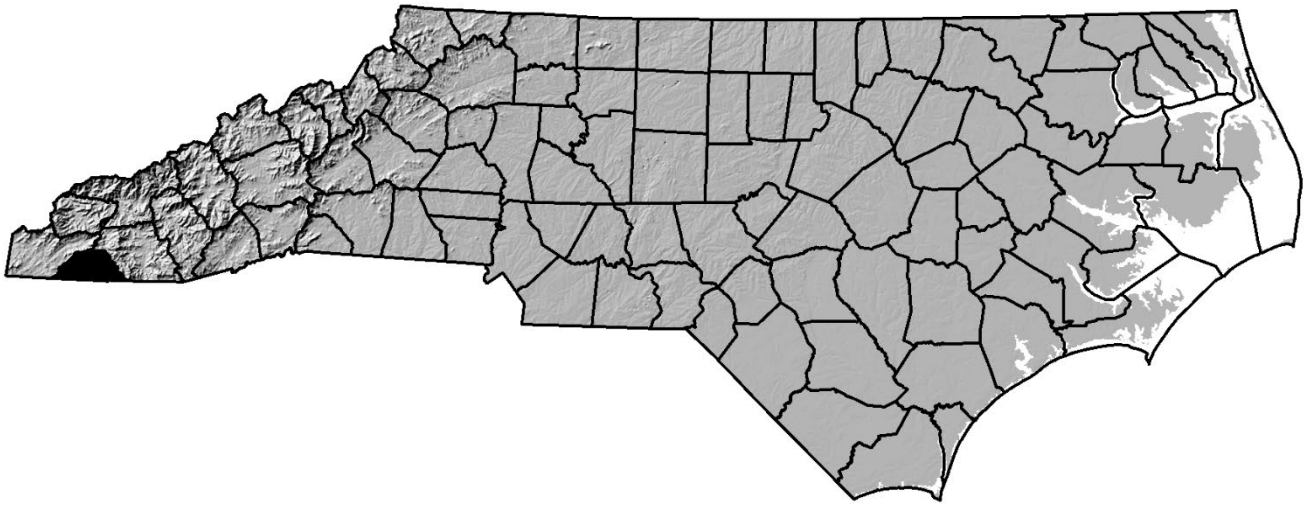
ANNUAL REPORT FOR 2024



Hyatt Mill Creek Site #5 Mitigation Site
ONE ID #: 022-001
Clay County
TIP No. A-0011C
COE Action ID: SAW-2019-00437
NCDWR Project #: 2019-0210

Prepared By:
Environmental Analysis Unit
North Carolina Department of Transportation
December 2024

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SUMMARY

The following report summarizes the stream monitoring activities that have occurred during the year 2024 at the Hyatt Mill Creek Site #5 mitigation site in Clay County. The North Carolina Department of Transportation (NCDOT) completed the streambank reforestation at this project in February 2021. This report provides the monitoring results for the third formal year of monitoring (2024). The year 2024 monitoring period is the third of seven scheduled years of monitoring on the Hyatt Mill Creek Site #5.

Based on the overall conclusions of monitoring at Hyatt Mill Creek Site #5, it has met the required monitoring protocols for stream stability for the third formal year of monitoring. Based on comparing the monitoring data to the as-built, the stream channel remains stable throughout at this time.

The 2024 vegetation monitoring of the site revealed an average tree density of 510 trees per acre with an average tree height of 2.9 feet. This average is above the minimum success criteria of 320 trees per acre for Year 3. NCDOT completed supplemental buffer planting in February 2024. NCDOT plans to conduct herbicide treatment of invasive vegetation across the site during the 2025 growing season.

NCDOT proposes to continue stream and vegetation monitoring at the Hyatt Mill Creek Site #5 in 2025.

1.0 INTRODUCTION

1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during the Year 2024 at the Hyatt Mill Creek Site #5. Site #5 is located adjacent to NC 69 at the intersection with American Way Road in Clay County from Sta. 89+10 to 94+85 -L- Lt. (Roadway Plan Sheets 9 & 10, Figure 2). Site #5 was constructed to offset stream impacts associated with Transportation Improvement Program (TIP) number A-0011C in Clay County.

The mitigation site provided approximately 633 linear feet of stream relocation. Streambank reforestation was completed in February 2021 by NCDOT. The project involved relocating the channel adjacent to the widening of NC 69 under the A-0011C roadway project. A new floodplain and channel were excavated and several in- stream structures such as rock cross vanes and grade control riffles were installed. No utility easements affect this mitigation site.

1.2 Purpose

For a mitigation site to be considered successful, the site must meet the success criteria. This report details the monitoring in 2024 at the Hyatt Mill Creek Site #5. Hydrologic monitoring was not required for this site.

1.3 Project History

June 2020	Construction Completed
February 2021	Streambank Reforestation Completed
August 2021	As-Built Survey Completed
August 2022	Stream Channel and Vegetation Monitoring (Year 1)
March 2023	Supplemental Buffer Planting
July 2023	Vegetation Monitoring (Year 2)
August 2023	Invasive Species Herbicide Treatment
November 2023	Stream Channel and Vegetation Monitoring (Year 2)
February 2024	Supplemental Buffer Planting
August 2024	Vegetation Monitoring (Year 3)
December 2024	Stream Channel Monitoring (Year 3)

1.4 Debit Ledger

The Hyatt Mill Creek Site #5 stream mitigation site was used in its entirety to compensate for unavoidable stream impacts from the A-0011C project.

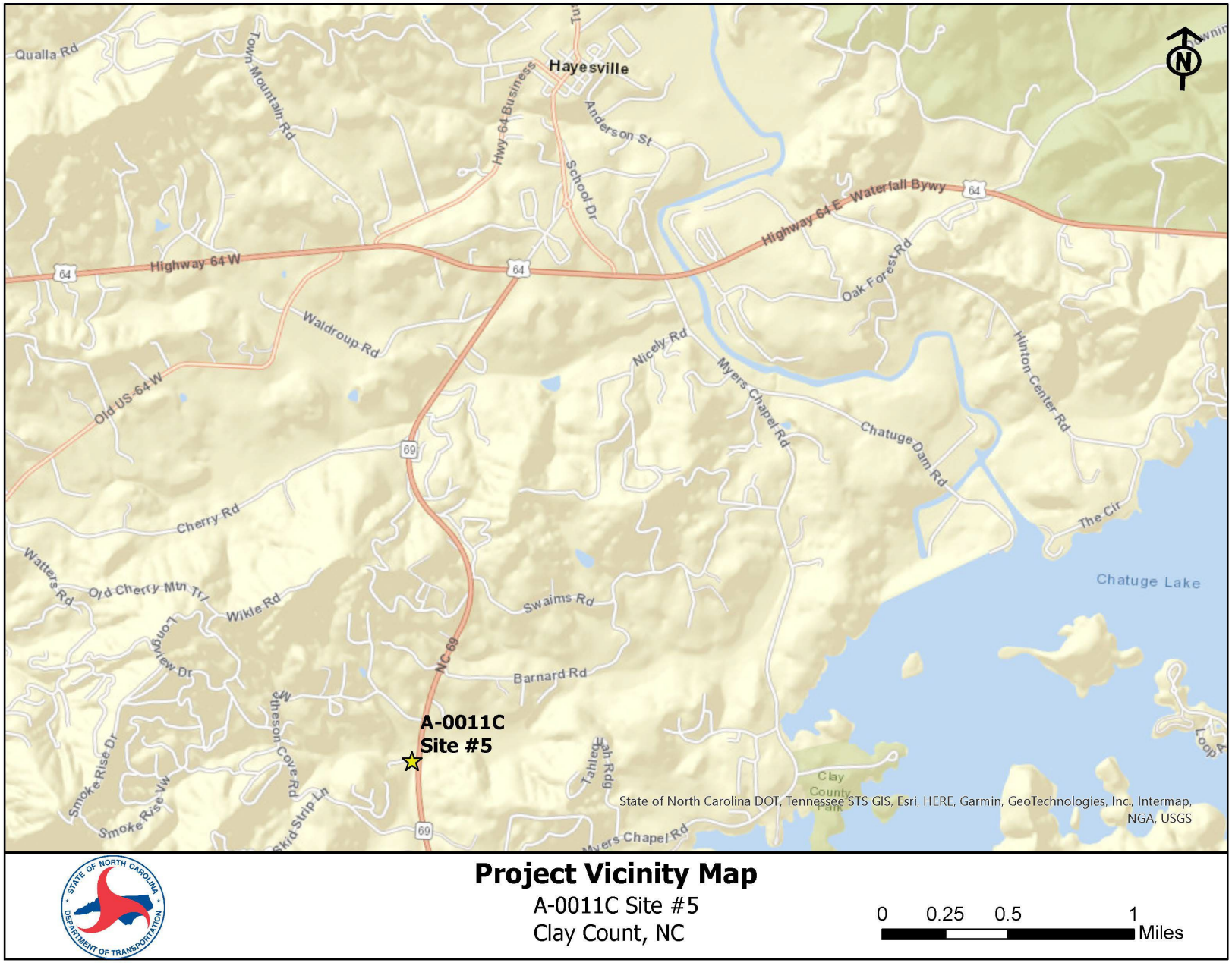


Figure 1. Site #5 Vicinity Map

2.0 STREAM ASSESSMENT

2.1 Success Criteria

Based on email correspondence with the Regulatory Agencies (July 1, 2020), it was agreed to follow the mitigation plan language as it relates to the vegetation monitoring.

USACE Condition #4

"This permit verification authorizes the relocation of stream 5, Hyatt Mill Creek. The relocation of Hyatt Mill Creek will be constructed and monitored in accordance with the enclosed document titled 'A-0011C Stream Relocation Monitoring Plan'". See Appendix C for A-0011C Stream Relocation Monitoring Plan

General Monitoring Plan

Monitoring requirements and success criteria outlined in the latest guidance by USACE (Wilmington District) in October 2016 (Stream and Wetland Compensatory Mitigation Update) (Guidelines) will be followed and are briefly outlined below. Monitoring data collected at the Site will include reference photos, plant survival analysis, and channel stability analysis and will be reported in the format specified by RGL 08-03.

Riparian vegetation and stream morphology is proposed to be monitored for a period of seven years with measurements completed in years 1-3, year 5, and year 7. Visual monitoring results will be reported in all monitoring reports. Photo documentation of stream stability will be included in monitoring reports for years 4 and 6. If monitoring demonstrates the Site is successful by year 5 and no concerns have been identified, NCDOT may propose, in writing, to terminate monitoring at the Site and forego monitoring requirements for years 6 and 7. If USACE determines that terminating the site monitoring is acceptable, USACE will notify NCDOT in writing. Early closure will only be provided through written approval from USACE. Monitoring will be conducted by NCDOT or its duly authorized representatives. Monitoring reports must be provided to USACE for review no later than April 1 for all seven years of monitoring.

2.2 Stream Description

2.2.1 Post-Construction Conditions

The Hyatt Mill Creek Site #5 project involved the relocation of the stream to a new channel and excavation of a floodplain. The stream reach runs parallel to NC 69 and flows through an arch pipe under American Way Road and continues to the confluence with Coleman Creek. A new floodplain and channel were excavated along with several in-stream structures such as rock cross vanes and grade control riffles were installed. The planted riparian buffer zone will average 40 feet on both sides of the stream. No utility easements affect this mitigation site.

2.2.2 Monitoring Conditions

The objective of the Hyatt Mill Creek Site #5 stream relocation was to construct a low to moderate width-to-depth ratio C-type stream. A total of four cross sections (two in a riffle and two in a pool) were surveyed. For this report, only cross sections containing riffles were used in the comparison of channel morphology presented below in Table 1.

Table 1. Site #5 Abbreviated Morphological Summary

Hyatt Mill Creek Site #5: Cross Section #1 @ Sta. 01+76						
Variable	**As-Built 2021**	**2022**	**2023**	**2024**	**2026**	**2028**
Width of the Floodprone Area (ft.)	41.2	42.3	45.5	47.9		
Bankfull Width (ft.)	13.0	12.9	7.3	8.5		
Entrenchment Ratio	3.2	3.3	6.3	5.6		
Bankfull Mean Depth (ft.)	0.6	0.5	0.7	0.71		
Maximum Bankfull Depth (ft.)	1.0	1.0	1.3	1.57		
Width/Depth Ratio	21	28.0	10.1	11.9		
Bankfull Cross Sectional Area (ft2)	8.1	5.9	5.2	6.08		

Hyatt Mill Creek Site #5: Cross Section #3 @ Sta. 05+58						
Variable	**As-Built 2021**	**2022**	**2023**	**2024**	**2026**	**2028**
Width of the Floodprone Area (ft.)	36.5	34.7	33.8	33.9		
Bankfull Width (ft.)	14.9	14.4	13.6	10.9		
Entrenchment Ratio	2.5	2.4	2.5	3.1		
Bankfull Mean Depth (ft.)	0.8	0.7	0.6	0.6		
Maximum Bankfull Depth (ft.)	1.1	1.0	0.9	1.4		
Width/Depth Ratio	18.8	21.1	23.9	19.1		
Bankfull Cross Sectional Area (ft2)	11.7	9.7	7.8	6.2		

*Riffle values are used for classification purposes, pool values are shown in Appendix A.

2.3 Results of the Stream Assessment

2.3.1 Site Data

The assessment included the survey of four cross sections and the longitudinal profile of the Hyatt Mill Creek Site #5 established by NCDOT after construction. The length of the profile along the Hyatt Mill Creek Site #5 was approximately 633 linear feet. Four cross sections were established during the as-built monitoring year. Cross section locations were subsequently based on the stationing of the longitudinal profile and are presented below. The location of the cross sections and longitudinal profile are shown in Appendix A.

Hyatt Mill Creek Site #5 Cross-Sections:

- Cross-Section #1: Hyatt Mill Creek Site #5, Station 01+76, Riffle
- Cross-Section #2: Hyatt Mill Creek Site #5, Station 02+09, Pool
- Cross-Section #3: Hyatt Mill Creek Site #5, Station 05+58, Riffle
- Cross-Section #4: Hyatt Mill Creek Site #4, Station 05+96, Pool

Based on comparisons of the as-built (2021) to the MY3 (2024) monitoring data, all four cross sections appear stable with little or no active bank erosion. Floodplain aggradation, as noted in previous years, at both XS-1 and XS-2 seems to have subsided. The reach upstream of the culvert appears to manifest improved sediment conveyance as a result of Parrot Feather treatments. Sediment transport is expected to continue to improve as further aquatic vegetation control efforts are implemented. The lower stream reach appears stable, yet XS-3 (riffle) seems to have aggraded slightly since 2023 channel survey. This aggradation is expected due to increased conveyance of sediment load from upstream of the culvert at American Way. Channel dimensions for XS-3 remain within design parameters. Graphs of the cross sections are presented in Appendix A. Future survey data will vary depending on the actual location of the rod placement and alignment; however, this information should remain similar in appearance. Due to the vigor of live stake willows along the stream bank, the longitudinal profile along the entire reach was not completed. The vegetation height and thickness blocked the survey equipment line of sight; therefore, no profile data was collected along the stream reach. Supplemental photos along the entire stream reach have been provided in Appendix B.

3.0 VEGETATION: HYATT MILL CREEK MITIGATION SITE (YEAR 3 MONITORING)

3.1 Success Criteria

Mitigation Plan:

General Monitoring Plan

Riparian vegetation is proposed to be monitored for a period of seven years with measurements completed in years 1-3, year 5, and year 7. Visual monitoring results will be reported in all monitoring reports.

Vegetation

Vegetation planting should be conducted between November 15 and March 15. After planting has been completed, an initial evaluation will be performed to verify planting methods and to determine initial species composition and density. Supplemental planting and additional site modifications will be implemented, if necessary.

Two sample plots (0.02 acre in size, >2% of planted portion) will be installed within the site due to small size of the project. Vegetation monitoring for each sample plot will be conducted between July 1st and leaf drop to account for all effects of climatic or other conditions that may affect vegetation survival. Visual observations of the percent cover of shrub and herbaceous species will also be documented by photograph.

Vegetation Performance Criteria

Within planted portions of the site, a minimum of 320 planted stems per acre must be surviving in the first three monitoring years. Subsequently, a minimum of 260 stems per acre must be present a year 5 and 210 stems per acre at year 7. Since this site is located in the mountain region, trees in each plot must average 6 feet in height at year 5 and 8 feet in height a year 7. Volunteer stems of native plants will be considered in determining overall vegetation success; however, (1) volunteer stems will be counted separately from planted stems and (2) volunteer stems must be species from the approved planting list.

Visual Monitoring

The site will be visually monitored each year to identify areas of concern (poor plant vigor, invasive plants, etc.)

Remedial Actions

Monitoring reports will include a remedial action plan to address the portions of the site that fail to meet one or more of the required functional goals/performance standards. USACE will be notified as soon as possible once a need is identified that will require remedial action. If portions of the site are not meeting required criteria, replanting of all or part of the site will be required. If supplemental plantings exceed 20% of the total planted area, additional vegetation monitoring may be required by USACE.

The site will be monitored for the presence of invasive species and adaptive management aimed at controlling the species will be conducted. Treatments with herbicides, in coordination with USACE, will be used as needed where invasive species are identified in areas of planted and/or desirable species.

The stream relocation and buffers will remain under NCDOT ownership in perpetuity. No mow signs and white stakes will be erected along the stream buffers to protect against maintenance activities.

3.2 Description of Species

The following live stake species were planted in the Streambank Area (Type I):

Salix nigra, Black Willow

Cornus amomum, Silky Dogwood

The following tree species were planted in the Buffer Area (Type II):

Liriodendron tulipifera, Tulip Poplar

Platanus occidentalis, Sycamore

Fraxinus pennsylvanica, Green Ash

Betula nigra, River Birch

Quercus nigra, Water Oak

Quercus phellos, Willow Oak

3.3 Results of Vegetation Monitoring

Plot #	Tulip Poplar	Sycamore	Green Ash	River Birch	Water Oak	Willow Oak	Total (Year 3)	Total (at planting)	Density (Trees/Acre)	Avg. Tree Height (ft)
1	1			2	2	7	12	16	**510**	**2.1**
2		3		4	8	6	15	20	**510**	**3.6**
Year 3									**510**	**2.9**
Year 2									267	3.8
Year 1									97	N/A

Site Notes: The live stakes were surviving along the streambank. Other species noted within the site included red maple, black cherry, sumac, locust and various grasses. Kudzu was noted at the end of the stream relocation and some parrot feather was observed within the channel.

3.4 Conclusions

There are a total of two vegetation monitoring plots established throughout the buffer area. The 2024 vegetation monitoring of the site revealed an average tree density of 510 trees per acre. This average is above the minimum success criteria of 320 trees per acre for Year 3. NCDOT Div. 14 Roadside is scheduled to complete an herbicide treatment on the invasive species in 2025. NCDOT plans to continue vegetation monitoring in 2025.

4.0 OVERALL CONCLUSIONS/RECOMMENDATIONS

The Hyatt Mill Creek Site #5 mitigation site has met the required stream monitoring protocols for the third formal year of monitoring. The channel throughout the stream site remains stable after the third year of monitoring. The streambank and buffer area are meeting the minimum vegetation success criteria. Treatment of invasives throughout the site will continue in 2025.

5.0 REFERENCES

Mitigation Plan, US 19E Widening, Yancey and Mitchell Counties, North Carolina TIP Number A-0011C, WBS No. 35609.1.1, May 6, 2013 (Revised November 4, 2013)

Department of the Army Permit, Permittee: North Carolina Department of Transportation, Permit No. 2004-9987181 / 2004-30631, TIP No. A-0011C, Issuing Office: CESAW-RG-A

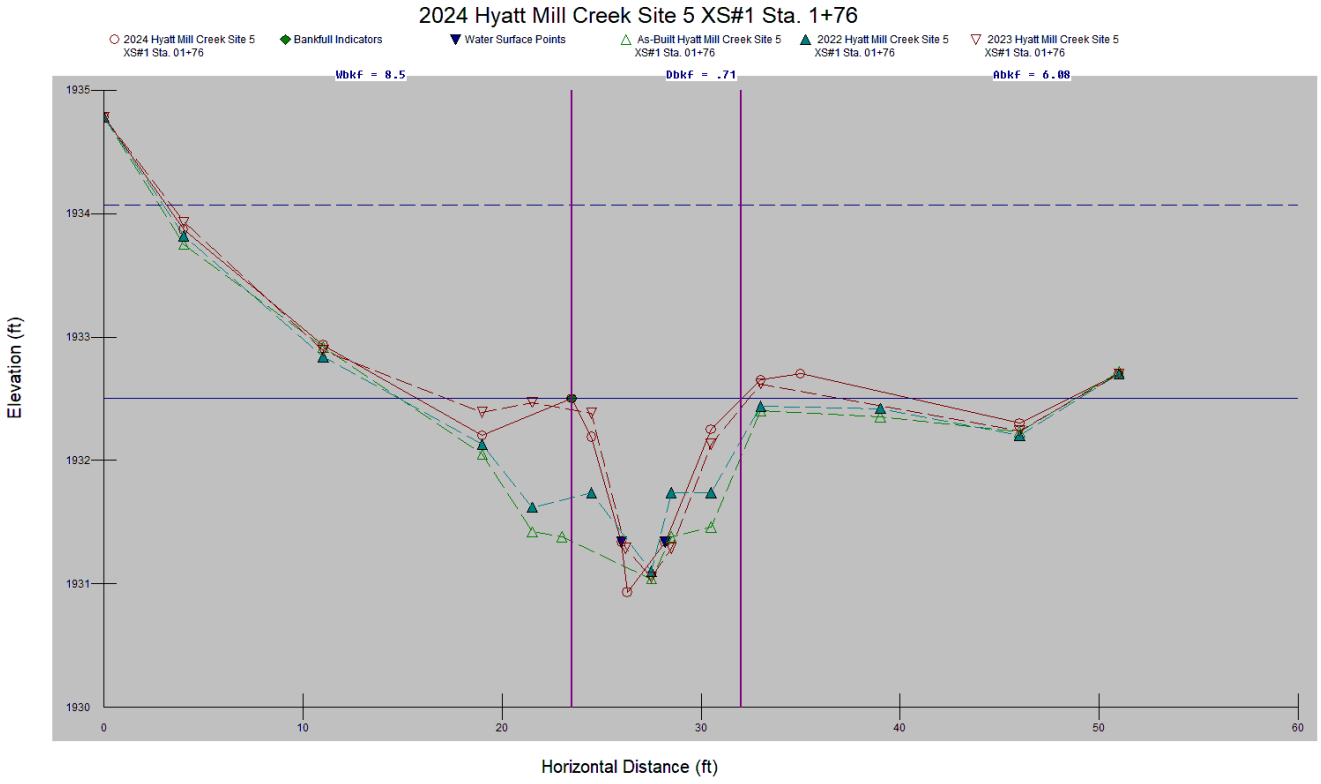
North Carolina Department of Environment and Natural Resources, Division of Water Resources, December 2, 2013, Proposed improvements to US 19E from SR 1186 in Yancey County to multilane section west of Spruce Pine in Mitchell County, State Project No. 6.909001T, WBS Element No. 35609.1.1, TIP R- 2519B, NCDWR Project No. 2013-0743v.2

Rosgen, D.L, 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

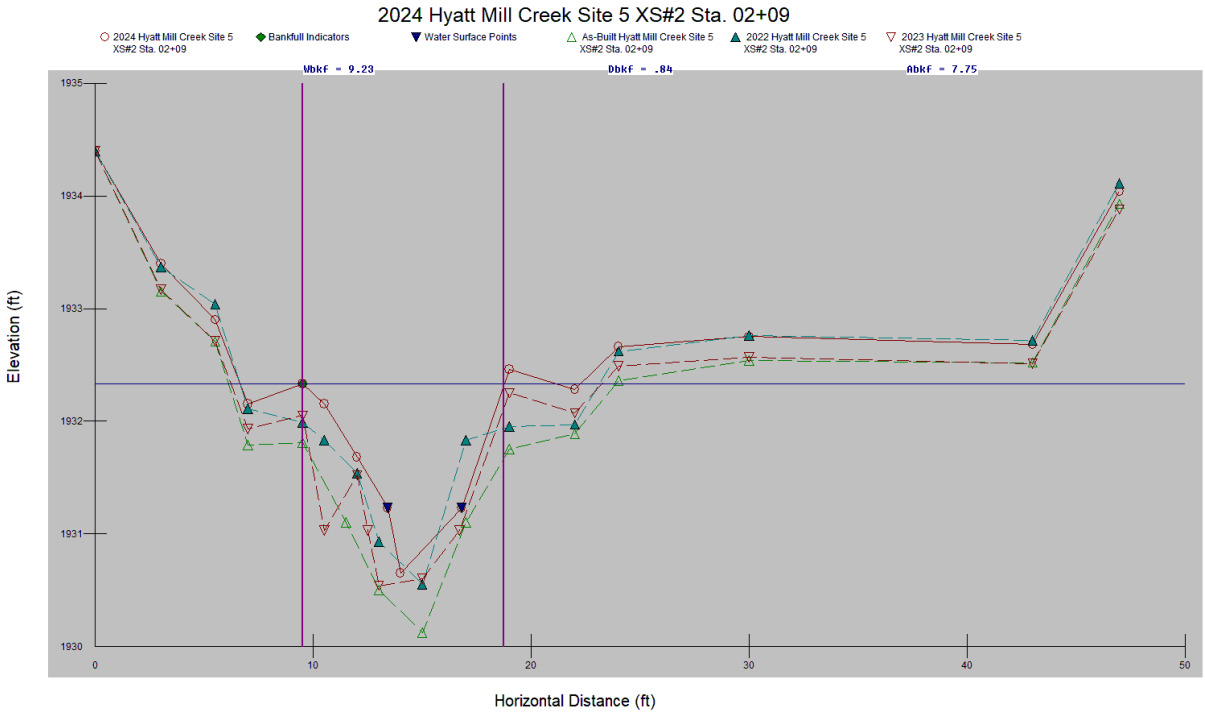
US Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. Prepared with cooperation from the US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Resources.

APPENDIX A

CROSS SECTIONS AND LONGITUDINAL PROFILE

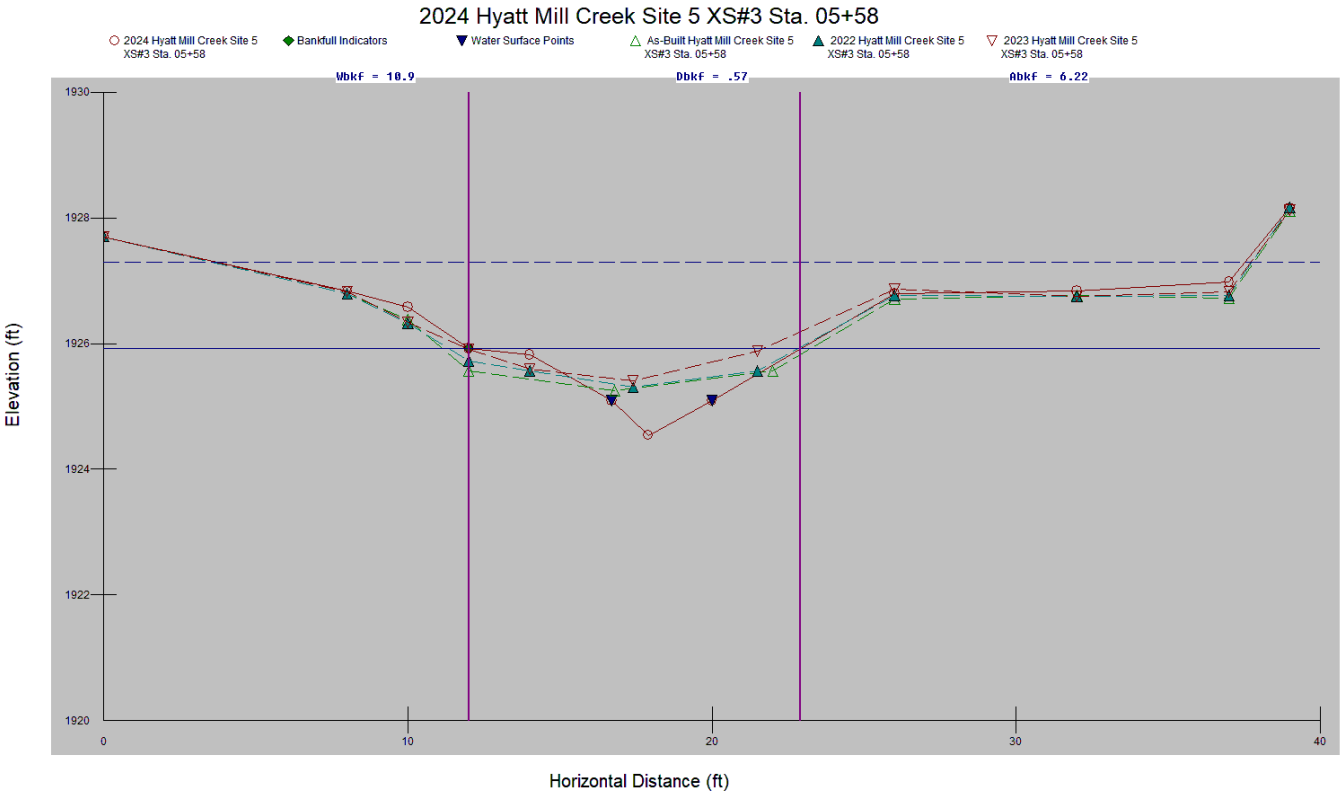


Site #5: Cross-Section #1 (Riffle) Abbreviated Morphological Summary						
Monitoring Year	**As-Built (2021)**	**2022**	**2023**	**2024**	**2026**	**2028**
Width of the Floodprone Area (ft.)	41.2	42.3	45.5	**47.9**		
Bankfull Width (ft.)	13.0	12.9	7.3	**8.5**		
Entrenchment Ratio	3.2	3.3	6.3	**5.6**		
Bankfull Mean Depth (ft.)	0.6	0.5	0.7	**0.71**		
Maximum Bankfull Depth (ft.)	1.0	1.0	1.3	**1.57**		
Width/Depth Ratio	21.0	28.0	10.1	**11.9**		
Bankfull Cross Sectional Area (ft^2)	8.1	5.9	5.2	**6.08**		

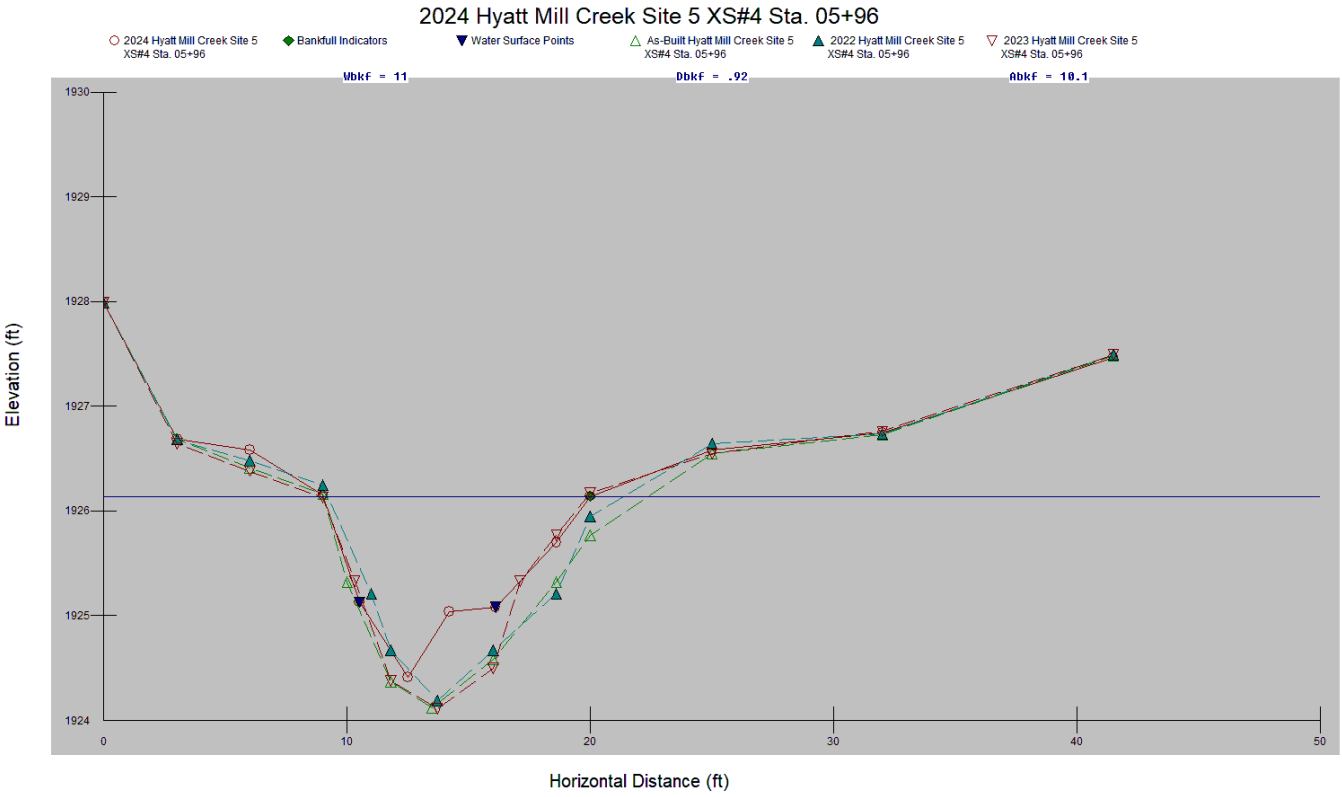


Site #5: Cross-Section #2 (Pool) Abbreviated Morphological Summary						
Monitoring Year	**As-Built (2021)**	**2022**	**2023**	**2024**	**2026**	**2028**
Bankfull Width (ft.)	**9.3**	**9.3**	**12.6**	**9.2**		
Bankfull Mean Depth (ft.)	**0.8**	**0.6**	**0.9**	**0.8**		
Maximum Bankfull Depth (ft.)	**1.6**	**1.4**	**1.7**	**1.7**		
Bankfull Cross Sectional Area (ft^2)	**7.8**	**5.2**	**11.3**	**7.8**		

*According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.



Site #5: Cross-Section #3 (Riffle) Abbreviated Morphological Summary						
Monitoring Year	**As-Built (2021)**	**2022**	**2023**	**2024**	**2026**	**2028**
Width of the Floodprone Area (ft.)	**36.5**	**34.7**	**33.8**	**33.9**		
Bankfull Width (ft.)	**14.9**	**14.4**	**13.6**	**10.9**		
Entrenchment Ratio	**2.5**	**2.4**	**2.5**	**3.1**		
Bankfull Mean Depth (ft.)	**0.8**	**0.7**	**0.6**	**0.6**		
Maximum Bankfull Depth (ft.)	**1.1**	**1.0**	**0.9**	**1.4**		
Width/Depth Ratio	**18.8**	**21.1**	**23.9**	**19.1**		
Bankfull Cross Sectional Area (ft^2)	**11.7**	**9.7**	**7.8**	**6.2**		



Site #5: Cross-Section #4 (Pool) Abbreviated Morphological Summary						
Monitoring Year	**As-Built (2021)**	**2022**	**2023**	**2024**	**2026**	**2028**
Bankfull Width (ft.)	**10.5**	**10.4**	**11.5**	**11.0**		
Bankfull Mean Depth (ft.)	**1.0**	**1.0**	**1.1**	**0.9**		
Maximum Bankfull Depth (ft.)	**1.7**	**1.8**	**2.1**	**1.73**		
Bankfull Cross Sectional Area (ft^2)	**10.4**	**10.9**	**13.1**	**10.1**		

*According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.

APPENDIX B

SITE PHOTOGRAPHS

Hyatt Mill Creek Site #5

Photo Point #1 (Upstream)

Photo Point #1(Downstream)

Photo Point #2 (Upstream)

Photo Point #2 (Downstream)

December 2024

Hyatt Mill Creek Site #5

Photo Point #3 (Upstream)

Photo Point #3 (Downstream)

Photo Point #4 (Upstream)

Photo Point #4 (Downstream)

December 2024

Hyatt Mill Creek Site #5

Vegetation Plot #1

Vegetation Plot #2

August 2024

Hyatt Mill Creek Site #5

Upstream overview from driveway crossing

Downstream overview from driveway crossing.

August 2024

Hyatt Mill Creek Site #5

Supplemental Photo PP 1 Area Upstream

Supplemental Photo PP1 Area Downstream

Supplemental Photo PP2 Area Upstream

Supplemental Photo PP2 Area Downstream

Supplemental Photo PP2 Area Upstream

Supplemental Photo PP2 Area Downstream

Hyatt Mill Creek Site #5

Supplemental Photo PP2 Area Upstream

Supplemental Photo PP2 Area Downstream

Site overview of upstream reach.

Hyatt Mill Creek Site #5

Site overview downstream reach.

Downstream of Confluence of UT Hyatt Mill Creek with Hyatt Mill Creek entering culver inlet. Division Forces cleared sediment to allow flow through main channel culvert (right barrel).

Supplemental Photos from December 2024

APPENDIX C

A-0011C STREAM RELOCATION MONITORING PLAN

A-0011C Stream Relocation Monitoring Plan

Hyatt Mill Creek

Clay County

Version 1.0

January 25, 2019

NCDOT Division 14

This plan addresses requirements for the relocation of a portion of Hyatt Mill Creek impacted for the widening of NC-69 from the Georgia Line to US 64, Clay County, NC (TIP A-0011C). The purpose of the project is to improve traffic service for motorists in the project area. Hyatt Mill Creek is closely confined between an existing business and NC-69 southbound. The property on the northbound side of NC-69 is deemed an historical property and through agency coordination could not be impacted. Therefor this portion of Hyatt Mill Creek would be impacted to complete the project. Specifically, the impact is a result of fill that is needed to for the two additional southbound lanes. The widening configuration was chosen in an effort to eliminate impacts to the historical property on the northbound side on NC-69.

The portion of Hyatt Mill Creek being relocated is approximately 600 linear feet. Existing Hyatt Mill Creek is a small stream (~0.35 mi^2 watershed) with an approximately 8-foot wide sand/gravel bed. The channel has a few areas of instability and is slightly entrenched. From Rogen Classification, this channel seems to be a straightened C channel. The designed (proposed low to moderate width-to-depth ratio C Type) channel is approximately 633 feet in length with a bankfull channel width of 10 feet. Average buffer width (measured from the bankfull channel limit) that will be replanted along the stream is 40 feet with widths ranging from 20 to 65 feet. There is an area on the left bank at approximate station 10+10 that has a buffer width of approximately 25 feet due to an existing pond that the R/W and buffer zone were brought in to avoid. In addition, two areas located at approximate stations 10+70 and 12+62 along the right bank have a buffer width ranging from 22 to 24 feet due to the stream alignment being generated to have an appropriate belt width based on the locations of the upstream pipe and the proposed driveway pipe arch. Floodplain access is expected to meet the success criteria based on design parameters. Hydrologic functions should be comparable to existing, but water quality and stream habitat functions should be lifted by improving bank stability, riffle habitat structures (habitat complexity), and reducing sediment inputs.

NCDOT will be responsible for implementing the monitoring plan. A consulting firm will be secured to complete the data collection and report writing.

GENERAL MONITORING PLAN

Monitoring requirements and success criteria outlined in the latest guidance by USACE (Wilmington District) in October 2016 (*Stream and Wetland Compensatory Mitigation Update*) (Guidelines) will be followed and are briefly outlined below. Monitoring data collected at the Site will include reference photos, plant survival analysis, and channel stability analysis and will be reported in the format specified by RGL 08-03.

Riparian vegetation and stream morphology is proposed to be monitored for a period of seven years with measurements completed in years 1-3, year 5, and year 7. Visual monitoring results will be reported in all monitoring reports. Photo documentation of stream stability will be included in monitoring reports for years 4 and 6. If monitoring demonstrates the Site is successful by year 5 and no concerns have been identified, NCDOT may propose, in writing, to terminate monitoring at the Site and forego monitoring requirements for years 6 and 7. If USACE determines that terminating the site monitoring is acceptable, USACE will notify NCDOT in writing. Early closure will only be provided through written approval from USACE. Monitoring will be conducted by NCDOT or its duly authorized representatives. Monitoring reports must be provided to USACE for review no later than April 1 for all seven years of monitoring.

Monitoring and success criteria for the Site will relate to project goals and objectives determined by NC SAM functional assessment method. Goals and objectives will be considered successful upon achieving stream and/or vegetation success criteria. **Table 1** provides a monitoring schedule for the Site.

Table 1. Monitoring Schedule

Resource	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Stream	■	■	■		■		■
Vegetation	■	■	■		■		■
Visual Assessment	■	■	■	■	■	■	■
Report Submittal	■	■	■	■	■	■	■

VEGETATION

Vegetation planting should be conducted between November 15 and March 15. After planting has been completed, an initial evaluation will be performed to verify planting methods and to determine initial species composition and density. Supplemental planting and additional Site modifications will be implemented, if necessary. Plants will be selected from the attached species list.

Two sample plots (0.02 ac in size, >2% of planted portion) will be installed within the Site (see Attachment A) due to small size of the project. Vegetation monitoring for each sample plot will be conducted between July 1st and leaf drop to account for an effects of climatic or other conditions that may affect vegetation survival. Visual observations of the percent cover of shrub and herbaceous species will also be documented by photograph.

Vegetation Performance Criteria

Within planted portions of the site, a minimum of 320 planted stems per acre must be surviving in the first three monitoring years. Subsequently, a minimum of 260 stems per acre must be present at year 5 and 210 stems per acre at year 7. Since this Site is located in the mountain region, trees in each plot must average 6 feet in height at year 5 and 8 feet in height at year 7. Volunteer stems of native plants will be considered in determining overall vegetation success; however, (1) volunteer stems will be counted separately from planted stems and (2) volunteer streams must be species from the approved planting list included in this plan.

STREAM CHANNEL STABILITY

Permanent, monumented cross-sections will be installed at an approximate frequency of one per 20 bankfull-widths, measured along the centerline of the channel (thalwag). In general, cross-section locations should be selected to represent 50% of pools and 50% of riffle areas. Locations of the cross sections will include areas predisposed to instability. Cross-section locations shall be detailed in the Site as-built survey. Monitoring cross section locations for the Site are depicted on the monitoring plan sheet (Attachment A).

Longitudinal profiles of the thalweg, water surface, bankfull, and top-of-bank shall be provided in the Site as-built survey from comparison with future geomorphological data. Unless there is evidence of channel bank or bed instability observed during monitoring efforts, additional profile surveys will not be required during the Stream Monitoring Period (years 1 through 7). In these cases where bed/bank instability is observed, USACE will determine if remedial measures are necessary. If remedial measures are necessary, additional longitudinal profiles may be required in these areas of concern to track changes in the channel and demonstrate stability

Determinations regarding the occurrence of bankfull events shall be based on the observation of overbank events utilizing physical evidence of overbank flooding. The need for crest gages to be installed to document the occurrence of bankfull events should not be necessary due to the length of stream restoration. Physical indicators, which are easily observable, include floodplain scour, vegetation flattening, sediment deposition on floodplains and wrack lines consisting of deposited debris associated with stream discharges. The presence of physical indicators supporting bankfull event determinations shall be photo-documented.

Stream Success Criteria

Criteria are included below in **Table 2**. During annual monitoring, if visual monitoring shows stream instability and/or causing more than a 15% increase in cross-sectional area, bank pins will be installed to assess the stability over time. During any given monitoring interval, bank height ratio (BHR) and entrenchment ratio (ER) will not change more than 10% from the baseline condition. Remedial actions in coordination with USACE may be needed if this criteria is not met.

Table 2. Functional Goal/Objectives and Performance Standards

Project Goal/Objective	Stream Success Criteria
(1) Hydrology	
(2) Flood Flow (Floodplain Access) (3) Streamside Area Attenuation	Four overbank events in separate monitoring years will be documented during the monitoring period.
(4) Wooded Riparian Buffer	Attaining vegetation success criteria including an average density of 320 planted stems per acre must be surviving in the first three monitoring years. Subsequently, 260 planted stems per acre must be surviving in year 5, and 210 planted stems per acre in year 7.
(3) Stream Stability (4) Channel Stability	Cross-sections, monitored annually, will be compared to as-built measurements to determine channel stability and maintenance of channel geomorphology. Bank Height Ratios and Entrenchment Ratios target is 10% max. increase between monitoring years and bank erosion will be minimized.
(4) Stream Geomorphology	Maintain a stable C-type channel.
(1) Water Quality	
(2) Streamside Area Vegetation (3) Upland Pollution Filtration	Attaining vegetation success criteria (Restore Wooded Riparian Buffer)
(1) Restore Habitat	
(2) In-stream Habitat (3) Stream Stability (3) In-stream Habitat	Attaining vegetation performance criteria (Restore Wooded Riparian Buffer) and stabilization of grade control/habitat structures.
(2) In-stream Habitat (3) Streamside Habitat (3) Thermoregulation	Attaining vegetation success criteria (Restore Wooded Riparian Buffer).

VISUAL MONITORING

The Site will be visually monitored each year to identify areas of concern (poor plant vigor, invasive plants, streambank instability, etc.). Results will be provided in the monitoring report in a plan view format and recommended courses of action will be identified for approval by USACE.

STREAM BUFFERS

Minimum stream buffer widths will be approximately 30 feet. Some areas of the stream buffer will exceed 30 feet, including widths in excess of 50 feet.

Note that, average buffer width (measured from the bankfull channel limit) that will be replanted along the stream is 40 feet with widths ranging from 20 to 65 feet. There is an area on the left bank at approximate station 10+10 that has a buffer width of approximately 25 feet due to an existing pond that the R/W and buffer zone were brought in to avoid. In addition, two areas located at approximate stations 10+70 and 12+62 along the right bank have a buffer width ranging from 22 to 24 feet due to the stream alignment being generated to have an appropriate belt width based on the locations of the upstream pipe and the proposed driveway pipe arch.

REMEDIAL ACTIONS

Monitoring reports will include a remedial action plan to address the portions of the site that fail to meet one or more of the required functional goals/performance standards. USACE will be notified as soon as possible once a need is identified that will require remedial action. If portions of the site are not meeting required criteria, replanting of all or part of the site will be required. If supplemental plantings exceed 20% of the total planted area, additional vegetation monitoring may be required by USACE.

If concerns regarding stream stability are identified from visual monitoring and/or >15% increase in cross-sectional area, bank pins may be used to help track bank stability. A reach that has >10% increase in bank height ratio may be a candidate for repair. In this case, coordination with USACE will be conducted to determine if remediation may be needed.

The site will be monitored for the presence of invasive species and adaptive management aimed at controlling the species will be conducted. Treatments with herbicides, in coordination with USACE, will be used as needed where invasive species are identified in areas of planted and/or desirable species. Beaver control will be implemented under NCDOT's statewide contract with USDA should beaver damage occur during the monitoring period. These activities will be documented in annual reports.

The stream relocation and buffers will remain under state ownership in perpetuity. No mow signs and white stakes will be erected along the stream buffers to protect against maintenance activities.

Planting and Volunteer Plant List

Stream Banks (TYPE I)

Cornus amomum Silky dogwood
Salix sericea Silky willow
Salix nigra Black willow
Cephalanthus occidentalis Buttonbush
Alnus serrulata Tag alder
Populus deltoides Cottonwood

Riparian-Upland Buffer (TYPE II)

Liriodendron tulipifera Tulip Poplar
Prunus serotine Black Cherry
Robinia psedoaccaia Black Locust
Acer rubrum Red Maple
Ulmus americana American elm
Fraxinus americana White ash
Cornus amomum silky dogwood
Carpinus caroliniana Ironwood
Cephalanthus occidentalis Buttonbush
Lindera benzoin Spicebush
Liquidambar styraciflua Sweetgum
Alnus serrulata Tag alder
Plantanus occidentalis Sycamore
Betula nigra River birch
Populus deltoides Cottonwood
Corylus americana American hazelnut
Quercus michauxii Swamp chestnut oak
Sambucus canadensis elderberry
Pinus strobus Eastern white pine
Pinus echinata Shortleaf pine
Pinus virginiana Virginia Pine
Quercus alba White oak
Quercus falcata Southern red oak
Quercus stellata Post oak
Juniperus virginiana Eastern red cedar
Diospyros virginiana Common persimmon
Juglans nigra Black walnut
Carya tomentosa Mockernut hickory
Carya glabra Pignut hickory
Ilex opaca American holly
Cornus florida Flowering dogwood
Juglans nigra Black walnut
Fagus grandifolia American beech
Cornus racemosa Gray dogwood
Hamamelis virginiana American witchhazel
Viburnum dentatum Southern arrowwood
Sambucus racemosa Red elderberry

APPENDIX D

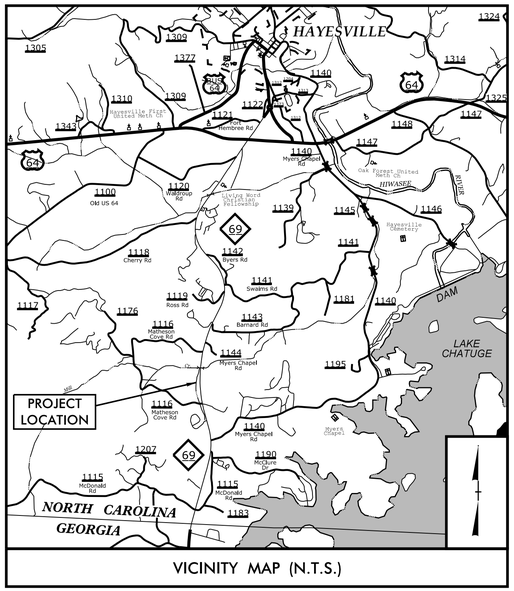
CROSS SECTION, VEGETATION PLOT & PHOTO POINT LOCATIONS (AS-BUILT PLANS)

09/08/99

TIP PROJECT: A-0011C

CONTRACT: _____

See Sheet OSM-1A For Index of Sheets



VICINITY MAP (N.T.S.)

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

PLAN FOR ON–SITE MITIGATION
CLAY COUNTY

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	A–0011C	OSM-1	28

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION
32574.1.FD7	APD–0069(007)	PE
32574.2.4	APD–0069(007)	RW, UTILITIES
32574.3.8	APD–0069(007)	CONSTRUCTION

LOCATION: NC 69 FROM GEORGIA STATE LINE TO US 64

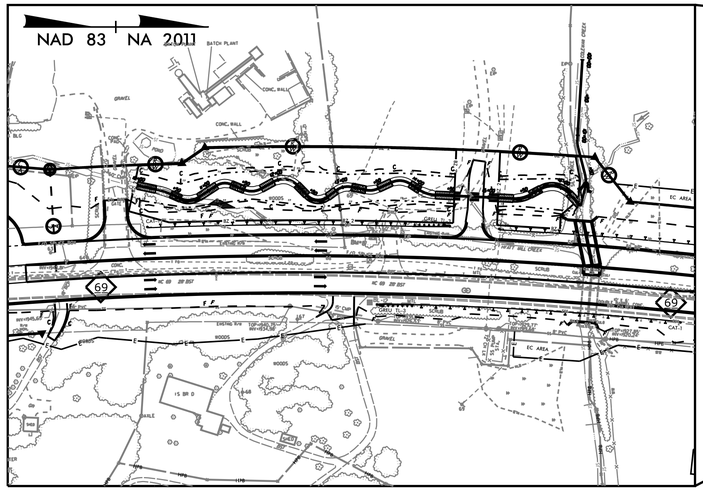
TYPE OF WORK: STREAM RELOCATION (GRADING & PLANTING)

As Built Plans

Site Completed 6-24-2020

As-Built Shots taken 9-27-2021

Planting Completed February 2022



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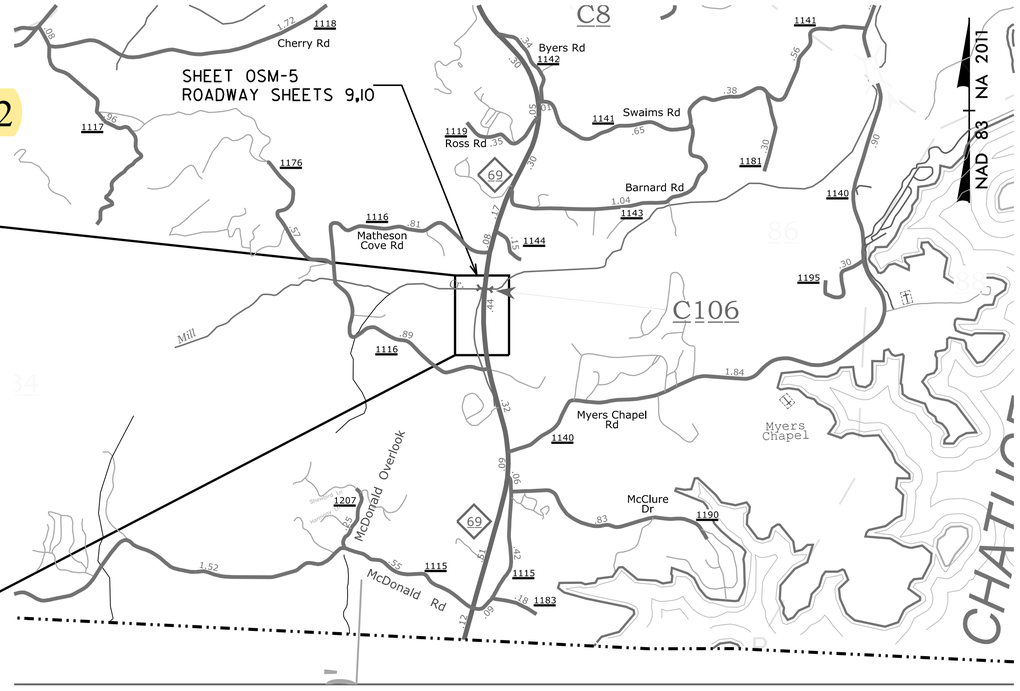


GRAPHIC SCALES

30 15 0 30 60
PLANS

30 15 0 30 60
PROFILE (HORIZONTAL)

3 1.5 0 3 6
PROFILE (VERTICAL)

PROJECT LENGTH

LENGTH OF TIP PROJECT A–0011C
STREAM RELOCATION = 633 LF (0.12 MI.)

2018 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE:

LETTING DATE:

PROJECT ENGINEER

PROJECT DESIGN ENGINEER

HYDRAULICS ENGINEER

P.E.

SIGNATURE:

STATE OF NORTH CAROLINA · DEPARTMENT OF TRANSPORTATION

8/17/99

REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
A-0011C	OSM-1A
R/W SHEET NO.	
	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

GENERAL NOTES:

1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE FOLLOWING STANDARDS:

A) NORTH CAROLINA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES" DATED JANURAY 2018, AND ANY SUPPLEMENTS THERETO ISSUED PRIOR TO THE DATE OF RECEIPT OF BIDS.

B) NORTH CAROLINA DEPARTMENT OF TRANSPORTATION "ROADWAY STANDARD DRAWINGS" DATED 2018, AND ANY SUPPLEMENTS THERETO ISSUED PRIOR TO THE DATE OF RECEIPT OF BIDS.

C) NORTH CAROLINA DEPARTMENT OF TRANSPORTATION "CONSTRUCTION MANUAL".

2. THE CONTRACTOR IS RESPONSIBLE FOR AVOIDING ANY DISTURBANCE OR DAMAGE TO EXISTING UTILITIES AND SHALL BE RESPONSIBLE FOR IMMEDIATELY REPAIRING ANY DAMAGES AT A COST INCIDENTAL TO THIS CONTRACT.

3. THE ABANDONED SECTION OF THE CHANNEL SHALL BE FILLED IN CONJUNCTION WITH THE ROADWAY WIDENING AND WILL NOT BE COMPLETED AS PART OF THE STREAM RELOCATION.

4. A PRECONSTRUCTION CONFERENCE SHALL BE COORDINATED BY THE ENGINEER PER DIVISION 16 OF THE NCDOT CONSTRUCTION MANUAL.

SEQUENCE OF CONSTRUCTION

PHASE 1 (ACCESS, PERIMETER CONTROLS, AND STAGING AND STOCKPILE AREAS FOR STREAM RELOCATION)

1. ESTABLISH CONSTRUCTION LIMITS AND LOCATION OF NEW STREAM ALIGNMNET. ONLY CLEAR AND GRUB AS NECESSARY FOR INSTALLATION OF PERIMETER CONTROLS. STABILIZE ALL DISTURBED AREAS AT THE END OF EACH DAY. THE ENGINEER MUST INSPECT AND APPROVE ALL LAYOUT WORK BEFORE CONSTRUCTION MAY BEGIN.

2. MOBILIZE EQUIPMENT AND MATERIALS TO THE SITE.

3. INSTALL TEMPORARY CONSTRUCTION GRAVEL ENTRANCE/EXIT PER EROSION AND SEDIMENT CONTROL PLAN.

4. ESTABLISH STAGING AREAS AND MARK CONSTRUCTION EQUIPMENT ACCESS LOCATIONS WITH VISIBLE MARKERS. CONSTRUCTION EQUIPMENT SHALL BE CONTAINED WITHIN THE LIMITS OF CONSTRUCTION AS DEPICTED IN THE PLANS OR SPECIFIED BY THE ENGINEER.

5. INSTALL TEMPORARY PIPE, CONSTRUCTION ACCESS PATH AND TEMPORARY GRAVEL DRIVEWAY. INSTALL SILT FENCE WITHIN STOCKPILE AREAS.

PHASE 2 (INSTREAM WORK AREA STA 101+60 TO 101+85 AND COLEMAN CREEK, STA 14+25 TO STA 16+33)

6. INSTALL PUMP AROUND ON COLEMAN CREEK AS SHOWN ON THE EROSION AND SEDIMENT CONTROL PLAN (PREPARED BY OTHERS). INSTALL ROCK CROSS VANE ALONG COLEMAN CREEK FROM STA 101+60 TO 101+85.

7. WORKING FROM DOWNSTREAM TO UPSTREAM, BEGIN CONSTRUCTION OF RELOCATED STREAM STRUCTURES AND GRADING. ONLY OPEN AS MUCH CHANNEL AS MAY BE STABILIZED AT THE END OF EACH WORK DAY USING STONE IN STREAM OR MATTING FOR ADJACENT SLOPES. INSTALL PROPOSED 95" X 67" CORRUGATED STEEL ARCH PIPE, AND ENDWALLS ON NEW STREAM ALIGNMENT AS SHOWN ON THE ROADWAY PLANS (PREPARED BY OTHERS). BACKFILL DRIVEWAY AND PROVIDE STONE FOR ACCESS FOR TEMPORARY DRIVEWAY AS SHOWN ON THE EROSION AND SEDIMENT CONTROL PLAN (PREPARED BY OTHERS). DEWATER WORK AREA TO A SPECIAL STILLING BASIN WHEN EQUIPMENT IS ACTIVE IN CHANNEL. CONTINUE WORKING UPSTREAM TO COMPLETE INSTREAM WORK ON NEW ALIGNMENT UP TO STA 14+25.

8. WHEN ALL AREAS ARE STABILIZED AND WITH PERMISSION FROM THE ENGINEER, REMOVE TEMPORARY GRAVEL DRIVEWAY AND OPEN DRIVEWAY ACCESS OVER NEW STREAM CULVERT.

PHASE 3 (INSTREAM WORK AREA STA 11+09 TO STA 14+25)

9. INSTALL COIR FIBER WATTLE BARRIER AS SHOWN ON THE EROSION AND SEDIMENT CONTROL PLAN (PREPARED BY OTHERS). WORKING FROM DOWNSTREAM TO UPSTREAM, BEGIN CONSTRUCTION OF RELOCATED STREAM STRUCTURES AND GRADING STARTING AT STA 14+25. ONLY OPEN AS MUCH CHANNEL AS MAY BE STABILIZED AT THE END OF EACH WORK DAY USING STONE IN STREAM OR MATTING FOR ADJACENT SLOPES. DEWATER WORK AREA TO A SPECIAL STILLING BASIN WHEN EQUIPMENT IS ACTIVE IN CHANNEL. CONTINUE WORKING UPSTREAM TO COMPLETE INSTREAM WORK ON NEW ALIGNMENT UP TO STA 11+09.

PHASE 4 (INSTREAM WORK AREA STA 10+00 TO STA 11+09)

10. DURING A 3-DAY DRY WEATHER FORECAST FROM THE NATIONAL WEATHER SERVICE, ESTABLISH STREAM DIVERSION/PUMP AROUND FROM STA 10+00 (EX 60" CMP) TO EXISTING CHANNEL AS SHOWN ON THE EROSION AND SEDIMENT CONTROL PLAN (PREPARED BY OTHERS). COMPLETE CONSTRUCTION OF STREAM STRUCTURES AND GRADING TO BRING RELOCATED STREAM ONLINE. ONLY OPEN AS MUCH CHANNEL AS MAY BE STABILIZED AT THE END OF EACH WORK DAY USING STONE IN STREAM OR MATTING FOR ADJACENT SLOPES. DEWATER WORK AREA TO A SPECIAL STILLING BASIN WHEN EQUIPMENT IS ACTIVE IN CHANNEL. DURING NON-WORK HOURS, MAINTAIN STREAM FLOW TO EXISTING CHANNEL USING IMPERVIOUS DIKES AS NEEDED. CONTINUE WORKING UPSTREAM TO COMPLETE INSTREAM WORK ON NEW ALIGNMENT UP TO STA 10+00. THE CONTRACTOR SHALL RECEIVE APPROVAL FROM THE ENGINEER PRIOR TO DIRECTING FLOW INTO THE NEW STREAM.

11. UPON PERMANENT STABILIZATION AND WITH APPROVAL FROM THE ENGINEER, REMOVE PERIMETER CONTROLS AND CONSTRUCTION ACCESS ROAD EXCLUDING TEMPORARY DRIVEWAY ACCESS PATH. IMMEDIATELY STABILIZE ANY DISTURBED AREAS RESULTING FROM THIS WORK.

INDEX OF SHEETS

STREAM SYMBOLS

PLAN VIEW SYMBOLS

- RIFFLE GRADE CONTROL
- WOOD DROP RIFFLE
- ROCK TOE PROTECTION
- STREAM PLUG
- PROPOSED 95" x 67" PIPE ARCH CULVERT
- FLOODPLAIN LINE (FP)
- BUFFER ZONE (BZ 2)
- BACKFILL EXISTING CHANNEL
- ROCK CROSS VANE

CROSS SECTION SYMBOLS

- EXISTING GROUND ELEVATION
- PROPOSED GROUND ELEVATION
- PROPOSED RIFFFLE GRADE CONTROL
- PROPOSED WOOD DROP RIFFLE
- CHANNEL SUBSTRATE MATERIAL

PROFILE SYMBOLS

- EXISTING GROUND ELEVATION
- PROPOSED GROUND ELEVATION
- PROPOSED BANKFULL
- PROPOSED RIFFFLE GRADE CONTROL
- PROPOSED WOOD DROP RIFFLE

PLANTING SYMBOLS

- TYPE 1
- TYPE 2 - TREES AND SHRUBS
- TYPE 2 - EMBANKMENT SHRUBS

12/2/2016

PROJECT REFERENCE NO.	SHEET NO.
A-0011C	OSM-1B

STATE OF NORTH CAROLINA, DIVISION OF HIGHWAYS

CONVENTIONAL PLAN SHEET SYMBOLS

Note: Not to Scale **S.U.E. = Subsurface Utility Engineering*

BOUNDARIES AND PROPERTY:

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin (EIP)
- Computed Property Corner
- Property Monument (ECM)
- Parcel/Sequence Number (123)
- Existing Fence Line
- Proposed Woven Wire Fence
- Proposed Chain Link Fence
- Proposed Barbed Wire Fence
- Existing Wetland Boundary (WLB)
- Proposed Wetland Boundary (WLB)
- Existing Endangered Animal Boundary (EAB)
- Existing Endangered Plant Boundary (EPB)
- Existing Historic Property Boundary (HPB)
- Known Contamination Area: Soil (S)
- Potential Contamination Area: Soil (S)
- Known Contamination Area: Water (W)
- Potential Contamination Area: Water (W)
- Contaminated Site: Known or Potential

BUILDINGS AND OTHER CULTURE:

- Gas Pump Vent or U/G Tank Cap
- Sign (S)
- Well (W)
- Small Mine
- Foundation
- Area Outline
- Cemetery
- Building
- School
- Church
- Dam

HYDROLOGY:

- Stream or Body of Water
- Hydro, Pool or Reservoir
- Jurisdictional Stream (JS)
- Buffer Zone 1 (BZ 1)
- Buffer Zone 2 (BZ 2)
- Flow Arrow
- Disappearing Stream
- Spring
- Wetland
- Proposed Lateral, Tail, Head Ditch (FLOW)
- False Sump

RAILROADS:

- Standard Gauge (CSX TRANSPORTATION)
- RR Signal Milepost (MILEPOST 35)
- Switch (SWITCH)
- RR Abandoned
- RR Dismantled

RIGHT OF WAY & PROJECT CONTROL:

- Secondary Horiz and Vert Control Point
- Primary Horiz Control Point
- Primary Horiz and Vert Control Point
- Exist Permanent Easment Pin and Cap
- New Permanent Easement Pin and Cap
- Vertical Benchmark
- Existing Right of Way Marker
- Existing Right of Way Line
- New Right of Way Line (RW)
- New Right of Way Line with Pin and Cap (RW)
- New Right of Way Line with Concrete or Granite R/W Marker (RW)
- New Control of Access Line with Concrete C/A Marker (CA)
- Existing Control of Access (CA)
- New Control of Access (CA)
- Existing Easement Line (E)
- New Temporary Construction Easement (E)
- New Temporary Drainage Easement (TDE)
- New Permanent Drainage Easement (PDE)
- New Permanent Drainage / Utility Easement (DUE)
- New Permanent Utility Easement (PUE)
- New Temporary Utility Easement (TUE)
- New Aerial Utility Easement (AUE)

ROADS AND RELATED FEATURES:

- Existing Edge of Pavement
- Existing Curb
- Proposed Slope Stakes Cut (C)
- Proposed Slope Stakes Fill (F)
- Proposed Curb Ramp (CR)
- Existing Metal Guardrail
- Proposed Guardrail
- Existing Cable Guiderail
- Proposed Cable Guiderail
- Equality Symbol
- Pavement Removal

VEGETATION:

- Single Tree
- Single Shrub
- Hedge
- Woods Line
- Orchard
- Vineyard

EXISTING STRUCTURES:

MAJOR:

- Bridge, Tunnel or Box Culvert (CONC)
- Bridge Wing Wall, Head Wall and End Wall (CONC WW)

MINOR:

- Head and End Wall (CONC HW)
- Pipe Culvert
- Footbridge
- Drainage Box: Catch Basin, DI or JB (CB)
- Paved Ditch Gutter
- Storm Sewer Manhole
- Storm Sewer (S)

UTILITIES:

POWER:

- Existing Power Pole
- Proposed Power Pole
- Existing Joint Use Pole
- Proposed Joint Use Pole
- Power Manhole (P)
- Power Line Tower
- Power Transformer
- U/G Power Cable Hand Hole
- H-Frame Pole
- U/G Power Line LOS B (S.U.E.*) (P)
- U/G Power Line LOS C (S.U.E.*) (P)
- U/G Power Line LOS D (S.U.E.*) (P)

TELEPHONE:

- Existing Telephone Pole
- Proposed Telephone Pole
- Telephone Manhole (T)
- Telephone Pedestal (T)
- Telephone Cell Tower
- U/G Telephone Cable Hand Hole (HH)
- U/G Telephone Cable LOS B (S.U.E.*) (T)
- U/G Telephone Cable LOS C (S.U.E.*) (T)
- U/G Telephone Cable LOS D (S.U.E.*) (T)
- U/G Telephone Conduit LOS B (S.U.E.*) (TC)
- U/G Telephone Conduit LOS C (S.U.E.*) (TC)
- U/G Telephone Conduit LOS D (S.U.E.*) (TC)
- U/G Fiber Optics Cable LOS B (S.U.E.*) (T FO)
- U/G Fiber Optics Cable LOS C (S.U.E.*) (T FO)
- U/G Fiber Optics Cable LOS D (S.U.E.*) (T FO)

WATER:

- Water Manhole (W)
- Water Meter
- Water Valve
- Water Hydrant
- U/G Water Line LOS B (S.U.E*) (W)
- U/G Water Line LOS C (S.U.E*) (W)
- U/G Water Line LOS D (S.U.E*) (W)
- Above Ground Water Line (A/G Water)

TV:

- TV Pedestal (C)
- TV Tower
- U/G TV Cable Hand Hole (HH)
- U/G TV Cable LOS B (S.U.E.*) (TV)
- U/G TV Cable LOS C (S.U.E.*) (TV)
- U/G TV Cable LOS D (S.U.E.*) (TV)
- U/G Fiber Optic Cable LOS B (S.U.E.*) (TV FO)
- U/G Fiber Optic Cable LOS C (S.U.E.*) (TV FO)
- U/G Fiber Optic Cable LOS D (S.U.E.*) (TV FO)

GAS:

- Gas Valve
- Gas Meter
- U/G Gas Line LOS B (S.U.E.*) (G)
- U/G Gas Line LOS C (S.U.E.*) (G)
- U/G Gas Line LOS D (S.U.E.*) (G)
- Above Ground Gas Line (A/G Gas)

SANITARY SEWER:

- Sanitary Sewer Manhole
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line (SS)
- Above Ground Sanitary Sewer (A/G Sanitary Sewer)
- SS Forced Main Line LOS B (S.U.E.*) (FSS)
- SS Forced Main Line LOS C (S.U.E.*) (FSS)
- SS Forced Main Line LOS D (S.U.E.*) (FSS)

MISCELLANEOUS:

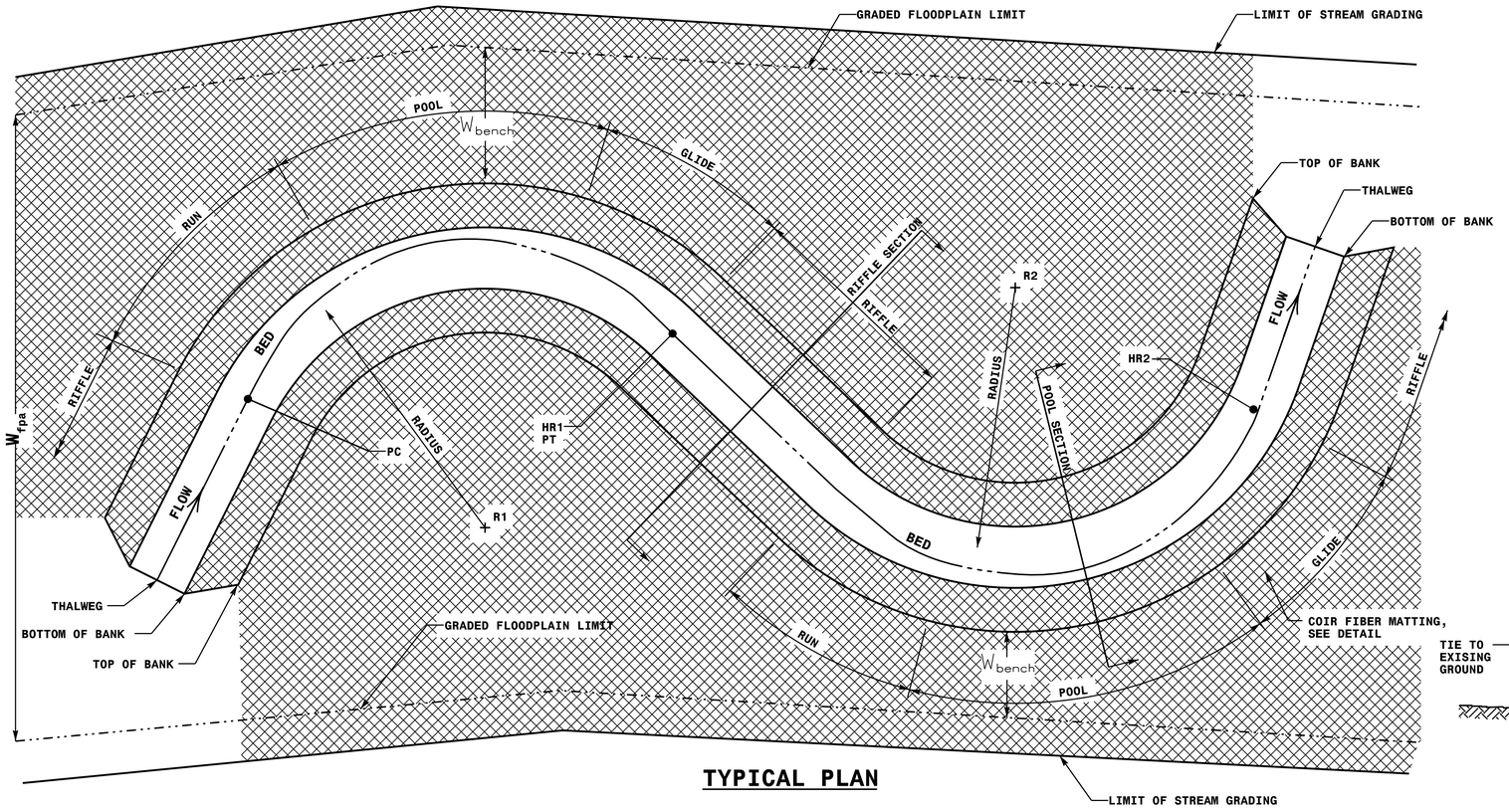
- Utility Pole
- Utility Pole with Base
- Utility Located Object
- Utility Traffic Signal Box (S)
- Utility Unknown U/G Line LOS B (S.U.E.*) (?UTL)
- U/G Tank; Water, Gas, Oil
- Underground Storage Tank, Approx. Loc. (UST)
- A/G Tank; Water, Gas, Oil
- Geoenvironmental Boring
- U/G Test Hole LOS A (S.U.E.*)
- Abandoned According to Utility Records (AATUR)
- End of Information (E.O.I.)

8/17/99

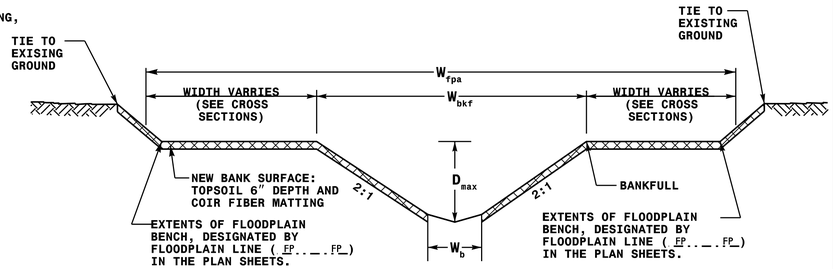
REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
A–0011C	OSM–2
R/W SHEET NO.	
	HYDRAULICS ENGINEER

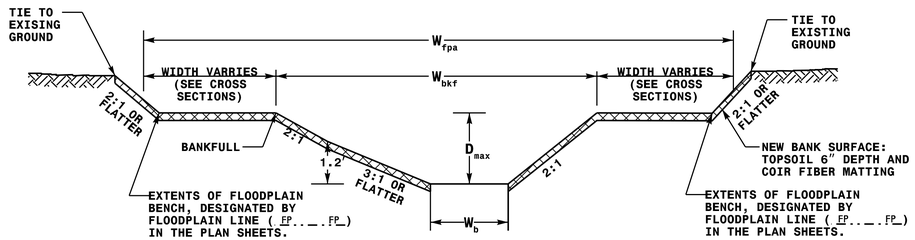
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



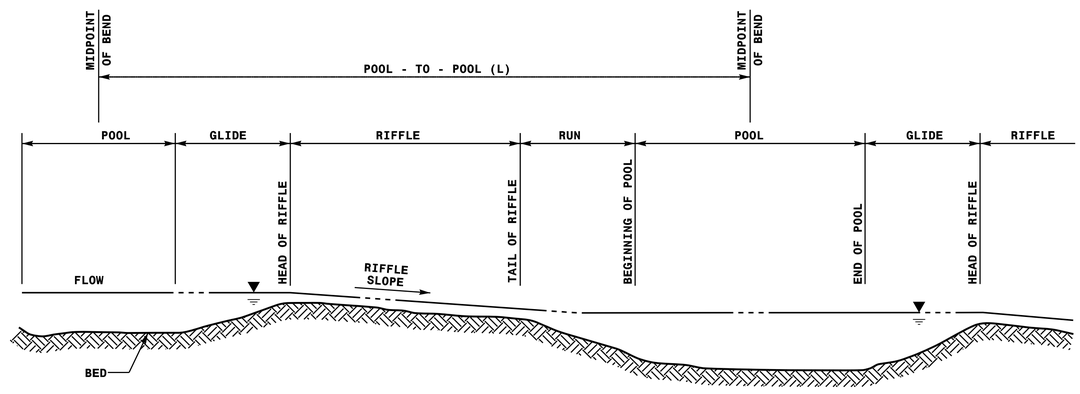
TYPICAL PLAN



TYPICAL RIFFLE WITH BANKFULL BENCH



TYPICAL POOL WITH BANKFULL BENCH



TYPICAL PROFILE

CHANNEL TYPICAL DETAIL

NOT TO SCALE

NOTES:
1) THE COORDINATES FOR EACH CENTER OF RADIUS (EX. "R1","R2") AND EACH HEAD OF RIFFLE ("HR1","HR2") ARE INDICATED ON THE PLAN SHEETS.

W_{bkf} = BANKFULL WIDTH
D_{max} = MAXIMUM DEPTH
W_b = BOTTOM WIDTH
W_{fpa} = FLOOD PRONE AREA WIDTH

CROSS SECTION DIMENSIONS (IN FEET)

	RIFFLE				POOL				
	W_{bkf}	D_{max}	W_b	W_{fpa}	W_{bkf}	D_{max}	W_b	W_{fpa}	Width/Depth RATIO
HYATT MILL CREEK	10.0	1.2	6.0	SEE CROSS SECTIONS	11.0	2.2	0.6	SEE CROSS SECTIONS	11.6

8/17/99

REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
A-0011C	OSM-2A
R/W SHEET NO.	
	HYDRAULICS ENGINEER

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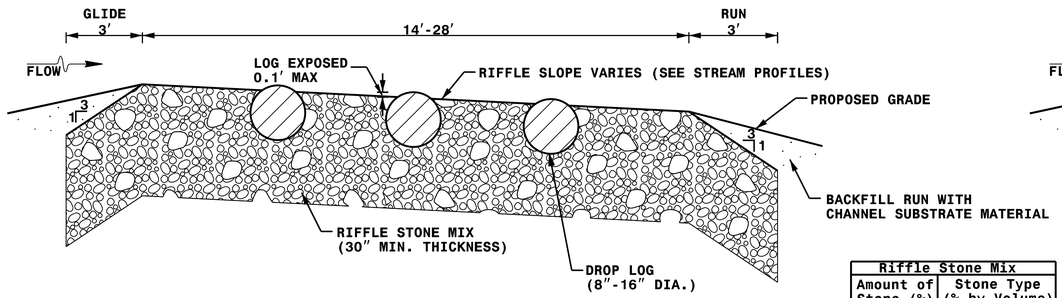
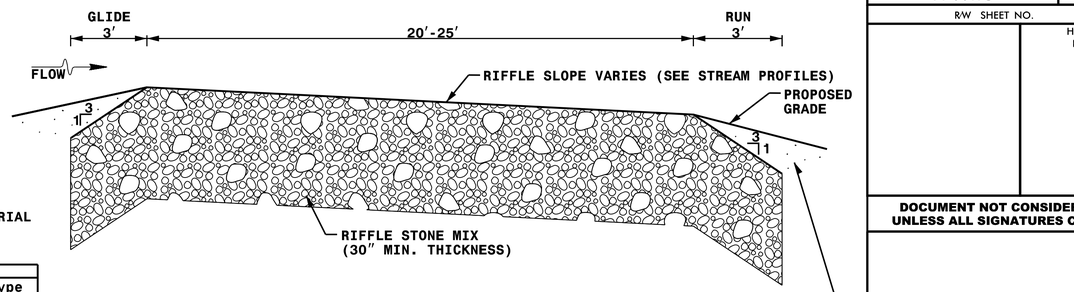


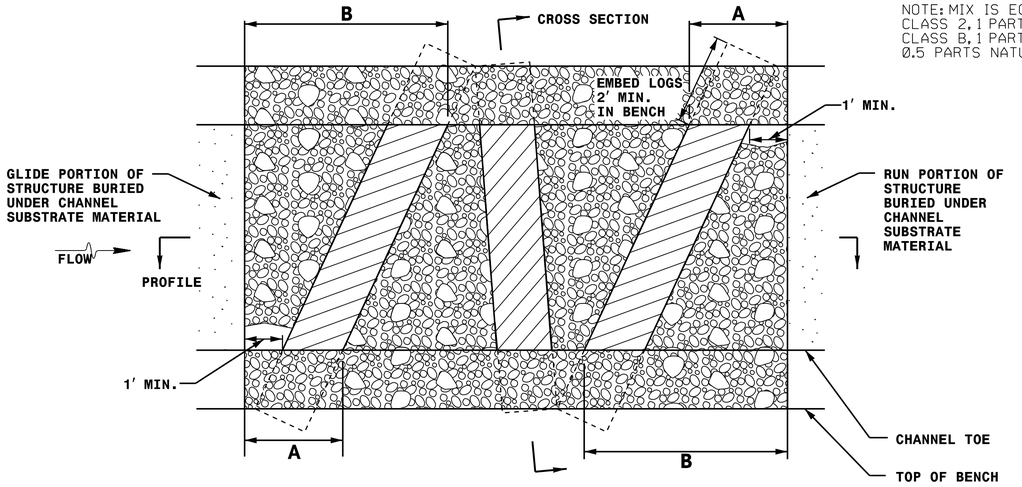
PROFILE VIEW



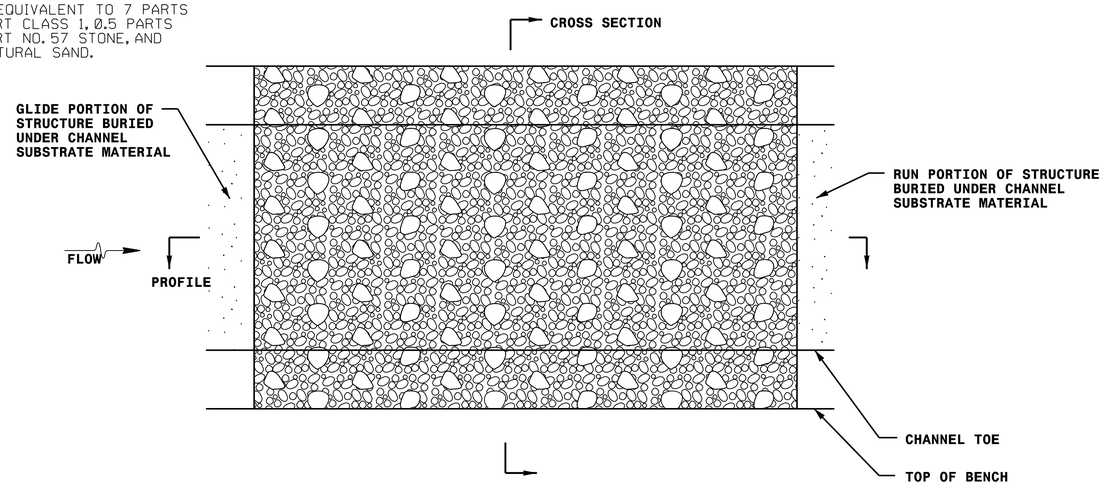
PROFILE VIEW

Riffle Stone Mix	
Amount of Stone (%)	Stone Type (% by Volume)
70%	Class 2
10%	Class 1
5%	Class B
10	NO. 57
5	NATURAL SAND
100%	Total

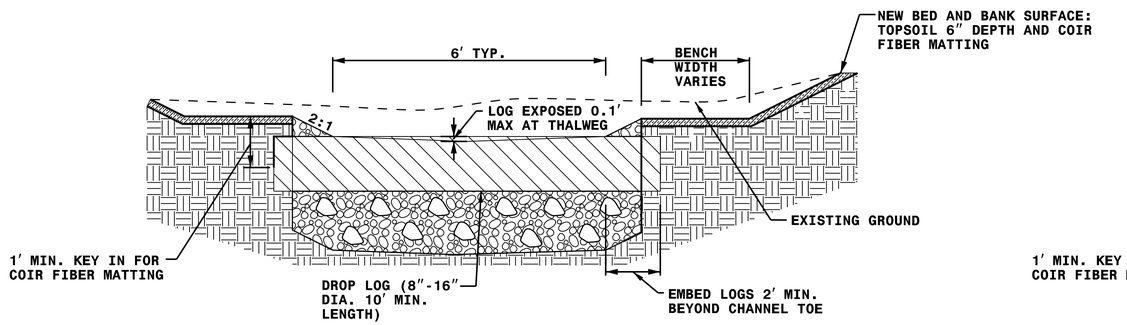
NOTE: MIX IS EQUIVALENT TO 7 PARTS CLASS 2, 1 PART CLASS 1, 0.5 PARTS CLASS B, 1 PART NO. 57 STONE, AND 0.5 PARTS NATURAL SAND.



PLAN VIEW



PLAN VIEW



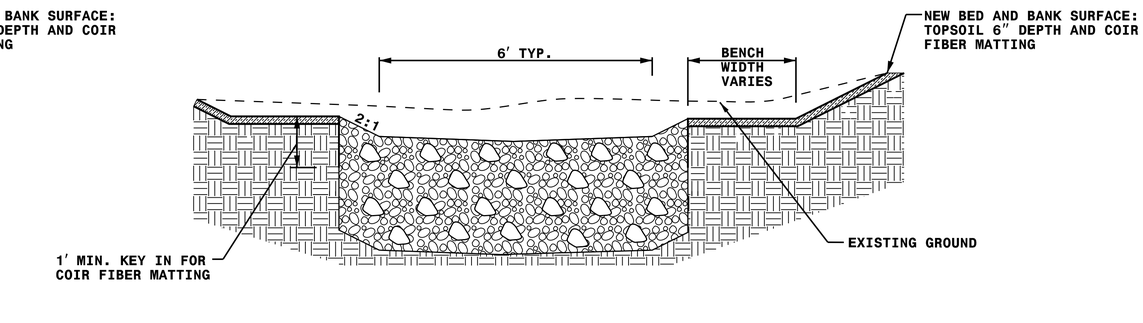
CROSS SECTION

DROP LOGS			
STATION FROM	STATION TO	A	B
10+46	10+60	2.5	5
11+33	11+52	3.5	6.5
12+27	12+46	3.5	6.5
13+12	13+31	3.5	6.5
13+93	14+08	2.5	5
15+56	15+72	3	5.5

WOOD DROP RIFFLE DETAIL

NOT TO SCALE

NOTES:
1) FURNISH AND INSTALL A WELL-GRADED RIFFLE MIX TO MINIMIZE VOIDS. ENSURE THAT THE RIFFLE MIX IS WELL MIXED.
2) FURNISH NATURAL SAND MEETING SIZE REQUIREMENTS OF 2S FINE AGGREGATE
3) BANK AND BENCH DIMENSIONS VARY, SEE CROSS SECTIONS FOR DIMENSIONS AT EACH INDIVIDUAL STRUCTURE.
4) DROP LOG TO CONSIST OF HARDWOOD SPECIES APPROVED BY THE ENGINEER.



CROSS SECTION

RIFFLE GRADE CONTROL DETAIL

NOT TO SCALE

NOTES:
1) FURNISH AND INSTALL A WELL-GRADED RIFFLE MIX TO MINIMIZE VOIDS. ENSURE THAT THE RIFFLE MIX IS WELL MIXED.
2) FURNISH NATURAL SAND MEETING SIZE REQUIREMENTS OF 2S FINE AGGREGATE
3) BANK AND BENCH DIMENSIONS VARY, SEE CROSS SECTIONS FOR DIMENSIONS AT EACH INDIVIDUAL STRUCTURE.
4) DROP LOG TO CONSIST OF HARDWOOD SPECIES APPROVED BY THE ENGINEER.

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REVISIONS

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A-0011C	OSM-2B
R/W SHEET NO.	
	HYDRAULICS ENGINEER

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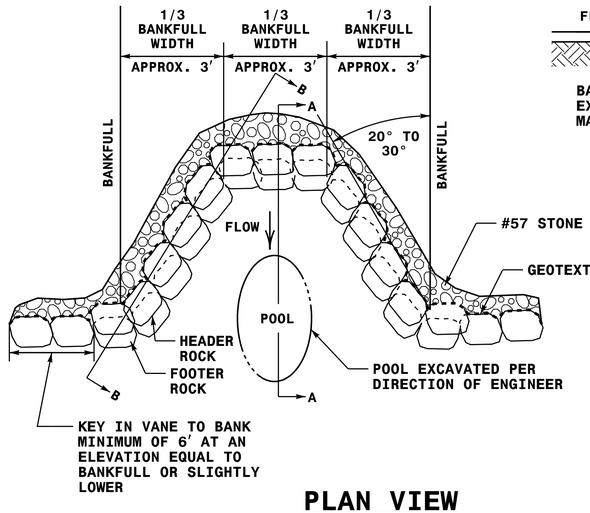
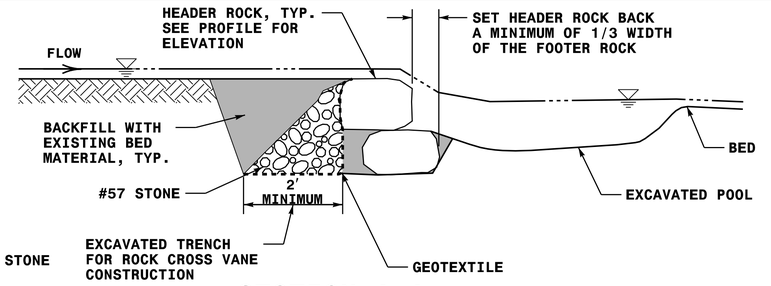
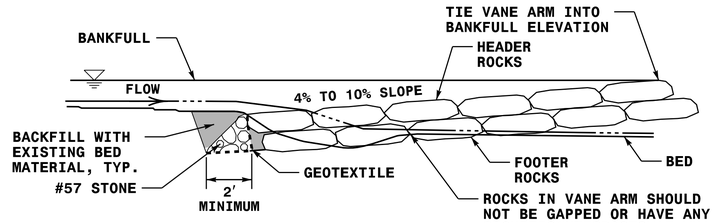


PLAN VIEW



SECTION A-A



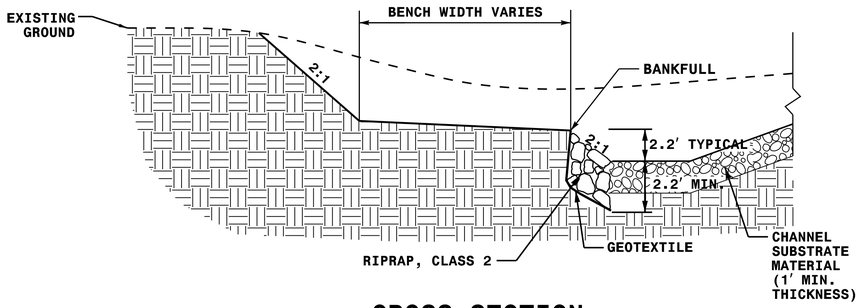
SECTION B-B

	BOULDER DIMENSIONS (FT)		
STATION	HEIGHT	WIDTH	LENGTH
101+64	1.5′ - 2′	2.5′ - 3′	3.5 - 4′

ROCK CROSS VANE DETAIL

NOT TO SCALE

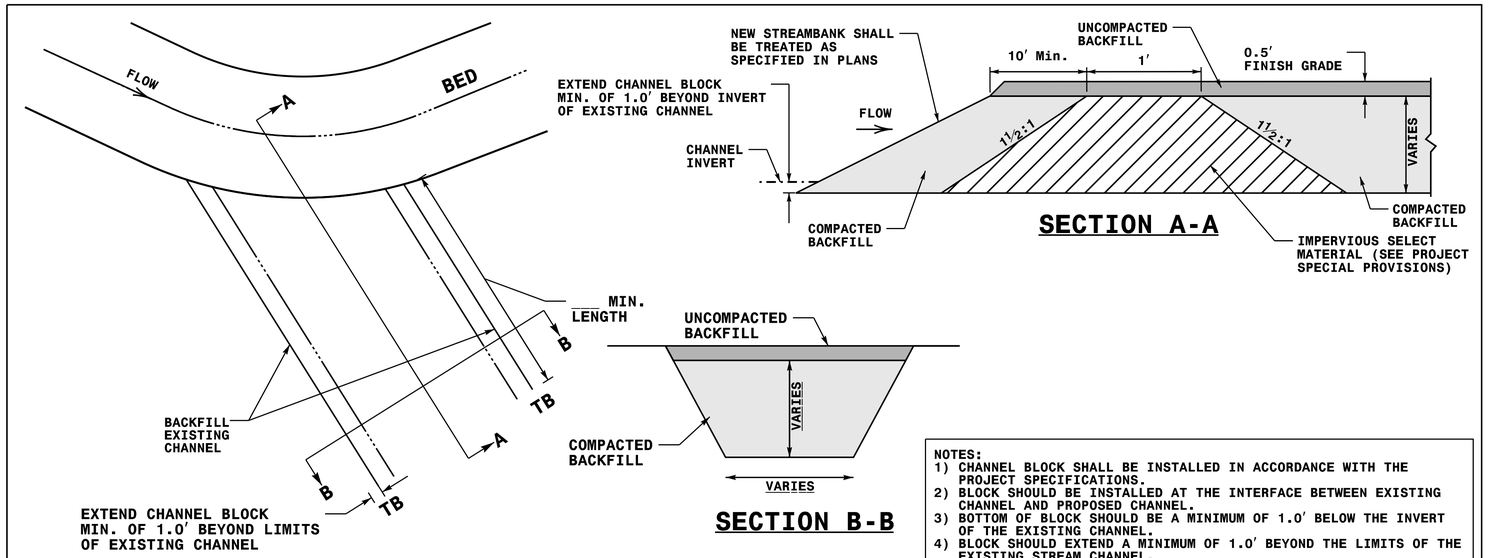
NOTES:
1) DEEPEST PART OF POOL TO BE IN LINE WITH WHERE VANE ARM TIES INTO BANKFULL.
2) DO NOT EXCAVATE POOL TOO CLOSE TO FOOTER BOULDERS.
3) CLASS "A" STONE CAN BE USED TO REDUCE VOIDS BETWEEN HEADERS AND FOOTERS.
4) COMPACT BACKFILL TO EXTENT POSSIBLE OR AT THE DIRECTION OF THE ENGINEER.
5) POOL DEPTH SHOULD BE 2 TO 3 TIMES BANKFULL DEPTH.



CROSS SECTION

ROCK TOE PROTECTION

NOT TO SCALE



PLAN VIEW

SECTION A-A

SECTION B-B

STREAM PLUG

NOT TO SCALE

NOTES:
1) CHANNEL BLOCK SHALL BE INSTALLED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
2) BLOCK SHOULD BE INSTALLED AT THE INTERFACE BETWEEN EXISTING CHANNEL AND PROPOSED CHANNEL.
3) BOTTOM OF BLOCK SHOULD BE A MINIMUM OF 1.0′ BELOW THE INVERT OF THE EXISTING CHANNEL.
4) BLOCK SHOULD EXTEND A MINIMUM OF 1.0′ BEYOND THE LIMITS OF THE EXISTING STREAM CHANNEL.
5) INSTALL EROSION CONTROL MATTING AND SEED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS IMMEDIATELY AFTER GRADING.
6) COMPACT BACKFILL TO EXTENT POSSIBLE OR AT THE DIRECTION OF THE ENGINEER.

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NOTES:
1) ALL EXCAVATION SHALL BE PERFORMED IN ONLY DRY OR ISOLATED SECTIONS OF CHANNEL.
2) IMPERVIOUS DIKES ARE TO BE USED TO ISOLATE WORK FROM STREAM FLOW WHEN NECESSARY.
3) ALL GRADED AREAS SHALL BE STABILIZED WITHIN 24 HOURS.
4) MAINTENANCE OF STREAM FLOW OPERATIONS SHALL BE INCIDENTAL TO THE WORK. THIS INCLUDES POLYETHYLENE SHEETING, DIVERSION PIPES, PUMPS AND HOSES.
5) PUMPS AND HOSES SHALL BE OF SUFFICIENT SIZE TO DEWATER THE WORK AREA.

SEQUENCE OF CONSTRUCTION FOR PUMP AROUND OPERATION

1. INSTALL SPECIAL STILLING BASIN(S).

2. INSTALL UPSTREAM PUMP AND TEMPORARY FLEXIBLE HOSE.

3. PLACE UPSTREAM IMPERVIOUS DIKE AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.

4. PLACE DOWNSTREAM IMPERVIOUS DIKE AND PUMPING APPARATUS. DEWATER ENTRAPPED AREA. AREA TO BE DEWATERED SHALL BE EQUAL TO ONE DAY'S WORK.

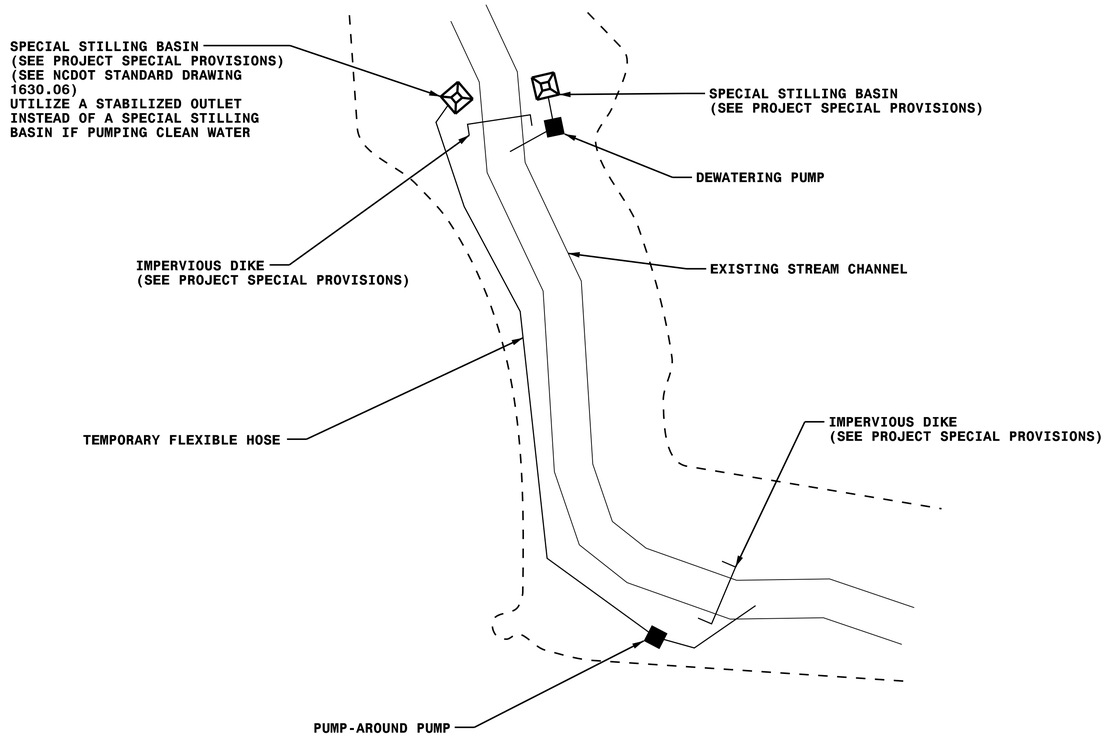
5. PERFORM STREAM RESTORATION WORK IN ACCORDANCE WITH THE PLANS.

6. EXCAVATE ANY ACCUMULATED SILT AND DEWATER BEFORE REMOVAL OF IMPERVIOUS DIKES. REMOVE IMPERVIOUS DIKES, PUMPS, AND TEMPORARY FLEXIBLE HOSE. (DOWNSTREAM IMPERVIOUS DIKES FIRST).

7. ALL GRADING AND STABILIZATION MUST BE COMPLETED IN ONE DAY WITHIN THE PUMP AROUND AREAS BETWEEN THE IMPERVIOUS DIKES. THE IMPERVIOUS DIKE LOCATIONS AS SHOWN ON THE SHEET ONLY SHOW THE UPPER AND LOWER EXTENT OF WORK FOR EACH STREAM SEGMENT. THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING THE LOCATION OF THE IMPERVIOUS DIKE(S) FOR EACH DAY'S WORK.

8. REMOVE SPECIAL STILLING BASIN(S) AND BACKFILL. STABILIZE DISTURBED AREA WITH SEED AND MULCH.

EXAMPLE OF PUMP-AROUND OPERATION



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	HYDRAULICS ENGINEER

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REVISIONS

	Variable	Existing	Proposed Design	Reference Reach 1	Reference Reach 2
1	Stream Type	C4	C4	C4b	C4
2	Drainage Area (sq mi)	0.35	0.35	0.31	0.41
3	Bankfull Width (ft)	Mean: 8.7 Range: 8.6 – 8.8	Mean: 10.0 Range: -- – --	Mean: 9.9 Range: -- – --	Mean: 9.6 Range: -- – --
4	Bankfull Mean Depth (ft)	Mean: 1.0 Range: 0.8 – 1.2	Mean: 0.9 Range: -- – --	Mean: 0.9 Range: -- – --	Mean: 0.7 Range: -- – --
5	Width-to-Depth Ratio	Mean: 8.1 Range: 5.5 – 10.6	Mean: 11.6 Range: -- – --	Mean: 10.7 Range: -- – --	Mean: 13.0 Range: -- – --
6	Bankfull Cross-Sectional Area (sq ft)	Mean: 8.0 Range: 7.3 – 8.6	Mean: 8.6 Range: -- – --	Mean: 9.1 Range: -- – --	Mean: 7.0 Range: -- – --
7	Bankfull Mean Velocity (ft/s)	Mean: 5.7 Range: 4.8 – 6.5	Mean: 4.7 Range: -- – --	Mean: 4.9 Range: -- – --	Mean: 3.9 Range: -- – --
8	Bankfull Discharge (cfs)	Mean: 45.3 Range: 35.1 – 55.5	Mean: 40.6 Range: -- – --	Mean: 44.9 Range: -- – --	Mean: 27.3 Range: -- – --
9	Bankfull Max Depth (ft)	Mean: 1.5 Range: 1.3 – 1.7	Mean: 1.2 Range: -- – --	Mean: 1.2 Range: -- – --	Mean: 1.0 Range: -- – --
10	Ratio of Bankfull Max Depth to Bankfull Mean Depth	Mean: 1.5 Range: 1.4 – 1.6	Mean: 1.4 Range: -- – --	Mean: 1.3 Range: -- – --	Mean: 1.4 Range: -- – --
11	Ratio of Low Bank Height to Bankfull Max Depth	Mean: 0.8 Range: 0.6 – 1.0	Mean: 1.0 Range: -- – --	Mean: 1.0 Range: -- – --	Mean: 1.0 Range: -- – --
12	Width of Flood-Prone Area (ft)	Mean: 27.7 Range: 22.7 – 32.7	Mean: 37.4 Range: 30.4 – 45.4	Mean: 23.8 Range: -- – --	Mean: 31.1 Range: -- – --
13	Entrenchment Ratio	Mean: 3.7 Range: 2.6 – 4.8	Mean: 3.7 Range: 3.0 – 4.5	Mean: 2.4 Range: -- – --	Mean: 3.3 Range: -- – --
14	Meander Length (ft)	Mean: 88 Range: 44 – 123	Mean: 81 Range: 68 – 89	Mean: 93 Range: -- – --	Mean: 48 Range: 37 – 55
15	Ratio of Meander Length to Bankfull Width	Mean: 10.1 Range: 5.0 – 14.3	Mean: 8.1 Range: 6.8 – 8.9	Mean: 9.4 Range: -- – --	Mean: 5.0 Range: 3.9 – 5.7
16	Radius of Curvature (ft)	Mean: 17 Range: 6 – 36	Mean: 28 Range: 20 – 40	Mean: 22 Range: 19 – 25	Mean: 21 Range: 17 – 28
17	Ratio of Radius of Curvature to Bankfull Width	Mean: 1.9 Range: 0.7 – 4.2	Mean: 2.8 Range: 2.0 – 4.0	Mean: 2.2 Range: 1.9 – 2.5	Mean: 2.2 Range: 1.7 – 2.9
18	Belt Width (ft)	Mean: 20 Range: 15 – 24	Mean: 26 Range: 19 – 32	Mean: 36 Range: 27 – 44	Mean: 26 Range: 23 – 31
19	Meander Width Ratio	Mean: 2.3 Range: 1.7 – 2.8	Mean: 2.6 Range: 1.9 – 3.2	Mean: 3.6 Range: 2.8 – 4.4	Mean: 2.7 Range: 2.4 – 3.2
20	Sinuosity	Mean: 1.04 Range: -- – --	Mean: 1.08 Range: -- – --	Mean: 1.21 Range: -- – --	Mean: 1.22 Range: -- – --
21	Valley Slope (ft/ft)	Mean: 0.020 Range: -- – --	Mean: 0.017 Range: -- – --	Mean: 0.026 Range: -- – --	Mean: 0.014 Range: -- – --
22	Average Slope (ft/ft)	Mean: 0.017 Range: -- – --	Mean: 0.016 Range: -- – --	Mean: 0.022 Range: -- – --	Mean: 0.011 Range: -- – --
23	Riffle Slope (ft/ft)	Mean: 0.042 Range: 0.019 – 0.069	Mean: 0.030 Range: 0.026 – 0.035	Mean: 0.051 Range: 0.005 – 0.088	Mean: 0.049 Range: 0.012 – 0.112
24	Ratio of Riffle Slope to Average Slope	Mean: 2.5 Range: 1.1 – 4.1	Mean: 1.9 Range: 1.6 – 2.2	Mean: 2.3 Range: 0.2 – 4.0	Mean: 4.5 Range: 1.1 – 10.2
25	Pool Slope (ft/ft)	Mean: 0.008 Range: 0.000 – 0.031	Mean: 0.004 Range: 0.000 – 0.006	Mean: 0.005 Range: 0.004 – 0.005	Mean: 0.004 Range: 0.002 – 0.006
26	Ratio of Pool Slope to Average Slope	Mean: 0.5 Range: 0.0 – 1.8	Mean: 0.3 Range: 0.0 – 0.4	Mean: 0.2 Range: 0.2 – 0.2	Mean: 0.3 Range: 0.1 – 0.5
27	Maximum Pool Depth (ft)	Mean: 1.8 Range: -- – --	Mean: 2.2 Range: -- – --	Mean: 1.3 Range: -- – --	Mean: 1.1 Range: -- – --
28	Ratio of Pool Depth to Average Bankfull Depth	Mean: 1.8 Range: 1.5 – 2.3	Mean: 2.6 Range: -- – --	Mean: 1.4 Range: -- – --	Mean: 1.6 Range: -- – --
29	Pool Width (ft)	Mean: 6.5 Range: -- – --	Mean: 11.0 Range: -- – --	Mean: 9.8 Range: -- – --	Mean: 6.6 Range: -- – --
30	Ratio of Pool Width to Bankfull Width	Mean: 0.7 Range: 0.7 – 0.8	Mean: 1.1 Range: -- – --	Mean: 1.0 Range: -- – --	Mean: 0.7 Range: -- – --
31	Pool Area (sq ft)	Mean: 8.0 Range: -- – --	Mean: 13.6 Range: -- – --	Mean: 8.7 Range: -- – --	Mean: 4.8 Range: -- – --
32	Ratio of Pool Area to Bankfull Area	Mean: 1.0 Range: 0.9 – 1.1	Mean: 1.6 Range: -- – --	Mean: 1.0 Range: -- – --	Mean: 0.7 Range: -- – --
33	Pool to Pool Spacing (ft)	Mean: 70.0 Range: 23.5 – 107.5	Mean: 43.2 Range: 37.0 – 50.5	Mean: 54.0 Range: -- – --	Mean: 22.2 Range: 9.5 – 37.0
34	Ratio of Pool to Pool Spacing to Bankfull Width	Mean: 8.0 Range: 2.7 – 12.5	Mean: 4.3 Range: 3.7 – 5.1	Mean: 5.5 Range: -- – --	Mean: 2.3 Range: 1.0 – 3.9

* There is a 100 ft radius curve where the proposed alignment transitions into the existing alignment at the upstream limits. This curve isn't included in the table since it skews the Meander Length, Radius of Curvature, and Belt Width results based on the majority of the

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REVISIONS

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R/W SHEET NO.	
	HYDRAULICS ENGINEER

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SUMMARY OF QUANTITIES

DESCRIPTION	SECTION	QUANTITY	UNIT	ITEM DESCRIPTION
1077000000-E	SP	112	TON	NO. 57 STONE
3628000000-E	876	66	TON	RIPRAP, CLASS 1
3635000000-E	876	378	TON	RIPRAP, CLASS 2
3642000000-E	876	1	TON	RIPRAP, CLASS A
3649000000-E	876	66	TON	RIPRAP, CLASS B
3651000000-E	SP	16	TON	BOULDERS
3656000000-E	876	127	SY	GEOTEXTILE FOR DRAINAGE
6037000000-E	SP	2315	SY	COIR FIBER MAT
6084000000-E	1660	1	ACR	SEEDING AND MULCHING
6126000000-E	SP	1	ACR	STREAMBANK REFORESTATION
6132000000-N	SP	18	EA	LOGS
6133000000-N	SP	1	LS	SURVEYING FOR MITIGATION
6133000000-N	SP	1	LS	SITE GRADING FOR MITIGATION
6133000000-N	SP	1	LS	DIVERSION PUMPING
6138000000-E	SP	5	CY	IMPERVIOUS SELECT MATERIAL
6150000000-E	SP	104	TON	CHANNEL SUBSTRATE MATERIAL
6150000000-E	SP	21	TON	NATURAL SAND
6900000000-E	SP	386	CY	TOPSOIL

SUMMARY OF EARTHWORK FOR MITIGATION

MITIGATION UNCLASSIFIED EXCAV. (CU. YD.)	MITIGATION EMBANKMENT	MITIGATION BORROW (CU. YD.)	MITIGATION WASTE (CU. YD.)
2428	14	0	2414

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30' 15' 0' 30' 60'

C-1
PI Sta 10+35.31
Δ = 11° 28' 21.7" (RT)
D = 57° 17' 44.8"
L = 20.02'
T = 10.05'
R = 100.00'

C-2
PI Sta 10+73.76
Δ = 56° 38' 22.9" (LT)
D = 229° 10' 59.2"
L = 24.71'
T = 13.47'
R = 25.00'

C-3
PI Sta 11+23.47
Δ = 55° 04' 43.6" (RT)
D = 286° 28' 44.0"
L = 19.23'
T = 10.43'
R = 20.00'

C-4
PI Sta 11+64.19
Δ = 50° 58' 34.4" (LT)
D = 229° 10' 59.2"
L = 22.24'
T = 11.92'
R = 25.00'

C-5
PI Sta 12+13.50
Δ = 74° 25' 27.5" (RT)
D = 229° 10' 59.2"
L = 32.47'
T = 18.98'
R = 25.00'

C-6
PI Sta 12+64.39
Δ = 82° 03' 23.6" (LT)
D = 286° 28' 44.0"
L = 28.64'
T = 17.40'
R = 20.00'

C-7
PI Sta 13+01.89
Δ = 48° 28' 48.0" (RT)
D = 229° 10' 59.2"
L = 21.15'
T = 11.26'
R = 25.00'

C-8
PI Sta 13+39.56
Δ = 36° 33' 34.4" (LT)
D = 229° 10' 59.2"
L = 15.95'
T = 8.26'
R = 25.00'

C-9
PI Sta 13+81.00
Δ = 57° 36' 08.4" (RT)
D = 229° 10' 59.2"
L = 25.13'
T = 13.74'
R = 25.00'

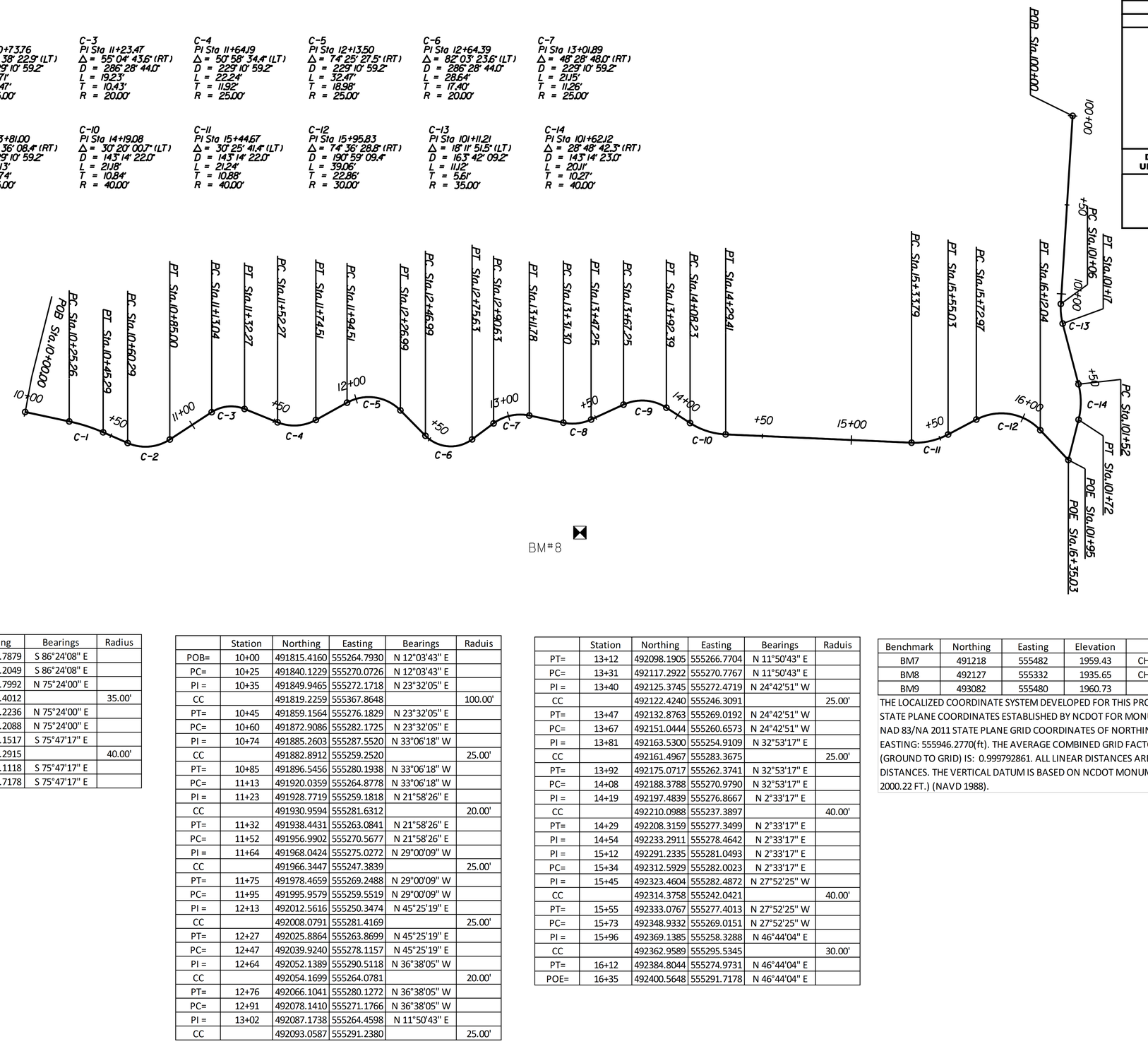
C-10
PI Sta 14+19.08
Δ = 30° 20' 00.7" (LT)
D = 143° 14' 22.0"
L = 21.18'
T = 10.84'
R = 40.00'

C-11
PI Sta 15+44.67
Δ = 30° 25' 41.4" (LT)
D = 143° 14' 22.0"
L = 21.24'
T = 10.88'
R = 40.00'

C-12
PI Sta 15+95.83
Δ = 74° 36' 28.8" (RT)
D = 190° 59' 09.4"
L = 39.06'
T = 22.86'
R = 30.00'

C-13
PI Sta 101+11.21
Δ = 18° 11' 51.5" (LT)
D = 163° 42' 09.2"
L = 11.12'
T = 5.61'
R = 35.00'

C-14
PI Sta 101+62.12
Δ = 28° 48' 42.3" (RT)
D = 143° 14' 23.0"
L = 20.11'
T = 10.27'
R = 40.00'



	Station	Northing	Easting	Bearings	Radius
POB=	100+00	492402.9370	555098.7879	S 86°24'08" E	
PC=	101+06	492396.3089	555204.2049	S 86°24'08" E	
PI =	101+11	492395.9572	555209.7992	N 75°24'00" E	
CC		492431.2400	555206.4012		35.00'
PT=	101+17	492397.3701	555215.2236	N 75°24'00" E	
PC=	101+52	492406.2226	555249.2088	N 75°24'00" E	
PI =	101+62	492408.8125	555259.1517	S 75°47'17" E	
CC		492367.5142	555259.2915		40.00'
PT=	101+72	492406.2900	555269.1118	S 75°47'17" E	
POE=	101+95	492400.5648	555291.7178	S 75°47'17" E	

	Station	Northing	Easting	Bearings	Raduis
POB=	10+00	491815.4160	555264.7930	N 12°03'43" E	
PC=	10+25	491840.1229	555270.0726	N 12°03'43" E	
PI =	10+35	491849.9465	555272.1718	N 23°32'05" E	
CC		491819.2259	555367.8648		100.00'
PT=	10+45	491859.1564	555276.1829	N 23°32'05" E	
PC=	10+60	491872.9086	555282.1725	N 23°32'05" E	
PI =	10+74	491885.2603	555287.5520	N 33°06'18" W	
CC		491882.8912	555259.2520		25.00'
PT=	10+85	491896.5456	555280.1938	N 33°06'18" W	
PC=	11+13	491920.0359	555264.8778	N 33°06'18" W	
PI =	11+23	491928.7719	555259.1818	N 21°58'26" E	
CC		491930.9594	555281.6312		20.00'
PT=	11+32	491938.4431	555263.0841	N 21°58'26" E	
PC=	11+52	491956.9902	555270.5677	N 21°58'26" E	
PI =	11+64	491968.0424	555275.0272	N 29°00'09" W	
CC		491966.3447	555247.3839		25.00'
PT=	11+75	491978.4659	555269.2488	N 29°00'09" W	
PC=	11+95	491995.9579	555259.5519	N 29°00'09" W	
PI =	12+13	492012.5616	555250.3474	N 45°25'19" E	
CC		492008.0791	555281.4169		25.00'
PT=	12+27	492025.8864	555263.8699	N 45°25'19" E	
PC=	12+47	492039.9240	555278.1157	N 45°25'19" E	
PI =	12+64	492052.1389	555290.5118	N 36°38'05" W	
CC		492054.1699	555264.0781		20.00'
PT=	12+76	492066.1041	555280.1272	N 36°38'05" W	
PC=	12+91	492078.1410	555271.1766	N 36°38'05" W	
PI =	13+02	492087.1738	555264.4598	N 11°50'43" E	
CC		492093.0587	555291.2380		25.00'

	Station	Northing	Easting	Bearings	Raduis
PT=	13+12	492098.1905	555266.7704	N 11°50'43" E	
PC=	13+31	492117.2922	555270.7767	N 11°50'43" E	
PI =	13+40	492125.3745	555272.4719	N 24°42'51" W	
CC		492122.4240	555246.3091		25.00'
PT=	13+47	492132.8763	555269.0192	N 24°42'51" W	
PC=	13+67	492151.0444	555260.6573	N 24°42'51" W	
PI =	13+81	492163.5300	555254.9109	N 32°53'17" E	
CC		492161.4967	555283.3675		25.00'
PT=	13+92	492175.0717	555262.3741	N 32°53'17" E	
PC=	14+08	492188.3788	555270.9790	N 32°53'17" E	
PI =	14+19	492197.4839	555276.8667	N 2°33'17" E	
CC		492210.0988	555237.3897		40.00'
PT=	14+29	492208.3159	555277.3499	N 2°33'17" E	
PI =	14+54	492233.2911	555278.4642	N 2°33'17" E	
PI =	15+12	492291.2335	555281.0493	N 2°33'17" E	
PC=	15+34	492312.5929	555282.0023	N 2°33'17" E	
PI =	15+45	492323.4604	555282.4872	N 27°52'25" W	
CC		492314.3758	555242.0421		40.00'
PT=	15+55	492333.0767	555277.4013	N 27°52'25" W	
PC=	15+73	492348.9332	555269.0151	N 27°52'25" W	
PI =	15+96	492369.1385	555258.3288	N 46°44'04" E	
CC		492362.9589	555295.5345		30.00'
PT=	16+12	492384.8044	555274.9731	N 46°44'04" E	
POE=	16+35	492400.5648	555291.7178	N 46°44'04" E	

Benchmark	Northing	Easting	Elevation	Description
BM7	491218	555482	1959.43	CHISELED 'X' ON CONC HW
BM8	492127	555332	1935.65	CHISELED 'X' ON CONC HW
BM9	493082	555480	1960.73	PAINTED BOLT ON FH

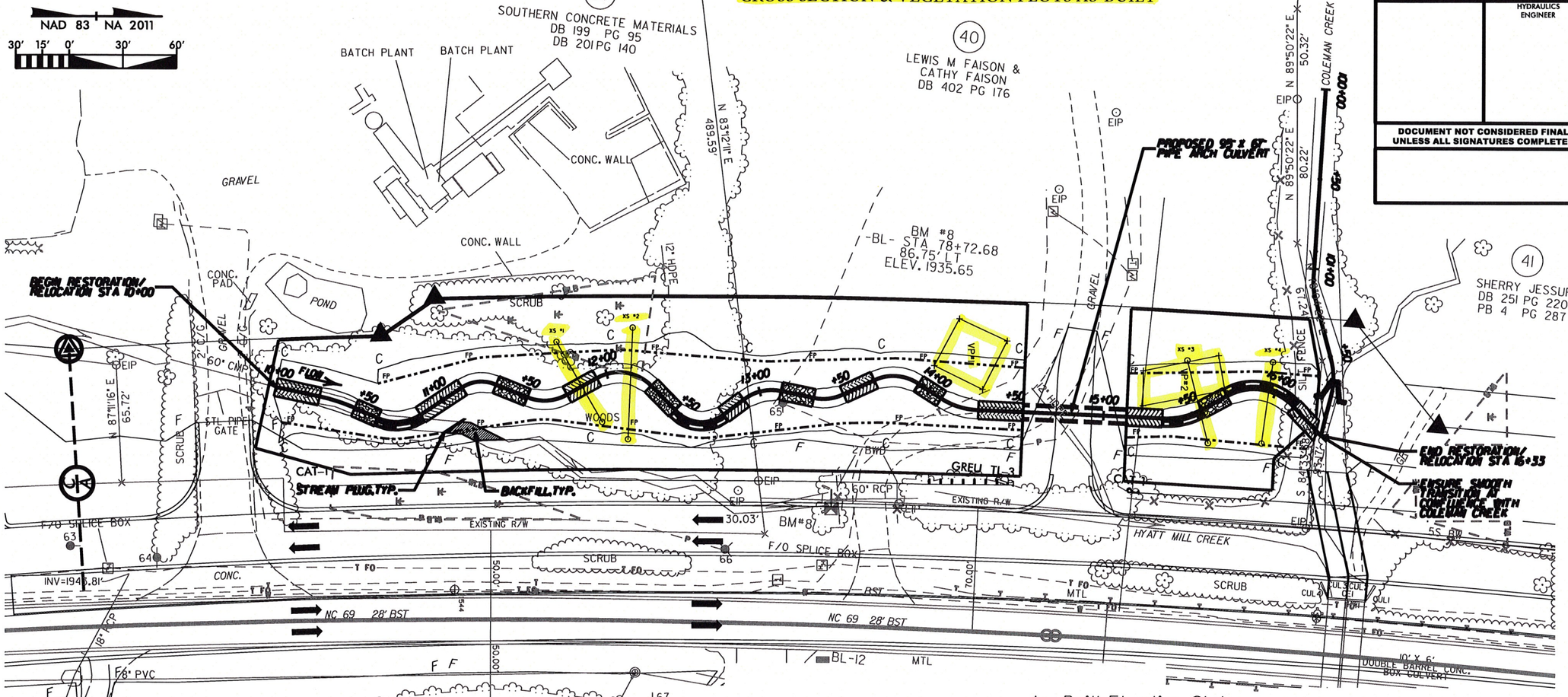
THE LOCALIZED COORDINATE SYSTEM DEVELOPED FOR THIS PROJECT IS BASED ON THE STATE PLANE COORDINATES ESTABLISHED BY NCDOT FOR MONUMENT "GPS 105" WITH NAD 83/NA 2011 STATE PLANE GRID COORDINATES OF NORTHING: 494294.9050(ft), EASTING: 555946.2770(ft). THE AVERAGE COMBINED GRID FACTOR USED ON THIS PROJECT (GROUND TO GRID) IS: 0.999792861. ALL LINEAR DISTANCES ARE LOCALIZED HORIZONTAL DISTANCES. THE VERTICAL DATUM IS BASED ON NCDOT MONUMENT "GPS 105" (ELEV. 2000.22 FT.) (NAVD 1988).

PROJECT REFERENCE NO.	SHEET NO.
A-0011C	OSM-5
R/W SHEET NO.	
	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS 8/17/99

CROSS SECTION & VEGETATION PLOTS AS-BUILT



As-Built Elevation Shots

Structure Locations

Structure Type	Station From*	Start Elevation	Tape Sta. 9-27-21	Elevation Shot 9-27-21	Difference		Station To*	End Elevation	Tape Sta. 9-27-21	Elevation Shot 9-27-21	Difference
Riffle Grade Control	10+00	1934.4	10+00	1934.58	0.18		10+25	1933.7			
Wood Drop Riffle	10+46	1933.7	10+50	1933.57	-0.13		10+60	1933.3			
Rock Toe Protection	10+60						10+85				
Stream Plug	10+82						11+06				
Riffle Grade Control	10+85	1933.2	10+79	1932.96	-0.24		11+13	1932.3			
Wood Drop Riffle	11+33	1932.2	11+37	1932.15	-0.05		11+52	1931.6	11+42	1932.03	0.43
Riffle Grade Control	11+75	1931.5	11+76	1931.04	-0.46		11+94	1930.9			
Wood Drop Riffle	12+27	1930.8	12+29	1930.4	-0.4		12+46	1930.2	12+37	1930.59	0.39
Rock Toe Protection	12+46						12+76				
Riffle Grade Control	12+76	1930.1	12+65	1929.87	-0.23		12+90	1929.7	12+82	1929.22	-0.48
Wood Drop Riffle	13+12	1929.7	13+10	1929.11	-0.59		13+31	1929.1	13+25	1929.3	0.2
Riffle Grade Control	13+48	1929	13+41	1928.92	-0.08		13+67	1928.5	13+58	1928.31	-0.19
Wood Drop Riffle	13+93	1928.4	13+98	1928.23	-0.17		14+08	1928			
Riffle Grade Control	14+30	1927.9	14+29	1927.32	-0.58		14+55	1927.2			
95" x 67" Pipe Arch Culvert	14+55	1926.2	14+49	1926.49	0.29		15+13	1925.5	15+09	1925.89	0.39
Riffle Grade Control	15+13	1926.5					15+33	1925.8	15+28	1925.45	-0.35
Rock Toe Protection	15+33		15+39	1924.76			15+56		15+58	1925.27	
Wood Drop Riffle	15+56	1925.7					15+72	1925.2	15+71	1924.82	-0.38
Rock Toe Protection	15+72		15+77	1924.24			16+13				
Riffle Grade Control	16+13	1925	16+14	1924.39	-0.61		16+33	1924.4	16+33	1923.51	-0.89
Rock Cross Vane	101+64						101+75				

NOTES:

1. SEE SHEET OSM-4 FOR BASELINE INFORMATION.

2. ROADWAY AND STRUCTURE INFORMATION PROVIDED ON THIS SHEET IS FOR INFORMATION PURPOSES ONLY. SEE ROADWAY PLANS (PREPARD BY OTHERS) FOR PROPOSED ROADWAY AND STRUCTURE INFORMATION.

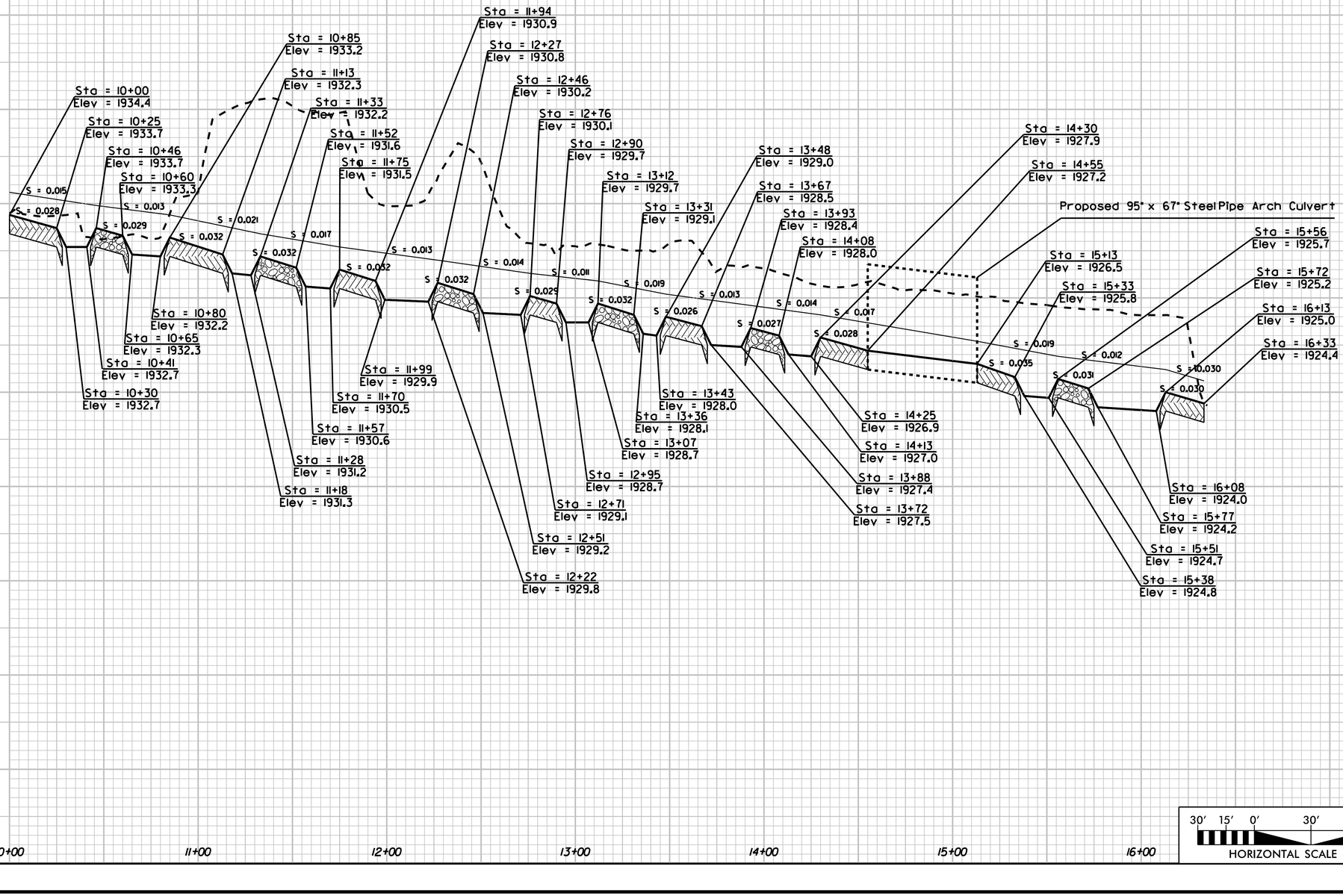
5/14/99

PROJECT REFERENCE NO.	SHEET NO.
A-001C	OSM-6

HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

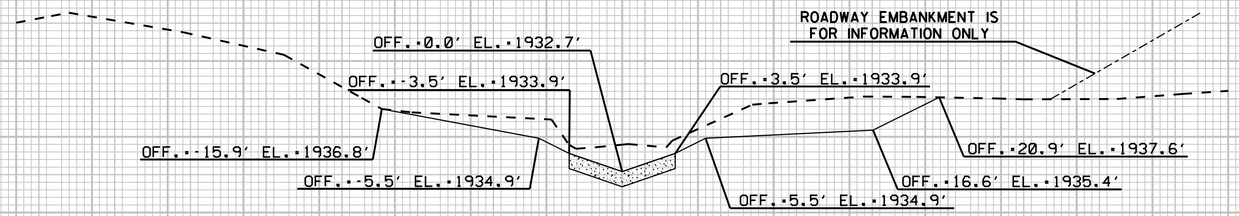
See table on OSM-5 for asbuilt elevation shots



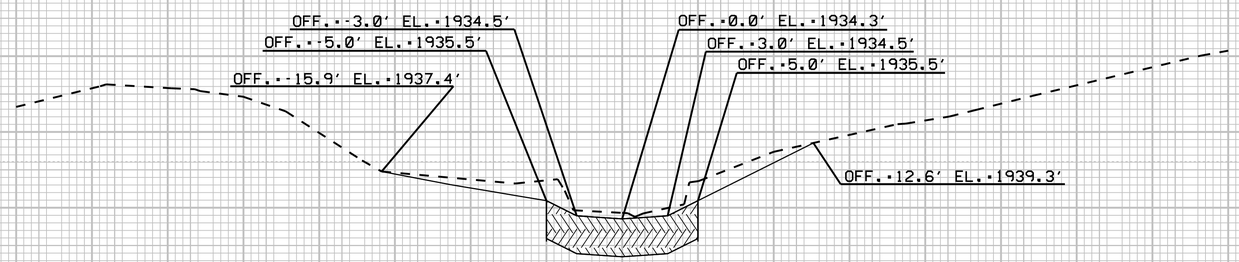
6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-7

10+36.00



10+25.00



10+05.00

6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-8

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

1940 1935 1930 1925 1920 1915

OFF.--32.3' EL.-1939.8'
OFF.-0.6' EL.-1932.2'
OFF.-0.0' EL.-1932.2'
OFF.--4.0' EL.-1933.4'
OFF.--24.2' EL.-1935.8'
OFF.--6.0' EL.-1934.4'
ROADWAY EMBANKMENT IS FOR INFORMATION ONLY
OFF.-5.0' EL.-1934.4'
OFF.-12.2' EL.-1936.1'
OFF.-9.4' EL.-1934.7'

10+73.00

OFF.--34.3' EI-1939.7'
OFF.-0.0' EL.-1933.3'
OFF.--3.0' EL.-1933.5'
OFF.--5.0' EL.-1934.5'
OFF.--23.8' EL.-1935.8'
ROADWAY EMBANKMENT IS FOR INFORMATION ONLY
OFF.-3.0' EL.-1933.5'
OFF.-5.0' EL.-1934.5'
OFF.-13.9' EL.-1936.4'
OFF.-11.0' EL.-1935.0'

10+60.00

OFF.-0.0' EL.-1933.7'
OFF.--3.0' EL.-1933.9'
OFF.--5.0' EL.-1934.9'
OFF.--16.9' EL.-1936.4'
ROADWAY EMBANKMENT IS FOR INFORMATION ONLY
OFF.-3.0' EL.-1933.9'
OFF.-5.0' EL.-1934.9'
OFF.-18.5' EL.-1937.2'
OFF.-14.7' EL.-1935.3'

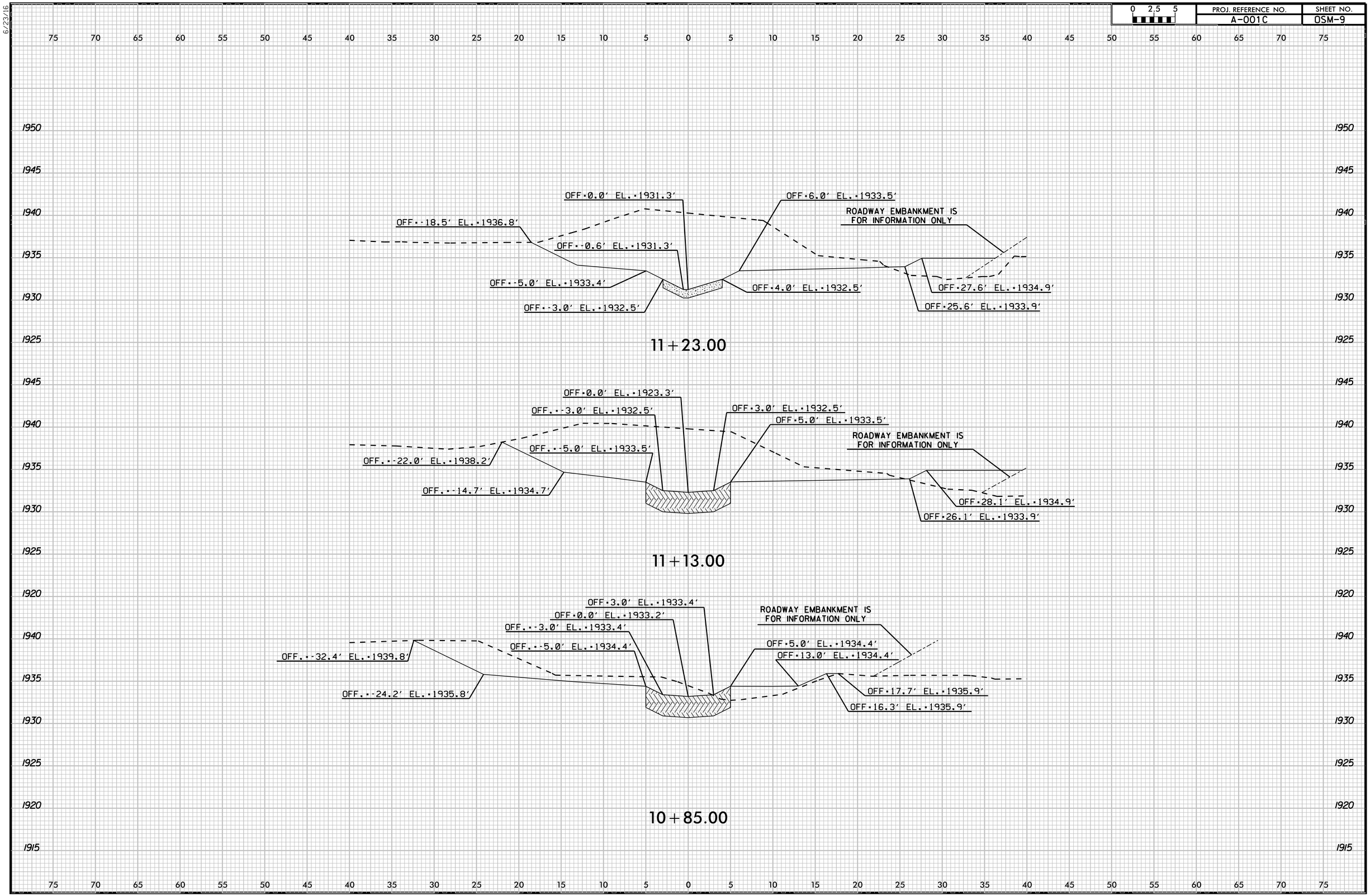
10+46.00

1940 1935 1930 1925 1920 1915

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

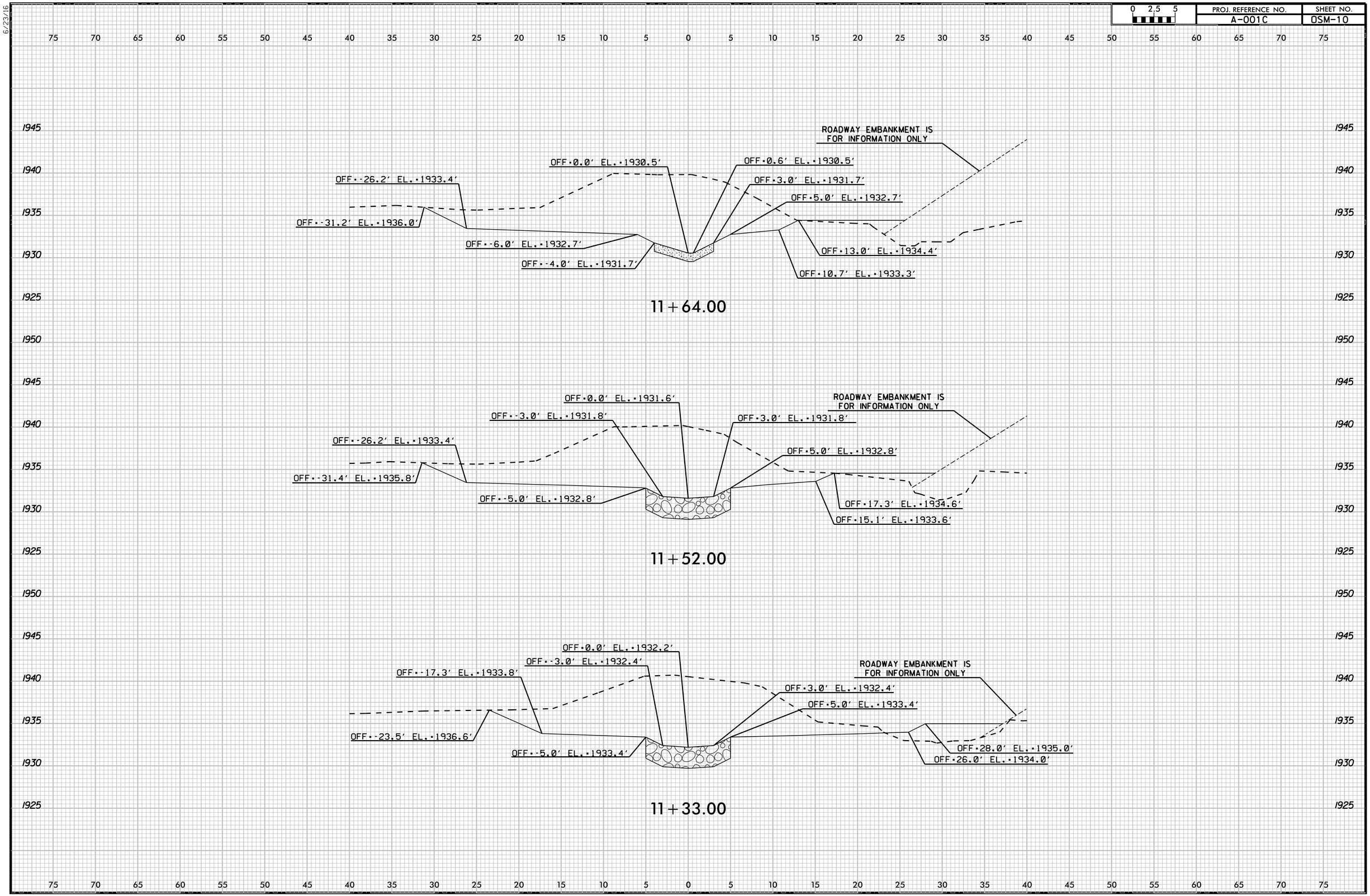
6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-9



6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-10



6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-11

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

1940 1935 1930 1925 1920 1945

OFF 0.0' EL. 1929.8'
OFF -0.6' EL. 1929.8'
OFF 12.7' EL. 1932.6'
OFF -17.2' EL. 1934.9'
OFF -5.0' EL. 1932.0'
OFF -3.0' EL. 1931.0'
OFF 4.0' EL. 1931.0'
OFF 6.0' EL. 1932.0'
OFF 31.1' EL. 1932.6'
OFF 34.8' EL. 1934.4'

12+11.00

OFF 0.0' EL. 1930.9'
OFF -3.0' EL. 1931.1'
OFF -16.9' EL. 1933.1'
OFF -21.7' EL. 1935.3'
OFF -5.0' EL. 1932.1'
OFF 35.0' EL. 1933.7'
OFF 3.0' EL. 1931.1'
OFF 5.0' EL. 1932.1'
OFF 32.2' EL. 1932.6'

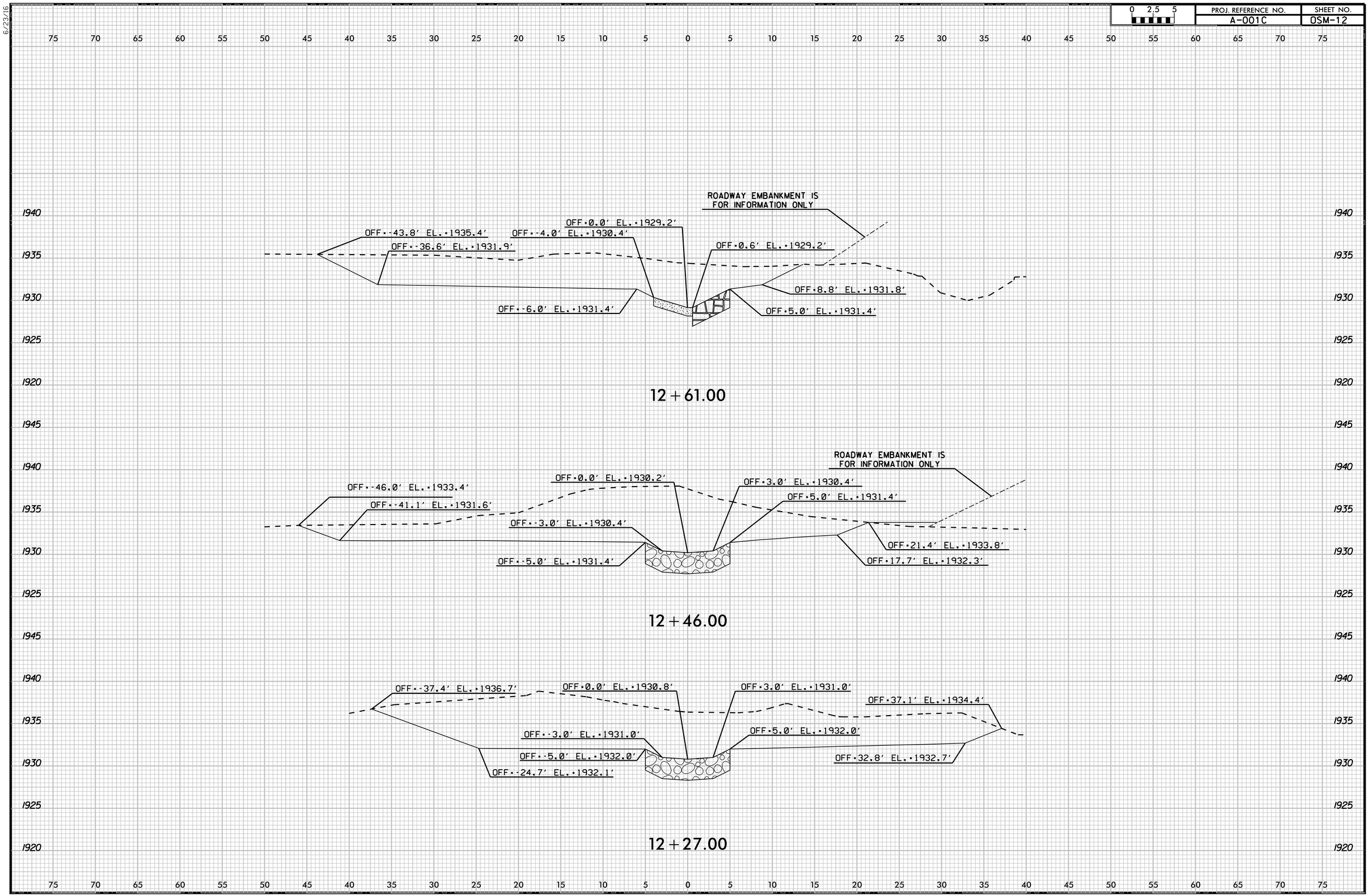
11+94.00

OFF 0.0' EL. 1931.5'
OFF -3.0' EL. 1931.7'
OFF -26.1' EL. 1933.4'
OFF -31.8' EL. 1936.1'
OFF -5.0' EL. 1932.7'
OFF 3.0' EL. 1931.7'
ROADWAY EMBANKMENT IS FOR INFORMATION ONLY
OFF 22.1' EL. 1934.4'
OFF 18.4' EL. 1933.0'
OFF 5.0' EL. 1932.7'

11+75.00

6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-12



6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-13

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

1940 1935 1930 1925 1920

ROADWAY EMBANKMENT IS FOR INFORMATION ONLY

OFF - 0.0' EL. - 1928.7'
OFF - -17.6' EL. - 1931.4'
OFF - -0.6' EL. - 1928.7'
OFF - -3.0' EL. - 1929.9'
OFF - 4.0' EL. - 1929.9'
OFF - 6.0' EL. - 1930.9'
OFF - -20.4' EL. - 1932.7'
OFF - 25.0' EL. - 1932.2'
OFF - -5.0' EL. - 1930.9'
OFF - 22.8' EL. - 1931.1'

13 + 01.00

OFF - -42.4' EL. - 1936.8'

ROADWAY EMBANKMENT IS FOR INFORMATION ONLY

OFF - 0.0' EL. - 1929.7'
OFF - 3.0' EL. - 1929.9'
OFF - -3.0' EL. - 1929.9'
OFF - 5.0' EL. - 1930.9'
OFF - -29.5' EL. - 1931.8'
OFF - 24.7' EL. - 1932.2'
OFF - -5.0' EL. - 1930.9'
OFF - 22.2' EL. - 1931.2'

12 + 90.00

OFF - -55.1' EL. - 1937.3'

ROADWAY EMBANKMENT IS FOR INFORMATION ONLY

OFF - 0.0' EL. - 1930.1'
OFF - -3.0' EL. - 1930.3'
OFF - 3.0' EL. - 1930.3'
OFF - 5.0' EL. - 1931.3'
OFF - -41.8' EL. - 1932.1'
OFF - 16.3' EL. - 1932.5'
OFF - -5.0' EL. - 1931.3'
OFF - 13.9' EL. - 1931.4'

12 + 76.00

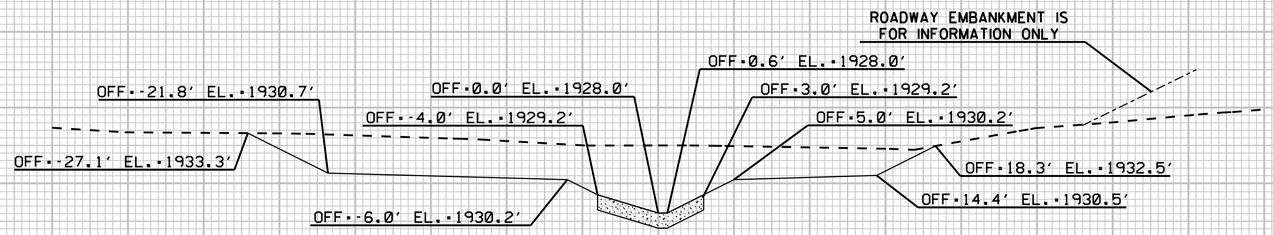
75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

6/23/16

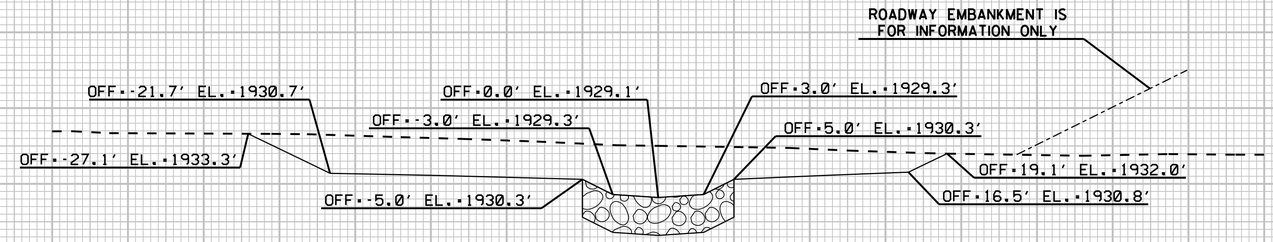
0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-14

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

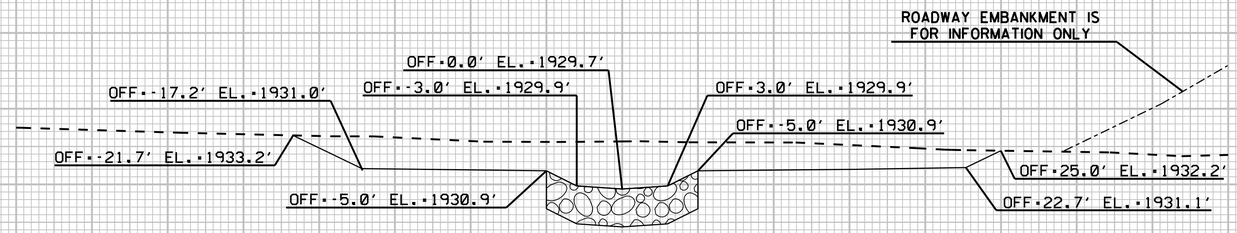
1940 1935 1930 1925 1920 1915



13 + 40.00



13 + 31.00



13 + 12.00

1940 1935 1930 1925 1920 1915

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-15

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

1940 1935 1930 1925 1920 1915

OFF 0.0' EL. 1927.5'
OFF -0.6' EL. 1927.5'
OFF -3.0' EL. 1928.7'
OFF -13.6 EL. 1931.8'
OFF -9.9 EL. 1929.9'
OFF -5.0' EL. 1929.7'
OFF 4.0' EL. 1928.7'
OFF 6.0' EL. 1929.7'
OFF 32.1' EL. 1932.8'
OFF 26.4' EL. 1929.9'

13+80.00

OFF 0.0' EL. 1928.5'
OFF -3.0' EL. 1928.7'
OFF -5.0' EL. 1929.7'
OFF -19.3' EL. 1933.2'
OFF -13.0' EL. 1930.3'
OFF 3.0' EL. 1928.7'
OFF 5.0' EL. 1929.7'
OFF 32.6' EL. 1932.6'
OFF 26.4' EL. 1929.9'

13+67.00

ROADWAY EMBANKMENT IS FOR INFORMATION ONLY

OFF -21.2' EL. 1930.6'
OFF -26.9' EL. 1933.3'
OFF 0.0' EL. 1929.0'
OFF -3.0' EL. 1929.2'
OFF -5.0' EL. 1930.2'
OFF 3.0' EL. 1929.2'
OFF 5.0' EL. 1930.2'
OFF 25.3' EL. 1933.8'
OFF 17.5' EL. 1930.3'

13+48.00

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-16

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

1940 1935 1930 1925 1920 1915

ROADWAY EMBANKMENT IS FOR INFORMATION ONLY

OFF - 25.1' EL. 1929.2'
OFF - 29.5' EL. 1931.3'
OFF 0.0' EL. 1927.0'
OFF - 4.0' EL. 1928.2'
OFF - 6.0' EL. 1929.2'
OFF 0.6' EL. 1927.0'
OFF 5.0' EL. 1929.2'
OFF 15.1' EL. 1931.1'
OFF 11.4' EL. 1929.4'
OFF 3.0' EL. 1928.2'

14+19.00

ROADWAY EMBANKMENT IS FOR INFORMATION ONLY

OFF 0.0' EL. 1928.0'
OFF - 3.0' EL. 1928.2'
OFF - 5.0' EL. 1929.2'
OFF - 23.4' EL. 1929.3'
OFF - 28.4' EL. 1931.5'
OFF 3.0' EL. 1928.2'
OFF 5.0' EL. 1929.2'
OFF 22.6' EL. 1931.8'
OFF 17.6' EL. 1929.6'

14+08.00

OFF 0.0' EL. 1928.4'
OFF - 3.0' EL. 1928.6'
OFF - 5.0' EL. 1929.6'
OFF - 20.3' EL. 1931.8'
OFF - 15.2' EL. 1929.6'
OFF 3.0' EL. 1928.6'
OFF 5.0' EL. 1929.6'
OFF 33.3' EL. 1933.1'
OFF 26.2' EL. 1929.9'

13+93.00

6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-17

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

1935 1930 1925 1920 1915 1910

ROADWAY EMBANKMENT IS FOR INFORMATION ONLY

OFF -25.2' EL. 1927.5'
OFF -30.3' EL. 1930.1'
OFF -5.0' EL. 1925.9'
OFF -7.0' EL. 1926.9'
OFF 0.0' EL. 1924.7'
OFF 0.6' EL. 1924.7'
OFF 5.0' EL. 1926.9'
OFF 16.6' EL. 1929.3'
OFF 12.2' EL. 1927.3'

15+45.00

ROADWAY EMBANKMENT IS FOR INFORMATION ONLY

OFF -25.4' EL. 1927.6'
OFF -30.5' EL. 1930.1'
OFF -3.0' EL. 1926.0'
OFF -5.0' EL. 1927.0'
OFF 0.0' EL. 1925.8'
OFF 3.0' EL. 1926.0'
OFF 5.0' EL. 1927.0'
OFF 14.3' EL. 1929.6'
OFF 10.2' EL. 1927.6'

15+33.00

1940 1935 1930 1925 1920 1915

ROADWAY EMBANKMENT IS FOR INFORMATION ONLY

OFF -29.7' EL. 1931.2'
OFF -25.5' EL. 1929.1'
OFF -3.0' EL. 1928.1'
OFF -5.0' EL. 1929.1'
OFF 0.0' EL. 1927.9'
OFF 3.0' EL. 1928.1'
OFF 5.0' EL. 1929.1'
OFF 13.2' EL. 1930.8'
OFF 9.8' EL. 1929.1'

14+30.00

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

6/23/16

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	A-001C	OSM-18

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

1935 1930 1925 1920 1915 1910

OFF 0.0' EL. 1924.1'
OFF -0.6' EL. 1924.1'
OFF -5.0' EL. 1926.3'
OFF -10.2' EL. 1926.5'
OFF -16.0' EL. 1929.3'
OFF 5.0' EL. 1925.3'
OFF 7.0' EL. 1926.3'
OFF 35.1' EL. 1928.7'
OFF 30.7' EL. 1926.5'

15+93.00

OFF 0.0' EL. 1925.2'
OFF -3.0' EL. 1925.4'
OFF -5.0' EL. 1926.4'
OFF -20.8' EL. 1929.7'
OFF -15.2' EL. 1927.0'
OFF 3.0' EL. 1925.4'
OFF 5.0' EL. 1926.4'
OFF 35.6' EL. 1928.7'
OFF 30.2' EL. 1926.5'

15+72.00

ROADWAY EMBANKMENT IS FOR INFORMATION ONLY
OFF -23.3' EL. 1927.4'
OFF -29.1' EL. 1930.0'
OFF 0.0' EL. 1925.7'
OFF -3.0' EL. 1925.9'
OFF -5.0' EL. 1926.9'
OFF 3.0' EL. 1925.9'
OFF 5.0' EL. 1926.9'
OFF 24.7' EL. 1929.0'
OFF 19.7' EL. 1926.9'

15+56.00

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

6/23/16

0 2.5 5

PROJ. REFERENCE NO.	SHEET NO.
A-001C	OSM-19

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

1935
1930
1925
1920
1915
1910

OFF=0.0' EL.=1925.0'
OFF=-3.0' EL.=1925.2'
OFF=-5.0' EL.=1926.2'
OFF=-23.3' EL.=1926.2'
OFF=3.0' EL.=1925.2'
OFF=5.0' EL.=1926.2'
OFF=35.9' EL.=1928.8'
OFF=30.1' EL.=1926.5'

16+13.00

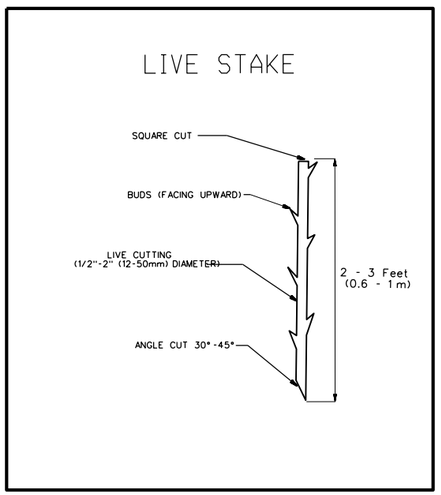
75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

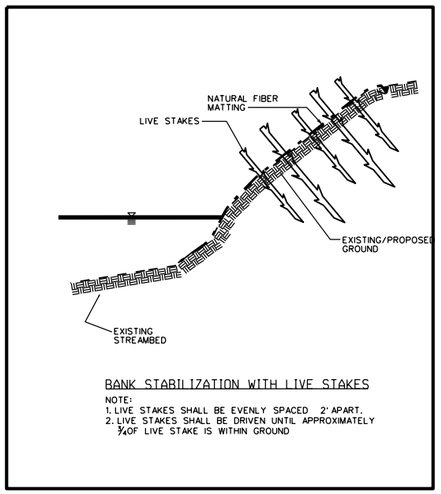
1935
1930
1925
1920
1915
1910

PROJECT REFERENCE NO.	SHEET NO.
A-0011C	OSM-20
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PLANTING DETAILS

LIVE STAKE PLANTING DETAIL

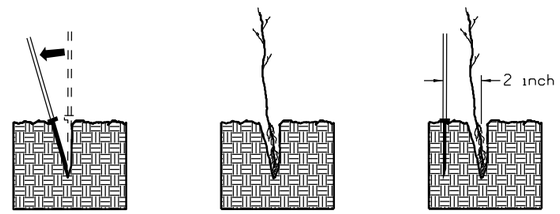




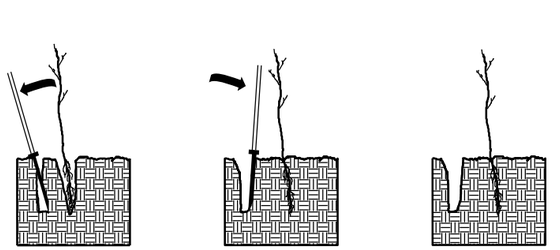
BANK STABILIZATION WITH LIVE STAKES

NOTE:
1. LIVE STAKES SHALL BE EVENLY SPACED 2' APART.
2. LIVE STAKES SHALL BE DRIVEN UNTIL APPROXIMATELY ¾ OF LIVE STAKE IS WITHIN GROUND

BAREROOT PLANTING DETAIL
DIBBLE PLANTING METHOD
USING THE KBC PLANTING BAR



1. Insert planting bar as shown and pull handle toward planter.
2. Remove planting bar and place seedling at correct depth.
3. Insert planting bar 2 inches toward planter from seedling.



4. Pull handle of bar toward planter, firming soil at bottom.
5. Push handle forward firming soil at top.
6. Leave compaction hole open. Water thoroughly.

PLANTING NOTES:

PLANTING BAG
During planting, seedlings shall be kept in a moist canvas bag or similar container to prevent the root systems from drying.

KBC PLANTING BAR
Planting bar shall have a blade with a triangular cross section, and shall be 12 inches long, 4 inches wide and 1 inch thick at center.

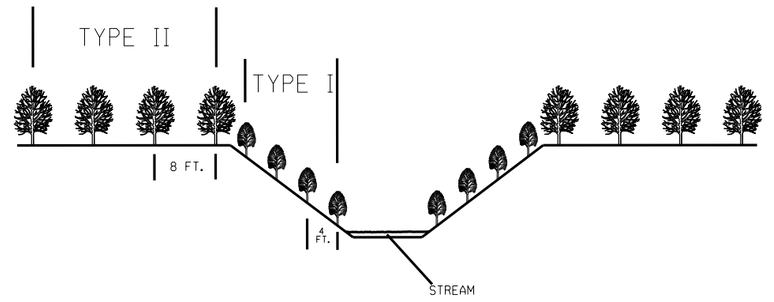
ROOT PRUNING
All seedlings shall be root pruned, if necessary, so that no roots extend more than 10 inches below the root collar.

REFORESTATION AS-BUILT PLANS

☐ TYPE 1 STREAMBANK REFORESTATION SHALL BE PLANTED 3 FT. TO 5 FT. ON CENTER, RANDOM SPACING, AVERAGING 4 FT. ON CENTER, APPROXIMATELY 2724 PLANTS PER ACRE.

☐ TYPE 2 STREAMBANK REFORESTATION SHALL BE PLANTED 6 FT. TO 10 FT. ON CENTER, RANDOM SPACING, AVERAGING 8 FT. ON CENTER, APPROXIMATELY 680 PLANTS PER ACRE.

STREAMBANK REFORESTATION TYPICAL



REFORESTATION

MIXTURE, TYPE, SIZE, AND FURNISH SHALL CONFORM TO THE FOLLOWING:

TYPE 1		
50% SALIX NIGRA	BLACK WILLOW	12 in - 18 in BR
50% CORNUS AMOMUM	SILKY DOGWOOD	12 in - 18 in BR
TYPE 2		
25% PLATANUS OCCIDENTALIS	SYCAMORE	12 in - 18 in BR
25% LIRIODENDRON TULIPIFERA	YELLOW POPLAR	12 in - 18 in BR
25% BETULA NIGRA	RIVER BIRCH	12 in - 18 in BR
25% FRAXINUS PENNSYLVANICA	GREEN ASH	12 in - 18 in BR

☐ SEE PLAN SHEETS FOR AREAS TO BE PLANTED

STREAMBANK REFORESTATION DETAIL SHEET 1 OF 2

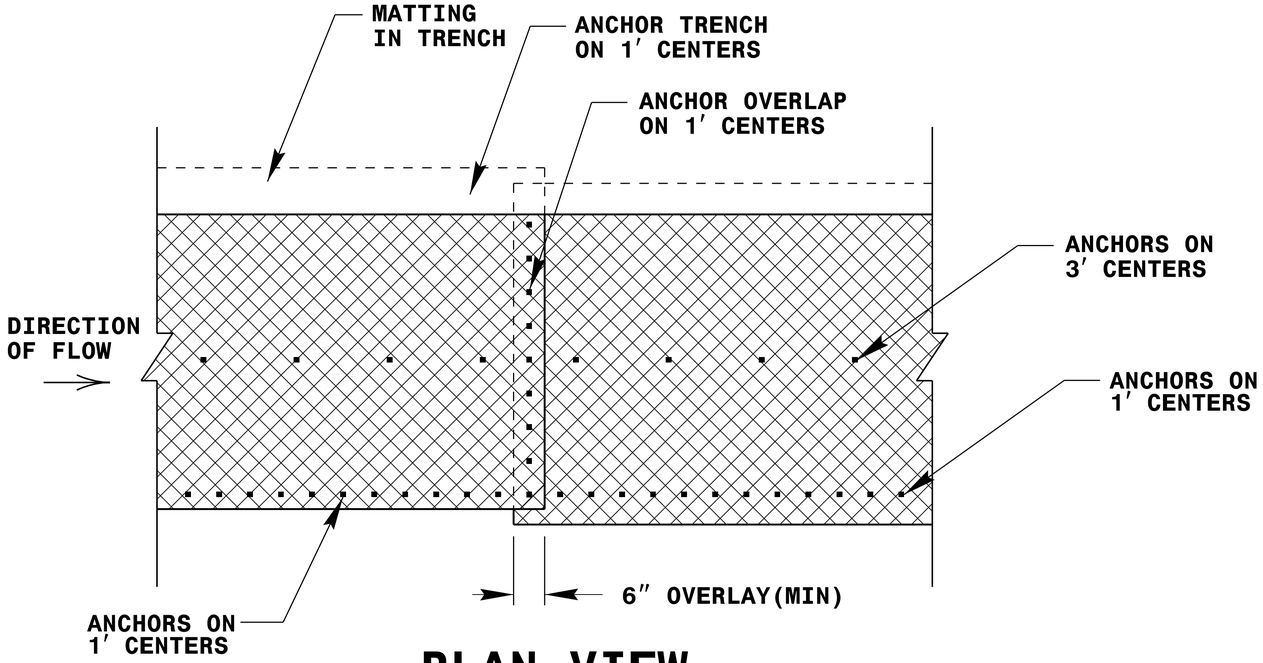
N.C.D.O.T. - ROADSIDE ENVIRONMENTAL UNIT

8/17/99

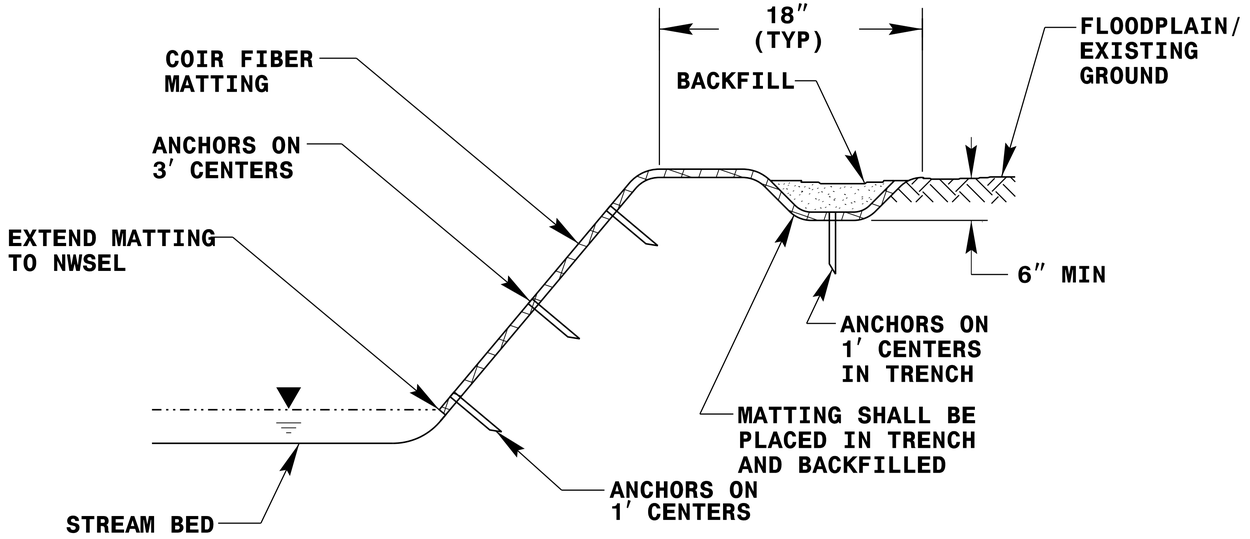
REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
A–0011C	OSM–21
R/W SHEET NO.	
	HYDRAULICS ENGINEER

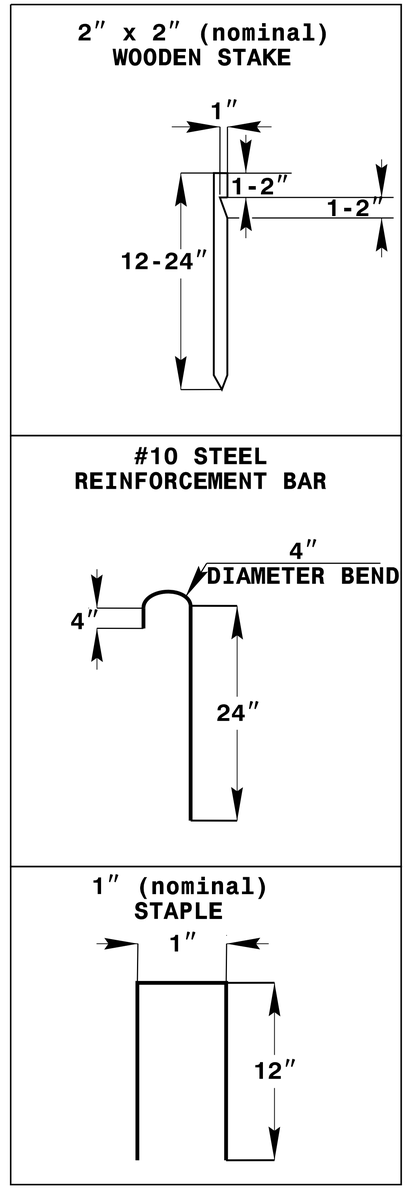
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



PLAN VIEW



TYPICAL CROSS SECTION



ANCHOR OPTIONS

COIR FIBER MATTING DETAIL

NOT TO SCALE

STREAMBANK REFORESTATION

DETAIL SHEET 2 OF 2

N.C.D.O.T. – ROADSIDE ENVIRONMENTAL UNIT

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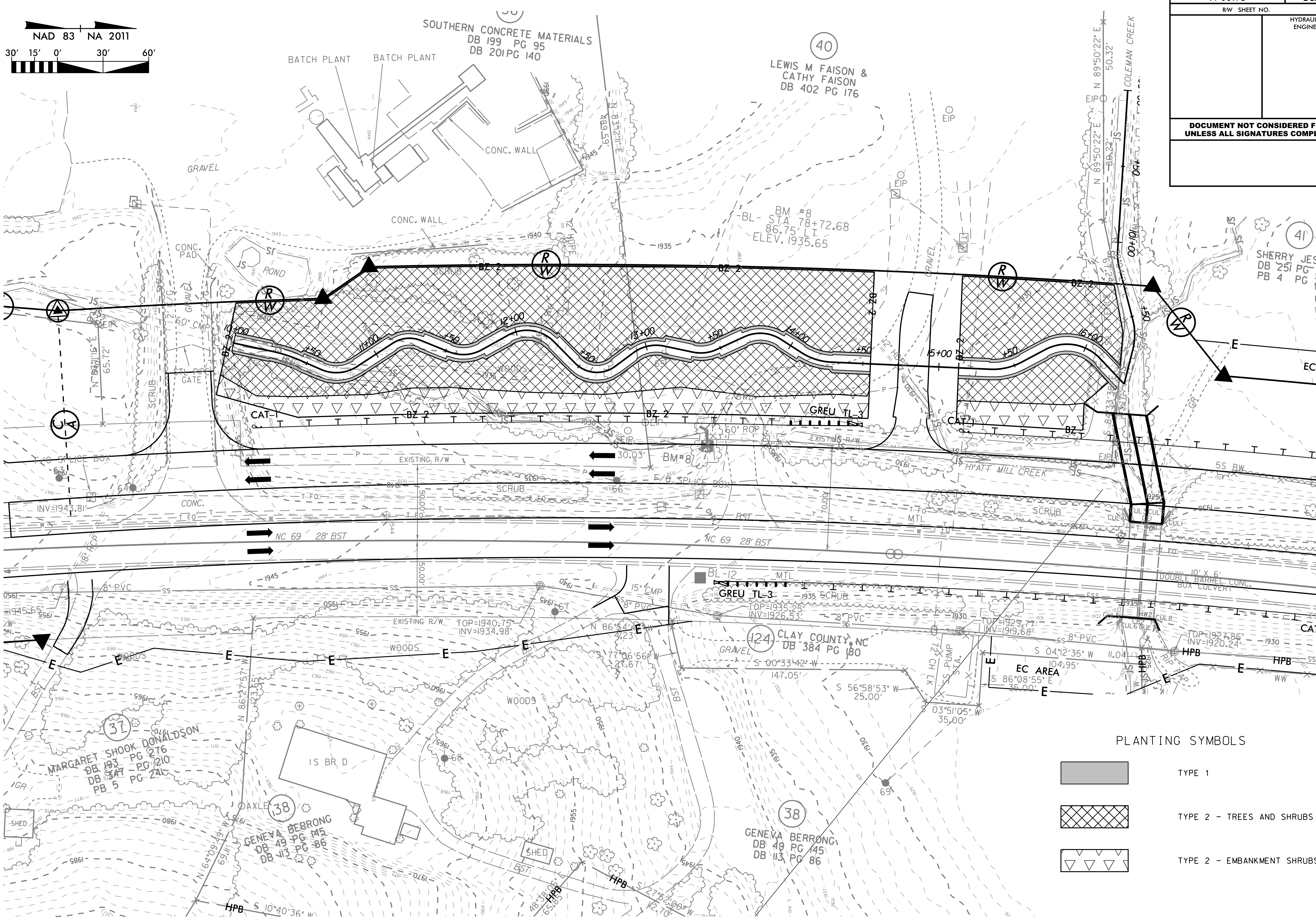
PROJECT REFERENCE NO.	SHEET NO.
A-0011C	OSM-22
R/W SHEET NO.	
	HYDRAULICS ENGINEER

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

8/17/99

REVISIONS



NAD 83 NA 2011
30' 15' 0' 30' 60'
SOUTHERN CONCRETE MATERIALS
DB 199 PG 95
DB 201 PG 140
BATCH PLANT
BATCH PLANT
40
LEWIS M FAISON &
CATHY FAISON
DB 402 PG 176
GRAVEL
CONC. WALL
CONC. WALL
CONC. PAD
POND
BM #8
-BL- STA 78+72.68
86.75' LT
ELEV. 1935.65
COLEMAN CREEK
41
SHERRY JESS
DB 251 PG
PB 4 PG
60" CMP
STL PIPE GATE
CAT-1
GREU TL-3
60" RCP
BM#8
EXISTING R/W
T FO SPLICE BOX
SCRUB
HYATT MILL CREEK
INV=1943.81'
CONC.
NC 69 28' BST
NC 69 28' BST
10' X 6' DOUBLE BARREL CONC. BOX COLVERT
BL-12
MTL
15" CMP
8" PVC
TOP=1935.25'
INV=1926.53'
TOP=1940.75'
INV=1934.98'
TOP=1929.77'
INV=1919.68'
TOP=1927.85'
INV=1920.24'
124
CLAY COUNTY, NC
DB 384 PG 180
WOODS
EC AREA
PUMP STA.
37
MARGARET SHOOK DONALDSON
DB 193 PG 276
DB 347 PG 210
PB 5 PG 241
38
GENEVA BERRONG
DB 49 PG 145
DB 113 PG 86
1S BR D
SHED
SHED
38
GENEVA BERRONG
DB 49 PG 145
DB 113 PG 86
PLANTING SYMBOLS
TYPE 1
TYPE 2 - TREES AND SHRUBS
TYPE 2 - EMBANKMENT SHRUBS