

BASELINE MONITORING DOCUMENT AND AS-BUILT BASELINE REPORT

Final

HOLMAN MILL MITIGATION SITE

Alamance County, NC
DEQ Contract 005795
DMS Project Number 96316

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PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

PREPARED BY:

Wildlands Engineering, Inc.
312 West Millbrook Road, Suite 225
Raleigh, NC 27609

Jason Lorch
jlorch@wildlandseng.com
Phone: (919) 851-9986

EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (Wildlands) completed a full delivery project at the Holman Mill Mitigation Site (Site) for the North Carolina Department of Environmental Quality Division of Mitigation Services (DMS) to restore and enhance a total of 8,717 linear feet (LF) of perennial and intermittent stream in Alamance County, NC. It is anticipated that the Site will generate 3,884 Stream Mitigation Units (SMUs) through the restoration and enhancement of UT to Pine Hill Branch and five unnamed tributaries (UT1, UT1A, UT2, UT2A, UT2B). The project is located in the Cape Fear River Basin Hydrologic Unit Code (HUC) 0303002 (Cape Fear 02) near Snow Camp, NC (Figure 1). The Site is also within the Cane Creek Targeted Local Watershed (TLW) (HUC 03030002050050), which flows into Cane Creek and eventually into the Haw River. A conservation easement was recorded on 32.4 acres within 2 parcels.

The Site is located within the Jordan Lake Water Supply Watershed, which has been designated as a Nutrient Sensitive Water. The TLW was identified in the DMS's Cape Fear River Basin Restoration Priorities 2009 (RBRP) report. This RBRP plan identifies agricultural operations and degraded water quality based on "fair" and "good-fair" benthic ratings as the impairments in the Cane Creek watershed. The RBRP report also identifies the successful completion of a number of stream and wetland projects within the Cane Creek watershed. The Site fully supports the Cataloging Unit (CU)-wide functional objectives stated in the 2011 Request for Proposals (RFP) to reduce and control nutrient inputs, reduce and control sediment inputs, and protect and augment Significant Natural Heritage Areas in the Cape Fear 02 River Basin.

The mitigation project is intended to provide numerous ecological benefits within the Cape Fear River Basin. While many of these benefits are limited to the Holman Mill Mitigation Site project area, others, such as pollutant removal and improved aquatic and terrestrial habitat, have more far-reaching effects. Expected improvements to water quality and ecological processes are outlined below as project goals and objectives. These project goals were established and completed with careful consideration of the goals and objectives described in the RBRP and to meet the DMS's mitigation needs, while maximizing the ecological and water quality uplift within the watershed. The following project specific goals established in the mitigation plan (Wildlands, 2015) are to:

- Reduce fecal coliform, nitrogen, and phosphorous inputs by removing cattle from streams and establishing and augmenting a forested riparian corridor *to* intercept and process sediment and nutrients before they reach the channel during storm events;
- Reduce sediment loads by stabilizing eroding stream banks;
- Return a network of streams to a stable form that is capable of supporting biological functions;
- Install instream structures to improve bed and bank stability, create fish and macroinvertibrate habitat, and help oxygenate streamflows; and
- Protect existing high quality streams and forested buffers.

The Site construction and as-built surveys were completed between January 2016 and April 2016. Minimal adjustments were made during construction, as needed, based on site conditions and availability of materials. One small section of the design alignment was adjusted to avoid impacts of mature trees. Specific changes are detailed in Section 5.1. Baseline (MY0) profiles and cross section dimensions closely match the design parameters. Cross section widths and pool depths occasionally deviate from the design parameters but fall within a normal range of variability for natural streams. The Site was built as designed and is on track to meeting the upcoming monitoring year's success criteria.

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Section 1: PROJECT GOALS, BACKGROUND AND ATTRIBUTES

1.1 Project Location and Setting

The Holman Mill Mitigation Site (Site) is located in the southern portion of Alamance County, southeast of Snow Camp (Figure 1). The Site is approximately 20 miles southeast of the City of Burlington. From Raleigh, NC, take I-40 West towards Durham. Take exit 273A for NC-54 West toward Chapel Hill. Travel approximately three miles and turn right to follow NC-54 West. Travel approximately 3.9 miles, take the Jones Ferry Road exit towards Carrboro. At the end of the ramp, turn left onto Jones Ferry Road and continue 0.9 miles. Turn right onto Old Greensboro Road. Travel 17.9 miles and turn left onto Holman Mill Road. Travel approximately 3.3 miles; the entrance to the Site is located on the left before reaching Clark Road. The Site is located on two parcels owned by two different property owners. See Holman Mill Mitigation Plan Table 1 (Wildlands, 2015) for property owners, and Parcel Identification Numbers (PIN). A conservation easement was recorded on 32.4 acres within two parcels (Deed Book 3472, Pages 951-968).

The Site is located within the Jordan Lake Water Supply Watershed, which has been designated as a Nutrient Sensitive Water. The Site's watershed is within the Cane Creek Targeted Local Watershed (TLW) HUC 03030002050050 and was identified in the North Carolina Division of Mitigation Services (DMS) Cape Fear River Basin Restoration Priorities 2009 (RBRP) report. This RBRP plan identifies agricultural operations and degraded water quality based on "fair" and "good-fair" benthic ratings as the impairments in the Cane Creek watershed. The RBRP report also identifies the successful completion of a number of stream and wetland projects within the Cane Creek watershed.

The Site is located in the Carolina Slate Belt of the Piedmont Physiographic Province. The Piedmont Province is characterized by gently rolling, well-rounded hills with long low ridges, with elevations ranging anywhere from 300 to 1,500 feet above sea level. The Carolina Slate Belt consists of heated and deformed volcanic and sedimentary rocks. The area is called "Slate Belt" because of the slatey cleavage of many of the surficial rocks. The region's geology also includes coarse-grained intrusive granites. Specifically, the proposed restoration site is located in the CZfv subregion within the Carolina Slate Belt. The CZfv subregion is classified as felsic metavolcanic rock. These rock types are described as metamorphosed dacitic to rhyolitic flows and tuffs interbedded with mafic and intermediate metavolcanic rock, meta-argillite, and metamudstone.

The six streams on the Site are located within the North Carolina Division of Water Resources (NCDWR) subbasin 03-06-04 of the Cape Fear River Basin. The NCDWR assigns best usage classifications to State Waters that reflect water quality conditions and potential resource usage. None of the six tributaries are classified by NCDWR and therefore are required to meet standards for Class C waters. Class C waters are protected for secondary recreation, fishing, and aquatic life. The downstream receiving water, UT to Pine Hill Branch (NCDWR Index No. 16-28-5-1), is classified as Water Supply V – Upstream (WS-V) and Nutrient Sensitive Waters (NSW) by NCDWR. Class WS-V waters are protected as water supplies and typically flow into other water bodies that are directly used as sources for drinking, culinary or food processing purposes. NSW classification represents water bodies that require nutrient management plans to reduce water quality impacts due to excessive nitrogen and phosphorus levels and algal populations.

Prior to construction activities, the stream channels had been degraded by livestock access and agricultural practices. Impacts to the stream included direct access by livestock, trampling of the riparian vegetation and stream banks, channelization, eroding banks, and a lack of stabilizing riparian vegetation. The adjacent floodplain area had been cleared for pasture and was grazed by livestock. The riparian

vegetation was either absent, limited to the streambanks, or periodically disturbed. Table 4 in Appendix 1 and Tables 5a-b in Appendix 2 present the pre-restoration conditions in detail.

1.2 Project Goals and Objectives

The mitigation project is intended to provide numerous ecological benefits within the Cape Fear River Basin. While many of these benefits are limited to the Holman Mill Mitigation Site project area, others, such as pollutant removal and improved aquatic and terrestrial habitat, have more far-reaching effects. Expected improvements to water quality and ecological processes are outlined below as project goals and objectives. These project goals were established and completed with careful consideration of the goals and objectives described in the RBRP and to meet the DMS's mitigation needs while maximizing the ecological and water quality uplift within the watershed. The following project specific goals established in the mitigation plan (Wildlands, 2015) are to:

The primary project goals will be:

- Reduce fecal coliform, nitrogen, and phosphorous inputs by removing cattle from streams and establishing and augmenting a forested riparian corridor *to* intercept and process sediment and nutrients before they reach the channel during storm events;
- Reduce sediment loads by stabilizing eroding stream banks;
- Return a network of streams to a stable form that is capable of supporting biological functions;
- Install instream structures to improve bed and bank stability, create fish and macroinvertibrate habitat, and help oxygenate streamflows; and
- Protect existing high quality streams and forested buffers.

Secondary project objectives are expected to include:

- Improving instream nutrient cycling by incorporating woody debris into constructed riffles and bank stabilization measures;
- Reducing thermal loadings through establishment of riparian shading;
- Reconnecting channels with floodplains to raise the local water table; and
- Create and implement a stream and riparian area restoration design that is both natural and aesthetically pleasing.

1.3 Project Structure, Restoration Type and Approach

The site design was developed to restore a small stream complex to a naturally occurring community, to create riparian habitat, and to improve water quality. Key factors addressed in the design were the establishment of stable habitats, improvement of riparian buffers, and the restoration of natural migration patterns for fish spawning. Figure 2 and Table 1 in Appendix 1 present the stream mitigation components for the Holman Mill Mitigation Site.

The final mitigation plan was submitted and accepted by DMS in May 2015. Construction activities were completed by Land Mechanic Designs, Inc in March 2016 and the planting was completed by Bruton Natural Systems, Inc. in March 2016. The baseline as-built survey was completed by Kee Mapping and Surveying, in April 2016. There were minor deviations reported in the as-built project elements compared to the design plans. A few structures were either added, eliminated, or adjusted slightly based on field conditions. In one location the stream alignment was adjusted to avoid impacts with mature trees. Field adjustments made during construction are described in detail in section 5.1. Appendix 1 provides more detailed project activity, history, contact information, and watershed/site background information for this project.

1.3.1 Project Structure

The project will provide 3,884 stream mitigation units (SMUs). Refer to Figure 2: Project Component/Asset Map for depiction of the stream restoration features and Table 1 for the project component and mitigation credit information for the Site.

1.3.2 Restoration Type and Approach

The design streams were restored with the appropriate level of intervention based on the surrounding landscape, climate, and natural vegetation communities but also with strong consideration of existing watershed conditions and trajectory. The Site consists of stream restoration and enhancement (Figure 2) activities. The specific proposed restoration activities are described below.

The stream restoration portion of this project includes five reaches:

- UT1 Reach 1: UT1 beginning at Holman Mill Road and running directly downstream of UT1A, approximately 208 feet in length;
- UT1 Reach 3: UT1 following 423 feet of enhancement 2 on UT1 Reach 2, approximately 309 feet in length;
- UT2A: UT2A from Northern property boundary to confluence with UT2, approximately 540 feet in length;
- UT2 Reach 3: UT2 following section of enhancement 1 and running to the confluence with UT2A, approximately 482 feet; and
- UT2 Reach 4: UT2 directly downstream of confluence of UT2 and UT2A to its terminus with UT to Pine Hill Branch, approximately 167 feet.

The project also includes stream enhancement on six reaches classified as enhancement II (EII) and one reach classified as enhancement I (EI):

- UT1 Reach 2: UT1 between restoration reaches 1 and 3, approximately 423 feet;
- UT1 Reach 4: UT1 following restoration reach 3 to UT1 terminus with UT to Pine Hill Branch, approximately 1,658 feet in length;
- UT1A: short spring fed channel starting near Holman Mill Road, approximately 94 feet in length;
- UT2 Reach 2: approximately 293 feet of enhancement I starting at bedrock knick point;
- UT2 Reach 1: UT2 at northern property line transitioning to reach 2 at bedrock knick point, approximately 588 feet; and
- UT2B: approximately 429 feet flowing southwest to northeast to its terminus with UT2.
- UT to Pine Hill Branch: 3,526 feet in length near eastern property boundary;

The restoration reaches were designed to be similar to C/E type streams according to the Rosgen classification system (Rosgen, 1996). The specific values for the design parameters were selected based on designer experience and judgment and were supported by morphologic data from reference reach data sets. The design width to depth ratios range from 13 to 14. A width to depth ratio in the 10 to 14 range is the delineating line between the C and E stream type. The morphologic design parameters are shown in Appendix 2, Tables 6a, 6b, and 6c for the restoration reaches, and fall within the ranges specified for C/E streams (Rosgen, 1996).

1.4 Project History, Contacts and Attribute Data

The Site was restored by Wildlands through a full delivery contract with DMS. Tables 2, 3, and 4 in Appendix 1 provide detailed information regarding the Project Activity and Reporting History, Project Contacts, and Project Baseline Information and Attributes, respectively.

Section 2: PERFORMANCE CRITERIA

The stream and wetland performance criteria for the project site follow approved performance criteria presented in the DMS Mitigation Plan Template (version 2.2, 06/08/2012), the DMS Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation (11/7/2011), and the Stream Mitigation Guidelines issued in April 2003 by the United States Army Corps of Engineers (USACE) and NCDWR. Annual monitoring and semi-annual site visits will be conducted to assess the condition of the finished project. The stream restoration and enhancement sections of the project will be assigned specific performance criteria components for stream morphology, hydrology, and vegetation. Performance criteria will be evaluated throughout the seven-year post-construction monitoring period. If all performance criteria have been successfully met and two bankfull events have occurred during separate years, Wildlands may propose to terminate stream and/or vegetation monitoring after year five. An outline of the performance criteria components follows.

2.1 Streams

2.1.1 Dimension

Riffle cross sections on the restoration and enhancement I reaches should be stable and should show little change in bankfull area, maximum depth ratio, and width-to-depth ratio. Per DMS guidance, bank height ratios shall not exceed 1.2 and entrenchment ratios shall be at least 2.2 for restored channels to be considered stable. All riffle cross sections should fall within the parameters defined for channels of the appropriate Rosgen stream type. If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Indicators of instability include a trend in vertical incision or eroding channel banks over the seven year monitoring period. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in the width-to-depth ratio in meandering channels or an increase in pool depth. Remedial action would not be taken if channel changes indicate a movement toward stability.

2.1.2 Pattern and Profile

Longitudinal profile surveys will not be conducted during the seven year monitoring period unless other indicators during the annual monitoring indicate a trend toward vertical and lateral instability. If a longitudinal profile is deemed necessary, monitoring will follow standards as described in the DMS Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation (11/7/2011) and the 2003 USACE and NCDWR Stream Mitigation Guidance for the necessary reaches. Visual assessments and photo documentation should indicate that streams are remaining stable and do not indicate a trend toward vertical or lateral instability. A longitudinal profile was conducted as part of the as-built survey to provide a baseline for comparison should it become necessary to perform longitudinal profile surveys later during monitoring and to insure accordance with design plans.

2.1.3 Substrate

A reach-wide pebble count will be performed annually in restoration and enhancement level I reaches for classification purposes. A pebble count will be performed at each surveyed riffle cross section to characterize the pavement. Substrate materials in the restoration and enhancement level I reaches should indicate a progression towards or the maintenance of coarser materials in the riffle features and smaller particles in the pool features.

2.1.4 Photo Documentation

Photographs should illustrate the site's vegetation and morphological stability on an annual basis. Cross section photos should demonstrate no excessive erosion or degradation of the banks. Longitudinal

photos should indicate the absence of persistent bars within the channel or vertical incision. Grade control structures should remain stable. Deposition of sediment on the bank side of vane arms is preferable. Maintenance of scour pools on the channel side of vane arms is expected.

2.1.5 Hydrology Documentation

Two bankfull flow events must be documented on the restoration reaches within the seven year monitoring period. The two bankfull events must occur in separate years. Stream monitoring will continue until success criteria in the form of two bankfull events in separate years have been documented.

2.2 Vegetation

The final vegetative success criteria will be the survival of 210 planted stems per acre in the riparian corridor at the end of the required monitoring period (year seven). The interim measure of vegetative success for the site will be the survival of at least 320 planted stems per acre at the end of the third monitoring year and at least 260 stems per acre at the end of the fifth year of monitoring. Planted vegetation must average 10 feet in height in each plot at the end of the seventh year of monitoring. If this performance standard is met by year five and stem density is trending towards success (i.e., no less than 260 five-year-old stems/acre), monitoring of vegetation on the site may be terminated with written approval by the USACE in consultation with the NC Interagency Review Team (IRT). The extent of invasive species coverage will also be monitored and controlled as necessary throughout the required monitoring period (year five or seven).

2.3 Schedule and Reporting

Monitoring reports will be prepared in the fall of each year of monitoring and submitted to DMS. Based on the DMS Monitoring Report Template (version 1.5, 06/08/2012), the monitoring reports will include the following:

- Project background which includes project objectives, project structure, restoration type and approach, location and setting, history and background;
- Monitoring current condition maps with major project elements noted such items as grade control structures, vegetation plots, permanent cross sections, crest gages, and pressure transducers;
- Photographs showing views of the restored Site taken from fixed point stations;
- Assessment of the stability of the Site based on the cross sections;
- Vegetative data as described above including the identification of any invasion by undesirable plant species;
- Stream flow gage attainment;
- A description of damage by animals or vandalism;
- Maintenance issues and recommended remediation measures will be detailed and documented; and
- Wildlife observations.

Section 3: MONITORING PLAN

Monitoring will consist of collecting morphological, vegetative, and hydrological data to assess the project performance based on the restoration goals and objectives on an annual basis or until performance criteria is met. The performance of the project will be assessed using measurements of the stream channel's dimension, pattern, substrate composition, permanent photographs, vegetation, and surface water hydrology. Any areas with identified high priority problems, such as streambank instability, aggradation/degradation, or lack of vegetation establishment will be evaluated on a case-by-case basis. The monitoring period will extend seven years beyond completion of construction or until performance criteria have been met. Figures 3.0 – 3.2 depict locations of all monitoring activities described below.

3.1 Stream

Geomorphic assessments will follow guidelines outlined in the Stream Channel Reference Sites: An Illustrated Guide to Field Techniques (Harrelson et al., 1994), methodologies utilized in the Rosgen stream assessment and classification document (Rosgen, 1994 and 1996), and in the Stream Restoration: A Natural Channel Design Handbook (Doll et al, 2003). Refer to Figure 3 in Appendix 1 for the monitoring locations discussed below.

3.1.1 Dimension

A total of eight cross sections were installed along the stream restoration reaches. Two cross sections were installed per 1,000 linear feet of stream restoration work, with riffle and pool sections in proportion to DMS guidance. Each cross section was permanently marked with pins to establish its location. Cross section surveys include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg to monitor any trends in bank erosion. If moderate bank erosion is observed at a stream reach during the monitoring period, a series of bank pins will be installed in representative areas where erosion is occurring for reaches with a bankfull width of greater than three feet. Bank pins will be installed in at least three locations (one in upper third of the pool, one at the mid-point of the pool, and one in the lower third of the pool). Bank pins will be monitored by measuring exposed rebar and maintaining pins flush to bank to capture bank erosion progression. Annual cross section and bank pin surveys (if applicable) will be conducted in monitoring years one (MY1), two (MY2), three (MY3), five (MY5), and seven (MY7). Photographs will be taken annually of the cross sections looking upstream and downstream.

3.1.2 Pattern and Profile

Longitudinal profile surveys will not be conducted during the seven year monitoring period unless other indicators during the annual monitoring show a trend toward vertical and lateral instability. If a longitudinal profile is deemed necessary, monitoring will follow standards as described in the DMS Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation (11/7/2011) and the 2003 USACE and NCDWR Stream Mitigation Guidance for the necessary reaches. Stream pattern and profile will be assessed visually as described below in section 3.1.6.

3.1.3 Substrate

A reach-wide pebble count will be performed in each restoration and enhancement I reach each year for classification purposes. A pebble count will be performed at each surveyed riffle cross section to characterize the pavement during the years of the cross section survey.

3.1.4 Photo Reference Points

A total of 45 permanent photograph reference points were established within the project area after construction. Photographs will be taken once a year to visually document stability for seven years following construction. Permanent markers were established so that the same locations and view directions on the site are monitored each year. Photographs will be used to monitor stream restoration and enhancement reaches. The photographer will make every effort to maintain the same view in each photo over time. The representative digital photo(s) will be taken on the same day(s) the surveys are conducted.

3.1.5 Hydrology Documentation

Three manual crest gages and three pressure transducer automated crest gages were installed on the Site (Figure 3, Appendix 1). The crest gages were installed at three surveyed riffle cross sections along UT1, UT2 and UT2a (XS 4, 5 and 7), and will be checked during each site visit to determine if a bankfull event has occurred since the last visit. Photographs will be used to document the occurrence of debris lines and sediment deposition as evidence of bankfull events. Additionally, the pressure transducer data will be plotted and included in the annual monitoring reports.

3.1.6 Visual Assessment

Visual assessments will be performed along all stream and wetland areas on a semi-annual basis during the seven year monitoring period. Problem areas will be noted such as channel instability (i.e. lateral and/or vertical instability, in-stream structure failure/instability and/or piping, headcuts), vegetated health (i.e. low stem density, vegetation mortality, invasive species or encroachment), beaver activity, or livestock access. Areas of concern will be mapped in the Current Condition Plan View (CCPV) map, photographed, and accompanied by a written description in the annual report. Problem areas will be re-evaluated during each subsequent visual assessment. Should remedial actions be required, recommendations will be provided in the annual monitoring report.

3.2 Vegetation

Planted woody vegetation will be monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-DMS Level 2 Protocol (Lee et al., 2006) to monitor and assess the planted woody vegetation. A total of 17 standard 10 meter by 10 meter vegetation plots were established within the project easement area.

Vegetation plots were randomly established within the planted corridor of the restoration areas to capture the heterogeneity of the designed vegetative communities. The vegetation plot corners have been marked and are recoverable either through field identification or with the use of a GPS unit. Reference photographs were taken at the origin looking diagonally across the plot to the opposite corner during the baseline monitoring in March 2016. Subsequent annual assessments following baseline survey will capture the same reference photograph locations. Species composition, density and survival rates will be evaluated on an annual basis by plot and for the entire site. Individual plot data will be provided and will include height, density, vigor, damage (if any), and survival. Planted woody stems will be marked annually, as needed, based off of a known origin so they can be found in succeeding monitoring years. Mortality will be determined from the difference between the baseline year's living planted stems and the current year's living planted stems.

Section 4: MAINTENANCE AND CONTINGENCY PLAN

Wildlands will perform maintenance as needed on the mitigation project. A physical inspection of the Site shall be conducted a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include one or more of the following components.

4.1 Stream

Stream problem areas will be mapped and included in the Current Condition Plan View (CCPV) as part of the annual stream assessment. Stream problems areas may include bank erosion, structure failure, beaver dams, aggradation/degradation, etc. Routine channel maintenance and repair activities may include chinking of in-stream structures to prevent piping, securing loose coir matting, and supplemental installations of live stakes and other target vegetation along the channel. Areas where storm water runoff flows into the channel may also require maintenance to prevent bank failures and head-cutting.

4.2 Vegetation

Vegetation shall be maintained to ensure the health and vigor of the targeted community. Vegetative problem areas will be mapped and included in the CCPV as part of the annual vegetation assessment. Vegetation problems areas may include planted vegetation not meeting performance criteria, persistent invasive species, barren areas with little to no herbaceous cover, or grass suffocation/crowding of planted stems. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.

4.3 Site Boundary

Site boundary issues will be mapped and included in the CCPV as part of the annual visual assessment. Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree-blazing, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.

Section 5: AS-BUILT CONDITION (BASELINE)

The Site construction and as-built surveys were completed in March 2016. The survey included developing an as-built topographic surface, locating the channel boundaries, structures, and cross sections. For comparison purposes, the baseline monitoring divided the reach assessments in the same way they were established for design parameters: UT1, UT2 Reach 2, UT2 Reach 3, UT2 Reach 4, and UT2a.

5.1 As-Built/Record Drawings

A half size set of record drawings are located in Appendix 4 with the post-construction survey, alignments, and any significant field adjustments made during construction for the project. Minimal adjustments were made during construction, where needed, based on field evaluation.

5.1.1 UT1

- Station 100+00 rock added to roadside ditch to provide flow dissipation and structural support;
- Station 100+75 brush toe was not installed in order to avoid impacts to existing mature trees;
- Station 101+35 rock outlet was relocated due to changes in drainage patterns between project design and construction;
- Stations 105+10, 106+30, and 106+60, constructed riffles were installed where channel stabilization was needed.
- Station 107+50 angled log drops were installed rather than log j-hooks to avoid impacts to existing mature trees.;
- Station 111+90 constructed riffle was shifted upstream where channel stabilization was needed;
- Station 114+45 brush toe was not installed in order to minimize impacts to steep hillslope;
- Station 116+45 sod mats were extended further downstream to stabilize the bank; and
- Station 117+90 constructed riffle was installed for grade stabilization.

5.1.2 UT1A

- UT1A was stabilized during construction due to degradation that occurred between project design and construction.

5.1.3 UT2 Reach 2

- Station 206+125 constructed riffle was not installed in order to allow plunge pool downstream of bedrock to remain; and
- Station 207+50 angled log drop was not installed to avoid impacts to existing mature trees.

5.1.4 UT2 Reach 3

- No field adjustments were made during construction.

5.1.5 UT2 Reach 4

- Station 213+90 to Station 215+30 alignment changed to avoid impacts to existing mature trees and to avoid impacting eroded banks that had formed on UT to Pine Hill Branch.

5.1.6 UT2A

- Station 301+15 brush toe was not installed in order to avoid impacts to existing mature trees.

5.2 Baseline Data Assessment

Baseline monitoring (MY0) was conducted between March 2016 and April 2016. The first annual monitoring assessment (MY1) will be completed in the fall of 2016. The streams will be monitored for a total of seven years, with the final monitoring activities concluding in 2022. The close-out for the Holman Mill Mitigation Site will be conducted in 2023 given the performance criteria has been met. As part of the closeout process, DMS will evaluate the Site at the end of the fourth year monitoring period to determine whether or not the Site is eligible to closeout following monitoring year five. If the Site is meeting performance criteria, DMS will propose to the IRT to proceed with the closeout process. If the Site is not meeting performance criteria, then an additional two years of monitoring will be conducted by Wildlands.

5.2.1 Morphological State of the Channel

Refer to Appendix 2 for summary data tables, morphological plots, and stream photographs.

Profile

The MY0 profiles closely match the profile design parameters with the exception of the pool depths and riffle slopes. On the design profiles, riffles were depicted as straight lines with consistent slopes. However, at some locations the as-built survey riffle profiles are not consistent in slope due to natural deposition and scour within some riffle reaches. The surveyed riffle slopes exceed design parameters on UT2 Reach 4 due to the straightening of the channel from stations 213+90 through 215+30 to avoid existing mature trees. Additionally, constructed pool depths exceed design parameters and are expected to trend towards design depths as a result of natural deposition over time. These variations in riffle slope and pool depths do not constitute a problem or indicate a need for remedial actions and will be assessed visually during the CCPV site walks. The plotted longitudinal profiles and related summary data can be found in Appendix 2.

Dimension

The MY0 dimension numbers fall within standard ranges as compared to the design parameters. Variations are primarily associated with a wider constructed bankfull width as reflected in the cross sections. It is expected that over time as vegetation is established, the channels may narrow more toward dimensions characteristic of an E channel. This narrowing over time would not be seen as an indicator of instability in and of itself. Summary data and cross section plots of each project reach can be found in Appendix 2.

Pattern

The MY0 pattern metrics fell within the design parameters for all six reaches. A major alignment change occurred on UT2 Reach 4 between stations 213+90 and 215+30 in order to avoid impact to existing mature trees and to realign the confluence away from a bank on UT to Pine Hill Branch which had become unstable since the site design. Pattern data will be evaluated in monitoring year five if there are any indicators through the profile or dimensions that significant geomorphic adjustments have occurred.

Sediment Transport

As-built shear stresses and velocities are similar to design calculations and should reduce the risk of further erosion along all restoration reaches. The as-built condition for each of these reaches indicates an overall increase in substrate particle size (Tables 6a – 6c). The substrate data for each constructed reach was compared to the design shear stress parameters from the mitigation plan to assess the potential for bed degradation. The shear stresses calculated for the constructed channels are within the allowable range, which indicates the channel is not at risk to trend toward channel degradation.

5.2.2 Vegetation

The MY0 vegetation survey was complete in March 2016. The average MY0 planted density is 634 stems/acre, which exceeds the MY3 interim stem density requirement of 320 planted stems per acre. Summary data and photographs of each plot can be found in Appendix 3.

5.2.3 Hydrology

At this time, there have been no bankfull events recorded since completion of construction. Bankfull events recorded during 2016 will be included in the year one monitoring report.

Section 6: REFERENCES

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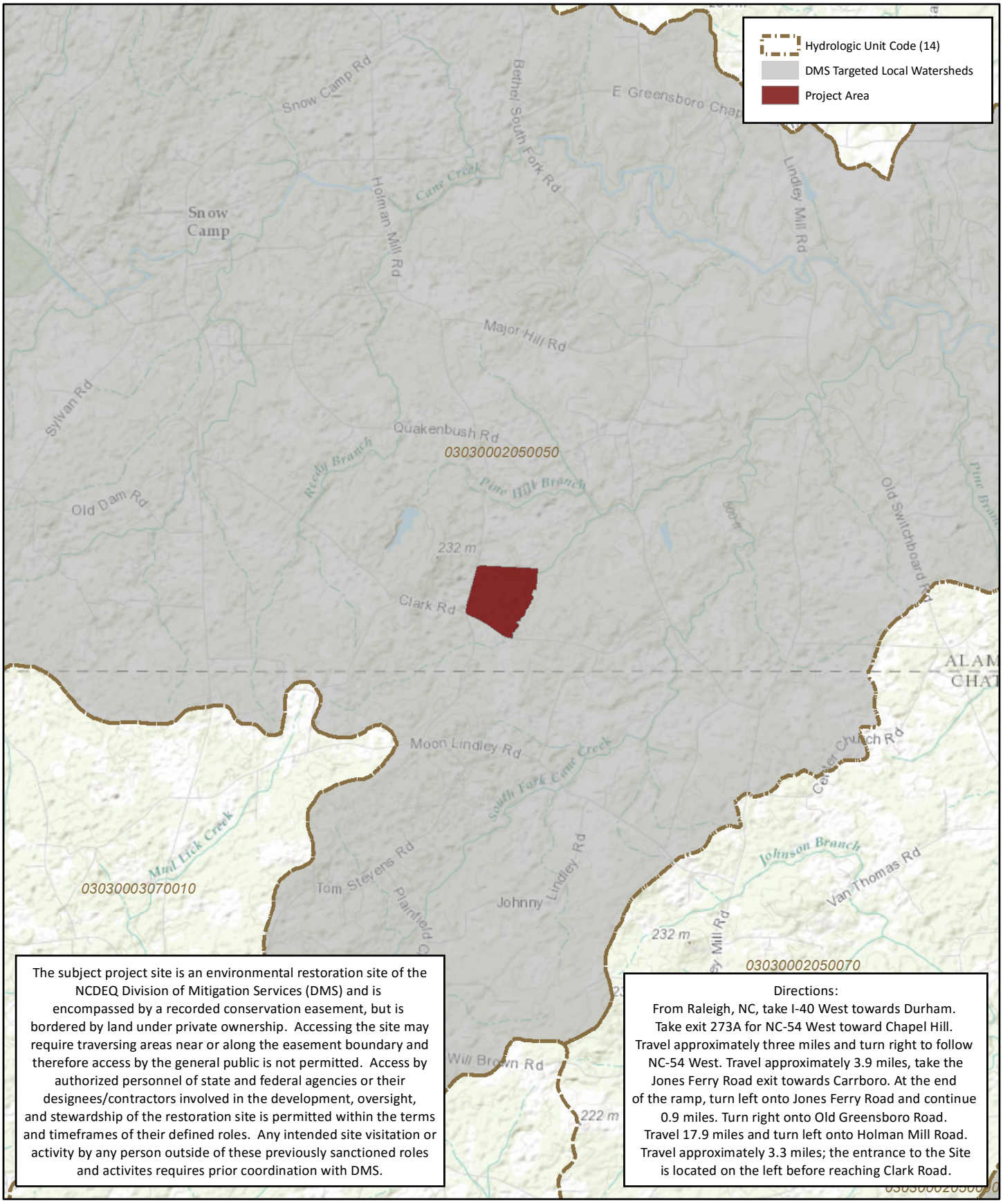
APPENDIX 1. General Tables and Figures



The subject project site is an environmental restoration site of the NCDEQ Division of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight, and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activites requires prior coordination with DMS.

Directions:
From Raleigh, NC, take I-40 West towards Durham. Take exit 273A for NC-54 West toward Chapel Hill. Travel approximately three miles and turn right to follow NC-54 West. Travel approximately 3.9 miles, take the Jones Ferry Road exit towards Carrboro. At the end of the ramp, turn left onto Jones Ferry Road and continue 0.9 miles. Turn right onto Old Greensboro Road. Travel 17.9 miles and turn left onto Holman Mill Road. Travel approximately 3.3 miles; the entrance to the Site is located on the left before reaching Clark Road.

WILDLANDS ENGINEERING

0 0.5 1 Miles

N

Figure 1 Project Vicinity Map
Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

Alamance County, NC

WILDLANDS ENGINEERING

0 200 400 Feet

Figure 2 Project Component/ Asset Map
Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

Alamance County, NC

WILDLANDS ENGINEERING

0 175 350 525 700 Feet

N

Figure 3.0 Monitoring Plan View Map
(Key)
Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

Alamance County, NC

WILDLANDS ENGINEERING

0 125 250 375 500 Feet

Figure 3.1 Monitoring Plan View Map
Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

Alamance County, NC

WILDLANDS ENGINEERING

0 125 250 375 500 Feet

N

Figure 3.2 Monitoring Plan View Map
Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

Alamance County, NC

Table 1. Project Components and Mitigation Credits
Holman Mill Mitigation Site
DMS Project No.96316
Monitoring Year 0 - 2016

MITIGATION CREDITS									
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	3,884	N/A	N/A	N/A	N/A	N/A			

PROJECT COMPONENTS							
Reach ID	As-Built Stationing/ Location	Existing Footage/ Acreage	Approach	Restoration or Restoration Equivalent	Restoration Footage/ Acreage	Mitigation Ratio	Credits (SMU/ WMU)
STREAMS							
UT to Pine Hill Branch	600+00 - 635+26	3,526	EII	Restoration	3,526	5	705
UT1 Reach 1	100+00-102+08	215	P1	Restoration	208	1	208
UT1 Reach 2	102+08 - 106+31	433	EII	Restoration	423	2.5	169
UT1 Reach 3	106+31 - 109+40	331	P1	Restoration	309	1	309
UT1 Reach 4	109+40 - 125+98	1,687	EII	Restoration	1,658	2.5	663
UT1A	400+00 - 400+94	84	EII	Restoration	94	2.5	38
UT2A	300+00 - 305+40	468	P1	Restoration	540	1	540
UT2 Reach 1	200+00 - 205+88	588	EII	Restoration	588	2.5	235
UT2 Reach2	205+88 - 208+81	298	E1	Restoration	293	1.5	195
UT2 Reach 3	208+81 - 213+63	396	P1	Restoration	482	1	482
UT2 Reach 4	213+63 - 215+30	242	P1	Restoration	167	1	167
UT2B	500+00 - 504+29	429	EII	Restoration	429	2.5	172

COMPONENT SUMMATION						
Restoration Level	Stream (LF)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (acres)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	1,706	-	-	-	-	-
Enhancement		-	-	-	-	-
Enhancement I	293					
Enhancement II	6,718					
Creation		-	-	-		
Preservation	-	-	-	-		-
High Quality Preservation	-	-	-	-		-

N/A: not applicable

Table 2. Project Activity and Reporting History

Holman Mill Mitigation Site
DMS Project No.96316
Monitoring Year 0 -2016

Activity or Report	Date Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	April 2014- April 2015	May 2015
Final Design - Construction Plans	May 2015- October 2015	October 2015
Construction	January 2016- March 2016	March 2016
Temporary S&E mix applied to entire project area[1]	March 2016	March 2016
Permanent seed mix applied to reach/segments	March 2016	March 2016
Bare root and live stake plantings for reach/segments	March 2016	March 2016
Baseline Monitoring Document (Year 0)	March 2016- April 2016	May 2016
Year 1 Monitoring	2016	December 2016
Year 2 Monitoring	2017	December 2017
Year 3 Monitoring	2018	December 2018
Year 4 Monitoring	2019	December 2019
Year 5 Monitoring	2020	December 2020
Year 6 Monitoring	2021	December 2021
Year 7 Monitoring	2022	December 2022

[1]Seed and mulch is added as each section of construction is completed.

Table 3. Project Contact Table

Holman Mill Mitigation Site
DMS Project No.96316
Monitoring Year 0 - 2016

Designer Angela Allen, PE	**Wildlands Engineering, Inc.** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
Planting Contractor	**Bruton Natural Systems, Inc** P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
Seed Mix Sources	**Green Resource, LLC**
Nursery Stock Suppliers	
Bare Roots	**Dykes and Son Nursery**
Live Stakes	**Bruton Natural Systems, Inc**
Monitoring Performers Monitoring, POC	**Wildlands Engineering, Inc.** Jason Lorch 919.851.9986, ext. 107

Table 4. Project Information and Attributes
Holman Mill Mitigation Site
DMS Project No.96316
Monitoring Year 0 -2016

PROJECT INFORMATION	
Project Name	Holman Mill Mitigation Site
County	Alamance County
Project Area (acres)	32.4 acres
Project Coordinates (latitude and longitude)	35°51'310.12"N, 79°23'16.00"W
PROJECT WATERSHED SUMMARY INFORMATION	
Physiographic Province	Carolina Slate Belt of the Piedmont Physiographic Province
River Basin	Cape Fear River
USGS Hydrologic Unit 8-digit	03030002
USGS Hydrologic Unit 14-digit	03030002050050
DWR Sub-basin	03-06-04
Project Drainiage Area (acres)	1,077
Project Drainage Area Percentage of Impervious Area	3%
CGIA Land Use Classification	49% Forested/ Scrubland, 42% Agriculture/ Managed Herbaceous, 4% Pasture, 3% Watershed Impervious Cover, 2% Residential, <1% Open Water

REACH SUMMARY INFORMATION						
Parameters	**UT to Pine Hill Branch**	**UT1**	**UT1A**	**UT2**	**UT2A**	**UT2B**
Length of reach (linear feet) - Post-Restoration	3,526	2,598	94	1,530	540	429
Drainage area (acres)	1,077	102	20	130	47	18
NCDWR stream identification score	44.5	33.5/30.5	25.5	35	36.75	26.5
NCDWR Water Quality Classification	N/A					
Morphological Desription (stream type)	P	P	I	P	P	I
Evolutionary trend (Simon's Model) - Pre- Restoration	I	II	NA	III/IV	III/IV	NA
Underlying mapped soils	Georgeville silty clay loam, Local alluvial land, Herndon silt loam, Goldston Channery Silt Loam					
Drainage class	---	---	---	---	---	---
Soil Hydric status	---	---	---	---	---	---
Slope	---	---	---	---	---	---
FEMA classification	AE	AE	---	AE	AE	---
Native vegetation community	Piedmont bottomland forest, Bottomland hardwood forest					
Percent composition exotic invasive vegetation -Post-Restoration	0%					

REGULATORY CONSIDERATIONS			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No.27 and DWQ 401 Water Quality Certification No. 3885.
Waters of the United States - Section 401	Yes	Yes	
Division of Land Quality (Dam Safety)	No	N/A	N/A
Endangered Species Act	Yes	Yes	Holman Mill Mitigation Plan(2015); Wildlands determined "no effect" on Alamance County listed endangered species.
Historic Preservation Act	Yes	Yes	No historic resources were found to be impacted (letter from SHPO dated 3/24/14).
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	UT to Pine Hill Branch and portions of UT2 and UT2A are located within the floodway and flood fringe (FEMA Zone AE, FIRM panel 8786).
Essential Fisheries Habitat	No	N/A	N/A

Table 5. Monitoring Component Summary

Holman Mill Mitigation Site

DMS Project No.96316

Monitoring Year 0 - 2016

Parameter	Monitoring Feature	Quantity/Length by Reach							Frequency
		UT to Pine Hill Branch	UT1	UT1a	UT2-R1	UT2-R2, R3, R4	UT2a	UT2b	
Dimension	Riffle Cross Section	N/A	2	N/A	N/A	1	1	N/A	Annual
	Pool Cross Section	N/A	2	N/A	N/A	1	1	N/A	
Pattern	Pattern	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Substrate	Reach-wide (RW), Riffle (RF) 100 pebble	N/A	1 RW, 2 RF	N/A	N/A	1 RW, 1 RF	1 RW, 1 RF	N/A	Annual
Hydrology	Crest Gage	N/A	1	N/A	N/A	1	1	N/A	Annual
Vegetation	Vegetation Plots	12							Annual
Visual Assessment	All Streams	Y							Bi-annual
Exotic and Nuisance vegetation									Annual
Project Boundary									Annual
Reference Photos	Photos	45							Annual

APPENDIX 2. Morphological Summary and Data Plots

Table 6a. Baseline Stream Data Summary
Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

UT1

		PRE-RESTORATION		REFERENCE REACH DATA						DESIGN		AS-BUILT/BASELINE	
Parameter	**Gage**	**UT1 - Reach 1/3**		**Agony Acres UT1A-Reach 1**		**UT to Polecat Creek**		**UT to Varnals Creek**		**UT1 - Reach 1/3**		**UT1 - Reach 1/3**	
				Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle													
Bankfull Width (ft)		5.7		9.1	10.4	5.3	10.9	9.3	10.5	7.8		7.5	7.9
Floodprone Width (ft)		11.5		>36		25	65	20	64.0	15	65	23.4	23.6
Bankfull Mean Depth		0.7		1.0	1.2	1.0	1.1	1.1	1.2	0.6		0.6	
Bankfull Max Depth		1		1.8		1.4	1.7	1.5	1.7	0.8	1.0	0.9	
Bankfull Cross Sectional Area (ft^2)	N/A	4.3		10.7	11.3	5.4	12.4	10.3	12.3	4.3		4.3	4.6
Width/Depth Ratio		8.1		7.3	10.1	5.2	9.6	8.1	9.3	14.1		13.1	13.6
Entrenchment Ratio		2		>3.9		3.2	8.3	1.9	6.1	1.9	8.3	3.0	3.1
Bank Height Ratio		2.2		1.0		1.0	1.1	0.9	1.0	0.9	1.1	1.0	
D50 (mm)		33.11										28.8	32
Profile													
Riffle Length (ft)				---		---		---		---		12.5	31.4
Riffle Slope (ft/ft)		---		N/A		0.004	0.047	0.024	0.057	0.0158	0.0661	0.0200	0.0690
Pool Length (ft)	N/A			---		---		---		---		6.0	23.6
Pool Max Depth (ft)		---		2.5		1.8		2.5	2.6	0.9	1.7	1.5	3.4
Pool Spacing (ft)		---		N/A		34	52	8	82	2	44	20	53
Pool Volume (ft^3)													
Pattern													
Channel Beltwidth (ft)		62	82	21	93	28	50	15	45	12	69	11	45
Radius of Curvature (ft)		56	90	14	60	19	50	8	47	10	45	9	37
Rc:Bankfull Width (ft/ft)	N/A	6.2	9.9	1.5	5.8	2.0	5.3	0.6	3.2	1.3	5.8	1.2	4.7
Meander Length (ft)		209	300	N/A		--	--	--	--	25	128	31	75
Meander Width Ratio		6.8	9	2.3	8.9	3.0	5.3	1.0	3.0	1.6	8.9	1.5	5.7
Substrate, Bed and Transport Parameters													
Ri%/Ru%/P%/G%/S%													
SC%/Sa%/G%/C%/B%/Be%													
d16/d35/d50/d84/d95/d100	N/A	0.18/8.66/33.11/ 128/2655/>2048		---		---		---				.22/2.97/6.6/38.7/ 69.7/128	
Reach Shear Stress (Competency) lb/ft^2		1.6								0.85		0.7	
Max part size (mm) mobilized at bankfull													
Stream Power (Capacity) W/m^2													
Additional Reach Parameters													
Drainage Area (SM)		0.16		0.30		0.41		0.41		0.16		0.16	
Watershed Impervious Cover Estimate (%)		2%		---		---		---		2%		2%	
Rosgen Classification		B4		E4		E4		E4		C4		C4	
Bankfull Velocity (fps)		3		2.2	2.4	2.2	3.5	4.4	5.2	3.2		3.5	3.6
Bankfull Discharge (cfs)		14		25.3		20.3		54.000		14.0		15.0	16.7
Q-NFF regression		---											
Q-USGS extrapolation	N/A	---											
Q-Mannings		---											
Valley Length (ft)		---		---		---		---		468		468	
Channel Thalweg Length (ft)		2,648								519		517	
Sinuosity		1.12		1.35		1.4		1.2		1.15	1.20	1.1	
Water Surface Slope ($ft/ft)^2$		---		---		---		---		---		0.0246	
Bankfull Slope (ft/ft)		0.025		0.004	0.028	0.012		0.017		0.015	0.03	0.0203	

(---): Data was not provided
N/A: Not Applicable

Table 6b. Baseline Stream Data Summary
Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

UT2

Parameter	Gage	PRE-RESTORATION CONDITION				REFERENCE REACH DATA						DESIGN				AS-BUILT/BASELINE			
		UT2 - Reach 3		UT2 - Reach 4		Agony Acres UT1A-Reach 1		UT to Polecat Creek		UT to Varnals Creek		UT2 - Reach 3		UT2 - Reach 4		UT2 - Reach 3		UT2 - Reach 4	
						Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																			
Bankfull Width (ft)	N/A	5.7		5.4		9.1	10.4	5.3	10.9	9.3	10.5	7.9		11.2		9.7		9.7	
Floodprone Width (ft)		11.5		25.6		>36		25	65	20	64.0	17	79	25	90	100.0		100.0	
Bankfull Mean Depth		0.7		0.8		1.0	1.2	1.0	1.1	1.1	1.2	0.6		0.8		0.5		0.5	
Bankfull Max Depth		1		1.5		1.8		1.4	1.7	1.5	1.7	0.8	1.0	1.1	1.5	0.8		0.8	
Bankfull Cross Sectional Area (ft^2)		4.3		4.1		10.7	11.3	5.4	12.4	10.3	12.3	4.4		9.1		4.5		4.5	
Width/Depth Ratio		8.1		6.8		7.3	10.1	5.2	9.6	8.1	9.3	14.0		14.0		20.5		20.5	
Entrenchment Ratio		2		4.7		>3.9		3.2	8.3	1.9	6.1	2.2	10.0	2.2	8.0	10.4		10.4	
Bank Height Ratio		2.2		2.1		1.0		1.0	1.1	0.9	1.0	1.0	1.1	1.0	1.1	1.0		1.0	
D50 (mm)		33.11		0.69												11.4		11.4	
Profile																			
Riffle Length (ft)	N/A					---		---		---		---		---		14.7	45.8	23.7	31.4
Riffle Slope (ft/ft)		---		---		N/A		0.004	0.047	0.024	0.057	0.0138	0.0598	0.0062	0.0264	0.0135	0.0288	0.0395*	0.0592*
Pool Length (ft)						---		---		---		---		---		20.4	59.8	10.5	12.1
Pool Max Depth (ft)		---		2.3		2.5		1.8		2.5	2.6	0.9	1.7	1.3	2.5	1.5	2.7	1.9	3.1
Pool Spacing (ft)		---		---		N/A		34	52	8	82	4	44	3	63	56	87	33	61
Pool Volume (ft^3)																			
Pattern																			
Channel Beltwidth (ft)	N/A	62	82	16	50	21	93	28	50	15	45	13	70	18	100	31	52	20	
Radius of Curvature (ft)		56	90	10	47	14	60	19	50	8	47	10	46	15	65	18	42	45	
Rc:Bankfull Width (ft/ft)		6.2	9.9	1.2	5.6	1.5	5.8	2.0	5.3	0.6	3.2	1.3	5.8	1.3	5.8	1.9	4.3	4.6	
Meander Length (ft)		209	300	42	192	N/A		--	--	--	--	25	130	36	184	56	92	130	
Meander Width Ratio		6.8	9	1.9	6	2.3	8.9	3.0	5.3	1.0	3.0	1.6	8.9	1.6	8.9	3.2	5.4	2.1	
Substrate, Bed and Transport Parameters																			
Ri%/Ru%/P%/G%/S%	N/A																		
SC%/Sa%/G%/C%/B%/Be%																			
d16/d35/d50/d84/d95/d100		0.18/8.66/33.11/128/1655/>2048		Silt/Clay/0.43/0.69/17.84/32.14/64		---		---		---						SC/2.18/5.6/34.0/56.9/362.0		SC/2.18/5.6/34.0/56.9/362.0	
Reach Shear Stress (Competency) lb/ft^2		1.77		1.1								0.38		0.59		0.38		0.44	
Max part size (mm) mobilized at bankfull																			
Stream Power (Capacity) W/m^2																			
Additional Reach Parameters																			
Drainage Area (SM)	N/A	0.13		0.21		0.30		0.41		0.41		0.13		0.21		0.13		0.21	
Watershed Impervious Cover Estimate (%)		2%		2%		---		---		---		2%		2%		2%		2%	
Rosgen Classification		B4		E5		E4		E4		E4		C4		C4		C4		C4	
Bankfull Velocity (fps)		3		2.9		2.2	2.4	2.2	3.5	4.4	5.2	2.9		2.5		2.6		N/A	
Bankfull Discharge (cfs)		13		22		25.3		20.3		54		13.0		22.0		11.7		N/A	
Q-NFF regression		---		---															
Q-USGS extrapolation		---		---															
Q-Mannings		---		---															
Valley Length (ft)		---		---		---		---		---		386		152					
Channel Thalweg Length (ft)		396		242								479		210		482		167	
Sinuosity		1.12		1.17		1.35		1.4		1.2		1.15	1.25	1.13	1.20	1.2		1.1	
Water Surface Slope $(ft/ft)^2$		---		---		---		---		---		---		---		0.0119		0.0237	
Bankfull Slope (ft/ft)		0.0300		0.013		0.0040	0.028	0.012		0.0170		0.014		0.02		0.0120		0.0176	

*: Alignment change during consturction created steeper riffles
(---): Data was not provided
N/A: Not Applicable

Table 6c. Baseline Stream Data Summary
Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

UT2A

		PRE-RESTORATION		REFERENCE REACH DATA						DESIGN		AS-BUILT/ BASELINE	
Parameter	**Gage**	**UT2A**		**Agony Acres UT1A-Reach 1**		**UT to Polecat Creek**		**UT to Varnals Creek**		**UT2A**		**UT2A**	
				Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle													
Bankfull Width (ft)	N/A	5.1		9.1	10.4	5.3	10.9	9.3	10.5	6.4		6.6	
Floodprone Width (ft)		11.5		>36		25	65	20	64.0	14	80	100.0	
Bankfull Mean Depth		0.4		1.0	1.2	1.0	1.1	1.1	1.2	0.5		0.5	
Bankfull Max Depth		0.9		1.8		1.4	1.7	1.5	1.7	0.7	0.9	0.7	
Bankfull Cross Sectional Area (ft^2)		2.1		10.7	11.3	5.4	12.4	10.3	12.3	3.3		3.2	
Width/Depth Ratio		12		7.3	10.1	5.2	9.6	8.1	9.3	13.0		13.5	
Entrenchment Ratio		2.3		>3.9		3.2	8.3	1.9	6.1	2.2	12.5	15.1	
Bank Height Ratio		3.4		1.0		1.0	1.1	0.9	1.0	0.9	1.1	1.0	
D50 (mm)		3.18										18.3	
Profile													
Riffle Length (ft)	N/A			---		---		---		---		17.9	38.2
Riffle Slope (ft/ft)		---		N/A		0.004	0.047	0.024	0.057	0.018	0.08	0.0007	0.0520
Pool Length (ft)				---		---		---		---		16.3	33.0
Pool Max Depth (ft)		2.4		2.5		1.8		2.5	2.6	0.8	1.6	1.5	3.3
Pool Spacing (ft)		---		N/A		34	52	8	82	2	36	29	62
Pool Volume (ft^3)													
Pattern													
Channel Beltwidth (ft)	N/A	15	30	21	93	28	50	15	45	10	57	25	40
Radius of Curvature (ft)		5.8	33	14	60	19	50	8	47	8	37	11	31
Rc:Bankfull Width (ft/ft)		1.1	6.5	1.5	5.8	2.0	5.3	0.6	3.2	1.3	5.8	1.7	4.7
Meander Length (ft)		27	69	N/A		--	--	--	--	20	105	41	61
Meander Width Ratio		2.9	5.9	2.3	8.9	3.0	5.3	1.0	3.0	1.6	8.6	3.8	6.1
Substrate, Bed and Transport Parameters													
Ri%/Ru%/P%/G%/S%	N/A												
SC%/Sa%/G%/C%/B%/Be%													
d16/d35/d50/d84/d95/d100		Silt/Clay/0.56/3.18/ 17.4/25.53/64		---		---		---				3.15/11.86/18.3/43 .5/101.2/362	
Reach Shear Stress (Competency) lb/ft^2		1.85								0.52		0.45	
Max part size (mm) mobilized at bankfull													
Stream Power (Capacity) W/m^2													
Additional Reach Parameters													
Drainage Area (SM)	N/A	0.08		0.30		0.41		0.41		0.08		0.08	
Watershed Impervious Cover Estimate (%)		2%		---		---		---		2%		2%	
Rosgen Classification		C4b		E4		E4		E4		C4		C4	
Bankfull Velocity (fps)		2.5		2.2	2.4	2.2	3.5	4.4	5.2	3.1		2.9	
Bankfull Discharge (cfs)		9		25.3		20.3		54		9.0		8.6	
Q-NFF regression		---											
Q-USGS extrapolation		---											
Q-Mannings		---											
Valley Length (ft)		---		---		---		---		480		480	
Channel Thalweg Length (ft)		468								540		540	
Sinuosity		1.15		1.35		1.4		1.2		1.15	1.25	1.1	
Water Surface Slope ($ft/ft)^2$		---		---		---		---		---		0.0129	
Bankfull Slope (ft/ft)		0.023		0.0040	0.028	0.012		0.0170		0.007	0.018	0.0143	

(---): Data was not provided
N/A: Not Applicable

Table 7. Morphology and Hydraulic Summary (Dimensional Parameters - Cross Section)

Holman Mill Mitigation Site

DMS Project No. 96316

Monitoring Year 0 - 2016

	UT1 Reach 1																UT1 Reach 3													
	Cross Section 1 (Riffle)								Cross Section 2 (Pool)								Cross Section 3 (Pool)								Cross Section 4 (Riffle)							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
based on fixed bankfull elevation	570.5								569.8								554.1								553.9							
Bankfull Width (ft)	7.9								8.4								9.6								7.5							
Floodprone Width (ft)	23.6								N/A								N/A								23.4							
Bankfull Mean Depth (ft)	0.6								0.9								0.9								0.6							
Bankfull Max Depth (ft)	0.9								1.6								1.8								0.9							
Bankfull Cross Sectional Area (ft^2)	4.6								7.4								8.2								4.3							
Bankfull Width/Depth Ratio	13.6								9.5								11.3								13.1							
Bankfull Entrenchment Ratio	3.0								N/A								N/A								3.1							
Bankfull Bank Height Ratio	1.0								1.0								1.0								1.0							
	UT2 Reach 3																UT2A															
	Cross Section 5 (Riffle)								Cross Section 6 (Pool)								Cross Section 7 (Riffle)								Cross Section 8 (Pool)							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
based on fixed bankfull elevation	520.1								519.5								520.5								520.2							
Bankfull Width (ft)	9.7								9.9								6.6								9.7							
Floodprone Width (ft)	100.0								N/A								100.0								N/A							
Bankfull Mean Depth (ft)	0.5								0.9								0.5								0.9							
Bankfull Max Depth (ft)	0.8								1.6								0.7								1.5							
Bankfull Cross Sectional Area (ft^2)	4.5								8.9								3.2								9.1							
Bankfull Width/Depth Ratio	20.5								11.0								13.5								10.4							
Bankfull Entrenchment Ratio	10.4								N/A								15.1								N/A							
Bankfull Bank Height Ratio	1.0								1.0								1.0								1.0							

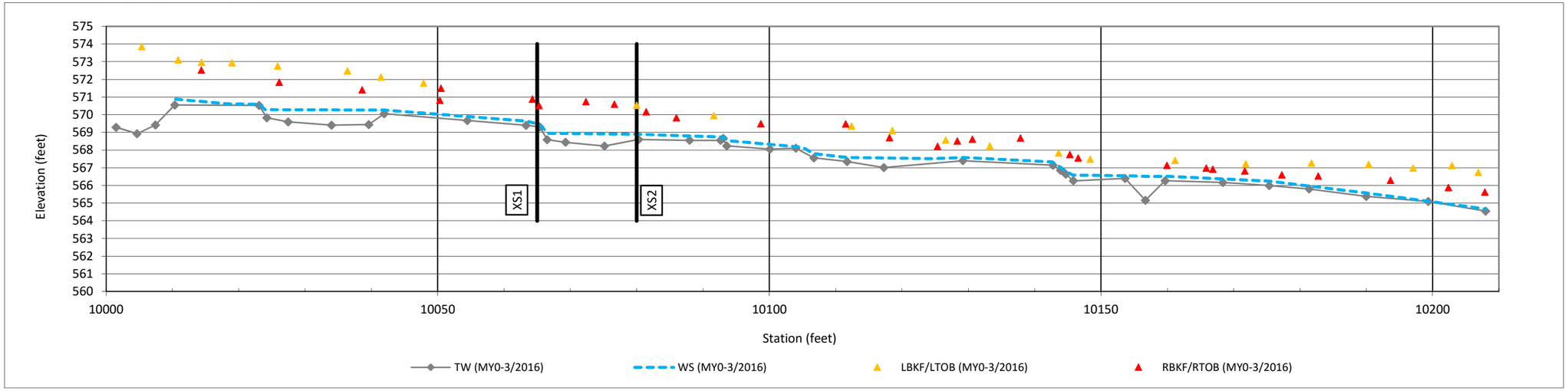
Longitudinal Profile Plots

Holman Mill Mitigation Site

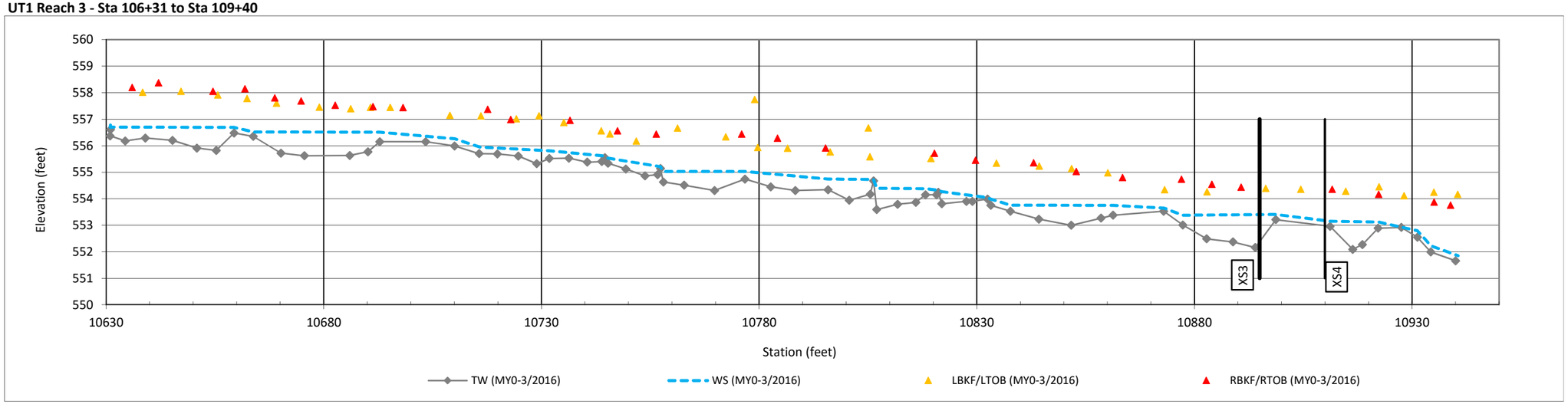
DMS Project No. 96316

Monitoring Year 0 - 2016

UT1 Reach 1 - Sta 100+00 to Sta 102+08



UT1 Reach 3 - Sta 106+31 to Sta 109+40



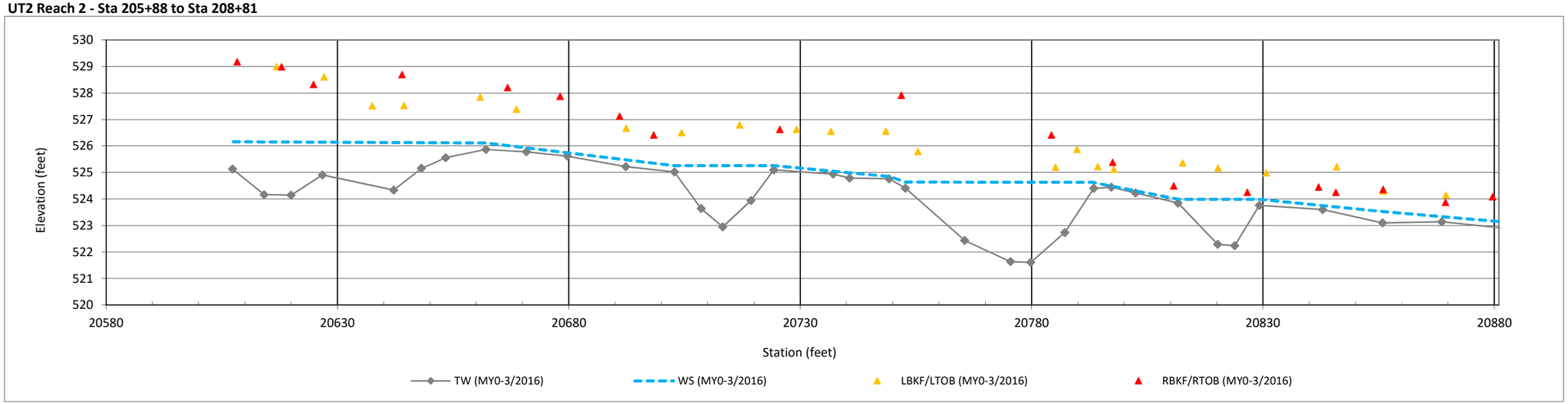
Longitudinal Profile Plots

Holman Mill Mitigation Site

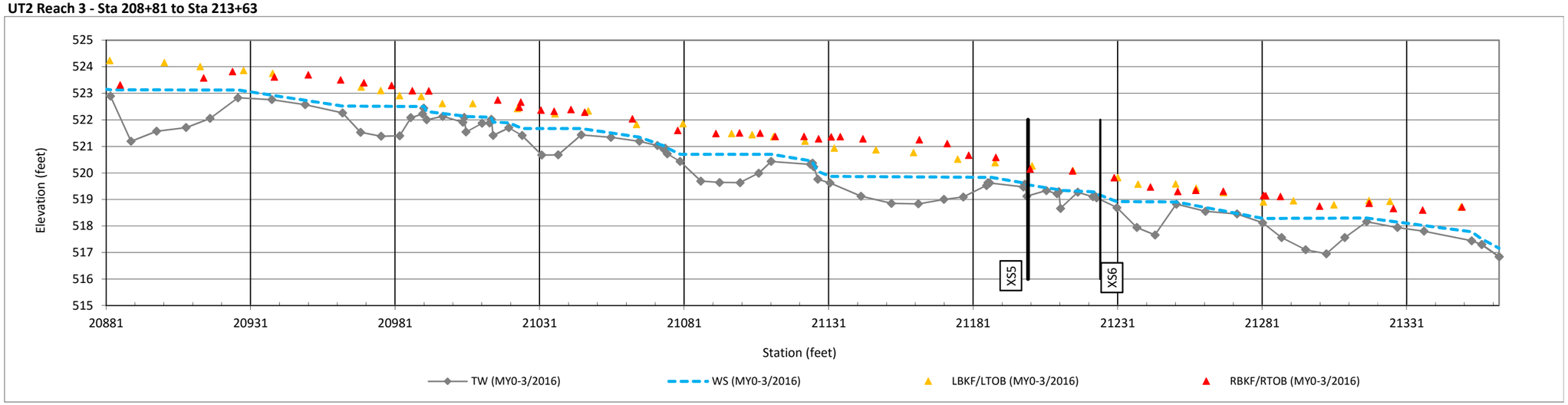
DMS Project No. 96316

Monitoring Year 0 - 2016

UT2 Reach 2 - Sta 205+88 to Sta 208+81



UT2 Reach 3 - Sta 208+81 to Sta 213+63



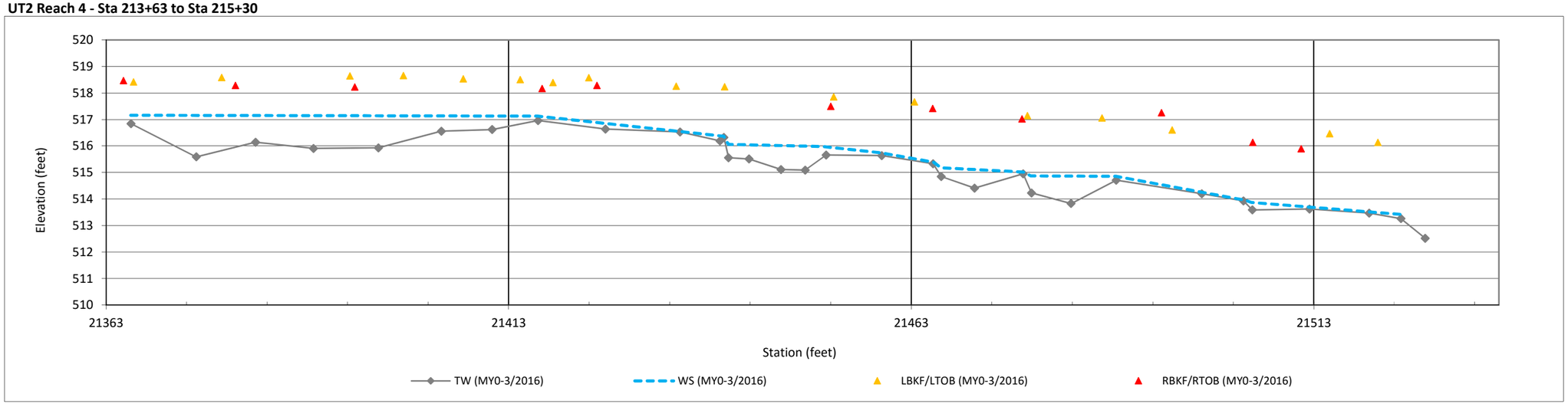
Longitudinal Profile Plots

Holman Mill Mitigation Site

DMS Project No. 96316

Monitoring Year 0 - 2016

UT2 Reach 4 - Sta 213+63 to Sta 215+30



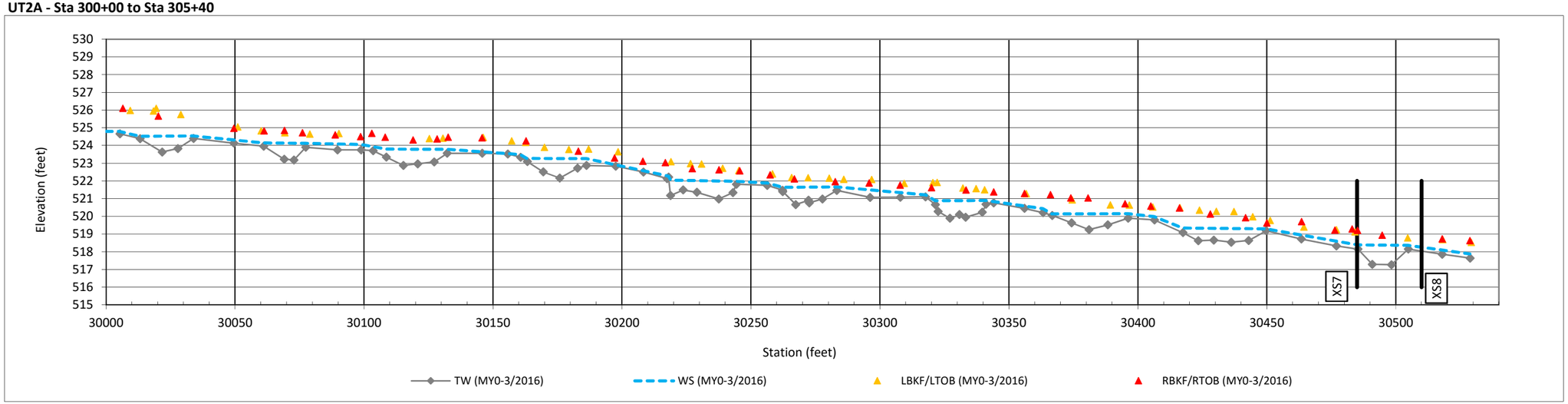
Longitudinal Profile Plots

Holman Mill Mitigation Site

DMS Project No. 96316

Monitoring Year 0 - 2016

UT2A - Sta 300+00 to Sta 305+40

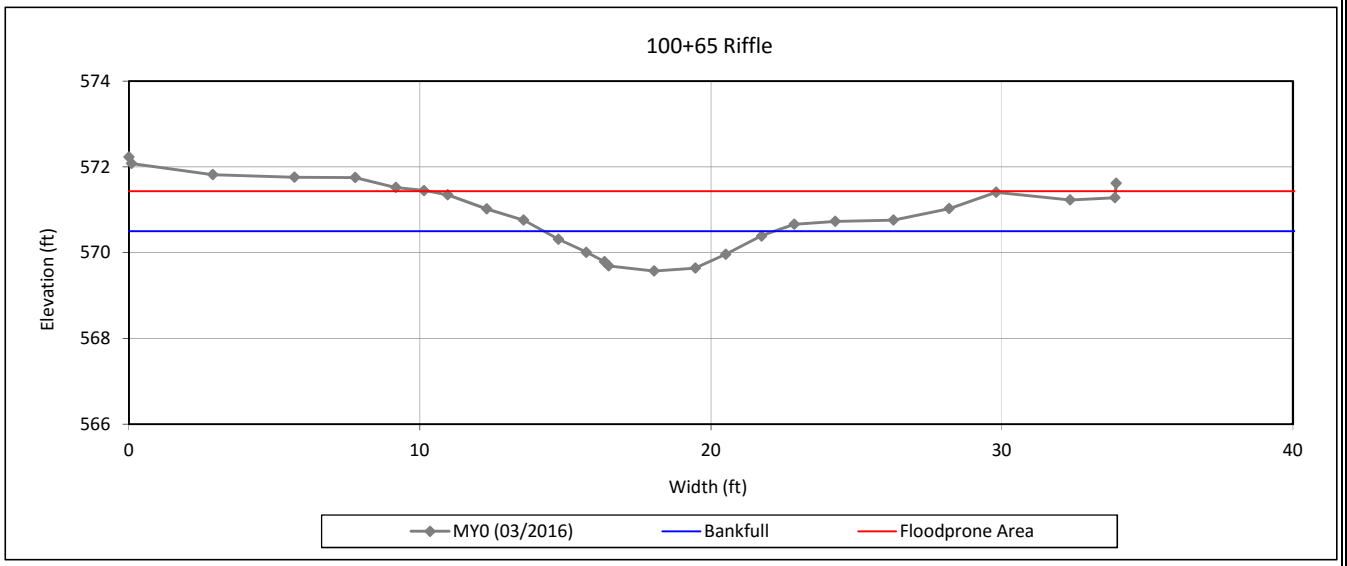


Cross Section Plots

Holman Mill Mitigation Site (NCDMS Project No. 93616)

Monitoring Year 0 - 2016

Cross Section 1- UT1



Bankfull Dimensions	
4.6	x-section area (ft.sq.)
7.9	width (ft)
0.6	mean depth (ft)
0.9	max depth (ft)
8.2	wetted parimeter (ft)
0.6	hyd radi (ft)
13.6	width-depth ratio
23.6	W flood prone area (ft)
3.0	entrenchment ratio
1.0	low bank height ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

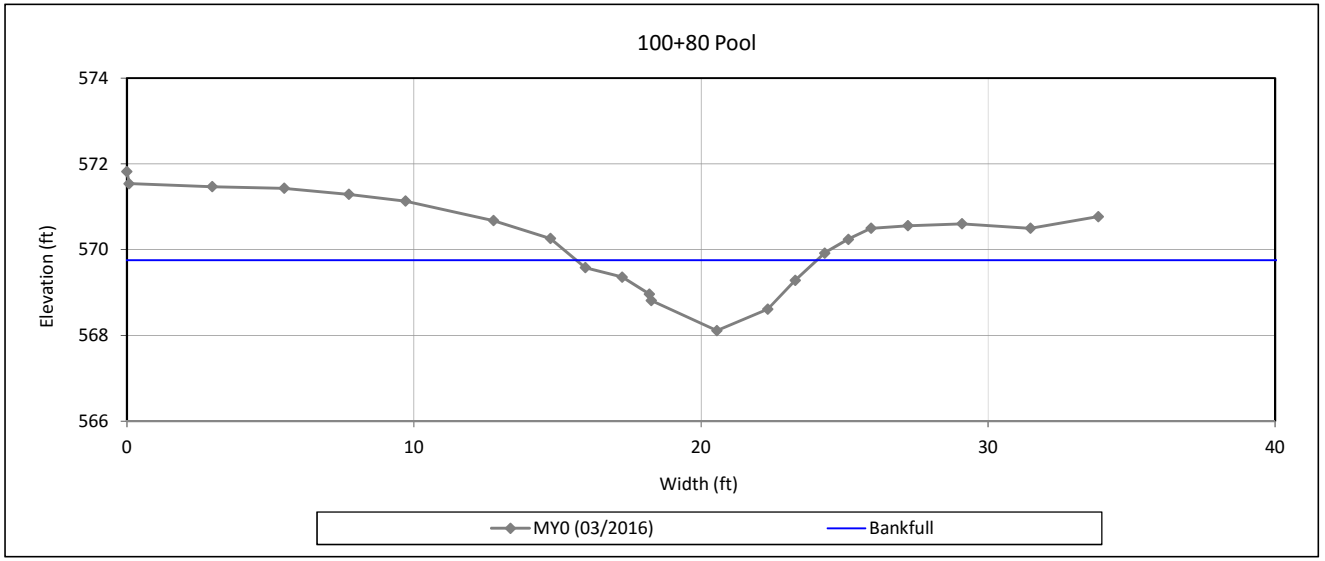
View Downstream

Cross Section Plots

Holman Mill Mitigation Site (NCDMS Project No. 93616)

Monitoring Year 0 - 2016

Cross Section 2- UT1



Bankfull Dimensions	
7.4	x-section area (ft.sq.)
8.4	width (ft)
0.9	mean depth (ft)
1.6	max depth (ft)
9.1	wetted parimeter (ft)
0.8	hyd radi (ft)
9.5	width-depth ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

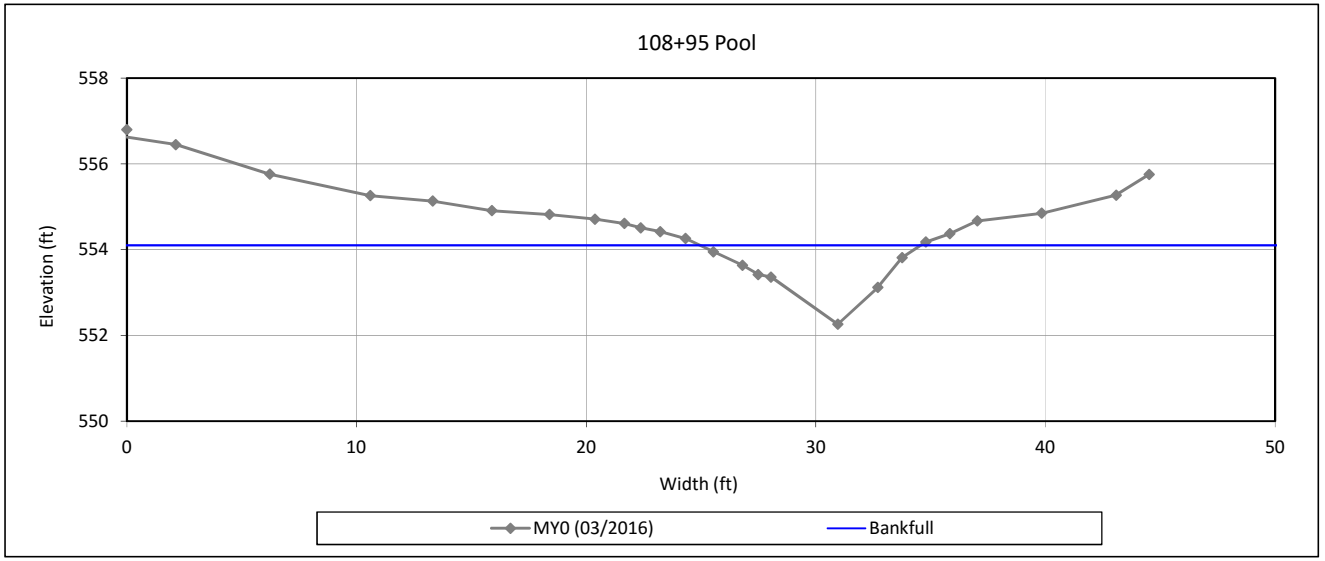
View Downstream

Cross Section Plots

Holman Mill Mitigation Site (NCDMS Project No. 93616)

Monitoring Year 0 - 2016

Cross Section 3- UT1



Bankfull Dimensions	
8.2	x-section area (ft.sq.)
9.6	width (ft)
0.9	mean depth (ft)
1.8	max depth (ft)
10.4	wetted parimeter (ft)
0.8	hyd radi (ft)
11.3	width-depth ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

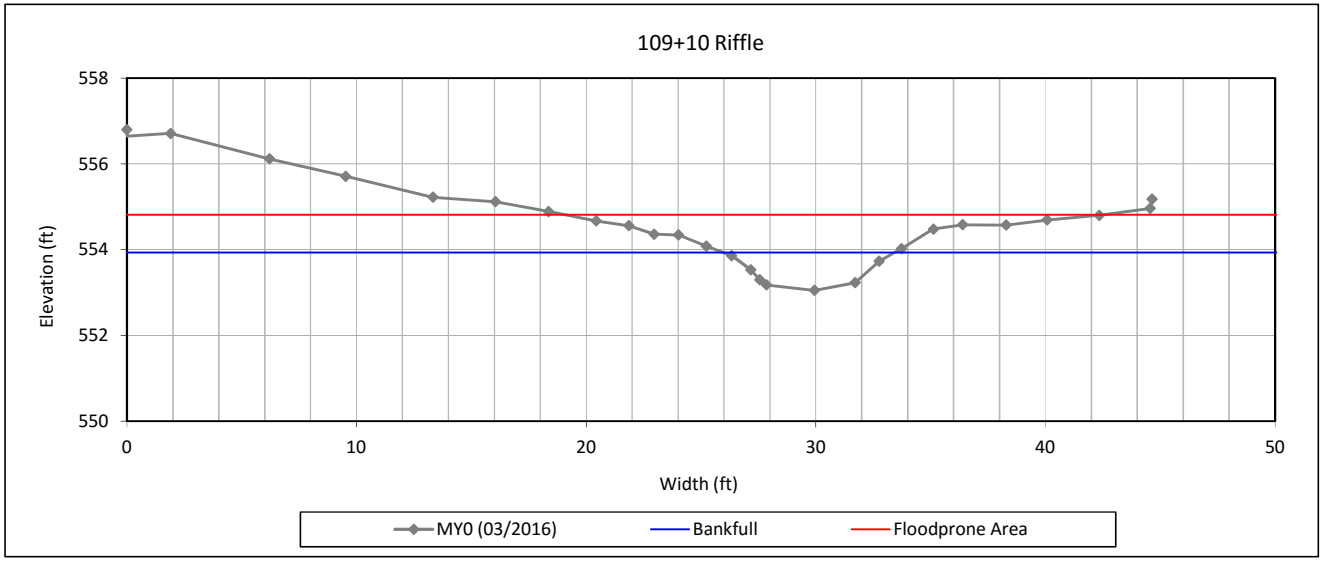
View Downstream

Cross Section Plots

Holman Mill Mitigation Site (NCDMS Project No. 93616)

Monitoring Year 0 - 2016

Cross Section 4- UT1



Bankfull Dimensions	
4.3	x-section area (ft.sq.)
7.5	width (ft)
0.6	mean depth (ft)
0.9	max depth (ft)
7.8	wetted parimeter (ft)
0.5	hyd radi (ft)
13.1	width-depth ratio
23.4	W flood prone area (ft)
3.1	entrenchment ratio
1.0	low bank height ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

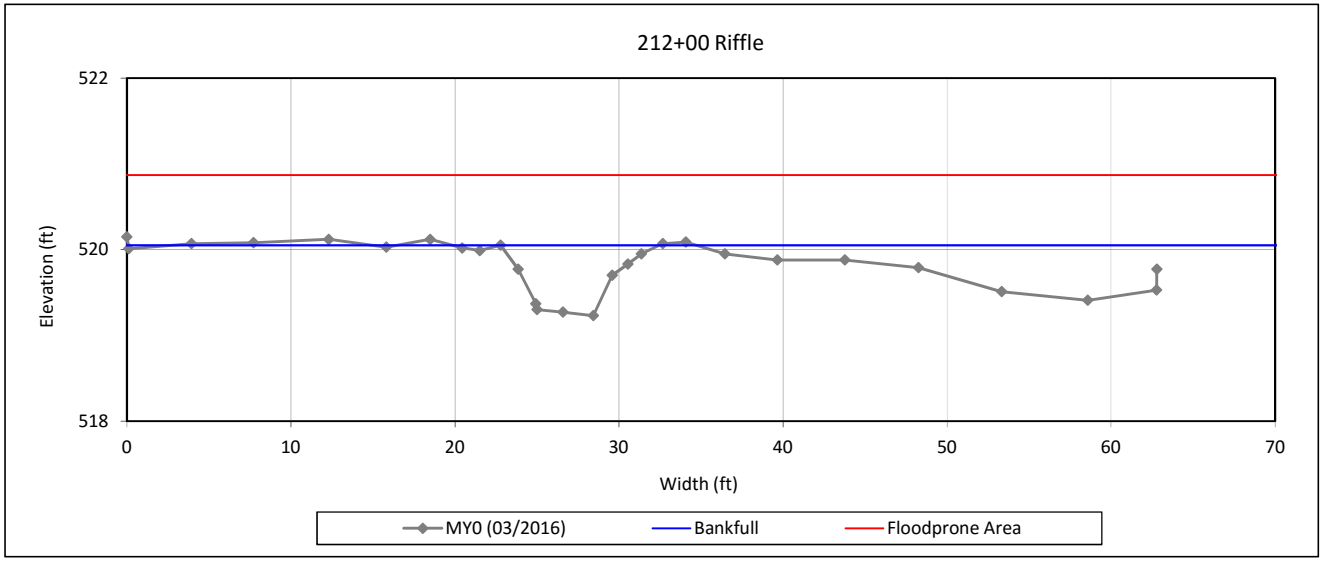
View Downstream

Cross Section Plots

Holman Mill Mitigation Site (NCDMS Project No. 93616)

Monitoring Year 0 - 2016

Cross Section 5- UT2



Bankfull Dimensions	
4.5	x-section area (ft.sq.)
9.7	width (ft)
0.5	mean depth (ft)
0.8	max depth (ft)
9.9	wetted parimeter (ft)
0.5	hyd radi (ft)
20.5	width-depth ratio
100.0	W flood prone area (ft)
10.4	entrenchment ratio
1.0	low bank height ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

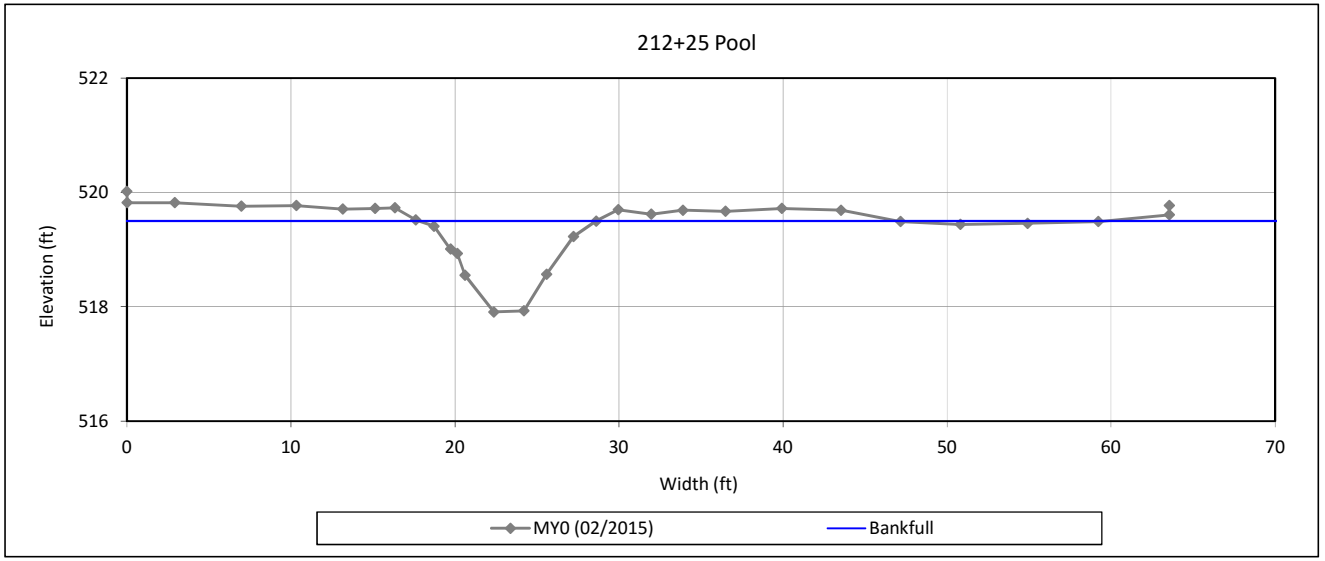
View Downstream

Cross Section Plots

Holman Mill Mitigation Site (NCDMS Project No. 93616)

Monitoring Year 0 - 2016

Cross Section 6- UT2



Bankfull Dimensions	
8.9	x-section area (ft.sq.)
9.9	width (ft)
0.9	mean depth (ft)
1.6	max depth (ft)
10.5	wetted parimeter (ft)
0.8	hyd radi (ft)
11.0	width-depth ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

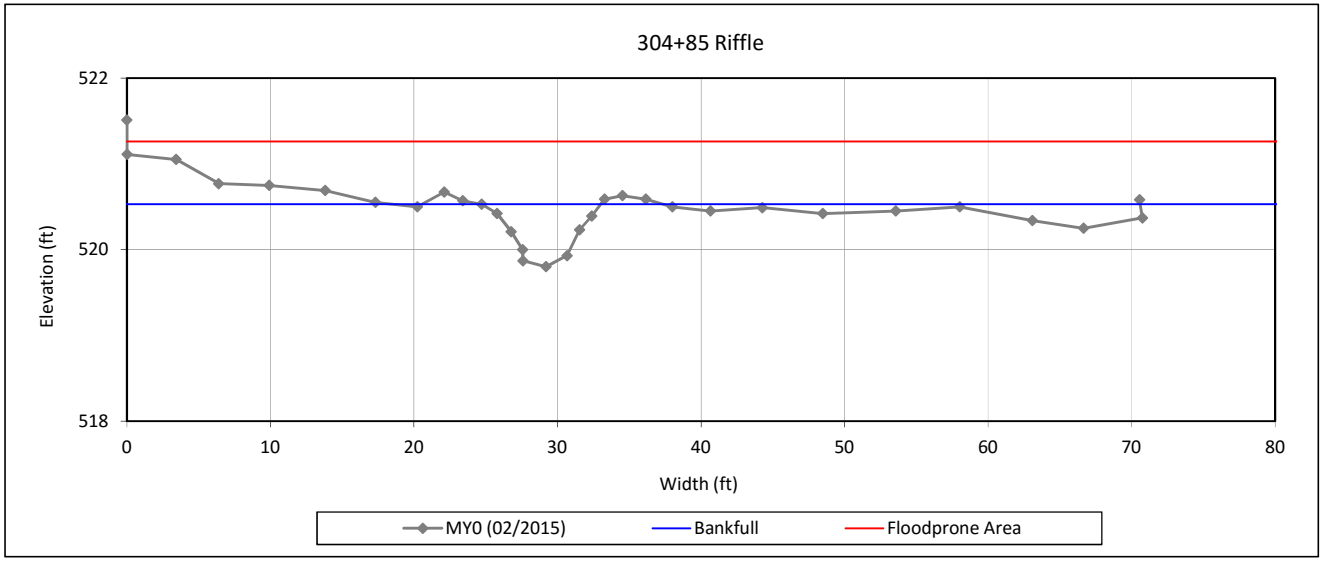
View Downstream

Cross Section Plots

Holman Mill Mitigation Site (NCDMS Project No. 93616)

Monitoring Year 0 - 2016

Cross Section 7- UT2A



Bankfull Dimensions	
3.2	x-section area (ft.sq.)
6.6	width (ft)
0.5	mean depth (ft)
0.7	max depth (ft)
6.8	wetted parimeter (ft)
0.5	hyd radi (ft)
13.5	width-depth ratio
100.0	W flood prone area (ft)
15.1	entrenchment ratio
1.0	low bank height ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

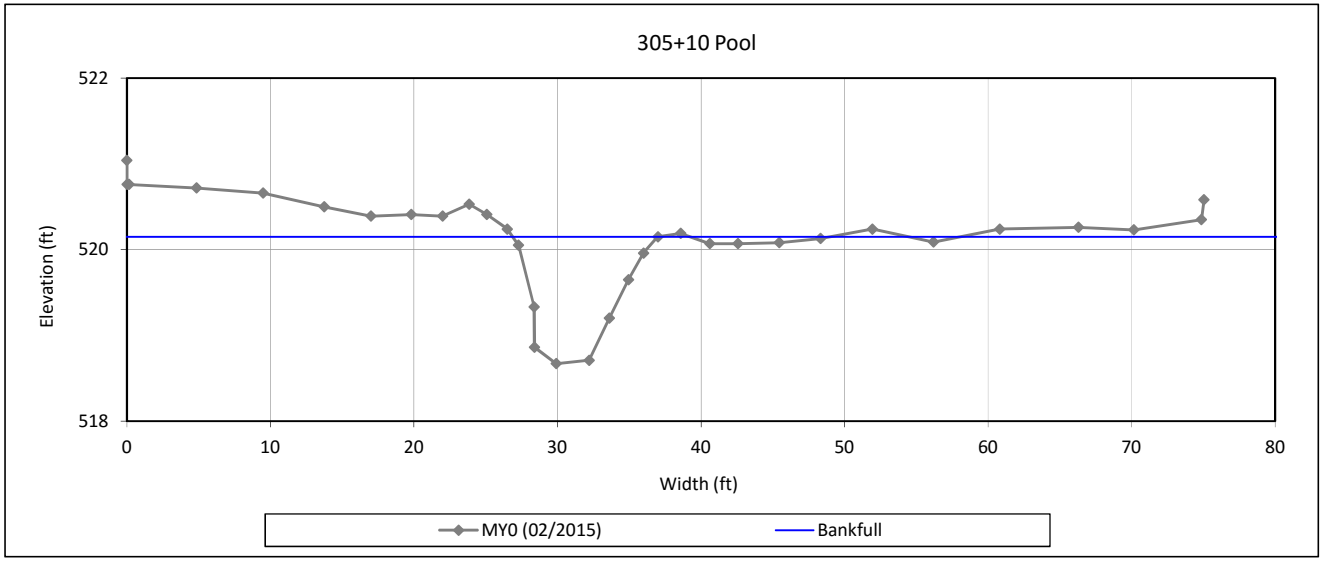
View Downstream

Cross Section Plots

Holman Mill Mitigation Site (NCDMS Project No. 93616)

Monitoring Year 0 - 2016

Cross Section 8- UT2A



Bankfull Dimensions	
9.1	x-section area (ft.sq.)
9.7	width (ft)
0.9	mean depth (ft)
1.5	max depth (ft)
10.6	wetted parimeter (ft)
0.9	hyd radi (ft)
10.4	width-depth ratio

Survey Date: 3/2016
Field Crew: Kee Surveying

View Downstream

Reachwide and Cross Section Pebble Count Plots

Holman Mill Mitigation Site

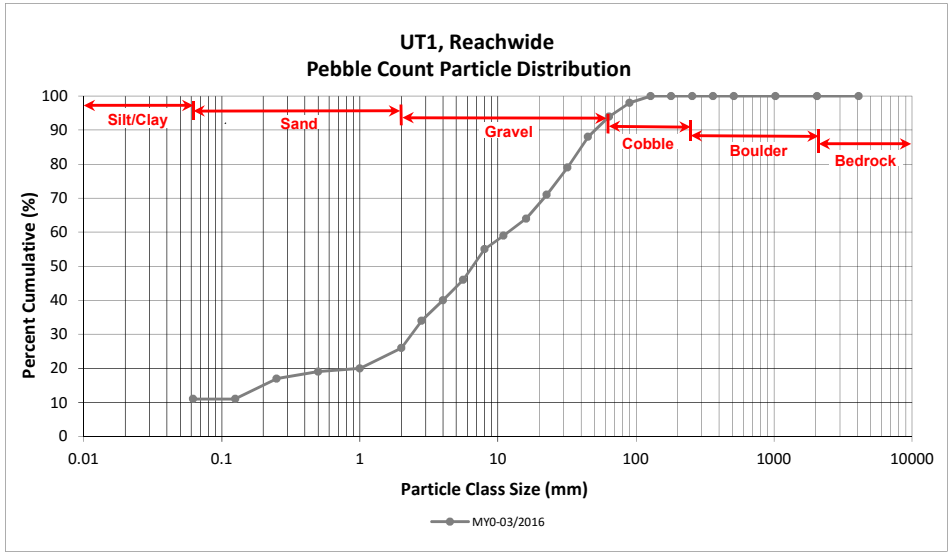
DMS Project No. 93616

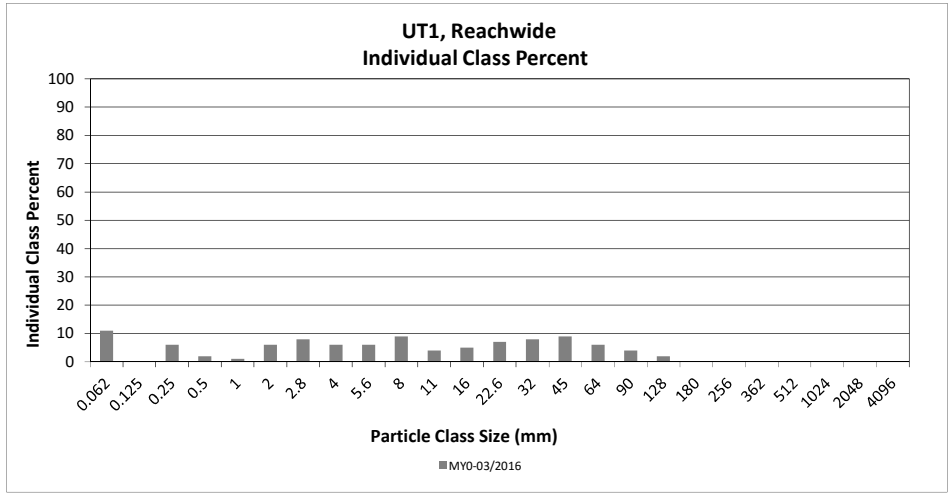
Monitoring Year 0 - 2016

UT1, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	9	11	11	11
SAND	Very fine	0.062	0.125					11
	Fine	0.125	0.250		6	6	6	17
	Medium	0.25	0.50		2	2	2	19
	Coarse	0.5	1.0		1	1	1	20
	Very Coarse	1.0	2.0	1	5	6	6	26
GRAVEL	Very Fine	2.0	2.8	2	6	8	8	34
	Very Fine	2.8	4.0	2	4	6	6	40
	Fine	4.0	5.6	2	4	6	6	46
	Fine	5.6	8.0	4	5	9	9	55
	Medium	8.0	11.0	3	1	4	4	59
	Medium	11.0	16.0	3	2	5	5	64
	Coarse	16.0	22.6	6	1	7	7	71
	Coarse	22.6	32	5	3	8	8	79
	Very Coarse	32	45	9		9	9	88
	Very Coarse	45	64	5	1	6	6	94
COBBLE	Small	64	90	4		4	4	98
	Small	90	128	2		2	2	100
	Large	128	180					100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.22
D_{35} =	2.97
D_{50} =	6.6
D_{84} =	38.7
D_{95} =	69.7
D_{100} =	128.0





Reachwide and Cross Section Pebble Count Plots

Holman Mill Mitigation Site

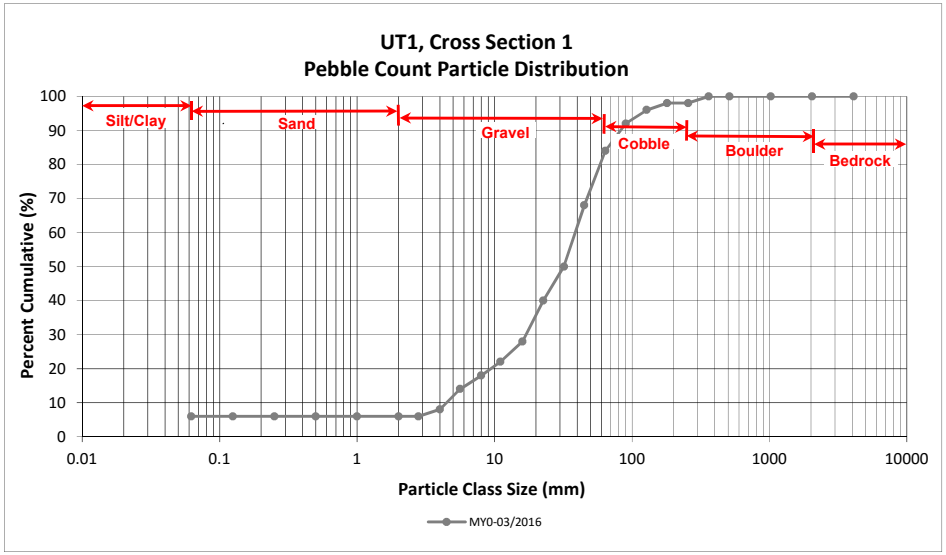
DMS Project No. 93616

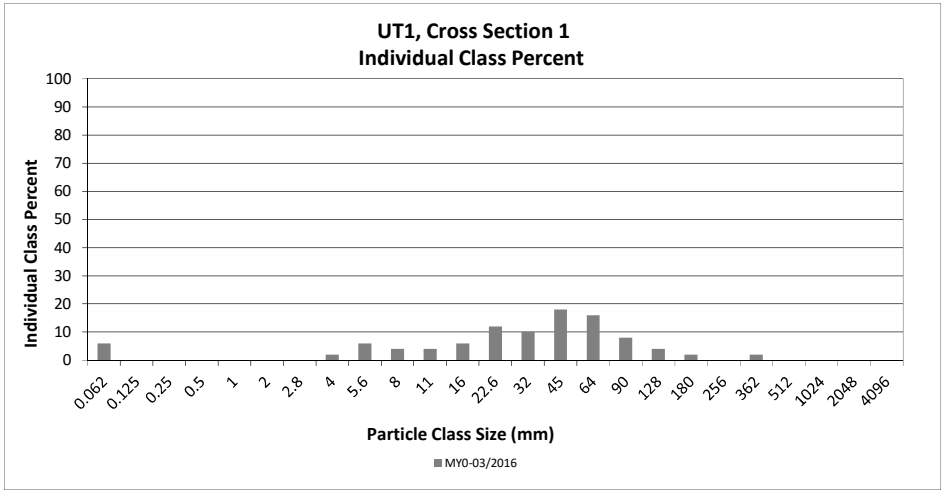
Monitoring Year 0 - 2016

UT1, Cross Section 1

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	6	6	6
SAND	Very fine	0.062	0.125			6
	Fine	0.125	0.250			6
	Medium	0.25	0.50			6
	Coarse	0.5	1.0			6
	Very Coarse	1.0	2.0			6
GRAVEL	Very Fine	2.0	2.8			6
	Very Fine	2.8	4.0	2	2	8
	Fine	4.0	5.6	6	6	14
	Fine	5.6	8.0	4	4	18
	Medium	8.0	11.0	4	4	22
	Medium	11.0	16.0	6	6	28
	Coarse	16.0	22.6	12	12	40
	Coarse	22.6	32	10	10	50
	Very Coarse	32	45	18	18	68
	Very Coarse	45	64	16	16	84
COBBLE	Small	64	90	8	8	92
	Small	90	128	4	4	96
	Large	128	180	2	2	98
	Large	180	256			98
BOULDER	Small	256	362	2	2	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 1	
Channel materials (mm)	
D_{16} =	6.69
D_{35} =	19.57
D_{50} =	32.0
D_{84} =	64.0
D_{95} =	117.2
D_{100} =	362.0





Reachwide and Cross Section Pebble Count Plots

Holman Mill Mitigation Site

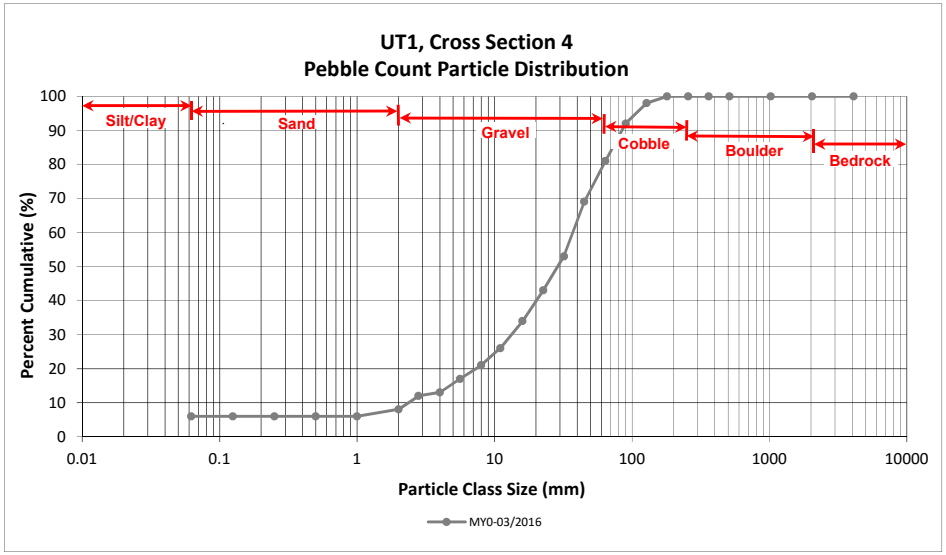
DMS Project No. 93616

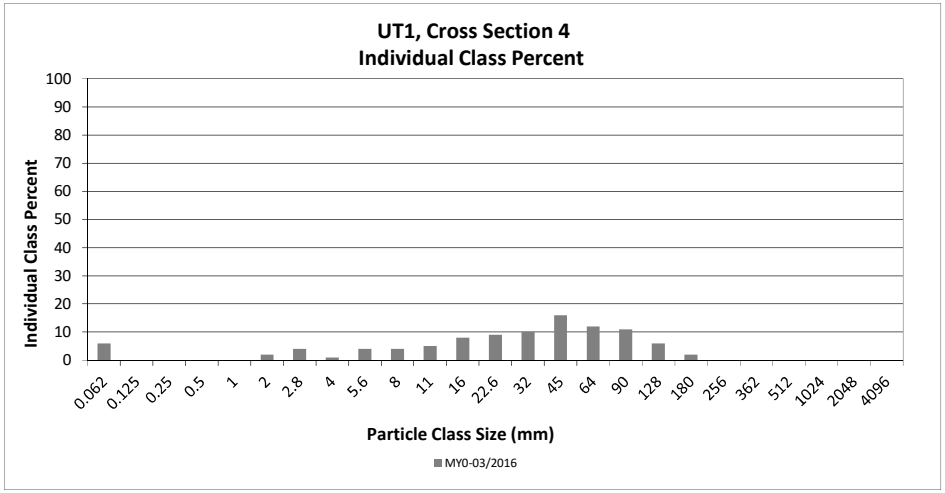
Monitoring Year 0 - 2016

UT1, Cross Section 4

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	6	6	6
SAND	Very fine	0.062	0.125			6
	Fine	0.125	0.250			6
	Medium	0.25	0.50			6
	Coarse	0.5	1.0			6
	Very Coarse	1.0	2.0	2	2	8
GRAVEL	Very Fine	2.0	2.8	4	4	12
	Very Fine	2.8	4.0	1	1	13
	Fine	4.0	5.6	4	4	17
	Fine	5.6	8.0	4	4	21
	Medium	8.0	11.0	5	5	26
	Medium	11.0	16.0	8	8	34
	Coarse	16.0	22.6	9	9	43
	Coarse	22.6	32	10	10	53
	Very Coarse	32	45	16	16	69
	Very Coarse	45	64	12	12	81
COBBLE	Small	64	90	11	11	92
	Small	90	128	6	6	98
	Large	128	180	2	2	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 4	
Channel materials (mm)	
D_{16} =	5.15
D_{35} =	16.63
D_{50} =	28.8
D_{84} =	70.2
D_{95} =	107.3
D_{100} =	180.0





Reachwide and Cross Section Pebble Count Plots

Holman Mill Mitigation Site

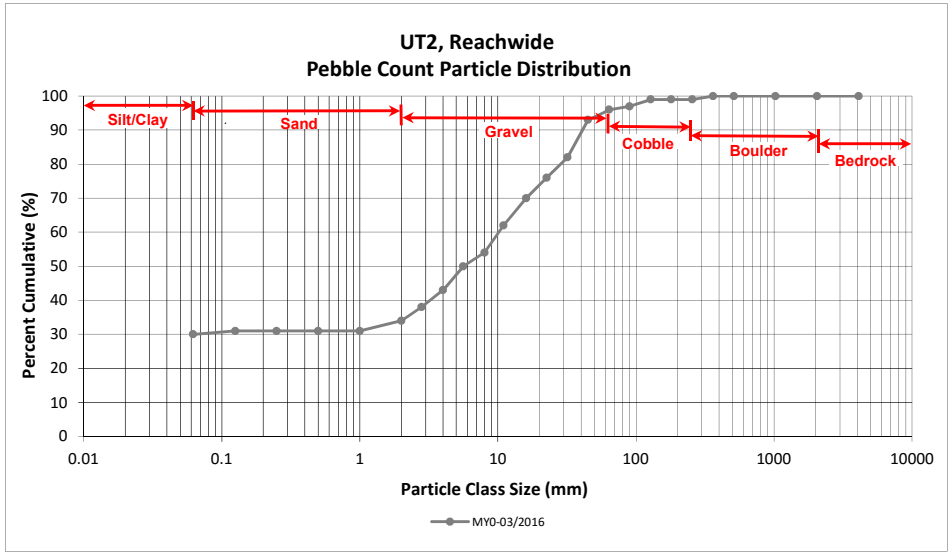
DMS Project No. 93616

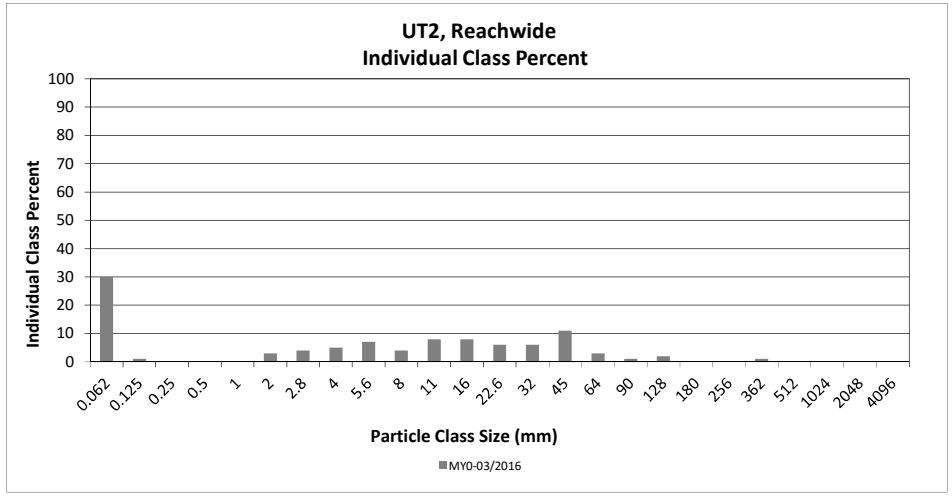
Monitoring Year 0 - 2016

UT2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	29	30	30	30
SAND	Very fine	0.062	0.125		1	1	1	31
	Fine	0.125	0.250					31
	Medium	0.25	0.50					31
	Coarse	0.5	1.0					31
	Very Coarse	1.0	2.0		3	3	3	34
GRAVEL	Very Fine	2.0	2.8	2	2	4	4	38
	Very Fine	2.8	4.0	4	1	5	5	43
	Fine	4.0	5.6	5	2	7	7	50
	Fine	5.6	8.0	2	2	4	4	54
	Medium	8.0	11.0	6	2	8	8	62
	Medium	11.0	16.0	6	2	8	8	70
	Coarse	16.0	22.6	5	1	6	6	76
	Coarse	22.6	32	4	2	6	6	82
	Very Coarse	32	45	9	2	11	11	93
	Very Coarse	45	64	3		3	3	96
COBBLE	Small	64	90	1		1	1	97
	Small	90	128	1	1	2	2	99
	Large	128	180					99
	Large	180	256					99
BOULDER	Small	256	362	1		1	1	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	2.18
D_{50} =	5.6
D_{84} =	34.0
D_{95} =	56.9
D_{100} =	362.0





Reachwide and Cross Section Pebble Count Plots

Holman Mill Mitigation Site

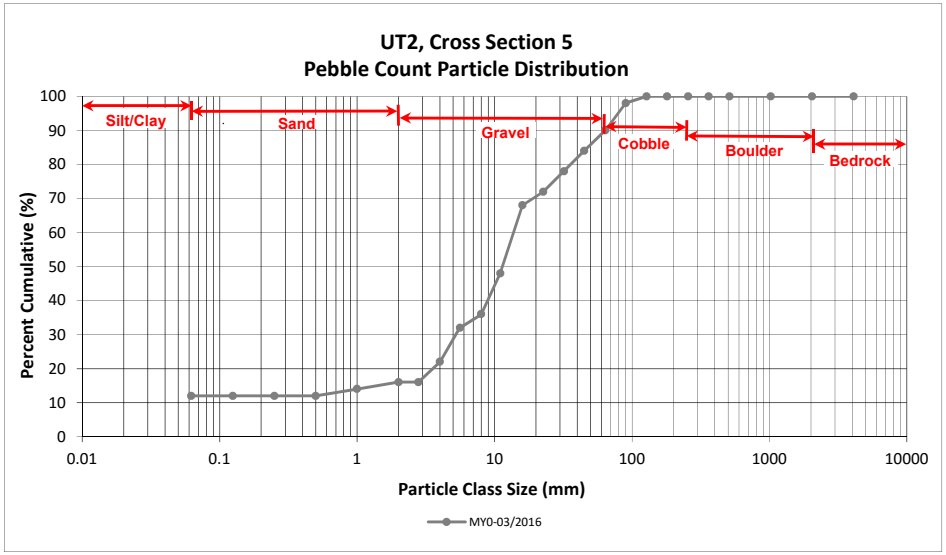
DMS Project No. 93616

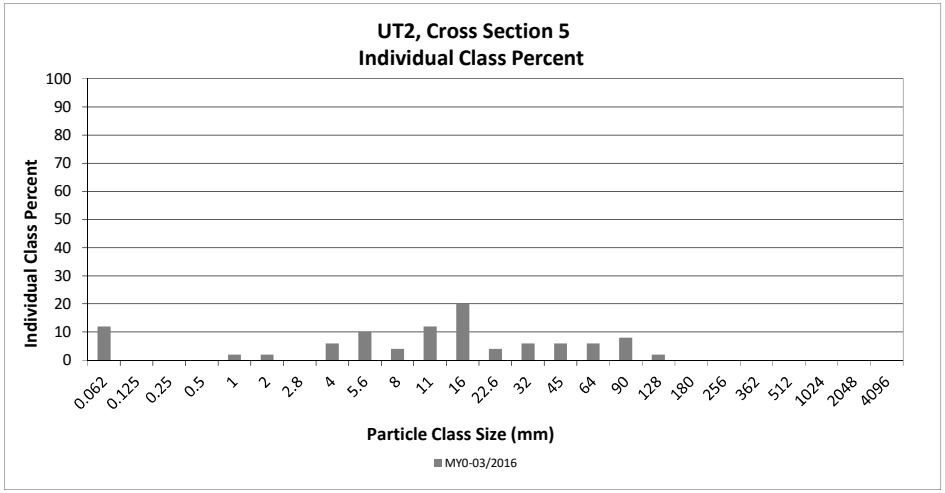
Monitoring Year 0 - 2016

UT2, Cross Section 5

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	12	12	12
SAND	Very fine	0.062	0.125			12
	Fine	0.125	0.250			12
	Medium	0.25	0.50			12
	Coarse	0.5	1.0	2	2	14
	Very Coarse	1.0	2.0	2	2	16
GRAVEL	Very Fine	2.0	2.8			16
	Very Fine	2.8	4.0	6	6	22
	Fine	4.0	5.6	10	10	32
	Fine	5.6	8.0	4	4	36
	Medium	8.0	11.0	12	12	48
	Medium	11.0	16.0	20	20	68
	Coarse	16.0	22.6	4	4	72
	Coarse	22.6	32	6	6	78
	Very Coarse	32	45	6	6	84
	Very Coarse	45	64	6	6	90
COBBLE	Small	64	90	8	8	98
	Small	90	128	2	2	100
	Large	128	180			100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 5	
Channel materials (mm)	
D_{16} =	2.00
D_{35} =	7.32
D_{50} =	11.4
D_{84} =	45.0
D_{95} =	79.2
D_{100} =	128.0





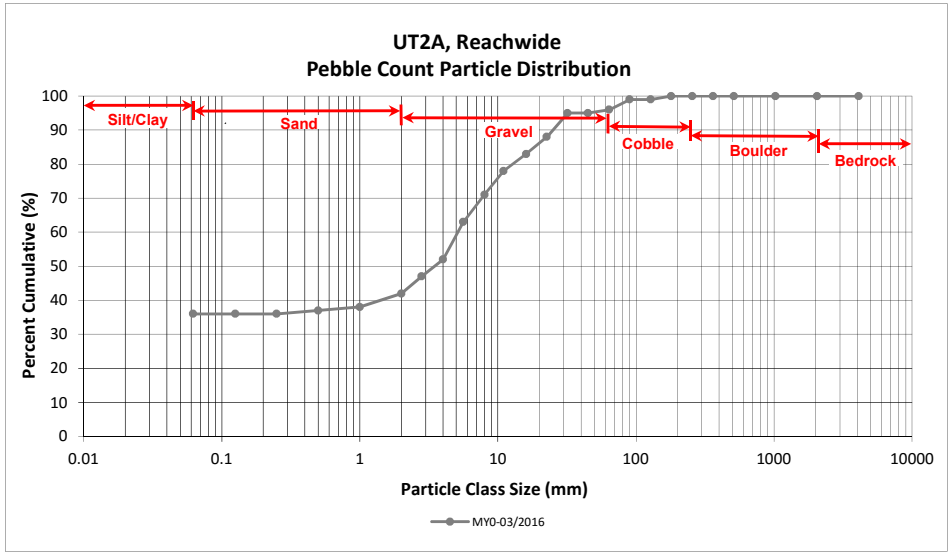
Reachwide and Cross Section Pebble Count Plots

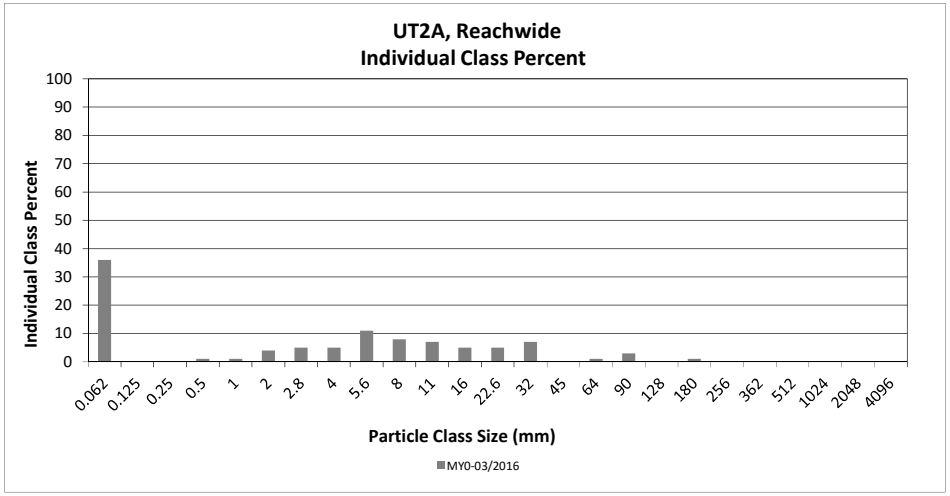
Holman Mill Mitigation Site
DMS Project No. 93616
Monitoring Year 0 - 2016

UT2A, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		36	36	36	36
SAND	Very fine	0.062	0.125					36
	Fine	0.125	0.250					36
	Medium	0.25	0.50		1	1	1	37
	Coarse	0.5	1.0		1	1	1	38
	Very Coarse	1.0	2.0	1	3	4	4	42
GRAVEL	Very Fine	2.0	2.8	2	3	5	5	47
	Very Fine	2.8	4.0	2	3	5	5	52
	Fine	4.0	5.6	8	3	11	11	63
	Fine	5.6	8.0	8		8	8	71
	Medium	8.0	11.0	7		7	7	78
	Medium	11.0	16.0	5		5	5	83
	Coarse	16.0	22.6	5		5	5	88
	Coarse	22.6	32	7		7	7	95
	Very Coarse	32	45					95
	Very Coarse	45	64	1		1	1	96
COBBLE	Small	64	90	3		3	3	99
	Small	90	128					99
	Large	128	180	1		1	1	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	3.5
D_{84} =	17.1
D_{95} =	32.0
D_{100} =	180.0





Reachwide and Cross Section Pebble Count Plots

Holman Mill Mitigation Site

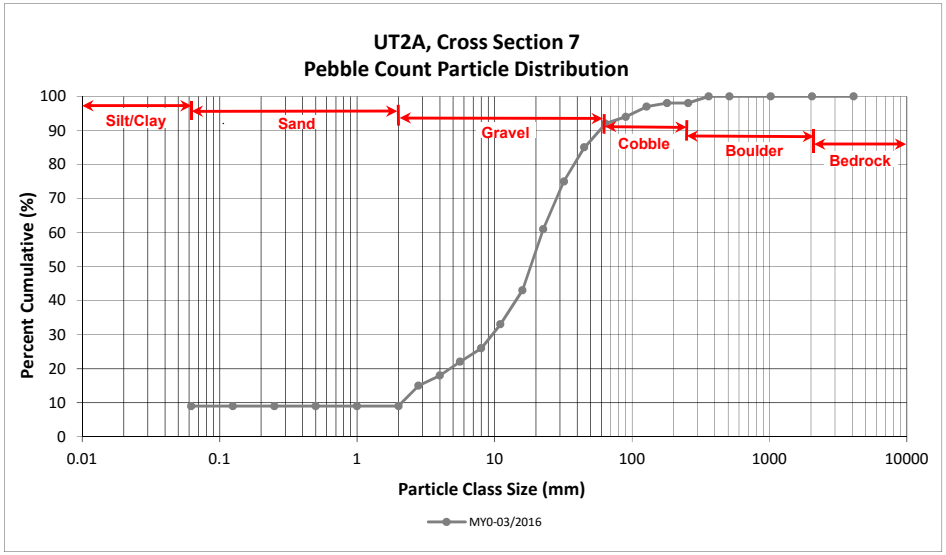
DMS Project No. 93616

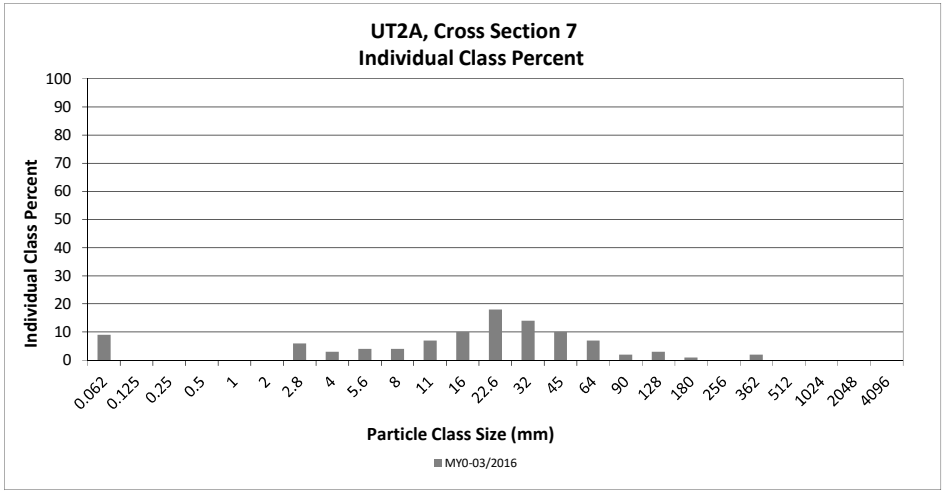
Monitoring Year 0 - 2016

UT2A, Cross Section 7

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	9	9	9
SAND	Very fine	0.062	0.125			9
	Fine	0.125	0.250			9
	Medium	0.25	0.50			9
	Coarse	0.5	1.0			9
	Very Coarse	1.0	2.0			9
GRAVEL	Very Fine	2.0	2.8	6	6	15
	Very Fine	2.8	4.0	3	3	18
	Fine	4.0	5.6	4	4	22
	Fine	5.6	8.0	4	4	26
	Medium	8.0	11.0	7	7	33
	Medium	11.0	16.0	10	10	43
	Coarse	16.0	22.6	18	18	61
	Coarse	22.6	32	14	14	75
	Very Coarse	32	45	10	10	85
	Very Coarse	45	64	7	7	92
COBBLE	Small	64	90	2	2	94
	Small	90	128	3	3	97
	Large	128	180	1	1	98
	Large	180	256			98
BOULDER	Small	256	362	2	2	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 7	
Channel materials (mm)	
D_{16} =	3.15
D_{35} =	11.86
D_{50} =	18.3
D_{84} =	43.5
D_{95} =	101.2
D_{100} =	362.0





STREAM PHOTOGRAPHS
Holman Mill

	
PHOTO POINT 1 – looking upstream *(03/09/2016)*	**PHOTO POINT 1** – looking downstream *(03/09/2016)*
	
PHOTO POINT 2 – looking upstream *(03/09/2016)*	**PHOTO POINT 2** – looking downstream *(03/09/2016)*
	
PHOTO POINT 3 – looking upstream *(03/09/2016)*	**PHOTO POINT 3** – looking downstream *(03/09/2016)*

	
PHOTO POINT 4 – looking upstream *(03/09/2016)*	**PHOTO POINT 4** – looking downstream *(03/09/2016)*
	
PHOTO POINT 5 – looking upstream *(03/09/2016)*	**PHOTO POINT 5** – looking downstream *(03/09/2016)*
	
PHOTO POINT 6 – looking upstream *(03/09/2016)*	**PHOTO POINT 6** – looking downstream *(03/09/2016)*

PHOTO POINT 7 – looking upstream *(03/09/2016)*

PHOTO POINT 7 – looking downstream *(03/09/2016)*

PHOTO POINT 8 – looking upstream *(03/09/2016)*

PHOTO POINT 8 – looking downstream *(03/09/2016)*

PHOTO POINT 9 – looking upstream *(03/09/2016)*

PHOTO POINT 9 – looking downstream (*03/09/2016)*

PHOTO POINT 10 – looking upstream *(03/09/2016)*

PHOTO POINT 10 – looking downstream *(03/09/2016)*

PHOTO POINT 11 – looking upstream *(03/09/2016)*

PHOTO POINT 11 – looking downstream *(03/09/2016)*

PHOTO POINT 12 – looking upstream (*03/09/2016)*

PHOTO POINT 12 – looking downstream *(03/09/2016)*

PHOTO POINT 13 – looking upstream *(03/09/2016)*

PHOTO POINT 13 – looking downstream *(03/09/2016)*

PHOTO POINT 14 – looking upstream *(03/09/2016)*

PHOTO POINT 14 – looking downstream *(03/09/2016)*

PHOTO POINT 15 – looking upstream *(03/09/2016)*

PHOTO POINT 15 – looking downstream *(03/09/2016)*

	
PHOTO POINT 16 – looking upstream *(03/09/2016)*	**PHOTO POINT 16** – looking downstream *(03/09/2016)*
	
PHOTO POINT 17 – looking upstream *(03/24/2016)*	**PHOTO POINT 17** – looking downstream *(03/24/2016)*
	
PHOTO POINT 18 – looking upstream *(03/24/2016)*	**PHOTO POINT 18** – looking downstream *(03/24/2016)*

	
PHOTO POINT 19 – looking upstream *(03/24/2016)*	**PHOTO POINT 19** – looking downstream *(03/24/2016)*
	
PHOTO POINT 20 – looking upstream *(03/24/2016)*	**PHOTO POINT 20** – looking downstream *(03/24/2016)*
	
PHOTO POINT 21 – looking upstream *(03/24/2016)*	**PHOTO POINT 21** – looking downstream *(03/24/2016)*

	
PHOTO POINT 22 – looking upstream *(03/24/2016)*	**PHOTO POINT 22** – looking downstream *(03/24/2016)*
	
PHOTO POINT 23 – looking upstream *(03/24/2016)*	**PHOTO POINT 23** – looking downstream *(03/24/2016)*
	
PHOTO POINT 24 – looking upstream *(03/24/2016)*	**PHOTO POINT 24** – looking downstream *(03/24/2016)*

	
PHOTO POINT 25 – looking upstream *(03/24/2016)*	**PHOTO POINT 25** – looking downstream *(03/24/2016)*
	
PHOTO POINT 26 – looking upstream (*03/24/2016)*	**PHOTO POINT 26** – looking downstream *(03/24/2016)*
	
PHOTO POINT 27 – looking upstream *(03/24/2016)*	**PHOTO POINT 27** – looking downstream *(03/24/2016)*

	
PHOTO POINT 28 – looking upstream *(03/24/2016)*	**PHOTO POINT 28** – looking downstream *(03/24/2016)*
	
PHOTO POINT 29 – looking upstream *(03/24/2016)*	**PHOTO POINT 29** – looking downstream *(03/24/2016)*
	
PHOTO POINT 30 – looking upstream *(03/09/2016)*	**PHOTO POINT 30** – looking downstream *(03/09/2016)*

PHOTO POINT 31 – looking upstream *(03/09/2016)*

PHOTO POINT 31 – looking downstream *(03/09/2016)*

PHOTO POINT 32 – looking upstream *(03/09/2016)*

PHOTO POINT 32 – looking downstream *(03/09/2016)*

PHOTO POINT 33 – looking upstream *(03/09/2016)*

PHOTO POINT 33 – looking downstream *(03/09/2016)*

PHOTO POINT 34 – looking upstream *(03/09/2016)*

PHOTO POINT 34 – looking downstream *(03/09/2016)*

PHOTO POINT 35 – looking upstream *(03/09/2016)*

PHOTO POINT 35 – looking downstream *(03/09/2016)*

PHOTO POINT 36 – looking upstream *(03/09/2016)*

PHOTO POINT 36 – looking downstream *(03/09/2016)*

	
PHOTO POINT 37 – looking upstream *(03/09/2016)*	**PHOTO POINT 37** – looking downstream *(03/09/2016)*
	
PHOTO POINT 38 – looking upstream *(03/09/2016)*	**PHOTO POINT 38** – looking downstream *(03/09/2016)*
	
PHOTO POINT 39 – looking upstream *(03/09/2016)*	**PHOTO POINT 39** – looking downstream *(03/09/2016)*

PHOTO POINT 40 – looking upstream *(03/09/2016)*

PHOTO POINT 40 – looking downstream *(03/09/2016)*

PHOTO POINT 41 – looking upstream *(03/09/2016)*

PHOTO POINT 41 – looking downstream *(03/09/2016)*

PHOTO POINT 42 – looking upstream *(03/09/2016)*

PHOTO POINT 42 – looking downstream *(03/09/2016)*

PHOTO POINT 43 – looking upstream *(03/09/2016)*

PHOTO POINT 43 – looking downstream *(03/09/2016)*

PHOTO POINT 44 – looking upstream *(03/09/2016)*

PHOTO POINT 44 – looking downstream *(03/09/2016)*

PHOTO POINT 45 – looking upstream *(03/09/2016)*

PHOTO POINT 45 – looking downstream *(03/09/2016)*

APPENDIX 3. Vegetation Plot Data

Table 8. Planted and Total Stems

Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

			Current Plot Data (MY0 2016)														
			96316-WEI-0001			96316-WEI-0002			96316-WEI-0003			96316-WEI-0004			96316-WEI-0005		
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**
Betula nigra	River Birch, Red Birch	Tree	6	6	6	6	6	6	3	3	3				3	3	3
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	6	6	6	4	4	4	4	4	4	6	6	6	4	4	4
Liriodendron tulipifera	Tulip Poplar	Tree	3	3	3	3	3	3	5	5	5	5	5	5	4	4	4
Platanus occidentalis	Sycamore, Plane-tree	Tree										3	3	3	3	3	3
Quercus palustris	Pin Oak	Tree				2	2	2	2	2	2	2	2	2	2	2	2
Quercus phellos	Willow Oak	Tree	1	1	1	1	1	1	1	1	1						
		Stem count	16	16	16	16	16	16	15	15	15	16	16	16	16	16	16
		size (ares)	1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02		
		Species count	4	4	4	5	5	5	5	5	5	4	4	4	5	5	5
		Stems per ACRE	647.5	647.5	647.5	647.5	647.5	647.5	607	607	607	647.5	647.5	647.5	647.5	647.5	647.5

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%

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 8. Planted and Total Stems

Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

			Current Plot Data (MY0 2016)														
			96316-WEI-0006			96316-WEI-0007			96316-WEI-0008			96316-WEI-0009			96316-WEI-0010		
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**
Betula nigra	River Birch, Red Birch	Tree	2	2	2							1	1	1	5	5	5
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	7	7	7	3	3	3	5	5	5						
Liriodendron tulipifera	Tulip Poplar	Tree	2	2	2	1	1	1				1	1	1	3	3	3
Platanus occidentalis	Sycamore, Plane-tree	Tree				5	5	5	6	6	6	11	11	11	5	5	5
Quercus palustris	Pin Oak	Tree	3	3	3	2	2	2	1	1	1	1	1	1	1	1	1
Quercus phellos	Willow Oak	Tree				5	5	5	4	4	4	2	2	2	2	2	2
		Stem count	14	14	14	16	16	16	16	16	16	16	16	16	16	16	16
		size (ares)	1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02		
		Species count	4	4	4	5	5	5	4	4	4	5	5	5	5	5	5
		Stems per ACRE	566.6	566.6	566.6	647.5	647.5	647.5	647.5	647.5	647.5	647.5	647.5	647.5	647.5	647.5	647.5

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%

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 8. Planted and Total Stems

Holman Mill Mitigation Site
DMS Project No. 96316
Monitoring Year 0 - 2016

			Current Plot Data (MY0 2016)						Annual Means		
			96316-WEI-0011			96316-WEI-0012			MY0 (2016)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	River Birch, Red Birch	Tree	4	4	4	1	1	1	31	31	31
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree							39	39	39
Liriodendron tulipifera	Tulip Poplar	Tree	3	3	3	5	5	5	35	35	35
Platanus occidentalis	Sycamore, Plane-tree	Tree	5	5	5	7	7	7	45	45	45
Quercus palustris	Pin Oak	Tree	1	1	1	1	1	1	18	18	18
Quercus phellos	Willow Oak	Tree	3	3	3	1	1	1	20	20	20
		Stem count	16	16	16	15	15	15	188	188	188
		size (ares)	1			1			12		
		size (ACRES)	0.02			0.02			0.30		
		Species count	5	5	5	5	5	5	6	6	6
		Stems per ACRE	647.5	647.5	647.5	607	607	607	634	634	634

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%

PnoLS: Number of Planted stems excluding live stakes
P-all: Number of planted stems including live stakes,
T: Total Stems

VEGETATION PHOTOGRAPHS
Holman Mill

VEG PLOT 1 *(03/24/2016)*

VEG PLOT 2 *(03/24/2016)*

VEG PLOT 3 *(03/24/2016)*

VEG PLOT 4 *(03/24/2016)*

VEG PLOT 5 *(03/24/2016)*

VEG PLOT 6 *(03/24/2016)*

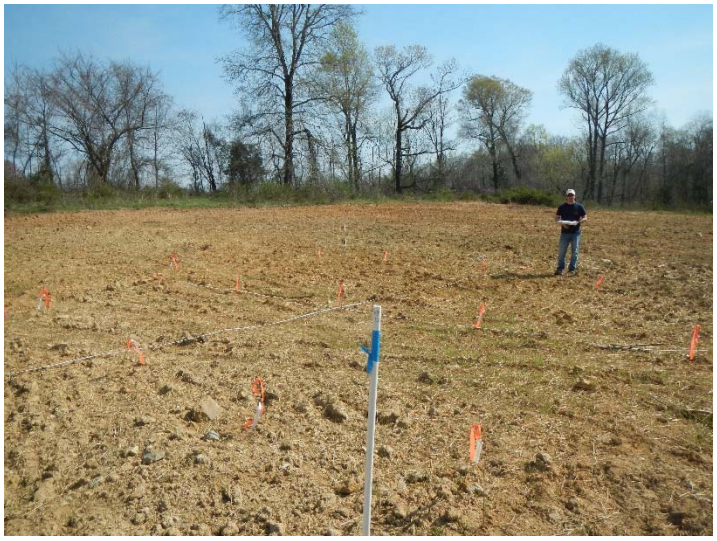
VEG PLOT 7 *(03/24/2016)*

VEG PLOT 8 *(03/24/2016)*

VEG PLOT 9 *(03/24/2016)*

VEG PLOT 10 *(03/24/2016)*

VEG PLOT 11 *(03/24/2016)*



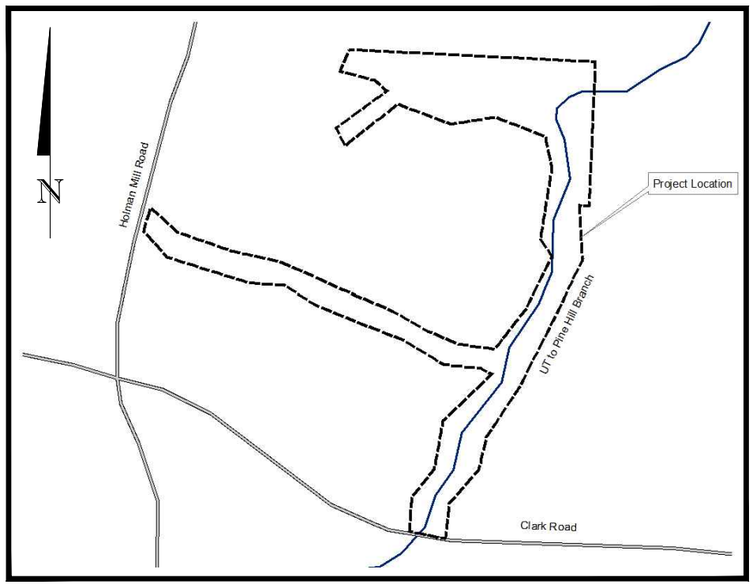
VEG PLOT 12 *(03/24/2016)*

APPENDIX 4. As-Built Plan Sheets

October 31, 2016

Holman Mill Mitigation Project

Cape Fear River Basin 03030002
Alamance County, North Carolina
for
NCDEQ Division of Mitigation Services



Vicinity Map
Not to Scale

CERTIFICATE OF SURVEY AND ACCURACY

I, NOLAN R. CARMACK, CERTIFY THAT THE GROUND TOPOGRAPHIC SURVEY PORTION OF THIS PROJECT WAS COMPLETED UNDER MY DIRECT SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION AND THAT THE ORIGINAL DIGITAL FILES WERE PROVIDED BY KEE MAPPING AND SURVEYING, PA AS SHOWN ON AN AS-BUILT SURVEY FOR "THE STATE OF NC, DIVISION OF MITIGATION SERVICES", JOB #1510161-AB, DATED OCTOBER 25TH, 2016 AND WERE INCORPORATED HEREIN BY WILDLANDS ENGINEERING, INC TO PRODUCE THE RECORD DRAWINGS; THAT THIS SURVEY WAS PERFORMED AT THE 95% CONFIDENCE LEVEL TO MEET THE FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS; THAT THIS SURVEY WAS PERFORMED TO MEET THE REQUIREMENTS FOR A TOPOGRAPHIC SURVEY TO THE ACCURACY OF CLASS A HORIZONTAL AND CLASS C VERTICAL; THAT THE ORIGINAL DATA WAS OBTAINED BETWEEN THE DATES OF 3/2/16-10/24/16 ; THAT THE CONTOURS SHOWN AS BROKEN LINES MAY NOT MEET THE STATED STANDARD AND ALL COORDINATES ARE BASED ON NAD 83 (NSRS 2011) AND ALL ELEVATIONS ARE BASED ON NAVD 88; THAT THIS MAP MEETS THE SPECIFICATIONS FOR TOPOGRAPHIC SURVEYS AS STATED IN TITLE 21, CHAPTER 56, SECTION .1606; WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS THE 31ST DAY OF OCTOBER, 2016.

OFFICIAL SEAL

NORTH CAROLINA PROFESSIONAL SEAL L-5076 LAND SURVEYOR NOLAN R. CARMACK

NOLAN R. CARMACK, PLS L-5076

FINAL RECORD DRAWINGS
Issued October 2016

Stream Origins

Stream	Latitude	Longitude
UT1	N 35° 51' 09.14"	W 79° 23' 29.27"
UT2	N 35° 51' 18.47"	W 79° 23' 15.11"
UT2A	N 35° 51' 19.28"	W 79° 23' 06.82"

Sheet Index

Project Directory

Surveying:
Kee Mapping & Surveying, PA
88 Central Avenue
Asheville, NC 28801
Brad Kee, PLS
828-575-9021

Engineering:
Wildlands Engineering, Inc
License No. F-0831
312 West Millbrook Road, Suite 225
Raleigh, NC 27609
Angela N. Allen, PE
919-851-9986

Owner:
NCDEQ Division of
Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652
Kristie Corson
919-707-8935

DEQ Contract No. 005795

DMS ID No. 96316

WILDLANDS ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANGELA N ALLEN

Holman Mill Mitigation Project
Alamance County, North Carolina

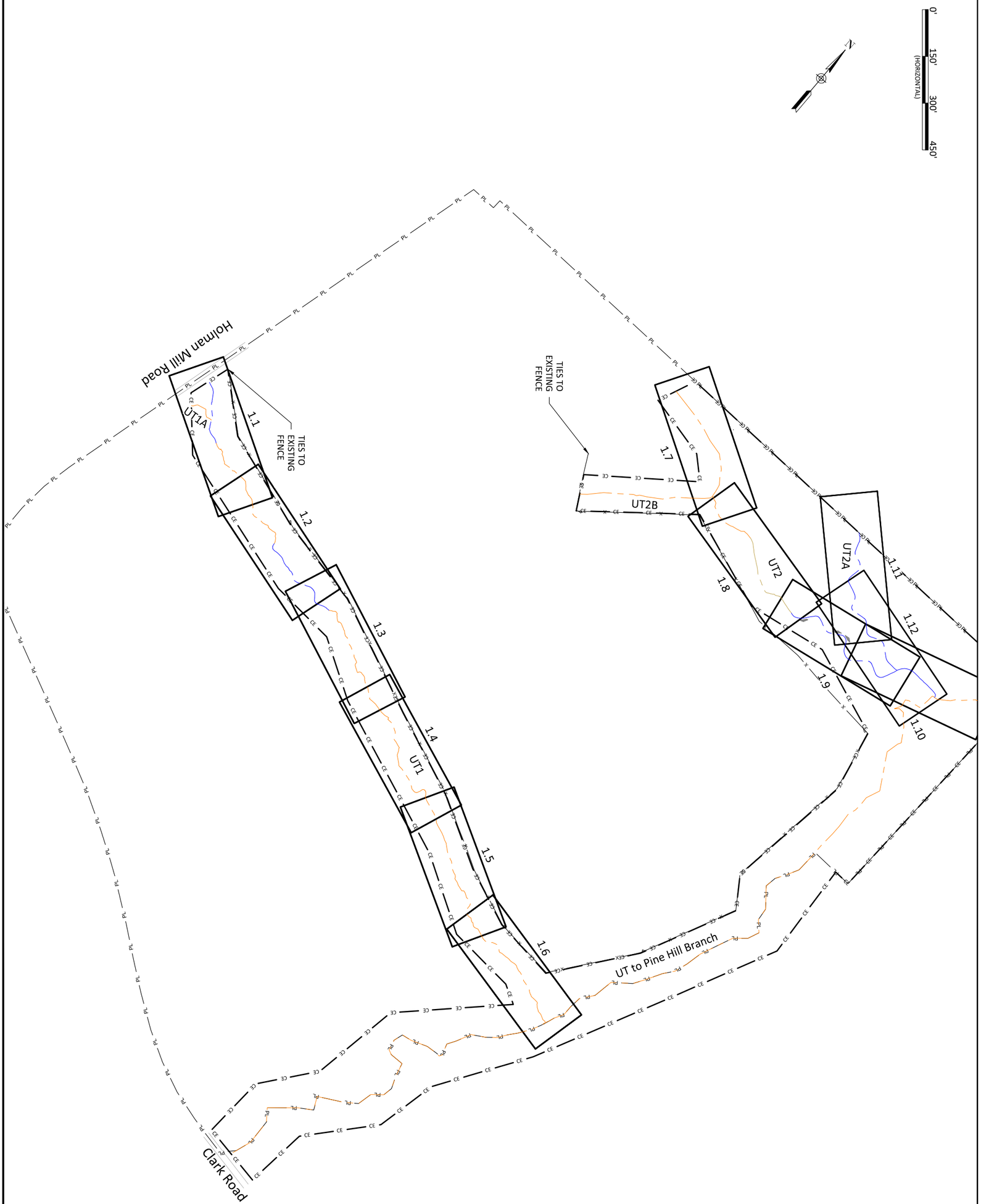
Title Sheet

Record Drawing

Revisions:

Date: 10.31.2016
Job Number: 005-02316
Project Engineer: ANA
Drawn By: CAM
Checked By: JNK

Sheet 0.1



Record Drawing

Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

Revisions:

0.2

Sheet

Holman Mill Mitigation Project
Alamance County, North Carolina

Stream Overlay Overview

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 040280 ANNE NICOLE ALLEN

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312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831

October 31, 2016

Legend

Existing Features

Existing Thalweg Alignment

Proposed Features

Proposed Thalweg Alignment

Proposed Bankfull

Proposed Major Contour (520)

Proposed Minor Contour

Proposed Constructed Riffle

Proposed Log Vane

Proposed Angled Log Drop

Proposed Log J-Hook

Proposed Brush Toe

Proposed Cover Log

Proposed Boulder Sill

Proposed Boulder J-Hook with Sill

Proposed Transplanted Sod Mats

Proposed Rock Outlet

PL PL PL Property Line

As-Built Features

10+00 As-Built Thalweg Alignment - Restoration

10+00 As-Built Thalweg Alignment - Enhancement I

10+00 As-Built Thalweg Alignment - Enhancement II

As-Built Bankfull

CE CE Conservation Easement

520 As-Built Major Contour

As-Built Minor Contour

As-Built Constructed Riffle

As-Built Log Vane

As-Built Angled Log Drop

As-Built Brush Toe

As-Built Cover Log

As-Built Boulder Sill

As-Built Transplanted Sod Mats

As-Built Rock Outlet

As-Built Boulder Toe

x As-Built Fence

NOTE: FEATURES IN RED INDICATE DEVIATION FROM FINAL CONSTRUCTION PLANS.

Record Drawing

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Raleigh, NC 27609
Tel. 919.851.9986
Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANGELA N ALLEN

Holman Mill Mitigation Project
Alamance County, North Carolina

Legend

Revisions:

Date:	10.31.2016
Job Number:	005-02416
Project Engineer:	ANA
Drawn By:	CAM
Checked By:	JNK

Sheet 0.3

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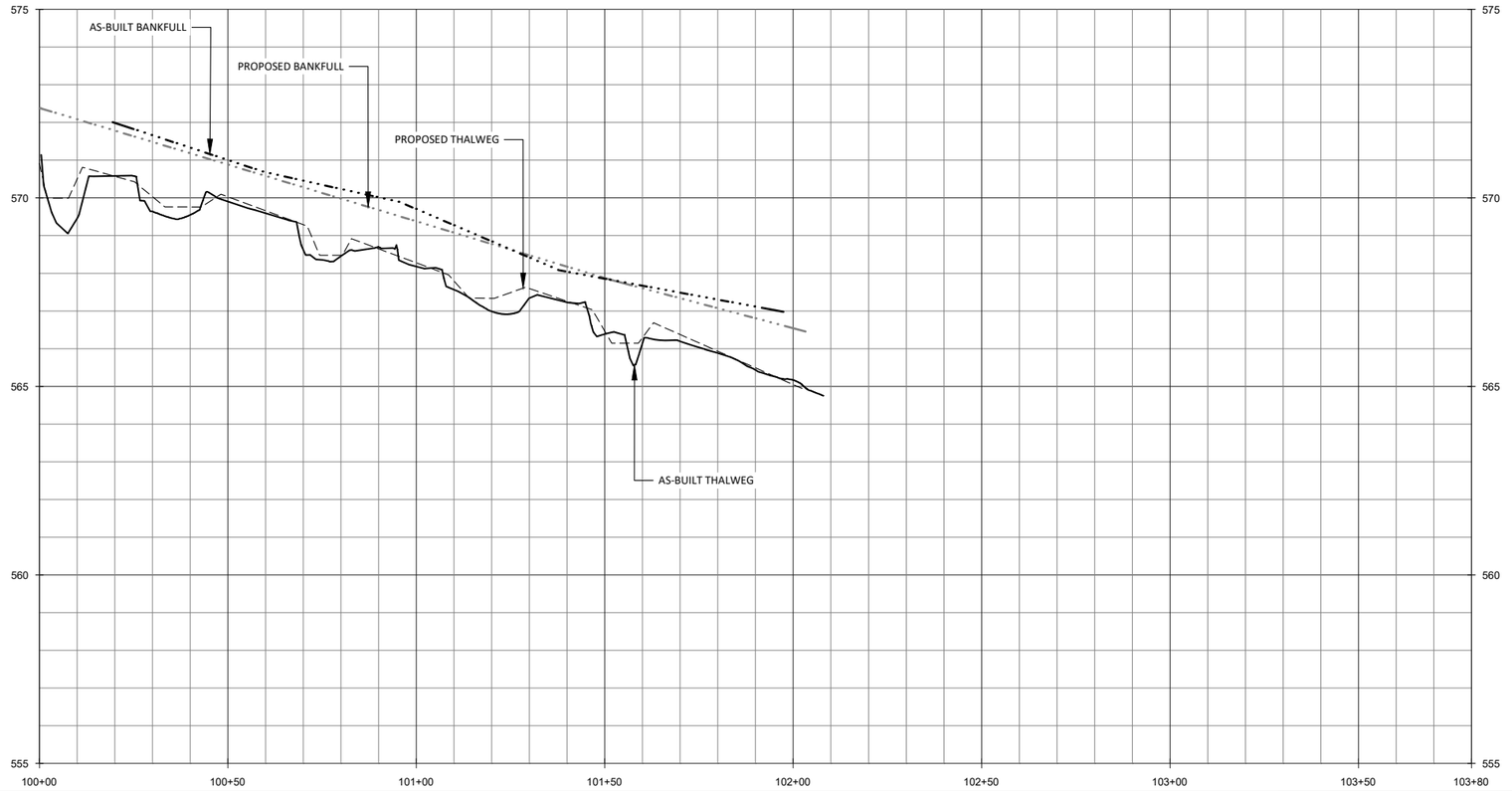
October 31, 2016



NOTE:

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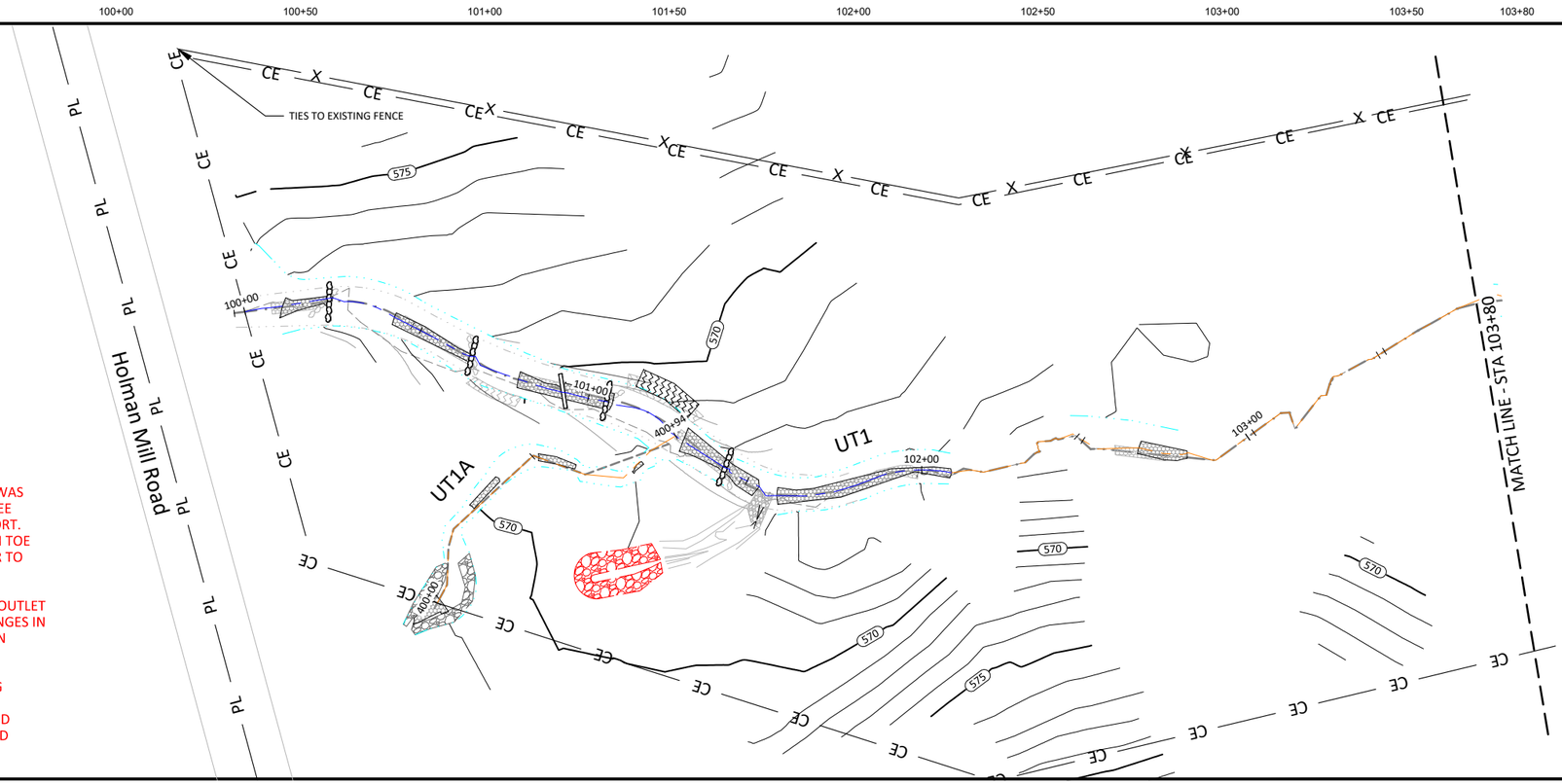


NOTE: 1. AT STATION 100+00 LT, ROCK WAS ADDED TO ROADSIDE DITCH. SEE SECTION 5.1 OF AS-BUILT REPORT.
2. AT STATION 100+75 RT, BRUSH TOE WAS NOT INSTALLED IN ORDER TO AVOID IMPACTS TO EXISTING, MATURE TREES.
3. AT STATION 101+35 RT, ROCK OUTLET WAS RELOCATED DUE TO CHANGES IN DRAINAGE PATTERNS BETWEEN PROJECT DESIGN AND CONSTRUCTION.
4. UT1A WAS STABILIZED DURING CONSTRUCTION DUE TO DEGRADATION THAT OCCURRED BETWEEN PROJECT DESIGN AND CONSTRUCTION.

Record Drawing

WILDLANDS ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel. 919.851.9986
Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANGELA N ALLEN

Holman Mill Mitigation Project
Alamance County, North Carolina

UT1 Reaches 1 & 2
Stream Overlay Plans

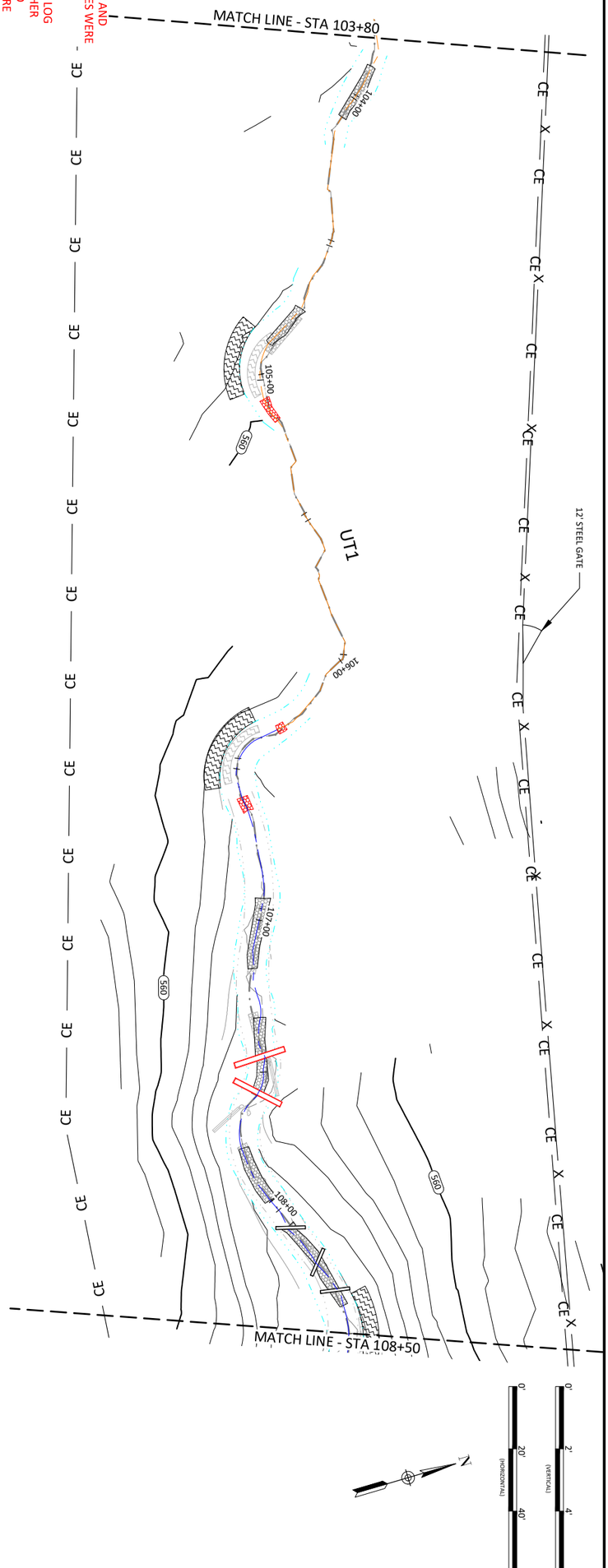
Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

Revisions:

Sheet 1.1

F:\Projects\005-02146 Holman Mill\GeoEM\Final\As-Built Record Drawings\02146-AB-Profiles.dwg

NOTE: 1. AT STATIONS 105+10, 106+30 AND 106+60, CONSTRUCTED RIFFLES WERE INSTALLED WHERE CHANNEL STABILIZATION WAS NEEDED.
2. AT STATION 107+50, ANGLED LOG DROPS WERE INSTALLED RATHER THAN LOG J-HOOKS TO AVOID IMPACTS TO EXISTING, MATURE TREES ON LEFT BANK.



NOTE:
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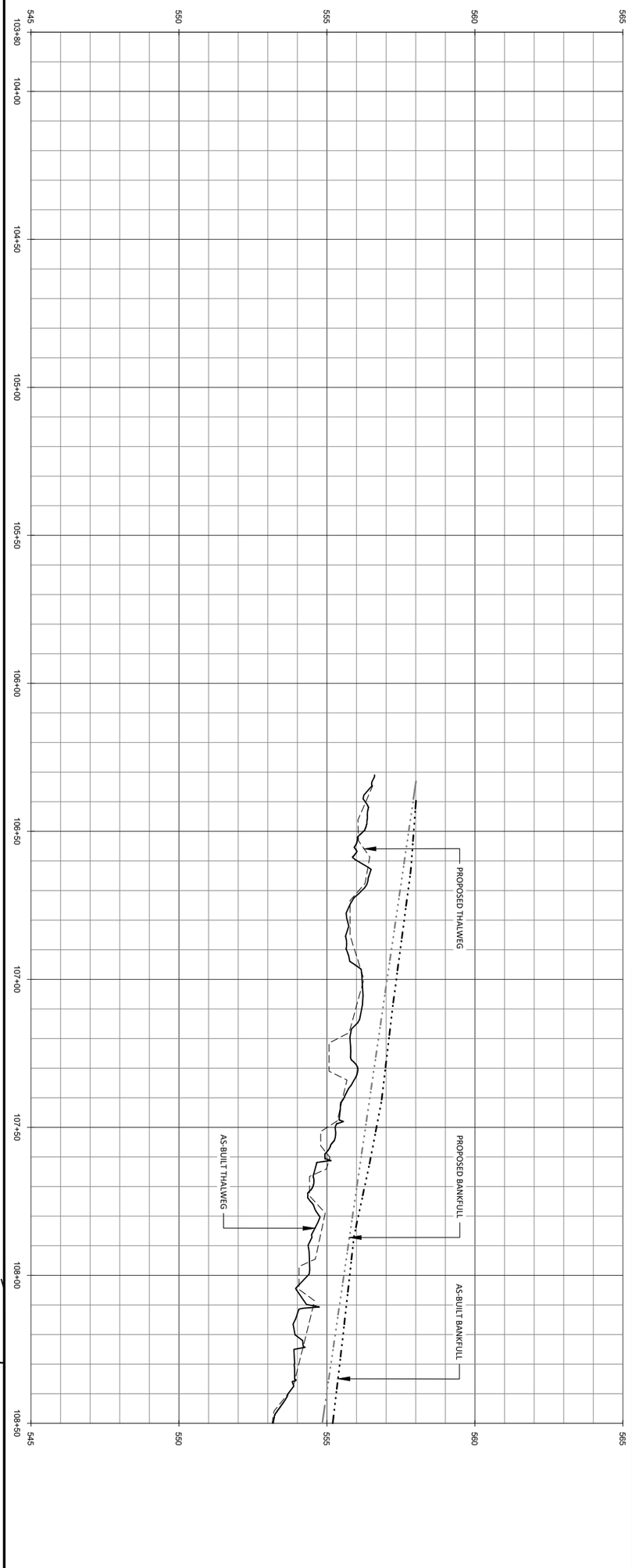


Record Drawing

Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

Revisions:

1.2
Sheet

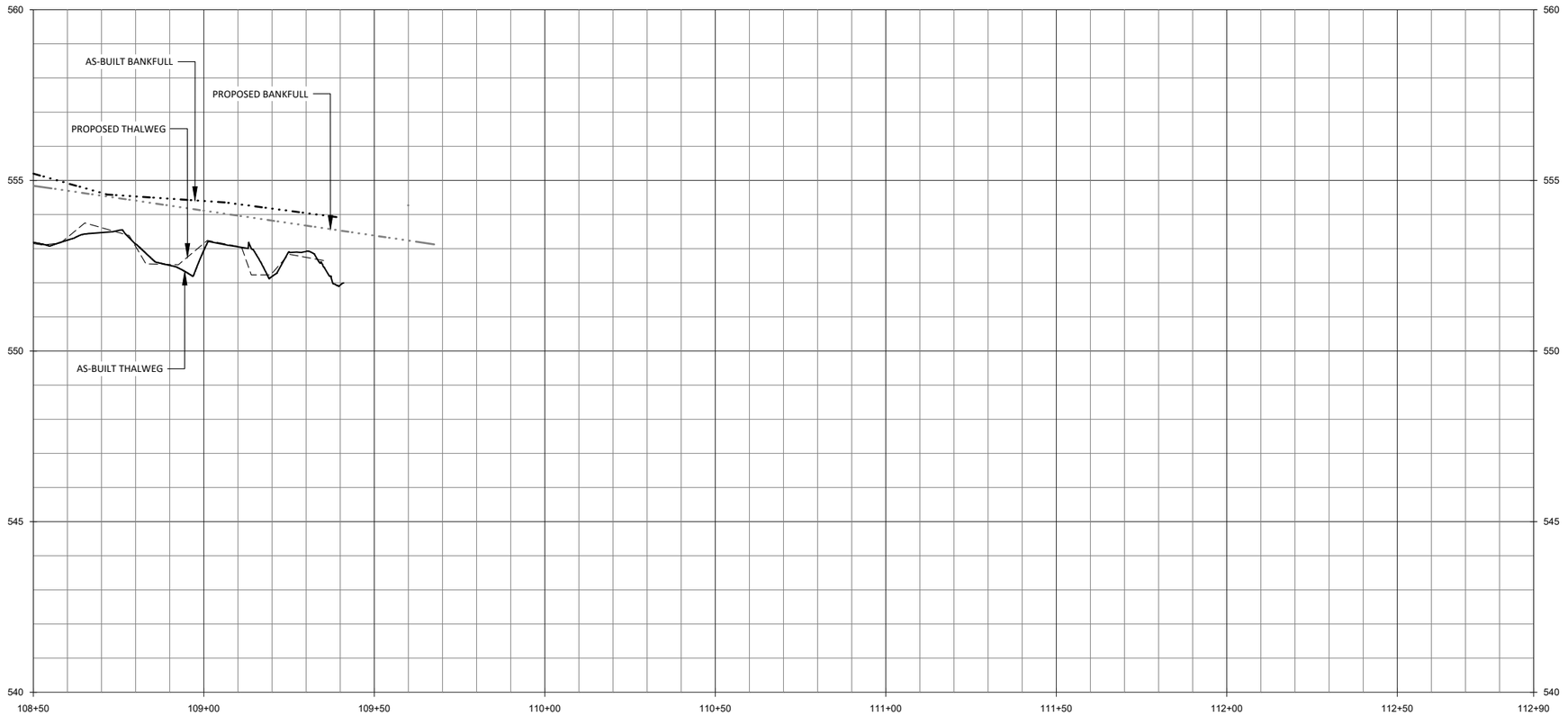
Holman Mill Mitigation Project
Alamance County, North Carolina

UT1 Reaches 2 & 3
Stream Overlay Plans

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANDREA N. ALLEN

WILDLANDS ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831

October 31, 2016



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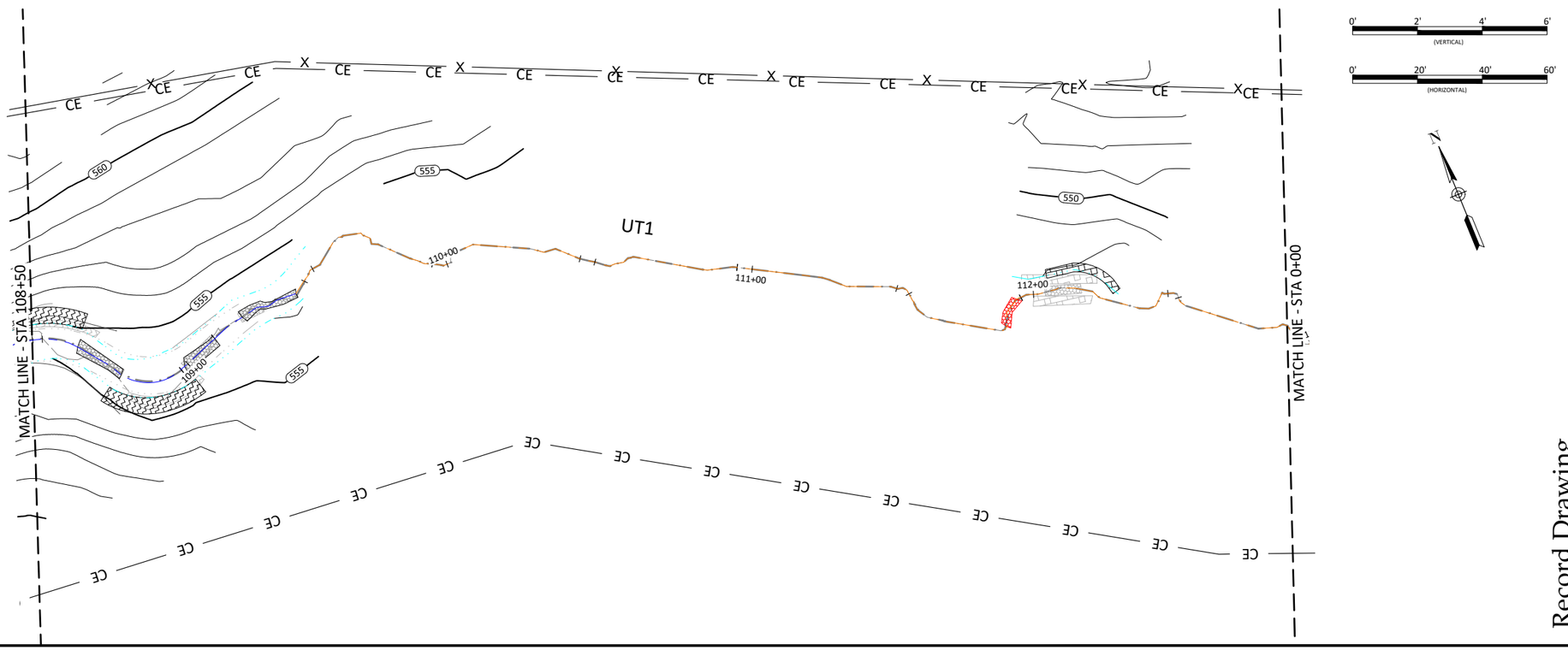


NOTE: 1. AT STATION 111+90, CONSTRUCTED RIFFLE WAS SHIFTED UPSTREAM WHERE CHANNEL STABILIZATION WAS NEEDED.

Record Drawing

WILDLANDS ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANGELA N ALLEN

Holman Mill Mitigation Project
Alamance County, North Carolina

UT1 Reaches 3 & 4
Stream Overlay Plans

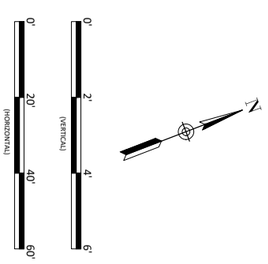
Revisions:

Date:	10.31.2016
Job Number:	085-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

Sheet 1.3

F:\Projects\085-02146 Holman Mill\Cad\Plans\As-Built\Record Drawings\02146-AB-Profiles.dgn

NOTE: 1. AT STATION 114+45 LT, BRUSH TOE WAS NOT INSTALLED IN ORDER TO MINIMIZE DISTURBANCE TO HILLSLOPE.
2. AT STATION 116+45 RT, SOD MATS WERE EXTENDED FURTHER DOWNSTREAM TO STABILIZE BANK.



Record Drawing

Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

1.4
Sheet

Revisions:

Holman Mill Mitigation Project
Alamance County, North Carolina

UT1 Reach 4
Stream Overlay Plans

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANGELA N. ALLEN

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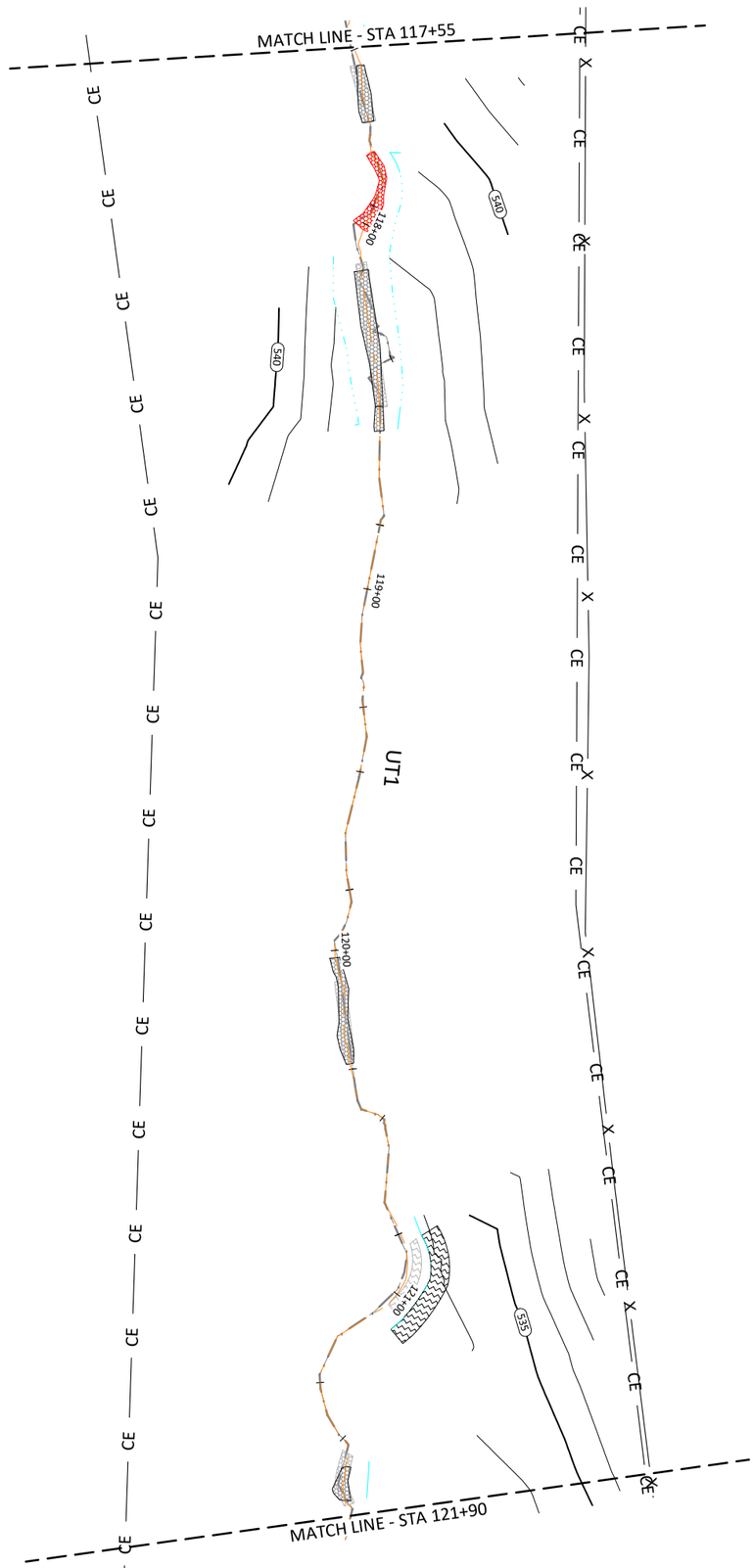
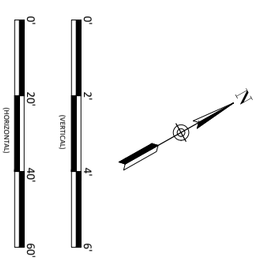
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831

NOTE: 1. AT STATION 117+90, CONSTRUCTED RIFFLE WAS INSTALLED FOR GRADE STABILIZATION.





Record Drawing

Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

1.5
Sheet

Revisions:

Holman Mill Mitigation Project
Alamance County, North Carolina

UT1
Stream Overlay Plans

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANGELA N. ALLEN

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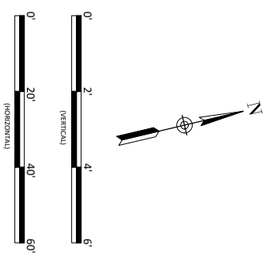
312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831



Record Drawing

Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

Revisions:

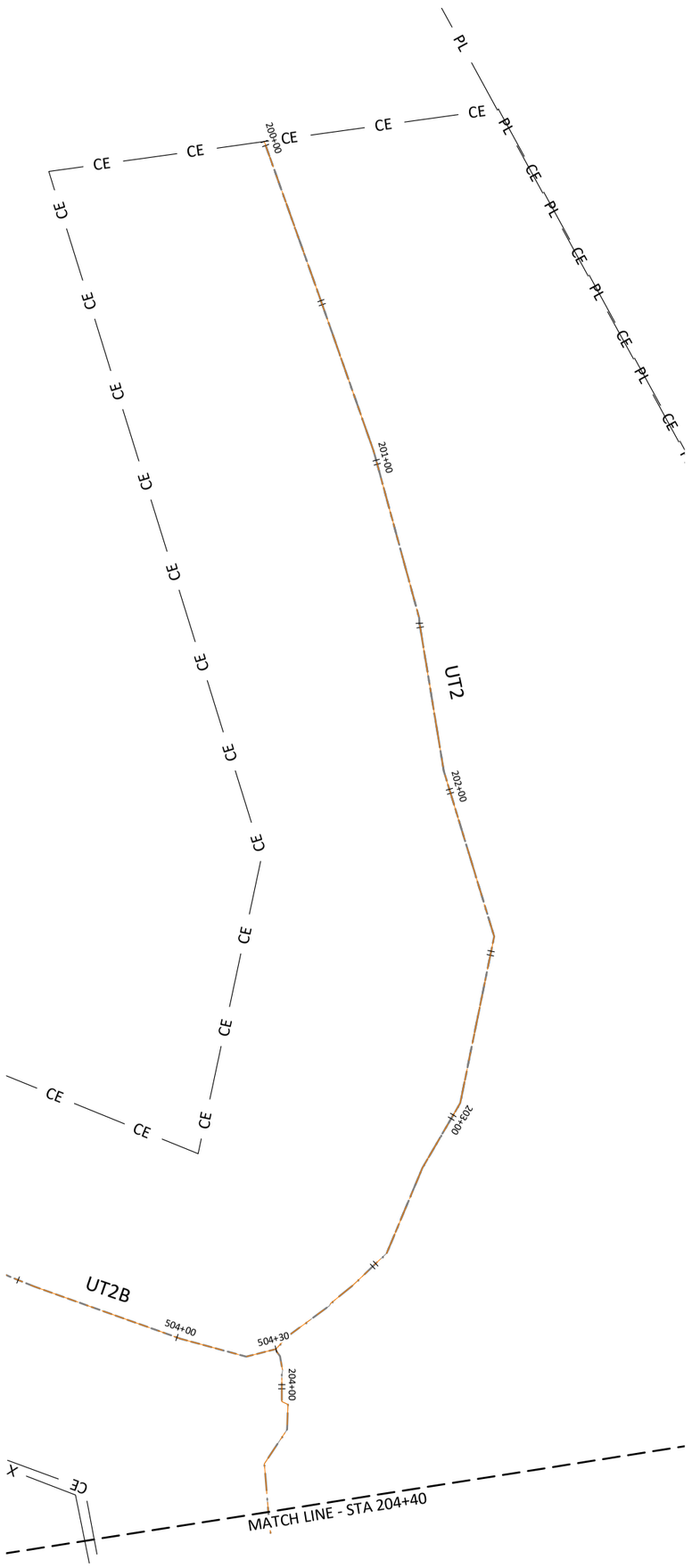
1.6
Sheet

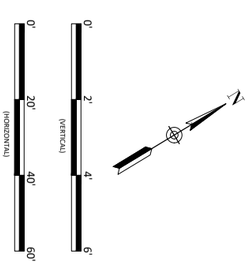
Holman Mill Mitigation Project
Alamance County, North Carolina

UT1
Stream Overlay Plans

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANNETTE N. ALLEN

WILDLANDS ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831





Record Drawing

Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

1.7
Sheet

Revisions:

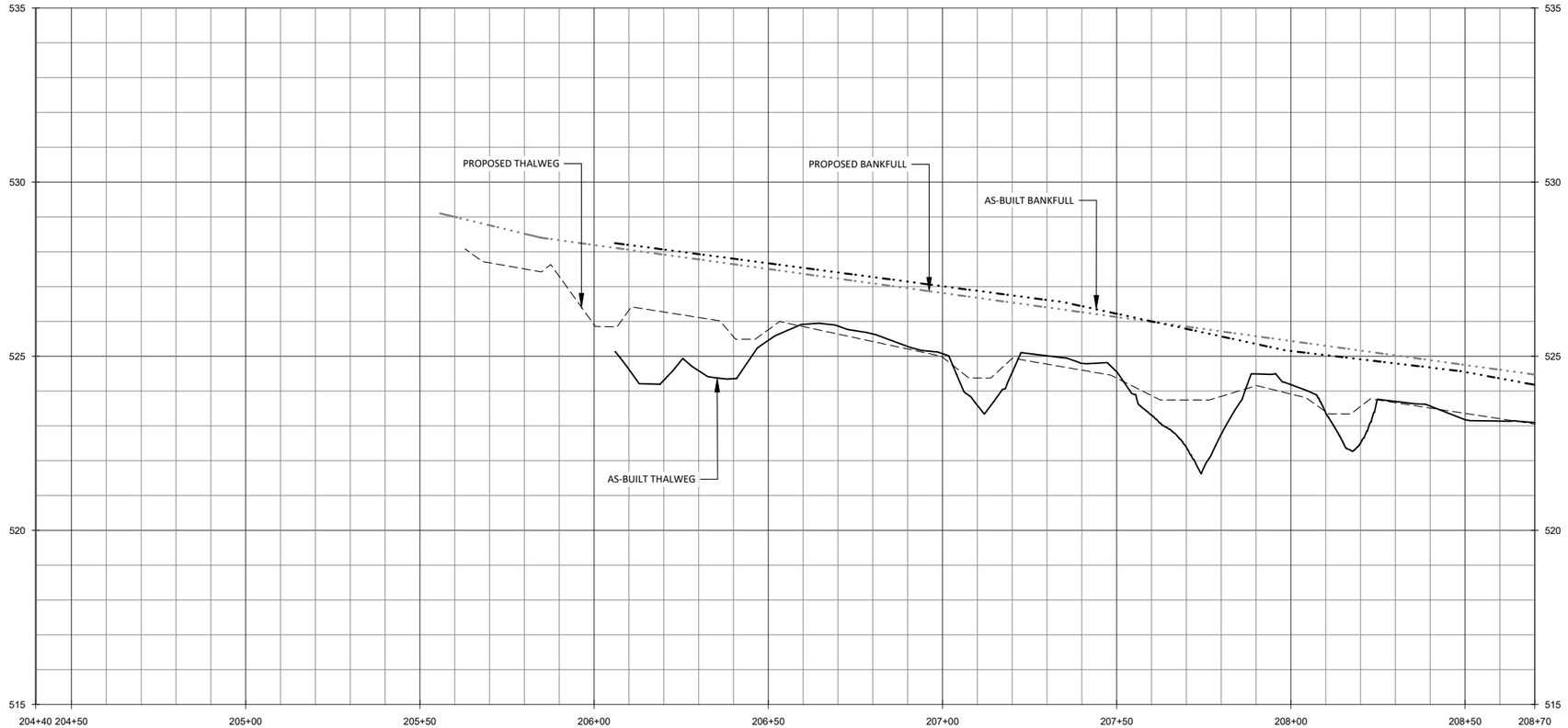
Holman Mill Mitigation Project
Alamance County, North Carolina

UT2 Reach 1
Stream Overlay Plans

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANNE NICOLE ALLEN

WILDLANDS ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831

October 31, 2016



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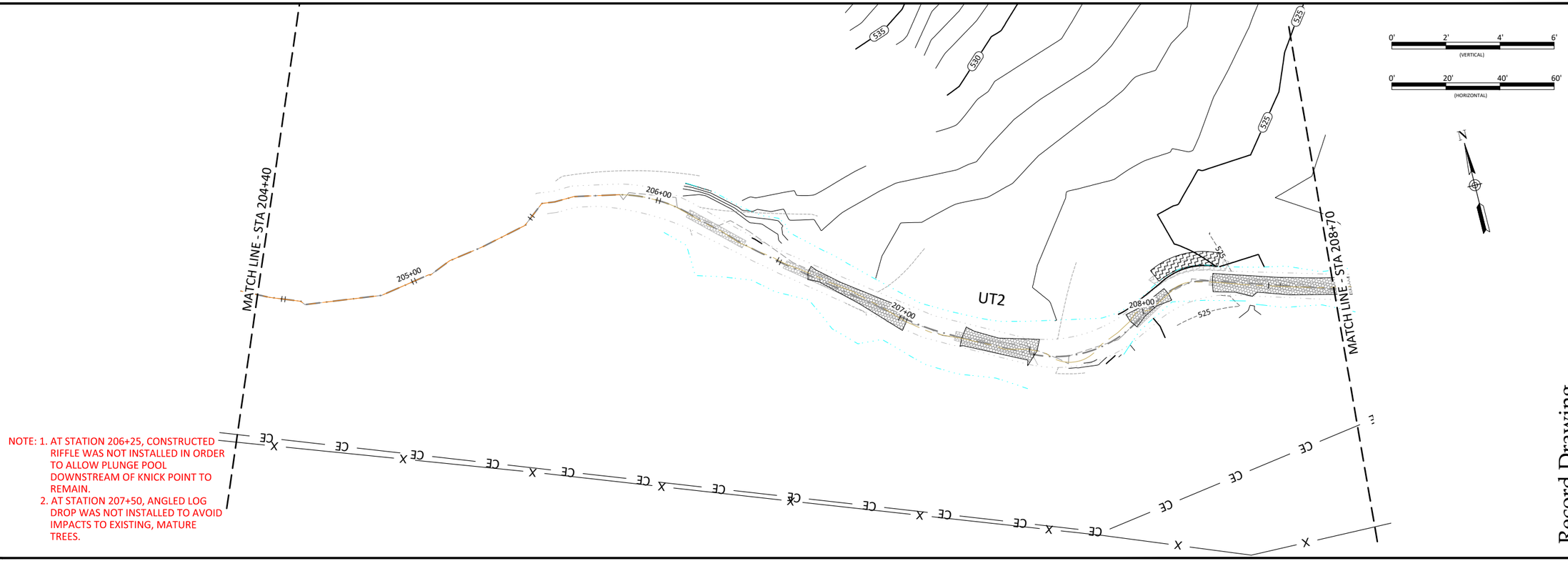
AS-BUILT PROFILE BASED ON PROPOSED ALIGNMENT.



NOTE: 1. AT STATION 206+25, CONSTRUCTED RIFFLE WAS NOT INSTALLED IN ORDER TO ALLOW PLUNGE POOL DOWNSTREAM OF KNICK POINT TO REMAIN.
2. AT STATION 207+50, ANGLED LOG DROP WAS NOT INSTALLED TO AVOID IMPACTS TO EXISTING, MATURE TREES.

Record Drawing

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312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel: 919.851.9986
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NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANGELA N ALLEN

Holman Mill Mitigation Project
Alamance County, North Carolina

UT2 Reaches 1 & 2
Stream Overlay Plans

Revisions:

Date: 10.31.2016
Job Number: 005-02146
Project Engineer: ANA
Drawn By: CLM
Checked By: JNK

Sheet 1.8

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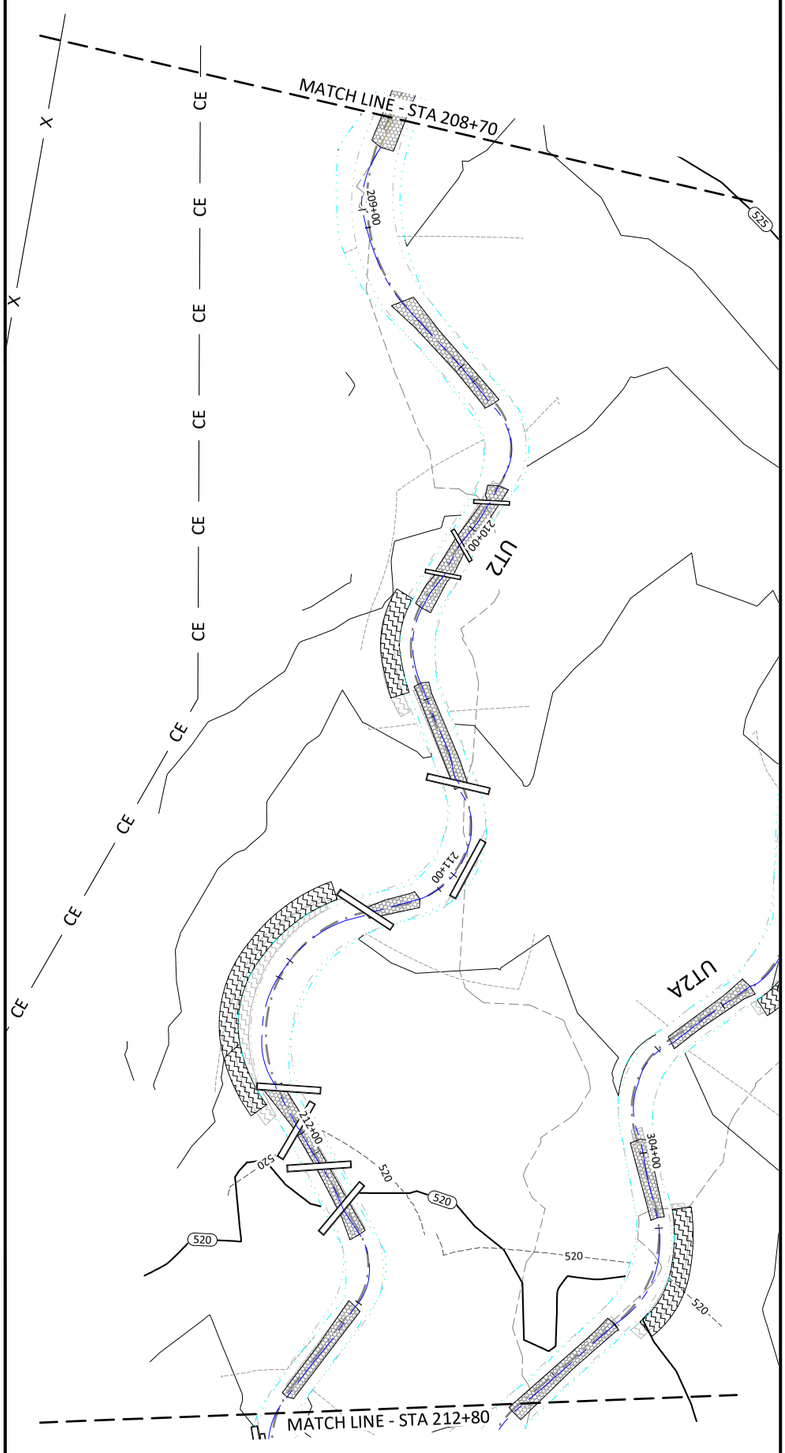

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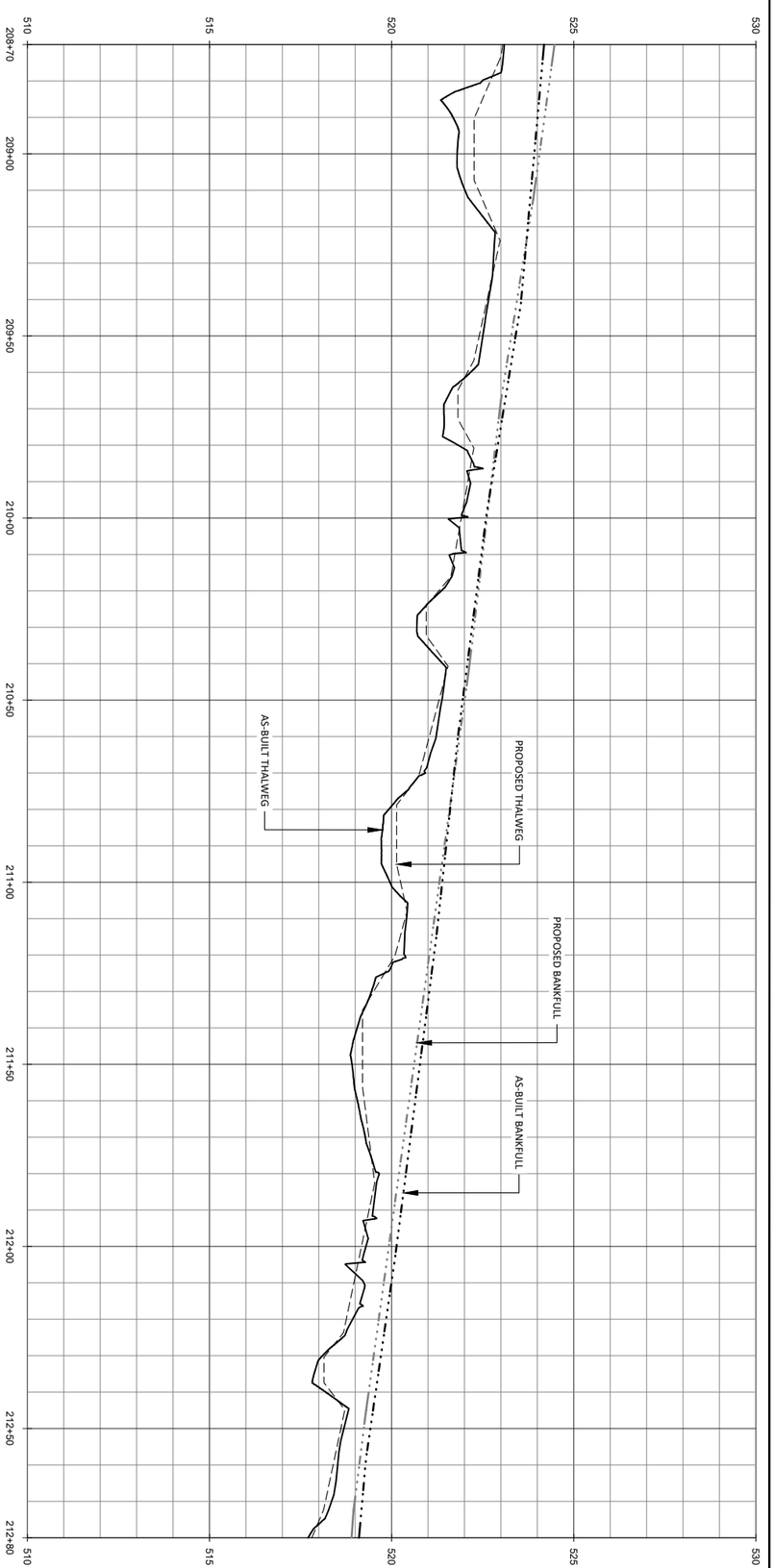

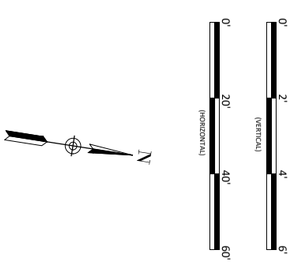

Record Drawing

Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

Revisions:

1.9

Sheet

Holman Mill Mitigation Project
Alamance County, North Carolina

UT2 Reaches 2 & 3
Stream Overlay Plans

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANGELA N ALLEN

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Raleigh, NC 27609
Tel: 919.851.9986
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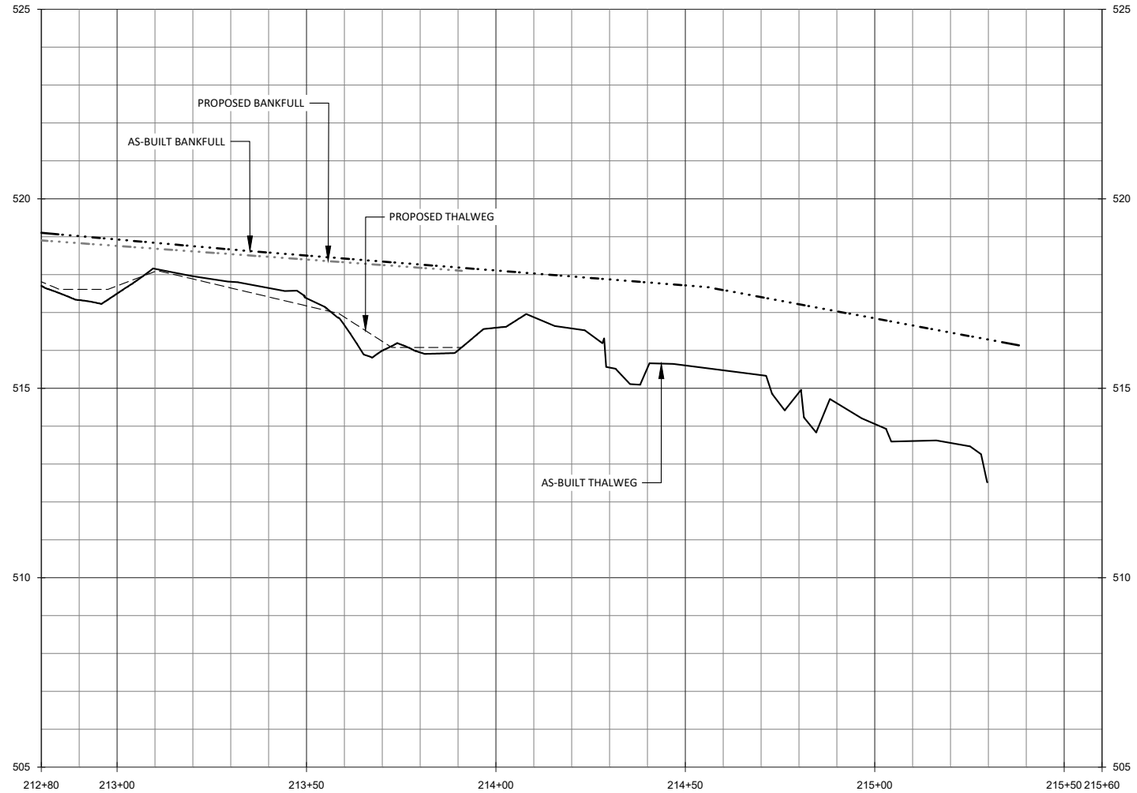
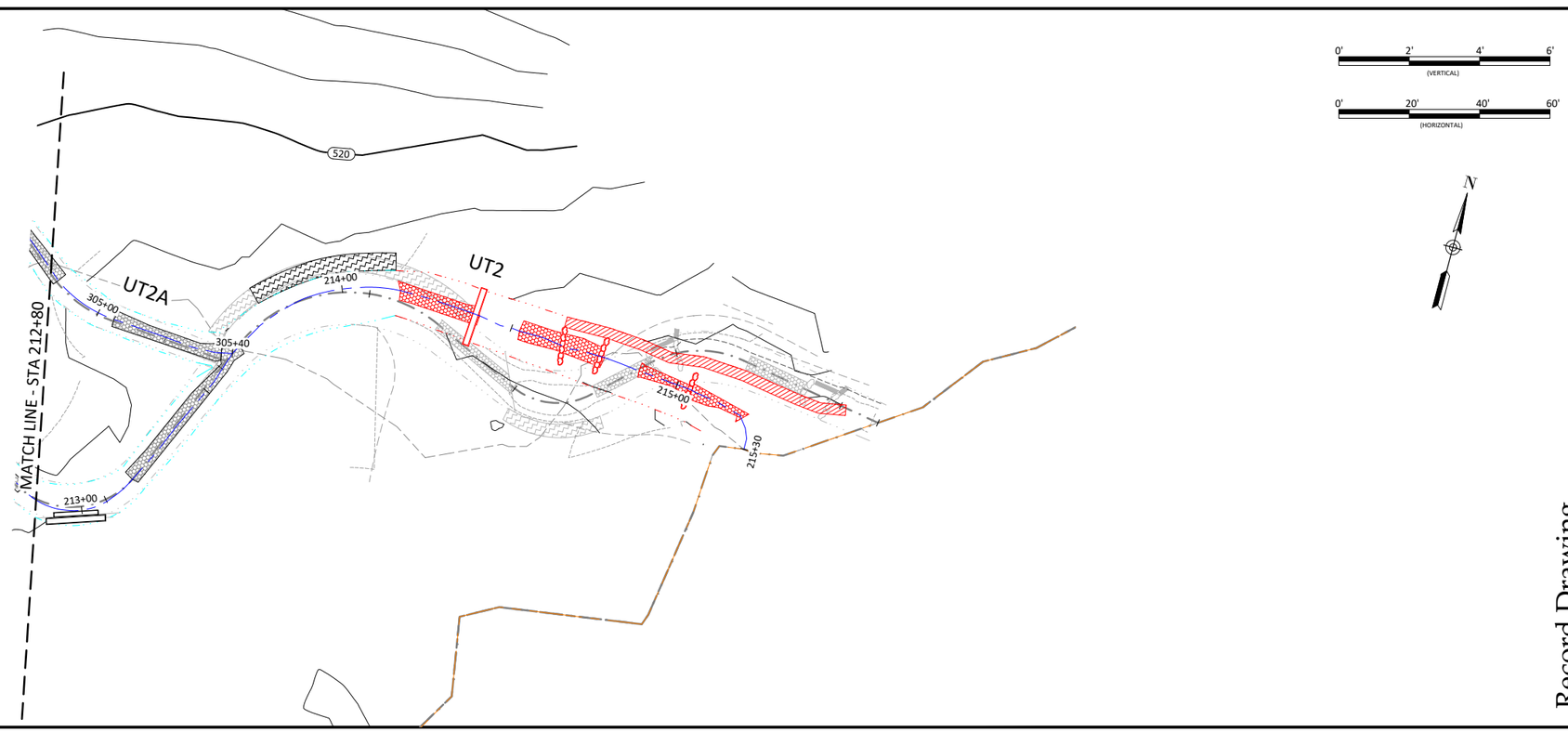
October 31, 2016



NOTE:

AS-BUILT PROFILE BASED ON PROPOSED ALIGNMENT UP TO POINT WHERE AS-BUILT ALIGNMENT DEVIATES FROM PROPOSED ALIGNMENT. AT THIS POINT, ONLY THE AS-BUILT PROFILE BASED ON THE AS-BUILT ALIGNMENT IS SHOWN.



NOTE: 1. AT STATION 213+90, ALIGNMENT CHANGED TO AVOID IMPACTS TO EXISTING, MATURE TREES AND TO AVOID IMPACTING ERODED BANKS THAT HAD FORMED ON RIGHT BANK OF UT TO PINE HILL BRANCH.

Record Drawing

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Raleigh, NC 27609
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Holman Mill Mitigation Project
Alamance County, North Carolina

UT2 Reaches 3 & 4
Stream Overlay Plans

Revisions:

Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

Sheet 1.10

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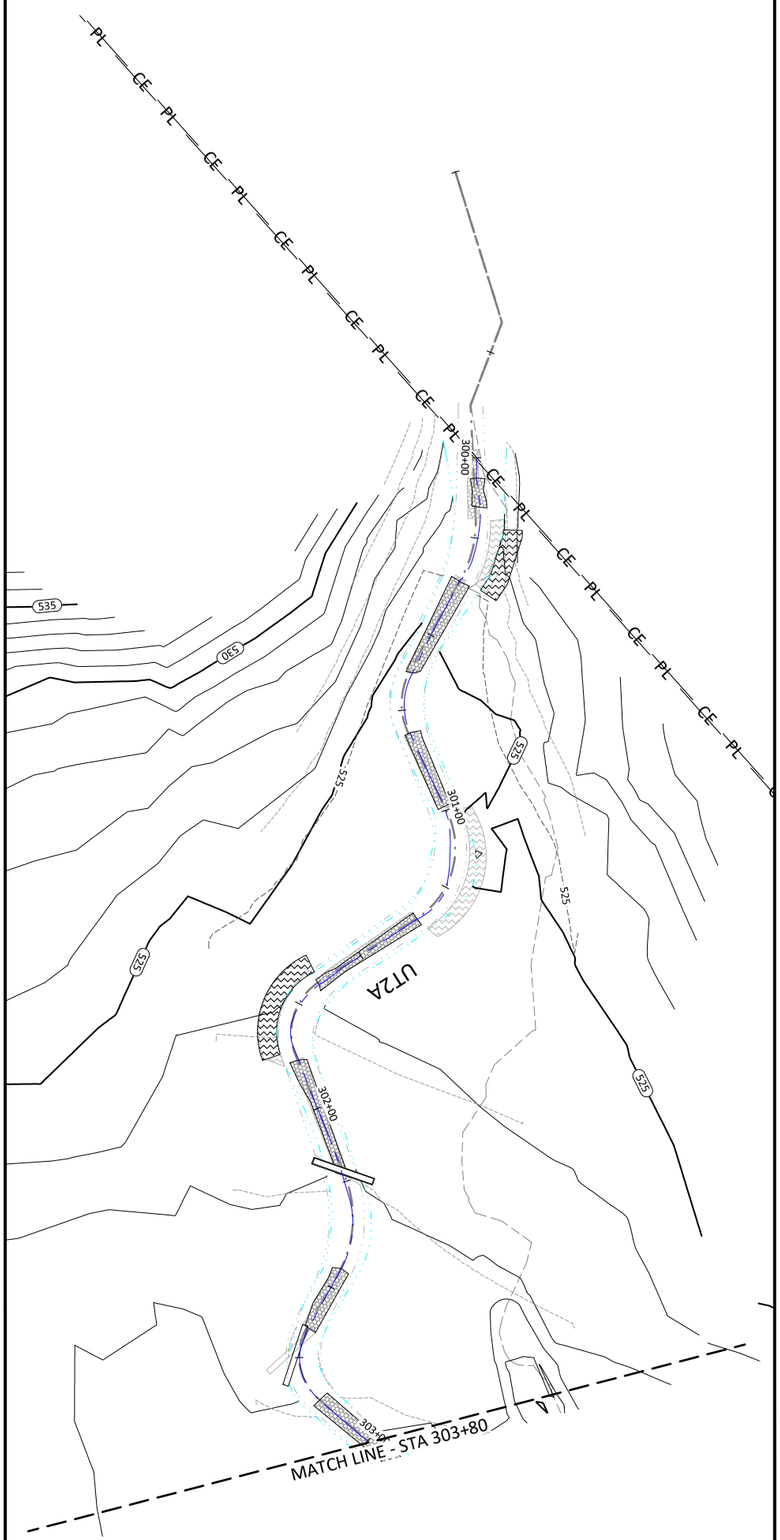
NOTE: 1. AT STATION 301+15, BRUSH TOE WAS NOT INSTALLED IN ORDER TO AVOID IMPACTS TO EXISTING, MATURE TREES.



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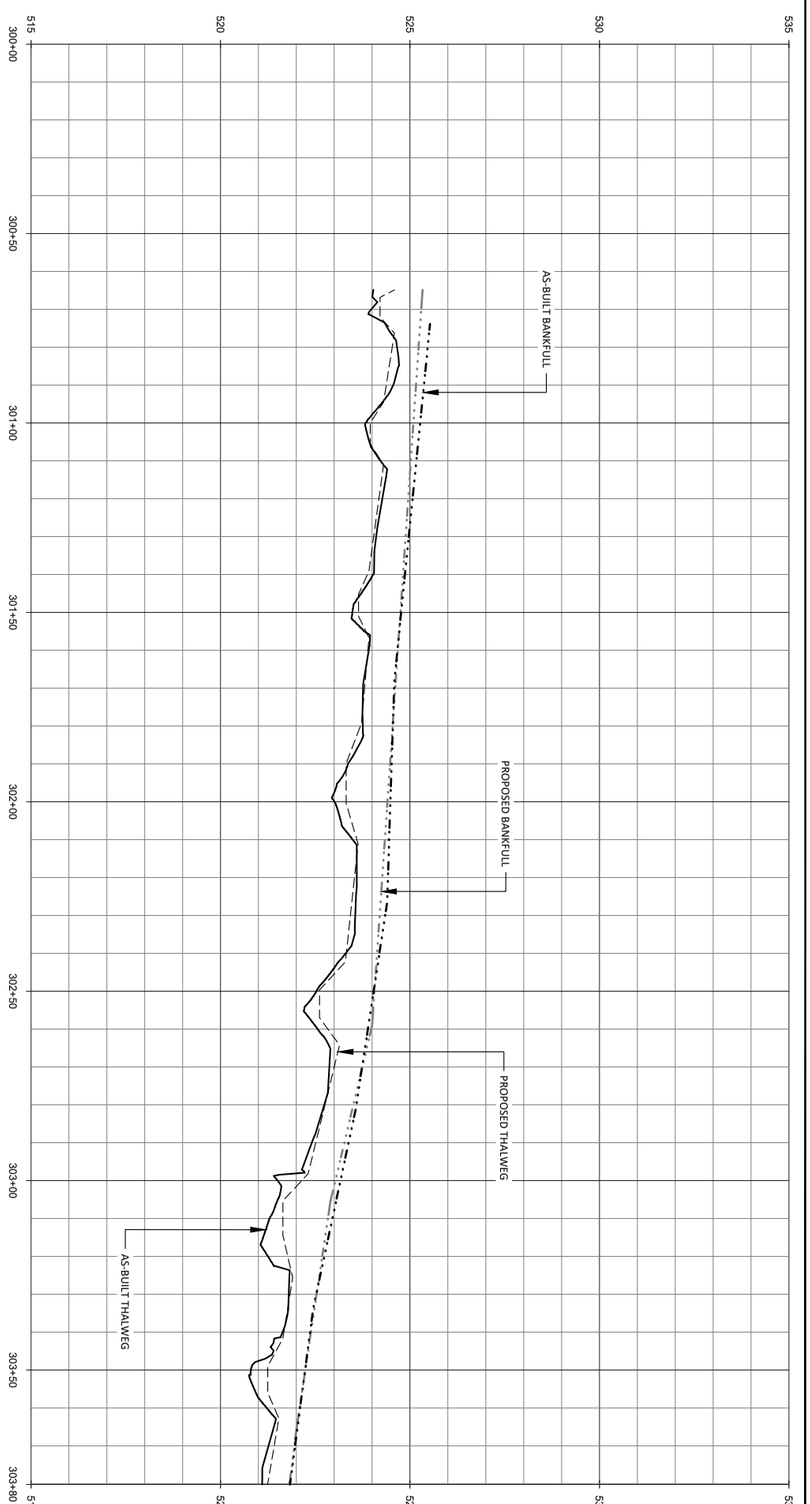
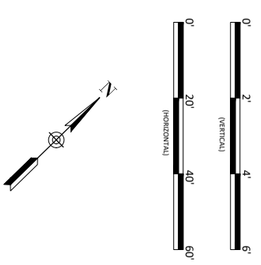




Record Drawing

Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

1.11
Sheet

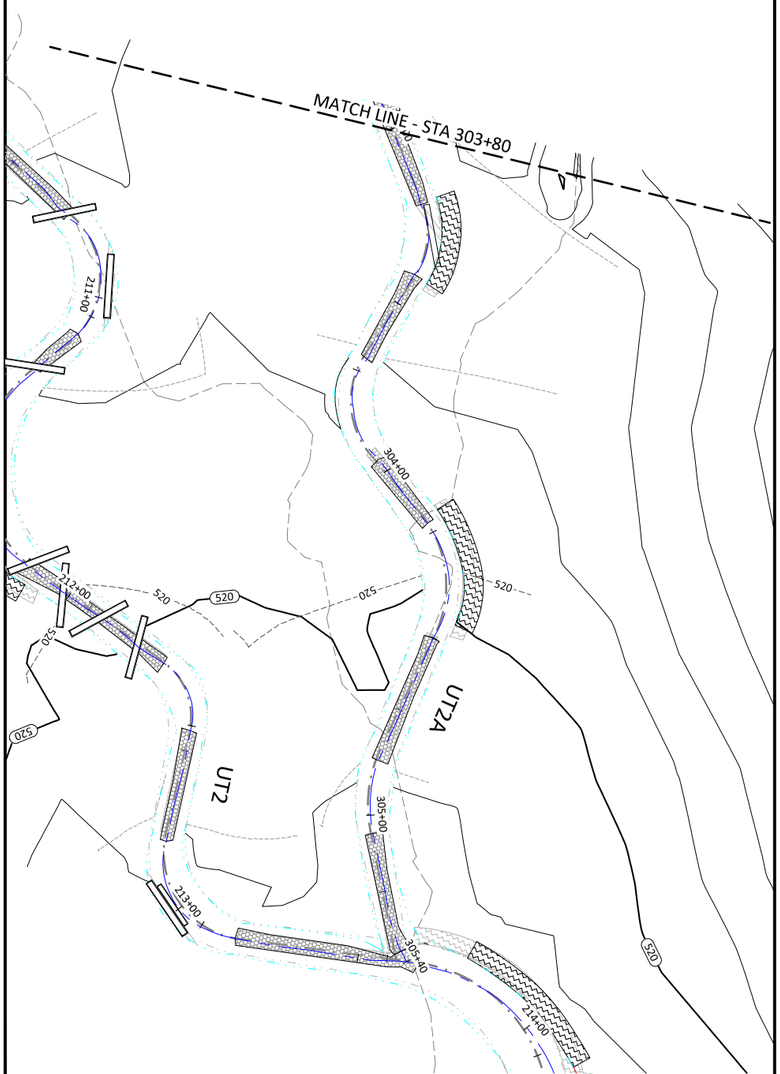
Revisions:
08-04-2015 Extension of pump around on UT2A

Holman Mill Mitigation Project
Alamance County, North Carolina

UT2A
Stream Overlay Plans

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANGELA N. ALLEN

WILDLANDS ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831



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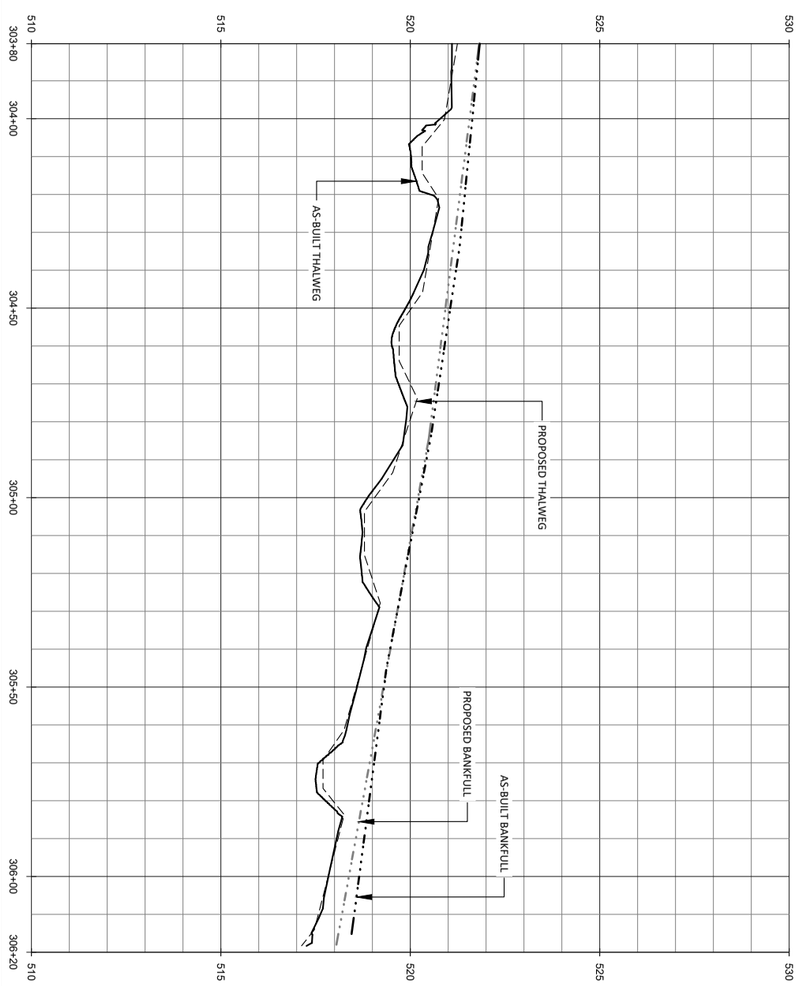
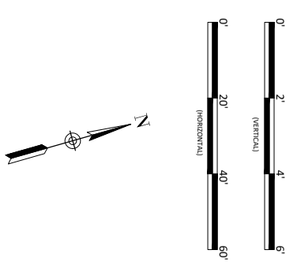




Record Drawing

Date:	10.31.2016
Job Number:	005-02146
Project Engineer:	ANA
Drawn By:	CLM
Checked By:	JNK

1.12
Sheet

Revisions:

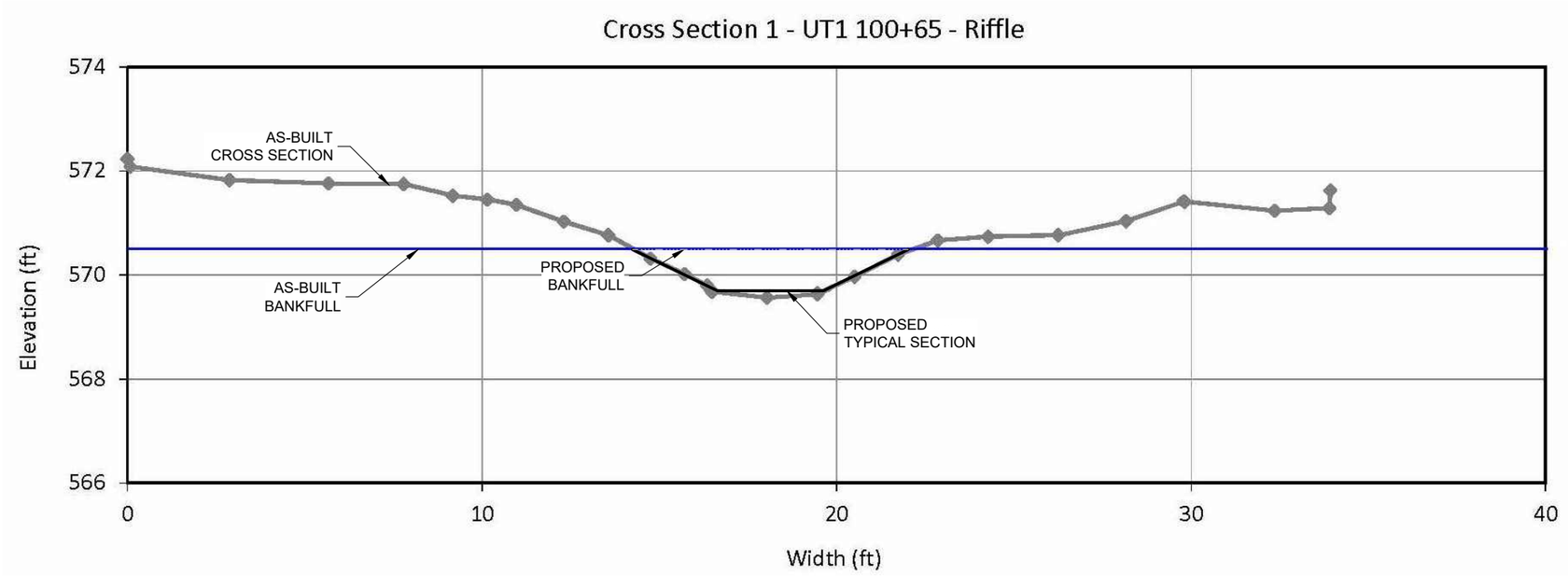
08-04-2015 extension of pump around on UT2A

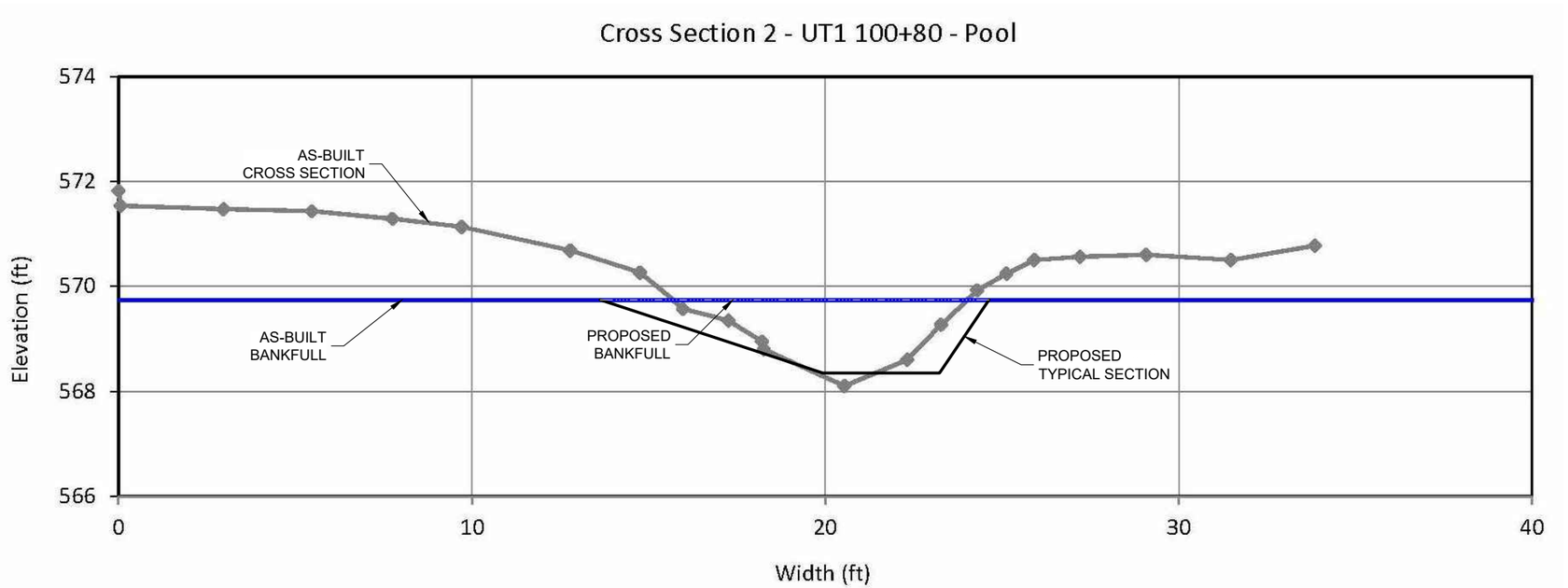
Holman Mill Mitigation Project
Alamance County, North Carolina

UT2A
Stream Overlay Plans

NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANNETTE N. ALLEN

WILDLANDS ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831





Record Drawing

Holman Mill Mitigation Project
Alamance County, North Carolina

Cross Section and Typical Section Overlays

WILDLANDS ENGINEERING
312 W. Millbrook Road, Ste 225
Raleigh, NC 27609
Tel. 919.851.9986
Firm License No. F-0831

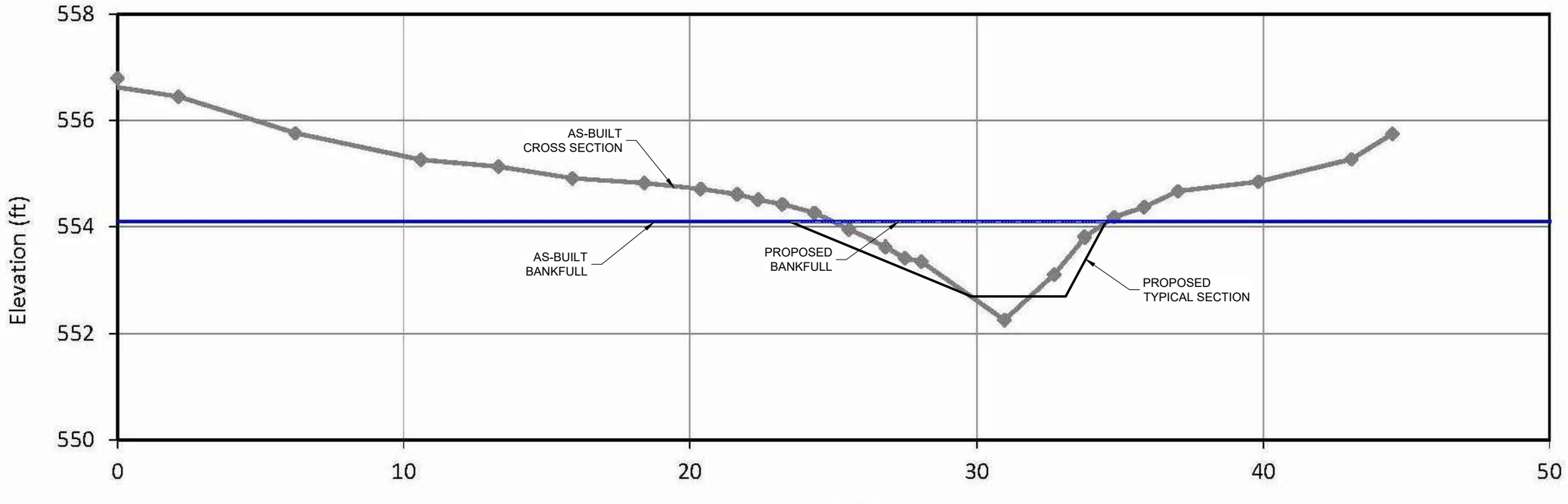
NORTH CAROLINA PROFESSIONAL SEAL 040280 ENGINEER ANGELA N ALLEN

Revisions:

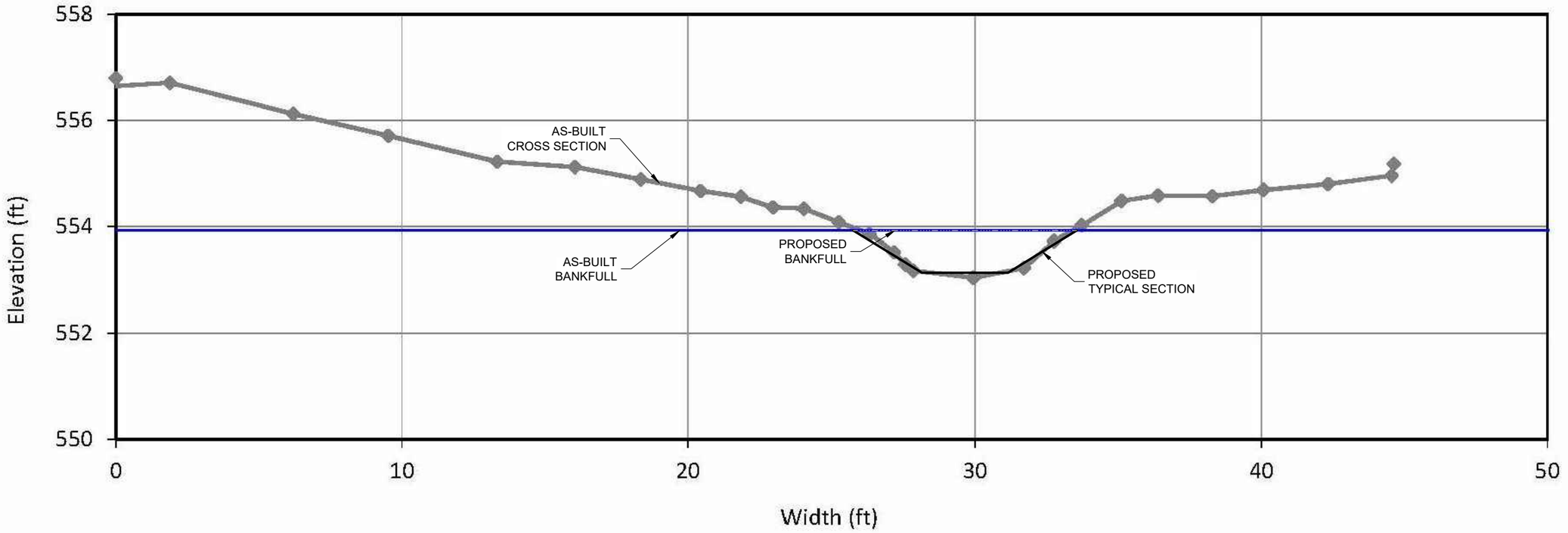
Date: 10.31.2016
Job Number: 005-02166
Project Engineer: ANA
Drawn By: CLM
Checked By: JNK

Sheet 2.1

Cross Section 3 - UT1 108+95 - Pool



Cross Section 4 - UT1 109+10 - Riffle



Record Drawing

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Holman Mill Mitigation Project
Alamance County, North Carolina

Cross Section and Typical Section Overlays

Revisions:

Date: 10.31.2016
Job Number: 005-02416
Project Engineer: ANA
Drawn by: CTM
Checked By: JNK

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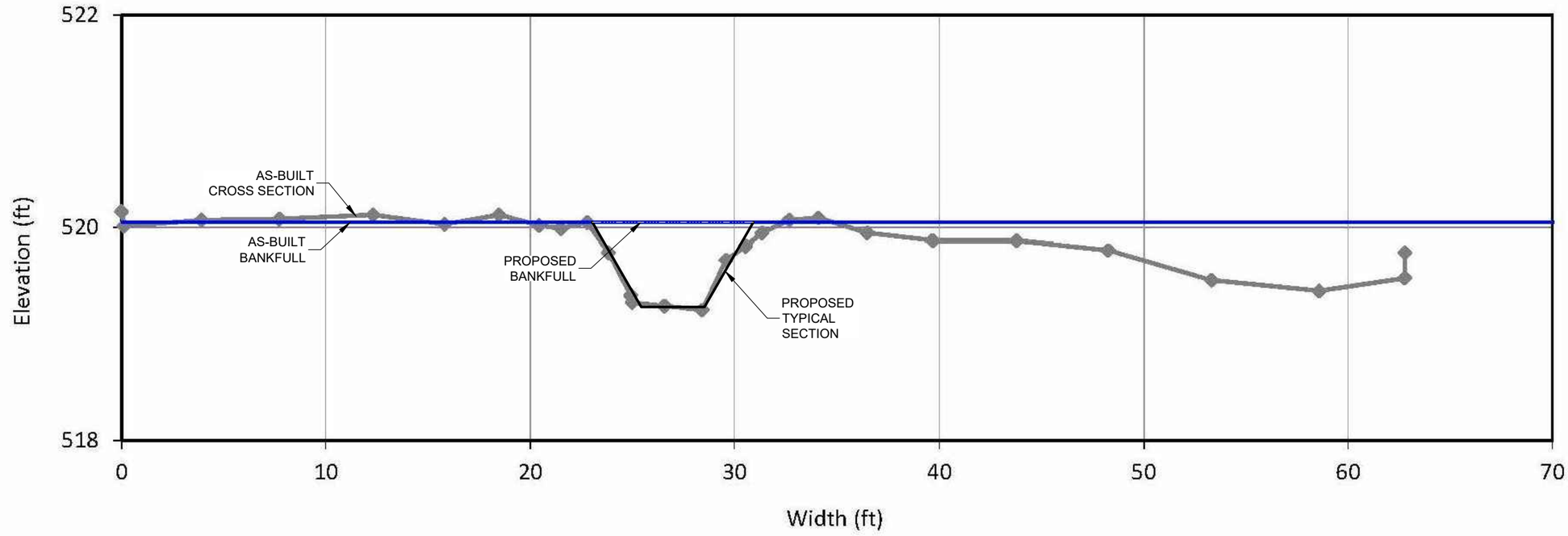
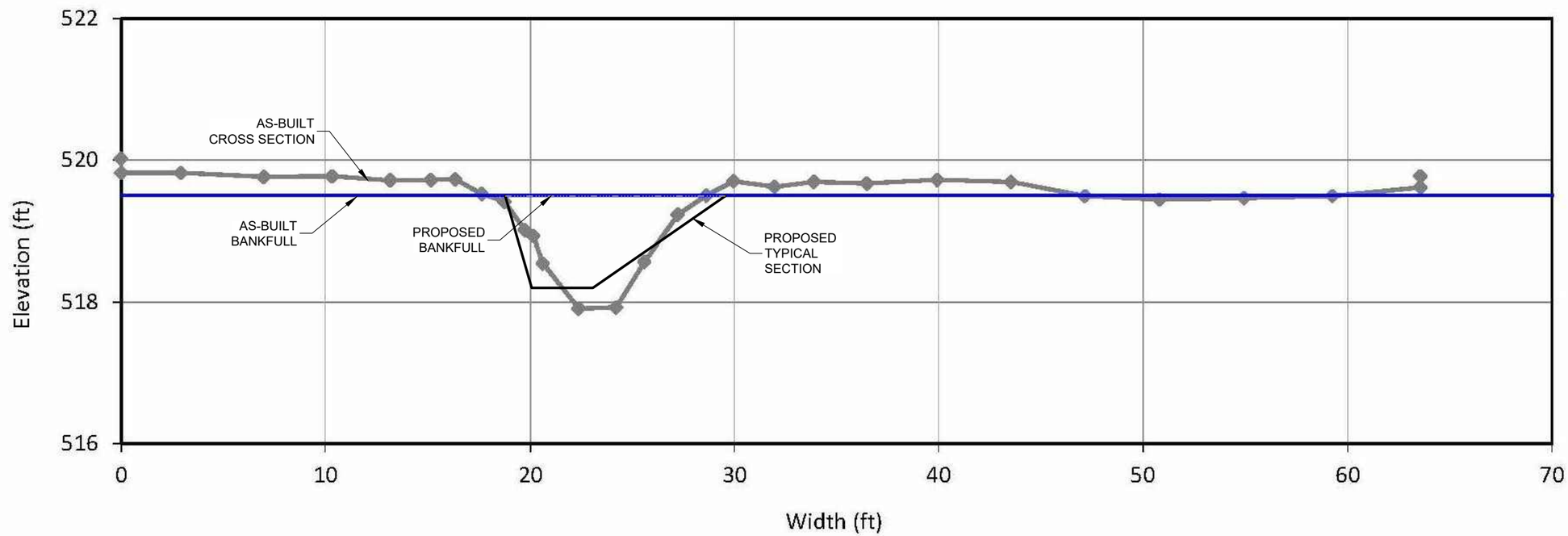
Cross Section 5 - UT2 212+00 - Riffle



Cross Section 6 - UT2 212+25 - Pool



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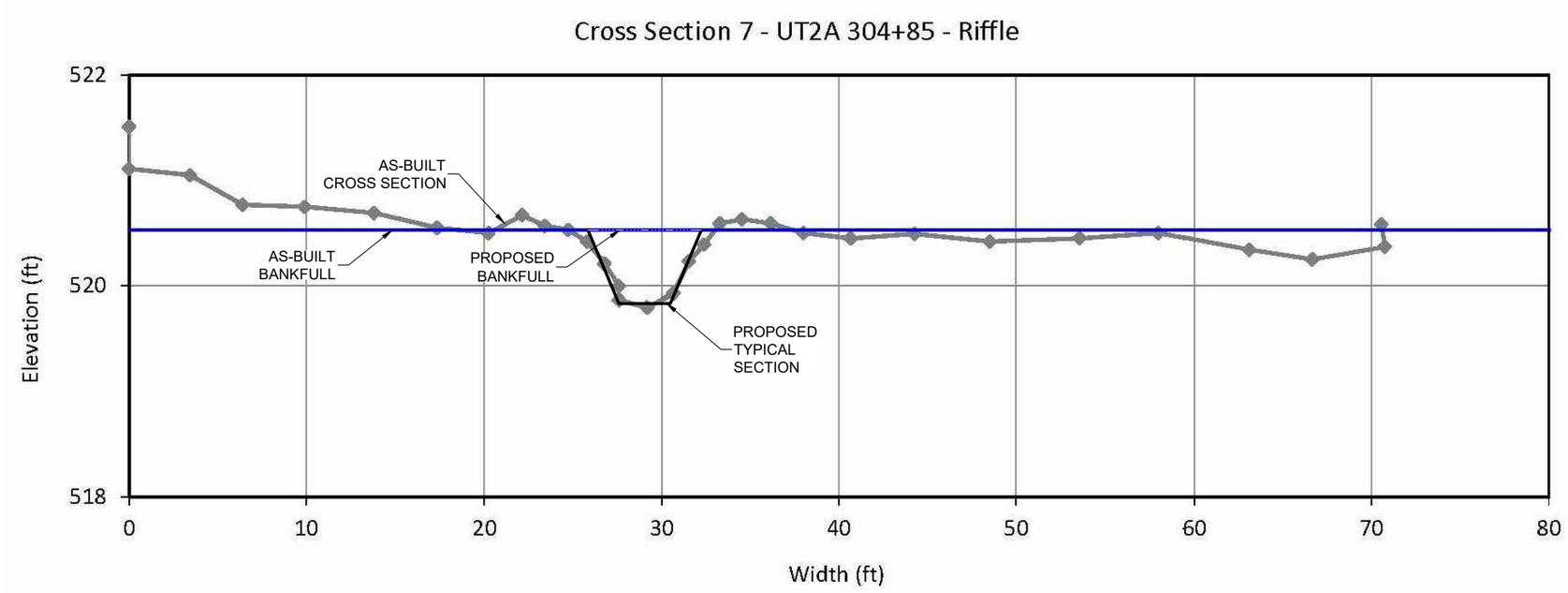
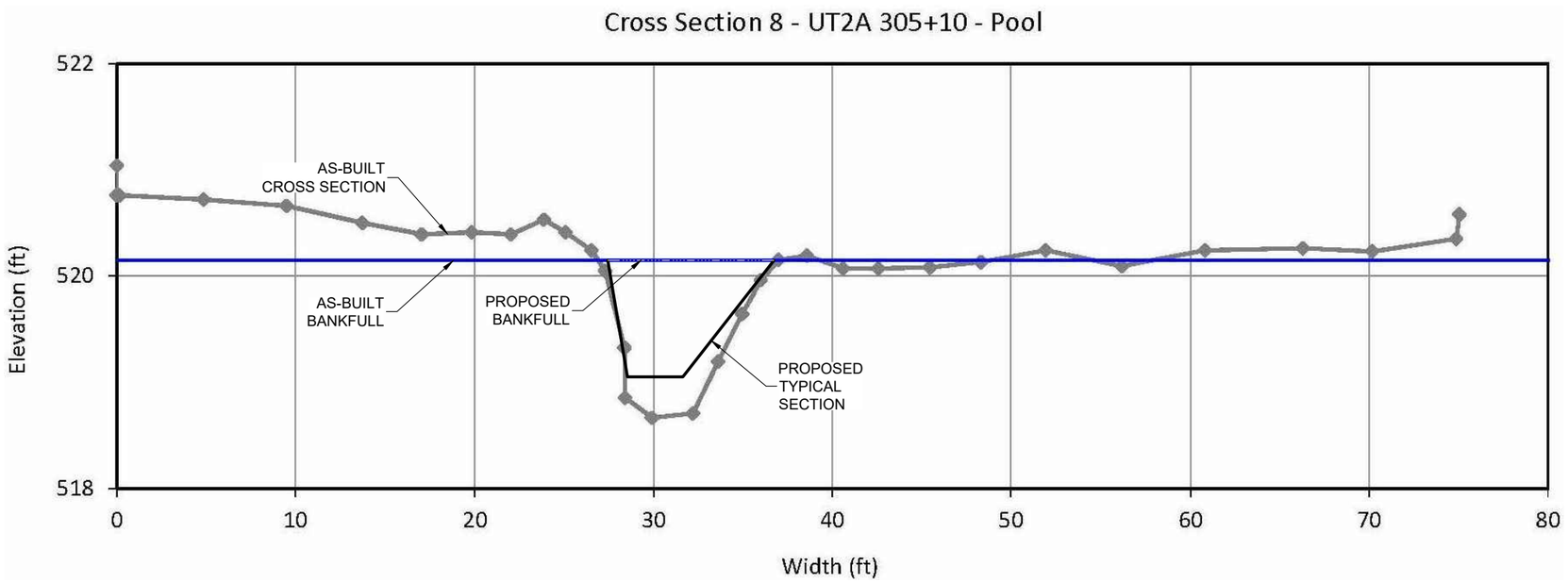
Drawn By: CAS
Checked By: JNK

Sheet 2.3





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Alamance County, North Carolina

Cross Section and Typical Section Overlays

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Job Number: 005-02166
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Drawn By: CLM
Checked By: JNK

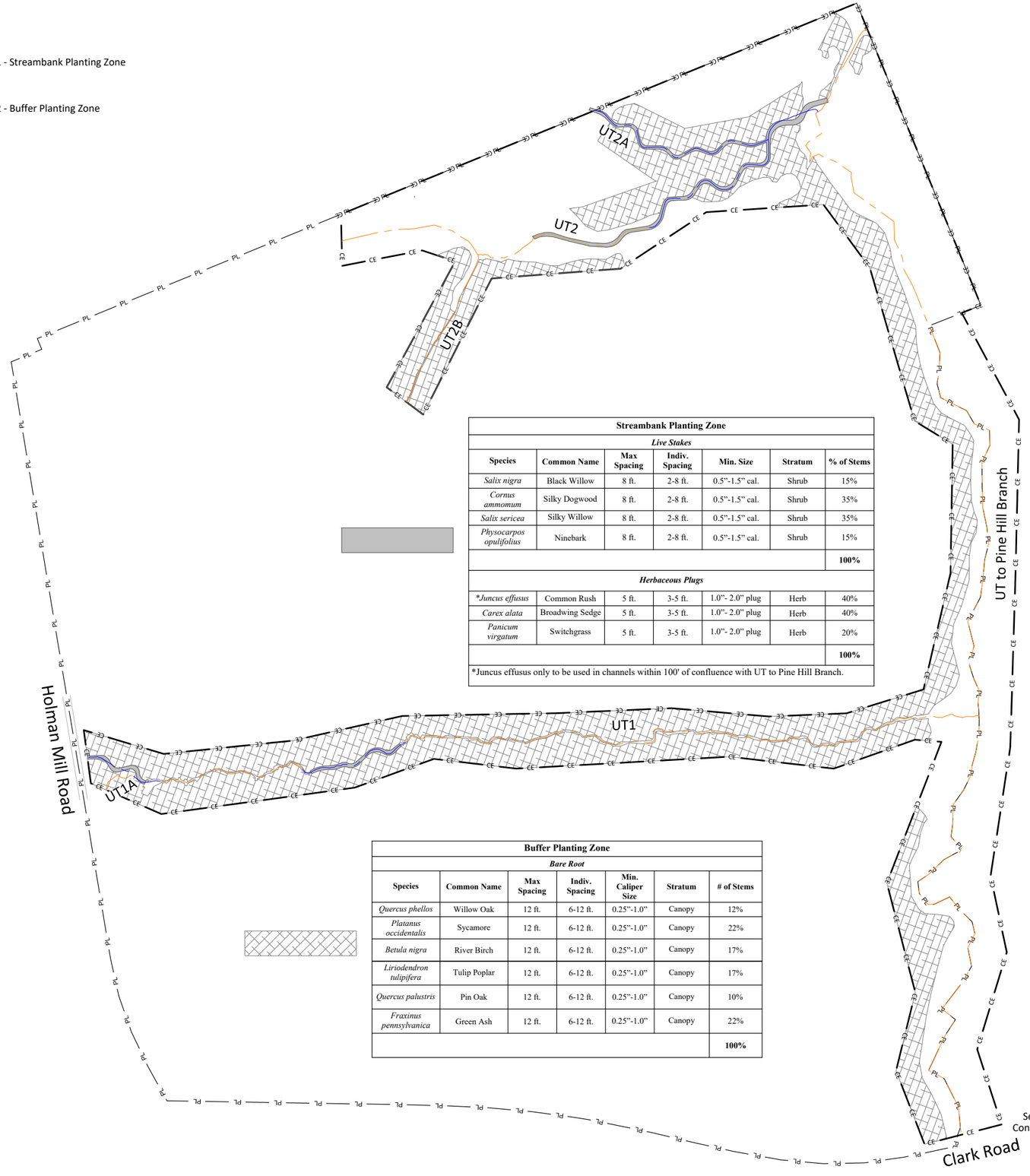
Sheet 2.4

October 31, 2016

October 31, 2016

Zone 1 - Streambank Planting Zone

Zone 2 - Buffer Planting Zone



0' 150' 300' 450'
(HORIZONTAL)

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Streambank Planting Zone						
Live Stakes						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Size**	**Stratum**	**% of Stems**
Salix nigra	Black Willow	8 ft.	2-8 ft.	0.5"-1.5" cal.	Shrub	15%
Cornus ammomum	Silky Dogwood	8 ft.	2-8 ft.	0.5"-1.5" cal.	Shrub	35%
Salix sericea	Silky Willow	8 ft.	2-8 ft.	0.5"-1.5" cal.	Shrub	35%
Physocarpos opulifolius	Ninebark	8 ft.	2-8 ft.	0.5"-1.5" cal.	Shrub	15%
						100%
Herbaceous Plugs						
**Juncus effusus*	Common Rush	5 ft.	3-5 ft.	1.0"- 2.0" plug	Herb	40%
Carex alata	Broadwing Sedge	5 ft.	3-5 ft.	1.0"- 2.0" plug	Herb	40%
Panicum virgatum	Switchgrass	5 ft.	3-5 ft.	1.0"- 2.0" plug	Herb	20%
						100%
*Juncus effusus only to be used in channels within 100' of confluence with UT to Pine Hill Branch.						

Buffer Planting Zone						
Bare Root						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Caliper Size**	**Stratum**	**# of Stems**
Quercus phellos	Willow Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	12%
Platanus occidentalis	Sycamore	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	22%
Betula nigra	River Birch	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	17%
Liriodendron tulipifera	Tulip Poplar	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	17%
Quercus palustris	Pin Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
Fraxinus pennsylvanica	Green Ash	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	22%
						100%

Permanent Riparian Seeding				
Pure Live Seed (20 lbs/ acre)				
Approved Date	**Species Name**	**Common Name**	**Stratum**	**Density (lbs/acre)**
All Year	*Panicum rigidulum*	Redtop Panicgrass	Herb	1.5
All Year	*Agrostis hyemalis*	Winter Bentgrass	Herb	4.0
All Year	*Chasmanthium latifolium*	River Oats	Herb	2.0
All Year	*Rudbeckia hirta*	Blackeyed Susan	Herb	1.0
All Year	*Coreopsis lanceolata*	Lanceleaf Coreopsis	Herb	1.0
All Year	*Carex vulpinoidea*	Fox Sedge	Herb	3.0
All Year	*Panicum clandestinum*	Deertongue	Herb	3.5
All Year	*Elymus virginicus*	Virginia Wild Rye	Herb	2.0
All Year	*Asclepias syrica*	Common Milkweed	Herb	0.2
All Year	*Baptisia australis*	Blue False Indigo	Herb	0.2
All Year	*Gaillardia pulchella*	Annual Gaillardia	Herb	1.0
All Year	*Echinacea purpurea*	Pale Purple Coneflower	Herb	0.6

Permanent Seeding Outside Easement				
Approved Date	**Species Name**	**Stratum**	**Common Name**	**Density (lbs/acre)**
All Year	*Festuca arundinacea*	Herb	Tall Fescue	40

Record Drawing

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Holman Mill Mitigation Project
Alamance County, North Carolina
Planting Plan

Revisions:

Date: 10.31.2016
Job Number: 005-02146
Project Engineer: ANA
Drawn By: CLM
Checked By: JNK

Sheet 3.1

F:\Projects\005-02146 Holman Mill\Grafx\Plans\As-Built\Record Drawings\02146-AB-Planting Plan.dgn