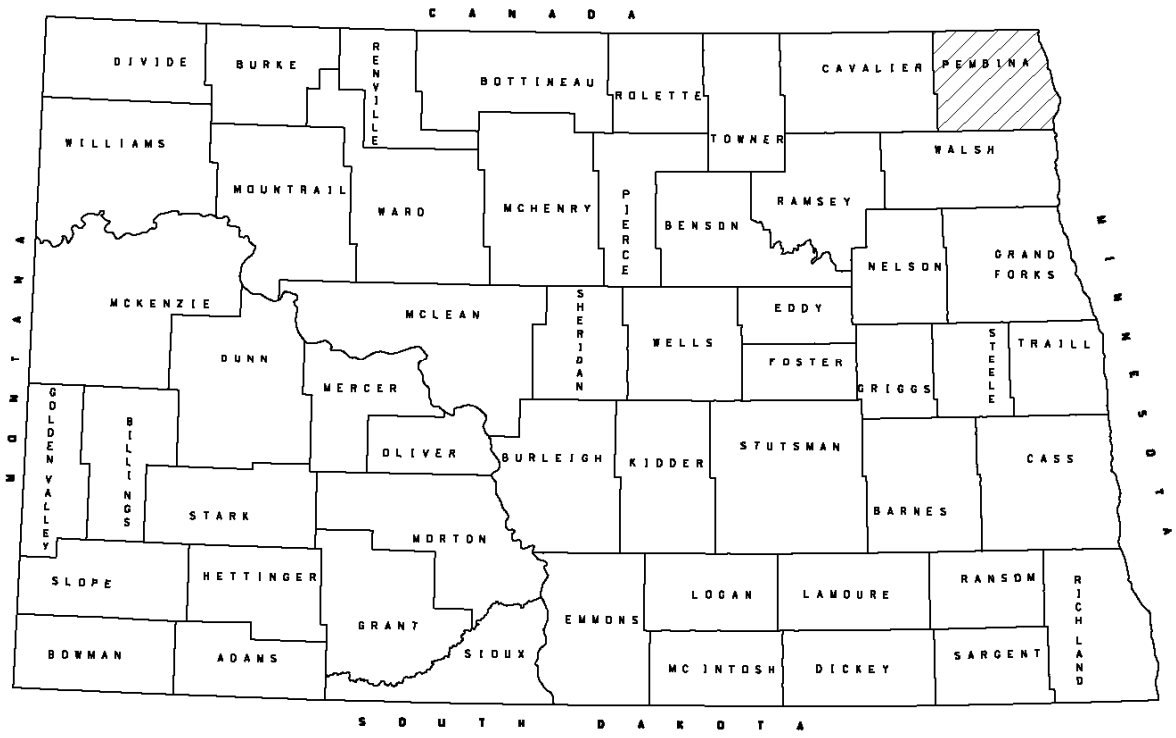
LINEAR SOILS SURVEY AND RECOMMENDATIONS

PROJECT NO. SS-6-032(069)219

PCN 23210

COUNTY PEMBINA

HWY 32, RP 219.556 to 236.674



PREPARED BY: Brent Flaa, PE

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

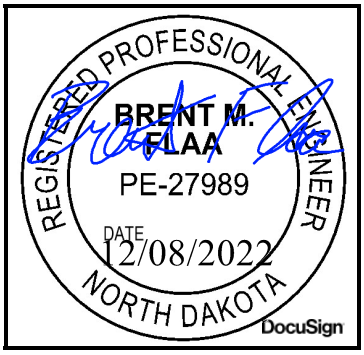
December 2022

SS-6-032(069)219

W Jct 5 N to State Line

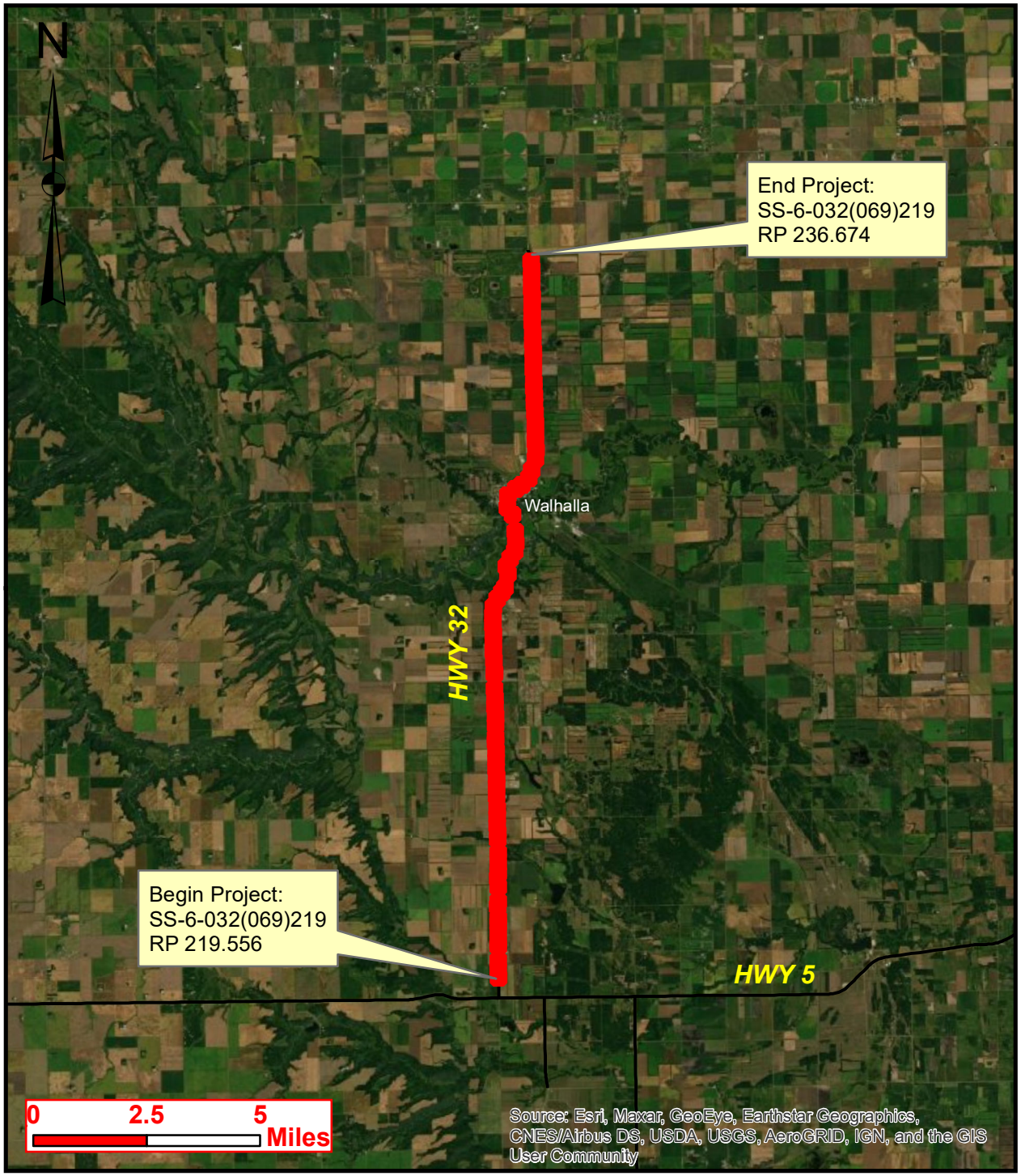
CERTIFICATION

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 Brent Flaa, Registration number PE-27989 on 12/8/2022 and the original document is stored at the North Dakota Department of Transportation.



Project Location

Project: SS-6-032(069)219
PCN: 23210
Scope: Structural Overlay
Location: RP 219.556 to RP 236.674



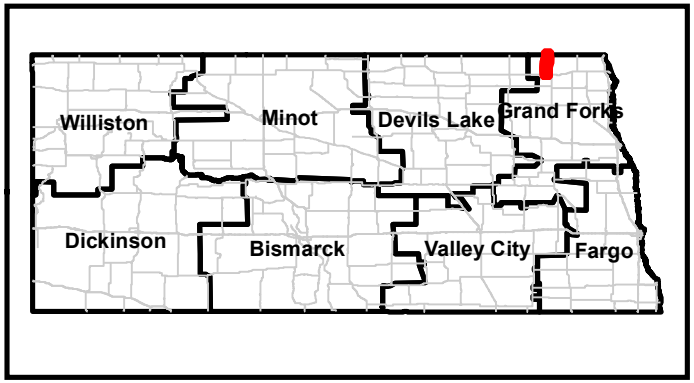


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Appendix C – Boring Locations
Appendix D – Summary of Soils Analysis
Appendix E – Lab Results

Introduction

Location: HWY 32, West Jct 5 N to State Line
Reference Points: 219.556 to 236.674
Project Length: 17.0666
Proposed Project Scope: Structural Overlay
Investigation Scope: 1000' Intervals and Identified Maintenance Areas

Maintenance Review

Date of Maintenance Review: 06/24/2021
Materials and Research Person Conducting the Review: Jamie Naumann
Maintenance Person Conducting Review: Curt Dunn

Table 1 – Identified Maintenance Areas

Location RP + Feet	Distress Identified	Maintenance Comments	Drilling Required
223+4311	Rutting	Quite a few of these throughout the project. Cored several areas. Asphalt was the same thickness all the way across the lane. No base measurement.	No
228+1500 to 229+2200	Alligator Cracking	Hand patches. Located on a hill and curve. Heavy traffic.	Yes
230+3483	Longitude Cracks	Hand patches. Dura-Patch done this spring along with rutting strip patches done twice a year for the past 4 years. All city limits roads in town look like this.	No
231+4450	Longitude Cracks	Hand patches. Dura-Patch done this spring along with rutting strip patches done twice a year for the past 4 years.	No

Summary of Soil Investigation

The soil investigation was completed on 7/28/2021. The investigation consisted of 81 borings.

Table 2 – Boring Locations Summary

Boring Location	Pavement Distress	Justification for Boring	Boring Depth	Boring Locations/Comments
219+2936 to 236+3559	N/A	Reconstruction	5 feet	Conduct borings at 1000' intervals along the project limits (taking into account previous borings, do not redrill). A total number of approximately 76 borings.
228+1500 to 229+2200	Alligator Cracking	Identified Maintenance Area	10 feet	One boring every 1000' along the roadway within distress area. A total number of 5 borings.

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

Summary of Soil Analysis

Project Limits – 220+0000 to 236+1900: The project soils can be broken up into three subgroups corresponding to their location on the project. Starting at the junction of Highway 32 and Highway 5 heading north the first approximately 7.5 miles of this stretch of Highway 32 lays on a flat upland plan, then the Highway drops 200 feet of elevation as it drops down into the Pembina River Valley and passes through Walhalla, the final stretch then passes through glacial Lake Agassiz until the project terminates at the Canadian border.

> **Subgroup 1 – 220+0000 to 225+2950:** The majority of soils within this area of the project are sandy elastic silts and silty sands with AASHTO classifications of A-7-5 and A-7-6.
>
> **Subgroup 2 – 225+4000 to 230+5120:** The soils within this area of the project vary from clayey/silty sands to lean and fat clays with sand. The soils have multiple different AASHTO classifications including A-2-4, A-2-6, A-2-7, A-4, A-6, A-7-5, and A-7-6.
>
> **Subgroup 3 – 231+1000 to 236+1900:** The soils within this area of the project are silty sand with AASHTO classifications of A-2-4 and A-4.

Identified Maintenance Area – 228+2000 to 229+1000: The soils within the identified maintenance area classify as A-7-6, A-7-5, and A-2-7.

Summary of Soil Analysis

Soil Sample Distribution

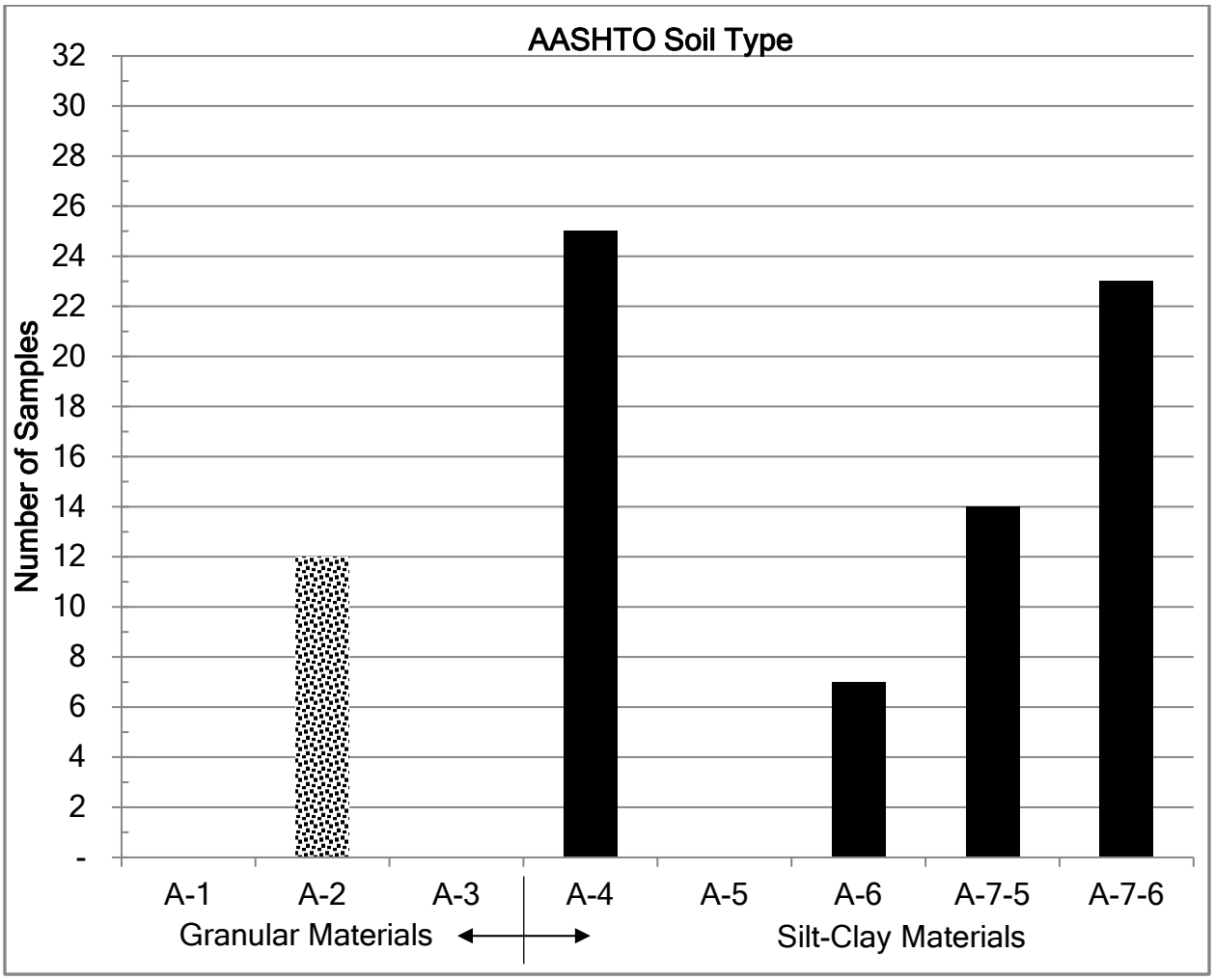


Figure 1 - Soil Sample Distribution

Design Recommendations

Project Limits – 220+0000 to 236+1900: The soils throughout the project are poor subgrade material. Removing and replacing the existing subgrade along the alignment would be cost prohibitive, it is recommended to design the new pavement section to accommodate the existing subgrade soils.

Identified Maintenance Area – 228+2000 to 229+1000: The soils within the identified maintenance area are sandy lean/fat clays with some silt. The soils throughout the maintenance area are similar to the soils found through the project. There is not a change in soil type or water content that would indicate that the subgrade is causing the roadway distress at this location. No additional subgrade mitigation is recommended for this maintenance area.

Design Information

Pipe Replacement: None

Compaction Method: T-180

Subgrade Prep: None

Subcut Recommendations: None

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.

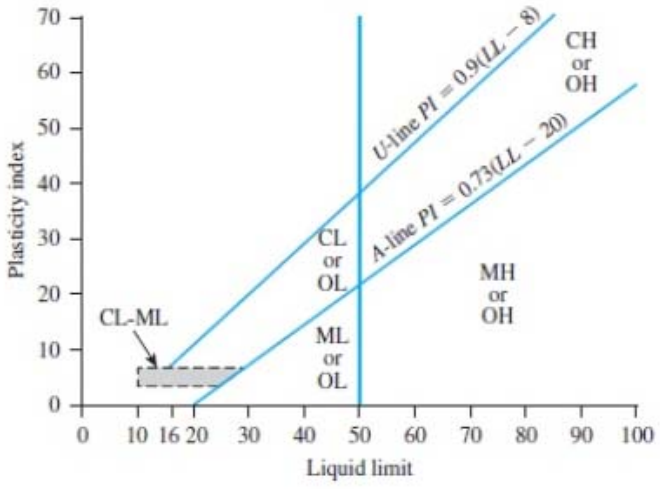
[b] Sands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.

[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 :



Frost Depth Map



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

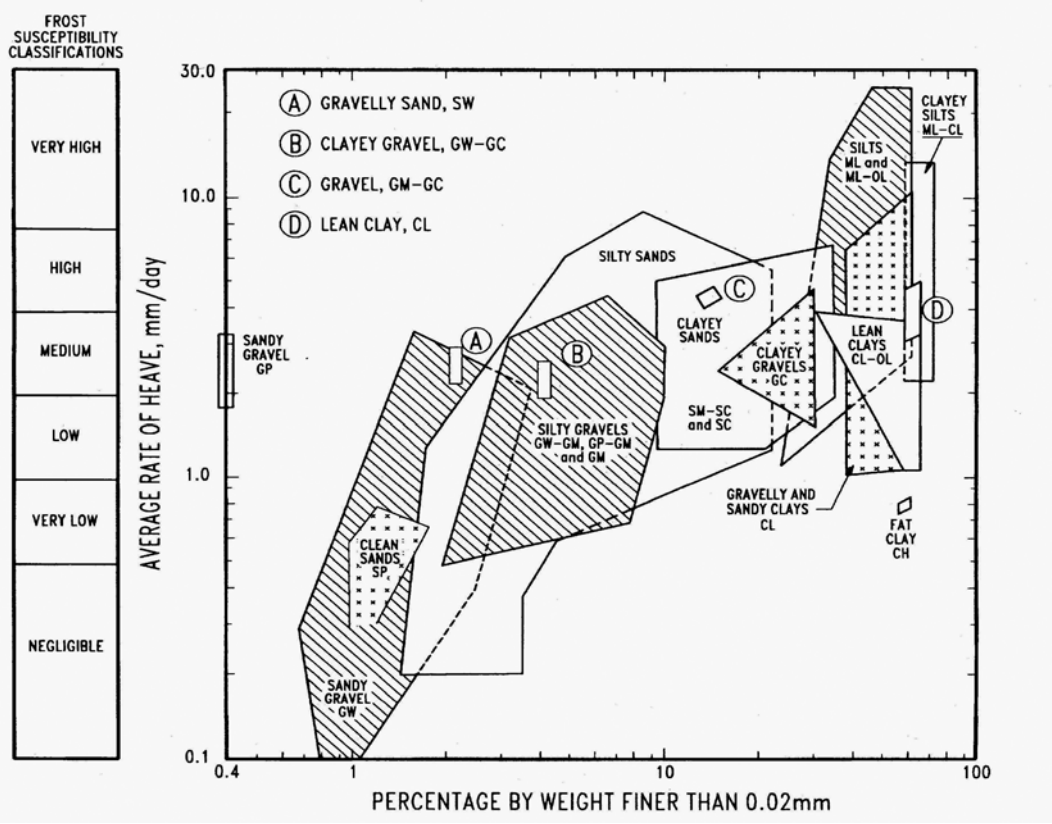


Figure 7-20. Average rate of heave versus % fines for natural soil gradations (Kaplar, 1974).

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)

Sheet	
1	of 1

Project Number	PCN	Date of Survey
SS-6-032(069)219	23210	06/24/2021

Section Maintenance Contact	Completed By
Curt Dunn	Jamie Naumann

Highway Reference Points	Surface Types
219+2936 to 236+3559	Asphalt

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
223+4311	Rutting	Rutting with transverse cracks. Hand patches.	Quite a few of these throughout the project. Cored several areas. Asphalt was the same thickness all the way across the lane . No base measurement.	2-3	No
228+1500 to 229+2200	Alligator Cracking	Includes rutting and transverse cracks.	Hand patches. Located on a hill and curve. Heavy traffic.	4-5	Yes
230+3483	Longitude Cracks	Transverse cracking as well.	Hand patches. Dura-Patch done this spring along with rutting strip patches done twice a year for past 4 years. All city limits roads in town looks like this.	6-7	No
231+4450	Longitude Cracks	Transverse cracking as well.	Hand patches. Dura-Patch done this spring along with rutting strip patches done twice a year for past 4 years.	8-9	No

Comments

Most distresses are worse in southbound lane. Unsure on previous patch date. General overview photos are pictures 1 and 10. City limits very uniform with distresses. North of town less beat up and in much better condition. Dura-Patch done this spring along with rutting strip patches done twice a year for past 4 years.

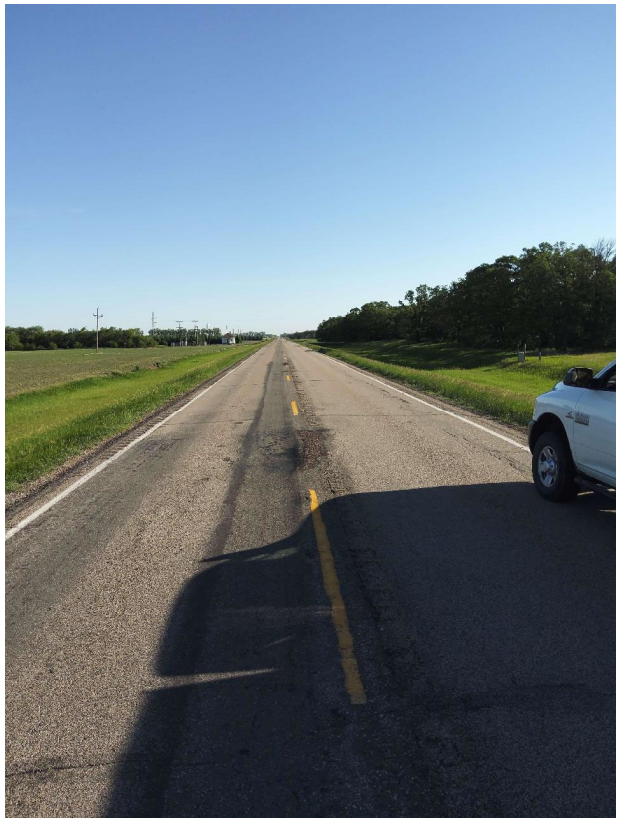
Good ride from train tracks on North side of town to the Canadian border.



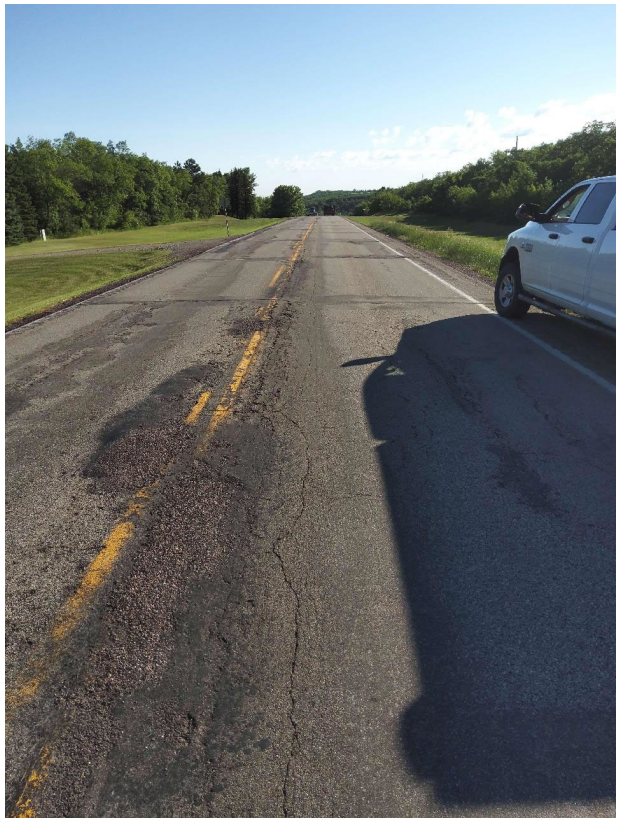
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General Overview



2
223+4311



3
223+4311



4
228+1500 to 229+2200



5
228+1500 to 229+2200



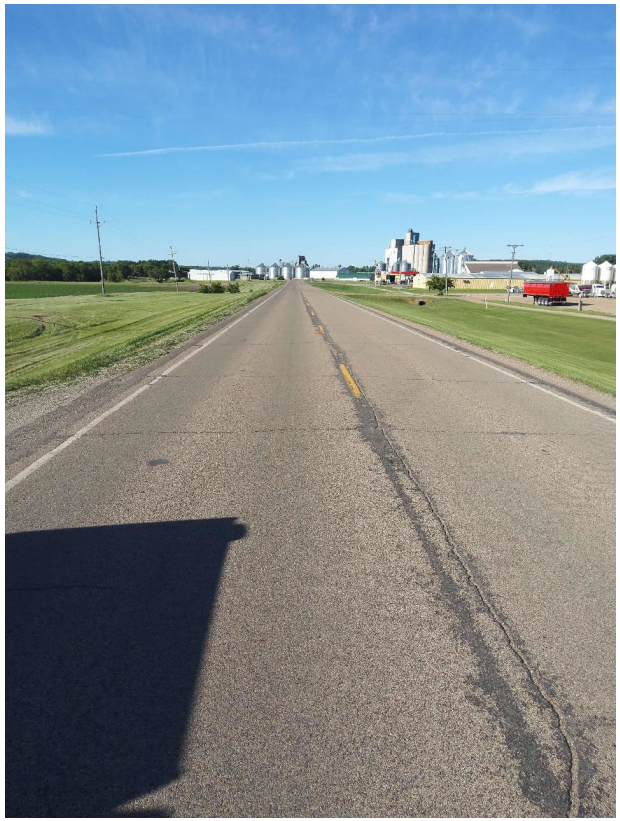
6
230+3483



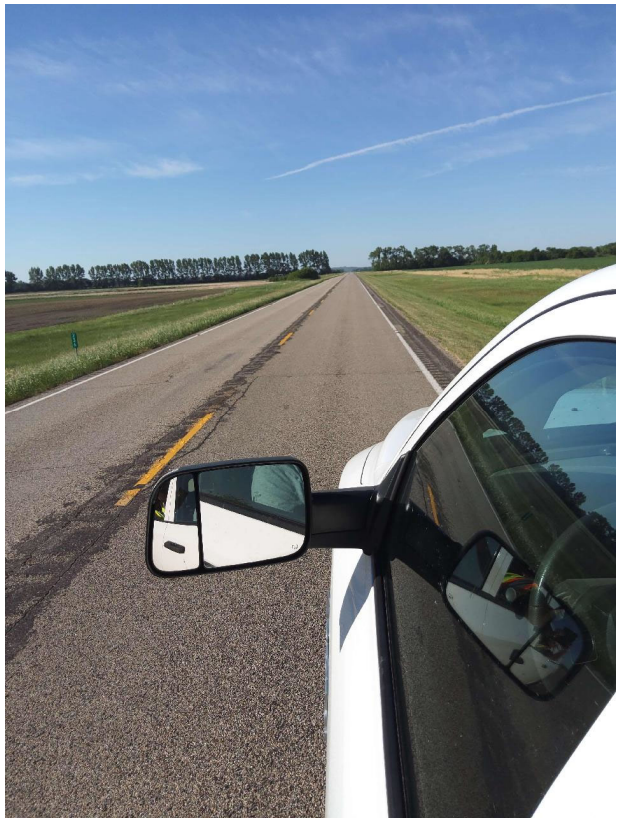
7
230+3483



8
231+4450



9
231+4450



10
General Overview

APPENDIX C

BORING LOCATIONS



Legend

- Boring Locations
- Reference Point

0 3,000 6,000 Feet

Project Number: SS-6-032(069)219

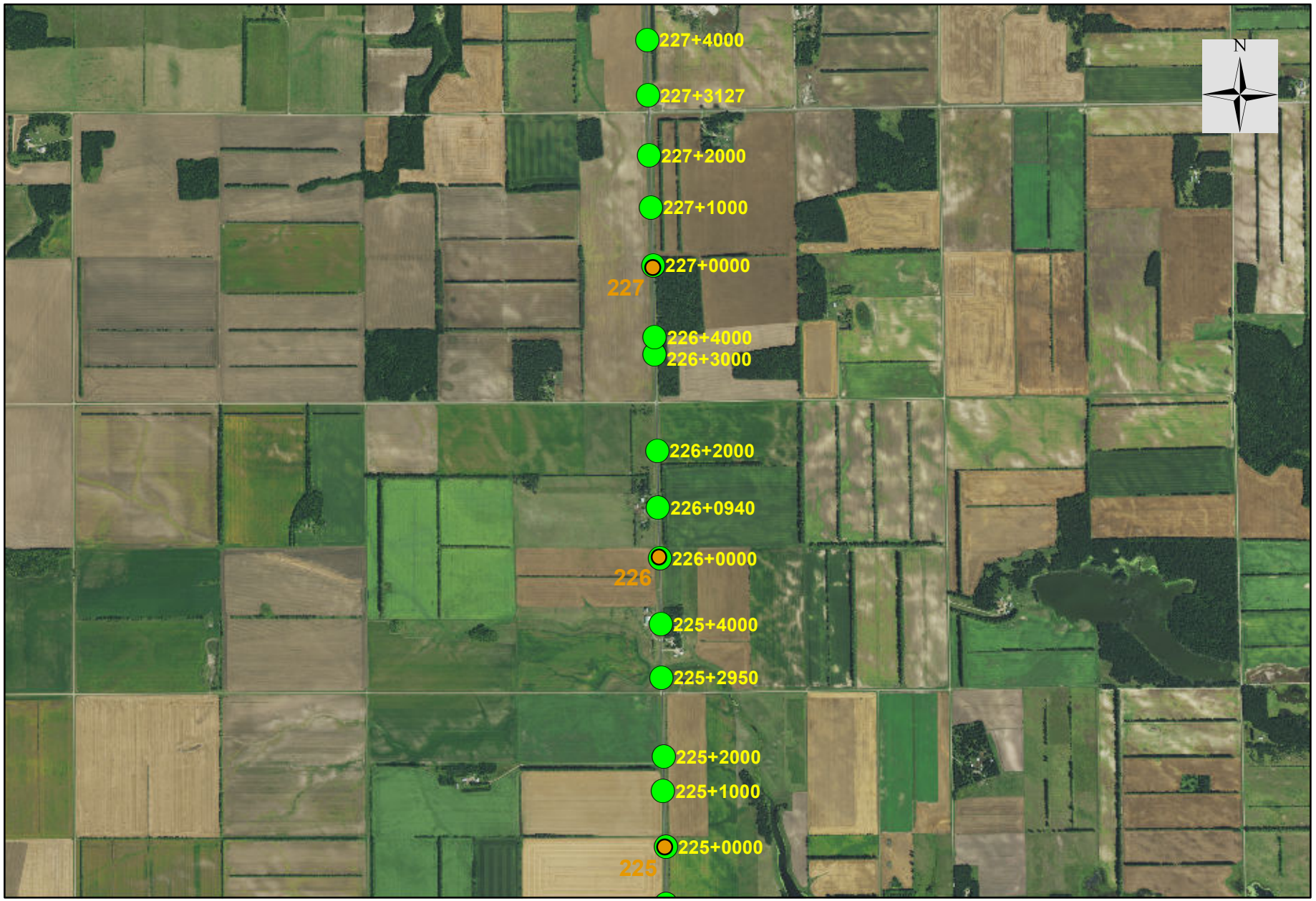


Legend

- Boring Locations
- Reference Point

0 3,000 6,000 Feet

Project Number: SS-6-032(069)219

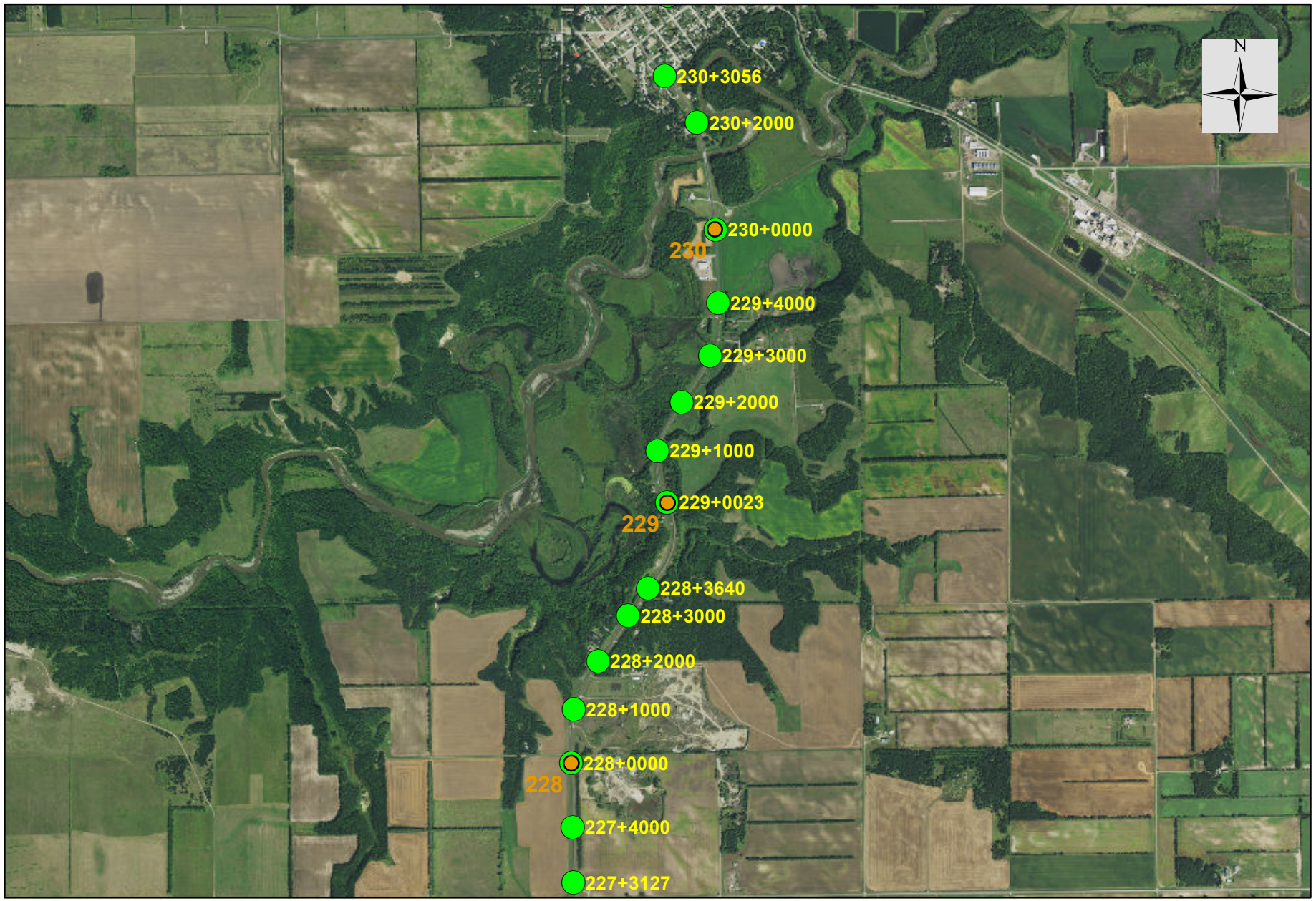


Legend

- Boring Locations
- Reference Point

0 3,000 6,000 Feet

Project Number: SS-6-032(069)219

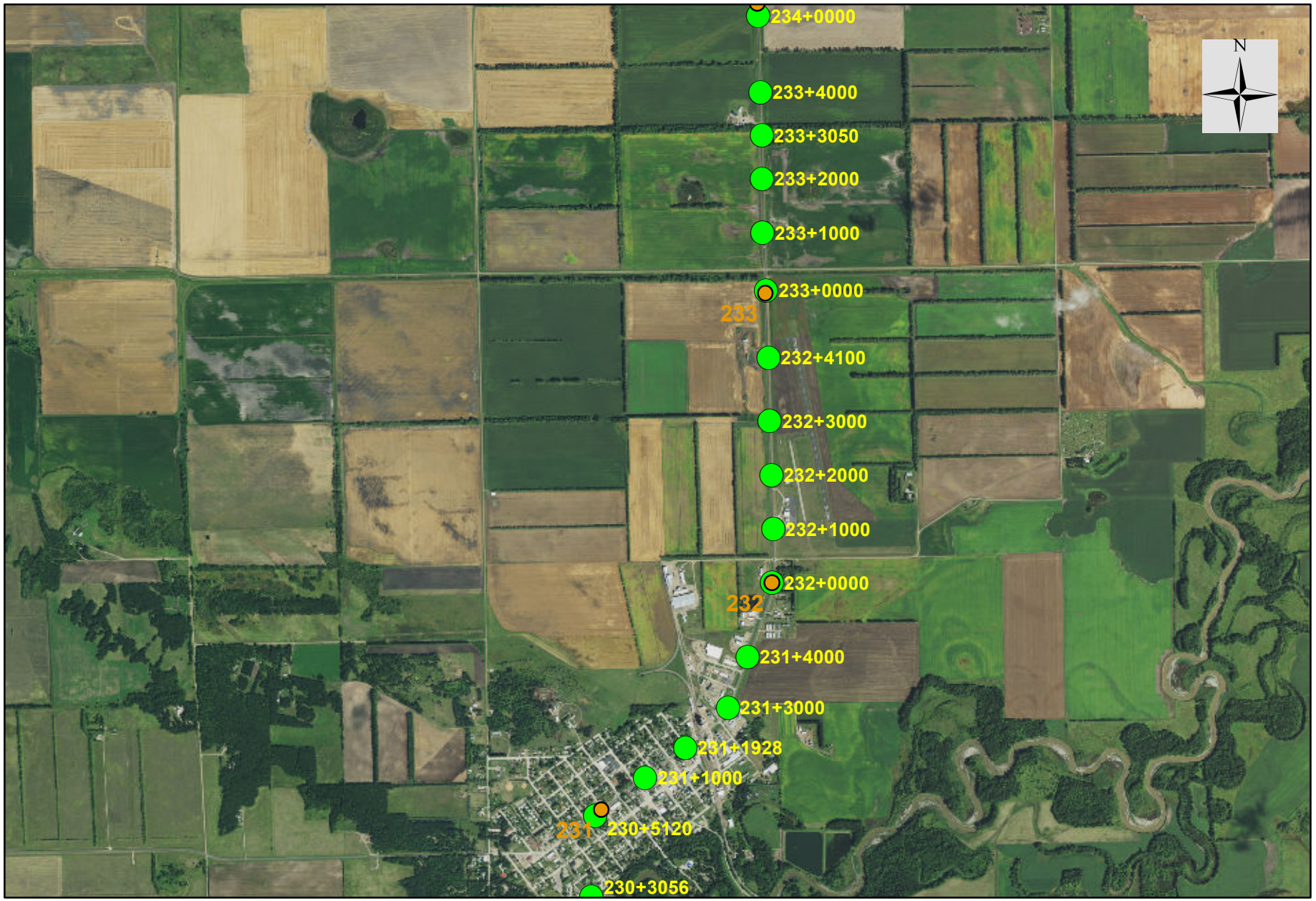


Legend

- Boring Locations
- Reference Point

0 3,000 6,000 Feet

Project Number: SS-6-032(069)219



Legend

- Boring Locations
- Reference Point

0 3,000 6,000 Feet

Project Number: SS-6-032(069)219



Legend

- Boring Locations
- Reference Point

0 3,000 6,000 Feet

Project Number: SS-6-032(069)219

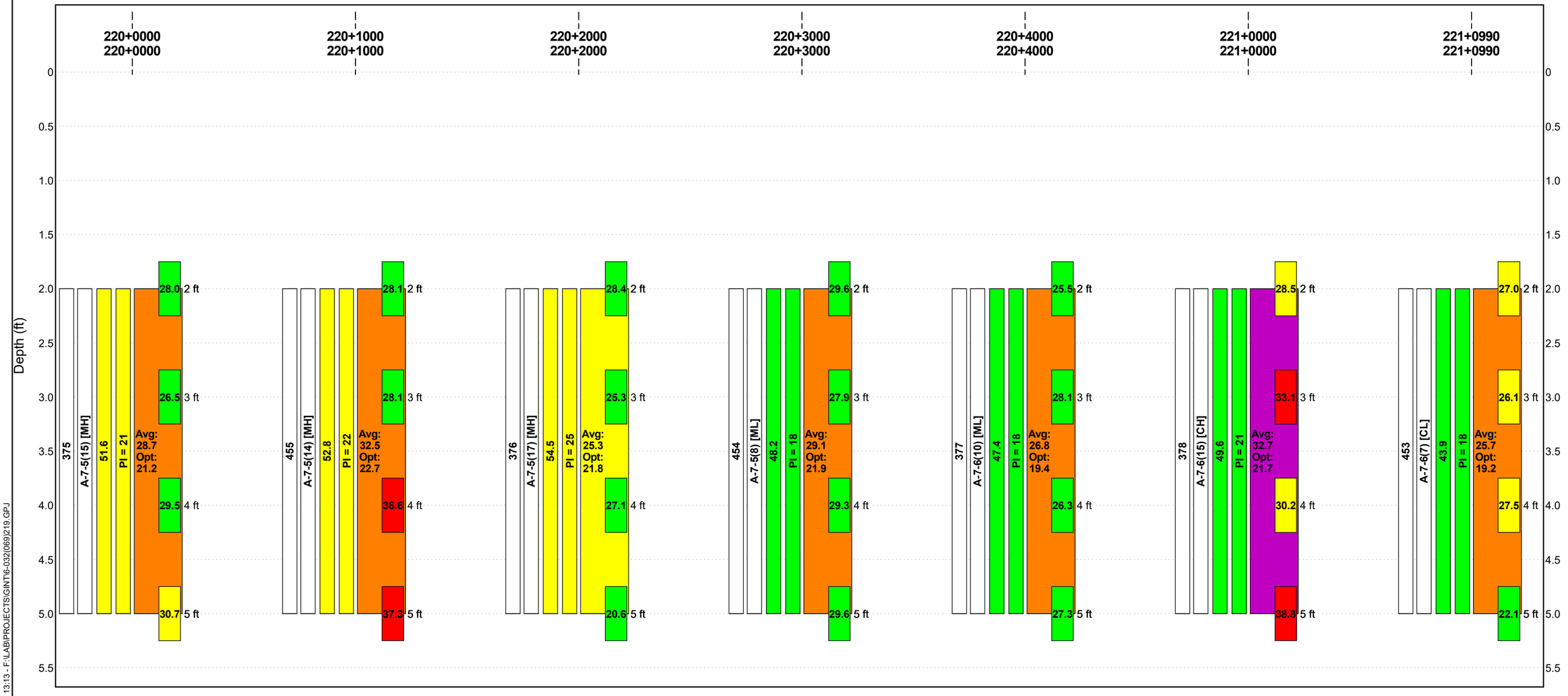
APPENDIX D

SUMMARY OF SOILS ANALYSIS

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

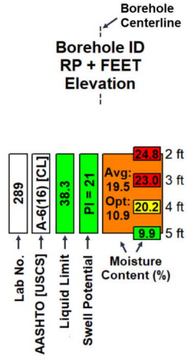
PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County



Boreholes Equally Spaced (0 to 2000 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

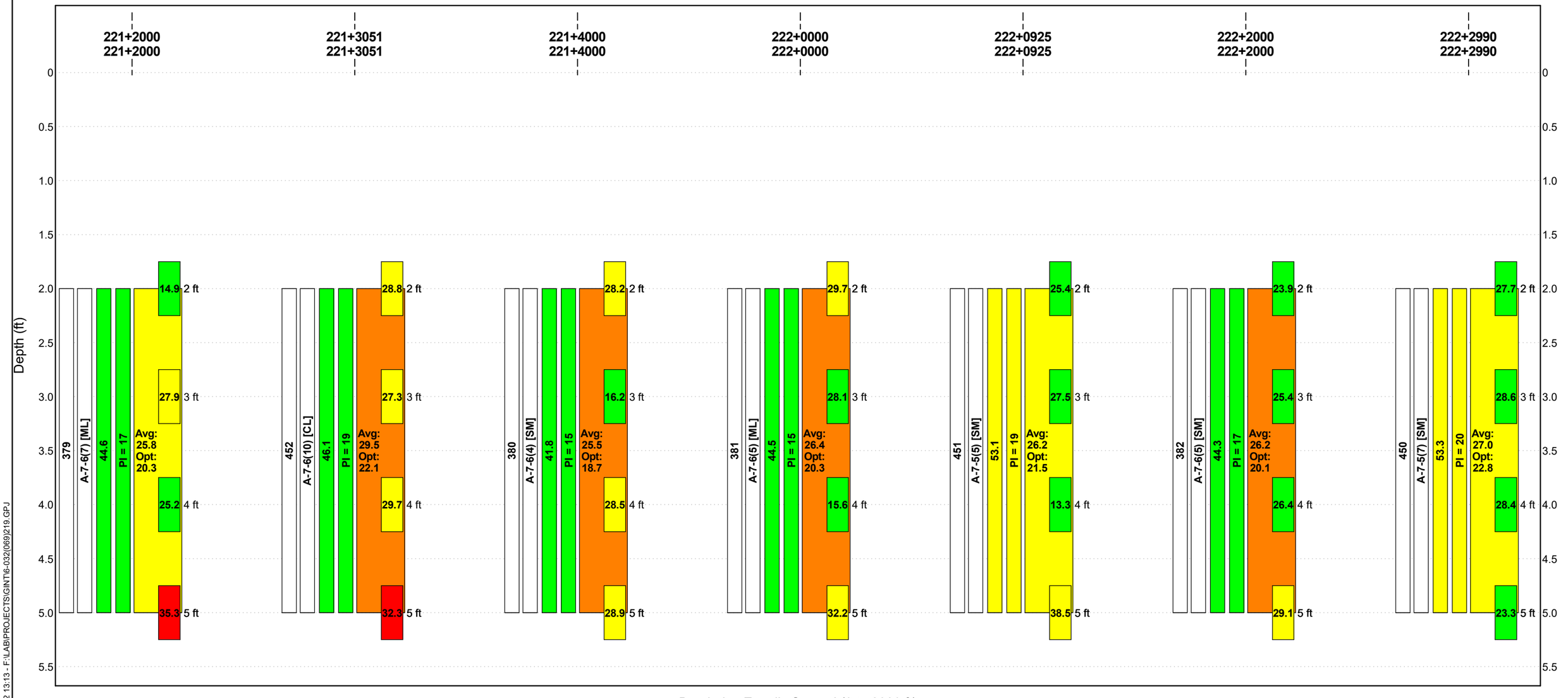


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NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

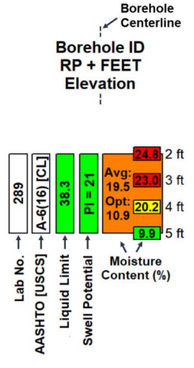
PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

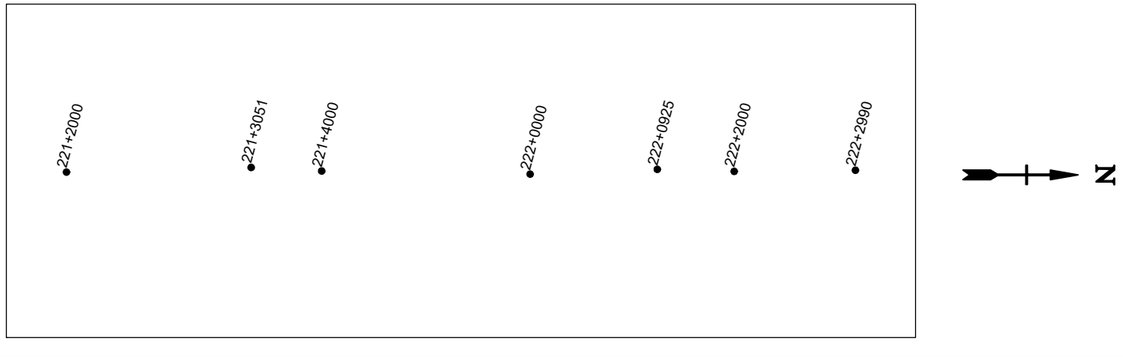


Boreholes Equally Spaced (0 to 2000 ft)

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

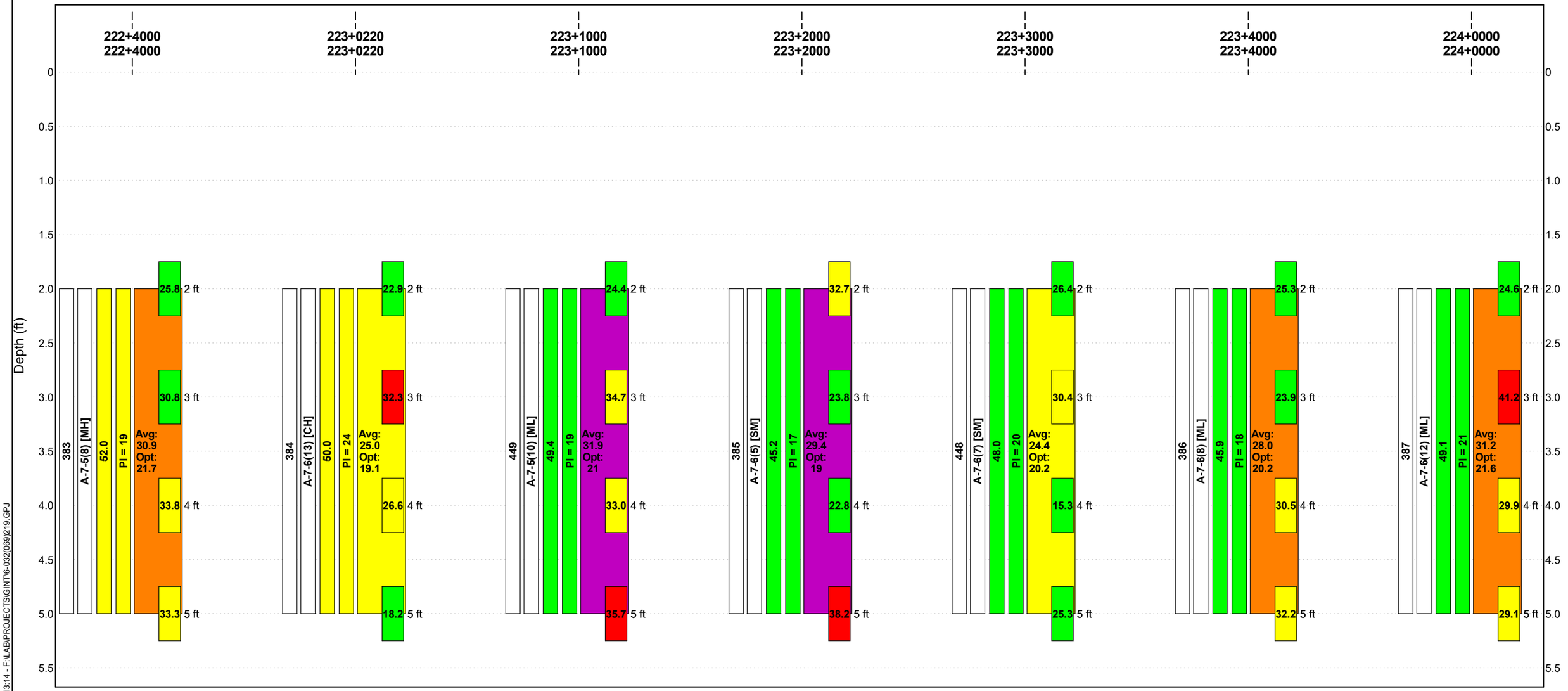


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NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

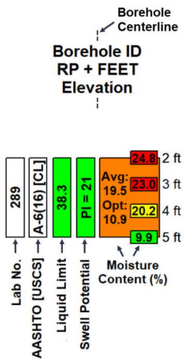
PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

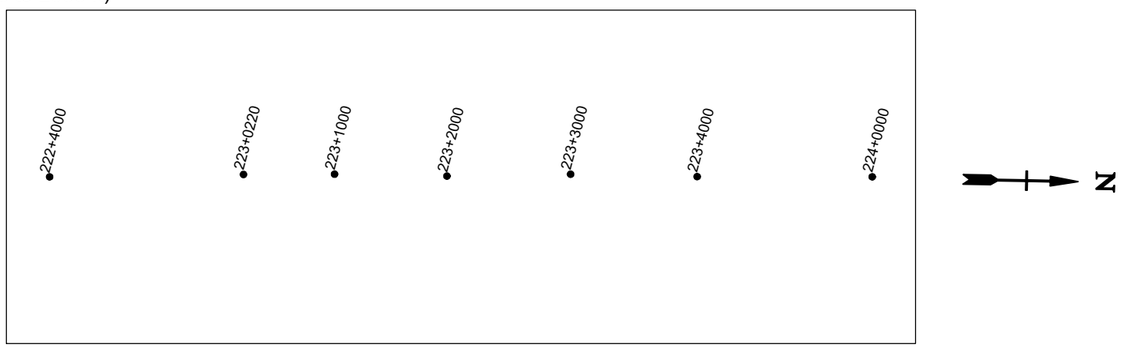


Boreholes Equally Spaced (0 to 2000 ft)

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



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

PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

224+1200 224+1200	224+2300 224+2300	224+3220 224+3220	224+4000 224+4248	225+0000 225+0000	225+1000 225+1000	225+2000 225+2000
27.6 2 ft	20.9 2 ft	27.2 2 ft	23.0 2 ft	26.3 2 ft	25.5 2 ft	26.0 2 ft
29.8 3 ft	26.8 3 ft	27.8 3 ft	27.7 3 ft	24.7 3 ft	30.6 3 ft	28.9 3 ft
447 A-7-6(5) [ML] 43.4 PI = 14 Avg: 29.4 Opt: 20.7	388 A-7-6(15) [CL] 44.4 PI = 20 Avg: 26.2 Opt: 17.5	446 A-7-6(8) [ML] 41.4 PI = 14 Avg: 27.6 Opt: 18.1	389 A-6(3) [SC] 39.5 PI = 14 Avg: 24.5 Opt: 17.8	390 A-7-6(4) [SM] 42.5 PI = 16 Avg: 28.6 Opt: 18.5	445 A-7-5(6) [SM] 47.5 PI = 17 Avg: 29.7 Opt: 19.6	391 A-7-5(12) [MH] 53.2 PI = 21 Avg: 30.0 Opt: 23.2
32.5 4 ft	30.4 4 ft	29.2 4 ft	19.1 4 ft	28.5 4 ft	24.6 4 ft	30.7 4 ft
27.8 5 ft	26.8 5 ft	26.2 5 ft	28.3 5 ft	35.0 5 ft	38.1 5 ft	34.4 5 ft

Depth (ft)

0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5

Boreholes Equally Spaced (0 to 1800 ft)

LEGEND

Borehole Centerline

Borehole ID
RP + FEET
Elevation

289 | A-6(16) [CL] | 38.3 | PI = 21 | Avg: 19.5 | Opt: 10.9 | 24.8 2 ft | 23.0 3 ft | 20.2 4 ft | 9.9 5 ft

Lab No. → AASHTO [USCS] → Liquid Limit → Swell Potential → Moisture Content (%)

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

224+1200 224+2300 224+3220 224+4000 225+0000 225+1000 225+2000

N

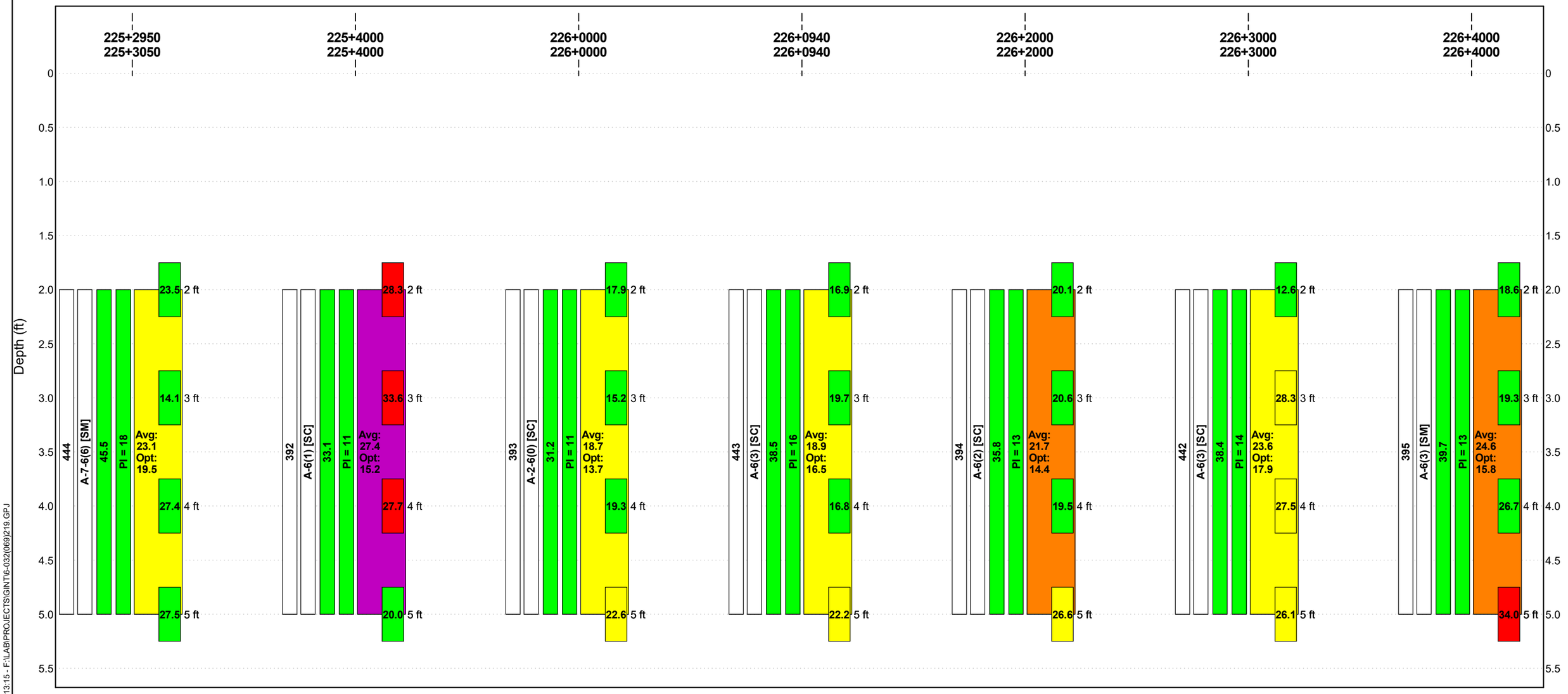
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NDDOT
North Dakota Department of Transportation

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

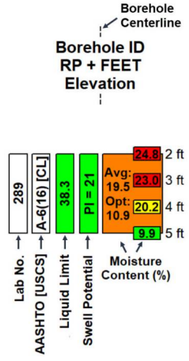
PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

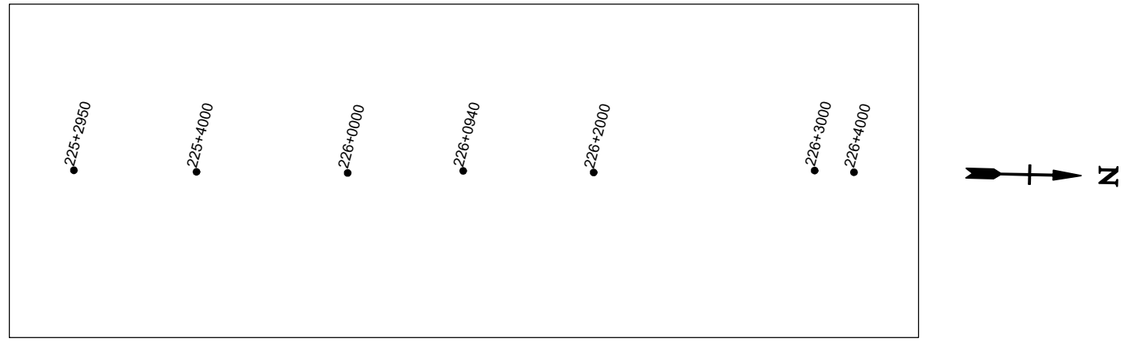


Boreholes Equally Spaced (0 to 2000 ft)

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



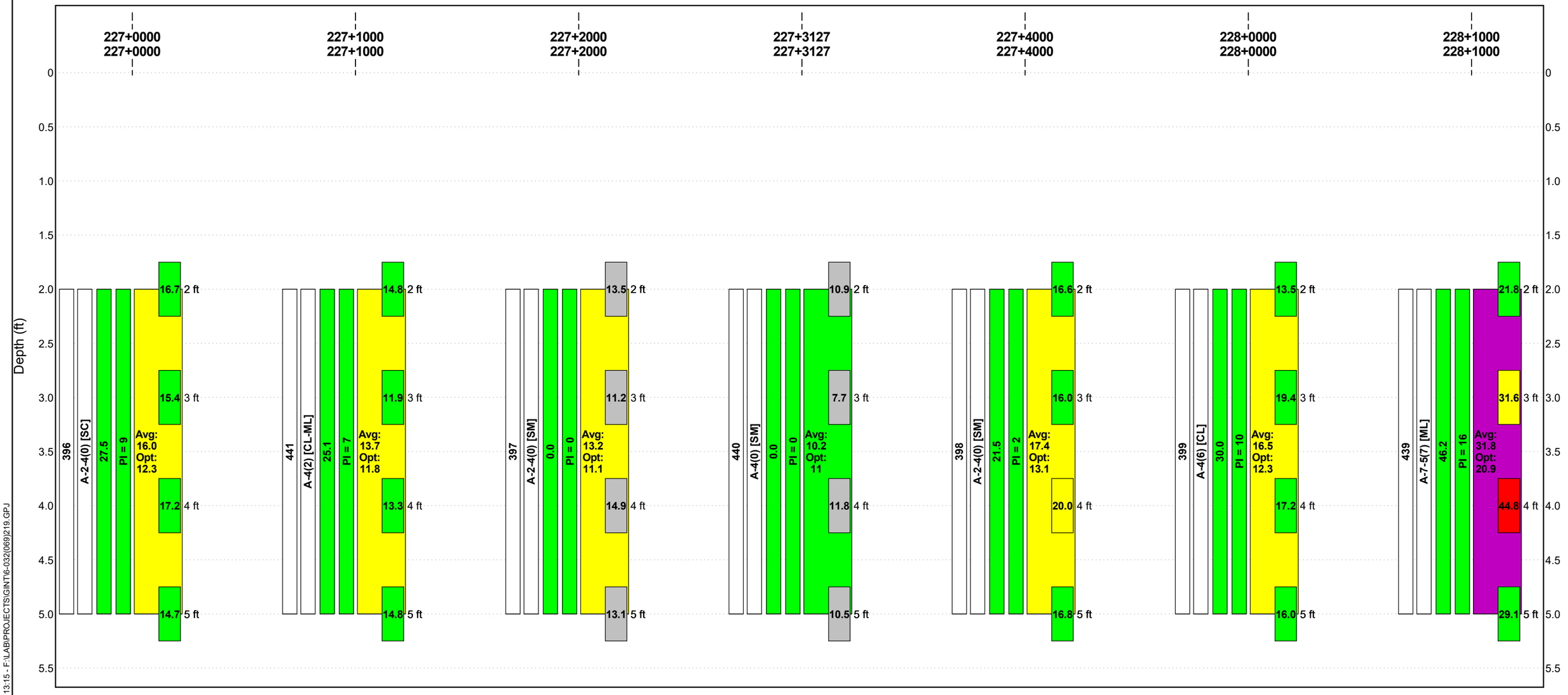
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NDDOT
North Dakota Department of Transportation

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

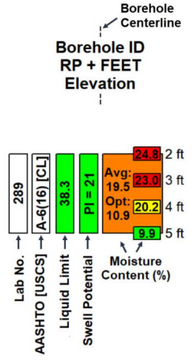
PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

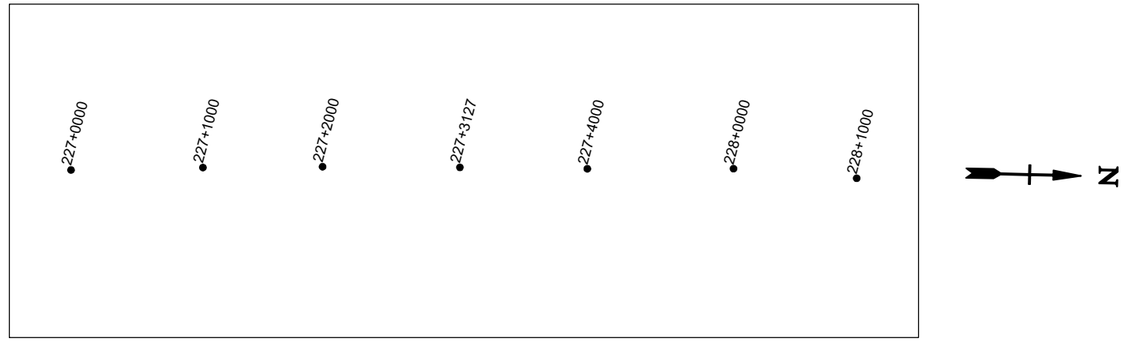


Boreholes Equally Spaced (0 to 2000 ft)

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

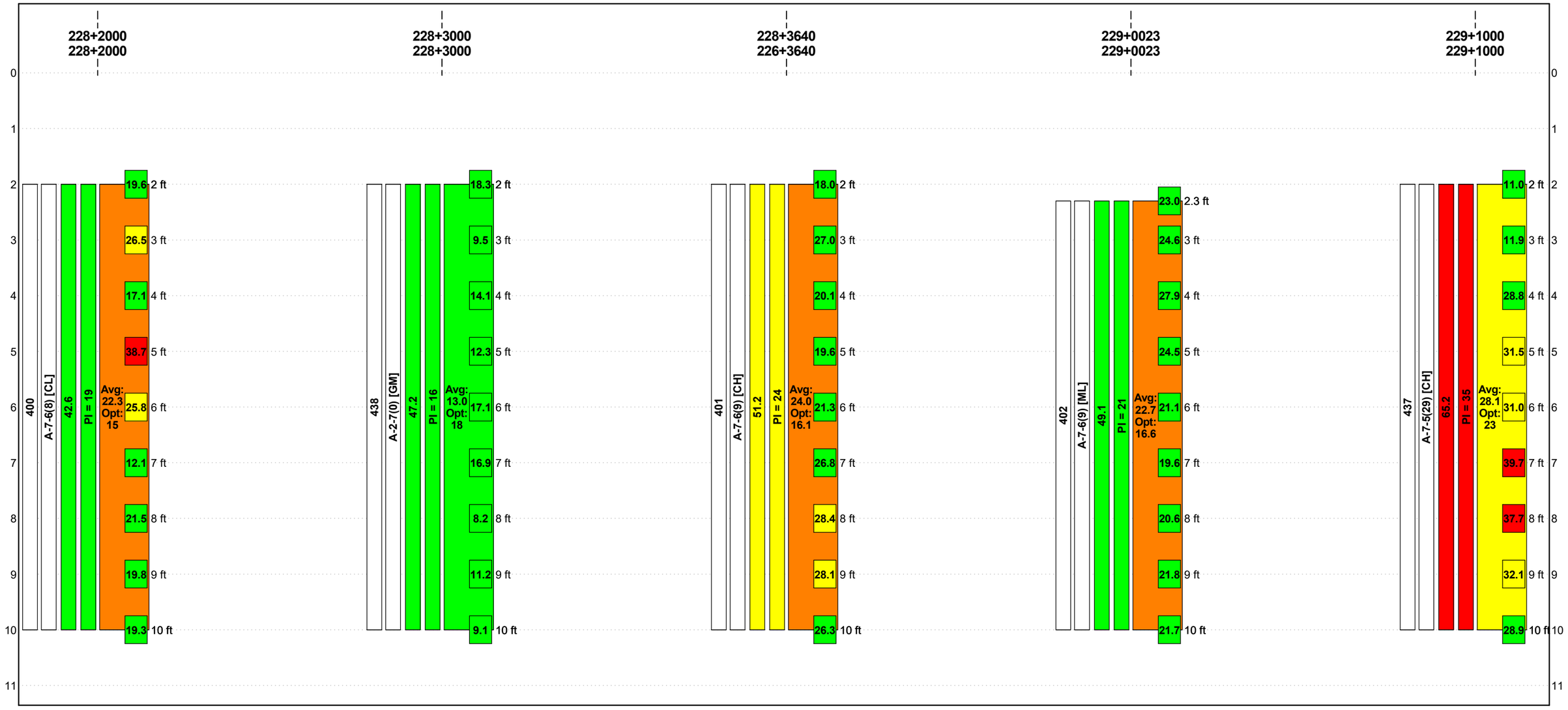


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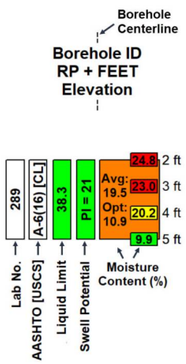
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

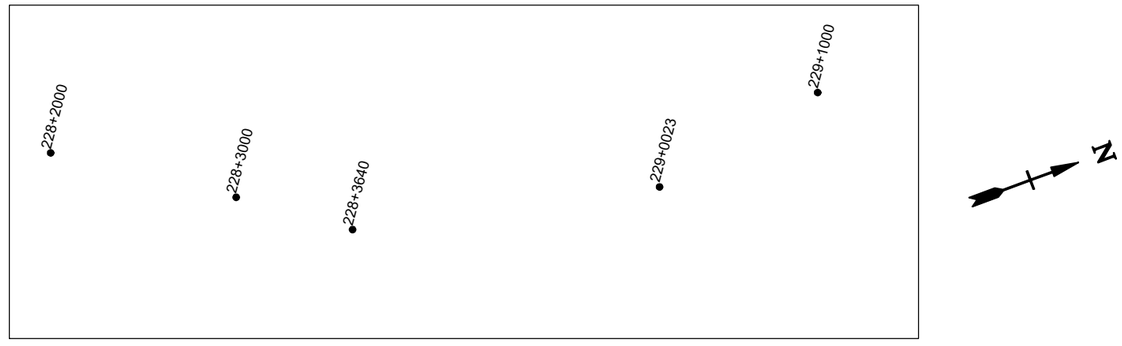


LEGEND



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 1300 ft)



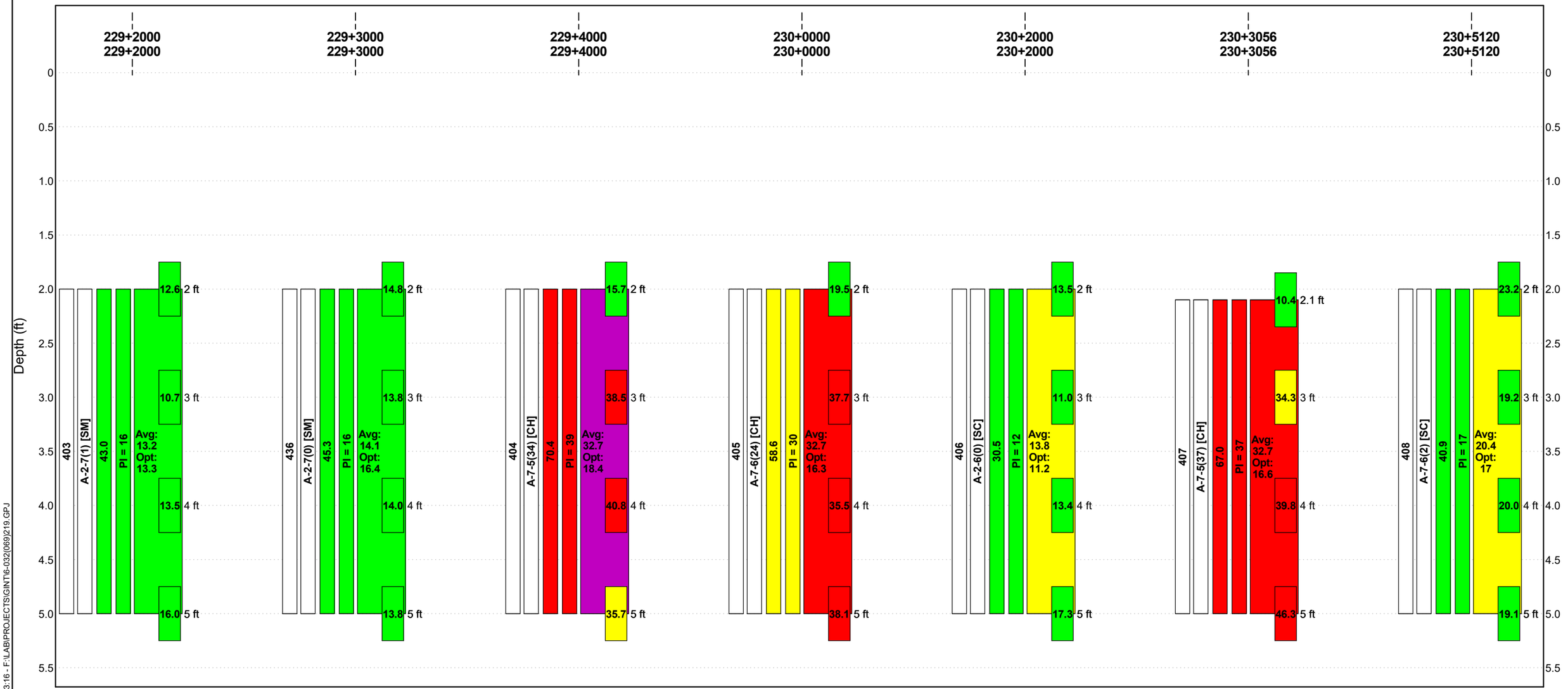
NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 12/2/22 13:15 - F:\LAB\PROJECTS\GINT\6-032(069)219.GPJ

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300 AIRPORT ROAD
BISMARCK, ND 58504

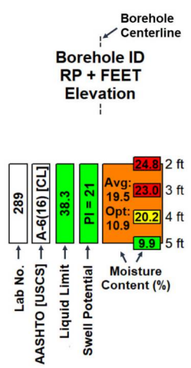
PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

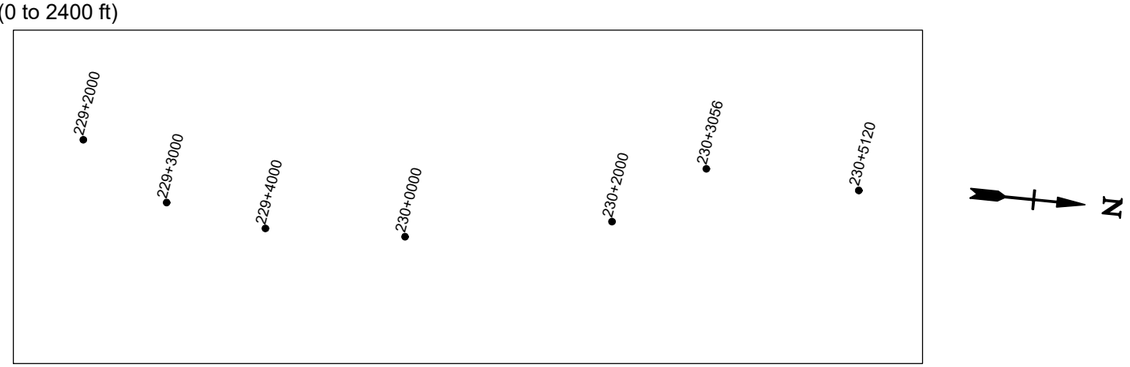


Boreholes Equally Spaced (0 to 2400 ft)

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

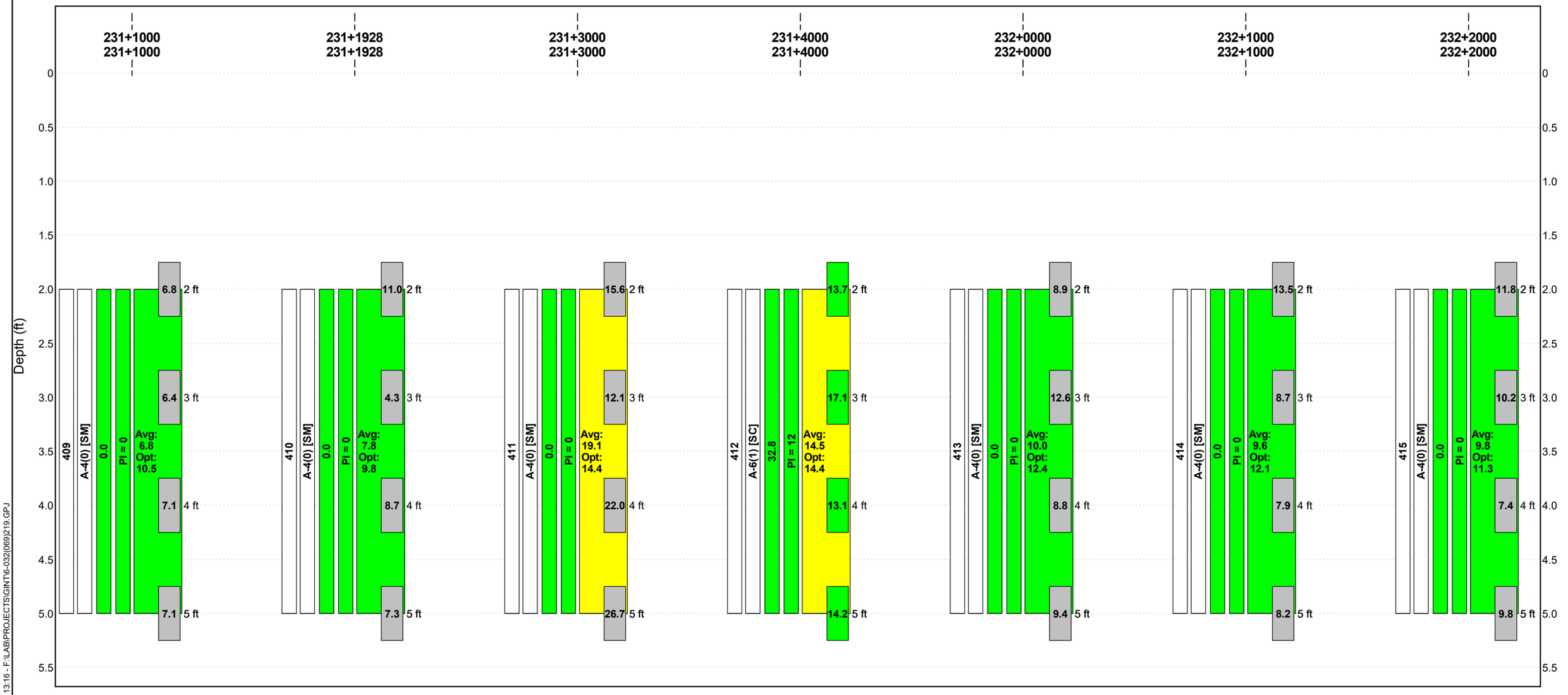


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 12/2/22 13:16 - F:\LAB\PROJECTS\GINT\6-032(069)219.GPJ

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

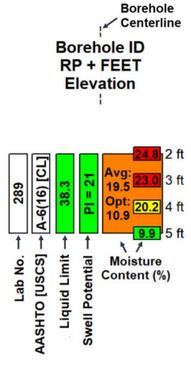
PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

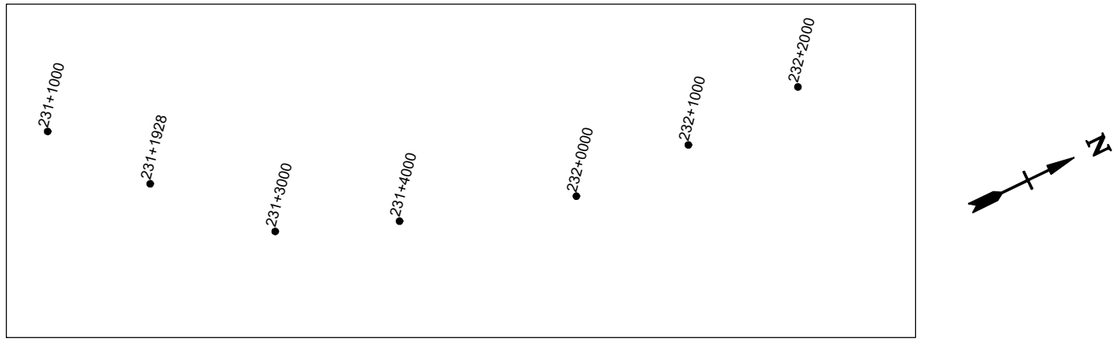


Boreholes Equally Spaced (0 to 2000 ft)

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

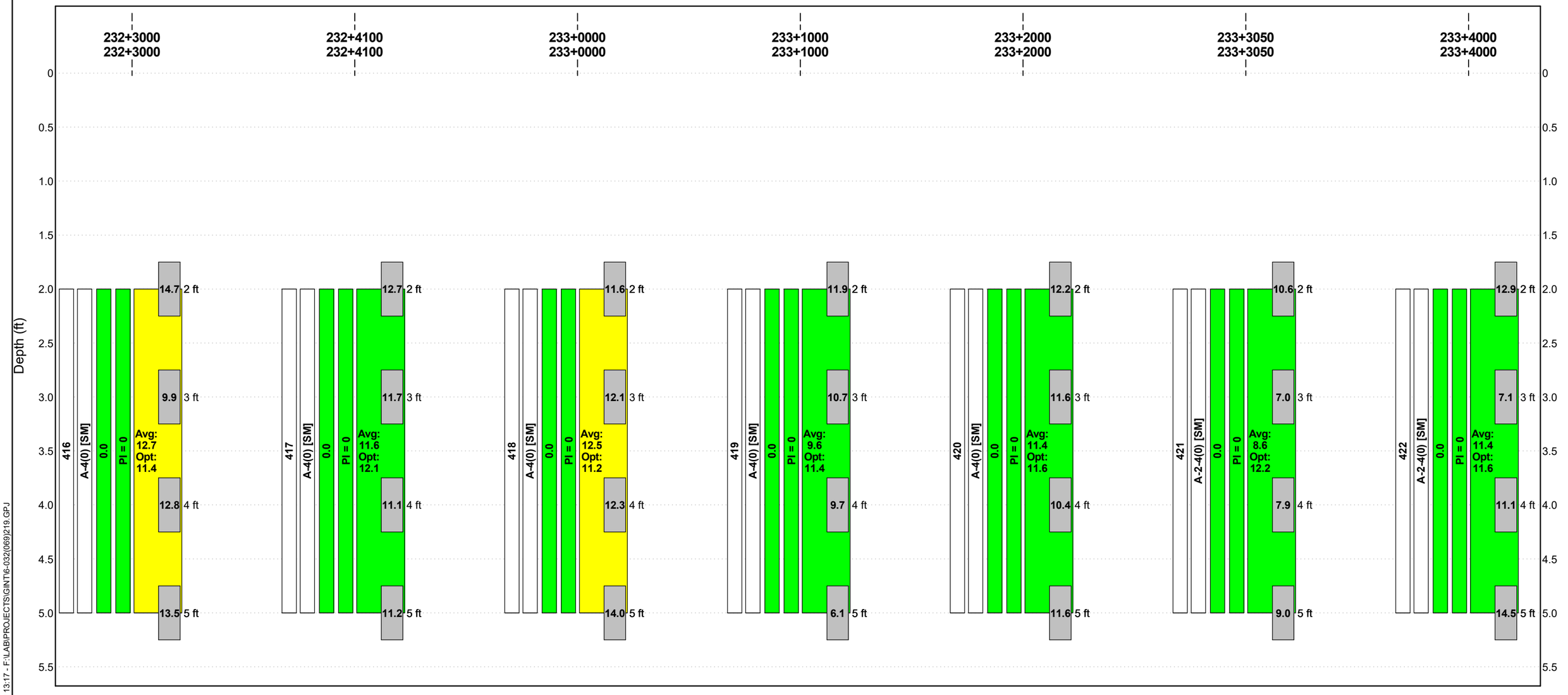


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 12/2/22 13:16 - F:\LAB\PROJECTS\GINT\6-032(069)219.GPJ

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

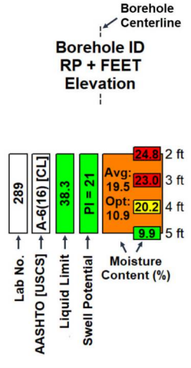
PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

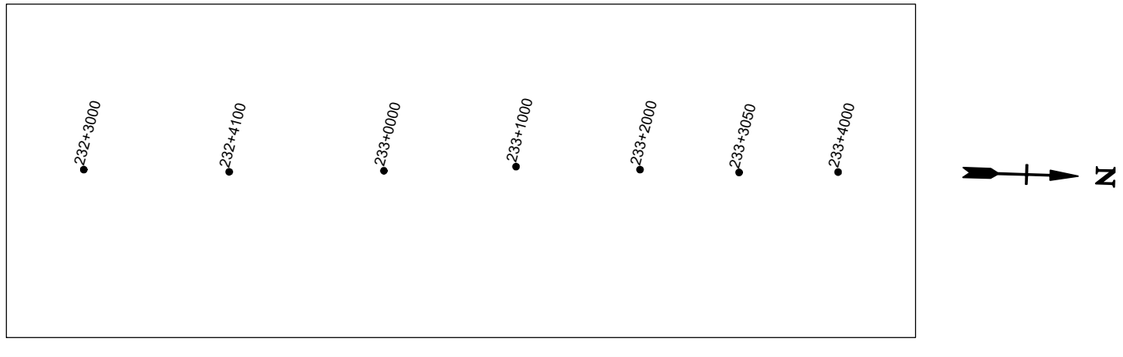


Boreholes Equally Spaced (0 to 2000 ft)

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

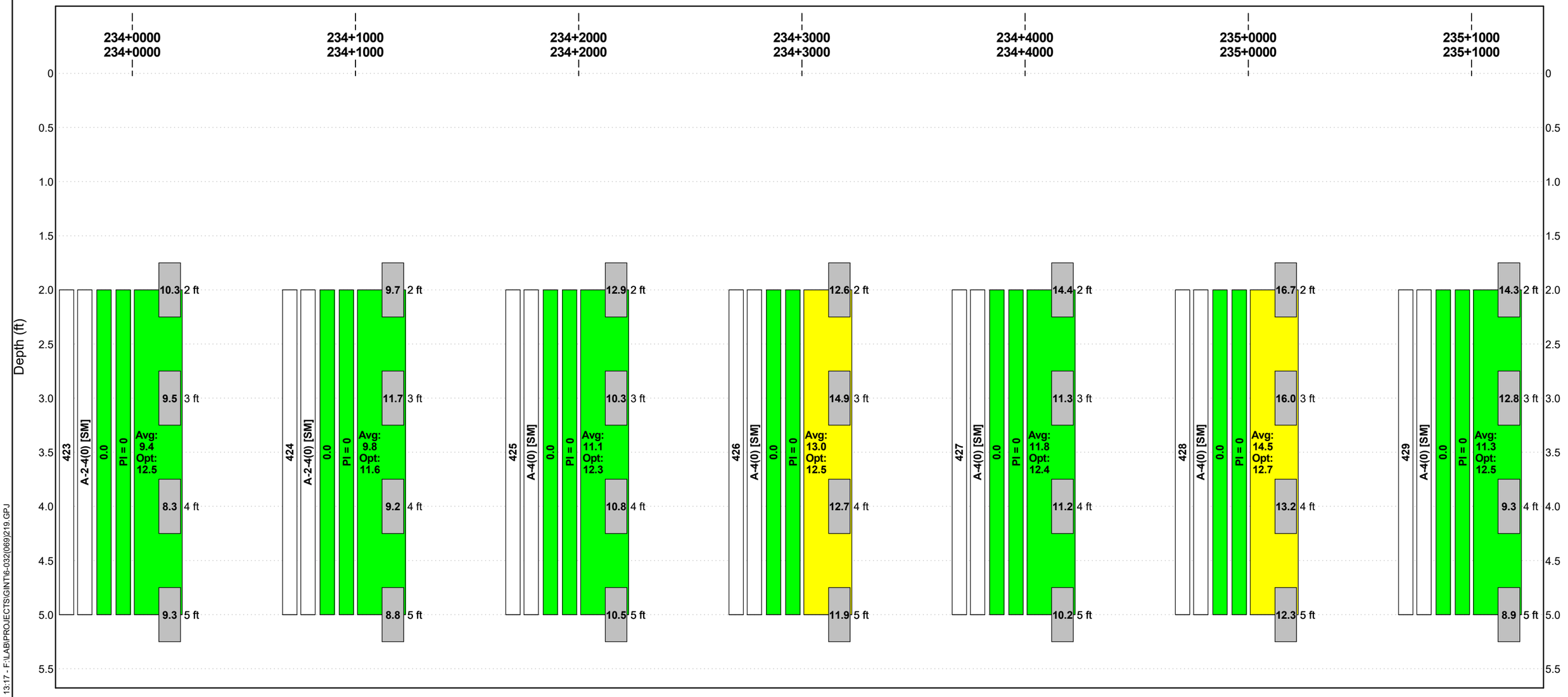


NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 12/2/22 13:17 - F:\LAB\PROJECTS\GINT\6-032(069)219.GPJ

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

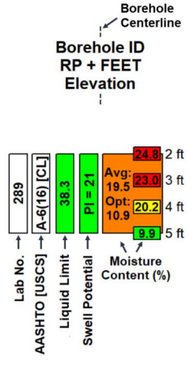
PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

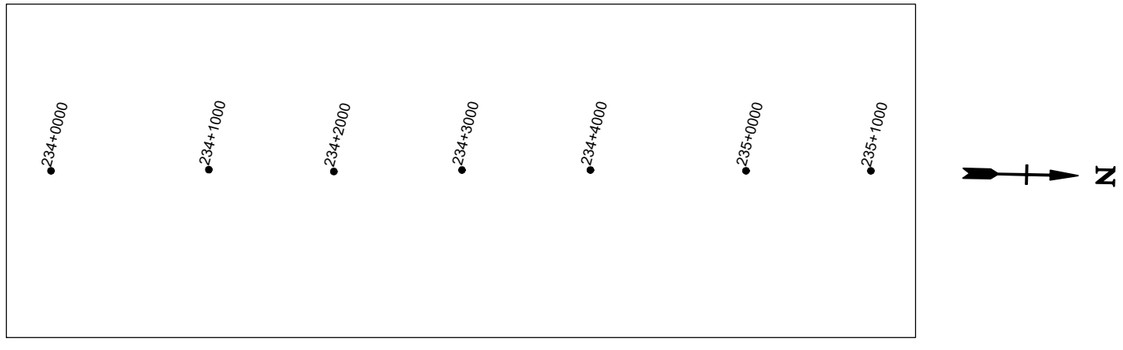


Boreholes Equally Spaced (0 to 2000 ft)

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



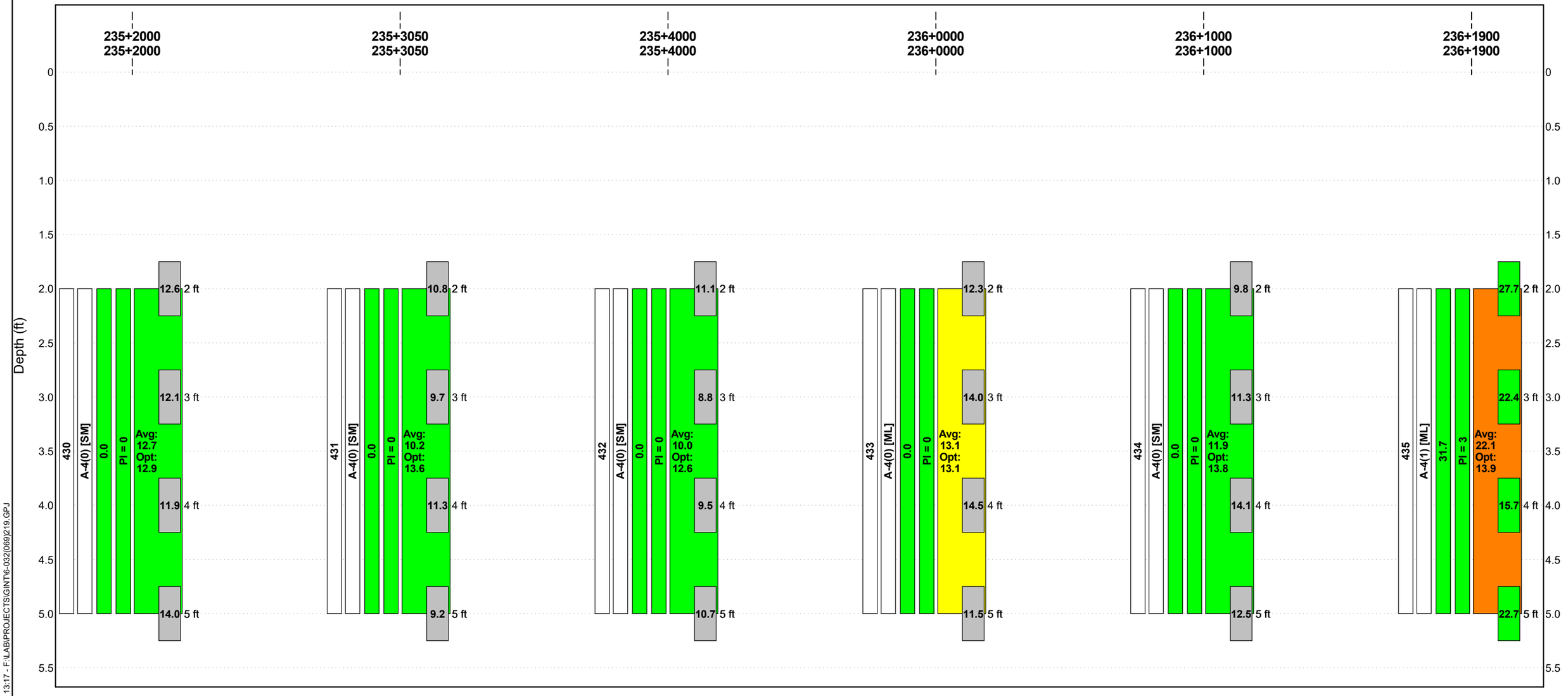
NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 12/2/22 13:17 - F:\LAB\PROJECTS\GINT\6-032(069)219.GPJ

NDDOT
North Dakota Department of Transportation

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

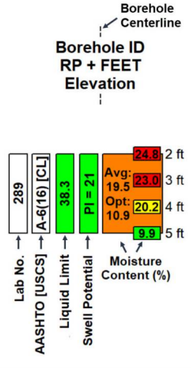
PROJECT NUMBER SS-6-032(069)219 **PCN** 23210

LOCATION Pembina County

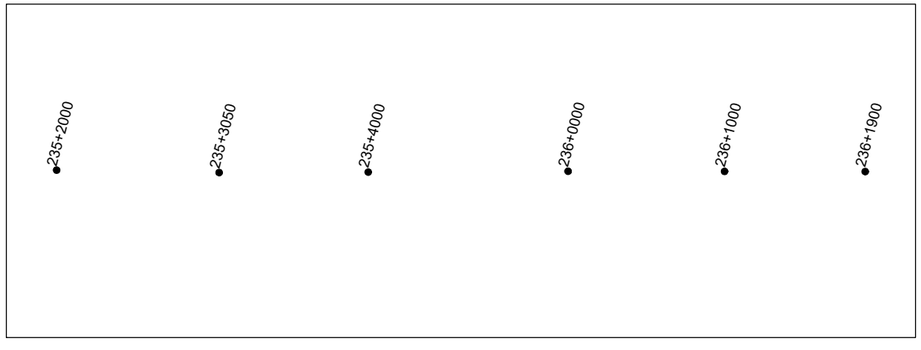


Boreholes Equally Spaced (0 to 1600 ft)

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 - 12/2/22 13:17 - F:\LAB\PROJECTS\GINT\6-032(069)219.GPJ

APPENDIX E

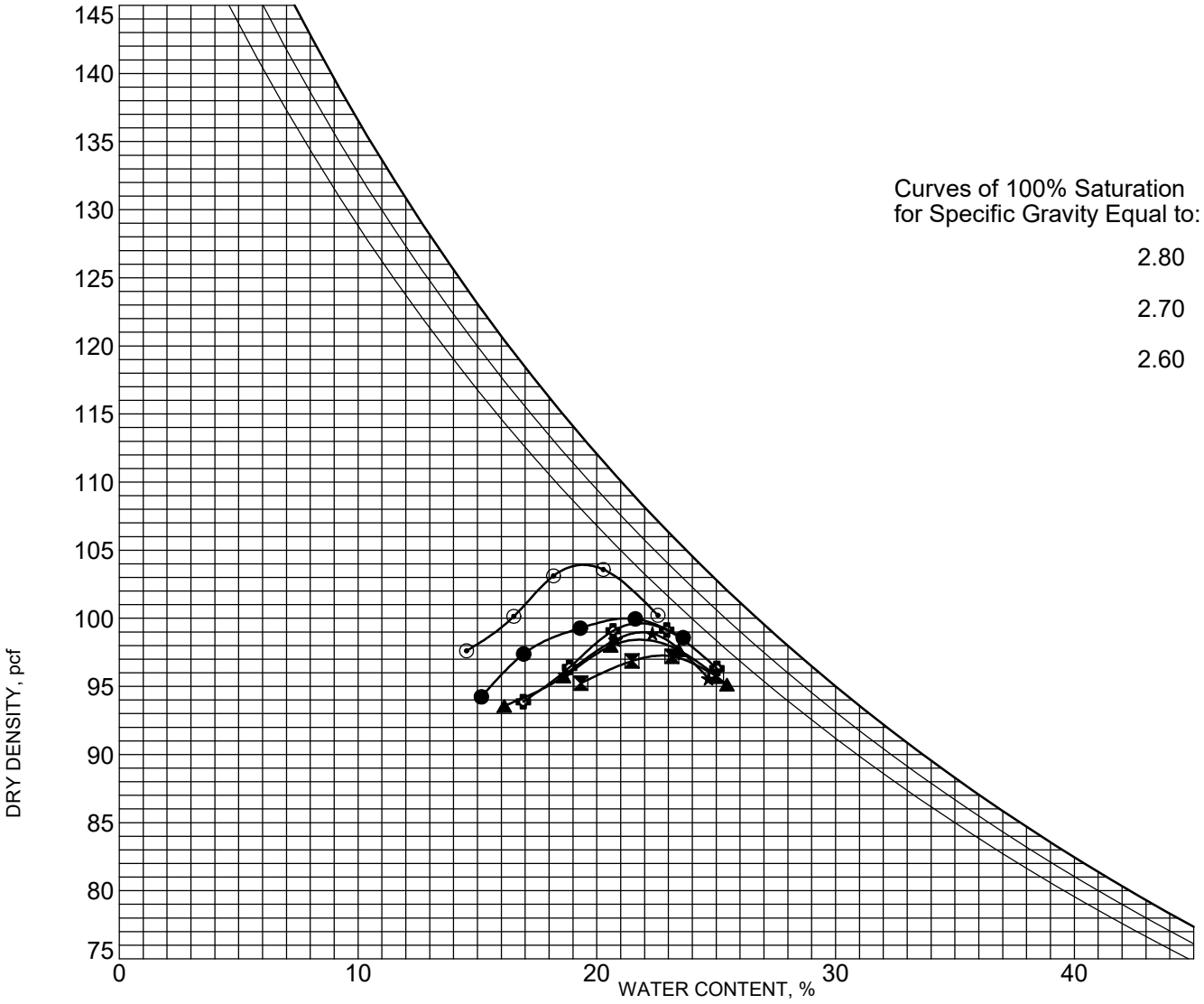
LAB RESULTS

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210



BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	220+0000	2.0	A-7-5 (15)	SANDY ELASTIC SILT(MH)
⊠	220+1000	2.0	A-7-5 (14)	SANDY ELASTIC SILT(MH)
▲	220+2000	2.0	A-7-5 (17)	SANDY ELASTIC SILT(MH)
★	220+3000	2.0	A-7-5 (8)	SANDY SILT(ML)
⊙	220+4000	2.0	A-7-6 (10)	SANDY SILT(ML)
✿	221+0000	2.0	A-7-6 (15)	SANDY FAT CLAY(CH)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	220+0000	2.0	AASHTO T-180 Method A	52	30	22	100.0 PCF	21.2 %
⊠	220+1000	2.0	AASHTO T-180 Method A	53	31	22	97.3 PCF	22.7 %
▲	220+2000	2.0	AASHTO T-180 Method A	55	30	25	98.4 PCF	21.8 %
★	220+3000	2.0	AASHTO T-180 Method A	48	30	18	99.0 PCF	21.9 %
⊙	220+4000	2.0	AASHTO T-180 Method A	47	29	18	103.9 PCF	19.4 %
✿	221+0000	2.0	AASHTO T-180 Method A	50	28	22	99.6 PCF	21.7 %

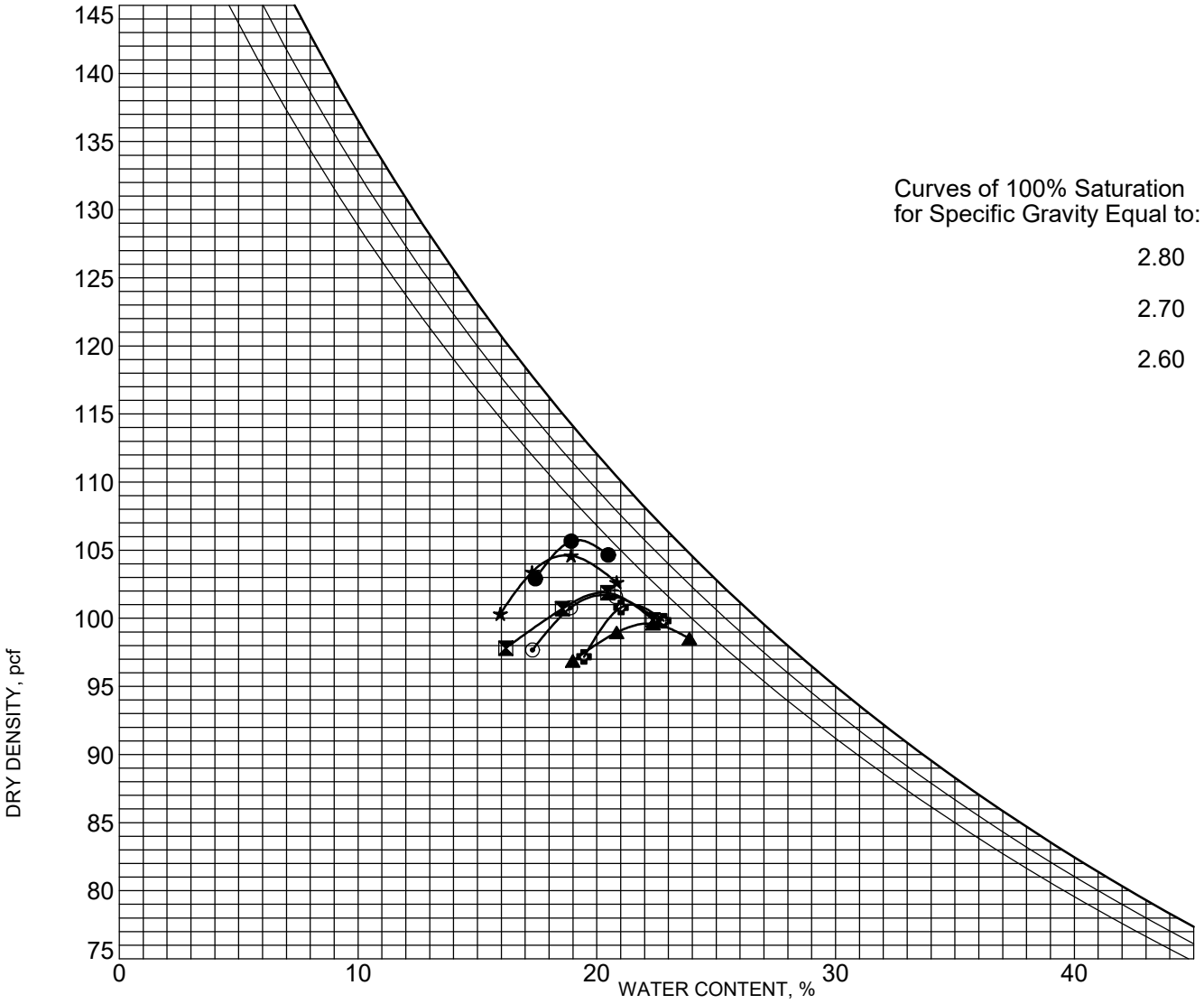
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 12/2/22 13:21 - F:\LAB\PROJECTS\GINT\6-032(069)219.GPJ

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210



	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	221+0990	2.0	A-7-6 (7)	SANDY LEAN CLAY(CL)
⊠	221+2000	2.0	A-7-6 (7)	SANDY SILT(ML)
▲	221+3051	2.0	A-7-6 (10)	SANDY LEAN CLAY(CL)
★	221+4000	2.0	A-7-6 (4)	SILTY SAND(SM)
⊙	222+0000	2.0	A-7-6 (5)	SANDY SILT(ML)
✿	222+0925	2.0	A-7-5 (5)	SILTY SAND(SM)

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	221+0990	2.0	AASHTO T-180 Method A	44	26	18	105.7 PCF	19.2 %
⊠	221+2000	2.0	AASHTO T-180 Method A	45	27	18	101.9 PCF	20.3 %
▲	221+3051	2.0	AASHTO T-180 Method A	46	27	19	99.6 PCF	22.1 %
★	221+4000	2.0	AASHTO T-180 Method A	42	27	15	104.6 PCF	18.7 %
⊙	222+0000	2.0	AASHTO T-180 Method A	44	29	15	101.7 PCF	20.3 %
✿	222+0925	2.0	AASHTO T-180 Method A	53	34	19	101.0 PCF	21.5 %

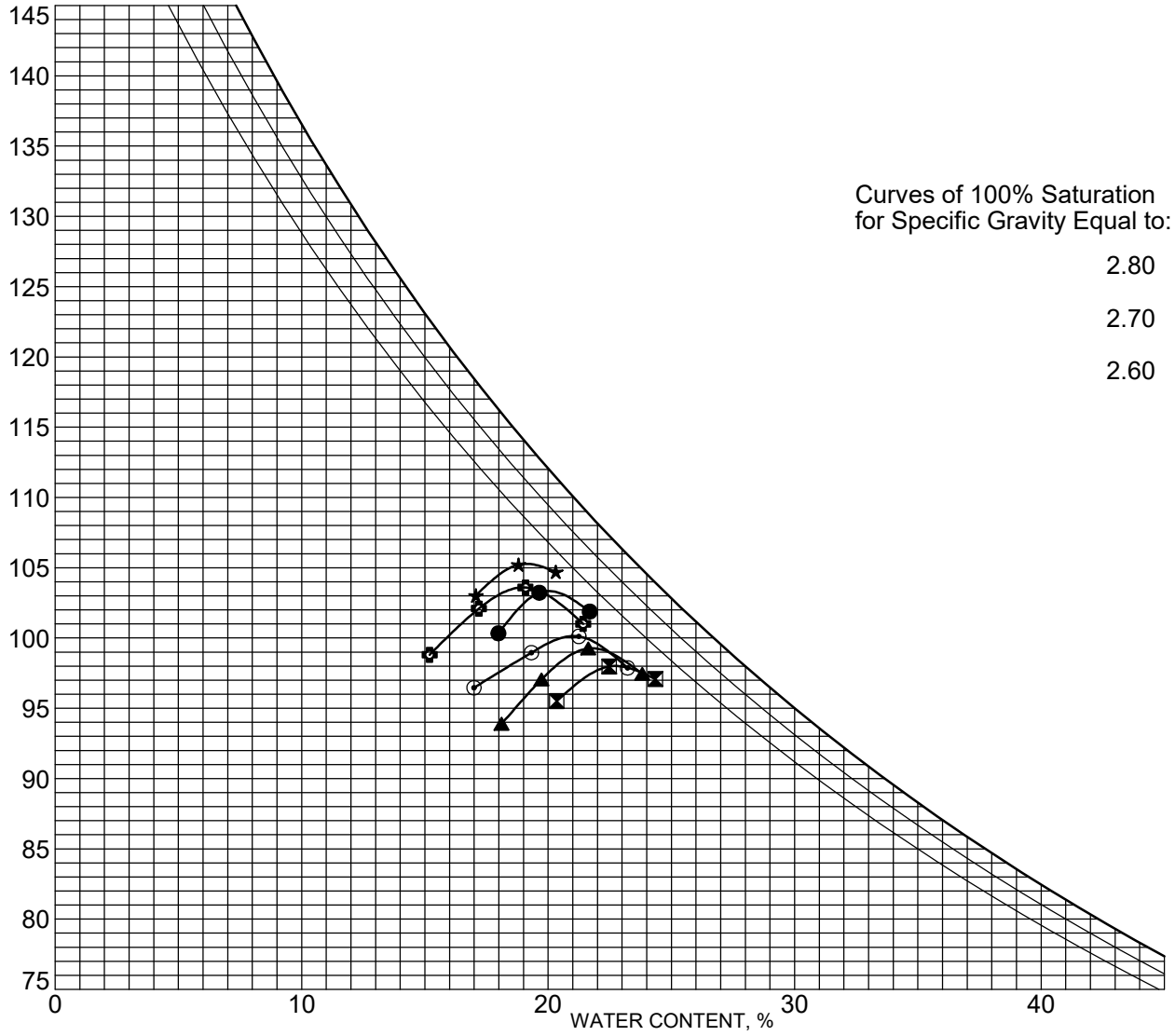
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 12/2/22 13:21 - F:\LAB\PROJECTS\GINT\6-032(069)219.GPJ

MOISTURE-DENSITY RELATIONSHIP

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300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210



	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	222+2000	2.0	A-7-6 (5)	SILTY SAND(SM)
⊠	222+2990	2.0	A-7-5 (7)	SILTY SAND(SM)
▲	222+4000	2.0	A-7-5 (8)	SANDY ELASTIC SILT(MH)
★	223+0220	2.0	A-7-6 (13)	SANDY FAT CLAY(CH)
⊙	223+1000	2.0	A-7-5 (10)	SANDY SILT(ML)
✿	223+2000	2.0	A-7-6 (5)	SILTY SAND(SM)

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	222+2000	2.0	AASHTO T-180 Method A	44	27	17	103.3 PCF	20.1 %
⊠	222+2990	2.0	AASHTO T-180 Method A	53	33	20	98.0 PCF	22.8 %
▲	222+4000	2.0	AASHTO T-180 Method A	52	33	19	99.3 PCF	21.7 %
★	223+0220	2.0	AASHTO T-180 Method A	50	26	24	105.3 PCF	19.1 %
⊙	223+1000	2.0	AASHTO T-180 Method A	49	30	19	100.1 PCF	21.0 %
✿	223+2000	2.0	AASHTO T-180 Method A	45	29	16	103.6 PCF	19.0 %

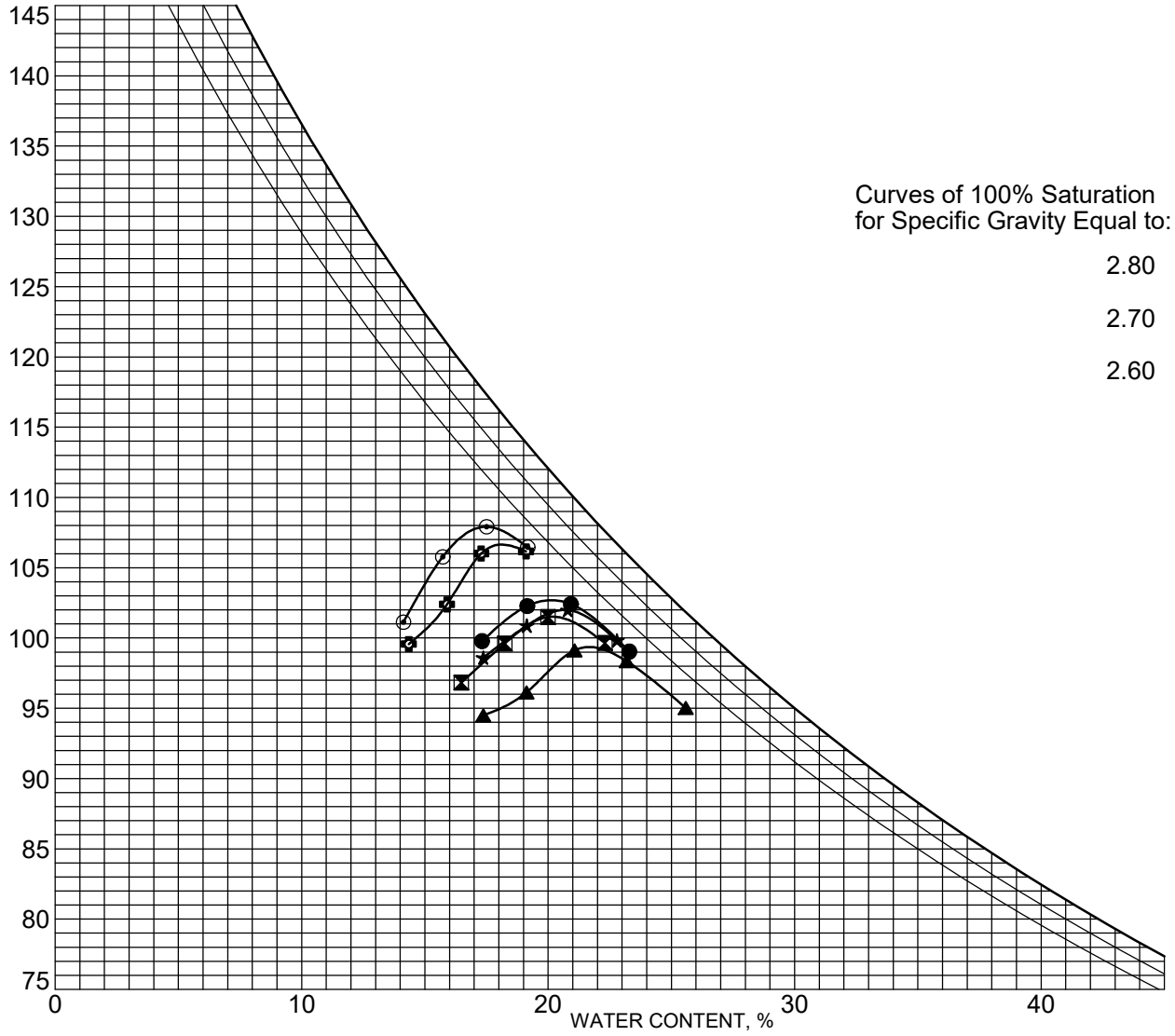
COMPACTION (MULTIPLE CURVES) - 20171219.GDT - 12/2/22 13:21 - F:\LAB\PROJECTS\GINT\6-032(069)219.GPJ

MOISTURE-DENSITY RELATIONSHIP

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

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210



	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	223+3000	2.0	A-7-6 (7)	SILTY SAND(SM)
⊠	223+4000	2.0	A-7-6 (8)	SANDY SILT(ML)
▲	224+0000	2.0	A-7-6 (12)	SANDY SILT(ML)
★	224+1200	2.0	A-7-6 (5)	SANDY SILT(ML)
⊙	224+2300	2.0	A-7-6 (15)	LEAN CLAY with SAND(CL)
✿	224+3220	2.0	A-7-6 (8)	SANDY SILT(ML)

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	223+3000	2.0	AASHTO T-180 Method A	48	28	20	102.7 PCF	20.2 %
⊠	223+4000	2.0	AASHTO T-180 Method A	46	28	18	101.5 PCF	20.2 %
▲	224+0000	2.0	AASHTO T-180 Method A	49	28	21	99.4 PCF	21.6 %
★	224+1200	2.0	AASHTO T-180 Method A	43	29	14	102.0 PCF	20.7 %
⊙	224+2300	2.0	AASHTO T-180 Method A	44	24	20	107.9 PCF	17.5 %
✿	224+3220	2.0	AASHTO T-180 Method A	41	28	13	106.6 PCF	18.1 %

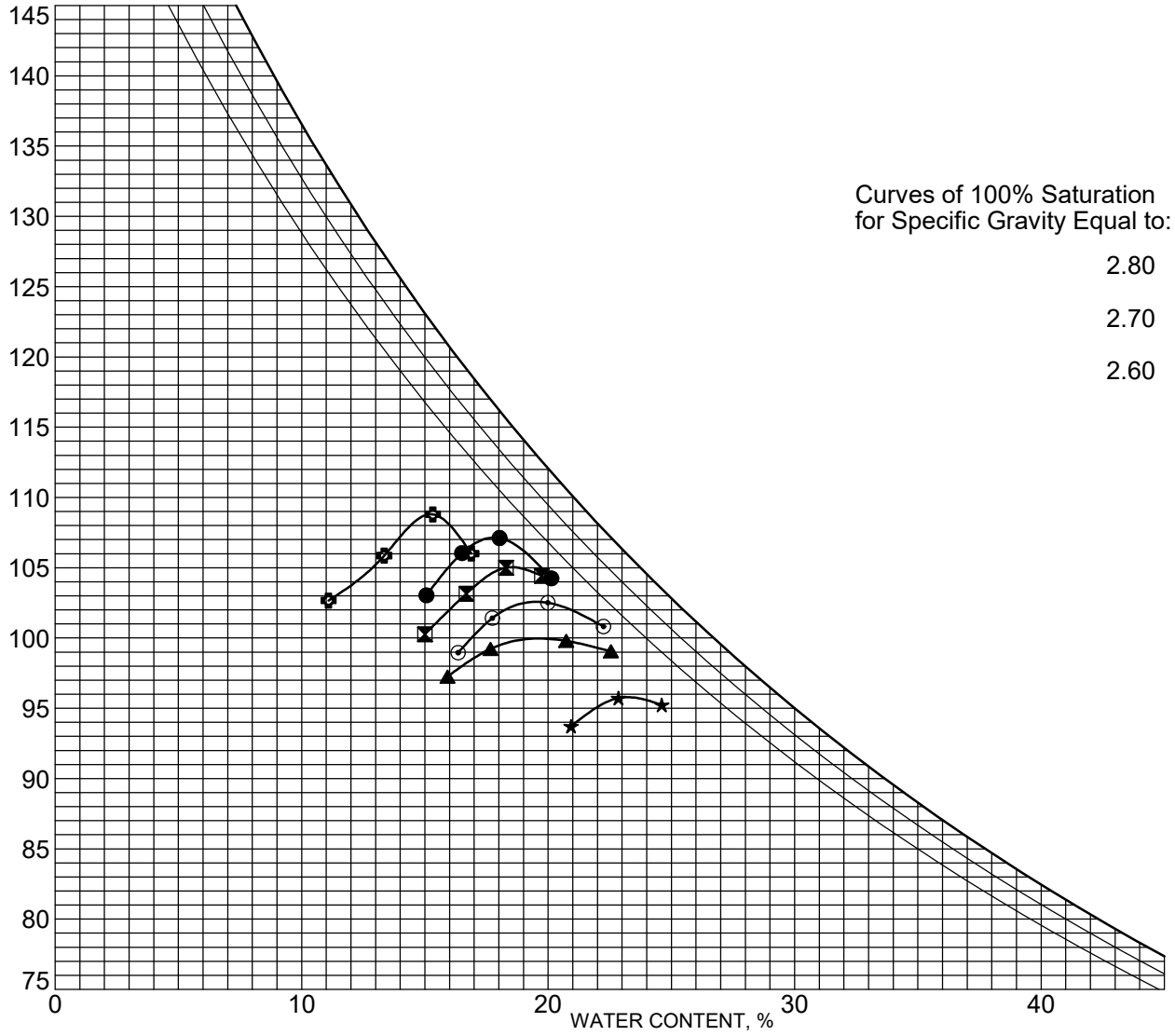
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MOISTURE-DENSITY RELATIONSHIP

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

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	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	224+4000	2.0	A-6 (3)	CLAYEY SAND(SC)
⊠	225+0000	2.0	A-7-6 (4)	SILTY SAND(SM)
▲	225+1000	2.0	A-7-5 (6)	SILTY SAND(SM)
★	225+2000	2.0	A-7-5 (12)	SANDY ELASTIC SILT(MH)
⊙	225+2950	2.0	A-7-6 (6)	SILTY SAND(SM)
✿	225+4000	2.0	A-6 (1)	CLAYEY SAND(SC)

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	224+4000	2.0	AASHTO T-180 Method A	39	25	14	107.1 PCF	17.8 %
⊠	225+0000	2.0	AASHTO T-180 Method A	43	27	16	105.0 PCF	18.5 %
▲	225+1000	2.0	AASHTO T-180 Method A	48	31	17	100.0 PCF	19.6 %
★	225+2000	2.0	AASHTO T-180 Method A	53	32	21	95.8 PCF	23.2 %
⊙	225+2950	2.0	AASHTO T-180 Method A	46	28	18	102.6 PCF	19.5 %
✿	225+4000	2.0	AASHTO T-180 Method A	33	22	11	108.8 PCF	15.2 %

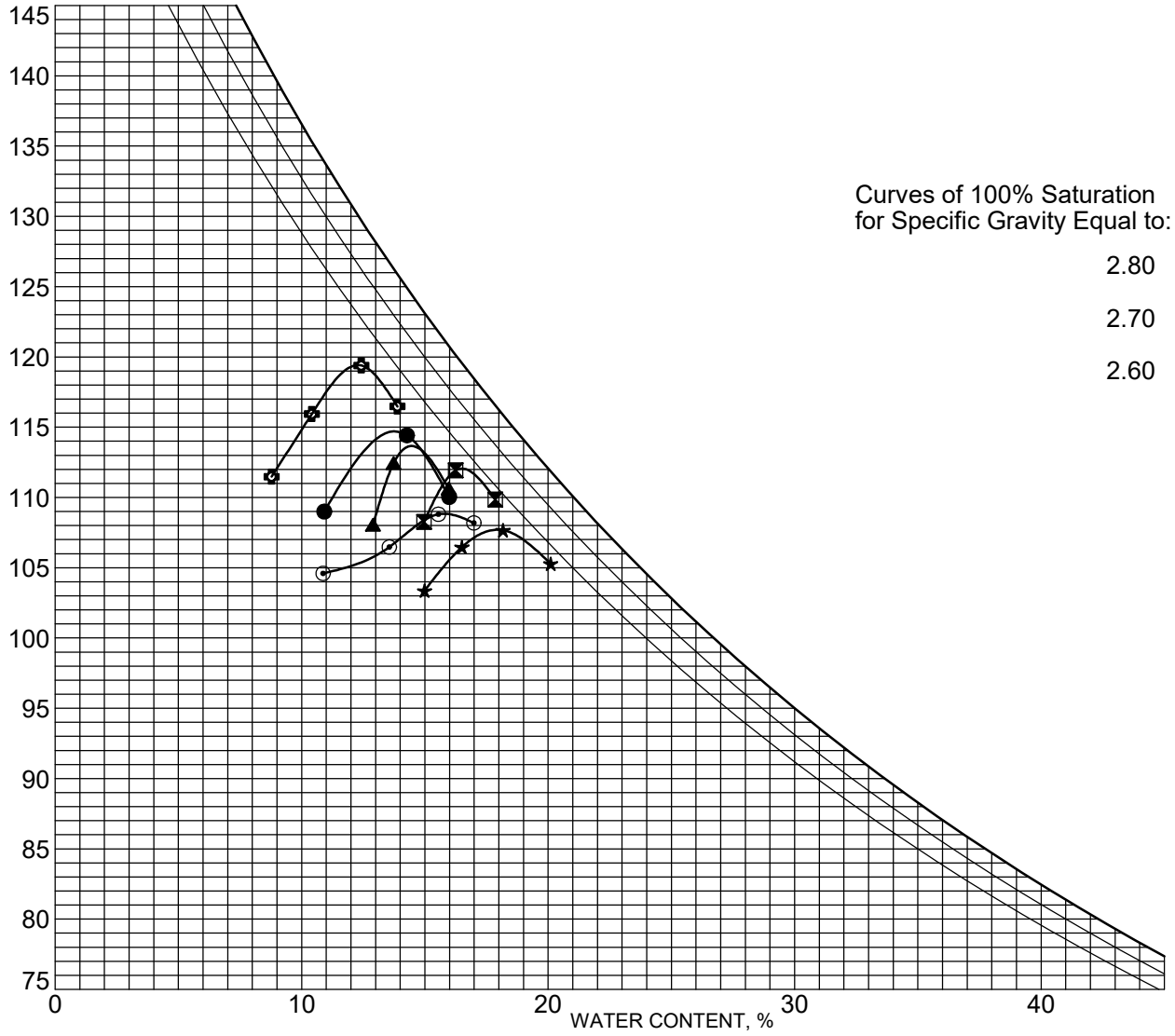
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BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	226+0000	2.0	A-2-6 (0)	CLAYEY SAND(SC)
⊠	226+0940	2.0	A-6 (3)	CLAYEY SAND(SC)
▲	226+2000	2.0	A-6 (2)	CLAYEY SAND(SC)
★	226+3000	2.0	A-6 (3)	CLAYEY SAND(SC)
⊙	226+4000	2.0	A-6 (3)	SILTY SAND(SM)
✿	227+0000	2.0	A-2-4 (0)	CLAYEY SAND(SC)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	226+0000	2.0	AASHTO T-180 Method A	31	20	11	114.7 PCF	13.7 %
⊠	226+0940	2.0	AASHTO T-180 Method A	39	22	17	112.1 PCF	16.5 %
▲	226+2000	2.0	AASHTO T-180 Method A	36	22	14	113.7 PCF	14.4 %
★	226+3000	2.0	AASHTO T-180 Method A	38	24	14	107.7 PCF	17.9 %
⊙	226+4000	2.0	AASHTO T-180 Method A	40	27	13	108.8 PCF	15.8 %
✿	227+0000	2.0	AASHTO T-180 Method A	28	18	10	119.4 PCF	12.3 %

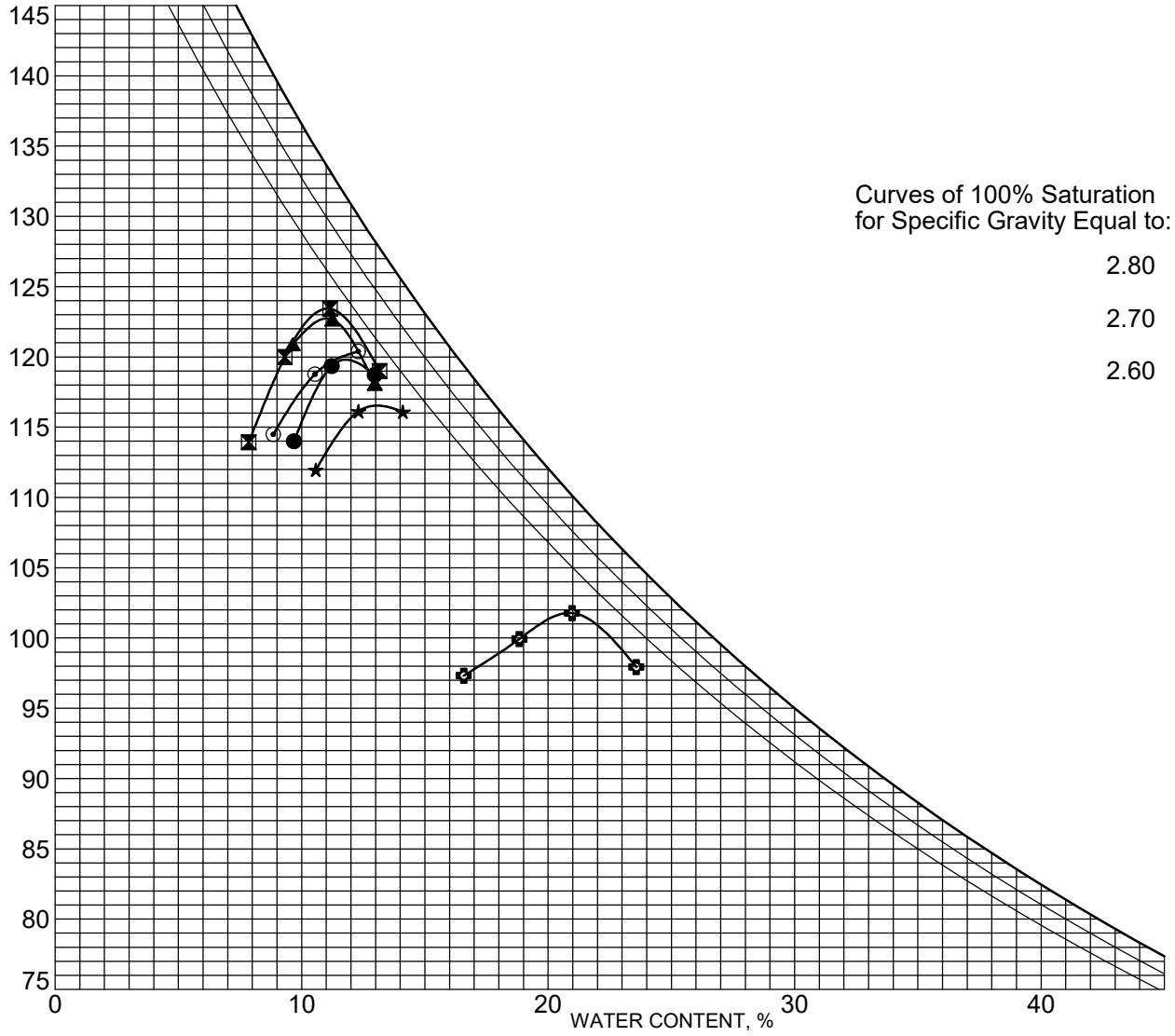
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BOREHOLE		DEPTH	AASHTO Classification	USCS Description
●	227+1000	2.0	A-4 (2)	SANDY SILTY CLAY(CL-ML)
⊠	227+2000	2.0	A-2-4 (0)	SILTY SAND(SM)
▲	227+3127	2.0	A-4 (0)	SILTY SAND(SM)
★	227+4000	2.0	A-2-4 (0)	SILTY SAND(SM)
⊙	228+0000	2.0	A-4 (6)	LEAN CLAY with SAND(CL)
✿	228+1000	2.0	A-7-5 (7)	SANDY SILT(ML)

BOREHOLE		DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	227+1000	2.0	AASHTO T-180 Method A	25	18	7	119.8 PCF	11.8 %
⊠	227+2000	2.0	AASHTO T-180 Method A	NP	NP	NP	123.4 PCF	11.1 %
▲	227+3127	2.0	AASHTO T-180 Method A	NP	NP	NP	122.7 PCF	11.0 %
★	227+4000	2.0	AASHTO T-180 Method A	21	19	2	116.5 PCF	13.1 %
⊙	228+0000	2.0	AASHTO T-180 Method A	30	20	10	120.4 PCF	12.3 %
✿	228+1000	2.0	AASHTO T-180 Method A	46	30	16	101.8 PCF	20.9 %

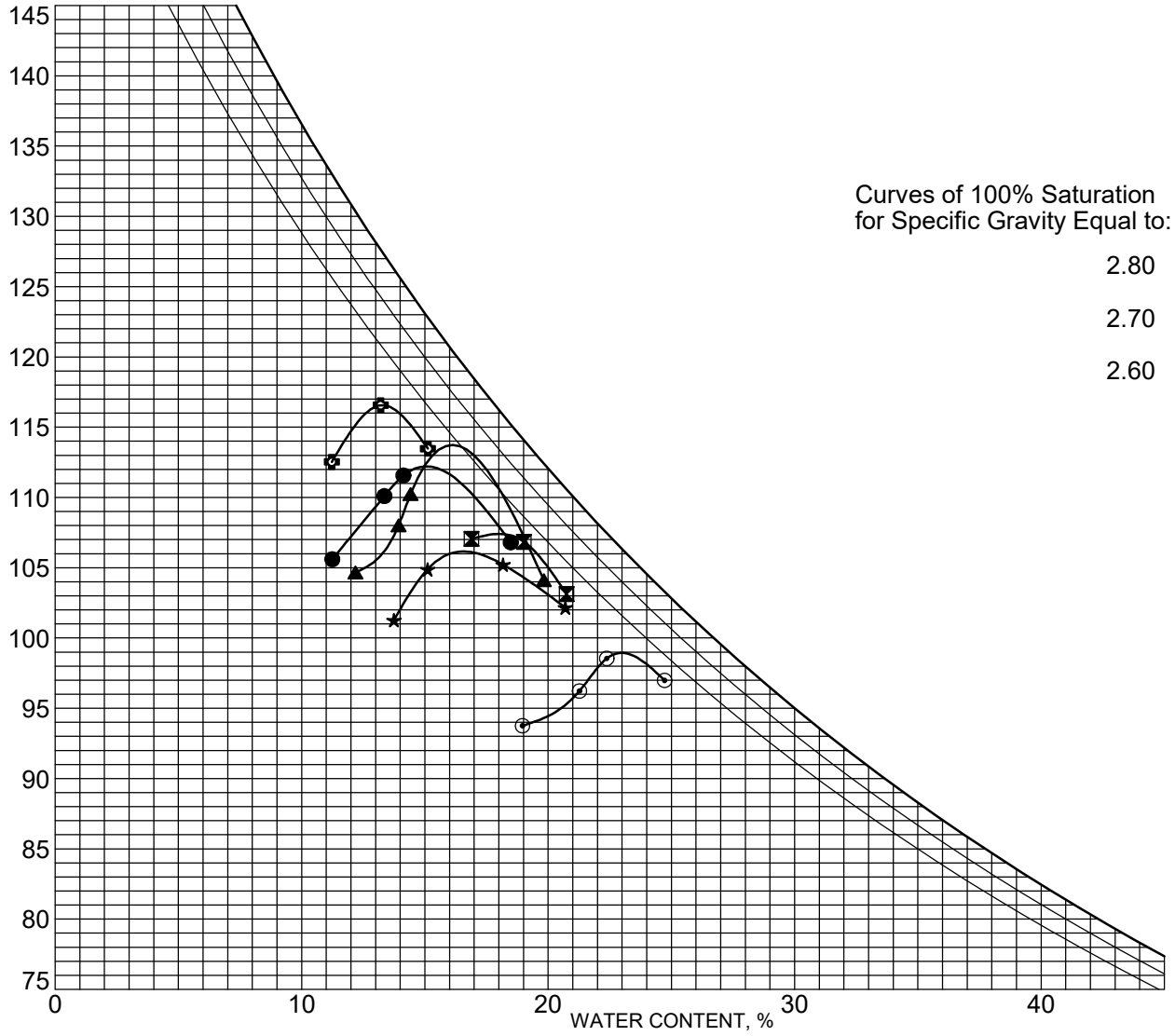
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	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	228+2000	2.0	A-7-6 (8)	SANDY LEAN CLAY(CL)
⊠	228+3000	2.0	A-2-7 (0)	SILTY GRAVEL with SAND(GM)
▲	228+3640	2.0	A-7-6 (9)	SANDY FAT CLAY(CH)
★	229+0023	2.3	A-7-6 (9)	SANDY SILT(ML)
⊙	229+1000	2.0	A-7-5 (29)	FAT CLAY with SAND(CH)
✿	229+2000	2.0	A-2-7 (1)	SILTY SAND with GRAVEL(SM)

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	228+2000	2.0	AASHTO T-180 Method A	43	24	19	112.2 PCF	15.0 %
⊠	228+3000	2.0	AASHTO T-180 Method A	47	31	16	107.4 PCF	18.0 %
▲	228+3640	2.0	AASHTO T-180 Method A	51	28	23	113.7 PCF	16.1 %
★	229+0023	2.3	AASHTO T-180 Method A	49	28	21	106.2 PCF	16.6 %
⊙	229+1000	2.0	AASHTO T-180 Method A	65	31	34	98.9 PCF	23.0 %
✿	229+2000	2.0	AASHTO T-180 Method A	43	27	16	116.6 PCF	13.3 %

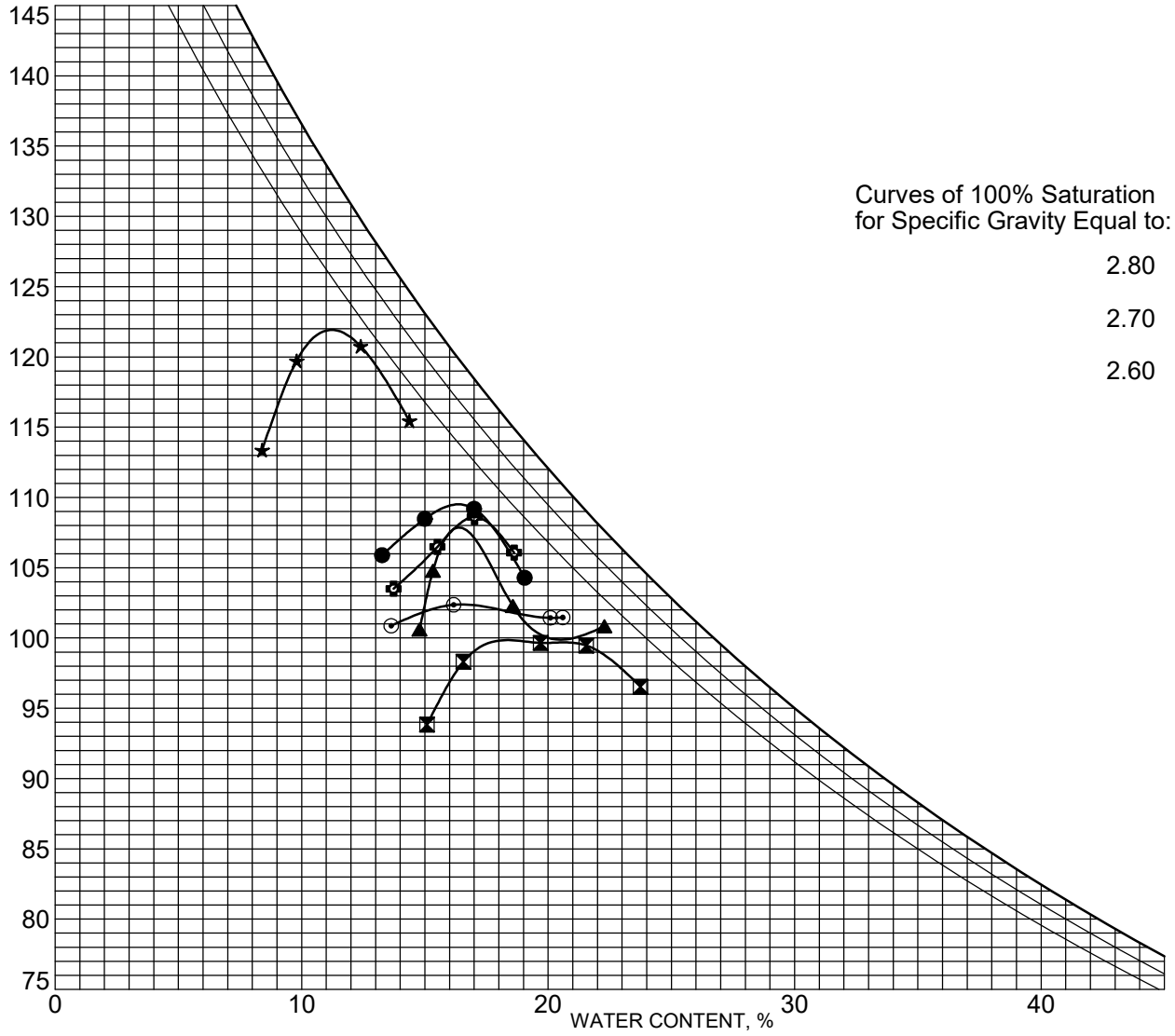
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	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	229+3000	2.0	A-2-7 (0)	SILTY SAND with GRAVEL(SM)
⊠	229+4000	2.0	A-7-5 (34)	FAT CLAY with SAND(CH)
▲	230+0000	2.0	A-7-6 (24)	FAT CLAY with SAND(CH)
★	230+2000	2.0	A-2-6 (0)	CLAYEY SAND(SC)
⊙	230+3056	2.1	A-7-5 (37)	FAT CLAY(CH)
✿	230+5120	2.0	A-7-6 (2)	CLAYEY SAND(SC)

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	229+3000	2.0	AASHTO T-180 Method A	45	30	15	109.5 PCF	16.4 %
⊠	229+4000	2.0	AASHTO T-180 Method A	70	32	38	99.9 PCF	18.4 %
▲	230+0000	2.0	AASHTO T-180 Method A	59	29	30	107.9 PCF	16.3 %
★	230+2000	2.0	AASHTO T-180 Method A	30	19	11	121.9 PCF	11.2 %
⊙	230+3056	2.1	AASHTO T-180 Method A	67	30	37	102.4 PCF	16.6 %
✿	230+5120	2.0	AASHTO T-180 Method A	41	24	17	108.6 PCF	17.0 %

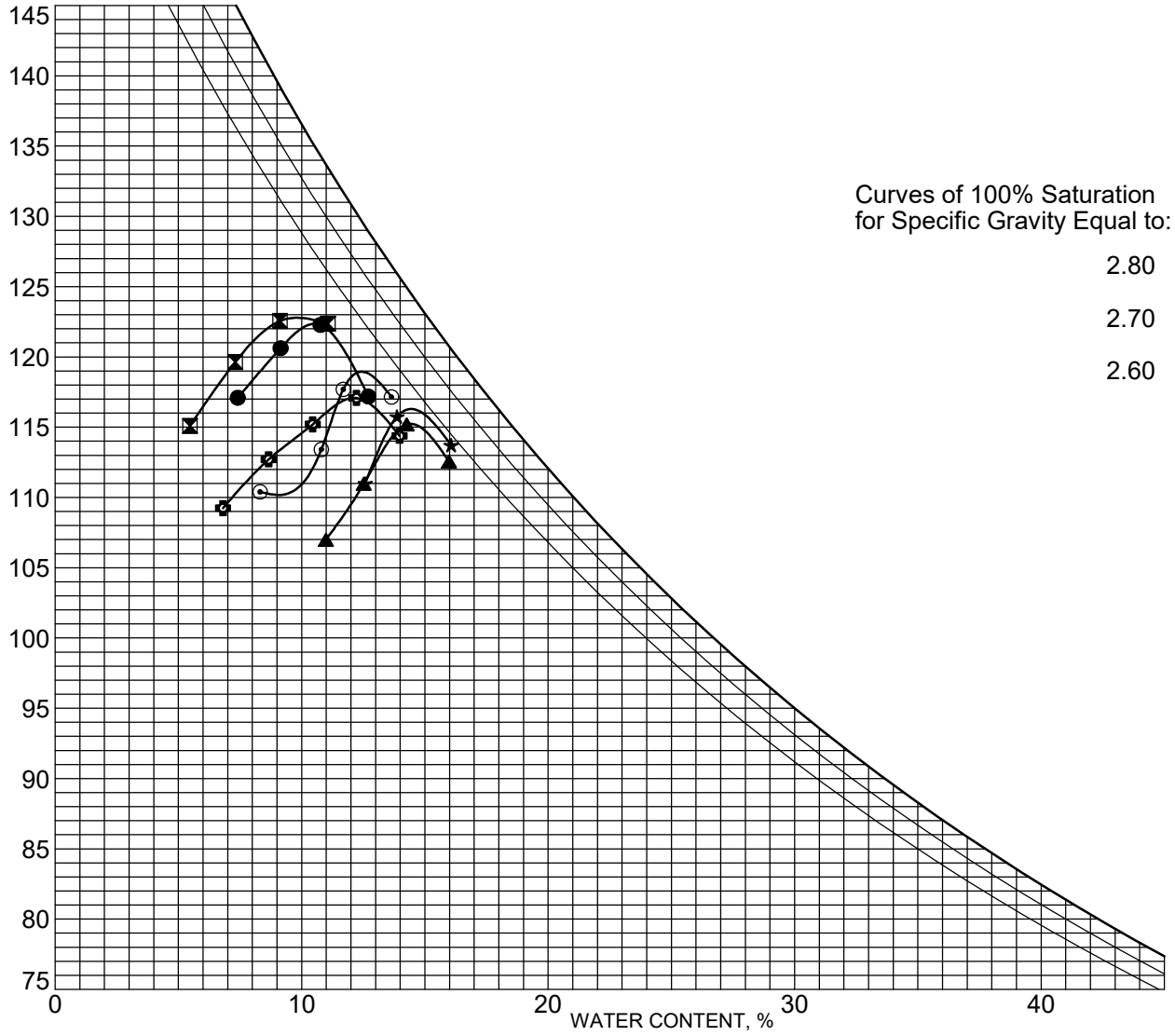
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	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	231+1000	2.0	A-4 (0)	SILTY SAND(SM)
⊠	231+1928	2.0	A-4 (0)	SILTY SAND(SM)
▲	231+3000	2.0	A-4 (0)	SILTY SAND(SM)
★	231+4000	2.0	A-6 (1)	CLAYEY SAND(SC)
⊙	232+0000	2.0	A-4 (0)	SILTY SAND(SM)
✿	232+1000	2.0	A-4 (0)	SILTY SAND(SM)

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	231+1000	2.0	AASHTO T-180 Method A	NP	NP	NP	122.3 PCF	10.5 %
⊠	231+1928	2.0	AASHTO T-180 Method A	NP	NP	NP	122.8 PCF	9.8 %
▲	231+3000	2.0	AASHTO T-180 Method A	NP	NP	NP	115.2 PCF	14.4 %
★	231+4000	2.0	AASHTO T-180 Method A	33	21	12	116.3 PCF	14.4 %
⊙	232+0000	2.0	AASHTO T-180 Method A	NP	NP	NP	118.9 PCF	12.4 %
✿	232+1000	2.0	AASHTO T-180 Method A	NP	NP	NP	117.1 PCF	12.1 %

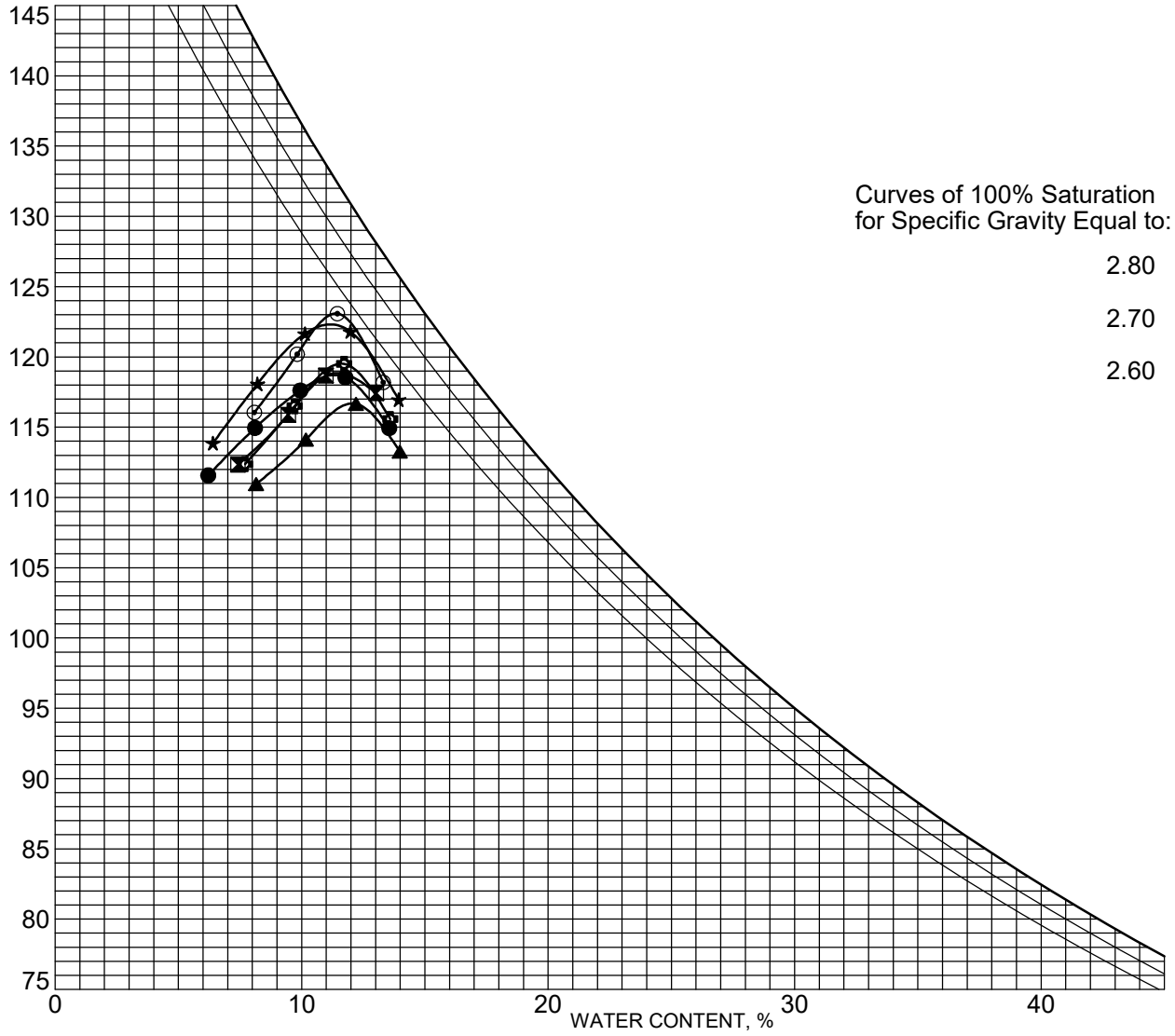
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	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	232+2000	2.0	A-4 (0)	SILTY SAND(SM)
⊠	232+3000	2.0	A-4 (0)	SILTY SAND(SM)
▲	232+4100	2.0	A-4 (0)	SILTY SAND(SM)
★	233+0000	2.0	A-4 (0)	SILTY SAND(SM)
⊙	233+1000	2.0	A-4 (0)	SILTY SAND(SM)
✪	233+2000	2.0	A-4 (0)	SILTY SAND(SM)

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	232+2000	2.0	AASHTO T-180 Method A	NP	NP	NP	118.7 PCF	11.3 %
⊠	232+3000	2.0	AASHTO T-180 Method A	NP	NP	NP	118.9 PCF	11.4 %
▲	232+4100	2.0	AASHTO T-180 Method A	NP	NP	NP	116.7 PCF	12.1 %
★	233+0000	2.0	AASHTO T-180 Method A	NP	NP	NP	122.3 PCF	11.2 %
⊙	233+1000	2.0	AASHTO T-180 Method A	NP	NP	NP	123.1 PCF	11.4 %
✪	233+2000	2.0	AASHTO T-180 Method A	NP	NP	NP	119.5 PCF	11.6 %

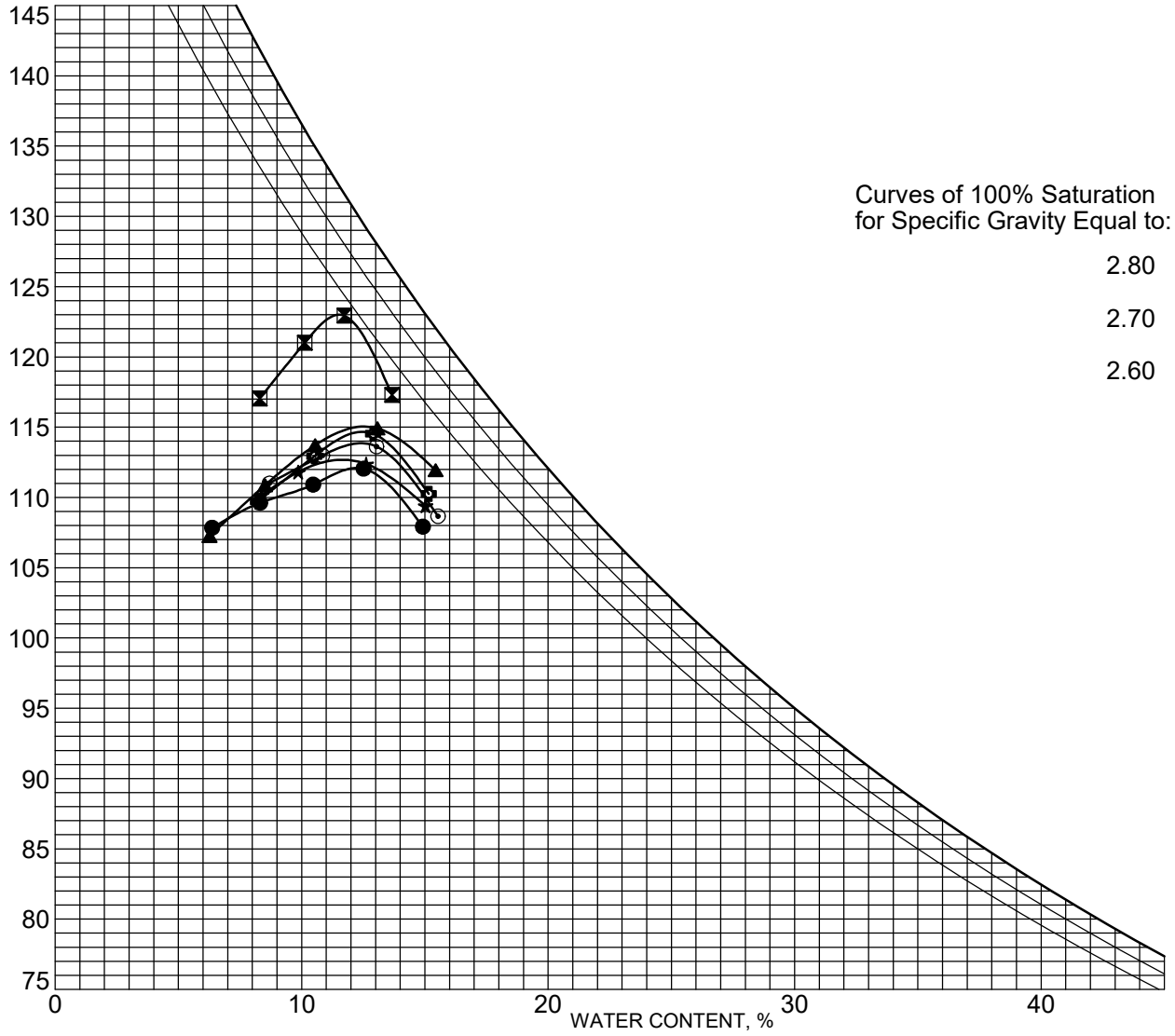
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	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	233+3050	2.0	A-2-4 (0)	SILTY SAND(SM)
⊠	233+4000	2.0	A-2-4 (0)	SILTY SAND(SM)
▲	234+0000	2.0	A-2-4 (0)	SILTY SAND(SM)
★	234+1000	2.0	A-2-4 (0)	SILTY SAND(SM)
⊙	234+2000	2.0	A-4 (0)	SILTY SAND(SM)
✪	234+3000	2.0	A-4 (0)	SILTY SAND(SM)

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	233+3050	2.0	AASHTO T-180 Method A	NP	NP	NP	112.1 PCF	12.2 %
⊠	233+4000	2.0	AASHTO T-180 Method A	NP	NP	NP	123.0 PCF	11.6 %
▲	234+0000	2.0	AASHTO T-180 Method A	NP	NP	NP	115.0 PCF	12.5 %
★	234+1000	2.0	AASHTO T-180 Method A	NP	NP	NP	112.7 PCF	11.6 %
⊙	234+2000	2.0	AASHTO T-180 Method A	NP	NP	NP	113.9 PCF	12.3 %
✪	234+3000	2.0	AASHTO T-180 Method A	NP	NP	NP	114.7 PCF	12.5 %

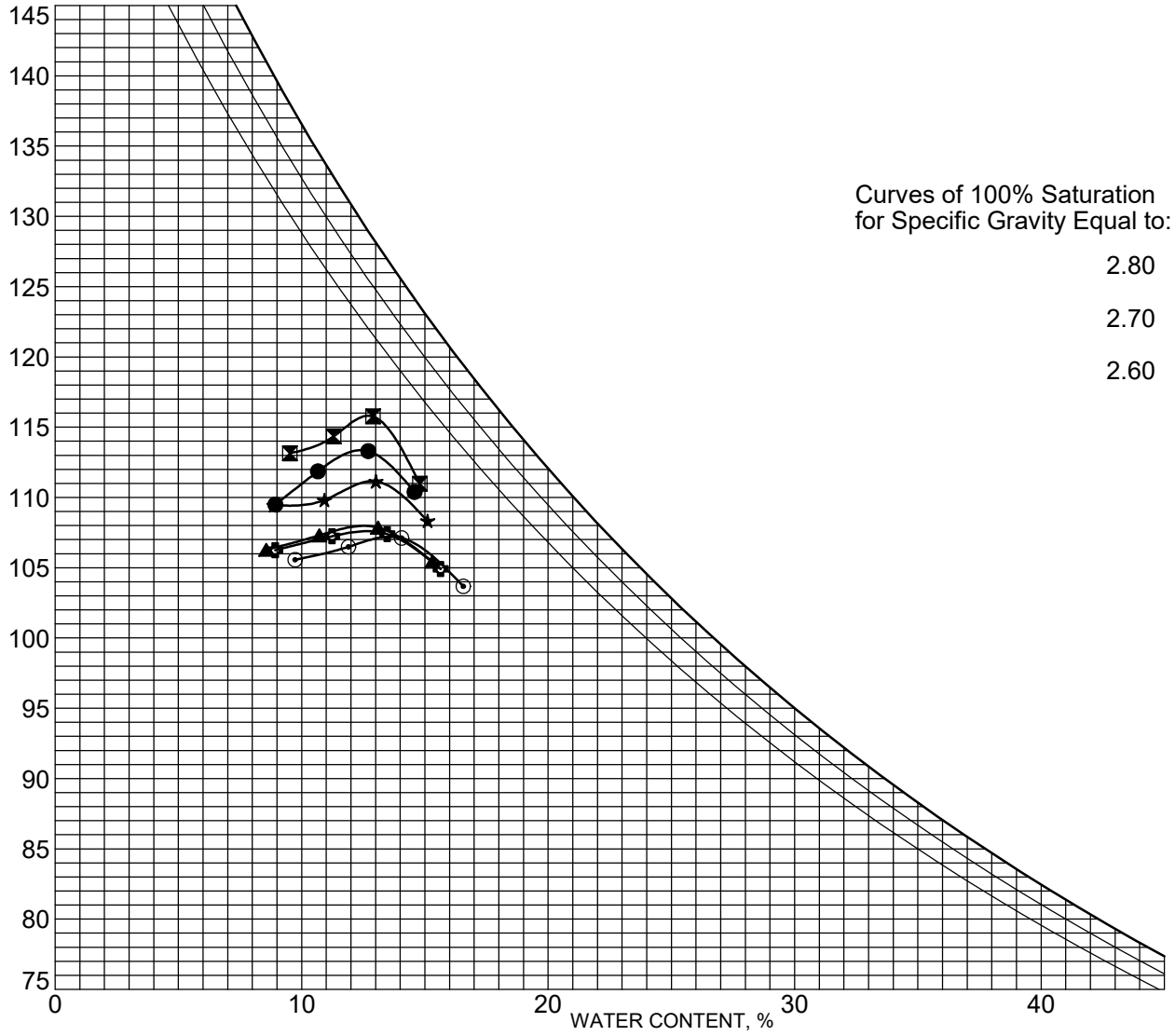
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	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	**234+4000**	**2.0**	**A-4 (0)**	**SILTY SAND(SM)**
⊠	**235+0000**	**2.0**	**A-4 (0)**	**SILTY SAND(SM)**
▲	**235+1000**	**2.0**	**A-4 (0)**	**SILTY SAND(SM)**
★	**235+2000**	**2.0**	**A-4 (0)**	**SILTY SAND(SM)**
⊙	**235+3050**	**2.0**	**A-4 (0)**	**SILTY SAND(SM)**
✪	**235+4000**	**2.0**	**A-4 (0)**	**SILTY SAND(SM)**

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**234+4000**	**2.0**	**AASHTO T-180 Method A**	**NP**	**NP**	**NP**	**113.4 PCF**	**12.4 %**
⊠	**235+0000**	**2.0**	**AASHTO T-180 Method A**	**NP**	**NP**	**NP**	**115.8 PCF**	**12.7 %**
▲	**235+1000**	**2.0**	**AASHTO T-180 Method A**	**NP**	**NP**	**NP**	**108.0 PCF**	**12.5 %**
★	**235+2000**	**2.0**	**AASHTO T-180 Method A**	**NP**	**NP**	**NP**	**111.2 PCF**	**12.9 %**
⊙	**235+3050**	**2.0**	**AASHTO T-180 Method A**	**NP**	**NP**	**NP**	**107.2 PCF**	**13.6 %**
✪	**235+4000**	**2.0**	**AASHTO T-180 Method A**	**NP**	**NP**	**NP**	**107.6 PCF**	**12.6 %**

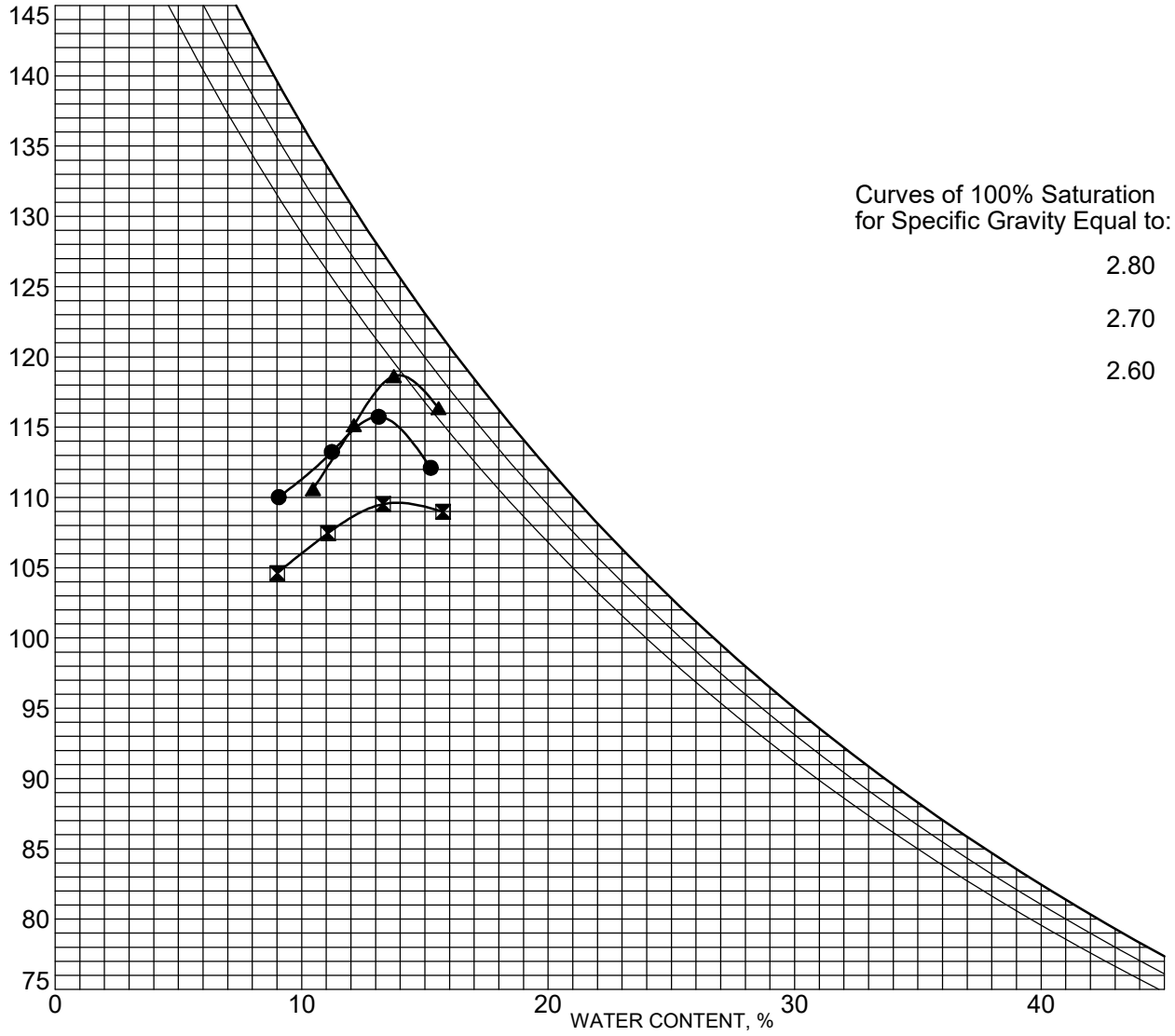
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	BOREHOLE	DEPTH	AASHTO Classification	USCS Description
●	**236+0000**	**2.0**	**A-4 (0)**	**SANDY SILT(ML)**
⊠	**236+1000**	**2.0**	**A-4 (0)**	**SILTY SAND(SM)**
▲	**236+1900**	**2.0**	**A-4 (1)**	**SANDY SILT(ML)**

	BOREHOLE	DEPTH	Test Method	LL	PL	PI	Max DD	Optimum WC
●	**236+0000**	**2.0**	**AASHTO T-180 Method A**	**NP**	**NP**	**NP**	**115.7 PCF**	**13.1 %**
⊠	**236+1000**	**2.0**	**AASHTO T-180 Method A**	**NP**	**NP**	**NP**	**109.6 PCF**	**13.8 %**
▲	**236+1900**	**2.0**	**AASHTO T-180 Method A**	**32**	**29**	**3**	**118.7 PCF**	**13.9 %**

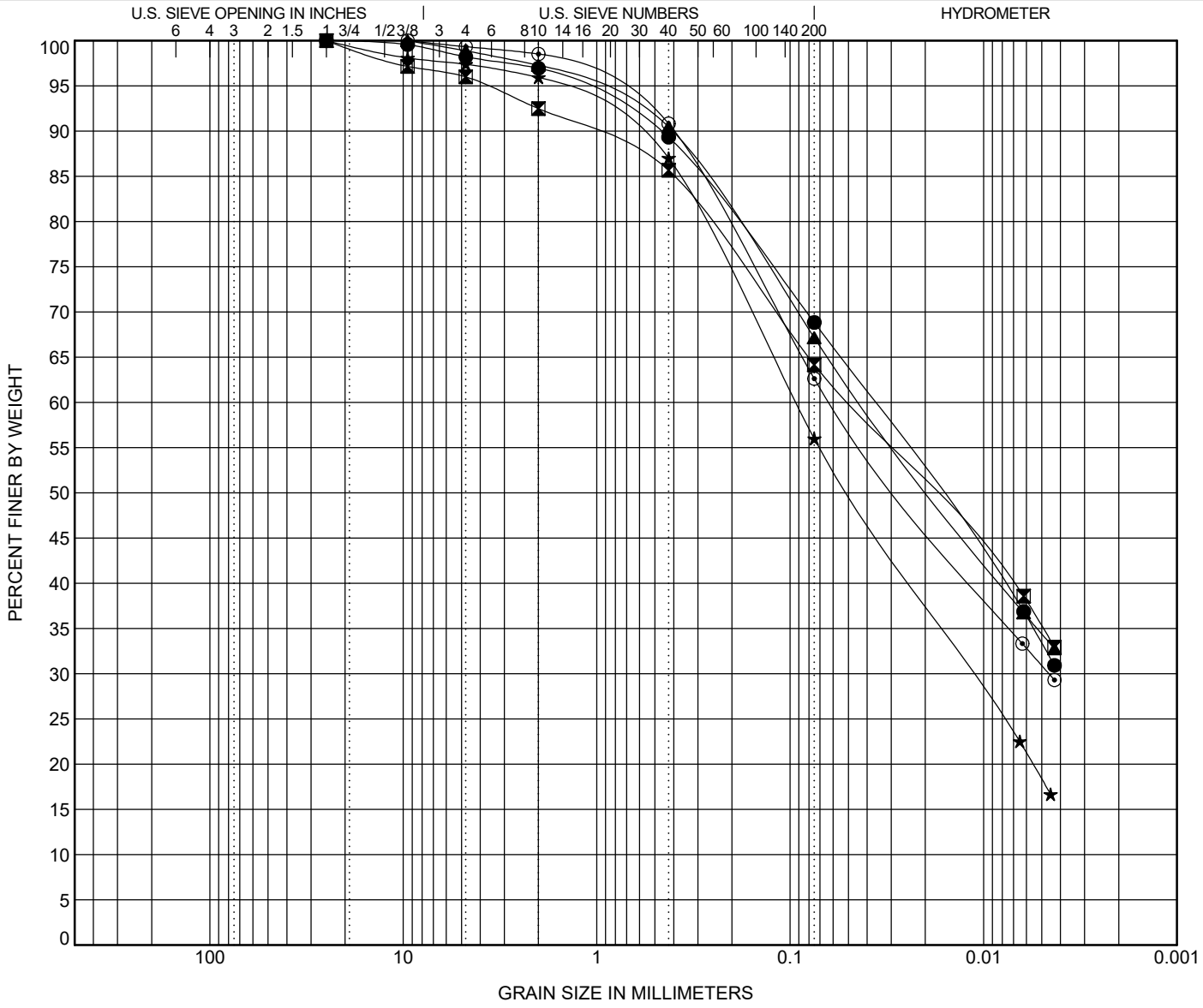
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GRAIN SIZE DISTRIBUTION

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	220+0000	2.0	A-7-5 (15)	MH	52	30	22		
⊠	220+1000	2.0	A-7-5 (14)	MH	53	31	22		
▲	220+2000	2.0	A-7-5 (17)	MH	55	30	25		
★	220+3000	2.0	A-7-5 (8)	ML	48	30	18		
⊙	220+4000	2.0	A-7-6 (10)	ML	47	29	18		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	220+0000	2.0	25	0.038			1.8	29.4	68.8	
⊠	220+1000	2.0	25	0.05			4.0	31.8	64.2	
▲	220+2000	2.0	9.5	0.042			1.1	31.7	67.2	
★	220+3000	2.0	25	0.094	0.011		2.6	41.4	56.0	
⊙	220+4000	2.0	9.5	0.06	0.005		0.7	36.7	62.6	

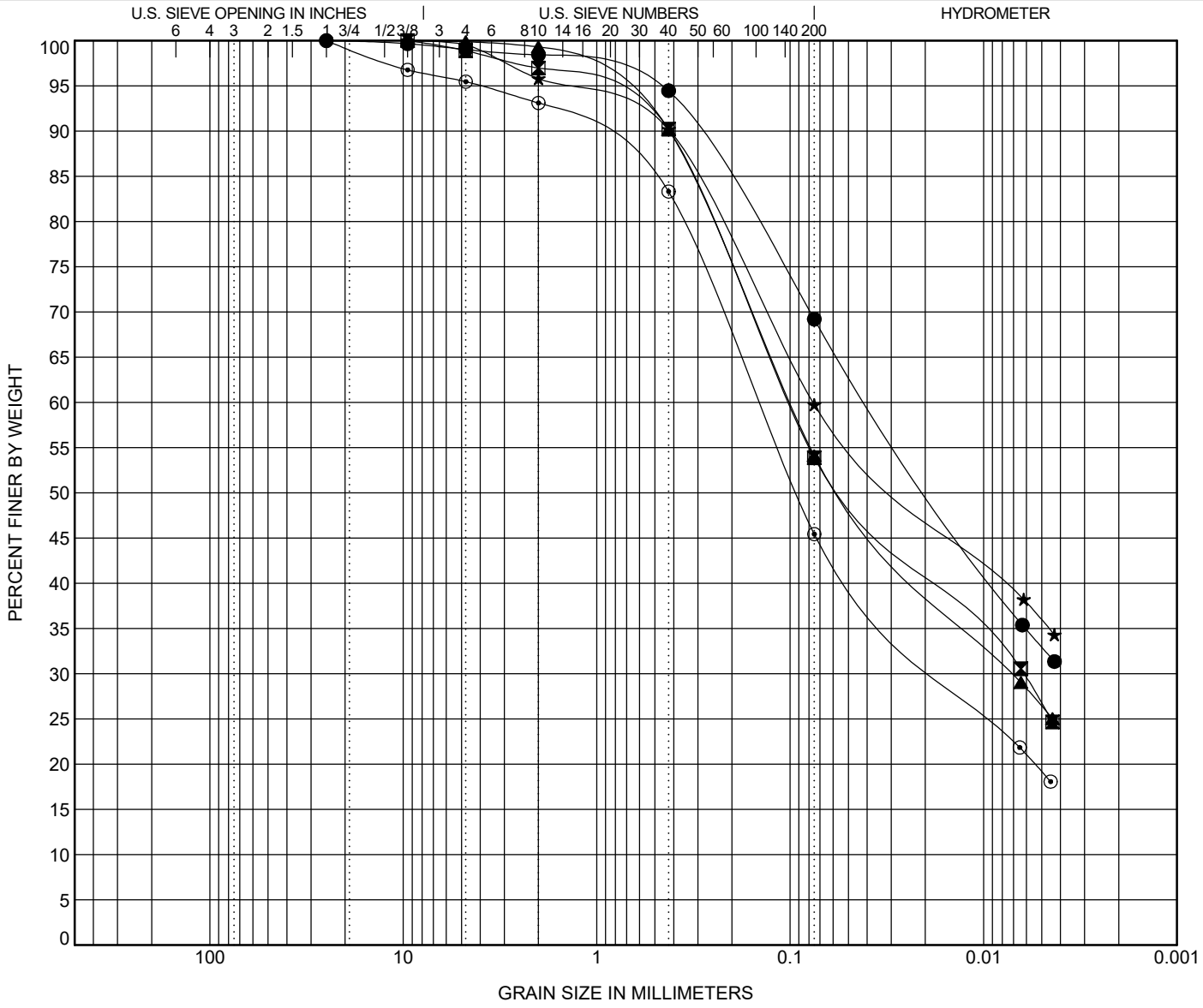
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PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	221+0000	2.0	A-7-6 (15)	CH	50	28	22		
⊠	221+0990	2.0	A-7-6 (7)	CL	44	26	18		
▲	221+2000	2.0	A-7-6 (7)	ML	45	27	18		
★	221+3051	2.0	A-7-6 (10)	CL	46	27	19		
⊙	221+4000	2.0	A-7-6 (4)	SM	42	27	15		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	221+0000	2.0	25	0.038			1.0	29.8	69.2	
⊠	221+0990	2.0	9.5	0.1	0.006		1.1	45.0	53.9	
▲	221+2000	2.0	9.5	0.1	0.007		0.1	45.8	54.1	
★	221+3051	2.0	9.5	0.076			0.4	39.8	59.7	
⊙	221+4000	2.0	25	0.146	0.015		4.5	50.0	45.4	

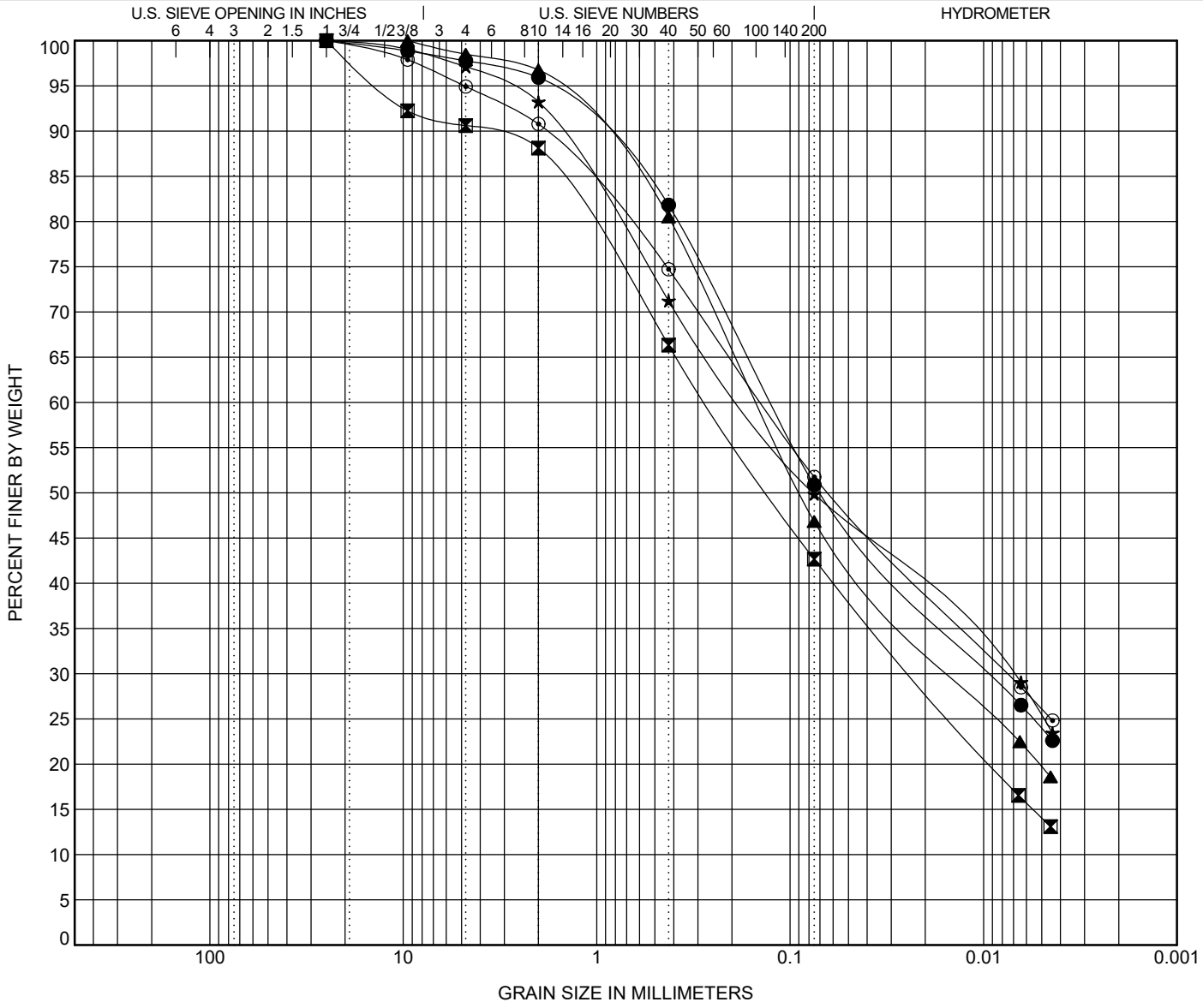
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PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	222+0000	2.0	A-7-6 (5)	ML	44	29	15		
⊠	222+0925	2.0	A-7-5 (5)	SM	53	34	19		
▲	222+2000	2.0	A-7-6 (5)	SM	44	27	17		
★	222+2990	2.0	A-7-5 (7)	SM	53	33	20		
⊙	222+4000	2.0	A-7-5 (8)	MH	52	33	19		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	222+0000	2.0	25	0.125	0.009		2.2	46.9	50.9	
⊠	222+0925	2.0	25	0.267	0.023		9.4	48.0	42.7	
▲	222+2000	2.0	9.5	0.148	0.014		1.5	51.7	46.8	
★	222+2990	2.0	25	0.171	0.007		2.9	47.3	49.9	
⊙	222+4000	2.0	25	0.14	0.008		5.1	43.2	51.8	

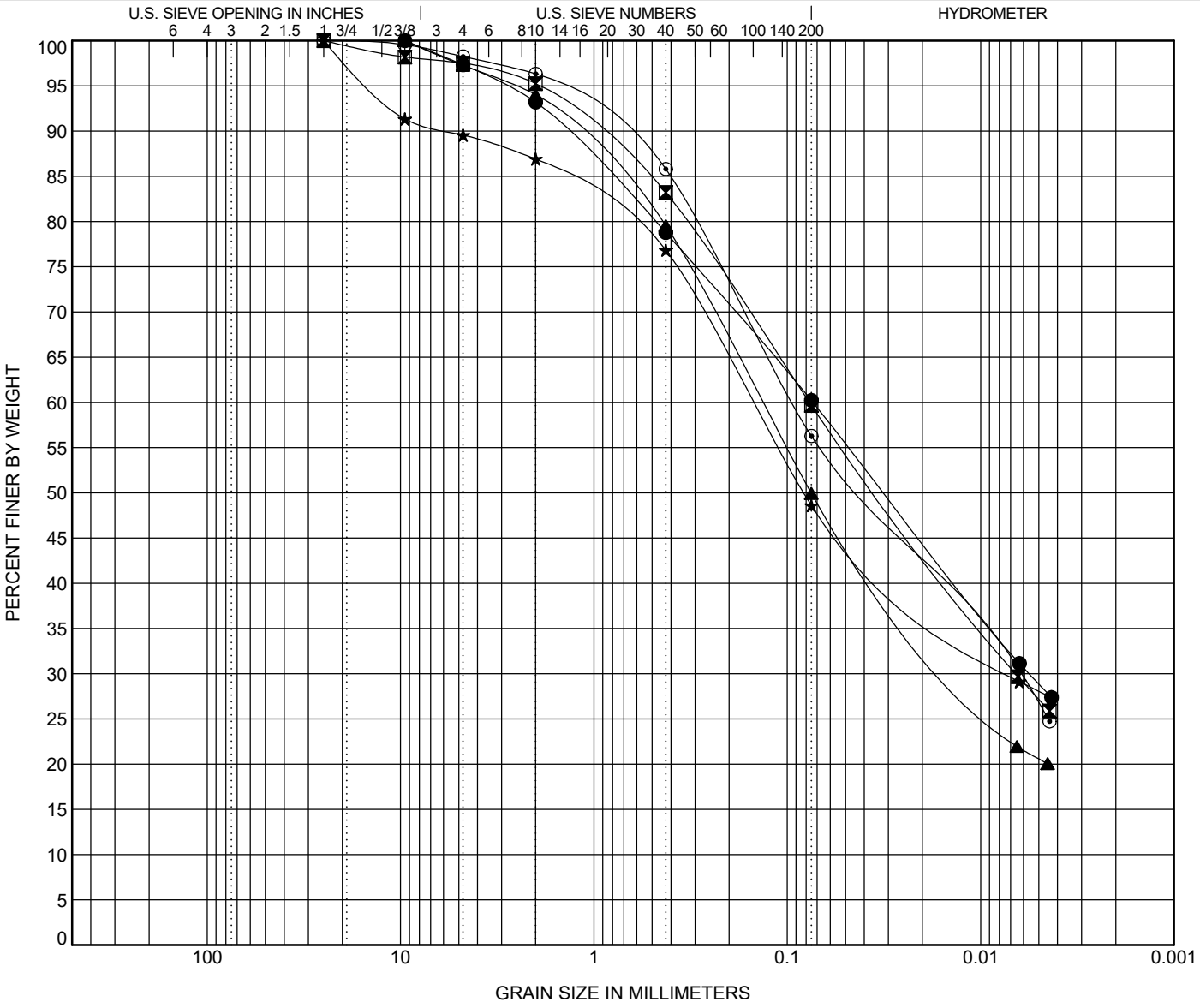
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 223+0220	2.0	A-7-6 (13)	CH	50	26	24		
⊠ 223+1000	2.0	A-7-5 (10)	ML	49	30	19		
▲ 223+2000	2.0	A-7-6 (5)	SM	45	29	16		
★ 223+3000	2.0	A-7-6 (7)	SM	48	28	20		
⊙ 223+4000	2.0	A-7-6 (8)	ML	46	28	18		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 223+0220	2.0	9.5	0.074	0.006		2.7	37.1	60.2	
⊠ 223+1000	2.0	25	0.077	0.007		2.5	37.8	59.7	
▲ 223+2000	2.0	9.5	0.135	0.013		2.7	47.3	49.9	
★ 223+3000	2.0	25	0.151	0.007		10.5	41.0	48.6	
⊙ 223+4000	2.0	25	0.093	0.006		1.8	42.0	56.3	

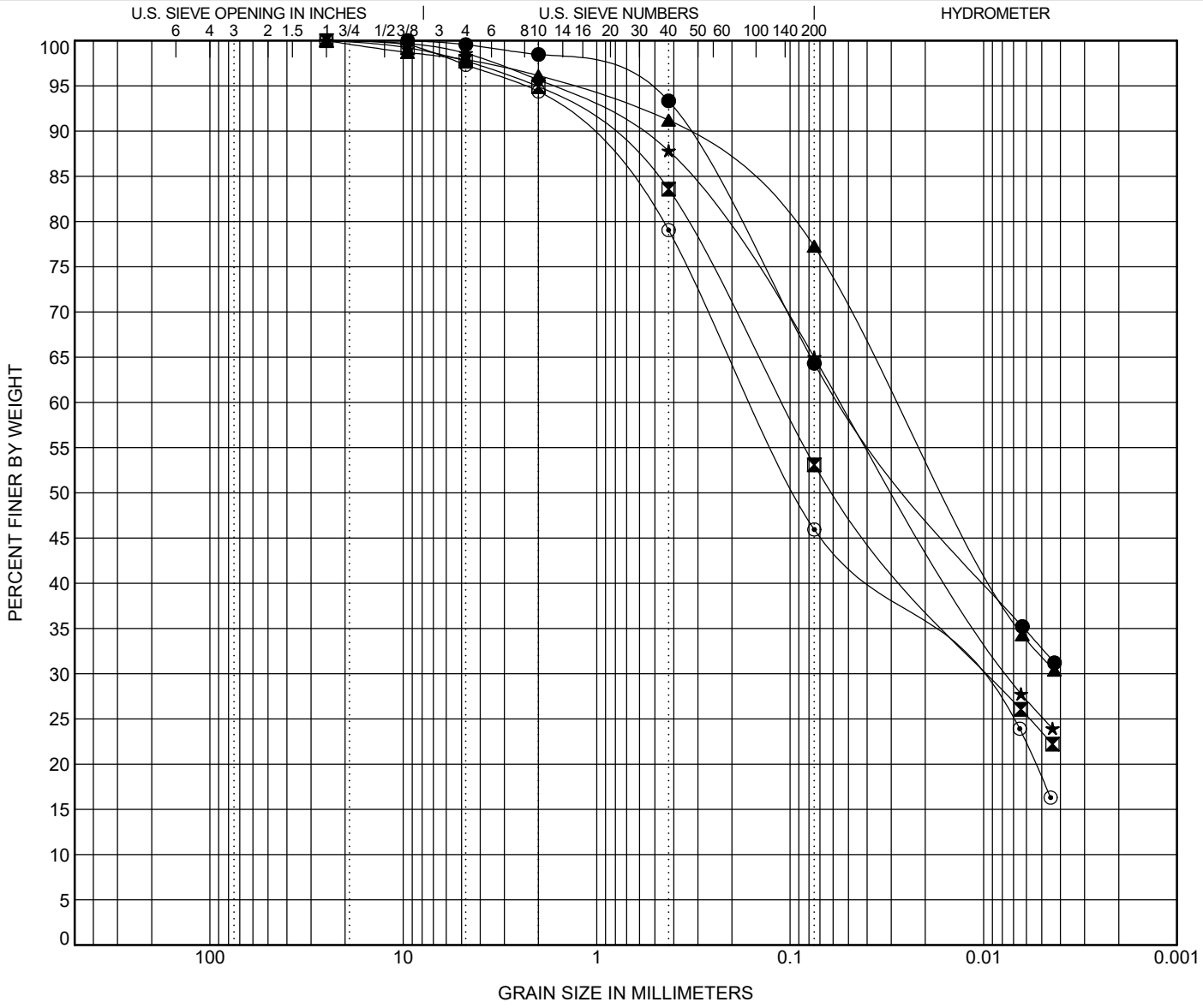
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 224+0000	2.0	A-7-6 (12)	ML	49	28	21		
⊠ 224+1200	2.0	A-7-6 (5)	ML	43	29	14		
▲ 224+2300	2.0	A-7-6 (15)	CL	44	24	20		
★ 224+3220	2.0	A-7-6 (8)	ML	41	28	13		
⊙ 224+4000	2.0	A-6 (3)	SC	39	25	14		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 224+0000	2.0	9.5	0.052			0.4	35.2	64.3	
⊠ 224+1200	2.0	25	0.111	0.009		2.3	44.6	53.1	
▲ 224+2300	2.0	25	0.028			2.1	20.6	77.3	
★ 224+3220	2.0	25	0.054	0.007		1.4	33.6	65.0	
⊙ 224+4000	2.0	25	0.157	0.013		2.7	51.4	45.9	

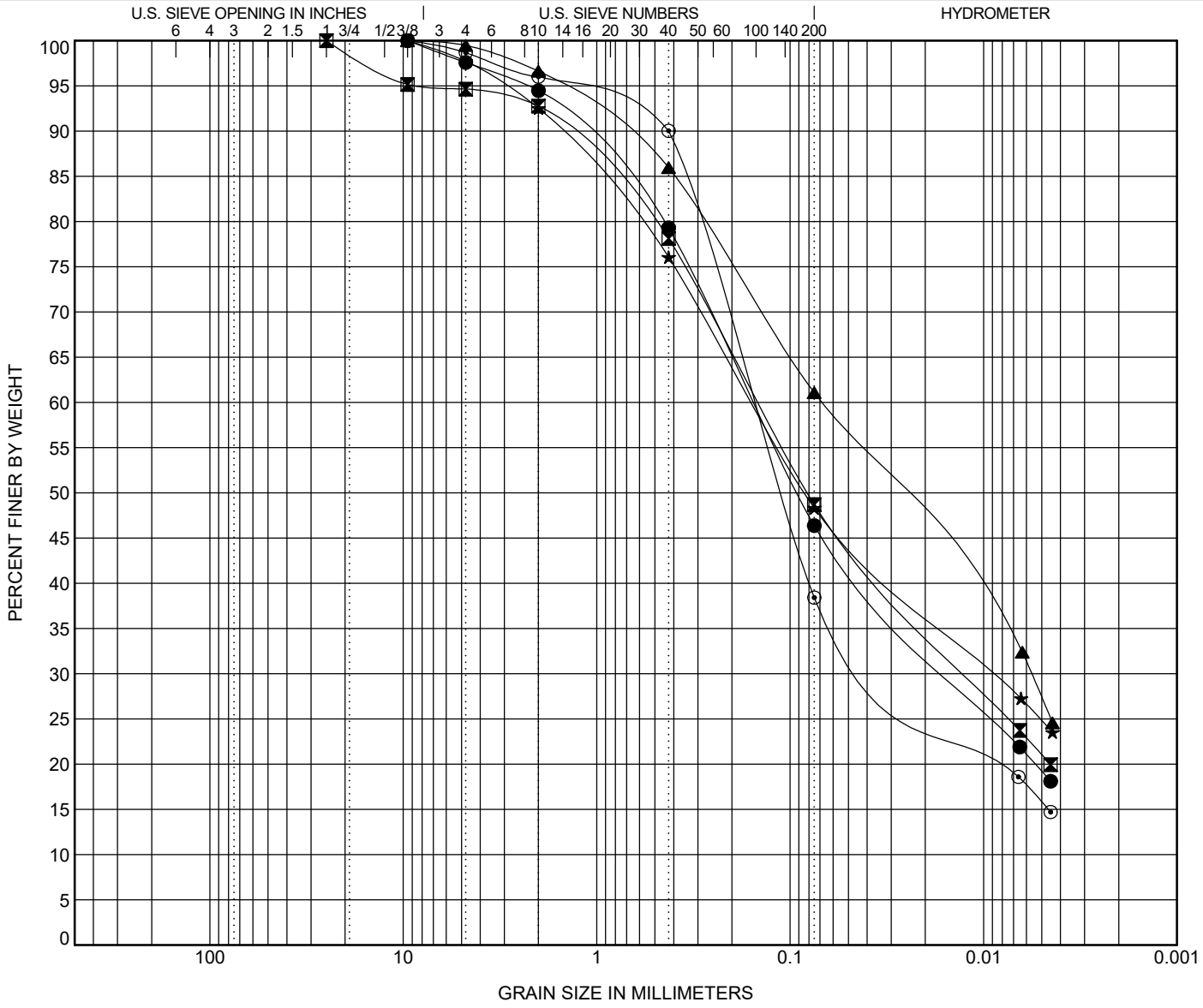
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PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	225+0000	2.0	A-7-6 (4)	SM	43	27	16		
⊠	225+1000	2.0	A-7-5 (6)	SM	48	31	17		
▲	225+2000	2.0	A-7-5 (12)	MH	53	32	21		
★	225+2950	2.0	A-7-6 (6)	SM	46	28	18		
⊙	225+4000	2.0	A-6 (1)	SC	33	22	11		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	225+0000	2.0	9.5	0.154	0.015		2.4	51.2	46.4	
⊠	225+1000	2.0	25	0.146	0.012		5.4	45.9	48.7	
▲	225+2000	2.0	9.5	0.068	0.006		0.5	38.4	61.1	
★	225+2950	2.0	9.5	0.156	0.009		2.3	49.4	48.3	
⊙	225+4000	2.0	9.5	0.155	0.027		1.3	60.3	38.4	

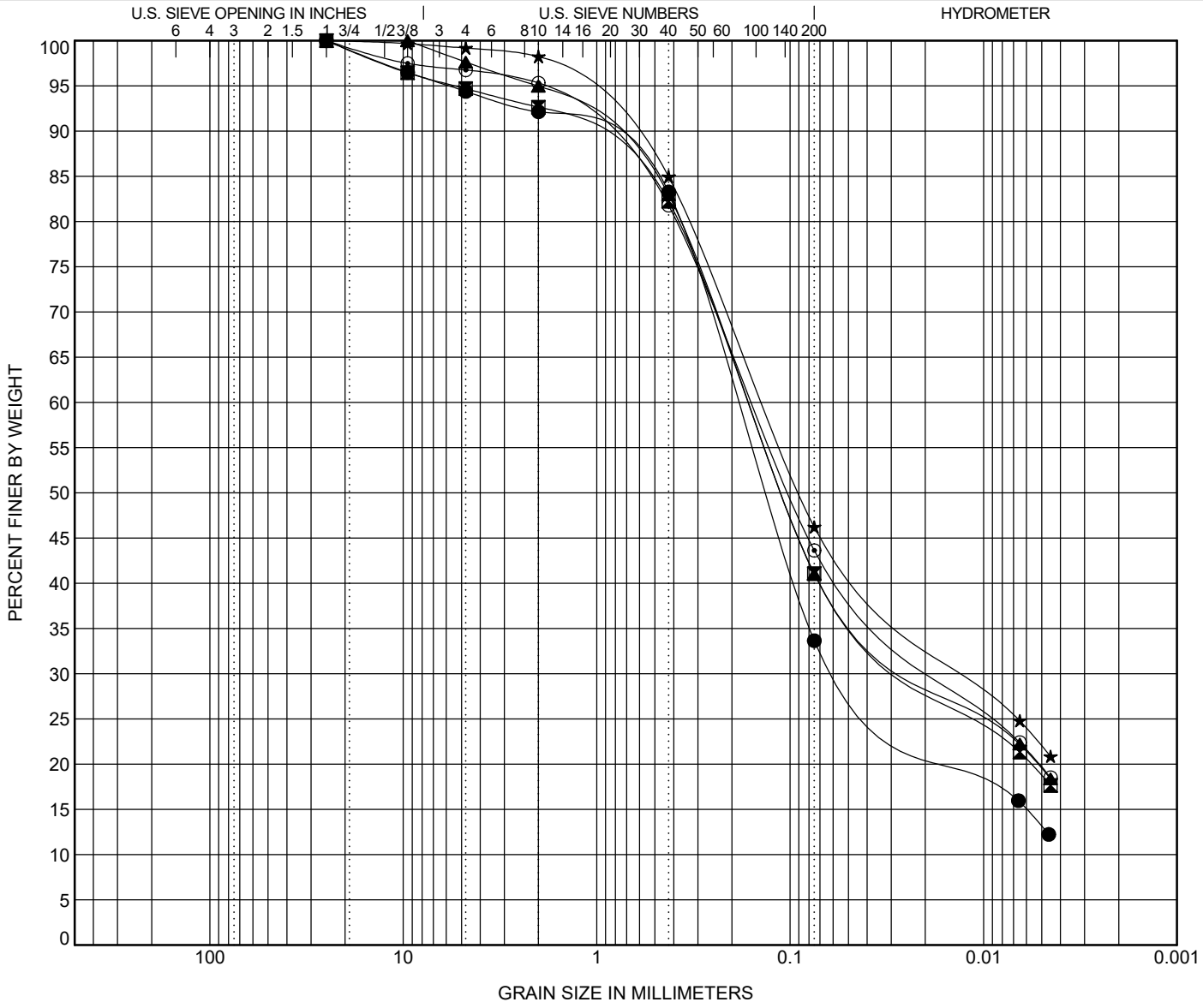
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	226+0000	2.0	A-2-6 (0)	SC	31	20	11		
⊠	226+0940	2.0	A-6 (3)	SC	39	22	17		
▲	226+2000	2.0	A-6 (2)	SC	36	22	14		
★	226+3000	2.0	A-6 (3)	SC	38	24	14		
⊙	226+4000	2.0	A-6 (3)	SM	40	27	13		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	226+0000	2.0	25	0.188	0.045		5.6	60.7	33.7	
⊠	226+0940	2.0	25	0.167	0.019		5.3	53.6	41.1	
▲	226+2000	2.0	9.5	0.164	0.018		2.4	56.6	41.0	
★	226+3000	2.0	25	0.139	0.012		0.8	53.0	46.2	
⊙	226+4000	2.0	25	0.158	0.016		3.2	53.1	43.6	

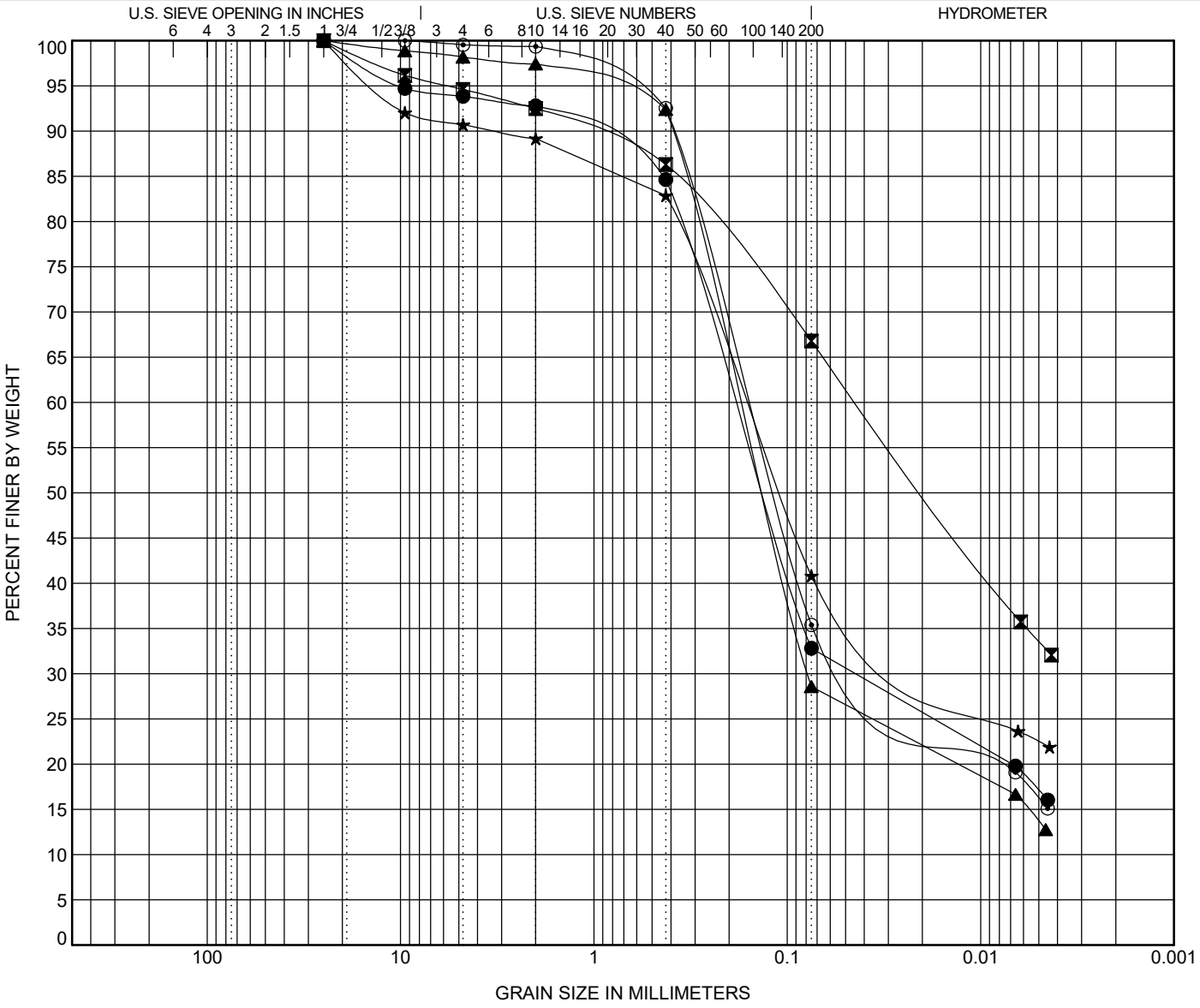
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	227+0000	2.0	A-2-4 (0)	SC	28	18	10		
⊠	227+1000	2.0	A-4 (2)	CL-ML	25	18	7		
▲	227+2000	2.0	A-2-4 (0)	SM	NP	NP	NP		
★	227+3127	2.0	A-4 (0)	SM	NP	NP	NP		
⊙	227+4000	2.0	A-2-4 (0)	SM	21	19	2		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	227+0000	2.0	25	0.186	0.044		6.2	61.0	32.8	
⊠	227+1000	2.0	25	0.044			5.4	27.8	66.8	
▲	227+2000	2.0	25	0.176	0.078		1.8	69.6	28.6	
★	227+3127	2.0	25	0.165	0.016		9.3	49.9	40.8	
⊙	227+4000	2.0	9.5	0.158	0.034		0.5	64.1	35.4	

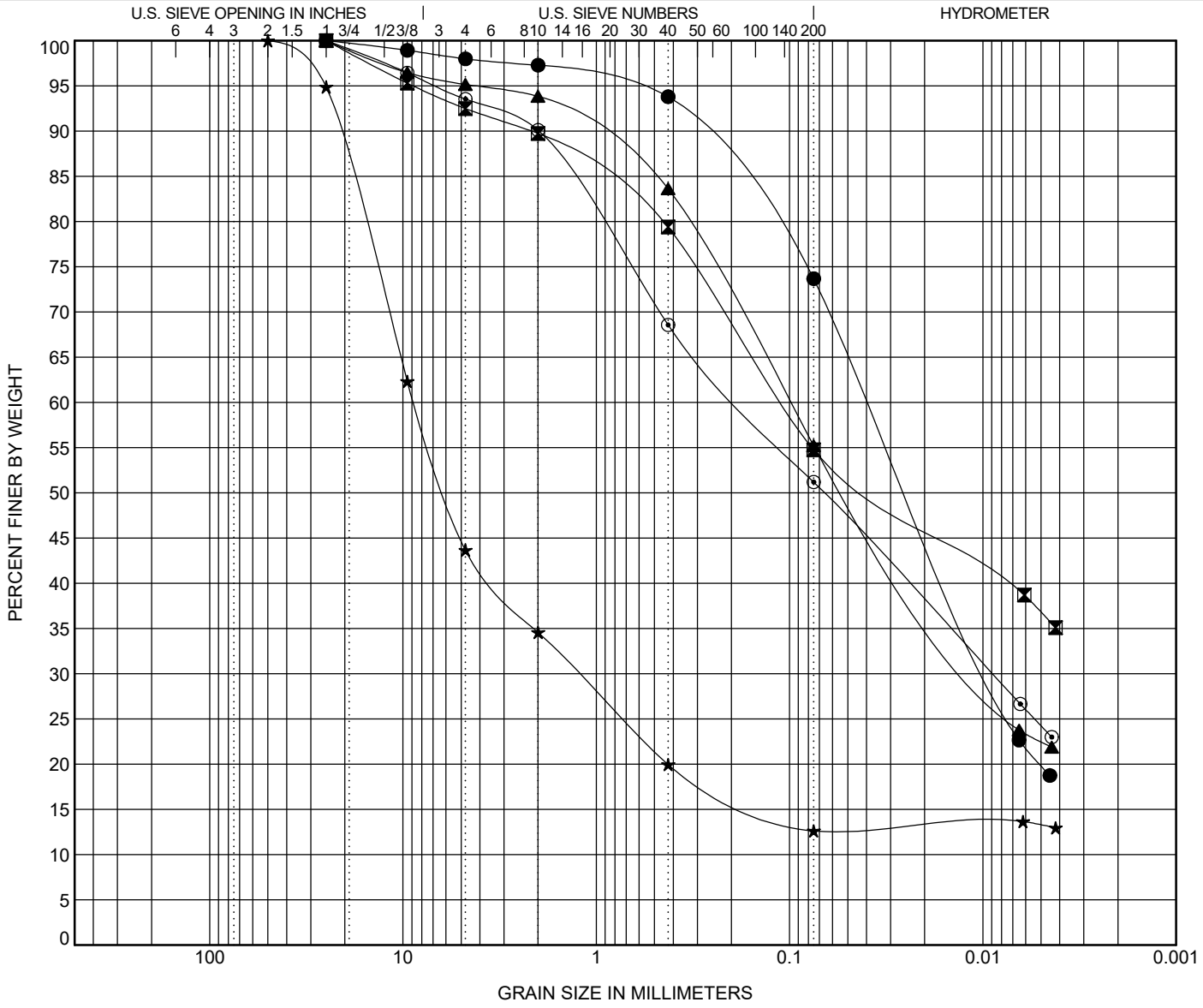
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	228+0000	2.0	A-4 (6)	CL	30	20	10		
⊠	228+1000	2.0	A-7-5 (7)	ML	46	30	16		
▲	228+2000	2.0	A-7-6 (8)	CL	43	24	19		
★	228+3000	2.0	A-2-7 (0)	GM	47	31	16		
⊙	228+3640	2.0	A-7-6 (9)	CH	51	28	23		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	228+0000	2.0	25	0.039	0.009		2.0	24.3	73.7	
⊠	228+1000	2.0	25	0.108			7.5	37.7	54.8	
▲	228+2000	2.0	25	0.1	0.011		4.8	39.9	55.2	
★	228+3000	2.0	50	8.717	1.233		56.4	31.0	12.6	
⊙	228+3640	2.0	25	0.181	0.009		6.5	42.3	51.2	

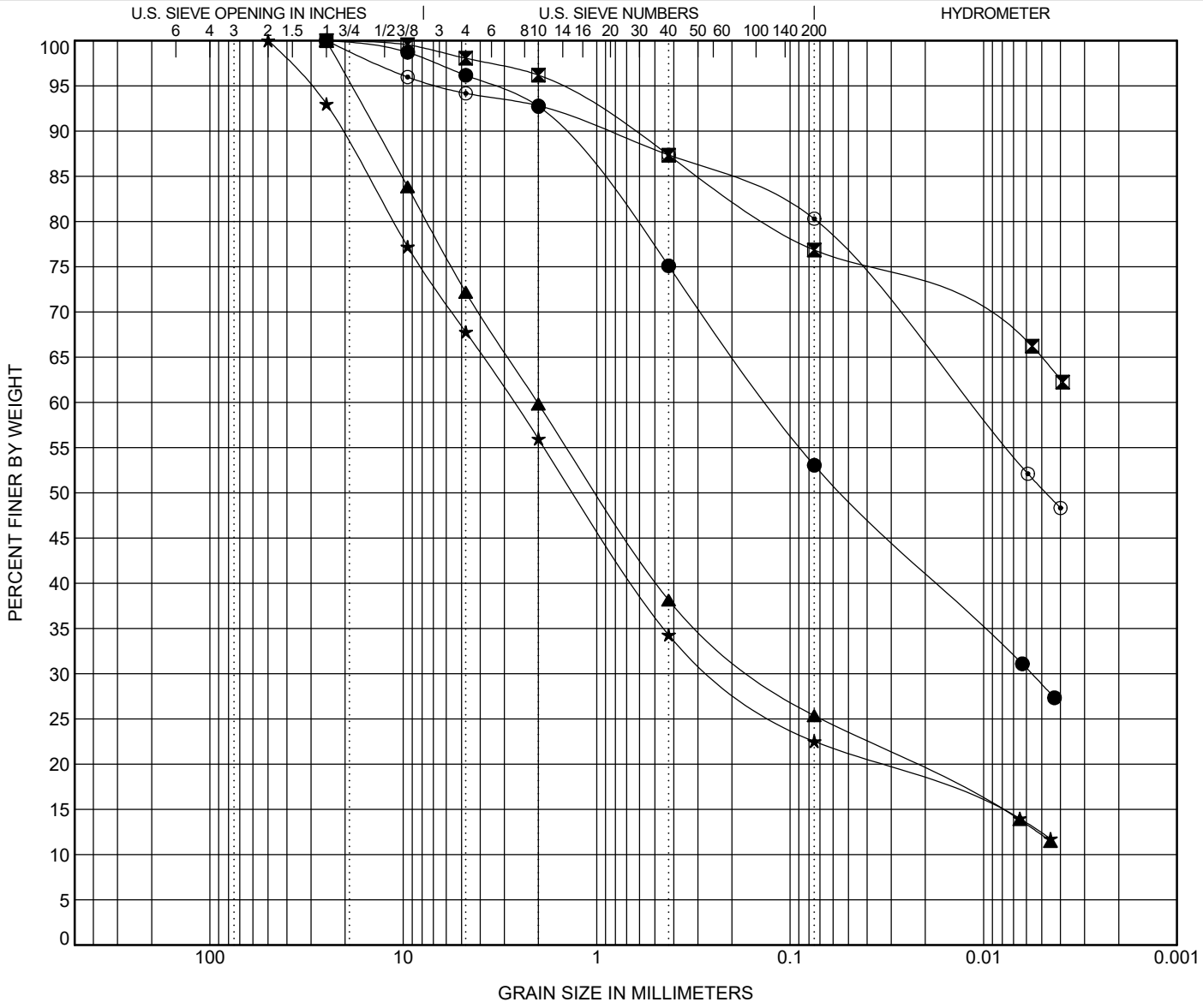
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 229+0023	2.3	A-7-6 (9)	ML	49	28	21		
⊠ 229+1000	2.0	A-7-5 (29)	CH	65	31	34		
▲ 229+2000	2.0	A-2-7 (1)	SM	43	27	16		
★ 229+3000	2.0	A-2-7 (0)	SM	45	30	15		
⊙ 229+4000	2.0	A-7-5 (34)	CH	70	32	38		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 229+0023	2.3	25	0.13	0.006		3.8	43.1	53.0	
⊠ 229+1000	2.0	25				2.0	21.2	76.9	
▲ 229+2000	2.0	25	2.025	0.141		27.8	46.8	25.4	
★ 229+3000	2.0	50	2.688	0.226		32.2	45.3	22.5	
⊙ 229+4000	2.0	25	0.012			5.8	13.9	80.3	

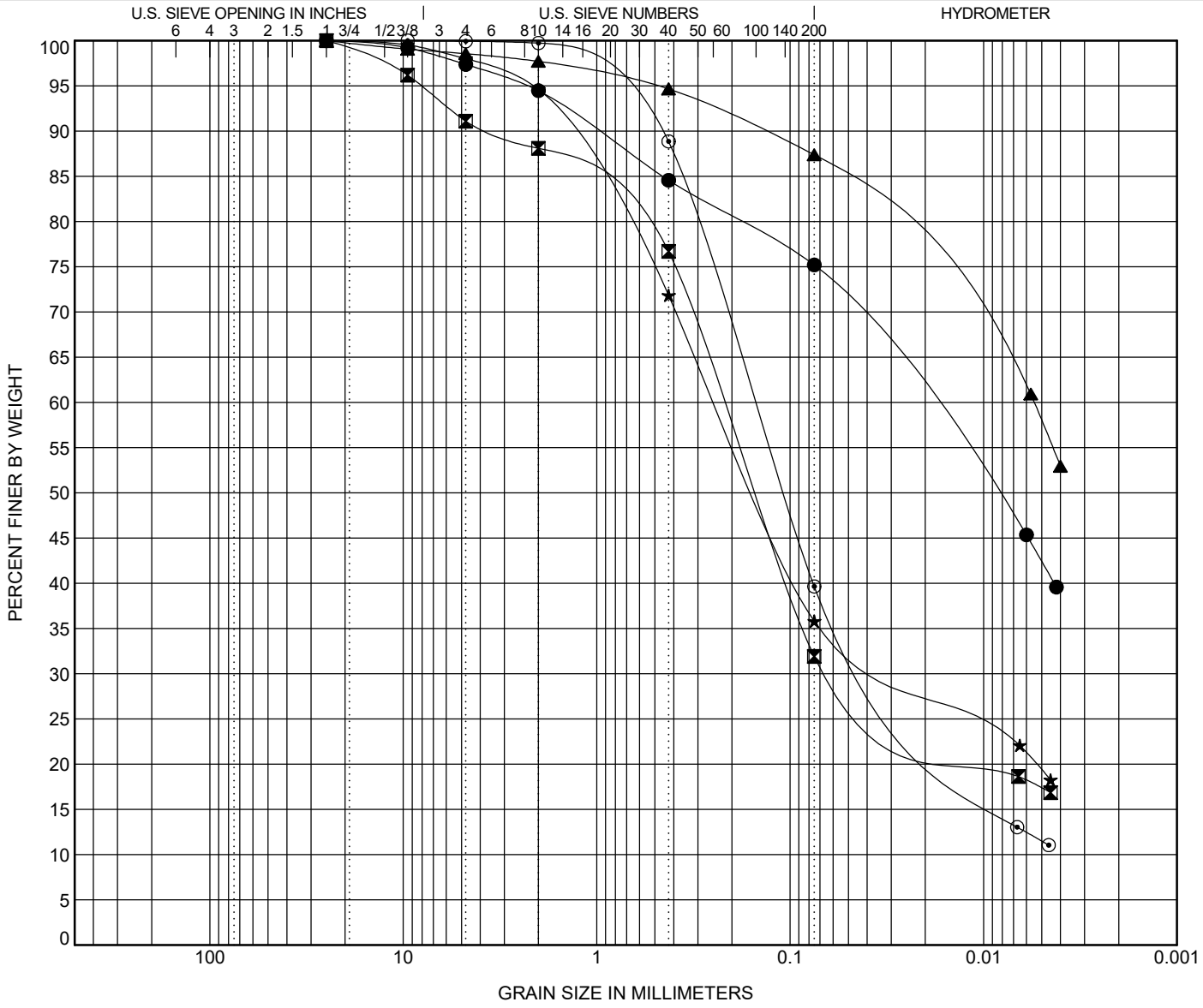
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	230+0000	2.0	A-7-6 (24)	CH	59	29	30		
⊠	230+2000	2.0	A-2-6 (0)	SC	30	19	11		
▲	230+3056	2.1	A-7-5 (37)	CH	67	30	37		
★	230+5120	2.0	A-7-6 (2)	SC	41	24	17		
⊙	231+1000	2.0	A-4 (0)	SM	NP	NP	NP		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	230+0000	2.0	25	0.021			2.6	22.2	75.2	
⊠	230+2000	2.0	25	0.223	0.053		8.9	59.2	31.9	
▲	230+3056	2.1	25	0.005			1.4	11.2	87.4	
★	230+5120	2.0	25	0.24	0.027		2.0	62.2	35.8	
⊙	231+1000	2.0	9.5	0.154	0.031		0.1	60.3	39.7	

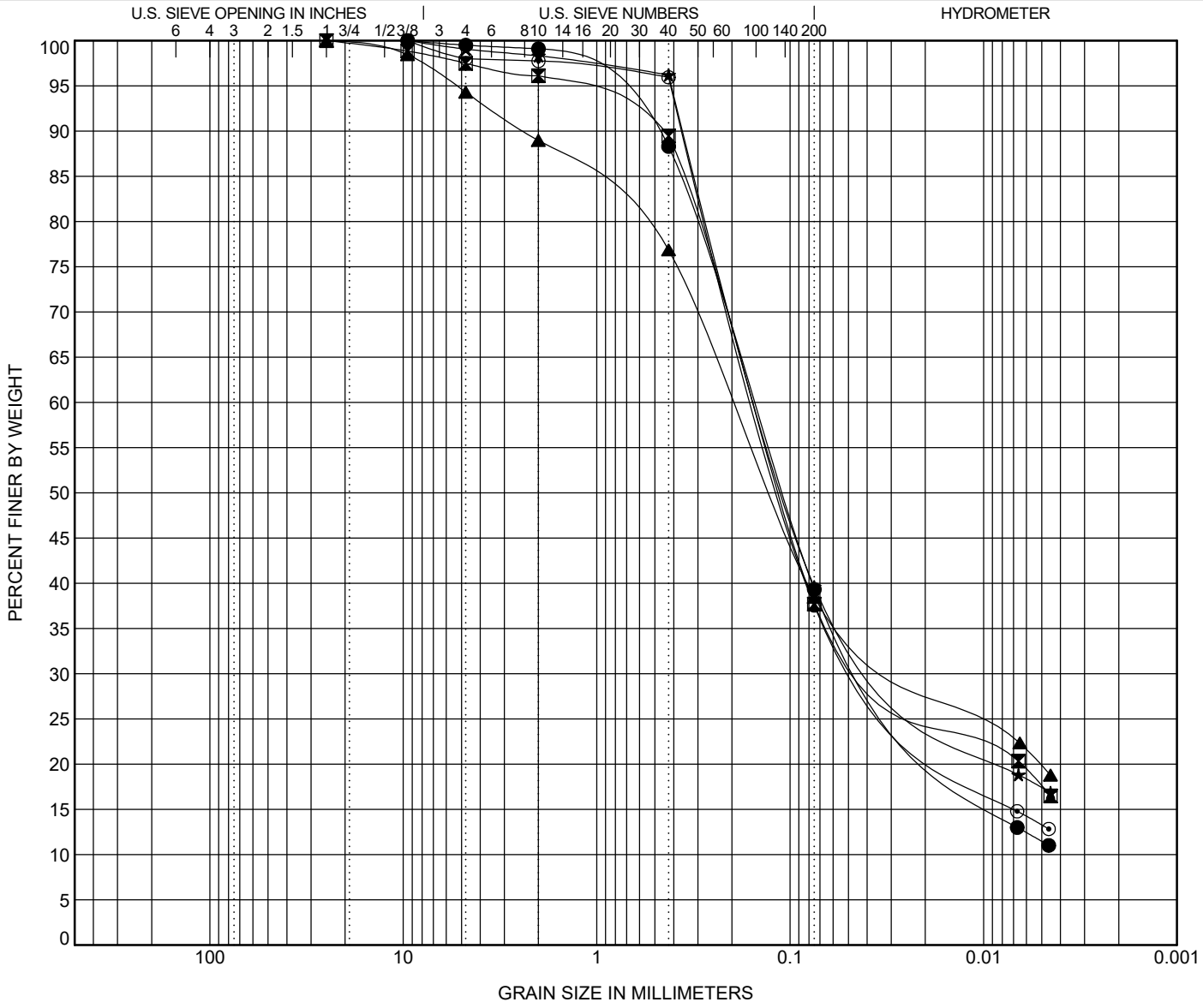
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	231+1928	2.0	A-4 (0)	SM	NP	NP	NP		
⊠	231+3000	2.0	A-4 (0)	SM	NP	NP	NP		
▲	231+4000	2.0	A-6 (1)	SC	33	21	12		
★	232+0000	2.0	A-4 (0)	SM	NP	NP	NP		
⊙	232+1000	2.0	A-4 (0)	SM	NP	NP	NP		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	231+1928	2.0	9.5	0.156	0.032		0.5	60.2	39.3	
⊠	231+3000	2.0	25	0.158	0.026		2.5	59.8	37.7	
▲	231+4000	2.0	25	0.198	0.021		5.7	55.8	38.5	
★	232+0000	2.0	9.5	0.14	0.024		0.9	59.5	39.6	
⊙	232+1000	2.0	9.5	0.146	0.034		2.0	60.5	37.5	

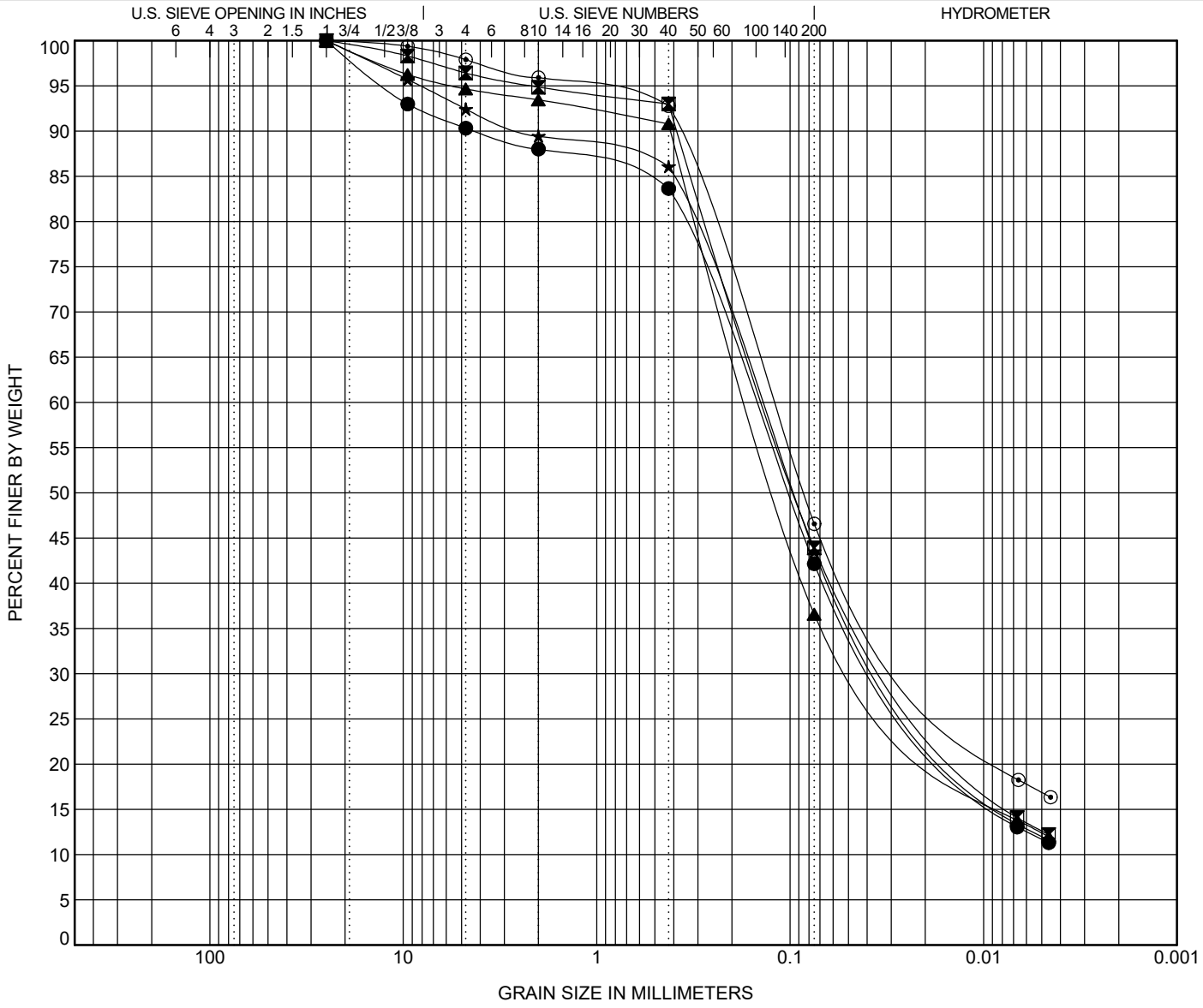
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COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	232+2000	2.0	A-4 (0)	SM	NP	NP	NP		
⊠	232+3000	2.0	A-4 (0)	SM	NP	NP	NP		
▲	232+4100	2.0	A-4 (0)	SM	NP	NP	NP		
★	233+0000	2.0	A-4 (0)	SM	NP	NP	NP		
⊙	233+1000	2.0	A-4 (0)	SM	NP	NP	NP		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	232+2000	2.0	25	0.158	0.027		9.7	48.2	42.2	
⊠	232+3000	2.0	25	0.132	0.024		3.6	52.5	43.9	
▲	232+4100	2.0	25	0.159	0.037		5.3	58.1	36.6	
★	233+0000	2.0	25	0.147	0.025		7.6	48.9	43.5	
⊙	233+1000	2.0	25	0.124	0.018		2.1	51.3	46.6	

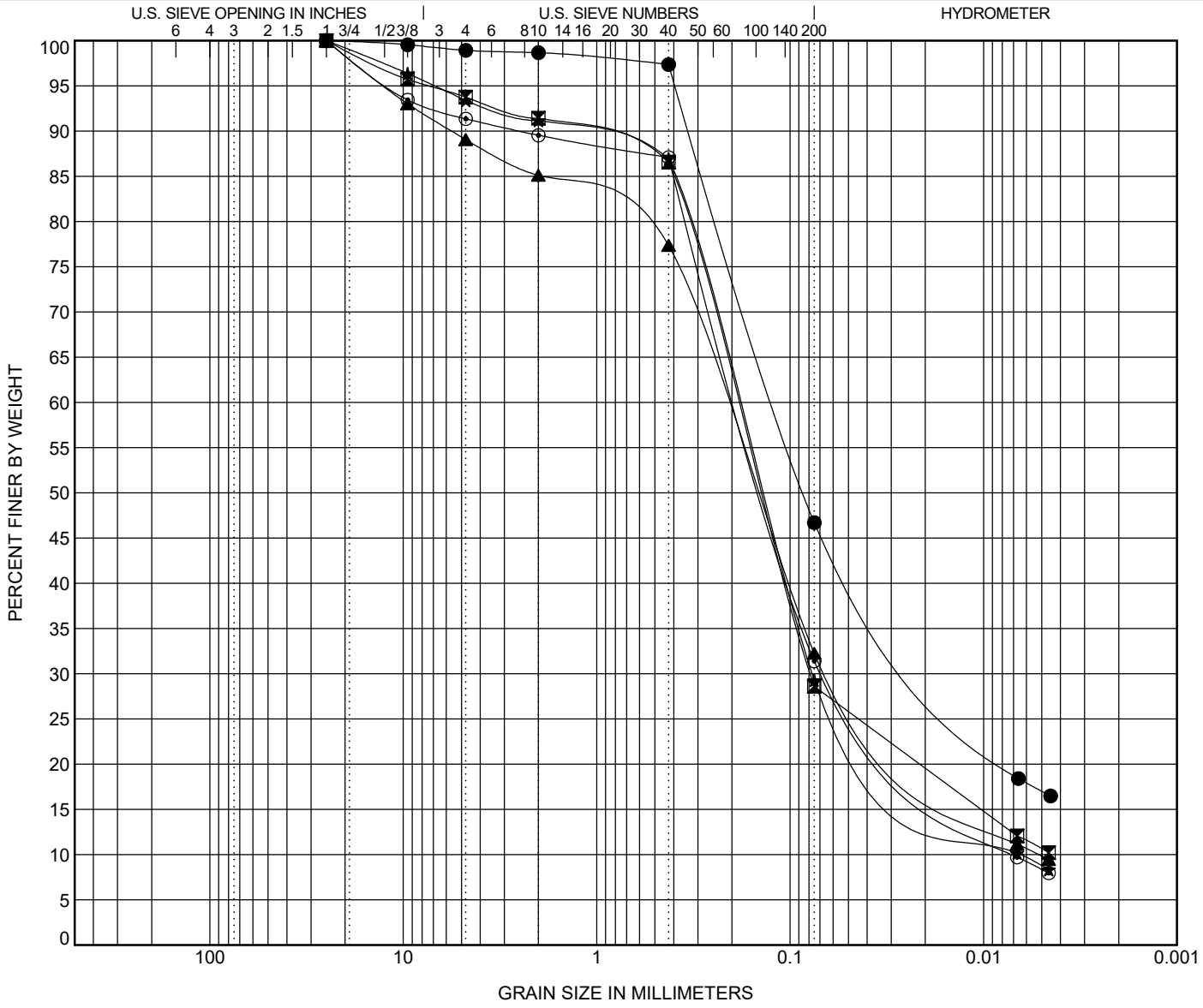
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GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	233+2000	2.0	A-4 (0)	SM	NP	NP	NP		
⊠	233+3050	2.0	A-2-4 (0)	SM	NP	NP	NP		
▲	233+4000	2.0	A-2-4 (0)	SM	NP	NP	NP	2.96	41.96
★	234+0000	2.0	A-2-4 (0)	SM	NP	NP	NP	4.80	29.20
⊙	234+1000	2.0	A-2-4 (0)	SM	NP	NP	NP	3.26	26.41

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	233+2000	2.0	25	0.118	0.018		1.1	52.2	46.7	
⊠	233+3050	2.0	25	0.192	0.078		6.2	65.1	28.6	
▲	233+4000	2.0	25	0.218	0.058	0.005	10.9	56.8	32.3	
★	234+0000	2.0	25	0.189	0.077	0.006	6.6	64.1	29.3	
⊙	234+1000	2.0	25	0.183	0.064	0.007	8.7	60.0	31.4	

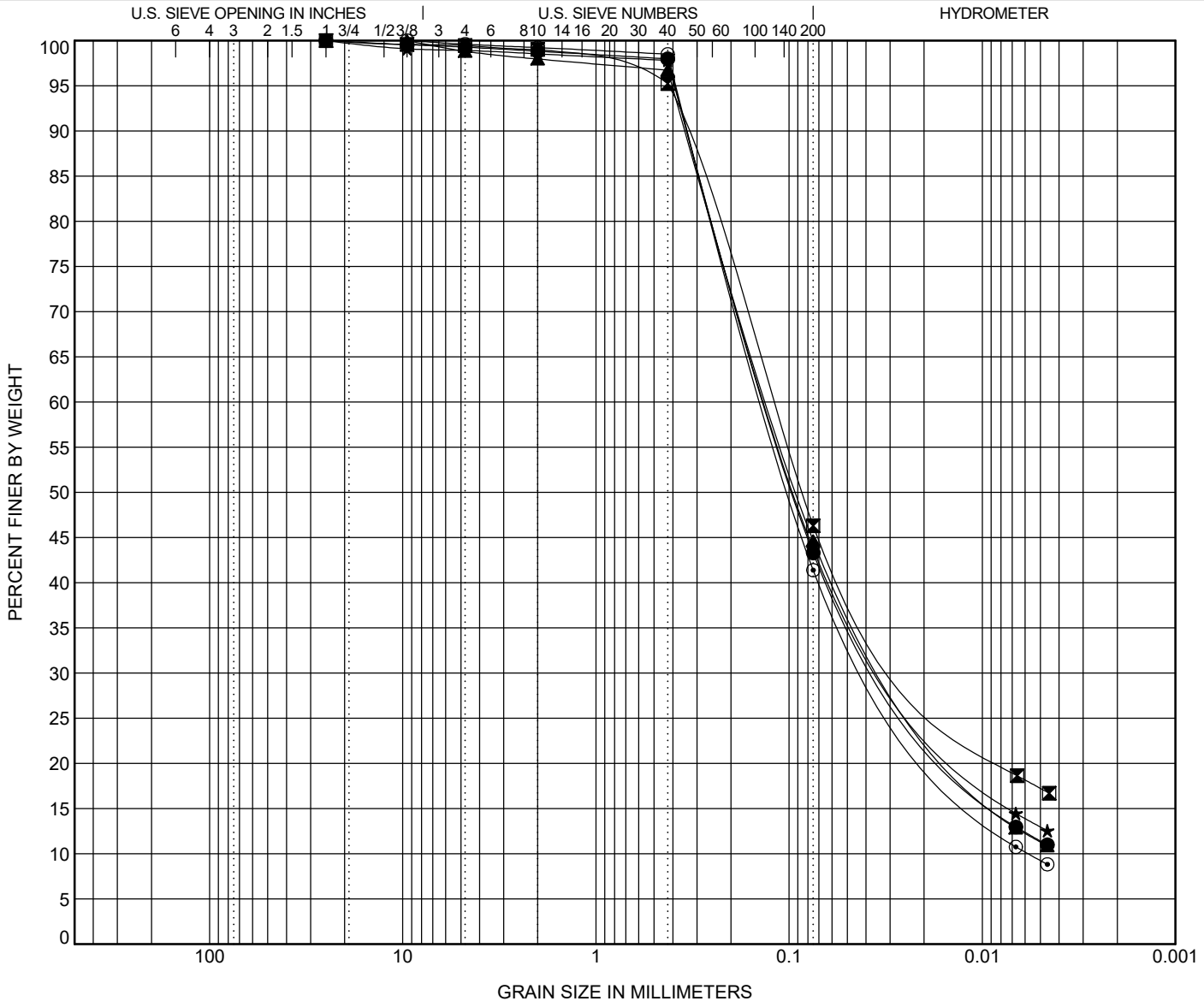
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GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	234+2000	2.0	A-4 (0)	SM	NP	NP	NP		
⊠	234+3000	2.0	A-4 (0)	SM	NP	NP	NP		
▲	234+4000	2.0	A-4 (0)	SM	NP	NP	NP		
★	235+0000	2.0	A-4 (0)	SM	NP	NP	NP		
⊙	235+1000	2.0	A-4 (0)	SM	NP	NP	NP	1.22	22.83

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	234+2000	2.0	25	0.127	0.026		0.7	56.0	43.3	
⊠	234+3000	2.0	25	0.122	0.018		0.5	53.2	46.3	
▲	234+4000	2.0	9.5	0.125	0.025		1.2	54.2	44.7	
★	235+0000	2.0	25	0.126	0.024		1.1	55.2	43.7	
⊙	235+1000	2.0	9.5	0.132	0.031	0.006	0.4	58.2	41.4	

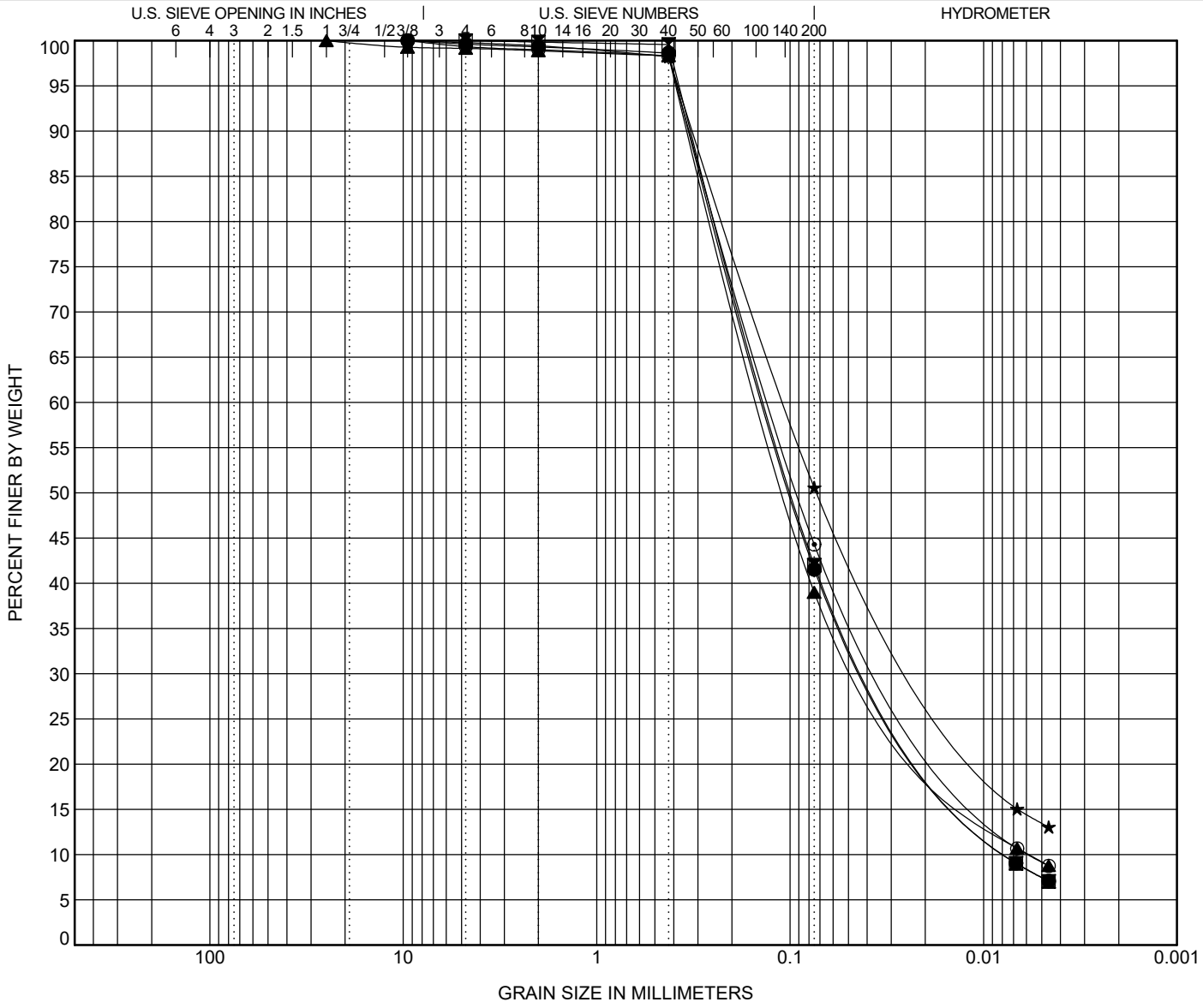
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NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 235+2000	2.0	A-4 (0)	SM	NP	NP	NP	1.07	18.02
⊠ 235+3050	2.0	A-4 (0)	SM	NP	NP	NP	1.04	17.67
▲ 235+4000	2.0	A-4 (0)	SM	NP	NP	NP	1.50	23.73
★ 236+0000	2.0	A-4 (0)	ML	NP	NP	NP		
⊙ 236+1000	2.0	A-4 (0)	SM	NP	NP	NP	0.99	21.14

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 235+2000	2.0	9.5	0.131	0.032	0.007	0.4	58.1	41.5	
⊠ 235+3050	2.0	4.75	0.129	0.031	0.007	0.0	58.0	42.0	
▲ 235+4000	2.0	25	0.139	0.035	0.006	0.9	60.1	39.0	
★ 236+0000	2.0	9.5	0.106	0.019		0.2	49.2	50.6	
⊙ 236+1000	2.0	9.5	0.124	0.027	0.006	0.7	55.0	44.3	

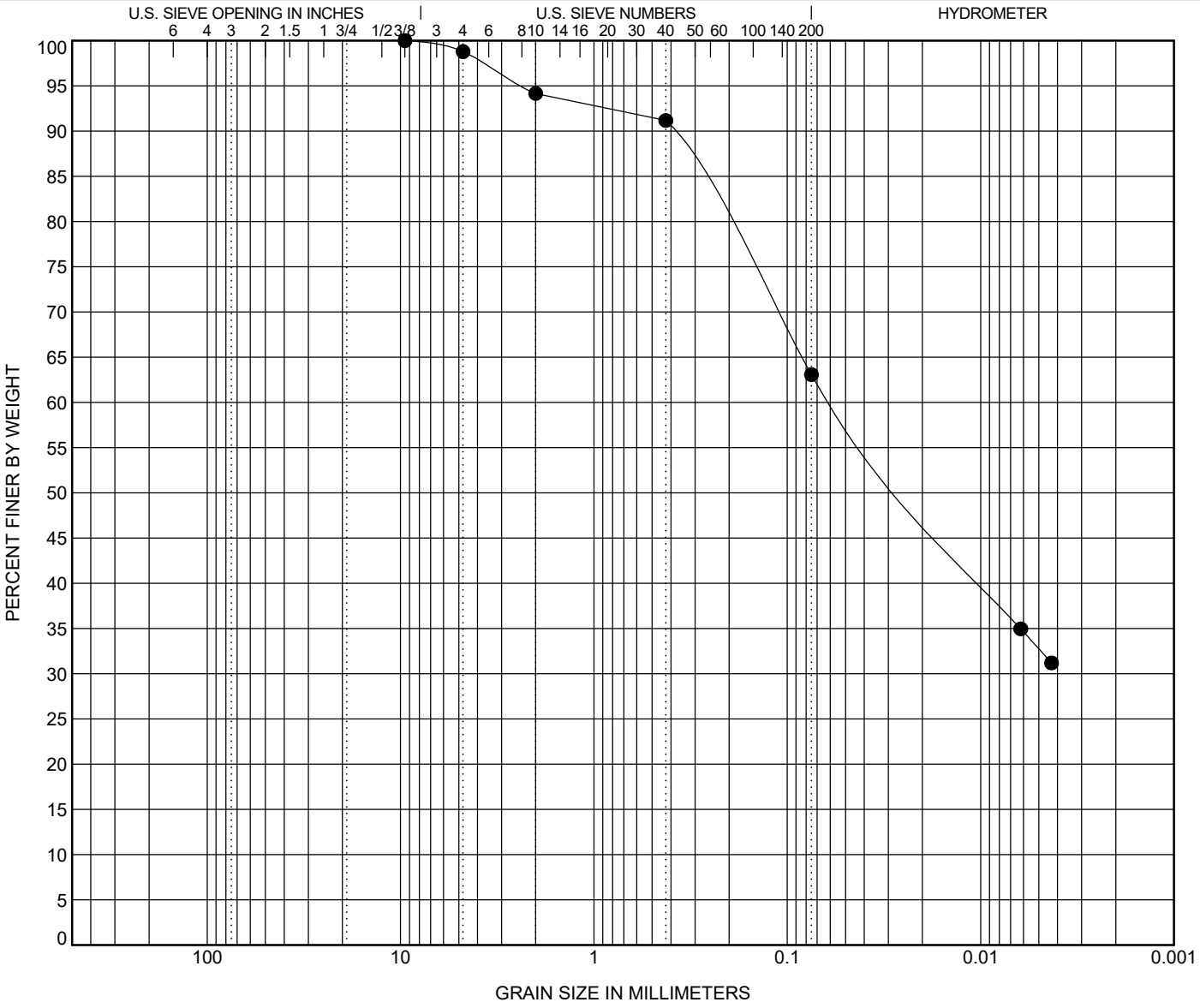
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GRAIN SIZE DISTRIBUTION

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

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● 236+1900	2.0	A-4 (1)	ML	32	29	3		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 236+1900	2.0	9.5	0.057			1.2	35.7	63.1	

GRAIN SIZE - 20171219.GDT - 12/2/22 13:19 - F:\LAB\PROJECTS\GINT\6-032(069)219.GPJ

SUMMARY OF LABORATORY RESULTS

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

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210

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
220+0000	2.0	52	30	22	25	69	A-7-5 (15)	MH	28.0	28.7			
220+0000	3.0								26.5	28.7			
220+0000	4.0								29.5	28.7			
220+0000	5.0								30.7	28.7			
220+1000	2.0	53	31	22	25	64	A-7-5 (14)	MH	28.1	32.5			
220+1000	3.0								28.1	32.5			
220+1000	4.0								36.6	32.5			
220+1000	5.0								37.3	32.5			
220+2000	2.0	55	30	25	9.5	67	A-7-5 (17)	MH	28.4	25.3			
220+2000	3.0								25.3	25.3			
220+2000	4.0								27.1	25.3			
220+2000	5.0								20.6	25.3			
220+3000	2.0	48	30	18	25	56	A-7-5 (8)	ML	29.6	29.1			
220+3000	3.0								27.9	29.1			
220+3000	4.0								29.3	29.1			
220+3000	5.0								29.6	29.1			
220+4000	2.0	47	29	18	9.5	63	A-7-6 (10)	ML	25.5	26.8			
220+4000	3.0								28.1	26.8			
220+4000	4.0								26.3	26.8			
220+4000	5.0								27.3	26.8			
221+0000	2.0	50	28	22	25	69	A-7-6 (15)	CH	28.5	32.7			
221+0000	3.0								33.1	32.7			
221+0000	4.0								30.2	32.7			
221+0000	5.0								38.8	32.7			
221+0990	2.0	44	26	18	9.5	54	A-7-6 (7)	CL	27.0	25.7			
221+0990	3.0								26.1	25.7			
221+0990	4.0								27.5	25.7			
221+0990	5.0								22.1	25.7			
221+2000	2.0	45	27	18	9.5	54	A-7-6 (7)	ML	14.9	25.8			
221+2000	3.0								27.9	25.8			
221+2000	4.0								25.2	25.8			
221+2000	5.0								35.3	25.8			
221+3051	2.0	46	27	19	9.5	60	A-7-6 (10)	CL	28.8	29.5			
221+3051	3.0								27.3	29.5			
221+3051	4.0								29.7	29.5			
221+3051	5.0								32.3	29.5			
221+4000	2.0	42	27	15	25	45	A-7-6 (4)	SM	28.2	25.5			
221+4000	3.0								16.2	25.5			
221+4000	4.0								28.5	25.5			
221+4000	5.0								28.9	25.5			
222+0000	2.0	44	29	15	25	51	A-7-6 (5)	ML	29.7	26.4			
222+0000	3.0								28.1	26.4			
222+0000	4.0								15.6	26.4			

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SUMMARY OF LABORATORY RESULTS

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

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210

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
222+0000	5.0								32.2	26.4			
222+0925	2.0	53	34	19	25	43	A-7-5 (5)	SM	25.4	26.2			
222+0925	3.0								27.5	26.2			
222+0925	4.0								13.3	26.2			
222+0925	5.0								38.5	26.2			
222+2000	2.0	44	27	17	9.5	47	A-7-6 (5)	SM	23.9	26.2			
222+2000	3.0								25.4	26.2			
222+2000	4.0								26.4	26.2			
222+2000	5.0								29.1	26.2			
222+2990	2.0	53	33	20	25	50	A-7-5 (7)	SM	27.7	27.0			
222+2990	3.0								28.6	27.0			
222+2990	4.0								28.4	27.0			
222+2990	5.0								23.3	27.0			
222+4000	2.0	52	33	19	25	52	A-7-5 (8)	MH	25.8	30.9			
222+4000	3.0								30.8	30.9			
222+4000	4.0								33.8	30.9			
222+4000	5.0								33.3	30.9			
223+0220	2.0	50	26	24	9.5	60	A-7-6 (13)	CH	22.9	25.0			
223+0220	3.0								32.3	25.0			
223+0220	4.0								26.6	25.0			
223+0220	5.0								18.2	25.0			
223+1000	2.0	49	30	19	25	60	A-7-5 (10)	ML	24.4	31.9			
223+1000	3.0								34.7	31.9			
223+1000	4.0								33.0	31.9			
223+1000	5.0								35.7	31.9			
223+2000	2.0	45	29	16	9.5	50	A-7-6 (5)	SM	32.7	29.4			
223+2000	3.0								23.8	29.4			
223+2000	4.0								22.8	29.4			
223+2000	5.0								38.2	29.4			
223+3000	2.0	48	28	20	25	49	A-7-6 (7)	SM	26.4	24.4			
223+3000	3.0								30.4	24.4			
223+3000	4.0								15.3	24.4			
223+3000	5.0								25.3	24.4			
223+4000	2.0	46	28	18	25	56	A-7-6 (8)	ML	25.3	28.0			
223+4000	3.0								23.9	28.0			
223+4000	4.0								30.5	28.0			
223+4000	5.0								32.2	28.0			
224+0000	2.0	49	28	21	9.5	64	A-7-6 (12)	ML	24.6	31.2			
224+0000	3.0								41.2	31.2			
224+0000	4.0								29.9	31.2			
224+0000	5.0								29.1	31.2			
224+1200	2.0	43	29	14	25	53	A-7-6 (5)	ML	27.6	29.4			
224+1200	3.0								29.8	29.4			

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SUMMARY OF LABORATORY RESULTS

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

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210

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
224+1200	4.0								32.5	29.4			
224+1200	5.0								27.8	29.4			
224+2300	2.0	44	24	20	25	77	A-7-6 (15)	CL	20.9	26.2			
224+2300	3.0								26.8	26.2			
224+2300	4.0								30.4	26.2			
224+2300	5.0								26.8	26.2			
224+3220	2.0	41	28	13	25	65	A-7-6 (8)	ML	27.2	27.6			
224+3220	3.0								27.8	27.6			
224+3220	4.0								29.2	27.6			
224+3220	5.0								26.2	27.6			
224+4000	2.0	39	25	14	25	46	A-6 (3)	SC	23.0	24.5			
224+4000	3.0								27.7	24.5			
224+4000	4.0								19.1	24.5			
224+4000	5.0								28.3	24.5			
225+0000	2.0	43	27	16	9.5	46	A-7-6 (4)	SM	26.3	28.6			
225+0000	3.0								24.7	28.6			
225+0000	4.0								28.5	28.6			
225+0000	5.0								35.0	28.6			
225+1000	2.0	48	31	17	25	49	A-7-5 (6)	SM	25.5	29.7			
225+1000	3.0								30.6	29.7			
225+1000	4.0								24.6	29.7			
225+1000	5.0								38.1	29.7			
225+2000	2.0	53	32	21	9.5	61	A-7-5 (12)	MH	26.0	30.0			
225+2000	3.0								28.9	30.0			
225+2000	4.0								30.7	30.0			
225+2000	5.0								34.4	30.0			
225+2950	2.0	46	28	18	9.5	48	A-7-6 (6)	SM	23.5	23.1			
225+2950	3.0								14.1	23.1			
225+2950	4.0								27.4	23.1			
225+2950	5.0								27.5	23.1			
225+4000	2.0	33	22	11	9.5	38	A-6 (1)	SC	28.3	27.4			
225+4000	3.0								33.6	27.4			
225+4000	4.0								27.7	27.4			
225+4000	5.0								20.0	27.4			
226+0000	2.0	31	20	11	25	34	A-2-6 (0)	SC	17.9	18.7			
226+0000	3.0								15.2	18.7			
226+0000	4.0								19.3	18.7			
226+0000	5.0								22.6	18.7			
226+0940	2.0	39	22	17	25	41	A-6 (3)	SC	16.9	18.9			
226+0940	3.0								19.7	18.9			
226+0940	4.0								16.8	18.9			
226+0940	5.0								22.2	18.9			
226+2000	2.0	36	22	14	9.5	41	A-6 (2)	SC	20.1	21.7			

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SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210

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
226+2000	3.0								20.6	21.7			
226+2000	4.0								19.5	21.7			
226+2000	5.0								26.6	21.7			
226+3000	2.0	38	24	14	25	46	A-6 (3)	SC	12.6	23.6			
226+3000	3.0								28.3	23.6			
226+3000	4.0								27.5	23.6			
226+3000	5.0								26.1	23.6			
226+4000	2.0	40	27	13	25	44	A-6 (3)	SM	18.6	24.6			
226+4000	3.0								19.3	24.6			
226+4000	4.0								26.7	24.6			
226+4000	5.0								34.0	24.6			
227+0000	2.0	28	18	10	25	33	A-2-4 (0)	SC	16.7	16.0			
227+0000	3.0								15.4	16.0			
227+0000	4.0								17.2	16.0			
227+0000	5.0								14.7	16.0			
227+1000	2.0	25	18	7	25	67	A-4 (2)	CL-ML	14.8	13.7			
227+1000	3.0								11.9	13.7			
227+1000	4.0								13.3	13.7			
227+1000	5.0								14.8	13.7			
227+2000	2.0	NP	NP	NP	25	29	A-2-4 (0)	SM	13.5	13.2			
227+2000	3.0								11.2	13.2			
227+2000	4.0								14.9	13.2			
227+2000	5.0								13.1	13.2			
227+3127	2.0	NP	NP	NP	25	41	A-4 (0)	SM	10.9	10.2			
227+3127	3.0								7.7	10.2			
227+3127	4.0								11.8	10.2			
227+3127	5.0								10.5	10.2			
227+4000	2.0	21	19	2	9.5	35	A-2-4 (0)	SM	16.6	17.4			
227+4000	3.0								16.0	17.4			
227+4000	4.0								20.0	17.4			
227+4000	5.0								16.8	17.4			
228+0000	2.0	30	20	10	25	74	A-4 (6)	CL	13.5	16.5			
228+0000	3.0								19.4	16.5			
228+0000	4.0								17.2	16.5			
228+0000	5.0								16.0	16.5			
228+1000	2.0	46	30	16	25	55	A-7-5 (7)	ML	21.8	31.8			
228+1000	3.0								31.6	31.8			
228+1000	4.0								44.8	31.8			
228+1000	5.0								29.1	31.8			
228+2000	2.0	43	24	19	25	55	A-7-6 (8)	CL	19.6	22.3			
228+2000	3.0								26.5	22.3			
228+2000	4.0								17.1	22.3			
228+2000	5.0								38.7	22.3			

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

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210

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
228+2000	6.0								25.8	22.3			
228+2000	7.0								12.1	22.3			
228+2000	8.0								21.5	22.3			
228+2000	9.0								19.8	22.3			
228+2000	10.0								19.3	22.3			
228+3000	2.0	47	31	16	50	13	A-2-7 (0)	GM	18.3	13.0			
228+3000	3.0								9.5	13.0			
228+3000	4.0								14.1	13.0			
228+3000	5.0								12.3	13.0			
228+3000	6.0								17.1	13.0			
228+3000	7.0								16.9	13.0			
228+3000	8.0								8.2	13.0			
228+3000	9.0								11.2	13.0			
228+3000	10.0								9.1	13.0			
228+3640	2.0	51	28	23	25	51	A-7-6 (9)	CH	18.0	24.0			
228+3640	3.0								27.0	24.0			
228+3640	4.0								20.1	24.0			
228+3640	5.0								19.6	24.0			
228+3640	6.0								21.3	24.0			
228+3640	7.0								26.8	24.0			
228+3640	8.0								28.4	24.0			
228+3640	9.0								28.1	24.0			
228+3640	10.0								26.3	24.0			
229+0023	2.3	49	28	21	25	53	A-7-6 (9)	ML	23.0	22.7			
229+0023	3.0								24.6	22.7			
229+0023	4.0								27.9	22.7			
229+0023	5.0								24.5	22.7			
229+0023	6.0								21.1	22.7			
229+0023	7.0								19.6	22.7			
229+0023	8.0								20.6	22.7			
229+0023	9.0								21.8	22.7			
229+0023	10.0								21.7	22.7			
229+1000	2.0	65	31	34	25	77	A-7-5 (29)	CH	11.0	28.1			
229+1000	3.0								11.9	28.1			
229+1000	4.0								28.8	28.1			
229+1000	5.0								31.5	28.1			
229+1000	6.0								31.0	28.1			
229+1000	7.0								39.7	28.1			
229+1000	8.0								37.7	28.1			
229+1000	9.0								32.1	28.1			
229+1000	10.0								28.9	28.1			
229+2000	2.0	43	27	16	25	25	A-2-7 (1)	SM	12.6	13.2			
229+2000	3.0								10.7	13.2			

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

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210

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
229+2000	4.0								13.5	13.2			
229+2000	5.0								16.0	13.2			
229+3000	2.0	45	30	15	50	23	A-2-7 (0)	SM	14.8	14.1			
229+3000	3.0								13.8	14.1			
229+3000	4.0								14.0	14.1			
229+3000	5.0								13.8	14.1			
229+4000	2.0	70	32	38	25	80	A-7-5 (34)	CH	15.7	32.7			
229+4000	3.0								38.5	32.7			
229+4000	4.0								40.8	32.7			
229+4000	5.0								35.7	32.7			
230+0000	2.0	59	29	30	25	75	A-7-6 (24)	CH	19.5	32.7			
230+0000	3.0								37.7	32.7			
230+0000	4.0								35.5	32.7			
230+0000	5.0								38.1	32.7			
230+2000	2.0	30	19	11	25	32	A-2-6 (0)	SC	13.5	13.8			
230+2000	3.0								11.0	13.8			
230+2000	4.0								13.4	13.8			
230+2000	5.0								17.3	13.8			
230+3056	2.1	67	30	37	25	87	A-7-5 (37)	CH	10.4	32.7			
230+3056	3.0								34.3	32.7			
230+3056	4.0								39.8	32.7			
230+3056	5.0								46.3	32.7			
230+5120	2.0	41	24	17	25	36	A-7-6 (2)	SC	23.2	20.4			
230+5120	3.0								19.2	20.4			
230+5120	4.0								20.0	20.4			
230+5120	5.0								19.1	20.4			
231+1000	2.0	NP	NP	NP	9.5	40	A-4 (0)	SM	6.8	6.8			
231+1000	3.0								6.4	6.8			
231+1000	4.0								7.1	6.8			
231+1000	5.0								7.1	6.8			
231+1928	2.0	NP	NP	NP	9.5	39	A-4 (0)	SM	11.0	7.8			
231+1928	3.0								4.3	7.8			
231+1928	4.0								8.7	7.8			
231+1928	5.0								7.3	7.8			
231+3000	2.0	NP	NP	NP	25	38	A-4 (0)	SM	15.6	19.1			
231+3000	3.0								12.1	19.1			
231+3000	4.0								22.0	19.1			
231+3000	5.0								26.7	19.1			
231+4000	2.0	33	21	12	25	38	A-6 (1)	SC	13.7	14.5			
231+4000	3.0								17.1	14.5			
231+4000	4.0								13.1	14.5			
231+4000	5.0								14.2	14.5			
232+0000	2.0	NP	NP	NP	9.5	40	A-4 (0)	SM	8.9	10.0			

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

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210

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
232+0000	3.0								12.6	10.0			
232+0000	4.0								8.8	10.0			
232+0000	5.0								9.4	10.0			
232+1000	2.0	NP	NP	NP	9.5	38	A-4 (0)	SM	13.5	9.6			
232+1000	3.0								8.7	9.6			
232+1000	4.0								7.9	9.6			
232+1000	5.0								8.2	9.6			
232+2000	2.0	NP	NP	NP	25	42	A-4 (0)	SM	11.8	9.8			
232+2000	3.0								10.2	9.8			
232+2000	4.0								7.4	9.8			
232+2000	5.0								9.8	9.8			
232+3000	2.0	NP	NP	NP	25	44	A-4 (0)	SM	14.7	12.7			
232+3000	3.0								9.9	12.7			
232+3000	4.0								12.8	12.7			
232+3000	5.0								13.5	12.7			
232+4100	2.0	NP	NP	NP	25	37	A-4 (0)	SM	12.7	11.6			
232+4100	3.0								11.7	11.6			
232+4100	4.0								11.1	11.6			
232+4100	5.0								11.2	11.6			
233+0000	2.0	NP	NP	NP	25	44	A-4 (0)	SM	11.6	12.5			
233+0000	3.0								12.1	12.5			
233+0000	4.0								12.3	12.5			
233+0000	5.0								14.0	12.5			
233+1000	2.0	NP	NP	NP	25	47	A-4 (0)	SM	11.9	9.6			
233+1000	3.0								10.7	9.6			
233+1000	4.0								9.7	9.6			
233+1000	5.0								6.1	9.6			
233+2000	2.0	NP	NP	NP	25	47	A-4 (0)	SM	12.2	11.4			
233+2000	3.0								11.6	11.4			
233+2000	4.0								10.4	11.4			
233+2000	5.0								11.6	11.4			
233+3050	2.0	NP	NP	NP	25	29	A-2-4 (0)	SM	10.6	8.6			
233+3050	3.0								7.0	8.6			
233+3050	4.0								7.9	8.6			
233+3050	5.0								9.0	8.6			
233+4000	2.0	NP	NP	NP	25	32	A-2-4 (0)	SM	12.9	11.4			
233+4000	3.0								7.1	11.4			
233+4000	4.0								11.1	11.4			
233+4000	5.0								14.5	11.4			
234+0000	2.0	NP	NP	NP	25	29	A-2-4 (0)	SM	10.3	9.4			
234+0000	3.0								9.5	9.4			
234+0000	4.0								8.3	9.4			
234+0000	5.0								9.3	9.4			

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300 AIRPORT ROAD
BISMARCK, ND 58504

SUMMARY OF LABORATORY RESULTS

PROJECT NUMBER SS-6-032(069)219 **LOCATION** Pembina County

PCN 23210

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
234+1000	2.0	NP	NP	NP	25	31	A-2-4 (0)	SM	9.7	9.8			
234+1000	3.0								11.7	9.8			
234+1000	4.0								9.2	9.8			
234+1000	5.0								8.8	9.8			
234+2000	2.0	NP	NP	NP	25	43	A-4 (0)	SM	12.9	11.1			
234+2000	3.0								10.3	11.1			
234+2000	4.0								10.8	11.1			
234+2000	5.0								10.5	11.1			
234+3000	2.0	NP	NP	NP	25	46	A-4 (0)	SM	12.6	13.0			
234+3000	3.0								14.9	13.0			
234+3000	4.0								12.7	13.0			
234+3000	5.0								11.9	13.0			
234+4000	2.0	NP	NP	NP	9.5	45	A-4 (0)	SM	14.4	11.8			
234+4000	3.0								11.3	11.8			
234+4000	4.0								11.2	11.8			
234+4000	5.0								10.2	11.8			
235+0000	2.0	NP	NP	NP	25	44	A-4 (0)	SM	16.7	14.5			
235+0000	3.0								16.0	14.5			
235+0000	4.0								13.2	14.5			
235+0000	5.0								12.3	14.5			
235+1000	2.0	NP	NP	NP	9.5	41	A-4 (0)	SM	14.3	11.3			
235+1000	3.0								12.8	11.3			
235+1000	4.0								9.3	11.3			
235+1000	5.0								8.9	11.3			
235+2000	2.0	NP	NP	NP	9.5	42	A-4 (0)	SM	12.6	12.7			
235+2000	3.0								12.1	12.7			
235+2000	4.0								11.9	12.7			
235+2000	5.0								14.0	12.7			
235+3050	2.0	NP	NP	NP	4.75	42	A-4 (0)	SM	10.8	10.2			
235+3050	3.0								9.7	10.2			
235+3050	4.0								11.3	10.2			
235+3050	5.0								9.2	10.2			
235+4000	2.0	NP	NP	NP	25	39	A-4 (0)	SM	11.1	10.0			
235+4000	3.0								8.8	10.0			
235+4000	4.0								9.5	10.0			
235+4000	5.0								10.7	10.0			
236+0000	2.0	NP	NP	NP	9.5	51	A-4 (0)	ML	12.3	13.1			
236+0000	3.0								14.0	13.1			
236+0000	4.0								14.5	13.1			
236+0000	5.0								11.5	13.1			
236+1000	2.0	NP	NP	NP	9.5	44	A-4 (0)	SM	9.8	11.9			
236+1000	3.0								11.3	11.9			
236+1000	4.0								14.1	11.9			

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PCN 23210

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
236+1000	5.0								12.5	11.9			
236+1900	2.0	32	29	3	9.5	63	A-4 (1)	ML	27.7	22.1			
236+1900	3.0								22.4	22.1			
236+1900	4.0								15.7	22.1			
236+1900	5.0								22.7	22.1			

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