

As-built Baseline Monitoring Report

FINAL

Meadow Brook Stream Mitigation Project

Yadkin County, North Carolina

Monitoring Year 0

Data Collection Period:

May 2019 – January 2020

Submission Date:

March 2020



NCDEQ Contract No. 7184

DMS ID No. 100024

USACE Action ID No. SAW-2017-01509

Prepared For:



NC Department of Environmental Quality
Division of Mitigation Services
217 West Jones Street; 3rd Floor
Raleigh, NC 27603

Prepared By:



Ecosystem Planning and Restoration
1150 SE Maynard Road, Suite 140
Cary, NC 27511



Mr. Harry Tsomides
NCDEQ – Division of Mitigation Services
5 Ravencroft Dr., Suite 102
Asheville, NC 28801

March 16, 2020

RE: Response to Task 6 Draft As-Built Baseline Monitoring Report Comments dated February 28, 2020
Meadow Brook Stream Restoration
Yadkin County, North Carolina
NCDMS Project # 100024, Contract # 7184

Dear Mr. Tsomides,

Ecosystem Planning and Restoration (EPR) has reviewed the comments on the Meadow Brook As-Built Baseline Monitoring Report provided February 28, 2020. The comments have been addressed as described below and the Final Baseline Report and electronic deliverables have been revised in response to this review.

- *Table 1 (Assets) – Please include significant digits in all numbers per the current guidance (attached).*
 - **The significant digits in Table 1 have been revised based on the current guidance.**
- *Table 1 footnote – Please indicate that wetlands are not currently part of the project assets.*
 - **A footnote has been added indicating that wetlands are not part of the project assets.**
- *Please capture additional buffer credits in Table 1 per the attached guidance.*
 - **Table 1 has been revised to provide details on the additional buffer credits provided by the project.**
- *DMS have approved the draft GIS digitals submittal. All GIS features match with the as-built condition.*
 - **Noted.**
- *Please provide the Turner Surveying as-built survey .pdf and .dwg files with the final electronic submittal. This as-built survey should bear a Professional Land Surveyor (PLS) seal.*
 - **The as-built survey .dwg has been included in the final electronic submittal. EPR did not receive a sealed .pdf version of the as-built survey but EPR's record drawings, which are included in the 5. As-Built Plans folder, were sealed by David Turner with Turner Land Surveying PLLC.**



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- *Please provide the final EPR design plan .pdf and .dwg files with the final electronic submittal. The design plan should bear a Professional Engineer's seal.*
 - **The final sealed EPR design plans and final design .dwg files have been included in the final electronic submittal in the 4. Geomorph > Design Support Data folder.**

- *Please include all required project permits and the FEMA Floodplain Compliance permit (if applicable) and any supporting documentation in the final electronic submittal. This should be included in a separate "Project Permits" folder.*
 - **All required project permit approvals have been copied to the 6. Project Permits folder in the final electronic submittal.**

If you have any questions regarding the As-Built Baseline Report, please contact me at 919-388-0787 or via email at ktweedy@eprusa.net.

Sincerely, Kevin Tweedy, PE

A handwritten signature in black ink, appearing to read 'Kevin Tweedy'. The signature is fluid and cursive, with a large initial 'K' and 'T'.

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Meadow Brook Stream Mitigation Project

Baseline Monitoring Document and As-Built Report-Final

Yadkin County, North Carolina

DMS Project ID #100024

1.0 PROJECT SUMMARY

Ecosystem Planning and Restoration, PLLC (EPR) implemented the Meadow Brook Stream Mitigation Project (Project; Site) for the North Carolina Division of Mitigation Services (DMS) to provide 3,409 stream mitigation units (SMUs) in the Yadkin River Basin, Hydrologic Unit Code (HUC) 03040101. The Project restored and enhanced 3,437 linear feet (LF) of two perennial unnamed tributaries (UT) to South Deep Creek. The mainstem is referred herein as “Meadow Brook” (MB) and the smaller tributary is referred to as “UT to Meadow Brook” or “UT.” While no wetland credits are sought for the Site, the stream channels were reconnected to existing floodplain wetlands to restore a functioning stream-wetland complex within the 11.2-acre conservation easement. Mitigation assets are listed in Table 1 of Appendix A.

The Site is located in NC Division of Water Resources (NCDWR) sub-basin 03-07-02 and DMS targeted local watershed 03040101130020. The Site was historically utilized for agricultural and cattle practices. As such, wetlands and streams in the project area were adversely impacted by direct cattle access, farming activities, and stream channelization. The Site is situated on historic pastureland in a WS-III watershed that is 57% agricultural land, 33% forest, 6% developed open space, and 3% herbaceous land. Prior to construction activities, both project streams were incised, straightened, and suffered from significant cattle damage. The adjacent wetlands were similarly trampled, heavily grazed, routinely mowed, and drained by multiple ditches and the channelization of the project streams. Pre-construction, or pre-existing, site conditions are provided in Table 4 of Appendix A and the Baseline Stream Data Summary Tables in Appendix D. Photos and a more detailed description of Site conditions before restoration are available in the Mitigation Plan (Final version submitted September 2018).

1.1 Goals and Objectives

The Project goals were established based on an assessment of site conditions and restoration potential with careful consideration of the stressors identified in the Upper Yadkin Pee-Dee River Basin Restoration Priorities (RBRP) report (NCEEP, 2009) and Yadkin Pee-Dee Basinwide Water Quality Plan (NCDWQ, 2008). As such, the established project goals include:

- 1) Reduce sediment inputs and stream turbidity;
- 2) Reduce nutrient inputs;
- 3) Reduce fecal coliform inputs;
- 4) Restore/enhance degraded riparian buffers;
- 5) Protect high resource value waters (including water supply classifications);
- 6) Implement agricultural best management practices (BMPs) in Agricultural watersheds.

Site construction was completed in June 2019 and the as-built survey was completed in August 2019. Planting and baseline vegetation data collection occurred in January 2020. A detailed timeline of the Project activity and reporting history are provided in Table 2 of Appendix A. During construction, multiple grade control structures were added as a response to minor



downcutting that occurred during flood events. Other than adding grade control, minimal adjustments were made to the project design during construction. All changes from the design are detailed below in Section 1.3.1. Baseline (MY0) profiles and cross-section dimensions closely match the design parameters with little variation. The Site was built as designed and is expected to meet the upcoming monitoring year's success criteria.

The proposed streams were broken into five reaches for design purposes. Meadow Brook consists of four reaches while the UT is one reach. The design criteria were based on surveys of multiple reference reaches, published reference reach data, and on design criteria and monitoring data from past successful restoration projects performed throughout the Piedmont region of North Carolina. Restoration practices involved raising the streambeds of the project streams and restoring them back to their historic locations along the fall of the valley, thereby restoring historic flow dynamics and a healthy headwater stream-wetland complex. Buffers in excess of 50 feet were established along most reaches.

Functional uplift will come from restoring natural riparian vegetation, excluding livestock from all project streams, and restoring the project streams to a stable condition, connected to their adjacent floodplain wetlands. The Project has restored the plan form and bed form diversity to conditions similar to reference channels (Appendix D, Table 8). Functional uplift was achieved by incorporating woody structures throughout the reach and by planting a forested buffer that will serve as a source of large woody debris in the future. Additionally, lateral stability was improved in the short term by removing the cattle and reducing shear stresses in the channel. As the riparian buffer continues to establish, lateral stability should improve further and increase the resiliency of the restored channels.

1.2 Mitigation Components

The current condition plan view (CCPV) in Appendix B (Figure 2) shows the mitigation assets along with the location of monitoring features. Post-construction conditions (Appendix A, Table 1) at the Site generated 3,409 SMUs as a result of the following:

- 2,593 linear feet of Priority 1 stream restoration
- 626 linear feet of Priority 2 stream restoration
- 218 linear feet of Enhancement I
- 2.91 acres of riparian buffers outside of the required 50-foot stream buffers were protected and planted within the conservation easement.

As illustrated in the As-Built Plan Sheets in Appendix E, the plan form of the proposed streams did not deviate significantly from the proposed design and the stream lengths are unchanged from the approved mitigation plan.

Additional construction activities performed at the Site included the following:

- Planting approximately 8,800 stems within the easement,
- Fencing of entire conservation easement,



- Installing a well, multiple cattle waterers, and water lines to support these facilities, and
- Protecting and planting a wetland area at the base of the cattle loafing and barn area to treat agricultural runoff.

1.3 Construction

Construction began in January 2019 and site earthwork was completed in June 2019. Table 3 in Appendix A outlines the Project contacts. Construction progress was slow due to the prevalence of wetlands at the Site and almost weekly precipitation during this time frame. During construction there were multiple bankfull, or near bankfull, discharge events. Site visits frequently documented rack lines and recent sediment deposition in the floodplain of the newly built channel. The gage records at the Yadkin River in Elkin confirm that at least three events above bankfull occurred in the months of February and April 2019.

Deviations from the design are shown in the As-Built Plan Sheets (Appendix E) and are described in detail within this section.

1.3.1 In-Stream Work and Floodplain Grading

The As-Built Plan Sheets (Appendix E) provide a visual markup of the design to show what was installed during construction. The Site was built as designed and is expected to meet the upcoming monitoring year's success criteria.

During construction, the Site experienced multiple bankfull flow events with minimal lateral adjustment and minor vertical adjustment due to the lack of sorted bed material resulting from the Priority 1 restoration approach. Due to the sandy soils at the site and that the channel was freshly excavated, these storm events led to some downcutting, primarily on the UT. Additional grade control was added throughout the UT and a few places on the mainstem as listed below:

- Constructed Riffles were added at following stations:
 - Reach 4 34+00 to 34+22
 - UT 11+36 to 11+56
 - UT 12+20 to 12+37
 - UT 12+88 to 13+02
 - UT 13+76 to 13+94
 - UT 15+36 to 15+59
- Meadow Brook Station 33+40: J-Hook vane component was added to the log vane to provide grade control
- UT Station 12+00: added log drop structure



There were six woody riffle floodplain interceptor structures called for in the design but only two of these were installed. Due to the activities required to excavate the channel and grade the floodplain, these structures were placed where concentrated flow was observed entering the channel from the wetlands. This was done to avoid placing them where flow would circumvent the structures and ensure placement where they would be most effective.

- Woody Riffle Floodplain Interceptors were not installed at the following stations:
 - MB 18+50
 - MB 24+50
 - MB 29+50
 - UT 13+00
- Meadow Brook Station 20+85: Floodplain interceptor shown on the right bank near Station 20+85 was moved to 20+94 to intercept concentrated flow coming from the wetland treatment cell.
- MB Station 26+50: Floodplain interceptor shown on the left bank near Station 26+50 was moved to 26+86 to intercept flow over the second log vane in that bend

As shown in Appendix D, the dimensions of the surveyed cross sections closely matched the design criteria. The location of two monitoring cross sections were moved from the Mitigation Plan proposed locations due to the presence of bedrock.

As shown in the As-built Plan Sheets in Appendix E, the centerline profile was built roughly to the planned dimensions. There are some pools that are filled with sediment that are expected to flush now that construction is complete and riparian vegetation has been planted. Some vertical adjustment can be seen throughout the Meadow Brook profile, primarily at the head of proposed riffle features due to the lack of sorted bed material resulting from the Priority 1 restoration approach. As noted above, grade control was added as needed during construction, primarily to the UT, the mainstem profile is expected to be stable due to the implemented grade control and existing bed rock features.

1.4 Site Planting

Planting for site occurred in two phases. The riparian and upland areas in the downstream end of the project were planted in March 2019 during construction. Planting for the rest of the project was not completed until January 2020 because construction was not completed until after the end of the dormant season. The stems planted in March 2019 were assessed for survival and replaced as necessary during final planting. Live stakes were planted across the entire site when construction was completed in June 2019.

The following revisions were made to the planting plan to adapt to site conditions and minimize plant mortality:



- American Holly and Eastern Red Cedar were included in the planting list for the upland vegetation planting zone, each proposed to comprise 5% of species in that zone. These species were planted in the initial phase performed in March 2019 but not in the subsequent planting. The relative frequency of other species was increased to meet the planting density required.
- Live stake whips were planted in small areas of standing water within the riparian wetland vegetation planting zone. The whip species solely consisted of species from the streambank live staking zone species list.

2.0 BASELINE DATA ASSESSMENT

This report establishes the baseline data that will be used to determine the success of the Meadow Brook Stream Mitigation Project. The performance criteria and as-built site conditions are described in the following sections to evaluate whether the project is meeting the success criteria in subsequent monitoring years.

2.1 Performance Criteria

Project success criteria were established in accordance with the *NCDMS Mitigation Plan Template* (ver. 06/2017), and *U.S. Army Corps of Engineers – Wilmington District Public Notice: Notification of Issuance of Guidance for Compensatory Stream and Wetland Mitigation Conducted for Wilmington District* (October 24, 2016). The monitoring plan for the site will follow this guidance. Table 1 details the USACE success criteria that evaluate whether project goals have been met throughout the monitoring period.

Table A. USACE Mitigation Success Criteria

Restored Stream Channels
<ul style="list-style-type: none"> • All streams must maintain an Ordinary High-Water Mark (OHWM), per RGL 05-05. • Continuous surface flow must be documented each year for at least 30 consecutive days. • Bank height ratio (BHR) cannot exceed 1.2 for all measured cross sections on a given reach. • Entrenchment ratio (ER) must be above 2.2 for all measured riffle cross-sections on a given reach (for C and E streams). • BHR and ER should not change by more than 10% in any given year for all measured cross sections on a given reach. • Must document occurrence of at least 4 bankfull events in separate years during the monitoring period.



Riparian Vegetation
<ul style="list-style-type: none"> • Within planted portions of the site, a minimum of 320 stems per acre must be present at year 3; a minimum of 260 stems per acre must be present at year 4; and a minimum of 210 stems per acre must be present at year 7. • Trees must average 7 feet in height at year 5, and 10 feet in height at year 7. • Planted and volunteer stems are counted, provided they are included in the approved planting list for the site. • Any single species can only account for 50% of the required stems per monitoring plot.

2.2 Stream Monitoring

Stream monitoring will include monitoring of the hydrologic and geomorphic functions of Meadow Brook and the UT to Meadow Brook. Monitored parameters, methods, schedule/frequency, and extent are summarized in Table 2. These monitoring parameters follow USACE guidance but will also allow for monitoring of other parameters to document site performance related to the project goals listed in Section 1.1. The locations of the established monitoring cross sections are shown in Figure 2 (Appendix B).

Table B. Stream Monitoring Summary

Parameter	Method	Schedule/ Frequency	Number/ Extent
Stream Profile	Full longitudinal survey	As-built only (unless otherwise required)	All restored and enhanced stream channels
Stream Dimension	Cross sections	Years 1, 2, 3, 5, and 7	10 cross sections on Meadow Brook 3 cross sections on UT to Meadow Brook
Channel Stability	Photo Points	Yearly	16 photo points
	Visual Assessment	Yearly	All restored stream channels
	Additional Cross sections	Yearly	Only if instability is documented during monitoring
Stream Hydrology	Pressure transducers Precipitation recorder Photos of flood indicators	Continuous recording through monitoring period	1 on Meadow Brook and 1 on UT to Meadow Brook

2.2.1 Stream Profile

A full longitudinal profile was surveyed for the entire length of the restored stream in August 2019 to document as-built conditions. This survey is tied to a permanent benchmark and includes thalweg, water surface, right bank and left bank features. Profile measurements were taken at the head of each feature (e.g. riffle, pool) and at the max depth of pools. The locations



of in-stream structures and cross-sections are shown on the profile plot as well, which is included in Appendix D.

The surveyed longitudinal profile shows that the constructed bedform features are consistent with the reference and design criteria. Table 8 in Appendix D summarizes the measured profile data. The longitudinal profile will not be surveyed in subsequent years unless vertical channel instability has been observed during monitoring and remedial actions or repairs are needed.

2.2.2 Stream Dimension

13 permanent cross sections were installed across the site; 10 on Meadow Brook and 3 on the UT to Meadow Brook. 7 cross sections were installed in riffles and 6 were installed in pools. Each cross-section was marked using a length of rebar and PVC pipe on both streambanks. The location and elevation of each pin was recorded to facilitate data comparison from year to year. Cross-sections will be surveyed in Monitoring Years 1, 2, 3, 5, and 7 and reported data will include measurements of Bank Height Ratio (BHR), Entrenchment Ratio (ER). Reference photos will be taken of both streambanks every year to provide a visual assessment of any changes that may occur.

The surveyed cross-sections indicate that the as-built stream dimensions are consistent with the reference and design criteria. The cross-section plots, photos, and data summary (Tables 8 and 9) are included in Appendix D. These two tables will be updated in subsequent monitoring years to facilitate comparison between monitoring years. There should be little change in the channel dimension data over the monitoring period, but if changes do take place they will be documented and evaluated to determine if they indicate a shift toward stability (potentially represented by settling, vegetative changes, or deposition on top of stream banks) or instability (represented by erosion and down-cutting). Any unstable areas will be assessed to determine whether they are systemic and whether repairs are needed.

2.2.3 Channel Stability

Channel stability will be assessed on a yearly basis using photographs to visually document the condition of the restored project streams. Photographs will be taken from the same location in the same direction each year. 16 photo points were established during baseline monitoring and are shown in the CCPV (Figure 2) and As-Built Plan Sheets (Appendix E).

Visual assessments of channel stability will also be made regularly throughout the monitoring year. Any potential issues with the site will be documented, photographed and reported in the yearly monitoring report. Additional cross-sections will only be surveyed if instability is documented during monitoring.

2.2.4 Stream Hydrology

Two pressure transducers were installed in Meadow Brook and the UT to Meadow Brook to document stream flow and the occurrence of bankfull events within the monitoring period. The locations of these gauges are shown in the CCPV (Figure 2 in Appendix B) and As-Built Plan



Sheets (Appendix E). Both gauges were installed in the downstream end of pools. The constructed bankfull elevation at each gauge was recorded. This elevation will be compared with the gauge readings to determine whether a bankfull event has occurred. Photos will be taken of flood indicators such as debris lines and sediment deposition on the floodplain whenever it is apparent that a bankfull event has occurred.

A tipping bucket rain gauge was also installed to accurately document rainfall at the Site. The rainfall data will be compared to the flow gauge data to verify that high flows at the Site are correlated with rainfall events. The monitoring gauges will be downloaded regularly throughout each monitoring year and data will be presented the annual monitoring reports.

2.3 Riparian Vegetation

Riparian vegetation monitoring will evaluate the establishment of planted and volunteer vegetation across the site. Monitored parameters, methods, schedule/frequency, and extent are summarized in Table C. These monitoring parameters follow USACE guidance but will also allow for monitoring of other parameters to document site performance related to the project goals listed in Section 1.1.

Table C. Riparian Vegetation Monitoring Summary

Parameter	Method	Schedule/ Frequency	Number/ Extent	Data Collected
Vegetation establishment and vigor	Permanent vegetation plots, 0.02 acre in size (minimum)	Between July 1st and leaf drop. As-built, Years 1, 2, 3, 5, and 7	6 plots, spread across site	Species, height, location, planted vs. volunteer, and age.
	Annual random vegetation plots, 0.02 acre in size (minimum)	Between July 1st and leaf drop. Years 1, 2, 3, 5, and 7	6 plots, randomly selected each year	Species, and height.

2.3.1 Baseline Vegetation Monitoring

Baseline vegetation monitoring occurred in January 2020, soon after site planting was completed. Final vegetation plot location did not vary significantly from the locations suggested in the mitigation plan. The corners of the permanent vegetation plots were marked using steel t-posts and the location of each plot was recorded using GPS. The individual trees within each permanent plot were tagged and labeled to facilitate monitoring efforts in future years. The planted stems were counted and measured during baseline monitoring. Species data will be collected during Monitoring Year 1. In subsequent monitoring years, the location of the temporary random vegetation plots will be recorded using GPS and species and height data will be collected.



Planted stems per plot ranged from 16 to 29, or 647 to 1174 stems per acre. The locations of the 6 permanent vegetation plots are shown in the CCPV (Figure 2).

2.4 Wetland Hydrology

While no wetland mitigation credit was proposed as a part of this Project, efforts were taken to ensure that there was no net loss of existing riparian wetland function after construction. A preliminary jurisdictional wetland determination (PJD) and NCWAM assessment was completed prior to completion to document the extent and functionality of the existing wetlands at the site. The same assessments will be made after the monitoring period ends to document that there was no net loss of wetland functionality over the life of the project. In addition, any hydrophytic vegetation that is present within any vegetation plots that are located in planting Zone 2 (Riparian Wetlands) will be documented during annual monitoring and records of the extent and species diversity of this vegetation will be kept.

Additionally, as required by the 401/404 permit, two groundwater gauges were installed in the wetlands at the Site. These data will be provided in subsequent monitoring years but are not associated with any success criteria for mitigation. The locations of the 2 wetland groundwater gauges are shown in the CCPV (Figure 2).



3.0 REFERENCES

North Carolina Ecosystem Enhancement Program. 2009. Upper Yadkin Pee-Dee River Basin Restoration Priorities.

North Carolina Department of Environmental Quality, Division of Mitigation Services. 2017. As-built Baseline Monitoring Report Format, Data, and Content Requirement June 2017.

North Carolina Division of Water Quality. 2008. Yadkin Pee-Dee Basinwide Water Quality Plan.

U.S. Army Corps of Engineers. 2016. Wilmington District Public Notice: Notification of Issuance of Guidance for Compensatory Stream and Wetland Mitigation Conducted for Wilmington District.



Appendix A

Project Information Tables

Table 1. Project Mitigation Components

Table 2. Project Activity and Reporting History

Table 3. Project Contacts Table

Table 4. Project Baseline Information and Attributes

**Table 1. Project Mitigation Components
Meadow Brook Stream Mitigation Project - DMS ID 100024**

Project Segment	Existing Footage or Acreage	Mitigation Plan Footage or Acreage	Mitigation Category	Restoration Level	Priority Level	Mitigation Ratio (X:1)	As-Built Footage or Acreage	Comments
Meadow Brook Reach 1	1304	1917	Warm	R	1	1.00000	1917	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.
Meadow Brook Reach 2	327	353	Warm	R	2	1.00000	353	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.
Meadow Brook Reach 3	289	273	Warm	R	2	1.00000	273	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.
Meadow Brook Reach 4	283	218	Warm	EI	-	1.50000	218	Habitat Structures, Planted Buffer, Livestock Exclusion, Permanent Conservation Easement.
UT to Meadow Brook	396	676	Warm	R	1	1.00000	676	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement.
Wetland A	2.930	2.630	RR	N/A		0.00000	2.63	Planted, excluded livestock, plugged ditches, and encompasses section of priority 2 reach.
Wetland B	2.230	2.000	RR	N/A		0.00000	2.00	Planted, excluded livestock, plugged ditches, and encompasses section of priority 2 reach.
Wetland C	0.820	0.740	RR	N/A		0.00000	0.74	Planted, excluded livestock, plugged ditches, and encompasses section of priority 2 reach.
Wetland D	0.100	0.090	RR	N/A		0.00000	0.09	Planted, excluded livestock, and encompasses section of priority 2 reach.

*Note: Wetlands are not currently part of the project assets and are not generating mitigation credits

Restoration Level	Stream			Riparian Wetland		Non-Rip Wetland	Coastal Marsh
	Warm	Cool	Cold	Riverine	Non-Riv		
Restoration	3219.000						
Re-establishment							
Rehabilitation				5.460			
Enhancement							
Enhancement I	145.333						
Enhancement II							
Creation							
Preservation							
Totals	3364.333			5.460			

Total Base SMUs	3364.333
Credit Loss in Required Buffer	-142.550
Credit Gain for Additional Buffer	187.600
Net Change in Credit from Buffers	45.000
Total Adjusted SMUs*	3409.333

*Credit adjustment for Non-standard Buffer Width calculation using Wilmington District Stream Buffer Credit Calculator (Updated 1/19/2019)

Appendix A

Meadow Brook Stream Restoration Project
DMS # 100024



**Table 2. Project Activity and Reporting History
Meadow Brook Stream Mitigation Project - DMS ID 100024**

Elapsed Time Since grading complete: 0 yrs 7 months
 Elapsed Time Since planting complete: 0 yrs 1 months
 Number of reporting Years¹: 0

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Institution Date	-	Aug-17
404 permit date	-	Oct-18
Final Mitigation Plan	2017 to 2018	Sep-18
Final Design – Construction Plans	-	Dec-18
Site Earthwork	Jan to June 2019	Jun-19
As-Built Survey Performed	Aug-19	Aug-19
Bare root plantings	-	Jan-20
As-built Baseline Monitoring Report (Monitoring Year 0)	2019	Feb-20
Year 1 Monitoring	2020	Dec-20
Year 2 Monitoring	2021	Dec-21
Year 3 Monitoring	2022	Dec-22
Year 4 Monitoring	2023	Dec-23
Year 5 Monitoring	2024	Dec-24
Year 6 Monitoring	2025	Dec-25
Year 7 Monitoring	2026	Dec-26

¹ = The number of reports or data points produced excluding the baseline

Table 3. Project Contacts Table
Meadow Brook Stream Restoration Project - DMS ID 100024

Designer	Ecosystem Planning and Restoration, PLLC 1150 SE Maynard Rd. Ste 140 Cary, NC 27511
Primary project design POC	Kevin Tweedy, PE (919) 388-0787
Construction Contractor	Yadkin Valley Construction, Inc 2961 Old 60 Hwy Ronda, NC 28670
Construction contractor POC	Brad Benton
Survey Contractor	Turner Land Surveying, PLLC PO Box 148, Swannanoa, NC 28778
Survey contractor POC	Lissa Turner (919) 827-0745
Planting Contractor	Foggy Mountain Nursery 797 Helton Creek Road Lansing, NC 28643
Planting contractor POC	Glenn Sullivan
Seeding Contractor	Yadkin Valley Construction, Inc
Contractor point of contact	
Seed Mix Sources	Green Resource (Sourced through Swan Creek Farm Supply) 5204 Highgreen Court Colfax, NC 27235
Nursery Stock Suppliers	Foggy Mountain Nursery
Monitoring Performers	Ecosystem Planning and Restoration, PLLC
Stream Monitoring POC	Cidney Jones, EPR (919) 388-0787
Vegetation Monitoring POC	Tom Barrett, EPR (919) 388-0787

**Table 4. Project Baseline Information and Attributes
Meadow Brook Stream Restoration Project - DMS ID 100024**

Project Background Information					
Project Name	Meadow Brook Stream Mitigation Project				
County	Yadkin				
Project Area (acres)	11.2				
Project Coordinates (latitude and longitude)	36.14139 / 80.81889				
Planted Acreage (Acres of Woody Stems Planted)	11.2				
Project Watershed Summary Information					
Physiographic Province	Northern Inner Piedmont				
River Basin	Yadkin Pee-Dee				
USGS Hydrologic Unit 8-digit	03040101	USGS Hydrologic Unit 14-digit	03040101130020		
DWR Sub-basin	03-07-02				
Project Drainage Area (Acres and Square Miles)	1088 acres/ 1.7 Sq.Mi.				
Project Drainage Area Percentage of Impervious Area	< 1%				
CGIA Land Use Classification	Pasture (57%) and Deciduous Forest (26%)				
Reach Summary Information					
Parameters	Meadow Brook				UT to Meadow Brook
	Reach 1	Reach 2	Reach 3	Reach 4	
Length of reach (linear feet)	1304	327	289	283	396
Valley confinement (Confined, moderately confined, unconfined)	Unconfined	Unconfined	Confined	Confined	Unconfined
Drainage area (Acres and Square Miles)	.93 sq mi / 595 ac	1.51 sq mi / 966 ac	1.73 sq mi / 1107 ac	1.73 sq mi / 1107 ac	.56 sq mi / 358 ac
Perennial, Intermittent, Ephemeral	Perennial				
NCDWR Water Quality Classification	WS-III				
Stream Classification (existing)	Incised E4	E4	E4	E4	E4
Stream Classification (proposed)	C4	C4	B4c	B4c	C4
Evolutionary trend (Simon)	IV				
FEMA classification	AE				

**Table 4. Project Baseline Information and Attributes (continued)
Meadow Brook Stream Restoration Project - DMS ID 100024**

Wetland Summary Information					
Parameters	Wetland A	Wetland B	Wetland C	Wetland D	
Size of Wetland (acres)	2.93	2.23	0.82	0.10	
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian Riverine	Riparian Riverine	Riparian Riverine	Riparian Riverine	
Mapped Soil Series	Dan River Sandy Loam	Dan River Sandy Loam	Dan River Sandy Loam / Clifford sandy clay loam	Dan River Sandy Loam	
Drainage class	Well-drained	Well-drained	Well-drained	Well-drained	
Soil Hydric Status	Non-Hydric ⁺	Non-Hydric ⁺	Non-Hydric ⁺	Non-Hydric ⁺	
Source of Hydrology	Groundwater, precipitation, runoff, overbank flooding	Groundwater, precipitation, runoff, overbank flooding	Groundwater, precipitation, runoff, overbank flooding	Groundwater, precipitation, runoff, overbank flooding	
Restoration or enhancement method (hydrologic, vegetative etc.)	Vegetative*	Vegetative*		Vegetative*	
Regulatory Considerations					
Parameters	Applicable?	Resolved?	Supporting Docs?		
Water of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No. 27 - ID # SAW-2017-01509		
Water of the United States - Section 401	Yes	Yes	DWQ 401 Water Quality Certification No. 4134 - ID # 20180919		
Division of Land Quality (Erosion and Sediment Control)	Yes	Yes	General Permit NCG010000 - ID # YADKI-2019-004		
Endangered Species Act	Yes	Yes	Categorical Exclusion Document in Appendix 7 of Mitigation Plan		
Historic Preservation Act	Yes	Yes			
Coastal Zone Management Act (CZMA or CAMA)	No	-			
FEMA Floodplain Compliance	Yes	Yes	Yadkin County Floodplain Development Permit - ID # 2018-1		
Essential Fisheries Habitat	No	-			

* Wetlands are not being restored or enhanced for mitigation credit but functional uplift is expected and there will be no net loss of wetland functions.

+ Jurisdictional wetlands were identified on soils mapped as non-hydric.

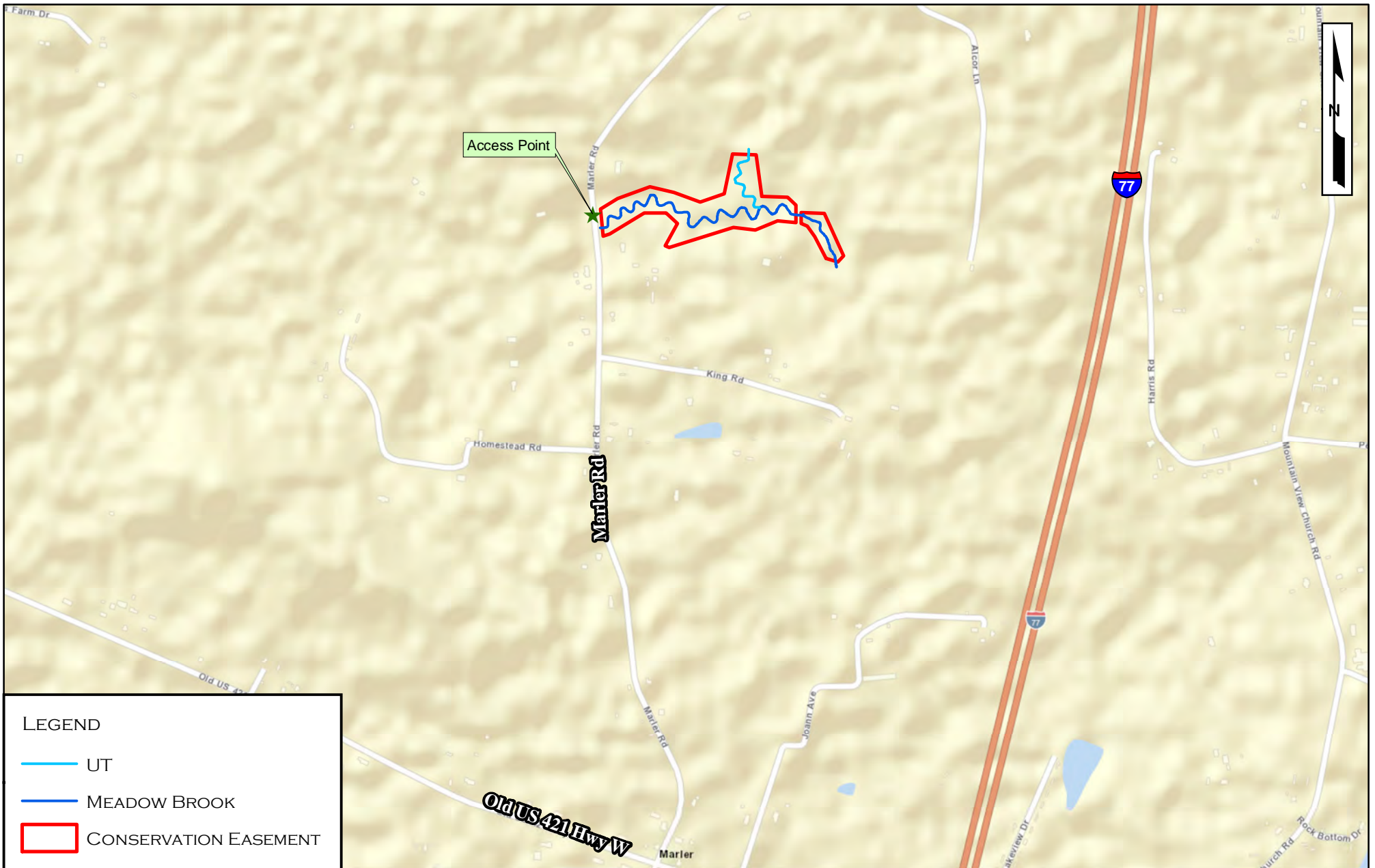
Appendix B

Visual Assessment Exhibits and Guidance

Figure 1. Project Location Map

Figure 2. Current Condition Plan View

Baseline Photo Log



MEADOW BROOK STREAM MITIGATION PROJECT

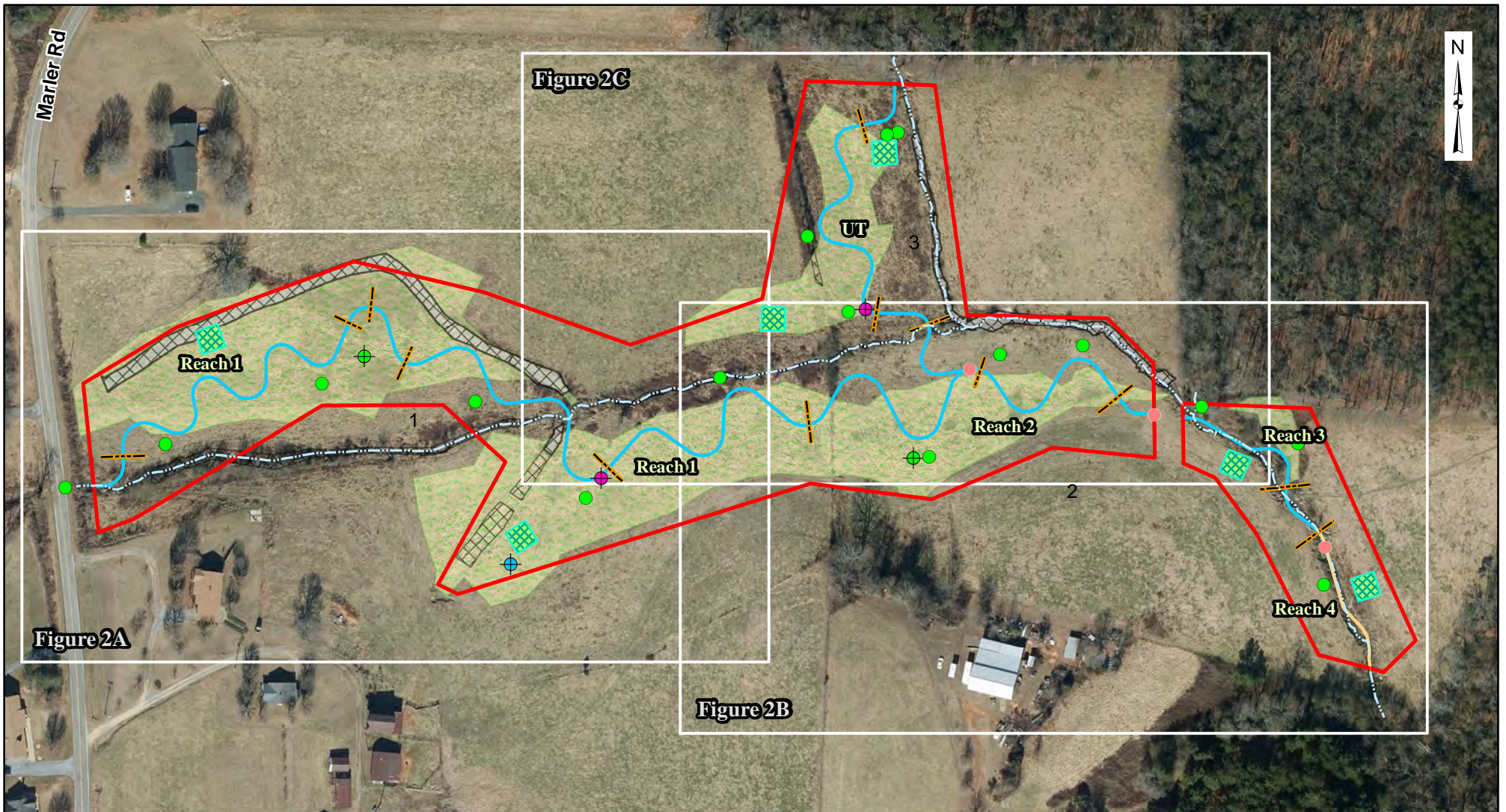
PROJECT LOCATION MAP
MONITORING YEAR 0



FIGURE 1

DMS PROJECT #100024
YADKIN COUNTY, NC

JANUARY 2020



Legend

Photo Points	Rain Gauge	Reach Breaks	Vegetation Plots
Pre-Existing Streams	Stream Gauge	Stream Restoration	Cross Sections
Existing Wetlands	Wetland Gauge	Stream Enhancement	Unfilled Ditches
Conservation Easement			Filled Ditches

NC OneMap Orthoimagery (2018)

0 200

 FEET
 1 inch = 200 feet

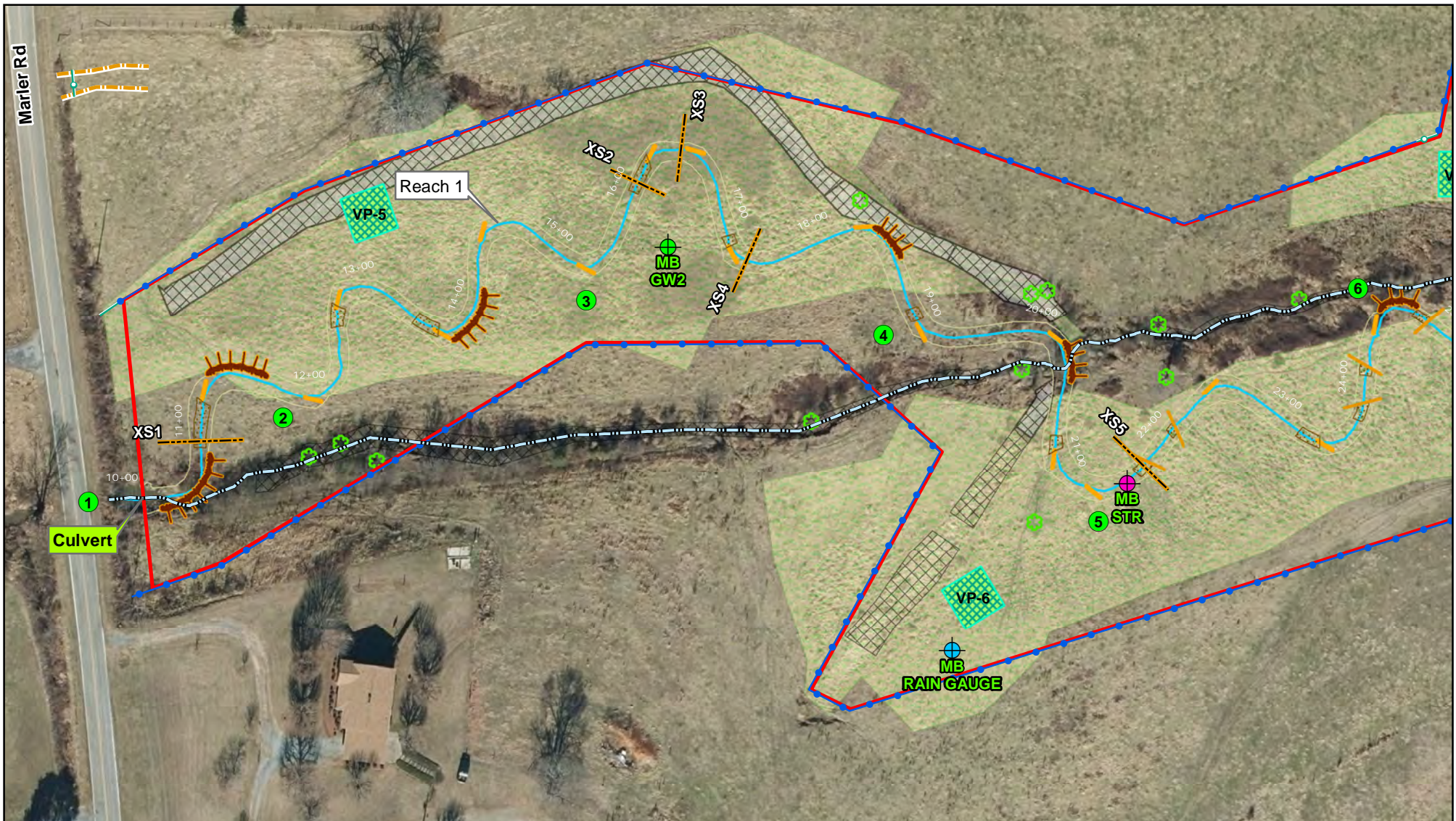
MEADOW BROOK STREAM MITIGATION PROJECT
 CURRENT CONDITION PLAN VIEW: OVERVIEW
 MYO: 2020

DMS PROJECT ID# 100024
 JANUARY 2020

FIGURE 2

YADKIN COUNTY, NC

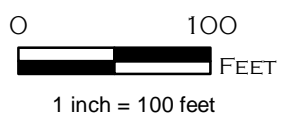
ECOSYSTEM PLANNING & RESTORATION



Legend

- | | | | | |
|----------------------|-----------------------|---------------|------------------|-------------|
| Thalweg (ASB) | Existing Wetlands | Rain Gauge | Vegetation Plots | Farm Path |
| Top of Bank (ASB) | Conservation Easement | Stream Gauge | Unfilled Ditches | Fencing |
| Pre-Existing Streams | Cross Sections | Wetland Gauge | Filled Ditches | Fence Gates |
| Photo Points | | | | |

NC OneMap Orthoimagery (2018)



MEADOW BROOK STREAM MITIGATION PROJECT
 CURRENT CONDITION PLAN VIEW: ASSET MAP
 MYO: 2020

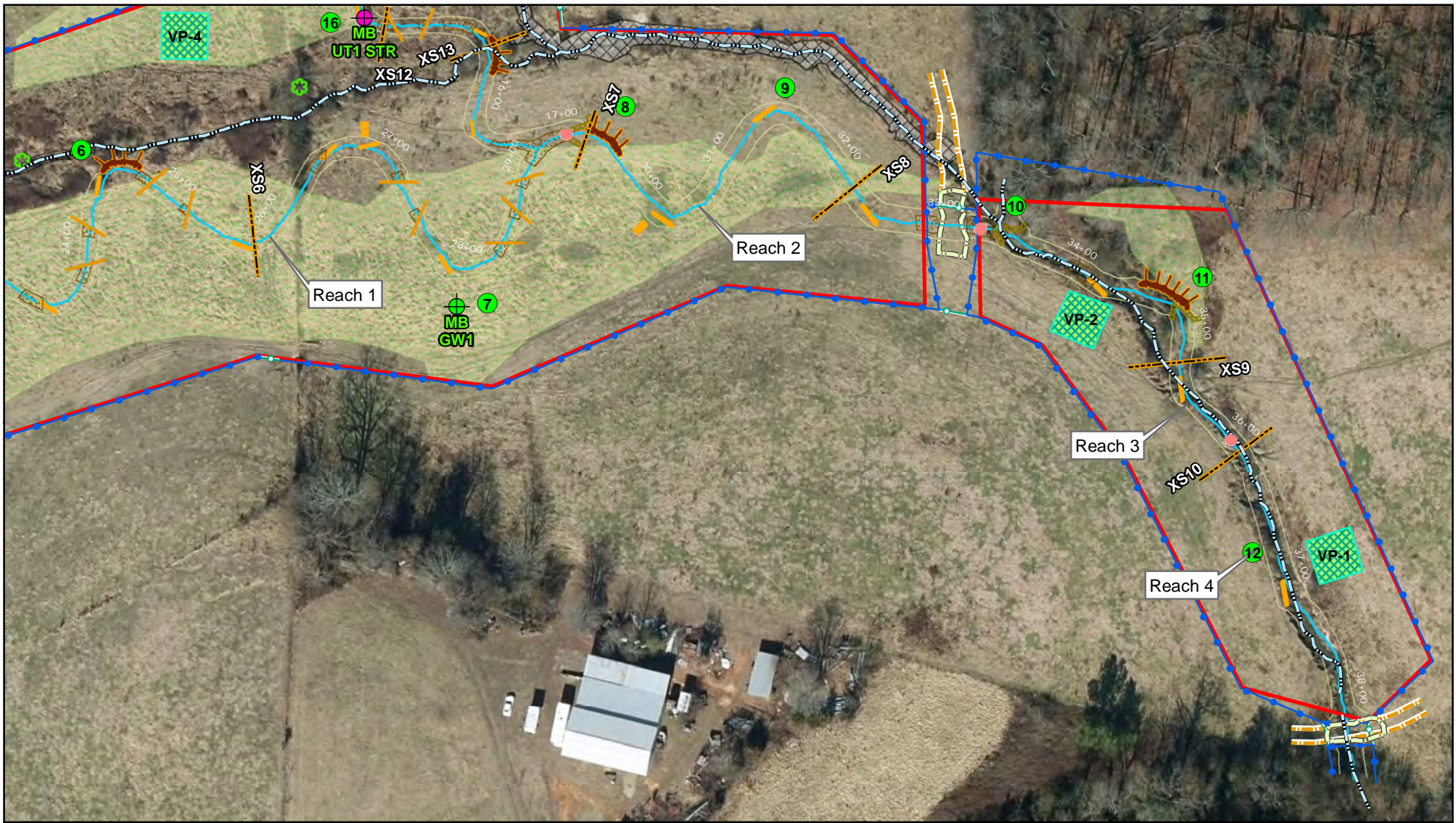


DMS PROJECT
 ID# 100024
 JANUARY 2020

FIGURE 2A

YADKIN COUNTY, NC

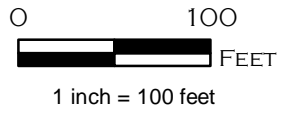




Legend

- Thalweg (ASB)
- Top of Bank (ASB)
- Pre-Existing Streams
- Reach Breaks
- Existing Wetlands
- Conservation Easement
- Cross Sections
- Photo Points
- Stream Gauge
- Wetland Gauge
- Vegetation Plots
- Unfilled Ditches
- Filled Ditches
- Stream Crossing
- Farm Path
- Fencing
- Fence Gates

NC OneMap Orthoimagery (2018)



MEADOW BROOK STREAM MITIGATION PROJECT
 CURRENT CONDITION PLAN VIEW: ASSET MAP
 MYO: 2020

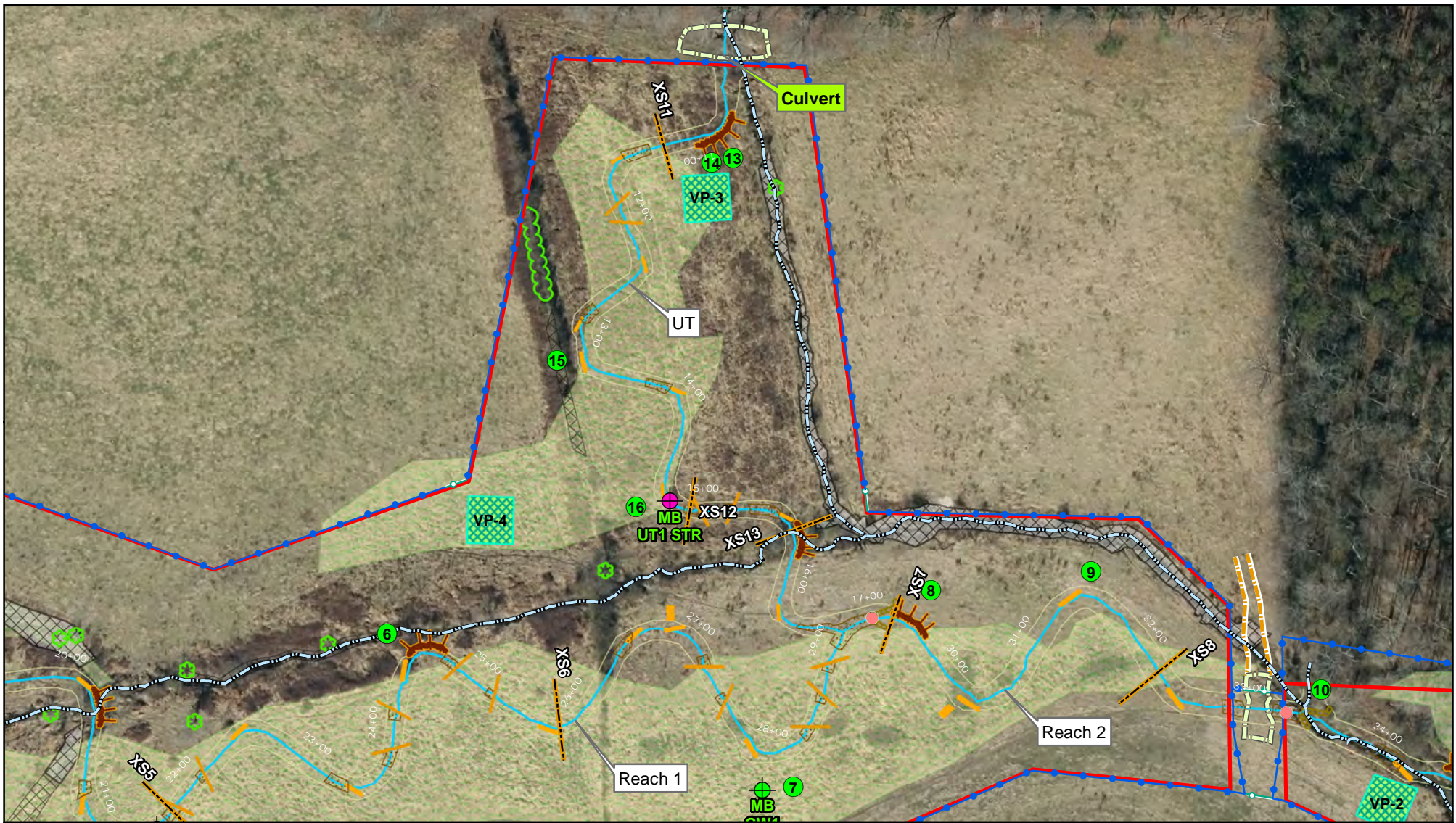


DMS PROJECT
 ID# 100024
 JANUARY 2020

FIGURE 2B

YADKIN COUNTY, NC

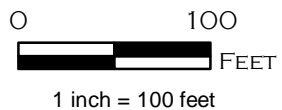




Legend

- Thalweg (ASB)
- Top of Bank (ASB)
- Pre-Existing Streams
- Reach Breaks
- Existing Wetlands
- Conservation Easement
- Cross Sections
- Photo Points
- Stream Gauge
- Wetland Gauge
- Vegetation Plots
- Unfilled Ditches
- Filled Ditches
- Stream Crossing
- Farm Path
- Fencing
- Fence Gates

NC OneMap Orthoimagery (2018)



MEADOW BROOK STREAM MITIGATION PROJECT
 CURRENT CONDITION PLAN VIEW: ASSET MAP
 MYO: 2020



DMS PROJECT
 ID# 100024
 JANUARY 2020

FIGURE 2C

YADKIN COUNTY, NC



ECOSYSTEM
 PLANNING &
 RESTORATION

**Meadow Brook Stream Restoration Project
Baseline - Photo Log**



Photo Point 1 – Reach 1, Sta. 0+00
Facing Downstream (1/22/2020)



Photo Point 2 – Reach 1, Sta. 11+90
Facing Downstream (1/22/2020)



Photo Point 3 – Reach 1, Sta. 15+35
Facing Downstream (1/22/2020)



Photo Point 4 – Reach 1, Sta. 19+10
Facing Downstream (1/22/2020)



Photo Point 5 – Reach 1, Sta. 21+50
Facing Downstream (1/22/2020)



Photo Point 6 – Reach 1, Sta. 24+50
Facing Downstream (1/22/2020)

**Meadow Brook Stream Restoration Project
Baseline - Photo Log**



Photo Point 7 – Reach 1, Sta. 28+20
Facing Downstream (1/22/2020)



Photo Point 8 – Reach 2, Sta. 29+70
Facing Upstream (1/22/2020)



Photo Point 9 – Reach 2, Sta. 31+60
Facing Downstream (1/22/2020)



Photo Point 10 – Reach 3, Sta. 33+55
Facing Upstream (1/22/2020)



Photo Point 11 – Reach 3, Sta. 34+80
Facing Downstream (1/22/2020)



Photo Point 12 – Reach 4, Sta. 36+90
Facing Downstream (1/22/2020)

**Meadow Brook Stream Restoration Project
Baseline - Photo Log**



Photo Point 13 – UT, Sta. 10+90
Facing Upstream (1/22/2020)



Photo Point 14 – UT, Sta. 10+90
Facing Downstream (1/22/2020)



Photo Point 15 – UT, Sta. 13+20
Facing Downstream (1/22/2020)



Photo Point 16 – UT, Sta. 14+90
Facing Downstream (1/22/2020)

Appendix C

Vegetation Plot Data

Table 5. Vegetation Planting Information

Table 6. Riparian Buffer Vegetation Totals

Table 7. Stem Count By Plot

Vegetation Photo Log

**Table 5. Vegetation Planting Information
Meadow Brook Stream Restoration Project (DMS No. 100024)**

Livestake Planting				
Scientific Name	Common Name	% by Species	Approx. Stem Count	
<i>Cornus amomum</i>	Silky dogwood	40%	766	
<i>Salix sericea</i>	Silky willow	30%	575	
<i>Salix nigra</i>	Black willow	20%	383	
<i>Sambucus canadensis</i>	Elderberry	10%	192	
Riparian Wetlands Planting				
Scientific Name	Common Name	% by Species	Approx. Stem Count	Wetland Indicator Status
<i>Betula nigra</i>	River Birch	20%	1251	FACW
<i>Celtis laevigata</i>	Sugarberry	5%	313	FACW
<i>Diospyros virginiana</i>	Persimmon	10%	626	FAC
<i>Fraxinus pennsylvanica</i>	Green Ash	10%	626	FACW
<i>Platanus occidentalis</i>	Sycamore	20%	1251	FACW
<i>Quercus nigra</i>	Water Oak	10%	626	FAC
<i>Quercus phellos</i>	Willow Oak	15%	938	FAC
<i>Ulmus americana</i>	American Elm	10%	626	FACW
Upland Planting				
Scientific Name	Common Name	% by Species	Approx. Stem Count	Wetland Indicator Status
<i>Carya glabra</i>	Pignut Hickory	10%	61	FACU
<i>Carya tomentosa</i>	Mockernut Hickory	10%	61	NI
<i>Cercis canadensis</i>	Redbud	5%	31	FACU
<i>Cornus florida</i>	Flowering Dogwood	5%	31	FACU
<i>Diospyros virginiana</i>	Persimmon	10%	61	FAC
<i>Ilex opaca</i>	American Holly	5%	31	FACU
<i>Juniperus virginiana</i>	Eastern Red Cedar	5%	31	FACU
<i>Liriodendron tulipifera</i>	Tulip Poplar	10%	61	FACU
<i>Oxydendrum arboreum</i>	Sourwood	5%	31	UPL
<i>Prunus serotina</i>	Black Cherry	5%	31	FACU
<i>Quercus alba</i>	White Oak	10%	61	FACU
<i>Quercus falcata</i>	Southern Red Oak	10%	61	FACU
<i>Quercus rubra</i>	Northern Red Oak	10%	61	FACU

Table 6. Riparian Buffer Vegetation Totals

Plot #	Total Stems per Acre	Success Criteria Met?
1	809	Yes
2	1174	Yes
3	728	Yes
4	647	Yes
5	728	Yes
6	688	Yes
Project Avg	796	Yes

Table 7. Stem Count By Plot
Meadow Brook Stream Restoration Project (DMS No. 100024)

Scientific Name	Common Name	Species Type	Current Plot Data (MY0 2020)																		Annual Means		
			VP-1			VP-2			VP-3			VP-3			VP-3			VP-3			MY0 (2020)		
			Planted	Vol	Total	Planted	Vol	Total	Planted	Vol	Total	Planted	Vol	Total	Planted	Vol	Total	Planted	Vol	Total	Planted	Vol	Total
<i>Betula nigra</i>	River Birch	Tree																					
<i>Celtis laevigata</i>	Sugarberry	Tree																					
<i>Diospyros virginiana</i>	Persimmon	Tree																					
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree																					
<i>Platanus occidentalis</i>	Sycamore	Tree																					
<i>Quercus nigra</i>	Water Oak	Tree																					
<i>Quercus phellos</i>	Willow Oak	Tree																					
<i>Ulmus americana</i>	American Elm	Tree																					
<i>Carya glabra</i>	Pignut Hickory	Tree																					
<i>Carya tomentosa</i>	Mockernut Hickory	Tree																					
<i>Cercis canadensis</i>	Redbud	Tree																					
<i>Cornus florida</i>	Flowering Dogwood	Tree																					
<i>Diospyros virginiana</i>	Persimmon	Tree																					
<i>Ilex opaca</i>	American Holly	Tree																					
<i>Juniperus virginiana</i>	Eastern Red Cedar	Tree																					
<i>Liriodendron tulipifera</i>	Tulip Poplar	Tree																					
<i>Oxydendrum arboreum</i>	Sourwood	Tree																					
<i>Prunus serotina</i>	Black Cherry	Tree																					
<i>Quercus alba</i>	White Oak	Tree																					
<i>Quercus falcata</i>	Southern Red Oak	Tree																					
<i>Quercus rubra</i>	Northern Red Oak	Tree																					
Initial count of bare root planted stems, species TBD			20		20	29		29	18		18	16		16	18		18	17		17	20		20
Stem count			20	0	20	29	0	29	18	0	18	16	0	16	18	0	18	17	0	17	20	0	20
size (ares)			1			1			1			1			1			1					
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02					
Species count			1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1
Stems per ACRE			809	0	809	1174	0	1174	728	0	728	647	0	647	728	0	728	688	0	688	796	0	796

Color for Density

- Exceeds requirements by 10%
- Exceeds requirements, but by less than 10%
- Fails to meet requirements, by less than 10%
- Fails to meet requirements by more than 10%
- Volunteer Species Included in Total

**Meadow Brook Stream Restoration Project
Vegetation Photo Log**



Veg Plot 1 – SE Corner (1/22/2020)



Veg Plot 2 – NE Corner (1/22/2020)



Veg Plot 3 – SE Corner (1/17/2020)



Veg Plot 4 – NW Corner (1/17/2020)



Veg Plot 5 – NW Corner (1/17/2020)



Veg Plot 6 – N Corner (1/17/2020)

Appendix D

Stream Geomorphology

Table 8. Baseline Stream Data Summary

Table 9. Monitoring Data – Dimensional Morphology Summary

Table 10. Monitoring Data – Stream Reach Data Summary

Longitudinal Profile Plot

Cross Section Plots

Table 8a. Baseline Stream Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - Meadow Brook Reach 1 (1936 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
	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
Dimension and Substrate - Riffle Only																								
Bankfull Width (ft)	7	25	11.5	7.2	12.5	11.6	19.6	5.4	4	13.8	15.4	-	16.9	-	N/A	13.8	14.5	15.7	13.3	16.0	16.4	18.3	2.1	3
Floodprone Width (ft)				56.0	192.8	209.0	297.0	102.6	4	30.8	291.0	-	552	-	N/A	180.0	215.0	250.0	>44	>54	>56	>62	-	3
Bankfull Mean Depth (ft)	0.9	2.3	1.5	0.8	1.5	1.4	2.2	0.6	4	0.8	1.3	-	1.7	-	N/A	1.1	1.3	1.6	1.1	1.2	1.2	1.2	0.0	3
¹ Bankfull Max Depth (ft)				2.0	2.3	2.2	2.8	0.4	4	1.1	1.8	-	2.4	-	N/A	1.3	1.8	2.2	1.8	1.8	1.8	1.9	0.1	3
Bankfull Cross Sectional Area (ft ²)	9	40	15.1	15.1	15.7	15.4	16.9	0.9	4	11.0	19.9	-	28.7	-	N/A	15.2	19.0	25.1	16.4	18.9	19.5	20.7	1.8	3
Width/Depth Ratio				3.3	11.4	8.4	25.4	9.8	4	10.0	12.5	-	15	-	N/A	10.0	11.0	13.0	10.8	13.6	13.8	16.2	2.2	3
Entrenchment Ratio				5.7	17.5	15.7	33.0	12.5	4	2.2	3.1	-	40.0	-	N/A	12.2	22.6	33.0	>3.1	>3.1	>3.1	>3.1	-	3
¹ Bank Height Ratio				1.0	1.2	1.2	1.5	0.2	5	1.0	1.1	-	1.1	-	N/A	1.0	1.0	1.0	1	1	1	1	-	3
Profile																								
Riffle Length (ft)				11.0	48.7	20.0	216.0	74.2	7	Total riffle length 60-70% of reach length						31.0	52.0	72.0	32.2	55.7	60.1	72.0	14.2	12
Riffle Slope (ft/ft)				0.003	0.00757	0.004	0.022	0.0067	7	0.002	0.0045	-	0.007	-	-	0.0034	0.0045	0.006	0.003	0.004	0.004	0.006	0.001	12
Pool Length (ft)				9.0	43.9	39.0	98.0	36.8	8	Total pool length 30-40% of reach length						20.0	26.3	38.0	20.4	27.9	26.6	36.7	5.1	17
Pool Max depth (ft)				2.1	2.5	2.5	2.8	0.2	8	1.6	3.8	-	5.0	-	-	2.1	3.2	4.7	0.7	1.5	1.3	3.1	0.7	19
Pool Spacing (ft)				30.0	88.0	73.0	177.0	55.0	8	61.4	84.4	-	140	-	-	40.5	86.0	120.0	50.0	95.0	99.6	119.4	20.9	16
Pattern																								
Channel Beltwidth (ft)				11.0	27.1	24.0	44.0	12.1	10	53.7	88.3	-	122.8	-	-	54.8	75.5	106.8	55.0	76.3	69.1	106.6	15.0	18
Radius of Curvature (ft)				12.0	62.2	31.0	150.0	49.7	11	30.7	42.2	-	53.7	-	-	30.4	36.3	41.4	30.4	32.6	31.5	40.8	2.7	18
Rc:Bankfull width (ft/ft)				1.1	5.7	2.8	13.6	4.5	11	2.0	2.8	-	3.5	-	-	2.1	2.5	2.8	1.9	2.0	2.0	2.5	0.2	18
Meander Wavelength (ft)				65.0	176.4	120.0	450.0	143.9	7	107.5	145.8	-	184.2	-	-	103	138.1	189	108.0	135.0	136.4	166.0	18.0	17
Meander Width Ratio				1.0	2.5	2.2	4.0	1.1	10	3.5	5.8	-	8.0	-	-	3.7	5.1	7.2	3.4	4.7	4.3	6.6	0.8	17
Transport parameters																								
Reach Shear Stress (competency) lb/ft ²				1												0.3			0.22					
Max part size (mm) mobilized at bankfull				243												68			50					
Stream Power (transport capacity) W/m ²				4.6												10			14.5					
Additional Reach Parameters																								
Rosgen Classification				E4						C4						C4			C4					
Bankfull Velocity (fps)	0.8	25.6	5.6	4.8												3.8			3.9					
Bankfull Discharge (cfs)	30	230	84.5	73												73			73					
Valley length (ft)				1249						-						1358*			1358					
Channel Thalweg length (ft)				1304						-						1936			1965					
Sinuosity (ft)				1.0						1.2 to 1.6						1.4			1.4					
Water Surface Slope (Channel) (ft/ft)				0.00498						-						0.0034			0.0035					
BF slope (ft/ft)				0.00498						-						0.0034			0.0035					
³ Bankfull Floodplain Area (acres)				5.5						-						6.7			5.5					
⁴ % of Reach with Eroding Banks				61%						-														
Channel Stability or Habitat Metric				37%						-														
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

* Note that the valley length has increased in the proposed alignment.

**Table 8b. Baseline Stream Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - Meadow Brook Reach 2 (393 feet)**

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
	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
Dimension and Substrate - Riffle Only																								
Bankfull Width (ft)	8.5	30	14.2	14.5	14.5	14.5	14.5	-	1	15.2	16.9	-	18.6	-	-	16.1	16.6	18.4	19.5	19.5	19.5	19.5	-	1
Floodprone Width (ft)				48.0	48.0	48.0	48.0	-	1	37.2	323.0	-	608	-	-	180.0	197.5	215.0	>63	>63	>63	>63	-	1
Bankfull Mean Depth (ft)	1.1	3	1.7	1.7	1.7	1.7	1.7	-	1	1	1.5	-	1.9	-	-	1.2	1.4	1.8	1.4	1.4	1.4	1.4	-	1
¹ Bankfull Max Depth (ft)				2.5	2.5	2.5	2.5	-	1	1.2	1.9	-	2.6	-	-	1.5	1.9	2.6	2.0	2.0	2.0	2.0	-	1
Bankfull Cross Sectional Area (ft ²)	13	53	21.6	24.0	24.0	24.0	24.0	-	1	15.2	25.3	-	35.3	-	-	19.3	23.0	33.1	26.4	26.4	26.4	26.4	-	1
Width/Depth Ratio				8.7	8.7	8.7	8.7	-	1	10.0	12.5	-	15	-	-	10.0	12.0	13.0	14.3	14.3	14.3	14.3	-	1
Entrenchment Ratio				3.3	3.3	3.3	3.3	-	1	2.2	3.1	-	40.0	-	-	11.1	12.2	13.2	>3.2	>3.2	>3.2	>3.2	-	1
¹ Bank Height Ratio				1.0	1.0	1.0	1.0	-	1	1.0	1.1	-	1.1	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	1
Profile																								
Riffle Length (ft)				20.0	55.0	55.0	90.0	-	2	Total riffle length 60-70% of reach length						37.0	49.0	53.0	66.6	77.8	80.6	86.3	8.3	3
Riffle Slope (ft/ft)				0.002	0.031	0.031	0.06	-	2	0.002	0.0045	-	0.007	-	-	0.0038	0.0045	0.006	0.001	0.003	0.002	0.005	0.001	3
Pool Length (ft)				72.0	134.0	134.0	196.0	-	2	Total pool length 30-40% of reach length						32.0	34.0	39.0	16.8	24.7	23.7	34.5	6.5	4
Pool Max depth (ft)				3.1	3.4	3.4	3.7	-	2	2	4.3	-	6.7	-	-	2.8	3.2	4.9	1.0	1.8	1.7	2.9	0.7	4
Pool Spacing (ft)				135.0	213.0	213.0	290.0	-	2	67.6	93.0	-	118.3	-	-	95.0	108.0	111.0	89.8	115.9	112.1	149.5	21.9	4
Pattern																								
Channel Beltwidth (ft)				25.0	25.0	25.0	25.0	-	1	59.2	97.2	-	135.2	-	-	49.3	84.8	92.3	81.2	87.7	89.9	92.1	4.7	3
Radius of Curvature (ft)				25.0	25.0	25.0	25.0	-	1	33.8	46.5	-	59.2	-	-	37.1	38.1	42.1	37.3	38.5	38.7	39.2	0.7	4
Rc:Bankfull width (ft/ft)				2.3	2.3	2.3	2.3	-	1	2.0	2.8	-	3.5	-	-	2.3	2.3	2.6	1.9	2.0	2.0	2.0	0.0	4
Meander Wavelength (ft)				295.0	295.0	295.0	295.0	-	1	118.3	160.6	-	202.8	-	-	144.0	154.0	187.0	149.2	154.3	155.5	156.8	3.0	4
Meander Width Ratio				2.3	2.3	2.3	2.3	-	1	3.5	5.8	-	8.0	-	-	3.0	5.2	5.7	4.2	4.5	4.6	4.7	0.2	3
Transport parameters																								
Reach Shear Stress (competency) lb/ft ²							0.7									0.3						0.3		
Max part size (mm) mobilized at bankfull							186									81						60		
Stream Power (transport capacity) W/m ²							43									15						18		
Additional Reach Parameters																								
Rosgen Classification							E4						C4				C4					C4		
Bankfull Velocity (fps)	3.3	6.6	5.6				4.4									2.8						3.8		
Bankfull Discharge (cfs)	43	350	120.0				100									100						100		
Valley length (ft)							322						-			322						322		
Channel Thalweg length (ft)							350						-			393						390		
Sinuosity (ft)							1.1						1.2 to 1.6			1.2						1.2		
Water Surface Slope (Channel) (ft/ft)							0.00685						-			0.0038						0.0039		
BF slope (ft/ft)							0.00685						-			0.0038						0.0039		
³ Bankfull Floodplain Area (acres)							0.4						-			1.5						0.9		
⁴ % of Reach with Eroding Banks							33%						-											
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 8c. Baseline Stream Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - Meadow Brook Reach 3 (273 feet) and Meadow Brook Reach 4 (218 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline							
	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		
Dimension and Substrate - Riffle Only																										
Bankfull Width (ft)	8.8	32	14.9	21	21	21	21	-	1	17.7	19.7	-	21.6	-	-	17.7	17.7	18.4	17.8	17.8	17.8	17.8	-	1		
Floodprone Width (ft)				38	38	38	38	-	1	27.5	736.0	-	708	-	-	35.0	52.5	70.0	>70	>70	>70	>70	-	1		
Bankfull Mean Depth (ft)	1.1	3	1.8	1.4	1.4	1.4	1.4	-	1	1.0	1.4	-	1.8	-	-	1.4	1.5	1.5	1.3	1.3	1.3	1.3	-	1		
¹ Bankfull Max Depth (ft)				2.9	2.9	2.9	2.9	-	1	1.1	1.7	-	2.3	-	-	1.5	1.9	2.0	2.1	2.1	2.1	2.1	-	1		
Bankfull Cross Sectional Area (ft ²)	15	62	23.6	30	30	30	30	-	1	17.7	28.3	-	38.88	-	-	24.8	26.0	27.6	24.0	24.0	24.0	24.0	-	1		
Width/Depth Ratio				15	15	15	15	-	1	12.0	15.0	-	18	-	-	12.0	12.0	13.0	13.3	13.3	13.3	13.3	-	1		
Entrenchment Ratio				2	2	2	2	-	1	1.4	1.8	-	40	-	-	1.9	2.9	3.9	>3.9	>3.9	>3.9	>3.9	-	1		
¹ Bank Height Ratio				1.0	1.0	1.0	1.0	-	1	1.0	1.1	-	1.1	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	1		
Profile																										
Riffle Length (ft)				7	12	12	18	-	2	Total riffle length 60-70% of reach length						16.0	23.5	30.0	38.2	73.5	62.2	131.4	36.9	4		
Riffle Slope (ft/ft)				0.080	0.068	0.068	0.056	-	2	0.002	0.007	-	0.015	-	-	0.007	0.008	0.01	0.002	0.006	0.007	0.010	0.003	4		
Pool Length (ft)				50	142	152	225	88	3	Total pool length 30-40% of reach length						21.0	27.5	64.0	17.7	36.2	34.0	59.3	13.4	5		
Pool Max depth (ft)				2.7	3.1	3.1	3.4	0.4	3	2.0	4.2	-	6.3	-	-	3.0	2.7	5.3	1.2	1.4	1.4	1.9	0.2	5		
Pool Spacing (ft)				60	152	152	243	-	2	29.5	63.9	-	98.3	-	-	22.0	61.0	104.0	29.9	94.0	103.4	168.9	47.2	5		
Pattern																										
Channel Beltwidth (ft)				28	35	35	41	-	2	-	-	-	-	-	-	27.1	35.6	50.1	-	-	-	-	-	-		
Radius of Curvature (ft)				25	50	50	74	-	2	-	-	-	-	-	-	38.0	43.0	49.0	39.2	40.8	40.8	42.4	1.6	2		
Rc:Bankfull width (ft/ft)				2.3	4.5	4.5	6.7	-	2	-	-	-	-	-	-	2.1	2.4	2.7	2.2	2.3	2.3	2.4	0.1	2		
Meander Wavelength (ft)				295	295	295	295	-	1	-	-	-	-	-	-	92.0	130.0	172.0	-	-	-	-	-	-		
Meander Width Ratio				2.5	3.1	3.1	3.7	-	2	-	-	-	-	-	-	1.5	2.0	2.8	-	-	-	-	-	-		
Transport parameters																										
Reach Shear Stress (competency) lb/ft ²																	0.6							0.53		
Max part size (mm) mobilized at bankfull																	158								98	
Stream Power (transport capacity) W/m ²																	58								43	
Additional Reach Parameters																										
Rosgen Classification																		E4							B4c	
Bankfull Velocity (fps)	3.3	6.5	5.6															3.9								Bc4
Bankfull Discharge (cfs)	50	400	131.0															116								Bc4
Valley length (ft)																		508								508
Channel Thalweg length (ft)																		523								532
Sinuosity (ft)																		1.03								1.05
Water Surface Slope (Channel) (ft/ft)																		0.00369								0.007
BF slope (ft/ft)																		0.00369								0.007
³ Bankfull Floodplain Area (acres)																		0.4								0.4
⁴ % of Reach with Eroding Banks																		18%								
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 8d. Baseline Stream Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - UT to Meadow Brook (703 feet)**

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
	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
Dimension and Substrate - Riffle Only																								
Bankfull Width (ft)	6	21	9.3	8	8	8	8	-	1	11.8	13.2	-	14.5	-	-	11.8	12.4	13.4	11.1	12.0	12.0	12.9	0.9	3
Floodprone Width (ft)				195	195	195	195	-	1	28.9	250.0	-	472	-	-	188	188	188	>49	>49	>49	>49	-	3
Bankfull Mean Depth (ft)	0.8	2.1	1.2	1.5	1.5	1.5	1.5	-	1	0.8	1.2	-	1.5	-	-	0.9	1.1	1.4	1.0	1.1	1.1	1.2	0.1	3
¹ Bankfull Max Depth (ft)				2.2	2.2	2.2	2.2	-	1	0.9	1.5	-	2	-	-	1.1	1.6	1.9	1.5	1.7	1.7	1.9	0.2	3
Bankfull Cross Sectional Area (ft ²)	7	30	10.3	11	11	11	11	-	1	9.4	15.6	-	21.8	-	-	11	14	19	10.9	13.2	13.2	15.5	2.3	3
Width/Depth Ratio				5	5	5	5	-	1	10	12.5	-	15	-	-	10	11	13	10.6	11.0	11.0	11.4	0.4	3
Entrenchment Ratio				26	26	26	26	-	1	2.2	3.1	-	40	-	-	15	15.0	15.0	>3.8	>4.1	>4.1	>4.4	-	3
¹ Bank Height Ratio				1.2	1.2	1.2	1.2	-	1	1	1.1	-	1.1	-	-	1	1	1	1	1	1	1	0.0	3
Profile																								
Riffle Length (ft)				8	85	118	129	67	3	Total riffle length 60-70% of reach length						27	37	53.6	33.5	43.4	44.4	51.2	7.6	4
Riffle Slope (ft/ft)				0.0066	0.02153	0.008	0.050	0.025	3	0.002	0.0045	-	0.007	-	-	0.005	0.006	0.008	0.001	0.008	0.010	0.013	0.005	5
Pool Length (ft)				29	39	31	56	15	3	Total pool length 30-40% of reach length						17	23	52	21.9	29.1	26.0	39.5	6.8	5
Pool Max depth (ft)				3.1	3.3	3.1	3.6	0.3	3	1.6	3.4	-	5.3	-	-	2.2	2.6	3.85	0.9	1.3	1.4	1.8	0.4	5
Pool Spacing (ft)				65	160	160	254	-	2	52.6	72.3	-	92.05	-	-	10	56	92	49.8	70.6	68.9	95.0	16.6	4
Pattern																								
Channel Beltwidth (ft)				16	16	16	16	0	3	46.0	75.6	-	105.2	-	-	44.7	61.7	68.7	45.4	56.8	56.7	67.8	7.7	6
Radius of Curvature (ft)				81	81	81	81	-	1	26.3	36.2	-	46.0	-	-	28.3	29.8	34.3	26.4	30.0	29.7	33.9	2.8	7
Rc:Bankfull width (ft/ft)				7.4	7.4	7.4	7.4	-	1	2.0	2.8	-	3.5	-	-	2.2	2.4	2.7	2.2	2.5	2.5	2.8	0.2	7
Meander Wavelength (ft)				-	-	-	-	-	-	92.1	124.9	-	157.8	-	-	97.0	119.0	128.0	113.9	117.9	116.0	126.0	4.1	6
Meander Width Ratio				1.5	1.5	1.5	1.5	0.0	3	3.5	5.8	-	8.0	-	-	3.5	4.9	5.4	3.8	4.7	4.7	5.6	0.6	6
Transport parameters																								
Reach Shear Stress (competency) lb/ft ²								1.8								0.3							0.3	
Max part size (mm) mobilized at bankfull								459								81							60	
Stream Power (transport capacity) W/m ²								97								11							29	
Additional Reach Parameters																								
Rosgen Classification								E4					C4			C4							C4	
Bankfull Velocity (fps)	2.9	6.7	5.7					6.8								2.7							5.8	
Bankfull Discharge (cfs)	20	200	59.0					77								37							77	
Valley length (ft)								381					-			514*							524	
Channel Thalweg length (ft)								396					-			703							694	
Sinuosity (ft)								1.04					1.2 to 1.6			1.37							1.32	
Water Surface Slope (Channel) (ft/ft)								0.00828					-			0.0047							0.005	
BF slope (ft/ft)								0.00828					-			0.0047							0.005	
³ Bankfull Floodplain Area (acres)								1.7					-			2.2							1.5	
⁴ % of Reach with Eroding Banks								80%					-											
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

* Note that the valley length has increased in the proposed alignment.

**Table 9. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Meadow Brook Stream Mitigation Project (DMS No. 100024)**

		Main Stem - Reach 1 (1,936 feet)																																		
		Cross Section 1 (Riffle)							Cross Section 2 (Riffle)							Cross Section 3 (Pool)							Cross Section 4 (Pool)							Cross Section 5 (Riffle)						
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		1042.87							1040.55							1040.37							1040.25							1039.55						
Bankfull Width (ft)		16.42							13.3							16.07							18.92							18.29						
Floodprone Width (ft)		>62							>44							N/A							N/A							>56						
Bankfull Mean Depth (ft)		1.19							1.23							1.14							1.47							1.13						
Bankfull Max Depth (ft)		1.79							1.79							2.32							3.42							1.94						
Bankfull Cross Sectional Area (ft ²)		19.49							16.4							18.32							27.82							20.68						
Bankfull Width/Depth Ratio		13.80							10.81							14.1							12.87							16.19						
Bankfull Entrenchment Ratio		>3.78							>3.31							N/A							N/A							>3.06						
Bankfull Bank Height Ratio		1							1							1							1							1						
Cross Sectional Area between end pins (ft ²)		-							-							-							-							-						
d50 (mm)		-							-							-							-							-						
		Main Stem - Reach 1 (1,936 feet)							Main Stem - Reach 2 (393 feet)							Main Stem - Reach 3 (273 feet)																				
		Cross Section 6 (Pool)							Cross Section 7 (Pool)							Cross Section 8 (Riffle)							Cross Section 9 (Riffle)							Cross Section 10 (Pool)						
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		1037.65							1036.00							1034.63							1032.62							1032.85						
Bankfull Width (ft)		22.18							26.53							19.48							17.84							23.23						
Floodprone Width (ft)		N/A							N/A							>63							>70							N/A						
Bankfull Mean Depth (ft)		1.48							1.55							1.36							1.34							1.41						
Bankfull Max Depth (ft)		3.32							3.49							2.04							2.09							2.39						
Bankfull Cross Sectional Area (ft ²)		32.86							41.01							26.44							23.96							32.75						
Bankfull Width/Depth Ratio		14.99							17.12							14.32							13.31							16.48						
Bankfull Entrenchment Ratio		N/A							N/A							>3.23							>3.87							N/A						
Bankfull Bank Height Ratio		1							1							1							1							1						
Cross Sectional Area between end pins (ft ²)		-							-							-							-							-						
d50 (mm)		-							-							-							-							-						
		UT (703 feet)																																		
		Cross Section 11 (Riffle)							Cross Section 12 (Riffle)							Cross Section 13 (Pool)																				
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+														
Record elevation (datum) used		1038.48							1037.08							1036.46																				
Bankfull Width (ft)		12.88							11.14							10.45																				
Floodprone Width (ft)		>49							>49							N/A																				
Bankfull Mean Depth (ft)		1.21							0.98							1.87																				
Bankfull Max Depth (ft)		1.88							1.54							3.14																				
Bankfull Cross Sectional Area (ft ²)		15.54							10.89							19.55																				
Bankfull Width/Depth Ratio		10.64							11.37							5.59																				
Bankfull Entrenchment Ratio		>3.8							>4.4							N/A																				
Bankfull Bank Height Ratio		1							1							1																				
Cross Sectional Area between end pins (ft ²)		-							-							-																				
d50 (mm)		-							-							-																				

1 = Widths and depths for annual measurements will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established. If the performer has inherited the project and cannot acquire the datum used for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: "It is uncertain if the monitoring datum has been consistent over the monitoring history, which may influence calculated values. Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary."

Table 10a. Monitoring Data - Stream Reach Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - Meadow Brook Reach 1 (1936 feet)

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
	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
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	13.3	16.003	16.42	18.29	2.1	3																														
Floodprone Width (ft)	>44	>54	>56	>62	-	3																														
Bankfull Mean Depth (ft)	1.1	1.2	1.2	1.2	0.0	3																														
¹ Bankfull Max Depth (ft)	1.8	1.8	1.8	1.9	0.1	3																														
Bankfull Cross Sectional Area (ft ²)	16.4	18.9	19.5	20.7	1.8	3																														
Width/Depth Ratio	10.8	13.6	13.8	16.2	2.2	3																														
Entrenchment Ratio	>3.1	>3.1	>3.1	>3.1	-	3																														
¹ Bank Height Ratio	1	1	1	1	-	3																														
Profile																																				
Riffle Length (ft)	32.159	55.736	60.145	72.003	14.194	12																														
Riffle Slope (ft/ft)	0.003	0.004	0.004	0.006	0.001	12																														
Pool Length (ft)	20.409	27.884	26.607	36.731	5.1084	17																														
Pool Max depth (ft)	0.663	1.4958	1.34	3.133	0.6676	19																														
Pool Spacing (ft)	49.97	94.985	99.565	119.4	20.897	16																														
Pattern																																				
Channel Beltwidth (ft)	55.0	76.3	69.1	106.6	15.0	18																														
Radius of Curvature (ft)	30.4	32.6	31.5	40.8	2.7	18																														
Rc:Bankfull width (ft/ft)	1.9	2.0	2.0	2.5	0.2	18																														
Meander Wavelength (ft)	108.0	135.0	136.4	166.0	18.0	17																														
Meander Width Ratio	3.4	4.7	4.3	6.6	0.8	17																														
Additional Reach Parameters																																				
Rosgen Classification	C4																																			
Channel Thalweg length (ft)	1965																																			
Sinuosity (ft)	1.4																																			
Water Surface Slope (Channel) (ft/ft)	0.0035																																			
BF slope (ft/ft)	0.0035																																			
³ Ri% / Ru% / P% / G% / S%																																				
³ SC% / Sa% / G% / C% / B% / Be%																																				
³ d16 / d35 / d50 / d84 / d95 /																																				
² % of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

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

Table 10b. Monitoring Data - Stream Reach Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - Meadow Brook Reach 2 (393 feet)

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
	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
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	19.48	19.48	19.48	19.48	-	1																														
Floodprone Width (ft)	>63	>63	>63	>63	-	1																														
Bankfull Mean Depth (ft)	1.4	1.4	1.4	1.4	-	1																														
¹ Bankfull Max Depth (ft)	2.0	2.0	2.0	2.0	-	1																														
Bankfull Cross Sectional Area (ft ²)	26.44	26.44	26.44	26.44	-	1																														
Width/Depth Ratio	14.32	14.32	14.32	14.32	-	1																														
Entrenchment Ratio	>3.2	>3.2	>3.2	>3.2	-	1																														
¹ Bank Height Ratio	1	1	1	1	-	1																														
Profile																																				
Riffle Length (ft)	66.562	77.793	80.557	86.259	8.3	3																														
Riffle Slope (ft/ft)	0.001	0.003	0.002	0.005	0.001	3																														
Pool Length (ft)	16.821	24.68	23.716	34.469	6.5	4																														
Pool Max depth (ft)	1.0	1.8	1.7	2.9	0.7	4																														
Pool Spacing (ft)	89.8	115.9	112.1	149.5	21.9	4																														
Pattern																																				
Channel Beltwidth (ft)	81.2	87.7	89.9	92.1	4.7	3																														
Radius of Curvature (ft)	37.3	38.5	38.7	39.2	0.7	4																														
Rc:Bankfull width (ft/ft)	1.9	2.0	2.0	2.0	0.0	4																														
Meander Wavelength (ft)	149.2	154.3	155.5	156.8	3.0	4																														
Meander Width Ratio	4.2	4.5	4.6	4.7	0.2	3																														
Additional Reach Parameters																																				
Rosgen Classification	C4																																			
Channel Thalweg length (ft)	390																																			
Sinuosity (ft)	1.2																																			
Water Surface Slope (Channel) (ft/ft)	0.0039																																			
BF slope (ft/ft)	0.0039																																			
³ Ri% / Ru% / P% / G% / S%																																				
³ SC% / Sa% / G% / C% / B% / Be%																																				
³ d16 / d35 / d50 / d84 / d95 /																																				
² % of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

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

Table 10c. Monitoring Data - Stream Reach Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - Meadow Brook Reach 3 (273 feet) and Meadow Brook Reach 4 (218 feet)

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
	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
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	17.84	17.84	17.84	17.84	-	1																														
Floodprone Width (ft)	>70	>70	>70	>70	-	1																														
Bankfull Mean Depth (ft)	1.3	1.3	1.3	1.3	-	1																														
¹ Bankfull Max Depth (ft)	2.1	2.1	2.1	2.1	-	1																														
Bankfull Cross Sectional Area (ft ²)	24.0	24.0	24.0	24.0	-	1																														
Width/Depth Ratio	13.31	13.31	13.31	13.31	-	1																														
Entrenchment Ratio	>3.9	>3.9	>3.9	>3.9	-	1																														
¹ Bank Height Ratio	1	1	1	1	-	1																														
Profile																																				
Riffle Length (ft)	38.205	73.491	62.175	131.41	36.941	4																														
Riffle Slope (ft/ft)	0.002	0.006	0.007	0.010	0.003	4																														
Pool Length (ft)	17.685	36.168	33.999	59.308	13.444	5																														
Pool Max depth (ft)	1.2	1.4	1.4	1.9	0.2	5																														
Pool Spacing (ft)	29.9	94.0	103.4	168.9	47.2	5																														
Pattern																																				
Channel Beltwidth (ft)	-	-	-	-	-	-																														
Radius of Curvature (ft)	39.2	40.8	40.8	42.4	1.6	2.0																														
Rc:Bankfull width (ft/ft)	2.2	2.3	2.3	2.4	0.1	2.0																														
Meander Wavelength (ft)	-	-	-	-	-	-																														
Meander Width Ratio	-	-	-	-	-	-																														
Additional Reach Parameters																																				
Rosgen Classification					Bc4																															
Channel Thalweg length (ft)					532																															
Sinuosity (ft)					1.05																															
Water Surface Slope (Channel) (ft/ft)					0.007																															
BF slope (ft/ft)					0.007																															
³ Ri% / Ru% / P% / G% / S%																																				
³ SC% / Sa% / G% / C% / B% / Be%																																				
³ d16 / d35 / d50 / d84 / d95 /																																				
² % of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

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

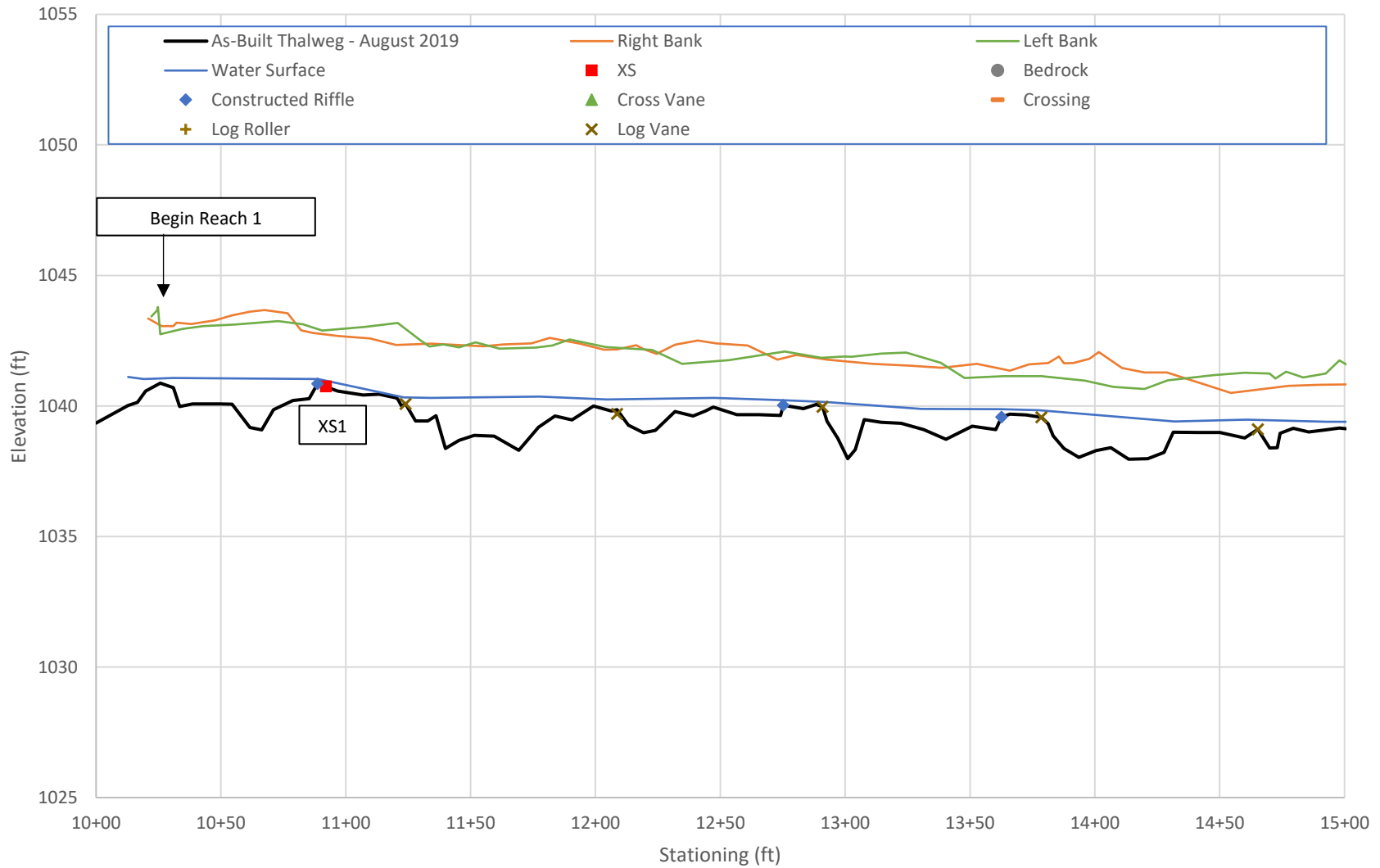
Table 10d. Monitoring Data - Stream Reach Data Summary
Meadow Brook Stream Restoration Project (DMS No. 100024) - UT to Meadow Brook (703 feet)

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
	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
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	11.14	12.01	12.01	12.88	0.87	3																														
Floodprone Width (ft)	>49	>49	>49	>49	-	3																														
Bankfull Mean Depth (ft)	1.0	1.1	1.1	1.2	0.1	3																														
¹ Bankfull Max Depth (ft)	1.5	1.7	1.7	1.9	0.2	3																														
Bankfull Cross Sectional Area (ft ²)	10.9	13.2	13.2	15.5	2.3	3																														
Width/Depth Ratio	10.6	11.0	11.0	11.4	0.4	3																														
Entrenchment Ratio	>3.8	>4.1	>4.1	>4.4	-	3																														
¹ Bank Height Ratio	1	1	1	1	0	3																														
Profile																																				
Riffle Length (ft)	33.499	43.384	44.402	51.232	7.6053	4																														
Riffle Slope (ft/ft)	0.001	0.008	0.010	0.013	0.005	5																														
Pool Length (ft)	21.9	29.1	26.0	39.5	6.8	5																														
Pool Max depth (ft)	0.9	1.3	1.4	1.8	0.4	5																														
Pool Spacing (ft)	49.828	70.649	68.9	94.97	16.588	4																														
Pattern																																				
Channel Beltwidth (ft)	45.4	56.8	56.7	67.8	7.7	6.0																														
Radius of Curvature (ft)	26.4	30.0	29.7	33.9	2.8	7.0																														
Rc:Bankfull width (ft/ft)	2.2	2.5	2.5	2.8	0.2	7.0																														
Meander Wavelength (ft)	113.9	117.9	116.0	126.0	4.1	6.0																														
Meander Width Ratio	3.8	4.7	4.7	5.6	0.6	6.0																														
Additional Reach Parameters																																				
Rosgen Classification				C4																																
Channel Thalweg length (ft)				694																																
Sinuosity (ft)				1.32																																
Water Surface Slope (Channel) (ft/ft)				0.005																																
BF slope (ft/ft)				0.005																																
³ Ri% / Ru% / P% / G% / S%																																				
³ SC% / Sa% / G% / C% / B% / Be%																																				
³ d16 / d35 / d50 / d84 / d95 /																																				
² % of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

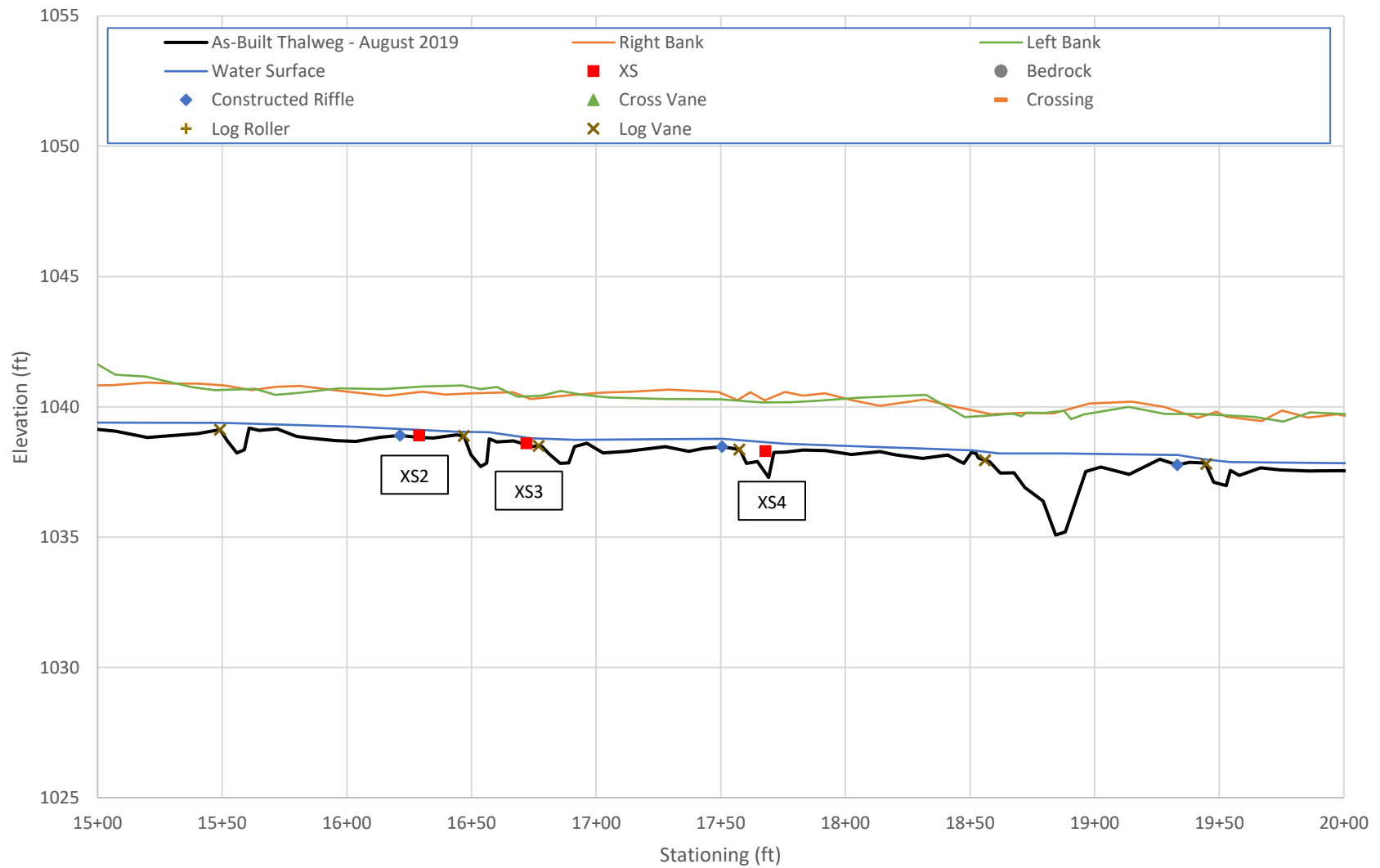
Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

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

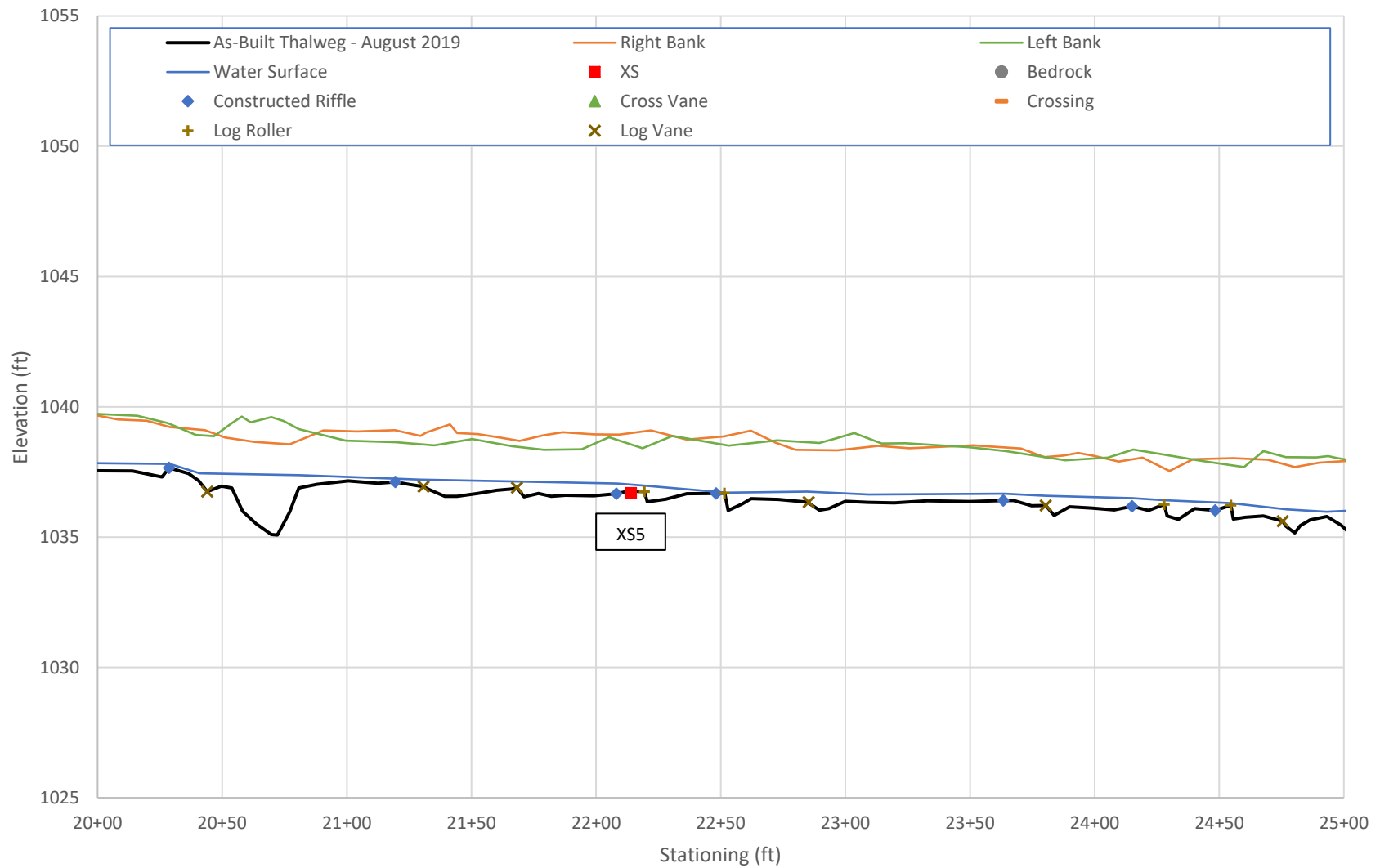
Longitudinal Profile - Baseline (August 2019) Mainstem - Sta. 10+00 - 15+00



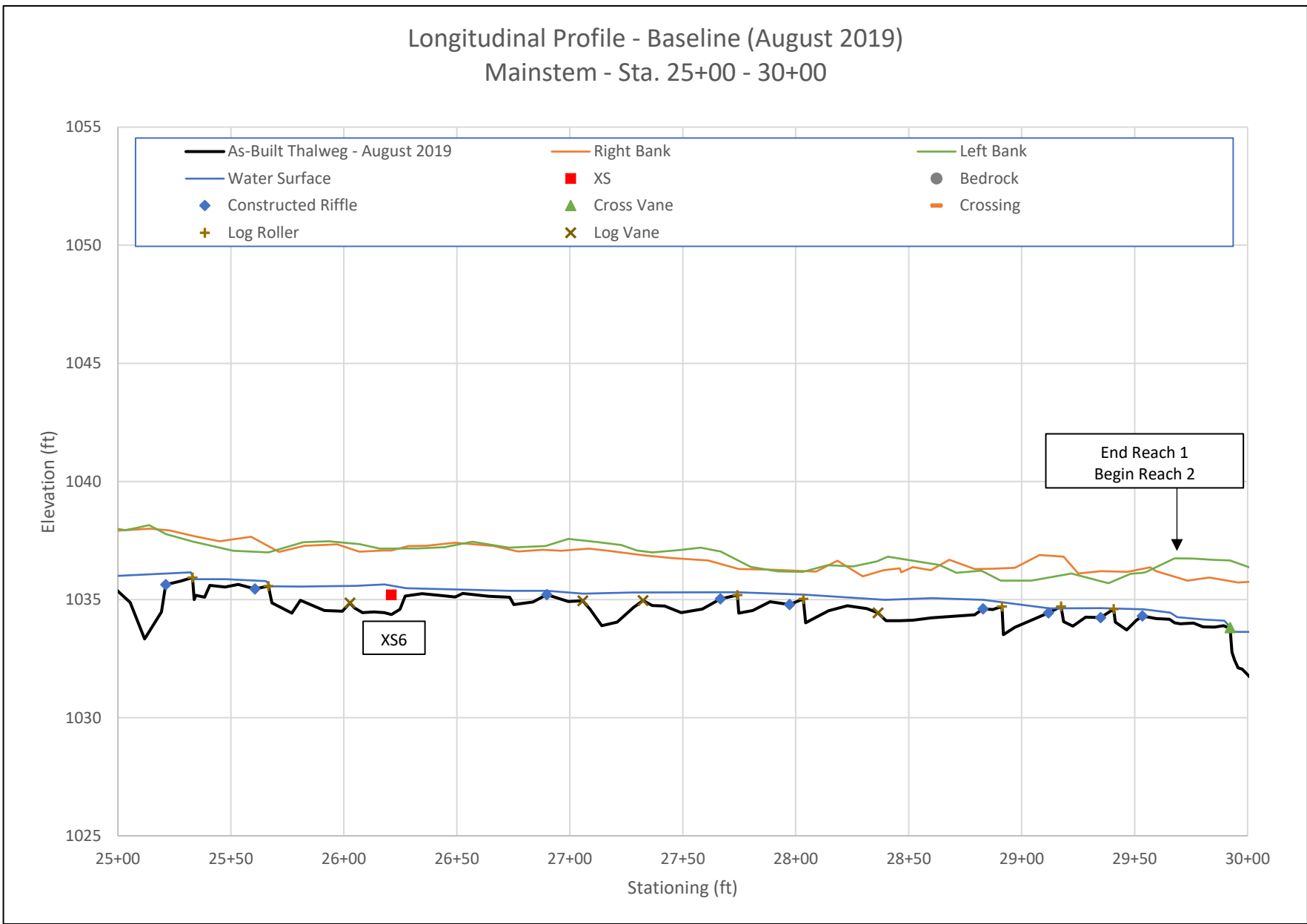
Longitudinal Profile - Baseline (August 2019) Mainstem - Sta. 15+00 - 20+00



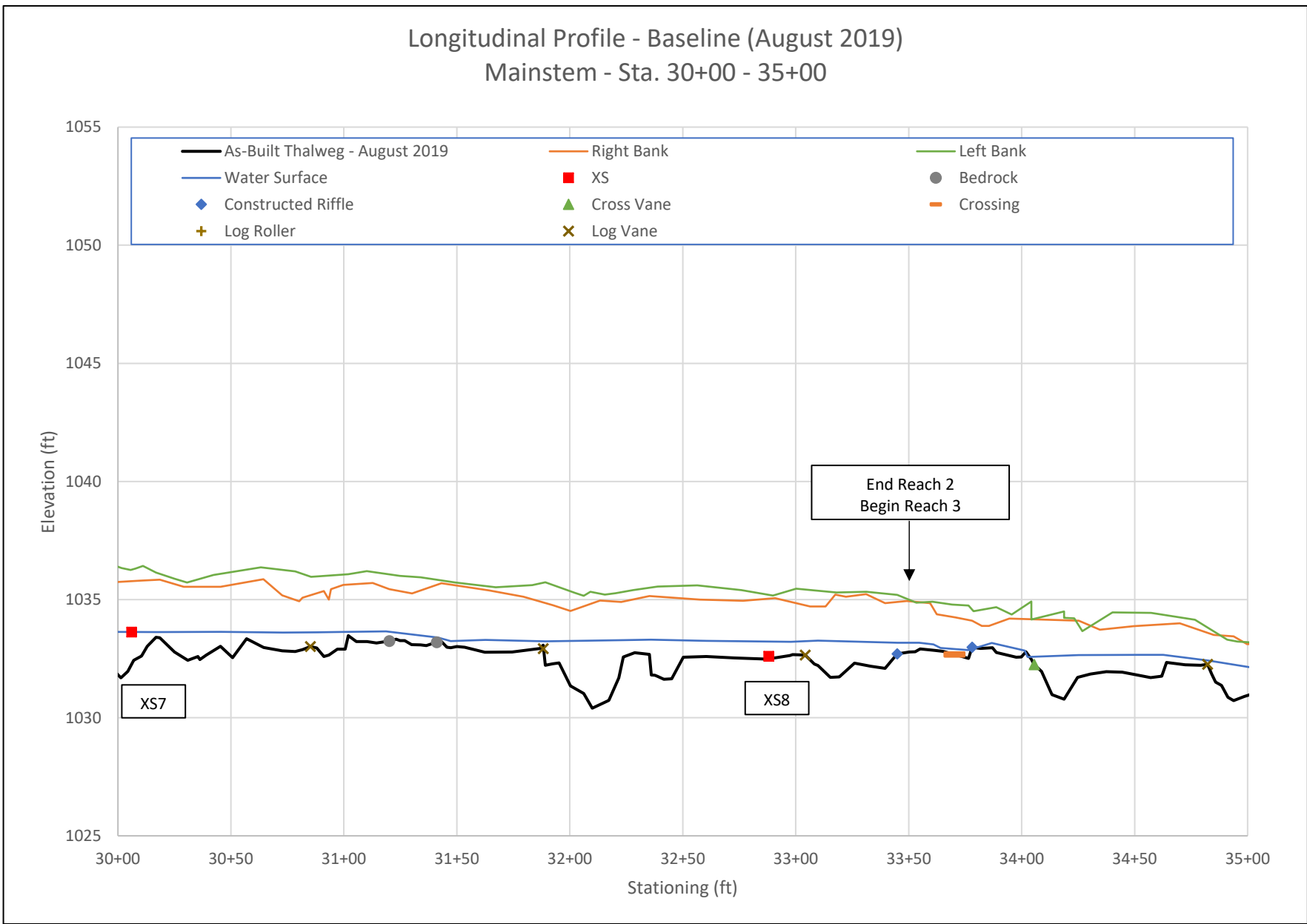
Longitudinal Profile - Baseline (August 2019) Mainstem - Sta. 20+00 - 25+00



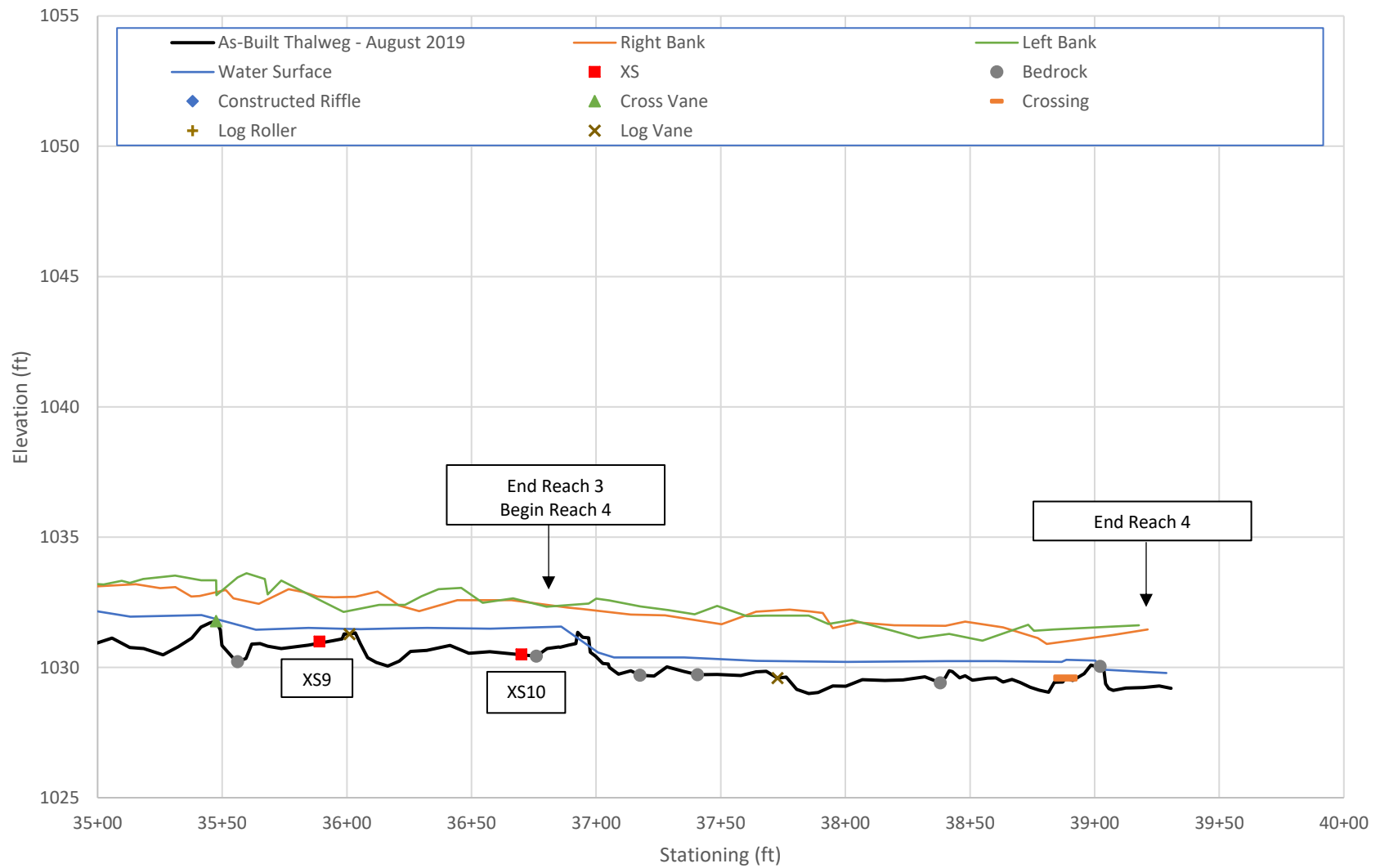
Longitudinal Profile - Baseline (August 2019) Mainstem - Sta. 25+00 - 30+00



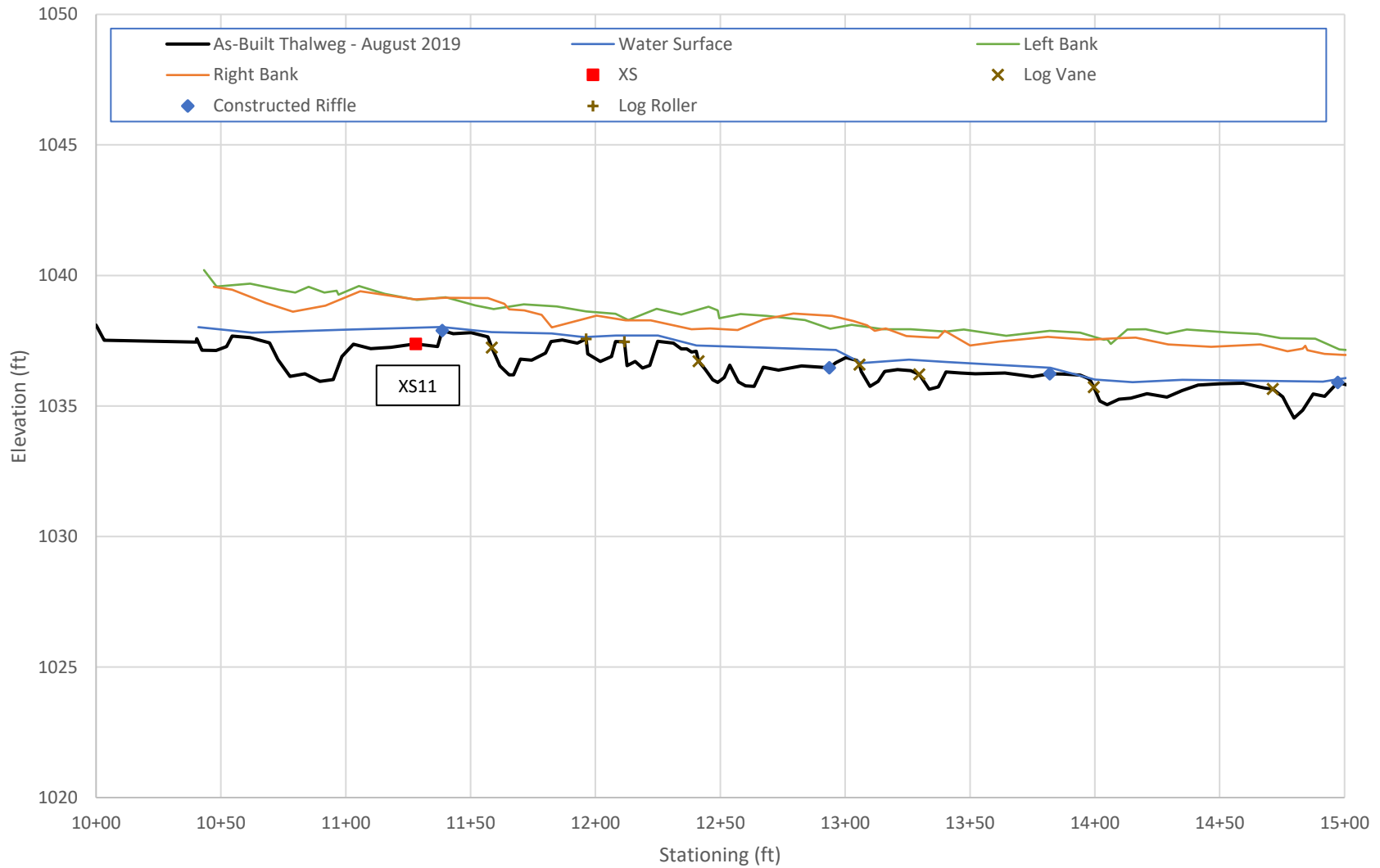
Longitudinal Profile - Baseline (August 2019) Mainstem - Sta. 30+00 - 35+00



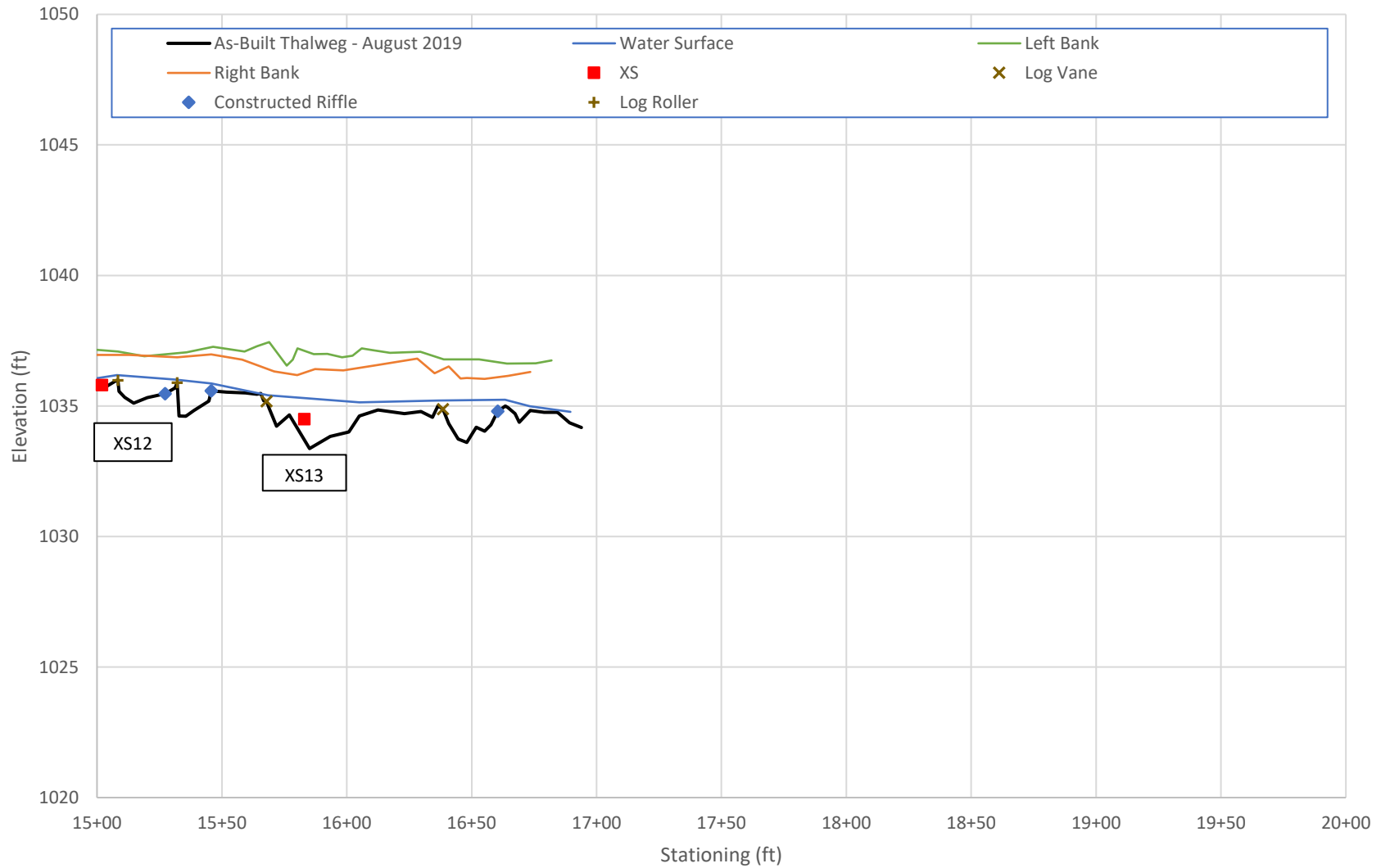
Longitudinal Profile - Baseline (August 2019) Mainstem - Sta. 35+00 - 39+31



Longitudinal Profile - Baseline (August 2019) UT - Sta. 10+00 - 15+00



Longitudinal Profile - Baseline (August 2019)
UT - Sta. 15+00 - 16+94



Cross Section Plot - Baseline
XS1 - Reach 1
Station 10+87 - Riffle

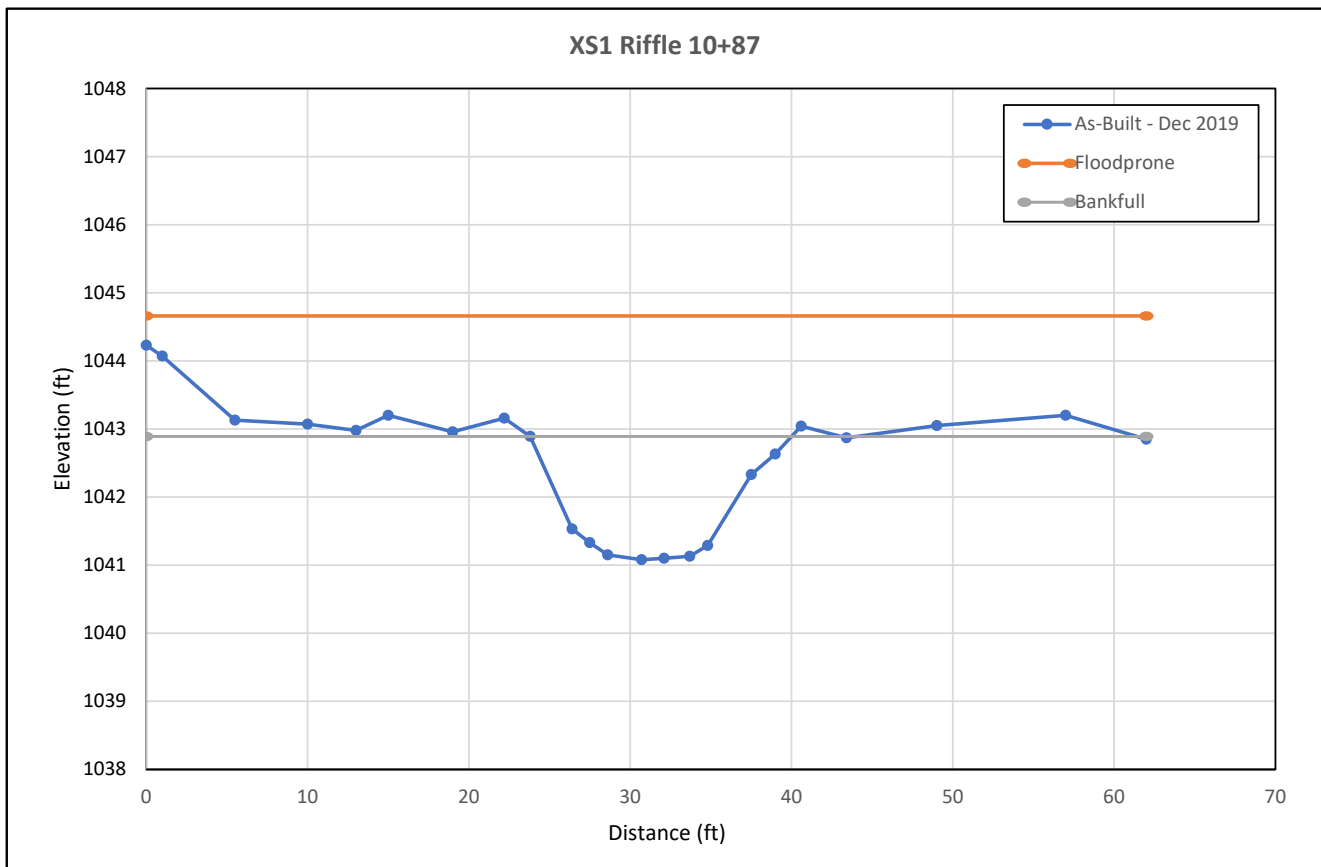


XS1 looking upstream



XS1 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1042.87	19.49	16.42	1044.66	> 62	1.79	1.19	13.8	> 3.78	1



Cross Section Plot - Baseline
XS2 - Reach 1
Station 16+08- Riffle

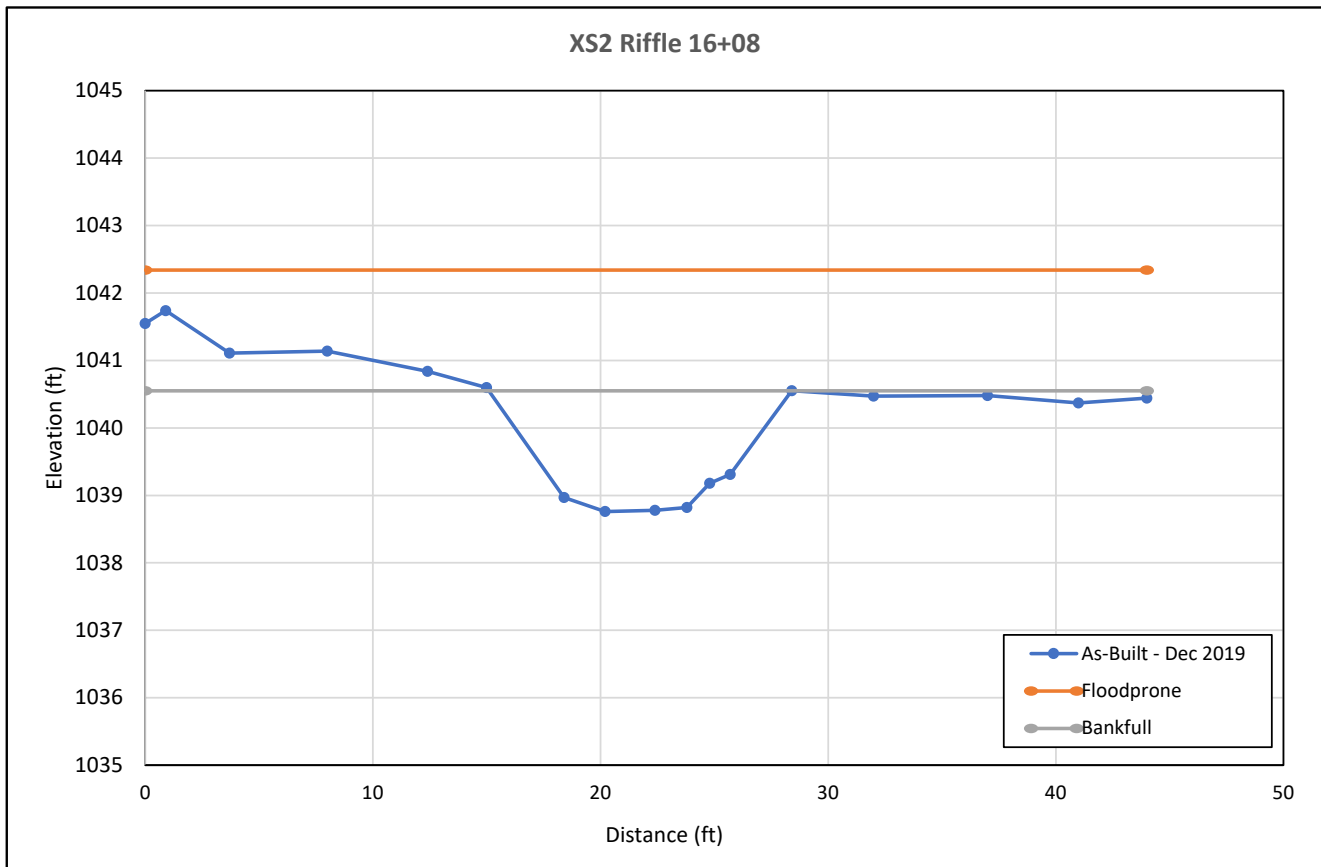


XS2 looking upstream



XS2 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1040.55	16.4	13.3	1042.34	> 44	1.79	1.23	10.81	> 3.31	1



Cross Section Plot - Baseline
XS3 - Reach 1
Station 16+48- Pool

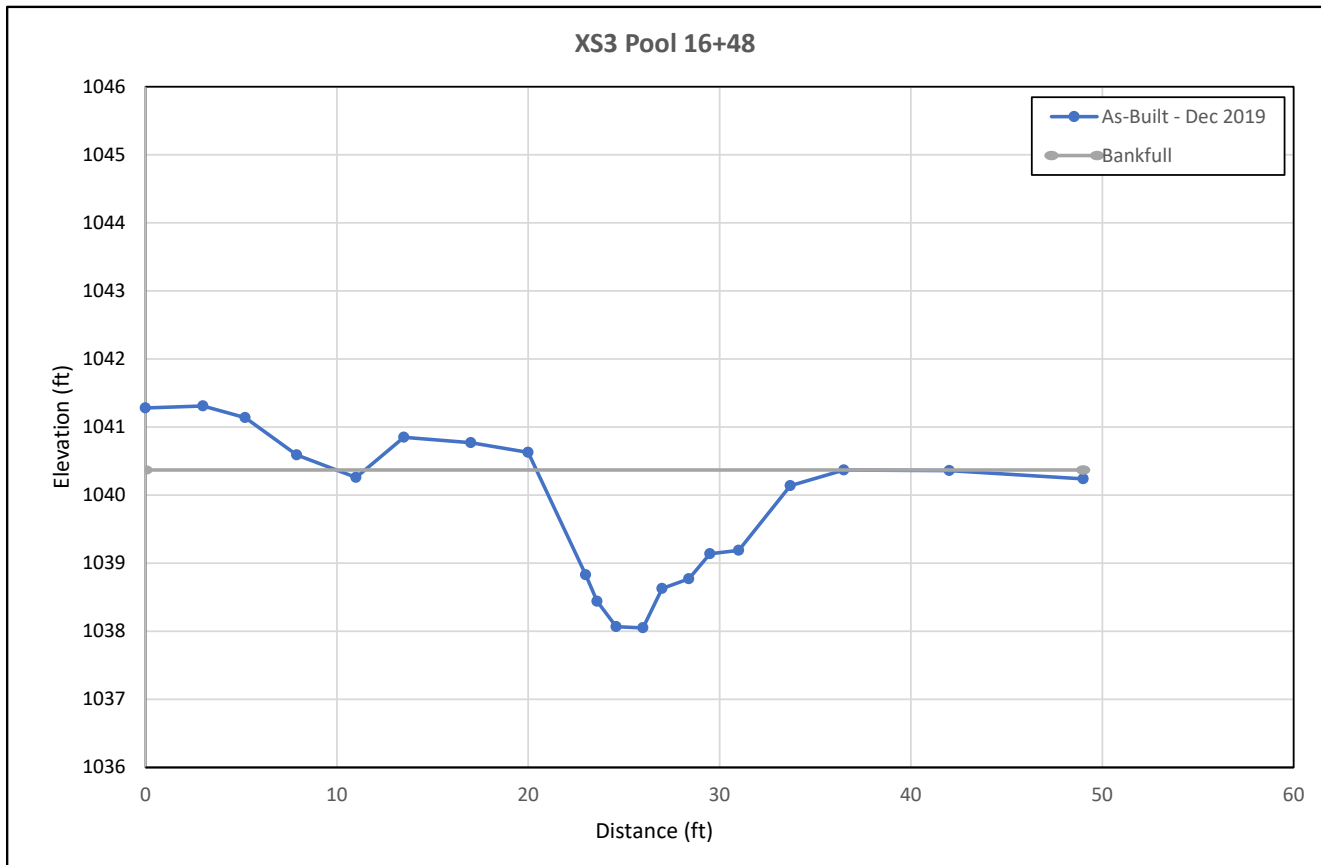


XS3 looking upstream



XS3 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1040.37	18.32	16.07	NA	NA	2.32	1.14	14.1	NA	1



Cross Section Plot - Baseline
XS4 - Reach 1
Station 17+38- Pool

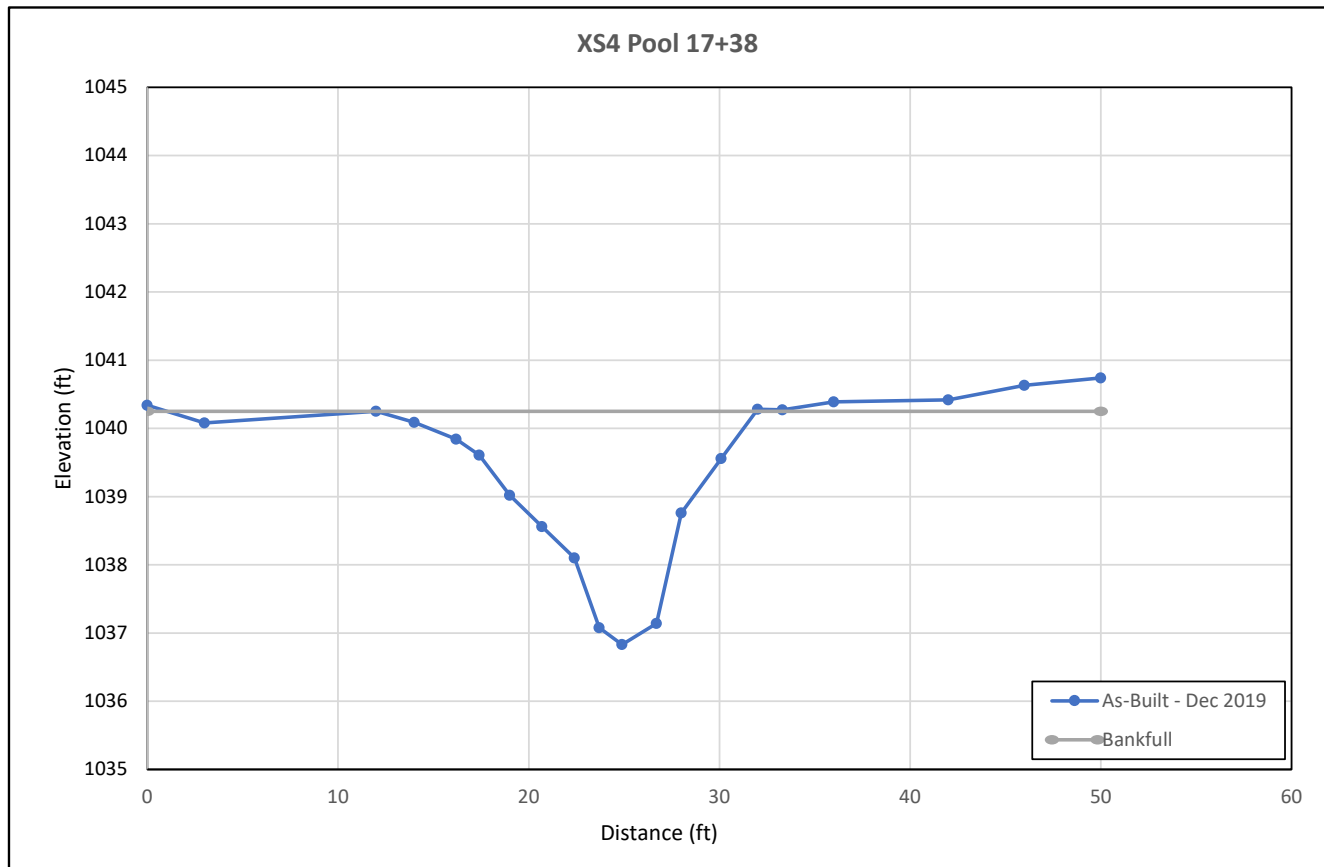


XS4 looking upstream



XS4 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1040.25	27.82	18.92	NA	NA	3.42	1.47	12.87	NA	1



Cross Section Plot - Baseline
XS5 - Reach 1
Station 21+77 - Riffle

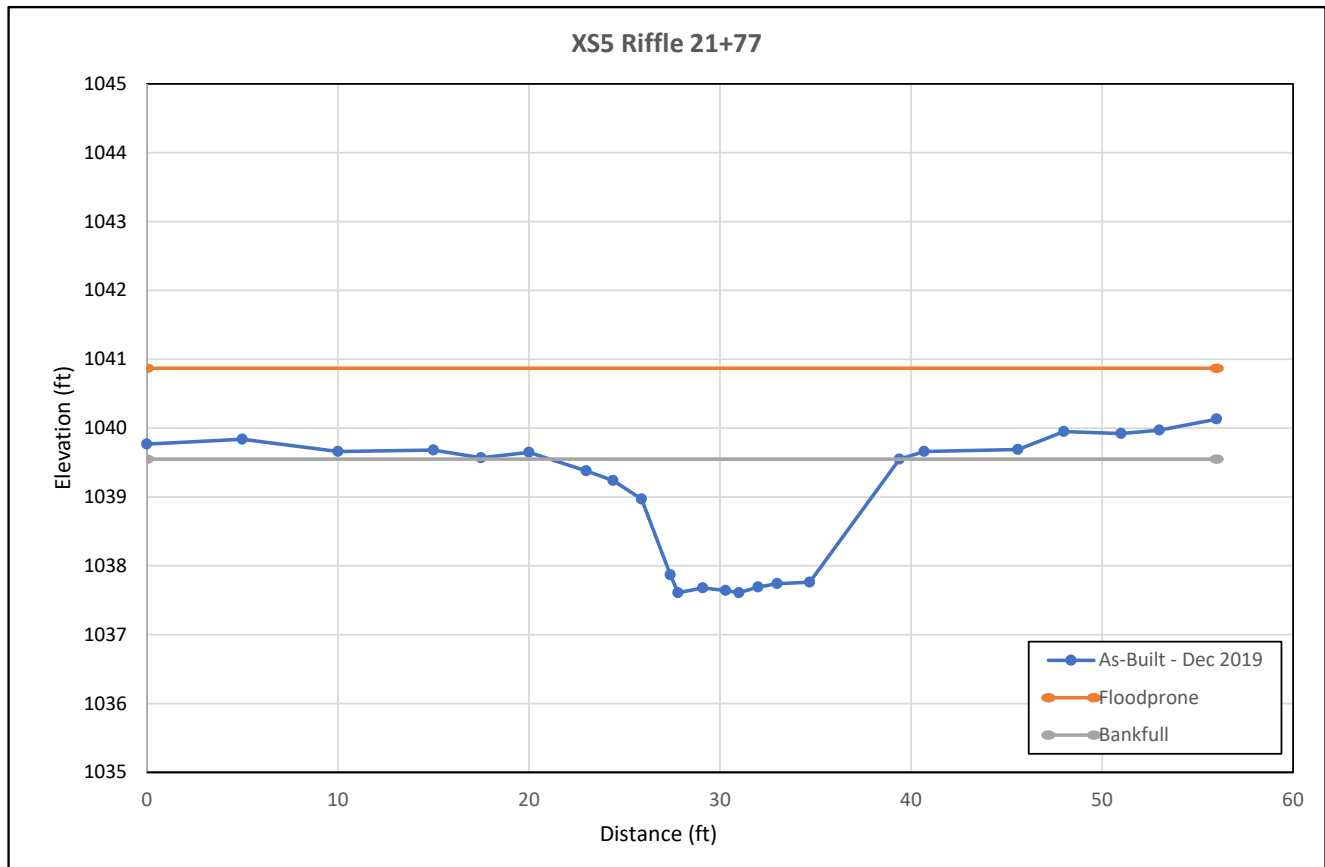


XS5 looking upstream



XS5 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1039.55	20.68	18.29	1041.49	> 56	1.94	1.13	16.19	> 3.06	1



Cross Section Plot - Baseline
XS6 - Reach 1
Station 25+74 - Pool

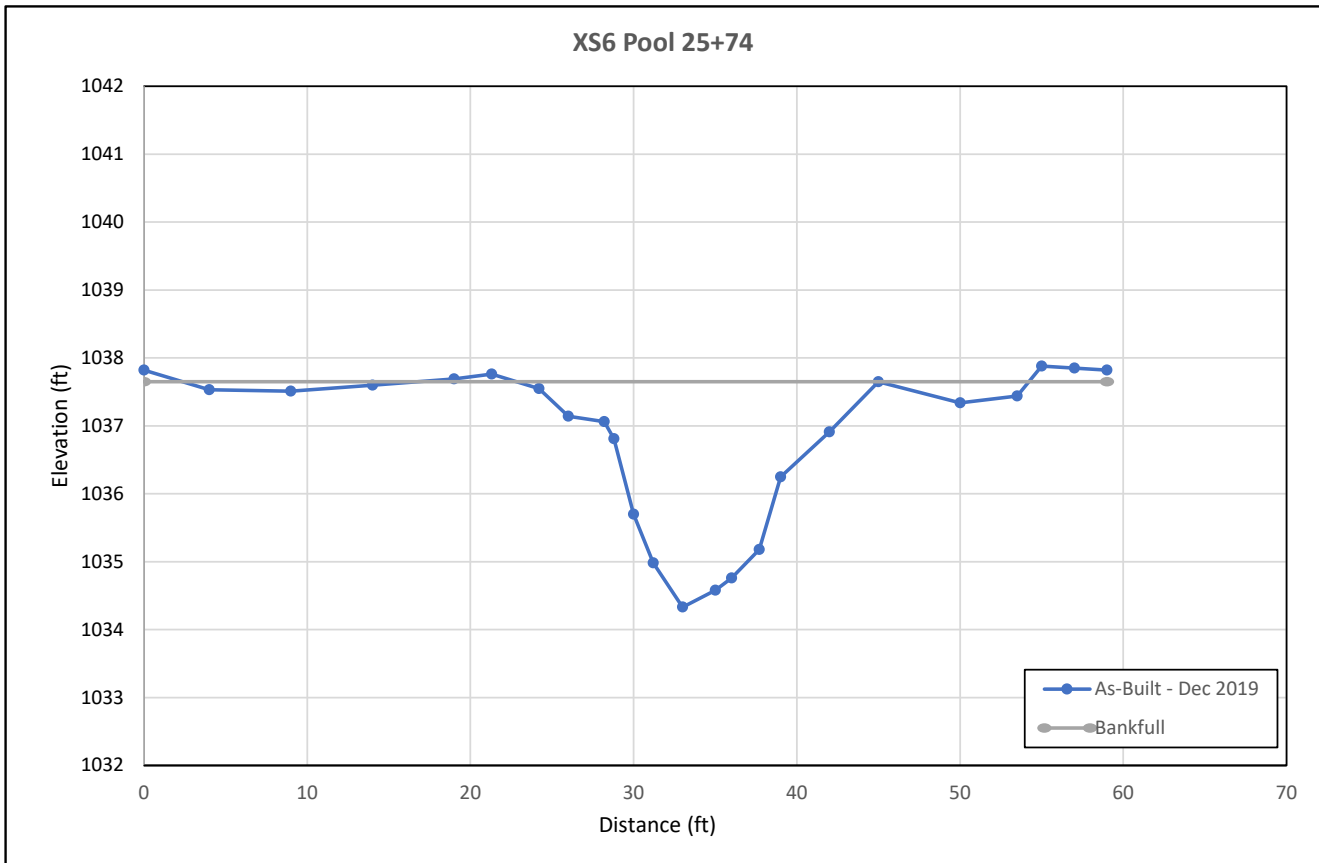


XS6 looking upstream



XS6 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1037.65	32.86	22.18	NA	NA	3.32	1.48	14.99	NA	1



Cross Section Plot - Baseline
XS7 - Reach 2
Station 29+50 - Pool

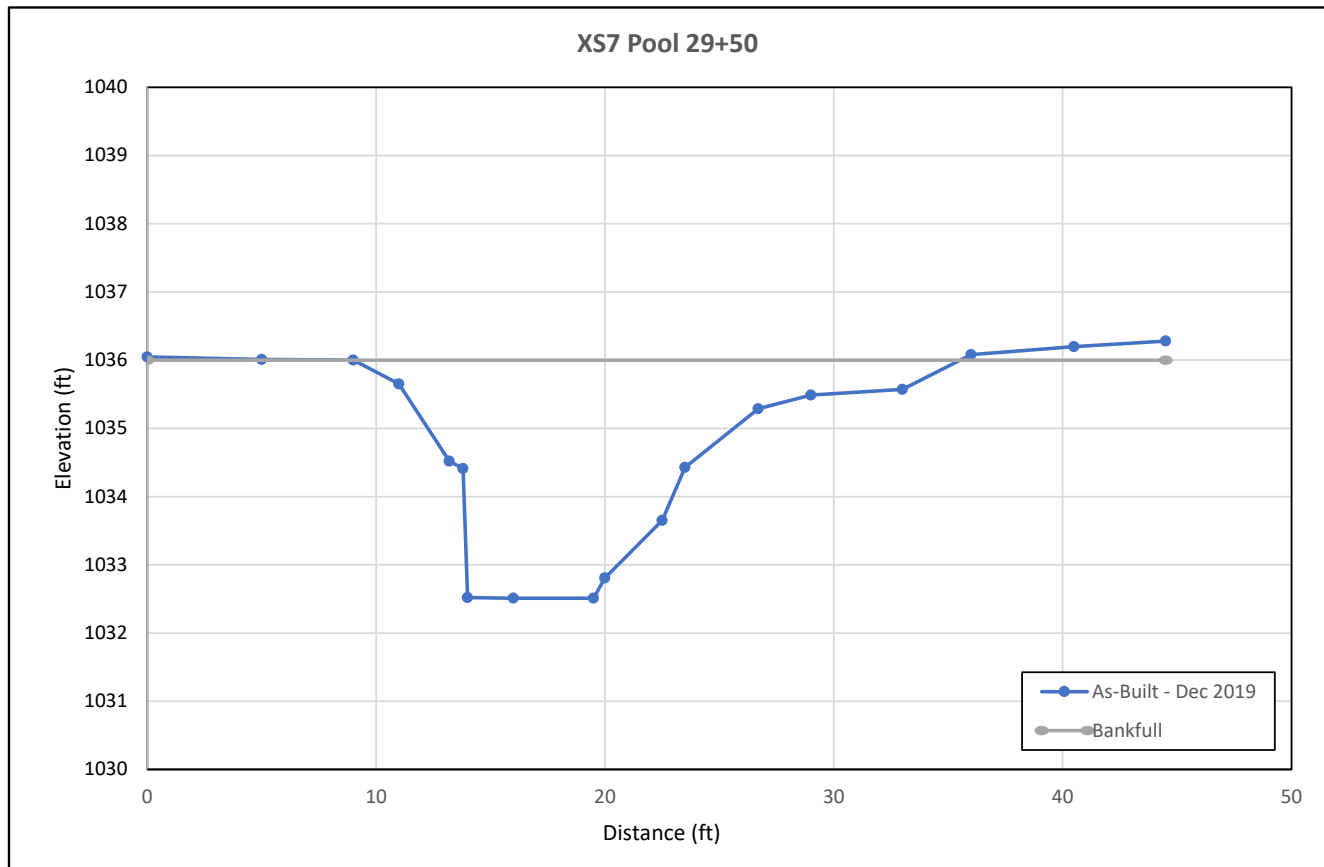


XS7 looking upstream



XS7 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1036	41.01	26.53	NA	NA	3.49	1.55	17.12	NA	1



Cross Section Plot - Baseline
XS8 - Reach 2
Station 32+28 - Riffle

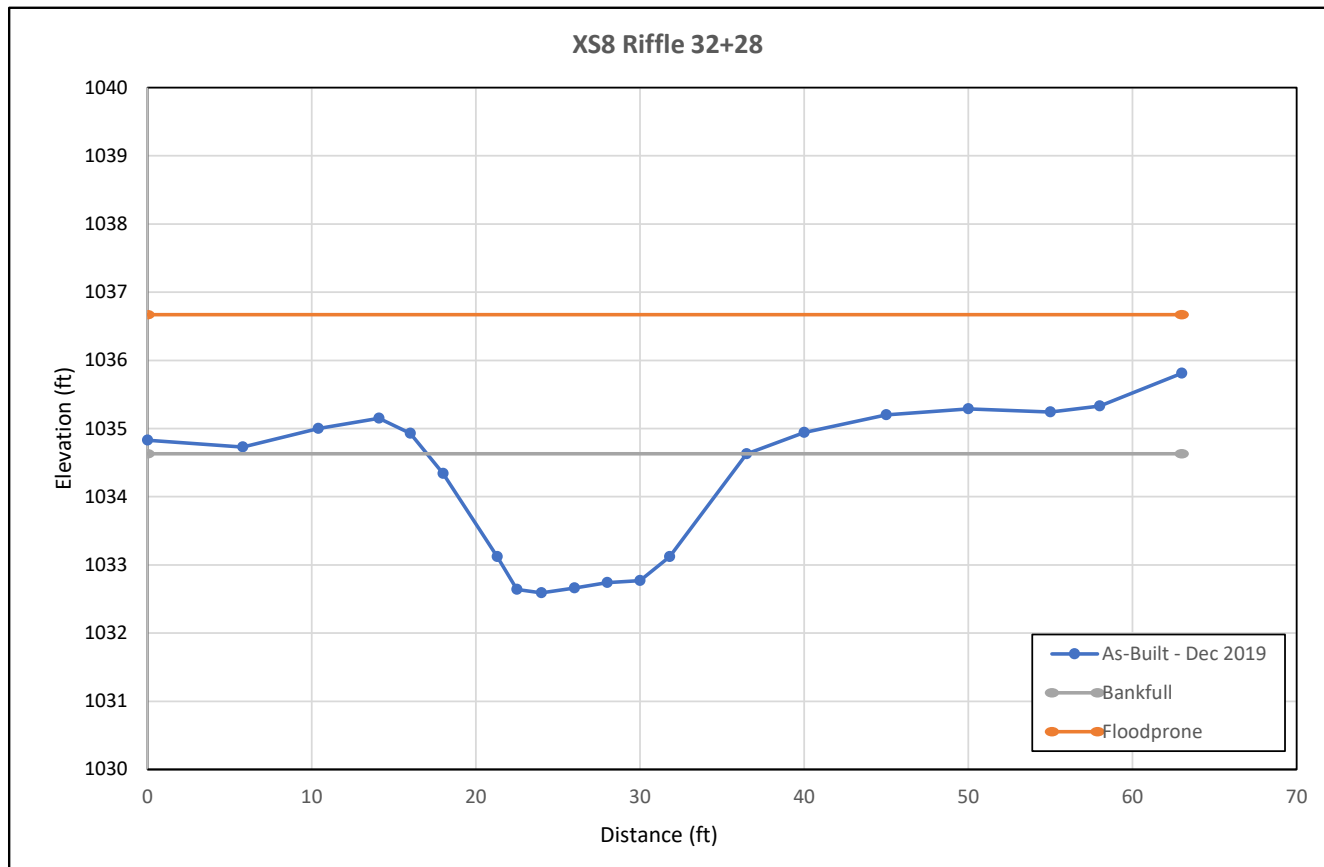


XS8 looking upstream



XS8 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1034.63	26.44	19.48	1036.67	> 63	2.04	1.36	14.32	> 3.23	1



Cross Section Plot - Baseline
XS9 - Reach 3
Station 35+28 - Riffle

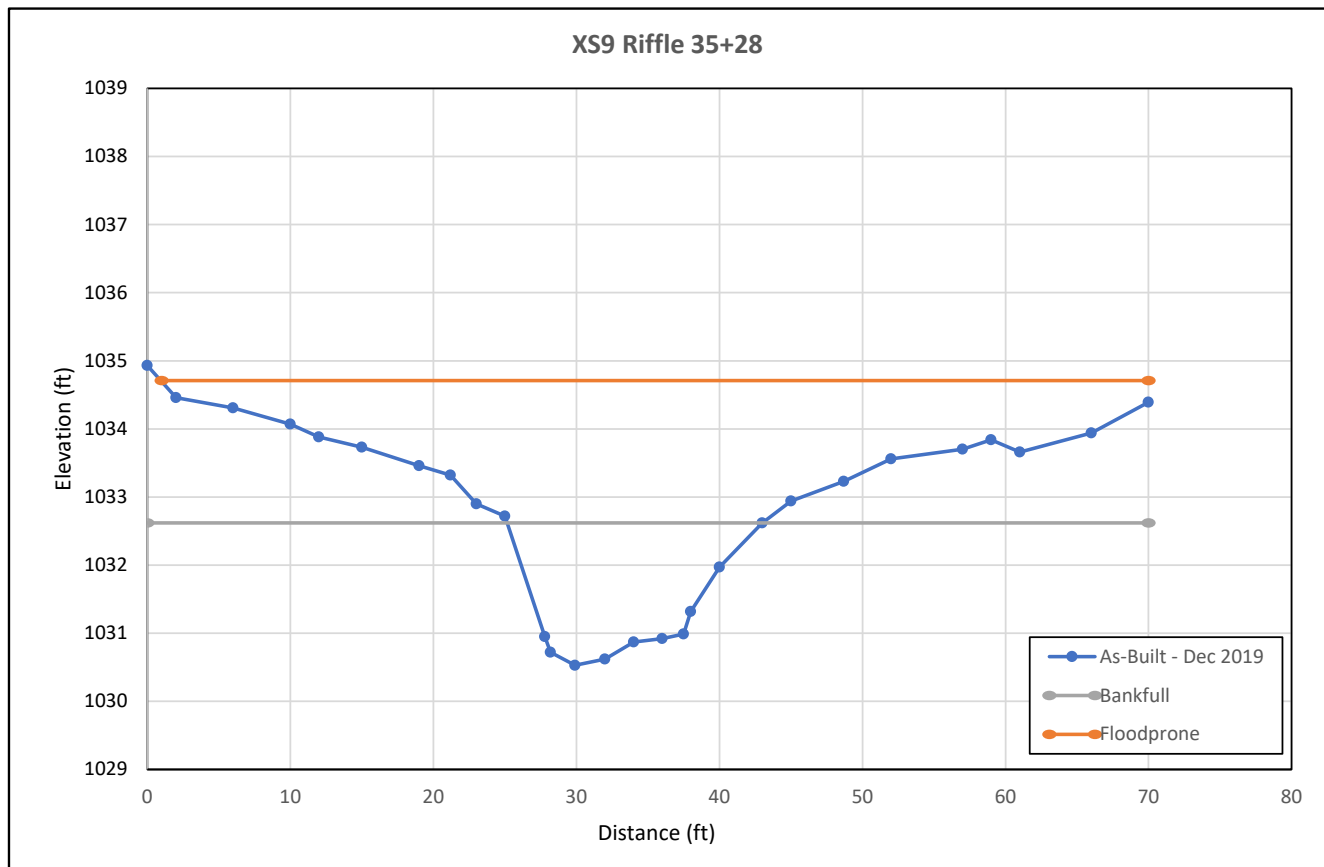


XS9 looking upstream



XS9 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1032.62	23.96	17.84	1034.71	> 70	2.09	1.34	13.31	> 3.87	1



Cross Section Plot - Baseline
XS10 - Reach 3
Station 36+11- Pool

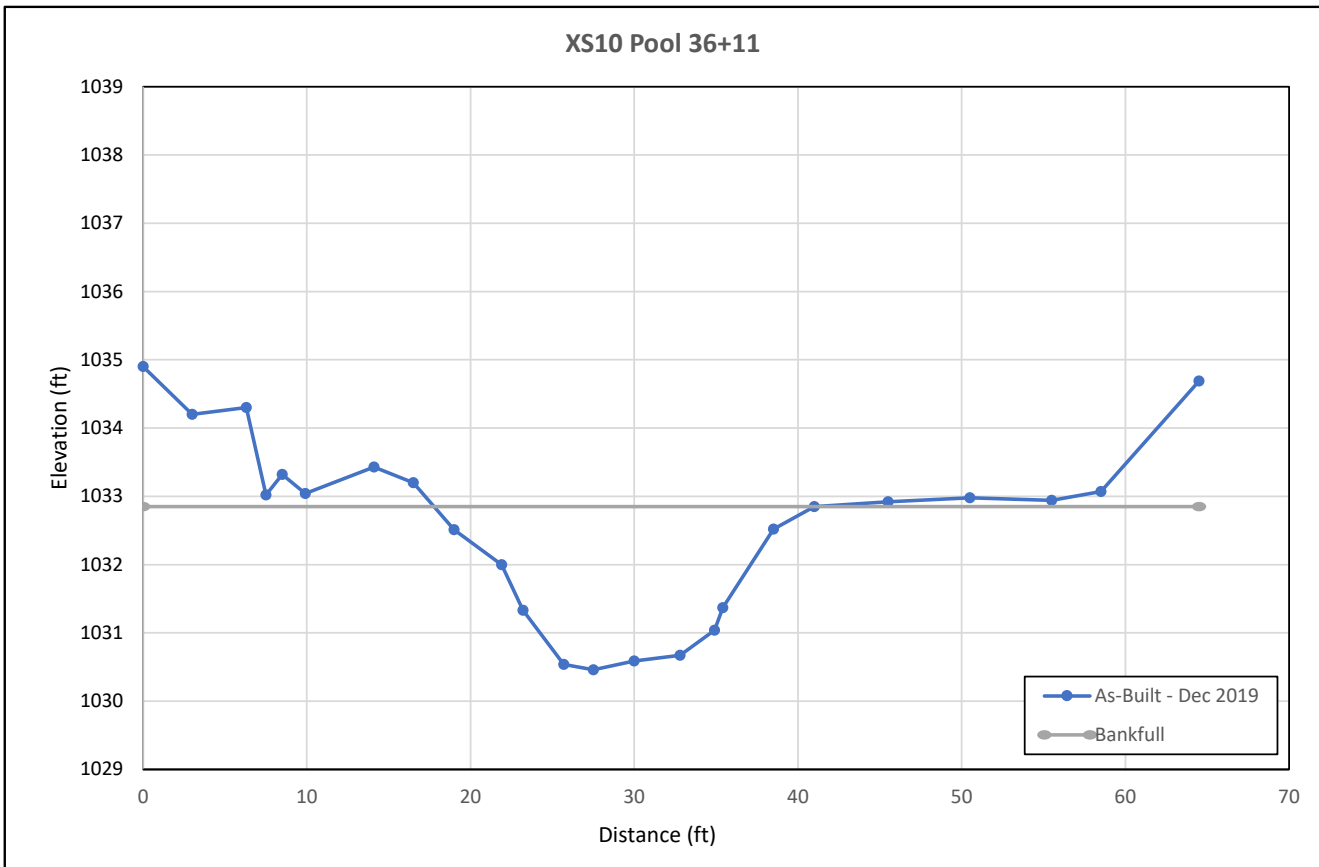


XS10 looking upstream



XS10 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1032.85	32.75	23.23	NA	NA	2.39	1.41	16.48	NA	1



Cross Section Plot - Baseline
XS11 - UT
Station 11+25 - Riffle

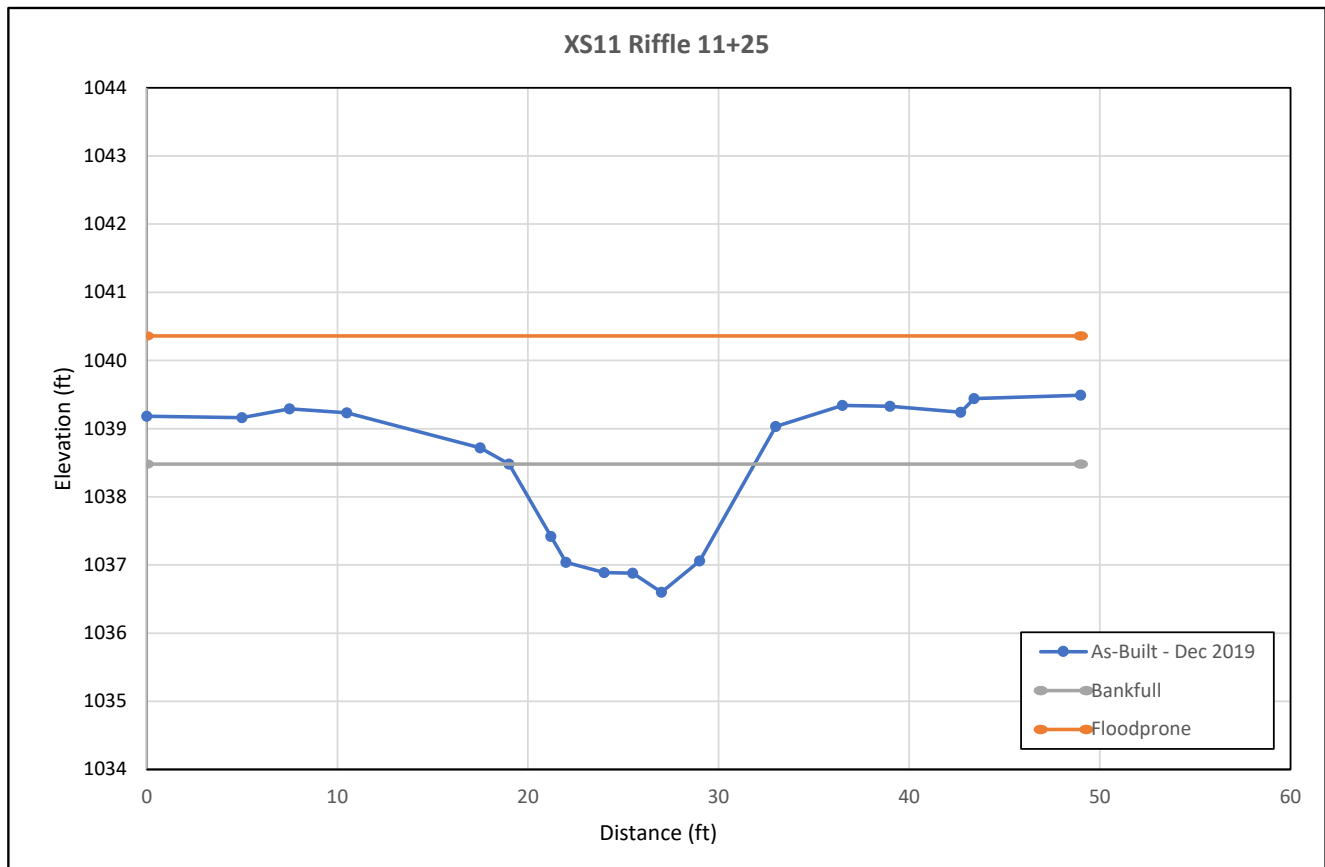


XS11 looking upstream



XS11 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1038.48	15.54	12.88	1040.36	> 49	1.88	1.21	10.64	> 3.8	1



Cross Section Plot - Baseline
XS12 - UT
Station 14+93 - Riffle

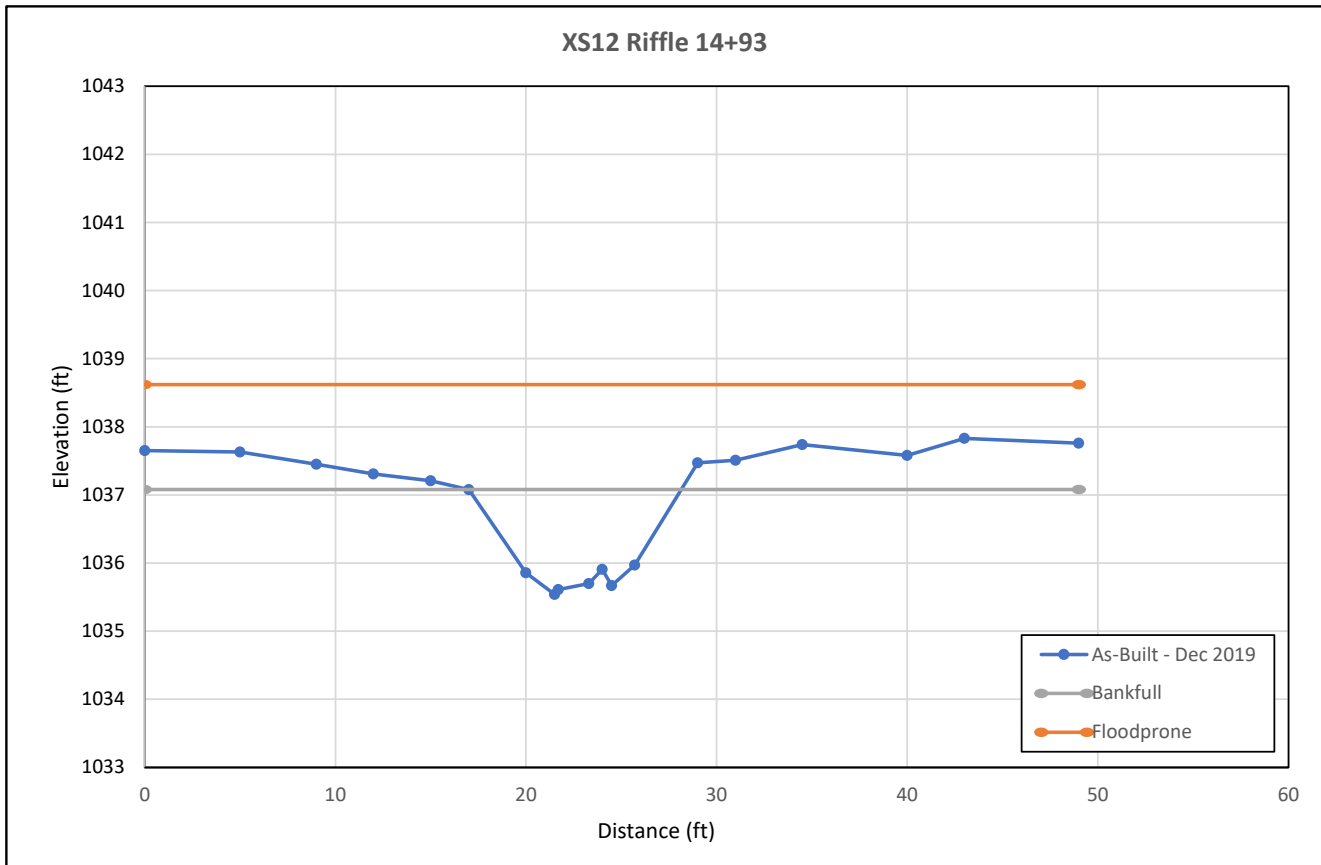


XS12 looking upstream



XS12 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1037.08	10.89	11.14	1038.62	> 49	1.54	0.98	11.37	> 4.4	1



Cross Section Plot - Baseline
XS13 - UT
Station 15+72 - Pool

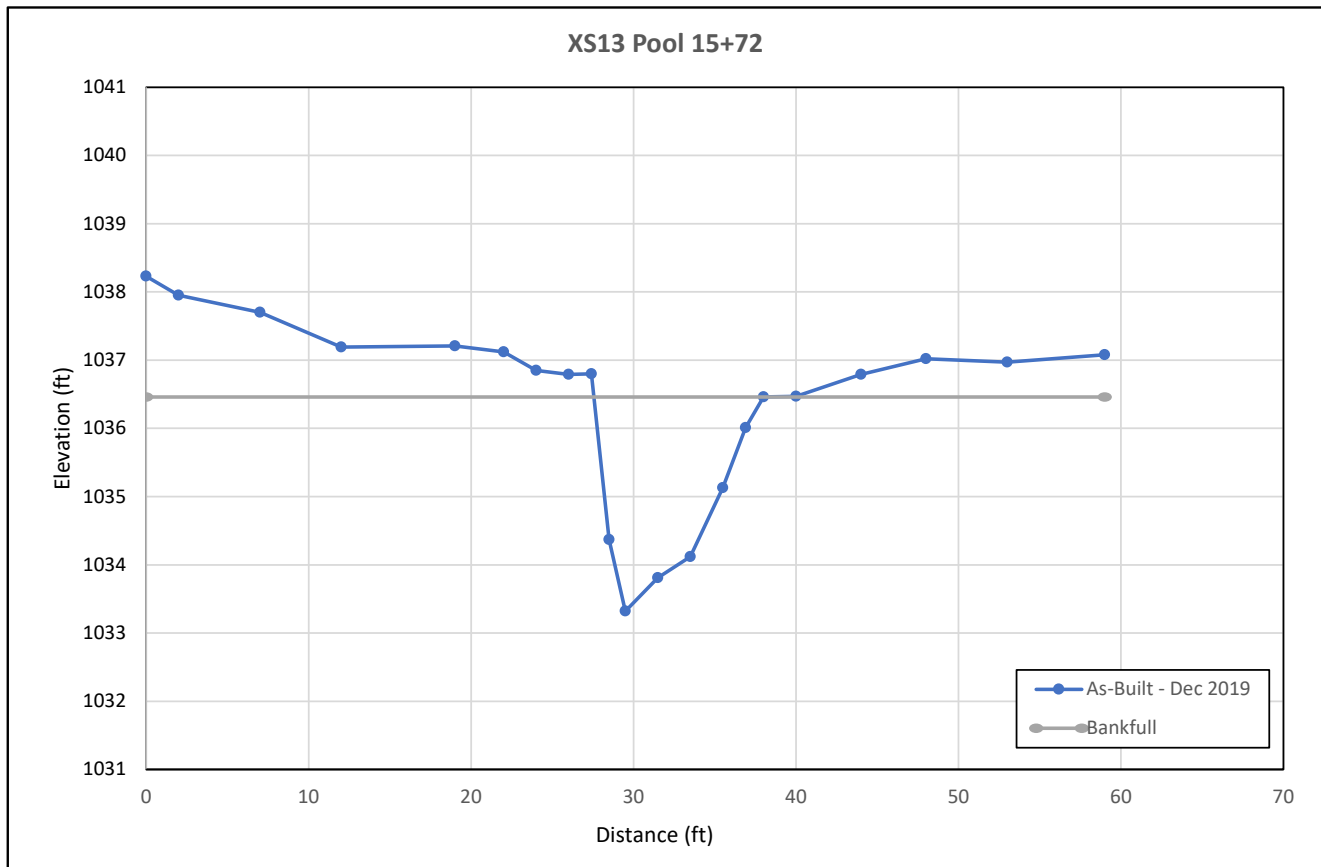


XS13 looking upstream



XS13 looking downstream

Bankfull Elevation (ft)	Bankfull Area (ft ²)	Bankfull Width (ft)	Floodprone Elevation (ft)	Floodprone Width (ft)	Max Depth (ft)	Mean Depth (ft)	W/D Ratio	Entrenchment Ratio	Bank Height Ratio
1036.46	19.55	10.45	NA	NA	3.14	1.87	5.59	NA	1



Appendix E
As-Built Plan Sheets

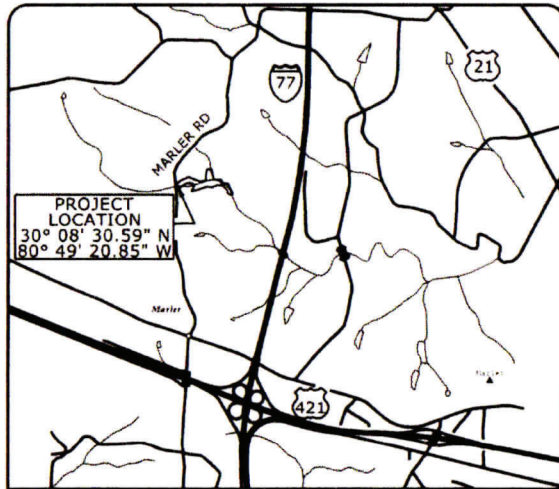
PROJECT: MEADOW BROOK

NC DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES

STATE NC	PROJECT REFERENCE NO. 082	SHEET NO. 1	TOTAL SHEETS 10
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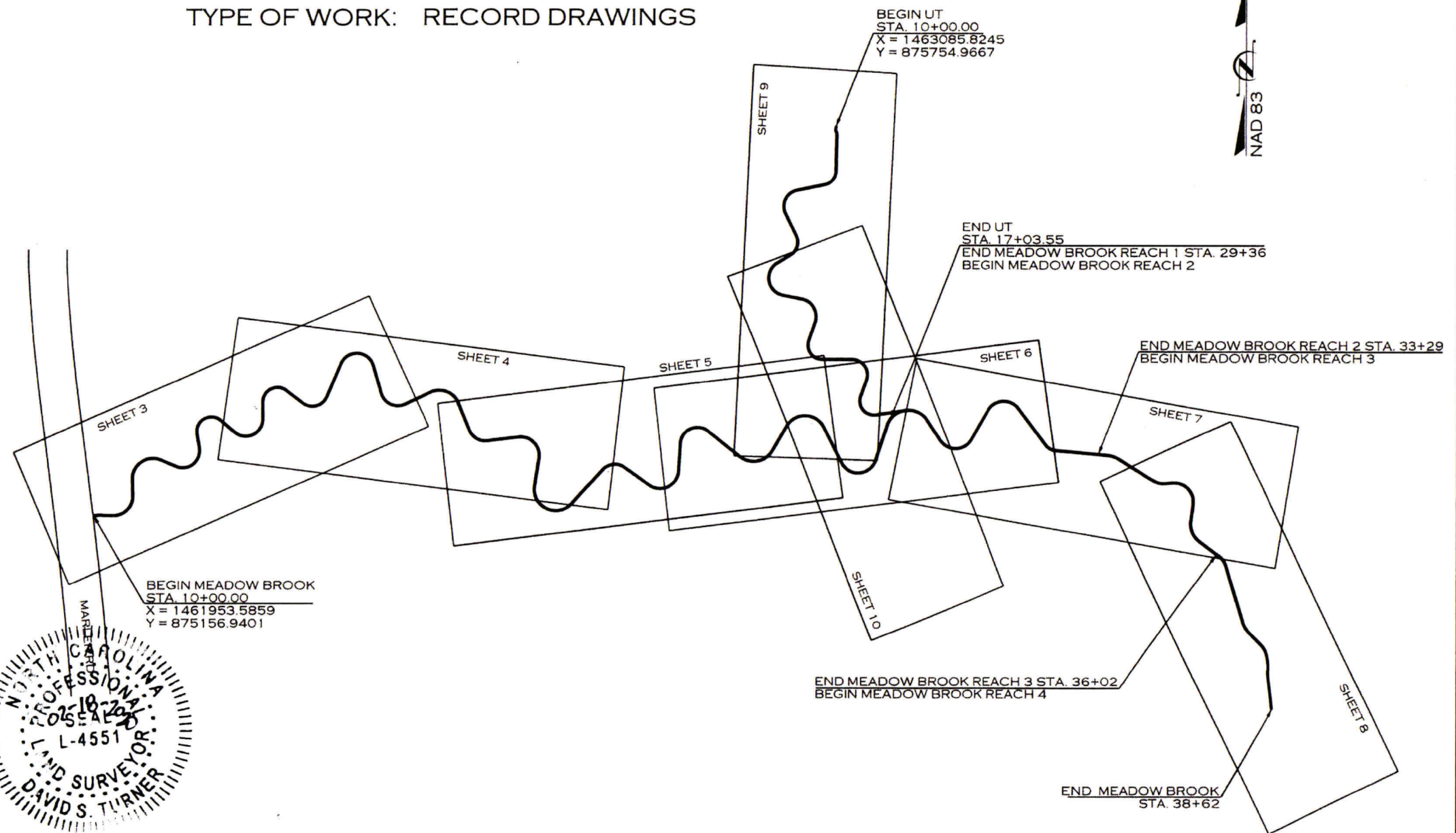
YADKIN COUNTY

LOCATION: MARLER RD., YADKIN COUNTY, NC
TYPE OF WORK: RECORD DRAWINGS



VICINITY MAP

INDEX OF SHEETS	
1...	TITLE SHEET
2...	STREAM CONVENTIONAL SYMBOLS GENERAL NOTES CONSTRUCTION SEQUENCE
3-10...	PLAN AND PROFILE

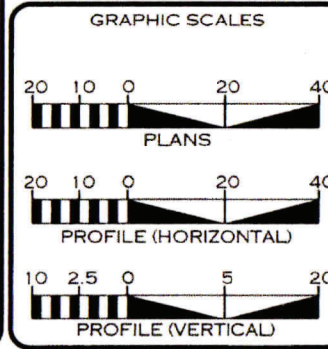
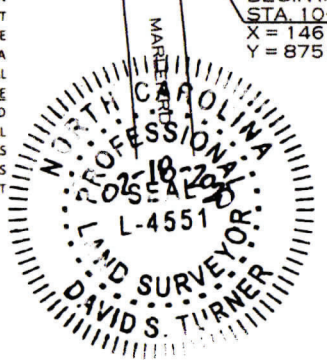


SURVEYOR CERTIFICATION

I, DAVID S. TURNER, HEREBY CERTIFY THAT THE GROUND TOPOGRAPHIC SURVEY PORTION OF THIS PROJECT WAS COMPLETED UNDER MY DIRECT SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY DIRECT SUPERVISION, THAT THE RECORD DRAWINGS WERE PREPARED BY ECOSYSTEM PLANNING AND RESTORATION, PLLC FROM DIGITAL FILES PROVIDED BY TURNER LAND SURVEYING, PLLC AS SHOWN ON AN AS-BUILT SURVEY FOR "THE STATE OF NC, DIVISION OF MITIGATION SERVICES" DATED AUGUST 18, 2019; THAT THIS SURVEY WAS PERFORMED AT THE 95% CONFIDENCE LEVEL TO MEET THE FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS; THAT THE SURVEY WAS PERFORMED TO MEET THE REQUIREMENTS FOR A TOPOGRAPHIC SURVEY TO THE ACCURACY OF CLASS A HORIZONTAL AND CLASS C VERTICAL WHERE APPLICABLE; THAT THE ORIGINAL DATA WAS OBTAINED BETWEEN THE DATES OF JUNE 8 & 31 JULY OF 2019; THAT THE CONTOURS SHOWN AS BROKEN LINES MAY NOT MEET THE STATED STANDARD; THAT ALL COORDINATES ARE BASED ON THE NAD83(NSRS 2011) DATUM AND ALL ELEVATIONS ARE BASED ON THE NAVD88 DATUM; THAT THIS MAP MEETS THE SPECIFICATIONS FOR TOPOGRAPHIC SURVEYS STATED IN TITLE 21, CHAPTER 56, SECTION .1606; AND THAT THIS MAP WAS NOT PREPARED IN ACCORDANCE WITH G.S. 47-30, AS AMENDED AND DOES NOT REPRESENT AN OFFICIAL BOUNDARY SURVEY.

WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 18th DAY OF Feb., 2020.

David S. Turner
DAVID S. TURNER, P.L.S. #L-4551



REVISIONS				
NO.	DESCRIPTION	ENGR.	APPROV.	DATE
1	RECORD DRAWINGS	CJ	KLT	2/12/20

PREPARED FOR:

NC DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

HARRY TSOMIDES
PROJECT MANAGER

PREPARED IN THE OFFICE OF:

ECOSYSTEM PLANNING & RESTORATION
1150 SE MAYNARD RD
SUITE 140
CARY, NC 27511
LICENSE # P-1182

FALL 2019
COMPLETION DATE:

CIDNEY JONES, PE
PROJECT ENGINEER

SIGNATURE: _____ P.E.

STREAM CONVENTIONAL SYMBOLS

PROJECT # 082 SHEET NO. 2

SYMBOLY / NOTES

- ROCK J-HOOK (JH)
- ROCK VANE (RV)
- OFFSET ROCK CROSS VANE (OV)
- ROCK CROSS VANE (XV)
- TEMPORARY SILT CHECK
- ROOT WAD (RW)
- GRADE CONTROL LOG J-HOOK (LJH)
- LOG VANE (LV)
- LOG STEP (LS)
- ROCK STEP (RS)
- LOG CROSS VANE (XV)
- CONSTRUCTED CASCADE (CC)
- CONSTRUCTED RIFFLE (CR)
- BOULDER CLUSTER
- LOG ROLLER (LR)
- GRADE CONTROL WOODY RIFFLE (WR)
- TOEWOOD WITH GEOLIFT (TW)
- SOD MATS (SM)
- DEBRIS JAM (DJT#)
- SINGLE WING DEFLECTOR (SW)
- DOUBLE WING DEFLECTOR (DW)
- SF — SAFETY FENCE
- TP — TAPE FENCE
- ||| — SILT FENCE
- CE — CONSERVATION EASEMENT
- - 20 - - EXISTING MAJOR CONTOUR
- - - - - EXISTING MINOR CONTOUR
- 20 — PROPOSED MAJOR CONTOUR
- 21 — PROPOSED MINOR CONTOUR
- - - - - LIMITS OF DISTURBANCE
- — — — — BANKFULL BENCH (GRADE)
- - - - - PROPERTY LINE
- ::::: ACCESS ROAD
- 10+00 ——— STREAM THALWEG
- STREAM TOP OF BANKS
- ||| FOOT BRIDGE
- ||| TEMPORARY STREAM CROSSING
- ||| PERMANENT FORD STREAM CROSSING (PFC)
- ⊕ TRANSPLANTED VEGETATION
- ✕ TREE REMOVAL
- ⊕ TREE PROTECTION
- [X] GEOLIFT
- [] CHANNEL FILL
- [] DITCH PLUG
- [/] GRADE BANK 2:1 OR FLATTER
- [] EXISTING WETLANDS

MONITORING FEATURES

- VP VEGETATION MONITORING PLOT
- ⊕ MONITORING GAUGE
- ⊙ PHOTO POINT
- XS ——— MONITORING CROSS SECTION

ASBUILT FEATURES

- [] ASBUILT CONSTRUCTED RIFFLE
- [] ASBUILT TOE WOOD

**NOTE: ALL ITEMS ABOVE MAY NOT BE USED ON THIS PROJECT

GENERAL NOTES

1. CONSTRUCTION WAS COMPLETED IN JUNE 2019.
2. TOPOGRAPHIC SURVEY WAS COMPLETED BY TURNER LAND SURVEYING, PLLC IN SEPTEMBER 2017.
3. ASBUILT SURVEY WAS COMPLETED BY TURNER LAND SURVEYING, PLLC IN AUGUST 2019.

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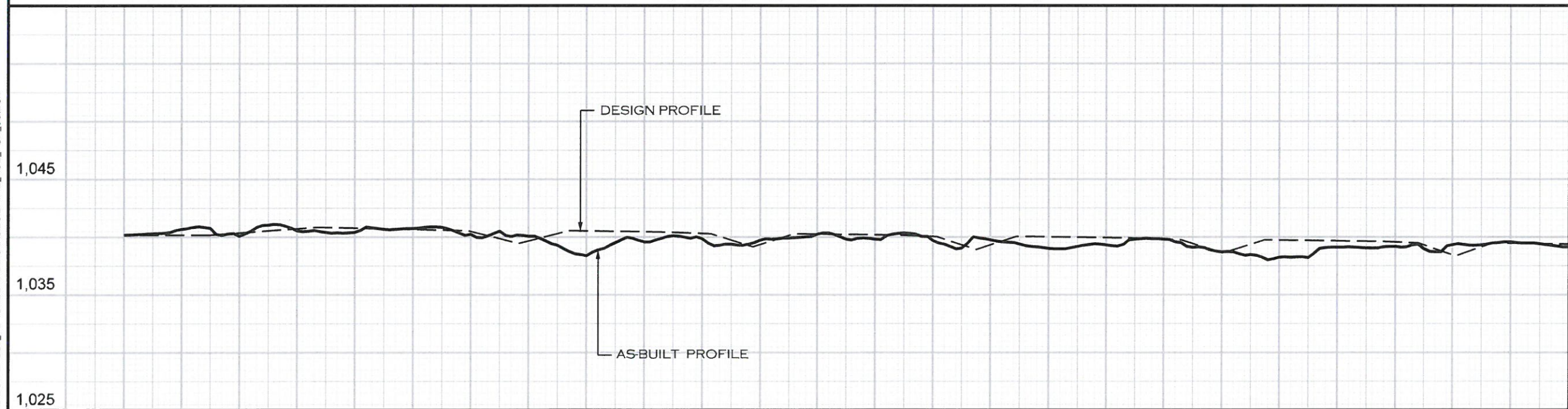
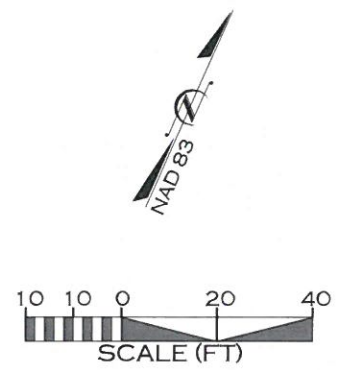
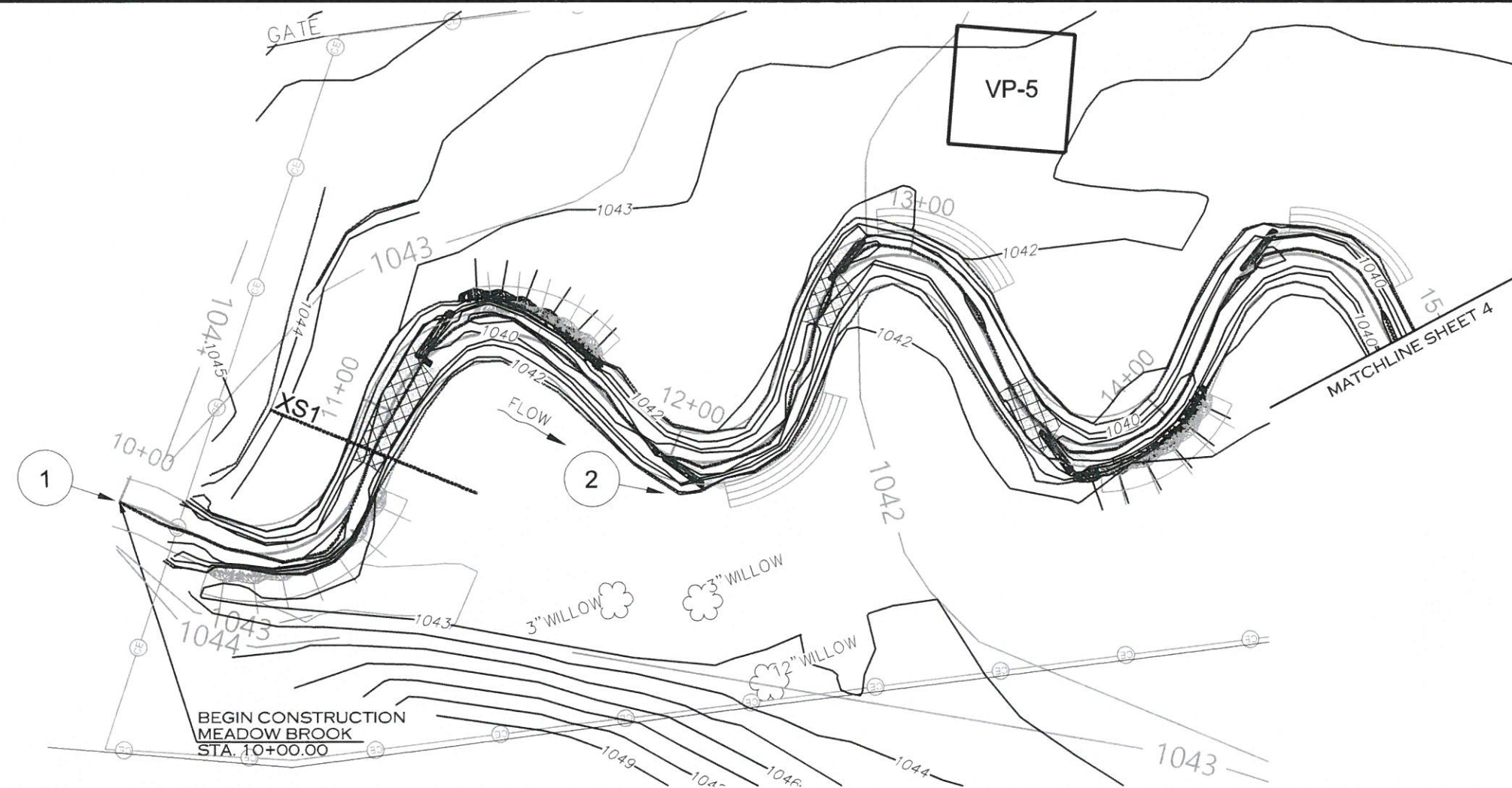
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DIVISION OF MITIGATION SERVICES
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RALEIGH, NC 27699-1652

MEADOW BROOK
YADKIN COUNTY, NC

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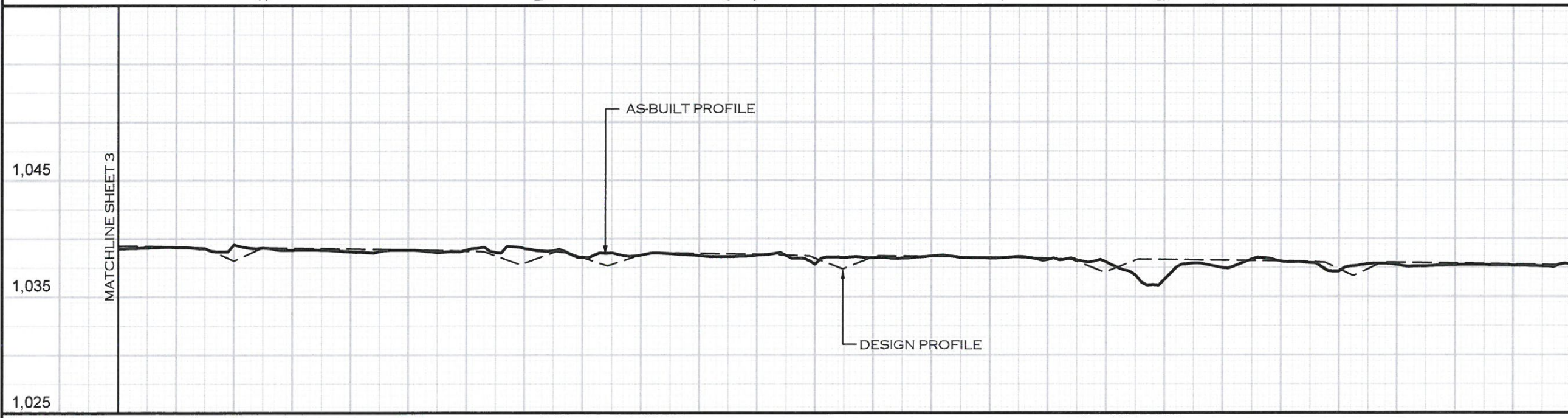
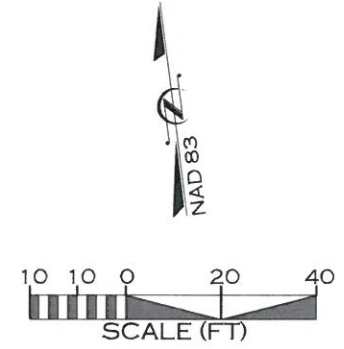
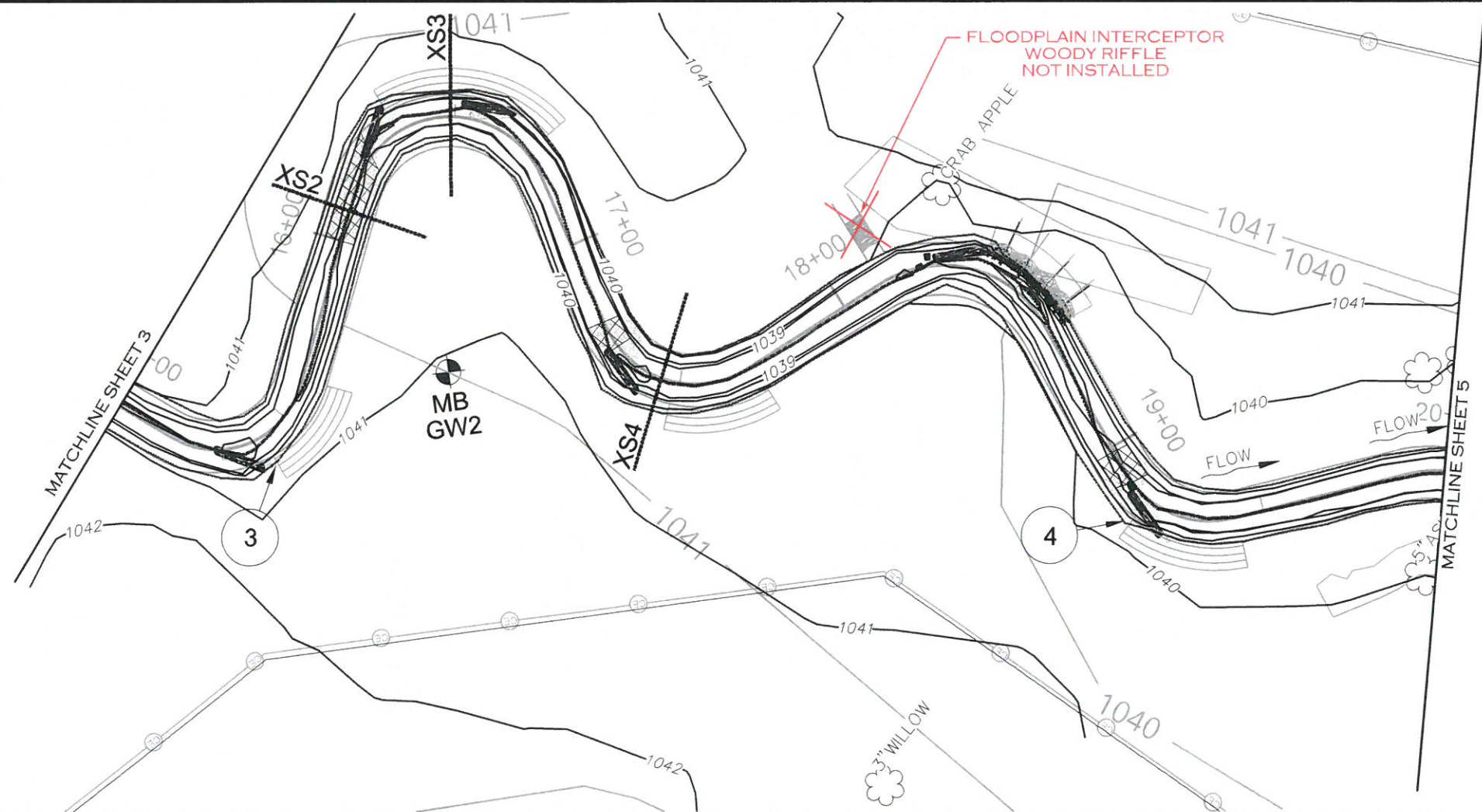
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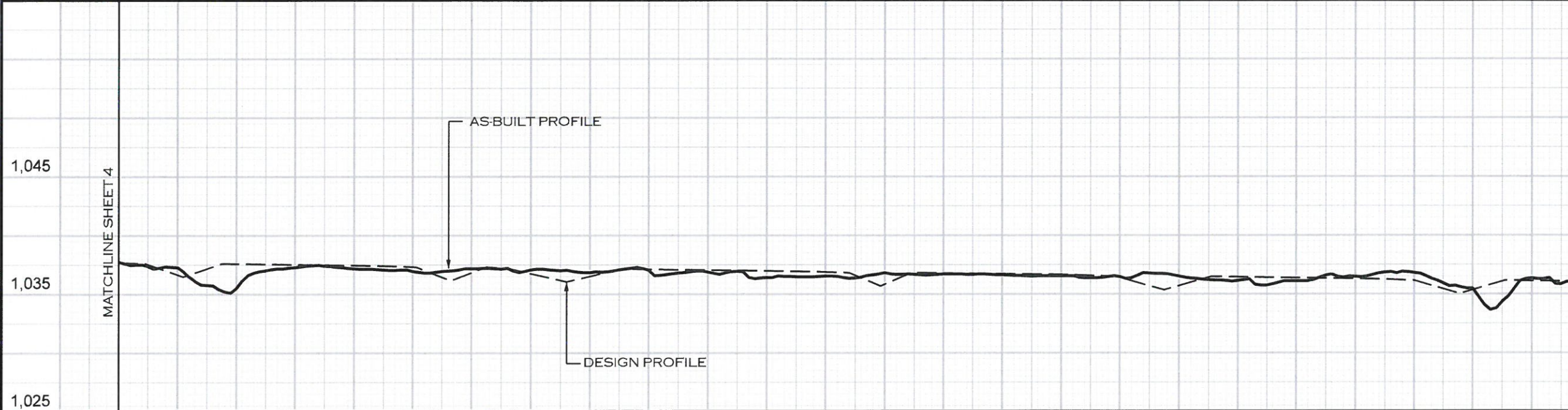
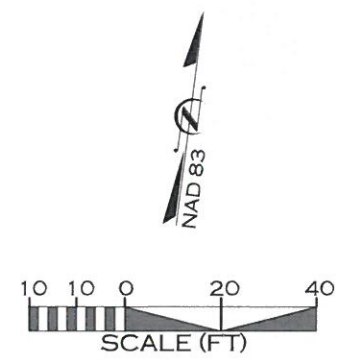
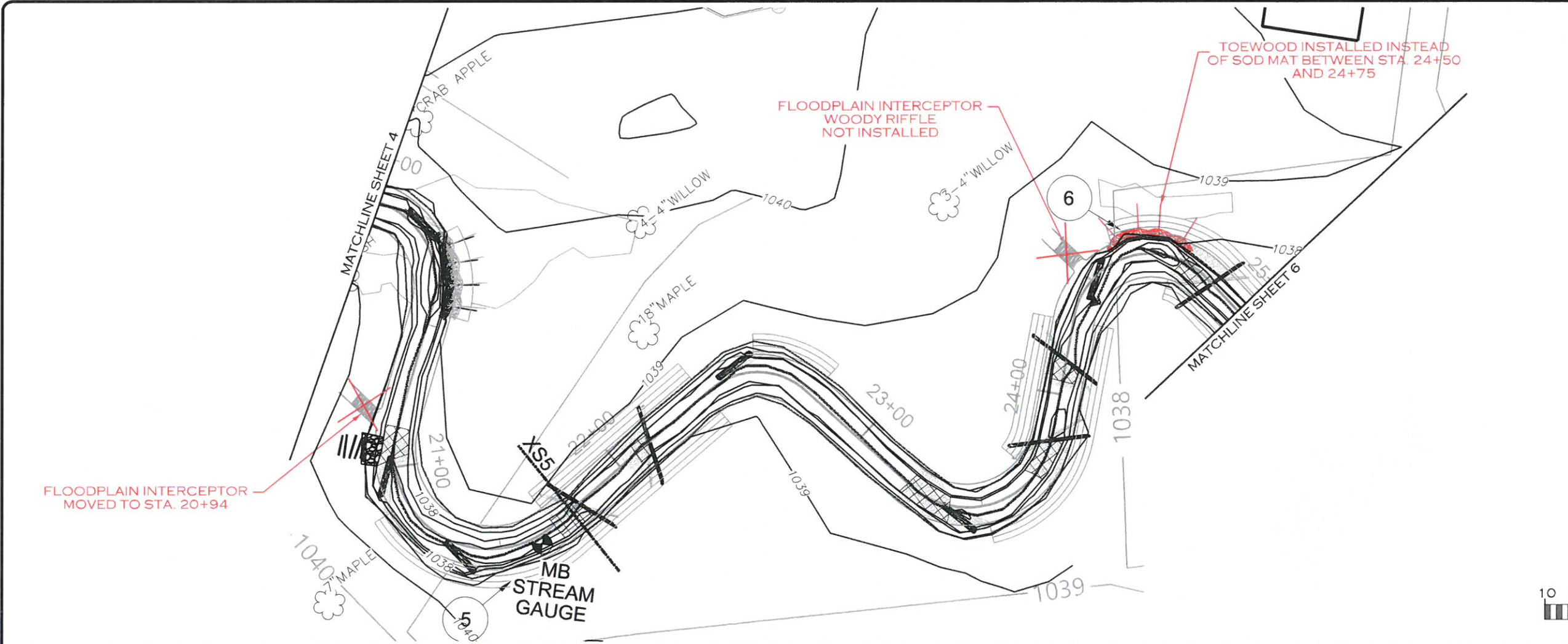
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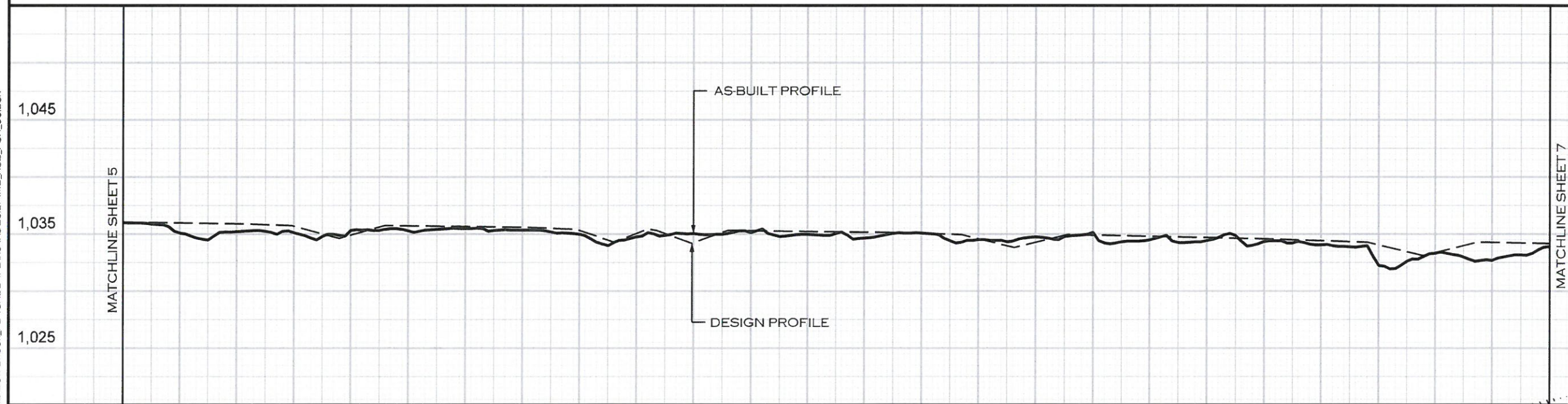
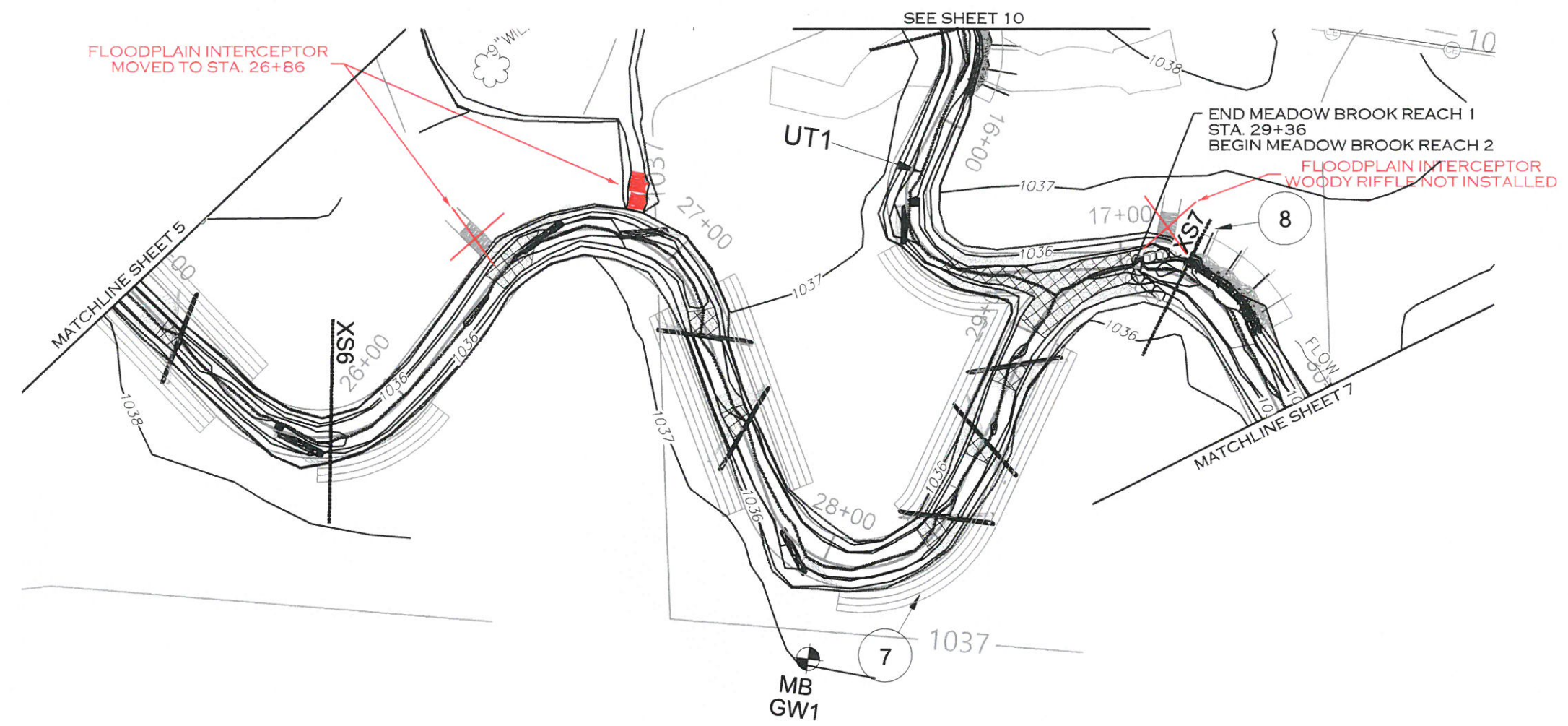
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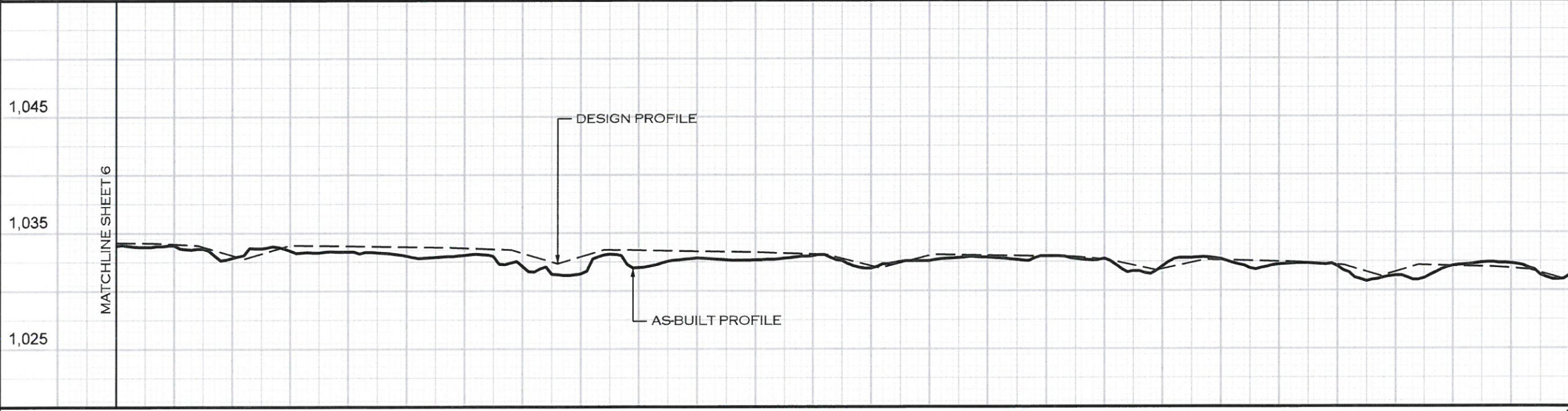
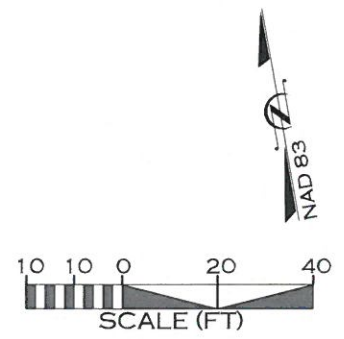
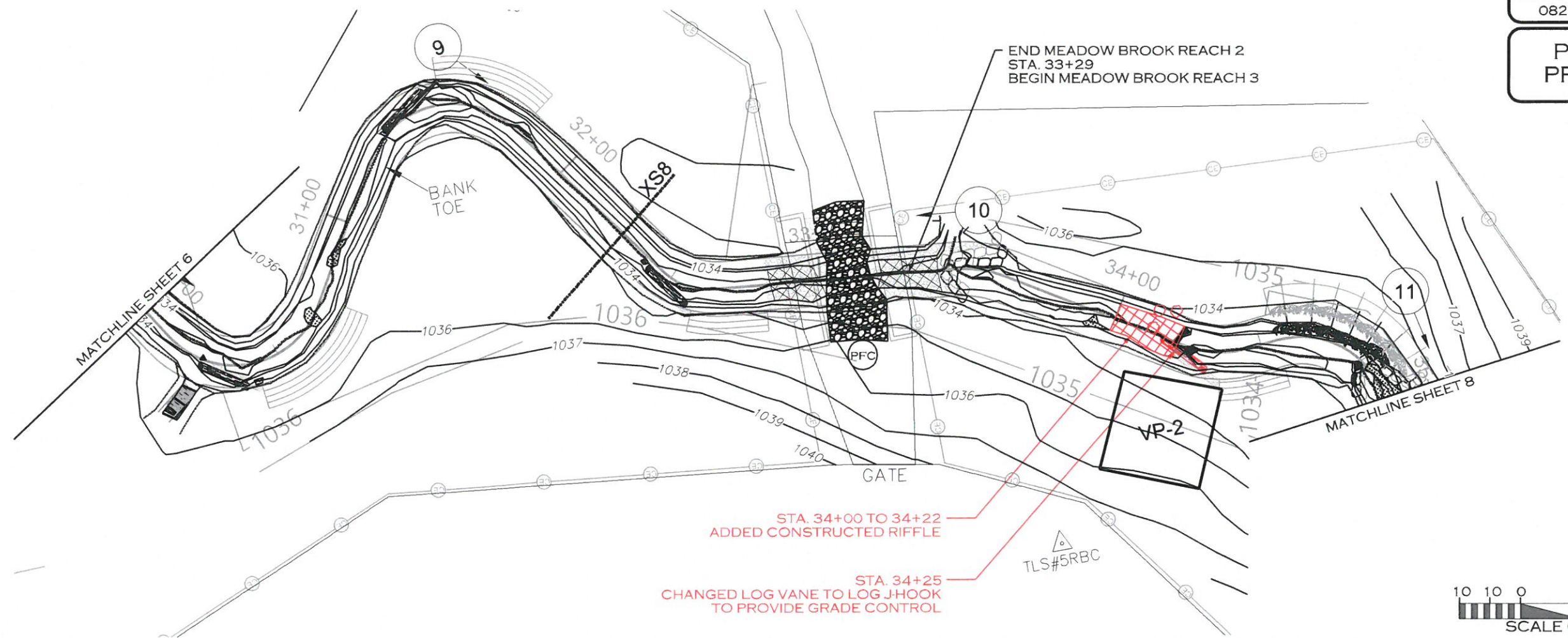
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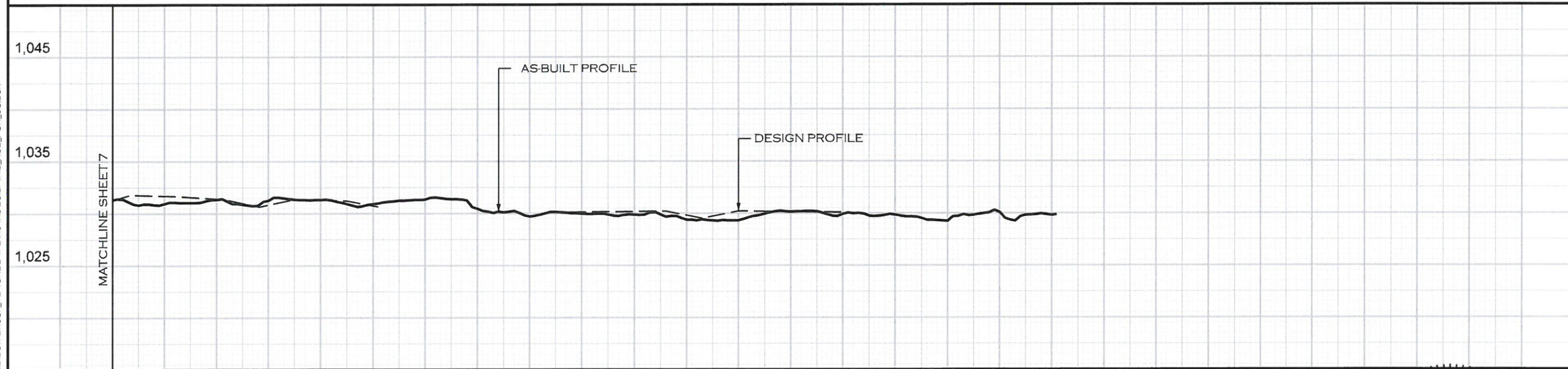
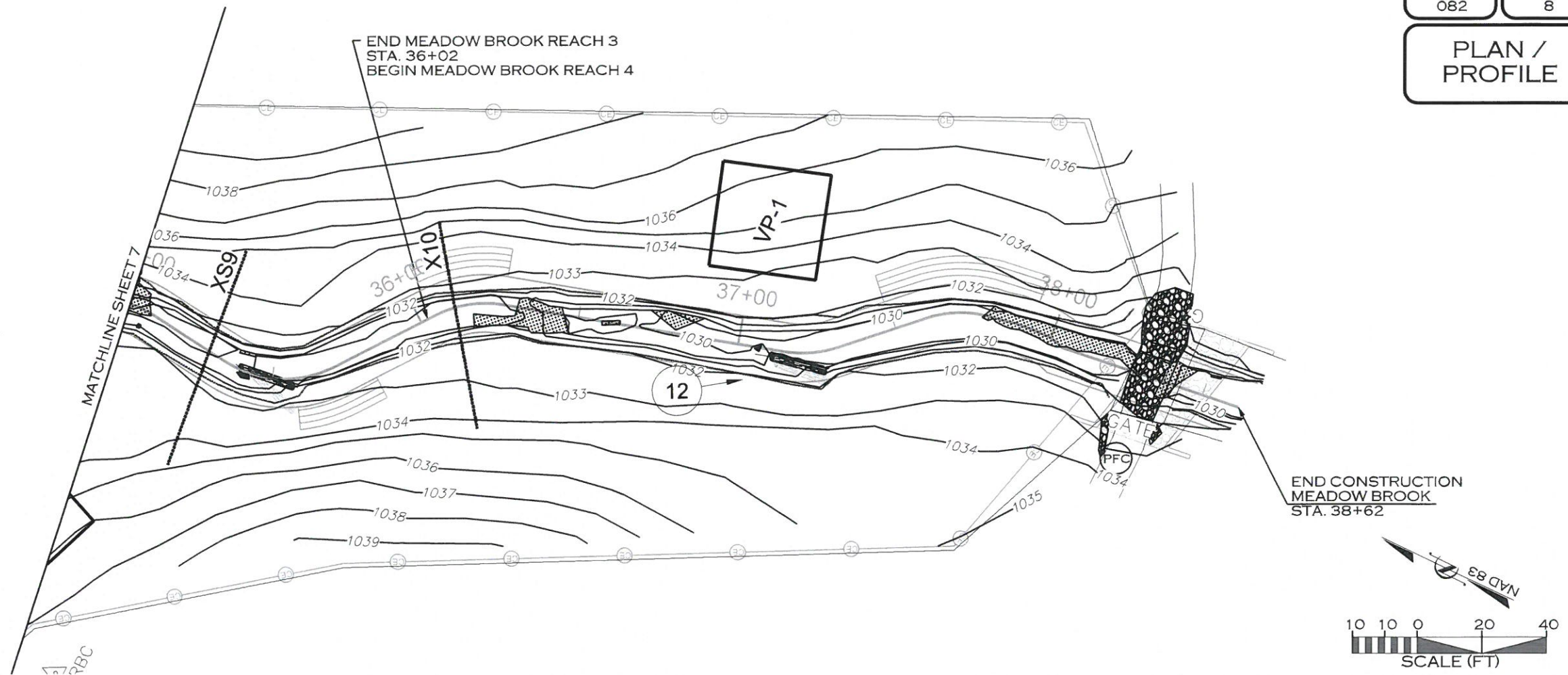
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SEAL
043187
ENGINEER
CIDNEY J. JONES

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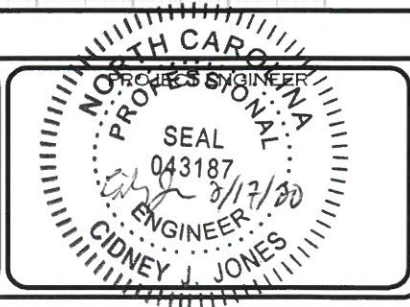
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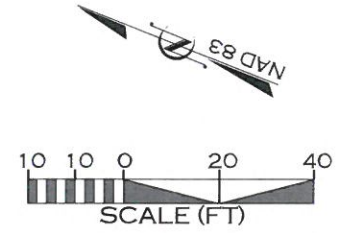
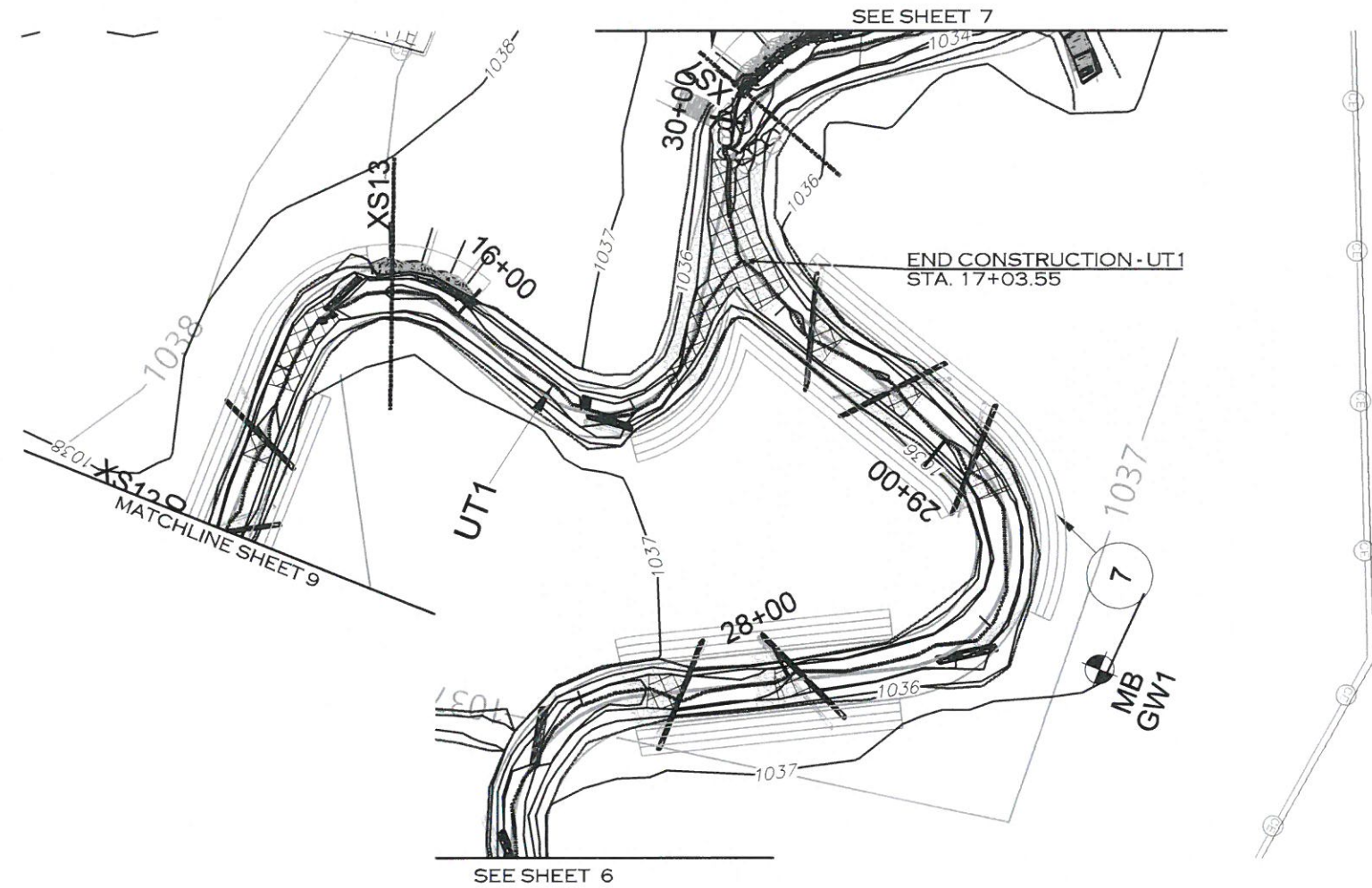
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NORTH CAROLINA
PROFESSIONAL ENGINEER
SEAL
043187
CIDNEY J. JONES