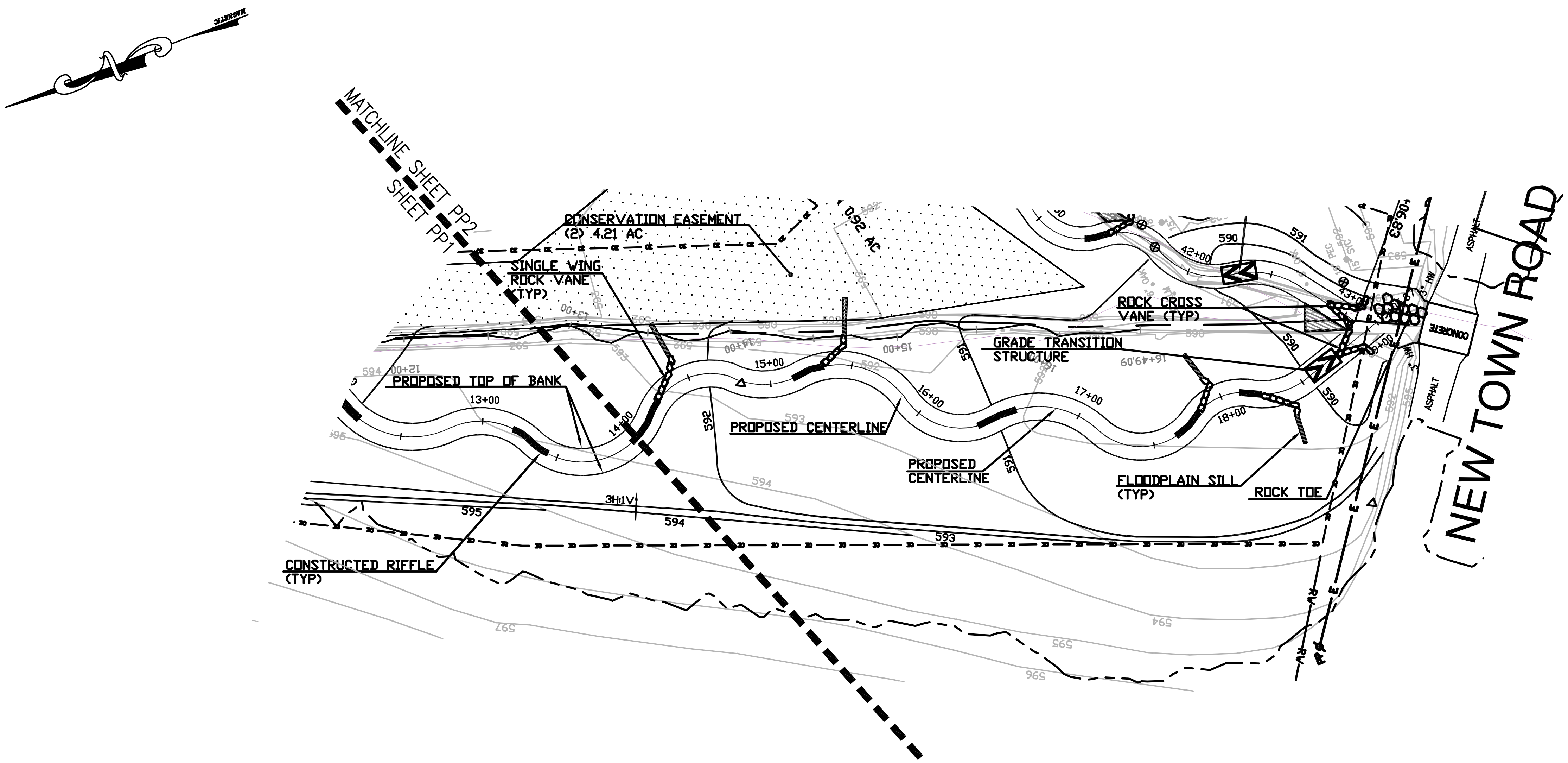
DWG NAME: Restoration Plan and Profile

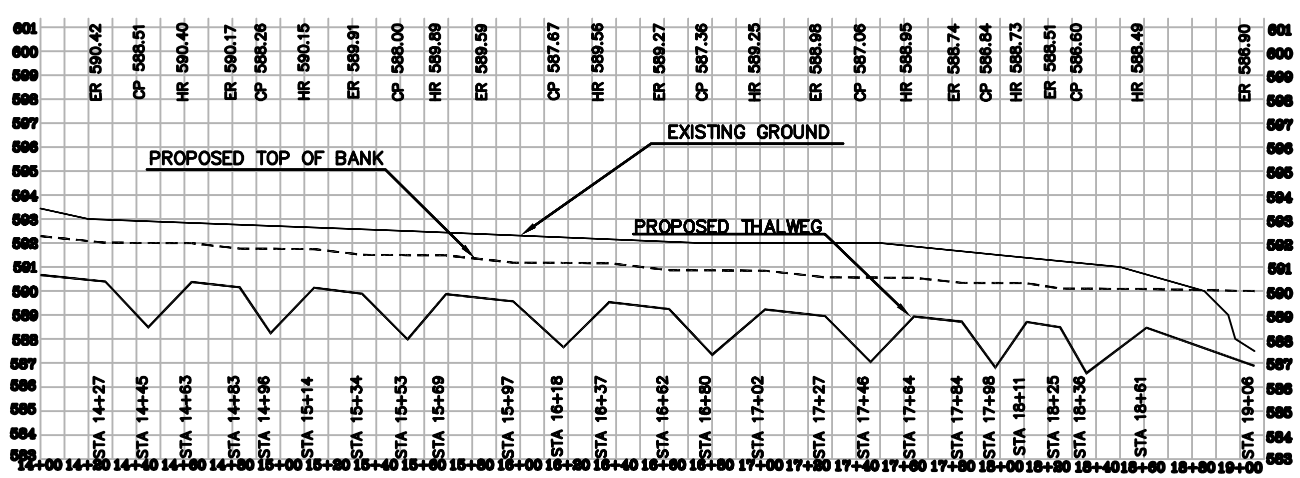
SCALE: 1"=40'

PERMIT SET

SHEET NO.

PP1





SCALE:
HORIZONTAL - 1" = 40'
VERTICAL - 1" = 4'

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

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Environmental Banc & Exchange
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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 829-9913

SEAL: NORTH CAROLINA PROFESSIONAL SEAL 13344 ENGINEER BECKY LYNNE WARD

NEWTOWN PLAN AND PROFILE STATION 12+00 TO 19+06 UNDERWOOD CREEK UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

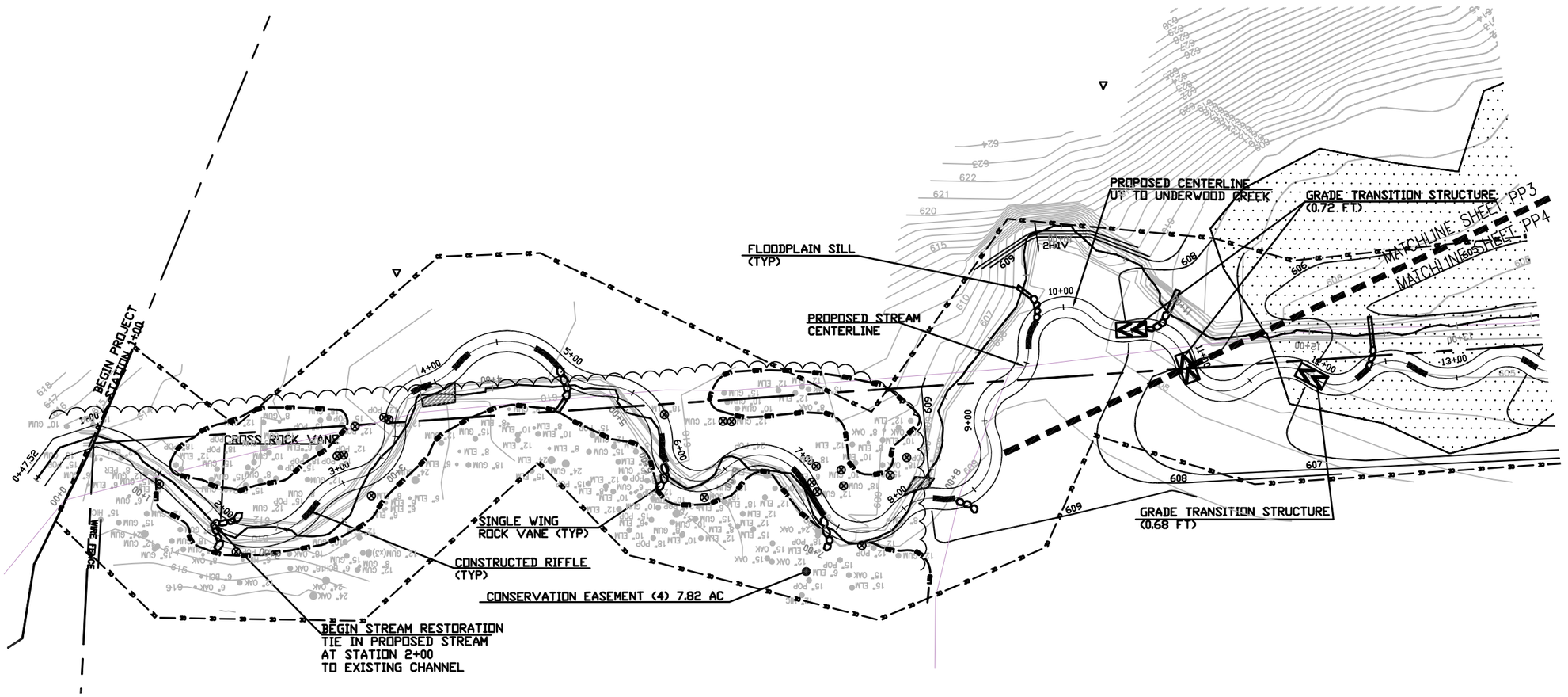
PROJECT NAME: New Town Creek

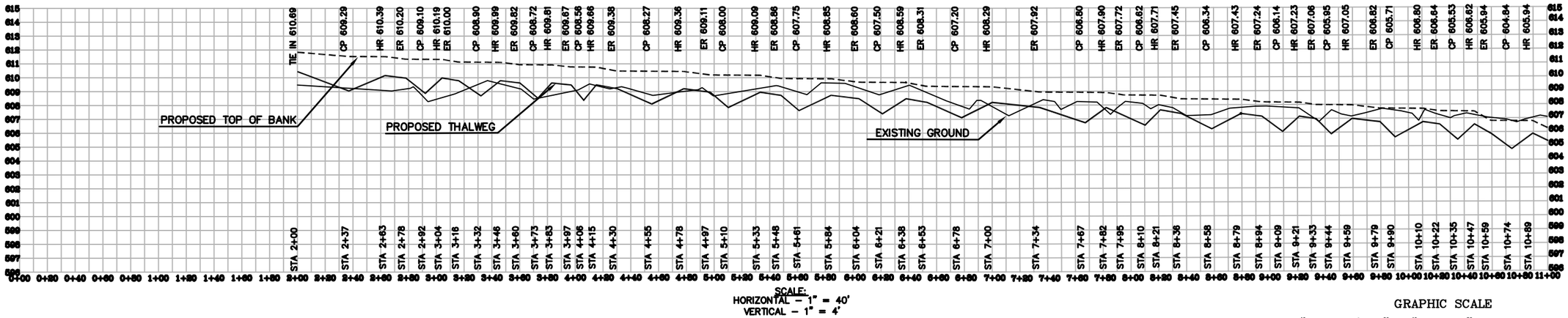
DWG NAME: Restoration Plan and Profile

SCALE: 1"=40'

PERMIT SET

SHEET NO. PP2





GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

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Raleigh, NC 27615-6083 FAX (919) 870-6369
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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL:

NEWTOWN PLAN AND PROFILE STATION 0+00 TO 11+00 UT TO UNDERWOOD CREEK UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

PROJECT NAME: New Town Creek

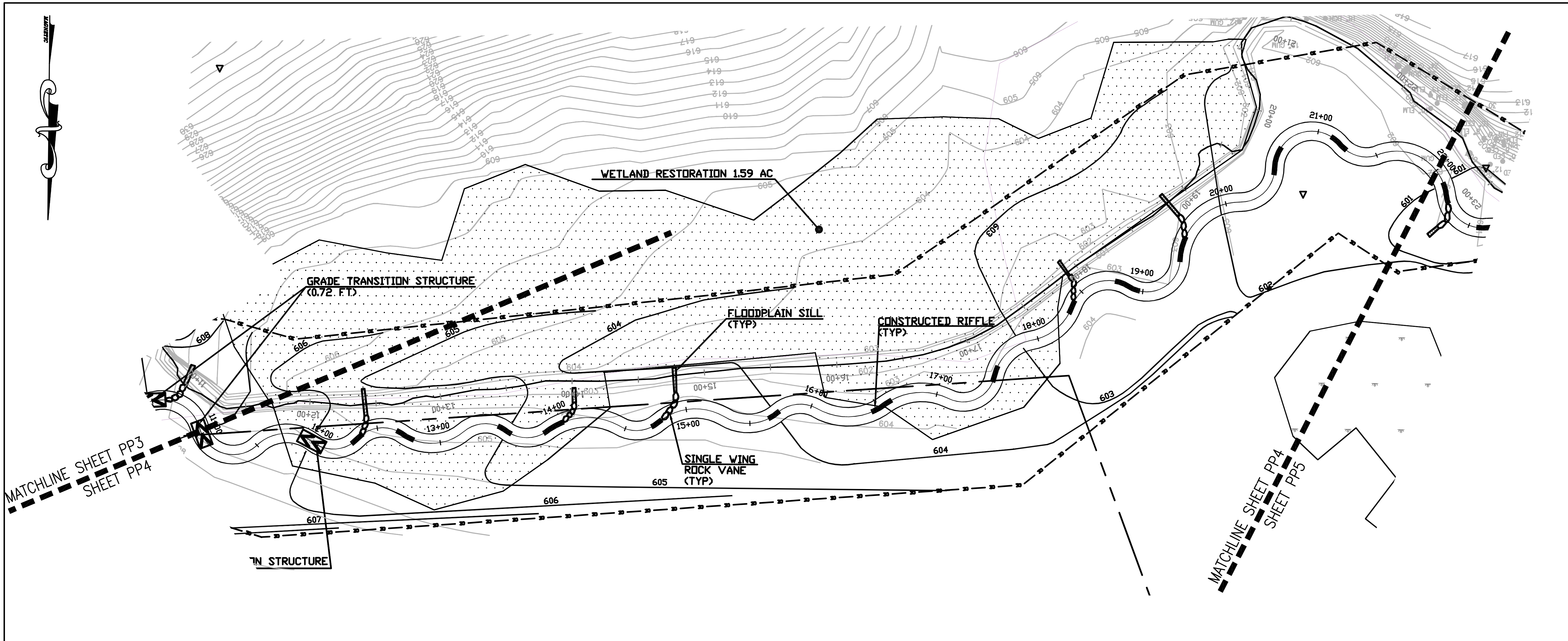
DWG NAME: Restoration Plan and Profile

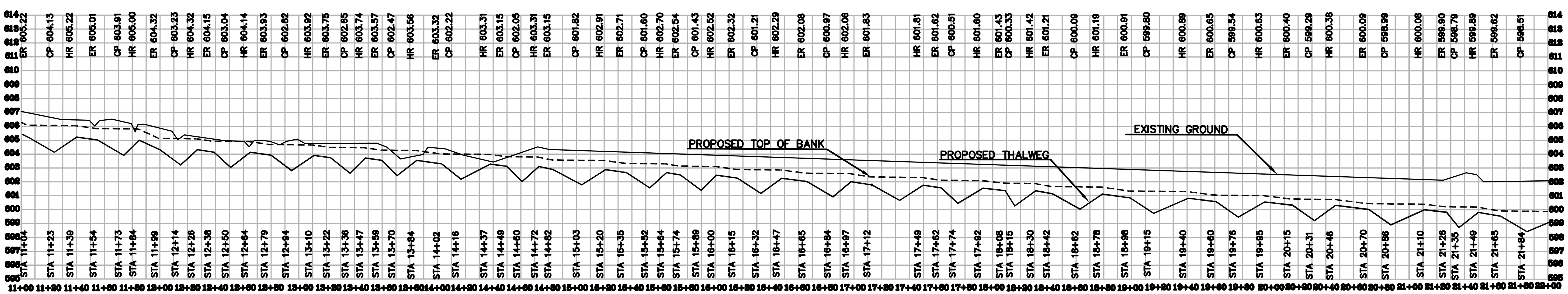
SCALE: 1"=40'

PERMIT SET

SHEET NO.

PP3





SCALE:
VERTICAL – 1" = 4'
HORIZONTAL – 1" = 40'

GRAPHIC SCALE

(IN FEET)
1 inch = 40 ft.

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Environmental Banc & Exchange
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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL:

NEWTOWN PLAN AND PROFILE
STATION 11+00 TO 22+00
UT TO UNDERWOOD CREEK
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

PROJECT NAME: New Town Creek

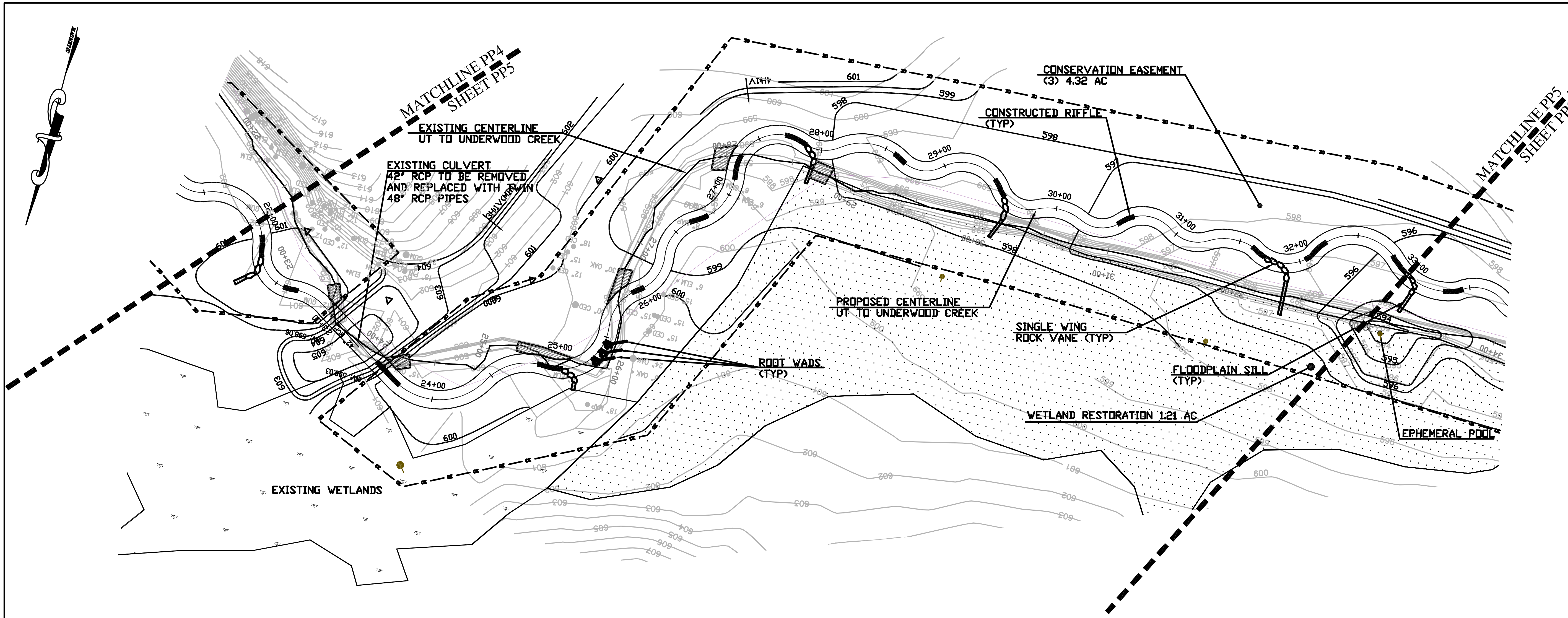
DWG NAME: Restoration Plan and Profile

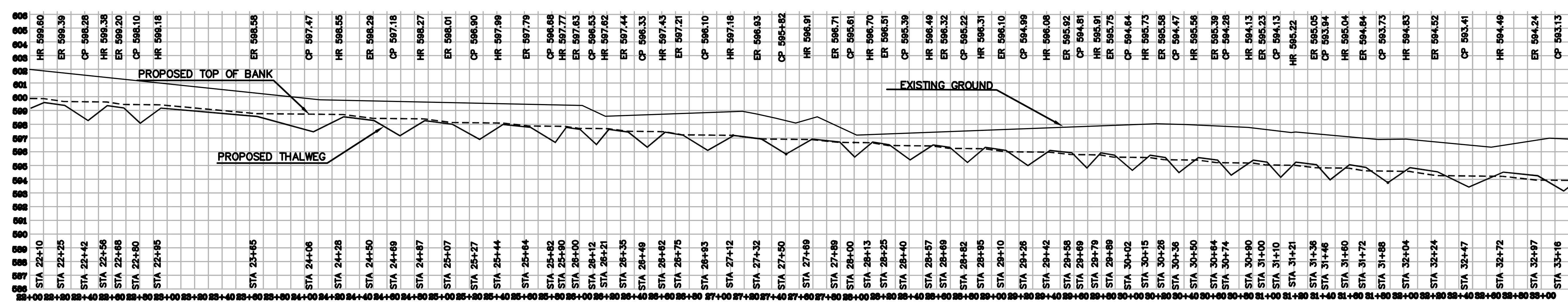
SCALE: 1"=40'

PERMIT SET

SHEET NO.

PP4





SCALE:
HORIZONTAL - 1" = 40'
VERTICAL - 1" = 4'

GRAPHIC SCALE
(IN FEET)
1 inch = 40 ft.

Ward Consulting Engineers, P.C.
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Environmental Banc & Exchange
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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 829-9913

SEAL:

NEWTOWN PLAN AND PROFILE
STATION 22+00 TO 33+00
UT TO UNDERWOOD CREEK
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

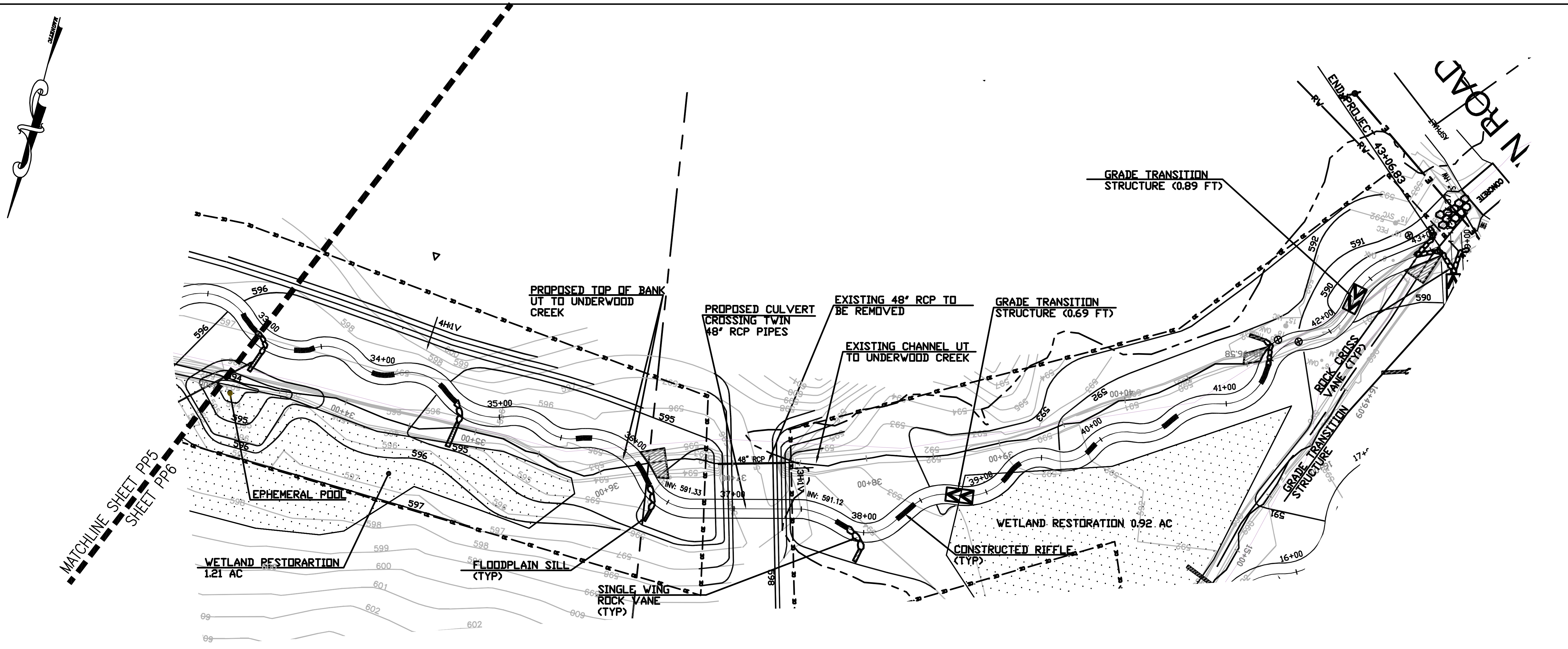
PROJECT NAME: New Town Creek

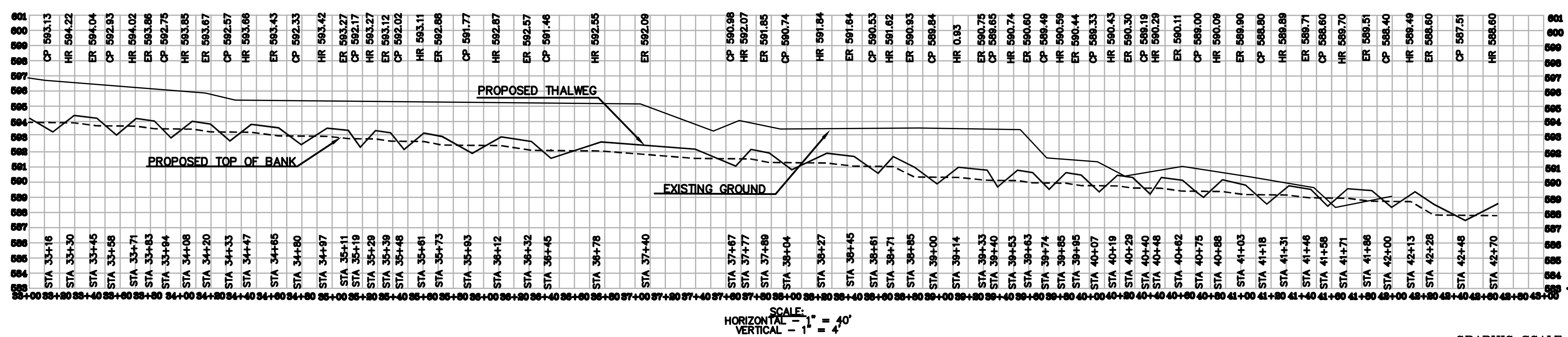
DWG NAME: Restoration Plan and Profile

SCALE: 1"=40'

PERMIT SET

SHEET NO. PP5





GRAPHIC SCALE

(IN FEET)
1 inch = 40 ft.

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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 829-9913

SEAL:

NEWTOWN PLAN AND PROFILE
STATION 33+00 TO 44+00
UT TO UNDERWOOD CREEK
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

PROJECT NAME: New Town Creek

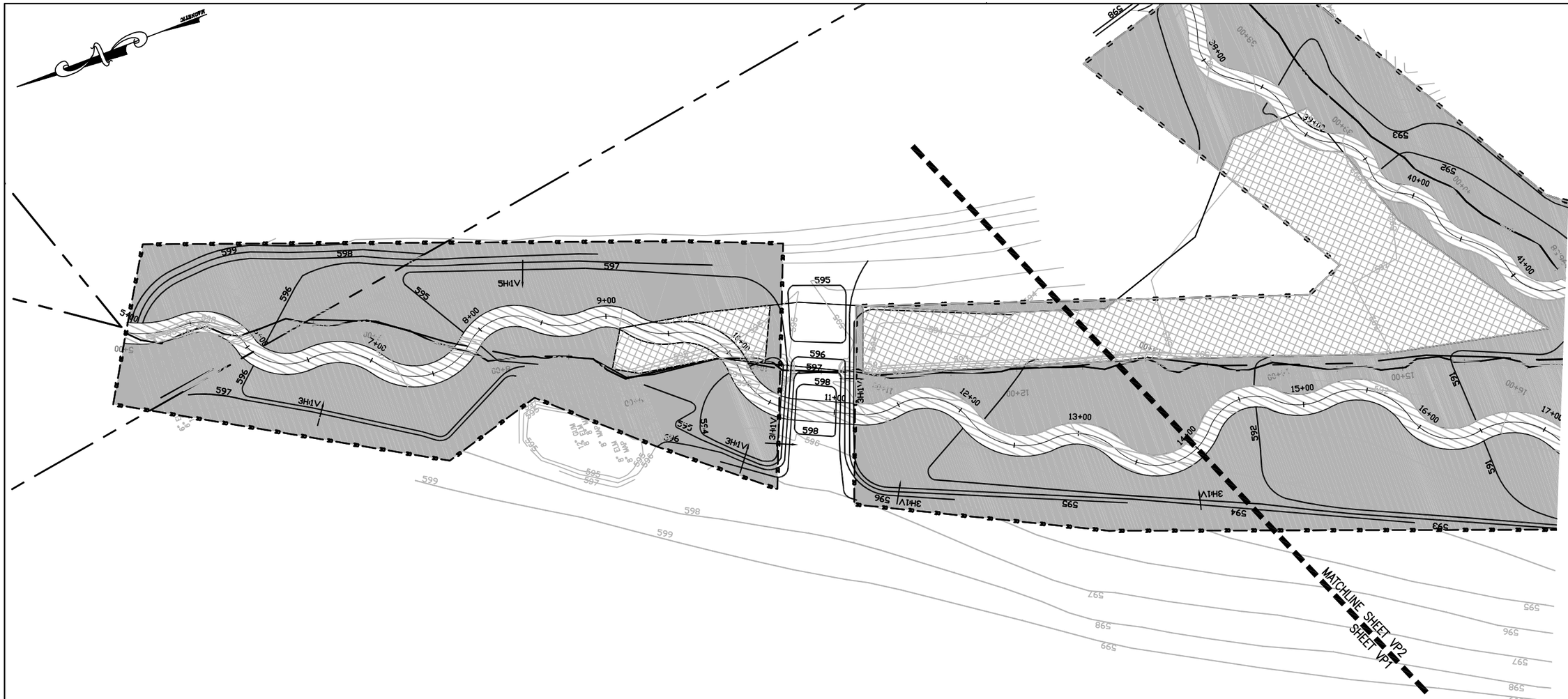
DWG NAME: Restoration Plan and Profile

SCALE: 1"=40'

PERMIT SET

SHEET NO.

PP6



LEGEND

ZONE 1 - PIEDMONT ALLUVIAL FOREST STREAM BANK-1.87 ACRES
ZONE 2 - PIEDMONT ALLUVIAL FOREST STREAM BUFFER-11.99 ACRES
ZONE 3 - PIEDMONT ALLUVIAL FOREST WETLAND RESTORATION-3.38 ACRES

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

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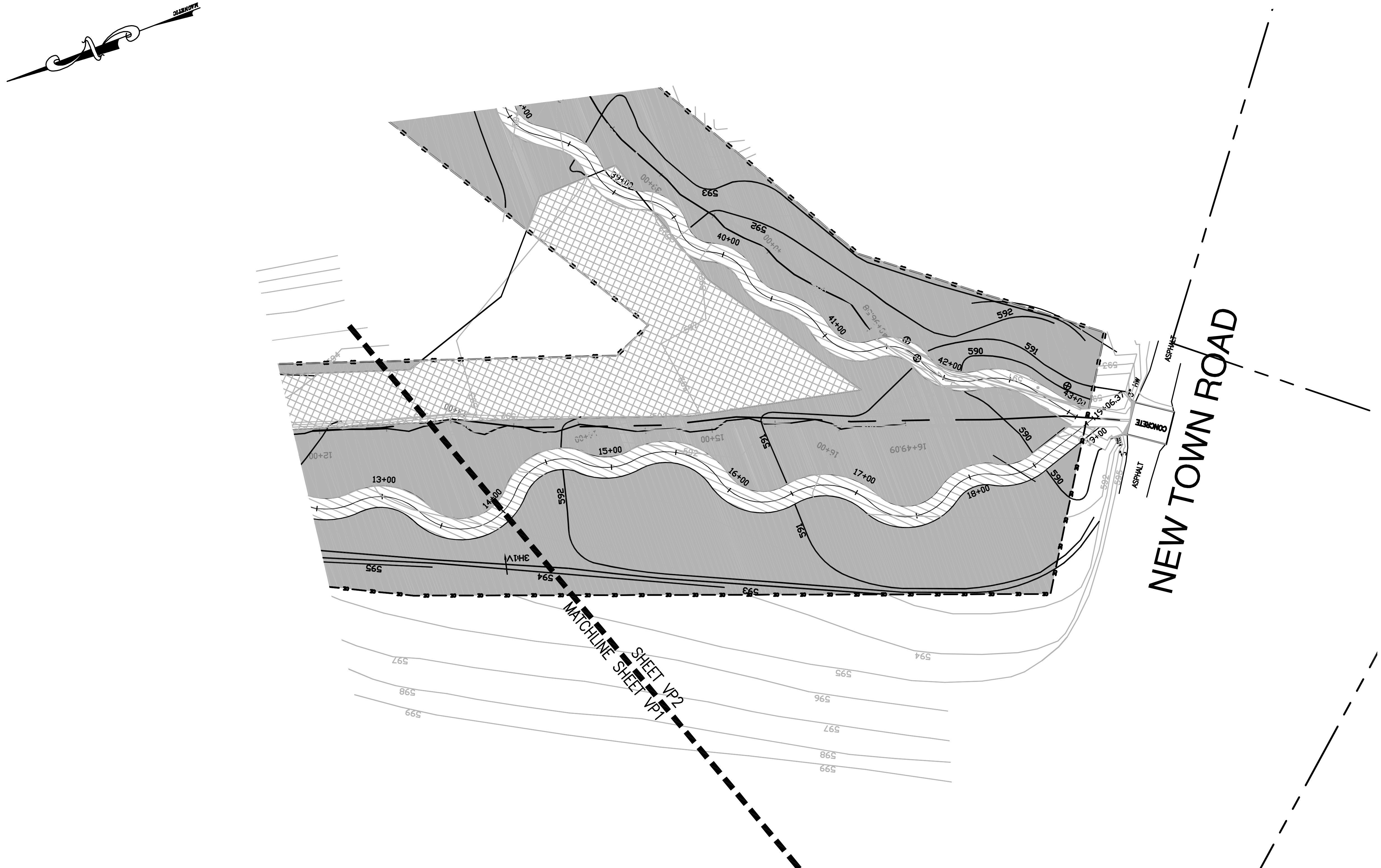
Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL:

NEWTOWN PLANTING PLAN
STATION 5+00 TO 14+00
UNDERWOOD CREEK
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010
REVISIONS:
PROJECT NAME: New Town Creek
DWG NAME: Planting Plan
SCALE: 1"=40'
PERMIT SET
SHEET NO.
VP1



LEGEND

- ZONE 1 - PIEDMONT ALLUVIAL FOREST STREAM BANK
- ZONE 2 - PIEDMONT ALLUVIAL FOREST STREAM BUFFER
- ZONE 3 - PIEDMONT ALLUVIAL FOREST WETLAND RESTORATION

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

Ward Consulting Engineers, P.C.
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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL:

NORTH CAROLINA PROFESSIONAL SEAL 1334 ENGINEER BECKY LYNNE WARD

NEWTOWN PLANTING PLAN
STATION 14+00 TO 19+06.37
UNDERWOOD CREEK
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

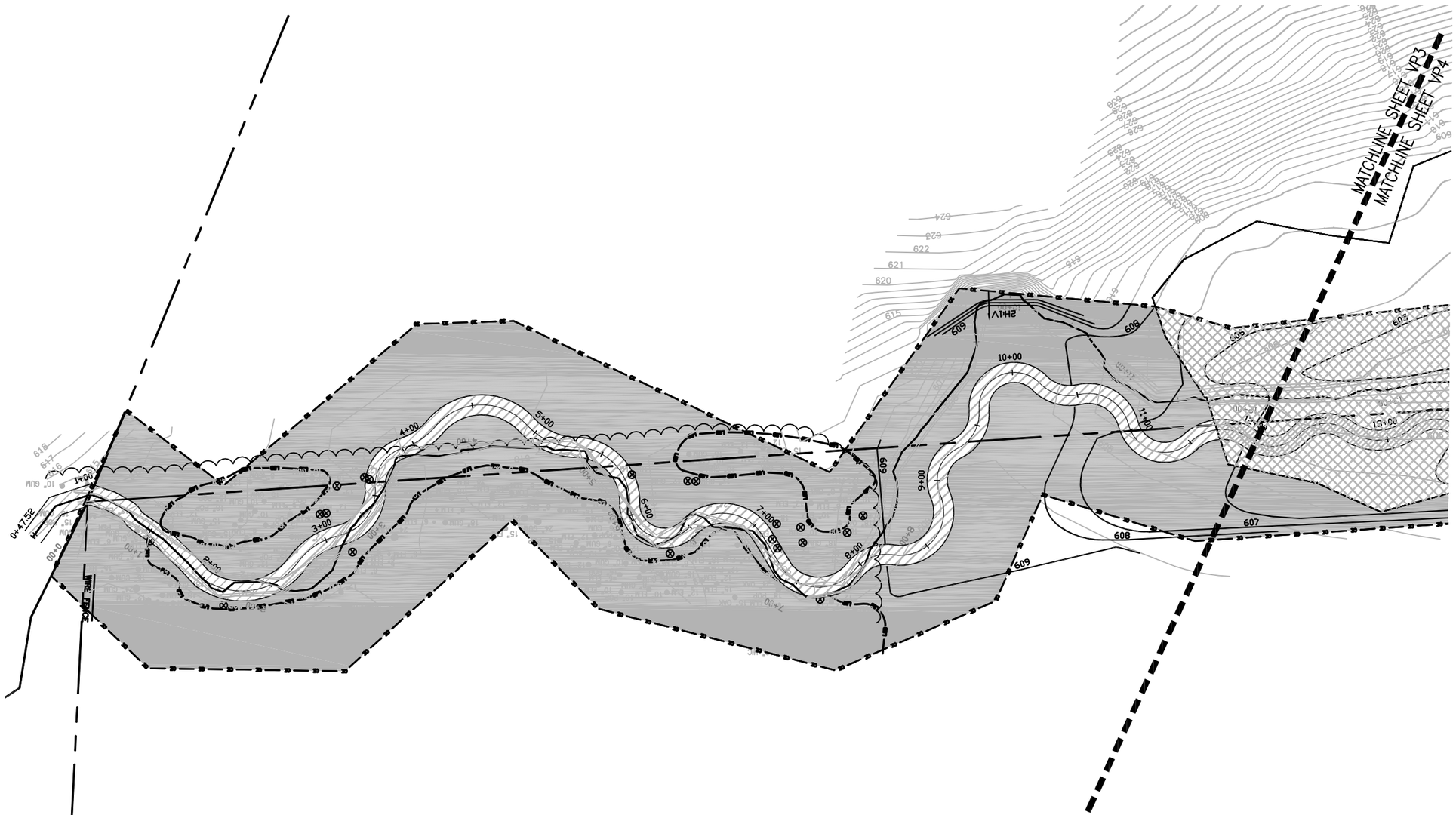
PROJECT NAME: New Town Creek

DWG NAME: Planting Plan

SCALE: 1"=40'

PERMIT SET

SHEET NO. VP2



LEGEND

- ZONE 1 - PIEDMONT ALLUVIAL FOREST STREAM BANK
- ZONE 2 - PIEDMONT ALLUVIAL FOREST STREAM BUFFER
- ZONE 3 - PIEDMONT ALLUVIAL FOREST WETLAND RESTORATION

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

Ward Consulting Engineers, P.C.

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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL:

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 13341 BECKY LYNN WARD

NEWTOWN PLANTING PLAN
STATION 0+00 TO 12+00
UT TO UNDERWOOD CREEK
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

PROJECT NAME: New Town Creek

DWG NAME: Planting Plan

SCALE: 1"=40'

PERMIT SET

SHEET NO.

VP3

LEGEND

- ZONE 1 - PIEDMONT ALLUVIAL FOREST STREAM BANK.
- ZONE 2 - PIEDMONT ALLUVIAL FOREST STREAM BUFFER.
- ZONE 3 - PIEDMONT ALLUVIAL FOREST WETLAND RESTORATION.

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

Ward Consulting Engineers, P.C.

8568 Six Forks Rd. Suite 104 (919) 870-0526
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Environmental Banc & Exchange
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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL:

NEWTOWN PLANTING PLAN
STATION 12+00 TO 24+00
UT TO UNDERWOOD CREEK
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

PROJECT NAME: New Town Creek

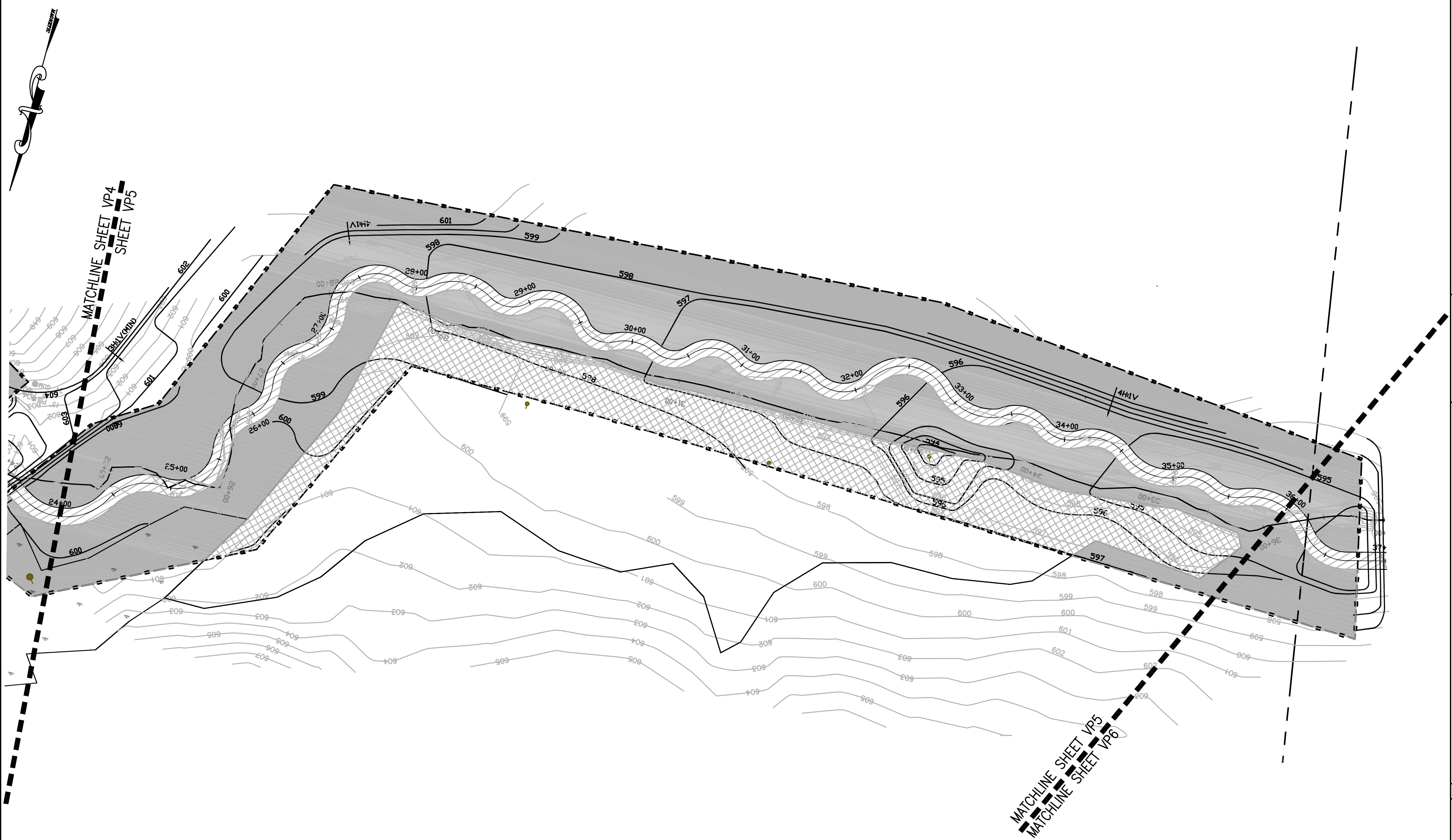
DWG NAME: Planting Plan

SCALE: 1"=40'

PERMIT SET

SHEET NO.

VP04



LEGEND

- ZONE 1 - PIEDMONT ALLUVIAL FOREST STREAM BANK
- ZONE 2 - PIEDMONT ALLUVIAL FOREST STREAM BUFFER
- ZONE 3 - PIEDMONT ALLUVIAL FOREST WETLAND RESTORATION

GRAPHIC SCALE

(IN FEET)
1 inch = 40 ft.

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Environmental Banc & Exchange
909 Capability Drive, Suite 3100
Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

SEAL: NORTH CAROLINA PROFESSIONAL SEAL 13344 ENGINEER BETTY LYNNE WARD

NEWTOWN PLANTING PLAN
STATION 24+00 TO 36+00
UT TO UNDERWOOD CREEK
UNION COUNTY, NORTH CAROLINA

DATE: 01 MARCH 2010

REVISIONS:

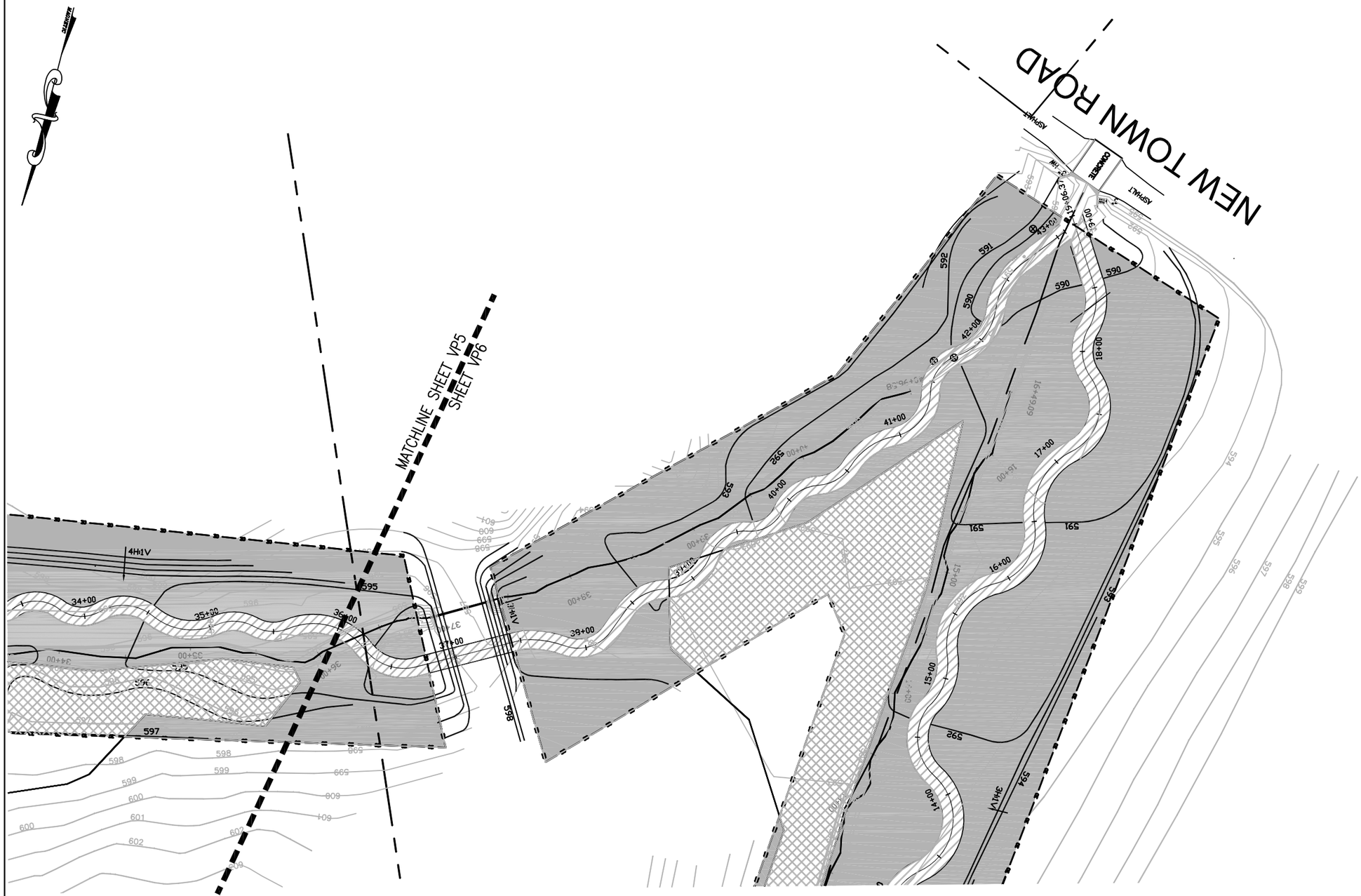
PROJECT NAME: New Town Creek

DWG NAME: Planting Plan

SCALE: 1"=40'

PERMIT SET

SHEET NO. VP5



LEGEND

ZONE 1 - PIEDMONT ALLUVIAL FOREST STREAM BANK·
ZONE 2 - PIEDMONT ALLUVIAL FOREST STREAM BUFFER·
ZONE 3 - PIEDMONT ALLUVIAL FOREST WETLAND RESTORATION·

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

NEWTOWN PLANTING PLAN
STATION 36+00 TO 43+06
UT TO UNDERWOOD CREEK
UNION COUNTY, NORTH CAROLINA

SEAL:

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 13341 BECKY L. KING

Ward Consulting Engineers, P.C.
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Raleigh, NC 27615-5083 FAX (919) 870-5369

Environmental Banc & Exchange
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Raleigh NC 27606 Phone: (919) 829-9909
Fax: (919) 229-9913

DATE: 01 MARCH 2010

REVISIONS:

PROJECT NAME: New Town Creek

DWG NAME: Planting Plan

SCALE: 1"=40'

PERMIT SET

SHEET NO.

VP6

13.0 Appendices

Appendix 1: Restoration & Reference Site USACE Wetland Determination Data Forms

Appendix 2: Restoration Site NCDWQ Stream Classification Forms

Appendix 3: Restoration Site Cross Sections

Appendix 4: Reference Sites Cross Sections

Appendix 5: Restoration Site Soil Boring Location Map and Log

Appendix 6: Categorical Exclusion Approved Check List

Appendix 7: FEMA FIRM Panel 5404

Appendix 1: Restoration & Reference Site USACE Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont (DRAFT)

Project/Site: Newtown Stream & Wetland Restoration City/County: Union Sampling Date: 1/18/10

Applicant/Owner: State: NC Sampling Point: Flag 2

Investigator(s): Chris Sheats, Mike Callaham Section, Township, Range: Newtown

Landform (hillslope, terrace, etc.): toe of slope Local relief (concave, convex, none): concave

Slope (%): 3 Lat: Long: Datum: NAD83

Soil Map Unit Name: Chewacla NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No ____	**Is the Sampled Area within a Wetland?** Yes ✓ No ____
Hydric Soil Present?	Yes ✓	No ____	
Wetland Hydrology Present?	Yes ✓	No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. Diospyros virginiana	5	NO	FAC
2. Ulmus rubra	20	YES	FAC
3.			
4.			
5.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. Alnus serrulata	5	NO	FACW+
2. Ligustrum sinense	30	YES	FAC
3. Sambucus canadensis	5	NO	FACW-
4. Cephalanthus occidentalis	5	NO	OBL
5.			
	= Total Cover		
Herb Stratum (Plot size: ____)			
1. Carex sp.	10	NO	-
2. Juncus effusus	80	YES	FACW
3. Persicaria sagittatum	5	NO	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. Lonicera japonica	20	YES	FAC
2.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Flag 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1	2.5Y 3/3	80	2.5Y 6/2	20	D	M	sandy loam	
1-6	2.5Y 3/2	75	2.5Y 6/2	25	D	M	sandy loam	
6-12+	2.5Y 3/2	75	10YR 5/4	15	C	M	sandy loam	2.5 6/1 10% Depletions

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ✓ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ✓ Sparsely Vegetated Concave Surface (B8)
- ✓ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ✓ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): _____

Water Table Present? Yes ___ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 5

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Appendix 2: Restoration Site NCDWQ Stream Classification Forms

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2/25/10	**Project:** Newtown Restoration		**Latitude:**
Evaluator: The Catena Group	**Site:** Underwood Creek		**Longitude:**
Total Points: 31 *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30*	**County:** Union, Co.		**Other** *e.g. Quad Name*:

A. Geomorphology (Subtotal = 16)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	(1)	2	3
11. Grade controls	0	(0.5)	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = (3)	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 5)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	0	(1)	2	3
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2/19/10	**Project:** Newtown Streams	**Latitude:**	
Evaluator: The Catena Group	**Site:** UT to Underwood Creek	**Longitude:**	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 36.5	**County:** Union, NC	**Other** *e.g. Quad Name:*	

A. Geomorphology (Subtotal = 19)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	1	(2)	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	1	(2)	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	0	(0.5)	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = (3)	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 7)				
20[b]. Fibrous roots in channel	(3)	2	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Sketch:

Bank height = 4 ft
Bankful width = 7 ft
Water depth = 2-20 in
Substrate = sand, gravel
Velocity = medium
Clarity = clear

Appendix 3: Restoration Site Cross Sections

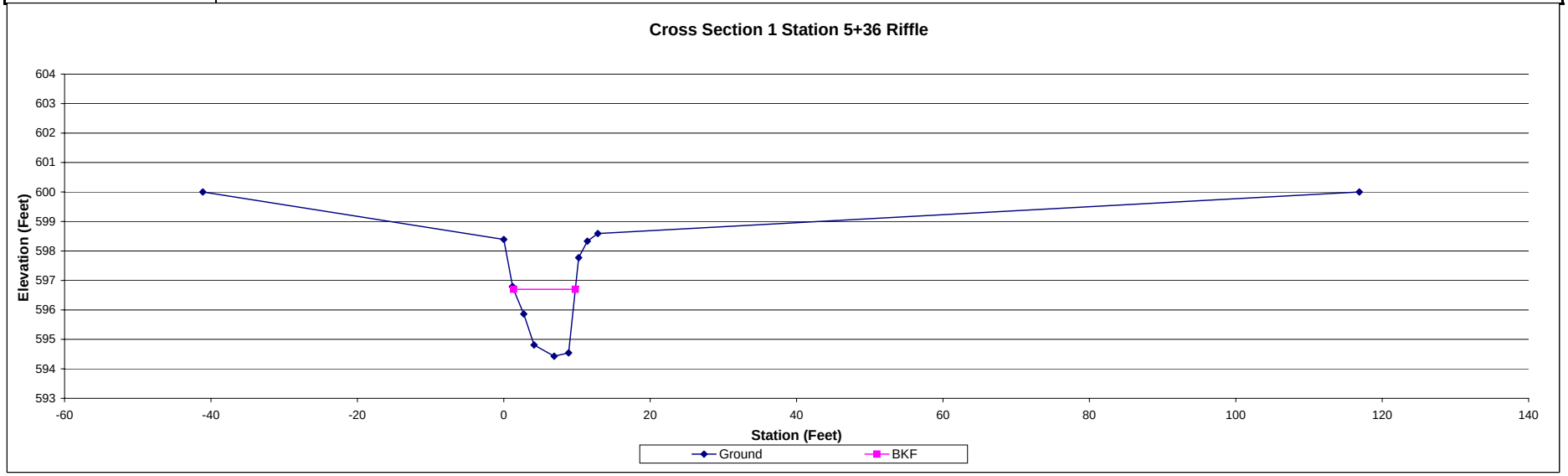
Project:	New Town Main Channel
Cross Section	1
Feature	Riffle
Station:	5+36
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	13.7
W (BKF)	8.4
Max d	2.3
Mean d	1.6
W/D	5.2

Baseline Section

Station	Elevation	Notes
-41.12	600.00	TOPO
0.00	598.39	TOBL
1.20	596.79	Bankfull Left
1.18	596.79	X1
2.73	595.86	X1
4.13	594.81	X1 TOE
6.88	594.43	X1 TW
8.86	594.54	X1 TOE
10.22	597.77	X1 TOBR
11.41	598.33	X1
12.85	598.59	X1
116.88	600.00	0.00

Photo of XS-1, looking in the downstream direction



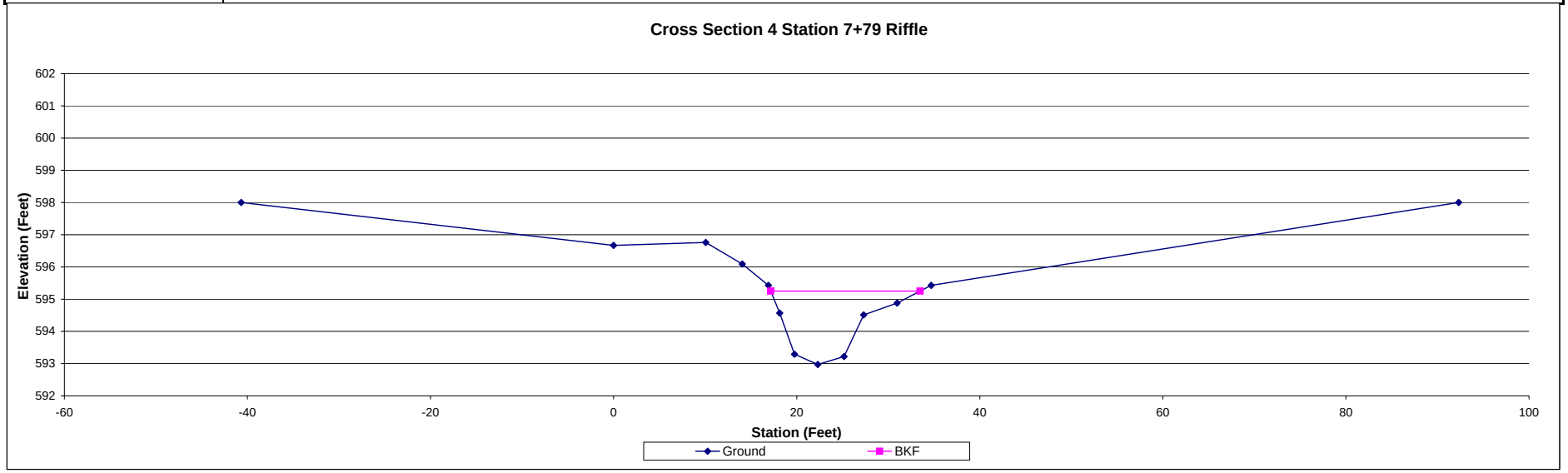
Project:	New Town Main Channel
Cross Section	4
Feature	Riffle
Station:	7+79
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	19.6
W (BKF)	16.3
Max d	2.3
Mean d	1.2
W/D	13.6

Baseline Section

Station	Elevation	Notes
-40.69	598.00	TOPO
0.00	596.67	X4
10.07	596.76	TOBL
14.05	596.09	X4
16.90	595.43	X4
18.15	594.57	Bankfull Left
19.76	593.29	X4 TOE
22.31	592.97	X4 TW
25.18	593.22	X4 TOE
27.31	594.51	Bankfull Right
30.97	594.88	X4
34.70	595.43	X4
92.31	598	TOPO

Photo of XS-4 looking in the downstream direction



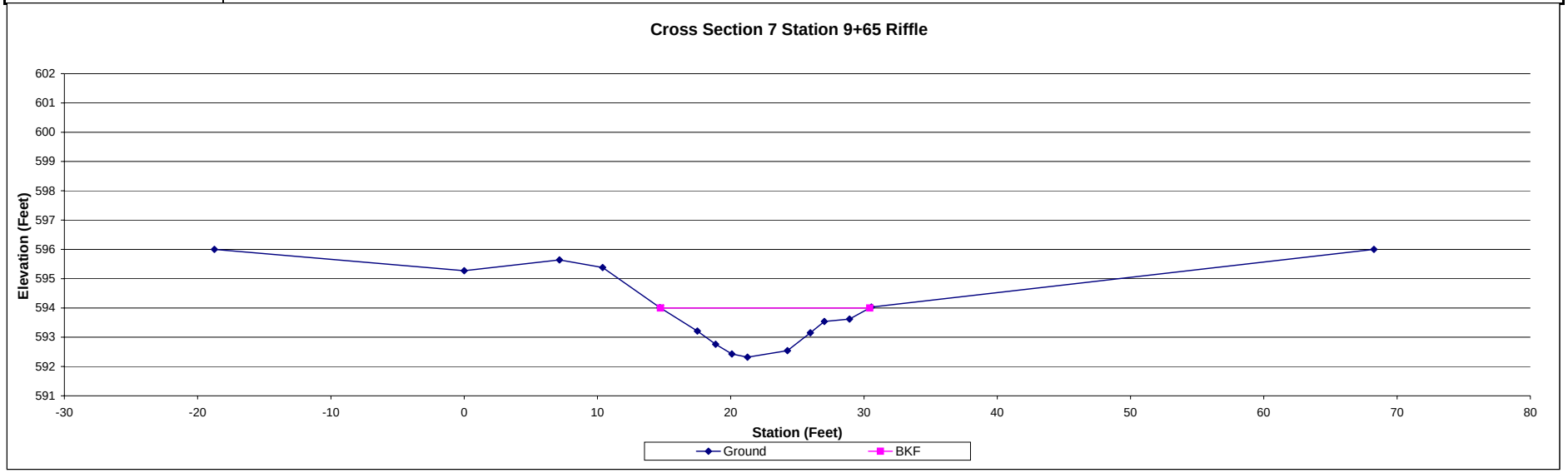
Project:	New Town Main Channel
Cross Section	7
Feature	Riffle
Station:	9+65
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	14.6
W (BKF)	15.7
Max d	1.7
Mean d	0.9
W/D	16.8

Baseline Section

Station	Elevation	Notes
-18.74	596.00	TOPO
0.00	595.27	X7
7.15	595.64	TOBL
10.39	595.38	X7
14.69	594.01	X7
17.50	593.21	X7
18.87	592.76	X7
20.09	592.43	X7TOE
21.26	592.32	TW
24.26	592.54	X7TOE
25.97	593.15	X7
27.02	593.54	Bankfull Right
28.91	593.62	X7
30.55	594.03	TOBR
68.26	596	TOPO

Photo of XS-7, looking in the downstream direction



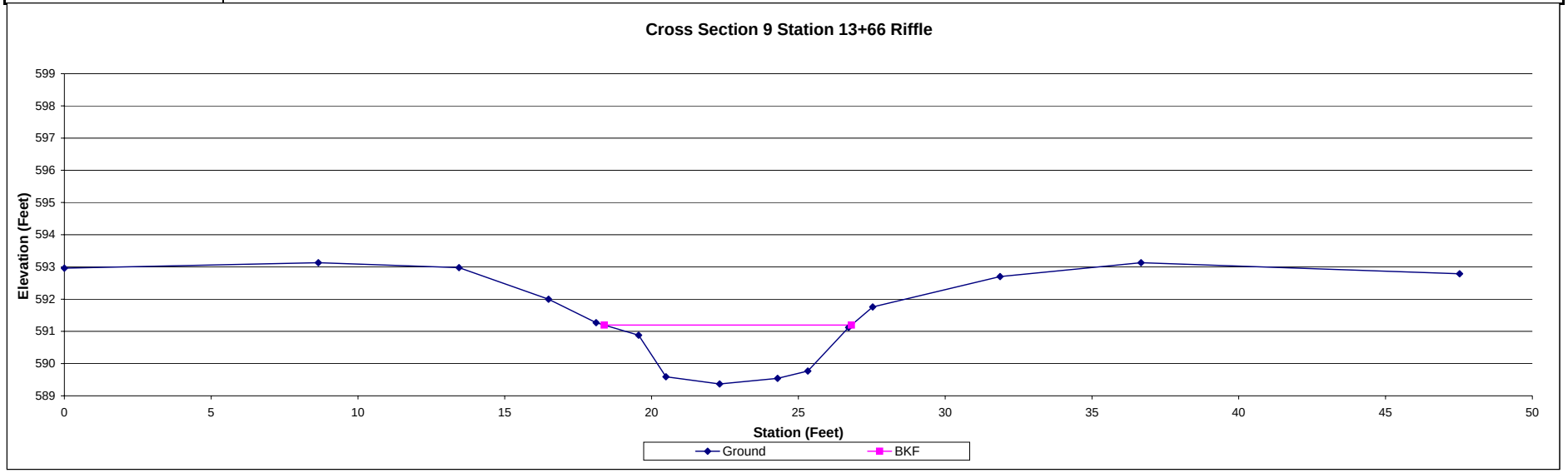
Project:	New Town Main Channel
Cross Section 9	
Feature	Riffle
Station:	13+66
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	10.9
W (BKF)	8.4
Max d	1.8
Mean d	1.3
W/D	6.5

Baseline Section

Station	Elevation	Notes
0.00	592.96	X9
8.65	593.13	X9
13.44	592.98	X9
16.49	592.00	TOBL
18.11	591.27	Bankfull Left
19.56	590.88	X9
20.49	589.59	X9 TOE
22.32	589.37	X9 TW
24.29	589.54	X9
25.32	589.77	X9 TOE
26.71	591.12	Bankfull Right
27.53	591.76	X9 TOBR
31.87	592.70	X9
36.67	593.13	X9
47.52	592.79	X9

Photo of XS-9, looking in the downstream direction



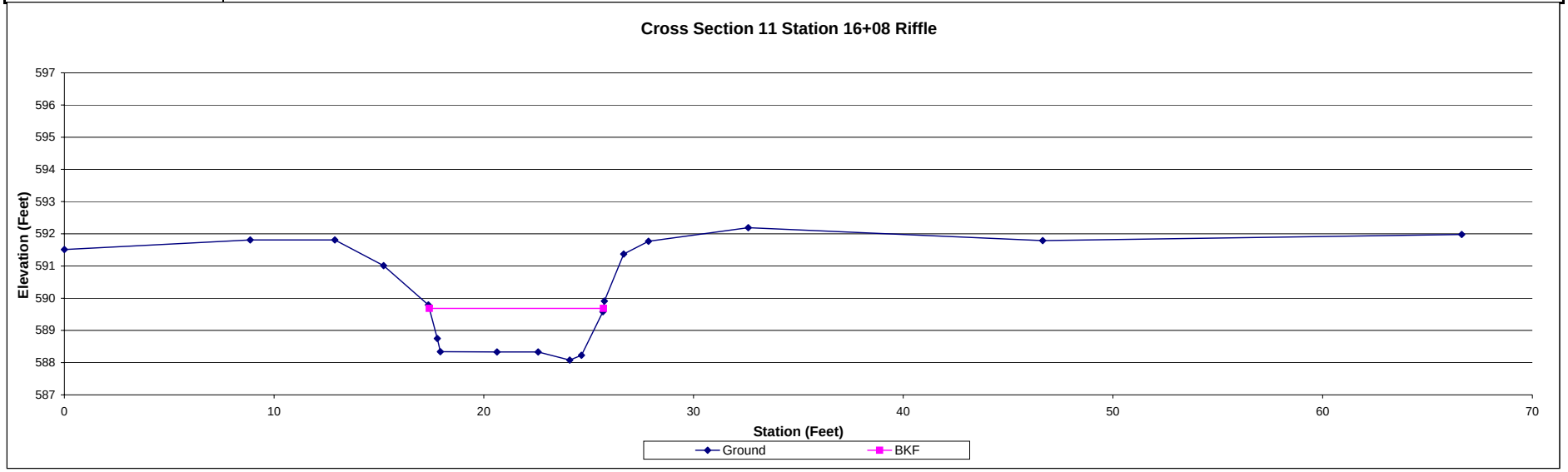
Project:	New Town Main Channel
Cross Section	11
Feature	Riffle
Station:	16+08
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	10.5
W (BKF)	8.3
Max d	1.6
Mean d	1.3
W/D	6.5

Baseline Section

Station	Elevation	Notes
0.00	591.51	X11
8.86	591.81	X11
12.90	591.81	X11 TOBL
15.22	591.01	X11
17.36	589.79	Bankfull Left
17.78	588.75	X11
17.93	588.34	X11 TOE
20.63	588.33	X11
22.59	588.33	X11
24.10	588.08	X11 TW
24.66	588.23	X11 TOE
25.68	589.58	Bankfull Right
25.75	589.91	X11
26.67	591.37	X11 TOBR
27.85	591.77	X11
32.61	592.19	X11
46.65	591.79	X11
66.63	591.98	X11

Photo of XS-11, looking in the downstream direction



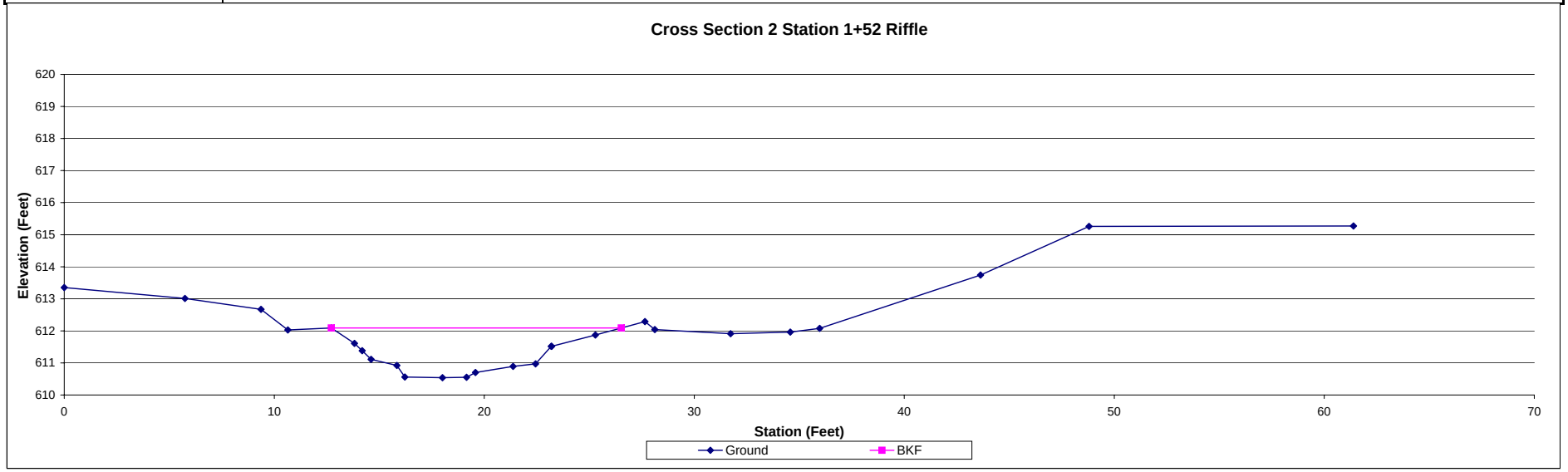
Project:	New Town Trib
Cross Section 2	
Feature	Riffle
Station:	1+52
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	13.0
W (BKF)	13.8
Max d	1.6
Mean d	0.9
W/D	14.7

Baseline Section

Station	Elevation	Notes
0.00	613.35	X2
5.75	613.01	X2
9.37	612.67	X2
10.65	612.03	X2
12.72	612.09	TOBL
13.82	611.61	X2
14.19	611.38	X2
14.61	611.11	Bankfull Left
15.84	610.92	X2
16.22	610.56	X2 TOE
18.01	610.54	X2 TW
19.16	610.55	X2
19.58	610.70	X2
21.37	610.89	X2
22.44	610.97	X2 TOE
23.19	611.52	Bankfull Right
23.21	611.52	X2 TOBR
25.29	611.87	X2
27.65	612.29	X2
28.12	612.04	X2
31.73	611.91	X2
34.57	611.96	X2
35.97	612.08	X2
43.63	613.74	X2
48.80	615.26	X2
61.39	615.27	X2

Photo of XS-2, looking in the downstream direction



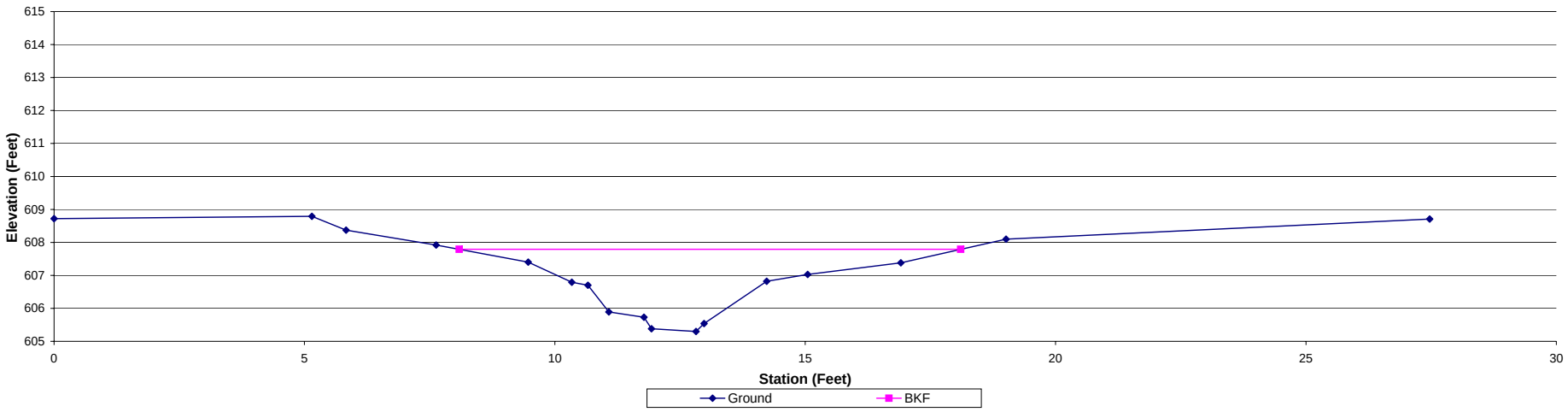
Project:	New Town Trib
Cross Section 8	
Feature	Riffle
Station:	9+24
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	10.4
W (BKF)	10.0
Max d	2.5
Mean d	1.0
W/D	9.6

Baseline Section

Station	Elevation	Notes
0.00	608.72	X8
5.15	608.79	X8 TOBL
5.83	608.37	X8
7.63	607.92	X8
9.47	607.40	X8
10.34	606.79	Bankfull Left
10.66	606.70	X8
11.08	605.89	X8
11.78	605.73	X8
11.93	605.38	X8 TOE
12.82	605.30	TW
12.98	605.54	X8 TOE
14.23	606.82	X8
15.05	607.03	X8
16.91	607.38	X8
19.01	608.10	X8
27.47	608.71	X8

Photo of XS-8 looking in the downstream direction



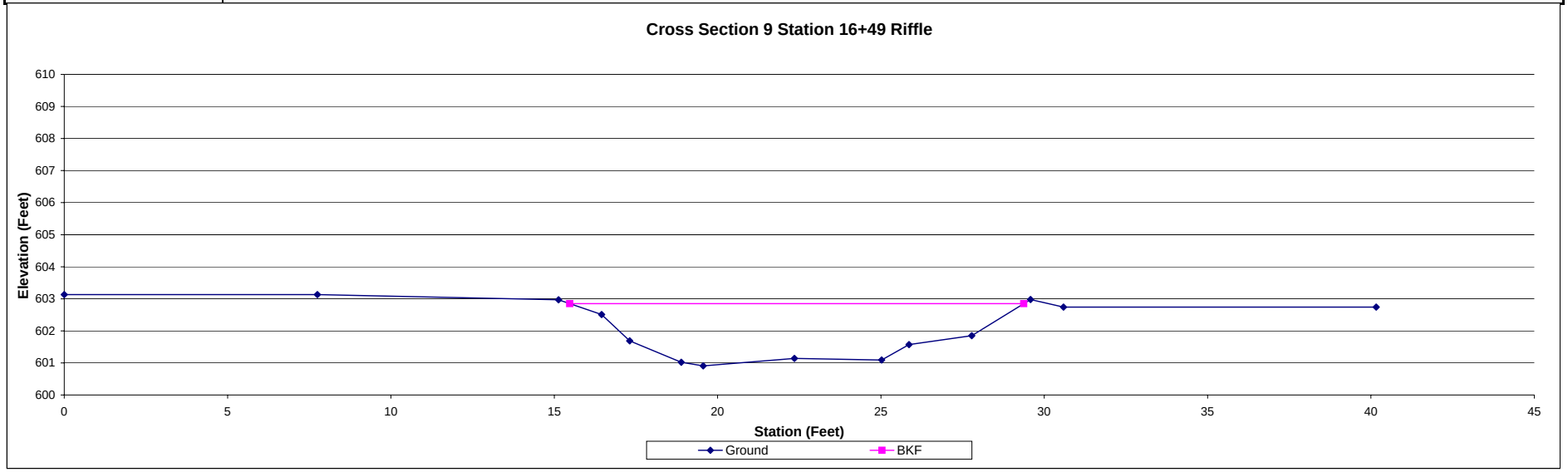
Project:	New Town Trib
Cross Section	9
Feature	Riffle
Station:	16+49
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	18.7
W (BKF)	13.9
Max d	1.9
Mean d	1.3
W/D	10.3

Baseline Section

Station	Elevation	Notes
0.00	603.13	X9
7.75	603.13	X9
15.13	602.97	X9 TOBL
16.45	602.51	X9
17.31	601.69	X9
18.89	601.02	X9 TOE
19.56	600.91	X9 TW
22.35	601.14	X9
25.02	601.09	X9 TOE
25.86	601.57	X9
27.78	601.85	Bankfull Right
29.58	602.98	X9 TOBR
30.59	602.74	X9
40.16	602.74	X9

Photo of XS-9, looking in the downstream direction



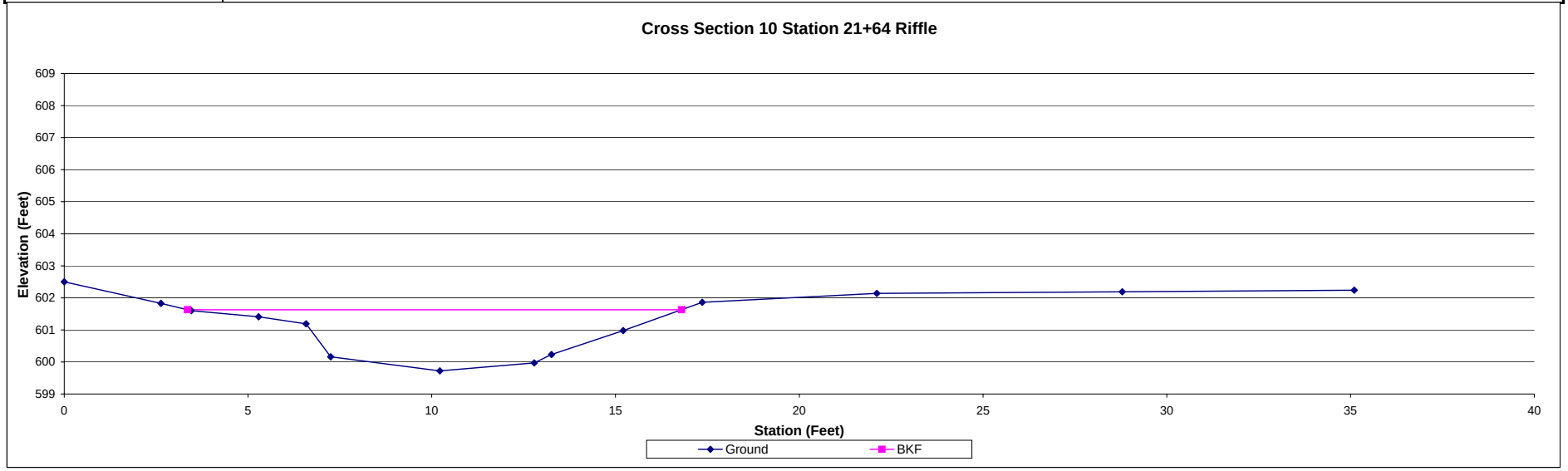
Project:	New Town Trib
Cross Section	10
Feature	Riffle
Station:	21+64
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	14.1
W (BKF)	13.4
Max d	1.9
Mean d	1.1
W/D	12.8

Baseline Section

Station	Elevation	Notes
0.00	602.50	X10
2.63	601.83	X10
3.46	601.60	Bankfull Left
5.29	601.41	X10
6.58	601.19	X10 TOBL
7.25	600.16	X10 TOE
10.22	599.72	X10 TW
12.79	599.97	X10
13.26	600.23	X10 TOE
15.21	600.98	Bankfull Right
17.36	601.86	X10 TOBR
22.11	602.14	X10
28.79	602.19	X10
35.10	602.24	X10

Photo of XS-10, looking in the downstream direction



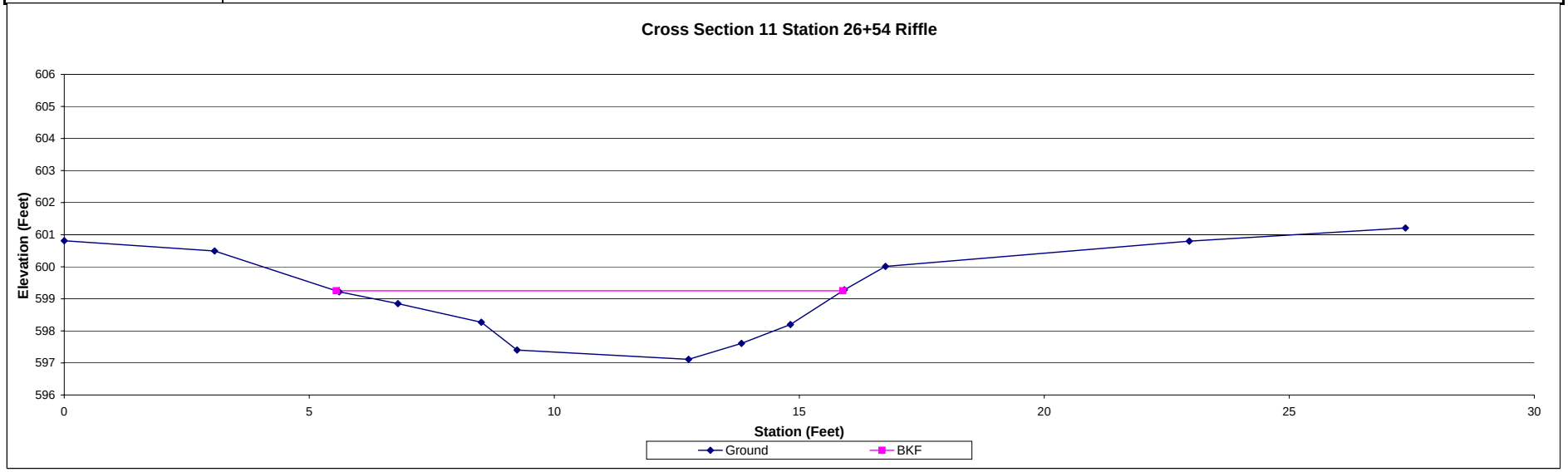
Project:	New Town Trib
Cross Section	11
Feature	Riffle
Station:	26+54
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	13.4
W (BKF)	10.3
Max d	2.1
Mean d	1.3
W/D	8.0

Baseline Section

Station	Elevation	Notes
0.00	600.81	X11
3.07	600.49	TOBL
5.61	599.22	Bankfull Left
6.81	598.85	X11
8.51	598.27	X11
9.24	597.40	X11TOE
12.74	597.11	X11TW
13.82	597.61	X11TOE
14.82	598.20	X11
15.92	599.28	Bankfull Right
16.76	600.01	TOBR
22.96	600.80	X11
27.37	601.21	X11

Photo of XS-11, looking in the downstream direction



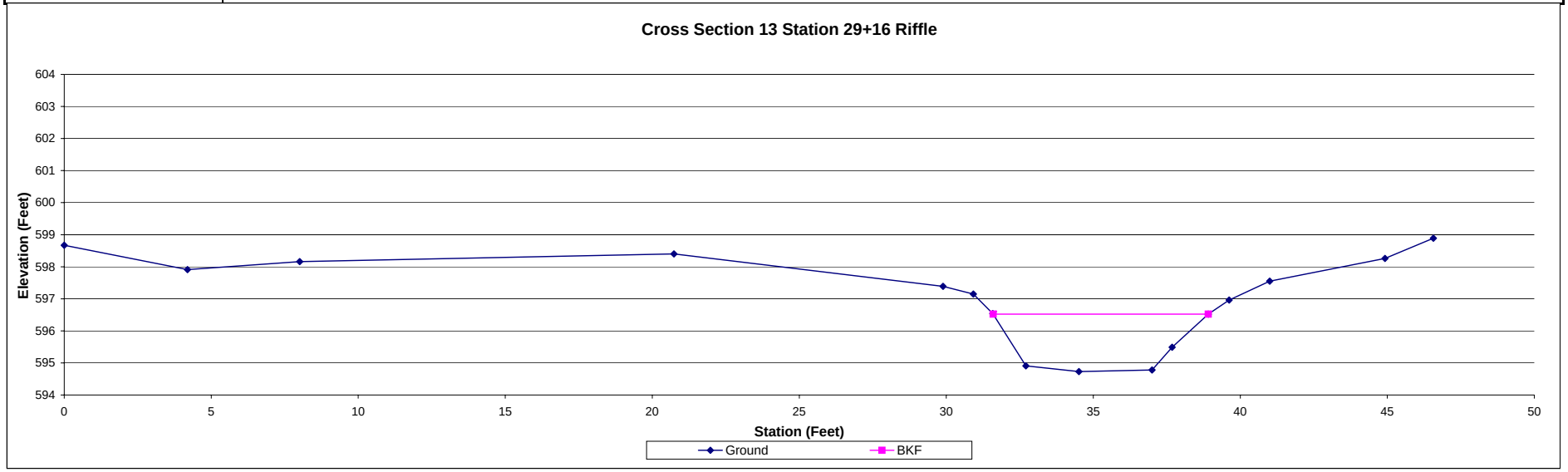
Project:	New Town Trib
Cross Section	13
Feature	Riffle
Station:	29+16
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	8.6
W (BKF)	7.3
Max d	1.8
Mean d	1.2
W/D	6.2

Baseline Section

Station	Elevation	Notes
0.00	598.67	X13
4.19	597.91	X13
8.01	598.16	X13
20.74	598.40	X13
29.89	597.39	TOBL
30.92	597.15	X13
31.58	596.54	X13
32.71	594.91	X13TOE
34.51	594.73	TW
37.00	594.78	X13TOE
37.68	595.49	X13
38.91	596.52	Bankfull Right
39.62	596.96	X13
41.00	597.55	TOBR
44.92	598.26	X13
46.57	598.89	X13

Photo of XS-13, looking in the downstream direction



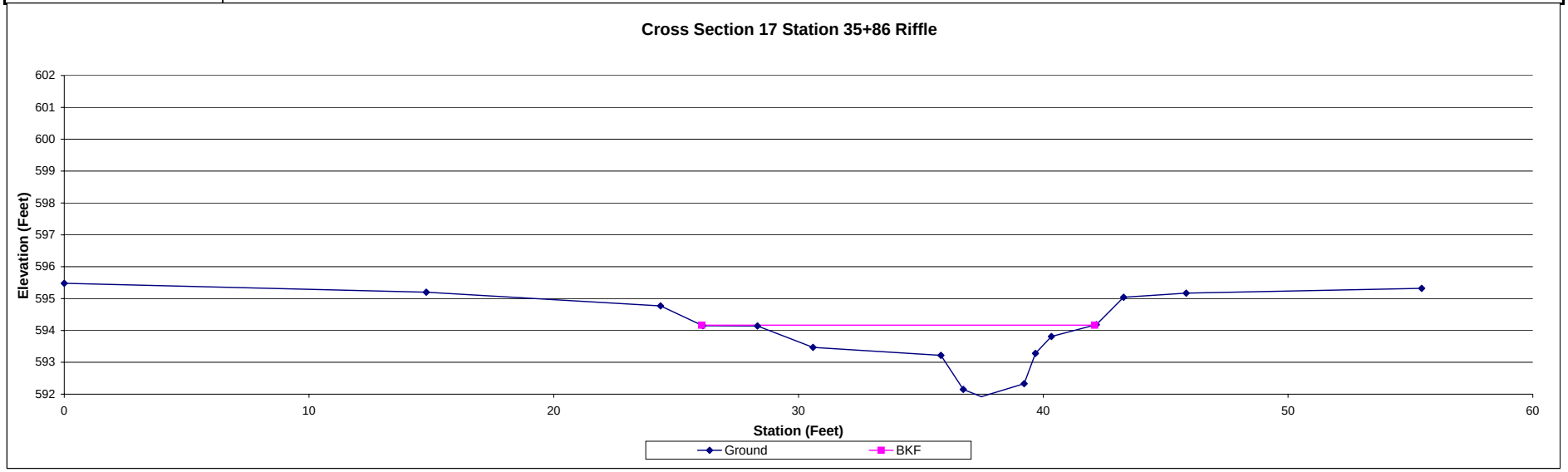
Project:	New Town Trib
Cross Section	17
Feature	Riffle
Station:	35+86
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	13.0
W (BKF)	16.0
Max d	2.2
Mean d	0.8
W/D	19.9

Baseline Section

Station	Elevation	Notes
0.00	595.48	X17
14.79	595.20	X17
24.36	594.77	X17
26.09	594.15	Bankfull Left
28.32	594.14	X17
30.59	593.47	X17
35.82	593.22	X17 TOBL
36.73	592.15	X17 TOE
37.47	591.92	X17 TW
39.22	592.33	X17 TOE
39.68	593.28	X17
40.33	593.81	X17
42.17	594.18	Bankfull Right
43.28	595.04	X17 TOBR
45.84	595.17	X17
55.46	595.32	X17

Photo of XS-17, looking in the downstream direction



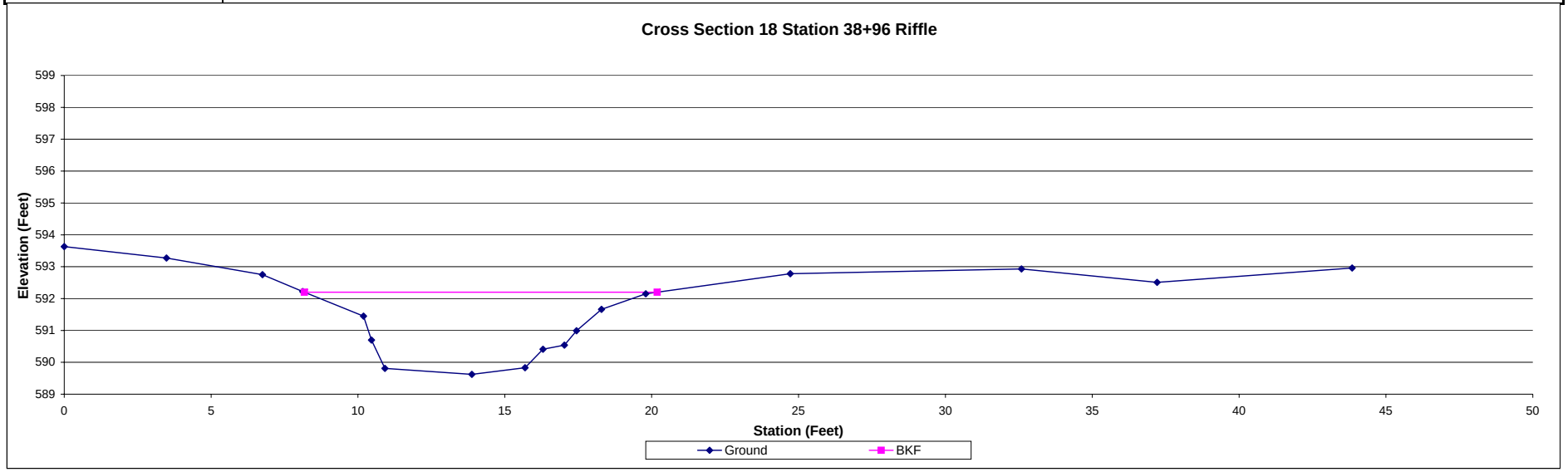
Project:	New Town Trib
Cross Section	18
Feature	Riffle
Station:	38+96
Date:	13-Jan-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	18.8
W (BKF)	12.0
Max d	2.6
Mean d	1.6
W/D	7.7

Baseline Section

Station	Elevation	Notes
0.00	593.63	X18
3.48	593.27	X18
6.75	592.75	X18
8.12	592.22	X18
10.19	591.45	Bankfull Left
10.46	590.70	X18 TOBL
10.92	589.81	X18 TOE
13.88	589.62	X18 TW
15.69	589.83	XS TOE
16.30	590.41	XS18
17.03	590.54	XS18
17.44	590.99	Bankfull Right
18.29	591.66	XS18 TOBR
19.80	592.15	XS18
24.72	592.78	XS18
32.59	592.93	XS18
37.21	592.51	XS18
43.85	592.96	XS18

Photo of XS-18, looking in the downstream direction



Appendix 4: Reference Sites Cross Sections

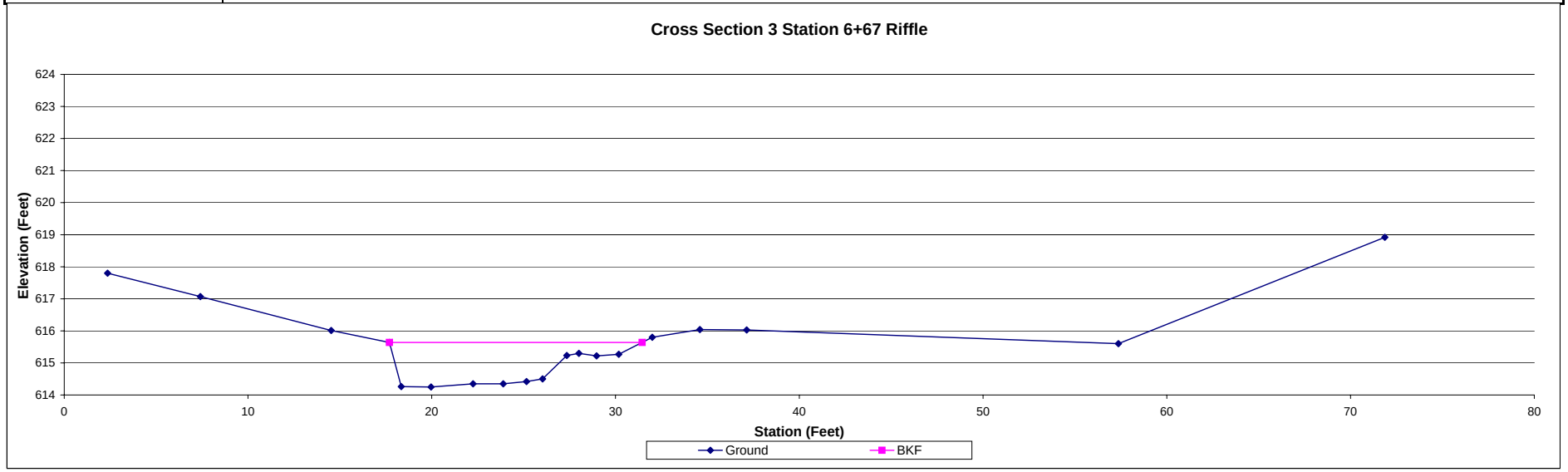
Project:	New Town Trib-Reference
Cross Section 3	
Feature	Riffle
Station:	6+67
Date:	2-Feb-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	12.8
W (BKF)	13.8
Max d	1.4
Mean d	0.9
W/D	14.7

Baseline Section

Station	Elevation	Notes
2.36	617.80	X3
7.41	617.07	X3
14.53	616.01	X3
17.70	615.64	Bankfull Left
18.34	614.26	X3TOE
19.96	614.25	X3TW
22.25	614.35	X3
23.89	614.35	X3
25.16	614.42	X3
26.03	614.50	X3TOE
27.35	615.23	X3
28.01	615.30	X3
28.97	615.22	X3
30.18	615.27	X3
32.00	615.80	Bankfull Right
34.59	616.04	TOBR
37.14	616.03	X3
57.37	615.60	X3
71.87	618.92	X3

Photo of XS-3, looking in the downstream direction



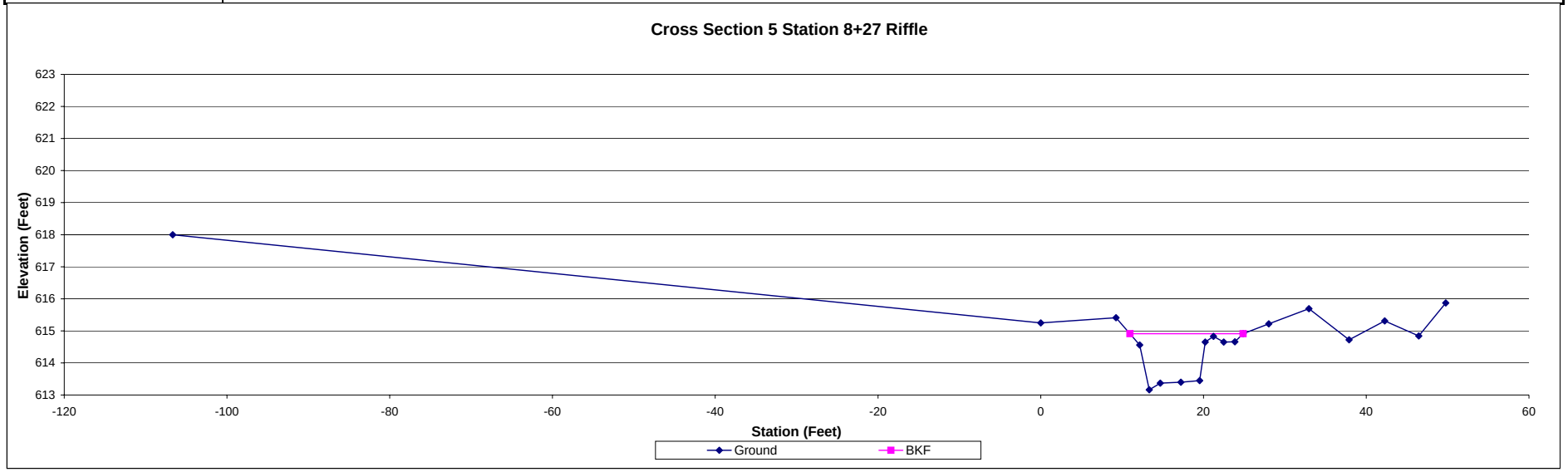
Project:	New Town Trib-Reference
Cross Section	5
Feature	Riffle
Station:	8+27
Date:	2-Feb-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	13.0
W (BKF)	13.9
Max d	1.8
Mean d	0.9
W/D	14.8

Baseline Section

Station	Elevation	Notes
-106.66	618.00	TOPO
0.00	615.25	X5
9.25	615.41	Bankfull Left
12.16	614.56	X5
13.34	613.16	X5TW
14.69	613.37	X5
17.22	613.40	X5
19.53	613.45	X5TOE
20.22	614.65	X5
21.23	614.83	TOBR
22.49	614.65	X5
23.86	614.66	X5
24.87	614.91	Bankfull Right
28.02	615.22	X5
32.96	615.69	X5
37.89	614.72	X5
42.27	615.31	X5
46.46	614.84	X5
49.78	615.87	X5

Photo of XS-5, looking in the downstream direction



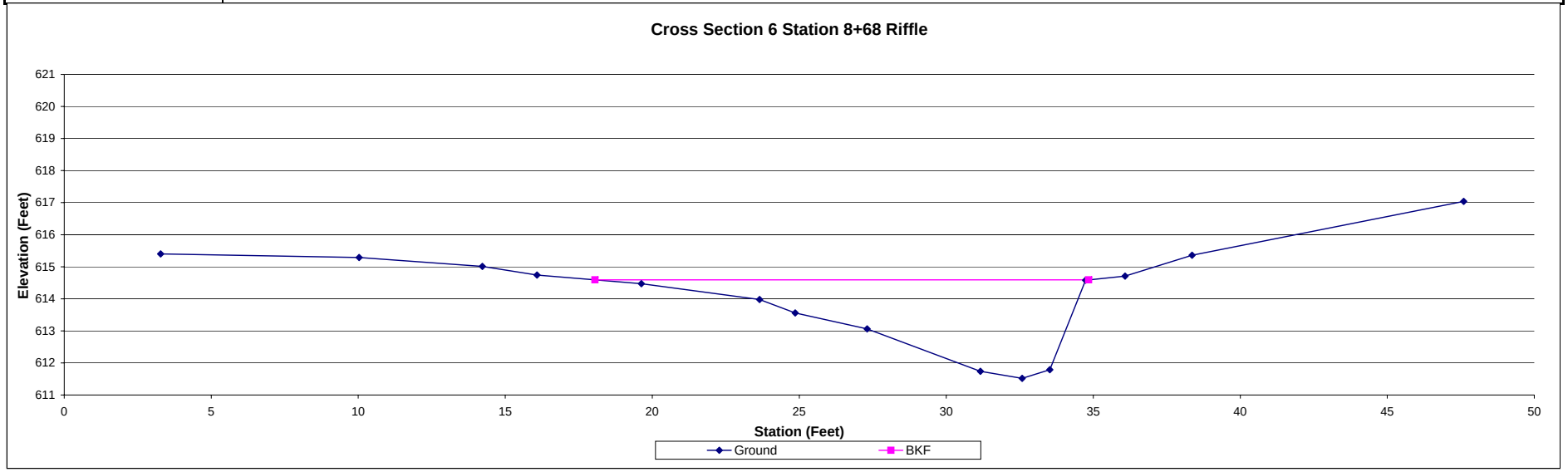
Project:	New Town Trib-Reference
Cross Section	6
Feature	Riffle
Station:	8+68
Date:	2-Feb-10
Crew:	BW, RL, SV

Bankfull Summary	
A (BKF)	22.9
W (BKF)	16.8
Max d	3.1
Mean d	1.4
W/D	12.3

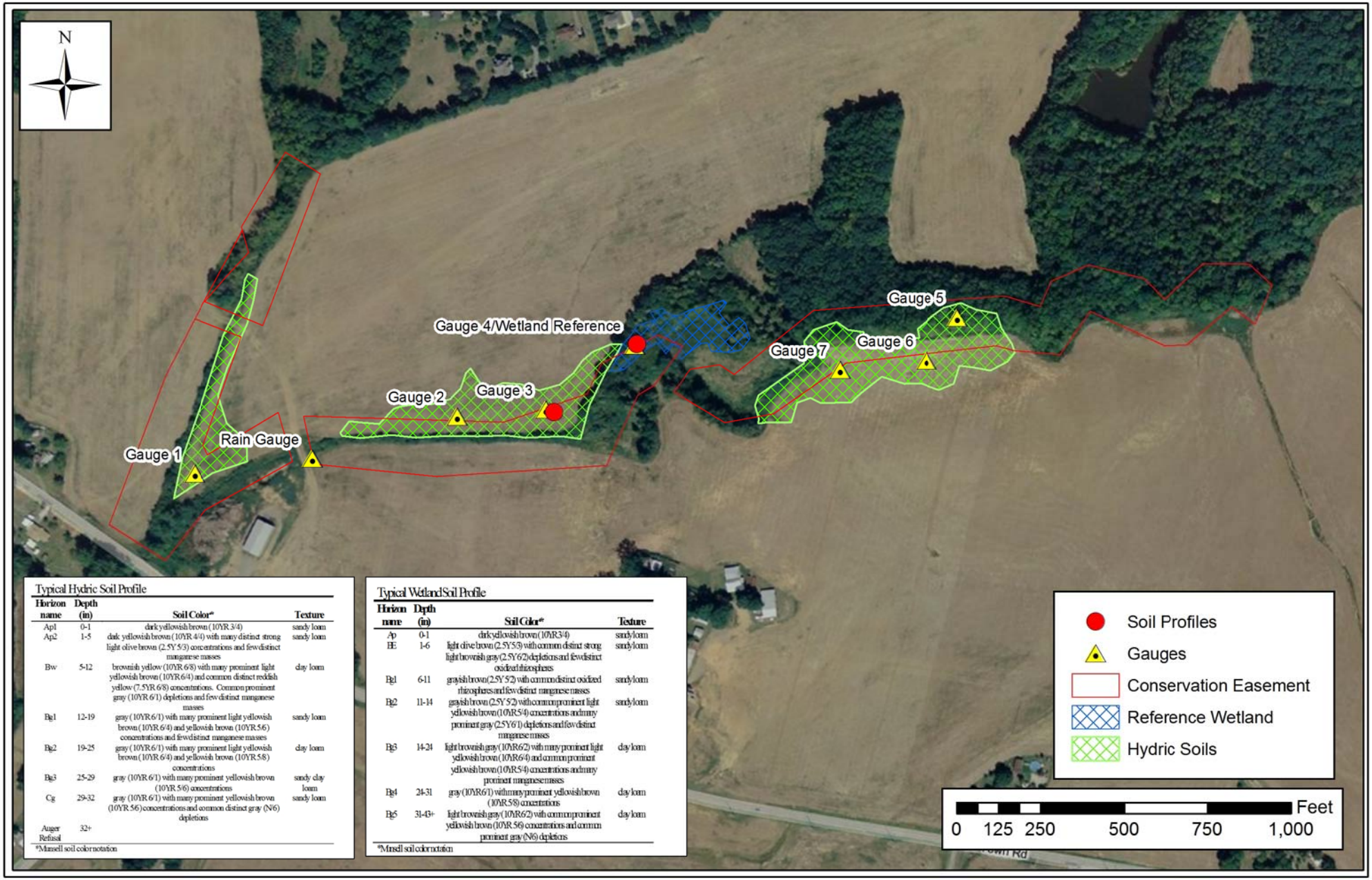
Baseline Section

Station	Elevation	Notes
3.28	615.40	X6
10.03	615.29	X6
14.22	615.01	X6
16.08	614.74	X6
19.63	614.47	Bankfull Left
23.65	613.98	TOBL
24.86	613.56	X6
27.31	613.06	X6
31.16	611.74	X6
32.58	611.52	X6TW
33.52	611.79	X6TOE
34.74	614.58	TOBR
36.08	614.71	Bankfull Right
38.36	615.36	X6
47.60	617.04	X6

Photo of XS-6, looking in the downstream direction



Appendix 5: Restoration Site Soil Boring Location Map and Log



Typical Hydric Soil Profile

Horizon name	Depth (in)	Soil Color*	Texture
Ap1	0-1	dark yellowish brown (10YR 3/4)	sandy loam
Ap2	1-5	dark yellowish brown (10YR 4/4) with many distinct strong light olive brown (2.5Y 5/3) concentrations and few distinct manganese masses	sandy loam
Bw	5-12	brownish yellow (10YR 6/8) with many prominent light yellowish brown (10YR 6/4) and common distinct reddish yellow (7.5YR 6/8) concentrations. Common prominent gray (10YR 6/1) depletions and few distinct manganese masses	clay loam
Bg1	12-19	gray (10YR 6/1) with many prominent light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/6) concentrations and few distinct manganese masses	sandy loam
Bg2	19-25	gray (10YR 6/1) with many prominent light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/8) concentrations	clay loam
Bg3	25-29	gray (10YR 6/1) with many prominent yellowish brown (10YR 5/6) concentrations	sandy clay loam
Cg	29-32	gray (10YR 6/1) with many prominent yellowish brown (10YR 5/6) concentrations and common distinct gray (N6) depletions	sandy loam
Auger Refusal	32+		

*Munsell soil color notation

Typical Wetland Soil Profile

Horizon name	Depth (in)	Soil Color*	Texture
Ap	0-1	dark yellowish brown (10YR 3/4)	sandy loam
BE	1-6	light olive brown (2.5Y 5/3) with common distinct strong light brownish gray (2.5Y 6/2) depletions and few distinct oxidized rhizospheres	sandy loam
Bg1	6-11	grayish brown (2.5Y 5/2) with common distinct oxidized rhizospheres and few distinct manganese masses	sandy loam
Bg2	11-14	grayish brown (2.5Y 5/2) with common prominent light yellowish brown (10YR 5/4) concentrations and many prominent gray (2.5Y 6/1) depletions and few distinct manganese masses	sandy loam
Bg3	14-24	light brownish gray (10YR 6/2) with many prominent light yellowish brown (10YR 6/4) and common prominent yellowish brown (10YR 5/4) concentrations and many prominent manganese masses	clay loam
Bg4	24-31	gray (10YR 6/1) with many prominent yellowish brown (10YR 5/8) concentrations	clay loam
Bg5	31-43+	light brownish gray (10YR 6/2) with common prominent yellowish brown (10YR 5/6) concentrations and common prominent gray (N6) depletions	clay loam

*Munsell soil color notation

The Catena Group

Newtown Soil Log and Profile Description Location Map

Aerial Orthophotography
(Source: Microsoft Virtual Earth)

Date: April 2010

Scale: As Shown

Job No.: 4143

Appendix 5

Appendix 6: Categorical Exclusion Approved Check List

Kimley-Horn
and Associates, Inc.

November 11, 2009

Suite 300
4651 Charlotte Park Drive
Charlotte, North Carolina
28217-1911

Mr. Donnie Brew
Environmental Protection Specialist
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, North Carolina 27601

Re: Newtown Stream and Wetland Mitigation Project
Full Delivery Project
Union County, North Carolina

Dear Mr. Brew:

This letter serves to transmit a Categorical Exclusion Form for the above referenced Ecosystem Enhancement Program Project to your agency for your review and approval.

The Newtown Stream and Wetland Mitigation Project is located approximately 4.5 miles west of the Town of Monroe on Newtown Road (Figure 1). The project proposes restorative work on Underwood Creek and an Unnamed Tributary to Underwood Creek and wetlands adjacent to these streams. Restoration of these tributaries and their buffers will reduce the amount of sediment, nutrient, and fecal coliform flowing from the site and improve water quality. In addition, degraded (converted) and existing wetlands are disconnected from the stream and are no longer riverine in nature. As a result, these wetlands can no longer perform water quality, quantity, and habitat functions of a riverine wetland and will be enhanced or restored.

I appreciate your assistance with this matter. If you have any questions regarding this application, please do not hesitate to call me at 704.409.1802.

Very truly yours,

KIMLEY-HORN AND ASSOCIATES, INC.

Chris Tinklenberg
Environmental Analyst

TEL 704 333 5131
FAX 704 333 0845

Version 1.4, 8/18/05

Categorical Exclusion Form for Ecosystem Enhancement Program Projects

Part 1: General Project Information	
Project Name:	Newtown Stream and Wetland Mitigation Project
County Name:	Union County, North Carolina
EEP Number:	RFP#16-001117
Project Sponsor:	Environmental Banc & Exchange, LLC
Project Contact Name:	Norton Webster (919) 829-9909
Project Contact Address:	909 Capability Dr., Suite 3100, Raleigh, NC 27606
Project Contact E-mail:	norton@ebxusa.com
EEP Project Manager:	Tim Baumgartner (919) 715-7915

Project Description

The project involves approximately 5,088 feet of Underwood Creek and an Unnamed Tributary to Underwood Creek. The project will create stable stream banks and a riffle/pool system as well as provide the opportunity to establish root mass, which provides bank stability and habitat from the edge of the water throughout the flood plain. The project will seek to re-establish the riparian flood plain corridor with native forested vegetation and microtopography.

For Official Use Only

Reviewed By:

Date | **EEP Project Manager**

Conditional Approved By:

Date | **For Division Administrator FHWA**

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

Final Approval By:

Date | **For Division Administrator FHWA**

Part 2: All Projects	
Regulation/Question	**Response**
Coastal Zone Management Act (CZMA)	
1. Is the project located in a CAMA county?	☐ Yes ☒ No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?	☐ Yes ☐ No ☒ N/A

3. Has a CAMA permit been secured?	☐Yes ☐No ☒N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?	☐Yes ☐No ☒N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	
1. Is this a "full-delivery" project?	☒Yes ☐No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?	☐Yes ☒No ☐N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐Yes ☒No ☐N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐Yes ☐No ☒N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?	☐Yes ☐No ☒N/A
6. Is there an approved hazardous mitigation plan?	☐Yes ☐No ☒N/A
National Historic Preservation Act (Section 106)	
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?	☐Yes ☒No
2. Does the project affect such properties and does the SHPO/THPO concur?	☐Yes ☐No ☒N/A
3. If the effects are adverse, have they been resolved?	☐Yes ☐No ☒N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)	
1. Is this a "full-delivery" project?	☐Yes ☒No
2. Does the project require the acquisition of real estate?	☐Yes ☐No ☒N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	☐Yes ☐No ☒N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	☐Yes ☐No ☒N/A

Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☐Yes ☒No
2. Is the site of religious importance to American Indians?	☐Yes ☐No ☒N/A

3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	☐Yes ☐No ☒N/A
4. Have the effects of the project on this site been considered?	☐Yes ☐No ☒N/A
Antiquities Act (AA)	
1. Is the project located on Federal lands?	☐Yes ☒No
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	☐Yes ☐No ☒N/A
3. Will a permit from the appropriate Federal agency be required?	☐Yes ☐No ☒N/A
4. Has a permit been obtained?	☐Yes ☐No ☒N/A
Archaeological Resources Protection Act (ARPA)	
1. Is the project located on federal or Indian lands (reservation)?	☐Yes ☒No
2. Will there be a loss or destruction of archaeological resources?	☐Yes ☐No ☒N/A
3. Will a permit from the appropriate Federal agency be required?	☐Yes ☐No ☒N/A
4. Has a permit been obtained?	☐Yes ☐No ☒N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	☒Yes ☐No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	☐Yes ☒No ☐N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	☐Yes ☐No ☒N/A
4. Is the project "likely to adversely affect" the species and/or "likely to adversely modify" Designated Critical Habitat?	☐Yes ☐No ☒N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	☒Yes ☐No ☐N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	☐Yes ☐No ☒N/A
Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	☐Yes ☒No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	☐Yes ☐No ☒N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	☐Yes ☐No ☒N/A

Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	☒Yes ☐No
2. Has NRCS determined that the project contains prime, unique, statewide or locally important farmland?	☒Yes ☐No ☐N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	☒Yes ☐No ☐N/A
Fish and Wildlife Coordination Act (FWCA)	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	☒Yes ☐No
2. Have the USFWS and the NCWRC been consulted?	☒Yes ☐No ☐N/A
Land and Water Conservation Fund Act (Section 6(f))	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	☐Yes ☒No
2. Has the NPS approved of the conversion?	☐Yes ☐No ☒N/A
Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)	
1. Is the project located in an estuarine system?	☐Yes ☒No
2. Is suitable habitat present for EFH-protected species?	☐Yes ☐No ☒N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	☐Yes ☐No ☒N/A
4. Will the project adversely affect EFH?	☐Yes ☐No ☒N/A
5. Has consultation with NOAA-Fisheries occurred?	☐Yes ☐No ☒N/A
Migratory Bird Treaty Act (MBTA)	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	☐Yes ☒No
2. Have the USFWS recommendations been incorporated?	☐Yes ☐No ☒N/A
Wilderness Act	
1. Is the project in a Wilderness area?	☐Yes ☒No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	☐Yes ☐No ☒N/A

Threatened and Endangered Species

Kimley-Horn
and Associates, Inc.

October 20, 2009

Suite 300
4651 Charlotte Park Drive
Charlotte, North Carolina
28217-1911

Mr. Dale Suiter
United States Fish and Wildlife Service
P.O. Box 33726
Raleigh, NC 27636-3726

Subject: Newtown Stream and Wetland Mitigation Project in Union County
Full Delivery Project
Union County, North Carolina

Dear Mr. Suiter,

The Newtown site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. The existing channel is significantly degraded and highly unstable due to impacts from adjacent agricultural practices (see attached USGS site maps with approximate property lines and areas of potential ground disturbance, as depicted by the Concept Easement area).

The project will create stable stream banks and a riffle/pool system as well as provide the opportunity to establish root mass, which provides bank stability and habitat from the edge of the water throughout the flood plain. The project will seek to re-establish the riparian flood plain corridor with native forested vegetation and microtopography. Heavy equipment will be used to help restore natural channel pattern and profile.

We have already obtained an updated species list for Union County from your website (http://nc-es.fws.gov/es/countyfr.html). **Table 1** (below) lists the federally protected species for Union County. We are requesting that you please provide any known information for each species in the county.

Table 1. Federally Protected Species Listed for Union County, North Carolina

Common Name	Scientific Name	Federal Status	Suitable Habitat Present	Biological Conclusion
Carolina heelsplitter	*Lasmigona decorata*	E	No	No Effect
Michaux's sumac	*Rhus michauxii*	E	No	No Effect
Shweinitz's sunflower	*Helianthus schweinitzii*	E	No	No Effect

Note: E=Endangered

Critical habitat has been designated for the Carolina heelsplitter in Union County. However, this project is not listed in any of the specific critical habitat areas, nor does the

TEL 704 333 5131
FAX 704 333 0845

existing channel exhibit any of the primary constituent elements as described in the critical habitat designation.

Please provide comments on any possible issues that might emerge with respect to endangered species, migratory birds, or other trust resources as a result of constructing a wetland and stream restoration project on the subject property. A USGS map showing the approximate property lines, areas of potential ground disturbance, and action area is enclosed.

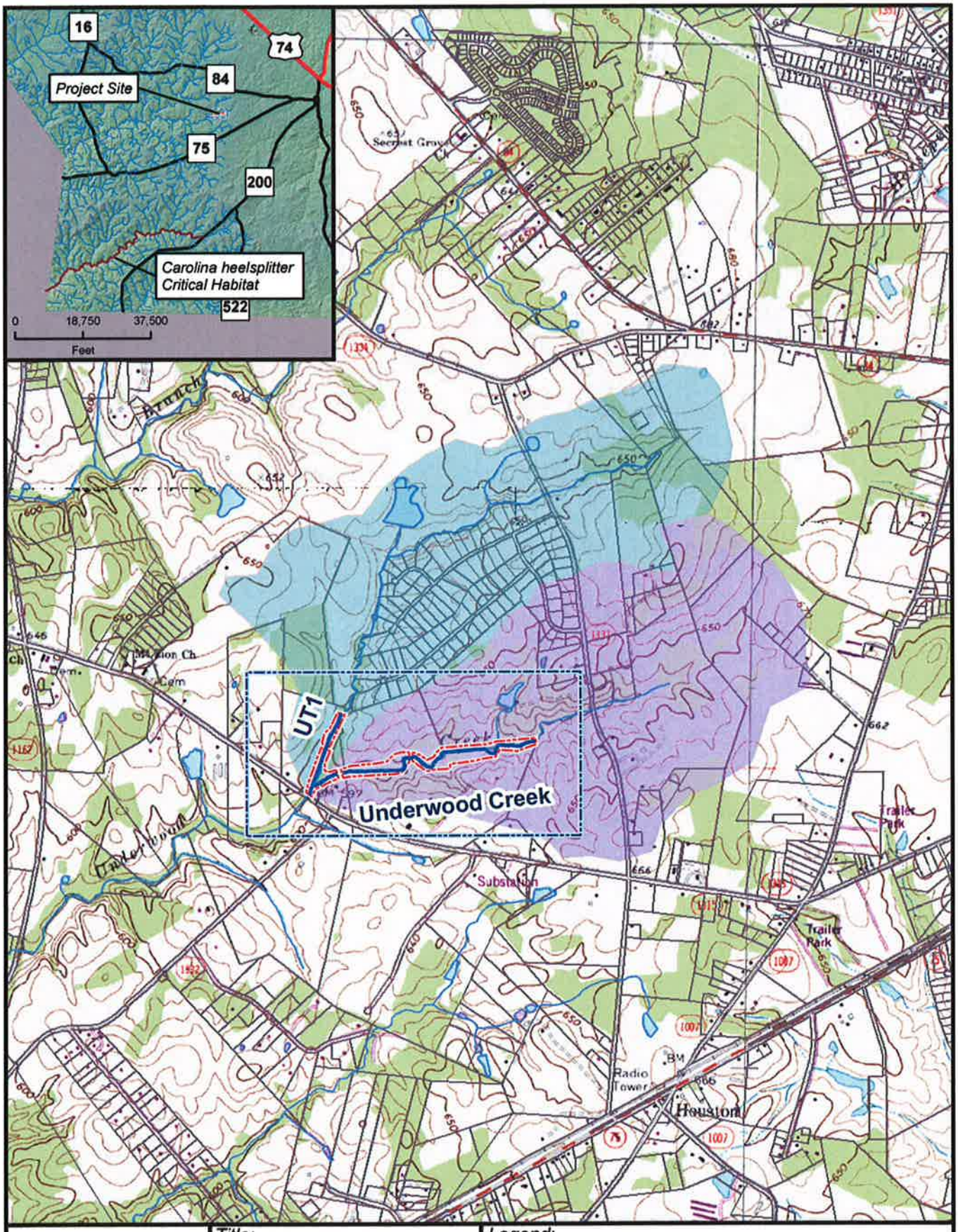
If we have not heard from you in 30 days, we will assume that our species list is correct, that you do not have any comments regarding associated laws, and that you do not have any information relevant to this project at the current time.

Thank you in advance for your timely response and cooperation. Please email (Jason.Diaz@Kimley-Horn.com) or fax (704-333-0845) a copy of your reply to my attention and send an original copy by mail. If you have any questions regarding this request, please call me at (704) 954-7464.

Sincerely,

Kimley-Horn and Associates, Inc.

Jason Claudio-Diaz, P.E., CFM



EBX

Ecosystem Enhancement Program

Kimley-Horn and Associates, Inc.

Title: USGS Site Map

0 1,000 2,000
Feet

Legend:

- Existing Streams
- DWQ Catawba Streams
- UT1 Watershed
- Underwood Creek Watershed
- Action Area
- Concept Easement
- Parcel Boundaries

NC Wildlife Resources Commission Correspondence

Kimley-Horn
and Associates, Inc.

October 20, 2009

Suite 300
4651 Charlotte Park Drive
Charlotte, North Carolina
28217-1911

Shannon Deaton
North Carolina Wildlife Resource Commission
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699

Subject: Newtown Stream and Wetland Mitigation Project in Union County
Full Delivery Project
Union County, North Carolina

Dear Ms. Deaton,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with a potential wetland and stream restoration project on the Newtown site (see attached USGS site map with approximate property lines and areas of potential ground disturbance, as depicted by the Concept Easement area).

The Newtown site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Several sections of channel are significantly degraded and highly unstable due to impacts from adjacent agricultural practices.

Thank you in advance for your timely response and cooperation. Please email (Jason.Diaz@Kimley-Horn.com) or fax (704-333-0845) a copy of your reply to my attention and send an original copy by mail. If you have any questions regarding this request or the extent of site disturbance associated with this project, please call me at (704) 954-7464.

Sincerely,

Kimley-Horn and Associates, Inc.

Jason Claudio-Diaz, P.E., CFM

TEL 704 333 5131
FAX 704 333 0845

EBX

Ecosystem Enhancement Program

Kimley-Horn and Associates, Inc.

Title: USGS Site Map

0 1,000 2,000

Feet

N

Legend:

- Existing Streams
- DWQ Catawba Streams
- Action Area
- Concept Easement
- Parcel Boundaries

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

30 October 2009

Mr. Jason Claudio-Diaz
Kimley-Horn and Associates, Inc.
4651 Charlotte Park Drive
Suite 300
Charlotte, NC 28217

Subject: Newtown Stream and Wetland Mitigation Project – Union County, North Carolina.

Dear Mr. Claudio-Diaz:

Biologists with the North Carolina Wildlife Resources Commission have reviewed the subject information. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667d) and North Carolina General Statutes (G.S. 113-131 et seq.).

The proposed project includes stream and wetland restoration on the Newtown site. Several sections of stream channel are significantly degraded and highly unstable due to adjacent agricultural activities. Underwood Creek is a tributary to Little Twelvemile Creek in the Catawba River basin. There are records for the federal species of concern and state special concern Carolina darter (*Etheostoma collis*), and the state significantly rare Eastern creekshell (*Villosa delumbis*) in Little Twelvemile Creek.

Stream and wetland restoration projects often improve water quality and aquatic habitat. We recommend establishing native, forested buffers in riparian areas to protect water quality, improve terrestrial habitat, and provide a travel corridor for wildlife species. Provided natural channel design methods are used and measures are taken to minimize erosion and sedimentation from construction/restoration activities, we do not anticipate the project to result in significant adverse impacts to aquatic and terrestrial wildlife resources.

Thank you for the opportunity to review this project. If we can provide further assistance, please contact our office at (336) 449-7625.

Sincerely,

Shari L. Bryant

Shari L. Bryant
Piedmont Region Coordinator
Habitat Conservation Program

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

Natural Resource Conservation Service
Correspondence

Kimley-Horn
and Associates, Inc.

October 20, 2009

Suite 300
4651 Charlotte Park Drive
Charlotte, North Carolina
28217-1911

Mr. Kent Clary
NRCS Regional Soil Specialist
589 Raccoon Road, Suite 246
Waynesville, NC 28786-3217

Subject: Newtown Stream and Wetland Mitigation Project in Union County
Full Delivery Project
Union County, North Carolina

Dear Mr. Clary,

Kimley-Horn and Associates, Inc. is writing this letter on behalf of our client, Environmental Banc & Exchange, LLC, to request input from your agency regarding a proposed wetland and stream restoration site and the potential effects it may have on farmland resources. This project is a full delivery project for the North Carolina Ecosystem Enhancement Program. We have completed sections I and III of the attached Form AD-1006. Also enclosed is a USGS site map with approximate property lines and areas of potential ground disturbance, as depicted by the Concept Easement area.

Thank you in advance for your timely response and cooperation. Please email (Jason.Diaz@Kimley-Horn.com) or fax (704-333-0845) a copy of your reply to my attention and send an original copy by mail. If you have any questions regarding this request, please call me at (704) 954-7464.

Sincerely,

Kimley-Horn and Associates, Inc.

Jason Claudio-Diaz, P.E., CFM

TEL 704 333 5131
FAX 704 333 0845

EBX

Ecosystem Enhancement Program

Kimley-Horn and Associates, Inc.

Title: USGS Site Map

0 1,000 2,000

Feet

N

Legend:

- Existing Streams
- DWQ Catawba Streams
- Action Area
- Concept Easement
- Parcel Boundaries

United States Department of Agriculture

NRCS
Natural Resources Conservation Service
589 Raccoon Road, Suite 246
Waynesville, NC 28786
Phone 828 456-6341 ext. 5 FAX 828 452-7031

October 27, 2009

Jason Claudio-Diaz, P.E., CFM
Kimley-Horn and Associates, Inc.
4651 Charlotte Park Drive Suite 300
Charlotte, NC 28217-1911

Re: USDA Farmland Conversion Impact Rating Forms (AD-1006)
Newtown Stream and Wetland Mitigation Project - Union County, NC

Mr. Claudio-Diaz,

Attached you will find an AD-1006 with Parts II, IV, and V completed as required of NRCS. Based on the maps that you provided, it appears that 16.0 acres of prime farmland and 1.5 acres of statewide important farmland will be impacted by the proposed project. Also attached for your reference is a soils map of the site and a Farmland Classification report generated from the Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/).

If I can be of further assistance, please feel free to contact me.

M. Kent Clary

M. Kent Clary
Area Resource Soil Scientist
USDA-NRCS

cc w/attach.: Mark Ferguson, District Conservationist, USDA-NRCS, Monroe, NC

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 8/20/09
Name Of Project Newtown Stream and Wetland Restoration	Federal Agency Involved FHWA
Proposed Land Use Conservation Easement	County And State Union County, North Carolina
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 10/22/2009

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).* Yes ☑ No ☐		Acres Irrigated 0	Average Farm Size 161 ACRES
Major Crop(s) CORN, HAY, SOYBEANS, WHEAT	Farmable Land In Govt. Jurisdiction Acres: 384,651 %94	Amount Of Farmland As Defined in FPPA Acres: 291,581 %77	
Name Of Land Evaluation System Used UNION CALES	Name Of Local Site Assessment System	Date Land Evaluation Returned By NRCS 10/27/2009	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	17.5			
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	17.5	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	16.0			
B. Total Acres Statewide And Local Important Farmland	1.5			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	<.1			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	41.4			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	* 87	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use					
2. Perimeter In Nonurban Use					
3. Percent Of Site Being Farmed					
4. Protection Provided By State And Local Government					
5. Distance From Urban Builtup Area					
6. Distance To Urban Support Services					
7. Size Of Present Farm Unit Compared To Average					
8. Creation Of Nonfarmable Farmland					
9. Availability Of Farm Support Services					
10. On-Farm Investments					
11. Effects Of Conversion On Farm Support Services					
12. Compatibility With Existing Agricultural Use					
TOTAL SITE ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	0	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	0	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	0	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

Form AD-1006 (10-83)

This form was electronically produced by National Production Services Staff

Farmland Classification

Farmland Classification— Summary by Map Unit — Union County, North Carolina				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BaB	Badin channery silt loam, 2 to 8 percent slopes	Farmland of statewide importance	0.2	1.0%
BaC	Badin channery silt loam, 8 to 15 percent slopes	Farmland of statewide importance	1.2	6.7%
ChA	Chewacla silt loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	15.8	90.3%
CmB	Cid channery silt loam, 1 to 5 percent slopes	Farmland of statewide importance	0.2	0.9%
TbB2	Tarrus gravelly silty clay loam, 2 to 8 percent slopes, moderately eroded	All areas are prime farmland	0.2	1.2%
Totals for Area of Interest			**17.5**	**100.0%**

Description

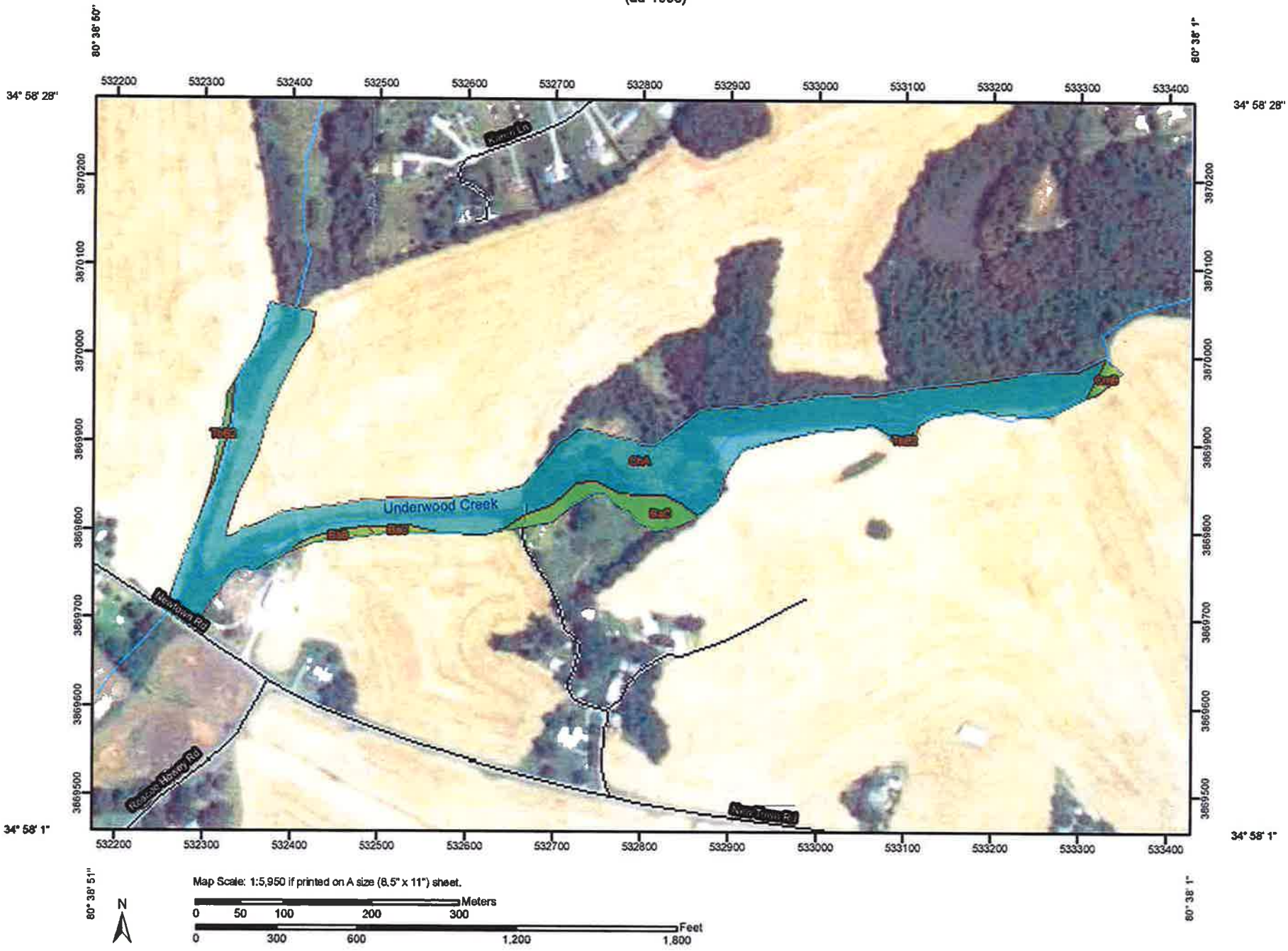
Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

Rating Options

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

Farmland Classification—Union County, North Carolina
(ad-1006)



U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 8/20/09
Name Of Project Newtown Stream and Wetland Restoration	Federal Agency Involved FHWA
Proposed Land Use Conservation Easement	County And State Union County, North Carolina
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 10/22/2009

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).* Yes ☑ No ☐

Acres Irrigated	Average Farm Size
0	161 ACRES

Major Crop(s)	Farmable Land In Govt. Jurisdiction	Amount Of Farmland As Defined in FPPA
CORN, HAY, SOYBEANS, WHEAT	Acres: 384,651 %94	Acres: 291,581 %77
Name Of Land Evaluation System Used: UNION CALES	Name Of Local Site Assessment System	Date Land Evaluation Returned By NRCS: 10/27/2009

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	17.5			
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	17.5	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	16.0			
B. Total Acres Statewide And Local Important Farmland	1.5			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	<.1			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	41.4			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	* 87	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	13			
2. Perimeter In Nonurban Use	10	10			
3. Percent Of Site Being Farmed	20	17			
4. Protection Provided By State And Local Government	20	20			
5. Distance From Urban Builtup Area	15	15			
6. Distance To Urban Support Services	15	0			
7. Size Of Present Farm Unit Compared To Average	10	0			
8. Creation Of Nonfarmable Farmland	10	0			
9. Availability Of Farm Support Services	5	5			
10. On-Farm Investments	20	12			
11. Effects Of Conversion On Farm Support Services	10	0			
12. Compatibility With Existing Agricultural Use	10	0			
TOTAL SITE ASSESSMENT POINTS	160	0 92	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	0 87	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	0 92	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	0 179	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Form AD-1006 (10-83)

State Historic Preservation Office Correspondence

Kimley-Horn
and Associates, Inc.

October 20, 2009

Suite 300
4651 Charlotte Park Drive
Charlotte, North Carolina
28217-1911

Ms. Renee Gledhill-Earley
Environmental Review Coordinator
North Carolina State Historic Preservation Office
515 Blount Street
Raleigh, NC 27699

Subject: Newtown Stream and Wetland Mitigation Project in Union County
Full Delivery Project
Union County, North Carolina

Dear Ms. Gledhill-Earley,

Kimley-Horn and Associates, Inc (KHA) is writing this letter on behalf of our client, Environmental Banc & Exchange, LLC (EBX), to request a review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential wetland and stream restoration project on the Newtown site (see attached USGS site maps with approximate property lines and areas of potential ground disturbance, as depicted by the Concept Easement area).

The Newtown site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. The existing channel is significantly degraded and highly unstable due to impacts from adjacent agricultural practices.

No architectural structures or archeological artifacts were observed or noted during preliminary surveys of the site conducted by KHA or EBX staff for restoration purposes. Historically, the majority of the site has been disturbed due to agricultural purposes such as tilling. Enclosed are current photos of the site.

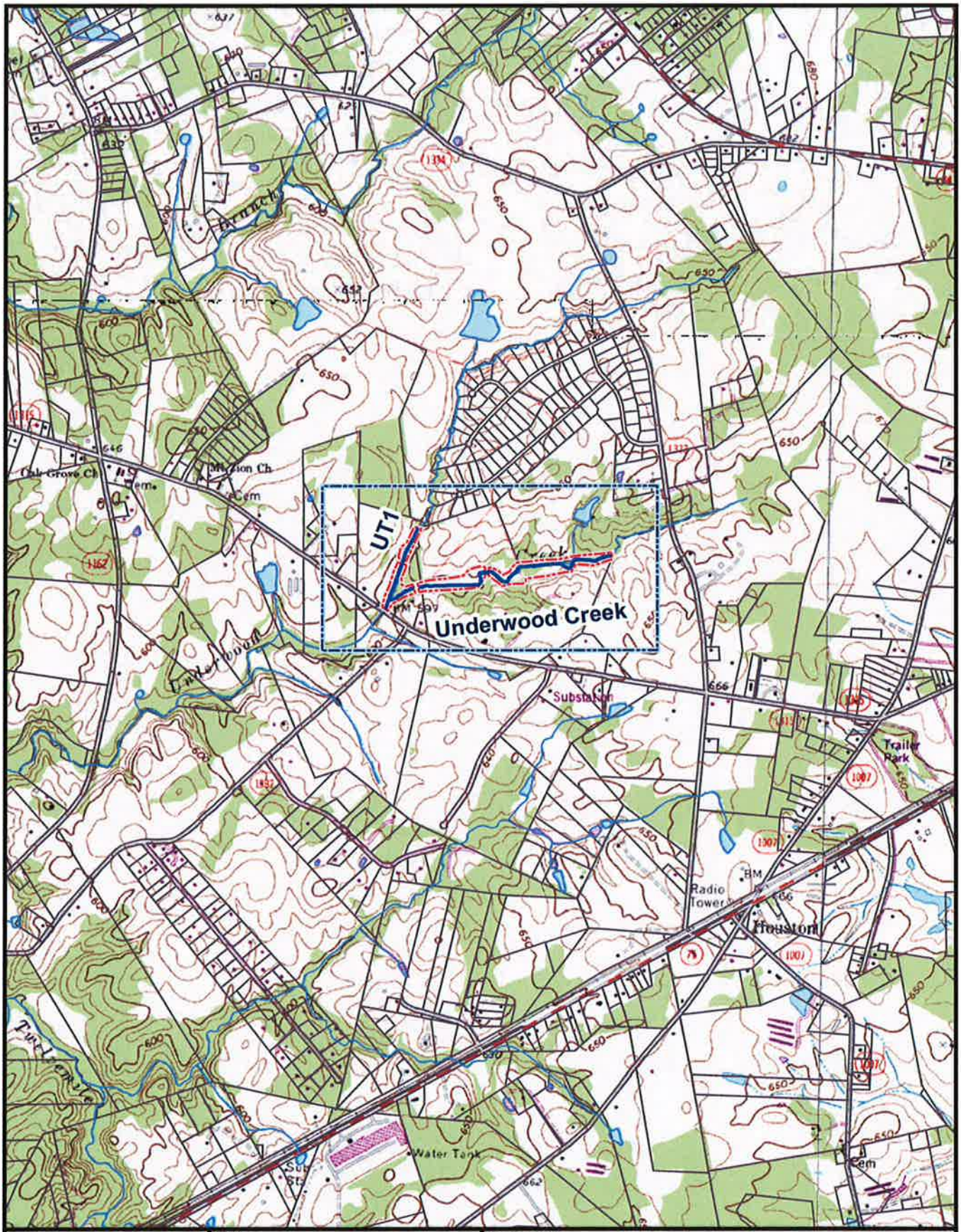
We request that you review this site based on the attached information to determine the presence of any historic properties. Thank you in advance for your timely response and cooperation. Please email (Jason.Diaz@Kimley-Horn.com) or fax (704-333-0845) a copy of your reply to my attention and send an original copy by mail. If you have any questions regarding this request, please call me at (704) 954-7464.

Sincerely,

Kimley-Horn and Associates, Inc.

Jason Claudio-Diaz, P.E., CFM

TEL 704 333 5131
FAX 704 333 0845


UT1
Underwood Creek
Substation
Trailer Park
Radio Tower
Houston
Water Tank
Old Grove Ch
Mission Ch
Cem
Title: USGS Site Map
0 1,000 2,000
Feet
N
Legend:
Existing Streams
DWQ Catawba Streams
Action Area
Concept Easement
Parcel Boundaries
EBX
Ecosystem Enhancement Program
Kimley-Horn and Associates, Inc.

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

Beverly Eaves Perdue, Governor
Linda A. Carlisle, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

November 3, 2009

Jason Claudio-Diaz
Kimley-Horn and Associates, Inc.
4651 Charlotte Park Drive
Suite 300
Charlotte, NC 28217

Re: Newtown Stream and Wetland Mitigation Project, Union County, ER 09-2640

Dear Mr. Claudio-Diaz:

Thank you for your letter of October 20, 2009, concerning the above project.

We have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579. In all future communication concerning this project, please cite the above-referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

Appendix 7: FEMA FIRM Panel 5404

STATE OF NORTH CAROLINA FIRM PANEL LOCATOR DIAGRAM

DATUM INFORMATION

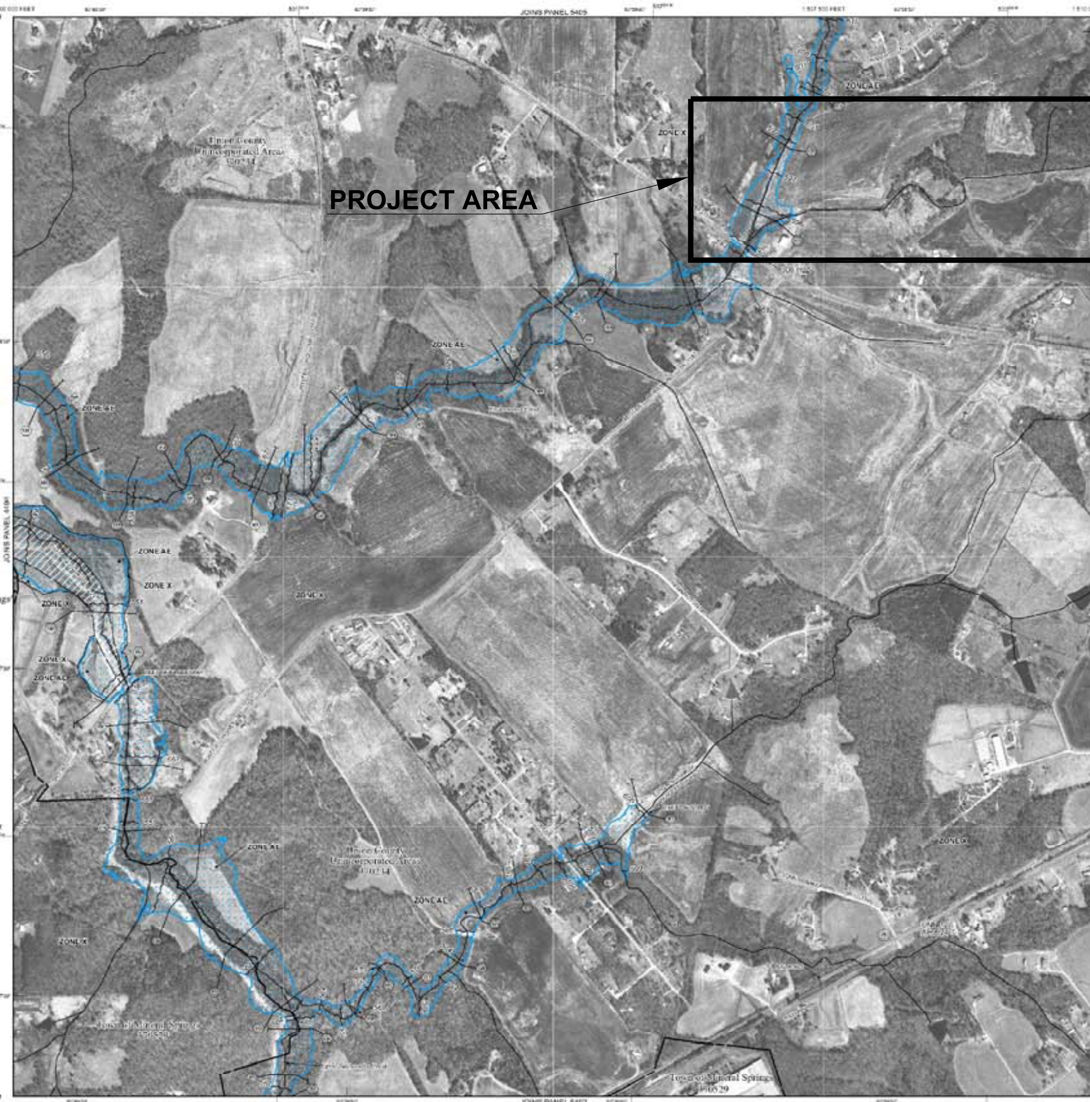
All streams listed in the **Flood Hazard Data Table** below were studied by detailed methods using field survey. Other flood hazard data shown on this map may have been derived using either a coastal analysis or limited detailed Riverine analysis. More information on the flooding sources studied by these analyses is contained in the Flood Insurance Study report.

FLOOD HAZARD DATA TABLE

Cross Section	Stream Station ¹	Peak Discharge (cfs)	1% Annual Chance (100-year) Water Surface Elevation (feet NAVD 88)	Floodway Width (feet) Left/Right Distance from the Center of Stream to Encroachment Boundary (Looking Downstream) or Total Floodway Width
LITTLE TWELVEMILE CREEK				
155	15,540	NA	551.2	151
164	16,380	NA	553.1	62

¹ Feet above mouth

www.ncfloodmaps.com



LEGEND

NOTES TO USERS

GRID NORTH
MAP SCALE 1" = 500' (1 : 6,000)

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 5404J

FIRM
FLOOD INSURANCE RATE MAP
NORTH CAROLINA

PANEL 5404

EFFECTIVE DATE
OCTOBER 16, 2008

MAP NUMBER
3710540400J

State of North Carolina
Federal Emergency Management Agency