Stearns County Ditch 25 Profile Evaluation

Stearns County, Minnesota
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PREPARED FOR:
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ENGINEER CERTIFICATION:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

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Signed: 

Date: 04-25-2017

Registration: MN No. 44578

CIVIL METHODS, INC.
PROFESSIONAL ENGINEERS
LAND | WATER | INFRASTRUCTURE

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1. INTRODUCTION

1.1 Project Overview

Stearns County Ditch 25 (CD25) is a public ditch located in Avon and St. Wendel Townships, Stearns County, Minnesota. It runs a length of approximately 3.1 miles, starting at the eastern end of Kepper Lake and terminating in a creek discharging to the North Fork Watab River. The ditch location and surrounding features are shown in Figure 1.

Based on available records, CD25 was originally constructed in 1905. Since that time, natural processes as well as maintenance operations and other activities that impact the ditch have taken place. As a result, the ditch profile (bottom elevations), cross sections, and other characteristics have changed to some extent.

As the Drainage Authority, Stearns County (County) has an interest in using available records and data to determine the original profile of CD25 where possible, and if this is not possible, to reestablish records defining the ditch characteristics. The goal of this investigation was to analyze available CD25 records and data in order to achieve this objective.

1.2 MN 103E.101 Statutory Compliance

It is expected that the CD25 Profile report may be used in support of reestablishment of the drainage system records, as described in MN Statutes Sect 103E.101A, Subd. 4a. Therefore, wherever applicable, the analysis and reporting have been done in a manner consistent with the statute.

2. INFORMATION SOURCES

2.1 Thorough Review of Records Completed

Stearns County has been the Drainage Authority for CD25 from the time of construction until the present, so all ditch construction, maintenance, and administration records are held with the County. Other entities with jurisdiction in this vicinity were contacted to check whether other pertinent information may be available.

In preparation for this study, County staff gathered and provided the drainage system records listed below. Also, the County recently completed a transfer of its archived ditch records into electronic format, providing an opportunity to search those records for any information relevant to CD25. Therefore, it can be stated with a high level of confidence that all available information has been considered.

2.2 Drainage System Records and Site Data Resources

A number of drainage system records were reviewed in detail and utilized in defining the ditch profile. In addition to drainage system records, other site data was used to put the records in

context and further strengthen the interpretation of the original ditch profile. Details regarding how the information was processed and incorporated into the proposed alignment and profile are provided in Sections 3.4 and 3.5.

- Original ditch records (profile and construction records); included in Appendix A
- Aerial photographs (current and historical)
- Survey data (with "hard-bottom", top of bank, and top of muck measurements)
- Current elevation data (LIDAR)
- Any available culvert/bridge design information
- Soil borings; notes in Appendix B, locations on Plan & Profile sheets (Appendix C)

3. CD25 INFORMATION ANALYSIS

A methodical approach was used to review, analyze, and incorporate the relevant information from each informational resource into an overall assessment of the ditch profile. The starting point for the analysis were the original ditch construction records. In this section, the information from the construction records and other sources is described in more detail, along with the specific approach used to integrate the available information, address discrepancies, and establish an appropriate ditch profile.

3.1 Current Ditch Alignment

An existing conditions plan and profile investigation was conducted in 2014. This investigation included what was designated the "hard bottom" of the ditch and identified the current alignment of the ditch in plan view. In general, it can be seen that for most of its length, the ditch in plan view reflects what is shown in the original ditch map accompanying the construction records. However, there are some discrepancies where the current ditch geometry has more bends or is positioned slightly differently than what is shown on the original map.

For purposes of establishing a profile, it is assumed that the current ditch is correctly situated in terms of its alignment. While it is possible that the ditch has been realigned or segments of it have shifted since the time of construction, absent any other specific information, the current alignment is the most reasonable layout to associate with an official profile moving forward. In any case, while excavation/maintenance activities may be performed to achieve a desired elevation profile, no modification of the ditch alignment is anticipated. Therefore, the alignment and stationing shown in the "existing conditions plan and profile" was assumed to be correct, providing context for processing the profile information.

3.2 Current Ditch Profile

The "hard bottom" survey of CD25 mentioned above was identified to demarcate the potential lower limit of the original excavation depth. In addition to the survey data, several hand-auger

borings were conducted along the centerline of the ditch, in order to verify the character of the subsurface and identify any relevant anomalies.

Figure 2 illustrates the hard-bottom profile relative to the "top of muck" survey, the profile from the original ditch records, and the recommended profile.

3.3 Original Ditch Records

The Original Ditch Records are included in Appendix A. The records consist of the "Map of County Ditch 25" as well as the "Engineer's Report in Ditch Proceedings," the latter of which contains detailed construction records. Stationing along the ditch is identified in each document, allowing the information from the to be correlated.

It is apparent from the original records that for most of its length, the ditch was constructed according to a set alignment and slope. However, at one point (original Station 127+91) the ditch excavation appears to have intersected with a pre-existing ditch, at a lower elevation than the ditch bottom at that point. According to the original records, the excavation continued at Station 138+00.

The use of the pre-existing ditch bottom as the bottom of CD25 for this segment appears to be a deviation from the original ditch design, but it does represent the original as-built conditions. Given the circumstances, the original Station 138+00 would not be located at the expected distance from Station 127+91. Instead, it is important to identify where the original excavation continued, at the downstream end of the segment utilizing the pre-existing ditch. Considering the location of property lines as well as the original and existing alignments, the segment utilizing the existing ditch bottom in this location ends at the (new) station 140+21.4. The next section provides a discussion of how the new stationing was developed.

3.4 Correlation between Original and Current Ditch Alignment

The original ditch map shows a number of points where the alignment of the ditch changes significantly. These points are also identified in the engineer's report, and they provide a way to correlate the original construction records to current conditions. It is understood that the measuring of distances and other dimensions in the field, particularly at the time of ditch construction, is subject to error. By identifying key points, or "anchor points" that are recognizable both in the field and on the original map, analysis of the profile can be done in a segmented fashion, distributing measurement error and better reflecting the conditions as constructed.

The basic procedure for projecting the original design information onto the actual alignment is as follows:

1. Identify "anchor points," or locations of alignment changes that are identifiable in both the original design and existing alignments. In the field, these locations represent how

the ditch was actually constructed, and it can be inferred that between any two of these clearly identifiable points, the original builders intended to follow the design parameters for that particular segment.

2. With the anchor points correlated, calculate both the actual constructed length and the original design length of each segment, and then calculate the length ratio (constructed/design) for each segment. This allows the original design stationing to be either stretched or shortened on a segment-by-segment basis, so that it lines up with the constructed stationing for comparison.

3. To compare elevation information, list the survey data with stations and elevations along the actual/constructed alignment. The "ditch bottom" or "bottom of sediment" elevations are taken to be the most reflective of the ditch profile. Interpolation between these known points is used to determine the existing ditch bottom elevation at any given point along the constructed alignment.

The following table summarizes the correlation between the original design alignment and the actual constructed alignment. Note that the starting point of the constructed ("new") alignment corresponds to Station 0+13.01 of the design ("old") alignment. Also, some of the alignment changes shown in the original ditch records are not included in the table, because the change was not pronounced enough to definitively identify it in the field.

Table 1. Correlation of Original and New Alignment Stationing

Segment	Old Start Station	Old End Station	Old Length	New Start Station	New End Station	New Length	Length Ratio (New/Old)
1	0+13.01	8+75	861.99	0	8+63.6	863.6	1.001868
2	8+75	46+53	3778	8+63.6	46+48.45	3784.85	1.001813
3	46+53	51+55	502	46+48.45	51+42.38	493.93	0.983924
4	51+55	59+40	785	51+42.38	59+18.3	775.92	0.988433
5	59+40	79+88	2048	59+18.3	79+88.55	2070.25	1.010864
6	79+88	91+96	1208	79+88.55	91+94.58	1206.03	0.998369
7	91+96	99+81.5	785.5	91+94.58	99+74.43	779.85	0.992807
8	99+81.5	104+22	440.5	99+74.43	104+00.24	425.81	0.966652
9	104+22	121+25	1703	104+00.24	120+97.4	1697.16	0.996571
10	121+25	138+00	1675	120+97.4	139+87.4	1890	1.128358
11	138+00	145+70	770	139+87.4	147+11.51	724.11	0.940403
12	145+70	155+00	930	147+11.51	155+62.87	851.36	0.915441
13	155+00	161+78	678	155+62.87	162+77.94	715.07	1.054676

3.5 Correlation between Original Design and Current Ditch Profile

3.5.1 *Ambiguity of Original Vertical Datum*

The key challenge of defining the original design profile is the fact that the elevations cited in the Engineer's Report and Original Plan and Profile are measured from an unknown, local datum. Therefore, while defining the alignment and the general shape/slopes of the design profile is relatively straightforward, determining the proper vertical placement of the profile requires weighing multiple factors and applying engineering judgement.

3.5.2 *Role of the Original Design Profile*

The original design, as reflected in Exhibit 2 of the 1905 Engineer's Report (see Appendix A), is the best information available regarding the intended ditch construction. However, there would be a variety of potential circumstances in which field conditions would result in the actual construction varying from the design. It is important to understand that the builders would be guided primarily by the design, but would also make practical adjustments in the field, provided that any modifications do not fundamentally alter the functionality of the ditch.

The possibility of the builders deviating logically from the original design profile is most relevant in the segment described above, between original design (old) Stations 127+91 and (old) 138+00. At Station (old) 127+91, the original design profile is set aside, and the bottom of the pre-existing ditch is essentially considered to be the bottom of the new ditch. Based on the original plan and profile, this elevation sits over 4 feet below the original design profile. At the time of construction, it is very likely that rather than have an abrupt 4-foot drop in profile elevation, the segment upstream of (old) Station 127+91 was excavated for a gradual transition to the pre-existing ditch bottom. Whether it was originally excavated as a gradual transition, or whether it equilibrated that way over time, the end result is that the current ditch bottom does not express an abrupt change in elevation immediately upstream of (old) 127+91. It is unlikely that the as-built profile in that location was ever actually at a substantially higher elevation (relative to the pre-existing ditch bottom) for any extended period of time.

3.5.3 *Comparing with Survey Data*

To compare elevation information, list the survey data with stations and elevations along the actual/constructed alignment. The "ditch bottom" or "bottom of sediment" elevations are taken to be the most reflective of the ditch profile. Interpolation between these known points is used to determine the existing ditch bottom elevation at any given point along the constructed alignment.

3.5.4 *Structures*

From the point of beginning to the terminus of CD25, there are 4 crossing structures installed along the waterway. There is one field bridge approximately at Station 103+30, the Lake Wobegon Trail bridge crossing at Station 161+16, a culvert under Meadowview Road at approximately Station 17+90, and another under Norway Road at 149+81. With their fixed bottom inverts, the structure crossings have the potential to affect the control elevation of the ditch, and should be considered in establishing the official profile.

3.5.5 *Downstream Control Elevation*

As described above, at its downstream end, CD25 terminates in an existing creek that discharges to the downstream waterway. Practically speaking, the elevation of the existing creek at the point of terminus is a limiting elevation for the ditch bottom. Under normal circumstances the creek downstream of the terminus would not be excavated lower than its current or natural elevation. It follows that at that location, there would be essentially no benefit to excavating the ditch bottom below the creek elevation. Therefore, it is logical to stipulate that the profile at that location is at an elevation no lower than the surveyed "hard bottom" elevation.

3.5.6 *Upstream Control Elevation*

The beginning point of the ditch is the outlet elevation of Kepper Lake. It should be noted that at the time of original ditch construction, less emphasis was placed on the potential ecological issues associated with draining wetlands or impacting the outlet elevation of a lake. The original plan and profile shows the point of beginning of the ditch at an elevation 4 feet below the water level at that time. However, as indicated previously, there is no clear indication of what elevation that corresponds using a modern datum.

The survey data at this location (lake outlet) indicate a ditch bottom elevation of 1118.98 and a top of sediment elevation of 1120.41. Also, the Engineer's Report indicates a slope of 0.2% for the design profile.

3.5.7 *Synthesis of Information and Resolution of Discrepancies*

The various factors above were weighed and discrepancies resolved in the following manner in order to determine the most appropriate profile elevations:

1. The highest invert of the culvert under Meadowview Road was set at the bottom of the profile (Station 17+76, Elevation 1116.3). This was the most reasonable approach for several reasons. First, nothing indicates that the culvert was not originally set at the design profile elevation. Secondly, if the design profile slope is applied to the profile upstream of this location, and the culvert is set at the current invert elevation, this will produce a discharge elevation at Kepper Lake that closely reflects the surveyed

discharge elevation. Again, having no other specific lake outlet elevation from the time of construction, the best available information is the ditch bottom survey. Therefore, setting the profile at these elevations is both supported by the available data and allows the preservation of the existing lake outlet and culvert elevations.

2. For the segment starting immediately downstream of the Meadowview Road Culvert (Station 18+00, Elevation 1116.3) and continuing to a high point marking a break in slope (Station 67+00, Elevation 1111), the original design profile slopes were used, with elevations relative to the inverts of the culvert under Meadowview Road.

3. For the next segment (Station 67+00 to Station 142+70), the original design profile was ignored in favor of a slope more resembling the existing ditch. The reasoning behind this is explained in Section 3.5.2. Essentially, a gradual slope along the entire segment is a much more likely description of the original construction (as opposed to a flatter slope followed by a steep drop, as the original design profile would suggest), in addition to being consistent with existing conditions and in general a more stable profile.

4. For the segment running from Station 142+70, at elevation 1095.4, to the terminus at 163+12, the original design profile slope is again used, with the downstream end tied in to the bottom elevation of the creek (1093.3) where the ditch ultimately discharges. The current culvert inverts under Norway Road conform to within 1 inch of this profile.

3.6 Recommended Profile

3.6.1 *Summary of Alignment and Profile*

The alignment of the recommended profile follows the existing alignment of the ditch, as reflected in the survey. It runs from Station 0+00 to Station 163+12. The recommended official profile is detailed in the following table:

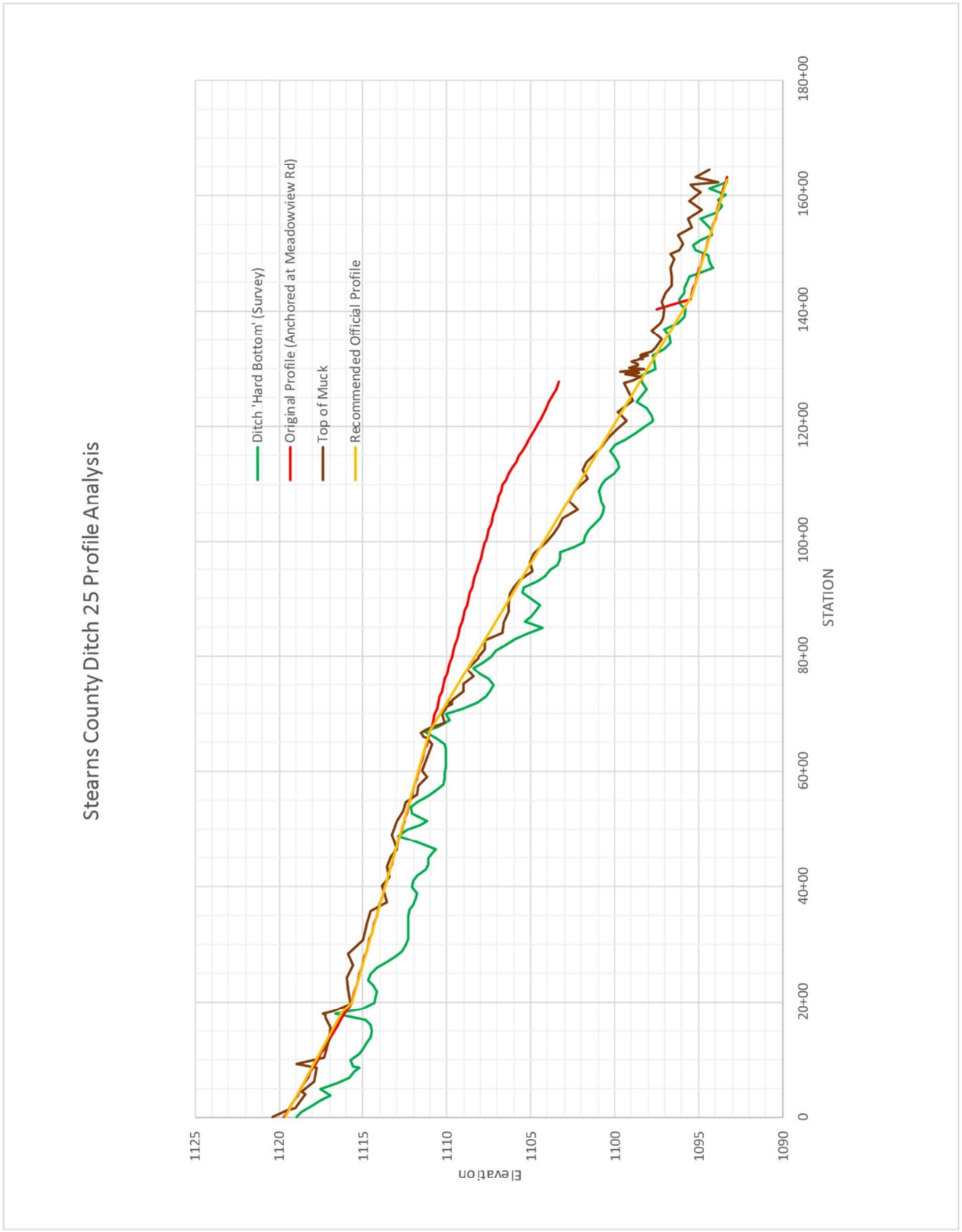
Table 2. Recommended Profile

Station	Elevation
0+00	1119.6
17+76	1116.3
18+00	1116.3
20+00	1115.7
67+00	1111
142+70	1095.4
162+78	1093.3

3.6.2 *Comparison of Recommended and Current Profiles*

A graph showing the current ditch bottom (survey), top of sediment (survey), adjusted original design profile, and recommended official profile is provided on the following page.

Figure 2. Comparison of Analyzed Profiles



3.7 Key Outcomes

3.7.1 *Implications of Profile for Ditch Maintenance*

As described above, the surveyed inverts of the Meadowview Road Culvert (among other data points) were used to set the elevations of the recommended profile. Currently, the runout elevation of the lake (according to the same survey) is approximately 4' higher in elevation than the culvert inverts. This indicates that water levels in the lake are being controlled at the ditch inlet, and not by the Meadowview Road culvert.

Downstream of the culvert, the recommended profile follows the original design profile slope, which places the recommended profile just below the current top-of-muck elevations over most of the next ~3000 ft. However, as can be seen in the profile chart, cleaning the ditch down to the recommended profile anywhere east of the Meadowview Road culvert would not change the controlling runout elevation of the lake, and in fact would not impact anything west of Meadowview Road. Even if potential long-term effects of ditch maintenance east of Meadowview Road are considered, the presence of the roadway and culvert at that location would prevent any potential erosive action (head cutting) from lowering the ditch bottom elevations at the lake outlet.

In summary, based on the site survey data and the preceding analysis, if the culvert elevations remain as they are, performing ditch maintenance east of Meadowview Road to a degree consistent with the recommended profile would not impact the runout elevation or normal water levels in Kepper Lake. Therefore, performing such maintenance would not necessitate the placement of an outlet control structure at the Lake outlet.

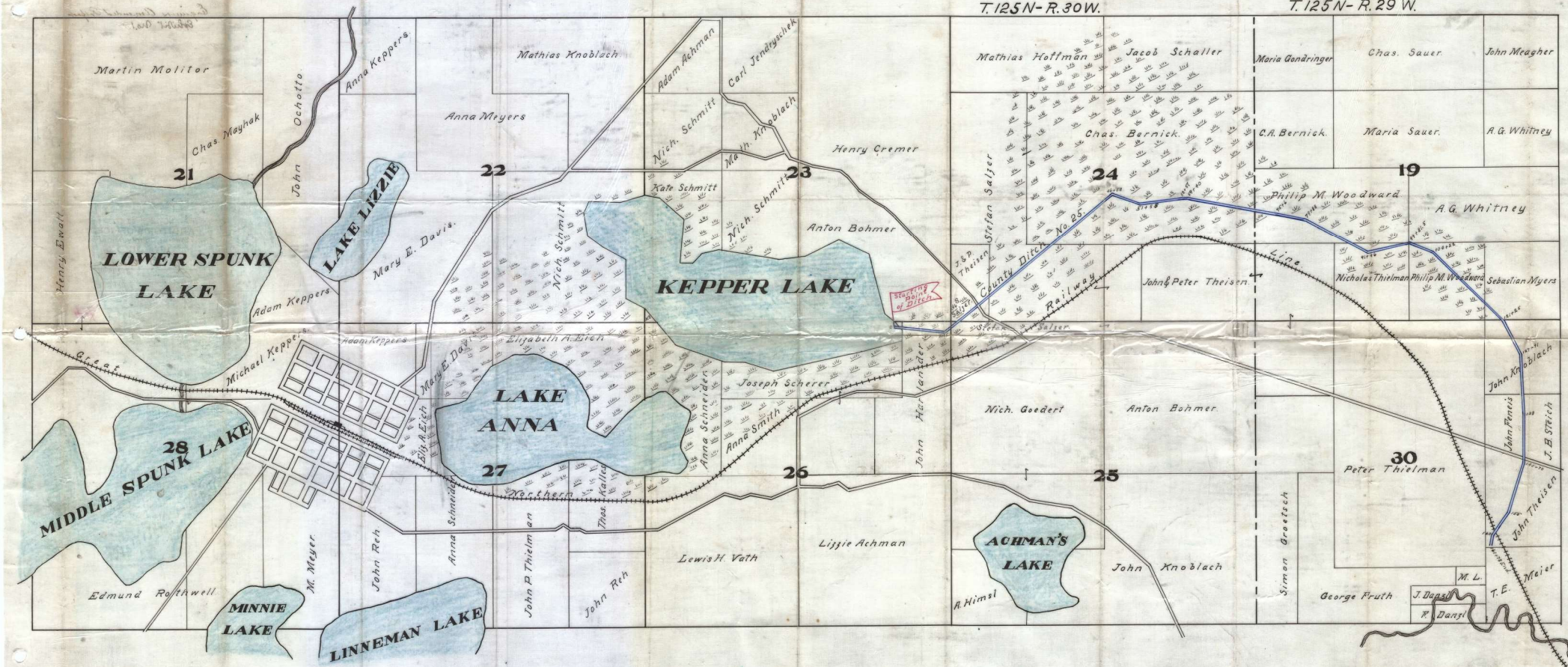
Appendix A – Original Ditch Records

MAP OF
COUNTY DITCH NO. 25

STEARNS CO., MINN.

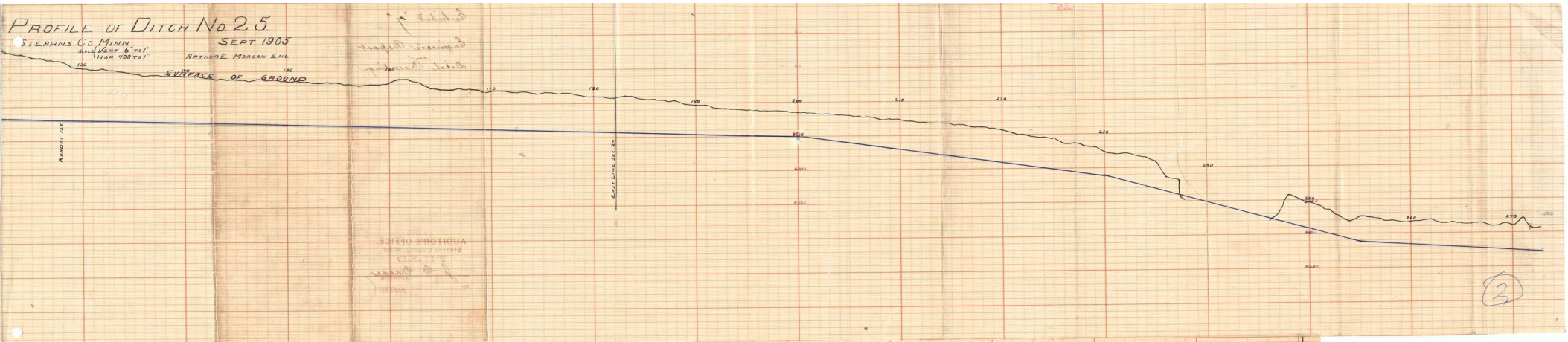
Nov. 1905. Arthur E. Morgan, C.E.

Scale: 1 in. = 12 Chains.

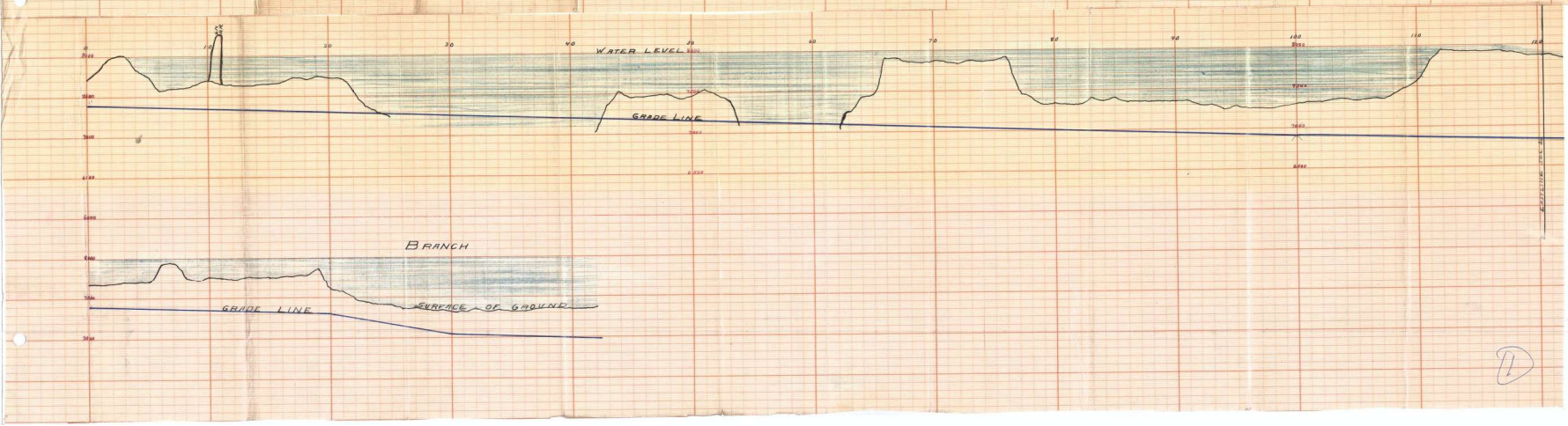


PROFILE OF DITCH No. 25.

STEARNS CO. MINN.
SCALE VERT. 6 TO 1"
HOR. 400 TO 1"
SEPT. 1905
ARTHUR E. MORGAN, ENG.



(2)

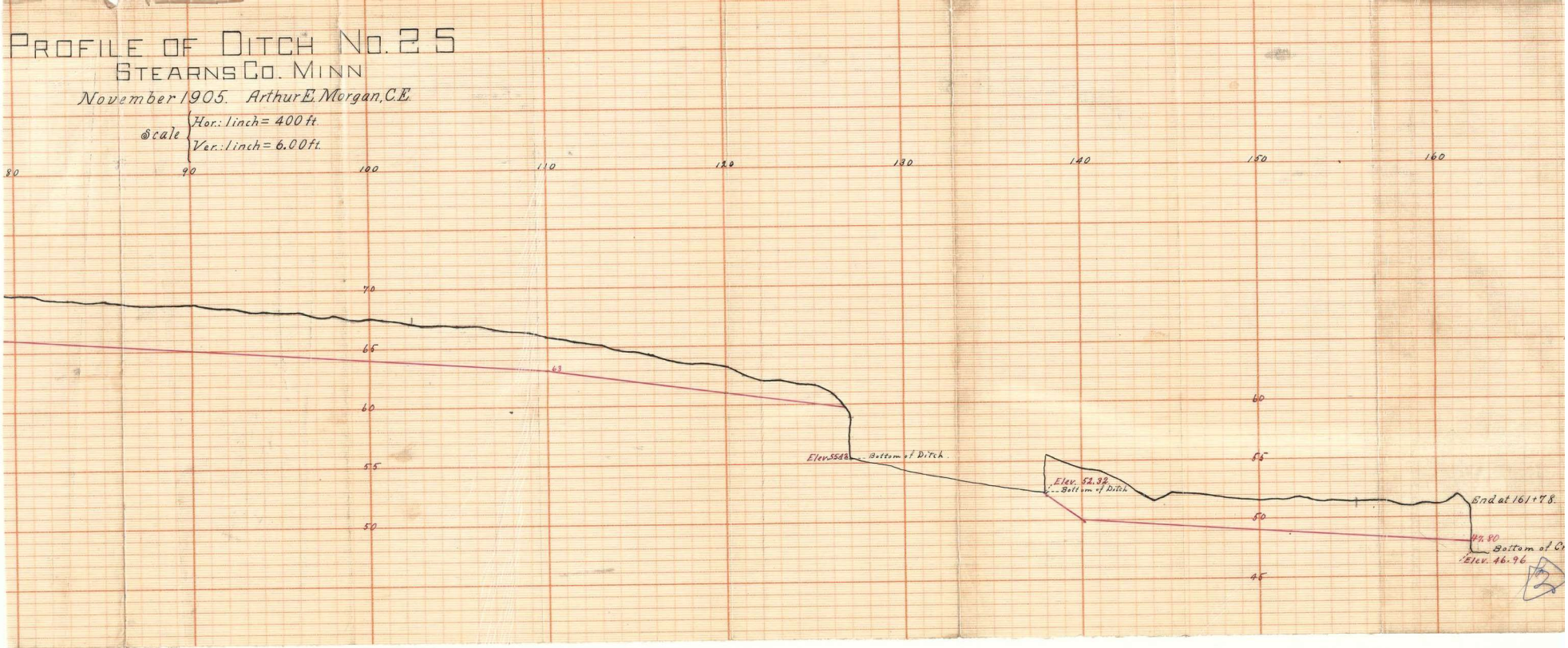


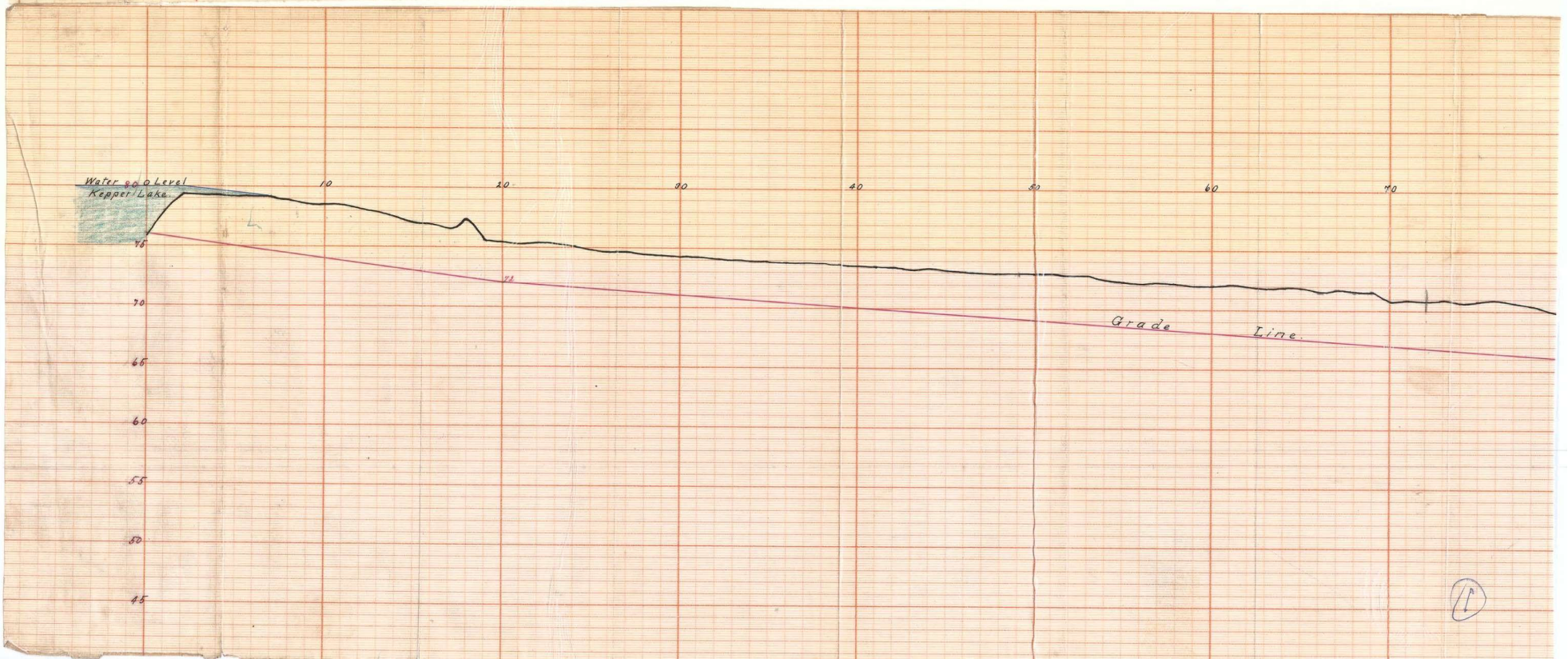
(1)

Profile of Ditch No. 25
Stearns Co. Minn

November 1905. Arthur E. Morgan, C.E.

Scale { Hor.: 1 inch = 400 ft.
Ver.: 1 inch = 6.00 ft.





29

Amended

EXHIBIT 2

ENGINEER'S REPORT

—IN—

DITCH PROCEEDINGS

NOV 27 1905
AUDITOR'S OFFICE,
Stearns County, Minn.
FILED
J. C. Cuney
AUDITOR.
By _____ DEPUTY.

EXHIBIT 2 OF ENGINEER'S REPORT IN DITCH PROCEEDINGS.

Showing Estimated Depth of Cut, Width, No. of Cubic Yards Removed and Cost of Same, in Ditch No. 25 Stearns

Main

Journal-Press Co., Printers and Binders St. Cloud—9293

REMARKS	Station	Elevation of Surface FEET	Elevation of Surface 100ths	Elevation of Bottom FEET	Elevation of Bottom 100ths	Cut FEET	Cut 100ths	Width at Top FEET	Width at Top 100ths	Width at Bottom FEET	Width at Bottom 100ths	Area of Cross Section FEET	Area of Cross Section 100ths	Cubic Yards in Section Preceding YARDS	Cubic Yards in Section Preceding 100ths	Estimated Cost per Cubic Yard Dollars	Estimated Cost per Cubic Yard Cents	Total Estimated Cost of Section Preceding Dollars	Total Estimated Cost of Section Preceding Cents	Record of Bench Marks
	0	75	80	76	00															
	1	78	00	75	80	2	20	6	20	4	00	11	20	20	70		12½	2	59	P.B.M. Nail in base of 12" Elm 200 ft. N'ly of Sta. No. 5, - near large boulder, Elev. 81.00
	2	79	41	75	60	3	80	7	80		"	22	40	62	20		"	7	78	
	3	79	34	75	40	3	90	7	90		"	23	20	84	40		"	10	55	
	4	79	27	75	20	4	10	8	10		"	24	80	88	90		"	11	11	
	5	79	22	75	00	4	20	8	20		"	25	60	93	30		"	11	66	
	6	79	20	74	80	4	40	8	40		"	27	30	97	90		"	12	24	
	7	79	15	74	60	4	60	8	60		"	29	00	104	30		"	13	04	
A.C. at 8+75	8	78	92	74	40	4	50	8	50		"	28	10	105	80		"	13	22	
	9	78	58	74	20	4	40	8	40		"	27	30	102	60		"	12	83	
	10	78	63	74	00	4	60	8	60		"	29	00	104	90		"	13	04	
	11	78	54	73	80	4	70	8	70		"	29	80	108	70		"	13	61	
	12	78	22	73	60	4	60	8	60		"	29	00	108	90		"	13	61	
	13	77	86	73	40	4	50	8	50		"	28	10	105	70		"	13	21	
	14	77	54	73	28	4	30	8	30		"	26	40	100	90		"	12	61	
	15	77	14	73	00	4	10	8	10		"	24	80	94	80		"	11	85	
	16	76	94	72	80	4	10	8	10		"	24	80	91	80		"	11	47	
	17	76	56	72	60	4	00	8	00		"	24	00	90	40		"	11	30	
Sta. 18 in middle of road. Stake set at 18+7.	18	77	40	72	40	5	00	9	00		"	32	50	104	60		"	13	08	
	19	75	62	72	20	3	40	7	40		"	19	40	96	10		"	12	01	
	20	75	54	72	00	3	50	7	50		"	20	10	73	10		"	9	14	
														1839	80			229	95	

EXHIBIT 2 OF ENGINEER'S REPORT IN DITCH PROCEEDINGS.

Showing Estimated Depth of Cut, Width, No. of Cubic Yards Removed and Cost of Same, in Ditch No. 25 Stearns Main.

Journal-Press Co., Printers and Binders St. Cloud—9293

Station	Elevation of Surface		Elevation of Bottom		Cut		Width at Top		Width at Bottom		Area of Cross Section		Cubic Yards in Section Preceding		Estimated Cost per Cubic Yard		Total Estimated Cost of Section Preceding		Record of Bench Marks	REMARKS
	FEET	100ths	FEET	100ths	FEET	100ths	FEET	100ths	FEET	100ths	FEET	100ths	YARDS	100ths	Dollars	Cents	Dollars	Cents		
21	75	29	71	90	3	40	7	40	4	00	19	40	73	10		12½	9	14		
22	75	42	71	80	3	60	7	60		"	20	90	74	60		"	9	32		
23	75	~~15~~ 33	71	70	3	60	7	60		"	20	90	77	40		"	9	68		
24	75	11	71	60	3	50	7	50		"	20	10	75	90		"	9	49		
25	74	83	71	50	3	30	7	30		"	18	60	71	70		"	8	96		
26	74	68	71	40	3	30	7	30		"	18	60	68	90		"	8	61		
27	74	66	71	30	3	40	7	40		"	19	40	76	46		"	8	80		
28	74	51	71	20	3	30	7	30		"	18	60	70	40		"	8	80		
29	74	41	71	10	3	30	7	30		"	18	60	68	90		"	8	61		
30	74	34	71	00	3	30	7	30		"	18	60	68	90		"	8	61		
31	74	28	70	90	3	40	7	40		"	19	40	70	40		"	8	80		
32	74	09	70	80	3	30	7	30		"	18	60	70	40		"	8	80		
33	74	01	70	70	3	30	7	30		"	18	60	68	90		"	8	61		
34	73	86	70	60	3	30	7	30		"	18	60	68	90		"	8	61		
35	73	91	70	50	3	40	7	40		"	19	40	70	40		"	8	80		
36	73	82	70	40	3	40	7	40		"	19	40	71	90		"	8	99		
37	73	80	70	30	3	50	7	50		"	20	10	73	10		"	9	14		
38	73	75	70	20	3	60	7	60		"	20	90	75	90		"	9	49		
39	73	68	70	10	3	60	7	60		"	20	90	77	40		"	9	67		
40	73	57	70	00	3	60	7	60		"	20	90	77	40		"	9	68		
													1444	90			180	61		

P. 13. M. 75.90. Mail in base of tamarac
50 ft. S. of Sta. No. 22. Mail in base of tamarac 40' N. & W. of Sta. 36
P. 13 M. El. 74.65 Mail in base of tamarac 40' N. & W. of Sta. 36

EXHIBIT 2 OF ENGINEER'S REPORT IN DITCH PROCEEDINGS.

Showing Estimated Depth of Cut, Width, No. of Cubic Yards Removed and Cost of Same, in Ditch No. 25 Stearns Co Main.

Journal-Press Co., Printers and Binders, St. Cloud—9293

REMARKS	Station	Elevation of Surface FEET	Elevation of Surface 100ths	Elevation of Bottom FEET	Elevation of Bottom 100ths	Cut FEET	Cut 100ths	Width at Top FEET	Width at Top 100ths	Width at Bottom FEET	Width at Bottom 100ths	Area of Cross Section FEET	Area of Cross Section 100ths	Cubic Yards in Section Preceding YARDS	Cubic Yards in Section Preceding 100ths	Estimated Cost per Cubic Yard Dollars	Estimated Cost per Cubic Yard Cents	Total Estimated Cost of Section Preceding Dollars	Total Estimated Cost of Section Preceding Cents	Record of Bench Marks
	41	73	58	69	90	3	70	7	70	4	00	21	60	78	70		12½	9	84	
	42	73	54	69	80	3	70	7	70		"	21	60	80	00		"	10	00	
	43	73	27	69	70	3	60	7	60		"	20	90	78	70		"	9	84	
	44	73	37	69	60	3	80	7	80		"	22	40	80	20		"	10	03	
	45	73	24	69	50	3	70	7	70		"	21	60	81	50		"	10	19	
A.C. at 46+53	46	73	10	69	40	3	70	7	70		"	21	60	80	00		"	10	00	
	47	73	00	69	30	3	70	7	70		"	21	60	80	00		"	10	00	
	48	72	94	69	20	3	70	7	70		"	21	60	80	00		"	10	00	
	49	72	96	69	10	3	90	7	90		"	23	20	83	00		"	10	37	
	50	72	85	69	00	3	90	7	90		"	23	20	85	90		"	10	74	
A.C. at 51+55	51	72	96	68	90	4	10	8	10		"	24	80	88	90		"	11	11	
G.S. 1 ft. South.	52	72	76	68	80	4	00	8	00		"	24	00	90	40		"	11	30	
	53	72	82	68	70	4	10	8	10		"	24	80	90	80		"	11	30	
	54	72	48	68	60	3	90	7	90		"	23	20	88	90		"	11	11	
	55	72	29	68	50	3	80	7	80		"	22	40	84	80		"	10	55	
	56	72	16	68	40	3	80	7	80		"	22	40	83	00		"	10	37	
	57	72	22	68	30	3	90	7	90		"	23	20	84	40		"	10	55	
A.C. at 58+57	58	72	24	68	20	4	00	8	00		"	24	00	87	40		"	10	92	
A.C. at 59+40.	59	71	97	68	10	3	90	7	90		"	23	20	87	40		"	10	92	
	60	71	97	68	00	4	00	8	00		"	24	00	87	40		"	10	93	
														1680	60			21	07	

EXHIBIT 2 OF ENGINEER'S REPORT IN DITCH PROCEEDINGS.

Showing Estimated Depth of Cut, Width, No. of Cubic Yards Removed and Cost of Same, in Ditch No. 25 Stearns Co

Main

Journal-Press Co., Printers and Binders St. Cloud—9293

REMARKS	Station	Elevation of Surface FEET	Elevation of Surface 100ths	Elevation of Bottom FEET	Elevation of Bottom 100ths	Cut FEET	Cut 100ths	Width at Top FEET	Width at Top 100ths	Width at Bottom FEET	Width at Bottom 100ths	Area of Cross Section FEET	Area of Cross Section 100ths	Cubic Yards in Section Preceding YARDS	Cubic Yards in Section Preceding 100ths	Estimated Cost per Cubic Yard Dollars	Estimated Cost per Cubic Yard Cents	Total Estimated Cost of Section Preceding Dollars	Total Estimated Cost of Section Preceding Cents	Record of Bench Marks
	61	72	12	67	90	4	20	8	20	4	00	25	60	91	80		12½	11	47	P. B. M. El. 72.99. Mail in base of 8" tamarac 200 feet S. of Sta. No. 62.
	62	71	97	67	80	4	20	8	20		"	25	60	94	80		"	11	85	
	63	71	84	67	70	4	10	8	10		"	24	80	93	30		"	11	66	
	64	71	86	67	60	4	30	8	30		"	26	40	94	80		"	11	85	
	65	71	81	67	50	4	30	8	30		"	26	40	97	80		"	12	23	
	66	71	51	67	40	4	10	8	10		"	24	80	94	80		"	11	85	
	67	71	78	67	20	4	50	8	50		"	28	10	98	00		"	12	25	
	68	71	60	67	20	4	40	8	40		"	27	30	102	60		"	12	82	
	69	71	55	67	10	4	50	8	50		"	28	10	102	60		"	12	83	
	70	70	78	67	00	3	80	7	80		"	22	40	93	50		"	11	69	
	71	70	85	66	90	4	00	8	00		"	24	00	85	90		"	10	74	
	72	70	82	66	80	4	00	8	00		"	24	00	88	90		"	11	11	
	73	70	92	66	70	4	20	8	20		"	25	60	91	80		"	11	48	
	74	70	63	66	60	4	00	8	00		"	24	00	91	80		"	11	48	
A. B. at 75+6	75	70	75	66	50	4	30	8	30		"	26	40	98	30		"	11	66	
	76	70	86	66	40	4	50	8	50		"	28	10	100	90		"	12	61	
	77	70	66	66	30	4	40	8	40		"	27	30	102	60		"	12	82	
	78	70	43	66	20	4	20	8	20		"	25	60	98	00		"	12	25	
A. C. at 79+88	79	70	03	66	10	3	90	7	90		"	23	20	90	40		"	11	30	
	80	69	78	66	00	3	80	7	80		"	22	40	84	40		"	10	55	
														1892	00			236	50	

EXHIBIT 2 OF ENGINEER'S REPORT IN DITCH PROCEEDINGS.

Showing Estimated Depth of Cut, Width, No. of Cubic Yards Removed and Cost of Same, in Ditch No. 25 Stearns Co Main.

Journal-Press Co., Printers and Binders St. Cloud—9293

REMARKS	Station	Elevation of Surface FEET	Elevation of Surface 100ths	Elevation of Bottom FEET	Elevation of Bottom 100ths	Cut FEET	Cut 100ths	Width at Top FEET	Width at Top 100ths	Width at Bottom FEET	Width at Bottom 100ths	Area of Cross Section FEET	Area of Cross Section 100ths	Cubic Yards in Section Preceding YARDS	Cubic Yards in Section Preceding 100ths	Estimated Cost per Cubic Yard Dollars	Estimated Cost per Cubic Yard Cents	Total Estimated Cost of Section Preceding Dollars	Total Estimated Cost of Section Preceding Cents	Record of Bench Marks
	81	69	75	65	90	3	90	7	90	4	00	23	20	84	40		12½	10	55	
	82	69	43	65	80	3	60	7	60		"	20	90	81	70		"	10	21	
	83	69	38	65	70	3	70	7	70		"	21	60	78	70		"	9	84	
	84	69	20	65	60	3	60	7	60		"	20	90	78	70		"	9	84	
	85	69	33	65	50	3	80	7	80		"	22	40	80	20		"	10	02	
	86	69	10	65	40	3	70	7	70		"	21	60	81	50		"	10	19	
	87	68	86	65	30	3	60	7	60		"	20	90	78	70		"	9	84	
	88	68	89	65	20	3	70	7	70		"	21	60	78	70		"	9	84	
	89	68	94	65	10	3	80	7	80		"	22	40	81	50		"	10	19	
	90	68	89	65	00	3	90	7	90		"	23	20	84	40		"	10	55	
A.C. at 91 + 96	91	68	69	64	90	3	80	7	80		"	22	40	84	40		"	10	55	
	92	68	55	64	80	3	80	7	80		"	22	40	83	00		"	10	37	
	93	68	33	64	70	3	60	7	60		"	20	90	80	20		"	10	02	
	94	68	33	64	60	3	70	7	70		"	21	60	78	70		"	9	84	
	95	68	14	64	50	3	60	7	60		"	20	90	78	70		"	9	84	
	96	68	19	64	40	3	80	7	80		"	22	40	80	20		"	10	02	
	97	67	77	64	30	3	50	7	50		"	20	10	78	70		"	9	84	
	98	67	85	64	20	3	70	7	70		"	21	60	76	80		"	9	60	
A.C. at 99 + 81.5	99	67	49	64	10	3	40	7	40		"	19	40	75	90		"	9	49	
	100	67	56	64	00	3	60	7	60		"	20	90	74	60		"	9	82	
														1599	70			199	96	

EXHIBIT 2 OF ENGINEER'S REPORT IN DITCH PROCEEDINGS.

Showing Estimated Depth of Cut, Width, No. of Cubic Yards Removed and Cost of Same, in Ditch No. 25 Stearns Co

Main

Journal-Press Co., Printers and Binders St. Cloud—9293

REMARKS	Station	Elevation of Surface		Elevation of Bottom		Cut		Width at Top		Width at Bottom		Area of Cross Section		Cubic Yards in Section Preceding		Estimated Cost per Cubic Yard		Total Estimated Cost of Section Preceding		Record of Bench Marks
		FEET	100ths	FEET	100ths	FEET	100ths	FEET	100ths	FEET	100ths	FEET	100ths	YARDS	100ths	Dollars	Cents	Dollars	Cents	
	101	67	40	63	90	3	50	7	50	4	00	20	10	75	90		12½	9	49	
	102	67	07	63	80	3	30	7	30		"	18	60	71	70		"	8	96	
	103	66	82	63	70	3	10	7	10		"	17	20	66	30		"	8	29	
A.C. at 104+22	104	66	87	63	60	3	30	7	30		"	18	60	66	30		"	8	29	
At 104 G.S. 2 Ft. N'ly. Line Stake in Ditch	105	66	77	63	50	3	30	7	30		"	18	60	68	90		"	8	61	
	106	66	82	63	40	3	40	7	40		"	19	40	70	40		"	8	80	
	107	66	52	63	30	3	20	7	20		"	17	90	69	10		"	8	64	
	108	66	42	63	20	3	20	7	20		"	17	90	66	30		"	8	29	
	109	66	27	63	10	3	20	7	20		"	17	90	66	30		"	8	29	
	110	65	80	63	00	2	80	6	80		"	15	10	61	10		"	7	64	
	111	65	67	62	80	2	90	6	90		"	15	80	57	20		"	7	15	
	112	65	85	62	60	2	80	6	80		"	15	10	57	20		"	7	15	
	113	65	22	62	40	2	80	6	80		"	15	10	55	90		"	6	99	
	114	64	75	62	20	2	60	6	60		"	13	80	53	50		"	6	69	
	115	64	57	62	00	2	60	6	60		"	13	80	51	10		"	6	39	
	116	64	17	61	80	2	40	6	40		"	12	50	48	70		"	6	09	
	117	63	82	61	60	2	20	6	20		"	11	20	43	90		"	5	49	
	118	63	55	61	40	2	20	6	20		"	11	20	41	50		"	5	19	
	119	63	45	61	20	2	30	6	30		"	11	80	42	60		"	5	32	
	120	63	25	61	00	2	30	6	30		"	11	80	43	70		"	5	46	
														1177	60			147	22	

P.I. 77. Elev. 67.22. Nail in base of 4" tamarac 300 ft. S. of Sta. No. 107.

EXHIBIT 2 OF ENGINEER'S REPORT IN DITCH PROCEEDINGS.

Showing Estimated Depth of Cut, Width, No. of Cubic Yards Removed and Cost of Same, in Ditch No. 25 Stearns Co Main.

ournal-Press Co., Printers and Binders St. Cloud—9293

REMARKS	Station	Elevation of Surface FEET	Elevation of Surface 100ths	Elevation of Bottom FEET	Elevation of Bottom 100ths	Cut FEET	Cut 100ths	Width at Top FEET	Width at Top 100ths	Width at Bottom FEET	Width at Bottom 100ths	Area of Cross Section FEET	Area of Cross Section 100ths	Cubic Yards in Section Preceding YARDS	Cubic Yards in Section Preceding 100ths	Estimated Cost per Cubic Yard Dollars	Estimated Cost per Cubic Yard Cents	Total Estimated Cost of Section Preceding Dollars	Total Estimated Cost of Section Preceding Cents	Record of Bench Marks
A.C. at 121+35	121	62	48	60	80	1	70	5	70	4	00	8	20	37	00		12½	4	62	
	122	62	08	60	60	1	50	5	50		"	7	10	28	30		"	3	54	
	123	62	09	60	40	1	70	5	70		"	8	20	28	30		"	3	54	
	124	61	82	60	20	1	60	5	60		"	7	76	29	40		"	3	67	
	125	61	74	60	06	1	70	5	70		"	8	20	29	40		"	3	68	
In old ditch. S.S. 2 ft. E.	126	60	90	59	80	1	10	5	10		"	5	00	24	40		"	3	05	
A.C. at 127+91	127	58	85	59	60									9	30		"	1	16	
	128																			
	129																			
	130																			
	131																			
	132																			
	133																			
	134																			
	135																			
	136																			
	137																			
A.C. at 138	138	55	59	52	00	2	60	7	60		"	13	80							
	139	54	97	51	00	4	00	8	00		"	24	00	70	00			8	75	
	140	54	37	50	00	4	40	8	40		"	27	30	95	00			11	87	
														351	10			43	88	

EXHIBIT 2 OF ENGINEER'S REPORT IN DITCH PROCEEDINGS.

Showing Estimated Depth of Cut, Width, No. of Cubic Yards Removed and Cost of Same, in Ditch No. 25 Stearns Main.

urnal-Press Co., Printers and Binders St. Cloud—9293

REMARKS	Station	Elevation of Surface FEET	Elevation of Surface 100ths	Elevation of Bottom FEET	Elevation of Bottom 100ths	Cut FEET	Cut 100ths	Width at Top FEET	Width at Top 100ths	Width at Bottom FEET	Width at Bottom 100ths	Area of Cross Section FEET	Area of Cross Section 100ths	Cubic Yards in Section Preceding YARDS	Cubic Yards in Section Preceding 100ths	Estimated Cost per Cubic Yard Dollars	Estimated Cost per Cubic Yard Cents	Total Estimated Cost of Section Preceding Dollars	Total Estimated Cost of Section Preceding Cents	Record of Bench Marks
	141	54	06	49	90	4	20	8	20	4	00	25	60	98	00		12½	1	225	
	142	53	38	49	80	3	60	7	60		"	20	90	86	10			1	076	
	143	52	42	49	70	2	70	6	70		"	14	40	65	40				818	
	144	51	78	49	60	2	20	6	20		"	11	20	47	40				592	
A. C. at 145+79	145	52	34	49	50	2	90	6	90		"	15	80	50	00				625	
	146	52	24	49	40	2	80	6	80		"	15	10	57	20				715	
	147	51	95	49	30	2	70	6	70		"	14	40	54	60				683	
	148	51	76	49	20	2	60	6	60		"	13	80	52	20				652	
	149	51	58	49	10	2	50	6	50		"	13	10	49	80				622	
	150	51	60	49	00	2	60	6	60		"	13	80	49	80				623	
	151	51	63	48	90	2	70	6	70		"	14	40	52	20				653	
	152	51	90	48	80	3	10	7	10		"	17	20	58	50				731	
	153	51	40	48	70	2	70	6	70		"	14	40	58	50				731	
	154	51	58	48	60	3	08	7	00		"	16	50	57	20				715	
A. C. at 155	155	51	37	48	50	2	90	6	90		"	15	80	59	80				748	
	156	51	45	48	40	3	18	7	10		"	17	20	61	16				764	
	157	51	42	48	30	3	18	7	10		"	17	20	63	70				796	
	158	50	90	48	20	2	70	6	70		"	14	40	58	50				731	
	159	51	27	48	10	3	20	7	24		"	17	90	59	80				747	
A. C. at 160	160	51	00	48	00	3	00	7	00		"	16	50	68	70				796	
														1203	50			150	43	

EXHIBIT 2 OF ENGINEER'S REPORT IN DITCH PROCEEDINGS.

Showing Estimated Depth of Cut, Width, No. of Cubic Yards Removed and Cost of Same, in Ditch No. 25 Stearns

Main

urnal-Press Co., Printers and Binders St. Cloud—9293

BIT 2

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REMARKS	Station	Elevation of Surface FEET	Elevation of Surface 100ths	Elevation of Bottom FEET	Elevation of Bottom 100ths	Cut FEET	Cut 100ths	Width at Top FEET	Width at Top 100ths	Width at Bottom FEET	Width at Bottom 100ths	Area of Cross Section FEET	Area of Cross Section 100ths	Cubic Yards in Section Preceding YARDS	Cubic Yards in Section Preceding 100ths	Estimated Cost per Cubic Yard Dollars	Estimated Cost per Cubic Yard Cents	Total Estimated Cost of Section Preceding Dollars	Total Estimated Cost of Section Preceding Cents	Record of Bench Marks
	161	52	16	47	90	4	30	8	30	4	00	26	40	79	40		12½	9	93	
In creek.	161+78	50	70	47	80	2	90	6	70			15	80	60	90			7	61	
														140	30			17	54	
						Total cu yds =								11329.	50					
						" cost												$1416	16	

P. B. 72. Ed. 57.00. Centre of an X marked on foundations in N foundation of R.R. bridge; it is about 1 ft. below iron girder and 4 ft. E. of it on 4 th tier of stone from surface of ground. & 4" below top of said stone.

Appendix B – Soil Boring Records

11-15-16

200-16 - - No Soil Transition
- 30" Boring -

200-15 Soil Transition
-26" Bore
- 1" white silt
- [illegible] - 1"-6" Peat
6"-26" Sand - Black silt

200-14 Soil transition
24" Bore
14"- white clay
10"- Black-sand-Silt

200-13 SOIL TRANSITION
24" BORE
1" - CLAY
4" - PEAT
24" - BLACK SILT.

11-15-16
DS. CW. JB.

Soil Transition

200-12 35" Bore

2" clay

33" Black sand silt

Soil Transition

200-11 16" Bore

all Gravel - No Picture.

200-10 Soil Transition

24" Bore

4" clay 20" Black Sand Silt

200-09 Soil Transition

26" Bore

2" clay

24" Black Sand Silt

11-15-16
DS.cw JB

200-08 Soil Transition

60" Bore

60" Black silt

11-15-16
DS. CW, JB

200-08 Soil Transition

60" Bore

60" Black Silt

11-16-16
DS CW

200-07 soil Transition

36" Bore

2" clay

34" Black Silt

200-06 Soil Transition

24" Bore

12" Black clay

12" Black Sand

200-05 Soil Transition

48" Bore

12" clay

36" Black Sand Silt

11-16-16 Ds ov

200-04 Soil Transition

60" Bore

60" - Sand Gravel silt

soil wouldnt stay in cylinder

No Picture.

200-03 Soil Transition

24" Bore

2" clay

12' Peat

10" Black Silt sand

200-02 Soil Transition

24" Bore

all Sand, Silt, Rock

To Hard to

Go Deeper

11-16-16 DS CW

200-01 Soil Transition

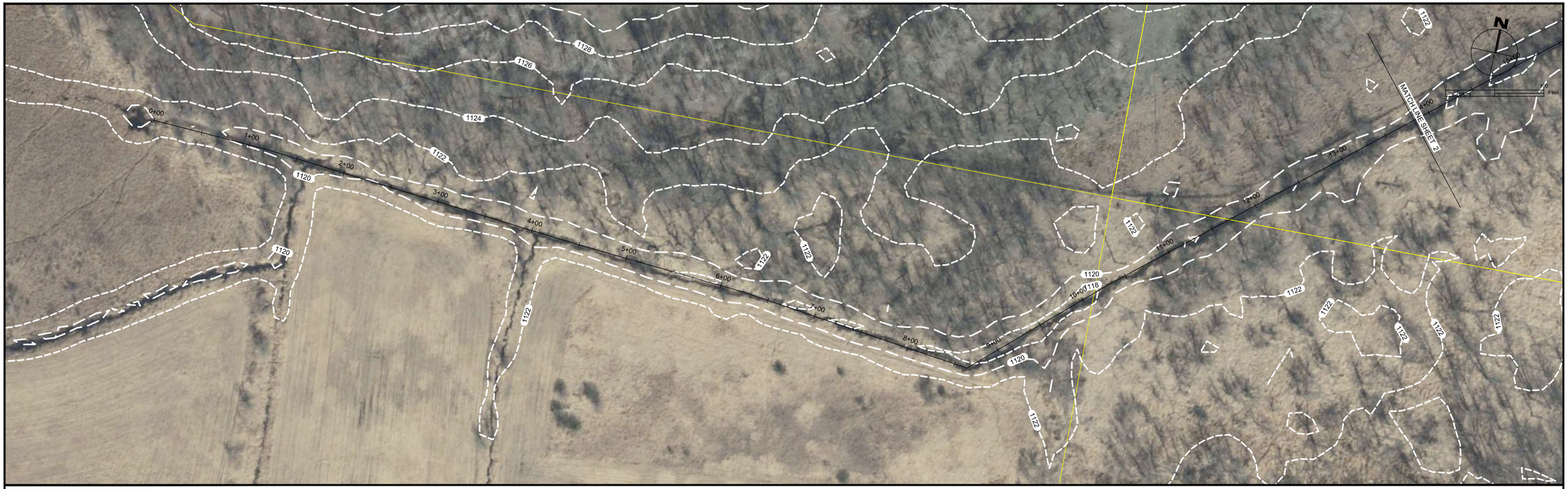
24" Borg.

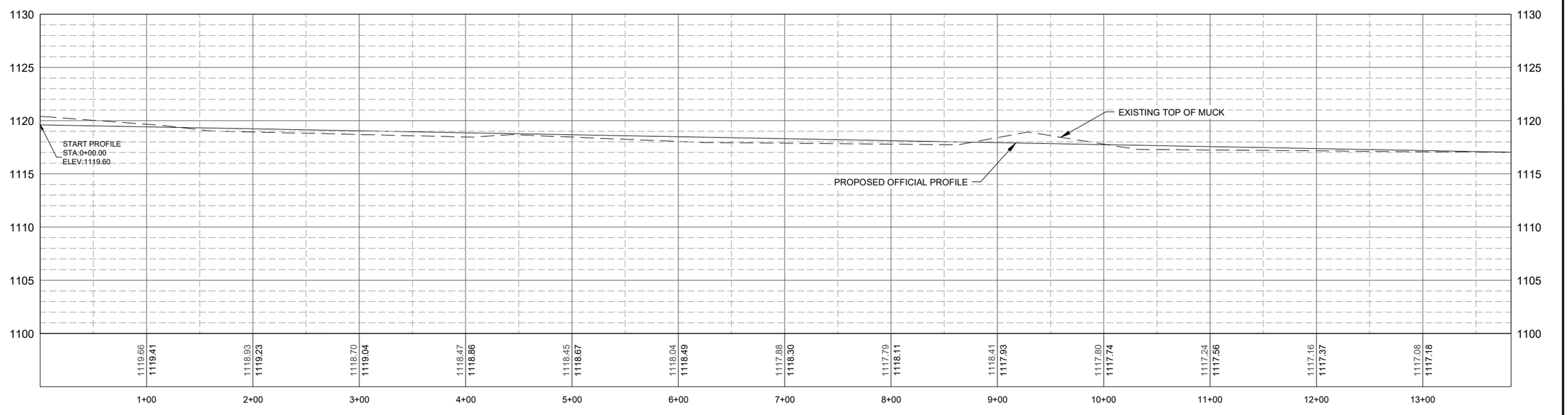
2" clay

6" Peat

16" muck - silt

Appendix C – Plan and Profile Sheets





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Kent E. Brander, P.E.

DATE: 12-13-2016

LIC. NO.: 44578

DESIGNED: KEB
DRAWN: KEB
CHECKED: DMP

DATE / REVISION:

OWNER:
COUNTY OF STEARNS
705 Courthouse Square
St. Cloud, MN 56303

TITLE:
DITCH PLAN & PROFILE
STEARNS COUNTY DITCH #25 PROFILE EVALUATION
AVON & ST. WENDEL TOWNSHIPS, STEARNS COUNTY, MN

SHEET NO:
1

Print Date: 12/14/2016 8:45 AM
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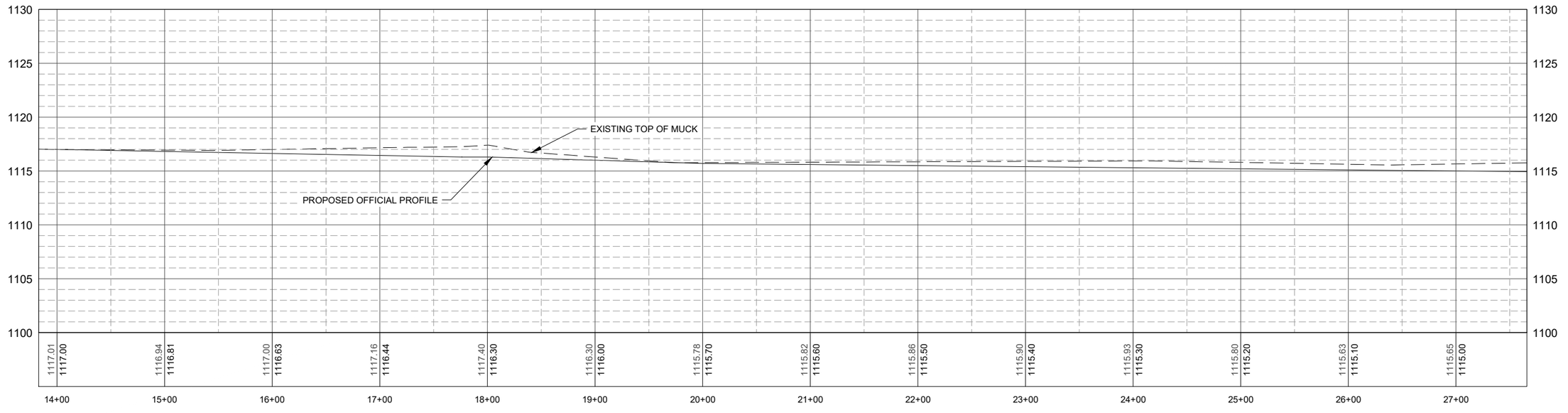

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705 Courthouse Square
St. Cloud, MN 56303

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DITCH PLAN & PROFILE
STEARNS COUNTY DITCH #25 PROFILE EVALUATION
AVON & ST. WENDEL TOWNSHIPS, STEARNS COUNTY, MN

SHEET NO:
2

Print Date: 12/14/2016 8:46 AM
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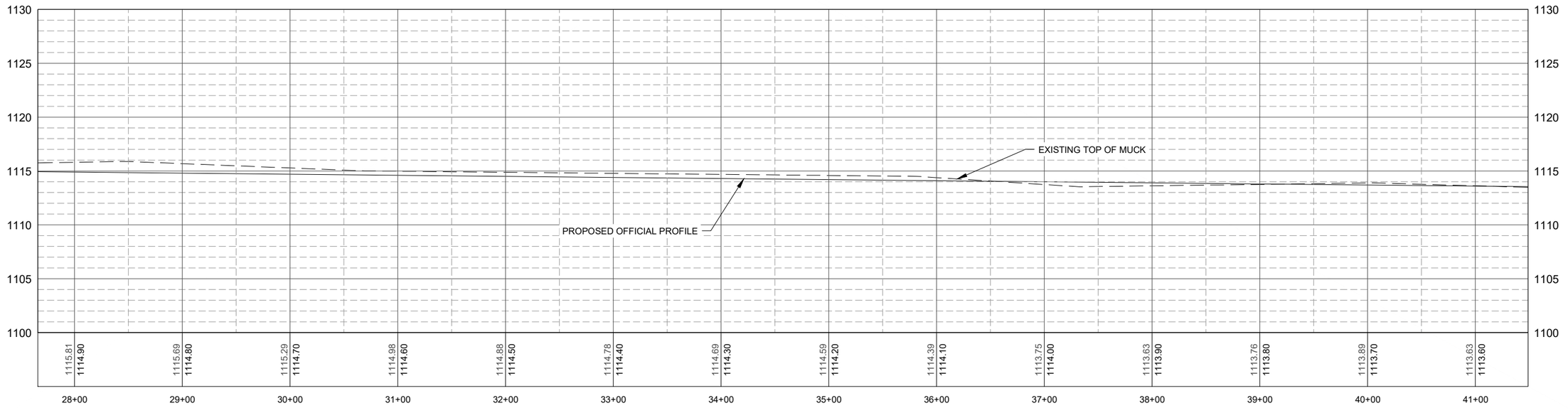

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St. Cloud, MN 56303

TITLE:
DITCH PLAN & PROFILE
STEARNS COUNTY DITCH #25 PROFILE EVALUATION
AVON & ST. WENDEL TOWNSHIPS, STEARNS COUNTY, MN

SHEET NO:
3

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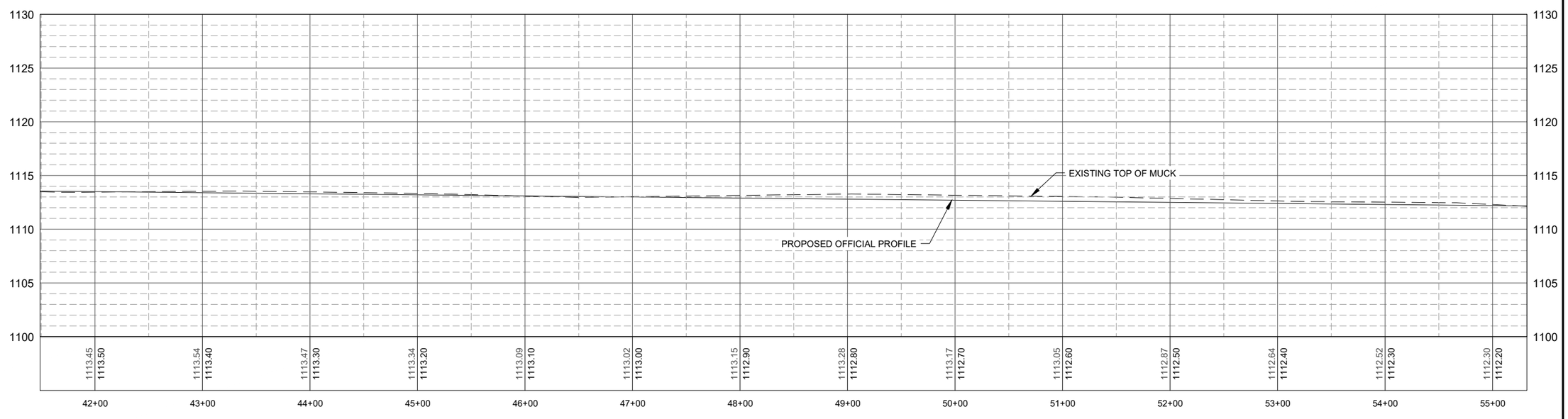

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Kent E. Brander, P.E.

DATE: 12-13-2016

LIC. NO.: 44578

DESIGNED: KEB
DRAWN: KEB
CHECKED: DMP

DATE / REVISION:

OWNER:
COUNTY OF STEARNS
705 Courthouse Square
St. Cloud, MN 56303

TITLE:
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SHEET NO:
4

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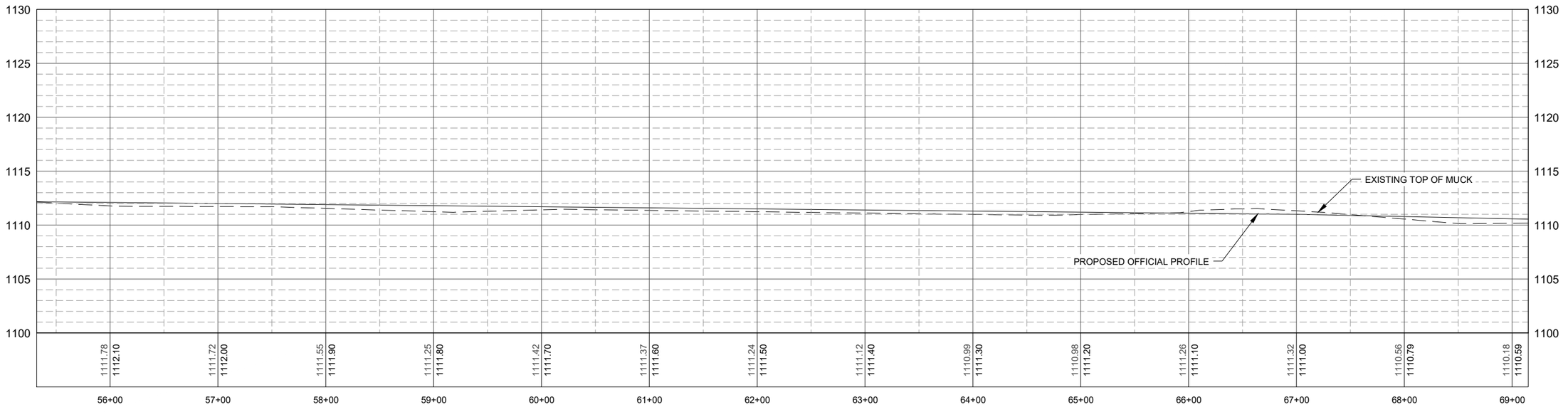

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SHEET NO:
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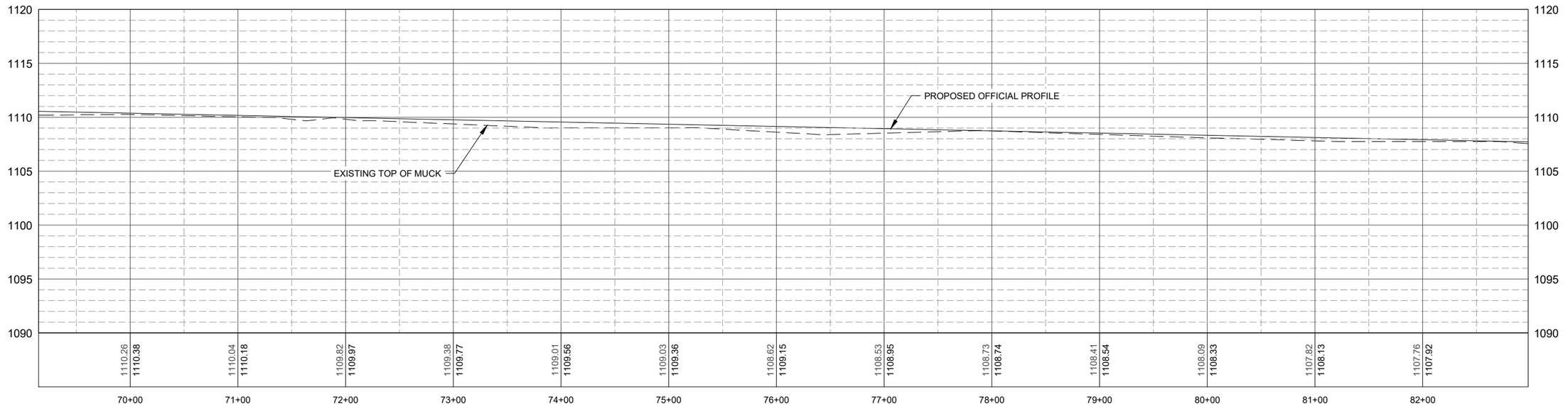

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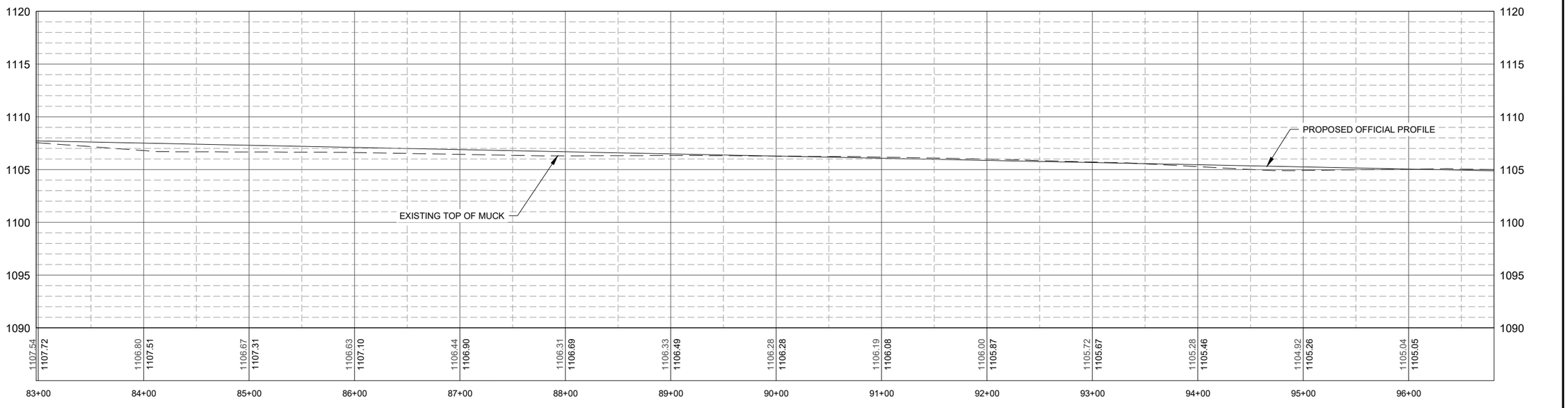

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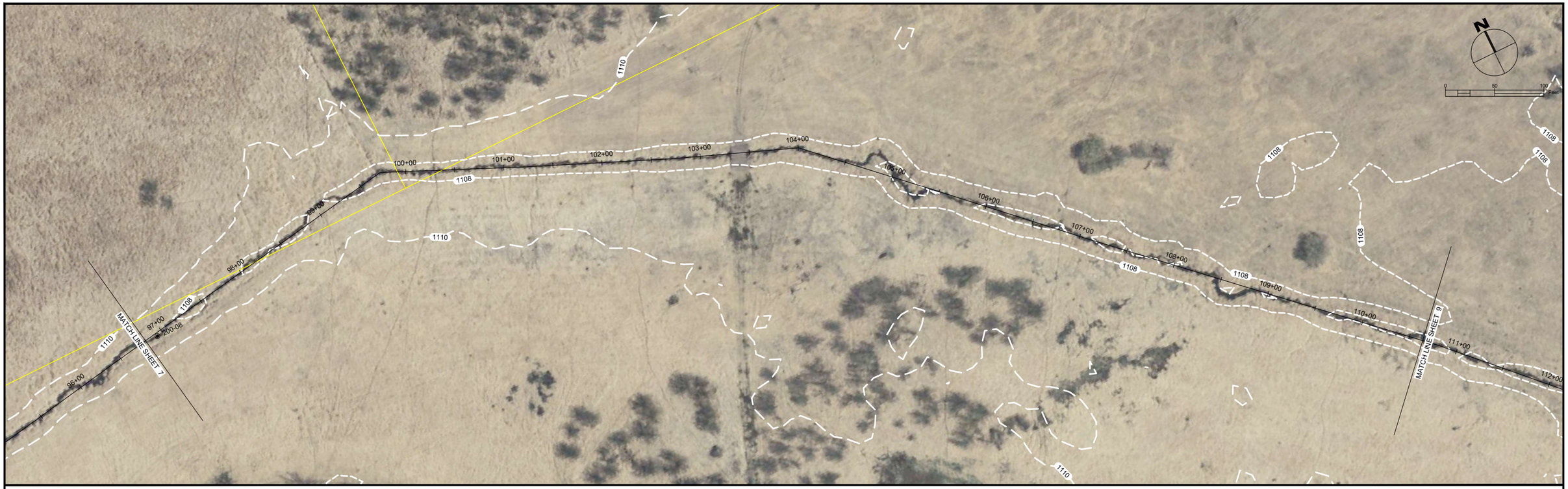

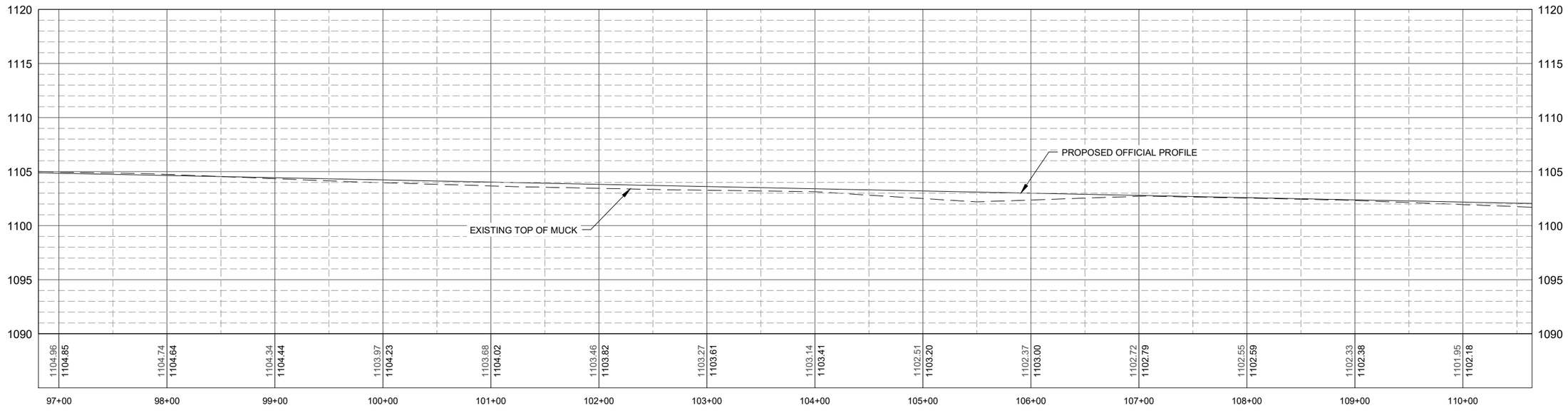

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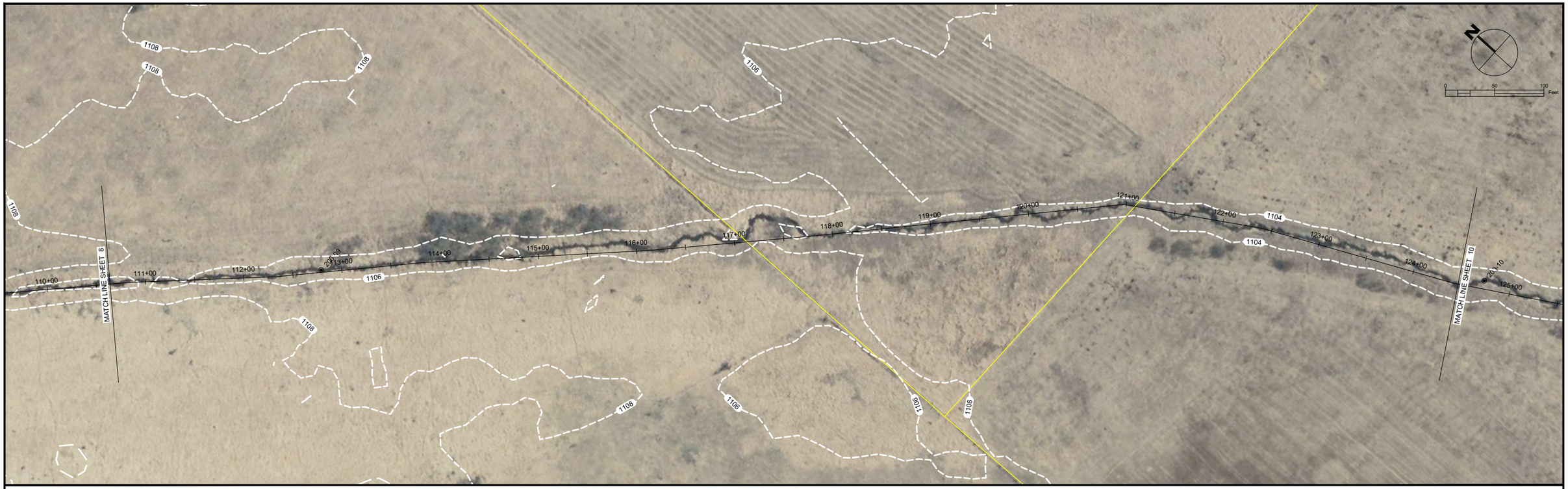

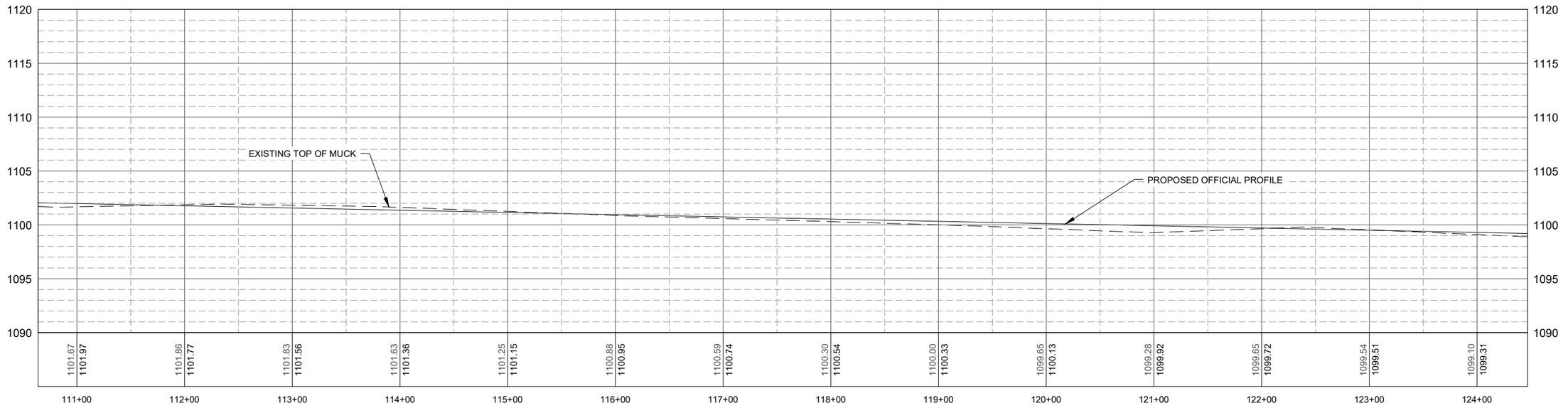

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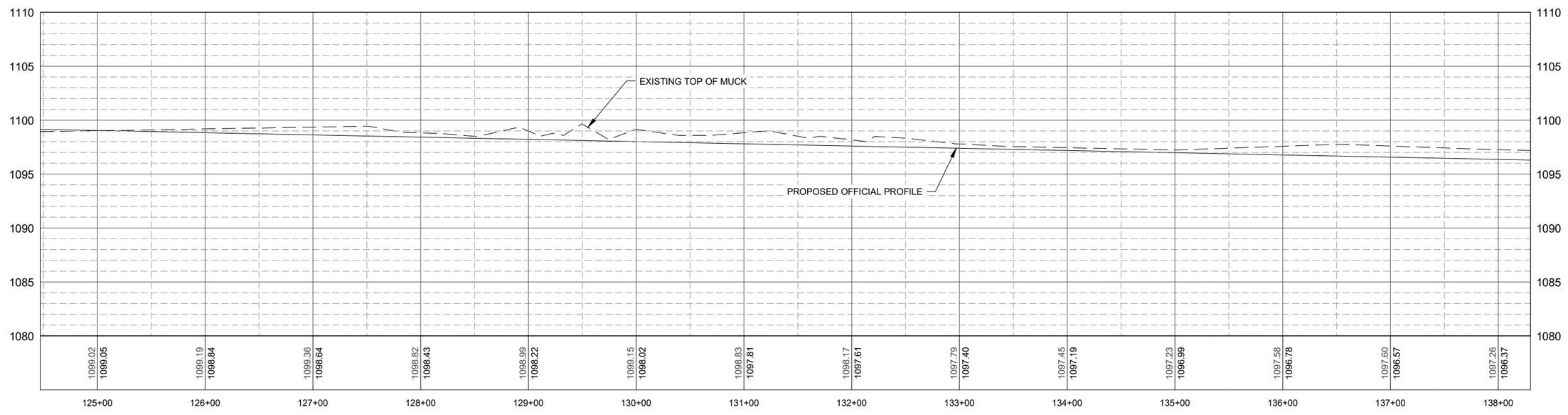

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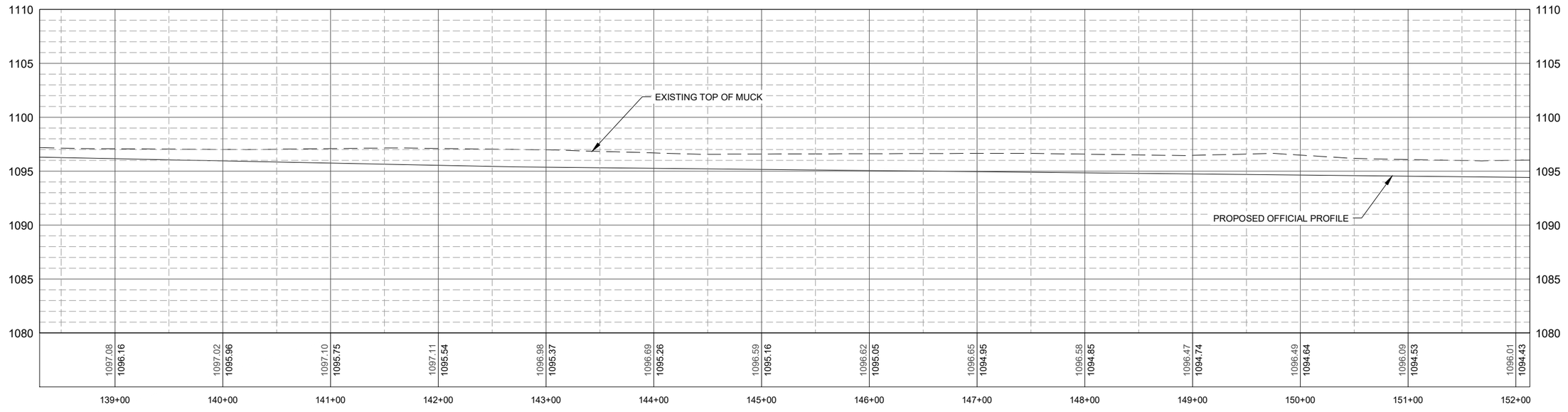

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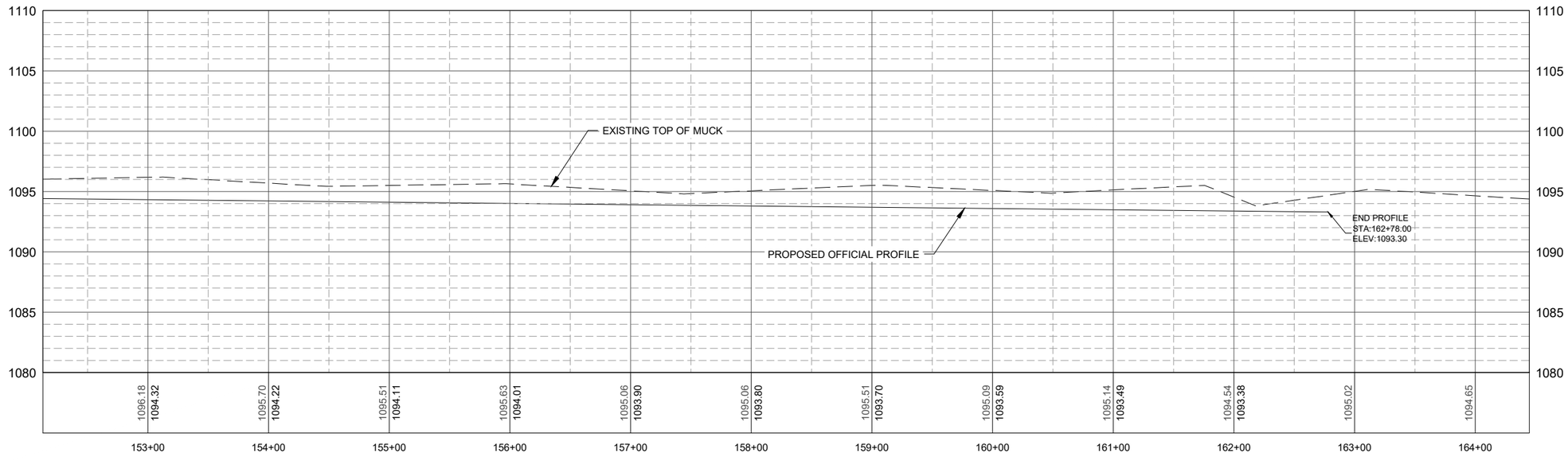

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