Monitoring Report
Year 5
FINAL
Little Buffalo Creek Stream Mitigation Project

NCDEQ-DMS Project Number: 94147
Contract Number: 2029
USACE Permit Action ID: 2014-00386
DWR Permit: 14-0129
Cabarrus County

Data collection: October 2019-January 2020
Draft Submitted: February 2020
Final Submitted: March 2020

Reach 1 Restoration Area Pre-Construction

Reach 1 Restoration Area MY5

Prepared for:

Environmental Quality

North Carolina Department of Environmental Quality
Division of Mitigation Services
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March 5, 2020

Ed Samanns
Project Manager
WSP (formerly Louis Berger)
412 Mount Kemble Avenue
PO Box 1946
Morristown, NJ 07962-1946

Subject: DRAFT Monitoring Year 5 report for the
Little Buffalo Creek Stream Mitigation Project
Yadkin River Basin – CU# 03040105– Cabarrus County
DMS Project ID No. 94147
Contract # 002029

Dear Mr. Samanns:

On February 17, 2020, the Division of Mitigation Services (DMS) received the DRAFT Monitoring Year 5 report for the Little Buffalo Creek Stream Mitigation Project site from WSP (formerly Louis Berger). The report establishes the Year 5 monitoring conditions at the site.

Anticipated mitigation on the site includes 2,017 linear feet of stream restoration; 1,244 linear feet of stream Enhancement (Level I); 7,723 linear feet of stream Enhancement (Level II); and 2,378 linear feet of stream Preservation for a total of 6,411 Stream Mitigation Units (SMUs).

DMS, DEQ Stewardship and WSP conducted a site visit on March 3, 2020 to review conditions on the site. Comments from the site visit are captured in this letter as well as comments from the DRAFT MY5 report.

General: Based on the data gaps reported in MY5, DMS recommends continued monitoring and maintenance of the stream flow gauges on the site in 2020 until project closeout. Available 2020 data should be collected before and reported by WSP at the June 9, 2020 NC IRT project closeout presentation.

General: DMS recommends including the June 19, 2018 IRT site visit minutes in the appendices. In the comment response letter, please confirm that actions items and discussion points from the meeting have been implemented and/ or resolved. If not, please provide anticipated completion date/s.

Section 1.4 - Mitigation Components and Design: This section indicates DMS will receive approximately 6,411 as of December 2017 but the credits were determined by the July 2015 As-Built Report. Please update the 2017 reference to the appropriate date. The 6,376 SMU value assumes additional credit from the UT3 EI work but this is not made clear in the text. Please update the text to reflect this assumption. Refer to the June 19, 2018 IRT site visit minutes regarding the requirement for a Mitigation Plan Addendum to add project credits and edit this section accordingly.

Section 1.5.1.3 - Volunteer Species (Supplemental Plantings): Please describe the placement of the supplemental plantings relative to the vegetation plots and non-plot areas. A supplemental planting map (with planting dates) would be helpful and at a minimum should be provided in the project closeout report.

Section 1.5.2 - Stream Assessment: In the report text, please indicate the approximate stream stations where the former beaver dams were located. Based on a review of the draft report, it appears that WSP does not currently consider the previous aggradation (linear wetlands) on UT 2 and UT3 a project issue. Please confirm in the comment response letter. If aggradation (linear wetlands) are still considered a project issue, please update the report text and edit the CCPV (Figures 3 & 4) to more clearly indicate the sections of UT 2 and UT3 that are considered linear wetlands and the sections considered stream channel.

Section 1.5.2 - Stream Assessment: In the data gap summary section, please also note the project reach associated with each gauge: (i.e.: **UT 2 Lower** – Gauge 3 (Missing Data: 08/21/2019 – 10/09/2019)).

Section 1.5.4 - Monitoring Year 5 Summary: The term channelization is used in this section and several other sections of the document. Consider using alternate wording to describe the process since channelization typically refers to the straightening and ditching of streams.

Figure A1 – Project Components Map: Recommend removing the "Proposed Easement Following Modification To Easement With DMS" callout and leader as the easement has been amended. Also; this is not applicable to the project components.

Table 2: Year 4 Monitoring – Please update the completion date to the final report delivery date.

CCPV Maps: Stream Thalweg colors on the CCPV maps and legend should be consistent with the Project Components Map (Fig. A-1). Please update the CCPV stream thalweg colors to match the Project Components Map. Please also confirm that the aerial imagery is the most recent available. Please update if more recent aerial imagery is available.

Visual Stream Morphology Assessment Table 5: If applicable, please update the table to reflect any aggradation observed in UT 2 and/ or UT3 (see comment above). Please label all of the tables in this section with a title (Tables 5a-g).

Appendix D - Table 11a: Please note that BHR is not required for pools. A dash can be utilized for pools (BHR).

Appendix E - Figure 6c - Water Level and Rainfall Plots - Little Buffalo Creek Hydrology Monitoring Graph UT 2 Lower: Leader pointing to the missing data needs to be shifted to the correct interval of missing data.

Table 13 - Continuous Stream Flow Record: Please show the maximum number of consecutive days for each gauge beneath the date ranges.
Example:
12/18/14-
5/25/15
(158 Days)

Digital Support File Comments:

- MY5 spatial features are corrupted and cannot be uploaded into ArcMap. Please re-send these features in a separate zipped folder. Sending them in a zipped folder has helped prevent this issue previously.

- Some of the current features have merged segments from specific reaches (i.e. Little Buffalo Creek Reach 2 and 3, 3 and 4, etc.), but do not clearly result from adding together reported restoration footage among those specific reaches. For example, the feature "Little Buffalo Creek Reach 2 and 3" has a length of 1433 in the geodatabase, while reach 2 is reported at 1244 ft and the EII segment of Reach 3 is reported at 839 ft. Because there are additional merged segments (i.e. Reach 3 and 4), the distinct feature segments (i.e. Reach 3 EII, Reach 4 EII, etc) cannot be distinguished or compared to the asset table.

  Please provide DMS with stream features that are segmented based on the Restoration Footage or Acreage column of the asset table, ensuring that these segments accurately represent the creditable footage reported.

- Please specify low top of bank elevation in the stream cross section Figures or Table 11a.

Comments based on the 3/3/20 DMS site visit:

- Please include the drainage swales shapefile in the final digital support file CD.

- Recent cattle encroachment was observed during the site visit. Please continue to work with the project landowners to eliminate all cattle encroachment within the conservation easement.

- Please work to address all outstanding work/ project action items (crossing above UT3; main stem crossing; crossing above UT1, etc.) ASAP and well before the June 9, 2020 closeout presentation with the NC IRT.

- Please continue to remove beaver and beaver dam/s from all project reaches through project closeout.

- A failed pond overflow pipe was noted above UT2 during the site visit. Please assess and determine potential effects to UT2 and the downstream project reaches. Does this change in hydrology represent a long term stability issue for the project reach and/or site?

- Minor head cuts were observed on UT2 and UT3. Please assess and determine if these areas represent long term stability issues for the project site.

- Please continue to measure and track any areas along UT2 and UT3 that function more as "linear wetlands" as opposed to streams with a functional bed and bank. Areas functioning as linear wetlands represent a credit risk (potential mitigation credit loss) at project closeout.

- Vegetation data in MY5 is meeting the success criteria; however, several bare areas within the conservation easement were observed during the site visit. DMS recommends conducting random vegetation transects in some of these areas and reporting this data at the closeout presentation and site visit to substantiate the overall vegetation success criteria data results.

- Based on the potential project credits "at risk" on the site, the final project invoice should be delayed until the IRT reviews and closes the project site.

Please provide an electronic comment response letter addressing the DMS comments received. This comment response letter should also be included in the FINAL MY5 revised report after the report cover. Please send two (2) final hard copies and the final electronic deliverables and support files (on a CD) directly to my attention at the address below (Western DMS field office). The final electronic monitoring report with all attachments should be named:
Little Buffalo Creek_94147_MY5_2019.pdf

If you have any questions, please contact me at any time at (828) 273-1673 or email me at paul.wiesner@ncdenr.gov .

Sincerely,

Paul Wiesner

Paul Wiesner
Western Regional Supervisor
NCDENR – Division of Mitigation Services
5 Ravenscroft Dr., Suite 102
Asheville, NC 28801
(828)273-1673 Mobile

cc: file

Your ref.: 94147

Our ref.: LE2000992

March 24, 2020

Paul Wiesner, Western Regional Supervisor
NCDENR - Division of Mitigation Services
5 Ravenscroft Dr., Suite 102
Asheville, NC 28801

Subject: Little Buffalo Creek Stream Mitigation Project – MY5 Report Comments & Responses

Dear Mr. Wiesner:

WSP has reviewed your comments, received on March 5, 2020, for the DRAFT Monitoring Year 5 report for the Little Buffalo Creek Stream Mitigation Project site. We offer the following responses.

General: Based on the data gaps reported in MY5, DMS recommends continued monitoring and maintenance of the stream flow gauges on the site in 2020 until project closeout. Available 2020 data should be collected before and reported by WSP at the June 9, 2020 NC IRT project closeout presentation.

- *WSP will continue to monitor stream flow gauges until project closeout. Data collected from the stream flow gauges will be analyzed and results will be reported at the June 9, 2020 NC IRT project closeout presentation.*

General: DMS recommends including the June 19, 2018 IRT site visit minutes in the appendices. In the comment response letter, please confirm that actions items and discussion points from the meeting have been implemented and/ or resolved. If not, please provide anticipated completion date/s.

- *The Monitoring Year 5 report has been updated to include the June 19, 2018 IRT site visit minutes in Appendix F and offers the following responses to action items and discussion points listed in the site visit minutes:*

IRT Site Visit: Action Items

1. Color code stream centerlines in CCPV maps for MY4 and MY5 reports to distinguish levels of restoration effort.

- *This was done for the CCPV shown in MY4 and MY5 reports.*

2. Remove beaver dam and spread debris on the copper area and the bare area around vegetation plot 11.

- *The beaver dam was removed in MY4 and the debris was spread out near the beaver dam, to facilitate vegetative re-growth adjacent to the dam. It was not spread over the bare (high copper) area. The dam was more than 125 feet downstream from where the beaver dam was located. The debris was not moved this full distance in order to avoid additional disturbance to vegetated portions of the riparian buffer.*

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3. Deploy a new gauge mid-point of stream length UT-2. Install the gauge at an increased depth, sufficient to record water levels beneath the channel.

- *The existing Gauge 3 is located at station 16+80; approximately halfway between the start of restoration (13+80) and the end of UT-2 (19+50), along the area of continued channel formation. A replacement gauge was installed approximately 75 feet downstream (17+55) of Gauge 3 during the fall of 2019. The replacement gauge was installed during a period when the original Gauge 3 could not be found. The replacement gauge is located in a segment with a well-defined channel (bed and banks). The original Gauge 3 was found a few months later (winter 2019) and now both gauges are functioning. Additionally, visual monitoring and photo collection has continued to ensure appropriate documentation of stream flow in this area.*

4. Install groundwater well on UT-2 in conjunction with new gauge.

- *Gauge 13 was installed adjacent to existing Gauge 3 and the groundwater level has been compared to stream flow data in the MY4 and MY5 reports.*

5. Replant around UT-2 with more mature trees at least 4 different species.

- *Approximately 70 4-foot tall trees consisting of eight different species were replanted across 1.41 acres around UT 2 in November 2018. Figures depicting the replanting locations has been added in Appendix F of the Monitoring Year 5 report.*

6. Measure linear stream length that may be considered a linear wetland at closeout for more accurate number in the winter. (DMS Note: This should be measured in both MY4 & MY5 to track any changes. Measurements will be much easier in the dormant season).

- *In MY4, approximately 230 feet of stream length in UT 2 and 216 feet of stream length in UT 3 were identified as areas of aggradation/linear wetland. Based on observations of flow and features indicating channel development during MY5 site visits, UT 2 is currently shown without any areas of aggradation/linear wetland and the UT 3 stream length of aggradation/linear wetland has been lessened to 185 feet (split between two segments). WSP will continue to monitor the relevant segments of UT 2 and UT3. As part of this monitoring, WSP will document flow, and evidence of channel development or aggradation. It may be difficult to document features during the growing season when vegetation becomes thick. However, photos from January-March 2020 have been collected to highlight the channel condition during the dormant season.*

7. Replant the left bank riparian corridor of Reach 4 (cattle grazed area) with more mature trees of at least 4 different species.

- *In November 2018, approximately 60 4-foot tall trees consisting of eight different species were replanted across 1.27 acres around Reach 4. A figure depicting the replanting locations has been added in Appendix F of the Monitoring Year 5 report.*

8. Deploy a new gauge near the mid-point of UT-3.

- *Gauge 12 was installed near stream station 18+25 and flow data has been analyzed in the MY4 and MY5 reports. This gauge was placed at the approximate midpoint of the restoration length (10+00-24+50).*

9. Replant around UT-3 with more mature trees of at least 4 different species.

- *In November 2018, approximately 120 4-foot tall trees consisting of eight different species were replanted across 2.79 acres around UT 3. A figure depicting the replanting locations has been added in Appendix F of the Monitoring Year 5 report.*

10. Conduct more vegetation transects around Vegetation Plot #11, UT-2, Reach 4, and UT-3.

- *Random vegetation plots were established and assessed in September 2018 for the MY4 report. Two randomly placed 10 x 10-meter vegetation plots were assessed in each of the four areas mentioned above. For the eight random vegetation plots, seven were exceeding requirements for planted stems by 10% (387 to 4695 stems/acre) and one was exceeding requirements by less than*

10% (290 stems per acre). More detailed results were presented in the MY4 report. During the March 3, 2020 site visit with DMS, it was decided WSP will conduct more random vegetation plots along UT 3 and other areas of concern. Results from the additional random vegetation plots will be available during the closeout presentation.

11. Take lots of photographs of the tributary flow, at different times of the year, to highlight channel performance.

- *Additional photographs were presented in the Monitoring Year 5 report. WSP will continue to document flow with photographs until project closeout.*

12. Include this meeting summary in the Appendix of MY4's report.

- *This meeting summary was presented in the MY4 report (Appendix F) and was requested to be included in MY5. It will be shown in Appendix F of the final MY5 report.*

IRT Site Visit: Discussion Points

Reach 1:

- The IRT recommended an additional 20 feet of fencing in this area to create a filter/buffer for the tributary to protect water quality in Little Buffalo Creek. Any increased filtering capacity is better than the existing conditions.
- *The location where this fence was recommended is along a confluence adjacent to the downstream end of the Reach 1 restoration segment. The landowner indicated that installation was not feasible. The fence would limit access to a critical water source for their livestock.*
- Consider speaking with Marcus [Harward] about keeping [poorer] cows elsewhere and/or to Phil Cline about potentially adding fenced area.
- *Up to this point, landowners have not been interested in modifying the use of their land to reduce the potential for easement encroachment.*
- Paul recommended random transects (10m x 10m) to be more representative of the vegetation in the area.
- *As mentioned above, random vegetation plots were conducted and results were discussed in the MY4 report. WSP will perform additional random vegetation plots along UT3 among other areas. Results will be available during the closeout presentation.*

Buffer width:

- [IRT] explained that buffer width should be 50 feet or greater and too much length without that buffer width would be a concern.
- *WSP will perform a desktop analysis to confirm the 50' buffer width is contained within the conservation easement boundary for the site. Areas of potential concern will be spot-checked via field measurements. Results will be presented in the closeout report and presentation. An exhibit will be available during the project closeout presentation.*

UT-2:

- IRT noted that the tree density was sufficient but was concerned that their vigor (i.e., size) was not where it should be.
- *Vegetation Plot #8 is located along UT 2. During vegetation monitoring for MY5, tree heights ranged from 1 to 9 feet with an average near 5 feet. WSP will re-assess tree heights prior to the project closeout.*

Reach 4:

- IRT expressed concern about the size of the tree saplings.

- *Vegetation Plot #4 is located along Reach 4. During vegetation monitoring for MY5, tree heights ranged from 1.5 to 6 feet with an average near 3.5 feet. WSP will re-assess tree heights prior to the project closeout.*

The lower portions of UT-3 (ash grove):

- [WSP] asked about incorporating the extra section of work that had been done into the credit table (this would require a mitigation plan modification). IRT highly recommended against trying to modify the existing mitigation plan to incorporate the extra section of work [WSP] completed as it could potentially open the project to additional monitoring. IRT suggested that [WSP] note that extra repairs were made in the final report and to also mention it at close out.
  - *Based on this information from IRT, WSP will not be requesting additional credit along UT3. A more thorough discussion of the project credit situation has been included in the MY5 report.*

Reach 5:

- UT-5 was considered by the IRT to potentially not be a stream and is considered a clear credit risk.
  - *Based on field observations, gauge data, and discussions with DMS, no credit will be requested for UT-5.*

Miscellaneous:

- IRT requested that MY4 and MY5 reports include discussion on initial planted acreage versus replanted acreage (as percentages).
  - *The MY4 report included a brief statement regarding reseeded areas along particular stream segments. The MY5 reports includes a more thorough discussion of replanting areas, dates, and total acreage.*
- IRT recommended providing before and after photos of the site in MY5 report for their closeout review to understand the uplift that has occurred.
  - *WSP will provide before and after photos of the site in the closeout report and presentation. Based on discussions with DMS, this comparison would fit more appropriately in the closeout report as opposed to the MY5 report.*

Section 1.4 - Mitigation Components and Design: This section indicates DMS will receive approximately 6,411 as of December 2017 but the credits were determined by the July 2015 As- Built Report. Please update the 2017 reference to the appropriate date. The 6,376 SMU value assumes additional credit from the UT3 EI work but this is not made clear in the text. Please update the text to reflect this assumption. Refer to the June 19, 2018 IRT site visit minutes regarding the requirement for a Mitigation Plan Addendum to add project credits and edit this section accordingly.

- *This section of the report has been revised to clarify the project crediting, as well as providing an accurate timeline of credit accounting and discussion.*

Section 1.5.1.3 - Volunteer Species (Supplemental Plantings): Please describe the placement of the supplemental plantings relative to the vegetation plots and non-plot areas. A supplemental planting map (with planting dates) would be helpful and at a minimum should be provided in the project closeout report.

- *WSP added text in section "1.5.1.6 Additional Tree Planting" of the Monitoring Year 5 report that describes locations of supplemental plantings from February 2016, March 2017, and November 2018. A map depicting these planting locations and dates has been included in Appendix F. This map will also be included in the project closeout report.*

Section 1.5.2 - Stream Assessment: In the report text, please indicate the approximate stream stations where the former beaver dams were located. Based on a review of the draft report, it appears that WSP does not currently consider the previous aggradation (linear wetlands) on UT 2 and UT3 a project issue. Please confirm in the comment response letter. If aggradation (linear wetlands) are still considered a project issue,

please update the report text and edit the CCPV (Figures 3 & 4) to more clearly indicate the sections of UT 2 and UT3 that are considered linear wetlands and the sections considered stream channel.

- *Approximate stream stations for the locations of the former beaver dams were added to the text: 23+75 in Reach 1 (MY4) and 12+50 and 16+00 in UT 7 (MY5).*
- *The previously identified area of aggradation (linear wetland) in UT 2 near stream station 17+00 is not considered a project issue at this time because continuous flow has been documented for multiple years and evidence of channel development has been observed in this section through Year 4 and Year 5. During the June 19, 2018 IRT site visit, the attendees agreed that as trees mature in the area, additional water observed may begin to be taken up by evapotranspiration and the tree roots will help maintain a defined channel. In July 2019, a sparsely vegetated to unvegetated channel of flowing water surrounded by thick vegetation was noted in this area. More evidence of channel development was observed in January and March 2020, with areas of bank and bed formation. The active channel is difficult to observe due to the presence of water, sediment deposition, and thick herbaceous vegetation. WSP will continue to note evidence of channel development and take photographs in this section of UT 2.*
- *In UT3, the area of aggradation (linear wetland) from stream station 10+20 to approximately 11+20 was noted in the CCPV of Monitoring Year 5 report as minor bed aggradation. Continuous flow has been documented for multiple years. In January 2020, WSP observed a definitive flow path through bent/dead herbaceous vegetation. Another small segment of aggradation has been added to the CCPV between station 12+40 and 13+25. The channel in this area is shallow, and of the three areas mentioned (one along UT2 and two along UT3), this is the only area WSP considers to be functioning as a linear wetland. However, the appearance and function varies seasonally with the influence of vegetation and flow depth. As such, continued monitoring and discussion with DMS and IRT will be essential to determine the classification of this segment.*

Section 1.5.2 - Stream Assessment: In the data gap summary section, please also note the project reach associated with each gauge: (i.e.: **UT 2 Lower** – Gauge 3 (Missing Data: 08/21/2019 – 10/09/2019)).

- *The text in the Monitoring Year 5 report has been updated to indicate which project reach is associated with each gauge.*

Section 1.5.4 - Monitoring Year 5 Summary: The term channelization is used in this section and several other sections of the document. Consider using alternate wording to describe the process since channelization typically refers to the straightening and ditching of streams.

- *There were three instances where the term "channelization" was used and has been replaced by the phrase "channel development" or "channel formation" to more appropriately describe the processes that are occurring on the site.*

Figure A1 – Project Components Map: Recommend removing the "Proposed Easement Following Modification To Easement With DMS" callout and leader as the easement has been amended. Also; this is not applicable to the project components.

- *This callout has been removed from Figure A-1.*

Table 2: Year 4 Monitoring – Please update the completion date to the final report delivery date.

- *The table has been updated and now uses March 2019 as the completion date.*

CCPV Maps: Stream Thalweg colors on the CCPV maps and legend should be consistent with the Project Components Map (Fig. A-1). Please update the CCPV stream thalweg colors to match the Project Components Map. Please also confirm that the aerial imagery is the most recent available. Please update if more recent aerial imagery is available.

- *The CCPV maps have been updated to include these requests.*

Visual Stream Morphology Assessment Table 5: If applicable, please update the table to reflect any aggradation observed in UT 2 and/ or UT3 (see comment above). Please label all of the tables in this section with a title (Tables 5a-g).

- *At the time of this response, WSP has updated Table 5 to list two separate areas of aggradation along UT 3 (10+20-11+20: 100' and 12+40-13+25: 85'). No aggradation will be shown for UT 2, but thorough monitoring will continue through project closeout. Evidence of channel development and/or aggradation will be documented in these three areas. If necessary, WSP will update figures and text in the closeout report and presentation to reflect changes since the MY5 report.*

Appendix D - Table 11a: Please note that BHR is not required for pools. A dash can be utilized for pools (BHR).

- *This table has been updated to show dashes for BHR for pools.*

Appendix E - Figure 6c - Water Level and Rainfall Plots - Little Buffalo Creek Hydrology Monitoring Graph UT 2 Lower: Leader pointing to the missing data needs to be shifted to the correct interval of missing data.

- *The leaders shown in UT 2 Lower graph were pointing to the period of time when it was believed the instrument was buried in sediment and when a new instrument was installed. The text box for the period of missing data was intended to explain where the data were missing and did not show a leader or limits for the data gap because the data gap was bounded by notes and limits on either side. WSP recognizes this may have been confusing and has adjusted Figure 6c.*

Table 13 - Continuous Stream Flow Record: Please show the maximum number of consecutive days for each gauge beneath the date ranges.
Example:
12/18/14-5/25/15 **(158 Days)**

- *Table 13 has been updated to include the number of days for each date range shown.*

Digital Support File Comments:

- MY5 spatial features are corrupted and cannot be uploaded into ArcMap. Please re-send these features in a separate zipped folder. Sending them in a zipped folder has helped prevent this issue previously.

  - *WSP has reviewed the shapefiles and addressed two corrupted shapefiles. The zipped folder will be saved on the final digital support file CD. Let us know if there are any problems accessing the new shapefiles. We would be more than happy to resend via email.*

- Some of the current features have merged segments from specific reaches (i.e. Little Buffalo Creek Reach 2 and 3, 3 and 4, etc.), but do not clearly result from adding together reported restoration footage among those specific reaches. For example, the feature "Little Buffalo Creek Reach 2 and 3" has a length of 1433 in the geodatabase, while reach 2 is reported at 1244 ft and the EII segment of Reach 3 is reported at 839 ft. Because there are additional merged segments (i.e. Reach 3 and 4), the distinct feature segments (i.e. Reach 3 EII, Reach 4 EII, etc) cannot be distinguished or compared to the asset table.

  Please provide DMS with stream features that are segmented based on the Restoration Footage or Acreage column of the asset table, ensuring that these segments accurately represent the creditable footage reported.

  - *The provided shapefiles have been updated to segment the lines per mitigation area and stream reach. However, the lengths of the lines in "Little_Buffalo_Creek_94147_MY5 Stream Thalweg_Mitigation Activity.shp"do not match the asset table. The lengths are different due to recent survey and 5 years of natural channel migration resulting in increased sinuosity. The asset table is based on the line segments provided in "Little_Buffalo_Creek_94147_As-Built Stream Thalweg_Mitigation Activity.shp". These lines are still segmented according to stream reach and mitigation activity, but reflect the as-built alignments. The as-built alignments were used to develop the asset table and to calculate mitigation credit.*

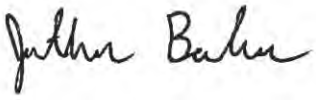
- Please specify low top of bank elevation in the stream cross section Figures or Table 11a.

  - *The tables on the cross section figures have been updated to include the low bank elevation.*

Comments based on the 3/3/20 DMS site visit:

- Please include the drainage swales shapefile in the final digital support file CD.
  - *This shapefile was sent via email on March 4, 2020 and will also be included in the final digital support file CD.*
- Recent cattle encroachment was observed during the site visit. Please continue to work with the project landowners to eliminate all cattle encroachment within the conservation easement.
  - *WSP will conduct site visits twice a month until project closeout. Any signs of cattle will be documented and brought to the attention of the landowner.*
- Please work to address all outstanding work/ project action items (crossing above UT3; main stem crossing; crossing above UT1, etc.) ASAP and well before the June 9, 2020 closeout presentation with the NC IRT.
  - *WSP has been in contact with contractors for repair work. The current target completion date is the end of April.*
- Please continue to remove beaver and beaver dam/s from all project reaches through project closeout.
  - *WSP will conduct site visits twice a month until project closeout. If beaver dams are found, a beaver trapper will be contacted and beaver dams will be removed.*

Kind regards,



(Jon Becker)

cc: Matt Holthaus and Ed Samanns

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CDROM Copy of Electronic Files

1.0 Executive Summary

1.1 Project Setting and Background

The Little Buffalo Creek Stream Mitigation site is located in Cabarrus County, North Carolina, two miles southwest of the Town of Gold Hill, and 12 miles east of Kannapolis. The site encompasses approximately 47 acres of former cattle pasture, cropland and riparian forest along Little Buffalo Creek and portions of seven unnamed tributaries (Figures 1 and 2). Little Buffalo Creek is located within the Yadkin River Basin (03040105; 03040105020060). Historic land use at the site had consisted primarily of ranching activities that had allowed cattle access to the stream and riparian zone. Several reaches of the stream have bedrock in their streambed and vertical migration of the stream has been confined to a small percentage of the project site.

1.2 Project Goals and Objectives

The goals of the Little Buffalo Creek Stream Restoration project include, but are not limited to, the enhancement of water quality and aquatic/terrestrial habitat, stream stability improvement, and erosion reduction. The uplift of these stream functions specifically requires:

- Protecting and improving water quality through the removal or minimization of the biological, chemical, and physical stressors:
  - Reducing sediment input into the stream from erosion;
  - Reducing non-point pollutant impacts by removing livestock access (including restoring forested buffer);
  - Protecting headwater springs.
- Improving aquatic and terrestrial wildlife habitat:
  - Moderating stream water temperatures by improving canopy coverage over the channel;
  - Restoring, enhancing, reconnecting, and protecting valuable wildlife habitat.
- Restore floodplain connectivity:
  - Reestablishing floodplain connection thereby dissipating energy associated with flood flows.

In addition to the ecological uplift that the project will provide to the Site through the improvement of the stream functions, this project establishes the following environmentally advantageous goals:

- Providing a water source for livestock removed from the stream and riparian corridor;
- Reducing the number of locations that livestock are able to cross the stream;
- Providing a safe and environmentally appropriate stream crossing point for livestock.

In order to achieve the project goals, WSP (formerly Louis Berger) proposes to accomplish the following objectives:

- Fence the cattle out of the stream and riparian corridor;
- Remove invasive vegetative species from the riparian corridor;
- Restore and enhance unstable portions of the stream;
- Preserve the stream channel and banks through a conservation easement;
- Plant the riparian corridor with native tree and shrub vegetation.

The expected ecological benefits and goals associated with the Little Buffalo Creek site mitigation plan serve to meet objectives consistent with the resource protection objectives detailed in the Yadkin-Pee Dee River Basinwide Water Quality Plan, 2008.

1.3 Project Success Criteria

Streams
For stream hydrology, a minimum of two bankfull events must be documented within the standard 5-year monitoring period. In order for the monitoring to be considered complete, the two verification events must occur in separate monitoring years. All of the morphologic and channel stability parameters will be evaluated in the context of hydrologic events to which the system is exposed.

- Dimension – General maintenance of a stable cross-section and hydrologic access to the floodplain features over the course of the monitoring period will generally represent success in dimensional stability. For stream dimension, cross-sectional overlays and key parameters such as cross-sectional area, and the channel's width to depth ratios should demonstrate relative stability in order to be deemed successful.
- Pattern – Pattern features should show little adjustment over the standard 5-year monitoring period. Rates of lateral migration need to be moderate.
- Profile – For the channels' profile, the reach under assessment should not demonstrate any trends in thalweg aggradation or degradation over any significant continuous portion of its length. Over the monitoring period, the profile should also demonstrate the maintenance or development of bedform (facets) more in keeping with reference level diversity and distributions for the stream type in question. It should also provide a meaningful contrast in terms of bedform diversity against the pre-existing condition. Bedform distributions, riffle/pool lengths and slopes will vary, but should do so with maintenance around design distributions. This requires that the majority of pools are maintained at greater depths with lower water surface slopes and riffles are shallow with greater water surface slopes.
- Substrate and Sediment Transport – Substrate measurements should indicate progression towards, or maintenance of the known distributions from the design phase. Sediment Transport should be deemed successful by the absence of any significant trend in the aggradation or depositional potential of the channel.

Vegetation
Survival of woody species planted at mitigation sites should be at least 260 stems/acre through Year 5. This is consistent with Wilmington District (1993) guidance for wetland mitigation (USACE 2003).

1.4 Mitigation Components and Design
The Little Buffalo Creek Site consists of six reaches along the main stem and seven unnamed tributaries (UTs). The main stem of Little Buffalo Creek as well as UT 4 and UT 7 are perennial streams. The remainders of the UTs are intermittent streams associated with groundwater seeps. This stream mitigation project includes reaches of restoration, enhancement, and preservation along the main stem and the associated UTs. In total, the Site will provide 13,362 linear feet of restoration, enhancement, and preservation (Tables 1 & 4). A summary of restoration and enhancement activity and reporting history can be found in Table 2.

Restoration activities have established a new, stable stream channel with the appropriate dimension, pattern and profile to transport perennial flow and sediment and have re-connected the stream to its floodplain. Reestablishment of native riparian forest vegetation and installation of cattle exclusion fencing were also performed as part of the restoration activities. Enhancement activities included reestablishing native riparian vegetation within a 50-foot easement along each bank of the stream corridor and excluding cattle with fencing. In the case of enhancement level I the activities included reshaping or relocating the bed and banks and riparian forest planting. Preservation was conducted within portions of the stream corridors that have intact riparian forests and stable stream reaches and included excluding cattle with fencing. WSP (formerly

Louis Berger) is contracted with DMS to provide 6,170 stream mitigation units through implementation of the Little Buffalo Creek Stream Mitigation Project. At a 1:1 ratio for restoration, 1.5:1 for enhancement level I, 2.5:1 for enhancement level II, and a 5:1 ratio for preservation, the DMS could receive, as of July 2015, approximately 6,411 stream mitigation units from the Site (Table 1). In addition, approximately 31 acres of riparian buffer have been protected within a 47 acre conservation easement.

The stream credit generation had the potential to increase to 6,450 stream mitigation units as a result of additional enhancement level I work conducted in the fall of 2016 within a portion of UT3. This area, previously assessed as enhancement level II, had additional entrenched portions of the tributary graded to re-connect the channel with its floodplain and the riparian zone replanted. Receiving increased credit for additional work performed in UT3 would require an addendum to the mitigation plan, which was not recommended by IRT during the June 19, 2018 site visit. Additionally, due to insufficient channel flow, UT5 is not anticipated to generate stream credits for enhancement level II work. Therefore, assuming UT5 and additional work in UT3 do not generate stream credit, the DMS could receive a maximum of 6,337 stream mitigation units for the Site.

1.5 Monitoring Year 5 Conditions Assessment

1.5.1 Vegetation Assessment

1.5.1.1 Planted Stems

The planted stem density requirement for Year 5 is 260 stems per acre. When examining planted stems only, in Year 5 of monitoring, all plots are exceeding requirements by 10% (290 to 678 stems/acre). Recruitment of native plant seedlings was recorded in all vegetation monitoring plots (Tables 6, 7, 8, and 9). The current average estimate of 411 planted stems per acre for the site is exceeding the required success criteria of 260 stems per acre.

The increased stems/acre count in vegetation monitoring plot 10 was due to the inclusion of a tulip tree (*Liriodendron tulipifera*) that was originally recorded in early monitoring years, not observed during MY4, but found in MY5. The stems/acre counts remained stable in vegetation monitoring plots 1, 2, 3, and 5. The remaining vegetation monitoring plots (4, 6, 7, 8, 9, 11, and 12) showed a decrease in stems per acre however all plots still met the success criterion for MY5. Vegetation monitoring plots 11 and 4 decreased by only one and two trees respectively.

The reason for the decrease in stems/acre counts in vegetation monitoring plots 6 and 7 was due to volunteer stems being miscounted as planted stems in MY4, which resulted in lower planted stem counts in MY5. Due to the thick coverage of blackberry, planted stems in vegetation monitoring plot 8 were outcompeted or not located, which resulted in a lower stems/acre count. Vegetation monitoring plot 4 had thick sections of natural vegetation that may have made it difficult to locate a swamp chestnut oak (*Quercus michauxii)* and tulip tree in MY5 that were less than 12 inches tall in MY4. Similarly, in vegetation monitoring plot 11, a small swamp chestnut oak was not located during the MY5 survey. For vegetation monitoring plot 12, there were several sugarberry (*Celtis laevigata*) trees which were potentially misidentified and counted as planted stems in MY4 and one planted American hornbeam (*Carpinus caroliniana*) that were not found in MY5.

1.5.1.2 Combined Planted/Volunteer Stems

When examining combined planted/volunteer stems in MY5, all vegetation monitoring plots are exceeding requirements by 10% (339 to 2,759 stems/acre). Recruitment of native plant seedlings was recorded in all vegetation monitoring plots (Tables 6, 7, 8, and 9). The current average estimate of 1,049 combined planted/volunteer stems per acre for the site is exceeding the planted stem success criteria of 260 stems per acre.

1.5.1.3 Volunteer Species/Volunteer Diversity

Species diversity has steadily increased from Year 0 (14 planted), to Year 1 (18 combined planted/volunteer), to Year 2 (18 combined planted/volunteer), to Year 3 (22 combined planted/volunteer), to Year 4 (23 combined planted/volunteer), to current Year 5 (25 combined planted/volunteer). The increase of two species in MY4 was due to direct plantings of slippery elm (*Ulmus rubra*) and blackgum (*Nyssa sylvatica*) in March 2017. The increase for one species in MY5, willow oak (*Quercus phellos*), was due to supplemental plantings that occurred in November 2018.

The remaining increase of species is a result of additional volunteers. In Year 1, three new volunteer species were noted: red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), and eastern red cedar (*Juniperus virginiana*). In Year 2, two new volunteer species were noted: boxelder (*Acer negundo*) and common elderberry (*Sambucus canadensis*). In the Year 3, five new volunteer species were noted: eastern baccharis (*Baccharis halimifolia*), common persimmon (*Diospyros virginiana*), loblolly pine (*Pinus taeda*), smooth sumac (*Rhus glabra*), and sassafras (*Sassafras albidum*). In the Year 4, one new volunteer species was noted: inkberry (*Ilex glabra*). In the current Year 5, four new volunteer species were noted: pawpaw (*Asimina triloba*), river birch (*Betula nigra*), bitternut hickory (*Carya cordiformis*), and white oak (*Quercus alba*).

When comparing planted stems only between Year 4 and Year 5, three vegetation monitoring plots (3, 4, and 10) have seen an increase in species diversity, five vegetation monitoring plots (1, 5, 8, 9, and 11), have maintained species diversity, and four vegetation monitoring plots (2, 6, 7, and 12) lost species diversity. The increased planted stem species diversity in vegetation monitoring plot 3 was due to the addition of a willow oak that was from the supplemental plantings that occurred in November 2018. In vegetation monitoring plots 4 and 10, the increase in planted stem diversity was due to planted stems documented in earlier years being found during MY5 that were not observed in MY4. In vegetation monitoring plots 6 and 7, volunteer stems were miscounted as planted stems in MY4, which resulted in lower planted stem species diversity in MY5. In vegetation monitoring plot 2, an eastern redbud (*Cercis canandensis*) that was present in all previous years of monitoring was not found during MY5, which decreased planted stem species diversity. Similarly, in vegetation monitoring plot 12, there were two species that were not found in MY5 that led to a decrease in planted stem diversity from MY4.

When comparing combined planted/volunteer stems between MY4 and MY5, eight vegetation monitoring plots (1, 3, 4, 6, 7, 8, 10, and 11) saw an increase in species diversity, one vegetation monitoring plot (9) maintained species diversity, and three vegetation monitoring plots (2, 5, and 12) lost species diversity. The increased combined planted/volunteer stem diversity in vegetation monitoring plots 1, 3, 4, 6, 7, 8, and 11 is due to new species recruitment that is to be expected as the site ages and becomes more established. In vegetation monitoring plot 5, a black cherry (*Prunus serotina*) observed in MY4 was not found in MY5, which caused the combined planted/volunteer stem diversity to decrease. The changes in planted/volunteer stem diversity in vegetation monitoring plots 10 (increase), 2, and 12 (decreases) are described as above.

1.5.1.4 Non-plot Assessment

Black willow and silky dogwood (*Cornus amomum*) live stakes throughout the restoration areas are doing well and very few have been observed to be dead. Surviving stakes are continuing to grow quickly and contribute to bank stability. Soft rush (*Juncus effusus*) has become established on parts of the stream bank and is contributing to overbank stability along sections of UT7 and UT3. Additional stability is being provided by grasses and sedges that have become established on banks throughout the site. Volunteer crop cover is no longer present and has been outcompeted by other species such as goldenrods (*Solidago*), asters (*Aster*), dogfennel (*Eupatorium capillifolium*), and native grasses.

Herbaceous cover along reach 1 has improved greatly through the previous reseedings; however, there is a small bare patch, approximately 0.02 acres, with no herbaceous cover on the left bank flood plain. This is due to an exceedance in copper within the soils that is preventing establishment, determined by sediment sampling during MY4. Overall herbaceous cover throughout the site has continued to improve.

1.5.1.5 Invasive Species

Past treatment and removal of privet (*Ligustrum*) and multiflora rose (*Rosa multiflora*) from riparian areas has been mostly successful for Reaches 1-5. Additional treatment during MY4 was primarily focused on princess tree, tree-of-heaven (*Ailanthus altissima*), and privet. During the MY5 monitoring, isolated occurrences have been observed but no significant regrowth is present. Isolated invasive plants have been removed by hand when observed, as feasible. Specific site visits (and minor invasive removal) were conducted by WSP personnel in April, July, October, and December 2019 and January 2020. The majority of encounters were with privet, along Reach 1 and UT 2. A volunteer princess tree (*Paulownia tomentosa*) was observed in vegetation monitoring plot 6 in October 2019 and was removed. The tree was not included in species diversity and stems/acre counts for MY5.

1.5.1.6 Additional Tree Planting

During the June 19, 2018 IRT site visit, Kim Browning, USACE, stated that the trees on the left bank of Reach 4, in entire UT 2, and in entire UT 3 did not exhibit the expected level of vigor (tree height) and recommended planting those areas with more mature trees of at least four different species. In an August 8, 2018 email, DMS verified that there is no success criteria standard for tree height on Little Buffalo Creek but recommended planting the areas the IRT noted with at least 4-foot-high trees as the IRT team will want to see successful vegetation (tree height) onsite at closeout. As such, between November 27-29, 2018, Carolina Silvics planted 300 trees (60 trees along Reach 4, 70 trees along UT 2, 120 trees along UT 3, and 50 trees in Reach 1) that were at least 4-foot-tall and selected for habitat from among twelve recommended species: silver maple, pin oak, white oak, willow oak, black gum, green ash, box elder, pignut hickory, shagbark hickory, mockernut hickory, hackberry, and tulip tree. A healthy willow oak from the November 2018 planting was found during MY5 in vegetation monitoring plot 3. Other trees from the planting were observed during field visits and appeared to be healthy. The additional planting in 2018 is the third occurrence of vegetation supplementation. The prior two events occurred in 2016 and 2017.

Each of the three supplemental plantings (2016, 2017, and 2018) covered between 4-7 acres. However, the planting areas overlapped year-after-year. All three plantings covered significant portions of UT 2 and UT 3. Segments along UT 7 were replanted in 2016, while isolated overbank areas along Reaches 1-4 were planted through all three years. The total replanted area, discounting overlap, is approximately 8.5 acres. Of the originally planted areas (zones 1, 2, and 3) approximately 35% has been subject to additional tree planting between 2016 and 2018 (8.5 ac of 24.2 ac). Figures which highlight the additional planting areas are included in Appendix F.

1.5.2 Stream Assessment

Geomorphologically, the site is functioning as anticipated. Issues identified in MY4 monitoring have been resolved. The following lists the key/potential problems identified through the project during MY4 monitoring and how the issues have been resolved through MY5:

- **Aggradation in Reach 1 Restoration section upstream of the Beaver Dam removal** - Due to the presence of a beaver dam near stream station 23+75, fine material (gravel and sand) has settled out within the channel and interior flood bench upstream of the beaver dam. This was caused by the backflow condition upstream of the beaver dam during flood events. The aggradation was evident in the MY4 profile survey, MS-1P cross section, and field observations. The aggradation was not

removed during the beaver dam removal in Year 4 as it would cause significant damage to the very well-established vegetation within the channel. Based on the visual gradation of this material, it was believed that additional storm events would remove the majority of this material and allow the channel to rebound to its condition prior to the beaver establishing the dam. During a November 16, 2018 site visit, the dam restoration area was noted to be stable. Observations made during MY5 field visits confirmed the channel is returning to its condition prior to the beaver dam. At this time, no maintenance work is being proposed for this area and it is assumed the channel will continue to transport the fine material naturally.

- **No defined channel for 230 feet portion of UT 2 (wetlands)** ***(continued from MY3)*** – As noted in the MY4 report, sections of UT 2 (station 15+30 to 17+60) were targeted for additional monitoring to ensure sufficient channel development and appropriate function. Continuous flow was noted during multiple field visits in MY5. The area of concern has decreased in length to approximately 100 feet (16+10 to 17+10). Even in this shortened section, WSP observed evidence of a defined channel during a January 2020 field visit. As such, the aggradation shape has been removed from the CCPV. Photo documentation of this location has been provided in Appendix B including several photos from July 2019 and January 2020. WSP will continue monitoring this area through project closeout.

The following lists the key/potential problems identified through the project during Year 5 monitoring:

- **Additional sediment aggradation in UT3 due to erosion/washout of old cattle crossing** – Adjacent to Old Mine Road, at the upstream end of UT 3, an old piped crossing is failing. The soil over this pipe is washing downstream and slowly raising the bed profile along the upstream section of UT 3. This is apparent in the profile plots (Figure 3a-k). The aggradation is most apparent between 10+20-11+20 and 12+40-13+25. The section starting at 10+20 exhibits typical channel characteristics (bed and banks). The channel section from 12+40 to 13+25 is less defined. Both sections will be monitored through project closeout. Additionally, a contractor has been scheduled to move and re-stabilize the crossing to eliminate the potential for any future sediment aggradation due to erosion of the crossing. All work will occur outside of the conservation easement.

- **Increased hydrology runoff in UT2 due to dam blowout** – Along the upstream extent of UT2, outside of the conservation easement, the area around the outflow pipe from the pond has blown out. This pond provides UT2 with its source hydrologic input. This was observed at the year 5 walkthrough with DMS in March 2020. The blowout has resulted in increased surface water volume entering UT2 due to an expanded conveyance around the outflow pipe. This increased hydrology is most evident within the area previously described as a linear wetland feature. A headcut has formed and has continued migrating upstream. The headcut has resulted in a more defined channel within the area. Bedrock is present both upstream and downstream, which will serve as vertical control as the channel adjusts to the increased hydrology. WSP will collect additional field data through project closeout. The additional data will include a rough estimate of bedrock locations/elevations through use of a probe rod. Currently WSP believes the stream will reach equilibrium and the headcut migration will quicken the process of channel formation. Immediately downstream of the headcut, there is a well-defined channel, along a section which had previously been described as a linear wetland.

- **Beaver dams present in UT 7** – Evidence of beavers was observed along UT 7 during the fall/winter of 2019. Two separate beaver dams, near stream stations 12+50 and 16+00, were observed and removed in early fall 2019. The larger of the two dams was rebuilt by winter (near stream station 16+00). A trapper successfully removed the beavers and dam in December 2019. Effects from the

beaver dam such as high debris lines, very fine sediment deposition, and a reduction of herbaceous vegetation cover on the stream banks of UT 7 were observed during the January 2020 field visit. It was also noted that the pool feature immediately upstream of the dam location has widened, cutting into the previously willow vegetated banks where beaver had cut the trees down. It is expected that over time the stream banks and channel will recover and the willow remnants will re-grow.

- **Cow encroachment in Reaches 3-5, UT 3, and UT 4** – Cattle encroachment was observed in October 2019 during an extreme drought season. Several cows were observed, a few of which were dead. The land/cattle owners and DMS were contacted immediately upon observation and the cattle were removed as quickly as possible. No major damage was observed to the channel or easement. Minor vegetation damage (trampling of grass) and one location which showed evidence of cows crossing the channel were observed. The area of cows crossing the channel was along UT 4, near vegetation plot 5. No impacts to vegetation plot 5 were observed. Signs of cattle, including cow pies and tracks, remained into the winter. Based on the location of the cattle, and their tracks, it appears the cows were entering the fenced easement at the existing cattle crossing and the crossing is in need of modifications for electrical connections. These modifications have already been discussed with DMS and the landowners and is expected to be completed by the end of April 2020. During the January 2020 field visit, two cows were observed in UT4. It is believed the two cows recently entered the site through a section of the cattle crossing. The landowners were already aware that they were loose and working to remove them at the time of the visit. DMS was immediately notified.

  Signs of cattle encroachment were also evident during the March (2020) pre-closeout site visit with NC DMS. The primary areas of encroachment corresponded with the same locations noted in October. As such, no changes were made to the CCPV or Table 6. Preventing cattle encroachment will be a focus through project closeout. Frequent site visits and coordination with stakeholders will be crucial as the project progresses. A final update will be provided in the closeout report.

No future channel maintenance is proposed at this time for MY5. Any maintenance work identified going forward will be limited to hand work to the maximum extent possible as heavy equipment would likely cause more damage than benefit.

As mentioned above, there is work planned at the upstream end of UT 3 to replace the crossing in a stable location near Old Mine Road. Additionally, a fencing contractor is scheduled to install final improvements at the main cattle crossing as well as near the crossing at Old Mine Road. All work is to occur outside (or at the boundary) of the conservation easement. No heavy machinery will be in the stream channel or within the easement.

The stream restoration and enhancement areas are relatively stable and will continue to adjust somewhat in response to storm events. Gauge data throughout the site indicate six different bankfull events during the MY5 monitoring period (Table 12). The bankfull event that occurred on December 20, 2018 was included in the total number of bankfull events for MY5. Of the remaining five events, three occurred in the spring, one occurred in the summer, and one occurred in the fall of 2019. The in-stream structures are remaining stable and functioning as designed and have had no change in functionality since MY4.

As commented by DMS in MY2 and MY3; as well as discussed with the IRT during the June 19, 2018 Site Visit; UT 2, UT 3, and UT 5 are being monitored to confirm continuous flow for 30 consecutive days within the intermittent streams. Table 13 provides documentation of the continuous flow periods for all areas for each monitoring year. Gauge 11 in UT 5 did not have a 30-day period of continuous flow during MY5 and is the only gauge that did not record a 30-day period of continuous flow for multiple years. As such, gauge 11 was removed in July 2019 and repurposed elsewhere as replacement hardware. All other gauges,

including those in UT 2 and UT 3, indicated a period of continuous flow for 30 days or more, as observed in the water level plots of Figure 6a-6e and summarized in Table 13. Gauge 6 in UT 3 could not be found for a significant portion of the year and was finally replaced in October. The period of data analysis for gauge 6 flow was extended beyond the other gauges to demonstrate a 30-day period of continuous flow in UT 3. It is possible other 30-day continuous flow periods occurred earlier in the year that in which the data was not recovered.

It should be noted that continuous data for the entire monitoring year is not available for five gauges during MY5. A summary of the data gaps is provided below:

- **UT 2 Lower - Gauge 3 (Missing Data: 08/21/2019 – 10/09/2019):** Due to vegetation overgrowth, this gauge could not be found during the spring/summer/fall site visits. The gauge was found in December 2019 once vegetation coverage decreased during seasonal retreat. Attempts to locate the gauge were made during all previous site visits, including the use of a metal detector. In October 2019 a replacement gauge was installed. Once the gauge was found in December, data was downloaded. The downloaded data covered through August, at which point the logger ran out of memory. As such, the gap in data is limited to the period between August when the old gauge ran out of memory and October when the new gauge was installed.

- **UT 3 Upper - Gauge 6 (Missing Data: 11/18/2018 – 10/09-2019):** Similar to gauge 3, gauge 6 could not be found during any of the site visits early in the year. Hoping to find the gauge once vegetative growth slowed down, a replacement gauge was not installed until October 2019. The original gauge was never found, even through use of a metal detector. The original gauge is likely buried or washed downstream. The available data from the replacement gauge is presented in this report.

- **UT 3 Upper - Gauge 9 (Missing Data: 07/11/2019 – 08/27/2019):** Gauge 9 was never missing or replaced. The data was downloaded during all site visits when other gauges were downloaded. The gap in data is due to an error in the gauge or mistake in the setting of the delayed restart after downloading data that was corrected during a follow up site visit.

- **UT 5 - Gauge 11 (Missing Data: 07/10/2019 – Present):** Due to a lack of continuous flow during MY4 and MY5 the gauge was removed during the early fall.

- **UT 2 Lower - Gauge 13 (Missing Data: 08/21/2019 – 12/19/2019):** Similar to gauge 3, gauge 13 could not be found during the spring/summer/fall site visits. The gauge was found in December 2019 with decreased vegetation coverage in the winter season However, unlike gauge 3, no replacement was installed in October 2019. As such, no data is available from the time the gauge ran out of memory (August 2019) to when it was found and restarted (December 2019).

In order to interpret the provided gauge data, a summary of rainfall totals has been provided below. Total annual rainfall for MY5 was the second highest recorded for all years of monitoring. The North Carolina Drought Management Advisory Council (https://www.ncdrought.org/) reported moderate drought conditions in the area from September 24 to October 22, 2019.

	Rainfall in inches*					
	Year 0 (2014)	**Year 1 (2015)**	**Year 2 (2016)**	**Year 3 (2017)**	**Year 4 (2018)**	**Year 5 (2019)**
January - March	8.97	5.75	7.86	8.56	14.14	14.20
April – June	8.33	6.29	9.37	17.67	12.47	10.65

July – September	14.57	7.9	9.23	8.92	26.78	9.13
October - December	6.9	25.3	11.43	6.09	20.28	13.43
Total	**38.77**	**45.24**	**37.89**	**41.24**	**73.67**	**47.41**

*Gauge NC-SN-6, Richfield, https://www.cocorahs.org/ViewData/StationPrecipSummary.aspx

As discussed in the MY4 report, gauge 11 had been added in UT 5 to determine if there were periods of continuous flow. Initial coordination was conducted between WSP (formerly Louis Berger), DMS, and the USACE regarding inclusion of UT 5 in this project. However, due to the lack of continuous flow, the gauge was removed during early fall, and no credit is anticipated for UT 5.

1.5.3 Site Boundary Assessment

1.5.3.1 Easement Modification

During MY4, the easement boundary modification was revised near the cattle crossing to include one new corner and remove the cattle crossing limits. This modification has been accepted by the State and finalized. No modifications to the easement boundary occurred during MY5.

The easement was marked with additional posts and signs during August 2019. These additional markings were installed along UT 7 and Reach 6.

1.5.3.2 Encroachments

During site visits to conduct vegetation monitoring in October 2019, WSP personnel observed cattle within the easement. No holes in the fence were observed. Based on the location of the cows and condition of the fence at the crossing, it appears the cattle entered the easement at the cattle crossing during the drought period. Signs indicated the cows may have passed under or over the fence with PVC slats along the north side of the crossing.

There appeared to be 10-12 live cows in the easement, as well as 5 dead cows. An additional 3-4 dead cows were observed in the adjacent field to the cattle crossing. The land/cattle owners reported that all cows (both live and dead) were removed from the easement within two weeks. DMS was alerted immediately and coordinated directly with the land owners as appropriate.

The October 2019 event resulted in cows within the easement upstream of the cattle crossing, along Reaches 3-5, UT 3, and UT 4. No significant damage was observed due to this event, however, fresh cow pies and trails in the outer extents of the easement corridor were observed during the engineering monitoring event. Final improvements to the fence at the cattle crossing should prevent future encroachment as well as facilitate any future maintenance required by the land owners following project closeout. In January 2020, there were two cows spotted within the conservation easement in UT 4, although no damage to any stream channels was observed. Cow pies were noted along the stream banks of UT 3, UT 4, and the mainstem. Landowners were aware during the field visit and were already working to remove the cattle.

Again, DMS was contacted immediately after the cows were observed. Paul Wiesner with DMS instructed WSP to work with the landowner to ensure swift removal from the easement. Additionally, Paul indicated that it might be helpful to invite the land owners to the pre-closeout meeting scheduled for March 2020. Property specialists have been invited to the meeting as well.

As mentioned in section 1.5.2 (above), signs of encroachment were again observed in March 2020, during the pre-closeout site visit. Representatives from WSP and NC DMS discussed this issue with Allen Hammill.

The team reiterated the importance of excluding cattle from the conservation easement. WSP will continue to monitor the site and coordinate with the stakeholders through project closeout.

1.5.3.3 Final Maintenance Work

On August 28th, 2019 a meeting was held with Allen Hammill at the project site. Modifications were discussed regarding the fence and grading at the crossings, as well as a few additional maintenance items. The notes from the meeting are included below. This work is scheduled to be completed by Kenneth Strader and KBS earthwork but has not been conducted yet. The improvements should be complete by the end of February 2020 and has only been delayed due to seasonal rainfall affecting the contractor's backlog. All work is to be conducted outside of the conservation easement.

- **Cattle Crossing on Mainstem** – Wood posts in the channel and barbed wire (downstream side) and PVC slats crossing (upstream side) will be removed and replaced with electrified breakaway wire from the corner posts. Approximately 3 lines on both the upstream and downstream side will be installed. All lines will be connected to be electrified. Vertical wires on the bottom line on both upstream and downstream sides will be added and crimped at a 6-12 inch spacing to the bottom line running perpendicular to the stream. Vertical crimped lines will drape to approximately 6-inches above the waterline/ground.

- **Fence across UT 1 just upstream of Old Mine Road** – The PVC slat line/gate structure will be removed and replaced with electric breakaway wire as described above and connected to the existing fence along Old Mine Road for the property owner to attach live lines to it if cows are brought into the field. There may be the need for 4-5 lines crossing this stream depending on the depth of the opening.

- **Cattle crossing at the top of UT 3** – The conservation easement fence will be relocated to the conservation easement line (approximately 0.5-feet off of the easement). The gate from the north side of the fence will be relocated to the south side (opposite corner from where it is at now). The fence currently in place going up to and across the embankment will be removed. Blackberry vegetation/shrubs from the embankment will be removed and disposed of offsite. The exposed concrete pipes at the outfall will be re-stabilized. Backfill material will be used to establish a smooth slope transition for a 15-foot wide cattle crossing immediately upstream of the relocated fence between the embankment and conservation easement. The existing 4-foot CMP under the road at the outfall will also be cleaned to remove built up soil.

1.5.4 Monitoring Year 5 Conditions Assessment Summary

Streams

In summary, the site is performing as intended through MY5 and is meeting the required success criteria going into project closeout. The site has experienced more than two bankfull events through MY5, as well as experienced bankfull events in each monitoring year. Cross sections show stability in channel dimensions through MY5, with the exception of minor aggradation in UT 3 and a section of widening in UT 7 from the beaver dam which has now been removed. Small deviations have occurred since construction of the channel geometry; however, this is to be expected and is within reason for a stable and successful restoration project. Pattern features have remained consistent, with only minor changes occurring in short sections of channel reaches. Pattern feature changes observed have been directly identified as the result of natural occurrences within channels and are not related to failures in design. Channel profiles, following the events of MY2 with major cattle encroachment, remain consistent. Areas affected by the MY2 encroachment show increased signs of stability and improved vegetation coverage despite the encroachment incident. Areas within UT 2

and UT 3 have been monitored more closely to ensure that stable channel development persists, as well as continuous flow. Lastly, bedform diversity and substrate/sediment transport measurements are as designed and indicated overall stability in the project through MY5.

Vegetation

Through MY5, planted woody species are meeting the density requirements of 260 stems/acre through the entire site. Additional plantings of larger species occurred in November 2018 in isolated areas showing lack of tree height or other deficiencies, per discussions and recommendations of the IRT and DMS. A significant rebound in planted woody vigor occurred between MY3 and MY4 thanks to the very wet season in MY4. This continued through MY5 and overall vigor for planted trees remained healthy with a majority of trees exhibiting only minor damage, if any. Lastly, the site is continuously being monitored and treated for invasive species. As of the end of the MY5 monitoring period, the site is 100% in compliance with vegetation monitoring requirements.

2.0 Methodology

Monitoring for stream stability, stream hydrology, and vegetation will be monitored annually for five years following the initial Baseline and As-Built Report. Annual monitoring requirements are based on the U.S. Army Corps of Engineers *Stream Mitigation Guidelines* document (USACE 2003) and supplemental requirements listed in the DMS *Stream and Wetland Mitigation Monitoring Guidelines* dated February 2014 (NCEEP 2014). Establishment, collection, and summarization of data collected was in accordance with the NCDEQ guidance document *EEP Annual Monitoring Report Format, Data Requirements, and Content Guidance* (April 2015). Additionally, DMS provided new bank height ratio calculation procedures (un-published) in 2018 to be implemented in MY4 and MY5, which modifies observations to maintain as-built bankfull area in determining bank height ratios versus as-built bankfull elevations.

2.1 Geomorphology

Surveys for Year 5 monitoring were conducted by WSP in December/January 2019/2020 using a Total Station, geo referenced to North Carolina State Plane (NAD83-State Plane Feet-FIPS3200) with vertical datum North American Vertical Datum of 1988 (Feet NAVD88).

2.2 Longitudinal Profiles

A total of approximately 2950 feet of channel along 8 longitudinal profiles is being surveyed annually. This includes 335 feet on LBC Reach 1; 225 feet on LBC Reach 3; 112 feet on LBC Reach 4; 51 feet on UT 2; 771 feet on UT 3; 411 feet on UT 4; 977 feet on UT 7; and 62 feet on UT 8. Data collected from annual monitoring is being compared with the as-built conditions to document the current state of the channel and any trends in the stream profile occurring throughout the monitoring period. The start and finish locations of each cross-section and longitudinal profile are collected using a Total Station.

2.3 Cross Sections & Particle Size Distribution

A total of 15 cross-sections, including 9 riffles and 6 pools were installed upon completion of construction and are being monitored annually. Two additional cross-sections were added within the step-pool portion of UT 7 in monitoring Year 2. The total number of cross-sections includes five on the main stem of Little Buffalo Creek, one on UT 2, four on UT 3, two on UT 4, and five on UT 7.

Pebble count surveys were conducted at each cross section, unless noted otherwise in this report. Moving from bank to bank, particles were picked up blindly and at random and measured in millimeters. Enough samples were taken to get a representative sample of particle size distribution for each cross section. Sample size ranged from 50 in pool areas dominated by fines to 100 in flowing riffle areas with a diversity of particle sizes.

2.4 Vegetation Monitoring

The Carolina Vegetation Survey (CVS)-DMS entry tool database was used to calculate the number of monitoring plots needed based on project acreage. Louis Berger (now WSP) established twelve vegetation monitoring plots across all reaches and tributaries of the project area based on guidance given in the *CVS-DMS Protocol for Recording Vegetation Version 4.2* (Lee et al. 2008). Each plot measures approximately 0.025 acres individually and is staked out with bright orange painted rebar and marked with two upright sections of PVC pipe. Photos were taken of each plot and yearly monitoring data was entered into the CVS-DMS database under the Little Buffalo Creek Stream Mitigation Project (Project ID 94147). Additional PVC markers were added to plot corners during Year 2 in order to make corner stakes easier to find among the increasing herbaceous cover.

For a monitoring event, rope is tied around the four corner stakes to mark out the plot. In Year 0, a GPS was used to collect coordinates of each stem and their position was measured in relation to the X and Y axis of the plot. Additionally, each stem was marked with pink flagging to make them easy to locate and identify during the next monitoring event. Flagging is re-applied each year. Planted stems were identified, measured, and given a vigor score ranging from 0 to 4 based on the CVS-DMS database. Naturally recruited stems were identified and tallied but marked as recruits in the database.

In MY4, random vegetation transects monitoring occurred along UT 3 (vegetation monitoring plot 3), Reach 4 (vegetation monitoring plot 4), UT 2 (vegetation monitoring plot 8), and Reach 1 (vegetation monitoring plot 11). The 10 x 10 meter random transect plots were randomly placed in the vicinity of the anchoring vegetation plot. The random plot was established by running a measuring tape 10 meters in a random direction. With the first measuring tape laid down, a second measure tap was run out 10 meters, intersecting at a right angle with the first measuring tape at the 5 meter mark. All living stems over 1 foot in height were counted in the four 5 x 5 meter quadrants and aggregated for the 10 x 10 meter random plot. The locations of the random plots were noted but no permanent markings were placed on the ground. The random plot data was manually entered into a CVS-DMS database excel spreadsheet (retaining all formulas) to obtain stems/acre data comparable to the established vegetation monitoring plots.

2.5 Hydrological Monitoring

A total of 13 water level gauges are installed on site, including three groundwater monitoring gauges. The gauges are being monitored biannually to document the highest stage for the monitoring interval and verify occurrences of bankfull and geomorphically significant flow events. In addition, observations of wrack and depositional features in the floodplain, if present, are being documented with photos. In February 2016, two groundwater monitoring wells were installed at the top and bottom of UT 3 to provide additional hydrological data to demonstrate groundwater connectivity to the stream channel. In September 2018, an additional groundwater gauge was installed in UT 2 and an additional surface water gauge was installed in the mid-section of UT 3.

In addition to the event stage monitoring, the gauges are being utilized to monitor base flow for verification of water flow for a continuous 30-day period. Gauges are secured in place through PVC structures in channel pools (Reach 1, Reach 4, UT 4 and UT 7), or in the channel bed (UT 2, UT 3). Elevations are tied to the gauge structures, in which the thalweg invert elevation immediately downstream of the gauge is also monitored. Base flow is recorded when the elevation of water recorded by the gauge rises above the downstream thalweg control elevation.

A surface water gauge was installed in UT 5 during the MY4 monitoring to monitor for continuous flow, but was subsequently removed due to the data not showing continuous flow and the channel appearing dry during a wet year and season.

2.6 Photo Points & Visual Assessment

Permanent photo stations were established at each cross-section to digitally document annual conditions of the left and right banks. Each vegetation monitoring plot includes a photo station taken diagonally from a plot corner towards the opposite plot corner. Additional permanent photo locations have been established throughout the project area and can be found on the Current Conditions Plan View (CCPV) maps in Appendix A. Visual stream assessments are conducted during annual monitoring to summarize performance percentages of morphological and structural features. Visual vegetation assessments are also occurring to catalog the extent and type of vegetation issue as compared to the total planted acreage within the project site.

3.0 References

NCDEQ: DMS 2018. Bank Height Ratio Guidance – Unpublished

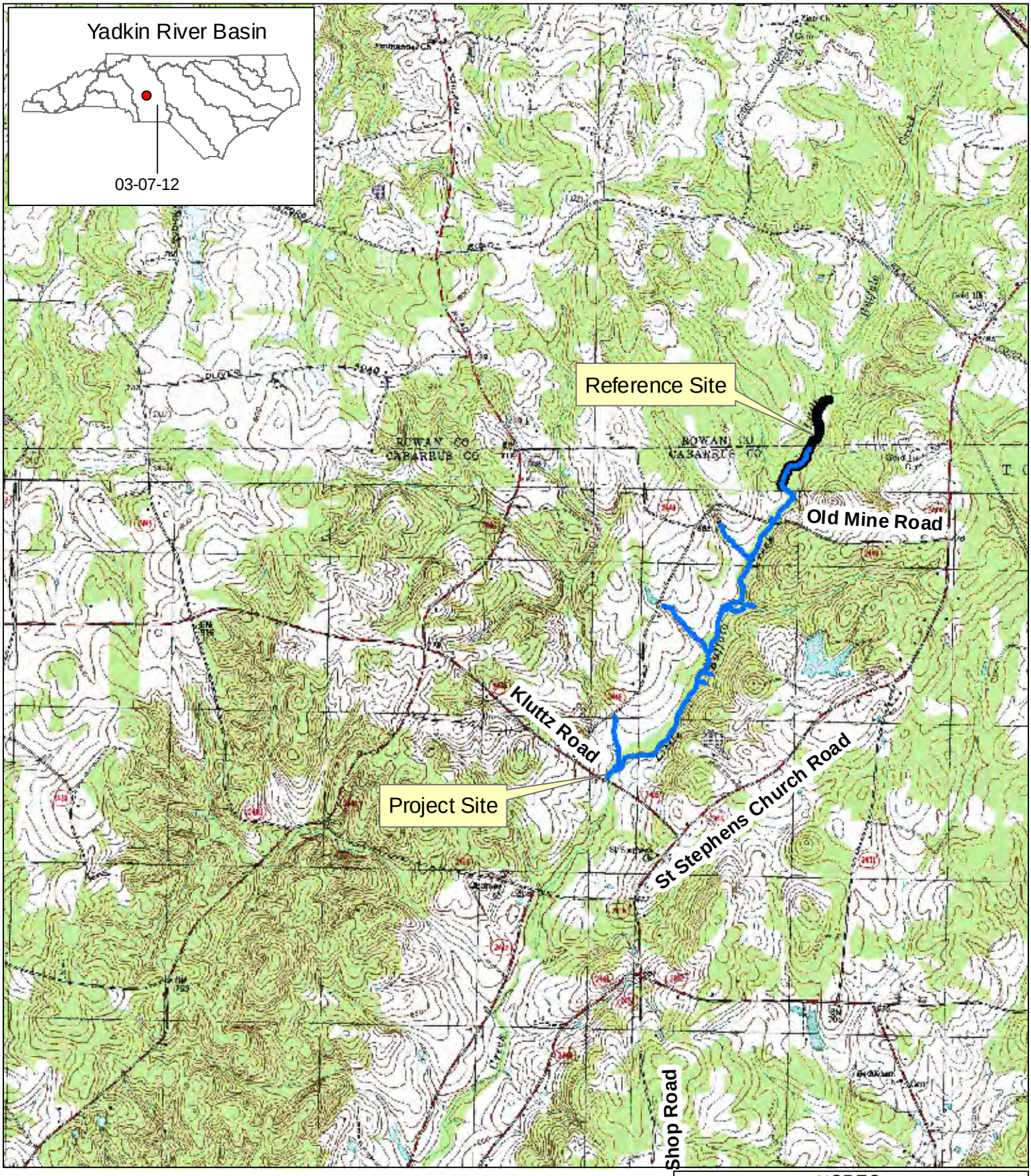
Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-DMS Protocol for Recording Vegetation, Version 4.2 (http://cvs.bio.unc.edu/methods.htm).

National Oceanic and Atmospheric Administration. Historical Palmer Drought Indices. December 2014 through November 2015. http://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/psi/201412-201511/. Accessed October 2016.

North Carolina Ecosystem Enhancement Program 2014. *Stream and Wetland Mitigation Monitoring Guidelines*. February 2014. 7pp.

USACE 2003. Stream Mitigation Guidelines. Prepared by: USACE, NCDWQ, USEPA, NCWRC.

Appendix A – Project Vicinity Map & Background Tables



Legend

- Project Stream Segments
- Reference Reach

N

0 0.5 1 Miles

Source: USGS Topographic Quads: Gold Hill, Rockwell, Richfield, and Mount Pleasant, NC

NCDEQ
Division of Mitigation Services

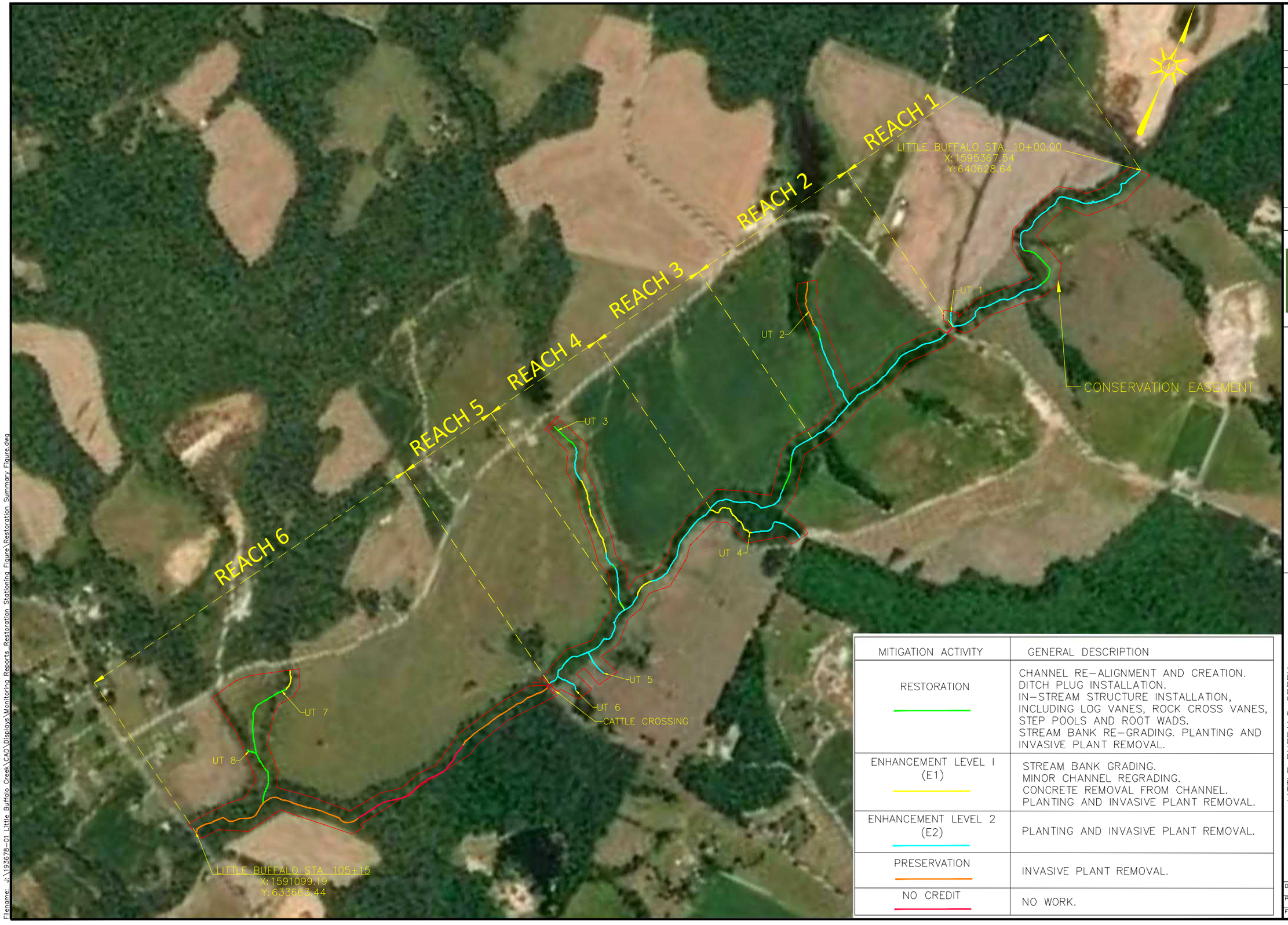
Little Buffalo Creek Creek
Stream Restoration, Cabarrus County, NC
DMS Project # 94147

Project Location Map

THE LOUIS BERGER GROUP
1001 Wade Avenue, Suite 400
Raleigh, NC 27605

Figure 1

November 2016



MITIGATION ACTIVITY	GENERAL DESCRIPTION
RESTORATION	CHANNEL RE-ALIGNMENT AND CREATION. DITCH PLUG INSTALLATION. IN-STREAM STRUCTURE INSTALLATION, INCLUDING LOG VANES, ROCK CROSS VANES, STEP POOLS AND ROOT WADS. STREAM BANK RE-GRADING. PLANTING AND INVASIVE PLANT REMOVAL.
ENHANCEMENT LEVEL I (E1)	STREAM BANK GRADING. MINOR CHANNEL REGRADING. CONCRETE REMOVAL FROM CHANNEL. PLANTING AND INVASIVE PLANT REMOVAL.
ENHANCEMENT LEVEL 2 (E2)	PLANTING AND INVASIVE PLANT REMOVAL.
PRESERVATION	INVASIVE PLANT REMOVAL.
NO CREDIT	NO WORK.

NO.	REVISIONS	DRN.	CHK.	DATE

NCDEQ-DMS

WSP USA Inc.
434 Fayetteville Street
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www.wsp.com

LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

PROJECT COMPONENTS MAP

DATE MARCH 2020
PROJECT NO. 94147
FIGURE A1

Filename: J:\193678-01 Little Buffalo Creek\CAD\Displays\Monitoring Reports_Restoration Stationing Figure\Restoration Summary Figure.dwg

Table 1. Project Components and Mitigation Credits
Little Buffalo Creek Stream Mitigation Project
DMS Project No. 94147

Mitigation Credit Summations

	Stream	Riparian Wetland	Non-riparian Wetland	Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset			
Overall Mitigation Units	6,411	0	0						

Project Components

Reach ID	Stationing	Existing Feet (linear feet)	Restoration Footage or Acreage	Restoration Level	Restoration or Rest Equiv.	Mitigation Ratio	Stream Mitigation Units	Notes
Reach 1	10+00 to 33+05	2,305	377 R 1928 EII	Restoration Enhancement Level II	N/A	Restoration 1:1 Enhancement Level II 2.5:1	1148	
Reach 2	33+66 to 46+10	1,244	1244 EII	Enhancement Level II	N/A	Enhancement Level II 2.5:1	498	
Reach 3	46+10 to 56+93	1,083	244 R 839 EII	Restoration Enhancement Level II	N/A	Restoration 1:1 Enhancement Level II 2.5:1	580	
Reach 4	56+93 to 66+62	969	151 EI 818 EII	Enhancement Level I Enhancement Level II	N/A	Enhancement Level I 1.5:1 Enhancement Level II 2.5:1	428	
Reach 5	66+62 to 74+88	826	826 EII	Enhancement Level II	N/A	Enhancement Level II 2.5:1	330	
Reach 6	75+19 to 82+55; 91+89 to 104+96	2,043	2,043 P	Preservation	N/A	Preservation 5:1	409	
UT 1	10+00 to 11+11	111	111 EII	Enhancement Level II	N/A	Enhancement Level II 2.5:1	44	
UT 2	10+00 to 19+51	951	49 R 567 EII 335 P	Restoration Enhancement Level II Preservation	N/A	Restoration 1:1 Enhancement Level II 2.5:1 Preservation 5:1	343	
UT 3	10+00 to 24+75	1,475	305 R; 536 EI 634 EII	Restoration Enhancement Level I Enhancement Level II	N/A	Restoration 1:1 Enhancement Level I 1.5:1 Enhancement Level II 2.5:1	916	There is the potential to increase stream mitigation units after
UT 4	100+00 to 18+31	831	410 EI 421 EII	Enhancement Level I Enhancement Level II	N/A	Enhancement Level I 1.5:1 Enhancement Level II 2.5:1	442	
UT 5	10+00 to 11+84	184	184 EII	Enhancement Level II	N/A	Enhancement Level II 2.5:1	74	At risk to not get credit due to lack of continous flow.
UT 6	10+00 to 11+51	151	151 EII	Enhancement Level II	N/A	Enhancement Level II 2.5:1	60	
UT 7	10+00 to 21+27	1,127	980 R 147 EI	Restoration Enhancement Level I	N/A	Restoration 1:1 Enhancement Level I 1.5:1	1078	
UT 8	10+19 to 10+81	62	62 R	Restoration	N/A	Restoration 1:1	62	

Note: Due to rounding some of the values when added may appear to be 1' short of total, this is purely a product of values being rounded to nearest linear foot

Length and Area Summations

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-riverine			
Restoration	2,017	N/A	N/A	N/A	201,700	N/A
Enhancement	N/A	N/A	N/A	N/A	N/A	N/A
Enhancement I	1,244	N/A	N/A	N/A	124,400	N/A
Enhancement II	7,723	N/A	N/A	N/A	772,300	N/A
Creation	N/A	N/A	N/A	N/A	N/A	N/A
Preservation	2,378	N/A	N/A	N/A	237,800	N/A
High Quality Preservation	N/A	N/A	N/A	N/A	N/A	N/A

BMP Elements

Element	Location	Purpose/Function	Notes

Table 2: Project Activity and Reporting History		
Little Buffalo Creek Stream Mitigation Project		
DMS Project No. 94147		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Technical Proposal	June 2009	August 2008
Categorical Exclusion	February 2010	March 2010
Secure Conservation Easement	March 2010	July 2012
Mitigation Plan	August 2010	April 2014
Final Design – Construction Plans	N/A	May 2014
Construction	June 2014	December 2014
Fencing Installation	June 2014	December 2014
Native Species Planting	December 2014	December 2014
Mitigation Plan / As-built (Year 0 Monitoring – Baseline)	March 2015	June 2015
Year 1 Monitoring	September 2015	December 2015
Replanting & Reseeding	N/A	February 2016
Year 2 Monitoring	September 2016	January 2017
Replanting & Reseeding	N/A	March 2017
Invasive Treatment	N/A	March 2017
Fence Repairs	N/A	December 2016
Construction Repairs	N/A	September 2016
Year 3 Monitoring	September 2017	February 2018
Beaver Trapped and Dam Breached	N/A	March 2018
Land Owner Coordination Meeting/Invasive Vegetation Walk Through/Soil Sample Collection	N/A	April 2018
Invasive Treatment - Spring	N/A	May 2018
Cattle Crossing and Fence Repairs	N/A	June 2018
IRT Site Visit and Additional Easement Sign Installation	N/A	June 2018
Invasive Treatment - Fall	N/A	September 2018
Beaver Dam Removal and Repair	N/A	November 2018
Replanting & Reseeding	N/A	November 2018
Year 4 Monitoring	September - November 2018	March 2019
Cattle Crossing Fence Repair and Ammendment	N/A	June 2019
Easement postings installed, beaver dam removal and Stewardship Meeting	N/A	August 2019
Year 5 Monitoring	October 2019	March 2020
Beaver Trapped and Dam Removed	December 2019	January 2020
Crossing Relocation/Repair and Fence Repair/Ammendment	January 2020	May 2020

Table 3: Project Contact Table Little Buffalo Creek Stream Mitigation Project DMS Project No. 94147	
Designer Primary Project Design POC	WSP USA Inc. 412 Mount Kemble Ave, PO Box 1946 Morristown, NJ 07962-1946 Edward Samanns (973) 407-1468
Construction Contractor **Construction contractor POC**	Backwater Environmental, Doug Smith P.O. Box 1107 Eden, NC 27289
Fencing Contractor	Strader Fencing Inc 5434 Amick Road Julian, NC 27283
Planting and Invasive Treatment Contractor	Carolina Sylvics 908 Indian Trail Edenton, NC 27932
Nursery Stock Suppliers	Mellow Marsh
	1312 Woody Store Rd.
	Siler City, NC 27344
	919-742-1200
	ArborGen Inc.
	2011 Broadbank Court
	Ridgeville, SC 29472
	843-851-4129
	Superior Trees Inc.
	12493 US-90
	Lee, FL 32059
	850-971-5159
Monitoring Performers	WSP USA, Inc. 434 Fayetteville Street, Suite 1500 Raleigh, NC 27601
Stream Monitoring POC	WSP USA, Inc., Jonathan Becker (919-836-4056)
Vegetation Monitoring POC	
Landowner Contact Information	Allen Hammill - landowner(704) 433-4656
	Larry Hammill - landowner (704) 202-3905
	Phil Cline - landowner (704) 791-6819
	Marcus Harward - landowner (704)-322-0840
Farmhand Contact Information	Marcus Harward - farm operator (704)-322-0840
	Garrett – Marcus' cow handler (704) 785-6487

Table 4 Project Information			
Project Name	Little Buffalo Creek Stream Mitigation Project		
County	Cabarrus County		
Project Area (acres)	12		
Project Coordinates (latitude and longitude)	35.491041°N, . -80.366698° W.		
Project Watershed Summary Information			
Physiographic Province	Piedmont		
River Basin	Yadkin-Pee Dee River		
USGS Hydrologic Unit 8-digit	3040105	USGS Hydrologic Unit 14-digit	3040105020060
DWQ Sub-basin	03-07-12		
Project Drainage Area (acres)	4,039		
Project Drainage Area Percentage of Impervious Area	5%		
CGIA Land Use Classification	Rural		
Thermal Regime	Warm		

Reach Summary Information (Mainstem)

Parameters	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Length of reach (linear feet)	2,305	1,244	1,083	969	826	2,043
Valley classification	Type 8	Type 8	Type 8	Type 8	Type 8	Type 8
Drainage area (acres)	1914	2146	2446	2568	2632	4039
NCDWQ stream identification score	37.5	37.5	37.5	37.5	37.5	37.5
NCDWQ Water Quality Classification	C	C	C	C	C	C
Morphological Description (stream type)	C4/F4	C4/E4	C4/F4	C4	C4/D4b	C4
Design Rosgen Stream Type	C4	C4	C4	C4	C4	C4
Evolutionary Trend						
Design Approach (P1, P2, P3, E, etc)	R; EII	EII	R; EII	EI; EII	EII	P
Underlying mapped soils	Chewacla/ Goldston	Chewacla	Chewacla	Chewacla	Chewacla	Chewacla
Drainage class	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained
Soil Hydric status	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric
Slope	0.48%	0.38%	0.51%	0.39%	0.47%	0.43%
FEMA classification	N/A	N/A	N/A	N/A	N/A	N/A
Native vegetation community	Pasture	Pasture	Pasture	Pasture	Pasture	Pasture
Percent composition of exotic invasive vegetation						

Reach Summary Information (Unnamed Tributaries

Parameters	UT 1	UT 2	UT 3	UT 4	UT 5	UT 6	UT 7/UT 8
Length of reach (linear feet)	111	951	1,475	831	184	151	1,127
Valley classification	N/A	Type 2	Type 2	Type 2	N/A	N/A	Type 8
Drainage area (acres)	293	193	62	254	8	16	1222
NCDWQ stream identification score	21	20	26.5	36.5	27.5	24.8	36.5
NCDWQ Water Quality Classification	C	C	C	C	C	C	C
Morphological Description (stream type)	N/A	B6	B6/G6	B4c	N/A	N/A	F4
Design Rosgen Stream Type	No Restoration	B6	B6	B4c	No Restoration	No Restoration	C4
Evolutionary Trend							
Design Approach (P1, P2, P3, E, etc)	EII	R; EII, P	R; EI; EII	EI; EII	EII	EII	R; EI
Underlying mapped soils	Chewacla	Chewacla	Badin/Georgeville	Goldston	Goldston	Goldston	Chewacla
Drainage class	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained	Mod. Well Drained - Well Drained
Soil Hydric status	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric	Non-hydric
Slope	N/A	2.45%	2.35%	2.17%	N/A	N/A	0.96%
FEMA classification	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Native vegetation community	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Percent composition of exaotic invasive vegetation	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Wetland Summary Information

Parameters	Wetland 1	Wetland 2	Wetland 3
Size of Wetland (acres)	N/A	N/A	N/A
Wetland Type (non-riparian, riparian riverine or riparian	N/A	N/A	N/A
Mapped Soil Series	N/A	N/A	N/A
Drainage class	N/A	N/A	N/A
Soil Hydric Status	N/A	N/A	N/A
Source of Hydrology	N/A	N/A	N/A
Hydrologic Impairment	N/A	N/A	N/A
Native vegetation community	N/A	N/A	N/A
Percent composition of exotic invasive vegetation	N/A	N/A	N/A

Regulatory Considerations

Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States – Section 404	Y	Y	Permit 2014-00386
Waters of the United States – Section 401	Y	Y	Letter from NCDENR dated February 24, 2015 Nationwide Permit Number 27
Endangered Species Act	Y	Y	Letter to USFWS dated November 16, 2009
Historic Preservation Act	Y	Y	Letter from NC SHPO dated February 2, 2010
Coastal Zone Management Act (CZMA)/ Coastal Area Management	N	N/A	N/A
FEMA Floodplain Compliance	Y	Y	FEMA Floodplain Checklist Restoration Plan Appendix 9
Essential Fisheries Habitat	N	N/A	N/A

Appendix B – Visual Assessment Data

Figures 2a-j – Integrated Current Condition Plan View – Monitoring Year 5

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAUGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT
- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

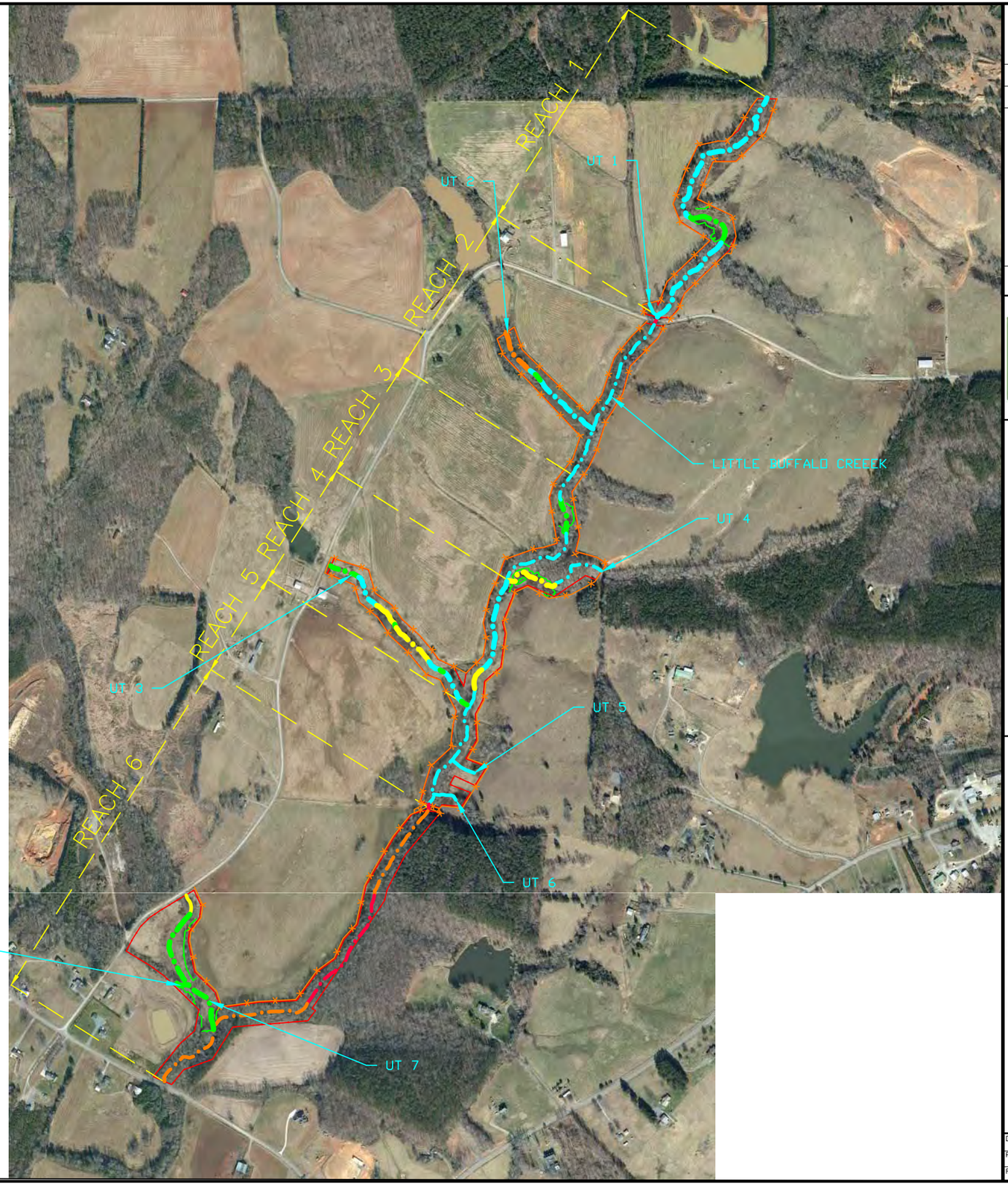
INVASIVE SPECIES

	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2019

0' 800' 1600'

SCALE: 1"= 800'



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LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW –MY5–

DATE MARCH 2020
PROJECT NO. 94147
FIGURE 1 OF 10

NO. | REVISIONS | DRN | CHK | DATE

Filename: J:\193678-01 Little Buffalo Creek\WAT\Docs\Report\MY5\Little Buffalo Creek Stream Mitigation_94147_MY5_2020\Support Files\2. Visual Assessment\CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

LITTLE BUFFALO
STA. 22+05
REACH 1 - END E2
BEGIN RESTORATION

BEGIN BEDROCK
EL: 638.68

END BEDROCK
EL: 638.56

GAUGE 1

VEGPLOT 12

PL 13

LITTLE BUFFALO
STA. 10+00
X: 1595367.54
Y: 640628.64
REACH 1 - BEGIN E2

GATE

CROSS SECTION MS-1P

LITTLE BUFFALO CREEK

BEGIN BEDROCK
EL: 638.03

END BEDROCK
EL: 637.97

VEGPLOT 11

CROSS SECTION MS-1R

PL 12

LITTLE BUFFALO
STA. 25+89
REACH 1 - BEGIN E2
END RESTORATION

0' 100' 200'

SCALE: 1"= 100'

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2019

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAUGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT

- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

NO.	REVISIONS	DRN.	CHK.	DATE

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LITTLE BUFFALO CREEK
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CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

CURRENT CONDITIONS PLAN VIEW –MY5–

DATE MARCH 2020
PROJECT NO. 94147
FIGURE 2 OF 10

Filename: J:\193678-01 Little Buffalo Creek\WAT\Docs\Report\MY5\Little Buffalo Creek Stream Mitigation_94147_MY5_2020\Support Files\2. Visual Assessment\CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

0’ 100’ 200’

SCALE: 1”= 100’

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2019

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
- AS-BUILT TOP OF BANK
- CONSERVATION EASEMENT
- CONSERVATION FENCE
- CONSTRUCTED RIFFLE
- BEDROCK
- ROOTWADS
- CONTROL POINT
- STREAM GAUGE
- H VISUAL MORPHIC ASSESSMENT POOR HABITAT

- VEGPLOT – EXCEEDS REQUIREMENTS BY >10%
- VEGPLOT – EXCEEDS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY <10%
- VEGPLOT – FAILS REQUIREMENTS BY >10%
- PHOTO LOCATION
- BANK SCOUR/ERODING
- AGGRADATION/DEGRADATION
- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%-40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

UT-2 STA. 13+79
BEGIN RESTORATION
END E2

UT-2 STA. 13+35
END PRESERVATION
BEGIN E2

UT-2 STA. 14+31
END RESTORATION
BEGIN E2

CROSS SECTION UT2-1R

VEGPLOT 8

UT 2

GAUGE 13

GAUGE 3

CHANNEL FORMATION IS CONTINUING TO OCCUR. SEE PHOTO APPENDIX F. (STA. 16+10-17+10)

REPLACEMENT GAUGE 3 INSTALLED IN OCTOBER

PL 10

LITTLE BUFFALO
STA. 42+55
END UT-2 STA. 19+52

VEGPLOT 9

LITTLE BUFFALO
STA. 33+11
END UT-1 STA. 11+11

LITTLE BUFFALO
STA. 33+16
REACH 1 - END E2
BOULDERS

LITTLE BUFFALO CREEK

LITTLE BUFFALO
STA. 33+78
REACH 2 - BEGIN E2

BEGIN UT-1 STA. 10+00
BEGIN E2

UT 1

CROSSWIND DR

GATE

PL 11

VEGPLOT 10

Filename: J:\193678-01 Little Buffalo Creek\WAT\Docs\Report\MY5\Little Buffalo Creek Stream Mitigation_94147_MY5_2020\Support Files\2. Visual Assessment\CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

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CURRENT CONDITIONS PLAN VIEW –MY5–

DATE MARCH 2020
PROJECT NO. 94147
FIGURE 3 OF 10

LEGEND:

- THALWEG, RESTORATION
- THALWEG, ENHANCEMENT LEVEL I
- THALWEG, ENHANCEMENT LEVEL II
- THALWEG, PRESERVATION
- THALWEG, OUT OF EASEMENT
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VEGETATION COVERAGE

INVASIVE SPECIES

	PRESENT (>75%)	POOR (75%-40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2019

DAM BLOWOUT AROUND EXISTING CONCRETE OUTLET PIPE

GAUGE 2

UT-2 STA. 10+00 BEGIN PRESERVATION

PL 9

UT-2 STA. 13+79 BEGIN RESTORATION END E2

UT-2 STA. 13+35 END PRESERVATION BEGIN E2

UT-2 STA. 14+31 END RESTORATION BEGIN E2

CROSS SECTION UT2-1R

VEGPLOT 8

UT 2

CHANNEL FORMATION IS CONTINUING TO OCCUR. SEE PHOTO APPENDIX F. (STA. 16+10-17+10)

GAUGE 13

HEADCUT

GAUGE 3

REPLACEMENT GAUGE 3 INSTALLED IN OCTOBER

0' 100' 200'

SCALE: 1"= 100'

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CURRENT CONDITIONS PLAN VIEW -MY5-

DATE MARCH 2020
PROJECT NO. 94147
FIGURE 4 OF 10

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LITTLE BUFFALO
STA. 57+08
END UT-4 STA. 18+48
END REACH 3
BEGIN REACH 4

BEGIN BEDROCK
EL. 624.94

END BEDROCK
EL. 624.30

CROSS SECTION UT4-1R

PL 7

GAUGE 4

VEGPLOT 4

VEGPLOT 5

GATE

EASEMENT ENCROACHMENT THROUGHOUT UT3, UT4, AND REACH 3-5 DURING MY5. SEVERAL COWS (DEAD AND ALIVE) OBSERVED IN CONSERVATION EASEMENT DURING OCTOBER DROUGHT..

CROSS SECTION UT4-1P

UT 4

BAROLOGGER

UT-4 STA. 14+25
END E2
BEGIN E1

UT-4 STA. 10+00
BEGIN E2

LITTLE BUFFALO CREEK

LITTLE BUFFALO
STA. 46+10
END REACH 2
BEGIN REACH 3

PL 8

VEGPLOT 7

VEGPLOT 6

LITTLE BUFFALO
STA. 48+25
REACH 3 - END E2
BEGIN RESTORATION

CROSS SECTION MS-2R

CROSS SECTION MS-2P

LITTLE BUFFALO
STA. 50+75
REACH 3 - BEGIN E2
END RESTORATION

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2019

0' 100' 200'

SCALE: 1"= 100'

LEGEND:

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- ENCROACHMENT/COW PRINTS
- LATERAL POINT BARS
- CHANNEL REPAIR AREA

VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%-40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

NO.	REVISIONS	DRN	CHK	DATE

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CURRENT CONDITIONS PLAN VIEW –MY5–

DATE MARCH 2020
PROJECT NO. 94147
FIGURE 5 OF 10

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VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

UT-3 STA. 20+31
BEGIN E2
END E1

UT 3

UT-3 STA. 21+60
END RESTORATION
BEGIN E2

UT-3 STA. 21+34
BEGIN RESTORATION
END E2

DEBRIS JAM OBSERVED ALONG PONDED AREA ADJACENT TO MAIN CHANNEL

LITTLE BUFFALO
STA. 65+41
CONC. REMOVAL SECTION
REACH 4 - END E1
BEGIN E2

GAUGE 7

UT-3 STA. 24+12
BEGIN RESTORATION
END E2

GAUGE 10

PL 6

CROSS SECTION MS-3P

LITTLE BUFFALO
STA. 63+88
CONC. REMOVAL SECTID
REACH 4 - END E2
BEGIN E1

LITTLE BUFFALO CREEK

CROSS SECTION UT3-3R

LITTLE BUFFALO
STA. 75+07
REACH 5 - END E2

UT-3 STA. 24+57
END RESTORATION
BEGIN E2

LITTLE BUFFALO
STA. 74+25
END UT-6 STA. 11+75

VEGPLOT 2

BEGIN BEDROCK
END BEDROCK EL: 621.83
EL: 621.84

BEGIN BEDROCK
EL: 620.91

END BEDROCK
EL: 621.45

GAUGE 5

END BEDROCK
EL: 621.18

BEGIN BEDROCK
EL: 621.38

LITTLE BUFFALO
STA. 66+81
END UT-3 STA. 24+76
END REACH 4
BEGIN REACH 5

GATE

PL 4

GAUGE 11

LITTLE BUFFALO
STA. 71+24
END UT-5 STA. 11+84

EASEMENT ENCROACHMENT THROUGHOUT UT3, UT4, AND REACH 3-5 DURING MY5. SEVERAL COWS (DEAD AND ALIVE) OBSERVED IN CONSERVATION EASEMENT DURING OCTOBER DROUGHT.

FENCE REPAIRED AT/NEAR CROSSING

UT 6

UT-6 STA. 10+00
BEGIN E2

UT 5

UT-5 STA. 10+00
BEGIN E2

LITTLE BUFFALO
STA. 75+57
REACH 6 -

0' 100' 200'

SCALE: 1"= 100'

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2019

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CURRENT CONDITIONS PLAN VIEW –MY5–

DATE MARCH 2020
PROJECT NO. 94147
FIGURE 6 OF 10

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0’ 100’ 200’

SCALE: 1”= 100’

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2019

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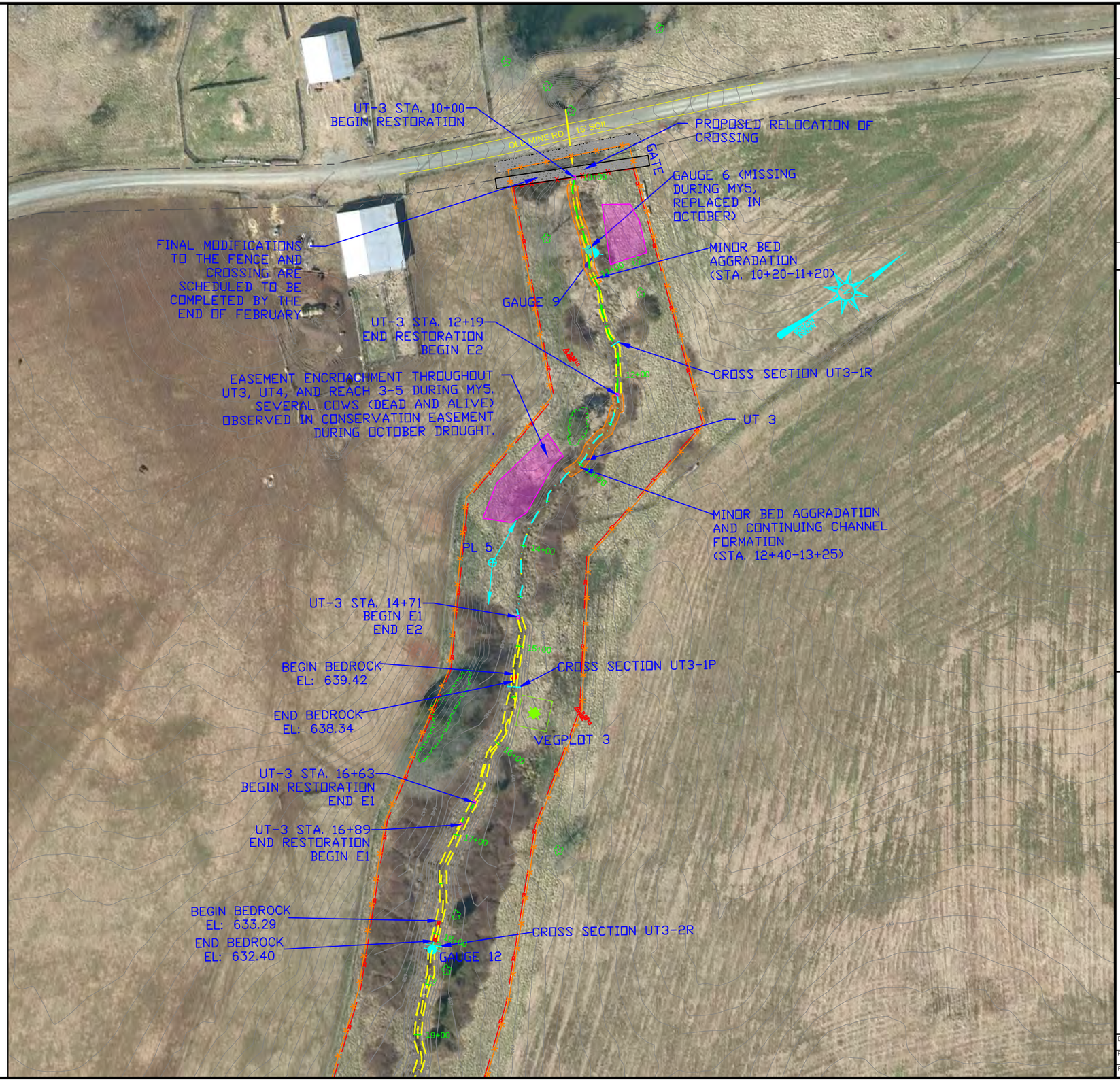
VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			



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CURRENT CONDITIONS PLAN VIEW –MY5–

DATE MARCH 2020
PROJECT NO. 94147
FIGURE 7 OF 10

Filenames: J:\193678-01 Little Buffalo Creek\WAT\Docs\Report\MY5\Little Buffalo Creek Stream Mitigation_94147_MY5_2020\Support Files\2. Visual Assessment\CCPV\LITTLE BUFFALO CREEK_CCPV.dwg

LEGEND:

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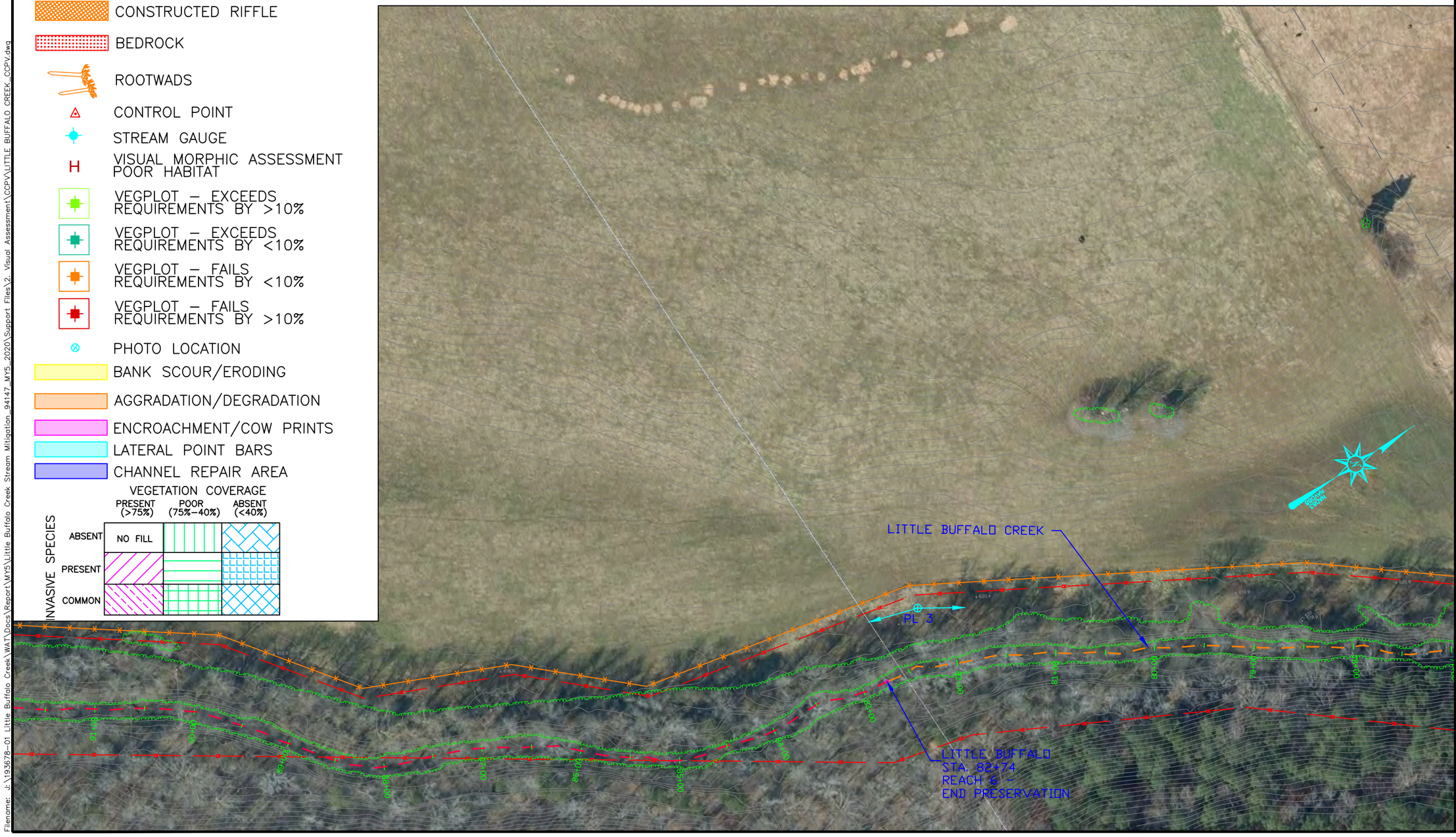
VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

0’ 100’ 200’

SCALE: 1”= 100’

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2019



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CURRENT CONDITIONS PLAN VIEW –MY5–

DATE MARCH 2020
PROJECT NO. 94147
FIGURE 8 OF 10

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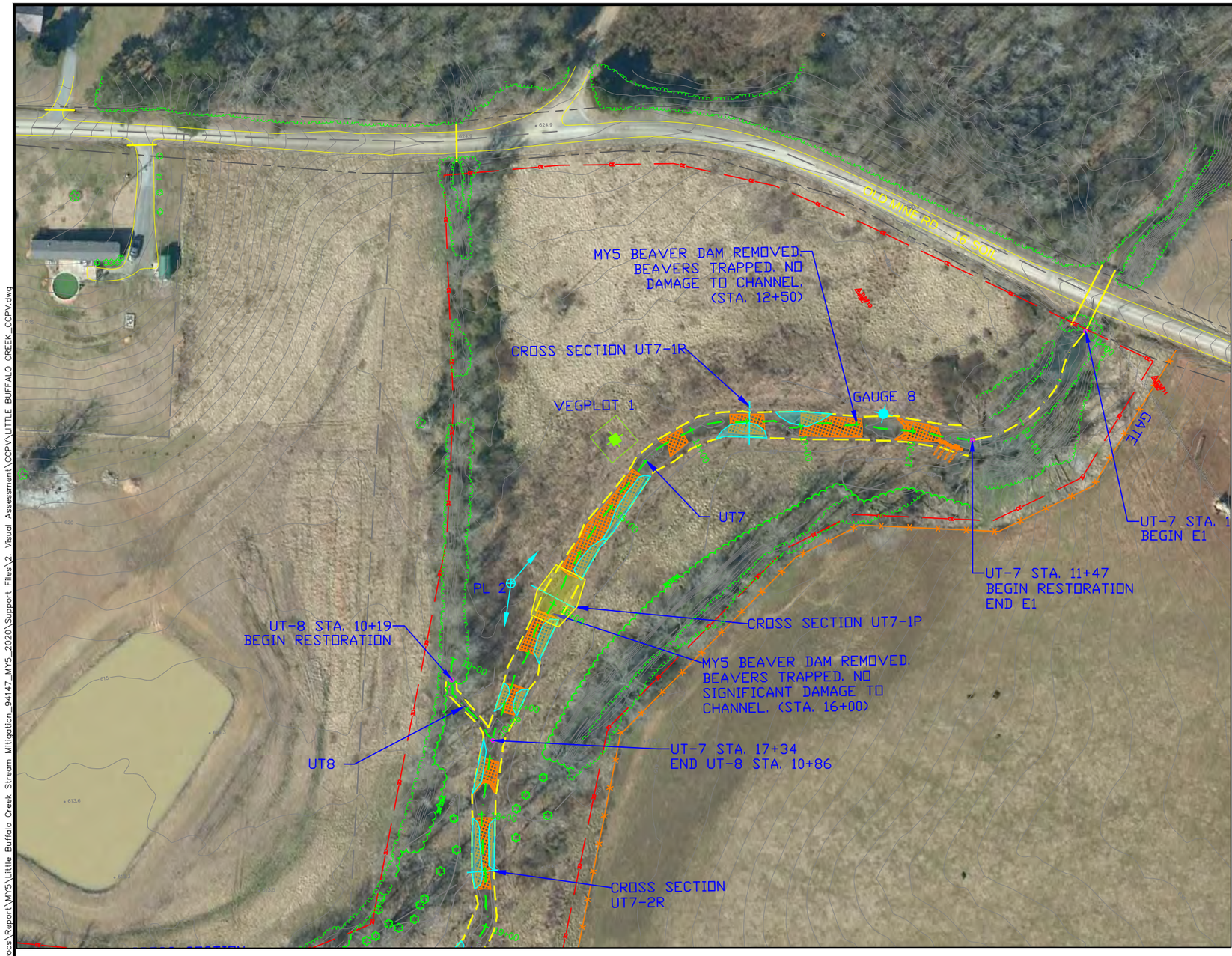

0' 100' 200'

SCALE: 1"= 100'

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2019

LEGEND:

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VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
PRESENT			
COMMON			

NO.	REVISIONS	DRN. CHK.	DATE

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CURRENT CONDITIONS PLAN VIEW –MY5–

DATE MARCH 2020
PROJECT NO. 94147
FIGURE 9 OF 10

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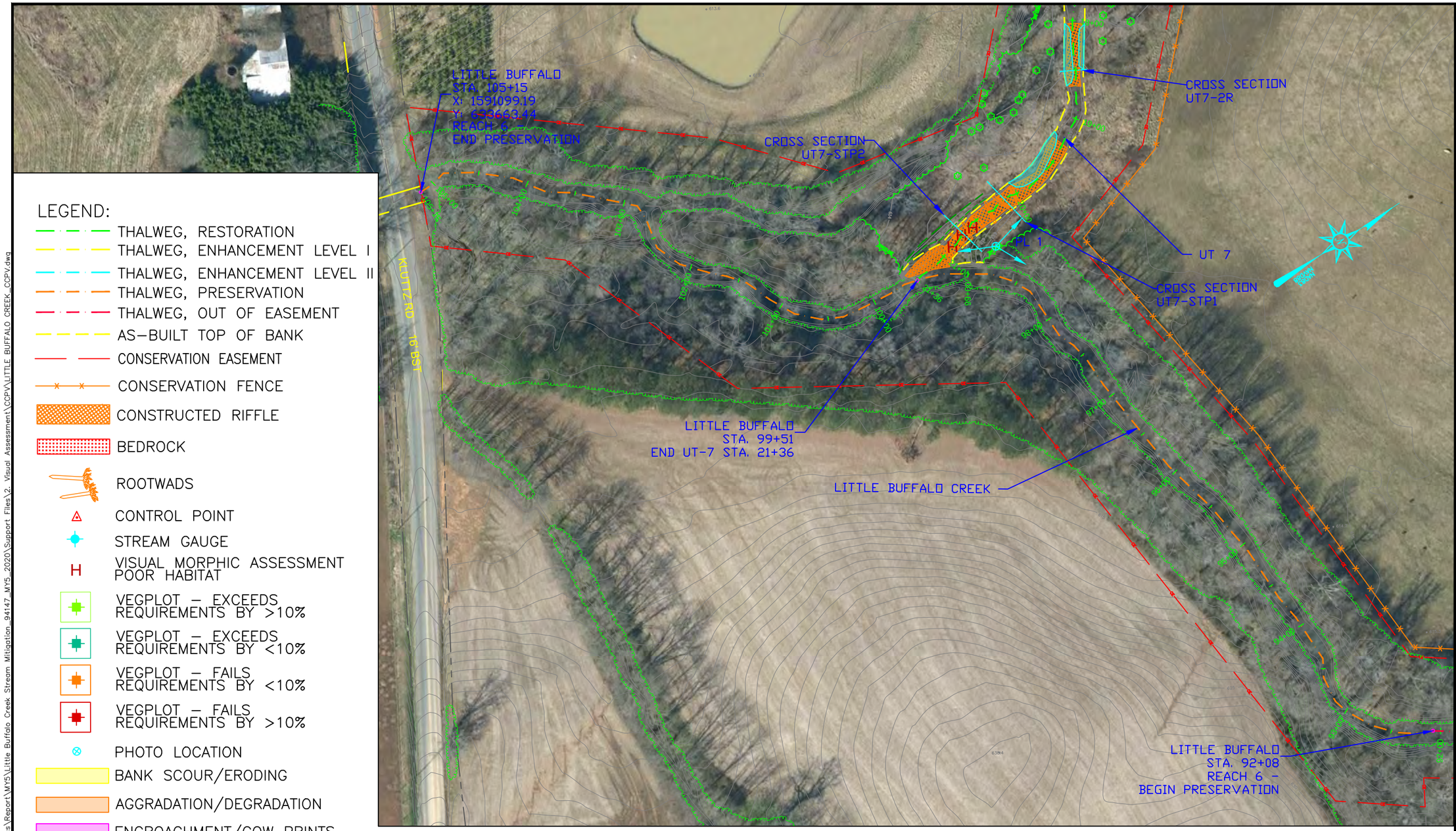

AERIAL SOURCE: NC DIGITAL ORTHOIMAGERY 2019

LEGEND:

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VEGETATION COVERAGE

INVASIVE SPECIES	PRESENT (>75%)	POOR (75%–40%)	ABSENT (<40%)
ABSENT	NO FILL		
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COMMON			

0' 100' 200'

SCALE: 1"= 100'

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CURRENT CONDITIONS PLAN VIEW -MY5-

DATE MARCH 2020
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FIGURE 10 OF 10

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Tables 5a-g – Visual Stream Morphology Assessment

Reach ID **Reach 1**
Assessed Length **381**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability**	1. Aggradation - No visual aggradation			0	0	100%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	6	6			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth > 1.6)	3	3			100%			
		2. Length appropriate?	3	3			100%			
	4. Thalwag Position	1. Thalweg centering at upstream of meander bend (Run)?	3	3			100%			
		2. Thalweg centering at downstream of meander bend (Glide)?	3	3			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	Log Vane structures installed incorrectly during construction, final as-built developed inner berm material overtop structures to bury the log vanes and have no structures within this reach.									

Reach ID **Reach 3**
Assessed Length **261**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability**	1. Aggradation - No visual aggradation			0	0	100%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	3	3			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	2	2			100%			
	2. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	2	2			100%			
	3. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	2	2			100%			

Reach ID **Reach 4**
Assessed Length **200**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability**	1. Aggradation - No visual aggradation			0	0	100%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	3	3			100%			
2. Bank	**1. Scoured/Eroding**	Visual point scour along small portion of bank within bankfull			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%

Reach ID UT 2
Assessed Length 279

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed[1]	1. Vertical Stability	1. Aggradation - No visual aggradation[1]			0	0	100%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	1	1			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%

1: The assessed length of UT2 for visual morphology has been limited to the portion of Enhancement Level I in the reach in past years. Assessed length has been increased to monitor a section of Enhancement Level II along the lower ends of UT2, measured in field at approximately 230 feet of stream, for a defined stream with flow. As of Year 5, a defined channel is present with flow. Seasonal photos and monitoring has been included in the MY5 report.

Reach ID UT 3
Assessed Length 898

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability	1. Aggradation - No visual aggradation[1]			2	185	79%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	8	8			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%

1: Sediment washing out from and existing cattle crossing has resulted in minor aggradation at the top of UT3. Additional monitoring has been conducted to evaluate the function of the channel as it continues to devlop more pronounced bed and banks.

Reach ID UT 4
Assessed Length 410

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability	1. Aggradation - No visual aggradation			0	0	100%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	8	8			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth > 1.6)	3	3			100%			
		2. Length appropriate?	3	3			100%			
	4. Thalwag Position	1. Thalweg centering at upstream of meander bend (Run)?	3	3			100%			
		2. Thalweg centering at downstream of meander bend (Glide)?	3	3			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%

Reach ID UT 7/8
Assessed Length 1189

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability	1. Aggradation - Lateral Point Bars have formed, but as expected due to the overwide channel design. Reach is in stable condition, so point bars were omitted from this section.			0	0	100%			
		2. Degradation - No visual degradation			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains as-built substrate	11	11			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth > 1.6)	3	4			75%			
		2. Length appropriate?	4	4			100%			
	4. Thalwag Position	1. Thalweg centering at upstream of meander bend (Run)?	4	4			100%			
		2. Thalweg centering at downstream of meander bend (Glide)?	4	4			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion[2]			1	50	98%	0	0	93%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	1	50	98%	0	0	93%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	9	9			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	9	9			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms. -DMS Identified piping in one rock vane in step pool feature	9	9			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	9	9			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.- step pools filled with large boulders from upstream of site, maintains small pools at low flow, but <1.6 Max to Mean Deptj	4	9			44%			

2: The bank scour was due to the presence of the beaver dam immediately downstream, and the removal of willow by the beavers. The beavers and their dam have been removed, and the banks are expected to recover naturally without additional maintenance.

Tables 6a-i – Vegetation Condition Assessment Table

Table 6 Vegetation Condition Assessment

Reach 1

Planted Acreage **5.47**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material - area does not meet threshold	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **7.29**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas		none	Pattern and Color	0	0.00	0.0%

Reach 2

Planted Acreage **2.85**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **3.73**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Cattle in easement during October (~12) and December (~2) site visits. Evidence included cowpies and tracks. Both times cows were removed ASAP.	none	Pattern and Color	2	0.07	1.9%

Reach 3

Planted Acreage **2.65**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **3.83**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Cattle in easement during October (~12) and December (~2) site visits. Evidence included cowpies and tracks. Both times cows were removed ASAP.	none	Pattern and Color	4	0.39	10.1%

Reach 4

Planted Acreage **2.26**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material - area does not meet threshold	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **3.1**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Cattle in easement during October (~12) and December (~2) site visits. Evidence included cowpies and tracks. Both times cows were removed ASAP.	none	Pattern and Color	3	0.40	13.0%

Reach 5

Planted Acreage **2.05**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **2.74**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Cattle in easement during October (~12) and December (~2) site visits. Evidence included cowpies and tracks. Both times cows were removed ASAP.	none	Pattern and Color	1	0.53	19.4%

UT 2

Planted Acreage **1.25**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **2.65**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas		none	Pattern and Color	0	0.00	0.0%

UT 3

Planted Acreage **3.21**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material. - area does not meet threshold	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	3.21	100.0%

Easement Acreage **4.11**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Cattle in easement during October (~12) and December (~2) site visits. Evidence included cowpies and tracks. Both times cows were removed ASAP.	none	Pattern and Color	3	0.12	3.0%

UT 4

Planted Acreage **1.43**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Top of bank area bare where sheet flow washed seeding into channel	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **2.01**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Cattle in easement during October (~12) and December (~2) site visits. Evidence included cowpies and tracks. Both times cows were removed ASAP.	none	Pattern and Color	3	0.31	15.3%

UT 7

Planted Acreage **2.63**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **6.07**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern		1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas		none	Pattern and Color	0	0.00	0.0%

Photo Appendix A: Vegetation Monitoring Plots

Veg Plot 1

Veg Plot 2

Veg Plot 3

Veg Plot 4

Veg Plot 5

Veg Plot 6

Veg Plot 7

Veg Plot 8

Veg Plot 9

Veg Plot 10

Veg Plot 11

Veg Plot 12

Photo Appendix B: Cross Sections

Cross Section MS-1P Downstream

Cross Section MS-1P Upstream

Cross Section MS-1R Downstream

Cross Section MS-1R Upstream

Cross Section MS-2P Downstream

Cross Section MS-2P Upstream

Cross Section MS-2R Downstream

Cross Section MS-2R Upstream

Cross Section MS-3P Downstream

Cross Section MS-3P Upstream

Cross Section UT2-1R Downstream

Cross Section UT2-1R Upstream

Cross Section UT3-1P Downstream

Cross Section UT3-1P Upstream

Cross Section UT3-1R Downstream

Cross Section UT3-1R Upstream

Cross Section UT3-2R Downstream

Cross Section UT3-2R Upstream

Cross Section UT3-3R Downstream

Cross Section UT3-3R Upstream

Cross Section UT4-1P Downstream

Cross Section UT4-1P Upstream

Cross Section UT4-1R Downstream

Cross Section UT4-1R Upstream

Cross Section UT7-1P Downstream

Cross Section UT7-1P Upstream

Cross Section UT7-1R Downstream

Cross Section UT7-1R Upstream

Cross Section UT7-2R Downstream

Cross Section UT7-2R Upstream

Cross Section UT7-STP1 Downstream

Cross Section UT7-STP1 Upstream

Cross Section UT7-STP2 Downstream

Cross Section UT7-STP2 Upstream

Photo Appendix C: Photo Stations

Photo Location 1-A – Mainstem Upstream

Photo Location 1-B – Mainstem Downstream

Photo Location 1-C – UT7 Upstream

Photo Location 2-A – UT7 Upstream

Photo Location 2-B – UT7 Downstream

Photo Location 3-A - Upstream

Photo Location 3-B – Downstream

Photo Location 4-A – Upstream

Photo Location 4-B – Downstream

Photo Location 5-A - Downstream

Photo Location 5-B – Upstream

Photo Location 6-A – Mainstem Downstream

Photo Location 6-B – Mainstem Upstream

Photo Location 6-C – UT3 Upstream

Photo Location 7-A – Mainstem Downstream

Photo Location 7-B – UT4 Downstream

Photo Location 7-C – Mainstem Upstream

Photo Location 7-D – UT4 Upstream

Photo Location 8-A – Downstream

Photo Location 8-B - Upstream

Photo Location 9-A – Downstream

Photo Location 9-B – Upstream

Photo Location 10-A – Mainstem Downstream

Photo Location 10-B – Mainstem Upstream

Photo Location 10-C – UT2 Upstream

Photo Location 11-A –Downstream

Photo Location 11-B – Upstream

Photo Location 12-A - Downstream

Photo Location 12-B – Upstream

Photo Location 13-A – Downstream

Photo Location 13-B – Upstream

Photo Appendix D: Problem Areas

Bare spot (Copper Toxicity) in floodplain in Reach 1

Cow observed near vegetation monitoring plot 7 in UT4 in October 2019

Cow tracks near confluence of Reach 3 and UT4 in January 2020

Cow tracks crossing UT4 in January 2020

Cow and calf spotted in conservation easement along UT4 in January 2020

Cow observed near vegetation monitoring plot 4 in October 2019

Blown out cattle crossing (Reach 5)

Dead cow under cattle crossing (Reach 5) in October 2019

Beaver dam at UT7

Beaver dam at UT7 in December 2019

Beaver dam at UT7 in December 2019

Photo taken in January 2020, view towards UT7 beaver dam location (pink flagging) that was removed in December 2019

Photo Appendix E: Significant Flow Events

Flattened vegetation in floodplain of Reach 1

High drift lines in Reach 1 near MS-1P

Flattened vegetation and drift lines in vegetation monitoring plot 11

Dropped debris in Reach 4 just upstream of Gauge 5

Debris jam and flattened vegetation in Reach 4

Drift lines along the bank of UT7 upstream of beaver dam that was removed

Photo Appendix F: UT2 and UT3

Flowing water in UT2 during July 2019

Flowing water in UT2 during July 2019

Flowing water in UT2 during July 2019

Flowing water in UT2 during January 2020

UT2 near Station 16+85 in January 2020, view downstream. The flagged rebar in the photos is the old location of gauge 3. WSP employee is indicating the thalweg and showing the depth of flowing water.

Small headcut in UT2 near Station 16+85 (January 2020)

Headcut in UT2 near Station 16+95 (March 2020)

Just downstream of small headcut in UT2, view downstream

Dam blowout around existing concrete outlet pipe (US end of UT2)

UT3 near Station 11+00 showing channel in January 2020

UT3 in near Station 11+50 showing channel in January 2020

Flow path through vegetation in UT3 near Station 12+00 in January 2020

Flow path through vegetation in UT3 near Station 12+00 in January 2020

Appendix C – Vegetation Plot Data

Table 7 - Vegetation Plot Criteria Attainment

Plot	MY5 Success Criteria Met (Y/N)	Tract Mean
1	Y	100%
2	Y	
3	Y	
4	Y	
5	Y	
6	Y	
7	Y	
8	Y	
9	Y	
10	Y	
11	Y	
12	Y	

Table 8 - CVS Vegetation Plot Metadata

Report Prepared By	Amanda Johnson
Date Prepared	2/5/2020 15:08
database name	cvs-eep-entrytool-v2.5.0.mdb
database location	J:\193678-01 Little Buffalo Creek\WAT\Docs\report\Support Files\3. V
computer name	L18US-D8243Z07
file size	60100608

DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------

Metadata	Description of database file, the report worksheets, and a summary of
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. T
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This
Plots	List of plots surveyed with location and summary data (live stems, dea
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
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
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and

PROJECT SUMMARY----------

Project Code	94147
project Name	Little Buffalo Creek Stream Mitigation Project
Description	Louis Berger is restoring the Little Buffalo Creek Stream Mitigation Site
River Basin	Yadkin-Pee Dee
length(ft)	
stream-to-edge width (ft)	
area (sq m)	48265.23781
Required Plots (calculated)	12
Sampled Plots	12

EEP Project Code 94147. Project Name: Little Buffalo Creek Stream Mitigation Project

			Current Plot Data (MY5 2019)																	
			94147-01-0001			94147-01-0002			94147-01-0003			94147-01-0004			94147-01-0005			94147-01-0006		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree																		
Acer rubrum	red maple	Tree												2						
Alnus serrulata	hazel alder	Shrub												3						
Asimina triloba	pawpaw	Tree																		1
Baccharis halimifolia	eastern baccharis	Shrub																		
Betula nigra	river birch	Tree			1									4						1
Carpinus caroliniana	American hornbeam	Tree			1						1							2	2	2
Carya cordiformis	bitternut hickory	Tree									1									
Celtis laevigata	sugarberry	Tree	2	2	2	1	1	1	2	2	2									
Cercis canadensis	eastern redbud	Tree	1	1	1										1	1	1			
Diospyros virginiana	common persimmon	Tree																		
Fraxinus pennsylvanica	green ash	Tree				3	3	3							2	2	2	2	2	2
Ilex glabra	inkberry	Shrub																		
Juglans nigra	black walnut	Tree			3															
Juniperus virginiana	eastern redcedar	Tree						3												
Liquidambar styraciflua	sweetgum	Tree			4												7			1
Liriodendron tulipifera	tulip tree	Tree										3	3	3						
Nyssa sylvatica	blackgum	Tree				1	1	2	1	1	2	1	1	2						
Pinus rigida	pitch pine	Tree																		
Pinus taeda	loblolly pine	Tree																		
Pinus virginiana	Virginia pine	Tree																		
Platanus occidentalis	American sycamore	Tree													3	3	4	2	2	15
Prunus serotina	black cherry	Tree																		
Quercus alba	white oak	Tree												2						
Quercus falcata	southern red oak	Tree	2	2	2				1	1	1	1	1	1						1
Quercus michauxii	swamp chestnut oak	Tree	3	3	3	2	2	2	2	2	3	4	4	4				1	1	2
Quercus phellos	willow oak	Tree							1	1	1									
Rhus glabra	smooth sumac	shrub																		
Sambucus	elderberry	Shrub																		
Sambucus canadensis	Common Elderberry	Shrub																		
Sassafras albidum	sassafras	Tree																		
Ulmus	elm	Tree																		
Ulmus rubra	slippery elm	Tree																		
Viburnum dentatum	southern arrowwood	Shrub	2	2	2				1	1	2	1	1	1						
		Stem count	10	10	19	7	7	11	8	8	13	10	10	22	6	6	14	7	7	25
		size (ares)	0.83613			0.83613			0.83613			0.83613			0.83613			0.83613		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	5	5	9	4	4	5	6	6	8	5	5	9	3	3	4	4	4	8
		Stems per ACRE	484	484	920	339	339	532	387	387	629	484	484	1065	290	290	678	339	339	1210

	Current Plot Data (MY5 2019)																	
	94147-01-0007			94147-01-0008			94147-01-0009			94147-01-0010			94147-01-0011			94147-01-0012		
Scientific Name	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo			2															
Acer rubrum			1												1			5
Alnus serrulata													2	2	2			
Asimina triloba																		
Baccharis halimifolia																		
Betula nigra			1			1							2	2	6			1
Carpinus caroliniana																		
Carya cordiformis																		
Celtis laevigata	2	2	2	2	2	2	7	7	8	1	1	2						
Cercis canadensis				1	1	1	1	1	1									
Diospyros virginiana																		1
Fraxinus pennsylvanica	1	1	3															
Ilex glabra																		
Juglans nigra			1															1
Juniperus virginiana			1			1												3
Liquidambar styraciflua						6									26			4
Liriodendron tulipifera							1	1	1	1	1	1						
Nyssa sylvatica	4	4	5	2	2	4	1	1	2	1	1	1				1	1	4
Pinus rigida																		
Pinus taeda															18			
Pinus virginiana																		3
Platanus occidentalis							2	2	2	2	2	2	1	1	3	1	1	1
Prunus serotina			1															
Quercus alba																		
Quercus falcata	1	1	1	3	3	5	1	1	1									
Quercus michauxii	2	2	3	3	3	3	1	1	3	1	1	1	1	1	1	5	5	7
Quercus phellos																		
Rhus glabra																		
Sambucus																		
Sambucus canadensis																		
Sassafras albidum																		
Ulmus																		
Ulmus rubra																		
Viburnum dentatum																		
Stem count	10	10	21	11	11	23	14	14	18	6	6	7	6	6	57	7	7	30
size (ares)	0.83613			0.83613			0.83613			0.83613			0.83613			0.83613		
size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02		
Species count	5	5	11	5	5	8	7	7	7	5	5	5	4	4	7	3	3	10
Stems per ACRE	484	484	1016	532	532	1113	678	678	871	290	290	339	290	290	2759	339	339	1452

	Annual Means																	
	MY5 (2019)			MY4 (2018)			MY3 (2017)			MY2 (2016)			MY1 (2015)			MY0 (2014)		
Scientific Name	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	0		2	3	3	3			5			2						
Acer rubrum			9			10			5			3			4			
Alnus serrulata	2	2	5	2	2	2	2	2	2	5	5	5	5	5	5	13	13	13
Asimina triloba			1															
Baccharis halimifolia									1									
Betula nigra	2	2	15															
Carpinus caroliniana	2	2	4	1	1	1	1	1	1	8	8	8	14	14	14	11	11	11
Carya cordiformis			1															
Celtis laevigata	17	17	19	32	32	32	14	14	14	13	13	13	4	4	4	29	29	29
Cercis canadensis	4	4	4	7	7	7	7	7	7	7	7	7	4	4	4	13	13	13
Diospyros virginiana			1			1			1									
Fraxinus pennsylvanica	8	8	10	7	7	7	8	8	9	14	14	14	7	7	7	14	14	14
Ilex glabra						1												
Juglans nigra			5									6						
Juniperus virginiana			8			7			4			3			1			
Liquidambar styraciflua			48	1	1	26			47			108			254			
Liriodendron tulipifera	5	5	5	5	5	5	6	6	7	5	5	7	10	10	13	19	19	19
Nyssa sylvatica	12	12	22	13	13	13	12	12	12									
Pinus rigida												3						
Pinus taeda			18			17			12									
Pinus virginiana			3			1									1			
Platanus occidentalis	11	11	27	16	16	16	10	10	28	12	12	27	10	10	52	16	16	16
Prunus serotina			1	1	1	2												
Quercus alba			2															
Quercus falcata	9	9	12	9	9	9	8	8	8	20	20	24	4	4	6	7	7	7
Quercus michauxii	25	25	32	34	34	34	26	26	26	8	8	8	6	6	6	10	10	10
Quercus phellos	1	1	1															
Rhus glabra						5			3									
Sambucus						2						8						
Sambucus canadensis									3									
Sassafras albidum									1									
Ulmus						10												
Ulmus rubra									16			1						
Viburnum dentatum	4	4	5	3	3	3	5	5	5	6	6	6	6	6	6	11	11	11
Stem count	102	102	260	134	134	214	99	99	217	98	98	253	70	70	377	143	143	143
size (ares)	10.03356			10.03356			10.03356			10.03356			10.03356			10.03356		
size (ACRES)	0.25			0.25			0.25			0.25			0.25			0.25		
Species count	14	13	25	14	14	23	11	11	22	10	10	18	10	10	14	10	10	10
Stems per ACRE	411	411	1049	540	540	863	399	399	875	395	395	1020	282	282	1521	577	577	577

Appendix D – Stream Measurement & Geomorphology Data

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: Mainstem Reach 1 (2,305 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					45.55	56.61	52.02	82.98	14.98	5	43.1	52.2	50.6	64.4	8.8	4	36	36	36	35.21	35.21	35.21	35.21		1
Floodprone Width (ft)					67.73	106.5	96.36	177.3	43.15	5	54.9	75.3	74.3	98	15.4	4	>88	>88	>88	>80	>80	>80	>80		1
Bankfull Mean Depth (ft)					0.65	1.18	1.24	1.6	0.35	5	0.98	1.16	1.1	1.38	0.18	4	0.96	0.96	0.96	1.23	1.23	1.23	1.23		1
[1]Bankfull Max Depth (ft)					2.54	3.04	2.8	3.83	0.58	5	2.17	2.41	2.5	2.5	0.14	4	1.5	1.5	1.5	1.79	1.79	1.79	1.79		1
Bankfull Cross Sectional Area (ft^2)					53.58	63.29	59.12	83.09	11.52	5	55.4	59.3	58.7	64.5	3.36	4	34.38	34.38	34.38	43.15	43.15	43.15	43.15		1
Width/Depth Ratio					32.51	56.56	40.56	127.7	40.14	5	31.3	47	46.2	64.4	14.35	4	37.5	37.5	37.5	28.73	28.73	28.73	28.73		1
Entrenchment Ratio					1.49	1.84	1.92	2.17	0.33	5	1.1	1.5	1.5	1.8	0.3	4	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2		1
[1]Bank Height Ratio					**0.91**	**1.09**		**1.37**								**4**	**1**	**1**	**1**	**1**	**1**	**1**	**1**		**1**
Profile																									
Riffle Length (ft)											7	28.8	27.5	52	13	8	35	40	50	7.73	23.71	22.04	38.44		
Riffle Slope (ft/ft)											0.009	0.02	0.018	0.422	0.01	8	0.003	0.014	0.028	0	0.026	0.022	0.076		
Pool Length (ft)											16	76.4	39.5	79	17.32	13	10	20	20	4.21	25.43	17.55	83.2		
Pool Max depth (ft)											2.9	3.2	3.3	3.5	0.24	13	1.5	1.81	1.81	1.96	2.71	2.48	3.76		
Pool Spacing (ft)											36	76.4	74	111	26.26	7	80	125	170	29.95	48.64	39.06	91.87		
Pattern																									
Channel Beltwidth (ft)																	84	84	84	59.64	105.8	92.68	165.2		
Radius of Curvature (ft)																	57.62	79.3	101	72.97	83.15	79.01	97.49		
Rc:Bankfull width (ft/ft)																	**35.24**	**36**	**69.62**	**27.95**	**35.6**	**36.13**	**46.36**		
Meander Wavelength (ft)																									
Meander Width Ratio																	1.21	2.33	2.38	1.29	3.04	2.57	5.91		
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2							0.334											0.32				0.322			
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification							C4						C4					C4				C4			
Bankfull Velocity (fps)							1.82											4.36				3.48			
Bankfull Discharge (cfs)							115																		
Valley length (ft)																									
Channel Thalweg length (ft)													932					2293.33				2299.79			
Sinuosity (ft)							1.05						1.25					1.05				1.05			
Water Surface Slope (Channel) (ft/ft)													0.38												
BF slope (ft/ft)													**0.38**												
[3]Bankfull Floodplain Area (acres)																		**0.45**				**0.3959**			
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data. 5. Of value/needed only if the n exceeds 3

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: Mainstem Reach 3 (1,083 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					34.42	41.48	41.54	48.48	7.03	3	43.1	52.2	50.6	64.4	8.8	4	40	40	40	38.31	38.31	38.31	38.31		1
Floodprone Width (ft)					258.2	265.4	265.4	272.6	7.21	3	54.9	75.3	74.3	98	15.4	4	>88	>88	>88	>90	>90	>90	>90		1
Bankfull Mean Depth (ft)					1.2	1.47	1.42	1.8	0.3	3	0.98	1.16	1.1	1.38	0.18	4	1.58	1.58	1.58	1.26	1.26	1.26	1.26		1
[1]Bankfull Max Depth (ft)					2.47	2.78	2.79	3.09	0.31	3	2.17	2.41	2.5	2.5	0.14	4	2	2	2	1.9	1.9	1.9	1.9		1
Bankfull Cross Sectional Area (ft^2)					58.33	59.79	58.96	62.09	2.01	3	55.4	59.3	58.7	64.5	3.36	4	63	63	63	48.23	48.23	48.23	48.23		1
Width/Depth Ratio					19.12	29.59	29.25	40.4	10.64	3	31.3	47	46.2	64.4	14.35	4	39.87	39.87	39.87	30.43	30.43	30.43	30.43		1
Entrenchment Ratio					5.33	6.53	6.56	7.71	1.19	3	1.1	1.5	1.5	1.8	0.3	4	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2		1
[1]Bank Height Ratio					**1.94**	**2.19**		**2.43**								**4**	**1**	**1**	**1**	**0.94**	**0.94**	**0.94**	**0.94**		**1**
Profile																									
Riffle Length (ft)											7	28.8	27.5	52	13	8	15	30	65	11.3	18.65	20.99	21.31		
Riffle Slope (ft/ft)											0.009	0.02	0.018	0.422	0.01	8	0.017	0.027	0.033	0.018	0.05	0.024	0.134		
Pool Length (ft)											16	76.4	39.5	79	17.32	13	10	15	20	6.32	12.33	10.63	21.53		
Pool Max depth (ft)											2.9	3.2	3.3	3.5	0.24	13	2	2.25	2.5	0.5	1.13	1.26	1.69		
Pool Spacing (ft)											36	76.4	74	111	26.26	7	70	70	70	36.04	45.42	46.77	53.33		
Pattern																									
Channel Beltwidth (ft)																				58.77	58.77	58.77	58.77		
Radius of Curvature (ft)																				83.8	83.8	83.8	83.8		
Rc:Bankfull width (ft/ft)																				**4.58**	**15.65**	**16.52**	**23.05**		
Meander Wavelength (ft)																									
Meander Width Ratio																				2.55	5.2	3.56	12.83		
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2							0.619											0.516				0.199			
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification							C4						C4					C4				C4			
Bankfull Velocity (fps)							2.73											3.03				3.96			
Bankfull Discharge (cfs)							163																		
Valley length (ft)																									
Channel Thalweg length (ft)													932					1030.85				1079.45			
Sinuosity (ft)							1.13						1.25					1.05				1.01			
Water Surface Slope (Channel) (ft/ft)													0.38												
BF slope (ft/ft)													**0.38**												
[3]Bankfull Floodplain Area (acres)																		**0.49**				**0.074**			
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data. 5. Of value/needed only if the n exceeds 3

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 2 (951 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)																	4	4	4	3.52	3.52	3.52	3.52		1
Floodprone Width (ft)																	7	7	7	8.34	8.34	8.34	8.34		1
Bankfull Mean Depth (ft)																	0.47	0.47	0.47	0.52	0.52	0.52	0.52		1
[1]Bankfull Max Depth (ft)																	0.75	0.75	0.75	0.72	0.72	0.72	0.72		1
Bankfull Cross Sectional Area (ft^2)																	1.88	1.88	1.88	1.82	1.82	1.82	1.82		1
Width/Depth Ratio																	8.51	8.51	8.51	6.82	6.82	6.82	6.82		1
Entrenchment Ratio																	1.75	1.75	1.75	2.37	2.37	2.37	2.37		1
[1]Bank Height Ratio																	**1**	**1**	**1**	**1.01**	**1.01**	**1.01**	**1.01**		**1**
Profile																									
Riffle Length (ft)																	51.74	51.74	51.74	6.98	13.52	13.52	20.07		
Riffle Slope (ft/ft)																	0.024	0.024	0.024	0.01	0.013	0.013	0.016		
Pool Length (ft)																				12.76	12.76	12.76	12.76		
Pool Max depth (ft)																				0.89	0.89	0.89	0.89		
Pool Spacing (ft)																				30.63	30.63	30.63	30.63		
Pattern																									
Channel Beltwidth (ft)																									
Radius of Curvature (ft)																									
Rc:Bankfull width (ft/ft)																									
Meander Wavelength (ft)																									
Meander Width Ratio																									
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2																	0.571			0.249					
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification																	B6			B6					
Bankfull Velocity (fps)																				1.66					
Bankfull Discharge (cfs)																									
Valley length (ft)																									
Channel Thalweg length (ft)																	951			951.37					
Sinuosity (ft)																				0.96					
Water Surface Slope (Channel) (ft/ft)																									
BF slope (ft/ft)																									
[3]Bankfull Floodplain Area (acres)																									
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 3 (1,475 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)																	4	4	4	3.5	4.38	3.73	5.91		3
Floodprone Width (ft)																	7	7	7	6.35	14.65	13.14	24.45		3
Bankfull Mean Depth (ft)																	0.47	0.47	0.47	0.2	0.34	0.29	0.53		3
[1]Bankfull Max Depth (ft)																	0.75	0.75	0.75	0.31	0.58	0.61	0.82		3
Bankfull Cross Sectional Area (ft^2)																	1.88	1.88	1.88	0.75	1.43	1.69	1.84		3
Width/Depth Ratio																	8.51	8.51	8.51	6.66	15.31	18.61	20.67		3
Entrenchment Ratio																	1.75	1.75	1.75	1.7	3.64	2.22	6.99		3
[1]Bank Height Ratio																	**1**	**1**	**1**	**0.54**	**0.64**	**0.64**	**0.74**		**3**
Profile																									
Riffle Length (ft)																	197.1	355.9	514.7	57.25	107.8	89.01	215.1		
Riffle Slope (ft/ft)																	0.006	0.012	0.044	0.011	0.017	0.014	0.029		
Pool Length (ft)																				1.5	12.97	6.04	31.37		
Pool Max depth (ft)																				4.14	4.46	4.61	4.62		
Pool Spacing (ft)																				114.3	133.6	143.3	143.3		
Pattern																									
Channel Beltwidth (ft)																	50.42	59.15	61.2	13.4	34.2	42.73	46.46		
Radius of Curvature (ft)																				21.64	35.62	35.15	50.55		
Rc:Bankfull width (ft/ft)																				**2.38**	**15.62**	**14.63**	**30.84**		
Meander Wavelength (ft)																									
Meander Width Ratio																				0.43	5.37	2.44	19.52		
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2																	0.285			0.29					
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification																	B6			B6					
Bankfull Velocity (fps)																				1.47					
Bankfull Discharge (cfs)																									
Valley length (ft)																									
Channel Thalweg length (ft)																	1475			1469.07					
Sinuosity (ft)																				0.95					
Water Surface Slope (Channel) (ft/ft)																				0.019					
BF slope (ft/ft)																				**0.019**					
[3]Bankfull Floodplain Area (acres)																				**0.84**					
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 4 (831 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)																				13.32	13.32	13.32	13.32		1
Floodprone Width (ft)																				>50	>50	>50	>50		1
Bankfull Mean Depth (ft)																				0.91	0.91	0.91	0.91		1
[1]Bankfull Max Depth (ft)																				1.71	1.71	1.71	1.71		1
Bankfull Cross Sectional Area (ft^2)																				12.13	12.13	12.13	12.13		1
Width/Depth Ratio																				14.63	14.63	14.63	14.63		1
Entrenchment Ratio																				>2.2	>2.2	>2.2	>2.2		1
[1]Bank Height Ratio																				**0.6**	**0.6**	**0.6**	**0.6**		**1**
Profile																									
Riffle Length (ft)																				4.74	19.81	21.81	30.73		
Riffle Slope (ft/ft)																				0.012	0.027	0.018	0.074		
Pool Length (ft)																				6.99	12.56	9.1	26.02		
Pool Max depth (ft)																				1.89	2.28	2.32	2.7		
Pool Spacing (ft)																				50.06	56.72	55.31	68.08		
Pattern																									
Channel Beltwidth (ft)																				80.13	98.47	98.47	116.8		
Radius of Curvature (ft)																				36.7	47.23	49.01	56.95		
Rc:Bankfull width (ft/ft)																				**16.34**	**19.23**	**18.89**	**23.76**		
Meander Wavelength (ft)																				221.95	221.95	221.95	221.95		
Meander Width Ratio																				3.37	5.19	4.91	7.15		
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2																				1.35					
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification																				C4b					
Bankfull Velocity (fps)																				4.23					
Bankfull Discharge (cfs)																									
Valley length (ft)																									
Channel Thalweg length (ft)																				830.01					
Sinuosity (ft)																				0.806					
Water Surface Slope (Channel) (ft/ft)																									
BF slope (ft/ft)																									
[3]Bankfull Floodplain Area (acres)																				**0.03**					
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).
3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.
4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 10a. Baseline Stream Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 7 (1,127 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					20.47	26.07	26.81	30.18	4.06	4	43.1	52.2	50.6	64.4	8.8	4	25	25	25	18.58	19.65	19.65	20.71		2
Floodprone Width (ft)					39.2	54.4	43.82	90.77	24.57	4	54.9	75.3	74.3	98	15.4	4	>55	>55	>55	>80			>100		2
Bankfull Mean Depth (ft)					0.85	1	1	1.17	0.13	4	0.98	1.16	1.1	1.38	0.18	4	0.98	0.98	0.98	0.96	1.07	1.07	1.17		2
[1]Bankfull Max Depth (ft)					1.79	2.16	1.94	2.95	0.54	4	2.17	2.41	2.5	2.5	0.14	4	1.13	1.13	1.13	1.17	1.43	1.43	1.69		2
Bankfull Cross Sectional Area (ft^2)					19.96	26.07	26.67	31	5.47	4	55.4	59.3	58.7	64.5	3.36	4	24.44	24.44	24.44	19.93	20.81	20.81	21.68		2
Width/Depth Ratio					20.89	26.33	26.3	31.81	5.33	4	31.3	47	46.2	64.4	14.35	4	25.51	25.51	25.51	15.92	18.72	18.72	21.52		2
Entrenchment Ratio					1.45	2.07	1.92	3.01	0.75	4	1.1	1.5	1.5	1.8	0.3	4	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2		2
[1]Bank Height Ratio																**4**	**1**	**1**	**1**	**0.78**	**0.85**	**0.85**	**0.92**		**2**
Profile																									
Riffle Length (ft)											7	28.8	27.5	52	13	8	10	35	60	9.79	36.53	37.12	54.31		
Riffle Slope (ft/ft)											0.009	0.02	0.018	0.422	0.01	8	0.008	0.01	0.01	0.001	0.014	0.013	0.039		
Pool Length (ft)											16	76.4	39.5	79	17.32	13	10	10	20	8.16	15.87	13.77	28.95		
Pool Max depth (ft)											2.9	3.2	3.3	3.5	0.24	13	1.5	2	2	1	2.05	2.04	2.85		
Pool Spacing (ft)											36	76.4	74	111	26.26	7	15	55	100	13.27	54.36	56.47	130.7		
Pattern																									
Channel Beltwidth (ft)																	201	201	201	154.6	209.3	209.3	264		
Radius of Curvature (ft)																	50	137.5	686	90.88	194.3	125.7	434.9		
Rc:Bankfull width (ft/ft)																	**28**	**31.5**	**31**	**15.71**	**20.53**	**21.99**	**22.62**		
Meander Wavelength (ft)																	720	720	720	687.9	687.9	687.9	687.9		
Meander Width Ratio																	6.48	6.38	7.18	9.838	10.19	9.514	11.67		
Transport parameters																									
Reach Shear Stress (competency) lb/ft^2							0.479											0.407				0.358			
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Rosgen Classification							F4/C4						C4					C4				C4			
Bankfull Velocity (fps)							3.7											3.93				4.61			
Bankfull Discharge (cfs)							96																		
Valley length (ft)																									
Channel Thalweg length (ft)													932					1110.53				1126.71			
Sinuosity (ft)													1.25					1.21				1.23			
Water Surface Slope (Channel) (ft/ft)													0.38					0.006				0.006			
BF slope (ft/ft)													**0.38**					**0.006**				**0.005**			
[3]Bankfull Floodplain Area (acres)																		**0.459**				**5.35**			
[4]% of Reach with Eroding Banks																									
Channel Stability or Habitat Metric																									
Biological or Other																									

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).
3. Utilizing XS measurement data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.
4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 1 (2,305 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%															41.8	25.4	19.4	13.4	0			30.5	14.7	36.8	18	0		
[1]SC% / Sa% / G% / C% / B% / Be%	26	22.1	51.9	0	0	0		10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.04	0.69	2.33	10.3	21.3			0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	0	100	0	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						100	0	0	0			

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 3 (1,083 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%															41.3	13	13	32.7	0			25.8	20.2	26	28	0		
[1]SC% / Sa% / G% / C% / B% / Be%	17	20	41	22	0	0		10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.06	0.9	12.5	94.2	159			0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	5	95	0	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						98	2	0	0			

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 4 (969 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%	40.9	28.8	11.7	18.6	0																	40.9	28.8	11.7	18.6	0		
[1]SC% / Sa% / G% / C% / B% / Be%	24.8	21	28.6	2.9	1	21.9		10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.04	0.74	2.75	bedroc	bedrock			0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	0	100	0	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						100	0	0	0			

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: UT2 (951 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%															100	0	0	0	0			90	2	6	2	0		
[1]SC% / Sa% / G% / C% / B% / Be%								10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)								0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	90	10	0	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						90	10	0	0			

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: UT3 (1,475 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%															100	0	0	0	0			83.7	3.2	5.5	7.6	0		
[1]SC% / Sa% / G% / C% / B% / Be%								10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)								0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	50	30	20	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						80	18	2	0			

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: UT4 (831 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%																						43.1	21.2	19.7	16	0		
[1]SC% / Sa% / G% / C% / B% / Be%	10.2	20.4	59.2	0	0	10.2		10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.24	2.96	6.85	26.8	bedrock			0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	0	100	0	0		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						100	0	0	0			

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Banks, and Hydrologic Containment Parameter Distribution)
Little Buffalo Creek (94147) Segment/Reach: UT7 (1,127 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%															40.7	18.9	15.6	15.1	9.7			34.9	26.1	12.1	18.2	8.7		
[1]SC% / Sa% / G% / C% / B% / Be%	24.3	19.4	50.5	5.8	0	0		10.2	20.4	59.2	0	0	10.2															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.04	0.78	3.3	14.3	75.1			0.24	2.96	6.85	26.8	bedrock																
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																						0	0	0	15	85		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																						95	5	0	0			

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design measurements), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section measurements and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 1 (2,305 feet)

	Cross Section 1 (Riffle)-1R							Cross Section 2 (Pool)-1P						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	640.21	640.21	640.21	640.21	641.24	640.42		640.24	640.24	640.24	640.24	640.730	640.65	
Bankfull Width (ft)	35.21	36.55	37.70	38.49	35.95	33.59		35.77	36.90	36.53	37.81	48.400	48.92	
Floodprone Width (ft)	>80	125.20	135.20	>100	>100	>100		>80	127.00	158.50	>100	>100	>100	
Bankfull Mean Depth (ft)	1.23	1.16	1.15	1.23	1.20	1.28		1.11	0.97	1.15	1.14	0.820	0.81	
Bankfull Max Depth (ft)	1.79	1.78	1.96	2.26	2.36	2.38		2.48	2.03	2.52	2.25	2.270	2.58	
Bankfull Cross Sectional Area (ft^2)	43.15	42.32	43.25	47.22	43.15	43.15		39.80	35.60	42.08	43.05	39.800	39.8	
Bankfull Width/Depth Ratio	28.73	31.56	32.87	31.37	29.95	26.15		32.15	38.17	31.71	33.21	58.860	60.13	
Bankfull Entrenchment Ratio	>2.2	3.43	3.59	>2.2	>2.2	>2.2		>2.2	3.44	4.34	>2.2	>2.2	2.13	
Bankfull Bank Height Ratio[2]	1.00	0.97	1.09	0.42	0.45	0.39		0.73	0.88	0.94	0.76	-	-	
Cross Sectional Area between end pins (ft^2)	77.79	86.15	88.38	92.57	85.02	79.95		85.42	81.10	88.9	93.80	61.430	65.59	
d50 (mm)	15.90	21.00	22.00	81.73	17.35	20.87		5.00	16.00	11.00	32.00	4.61	16.98	

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 3 (1,083 feet)

	Cross Section 1 (Riffle)-2R							Cross Section 2 (Pool)-2P						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	630.92	630.92	630.92	630.92	631.08	630.92		629.80	629.80	629.80	629.80	630.14	630.11	
Bankfull Width (ft)	38.31	41.03	38.35	37.41	40.07	37.86		39.59	26.70	33.35	37.91	43.99	40.94	
Floodprone Width (ft)	>90	419.00	488.00	>100	>100	>100		>90	350.00	368.00	99.57	>100	>100	
Bankfull Mean Depth (ft)	1.26	1.25	1.37	1.38	1.20	1.27		1.11	1.59	1.00	0.92	1.00	1.07	
Bankfull Max Depth (ft)	1.90	2.18	2.97	2.94	3.02	2.99		2.44	2.20	2.26	2.26	2.50	2.49	
Bankfull Cross Sectional Area (ft^2)	48.23	51.15	52.43	51.64	48.23	48.23		43.79	42.50	33.19	34.92	43.79	43.79	
Bankfull Width/Depth Ratio	30.43	32.91	28.05	27.10	33.29	29.72		35.79	16.77	33.52	41.16	44.19	38.28	
Bankfull Entrenchment Ratio	>2.2	10.21	12.73	>2.2	>2.2	>2.2		>2.2	13.11	11.03	2.63	>2.2	>2.2	
Bankfull Bank Height Ratio[2]	0.94	1.06	1.38	1.44	0.42	0.39		0.69	0.72	0.84	0.82	-	-	
Cross Sectional Area between end pins (ft^2)	116.34	104.46	103.94	106.00	92.88	98.96		89.91	77.86	68.32	69.90	64.30	65.00	
d50 (mm)	31.00	29.00	13.5	49.22	49.54	45.59		6.70	9.00	14.50	42.83	33.50	33.3	

NOTE: XS 2R and 2P reshaped as part of MY2 to remove backwater and overflow conditions upstream.

As observed in the method of determining bank height ratio, modifications to the channel in year 2 at XS 2R has created high bank height ratios. This is not a valid characterization of stability at this section with holding by holding the as-built baseline bankfull elevation in determining cross-section characterizations. The channel in this section of restoration is a tiered system and is providing proper floodplain connection to allow waters out of the channel. The work was performed due to backwater conditions caused by this riffle, which was a greater sign of instability.

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: Mainstem Reach 4 (969 feet)

	Cross Section 1 (Pool)-3P						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	624.26	624.26	624.26	624.26	624.66	624.53	
Bankfull Width (ft)	29.35	25.94	24.64	22.88	31.28	30.38	
Floodprone Width (ft)	>65	438.00	435.00	>100	>100	>100	
Bankfull Mean Depth (ft)	1.87	2.38	2.36	2.22	1.76	1.81	
Bankfull Max Depth (ft)	3.12	3.38	3.32	3.24	3.32	3.3	
Bankfull Cross Sectional Area (ft^2)	54.90	61.79	58.25	50.77	54.90	54.9	
Bankfull Width/Depth Ratio	15.69	10.89	10.42	10.32	17.82	16.78	
Bankfull Entrenchment Ratio	>2.2	16.89	17.65	>2.2	>2.2	>2.2	
Bankfull Bank Height Ratio[2]	0.70	0.66	0.73	0.72	-	-	
Cross Sectional Area between end pins (ft^2)	106.25	112.61	110.74	99.73	92.04	95.33	
d50 (mm)	3.40	13.00	19.50	41.75	30.68	27.59	

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: UT 2 (951 feet)

	Cross Section 1 (Riffle)-1R						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	639.34	639.34	639.34	639.34	639.07	638.89	
Bankfull Width (ft)	3.52	6.23	4.31	3.59	3.04	3.58	
Floodprone Width (ft)	8.34	31.10	40.80	10.96	6.79	5.29	
Bankfull Mean Depth (ft)	0.52	0.42	0.80	0.90	0.60	0.51	
Bankfull Max Depth (ft)	0.72	0.96	1.03	1.2	0.85	0.77	
Bankfull Cross Sectional Area (ft^2)	1.82	2.65	3.43	3.22	1.82	1.82	
Bankfull Width/Depth Ratio	6.82	14.65	5.42	4.00	5.08	7.04	
Bankfull Entrenchment Ratio	2.37	5.00	9.46	>2.2	2.20	1.48	
Bankfull Bank Height Ratio[2]	1.01	0.86	1.20	1.18	1.39	1.83	
Cross Sectional Area between end pins (ft^2)	20.73	21.69	20.37	20.83	18.02	20.09	
d50 (mm)	5.00	silt/clay	silt/clay	5.36	silt/clay	10.48	

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: UT3 (1,475 feet)

	Cross Section 1 (Riffle)-1R							Cross Section 2 (Riffle)-2R							Cross Section 3 (Riffle)-3R							Cross Section 4 (Pool)-1P						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	647.14	647.14	647.14	647.14	647.16	647.40		632.79	633.69	633.69	633.69	633.21	633.13		622.92	623.77	623.77	623.77	623.14	623.04		638.72	639.22	639.22	639.22	639.19	639.21	
Bankfull Width (ft)	3.50	5.20	5.42	4.66	4.79	5.48		5.91	11.93	8.65	13.46	7.40	6.04		3.73	7.17	8.16	7.29	3.58	3.38		4.06	8.51	6.87	9.21	5.55	5.50	
Floodprone Width (ft)	24.45	29.60	27.50	11.22	11.03	12.96		13.14	31.20	30.20	15.96	13.67	10.45		6.35	>100	>100	90.60	5.62	5.55		8.28	20.40	15.30	9.41	11.67	9.35	
Bankfull Mean Depth (ft)	0.53	0.30	5.42	0.29	0.38	0.34		0.29	0.99	1.19	0.54	0.23	0.28		0.20	0.48	0.58	0.55	0.21	0.22		0.25	0.58	0.46	0.22	0.18	0.18	
Bankfull Max Depth (ft)	0.82	0.78	0.60	0.64	0.67	0.56		0.61	1.62	1.56	1.05	0.48	0.50		0.31	1.05	1.08	1.05	0.34	0.34		0.46	1.19	0.79	0.51	0.46	0.30	
Bankfull Cross Sectional Area (ft^2)	1.84	1.55	1.80	1.36	1.84	1.84		1.69	11.79	10.31	7.29	1.69	1.69		0.75	3.41	4.75	4.02	0.75	0.75		1.01	4.90	3.14	2.03	1.01	1.01	
Bankfull Width/Depth Ratio	6.66	17.47	16.31	16.01	12.47	16.32		20.67	12.06	7.25	24.84	32.40	21.59		18.61	15.08	14.02	13.21	17.09	15.23		16.32	8.51	15.06	41.78	30.50	29.95	
Bankfull Entrenchment Ratio	6.99	5.70	5.07	>2.2	2.30	>2.2		2.22	2.62	3.49	1.19	1.85	1.73		1.70	>2.2	>2.2	>2.2	1.57	1.64		2.04	2.40	2.23	1.02	2.10	1.70	
Bankfull Bank Height Ratio[2]	0.74	1.04	0.69	0.90	1.33	0.75		0.57	0.35	0.54	0.82	2.29	1.01		0.71	0.99	1.03	1.17	2.56	1.21		0.54	0.46	0.64	0.53	-	-	
Cross Sectional Area between end pins (ft^2)	13.50	13.86	15.62	14.11	13.77	13.13		26.63	32.12	30.79	26.15	24.96	26.15		15.64	14.90	15.72	13.13	13.96	14.32		27.61	28.88	24.81	23.54	22.36	23.17	
d50 (mm)	silt/clay	silt/clay	silt/clay	silt/clay	silt/clay	silt/clay		4.50	0.19	silt/clay	silt/clay	silt/clay	0.10		0.11	silt/clay	silt/clay	silt/clay	0.50	2.08		silt/clay	silt/clay	silt/clay	silt/clay	silt/clay	0.12	

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

NOTE: MY1 Data modified to use same bankfull elevation as baseline data for 1R. MY1 Bankfull for 2R, 3R and 1P established as baseline bankfull as the original bankfull only had slope indications to identify, where MY1 provided more thorough evidence of bankfull.

MY3 field survey bankfull indicates a change in bankfull from baseline elevation. This is expected due to the cattle damage in the channel during MY2. The stream appears more stable in MY3 than in past. Baseline bankful for previous years still used as per North Carolina DMS protocols, but MY3 bankfull elevations are shown on the Cross Section plot exhibits.

MY4 monitoring protocols by DMS requires baseline cross section area remain constant for determining other ratios. This leads to misleading results for UT3, as baseline values were calculated immediately after construction, and based on a small 6-inch deep channel that only slope indications were available to determine bankfull after cutting entrenched banks back. MY1 cross-sectional area is more realistic for baseline data. The reach is stable, which is not indicated based on MY4 cross sectional values.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: UT 4 (831 feet)

	Cross Section 1 (Riffle)-1R							Cross Section 2 (Pool)-1P						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	627.41	627.41	627.41	627.41	627.88	627.69		629.84	629.84	629.84	629.84	630.43	630.37	
Bankfull Width (ft)	13.32	13.94	14.33	11.55	13.07	13.05		20.38	17.20	19.45	18.10	21.08	21.61	
Floodprone Width (ft)	>50	>100	>100	35.53	>100	38.25		>100	>100	>100	77.83	>100	>100	
Bankfull Mean Depth (ft)	0.91	0.89	0.73	0.84	0.93	0.93		1.34	1.35	1.22	1.32	1.30	1.27	
Bankfull Max Depth (ft)	1.71	1.65	1.74	1.76	1.93	1.83		2.71	2.53	2.94	2.64	3.18	3.27	
Bankfull Cross Sectional Area (ft^2)	12.13	12.35	10.42	9.70	12.13	12.13		27.37	23.29	23.75	23.94	27.37	27.37	
Bankfull Width/Depth Ratio	14.63	15.73	19.70	13.75	14.08	14.04		15.18	12.71	15.93	18.10	16.24	17.06	
Bankfull Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2		>2.2	>2.2	>2.2	>2.2	>2.2	>2.2	
Bankfull Bank Height Ratio[2]	0.60	0.99	1.16	0.80	0.47	0.43		0.63	0.85	1.07	0.95	-	-	
Cross Sectional Area between end pins (ft^2)	29.20	32.81	31.19	29.13	25.00	28.00		54.73	53.60	54.93	53.03	43.31	45.06	
d50 (mm)	8.90	6.90	10.00	11.30	20.55	14.59		7.00	0.18	10.00	41.10	3.43	6.85	

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Little Buffalo Creek (94147) Segment/Reach: UT 7 (1,127 feet)

	Cross Section 1 (Riffle)-1R							Cross Section 2 (Riffle)-2R							Cross Section 3 (Pool)-1P							Cross Section 4 (Step Pool)-STP1							Cross Section 5 (Step Pool)-STP2						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	615.87	615.87	615.87	615.87	616.44	616.13		613.60	613.60	613.60	613.60	613.43	613.38		614.93	614.93	614.93	614.93	615.03	614.75				612.87	612.87	613.07	612.96				610.22	610.22	610.25	610.36	
Bankfull Width (ft)	20.71	21.76	21.47	21.15	21.45	21.94		18.58	21.20	21.61	18.23	17.61	17.73		27.10	29.90	23.14	22.65	22.46	23.37				28.17	26.53	30.22	28.73				20.56	22.82	21.98	21.92	
Floodprone Width (ft)	>100	>100	>100	>100	>100	>100		>80	>100	>100	>100	>100	>100		>80	>100	>100	>100	>100	>100				>100	>100	>100	>100				>100	38.67	55.00	52.59	
Bankfull Mean Depth (ft)	0.96	0.75	0.98	0.86	0.93	0.91		1.17	1.02	1.21	1.15	1.23	1.22		0.96	0.81	1.24	1.11	1.16	1.11				1.86	1.70	1.74	1.83				1.66	1.37	1.56	1.56	
Bankfull Max Depth (ft)	1.17	0.92	1.29	1.31	1.74	1.51		1.69	1.82	2.04	1.78	1.67	1.82		1.29	1.25	1.53	1.61	1.73	1.58				2.55	2.32	2.68	2.80				2.32	2.04	2.62	2.61	
Bankfull Cross Sectional Area (ft^2)	19.93	16.42	21.15	18.21	19.93	19.93		21.68	21.71	26.11	21.00	21.68	21.68		25.98	24.19	28.70	25.11	25.98	25.98				52.44	44.98	52.44	52.44				34.22	31.17	34.22	34.22	
Bankfull Width/Depth Ratio	21.52	28.86	21.80	24.56	23.09	24.15		15.92	20.70	17.89	15.83	14.30	14.50		28.27	36.96	18.65	20.43	19.42	21.02				15.13	15.65	17.42	15.74				12.35	16.71	14.12	14.04	
Bankfull Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2	>2.2	>2.2		>2.2	>2.2	>2.2	>2.2	>2.2	>2.2		>2.2	>2.2	>2.2	>2.2	>2.2	>2.2				>2.2	>2.2	>2.2	>2.2				>2.2	1.69	2.50	>2.2	
Bankfull Bank Height Ratio[2]	0.78	0.84	0.96	1.24	1.02	0.83		0.92	1.25	1.12	0.97	1.13	1.00		0.67	1.23	0.80	1.03	-	-				0.92	0.92	-	-				0.78	0.50	-	-	
Cross Sectional Area between end pins (ft^2)	66.61	65.98	73.43	67.07	50.19	59.84		52.17	56.85	61.51	55.95	58.95	60.38		76.83	80.07	90.25	81.55	76.23	86.70				149.86	133.36	139.31	141.94				200.48	197.13	197.08	193.37	
d50 (mm)	23.00	11.00	18.00	36.00	12.87	15.12		0.50	0.50	20.00	27.84	30.29	36.23		silt/clay	silt/clay	silt/clay	silt/clay	silt/clay	0.22				49.00	39.22	45.00	19.15				30.00	41.10	36.33	28.77	

1 = Widths and depths for annual measurements are based on the baseline bankfull datum regardless of dimensional/depositional development for MY1 - MY3. Beginning in MY4, DMS guidance altered the monitoring criteria to maintain baseline cross sectional area as the fixed ratio for comparison.
2 = Bankfull Bank Height Ratio for MY1 - MY 3is determined by maintaining the baseline bankfull max depth static while using the monitoring year lowest bank height surveyed. Beginning MY4, Bankfull Bank Height Ratio is determined by a changing bankfull elevation and max dept based on baseline cross sectional area and the monitoring year lowest bank height surveyed.

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: Mainstem Reach 1 (2,305 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	35.21	35.21	35.21	35.21		1	36.55	36.55	36.55	36.55		1	37.7	37.7	37.7	37.7		1	38.49	38.49	38.49	38.49		1	35.95	35.95	35.95	35.95		1	33.59	33.59	33.59	33.59		1
Floodprone Width (ft)	>80	>80	>80	>80		1	125.20	125.20	125.20	125.20		1	135.2	135.2	135.2	135.2		1	>100	>100	>100	>100		1	>100	>100	>100	>100		1	>100	>100	>100	>100		1
Bankfull Mean Depth (ft)	1.23	1.23	1.23	1.23		1	1.16	1.16	1.16	1.16		1	1.15	1.15	1.15	1.15		1	1.23	1.23	1.23	1.23		1	1.2	1.2	1.2	1.2		1	1.28	1.28	1.28	1.28		1
[1]Bankfull Max Depth (ft)	1.79	1.79	1.79	1.79		1	1.78	1.78	1.78	1.78		1	1.96	1.96	1.96	1.96		1	2.26	2.26	2.26	2.26		1	2.36	2.36	2.36	2.36		1	2.38	2.38	2.38	2.38		1
Bankfull Cross Sectional Area (ft^2)	43.15	43.15	43.15	43.15		1	42.32	42.32	42.32	42.32		1	43.25	43.25	43.25	43.25		1	47.22	47.22	47.22	47.22		1	43.15	43.15	43.15	43.15		1	43.15	43.15	43.15	43.15		1
Width/Depth Ratio	28.73	28.73	28.73	28.73		1	31.56	31.56	31.56	31.56		1	32.87	32.87	32.87	32.87		1	31.37	31.37	31.37	31.37		1	29.95	29.95	29.95	29.95		1	26.15	26.15	26.15	26.15		1
Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2		1	3.43	3.43	3.43	3.43		1	3.59	3.59	3.59	3.59		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1
[1]Bank Height Ratio	**1**	**1**	**1**	**1**		**1**	**0.97**	**0.97**	**0.97**	**0.97**		**1**	**1.09**	**1.09**	**1.09**	**1.09**		**1**	**0.42**	**0.42**	**0.42**	**0.42**		1	**0.45**	**0.45**	**0.45**	**0.45**		**1**	**0.39**	**0.39**	**0.39**	**0.39**		**1**
Profile																																				
Riffle Length (ft)	7.73	23.71	22.04	38.44			5.02	14.18	9.18	31.54			8.88	15.73	16.57	20.64			12.59	16.66	14.88	21.37			6.19	13.48	12.60	22.78			19.01	24.14	24.32	28.81		
Riffle Slope (ft/ft)	0.00	0.026	0.022	0.076			0.001	0.015	0.007	0.044			0.004	0.016	0.006	0.062			0.004	0.022	0.021	0.044			0.016	0.032	0.029	0.058			0.011	0.016	0.017	0.022		
Pool Length (ft)	4.21	25.43	17.55	83.2			2.96	7.07	6.1	14.54			6.82	22.35	21.04	39.29			9.78	27.54	24.39	48.90			1.51	12.13	12.39	20.64			6.93	18.10	17.49	27.36		
Pool Max depth (ft)	1.96	2.71	2.48	3.76			1.96	2.63	2.43	3.42			2.10	2.53	2.37	3.75			1.33	1.65	1.48	2.55			0.90	1.74	1.72	2.42			0.89	1.38	1.25	2.12		
Pool Spacing (ft)	29.95	48.64	39.06	91.87			14.66	32.47	23.01	54.64			21.81	33.95	34.70	46.54			28.90	40.23	40.13	51.92			9.85	27.04	27.19	45.08			7.81	30.35	32.12	62.82		
Pattern																																				
Channel Beltwidth (ft)	59.64	105.83	92.68	165.18																																
Radius of Curvature (ft)	72.965	83.153	79.01	97.485																																
Rc:Bankfull width (ft/ft)	**27.95**	**35.603**	**36.13**	**46.36**																																
Meander Wavelength (ft)																																				
Meander Width Ratio	1.2865	3.037	2.5652	5.9098																																

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Additional Reach Parameters																																				
Rosgen Classification	C4						C4c-						C4						C4						C4						C4					
Channel Thalweg length (ft)	2299.79						2318.86						2306.75						2305.11						2304.87						2311.24					
Sinuosity (ft)	1.05						1.05						1.05						1.05						1.05						1.05					
Water Surface Slope (Channel) (ft/ft)							NA (DRY)						NA (DRY/STAGNET WATER)						0.0015 (BACKWATER-BEAVER DAM)						0.0061						0.0043					
BF slope (ft/ft)							**0.0007**						**0.0014**						**0.0027**						**0.006**						**0.005**					
[3]R% / Ru% / P% / G% / S%	**30.5**	**14.7**	**36.8**	**18**	**0**		**35.2**	**19.6**	**19.5**	**25.6**	**0**		**25.7**	**12.3**	**36.5**	**25.5**	**0**		**22.6**	**15.4**	**37.4**	**24.6**	**0**		**25.8**	**16.9**	**31.0**	**26.3**	**0**		**33.6**	**7.8**	**40.3**	**18.3**	**0**	
[3]SC% / Sa% / G% / C% / B% / Be%													**0**	**0**	**76.6**	**0**	**0**	**23.4**	**7**	**0**	**82.7**	**0**	**0**	**10.3**	**0**	**0**	**73.0**	**0**	**27.0**	**0.0**	**0**	**2.2**	**80.9**	**0**	**0**	**16.8**
[3]d16 / d35 / d50 / d84 / d95 /													**0.78**	**10**	**17.5**	**45**	**Bed**		**14.72**	**27.09**	**41.24**	**Bed**	**Bed**		**4.31**	**7.43**	**10.32**	**39.22**	**Bed**		**0.96**	**7.52**	**18.57**	**Bed**	**Bed**	
[2]% of Reach with Eroding Banks							**0**																													
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: Mainstem Reach 3 (1,083 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	38.31	38.31	38.31	38.31		1	41.03	41.03	41.03	41.03		1	38.35	38.35	38.35	38.35		1	23.08	23.08	23.08	23.08		1	40.07	40.07	40.07	40.07		1	37.86	37.86	37.86	37.86		1
Floodprone Width (ft)	>90	>90	>90	>90		1	419.00	419.00	419.00	419.00		1	488	488	488	488		1	>100	>100	>100	>100		1	>100	>100	>100	>100		1	>100	>100	>100	>100		1
Bankfull Mean Depth (ft)	1.26	1.26	1.26	1.26		1	1.25	1.25	1.25	1.25		1	1.37	1.37	1.37	1.37		1	2.24	2.24	2.24	2.24		1	1.2	1.2	1.2	1.2		1	1.27	1.27	1.27	1.27		1
[1]Bankfull Max Depth (ft)	1.9	1.9	1.9	1.9		1	2.18	2.18	2.18	2.18		1	2.97	2.97	2.97	2.97		1	2.94	2.94	2.94	2.94		1	3.02	3.02	3.02	3.02		1	2.99	2.99	2.99	2.99		1
Bankfull Cross Sectional Area (ft^2)	48.23	48.23	48.23	48.23		1	51.15	51.15	51.15	51.15		1	52.43	52.43	52.43	52.43		1	51.64	51.64	51.64	51.64		1	48.23	48.23	48.23	48.23		1	48.23	48.23	48.23	48.23		1
Width/Depth Ratio	30.43	30.43	30.43	30.43		1	32.91	32.91	32.91	32.91		1	28.05	28.05	28.05	28.05		1	10.31	10.31	10.31	10.31		1	33.29	33.29	33.29	33.29		1	29.72	29.72	29.72	29.72		1
Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2		1	10.21	10.21	10.21	10.21		1	12.73	12.73	12.73	12.73		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1
[1]Bank Height Ratio	**0.94**	**0.94**	**0.94**	**0.94**		**1**	**1.06**	**1.06**	**1.06**	**1.06**		**1**	**1.38**	**1.38**	**1.38**	**1.38**		**1**	**1.44**	**1.44**	**1.44**	**1.44**		**1**	**0.42**	**0.42**	**0.42**	**0.42**		**1**	**0.39**	**0.39**	**0.39**	**0.39**		**1**
Profile																																				
Riffle Length (ft)	11.3	18.65	20.99	21.31			10.65	25.52	26.64	38.18			6.30	20.06	16.55	40.86		1	11.81	23.48	23.48	35.15			4.18	19.91	12.75	42.80			19.07	35.45	35.45	51.83		
Riffle Slope (ft/ft)	0.0182	0.0502	0.0241	0.1345			0.007	0.013	0.008	0.027			0.008	0.022	0.022	0.037		1	0.008	0.011	0.011	0.015			0.002	0.155	0.009	0.454			0.011	0.014	0.014	0.016		
Pool Length (ft)	6.32	12.33	10.63	21.53			7.42	17.75	21.33	24.51			2.19	20.09	4.60	68.96		1	8.91	19.63	24.99	64.83			7.60	34.17	34.91	59.24			15.99	27.36	24.11	47.08		
Pool Max depth (ft)	0.5	1.13	1.26	1.69			1.75	2.81	1.87	4.81			2.70	2.88	2.79	3.23		1	2.68	4.12	2.98	6.69			1.67	1.99	2.02	2.24			1.26	1.89	2.03	2.14		
Pool Spacing (ft)	36.04	45.42	46.77	53.33			48.94	61.06	51.44	82.8			16.88	40.66	30.84	84.05		1	2.21	39.18	30.57	93.38			21.62	37.50	24.74	66.13			5.87	35.50	35.66	64.97		
Pattern																																				
Channel Beltwidth (ft)	58.77	58.77	58.77	58.77																																
Radius of Curvature (ft)	83.8	83.8	83.8	83.8																																
Rc:Bankfull width (ft/ft)	**4.58**	**15.654**	**16.52**	**23.05**																																
Meander Wavelength (ft)																																				
Meander Width Ratio	2.5497	5.1978	3.5575	12.832																																

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Additional Reach Parameters																																				
Rosgen Classification	C4						C4						C4						C4						C4						C4					
Channel Thalweg length (ft)	1079.45						1069.58						1074.38						1075.39						1073.51						1076.99					
Sinuosity (ft)	1.01						1.01						1.01						1.01						1.01						1.01					
Water Surface Slope (Channel) (ft/ft)							NA (DRY)						0.002						0.0013						0.005						0.0032					
BF slope (ft/ft)							**0.0138**						**0.0084**						**0.007**						**0.0021**						**0.0019**					
[3]R% / Ru% / P% / G% / S%	**25.8**	**20.2**	**26**	**28**	**0**		**42**	**14.4**	**21.9**	**21.7**	**0**		**33**	**9.9**	**33.1**	**24**	**0**		**20.8**	**13.3**	**54.8**	**11.1**	**0**		**22.3**	**5.8**	**50.9**	**21**	**0**		**29.1**	**6.7**	**56.2**	**8**	**0**	
[3]SC% / Sa% / G% / C% / B% / Be%													**13.7**	**0**	**78.7**	**0**	**0**	**7.6**	**0**	**0**	**100**	**0**	**0**	**0**	**0**	**0**	**83.8**	**16.2**	**0**	**0**	**0**	**0**	**19**	**62.5**	**18.5**	
[3]d16 / d35 / d50 / d84 / d95 /													**2.5**	**9**	**14**	**25**	**38**		**23.69**	**36.14**	**45**	**77.57**	**90**		**11.3**	**29.92**	**42.4**	**84.97**	**172.57**		**5.5**	**17.26**	**27.59**	**165.79**	**Bed**	
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 2 (951 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	3.52	3.52	3.52	3.52		1	6.23	6.23	6.23	6.23		1	4.31	4.31	4.31	4.31		1	3.59	3.59	3.59	3.59		1	3.04	3.04	3.04	3.04		1	3.58	3.58	3.58	3.58		1
Floodprone Width (ft)	8.34	8.34	8.34	8.34		1	31.10	31.10	31.10	31.10		1	40.8	40.8	40.8	40.8		1	10.96	10.96	10.96	10.96		1	6.79	6.79	6.79	6.79		1	5.29	5.29	5.29	5.29		1
Bankfull Mean Depth (ft)	0.52	0.52	0.52	0.52		1	0.42	0.42	0.42	0.42		1	0.8	0.8	0.8	0.8		1	0.90	0.90	0.90	0.90		1	0.60	0.60	0.60	0.60		1	0.51	0.51	0.51	0.51		1
[1]Bankfull Max Depth (ft)	0.72	0.72	0.72	0.72		1	0.96	0.96	0.96	0.96		1	1.03	1.03	1.03	1.03		1	1.20	1.20	1.20	1.20		1	0.85	0.85	0.85	0.85		1	0.77	0.77	0.77	0.77		1
Bankfull Cross Sectional Area (ft^2)	1.82	1.82	1.82	1.82		1	2.65	2.65	2.65	2.65		1	3.43	3.43	3.43	3.43		1	3.22	3.22	3.22	3.22		1	1.82	1.82	1.82	1.82		1	1.82	1.82	1.82	1.82		1
Width/Depth Ratio	6.82	6.82	6.82	6.82		1	14.65	14.65	14.65	14.65		1	5.42	5.42	5.42	5.42		1	4.00	4.00	4.00	4.00		1	5.08	5.08	5.08	5.08		1	7.04	7.04	7.04	7.04		1
Entrenchment Ratio	2.37	2.37	2.37	2.37		1	5.00	5.00	5.00	5.00		1	9.46	9.46	9.46	9.46		1	>2.2	>2.2	>2.2	>2.2		1	2.20	2.20	2.20	2.20		1	1.48	1.48	1.48	1.48		1
[1]Bank Height Ratio	**1.01**	**1.01**	**1.01**	**1.01**		**1**	**0.86**	**0.86**	**0.86**	**0.86**		**1**	**1.2**	**1.2**	**1.2**	**1.2**		**1**	**1.18**	**1.18**	**1.18**	**1.18**		**1**	**1.39**	**1.39**	**1.39**	**1.39**		**1**	**1.83**	**1.83**	**1.83**	**1.83**		**1**
Profile																																				
Riffle Length (ft)	6.98	13.52	13.52	20.07			35.95	35.95	35.95	35.95			18.87	20.43	20.43	21.99			9.18	11.88	11.88	14.58			7.65	7.65	7.65	7.65			6.98	11.69	11.69	16.40		
Riffle Slope (ft/ft)	0.01	0.013	0.013	0.016			0.008	0.008	0.008	0.008			0.019	0.022	0.022	0.026			0.004	0.019	0.019	0.034			0.011	0.011	0.011	0.011			0.009	0.024	0.024	0.039		
Pool Length (ft)	12.76	12.76	12.76	12.76			NA	NA	NA	NA			7.71	11.145	11.145	14.58			8.52	8.52	8.52	8.52			6.48	16.30	13.72	28.71			12.12	14.65	14.65	17.18		
Pool Max depth (ft)	0.89	0.89	0.89	0.89			NA	NA	NA	NA			0.725	1.0875	1.0875	1.45			1.38	1.38	1.38	1.38			1.23	1.43	1.46	1.59			2.22	2.41	2.41	2.61		
Pool Spacing (ft)	30.63	30.63	30.63	30.63			NA	NA	NA	NA			36.22	36.22	36.22	36.22			NA	NA	NA	NA			6.94	13.9	13.9	20.86			26.91	26.91	26.91	26.91		
Pattern																																				
Channel Beltwidth (ft)																																				
Radius of Curvature (ft)																																				
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)																																				
Meander Width Ratio																																				

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Additional Reach Parameters																																				
Rosgen Classification	B6						B6						B6						B4c						B6c						B6					
Channel Thalweg length (ft)	951.37						951.54						952.31						952.33						952.54						952.33					
Sinuosity (ft)	0.96						0.96						0.96						0.96						0.96						0.96					
Water Surface Slope (Channel) (ft/ft)							NA (DRY)						NA (DRY)						0.0104						0.0041						0.0098					
BF slope (ft/ft)							**0.0482**						**0.0209**						**0.0113**						**0.0045**						**0.0266**					
[3]R% / Ru% / P% / G% / S%	**90**	**2**	**6**	**2**	**0**		**100**	**0**	**0**	**0**	**0**		**47.1**	**22.5**	**25.7**	**4.7**	**0**		**46.8**	**24.8**	**16.8**	**11.6**	**0**		**9.5**	**22.2**	**61**	**7.2**	**0**		**23.38**	**7.21**	**29.3**	**10.51**		
[3]SC% / Sa% / G% / C% / B% / Be%													**14.7**	**53.9**	**0**	**0**	**0**	**31.4**	**21.8**	**11.6**	**66.6**	**0**	**0**	**0**	**35.4**	**0**	**6.3**	**0**	**58.3**	**0**	**41**	**0**	**14.9**	**44.1**	**0**	**0**
[3]d16 / d35 / d50 / d84 / d95 /													**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**		**Silt/Clay**	**0.83**	**5.36**	**Bed**	**Bed**		**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**		**0.41**	**4.55**	**10.48**	**Bed**	**Bed**	
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 3 (1,475 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	3.5	4.38	3.73	5.91		3	5.20	8.10	7.17	11.93		3	5.42	7.41	8.16	8.65		3	4.66	8.47	7.29	13.46		3	3.58	5.26	4.79	7.40		3	3.38	4.97	5.50	6.04		3
Floodprone Width (ft)	6.35	14.65	13.14	24.45		3	29.60	30.40	30.40	>100		3	27.5	28.85	28.85	>100		3	11.22	39.26	15.96	90.60		3	5.62	10.11	11.03	13.67		3	5.55	8.45	9.35	10.45		3
Bankfull Mean Depth (ft)	0.2	0.34	0.29	0.53		3	0.30	0.59	0.48	0.99		3	0.58	2.40	1.19	5.42		3	0.29	0.46	0.54	0.55		3	0.21	0.27	0.23	0.38		3	0.18	0.23	0.22	0.28		3
[1]Bankfull Max Depth (ft)	0.31	0.58	0.61	0.82		3	0.78	1.15	1.05	1.62		3	0.6	1.08	1.08	1.56		3	0.64	0.91	1.05	1.05		3	0.34	0.50	0.48	0.67		3	0.30	0.38	0.34	0.50		3
Bankfull Cross Sectional Area (ft^2)	0.75	1.43	1.69	1.84		3	1.55	5.58	3.41	11.79		3	1.8	5.62	4.75	10.31		3	1.36	4.22	4.02	7.29		3	0.75	1.43	1.69	1.84		3	0.75	1.15	1.01	1.69		3
Width/Depth Ratio	6.66	15.31	18.61	20.67		3	12.06	14.87	15.08	17.47		3	7.25	12.53	14.02	16.31		3	13.21	18.02	16.01	24.84		3	12.47	20.65	17.09	32.40		3	15.23	22.26	21.59	29.95		3
Entrenchment Ratio	1.7	3.64	2.22	6.99		3	2.62	4.16	4.16	5.70		3	3.49	4.28	4.28	5.07		3	1.19	1.19	1.19	1.19		3	1.57	1.91	1.85	2.30		3	1.64	1.69	1.70	1.73		3
[1]Bank Height Ratio	**0.57**	**0.67**	**0.71**	**0.74**		**3**	**0.35**	**0.79**	**0.99**	**1.04**		**3**	**0.54**	**0.75**	**0.69**	**1.03**		**3**	**0.82**	**0.96**	**0.90**	**1.17**		**3**	**1.33**	**2.06**	**2.29**	**2.56**		**3**	**1.21**	**1.25**	**1.25**	**1.29**		**3**
Profile																																				
Riffle Length (ft)	57.25	107.81	89.01	215.05			31.91	81.09	72.62	143.24			Not Identifiable due to cattle damage						10.98	57.75	51.85	109.87			3.38	16.17	10.55	70.02			2.71	15.69	15.31	37.79		
Riffle Slope (ft/ft)	0.011	0.017	0.014	0.029			0.001	0.016	0.016	0.03									0.006	0.019	0.019	0.033			0.003	0.043	0.032	0.108			0.000	0.040	0.034	0.184		
Pool Length (ft)	1.5	12.97	6.04	31.37			6.73	16.17	12.09	33.76									2.00	9.44	9.13	21.10			0.91	8.70	5.15	31.75			0.97	15.16	16.52	39.02		
Pool Max depth (ft)	4.14	4.46	4.61	4.62			0.63	1.48	1.48	2.31									0.31	1.26	1.40	2.06			0.32	1.37	1.35	2.32			1.00	1.88	1.95	2.98		
Pool Spacing (ft)	114.27	133.63	143.31	143.31			125.06	186.72	186.72	248.38									26.92	80.80	77.14	123.04			3.93	24.64	20.79	49.80			0.00	26.73	27.72	62.10		
Pattern																																				
Channel Beltwidth (ft)	13.4	34.2	42.73	46.46																																
Radius of Curvature (ft)	21.64	35.62	35.15	50.55																																
Rc:Bankfull width (ft/ft)	**2.38**	**15.62**	**14.63**	**30.84**									Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline																							
Meander Wavelength (ft)																																				
Meander Width Ratio	0.43	5.37	2.44	19.52																																
Additional Reach Parameters																																				
Rosgen Classification	B6						B6c						B6						B6						B6						B6					
Channel Thalweg length (ft)	1469.07						1467.05						1471.15						1484.42						1489.27						1488.24					
Sinuosity (ft)	0.95						0.95						0.95						0.95						0.95						0.95					
Water Surface Slope (Channel) (ft/ft)	0.019						NA (DRY)						NA (DRY)						NA (NO VISUAL FLOW BUT SATURATED)						0.018						0.0175					
BF slope (ft/ft)	**0.019**						**0.0198**						**0.0249**						**0.0167**						**0.018**						**0.0222**					
[3]R% / Ru% / P% / G% / S%	**83.7**	**3.2**	**5.5**	**7.6**	**0**		**83.2**	**4.2**	**7.4**	**4.9**	**0.3**		**Not Identifiable due to cattle damage**						**69.7**	**10.7**	**9.5**	**10.1**	**0**		**45.0**	**14.2**	**25.1**	**15.8**	**0**		**31.1**	**13.2**	**38.7**	**17.1**	**0**	
[3]SC% / Sa% / G% / C% / B% / Be%													**92.3**	**4.7**	**1.6**	**0**	**0**	**1.4**	**94.3**	**3.5**	**0**	**0**	**0**	**2.2**	**83.4**	**0**	**6.8**	**3.7**	**6.6**	**0**	**78.7**	**0**	**16.5**	**0**	**4.7**	**0**
[3]d16 / d35 / d50 / d84 / d95 /													**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**		**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**Silt/Clay**		**Silt/Clay**	**Silt/Clay**	**Silt/Clay**	**0.63**	**5.97**		**Silt/Clay**	**Silt/Clay**	**0.16**	**6.89**	**14.55**	
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 4 (831 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	13.32	13.32	13.32	13.32		1	13.94	13.94	13.94	13.94		1	14.32691	14.32691	14.32691	14.32691		1	11.55	11.55	11.55	11.55		1	13.07	13.07	13.07	13.07		1	13.05	13.05	13.05	13.05		1
Floodprone Width (ft)	>50	>50	>50	>50		1	>100	>100	>100	>100		1	>100	>100	>100	>100		1	35.53	35.53	35.53	35.53		1	>100	>100	>100	>100		1	38.25	38.25	38.25	38.25		1
Bankfull Mean Depth (ft)	0.91	0.91	0.91	0.91		1	0.89	0.89	0.89	0.89		1	0.73	0.73	0.73	0.73		1	0.84	0.84	0.84	0.84		1	0.93	0.93	0.93	0.93		1	0.93	0.93	0.93	0.93		1
[1]Bankfull Max Depth (ft)	1.71	1.71	1.71	1.71		1	1.65	1.65	1.65	1.65		1	1.738	1.738	1.738	1.738		1	1.76	1.76	1.76	1.76		1	1.93	1.93	1.93	1.93		1	1.83	1.83	1.83	1.83		1
Bankfull Cross Sectional Area (ft^2)	12.13	12.13	12.13	12.13		1	12.35	12.35	12.35	12.35		1	10.42	10.42	10.42	10.42		1	9.70	9.70	9.70	9.70		1	12.13	12.13	12.13	12.13		1	12.13	12.13	12.13	12.13		1
Width/Depth Ratio	14.63	14.63	14.63	14.63		1	15.73	15.73	15.73	15.73		1	19.7	19.7	19.7	19.7		1	13.75	13.75	13.75	13.75		1	14.08	14.08	14.08	14.08		1	14.04	14.04	14.04	14.04		1
Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1	>2.2	>2.2	>2.2	>2.2		1
[1]Bank Height Ratio	**0.60**	**0.60**	**0.60**	**0.60**		**1**	**0.99**	**0.99**	**0.99**	**0.99**		**1**	**1.16**	**1.16**	**1.16**	**1.16**		**1**	**0.80**	**0.80**	**0.80**	**0.80**		**1**	**0.47**	**0.47**	**0.47**	**0.47**		**1**	**0.43**	**0.43**	**0.43**	**0.43**		**1**
Profile																																				
Riffle Length (ft)	4.74	19.81	21.81	30.73			11.72	23.29	21.67	36.64			4.04	13.83	11.615	30.23			3.55	15.06	10.92	37.19			5.16	13.42	13.08	28.88			3.85	12.82	10.45	32.42		
Riffle Slope (ft/ft)	0.012	0.027	0.018	0.074			0.013	0.025	0.024	0.037			0.005	0.036	0.035	0.070			0.005	0.034	0.025	0.072			0.018	0.034	0.035	0.055			0.010	0.032	0.032	0.065		
Pool Length (ft)	6.99	12.56	9.1	26.02			6.8	9.62	8.54	15.58			3.41	6.15	5.915	10.44			1.93	5.72	4.41	12.47			3.73	11.34	11.05	23.33			3.93	15.94	13.70	29.16		
Pool Max depth (ft)	1.89	2.28	2.32	2.7			1.71	2.42	2.52	2.88			1.835	2.679833	2.731	3.385			1.74	2.20	2.15	2.74			0.63	1.31	1.30	2.17			0.59	1.29	1.34	1.76		
Pool Spacing (ft)	50.06	56.72	55.31	68.08			22.59	37.51	42.3	46.92			7.58	27.92818	26.45	52			14.21	32.41	31.88	48.40			13.33	26.70	26.09	42.89			6.12	23.33	19.40	48.41		
Pattern																																				
Channel Beltwidth (ft)	80.13	98.47	98.47	116.81																																
Radius of Curvature (ft)	36.7	47.23	49.01	56.95																																
Rc:Bankfull width (ft/ft)	**16.34**	**19.23**	**18.89**	**23.76**																																
Meander Wavelength (ft)	221.95	221.95	221.95	221.95																																
Meander Width Ratio	3.37	5.19	4.91	7.15																																

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

Additional Reach Parameters																																				
Rosgen Classification	C4b						C4						C4						C4						C4						C4					
Channel Thalweg length (ft)	830.01						837.13						838.29						838.81						846.12						842.87					
Sinuosity (ft)	0.81						0.81						0.81						0.81						0.81						0.81					
Water Surface Slope (Channel) (ft/ft)							NA (DRY)						0.0138						0.014						0.015						0.014					
BF slope (ft/ft)							**0.0123**						**0.0123**						**0.0132**						**0.013**						**0.0133**					
[3]R% / Ru% / P% / G% / S%	**43.1**	**21.2**	**19.7**	**16**	**0**		**52.2**	**9.8**	**19.2**	**18.8**	**0**		**34**	**17.9**	**18.1**	**30**	**0**		**41.2**	**23.9**	**14.2**	**20.6**	**0**		**30.6**	**15.8**	**28.7**	**24.8**	**0**		**31.9**	**9.4**	**39.7**	**18.9**	**0**	
[3]SC% / Sa% / G% / C% / B% / Be%													**0**	**1.7**	**98.3**	**0**	**0**	**0**	**0**	**2.1**	**97.9**	**0**	**0**	**0**	**0**	**31.9**	**65.1**	**0**	**3**	**0**	**0**	**3.1**	**32.7**	**64.2**	**0**	**0**
[3]d16 / d35 / d50 / d84 / d95 /													**0.38**	**5**	**10**	**30**	**64**		**0.96**	**12.95**	**25.21**	**66.50**	**140.13**		**0.76**	**5.57**	**10.53**	**40.49**	**74.73**		**0.93**	**7.35**	**14.59**	**43.96**	**71.58**	
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary
Little Buffalo Creek (94147) - Segment/Reach: UT 7 (1,127 feet)

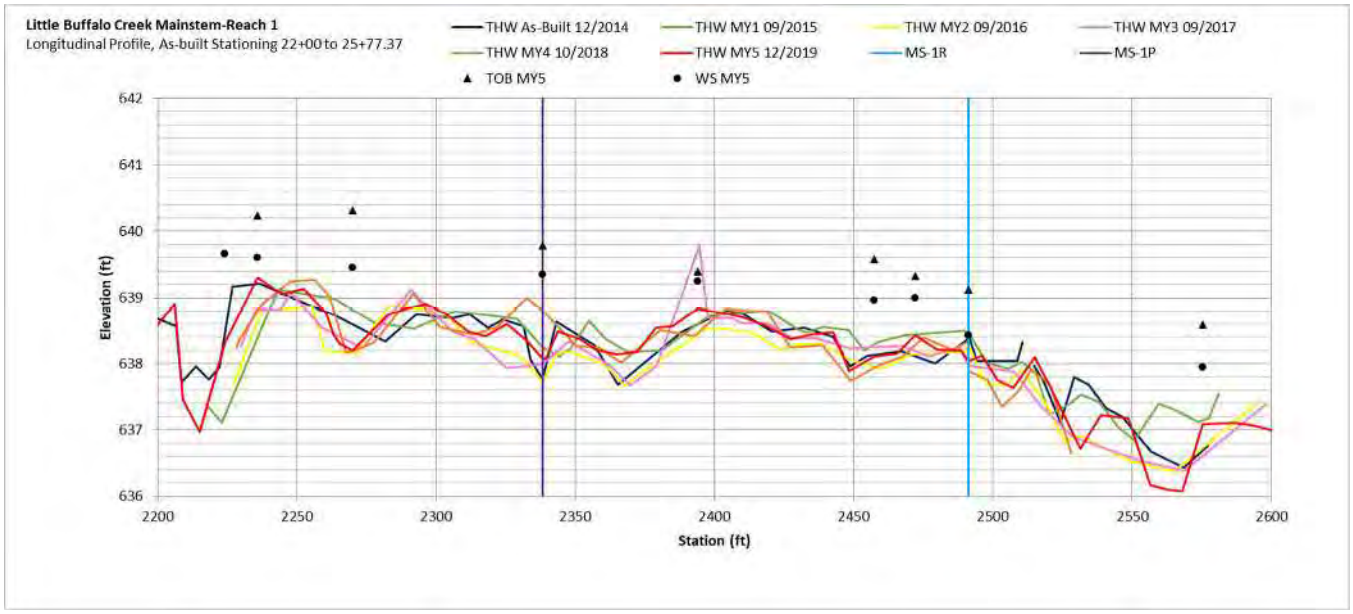
Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	18.58	19.65	19.65	20.71		2	21.20	21.48	21.48	21.76		2	21.47	21.54	21.54	21.61		2	18.23	19.69	19.69	21.15		2	17.61	19.53	19.53	21.45		2	17.73	19.84	19.84	21.94		2
Floodprone Width (ft)	>80			>100		2	>100	>100	>100	>100		2	>100	>100	>100	>100		2	>100	>100	>100	>100		2	>100	>100	>100	>100		2	>100	>100	>100	>100		2
Bankfull Mean Depth (ft)	0.96	1.07	1.07	1.17		2	0.75	0.89	0.89	1.02		2	0.98	1.10	1.10	1.21		2	0.86	1.01	1.01	1.15		2	0.93	1.08	1.08	1.23		2	0.91	1.07	1.07	1.22		2
[1]Bankfull Max Depth (ft)	1.17	1.43	1.43	1.69		2	0.92	1.37	1.37	1.82		2	1.29	1.67	1.67	2.04		2	1.31	1.55	1.55	1.78		2	1.67	1.705	1.705	1.74		2	1.51	1.67	1.67	1.82		2
Bankfull Cross Sectional Area (ft^2)	19.93	20.81	20.81	21.68		2	16.42	19.07	19.07	21.71		2	21.15	23.63	23.63	26.11		2	18.21	19.61	19.61	21.00		2	19.93	20.805	20.805	21.68		2	19.93	20.805	20.085	21.68		2
Width/Depth Ratio	15.92	18.72	18.72	21.52		2	20.70	24.78	24.78	28.86		2	17.89	19.85	19.85	21.80		2	15.83	20.20	20.20	24.56		2	14.3	18.695	18.695	23.09		2	14.5	19.33	19.33	24.15		2
Entrenchment Ratio	>2.2	>2.2	>2.2	>2.2		2	>2.2	>2.2	>2.2	>2.2		2	>2.2	>2.2	>2.2	>2.2		2	>2.2	>2.2	>2.2	>2.2		2	>2.2	>2.2	>2.2	>2.2		2	>2.2	>2.2	>2.2	>2.2		2
[1]Bank Height Ratio	**0.78**	**0.85**	**0.85**	**0.92**		**2**	**0.84**	**1.05**	**1.05**	**1.25**		**2**	**0.96**	**1.04**	**1.04**	**1.12**		**2**	**0.97**	**1.11**	**1.11**	**1.24**		**2**	**1.02**	**1.075**	**1.075**	**1.13**		**2**	**0.83**	**0.92**	**0.92**	**1.00**		**2**
Profile																																				
Riffle Length (ft)	9.79	36.53	37.12	54.31			9.14	29.70	30.63	67.19			8.10	26.04	26.01	42.49			10.09	24.33	24.79	48.87			3.09	20.29	17.36	45.06			10.56	22.4175	20.16	44.24		
Riffle Slope (ft/ft)	0.001	0.014	0.013	0.039			0.001	0.013	0.010	0.051			0.0005	0.012	0.010	0.022			0.002	0.019	0.014	0.064			0.002	0.092	0.018	0.720			0.008	0.029	0.015	0.136		
Pool Length (ft)	8.16	15.87	13.77	28.95			4.08	13.77	14.49	22.02			5.80	16.74	14.35	34.69			6.43	19.08	16.76	46.09			3.41	20.00	14.16	78.77			10.56	28.71	25.10	58.23		
Pool Max depth (ft)	1	2.05	2.04	2.85			1.19	1.94	2.00	2.62			1.61	2.25	2.15	3.11			6.43	1.95	1.91	3.96			1.25	2.47	2.50	4.01			1.15	1.95	2.08	2.81		
Pool Spacing (ft)	13.27	54.36	56.47	130.67			13.50	54.60	58.53	94.06			32.29	56.33	54.12	82.92			6.63	43.62	40.83	80.17			3.56	27.89	28.07	69.19			4.89	41.53	47.79	68.93		
Pattern																																				
Channel Beltwidth (ft)	154.56	209.27	209.27	263.98																																
Radius of Curvature (ft)	90.88	194.28	125.65	434.94																																
Rc:Bankfull width (ft/ft)	**15.71**	**20.53**	**21.99**	**22.62**																																
Meander Wavelength (ft)	687.9	687.9	687.9	687.9																																
Meander Width Ratio	9.8383	10.191	9.5145	11.67																																

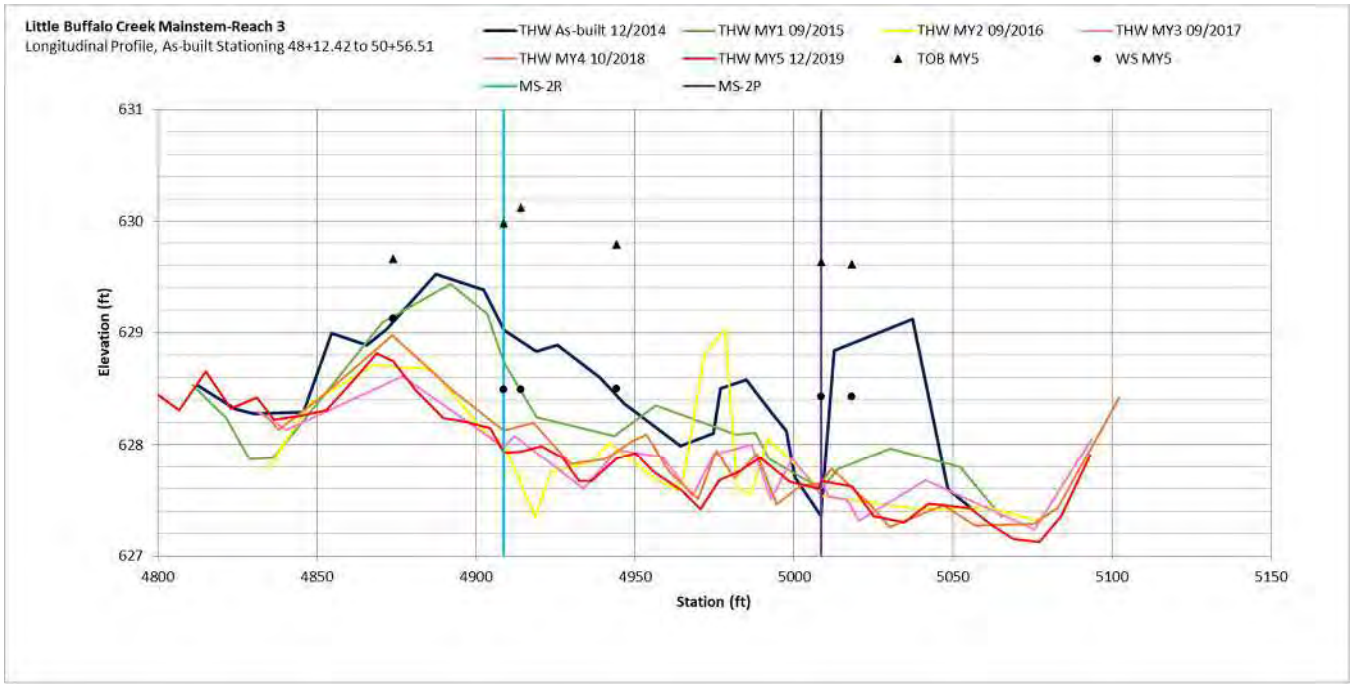
Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

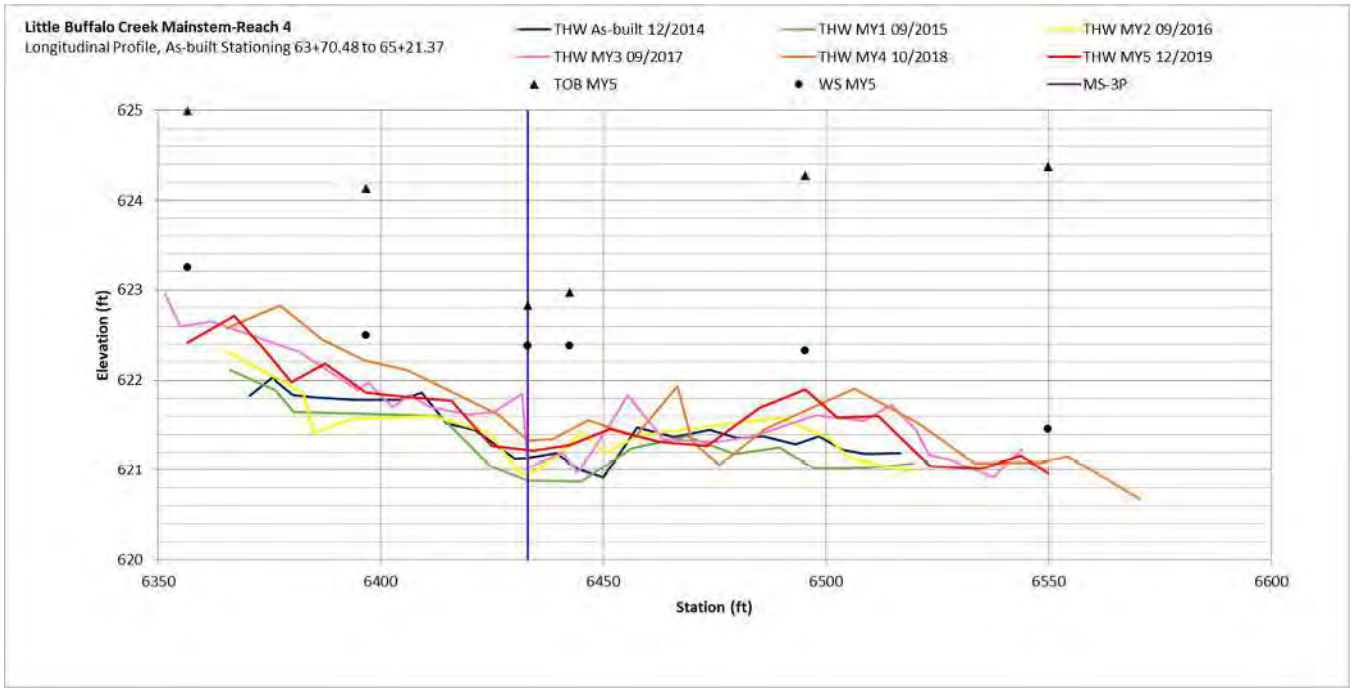
Additional Reach Parameters																																				
Rosgen Classification	C4						C4						C4						C4						C4						C4					
Channel Thalweg length (ft)	1126.71						1140.94						1154.67						1143.65						1140.69						1135.86					
Sinuosity (ft)	1.23						1.23						1.23						1.23						1.23						1.23					
Water Surface Slope (Channel) (ft/ft)	0.006						NA (DRY)						NA (DRY)						NA (DRY)						0.0087						0.0071					
BF slope (ft/ft)	**0.005**						**0.0053**						**0.0068**						**0.0064**						**0.0079**						**0.007**					
[3]R% / Ru% / P% / G% / S%	**34.9**	**26.1**	**12.1**	**18.2**	**8.7**		**41.1**	**13.7**	**17.6**	**17.4**	**10.2**		**30.1**	**14.3**	**24.7**	**25.1**	**5.8**		**25.0**	**17.4**	**28.4**	**22.8**	**6.3**		**20.9**	**13**	**39.2**	**19.5**	**7.4**		**26.9**	**13.5**	**40.2**	**19.4**	**0**	
[3]SC% / Sa% / G% / C% / B% / Be%													**21.8**	**17.9**	**45.5**	**12.5**	**1.7**	**0.6**	**29.9**	**0**	**68.9**	**0**	**1.2**	**0**	**13.2**	**0**	**85.6**	**0**	**1.2**	**0**	**12.8**	**20.2**	**48.7**	**16.6**	**1.7**	**0**
[3]d16 / d35 / d50 / d84 / d95 /													**N/A**	**8**	**17.5**	**50**	**100**		**N/A**	**18.82**	**32.67**	**61.10**	**98.87**		**6.28**	**18.35**	**28.34**	**65.33**	**119.69**		**0.5**	**4.93**	**14.3**	**72.85**	**168.3**	
[2]% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

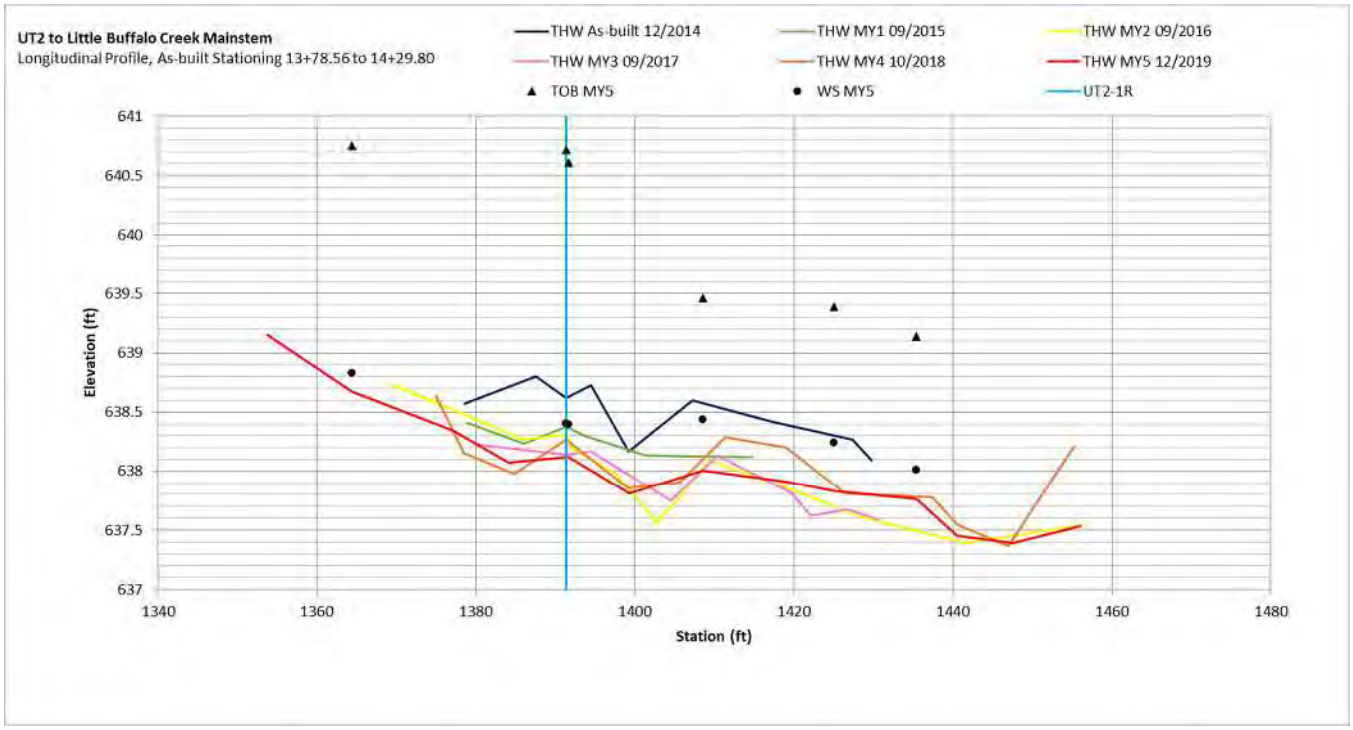
Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

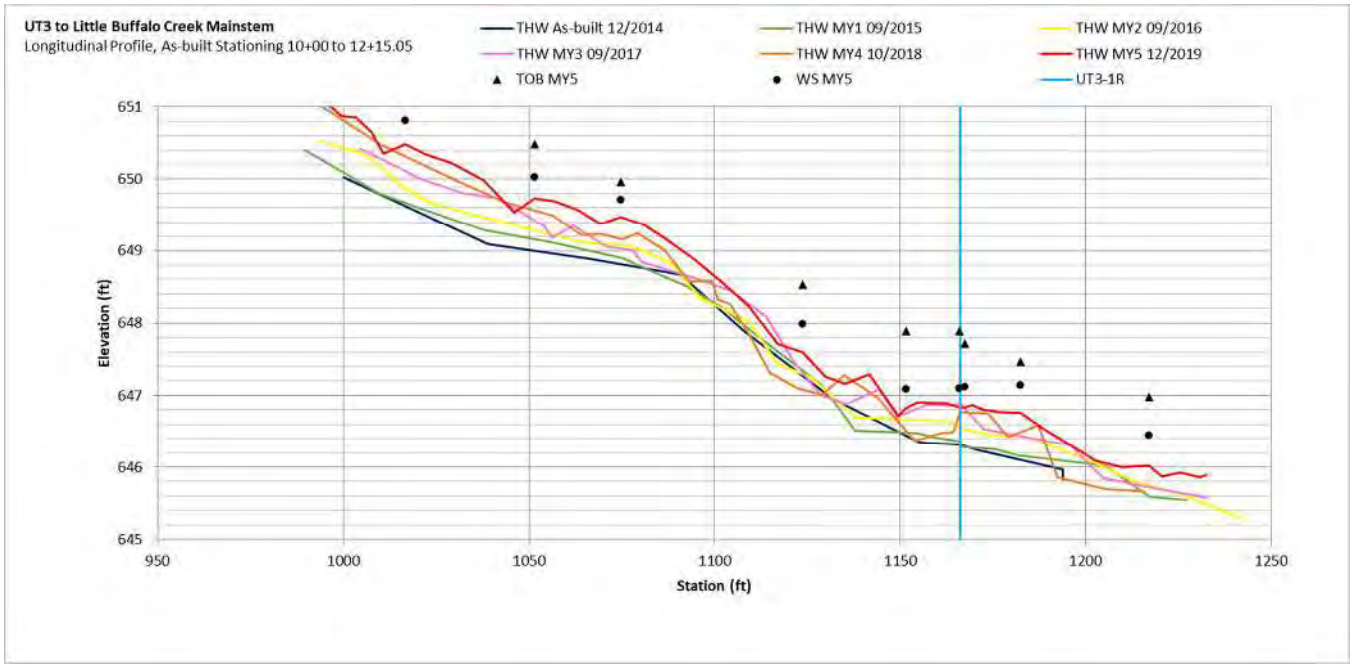
Figure 3a-k – Longitudinal Profile Plots

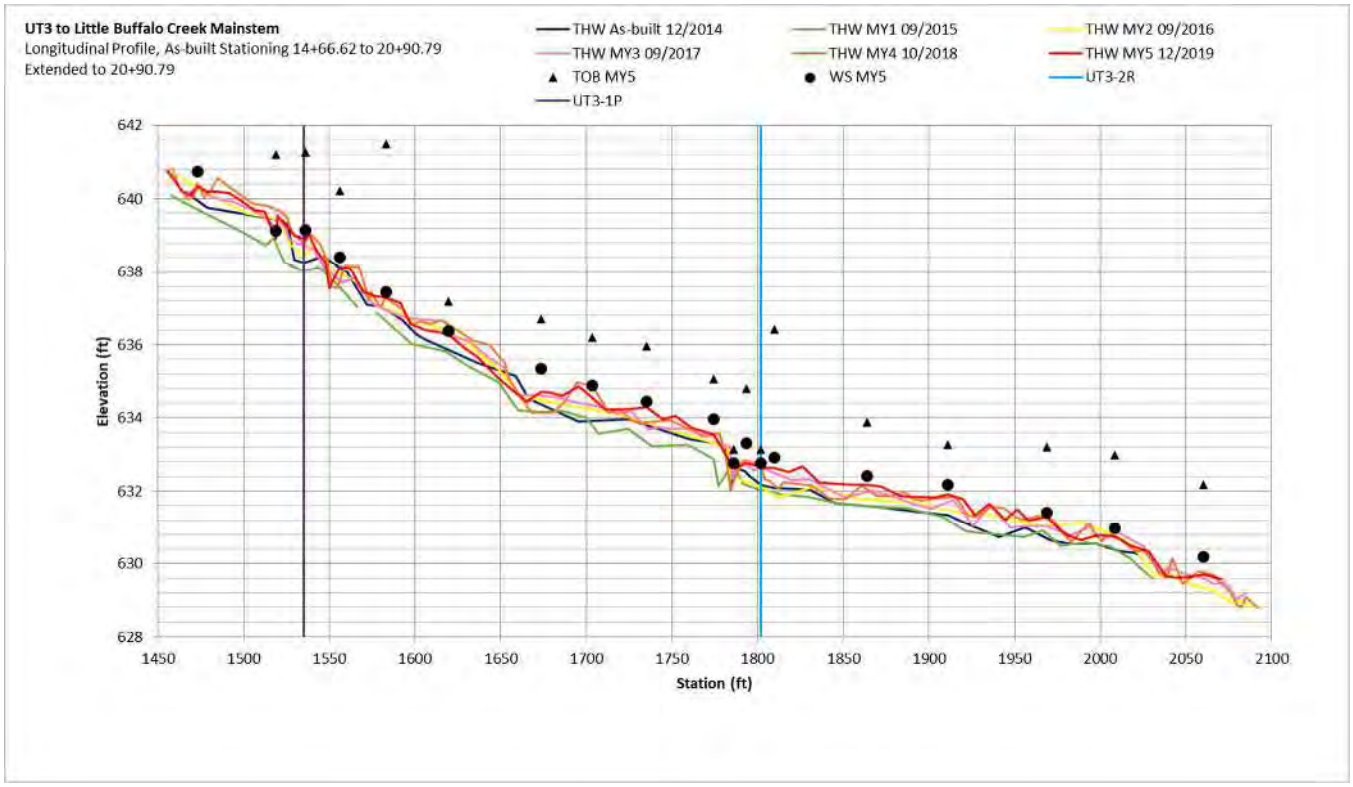

Little Buffalo Creek Mainstem-Reach 1
Longitudinal Profile, As-built Stationing 22+00 to 25+77.37
THW As-Built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 10/2018
THW MY5 12/2019
MS-1R
MS-1P
TOB MY5
WS MY5
Elevation (ft)
Station (ft)

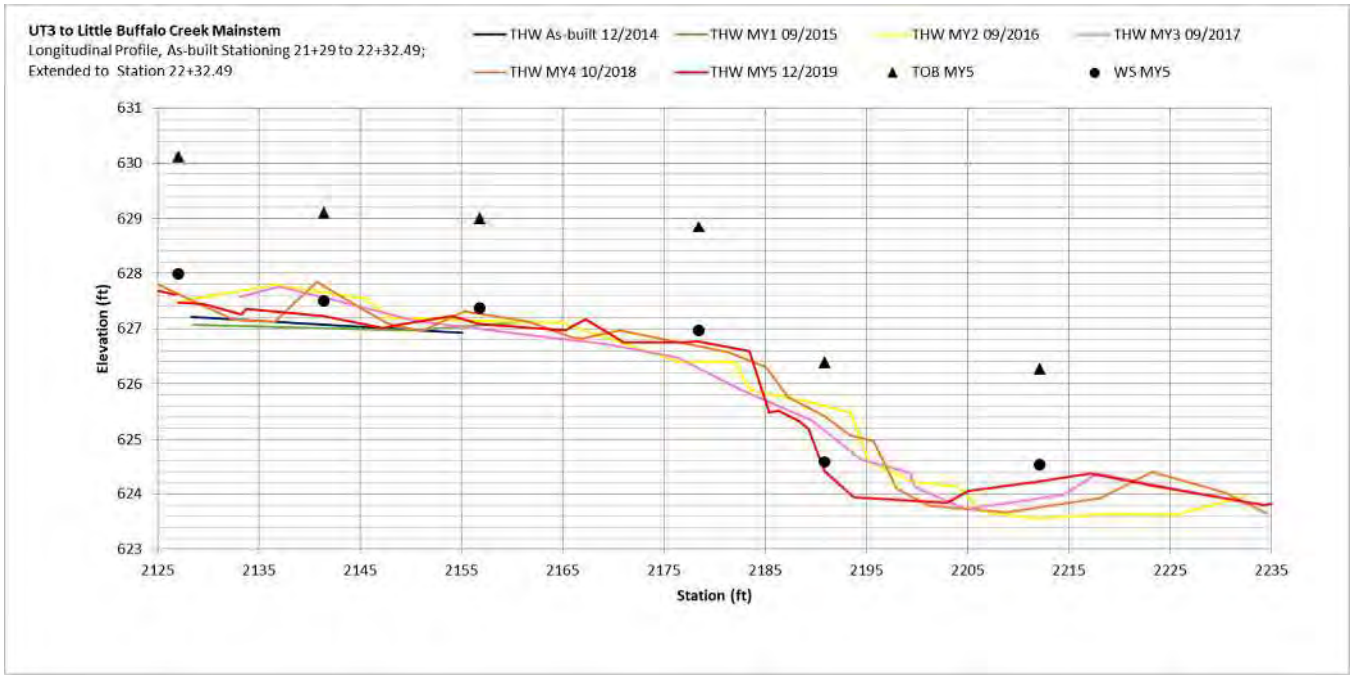

Little Buffalo Creek Mainstem-Reach 3
Longitudinal Profile, As-built Stationing 48+12.42 to 50+56.51
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 10/2018
THW MY5 12/2019
TOB MY5
WS MY5
MS-2R
MS-2P
Elevation (ft)
Station (ft)

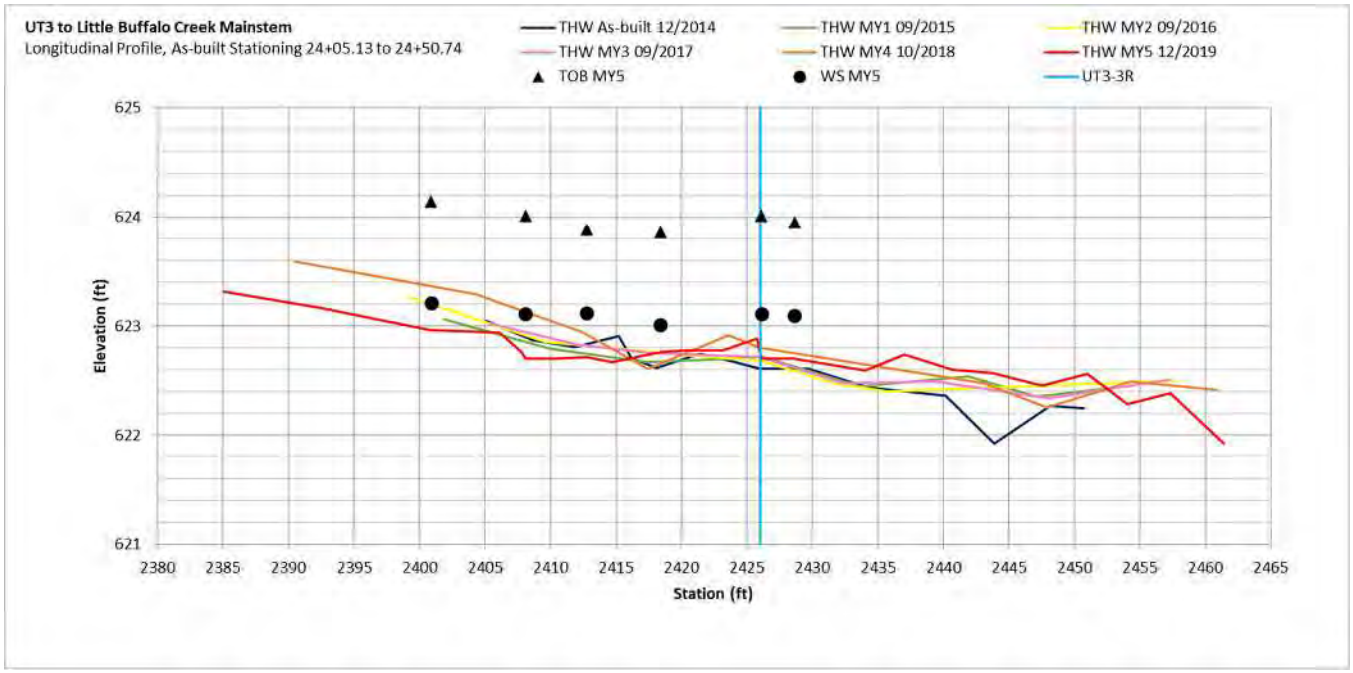

Little Buffalo Creek Mainstem-Reach 4
Longitudinal Profile, As-built Stationing 63+70.48 to 65+21.37
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 10/2018
THW MY5 12/2019
TOB MY5
WS MY5
MS-3P
Elevation (ft)
Station (ft)
625
624
623
622
621
620
6350
6400
6450
6500
6550
6600

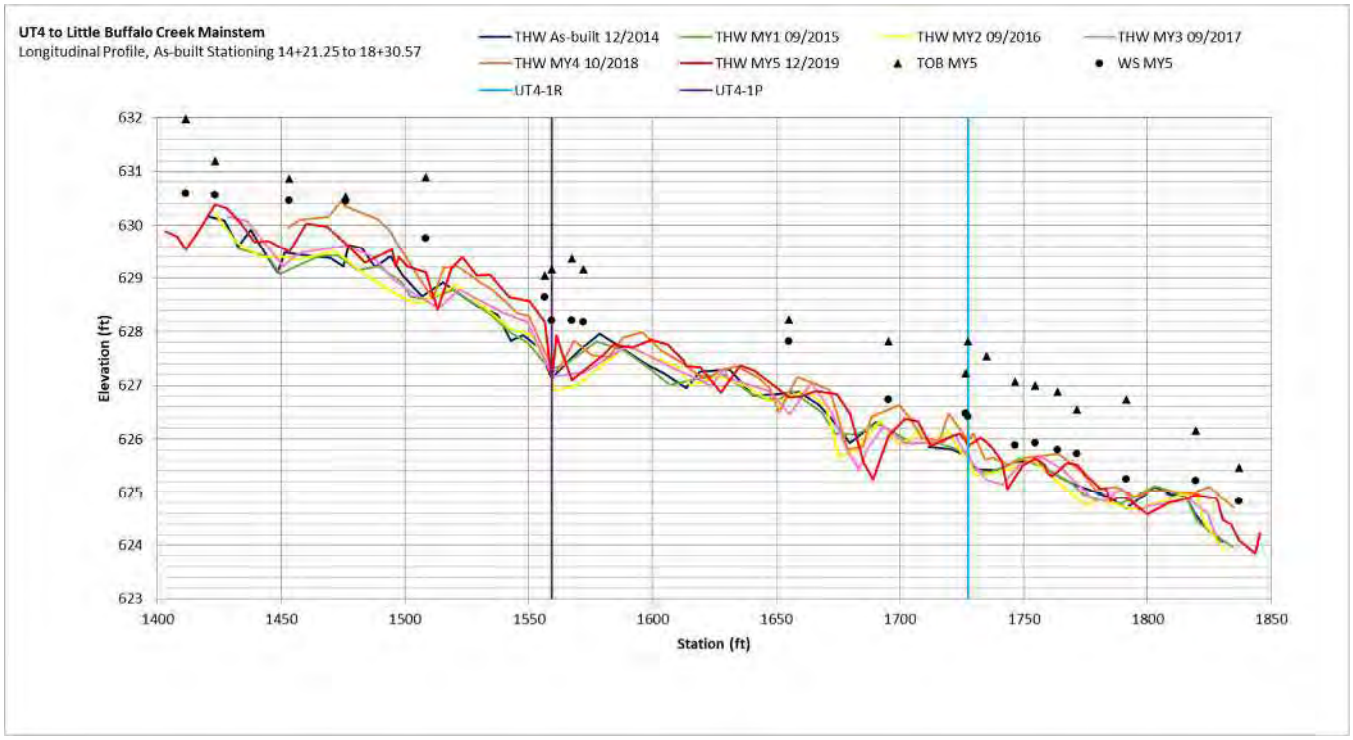

UT2 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 13+78.56 to 14+29.80
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 10/2018
THW MY5 12/2019
TOB MY5
WS MY5
UT2-1R
Elevation (ft)
Station (ft)
641
640.5
640
639.5
639
638.5
638
637.5
637
1340
1360
1380
1400
1420
1440
1460
1480

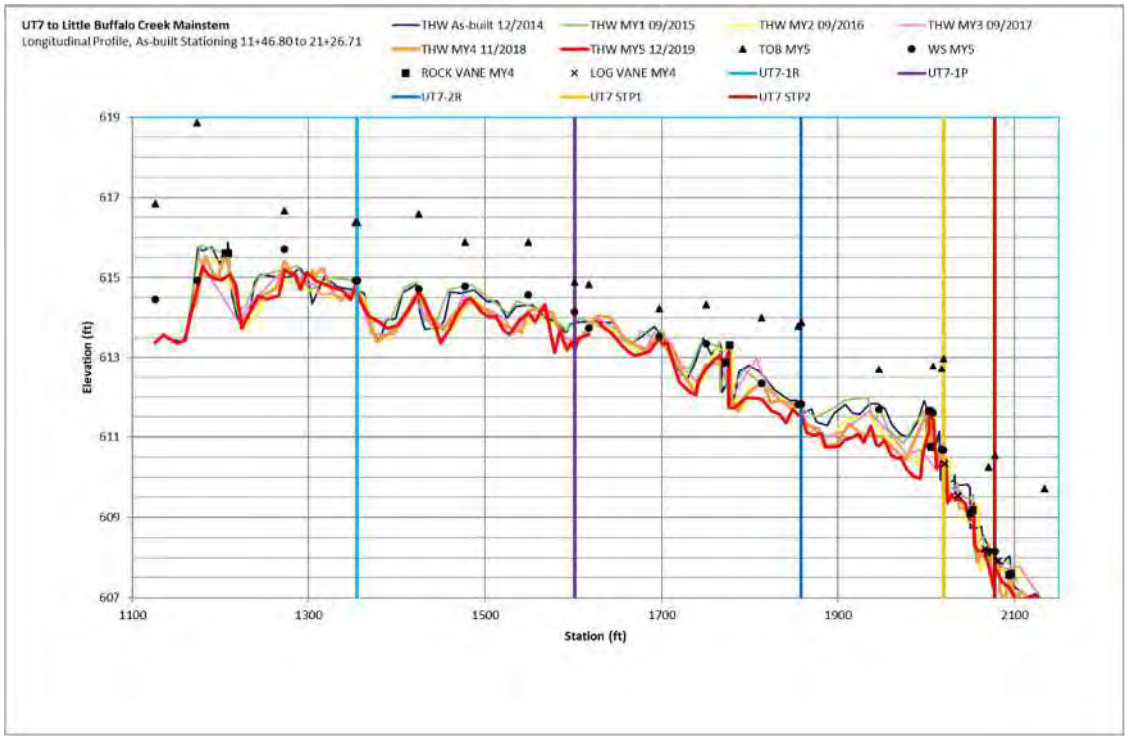

UT3 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 10+00 to 12+15.05
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 10/2018
THW MY5 12/2019
TOB MY5
WS MY5
UT3-1R
Elevation (ft)
Station (ft)
651
650
649
648
647
646
645
950
1000
1050
1100
1150
1200
1250

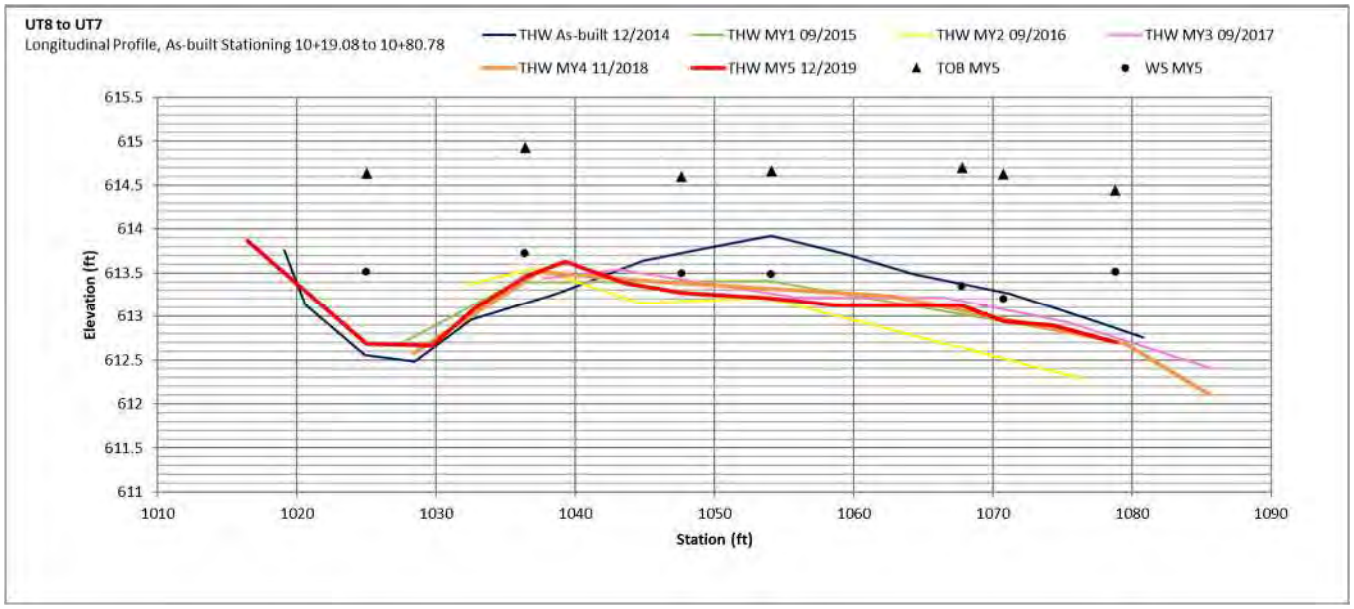

UT3 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 14+66.62 to 20+90.79
Extended to 20+90.79
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 10/2018
THW MY5 12/2019
TOB MY5
WS MY5
UT3-2R
UT3-1P
Elevation (ft)
Station (ft)
642
640
638
636
634
632
630
628
1450
1500
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000
2050
2100


UT3 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 21+29 to 22+32.49;
Extended to Station 22+32.49
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 10/2018
THW MY5 12/2019
TOB MY5
WS MY5
Elevation (ft)
Station (ft)


UT3 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 24+05.13 to 24+50.74
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 10/2018
THW MY5 12/2019
TOB MY5
WS MY5
UT3-3R
Elevation (ft)
Station (ft)


UT4 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 14+21.25 to 18+30.57
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 10/2018
THW MY5 12/2019
TOB MY5
WS MY5
UT4-1R
UT4-1P
Elevation (ft)
Station (ft)


UT7 to Little Buffalo Creek Mainstem
Longitudinal Profile, As-built Stationing 11+46.80 to 21+26.71
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 11/2018
THW MY5 12/2019
TOB MY5
WS MY5
ROCK VANE MY4
LOG VANE MY4
UT7-1R
UT7-1P
UT7-2R
UT7 STP1
UT7 STP2
Elevation (ft)
Station (ft)


UT8 to UT7
Longitudinal Profile, As-built Stationing 10+19.08 to 10+80.78
THW As-built 12/2014
THW MY1 09/2015
THW MY2 09/2016
THW MY3 09/2017
THW MY4 11/2018
THW MY5 12/2019
TOB MY5
WS MY5
615.5
615
614.5
614
613.5
613
612.5
612
611.5
611
Elevation (ft)
1010
1020
1030
1040
1050
1060
1070
1080
1090
Station (ft)

Figures 4a-q – Cross-section Plot Exhibits

Cross Section Plot Exhibit

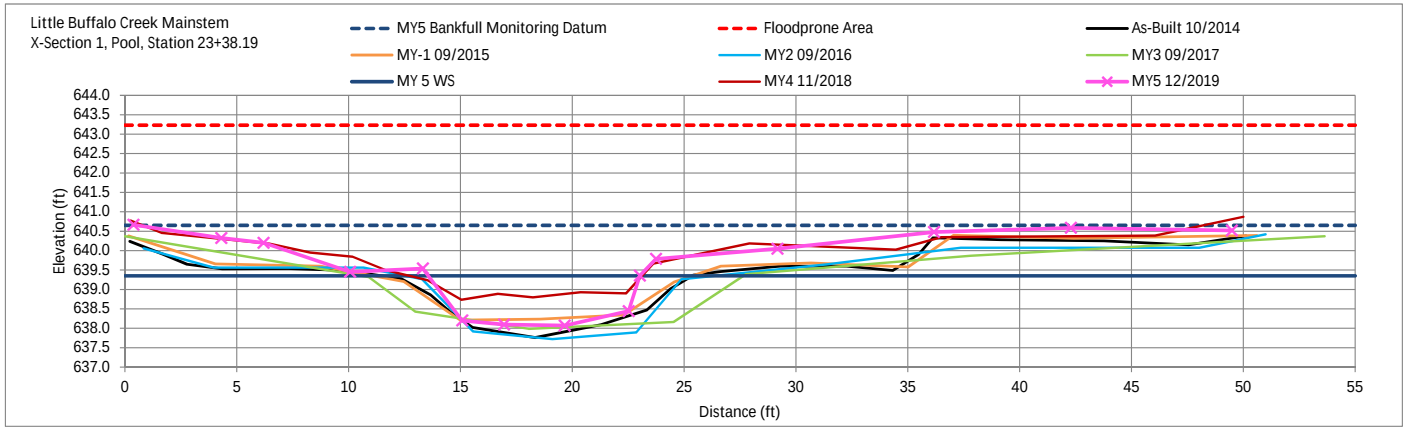
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	MS-1P
Drainage Area (sq mi):	2.99
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	640.99
0.38	640.66
4.31	640.32
6.20	640.20
10.07	639.45
13.32	639.54
15.08	638.20
16.95	638.10
19.66	638.07
22.52	638.44
23.02	639.35
23.74	639.79
29.17	640.05
36.17	640.48
42.29	640.59
49.49	640.52
50.29	640.97

SUMMARY DATA	
Bankfull Elevation:	640.65
Bankfull Cross-Sectional Area:	39.80
Bankfull Width:	48.92
Flood Prone Area Elevation:	643.23
Flood Prone Width:	>100
Max Depth at Bankfull:	2.58
Mean Depth at Bankful:	0.81
W/D Ratio:	60.13
Entrenchment Ratio:	2.13
Bank Height Ratio:	-
Low Top of Bank Elevation:	639.54
Stream Type	C4

Station and description	23+38.19 MS-1P Looking Upstream

23+38.19 MS-1P Looking Downstream



Cross Section Plot Exhibit

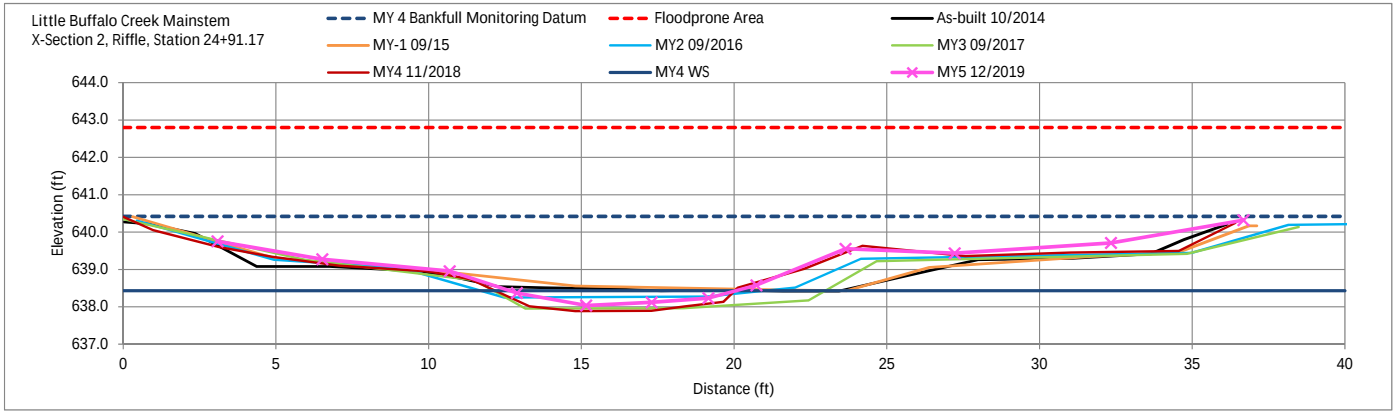
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	MS-1R
Drainage Area (sq mi):	2.99
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	640.52
3.09	639.75
6.52	639.27
10.69	638.96
12.89	638.37
15.16	638.04
17.30	638.12
19.16	638.23
20.73	638.58
23.65	639.55
27.22	639.43
32.34	639.71
36.68	640.32

SUMMARY DATA	
Bankfull Elevation:	640.42
Bankfull Cross-Sectional Area:	43.15
Bankfull Width:	33.59
Flood Prone Area Elevation:	642.80
Flood Prone Width:	>100
Max Depth at Bankfull:	2.38
Mean Depth at Bankful:	1.28
W/D Ratio:	26.15
Entrenchment Ratio:	>2.2
Bank Height Ratio:	0.39
Low Top of Bank Elevation:	638.96
Stream Type	C4

Station and description	24+91.17 MS-1R Looking Upstream

24+91.17 MS-1R Looking Downstream



Cross Section Plot Exhibit

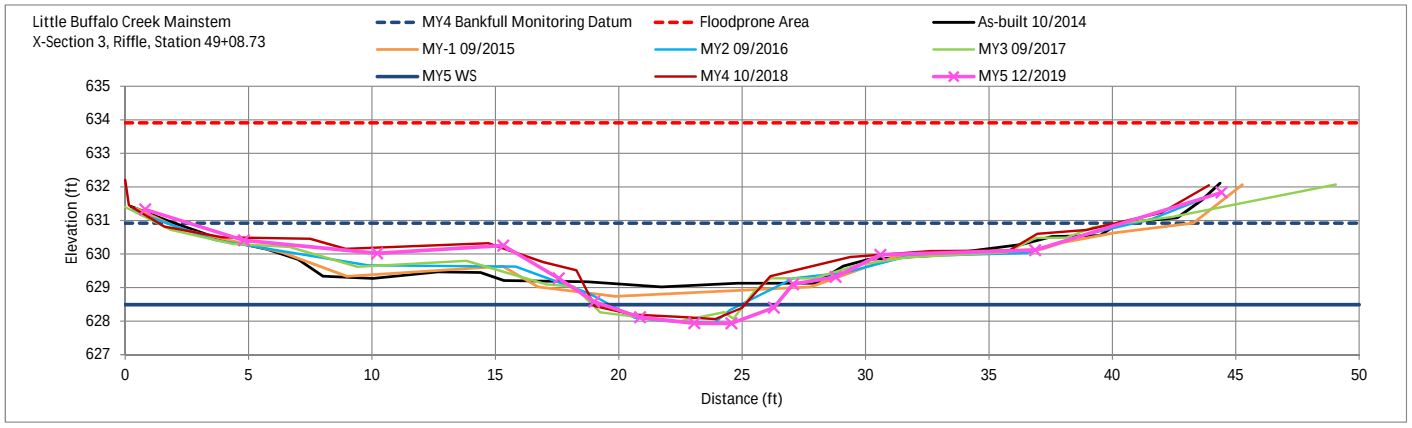
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	MS-2R
Drainage Area (sq mi):	3.35
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.81	631.33
4.81	630.41
10.21	630.02
15.32	630.25
17.57	629.27
19.00	628.58
20.86	628.11
23.06	627.94
24.56	627.93
26.28	628.40
27.06	629.10
28.78	629.32
30.60	629.98
36.87	630.12
44.42	631.83
44.85	632.74

SUMMARY DATA	
Bankfull Elevation:	630.92
Bankfull Cross-Sectional Area:	48.23
Bankfull Width:	37.86
Flood Prone Area Elevation:	633.91
Flood Prone Width:	>100
Max Depth at Bankfull:	2.99
Mean Depth at Bankful:	1.27
W/D Ratio:	29.72
Entrenchment Ratio:	>2.2
Bank Height Ratio:	0.39
Low Top of Bank Elevation:	629.10
Stream Type	C4

Station and description	4908.73 MS-2R Looking Upstream

4908.73 MS-2R Looking Downstream



Cross Section Plot Exhibit

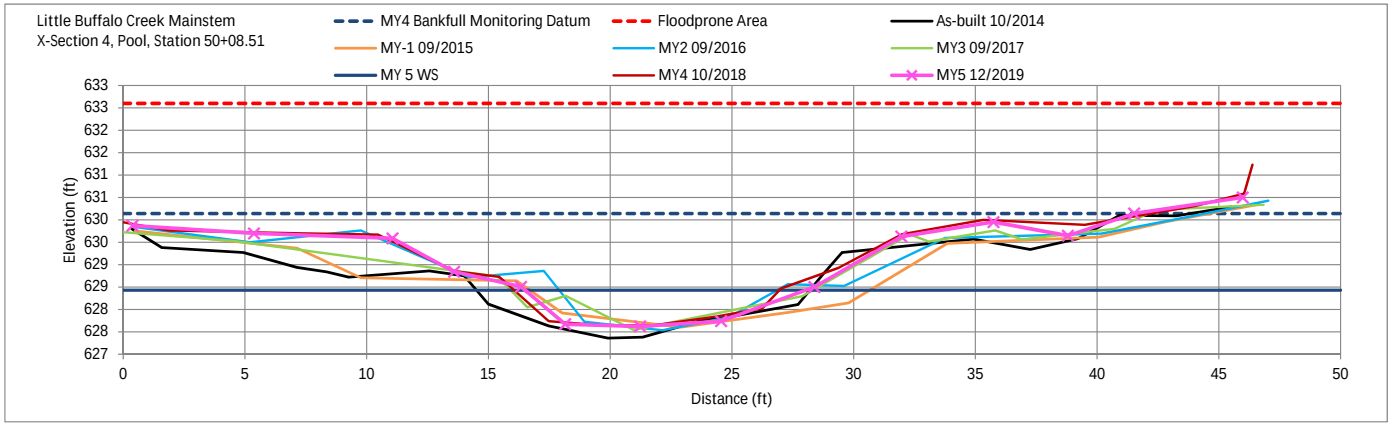
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	MS-2P
Drainage Area (sq mi):	3.35
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	630.54
0.38	629.87
5.37	629.70
11.06	**629.59**
13.59	628.84
16.34	628.51
18.15	627.67
21.23	**627.62**
24.56	627.74
28.39	628.50
31.96	629.63
35.74	629.95
38.80	629.65
41.52	630.14
45.98	630.50
46.49	631.24

SUMMARY DATA	
Bankfull Elevation:	630.11
Bankfull Cross-Sectional Area:	43.79
Bankfull Width:	40.94
Flood Prone Area Elevation:	632.60
Flood Prone Width:	>100
Max Depth at Bankfull:	2.49
Mean Depth at Bankful:	1.07
W/D Ratio:	38.28
Entrenchment Ratio:	>2.2
Bank Height Ratio:	-
Low Top of Bank Elevation:	628.51
Stream Type	C4

Station and description	5008.51 MS-2P Looking Upstream

5008.51 MS-2P Looking Downstream



Cross Section Plot Exhibit

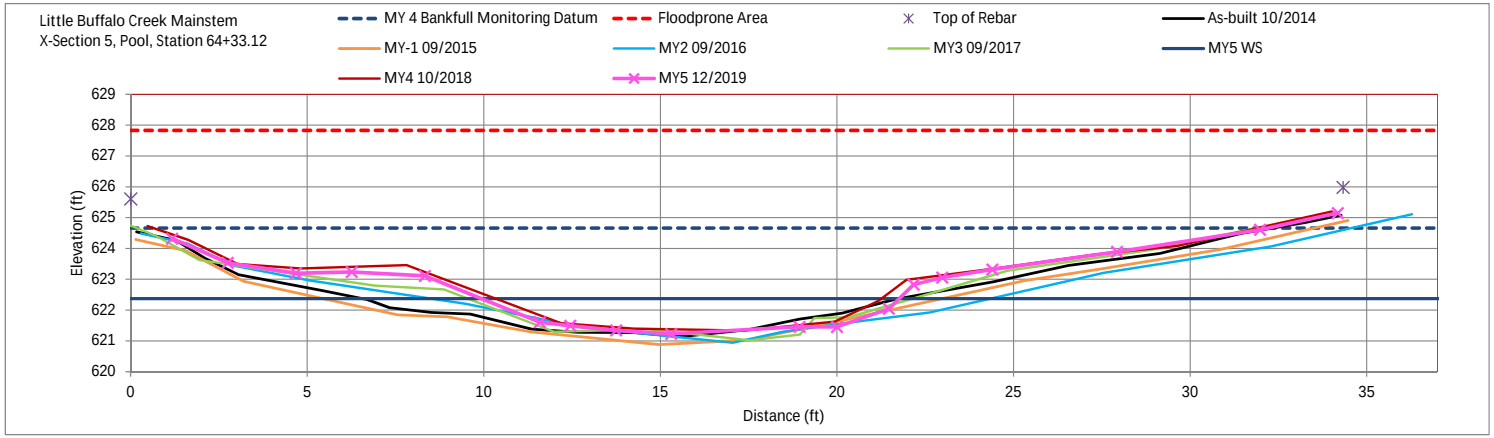
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	MS-3P
Drainage Area (sq mi):	4.01
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	625.61
1.18	624.32
2.75	623.53
4.68	623.20
6.26	623.24
8.33	623.11
11.59	621.61
12.45	621.49
13.75	621.34
15.31	621.23
18.94	621.46
20.00	621.45
21.47	622.05
22.17	622.83
22.98	623.06
24.4	623.32
27.93	623.89
31.98	624.61
34.18	625.15
34.33	625.98

SUMMARY DATA	
Bankfull Elevation:	624.53
Bankfull Cross-Sectional Area:	54.90
Bankfull Width:	30.38
Flood Prone Area Elevation:	627.83
Flood Prone Width:	>100
Max Depth at Bankfull:	3.30
Mean Depth at Bankful:	1.81
W/D Ratio:	16.78
Entrenchment Ratio:	>2.2
Bank Height Ratio:	-
Low Top of Bank Elevation:	622.83
Stream Type	C4

Station and description	6433.12 MS-3P Looking Upstream

6433.12 MS-3P Looking Downstream



Cross Section Plot Exhibit

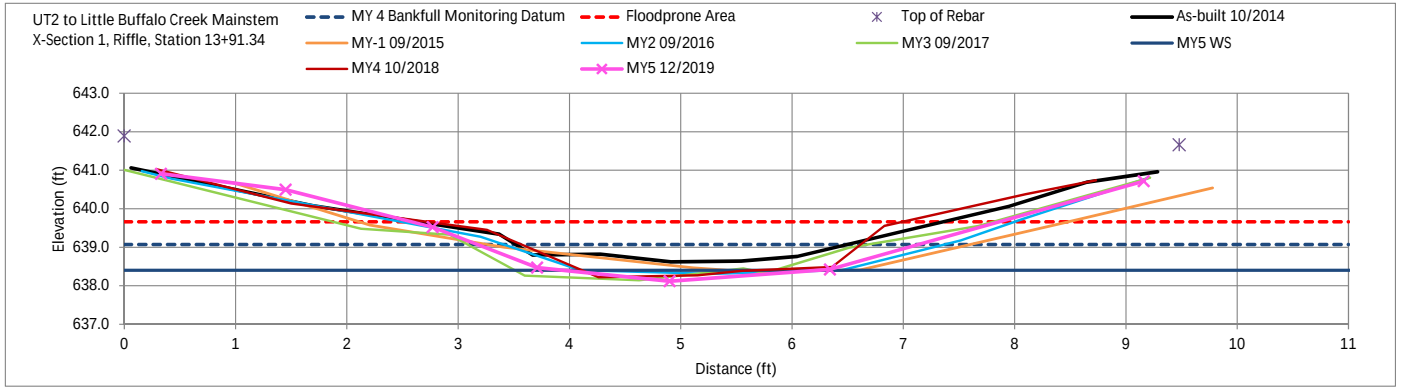
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT2-1R
Drainage Area (sq mi):	0.3
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	641.89
0.33	640.91
1.45	640.50
2.77	639.52
3.71	638.47
4.90	638.12
6.34	638.42
9.16	640.72
9.48	641.66

SUMMARY DATA	
Bankfull Elevation:	638.89
Bankfull Cross-Sectional Area:	1.82
Bankfull Width:	3.58
Flood Prone Area Elevation:	639.66
Flood Prone Width:	5.29
Max Depth at Bankfull:	0.77
Mean Depth at Bankful:	0.51
W/D Ratio:	7.04
Entrenchment Ratio:	1.48
Bank Height Ratio:	1.83
Low Top of Bank Elevation:	639.52
Stream Type	B6c

Station and description | 1391.34 UT2-1R Looking Upstream

1391.34 UT2-1R Looking Downstream



Cross Section Plot Exhibit

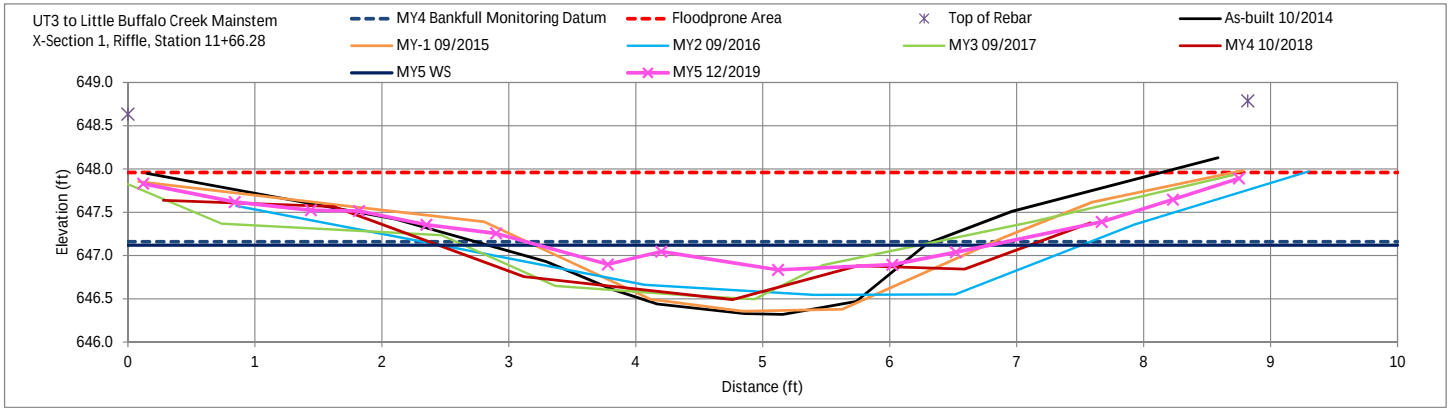
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT3-1R
Drainage Area (sq mi):	0.097
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	648.63
0.12	647.83
0.84	647.62
1.44	647.52
1.82	647.52
2.35	647.36
2.90	647.26
3.78	646.90
4.20	647.05
5.12	646.83
6.02	646.89
6.52	647.04
7.67	647.39
8.23	647.65
8.75	647.89
8.82	648.79

SUMMARY DATA	
Bankfull Elevation:	647.40
Bankfull Cross-Sectional Area:	1.84
Bankfull Width:	5.48
Flood Prone Area Elevation:	647.96
Flood Prone Width:	12.96
Max Depth at Bankfull:	0.56
Mean Depth at Bankful:	0.34
W/D Ratio:	16.32
Entrenchment Ratio:	>2.2
Bank Height Ratio:	0.75
Low Top of Bank Elevation:	647.26
Stream Type	B6

Station and description	1166.28 UT3-1R Looking Upstream

1166.28 UT3-1R Looking Downstream



Cross Section Plot Exhibit

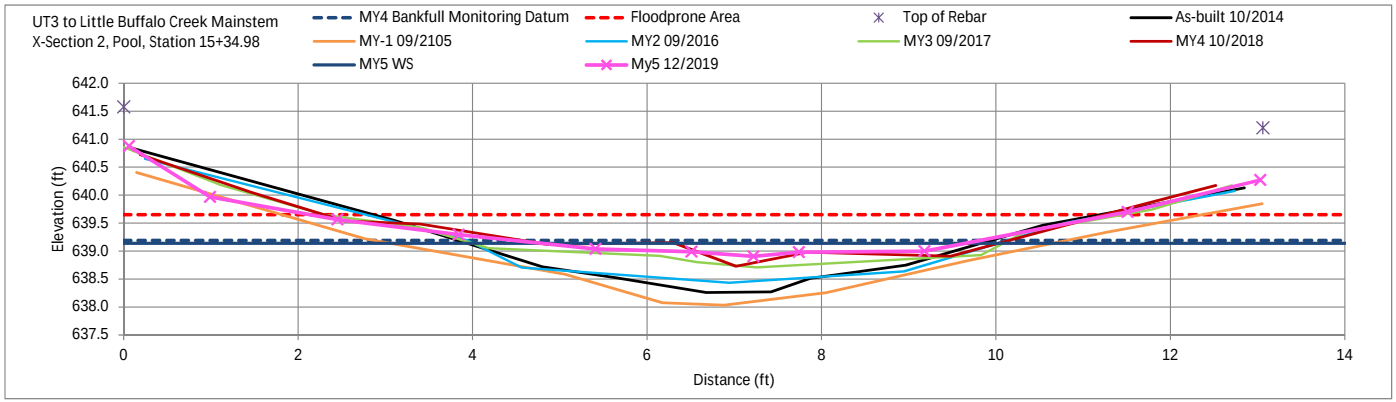
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT3-1P
Drainage Area (sq mi):	0.097
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	641.58
0.06	640.88
0.99	639.97
2.45	639.56
3.84	639.29
5.41	639.04
6.51	638.99
7.22	638.91
7.74	638.98
9.18	639.00
11.51	639.70
13.03	640.27
13.06	641.20

SUMMARY DATA	
Bankfull Elevation:	639.21
Bankfull Cross-Sectional Area:	1.01
Bankfull Width:	5.50
Flood Prone Area Elevation:	639.51
Flood Prone Width:	9.35
Max Depth at Bankfull:	0.30
Mean Depth at Bankful:	0.18
W/D Ratio:	29.95
Entrenchment Ratio:	1.70
Bank Height Ratio:	-
Low Top of Bank Elevation:	639.29
Stream Type	B6

Station and description	1534.98 UT3-1P Looking Upstream

1534.98 UT3-1P Looking Downstream



Cross Section Plot Exhibit

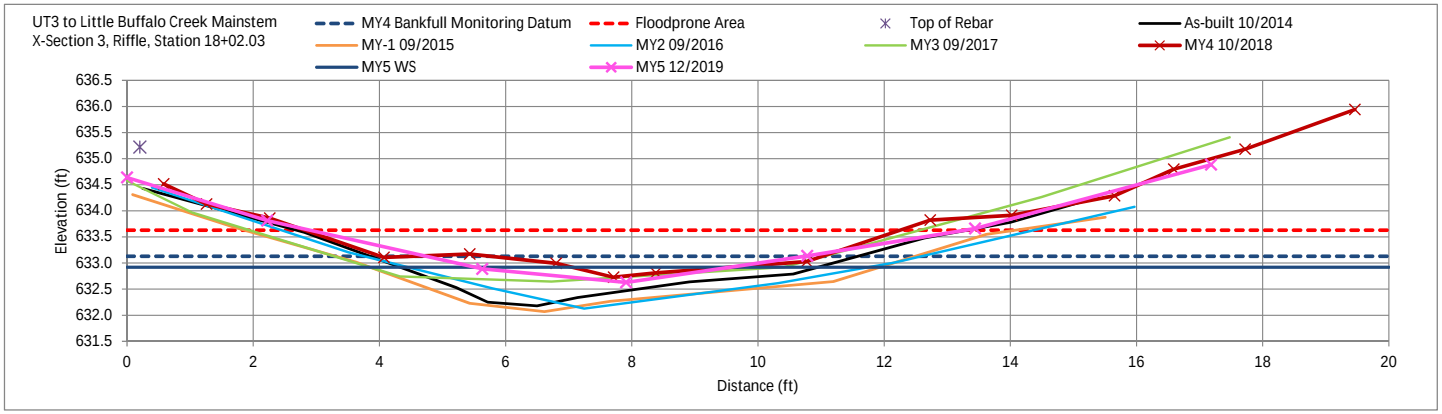
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT3-2R
Drainage Area (sq mi):	0.097
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	634.64
0.20	635.22
2.22	633.81
5.63	632.89
7.91	632.63
10.78	633.14
13.44	633.66
17.18	634.88

SUMMARY DATA	
Bankfull Elevation:	633.13
Bankfull Cross-Sectional Area:	1.69
Bankfull Width:	6.04
Flood Prone Area Elevation:	633.63
Flood Prone Width:	10.45
Max Depth at Bankfull:	0.50
Mean Depth at Bankful:	0.28
W/D Ratio:	21.59
Entrenchment Ratio:	1.73
Bank Height Ratio:	1.01
Low Top of Bank Elevation:	633.14
Stream Type	B6

Station and description	1802.03 UT3-2R Looking Upstream

1802.03 UT3-2R Looking Downstream



Cross Section Plot Exhibit

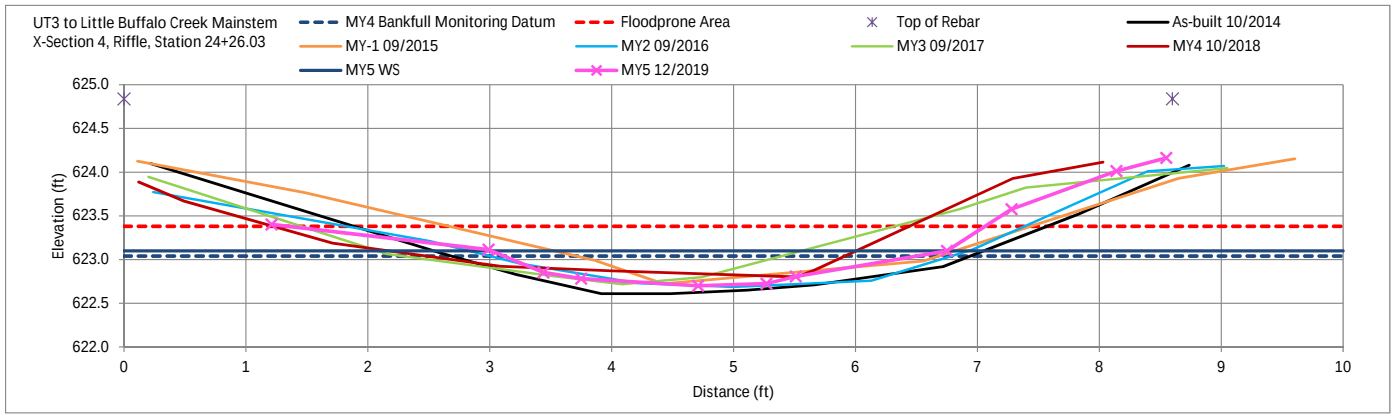
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT3-3R
Drainage Area (sq mi):	0.097
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	624.84
1.21	623.40
2.99	623.11
3.44	622.85
3.75	622.78
4.71	622.70
5.27	622.72
5.51	622.81
6.75	623.10
7.28	623.58
8.14	624.01
8.55	624.16
8.60	624.84

SUMMARY DATA	
Bankfull Elevation:	623.04
Bankfull Cross-Sectional Area:	0.75
Bankfull Width:	3.38
Flood Prone Area Elevation:	623.38
Flood Prone Width:	5.55
Max Depth at Bankfull:	0.34
Mean Depth at Bankful:	0.22
W/D Ratio:	15.23
Entrenchment Ratio:	1.64
Bank Height Ratio:	1.21
Low Top of Bank Elevation:	623.11
Stream Type	B6

Station and description	2426.03 UT3-3R Looking Upstream

2426.03 UT3-3R Looking Downstream



Cross Section Plot Exhibit

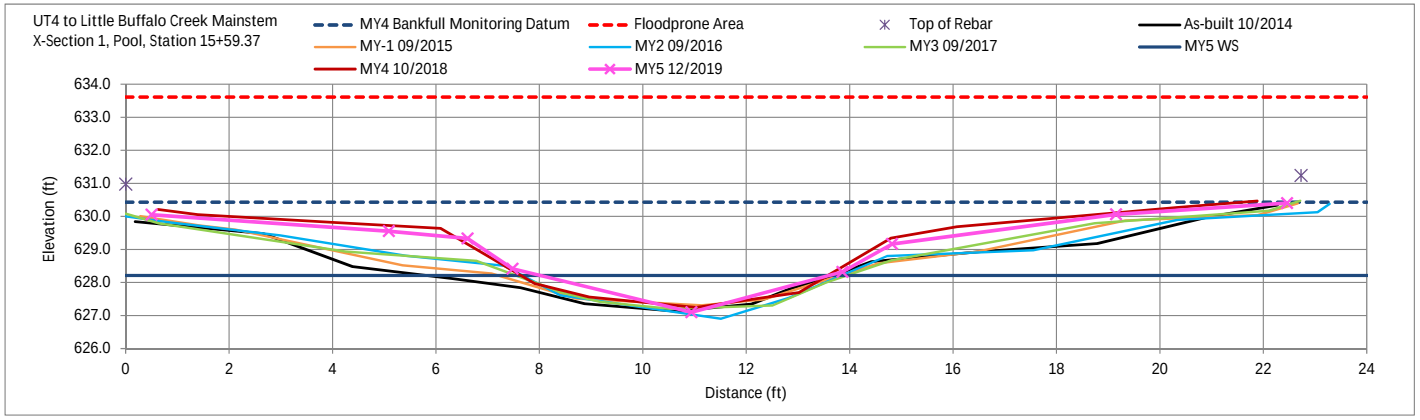
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT4-1P
Drainage Area (sq mi):	0.4
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	630.98
0.50	630.05
5.09	629.55
6.61	629.33
7.48	628.42
10.94	627.10
13.86	628.32
14.82	629.16
19.15	630.06
22.46	630.40
22.73	631.24

SUMMARY DATA	
Bankfull Elevation:	630.37
Bankfull Cross-Sectional Area:	27.37
Bankfull Width:	21.61
Flood Prone Area Elevation:	633.64
Flood Prone Width:	>100
Max Depth at Bankfull:	3.27
Mean Depth at Bankful:	1.27
W/D Ratio:	17.06
Entrenchment Ratio:	>2.2
Bank Height Ratio:	-
Low Top of Bank Elevation:	629.16
Stream Type	C4

Station and description	1559.37 UT4-1P Looking Upstream

1559.37 UT4-1P Looking Downstream



Cross Section Plot Exhibit

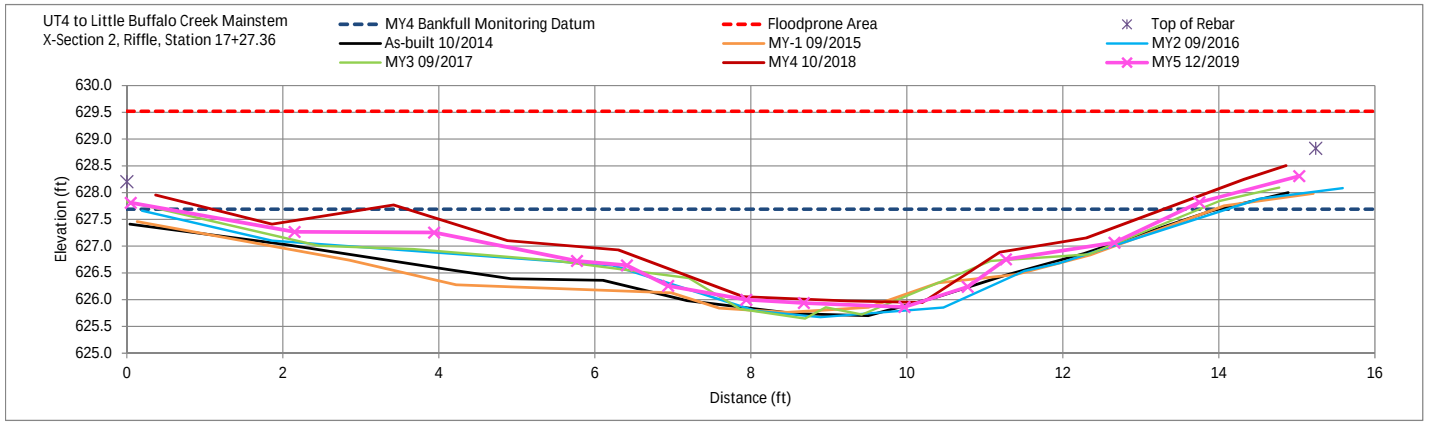
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT4-1R
Drainage Area (sq mi):	0.4
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	628.20
0.05	627.81
2.15	627.27
3.94	627.25
5.77	626.72
6.41	626.64
6.94	626.26
7.94	626.00
8.68	625.94
9.97	625.86
10.78	626.24
11.27	626.75
12.66	627.07
13.75	627.82
15.03	628.31
15.24	628.83

SUMMARY DATA	
Bankfull Elevation:	627.69
Bankfull Cross-Sectional Area:	12.13
Bankfull Width:	13.05
Flood Prone Area Elevation:	629.52
Flood Prone Width:	38.25
Max Depth at Bankfull:	1.83
Mean Depth at Bankful:	0.93
W/D Ratio:	14.04
Entrenchment Ratio:	>2.2
Bank Height Ratio:	0.43
Low Top of Bank Elevation:	626.64
Stream Type	C4

Station and description	1727.36 UT4-1R Looking Upstream

1727.36 UT4-1R Looking Downstream



Cross Section Plot Exhibit

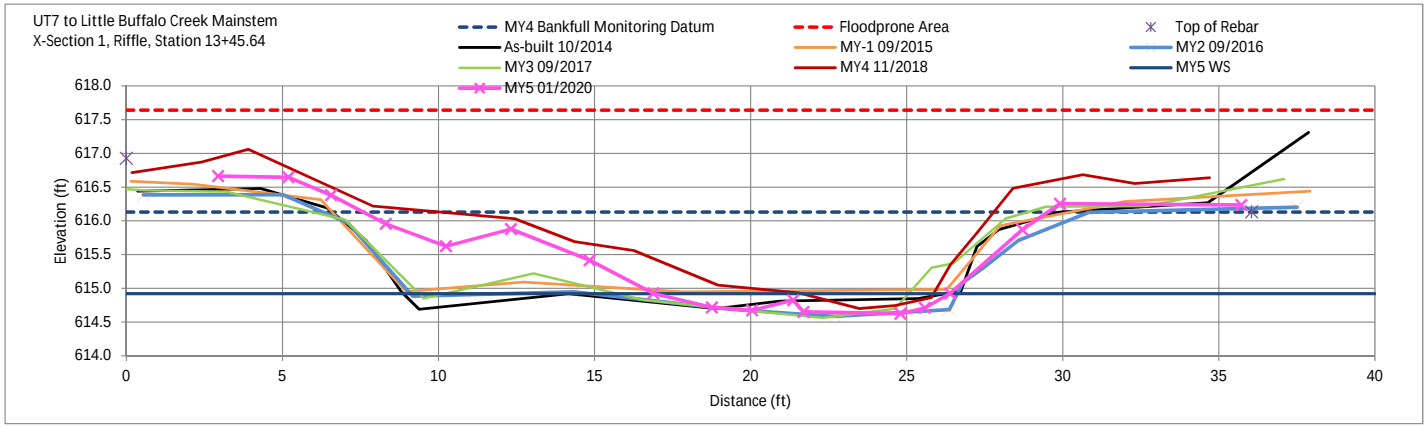
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT7-1R
Drainage Area (sq mi):	1.91
Date:	01/2020
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	616.93
2.94	616.66
5.19	616.65
6.56	616.38
8.31	615.96
10.24	615.63
12.32	615.88
14.84	615.42
16.88	614.93
18.76	614.72
20.05	614.68
21.36	614.82
21.69	614.65
24.80	614.63
25.58	614.71
26.39	614.92
28.7	615.87
29.91	616.25
35.72	616.24
36.05	616.13

SUMMARY DATA	
Bankfull Elevation:	616.13
Bankfull Cross-Sectional Area:	19.93
Bankfull Width:	21.94
Flood Prone Area Elevation:	617.64
Flood Prone Width:	>100
Max Depth at Bankfull:	1.51
Mean Depth at Bankful:	0.91
W/D Ratio:	24.15
Entrenchment Ratio:	>2.2
Bank Height Ratio:	0.83
Low Top of Bank Elevation:	615.88
Stream Type	C4

Station and description	1345.64 UT7-1R Looking Upstream

1345.64 UT7-1R Looking Downstream



Cross Section Plot Exhibit

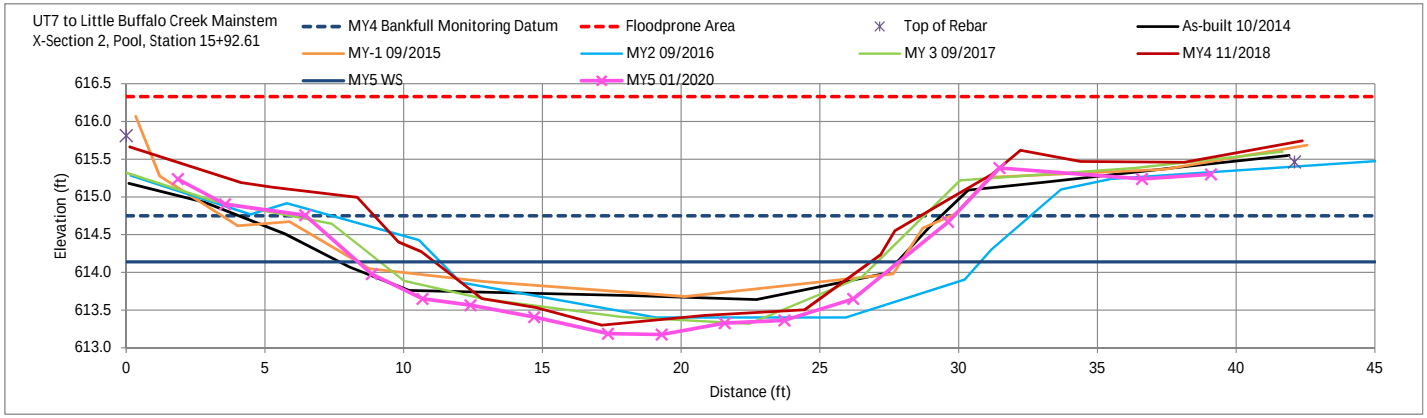
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT7-1P
Drainage Area (sq mi):	1.91
Date:	01/2020
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	615.81
1.86	615.24
3.56	614.90
6.45	614.76
8.85	613.98
10.68	613.65
12.41	613.57
14.70	613.41
17.36	613.19
19.30	613.18
21.57	613.33
23.72	613.36
26.2	613.65
29.62	614.67
31.47	615.38
36.61	615.24
39.09	615.30
42.1	615.46

SUMMARY DATA	
Bankfull Elevation:	614.75
Bankfull Cross-Sectional Area:	25.98
Bankfull Width:	23.37
Flood Prone Area Elevation:	616.33
Flood Prone Width:	>100
Max Depth at Bankfull:	1.58
Mean Depth at Bankful:	1.11
W/D Ratio:	21.02
Entrenchment Ratio:	>2.2
Bank Height Ratio:	-
Low Top of Bank Elevation:	614.76
Stream Type	C4

Station and description	1592.61 UT7-1P Looking Upstream

1592.61 UT7-1P Looking Downstream



Cross Section Plot Exhibit

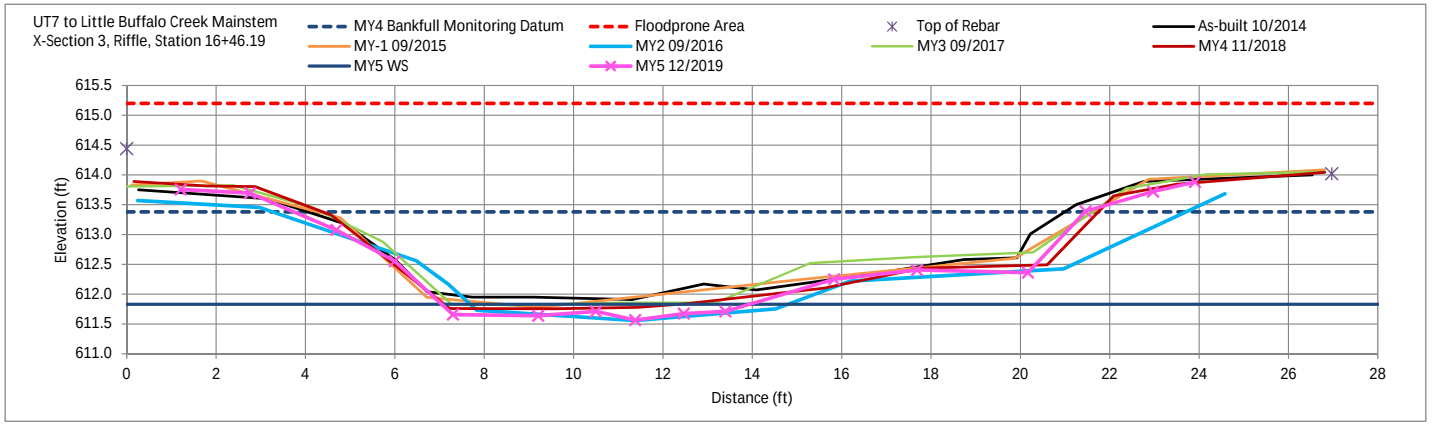
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT7-2R
Drainage Area (sq mi):	1.91
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	614.44
1.21	613.76
2.76	613.69
4.69	613.08
6.00	612.55
7.30	611.66
9.21	611.64
10.50	611.71
11.38	611.56
12.47	611.67
13.40	611.71
15.83	612.25
17.69	612.41
20.17	612.36
21.46	613.39
22.97	613.72
23.91	613.88
26.86	613.97
26.97	614.02

SUMMARY DATA	
Bankfull Elevation:	613.38
Bankfull Cross-Sectional Area:	21.68
Bankfull Width:	17.73
Flood Prone Area Elevation:	615.20
Flood Prone Width:	>100
Max Depth at Bankfull:	1.82
Mean Depth at Bankful:	1.22
W/D Ratio:	14.50
Entrenchment Ratio:	>2.2
Bank Height Ratio:	1.00
Low Top of Bank Elevation:	613.39
Stream Type	C4

Station and description	1846.19 UT7-2R Looking Upstream

1846.19 UT7-2R Looking Downstream



Cross Section Plot Exhibit

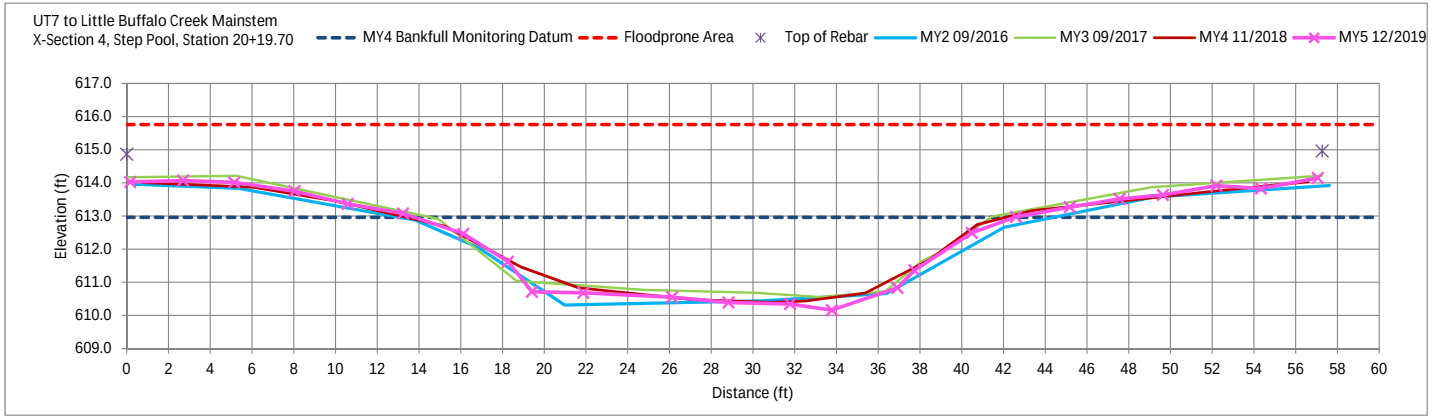
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT7-STP1
Drainage Area (sq mi):	1.91
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	614.86
0.17	614.03
2.70	614.07
5.15	614.01
8.04	613.75
10.59	613.37
13.24	613.08
16.13	612.46
18.26	611.62
19.41	610.71
21.88	610.68
26.13	610.55
28.83	610.39
31.78	610.35
33.78	610.16
36.92	610.83
37.74	611.36
40.49	612.49
42.60	612.97
45.18	613.27
47.56	613.51
49.64	613.64
52.20	613.91
54.34	613.83
57.06	614.15
57.27	614.96

SUMMARY DATA	
Bankfull Elevation:	612.96
Bankfull Cross-Sectional Area:	52.44
Bankfull Width:	28.73
Flood Prone Area Elevation:	615.76
Flood Prone Width:	>100
Max Depth at Bankfull:	2.80
Mean Depth at Bankful:	1.83
W/D Ratio:	15.74
Entrenchment Ratio:	>2.2
Bank Height Ratio:	0.83
Low Top of Bank Elevation:	612.49
Stream Type	C4b

Station and description	2019.70 UT7-STP1 Looking Upstream

2019.70 UT7-STP1 Looking Downstream



Cross Section Plot Exhibit

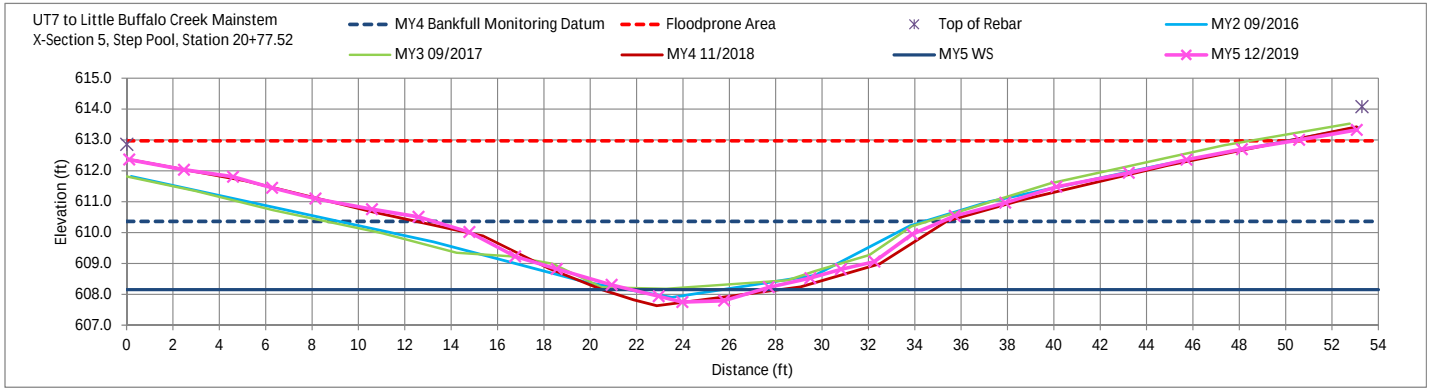
River Basin:	Yadkin-Pee Dee River
Watershed:	Little Buffalo Creek
XS ID:	UT7-STP2
Drainage Area (sq mi):	1.91
Date:	12/2019
Field Crew:	T. Gobble, T. Pendergraft, P. Stevens, C. Carswell - (WSP)

Station	Elevation
0.00	612.85
0.11	612.36
2.47	612.03
4.59	611.81
6.27	611.45
8.14	611.10
10.58	610.75
12.59	610.51
14.78	610.02
16.76	609.22
18.55	608.82
20.92	608.30
22.95	607.93
23.97	607.75
25.77	607.79
27.70	608.23
29.49	608.52
30.81	608.81
32.25	609.06
33.88	609.94
35.72	610.54
37.90	610.96
40.11	611.48
43.23	611.93
45.72	612.36
48.11	612.70
50.58	613.00
53.06	613.33
53.29	614.08

SUMMARY DATA	
Bankfull Elevation:	610.36
Bankfull Cross-Sectional Area:	34.22
Bankfull Width:	21.92
Flood Prone Area Elevation:	612.97
Flood Prone Width:	52.59
Max Depth at Bankfull:	2.61
Mean Depth at Bankful:	1.56
W/D Ratio:	14.04
Entrenchment Ratio:	>2.2
Bank Height Ratio:	0.87
Low Top of Bank Elevation:	610.02
Stream Type	B4

Station and description	2077.52 UT7-STP2 Looking Upstream

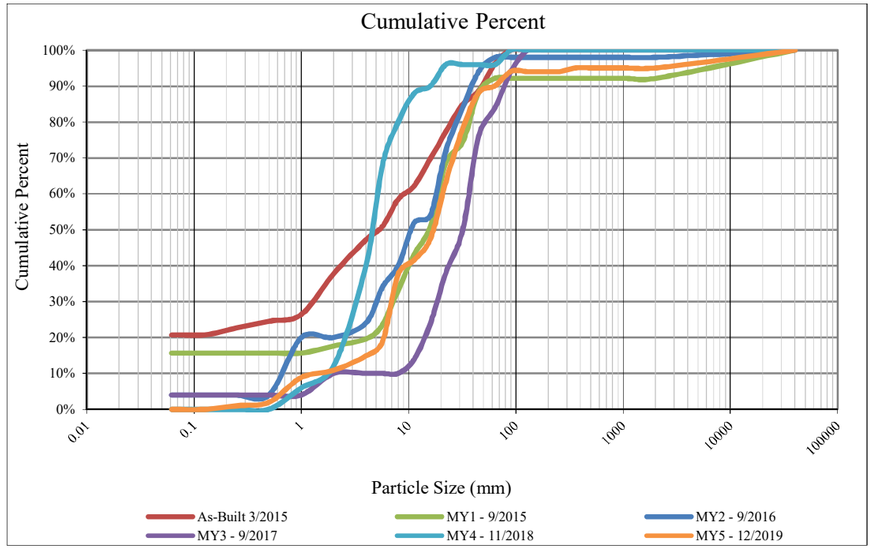
2077.52 UT7-STP2 Looking Downstream

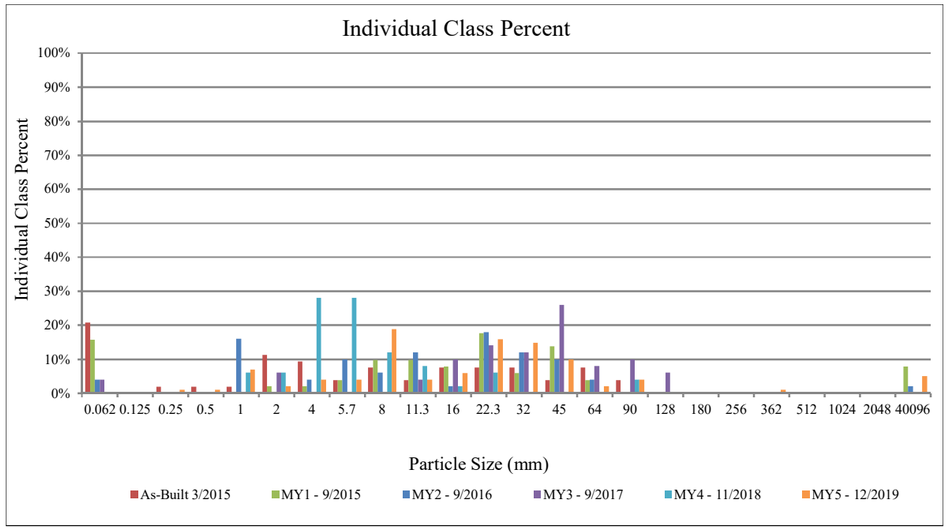


Figures 5a-q – Pebble Count Plots

Project Name: Little Buffalo Creek					
Cross-Section: MS-1P					
Feature: Pool					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	1	1%	1%
	medium sand	0.50	1	1%	2%
	coarse sand	1.00	7	7%	9%
	very coarse sand	2.0	2	2%	11%
Gravel	very fine gravel	4.0	4	4%	15%
	fine gravel	5.7	4	4%	19%
	fine gravel	8.0	19	19%	38%
	medium gravel	11.3	4	4%	42%
	medium gravel	16.0	6	6%	48%
	coarse gravel	22.3	16	16%	63%
	coarse gravel	32.0	15	15%	78%
	very coarse gravel	45	10	10%	88%
	very coarse gravel	64	2	2%	90%
Cobble	small cobble	90	4	4%	94%
	medium cobble	128	0	0%	94%
	large cobble	180	0	0%	94%
	very large cobble	256	0	0%	94%
Boulder	small boulder	362	1	1%	95%
	small boulder	512	0	0%	95%
	medium boulder	1024	0	0%	95%
	large boulder	2048	0	0%	95%
Bedrock	bedrock	40096	5	5%	100%
TOTAL % of whole count			101	100%	100%

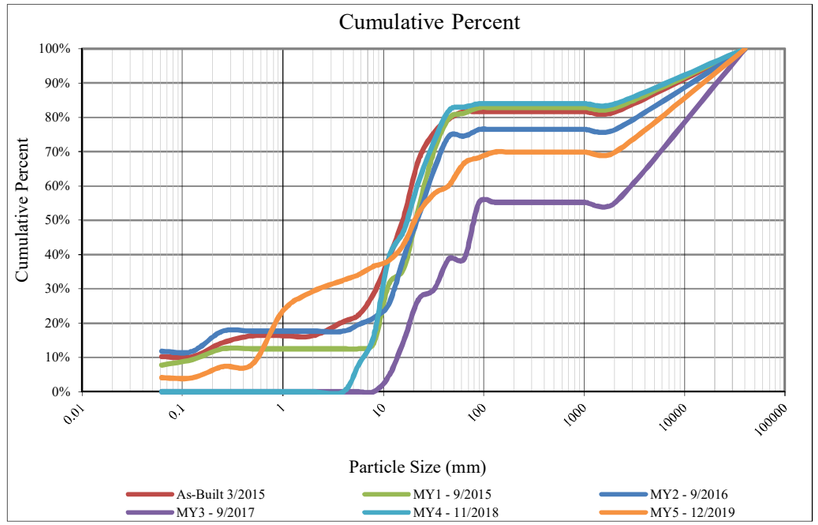
Summary Data	
D16	4.49
D35	7.68
D50	16.98
D84	39.59
D95	356.70
D100	Bedrock

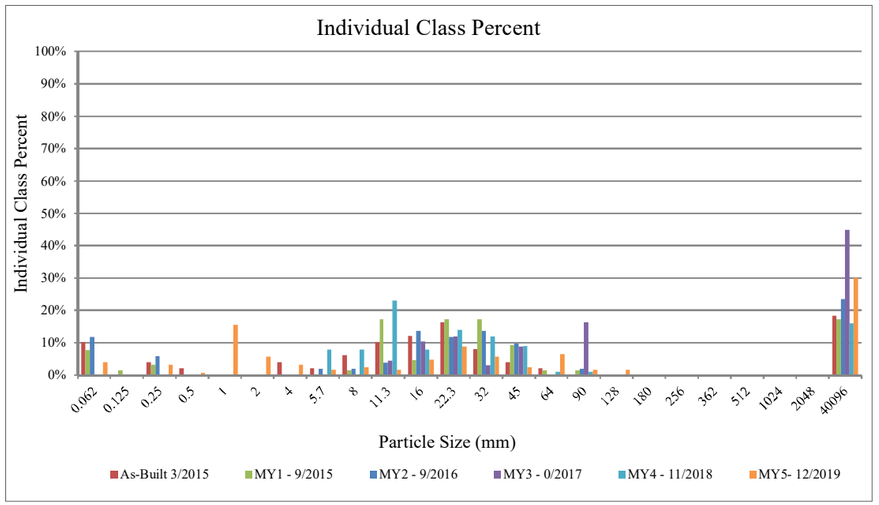




Project Name: Little Buffalo Creek					
Cross-Section: MS-1R					
Feature: Riffle					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	5	4%	4%
Sand	very fine sand	0.125	0	0%	4%
	fine sand	0.250	4	3%	7%
	medium sand	0.50	1	1%	8%
	coarse sand	1.00	19	15%	24%
	very coarse sand	2.0	7	6%	29%
Gravel	very fine gravel	4.0	4	3%	33%
	fine gravel	5.7	2	2%	34%
	fine gravel	8.0	3	2%	37%
	medium gravel	11.3	2	2%	38%
	medium gravel	16.0	6	5%	43%
	coarse gravel	22.3	11	9%	52%
	coarse gravel	32.0	7	6%	58%
	very coarse gravel	45	3	2%	60%
	very coarse gravel	64	8	7%	67%
Cobble	small cobble	90	2	2%	68%
	medium cobble	128	2	2%	70%
	large cobble	180	0	0%	70%
	very large cobble	256	0	0%	70%
Boulder	small boulder	362	0	0%	70%
	small boulder	512	0	0%	70%
	medium boulder	1024	0	0%	70%
	large boulder	2048	0	0%	70%
Bedrock	bedrock	40096	37	30%	100%
TOTAL % of whole count			123	100%	100%

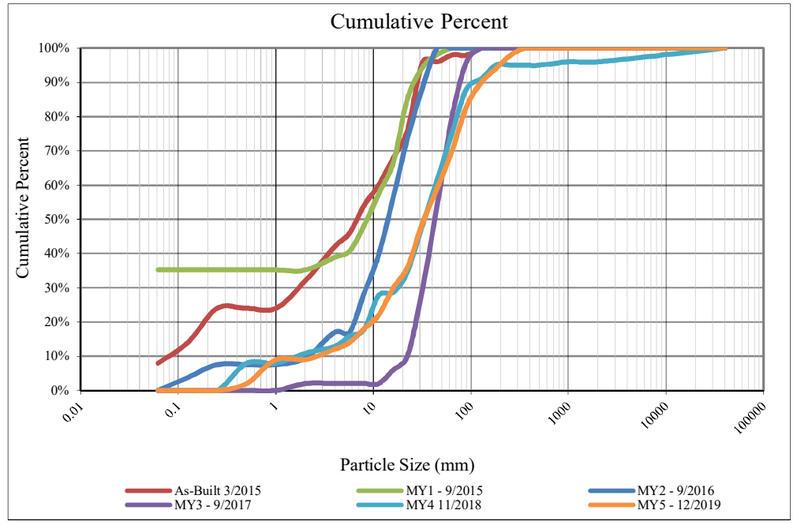
Summary Data	
D16	0.75
D35	6.51
D50	20.87
D84	Bedrock
D95	Bedrock
D100	Bedrock

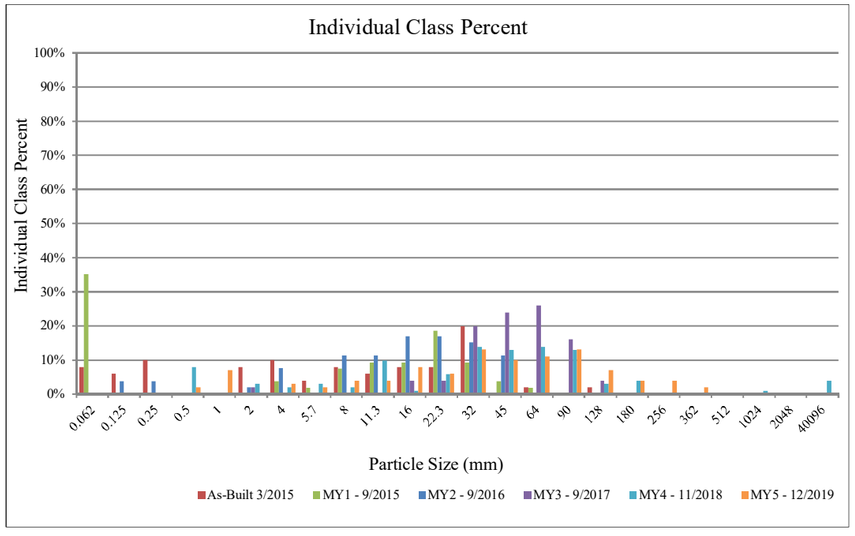




Project Name: Little Buffalo Creek					
Cross-Section: MS-2P					
Feature: Pool					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	0	0%	0%
	medium sand	0.50	2	2%	2%
	coarse sand	1.00	7	7%	9%
	very coarse sand	2.0	0	0%	9%
Gravel	very fine gravel	4.0	3	3%	12%
	fine gravel	5.7	2	2%	14%
	fine gravel	8.0	4	4%	18%
	medium gravel	11.3	4	4%	22%
	medium gravel	16.0	8	8%	30%
	coarse gravel	22.3	6	6%	36%
	coarse gravel	32.0	13	13%	49%
	very coarse gravel	45	10	10%	59%
	very coarse gravel	64	11	11%	70%
Cobble	small cobble	90	13	13%	83%
	medium cobble	128	7	7%	90%
	large cobble	180	4	4%	94%
	very large cobble	256	4	4%	98%
Boulder	small boulder	362	2	2%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

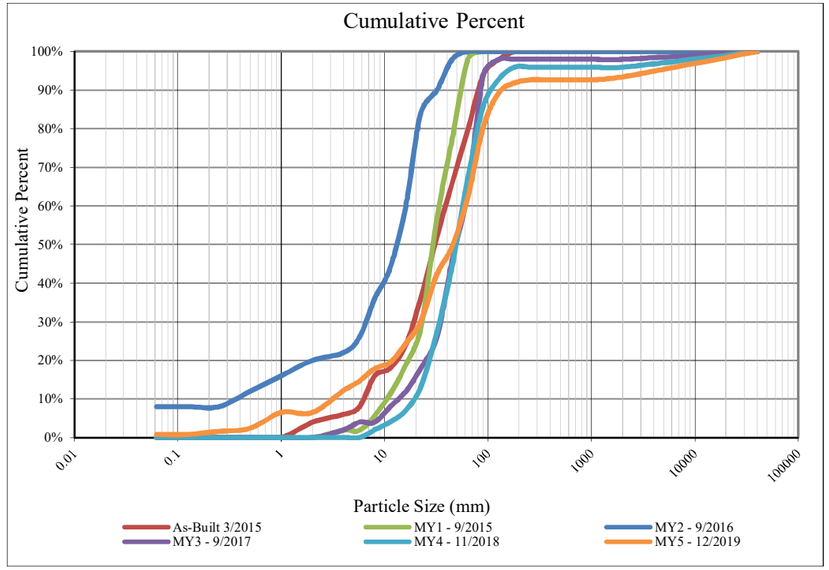
Summary Data	
D16	6.85
D35	21.25
D50	33.30
D84	95.43
D95	199.00
D100	362.00

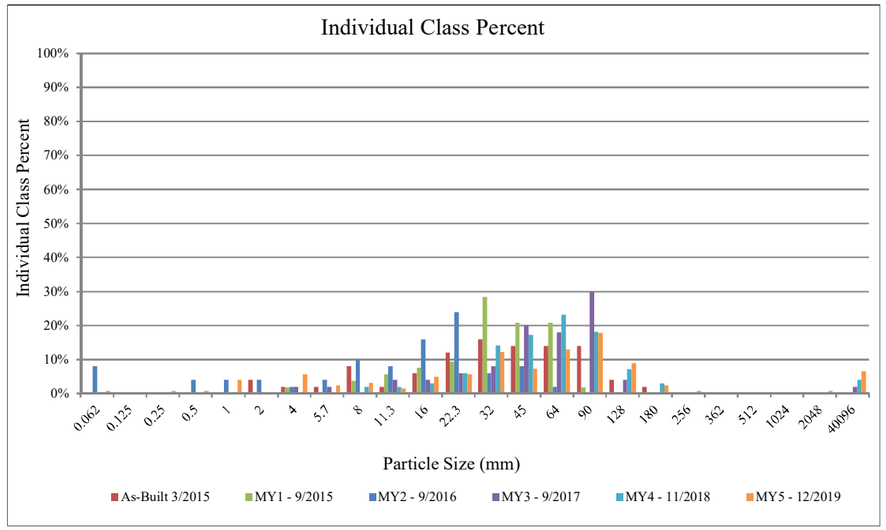




Project Name: Little Buffalo Creek					
Cross-Section: MS-2R					
Feature: Riffle					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	1	1%	1%
Sand	very fine sand	0.125	0	0%	1%
	fine sand	0.250	1	1%	2%
	medium sand	0.50	1	1%	2%
	coarse sand	1.00	5	4%	7%
	very coarse sand	2.0	0	0%	7%
Gravel	very fine gravel	4.0	7	6%	12%
	fine gravel	5.7	3	2%	15%
	fine gravel	8.0	4	3%	18%
	medium gravel	11.3	2	2%	20%
	medium gravel	16.0	6	5%	24%
	coarse gravel	22.3	7	6%	30%
	coarse gravel	32.0	15	12%	42%
	very coarse gravel	45	9	7%	50%
	very coarse gravel	64	16	13%	63%
Cobble	small cobble	90	22	18%	80%
	medium cobble	128	11	9%	89%
	large cobble	180	3	2%	92%
	very large cobble	256	1	1%	93%
Boulder	small boulder	362	0	0%	93%
	small boulder	512	0	0%	93%
	medium boulder	1024	0	0%	93%
	large boulder	2048	1	1%	93%
Bedrock	bedrock	40096	8	7%	100%
TOTAL % of whole count			123	100%	100%

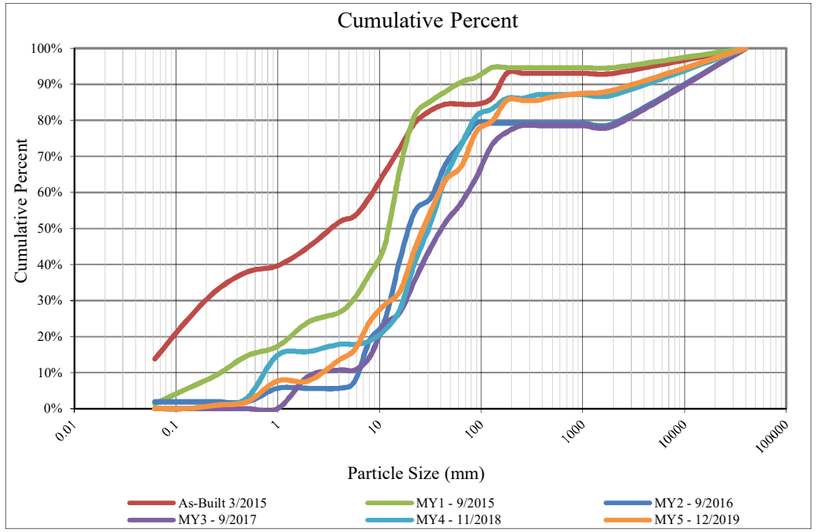
Summary Data	
D16	6.67
D35	26.21
D50	45.59
D84	104.92
D95	Bedrock
D100	Bedrock

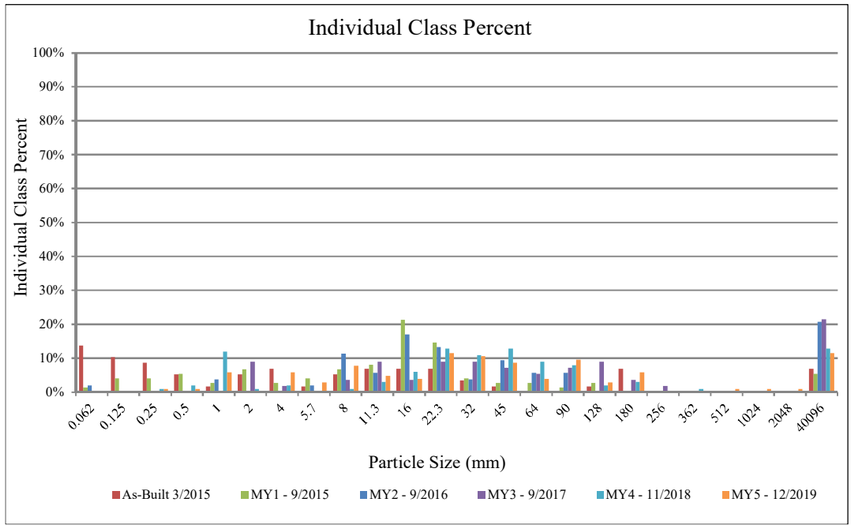




Project Name: Little Buffalo Creek					
Cross-Section: MS-3P					
Feature: Pool					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	1	1%	1%
	medium sand	0.50	1	1%	2%
	coarse sand	1.00	6	6%	8%
	very coarse sand	2.0	0	0%	8%
Gravel	very fine gravel	4.0	6	6%	13%
	fine gravel	5.7	3	3%	16%
	fine gravel	8.0	8	8%	24%
	medium gravel	11.3	5	5%	29%
	medium gravel	16.0	4	4%	33%
	coarse gravel	22.3	12	12%	44%
	coarse gravel	32.0	11	11%	55%
	very coarse gravel	45	9	9%	63%
	very coarse gravel	64	4	4%	67%
Cobble	small cobble	90	10	10%	77%
	medium cobble	128	3	3%	80%
	large cobble	180	6	6%	86%
	very large cobble	256	0	0%	86%
Boulder	small boulder	362	0	0%	86%
	small boulder	512	1	1%	87%
	medium boulder	1024	1	1%	88%
	large boulder	2048	1	1%	88%
Bedrock	bedrock	40096	12	12%	100%
TOTAL % of whole count			104	100%	100%

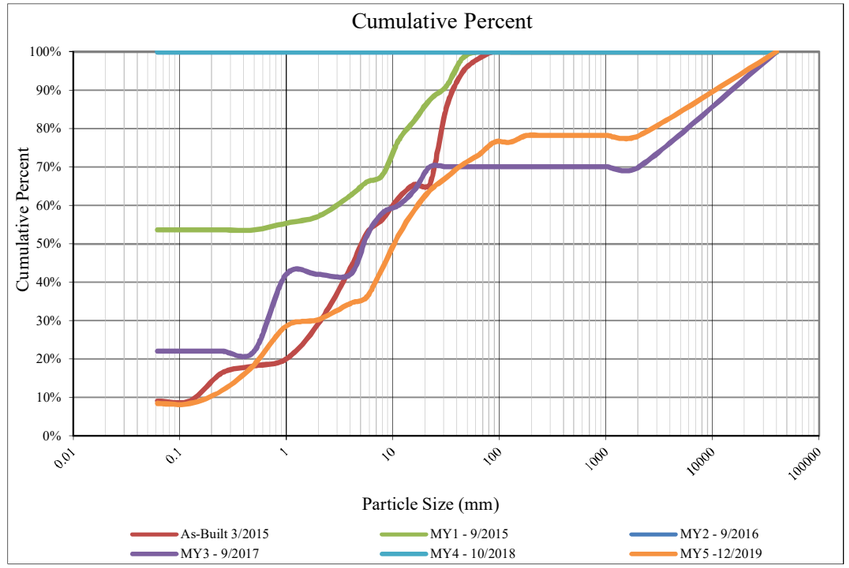
Summary Data	
D16	5.50
D35	17.26
D50	27.59
D84	165.79
D95	Bedrock
D100	Bedrock

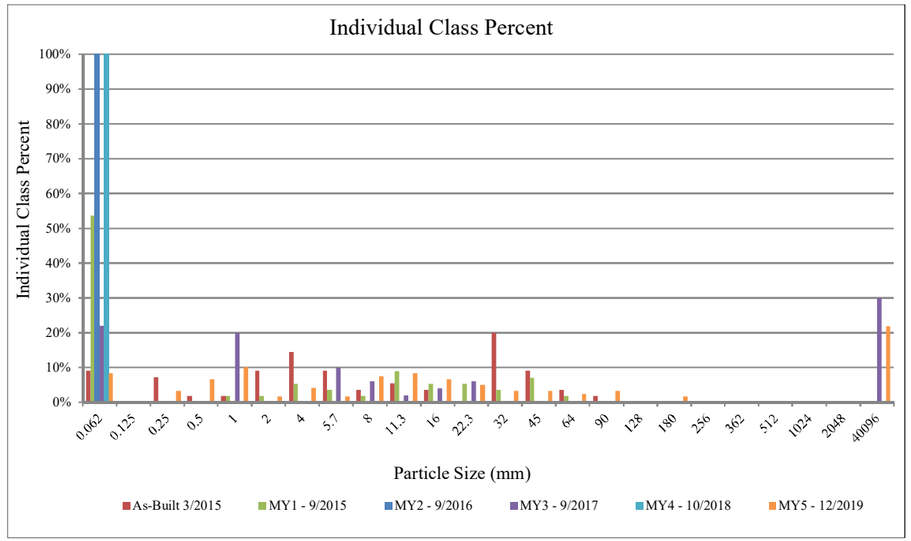




Project Name: Little Buffalo Creek					
Cross-Section: UT2-1R					
Feature: Riffle					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	10	8%	8%
Sand	very fine sand	0.125	0	0%	8%
	fine sand	0.250	4	3%	12%
	medium sand	0.50	8	7%	18%
	coarse sand	1.00	12	10%	29%
	very coarse sand	2.0	2	2%	30%
Gravel	very fine gravel	4.0	5	4%	34%
	fine gravel	5.7	2	2%	36%
	fine gravel	8.0	9	8%	44%
	medium gravel	11.3	10	8%	52%
	medium gravel	16.0	8	7%	59%
	coarse gravel	22.3	6	5%	64%
	coarse gravel	32.0	4	3%	67%
	very coarse gravel	45	4	3%	71%
	very coarse gravel	64	3	3%	73%
Cobble	small cobble	90	4	3%	76%
	medium cobble	128	0	0%	76%
	large cobble	180	2	2%	78%
	very large cobble	256	0	0%	78%
Boulder	small boulder	362	0	0%	78%
	small boulder	512	0	0%	78%
	medium boulder	1024	0	0%	78%
	large boulder	2048	0	0%	78%
Bedrock	bedrock	40096	26	22%	100%
TOTAL % of whole count			119	100%	100%

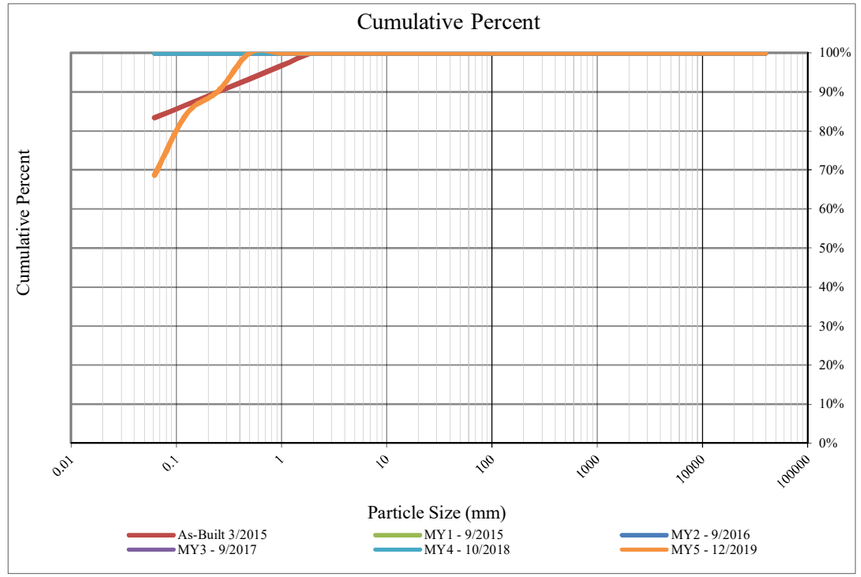
Summary Data	
D16	0.41
D35	4.55
D50	10.48
D84	Bedrock
D95	Bedrock
D100	Bedrock

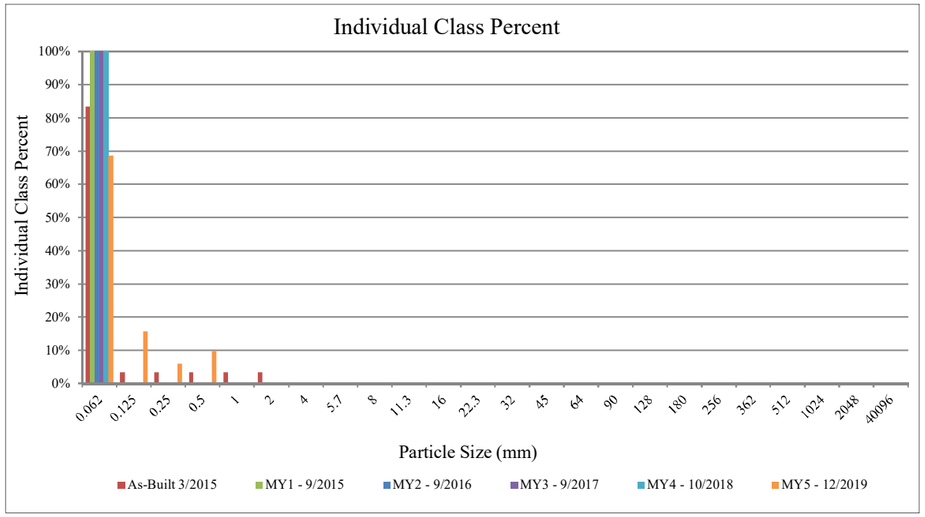




Project Name: Little Buffalo Creek					
Cross-Section: UT3-1R					
Feature: Riffle					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	35	69%	69%
Sand	very fine sand	0.125	8	16%	84%
	fine sand	0.250	3	6%	90%
	medium sand	0.50	5	10%	100%
	coarse sand	1.00	0	0%	100%
	very coarse sand	2.0	0	0%	100%
Gravel	very fine gravel	4.0	0	0%	100%
	fine gravel	5.7	0	0%	100%
	fine gravel	8.0	0	0%	100%
	medium gravel	11.3	0	0%	100%
	medium gravel	16.0	0	0%	100%
	coarse gravel	22.3	0	0%	100%
	coarse gravel	32.0	0	0%	100%
	very coarse gravel	45	0	0%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			51	100%	100%

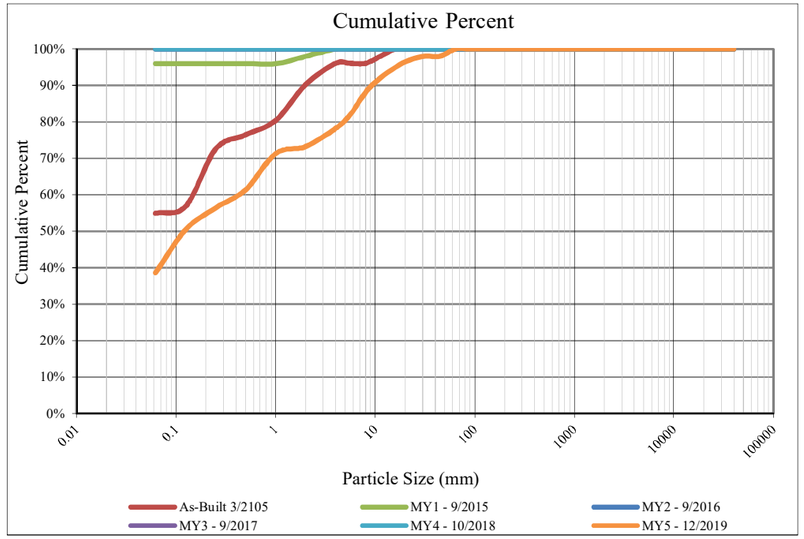
Summary Data	
D16	Silt/Clay
D35	Silt/Clay
D50	Silt/Clay
D84	0.13
D95	0.37
D100	0.50

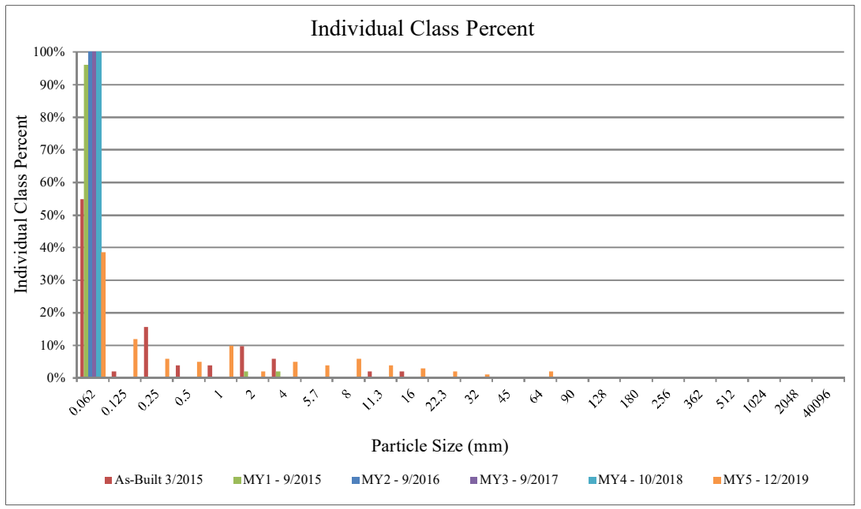




Project Name: Little Buffalo Creek					
Cross-Section: UT3-1P					
Feature: Pool					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	39	39%	39%
Sand	very fine sand	0.125	12	12%	50%
	fine sand	0.250	6	6%	56%
	medium sand	0.50	5	5%	61%
	coarse sand	1.00	10	10%	71%
	very coarse sand	2.0	2	2%	73%
Gravel	very fine gravel	4.0	5	5%	78%
	fine gravel	5.7	4	4%	82%
	fine gravel	8.0	6	6%	88%
	medium gravel	11.3	4	4%	92%
	medium gravel	16.0	3	3%	95%
	coarse gravel	22.3	2	2%	97%
	coarse gravel	32.0	1	1%	98%
	very coarse gravel	45	0	0%	98%
	very coarse gravel	64	2	2%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			101	100%	100%

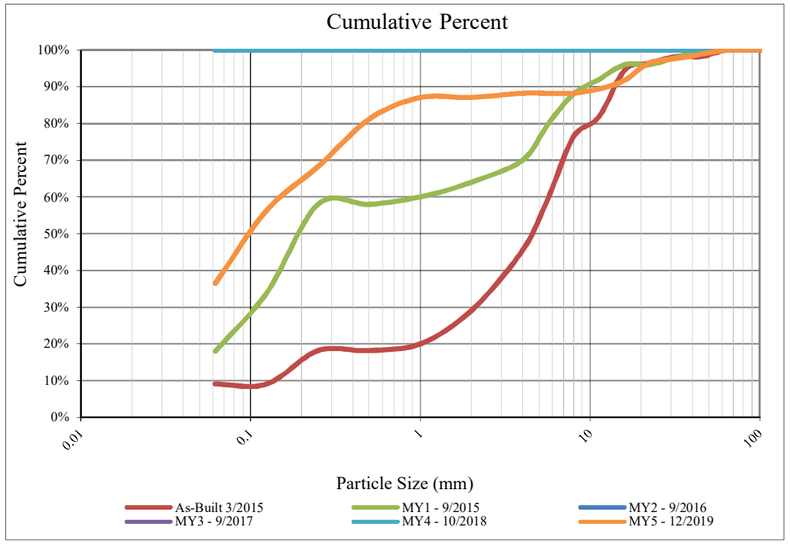
Summary Data	
D16	Silt/Clay
D35	Silt/Clay
D50	0.12
D84	6.41
D95	15.92
D100	64.00

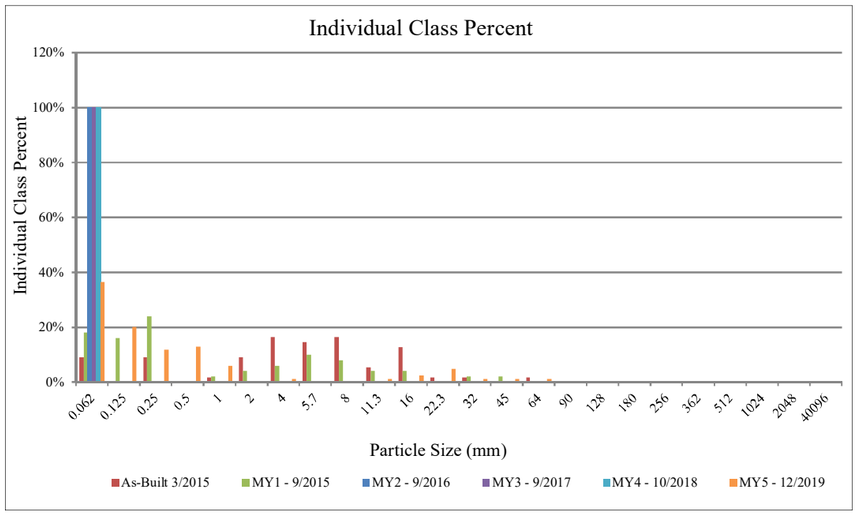




Project Name: Little Buffalo Creek					
Cross-Section: UT3-2R					
Feature: Riffle					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	31	36%	36%
Sand	very fine sand	0.125	17	20%	56%
	fine sand	0.250	10	12%	68%
	medium sand	0.50	11	13%	81%
	coarse sand	1.00	5	6%	87%
	very coarse sand	2.0	0	0%	87%
Gravel	very fine gravel	4.0	1	1%	88%
	fine gravel	5.7	0	0%	88%
	fine gravel	8.0	0	0%	88%
	medium gravel	11.3	1	1%	89%
	medium gravel	16.0	2	2%	92%
	coarse gravel	22.3	4	5%	96%
	coarse gravel	32.0	1	1%	98%
	very coarse gravel	45	1	1%	99%
	very coarse gravel	64	1	1%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			85	100%	100%

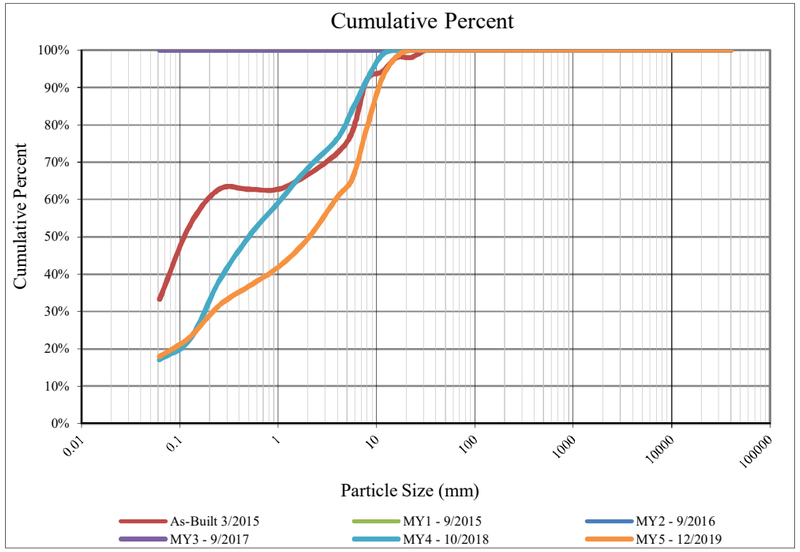
Summary Data	
D16	Silt/Clay
D35	Silt/Clay
D50	0.10
D84	0.74
D95	20.33
D100	64.00

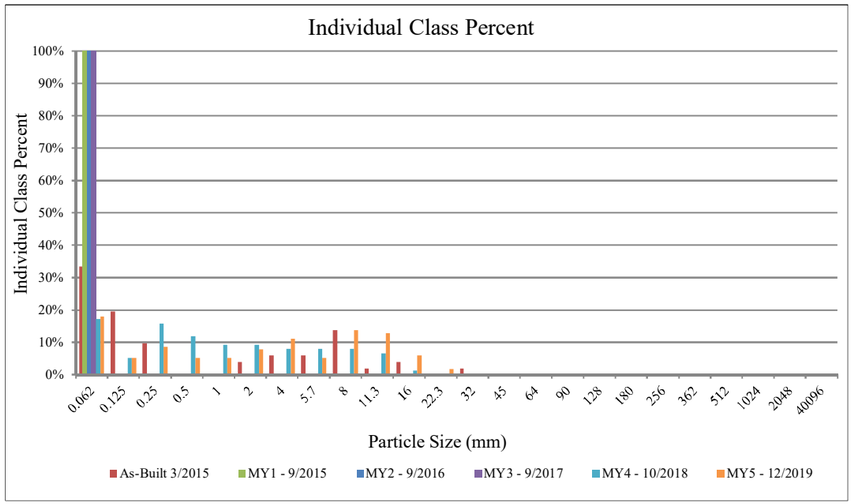




Project Name: Little Buffalo Creek					
Cross-Section: UT3-3R					
Feature: Riffle					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	21	18%	18%
Sand	very fine sand	0.125	6	5%	23%
	fine sand	0.250	10	9%	32%
	medium sand	0.50	6	5%	37%
	coarse sand	1.00	6	5%	42%
	very coarse sand	2.0	9	8%	50%
Gravel	very fine gravel	4.0	13	11%	61%
	fine gravel	5.7	6	5%	66%
	fine gravel	8.0	16	14%	79%
	medium gravel	11.3	15	13%	92%
	medium gravel	16.0	7	6%	98%
	coarse gravel	22.3	2	2%	100%
	coarse gravel	32.0	0	0%	100%
	very coarse gravel	45	0	0%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			117	100%	100%

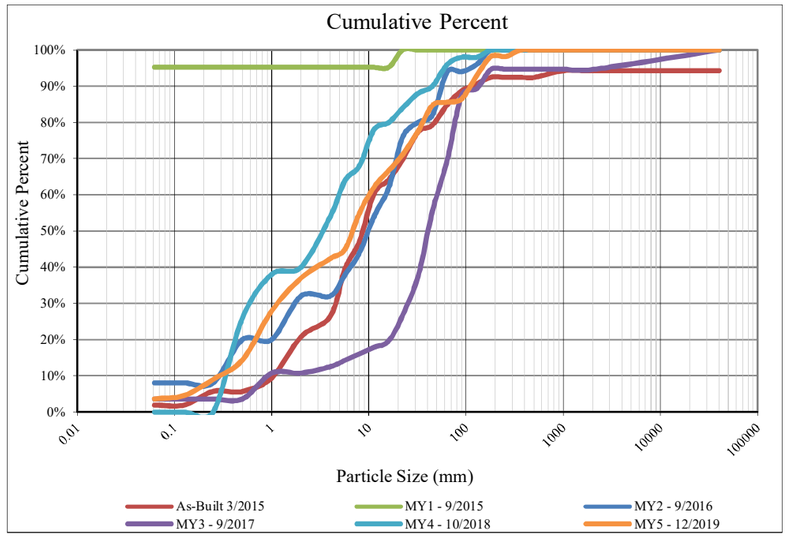
Summary Data	
D16	Silt/Clay
D35	0.41
D50	2.08
D84	9.16
D95	13.42
D100	22.30

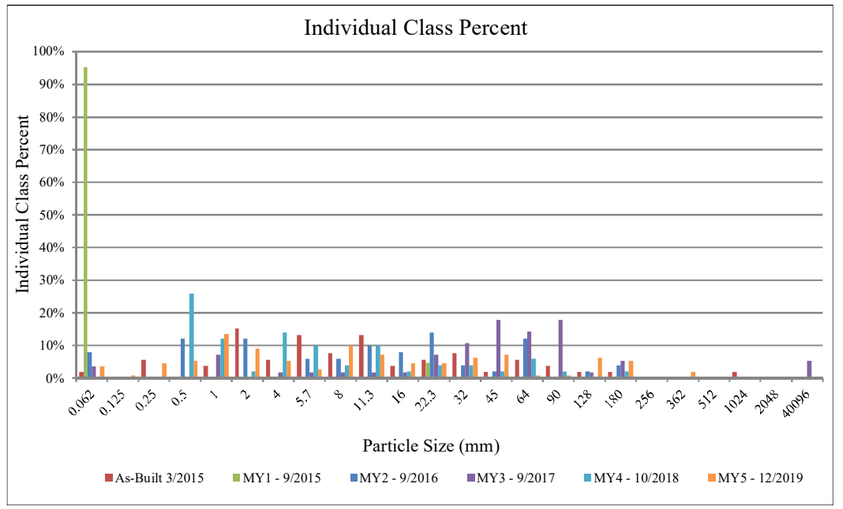




Project Name: Little Buffalo Creek					
Cross-Section: UT4-1P					
Feature: Pool					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	4	4%	4%
Sand	very fine sand	0.125	1	1%	5%
	fine sand	0.250	5	5%	9%
	medium sand	0.50	6	5%	14%
	coarse sand	1.00	15	14%	28%
	very coarse sand	2.0	10	9%	37%
Gravel	very fine gravel	4.0	6	5%	42%
	fine gravel	5.7	3	3%	45%
	fine gravel	8.0	11	10%	55%
	medium gravel	11.3	8	7%	62%
	medium gravel	16.0	5	5%	67%
	coarse gravel	22.3	5	5%	71%
	coarse gravel	32.0	7	6%	77%
	very coarse gravel	45	8	7%	85%
	very coarse gravel	64	1	1%	86%
Cobble	small cobble	90	1	1%	86%
	medium cobble	128	7	6%	93%
	large cobble	180	6	5%	98%
	very large cobble	256	0	0%	98%
Boulder	small boulder	362	2	2%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			111	100%	100%

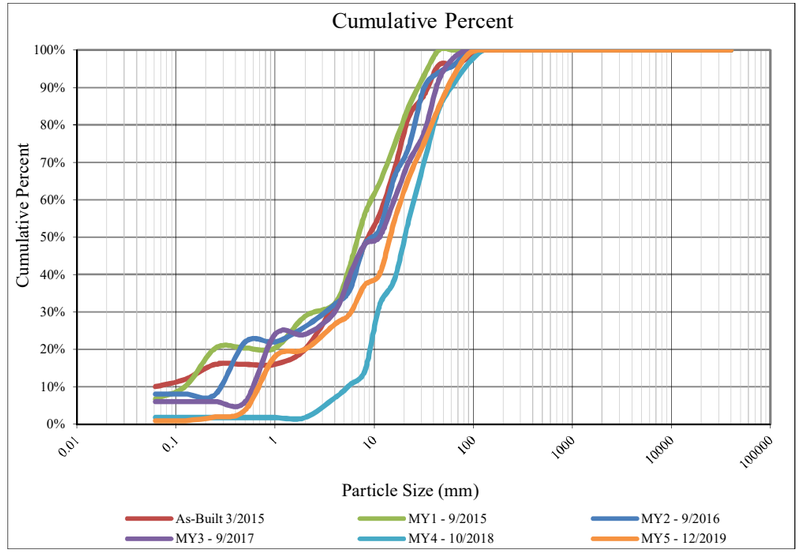
Summary Data	
D16	0.56
D35	1.79
D50	6.85
D84	43.77
D95	149.23
D100	362.00

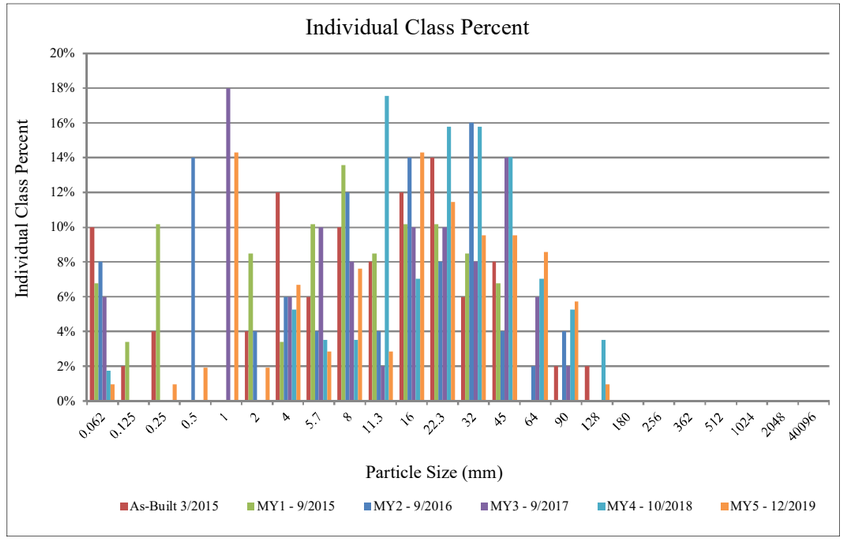




Project Name: Little Buffalo Creek					
Cross-Section: UT4-1R					
Feature: Riffle					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	1	1%	1%
Sand	very fine sand	0.125	0	0%	1%
	fine sand	0.250	1	1%	2%
	medium sand	0.50	2	2%	4%
	coarse sand	1.00	15	14%	18%
	very coarse sand	2.0	2	2%	20%
Gravel	very fine gravel	4.0	7	7%	27%
	fine gravel	5.7	3	3%	30%
	fine gravel	8.0	8	8%	37%
	medium gravel	11.3	3	3%	40%
	medium gravel	16.0	15	14%	54%
	coarse gravel	22.3	12	11%	66%
	coarse gravel	32.0	10	10%	75%
	very coarse gravel	45	10	10%	85%
	very coarse gravel	64	9	9%	93%
Cobble	small cobble	90	6	6%	99%
	medium cobble	128	1	1%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			105	100%	100%

Summary Data	
D16	0.93
D35	7.35
D50	14.59
D84	43.96
D95	71.58
D100	128.00

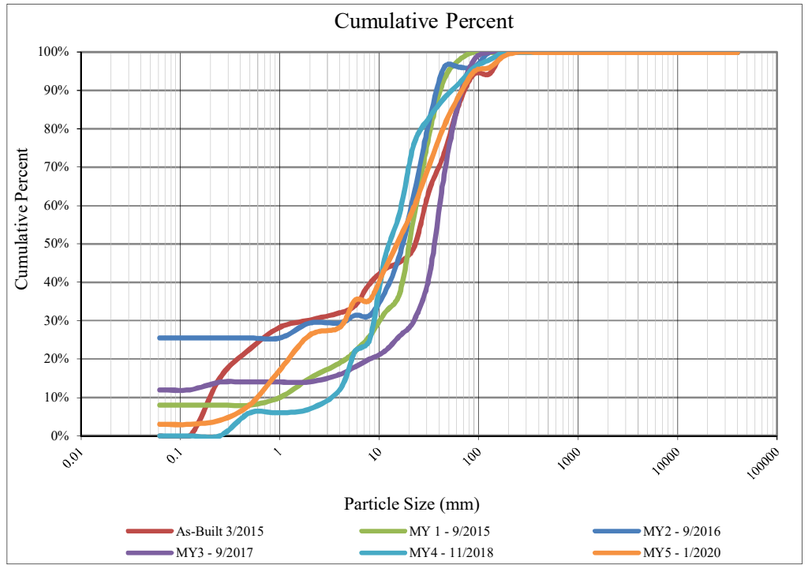


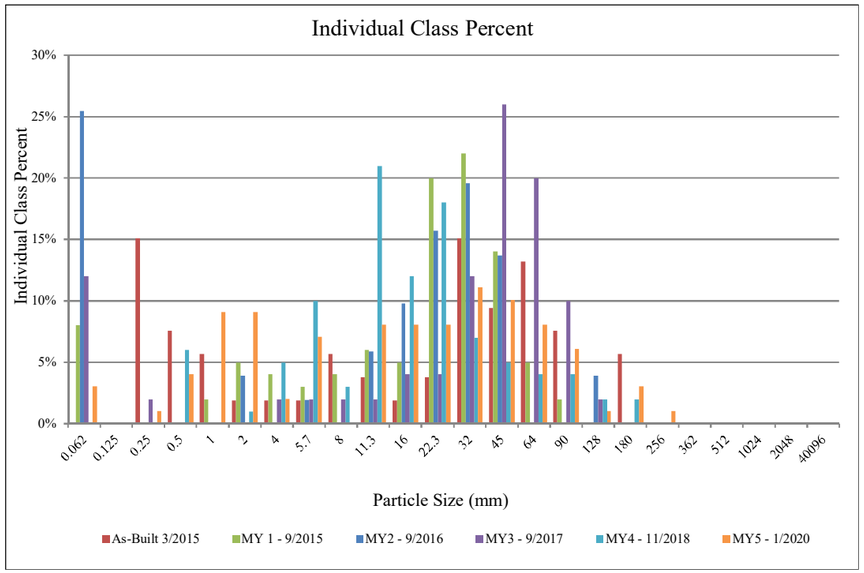


Project Name: Little Buffalo Creek					
Cross-Section: UT7-1R					
Feature: Riffle					
			2020		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	3	3%	3%
Sand	very fine sand	0.125	0	0%	3%
	fine sand	0.250	1	1%	4%
	medium sand	0.50	4	4%	8%
	coarse sand	1.00	9	9%	17%
	very coarse sand	2.0	9	9%	26%
Gravel	very fine gravel	4.0	2	2%	28%
	fine gravel	5.7	7	7%	35%
	fine gravel	8.0	0	0%	35%
	medium gravel	11.3	8	8%	43%
	medium gravel	16.0	8	8%	52%
	coarse gravel	22.3	8	8%	60%
	coarse gravel	32.0	11	11%	71%
	very coarse gravel	45	10	10%	81%
	very coarse gravel	64	8	8%	89%
Cobble	small cobble	90	6	6%	95%
	medium cobble	128	1	1%	96%
	large cobble	180	3	3%	99%
	very large cobble	256	1	1%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			99	100%	100%

*data collected after beaver dam was removed

Summary Data	
D16	0.94
D35	5.62
D50	15.12
D84	52.51
D95	91.90
D100	256.00

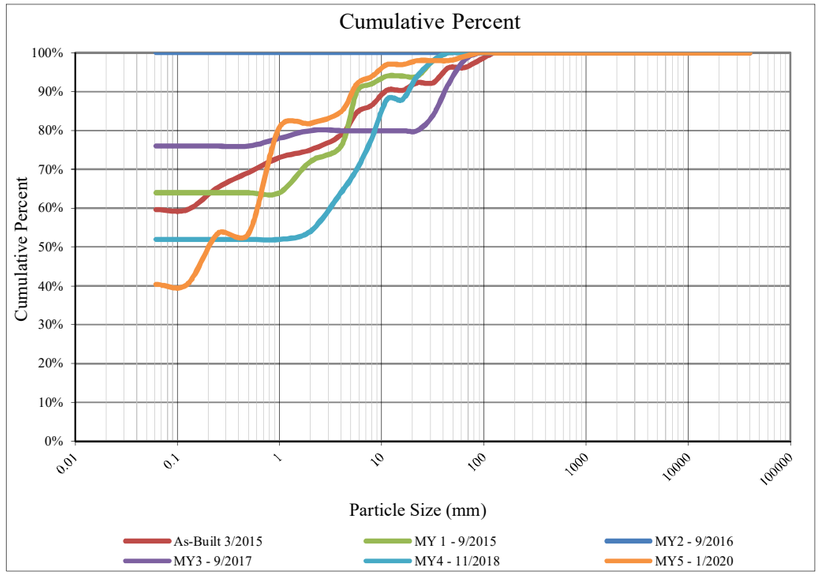


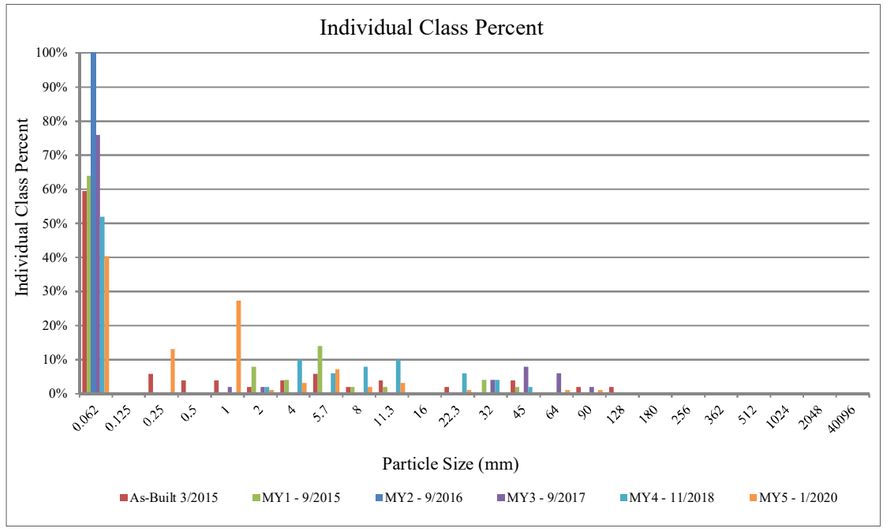


Project Name: Little Buffalo Creek					
Cross-Section: UT7-1P					
Feature: Pool					
			2020		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	40	40%	40%
Sand	very fine sand	0.125	0	0%	40%
	fine sand	0.250	13	13%	54%
	medium sand	0.50	0	0%	54%
	coarse sand	1.00	27	27%	81%
	very coarse sand	2.0	1	1%	82%
Gravel	very fine gravel	4.0	3	3%	85%
	fine gravel	5.7	7	7%	92%
	fine gravel	8.0	2	2%	94%
	medium gravel	11.3	3	3%	97%
	medium gravel	16.0	0	0%	97%
	coarse gravel	22.3	1	1%	98%
	coarse gravel	32.0	0	0%	98%
	very coarse gravel	45	0	0%	98%
	very coarse gravel	64	1	1%	99%
Cobble	small cobble	90	1	1%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			99	100%	100%

*data collected after beaver dam was removed

Summary Data	
D16	Silt/Clay
D35	Silt/Clay
D50	0.22
D84	3.44
D95	9.16
D100	90.00

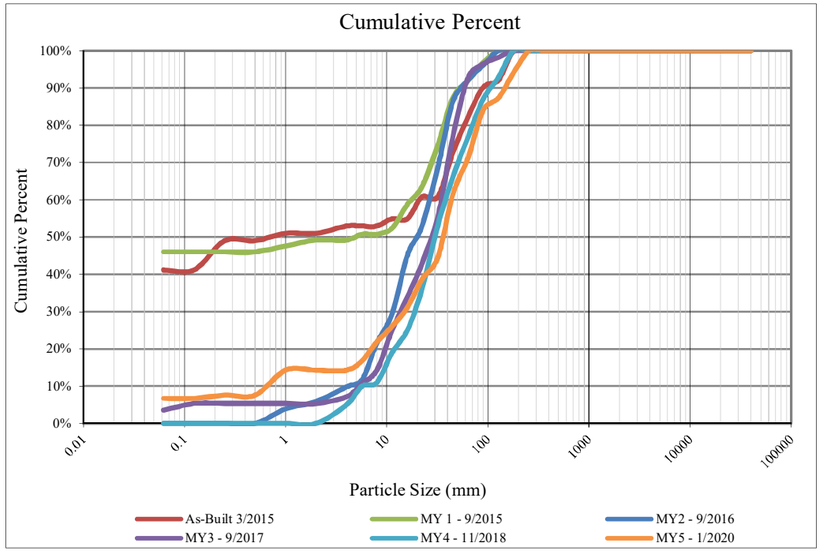


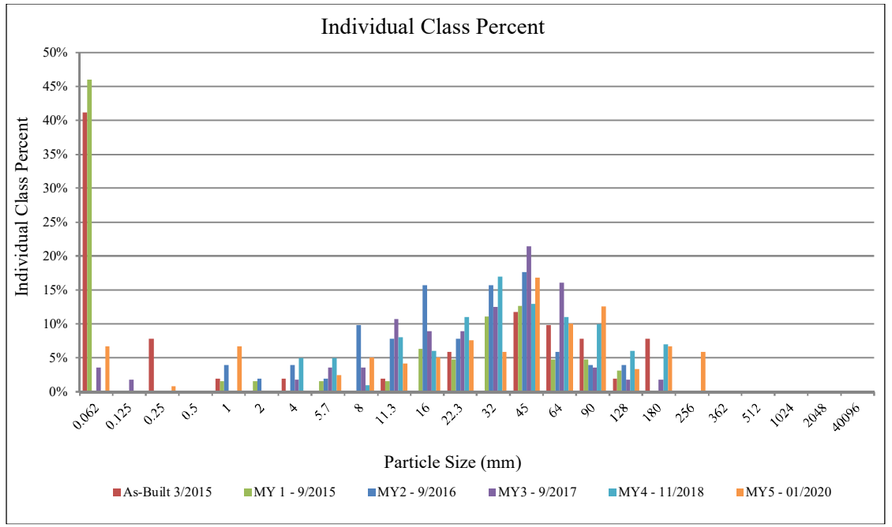


Project Name: Little Buffalo Creek					
Cross-Section: UT7-2R					
Feature: Riffle					
			2020		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	8	7%	7%
Sand	very fine sand	0.125	0	0%	7%
	fine sand	0.250	1	1%	8%
	medium sand	0.50	0	0%	8%
	coarse sand	1.00	8	7%	14%
	very coarse sand	2.0	0	0%	14%
Gravel	very fine gravel	4.0	0	0%	14%
	fine gravel	5.7	3	3%	17%
	fine gravel	8.0	6	5%	22%
	medium gravel	11.3	5	4%	26%
	medium gravel	16.0	6	5%	31%
	coarse gravel	22.3	9	8%	39%
	coarse gravel	32.0	7	6%	45%
	very coarse gravel	45	20	17%	61%
	very coarse gravel	64	12	10%	71%
Cobble	small cobble	90	15	13%	84%
	medium cobble	128	4	3%	87%
	large cobble	180	8	7%	94%
	very large cobble	256	7	6%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			119	100%	100%

*data collected after beaver dam was removed

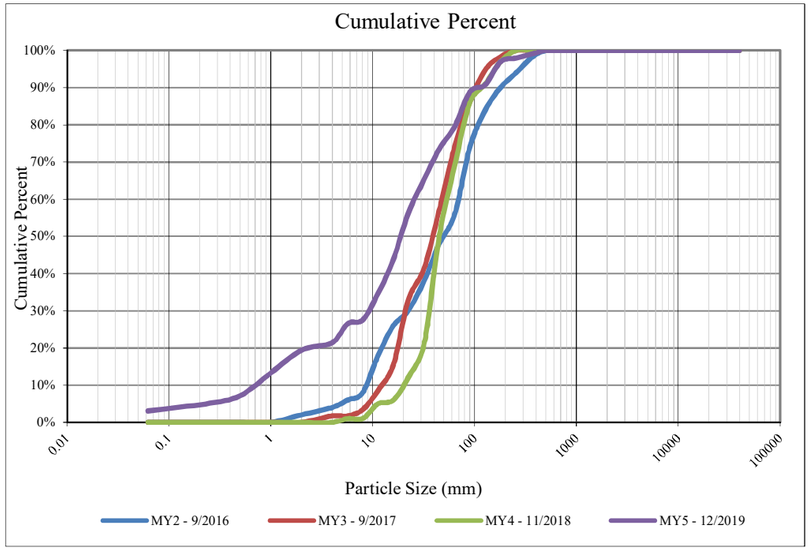
Summary Data	
D16	5.16
D35	19.26
D50	36.23
D84	89.93
D95	191.40
D100	256.00

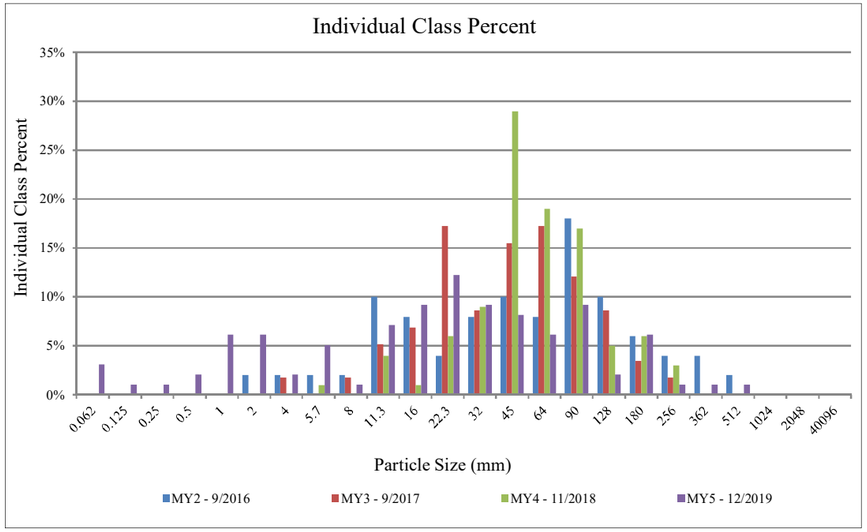




Project Name: Little Buffalo Creek					
Cross-Section: UT7-STP1					
Feature: Step Pool					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	3	3%	3%
Sand	very fine sand	0.125	1	1%	4%
	fine sand	0.250	1	1%	5%
	medium sand	0.50	2	2%	7%
	coarse sand	1.00	6	6%	13%
	very coarse sand	2.0	6	6%	19%
Gravel	very fine gravel	4.0	2	2%	21%
	fine gravel	5.7	5	5%	27%
	fine gravel	8.0	1	1%	28%
	medium gravel	11.3	7	7%	35%
	medium gravel	16.0	9	9%	44%
	coarse gravel	22.3	12	12%	56%
	coarse gravel	32.0	9	9%	65%
	very coarse gravel	45	8	8%	73%
	very coarse gravel	64	6	6%	80%
Cobble	small cobble	90	9	9%	89%
	medium cobble	128	2	2%	91%
	large cobble	180	6	6%	97%
	very large cobble	256	1	1%	98%
Boulder	small boulder	362	1	1%	99%
	small boulder	512	1	1%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			98	100%	100%

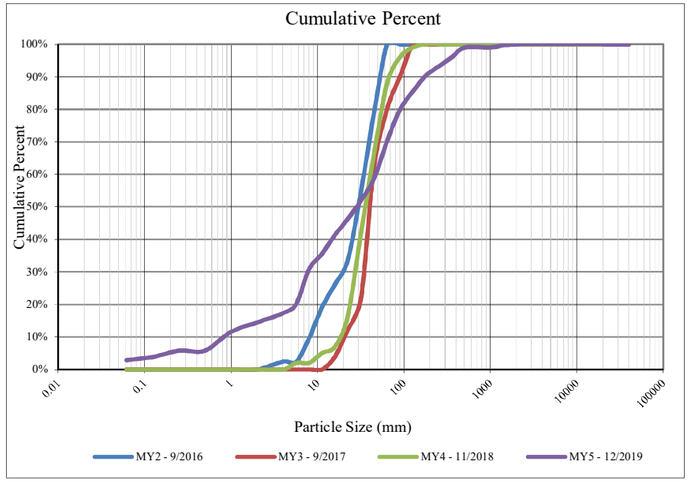
Summary Data	
D16	1.45
D35	11.46
D50	19.15
D84	76.48
D95	163.53
D100	512.00

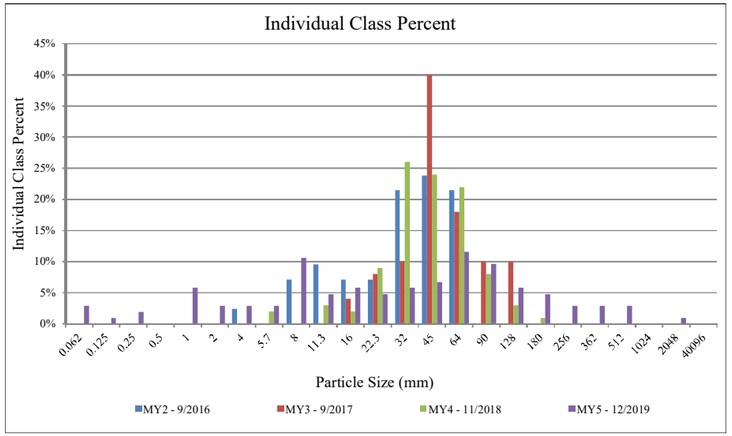




Project Name: Little Buffalo Creek					
Cross-Section: UT7-STP2					
Feature: Step Pool					
			2019		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	3	3%	3%
Sand	very fine sand	0.125	1	1%	4%
	fine sand	0.250	2	2%	6%
	medium sand	0.50	0	0%	6%
	coarse sand	1.00	6	6%	12%
	very coarse sand	2.0	3	3%	14%
Gravel	very fine gravel	4.0	3	3%	17%
	fine gravel	5.7	3	3%	20%
	fine gravel	8.0	11	11%	31%
	medium gravel	11.3	5	5%	36%
	medium gravel	16.0	6	6%	41%
	coarse gravel	22.3	5	5%	46%
	coarse gravel	32.0	6	6%	52%
	very coarse gravel	45	7	7%	59%
	very coarse gravel	64	12	12%	70%
Cobble	small cobble	90	10	10%	80%
	medium cobble	128	6	6%	86%
	large cobble	180	5	5%	90%
	very large cobble	256	3	3%	93%
Boulder	small boulder	362	3	3%	96%
	small boulder	512	3	3%	99%
	medium boulder	1024	0	0%	99%
	large boulder	2048	1	1%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			104	100%	100%

Summary Data	
D16	3.09
D35	10.90
D50	28.77
D84	117.61
D95	319.60
D100	2048.00



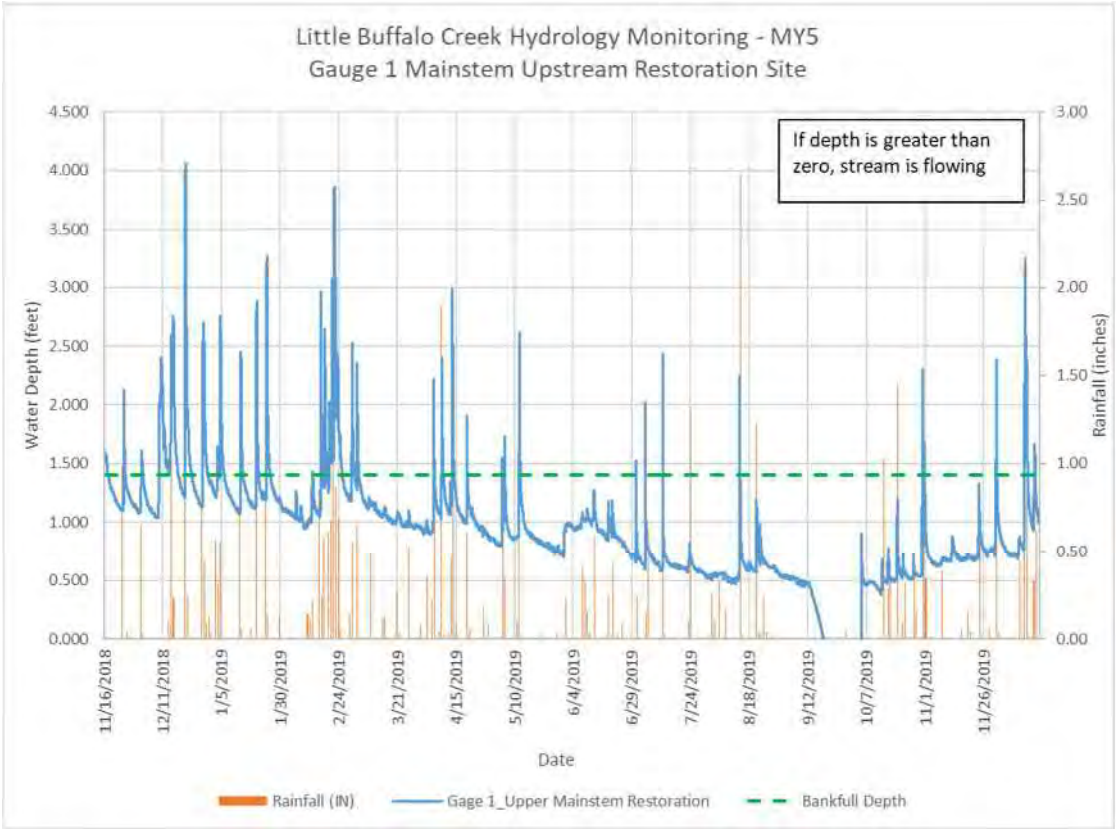


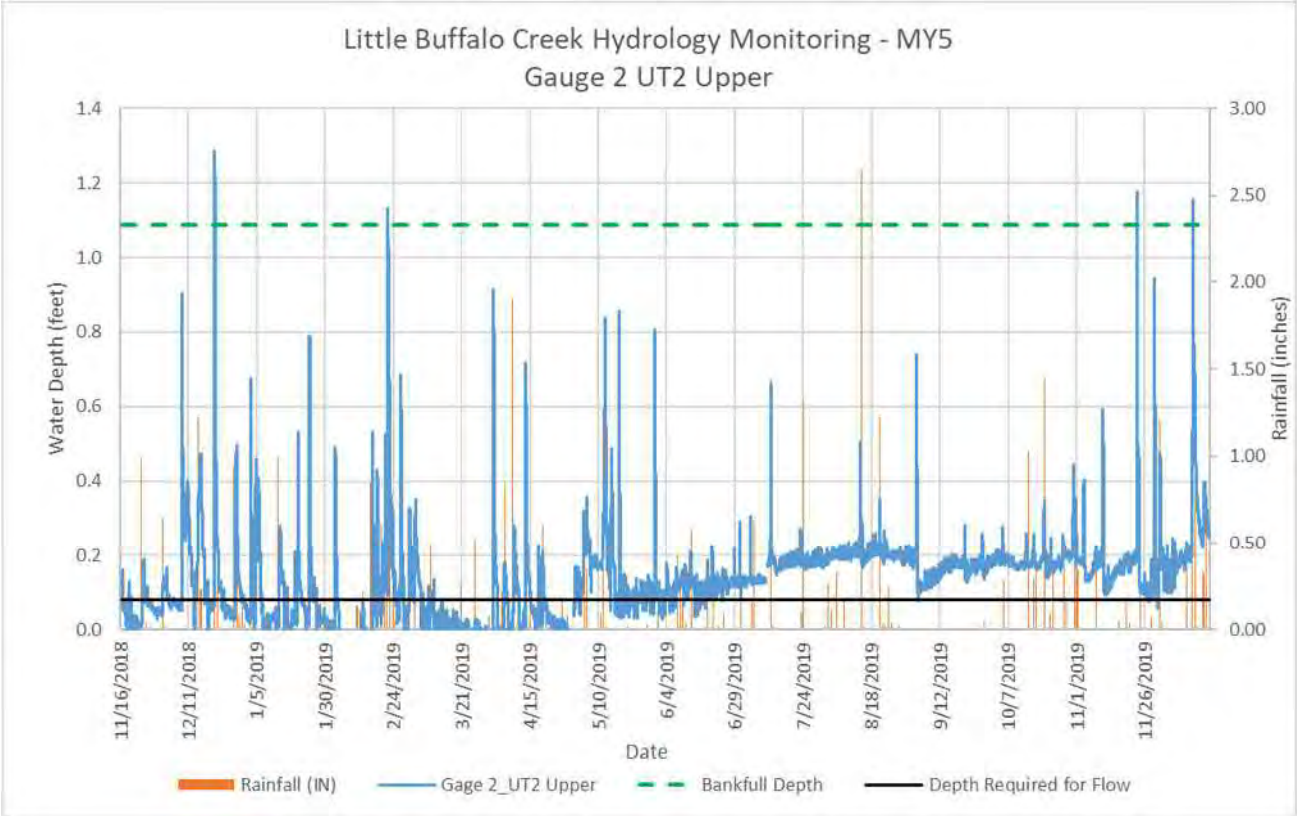
Appendix E – Hydrologic Data

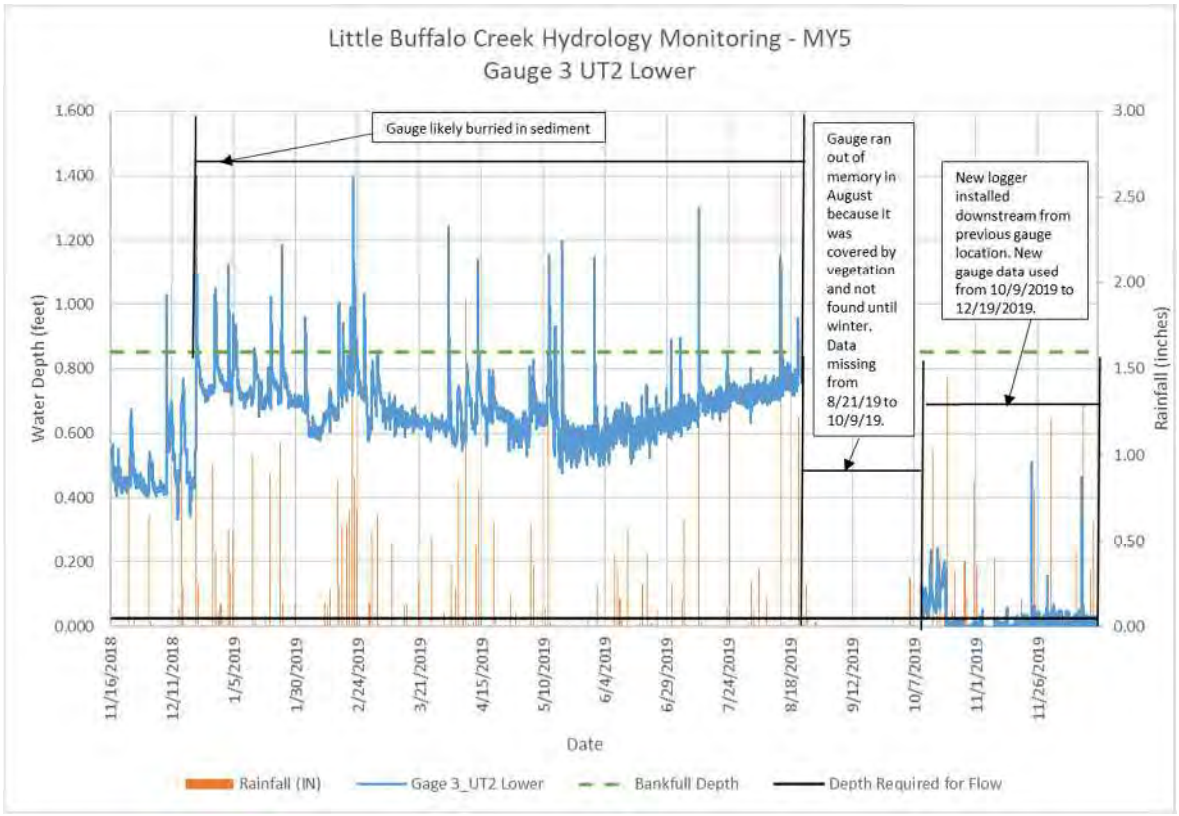
Table 12. Documentation of Geomorphologically Significant Flow Events					
Date of Observation	Date of Occurrence	Method	Greater than Qgs = Q2*0.66 stage?[1]	Greater than Qbkf Stage?	Notes
2/27/2016	11/9/2015	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
2/27/2016	12/22/2015	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
2/27/2016	12/30/2015	Surface Water Transducer Rack Lines	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations.
9/19/2016	5/20/2016	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
3/2/2017	1/23/2017	Surface Water Transducer Rack Lines	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
9/18/2017	5/5/2017	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
9/18/2017	5/25/2017	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
9/18/2017	6/5/2017	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/15/2018	4/24/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/15/2018	8/5/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
9/6/2018	9/16/2018	Photos/Surface Water Transducer	Yes	Yes	Hurricane Florence, photos taken during the storm by land owners
12/15/2018	10/11/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/15/2018	10/26/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/15/2018	11/13/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/15/2018	11/15/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
4/30/2019	12/20/2018	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
4/30/2019	2/22/2019	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
4/30/2019	4/13/2019	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
7/10/2019	5/12/2019	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
10/9/2019	7/12/2019	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations
12/19/2019	12/13/2019	Surface Water Transducer	Yes	Yes	Water level gages at multiple stations recorded elevations over surveyed bankful stage elevations

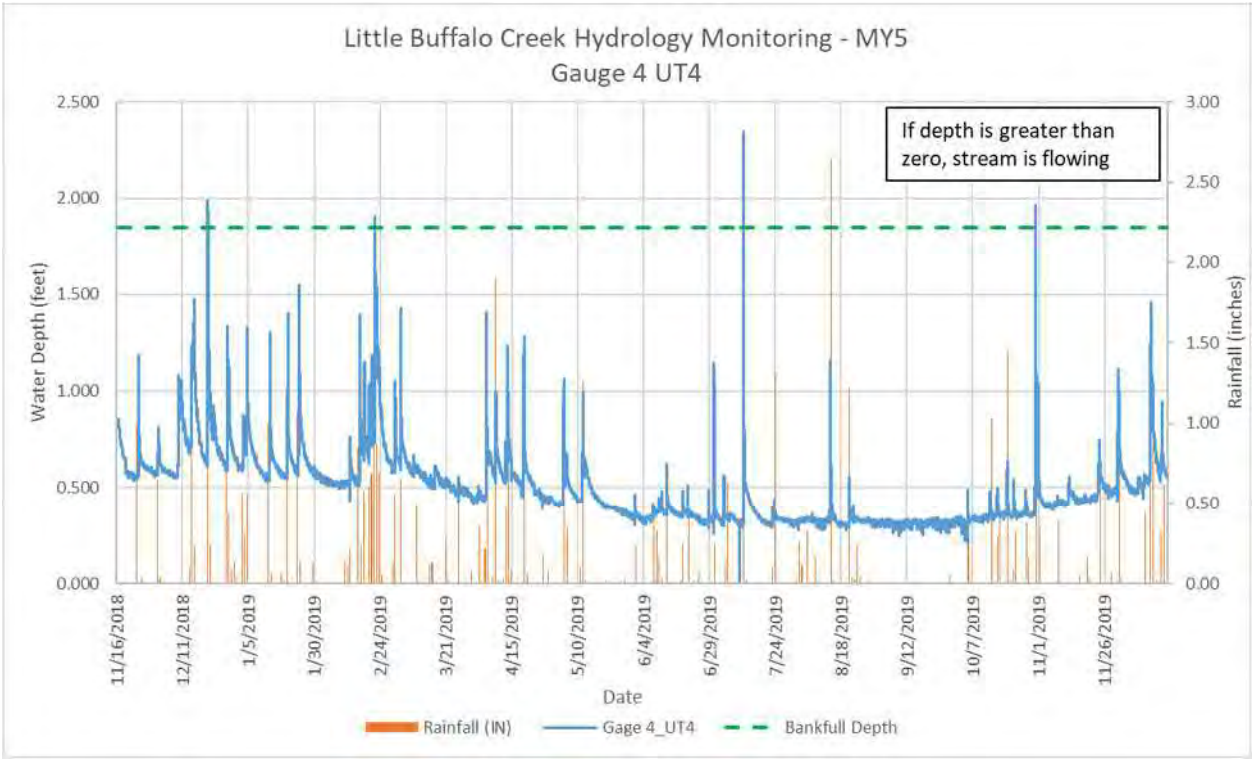
1) As stage relationships have not been calculated for the Qgs event, it is assumed that an event that has surpassed the identified bankfull stage on site also passed the Qgs event

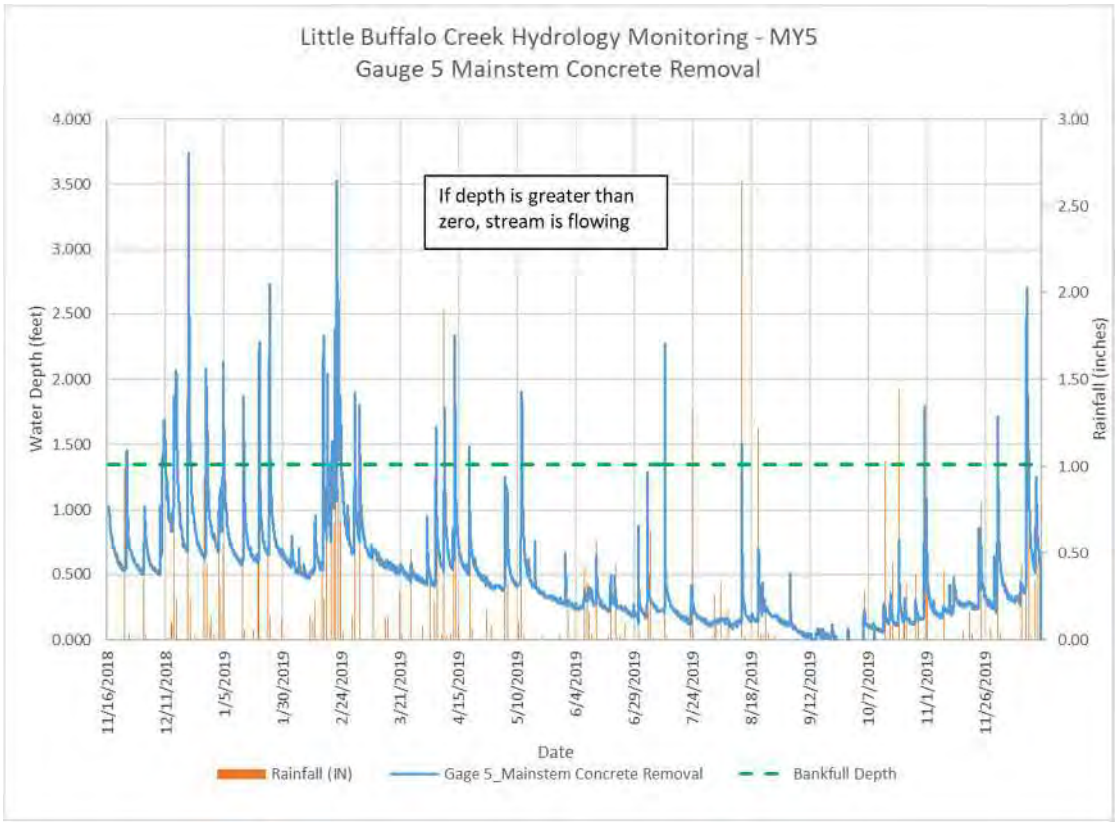
Figure 6a-g – Water Level and Rainfall Plots

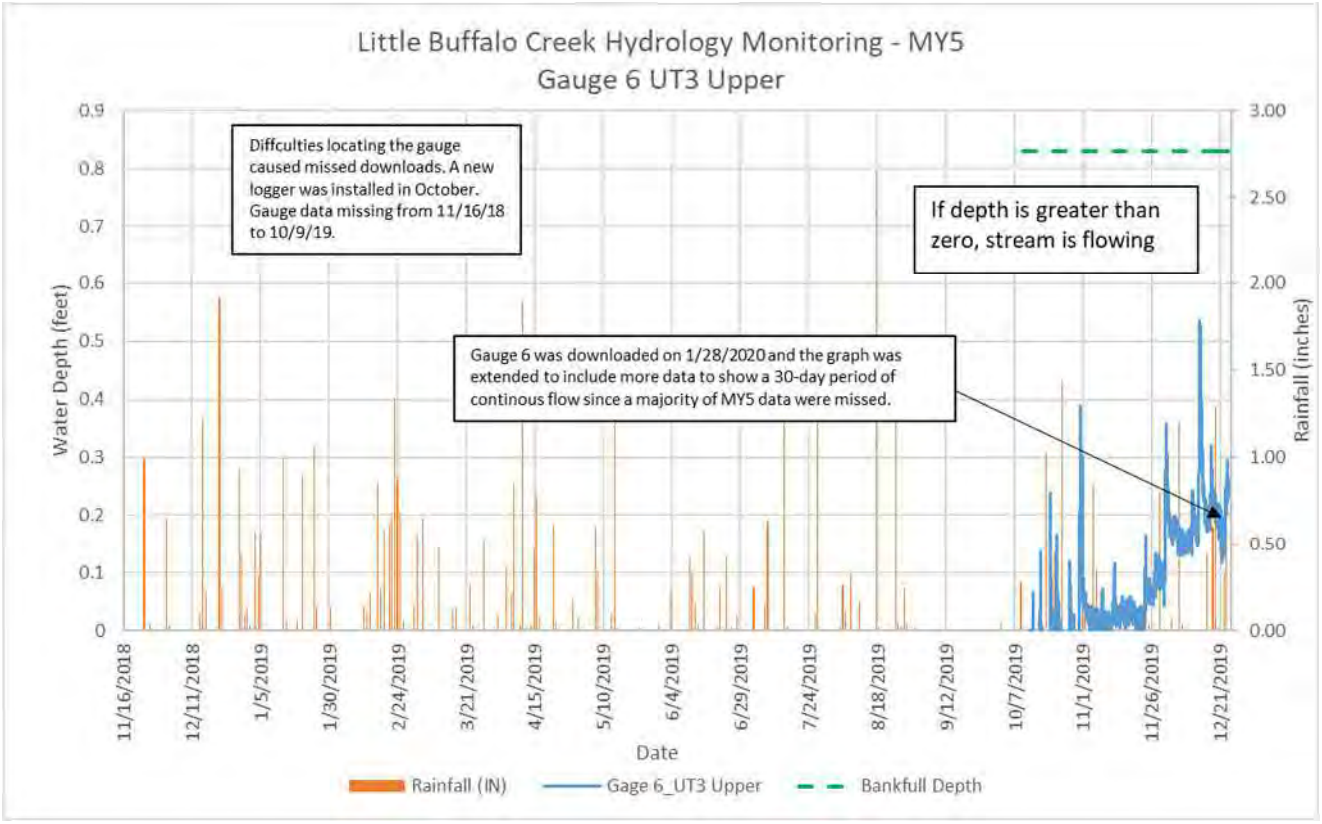

Little Buffalo Creek Hydrology Monitoring - MY5
Gauge 1 Mainstem Upstream Restoration Site
If depth is greater than zero, stream is flowing
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 1_Upper Mainstem Restoration
Bankfull Depth

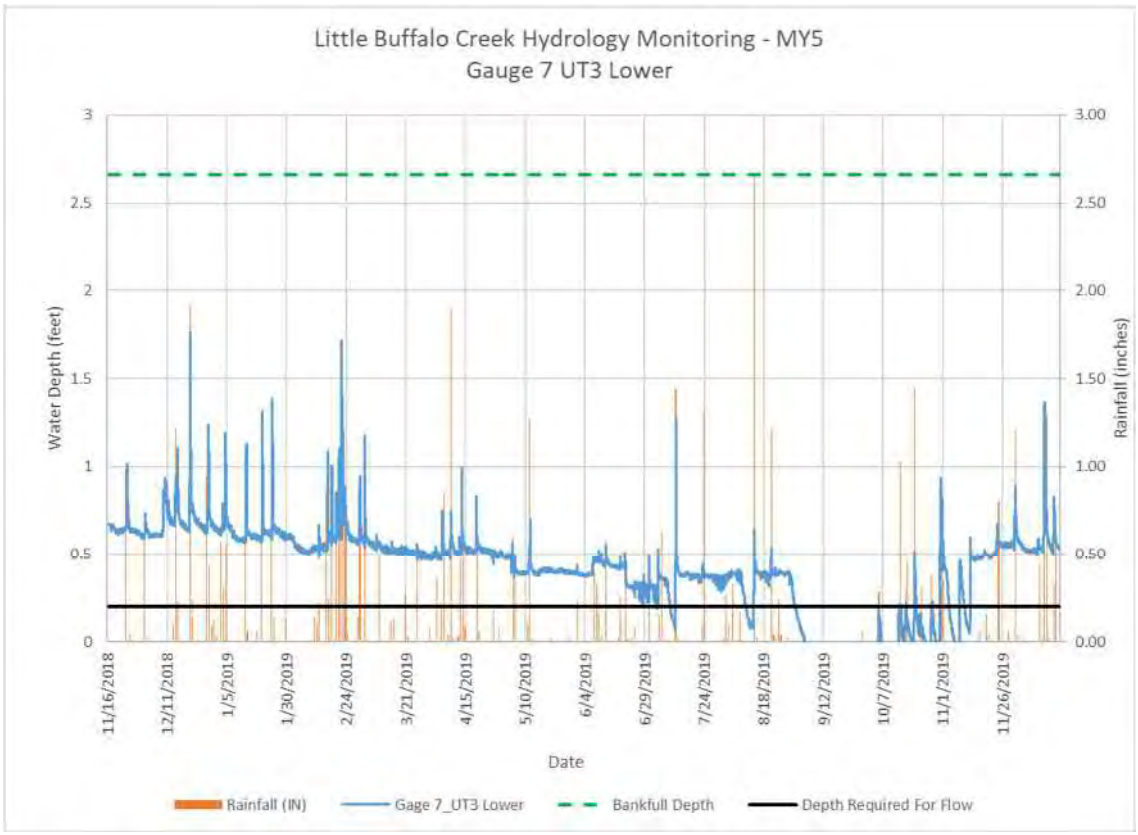

Little Buffalo Creek Hydrology Monitoring - MY5
Gauge 2 UT2 Upper
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 2_UT2 Upper
Bankfull Depth
Depth Required for Flow

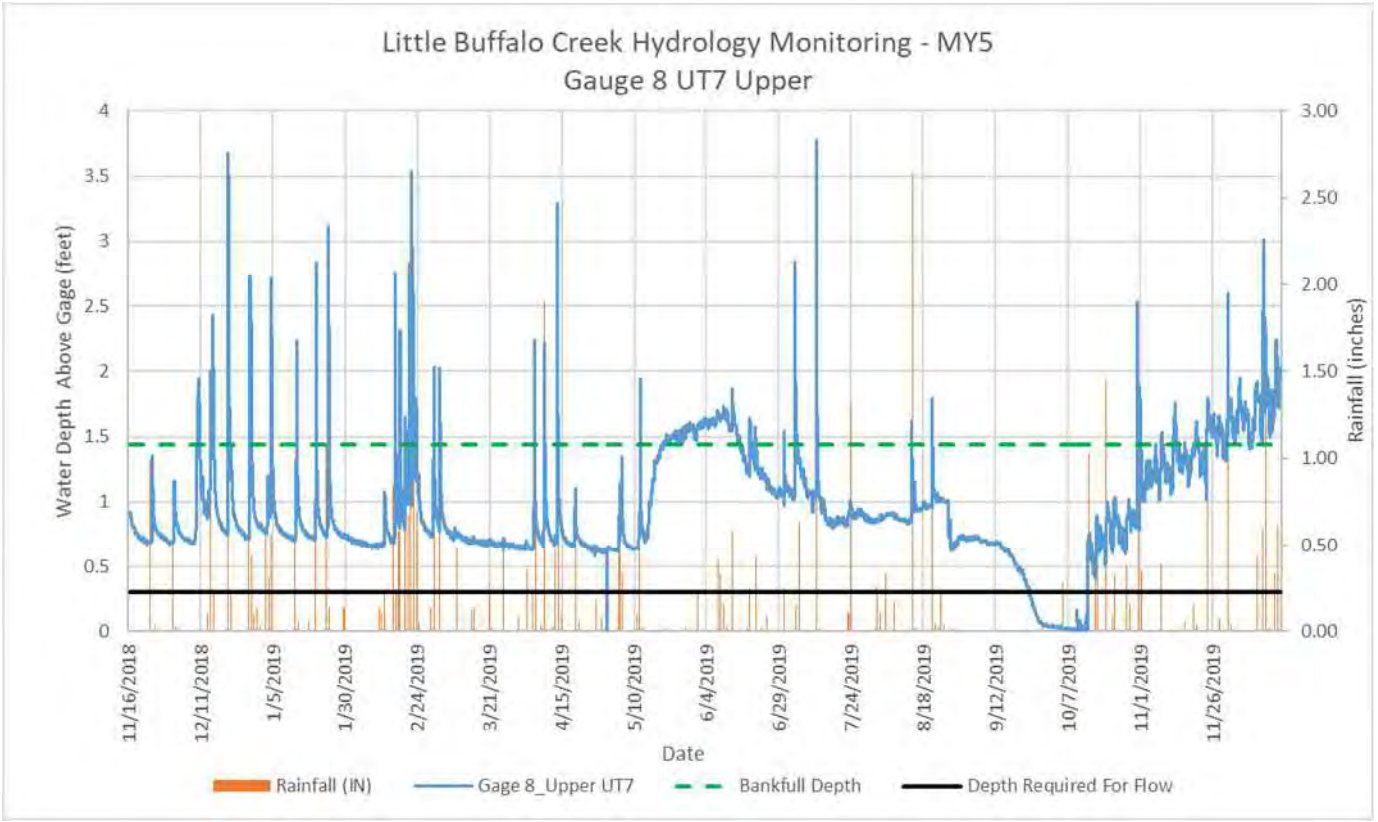

Little Buffalo Creek Hydrology Monitoring - MY5
Gauge 3 UT2 Lower
Gauge likely burried in sediment
Gauge ran out of memory in August because it was covered by vegetation and not found until winter. Data missing from 8/21/19 to 10/9/19.
New logger installed downstream from previous gauge location. New gauge data used from 10/9/2019 to 12/19/2019.
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 3_UT2 Lower
Bankfull Depth
Depth Required for Flow

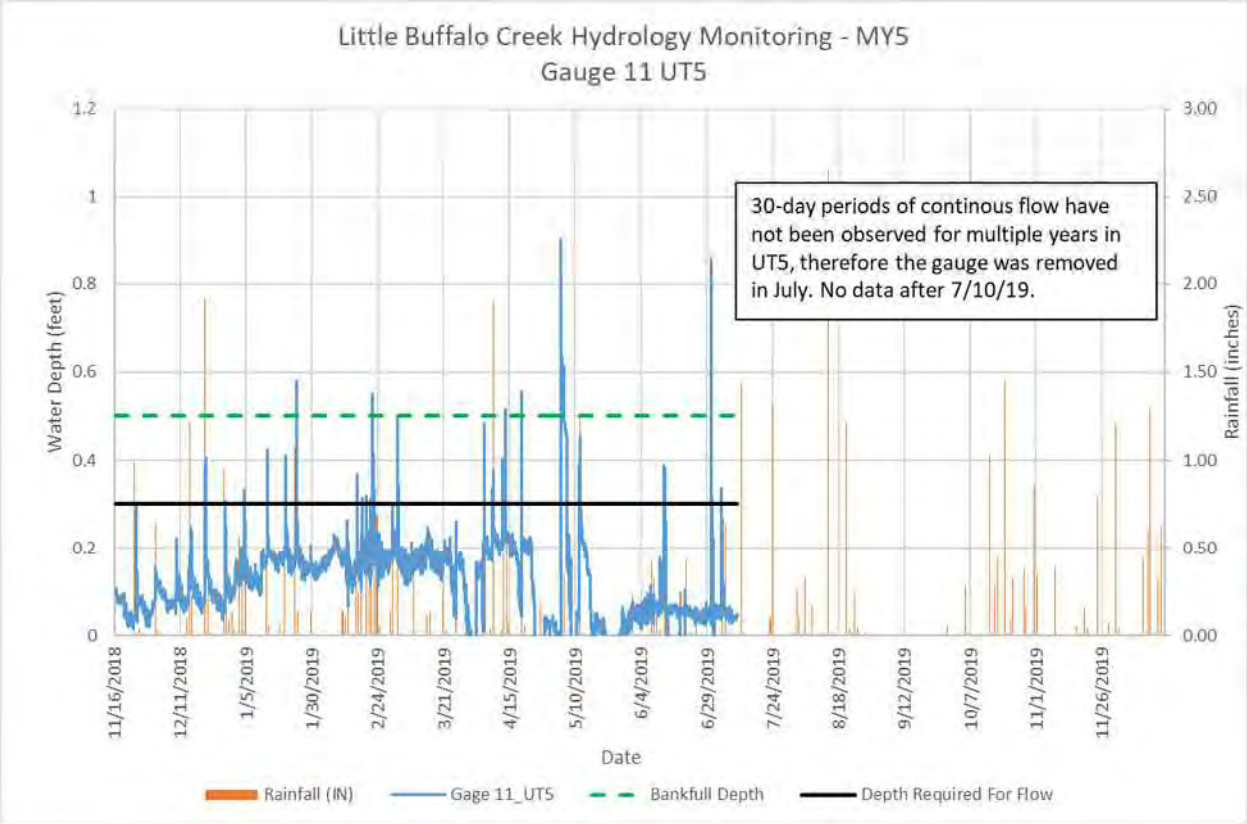

Little Buffalo Creek Hydrology Monitoring - MY5
Gauge 4 UT4
If depth is greater than zero, stream is flowing
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 4_UT4
Bankfull Depth

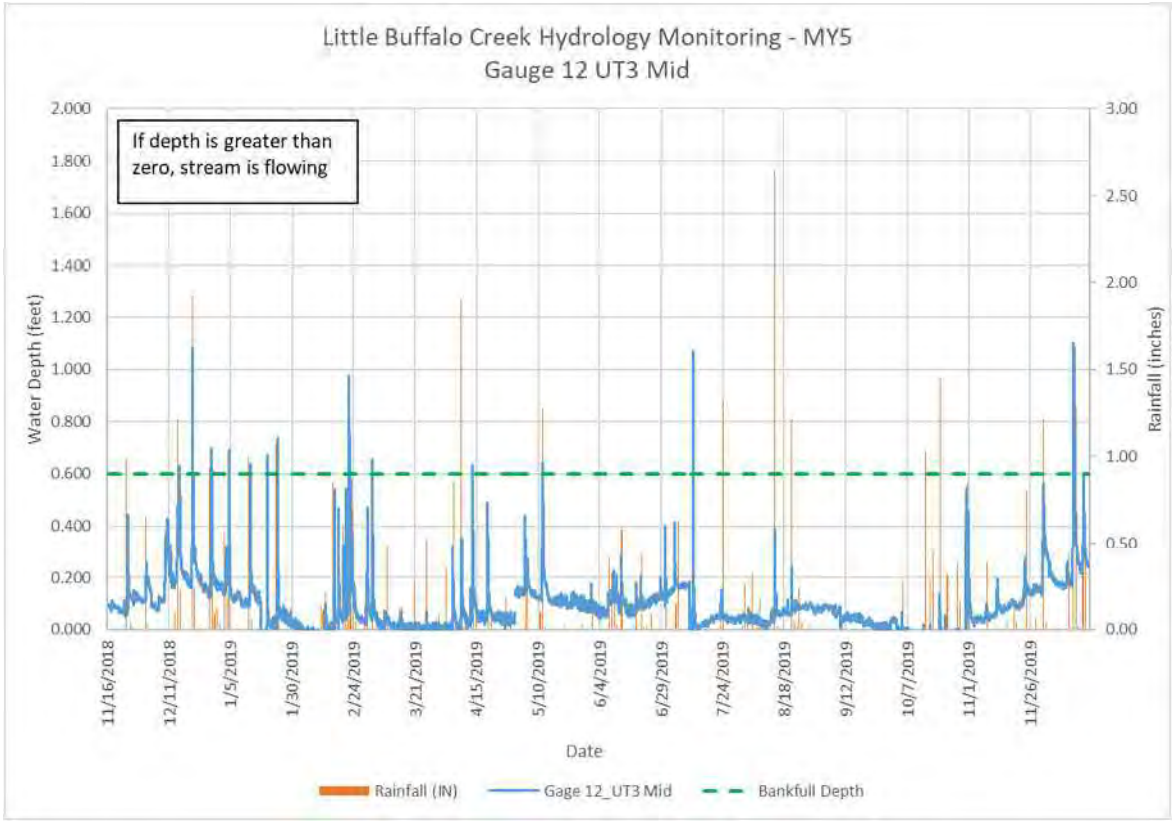

Little Buffalo Creek Hydrology Monitoring - MY5
Gauge 5 Mainstem Concrete Removal
If depth is greater than zero, stream is flowing
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 5_Mainstem Concrete Removal
Bankfull Depth

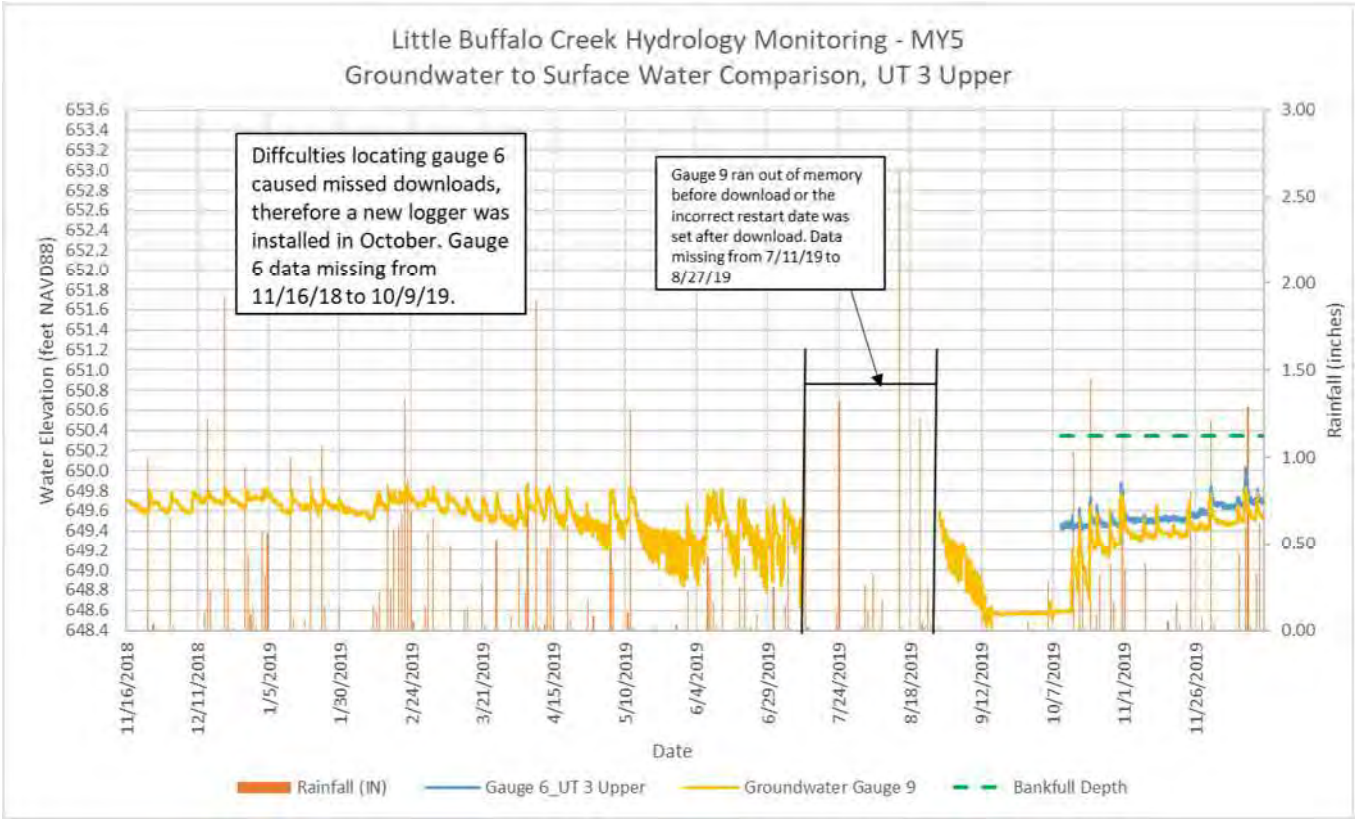

Little Buffalo Creek Hydrology Monitoring - MY5
Gauge 6 UT3 Upper
Diffculties locating the gauge caused missed downloads. A new logger was installed in October. Gauge data missing from 11/16/18 to 10/9/19.
If depth is greater than zero, stream is flowing
Gauge 6 was downloaded on 1/28/2020 and the graph was extended to include more data to show a 30-day period of continous flow since a majority of MY5 data were missed.
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 6_UT3 Upper
Bankfull Depth

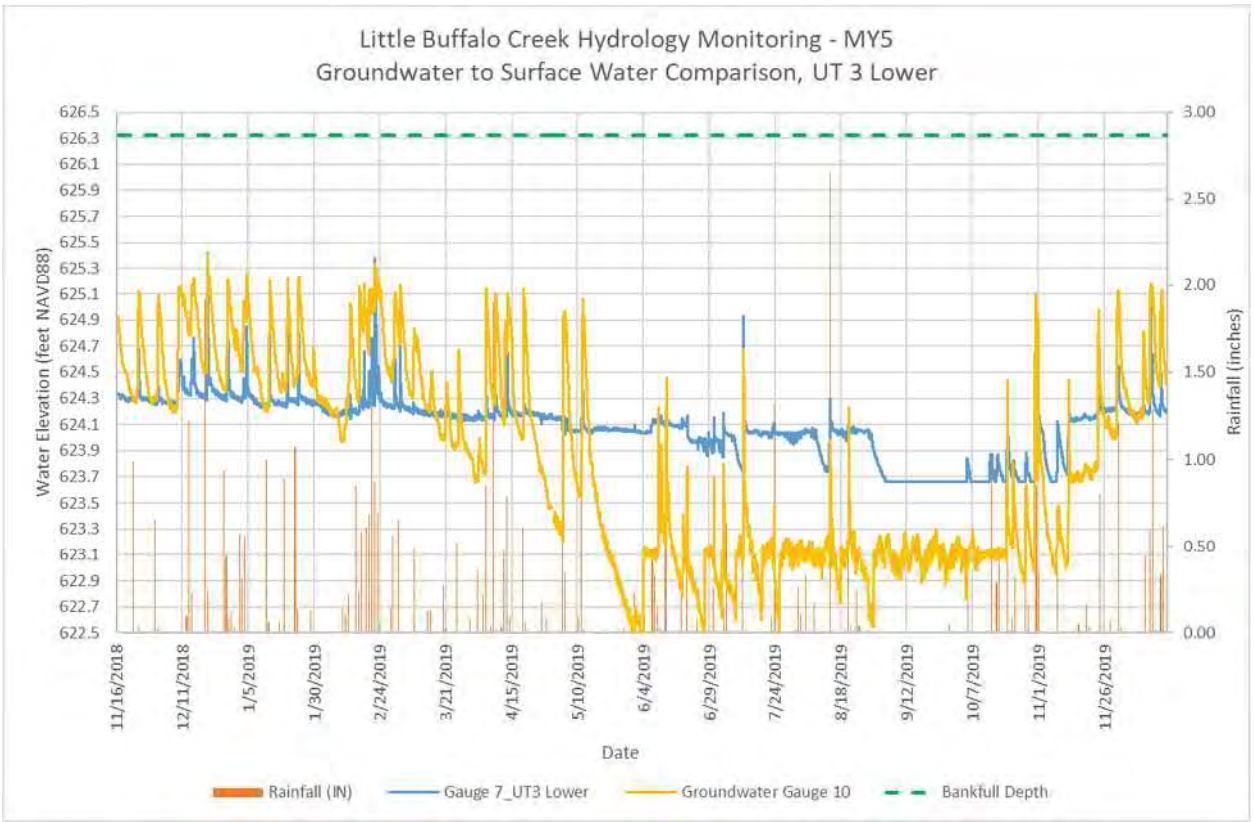

Little Buffalo Creek Hydrology Monitoring - MY5
Gauge 7 UT3 Lower
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 7_UT3 Lower
Bankfull Depth
Depth Required For Flow


Little Buffalo Creek Hydrology Monitoring - MY5
Gauge 8 UT7 Upper
Water Depth Above Gage (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 8_Upper UT7
Bankfull Depth
Depth Required For Flow


Little Buffalo Creek Hydrology Monitoring - MY5
Gauge 11 UT5
30-day periods of continous flow have not been observed for multiple years in UT5, therefore the gauge was removed in July. No data after 7/10/19.
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 11_UT5
Bankfull Depth
Depth Required For Flow


Little Buffalo Creek Hydrology Monitoring - MY5
Gauge 12 UT3 Mid
If depth is greater than zero, stream is flowing
Water Depth (feet)
Rainfall (inches)
Date
Rainfall (IN)
Gage 12_UT3 Mid
Bankfull Depth


Little Buffalo Creek Hydrology Monitoring - MY5
Groundwater to Surface Water Comparison, UT 3 Upper
Diffculties locating gauge 6 caused missed downloads, therefore a new logger was installed in October. Gauge 6 data missing from 11/16/18 to 10/9/19.
Gauge 9 ran out of memory before download or the incorrect restart date was set after download. Data missing from 7/11/19 to 8/27/19
Water Elevation (feet NAVD88)
Rainfall (inches)
Date
Rainfall (IN)
Gauge 6_UT 3 Upper
Groundwater Gauge 9
Bankfull Depth


Little Buffalo Creek Hydrology Monitoring - MY5
Groundwater to Surface Water Comparison, UT 3 Lower
Water Elevation (feet NAVD88)
Rainfall (inches)
Date
Rainfall (IN)
Gauge 7_UT3 Lower
Groundwater Gauge 10
Bankfull Depth

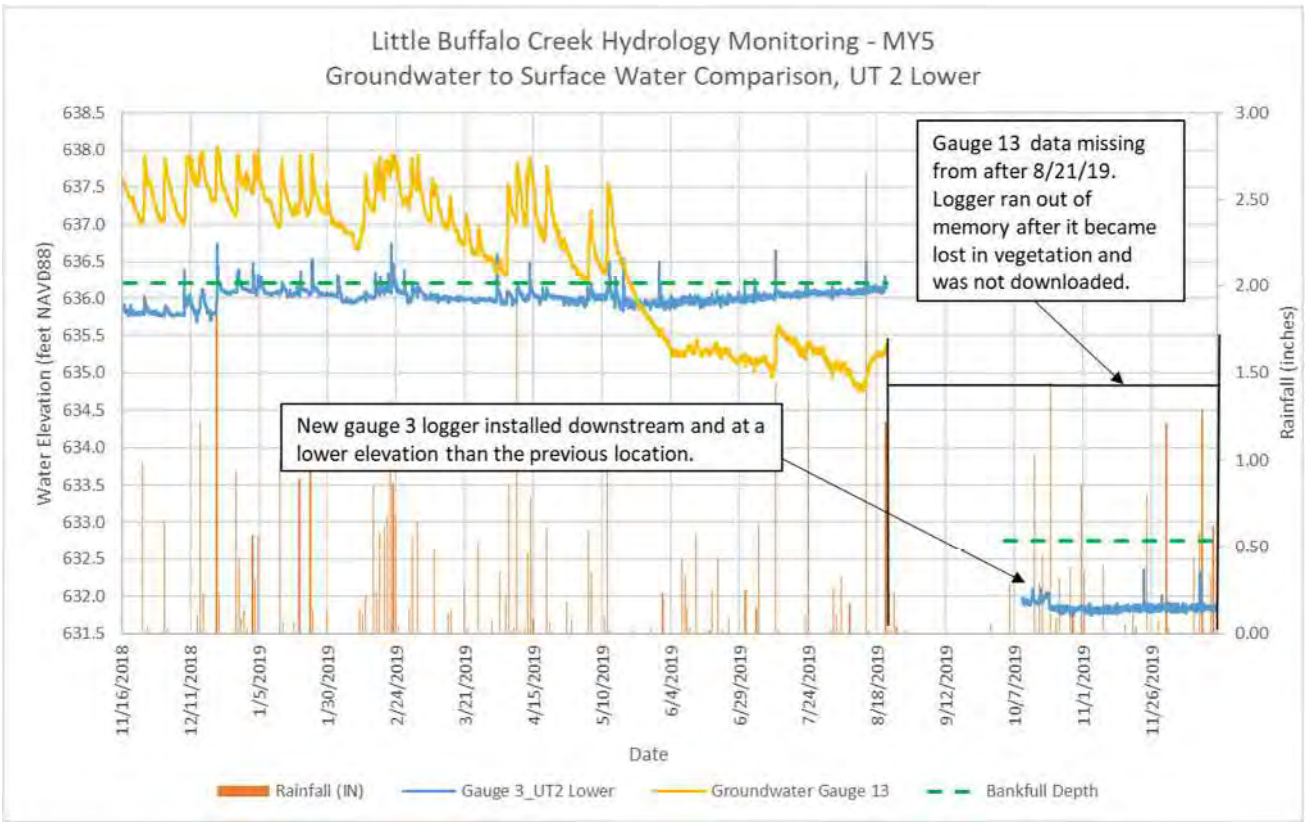

Little Buffalo Creek Hydrology Monitoring - MY5
Groundwater to Surface Water Comparison, UT 2 Lower
Water Elevation (feet NAVD88)
Rainfall (inches)
Date
Gauge 13 data missing from after 8/21/19. Logger ran out of memory after it became lost in vegetation and was not downloaded.
New gauge 3 logger installed downstream and at a lower elevation than the previous location.
Rainfall (IN)
Gauge 3_UT2 Lower
Groundwater Gauge 13
Bankfull Depth

Table 13 - Continuous Stream Flow Record							
Gauge	Tributary	30-Day Continuous Flow Met in Current Monitoring Period	MY 1 Period	MY 2 Period	MY 3 Period	MY 4 Period	MY 5 Period
1	LBC Reach 1	Y	12/18/14-5/25/15 (**159 days**)	2/27/16 - 7/14/16 (**139 days**)	9/22/16-9/26/17 (**370 days**)	3/12/18 - 6/25/18 (**106 days**)	11/16/18-9/18/19 (**307 days**)
2	UT 2 Upper	Y	12/18/14-9/1/15 (**258 days**)	-	7/19/17-9/26/17 (**70 days**)	1/23/18 - 4/12/18 (**80 days**)	9/5/19-11/29/19 (**86 days**)
3	UT 2 Lower	Y	12/18/14 - 8/2/15 (**228 days**)	2/26/16 - 7/14/16 (**140 days**)	1/1/17-2/1/17 (**32 days**)	9/18/18 - 11/16/18 (**60 days**)	11/16/18-12/20/18 (**35 days**)
4	UT 4	Y	3/21/15 - 9/3/15 (**167 days**)	2/26/16 - 7/13/16 (**139 days**)	9/19/16-9/26/17 (**373 days**)	9/27/17 - 7/1/18 (**278 days**)	11/16/18-12/19/19 (**399 days**)
5	LBC Reach 4	Y	12/18/14 - 3/13/15 (**86 days**)	2/26/16 - 6/12/16 (**108 days**)	11/17/16-7/27/17 (**253 days**)	11/7/17 - 6/17/18 (**223 days**)	11/16/18-9/13/19 (**302 days**)
6	UT 3 Upper	Y	12/18/14 - 6/22/15 (**187 days**)	-	5/30/17-8/26/17 (**89 days**)	8/18/18 - 11/16/18 (**91 days**)	11/22/19-12/23/19+* (**32 days**)
7	UT 3 Lower	Y	12/18/14 - 3/14/15 (**87 days**)	2/26/16 - 7/2/16 (**128 days**)	12/30/16-8/18/17 (**232 days**)	1/24/18 - 7/1/18 (**159 days**)	11/16/18-6/24/19 (**221 days**)
8	UT 7	Y	12/18/14 - 5/20/15 (**154 days**)	2/28/16 - 7/13/16 (**137 days**)	10/7/16-7/30/17 (**297 days**)	11/15/17 - 7/1/18 (**229 days**)	11/16/18-10/1/19 (**320 days**)
11	UT 5	N	NA	NA	NA	-	-
12	UT 3 Mid	Y	NA	NA	NA	9/18/18 - 11/16/18 (**60 days**)	4/8/19-7/10/19 (**94 days**)

Note: Period listed for observed continuous flow is for the longest period of observed continuous flow based on hydrologic gauges at the project site. Additional periods of 30-day continuous flow are observed at individual gauges besides what is shown in the table.

Note: loggers ran out of memory in MY2 (7/14/16) after changing the frequency recording to a shorter interval than being downloaded.

Note: Barometric pressure gauge was lost/damage in MY2 and replaced. Regional airport barometric pressure was used for compensation from 9/20/15 - 2/26/16 and is likely to cause periods showing no flow when flow occurred.

Note: Gauge 3 data missing from 8/21/19 - 10/9/19 because the logger ran out of memory after not being found until winter 2019. A new logger was installed approximately 75 feet downstream from previous gauge location in October. The new gauge data were used from 10/09/2019 - 12/19/2019. Gauge 3 likely had longer/more flow events but reads were affected by sediment. The most conservative estimate is presented in the table.

Note: Gauge 11 was removed on 7/10/19 after multiple years without recording a 30-day period of continuous flow.

*For gauge 6, data from 11/16/18 - 10/9/19 are missing because the gauge was lost. Since there were no data for a majority of MY5, the dates were extended to include more data to show a 30-day period of continuous flow. The continuous flow period extends past 12/23/19. Regional airport barometric pressure was used to adjust water levels for 12/20/19 – 12/23/19.

Appendix F – Supplemental Information

IRT Site Visit Minutes

Little Buffalo Creek – Old Mine Road, Gold Hill, Cabarrus County
June 19, 2018 – IRT Site Visit Meeting Summary

Attendees: Paul Wiesner & Kelly Phillips, DMS; Mac Haupt, NCDEQ/DWR; Kim Browning, USACE
Louis Berger: Robin Maycock (Project Manager); Matt Holthaus (Engineer); Douglas Parker (Botanist); Alston Willard (Field Tech/Intern)

Purpose: To provide IRT an opportunity to visit the site and make comments prior to closeout.

Coverage: The main channel from Reach 1, just north of vegetation plot 11, to the cattle crossing in Reach 5, as well as the lower portions of UT-2, UT-3, UT-4, UT-5, and UT-6.

Reach 1
The group walked in the pasture, north along the east fence line of Reach 1.

The small tributary, outside of the easement area

- The IRT recommended an additional 20 feet of fencing in this area to create a filter/buffer for the tributary to protect water quality in Little Buffalo Creek. Any increased filtering capacity is better than the existing conditions.
- Source of maggots is assumed to be a dead cow. It was pointed out that Marcus (tenant) owns several stock yards and tends to buy poorer cows with the thought of improving them.
- Consider speaking with Marcus about keeping such cows elsewhere and/or to Phil Cline about potentially adding fenced area. (DMS Note: We can't add conservation easement to the project at this point for numerous reasons. Any additional BMP type measures would be acceptable.)

Invasive species

- Upon crossing the fence, an area where mature Tree of Heavens were removed, to prevent seeding of the disturbed area to the north, was pointed out. Kelly stated that this had been a good idea.
- Invasive species maintenance is ongoing with another treatment occurring in the fall.

The bare area around Vegetation Plot 11 was examined.

- The small area where soil sampling results showed copper toxicity was pointed out and the anecdotal history of copper mining in the area was mentioned.
- The lack of trees in a narrow band encompassing vegetation plot 11 was examined. The soil sample report was shared, showing low nutrient soil, as well as that the area being shallow to rock, and wet.
    - It was noted that on the stream side of this area, there were healthy willow saplings, and on the upland side, healthy loblolly pines.
    - Robin suggested spreading the beaver dam soil and debris on the bare areas and the IRT agreed that it would be a good area to add depth and organic matter by adding the beaver dam debris and accumulated sediment.
    - Paul recommended random transects (100 meters square) to be more representative of the vegetation in the area.

The beaver dam area was examined.

- The IRT asked how long the dam had been there (since approximately November) and when it was removed. Robin stated that the beaver were trapped and the dam was breached in March).
- As beaver dam had been breached prior to the growing season, the trees survived, with the exception of small area behind the dam.

- The IRT team asked why Berger was waiting until the fall to reshape the dam area and Robin replied that they would prefer that it coincided with replanting and surveying trips.

General rule of thumb for performance tolerances at closeout were discussed:

- 5% of entire restoration length for streams.
- 10% of entire restoration area for vegetation (DMS Note: Site specific factors such as the area of copper toxicity are considered on a case-by-case basis.)

Buffer width:

- IRT stated that the buffer width appeared to be narrow just north of the bend.
- They explained that buffer width should be 50 feet or greater and too much length without that buffer width would be a concern.
- Thus, prior to closeout, Berger should measure and verify buffer widths.

Reach 2

The group then turned south, following the main branch. A turkey on her nest was encountered near vegetation plot 10. The group crossed under the bridge into Reach 2. The group primarily walked down the channel.

UT-2 was thoroughly examined:

- Flowing water was observed in the channel.
- The area was impacted by cattle following construction and has a shallow slope and as such, water is backing up, forming a linear wetland type system.
- The area was pointed out to be in a landscape position that is known to have seeps and UT-2 is fed by a pond.
- The consensus of the group was that as the trees matured they would transpire the accumulated water and help the stream maintain a channel.
- IRT recommended getting good photos year round to show the channel structure during each season.
- IRT requested that Gauge 3 not be replaced where it originally was but moved to the mid-point of the stream length of UT-2 where the channel is clearly evident.
- Installation of the gauge at an increased depth sufficient to record water levels beneath the channel was also requested. Correlation of the gauge water level reading to continuous channel flow is required for this type of installation. An accompanying groundwater monitoring well was also requested.
- DMS suggested random vegetation transects for this area.
- IRT noted that the tree density was sufficient but was concerned that their vigor (i.e., size) was not where it should be.
- IRT recommended additional plantings in this area with larger (5-gallon) trees of at least 4 different species.
- IRT stated that they would be looking for a defined channel with a history of flow and a lack of these two features would be an issue.
- Matt stated that if the gauge was in a pool, it was correlated to elevation to show continuous flow.
- DMS suggests continued monitoring and documentation of the “linear wetland areas”. Measured lengths should be discussed and documented in MY4 and MY5 reports. Detailed observations of any channel adjustments within these areas should be made and presented in the reports.

Reach 3

A small area of undercutting on the main branch was examined:

- The area appears to be stabilizing with tree growth, with no mass wasting, nice substrate, and connected to the floodplain.
- IRT stated the area looks good.

UT-4 was examined near Gauge 5

- IRT stated the area looks good.

Reach 4

The left bank riparian corridor was examined (where the cattle had gotten in and grazed):

- IRT expressed concern about the size of the tree saplings.
- IRT recommend replanting with more mature trees (5-gallon) of at least 4 different species.
- At closeout, IRT is looking for trees to be at or near 10 feet tall.
- IRT believes if the area is left alone (not replanted) this area could be a concern at closeout.

Enhancement level 1 area on main channel (concrete removal area):

- A small area with scour was examined.
- IRT stated it was not significant and had no issues with this area.

The lower portions of UT-3 (ash grove):

- It was pointed out that Berger did additional work in this area that was beyond the initial scope.
- Berger asked about incorporating the extra section of work that had been done into the credits (this would require a mitigation plan modification).
    - IRT highly recommended against trying to modify the existing mitigation plan to incorporate the extra section of work Berger completed as it could potentially open the project to additional monitoring.
    - IRT suggested that Berger note that extra repairs were made in the final report and to also mention it at close out.

UT-3 was thoroughly examined:

- The tributary was found to be flowing.
- Bare banks along UT-3 were pointed out as well as the fact that the willow live stakes had leafed out this year (had not the prior year).
- IRT recommended deploying a gauge at the mid-point of the stream length.
- IRT was concerned with the size of the tree saplings in this area and recommended planting with more mature trees (5-gallon) of at least 4 different species.
- IRT recommended getting good photos year around to show the channel structure during each season.

Reach 5

UT-5 was thoroughly examined:

- The tributary was found to have no flow but contained some wet areas.
- Gauge was moved to mid-point of the stream length
- Kim stated that she considered UT-5 to be a grass water-way.
- Mac stated it was likely not a stream.
- The soil was examined and found to vary between hydric and non-hydric.

- UT-5 was considered by the IRT to potentially not be a stream and is considered a clear credit risk.

UT-6 was examined:

- The tributary was found to have flow and has historically had flow.
- IRT no comments.
- IRT no need for a gauge.

Cattle Crossing

- IRT – cattle crossing looks good and the re-enforcement looks sufficient. There was no evidence of recent cattle access within the conservation easement.
- Asked about a hot wire for when cattle cross (had one, but the solar pack was removed by the landowners).
- Asked about why the gates weren't kept closed continuously (maintain cattle access to water).
- Asked about alternative water (had gotten a cost proposal for a well but was too expensive, researching other alternatives).
- IRT stated that they were not familiar with the blue pickle barrels but were good with whatever we wanted to try.
    - Verified that the blue barrels would be in addition to the existing fencing.
    - IRT recommended waiting to see how the new re-enforcement was working before installing the blue pickle barrels.
- IRT stated the biggest concern with the cattle crossing was continued maintenance by the landowners.
- The easement modification was brought up (at state property office for review) and the IRT expressed no concerns and made no comments regarding the easement modification.

Miscellaneous

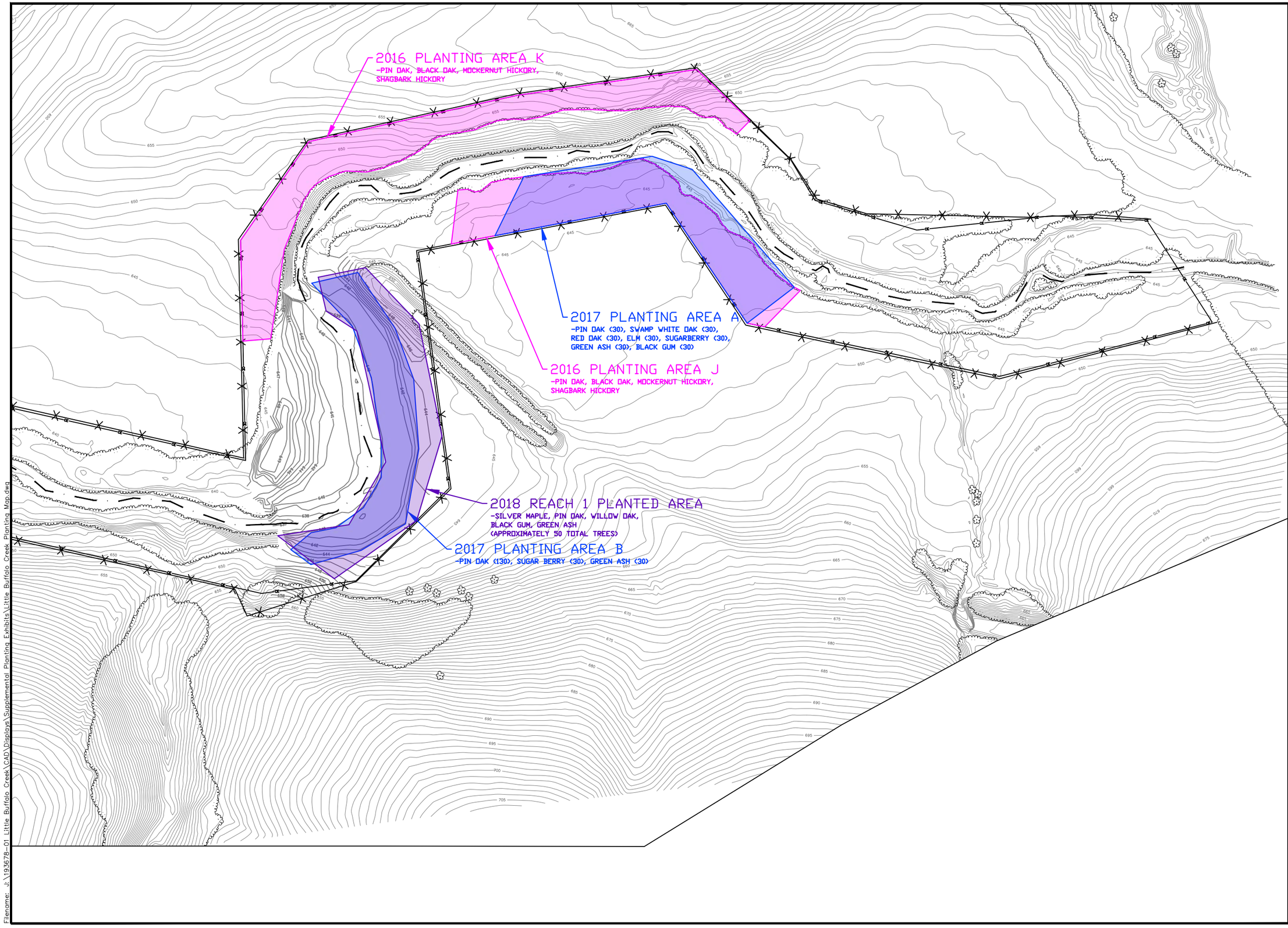
- Paul would proceed with getting Berger paid for MY3.
- IRT requested that MY4 and MY5 reports include discussion on initial planted acreage versus replanted acreage (as percentages).
- IRT recommended providing before and after photos of the site in MY5 report for their closeout review to understand the uplift that has occurred.
- IRT was complimentary of Berger's efforts to keep the cows out and appreciated that Berger staff visited the site frequently enough to be familiar with it and its issues.
- The possibility of an additional year's monitoring was brought up
    - IRT stated this was a possibility due to low vigor on the tree sapling growth
    - If an additional year of monitoring was requested, it could be tailored to just vegetation
    - Paul stated that the IRT, in the past, has been very reasonable in requesting additional monitoring years

Action Items:

1. Color code stream centerlines on CCPV maps for MY4 and MY5 reports to distinguish levels of restoration effort.
2. Remove beaver dam and spread debris on the copper area and the bare area around vegetation plot 11.
3. Deploy new gauge mid-point of stream length UT-2. Installation of the gauge at an increased depth sufficient to record water levels beneath the channel.
4. Install groundwater well on UT-2 in conjunction with new gauge.
5. Replant around UT-2 with more mature trees of at least 4 different species.

6. Measure linear stream length that may be considered a linear wetland at closeout for more accurate number in the winter. (DMS Note: This should be measured in both MY4 & MY5 to track any changes. Measurements will be much easier in the dormant season).
7. Replant the left bank riparian corridor of Reach 4 (cattle grazed area) with more mature trees of at least 4 different species.
8. Deploy new gauge mid- point of stream length UT-3.
9. Replant around UT-3 with more mature trees of at least 4 different species.
10. Conduct more vegetation transects around Vegetation Plot #11, UT-2, Reach 4, and UT-3.
11. Take lots of photographs of the tributary's in flow, at different times of the year, to show the channels.
12. Include this meeting summary in the Appendix of MY4's report.

Supplemental Planting Location Exhibits



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LITTLE BUFFALO CREEK
STREAM RESTORATION PROJECT
CABARRUS COUNTY
DIVISION OF MITIGATION SERVICES

DATE MARCH 2020
PROJECT NO. 94147
FIGURE 1 OF 9

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2017 PLANTING AREA E
-PIN OAK (30), SWAMP WHITE OAK (30), RED OAK (30), ELM (30), SUGARBERRY (30), GREEN ASH (30), BLACK GUM (30)

2016 PLANTING AREA H
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY, SHAGBARK HICKORY

2018 UT2 PLANTED AREA
-BOX ELDER, PIGNUT HICKORY, SHAGBARK HICKORY, MOCKERNUT HICKORY, HACKBERRY, TULIP POPULAR, WHITE OAK, WILLOW OAK (APPROXIMATELY 70 TOTAL TREES)

2017 PLANTING AREA D
-PIN OAK (60), SWAMP WHITE OAK (60), RED OAK, SUGARBERRY (60), ELM, BLACK GUM (60)

2016 PLANTING AREA I
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY, SHAGBARK HICKORY

2017 PLANTING AREA F
-PIN OAK, RED OAK, SWAMP WHITE OAK (30), SUGARBERRY (30), ELM (30), BLACK GUM (30)

2017 PLANTING AREA C
-PIN OAK (30), BLACK GUM (30), GREEN ASH (30), ELM (30)

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2017 PLANTING AREA E
-PIN OAK (30), SWAMP WHITE OAK (30), RED OAK (30), ELM (30), SUGARBERRY (30), GREEN ASH (30), BLACK GUM (30)

2016 PLANTING AREA H
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY, SHAGBARK HICKORY

2018 UT2 PLANTED AREA
-BOX ELDER, PIGNUT HICKORY, SHAGBARK HICKORY, MOCKERNUT HICKORY, HACKBERRY, TULIP POPULAR, WHITE OAK, WILLOW OAK (APPROXIMATELY 70 TOTAL TREES)

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2016 PLANTING AREA E
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY, SHAGBARK HICKORY

2017 PLANTING AREA G
-PIN OAK (30), SWAMP WHITE OAK (30), RED OAK (30), ELM, SUGARBERRY (30), GREEN ASH (30), BLACK GUM (30)

2016 PLANTING AREA F
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY, SHAGBARK HICKORY

2017 PLANTING AREA F
-PIN OAK (?), RED OAK (?), SWAMP WHITE OAK (30), SUGARBERRY (30), ELM (30), BLACK GUM (30)

2016 PLANTING AREA G
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY, SHAGBARK HICKORY

2017 PLANTING AREA H
-PIN OAK (30), SWAMP WHITE OAK (30), RED OAK (30), ELM (30), SUGARBERRY (30), GREEN ASH (30), BLACK GUM (30)

2018 REACH 4 PLANTED AREA
-SILVER MAPLE, PIN OAK, WILLOW OAK, BLACK GUM, GREEN ASH (APPROXIMATELY 50 TOTAL TREES)

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FIGURE 4 OF 9

2016 PLANTING AREA D
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY,
SHAGBARK HICKORY

2017 TRIB 3 PLANTING AREA
-SWAMP WHITE OAK (340), RED OAK (340),
BLACK GUM (110), PIN OAK (110),
BLACK WILLOW (475), GREEN ALDER (475)

2018 TRIB 3 PLANTED AREA
-BOX ELDER, PIGNUT HICKORY, SHAGBARK HICKORY,
MOCKERNUT HICKORY, HACKBERRY, TULIP POPULAR,
WHITE OAK, WILLOW OAK
(APPROXIMATELY 120 TOTAL TREES)

2017 PLANTING AREA I
-PIN OAK (20), SWAMP WHITE OAK (20),
RED OAK (20), ELM (20), SUGARBERRY (20),
GREEN ASH (20), BLACK GUM (20)

2016 PLANTING AREA C
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY,
SHAGBARK HICKORY

2017 PLANTING AREA H
-PIN OAK (30), SWAMP WHITE OAK (30),
RED OAK (30), ELM (30), SUGARBERRY (30),
GREEN ASH (30), BLACK GUM (30)

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FIGURE 5 OF 9

2018 TRIB 3 PLANTED AREA
-BOX ELDER, PIGNUT HICKORY, SHAGBARK HICKORY, MOCKERNUT HICKORY, HACKBERRY, TULIP POPULAR, WHITE OAK, WILLOW OAK (APPROXIMATELY 120 TOTAL TREES)

2016 PLANTING AREA D
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY, SHAGBARK HICKORY

2017 TRIB 3 PLANTING AREA
-SWAMP WHITE OAK (340), RED OAK (340), BLACK GUM (110), PIN OAK (110), BLACK WILLOW (475), GREEN ALDER (475)

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FIGURE 6 OF 9

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2016 PLANTING AREA A
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY, SHAGBARK HICKORY

PLANTING AREA B
-PIN OAK, BLACK OAK, MOCKERNUT HICKORY, SHAGBARK HICKORY

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