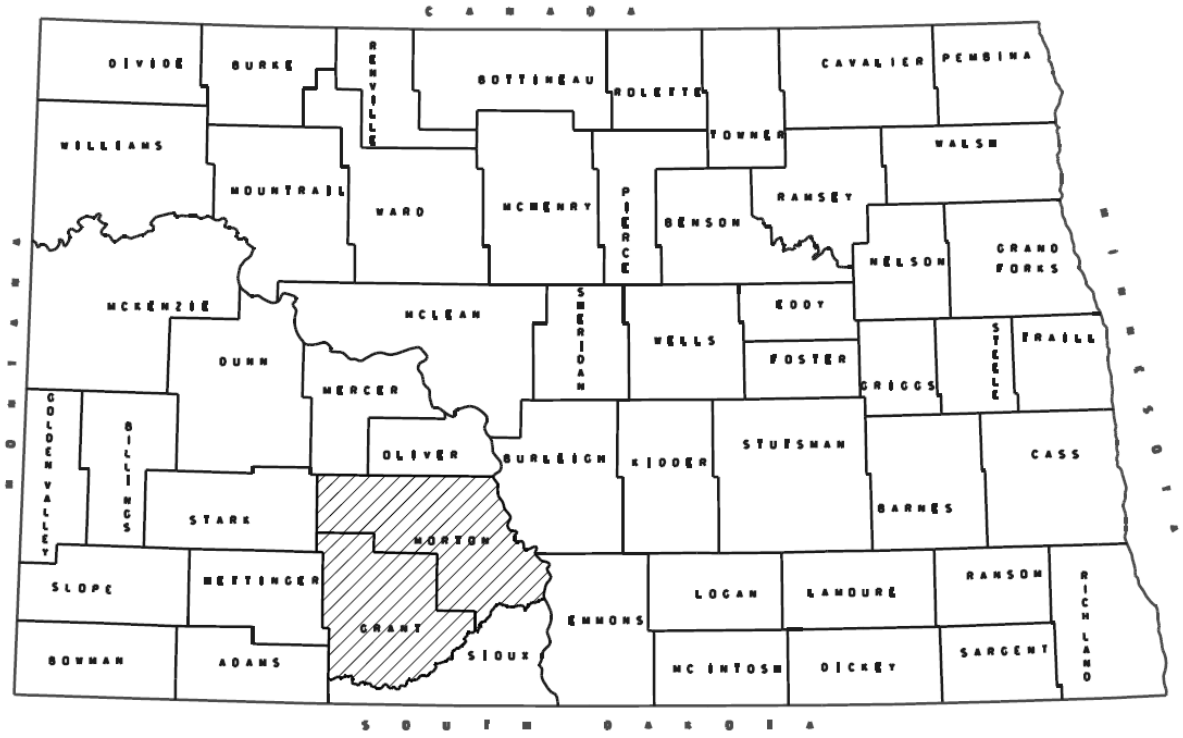
LINEAR SOILS SURVEY AND RECOMMENDATIONS

Project NO. X-1-049(031)036

PCN 23272

County Grant & Morton

HWY 49, RP 36.331 to 67.710



PREPARED BY: Riley McAdoo-Roesler

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION MATERIAL AND RESEARCH DIVISION

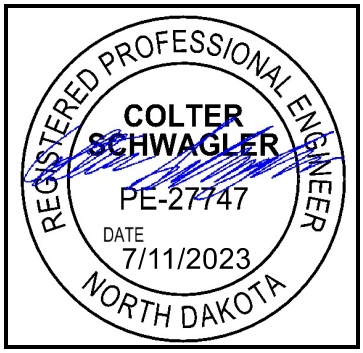
July 2023

X-1-049(031)036

JCT 21 – Elgin N to Glen Ullin

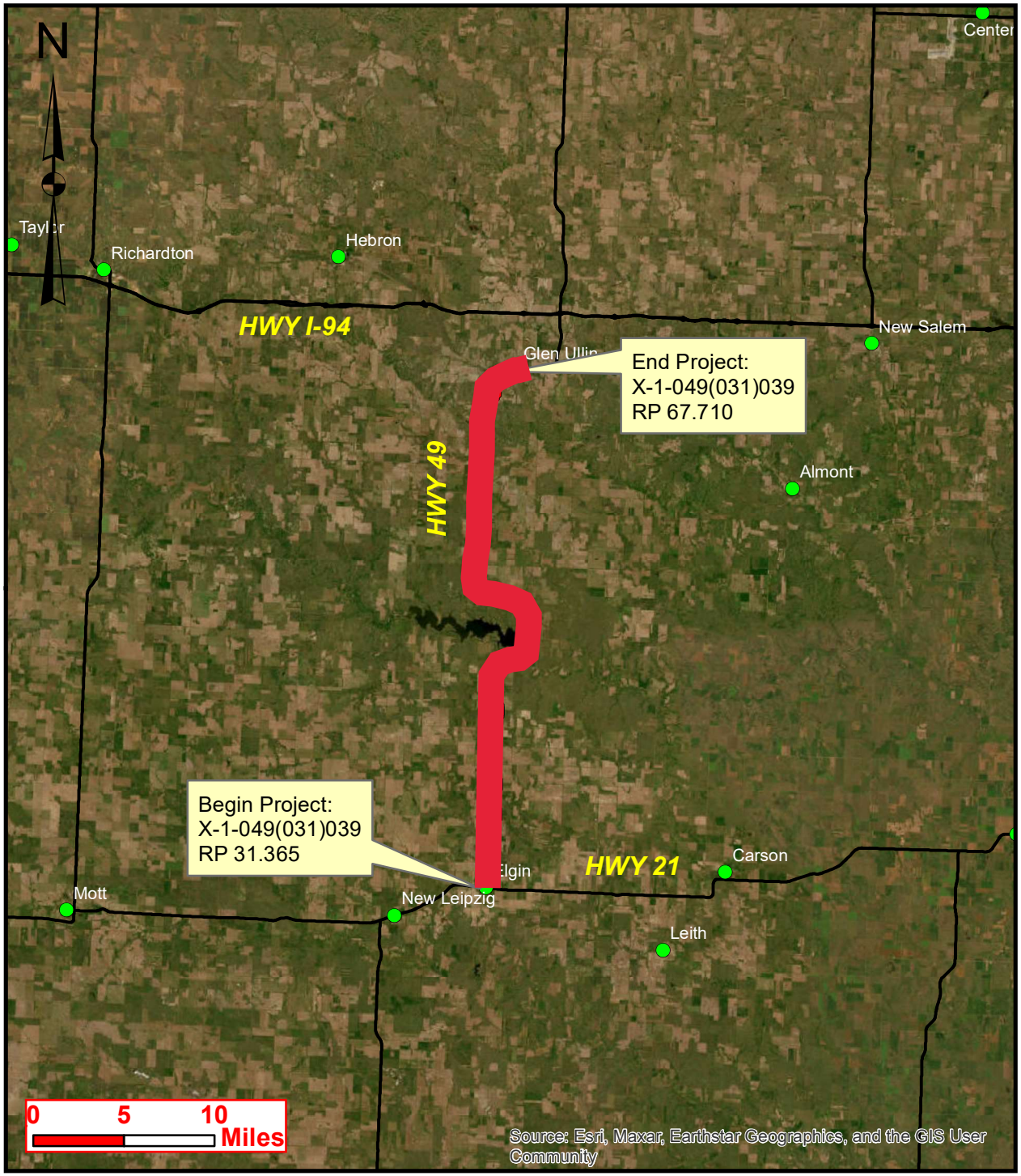
CERTIFICATION

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of North Dakota. This document was originally issued and sealed by Colter Schwagler, Registration number PE-27747 on 07/11/2023 and the original document is stored at the North Dakota Department of Transportation.



Project Location

Project: X-1-049(031)036
PCN: 23272
Scope: Minor Rehabilitation
Location: RP 36.331 to RP 67.710



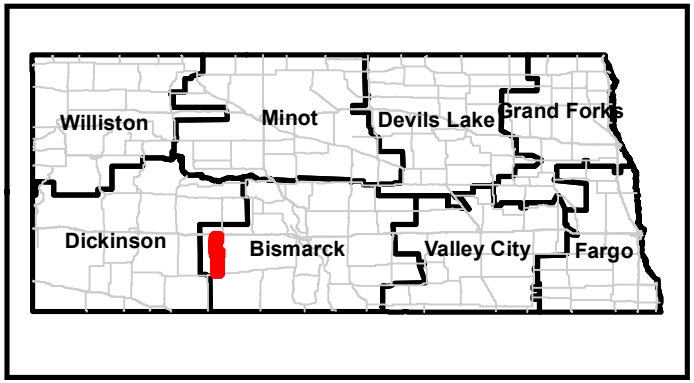


Table of Contents

Introduction 1
Maintenance Review 1
Summary of Soil Investigation 3
Summary of Soil Analysis 5
  Soil Sample Distribution 5
Design Recommendations 6
  Design Information 9
  Plan Notes 9

List of Figures

Figure 1 - Soil Sample Distribution 5

List of Tables

Table 1 - Identified Maintenance Areas 1
Table 2 - Boring Locations Summary 3
Table 3 - Subcut Recommendations 9

Appendices

Appendix A – Soil Classification

Appendix B – Maintenance Review and Subsurface Investigation Scope

Appendix C – Boring Locations

Appendix D – Summary of Soils Analysis

Appendix E – Lab Results

Introduction

Location: HWY 49, JCT 21 – Elgin N to Glen Ullin
Reference Points: 36.331 to 67.710
Project Length: 31.365 Miles
Proposed Project Scope: Minor Rehabilitation – Hot Bit. Surfacing, Sliver Grading
Investigation Scope: Identified Maintenance Areas

Maintenance Review

Date of Maintenance Review: 03/27/2023
Materials and Research Person Conducting the Review: Jamie Naumann
Maintenance Person Conducting Review: Terry Price

Table 1 - Identified Maintenance Areas

Location RP + Feet	Distress Identified	Maintenance Comments	Drilling Required
36+1747 to 67+3749	Transv. Cracks	Last crack seal 2020, chipseal 2013	No
37+3578	Culvert	Dip, 132” Cattle pass	Yes
38+1220 to 38+1400	Other	Snow blow in area, Problem for 6 plus years	No
40+2140 to 40+2178	Culvert	Dip, Patched in 2021, 6 plus years	Yes
42+0195 to 42+0336	Other	Both approach slabs sunk in, 6-year problem, signed both mudjacked 7 plus years ago	Yes
46+0248	Culvert	Cattle pass,6-year problem	Yes
46+0948 to 46+0972	Rutting	6-year plus problem, signed	Yes

48+1457	Rutting	Soft spot, 6-years plus problem	Yes
48+2987	Other	Year long bump, 6-year problem	Yes
54+0500	Culvert	Small dip	Yes
55+0421	Culvert	End sections coming off culvert, steep slopes	Yes
58+0177	Culvert	Dip	Yes
59+0489	Culvert	Dip, cattle pass, not in use	Yes
60+4100 to 60+4450	Other	High snow blow in area, 6 year plus issue	No
61+3031 to 61+3060	Culvert	Dips before and after box culvert	Yes
61+5200 to 61+5265	Culvert	Box culvert cattle pass, not in use	Yes
64+4723 to 64+4810	Culvert	Dips, cattle pass (not in use) & Culverts	Yes
66+1580	Culvert	Dip	Yes
66+2794 to 66+2833	Culvert	Dip, Box Culvert, camera run through in 2020	Yes
67+2477	Culvert	Dip	Yes

Summary of Soil Investigation

The soil investigation was completed on 05/08/2023. The investigation consisted of 53 borings.

Table 2 - Boring Locations Summary

Boring Location	Pavement Distress	Justification for Boring	Boring Depth	Boring Locations/Comments
37+3578	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.
40+2140 to 40+2178	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.
42+0195 to 42+2178	Other	Identified Maintenance Area	10 feet	Conduct 1 boring in each approach slab and one boring on each side approximately 100’ away. A total of 4 borings.
46+0248	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.
46+0948 to 46+0972	Rutting	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.
48+1457	Rutting	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.

48+2987	Other	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.
54+0500	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.
55+0421	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.
58+0177	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.
59+0489	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.
61+3031 to 61+3060	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.
61+5200 to 61+5265	Culvert	Identified Maintenance Area	10 feet	Conduct 3 borings in the identified area and one boring on each side approximately 100’ away. A total of 5 borings.
64+4730 to 64+4810	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 2 borings.
66+1580	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100’ away. A total of 3 borings.

66+2794 to 66+2833	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100' away. A total of 3 borings.
67+2477	Culvert	Identified Maintenance Area	10 feet	Conduct 1 borings in the identified area and one boring on each side approximately 100' away. A total of 3 borings.

Map of the boring locations are shown in Appendix C. The lab results and included in Appendix E.

Summary of Soil Analysis

Soil Sample Distribution

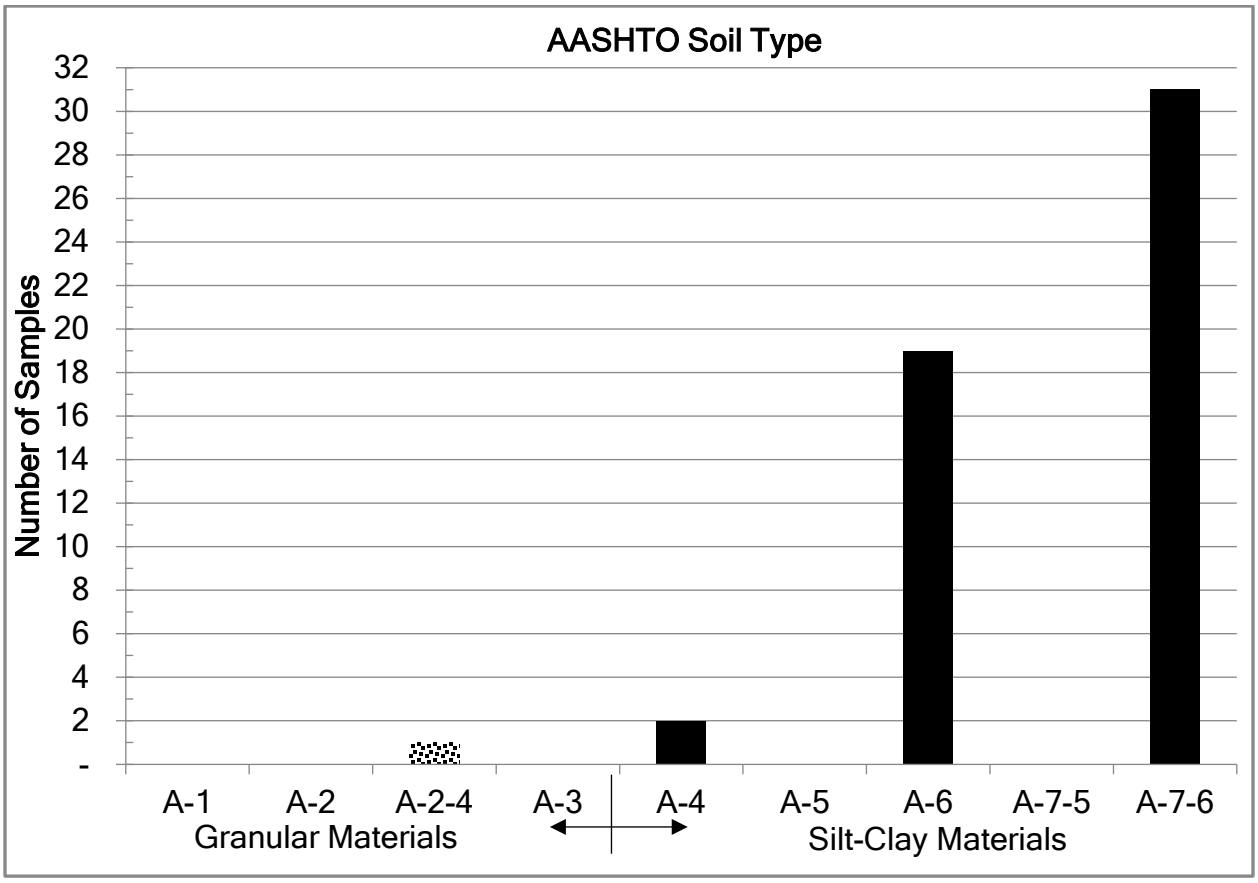


Figure 1 - Soil Sample Distribution

Design Recommendations

Project Limits – 36+1747 to 67+3748: The soils within the project limits are a part of the Tongue River and the Sentinel Butte formations. The soils found within the Tongue River and Sentinel Butte formation commonly consist of clays and silt with the Sentinel Butte having a typically higher sand content. The soils found within the project limits are primally lean clay.

Identified Maintenance Area – 37+3578: The soils within the identified maintenance area are lean clays with sand. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended, the maintenance area is likely caused by the condition of the existing pipe.

Identified Maintenance Area – 40+2140 to 40+2178: The soils within the identified maintenance area are lean clays with sand. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended, the maintenance area is likely caused by the condition of the existing pipe.

Identified Maintenance Area – 42+0195 to 42+2178: The soils with the identified maintenance area include silty sands and sandy lean clay. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. The approach slabs will be replaced and the lips of the bridge will be repaired as a part of this project. The proposed remediation should remediate the existing roadway distress.

Identified Maintenance Area – 46+0248: The soils within the identified maintenance area are lean clays. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended, the maintenance area is likely caused by the condition of the existing pipe.

Identified Maintenance Area – 46+0948 to 46+0972: The soils within the identified maintenance area are fat clays. The soils within the area are highly frost susceptible. The identified maintenance was analyzed in winter and in summer and is believed to be a frost heave. Therefore, it is recommended to subcut this maintenance area, see table 3 for subcut recommendations.

Identified Maintenance Area – 48+1457: The soils within the identified maintenance area are lean clays with sand. The soil analysis in the area shows that there is a difference in the surrounding soils and the soils with the area have an elevated in-place moisture content. It is recommended to subcut this maintenance area, see table 3 for subcut recommendations.

Identified Maintenance Area – 48+2987: The soils within the identified maintenance area are lean clays. There is a slight change in soil type that would indicate that the subgrade is causing the roadway distress at this location. With this change in soil type and the maintenance area falling within a cut section, it is recommended to subcut this maintenance area. See table 3 for subcut recommendations

Identified Maintenance Area – 54+0500: The soils within the identified maintenance area are lean clays with sand. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended, the maintenance area is likely caused by the condition of the existing pipe.

Identified Maintenance Area – 55+0421: The soils within the identified maintenance area are lean clays. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended, the maintenance area is likely caused by the condition of the existing pipe.

Identified Maintenance Area – 58+0177: The soils within the identified maintenance area are fat clays with sand. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended, the maintenance area is likely caused by the condition of the existing pipe.

Identified Maintenance Area – 59+0489: The soils within the identified maintenance area are fat clays. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location.. No subgrade mitigation is recommended, the maintenance area is likely caused by the condition of the existing pipe.

Identified Maintenance Area – 61+3031 to 61+3060: The soils within the identified maintenance area are sandy lean clays. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended.

Identified Maintenance Area – 61+5200 to 61+5265: The soils with the identified maintenance area are fat clays with sand. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended.

Identified Maintenance Area – 64+4730 to 64+4810: The soils within the identified maintenance area are lean clays. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. Based on the pipe survey it appears this pipe has joint separation that is contributing to the roadway distress. No subgrade mitigation is recommended, the maintenance area is likely caused by the condition of the existing pipe.

Identified Maintenance Area – 66+1580: The soils within the identified maintenance area are lean clays. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended, the maintenance area is likely caused by the condition of the existing pipe.

Identified Maintenance Area – 66+2794 to 66+2833: The soils within the identified maintenance area are lean clays with sand. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended.

Identified Maintenance Area – 67+2477: The soils with the identified maintenance area are fat clays. There is not a change in soil type, geology or water content that would indicate that the subgrade is causing the roadway distress at this location. No subgrade mitigation is recommended, the maintenance area is likely caused by the condition of the existing pipe.

Design Information

Pipe Replacement: None

Compaction Method: T-180

Subgrade Prep: None

Subcut Recommendations:

Location RP + Feet	Length	Depth
46+0900 to 46+1025	125’	52”
48+1400 to 48+1500	100’	36”
48+2940 to 48+3040	100’	36”

Table 3 - Subcut Recommendations

Calculate the subcut quantity based on the lengths and depths as shown in Table 3 above and adhere to the guidelines stated below.

Remarks: Subcut from the top of proposed pavement. Replace the removed material with class 5 aggregate and line the excavation with Geosynthetic Geogrid (Type G) in accordance with NDDOT Specification 709. Do not scarify the bottom of the subcut.

Drainage: None

Plan Notes

None

The recommendations in this report are based on the scope specified in the Introduction. If the scope of work, vertical profile or horizontal alignment is changed, in either the conceptual phase or the design phase, the Geotechnical Engineer must be notified as soon as possible to ensure that there is adequate geotechnical information addressing these areas.

APPENDIX A

SOIL CLASSIFICATION

AASHTO Classification System

Table 5.1. AASHTO Classification System

General Classification	*Granular materials (35% or less passing No. 200 Sieve (0.075 mm)*							*Silt-clay Materials More than 35% passing No. 200 Sieve (0.075 mm)*			
Group Classification	*A—1*		*A—3*	*A—2*				*A—4*	*A—5*	*A—6*	*A—7*
	A—1—a	*A—1—b*		*A—2—4*	*A—2—5*	*A—2—6*	*A—2—7*				*A—7—5 A—7—6*
(*a*) Sieve Analysis: Percent Passing											
(*i*) 2.00 mm (No. 10)	50 max										
(*ii*) 0.425 mm (No. 40)	30 max	50 max	51 min								
(*iii*) 0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
(*b*) Characteristics of fraction passing 0.425 mm (No. 40)											
(*i*) Liquid limit				40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
(*ii*) Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min*
(*c*) Usual types of significant Constituent materials	Stone Fragments Gravel and sand		Fine Sand	Silty or Clayey Gravel Sand				Silty Soils		Clayey Soils	
(*d*) General rating as subgrade.	Excellent to Good							Fair to Poor			

* If plasticity index is equal to or less than (liquid Limit—30), the soil is A—7—5 (*i.e.* PL > 30%)
If plasticity index is greater than (Liquid Limit—30), the soil is A—7—6 (*i.e.* PL < 30%)

Unified Soil Classification System, USCS

Table 5.2 Unified Soil Classification System (Based on Material Passing 76.2-mm Sieve)

Criteria for assigning group symbols				Group symbol
Coarse-grained soils More than 50% of retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[a]	$C_u \geq 4$ and $1 \leq C_c \leq 3$[c]	GW
			$C_u < 4$ and/or $1 > C_c > 3$[c]	GP
		Gravels with Fines More than 12% fines[a,d]	$PI < 4$ or plots below "A" line (Figure 5.3)	GM
			$PI > 7$ and plots on or above "A" line (Figure 5.3)	GC
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[b]	$C_u \geq 6$ and $1 \leq C_c \leq 3$[c]	SW
			$C_u < 6$ and/or $1 > C_c > 3$[c]	SP
		Sands with Fines More than 12% fines[b,d]	$PI < 4$ or plots below "A" line (Figure 5.3)	SM
			$PI > 7$ and plots on or above "A" line (Figure 5.3)	SC
Fine-grained soils 50% or more passes No. 200 sieve	Silts and clays Liquid limit less than 50	Inorganic	$PI > 7$ and plots on or above "A" line (Figure 5.3)[e]	CL
			$PI < 4$ or plots below "A" line (Figure 5.3)[e]	ML
		Organic	$\frac{\text{Liquid limit — oven dried}}{\text{Liquid limit — not dried}} < 0.75$; see Figure 5.3; OL zone	OL
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line (Figure 5.3)	CH
			PI plots below "A" line (Figure 5.3)	MH
		Organic	$\frac{\text{Liquid limit — oven dried}}{\text{Liquid limit — not dried}} < 0.75$; see Figure 5.3; OH zone	OH
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor			Pt

[a] Gravels with 5 to 12% fine require dual symbols: GW-GM, GW-GC, GP-GM, GP-GC.

[b] Sands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.

[c] $C_u = \frac{D_{60}}{D_{10}}$; $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}}$

[d] If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 5.3, use dual symbol GC-GM or SC-SM.

[e] If $4 \leq PI \leq 7$ and plots in the hatched area in Figure 5.3, use dual symbol CL-ML.

Plasticity Chart :

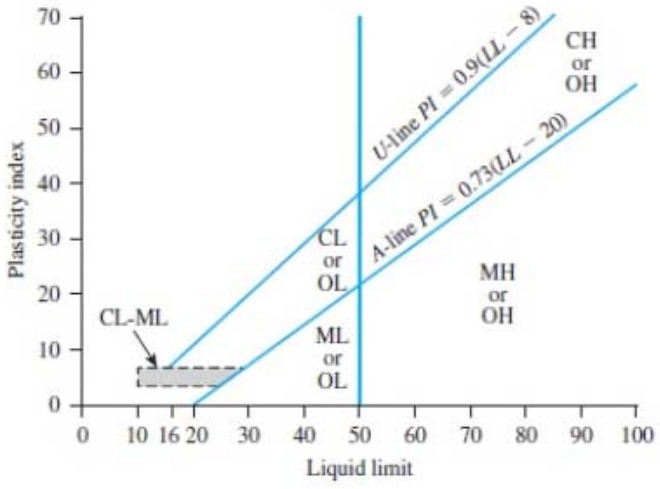


Table 7-12. Frost susceptibility classification of soils (NCHRP 1-37A).

Frost Group	Degree of Frost Susceptibility	Type of Soil	Percentage Finer than 0.075 mm (# 200) by wt.	Typical Soil Classification
F1	Negligible to low	Gravelly soils	3-10	GC, GP, GC-GM, GP-GM
F2	Low to medium	Gravelly soils	10-20	GM, GC-GM, GP-GM
		Sands	3-15	SW, SP, SM, SW-SM, SP-SM
F3	High	Gravelly Soils	Greater than 20	GM-GC
		Sands, except very fine silty sands	Greater than 15	SM, SC
		Clays PI>12	—	CL, CH
F4	Very high	All Silts	—	ML-MH
		Very Fine Silty Sands	Greater than 15	SM
		Clays PI<12	—	CL, CL-ML
		Varied clays and other fine grained, banded sediments	—	CL, ML, SM, CH

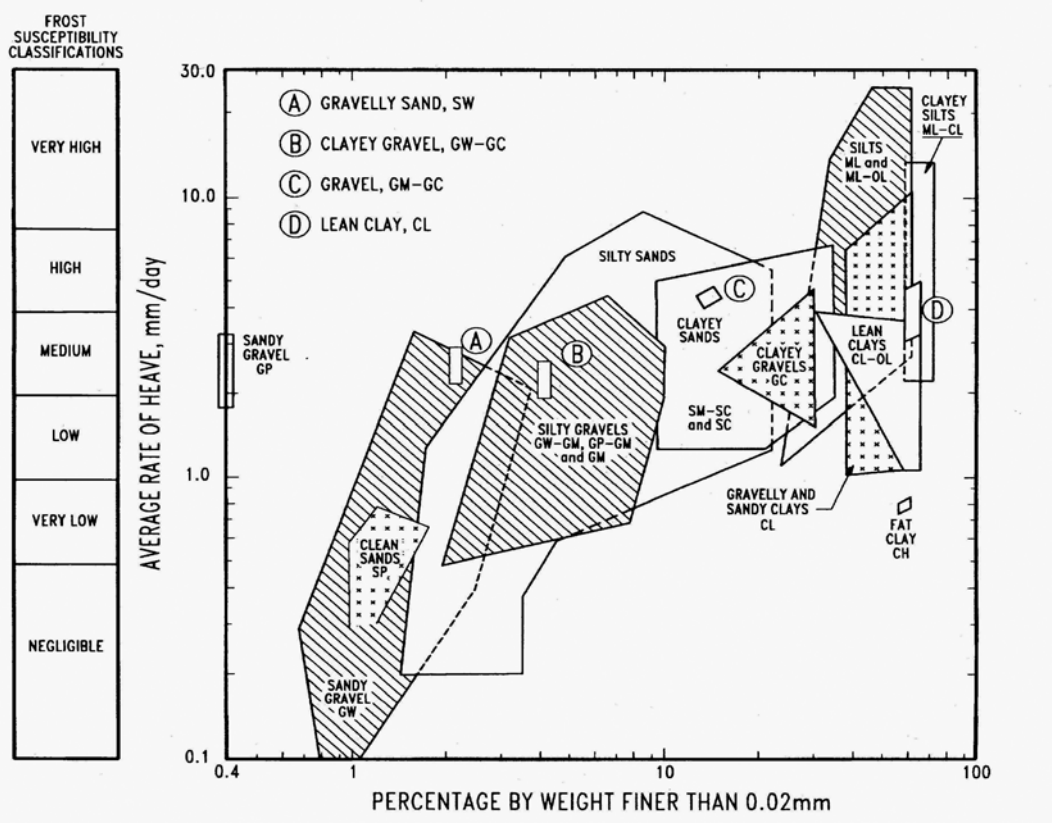


Figure 7-20. Average rate of heave versus % fines for natural soil gradations (Kaplar, 1974).

Frost Depth Map



*Values shown are in meters

APPENDIX B

MAINTENANCE REVIEW AND SUBSURFACE INVESTIGATION SCOPE

PAVEMENT EVALUATION LOG FOR LINEAR SOIL SURVEY

North Dakota Department of Transportation, Materials & Research

SFN 60472 (6-2017)

Project Number	PCN	Date of Survey
X-1-049(031)036	23272	03/27/2023

Section Maintenance Contact	Completed By
Terry Price	Jamie Naumann

Highway Reference Points	Surface Types
36+1747 to 67+3749	Asphalt

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
36+1747 to 67+3749	Transv. Cracks	10 to 15 feet apart	Last crack seal 2020, chipseal 2013	Na	No
37+3578	Culvert	Dip	132" cattle pass	1	Yes
38+1220 to 38+1400	Other	Snow blow in area	Problem for 6 plus years	2	No
40+2140 to 40+2178	Culvert	Dip, low area	Patched 2021, 6 years plus	3	Yes
42+0195 to 42+0336	Other	Both approach slabs sunk in	6 year plus problem, signed, both mudjacked previously 7 years plus.	4	Yes
46+0248	Culvert	Cattle pass, not in use	6 year problem	5	Yes
46+0948 to 46+0972	Rutting	Rt wheel path	6 year plus problem, signed	6-7	Yes
48+1457	Rutting	Soft Spot, both wheel tracks	6 year plus problem	8-9	Yes
48+2987	Other	Year long bump	6 year problem	10-11	Yes

Comments

PAVEMENT EVALUATION LOG FOR LINEAR SOIL SURVEY

North Dakota Department of Transportation, Materials & Research
SFN 60472 (6-2017)

Project Number	PCN	Date of Survey
X-1-049(031)036	23272	03/27/2023

Section Maintenance Contact	Completed By
Terry Price	Jamie Naumann

Highway Reference Points	Surface Types
36+1747 to 67+3749	Asphalt

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
54+0500	Culvert	Small Dip	Na	Na	Yes
55+0421	Culvert	End Sections coming off culvert, Steep slopes	Na	12	Yes
58+0177	Culvert	Dip	Na	13-15	Yes
59+0489	Culvert	Cattle Pass, Dip	Not in use	16-17	Yes
60+4100 to 60+4450	Other	High snow blow in area	6 year plus issue	18	No
61+3031 to 61+3060	Culvert	Dips before and after box culvert	Na	19-20	Yes
61+5200 to 61+5265	Culvert	Box culvert cattle pass	Not in use	21-22	Yes
64+4723 to 64+4810	Culvert	Dips, cattle pass (not in use) & culvert		23-25	Yes
66+1580	Culvert	Dip	Na	Na	Yes

Comments

PAVEMENT EVALUATION LOG FOR LINEAR SOIL SURVEY

North Dakota Department of Transportation, Materials & Research

SFN 60472 (6-2017)

Sheet 3 of 3

Project Number	PCN	Date of Survey
X-1-049(031)036	23272	03/27/2023

Section Maintenance Contact	Completed By
Terry Price	Jamie Naumann

Highway Reference Points	Surface Types
36+1747 to 67+3749	Asphalt

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
66+2794 to 66+2833	Culvert	Dip, Box culvert	Camera run through 2020	26-28	Yes
67+2477	Culvert	Dip	Na	29-30	Yes

Comments



1
37+3578



2
38+1220 to 38+1400



3
40+2140 to 40+2178



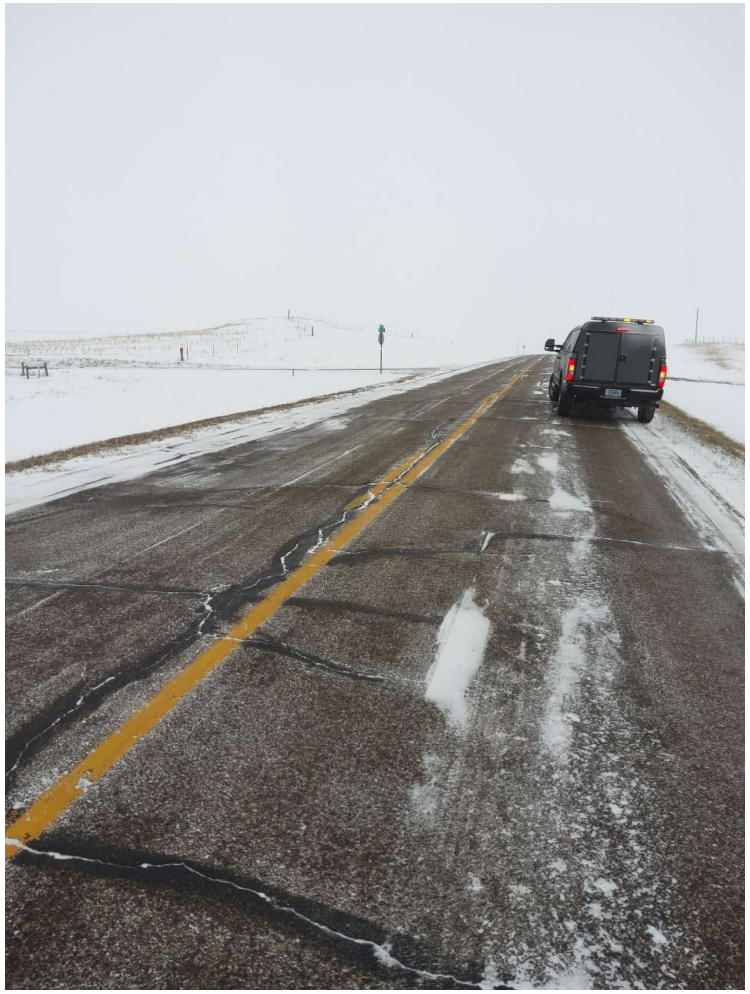
4
38+1220 to 38+1400



5
46+0248



6
46+0948 to 46+0972



7
46+0948 to 46+0972



8
48+1457



9
48+1457



10
48+2987



11
48+2987



12
55+0421



13
58+0177



14
58+0177



15
58+0177



16
59+0489



17
59+0489



18
60+4100 to 60+4450



19
61+3031 to 61+3060



20
61+3031 to 61+3060



21
61+5200 to 61+5265



22
61+5200 to 61+5265



23
63+3730 to 64+4810



24
63+3730 to 64+4810



25
63+3730 to 64+4810



26
66+2794 to 66+2833



27
66+2794 to 66+2833



28
66+2794 to 66+2833



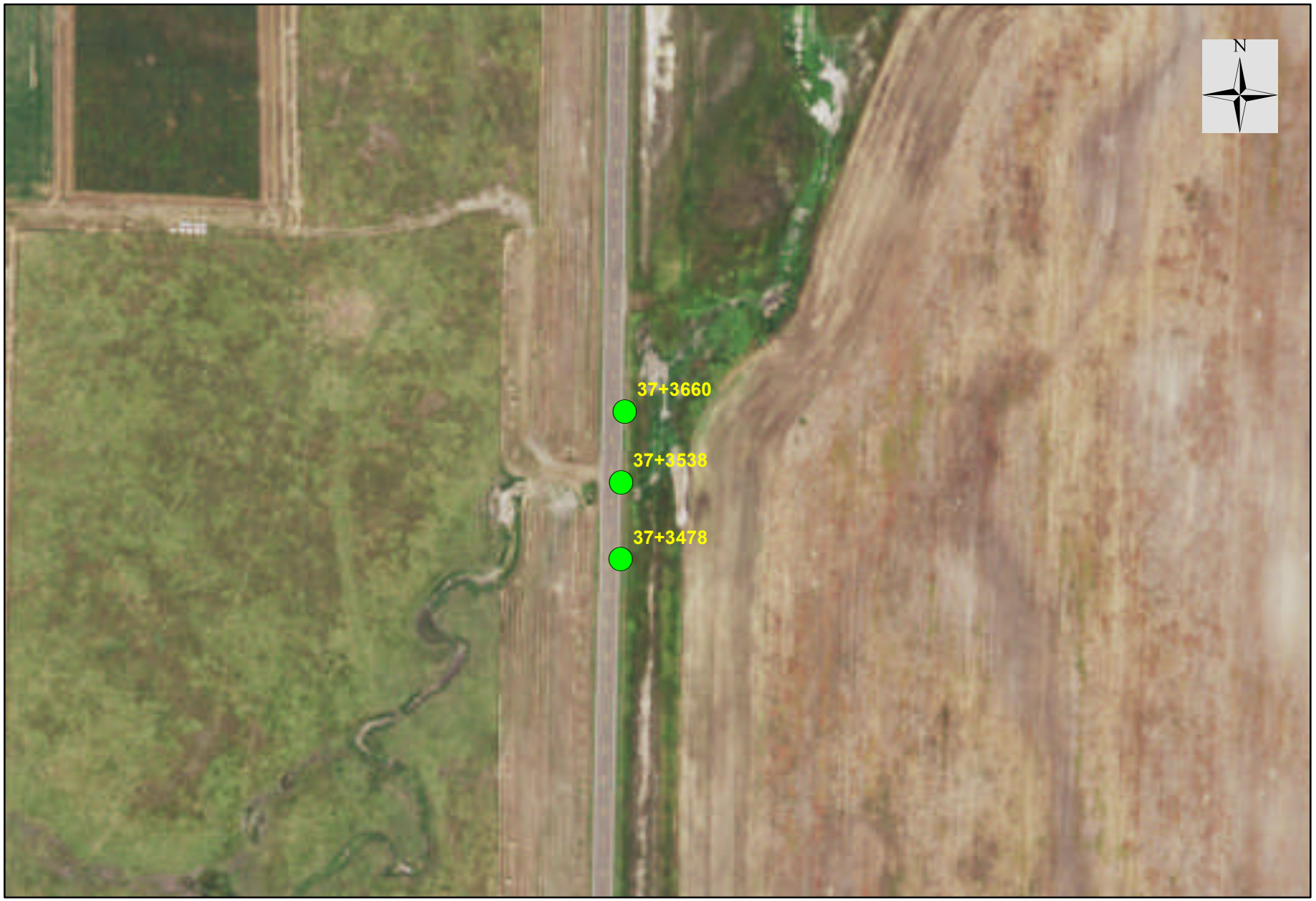
29
67+2477



30
67+2477

APPENDIX C

BORING LOCATIONS

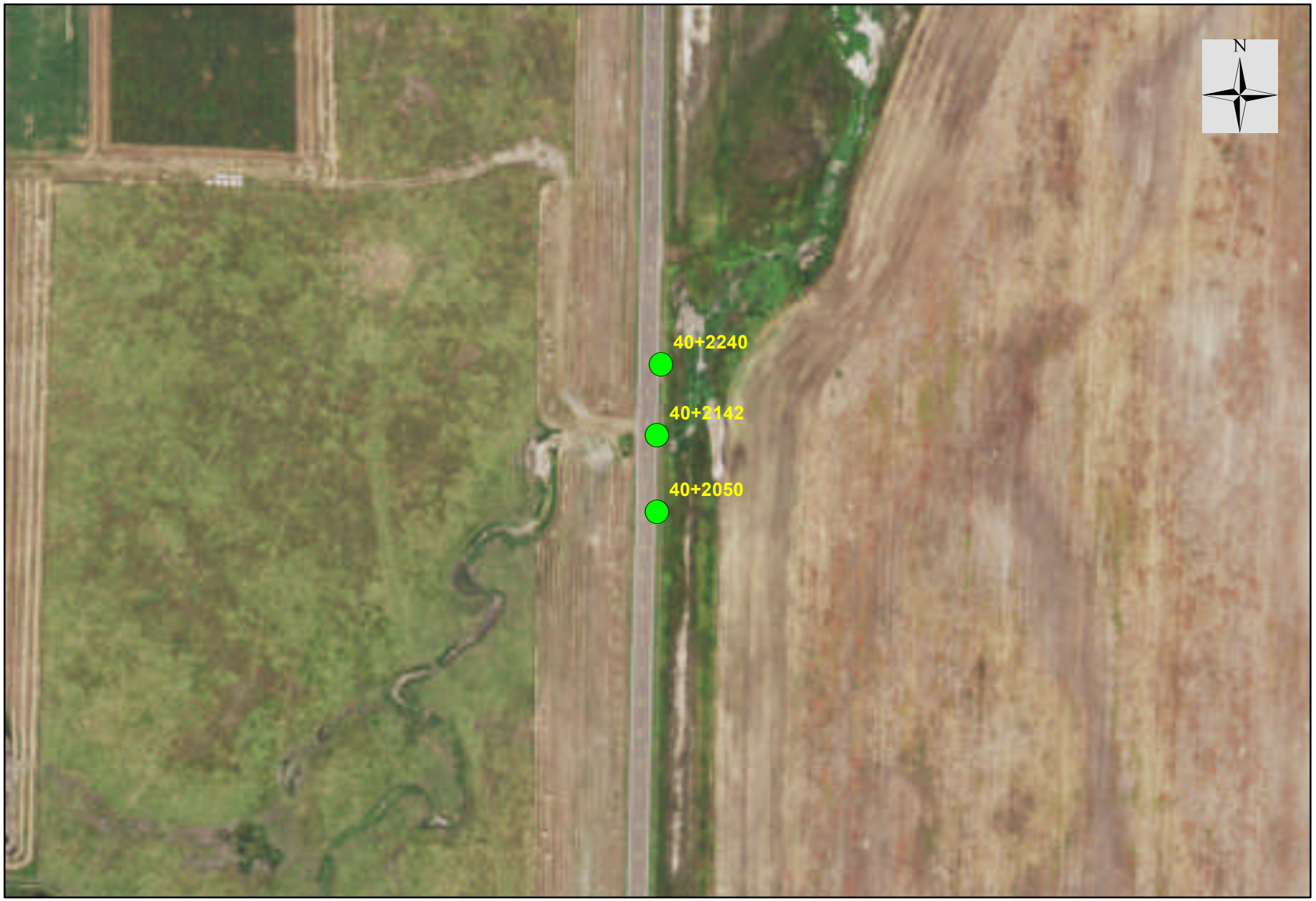


Legend

- Reference Point
- Boring Locations

0 225 450 Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039

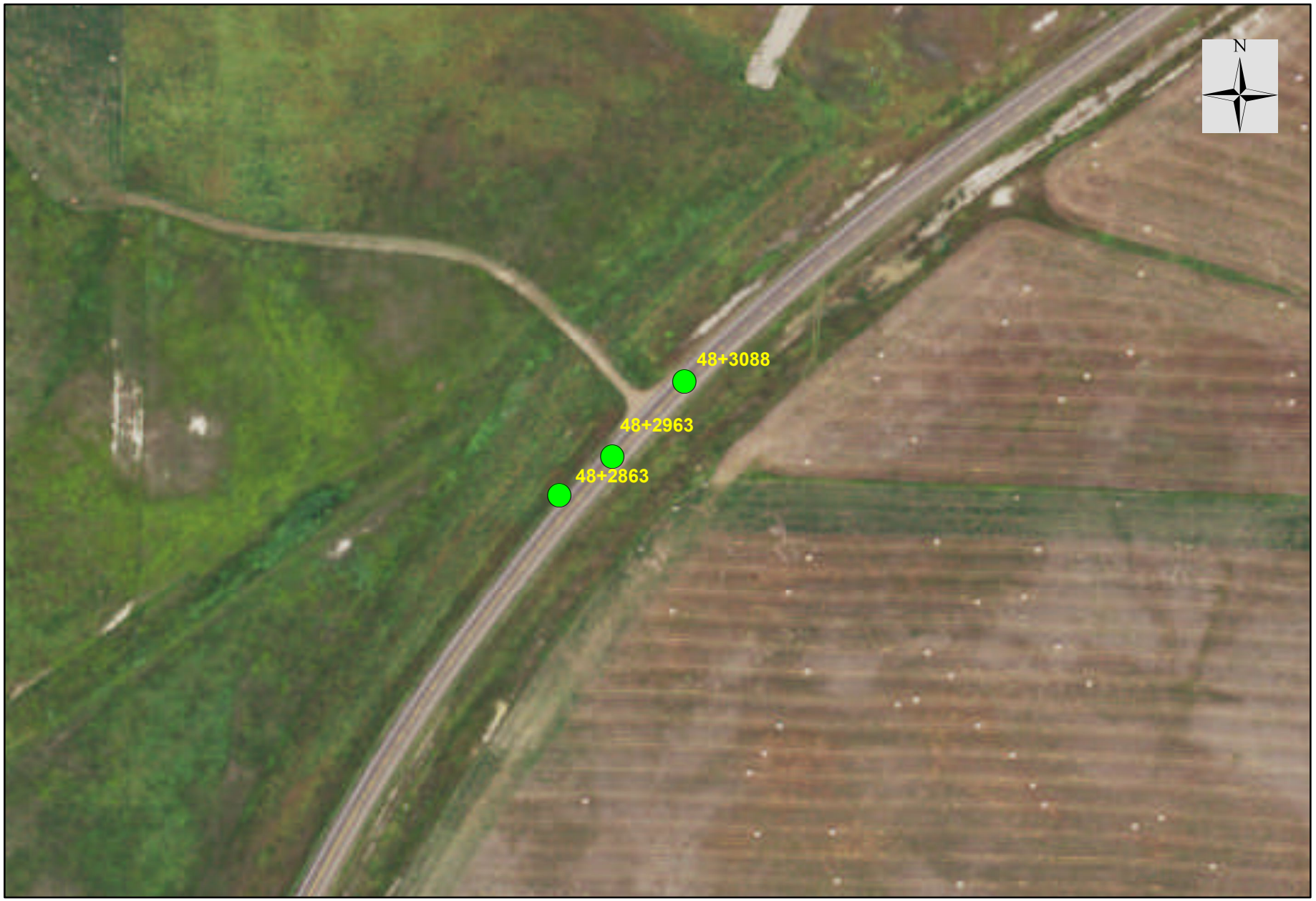


Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450 Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039



Legend

- Reference Point
- Boring Locations

0 225 450
Feet

Project Number: X-1-049(031)039

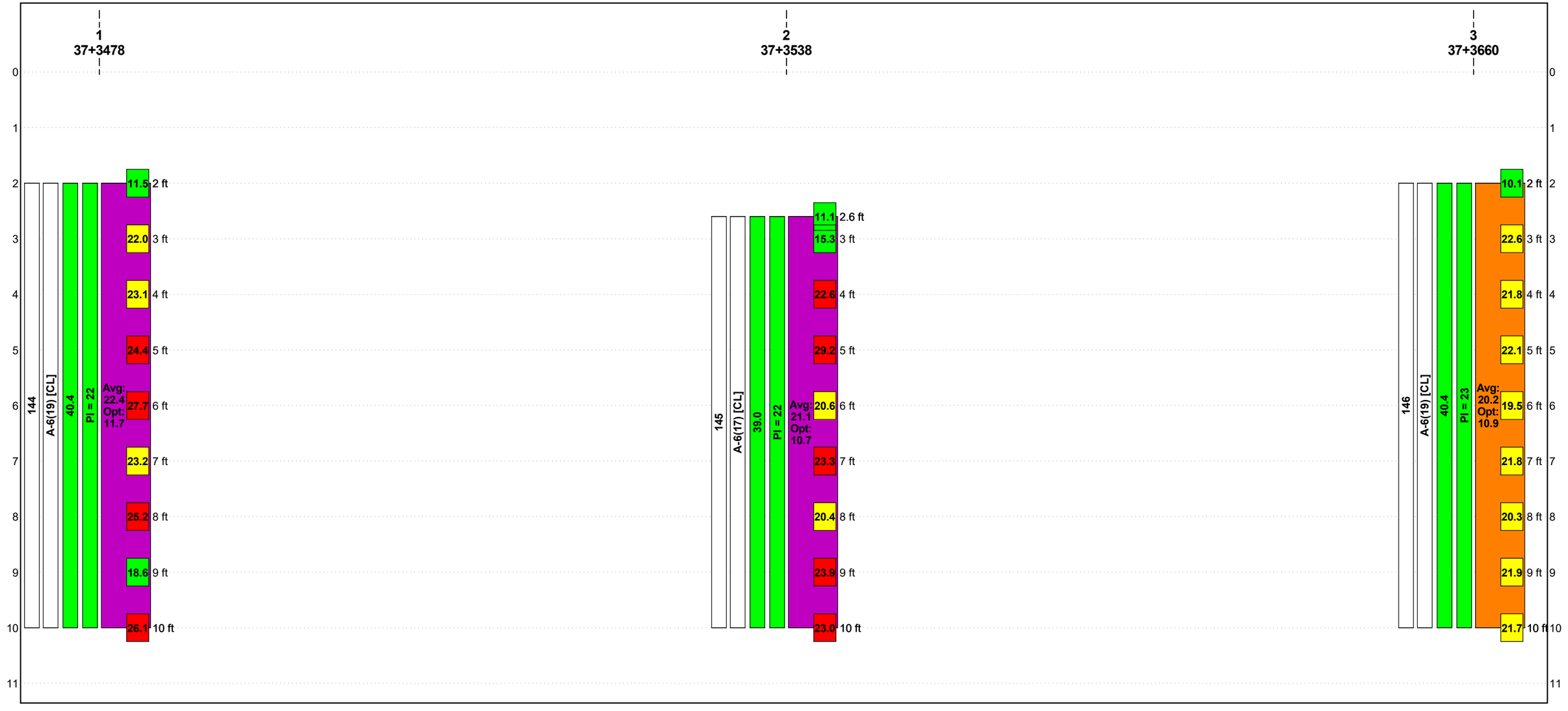
APPENDIX D

SUMMARY OF SOILS ANALYSIS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

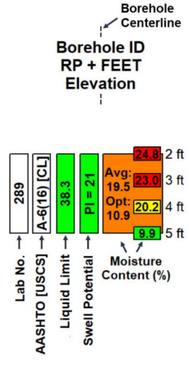
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

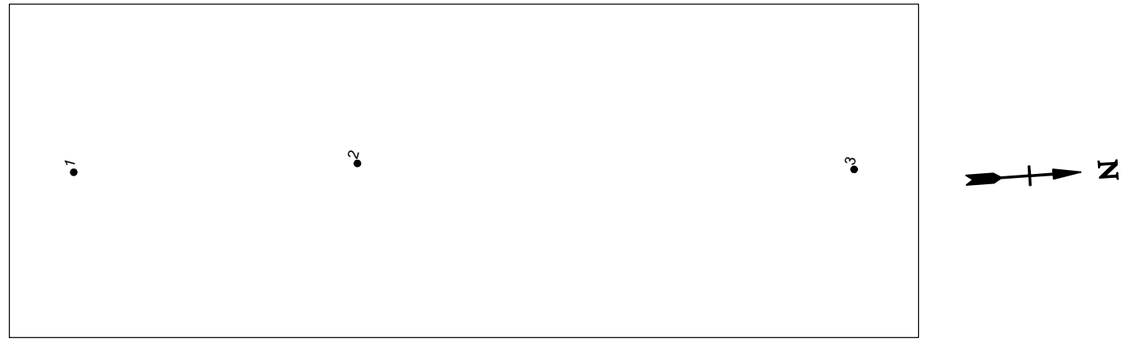


Boreholes Equally Spaced (0 to 60 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

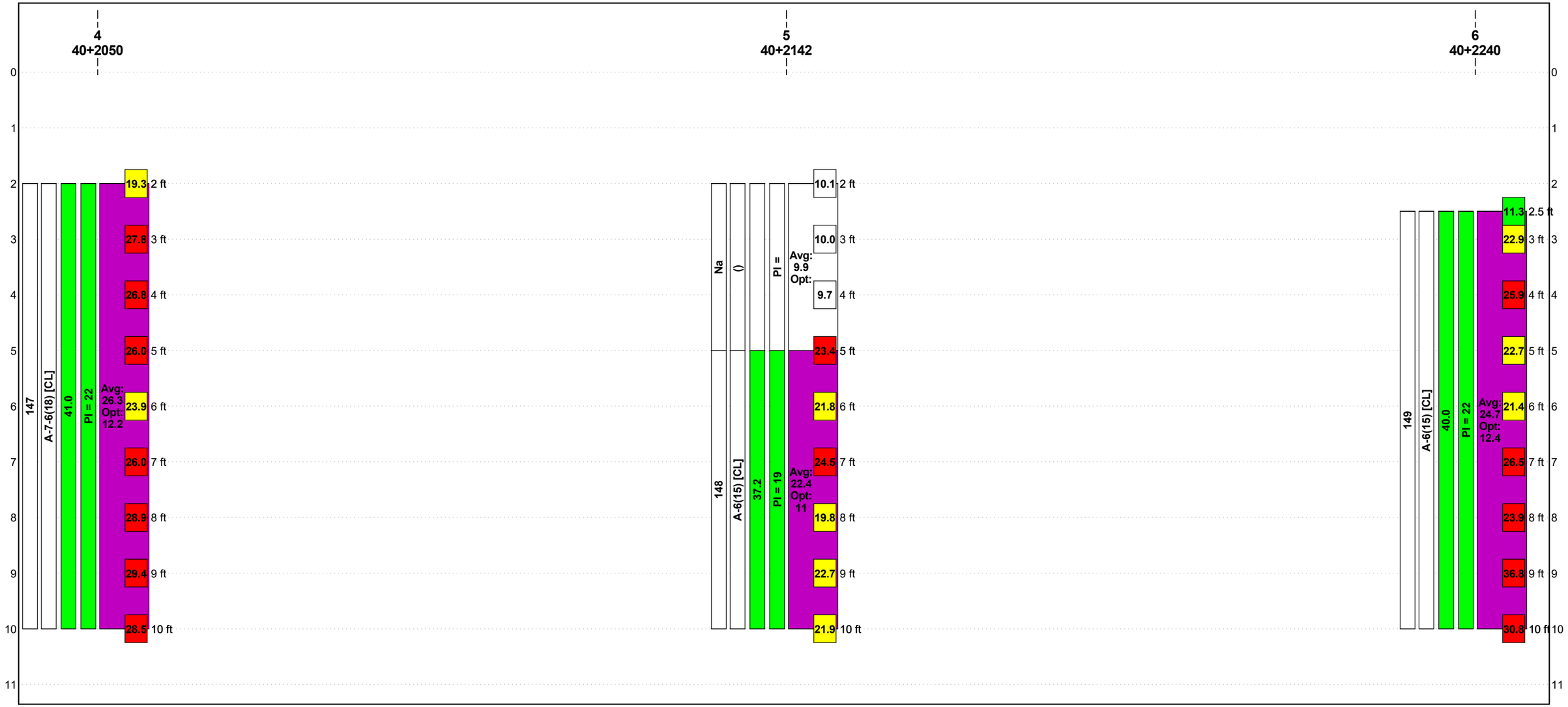


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:20 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

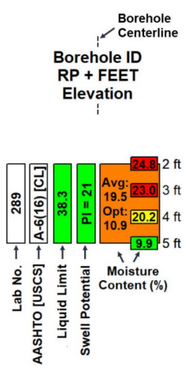
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

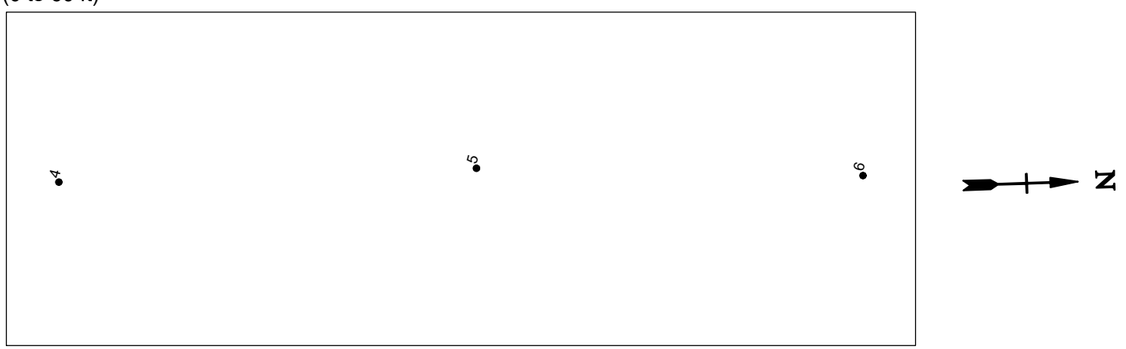


Boreholes Equally Spaced (0 to 60 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

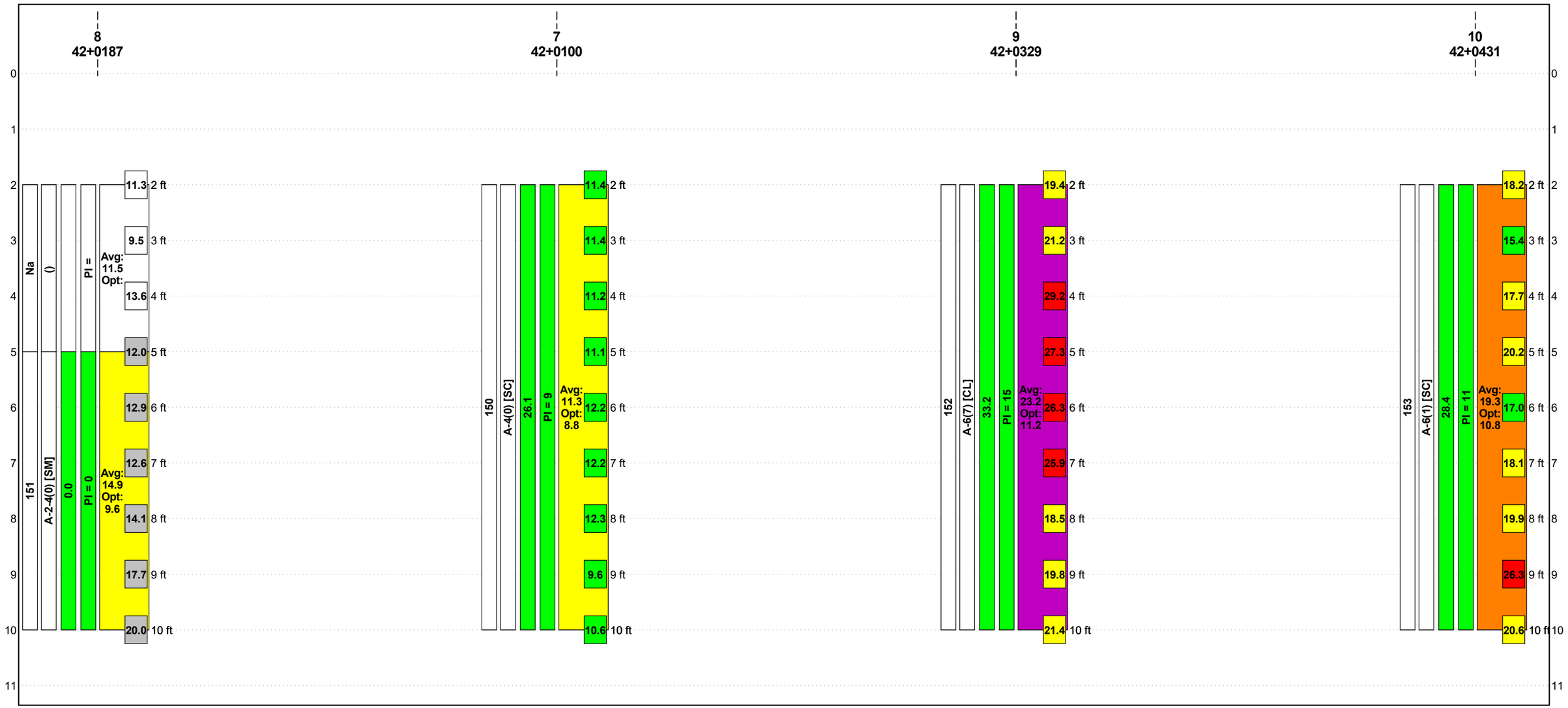


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:20 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

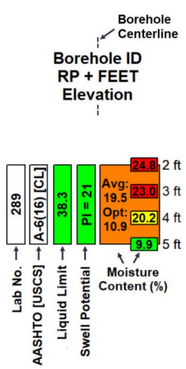
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton



Boreholes Equally Spaced (0 to 450 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:21 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

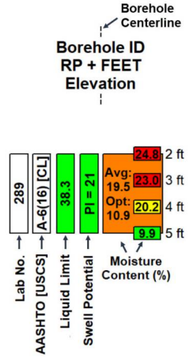
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

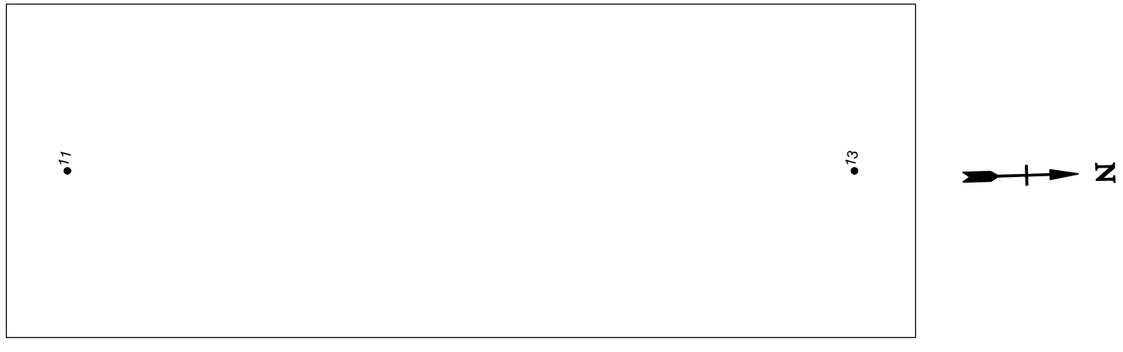


Boreholes Equally Spaced (0 to 3500 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

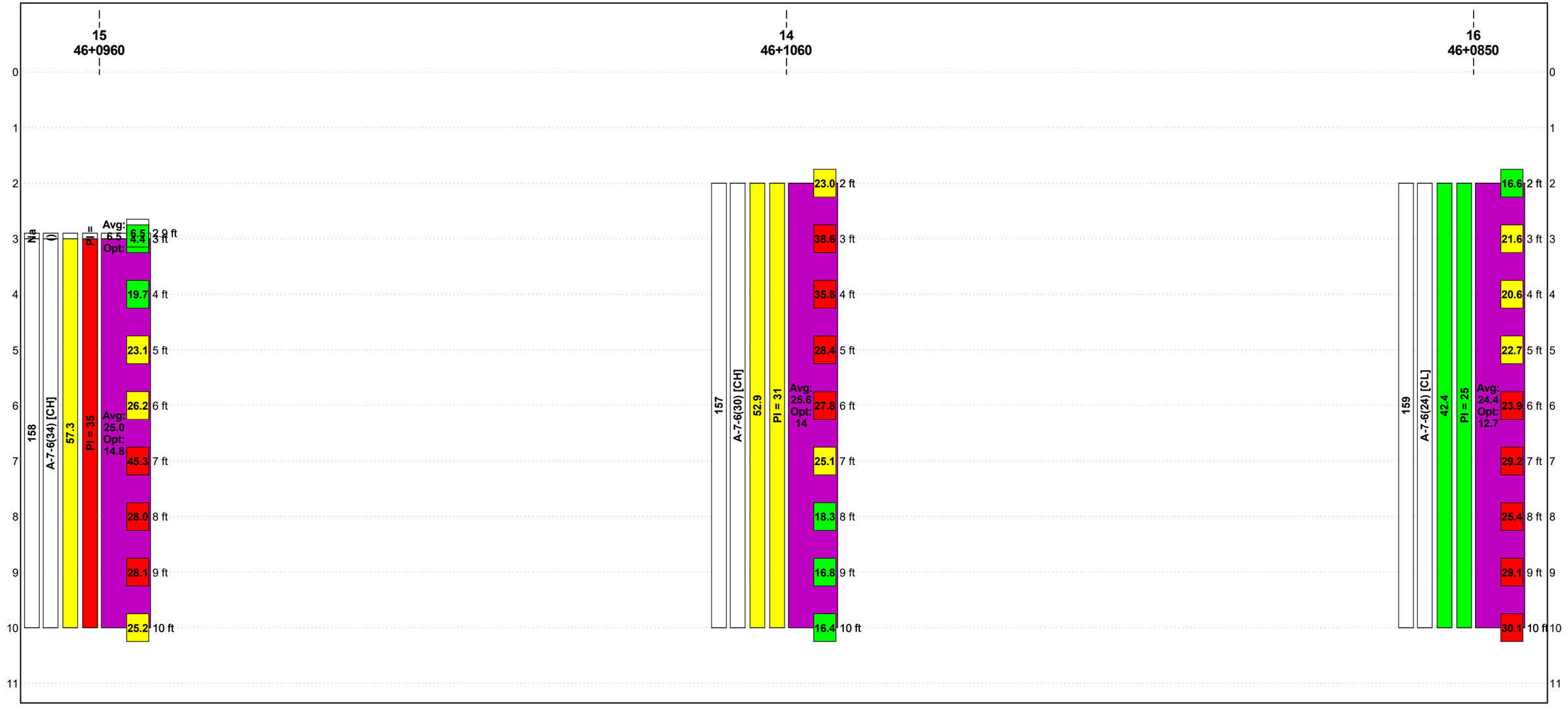


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 7/11/23 09:39 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

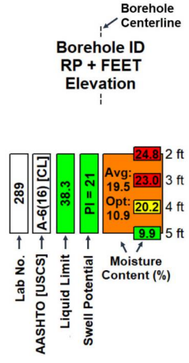
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

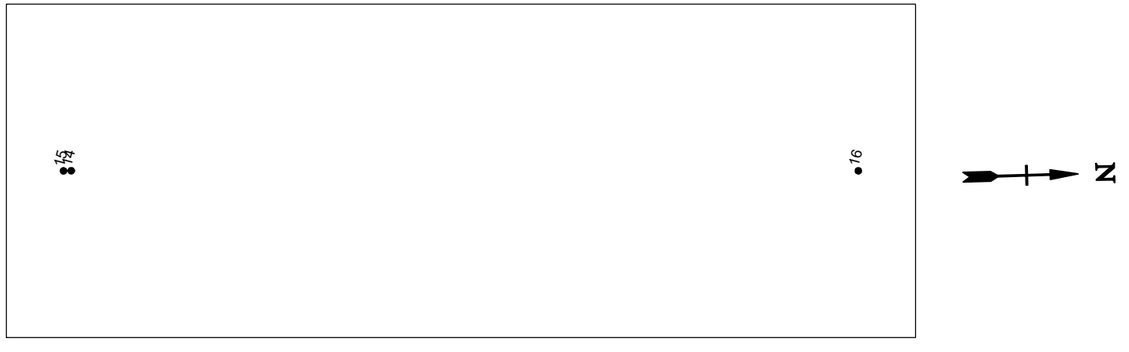


Boreholes Equally Spaced (0 to 3500 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

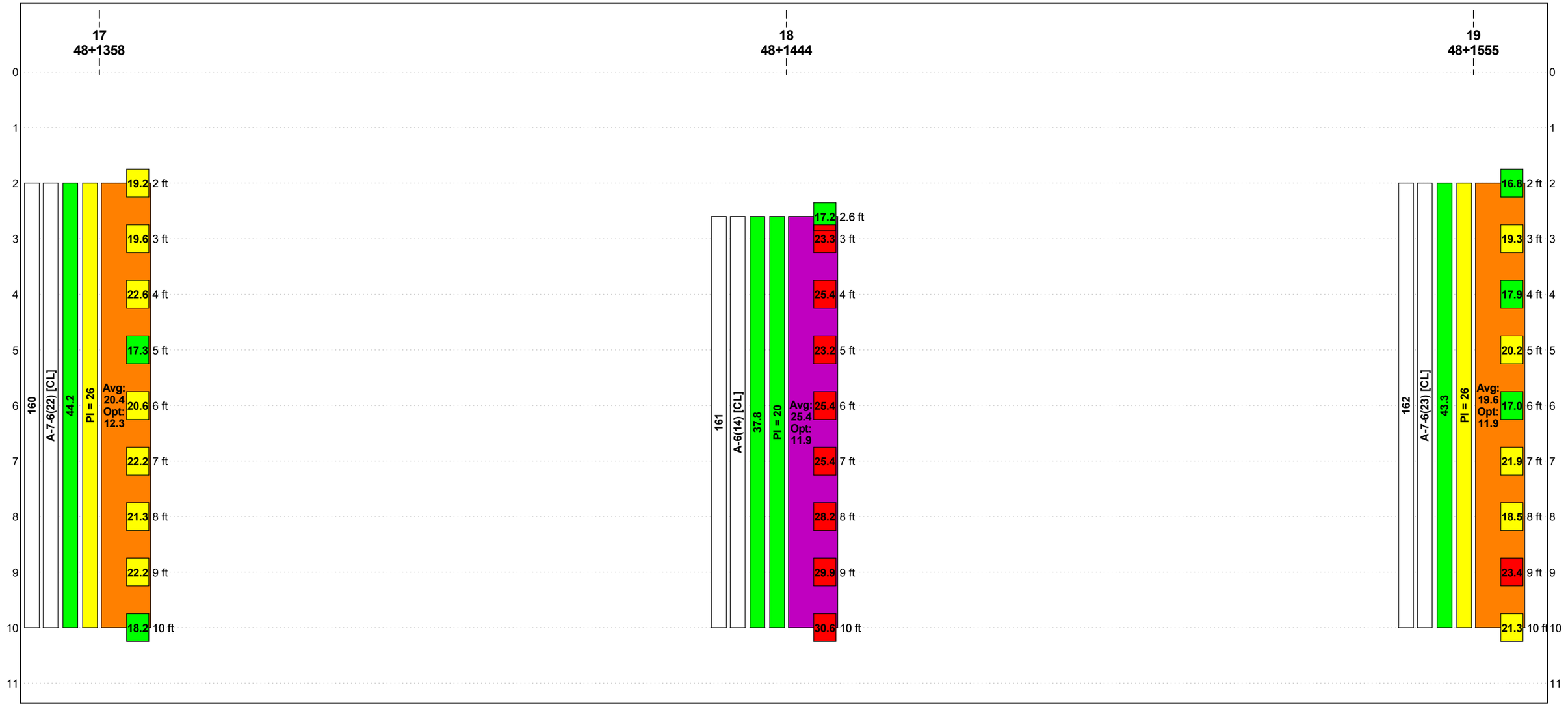


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:23 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

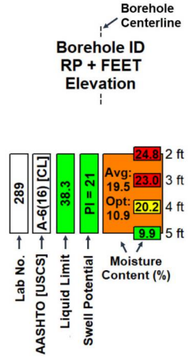
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

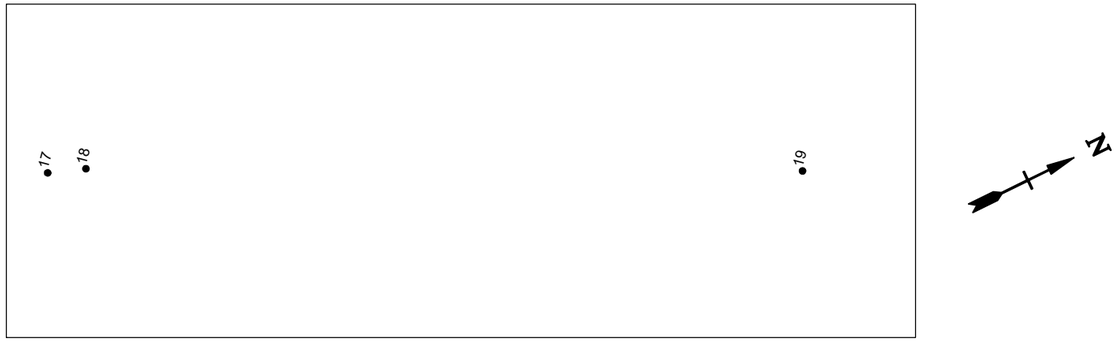


Boreholes Equally Spaced (0 to 500 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

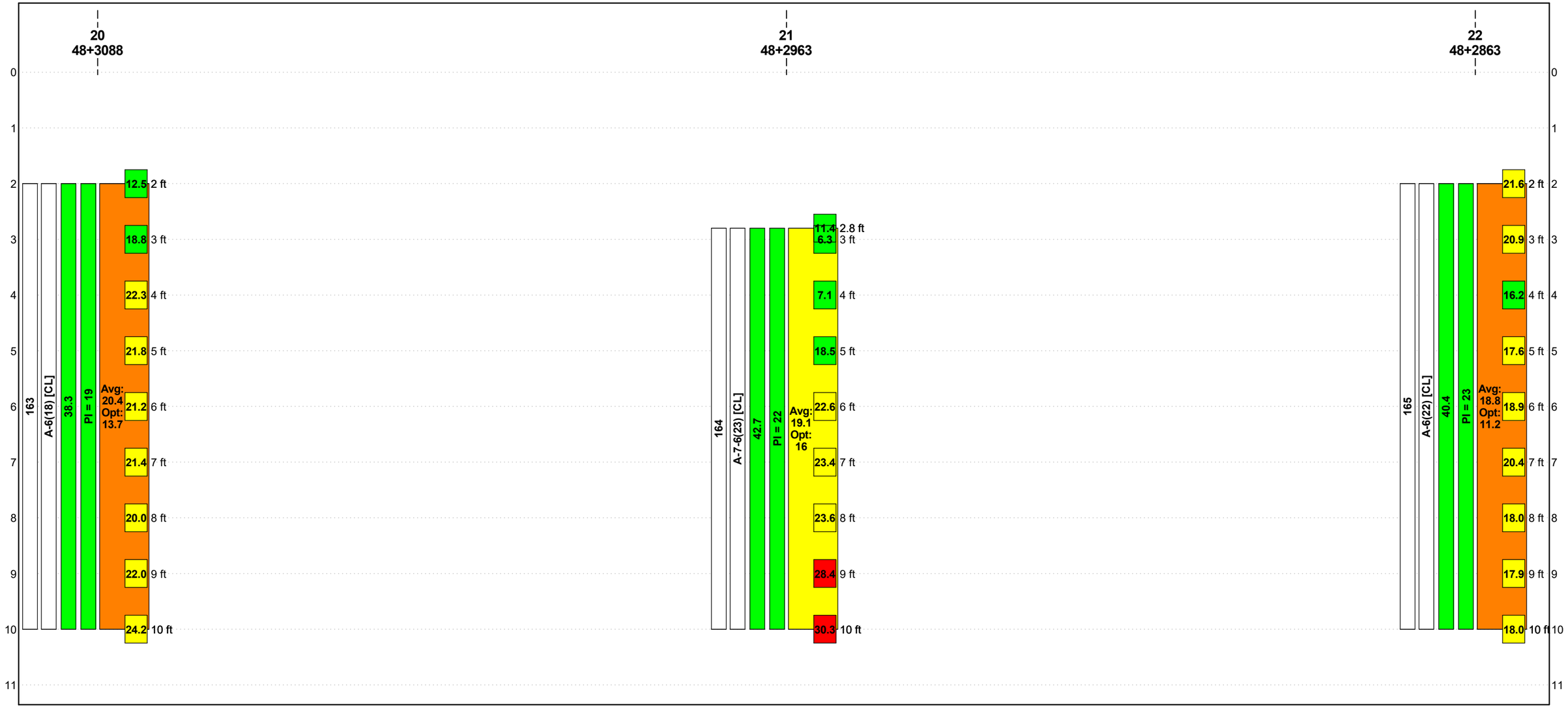


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:23 - F:\LAB\PROJECTS\GINT\11-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

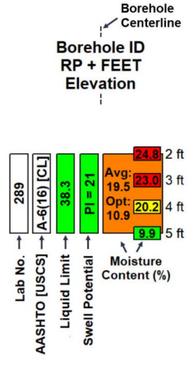
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

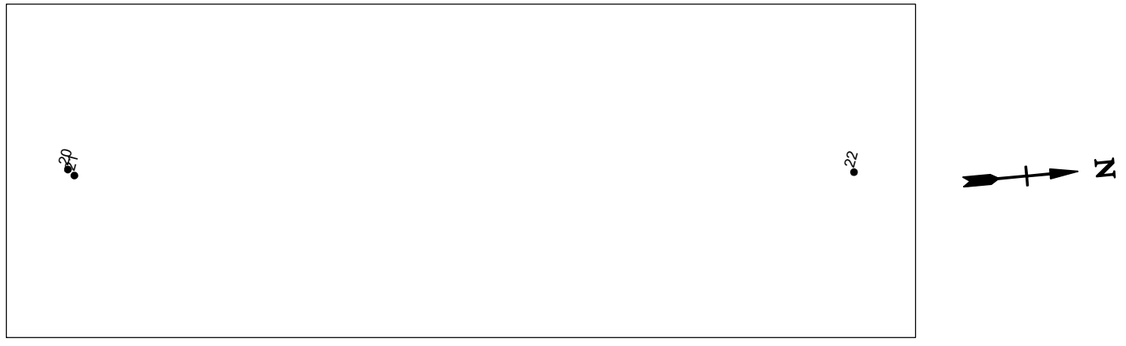


Boreholes Equally Spaced (0 to 6500 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

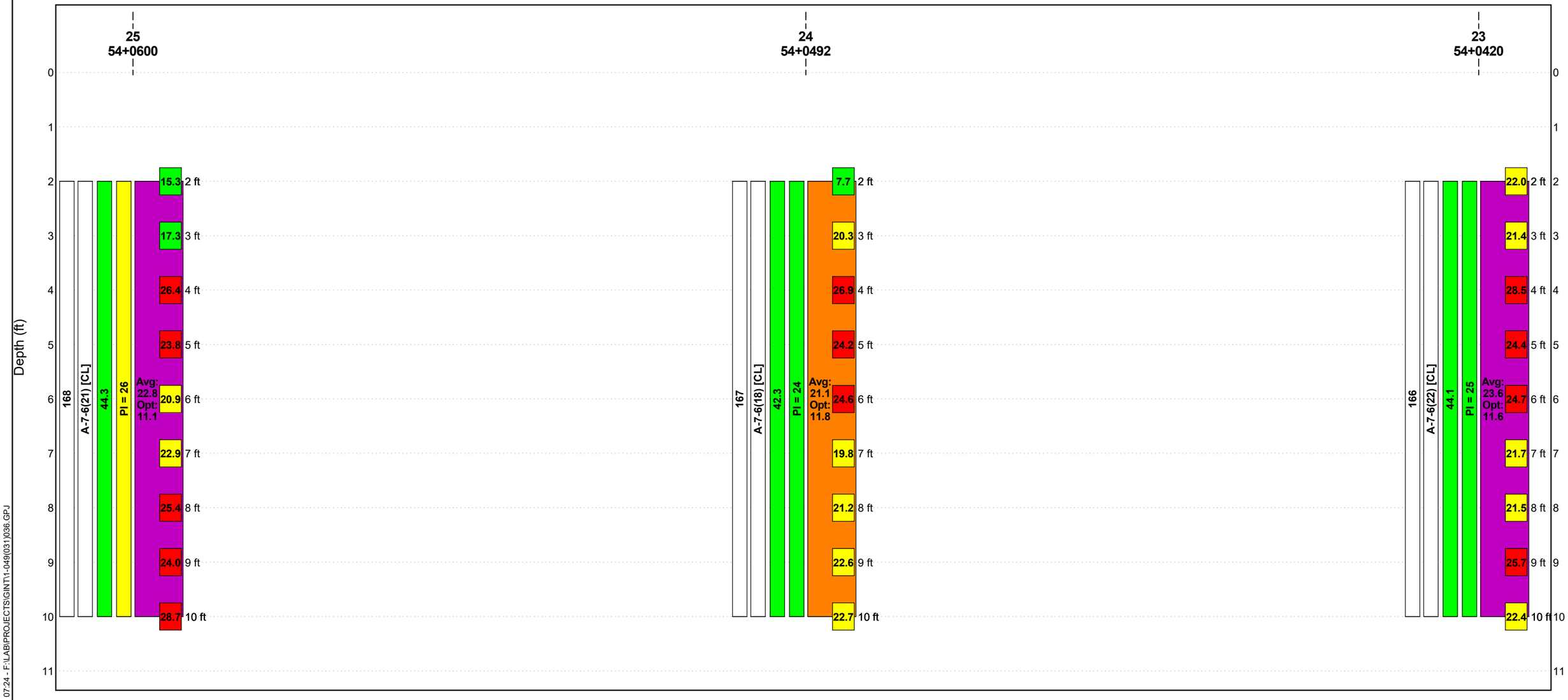


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:24 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

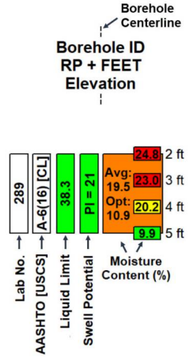
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

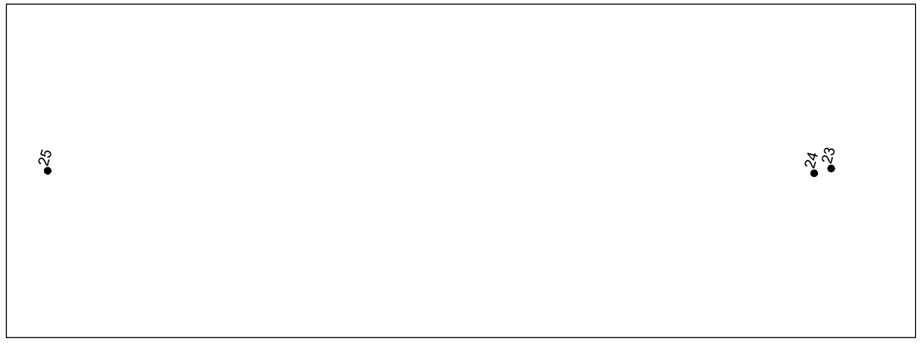


Boreholes Equally Spaced (0 to 1600 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

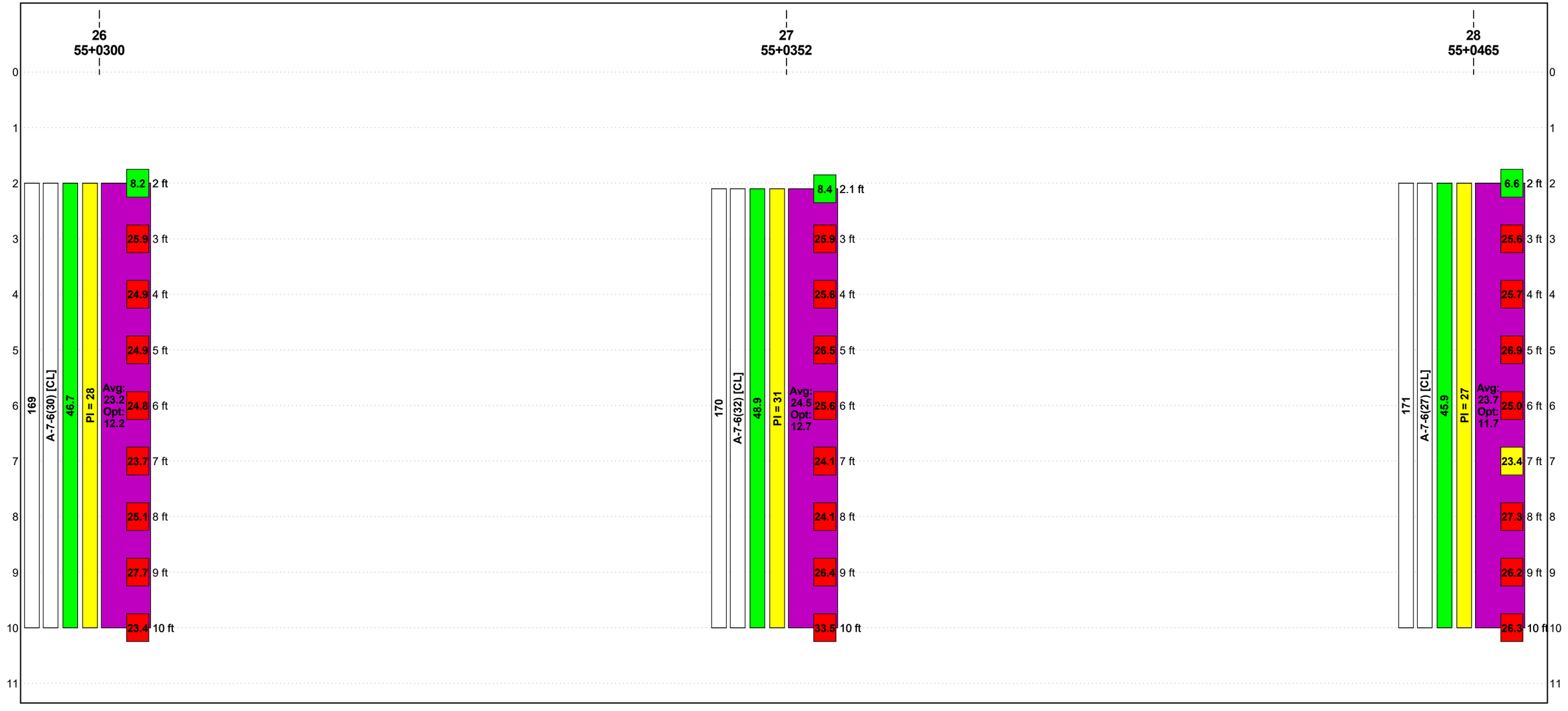


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:24 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

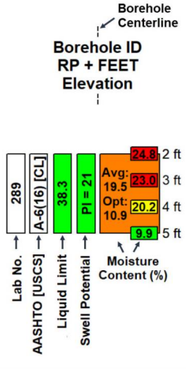
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

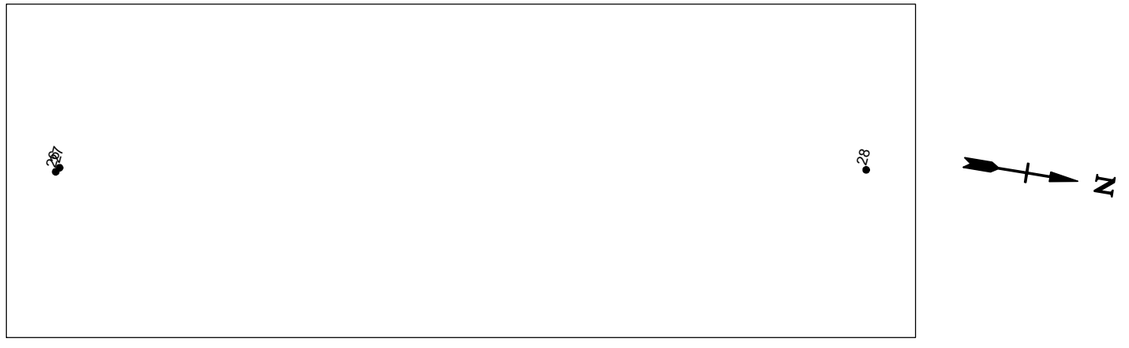


Boreholes Equally Spaced (0 to 4500 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

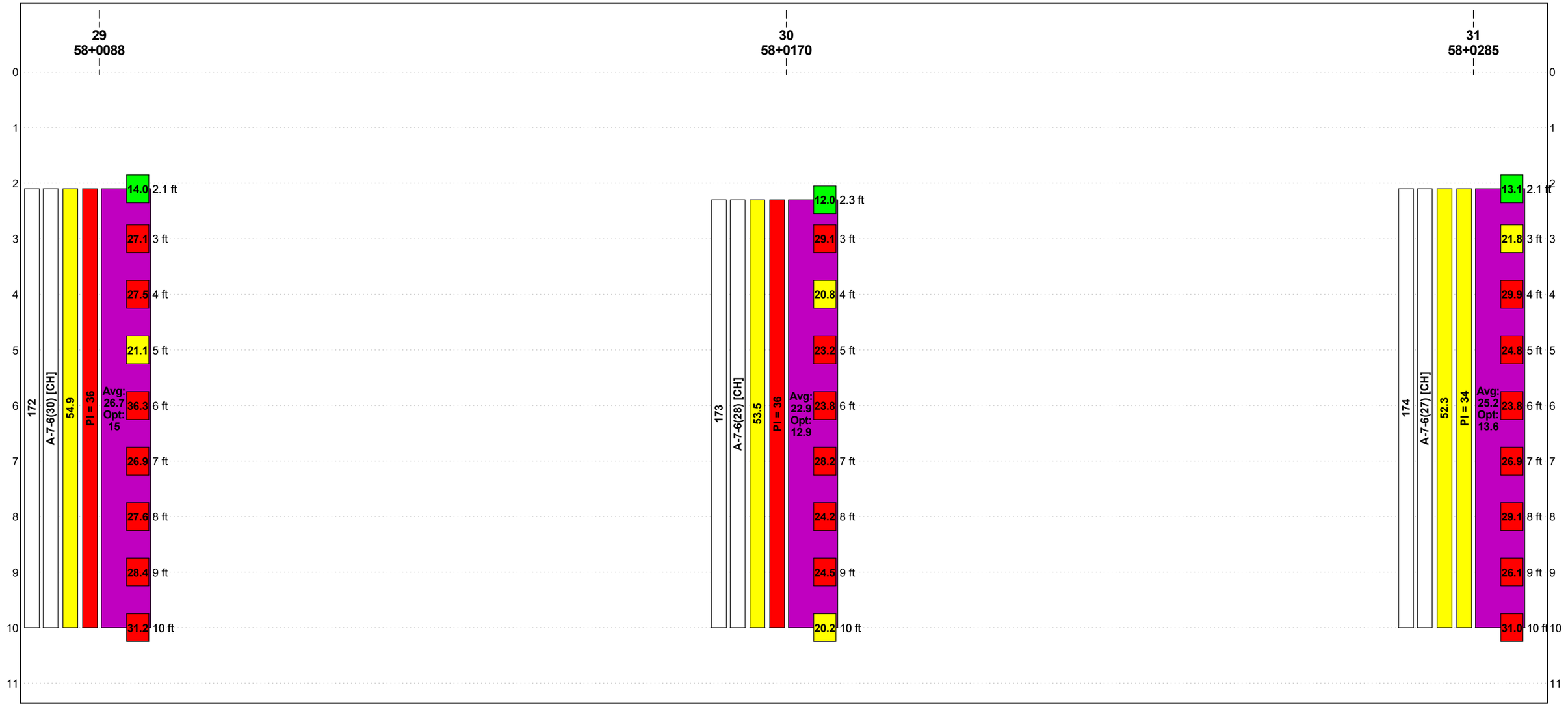


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:26 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

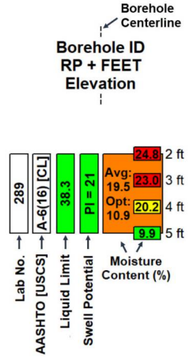
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton



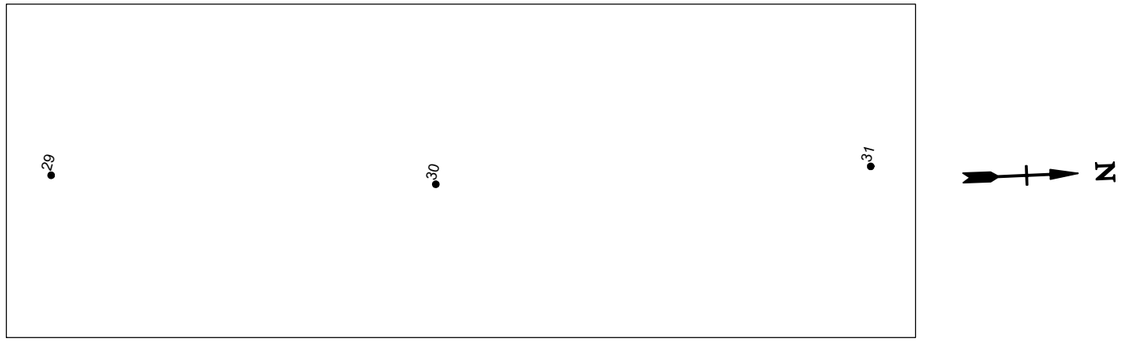
NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:26 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

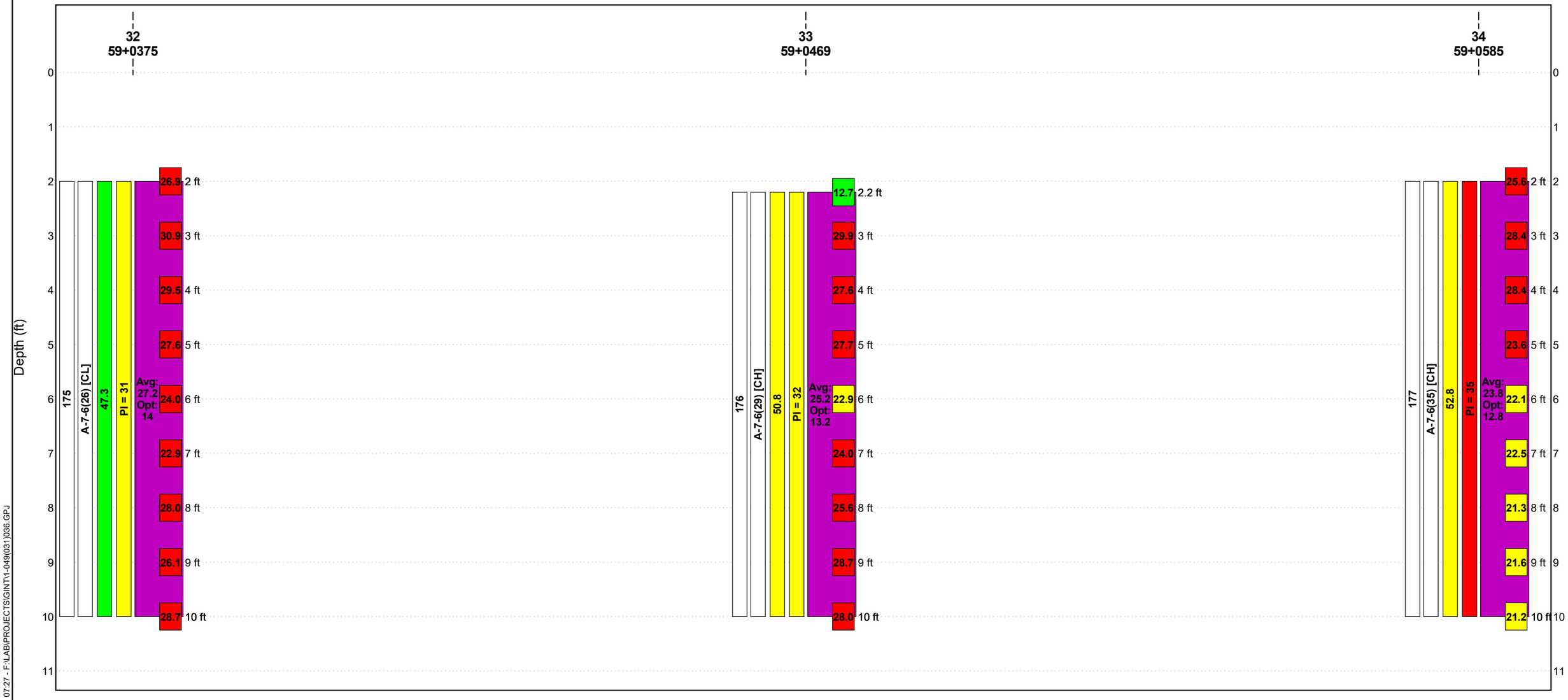
Boreholes Equally Spaced (0 to 65 ft)



NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

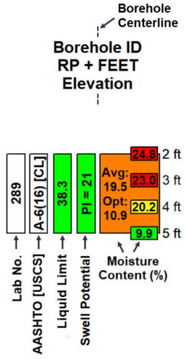
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

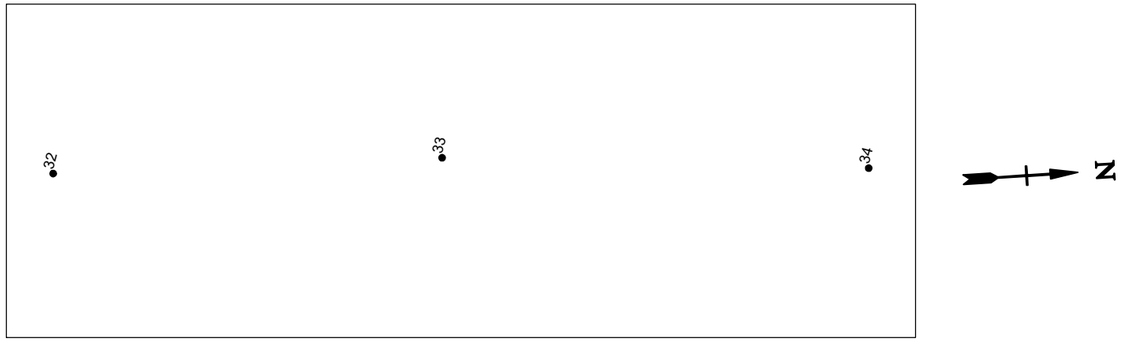


Boreholes Equally Spaced (0 to 65 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

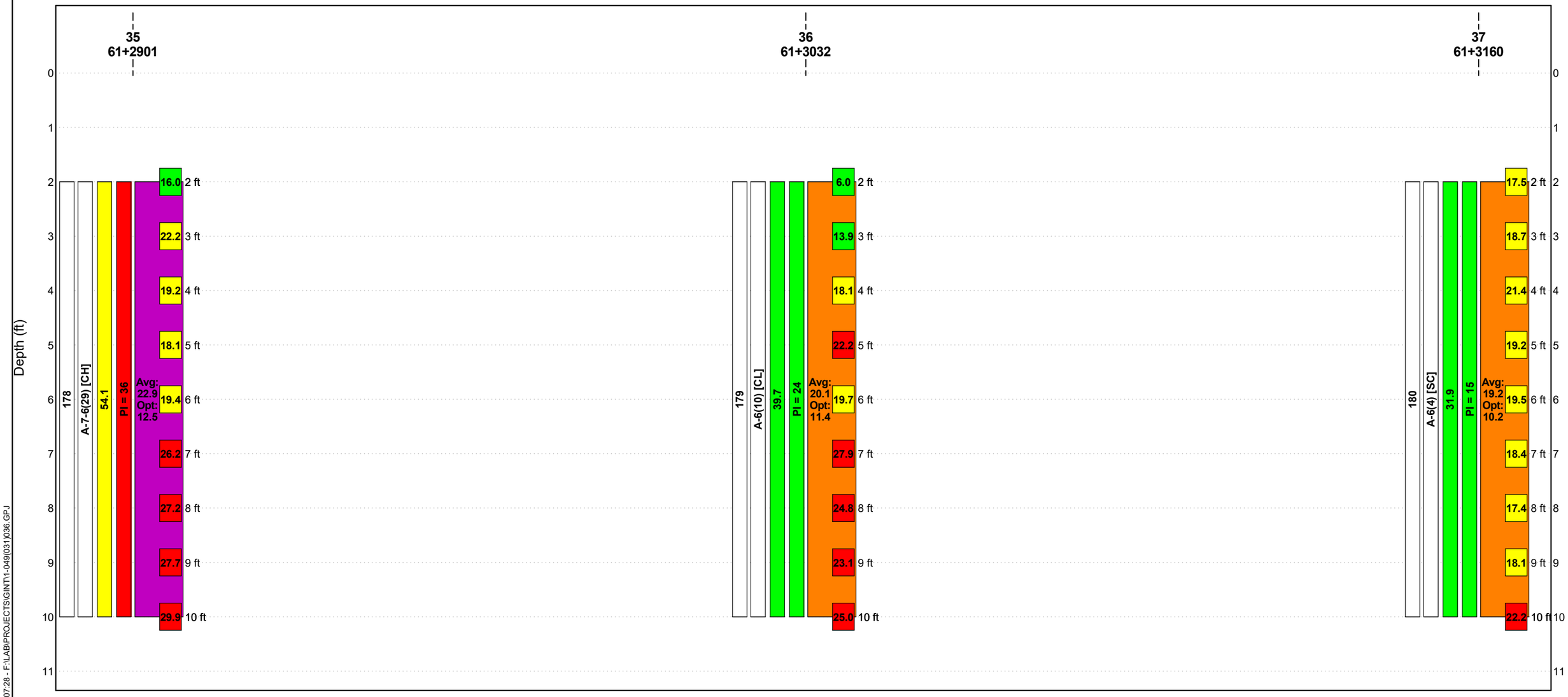


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:27 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

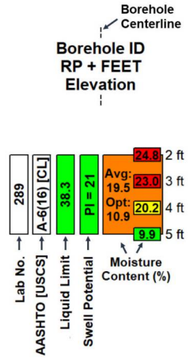
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

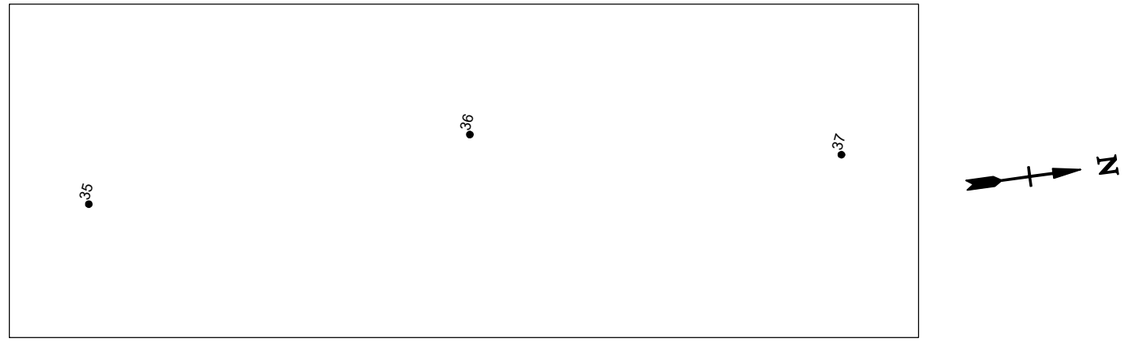


LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

Boreholes Equally Spaced (0 to 90 ft)

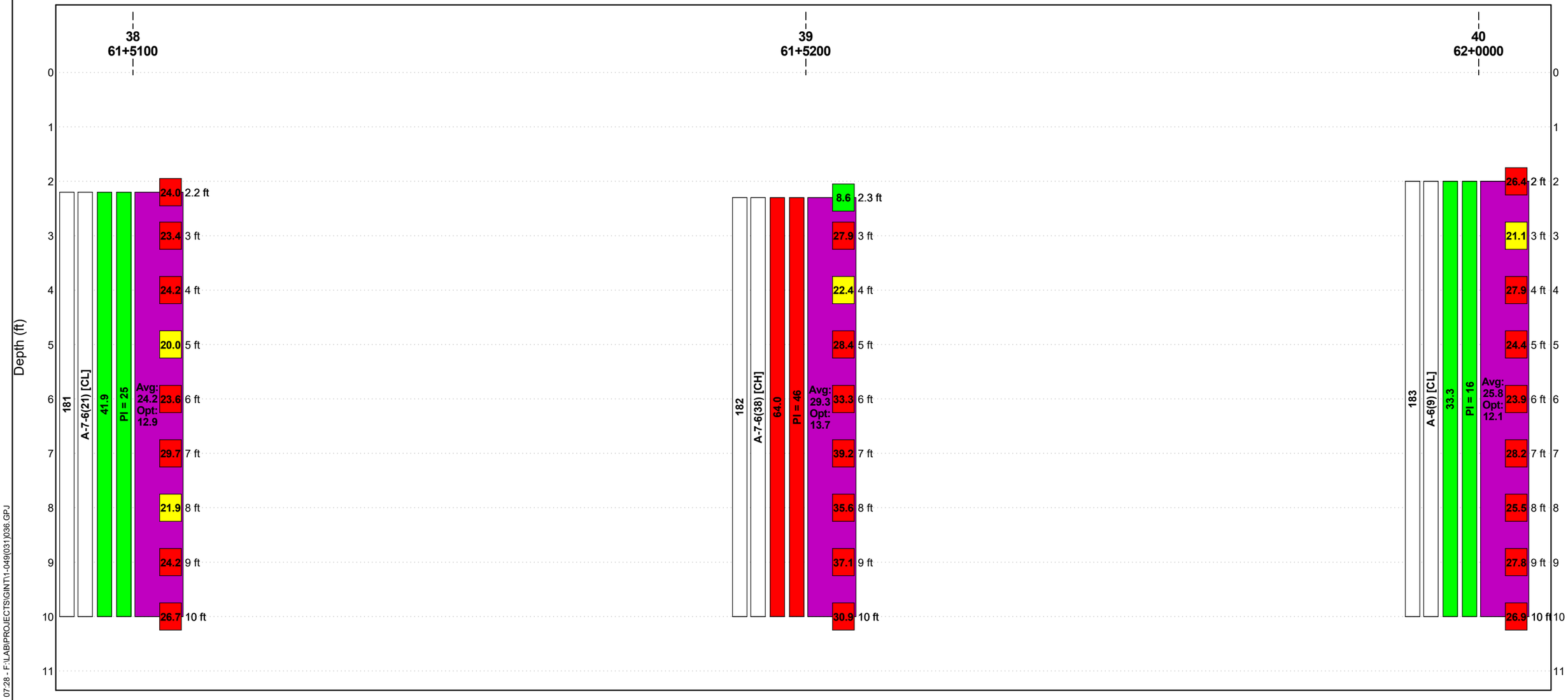


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:28 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

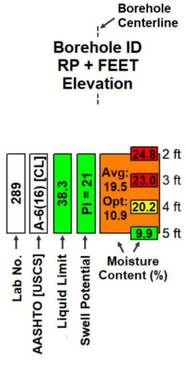
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

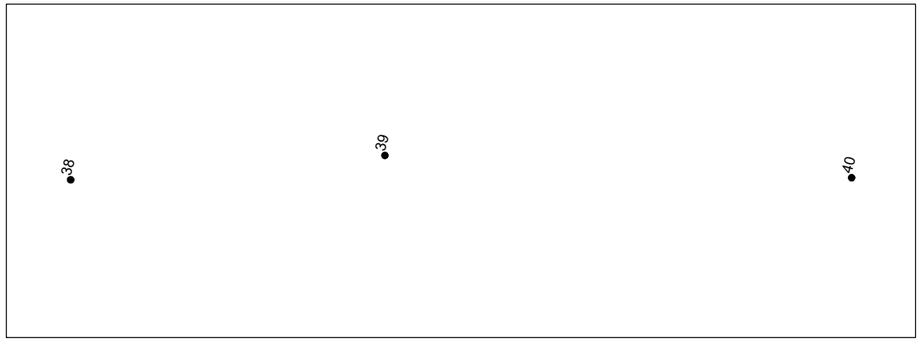


LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

Boreholes Equally Spaced (0 to 80 ft)



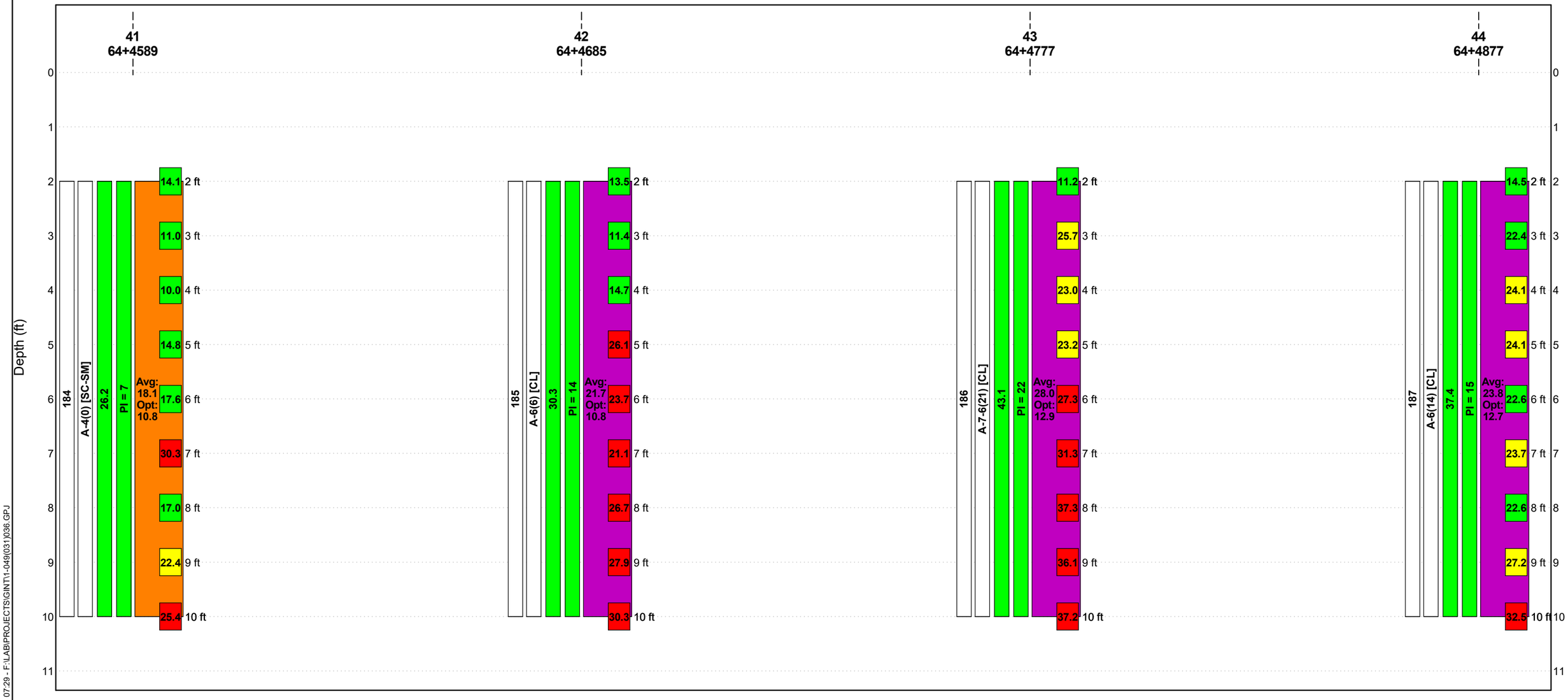
NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:28 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NDDOT
North Dakota Department of Transportation

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

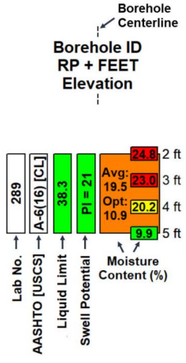
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

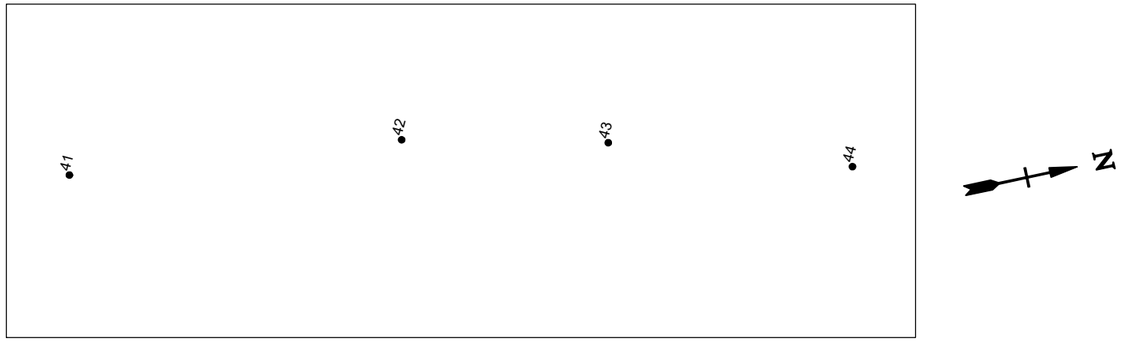


Boreholes Equally Spaced (0 to 90 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

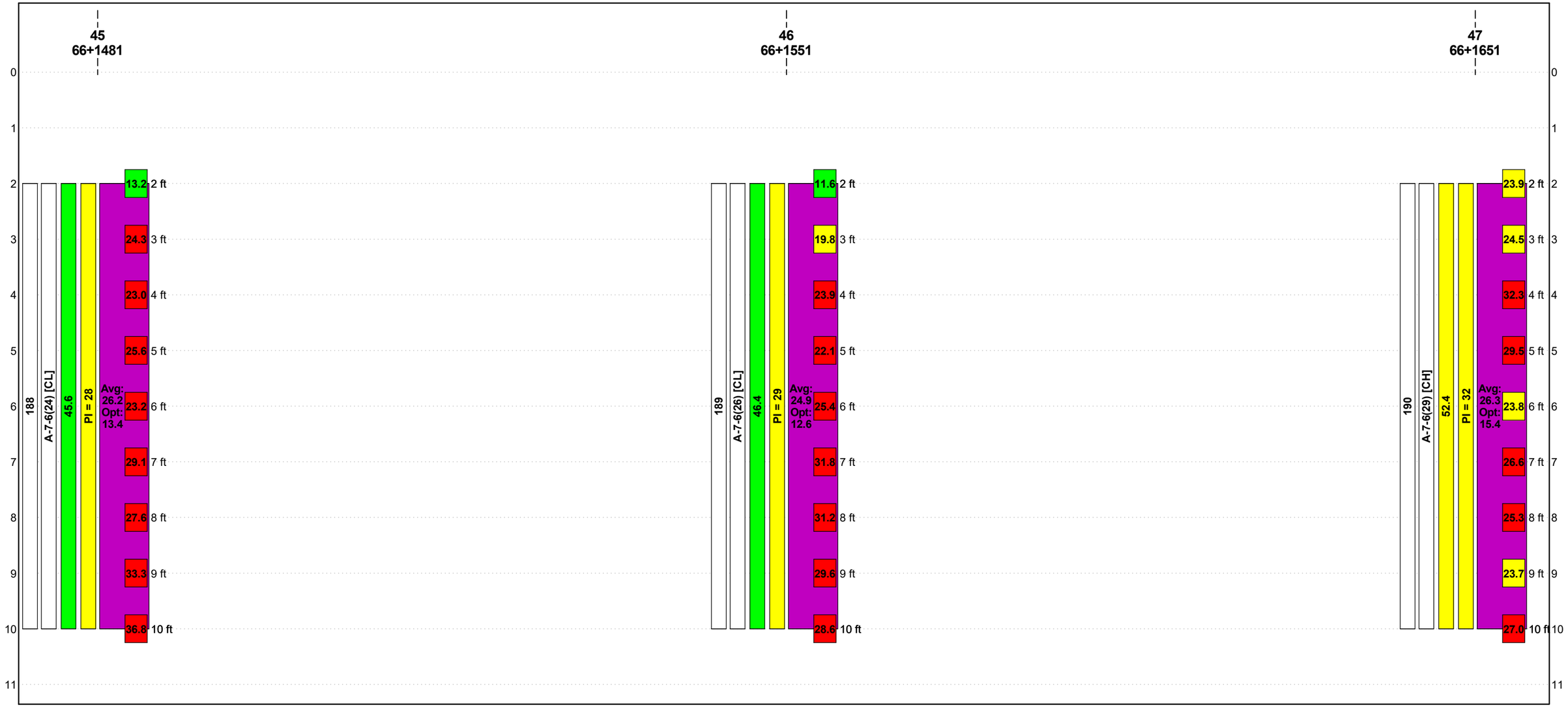


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:29 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

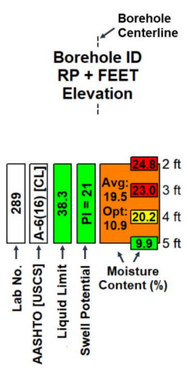
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

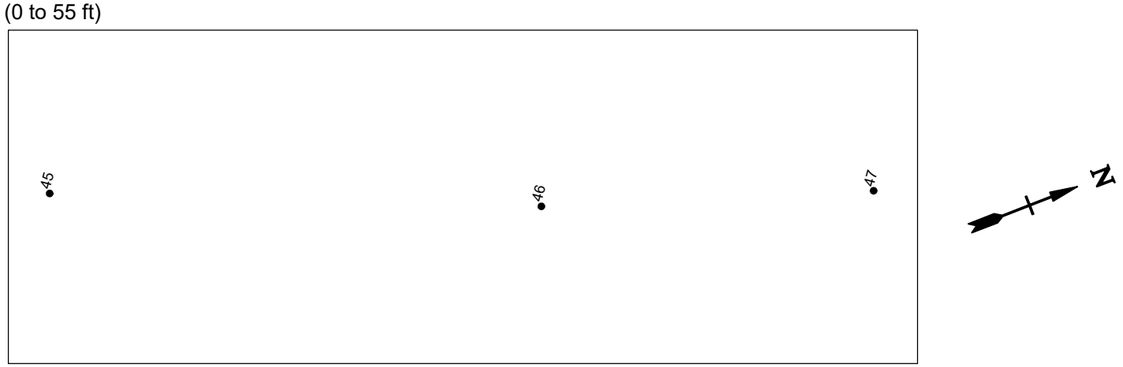


Boreholes Equally Spaced (0 to 55 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

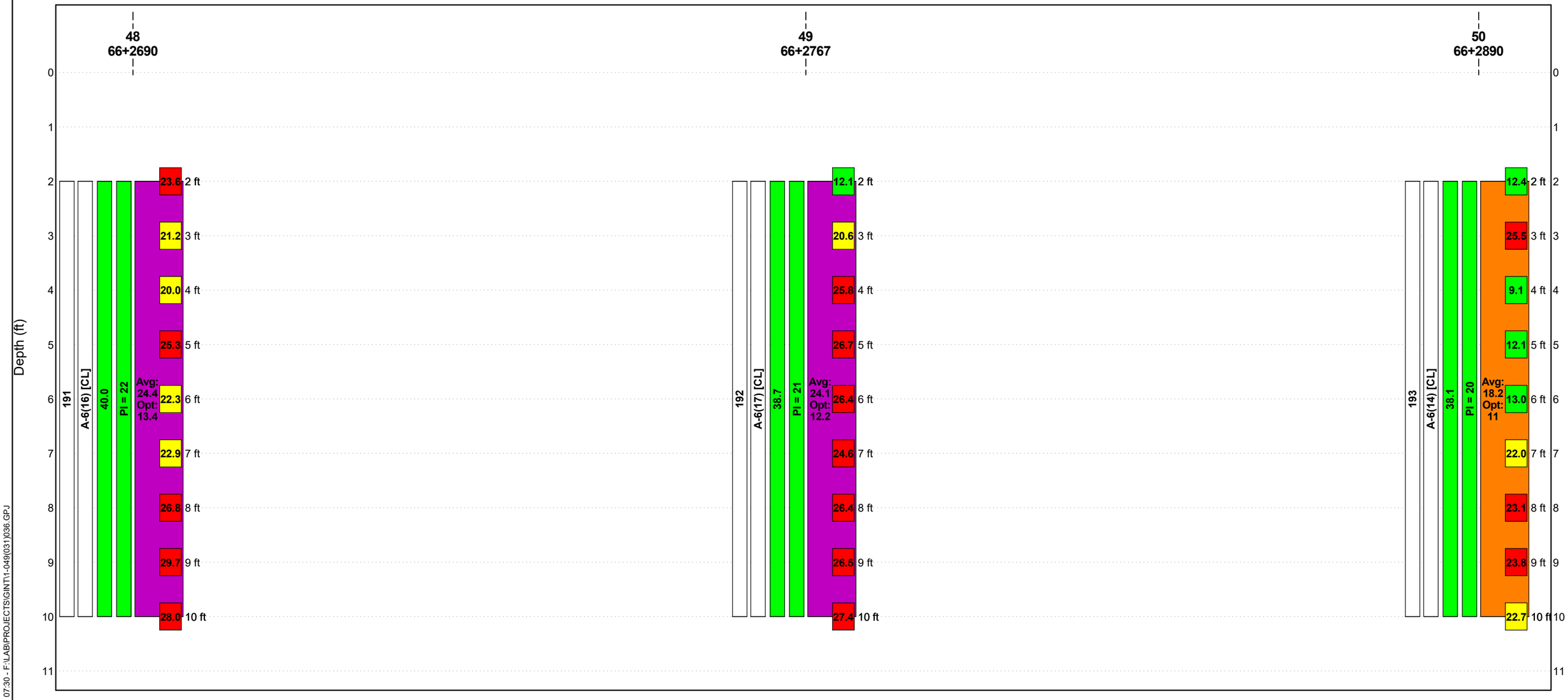


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:57 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

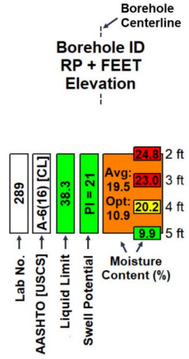
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton



Boreholes Equally Spaced (0 to 70 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt

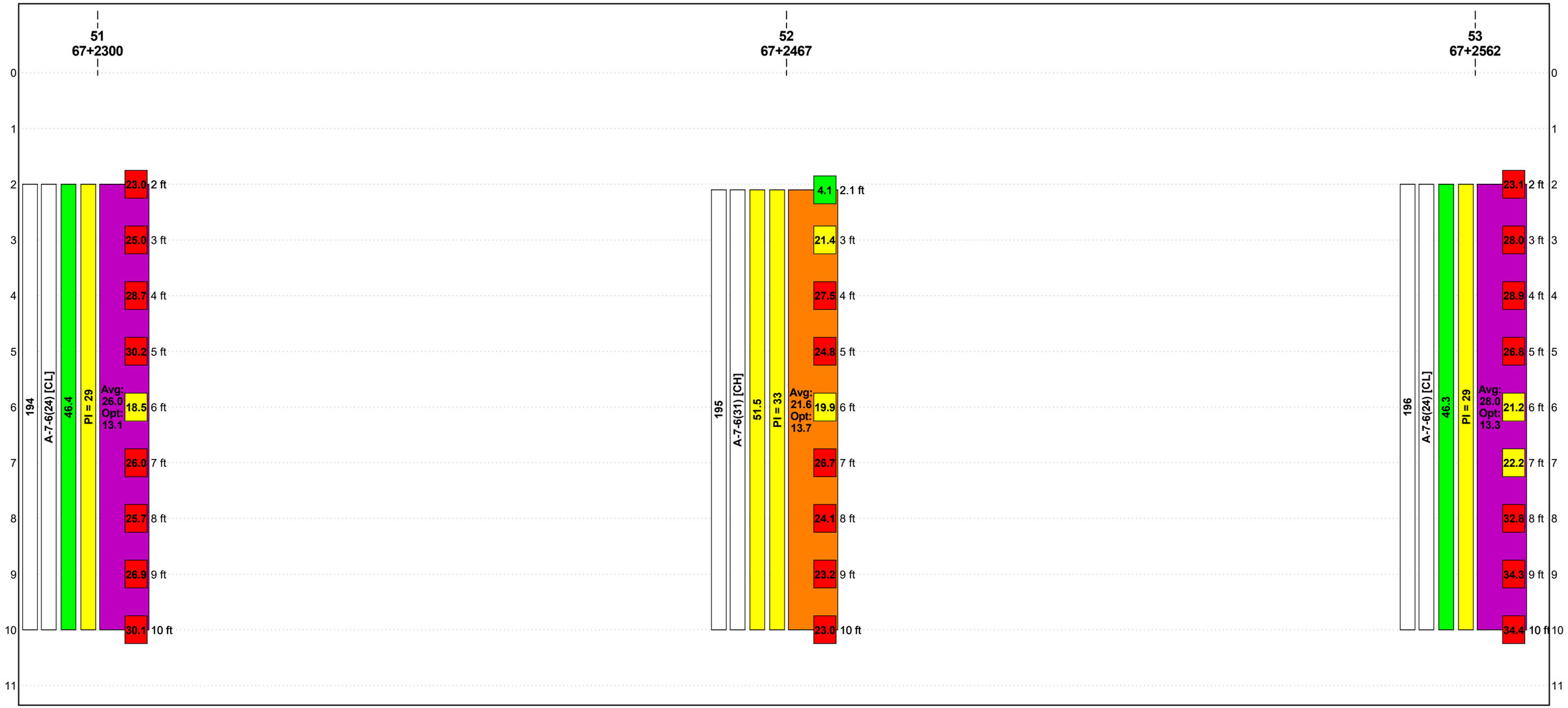


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:30 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

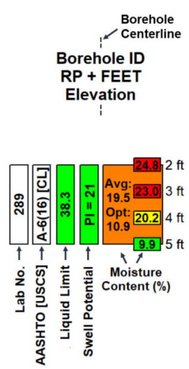
PROJECT NUMBER X-1-049(031)036 **PCN** 23272

LOCATION Grant & Morton

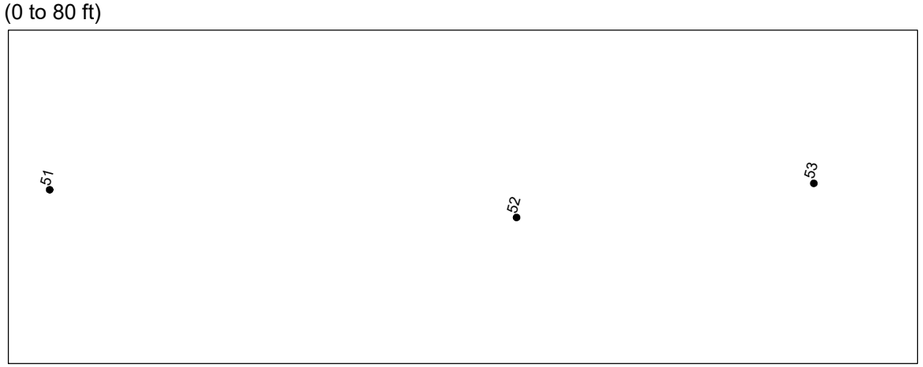


Boreholes Equally Spaced (0 to 80 ft)

LEGEND



Liquid Limit	LL<50	50<=LL<60	LL>=60	
Swell Potential	Low	Marginal	High	
Moisture Content	Below PL	0-5% Over PL	>5% Over PL	Non-Plastic
Avg. In-Place Moisture Content	MC < Opt	0<=MC<6% Over Opt	6<=MC<10% Over Opt	10<=MC<16% Over Opt	MC>16% Over Opt



NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/22/23 07:30 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

APPENDIX E

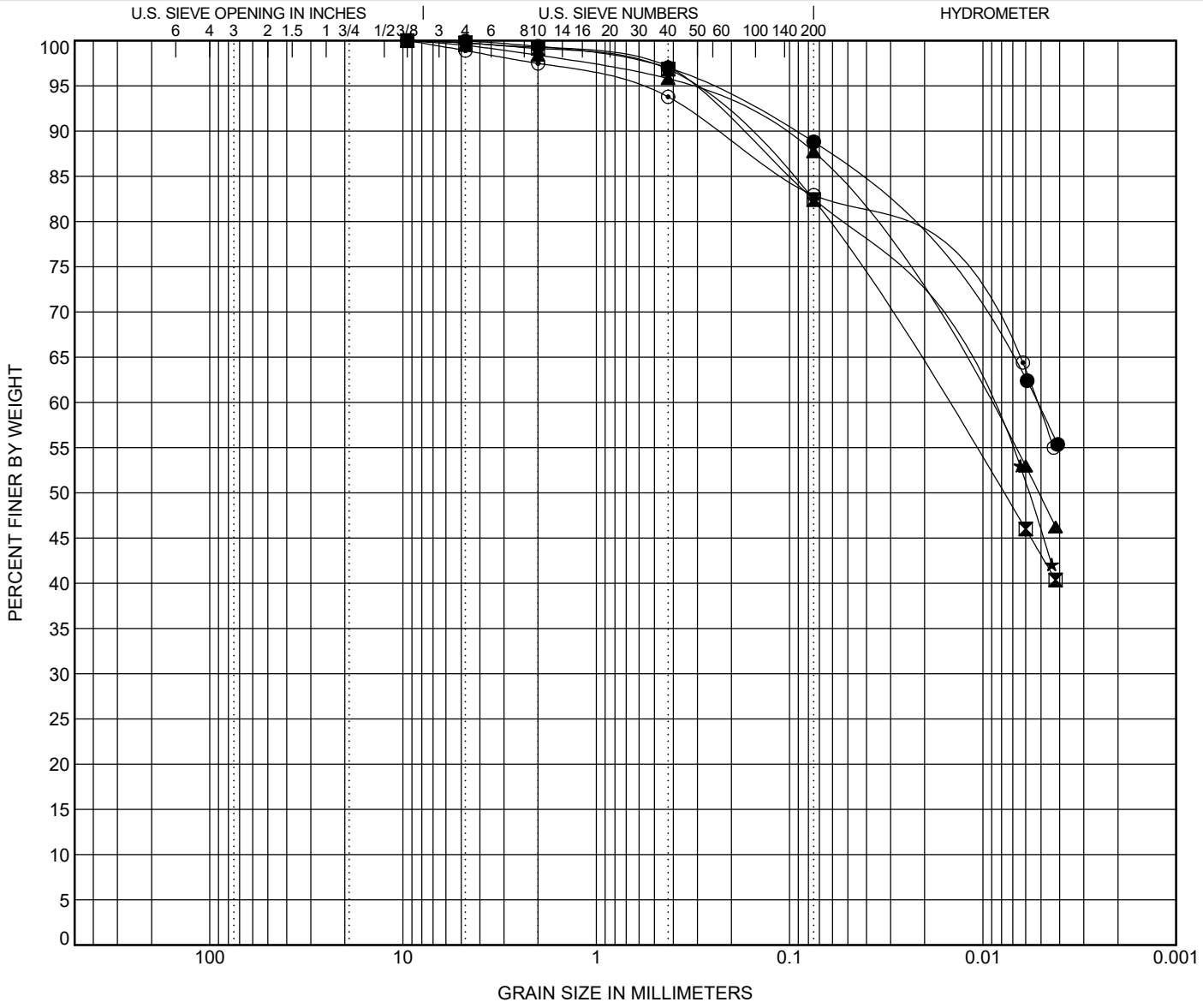
LAB RESULTS

GRAIN SIZE DISTRIBUTION

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	1	2.0	A-6 (19)	CL	40	19	21		
⊠	2	2.6	A-6 (17)	CL	39	17	22		
▲	3	2.0	A-6 (19)	CL	40	18	22		
★	4	2.0	A-7-6 (18)	CL	41	19	22		
⊙	5	5.0	A-6 (15)	CL	37	18	19		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	1	2.0	9.5				0.1	11.1	88.8	
⊠	2	2.6	9.5	0.008			0.2	17.3	82.4	
▲	3	2.0	9.5	0.005			0.5	11.7	87.7	
★	4	2.0	9.5	0.006			0.3	17.3	82.5	
⊙	5	5.0	9.5				1.1	16.0	82.9	

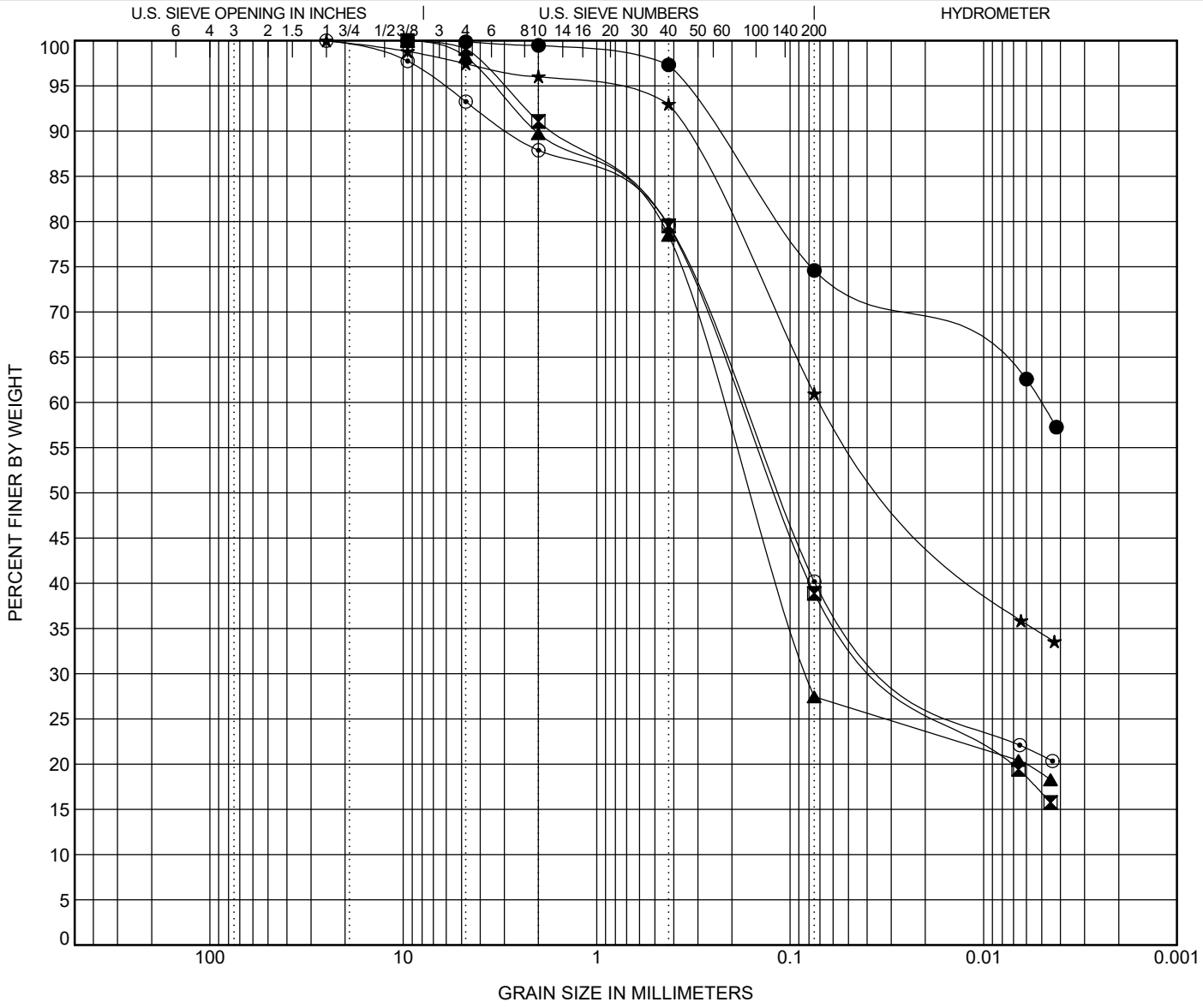
GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	6	2.5	A-6 (15)	CL	40	18	22		
⊠	7	2.0	A-4 (0)	SC	26	17	9		
▲	8	5.0	A-2-4 (0)	SM	NP	NP	NP		
★	9	2.0	A-6 (7)	CL	33	18	15		
⊙	10	2.0	A-6 (1)	SC	28	17	11		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	6	2.5	9.5				0.1	25.3	74.6	
⊠	7	2.0	9.5	0.121	0.025		0.9	60.2	38.9	
▲	8	5.0	9.5	0.161	0.082		1.8	70.8	27.4	
★	9	2.0	25	0.026			2.6	36.5	61.0	
⊙	10	2.0	25	0.115	0.019		6.7	53.1	40.2	

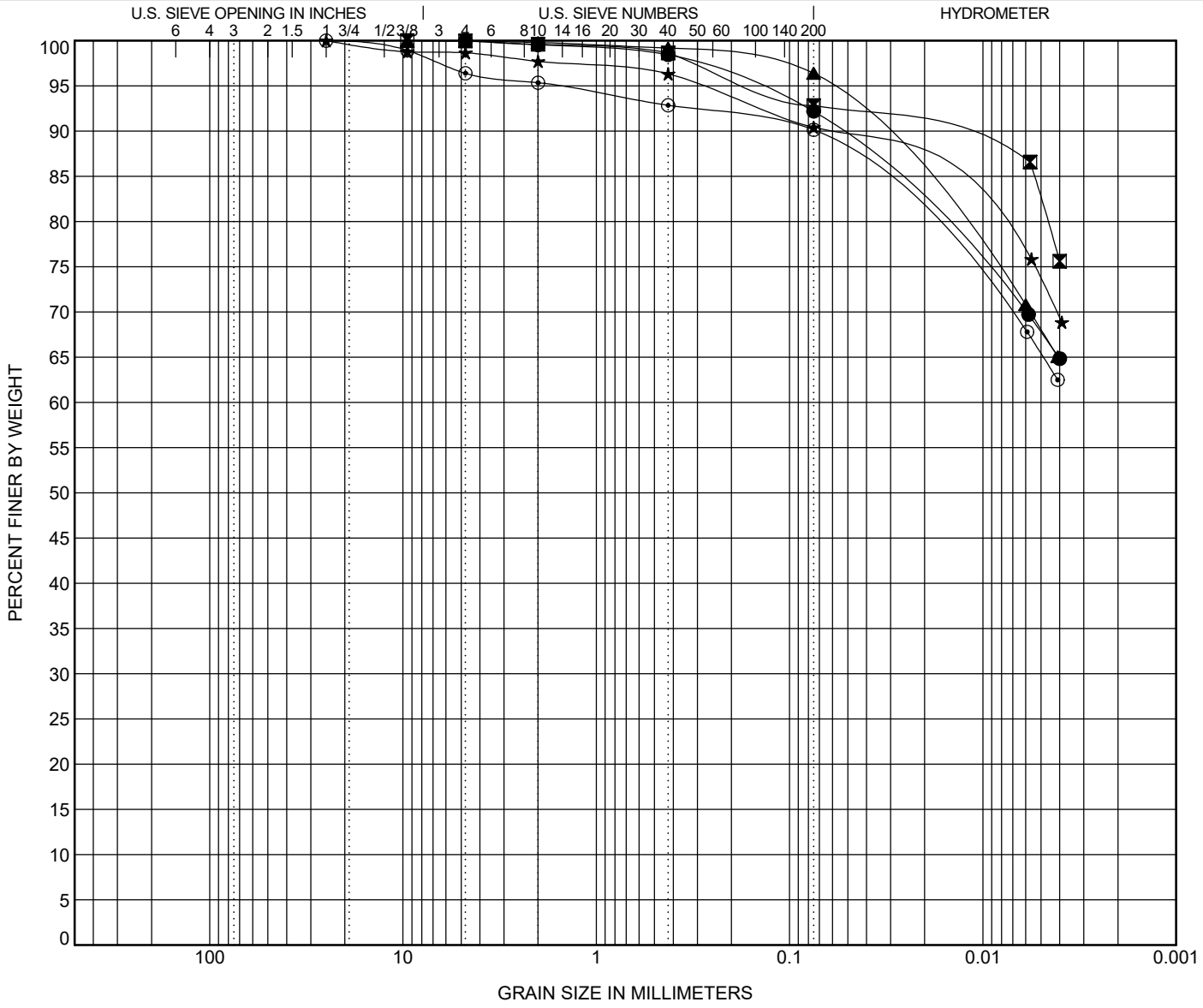
GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

GRAIN SIZE DISTRIBUTION

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 11	2.0	A-7-6 (26)	CL	47	20	27		
⊠ 11	2.2	A-7-6 (25)	CL	43	17	26		
▲ 13	2.0	A-6 (18)	CL	37	19	18		
★ 14	2.0	A-7-6 (30)	CH	53	22	31		
⊙ 15	3.0	A-7-6 (34)	CH	57	22	35		

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● 11	2.0	4.75				0.0	7.8	92.2	
⊠ 11	2.2	9.5				0.0	7.2	92.8	
▲ 13	2.0	9.5				0.1	3.5	96.4	
★ 14	2.0	25				1.3	8.2	90.4	
⊙ 15	3.0	25				3.6	6.2	90.1	

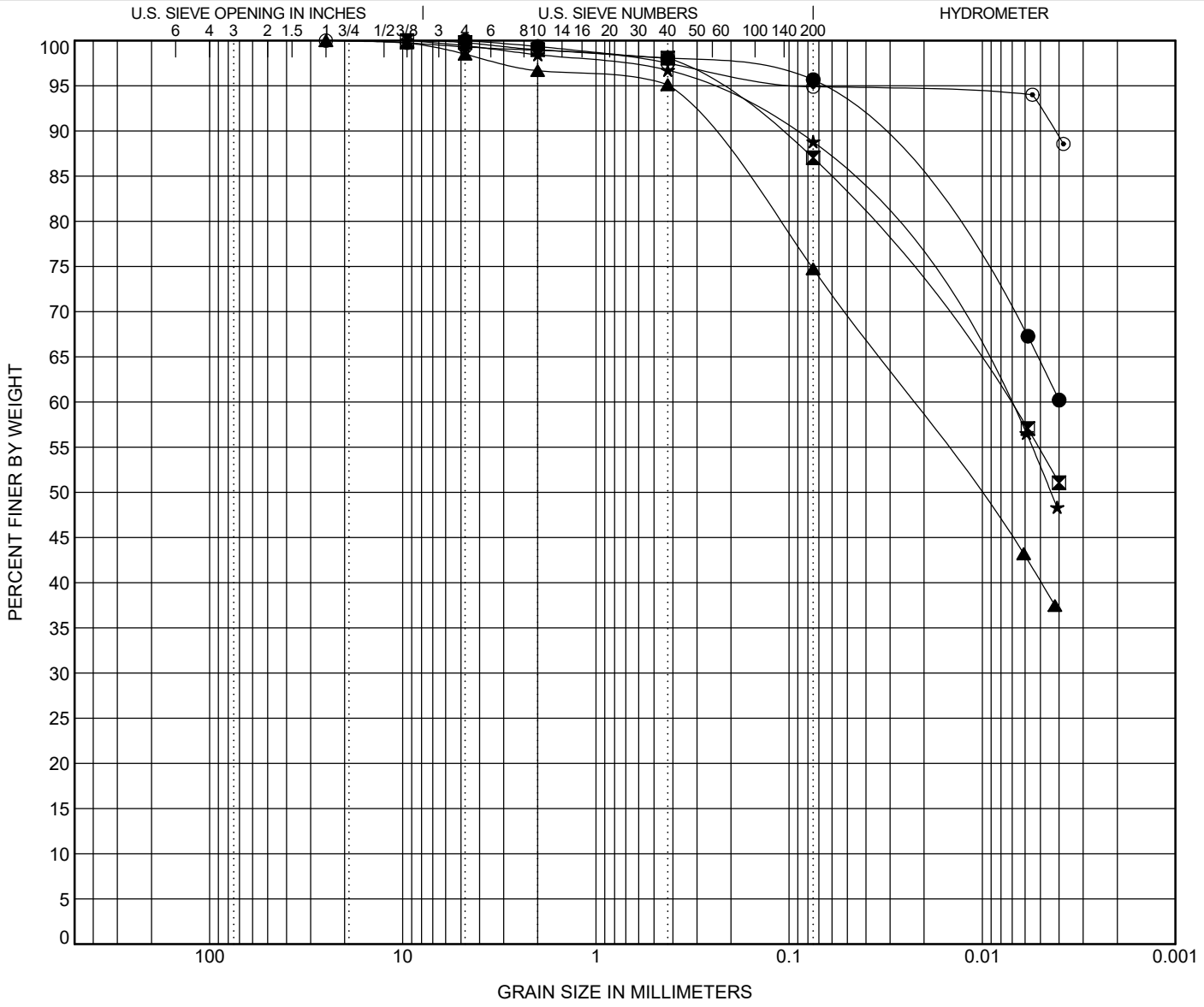
GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	16	2.0	A-7-6 (24)	CL	42	18	24		
⊠	17	2.0	A-7-6 (22)	CL	44	19	25		
▲	18	2.6	A-6 (14)	CL	38	18	20		
★	19	2.0	A-7-6 (23)	CL	43	18	25		
⊙	20	2.0	A-6 (18)	CL	38	20	18		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	16	2.0	4.75				0.0	4.3	95.7	
⊠	17	2.0	9.5				0.2	12.8	87.0	
▲	18	2.6	25	0.01			1.5	23.8	74.7	
★	19	2.0	9.5	0.004			0.6	10.6	88.8	
⊙	20	2.0	25				0.7	4.4	94.9	

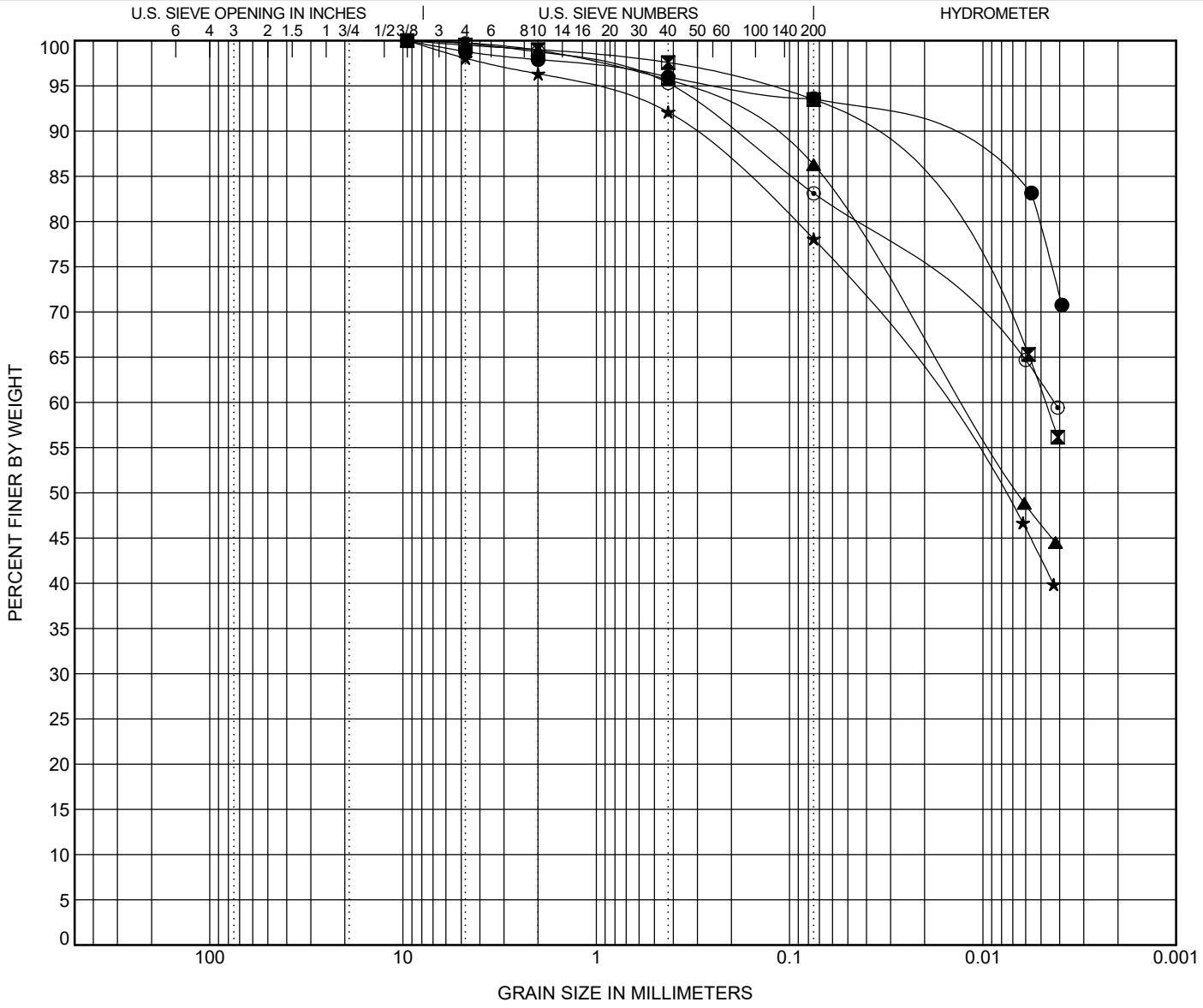
GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 21	2.8	A-7-6 (23)	CL	43	20	23		
⊠ 22	2.0	A-6 (22)	CL	40	17	23		
▲ 23	2.0	A-7-6 (22)	CL	44	19	25		
★ 24	2.0	A-7-6 (18)	CL	42	18	24		
⊙ 25	2.0	A-7-6 (21)	CL	44	18	26		

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● 21	2.8	9.5				1.2	5.2	93.6	
⊠ 22	2.0	9.5				0.5	6.0	93.5	
▲ 23	2.0	9.5	0.007			0.2	13.5	86.3	
★ 24	2.0	9.5	0.008			1.9	20.0	78.1	
⊙ 25	2.0	9.5				0.3	16.6	83.1	

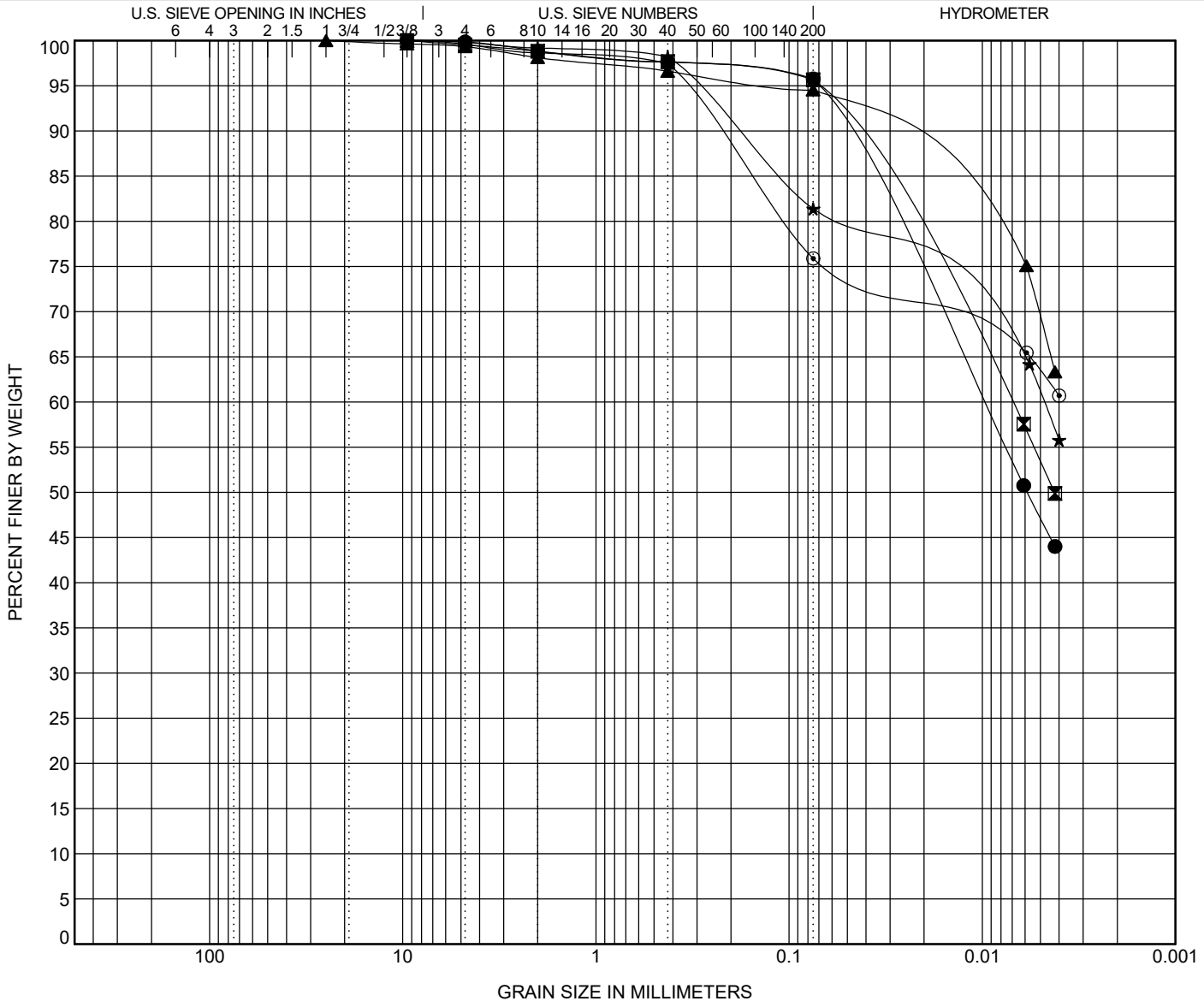
GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	26	2.0	A-7-6 (30)	CL	47	18	29		
⊠	27	2.1	A-7-6 (32)	CL	49	18	31		
▲	28	2.0	A-7-6 (27)	CL	46	19	27		
★	29	2.1	A-7-6 (30)	CH	55	19	36		
⊙	30	2.3	A-7-6 (28)	CH	54	17	37		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	26	2.0	9.5	0.006			0.1	4.1	95.8	
⊠	27	2.1	9.5	0.004			0.5	3.9	95.7	
▲	28	2.0	25				0.7	4.8	94.5	
★	29	2.1	9.5				0.2	18.4	81.4	
⊙	30	2.3	9.5				0.4	23.7	75.9	

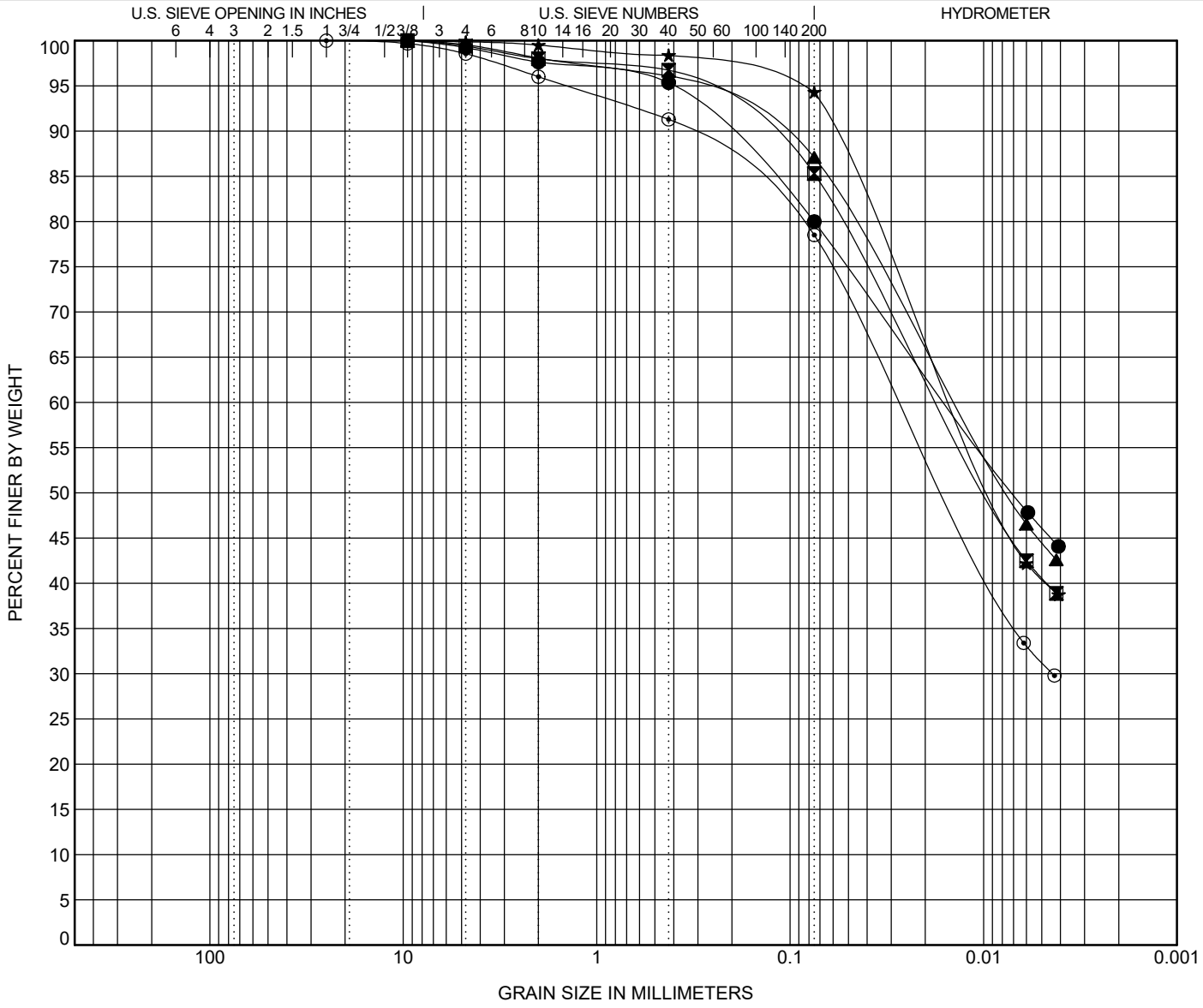
GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 31	2.1	A-7-6 (27)	CH	52	18	34		
⊠ 32	2.0	A-7-6 (26)	CL	47	17	30		
▲ 33	2.2	A-7-6 (29)	CH	51	19	32		
★ 34	2.0	A-7-6 (35)	CH	53	18	35		
⊙ 35	2.0	A-7-6 (29)	CH	54	18	36		

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● 31	2.1	9.5	0.007			0.8	19.2	80.0	
⊠ 32	2.0	9.5	0.009			0.6	14.1	85.3	
▲ 33	2.2	9.5	0.007			0.4	12.5	87.1	
★ 34	2.0	9.5	0.009			0.1	5.5	94.3	
⊙ 35	2.0	25	0.016	0.004		1.4	20.0	78.5	

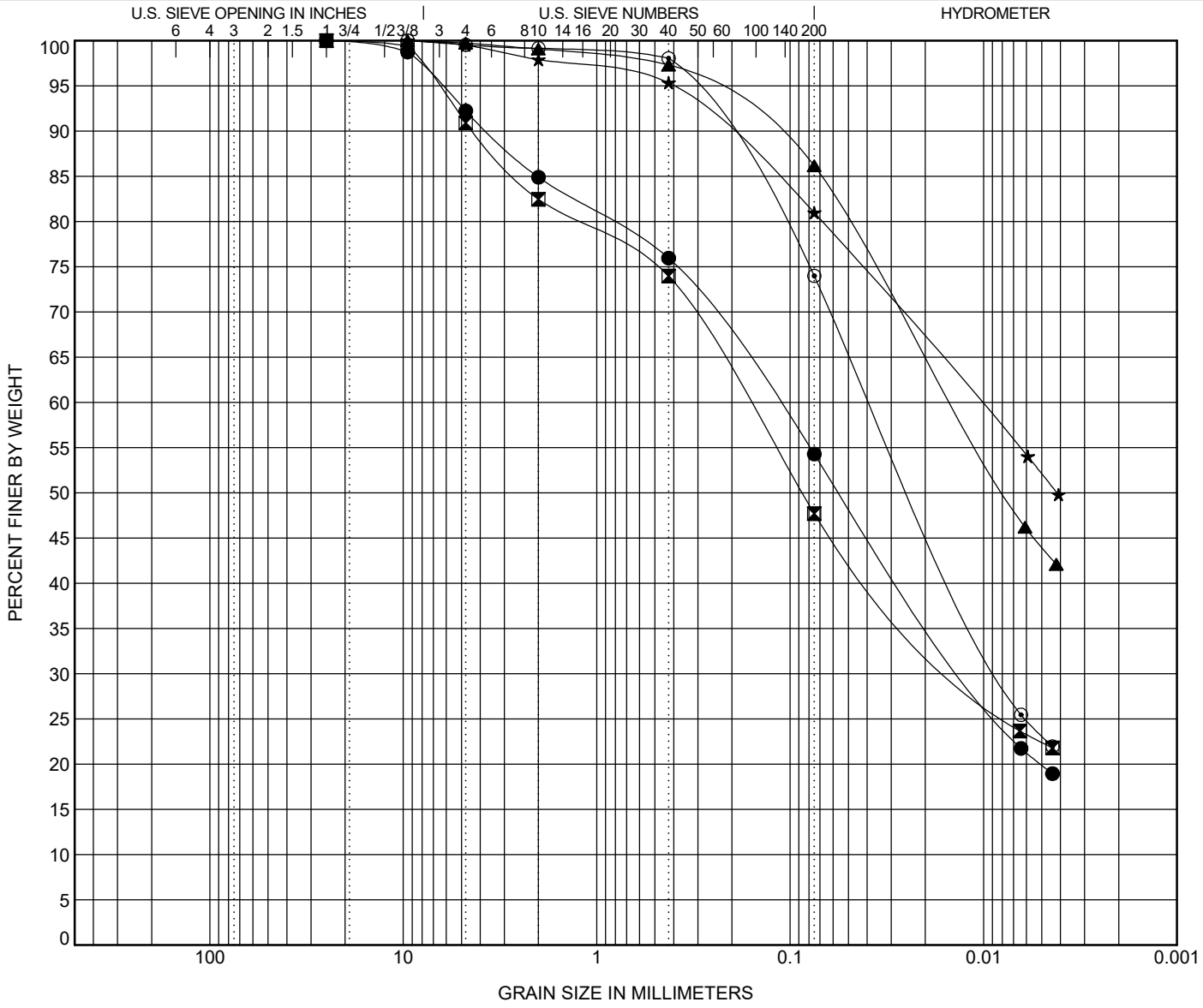
GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE		DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	36	2.0	A-6 (10)	CL	40	15	25		
⊠	37	2.0	A-6 (4)	SC	32	17	15		
▲	38	2.2	A-7-6 (21)	CL	42	17	25		
★	39	2.3	A-7-6 (38)	CH	64	18	46		
⊙	40	2.0	A-6 (9)	CL	33	18	15		

BOREHOLE		DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	36	2.0	25	0.054	0.012		7.8	37.9	54.3	
⊠	37	2.0	25	0.087	0.012		9.1	43.2	47.7	
▲	38	2.2	9.5	0.008			0.3	13.6	86.2	
★	39	2.3	9.5	0.004			0.5	18.5	81.0	
⊙	40	2.0	9.5	0.022	0.008		0.5	25.5	74.0	

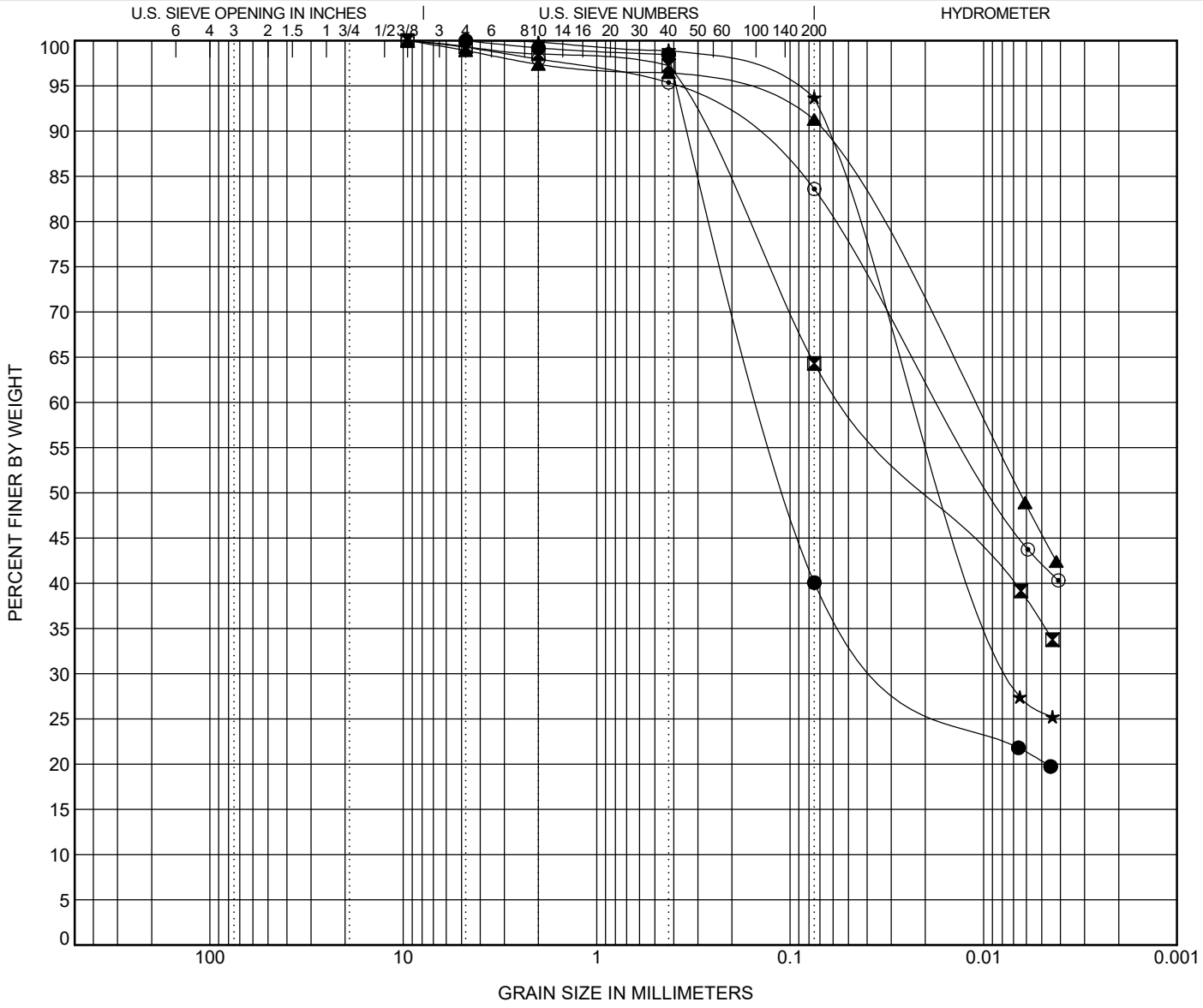
GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 41	2.0	A-4 (0)	SC-SM	26	19	7		
⊠ 42	2.0	A-6 (6)	CL	30	16	14		
▲ 43	2.0	A-7-6 (21)	CL	43	21	22		
★ 44	2.0	A-6 (14)	CL	37	23	14		
⊙ 45	2.0	A-7-6 (24)	CL	46	17	29		

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● 41	2.0	4.75	0.101	0.02		0.0	59.9	40.1	
⊠ 42	2.0	9.5	0.019			0.7	35.0	64.3	
▲ 43	2.0	9.5	0.007			1.1	7.6	91.3	
★ 44	2.0	4.75	0.015	0.007		0.0	6.3	93.7	
⊙ 45	2.0	9.5	0.009			0.7	15.7	83.6	

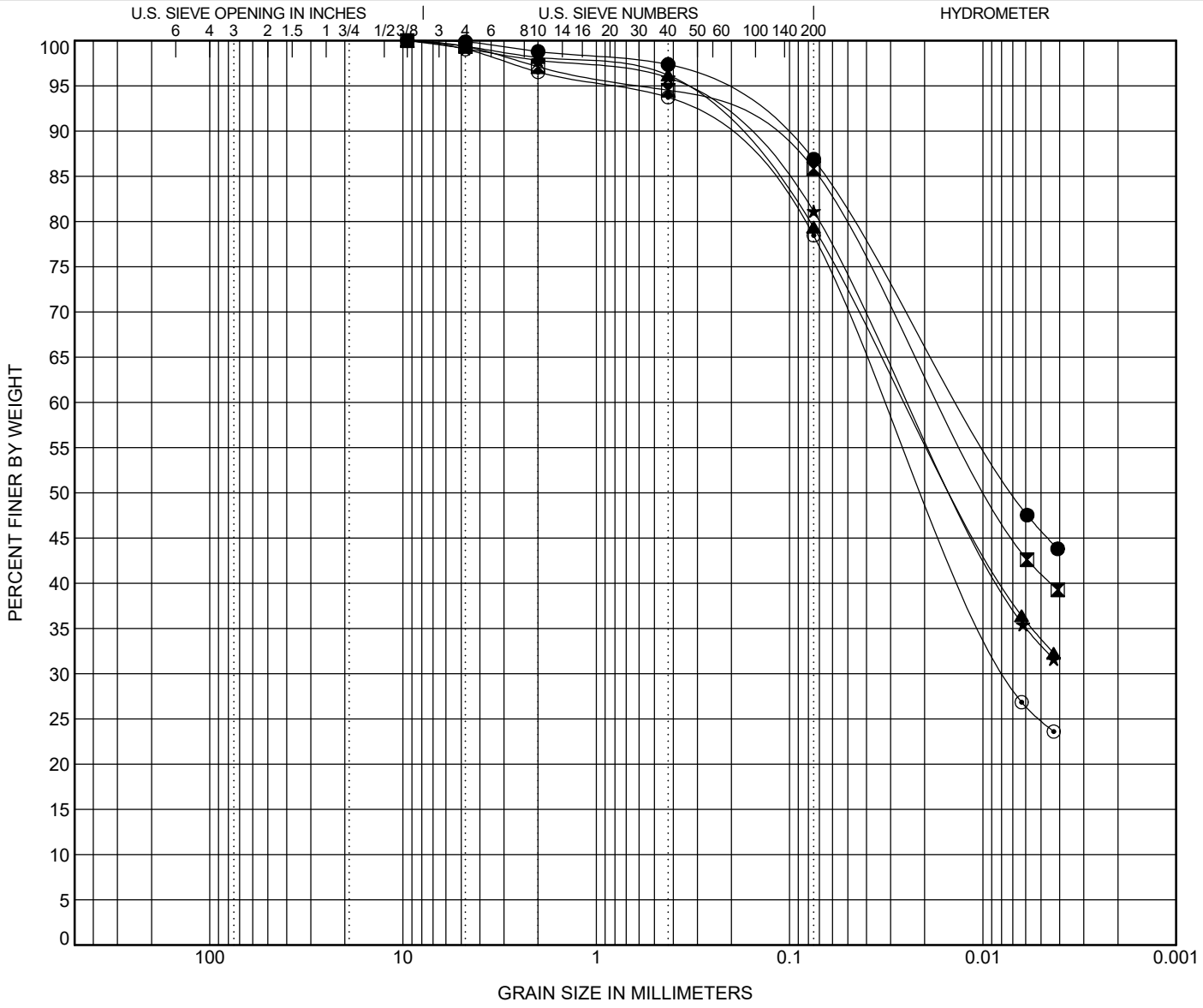
GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 46	2.0	A-7-6 (26)	CL	46	17	29		
⊠ 47	2.0	A-7-6 (29)	CH	52	20	32		
▲ 48	2.0	A-6 (16)	CL	40	18	22		
★ 49	2.0	A-6 (17)	CL	39	17	22		
⊙ 50	2.0	A-6 (14)	CL	38	18	20		

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● 46	2.0	9.5	0.007			0.1	13.0	86.9	
⊠ 47	2.0	9.5	0.009			0.6	13.5	85.8	
▲ 48	2.0	9.5	0.014			0.6	20.0	79.4	
★ 49	2.0	9.5	0.014			0.9	18.0	81.1	
⊙ 50	2.0	9.5	0.019	0.007		0.9	20.6	78.5	

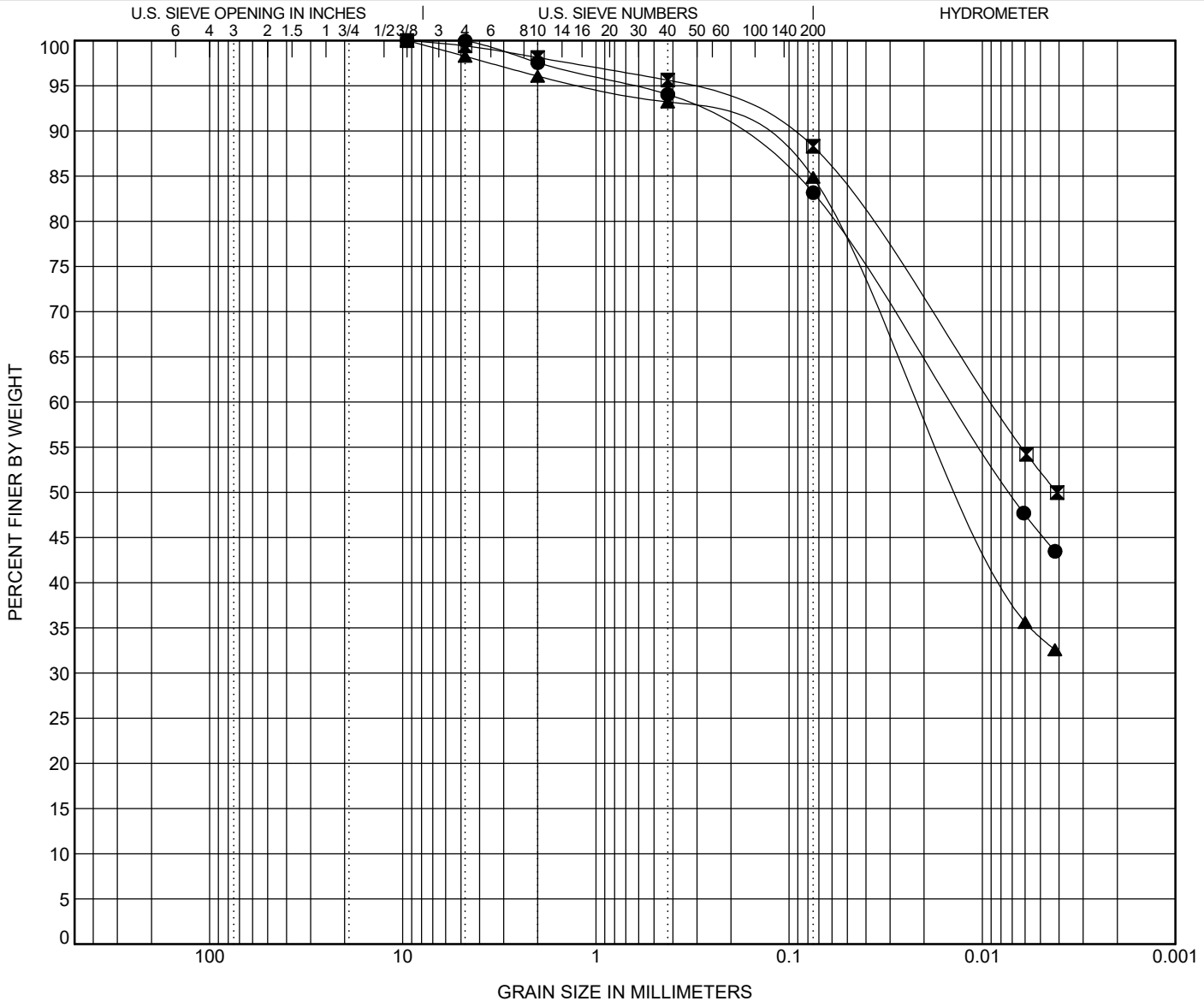
GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 51	2.0	A-7-6 (24)	CL	46	17	29		
⊠ 52	2.1	A-7-6 (31)	CH	52	18	34		
▲ 53	2.0	A-7-6 (24)	CL	46	18	28		

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● 51	2.0	9.5	0.007			0.0	16.8	83.2	
⊠ 52	2.1	9.5	0.004			0.6	11.1	88.3	
▲ 53	2.0	9.5	0.013			1.7	13.4	84.9	

GRAIN SIZE D ADJUSTED - 20171219.GDT - 6/22/23 08:38 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
1	2.0	40	19	21	9.5	89	A-6 (19)	CL	11.5	22.4			
1	3.0								22.0	22.4			
1	4.0								23.1	22.4			
1	5.0								24.4	22.4			
1	6.0								27.7	22.4			
1	7.0								23.2	22.4			
1	8.0								25.2	22.4			
1	9.0								18.6	22.4			
1	10.0								26.1	22.4			
2	2.6	39	17	22	9.5	82	A-6 (17)	CL	11.1	21.1			
2	3.0								15.3	21.1			
2	4.0								22.6	21.1			
2	5.0								29.2	21.1			
2	6.0								20.6	21.1			
2	7.0								23.3	21.1			
2	8.0								20.4	21.1			
2	9.0								23.9	21.1			
2	10.0								23.0	21.1			
3	2.0	40	18	22	9.5	88	A-6 (19)	CL	10.1	20.2			
3	3.0								22.6	20.2			
3	4.0								21.8	20.2			
3	5.0								22.1	20.2			
3	6.0								19.5	20.2			
3	7.0								21.8	20.2			
3	8.0								20.3	20.2			
3	9.0								21.9	20.2			
3	10.0								21.7	20.2			
4	2.0	41	19	22	9.5	82	A-7-6 (18)	CL	19.3	26.3			
4	3.0								27.8	26.3			
4	4.0								26.8	26.3			
4	5.0								26.0	26.3			
4	6.0								23.9	26.3			
4	7.0								26.0	26.3			
4	8.0								28.9	26.3			
4	9.0								29.4	26.3			
4	10.0								28.5	26.3			
5	2.0								10.1	9.9			
5	3.0								10.0	9.9			
5	4.0								9.7	9.9			
5	5.0	37	18	19	9.5	83	A-6 (15)	CL	23.4	22.4			
5	6.0								21.8	22.4			
5	7.0								24.5	22.4			
5	8.0								19.8	22.4			

LAB SUMMARY - 20171219.GDT - 6/22/23 11:16 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
5	9.0								22.7	22.4			
5	10.0								21.9	22.4			
6	2.5	40	18	22	9.5	75	A-6 (15)	CL	11.3	24.7			
6	3.0								22.9	24.7			
6	4.0								25.9	24.7			
6	5.0								22.7	24.7			
6	6.0								21.4	24.7			
6	7.0								26.5	24.7			
6	8.0								23.9	24.7			
6	9.0								36.8	24.7			
6	10.0								30.8	24.7			
7	2.0	26	17	9	9.5	39	A-4 (0)	SC	11.4	11.3			
7	3.0								11.4	11.3			
7	4.0								11.2	11.3			
7	5.0								11.1	11.3			
7	6.0								12.2	11.3			
7	7.0								12.2	11.3			
7	8.0								12.3	11.3			
7	9.0								9.6	11.3			
7	10.0								10.6	11.3			
8	2.0								11.3	11.5			
8	3.0								9.5	11.5			
8	4.0								13.6	11.5			
8	5.0	NP	NP	NP	9.5	27	A-2-4 (0)	SM	12.0	14.9			
8	6.0								12.9	14.9			
8	7.0								12.6	14.9			
8	8.0								14.1	14.9			
8	9.0								17.7	14.9			
8	10.0								20.0	14.9			
9	2.0	33	18	15	25	61	A-6 (7)	CL	19.4	23.2			
9	3.0								21.2	23.2			
9	4.0								29.2	23.2			
9	5.0								27.3	23.2			
9	6.0								26.3	23.2			
9	7.0								25.9	23.2			
9	8.0								18.5	23.2			
9	9.0								19.8	23.2			
9	10.0								21.4	23.2			
10	2.0	28	17	11	25	40	A-6 (1)	SC	18.2	19.3			
10	3.0								15.4	19.3			
10	4.0								17.7	19.3			
10	5.0								20.2	19.3			
10	6.0								17.0	19.3			

LAB SUMMARY - 20171219.GDT - 6/22/23 11:16 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
10	7.0								18.1	19.3			
10	8.0								19.9	19.3			
10	9.0								26.3	19.3			
10	10.0								20.6	19.3			
11	2.0	47	20	27	4.75	92	A-7-6 (26)	CL	17.5	17.5			
11	2.2	43	17	26	9.5	93	A-7-6 (25)	CL	10.5	22.8			
11	3.0								24.1	22.8			
11	4.0								28.7	22.8			
11	5.0								24.4	22.8			
11	6.0								18.7	22.8			
11	7.0								22.3	22.8			
11	8.0								26.1	22.8			
11	9.0								24.2	22.8			
11	10.0								26.4	22.8			
13	2.0	37	19	18	9.5	96	A-6 (18)	CL	10.6	22.7			
13	3.0								20.6	22.7			
13	4.0								21.8	22.7			
13	5.0								22.3	22.7			
13	6.0								28.3	22.7			
13	7.0								22.0	22.7			
13	8.0								24.7	22.7			
13	9.0								27.7	22.7			
13	10.0								26.3	22.7			
14	2.0	53	22	31	25	90	A-7-6 (30)	CH	23.0	25.6			
14	3.0								38.6	25.6			
14	4.0								35.8	25.6			
14	5.0								28.4	25.6			
14	6.0								27.8	25.6			
14	7.0								25.1	25.6			
14	8.0								18.3	25.6			
14	9.0								16.8	25.6			
14	10.0								16.4	25.6			
15	2.9								6.5	6.5			
15	3.0	57	22	35	25	90	A-7-6 (34)	CH	4.4	25.0			
15	4.0								19.7	25.0			
15	5.0								23.1	25.0			
15	6.0								26.2	25.0			
15	7.0								45.3	25.0			
15	8.0								28.0	25.0			
15	9.0								28.1	25.0			
15	10.0								25.2	25.0			
16	2.0	42	18	24	4.75	96	A-7-6 (24)	CL	16.6	24.4			
16	3.0								21.6	24.4			

LAB SUMMARY - 20171219.GDT - 6/22/23 11:16 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
16	4.0								20.6	24.4			
16	5.0								22.7	24.4			
16	6.0								23.9	24.4			
16	7.0								29.2	24.4			
16	8.0								25.4	24.4			
16	9.0								29.1	24.4			
16	10.0								30.1	24.4			
17	2.0	44	19	25	9.5	87	A-7-6 (22)	CL	19.2	20.4			
17	3.0								19.6	20.4			
17	4.0								22.6	20.4			
17	5.0								17.3	20.4			
17	6.0								20.6	20.4			
17	7.0								22.2	20.4			
17	8.0								21.3	20.4			
17	9.0								22.2	20.4			
17	10.0								18.2	20.4			
18	2.6	38	18	20	25	75	A-6 (14)	CL	17.2	25.4			
18	3.0								23.3	25.4			
18	4.0								25.4	25.4			
18	5.0								23.2	25.4			
18	6.0								25.4	25.4			
18	7.0								25.4	25.4			
18	8.0								28.2	25.4			
18	9.0								29.9	25.4			
18	10.0								30.6	25.4			
19	2.0	43	18	25	9.5	89	A-7-6 (23)	CL	16.8	19.6			
19	3.0								19.3	19.6			
19	4.0								17.9	19.6			
19	5.0								20.2	19.6			
19	6.0								17.0	19.6			
19	7.0								21.9	19.6			
19	8.0								18.5	19.6			
19	9.0								23.4	19.6			
19	10.0								21.3	19.6			
20	2.0	38	20	18	25	95	A-6 (18)	CL	12.5	20.4			
20	3.0								18.8	20.4			
20	4.0								22.3	20.4			
20	5.0								21.8	20.4			
20	6.0								21.2	20.4			
20	7.0								21.4	20.4			
20	8.0								20.0	20.4			
20	9.0								22.0	20.4			
20	10.0								24.2	20.4			

LAB SUMMARY - 20171219.GDT - 6/22/23 11:16 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
21	2.8	43	20	23	9.5	94	A-7-6 (23)	CL	11.4	19.1			
21	3.0								6.3	19.1			
21	4.0								7.1	19.1			
21	5.0								18.5	19.1			
21	6.0								22.6	19.1			
21	7.0								23.4	19.1			
21	8.0								23.6	19.1			
21	9.0								28.4	19.1			
21	10.0								30.3	19.1			
22	2.0	40	17	23	9.5	93	A-6 (22)	CL	21.6	18.8			
22	3.0								20.9	18.8			
22	4.0								16.2	18.8			
22	5.0								17.6	18.8			
22	6.0								18.9	18.8			
22	7.0								20.4	18.8			
22	8.0								18.0	18.8			
22	9.0								17.9	18.8			
22	10.0								18.0	18.8			
23	2.0	44	19	25	9.5	86	A-7-6 (22)	CL	22.0	23.6			
23	3.0								21.4	23.6			
23	4.0								28.5	23.6			
23	5.0								24.4	23.6			
23	6.0								24.7	23.6			
23	7.0								21.7	23.6			
23	8.0								21.5	23.6			
23	9.0								25.7	23.6			
23	10.0								22.4	23.6			
24	2.0	42	18	24	9.5	78	A-7-6 (18)	CL	7.7	21.1			
24	3.0								20.3	21.1			
24	4.0								26.9	21.1			
24	5.0								24.2	21.1			
24	6.0								24.6	21.1			
24	7.0								19.8	21.1			
24	8.0								21.2	21.1			
24	9.0								22.6	21.1			
24	10.0								22.7	21.1			
25	2.0	44	18	26	9.5	83	A-7-6 (21)	CL	15.3	22.8			
25	3.0								17.3	22.8			
25	4.0								26.4	22.8			
25	5.0								23.8	22.8			
25	6.0								20.9	22.8			
25	7.0								22.9	22.8			
25	8.0								25.4	22.8			

LAB SUMMARY - 20171219.GDT - 6/22/23 11:16 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

NDDOT North Dakota Department of Transportation

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
25	9.0								24.0	22.8			
25	10.0								28.7	22.8			
26	2.0	47	18	29	9.5	96	A-7-6 (30)	CL	8.2	23.2			
26	3.0								25.9	23.2			
26	4.0								24.9	23.2			
26	5.0								24.9	23.2			
26	6.0								24.8	23.2			
26	7.0								23.7	23.2			
26	8.0								25.1	23.2			
26	9.0								27.7	23.2			
26	10.0								23.4	23.2			
27	2.1	49	18	31	9.5	96	A-7-6 (32)	CL	8.4	24.5			
27	3.0								25.9	24.5			
27	4.0								25.6	24.5			
27	5.0								26.5	24.5			
27	6.0								25.6	24.5			
27	7.0								24.1	24.5			
27	8.0								24.1	24.5			
27	9.0								26.4	24.5			
27	10.0								33.5	24.5			
28	2.0	46	19	27	25	95	A-7-6 (27)	CL	6.6	23.7			
28	3.0								25.6	23.7			
28	4.0								25.7	23.7			
28	5.0								26.9	23.7			
28	6.0								25.0	23.7			
28	7.0								23.4	23.7			
28	8.0								27.3	23.7			
28	9.0								26.2	23.7			
28	10.0								26.3	23.7			
29	2.1	55	19	36	9.5	81	A-7-6 (30)	CH	14.0	26.7			
29	3.0								27.1	26.7			
29	4.0								27.5	26.7			
29	5.0								21.1	26.7			
29	6.0								36.3	26.7			
29	7.0								26.9	26.7			
29	8.0								27.6	26.7			
29	9.0								28.4	26.7			
29	10.0								31.2	26.7			
30	2.3	54	17	37	9.5	76	A-7-6 (28)	CH	12.0	22.9			
30	3.0								29.1	22.9			
30	4.0								20.8	22.9			
30	5.0								23.2	22.9			
30	6.0								23.8	22.9			

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
30	7.0								28.2	22.9			
30	8.0								24.2	22.9			
30	9.0								24.5	22.9			
30	10.0								20.2	22.9			
31	2.1	52	18	34	9.5	80	A-7-6 (27)	CH	13.1	25.2			
31	3.0								21.8	25.2			
31	4.0								29.9	25.2			
31	5.0								24.8	25.2			
31	6.0								23.8	25.2			
31	7.0								26.9	25.2			
31	8.0								29.1	25.2			
31	9.0								26.1	25.2			
31	10.0								31.0	25.2			
32	2.0	47	17	30	9.5	85	A-7-6 (26)	CL	26.9	27.2			
32	3.0								30.9	27.2			
32	4.0								29.5	27.2			
32	5.0								27.6	27.2			
32	6.0								24.0	27.2			
32	7.0								22.9	27.2			
32	8.0								28.0	27.2			
32	9.0								26.1	27.2			
32	10.0								28.7	27.2			
33	2.2	51	19	32	9.5	87	A-7-6 (29)	CH	12.7	25.2			
33	3.0								29.9	25.2			
33	4.0								27.6	25.2			
33	5.0								27.7	25.2			
33	6.0								22.9	25.2			
33	7.0								24.0	25.2			
33	8.0								25.6	25.2			
33	9.0								28.7	25.2			
33	10.0								28.0	25.2			
34	2.0	53	18	35	9.5	94	A-7-6 (35)	CH	25.6	23.8			
34	3.0								28.4	23.8			
34	4.0								28.4	23.8			
34	5.0								23.6	23.8			
34	6.0								22.1	23.8			
34	7.0								22.5	23.8			
34	8.0								21.3	23.8			
34	9.0								21.6	23.8			
34	10.0								21.2	23.8			
35	2.0	54	18	36	25	79	A-7-6 (29)	CH	16.0	22.9			
35	3.0								22.2	22.9			
35	4.0								19.2	22.9			

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
35	5.0								18.1	22.9			
35	6.0								19.4	22.9			
35	7.0								26.2	22.9			
35	8.0								27.2	22.9			
35	9.0								27.7	22.9			
35	10.0								29.9	22.9			
36	2.0	40	15	25	25	54	A-6 (10)	CL	6.0	20.1			
36	3.0								13.9	20.1			
36	4.0								18.1	20.1			
36	5.0								22.2	20.1			
36	6.0								19.7	20.1			
36	7.0								27.9	20.1			
36	8.0								24.8	20.1			
36	9.0								23.1	20.1			
36	10.0								25.0	20.1			
37	2.0	32	17	15	25	48	A-6 (4)	SC	17.5	19.2			
37	3.0								18.7	19.2			
37	4.0								21.4	19.2			
37	5.0								19.2	19.2			
37	6.0								19.5	19.2			
37	7.0								18.4	19.2			
37	8.0								17.4	19.2			
37	9.0								18.1	19.2			
37	10.0								22.2	19.2			
38	2.2	42	17	25	9.5	86	A-7-6 (21)	CL	24.0	24.2			
38	3.0								23.4	24.2			
38	4.0								24.2	24.2			
38	5.0								20.0	24.2			
38	6.0								23.6	24.2			
38	7.0								29.7	24.2			
38	8.0								21.9	24.2			
38	9.0								24.2	24.2			
38	10.0								26.7	24.2			
39	2.3	64	18	46	9.5	81	A-7-6 (38)	CH	8.6	29.3			
39	3.0								27.9	29.3			
39	4.0								22.4	29.3			
39	5.0								28.4	29.3			
39	6.0								33.3	29.3			
39	7.0								39.2	29.3			
39	8.0								35.6	29.3			
39	9.0								37.1	29.3			
39	10.0								30.9	29.3			
40	2.0	33	18	15	9.5	74	A-6 (9)	CL	26.4	25.8			

SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
40	3.0								21.1	25.8			
40	4.0								27.9	25.8			
40	5.0								24.4	25.8			
40	6.0								23.9	25.8			
40	7.0								28.2	25.8			
40	8.0								25.5	25.8			
40	9.0								27.8	25.8			
40	10.0								26.9	25.8			
41	2.0	26	19	7	4.75	40	A-4 (0)	SC-SM	14.1	18.1			
41	3.0								11.0	18.1			
41	4.0								10.0	18.1			
41	5.0								14.8	18.1			
41	6.0								17.6	18.1			
41	7.0								30.3	18.1			
41	8.0								17.0	18.1			
41	9.0								22.4	18.1			
41	10.0								25.4	18.1			
42	2.0	30	16	14	9.5	64	A-6 (6)	CL	13.5	21.7			
42	3.0								11.4	21.7			
42	4.0								14.7	21.7			
42	5.0								26.1	21.7			
42	6.0								23.7	21.7			
42	7.0								21.1	21.7			
42	8.0								26.7	21.7			
42	9.0								27.9	21.7			
42	10.0								30.3	21.7			
43	2.0	43	21	22	9.5	91	A-7-6 (21)	CL	11.2	28.0			
43	3.0								25.7	28.0			
43	4.0								23.0	28.0			
43	5.0								23.2	28.0			
43	6.0								27.3	28.0			
43	7.0								31.3	28.0			
43	8.0								37.3	28.0			
43	9.0								36.1	28.0			
43	10.0								37.2	28.0			
44	2.0	37	23	14	4.75	94	A-6 (14)	CL	14.5	23.8			
44	3.0								22.4	23.8			
44	4.0								24.1	23.8			
44	5.0								24.1	23.8			
44	6.0								22.6	23.8			
44	7.0								23.7	23.8			
44	8.0								22.6	23.8			
44	9.0								27.2	23.8			

LAB SUMMARY - 20171219.GDT - 6/22/23 11:16 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
44	10.0								32.5	23.8			
45	2.0	46	17	29	9.5	84	A-7-6 (24)	CL	13.2	26.2			
45	3.0								24.3	26.2			
45	4.0								23.0	26.2			
45	5.0								25.6	26.2			
45	6.0								23.2	26.2			
45	7.0								29.1	26.2			
45	8.0								27.6	26.2			
45	9.0								33.3	26.2			
45	10.0								36.8	26.2			
46	2.0	46	17	29	9.5	87	A-7-6 (26)	CL	11.6	24.9			
46	3.0								19.8	24.9			
46	4.0								23.9	24.9			
46	5.0								22.1	24.9			
46	6.0								25.4	24.9			
46	7.0								31.8	24.9			
46	8.0								31.2	24.9			
46	9.0								29.6	24.9			
46	10.0								28.6	24.9			
47	2.0	52	20	32	9.5	86	A-7-6 (29)	CH	23.9	26.3			
47	3.0								24.5	26.3			
47	4.0								32.3	26.3			
47	5.0								29.5	26.3			
47	6.0								23.8	26.3			
47	7.0								26.6	26.3			
47	8.0								25.3	26.3			
47	9.0								23.7	26.3			
47	10.0								27.0	26.3			
48	2.0	40	18	22	9.5	79	A-6 (16)	CL	23.6	24.4			
48	3.0								21.2	24.4			
48	4.0								20.0	24.4			
48	5.0								25.3	24.4			
48	6.0								22.3	24.4			
48	7.0								22.9	24.4			
48	8.0								26.8	24.4			
48	9.0								29.7	24.4			
48	10.0								28.0	24.4			
49	2.0	39	17	22	9.5	81	A-6 (17)	CL	12.1	24.1			
49	3.0								20.6	24.1			
49	4.0								25.8	24.1			
49	5.0								26.7	24.1			
49	6.0								26.4	24.1			
49	7.0								24.6	24.1			

SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
49	8.0								26.4	24.1			
49	9.0								26.5	24.1			
49	10.0								27.4	24.1			
50	2.0	38	18	20	9.5	78	A-6 (14)	CL	12.4	18.2			
50	3.0								25.5	18.2			
50	4.0								9.1	18.2			
50	5.0								12.1	18.2			
50	6.0								13.0	18.2			
50	7.0								22.0	18.2			
50	8.0								23.1	18.2			
50	9.0								23.8	18.2			
50	10.0								22.7	18.2			
51	2.0	46	17	29	9.5	83	A-7-6 (24)	CL	23.0	26.0			
51	3.0								25.0	26.0			
51	4.0								28.7	26.0			
51	5.0								30.2	26.0			
51	6.0								18.5	26.0			
51	7.0								26.0	26.0			
51	8.0								25.7	26.0			
51	9.0								26.9	26.0			
51	10.0								30.1	26.0			
52	2.1	52	18	34	9.5	88	A-7-6 (31)	CH	4.1	21.6			
52	3.0								21.4	21.6			
52	4.0								27.5	21.6			
52	5.0								24.8	21.6			
52	6.0								19.9	21.6			
52	7.0								26.7	21.6			
52	8.0								24.1	21.6			
52	9.0								23.2	21.6			
52	10.0								23.0	21.6			
53	2.0	46	18	28	9.5	85	A-7-6 (24)	CL	23.1	28.0			
53	3.0								28.0	28.0			
53	4.0								28.9	28.0			
53	5.0								26.8	28.0			
53	6.0								21.2	28.0			
53	7.0								22.2	28.0			
53	8.0								32.8	28.0			
53	9.0								34.3	28.0			
53	10.0								34.4	28.0			

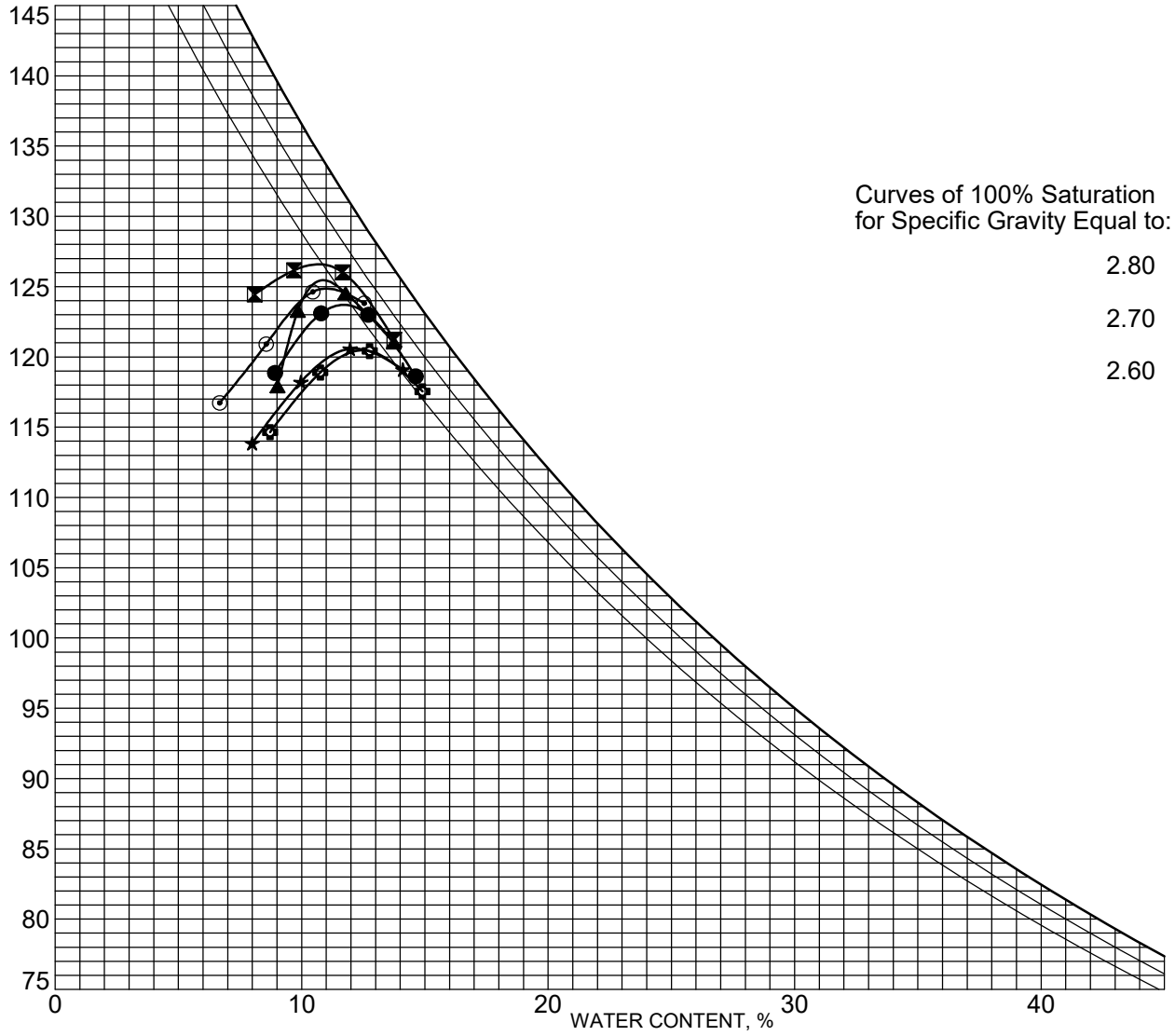
LAB SUMMARY - 20171219.GDT - 6/22/23 11:16 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

MOISTURE-DENSITY RELATIONSHIP

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	1	2.0	A-6 (19)	LEAN CLAY(CL)
⊠	2	2.6	A-6 (17)	LEAN CLAY with SAND(CL)
▲	3	2.0	A-6 (19)	LEAN CLAY(CL)
★	4	2.0	A-7-6 (18)	LEAN CLAY with SAND(CL)
⊙	5	5.0	A-6 (15)	LEAN CLAY with SAND(CL)
✿	6	2.5	A-6 (15)	LEAN CLAY with SAND(CL)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	1	2.0	AASHTO T-180 Method A	40	19	21	123.7 PCF	11.7 %
⊠	2	2.6	AASHTO T-180 Method A	39	17	22	126.6 PCF	10.7 %
▲	3	2.0	AASHTO T-180 Method A	40	18	22	125.5 PCF	10.9 %
★	4	2.0	AASHTO T-180 Method A	41	19	22	120.6 PCF	12.2 %
⊙	5	5.0	AASHTO T-180 Method A	37	18	19	124.9 PCF	11.0 %
✿	6	2.5	AASHTO T-180 Method A	40	18	22	120.5 PCF	12.4 %

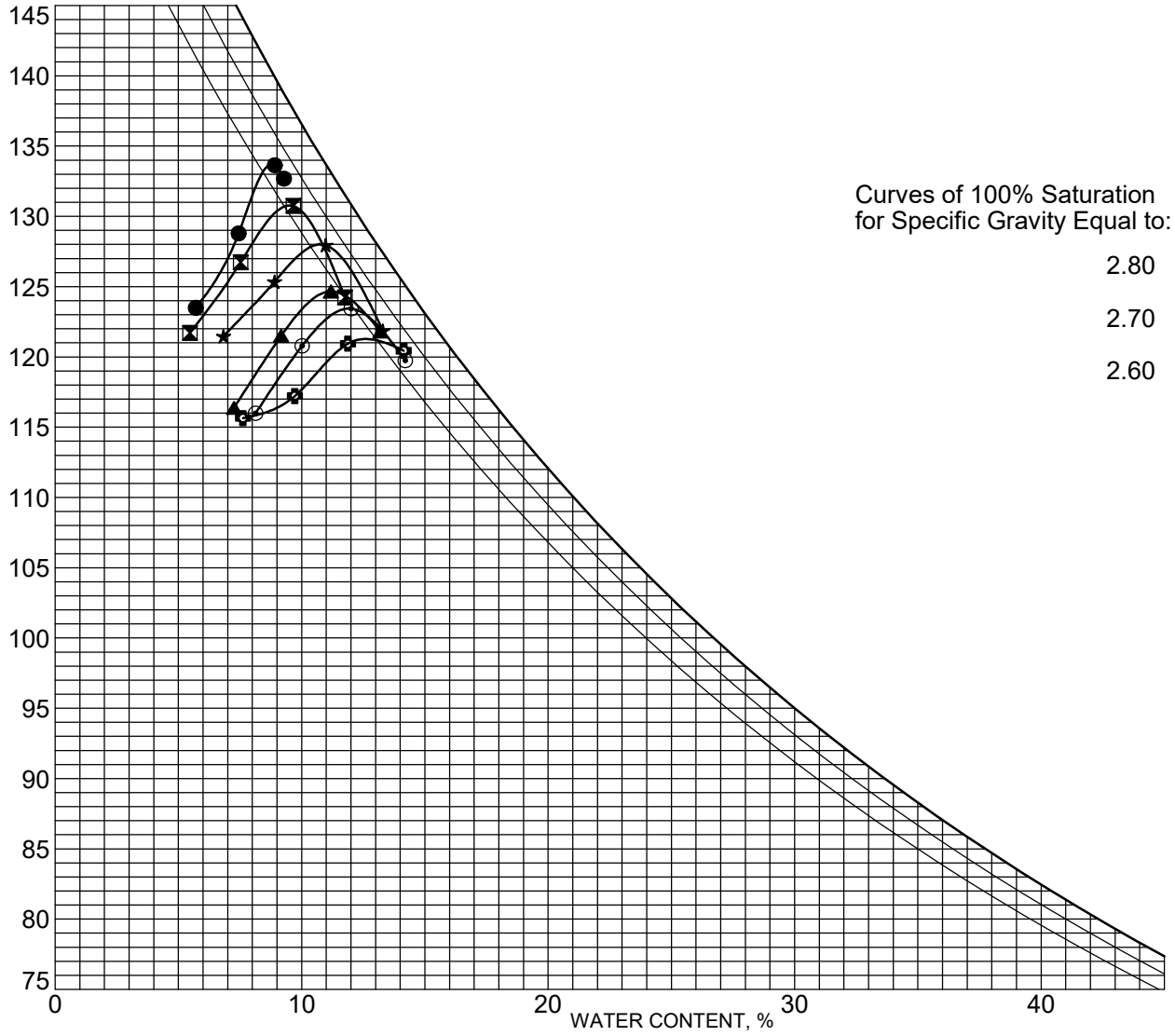
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 6/22/23 11:15 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

MOISTURE-DENSITY RELATIONSHIP

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	7	2.0	A-4 (0)	CLAYEY SAND(SC)
⊠	8	5.0	A-2-4 (0)	SILTY SAND(SM)
▲	9	2.0	A-6 (7)	SANDY LEAN CLAY(CL)
★	10	2.0	A-6 (1)	CLAYEY SAND(SC)
⊙	11	2.0	A-7-6 (26)	LEAN CLAY(CL)
✪	11	2.2	A-7-6 (25)	LEAN CLAY(CL)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	7	2.0	AASHTO T-180 Method A	26	17	9	133.7 PCF	8.8 %
⊠	8	5.0	AASHTO T-180 Method A	NP	NP	NP	130.8 PCF	9.6 %
▲	9	2.0	AASHTO T-180 Method A	33	18	15	124.7 PCF	11.2 %
★	10	2.0	AASHTO T-180 Method A	28	17	11	128.0 PCF	10.8 %
⊙	11	2.0	AASHTO T-180 Method A	47	20	27	123.4 PCF	11.9 %
✪	11	2.2	AASHTO T-180 Method A	43	17	26	121.3 PCF	12.6 %

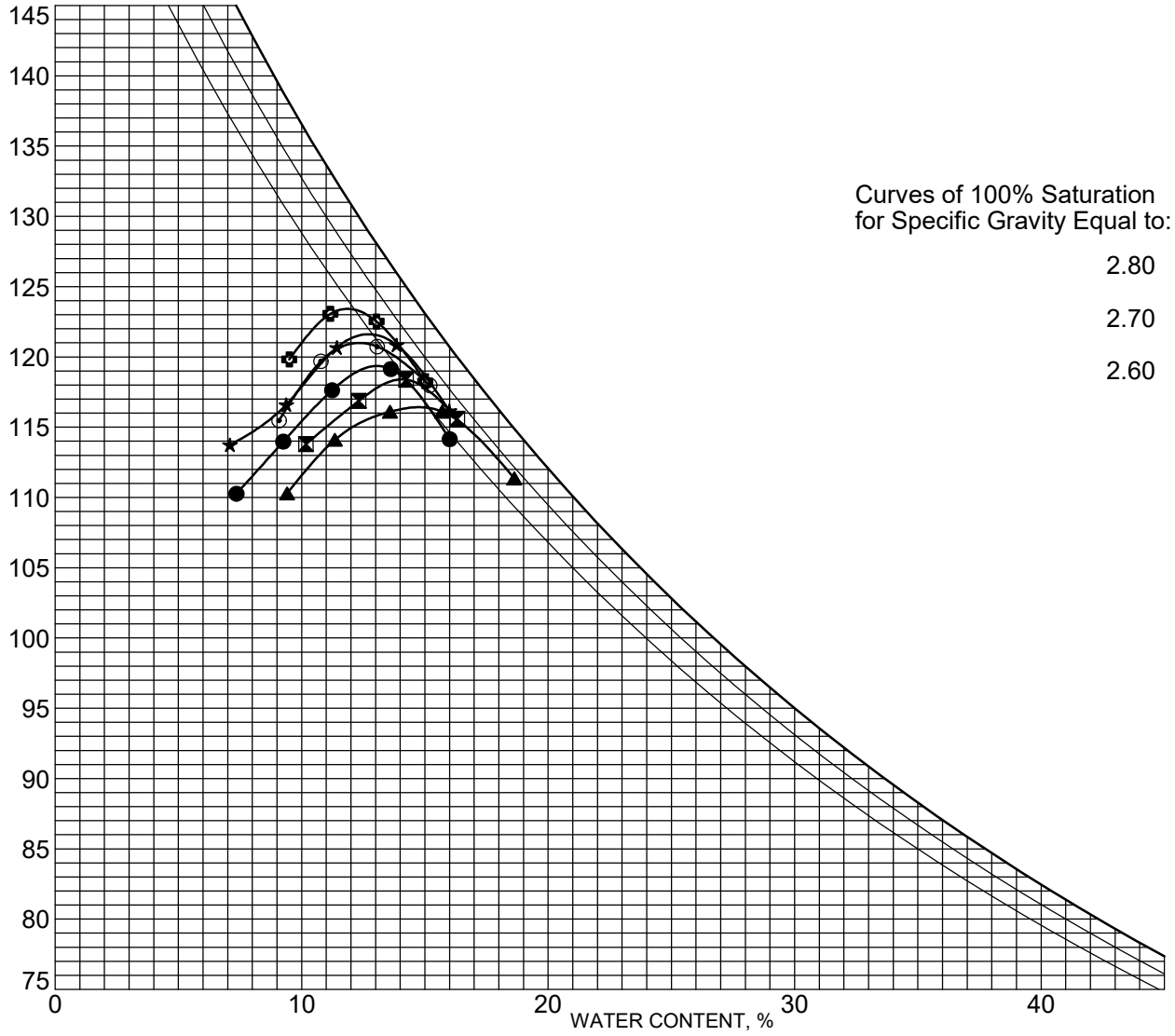
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 6/22/23 11:15 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

MOISTURE-DENSITY RELATIONSHIP

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	13	2.0	A-6 (18)	LEAN CLAY(CL)
⊠	14	2.0	A-7-6 (30)	FAT CLAY(CH)
▲	15	3.0	A-7-6 (34)	FAT CLAY(CH)
★	16	2.0	A-7-6 (24)	LEAN CLAY(CL)
⊙	17	2.0	A-7-6 (22)	LEAN CLAY(CL)
✿	18	2.6	A-6 (14)	LEAN CLAY with SAND(CL)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	13	2.0	AASHTO T-180 Method A	37	19	18	119.3 PCF	13.1 %
⊠	14	2.0	AASHTO T-180 Method A	53	22	31	118.4 PCF	14.0 %
▲	15	3.0	AASHTO T-180 Method A	57	22	35	116.4 PCF	14.8 %
★	16	2.0	AASHTO T-180 Method A	42	18	24	121.6 PCF	12.7 %
⊙	17	2.0	AASHTO T-180 Method A	44	19	25	121.0 PCF	12.3 %
✿	18	2.6	AASHTO T-180 Method A	38	18	20	123.4 PCF	11.9 %

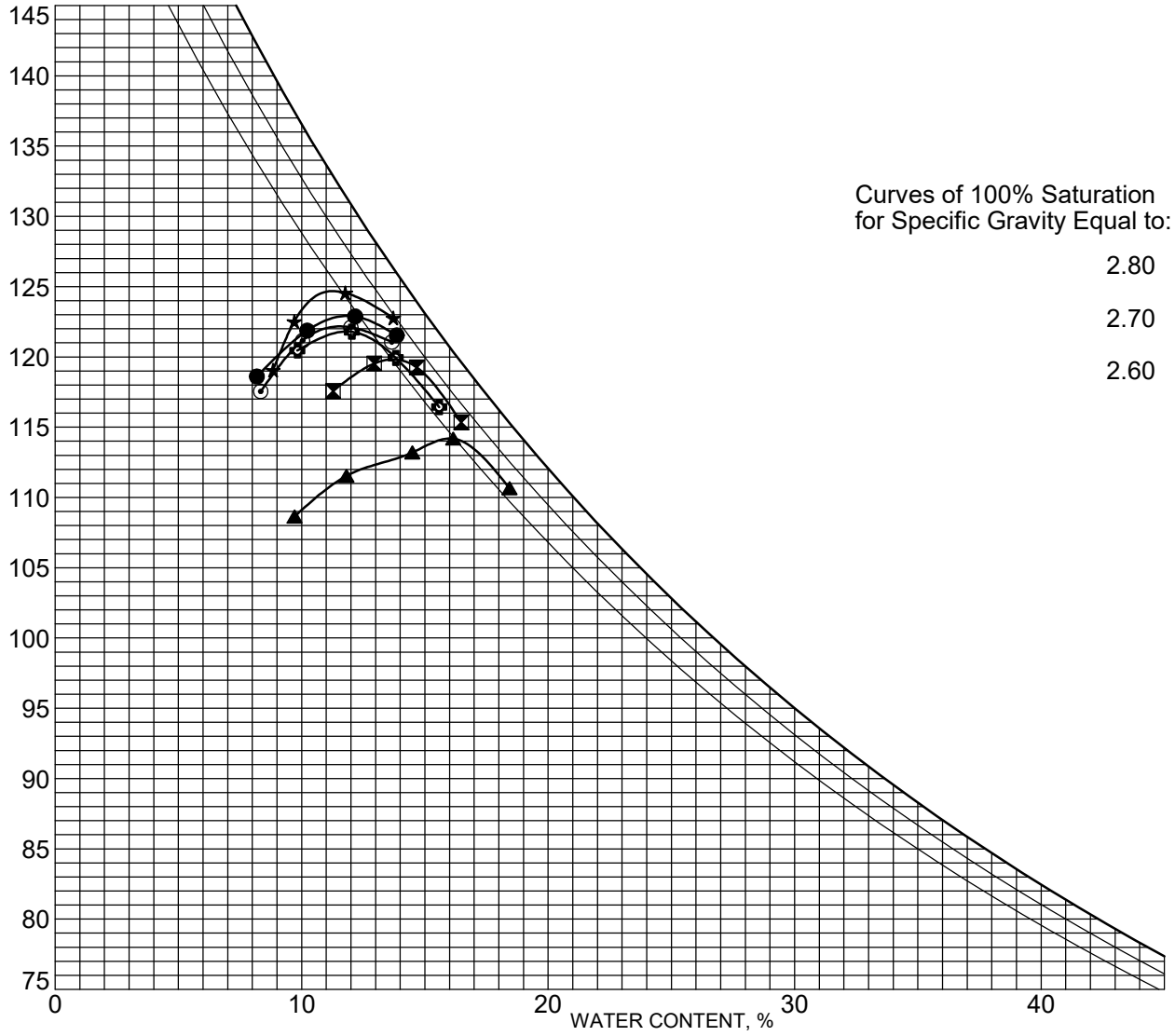
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 6/22/23 11:15 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

MOISTURE-DENSITY RELATIONSHIP

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	19	2.0	A-7-6 (23)	LEAN CLAY(CL)
⊠	20	2.0	A-6 (18)	LEAN CLAY(CL)
▲	21	2.8	A-7-6 (23)	LEAN CLAY(CL)
★	22	2.0	A-6 (22)	LEAN CLAY(CL)
⊙	23	2.0	A-7-6 (22)	LEAN CLAY(CL)
✿	24	2.0	A-7-6 (18)	LEAN CLAY with SAND(CL)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	19	2.0	AASHTO T-180 Method A	43	18	25	122.9 PCF	11.9 %
⊠	20	2.0	AASHTO T-180 Method A	38	20	18	119.8 PCF	13.7 %
▲	21	2.8	AASHTO T-180 Method A	43	20	23	114.2 PCF	16.0 %
★	22	2.0	AASHTO T-180 Method A	40	17	23	124.7 PCF	11.2 %
⊙	23	2.0	AASHTO T-180 Method A	44	19	25	122.2 PCF	11.6 %
✿	24	2.0	AASHTO T-180 Method A	42	18	24	121.8 PCF	11.8 %

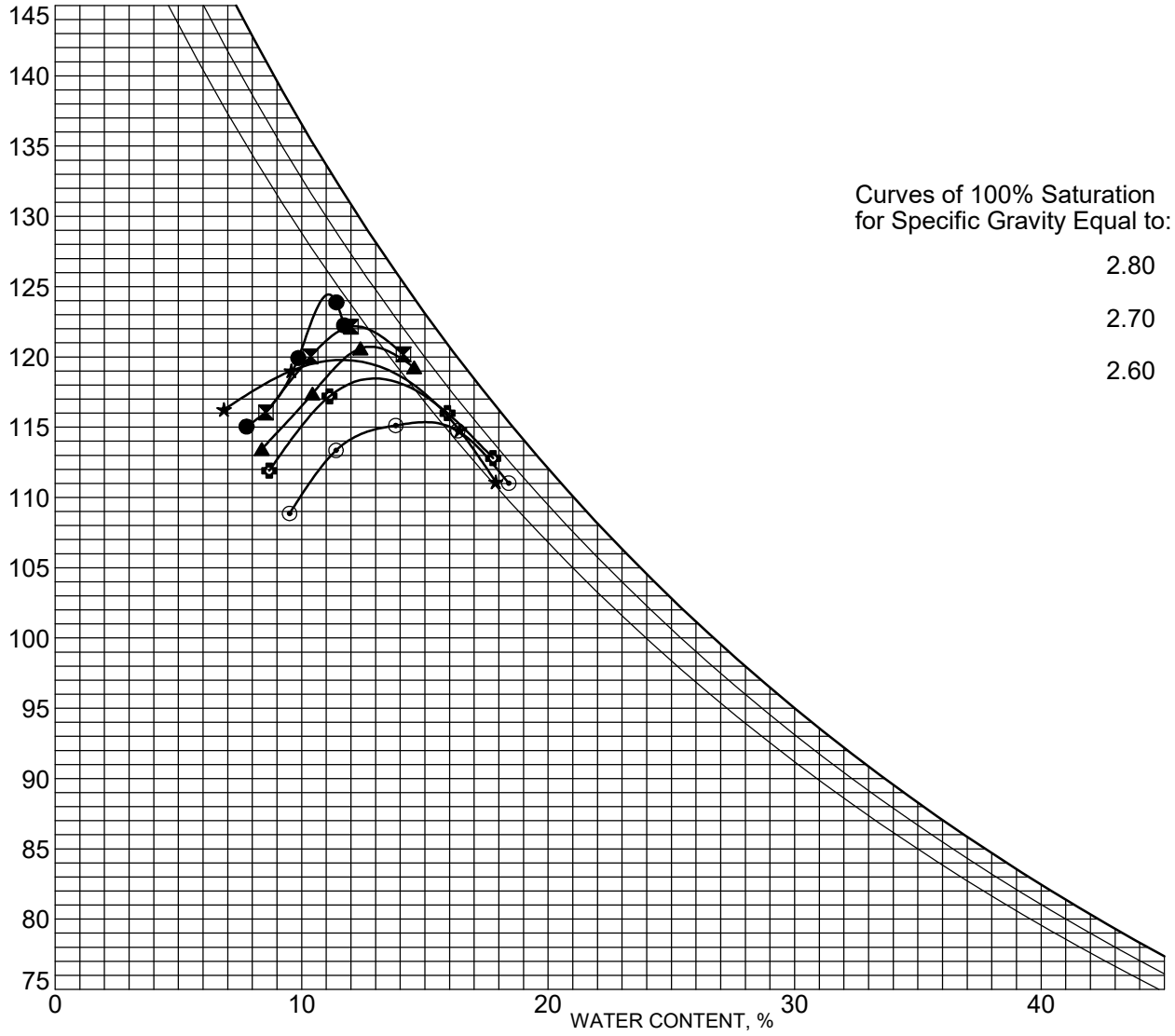
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 6/22/23 11:15 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

MOISTURE-DENSITY RELATIONSHIP

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	25	2.0	A-7-6 (21)	LEAN CLAY with SAND(CL)
⊠	26	2.0	A-7-6 (30)	LEAN CLAY(CL)
▲	27	2.1	A-7-6 (32)	LEAN CLAY(CL)
★	28	2.0	A-7-6 (27)	LEAN CLAY(CL)
⊙	29	2.1	A-7-6 (30)	FAT CLAY with SAND(CH)
✿	30	2.3	A-7-6 (28)	FAT CLAY with SAND(CH)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	25	2.0	AASHTO T-180 Method A	44	18	26	124.5 PCF	11.1 %
⊠	26	2.0	AASHTO T-180 Method A	47	18	29	122.2 PCF	12.2 %
▲	27	2.1	AASHTO T-180 Method A	49	18	31	120.7 PCF	12.7 %
★	28	2.0	AASHTO T-180 Method A	46	19	27	119.8 PCF	11.7 %
⊙	29	2.1	AASHTO T-180 Method A	55	19	36	115.4 PCF	15.0 %
✿	30	2.3	AASHTO T-180 Method A	54	17	37	118.5 PCF	12.9 %

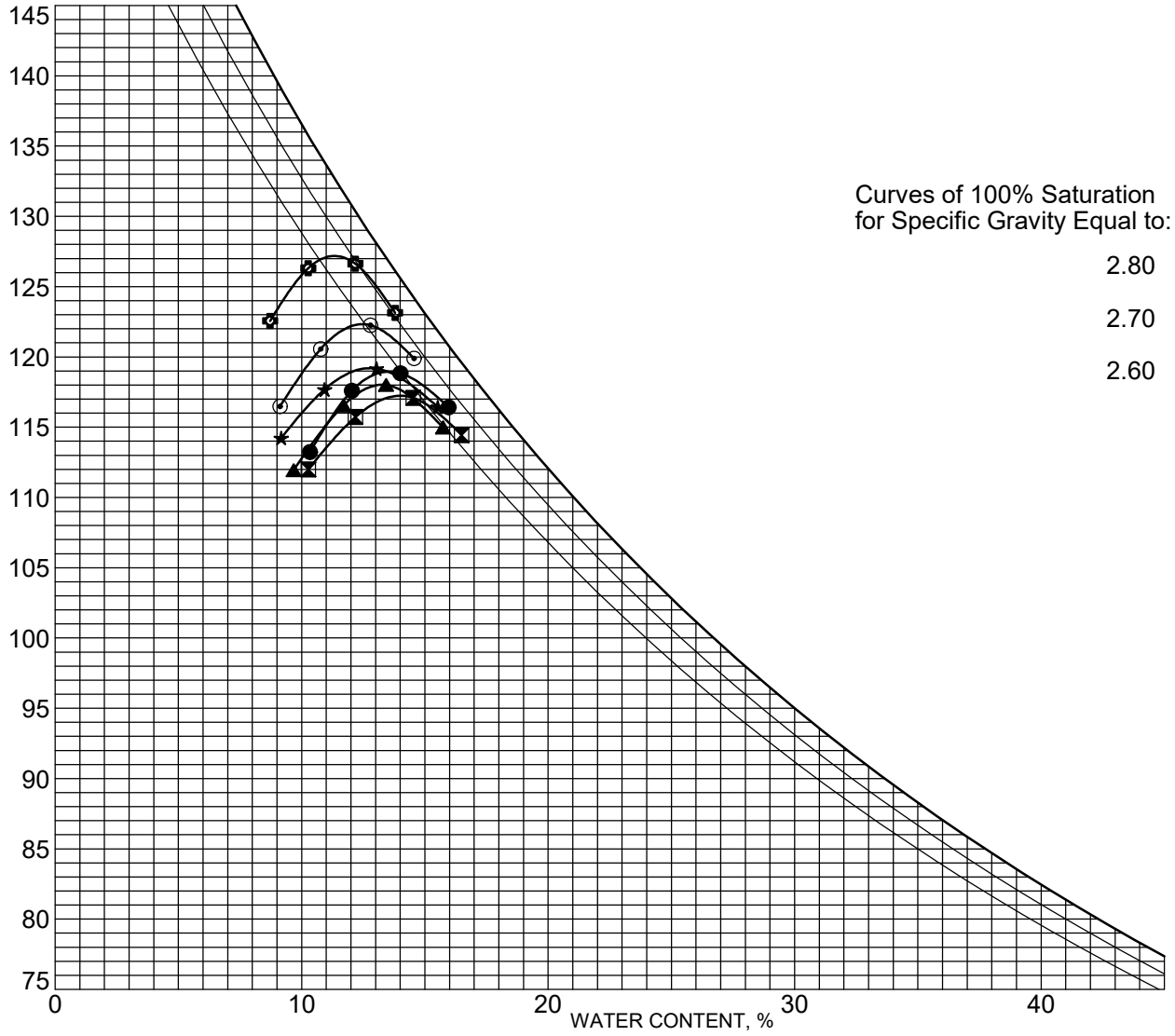
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 6/22/23 11:15 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

MOISTURE-DENSITY RELATIONSHIP

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	31	2.1	A-7-6 (27)	FAT CLAY with SAND(CH)
⊠	32	2.0	A-7-6 (26)	LEAN CLAY(CL)
▲	33	2.2	A-7-6 (29)	FAT CLAY(CH)
★	34	2.0	A-7-6 (35)	FAT CLAY(CH)
⊙	35	2.0	A-7-6 (29)	FAT CLAY with SAND(CH)
✿	36	2.0	A-6 (10)	SANDY LEAN CLAY(CL)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	31	2.1	AASHTO T-180 Method A	52	18	34	119.0 PCF	13.6 %
⊠	32	2.0	AASHTO T-180 Method A	47	17	30	117.2 PCF	14.0 %
▲	33	2.2	AASHTO T-180 Method A	51	19	32	118.0 PCF	13.2 %
★	34	2.0	AASHTO T-180 Method A	53	18	35	119.2 PCF	12.8 %
⊙	35	2.0	AASHTO T-180 Method A	54	18	36	122.3 PCF	12.5 %
✿	36	2.0	AASHTO T-180 Method A	40	15	25	127.2 PCF	11.4 %

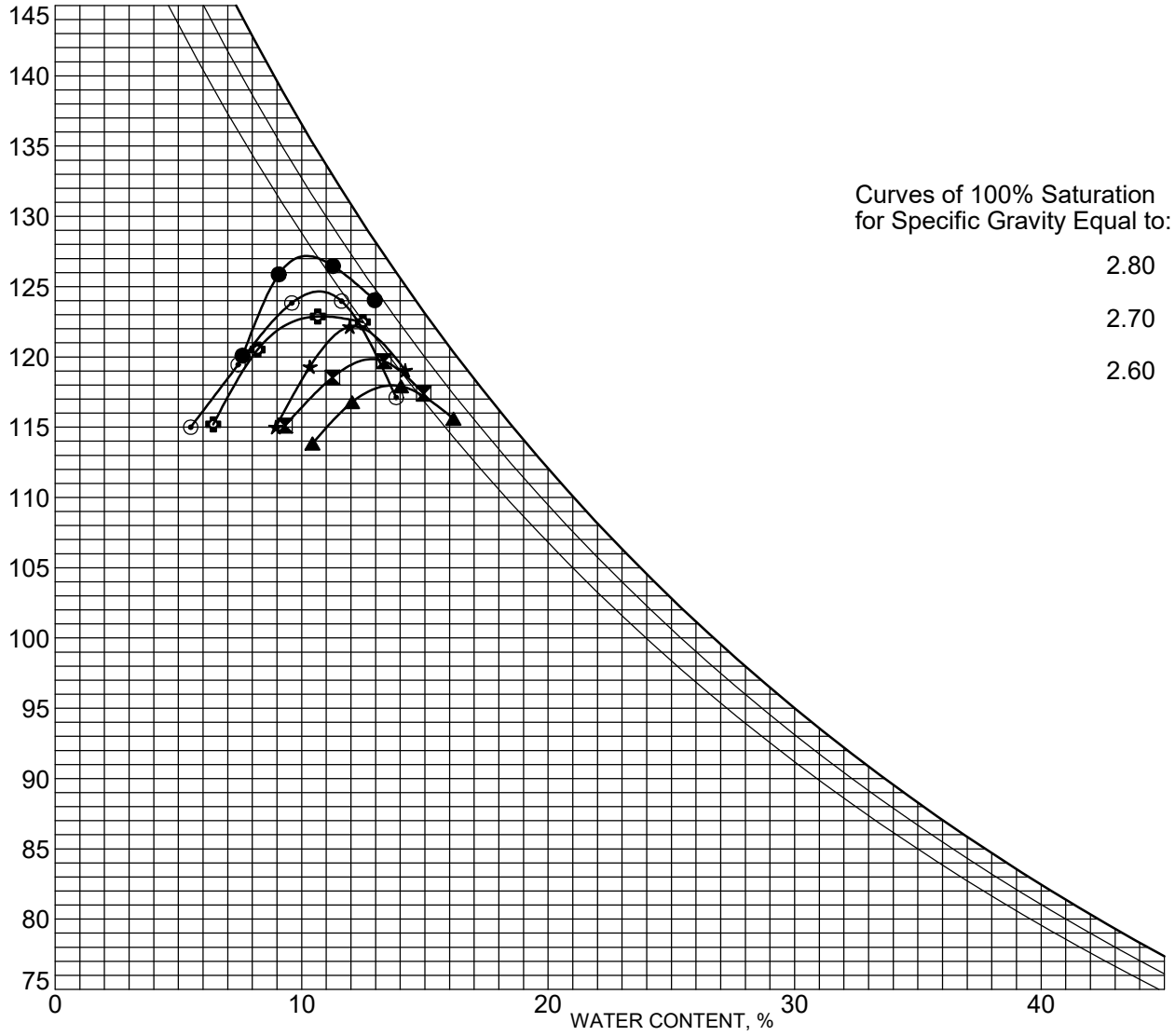
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 6/22/23 11:15 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

MOISTURE-DENSITY RELATIONSHIP

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	37	2.0	A-6 (4)	CLAYEY SAND(SC)
⊠	38	2.2	A-7-6 (21)	LEAN CLAY(CL)
▲	39	2.3	A-7-6 (38)	FAT CLAY with SAND(CH)
★	40	2.0	A-6 (9)	LEAN CLAY with SAND(CL)
⊙	41	2.0	A-4 (0)	SILTY, CLAYEY SAND(SC-SM)
✿	42	2.0	A-6 (6)	SANDY LEAN CLAY(CL)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	37	2.0	AASHTO T-180 Method A	32	17	15	127.2 PCF	10.2 %
⊠	38	2.2	AASHTO T-180 Method A	42	17	25	119.8 PCF	12.9 %
▲	39	2.3	AASHTO T-180 Method A	64	18	46	118.0 PCF	13.7 %
★	40	2.0	AASHTO T-180 Method A	33	18	15	122.2 PCF	12.1 %
⊙	41	2.0	AASHTO T-180 Method A	26	19	7	124.7 PCF	10.8 %
✿	42	2.0	AASHTO T-180 Method A	30	16	14	122.9 PCF	10.8 %

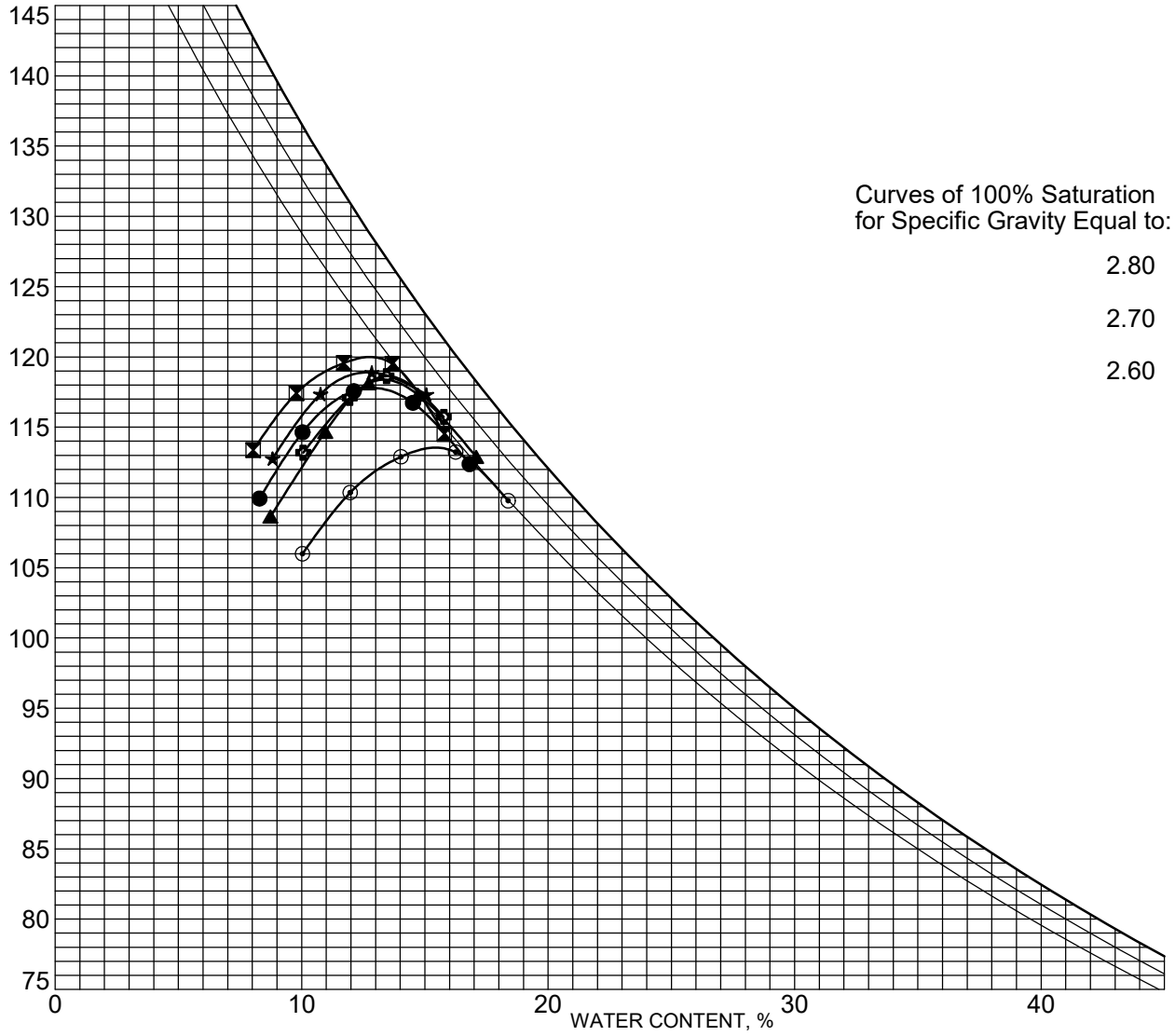
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 6/22/23 11:15 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

MOISTURE-DENSITY RELATIONSHIP

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	43	2.0	A-7-6 (21)	LEAN CLAY(CL)
⊠	44	2.0	A-6 (14)	LEAN CLAY(CL)
▲	45	2.0	A-7-6 (24)	LEAN CLAY with SAND(CL)
★	46	2.0	A-7-6 (26)	LEAN CLAY(CL)
⊙	47	2.0	A-7-6 (29)	FAT CLAY(CH)
✪	48	2.0	A-6 (16)	LEAN CLAY with SAND(CL)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	43	2.0	AASHTO T-180 Method A	43	21	22	117.8 PCF	12.9 %
⊠	44	2.0	AASHTO T-180 Method A	37	23	14	120.0 PCF	12.7 %
▲	45	2.0	AASHTO T-180 Method A	46	17	29	118.4 PCF	13.4 %
★	46	2.0	AASHTO T-180 Method A	46	17	29	118.9 PCF	12.6 %
⊙	47	2.0	AASHTO T-180 Method A	52	20	32	113.5 PCF	15.4 %
✪	48	2.0	AASHTO T-180 Method A	40	18	22	118.6 PCF	13.4 %

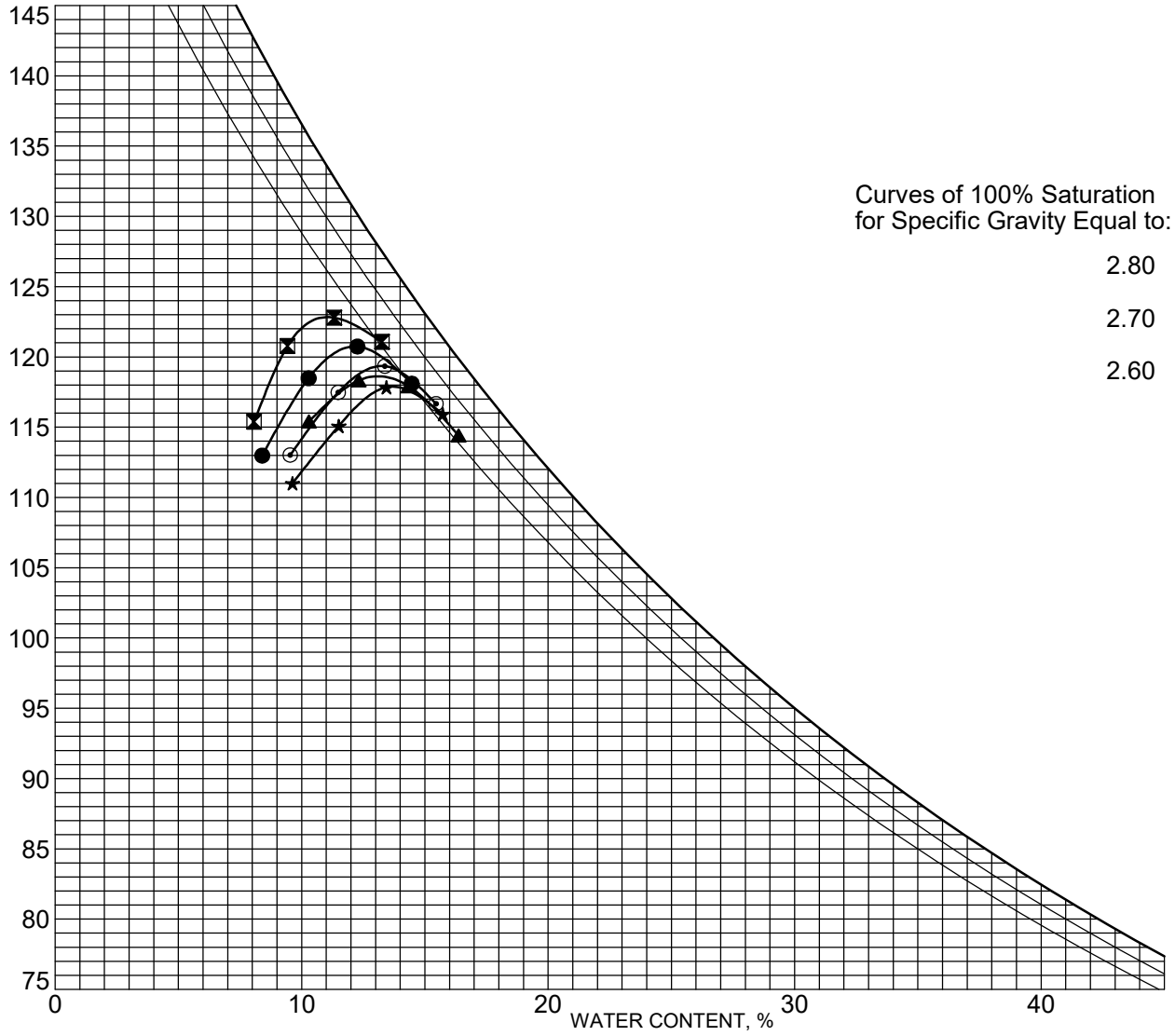
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 6/22/23 11:15 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ

MOISTURE-DENSITY RELATIONSHIP

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER X-1-049(031)036 **LOCATION** Grant & Morton County

PCN 23272



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	**49**	**2.0**	**A-6 (17)**	**LEAN CLAY with SAND(CL)**
⊠	**50**	**2.0**	**A-6 (14)**	**LEAN CLAY with SAND(CL)**
▲	**51**	**2.0**	**A-7-6 (24)**	**LEAN CLAY with SAND(CL)**
★	**52**	**2.1**	**A-7-6 (31)**	**FAT CLAY(CH)**
⊙	**53**	**2.0**	**A-7-6 (24)**	**LEAN CLAY with SAND(CL)**

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**49**	**2.0**	**AASHTO T-180 Method A**	**39**	**17**	**22**	**120.7 PCF**	**12.2 %**
⊠	**50**	**2.0**	**AASHTO T-180 Method A**	**38**	**18**	**20**	**122.8 PCF**	**11.0 %**
▲	**51**	**2.0**	**AASHTO T-180 Method A**	**46**	**17**	**29**	**118.6 PCF**	**13.1 %**
★	**52**	**2.1**	**AASHTO T-180 Method A**	**52**	**18**	**34**	**117.9 PCF**	**13.7 %**
⊙	**53**	**2.0**	**AASHTO T-180 Method A**	**46**	**18**	**28**	**119.4 PCF**	**13.3 %**

COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 6/22/23 11:15 - F:\LAB\PROJECTS\GINT\1-049(031)036.GPJ