BASELINE MONITORING DOCUMENT & AS-BUILT BASELINE REPORT

ROSES CREEK STREAM MITIGATION SITE

Burke County, North Carolina
NCDMS Project # 96309

Prepared for:

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

SIGNED SEALED, AND DATED THIS 13TH DAY OF SEPTEMBER 2016.

NORTH CAROLINA PROFESSIONAL SEAL 035636 ENGINEER CHRISTOPHER L. SMITH

Chris Smith, PE

EXECUTIVE SUMMARY

The North Carolina Department of Environmental Quality Division of Mitigation Services (DMS) contracted HDR|ICA to restore 4,746 linear feet of Roses Creek and three of its unnamed tributaries within the Roses Creek Stream Mitigation Site (hereafter referred to as the "Site") to assist in fulfilling stream mitigation needs in the watershed. The Site is located approximately 12 miles northwest of downtown Morganton in Burke County, NC. The Site contains Roses Creek and three unnamed headwater tributaries of Roses Creek (UT 1, UT 2 and UT 3). The Site is located within the 03050101060030 14-digit Hydrologic Unit, which is also an DMS Targeted Hydrologic Unit for Cataloging Unit 03050101 of the Catawba River Basin. Roses Creek is classified as a Water Supply Watershed (WS-III), as it is part of the headwaters that feed Lake Rhodhiss. According to NCDENR 2012 Water Quality Classification, Roses Creek is designated trout water; however, NC Wildlife Resource Commission indicated there are no trout resources at this location in response to the Categorical Exclusion notification (D. Besler, personal communication, April 16, 2014).

The Site is comprised of one property owned by Robert B. Sisk and Martha M. Sisk (PIN # 1767479652) (known as the Sisk Farm). The Natural Heritage Program (NHP) has not identified elemental occurrences or Significant Natural Heritage Areas within one mile of the Site. The Site is surrounded by the Pisgah National Forest. Based on a review of records from the North Carolina State Historic Preservation Office (NCSHPO), there are no properties listed on the National Register within one mile of the Site. The Sisk Farm is included on the NCSHPO's Study List for NC (Site ID BK0090). NCSHPO determined the project as proposed will not have an effect on any historic structures (R. Bartos, personal communication, April 25, 2014). NCSHPO requested that a comprehensive archaeological survey be conducted on the Site by an experienced archaeologist. The archeological survey concluded that the Site did not meet the requirements to be considered eligible for the National Register of Historic Places (URS, Phase I Archeological Survey for the Roses Creek Stream Mitigation Site, August 8, 2014).

Primary goals for the Site, as detailed in the Roses Creek Stream Mitigation Site Mitigation Plan (HDR|ICA 2015) include:

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

The following objectives accomplish the goals listed above:

1. Reducing water quality stressors and providing/enhancing flood attenuation through:
    a. Restoring the existing degraded, straightened and incised/entrenched streams as primarily a Priority 1 restoration where bankfull and larger

flows can access the floodplain allowing nutrients, sedimentation, trash and debris from upstream runoff to settle from floodwaters to the extent practical. Restoring a stable dimension, pattern, and profile will ensure the channel will transport and attenuate watershed flows and sediment loads without aggrading or degrading.

b. Restore channel banks by relocating the channel, excavating bankfull benches, placing in-stream structures to reduce shearing forces on outside meander bends, and planting native vegetative species to provide soil stability, thus reducing stream bank stressors.
c. Reducing point source (i.e. cattle and equipment crossings) and non-point source (i.e. stormwater runoff through pastures) pollution associated with on-site agricultural operations (hay production and cattle) by exclusionary fencing from the stream and riparian buffer and by eliminating all stream crossings from the easement.
d. Plant a vegetative buffer on stream banks and adjacent floodplains to treat nutrient enriched surface runoff from adjacent pastureland associated with on-site agricultural operations.
e. Restoring riparian buffers adjacent to the streams that are currently maintained for hay production that will attenuate floodwaters, in turn reducing stressors from upstream impacts.

2. Restoring and enhancing aquatic, semi-aquatic and riparian habitat through:
   a. Restoration of a sinuous gravel bed channel that promotes a stable bed form, and accommodates benthic macroinvertebrate and fish propagation. Additionally, woody materials such as log structures, overhanging planted vegetation and toe wood/brush toe in submerged water will provide a diversity of shading, bed form and foraging opportunities for aquatic organisms.
   b. Restoring native vegetation to the stream channel banks and the adjacent riparian corridor, that is currently grass dominated, will diversify flora and create a protected habitat corridor, which will provide an abundance of available foraging and cover habitat for a multitude of amphibians, reptiles, mammals and birds.
3. Restoring and enhancing habitat connectivity with adjacent natural habitats through:
   a. Planting the riparian buffer with native vegetation.
   b. Protection of the restored community will ensure a protected wildlife corridor between the Site and the upstream and downstream mature riparian buffers and upland habitats.
   c. Converting approximately 15 acres from existing agricultural land to riparian buffer protected by permanent conservation easement.

Monitoring Components and Duration

The first year monitoring report will be submitted in December 2016. Monitoring will continue for seven years or until agreed upon success criteria is achieved, with a report submitted at the beginning 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 Site is located approximately 12 miles northwest of downtown Morganton in Burke County, NC. (Figure 1)

Directions from Raleigh, NC:
From Raleigh or eastern NC: Travel on I-40 west to exit 103 (US-64/Burkemont Avenue) and turn right, go 0.7 miles; turn left onto Flemming Drive, go 1.1 miles; continue onto Sanford Drive, go 1.2 miles; turn left onto NC-181N/N Green Street, go 8.0 miles; turn left onto Fish Hatchery Road, go 2.4 miles; turn right onto Old Table Rock Mountain Road (National Forest Rd), go 0.4 miles; stay right onto Sisk Farm Road. The Site is approximately 0.3 miles at the end of Sisk Farm Road.

The Site is located within Targeted Local Watershed Catalogue Unit (CU) 03050101. The Site is located in the Inner Piedmont Physiographic Province of North Carolina.

1.2 Project Goals and Objectives

Primary goals for the Site, as detailed in the Roses Creek Stream Mitigation Site Mitigation Plan (HDR|ICA 2015) include:

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

The following objectives accomplish the goals listed above:

1. Reducing water quality stressors and providing/enhancing flood attenuation through:
    a. Restoring the existing degraded, straightened and incised/entrenched streams as primarily a Priority 1 restoration where bankfull and larger flows can access the floodplain allowing nutrients, sedimentation, trash and debris from upstream runoff to settle from floodwaters to the extent practical. Restoring a stable dimension, pattern, and profile will ensure the channel will transport and attenuate watershed flows and sediment loads without aggrading or degrading.
    b. Restore channel banks by relocating the channel, excavating bankfull benches, placing in-stream structures to reduce shearing forces on outside meander bends, and planting native vegetative species to provide soil stability, thus reducing stream bank stressors.
    c. Reducing point source (i.e. cattle and equipment crossings) and non-point source (i.e. stormwater runoff through pastures) pollution associated with on-site agricultural operations (hay production and cattle) by exclusionary

fencing from the stream and riparian buffer and by eliminating all stream crossings from the easement.

d. Plant a vegetative buffer on stream banks and adjacent floodplains to treat nutrient enriched surface runoff from adjacent pastureland associated with on-site agricultural operations.
e. Restoring riparian buffers adjacent to the streams that are currently maintained for hay production that will attenuate floodwaters, in turn reducing stressors from upstream impacts.

2. Restoring and enhancing aquatic, semi-aquatic and riparian habitat through:
   a. Restoration of a sinuous gravel bed channel that promotes a stable bed form, and accommodates benthic macroinvertebrate and fish propagation. Additionally, woody materials such as log structures, overhanging planted vegetation and toe wood/brush toe in submerged water will provide a diversity of shading, bed form and foraging opportunities for aquatic organisms.
   b. Restoring native vegetation to the stream channel banks and the adjacent riparian corridor, that is currently grass dominated, will diversify flora and create a protected habitat corridor, which will provide an abundance of available foraging and cover habitat for a multitude of amphibians, reptiles, mammals and birds.
3. Restoring and enhancing habitat connectivity with adjacent natural habitats through:
   a. Planting the riparian buffer with native vegetation.
   b. Protection of the restored community will ensure a protected wildlife corridor between the Site and the upstream and downstream mature riparian buffers and upland habitats.
   c. Converting approximately 15 acres from existing agricultural land to riparian buffer protected by permanent conservation easement.

1.3 Project Structure, Restoration Type and Approach

1.3.1 Project Structure

3,181 linear feet of Roses Creek, 297 linear feet of Unnamed Tributary 1, 707 linear feet of Unnamed Tributary 2, and 621 linear feet of Unnamed Tributary 3 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 mitigation included the following:

- Roses Creek – Restoring dimension, pattern, profile and riparian buffer and cattle exclusion (fencing) to 3,681 existing feet (3,181 restored feet) of Roses Creek.

- Roses Creek – Enhancement II through providing riparian buffer and cattle exclusion (fencing) of 38 existing linear feet.
- UT 1 – Restoring dimension, pattern, profile and riparian buffer and cattle exclusion (fencing) to 267 existing feet (297 restored feet) of UT 1.
- UT 1 – Enhancement I through providing an appropriate dimension and restoring the profile and riparian buffer of 633 existing linear feet.
- UT 2 – Restoring dimension, pattern, profile and riparian buffer and cattle exclusion (fencing) to 610 existing feet (707 restored feet) of UT 2 through the pasture.
- UT 3 – Restoring dimension, pattern, profile and riparian buffer and cattle exclusion (fencing) to 558 existing feet (621 restored feet) of UT 3.

1.3.3 Roses Creek Restoration and Enhancement

Roses Creek experienced bank failure leading to the deposition of sediment (from channel inverts and banks) and nutrient (from cattle) loading to on-site and downstream receiving waters.

The mitigated portions of Roses Creek included restoring bank height ratios to 1.0 through Priority I restoration; meandering the channel away from existing terrace slopes and back to the low point of the valley; providing bankfull benches as restored channels tie to the existing channel at the upstream and downstream extents of the Site; restoring a more natural and stable plan form and spacing of riffle-pool sequences; installation of wood and rock structures for grade control and habitat improvement; restoration of a vegetated riparian buffer; and removal of agricultural operations from the channel and riparian buffer through fencing. The proposed channel was designed as a moderate width to depth ratio, C type channel that conveys a bankfull discharge of approximately 300 cfs.

Restoration limits all agricultural operations crossing Roses Creek to the existing road crossing on Sisk Farm Road. The road crossing is not contained within the conservation easement.

Exclusionary fencing was installed along the easement boundary to exclude cattle and clearly demarcate the easement boundary for the landowners. A riparian buffer populated with native vegetative species was planted within the proposed conservation easement. HDR|ICA had all trees 12 inches and greater within the buffer surveyed. The survey was used during the stream channel design to ensure that mature tree disturbance is limited to the greatest practical extent possible during construction. Any portion of the existing buffer that was removed to facilitate restoration of Roses Creek was replanted with native vegetation.

Several sections of the existing channel were not completely filled during construction. These abandoned pockets of channel serve as ephemeral floodplain pools that may experience periodic wetting for substantial periods throughout the year. These ephemeral pools provide semi-aquatic habitat for flora and fauna within the proposed conservation easement while also acting as BMP's by collecting storm water runoff from the adjacent agricultural operation and detention of overbank flows from the restored stream channel.

The downstream 38 linear feet of Roses Creek received Enhancement II. This portion of Roses Creek is stable and received no physical modifications of the stream channel. Roses Creek was enhanced by installing exclusionary fencing to remove cattle from the stream channel and the adjacent riparian buffer. The buffer inside of the easement area was be restored by planting native vegetation.

1.3.4 UT 1 Restoration and Enhancement

Stream channel restoration of pattern, profile, dimension and riparian buffer was constructed for approximately 289 linear feet of UT 1. Prior to construction UT 1 had been straightened and channelized immediately downstream of a soil road culverted crossing. This soil road crossing is outside of the proposed easement area. Restoration activities on UT 1 included restoring 254 linear feet of UT 1 to an abandoned portion of the historic channel that is immediately east of the existing channelized reach. UT 1 was only restored through the noticeable historic channel and ties back to the existing channel at its downstream extent.

An additional 35 linear feet of UT 1 was restored near the middle of UT 1 within the proposed easement where an existing and dilapidated pipe culvert was located. The dilapidated culvert and road crossing was removed from the proposed easement area. UT 1 was day-lighted within the limits of the culvert's footprint in an effort to restore a stable and more nature channel section and profile. Both sections of channel modification are Priority 1 restorations which allow out of bank flows access to the historic floodplain.

The riparian buffer was restored by planting native vegetative species within the proposed conservation easement and exclusionary fencing has permanently removed agricultural operations (i.e. cattle and equipment access) from the channel and riparian buffer. Additionally, a power line easement that was previously crossing the proposed upstream restoration reach of UT 1 was relocated to a location north of the conservation easement. It is noted that there are no crossings or easements bisecting UT 1 within the proposed conservation easement.

The abandoned section of existing channel adjacent to the restored portion of UT 1 was not completely filled during construction. The abandoned pocket of channel serves as an ephemeral floodplain pool that may experience periodic wetting for substantial periods through the year. This ephemeral pool provides semi-aquatic habitat for flora and fauna within the proposed conservation easement while also acting as BMP's by collecting storm water runoff from the adjacent agricultural operation, and detention of overbank flows from the restored stream channel.

Enhancement II was proposed for the large majority of UT 1 within the Site. Investigations into channel stress have revealed that hoof shear on the invert and side slopes was the primary impediment to stability, therefore Enhancement II activities concentrated on removal of cattle from the channel and its adjacent buffer. Additionally, planting of deep rooting vegetative species along the channel banks promote soil stability and deposition of seed along the side slopes, which stabilize areas that have experienced degradation from hoof shear.

No crossings are located on UT 1 within the proposed conservation easement, ensuring stability of UT 1 to its confluence with Roses Creek within the proposed conservation easement.

The currently denuded and regularly maintained riparian buffer was restored by planting native vegetation within the proposed conservation easement. Restoration of the riparian buffer promotes terrestrial, aquatic and semiaquatic foraging, propagation, and cover habitat. Additionally, the restored buffer connects UT 1's riparian corridor with Roses Creek's restored wooded riparian buffer; and enhances the floodplains ability to uptake nutrients and settle other pollutants from high flow events.

1.3.5 UT 2 Restoration

Stream channel restoration of pattern, profile, dimension and riparian buffer was constructed for approximately 707 linear feet of UT 2. UT 2 was restored through the pasture within the Site, beginning at the upstream agricultural crossing and ending at its convergence with Roses Creek. The existing channel was modified and relocated from its natural valley position to a point at which it flowed adjacent to the existing soil road. Bankfull flows were entrenched in the existing channel and are abandoned from the historic floodplain causing high stress on the channel banks. The channel was restored back to the low point of the valley and moved away (to the west) from the soil road through Priority 1 restoration. An aerial power line previously paralleled UT 2 and Sisk Farm Road. Several sections of the power line were located directly above the channel, with the power line's easement affecting UT 2's riparian buffer. HDR|ICA coordinated with the landowners and Rutherford Electric Membership Corporation to relocate the power line to the east of Sisk Farm Road in an effort to remove potential effects of the

power line and it associated maintenance easement from the proposed conservation easement.

The proposed channel was designed as a moderate width to depth ratio C type channel through a relatively steep valley (0.026 ft/ft). The pond located upstream of the proposed conservation easement has modified natural flows through UT 2's reach. Short pool to pool spacing (averaging near 3 bankfull widths) and grade control structures are utilized throughout the restored channel in an attempt to dissipate energy (through pools) and maintain a relatively low bankfull slope of 0.002 ft/ft between drops. The low bankfull slope (and subsequent low stream power) is required in an attempt to reduce bed scour because the channel's substrate is dominated by fine particles (predominantly sand).

Several impervious channel plugs were installed in the abandoned portion of UT 2, creating several linear ephemeral pools that parallel Sisk Farm Road. The ephemeral pools may experience periodic wetting for substantial periods through the year. These ephemeral pools provide semi-aquatic habitat for flora and fauna within the conservation easement while also acting as BMP's by collecting storm water runoff from the adjacent agricultural operation, runoff from the adjacent Sisk Farm Road and detention of overbank flows from the restored stream channel.

It is noted that there are no crossings bisecting UT 2 within the conservation easement. The existing culvert immediately upstream of the conservation easement was replaced.

1.3.6 UT 3 Restoration

UT 3 is a headwater, spring fed channel that was moved from its natural valley position to the toe of slope of the adjacent hill slope along the adjacent pasture. Stream channel restoration of pattern, profile, dimension and riparian buffer was constructed for approximately 621 linear feet of UT 3. UT 3 was restored away from its current location adjacent to the hill slope, to the low point of its natural valley, which was previously utilized as pasture. The upstream most 120 feet of restored channel flows from the channel's origins within a hill slope adjacent to the pasture. The valley slope of the upstream most 120 feet of channel is relatively steep at approximately 0.12 ft/ft. Pool to pool spacing was set to a short distance (approaching every 2.5 bankfull widths) and meander geometry limited in this portion of the reach in an attempt to dissipate flows through bedform (i.e. pools) rather than planform. The remaining 500 feet of restored channel flows through the floodplain of Roses Creek. Roses Creek's floodplain displays a distinctly lower valley slope than the upstream most 120 feet of restored stream channel. The meander geometry of UT 3 is much more sinuous through the lower reach due to the lower valley slope, allowing energy to predominantly dissipate through planform.

The proposed channel was designed as a moderate width to depth ratio C type channel that conveys a bankfull discharge of approximately 2.6 cfs.

All agricultural operations including grazing cattle are fenced out of the tributary. Access to the existing at-grade soil channel crossing has been removed. Several impervious channel plugs were installed in the abandoned portions of UT 3, creating several linear ephemeral pools. The ephemeral pools may experience periodic wetting for substantial periods through the year. These ephemeral pools provide semi-aquatic habitat for flora and fauna within the proposed conservation easement.

1.4 Project History, Contacts and Attribute Data

HDR|ICA provided engineering, design, and construction oversight services for the Site. Construction began in February 2016 and finished in May of 2016. Site planting finalized on May 27, 2016. Baseline monitoring field data collection occurred in May of 2016.

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 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 1st 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).

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 in addition to visual observation of channel stability.

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 stability. Riffle sections should generally maintain a Bank Height Ratio of 1.0 – 1.2, 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

Pattern features should show little adjustment over the seven year monitoring period.

The profile should not demonstrate significant trends towards degradation or aggradation over a significant portion of a reach. Bank height ratios of 1.0 – 1.2 should generally characterize the profile. If over one third of the profile exhibits a bank height ratio exceeding 1.2 then additional investigations will be completed to assess the channel stability. Additionally, bed form composition may vary.

2.1.3 Substrate and Sediment Transport

There should be an absence of any significant trend in the aggradational or depositional potential of the channel. Substrate measurements should indicate the progression towards or the maintenance of the known distributions from the design phase.

2.1.4 Hydraulics

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

2.2 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. Planted vegetation must average 8 feet in height in each plot at year 7 since the Site is located in a designated Mountain County.

If the above performance standards for vegetation are met by year 5, then monitoring of vegetation on the Site may be terminated provided written approval is provided by the USACE in consultation with the IRT.

Should the performance criteria outlined above not be met during the monitoring period, HDR|ICA will provide DMS with their remediation proposal, detailing corrective actions and/or maintenance actions proposed and an implementation schedule for said actions, planned to meet the criteria. Upon review and approval of said corrective measures by DMS, HDR|ICA will implement the necessary corrective measures.

It is noted that plant species count may change after Year 1 surveys as plants may have been misidentified during baseline surveys due to a lack of leaf-out.

2.2.1 Noxious Species

Noxious species will be identified and controlled so that none become dominant or alter the desired community structure of the proposed Site. If noxious plants are identified as a problem in the proposed Site, HDR|ICA will develop a species-specific control plan for approval by DMS prior to implementation.

Through coordination with DMS during the 7-year monitoring period, HDR|ICA, where necessary, will remove, treat, or otherwise manage undesirable plant or animal species, including physical removal, use of herbicides, live trapping, confining wires, or nets.

All vegetation removal from the Site shall be done by mechanical means only, unless DMS has first authorized the use of herbicides or algaecides for the control of plants in or immediately adjacent to the affected areas.

3.0 MONITORING PLAN GUIDELINES

3.1 Stream Monitoring Standards

3.1.1 As-builts and Baseline Conditions

As-built surveys shall be conducted upon completion of channel construction to document baseline conditions. As-built surveys will include all measurements typically documented during subsequent channel geomorphological surveys. A longitudinal profile of the thalweg, water surface, bankfull, and top of bank, will be collected during the as-built survey of the constructed channel to compare with future geomorphological data, 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.

3.1.2 Channel Cross-sections

Roses Creek will have a minimum of 3 riffle cross-sections and 3 pool cross-sections. Per the 2003 Stream Mitigation Guidelines very narrow streams generally require two cross-sections per 1,000 feet. UT 1, UT 2 and UT 3 are all considered very narrow. Channel cross-sections shall be monitored for 7 years, with monitoring events occurring in years 1, 2, 3, 5, and 7. If supplemental monitoring is conducted, results may be considered towards meeting performance standards.

Cross-sectional measurements will at a minimum include bankfull width, bankfull cross-sectional area, bankfull mean depth, bankfull max depth, flood prone width, width/depth ratio, bank height ration and entrenchment ratio.

A pebble count on Roses Creek will be completed at one of the riffle cross sections that are to be monitored.

Bank pin arrays will be installed on the outside bend of each meander in which a cross-section is located on Roses Creek. Pins will be a minimum of 3 feet in length at intervals of 2 foot in depth on the facing of the channel bank. Pins will be installed at the monumented cross-section in the upstream third of the meander bend and in the downstream third of the meander bend. Pins will be 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.

3.1.3 Stream Gauges

Crest gauges were installed at the bottom of restoration on UT 1, the confluence of UT 2 and Roses Creek, the confluence of UT 3 and Roses Creek, and at the bottom of Roses Creek. Crest gauges will be monitored regularly to track large flow events that affect the site. Additionally, flow gauges were installed on UT 1, UT 2, and UT 3 to confirm that restored channels are perennial streams. Monitoring feature locations are documented in the monitoring Plan sheets located in Appendix D.

3.1.4 Visual Monitoring

Visual monitoring of all sections of the project shall be conducted in each of the required seven years of monitoring to identify areas of concern in both the vegetated buffer and restored stream channel. Visual monitoring of all sections of the stream project will be conducted twice per monitoring year. Generally, one visual monitoring event will be completed in conjunction with other stream channel stability monitoring (e.g., cross-sections, bank pins, etc.). At least 5 months shall separate each visual monitoring event.

Within the stream channel, visual monitoring shall be conducted along the entire length of the channel to identify and document excessive lateral movement of the channel, bank instability, instability/failure of in-stream structures, structure piping, headcuts, beaver activity, excessive live stake mortality, invasive species, aggradation/excessive sediment deposition, or other potential problems with the channel. Visual monitoring of streams shall be conducted only by individuals that have been properly trained to assess the stability of streams and condition of in-stream structures. If visual monitoring reveals substantial adjustments to the channel pattern and if there are substantial deviations in channel dimension and profile then the channel pattern will be surveyed.

Within the vegetated buffer, visual monitoring will be conducted by 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 channel identifying the location of each feature of concern, along with a written assessment and photographic documentation of the feature. Once a feature of concern has been identified, that same feature shall be reassessed on all subsequent visual assessments. Photographs should be taken from the same location year-to-year to document progression of the problem. The monitoring reports shall identify all features of concern and recommended courses of action, which may include continued monitoring, repair or other remedial action.

3.2 Vegetation Monitoring Standards

Seventeen (17) permanent plots (totaling greater than 2 percent of planted area within the Site) have been be established within the proposed restoration corridor. Vegetation will be monitored using the Carolina Vegetation Survey (CVS) protocols.

Vegetation plots will be monitored for 7 years, with monitoring events occurring in years 1, 2, 3, 5, and 7. If supplemental monitoring occurs, results may be considered 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.

Individual plot data for planted species must be provided. Plot data shall not be averaged over the entire site to obtain a single figure for stem density. Enumeration of the density of planted species: density = number of living, planted stems per acre. Stems are defined as individual plants, where plants with multiple shoots are treated as 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 be considered 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 be counted separately from planted vegetation in the monitoring reports.

Monitoring events will also be used as a time to evaluate the presence of invasive species which will be noted in the monitoring report.

3.3 Digital Photos

Permanent photo stations established at each of the 12 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.

3.4 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 the 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 the Site's streams can be documented.

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 12 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-DMS 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 945 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.

6.0 REFERENCES

Lee, M. T., Peet, R. K., Roberts, S. D. & Wentworth, T. R. 2008. CVS-EEP Protocol for Recording Vegeation. Version 4.2.

HDR|ICA Engineering. Mitigation Plan Roses Creek Stream Mitigation Site. Burke County, North Carolina. September 29, 2015.

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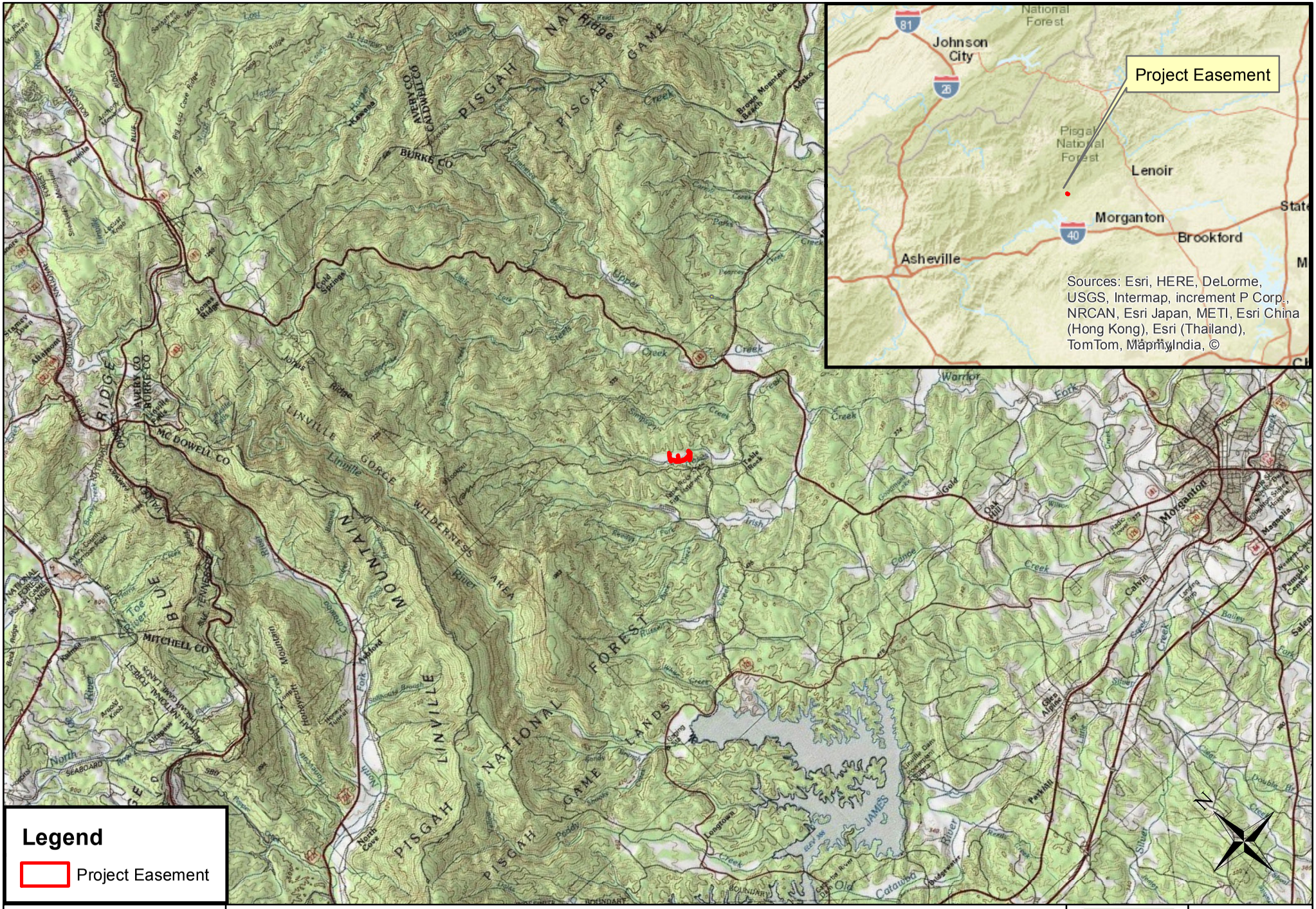
APPENDIX A
General Tables and Figures



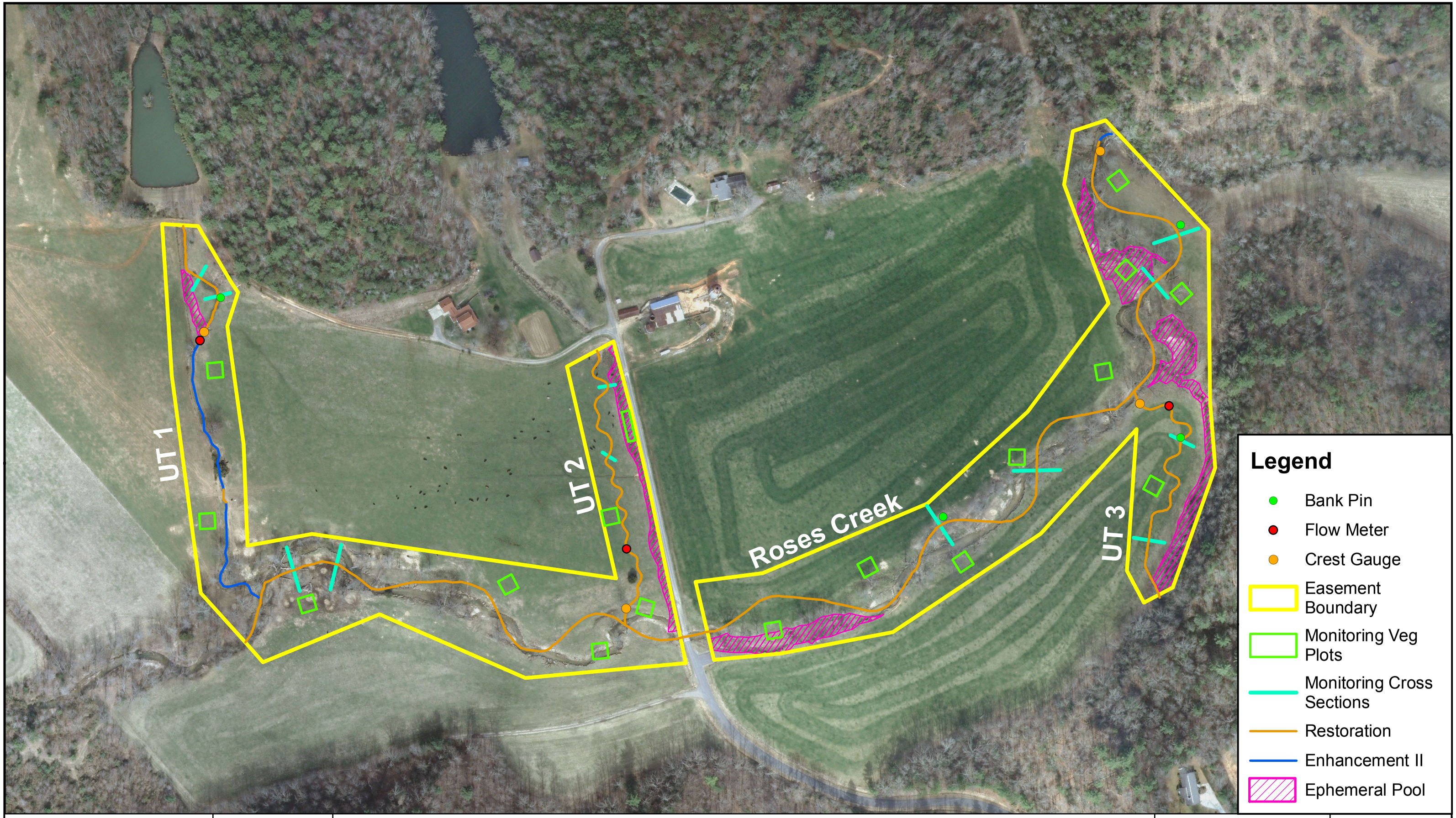
Roses Creek Stream Mitigation Site

Burke County, North Carolina

0 5,000 10,000 20,000 30,000 40,000 Feet

HDR | ICA

Figure 1



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Site Components

Roses Creek Stream Mitigation Site
Burke County, North Carolina

Figure 2

Table 1. Project Components and Mitigation Credits
Roses Creek (DMS Project ID No. 96309)

Roses Creek, Burke County DMS Project No. 96309									
Credit Summary									
	Stream SMU		Riparian Wetland WMU		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	5,009								
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
Roses Creek	10+00-41+81		3,643	PI	Restoration		3,181	1:1	3,121*
Roses Creek	41+81-42+19		38	-	EII		38	2.5:1	15
UT 1	10+00-12+54; 16+11-16+46		267	PI	Restoration		289	1:1	289
UT 1	12+54-16+11; 16+46-19+30		641	-	EII		641	2.5:1	256
UT 2	10+00-17+07		610	PI	Restoration		707	1:1	707
UT 3	10+00-16+21		558	PI	Restoration		621	1:1	621
Total	NA		5,757	PI	Restoration/ EII		5,477	1-2.5:1	5,009

* Stream Mitigation Units decreased by 60 to account for break in easement at the stream crossing on Sisk Farm Road

Component Summation						
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	4,798					
Enhancement II	679					

Table 2. Project Activity and Reporting History
Roses Creek (DMS Project ID No. 96309)

Activity or Report	Data Collection Complete	Completion or Delivery
Mitigation Plan	September 2015	September 2015
Final Design – Construction Plans	September 2015	March 2016
Construction	February 25, 2016	May 18, 2016
Temporary S&E Mix Applied to Entire Project Area	---	May 18, 2016
Permanent Seed Mix Applied to Entire Project Area	---	May 18, 2016
Bare Root, Containerized, and B&B plantings for Entire Project Area	---	May 27, 2016
Mitigation Plan/As-built (Year 0 Monitoring-Baseline)	May 2016	July 2016
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		
Year 6 Monitoring		
Year 7 Monitoring		

Table 3. Project Contacts Table
Roses Creek (DMS Project ID No. 96309)

Designer Primary project design POC	ICA Engineering 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Chris Smith (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	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Lloyd Glover (919) 639-6132
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) Dykes and Son Nursery, McMinnville, TN 2) Foggy Mountain Nursery (live stakes)
Monitoring Performers	HDR|ICA Engineering Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066
Stream Monitoring POC	HDR|ICA Engineering Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066
Vegetation Monitoring POC	HDR|ICA Engineering Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066

Table 4. Project Information
Roses Creek (DMS Project ID No. 96309)

Project Information				
Project Name	Roses Creek Stream Mitigation Site			
County	Burke			
Project Area (acres)	17.3			
Project Coordinates (latitude and longitude)	35.850953,-81.819541			
Project Watershed Summary Information				
Physiographic Province	Piedmont / Mountain			
River Basin	Catawba			
USGS Hydrologic Unit 8-digit	03050101	USGS Hydrologic Unit 14-digit	03050101060030	
NCDWQ Sub-basin	03-08-31			
Project Drainage Area (acres)	Roses: 3,309, UT 1: 35, UT 2: 47, UT 3: 10			
Project Drainage Area Percentage of Impervious Area	<1%			
CGIA Land Use Classification	Agricultural/Pasture			
Ecoregion	Northern Inner Piedmont			
Geological Unit	Zabg: Alligator Back Formation; Gneiss			
Reach Summary Information				
Parameters	**Roses Creek**	**UT 1**	**UT 2**	**UT 3**
Length of reach (linear feet)	3,681 existing	900 existing	610 existing	558 existing
Valley Classification	VIII	VIII	VIII	VIII
Drainage Area (acres)	3,309	35	47	13
NCDWQ Stream Identification Score	56	30	33.5	34
NCDWQ Water Quality Classification	WS-III; Tr	WS-III; Tr	WS-III; Tr	WS-III; Tr
Morphological Description (stream type)	E4, B4, and F4	B5, F5	B5	B5, G5
Evolutionary Trend	Simon's Stages: Premodified » Constructed » Degradation and Widening	Could maintain a B type channel in majority of reach Or F » B	G » B/E	G » B

Reach Summary Information (cont.)				
Parameters	**Roses Creek**	**UT 1**	**UT 2**	**UT 3**
Underlying Mapped Soils	Fontaflora-Ostin Complex	Unison fine sandy loam, Banister loam, Fontaflora-Ostin Complex	Unison fine sandy loam, Colvard sandy loam. Fontaflora-Ostin Complex	Colvard sandy loam. Fontaflora-Ostin Complex, Rhodhiss sandy loam
Drainage Class	Well drained	Well drained	Well drained	Well drained
Soil Hydric Status	NA	NA	NA	NA
Slope	0.0068	0.0350	0.0260	0.0268
FEMA Classification	Limited Detailed	NA	NA	NA
Native Vegetation Community	Piedmont/ Mountain Bottomland Forest	Piedmont/ Mountain Bottomland Forest	Piedmont/ Mountain Bottomland Forest	Piedmont/ Mountain Bottomland Forest
Percent Composition of Exotic Invasive Vegetation	<5%	<5%	<5%	<5%

Wetland Summary Information		
Parameters	Wetland 1	Wetland 2
Size of Wetland (acres)	0.06	0.04
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian Non-Riverine	Riparian Non-Riverine
Mapped Soil Series	CvA	UnB
Drainage Class	Well Drained	Well Drained
Soil Hydric Status	Non-Hydric	Non-Hydric
Source of Hydrology	Groundwater/ Overbank Flows	Groundwater/ Overbank Flows
Hydrologic Impairment	Existing Cattle Pasture	Existing Cattle Pasture
Native Vegetation Community		
Percent Composition of Exotic Invasive Vegetation	25% (*Microstegium vimineum*)	0%

Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	To Be Permitted	Mitigation Plan
Waters of the United States – Section 401	Yes	To Be Permitted	Mitigation Plan
Endangered Species Act	No	Yes	Categorical Exclusion
Historic Preservation Act	No	Yes	NCSHPO/Archeological Survey

Regulatory Considerations (cont.)			
Coastal Zone Management (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes*	CLOMR/LOMR
Essential Fisheries Habitat	No	N/A	N/A

*The CLOMR was approved before construction. The LOMR has been supported by the local floodplain administrator and is currently being reviewed by FEMA.

APPENDIX B
Morphological Summary Data and Plots

Figure B.1 Roses Creek - Longitudinal Profile

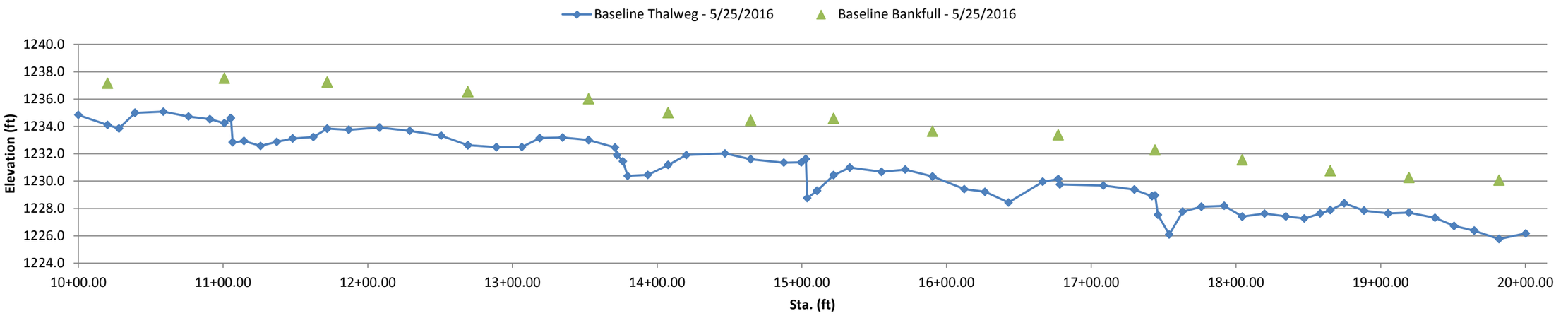

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Figure B.2 Roses Creek - Longitudinal Profile Cont.

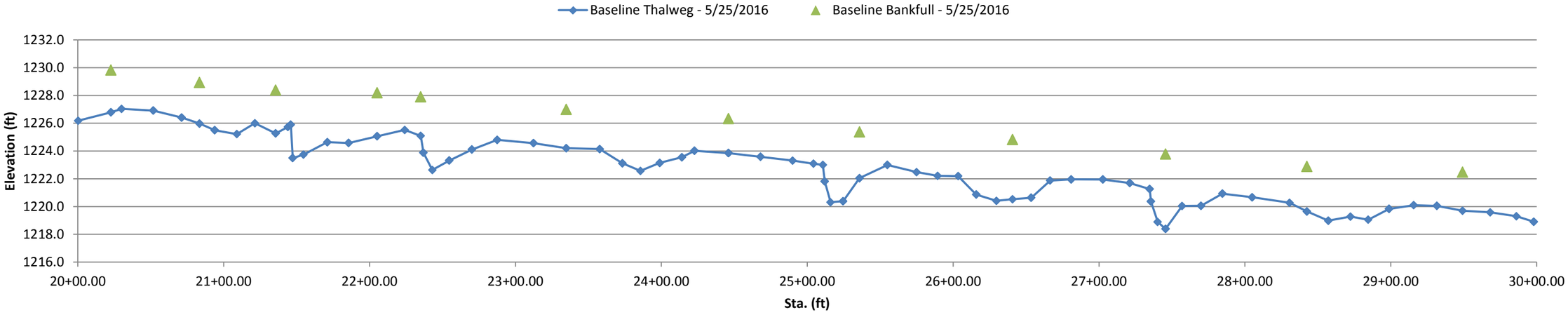


Figure B.3 Roses Creek - Longitudinal Profile Cont.

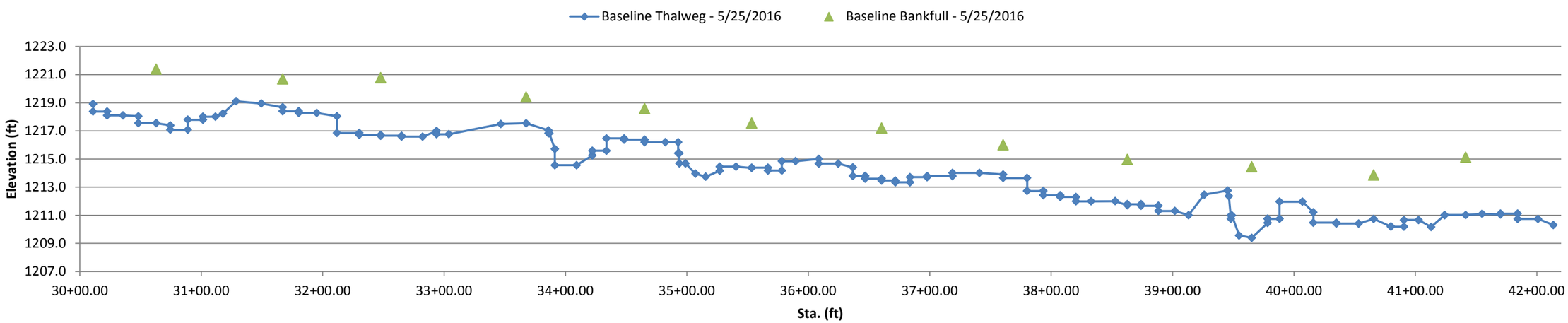


Figure B.4 UT 1 - Longitudinal Profile

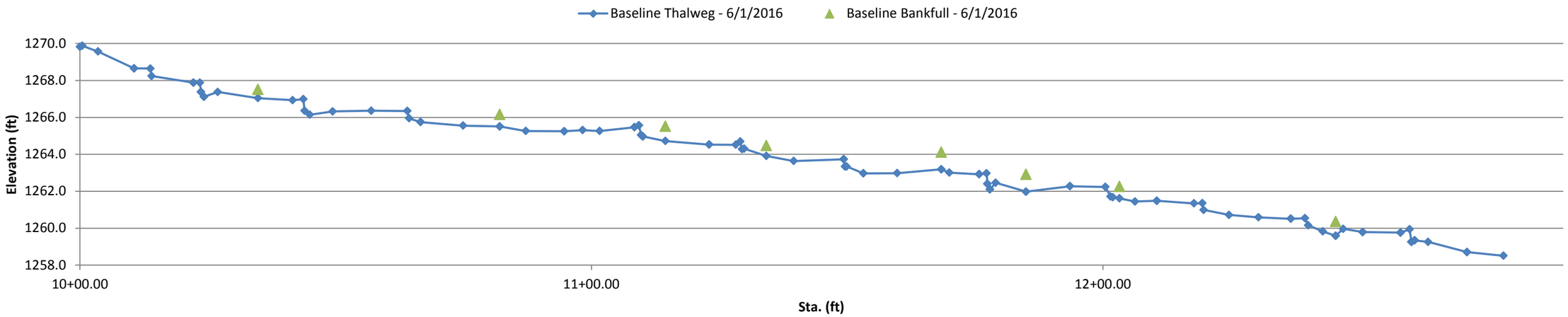


Figure B.5 UT 2 - Longitudinal Profile

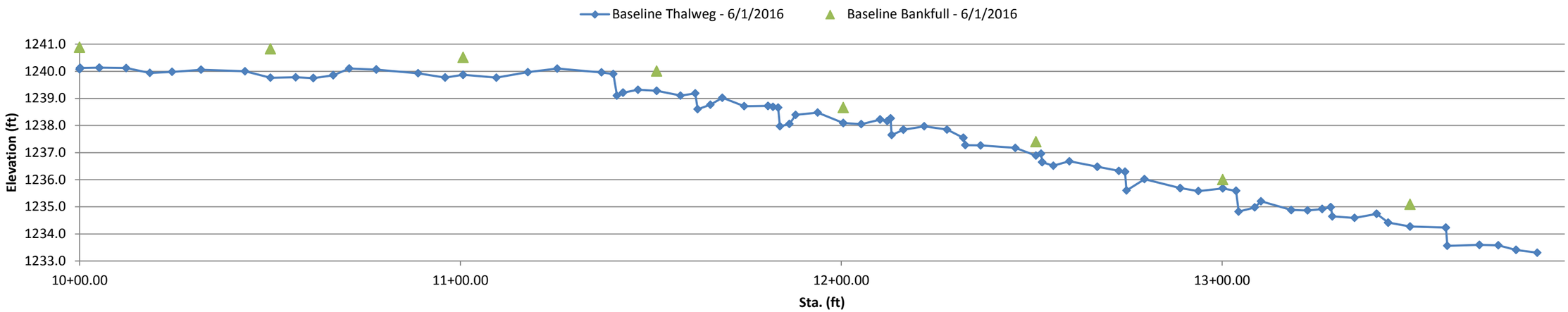
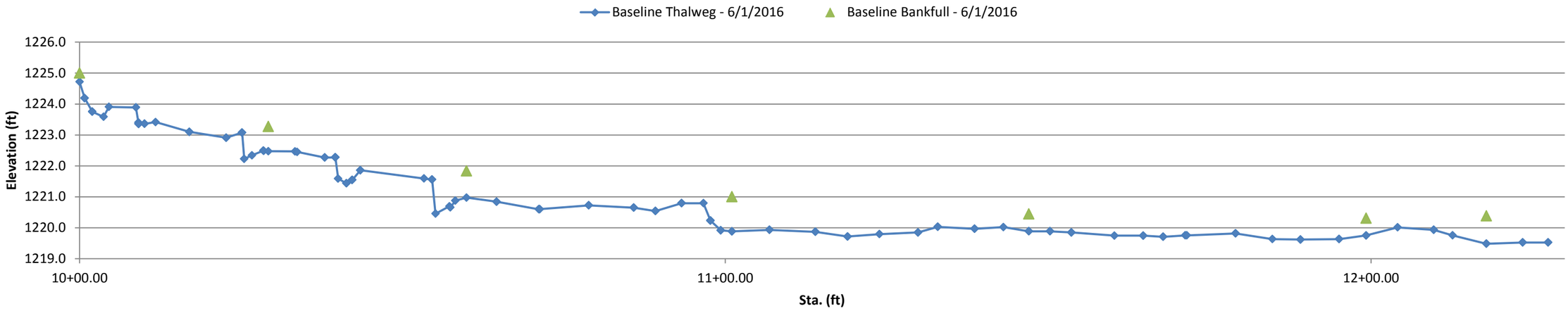
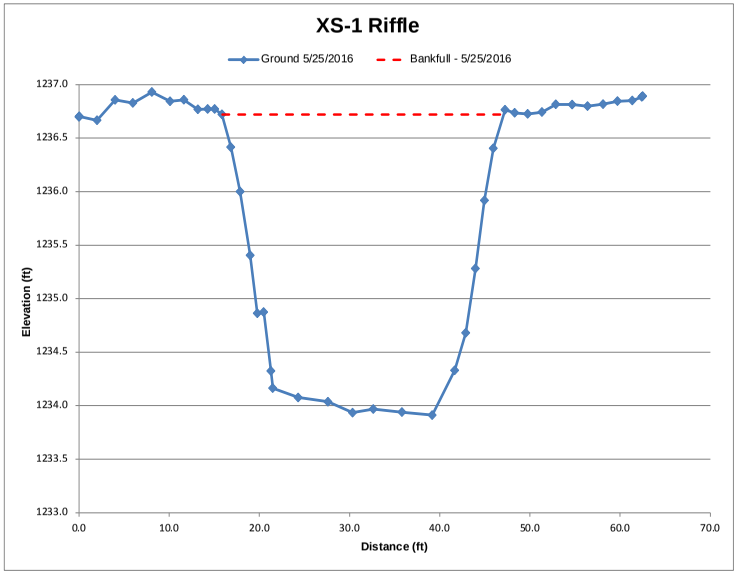


Figure B.6 UT 3 - Longitudinal Profile



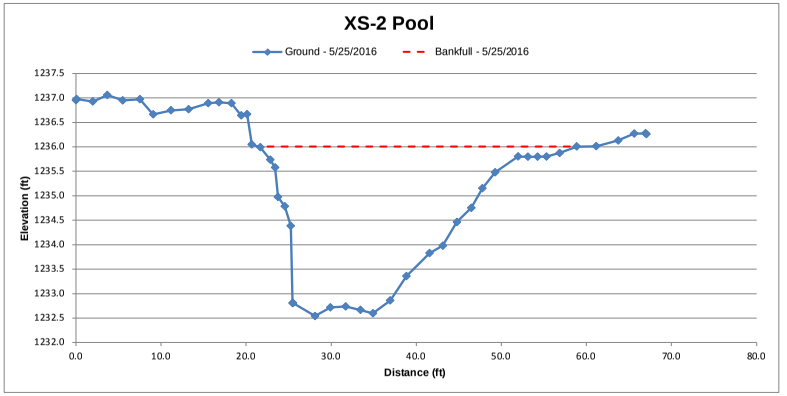
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-1	0.00	1236.70										
	0.03	1236.70										
	2.00	1236.67										
	4.00	1236.86										
	5.97	1236.83										
	8.08	1236.93										
	10.10	1236.84										
	11.63	1236.86										
	13.18	1236.77										
	14.27	1236.77										
	15.04	1236.77										
	15.85	1236.72										
	16.83	1236.42										
	17.86	1236.00										
	18.98	1235.40										
	19.77	1234.86										
	20.48	1234.87										
	21.28	1234.32										
	21.48	1234.16										
	24.31	1234.08										
	27.60	1234.04										
	30.33	1233.93										
	32.63	1233.97										
	35.81	1233.94										
	39.17	1233.91										
	41.66	1234.33										
	42.88	1234.68										
	43.96	1235.28										
	44.96	1235.92										
	45.94	1236.40										
	47.25	1236.76										
	48.31	1236.74										
	49.76	1236.73										
	51.34	1236.74										
	52.87	1236.82										
	54.69	1236.81										
	56.39	1236.80										
	58.11	1236.82										
	59.72	1236.85										
	61.36	1236.85										
	62.42	1236.88										
	62.50	1236.89										



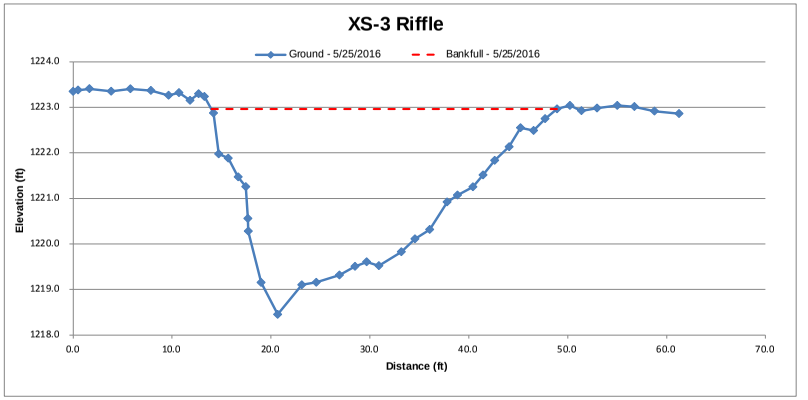
	Cross Section 1 (Riffle)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	33.80						
Floodprone Width (ft)	508.32						
Bankfull Mean Depth (ft)	2.00						
Bankfull Max Depth (ft)	2.81						
Bankfull Cross Sectional Area (ft^2)	67.70						
Bankfull Width/Depth Ratio	16.90						
Bankfull Entrenchment Ratio	15.04						
Bankfull Bank Height Ratio	1.00						

	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-2	0.00	1236.95										
	0.08	1236.98										
	1.98	1236.93										
	3.68	1237.06										
	5.49	1236.95										
	7.52	1236.97										
	9.08	1236.66										
	11.17	1236.75										
	13.23	1236.77										
	15.54	1236.89										
	16.81	1236.91										
	18.28	1236.89										
	19.43	1236.64										
	20.11	1236.67										
	20.67	1236.05										
	21.68	1235.99										
	22.84	1235.74										
	23.41	1235.58										
	23.74	1234.97										
	24.55	1234.78										
	25.24	1234.38										
	25.46	1232.81										
	25.52	1232.81										
	28.10	1232.54										
	29.91	1232.72										
	31.71	1232.74										
	33.44	1232.67										
	34.91	1232.60										
	36.94	1232.86										
	38.84	1233.36										
	41.56	1233.83										
	43.12	1233.98										
	44.78	1234.46										
	46.47	1234.75										
	47.77	1235.15										
	49.28	1235.48										
	51.97	1235.80										
	53.13	1235.80										
	54.27	1235.80										
	55.31	1235.80										
	56.85	1235.87										
	58.87	1236.01										
	61.15	1236.01										
	63.74	1236.13										
	65.63	1236.27										
	66.95	1236.28										
	67.06	1236.26										

	Cross Section 2 (Pool)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	38.53						
Floodprone Width (ft)							
Bankfull Mean Depth (ft)	1.73						
Bankfull Max Depth (ft)	3.47						
Bankfull Cross Sectional Area (ft^2)	66.48						
Bankfull Width/Depth Ratio							
Bankfull Entrenchment Ratio							
Bankfull Bank Height Ratio							



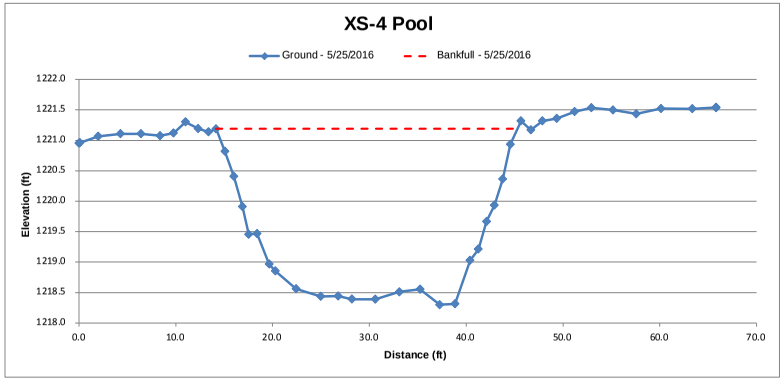
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-3	0.00	1223.35										
	0.50	1223.38										
	1.65	1223.41										
	3.85	1223.35										
	5.79	1223.40										
	7.87	1223.37										
	9.65	1223.26										
	10.70	1223.32										
	11.82	1223.15										
	12.69	1223.30										
	13.27	1223.24										
	14.19	1222.87										
	14.72	1221.98										
	15.69	1221.88										
	16.69	1221.47										
	17.46	1221.26										
	17.68	1220.56										
	17.71	1220.28										
	19.00	1219.15										
	20.68	1218.45										
	23.13	1219.10										
	24.58	1219.16										
	26.93	1219.32										
	28.50	1219.51										
	29.68	1219.61										
	30.92	1219.52										
	33.18	1219.83										
	34.56	1220.11										
	36.05	1220.32										
	37.81	1220.92										
	38.86	1221.07										
	40.43	1221.25										
	41.44	1221.51										
	42.63	1221.83										
	44.08	1222.13										
	45.23	1222.55										
	46.56	1222.49										
	47.72	1222.75										
	48.92	1222.96										
	50.23	1223.04										
	51.39	1222.92										
	52.97	1222.98										
	55.02	1223.04										
	56.75	1223.01										
	58.78	1222.92										
	61.26	1222.86										
	63.27	1222.92										



	Cross Section 3 (Riffle)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	32.44						
Floodprone Width (ft)	812.77						
Bankfull Mean Depth (ft)	2.19						
Bankfull Max Depth (ft)	4.10						
Bankfull Cross Sectional Area (ft^2)	71.10						
Bankfull Width/Depth Ratio	14.81						
Bankfull Entrenchment Ratio	25.05						
Bankfull Bank Height Ratio	1.00						

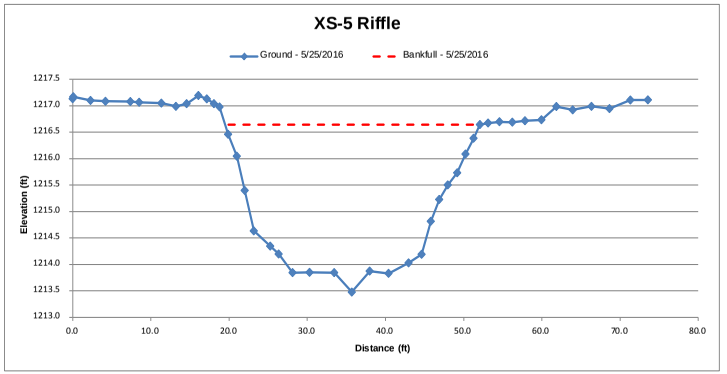
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-4	0.00	1220.95										
	0.10	1220.96										
	1.98	1221.07										
	4.29	1221.11										
	6.41	1221.11										
	8.38	1221.08										
	9.77	1221.12										
	11.01	1221.30										
	12.31	1221.19										
	13.39	1221.14										
	14.16	1221.19										
	15.08	1220.82										
	16.00	1220.41										
	16.89	1219.91										
	17.53	1219.46										
	18.41	1219.47										
	19.66	1218.97										
	20.29	1218.85										
	22.43	1218.56										
	24.98	1218.44										
	26.79	1218.44										
	28.20	1218.39										
	30.61	1218.39										
	33.10	1218.51										
	35.25	1218.55										
	37.26	1218.30										
	38.85	1218.31										
	40.40	1219.03										
	41.26	1219.21										
	42.11	1219.67										
	42.92	1219.93										
	43.77	1220.36										
	44.57	1220.93										
	45.66	1221.32										
	46.69	1221.17										
	47.88	1221.32										
	49.37	1221.36										
	51.21	1221.47										
	52.94	1221.54										
	55.17	1221.50										
	57.57	1221.43										
	60.13	1221.52										
	63.36	1221.52										
	65.82	1221.54										
	65.83	1221.53										

	Cross Section 4 (Pool)					
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	31.11					
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	2.19					
Bankfull Max Depth (ft)	2.89					
Bankfull Cross Sectional Area (ft^2)	68.21					
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Bankfull Bank Height Ratio						



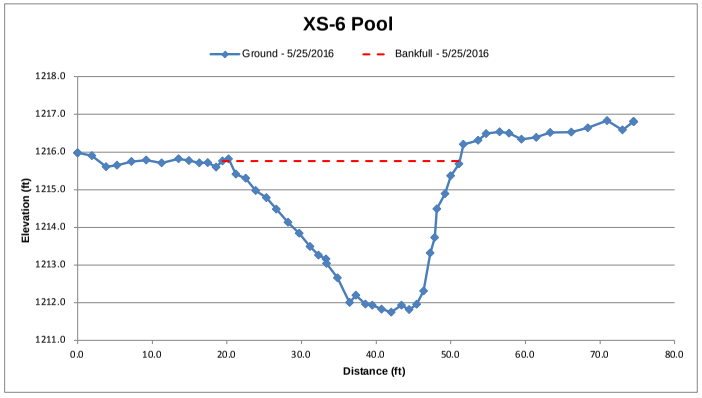
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-5	0	1217.13										
	0.08	1217.17										
	2.29	1217.10										
	4.2	1217.09										
	7.38	1217.08										
	8.5	1217.07										
	11.34	1217.05										
	13.21	1216.99										
	14.57	1217.04										
	16.08	1217.20										
	17.16	1217.13										
	18.07	1217.04										
	18.79	1216.98										
	19.88	1216.46										
	20.99	1216.05										
	22.01	1215.40										
	23.17	1214.63										
	25.27	1214.35										
	26.35	1214.20										
	28.12	1213.85										
	30.29	1213.85										
	33.45	1213.85										
	35.7	1213.48										
	37.99	1213.87										
	40.4	1213.83										
	42.97	1214.03										
	44.63	1214.19										
	45.81	1214.81										
	46.88	1215.23										
	47.98	1215.50										
	49.18	1215.73										
	50.24	1216.09										
	51.27	1216.39										
	52.08	1216.64										
	53.13	1216.67										
	54.58	1216.70										
	56.24	1216.69										
	57.85	1216.72										
	59.95	1216.74										
	61.86	1216.99										
	63.95	1216.92										
	66.36	1216.99										
	68.66	1216.95										
	71.34	1217.11										
	73.57	1217.11										
	73.59	1217.11										

	Cross Section 5 (Riffle)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	32.56						
Floodprone Width (ft)	563.60						
Bankfull Mean Depth (ft)	2.13						
Bankfull Max Depth (ft)	3.16						
Bankfull Cross Sectional Area (ft^2)	69.41						
Bankfull Width/Depth Ratio	15.29						
Bankfull Entrenchment Ratio	17.31						
Bankfull Bank Height Ratio	1.00						



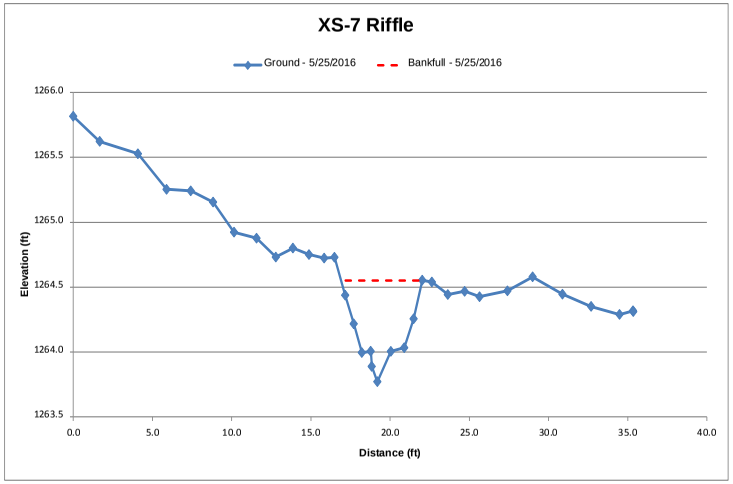
	Baseline/As-Built		Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-6	0.00	1215.97	59.48	1216.34										
	0.01	1215.98	61.46	1216.39										
	1.91	1215.90	63.32	1216.52										
	3.82	1215.61	66.15	1216.53										
	5.29	1215.65	68.38	1216.64										
	7.23	1215.75	70.96	1216.83										
	9.20	1215.79	73.02	1216.59										
	11.26	1215.71	74.48	1216.81										
	13.54	1215.82	74.54	1216.81										
	14.92	1215.77												
	16.31	1215.71												
	17.44	1215.72												
	18.56	1215.60												
	19.42	1215.76												
	20.22	1215.82												
	21.21	1215.41												
	22.54	1215.31												
	23.86	1214.98												
	25.29	1214.79												
	26.63	1214.48												
	28.21	1214.13												
	29.70	1213.84												
	31.14	1213.49												
	32.28	1213.26												
	33.29	1213.16												
	33.37	1213.04												
	34.83	1212.66												
	36.45	1212.00												
	37.29	1212.20												
	38.57	1211.96												
	39.49	1211.93												
	40.73	1211.83												
	42.03	1211.75												
	43.40	1211.93												
	44.42	1211.82												
	45.43	1211.96												
	46.37	1212.31												
	47.25	1213.32												
	47.85	1213.73												
	48.15	1214.49												
	49.24	1214.89												
	49.99	1215.37												
	51.11	1215.68												
	51.69	1216.20												
	53.66	1216.31												
	54.75	1216.49												
	56.55	1216.54												
	57.82	1216.50												

	Cross Section 6 (Pool)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	31.02						
Floodprone Width (ft)							
Bankfull Mean Depth (ft)	2.37						
Bankfull Max Depth (ft)	4.07						
Bankfull Cross Sectional Area (ft^2)	73.63						
Bankfull Width/Depth Ratio							
Bankfull Entrenchment Ratio							
Bankfull Bank Height Ratio							



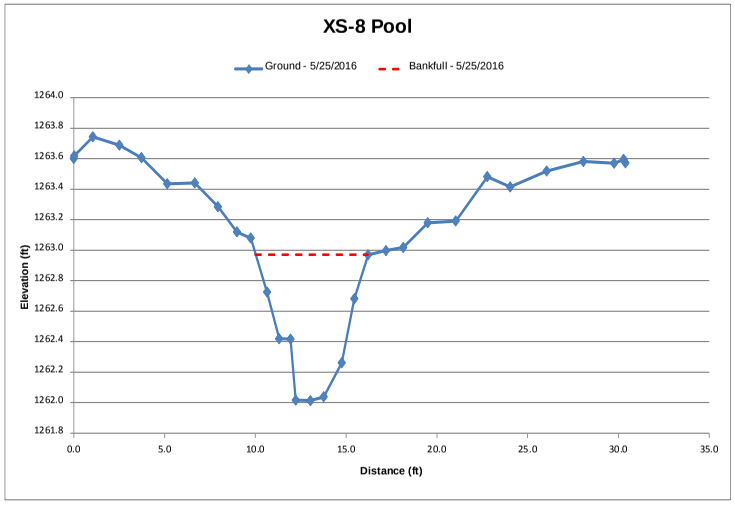
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-7	0.00	1265.82										
	1.67	1265.62										
	4.08	1265.53										
	5.89	1265.25										
	7.42	1265.24										
	8.83	1265.16										
	10.15	1264.92										
	11.57	1264.88										
	12.79	1264.73										
	13.87	1264.80										
	14.88	1264.75										
	15.84	1264.72										
	16.49	1264.73										
	17.17	1264.44										
	17.71	1264.22										
	18.22	1263.99										
	18.78	1264.00										
	18.84	1263.89										
	19.20	1263.77										
	20.05	1264.00										
	20.90	1264.03										
	21.49	1264.26										
	22.03	1264.55										
	22.64	1264.54										
	23.65	1264.44										
	24.71	1264.47										
	25.65	1264.43										
	27.41	1264.47										
	29.00	1264.58										
	30.89	1264.44										
	32.70	1264.35										
	34.49	1264.29										
	35.34	1264.32										
	35.36	1264.31										

	Cross Section 7 (Riffle)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	5.12						
Floodprone Width (ft)	91.80						
Bankfull Mean Depth (ft)	0.45						
Bankfull Max Depth (ft)	0.78						
Bankfull Cross Sectional Area (ft^2)	2.30						
Bankfull Width/Depth Ratio	11.38						
Bankfull Entrenchment Ratio	17.93						
Bankfull Bank Height Ratio	1.00						



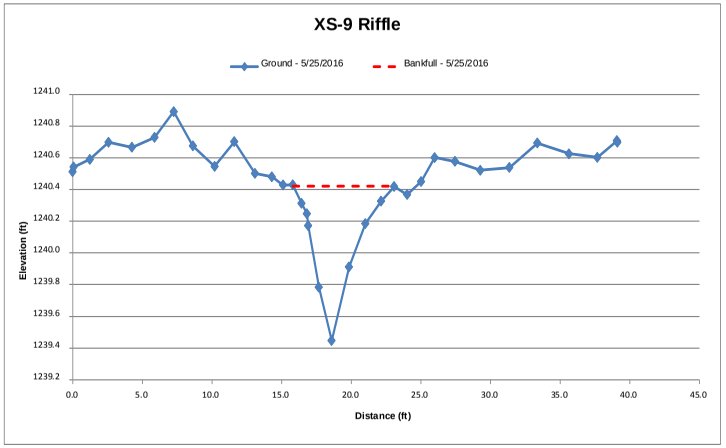
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-8	0.00	1263.60										
	0.03	1263.62										
	1.05	1263.74										
	2.51	1263.69										
	3.73	1263.61										
	5.15	1263.43										
	6.67	1263.44										
	7.94	1263.28										
	8.99	1263.12										
	9.75	1263.08										
	10.65	1262.72										
	11.31	1262.42										
	11.94	1262.42										
	12.23	1262.02										
	13.04	1262.01										
	13.77	1262.04										
	14.76	1262.26										
	15.46	1262.68										
	16.21	1262.97										
	17.20	1263.00										
	18.15	1263.02										
	19.50	1263.18										
	21.04	1263.19										
	22.78	1263.48										
	24.04	1263.41										
	26.05	1263.52										
	28.08	1263.58										
	29.77	1263.57										
	30.29	1263.59										
	30.39	1263.57										

	Cross Section 8 (Pool)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	6.24						
Floodprone Width (ft)							
Bankfull Mean Depth (ft)	0.58						
Bankfull Max Depth (ft)	0.96						
Bankfull Cross Sectional Area (ft^2)	3.64						
Bankfull Width/Depth Ratio							
Bankfull Entrenchment Ratio							
Bankfull Bank Height Ratio							



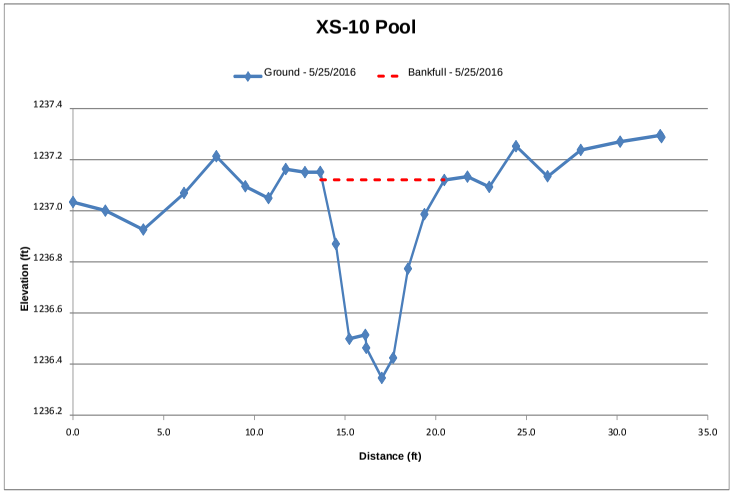
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-9	0.00	1240.51										
	0.07	1240.54										
	1.24	1240.59										
	2.58	1240.70										
	4.26	1240.67										
	5.89	1240.73										
	7.26	1240.89										
	8.64	1240.67										
	10.20	1240.55										
	11.61	1240.70										
	13.10	1240.50										
	14.31	1240.48										
	15.12	1240.43										
	15.81	1240.43										
	16.44	1240.31										
	16.82	1240.25										
	16.92	1240.17										
	17.68	1239.78										
	18.60	1239.45										
	19.85	1239.91										
	21.02	1240.19										
	22.15	1240.33										
	23.09	1240.42										
	24.02	1240.37										
	25.03	1240.45										
	26.00	1240.60										
	27.46	1240.58										
	29.28	1240.52										
	31.36	1240.54										
	33.37	1240.69										
	35.64	1240.63										
	37.68	1240.60										
	39.09	1240.71										
	39.12	1240.70										

	Cross Section 9 (Riffle)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	5.56						
Floodprone Width (ft)	418.38						
Bankfull Mean Depth (ft)	0.37						
Bankfull Max Depth (ft)	0.86						
Bankfull Cross Sectional Area (ft^2)	2.07						
Bankfull Width/Depth Ratio	15.03						
Bankfull Entrenchment Ratio	75.25						
Bankfull Bank Height Ratio	1.00						



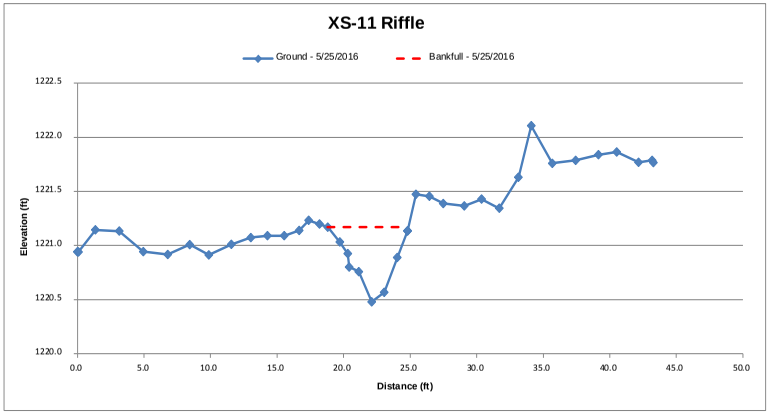
	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-10	0.00	1237.03										
	1.78	1237.00										
	3.88	1236.93										
	6.12	1237.07										
	7.90	1237.21										
	9.50	1237.09										
	10.78	1237.05										
	11.73	1237.16										
	12.79	1237.15										
	13.63	1237.15										
	14.49	1236.87										
	15.24	1236.50										
	16.12	1236.51										
	16.17	1236.46										
	17.03	1236.35										
	17.65	1236.42										
	18.47	1236.77										
	19.38	1236.99										
	20.47	1237.12										
	21.75	1237.13										
	22.95	1237.09										
	24.43	1237.25										
	26.17	1237.13										
	28.00	1237.24										
	30.17	1237.27										
	32.38	1237.29										
	32.45	1237.29										

	Cross Section 10 (Pool)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	6.7						
Floodprone Width (ft)							
Bankfull Mean Depth (ft)	0.4						
Bankfull Max Depth (ft)	0.77						
Bankfull Cross Sectional Area (ft^2)	2.79						
Bankfull Width/Depth Ratio							
Bankfull Entrenchment Ratio							
Bankfull Bank Height Ratio							

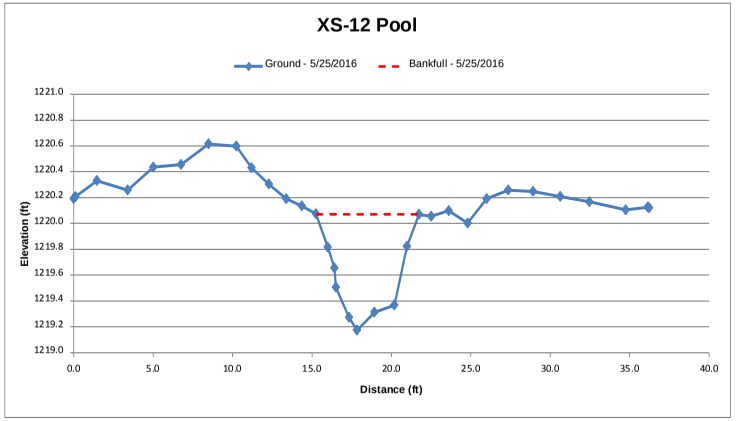


	Baseline/As-Built		Baseline/As-Built		MY1		MY2		MY3		MY4	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-11	0.00	1220.94										
	0.08	1220.94										
	1.35	1221.14										
	3.15	1221.13										
	4.95	1220.94										
	6.79	1220.92										
	8.44	1221.01										
	9.87	1220.91										
	11.57	1221.01										
	13.03	1221.07										
	14.28	1221.09										
	15.54	1221.09										
	16.67	1221.14										
	17.38	1221.23										
	18.19	1221.20										
	18.81	1221.17										
	19.72	1221.03										
	20.32	1220.93										
	20.42	1220.80										
	21.14	1220.76										
	22.11	1220.48										
	23.05	1220.57										
	24.03	1220.89										
	24.81	1221.14										
	24.81	1221.14										
	25.44	1221.47										
	26.45	1221.45										
	27.49	1221.39										
	29.07	1221.37										
	30.37	1221.43										
	31.70	1221.34										
	33.14	1221.63										
	34.11	1222.11										
	35.68	1221.76										
	37.44	1221.79										
	39.15	1221.84										
	40.52	1221.86										
	42.17	1221.77										
	43.19	1221.79										
	43.28	1221.76										

	Cross Section 11 (Riffle)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	6.00						
Floodprone Width (ft)	175.41						
Bankfull Mean Depth (ft)	0.36						
Bankfull Max Depth (ft)	0.69						
Bankfull Cross Sectional Area (ft^2)	2.19						
Bankfull Width/Depth Ratio	16.67						
Bankfull Entrenchment Ratio	29.24						
Bankfull Bank Height Ratio	1.00						



	Baseline/As-Built		MY1		MY2		MY3		MY4		MY5	
	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.	Station	Elev.
XS-12	0.00	1220.19										
	0.11	1220.21										
	1.46	1220.33										
	3.40	1220.26										
	5.01	1220.44										
	6.76	1220.46										
	8.49	1220.62										
	10.24	1220.60										
	11.20	1220.43										
	12.29	1220.31										
	13.38	1220.19										
	14.36	1220.14										
	15.25	1220.08										
	15.99	1219.82										
	16.41	1219.66										
	16.51	1219.51										
	17.34	1219.27										
	17.83	1219.17										
	18.93	1219.31										
	20.19	1219.37										
	20.98	1219.82										
	21.74	1220.07										
	22.51	1220.06										
	23.61	1220.10										
	24.80	1220.00										
	26.00	1220.19										
	27.36	1220.26										
	28.92	1220.25										
	30.63	1220.21										
	32.46	1220.17										
	34.75	1220.11										
	36.14	1220.13										
	36.23	1220.12										



	Cross Section 12 (Pool)						
Dimension and substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
Based on fixed baseline bankfull elevation							
Bankfull Width (ft)	8.85						
Floodprone Width (ft)							
Bankfull Mean Depth (ft)	0.4						
Bankfull Max Depth (ft)	0.9						
Bankfull Cross Sectional Area (ft^2)	3.61						
Bankfull Width/Depth Ratio							
Bankfull Entrenchment Ratio							
Bankfull Bank Height Ratio							

Table 5. Baseline Stream Data Summary
Roses Creek Mitigation Site
Roses Creek: 3,200 Lf.

Parameter	Regional Curve		Pre-Existing Condition	Reference - Roses Creek Upstream	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Eq. Mountains	Eq. Piedmont	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	35.00	26.20	41.10	30.50	30.50	31.02	31.98	31.11	33.80	1.58	3.00
Floodprone Width (ft)			78.90	250.00	480.00	394.24	524.76	508.32	671.72	139.47	3.00
Bankfull Mean Depth (ft)	1.80	2.60	1.67	1.88	2.18	2.00	2.19	2.19	2.37	0.19	3.00
Bankfull Max Depth (ft)			2.92	2.71	2.72	2.81	3.26	2.89	4.07	0.71	3.00
Bankfull Cross Sectional Area (ft^2)	66.00	66.10	68.83	57.40	66.40	67.70	69.85	68.21	73.63	3.29	3.00
Width/Depth Ratio			24.60	16.20	14.00	13.09	14.73	14.21	16.90	1.96	3.00
Entrenchment Ratio			1.92	8.20	15.70	12.67	16.45	15.04	21.65	4.65	3.00
Bank Height Ratio			1.80	1.00	1.00	1.00	1.00	1.00	1.00	0.00	3.00
d50 (mm)			61.30	61.30	61.30						
Profile											
Riffle Length (ft)						37.17	64.41	58.40	106.19	18.18	23.00
Riffle Slope (ft/ft)			0.01	0.02	0.03	0.01	0.02	0.02	0.05	0.01	23.00
Pool Length (ft)						17.36	53.01	54.24	93.29	20.18	26.00
Pool Max depth (ft)			4.13	4.70	4.36	3.31	4.50	4.43	6.20	0.80	26.00
Pool Spacing (ft)			37.00 - 171.00	76.9 - 227.9	2.0 - 7.5	86.78	130.47	130.18	210.45	35.20	25.00
Pool Cross Sectional Area (ft^2)											
Pattern											
Channel Beltwidth (ft)			73.00 - 152.00	30.0 - 195.0	61.0 - 195.2						
Radius of Curvature (ft)			28 - 168	30.0 - 178.0	61.0 - 91.5						
Rc: Bankfull Width (ft/ft)			0.7 - 4.1	1.0 - 5.8	2.0 - 3.0						
Meander Wavelength (ft)			200 - 375	60 - 344	61.0 - 344.0						
Meander Width Ratio			1.78 - 3.70	1.0 - 6.4	2.0 - 6.4						
Substrate, bed and transport parameters											
Ri% / P%						35% / 65%					
SC% / Sa% / G% / C% / B% / Be%											
d16 / d35 / d50 / d84 / d95/ di^3 / di^{50} (mm)											
Reach Shear Stress (competency) lb/ft^2											
Max part size (mm) mobilized at bankfull											
Unit Stream Power (transport capacity) lbs/ft.s			3.83		3.83	3.83					
Additional Reach Parameters											
Drainage Area (SM)			5.17	4.66	5.17						
Impervious cover estimate (%)											
Rosgen Classification			B4	C4	C4	C4					
Bankfull Velocity (fps)				5.10	4.80						
Bankfull Discharge (cfs)			300.00	295.00	300.00						
Valley length (ft)			2894.00		2894.00	2894.00					
Channel Thalweg length (ft)			3425.00		3219.00	3219.00					
Sinuosity (ft)			1.18	1.11	1.11	1.11					
Water Surface Slope (Channel) (ft/ft)			0.0099	0.0192	0.0062	0.0059					
BF slope (ft/ft)					0.0062	0.0059					
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 5a. Baseline Stream Data Summary
Roses Creek Mitigation Site
UT 1 to Roses Creek: 234 LF

Parameter	Regional Curve		Pre-Existing Condition	Reference - UT West Branch Rocky River	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Eq. Mountains	Eq. Piedmont	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	6.70	5.30	6.00	4.40	5.00	5.12	5.12	5.12	5.12	0.00	1.00
Floodprone Width (ft)			8.40	27.50	60.00	91.80	91.80	91.80	91.80	0.00	1.00
Bankfull Mean Depth (ft)	0.50	0.70	0.23	0.51	0.38	0.45	0.45	0.45	0.45	0.00	1.00
Bankfull Max Depth (ft)			0.36	1.00	0.58	0.78	0.78	0.78	0.78	0.00	1.00
Bankfull Cross Sectional Area (ft^2)	3.20	3.30	1.39	2.30	2.10	2.30	2.30	2.30	2.30	0.00	1.00
Width/Depth Ratio			26.20	12.80	13.00	11.38	11.38	11.38	11.38	0.00	1.00
Entrenchment Ratio			1.40	6.28	12.00	17.93	17.93	17.93	17.93	0.00	1.00
Bank Height Ratio			6.11	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
d50 (mm)											
Profile											
Riffle Length (ft)						7.20	10.60	9.60	17.00	2.91	12.00
Riffle Slope (ft/ft)			0.0260	0.0033 - 0.0284	0.0021 - 0.0029	0.0201	0.0265	0.0213	0.0799	0.0210	12.00
Pool Length (ft)						3.60	11.89	9.80	37.39	9.23	11.00
Pool Max depth (ft)			Channelized	1.98	0.77	0.49	0.73	0.77	0.96	0.19	11.00
Pool Spacing (ft)			Channelized	10.10 - 41.0	10.0 - 30.0	18.40	24.04	20.90	45.59	8.03	10.00
Pool Cross Sectional Area (ft^2)											
Pattern											
Channel Beltwidth (ft)			Channelized	12.00 - 18.00	10.00 - 30.00						
Radius of Curvature (ft)			Channelized	10.00 - 14.00	12.00 - 15.00						
Rc: Bankfull Width (ft/ft)			Channelized	2.30 - 3.20	2.40 - 3.00						
Meander Wavelength (ft)			Channelized	45.00 - 66.00	20.0 - 55.0						
Meander Width Ratio			Channelized	2.74 - 4.11	2.00 - 6.00						
Substrate, bed and transport parameters											
Ri% / P%						49% / 51%					
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			0.07		0.07	0.07					
Additional Reach Parameters											
Drainage Area (SM)			0.06	0.07	0.06						
Impervious cover estimate (%)											
Rosgen Classification			F5	C5	C5	C5					
Bankfull Velocity (fps)				1.30	1.10						
Bankfull Discharge (cfs)			2.4	3.00	2.40						
Valley length (ft)			199.00		199.00	199.00					
Channel Thalweg length (ft)			199.00		234.00	234.00					
Sinuosity (ft)			1.00	1.16	1.18	1.18					
Water Surface Slope (Channel) (ft/ft)			0.0260	0.0033 - 0.0284	0.0021	0.0027					
BF slope (ft/ft)					0.0021	0.0027					
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 5b. Baseline Stream Data Summary
Roses Creek Mitigation Site
UT 2 to Roses Creek: 707 LF

Parameter	Regional Curve		Pre-Existing Condition	Reference - UT West Branch Rocky River	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Mountains Eq.	Piedmont Eq.	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	7.10	5.60	4.40	4.40	5.00	6.70	6.70	6.70	6.70	0.00	1.00
Floodprone Width (ft)			8.10	27.50	60.00	32.45	32.45	32.45	32.45	0.00	1.00
Bankfull Mean Depth (ft)	0.50	0.80	0.95	0.51	0.38	0.42	0.42	0.42	0.42	0.00	1.00
Bankfull Max Depth (ft)			1.39	1.00	0.58	0.77	0.77	0.77	0.77	0.00	1.00
Bankfull Cross Sectional Area (ft^2)	3.50	3.70	4.16	2.30	2.10	2.79	2.79	2.79	2.79	0.00	1.00
Width/Depth Ratio			4.60	12.80	13.00	15.95	15.95	15.95	15.95	0.00	1.00
Entrenchment Ratio			1.84	6.28	12.00	4.84	4.84	4.84	4.84	0.00	1.00
Bank Height Ratio			1.70	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
d50 (mm)											
Profile											
Riffle Length (ft)						4.27	13.94	13.33	31.46	6.12	23.00
Riffle Slope (ft/ft)			0.0260	0.0033 - 0.0284	0.0021 - 0.0030	0.0020	0.0025	0.0025	0.0038	0.0006	23.00
Pool Length (ft)						3.73	10.18	8.00	27.19	5.71	24.00
Pool Max depth (ft)			Channelized	1.98	0.77	0.53	0.96	0.92	1.59	0.24	24.00
Pool Spacing (ft)			Channelized	10.10 - 41.00	10.0 - 30.00	7.46	25.57	22.39	57.59	11.77	23.00
Pool Cross Sectional Area (ft^2)											
Pattern											
Channel Beltwidth (ft)			Channelized	12.00 - 18.00	13.70 - 30.00						
Radius of Curvature (ft)			Channelized	10.00 - 14.00	12.00 - 16.00						
Rc: Bankfull Width (ft/ft)			Channelized	2.30 - 3.20	2.40 - 3.20						
Meander Wavelength (ft)			Channelized	45.00 - 66.00	20.00 - 75.50						
Meander Width Ratio			Channelized	2.74 - 4.11	2.70 - 6.00						
Substrate, bed and transport parameters											
Ri% / P%						58% / 42%					
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			0.89		0.06	0.06					
Additional Reach Parameters											
Drainage Area (SM)			0.07	0.07	0.07						
Impervious cover estimate (%)											
Rosgen Classification			G5	C5	C5	C5					
Bankfull Velocity (fps)				1.30	1.10						
Bankfull Discharge (cfs)			2.40	3.00	2.40						
Valley length (ft)			575.00		575.00	575.00					
Channel Thalweg length (ft)			575.00		707.00	707.00					
Sinuosity (ft)			1.00	1.16	1.99	1.23					
Water Surface Slope (Channel) (ft/ft)			0.0260	0.0033 - 0.0284	0.0021	0.0023					
BF slope (ft/ft)					0.0021	0.0023					
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 5c. Baseline Stream Data Summary
Roses Creek Mitigation Site
UT 3 to Roses Creek: 620 LF

Parameter	Regional Curve		Pre-Existing Condition	Reference - UT West Branch Rocky River	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Mountains Eq.	Piedmont Eq.	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	4.50	3.50	5.00	4.40	5.50	6.00	6.00	6.00	6.00	0.00	1
Floodprone Width (ft)			44.13	27.50	70.00	175.41	175.41	175.41	175.41	0.00	1
Bankfull Mean Depth (ft)	0.30	0.30	0.26	0.51	0.42	0.36	0.36	0.36	0.36	0.00	1
Bankfull Max Depth (ft)			1.70	1.00	0.63	0.69	0.69	0.69	0.69	0.00	1
Bankfull Cross Sectional Area (ft^2)	1.50	1.60	2.40	2.30	2.60	2.19	2.19	2.19	2.19	0.00	1
Width/Depth Ratio			12.23	12.80	13.10	16.67	16.67	16.67	16.67	0.00	1
Entrenchment Ratio			9.52	6.28	12.70	29.24	29.24	29.24	29.24	0.00	1
Bank Height Ratio			3.33	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1
d50 (mm)											
Profile											
Riffle Length (ft)						4.0	13.7	11.1	46.1	9.2	20
Riffle Slope (ft/ft)			0.0295	0.0033 - 0.0284	0.0029 - 0.0045	0.0025	0.0030	0.0030	0.0035	0.0004	20
Pool Length (ft)						3.2	12.1	8.1	34.6	9.0	20
Pool Max depth (ft)			Channelized	1.98	0.84	0.76	1.49	1.29	2.61	0.61	20
Pool Spacing (ft)			Channelized	10.10 - 41.00	12.7 - 51.70	10.3	25.0	25.8	45.3	9.4	19
Pool Cross Sectional Area (ft^2)											
Pattern											
Channel Beltwidth (ft)			Channelized	12.00 - 18.00	15.10 - 49.50						
Radius of Curvature (ft)			Channelized	10.00 - 14.00	12.70 - 17.60						
Rc: Bankfull Width (ft/ft)			Channelized	2.30 - 3.20	2.30 - 3.20						
Meander Wavelength (ft)			Channelized	45.00 - 66.00	15.10 - 83.10						
Meander Width Ratio			Channelized	2.74 - 4.11	2.70 - 9.00						
Substrate, bed and transport parameters											
Ri% / P%						53% / 47%					
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			0.09		0.08	0.08					
Additional Reach Parameters											
Drainage Area (SM)			0.02	0.07	0.02						
Impervious cover estimate (%)											
Rosgen Classification			B5	C5	C5	C5					
Bankfull Velocity (fps)				1.30	1.00						
Bankfull Discharge (cfs)			2.6	3.0	2.6						
Valley length (ft)			422		422	422					
Channel Thalweg length (ft)			422		620	620					
Sinuosity (ft)			1.00	1.16	1.47	1.47					
Water Surface Slope (Channel) (ft/ft)			0.0268	0.0033 - 0.0284	0.0021	0.0037					
BF slope (ft/ft)					0.0021	0.0037					
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)
Roses Creek Mitigation Site
Roses Creek: 3,200 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)	33.80							38.53						
Floodprone Width (ft)	508.32							528.00						
Bankfull Mean Depth (ft)	2.00							1.73						
Bankfull Max Depth (ft)	2.81							3.47						
Bankfull Cross Sectional Area (ft^2)	67.70							66.48						
Bankfull Width/Depth Ratio	16.90							22.27						
Bankfull Entrenchment Ratio	15.04							13.70						
Bankfull Bank Height Ratio	1.00							1.00						
	Cross Section 3 (Pool)							**Cross Section 4 (Riffle)**						
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	32.44							31.11						
Floodprone Width (ft)	812.77							394.24						
Bankfull Mean Depth (ft)	2.19							2.19						
Bankfull Max Depth (ft)	4.10							2.89						
Bankfull Cross Sectional Area (ft^2)	71.10							68.21						
Bankfull Width/Depth Ratio	14.81							14.21						
Bankfull Entrenchment Ratio	25.05							12.67						
Bankfull Bank Height Ratio	1.00							1.00						
	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)	32.56							31.02						
Floodprone Width (ft)	563.60							671.72						
Bankfull Mean Depth (ft)	2.13							2.37						
Bankfull Max Depth (ft)	3.16							4.07						
Bankfull Cross Sectional Area (ft^2)	69.41							73.63						
Bankfull Width/Depth Ratio	15.29							13.09						
Bankfull Entrenchment Ratio	17.31							21.65						
Bankfull Bank Height Ratio	1.00							1.00						

Table 6a. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)
Roses Creek Mitigation Site
UT 1 Roses Creek: 234 LF

	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)	5.12							6.24						
Floodprone Width (ft)	91.80							134.18						
Bankfull Mean Depth (ft)	0.45							0.58						
Bankfull Max Depth (ft)	0.78							0.96						
Bankfull Cross Sectional Area (ft^2)	2.30							3.64						
Bankfull Width/Depth Ratio	11.38							10.76						
Bankfull Entrenchment Ratio	17.93							21.51						
Bankfull Bank Height Ratio	1.00							1.00						

Table 6b. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)
Roses Creek Mitigation Site
UT2 Roses Creek: 707 LF

	Cross Section 9 (Pool)							Cross Section 10 (Riffle)						
Dimension	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	5.56							6.70						
Floodprone Width (ft)	418.38							59.40						
Bankfull Mean Depth (ft)	0.37							0.42						
Bankfull Max Depth (ft)	0.86							0.77						
Bankfull Cross Sectional Area (ft^2)	2.07							2.79						
Bankfull Width/Depth Ratio	15.03							15.95						
Bankfull Entrenchment Ratio	75.25							8.86						
Bankfull Bank Height Ratio	1.00							1.00						

Table 6c. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)
Roses Creek Mitigation Site
UT3 Roses Creek: 620 LF

	Cross Section 11 (Riffle)							Cross Section 12 (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)	6.00							8.85						
Floodprone Width (ft)	175.41							385.59						
Bankfull Mean Depth (ft)	0.36							0.41						
Bankfull Max Depth (ft)	0.69							0.90						
Bankfull Cross Sectional Area (ft^2)	2.19							3.61						
Bankfull Width/Depth Ratio	16.67							21.59						
Bankfull Entrenchment Ratio	29.24							60.34						
Bankfull Bank Height Ratio	1.00							1.00						

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

Vegetation Plot #10 Baseline

Vegetation Plot #11 Baseline

Vegetation Plot #12 Baseline

Vegetation Plot #13 Baseline

Vegetation Plot #14 Baseline

Vegetation Plot #15 Baseline

Vegetation Plot #16 Baseline

Vegetation Plot #17 Baseline

Table 7. Planted and Total Stem Counts (Species by Plot with Annual Means)
Roses Creek (DMS Project ID No. 96309)

Table 7. Planted and Total Stem Counts (Species by Plot with Annual Means)
DMS Project Code 96309. Project Name: Roses Creek

			Current Plot Data (MY0 2016)																						
			96309-WFW-0001			96309-WFW-0002			96309-WFW-0003			96309-WFW-0004			96309-WFW-0005			96309-WFW-0006			96309-WFW-0007			96309-WFW-0008		
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
Betula nigra	river birch	Tree	2	2	2	1	1	1	3	3	3	2	2	2	1	1	1	4	4	4	5	5	5	1	1	1
Cephalanthus occidentalis	common buttonbush	Shrub																								
Cornus alternifolia	alternateleaf dogwood	Tree													1	1	1				1	1	1			
Cornus amomum	silky dogwood	Shrub	2	2	2	3	3	3	3	3	3				3	3	3	5	5	5	4	4	4	2	2	2
Fraxinus nigra	black ash	Tree										2	2	2	2	2	2	2	2	2						
Fraxinus pennsylvanica	green ash	Tree	2	2	2	4	4	4	2	2	2	6	6	6	5	5	5	12	12	12	5	5	5	4	4	4
Liriodendron tulipifera	tuliptree	Tree	1	1	1																			1	1	1
Platanus occidentalis	American sycamore	Tree	4	4	4	5	5	5	6	6	6	7	7	7	3	3	3	1	1	1	2	2	2	7	7	7
Quercus michauxii	swamp chestnut oak	Tree																								
Quercus nigra	water oak	Tree																								
Quercus phellos	willow oak	Tree	5	5	5	6	6	6	8	8	8	1	1	1	2	2	2	1	1	1	3	3	3	5	5	5
Salix nigra	black willow	Tree	1	1	1																					
Ulmus americana	American elm	Tree	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1									
		Stem count	18	18	18	21	21	21	24	24	24	19	19	19	18	18	18	25	25	25	20	20	20	20	20	20
		size (ares)	1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	8	8	8	6	6	6	6	6	6	6	6	6	8	8	8	6	6	6	6	6	6	6	6	6
		Stems per ACRE	900	900	900	1050	1050	1050	1200	1200	1200	950	950	950	900	900	900	1012	1012	1012	1000	1000	1000	1000	1000	1000

Table 7a
DMS Project Code 96309. Project Name: Roses Creek

Scientific Name	Common Name	Species Type	96309-WFW-0009			96309-WFW-0010			96309-WFW-0011			96309-WFW-0012			96309-WFW-0013			96309-WFW-0014			96309-WFW-0015			96309-WFW-0016		
			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	1	1	1	2	2	2	4	4	4															
Cephalanthus occidentalis	common buttonbush	Shrub	1	1	1	2	2	2	2	2	2															
Cornus alternifolia	alternateleaf dogwood	Tree																								
Cornus amomum	silky dogwood	Shrub	5	5	5	2	2	2	2	2	2	1	1	1	5	5	5	3	3	3	3	3	3	8	8	8
Fraxinus nigra	black ash	Tree													1	1	1	1	1	1				1	1	1
Fraxinus pennsylvanica	green ash	Tree	4	4	4	5	5	5	6	6	6	4	4	4	6	6	6	3	3	3	4	4	4			
Liriodendron tulipifera	tuliptree	Tree										2	2	2	3	3	3	2	2	2	1	1	1			
Platanus occidentalis	American sycamore	Tree	3	3	3	1	1	1				2	2	2	4	4	4	7	7	7	3	3	3			
Quercus michauxii	swamp chestnut oak	Tree							2	2	2															
Quercus nigra	water oak	Tree				1	1	1																		
Quercus phellos	willow oak	Tree	6	6	6	3	3	3	4	4	4	9	9	9	1	1	1	2	2	2	3	3	3	4	4	4
Salix nigra	black willow	Tree																						6	6	6
Ulmus americana	American elm	Tree																								
		Stem count	20	20	20	16	16	16	20	20	20	18	18	18	20	20	20	18	18	18	14	14	14	19	19	19
		size (ares)	1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	6	6	6	7	7	7	6	6	6	5	5	5	6	6	6	6	6	6	5	5	5	4	4	4
		Stems per ACRE	1000	1000	1000	800	800	800	1000	1000	1000	900	900	900	1000	1000	1000	900	900	900	700	700	700	950	950	950

Table 7b
DMS Project Code 96309. Project Name: Roses Creek

Scientific Name	Common Name	Species Type	96309-WFW-0017			MY0 (2016)		
			PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree				26	26	26
Cephalanthus occidentalis	common buttonbush	Shrub				5	5	5
Cornus alternifolia	alternateleaf dogwood	Tree				2	2	2
Cornus amomum	silky dogwood	Shrub	3	3	3	54	54	54
Fraxinus nigra	black ash	Tree				9	9	9
Fraxinus pennsylvanica	green ash	Tree	2	2	2	74	74	74
Liriodendron tulipifera	tuliptree	Tree	2	2	2	12	12	12
Platanus occidentalis	American sycamore	Tree	4	4	4	59	59	59
Quercus michauxii	swamp chestnut oak	Tree				2	2	2
Quercus nigra	water oak	Tree				1	1	1
Quercus phellos	willow oak	Tree	5	5	5	68	68	68
Salix nigra	black willow	Tree				7	7	7
Ulmus americana	American elm	Tree				7	7	7
		Stem count	16	16	16	326	326	326
		size (ares)	1			1		
		size (ACRES)	0.02			0.02		
		Species count	5	5	5	13	13	13
		Stems per ACRE	800	800	800	944.8	944.8	944.8

Color for Density

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

APPENDIX D
Record Drawings

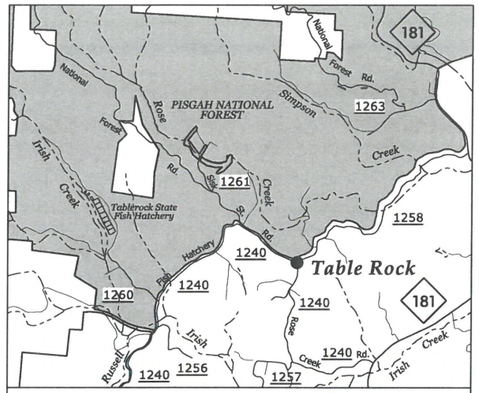
STATE		SHEET NO.
N.C.	ROSES CREEK	1

RECORD DRAWINGS
ROSES CREEK

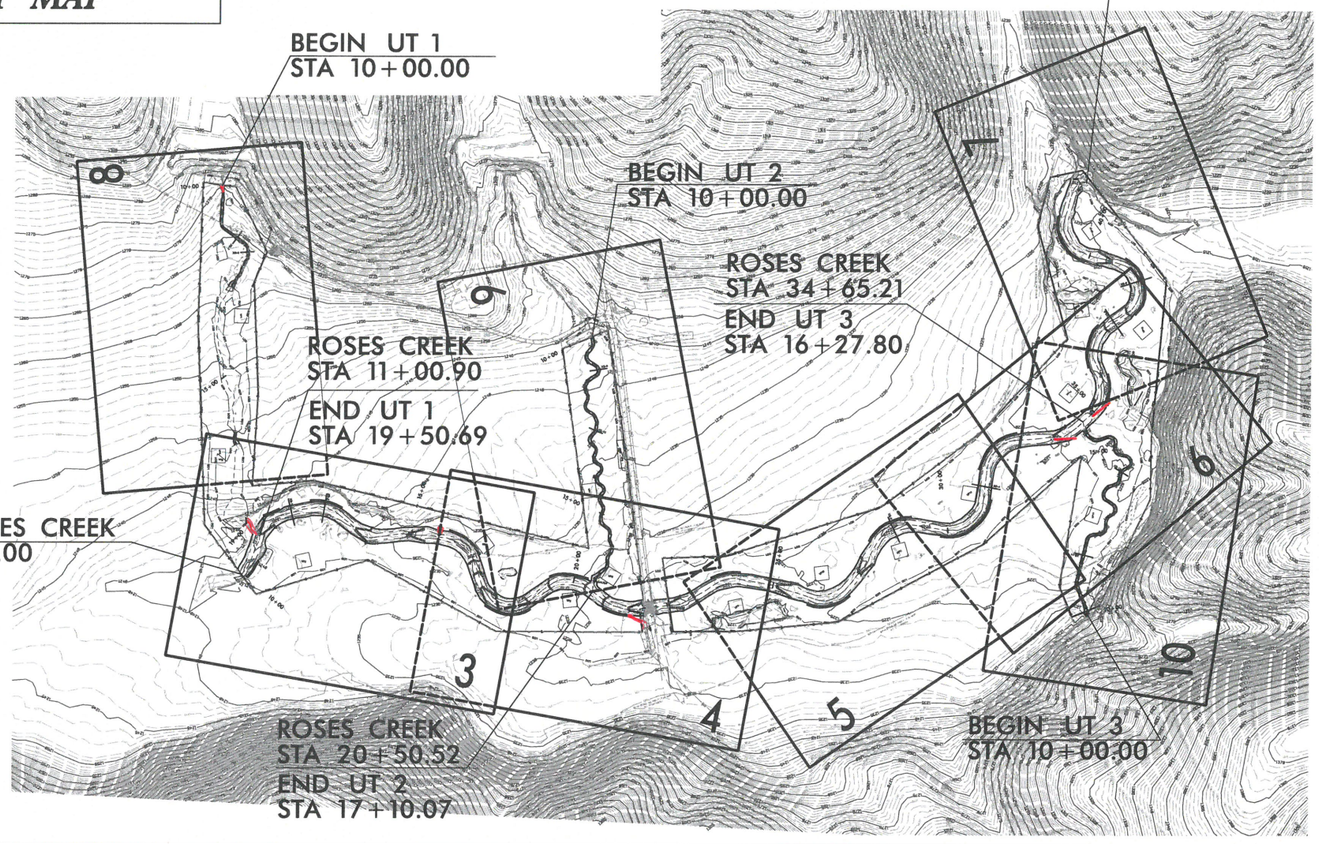
LOCATION: BURKE COUNTY, NORTH CAROLINA

LAT: 35°51'01" N **LONG: –81°49'11" W**

TYPE OF WORK: STREAM RESTORATION (CLEARING, GRUBBING, GRADING, EROSION CONTROL AND PLANTING)



VICINITY MAP



RECORD DRAWINGS

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NORTH CAROLINA PROFESSIONAL SEAL 035636 ENGINEER CHRISTOPHER L. SMITH
8/3/16

LEGEND

- 15+00 — ASBUILT ALIGNMENTS & STATIONING
- THALWEG
- BANKFULL
- EPHEMERAL POOL
- CONSERVATION EASEMENT
- FENCE
- LOD — LIMITS OF DISTURBANCE
- CONSTRUCTION REVISION
- XS-1 — CROSS-SECTION LOCATION
- GAUGE
- W.L.B. — EXISTING WETLANDS
- 10 x 10 VEG PLOT
- 5 x 20 VEG PLOT
- BRUSH TOE
- ROCK L-VANE
- ROCK CROSS VANE
- ROCK STEP STRUCTURE w/ BOULDERS
- ROCK STEP STRUCTURE w/ CLASS B RIP RAP
- ROCK /LOG CROSS VANE
- FLOODPLAIN INTERCEPTOR

EEP PROJECT #: 96309

CONTRACT: ROSES CREEK

8/2/2016
R:\16_CAD_BIM\6.2_Work_In_Progress\stream\Proj\Record Drawings\RosesCrk_psh_01.dgn
ICA Engineering

SURVEY PREPARED BY:

KEE MAPPING & SURVEYING
P.O. BOX 2566
ASHEVILLE, NC 28802
(828) 575–9021

GRAPHIC SCALES

50 25 0 50 100
PLANS

10 5 0 10 20
PROFILE (HORIZONTAL)

20 10 0 20 40
PROFILE (VERTICAL)

DESIGN DATA

ROSES CREEK			UT 1			UT 2			UT 3		
DESIGN STREAM TYPE	=	C4	DESIGN STREAM TYPE	=	C5	DESIGN STREAM TYPE	=	C5	DESIGN STREAM TYPE	=	C5
BANKFULL AREA (FT^2) CROSS-SECTIONED	=	66.4	BANKFULL AREA (FT^2) CROSS-SECTIONED	=	2.1	BANKFULL AREA (FT^2) CROSS-SECTIONED	=	2.1	BANKFULL AREA (FT^2) CROSS-SECTIONED	=	2.6
BANKFULL WIDTH (FT)	=	30.5	BANKFULL WIDTH (FT)	=	5.0	BANKFULL WIDTH (FT)	=	5.0	BANKFULL WIDTH (FT)	=	5.5
MAX DEPTH (FT)	=	2.72	MAX DEPTH (FT)	=	0.58	MAX DEPTH (FT)	=	0.58	MAX DEPTH (FT)	=	0.63
WIDTH /DEPTH RATIO	=	14.0	WIDTH /DEPTH RATIO	=	13.0	WIDTH /DEPTH RATIO	=	13.0	WIDTH /DEPTH RATIO	=	13.1
DRAINAGE AREA (MI^2)	=	5.17	DRAINAGE AREA (MI^2)	=	0.06	DRAINAGE AREA (MI^2)	=	0.07	DRAINAGE AREA (MI^2)	=	0.02
BANKFULL SLOPE(FT/FT)	=	0.0062	BANKFULL SLOPE(FT/FT)	=	0.0021	BANKFULL SLOPE(FT/FT)	=	0.0021	BANKFULL SLOPE(FT/FT)	=	0.0021

PROJECT LENGTH

		PROPOSED DESIGN STREAM LENGTH	ASBUILT STREAM LENGTH
ROSES CREEK	=	3,219.20 FT	3,222.56 FT
UT 1	=	930.38 FT	950.69 FT
UT 2	=	707.59 FT	710.07 FT
UT 3	=	621.03 FT	627.80 FT

INDEX OF SHEETS

Prepared in the Office of:

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

CHRISTOPHER L. SMITH
PROJECT MANAGER

RECORD DRAWINGS OVERVIEW MAP

BEGIN UT 1
STA 10+00.00

END ROSES CREEK
STA 42+22.56

BEGIN UT 2
STA 10+00.00

ROSES CREEK
STA 34+65.21
END UT 3
STA 16+27.80

ROSES CREEK
STA 11+00.90
END UT 1
STA 19+50.69

END UT 2
STA 17+10.07

BEGIN ROSES CREEK
STA 10+00.00

BEGIN UT 3
STA 10+00.00

UT 1
UT 2
UT 3
ROSES CREEK
SISK FARM RD
FENCE
40' WIDE UTILITY R/W PER RUTHERFORD ELECTRIC MEMBERSHIP CORPORATION

10+00
15+00
19+00
20+00
25+00
30+00
35+00
40+00

RECORD DRAWING PLAN SHEETS SEE SHEETS 3 THRU 10

RECORD DRAWINGS

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NORTH CAROLINA PROFESSIONAL SEAL 035630 ENGINEER CHRISTOPHER L. SMITH
8/3/16

LEGEND

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- BANKFULL
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- CONSERVATION EASEMENT
- FENCE
- LOD — LIMITS OF DISTURBANCE
- XS-1 — CROSS-SECTION LOCATION
- GAUGE
- CONSTRUCTION REVISION
- WLB — EXISTING WETLANDS
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- ROCK CROSS VANE
- ROCK STEP STRUCTURE w/ BOULDERS
- ROCK STEP STRUCTURE w/ CLASS B RIP RAP
- ROCK /LOG CROSS VANE
- FLOODPLAIN INTERCEPTOR

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NC License No: P-0258

ROSES CREEK
STREAM RESTORATION PROJECT
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE
100 0 100 200
PLANS

DATE: 07-18-16

RECORD DRAWINGS OVERVIEW MAP

SHEET
2

EEP# 963090

8/2/2016
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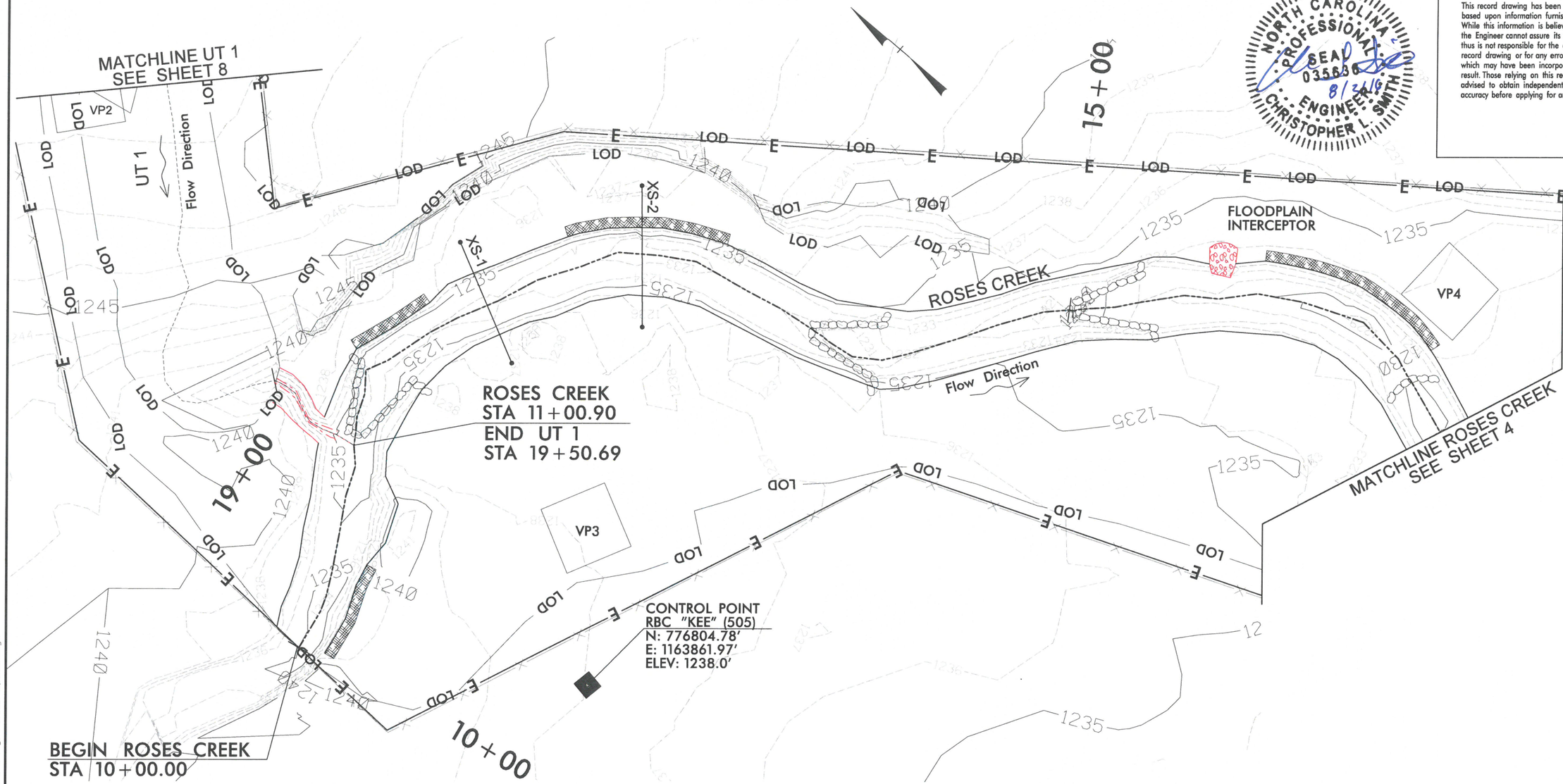

RECORD DRAWING PROJECT OVERVIEW MAP SEE SHEET 2
RECORD DRAWING PLAN SHEETS SEE SHEETS 3 THRU 10

LEGEND

- 15+00 — ASBUILT ALIGNMENTS & STATIONING
- THALWEG
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NORTH CAROLINA PROFESSIONAL SEAL 035690 ENGINEER CHRISTOPHER L. SMITH
8/24/16

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ROSES CREEK RESTORATION PROJECT
STREAM
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE 50 25 0 25 PLANS

DATE: 07-18-16

RECORD DRAWINGS

SHEET 3

EEP# 96309

8/22/2016
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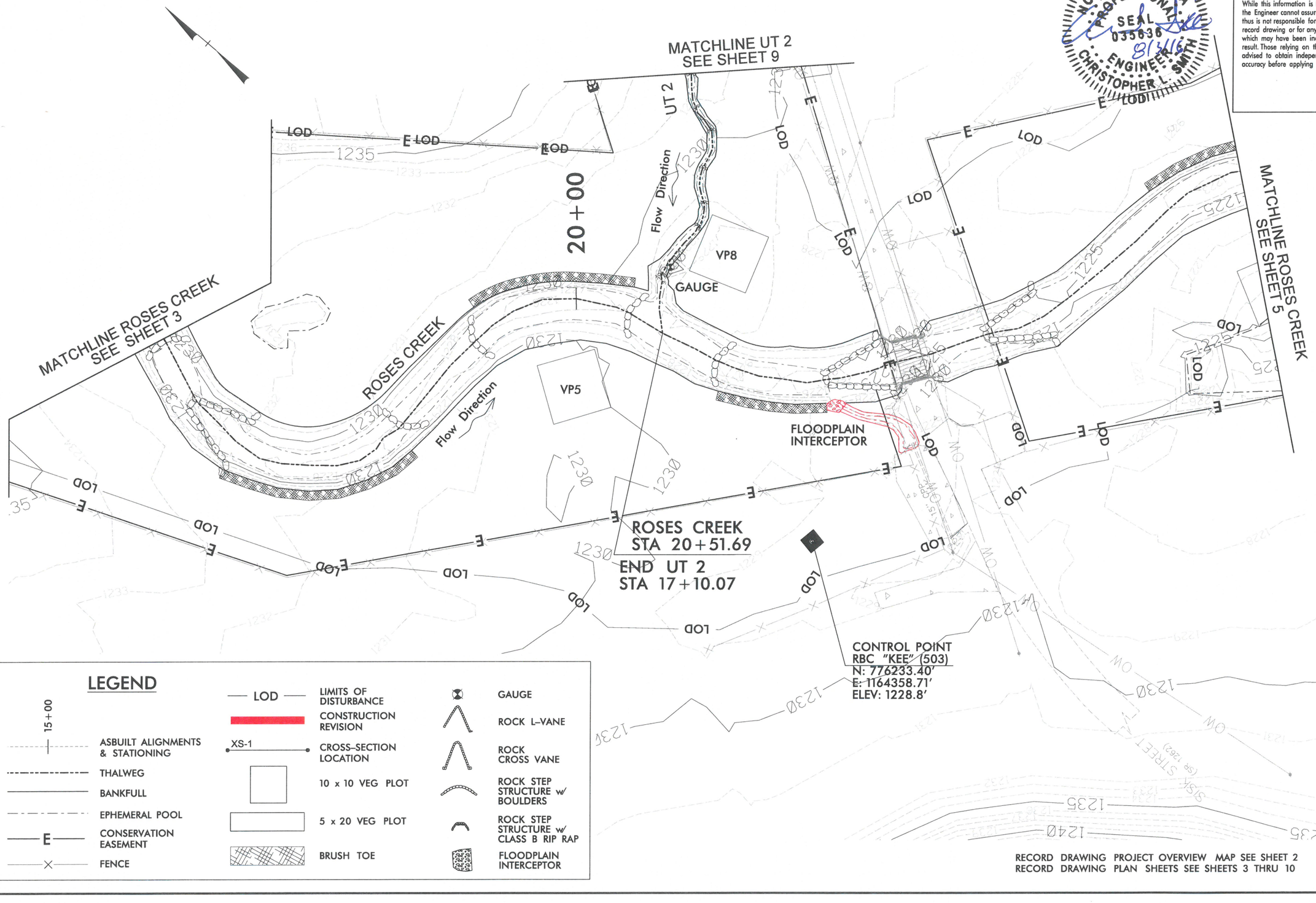

LEGEND

- 15+00 — STATIONING
- ASBUILT ALIGNMENTS & STATIONING
- THALWEG
- BANKFULL
- EPHEMERAL POOL
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8/3/16

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PROJECT
ROSES CREEK
STREAM RESTORATION PROJECT
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 07-18-16

RECORD DRAWING PLAN SHEET

SHEET
4

EEP# 96309

8/26/2016
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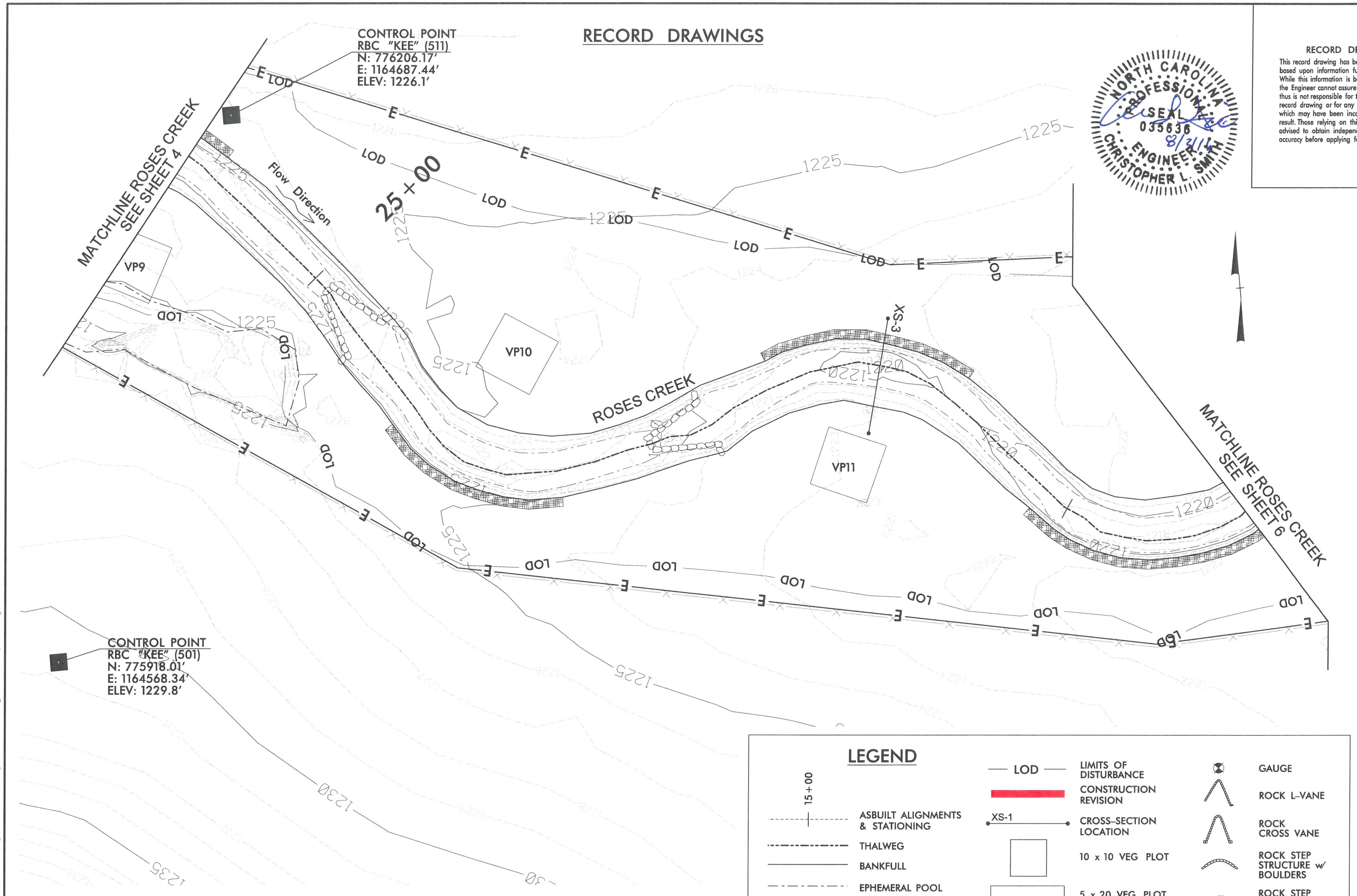

LEGEND

15+00	ASBUILT ALIGNMENTS & STATIONING	LOD	LIMITS OF DISTURBANCE		GAUGE
	THALWEG		CONSTRUCTION REVISION		ROCK L-VANE
	BANKFULL	XS-1	CROSS-SECTION LOCATION		ROCK CROSS VANE
	EPHEMERAL POOL		10 x 10 VEG PLOT		ROCK STEP STRUCTURE w/ BOULDERS
E	CONSERVATION EASEMENT		5 x 20 VEG PLOT		ROCK STEP STRUCTURE w/ CLASS B RIP RAP
	FENCE		BRUSH TOE		FLOODPLAIN INTERCEPTOR

RECORD DRAWING PROJECT OVERVIEW MAP SEE SHEET 2
RECORD DRAWING PLAN SHEETS SEE SHEETS 3 THRU 10

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NORTH CAROLINA PROFESSIONAL SEAL 035636 ENGINEER CHRISTOPHER L. SMITH
8/2/16

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ROSES CREEK STREAM RESTORATION PROJECT
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE
25 0 25 50
PLANS

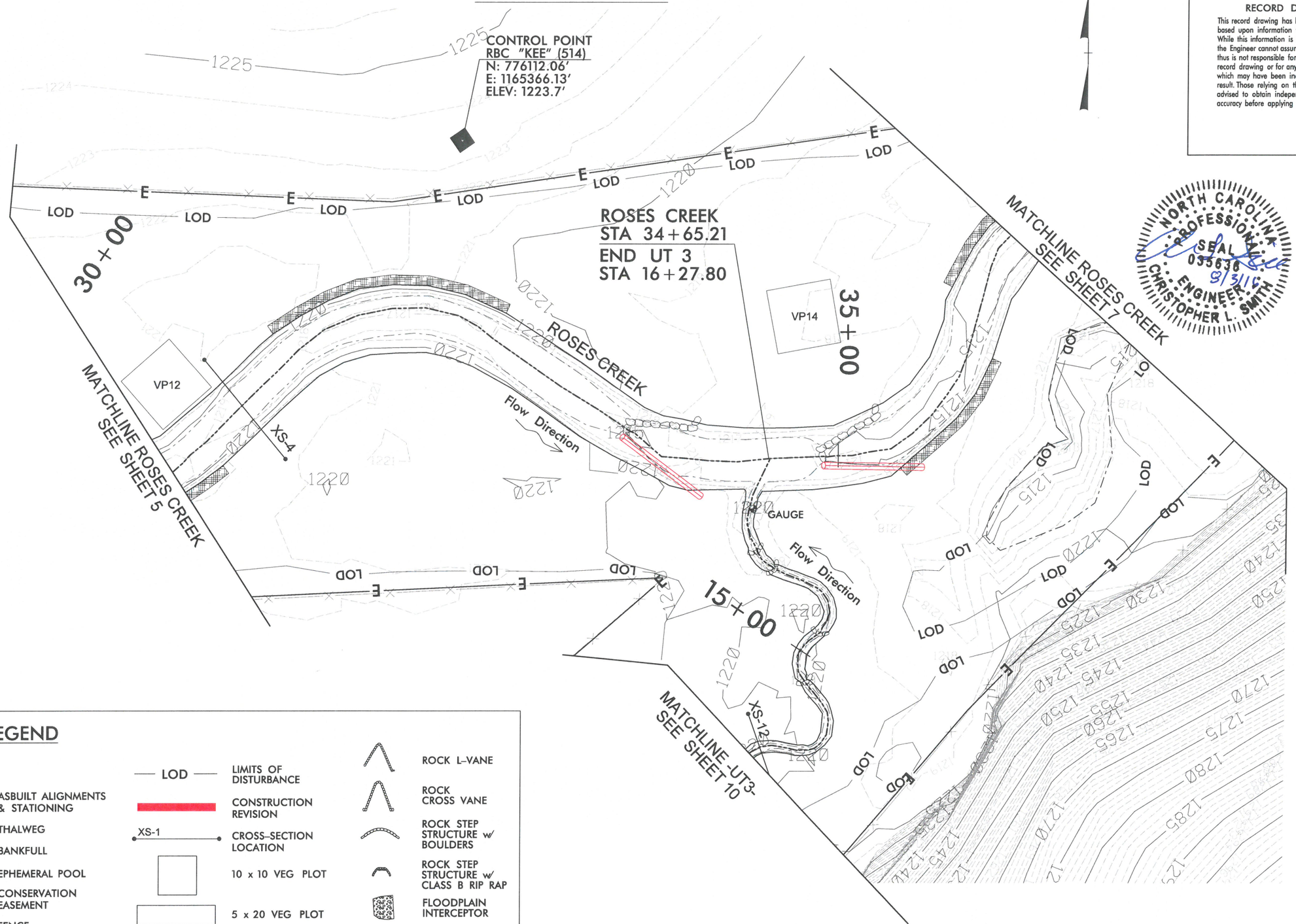
DATE: 07-18-16

RECORD DRAWING PLAN SHEET

SHEET
5

EEP# 96309

RECORD DRAWINGS



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8/31/16

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NC Licensee No: P-0258

ROSES CREEK PROJECT
STREAM RESTORATION
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE 50 25 0 25 PLANS

DATE: 07-18-16

RECORD DRAWING PLAN SHEET

SHEET 6

EEP# 96309

8/26/2016
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ICA Engineering

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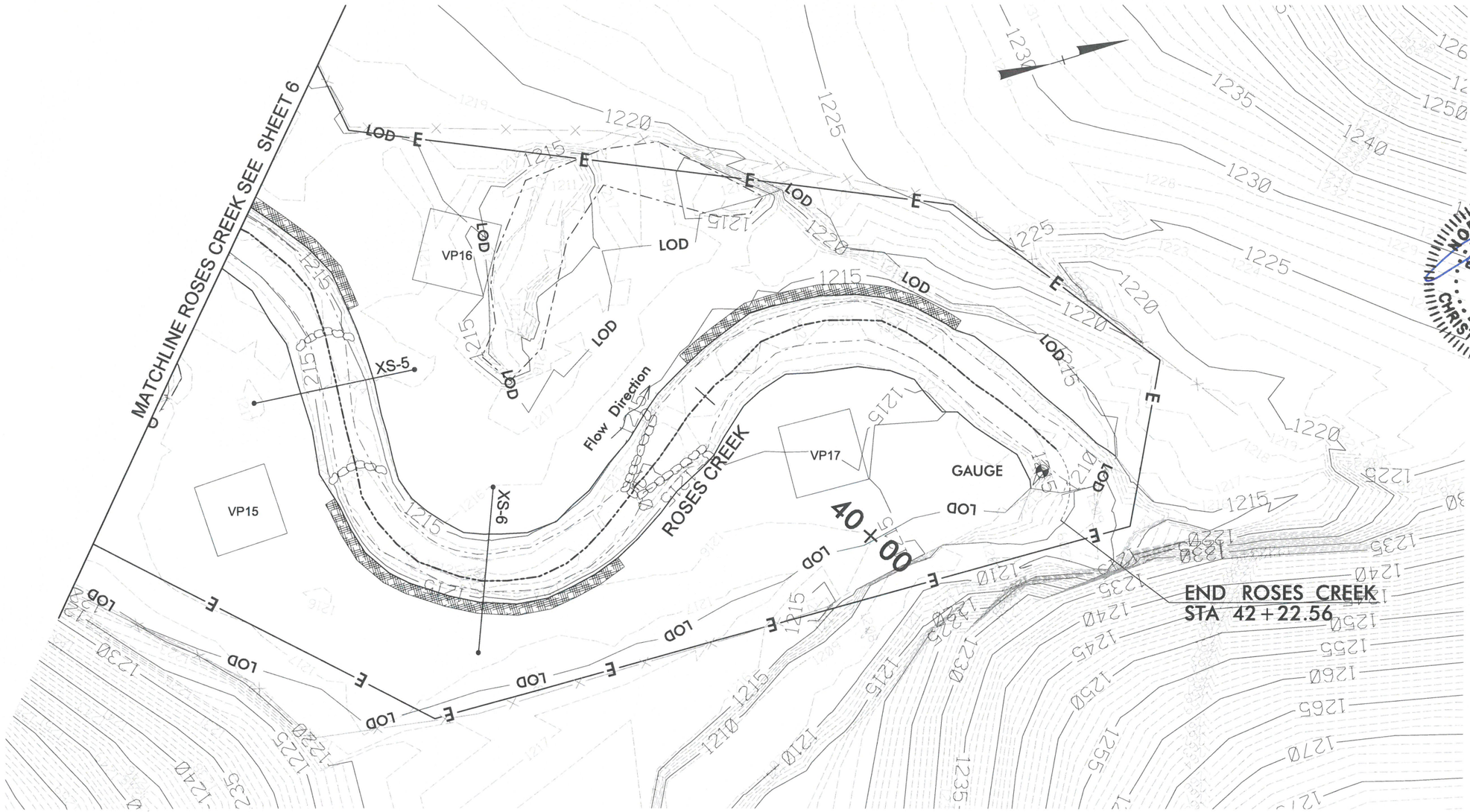

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8/3/16

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ROSES CREEK RESTORATION PROJECT
STREAM
BURKE COUNTY, NORTH CAROLINA

LEGEND

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- FLOODPLAIN INTERCEPTOR

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 07-18-16

RECORD DRAWING PLAN SHEET

SHEET
7

EEP# 96309

RECORD DRAWING PROJECT OVERVIEW MAP SEE SHEET 2
RECORD DRAWING PLAN SHEETS SEE SHEETS 3 THRU 10

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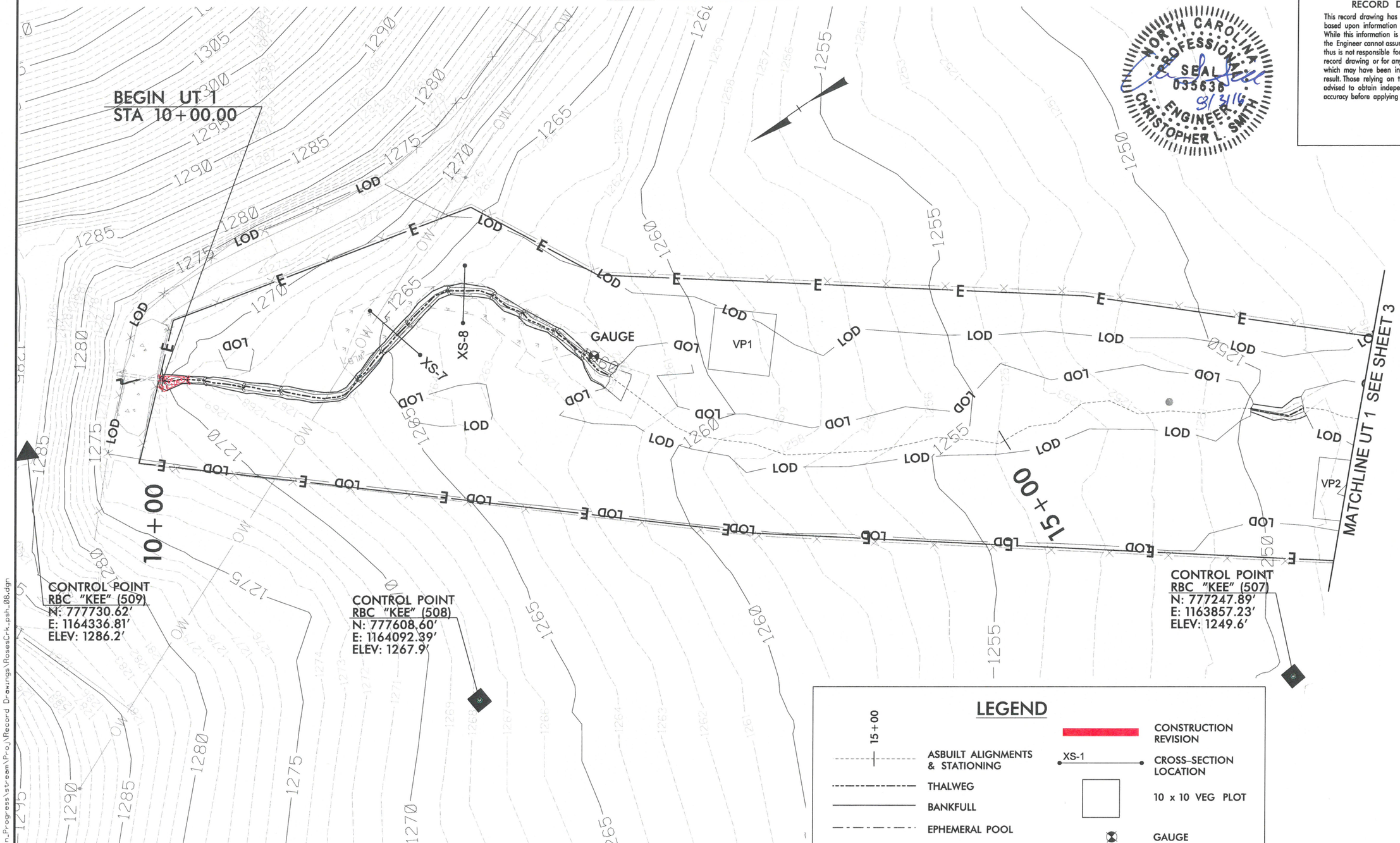

RECORD DRAWING PROJECT OVERVIEW MAP SEE SHEET 2
RECORD DRAWING PLAN SHEETS SEE SHEETS 3 THRU 10

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NORTH CAROLINA PROFESSIONAL SEAL 035636 ENGINEER CHRISTOPHER L. SMITH
8/3/16

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Raleigh, NC 27607
NC License No: P-0258

ROSES CREEK
STREAM RESTORATION PROJECT
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE 50 25 0 25 PLANS

DATE: 07-18-16

RECORD DRAWING PLAN SHEET

SHEET 8

EEP# 96309

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ICA Engineering

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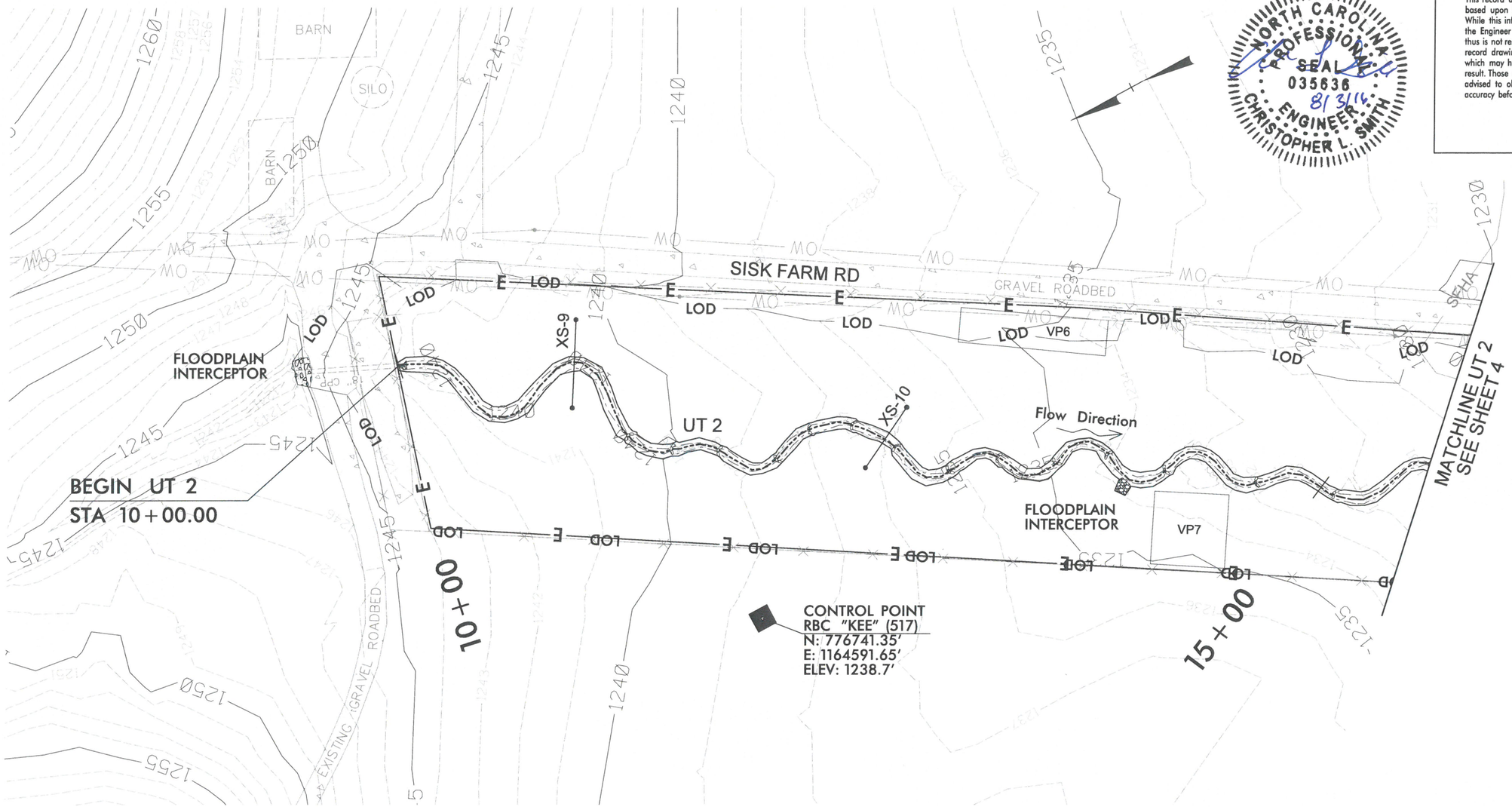

LEGEND

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RECORD DRAWING PROJECT OVERVIEW MAP SEE SHEET 2
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NORTH CAROLINA PROFESSIONAL SEAL 035636 ENGINEER CHRISTOPHER L SMITH
8/3/16

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Raleigh, NC 27607
NC License No. F-0258

ROSES CREEK RESTORATION PROJECT
STREAM
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE 50 25 0 25 — PLANS

DATE: 07-18-16

RECORD DRAWING PLAN SHEET

SHEET 9

EEP# 96309

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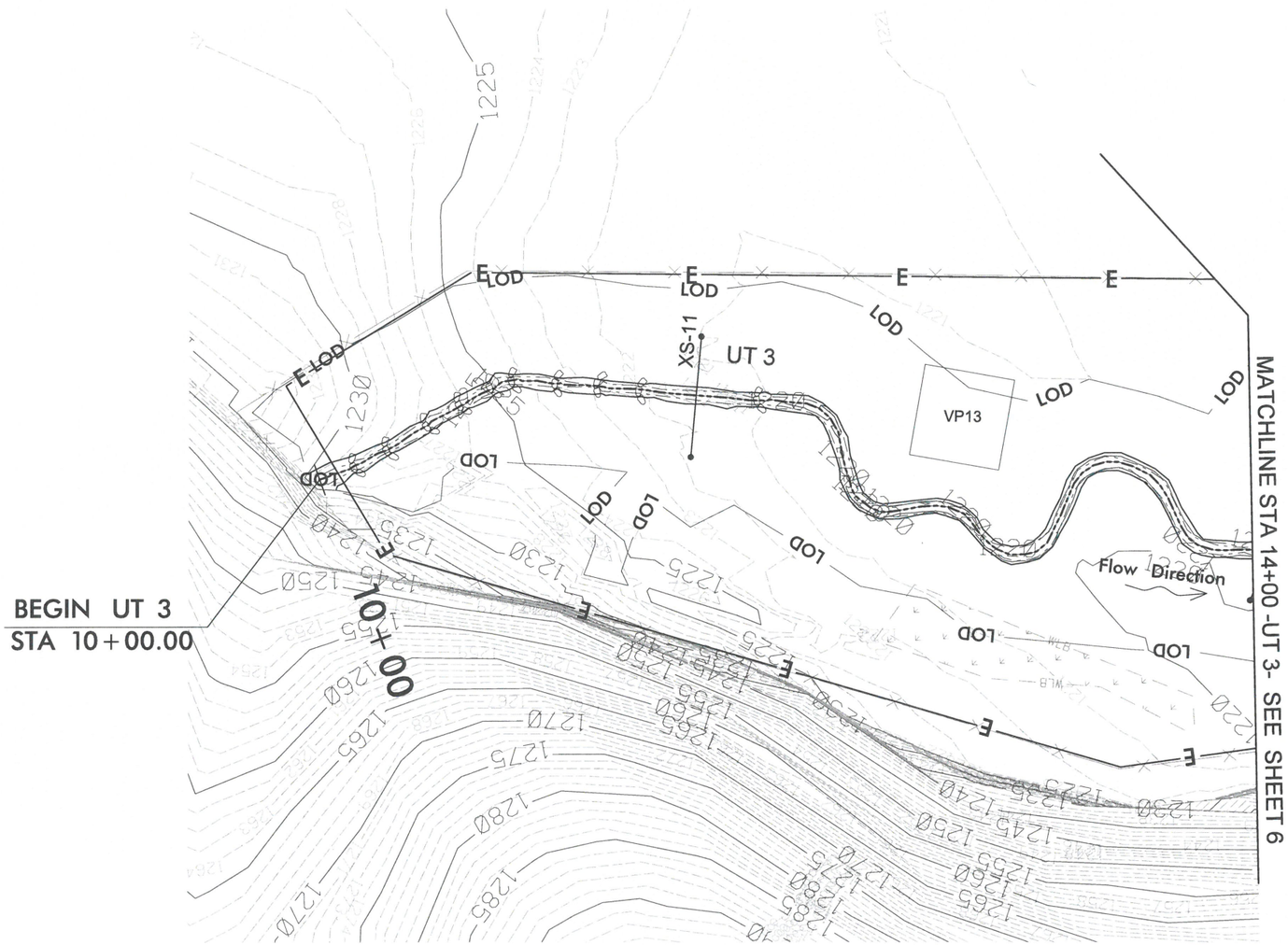
ICA Engineering

RECORD DRAWINGS



RECORD DRAWING PROJECT OVERVIEW MAP SEE SHEET 2
RECORD DRAWING PLAN SHEETS SEE SHEETS 3 THRU 10

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NORTH CAROLINA PROFESSIONAL SEAL 035636 ENGINEER CHRISTOPHER L. SMITH
9/3/16

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ROSES CREEK STREAM RESTORATION PROJECT
BURKE COUNTY, NORTH CAROLINA

GRAPHIC SCALE 50 25 0 25 — PLANS

DATE: 07-18-16

RECORD DRAWING PLAN SHEET

SHEET 10

EEP# 96309

8/2/2016
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