AS-BUILT BASELINE MONITORING REPORT

FINAL

KEY MILL MITIGATION SITE

Surry County, NC
NCDEQ Contract No. 7180
DMS Project No. 100025
USACE Action ID No. SAW-2017-01504
Yadkin River Basin
HUC 03040101

Data Collection Period: September 2019 – July 2020
Submission Date: October 5, 2020

PREPARED FOR:

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

October 5, 2020

Mr. Matthew Reid
Project Manager
NCDEQ – Division of Mitigation Services
5 Ravenscroft Dr., Suite 102
Asheville, NC 28801

RE: Task 6 – Final As-built Baseline Monitoring Report
Key Mill Mitigation Site, Surry County
Yadkin River Basin – HUC 03040101
DMS Project ID No. 100025 / DEQ Contract #7180

Dear Mr. Reid:

Wildlands Engineering, Inc. (Wildlands) has reviewed the Division of Mitigation Services (DMS) comments from the Draft As-built Baseline Monitoring report for the Key Mill Mitigation Site. The report has been updated to reflect those comments. The Final As-built Baseline Monitoring Document and Record Drawings are included. Wildlands' responses to DMS' report comments are noted below in *italics*.

DMS comment: There was considerable storm damage caused to the site during the winter/spring 2020. Please include a brief discussion regarding the impact and changes to the timeline this had on construction, repairs and asbuilt/MY0 data collection that followed.

Wildlands response: The site received approximately 4.2" of rain on February 6, 2020. This equated to an event between a 25-yr and 50-yr recurrence interval based on NOAA precipitation frequency for Mount Airy. Due to critical areas being graded just the day before, considerable damage was sustained throughout the site. Repair efforts added approximately 4 weeks to the completion of earthwork, which consequentially delayed planting and as-built survey. In addition, some monitoring features had to be re-installed after the repairs were completed.

DMS comment: Bull Creek Reach 3: Section discusses BMP installed at Station 115+10. According to the asbuilt sheets, this stationing may be a mistake. The correct station appears to be 155+10.

Wildlands response: The stationing text has been revised to 155+10 to correctly reflect the location of the BMPs' confluence with Bull Creek Reach 3.

DMS comment: There were several instances where cross-section locations were moved after the as-built survey was completed. For clarification, do the cross-section plots shown in the report represent the relocated cross-sections that will be used for the overlays in future monitoring years?

Wildlands response: Yes, the cross-section plots represented in the report are of the relocated cross-sections that will be used for the overlays in subsequent monitoring years.

DMS comment: Thank you for identifying the 127 LF of fence inadvertently installed inside the conservation easement and relocating this before MY1 is completed.

Wildlands response: You are welcome.

DMS comment: Numerous rock sills were replaced with logs sills due to local material availability. Were there more trees removed during construction than originally anticipated? Or, was this design decision based on other factors?

Wildlands response: We spec our sills to be interchangeable between boulders and logs. The functionality does not change. We removed a small number of additional trees during construction, which allowed us to use more logs and on-site materials as opposed to hauling in boulders.

DMS comment: Please modify existing photo point locations or add additional photo points to capture crossings/CE breaks for MY1. Please include cattle crossing area under Key Rd.

Wildlands response: Photo point locations have been either modified or added, as needed, to capture both an upstream and downstream representative photo of each culvert crossing/CE break, as well as both a northern and southern view of the cattle crossing at Key Mill Rd. These photo locations have been updated in the As-built Monitoring Plan View Maps (Figures 3.0 – 3.3), as well as in the Record Drawings. These location changes are depicted in red on the Record Drawings where they differ from those collected during the baseline survey. In addition, photos were collected in these locations during MY0, included in the MY0 photo log to serve as a baseline depiction of the revised location for comparison throughout the monitoring period, and recorded as changes in Section 5.1 Record Drawings of the As-built Baseline Monitoring Report.

DMS comment: The planting list shown in the Record Drawing differs from the planting list shown on the planting plan sheets provided in the approved Mitigation Plan. For the Record Drawing, please call out in Red the species that were not in the approved mitigation plan. For example, Black Gum, Silver Maple, Green Ash, Paw Paw, Southern Red Oak, Northern Red Oak, American Holly and American Beech were planted, but not in the approved mitigation plan.

Wildlands response: The record drawing planting list has been updated to reference the approved planting list from the Mitigation Plan. Species that were not listed on the approved planting list are shown in red as are changes in the planted densities. In addition, these updates have been revised in Section 5.1.17 Planting List of the As-built Baseline Monitoring Report.

DMS Comment: The IRT has requested that Green Ash not make up more than 5% of the planted stems on site. The planting plan shows that Green Ash comprises 12.5% of the planted stems. If a replant is required in the future, please exclude Green Ash from the list.

Wildlands response: Wildlands acknowledges that the planting density is higher than the IRT's recommended density for green ash and will refrain from using green ash if supplemental replanting is needed in the future.

DMS Comment: Are the green hatched areas that were not planted shown on the planting plan existing undisturbed forested areas? There is considerable area that was slated for planting that did not occur. Likewise, there are numerous areas that were planted that was not planned. Briefly explain this change to the planting plan.

Wildlands response: The green hatched areas that represent areas not planted per plan are mature forested areas. It was determined during construction that the density of trees and understory species were sufficient and met the stem count criteria. The red hatched areas represent areas that were planted but were not planned or the planting area was altered. There are two primary sections where this occurs: Bull Creek Reach 1A (Sheet 2.2) and near the confluence of Bull Creek and UT3 (Sheets 2.4 and 2.9). Bull Creek Reach 1A was due to the realignment of the stream to avoid a bedrock outcropping. The area near

UT3 confluence was where construction staging was expanded and where dirt was harvested to backfill the old channel. Planting in this area consisted of pasture seeding only.

Electronic Deliverables:

DMS Comment: Please include the zero credit connecting feature that spans the easement break.

Wildlands response: As requested the connecting feature has been included as a "Not for credit" polyline as part of the Project Stream feature class in the electronic geodatabase submittal.

DMS Comment: Before resubmitting, please isolate the stream features contained in "AlignmentDeviations_new.shp" and consolidate with "StreamPH_new.shp" for clarity. Please remove any old or irrelevant features from "StreamsPH_new.shp.

Wildlands response: As requested the two stream feature classes have been consolidated into one feature class, which is named "Project_Streams_AB". Additionally, old and/or irrelevant data have been removed.

Wildlands acknowledges that 180 days must separate MY0 versus MY1 data. Therefore, MY1 data collection will commence in late fall and/or early winter, and delivery of the MY1 report will be delayed until January 31st to account for this requirement.

As requested, Wildlands has included one hard copy of the Final Key Mill Mitigation Site As-built Baseline Monitoring Report and Record Drawings, as well as a USB drive that includes the full final electronic copy with the electronic support files of the report, and a PDF of our written responses to comments. Additionally, a copy of our response letter has been included after the report cover page of the revised report.

Sincerely,

Kristi Suggs
Senior Environmental Scientist
ksuggs@wildlandseng.com

AS-BUILT BASELINE MONITORING REPORT

KEY MILL MITIGATION SITE

Surry County, NC

Yadkin River Basin
HUC 03040101

DMS Project No. 100025
USACE Action ID No. SAW-2017-01504

PREPARED BY:

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EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (Wildlands) implemented a full-delivery stream mitigation project at the Key Mill Mitigation Site (Site) for the North Carolina Department of Environmental Quality (DEQ) Division of Mitigation Services (DMS). The project restored, enhanced, and preserved a total of 7,437 linear feet (LF) of perennial and intermittent stream in Surry County, NC. The Site is located within the DMS targeted watershed for the Yadkin River Basin Hydrologic Unit Code (HUC) 03040101110040 and the NC Division of Water Resources (NCDWR) Sub-basin 03-07-03. The project is providing 6,107.300 cool stream mitigation units (SMUs) for the Yadkin River Basin HUC 03040101 (Yadkin 01).

The Site has a long history of agricultural activity and most of the stressors to stream functions are related to this historic and current land use practices. The major stream stressors for the Site were concentrated agricultural runoff inputs, degraded instream habitat, active stream incision, lack of stabilizing streamside vegetation, bank erosion and failure, and the lack of bedform diversity. The effects of these stressors resulted in degraded water quality and habitat throughout the Site when compared to reference conditions. The project approach for the Site focused on evaluating the Site's existing functional condition and evaluating its potential for recovery and need for intervention.

The project goals defined in the mitigation plan (Wildlands, 2019) were established with careful consideration of 2009 Upper Yadkin Pee Dee River Basin Restoration Priorities (RBRP) goals and objectives to address stressors identified in the watershed. The established project goals include:

- Improve stream channel stability,
- Stabilize eroding stream banks,
- Exclude livestock from stream channels,
- Reconnect channels with historic floodplains,
- Improve instream habitat,
- Reduce sediment and nutrient input from adjacent farm fields,
- Restore and enhance native floodplain vegetation, and
- Permanently protect the project site from degradational impacts.

The Site construction and as-built surveys were completed between April and July 2020. Planting and baseline vegetation data collection occurred during April 2020. Minimal adjustments were made during construction and specific changes are detailed in Section 5.1. Baseline (MY0) profiles and cross-section dimensions closely match the design parameters with little variation. A small section of fence line was inadvertently installed inside the easement along the upper extent of UT1A. The fence will be relocated and documented in the MY1 Report. The Site has been built as designed and is expected to meet the upcoming monitoring year's success criteria.

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LIST OF ACRONYMS

Best Management Practice (BMP)
Current Condition Plan View (CCPV)
Department of Environmental Quality (DEQ)
Division of Mitigation Services (DMS)
Hydrologic Unit Code (HUC)
Interagency Review Team (IRT)
Monitoring Year (MY)
North Carolina Division of Water Resources (NCDWR)
Stream Mitigation Unit (SMU)
Step Pool Stormwater Conveyance (SPSC)
United States Army Corps of Engineers (USACE)
Unnamed Tributary (UT)
Yadkin Pee Dee River Basin Priorities (RBRP)

Section 1: PROJECT GOALS, BACKGROUND, AND ATTRIBUTES

1.1 Project Location and Setting

The Key Mill Mitigation Site (Site) is located in Surry County approximately 7.2 miles south of City of Mount Airy, NC in the Yadkin River Basin HUC 03040101110040 and NCDWR Sub-basin 03-07-03 (Figure 1). Located in the Smith River Allochthon of the Piedmont physiographic province (NCGS, 1985), the project watershed is predominately forested land with some areas of agriculture including the Site.

The Site is located on one parcel, bisected by Key Road creating a western side and an eastern side (herein referenced as the West side and the East side) to the project. The Site is predominantly actively grazed pasture with the downstream extent of the Site forested. Bull Creek is the primary stream, which flows southeast through the center of the Site. There are five unnamed tributaries (UT1, UT2, UT2A-C, UT3, and UT3A-C) that join Bull Creek within the Site limits (Figure 2). Valleys throughout the Site have moderately steep walls with alluvial bottoms, whereas valleys along the upstream extents of the project's East side tributaries are narrow with colluvial bottoms.

The West side of the project contains the upstream portion of Bull Creek (Reaches 1A, 1B, and 2), as well as, UT1A, UT1B, and UT1C. UT1C joins Bull Creek Reach 2 near the bottom of the West Side of the Site and flows through a culvert under Key Road into the eastern side of the Site. The East Side of the site contains the downstream portion of Bull Creek (Reach 3 and 4), as well as UT2, UT2A-C, UT3, UT3A-C. The Site drains approximately 2.15 square miles of rural land. Downstream of the Site, Bull Creek continues southeast to join the Ararat River near the Cedar Hill community.

Prior to construction, the Site had been primarily used for agriculture. Lands upstream and downstream of the Site are predominantly forested though there are some areas of agricultural lands and small residential areas within the watershed. Agricultural activities within the Site had led to streams in various stages of impairment. Most of the streams on the Site were impaired from limited to non-existent buffers, concentrated agricultural runoff inputs, degraded instream habitat, active stream incision, bank erosion and failure, and the lack of bedform diversity. Pre-construction conditions are outlined in Table 4 of Appendix 1 and Table 6 of Appendix 2.

1.2 Project Goals and Objectives

The Site is providing numerous ecological benefits within the Yadkin Valley Basin. The project goals were established with careful consideration to address stressors that were identified in the RBRP (EEP, 2009). Improvements to water quality and ecological processes are outlined below as project goals and objectives.

Goals	Objectives
Improve stream channel stability.	Restore stream channels that will maintain a stable pattern and profile considering the hydrologic and sediment inputs to the system, the landscape setting, and the watershed conditions. Create stable tie-ins for tributaries joining restored channels. Add bank revetments and in-stream structures to protect restored streams.
Stabilize eroding stream banks.	Reconstruct stream channels slated for restoration with stable dimensions. Add bank revetments and in-stream structures to reaches to protect restored/enhanced streams.
Exclude livestock from stream channels.	Install livestock fencing and watering systems as needed to exclude livestock from stream channels and riparian areas.
Reconnect channels with historic floodplains.	Reconstruct stream channels with appropriate bankfull dimensions and depth relative to the floodplain.
Improve instream habitat.	Remove man-made impoundments and culvert crossings within easement. Install habitat features such as constructed riffles, cover logs, and brush toes into restored/enhanced streams. Add woody materials to channel beds. Construct pools of varying depth.
Reduce sediment and nutrient input from adjacent farm fields.	Restore the streams' riparian buffers. Construct a BMP to slow and treat runoff from farm fields before entering Site streams.
Restore and enhance native floodplain vegetation.	Plant native tree species in riparian zone where currently insufficient.
Permanently protect the project site from degradational impacts.	Record a conservation easement on the Site and install livestock exclusion fencing.

1.3 Project Structure, Restoration Type and Approach

The final mitigation plan was submitted and accepted by DMS in October of 2018 and the IRT in January of 2019. Construction activities were completed in April 2020 by Carolina Environmental Contracting, Inc. Kee Mapping & Surveying, P.A. completed the as-built survey in June 2020. Planting was completed following construction in April of 2020 by Bruton Natural Systems, Inc. Field adjustments made during construction are described in further detail in section 5.1 and depicted in the record drawings in Appendix 4. Please refer to Appendix 1 for detailed project activity, history, contact information, and watershed/site background information.

1.3.1 Project Structure

The project will provide 6,107.300 cool stream mitigation units (SMUs) in the Yadkin 01 service area. Project mitigation components are outlined in the Mitigation Assets and Components Table (Table 1) and depicted in the As-built Monitoring Plan View Maps (Figures 3.0 - 3.2) that are located in Appendix 1.

1.3.2 Restoration Type and Approach

The design approach for this Site was chosen based on the surrounding landscape, climate, natural vegetation communities but also with thorough consideration to existing watershed conditions and trajectory. The mitigation approaches for the streams on the Site were developed to achieve the maximum potential for functional uplift relative to the existing conditions on the Site. The project includes stream restoration, enhancement II, and preservation.

When needed, the project streams were reconnected with an active flood bench or floodplain at the bankfull stage, and the bankfull channels were constructed with stable dimension, pattern, and profile. Instream structures were constructed in channel to help maintain stable channel morphology and improve aquatic habitat. Reaches that were stable and functioning were preserved to protect them from future impacts from cattle and agricultural production.

All the project reaches are protected in perpetuity with the implementation of a conservation easement. Along restoration and enhancement reaches, streambanks and floodplains were planted with native tree and shrub species as depicted in the planting plan of the record drawings located in Appendix 4. Invasive species within the riparian buffers of restoration and enhancement reaches were treated at the time of construction. The extent of invasive species coverage will be monitored, mapped, and controlled as necessary throughout the required monitoring period.

Specific stream mitigation types are illustrated in Figure 2 and detailed below. The Site vegetative planting plan is depicted on sheets 2.1 through 2.9 of the record drawings located in Appendix 4.

Bull Creek Reach 1 A

Reach 1A enters the Site at Station 100+95 from the west as a perennial stream. The valley at the upstream extent is confined but gently sloping at 1.0%. To allow for a Priority 1 restoration approach to begin at the property boundary, an agreement was made with the upstream landowner to allow for hydraulic trespass.

The channel was constructed as a Rosgen C3-type stream with a slope of approximately 0.7%. Because bedrock was exposed in the left floodplain during construction, the channel was realigned from the head of the reach to the start of Reach 1B. Brush toe was incorporated along the outside meander bends to increase shear resistance. Riffles, log sills, and log j-hooks were incorporated to provide grade control.

Bull Creek Reach 1 B

Bull Creek Reach 1B begins at station 105+39. Here, the stream becomes confined along the right valley toe, the left floodplain widens, and the slope steepens slightly to approximately 1.2%. The design channel remains as a Rosgen C3-type stream, and a Priority 1 restoration approach continues for approximately seven hundred feet to the start of Reach 2 at Station 112+61. Brush toe and lunker logs were used to promote the beneficial re-use of woody debris in the channel. Constructed riffles and log sills were incorporated to provide grade control. Constructed riffle types are more diverse along this reach (as compared to Reach 1A) to promote bed form diversity.

Bull Creek Reach 2

Bull Creek Reach 2 begins at station 112+61 where the valley slope increases and the design transitions to a Rosgen C3b-type stream. Near the downstream extent of Reach 2, UT1C joins Bull Creek at Station 116+79. Below the confluence with UT1C, the design approach transitions to Priority 2 to re-connect to the existing channel bed elevation at an existing ford crossing. Structures (i.e., brush toe, rock sills, log sills, boulder toe, log j-hooks and log-rock cascade riffles, etc.) were added along this reach to dissipate shear stress along the bank and bed of the channel, as well as aid in grade control.

In order to avoid impacting remnants of an old mill dam, hand stacked by a Key family ancestor, no restoration activities occurred along the channel just upstream of Key Road. However, the area was fenced to exclude livestock from accessing the stream except during times in which cattle are moved between pastures. The stream then flows under Key Road through two 60-inch corrugated metal pipes into the East side of the Site.

Bull Creek Reach 3

Bull Creek Reach 3 begins downstream of the Key Rd. and an internal cattle crossing at station 150+30. The valley is wider and gently sloping at <1.0%. Reach 3 was designed as a Rosgen C3-type stream with an average channel slope of 0.95% for approximately 1,700 feet.

UT2C and UT3C join Reach 3 at Station 151+20 and 156+00, respectively, before an internal farm road crossing of dual arch pipe culverts at Station 158+63. Reach 3 continues past the culvert as a Priority 2 Rosgen C3-type stream for approximately 900 linear feet prior to tying into the downstream preservation reach at Station 167+56. Throughout the reach the channel receives drainage from multiple stabilized wetland seeps and drainage swales. Log vanes and brush toe were incorporated along this reach to reduce bank erosion. Log sills and constructed riffles provide grade control.

Approximately 500 linear feet downstream of the Key Road crossing, a step-pool conveyance channel (SPCC) best management practice (BMP) was implemented within the right floodplain and joins Reach 3 at Station 155+10. The SPCC was designed to capture pasture runoff from a gully with a drainage area of approximately 20 acres. This BMP will provide initial stormwater run-off treatment before discharging into the restored stream.

Bull Creek Reach 4

Bull Creek Reach 4 begins at station 167+56. This reach was identified for preservation and continues from the downstream extent of Reach 3 to the property boundary. The reach is currently stable and exhibits mature vegetation. Desirable aquatic habitat is present throughout the reach and includes undercut banks, root mats, leaf packs, and small debris jams. Stabilizing the upstream reaches will allow for this reach to remain stable and reduce the sediment load.

UT1A

UT1A originates as a perennial stream outside of the conservation easement and begins within the project boundaries at station 200+21. Enhancement level II was incorporated along this reach to promote long-term channel stability and included isolated pockets of bank grading, fence installation for cattle exclusion, the removal of a collapsed culvert, profile adjustments, the installation of a new appropriately sized culverted crossing, and riparian plantings. A cucumber magnolia tree, located along the right bank of UT1A approximately 100 feet downstream of the existing culvert, was preserved at the request of the landowner.

UT1B and UT1C

Downstream of the enhancement reach, reach UT1B begins at station 208+85. It has an average slope of 3.2% and designed as Rosgen B4-type stream. A Priority 2 restoration approach was implemented due to the narrow and steep valley and short valley length. Log and rock sills along with woody riffles were utilized for grade control, while native and chunky riffles were implemented to promote bedform diversity. UT1B terminates at an internal crossing, Station 210+97, and is succeeded by UT1C.

UT1C begins at station 211+36 where the valley and channel slopes steepen. The design transitions to a Rosgen B4a-type stream. Due to a wider valley, the reach was constructed almost entirely offline, within the left floodplain of the existing channel. Rock sills were incorporated for grade control and brush toe for bank stability. A Priority 2 restoration continues along UT1C to tie into the confluence with Bull Creek Reach 2 at Station 213+93.

UT2

UT2 originates from a spring head within the wooded area on an adjacent property. The reach enters the site as an intermittent stream at Station 350+00 and remains intermittent to its confluence with UT2A at Station 350+42. The valley is confined with a steep slope of approximately 6.4%. The channel

was designed as a Rosgen B4-type stream and was restored using a Priority 2 approach. Logs sills and constructed riffles were implemented to provide grade control along this reach.

UT2A, UT2B, and UT2C

As UT2A originates off the property as a perennial stream and enters the project Site at Station 300+00. The valley is moderately confined with a slope of 2.9% and conveys a 0.05 square mile drainage area. This reach was restored as a B4-type stream using Priority 2 restoration with an average channel slope of 2.5%. Chunky riffles were utilized to dissipate channel velocity, log sills to facilitate grade control, and brush toe to protect and stabilize outside meander bends. UT2A ends at an internal culvert crossing at Station 303+15 where the valley widens.

UT2B begins downstream of the internal culvert crossing at Station 303+50. This reach has a valley slope of 3.1%, a channel slope of 2%, and was restored as a Rosgen C4b-type stream using Priority 2 restoration. UT2B continues to be confined by steep valley walls before opening up near its end at Station 306+13. Like UT2A, structures were incorporated to dissipate channel velocity, stabilize stream banks, and facilitate grade control.

UT2C begins at station 306+13. The valley widens as it transitions downstream towards Bull Creek and the valley slope decreases to 1.9%. This reach was restored as a Rosgen C4-type stream with an average channel slope of 1.4%. Priority 2 restoration was used along the reach to tie it into the lower bed elevation of Bull Creek at Station 310+82. Brush toe was incorporated along outer meanders throughout the reach to stabilize the stream banks. Constructed riffles were used to increase bedform diversity, and log sills were used to provide grade control, when needed.

UT3

UT3 begins outside the project limits from one of the outlets of an existing farm pond. This reach enters the project area at Station 450+38 flows downstream for 18 feet before the confluence with UT3A. UT3 is an Enhancement II reach.

UT3A, UT3B, and UT3C

UT3A originates from another outlet of the farm pond and enters the project area 400+57. An Enhancement level II approach was implemented along this reach and included cattle exclusion, areas of bank grading, profile manipulation to enhance the functionality of this stream. A small section of channel realignment was implemented at Station 401+64 to 402+45 to improve bank stability and meander pattern. The enhancement reach ends at Station 404+70 where it transitions to UT3B.

UT3B begins at station 404+70. With an average channel slope of 3.2%, UT3B was designed as a Rosgen B4-type stream. Priority 2 restoration was implemented along the reach. Tall mature trees located on both of banks of the reach were avoided when possible. Log sills were frequently incorporated into the channel design to maintain grade control and flatten riffle slopes. Brush toe was incorporated to protect the stream banks. UT3B ends at an internal crossing (Station 407+77) before transitioning to UT3C.

UT3C begins at station 408+12 after an internal arched corrugated metal pipe crossing and continues for approximately 400 feet through a confined valley to an open floodplain upstream of its confluence with Bull Creek at Station 412+24. The majority of this reach incorporated Priority 1 restoration before transitioning to Priority 2 near its confluence with Bull Creek Reach 3. With a channel slope of 1.3%, the reach was designed as a Rosgen C4-type stream. Brush toe, constructed riffles, and log sills were incorporated to maintain the stream's structural integrity.

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.

Section 2: PERFORMANCE STANDARDS

The stream performance criteria for the Site follow approved performance criteria presented in the Key Mill Site Mitigation Plan (2019) and is based on performance criteria presented in the DMS Mitigation Plan Template (August 2016), and the Stream and Wetland Mitigation Guidance issued in October 2016 by the USACE. Annual monitoring and semi-annual site visits will be conducted to assess the condition of the finished project. Specific performance standard components are proposed for stream morphology, hydrology, and vegetation. Performance criteria will be evaluated throughout the seven-year post-construction monitoring period. The monitoring plan designed to verify that performance standards are met is described in Section 3.

2.1 Streams

2.1.1 Dimension

Riffle cross-sections on the restoration reaches should be stable and should show little change in bankfull area, bank height ratio, and width-to-depth ratio. All riffle cross-sections should fall within the parameters defined for the designated stream type. Bank height ratios shall not exceed 1.2 and entrenchment ratios shall be at least 1.4 for B-type channels and 2.2 for restored C-type channels. 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 vertically incising thalweg or eroding channel banks. 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 will not be taken if channel changes indicate a movement toward stability.

2.1.2 Pattern and Profile

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. Annual longitudinal profile surveys are not required 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 2016 USACE Stream and Wetland Mitigation Guidance for the necessary reaches.

Restoration reaches must remain vertically stable throughout the monitoring period with little indication of downcutting or significant aggradation. Deposition of sediments at certain locations (such as the inside of meander bends) is expected and acceptable. Changes in pool depth are not an indication of vertical instability. Restoration reaches must remain laterally stable and major changes planform pattern dimensions and sinuosity should not occur. However, migration of meanders on alluvial channels is not an indication of instability if cross sectional dimensions continue to meet the requirements.

2.1.3 Substrate

A pebble count was conducted at each surveyed riffle to characterize the pavement during the baseline monitoring only. A reach-wide pebble count will be performed in each restoration reach for monitoring years 1, 2, 3, 5 and 7. Reach-wide counts will be conducted for classification purposes. Restoration reaches should show maintenance of coarser materials in the riffle features and finer particles in the pool features. Riffles may fine over the course of monitoring due to the stabilization of contributing watershed sediment sources. Successful substrate measurements show that the restored stream meet the objective of maintaining stable banks through reduced shear stress.

However, natural variations in pool and riffle substrate is expected as a result of sediment transport processes in steeper sloped channels.

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 of mid-channel bars 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

The occurrence of bankfull events will be documented throughout the monitoring period. Four bankfull flow events must be documented within the seven-year monitoring period. The four bankfull events must occur in separate years. In addition, a stream gage pressure transducer was installed on the restored intermittent channel (UT2) to document 30 consecutive days of baseflow. Stream monitoring will continue until performance standards in the form of four bankfull events in separate years have been documented.

2.2 Vegetation

The final vegetative performance standard will be the survival of 210 planted stems per acre in the planted riparian areas at the end of the required seven-year monitoring period. 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 MY3 and at least 260 stems per acre at the end of MY5. In NC mountain counties, such as Surry County, planted trees must average 6 feet in height in each plot at the end of MY5 and 8 feet in height at MY7. The extent of invasive species coverage will also be monitored and controlled as necessary throughout the required monitoring period.

2.3 Visual Assessments

Visual assessments should support the specific performance standards for each metric as described above.

2.4 Schedule and Reporting

Monitoring reports will be prepared in the fall of each year of monitoring and submitted to DMS. Based on the DMS Annual Monitoring Template (April 2015), 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,
- Project Asset Map of major project elements,
- Photographs showing views of the restored Site taken from fixed point stations,
- CCPV Map with monitoring features and current problem areas noted such as stability and easement encroachment based on the cross-section surveys and annual visual assessments,
- Assessment of the stability of the stream based on the cross-sections,
- Vegetative data as described above including the identification of any invasion by undesirable plant species,
- A description of damage by animals or vandalism,
- Maintenance issues and recommended remediation measures will be documented, and
- Wildlife observations.

Section 3: MONITORING PLAN & METHODOLOGY

Annual monitoring will consist of collecting morphologic, vegetative, and hydrologic data to assess the project success based on the restoration goals, as outlined in the Key Mill Mitigation Site Mitigation Plan (2019). Monitoring requirements will follow guidelines outlined in the DMS Annual Monitoring and Closeout Reporting Template (April 2015) and the USACE Stream and Wetland Mitigation Guidance (October 2016). Installed monitoring device and plot locations closely mimic the locations of those proposed in the Site's Mitigation Plan. Deviations from these locations were made when professional judgement deemed them necessary to better represent as-built field conditions or when installation of the device in the proposed location was not physically feasible.

Project success will be assessed by measuring channel dimension, substrate composition, vegetation, surface water hydrology, and by analyzing photographs and performing visual assessments. Any high priority problem areas identified, such as unstable stream banks, bed instability, aggradation/degradation, and/or poor vegetation establishment will be evaluated on a case-by-case basis. The problem areas will be visually noted and reported to DMS staff in the annual report. Standard DMS monitoring reports will be submitted in monitoring years 1, 2, 3, 5, and 7. Monitoring activities in years 4 and 6 will be documented in a memorandum to include a project summary update, annual photos, and updated monitoring plan map. Closeout will occur seven years beyond completion of construction or once performance standards are met. All survey data will be georeferenced to North Carolina State Plane coordinates. Refer to Table 5 in Appendix 1 for the monitoring component summary.

3.1 Streams

Geomorphic assessments 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 documents (Rosgen, 1994 and 1996), and in the Stream Restoration: A Natural Channel Design Handbook (Doll et al., 2003). Please refer to Figures 3.0 through 3.3 in Appendix 1 for monitoring locations discussed below.

3.1.1 Dimension

To assess channel dimension performance, 15 permanent cross-sections were installed along stream restoration reaches as defined in Table 20 and Table 21 of the Mitigation Plan. Cross-section locations were chosen in the field to be representative of the typical dimensions for each project reach. Each cross-section is permanently marked with rebar installed in concrete and ½ inch PVC pipes. Cross-section surveys will include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg. Cross-section surveys will be conducted in monitoring years one, two, three, five, and seven. Photographs will be taken of the cross-sections looking downstream during the survey assessment.

3.1.2 Pattern and Profile

Longitudinal profile surveys will not be conducted during the seven-year post-construction 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 Stream Mitigation Guidelines issued in October 2016 by the USACE for the necessary reaches. Stream pattern and profile will be assessed visually as described below in Section 3.1.6.

3.1.3 Substrate

Reach-wide pebble count will be performed in each restoration reach for classification purposes and will be conducted in monitoring years one, two, three, five, and seven. Riffle 100-count substrate sampling were collected in each surveyed riffle cross-section during the baseline monitoring only to characterize pavement at as-built.

3.1.4 Photo Reference Points

A total of 25 permanent photograph reference points were established along the stream reaches after construction. Photographs will be taken once a year to visually document stability for the seven-year monitoring period. Permanent markers were established and located with GPS equipment so that the same locations and view directions on the site are photographed each year. Photos will be used to monitor all restoration, enhancement II, and preservation stream reaches.

Longitudinal reference photos were established along the channel and will be documented by taking a photo looking upstream and downstream. Cross-sectional photos will be taken of each permanent cross-section looking upstream and downstream.

3.1.5 Visual Assessment

Visual assessments will be performed along stream reaches on a semi-annual basis during the seven-year monitoring period. Areas of concern, such as channel instability (i.e. lateral and/or vertical instability, in-stream structure failure/instability and/or piping, headcuts), vegetation health (i.e. low stem density, mortality, invasive species, and/or encroachment), beaver activity, or livestock trespass; will be mapped, photographed, and described in the annual monitoring reports. 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 Hydrology Documentation

Automated pressure transducers will document stream hydrology and will be used on mitigation reaches that implement restoration approaches throughout the seven-year monitoring period. Henceforth, these devices will be referred to as “crest gages (CG)” for those recording bankfull events and “stream gages (SG)” for those recording baseflow.

3.2.1 Bankfull Events

The occurrence of bankfull events will be documented with the use of automated CGs, photographs, and visual assessments such as debris lines. CGs were set to record bankfull events every three hours and were installed within the stream’s riffle. A total of 5 CGs were installed along restoration reaches (Bull Creek Reach 2 and 3, UT1C, UT2C, and UT3C). The CGs will be downloaded quarterly to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition observed during field visits.

3.2.2 Baseflow Monitoring

Streamflow stage will be monitored to document 30 days of continuous flow using a continuous stage recorder or SG. One automated SG was installed on UT2 and was set to record every 2 hours. Evidence of channel flow will be documented with a photo when possible. Transducer data will be plotted and included in the annual monitoring reports.

3.3 Vegetation

Vegetative plot monitoring will be conducted in post-construction monitoring years 1, 2, 3, 5, and 7. Permanent plots will be monitored in accordance with the guidelines and procedures developed by the

Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008) and the 2016 USACE Stream and Wetland Mitigation Guidance to assess the vegetation success. For both permanent and random plots, all woody stems, including exotic and invasive species, should be counted. Supplemental plantings and volunteer plants must be present for at least two growing seasons before counting toward performance standards for monitoring years five and seven. Exotic/invasive species will not count toward success of performance standards.

A total of 8 permanent vegetation plots were established within the project easement area. Permanent vegetation plots were randomly established within the planted stream riparian buffer areas to capture the heterogeneity of the designed vegetative communities. The locations of permanent vegetation plots were chosen in the field using the same distribution throughout the planting areas, as shown in the Site's Mitigation Plan, and to best represent the planted areas within the easement.

All of the permanent vegetative plots were established as either a standard 10-meter by 10-meter square plot or a 5-meter by 20-meter plot. The vegetation plot corners have been marked and are recoverable either through field identification or with the use of a GPS unit. Reference photographs at the origin looking diagonally across the plot to the opposite corner were taken during the MY0 in April 2020. Subsequent assessments in monitoring years one, two, three, five, and seven following baseline survey will capture the same reference photograph locations.

Beginning in MY1, individual permanent plot data will include diameter, height, density, vigor, damage (if any), and percent survival. Planted woody stems were marked and mapped in MY0 and will be re-marked, if needed, during subsequent monitoring year assessments using a known origin so they can be found. Mortality will be determined from the difference between the baseline year's living planted stems and the current year's living planted stems.

To evaluate random vegetation performance for the Site, 5 mobile vegetation plots were established in MY0, for use in MY1, using a circular or 100 m^2 square/rectangular plot. Mobile plots will be re-established in different and random locations throughout the planted conservation easement in monitoring years 2, 3, 5, and 7. These locations will be geographically recorded and depicted in the CCPV maps for the corresponding monitoring assessment year. Mobile vegetation plot assessments will document the number of stems, species type, and stem height within the plot.

Please refer to Figures 3.0 through 3.3 in Appendix 1 for the permanent and mobile MY0/1 vegetation monitoring plot locations.

Section 4: ADAPTIVE MANAGEMENT AND CONTINGENCY PLAN

4.1 Adaptive Management 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 or until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance for stream features should be most often expected in the first two years following site construction. The need for maintenance will be evaluated annually during monitoring activities. Maintenance activities may include the following.

Component/ Feature	Maintenance through project close-out
Stream	Routine channel maintenance and repair activities may include chinking of in-stream structures to prevent piping, securing of loose coir matting, and supplemental installations of live stakes and other target vegetation along the channel – these shall be conducted where success criteria are threatened or at the discretion of the Designer. Areas where storm water and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting. Beaver activity will be monitored and beaver dams on project streams will typically be removed, at the discretion of the Designer, during the monitoring period to allow for bank stabilization and stream development outside of this type of influence.
Vegetation	Vegetation shall be maintained to ensure the health and vigor of the targeted community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species requiring treatment per the Invasive Species Treatment Plan (Appendix 6) shall be treated in accordance with that plan and with NC Department of Agriculture (NCDA) rules and regulations.
BMP	Routine BMP maintenance may include removal of accumulated sediment from the bottom of the BMP. Stone and boulders may require adjustment to prevent scour. Wildlands will evaluate and determine whether sediment removal is necessary based on observations of the constructed sediment storage volume and volume remaining in subsequent monitoring years.
Stream Crossings	Stream crossings shall be maintained to ensure stability and functionality when livestock are present. Routine maintenance and repair activities may include additional matting, gravel, and seeding for ford crossings. Maintenance and repair for culvert crossings used for livestock should be minimal but may require additional gravel and seeding to minimize runoff to the adjacent waterbody. Cattle exclusion fencing and gates where applicable shall be regularly inspected and maintained as needed.
Site Boundary	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.

Wildlands will develop necessary adaptive measures or implement appropriate remedial actions in the event that the Site or a specific component of the Site fails to achieve the success criteria outlined above. The project-specific monitoring plan developed during the design phase identifies an appropriate threshold for maintenance intervention based on the monitored items. Any actions implemented will be designed to achieve the success criteria specified previously and will include a work schedule and

updated monitoring criteria. If, during annual monitoring it is determined the Site's ability to achieve Site performance standards are jeopardized, Wildlands will notify DMS and the members of the IRT and work to develop contingency plans and remedial actions.

Section 5: AS-BUILT CONDITION (BASELINE)

The Site construction and as-built surveys were completed between April 2020 and June 2020. The survey included developing an as-built topographic surface and locating the channel boundaries, structures, and cross-sections. For comparison purposes, during the baseline assessments, reaches were divided into assessment reaches in the same way that they were established for design parameters: Bull Creek Reach 1A and 1B, Bull Creek Reach 2 – Reach 4, UT1A – UT1C, UT2, UT2A – UT2C, UT3, and UT3A – UT3C. Monitoring location field adjustments were completed in July 2020, and planting and baseline vegetation data collection was completed in April 2020.

5.1 Record Drawings

A sealed half-size record drawing is located in Appendix 4 that includes redlines for any significant field adjustments made during construction that were different from the design plans. Specific changes by each project area are detailed below:

5.1.1 Bull Creek Reach 1A

- Station 100+95 - 105+39: The channel design was altered and realigned due to bedrock that was present in the left floodplain. Due to channel realignment the following structure adjustments were made:
    - A log vane was replaced with a log sill to improve stability within the altered alignment,
    - Boulder toe was replaced with brush toe due to sufficient channel stability from bedrock in the channel,
    - A log sill was added to improve channel stability through the alignment deviation, and
    - A log vane was replaced with a log j-hook to improve channel stability at the downstream end of the alignment deviation.

5.1.2 Bull Creek Reach 1B

- Station 105+75: The vernal pool at depicted location was not installed because it was not necessary to balance onsite earthwork volumes at this location.
- Station 107+40: A log sill and a log vane were omitted due to the presence of bedrock.
- Station 110+48: The location of cross-section 3 (XS3) was adjusted after the as-built survey was collected so that the cross section would no longer share its left cross section pin with XS2.

5.1.3 Bull Creek Reach 2

- Station 113+80: A log sill was substituted for rock sill due to local material availability and site conditions.
- Station 113+85: Brush toe was substituted for brush mattress due to sufficient bank stability following the construction of the design channel.
- Station 114+32: Crest gage 1 (CG1) was moved upstream after the as-built survey was collected to avoid the possibility of false bankfull readings in the event that water should back up at the confluence.
- Station 115+45: Brush toe was substituted for boulder toe due to sufficient bank stability following the construction of the design channel.

- Station 115+88: The location of XS4 was adjusted after the as-built survey was collected because the cross section was inadvertently disturbed from construction equipment during channel repairs from a large storm event.
- Station 116+00: A log sill was substituted for rock sill due to local material availability and similar functionality.
- Station 116+62: Photo point 4A was added after the survey was completed at the request of DMS to capture a view of the conservation easement break.
- Station 118+30: Photo points 4B and 4C were added after the survey was completed at the request of DMS to capture views across the cattle crossing.

5.1.4 Bull Creek Reach 3

- Station 150+XX: Photo point 4D was added after the survey was completed at the request of DMS to capture a view of the conservation easement break.
- Station 150+62: Boulder toe was replaced with a brush toe due to local material availability and to improve in-stream habitat.
- Station 157+72: Brush mattress was replaced with brush toe due to time of year or installation.
- Station 157+72: A log vane was removed due to bank stability and habitat enhancement provided by brush toe.
- Station 158+22: Photo point 7 was moved after the survey was completed at the request of DMS to capture a downstream view of the culvert crossing.
- Station 158+40: A rock sill was replaced with a log sill due to local material availability and similar functionality.
- Station 159+50: Photo point 8 was moved after the survey was completed at the request of DMS to capture an upstream view of the culvert crossing.
- Station 159+84: Brush toe was substituted for a boulder toe due to local material availability and to provide habitat enhancement.
- Station 159+84: A log vane was removed due to the bank stability and habitat enhancement provided by the brush toe.
- Station 161+14: XS7 and CG5 were moved after the as-built survey was collected because the current riffle location better represents the conditions of the reach.
- Station 161+56: A log vane was removed, and a brush toe was added to outside bank to improve stability for the entire outside bank.
- Station 163+30: A log vane was removed, and a brush toe was extended due to availability of materials and to improve stream bank stability and habitat.
- Station 164+47: A log vane was removed, a log sill was added, and a brush toe was extended due to local availability of materials and to improve channel stability and habitat.
- Station 165+75: A log vane was removed, and a brush toe was extended due to availability of materials and the improved habitat provided by the brush toe.

- Station 166+97: A log sill was substituted for rock sill due to local material availability and site conditions.
- Station 167+00: A brush toe was added to improve bank stability.

5.1.5 Bull Creek Reach 4

- No changes.

5.1.6 UT1A

- Station 202+26: Pool was not excavated due to existing profile stability.
- Station 203+32: Photo point 12 was moved after the survey was completed at the request of DMS to capture a downstream view of the culvert crossing.
- Station 203+90: Photo point 12A was added after the survey was completed at the request of DMS to capture an upstream view of the culvert crossing.
- See Section 5.1.18 for easement encroachment areas.

5.1.7 UT1B

- Station 209+24: XS9 was relocated after the as-built survey was collected because the current riffle location better represents the conditions of the reach.
- Station 209+65: During construction, a riffle, a pool, and a rock sill were omitted due to sufficient stability and slope on the reach.
- Station 210+83: Photo point 14A was added after the survey was completed at the request of DMS to capture a downstream view of the culvert crossing.

5.1.8 UT1C

- Station 211+57: Photo point 14B was added after the survey was completed at the request of DMS to capture an upstream view of the culvert crossing.
- Station 212+35: During construction upstream rock and roll riffle and boulder sill were omitted and riffle was extended to connect to downstream rock and roll riffle.
- Station 212+62: CG2 was moved upstream after as-built survey was collected to avoid the possibility of false bankfull readings in the event that water should back up at the confluence.

5.1.9 UT2

- Station 350+08: Rock sill was replaced with log sill due to local material availability and similar functionality.
- Station 350+27: Rock sill was replaced with log sill due to local material availability and similar functionality.

5.1.10 UT2A

- Station 300+40: Rock sill was replaced with log sill due to local material availability and similar functionality.
- Station 302+25: Rock sill was replaced with log sill due to local material availability and similar functionality.
- Station 302+83: Rock sill was replaced with log sill due to local material availability and similar functionality.

- Station 302+95: Photo point 17 was moved after the survey was completed at the request of DMS to capture a downstream view of the culvert crossing.

5.1.11 UT2B

- Station 303+59: Rock sill was replaced with log sill due to local material availability and similar functionality.
- Station 303+90: Photo point 18 was moved after the survey was completed at the request of DMS to capture an upstream view of the culvert crossing.
- Station 305+90: Rock sill was replaced with log sill due to local material availability and similar functionality.

5.1.12 UT2C

- Station 310+33: Rock sill was replaced with log sill due to local material availability and similar functionality.

5.1.13 UT3

- No changes

5.1.14 UT3A

- Station 401+64 – 402+45: The channel design was altered and realigned to improve bank stability and meander pattern
- Station 401+71 - 402+29: Rock sills were replaced with log sills due to local material availability and similar functionality.

5.1.15 UT3B

- Station 404+89 – 407+35: Riffle elevations adjusted due to the upstream tie in elevation being changed due to field conditions.
- Station 402+82: Rock sills were replaced with log sills due to local material availability and similar functionality.
- Station 405+06: Rock sills were replaced with log sills due to local material availability and similar functionality.
- Station 405+32: Rock sills were replaced with log sills due to local material availability and similar functionality.
- Station 405+58: Rock sills were replaced with log sills due to local material availability and similar functionality.
- Station 405+82: Rock sills were replaced with log sills due to local material availability and similar functionality.
- Station 406+59: Rock sills were replaced with log sills due to local material availability and similar functionality.
- Station 406+85: Rock sills were replaced with log sills due to local material availability and similar functionality.
- Station 407+09: Rock sills were replaced with log sills due to local material availability and similar functionality.

- Station 407+35: Rock sills were replaced with log sills due to local material availability and similar functionality.
- Station 407+41: Photo point 22A was added after the survey was completed at the request of DMS to capture a downstream view of the culvert crossing.

5.1.16 UT3C

- Station 408+22: Rock sills were replaced with log sills due to local material availability and similar functionality.
- Station 408+33: Photo point 24 was moved after the survey was completed at the request of DMS to capture an upstream view of the culvert crossing.
- Station 411+86: Rock sills were replaced with log sills due to local material availability and similar functionality.

5.1.17 Planting Plan

Changes to the as-built planting list were made to account for the species availability at the time of planting. Changes in the location of bare root plantings were adjusted as needed along the top of bank in the areas where channel realignment was conducted. Planting contractor provided quantities for the entire site. Total bare root plant quantities were not broken up between shaded and unshaded planting areas. Total herbaceous plant quantities were not broken up between streambank, vernal pool, and wetland area planting zones. Specific changes to the plant species lists are outlined below.

Buffer Planting Zone –

- The following bareroot species were removed from the planting list due to the lack of available species at the time of planting: Tag alder (*Alnus serrulata*), Bigleaf magnolia (*Magnolia macrophylla*), Willow oak (*Quercus phellos*), and Swamp chestnut oak (*Quercus michauxii*).
- The following species were added to the bareroot planting list to increase species diversity at the direction of the engineer: Northern red oak (*Quercus rubra*), Southern red oak (*Quercus falcata*), Paw paw (*Asimina triloba*), Black gum (*Nyssa sylvatica*), Silver maple (*Acer saccharinum*), Green ash (*Fraxinus pennsylvanica*), American holly (*Ilex opaca*), and American Beech (*Fagus gradifolia*).
- The remaining species' "Percent of Stems" within the Buffer Planting Zone planting area were adjusted accordingly.

Streambank, Vernal Pool, and Wetland Planting Zone –

- The following herbaceous species were removed from the planting list due to the lack of available species at the time of planting: Bluejoint grass (*Calamagrostis canadensis*) and Broadwing sedge (*Carex alata*).
- The following species were added to the livestakes planting list to increase species diversity at the direction of the engineer: Button bush (*Cephalanthus occidentalis*) and Elderberry (*Sambucus canadensis*).
- The following species were added to the herbaceous planting list to increase species diversity at the direction of the engineer: Green bulrush (*Scrirpus altrovirens*), Fringed sedge (*Carex crinita*), Bushy beardgrass, (*Andropogon glomeratus*), Upright sedge (*Carex stricta*), and Softstem bulrush (*Schoenoplectus tabernaemontani*).

- The remaining species' "Percent of Stems" within the Streambank, Vernal Pool, and Wetland planting zones were adjusted accordingly.

Permanent Riparian Seeding –

- The following species of live seed were removed from the permanent riparian seed list due to the lack of available seed at the time of planting: Cardinal flower (*Lobelia cardinalis L.*) and Dense blazing star (*Liatris spicata*).
- The following species of live seed were added to the permanent riparian seed planting list to increase species diversity at the direction of the engineer: Bearded beggartick (*Bidens aristosa*).

5.1.18 Encroachment Areas

- Approximately 127 LF of fence line was inadvertently installed inside the easement along the upper extent of UT1A. The fence will be relocated and documented in the MY1 Report.
- Station 203+47: On UT1A, less than one linear foot of pipe extends into the project area on the upstream side of the internal easement crossing. A loss of one linear foot is reflected in the total as-built linear footage for UT1A in Table 1 of Appendix 1.

5.2 Baseline Data Assessment

MY0 was conducted between September 2019 to July 2020 with the vegetation data collection occurring during April 2020. The first annual monitoring assessment (MY1) will be completed in the late fall and/or early winter of 2020 to ensure that at least 180 days separate the collection of MY0 data from MY1 data. Subsequently, the MY1 monitoring report submittal will be delayed to account for this requirement. The streams will be monitored for a total of seven years, with the final monitoring activities scheduled for 2026.

5.2.1 Morphological State of the Channel

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

Profile

The MY0 profiles generally match the profile design parameters. On-site as-built reviews showed no visual indicators of vertically instability. Variations from the design profile often reflect field changes during construction as a result of field conditions and do not constitute a problem or indicate a need for remedial actions. Channels profiles will continue to be assessed visually during the semi-annual Site walks.

Dimension

The MY0 dimension numbers closely match the design parameters with minor variations. Over time as vegetation is established, the channels may narrow. This narrowing is normal and not an indicator of instability.

Pattern

The MY0 pattern metrics fell within acceptable ranges of the design parameters.

Bankfull Events

Bankfull events recorded following completion of construction will be reported in the Year 1 monitoring report.

5.2.2 Vegetation

The overall MY0 planted density is 557 stems/acre, which exceeds the interim measure of vegetative success of at least 320 planted stems per acre at the end of the third monitoring year. Summary data

and photographs of each plot can be found in Appendix 3.

Section 6: REFERENCES

Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E. 2003. Stream Restoration A Natural Channel Design Handbook.

Harrelson, Cheryl C; Rawlins, C.L.; Potyondy, John P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

Lee, Michael T., Peet, Robert K., Steven D., Wentworth, Thomas R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Retrieved from: http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-2.pdf.

North Carolina Ecosystem Enhancement Program (EEP), February 2009. Upper Yadkin Pee-Dee River Basin Restoration Priorities.

North Carolina Division of Mitigation Services (DMS), October 2015. DMS Stream and Wetland Mitigation Plan Template and Guidance.

North Carolina DMS, April 2015. DMS Annual Monitoring and Closeout Reporting Template.

North Carolina Division of Water Resources (NCDWR), 2015. Surface Water Classifications. http://portal.ncdenr.org/web/wq/ps/csu/classifications.

North Carolina Geological Survey (NCGS), 1985. Geologic Map of North Carolina: North Carolina Survey, General Geologic Map, scale 1:500,000. https://deq.nc.gov/about/divisions/energy-mineral-land-resources/north-carolina-geological-survey/ncgs-maps/1985-geologic-map-of-nc4.

Rosgen, D. L. 1994. A classification of natural rivers. *Catena* 22:169-199.

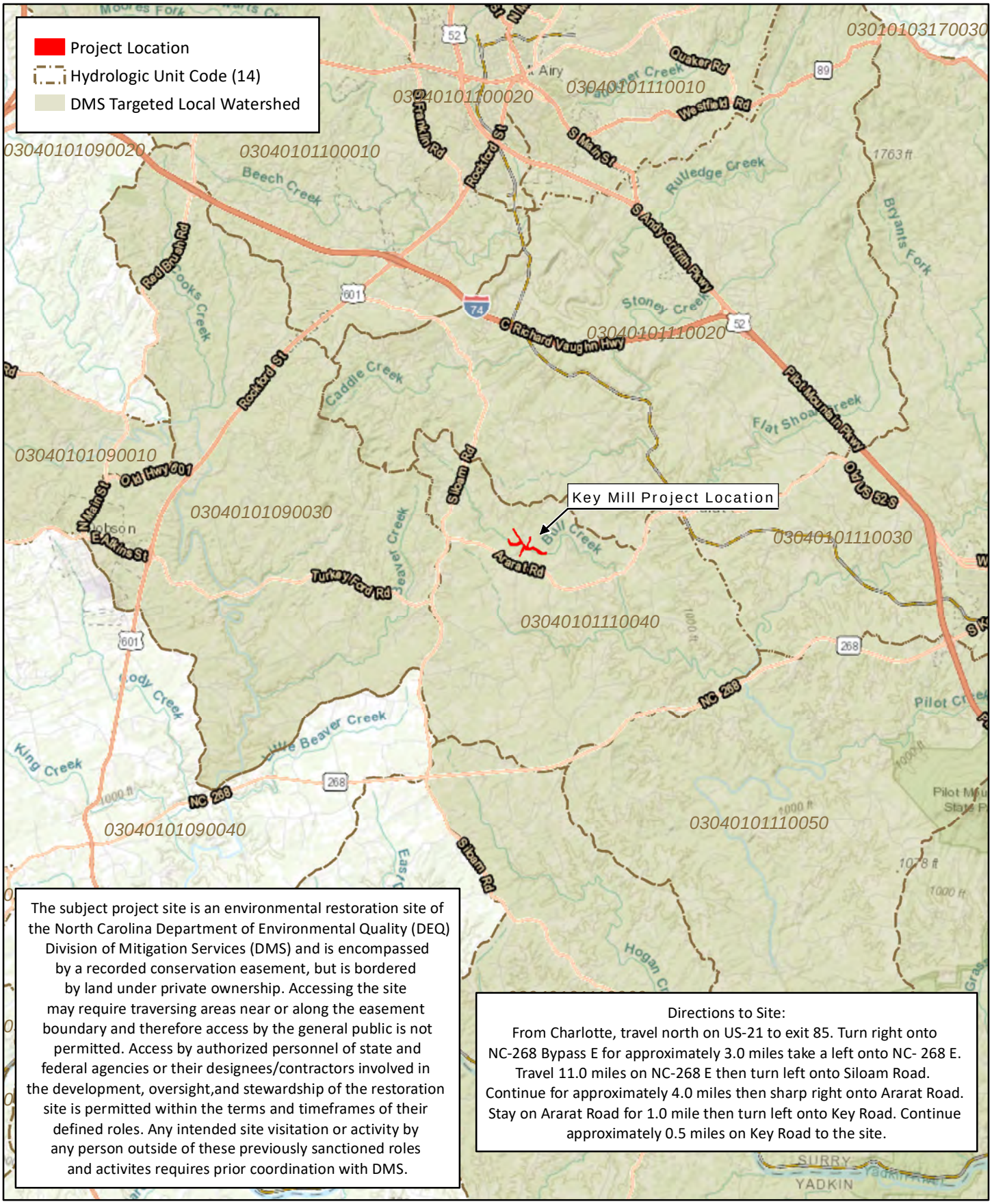
Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

Simon, A. 1989. A model of channel response in disturbed alluvial channels. Earth Surface Processes and Landforms 14(1):11-26.

United States Army Corps of Engineers (USACE), October 2016. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

Wildlands Engineering, Inc (Wildlands), 2019. Key Mill Mitigation Site Mitigation Plan. DMS, Raleigh, NC.

APPENDIX 1. General Figures and Tables

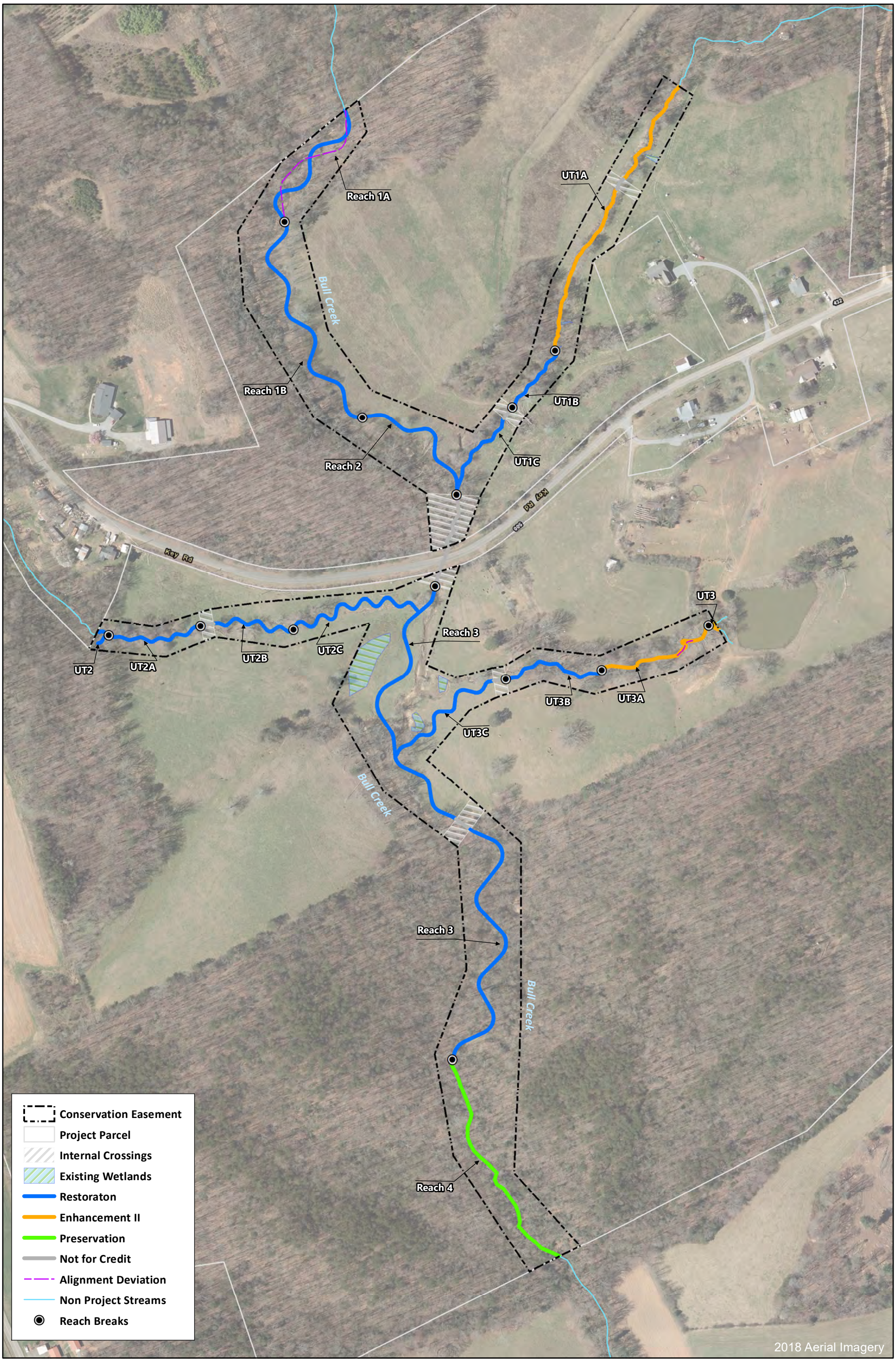


WILDLANDS ENGINEERING

0 1 2 Mile

N

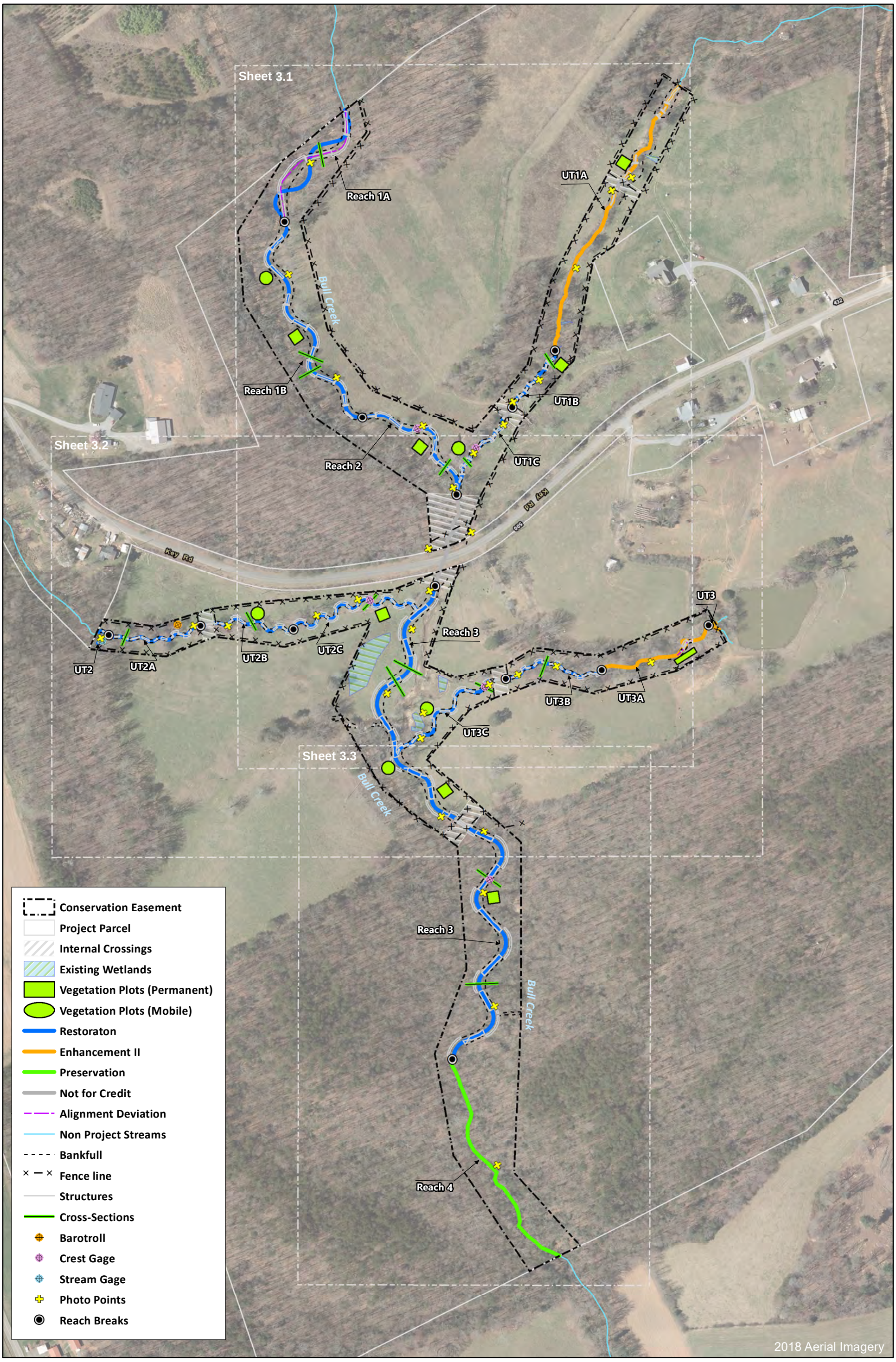
Figure 1 Project Vicinity Map
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020
Surry County, NC



WILDLANDS ENGINEERING

0 250 500 Feet

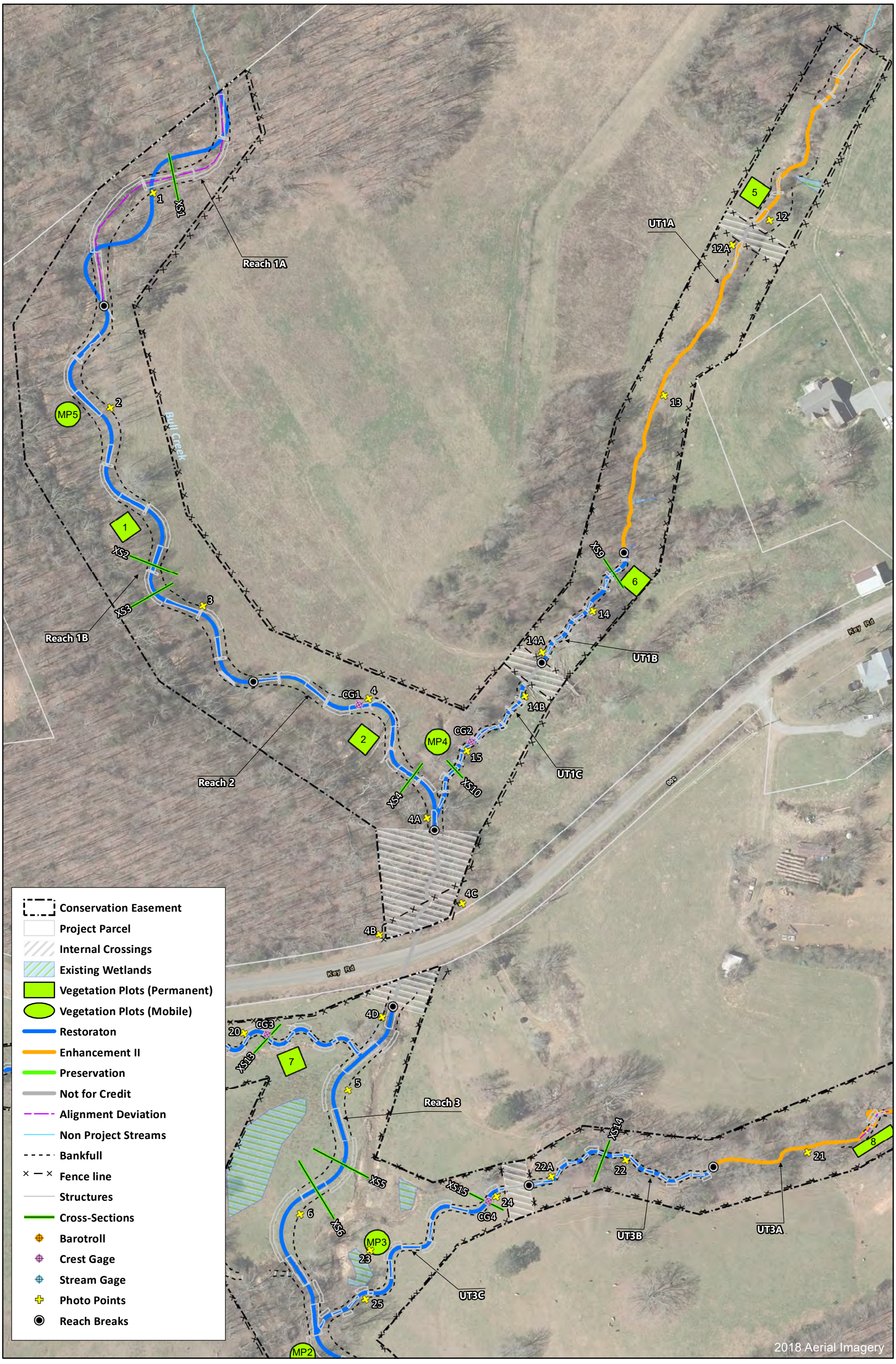
Figure 2 Project Component/ Asset Map
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020
Surry County, NC



WILDLANDS ENGINEERING

0 250 500 Feet

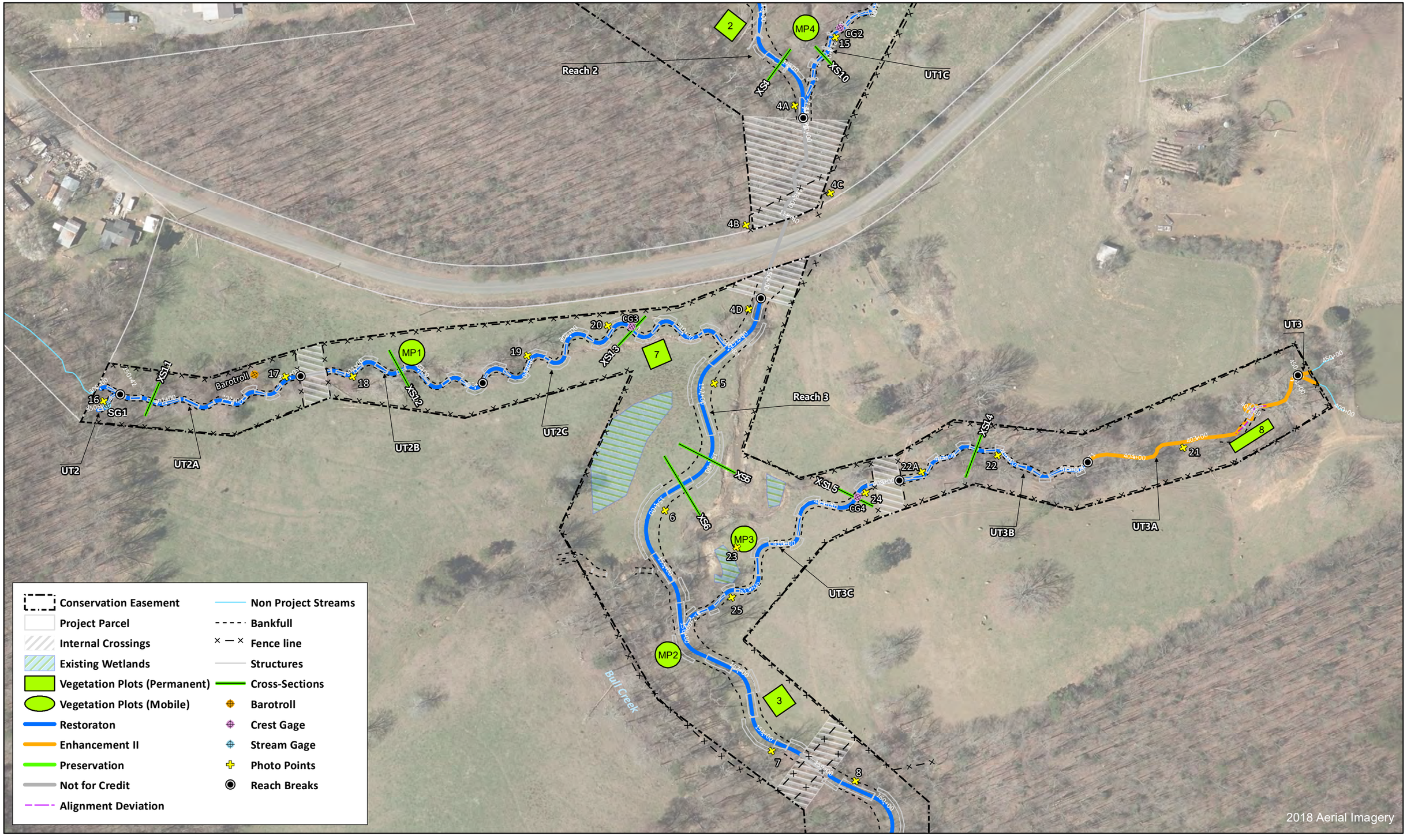
Figure 3.0 As-Built Monitoring Plan View (Key)
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020
Surry County, NC



WILDLANDS ENGINEERING

0 130 260 Feet

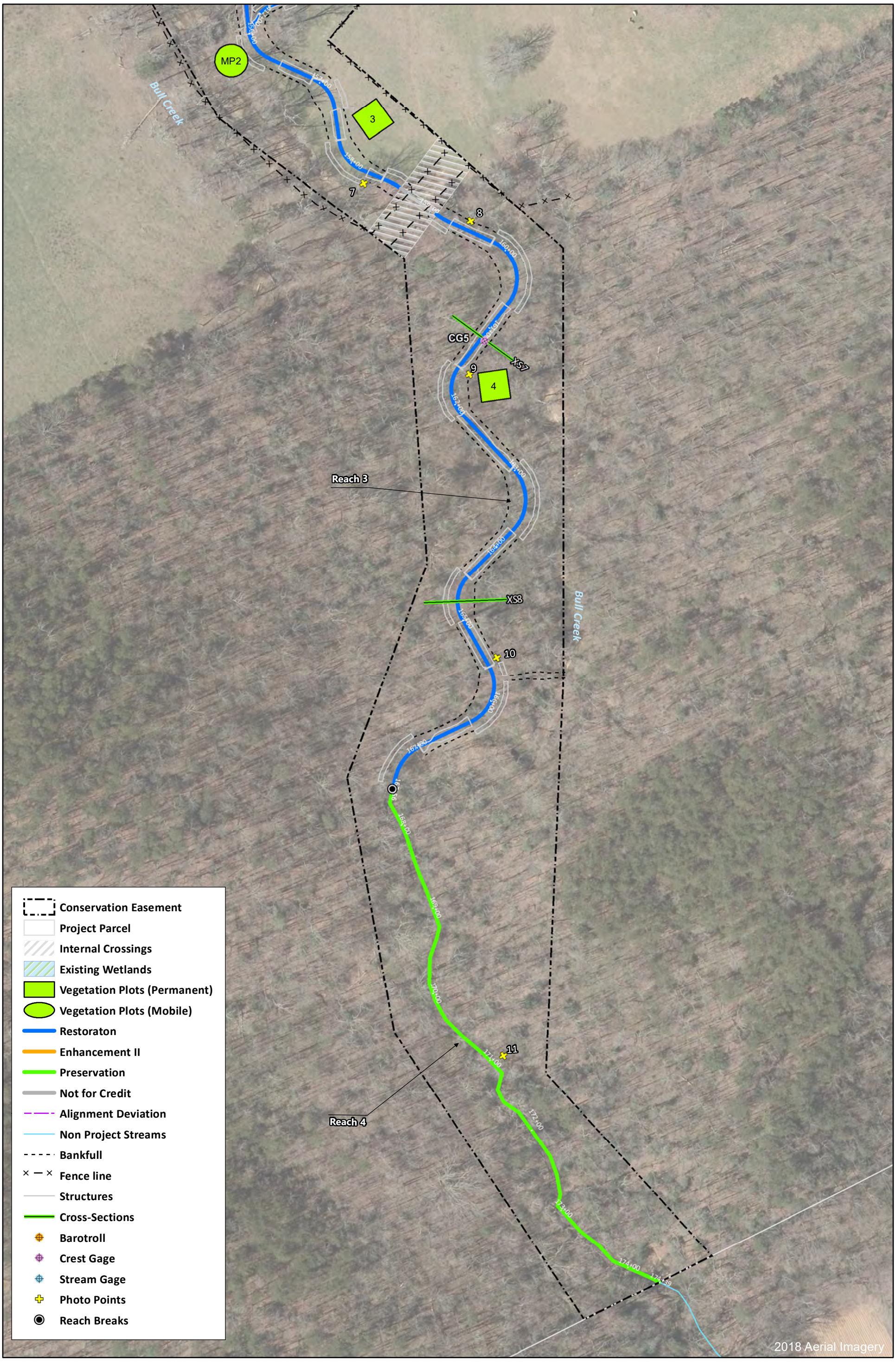
Figure 3.1 As-Built Monitoring Plan View
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020
Surry County, NC



WILDLANDS ENGINEERING

0 125 250 Feet

Figure 3.2 As-Built Monitoring Plan View
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020
Surry County, NC



WILDLANDS ENGINEERING

Figure 3.3 As-Built Monitoring Plan View
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020
Surry County, NC

Table 1. Mitigation Assets and Components

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Project Components								
Project Area/Reach	**Existing Footage (LF) or Acreage**	**Mitigation Plan Footage/ Acreage**	**Mitigation Category**	**Restoration Level**	**Priority Level**	**Mitigation Ratio (X:1)**	**As-Built Footage/ Acreage**	**Notes/Comments**
Bull Creek Reach 1A	435	444	Cool	Restoration	P1	1.000	421	N/A
Bull Creek Reach 1B	876	722	Cool	Restoration	P1	1.000	722	N/A
Bull Creek Reach 2	403	418	Cool	Restoration	P2	1.000	418	N/A
Bull Creek Reach 3	2,291	1,674	Cool	Restoration	P2	1.000	1,676	N/A
Bull Creek Reach 4	683	683	Cool	Preservation	N/A	10.000	683	N/A
UT1A	866	829	Cool	Enhancement II	N/A	2.500	832	N/A
UT1B	188	212	Cool	Restoration	P2	1.000	212	N/A
UT1C	332	257	Cool	Restoration	P2	1.000	257	N/A
UT2	61	42	Cool	Restoration	P2	1.000	42	N/A
UT2A	349	315	Cool	Restoration	P2	1.000	315	N/A
UT2B	299	263	Cool	Restoration	P2	1.000	263	N/A
UT2C	223	469	Cool	Restoration	P2	1.000	469	N/A
UT3	21	18	Cool	Enhancement II	N/A	2.500	18	N/A
UT3A	249	413	Cool	Enhancement II	N/A	2.500	390	N/A
UT3B	414	307	Cool	Restoration	P2	1.000	307	N/A
UT3C	296	412	Cool	Restoration	P1, P2	1.000	412	N/A

Project Credits							
Restoration Level	**Stream**			**Riparian Wetland**		**Non-Riparian Wetland**	**Coastal Marsh**
	Warm	**Cool**	**Cold**	**Riverine**	**Non-Riv**		
Restoration	N/A	5,535.000	N/A	N/A	N/A	N/A	N/A
Re-establishment				N/A	N/A	N/A	N/A
Rehabilitation				N/A	N/A	N/A	N/A
Enhancement				N/A	N/A	N/A	N/A
Enhancement I	N/A		N/A				
Enhancement II	N/A	504.000	N/A				
Creation				N/A	N/A	N/A	N/A
Preservation	N/A	68.300	N/A	N/A	N/A	N/A	
Totals	**N/A**	**6,107.300**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

Table 2. Project Activity and Reporting History

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Activity or Report		Data Collection Complete	Completion or Delivery
404 Permit		May 2019	May 2019
Mitigation Plan		January 2017 - January 2019	January 2019
Final Design - Construction Plans		May 2019	May 2019
Construction		June 2019 - April 2020	April 2020
Temporary S&E mix applied to entire project area[1]		June 2019 - April 2020	April 2020
Permanent seed mix applied to reach/segments[1]		April 2020	April 2020
Bare root and live stake plantings for reach/segments		April 2020	April 2020
Baseline Monitoring Document (Year 0)		July 2020	October 2020
Year 1 Monitoring	Stream Survey		
	Vegetation Survey		
Year 2 Monitoring	Stream Survey		
	Vegetation Survey		
Year 3 Monitoring	Stream Survey		
	Vegetation Survey		
Year 4 Monitoring	Stream Survey		
	Vegetation Survey		
Year 5 Monitoring	Stream Survey		
	Vegetation Survey		
Year 6 Monitoring	Stream Survey		
	Vegetation Survey		
Year 7 Monitoring	Stream Survey		
	Vegetation Survey		

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

Table 3. Project Contact Table

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Designers Aaron Earley, PE, CFM	**Wildlands Engineering, Inc.** 1430 South Mint Street, Suite 104 Charlotte, NC 28203 704.332.7754
Construction Contractors	**Carolina Environmental Contracting, Inc.** 150 Pine Ridge Rd Mt Airy, NC 27030
Planting Contractor	**Bruton Natural Systems, Inc.** PO Box 1197 Fremont, NC 27830
Seeding Contractor	**Carolina Environmental Contracting, Inc.** 150 Pine Ridge Rd Mt Airy, NC 27030
Seed Mix Sources	**Carolina Environmental Contracting, Inc.**
Nursery Stock Suppliers Bare Roots Live Stakes	**Bruton Natural Systems, Inc.**
Herbaceous Plugs	**Wetland Plants, Inc.**
Monitoring Performers	**Wildlands Engineering, Inc.**
Monitoring, POC	Kristi Suggs (704) 332.7754 x.110

Table 4. Project Information and Attributes
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Project Information	
Project Name	Key Mill Mitigation Site Surry County
Project Area (acres)	20.8
Project Coordinates (latitude and longitude)	36° 23' 57.4794"N -80° 36' 11.88"W
Planted Acreage (Acre of Woody Stems Planted)	9.8
Project Watershed Summary Information	
Physiographic Province	Piedmont Physiographic Province
River Basin	Yadkin River
USGS Hydrologic Unit 8-digit	3040101
USGS Hydrologic Unit 14-digit	3040101110040
DWR Sub-basin	03-07-03
Project Drainage Area (acres)	Bull Creek Reach 1A, 1B, & 2: (1,146); Bull Creek Reach 3 & 4: (1,293); UT1A-C: (102); UT2A-C: (32); UT2: (6); UT3 & UT3-C: (45)
Project Drainage Area Percentage of Impervious Area	1%
2011 NLCD Land Use Classification	Bull Creek- Forest (58%), Cultivated (33%), Urban (9%) UT1A-C - Forest (70%), Cultivated (21%), Urban (9%) UT2A-C - Forest (32%), Cultivated (49%), Urban (19%) UT2 - Forest (55%), Cultivated (45%), Urban (0%) UT3/UT3A-C - Forest (22%), Cultivated (74%), Urban (4%)

Reach Summary Information

Parameters	Bull Creek Reach 1A	Bull Creek Reach 1B	Bull Creek Reach 2	Bull Creek Reach 3	Bull Creek Reach 4	UT1A	UT1B	UT1C
Length of reach (linear feet) - Post-Restoration	421	722	418	1,676	683	832	212	257
Valley confinement (Confined, moderately confined, unconfined)	Confined to Moderately Confined			Moderately Confined		Confined		
Drainage area (acres)	1,146			1,293		102		
Perennial, Intermittent, Ephemeral	P	P	P	P	P	P	P	P
NCDWR Water Quality Classification	C							
Morphological Description (stream type) - Pre-Restoration	F3			F3/G3c	---	---	G4c	G4
Morphological Description (stream type) - Post-Restoration	C3		C3b	C3	---	---	B4	B4a
Evolutionary trend (Simon's Model) - Pre- Restoration	IV/V				VI	III/IV		
FEMA classification	Outside SFHA							

Parameters	UT2	UT2A	UT2B	UT2C	UT3	UT3A	UT3B	UT3C
Length of reach (linear feet) - Post-Restoration	42	315	263	469	18	390	307	412
Valley confinement (Confined, moderately confined, unconfined)	Confined		Moderatley Confined		Confined		Moderatley Confined	
Drainage area (acres)	6	32			45			
Perennial, Intermittent, Ephemeral	I	P	P	P	I	I/P	P	P
NCDWR Water Quality Classification	C							
Morphological Description (stream type) - Pre-Restoration	G4	G5	G5c	G5	---	---	G5	G5c
Morphological Description (stream type) - Post-Restoration	B4	B4	C4b	C4	---	---	B4	C4
Evolutionary trend (Simon's Model) - Pre- Restoration	III/IV							
FEMA classification	Outside SFHA							

Regulatory Considerations

Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States - Section 404	Yes	Yes	USACE Action ID# SAW-2017-01504
Waters of the United States - Section 401	Yes	Yes	DWR# 17-1045
Division of Land Quality (Erosion and Sediment Control)	Yes	Yes	NPDES Construction Stormwater General Permit NCG010000
Endangered Species Act	Yes	Yes	Categorical Exclusion Document in Mitigation Plan
Historic Preservation Act	Yes	Yes	Categorical Exclusion Document in Mitigation Plan
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	N/A	Not located in a Special Flood Hazard Area
Essential Fisheries Habitat	No	N/A	N/A

Table 5a. Monitoring Component Summary

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

Parameter	Monitoring Feature	Quantity / Length by Reach						Frequency	Notes
		Bull Creek Reach 1A	Bull Creek Reach 1B	Bull Creek Reach 2	Bull Creek Reach 3	UT1B	UT1C		
Dimension	Riffle Cross-Section	1	1	1	2	1	1	Year 1, 2, 3, 5, and 7	1
	Pool Cross-Section	---	1	---	2	---	---		
Pattern	Pattern	N/A						N/A	2
Profile	Longitudinal Profile	N/A						N/A	
Substrate	Reach Wide (RW) Pebble Count	1 RW	1 RW	1 RW	1 RW	1 RW	1 RW	Year 1, 2, 3, 5, and 7	3
Hydrology	Crest Gage (CG) and/or Stream Flow Gage (SG)	1 CG			1 CG	1 CG		Quarterly	4
Vegetation	CVS Level 2	8 (5 permanent, 3 mobile)						Year 1, 2, 3, 5, and 7	5
Visual Assessment		Yes						Semi-Annually	
Exotic and Nuisance Vegetation								Semi-Annually	6
Project Boundary								Annually	7
Reference Photos	Photographs	12						Annually	

Parameter	Monitoring Feature	Quantity / Length by Reach						Frequency	Notes
		UT2	UT2A	UT2B	UT2C	UT3B	UT3C		
Dimension	Riffle Cross-Section	---	1	1	1	1	1	Year 1, 2, 3, 5, and 7	1
	Pool Cross-Section	---	---	---	---	---	---		
Pattern	Pattern	N/A						N/A	2
Profile	Longitudinal Profile	N/A						N/A	
Substrate	Reach Wide (RW) Pebble Count	---	1 RW	1 RW	1 RW	1 RW	1 RW	Year 1, 2, 3, 5, and 7	3
Hydrology	Crest Gage (CG) and/or Stream Flow Gage (SG)	1 SG	1 CG			1 CG		Quarterly	4
Vegetation	CVS Level 2	3 (1 permanent, 2 mobile)						Year 1, 2, 3, 5, and 7	5
Visual Assessment		Yes						Semi-Annually	
Exotic and Nuisance Vegetation								Semi-Annually	6
Project Boundary								Annually	7
Reference Photos	Photographs	9						Annually	

Notes:

1. Cross-sections have been permanently marked with rebar to establish location. Surveys include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg.
2. Pattern and profile will be assessed visually during semi-annual site visits. Longitudinal profile data was collected during as-built baseline monitoring survey only, unless observations indicate widespread lack of vertical stability (greater than 10% of reach is affected) and profile survey is warranted in additional years to monitor adjustments or survey repair work.
3. Reach wide pebble counts will be conducted each year a monitoring report is submitted. Riffle (100) pebble counts have been conducted during as-built baseline monitoring only unless observations indicate otherwise during post-construction monitoring.
4. Crest gages and/or stream gages (pressure transducers) will be inspected quarterly or semi-annually, evidence of bankfull events will be documented with a photo when possible. The stream gage (pressure transducer) has been set to record stage once every 2 hours.
5. Both mobile and permanent vegetation plots will be utilized to evaluate the vegetation performance for the areas planted. Permanent vegetation monitoring plot assessments will follow CVS Level 2 protocols. Mobile vegetation monitoring plot assessments will document number of planted stems and species using a circular or 100 m2 square/rectangular plot.
6. Locations of exotic and nuisance vegetation will be mapped.
7. Locations of vegetation damage, boundary encroachments, etc. will be mapped.

Table 5b. Monitoring Component Summary

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

Parameter	Monitoring Feature	Quantity / Length by Reach				Frequency	Notes
		UT1A	UT3	UT3A	Bull Creek Reach 4		
Dimension	Riffle Cross-Section	---	---	---	---	Year 1, 2, 3, 5, and 7	
	Pool Cross-Section	---	---	---	---		
Pattern	Pattern	N/A				N/A	
Profile	Longitudinal Profile	N/A				N/A	
Substrate	Reach Wide (RW) Pebble Count	---	---	---	---	Year 1, 2, 3, 5, and 7	
Hydrology	Crest Gage (CG) and/or Stream Flow Gage (SG)	---	---	---	---	Quarterly	
Vegetation	CVS Level 2	2 (2 permanent)			---	Year 1, 2, 3, 5, and 7	1
Visual Assessment		Yes				Semi-Annually	
Exotic and Nuisance Vegetation						Semi-Annually	2
Project Boundary						Annually	3
Reference Photos	Photographs	4				Annually	

Notes:

1. Both mobile and permanent vegetation plots will be utilized to evaluate the vegetation performance for the areas planted. Permanent vegetation monitoring plot assessments will follow CVS Level 2 protocols. Mobile vegetation monitoring plot assessments will document number of planted stems and species using a circular or 100 m2 square/rectangular plot.
2. Locations of exotic and nuisance vegetation will be mapped.
3. Locations of vegetation damage, boundary encroachments, etc. will be mapped.

MEETING NOTES

MEETING:	Post-Contract IRT Site Walk **KEY MILL Mitigation Site** Yadkin 03040101; Surry County, NC DEQ Contract No. 7180 DMS Project No. 100025 Wildlands Project No. 005-02165
DATE:	Monday, August 14, 2017
LOCATION:	515 Key Road Ararat, NC

Attendees

Todd Tugwell, USACE	Paul Wiesner, DMS	Christine Blackwelder, Wildlands
Andrea Leslie, USFWS	Matthew Reid, DMS	
Mac Haupt, DWR	Shawn Wilkerson, Wildlands	

Materials

- Wildlands Engineering Technical Proposal dated 2/15/2017 in response to DMS RFP 16-006993

Meeting Notes

The meeting began at 1 pm. Shawn presented an overview of the project at the parking location. From there, the group proceeded to walk the entire site in the following order: Bull Creek Reach 2, Bull Creek Reach 3, wetland BMP, UT2, UT3, Bull Creek Reach 1, UT1. The meeting concluded at 4:30 PM. For organizational purposes, the meeting notes are arranged by stream reach, from upstream to downstream.

1. **Bull Creek**
    - **Reach 1**
        - Bull Creek Reach 1 will be primarily constructed offline, into the right floodplain on the upstream half of the reach and into the left floodplain on the downstream half of the reach.
        - IRT members expressed concern over legacy sediments that may exist behind the old mill dams. They pointed to crack between soil layers in a cut bank and noted that the backwater from the old dams may have extended far upstream. Wildlands will shoot survey grades on top of the old dams and compare to soil layers during existing conditions analysis. Shawn also noted that the legacy sediments seemed consolidated and have been in place for 80 years since the last mill dam breach.

- **Reach 2/Wetland BMP**
  - Bull Creek Reach 2 will be restored and moved into the left floodplain, off the right valley wall. Group agreed with this approach. The group noted that Bull Creek Reach 2 (downstream of Key Road) has bank height ratios around 2 and is eroded.
  - Wetland BMP – This wetland is designed to treat agricultural drainage from a defined valley that does not have a flowing stream. Some discussion over whether a stream once ran here and had been buried. Todd asked if there is a pipe which outlets into Bull Creek – there is not. No direct credit has been requested for BMP.
- **Reach 3**
  - Within the woods, Bull Creek Reach 3 has eroded, high banks, and privet dominates the understory. Approximately halfway down the reach, the bank heights drop, invasive species are small and sporadic, and the banks are more stable.
    - IRT team members do not consider the first half of this reach to be preservation quality.
    - Paul/Shawn remarked that, due to the restrictions set forth in the RFP, only 81 SMUs are requested for the 1,460 LF stretch, which equates to an 18:1 ratio.
    - Todd, Andrea, Mac agreed that they like the lower half of the project for preservation. Discussion about potentially proposing the lower half at a 10:1 credit, and conserving the upper half of Bull Creek Reach 3 at no credit.
    - Discussion about potentially extending restoration into the woods for a distance. Wildlands is agreeable to extending the P1 restoration a few hundred feet and tying into the preservation section.
    - Several solutions are possible here. If the IRT is agreeable we will select final approach after survey and preliminary design.

2. **UT1 -**The group agreed with the approximate break between restoration and enhancement II on UT1.
3. **UT2/UT2A -** UT2 and UT2A approaches were reviewed and approved by the group. Discussion about UT2 where it hits the flat floodplain of Bull Creek and whether the creek would have naturally splayed into a wetland. This area is heavily trampled by cattle and is growing over with aquatic vegetation, but has fast flow. Wildlands will review the stream type during design.
4. **UT3 -** The group agreed on the approximate break between restoration and enhancement II on UT3. Although incised, the stream in the enhancement II section is not eroding, and with the upstream pond controlling peak watershed flows, the stream is unlikely to see flashy, eroding flows. Where restoration is proposed, the banks are actively eroding and migrating, and restoration is appropriate.
5. **Ratios -** The group agreed upon the credit ratios presented in the Proposal and below
   - Restoration, 1:1
   - Enhancement II, 2.5:1
   - Preservation, 10:1
6. **Stream Crossings** - All crossings are internal, which allows legal recourse if crossing restrictions are not observed.

- **Bull Creek/Key Road Crossing (#1 on proposal figure 6):** Todd asked for Wildlands to explain this crossing in detail. The farmer currently rotates cattle between fields upstream and downstream of Key Road. Cattle are moved through the Key Road culvert. This is the only way the farmer can move cattle between fields, so Wildlands has proposed an internal crossing upstream and downstream of the road, which allows the farmer to move the cattle through the stream. Andrea expressed concern about cattle entering the easement during crossing events. Temporary fence will be strung during crossing events to prevent cattle from entering the remainder of the easement.
- **UT1 – upstream crossing (#3 on proposal figure 6):** Todd asked if this crossing could move upstream of the conservation easement. No - the farmer cannot gain access to his upper fields by crossing the stream above the project because the right valley wall is too steep to traverse.
- **UT1 - downstream crossing (#4 on proposal figure 6):** Todd asked if this crossing could be eliminated. No – the farmer needs this crossing to gain access to his lower fields.

7. **General suggestions/recommendations of the IRT**
   - Overall, members of the IRT would like to see the proposed approach (restoration, enhancement, preservation) presented in the Mitigation Plan in the context of evolutionary stage.

These meeting minutes were prepared by Christine Blackwelder and reviewed by Shawn Wilkerson on August 15, 2017, and represent the authors' interpretation of events. Please report and discrepancies or corrections within 5 business days of receipt of these minutes.

APPENDIX 2. Morphological Summary Data and Plots

Table 6a. Baseline Stream Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

		Pre-Restoration Condition												Design												As-Built/Baseline											
Parameter	**Gage**	**Bull Creek R1A**		**Bull Creek R1B**		**Bull Creek R2**		**Bull Creek R3**		**UT1B**		**UT1C**		**Bull Creek R1A**		**Bull Creek R1B**		**Bull Creek R2**		**Bull Creek R3**		**UT1B**		**UT1C**		**Bull Creek R1A**		**Bull Creek R1B**		**Bull Creek R2**		**Bull Creek R3**		**UT1B**		**UT1C**	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																																					
Bankfull Width (ft)		16.2	19.1	16.2	19.1	16.2	19.1	18.0	25.4	5.6	7.0	5.6	7.0	19.5		17.5		16.0		21.0		8.5		8.3		19.4		17.3		16.4		19.6	21.2	6.8		6.9	
Floodprone Width[2] (ft)		21	25	21	25	21	25	27	53	14	17	14	17	42.9	97.5	38.5	87.5	35.2	80.0	46.2	105.0	12.0	19.0	12.0	18.0	70.1		67.6		55.7		94.0	99.0	23.6		34.0	
Bankfull Mean Depth (ft)		1.1		1.1		1.1		1.1	2.1	0.7	1.0	0.7	1.0	1.6		1.3		1.2		1.5		0.6		0.6		1.5		1.7		1.4		1.6	1.8	0.6		0.8	
Bankfull Max Depth (ft)		1.8	2.1	1.8	2.1	1.8	2.1	1.6	2.7	1.0	1.5	1.0	1.5	2.0	2.8	1.7	2.4	1.4	1.9	1.8	2.4	0.7	1.0	0.7	1.1	2.8		2.9		2.5		2.7	3.0	0.9		1.3	
Bankfull Cross-sectional Area (ft^2)	N/A	18.7	21.6	18.7	21.6	18.7	21.6	26.2	39.5	3.9	6.8	3.9	6.8	30.2		23.2		19.3		31.1		5.3		4.8		28.2		29.7		22.9		33.5	36.0	3.9		5.7	
Width/Depth Ratio		14.1	16.8	14.1	16.8	14.1	16.2	8.5	22.5	7.3	8.1	7.3	8.1	12.6		13.2		13.3		14.2		13.8		14.5		13.4		10.1		11.8		10.7	13.4	11.7		8.3	
Entrenchment Ratio[2]		1.3		1.3		1.3		1.3	2.9	2.4	2.5	2.4	2.5	2.2	4.6	>2.2		6.3	7.8	>2.2		2.8	3.3	2.7	2.9	3.6		3.9		3.4		4.3	4.7	3.5		4.9	
Bank Height Ratio		3.7	4.1	3.7	4.1	3.7	4.1	1.9	2.8	5.0	7.9	5.0	7.9	1.0												1.0		1.0		1.0		1.0	1.0	1.0		1.0	
D_{50} (mm)		91.6	96.6	91.6	96.6	25.8	37.2	64.0		17.7	24.2	17.7	24.2													107.3		82.2		135.9		56.4	56.9	33.9		56.2	
Profile																																					
Riffle Length (ft)																																					
Riffle Slope (ft/ft)														0.0100	0.0148	0.0162	0.0203	0.0172	0.0318	0.0103	0.0171	0.0314	0.0801	0.0080	0.0526	0.0050	0.0140	0.0133	0.0258	0.0274	0.0377	0.0037	0.0197	0.0285	0.0604	0.0108	0.0527
Pool Length (ft)	N/A																																				
Pool Max Depth (ft)		4.9		4.9		4.9		1.5	2.3	2.6		2.6		4.0	5.6	3.5	4.8	3.2		3.9	6.5	1.3	1.8	1.7		4.3	5.0	3.1	4.6	3.3	4.2	3.0	5.4	0.9	2.0	1.2	2.4
Pool Spacing (ft)		52.0		52.0		52.0		N/A		48.0	262.0	48.0	262.0	96.0	111.0	80.0	101.0	74.6	76.7	55.8	149.0	20.0	54.0	20.0	27.0	230.4		76.6	110.1	59.3	99.2	60.8	187.8	19.9	63.0	18.2	51.5
Pool Volume (ft^3)																																					
Pattern																																					
Channel Beltwidth (ft)		---		---		---		---		---		---		68.8	89.4	53.4	81.3	45.0	69.2	39.0	108.4	N/A[1]	N/A[1]	N/A[1]	N/A[1]	68.8	89.4	53.4	81.3	45.0	69.2	39.0	108.4	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Radius of Curvature (ft)		---		---		---		---		---		---		35.0	50.0	32.0	50.0	30.0	50.5	36.0	85.6	N/A[1]	N/A[1]	N/A[1]	N/A[1]	35.0	50.0	32.0	50.0	30.0	50.5	36.0	85.6	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Rc/Bankfull Width	N/A	---		---		---		---		---		---		1.8	2.6	1.8	2.9	1.9	3.2	1.7	4.1	N/A[1]	N/A[1]	N/A[1]	N/A[1]	1.8	2.6	1.8	2.9	1.9	3.2	1.7	4.1	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Meander Length (ft)		---		---		---		---		---		---		192.2	207.2	179.2	199.8	149.3	171.4	177.0	312.4	N/A[1]	N/A[1]	N/A[1]	N/A[1]	192.2	207.2	179.2	199.8	149.3	171.4	177.0	312.4	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Meander Width Ratio		---		---		---		---		---		---		3.5	4.6	3.1	4.6	2.8	4.3	1.9	5.2	N/A[1]	N/A[1]	N/A[1]	N/A[1]	3.5	4.6	3.1	4.6	2.8	4.3	1.9	5.2	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Substrate, Bed and Transport Parameters																																					
Ri%/Ru%/P%/G%/S%																																					
SC%/Sa%/G%/C%/B%/Be%																																					
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	N/A	0.3/2.8/34.3/167.3/287.3/>2048				0.5/9.2/13.7/100.0/180.0/362.0		0.5/3.4/13.3/109.5/166.9/256.0		0.3/8.0/13.5/33.6/75.9/180.0																		0.1/5.6/20.7/113.8/171.4/362.0		0.1/5.6/28.5/151.8/256.0/362.0		SC/0.3/11.0/222.4/346.7/512.0		0.2/0.5/19.0/96.0/146.7/362.0		0.3/6.4/12.8/45.0/101.2/ 256.0		0.3/1.8/8.9/87.3/137.0/1024.0	
Reach Shear Stress (Competency) lb/ft^2														0.64		0.98		1.76		1.02		1.19		1.50		0.66		1.32		2.17		0.92		1.31		2.03	
Max part size (mm) mobilized at bankfull														49		77		140		80		94		119		29.0		60.0		89.0		42.0	47.0	53.0		94.0	
Stream Power (Capacity) W/m^2																																					
Additional Reach Parameters																																					
Drainage Area (SM)		1.63		1.68		1.79		2.02		0.16		0.16		1.63		1.68		1.79		2.02		0.16		0.16		1.63		1.68		1.79		2.02		0.16		0.16	
Watershed Impervious Cover Estimate (%)		1%								<1%				1%								<1%				1%								<1%			
Rosgen Classification		F3		F3		F3		F3/G3c		G4c		G4		C3		C3		C3b		C3		B4		B4a		C3		C3		C3b		C3		B4		B4a	
Bankfull Velocity (fps)		4.8	4.9	4.8	4.9	4.8	4.9	4.2	4.3	3.5	5.0	3.5	5.0	3.2		3.9		5.2		3.9		3.8		4.1		3.8		5.6		6.6		4.7	5.1	4.4		6.2	
Bankfull Discharge (cfs)		90.0		90.0		99.0		116.0		19.0		19.0		90.0		90.0		99.0		116.0		19.0		19.00		107		166		151		157	184	17		35	
Q-NFF regression (2-yr)	N/A																																				
Q-USGS extrapolation (1.2-yr)														111				119		130		20		20													
Max Q-Mannings														1,484				N/A		922		1,159															
Valley Slope (ft/ft)		0.0100		0.0120		0.0270		0.0080		0.0240		0.0370		0.0086		0.0150		0.0295		0.0118		0.0335		0.0458		---		---		---		---		---		---		---	
Channel Thalweg Length (ft)		435		876		403		2,291		188		332		444		722		418		1,674		212		257		421		722		418		1,676		212		257	
Sinuosity		1.2		1.2		1.2		1.2		1.1		1.3		1.3		1.2		1.2		1.3		1.1		1.1		1.2		1.2		1.2		1.3		1.1		1.1	
Bankfull/Channel Slope (ft/ft)		0.0130		0.0090		0.0160		0.0190		0.0140		0.0440		0.0069		0.0123		0.0242		0.0076	0.0114	0.0316		0.0425		0.0071		0.0124		0.0249		0.0092		0.0349		0.0407	

1. Pattern data is not applicable for A-type and B-type channels
2. ER is based on the width of the cross-section, in lieu of assuming the width across the floodplain.
SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 6b. Baseline Stream Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

		Pre-Restoration Condition												Design												As-Built/Baseline											
Parameter	**Gage**	**UT2**		**UT2A**		**UT2B**		**UT2C**		**UT3B**		**UT3C**		**UT2**		**UT2A**		**UT2B**		**UT2C**		**UT3B**		**UT3C**		**UT2**		**UT2A**		**UT2B**		**UT2C**		**UT3B**		**UT3C**	
		Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle																																					
Bankfull Width (ft)		5.3		5.3		5.3		5.3		3.9	5.7	3.9	5.7	3.5		6.0		6.0		6.8		7.0		7.5		N/A		6.8		8.1		7.8		6.9		8.8	
Floodprone Width[2] (ft)		84	112	84	112	84	112	84	112	9	14	9	14	5.0	8.0	8.0	13.0	13.0	30.0	15.0	34.0	10.0	15.0	16.5	37.5	N/A		30.3		32.0		48.2		21.4		55.8	
Bankfull Mean Depth (ft)		1.1	1.4	1.1	1.4	1.1	1.4	1.1	1.4	0.7		0.7		0.2		0.5		0.5		0.5		0.5		0.6		N/A		0.5		0.6		0.7		0.5		0.8	
Bankfull Max Depth (ft)		1.9	2.0	1.9	2.0	1.9	2.0	1.9	2.0	0.8	1.2	0.8	1.2	0.3	0.4	0.5	0.7	0.5	0.7	0.6	0.8	0.6	0.8	0.8	1.0	N/A		0.8		1.1		1.1		0.8		1.3	
Bankfull Cross-sectional Area (ft^2)	N/A	5.7	7.4	5.7	7.4	5.7	7.4	5.7	7.4	2.8	4.1	2.8	4.1	0.9		2.7		2.6		3.2		3.6		4.7		N/A		3.4		4.8		5.8		3.5		6.8	
Width/Depth Ratio		3.7	4.8	3.7	4.8	3.7	4.8	3.7	4.8	5.4	7.8	5.4	7.8	14.2		13.3		13.3		12.9		13.7		12.0		N/A		13.9		11.7		10.5		13.4		11.3	
Entrenchment Ratio[2]		16.0	21.2	16.0	21.2	16.0	21.2	16.0	21.2	1.6	3.5	1.6	3.5	1.4	2.2	2.8	5.7	5.0	7.5	5.1	6.6	3.1	6.0	>2.2		N/A		4.4		3.5		6.2		3.1		6.3	
Bank Height Ratio		1.4	1.9	1.4	1.9	1.4	1.9	1.4	1.9	2.7	3.8	2.7	3.8	1.0												N/A		1.0		1.0		1.0		1.0		1.0	
D_{50} (mm)		SC	0.1	SC	1.1	SC	2.1	SC	3.1	3.6	6.4	3.6	6.4													N/A		58.6		69.3		49.0		21.1		28.2	
Profile																																					
Riffle Length (ft)																																					
Riffle Slope (ft/ft)														0.0457	0.0681	0.0287	0.0414	0.0135	0.0409	0.0135	0.0449	0.0385	0.0488	0.0198	0.0266	N/A		0.0046	0.0347	0.0054	0.0371	0.0132	0.0510	0.0113	0.0530	0.0081	0.0249
Pool Length (ft)	N/A																																				
Pool Max Depth (ft)		---		---		---		---		---		---		1.6		1.3		1.4		1.5		1.6		1.9		N/A		1.4	2.2	1.6	2.2	1.4	2.1	0.9	2.6	1.8	2.5
Pool Spacing (ft)		---		---		---		---		---		---		21.0		22.0	33.0	23.0	44.0	30.0	47.0	24.0	29.0	31.0	58.0	N/A		18.6	39.9	20.5	44.1	26.1	55.9	19.5	30.4	17.4	79.9
Pool Volume (ft^3)																																					
Pattern																																					
Channel Beltwidth (ft)		---		---		---		---		---		---		N/A[1]	N/A[1]	N/A[1]	N/A[1]	19.0	26.0	23.0	34.0	N/A[1]	N/A[1]	17.2	44.8	N/A[1]	N/A[1]	N/A[1]	N/A[1]	19.0	26	23.0	34.0	N/A[1]	N/A[1]	17.2	44.8
Radius of Curvature (ft)		---		---		---		---		---		---		N/A[1]	N/A[1]	N/A[1]	N/A[1]	12.0	15.0	13.0	17.0	N/A[1]	N/A[1]	12.0	22.0	N/A[1]	N/A[1]	N/A[1]	N/A[1]	12.0	15.0	13.0	17.0	N/A[1]	N/A[1]	12.0	22.0
Rc/Bankfull Width	N/A	---		---		---		---		---		---		N/A[1]	N/A[1]	N/A[1]	N/A[1]	2.0	2.5	1.9	2.5	N/A[1]	N/A[1]	1.6	2.9	N/A[1]	N/A[1]	N/A[1]	N/A[1]	2.0	2.5	1.9	2.5	N/A[1]	N/A[1]	1.6	2.9
Meander Length (ft)		---		---		---		---		---		---		N/A[1]	N/A[1]	N/A[1]	N/A[1]	56.0	76.0	73.0	90.0	N/A[1]	N/A[1]	65.2	118.0	N/A[1]	N/A[1]	N/A[1]	N/A[1]	56.0	76.0	73.0	90.0	N/A[1]	N/A[1]	65.2	118.0
Meander Width Ratio		---		---		---		---		---		---		N/A[1]	N/A[1]	N/A[1]	N/A[1]	3.2	4.3	3.3	4.9	N/A[1]	N/A[1]	2.2	6.0	N/A[1]	N/A[1]	N/A[1]	N/A[1]	3.2	4.3	3.3	4.9	N/A[1]	N/A[1]	2.2	6.0
Substrate, Bed and Transport Parameters																																					
Ri%/Ru%/P%/G%/S%																																					
SC%/Sa%/G%/C%/B%/Be%																																					
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	N/A	N/A		SC/0.1/0.2/8.4/12.5/32.0						SC/0.5/5.9/21.0/100.0/256.0																N/A		SC/0.1/0.8/ 64.0/ 85.4/128.0		SC/0.1/1.3/ 85.4/137.0/256.0		SC/0.1/8.9/92.5/1 24.6/256.0		0.8/4.2/9.4/ 64.0/165.3/362.0		0.1/0.3/4.0/73.4/ 148.1/256.0	
Reach Shear Stress (Competency) lb/ft^2														1.06		1.05		0.52		0.38		1.13		0.55		N/A		0.74		0.69		0.59		0.99		0.66	
Max part size (mm) mobilized at bankfull														84		83		40		29		89		42		N/A		36.0		35.0		28.0		50.0		28.0	
Stream Power (Capacity) W/m^2																																					
Additional Reach Parameters																																					
Drainage Area (SM)		0.01		0.05		0.05		0.05		0.07		0.07		0.01		0.04		0.05		0.05		0.07		0.07		0.01		0.04		0.05		0.05		0.07		0.07	
Watershed Impervious Cover Estimate (%)		<1%												<1%												<1%											
Rosgen Classification		G4		G5		G5c		G5		G5		G5c		B4		B4		C4b		C4		B4		C4		B4		B4		C4b		C4		B4		C4	
Bankfull Velocity (fps)		1.9	2.2	1.9	2.2	1.9	2.2	1.9	2.2	4.0	4.2	4.0	4.2	3.0		2.7		2.4		2.2		3.3		2.4		N/A		3.6		3.7		3.3		4.2		3.4	
Bankfull Discharge (cfs)		3.0		7.0		7.0		7.0		12.0		12.0		3.0		7.0		7.0		7.0		12.0		12.0		N/A		12		18		19		15		23	
Q-NFF regression (2-yr)	N/A																																				
Q-USGS extrapolation (1.2-yr)														3		9						11															
Max Q-Mannings														N/A		62						102															
Valley Slope (ft/ft)		0.0640		0.0290		0.0310		0.0190		0.0360		0.0160		0.0731		0.0272		0.0234		0.0179		0.0329		0.0153		---		---		---		---		---		---		---	
Channel Thalweg Length (ft)		61		349		299		223		414		296		42		315		263		469		307		412		42		315		263		469		307		412	
Sinuosity		1.1		1.1		1.2		1.1		1.5		1.2		N/A		1.1		1.2		1.3		1.1		1.2		N/A		1.1		1.2		1.3		1.1		1.2	
Bankfull/Channel Slope (ft/ft)		0.0470		0.0220		0.0170		0.0200		0.0230		0.0170		0.0580		0.0229	0.0387	0.0200		0.0135		0.0304	0.0363	0.0121	0.0146	N/A		0.0237		0.0184		0.0134		0.0317		0.0132	

1. Pattern data is not applicable for A-type and B-type channels
2. ER is based on the width of the cross-section, in lieu of assuming the width across the floodplain.
SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 7. Reference Reach Data Summary
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Reference Reach Data																			
Parameter	**Gage**	**UT to Catawba R1**		**UT to Catawba R2**		**UT to Sandy Run**		**Box Creek**		**UT to Kelly Branch**		**UT to Gap Branch**		**UT to South Fork**		**Timber Tributary**	
		Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle																			
Bankfull Width (ft)	N/A	9.7	12.4	12.3		7.3	7.8	23.5		7.9		6.2		8.2	11.2	8.9			
Floodprone Width (ft)		52.0	79.0	53.0		12.2	15.6	76.3		9.1		20.9		14.7	18.5	13.6			
Bankfull Mean Depth		1.2	1.4	1.1		0.7	0.8	1.2		0.7		0.6		1.0	1.4	0.5			
Bankfull Max Depth		1.7		1.7		1.1	1.4	1.9		1.1		1.0		1.5	1.6	0.7			
Bankfull Cross-sectional Area (ft^2)		11.4	17.5	13.2		5.7	6.2	28.9		5.7		3.8		10.7	11.1	4.6			
Width/Depth Ratio		8.1	8.9	11.5		6.6	9.8	19.1		10.9		10.1		6.0	11.7	17.0	17.5		
Entrenchment Ratio		5.4	6.4	4.3		1.6	2.1	3.3		1.2		3.4		1.5	1.9	1.5			
Bank Height Ratio		0.9	1.4	0.8	1.3	1.7	2.6	1.5		2.5		1.0		1.8	2.1	1.0	2.4		
D50 (mm)		1.8		75.9		19.0		22		N/A		19.0		38.0		6.5			
Profile																			
Riffle Length (ft)	N/A	---		---		---		---		---		---		---		---			
Riffle Slope (ft/ft)		0.0114	0.0605	0.0142	0.3451	0.0036	0.0420	0.0063	0.0770	N/A		0.0110	0.1400	0.0120	0.0320	0.0230	0.1700		
Pool Length (ft)		---		---		---		---		---		---		---		---			
Pool Max Depth (ft)		2.5		N/A		1.3	1.5	4.4		N/A		1.5		2.4		N/A			
Pool Spacing (ft)		31	60	19	46	9	55	29	88	N/A		18	27	36	149	13	49		
Pool Volume (ft^3)		---		---		---		---		---		---		---		---			
Pattern																			
Channel Beltwidth (ft)	N/A	55		23		24	60	62	88	18	34	N/A		25	56	N/A			
Radius of Curvature (ft)		31	56	29	52	14	29	7	38	8	26	N/A		9	28	N/A			
Rc/Bankfull Width		2.8	5.1	2.4	4.2	1.9	3.8	0.3	1.6	N/A		N/A		0.9	2.9	N/A			
Meander Length (ft)		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A			
Meander Width Ratio		4.4	5.7	1.8		3.3	7.6	2.6	3.7	2.3	4.3	N/A		2.6	5.8	N/A			
Substrate, Bed and Transport Parameters																			
Ri%/Ru%/P%/G%/S%	N/A																		
SC%/Sa%/G%/C%/B%/Be%																			
d16/d35/d50/d84/d95/d100		0.3/0.4/1.8/12.8/25.2/90.0		0.5/29.8/75.9/170.8/332.0/2048.0		0.062/1/19/76/150		4.1/11/22/50/78		N/A		0.37/8/19.02/102.3/256/>2048		8.9/27/38/71/150		0.49/3.5/6.5/48.0/83.0/128.0	
Reach Shear Stress (Competency) lb/ft^2																			
Max part size (mm) mobilized at bankfull																			
Stream Power (Capacity) W/m^2																			
Additional Reach Parameters																			
Drainage Area (SM)	N/A	1.6		1.6		0.2		2.1		0.1		0.0		0.2		0.1			
Watershed Impervious Cover Estimate (%)		---		---		---		---		---		---		---		---			
Rosgen Classification		E5		E3b/ C3b		E4		C4		B4/ B4a		B4a or A4		B4c		B4			
Bankfull Velocity (fps)		5.5		6.1		3.4		3.4		5.9		5.0		2.7		3.7			
Bankfull Discharge (cfs)		80		80		20		99		23		19		26	32	17			
Q-NFF regression (2-yr)																			
Q-USGS extrapolation (1.2-yr)																			
Q-Mannings																			
Valley Length (ft)		---		---		---		---		---		---		---		---			
Channel Thalweg Length (ft)		---		---		---		---		---		---		---		---			
Sinuosity		1.1		1.1		1.6		1.3		1.2		---		1.3		N/A			
Water Surface Slope (ft/ft)		---		---		---		---		---		---		---		---			
Bankfull/Channel Slope (ft/ft)		0.0046		0.0270		0.0150		0.0084		0.0300	0.0650	0.0680		0.0067		---			

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided N/A: Not Applicable

Table 8a. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

	Bull Creek Reach 1A Cross-Section 1, Riffle								Bull Creek Reach 1B Cross-Section 2, Riffle							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull elevation	1106.41								1099.36							
Bankfull Width (ft)	19.4								17.3							
Floodprone Width (ft)[1]	70.1								67.6							
Bankfull Mean Depth (ft)	1.5								1.7							
Bankfull Max Depth (ft)	2.8								2.9							
Bankfull Cross-Sectional Area (ft^2)	28.2								29.7							
Bankfull Width/Depth Ratio	13.4								10.1							
Bankfull Entrenchment Ratio[2]	3.6								3.9							
Bankfull Bank Height Ratio	1.0								1.0							
	Bull Creek Reach 1B Cross-Section 3, Pool								**Bull Creek Reach 2 Cross-Section 4, Riffle**							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull elevation	1098.70								1088.01							
Bankfull Width (ft)	24.4								16.4							
Floodprone Width (ft)[1]	N/A								55.7							
Bankfull Mean Depth (ft)	2.3								1.4							
Bankfull Max Depth (ft)	5.3								2.5							
Bankfull Cross-Sectional Area (ft^2)	56.8								22.9							
Bankfull Width/Depth Ratio	10.5								11.8							
Bankfull Entrenchment Ratio[2]	N/A								3.4							
Bankfull Bank Height Ratio	N/A								1.0							
	Bull Creek Reach 3 Cross-Section 5, Pool								**Bull Creek Reach 3 Cross-Section 6, Riffle**							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
Bankfull elevation	1079.64								1079.35							
Bankfull Width (ft)	27.0								21.2							
Floodprone Width (ft)[1]	N/A								99.0							
Bankfull Mean Depth (ft)	1.8								1.6							
Bankfull Max Depth (ft)	3.7								2.7							
Bankfull Cross-Sectional Area (ft^2)	49.0								33.5							
Bankfull Width/Depth Ratio	14.9								13.4							
Bankfull Entrenchment Ratio[2]	N/A								4.7							
Bankfull Bank Height Ratio	N/A								1.0							

1. Floodprone width is based on the width of the cross-section, in lieu of assuming the width across the floodplain.
2. ER is based on the width of the cross-section, in lieu of assuming the width across the floodplain.
N/A: Not Applicable

Table 8b. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

	Bull Creek Reach 3 Cross-Section 7, Riffle								Bull Creek Reach 3 Cross-Section 8, Pool							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
bankfull elevation	1073.27								1068.53							
Bankfull Width (ft)	19.6								29.3							
Floodprone Width (ft)[1]	84.0								N/A							
Bankfull Mean Depth (ft)	1.8								1.9							
Bankfull Max Depth (ft)	3.0								4.3							
Bankfull Cross-Sectional Area (ft^2)	36.0								55.1							
Bankfull Width/Depth Ratio	10.7								15.6							
Bankfull Entrenchment Ratio[2]	4.3								N/A							
Bankfull Bank Height Ratio	1.0								N/A							
	UT1B Cross-Section 9, Riffle								**UT1C Cross-Section 10, Riffle**							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
bankfull elevation	1101.94								1089.27							
Bankfull Width (ft)	6.8								6.9							
Floodprone Width (ft)[1]	23.6								34.0							
Bankfull Mean Depth (ft)	0.6								0.8							
Bankfull Max Depth (ft)	0.9								1.3							
Bankfull Cross-Sectional Area (ft^2)	3.9								5.7							
Bankfull Width/Depth Ratio	11.7								8.3							
Bankfull Entrenchment Ratio[2]	3.5								4.9							
Bankfull Bank Height Ratio	1.0								1.0							
	UT2A Cross-Section 11, Riffle								**UT2B Cross-Section 12, Riffle**							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
bankfull elevation	1096.25								1088.43							
Bankfull Width (ft)	6.8								8.1							
Floodprone Width (ft)[1]	30.3								32.0							
Bankfull Mean Depth (ft)	0.5								0.6							
Bankfull Max Depth (ft)	0.8								1.1							
Bankfull Cross-Sectional Area (ft^2)	3.4								4.8							
Bankfull Width/Depth Ratio	13.9								13.4							
Bankfull Entrenchment Ratio[2]	4.4								4.0							
Bankfull Bank Height Ratio	1.0								1.0							

1. Floodprone width is based on the width of the cross-section, in lieu of assuming the width across the floodplain.
2. ER is based on the width of the cross-section, in lieu of assuming the width across the floodplain.
N/A: Not Applicable

Table 8c. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

	UT2C Cross-Section 13, Riffle								UT3B Cross-Section 14, Riffle							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
bankfull elevation	1081.59								1084.57							
Bankfull Width (ft)	7.8								6.9							
Floodprone Width (ft)[1]	48.2								21.4							
Bankfull Mean Depth (ft)	0.7								0.5							
Bankfull Max Depth (ft)	1.1								0.8							
Bankfull Cross-Sectional Area (ft^2)	5.8								3.5							
Bankfull Width/Depth Ratio	10.5								13.4							
Bankfull Entrenchment Ratio[2]	6.2								3.1							
Bankfull Bank Height Ratio	1.0								1.0							

	UT3C Cross-Section 15, Riffle							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
bankfull elevation	1081.13							
Bankfull Width (ft)	8.8							
Floodprone Width (ft)[1]	55.8							
Bankfull Mean Depth (ft)	0.8							
Bankfull Max Depth (ft)	1.3							
Bankfull Cross-Sectional Area (ft^2)	6.8							
Bankfull Width/Depth Ratio	11.3							
Bankfull Entrenchment Ratio[2]	6.3							
Bankfull Bank Height Ratio	1.0							

1. Floodprone width is based on the width of the cross-section, in lieu of assuming the width across the floodplain.

2. ER is based on the width of the cross-section, in lieu of assuming the width across the floodplain.

N/A: Not Applicable

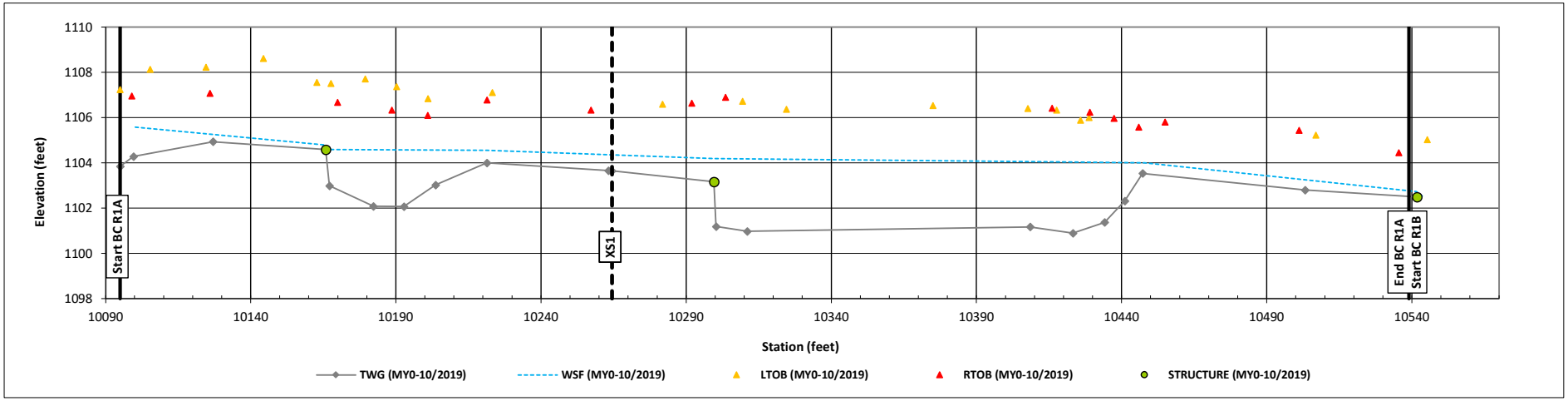
Longitudinal Profile Plots

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

Bull Creek Reach 1A (STA 100+95 to 105+39)



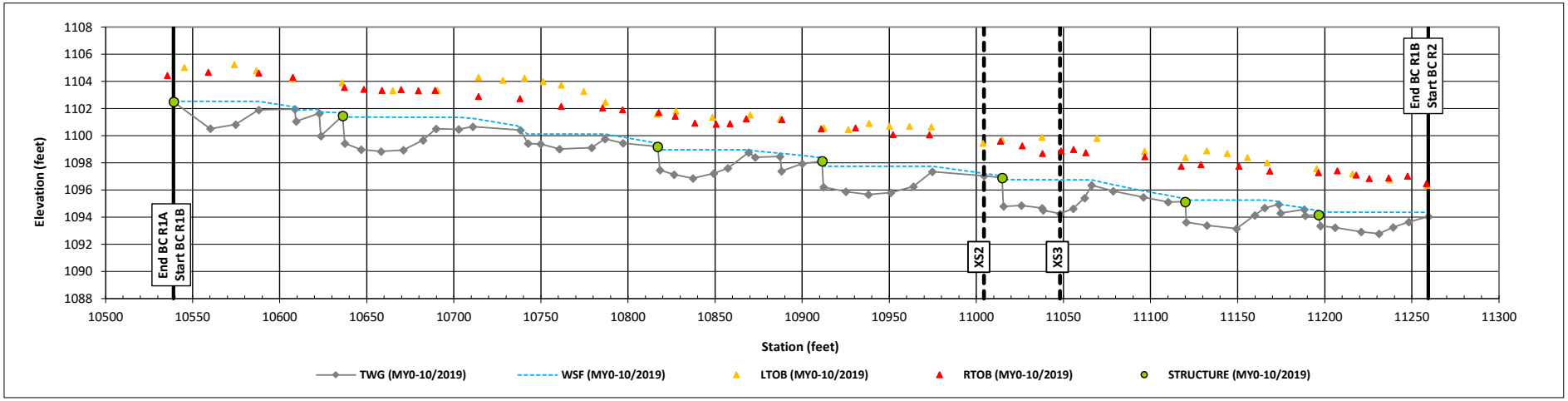
Longitudinal Profile Plots

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

Bull Creek Reach 1B (STA 105+39 to 112+61)



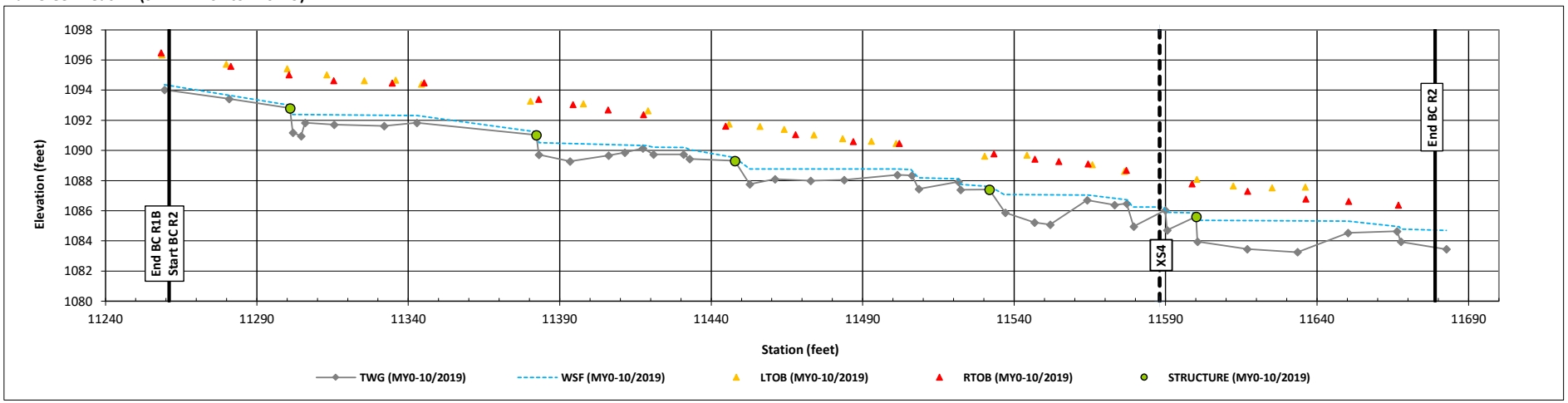
Longitudinal Profile Plots

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

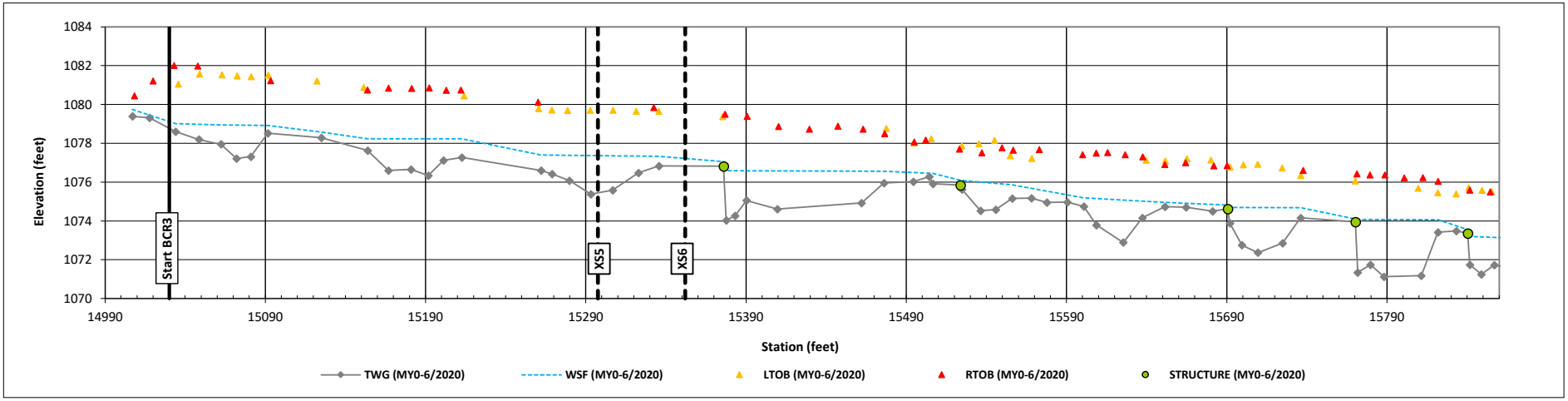
Bull Creek Reach 2 (STA 112+61 to 116+79)

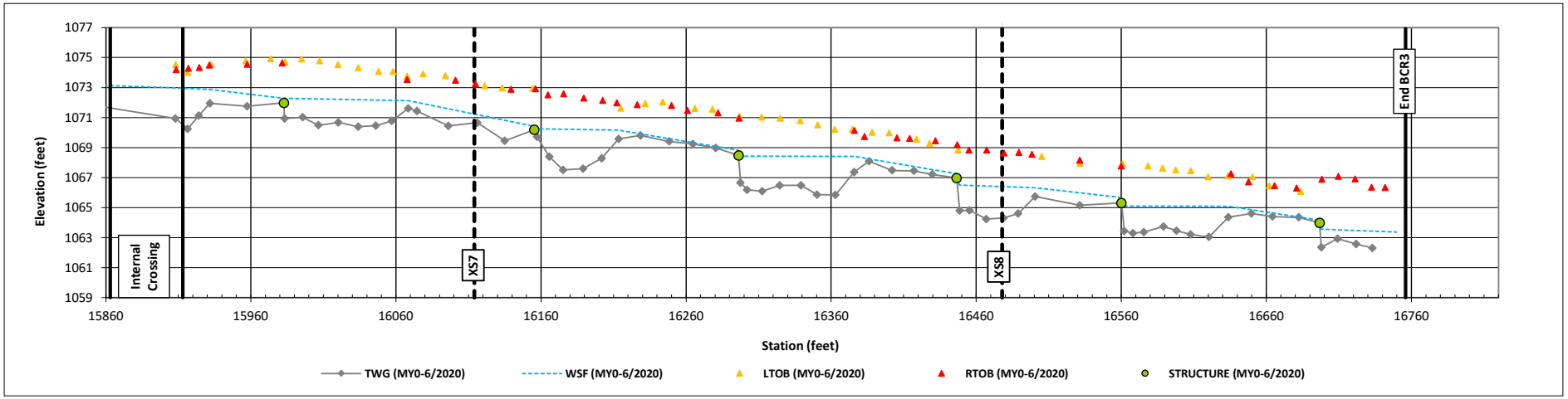


Longitudinal Profile Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Bull Creek Reach 3 (STA 150+30 to 167+56)





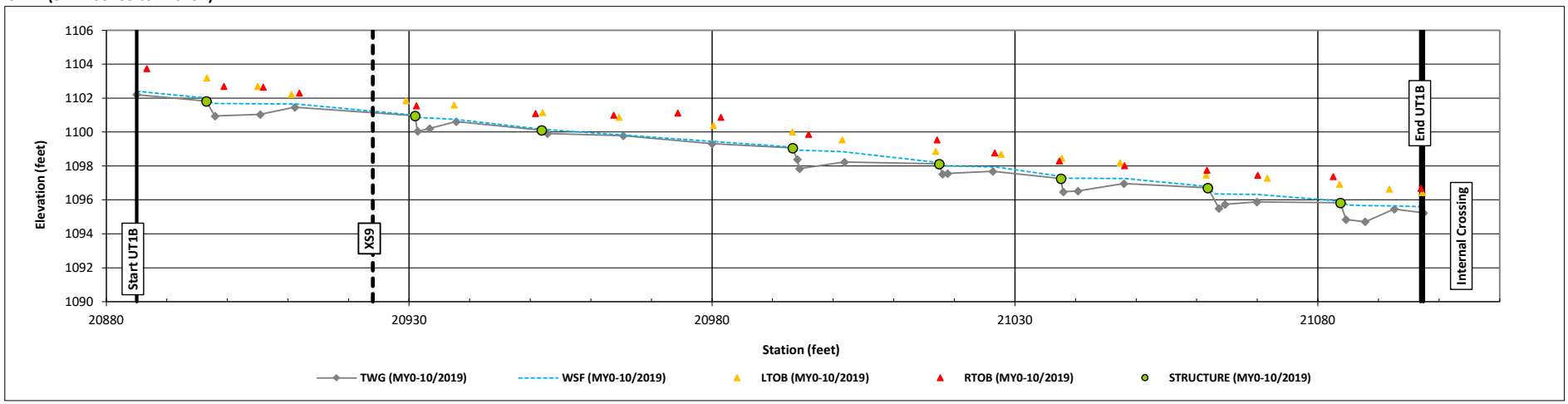
Longitudinal Profile Plots

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

UT1B (STA 208+85 to 210+97)



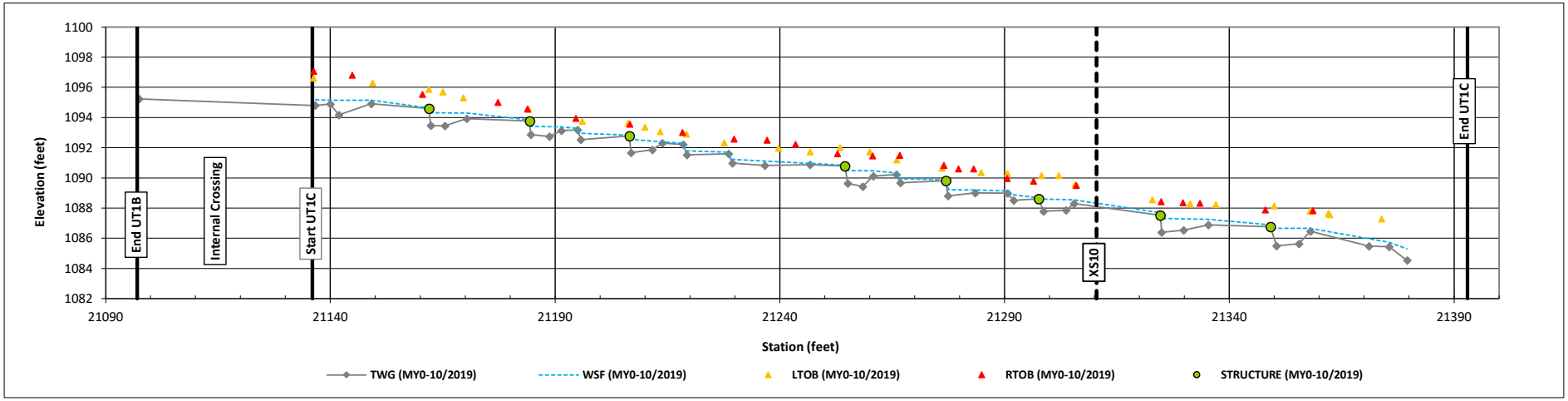
Longitudinal Profile Plots

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

UT1C (STA 211+36 to 213+93)



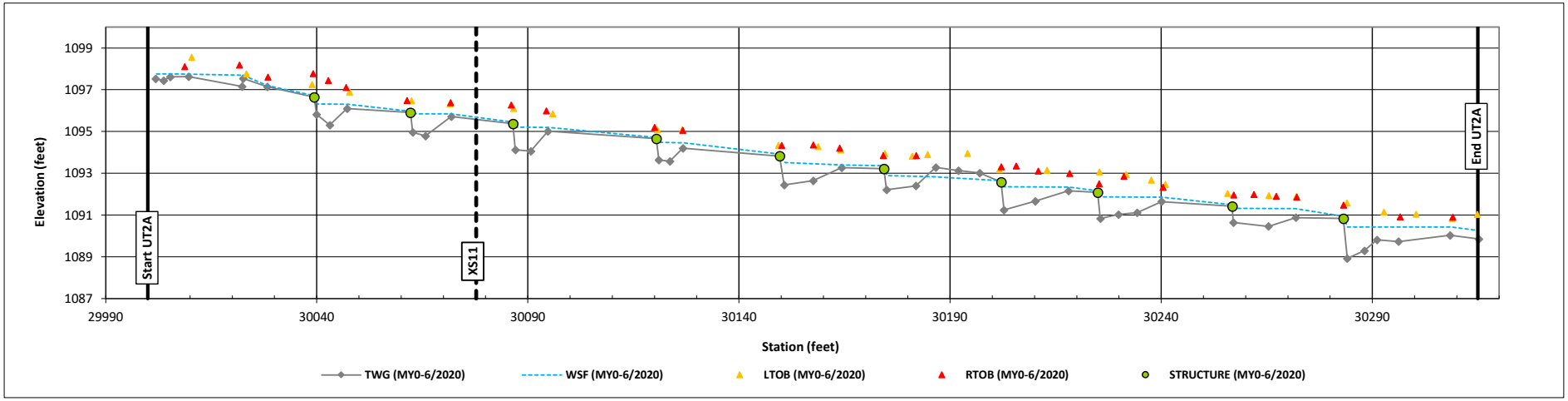
Longitudinal Profile Plots

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

UT2A (STA 300+00 to 303+15)



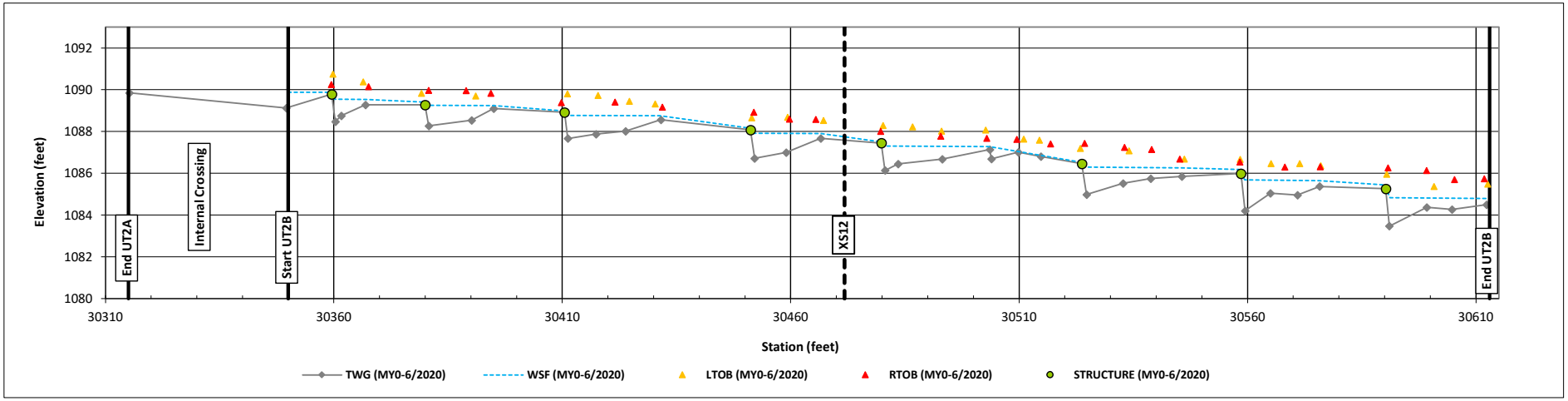
Longitudinal Profile Plots

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

UT2B (STA 303+50 to 306+13)



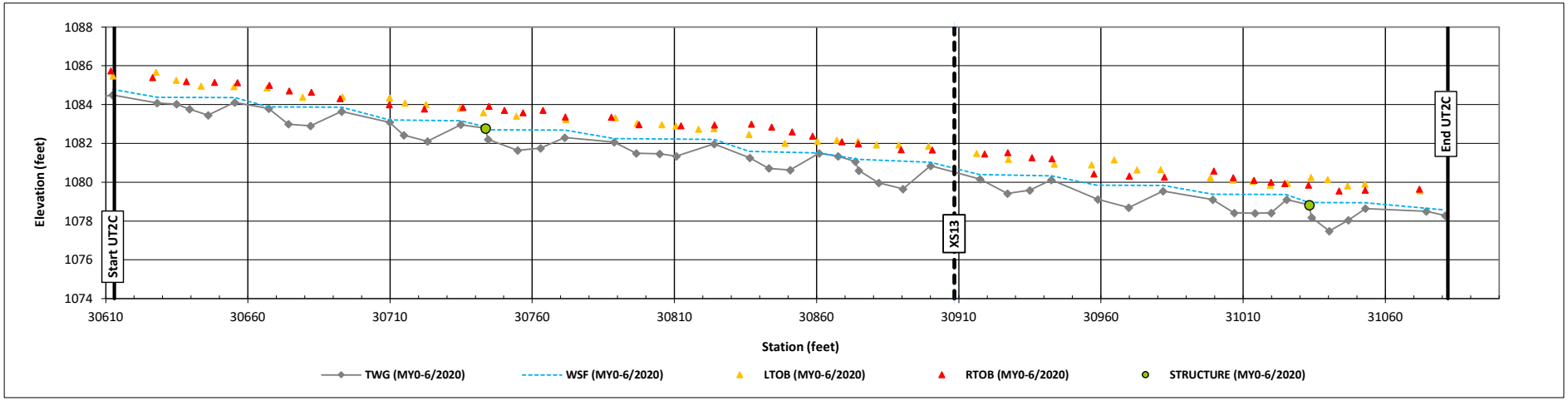
Longitudinal Profile Plots

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

UT2C (STA 306+13 to 310+82)



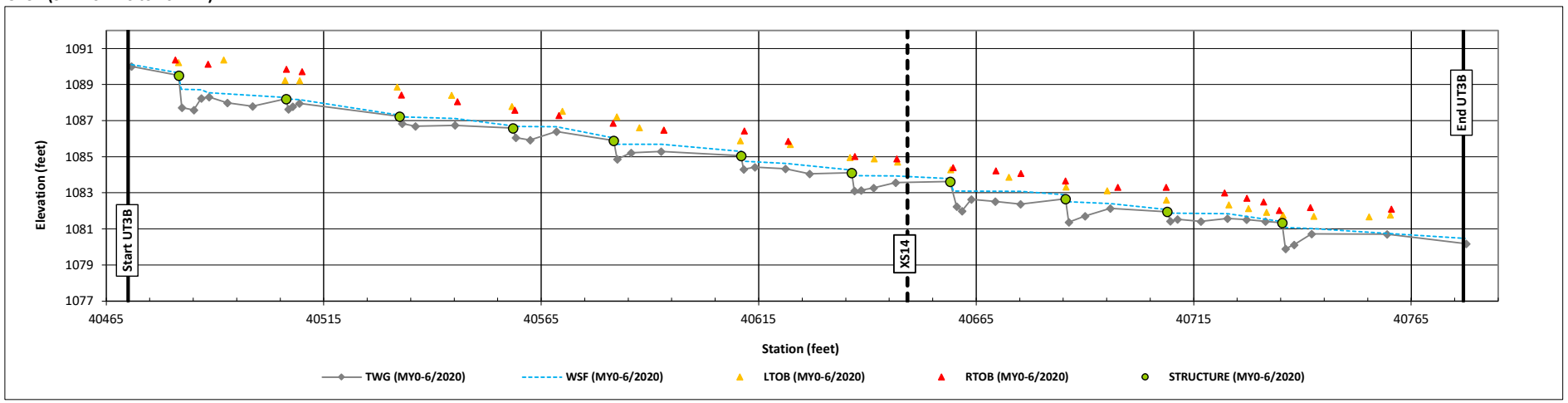
Longitudinal Profile Plots

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

UT3B (STA 404+70 to 407+77)



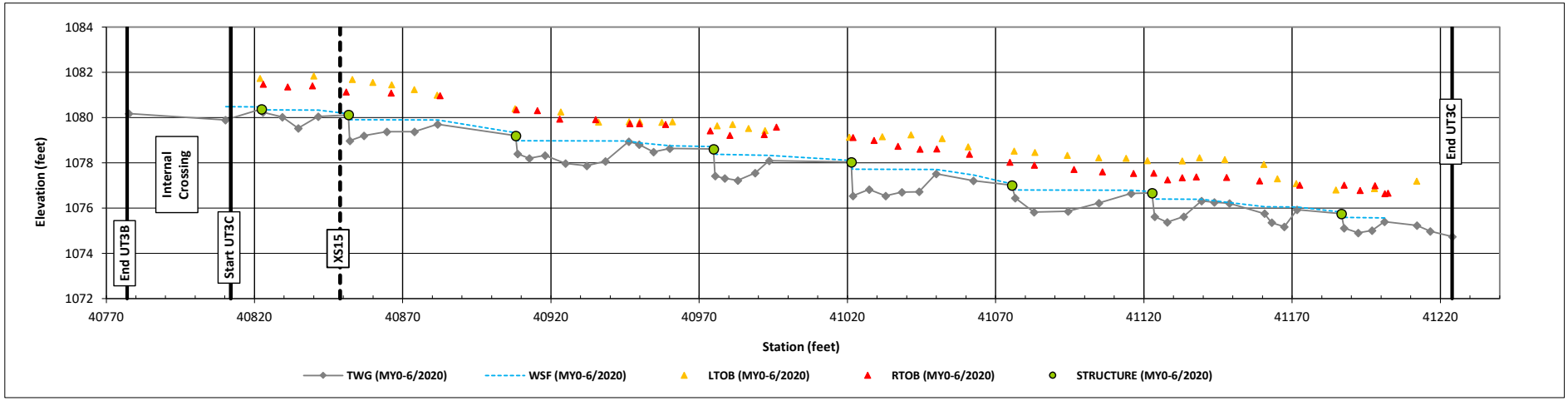
Longitudinal Profile Plots

Key Mill Mitigation Site

DMS Project No. 100025

Monitoring Year 0 - 2020

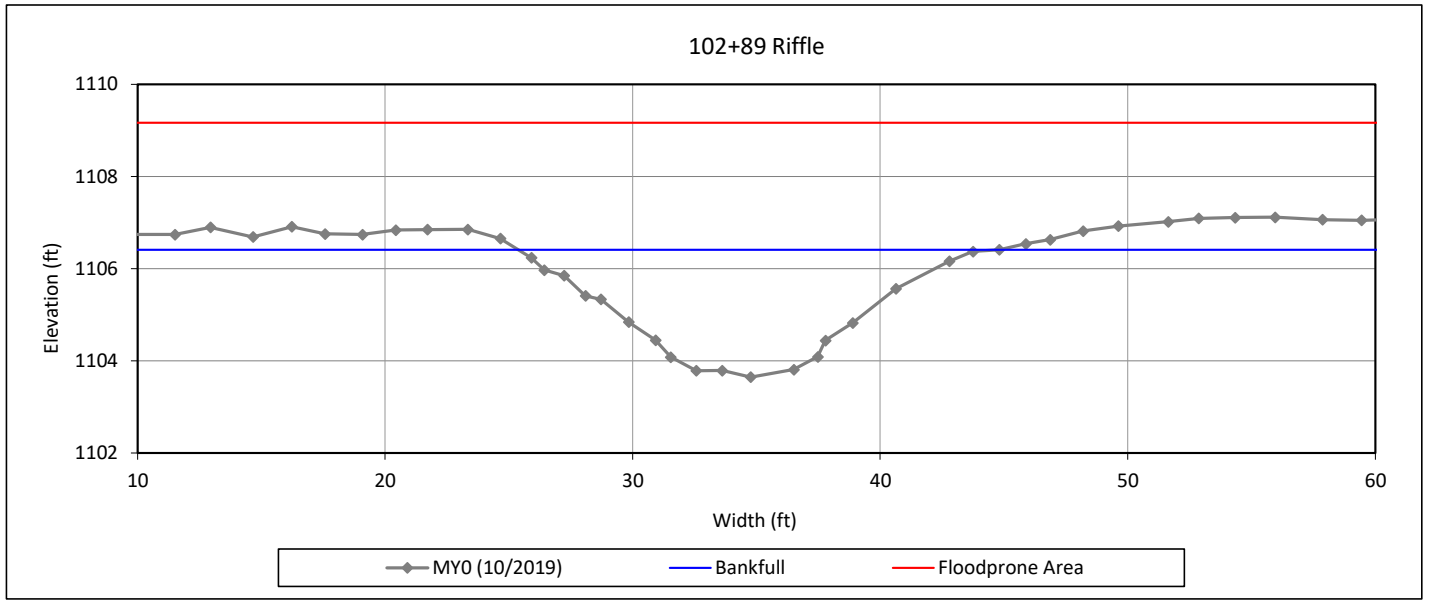
UT3C (STA 408+12 to 412+24)



Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 1-Bull Creek Reach 1A



Bankfull Dimensions

28.2	x-section area (ft.sq.)
19.4	width (ft)
1.5	mean depth (ft)
2.8	max depth (ft)
20.5	wetted perimeter (ft)
1.4	hydraulic radius (ft)
13.4	width-depth ratio
70.1	W flood prone area (ft)
3.6	entrenchment ratio
1.0	low bank height ratio

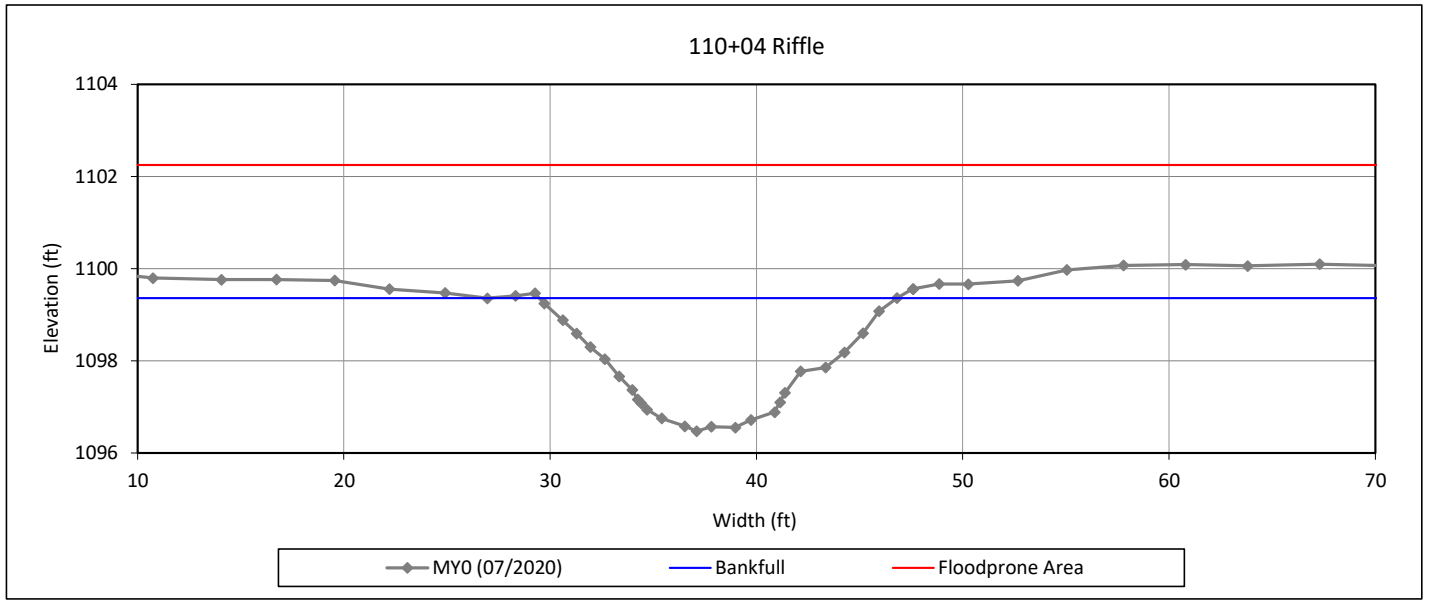
Survey Date: 10/2019
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 2-Bull Creek Reach 1B



Bankfull Dimensions

29.7	x-section area (ft.sq.)
17.3	width (ft)
1.7	mean depth (ft)
2.9	max depth (ft)
18.6	wetted perimeter (ft)
1.6	hydraulic radius (ft)
10.1	width-depth ratio
67.6	W flood prone area (ft)
3.9	entrenchment ratio
1.0	low bank height ratio

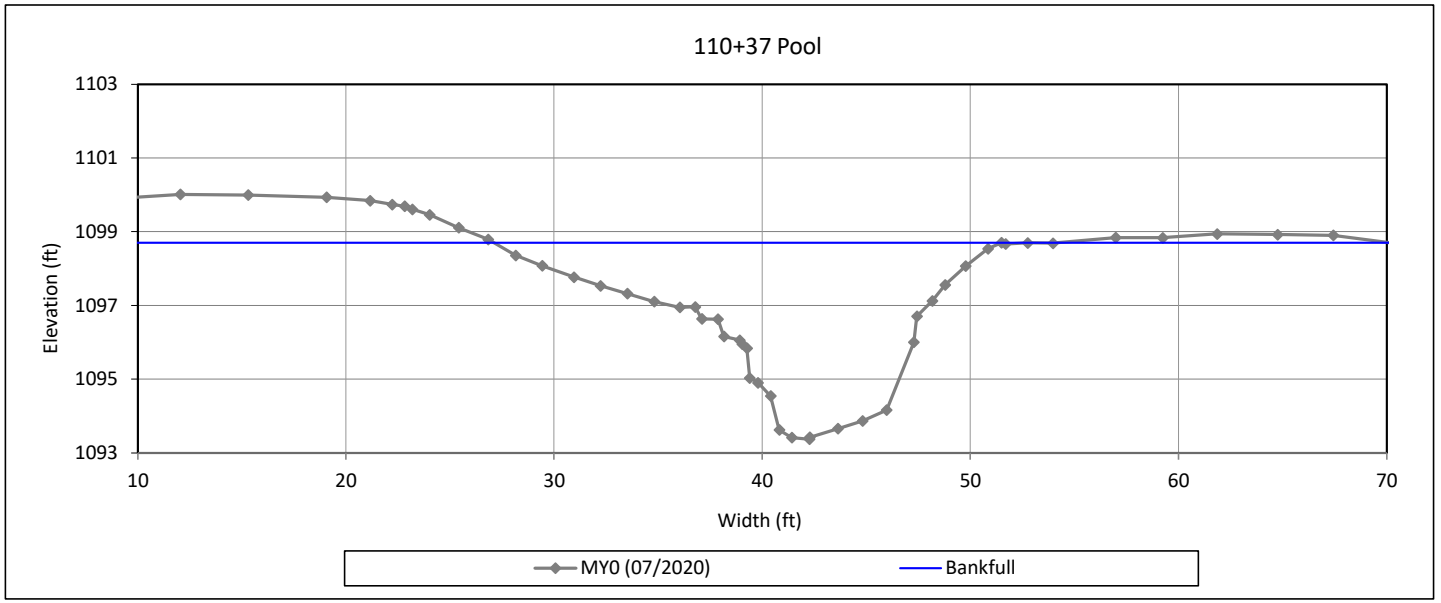
Survey Date: 07/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 3-Bull Creek Reach 1B



Bankfull Dimensions	
56.8	x-section area (ft.sq.)
24.4	width (ft)
2.3	mean depth (ft)
5.3	max depth (ft)
28.6	wetted perimeter (ft)
2.0	hydraulic radius (ft)
10.5	width-depth ratio

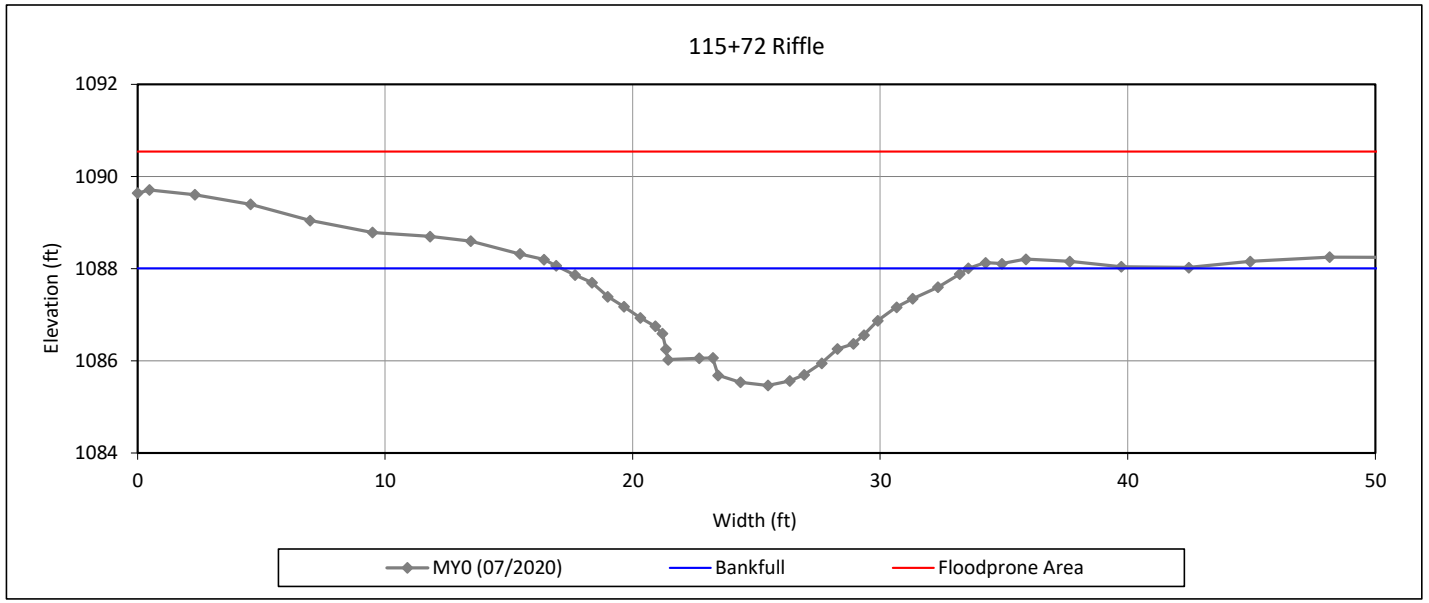
Survey Date: 07/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 4-Bull Creek Reach 2



Bankfull Dimensions

22.9	x-section area (ft.sq.)
16.4	width (ft)
1.4	mean depth (ft)
2.5	max depth (ft)
17.8	wetted perimeter (ft)
1.3	hydraulic radius (ft)
11.8	width-depth ratio
55.7	W flood prone area (ft)
3.4	entrenchment ratio
1.0	low bank height ratio

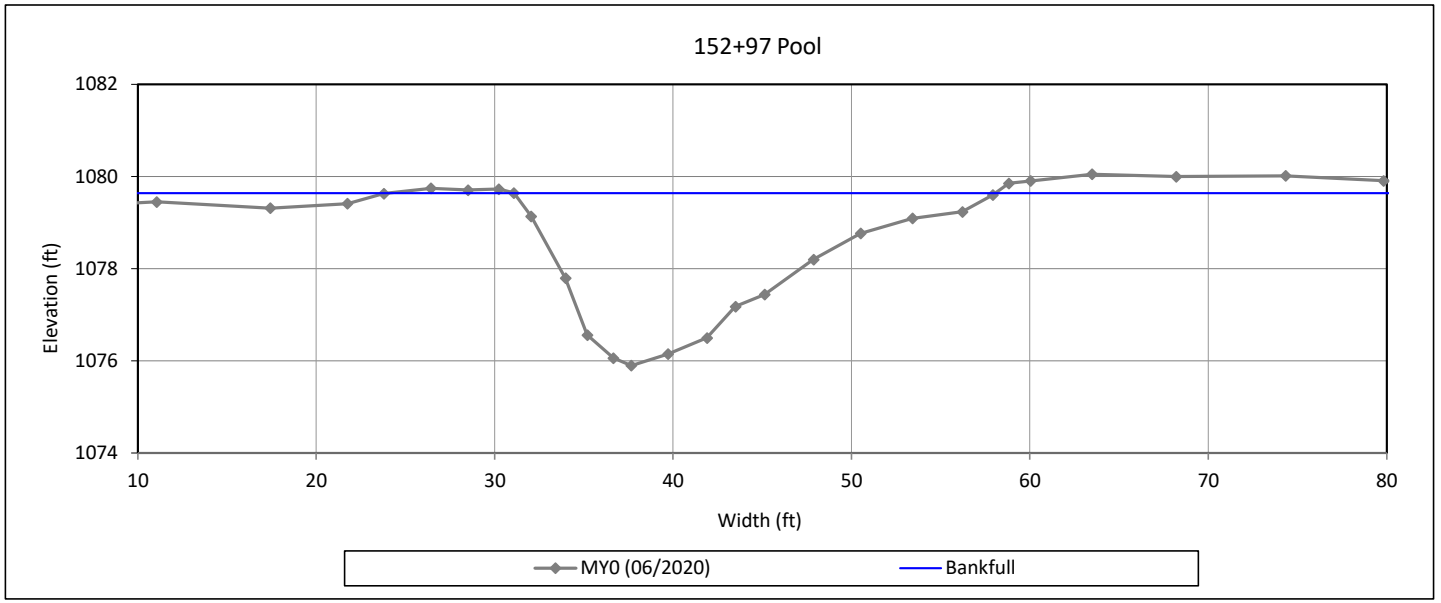
Survey Date: 07/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 5-Bull Creek Reach 3



Bankfull Dimensions	
49.0	x-section area (ft.sq.)
27.0	width (ft)
1.8	mean depth (ft)
3.7	max depth (ft)
28.6	wetted perimeter (ft)
1.7	hydraulic radius (ft)
14.9	width-depth ratio

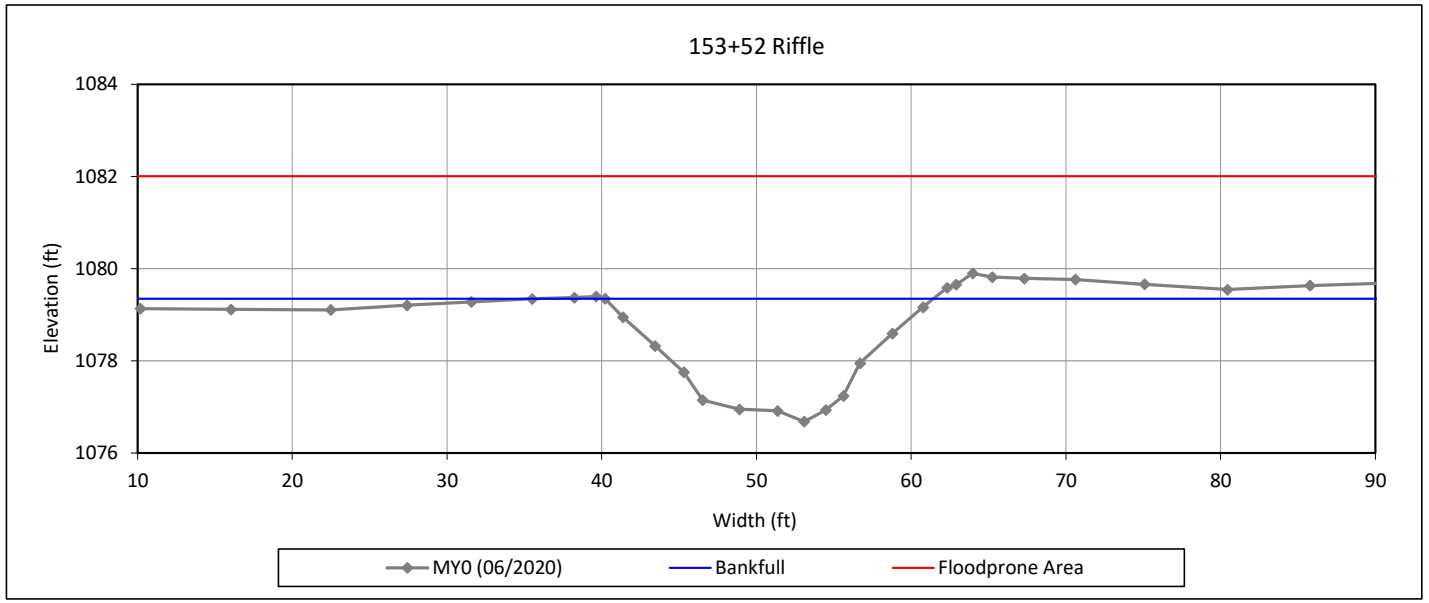
Survey Date: 06/2020
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 6-Bull Creek Reach 3



Bankfull Dimensions

33.5	x-section area (ft.sq.)
21.2	width (ft)
1.6	mean depth (ft)
2.7	max depth (ft)
22.1	wetted perimeter (ft)
1.5	hydraulic radius (ft)
13.4	width-depth ratio
99.0	W flood prone area (ft)
4.7	entrenchment ratio
1.0	low bank height ratio

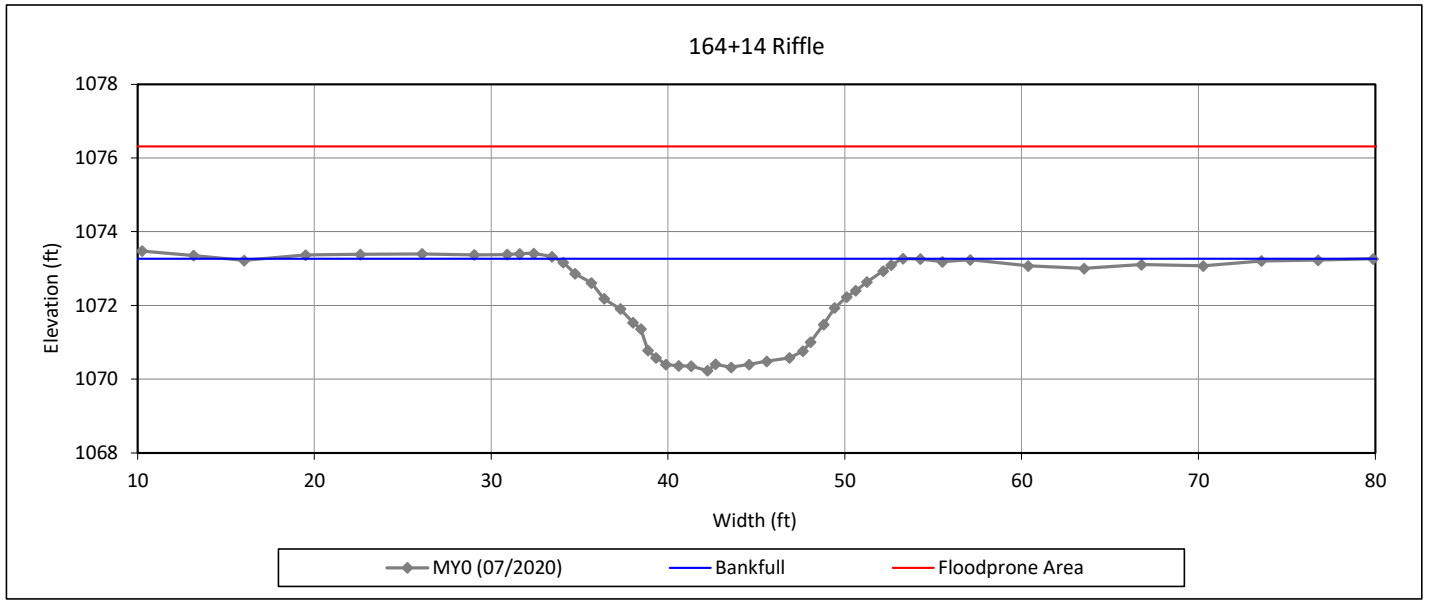
Survey Date: 06/2020
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 7-Bull Creek Reach 3



Bankfull Dimensions

36.0	x-section area (ft.sq.)
19.6	width (ft)
1.8	mean depth (ft)
3.0	max depth (ft)
21.1	wetted perimeter (ft)
1.7	hydraulic radius (ft)
10.7	width-depth ratio
84.0	W flood prone area (ft)
4.3	entrenchment ratio
1.0	low bank height ratio

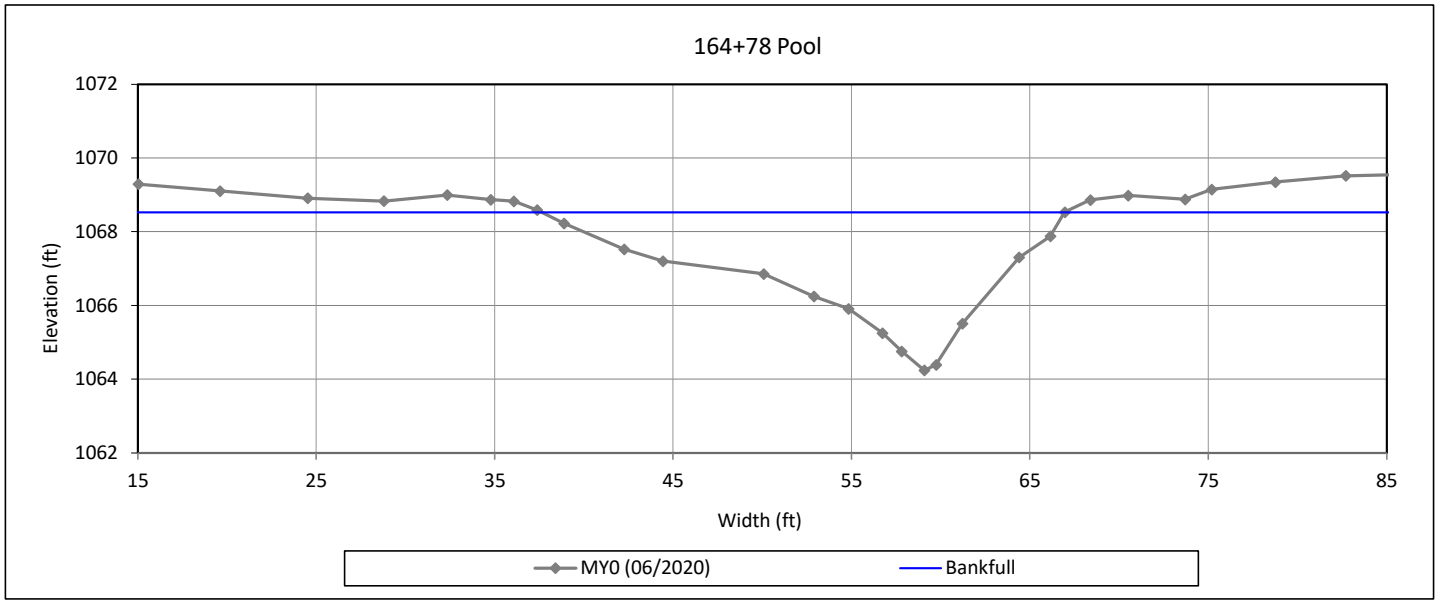
Survey Date: 07/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 8-Bull Creek Reach 3



Bankfull Dimensions	
55.1	x-section area (ft.sq.)
29.3	width (ft)
1.9	mean depth (ft)
4.3	max depth (ft)
31.1	wetted perimeter (ft)
1.8	hydraulic radius (ft)
15.6	width-depth ratio

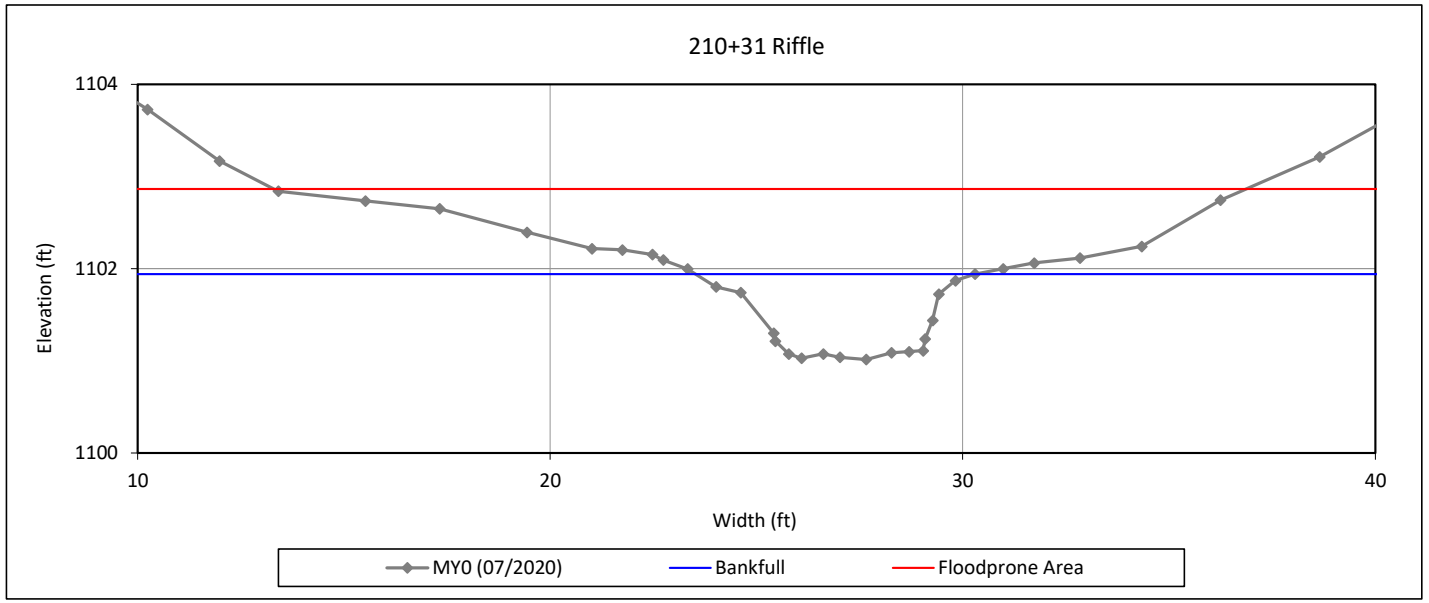
Survey Date: 06/2020
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 9-UT1B



Bankfull Dimensions

3.9	x-section area (ft.sq.)
6.8	width (ft)
0.6	mean depth (ft)
0.9	max depth (ft)
7.4	wetted perimeter (ft)
0.5	hydraulic radius (ft)
11.7	width-depth ratio
23.6	W flood prone area (ft)
3.5	entrenchment ratio
1.0	low bank height ratio

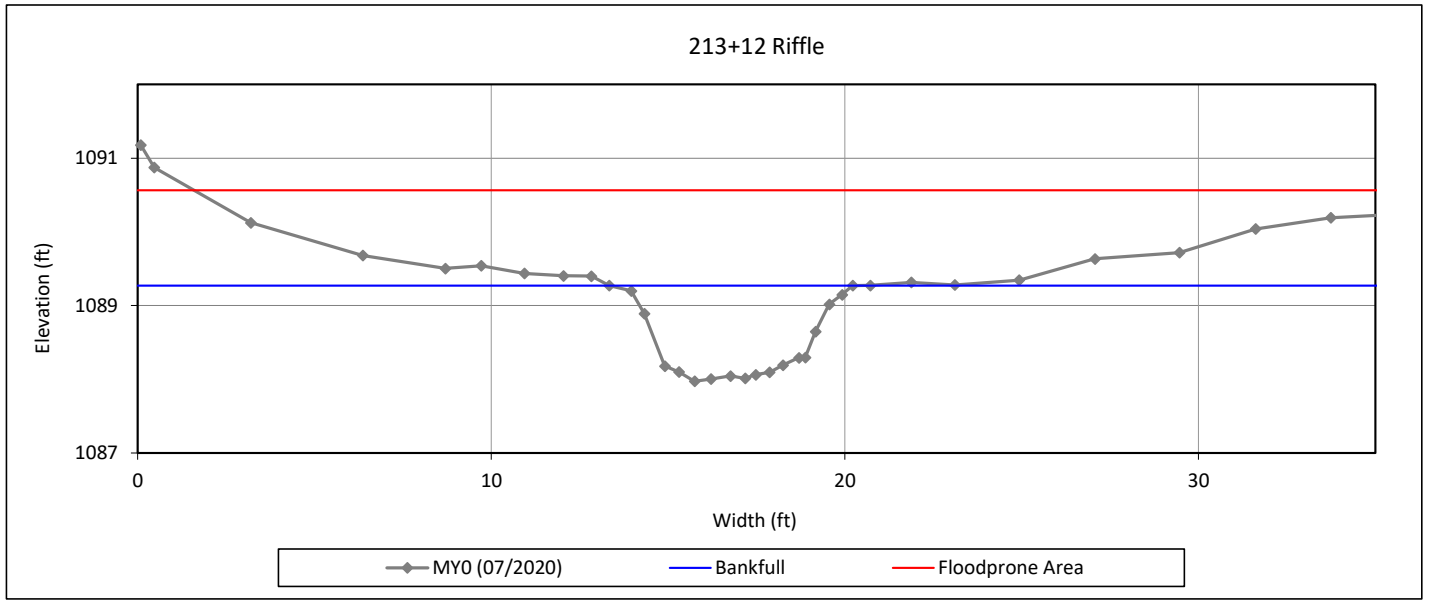
Survey Date: 07/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 10-UT1C



Bankfull Dimensions

5.7	x-section area (ft.sq.)
6.9	width (ft)
0.8	mean depth (ft)
1.3	max depth (ft)
7.7	wetted perimeter (ft)
0.7	hydraulic radius (ft)
8.3	width-depth ratio
34.0	W flood prone area (ft)
4.9	entrenchment ratio
1.0	low bank height ratio

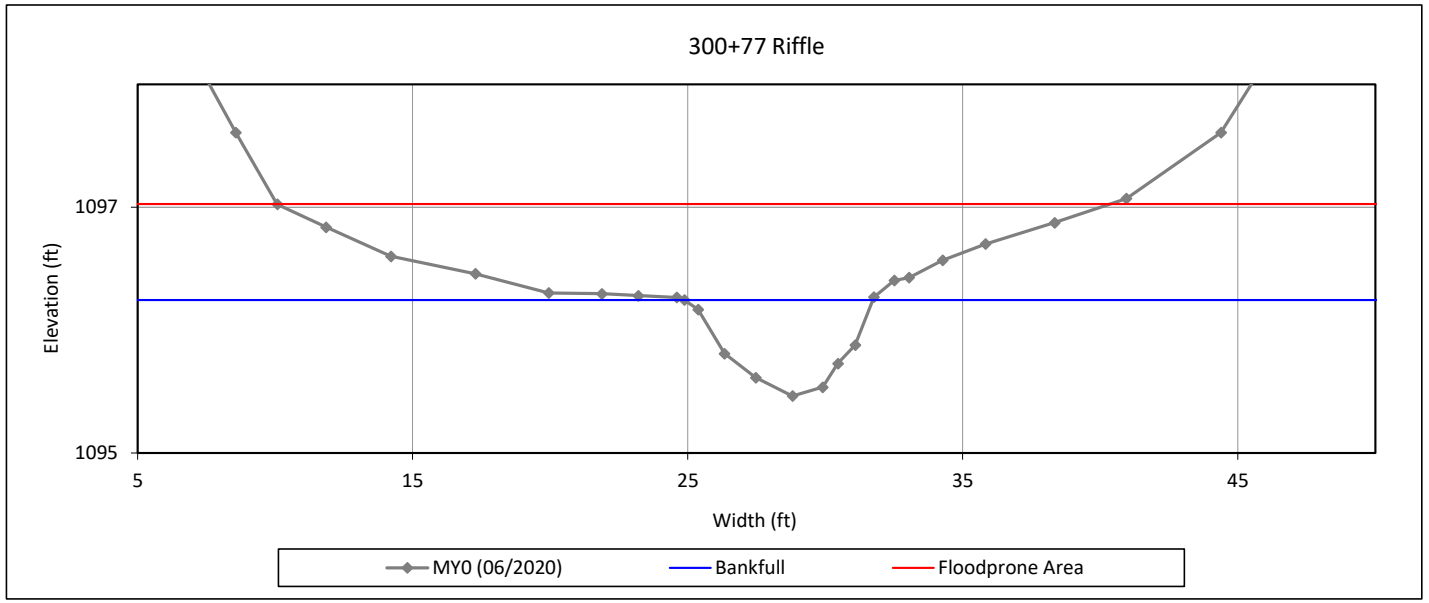
Survey Date: 07/2020
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 11-UT2A



Bankfull Dimensions

3.4	x-section area (ft.sq.)
6.8	width (ft)
0.5	mean depth (ft)
0.8	max depth (ft)
7.1	wetted perimeter (ft)
0.5	hydraulic radius (ft)
13.9	width-depth ratio
30.3	W flood prone area (ft)
4.4	entrenchment ratio
1.0	low bank height ratio

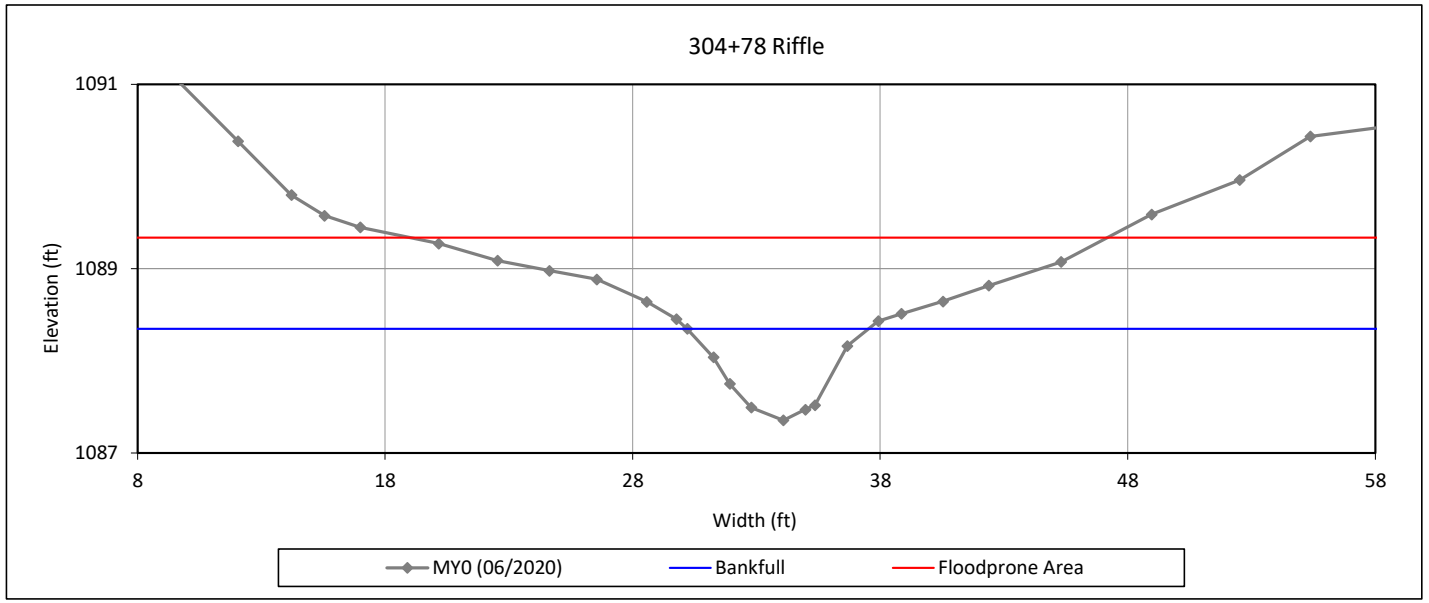
Survey Date: 06/2020
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 12-UT2B



Bankfull Dimensions

4.2	x-section area (ft.sq.)
7.3	width (ft)
0.6	mean depth (ft)
1.0	max depth (ft)
7.7	wetted perimeter (ft)
0.5	hydraulic radius (ft)
12.8	width-depth ratio
32.0	W flood prone area (ft)
4.4	entrenchment ratio
1.0	low bank height ratio

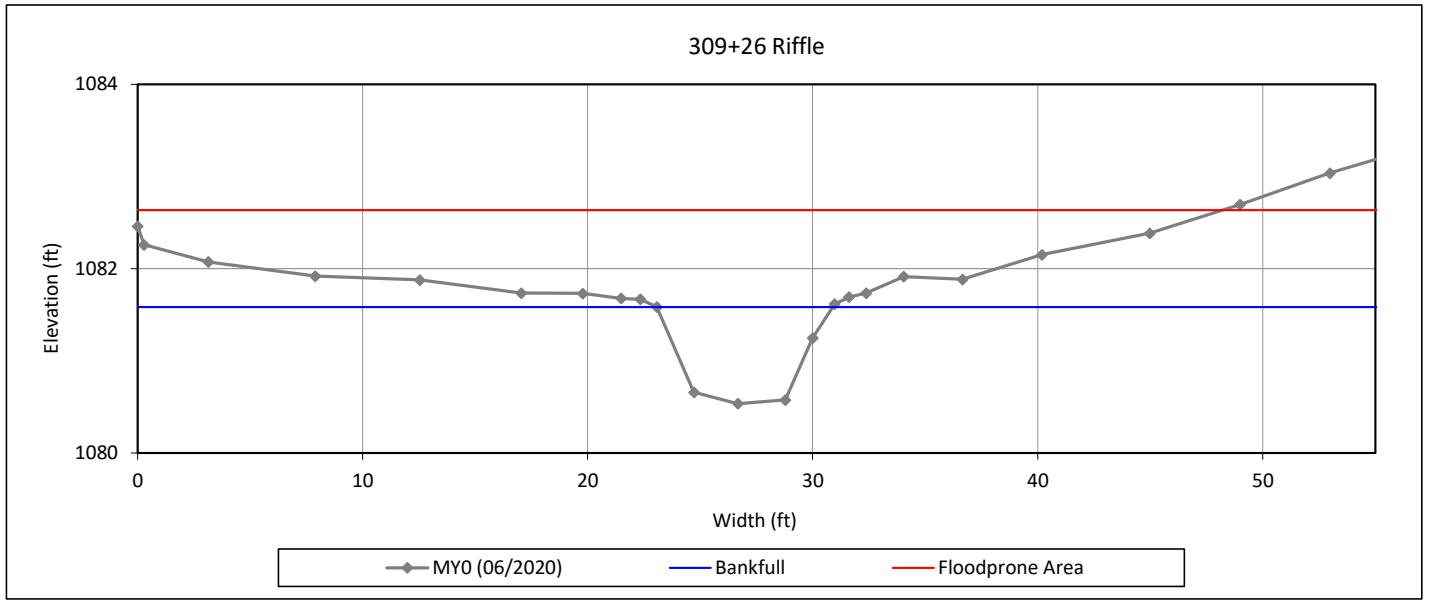
Survey Date: 06/2020
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 13-UT2C



Bankfull Dimensions

5.8	x-section area (ft.sq.)
7.8	width (ft)
0.7	mean depth (ft)
1.1	max depth (ft)
8.3	wetted perimeter (ft)
0.7	hydraulic radius (ft)
10.5	width-depth ratio
48.2	W flood prone area (ft)
6.2	entrenchment ratio
1.0	low bank height ratio

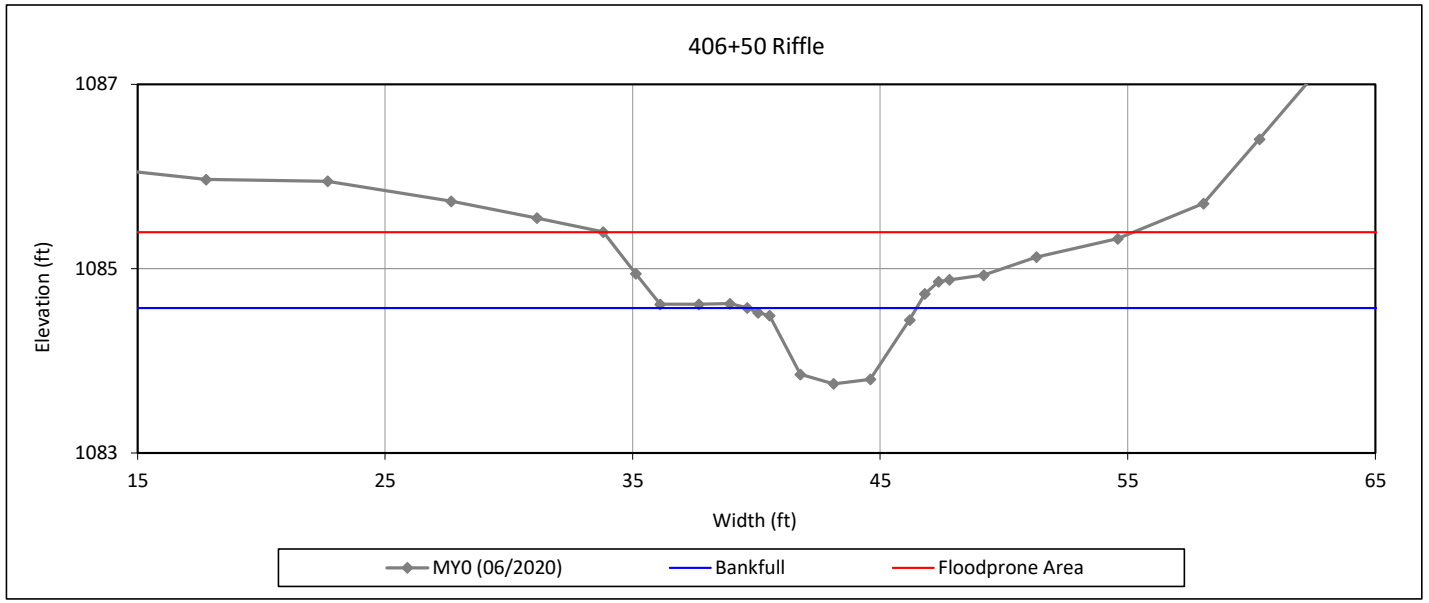
Survey Date: 06/2020
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 14-UT3B



Bankfull Dimensions

3.5	x-section area (ft.sq.)
6.9	width (ft)
0.5	mean depth (ft)
0.8	max depth (ft)
7.2	wetted perimeter (ft)
0.5	hydraulic radius (ft)
13.4	width-depth ratio
21.4	W flood prone area (ft)
3.1	entrenchment ratio
1.0	low bank height ratio

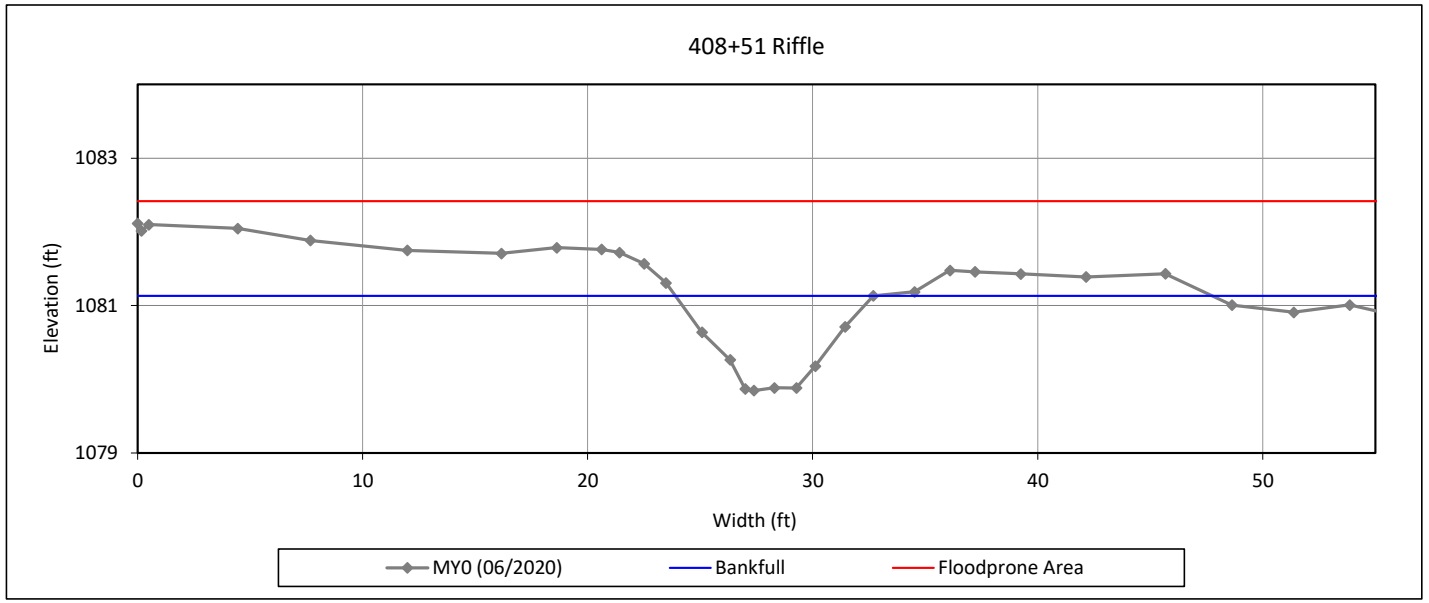
Survey Date: 06/2020
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Cross-Section 15-UT3C



Bankfull Dimensions

6.8	x-section area (ft.sq.)
8.8	width (ft)
0.8	mean depth (ft)
1.3	max depth (ft)
9.3	wetted perimeter (ft)
0.7	hydraulic radius (ft)
11.3	width-depth ratio
55.8	W flood prone area (ft)
6.3	entrenchment ratio
1.0	low bank height ratio

Survey Date: 06/2020
Field Crew: Kee Mapping & Surveying

View Downstream

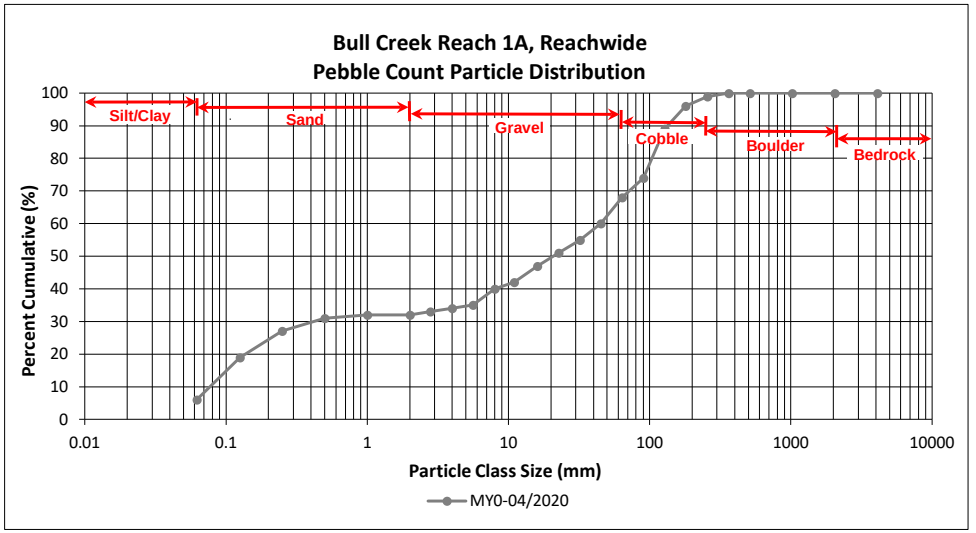
Reachwide and Cross-Section Pebble Count Plots

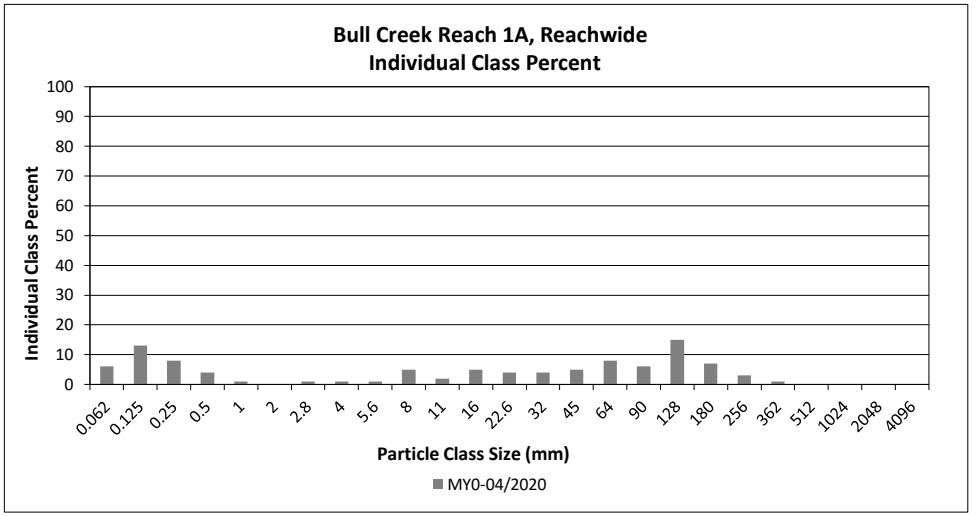
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Bull Creek Reach 1A, 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		6	6	6	6
SAND	Very fine	0.062	0.125	1	12	13	13	19
	Fine	0.125	0.250		8	8	8	27
	Medium	0.25	0.50	1	3	4	4	31
	Coarse	0.5	1.0	1		1	1	32
	Very Coarse	1.0	2.0					32
GRAVEL	Very Fine	2.0	2.8		1	1	1	33
	Very Fine	2.8	4.0		1	1	1	34
	Fine	4.0	5.6		1	1	1	35
	Fine	5.6	8.0		5	5	5	40
	Medium	8.0	11.0	1	1	2	2	42
	Medium	11.0	16.0		5	5	5	47
	Coarse	16.0	22.6	1	3	4	4	51
	Coarse	22.6	32	1	3	4	4	55
	Very Coarse	32	45	4	1	5	5	60
	Very Coarse	45	64	8		8	8	68
COBBLE	Small	64	90	6		6	6	74
	Small	90	128	15		15	15	89
	Large	128	180	7		7	7	96
	Large	180	256	3		3	3	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} =	0.1
D_{35} =	5.6
D_{50} =	20.7
D_{84} =	113.8
D_{95} =	171.4
D_{100} =	362.0





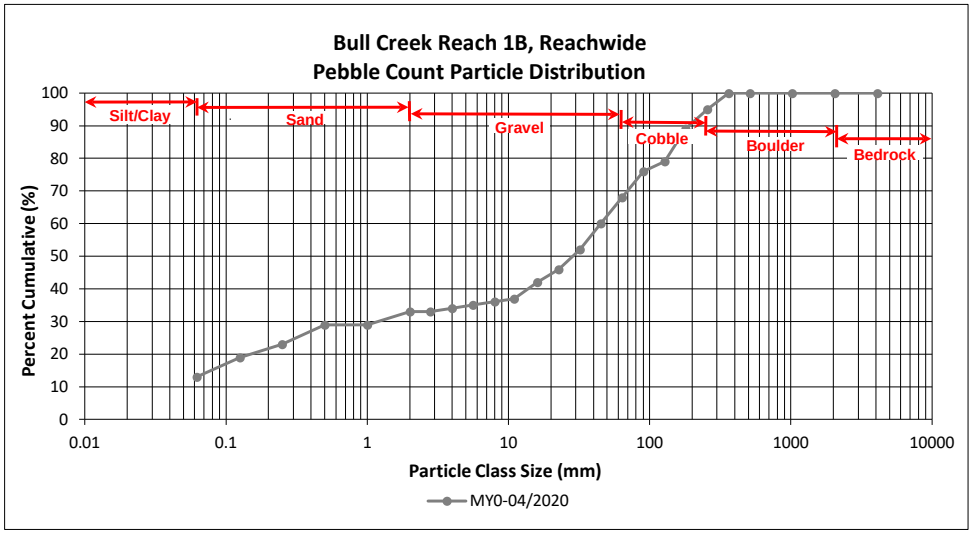
Reachwide and Cross-Section Pebble Count Plots

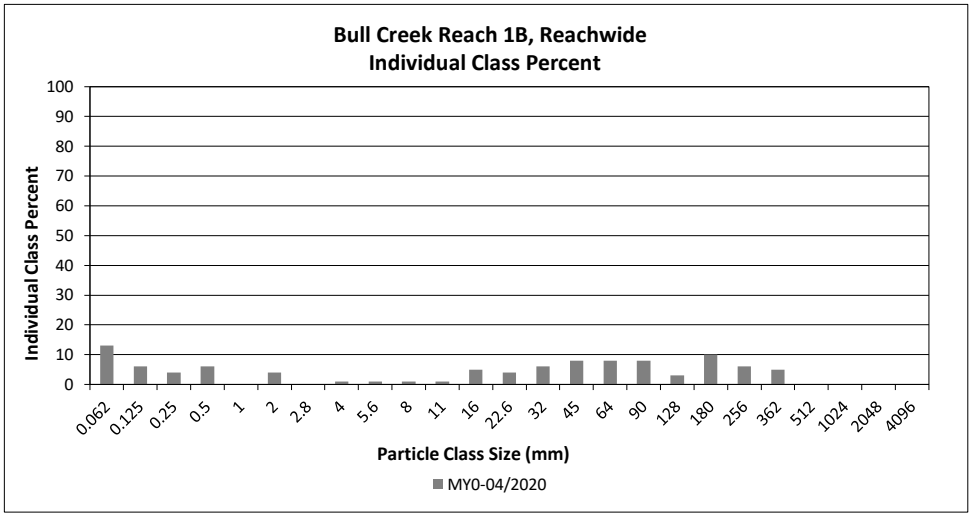
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Bull Creek Reach 1B, 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	12	13	13	13
SAND	Very fine	0.062	0.125	1	5	6	6	19
	Fine	0.125	0.250	1	3	4	4	23
	Medium	0.25	0.50	1	5	6	6	29
	Coarse	0.5	1.0					29
	Very Coarse	1.0	2.0		4	4	4	33
GRAVEL	Very Fine	2.0	2.8					33
	Very Fine	2.8	4.0		1	1	1	34
	Fine	4.0	5.6		1	1	1	35
	Fine	5.6	8.0		1	1	1	36
	Medium	8.0	11.0		1	1	1	37
	Medium	11.0	16.0		5	5	5	42
	Coarse	16.0	22.6	3	1	4	4	46
	Coarse	22.6	32	2	4	6	6	52
	Very Coarse	32	45	5	3	8	8	60
	Very Coarse	45	64	6	2	8	8	68
COBBLE	Small	64	90	6	2	8	8	76
	Small	90	128	3		3	3	79
	Large	128	180	10		10	10	89
	Large	180	256	6		6	6	95
BOULDER	Small	256	362	5		5	5	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} =	0.1
D_{35} =	5.6
D_{50} =	28.5
D_{84} =	151.8
D_{95} =	256.0
D_{100} =	362.0





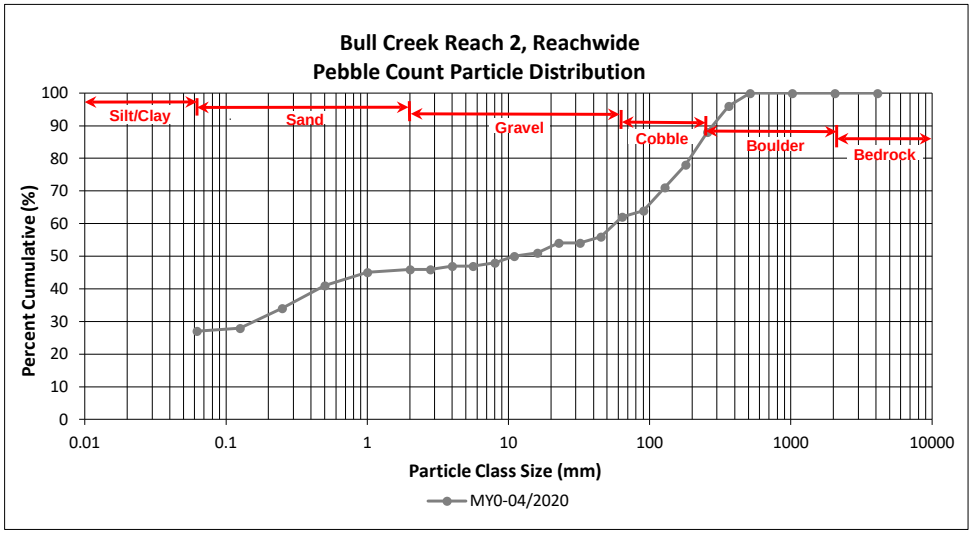
Reachwide and Cross-Section Pebble Count Plots

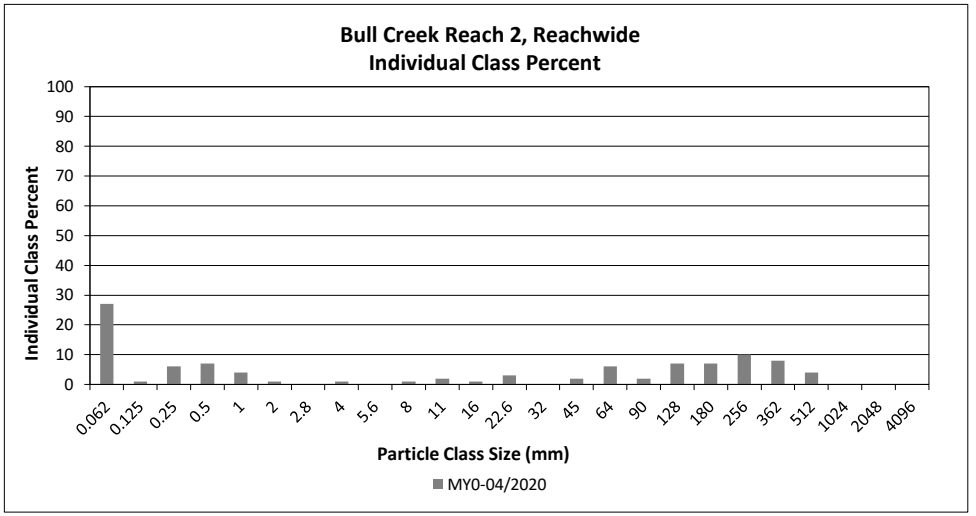
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Bull Creek Reach 2, 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	26	27	27	27
SAND	Very fine	0.062	0.125		1	1	1	28
	Fine	0.125	0.250		6	6	6	34
	Medium	0.25	0.50		7	7	7	41
	Coarse	0.5	1.0	1	3	4	4	45
	Very Coarse	1.0	2.0		1	1	1	46
GRAVEL	Very Fine	2.0	2.8					46
	Very Fine	2.8	4.0		1	1	1	47
	Fine	4.0	5.6					47
	Fine	5.6	8.0	1		1	1	48
	Medium	8.0	11.0	1	1	2	2	50
	Medium	11.0	16.0		1	1	1	51
	Coarse	16.0	22.6	1	2	3	3	54
	Coarse	22.6	32					54
	Very Coarse	32	45	1	1	2	2	56
	Very Coarse	45	64	6		6	6	62
COBBLE	Small	64	90	2		2	2	64
	Small	90	128	7		7	7	71
	Large	128	180	7		7	7	78
	Large	180	256	10		10	10	88
BOULDER	Small	256	362	8		8	8	96
	Small	362	512	4		4	4	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} =	0.3
D_{50} =	11.0
D_{84} =	222.4
D_{95} =	346.7
D_{100} =	512.0





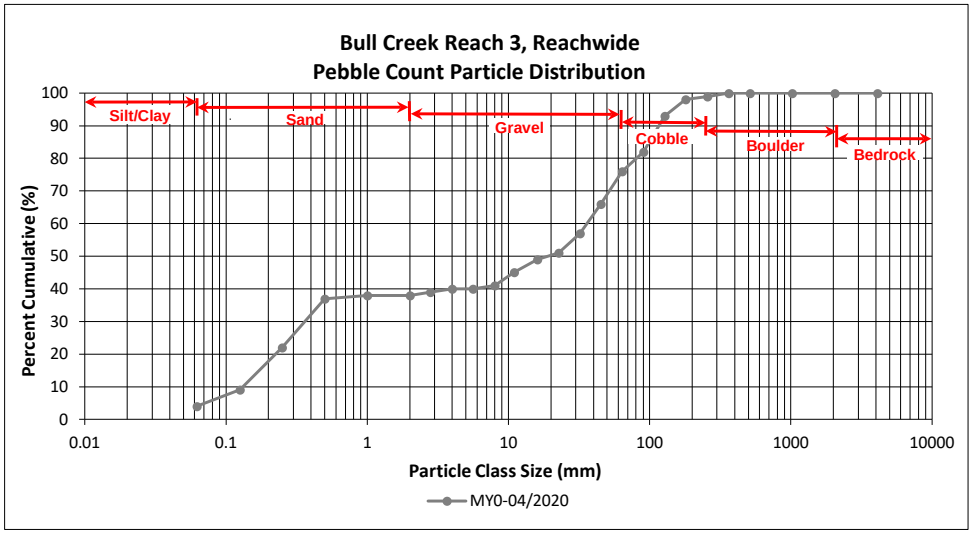
Reachwide and Cross-Section Pebble Count Plots

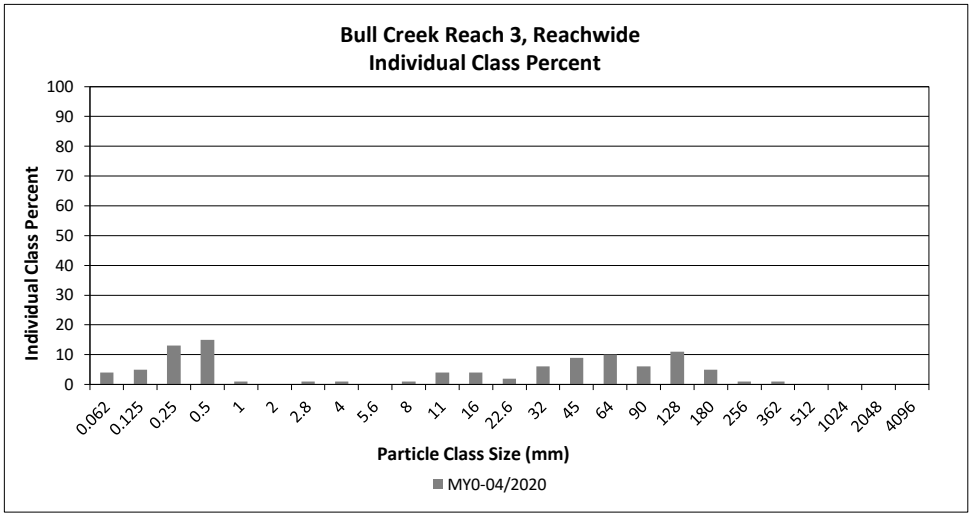
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Bull Creek Reach 3, 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	3	4	4	4
SAND	Very fine	0.062	0.125	2	3	5	5	9
	Fine	0.125	0.250	2	11	13	13	22
	Medium	0.25	0.50	3	12	15	15	37
	Coarse	0.5	1.0	1		1	1	38
	Very Coarse	1.0	2.0					38
GRAVEL	Very Fine	2.0	2.8		1	1	1	39
	Very Fine	2.8	4.0		1	1	1	40
	Fine	4.0	5.6					40
	Fine	5.6	8.0	1		1	1	41
	Medium	8.0	11.0		4	4	4	45
	Medium	11.0	16.0	1	3	4	4	49
	Coarse	16.0	22.6		2	2	2	51
	Coarse	22.6	32	2	4	6	6	57
	Very Coarse	32	45	5	4	9	9	66
	Very Coarse	45	64	10		10	10	76
COBBLE	Small	64	90	5	1	6	6	82
	Small	90	128	10	1	11	11	93
	Large	128	180	5		5	5	98
	Large	180	256	1		1	1	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} =	0.2
D_{35} =	0.5
D_{50} =	19.0
D_{84} =	96.0
D_{95} =	146.7
D_{100} =	362.0





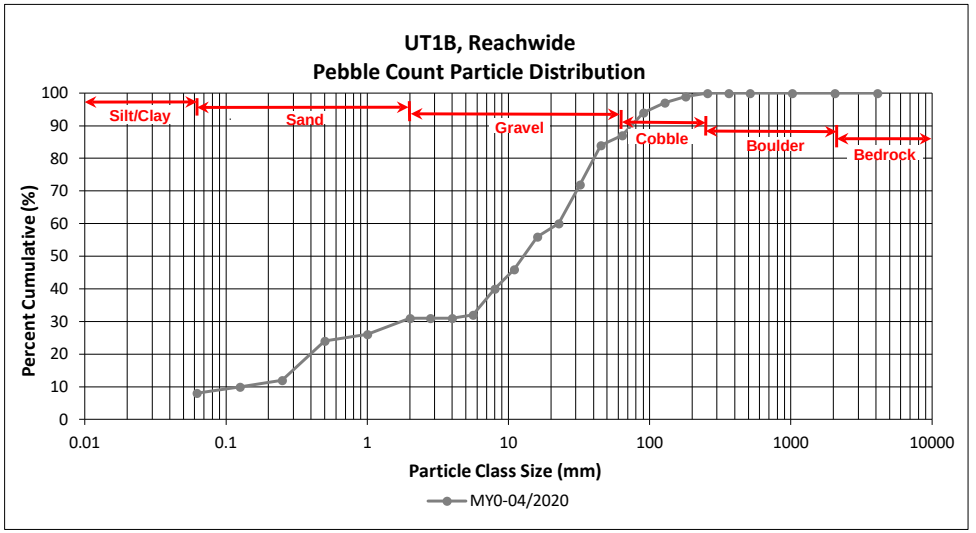
Reachwide and Cross-Section Pebble Count Plots

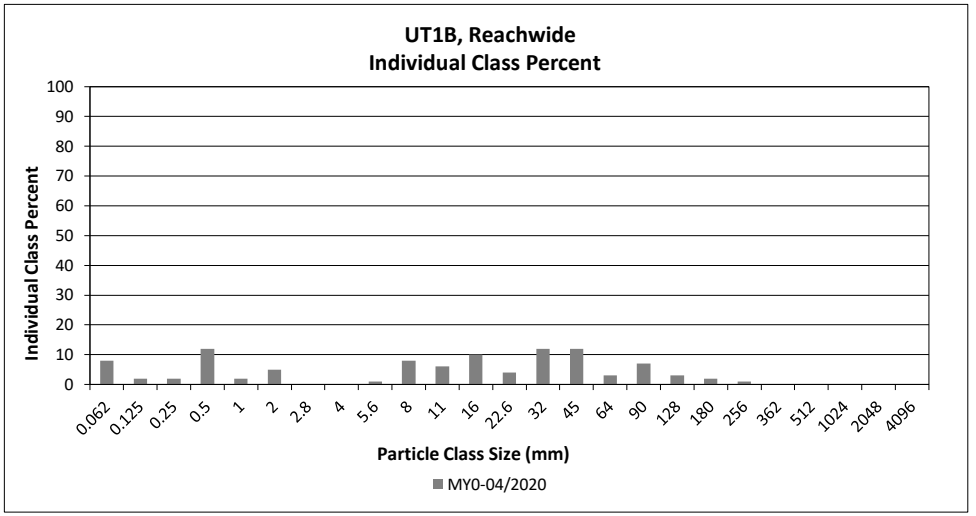
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT1B, 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	7	8	8	8
SAND	Very fine	0.062	0.125		2	2	2	10
	Fine	0.125	0.250		2	2	2	12
	Medium	0.25	0.50	2	10	12	12	24
	Coarse	0.5	1.0		2	2	2	26
	Very Coarse	1.0	2.0		5	5	5	31
GRAVEL	Very Fine	2.0	2.8					31
	Very Fine	2.8	4.0					31
	Fine	4.0	5.6	1		1	1	32
	Fine	5.6	8.0	4	4	8	8	40
	Medium	8.0	11.0		6	6	6	46
	Medium	11.0	16.0	6	4	10	10	56
	Coarse	16.0	22.6	3	1	4	4	60
	Coarse	22.6	32	9	3	12	12	72
	Very Coarse	32	45	9	3	12	12	84
	Very Coarse	45	64	3		3	3	87
COBBLE	Small	64	90	6	1	7	7	94
	Small	90	128	3		3	3	97
	Large	128	180	2		2	2	99
	Large	180	256	1		1	1	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} =	0.3
D_{35} =	6.4
D_{50} =	12.8
D_{84} =	45.0
D_{95} =	101.2
D_{100} =	256.0





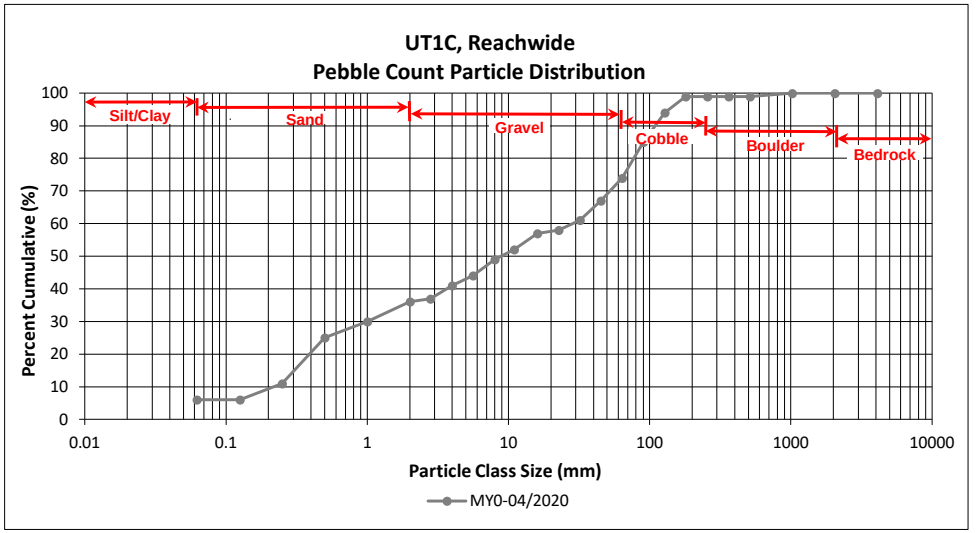
Reachwide and Cross-Section Pebble Count Plots

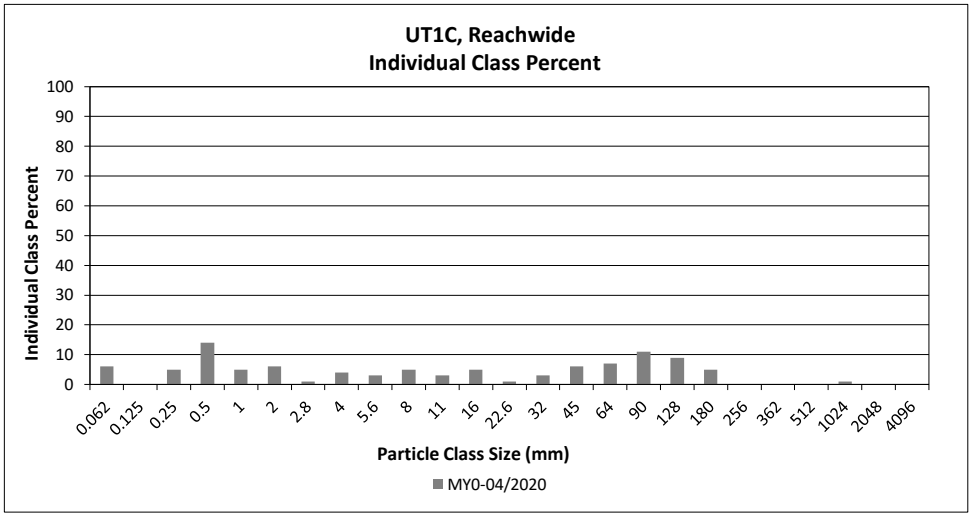
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT1C, 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		6	6	6	6
SAND	Very fine	0.062	0.125					6
	Fine	0.125	0.250		5	5	5	11
	Medium	0.25	0.50	3	11	14	14	25
	Coarse	0.5	1.0	2	3	5	5	30
	Very Coarse	1.0	2.0		6	6	6	36
GRAVEL	Very Fine	2.0	2.8		1	1	1	37
	Very Fine	2.8	4.0		4	4	4	41
	Fine	4.0	5.6	2	1	3	3	44
	Fine	5.6	8.0		5	5	5	49
	Medium	8.0	11.0		3	3	3	52
	Medium	11.0	16.0	2	3	5	5	57
	Coarse	16.0	22.6		1	1	1	58
	Coarse	22.6	32	3		3	3	61
	Very Coarse	32	45	5	1	6	6	67
	Very Coarse	45	64	7		7	7	74
COBBLE	Small	64	90	11		11	11	85
	Small	90	128	9		9	9	94
	Large	128	180	5		5	5	99
	Large	180	256					99
BOULDER	Small	256	362					99
	Small	362	512					99
	Medium	512	1024	1		1	1	100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.3
D_{35} =	1.8
D_{50} =	8.9
D_{84} =	87.3
D_{95} =	137.0
D_{100} =	1024.0





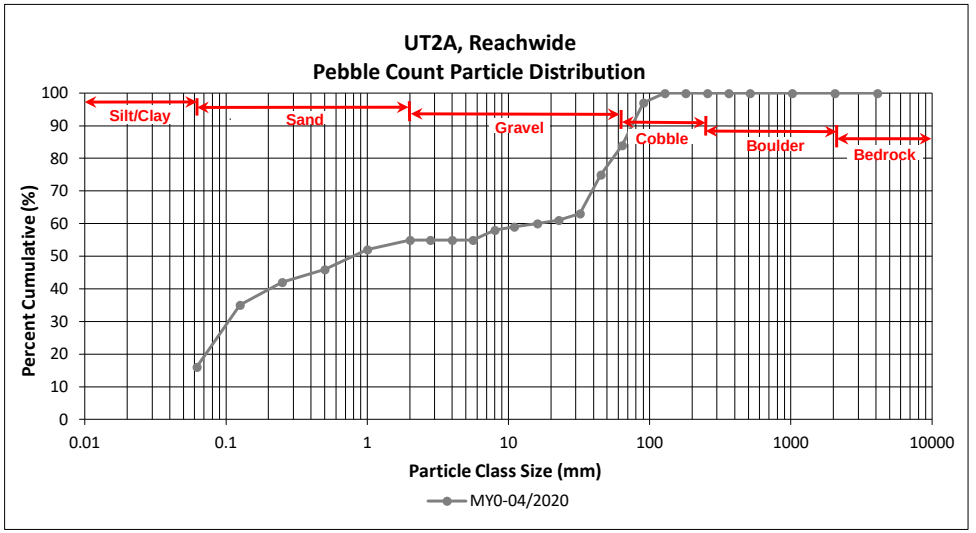
Reachwide and Cross-Section Pebble Count Plots

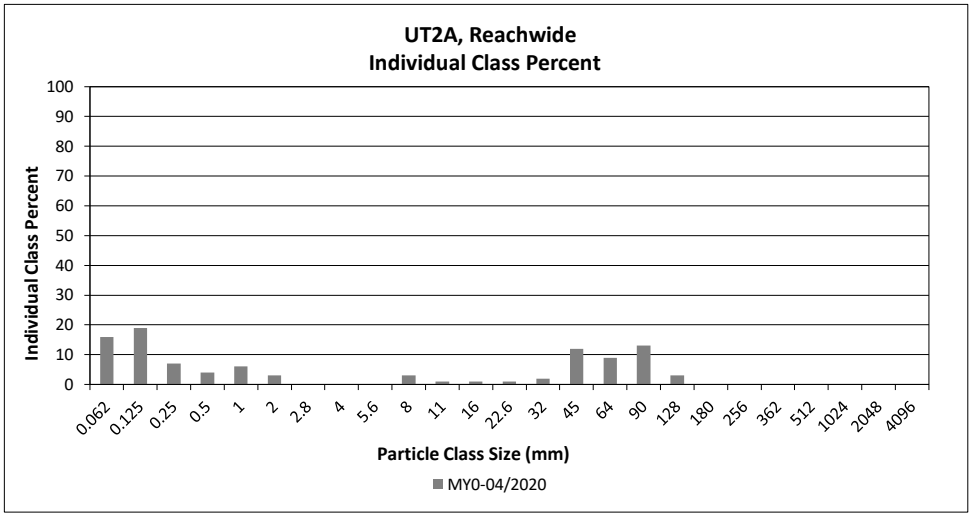
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

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	4	12	16	16	16
SAND	Very fine	0.062	0.125	4	15	19	19	35
	Fine	0.125	0.250		7	7	7	42
	Medium	0.25	0.50		4	4	4	46
	Coarse	0.5	1.0		6	6	6	52
	Very Coarse	1.0	2.0	1	2	3	3	55
GRAVEL	Very Fine	2.0	2.8					55
	Very Fine	2.8	4.0					55
	Fine	4.0	5.6					55
	Fine	5.6	8.0		3	3	3	58
	Medium	8.0	11.0	1		1	1	59
	Medium	11.0	16.0	1		1	1	60
	Coarse	16.0	22.6	1		1	1	61
	Coarse	22.6	32	1	1	2	2	63
	Very Coarse	32	45	12		12	12	75
	Very Coarse	45	64	9		9	9	84
COBBLE	Small	64	90	13		13	13	97
	Small	90	128	3		3	3	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} =	Silt/Clay
D_{35} =	0.1
D_{50} =	0.8
D_{84} =	64.0
D_{95} =	85.4
D_{100} =	128.0





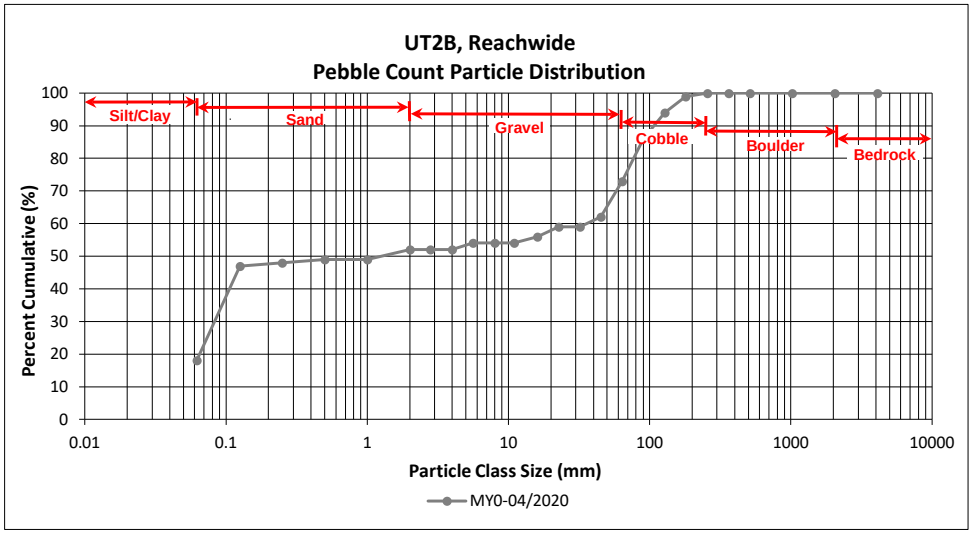
Reachwide and Cross-Section Pebble Count Plots

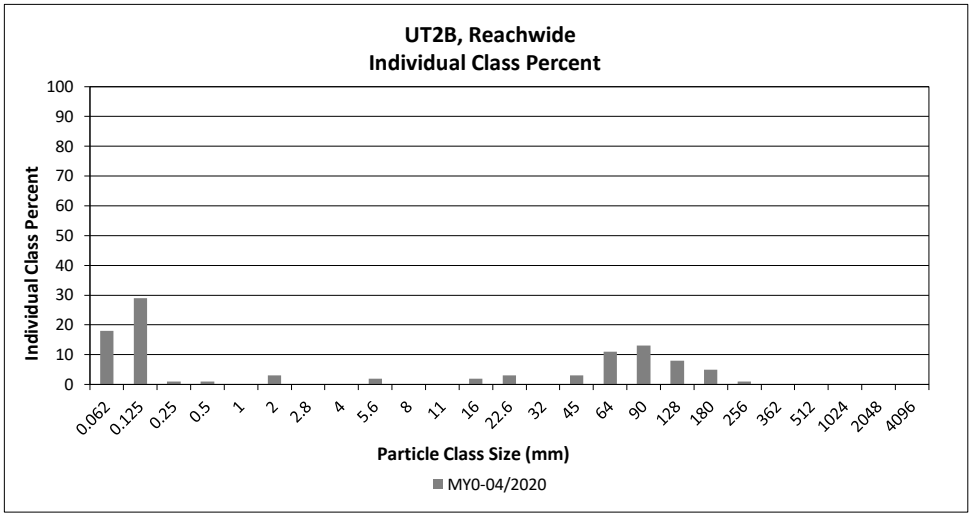
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT2B, 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	16	18	18	18
SAND	Very fine	0.062	0.125	5	24	29	29	47
	Fine	0.125	0.250	1		1	1	48
	Medium	0.25	0.50		1	1	1	49
	Coarse	0.5	1.0					49
	Very Coarse	1.0	2.0		3	3	3	52
GRAVEL	Very Fine	2.0	2.8					52
	Very Fine	2.8	4.0					52
	Fine	4.0	5.6		2	2	2	54
	Fine	5.6	8.0					54
	Medium	8.0	11.0					54
	Medium	11.0	16.0		2	2	2	56
	Coarse	16.0	22.6	1	2	3	3	59
	Coarse	22.6	32					59
	Very Coarse	32	45	3		3	3	62
	Very Coarse	45	64	11		11	11	73
COBBLE	Small	64	90	13		13	13	86
	Small	90	128	8		8	8	94
	Large	128	180	5		5	5	99
	Large	180	256	1		1	1	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} =	0.1
D_{50} =	1.3
D_{84} =	85.4
D_{95} =	137.0
D_{100} =	256.0





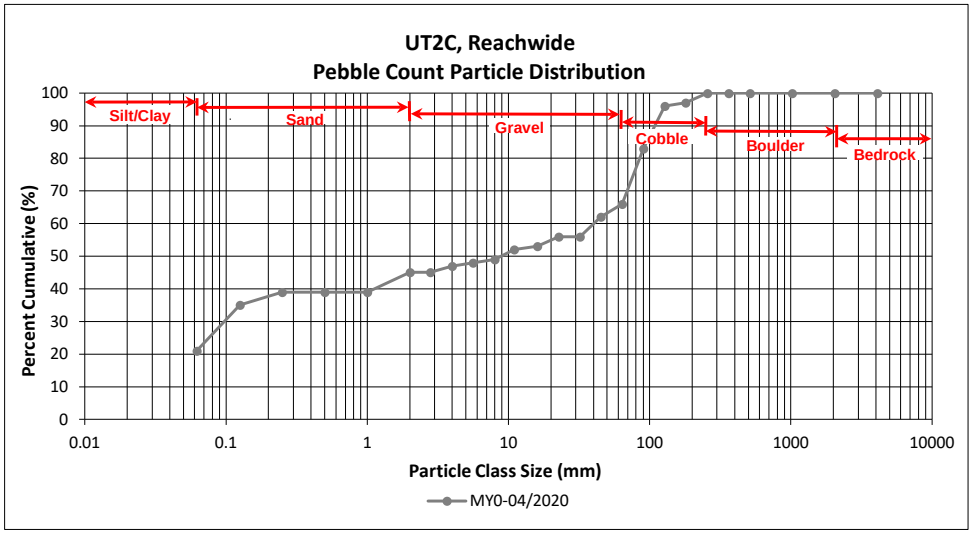
Reachwide and Cross-Section Pebble Count Plots

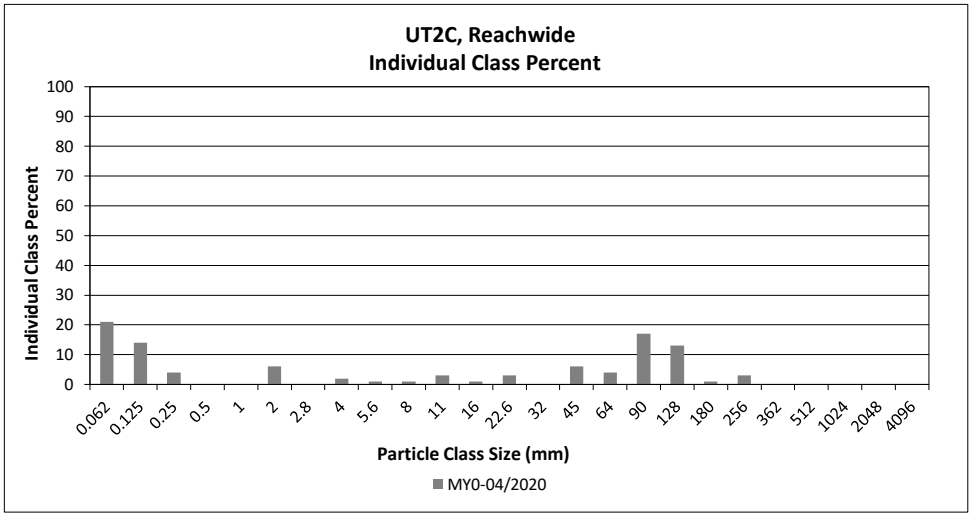
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT2C, 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	19	21	21	21
SAND	Very fine	0.062	0.125	2	12	14	14	35
	Fine	0.125	0.250		4	4	4	39
	Medium	0.25	0.50					39
	Coarse	0.5	1.0					39
	Very Coarse	1.0	2.0	3	3	6	6	45
GRAVEL	Very Fine	2.0	2.8					45
	Very Fine	2.8	4.0		2	2	2	47
	Fine	4.0	5.6		1	1	1	48
	Fine	5.6	8.0		1	1	1	49
	Medium	8.0	11.0		3	3	3	52
	Medium	11.0	16.0		1	1	1	53
	Coarse	16.0	22.6		3	3	3	56
	Coarse	22.6	32					56
	Very Coarse	32	45	5	1	6	6	62
	Very Coarse	45	64	4		4	4	66
COBBLE	Small	64	90	17		17	17	83
	Small	90	128	13		13	13	96
	Large	128	180	1		1	1	97
	Large	180	256	3		3	3	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} =	0.1
D_{50} =	8.9
D_{84} =	92.5
D_{95} =	124.6
D_{100} =	256.0





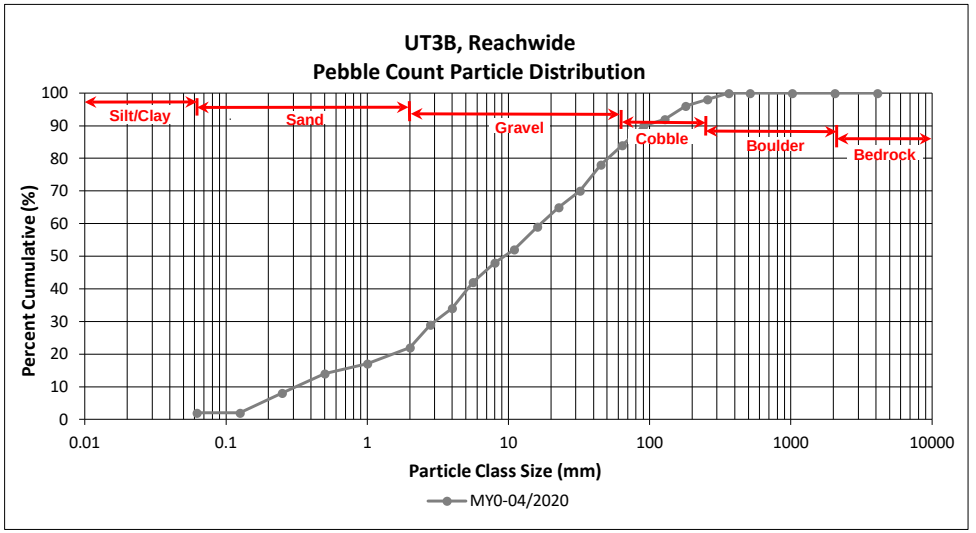
Reachwide and Cross-Section Pebble Count Plots

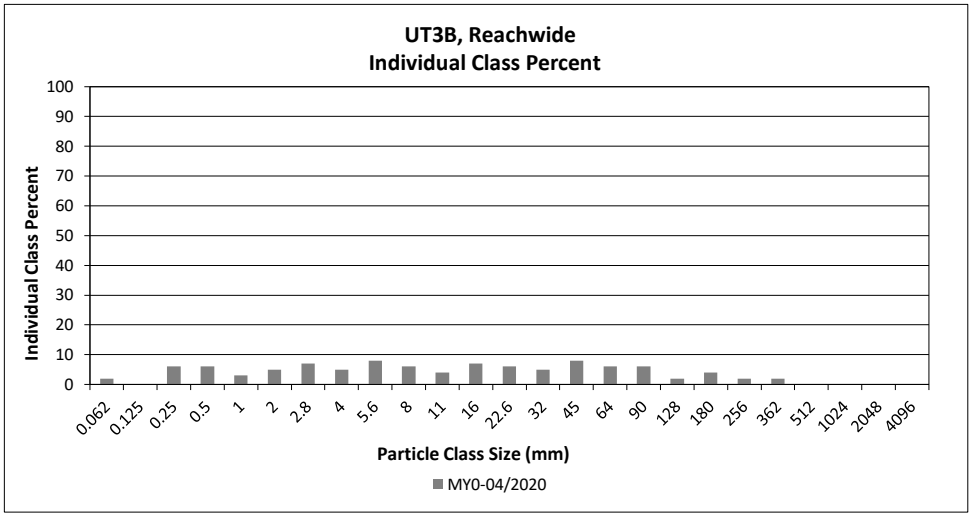
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT3B, 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	2	2	2
SAND	Very fine	0.062	0.125					2
	Fine	0.125	0.250	1	5	6	6	8
	Medium	0.25	0.50	1	5	6	6	14
	Coarse	0.5	1.0		3	3	3	17
	Very Coarse	1.0	2.0	2	3	5	5	22
GRAVEL	Very Fine	2.0	2.8	2	5	7	7	29
	Very Fine	2.8	4.0	1	4	5	5	34
	Fine	4.0	5.6	2	6	8	8	42
	Fine	5.6	8.0	2	4	6	6	48
	Medium	8.0	11.0	1	3	4	4	52
	Medium	11.0	16.0	5	2	7	7	59
	Coarse	16.0	22.6	4	2	6	6	65
	Coarse	22.6	32	1	4	5	5	70
	Very Coarse	32	45	7	1	8	8	78
	Very Coarse	45	64	5	1	6	6	84
COBBLE	Small	64	90	6		6	6	90
	Small	90	128	2		2	2	92
	Large	128	180	4		4	4	96
	Large	180	256	2		2	2	98
BOULDER	Small	256	362	2		2	2	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} =	0.8
D_{35} =	4.2
D_{50} =	9.4
D_{84} =	64.0
D_{95} =	165.3
D_{100} =	362.0





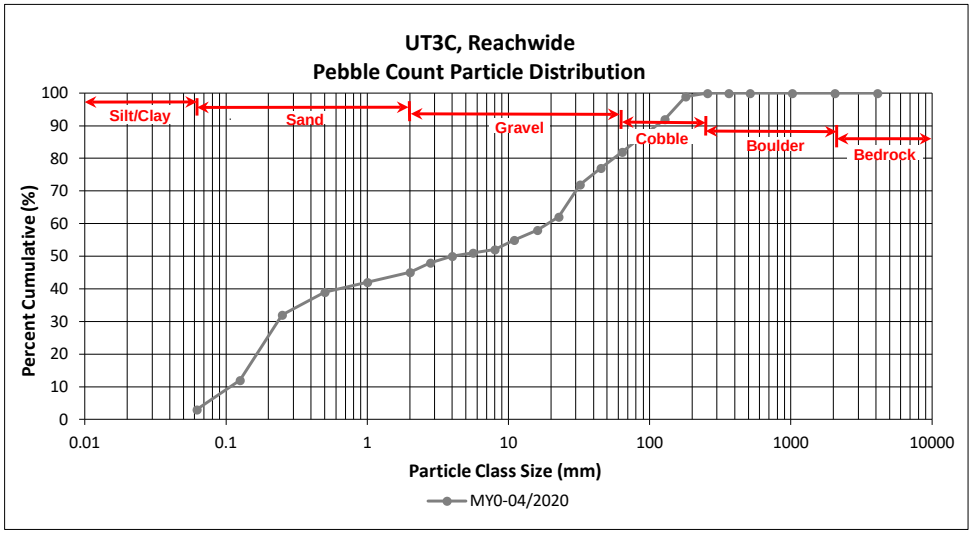
Reachwide and Cross-Section Pebble Count Plots

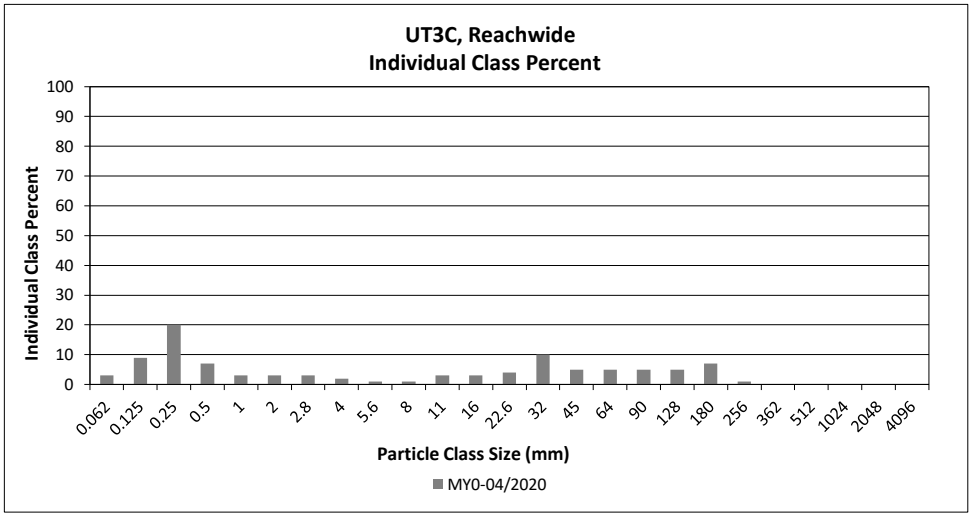
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT3C, 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		3	3	3	3
SAND	Very fine	0.062	0.125	1	8	9	9	12
	Fine	0.125	0.250	3	17	20	20	32
	Medium	0.25	0.50		7	7	7	39
	Coarse	0.5	1.0		3	3	3	42
	Very Coarse	1.0	2.0	1	2	3	3	45
GRAVEL	Very Fine	2.0	2.8		3	3	3	48
	Very Fine	2.8	4.0		2	2	2	50
	Fine	4.0	5.6		1	1	1	51
	Fine	5.6	8.0	1		1	1	52
	Medium	8.0	11.0	1	2	3	3	55
	Medium	11.0	16.0	2	1	3	3	58
	Coarse	16.0	22.6	4		4	4	62
	Coarse	22.6	32	9	1	10	10	72
	Very Coarse	32	45	5		5	5	77
	Very Coarse	45	64	5		5	5	82
COBBLE	Small	64	90	5		5	5	87
	Small	90	128	5		5	5	92
	Large	128	180	7		7	7	99
	Large	180	256	1		1	1	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} =	0.1
D_{35} =	0.3
D_{50} =	4.0
D_{84} =	73.4
D_{95} =	148.1
D_{100} =	256.0





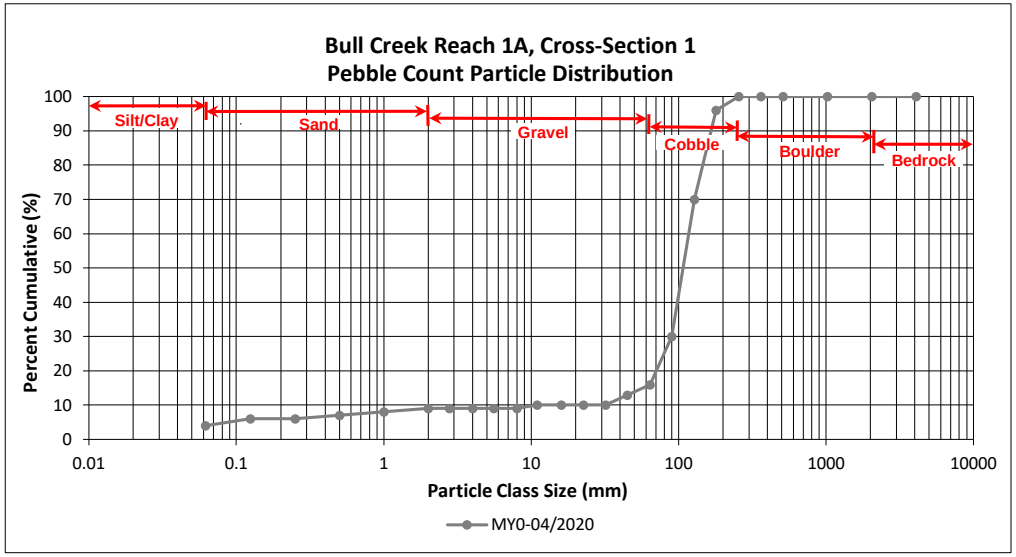
Reachwide and Cross-Section Pebble Count Plots

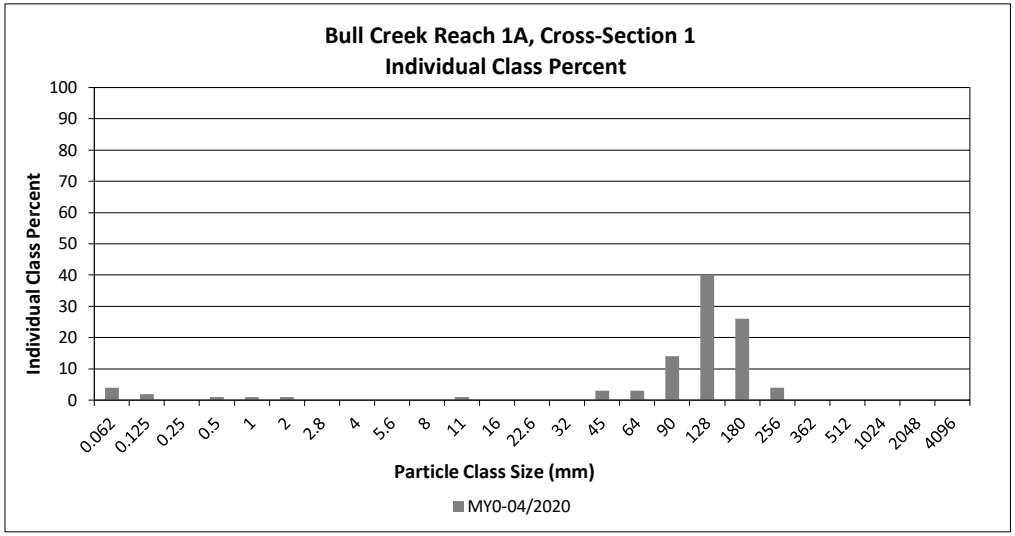
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Bull Creek Reach 1A, 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	4	4	4
SAND	Very fine	0.062	0.125	2	2	6
	Fine	0.125	0.250			6
	Medium	0.25	0.50	1	1	7
	Coarse	0.5	1.0	1	1	8
	Very Coarse	1.0	2.0	1	1	9
GRAVEL	Very Fine	2.0	2.8			9
	Very Fine	2.8	4.0			9
	Fine	4.0	5.6			9
	Fine	5.6	8.0			9
	Medium	8.0	11.0	1	1	10
	Medium	11.0	16.0			10
	Coarse	16.0	22.6			10
	Coarse	22.6	32			10
	Very Coarse	32	45	3	3	13
	Very Coarse	45	64	3	3	16
COBBLE	Small	64	90	14	14	30
	Small	90	128	40	40	70
	Large	128	180	26	26	96
	Large	180	256	4	4	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 1	
Channel materials (mm)	
D_{16} =	64.0
D_{35} =	94.1
D_{50} =	107.3
D_{84} =	153.8
D_{95} =	177.7
D_{100} =	256.0





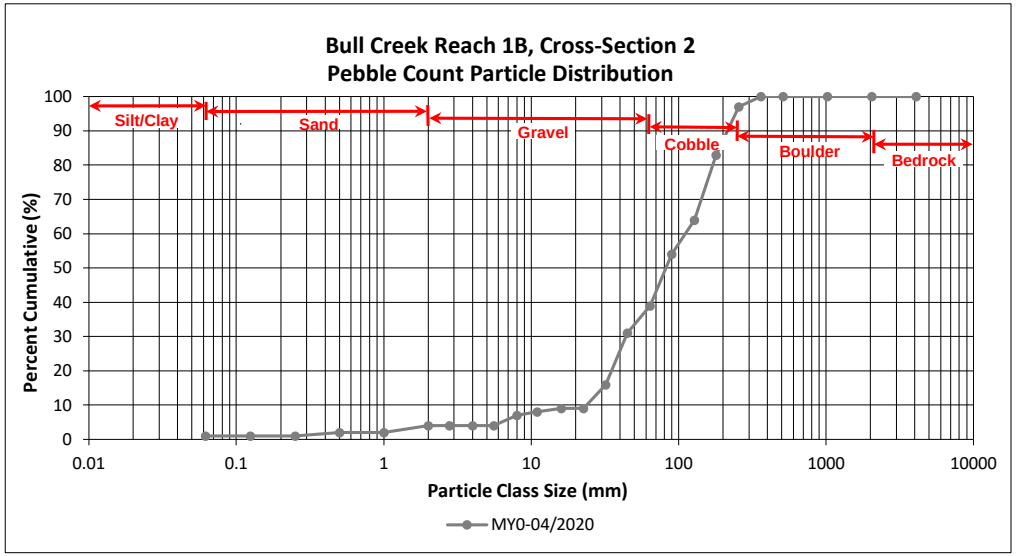
Reachwide and Cross-Section Pebble Count Plots

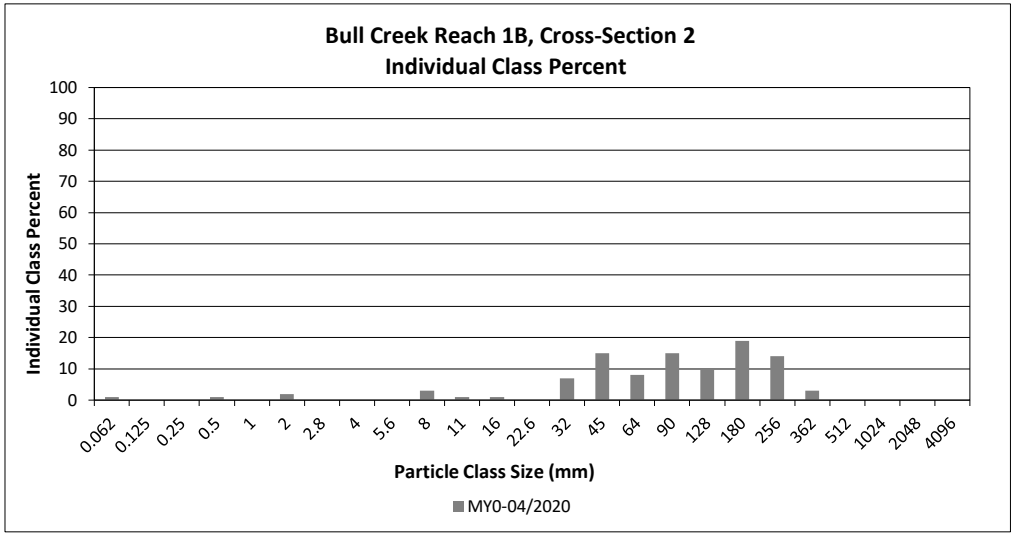
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Bull Creek Reach 1B, Cross-Section 2

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	1	1
SAND	Very fine	0.062	0.125			1
	Fine	0.125	0.250			1
	Medium	0.25	0.50	1	1	2
	Coarse	0.5	1.0			2
	Very Coarse	1.0	2.0	2	2	4
GRAVEL	Very Fine	2.0	2.8			4
	Very Fine	2.8	4.0			4
	Fine	4.0	5.6			4
	Fine	5.6	8.0	3	3	7
	Medium	8.0	11.0	1	1	8
	Medium	11.0	16.0	1	1	9
	Coarse	16.0	22.6			9
	Coarse	22.6	32	7	7	16
	Very Coarse	32	45	15	15	31
	Very Coarse	45	64	8	8	39
COBBLE	Small	64	90	15	15	54
	Small	90	128	10	10	64
	Large	128	180	19	19	83
	Large	180	256	14	14	97
BOULDER	Small	256	362	3	3	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 2	
Channel materials (mm)	
D_{16} =	32.0
D_{35} =	53.7
D_{50} =	82.2
D_{84} =	184.6
D_{95} =	243.4
D_{100} =	362.0





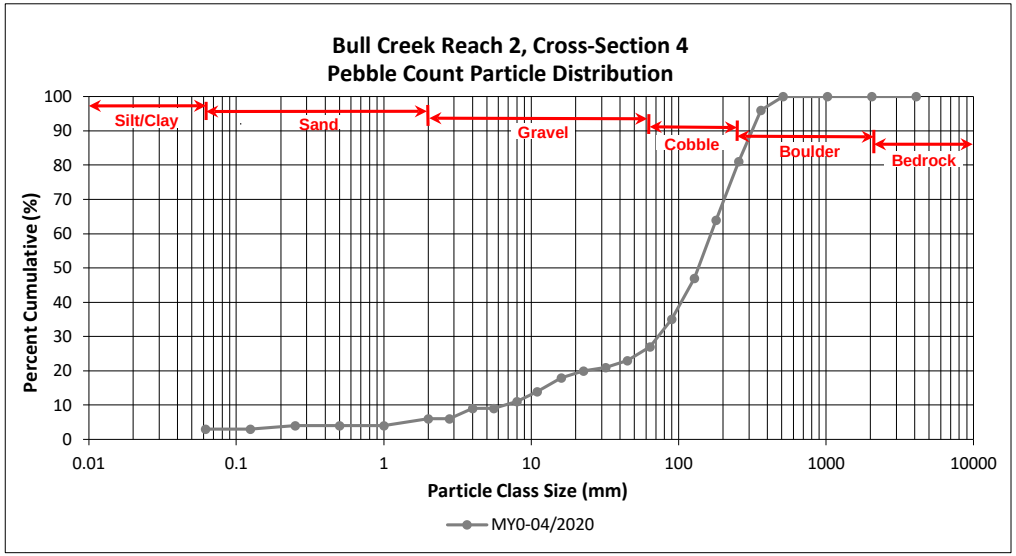
Reachwide and Cross-Section Pebble Count Plots

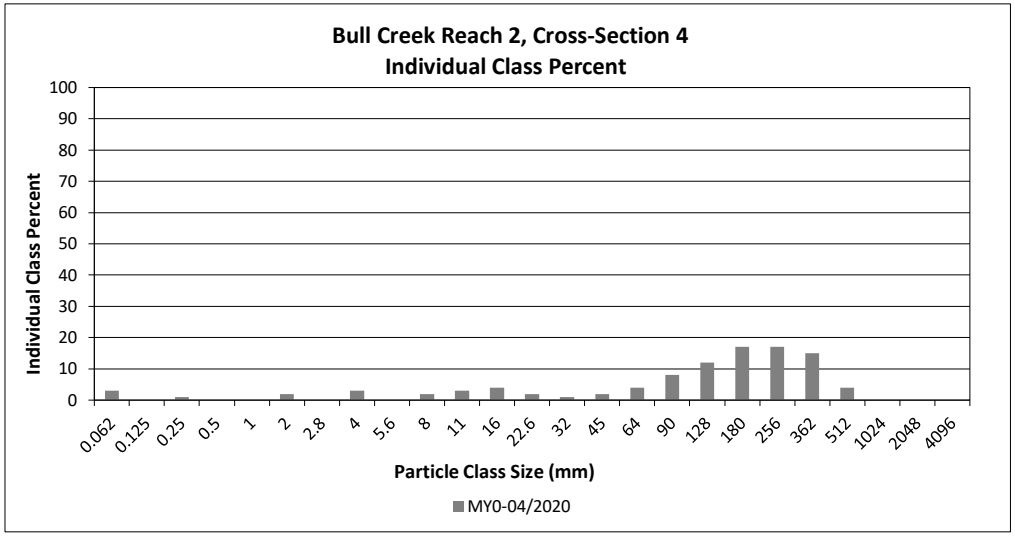
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Bull Creek Reach 2, 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	3	3	3
SAND	Very fine	0.062	0.125			3
	Fine	0.125	0.250	1	1	4
	Medium	0.25	0.50			4
	Coarse	0.5	1.0			4
	Very Coarse	1.0	2.0	2	2	6
GRAVEL	Very Fine	2.0	2.8			6
	Very Fine	2.8	4.0	3	3	9
	Fine	4.0	5.6			9
	Fine	5.6	8.0	2	2	11
	Medium	8.0	11.0	3	3	14
	Medium	11.0	16.0	4	4	18
	Coarse	16.0	22.6	2	2	20
	Coarse	22.6	32	1	1	21
	Very Coarse	32	45	2	2	23
	Very Coarse	45	64	4	4	27
COBBLE	Small	64	90	8	8	35
	Small	90	128	12	12	47
	Large	128	180	17	17	64
	Large	180	256	17	17	81
BOULDER	Small	256	362	15	15	96
	Small	362	512	4	4	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} =	13.3
D_{35} =	90.0
D_{50} =	135.9
D_{84} =	274.4
D_{95} =	353.7
D_{100} =	512.0





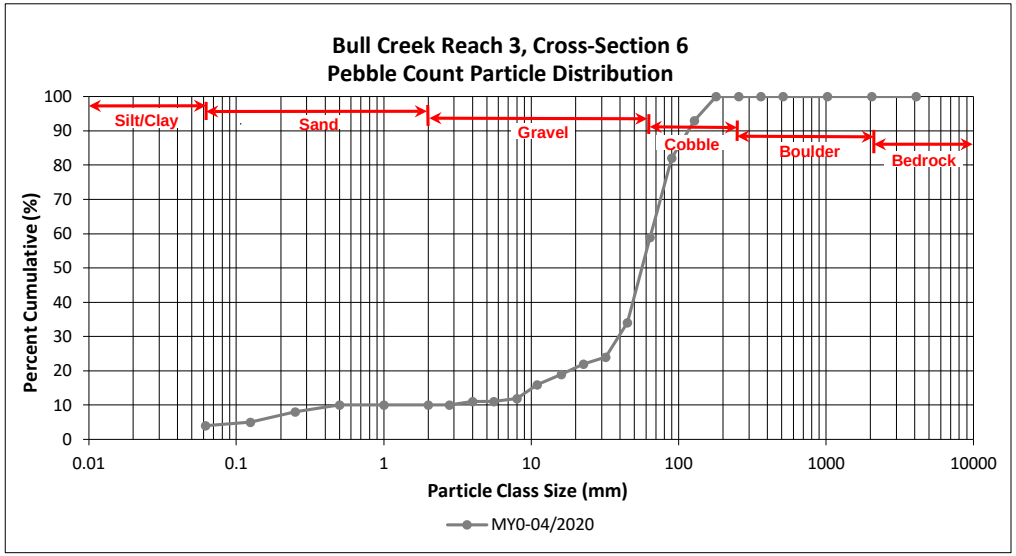
Reachwide and Cross-Section Pebble Count Plots

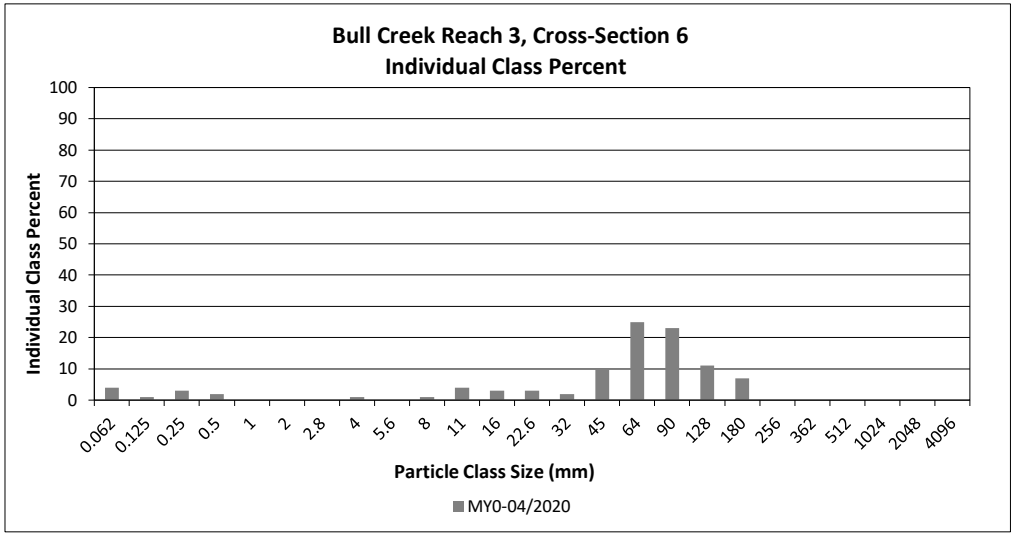
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Bull Creek Reach 3, Cross-Section 6

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	4	4
SAND	Very fine	0.062	0.125	1	1	5
	Fine	0.125	0.250	3	3	8
	Medium	0.25	0.50	2	2	10
	Coarse	0.5	1.0			10
	Very Coarse	1.0	2.0			10
GRAVEL	Very Fine	2.0	2.8			10
	Very Fine	2.8	4.0	1	1	11
	Fine	4.0	5.6			11
	Fine	5.6	8.0	1	1	12
	Medium	8.0	11.0	4	4	16
	Medium	11.0	16.0	3	3	19
	Coarse	16.0	22.6	3	3	22
	Coarse	22.6	32	2	2	24
	Very Coarse	32	45	10	10	34
	Very Coarse	45	64	25	25	59
COBBLE	Small	64	90	23	23	82
	Small	90	128	11	11	93
	Large	128	180	7	7	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 6	
Channel materials (mm)	
D_{16} =	11.0
D_{35} =	45.6
D_{50} =	56.4
D_{84} =	96.0
D_{95} =	141.1
D_{100} =	180.0





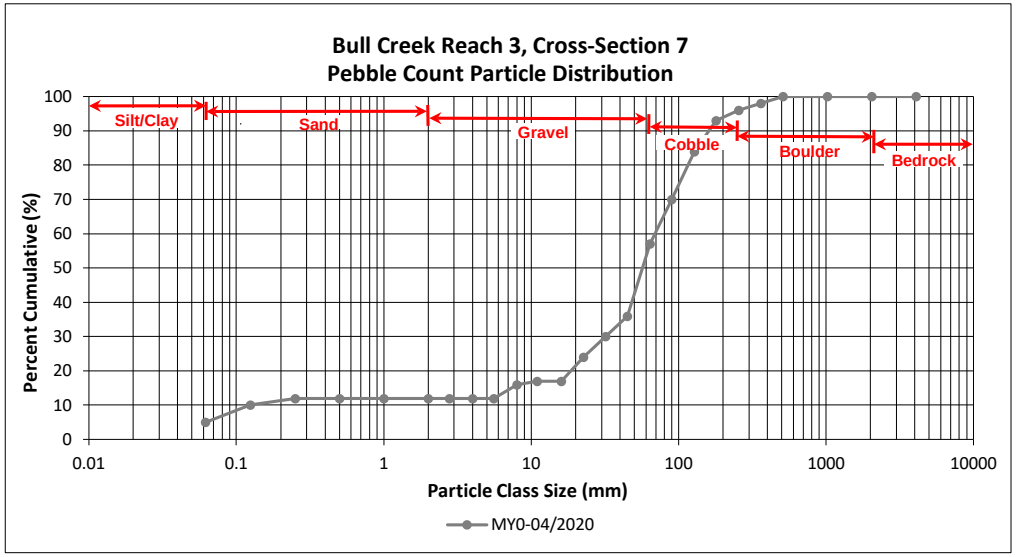
Reachwide and Cross-Section Pebble Count Plots

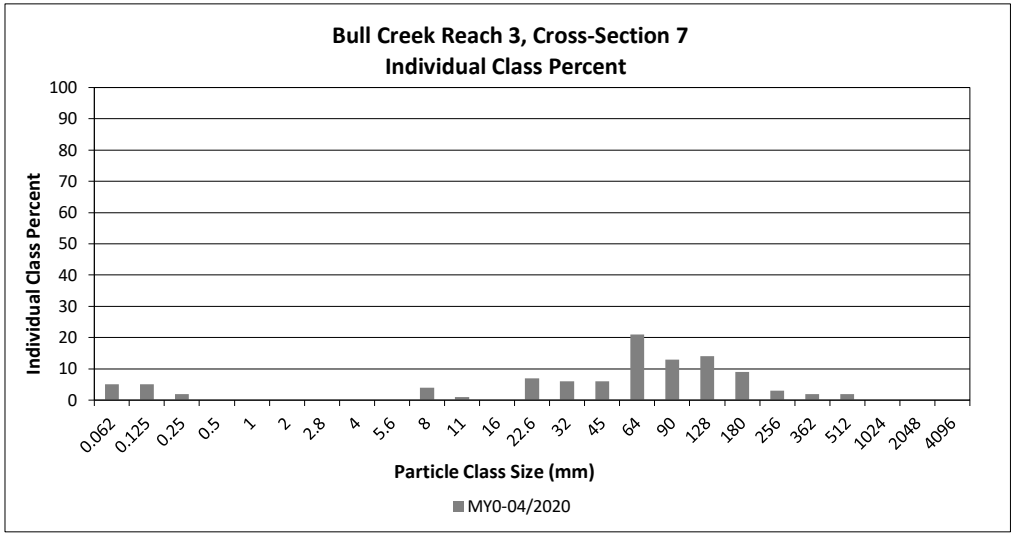
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Bull Creek Reach 3, 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	5	5	5
SAND	Very fine	0.062	0.125	5	5	10
	Fine	0.125	0.250	2	2	12
	Medium	0.25	0.50			12
	Coarse	0.5	1.0			12
	Very Coarse	1.0	2.0			12
GRAVEL	Very Fine	2.0	2.8			12
	Very Fine	2.8	4.0			12
	Fine	4.0	5.6			12
	Fine	5.6	8.0	4	4	16
	Medium	8.0	11.0	1	1	17
	Medium	11.0	16.0			17
	Coarse	16.0	22.6	7	7	24
	Coarse	22.6	32	6	6	30
	Very Coarse	32	45	6	6	36
	Very Coarse	45	64	21	21	57
COBBLE	Small	64	90	13	13	70
	Small	90	128	14	14	84
	Large	128	180	9	9	93
	Large	180	256	3	3	96
BOULDER	Small	256	362	2	2	98
	Small	362	512	2	2	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} =	8.0
D_{35} =	42.5
D_{50} =	56.9
D_{84} =	128.0
D_{95} =	227.6
D_{100} =	512.0





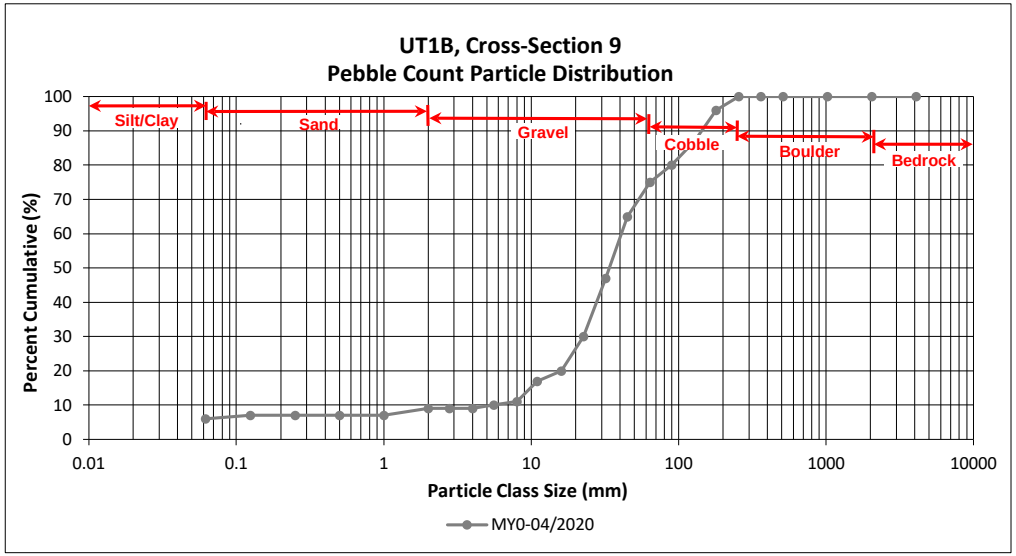
Reachwide and Cross-Section Pebble Count Plots

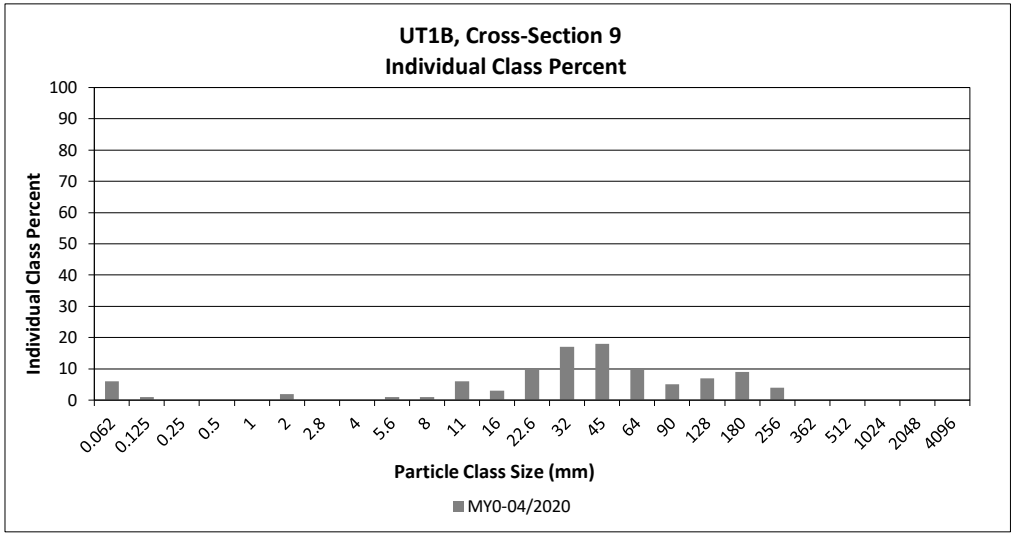
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT1B, Cross-Section 9

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	6	6	6
SAND	Very fine	0.062	0.125	1	1	7
	Fine	0.125	0.250			7
	Medium	0.25	0.50			7
	Coarse	0.5	1.0			7
	Very Coarse	1.0	2.0	2	2	9
GRAVEL	Very Fine	2.0	2.8			9
	Very Fine	2.8	4.0			9
	Fine	4.0	5.6	1	1	10
	Fine	5.6	8.0	1	1	11
	Medium	8.0	11.0	6	6	17
	Medium	11.0	16.0	3	3	20
	Coarse	16.0	22.6	10	10	30
	Coarse	22.6	32	17	17	47
	Very Coarse	32	45	18	18	65
	Very Coarse	45	64	10	10	75
COBBLE	Small	64	90	5	5	80
	Small	90	128	7	7	87
	Large	128	180	9	9	96
	Large	180	256	4	4	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 9	
Channel materials (mm)	
D_{16} =	10.4
D_{35} =	25.0
D_{50} =	33.9
D_{84} =	110.1
D_{95} =	173.3
D_{100} =	256.0





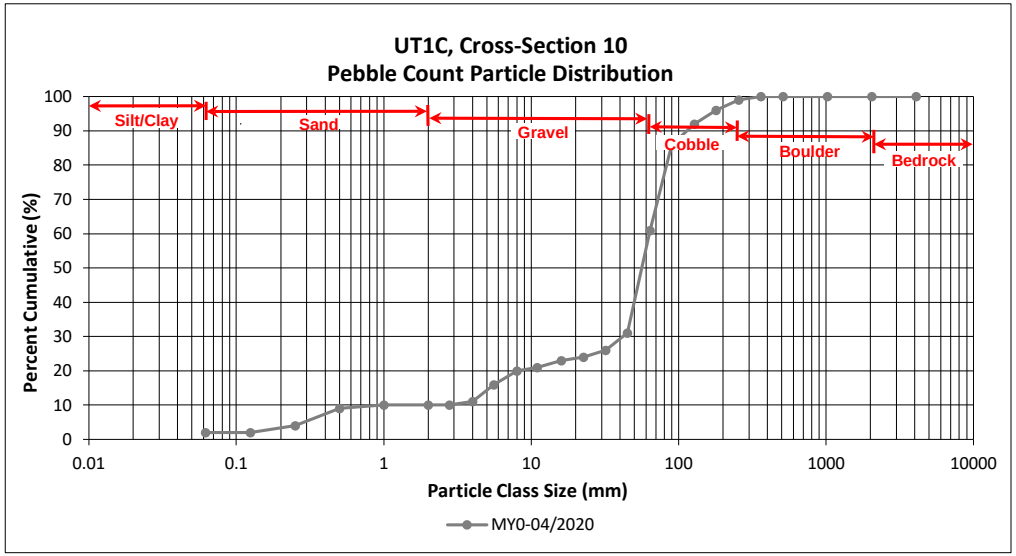
Reachwide and Cross-Section Pebble Count Plots

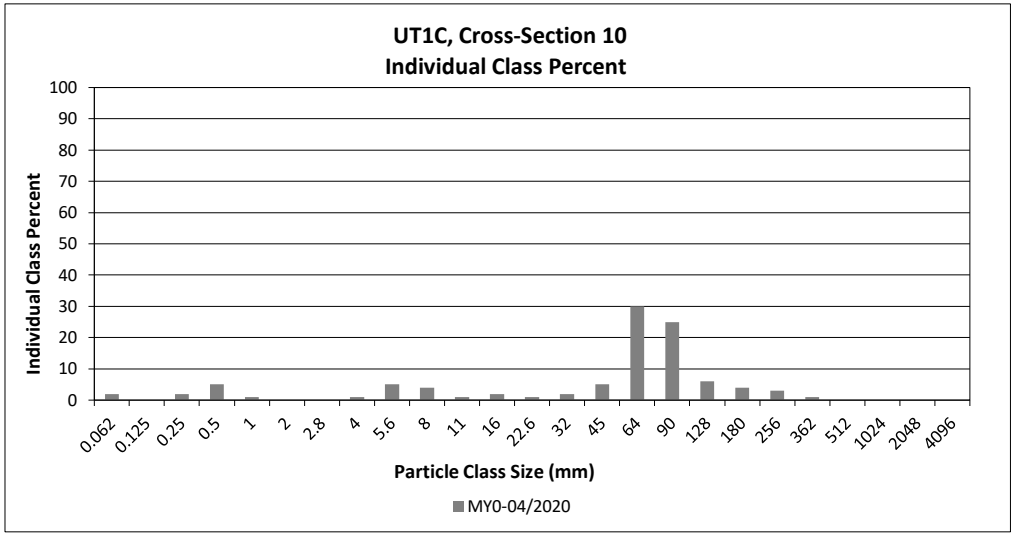
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT1C, Cross-Section 10

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	2	2	2
SAND	Very fine	0.062	0.125			2
	Fine	0.125	0.250	2	2	4
	Medium	0.25	0.50	5	5	9
	Coarse	0.5	1.0	1	1	10
	Very Coarse	1.0	2.0			10
GRAVEL	Very Fine	2.0	2.8			10
	Very Fine	2.8	4.0	1	1	11
	Fine	4.0	5.6	5	5	16
	Fine	5.6	8.0	4	4	20
	Medium	8.0	11.0	1	1	21
	Medium	11.0	16.0	2	2	23
	Coarse	16.0	22.6	1	1	24
	Coarse	22.6	32	2	2	26
	Very Coarse	32	45	5	5	31
	Very Coarse	45	64	30	30	61
COBBLE	Small	64	90	25	25	86
	Small	90	128	6	6	92
	Large	128	180	4	4	96
	Large	180	256	3	3	99
BOULDER	Small	256	362	1	1	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 10	
Channel materials (mm)	
D_{16} =	5.6
D_{35} =	47.2
D_{50} =	56.2
D_{84} =	87.6
D_{95} =	165.3
D_{100} =	362.0





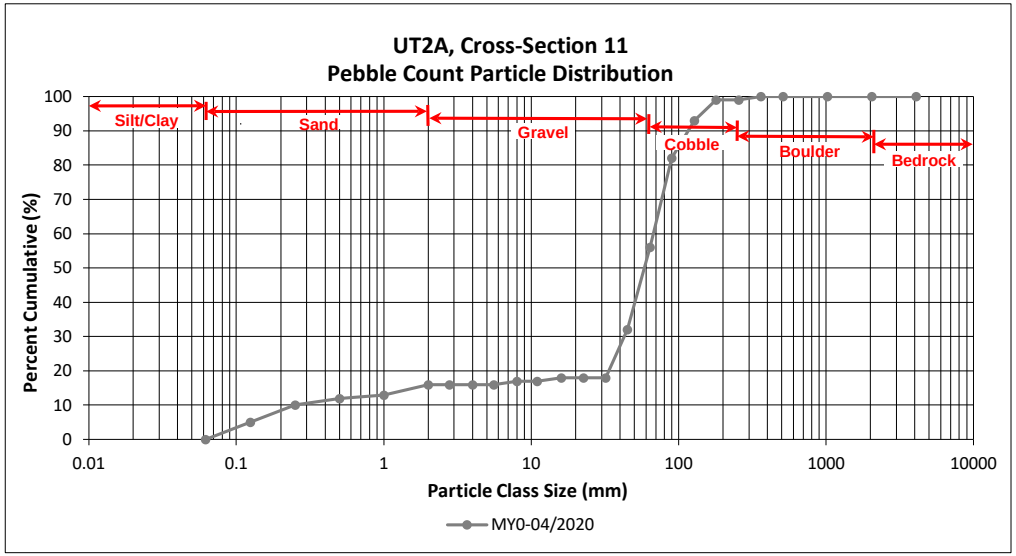
Reachwide and Cross-Section Pebble Count Plots

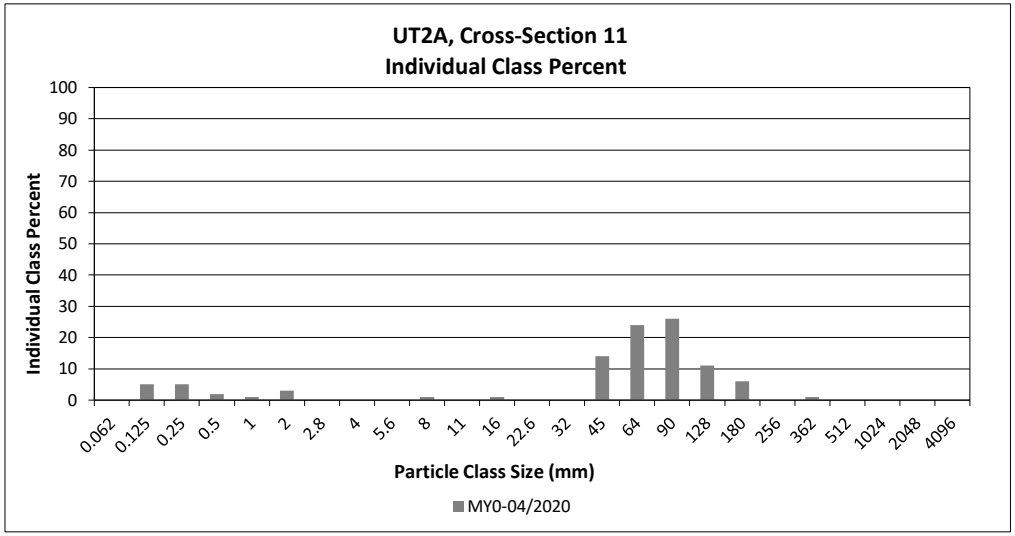
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT2A, Cross-Section 11

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			0
SAND	Very fine	0.062	0.125	5	5	5
	Fine	0.125	0.250	5	5	10
	Medium	0.25	0.50	2	2	12
	Coarse	0.5	1.0	1	1	13
	Very Coarse	1.0	2.0	3	3	16
GRAVEL	Very Fine	2.0	2.8			16
	Very Fine	2.8	4.0			16
	Fine	4.0	5.6			16
	Fine	5.6	8.0	1	1	17
	Medium	8.0	11.0			17
	Medium	11.0	16.0	1	1	18
	Coarse	16.0	22.6			18
	Coarse	22.6	32			18
	Very Coarse	32	45	14	14	32
	Very Coarse	45	64	24	24	56
COBBLE	Small	64	90	26	26	82
	Small	90	128	11	11	93
	Large	128	180	6	6	99
	Large	180	256			99
BOULDER	Small	256	362	1	1	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 11	
Channel materials (mm)	
D_{16} =	2.0
D_{35} =	47.0
D_{50} =	58.6
D_{84} =	96.0
D_{95} =	143.4
D_{100} =	362.0





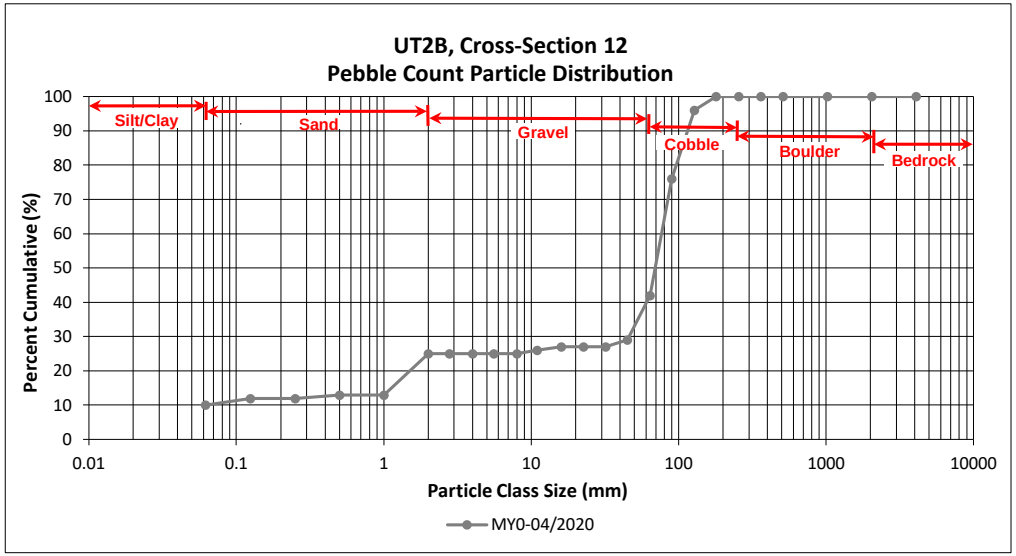
Reachwide and Cross-Section Pebble Count Plots

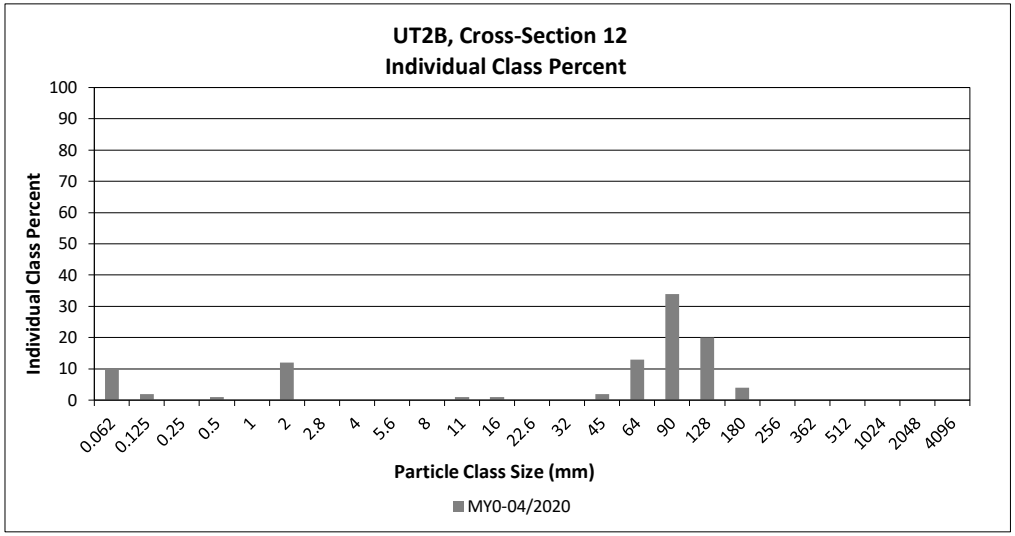
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT2B, Cross-Section 12

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	10	10	10
SAND	Very fine	0.062	0.125	2	2	12
	Fine	0.125	0.250			12
	Medium	0.25	0.50	1	1	13
	Coarse	0.5	1.0			13
	Very Coarse	1.0	2.0	12	12	25
GRAVEL	Very Fine	2.0	2.8			25
	Very Fine	2.8	4.0			25
	Fine	4.0	5.6			25
	Fine	5.6	8.0			25
	Medium	8.0	11.0	1	1	26
	Medium	11.0	16.0	1	1	27
	Coarse	16.0	22.6			27
	Coarse	22.6	32			27
	Very Coarse	32	45	2	2	29
	Very Coarse	45	64	13	13	42
COBBLE	Small	64	90	34	34	76
	Small	90	128	20	20	96
	Large	128	180	4	4	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 12	
Channel materials (mm)	
D_{16} =	1.2
D_{35} =	52.9
D_{50} =	69.3
D_{84} =	103.6
D_{95} =	125.8
D_{100} =	180.0





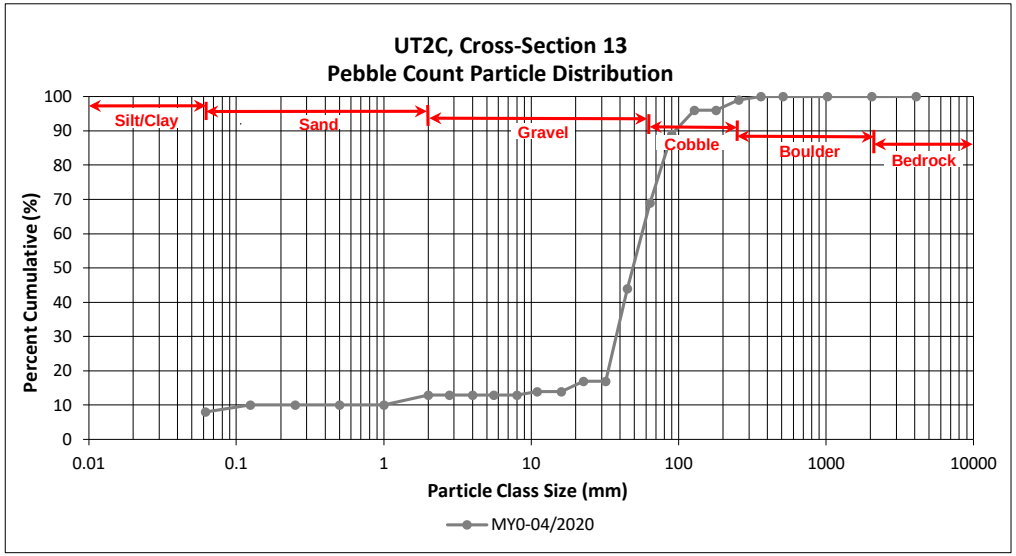
Reachwide and Cross-Section Pebble Count Plots

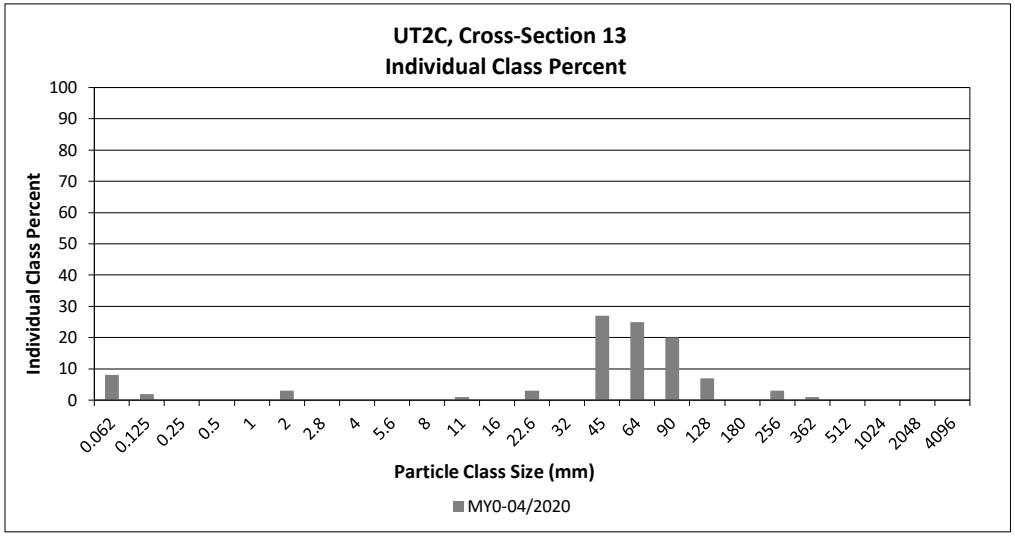
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT2C, Cross-Section 13

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	8	8	8
SAND	Very fine	0.062	0.125	2	2	10
	Fine	0.125	0.250			10
	Medium	0.25	0.50			10
	Coarse	0.5	1.0			10
	Very Coarse	1.0	2.0	3	3	13
GRAVEL	Very Fine	2.0	2.8			13
	Very Fine	2.8	4.0			13
	Fine	4.0	5.6			13
	Fine	5.6	8.0			13
	Medium	8.0	11.0	1	1	14
	Medium	11.0	16.0			14
	Coarse	16.0	22.6	3	3	17
	Coarse	22.6	32			17
	Very Coarse	32	45	27	27	44
	Very Coarse	45	64	25	25	69
COBBLE	Small	64	90	20	20	89
	Small	90	128	7	7	96
	Large	128	180			96
	Large	180	256	3	3	99
BOULDER	Small	256	362	1	1	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 13	
Channel materials (mm)	
D_{16} =	20.1
D_{35} =	40.2
D_{50} =	49.0
D_{84} =	82.6
D_{95} =	121.7
D_{100} =	362.0





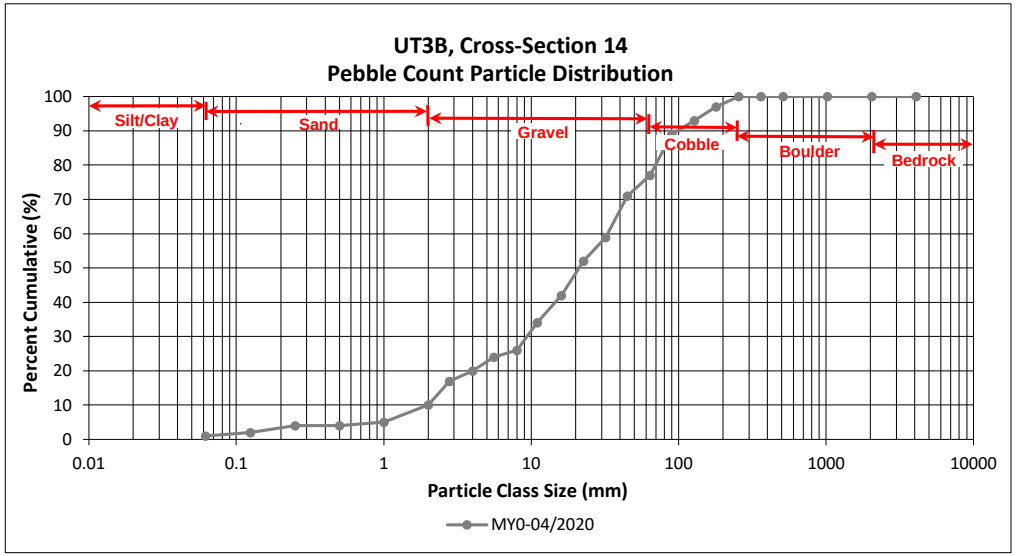
Reachwide and Cross-Section Pebble Count Plots

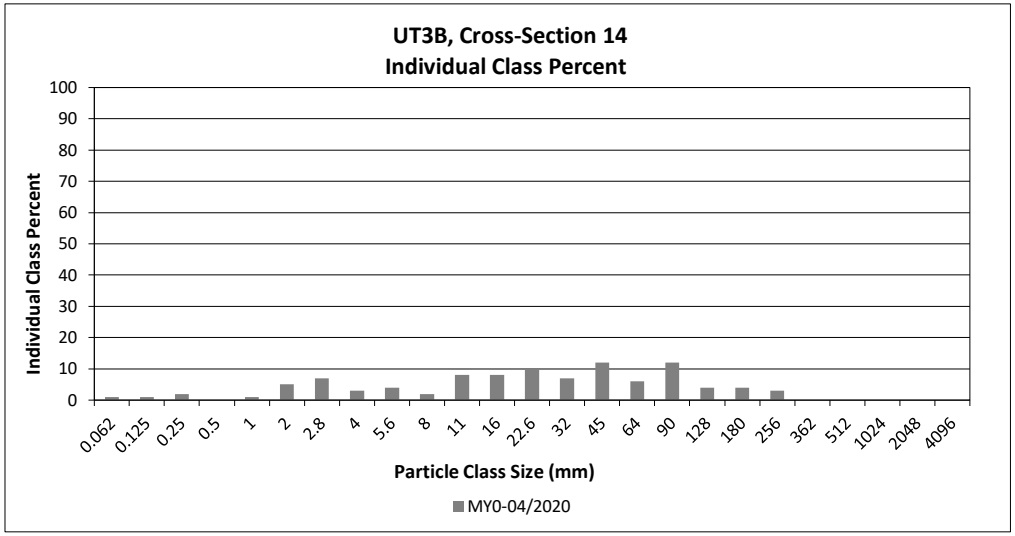
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT3B, Cross-Section 14

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	1	1
SAND	Very fine	0.062	0.125	1	1	2
	Fine	0.125	0.250	2	2	4
	Medium	0.25	0.50			4
	Coarse	0.5	1.0	1	1	5
	Very Coarse	1.0	2.0	5	5	10
GRAVEL	Very Fine	2.0	2.8	7	7	17
	Very Fine	2.8	4.0	3	3	20
	Fine	4.0	5.6	4	4	24
	Fine	5.6	8.0	2	2	26
	Medium	8.0	11.0	8	8	34
	Medium	11.0	16.0	8	8	42
	Coarse	16.0	22.6	10	10	52
	Coarse	22.6	32	7	7	59
	Very Coarse	32	45	12	12	71
	Very Coarse	45	64	6	6	77
COBBLE	Small	64	90	12	12	89
	Small	90	128	4	4	93
	Large	128	180	4	4	97
	Large	180	256	3	3	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 14	
Channel materials (mm)	
D_{16} =	2.7
D_{35} =	11.5
D_{50} =	21.1
D_{84} =	78.1
D_{95} =	151.8
D_{100} =	256.0





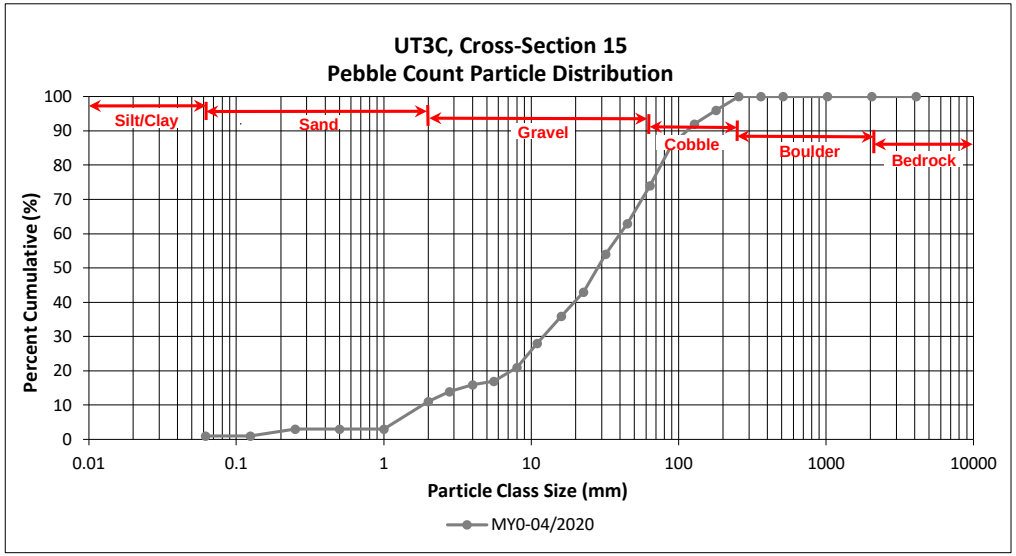
Reachwide and Cross-Section Pebble Count Plots

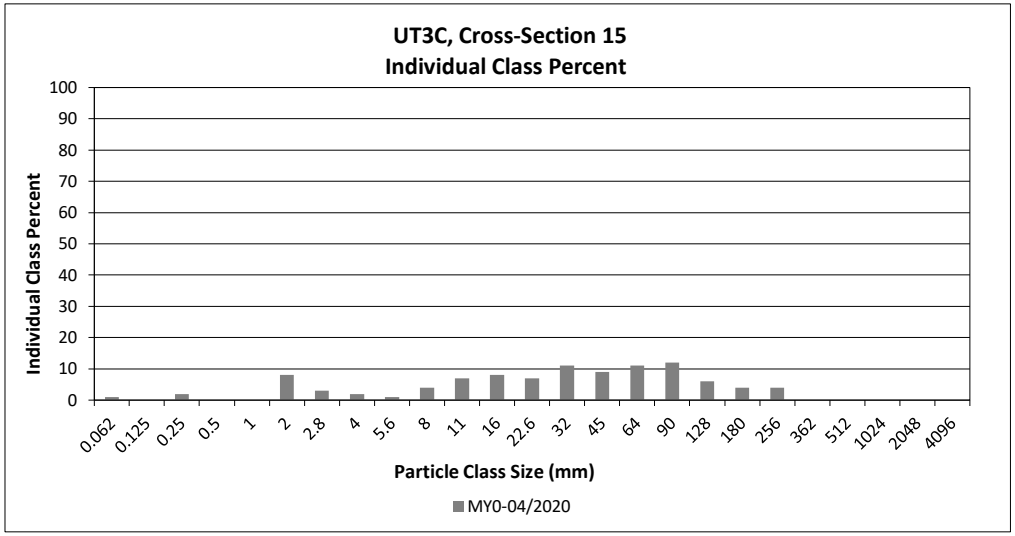
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

UT3C, Cross-Section 15

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	1	1	1
SAND	Very fine	0.062	0.125			1
	Fine	0.125	0.250	2	2	3
	Medium	0.25	0.50			3
	Coarse	0.5	1.0			3
	Very Coarse	1.0	2.0	8	8	11
GRAVEL	Very Fine	2.0	2.8	3	3	14
	Very Fine	2.8	4.0	2	2	16
	Fine	4.0	5.6	1	1	17
	Fine	5.6	8.0	4	4	21
	Medium	8.0	11.0	7	7	28
	Medium	11.0	16.0	8	8	36
	Coarse	16.0	22.6	7	7	43
	Coarse	22.6	32	11	11	54
	Very Coarse	32	45	9	9	63
	Very Coarse	45	64	11	11	74
COBBLE	Small	64	90	12	12	86
	Small	90	128	6	6	92
	Large	128	180	4	4	96
	Large	180	256	4	4	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 15	
Channel materials (mm)	
D_{16} =	4.0
D_{35} =	15.3
D_{50} =	28.2
D_{84} =	85.0
D_{95} =	165.3
D_{100} =	256.0





Stream Photographs
Bull Creek
Monitoring Year 0

	
Photo Point 1 – looking upstream (04/14/2020)	**Photo Point 1** – look downstream (04/14/2020)
	
Photo Point 2 – looking upstream (04/14/2020)	**Photo Point 2** – looking downstream (04/14/2020)
	
Photo Point 3 – looking upstream (04/14/2020)	**Photo Point 3** – looking downstream (04/14/2020)

Photo Point 4 – looking upstream (04/14/2020)

Photo Point 4 – looking downstream (04/14/2020)

Photo Point 4A – looking upstream (09/28/2020)

Photo Point 4A – looking downstream (09/28/2020)

Photo Point 4B – looking north (09/28/2020)

Photo Point 4C – looking south (09/28/2020)

Photo Point 4D – looking upstream (09/28/2020)

Photo Point 4D – looking downstream (09/28/2020)

Photo Point 5 – looking upstream (04/14/2020)

Photo Point 5 – looking downstream (04/14/2020)

Photo Point 6 – looking upstream (04/14/2020)

Photo Point 6 – looking downstream (04/14/2020)

	
Photo Point 7 – looking upstream (09/28/2020)	**Photo Point 7** – looking downstream (09/28/2020)
	
Photo Point 8 – looking upstream (09/28/2020)	**Photo Point 8** – looking downstream (09/28/2020)
	
Photo Point 9 – looking upstream (04/14/2020)	**Photo Point 9** – looking downstream (04/14/2020)

	
Photo Point 10 – looking upstream (04/14/2020)	**Photo Point 10** – looking downstream (04/14/2020)
	
Photo Point 11 – looking upstream (04/14/2020)	**Photo Point 11** – looking downstream (04/14/2020)

STREAM PHOTOGRAPHS
UT1
Monitoring Year 0

Photo Point 12 – looking upstream (9/28/2020)

Photo Point 12 – looking downstream (09/28/2020)

Photo Point 12A – looking upstream (9/28/2020)

Photo Point 12A – looking downstream (09/28/2020)

Photo Point 13 – looking upstream (04/16/2020)

Photo Point 13 – looking downstream (04/16/2020)

	
Photo Point 14 – looking upstream (04/14/2020)	**Photo Point 14** – looking downstream (04/14/2020)
	
Photo Point 14A – looking upstream (09/28/2020)	**Photo Point 14A** – looking downstream (09/28/2020)
	
Photo Point 14B – looking upstream (09/28/2020)	**Photo Point 14B** – looking downstream (09/28/2020)

	
Photo Point 15 – looking upstream (04/14/2020)	**Photo Point 15** – looking downstream (04/14/2020)

STREAM PHOTOGRAPHS
UT2
Monitoring Year 0

	
Photo Point 16 – looking upstream (04/14/2020)	**Photo Point 16** – looking downstream (04/14/2020)
	
Photo Point 17 – looking upstream (09/28/2020)	**Photo Point 17** – looking downstream (09/28/2020)
	
Photo Point 18 – looking upstream (09/28/2020)	**Photo Point 18** – looking downstream (09/28/2020)

	
Photo Point 19 – looking upstream (04/14/2020)	**Photo Point 19** – looking downstream (04/14/2020)
	
Photo Point 20 – looking upstream (04/14/2020)	**Photo Point 20** – looking downstream (04/14/2020)

STREAM PHOTOGRAPHS
UT3
Monitoring Year 0

Photo Point 21 – looking upstream (04/14/2020)

Photo Point 21 – looking downstream (04/14/2020)

Photo Point 22 – looking upstream (04/14/2020)

Photo Point 22 – looking downstream (04/14/2020)

Photo Point 22A – looking upstream (09/28/2020)

Photo Point 22A – looking downstream (09/28/2020)

Photo Point 23 – Wetland looking North (04/15/2020)

Photo Point 23 – Wetland looking East (04/15/2020)

Photo Point 23 – Wetland looking South (04/15/2020)

Photo Point 23 – Wetland looking West (04/15/2020)

Photo Point 24 – looking upstream (09/28/2020)

Photo Point 24 – looking downstream (09/28/2020)

	
Photo Point 25 – looking upstream (04/15/2020)	**Photo Point 25** – looking downstream (04/15/2020)

APPENDIX 3. Vegetation Plot Data

Table 9. Vegetation Plot Criteria Attainment

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Permanent Vegetation Plot	MY0 Success Criteria Met (Y/N)	Tract Mean (MY0 - 2020)	
1	Y	100%	100%
2	Y		
3	Y		
4	Y		
5	Y		
6	Y		
7	Y		
8	Y		
Mobile Vegetation Plot	**MY0 Success Criteria Met (Y/N)**		
1	Y	100%	
2	Y		
3	Y		
4	Y		
5	Y		

Table 10. CVS Permanent Vegetation Plot Metadata
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Report Prepared By	Brandon Romeo
Date Prepared	4/24/2020 12:17
Database Name	cvs-eep-entrytool-v2.5.0.mdb
Database Location	Q:\ActiveProjects\005-02165 Key Mill\Monitoring\Baseline Monitoring\Vegetation Assessment
Computer Name	JEFF-PC
File Size	72605696
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	100025
Project Name	Key Mill Mitigation Site
Description	Full delivery mitigation project in Surry County, NC.
Sampled Plots	8

Table 11a. Planted and Total Stem Counts
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Current Permanent Vegetation Plot Data (MY0 2020)														
Scientific Name	**Common Name**	**Species Type**	**Permanent Plot 1**			**Permanent Plot 2**			**Permanent Plot 3**			**Permanent Plot 4**		
			PnoLS	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer saccharinum	Silver Maple, Soft Maple	Tree												
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree	1	1	1	1	1	1	1	1	1			
Betula nigra	River Birch, Red Birch	Tree	3	3	3	3	3	3	1	1	1	1	1	1
Carpinus caroliniana	Ironwood	Shrub Tree	1	1	1									
Fagus grandifolia	American Beech	Tree	3	3	3									
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	1	1	1	3	3	3				1	1	1
Ilex opaca	American Holly, Christmas Holly	Shrub Tree	1	1	1	2	2	2				2	2	2
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree							5	5	5			
Platanus occidentalis	Sycamore, Plane-tree	Tree							3	3	3	4	4	4
Quercus falcata	Spanish Oak, Southern Red Oak	Tree							1	1	1	2	2	2
Quercus rubra	Northern Red Oak	Tree	4	4	4	2	2	2	2	2	2	2	2	2
Viburnum dentatum	Arrow-wood	Shrub Tree	1	1	1	1	1	1	5	5	5	1	1	1
		Stem count	15	15	15	12	12	12	18	18	18	13	13	13
		size (ares)		1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02	
		Species count	8	8	8	6	6	6	7	7	7	7	7	7
		Stems per ACRE	607	607	607	486	486	486	728	728	728	526	526	526

Current Permanent Vegetation Plot Data (MY0 2020)														
Scientific Name	**Common Name**	**Species Type**	**Permanent Plot 5**			**Permanent Plot 6**			**Permanent Plot 7**			**Permanent Plot 8**		
			PnoLS	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer saccharinum	Silver Maple, Soft Maple	Tree							2	2	2			
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree	1	1	1				1	1	1			
Betula nigra	River Birch, Red Birch	Tree	3	3	3	2	2	2				3	3	3
Carpinus caroliniana	Ironwood	Shrub Tree										3	3	3
Fagus grandifolia	American Beech	Tree										1	1	1
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree				2	2	2	2	2	2	3	3	3
Ilex opaca	American Holly, Christmas Holly	Shrub Tree										1	1	1
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree							1	1	1			
Platanus occidentalis	Sycamore, Plane-tree	Tree	3	3	3	4	4	4	2	2	2			
Quercus falcata	Spanish Oak, Southern Red Oak	Tree	1	1	1	2	2	2	1	1	1			
Quercus rubra	Northern Red Oak	Tree	1	1	1	2	2	2	1	1	1	2	2	2
Viburnum dentatum	Arrow-wood	Shrub Tree	3	3	3	3	3	3	1	1	1			
		Stem count	12	12	12	15	15	15	11	11	11	13	13	13
		size (ares)		1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02	
		Species count	6	6	6	6	6	6	8	8	8	6	6	6
		Stems per ACRE	486	486	486	607	607	607	445	445	445	526	526	526

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%
Volunteer species included in total

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

Table 11b. Planted and Total Stem Counts

Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Permanent Vegetation Plot Annual Mean					
Scientific Name	**Common Name**	**Species Type**	**MY0 (2020)**		
			PnoLS	**P-all**	**T**
Acer saccharinum	Silver Maple, Soft Maple	Tree	2	2	2
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree	5	5	5
Betula nigra	River Birch, Red Birch	Tree	16	16	16
Carpinus caroliniana	Ironwood	Shrub Tree	4	4	4
Fagus grandifolia	American Beech	Tree	4	4	4
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	12	12	12
Ilex opaca	American Holly, Christmas Holly	Shrub Tree	6	6	6
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree	6	6	6
Platanus occidentalis	Sycamore, Plane-tree	Tree	16	16	16
Quercus falcata	Spanish Oak, Southern Red Oak	Tree	7	7	7
Quercus rubra	Northern Red Oak	Tree	16	16	16
Viburnum dentatum	Arrow-wood	Shrub Tree	15	15	15
		Stem count	109	109	109
		size (ares)	8		
		size (ACRES)	0.20		
		Species count	12	12	12
		Stems per ACRE	551	551	551

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%
Volunteer species included in total

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

Table 11c. Planted and Total Stem Counts
Key Mill Mitigation Site
DMS Project No. 100025
Monitoring Year 0 - 2020

Current Mobile Vegetation Plot (MP) Data (MY0 2020)								
Scientific Name	**Common Name**	**Species Type**	**MP1**	**MP2**	**MP3**	**MP4**	**MVP5**	**MY0 (2020)**
			PnoLS	**PnoLS**	**PnoLS**	**PnoLS**	**PnoLS**	**PnoLS**
Acer saccharinum	Silver Maple, Soft Maple	Tree				1		1
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree					4	4
Betula nigra	River Birch, Red Birch	Tree	3	2	3	6	1	15
Carpinus caroliniana	Ironwood	Shrub Tree		3			2	5
Fagus grandifolia	American Beech	Tree		3			1	4
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree			3	4		7
Ilex opaca	American Holly, Christmas Holly	Shrub Tree		3			1	4
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree	2		1	1		4
Platanus occidentalis	Sycamore, Plane-tree	Tree	2		2			4
Quercus falcata	Spanish Oak, Southern Red Oak	Tree				1		1
Quercus rubra	Northern Red Oak	Tree	3	2	7	2	2	16
Viburnum dentatum	Arrow-wood	Shrub Tree	1	1	2	1		5
		Stem count	11	14	18	16	11	70
		size (ares)	1	1	1	1	1	5
		size (ACRES)	0.02	0.02	0.02	0.02	0.02	0.12
		Species count	5	6	6	7	6	12
		Stems per ACRE	445	567	728	647	445	567

Overall Site Annual Mean			
Scientific Name	**Common Name**	**Species Type**	**MY0 (2020)**
			PnoLS
Acer saccharinum	Silver Maple, Soft Maple	Tree	3
Asimina triloba	Common Pawpaw, Indian-banana	Shrub Tree	9
Betula nigra	River Birch, Red Birch	Tree	31
Carpinus caroliniana	Ironwood	Shrub Tree	9
Fagus grandifolia	American Beech	Tree	8
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	19
Ilex opaca	American Holly, Christmas Holly	Shrub Tree	10
Nyssa sylvatica	Sour Gum, Black Gum, Pepperidge	Tree	10
Platanus occidentalis	Sycamore, Plane-tree	Tree	20
Quercus falcata	Spanish Oak, Southern Red Oak	Tree	8
Quercus rubra	Northern Red Oak	Tree	32
Viburnum dentatum	Arrow-wood	Shrub Tree	20
		Stem count	179
		size (ares)	13
		size (ACRES)	0.32
		Species count	12
		Stems per ACRE	557

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%
Volunteer species included in total

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

VEGETATION PHOTOGRAPHS

Monitoring Year 0

Permanent Vegetation Plot 1 (04/21/2020)

Permanent Vegetation Plot 2 (04/21/2020)

Permanent Vegetation Plot 3 (04/21/2020)

Permanent Vegetation Plot 4 (07/02/2020)

Permanent Vegetation Plot 5 (04/21/2020)

Permanent Vegetation Plot 6 (04/21/2020)

	
Permanent Vegetation Plot 7 (04/21/2020)	**Permanent Vegetation Plot 8** (04/21/2020)

Mobile Vegetation Plot 1 (North) (04/21/2020)

Mobile Vegetation Plot 2 (North) (04/21/2020)

Mobile Vegetation Plot 3 (North) (04/21/2020)

Mobile Vegetation Plot 4 (North) (04/21/2020)

Mobile Vegetation Plot 5 (North) (04/21/2020)

APPENDIX 4. Record Drawings and a Sealed As-built Survey

Key Mill Mitigation Site - Record Drawings

Surry County, North Carolina

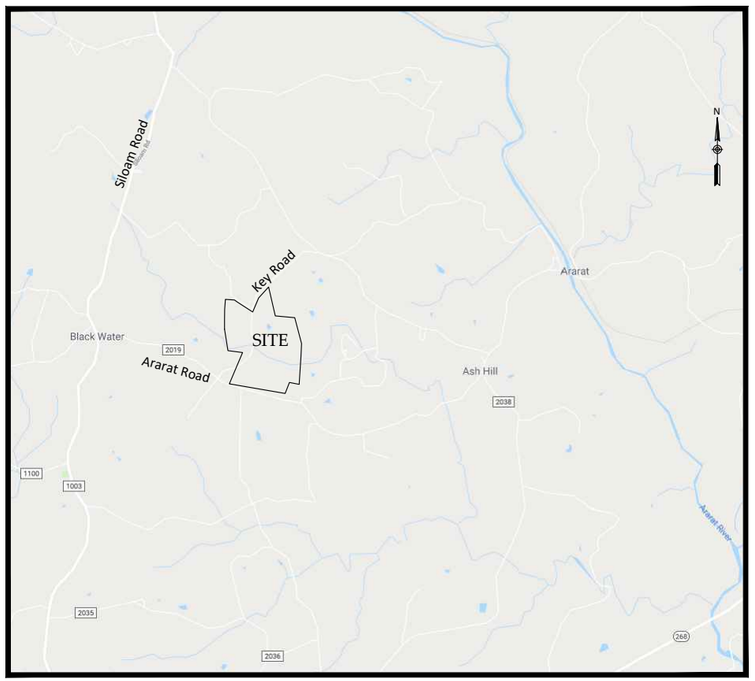
Yadkin River Basin HUC 03040101

for

NCDEQ

Division of Mitigation Services

Surry County, NC



Vicinity Map
Not to Scale

Environmental Quality

Record Drawings
August 27, 2020

CERTIFICATE OF SURVEY AND ACCURACY

I, PHILLIP B. KEE, CERTIFY THAT THE GROUND TOPOGRAPHIC SURVEY PORTION OF THIS PROJECT WAS COMPLETED UNDER MY DIRECT SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY DIRECT SUPERVISION; THAT THE RECORD DRAWINGS WERE PREPARED BY WILDLANDS ENGINEERING, INC. FROM DIGITAL FILES PROVIDED BY KEE MAPPING AND SURVEYING, PA AS SHOWN ON AN AS-BUILT SURVEY FOR "KEY MILL MITIGATION SITE AREA A-WEST & AREA B-EAST", JOB #190870-AB, DATED 01/31/20 (AREA A-WEST) & 07/23/20 (AREA B-EAST); THAT THIS SURVEY WAS PERFORMED AT THE 95% CONFIDENCE LEVEL TO MEET THE FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS AND TO MEET THE REQUIREMENTS OF A TOPOGRAPHIC SURVEY TO THE ACCURACY OF CLASS A HORIZONTAL AND CLASS C VERTICAL WHERE APPLICABLE; THAT THE ORIGINAL DATA WAS OBTAINED BETWEEN THE DATES OF 09/30/19-10/18/19 (AREA A-WEST) & 04/28/20-06/04/20 (AREA B-EAST); 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; THAT THIS MAP WAS NOT PREPARED IN ACCORDANCE WITH G.S. 47-30, AS AMENDED AND DOES NOT REPRESENT AN OFFICIAL BOUNDARY SURVEY.

WITNESS MY ORIGINAL SIGNATURE, LICENSE NUMBER, AND SEAL THIS 6TH DAY OF OCTOBER, 2020, A.D.

NORTH CAROLINA PROFESSIONAL SEAL L-4647 LAND SURVEYOR PHILLIP B. KEE

DocuSigned by:
Phillip B. Kee
D965004A7692407...

PHILLIP B. KEE, PLS L-4647

Sheet Index

Project Directory

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Aaron Earley, PE, CFM
704-332-7754

Surveying:
Kee Mapping & Surveying
Box P.O. 2566
Asheville, NC 28802
Phillip B. Kee, PLS
828-575-9021

Owner:
NCDEQ
Division of Mitigation Services
5 Ravenscroft Drive, Ste 102
Asheville, NC 28801
Matthew Reid
919-707-8976

DMS Project no. 100025

Yadkin River Basin HUB 03040101

USACE Action ID: SAW-2017-01504

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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. EARLEY 10-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
Title Sheet

Revisions: 10/06/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 0.1

October 6, 2020

J:\ACTIVE PROJECTS\NC\005-02165 Key Mill\Cad\As-Built\02165-AB-Cover and Notes.dwg

Existing Features

- Pre-Construction Property Line
- Pre-Construction Overhead Electric (OHE)
- Pre-Construction Power Pole
- Pre-Construction Tree
- Pre-Construction Pond

Design Features

- Design Thalweg Alignment (10+00)
- Design Major Contour (100)
- Design Minor Contour
- Design Terracell 140 Cattle Crossing
- Design Road over Culvert
- Design Various Constructed Riffles Per Plans
- Design Brush Toe
- Design Sod Mat
- Design Brush Mattress
- Design Boulder Toe
- Design Log Sill
- Design Log J-Hook
- Design Boulder J-Hook
- Design Log Vane
- Design Rock Sill
- Design Cover Log
- Design Rock Vane
- Design Lunker Log

As-Built Features

- As-Built Thalweg Alignment
- As-Built Bankfull
- As-Built Major Contour (100)
- As-Built Minor Contour
- As-Built Limits of Disturbance (LOD)
- As-Built Culvert
- As-Built Fencing (x)
- Recorded Conservation Easement (CE)
- Recorded Internal Crossing at Conservation Easement (CS-XS)
- As-Built Various Constructed Riffles Per Plans
- As-Built Brush Toe
- As-Built Boulder Toe / Riprap
- As-Built Log Sill
- As-Built Log Vane
- As-Built Rock Sill
- As-Built Log J-Hook

Monitoring Features

- Permanent Cross Section
- Vegetation Plot (VEG / VP#)
- Photo Point (PP#)
- Crest Gage (CG#)
- Stream Gauge (SG#)
- Barotroll (BT)

Notes:

1. Deviations from Design will be shown in Red.
2. Both the As-Built surveyed thalweg alignment and Design Centerline are depicted in this plan set.
3. The Design Centerline stationing is used for the profiles as well as project credit stationing.
4. Pre-construction topography by Kee Mapping and Surveying March 16, 2018.
5. Boundary survey by Kee Mapping and Surveying June 1, 2018.
6. As-built survey west of Key Road November 1, 2019.
7. As-built survey east of Key Road June 9, 2020.

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023449 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
General Notes and Legend

Revisions:

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 0.2

October 6, 2020

Reach	Reach Start			End Station	Type of Mitigation
	Northing	Easting	Station		
Bull Creek R1A	967255.23	1526843.10	100+95	105+39	Restoration
Bull Creek R1B	966953.15	1527027.89	105+39	112+61	Restoration
Bull Creek R2	966864.77	1527613.64	112+61	116+79	Restoration
Bull Creek R3	966807.00	1528127.22	150+30	167+56	Restoration
Bull Creek R4	966185.55	1529301.19	167+56	174+39	Preservation
UT1A	968069.36	1527267.64	200+21	208+85	Enhancement II
UT1B	967430.25	1527721.40	208+85	210+97	Restoration
UT1C	967245.93	1527800.36	211+36	213+93	Restoration
UT2	965906.42	1527791.97	350+00	350+42	Restoration
UT2A	965925.08	1527767.27	300+00	303+15	Restoration
UT2B	966181.96	1527894.24	303+50	306+13	Restoration
UT2C	966402.88	1528032.86	306+13	310+82	Restoration
UT3	967436.62	1528615.63	450+38	450+56	Enhancement II
UT3A	967430.52	1528625.75	400+57	404+70	Enhancement II
UT3B	967094.08	1528563.75	404+70	407+77	Restoration
UT3C	966848.62	1528451.56	408+12	412+24	Restoration

STA. 200+21
START REACH UT1A

STA. 208+85
END UT1A
BEGIN UT1B

STA. 210+97
END REACH UT1B

STA. 211+36
START REACH UT1C

STA. 213+93
END UT1C

STA. 310+82
END UT2C

STA. 306+13
END REACH UT2B
BEGIN REACH UT2C

STA. 303+15
END REACH UT2A

STA. 303+50
START REACH UT2B

STA. 350+42
END REACH UT2

STA. 300+00
START REACH UT2A

STA. 350+00
START REACH UT2

STA. 450+38
START UT3

STA 450+56
END UT3

STA. 400+57
START UT3A

STA. 404+70
END REACH UT3A
START REACH UT3B

STA. 407+77
END REACH UT3B

STA. 408+12
START UT3C

STA. 412+24
END UT3C

STA. 100+95
START BULL CREEK REACH 1A

STA. 105+39
END BULL CREEK REACH 1A
START BULL CREEK REACH 1B

STA. 112+61
END REACH 1B
START REACH 2

STA. 116+79
END BULL CREEK REACH 2

STA. 150+30
BEGIN BULL CREEK REACH 3

STA. 167+56
END REACH 3
START REACH 4

STA. 174+39
END REACH 4

UT1 UT2 UT2A UT3 UT3A BULL CREEK KEY ROAD

SHEET 1.1 SHEET 1.2 SHEET 1.3 SHEET 1.4 SHEET 1.5 SHEET 1.6 SHEET 1.7 SHEET 1.8 SHEET 1.9 SHEET 1.10 SHEET 1.11 SHEET 1.12 SHEET 1.13 SHEET 1.14 SHEET 1.15 SHEET 1.16 SHEET 1.17 SHEET 1.18 SHEET 1.19 SHEET 1.20 SHEET 1.21 SHEET 1.22 SHEET 1.23

JASON ELLIOT SMITH AND MARCIA LYNN SMITH
PIN: 5926-77-7725
DB: 907 PG: 890
PB: 19 PG: 146, TRACT 1

LINDA S. KEY
PIN: 5926-00-77-7192
DB: 302 PG: 610, DB: 385 PG: 465 & DB: 325 PG: 180
REFERENCES FOR DB: 302 PG: 610 & DB: 385 PG: 465
TRACT 1 - DB: 124 PAGE 426
TRACT 2 - DB: 149 PG: 69
TRACT 3 - DB: 117 PG: 278
TRACT 4 - DB: 124 PG: 375, SECOND TRACT

ZACHARY NEIL HARDY AND SARAH SMITH HARDY
PIN: 5926-66-6552
DB: 1169 PG: 387

MARY L. HOLYFIELD HEIRS
PIN: 5926-00-75-4818
DB: 204 PG: 127
REF.: DB: 167 PG: 581

DELANA SHINAULT
PIN: 5936-00-07-5126
DB: 1625 PG: 282
REF.: PORTION OF DB: 239 PG: 676

HOMEPLACE RECREATIONAL PARK, INC.
PIN: 5936-00-05-7889
DB: 1025 PG: 756 TRACTS 1 & 2
& DB: 1201 PG: 1206
PB: 19 PG: 29 & PB: 24 PG: 160

N

0' 150' 300' 450'
(HORIZONTAL)

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023349 AARON S. ERVIN
8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
Project Overview

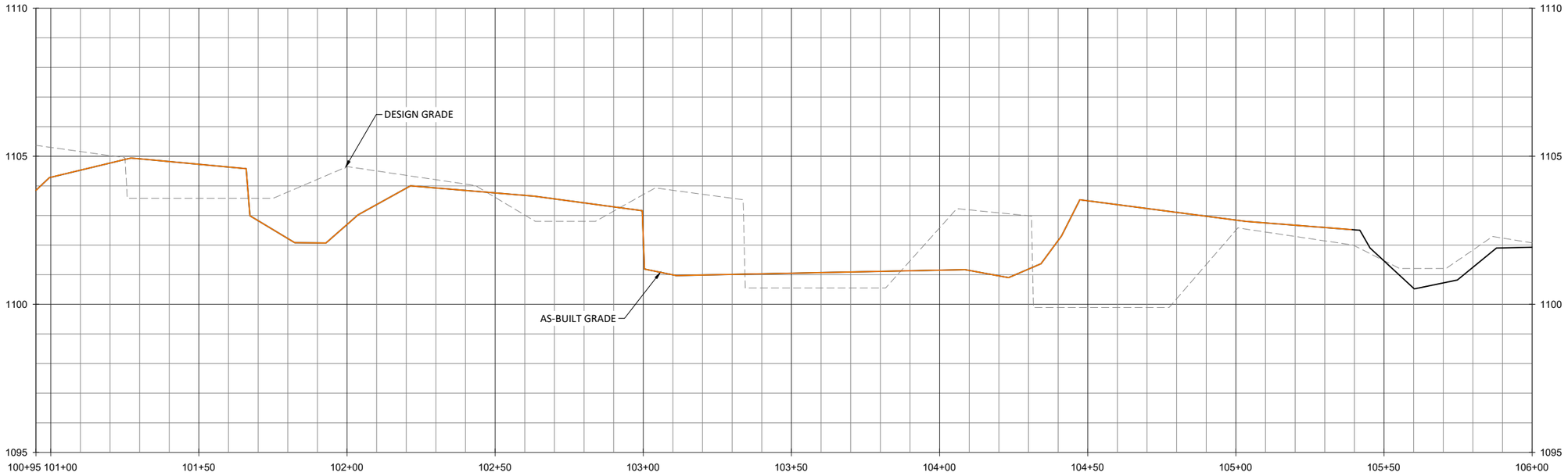
Revisions: 09/29/2020

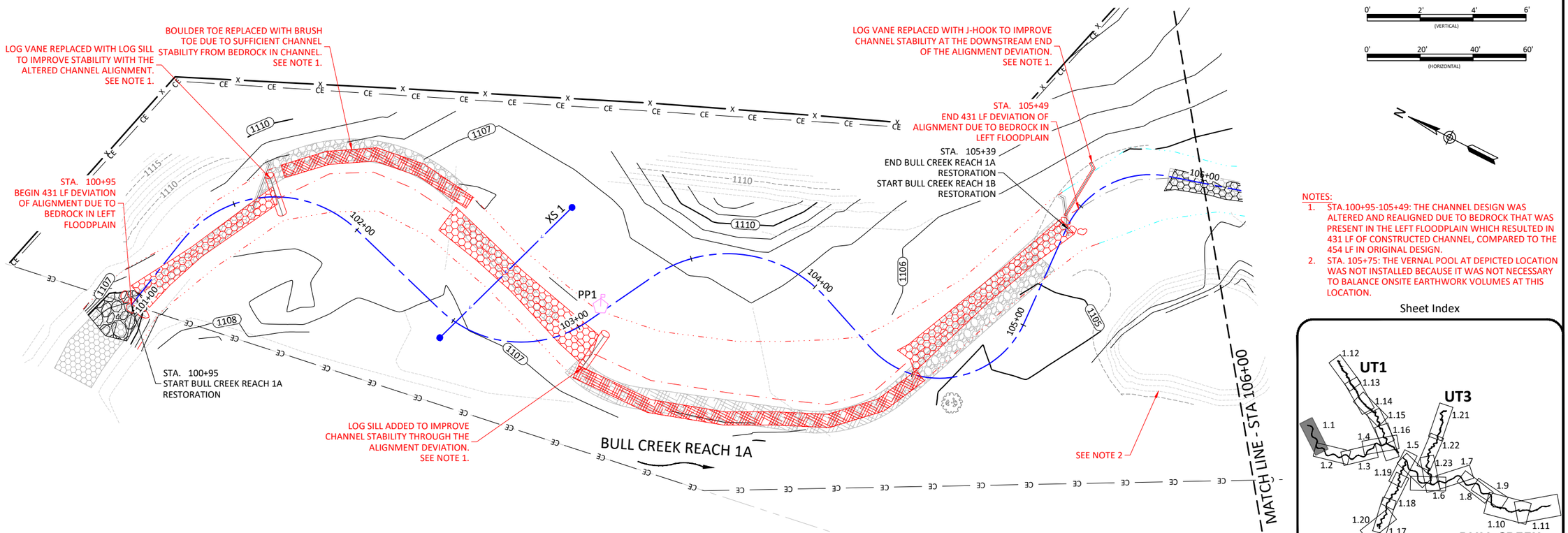
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/TTC
Checked By: JCK

Sheet 0.3

T:\ACTIVE PROJECTS (NCI)\005-02165 Key Mill\Cad\Ltd Built\02165-Ltd-built-West.dwg

October 6, 2020





NOTES:

1. STA.100+95-105+49: THE CHANNEL DESIGN WAS ALTERED AND REALIGNED DUE TO BEDROCK THAT WAS PRESENT IN THE LEFT FLOODPLAIN WHICH RESULTED IN 431 LF OF CONSTRUCTED CHANNEL, COMPARED TO THE 454 LF IN ORIGINAL DESIGN.
2. STA. 105+75: THE VERNAL POOL AT DEPICTED LOCATION WAS NOT INSTALLED BECAUSE IT WAS NOT NECESSARY TO BALANCE ONSITE EARTHWORK VOLUMES AT THIS LOCATION.

Sheet Index

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 028349 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 1A
Stream Plan and Profile

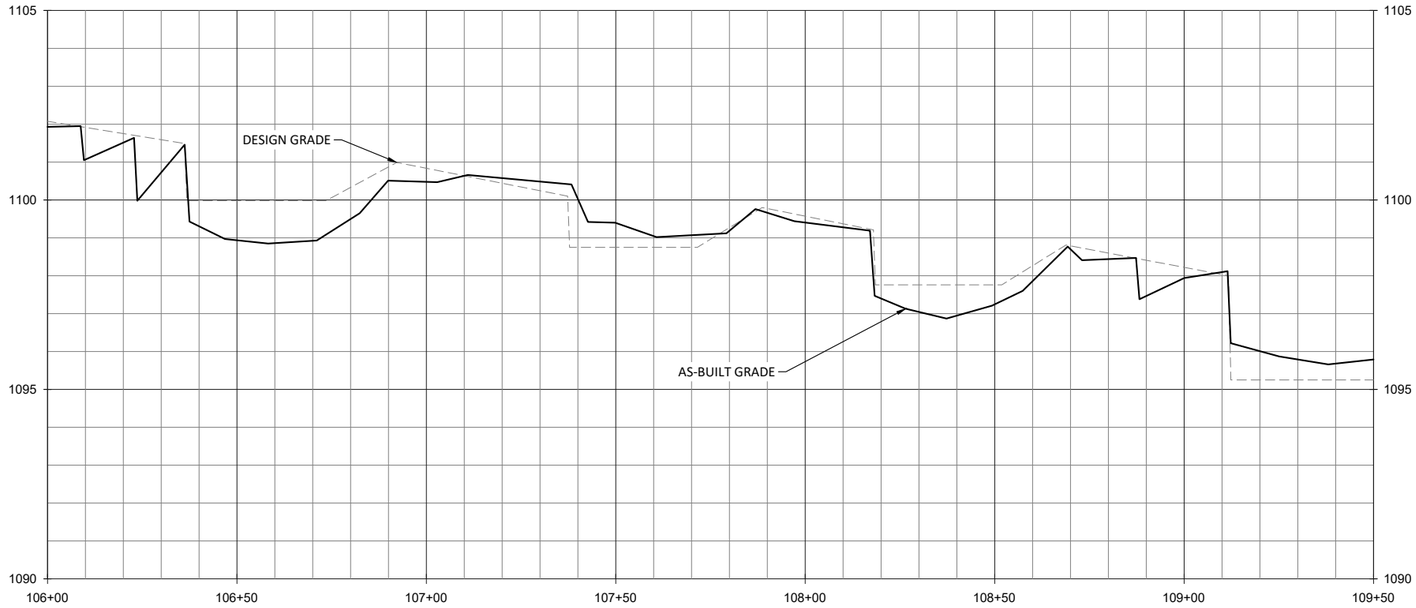
Revisions: 09/29/2020

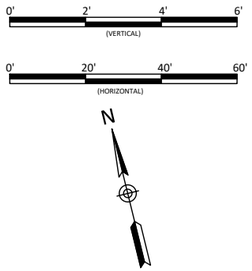
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.1

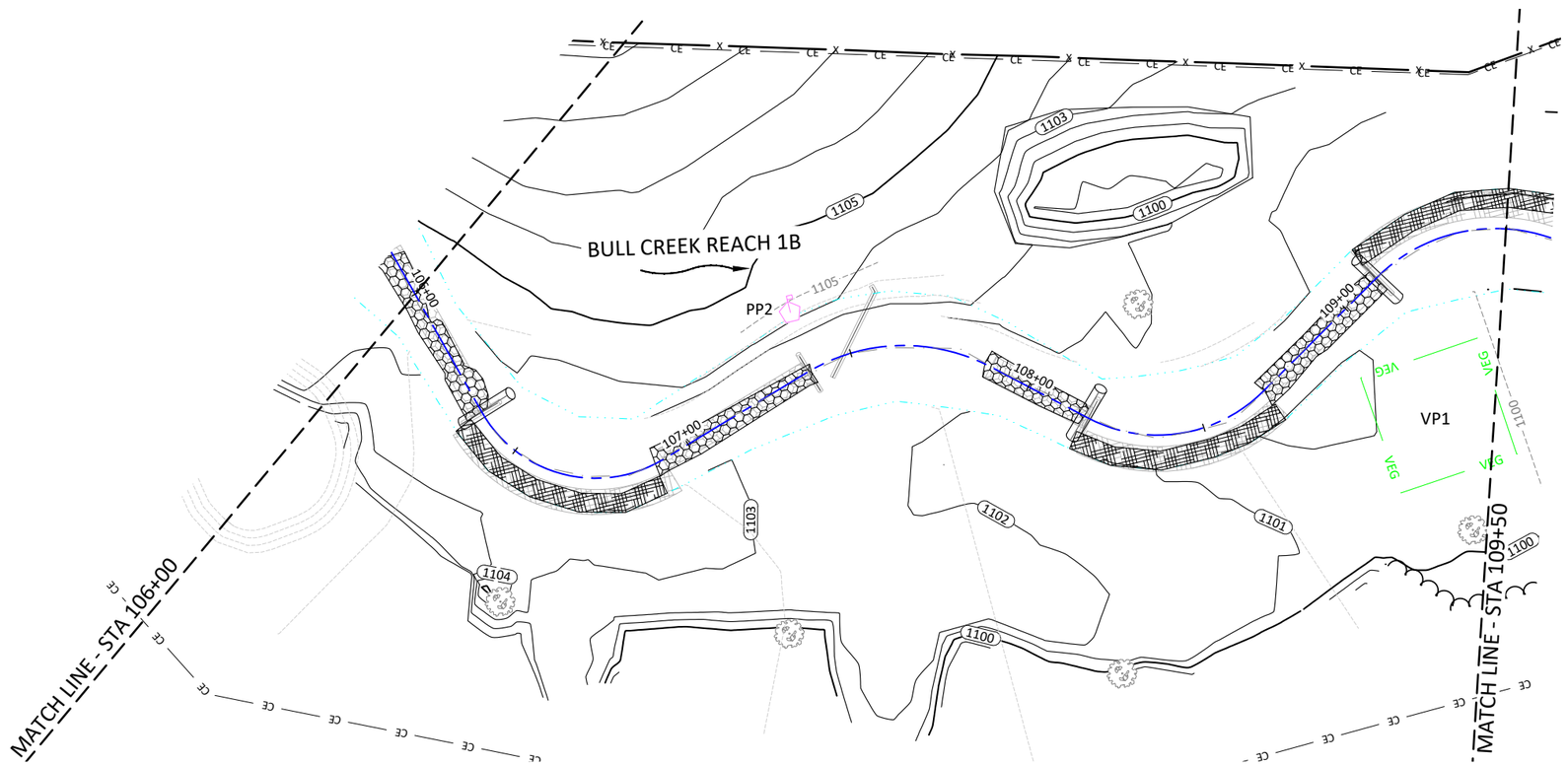
T:\ACTIVE PROJECTS\NC\005-02165 Key Mill\Grading\As-Built\02165-AsBuilt Vicinity.dwg

October 6, 2020





NOTE:
1. STA. 107+40: THE LOG SILL AND LOG VANE WERE OMITTED DUE TO PRESENCE OF BEDROCK.



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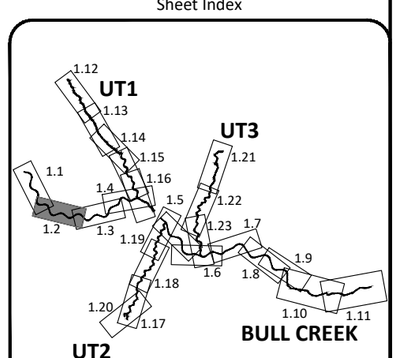

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NORTH CAROLINA PROFESSIONAL SEAL 023414 ENGINEER AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 1B
Stream Plan and Profile

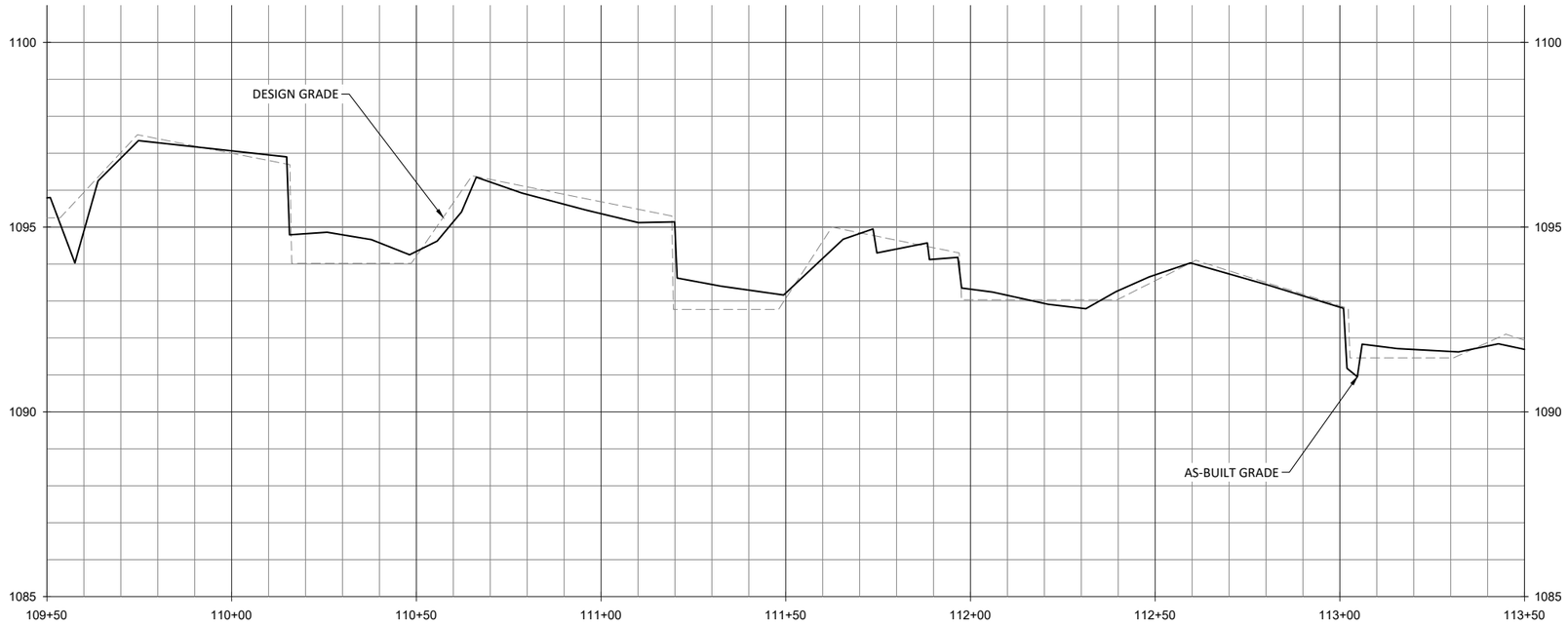
Revisions: 09/29/2020

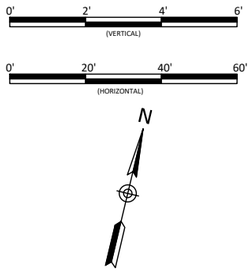
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

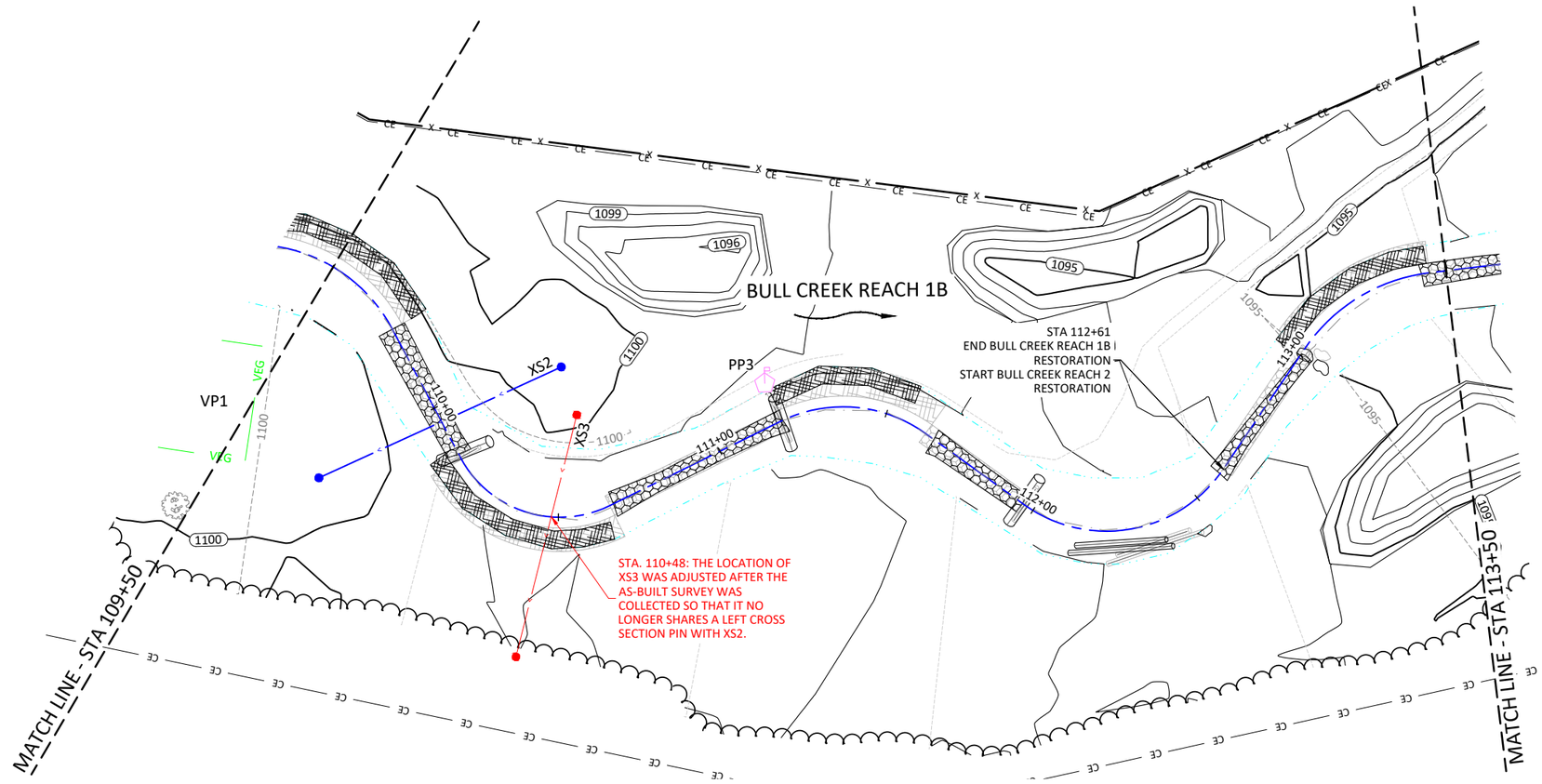
Sheet 1.2

T:\ACTIVE PROJECTS\NCI\005-02165\Key Mill\Grading\As-Built\02165-AsBuilt West.dwg

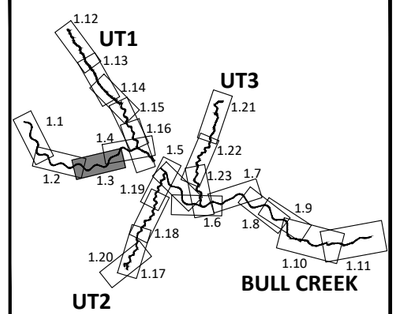
October 6, 2020







Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 023414 ENGINEER AARON S. ERVIN
9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 1B
Stream Plan and Profile

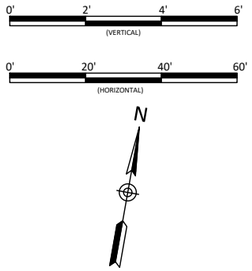
Revisions: 09/29/2020

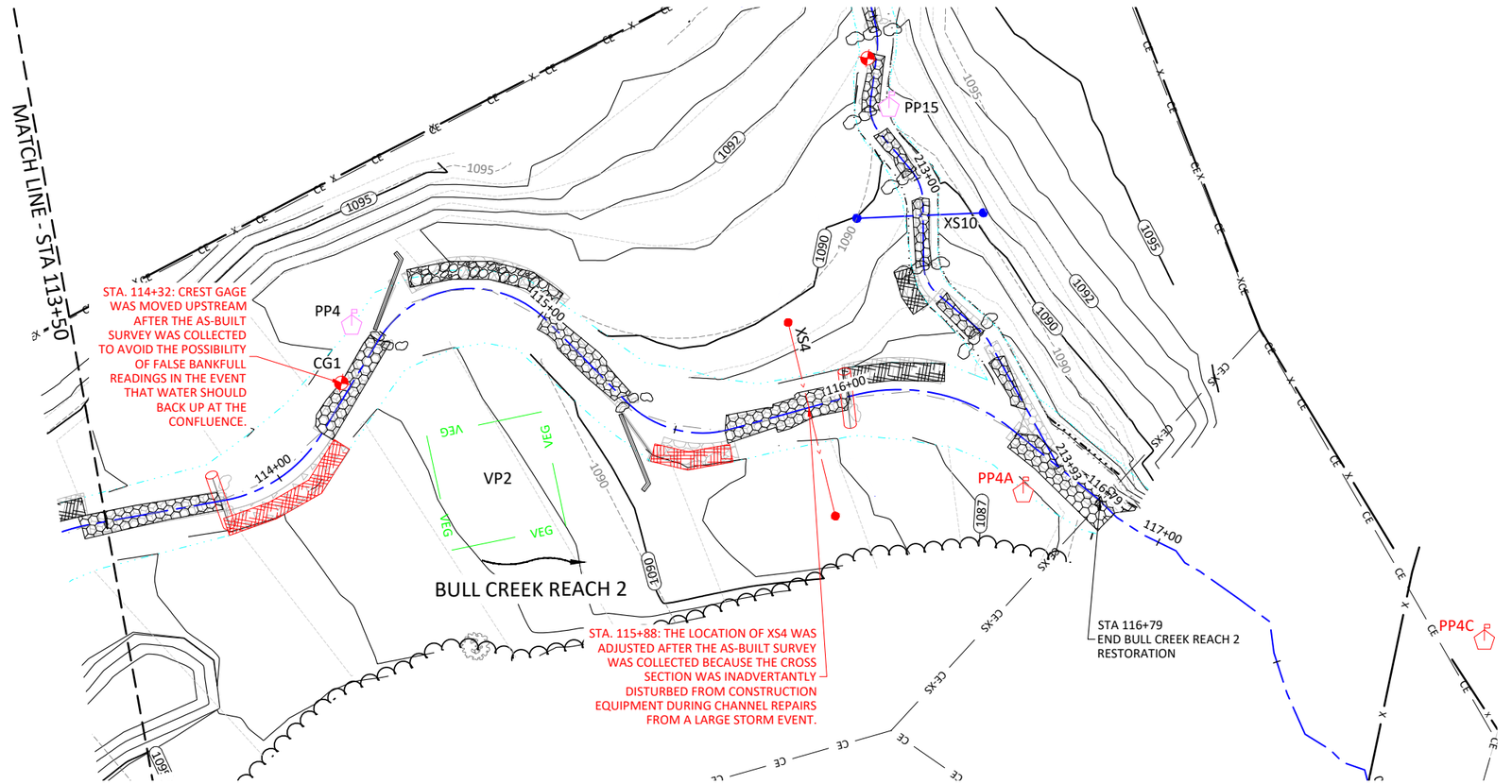
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.3

T:\ACTIVE PROJECTS\NCV\005-02165 Key Mill\GIS\Arc Built\02165 As-Built Work.mxd

October 6, 2020





NOTES:
1. STA. 113+80: LOG SILL WAS SUBSTITUTED FOR ROCK SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SITE CONDITIONS.
2. STA. 113+85: BRUSH TOE WAS SUBSTITUTED FOR BRUSH MATTRESS DUE TO SUFFICIENT BANK STABILITY FOLLOWING CONSTRUCTION OF THE PROPOSED CHANNEL.
3. STA. 115+45: BRUSH TOE WAS SUBSTITUTED FOR BOULDER TOE DUE TO SUFFICIENT BANK STABILITY FOLLOWING CONSTRUCTION OF THE PROPOSED CHANNEL.
4. STA. 116+00: LOG SILL WAS SUBSTITUTED FOR ROCK SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
5. STA. 116+62: PHOTO POINT 4A WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE THE CONSERVATION EASEMENT BREAK.

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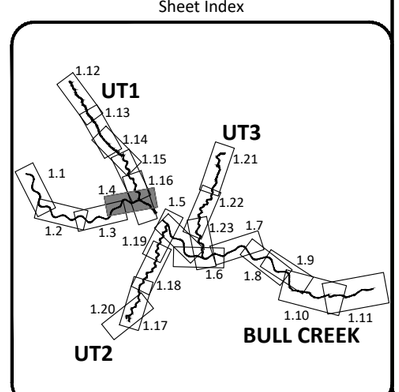

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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN
9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
Bull Creek Reach 2
Stream Plan and Profile

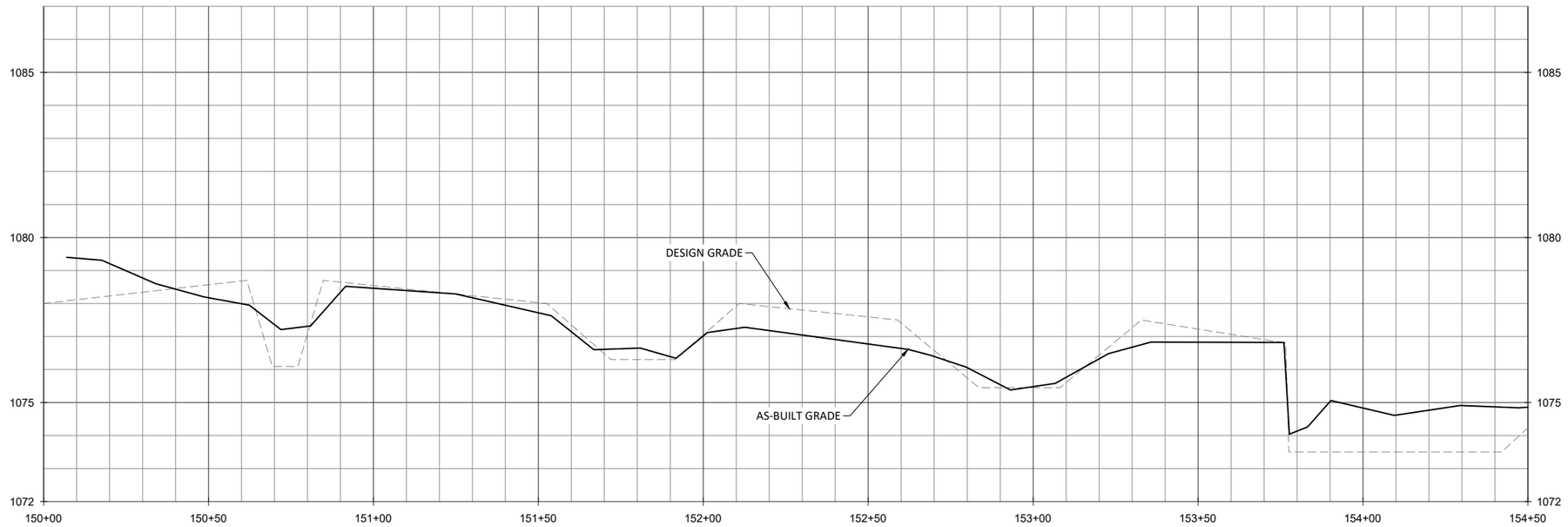
Revisions: 09/29/2020

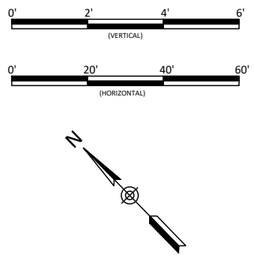
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

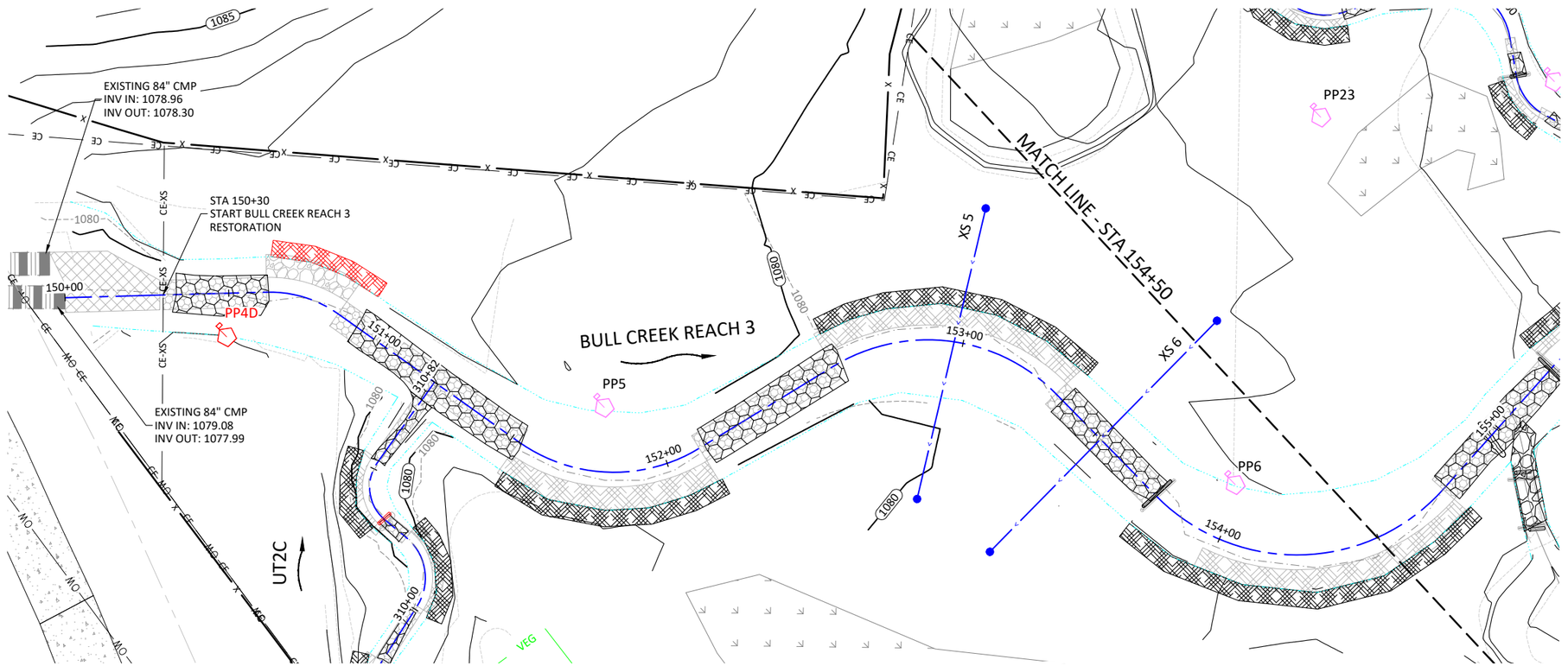
Sheet 1.4

T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cad\Xsc-Built\02165-AsBuilt-West.dwg

October 6, 2020







NOTE:
1. STA. 150+50: PHOTO POINT 4D WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE THE CONSERVATION EASEMENT BREAK.
2. STA. 150+62: BOULDER TOE REPLACED WITH BRUSH TOE DUE TO LOCAL MATERIAL AVAILABILITY AND TO IMPROVE IN-STREAM HABITAT.

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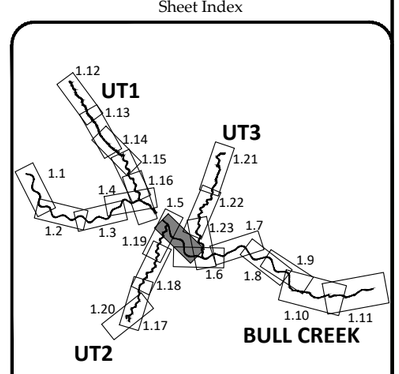

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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 3
Stream Plan and Profile

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.5

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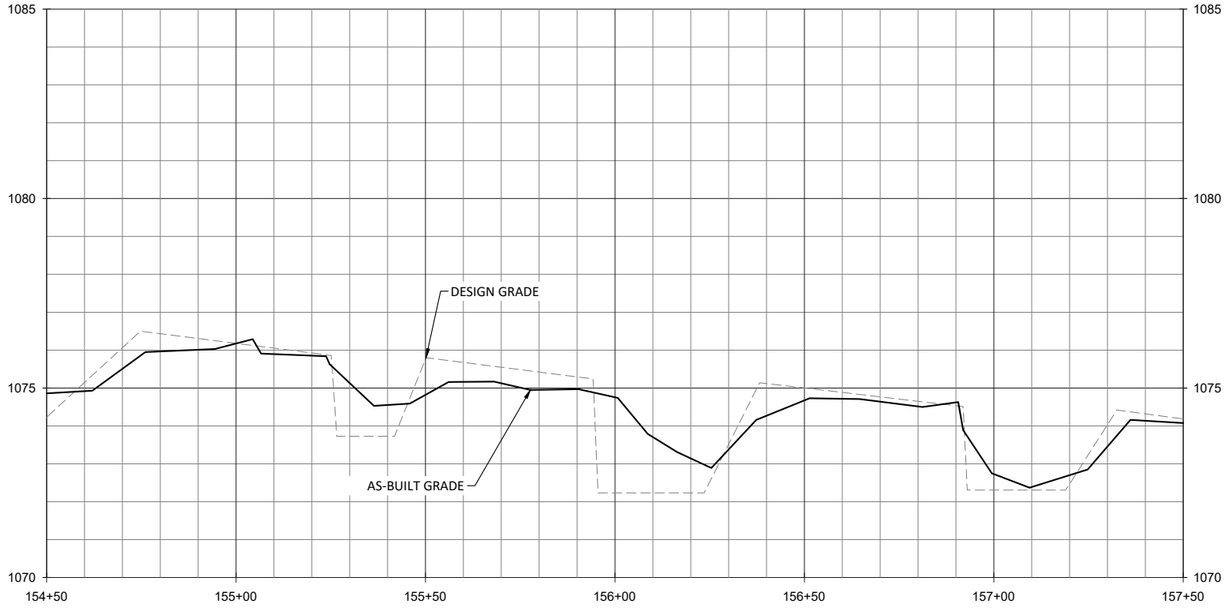
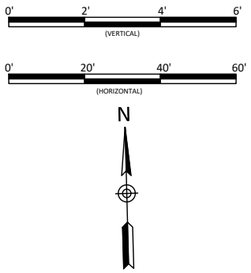
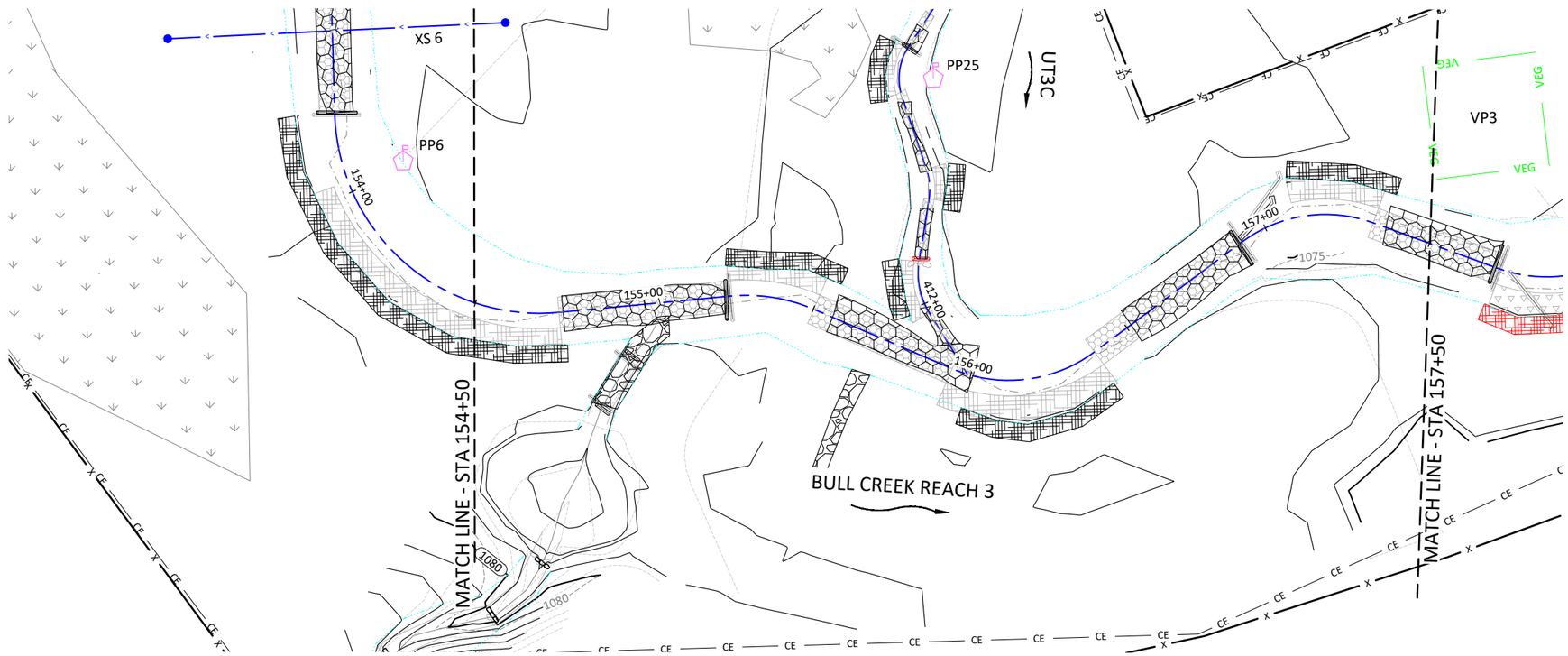
October 6, 2020







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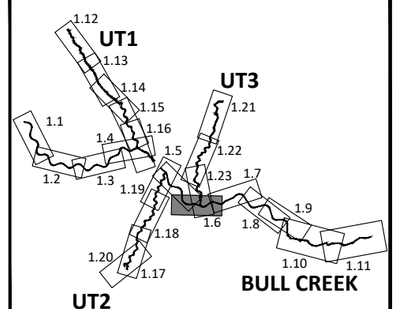

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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN 10-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 3
Stream Plan and Profile

Revisions:
09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.6

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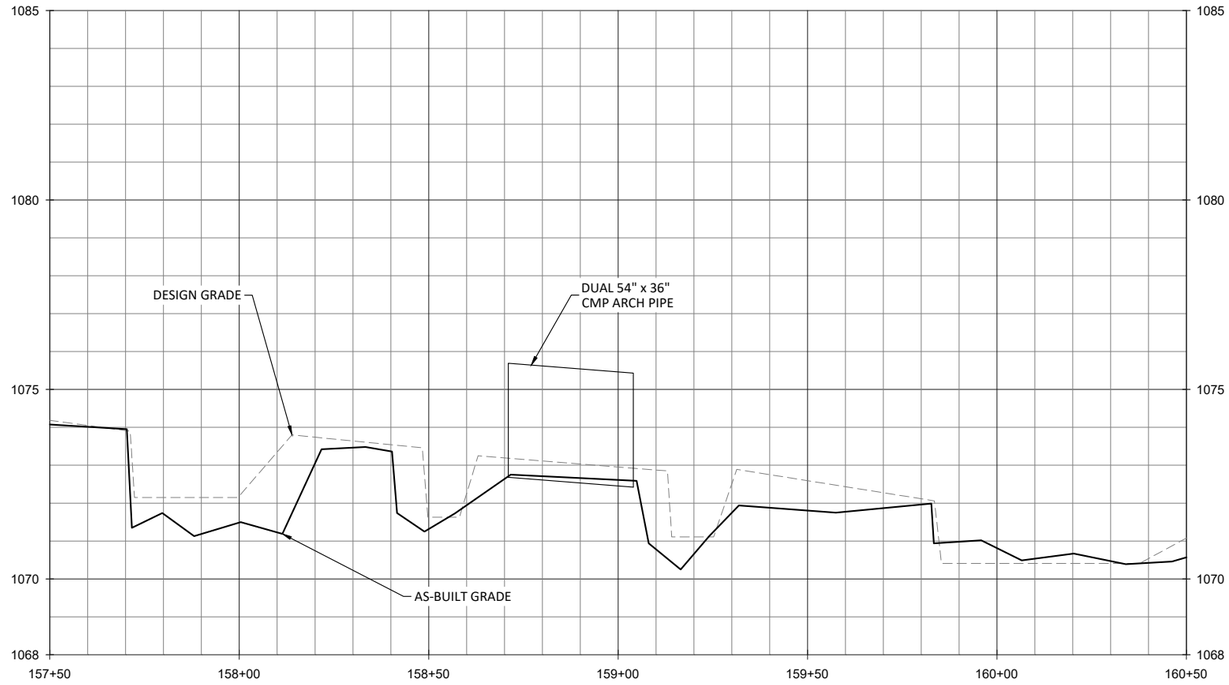

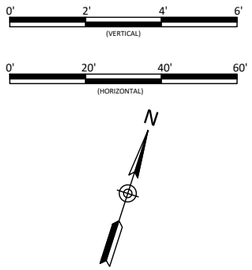

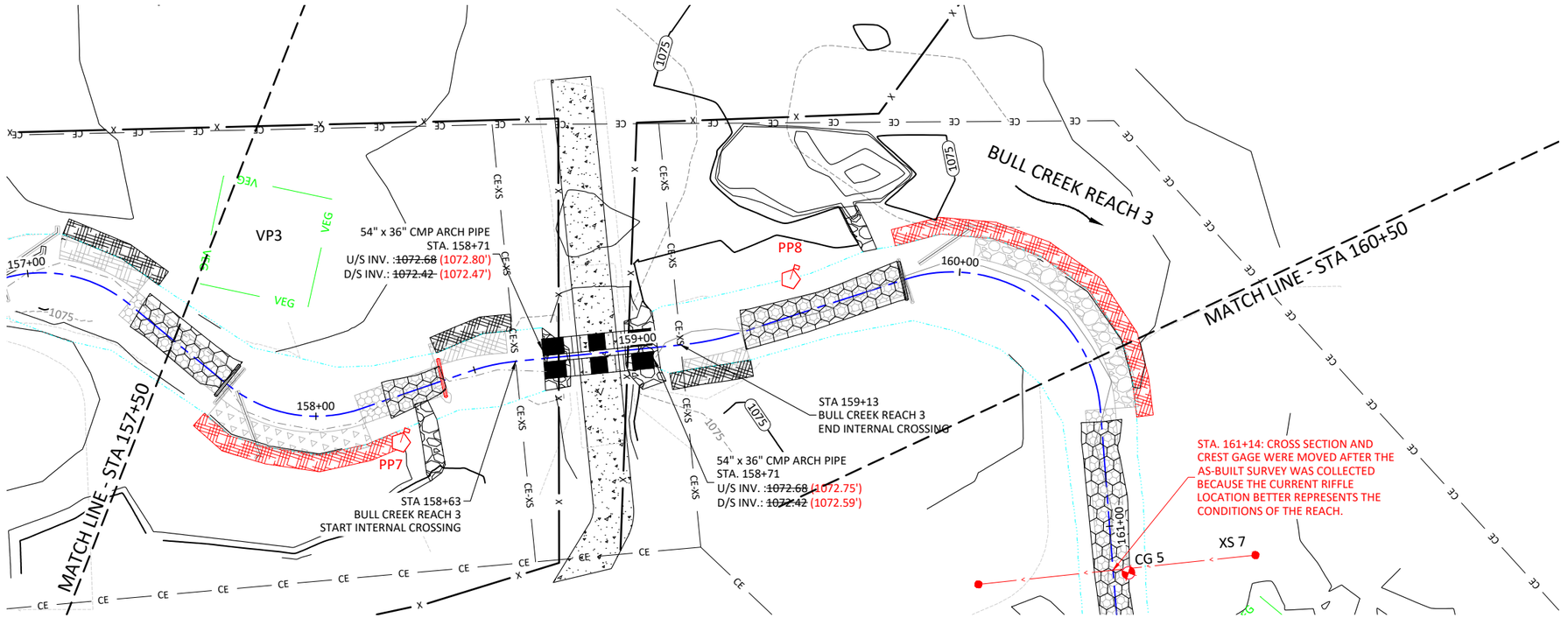

NOTE:

1. STA. 157+72: BRUSH MATTRESS REPLACED WITH BRUSH TOE DUE TO TIME OF YEAR OF INSTALLATION. LOG VANE REMOVED DUE TO BANK STABILITY AND HABITAT ENHANCEMENT PROVIDED BY BRUSH TOE.
2. STA. 158+22: PHOTO POINT 7 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.
3. STA. 158+40: ROCK SILL REPLACED WITH LOG SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
4. STA. 159+50: PHOTO POINT 8 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.
5. STA. 159+84: BRUSH TOE WAS SUBSTITUTED FOR BOULDER TOE AND LOG VANE REMOVED DUE TO LOCAL MATERIAL AVAILABILITY AND THE BANK STABILITY AND HABITAT ENHANCEMENT PROVIDED BY BRUSH TOE.

STA. 161+14: CROSS SECTION AND CREST GAGE WERE MOVED AFTER THE AS-BUILT SURVEY WAS COLLECTED BECAUSE THE CURRENT RIFFLE LOCATION BETTER REPRESENTS THE CONDITIONS OF THE REACH.

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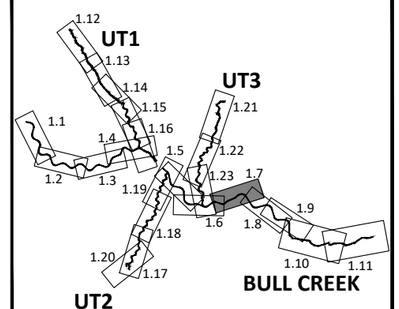

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NORTH CAROLINA PROFESSIONAL SEAL 023414 ENGINEER AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
Bull Creek Reach 3
Stream Plan and Profile

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.7

October 6, 2020

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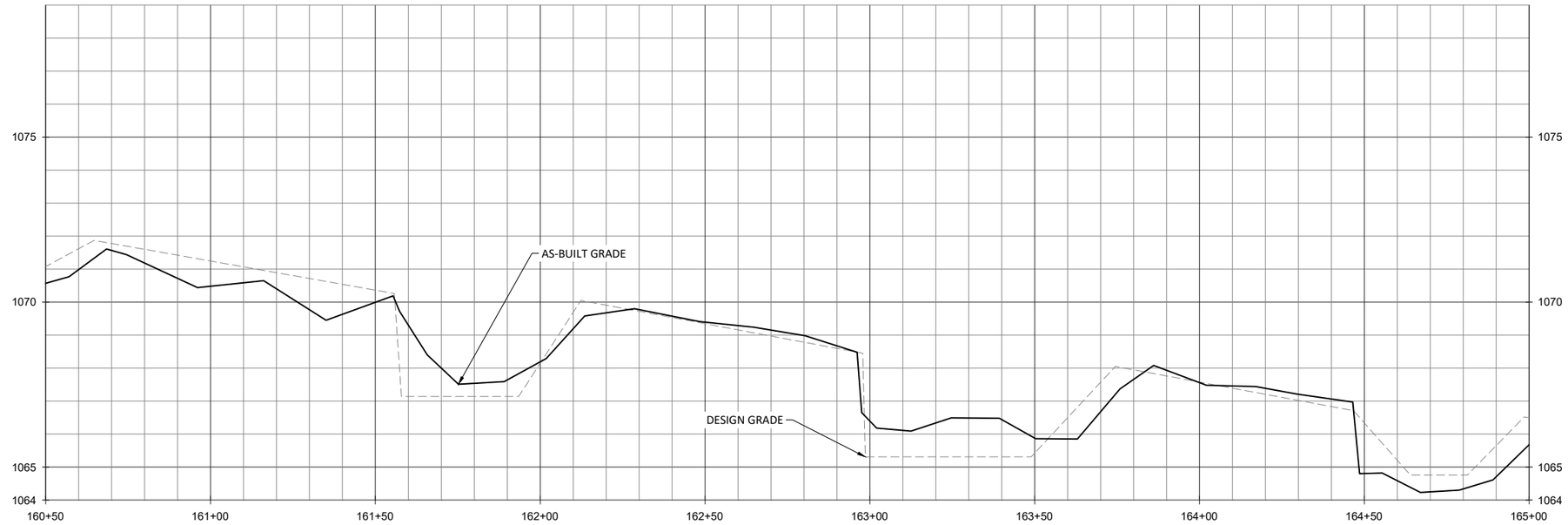
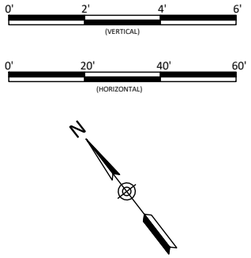
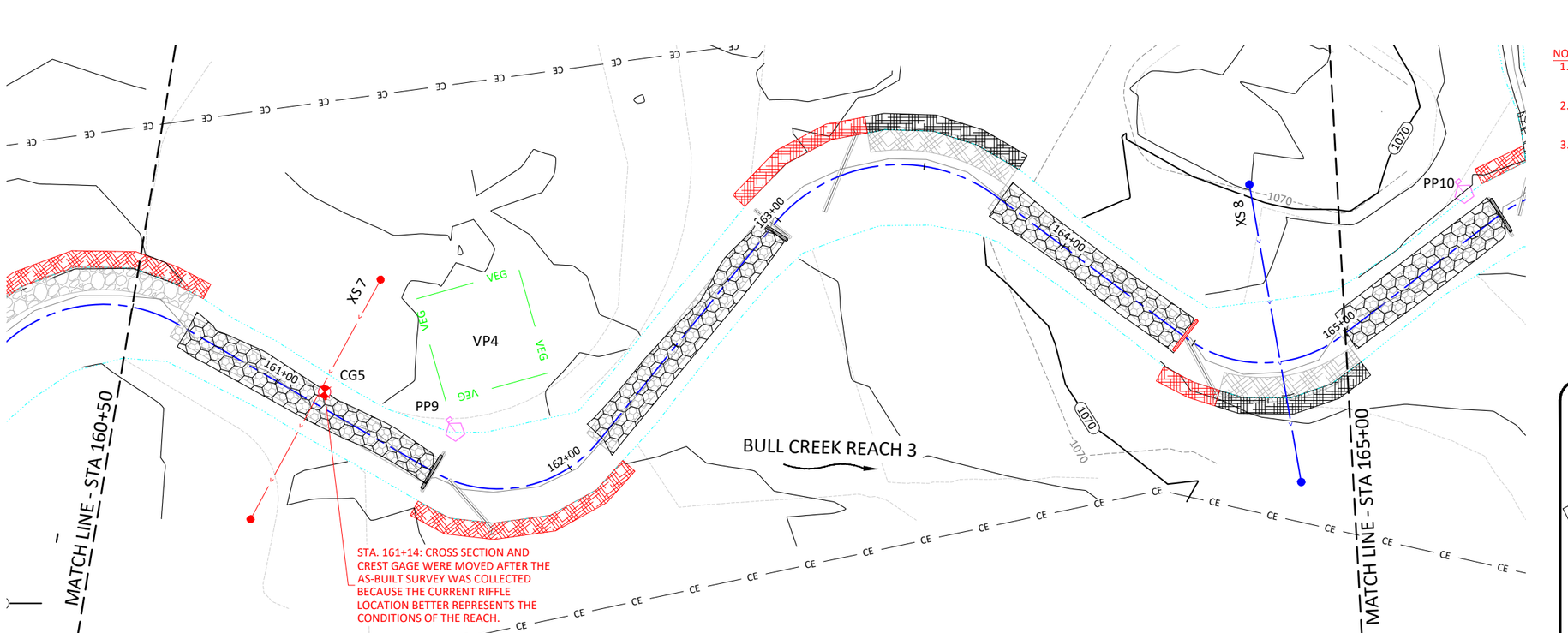
October 6, 2020







NOTE:
1. STA. 161+56: LOG VANE REMOVED AND BRUSH TOE ADDED TO OUTSIDE BANK TO IMPROVE STABILITY FOR THE ENTIRE OUTSIDE BANK.
2. STA. 163+30: LOG VANE REMOVED AND BRUSH TOE EXTENDED DUE TO AVAILABILITY OF MATERIALS AND TO IMPROVE STREAM BANK STABILITY AND HABITAT.
3. STA. 164+47: LOG VANE REMOVED, LOG SILL ADDED AND BRUSH TOE EXTENDED DUE TO LOCAL AVAILABILITY OF MATERIALS AND TO IMPROVE CHANNEL STABILITY AND HABITAT.

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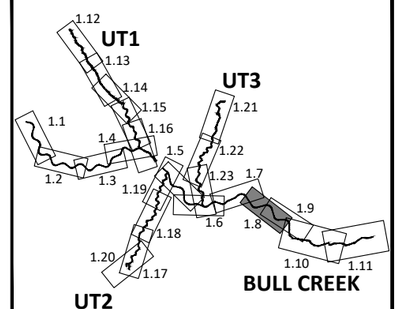

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023349 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 3
Stream Plan and Profile

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.8

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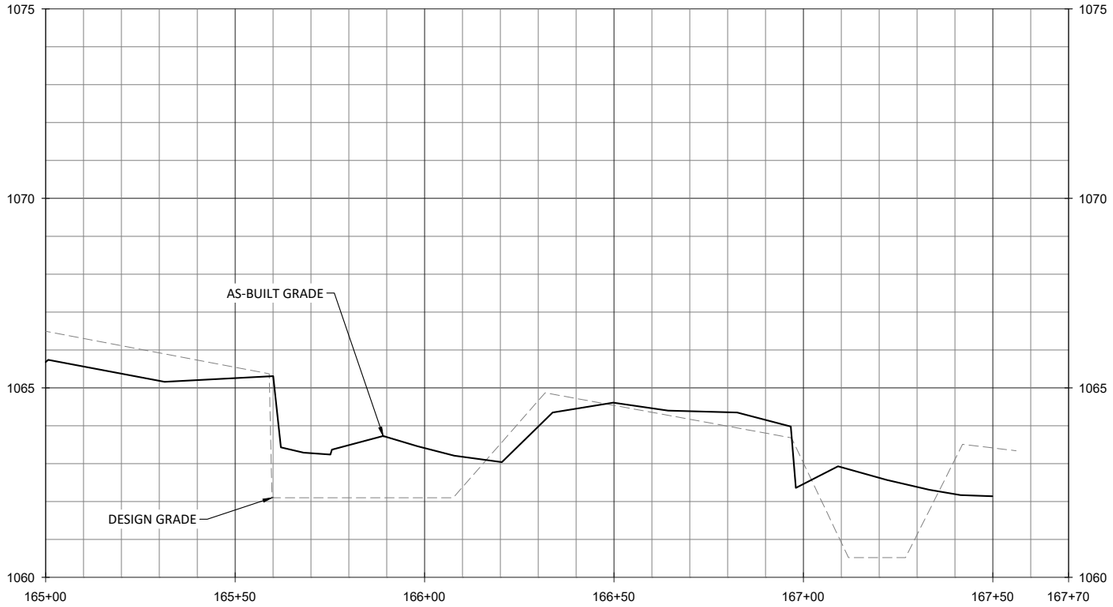
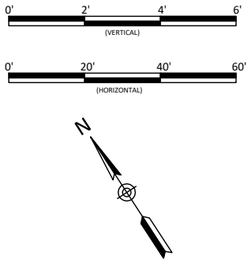
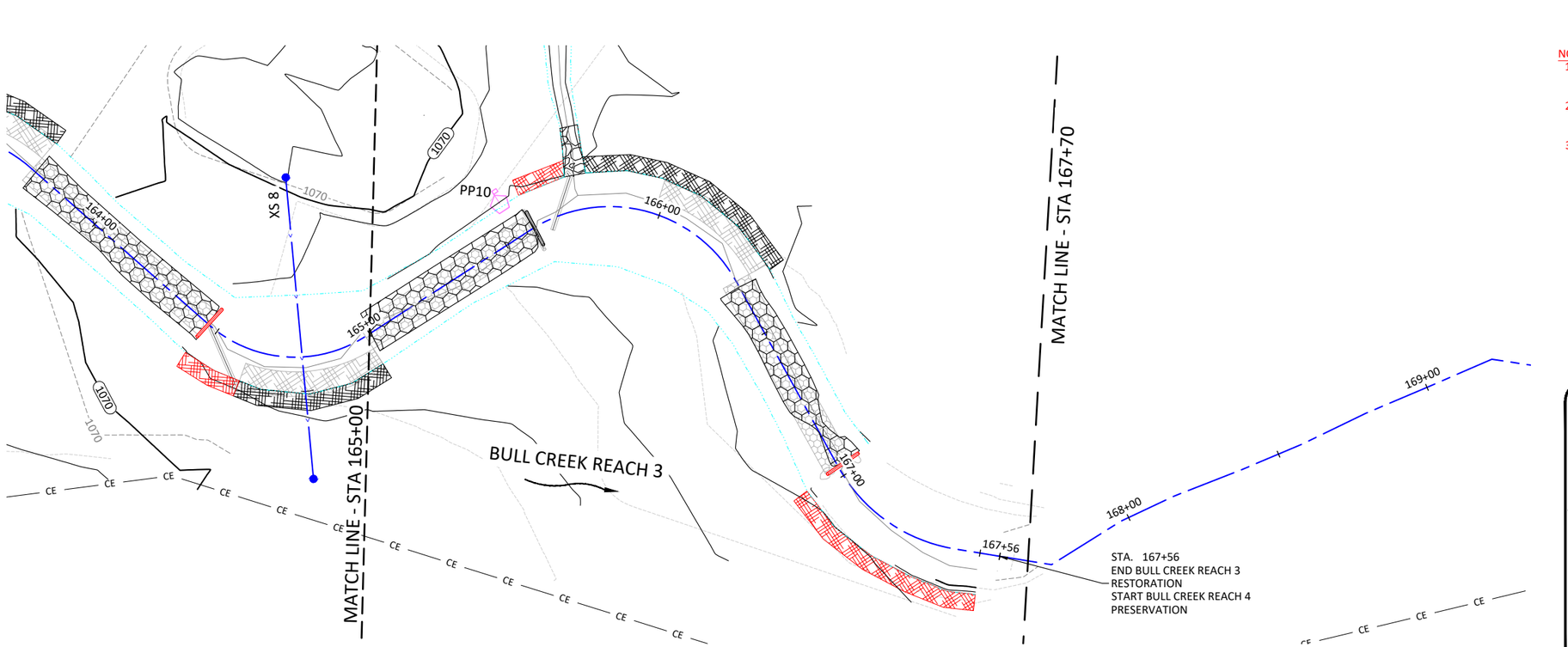
October 6, 2020







NOTE:
1. STA. 165+75: LOG VANE REMOVED AND BRUSH TOE EXTENDED DUE TO AVAILABILITY OF MATERIALS AND THE IMPROVED HABITAT PROVIDED BY BRUSH TOE.
2. STA. 166+97: LOG SILL WAS SUBSTITUTED FOR ROCK SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SITE CONDITIONS.
3. STA. 167+00: BRUSH TOE WAS ADDED TO IMPROVE BANK STABILITY.

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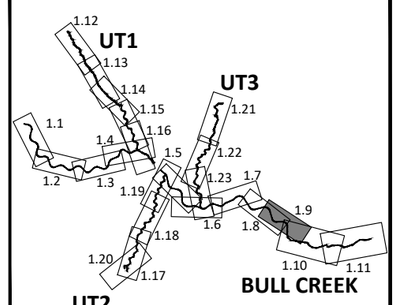

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NORTH CAROLINA PROFESSIONAL SEAL 028349 ENGINEER AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
Bull Creek Reach 3
Stream Plan and Profile

Revisions:
09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.9

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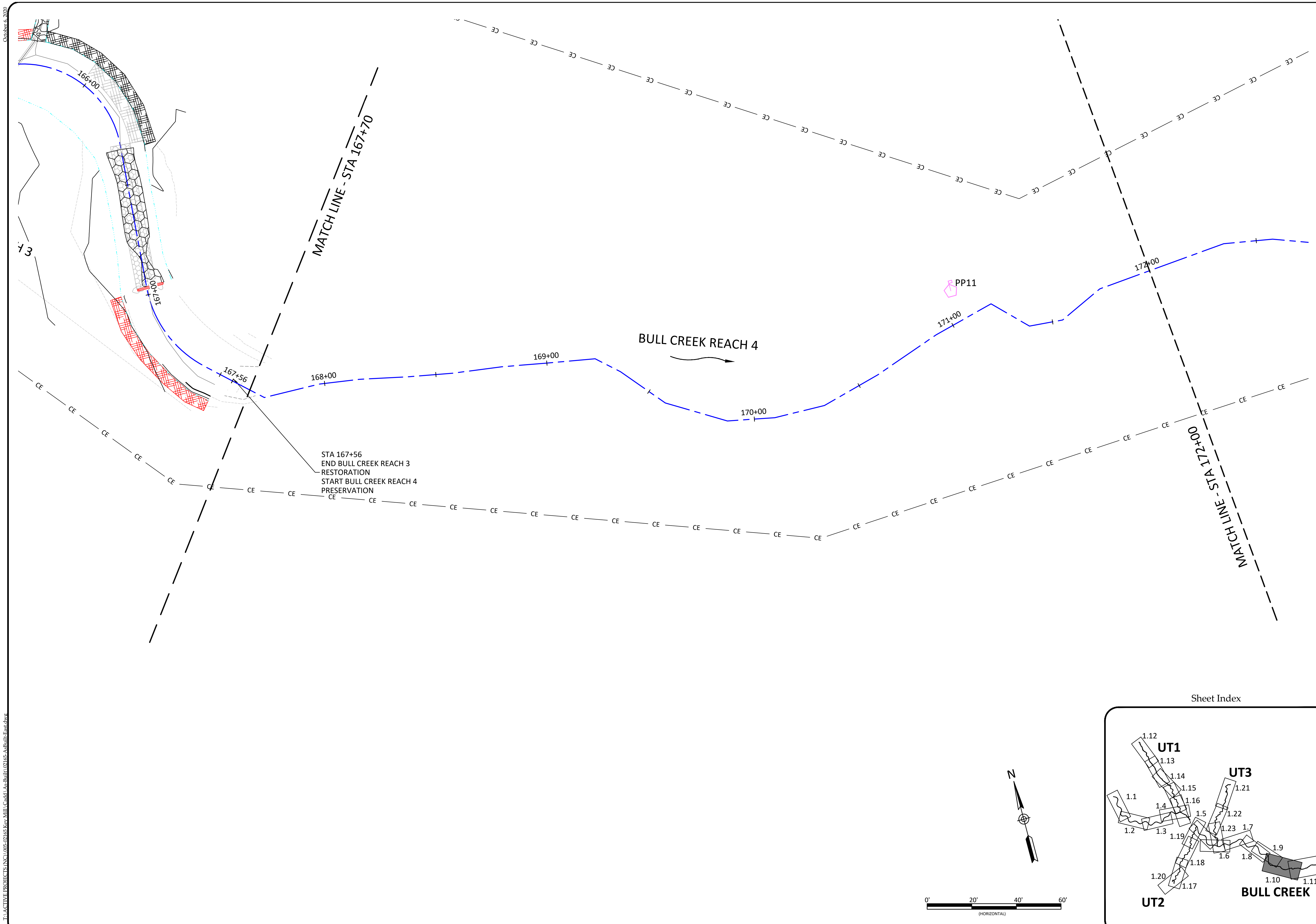

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NORTH CAROLINA PROFESSIONAL SEAL 028340 ENGINEER AARON S. EARLEY 8-27-20

Key Mill Mitigation Site - Record Drawings

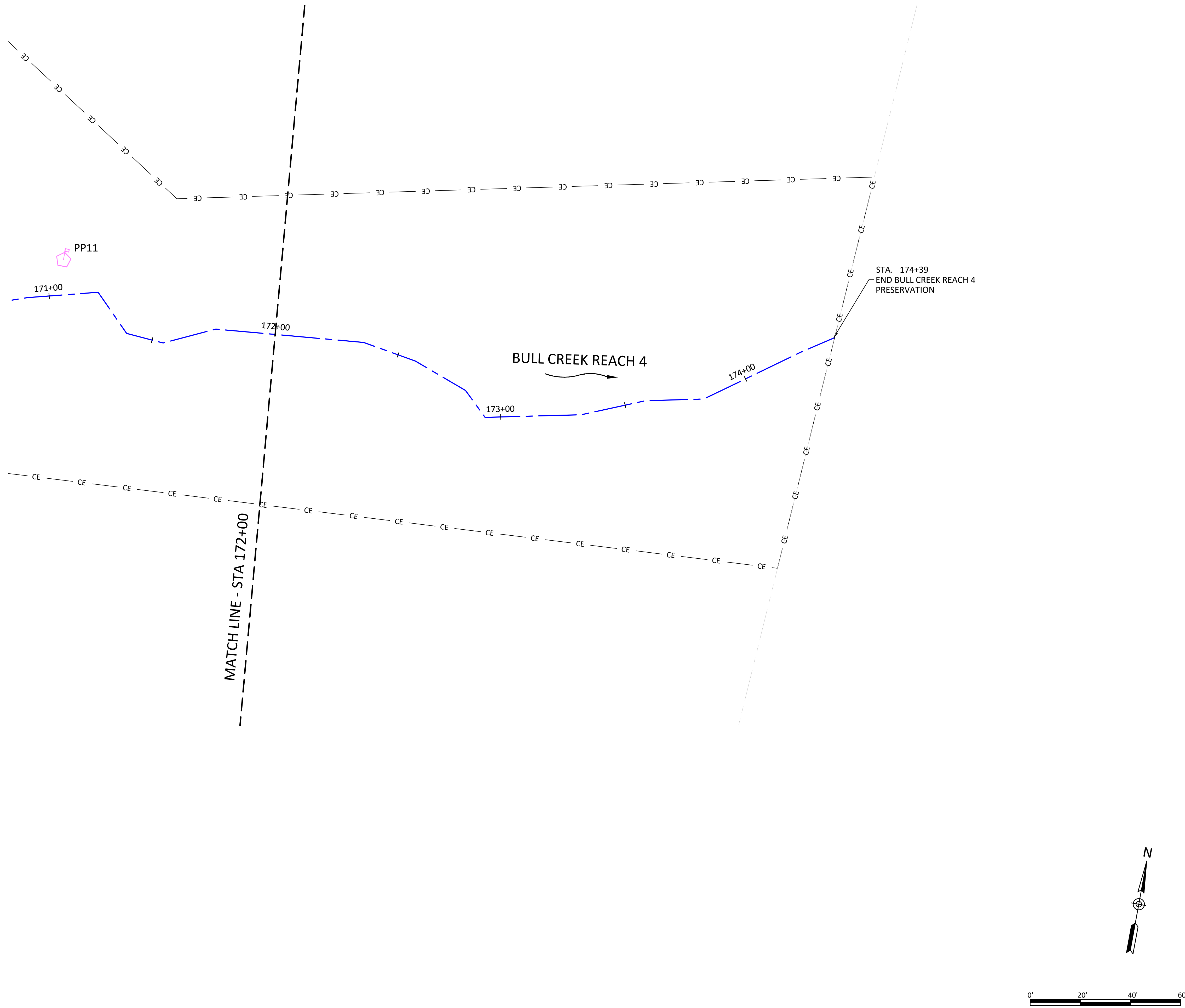
Surry County, North Carolina

Bull Creek Reach 4
Stream Plan

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.10



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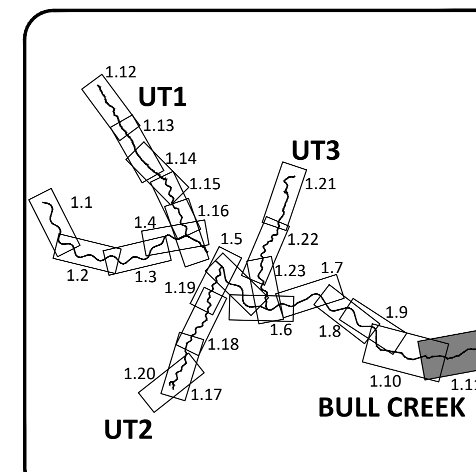

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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek Reach 4
Stream Plan

Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK

Revisions: 09/29/2020

Sheet 1.11

October 6, 2020
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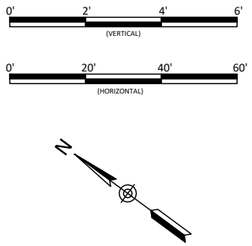
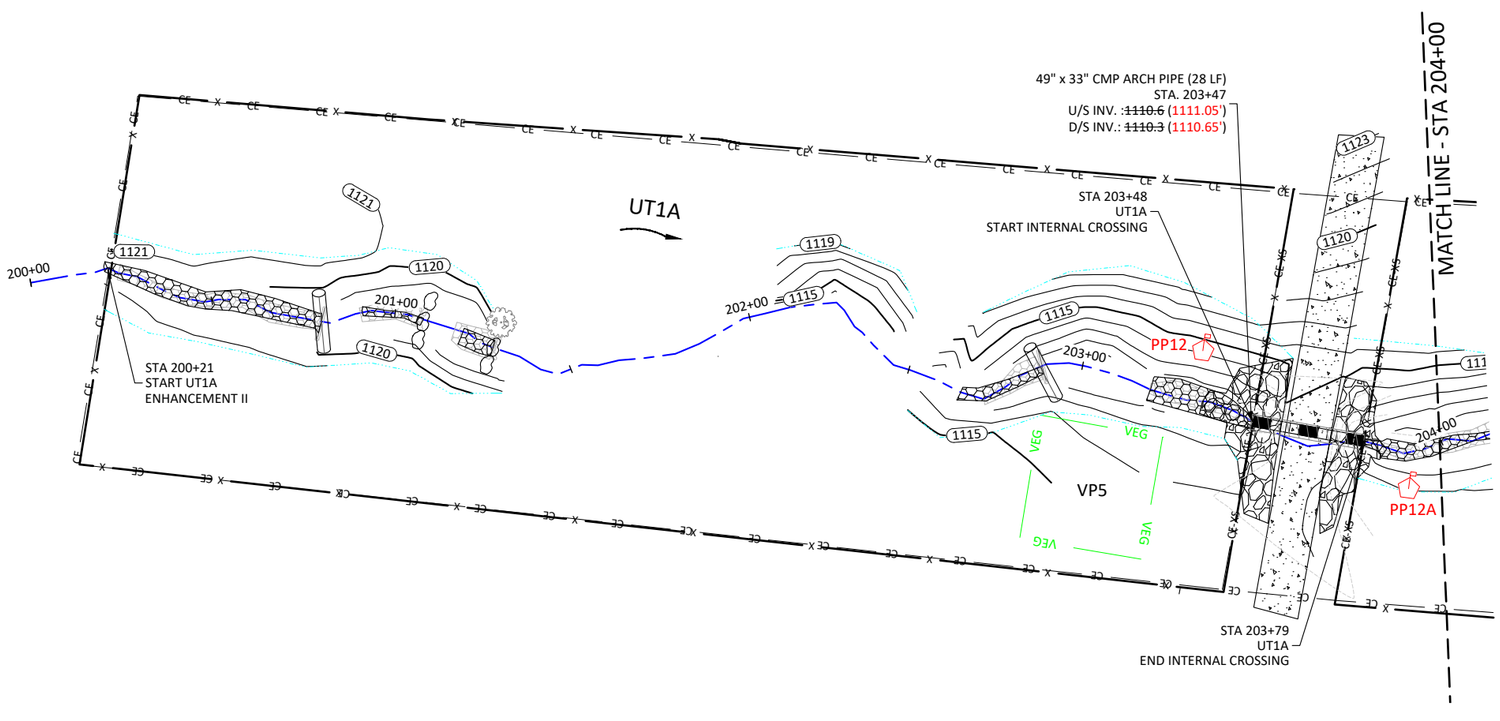
October 6, 2020



NOTES:
1. STA. 202+26: POOL WAS NOT EXCAVATED DUE TO EXISTING PROFILE STABILITY.
2. STA. 203+32: PHOTO POINT 12 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.
3. STA. 203+90: PHOTO POINT 12A WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.



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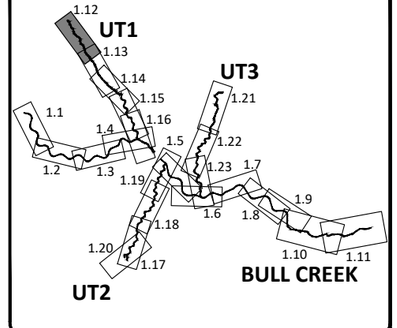

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023349 AARON S. ERVIN 8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT1A
Stream Plan and Profile

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.12

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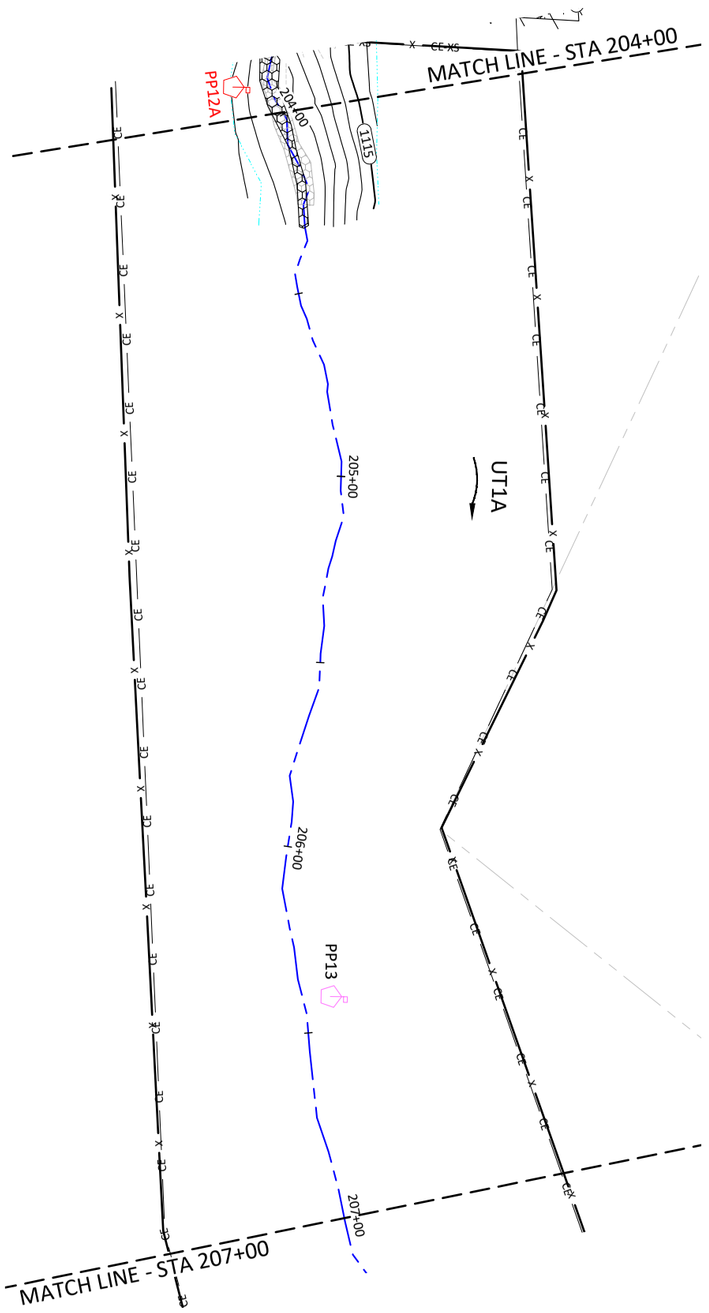

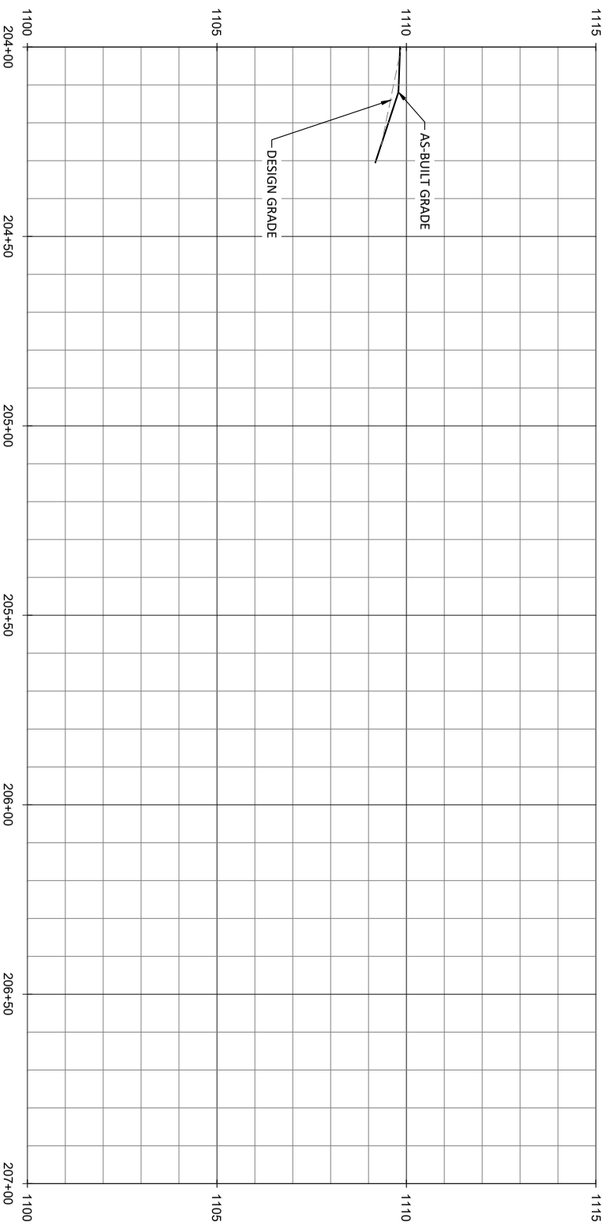

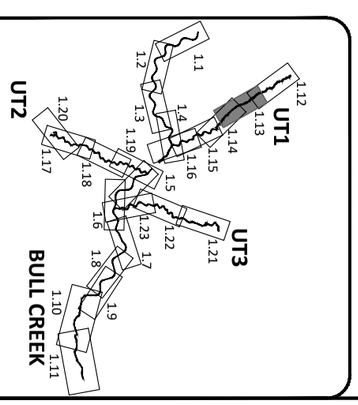

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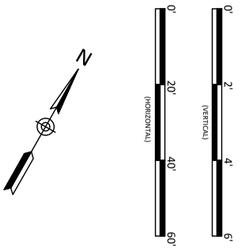

Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK

1.13
Sheet

Revisions:
09/29/2020

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT1A
Stream Plan and Profile

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023340 AARON S. EARLEY
8-27-20

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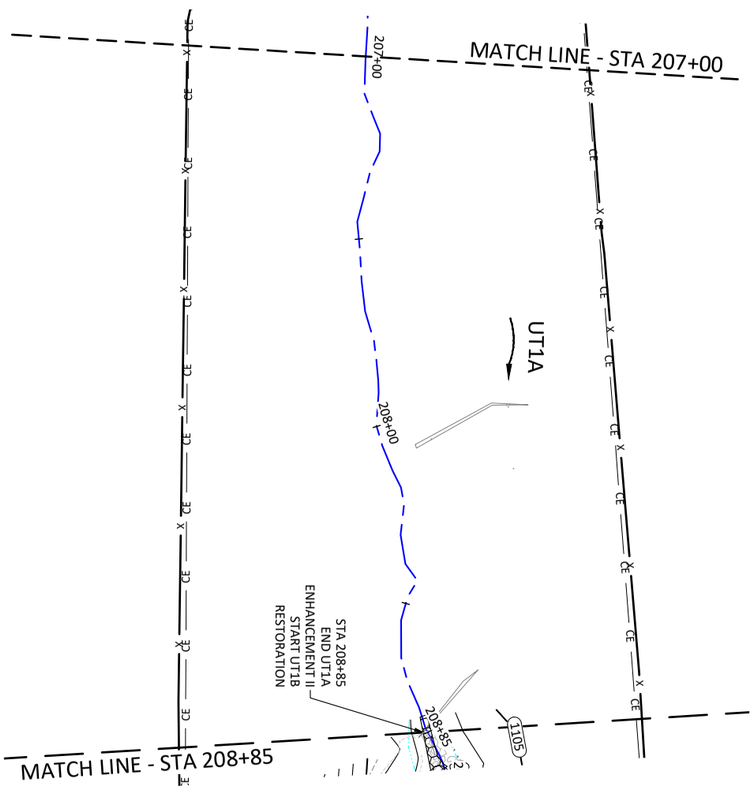

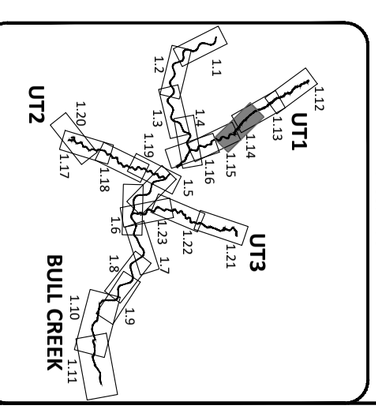

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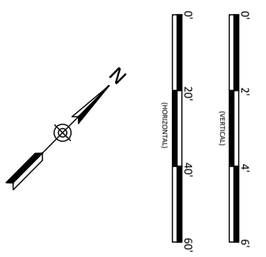

Date:	August 27, 2020
Job Number:	005-02165
Project Engineer:	AE
Drawn By:	ABP/JTC
Checked By:	JCK

1.14
Sheet

Revisions:
09/29/2020

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT1A
Stream Plan and Profile

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023340 AARON S. EARLEY
8-27-20

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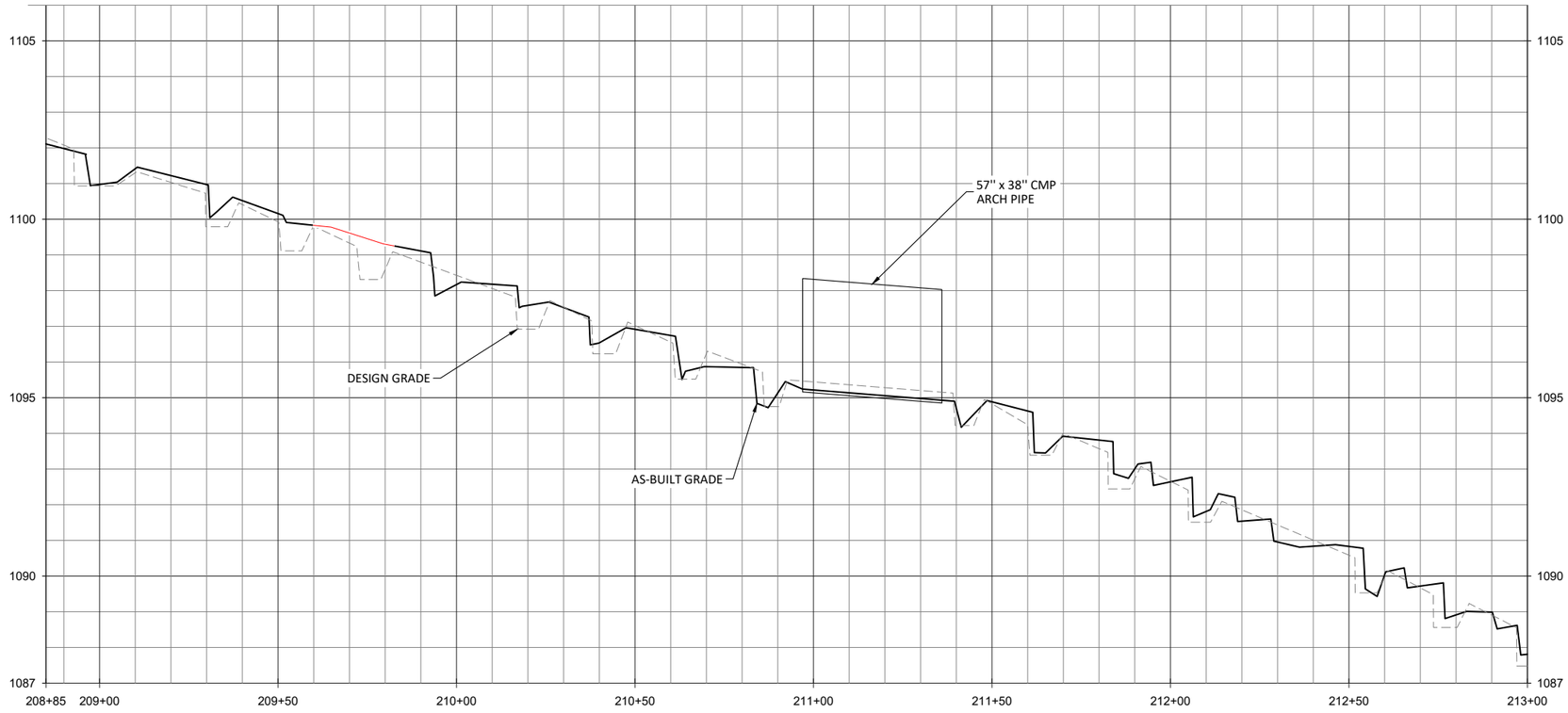
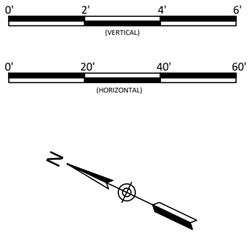
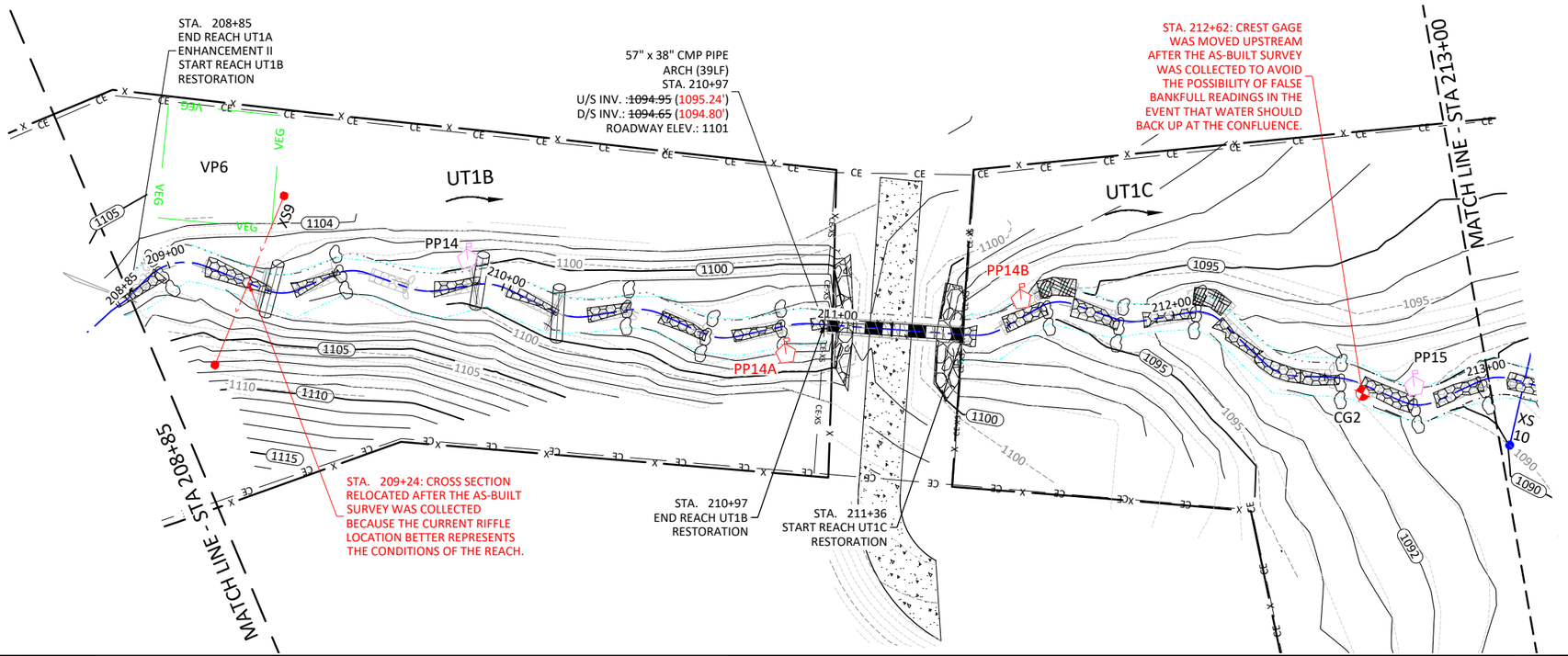
Firm License No. F-0831

October 6, 2020

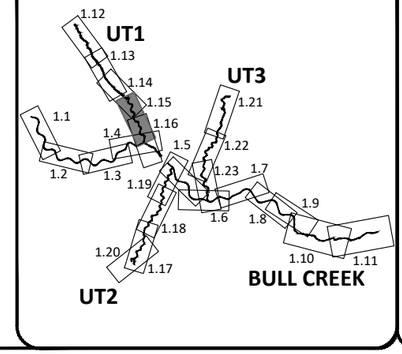






NOTE:
1. STA. 209+65: RIFFLE, ROCK SILL AND POOL WERE OMITTED DUE TO SUFFICIENT STABILITY AND SLOPE ON THE REACH.
2. STA. 210+83: PHOTO POINT 14A WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.
3. STA. 211+57: PHOTO POINT 14B WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.
4. STA. 212+35: UPSTREAM ROCK AND ROLL RIFFLE BOULDER SILL WAS OMITTED AND RIFFLE WAS EXTENDED TO CONNECT TO DOWNSTREAM ROCK AND ROLL RIFFLE.

Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN 8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
UT1B
Stream Plan and Profile

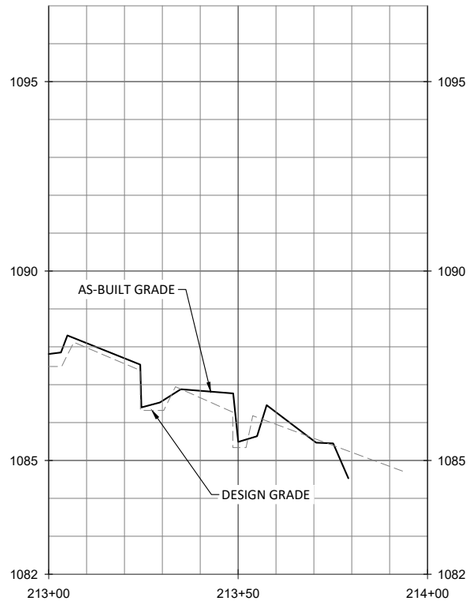
Revisions: 09/29/2020

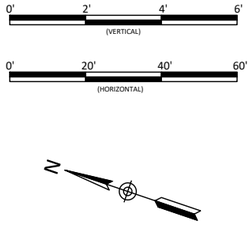
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

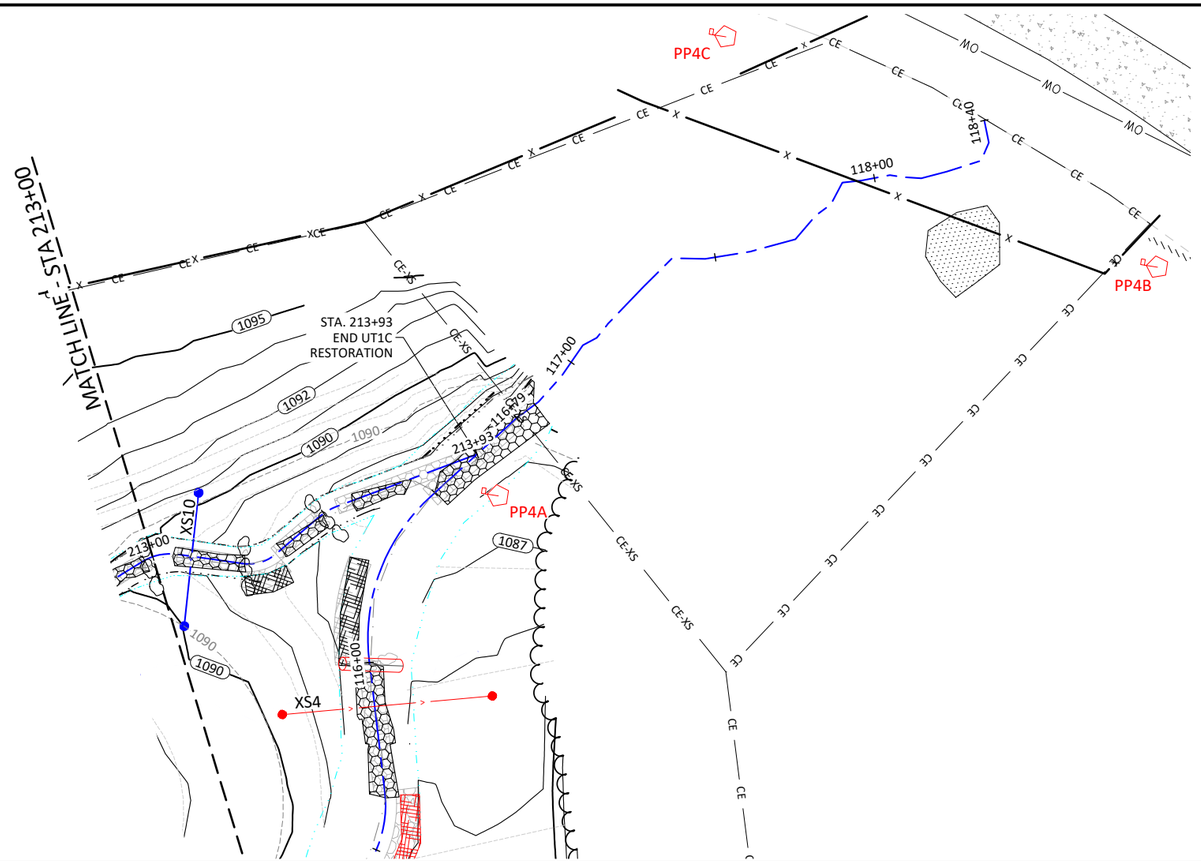
Sheet 1.15

T:\ACTIVE PROJECTS\WS\005-02165 Key Mill\Cad\As-Built\005-02165-AsBuilt-V1.dwg

October 6, 2020







NOTE:
1. STA. 118+30: PHOTO POINT 4B AND 4C WERE ADDED AFTER THE SURVEY WAS COMPLETE AT THE REQUEST OF DMS TO CAPTURE VIEWS ACROSS THE CATTLE CROSSING.

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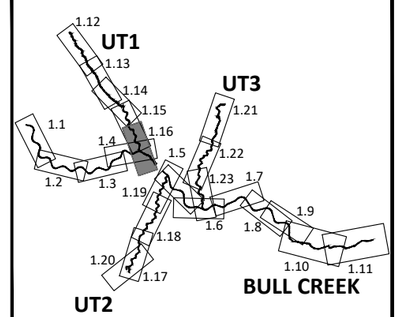

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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN 9-27-20

Key Mill Mitigation Site
Surry County, North Carolina

UT1C
As-Built Plan & Profile

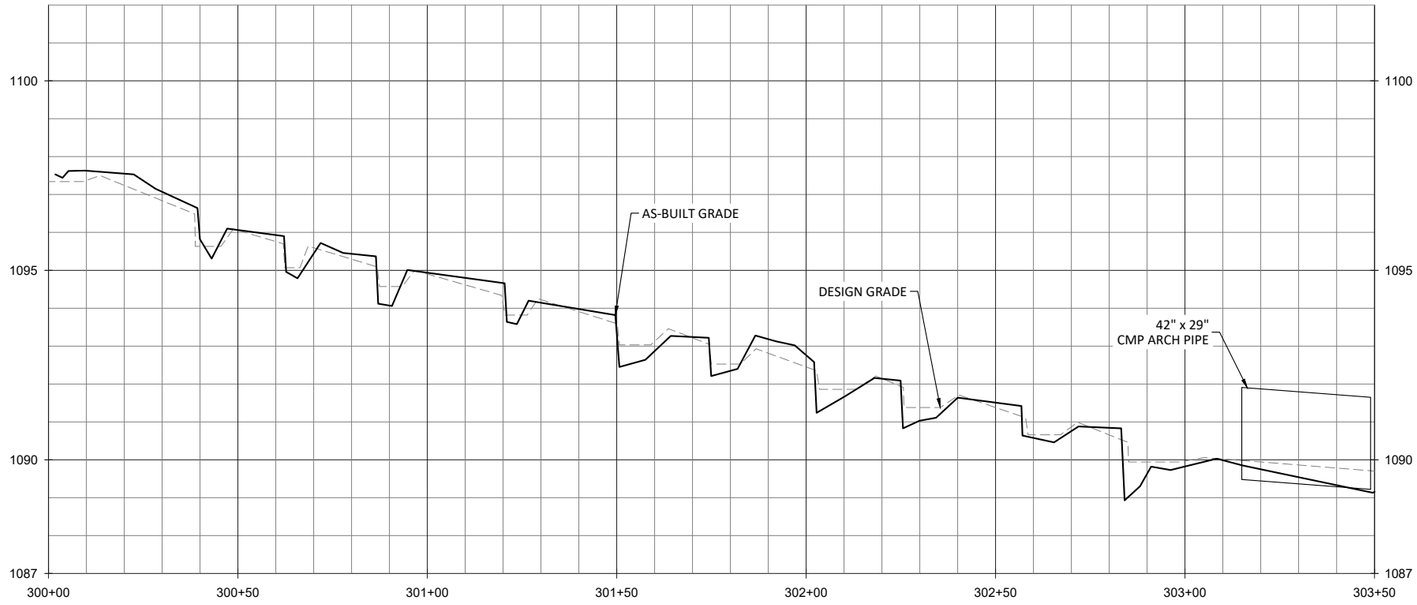
Revisions: 09/29/2020

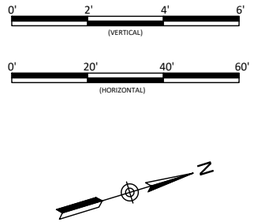
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

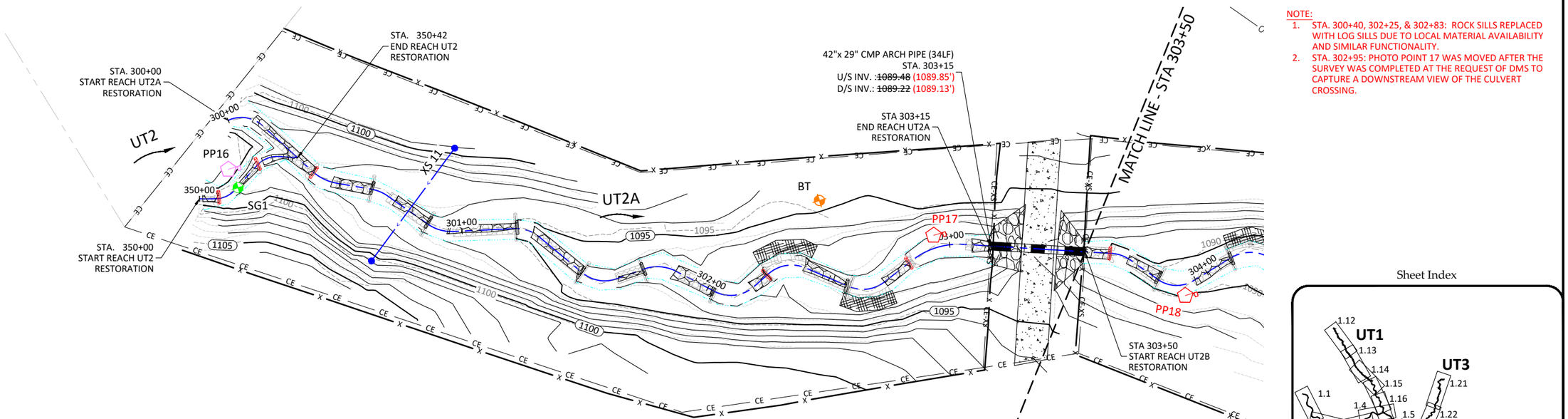
Sheet 1.16

T:\ACTIVE PROJECTS\NCV\005-02165 Key Mill\Cad\As-Built\02165-AsBuilt-West.dwg

October 6, 2020







NOTE:
1. STA. 300+40, 302+25, & 302+83: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
2. STA. 302+95: PHOTO POINT 17 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.

Sheet Index

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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN
8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
UT2A
Stream Plan and Profile

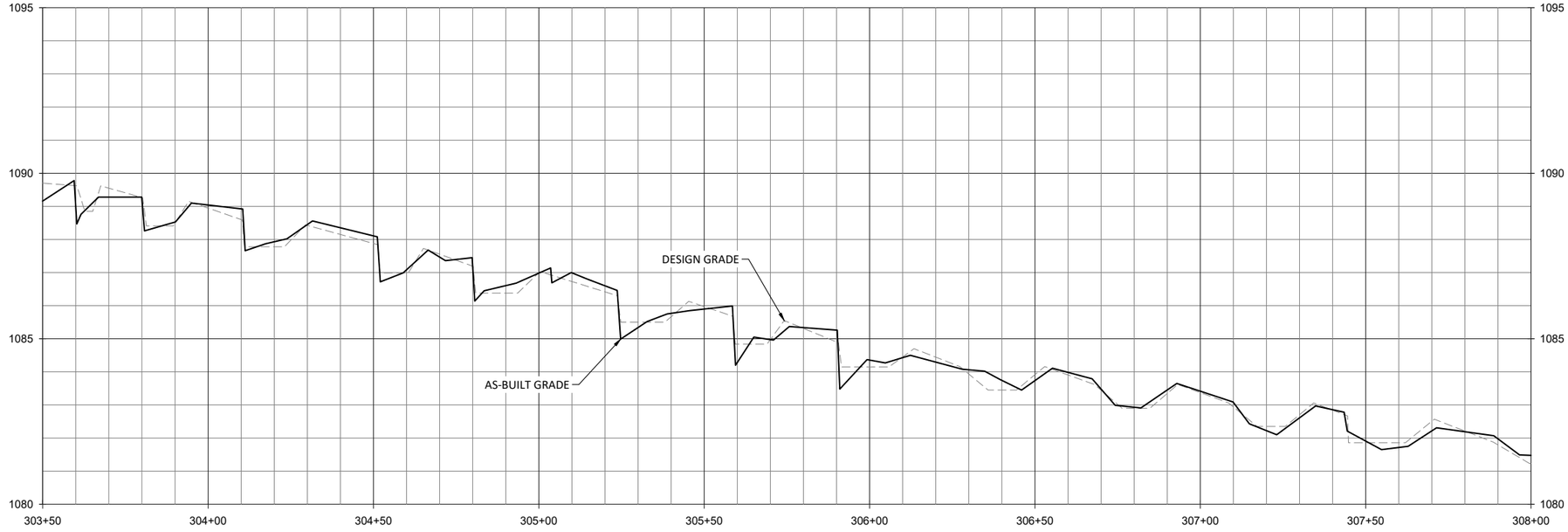
Revisions: 09/29/2020

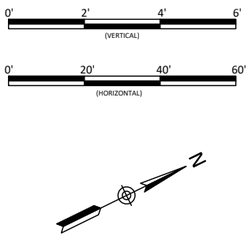
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

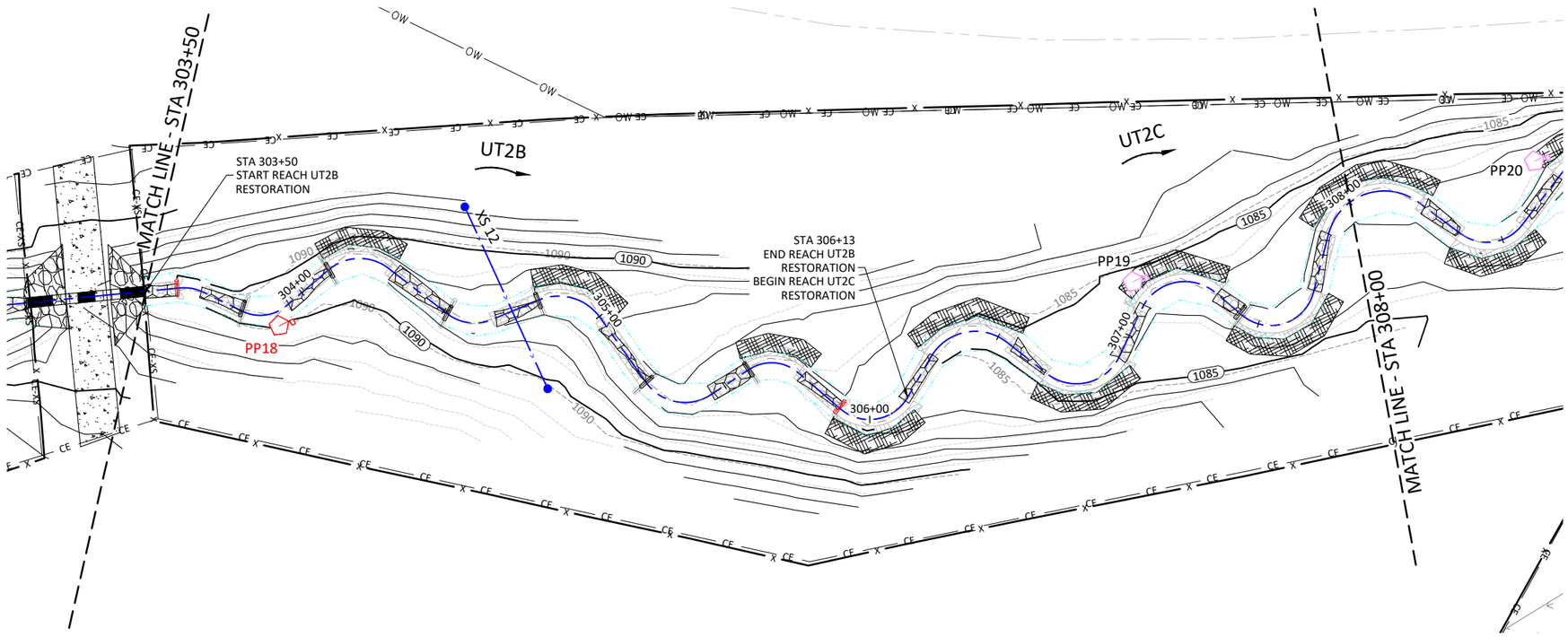
Sheet 1.17

T:\ACTIVE PROJECTS\NC\005-02165 Key Mill\Cad\As-Built\02165 As-Built Fig.dgn

October 6, 2020







NOTE:
1. STA. 303+59 & 305+90: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
2. STA. 303+90: PHOTO POINT 18 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.

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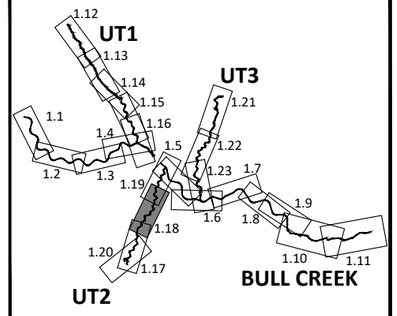

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023349 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
UT2B
Stream Plan and Profile

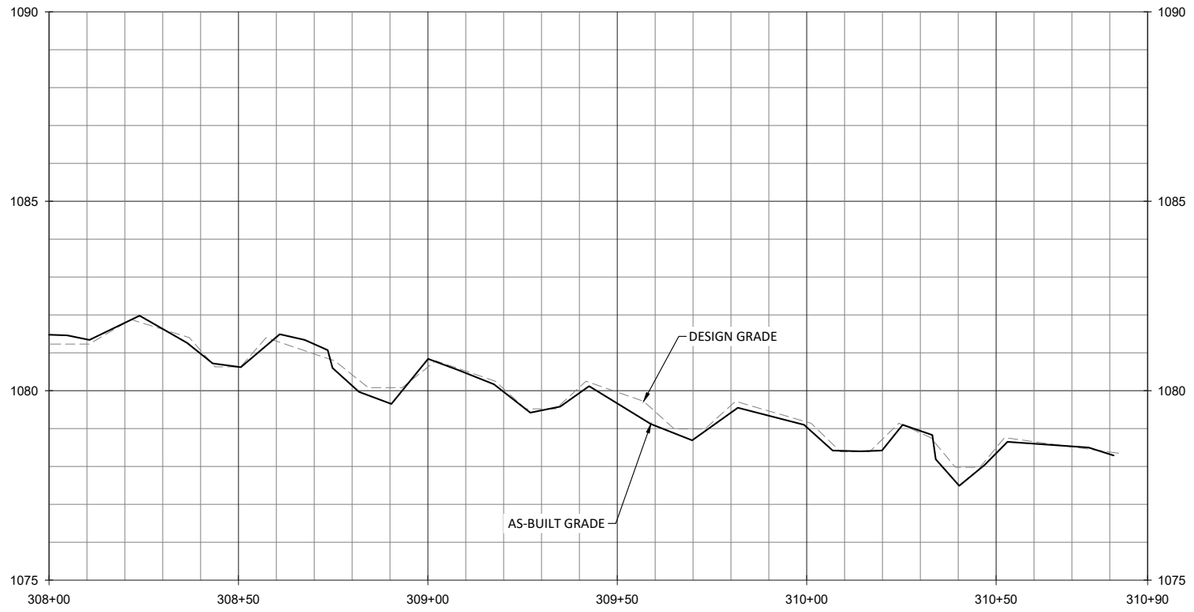
Revisions: 09/29/2020

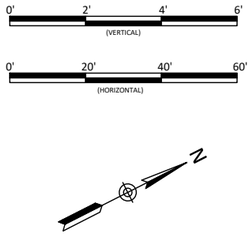
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

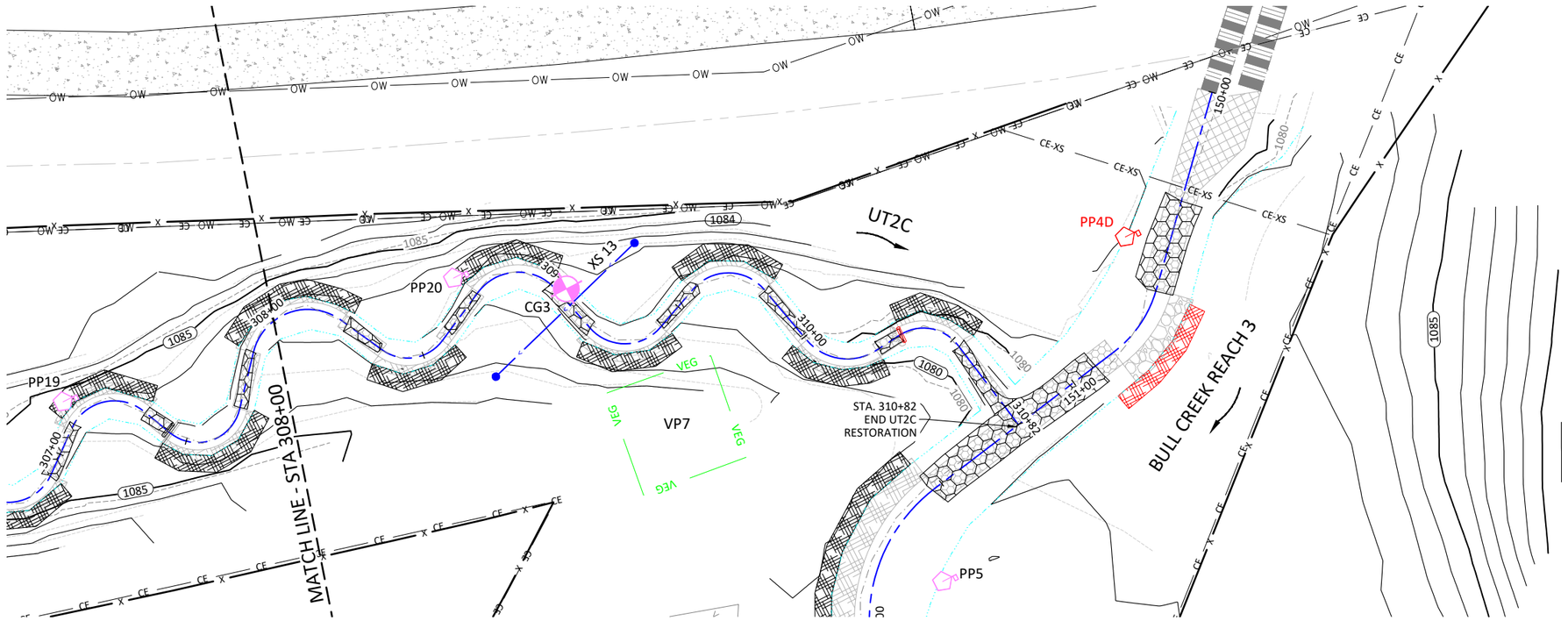
Sheet 1.18

T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cad\As-Built\02165-AsBuilt-Fea.dgn

October 6, 2020







NOTE:
1. STA. 310+33: ROCK SILL REPLACED WITH LOG SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.

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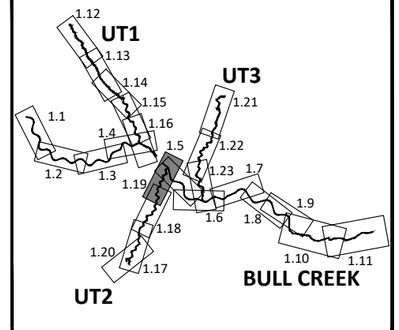

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 028349 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
UT2C
Stream Plan and Profile

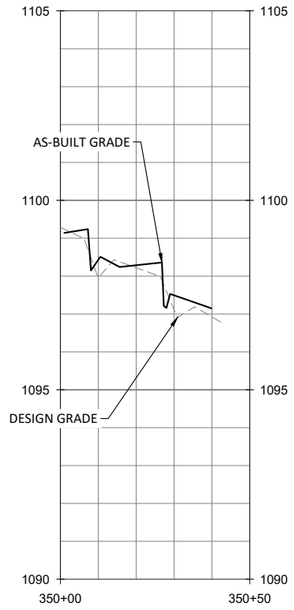
Revisions: 09/29/2020

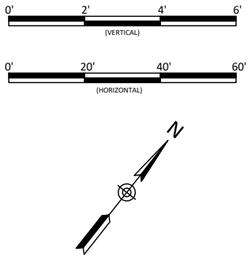
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

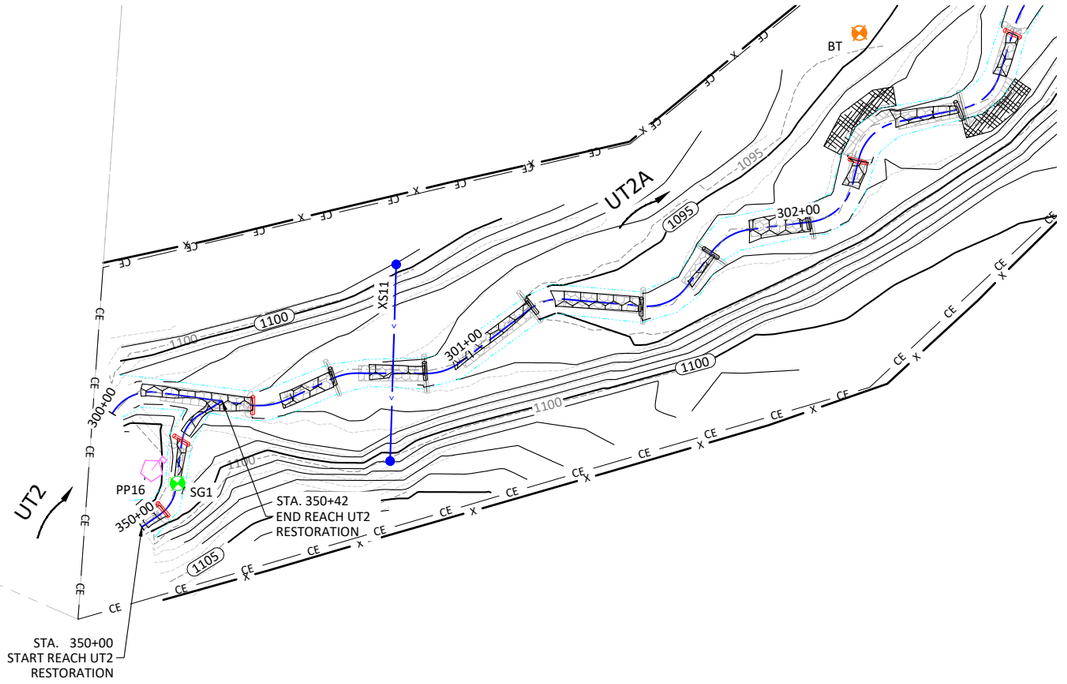
Sheet 1.19

T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cad\As-Built\02165-AsBuiltFeat.dgn

October 6, 2020

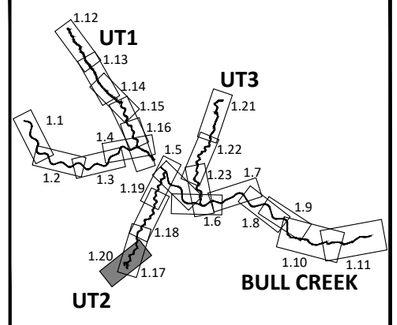






NOTE:
1. STA. 350+08 & 350+27: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.

Sheet Index



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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 023414 AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT2
Stream Plan and Profile

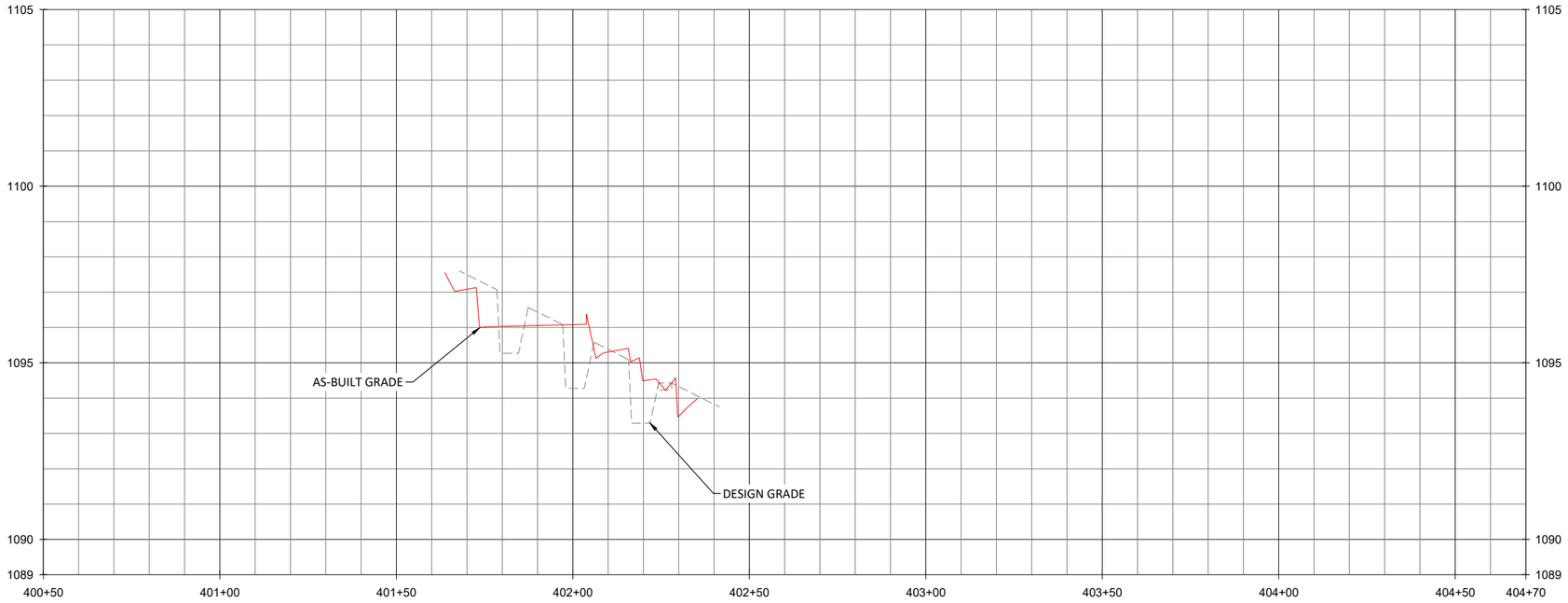
Revisions:
09/29/2020

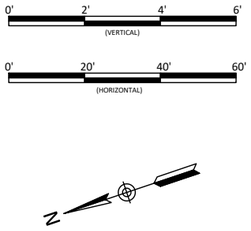
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

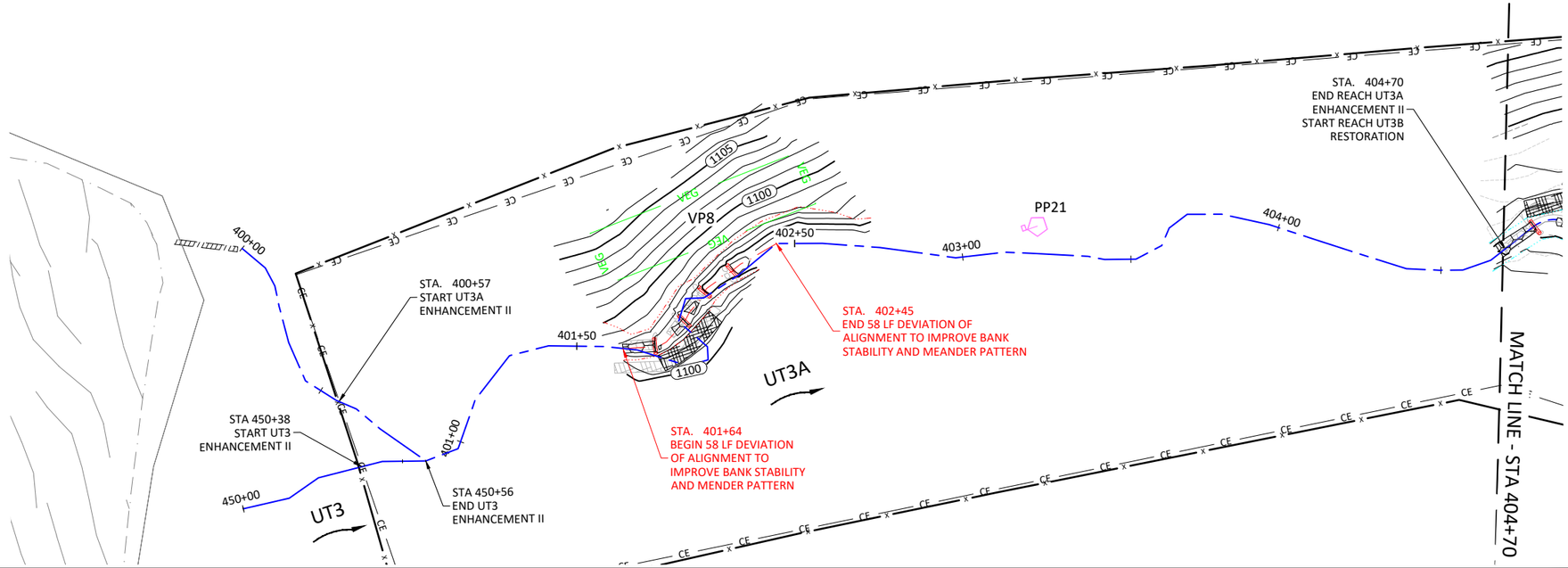
Sheet 1.20

T:\ACTIVE PROJECTS\NC\005-02165\Key Mill\Civil\As-Built\02165-AsBuilt.dwg

October 6, 2020







NOTE:

1. STA. 401+64 - 402+45: THE CHANNEL DESIGN WAS ALTERED AND REALIGNED TO IMPROVE BANK STABILITY AND MEANDER PATTERN WHICH RESULTED IN 58 LF OF CONSTRUCTED CHANNEL, COMPARED TO 81 LF IN THE ORIGINAL DESIGN.
2. STA. 401+71 - 402+29: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.

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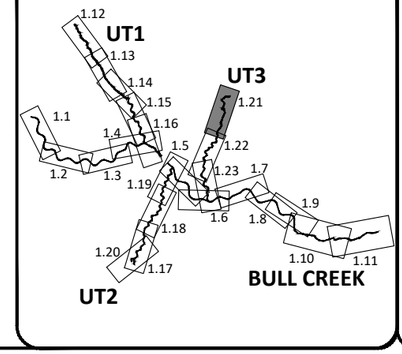

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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN 9-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina
UT3 and UT3A
Stream Plan and Profile

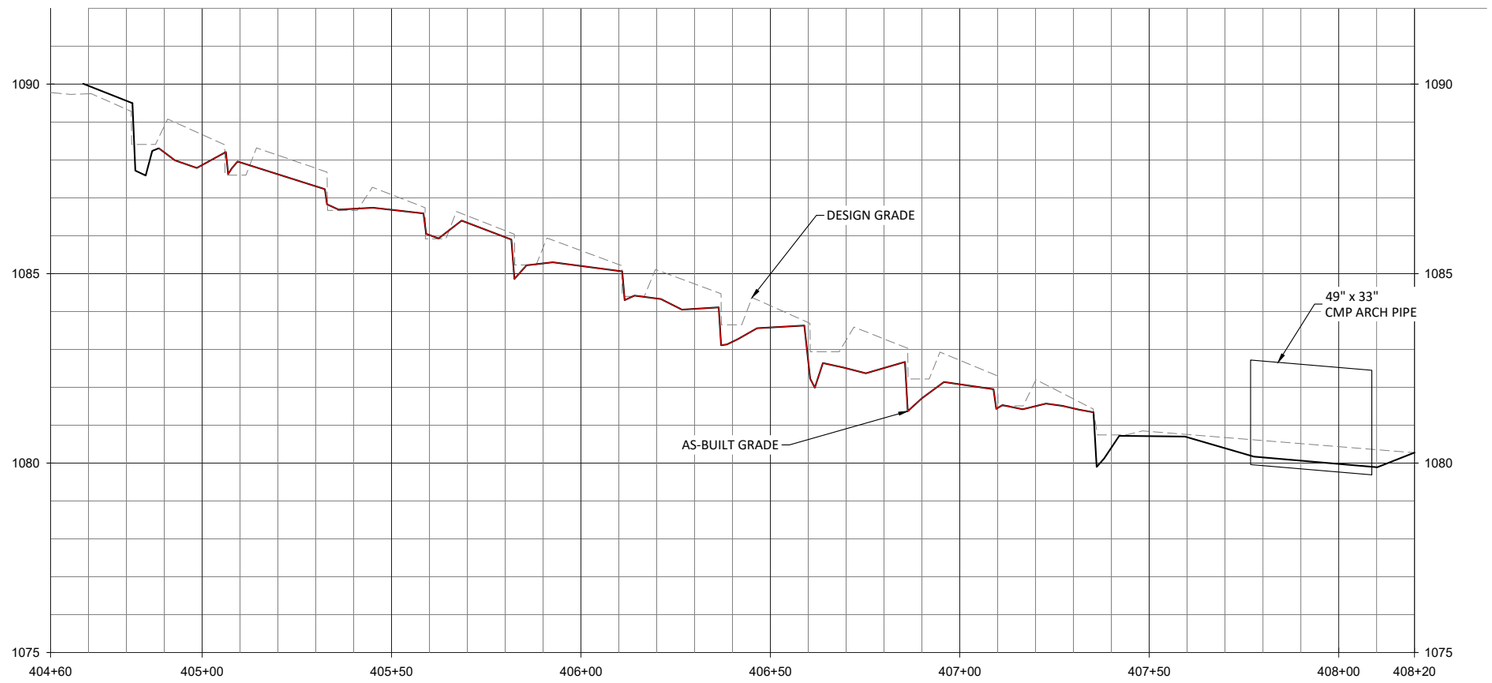
Revisions: 09/29/2020

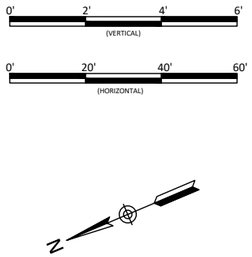
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

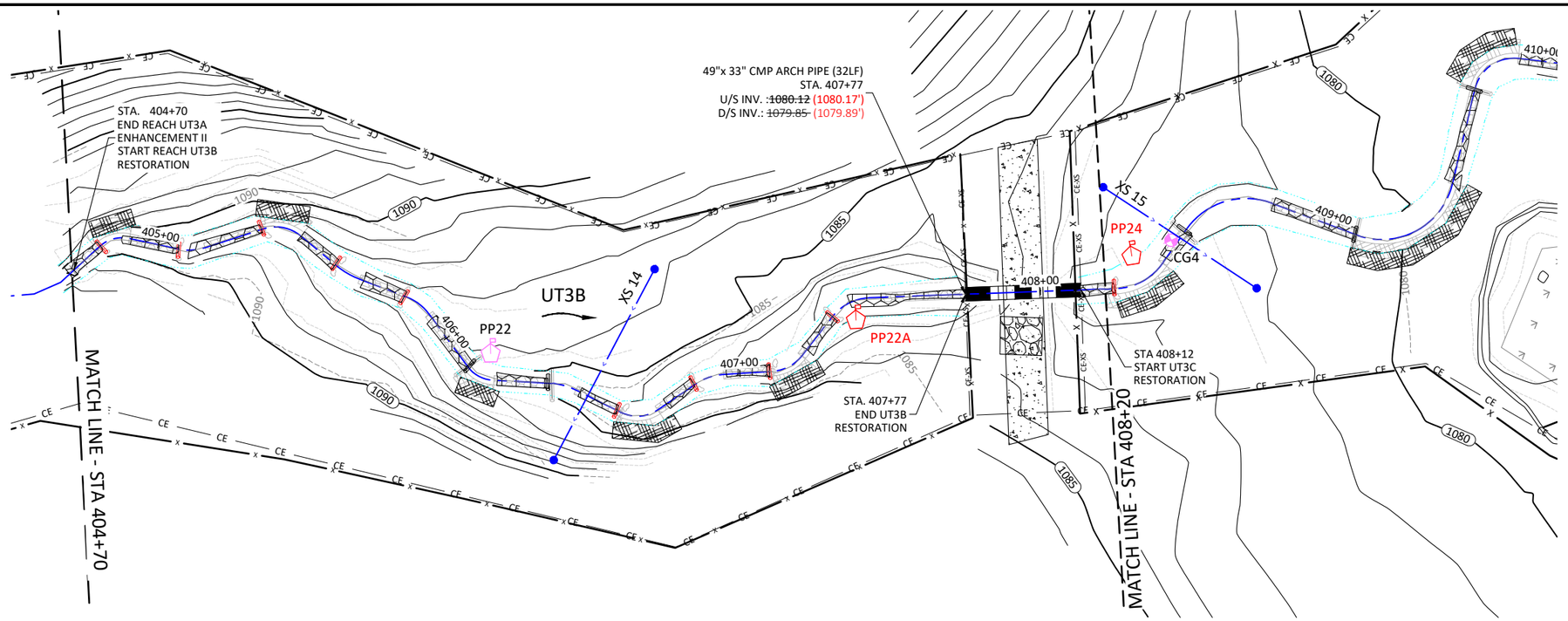
Sheet 1.21

T:\ACTIVE PROJECTS (NC)\005-02165 Key Mill\Cad\As-Built\02165-As-Built-Fig4.dgn

October 6, 2020







NOTE:
1. STA. 404+82, 405+06, 405+32, 405+58, 405+82, 406+59, 406+85, 407+09 AND 407+35: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
2. STA. 404+89 - 407+35: RIFFLE ELEVATIONS ADJUSTED DUE TO THE UPSTREAM TIE IN ELEVATION BEING CHANGED DUE TO FIELD CONDITIONS.
3. STA. 407+41: PHOTO POINT 22A WAS ADDED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE A DOWNSTREAM VIEW OF THE CULVERT CROSSING.

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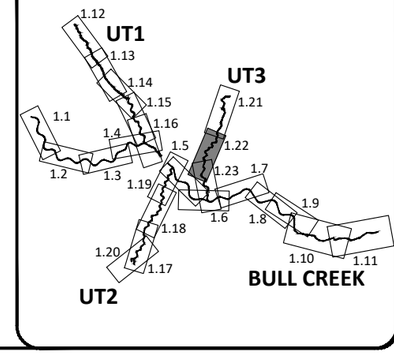

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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN
8-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT3B and UT3C
Stream Plan and Profile

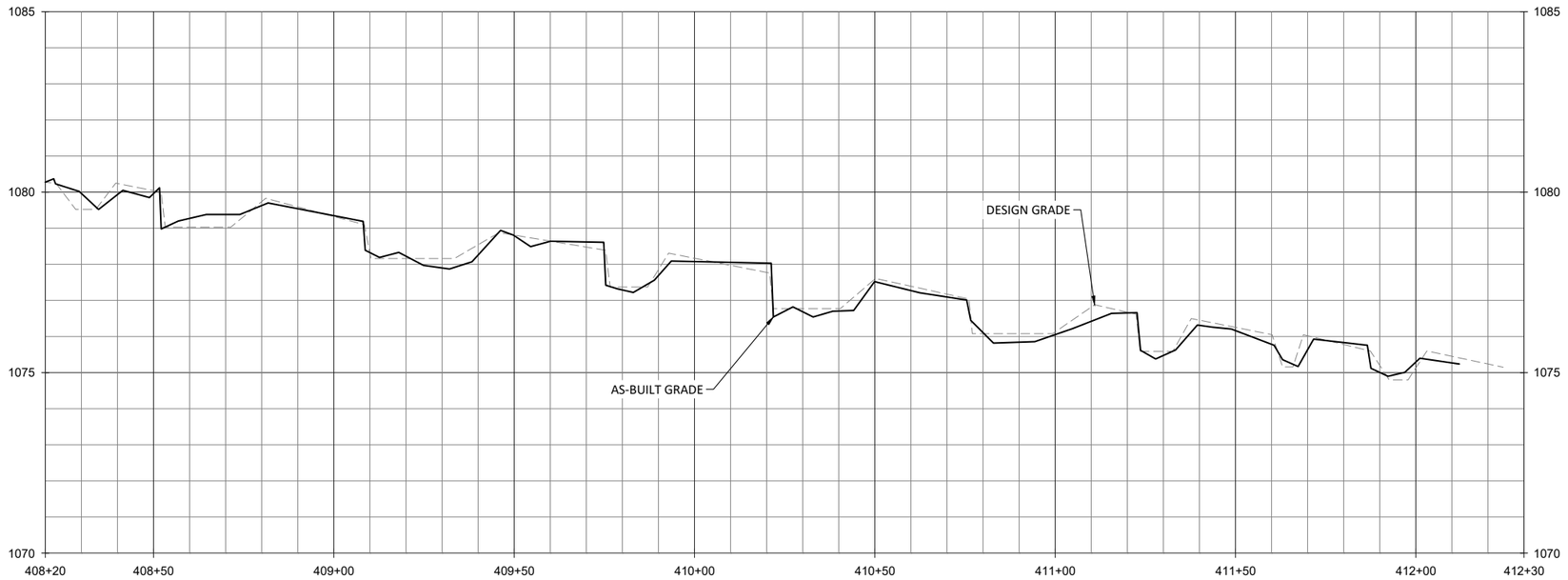
Revisions: 09/29/2020

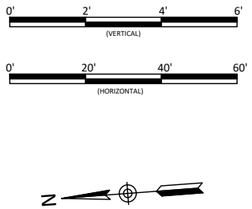
Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

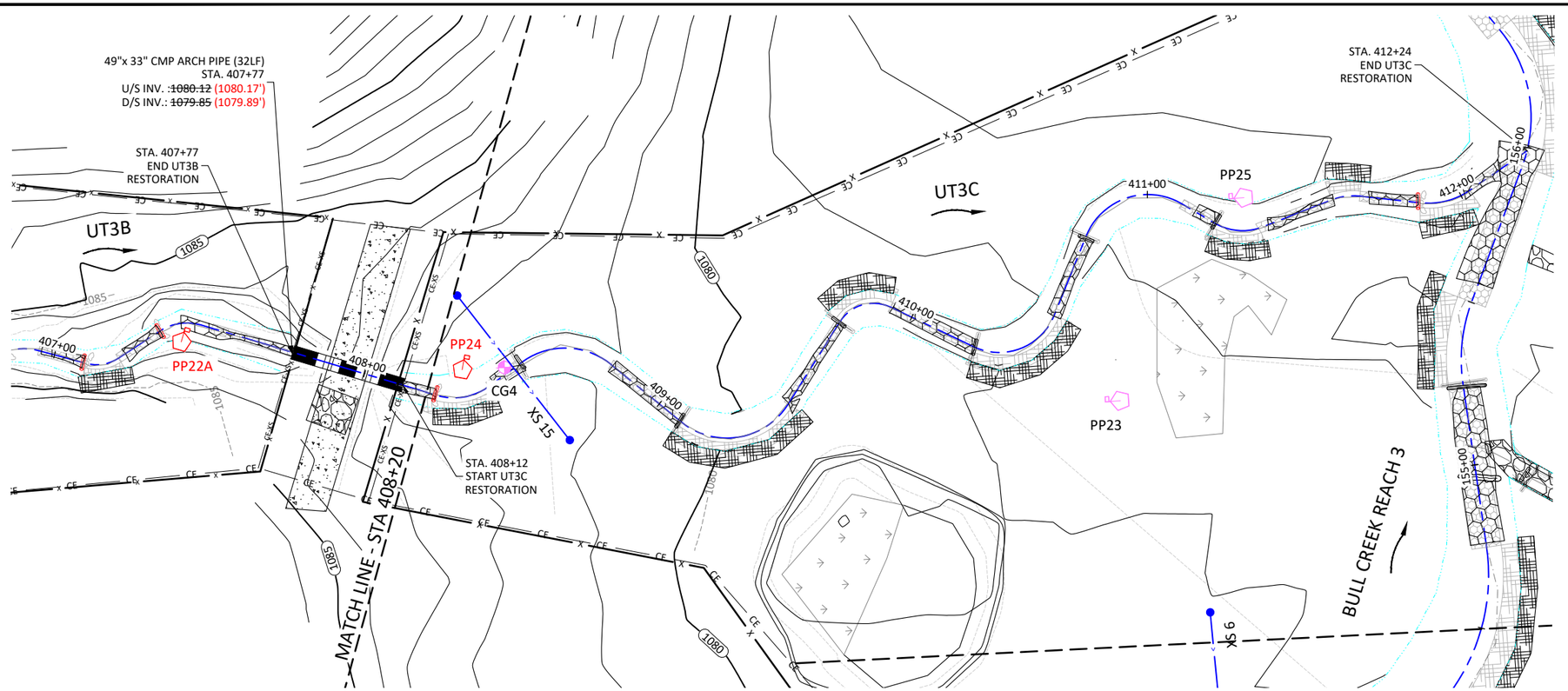
Sheet 1.22

T:\ACTIVE PROJECTS\NC\005-02165\Key Mill\Cad\As-Built\02165-AsBuilt-Fea.dgn

October 6, 2020

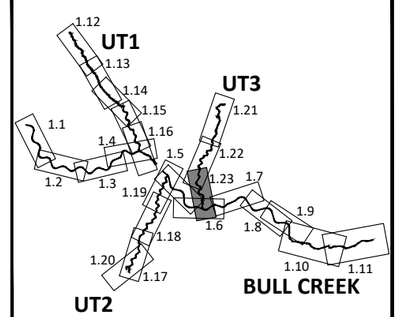






NOTE:
1. STA. 408+22: ROCK SILLS REPLACED WITH LOG SILLS DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.
2. STA. 408+33: PHOTO POINT 24 WAS MOVED AFTER THE SURVEY WAS COMPLETED AT THE REQUEST OF DMS TO CAPTURE AN UPSTREAM VIEW OF THE CULVERT CROSSING.
3. STA. 411+86: ROCK SILL REPLACED WITH LOG SILL DUE TO LOCAL MATERIAL AVAILABILITY AND SIMILAR FUNCTIONALITY.

Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN
10-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT3C
Stream Plan and Profile

Revisions: 09/29/2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 1.23

T:\ACTIVE PROJECTS\NCDMS\005-02165\Key Mill\Cad\As-Built\02165-As-Built-Plan.dwg

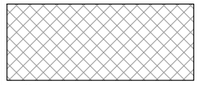
October 6, 2020

Streambank Planting Zone						
Live Stakes						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Size**	**Stratum**	**# of Stems**
Physocarpus opulifolius	Ninebark	8 ft.	2-8 ft.	0.5”-1.5” cal.	Shrub	~~20%~~ 10%
Cornus ammomum	Silky Dogwood	8 ft.	2-8 ft.	0.5”-1.5” cal.	Shrub	~~40%~~ 30%
Salix sericea	Silky Willow	8 ft.	2-8 ft.	0.5”-1.5” cal.	Shrub	40%
Cephalanthus occidentalis	Button Bush	8 ft.	2-8ft.	0.5" 1.5" cal.	Shrub	10%
Sambucus canadensis	Elderberry	8 ft.	2-8 ft.	0.5”-1.5” cal.	Shrub	10%
						100%

Buffer Planting Zone						
Bare Root						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Caliper Size**	**Stratum**	**# of Stems**
Alnus serrulata	Tag Alder	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	~~20%~~ 0%
Quercus rubra	Nothern Red Oak	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	12.5%
Platanus occidentalis	Sycamore	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	~~20%~~ 18%
Betula nigra	River Birch	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	~~25%~~ 18%
Quercus falcata	Southern Red Oak	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	8%
Asimina triloba	Paw Paw	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	3%
Nyssa sylvatica	Black Gum	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	6%
Acer saccharinum	Silver Maple	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	3%
Fraxinus pennsylvanica	Green Ash	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	12.5%
Carpinus caroliniana	Ironwood	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	~~5%~~ 4%
Viburnum dentatum	Arrowwood	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	~~5%~~ 4%
Ilex opaca	American Holly	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	4%
Fagus gradifolia	American Beech	12 ft.	6-12 ft.	0.25”-1.0”	Canopy	7%
Quercus phellos	Willow Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	~~20%~~ 0%
Quercus michauxii	Swamp Chestnut Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	~~20%~~ 0%
Magnolia macrophylla	Bigleaf Magnolia	12 ft.	6-12 ft.	0.25-1.0"	Canopy	~~5%~~ 0%
						100%

Note:
- Planting contractor provided plant quantities for entire site. Total plant quantities were not broken up between shaded and unshaded areas.

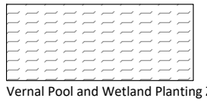
Buffer Planting Zone



Buffer Planting Zone - Shaded

Streambank, Vernal Pool and Wetland Planting Zone						
Herbaceous Plugs						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Size**	**Stratum**	**# of Stems**
Scirpus altrovirens	Green Bulrush	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	8%
Juncus effusus	Common Rush	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	~~35%~~ 40%
Calamagrostis canadensis	Bluejoint Grass	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	~~30%~~ 0%
Carex crinita	Fringed Sedge	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	13%
Andropogon glomeratus	Bushy Beardgrass	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	4%
Caryx stricta	Upright Sedge	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	18%
Schoenoplectus tabernaemontani	Softstem Bulrush	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	17%
Carex alata	Broadwing Sedge	5 ft.	3-5 ft.	1.0"-2.0" plug	Herb	~~35%~~ 0%
						100%

Note:
- Planting Contractor provided plant quantities for entire site. Total plant quantities were not broken up between streambank, vernal pool and wetland area planting zones.
- Herbaceous plugs shifted to similar species due to quality of materials available at nursery.

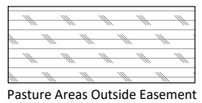


Vernal Pool and Wetland Planting Zone

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	1.0
All Year	*Agrostis hyemalis*	Winter Bentgrass	Herb	3.0
All Year	*Chasmanthium latifolium*	Indian Woodoats	Herb	0.4
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	1.5
All Year	*Panicum clandestinum*	Deertongue	Herb	3.0
All Year	*Elymus virginicus*	Virginia Wild Rye	Herb	3.5
All Year	*Panicum virgatum*	Switchgrass	Herb	2.0
All Year	*Schizachyrium scoparium*	Little Bluestem	Herb	2.0
All Year	*Asclepias syrica*	Common Milkweed	Herb	0.4
All Year	*Bidens aristosa*	Bearded Beggartick	Herb	1.0
All Year	*Eupatorium perfoliatum*	Boneset	Herb	0.2
All Year	*Lobelia cardinalis L.*	Cardinal Flower	Herb	~~0.4~~ 0.0
All Year	*Liatris spicata*	Dense Blazing Star	Herb	~~0.4~~ 0.0

Temporary Seeding				
Pure Live Seed				
Approved Date	**Species Name**	**Common Name**	**Stratum**	**Density (lbs/acre)**
Aug 15 - May 1	*Secale cereale*	Rye Grain	Herb	140
May 1 - Aug 15	*Setaria italica*	German Millet	Herb	50

*All disturbed areas.



Pasture Areas Outside Easement

Pasture Seeding				
Approved Date	**Species Name**	**Stratum**	**Common Name**	**Density (lbs/acre)**
All Year	*Festuca arundinacea*	Herb	Tall Fescue	80

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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Plant List
Planting Plan

Revisions:
09-25-2020

Date: August 27, 2020
Job Number: 065-02165
Project Engineer: AE
Drawn By: ABP/JTC
Checked By: JCK

Sheet 2.1

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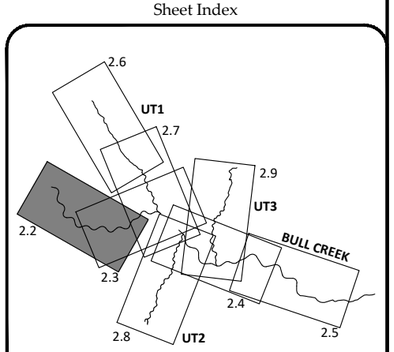
NOTES:

1. DEVIATIONS TO THE DESIGN PLANTING PLAN THAT WERE INSIDE OF THE AS-BUILT LIMIT OF DISTURBANCE AND WERE PLANTED ARE SHOWN IN RED.
2. DEVIATIONS TO THE DESIGN PLANTING PLAN THAT WERE OUTSIDE THE AS-BUILT LIMIT OF DISTURBANCE AND WERE NOT PLANTED ARE SHOWN IN GREEN.
3. STA.100+95-105+39: PLANTING AREA ALTERED DUE TO BEDROCK THAT WAS PRESENT IN THE LEFT FLOODPLAIN.

N

0' 40' 80' 120'
(HORIZONTAL)

Sheet Index



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NORTH CAROLINA PROFESSIONAL SEAL 023349 ENGINEER AARON S. ERVIN
10-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek West
Planting Plan

Revisions: 10-01-2020

Date: August 27, 2020
Job Number: 105-02165
Project Engineer: AE
Drawn By: ABT/JTC
Checked By: JCK

Sheet 2.2

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October 6, 2020

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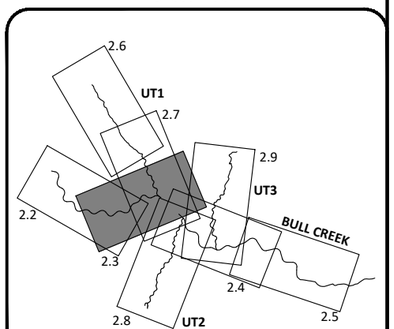

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10-27-20

Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek West
Planting Plan

Revisions: 10-01-2020

Date: August 27, 2020
Job Number: 005-02165
Project Engineer: AE
Drawn By: ABP/TTC
Checked By: JCK

Sheet 2.3

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October 6, 2020

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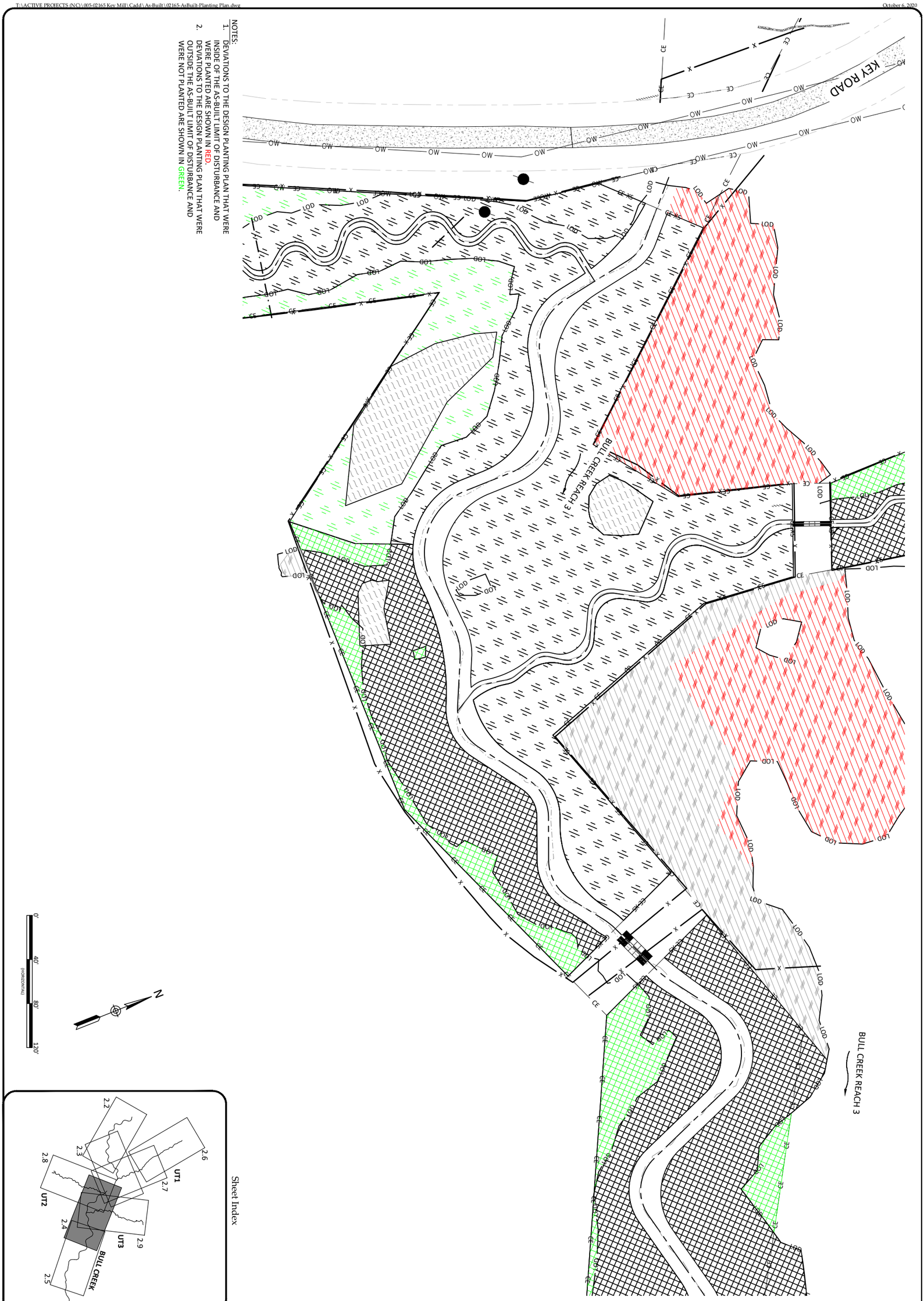

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Job Number:	005-02165
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Revisions:
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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek East
Planting Plan

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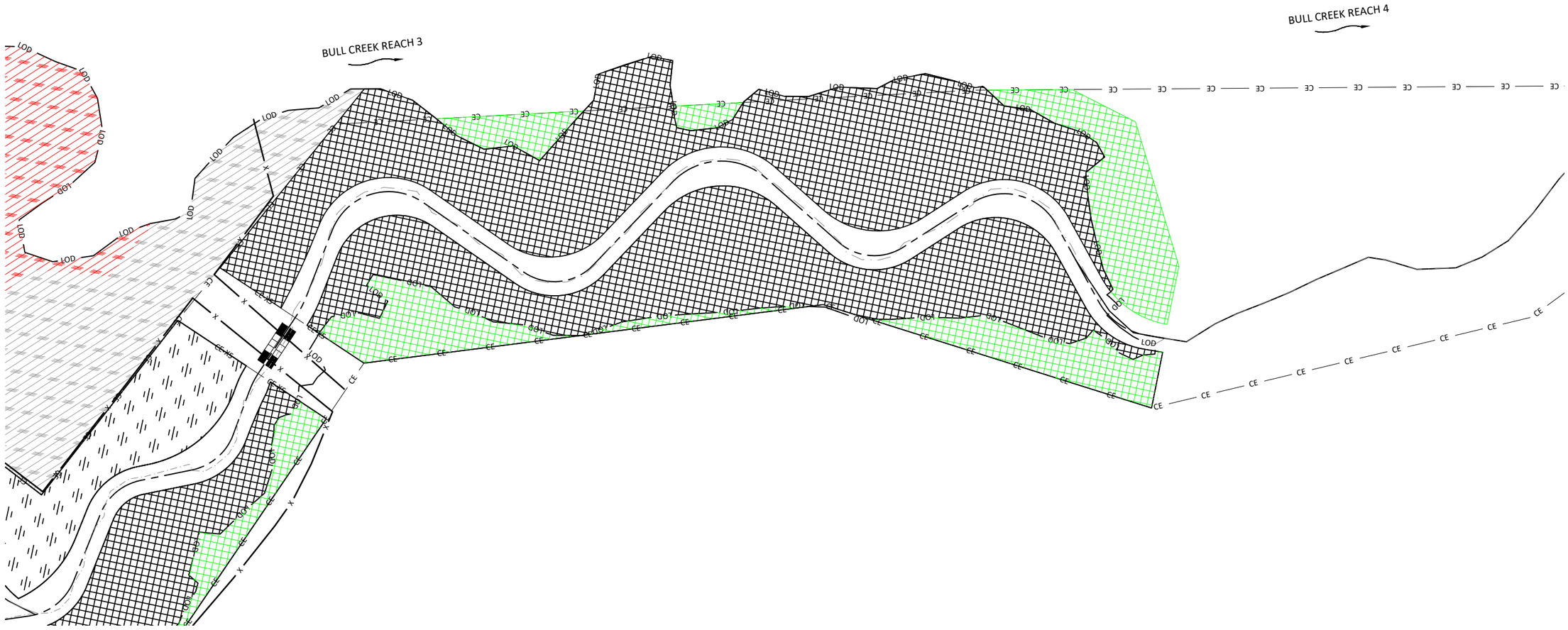

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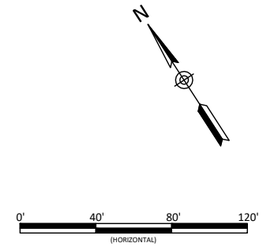

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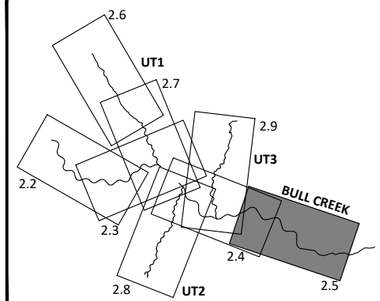

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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

Bull Creek East
Planting Plan

Revisions:
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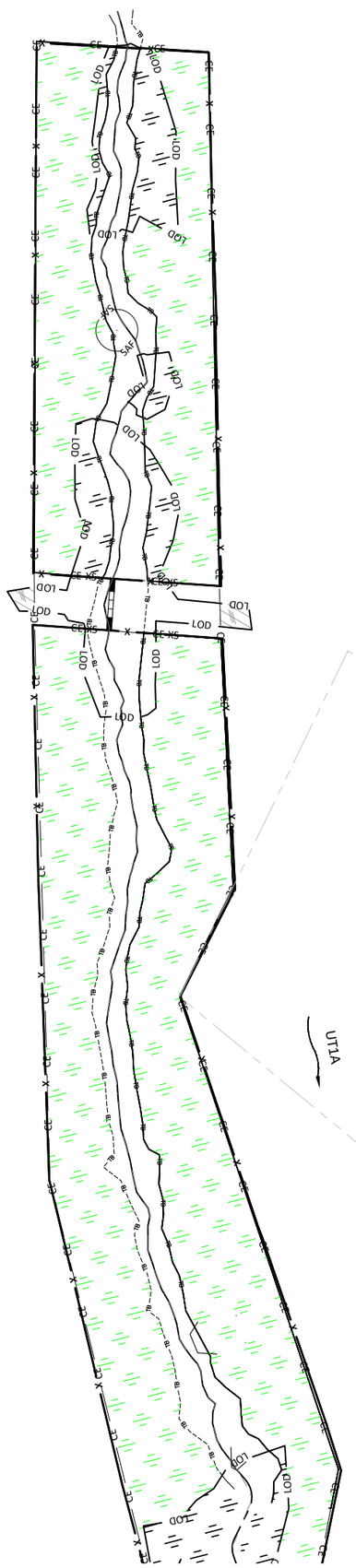

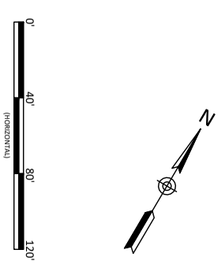

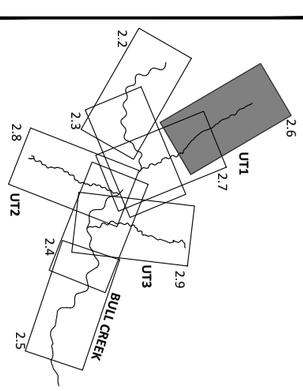

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Date:	August 27, 2020
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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

UT1
Planting Plan

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Key Mill Mitigation Site - Record Drawings
Surry County, North Carolina

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Key Mill Mitigation Site - Record Drawings
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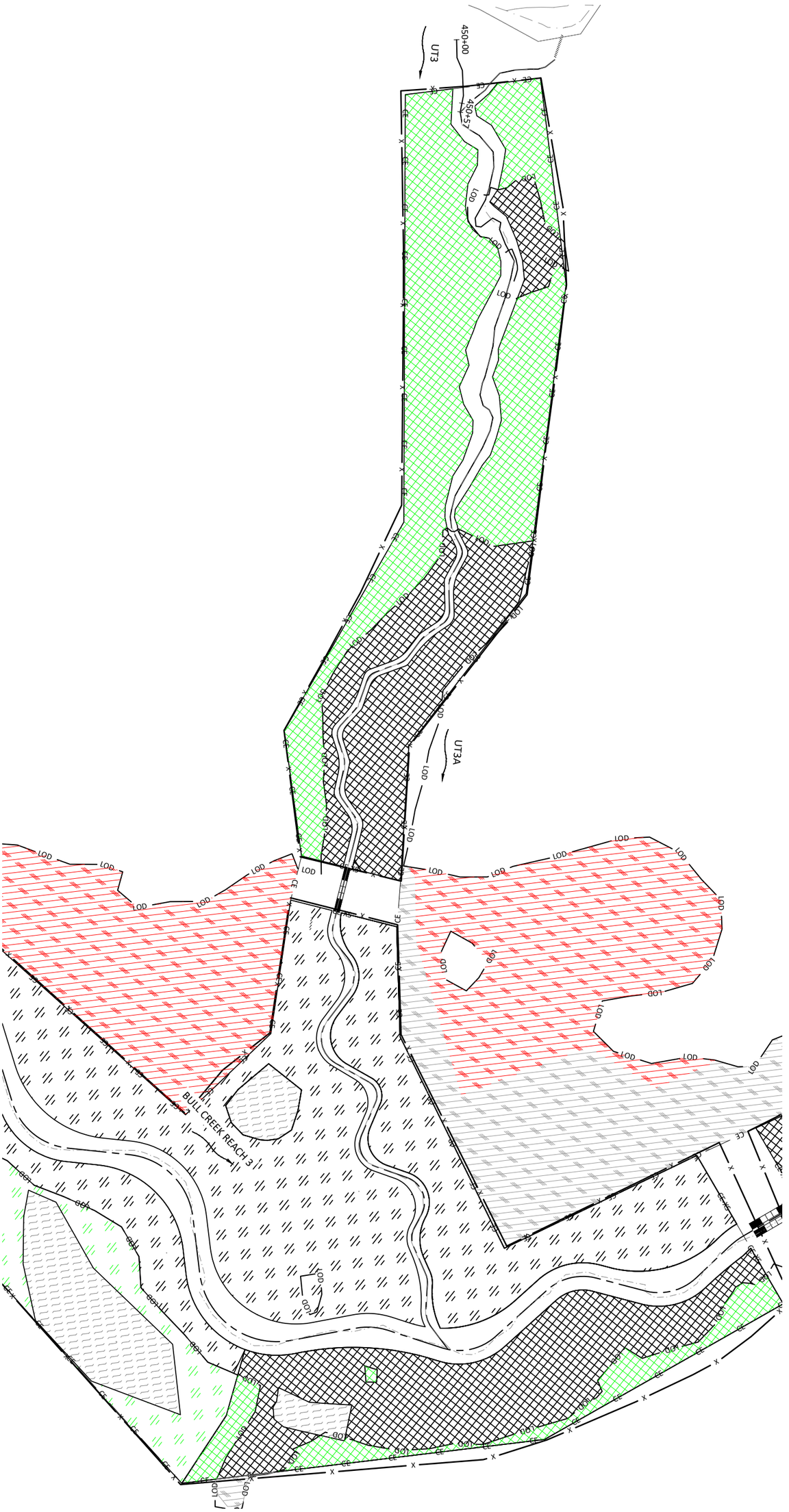

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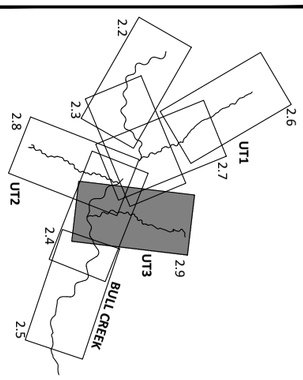
Sheet Index



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Key Mill Mitigation Site - Record Drawings
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