BASELINE MONITORING DOCUMENT & AS-BUILT BASELINE REPORT

UNNAMED TRIBUTARY TO MILLERS CREEK STREAM AND WETLAND MITIGATION SITE

Duplin County, North Carolina
DMS Project # 95719

Prepared for:

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Data Collected: March 1 – April 2, 2015
Submitted: July 31, 2015

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I HEREBY CERTIFY THAT THE DOCUMENTS CONTAINED HEREIN, UNNAMED TRIBUTARY TO MILLERS CREEK STREAM AND WETLAND MITIGATION BASELINE MONITORING DOCUMENT & AS-BUILT BASELINE REPORT, WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNED SEALED, AND DATED THIS 31ST DAY OF JULY 2015.

Kathleen M McKeithan

Kathleen M. McKeithan, PE

EXECUTIVE SUMMARY

The North Carolina Department of Environmental and Natural Resources Division of Mitigation Services (DMS) contracted ICA Engineering, Inc. (ICA) to restore 2,625 linear feet of the Unnamed Tributary to Millers Creek (UT) and 4.5 acres of riparian wetlands within the Unnamed Tributary to Millers Creek Stream and Wetland Mitigation Site (hereafter referred to as the “Site”) to assist in fulfilling stream mitigation goals in the watershed. The Site is located approximately one-half (0.5) mile west of Magnolia in Duplin County, North Carolina and contains an unnamed tributary to Millers Creek and associated restored riparian wetlands. The Site is located within DMS Targeted Local Watershed Catalogue Unit (CU) 03030006. The Site is comprised of one property owned by William Jeffrey Hatcher and wife Susan King Hatcher (PIN # 247100987405).

Primary goals for the Site, as detailed in the Unnamed Tributary to Millers Creek Stream and Wetland Mitigation Site Mitigation Plan (ICA 2014) include:

1. Reducing stressors to water quality,
2. Providing/enhancing flood attenuation,
3. Restoring and enhancing aquatic, semi-aquatic and riparian habitat, and
4. Restoring and enhancing habitat connectivity with adjacent natural habitats.

The following objectives accomplish the goals listed above:

1. Removing stressors to water quality and increasing attenuation is directly tied to:
    a. Restoration of the formerly deeply incised and entrenched UT as a Priority I (PI) restoration where bankfull and larger flows access the historic floodplain allowing nutrients, sedimentation, trash and debris from upstream urban runoff to settle from floodwaters.
    b. Restoration of the UT as PI restoration allows the Site to mitigate flood flows by reconnecting bankfull and higher flows to its historic floodplain.
    c. Restoration of the riparian buffers and wetlands adjacent to the UT (i.e. restoration of an existing pond and ditch back to riparian wetlands) allows floodwaters to attenuate, in turn reducing stressors from upstream impacts.
    d. Restoration of wetland hydrology within the riparian buffer supports hydrophytic vegetation, which assists in the uptake, storage and fixation of nutrients and sedimentation from overbank flows. Adjacent low quality pine plantations were removed and planted with native hydrophytic vegetation.
2. Restoring and enhancing aquatic, semi-aquatic and terrestrial habitat is directly tied to:
    a. Introduction of woody materials such as planted vegetation, log sills, soil lifts and toe wood to the restored channel. Woody materials will promote shading, bed form diversity and foraging opportunities for aquatic organisms, benthic macroinvertebrates, and fish.
    b. Restoration of native vegetation to the stream channel banks and the adjacent riparian corridor has diversified flora and provides an abundance of

available foraging and cover habitat for amphibians, reptiles, mammals and birds.

c. Restoration of wetland hydrology and introducing floodwaters back to the historic floodplain provides a diversity of habitats for semi-aquatic flora and fauna that may have not been seen on the Site since before anthropogenic disturbances.

3. Habitat restoration and connectivity can be directly tied to:
   a. The removal of existing pine plantations and replanting of native vegetation.
   b. The restored community ensures a protected habitat corridor between the Site and the downstream mature riparian buffers and upland habitats.

The UT was ditched and channelized in its pre-construction condition. Spoil was wasted along both banks (primarily the left bank) which filled previously drained hydric soils. The UT flowed straight down the valley's fall line, lacking typical meander geometry of a Coastal Plain stream. The channel bed was uniform and lacked deeps and shallows. A ditch was excavated along the eastern portion of the Site, in what appears to have been an attempt at draining a riparian wetland crenulation that naturally drained into the UT. A pond was excavated through hydric soils (confirmed by analyzing spoil material) on the northern portions of the Site within a natural crenulation. 1951 aerial photographs depict what appears to be maintained agricultural fields. Agricultural fields were planted in pines in 2008.

Construction to implement the Mitigation Plan began in November 2014 and was completed in January of 2015. Site planting concluded on March 10, 2015. 2,709 linear feet of stream was restored by using Priority I restoration techniques, incorporating in-stream structures, and planting the riparian buffer with native vegetation. Restoration efforts increased stream length of the UT from 2,095 linear feet in its pre-construction state to 2,709 linear feet. Planting occurred within approximately 12.35 acres of the conservation easement including stream banks, floodplain, restored wetlands, and riparian buffers. Initial stem counts indicate an average of 850 planted stems per acre (excluding live stakes) across the Site.

The Mitigation Plan was implemented without any substantial modifications. The Site provides 2,709 feet (2,709 SMU's) of restored stream and 8.77 acres of (8.0 WMU's) of restored riparian wetlands. The Site is protected by a permanent conservation easement held by the State of North Carolina.

Monitoring Components and Duration

The first year monitoring report will be submitted in December 2015. Monitoring will continue for seven years or until agreed upon success criteria are achieved, with a report submitted by the end of December for each monitoring year. Annual monitoring includes surveys of morphological conditions for the restored stream, representative surveys of vegetation, data collection of static groundwater levels throughout the Site, and an annual monitoring report that compiles and analyzes data to determine success levels.

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1.0 PROJECT GOALS, BACKGROUND AND ATTRIBUTES

1.1 Location and Setting

The North Carolina Department of Environmental and Natural Resources Division of Mitigation Services (DMS) contracted ICA Engineering, Inc. (ICA) to restore 2,625 linear feet of the Unnamed Tributary to Millers Creek (UT) and 4.5 acres of riparian buffer within the Unnamed Tributary to Millers Creek Site (hereafter referred to as the "Site") to assist in fulfilling stream mitigation goals in the watershed. The Site is located approximately one-half (0.5) mile west of Magnolia in Duplin County, North Carolina (Figure 1).

Directions from Raleigh, NC:

- Take I-40 East to exit 373.
- Turn right on NC 903 and proceed 2.7 miles.
- Turn right onto N Pope Street in 489 feet continue onto Cemetery Street.
- Google maps the Site as Cemetery Street, Magnolia, NC 28453 (34.895893, -78.066702). Estimated travel time from DMS's Raleigh office is 1 hour 15 minutes.

The Site is located within Targeted Local Watershed Catalogue Unit (CU) 03030006. The Site is located in the Coastal Plains Physiographic Province of North Carolina.

1.2 Project Goals and Objectives

The following goals and objectives address the primary issues within the sub-basin and assist DMS in meeting planning goals.

Primary goals for the Site, as detailed in the Unnamed Tributary to Millers Creek Stream and Wetland Mitigation Site Mitigation Plan (ICA 2014) include:

1. Reducing stressors to water quality,
2. Providing/enhancing flood attenuation,
3. Restoring and enhancing aquatic, semi-aquatic and riparian habitat, and
4. Restoring and enhancing habitat connectivity with adjacent natural habitats.

The following objectives accomplish the goals listed above:

1. Removing stressors to water quality and increasing attenuation is directly tied to:
    a. Restoration of the formerly deeply incised and entrenched UT as a Priority I (PI) restoration where bankfull and larger flows access the historic floodplain allowing nutrients, sedimentation, trash and debris from upstream urban runoff to settle from floodwaters.
    b. Restoration of the UT as PI restoration allows the Site to mitigate flood flows by reconnecting bankfull and higher flows to its historic floodplain.

   c. Restoration of the riparian buffers and wetlands adjacent to the UT (i.e. restoration of an existing pond and ditch back to riparian wetlands) allows floodwaters to attenuate, in turn reducing stressors from upstream impacts.
   d. Restoration of wetland hydrology within the riparian buffer supports hydrophytic vegetation, which assists in the uptake, storage and fixation of nutrients and sedimentation from overbank flows. Adjacent low quality pine plantations were removed and planted with native hydrophytic vegetation.
2. Restoring and enhancing aquatic, semi-aquatic and terrestrial habitat is directly tied to:
   a. Introduction of woody materials such as planted vegetation, log sills, soil lifts and toe wood to the restored channel. Woody materials will promote shading, bed form diversity and foraging opportunities for aquatic organisms, benthic macroinvertebrates, and fish.
   b. Restoration of native vegetation to the stream channel banks and the adjacent riparian corridor has diversified flora and provides an abundance of available foraging and cover habitat for amphibians, reptiles, mammals and birds.
   c. Restoration of wetland hydrology and introducing floodwaters back to the historic floodplain provides a diversity of habitats for semi-aquatic flora and fauna that may have not been seen on the Site since before anthropogenic disturbances.
3. Habitat restoration and connectivity can be directly tied to:
   a. The removal of existing pine plantations and replanting of native vegetation.
   b. The restored community ensures a protected habitat corridor between the Site and the downstream mature riparian buffers and upland habitats.

1.3 Project Structure, Restoration Type and Approach

1.3.1 Project Structure

2,709 linear feet of the UT and 8.77 acres of riparian wetlands were restored at the Site. Table 1 provides a summary of project components and mitigation credits (Appendix A). The location of each Site component is depicted in Figure 2 (Appendix A).

1.3.2 Restoration Type and Approach

The proposed work plan included:

- Restoring 2,100 existing linear feet of the UT (2,709 restored feet) beginning near the southern property boundary and ending near the confluence with another unnamed tributary near the northern property boundary;
- Restoring wetland hydrology to 8.77 acres of drained and modified (ditched and ponded) hydric soils to restore riparian wetlands adjacent to the UT.

- Restoring native vegetation to 10.71 acres of riparian buffers that were cultivated as a pine plantation, ponded (excavated pond) or within disturbed areas.

The pre-construction reach of the UT was highly incised, as evidenced by bank height ratios averaging 3.8, and historic straightening and channelization. Higher than bankfull flows rarely reached the UT's historic floodplain. Additionally, a pine plantation was planted within the riparian buffer along the east side of the UT.

The mitigated reach of the UT is a PI restored channel where bankfull elevations match top of ground (the historic floodplain). The channel design incorporated several in-stream woody structures such as densely vegetated soil lifts, toe wood, and log sills. The restored channel is a moderately low width to depth ratio E type channel that conveys a bankfull discharge of approximately 8.4 cfs. Spoil berms adjacent to the pre-construction channel were removed to allow bankfull and higher flows access to the natural floodplain throughout the Site.

Native vegetative species characteristic of a Coastal Plain Small Stream Swamp (Schafale & Weakley 1990) were planted within the restored riparian buffer and restored wetlands.

Soil amendments added during and following construction promote grass and tree growth within the disturbed areas on-site (outside of wetland areas). Signs posted along the easement boundary clearly demarcate the easement boundary.

The target wetland type restored is a Coastal Plain Small Stream Swamp Forest, Blackwater Subtype according to Schafale & Weakley (1990). These communities occur on various alluvial or organic soils throughout the Inner Coastal Plain. Hydrology is intermittently to seasonally flooded with variable flow regimes.

The targeted wetland type is a Bottomland Hardwood Forest according to NCWAM (WFAT 2010). Bottomland Hardwood Forests occur in geomorphic floodplains of second-order and larger streams. This wetland type historically existed in the floodplain of the UT. Based upon a comprehensive wetland delineation of the Site, fragmented wetland areas continued to occur within the historic floodplain. However, these areas were relatively small, disjunct, and impaired via hydrologic modifications.

A second wetland community type targeted a man-made ditch and associated crenulation in the valley that connects to the UT approximately 1,000 feet north of the southern property line. The target community type for this former wetland is Headwater Forest based upon NCWAM classification (WFAT 2010). This community type occurs in geomorphic floodplains of first-order or smaller streams and in topographic crenulations without streams.

1.4 Project History, Contacts and Attribute Data

ICA Engineering, Inc. (ICA) provided engineering, design, and construction oversight services for the Site. Construction began in November 2014 and finished in January of 2015. Site planting finalized on March 10, 2015. Baseline monitoring field data collection occurred at separate times; stream morphological surveys were conducted in March through April of 2015 and nine (9) vegetation plots were installed and surveyed in March of 2015.

Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 2-4 (Appendix A).

2.0 SUCCESS CRITERIA

The performance standards shall be consistent with the requirements described in Federal rule for compensatory mitigation project sites as described in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.5 paragraphs (a) and (b).

Monitoring of restoration efforts will be performed until success criteria are fulfilled. Monitoring includes stream channel/hydraulics, wetland hydrology, and vegetation. In general, the restoration success criteria, and required remediation actions, are based on the *Stream Mitigation Guidelines* (USACE et al. 2003) and the *Ecosystem Enhancement Program Monitoring Requirements and Performance Standards for stream and/or Wetland Mitigation* (NCEEP 2011).

2.1 Streams

Monitoring the restored stream reaches will be for geometric activity. Annual fall/winter monitoring will include development of channel cross-sections on riffles and pools and a water surface profile of the channel in addition to visual observation of channel stability.

Success criteria for stream restoration will include 1) successful classification of the reach as a functioning stream system (Rosgen 1996) and 2) channel variables indicative of a stable stream system.

2.1.1 Stream Dimension

General maintenance of a stable cross-section and hydrologic access to the floodplain features over the course of the monitoring period will generally represent success in dimensional stability. Some changes in dimension (such as lowering of bankfull width) should be expected. Key parameters such as cross-sectional area and the channel's width to depth ratio should demonstrate modes of overall change. Riffle sections should generally maintain a Bank Height Ratio of 1.0 – 1.5, with some variation in this ratio naturally occurring. Pool sections naturally adjust based on recent flows and time between flows; therefore, more variation on pool section geometry is expected.

2.1.2 Stream Pattern and Profile

The profile should not demonstrate significant trends towards degradation or aggradation over a significant portion of a reach. Additionally, bed form variables should remain noticeably intact and consistent with original design parameters that were based off of reference conditions. Pattern features should show little adjustment over the 7-year monitoring period.

2.1.3 Substrate

Project is a sand bed system, thus requiring no formal monitoring parameters for substrate.

2.1.4 Sediment Transport

There should be an absence of any significant trend in aggradational or depositional potential of the channel.

2.1.5 Hydraulics

A minimum of two bankfull events must be documented within the 7-year monitoring period. The two bankfull events shall occur within separate years.

2.2 Wetland

2.2.1 Hydrology

The hydrologic criteria for restored wetlands at the Site are identified below by community type:

1. For the **riparian bottomland hardwood forest community**, the hydrologic criterion will be the establishment of a static water table at, or within, 12 inches of the soil surface for a minimum of 12.5 percent of the growing season, equivalent to 38 days based upon hydrologic monitoring undertaken from Feb 1st through Nov 30th of each monitoring year.
2. For the **headwater riparian community (zero-order geomorphic position)**, the hydrologic criterion will be the establishment of a static water table at, or within, 12 inches of the soil surface for 10 percent of the growing season, equivalent to 30 days based upon hydrologic monitoring undertaken from Feb 1st through Nov 30th of each monitoring year.

In addition, hydrologic data from reference wetlands of similar landscape position and soil types will be collected and evaluated in comparison to hydrologic data of the restored wetlands. Hydroperiods of the restored wetlands should track (both in duration and amplitude) the hydroperiods of the reference wetlands. Given the natural variability of hydrologic conditions between wetland sites and even within a single wetland area, there will be no specific quantitative criteria attached to this comparison. However, data will be qualitatively assessed to assist in the evaluation of hydrologic conditions of the restoration site (particularly during periods of abnormally low rainfall when the minimum hydrologic criteria identified above are not met).

2.3 Vegetation

Vegetation success at the Site will be measured by survivability over a 7-year monitoring period. Vegetation survival must be at a minimum 320 stems per acre after Year 3, 260 stems per acre after Year 5, and 210 stems per acre after Year 7.

Should an abundance of any non-planted exotic, invasive or nuisance species including pine trees be identified during the visual assessments, it will be noted in the Annual Monitoring Report. If the exotic, invasive or nuisance species appear to be hindering the survival of planted species, a Plan of Corrective Action will be determined in concurrence with DMS and the USACE.

2.4 Scheduling and Reporting

Monitoring reports will be completed for 7 years or until agreed upon success criteria are achieved and will be provided to the DMS for review by December 31 of each year. Monitoring standards are determined using the 2003 USACE Wilmington District Stream Mitigation Guidelines, 2011 *NCEEP Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation* and WRAP Technical Note 00-02 (Sprecher 2000).

3.0 MONITORING PLAN GUIDELINES

3.1 Stream Hydraulics

To ensure accuracy and make note of any site changes, all data collected for monitoring purposes is manual data from the field.

Verification of bankfull events and changes in stream hydraulics will be recorded by a crest gauge installed in the stream as well as visual evidence of above bankfull flows. Evidence of above bankfull flows may include trash/debris lines in or above the floodplain, vegetation pushed over towards the downstream direction in the floodplain, terrace slope scour, and staining of vegetation. Early monitoring of crest gauges will allow for additional verification of bankfull design targets.

All visits to the site for purposes of data collection will be documented by the monitoring performer and will describe in detail: weather conditions; physical appearance of the site; highest stage for that monitoring interval as recorded on the crest gauge; a reset of the crest gauge; photo documentation. Data collected for the purposes of bankfull verification will be compiled and summarized in each annual version of the monitoring report.

3.2 Stream Channel Stability and Geomorphology

Assessment of the UT's dimension, pattern and profile is necessary to ensure that the reach maintains reference geomorphology. Visual based assessments, photographic documentation, and surveys of representative cross-sections will be used to monitor channel stability. Vegetation will be monitored annually to document plant survival and community composition. This section serves as the general guide to the extent and type of monitoring of different stream features.

3.2.1 Dimension

Per the 2003 Stream Mitigation Guidelines very narrow streams generally require two cross-sections per 1,000 feet. The Site's constructed stream channel width in the riffle of 8.8 feet is considered very narrow. ICA Engineering placed 10 permanent cross-sections (5 pools and 5 riffles). Channel cross-section monitoring events will occur in years 1, 2, 3, 5, and 7. Any supplemental monitoring results may apply towards meeting performance standards.

At a minimum, cross-sectional data will include Bank Height Ratio and Entrenchment Ratio.

Bank pin arrays are located on the outside bend of each meander in which a cross-section is located. Pins are a minimum of 3 feet in length and spaced on a 2-foot vertical interval on the channel bank. Installed pins are at monumented cross-section in the upstream third of the meander bend and in the downstream third of the meander bend. Pins were installed flush with the face of the stream bank. The length of exposed pin from the bank will be measured each monitoring year and reported. The pin will be will be hammered flush with the bank following measurement of the pin exposure length. Lateral exposure will be included in each monitoring report.

3.2.2 Profile

The as-built survey was conducted upon completion of channel construction to document baseline conditions and includes all measurements typically documented during subsequent channel geomorphological surveys. Comparison of future geomorphological data can utilize the longitudinal profile of the thalweg, bankfull, and top of bank collected during the as-built survey of the constructed channel, if necessary. Longitudinal profiles will not be required during routine channel stability monitoring (years 1 through 7) unless the monitoring efforts demonstrate channel bank or bed instability, in which case additional longitudinal profiles may be required along channel reaches of concern to track changes in the channel and demonstrate stability.

Calculations will utilize the profile data for surface slopes, riffle/pool lengths and depths, and pool-to-pool spacing.

3.2.3 Pattern

Year 5 monitoring efforts will collect stream parameters such as channel beltwidth, radius of curvature, and meander wavelength if profile and dimensional data indicate that significant geo-morphological adjustments have occurred.

3.2.4 Visual Assessment

Visual stream morphology stability assessments will be completed annually in accordance with the most current version of the DMS document entitled *Monitoring Requirements and performance Standards for Stream and/or Wetland Mitigation* (currently an EEP document dated November 7, 2011). The visual assessment data will be used to assess the channel bed, banks, and in-stream structures.

3.2.5 Bank Stability Assessments

Bank stability should be assessed as part of the annual visual assessment. Recording linear feet of unstable or collapsed banks will help guide repairs in the future, should they be necessary. Walkthroughs of the Site will accomplished this visual assessment. Near Bank Stress (NBS) and Bank Erosion Hazard Index (BEHI) assessments are not required as they do not exist for the entire project per-construction as part of the existing conditions survey.

3.3 Vegetation

Nine (9) permanent plots (totaling more than 2 percent of planted area within the Site) within the restoration corridor will be monitored using the Carolina Vegetation Survey (CVS) protocols.

Monitoring of vegetation plots will occur for 7 years, with monitoring events occurring in years 1, 2, 3, 5, and 7. If supplemental monitoring occurs, results may apply towards meeting performance standards. Year 1 monitoring will occur at least 180 days, occurring between March 1 and November 30, following the completion of initial vegetation planting.

Monitoring will provide individual plot data for planted species. Averaging the plot data over the entire site to obtain a single figure for stem density is not applicable. Enumeration of the density of planted species: density = number of living, planted stems per acre. Stems are individual plants, where plants with multiple shoots represent a single stem. Live stakes planted on the stream banks will not count toward meeting the stem density requirements.

Volunteer plants growing within plots may achieve successful stem quantities on a case-by-case basis in determining whether a project has met the overall goal of re-establishing the vegetated buffer; however, volunteer plants will tally separately from planted vegetation in the monitoring reports.

Monitoring events will provide an evaluation of the presence of invasive species, noted in the monitoring report. If visual assessments note an abundance of any non-planted exotic, invasive or nuisance species including pine trees hindering the survival of planted species, a Plan of Corrective Action will be determined in concurrence with DMS and the USACE.

3.4 Wetland

Shallow groundwater hydrology will be monitored via six (6) automated gauges (RDS, Inc. WM-20s) located within the riparian wetland restoration areas. Gauges have been installed in accordance with installation methods outlined in the Wetlands Regulatory Assistance Program (WRAP) Technical Note 00-02 (Sprecher, 2000). Water levels will be recorded once daily. Data will be downloaded from the gauges every two months. Data from well downloads will be compiled and graphically displayed to demonstrate hydroperiods of monitored areas. Gauge data will be collected and reported to NCEEP in each of the 7 years of monitoring. The data will be analyzed in the context of the antecedent rainfall conditions which will also be displayed on well hydrographs.

Visual monitoring of all wetland restoration areas will be conducted 2 times per year and a minimum of 5 months apart, in each of the required 7 years of monitoring. Visual monitoring will include walking throughout the entire Site to identify and document areas of low stem density or poor plant vigor, invasive species, beaver activity, herbivory, encroachments, indicators of livestock access, or other areas of concern.

The results of the visual assessment will be included in a plan view of the project identifying the location of each area of concern, along with a written assessment and photographic documentation of the area. Once an area of concern has been identified, that same feature shall be reassessed on all subsequent visual assessments. Photographs will be taken from the same location year-to-year to document progression of the problem. The monitoring reports will identify all areas of concern and recommended courses of action, which may include continued monitoring, repair or other remedial action.

3.5 Digital Photos

Permanent photo stations established at each of the 10 cross-sections and at every vegetation plot provide photographic documentation of the Site. Photos of the stream will be taken annually when vegetation leaf out is minimal. Vegetation photos will be taken on the same day that vegetative cover surveys take place. All digital photo records will indicate location, date and monitoring year.

3.6 Watershed

Any changes to the project watershed will be monitored and recorded. In the event that a change to the watershed might introduce new sediment or changes in water flow to the Site, such as a new development upstream, it will be closely monitored and analyzed. Any significant effects to Site’s streams will be documented so that action can be taken, if necessary. Additionally, rare or significant hydrologic and weather events will be recorded in detail so that changes to Site’s streams can be accounted.

4.0 MAINTENANCE AND CONTINGENCY PLANS

If, during the course of annual monitoring it is determined the Site's ability to achieve site performance standards are jeopardized, DMS will notify the USACE of the need to develop a Plan of Corrective Action. In-house technical staff or engineering and consulting services may prepare the Plan of Corrective Action. Once the Plan of Corrective Action is prepared and finalized DMS will:

1. Notify the USACE as required by the Nationwide 27 permit general conditions.
2. Revise performance standards, maintenance requirements, and monitoring requirements as necessary and/or required by the USACE.
3. Obtain other permits as necessary.
4. Implement the Corrective Action Plan.
5. Provide the USACE a Record Drawing of Corrective Actions. This document shall depict the extent and nature of the work performed.

5.0 AS-BUILT STATE

This section documents the as-built/baseline condition. Appendices B & C include Tables 5, 6, and 7 which detail specific geomorphic and vegetative data in relation to the as-built conditions. As-built/baseline drawings are included in Appendix D.

5.1 As-built/Record Drawings

As-built/Record Drawings are attached in Appendix D.

5.2 Morphologic State of the Channel

Upon completion of grading and structure installation, a baseline survey was performed for the entire restored length of stream and included 10 cross-sections. Baseline morphologic data is summarized in Table 5 and Table 6 in Appendix B. Plots of the profiles are shown in Figures B.1-B.3 in Appendix B. Cross-section plots and photos can also be found in Appendix B. Cross-section photos were taken facing the downstream direction.

5.3 Verification of Plantings

An initial evaluation of planted stems was performed per guidelines established in CVS-EEP Protocol for Recording Vegetation, Version 4.2 (Lee et al. 2008) to verify planting methods were successful and to determine species composition and density. Baseline vegetation plot data can be found in Table 7 in Appendix C. Plot photos are also located in Appendix C. Initial stem count measurements indicate an average of 850 planted stems per acre (excluding live stakes) across the Site. In addition, each individual plot met success criteria based on planted stems alone. A Final Planting List can be found in Appendix C.

5.4 Stream Gauges

One crest gauge was installed near cross-section 1 and one crest gauge was installed near the downstream extent of the project on the right bank. Both will be monitored regularly to track large flow events that affect the Site. Crest gauge locations are documented in the Monitoring Plan sheets located in Appendix D.

6.0 REFERENCES

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APPENDIX A
General Tables and Figures

Table 1. Project Components and Mitigation Credits
UT to Millers Creek (DMS Project ID No. 95719)

UT to the Millers Creek, Duplin County
DMS Project ID No. 95719

Mitigation Credits

	Stream (SMU)		Riparian Wetland (WMU)		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE	--	--	--
Totals	2,709		8.00						

Project Components

Project Component or Reach ID	Stationing/ Location	Existing Footage/ Acreage	Approach (PI, PII, etc.)	Restoration or Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio	SMU or WMU
UT Millers Creek	10+17 – 36+96	2,100	PI	Restoration	2,709	1:1	2,709
Drained Wetland (Pines)	NA	5.00	NA	Restoration	5.00	1:1	5.00
Drained Wetland (Mature Woods)	NA	2.55	NA	Restoration	2.55	1.25:1	2.04
Drained Wetland (Berm/Spoil Along UT)	NA	0.45	NA	Restoration	0.45	1:1	0.45
Pond	NA	0.77	NA	Restoration	0.77	1.5:1	0.51
TOTAL	NA	2,100/8.77	PI/NA	Restoration	2,709/8.77	1 – 1.5:1	2,709/8.00

Component Summation

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	2,709	8.77				

BMP Elements

Element	Location	Purpose/Function	Notes
Forested Buffer	UT Millers buffer	Buffer to protect stream	Filter nutrients and provide cover, foraging areas, habitat, woody debris, and wildlife corridor

Table 2. Project Activity and Reporting History
UT to Millers Creek (DMS Project ID No. 95719)

Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	August 2013	September 2014
Final Design – Construction Plans	September 2014	September 2014
Construction	November 3, 2014	January 23, 2015
Temporary S&E Mix Applied to Entire Project Area	---	January 23, 2013
Permanent Seed Mix Applied to Entire Project Area	---	January 23, 2013
Bare Root, Containerized, and B&B plantings for Entire Project Area	---	March 10, 2015
Mitigation Plan/As-built (Year 0 Monitoring-Baseline)	March 2015	April 2015
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		

Table 3. Project Contacts Table
UT to Millers Creek (DMS Project ID No. 95719)

Designer Primary project design POC	ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Kevin Williams (919) 851-6066
Construction Contractor Construction Contractor POC	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Lloyd Glover (919) 639-6132
Planting Contractor Planting Contractor POC	River Works, Inc. 6105 Chapel Hill Road Raleigh, NC 27607 Phillip Todd (919) 582-3574
Seeding Contractor Seeding Contractor POC	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Lloyd Glover (919) 639-6132
Seed Mix Sources	Green Resources – Triangle Office
Nursery Stock Suppliers	1) ArborGen 2) Mellow Marsh Farm, Inc. 3) Foggy Mountain Nursery (live stakes)
Monitoring Performers	ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Chris Smith (919) 851-6066
Stream Monitoring POC	ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Chris Smith (919) 851-6066
Vegetation Monitoring POC	Land Management Group, Inc 3805 Wrightsville Avenue, Suite 15 Wilmington, NC 28403 Kim Williams (910) 452-0001 x 1908

Table 4. Project Information
UT to Millers Creek (DMS Project ID No. 95719)

Project Information	
Project Name	UT to Millers Creek Stream and Wetland Mitigation Site
Project County	Duplin
Project Area (acres)	15.944 AC
Project Coordinates	34.894467,-78.067625
Project Watershed Summary Information	
Physiographic Region	Coastal Plain
Ecoregion	Southeastern Plains
Project River Basin	Cape Fear
USGS 8-digit HUC	03030006
USGS 14-digit HUC	03030006110040
NCDWQ Subbasin	03-06-19
Project Drainage Area	250 AC
Watershed Land Use	Cultivated, Southern Yellow Pine, Bottomland Forest / Hardwood Swamps

Reach Summary Information	
Parameters	**UT to Millers Creek**
Restored length	2,709 linear feet
Drainage Area	250 AC.
NCDWQ Index Number	36
NCDWQ Classification	C, Sw
Valley Type/Morphological Description	X/Existing G5, Restored E5
Dominant Soil Series	Bibb sandy loam and Torhunta fine sandy loam (USDA/NRCS records). Cape Fear, Rains, Plummer, Rutlege and Lynn Haven Soil series (additional series mapped by LMG)
Drainage Class	Poorly and very poorly
Soil Hydric Status	Bibb sandy loam (hydric) Torhunta mucky fine sandy loam (hydric)
Slope	0.0016
FEMA Classification	Zone X
Native Vegetation Community	Mixed stand of hardwoods and pine
Percent Composition of Exotic Invasives	<5%

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the U.S. –Sections 404 and 401	Yes	Yes	Restoration Plan
Endangered Species Act	No	Yes	NCNHP/USFWS
Historic Preservation Act	No	Yes	NCSHPO
CZMA/CAMA	No	Yes	--
FEMA Floodplain Compliance	Yes	Yes	HECRAS
Essential Fisheries Habitat	No	N/A	--

ICA Engineering

Vicinity Map

UT to Millers Creek Mitigation Site, Duplin County, NC

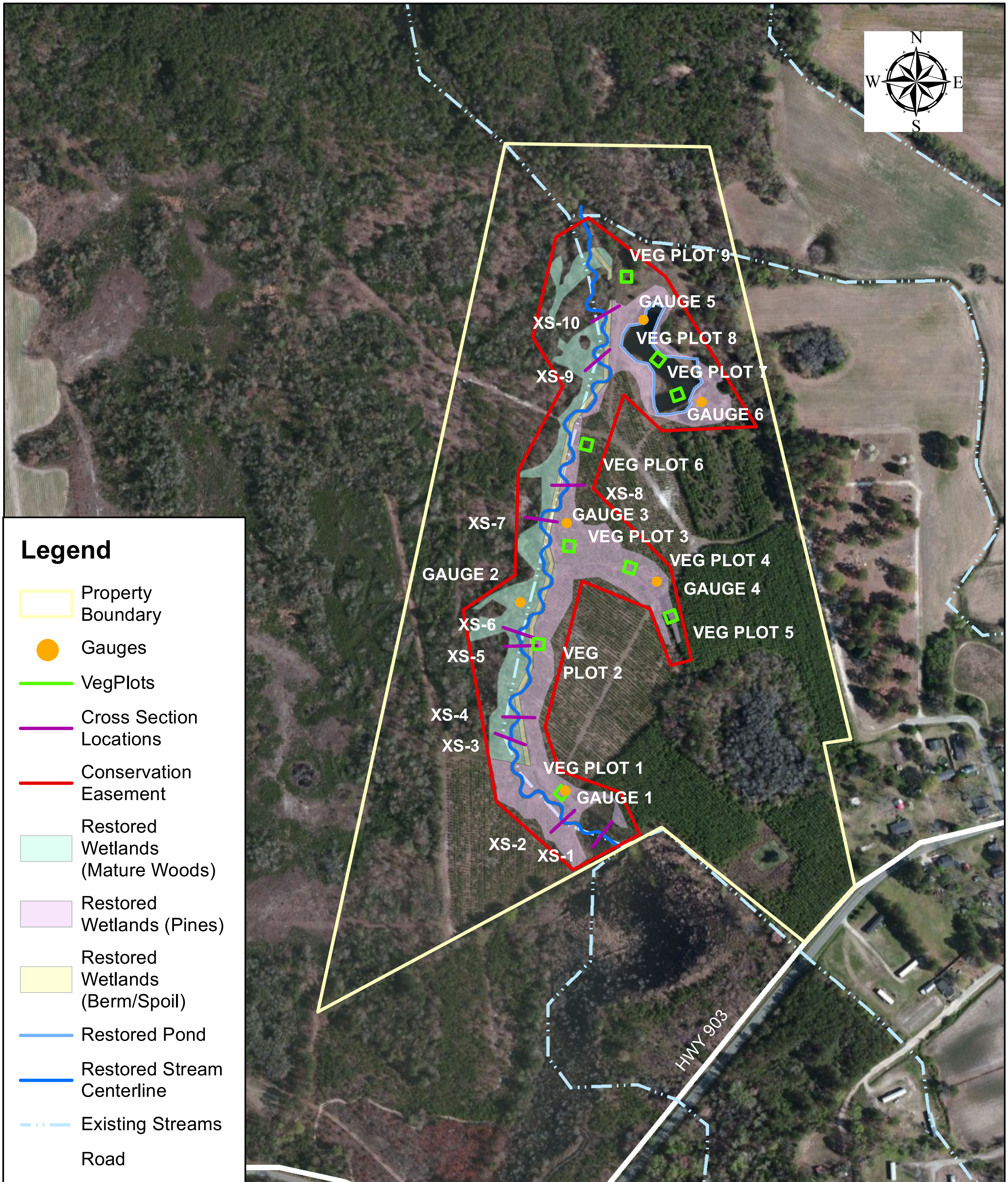
0 750 1,500 3,000 4,500 6,000 Feet

1 inch = 2,000 feet

NCDENR

Figure

1



ICA Engineering

Site Components

UT to Millers Creek Mitigation Site, Duplin County, NC

0 140 280 560 840 1,120 Feet

1 inch = 383 feet

NCDENR

Figure

2

APPENDIX B
Morphological Summary Data and Plots

Table 5. Baseline Stream Data Summary
UT to Millers Creek, DMS Project ID No. 95719
UT to Millers Creek: 2,709 LF

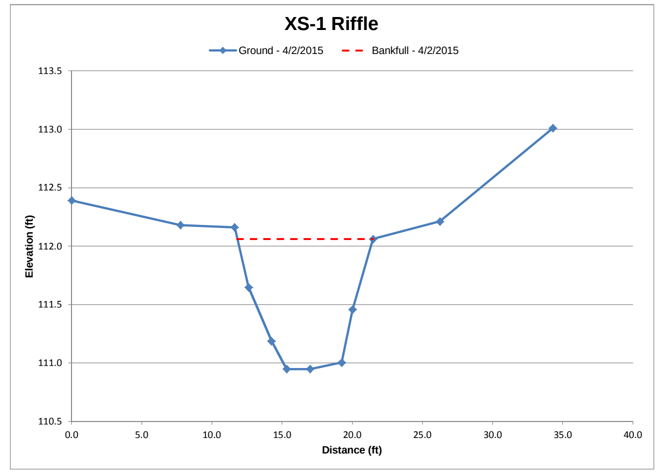
Parameter	Regional Curve	Pre-Existing Condition	Reference - Wildcat Branch	Referece - UT Brick Bound Swamp	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Eq.	Mean	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)		9.7	8.2	6.1	8.8	8.8	9.6	9.7	10.5	0.7	5
Floodprone Width (ft)		12.3	130.0	24.5	125.0	126.3	177.1	182.9	219.0	35.1	5
Bankfull Mean Depth (ft)		0.75	1.03	0.50	0.92	0.8	0.9	0.9	1.1	0.1	5
Bankfull Max Depth (ft)		1.1	1.6	1.0	1.4	1.1	1.5	1.5	1.8	0.3	5
Bankfull Cross Sectional Area (ft^2)		7.2	8.5	3.1	8.3	7.7	9.1	8.7	12.0	1.7	5
Width/Depth Ratio		12.9	8.0	12.2	9.5	8.8	10.2	10.0	12.2	1.4	5
Entrenchment Ratio		1.3	15.9	4.0	14.3	11.9	13.1	12.9	14.3	0.9	5
Bank Height Ratio		4.83	1.09	1.00	1.00	1.0	1.0	1.0	1.0	0.0	5
d50 (mm)		sand	sand	sand	sand						
Profile											
Riffle Length (ft)						8.6	21.9	22.8	33.6	9.0	7
Riffle Slope (ft/ft)		Channelized	0.0022	0.0012	0.0007	0.0039	0.0069	0.0075	0.0096	0.0019	7
Pool Length (ft)						9.1	27.0	25.7	53.9	11.6	61
Pool Max depth (ft)		Channelized	1.75	1.25	1.75	1.60	1.86	1.90	2.20	0.23	5
Pool Spacing (ft)		Channelized	14.0 - 16.6	15.29 - 27.81	20.1 - 84.9	12.5	41.8	40.3	96.3	18.4	63
Pool Cross Sectional Area (ft^2)						8.80	10.46	10.90	11.40	1.05	5
Pattern											
Channel Beltwidth (ft)		Channelized	13.8 - 19.4	13.8 - 19.4	17.5 - 52.5						
Radius of Curvature (ft)		Channelized	10.9 - 15.3	5.0 - 9.0	20.1 - 22.8						
Rc: Bankfull Width (ft/ft)		Channelized	1.3 - 1.9	0.9 - 1.5	2.3 - 2.6						
Meander Wavelength (ft)		Channelized	22.5 - 29.0	23.0 - 29.0	14.0 - 56.0						
Meander Width Ratio		Channelized	1.7 - 2.4	2.3 - 3.2	2.0 - 6.0						
Substrate, bed and transport parameters											
Ri% / P%						33/67					
SC% / Sa% / G% / C% / B% / Be%											
d16 / d35 / d50 / d84 / d95/ di^p / di^{sp} (mm)											
Reach Shear Stress (competency) lb/ft^2											
Max part size (mm) mobilized at bankfull											
Unit Stream Power (transport capacity) lbs/ft.s		0.01			0.01	0.02					
Additional Reach Parameters											
Drainage Area (SM)		0.37	0.44	0.11	0.37						
Impervious cover estimate (%)											
Rosgen Classification		G-F/5	E5	E5	E5	E5					
Bankfull Velocity (fps)			1.00	0.97	0.80						
Bankfull Discharge (cfs)		8.4	8.5	3.0	8.4						
Valley length (ft)		2126			2126	2126					
Channel Thalweg length (ft)		2339			2679	2709					
Sinuosity (ft)		1.10	1.15	1.35	1.26	1.27					
Water Surface Slope (Channel) (ft/ft)		0.0011	0.0024	0.0016	0.0005	0.0005					
BF slope (ft/ft)					0.0005	0.0005					
Bankfull Floodplain Area (acres)											
Proportion over wide (%)											
Entrenchment Class (ER Range)											
Incision Class (BHR Range)											
BEHI VL% / L% / M% / H% / VH% / E%											
Channel Stability or Habitat Metric											
Biological or Other											

Table 6. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)
UT to Millers Creek (DMS Project No. 95719)
UT to Millers Creek: 2,709 LF

	Cross Section 1 (Riffle)							**Cross Section 2 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	9.7							8.6						
Floodprone Width (ft)	195.2													
Bankfull Mean Depth (ft)	0.8							1						
Bankfull Max Depth (ft)	1.1							1.7						
Bankfull Cross Sectional Area (ft^2)	7.7							8.8						
Bankfull Width/Depth Ratio	12.2													
Bankfull Entrenchment Ratio	20.2													
Bankfull Bank Height Ratio	1.0													
	Cross Section 3 (Riffle)							**Cross Section 4 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	9.9							9.4						
Floodprone Width (ft)	126.3													
Bankfull Mean Depth (ft)	0.9							1.2						
Bankfull Max Depth (ft)	1.6							2.2						
Bankfull Cross Sectional Area (ft^2)	8.8							10.9						
Bankfull Width/Depth Ratio	11.1													
Bankfull Entrenchment Ratio	12.8													
Bankfull Bank Height Ratio	1.0													
	Cross Section 5 (Riffle)							**Cross Section 6 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation[1]														
Bankfull Width (ft)	9.1							10.5						
Floodprone Width (ft)	182.9													
Bankfull Mean Depth (ft)	0.9							1.0						
Bankfull Max Depth (ft)	1.4							1.6						
Bankfull Cross Sectional Area (ft^2)	8.4							10.1						
Bankfull Width/Depth Ratio	10.0													
Bankfull Entrenchment Ratio	20.0													
Bankfull Bank Height Ratio	1.0													
	Cross Section 7 (Riffle)							**Cross Section 8 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	8.8							9.5						
Floodprone Width (ft)	162.2													
Bankfull Mean Depth (ft)	1.0							1.2						
Bankfull Max Depth (ft)	1.5							1.9						
Bankfull Cross Sectional Area (ft^2)	8.7							11.1						
Bankfull Width/Depth Ratio	8.8													
Bankfull Entrenchment Ratio	18.5													
Bankfull Bank Height Ratio	1.0													
	Cross Section 9 (Riffle)							**Cross Section 10 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	10.5							9.8						
Floodprone Width (ft)	219													
Bankfull Mean Depth (ft)	1.1							1.2						
Bankfull Max Depth (ft)	1.8							1.9						
Bankfull Cross Sectional Area (ft^2)	12.0							11.4						
Bankfull Width/Depth Ratio	9.1													
Bankfull Entrenchment Ratio	20.9													
Bankfull Bank Height Ratio	1.0													

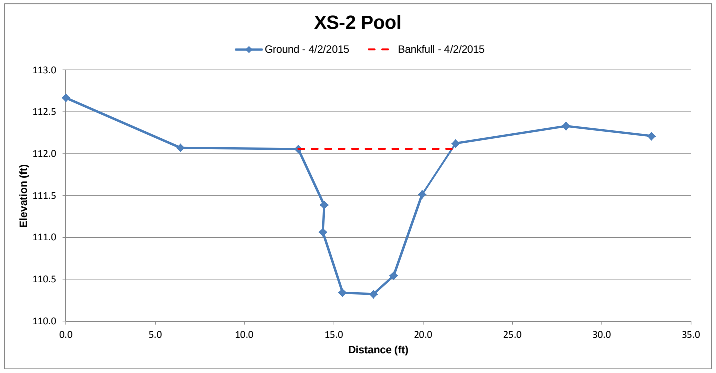
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-1	0.00	112.39										
	7.76	112.18										
	11.62	112.16										
	12.62	111.65										
	14.24	111.19										
	15.33	110.95										
	16.99	110.95										
	19.25	111.01										
	20.03	111.46										
	21.49	112.06										
	26.24	112.21										
	34.30	113.01										

	Cross Section 1 (Riffle)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	9.7						
Floodprone Width (ft)	195.2						
Bankfull Mean Depth (ft)	0.8						
Bankfull Max Depth (ft)	1.1						
Bankfull Cross Sectional Area (ft^2)	7.7						
Bankfull Width/Depth Ratio	12.2						
Bankfull Entrenchment Ratio	20.2						
Bankfull Bank Height Ratio	1.0						



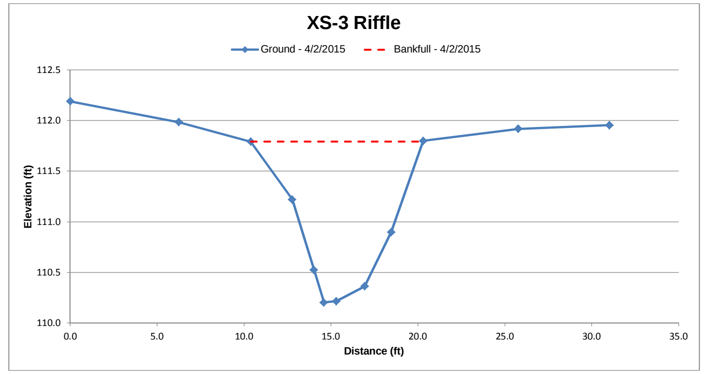
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-2	0.00	112.67										
	6.42	112.07										
	13.01	112.06										
	14.46	111.39										
	14.39	111.06										
	15.49	110.34										
	17.22	110.32										
	18.35	110.54										
	19.94	111.51										
	21.82	112.12										
	28.00	112.33										
	32.79	112.21										

	Cross Section 2 (Pool)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	8.6						
Floodprone Width (ft)							
Bankfull Mean Depth (ft)	1						
Bankfull Max Depth (ft)	1.7						
Bankfull Cross Sectional Area (ft^2)	8.8						
Bankfull Width/Depth Ratio							
Bankfull Entrenchment Ratio							
Bankfull Bank Height Ratio							



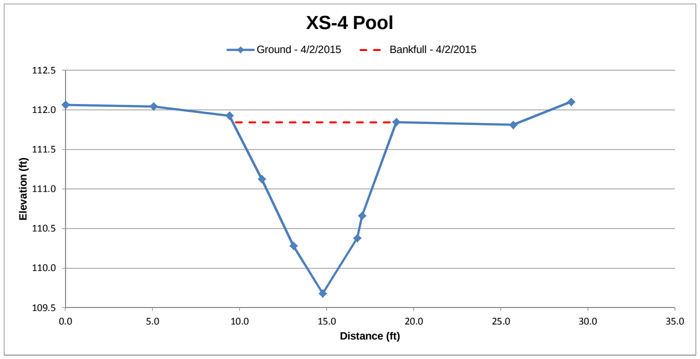
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-3	0.00	112.19										
	6.24	111.99										
	10.39	111.79										
	12.77	111.22										
	14.02	110.53										
	14.59	110.20										
	15.31	110.22										
	16.94	110.36										
	18.46	110.90										
	20.31	111.80										
	25.77	111.92										
	31.01	111.95										

	Cross Section 3 (Riffle)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	9.9						
Floodprone Width (ft)	126.3						
Bankfull Mean Depth (ft)	0.9						
Bankfull Max Depth (ft)	1.6						
Bankfull Cross Sectional Area (ft^2)	8.8						
Bankfull Width/Depth Ratio	11.1						
Bankfull Entrenchment Ratio	12.8						
Bankfull Bank Height Ratio	1.0						



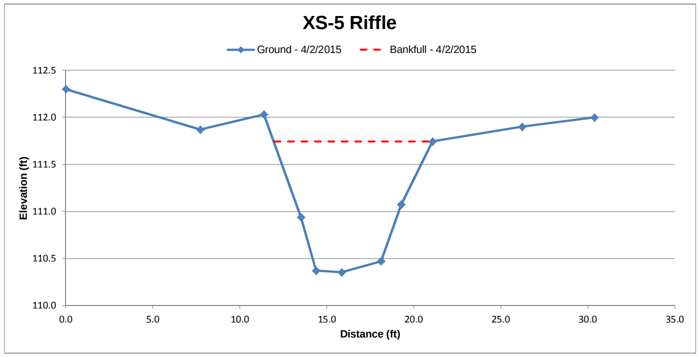
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-4	0.00	112.06										
	5.06	112.04										
	9.42	111.93										
	11.27	111.13										
	13.10	110.28										
	14.78	109.68										
	16.76	110.38										
	17.03	110.66										
	19.00	111.84										
	25.71	111.81										
	29.04	112.10										

	Cross Section 4 (Pool)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	9.4						
Floodprone Width (ft)							
Bankfull Mean Depth (ft)	1.2						
Bankfull Max Depth (ft)	2.2						
Bankfull Cross Sectional Area (ft^2)	10.9						
Bankfull Width/Depth Ratio							
Bankfull Entrenchment Ratio							
Bankfull Bank Height Ratio							



	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-5	0.00	112.30										
	7.73	111.87										
	11.38	112.03										
	13.52	110.94										
	14.38	110.37										
	15.86	110.35										
	18.11	110.47										
	19.28	111.07										
	21.07	111.74										
	26.23	111.90										
	30.38	112.00										

	Cross Section 5 (Riffle)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	9.1						
Floodprone Width (ft)	182.9						
Bankfull Mean Depth (ft)	0.9						
Bankfull Max Depth (ft)	1.4						
Bankfull Cross Sectional Area (ft^2)	8.4						
Bankfull Width/Depth Ratio	10.0						
Bankfull Entrenchment Ratio	20						
Bankfull Bank Height Ratio	1.0						

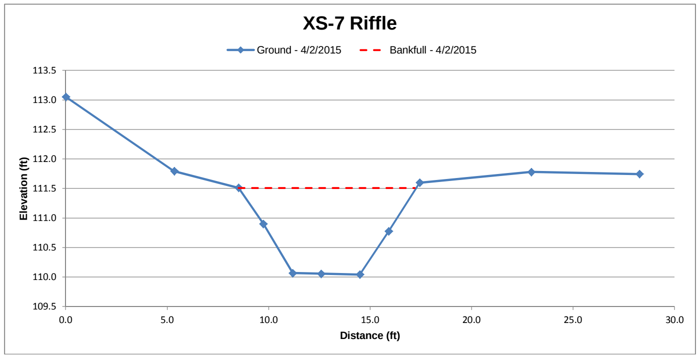


	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-6	0.00	111.80										
	5.78	111.94										
	9.55	111.79										
	11.49	110.97										
	12.92	110.11										
	14.28	109.99										
	16.42	109.98										
	18.05	110.84										
	20.57	111.56										
	27.08	111.73										
	31.53	111.88										

	Cross Section 6 (Pool)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	10.5						
Floodprone Width (ft)							
Bankfull Mean Depth (ft)	1.0						
Bankfull Max Depth (ft)	1.6						
Bankfull Cross Sectional Area (ft^2)	10.1						
Bankfull Width/Depth Ratio							
Bankfull Entrenchment Ratio							
Bankfull Bank Height Ratio							

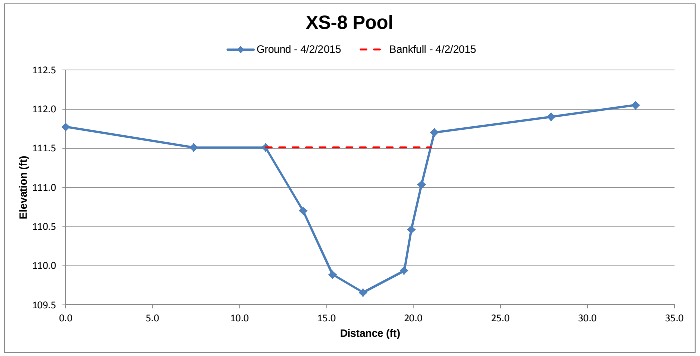
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-7	0.00	113.05										
	5.35	111.79										
	8.52	111.51										
	9.74	110.90										
	11.19	110.07										
	12.59	110.06										
	14.50	110.04										
	15.91	110.78										
	17.44	111.60										
	22.94	111.78										
	28.28	111.75										

	Cross Section 7 (Riffle)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	8.8						
Floodprone Width (ft)	162.2						
Bankfull Mean Depth (ft)	1.0						
Bankfull Max Depth (ft)	1.5						
Bankfull Cross Sectional Area (ft^2)	8.7						
Bankfull Width/Depth Ratio	8.8						
Bankfull Entrenchment Ratio	18.5						
Bankfull Bank Height Ratio	1.0						



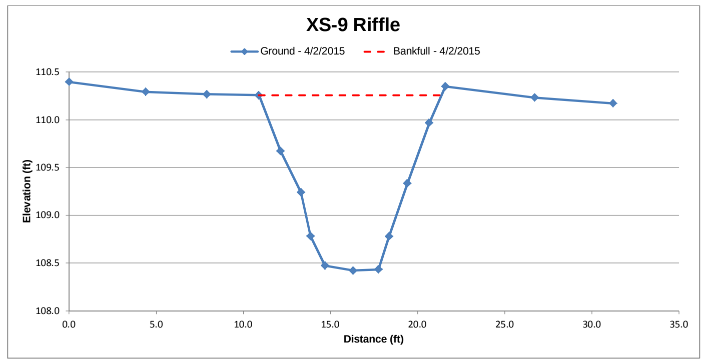
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-8	0.00	111.77										
	7.37	111.51										
	11.50	111.51										
	13.65	110.70										
	15.35	109.89										
	17.09	109.66										
	19.46	109.94										
	19.87	110.46										
	20.46	111.04										
	21.20	111.70										
	27.91	111.90										
	32.76	112.05										

	Cross Section 8 (Pool)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	9.5						
Floodprone Width (ft)							
Bankfull Mean Depth (ft)	1.2						
Bankfull Max Depth (ft)	1.9						
Bankfull Cross Sectional Area (ft^2)	11.1						
Bankfull Width/Depth Ratio							
Bankfull Entrenchment Ratio							
Bankfull Bank Height Ratio							



	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-9	0.00	110.40										
	4.40	110.29										
	7.91	110.27										
	10.89	110.26										
	12.13	109.67										
	13.31	109.24										
	13.86	108.78										
	14.69	108.47										
	16.31	108.42										
	17.75	108.43										
	18.36	108.78										
	19.42	109.34										
	20.67	109.97										
	21.59	110.35										
	26.72	110.23										
	31.22	110.17										

	Cross Section 9 (Riffle)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	10.5						
Floodprone Width (ft)	219						
Bankfull Mean Depth (ft)	1.1						
Bankfull Max Depth (ft)	1.8						
Bankfull Cross Sectional Area (ft^2)	12.0						
Bankfull Width/Depth Ratio	9.1						
Bankfull Entrenchment Ratio	20.9						
Bankfull Bank Height Ratio	1.0						



	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-10	0.00	110.36										
	2.79	109.71										
	7.35	109.47										
	10.53	109.34										
	12.12	108.75										
	13.81	107.92										
	14.98	107.44										
	16.64	107.34										
	18.05	107.73										
	18.64	107.63										
	19.08	108.58										
	20.57	109.27										
	26.23	109.29										
	31.34	109.46										

	Cross Section 10 (Pool)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	9.8						
Floodprone Width (ft)							
Bankfull Mean Depth (ft)	1.2						
Bankfull Max Depth (ft)	1.9						
Bankfull Cross Sectional Area (ft^2)	11.4						
Bankfull Width/Depth Ratio							
Bankfull Entrenchment Ratio							
Bankfull Bank Height Ratio							

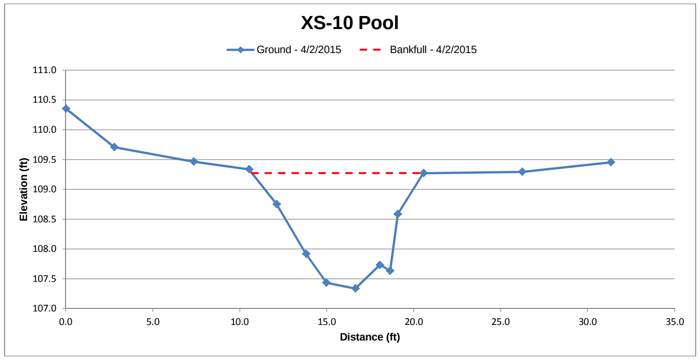


Figure B.1 UT Millers - Longitudinal Profile

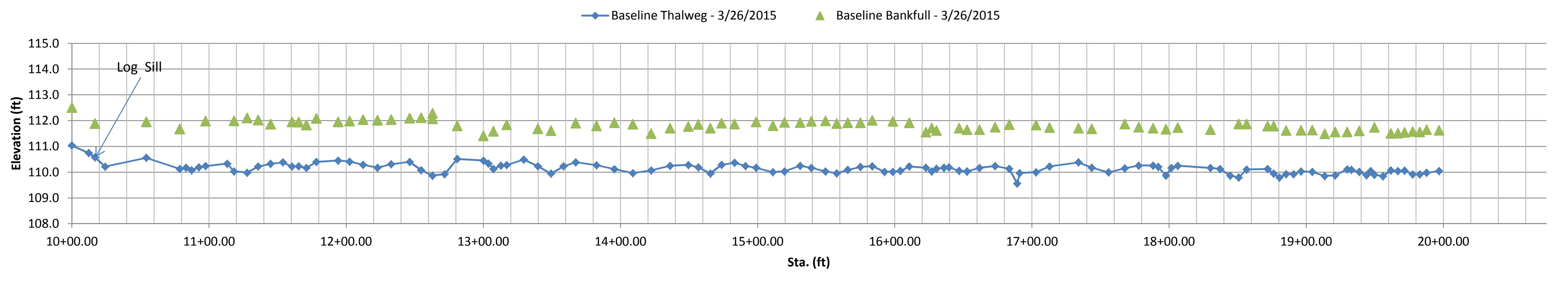


Figure B.2 UT Millers - Longitudinal Profile

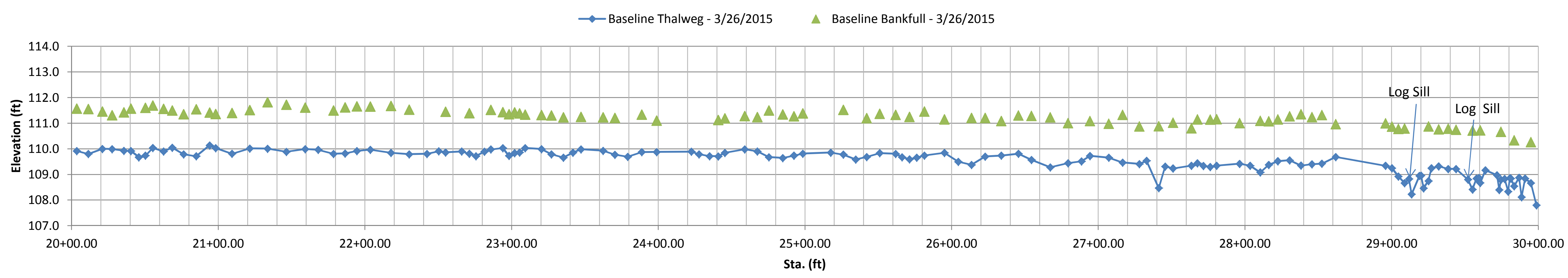
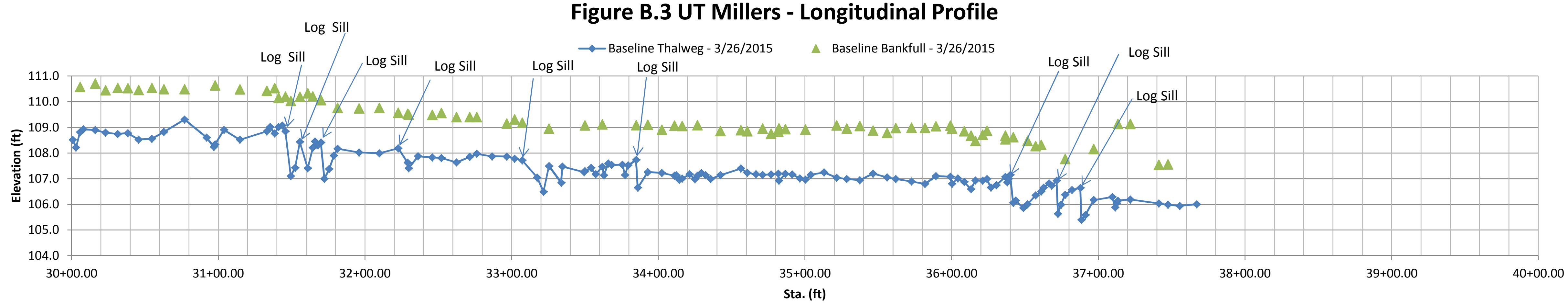
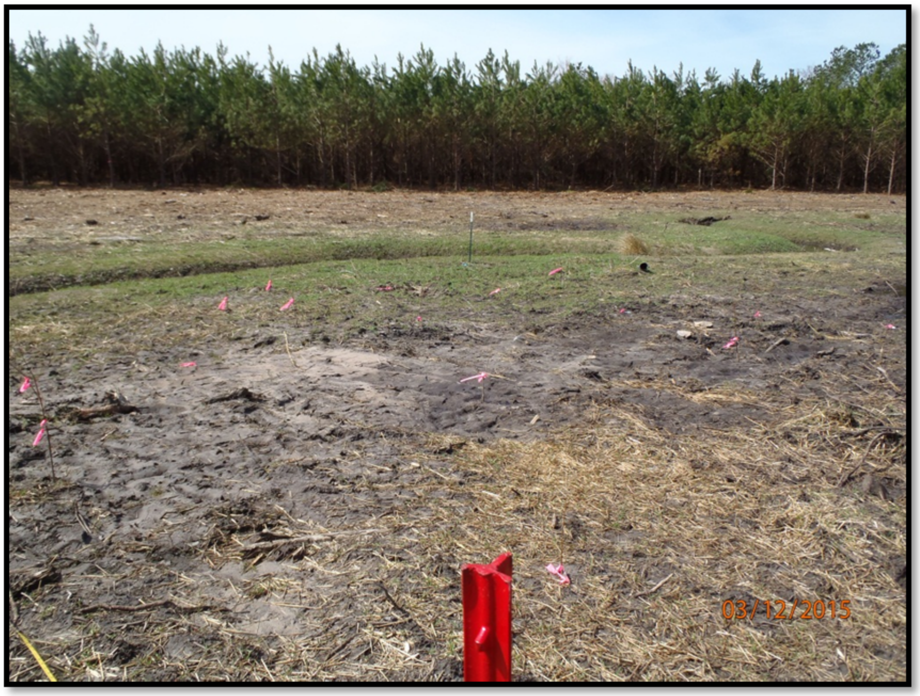


Figure B.3 UT Millers - Longitudinal Profile



APPENDIX C
Vegetation Data

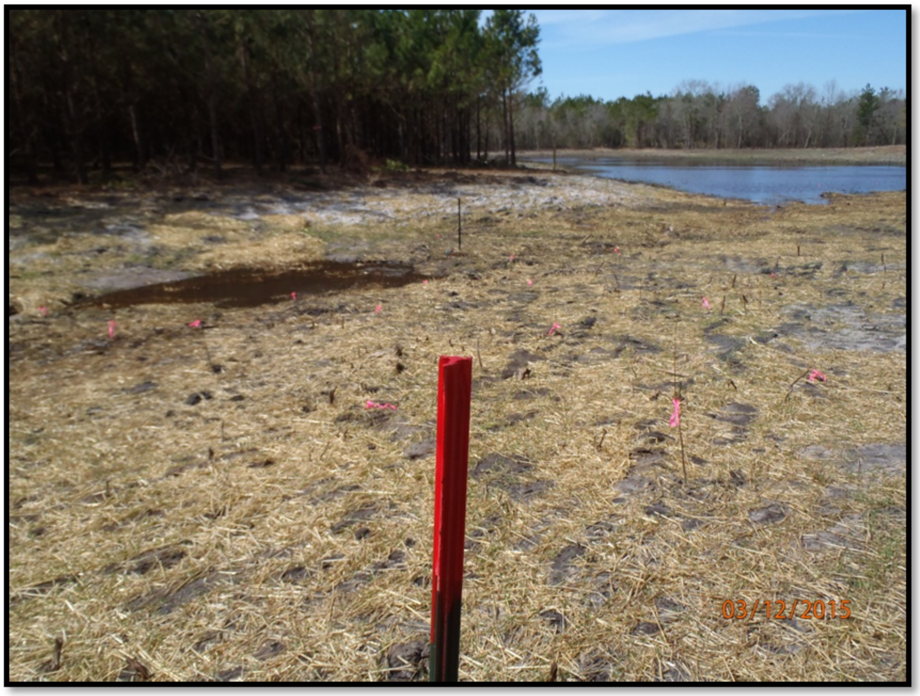


Vegetation Plot #1 Baseline

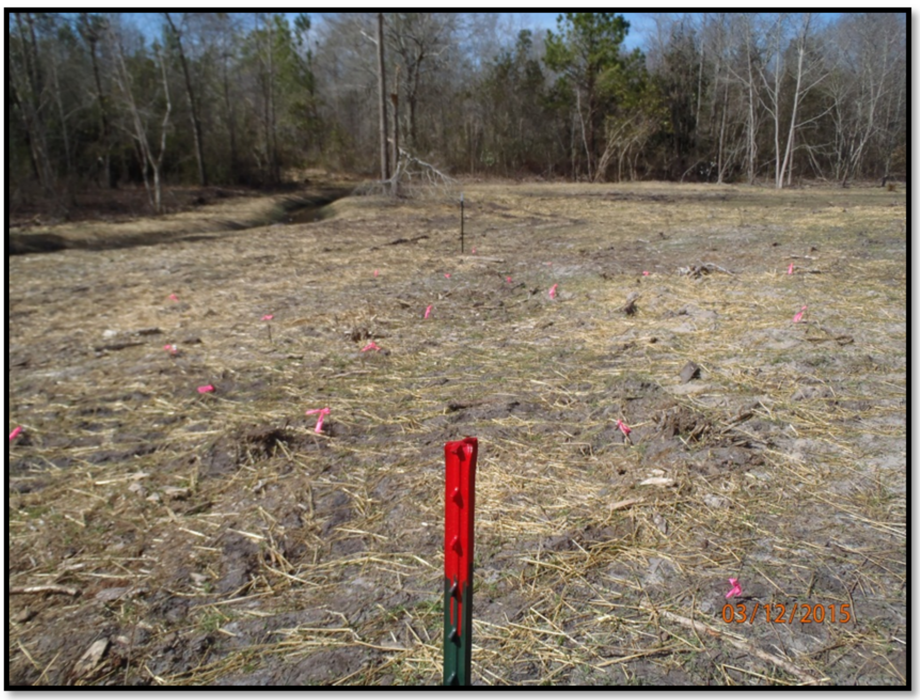
Vegetation Plot #2 Baseline

Vegetation Plot #3 Baseline

Vegetation Plot #4 Baseline



Vegetation Plot #5 Baseline



Vegetation Plot #6 Baseline

Vegetation Plot #7 Baseline

Vegetation Plot #8 Baseline

Vegetation Plot #9 Baseline

Table 7. Planted and Total Stem Counts (Species by

EEP Project Code 95719. Project Name: UT Millers Creek

			Current Plot Data (MY0 2015)																											Annual Means		
			95719-01-0001			95719-01-0002			95719-01-0003			95719-01-0004			95719-01-0005			95719-01-0006			95719-01-0007			95719-01-0008			95719-01-0009			MY0 (2015)		
Scientific Name	**Common Name**	**Species Type**	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	3	3	3	1	1	1				8	8	8	1	1	1													13	13	13
Fraxinus pennsylvanica	green ash	Tree				1	1	1	3	3	3							4	4	4	11	11	11	6	6	6	3	3	3	28	28	28
Liriodendron tulipifera	tuliptree	Tree	2	2	2	3	3	3	4	4	4							3	3	3				3	3	3	4	4	4	19	19	19
Magnolia virginiana	sweetbay	Tree				1	1	1																						1	1	1
Morella cerifera	wax myrtle	Shrub													3	3	3													3	3	3
Platanus occidentalis	American sycamore	Tree													8	8	8													8	8	8
Quercus michauxii	swamp chestnut oak	Tree	5	5	5	3	3	3	3	3	3							5	5	5				2	2	2	4	4	4	22	22	22
Quercus phellos	willow oak	Tree	1	1	1	5	5	5	5	5	5							11	11	11				1	1	1	5	5	5	28	28	28
Taxodium distichum	bald cypress	Tree	10	10	10	4	4	4	4	4	4	13	13	13	9	9	9	2	2	2	10	10	10	10	10	10	5	5	5	67	67	67
		Stem count	21	21	21	18	18	18	19	19	19	21	21	21	21	21	21	25	25	25	21	21	21	22	22	22	21	21	21	189	189	189
		size (ares)	1			1			1			1			1			1			1			1			1			9		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.22		
		Species count	5	5	5	7	7	7	5	5	5	2	2	2	4	4	4	5	5	5	2	2	2	5	5	5	5	5	5	9	9	9
		Stems per ACRE	849.8	849.8	849.8	728.4	728.4	728.4	768.9	768.9	768.9	849.8	849.8	849.8	849.8	849.8	849.8	1012	1012	1012	849.8	849.8	849.8	890.3	890.3	890.3	849.8	849.8	849.8	849.8	849.8	849.8

Color for Density

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

APPENDIX D
As-Built Plan Sheets

CONTRACT: UT MILLERS CREEK DMS PROJECT # 95719

NCDENR CONTRACT # 5000

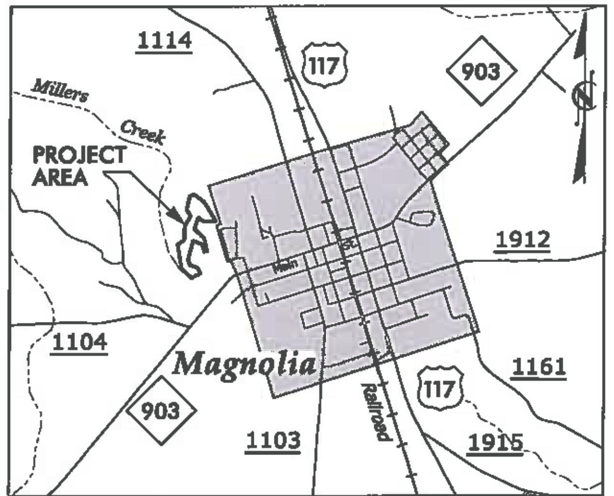
STATE		SHEET NO.	TOTAL SHEETS
N.C.	UT MILLERS CREEK	1	8

ASBUILT/BASELINE PLANS
UT MILLERS CREEK

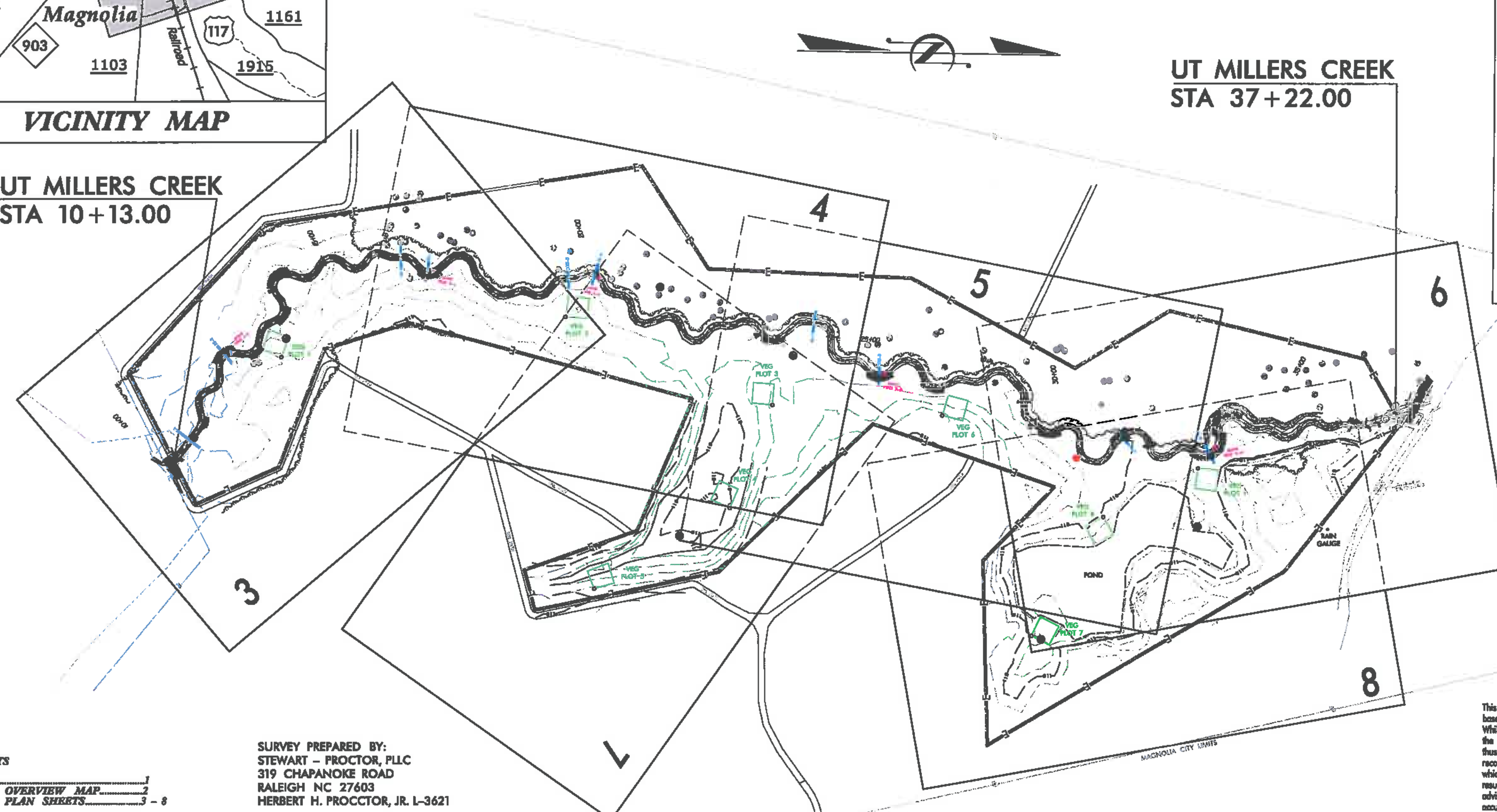
LOCATION: DUPLIN COUNTY, NORTH CAROLINA

LAT: 34°53' 48" N LONG: 78°04' 04" W

TYPE OF WORK: ASBUILT/BASELINE PLANS



VICINITY MAP



LEGEND

- CONSERVATION EASEMENT LINE
- THALWEG
- BANKFULL
- ASBUILT TOP OF TRAY
- ASBUILT TOE OF TRAY
- CROSS-SECTION LOCATIONS
- CONSTRUCTION REVISIONS
- LOG SILL
- 10M x 10M VEG PLOT
- VEG PLOT ORIGIN
- FLOODPLAIN INTERCEPTOR
- SOIL LIFT
- MONITORING WELL
- CREST GAUGE
- BANK PIN
- BRUSH TOE

AS BUILT

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INDEX OF SHEETS

SURVEY PREPARED BY:
STEWART – PROCTOR, PLLC
319 CHAPANOKE ROAD
RALEIGH NC 27603
HERBERT H. PROCCTOR, JR. L-3621

GRAPHIC SCALES

50 25 0 50 100
PLANS

10 5 0 10 20
PROFILE (HORIZONTAL)

20 10 0 20 40
PROFILE (VERTICAL)

DESIGN DATA

DESIGN STREAM TYPE	=	E5
BANKFULL AREA (FT^2) CROSS-SECTIONED	=	8.06
BANKFULL WIDTH (FT)	=	8.8
MAX DEPTH (FT)	=	1.40
WIDTH /DEPTH RATIO	=	9.5
DRAINAGE AREA (MI^2)	=	0.39
BANKFULL SLOPE(FT/FT)	=	0.0005

PROJECT LENGTH

EXISTING STREAM LENGTH	=	2,095 FT
PROPOSED DESIGN STREAM LENGTH	=	2,696 FT
ASBUILT STREAM LENGTH	=	2,709 FT

CHRISTOPHER L. SMITH
PROJECT ENGINEER

KATHLEEN M. McKEITHIAN
PROJECT DESIGNER

RYAN V. SMITH
PROJECT MANAGER

NORTH CAROLINA PROFESSIONAL SEAL 28432 ENGINEER KATHLEEN M. McKEITHAN

Kathleen McKeithan

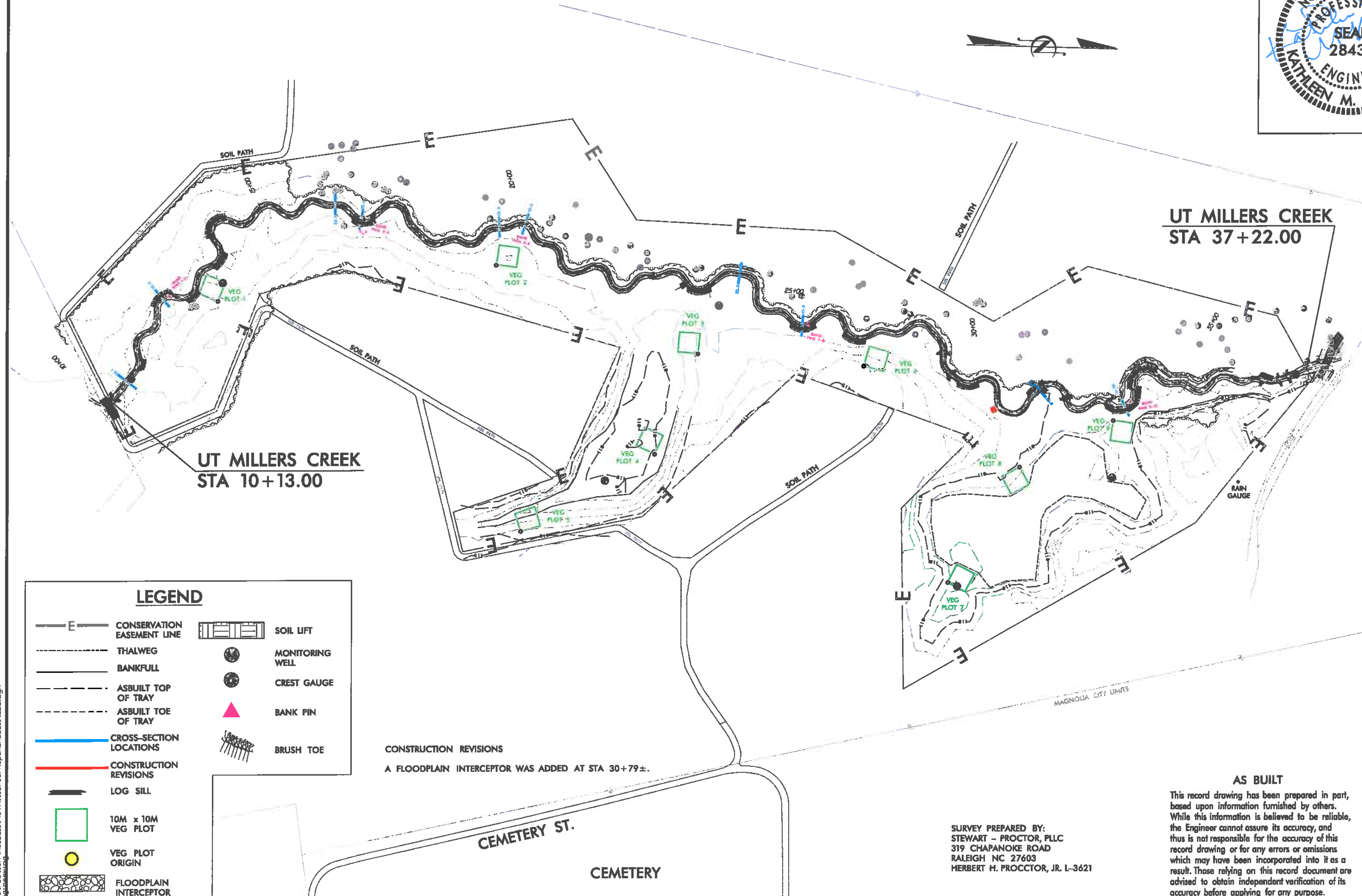
7.31.15

Prepared in the Office of:

ICA Engineering
5121 Kingdom Way, Suite 100
Raleigh, NC 27607
NC License No: F-0258

7/31/2015
R:\Construction\As_Built+\UTMillersCrk_psh_Asbuilt_01.dgn
ICA Engineering

ASBUILT/BASELINE OVERVIEW MAP



LEGEND

—E—	CONSERVATION EASEMENT LINE		SOIL LIFT
	THALWEG		MONITORING WELL
	BANKFULL		CREST GAUGE
	ASBUILT TOP OF TRAY		BANK PIN
	ASBUILT TOE OF TRAY		BRUSH TOE
	CROSS-SECTION LOCATIONS		
	CONSTRUCTION REVISIONS		
	LOG SILL		
	10M x 10M VEG PLOT		
	VEG PLOT ORIGIN		
	FLOODPLAIN INTERCEPTOR		

CONSTRUCTION REVISIONS

A FLOODPLAIN INTERCEPTOR WAS ADDED AT STA 30+79±.

SURVEY PREPARED BY:
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FOR ASBUILT/BASELINE PLANS SEE SHEETS 3 THRU 8

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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
75 0 75 150
PLANS

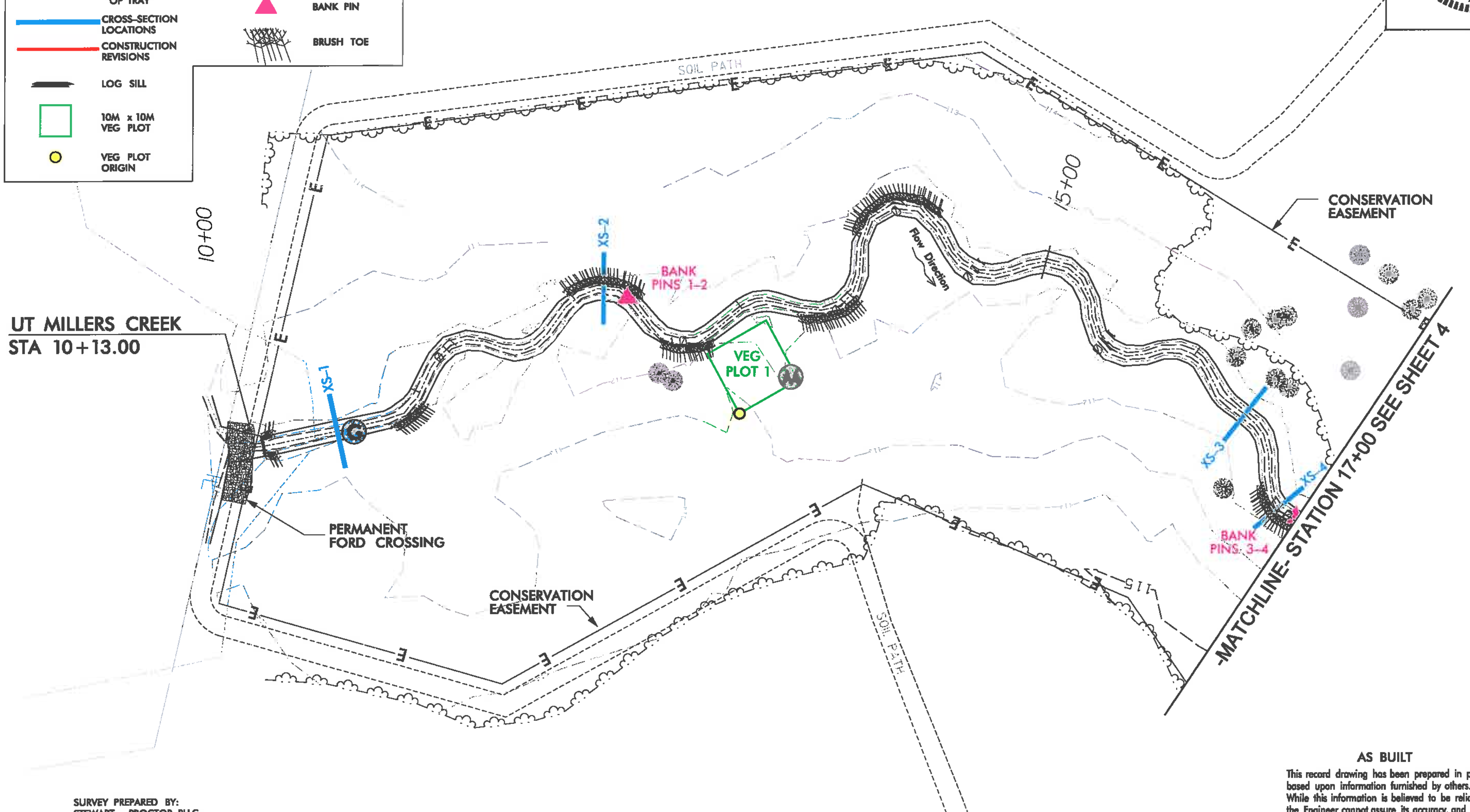
DATE: 07-31-15

ASBUILT/ BASELINE OVERVIEW MAP

ASBUILT/BASELINE PLAN

LEGEND

- CONSERVATION EASEMENT LINE
- THALWEG
- BANKFULL
- ASBUILT TOP OF TRAY
- ASBUILT TOE OF TRAY
- CROSS-SECTION LOCATIONS
- CONSTRUCTION REVISIONS
- LOG SILL
- 10M x 10M VEG PLOT
- VEG PLOT ORIGIN
- FLOODPLAIN INTERCEPTOR
- SOIL LIFT
- MONITORING WELL
- CREST GAUGE
- BANK PIN
- BRUSH TOE



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FOR ASBUILT/BASELINE OVERVIEW MAP SEE SHEET 2
FOR ASBUILT/BASELINE PLANS SEE SHEETS 3 THRU 8

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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA
STA 10+13 - STA 17+00

GRAPHIC SCALE 25 0 25 50 PLANS

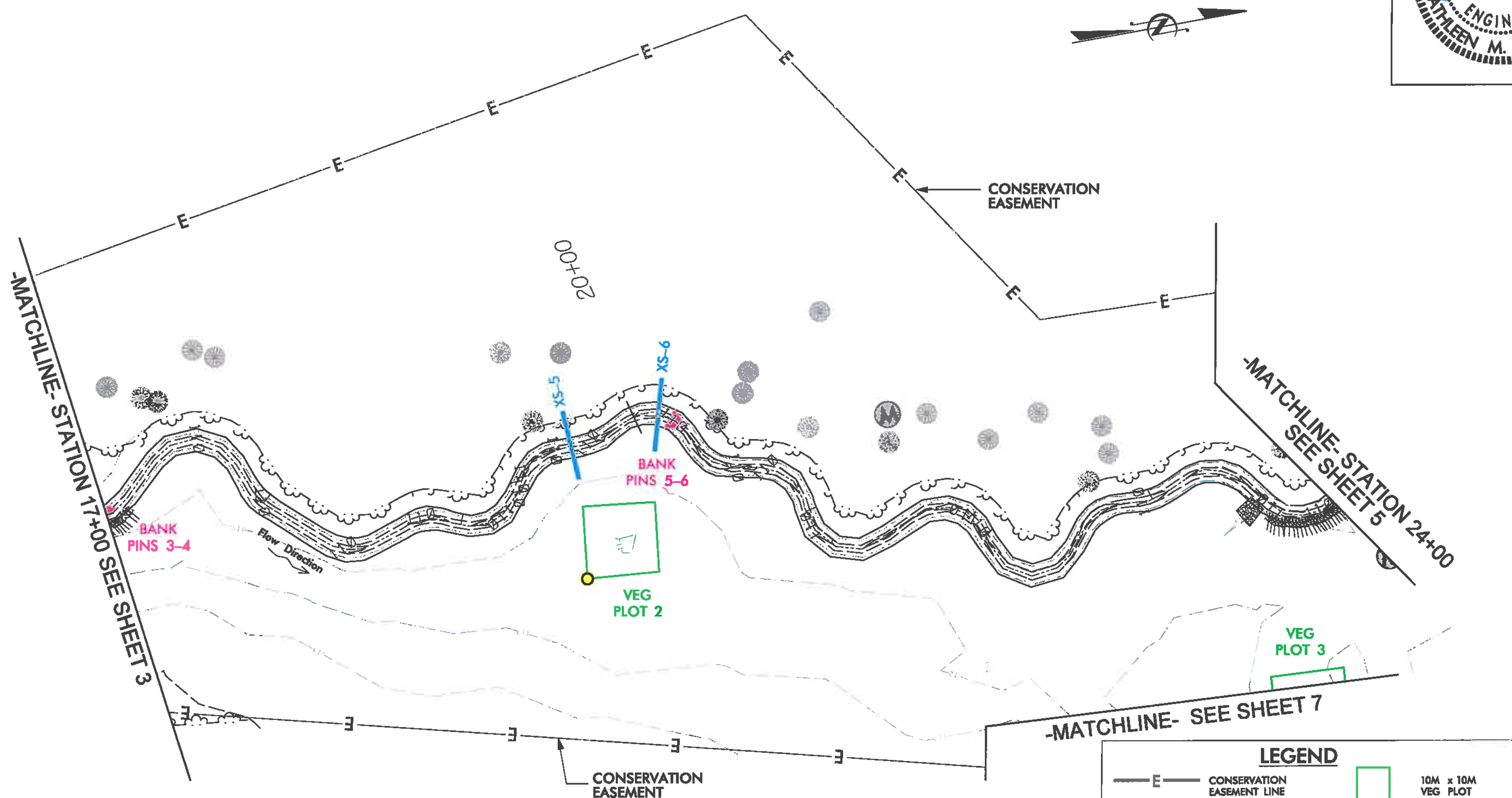
DATE: 07-31-15

ASBUILT/BASELINE PLAN

SHEET 3 OF 8

7/31/2015 R:\Construction\As_Built\UTMillersCrk_psh_Asbuilt_03.dgn

ASBUILT/BASELINE PLAN



LEGEND

—E—	CONSERVATION EASEMENT LINE		10M x 10M VEG PLOT
	THALWEG		VEG PLOT ORIGIN
	BANKFULL		FLOODPLAIN INTERCEPTOR
	ASBUILT TOP OF TRAY		SOIL LIFT
	ASBUILT TOE OF TRAY		MONITORING WELL
	CROSS-SECTION LOCATIONS		BANK PIN
	CONSTRUCTION REVISIONS		BRUSH TOE
	LOG SILL		

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FOR ASBUILT/BASELINE OVERVIEW MAP SEE SHEET 2
FOR ASBUILT/BASELINE PLANS SEE SHEETS 3 THRU 8

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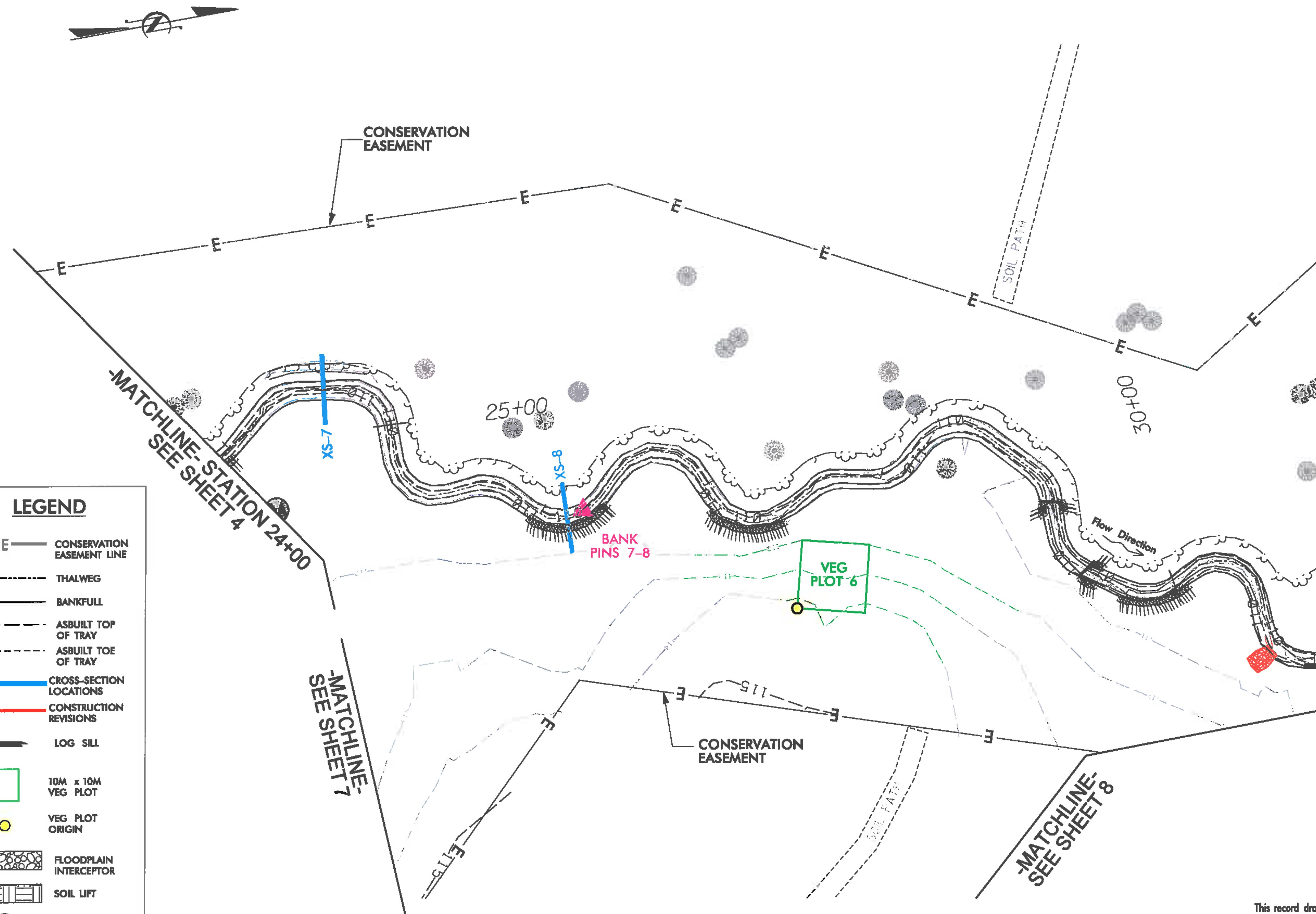
UT MILLERS CREEK STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA
STA 17+00 - STA 24+00

GRAPHIC SCALE 50 25 0 25
PLANS

DATE: 07-31-15

ASBUILT/BASELINE PLAN

ASBUILT/BASELINE PLAN



LEGEND

- CONSERVATION EASEMENT LINE
- THALWEG
- BANKFULL
- ASBUILT TOP OF TRAY
- ASBUILT TOE OF TRAY
- CROSS-SECTION LOCATIONS
- CONSTRUCTION REVISIONS
- LOG SILL
- 10M x 10M VEG PLOT
- VEG PLOT ORIGIN
- FLOODPLAIN INTERCEPTOR
- SOIL LIFT
- MONITORING WELL
- BANK PIN
- BRUSH TOE

NORTH CAROLINA PROFESSIONAL SEAL 28432 ENGINEER KATHLEEN M. McKEITHAN

7.31.15

CONSTRUCTION REVISIONS

A FLOODPLAIN INTERCEPTOR WAS ADDED AT STA 30+79±.

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HERBERT H. PROCCTOR, JR. L-3621

FOR ASBUILT/BASELINE OVERVIEW MAP SEE SHEET 2
FOR ASBUILT/BASELINE PLANS SEE SHEETS 3 THRU 8

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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA
STA 24+00 - STA 31+00

GRAPHIC SCALE
25 0 25 50
PLANS

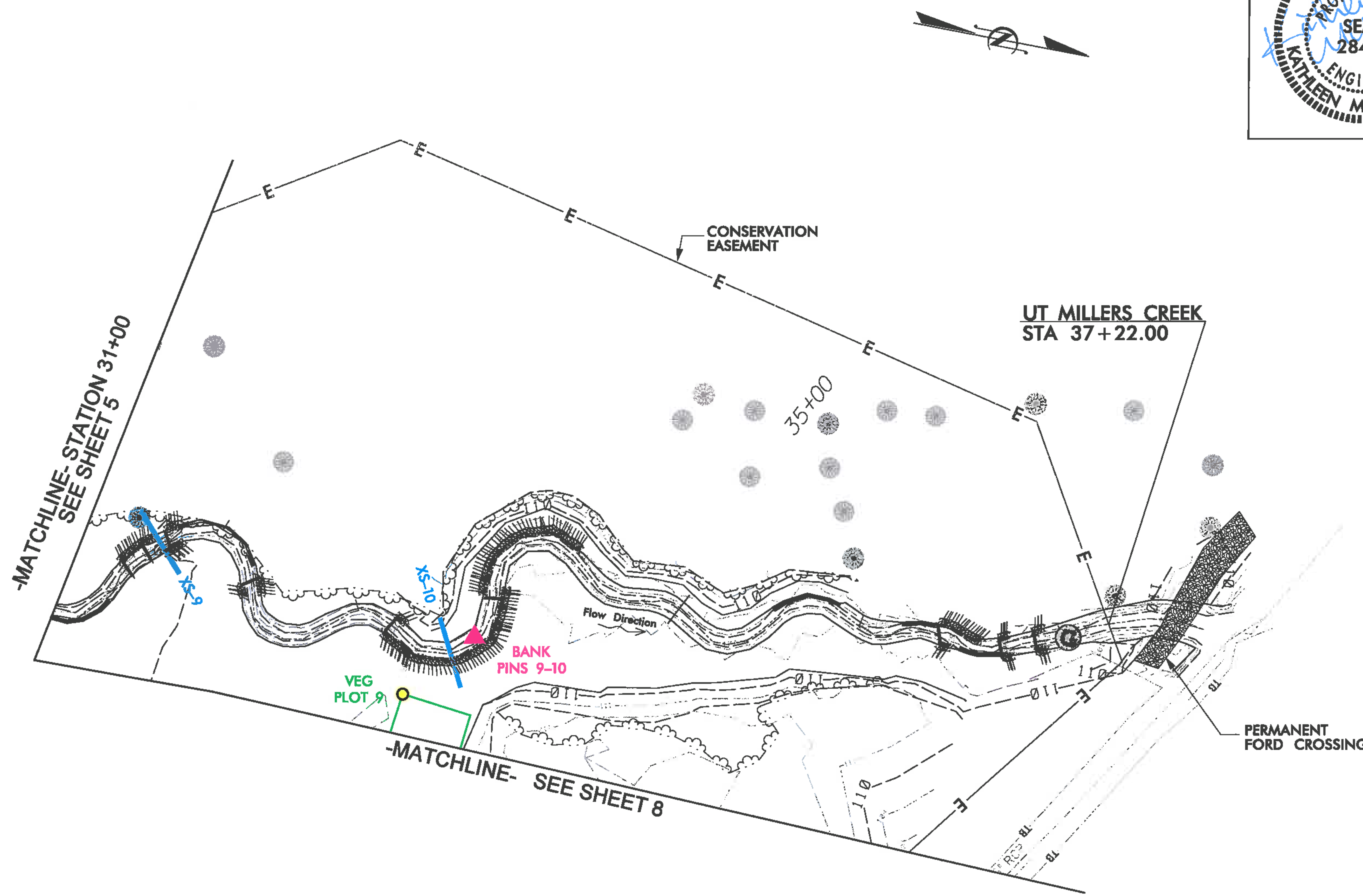
DATE: 07-31-15

ASBUILT/ BASELINE PLAN

ASBUILT/BASELINE PLAN

LEGEND

- E — CONSERVATION EASEMENT LINE
- THALWEG
- BANKFULL
- ASBUILT TOP OF TRAY
- ASBUILT TOE OF TRAY
- CROSS-SECTION LOCATIONS
- CONSTRUCTION REVISIONS
- LOG SILL
- 10M x 10M VEG PLOT
- VEG PLOT ORIGIN
- FLOODPLAIN INERCEPTOR
- SOIL LIFT
- CREST GAUGE
- BANK PIN
- BRUSH TOE



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UT MILLERS CREEK STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA
STA 31+00 - STA 37+22

GRAPHIC SCALE
25 0 25 50
PLANS

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FOR ASBUILT/BASELINE OVERVIEW MAP SEE SHEET 2
FOR ASBUILT/BASELINE PLANS SEE SHEETS 3 THRU 8

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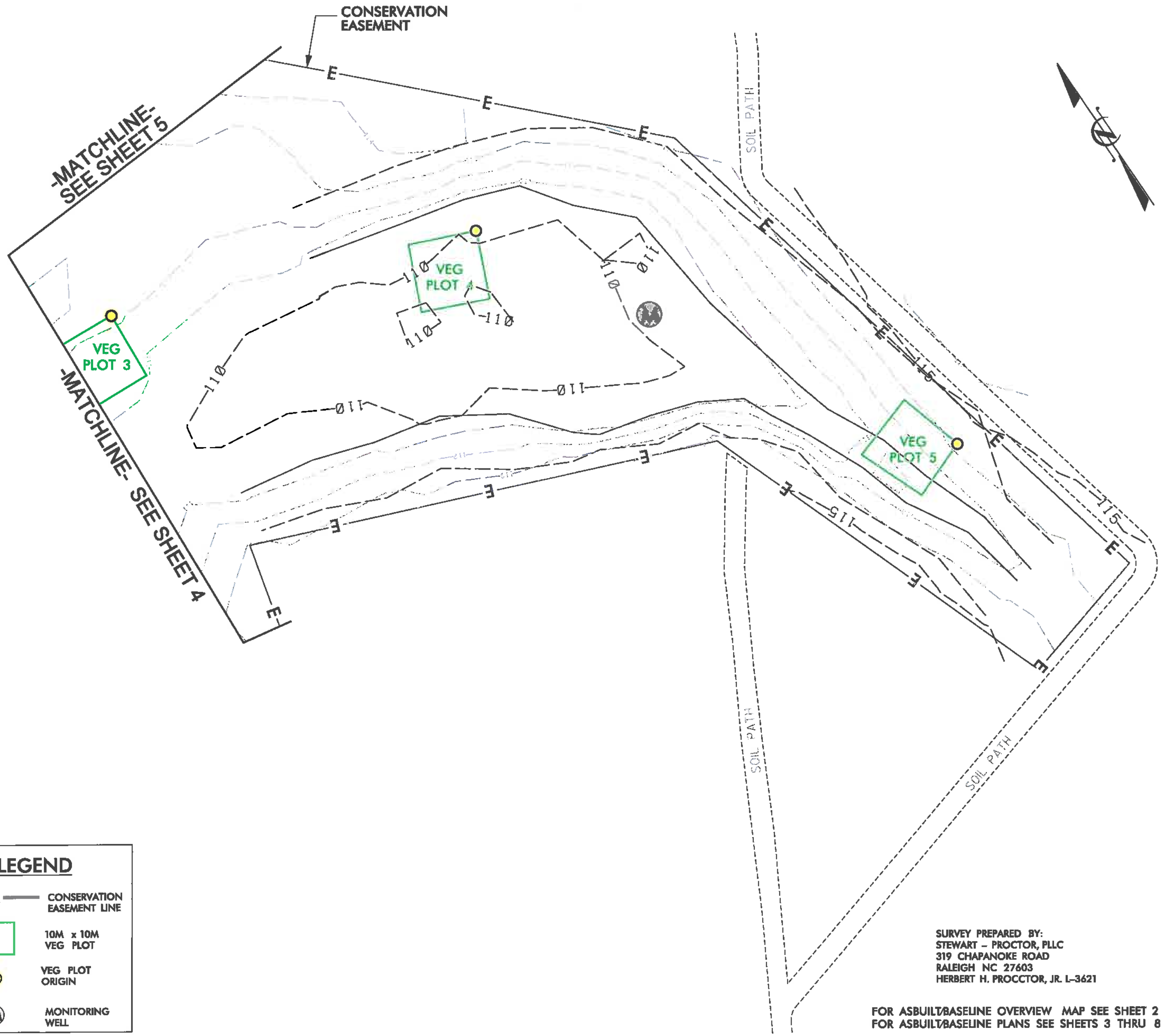
DATE: 07-31-15

ASBUILT/ BASELINE PLAN

SHEET 6 OF 8

7/31/2015 ...\Construction\As_Built\UTMillersCrk_psh_Asbuilt_06.dgn

ASBUILT/BASELINE PLAN



LEGEND

—E—	CONSERVATION EASEMENT LINE
□	10M x 10M VEG PLOT
●	VEG PLOT ORIGIN
Ⓜ	MONITORING WELL

SURVEY PREPARED BY:
STEWART – PROCTOR, PLLC
319 CHAPANOKE ROAD
RALEIGH NC 27603
HERBERT H. PROCCTOR, JR. L-3621

FOR ASBUILT/BASELINE OVERVIEW MAP SEE SHEET 2
FOR ASBUILT/BASELINE PLANS SEE SHEETS 3 THRU 8

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7-31-15

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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA

GRAPHIC SCALE
25 0 25 50
PLANS

DATE: 07-31-15

ASBUILT/ BASELINE PLAN

SHEET 7 OF 8

7/31/2015
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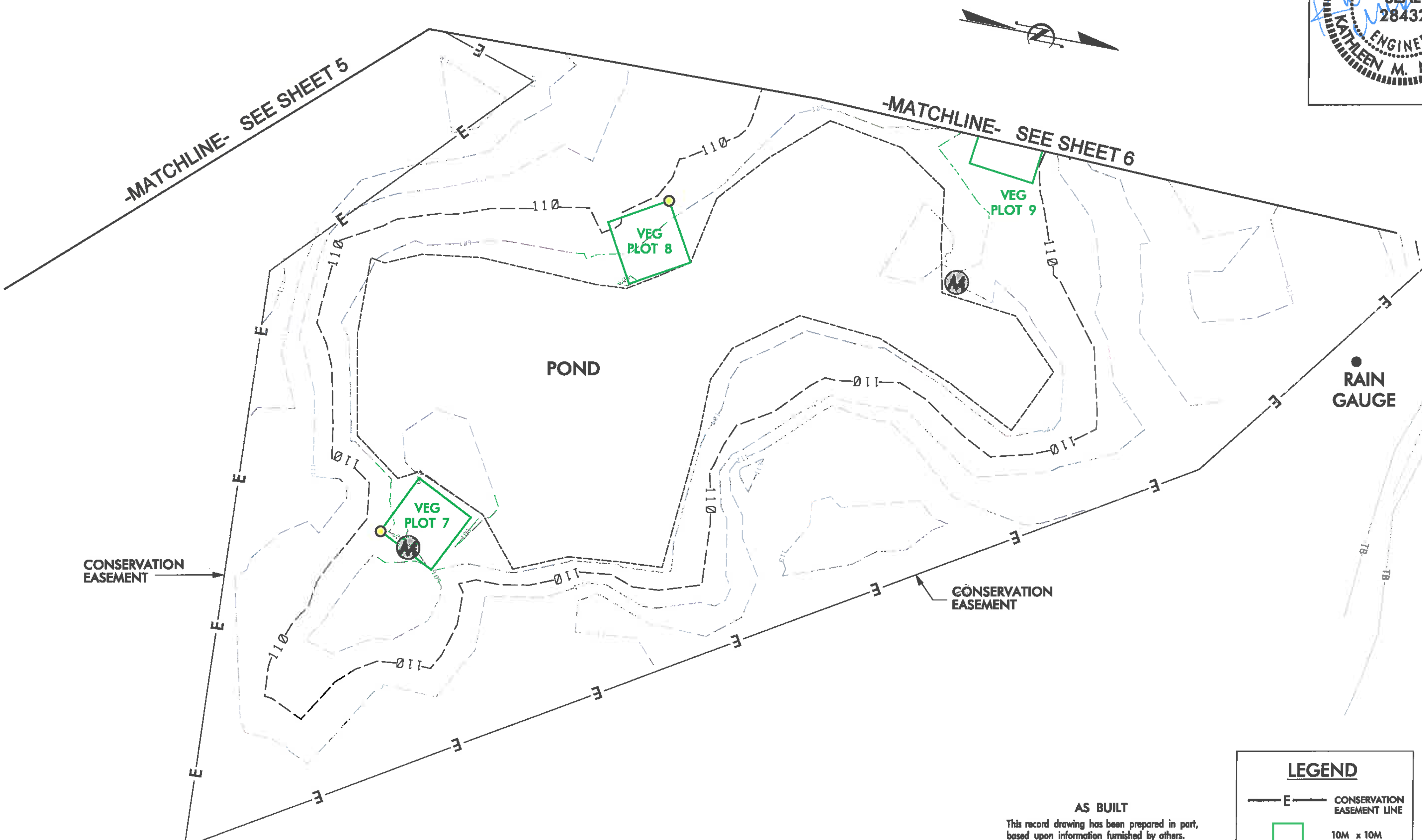
ASBUILT/BASELINE PLAN



NORTH CAROLINA PROFESSIONAL SEAL 28432 ENGINEER KATHLEEN M. McKEITHAN
7-31-15

SURVEY PREPARED BY:
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RALEIGH NC 27603
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FOR ASBUILT/BASELINE OVERVIEW MAP SEE SHEET 2
FOR ASBUILT/BASELINE PLANS SEE SHEETS 3 THRU 8

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LEGEND

- —E— CONSERVATION EASEMENT LINE
- 10M x 10M VEG PLOT
- VEG PLOT ORIGIN
- Ⓜ MONITORING WELL

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UT MILLERS CREEK
STREAM RESTORATION PROJECT
DUPLIN COUNTY, NORTH CAROLINA
POND

GRAPHIC SCALE
25 0 25 50
PLANS

DATE: 07-31-15

ASBUILT/ BASELINE PLAN

SHEET 8 OF 8

7/31/2015
R:\Construction\As_Built\UTMillersCrk_psh_Asbuilt_08.dgn