

# Technical Memorandum

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**To:** Mark Loidolt, PE  
Interim Benton County Engineer

**From:** Joe Lewis, PE  
Houston Engineering, Inc.

**Subject:** Benton County Ditch 9 Repair Report

**Date:** March 28, 2023

**Project:** 6183-0005

## INTRODUCTION AND EXECUTIVE SUMMARY

Benton County Ditch 9 (CD 9) is in disrepair and in need of repair. The channel is poorly defined in several areas, several culverts are perched and/or undersized, and there is significant sedimentation in some reaches of the ditch system. The Benton County Drainage Authority has contracted with Houston Engineering, Inc. (HEI) to prepare a repair report for the CD 9 public drainage system. The purpose of this report is to provide a description of current conditions and analysis of repair alternatives, including hydrologic and hydraulic analyses and a preliminary opinion of probable cost for the recommended repairs.

To restore the function of CD 9, we recommend the County complete a repair of the CD 9 open channel. This would include excavation of the majority of the channel to the As-Constructed and Subsequently Improved Condition (ACSIC) with the exception of some reaches within wetlands where impacts may occur that are not exempt from the mitigation requirements of the Wetland Conservation Act. Within those reaches, with consideration of the significant cost of mitigation, we recommend repairs be completed to a depth less than the ACSIC but providing a functional outlet for the drainage system. We conclude the proposed repairs are necessary to restore the function of the drainage system, and they are in the best interest of benefitted property owners.

To assist the County, preliminary design and cost information are provided in this report (see **Attachments B and C**). However, final construction plans, bid documents, and specifications will need to be prepared subsequent to the County establishing and ordering a repair be completed. Benton County retains the decision whether to accept, reject, or modify the Engineer's recommendation.

## CURRENT SYSTEM

### *LOCATION OF THE PUBLIC DRAINAGE SYSTEM*

Benton County Ditch 9 (CD 9), shown in **Figure 1**, is a 5.6-mile ditch system that consists of a 4.7-mile Main Trunk and a 0.9-mile Branch 1. The system is located within Sections 26, 27, 33 and 34 of Maywood Township (T37N R28W) and Sections 4, 5 and 8 of Glendorado Township (T36N R28W) in Benton County.

The Main Trunk flows northeast to southwest from 300 feet south of 75<sup>th</sup> Street NE to 100 feet north of 42<sup>nd</sup> Street NE, a distance of 4.7 miles, where it drains into the St Francis River. Branch 1 flows west to east from 700 feet west of 165<sup>th</sup> Avenue NE to its confluence with the Main Branch 750 feet west of the 62<sup>nd</sup> Street and 172<sup>nd</sup> Avenue NE intersection. The system consists entirely of open channel ditch sections. Benton County Ditch 14 (CD 14) outlets into CD 9 at the upstream starting point. Benton County Ditch 12 (CD 12) also outlets into CD 9 near the midpoint of the CD 9 Main Trunk.

The total drainage area tributary to CD 9 is approximately 11.3 square miles (7,230 acres) located in Maywood and Glendorado Township. This includes 5.4 and 1.8 square miles outletting from CD 14 and CD 12, respectively. Current land use in the tributary watershed is agricultural along with wetland, forest, and rural residential.

HEI completed an Engineer's Report dated 04/19/2022 documenting the ACSIC of CD 9, which was adopted by the Benton County Drainage Authority on September 6, 2022 through a record reestablishment proceeding. The Record Reestablishment serves to establish the ACSIC of the ditch for the purposes of this report.

### *FIELD SURVEY*

Field survey data, including photographs and elevations, were collected in April 2021. The survey data established the existing conditions and elevations of the open channel system and located culverts and other crossings along the ditch system. Additionally, soil borings were completed to assist in determining the ACSIC profile. All survey data was referenced to the North American Vertical Datum 1988 (NAVD88). (Note: Unless otherwise noted, all elevations provided herein are based on the NAVD88 datum).

### *CURRENT CONDITION OF THE SYSTEM*

The physical survey completed by HEI and ACSIC established during the Record Reestablishment show parts of the CD 9 system are in disrepair. **Table 1** summarizes the field observations and comparison of the current and ACSIC elevation profiles.







**Table 1: Summary of Current Conditions**

Location	Description
<b>Main Trunk</b>	
0+00 to 56+00	<ul style="list-style-type: none"> <li>• 1-1.5 feet of accumulated sediment above the ACSIC</li> <li>• Downstream half of this segment has significant tree growth adjacent to open channel ditch</li> <li>• Tree debris and sediment in channel has resulted in bank erosion at multiple locations</li> </ul>
56+00 to 140+00	<ul style="list-style-type: none"> <li>• Limited accumulated sediment (0.5-foot or less on average) above the ACSIC</li> <li>• Occasional blockages in open channel ditch</li> <li>• Limited trees adjacent to ditch</li> </ul>
140+00 to 216+00	<ul style="list-style-type: none"> <li>• 1-foot of accumulated sediment above the ACSIC</li> <li>• Limited trees adjacent to ditch</li> </ul>
216+00 to 238+00	<ul style="list-style-type: none"> <li>• 1 to 1.5-foot of accumulated sediment above the ACSIC</li> <li>• Trees on one or both sides of open ditch for much of segment</li> </ul>
238+00 to 250+00	<ul style="list-style-type: none"> <li>• Limited depths of accumulated sediment above the ACSIC</li> <li>• Trees on one or both sides of open ditch for much of segment</li> </ul>
<b>Branch 1</b>	
0+00 to 34+00	<ul style="list-style-type: none"> <li>• Limited depth of accumulated sediment (0.5-foot or less on average) above the ACSIC</li> <li>• Relatively shallow open channel ditch through pasture</li> <li>• No trees adjacent to open channel ditch</li> </ul>
34+00 to 47+00	<ul style="list-style-type: none"> <li>• Generally 2 to 3-foot sediment above the ACSIC</li> <li>• Difficult to locate exact alignment of ditch</li> <li>• No trees adjacent to open channel ditch</li> </ul>

### EXISTING CULVERT ANALYSIS

Existing culverts were analyzed to determine if the provided capacity meets drainage design standards. Additionally, the current culvert inverts were compared to the ACSIC profile. If culverts are not properly sized or are above the ACSIC profile, they can impair the efficiency of the drainage system. **Table 2** summarizes the condition of the current culverts on CD 9.

Culverts at county road crossings were evaluated based on the ability to pass the 50-year peak discharge without overtopping the roadway and township road crossings were evaluated based on the ability to pass the 10-year peak discharge without overtopping the roadway. Culverts at field

crossings were evaluated based on the ability to pass the 2-year discharge and without overtopping the banks. Peak discharges were calculated using USGS Regression Equations<sup>1</sup>.

**Table 2:** Summary of Culvert Crossing Analysis

Location	Maintenance Responsibility	Crossing	Existing	Design Criteria: Capacity	Current and ACSIC Elevation Comparison
<b>Main Trunk</b>					
8+43	Private	Field Crossing	5'x7' Concrete Box	Appropriately sized	0.5-feet below the ACSIC grade.
48+36	Private	Field Crossing	36" CMP 48" CMP	Appropriately sized	0.75-feet above the ACSIC grade.
123+05	Benton County	CSAH 7 and 55 <sup>th</sup> St NE	(2) 4'x10' Concrete Box	Appropriately sized	At the ACSIC grade.
195+33	Benton County	CSAH 4/ 65 <sup>th</sup> St NE	102"x62" Arch RCP	Appropriately sized	1.0-feet above the ACSIC grade.
218+00	Maywood Township	175 <sup>th</sup> Ave NE	(2) 60" CMP	Appropriately sized	1.75-feet above the ACSIC grade.
227+03	Private	Field Crossing	(3) 36" CMP	Appropriately sized	1.5-feet above the ACSIC grade.
<b>Branch 1</b>					
33+03	Benton County	CSAH 7/165 <sup>th</sup> Ave NE	30" RCP	Undersized	At the ACSIC grade.

## PROPOSED REPAIR

The purpose of the proposed repair is to restore the drainage system function to a level of service consistent with the ACSIC which includes removing any blockages, restoring the bottom width of the channel and addressing bank erosion. The Drainage Authority, when considering a repair, may evaluate various alternatives to the scope and nature of repairs. This report evaluates two alternatives: 1) a repair of the entire ditch to the ACSIC for the entire length of CD 9, and 2) a partial repair of the ditch to a depth at, or in some locations above, ACSIC grade. The purpose of a partial

<sup>1</sup> Lorenz, D.L., Sanocki, C.A., and Kocian, M.J., 2010, Techniques for estimating the magnitude and frequency of peak flows on small streams in Minnesota based on data through water year 2005: U.S. Geological Survey Scientific Investigations Report 2009–5250, 54 p.

repair is to restore the drainage system capacity as nearly to the ACSIC as practicable while minimizing costly regulatory compliance.

## **REPAIR ALTERNATIVES**

**Alternative 1** – This alternative consists of a repair to the ACSIC grade throughout the entire length of the system. This includes excavation of the open channel and replacing several crossings as necessary to restore the capacity of the system. Trees and brush will be cleared from within the channel and within the Right-of-Way (ROW) of the drainage system to enable access to complete the repairs and for future inspection and maintenance activities. Spoils from channel excavation would be placed and leveled adjacent to the channel on the existing spoil banks within the ROW of the drainage system. **Figure 2** provides a summary of the repair work proposed in Alternative 1.

Public road crossing replacements will have their proposed size and material confirmed by the road authority and their replacement coordinated with the road authority to determine whether the crossing will be replaced as part of the repair with the cost assessed to the road authority, or if the crossing will be replaced by the road authority at their cost at a time of their choosing. Specifically, the following public crossings are recommended for replacement in this alternative:

- CSAH 4 over the Main Trunk at Station 195+33 – Replace the 102" x 62" Arch RCP at the ACSIC grade.
- 175<sup>th</sup> Avenue over the Main Trunk at Station 218+00 -- Replace both 60" CMPs at the ACSIC grade
- CSAH 7 over Branch 1 at Station 33+03 – Replace 30" RCP with 48" RCP.

Additionally, two field crossings are recommended for replacement. They are:

- Field Crossing over the Main Trunk at Station 227+03 – Replace the 36" CMPs with three 36" CPPs at the ACSIC grade
- Field Crossing over the Main Trunk at Station 48+36 – Replace the current 36" and 48" CMPs with two 42" CPPs at ACSIC grade

These field crossings and public road crossings are either above the ACSIC channel grade, too small to adequately convey flows in the public drainage system, and/or in disrepair.

**Alternative 2** – This alternative is similar to Alternative 1, except areas where a full-depth repair may result in wetland impacts requiring mitigation. In portions of the ditch that cross or are adjacent to Type 3, 4 and 5 wetlands, where impacts that will require mitigation may occur, the channel will be excavated to a partial depth instead of the ACSIC grade. This will reduce or eliminate the need for mitigation of wetland impacts to save cost and preserve water resources while providing a sufficient level of function to benefitted landowners. The portions of the Main Trunk and Branch 1 that would have a reduced excavation depth are shown in the vertical profile seen in **Attachment B**. The lands adjacent to these reaches do not appear to be currently row cropped or pattern tiled and therefore

are unlikely to see a significant additional benefit from a repair to the ACSIC grade versus the partial profile depicted in **Attachment B. Figure 3** also provides a summary of the repair work proposed in Alternative 2.

In addition to wetland mitigation avoidance, Alternative 2 offers opportunity for cost savings by reducing the cost of replacing an existing culvert. Details of the culvert assessment are included in **Attachment A**. A summary of these differences in culvert replacement for this alternative are listed below:

- CSAH 4 over the Main Trunk at Station 195+33 -- The current crossing is approximately 1 foot above the ACSIC and passes the 50-year rainfall event. A Type 3 wetland is located upstream of the culvert crossing and would potentially be impacted by lowering the culvert invert. For these reasons, replacement of this culvert is not included in Alternative 2. **Table 3** below provides an estimate of the impact that the crossing has on drainage function.
- CSAH 7 over Branch 1 at Station 33+03 – This crossing is at the ACSIC elevation but was determined be undersized when considering typical road design criteria but still passes drainage design flows. Additionally, the culvert is scheduled to be replaced by the County when they reconstruct CSAH 7 in 2024. **Table 3** below provides an estimate of the impact that the crossing has on drainage function.

**Table 3:** Comparison of Water Surface Elevations for the 2-year Rainfall Event

Location	2-year Water Surface Elevation		
	Full ACSIC Repair	Partial Repair (Existing)	Overtopping Elevation
CSAH 4	1086.34	1086.48	1092.85
CSAH 7	1097.90	1098.06	1101.45

It is important to note that not pursuing a repair to the ACSIC as part of the current repair does not prevent the drainage authority from repairing to the ACSIC in future repairs. However, the drainage authority would need to reevaluate those future repairs for compliance with the Wetland Conservation Act and other applicable Rules and Statutes.

### **EXTERNAL FUNDING FOR ALTERNATIVE MEASURES AND TECHNICAL ASSISTANCE**

M.S. 103E.015 requires a Drainage Authority to investigate the potential of external funding sources and technical assistance during a petitioned repair, specifically for the purposes of wetland preservation or restoration, water quality improvements, reducing erosion and sedimentation, reducing downstream peak flows and flooding, and conserving, allocating and using drainage waters for agriculture, streamflow augmentation or other beneficial uses.

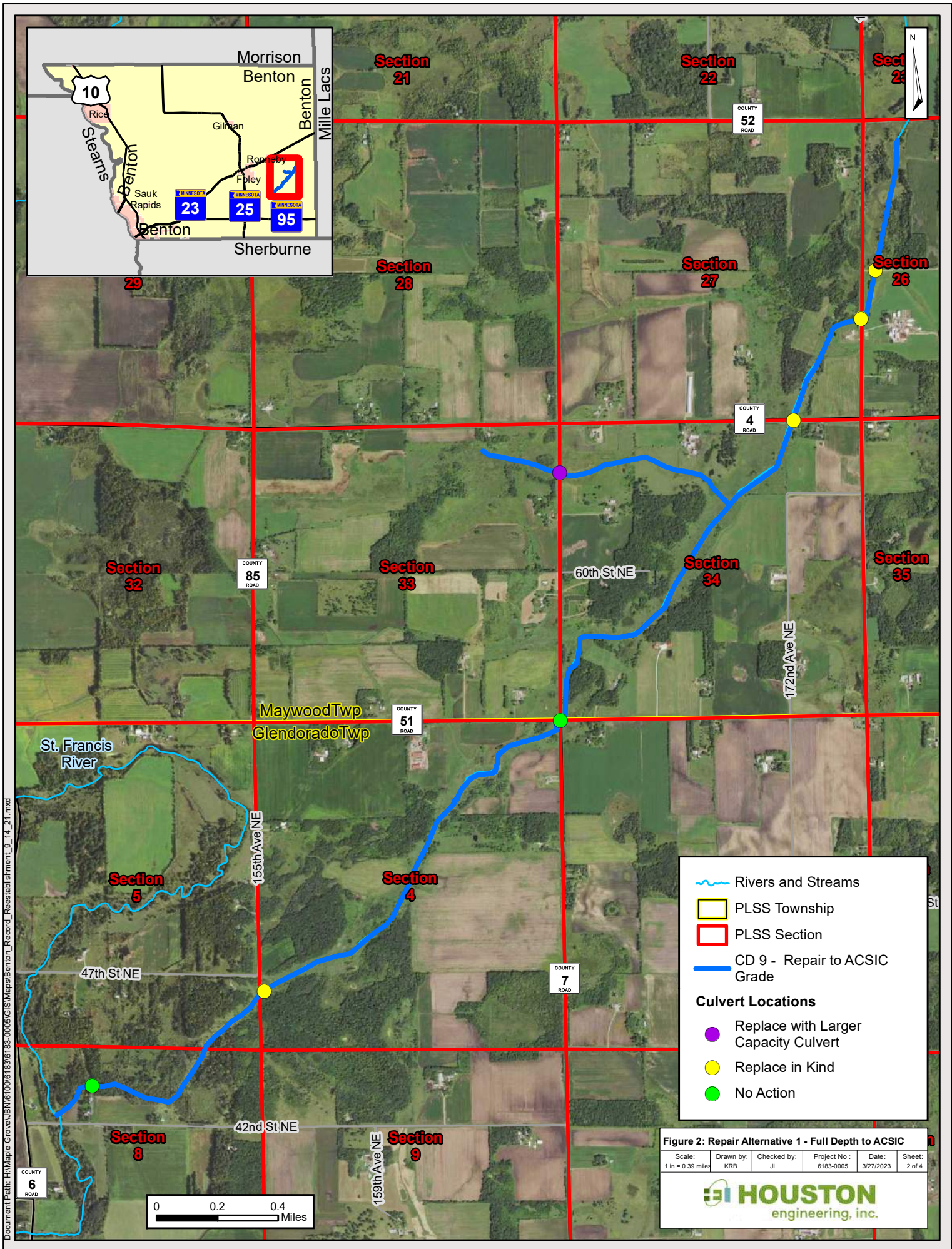
Construction of these measures requires voluntary landowner participation and is subject to the availability of funding. Implementation of these measures may coincide with the repair project but may also occur independently of the repairs. Coordination with the Benton County Soil and Water Conservation District will occur prior to the drainage system repairs. Through this coordination, the potential for external funding applications such as the Board of Water and Soil Resources Clean Water Fund's Multi-purpose Drainage Management grant program will be evaluated.

## EVALUATION OF REPAIR

### *HYDRAULIC IMPACTS*

CD 9 has significant sedimentation and several culverts located above the ACSIC grade. The proposed repairs would remove these obstructions to open channel flow and restore the hydraulic efficiency of the system. The proposed repairs will reduce peak water levels for smaller rain events, but they are not expected to significantly impact peak water levels for larger events such as the 100-year flood event. The differences in hydraulic performance or efficiency between the full and partial repair alternatives are described in **Table 4**. For segments of CD 9 not listed in **Table 4**, the ACSIC profile will be restored in Alternative 1 and 2 and have equivalent drainage efficiency. More information regarding the wetlands adjacent to the segments listed in **Table 4** can be found in the Regulatory section below.





Rivers and Streams

PLSS Township

PLSS Section

CD 9 - Repair to ACSIC Grade

**Culvert Locations**

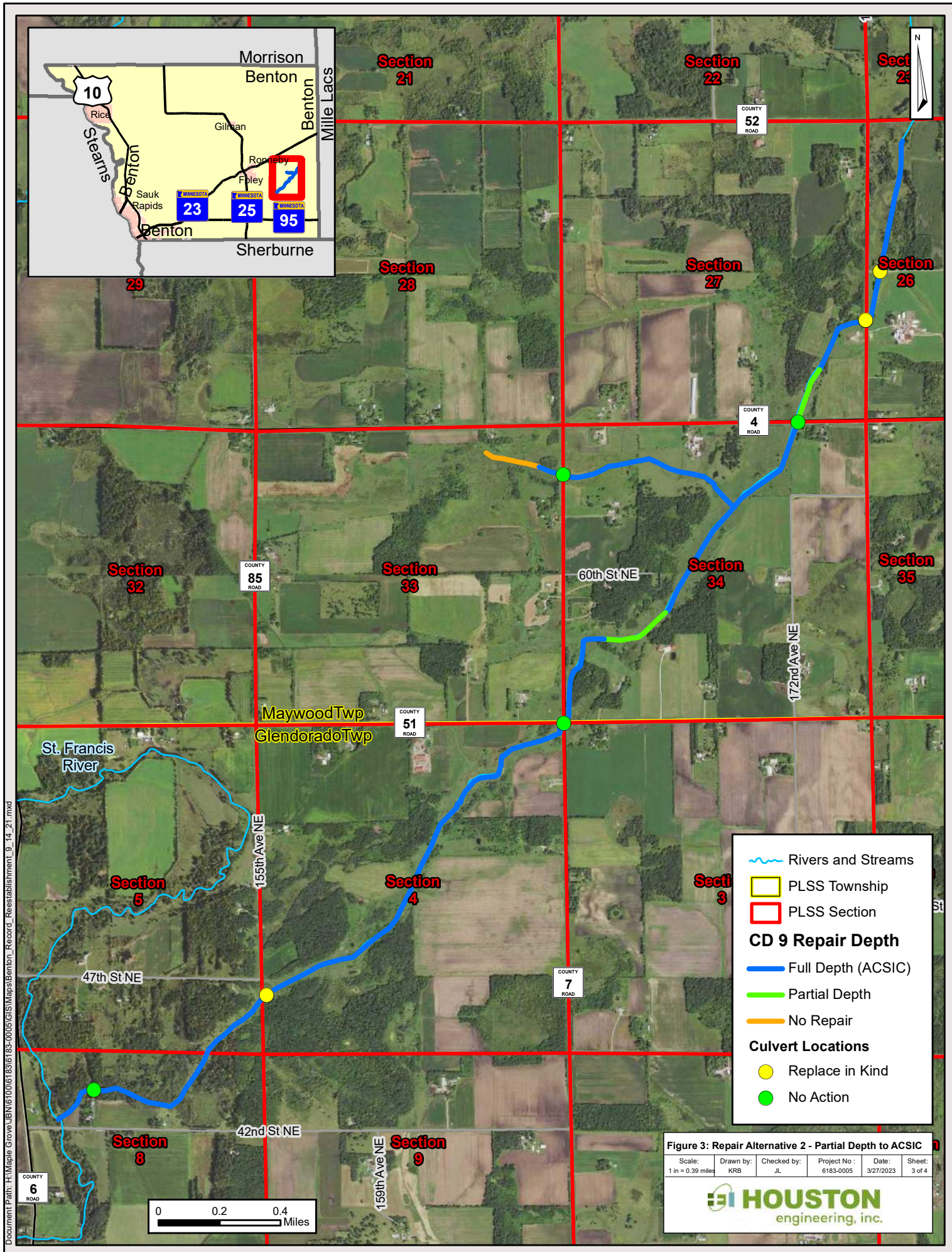
- Replace with Larger Capacity Culvert
- Replace in Kind
- No Action

**Figure 2: Repair Alternative 1 - Full Depth to ACSIC**

Scale: 1 in = 0.39 miles	Drawn by: KRB	Checked by: JL	Project No : 6183-0005	Date: 3/27/2023	Sheet: 2 of 4
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**HOUSTON**  
engineering, inc.





**Table 4:** Comparison of Drainage System Efficiency between Alternative 1 and Alternative 2

Full and Partial Repair Comparison			
Location	Current Condition	Alternative 2 Repair Description	Comparison of Drainage Efficiency between Alternative 1 and 2
<b>Main Trunk</b>			
STA 142+00 to 154+00	1 to 2' of accumulated sediment.	Alternative will generally remove between 0.5-1.5' of accumulated sediment rather than the full 1-2' of sediment.	Capacity of the current channel is approximately 40-50% of the ACSIC and Alternative 2 is expected to restore it to 85-90%.  Additionally, the surrounding lands of this segment either are elevated above the drainage system profile or are not in agricultural production.
STA 196+00 to 205+00	1 to 2' of accumulated sediment	At STA 196+00 near CSAH 4, none of the 1' of sediment will be removed and the culvert will not be lowered.  At STA 202+00 which has the greatest depth of accumulated sediment, most of the nearly 2' of sediment will be removed.	Capacity of the current channel is approximately 60-70% of the ACSIC and Alternative 2 is expected to restore it to 85-90%.



Capacities of the recommended culvert replacements are not larger than the ACSIC channel; they will not result in an increase in channel capacity, but they will reduce ponding behind structures during larger events.

## *REGULATORY CONSIDERATIONS*

### **Wetlands**

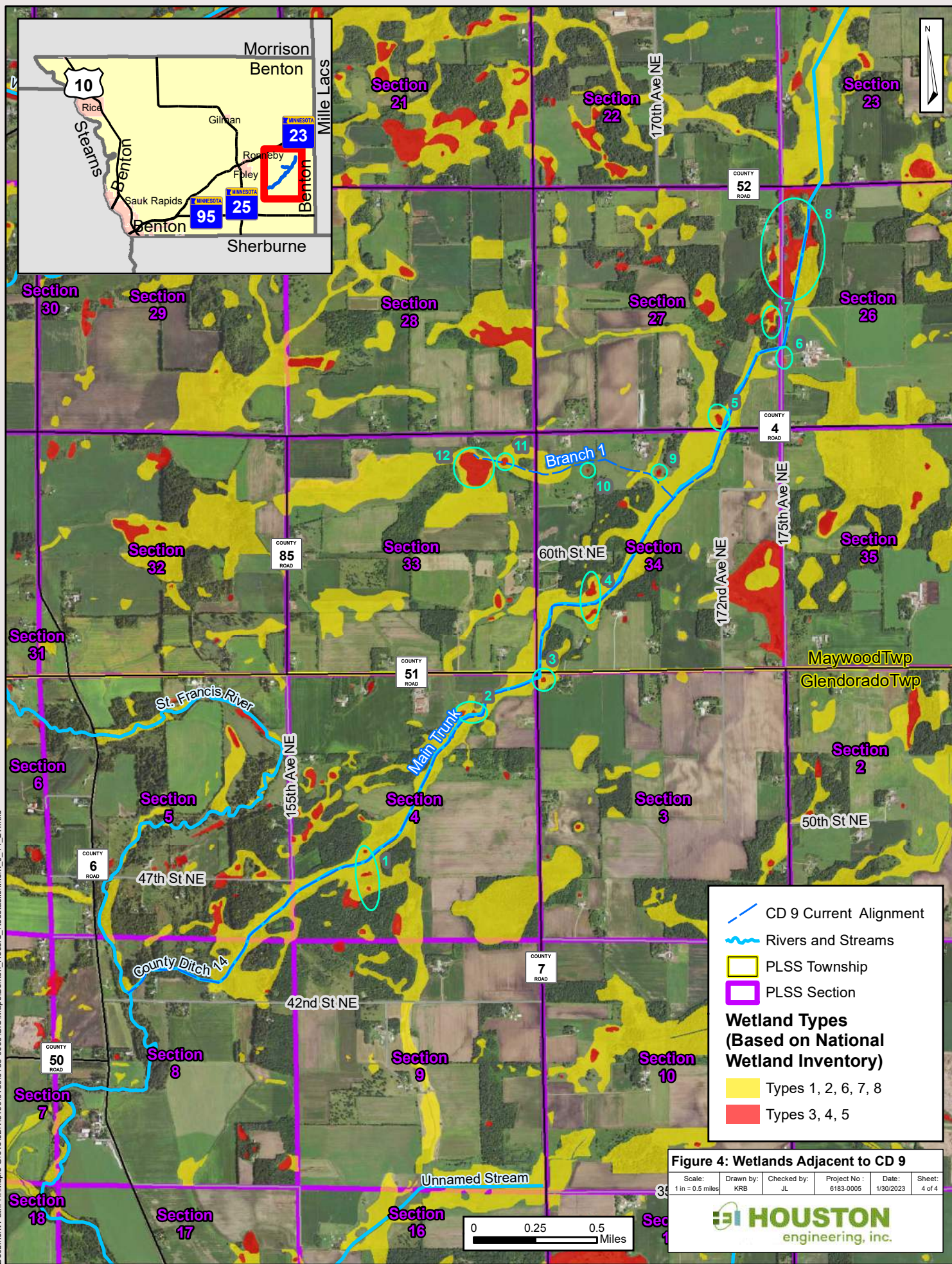
There are three regulatory programs that may be triggered by a drainage system repair project, including the Minnesota Department of Natural Resources (MnDNR) Public Waters Permitting Program, the federal Clean Water Act (CWA) implemented by the US Army Corps of Engineers (USACE), and the state Wetland Conservation Act (WCA) implemented by the Local Government Unit, in this case Benton County. The following is a review of the repair project relative to these three regulatory programs.

As seen in **Figure 4** CD 9 does not intersect any state-listed Public Waters or Public Water Wetlands (PWI). The main trunk of CD 9 channel is listed as a Public Watercourse but is categorized as a “Public Ditch / Altered Natural Watercourse”, which does not typically require any Public Waters permitting coordination with the MnDNR. Lateral 1 is not listed as a PWI or a Public Ditch / Altered Natural Watercourse.

The CD 9 public drainage system intersects wetlands identified in the MnDNR National Wetland Inventory (NWI) as shown in **Figure 4**. Under the two wetland regulatory programs, (Minnesota WCA and Federal CWA) activities related to repair of a public drainage system are generally exempt from permitting and mitigation requirements. These activities related to public drainage system maintenance and repair, and include:

- Excavation in wetlands when limited to removal of accumulated sediment or debris such as trees, logs, stumps, beaver dams, blockage of culverts, and trash, provided the removal does not result in alteration of the original cross-section of the wetland or watercourse;
- Removing those materials placed by beaver;
- Removing or moving materials blocking installed roadway culverts and related drainage structures; and
- Temporary or seasonal water level management activities done for the purpose of performing maintenance.







Under the federal CWA, drainage system maintenance or repair is exempt from regulation. Under the state WCA, activities related to maintenance or repair of a public drainage system are exempt from replacement, include:

- Maintenance or repair of a public drainage system which drains Type 1, 2, 6, 7, or 8 wetlands; and
- Maintenance or repair of a public drainage system which drains Type 3, 4, or 5 wetlands that have existed for 25 years or less.

To determine the actual extent of Type 3, 4 and 5 wetlands, HEI scientists visited the site on September 13<sup>th</sup>, 2022. Prior to visiting the site, the NWI and a series of years of aerial photography were reviewed to understand potential wetland types within the area. Once at the site, a 300-foot wide corridor was viewed to identify Type 3, 4, and 5 wetlands. Using this field information, and the NWI as a baseline dataset, the NWI map layers were edited to incorporate the results of the field survey (as shown in **Figure 4**).

The results from the field survey indicate that the corridor includes a total of approximately 297 acres of wetland, of which 15.2 acres is classified as a Type 3, 4 or 5 wetland. See **Figure 4** or the results of the field investigation.

Based on a review of the NWI data and field inventory work to confirm wetland types, there are eight locations on the main trunk and four locations on Lateral 1 of CD 9 where Type 3, 4, and 5 wetlands are present (**Figure 4**). **Table 5** provides a description of these sites and specifies locations where alternative repair work could be implemented to reduce potential wetland impacts. Three locations have the potential for impacts to Type 3, 4, and 5 wetlands if the repair work is implemented to the ACSIC. As such, the drainage system repair project may not meet the exemption criteria of the state WCA for all wetlands near the proposed repairs. Repair Alternative 2 (partial repair) has been developed to provide restoration of drainage while minimizing potential wetland impacts. Based on this review of the wetland locations and the depth of accumulated sediment above the ACSIC profile, we estimate approximately 3.6 acres of potential wetland impacts requiring mitigation under Alternative 1.

**Table 5: Potential Type 3, 4 and 5 Wetland Impact Summary**

Wetland Area on Figure 4	Station	Evaluation	Recommended Mitigation Efforts
<b>Main Channel</b>			
1	64+50	The north basin is approximately 160 feet from the ditch channel and appears to be a constructed stock pond. The south basin is approximately 225 feet from the ditch channel and appears to be a natural depression. Repair depth to ACSIC is not expected to impact this wetland given its distance to the CD 9 channel and the size of the area contributing to its hydrology. One additional wetland area is identified that is over 400 feet south of the ditch channel, this area is likely too far to be impacted by the proposed removal of 1-2 feet of sediment.	No mitigative efforts required. Repair to ACSIC.
2	104+00	Two small basins are identified north of the ditch channel. One is approximately 100 feet north of the ditch channel and the other is approximately 35 feet from the ditch channel. Limited repair work is proposed along this segment of CD 9 as the existing ditch channel is at ACSIC.	No mitigative efforts required. Repair to ACSIC.
3	122+00	One basin is identified approximately 165 feet east of the ditch channel. It is on the other side of CSAH 7 and South of CR 51. The culvert through the intersection is not proposed to be lowered and limit repair work is proposed along this segment of CD 9 as there is limited accumulated sediment above the ACSIC. Also, the wetland is across the highway from the ditch channel which greatly reducing the likelihood of any lateral drainage impacts to this basin.	No mitigative efforts required. Repair to ACSIC.
4	147+00	The north basin is approximately 175 feet from the ditch channel. The south basin is approximately 85 feet from the ditch channel.	Partial ditch repair as repair to ACSIC may impact wetlands.
5	197+00	One basin is identified approximately 85 feet west of the ditch channel.	Partial ditch repair as repair to ACSIC may impact wetlands.

6	218+00	One basin is identified approximately 265 feet southeast of the ditch channel. It is on the other side of a farm driveway from the ditch. The wetland is across the driveway from the ditch channel which greatly reducing the likelihood of any lateral drainage impacts to this basin. This wetland is a constructed stock pond. It is mapped by the NWI as a PUBHx.	No mitigative efforts required with TEP concurrence of the excavated wetland-stock pond. Ditch repair to ACSIC.
7	224+00	One basin is identified approximately 325 feet west of the ditch channel, and the second basin is approximately 250 feet west of the ditch channel. Both basins are on the other side of 175th Ave NE which greatly reduces the likelihood of any lateral drainage impacts to these basins.	Repair to ACSIC.
8	232+00	One basin is identified on the west side of the ditch channel. This basin appears to be a natural depression bisected by the roadway (175th Ave NE).	Repair to ACSIC and coordinate with TEP to determine extent of impact to wetland.
<b>Lateral 1</b>			
9	6+00	This basin is identified approximately 80 feet northeast of the ditch channel and appears to be a constructed stock pond. It is labeled on the NWI as a PUBHx or excavated basin.	Ditch repair to ACSIC with TEP concurrence of the excavated wetland-stock pond.
10	22+00	One basin is identified approximately 120 feet south of the ditch channel and appears to be a constructed stock pond. It is labeled on the NWI as a PUBHx or excavated basin.	Ditch repair to ACSIC with TEP concurrence of the excavated wetland-stock pond.
11	40+00	One basin is identified on the ditch channel alignment. This basin appears to be a natural depression.	No ditch repair to avoid wetland impact.
12	46+00	One basin is identified on the ditch channel alignment. This basin appears to be a natural depression.	No ditch repair to avoid wetland impact.



### **Threatened and Endangered Species**

Public drainage systems may encounter situations where Minnesota's Endangered Species Statute (MS 84.0895) and the associated Rules apply. The endangered species program regulates activities that take, import, transport, or sell any portion of an endangered or threatened species where these acts may be allowed by permit issued by the DNR. The statutes exempt the accidental, unknowing destruction of designated plants. However, it is the responsibility of the Engineer when preparing a final report to complete due diligence to avoid impacts to threatened and endangered species.

Based on the MnDNR's Natural Heritage Information System (NHIS) data (Houston Engineering License Agreement LA-1049), there is one species listed as a "Species of Special Concern". The Creek Heelsplitter, *Lasmigona compressa* is listed on the St. Francis River just downstream of the Ditch Channel. Species of special concern are not protected by Minnesota's Endangered Species Statute (Minnesota Statute 84.0894) or the associated Rules.

## PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST

A Preliminary Opinion of Probable Construction Cost (POPCC) was developed for Alternative 1 and Alternative 2 and a detailed breakdown is included as **Attachment C**. The estimated POPCC and other costs are summarized in **Table 6**. The public drainage infrastructure cost includes open channel excavation, replacement of private culverts, tree clearing, and seeding and stabilization in the ditch right-of-way.

**Table 6:** Preliminary Opinion of Probable Construction Cost Summary

Category	Alternative 1	Alternative 2
Drainage System Cost	\$563,422	\$558,468
Road Authority Cost	\$257,390	\$76,325
Wetland Mitigation Cost	\$360,000	\$0
<b>Total Repair Project Cost</b>	<b>\$1,180,811</b>	<b>\$634,793</b>

If wetland mitigation credits are purchased through the BWSR wetland credit bank, additional projects costs of approximately \$360,000 are expected.

## CONCLUSION / RECOMMENDATION

To restore the function of the CD 9 public drainage system to the condition as it was originally constructed, we recommend the County complete a partial repair of the system as described above as “Alternative 2” and depicted in **Attachment B**. We conclude that the proposed repairs are necessary to meet the current and future drainage needs, and that the repairs are in the best interest of the property owners. The recommended repairs are believed to provide the best value alternative, balancing the need to provide serviceable drainage while minimizing costly wetland impacts.

Regarding the replacement of the culverts at 175<sup>th</sup> Ave NE on the Main Trunk, it is recommended that the Township consider replacement depending on the condition and determination of each culverts remaining design life. If so, we recommend the Township accelerate the timeline for replacement of this culvert to conform to proper hydrologic capacity and ACSIC elevations as stated previously in this report.

To assist the Drainage Authority, concept-level design and cost information are provided in this memorandum. However, detailed construction plans, bid documents, and specifications will need to be prepared subsequent to the Drainage Authority establishing and ordering a project. The Drainage Authority retains the decision whether to accept, reject or modify the Engineer’s Recommendation.

Should the Drainage Authority choose to order a project, additional regulatory engagement with the WCA LGU will be required for both Alternative 1 and 2.

## LIST OF ATTACHMENTS

Attachment A: Culvert Analysis Summary

Attachment B: Benton County Ditch 9 Repair Plans

Attachment C: Preliminary Opinion of Probable Construction Cost

## ATTACHMENT A – CULVERT ANALYSIS SUMMARY

Existing										Proposed						
Authority	Branch	US Station	US Invert	DS Station	DS Invert	Length (ft)	Size	Type	Action	Length (ft)	Size	Type	US Station	US Invert	DS Station	DS Invert
Private	Main Trunk	8+56	1060.65	8+31	1060.73	25	5'x7'	Concrete box	No Action							
Private	Main Trunk	48+46	1068.16	48+25	1068.13	21	36" and 48"	CMP	Replace in Kind	27	2 – 42"	CPP	48+49	1067.30	48+22	1067.26
Benton County	Main Trunk	123+71	1077.14	122+45	1077.20	126	2 - 4'x10'	Concrete box	No Action							
Benton County	Main Trunk	195+77	1084.49	194+91	1084.26	86	62" rise by 102" span	RCP	No Action							
Maywood Township	Main Trunk	218+31	1088.48	217+72	1088.45	59	2 - 60"	CMP	Replace in Kind	71	2 -- 60"	CMP	218+37	1087.90	217+66	1087.80
Private	Main Trunk	227+21	1089.46	226+90	1088.92	29	3 – 36"	CMP	Replace in Kind	37	3 -- 36"	CPP	227+25	1088.00	226+86	1087.90
Benton County	Branch 1	33+30	1096.38	32+76	1096.27	54	30"	RCP	No Action							



## ATTACHMENT B – BENTON COUNTY DITCH 9 REPAIR PLANS

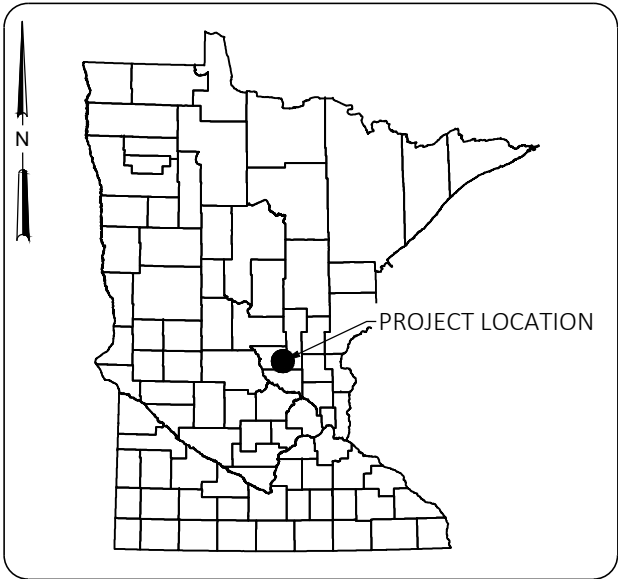
# BENTON COUNTY DITCH 9 REPAIR

## BENTON COUNTY, MN

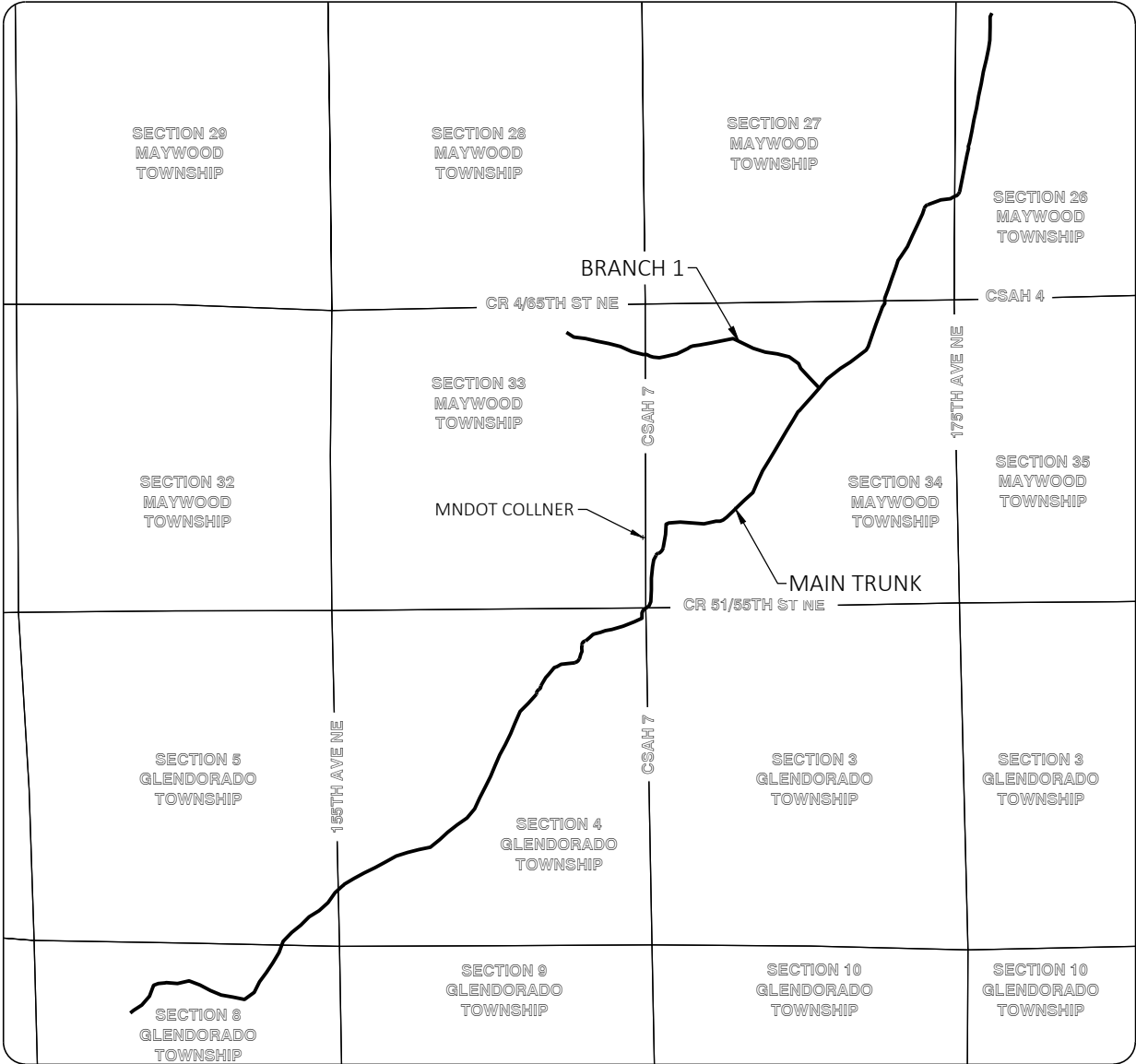
### GLENDORADO & MAYWOOD TOWNSHIPS

### MARCH 2023

TABLE OF CONTENTS	
SHEET #	SHEET TITLE
1	TITLESHEET
2	MT 0+00 - 58+00
3	MT 58+00 - 116+00
4	MT 116+00 - 174+00
5	MT 174+00 - 232+00
6	MT 232+00 - END
7	BR1 0+00 - END



VICINITY MAP



LOCATION MAP

**NOTES:**

1. GEODETIC CONTROL

VERTICAL: NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)

HORIZONTAL: COUNTY COORDINATES (MNDOT), BENTON COUNTY, US FOOT

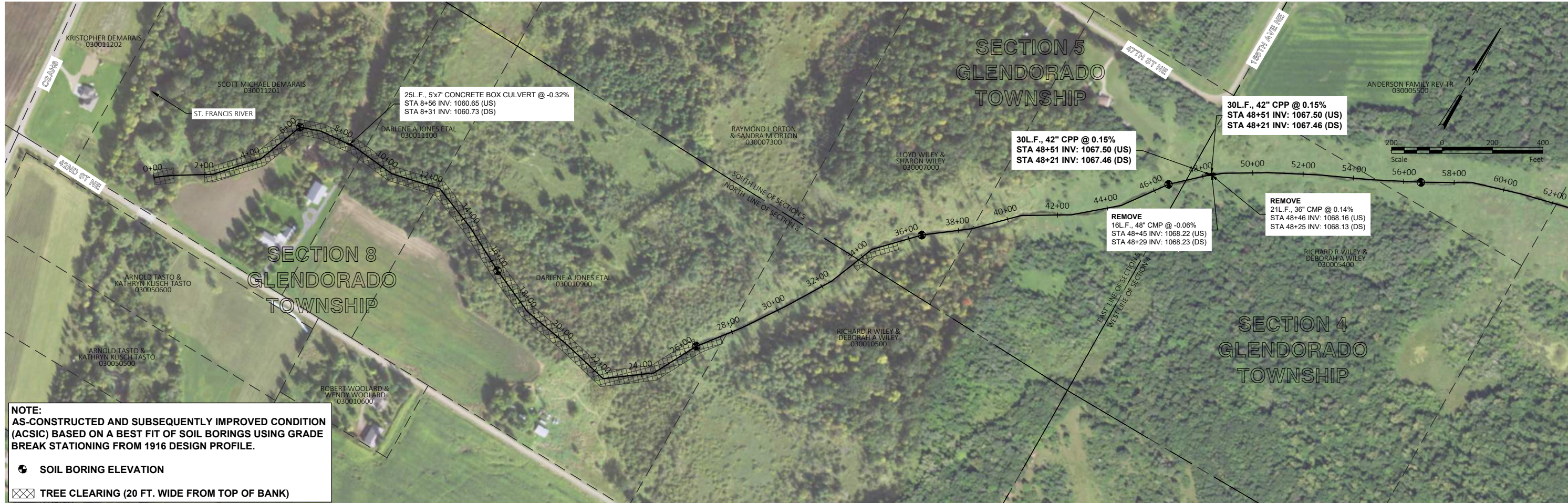
BENCHMARK: MNDOT COLLNER, SE QUARTER, SECTION 33, TOWNSHIP 37N, RANGE 28W

4.0 MILES EAST-SOUTHEAST OF FOLEY, 1.15 MILES SOUTH ALONG TRUNK HIGHWAY 25 FROM THE JUNCTION OF TRUNK HIGHWAY 25 AND TRUNK HIGHWAY 23 IN FOLEY TO TRUNK HIGHWAY 25 MILEPOINT 97.8, THEN 4.5 MILES EAST ON COUNTY ROAD 51, THEN 0.23 MILE NORTH ON COUNTY ROAD 7, 47.7 FEET WEST OF COUNTY ROAD 7, 19.2 FEET NORTH OF A FIELD ENTRANCE, 5.0 FEET SOUTH OF A WITNESS POST.

FIELD SURVEY COMPLETED BY HOUSTON ENGINEERING STAFF IN APRIL OF 2021.

**PRELIMINARY**  
NOT FOR CONSTRUCTION

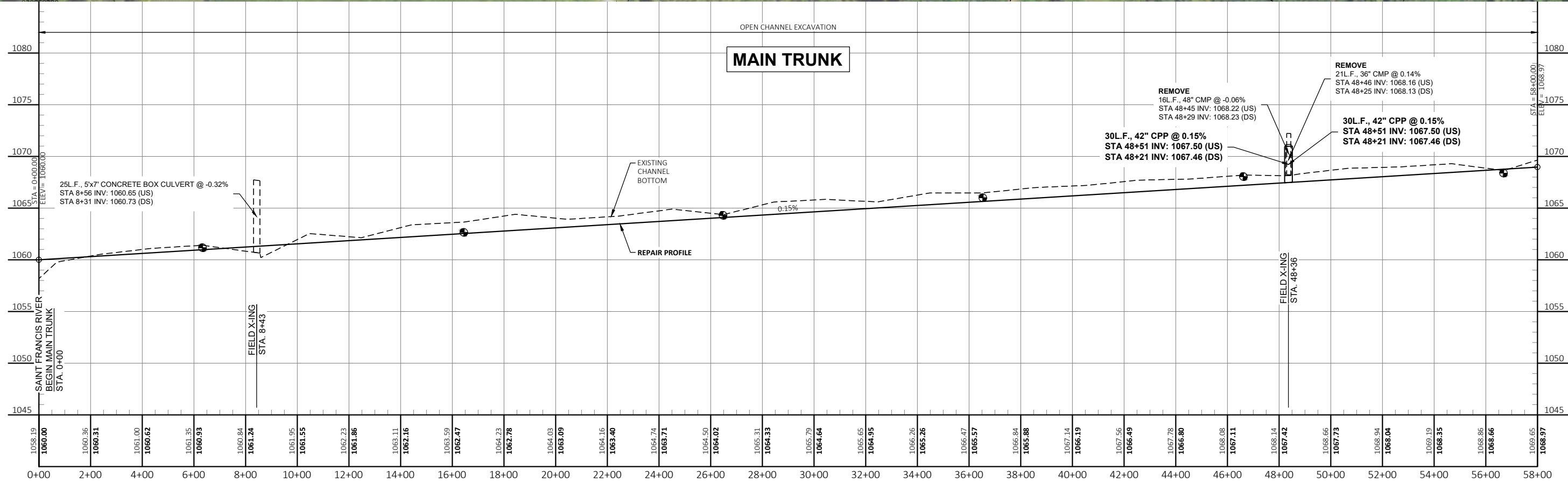




**NOTE:**  
AS-CONSTRUCTED AND SUBSEQUENTLY IMPROVED CONDITION (ACSIC) BASED ON A BEST FIT OF SOIL BORINGS USING GRADE BREAK STATIONING FROM 1916 DESIGN PROFILE.

● SOIL BORING ELEVATION

▨ TREE CLEARING (20 FT. WIDE FROM TOP OF BANK)



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No.	Revision	Date	By

PRELIMINARY

NOT FOR CONSTRUCTION

Drawn by  
KJL

Checked by  
GM

Date  
03-28-2023

Scale  
AS SHOWN

BENTON COUNTY DITCH 9 REPAIR

BENTON COUNTY, MN

GLENDORADO & MAYWOOD TOWNSHIPS

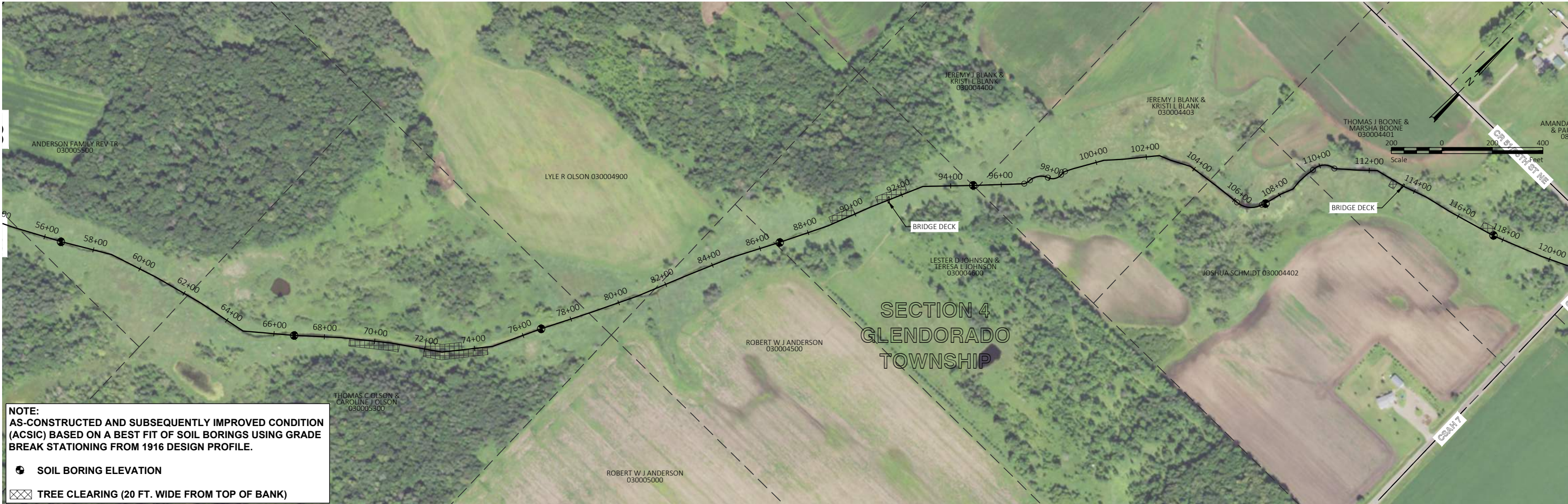
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PROJECT NO. 6183-0005

SHEET

2

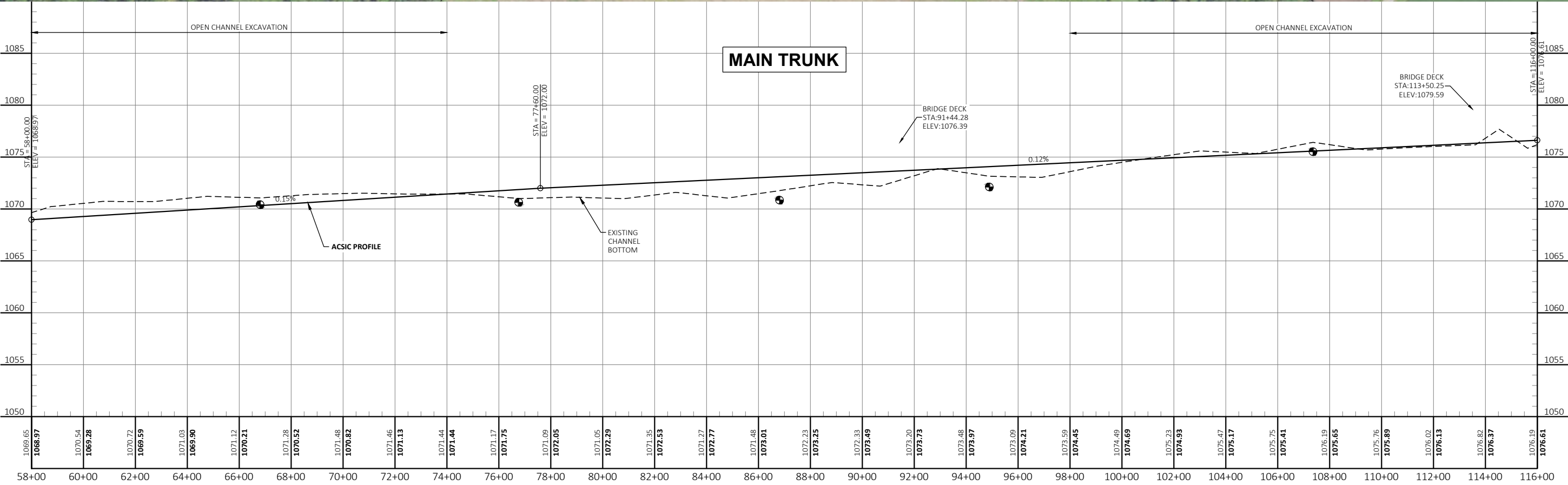




**NOTE:**  
AS-CONSTRUCTED AND SUBSEQUENTLY IMPROVED CONDITION (ACSIC) BASED ON A BEST FIT OF SOIL BORINGS USING GRADE BREAK STATIONING FROM 1916 DESIGN PROFILE.

**SOIL BORING ELEVATION**

**TREE CLEARING (20 FT. WIDE FROM TOP OF BANK)**



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No.	Revision	Date	By

PRELIMINARY

NOT FOR CONSTRUCTION

Drawn by  
KJL

Checked by  
GM

Date  
03-28-2023

Scale  
AS SHOWN

BENTON COUNTY DITCH 9 REPAIR

BENTON COUNTY, MN

GLENDORADO & MAYWOOD TOWNSHIPS

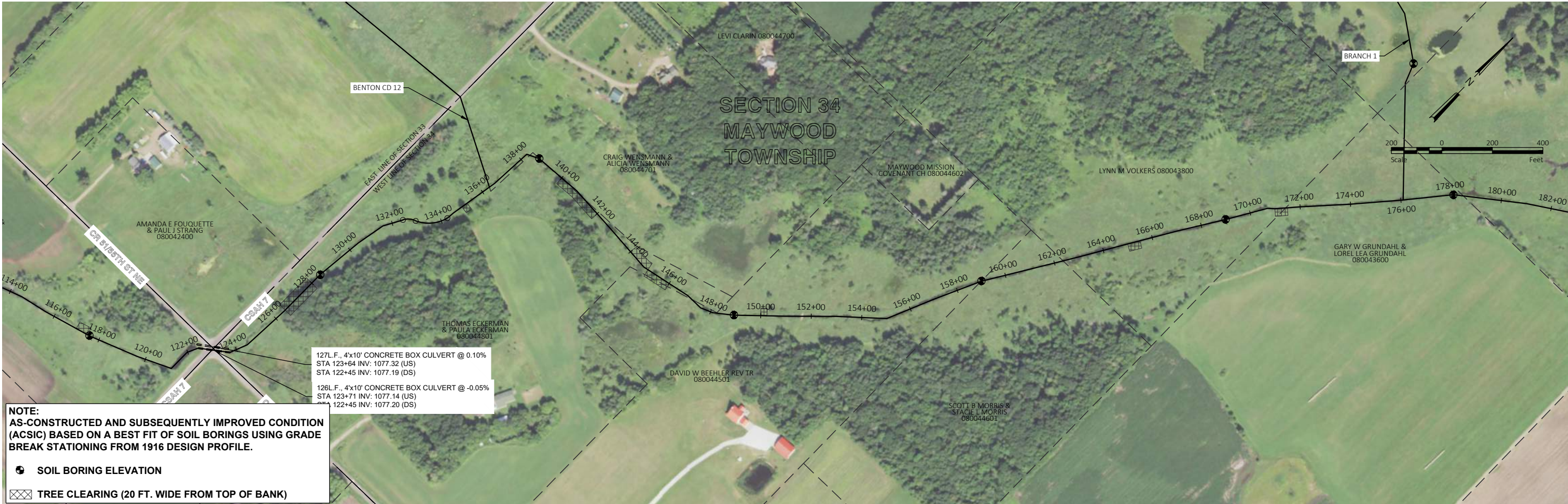
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PROJECT NO. 6183-0005

SHEET

3

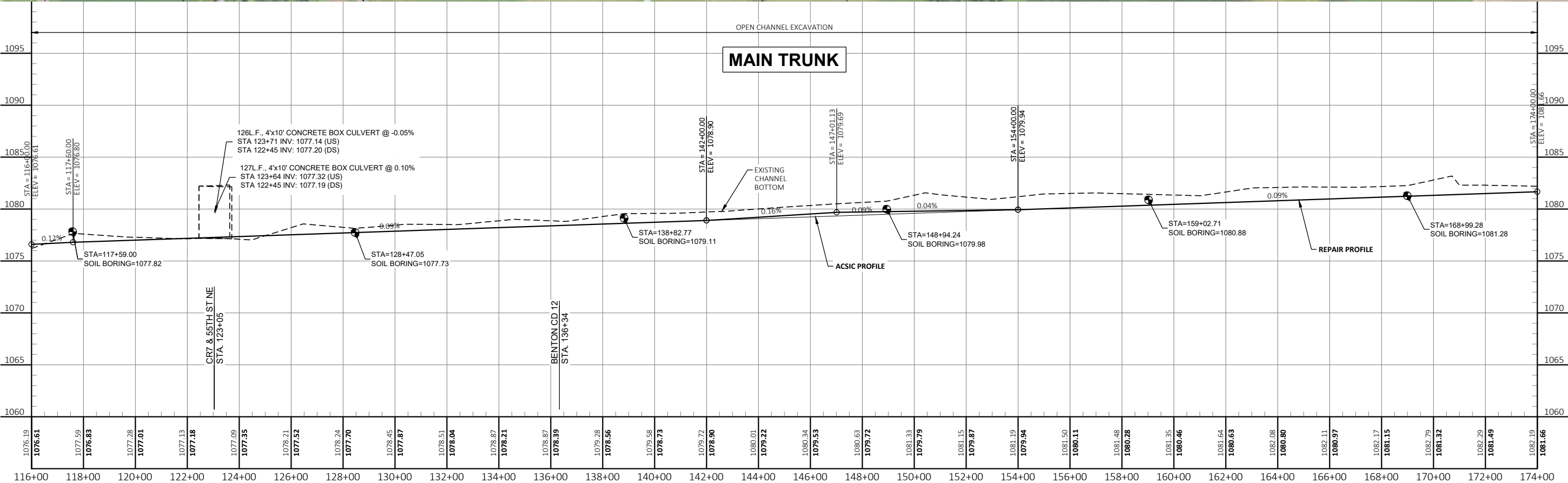




**NOTE:**  
AS-CONSTRUCTED AND SUBSEQUENTLY IMPROVED CONDITION (ACSIC) BASED ON A BEST FIT OF SOIL BORINGS USING GRADE BREAK STATIONING FROM 1916 DESIGN PROFILE.

**SOIL BORING ELEVATION**

**TREE CLEARING (20 FT. WIDE FROM TOP OF BANK)**



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No.	Revision	Date	By

PRELIMINARY

NOT FOR CONSTRUCTION

Drawn by  
KJL

Checked by  
GM

Date  
03-28-2023

Scale  
AS SHOWN

BENTON COUNTY DITCH 9 REPAIR

BENTON COUNTY, MN

GLENDORADO & MAYWOOD TOWNSHIPS

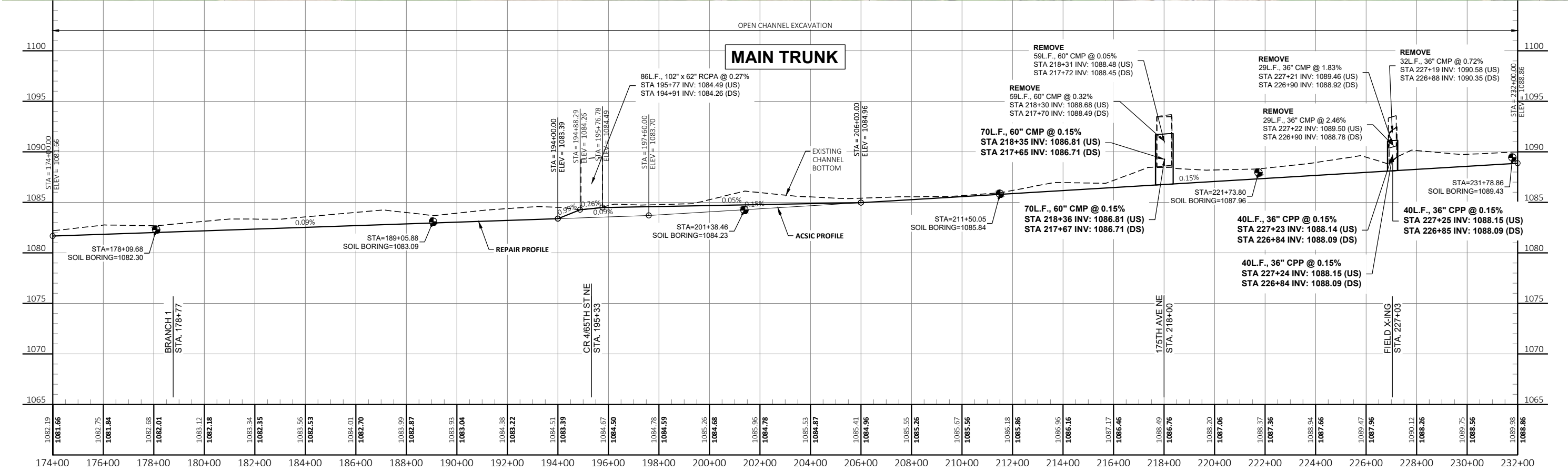
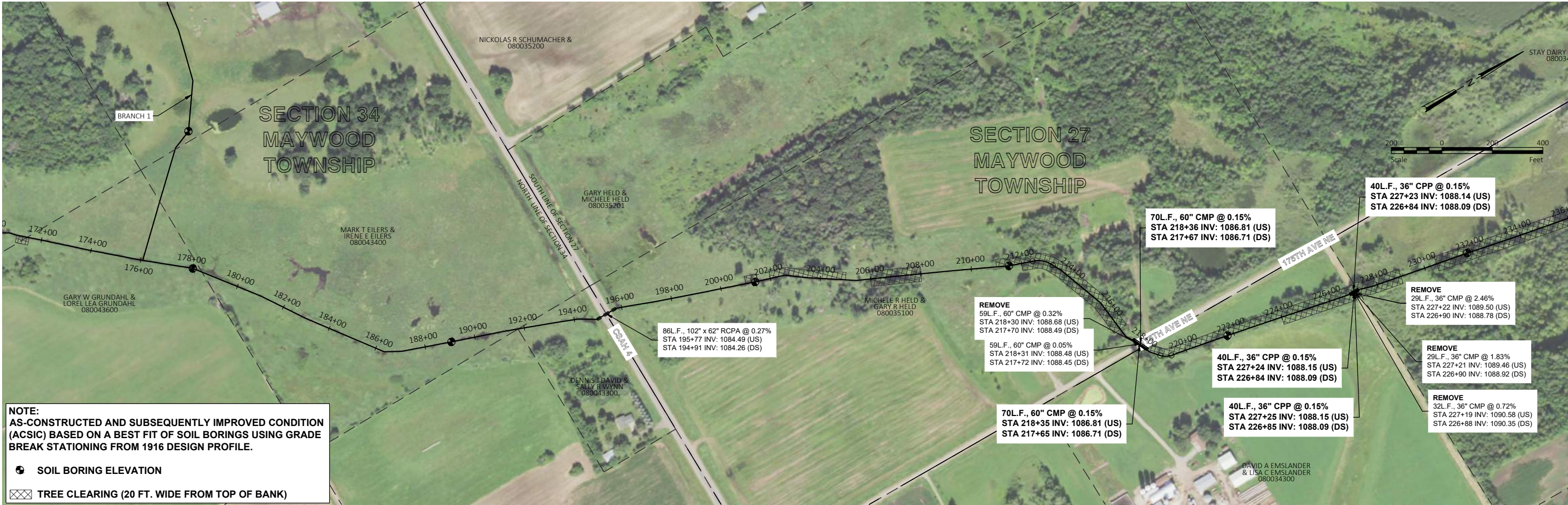
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PROJECT NO. 6183-0005

SHEET

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No.	Revision	Date	By

**PRELIMINARY**  
NOT FOR CONSTRUCTION



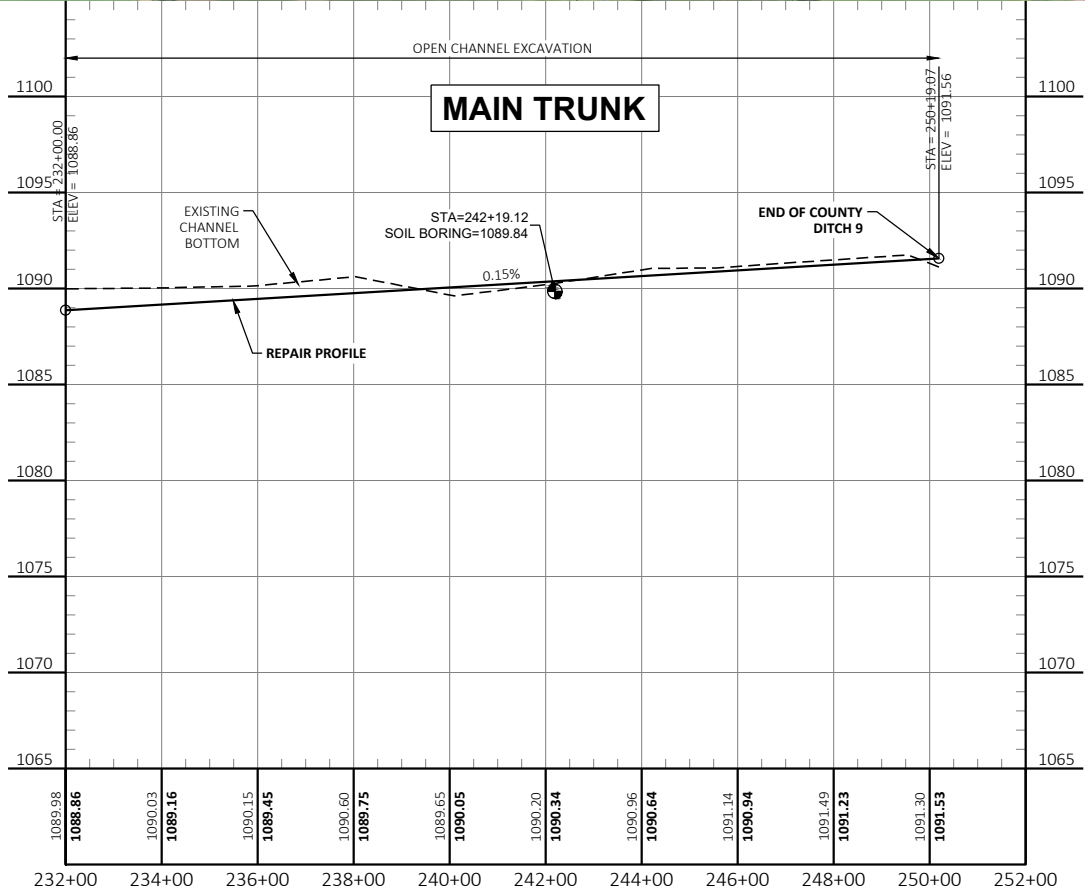
Drawn by KJL	Date 03-28-2023
Checked by GM	Scale AS SHOWN

BENTON COUNTY DITCH 9 REPAIR  
BENTON COUNTY, MN  
GLENDRADO & MAYWOOD TOWNSHIPS

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PROJECT NO. 6183-0005

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No.	Revision	Date	By

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NOT FOR CONSTRUCTION

Drawn by  
KJL

Checked by  
GM

Date  
03-28-2023

Scale  
AS SHOWN

BENTON COUNTY DITCH 9 REPAIR

BENTON COUNTY, MN

GLENDORADO & MAYWOOD TOWNSHIPS

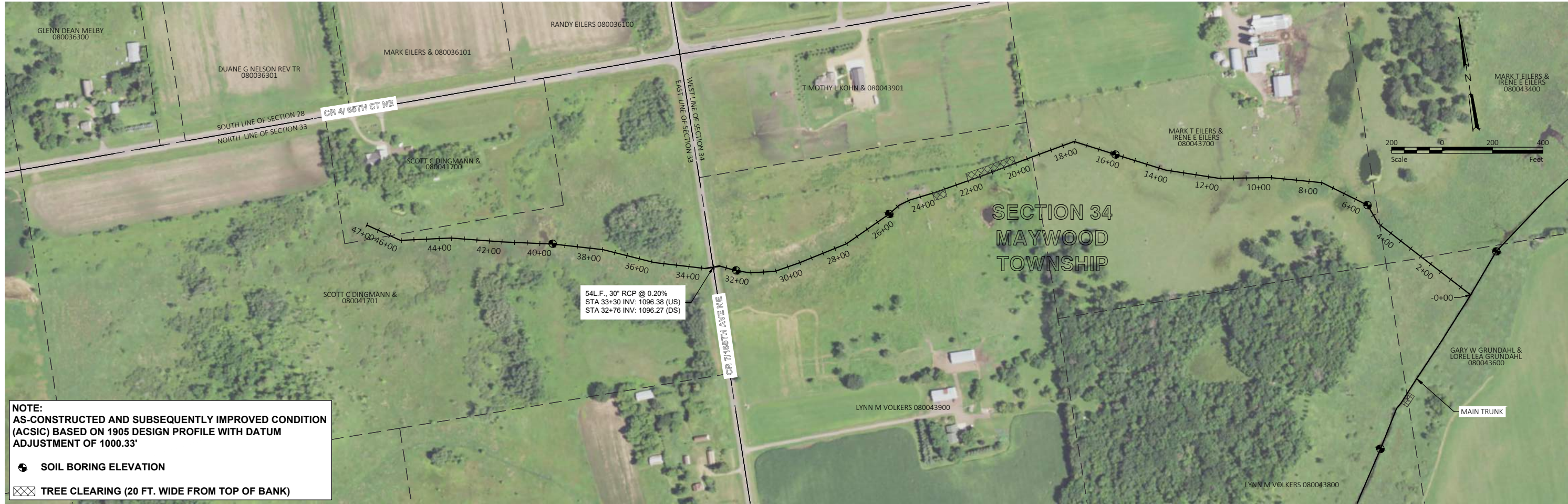
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PROJECT NO. 6183-0005

SHEET

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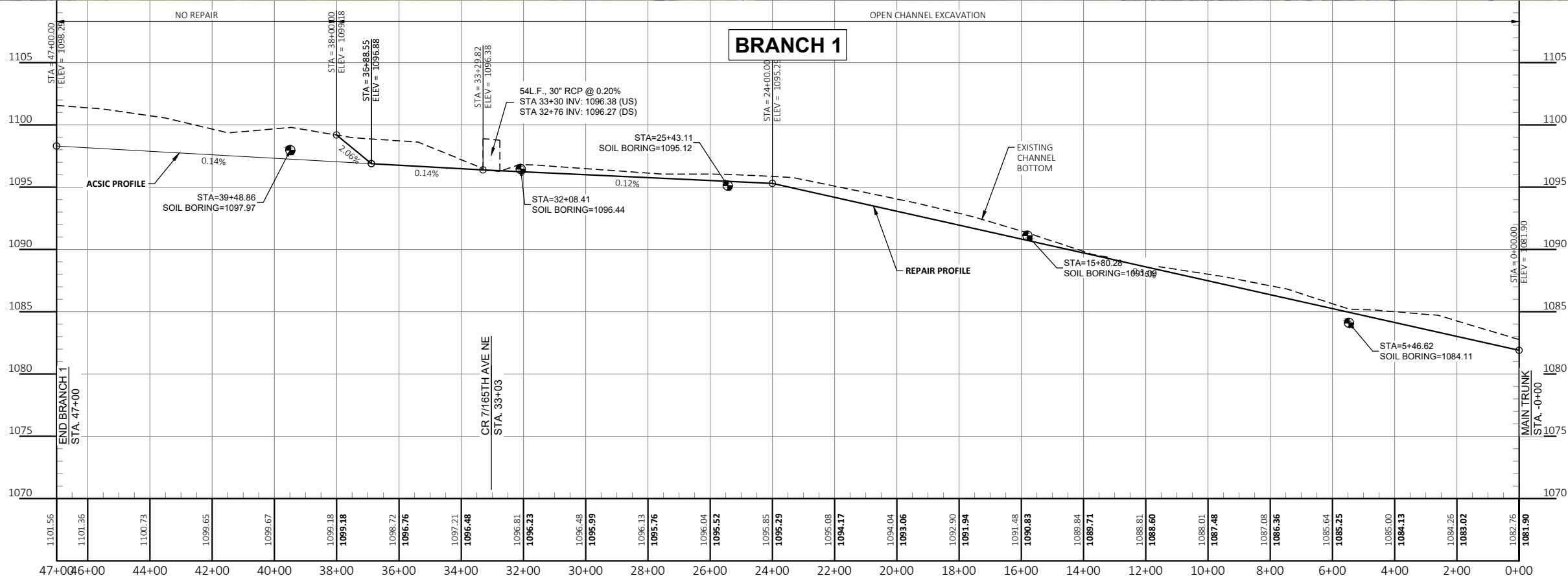




**NOTE:**  
AS-CONSTRUCTED AND SUBSEQUENTLY IMPROVED CONDITION (ACSIC) BASED ON 1905 DESIGN PROFILE WITH DATUM ADJUSTMENT OF 1000.33'

● SOIL BORING ELEVATION

▨ TREE CLEARING (20 FT. WIDE FROM TOP OF BANK)



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No.	Revision	Date	By

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Date  
03-28-2023

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AS SHOWN

BENTON COUNTY DITCH 9 REPAIR

BENTON COUNTY, MN

GLENDORADO & MAYWOOD TOWNSHIPS

BR1 0+00 - END

PROJECT NO. 6183-0005

SHEET

7

## ATTACHMENT C – PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST



Alternative 1 Preliminary Opinion of Probable Construction Cost					
Public Drainage System Infrastructure					
Item Number	Description	Units	Est'd Quantity	Unit Price	Extension
1	Mobilization	Lump Sum	1	\$20,000	\$20,000
2	Traffic Control	Lump Sum	1	\$10,000	\$10,000
3	Temporary and Permanent Removals	Lump Sum	1	\$2,000	\$2,000
4	Excavation of Open Channel (P)	Linear Foot	27119	\$5	\$135,595
5	Spoil Management (P)	Linear Foot	27119	\$2	\$54,238
6	Tree Clearing, Chipping, and Removal	Acre	5.7	\$15,000	\$85,500
7	Removal of Existing Culvert	Linear Foot	127.0	\$15	\$1,905
8	36" CP Pipe Culvert	Linear Foot	120.0	\$105	\$12,600
9	42" CP Pipe Culvert	Linear Foot	60.0	\$140	\$8,400
10	Gravel Roadway Patch	Each	2.0	\$5,000	\$10,000
11	SWPPP Documentation & Reporting	Lump Sum	1	\$2,500	\$2,500
12	Seeding and Mulch (P)	Acre	14.00	\$3,500	\$49,000
13	Silt Fence; Type PA	Linear Foot	100	\$5	\$500
14	Sediment Control Log	Linear Foot	100	\$4	\$400
				<b>Public Drainage Subtotal</b>	<b>\$392,638</b>
				20% Contingency	\$78,528
				Engineering	\$78,528
				Legal/Admin	\$13,728
				Wetland Mitigation	\$360,000
				<b>Public Drainage Total</b>	<b>\$923,422</b>
Public Road Crossings					
Item Number	Description	Units	Est'd Quantity	Unit Price	Extension
1	Removal and Disposal of Existing Culvert	Linear Foot	258	\$15	\$3,870
2	48" RC Pipe Culvert	Linear Foot	60	\$250	\$15,000
3	48" RC Apron	Each	2	\$2,000	\$4,000
4	102" span x 62" rise RC Pipe Culvert	Linear Foot	95	\$700	\$66,500
5	102" span RC Apron	Each	2	\$7,500	\$15,000
6	60" CM Pipe Culvert	Linear Foot	140	\$300	\$42,000
7	Bituminous Roadway Patch	Each	2	\$12,000	\$24,000
8	Gravel Roadway Patch	Each	1	\$5,000	\$5,000
9	Seeding and Mulch (P)	Acre	0.4	\$5,000	\$2,000
10	Erosion Control Blanket Cat. 3	Square Yard	500	\$4	\$2,000
				<b>Public Road Crossings Subtotal</b>	<b>\$179,370</b>
				20% Contingency	\$35,874
				Engineering	\$35,874
				Legal/Admin	\$6,272
				<b>Public Road Crossings Total</b>	<b>\$257,390</b>
				<b>TOTAL PROJECT COST</b>	<b>\$1,180,811</b>

**Alternative 2 Preliminary Opinion of Probable Construction Cost**

**Public Drainage System Infrastructure**

Item Number	Description	Units	Est'd Quantity	Unit Price	Extension
1	Mobilization	Lump Sum	1	\$20,000	\$20,000
2	Traffic Control	Lump Sum	1	\$10,000	\$10,000
3	Temporary and Permanent Removals	Lump Sum	1	\$2,000	\$2,000
4	Excavation of Open Channel (P)	Linear Foot	26219	\$5	\$131,095
5	Spoil Management (P)	Linear Foot	26219	\$2	\$52,438
6	Tree Clearing, Chipping, and Removal	Acre	5.7	\$15,000	\$85,500
7	Removal of Existing Culvert	Linear Foot	127.0	\$15	\$1,905
8	36" CP Pipe Culvert	Linear Foot	120.0	\$105	\$12,600
9	42" CP Pipe Culvert	Linear Foot	60.0	\$140	\$8,400
10	Gravel Roadway Patch	Each	2.0	\$5,000	\$10,000
11	SWPPP Documentation & Reporting	Lump Sum	1	\$2,500	\$2,500
12	Seeding and Mulch (P)	Acre	14.00	\$3,500	\$49,000
13	Silt Fence; Type PA	Linear Foot	100	\$5	\$500
14	Sediment Control Log	Linear Foot	100	\$4	\$400
<b>Public Drainage Subtotal</b>					<b>\$386,338</b>
				20% Contingency	\$77,268
				Engineering	\$77,268
				Legal/Admin	\$17,595
<b>Public Drainage Total</b>					<b>\$558,468</b>

**Public Road Crossings**

Item Number	Description	Units	Est'd Quantity	Unit Price	Extension
1	Removal of Existing Culvert	Linear Foot	120	\$15	\$1,800
2	60" CM Pipe Culvert	Linear Foot	140	\$300	\$42,000
3	Gravel Roadway Patch	Each	1	\$5,000	\$5,000
4	Seeding and Mulch (P)	Acre	0.4	\$5,000	\$2,000
5	Erosion Control Blanket Cat. 3	Square Yard	500	\$4	\$2,000
<b>Public Road Crossings Subtotal</b>					<b>\$52,800</b>
				20% Contingency	\$10,560
				Engineering	\$10,560
				Legal/Admin	\$2,405
<b>Public Road Crossings Total</b>					<b>\$76,325</b>
<b>TOTAL PROJECT COST</b>					<b>\$634,793</b>