

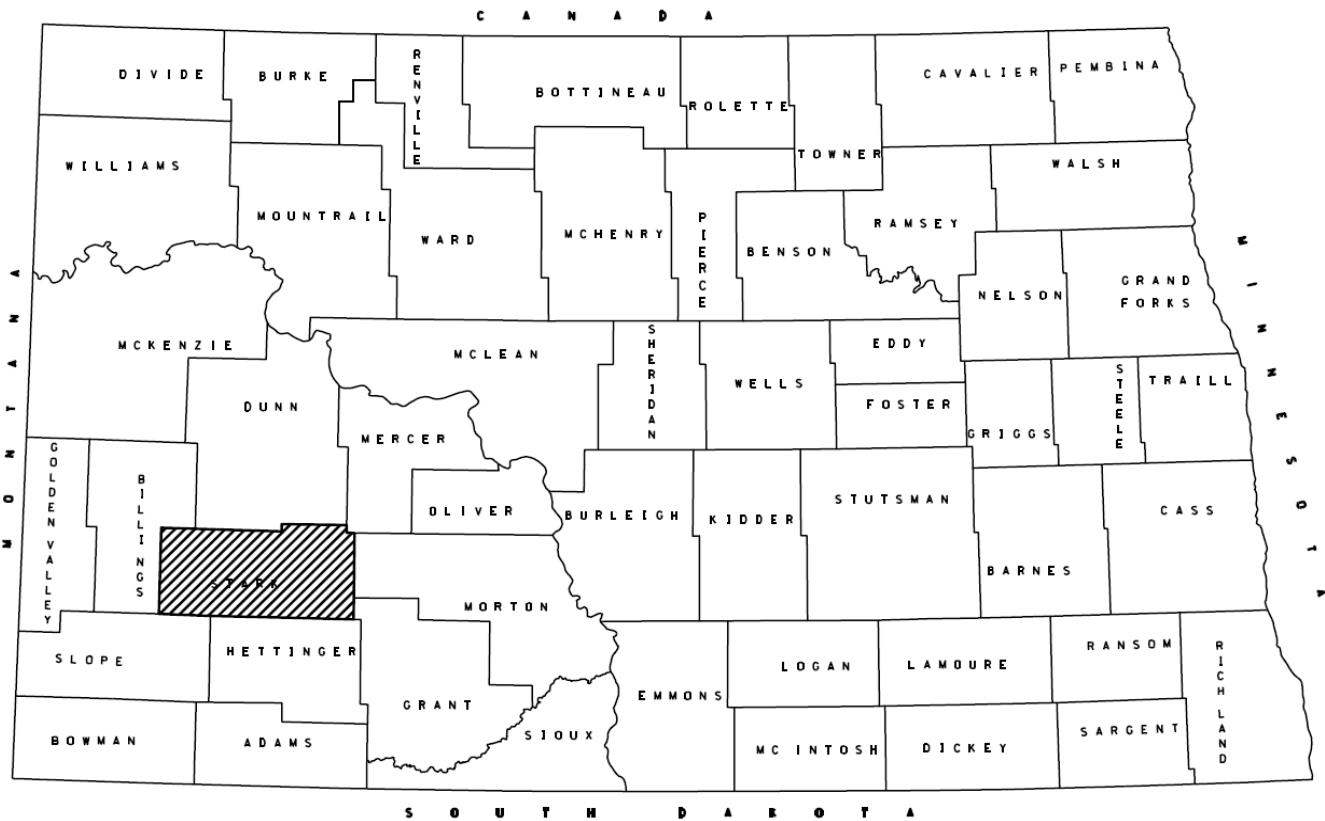
# **LINEAR SOILS SURVEY AND RECOMMENDATIONS**

**PROJECT NO. IM-5-094(147)063**

**PCN: 22839**

**COUNTY: STARK**

**I-94, Exit 64 interchange**



**PREPARED BY: Naveed Haider**

**NORTH DAKOTA DEPARTMENT OF TRANSPORTATION  
MATERIALS AND RESEARCH DIVISION**

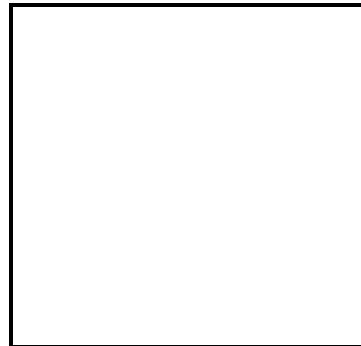
**August 2020**

**IM-5-094(147)063**

Location: Exit 64 interchange (I-94)

## **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 Matthew C. Kurle, Registration number PE-8777 on 08/19/2020 and the original document is stored at the North Dakota Department of Transportation.



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Matthew C. Kurle, P.E.

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Date



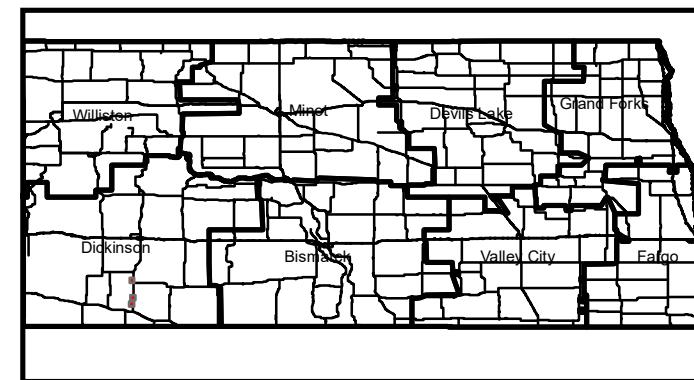
## Soil Investigation

Project: IM-5-094(147)063

PCN: 21839

Scope: Major Rehabilitation/Structural

Location: Exit 64 interchange ( I-94)



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Appendix B – Maintenance Review and Subsurface Investigation Scope
Appendix C – Boring Locations
Appendix D – Summary of Soils Analysis
Appendix E – Lab Results

## **Introduction**

PCN No: 22839  
Highway: 094.063  
Location: Exit 64 interchange ( I-94)  
Reference Points: RP 63.8000 to 64.6571  
Project Length: 0.8504 Miles  
Proposed Project Scope: Major Rehabilitation/Structural  
Investigation Scope: Identified Maintenance Areas

## **Summary of Soil Investigation**

Materials and Research Person Conducted Drilling/Logging: Jamie Naumann / Dallan Feist  
The soil investigation was completed on 5/21/2020.

The investigation consisted of 5 borings.

Table 1 – Boring Locations Summary

Boring Log No.	Boring Location	Boring Depth
1 & 2	East Bound Exit 64 to I-94. (See Appendix C)	45 feet
3	East Bound Exit 64 to I-94- LSS Boring ( See Appendix C)	10 feet
4 & 5	On 36th Street SW- West of I-94- LSS Boring ( See Appendix C)	10 feet

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

## **Summary of Soil Analysis**

### **Boring log 1 ( Deep):**

Boring no. 1 was completed to a depth of 45 feet along the proposed ramp realignment as shown in the boring location map in Appendix C.

Majority of soils in this boring ranged from lean to fatty clay. The in-place average moisture content of the soil was ranged from 18% to 26%. Coal was found at a depth of 15-18 feet

### **Boring log 2 ( Deep):**

Boring no. 2 was completed to a depth of 45 feet along the proposed ramp realignment as shown in the boring location map in Appendix C.

Majority soils in this boring ranged from lean to fatty clay. The in-place average moisture content of the soil was ranged from 23% to 30%. Coal was found at a depth of 6-11 feet and 6-11 and 16-21 feet.

**Boring Log No. 3 ( LSS):**

Boring no. 3 was completed to a depth of 10 feet along the proposed ramp realignment as shown in the boring location map in Appendix C.

Majority of soils in this boring were silty sand and sandy clay. However, there was a pocket of lean clay at the depth of 2 feet. The in-place average moisture content of the soil was ranged from 21% to 24% .

**Boring Log No. 4 ( LSS):**

Boring no. 4 was completed to a depth of 10 feet on west end of bridge abutment on 36<sup>th</sup> street SW , as shown in the boring location map in Appendix C.

Majority of soils in this boring were silty sand and sandy clay. The in-place average moisture content of the soil was ranged from 21% to 24%.

**Boring Log No. 5 ( LSS):**

Boring no 5 has been carried out west of bridge abutment on 36<sup>th</sup> street SW to a depth of 10 ft as shown in the boring location map in Appendix C.

Majority of soils in this boring were lean clay and clayey sand. In-place average moisture content of the soil was ranged from 19% to 30%.

The soils from a depth of 2-6 feet were found to have high silt percentages.

### Soil Sample Distribution

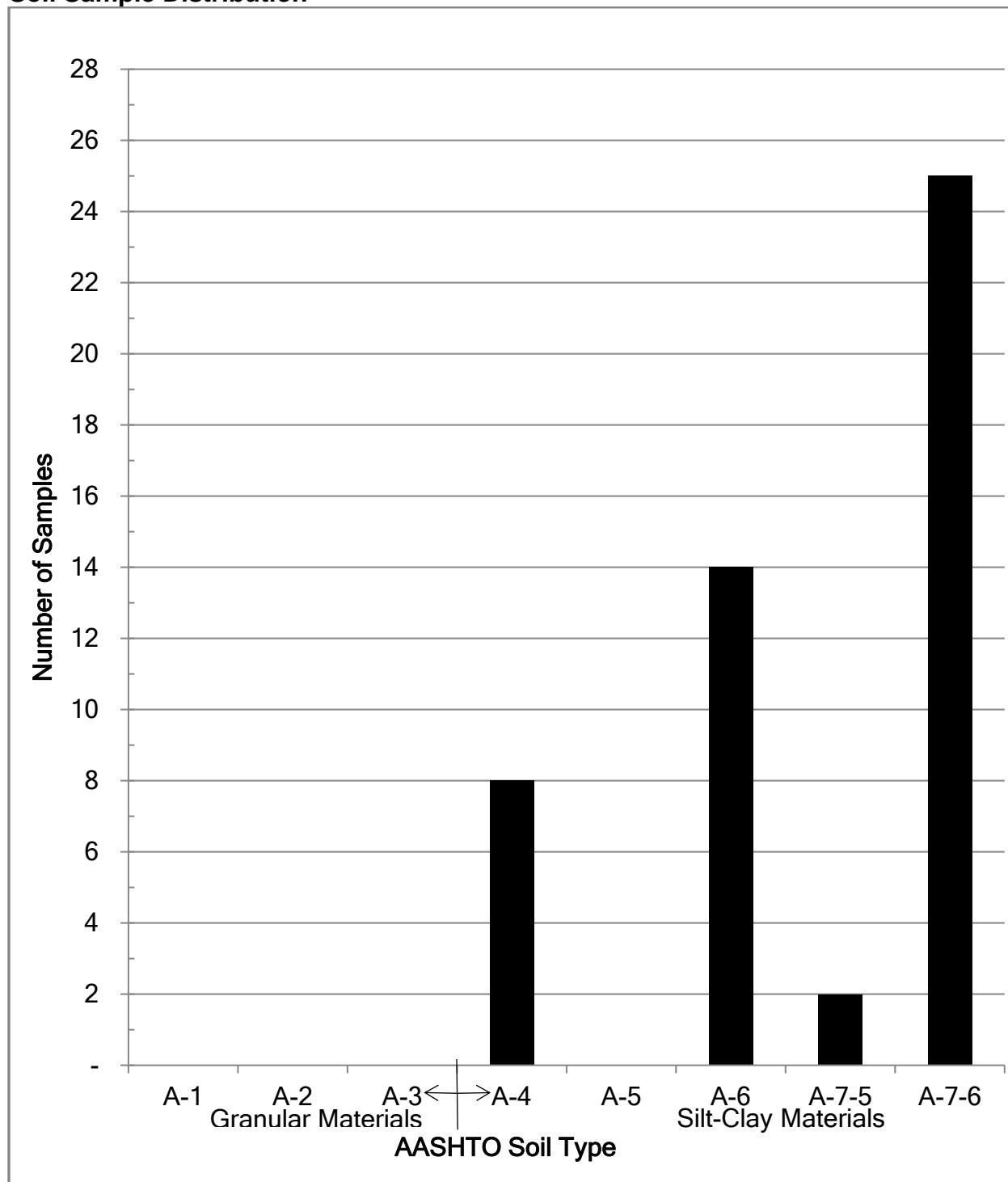


Figure 1 - Soil Sample Distribution

## **Design Recommendations**

### **36<sup>th</sup> Street SW ( East & West of Approach Slab)**

Due to the existing pavement distress, high silt contents in the existing soils and to accommodate pavement design recommendation, it is recommended to subcut 23.5" inches and 50' long East and West of the approach slabs of the bridge on 36<sup>th</sup> St SW at Exit 64 (I-94).

#### **Design Information:**

Compaction Method: T-180

Subgrade Prep: None

Subcut Recommendations:

Table 2 – Subcut Recommendations

<b>Location: RP + Feet</b>	<b>Length(Feet)</b>	<b>Depth(Inches)</b>
East of approach slabs (exit 64)	50 feet	23.5"
West of approach slabs (exit 64)	50 feet	23.5"

Calculate the subcut quantity based on the lengths and depths as shown in Table 2 above and adhere to the guidelines stated below.

**Remarks:** The depth of recommended subcut is from the top of proposed pavement. Place Geosynthetic Geogrid (Type G) at the bottom of all subcut excavations and backfill with Class 5 aggregate. Place 10" of aggregate on the geogrid prior to compacting. 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)			
	A-1		A-3	A-2				A-4	A-5	A-6	A-7
Group Classification	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. 4 sieve More than 50% of retained on No. 200 sieve	Gravels	Clean Gravels	GW
	More than 50% of coarse fraction retained on No. 4 sieve	Less than 5% fines <sup>a</sup>	GP
	Sands	Gravels with Fines	GM
	50% or more of coarse fraction passes No. 4 sieve	More than 12% fines <sup>a,d</sup>	GC
	Silts and clays Liquid limit less than 50	Clean Sands	SW
		Less than 5% fines <sup>b</sup>	SP
		Sands with Fines	SM
		More than 12% fines <sup>b,d</sup>	SC
Fine-grained soils 50% or more passes No. 200 sieve	Inorganic	$PI > 7$ and plots on or above "A" line (Figure 5.3) $PI < 4$ or plots below "A" line (Figure 5.3) <sup>c</sup>	CL
	Organic	Liquid limit — oven dried Liquid limit — not dried $< 0.75$ ; see Figure 5.3; OL zone	ML
	Inorganic	$PI$ plots on or above "A" line (Figure 5.3) $PI$ plots below "A" line (Figure 5.3)	CH
	Organic	Liquid limit — oven dried $< 0.75$ ; see Figure 5.3; OH zone	MH
		Liquid limit — not dried	OH
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor		Pt

<sup>a</sup>Gravels with 5 to 12% fine require dual symbols: GW-GM, GW-GC, GP-GM, GP-GC.

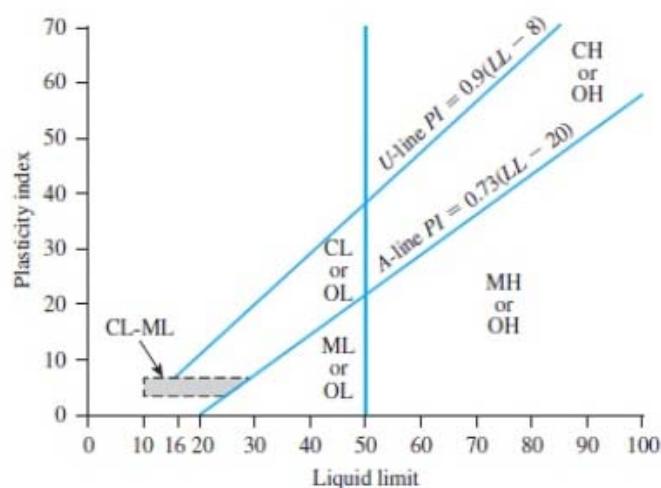
<sup>b</sup>Sands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.

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

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

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

## Plasticity Chart :



## **APPENDIX B**

## **SOIL INVESTIGATION SCOPE**

## LINEAR SOILS SURVEY FIELD INVESTIGATION SCOPE

<b>TO:</b>	File
<b>FROM:</b>	Naveed Haider – Materials and Research (Geotechnical)
<b>DATE:</b>	04/29/2020
<b>HIGHWAY:</b>	094.063
<b>PROJECT NUMBER:</b>	IM-5-094(147)063
<b>PCN:</b>	22839
<b>LOCATION:</b>	Exit 64 interchange
<b>IMPROVEMENT SCOPE:</b>	Major Rehabilitation
<b>SUBJECT:</b>	Deep and Linear Subsurface Soils Survey Investigation Scope

No maintenance review was completed for this project. Boring locations were based on the field review. The linear soils survey field investigation scope is based on the improvement strategy for the roadway as per Chapter 7 of the NDDOT Design Manual.

**Improvement Strategy:** Major Rehabilitation

**Investigation Scope:** Identified Areas

The following table shows the proposed subsurface investigation scope.

Boring Location	Justification for Boring	Boring Depth	Location
Exit 64 - I-94 (LSS boring no 1) See attachment	Major Rehabilitation	10 feet	Conduct 1 boring as shown on the attached map. Total 1 boring. Obtain 2 SPT sample every 5 feet.
Exit 64 - I-94 (LSS boring no 2 &3) See attachment	Major Rehabilitation	10 feet	Conduct 2 borings as shown on the attached map. A total number of 2 borings. Obtain 2 SPT sample every 5 feet.
Exit 64 - I-94. (Deep boring no 1 &2) See attachment	Major Rehabilitation	45 feet	Conduct 2 deep boring as shown on the attached map. Obtain 1 SPT and 1 Shelby tube sample every 5 feet.

The following are the associated tasks and dates for the completion of the Linear Soils Survey and Recommendations for this project.

Task	Completion ( <i>Anticipated</i> ) Date
Maintenance Review with District Maintenance Forces	N/A
Linear Soils Survey Field Work Complete	06/01/2020
Linear Soils Survey Lab Work	07/01/2020
Linear Soils Survey Report	06/1/2020*

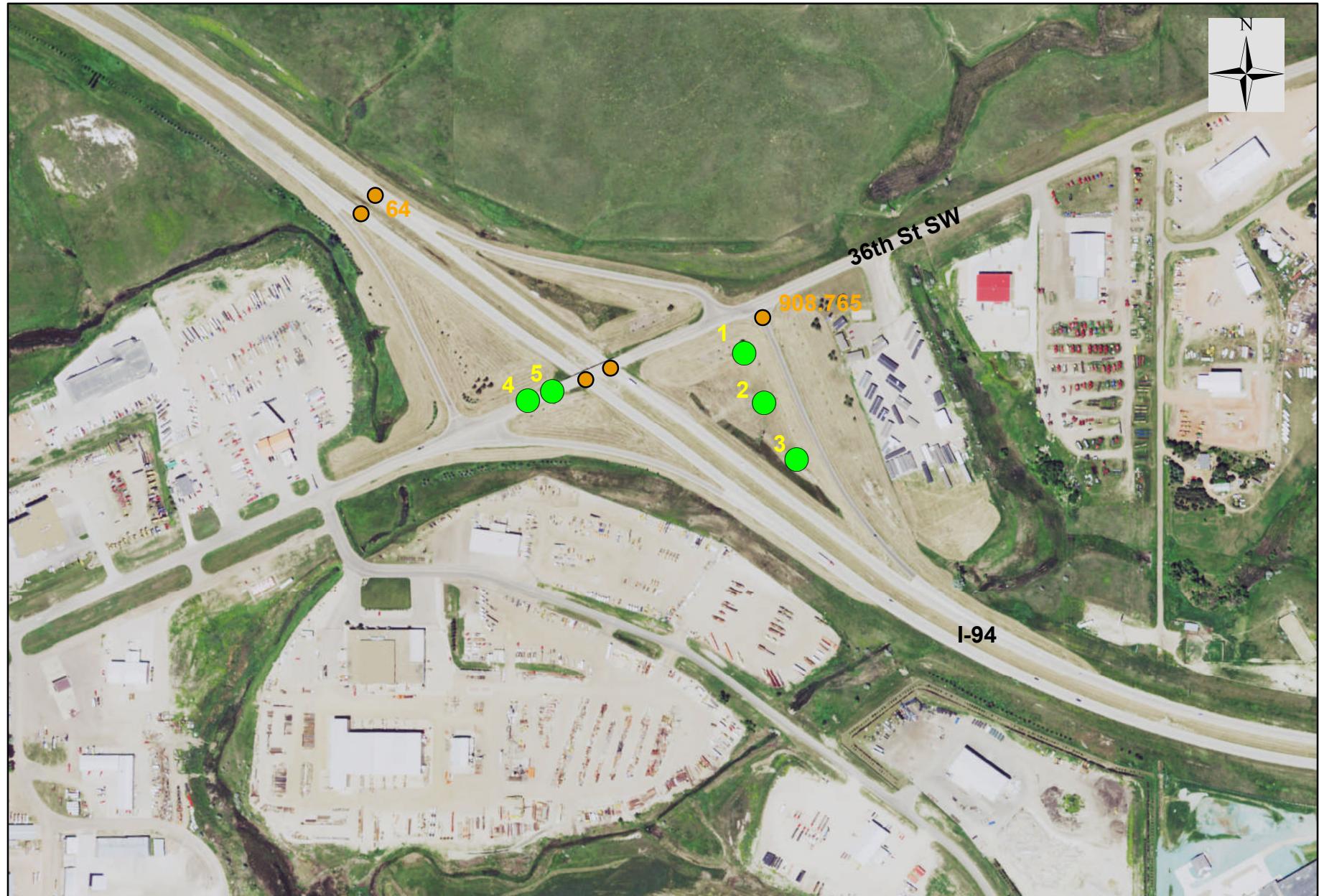
\*Milestone Task

	STATE	PROJECT NO.	SECTION NO.	SHEET NO.
ND	IM-5-094(147)063	sec	page	



## **APPENDIX C**

## **BORING LOCATIONS**



## Legend

- Reference Point
- Boring Locations

0 1,000 2,000  
Feet

Project Number: IM-5-094(147)063

## **APPENDIX D**

## **SUMMARY OF SOILS ANALYSIS**



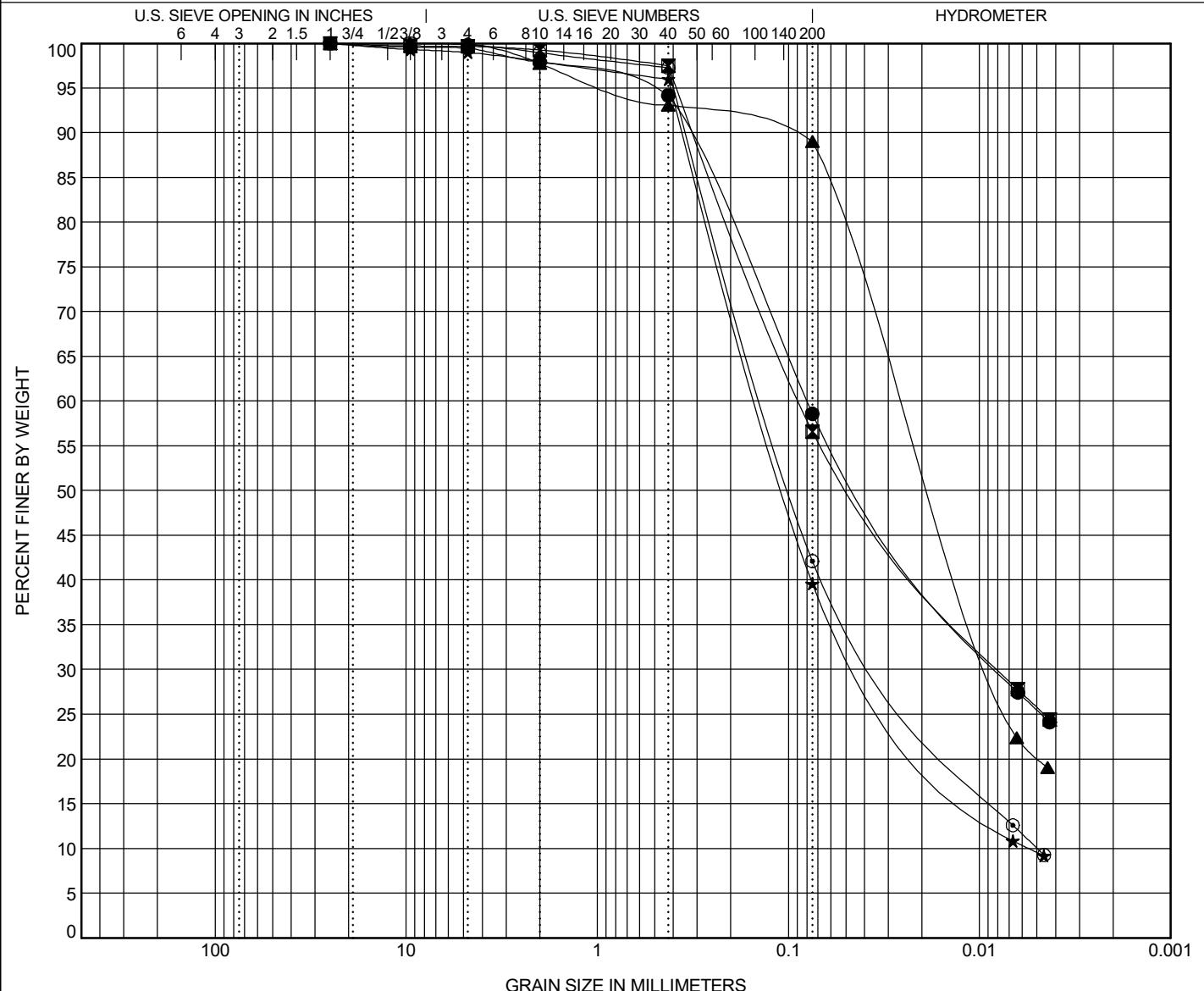
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION  
300 AIRPORT ROAD  
BISMARCK, ND 58504

## GRAIN SIZE DISTRIBUTION

PROJECT NUMBER IM-5-094(147)063 B1,2,3

LOCATION Stark County

PCN 22839



COBBLES	GRAVEL		SAND			SILT OR CLAY				
	coarse	fine	coarse	medium	fine					

GRAIN SIZE - 20171219.GDT - 7/15/20 16:21 - F:\LAB\PROJECTS\GINT5-094(147)063.GPJ

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
		coarse	fine		coarse	medium	fine				
● SB - 1	0.0	A-6 (7)			CL		35	19	16		
☒ SB - 1	2.0	A-6 (6)			CL		35	20	15		
▲ SB - 1	4.0	A-7-6 (17)			CL		41	23	18		
★ SB - 1	6.0	A-4 (0)			SM		NP	NP	NP	1.44	25.32
○ SB - 1	9.0	A-4 (0)			SM		NP	NP	NP	1.18	26.29
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● SB - 1	0.0	25	0.08	0.008		0.5	40.9		58.6		
☒ SB - 1	2.0	25	0.087	0.008		0.3	43.1		56.5		
▲ SB - 1	4.0	9.5	0.026	0.008		0.1	10.9		89.0		
★ SB - 1	6.0	25	0.141	0.034	0.006	1.0	59.4		39.6		
○ SB - 1	9.0	9.5	0.132	0.028	0.005	0.2	57.7		42.1		



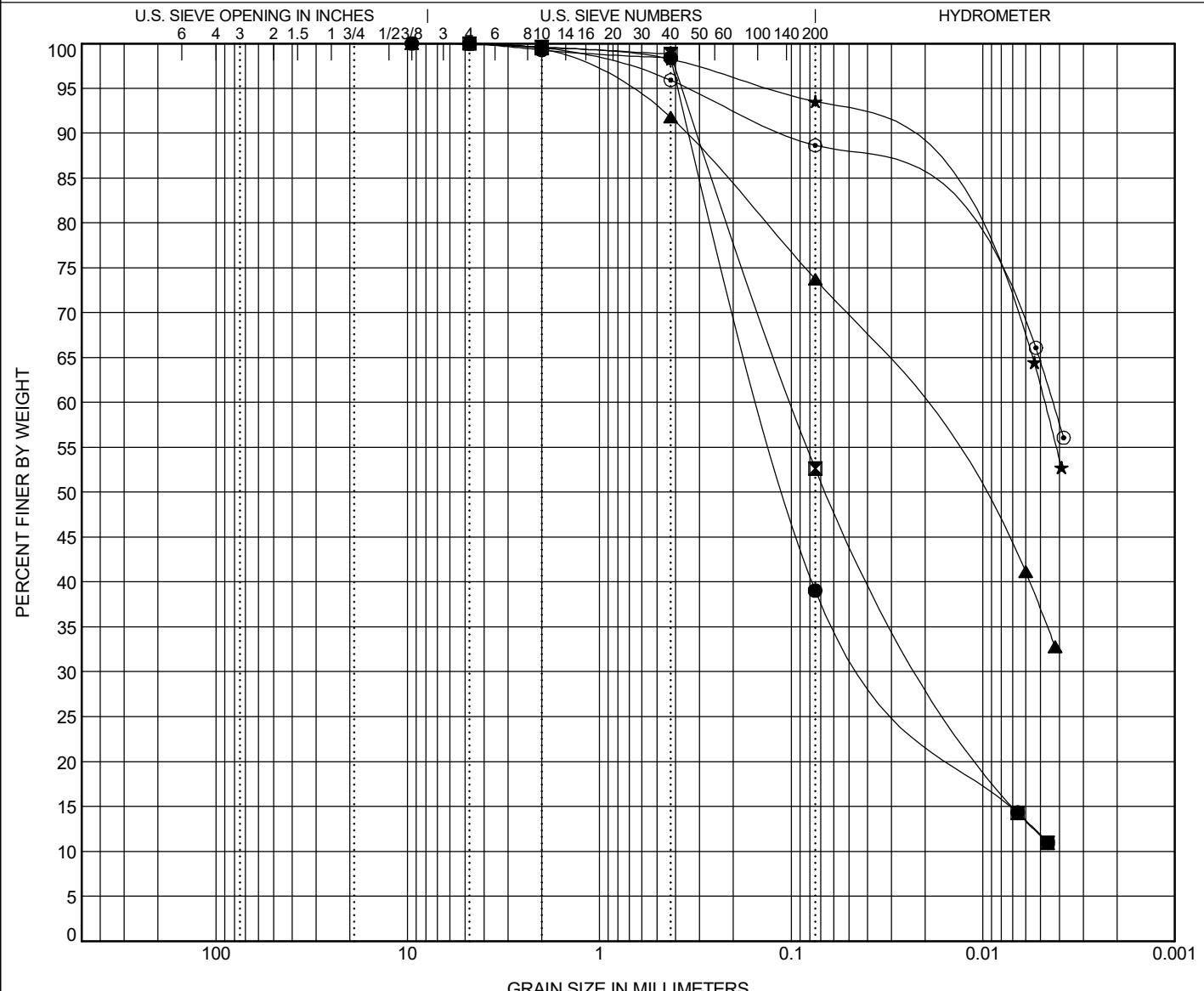
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LOCATION Stark County

PCN 22839



COBBLES	GRAVEL		SAND			SILT OR CLAY		
	coarse	fine	coarse	medium	fine			
● SB - 1	11.0	A-4 (0)		SM		NP	NP	NP
☒ SB - 1	14.0	A-4 (1)		ML		29	24	5
▲ SB - 1	19.0	A-7-5 (18)		MH		55	32	23
★ SB - 1	21.0	A-7-6 (36)		CH		60	27	33
○ SB - 1	24.0	A-7-6 (33)		CH		61	28	33

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
●	SB - 1	11.0	A-4 (0)			SM		NP	NP	NP	
☒	SB - 1	14.0	A-4 (1)			ML		29	24	5	
▲	SB - 1	19.0	A-7-5 (18)			MH		55	32	23	
★	SB - 1	21.0	A-7-6 (36)			CH		60	27	33	
○	SB - 1	24.0	A-7-6 (33)			CH		61	28	33	
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
●	SB - 1	11.0	9.5	0.138	0.031		0.0	61.0	39.0		
☒	SB - 1	14.0	4.75	0.099	0.018		0.0	47.4	52.6		
▲	SB - 1	19.0	9.5	0.026			0.0	26.3	73.7		
★	SB - 1	21.0	9.5	0.005			0.1	6.4	93.5		
○	SB - 1	24.0	4.75	0.004			0.0	11.4	88.6		



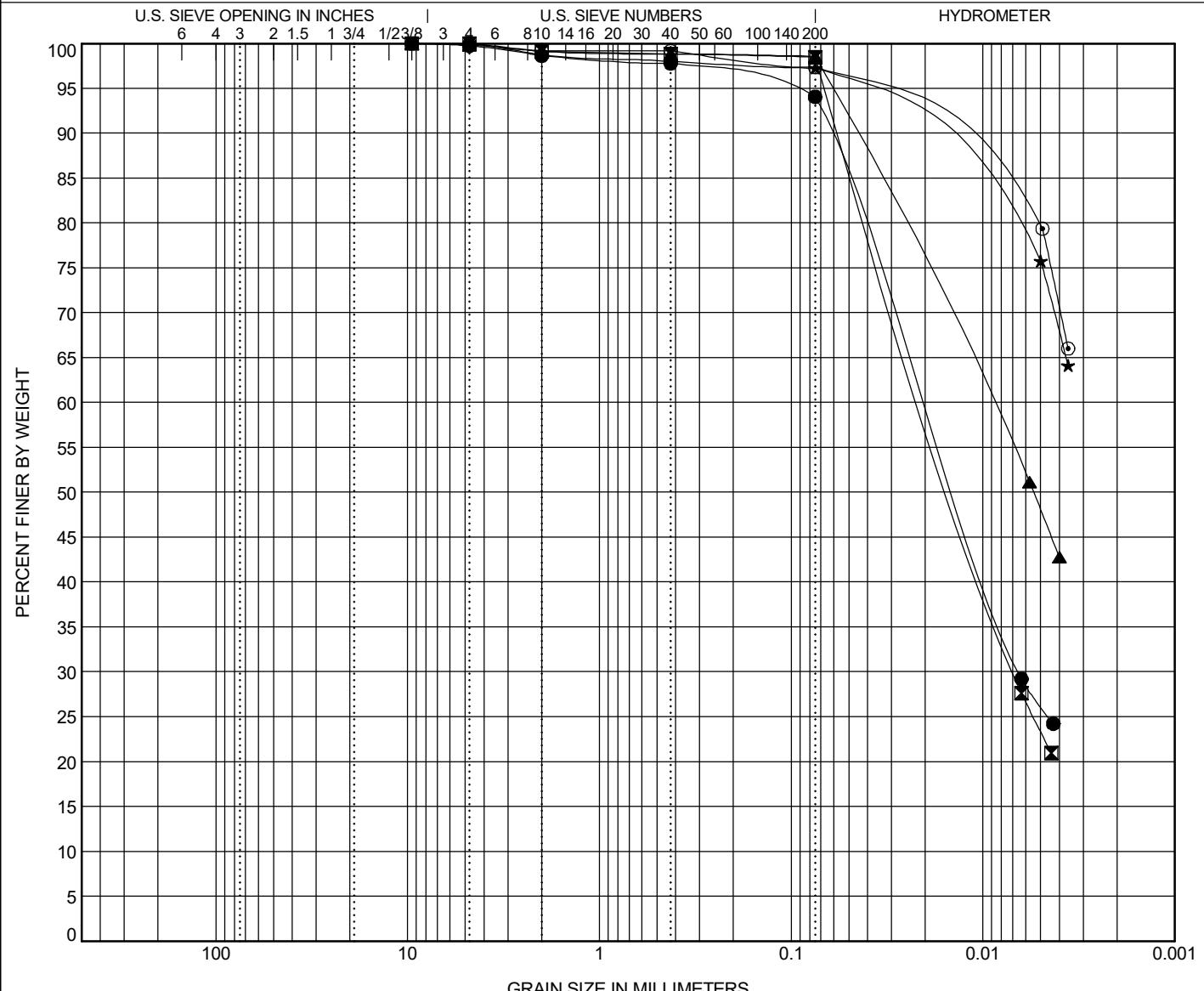
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LOCATION Stark County

PCN 22839



COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● SB - 1	26.0	A-6	(19)		CL		39	19	20		
☒ SB - 1	29.0	A-7-6	(38)		CH		56	21	35		
▲ SB - 1	31.0	A-7-6	(49)		CH		65	21	44		
★ SB - 1	34.0	A-7-6	(58)		CH		75	23	52		
○ SB - 1	36.0	A-7-6	(58)		CH		76	24	52		
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● SB - 1	26.0	9.5	0.02	0.006		0.3	5.7		94.1		
☒ SB - 1	29.0	9.5	0.02	0.007		0.0	1.5		98.5		
▲ SB - 1	31.0	9.5	0.009			0.2	1.3		98.6		
★ SB - 1	34.0	9.5				0.0	2.7		97.3		
○ SB - 1	36.0	4.75				0.0	2.7		97.3		



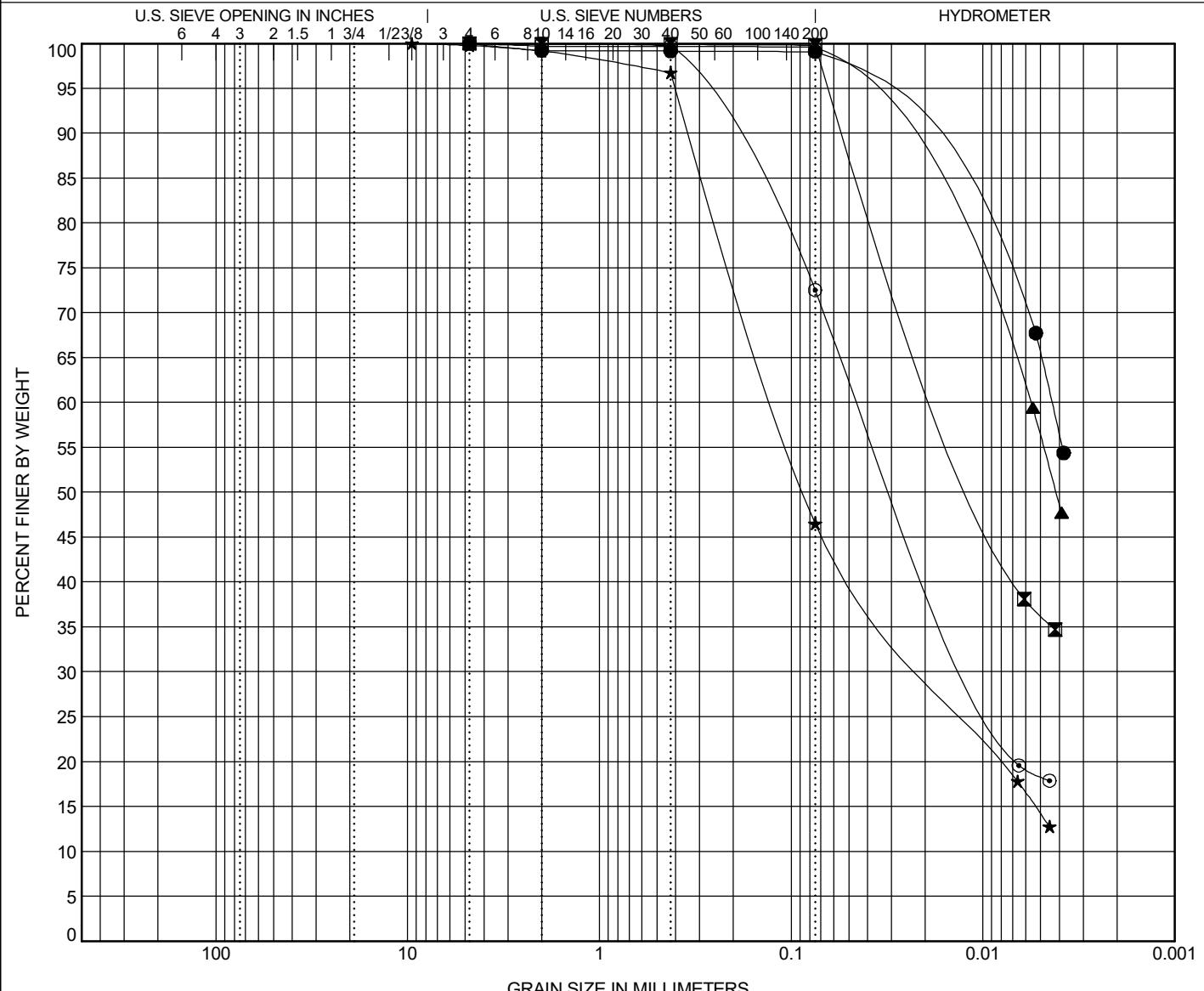
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COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● SB - 1	39.0	A-7-6	(61)		CH		75	21	54		
☒ SB - 1	41.0	A-7-6	(52)		CH		65	19	46		
▲ SB - 1	43.0	A-7-6	(56)		CH		69	20	49		
★ SB - 2	0.0	A-4	(0)		SM		NP	NP	NP		
○ SB - 2	2.0	A-6	(10)		CL		34	18	16		
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● SB - 1	39.0	4.75	0.004			0.0	0.9		99.1		
☒ SB - 1	41.0	4.75	0.015			0.0	0.2		99.8		
▲ SB - 1	43.0	4.75	0.006			0.0	0.4		99.6		
★ SB - 2	0.0	9.5	0.12	0.019		0.2	53.3		46.5		
○ SB - 2	2.0	2	0.042	0.011		0.0	27.5		72.5		



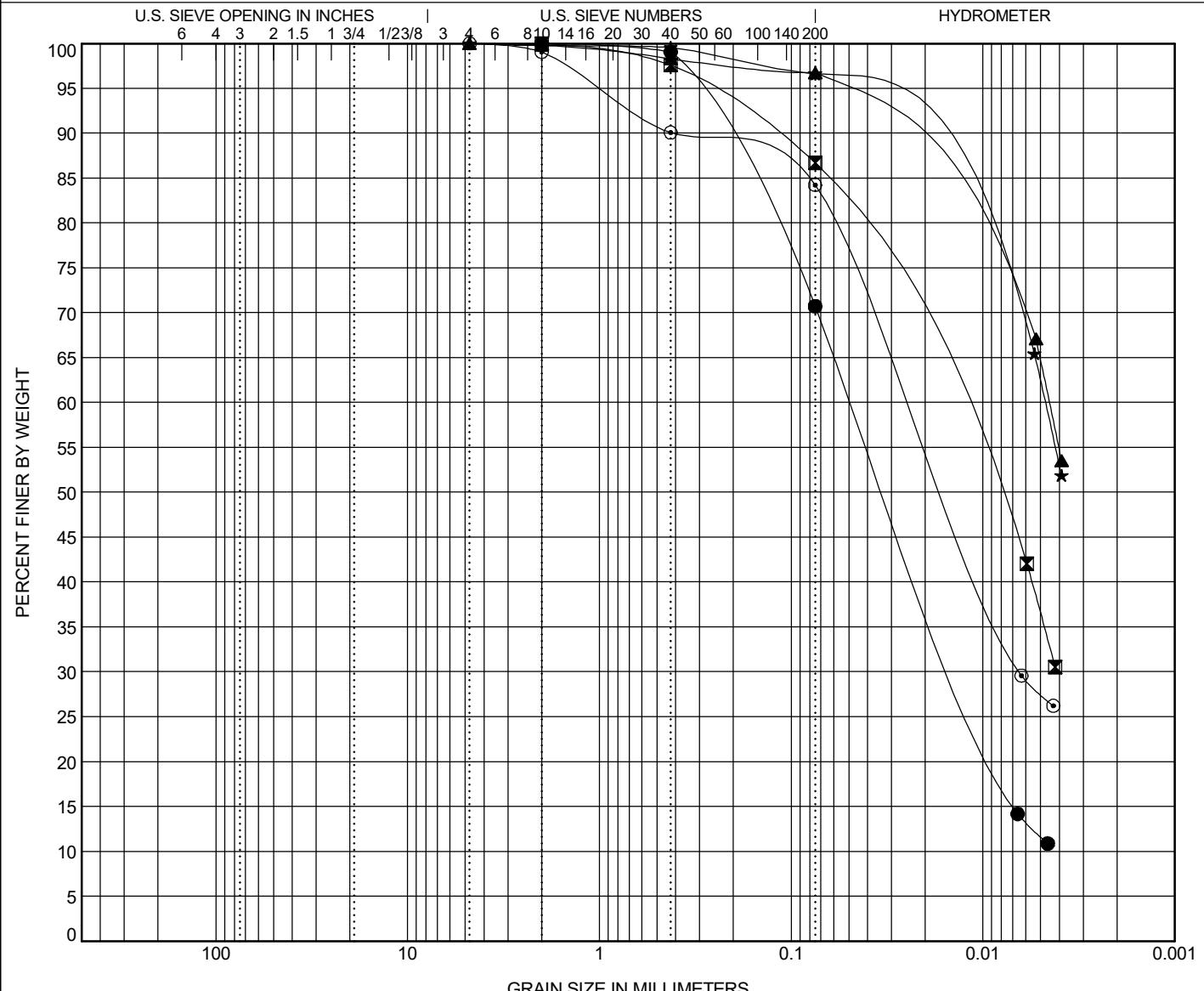
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LOCATION Stark County

PCN 22839



COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● SB - 2	4.0	A-4	(5)		ML		36	29	7		
☒ SB - 2	9.0	A-7-6	(27)		CH		56	29	27		
▲ SB - 2	11.0	A-7-6	(41)		CH		62	25	37		
★ SB - 2	14.0	A-7-6	(39)		CH		61	27	34		
○ SB - 2	16.0	A-7-5	(33)		CH		65	30	35		
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● SB - 2	4.0	2	0.047	0.013		0.0	29.3		70.7		
☒ SB - 2	9.0	2	0.016			0.0	13.3		86.7		
▲ SB - 2	11.0	4.75	0.005			0.0	3.3		96.7		
★ SB - 2	14.0	4.75	0.005			0.0	3.4		96.6		
○ SB - 2	16.0	4.75	0.025	0.006		0.0	15.8		84.2		



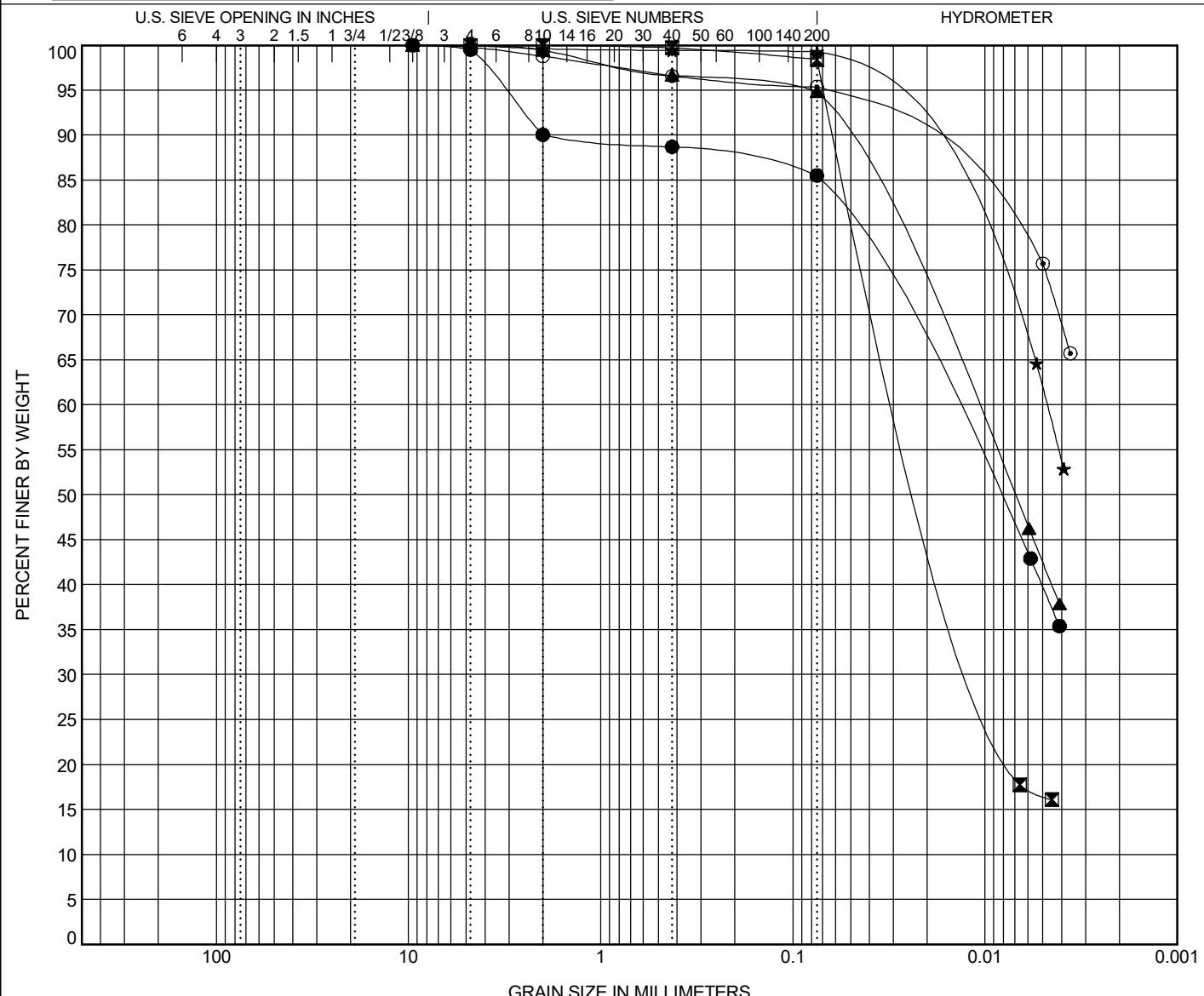
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COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● SB - 2	19.0	A-7-6	(22)		CL		46	22	24		
☒ SB - 2	21.0	A-7-6	(21)		CL		43	24	19		
▲ SB - 2	24.0	A-7-6	(34)		CH		52	19	33		
★ SB - 2	26.0	A-7-6	(54)		CH		68	20	48		
○ SB - 2	29.0	A-7-6	(51)		CH		70	22	48		
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● SB - 2	19.0	9.5	0.016			0.5	14.0		85.5		
☒ SB - 2	21.0	4.75	0.024	0.01		0.0	1.6		98.4		
▲ SB - 2	24.0	9.5	0.012			0.0	5.1		94.8		
★ SB - 2	26.0	9.5	0.005			0.1	0.7		99.3		
○ SB - 2	29.0	9.5				0.2	4.4		95.4		



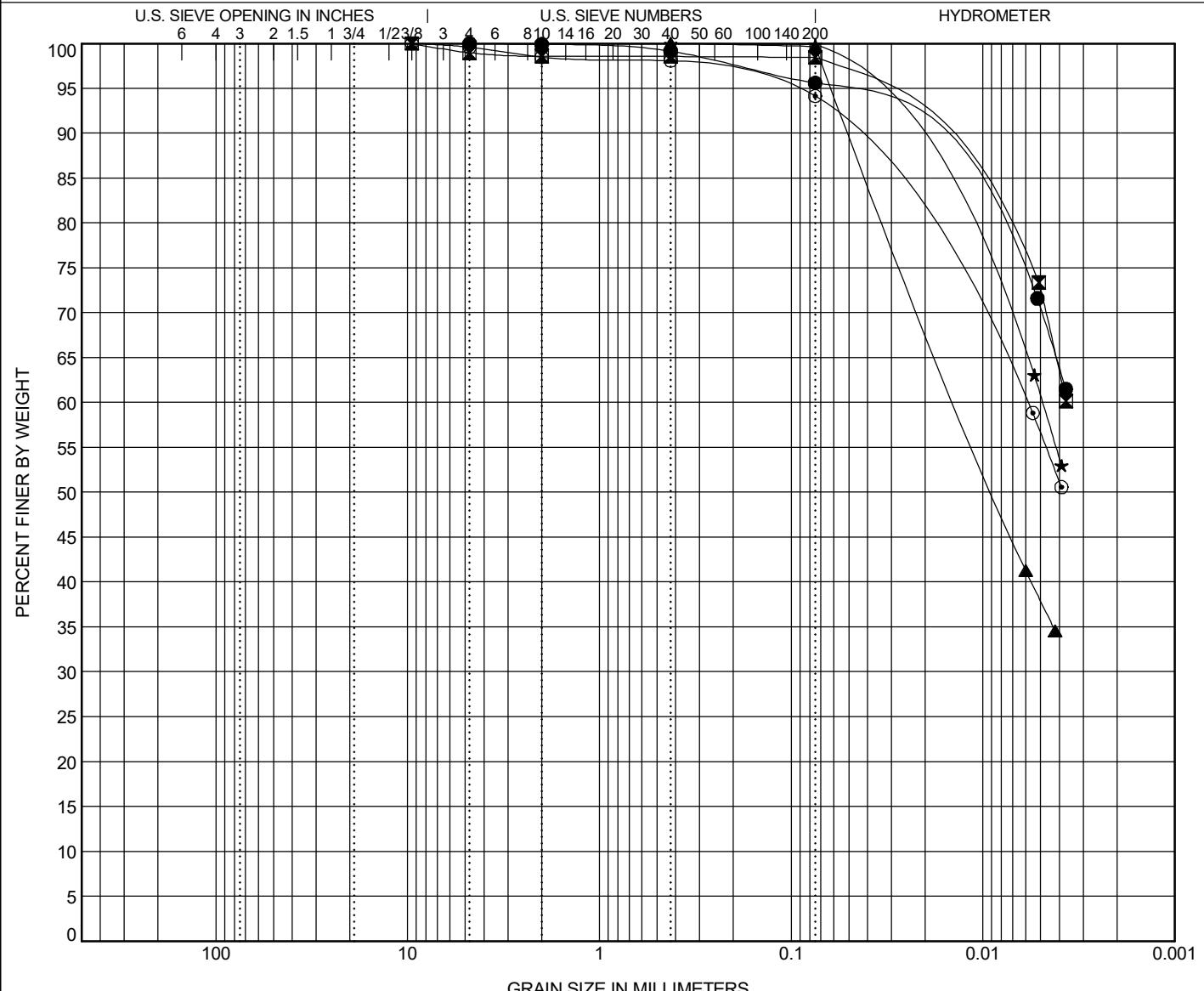
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PCN 22839



COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● SB - 2	31.0	A-7-6	(43)		CH		65	26	39		
☒ SB - 2	34.0	A-7-6	(57)		CH		75	25	50		
▲ SB - 2	36.0	A-7-6	(52)		CH		65	19	46		
★ SB - 2	39.0	A-7-6	(55)		CH		69	21	48		
○ SB - 2	41.0	A-7-6	(41)		CH		58	18	40		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● SB - 2	31.0	4.75				0.0	4.4		95.6
☒ SB - 2	34.0	9.5				1.0	0.5		98.5
▲ SB - 2	36.0	2	0.013			0.0	0.3		99.7
★ SB - 2	39.0	2	0.005			0.0	0.1		99.9
○ SB - 2	41.0	9.5	0.006			0.4	5.4		94.1



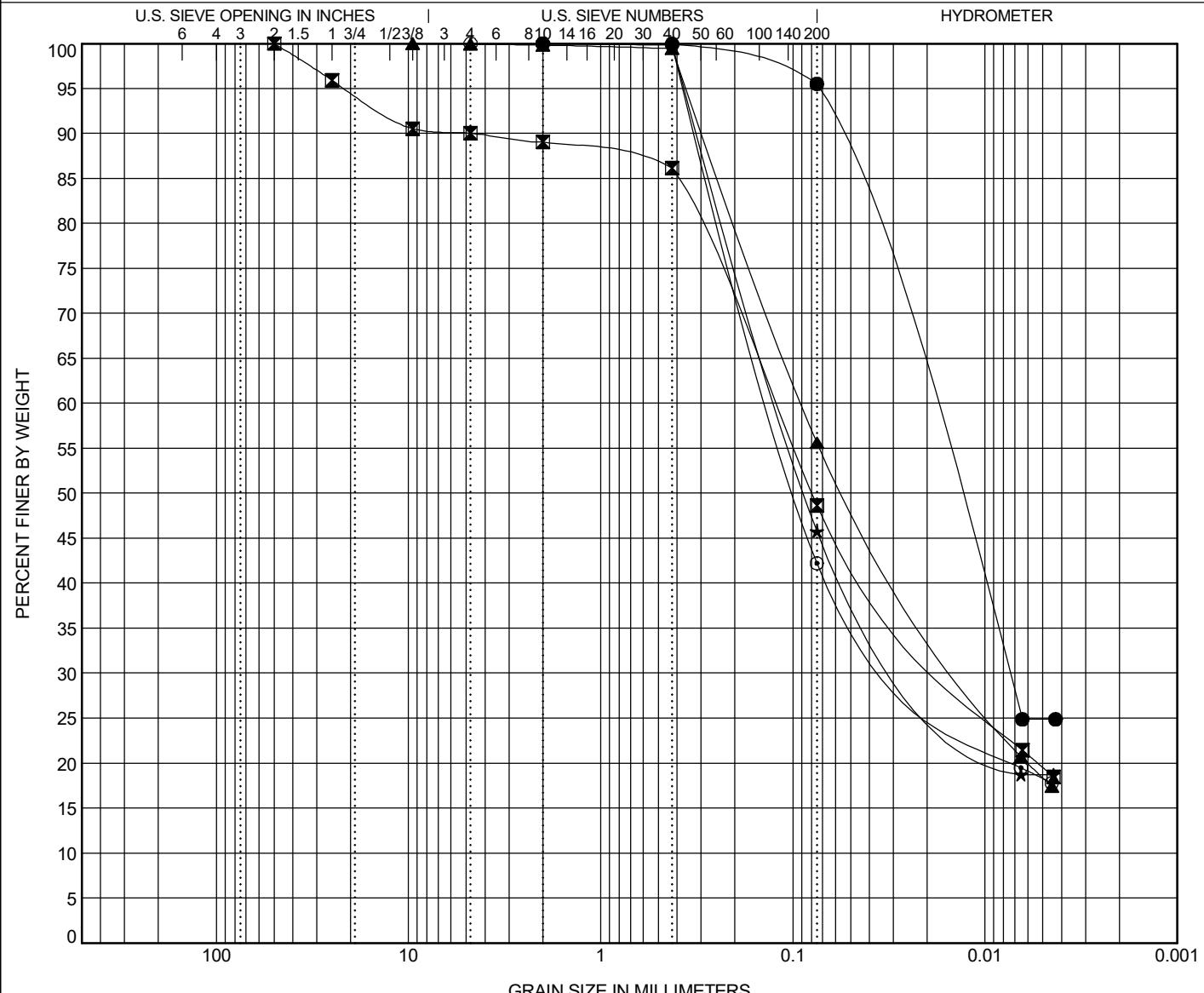
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION  
300 AIRPORT ROAD  
BISMARCK, ND 58504

## GRAIN SIZE DISTRIBUTION

PROJECT NUMBER IM-5-094(147)063 B1,2,3

LOCATION Stark County

PCN 22839



COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● SB - 2	43.0	A-7-6	(35)		CH		53	20	33		
☒ SB - 3	0.0	A-6	(6)		SC		39	19	20		
▲ SB - 3	2.0	A-6	(5)		CL		35	21	14		
★ SB - 3	4.0	A-4	(1)		SC		31	22	9		
○ SB - 3	6.0	A-4	(0)		SM		NP	NP	NP		
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● SB - 2	43.0	2	0.022	0.008		0.0	4.5		95.5		
☒ SB - 3	0.0	50	0.127	0.014		10.0	41.4		48.6		
▲ SB - 3	2.0	9.5	0.089	0.012		0.1	44.3		55.6		
★ SB - 3	4.0	2	0.118	0.018		0.0	54.2		45.8		
○ SB - 3	6.0	4.75	0.128	0.02		0.0	57.8		42.2		



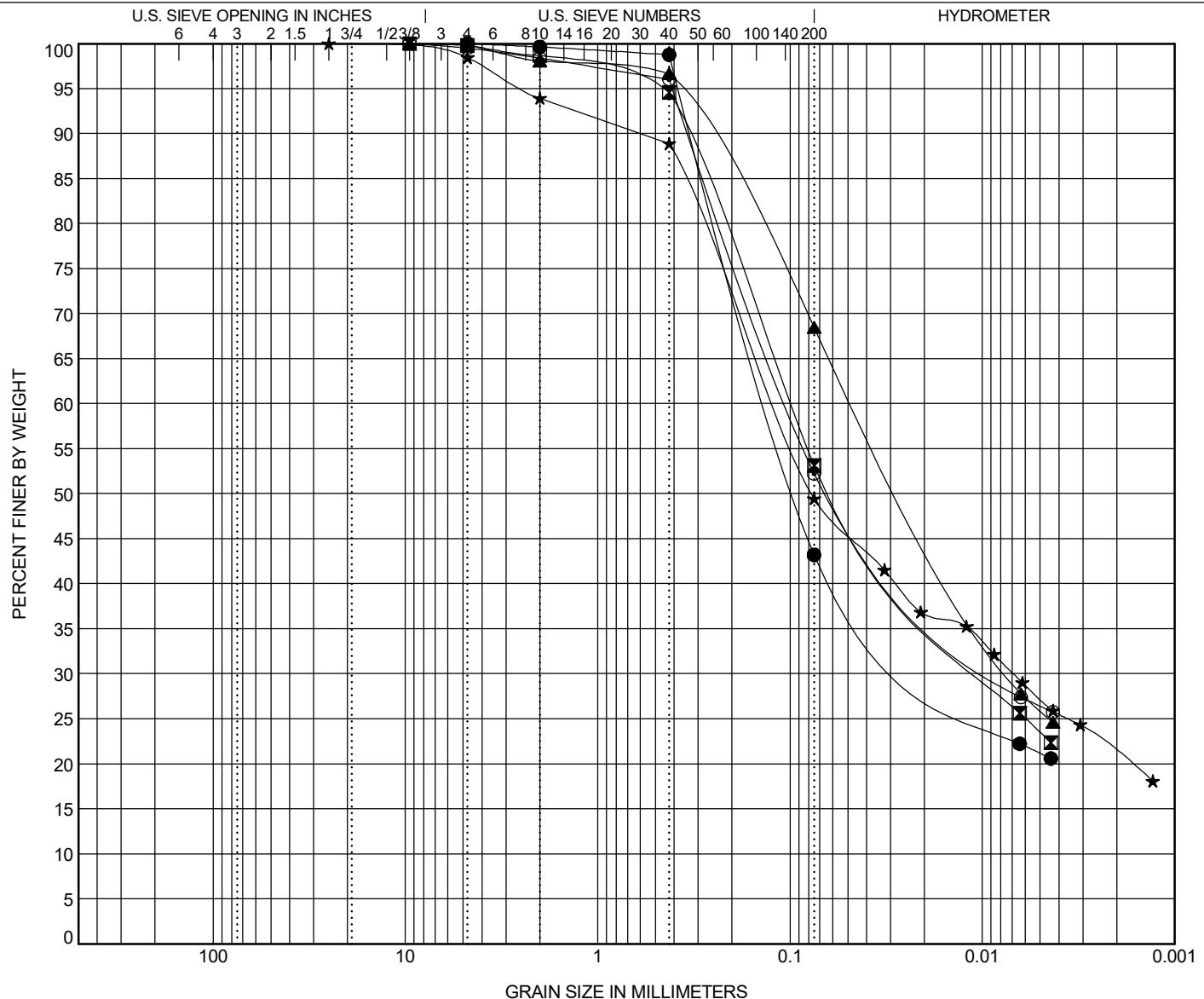
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION  
300 AIRPORT ROAD  
BISMARCK, ND 58504

## GRAIN SIZE DISTRIBUTION

PROJECT NUMBER IM-5-094(147)063 B1,2,3

LOCATION Stark County

PCN 22839



COBBLES	GRAVEL		SAND			SILT OR CLAY			
	coarse	fine	coarse	medium	fine				

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● SB - 3	8.0	A-6	(2)		SC		31	20	11		
☒ SB - 4	2.0	A-6	(6)		CL		32	15	17		
▲ SB - 4	4.0	A-6	(11)		CL		35	16	19		
★ SB - 4	6.0	A-6	(3)		SC		29	15	14		
○ SB - 4	8.0	A-6	(6)		CL		35	17	18		
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● SB - 3	8.0	4.75	0.127	0.016		0.0	56.8		43.2		
☒ SB - 4	2.0	9.5	0.1	0.009		0.2	46.7		53.1		
▲ SB - 4	4.0	9.5	0.045	0.007		0.2	31.4		68.4		
★ SB - 4	6.0	25	0.119	0.007		1.5	49.0	28.3	21.2		
○ SB - 4	8.0	9.5	0.102	0.008		0.5	47.3		52.2		



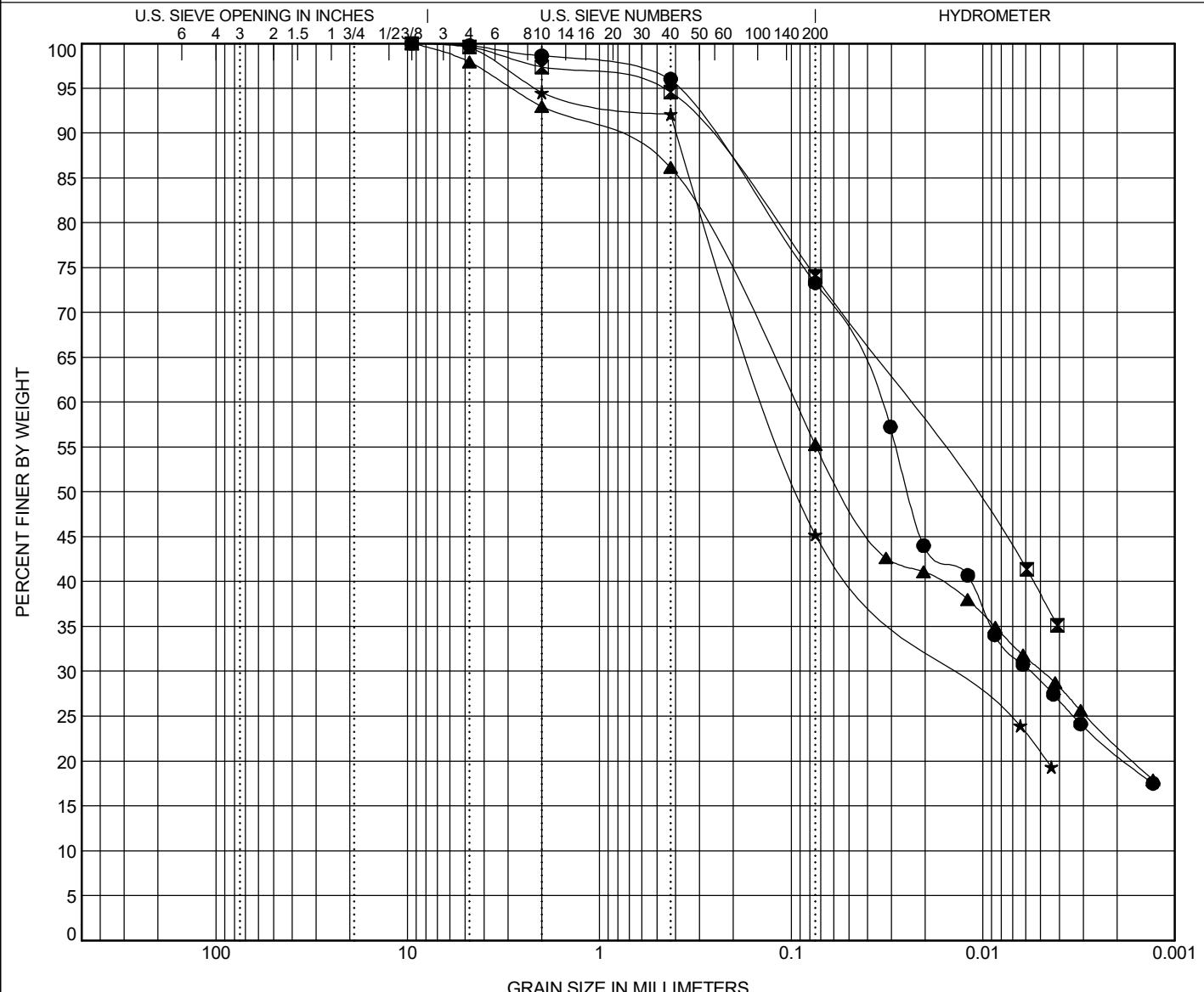
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION  
300 AIRPORT ROAD  
BISMARCK, ND 58504

## GRAIN SIZE DISTRIBUTION

PROJECT NUMBER IM-5-094(147)063 B1,2,3

LOCATION Stark County

PCN 22839



COBBLES	GRAVEL		SAND			SILT OR CLAY				
	coarse	fine	coarse	medium	fine					

BOREHOLE	DEPTH	AASHTO Classification			USCS Classification		LL	PL	PI	Cc	Cu
● SB - 5	2.0	A-6	(11)		CL		36	18	18		
☒ SB - 5	4.0	A-7-6	(16)		CL		42	18	24		
▲ SB - 5	6.0	A-6	(7)		CL		34	15	19		
★ SB - 5	8.0	A-6	(2)		SC		31	20	11		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● SB - 5	2.0	9.5	0.035	0.006		0.2	26.5	52.5	20.8
☒ SB - 5	4.0	9.5	0.025			0.4	25.6	74.0	
▲ SB - 5	6.0	9.5	0.098	0.005		2.1	42.7	33.5	21.7
★ SB - 5	8.0	9.5	0.13	0.013		0.4	54.4	45.2	



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

# LOG OF BORING SB - 1

PAGE 1 OF 1

PROJECT NUMBER IM-5-094(147)063 B1,2,3

PCN 22839

LOCATION Stark County

DRILLED BY Dallan LOGGED BY Jamie

DATE STARTED 5/21/20 COMPLETED 5/21/20

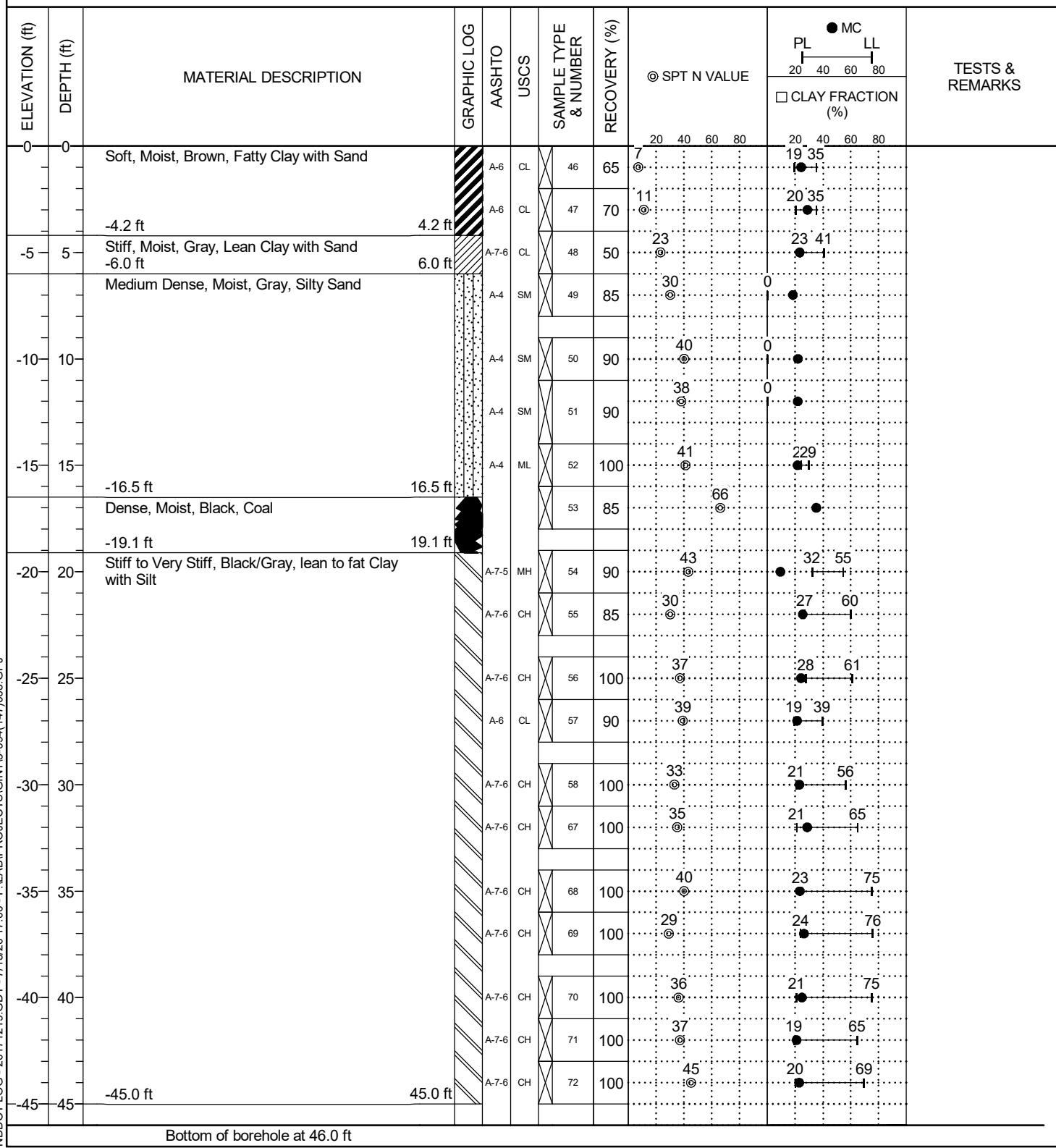
ELEVATION 0 ft

Northing 5199335.70 ft Easting 215388.02 ft

DRILLING METHOD

ENGINEER

NOTES



PROJECT NUMBER IM-5-094(147)063 B1,2,3

DATE STARTED 5/21/20 COMPLETED 5/21/20

PCN 22839

ELEVATION 0 ft

LOCATION Stark County

Northing 5199343.96 ft Easting 215416.28 ft

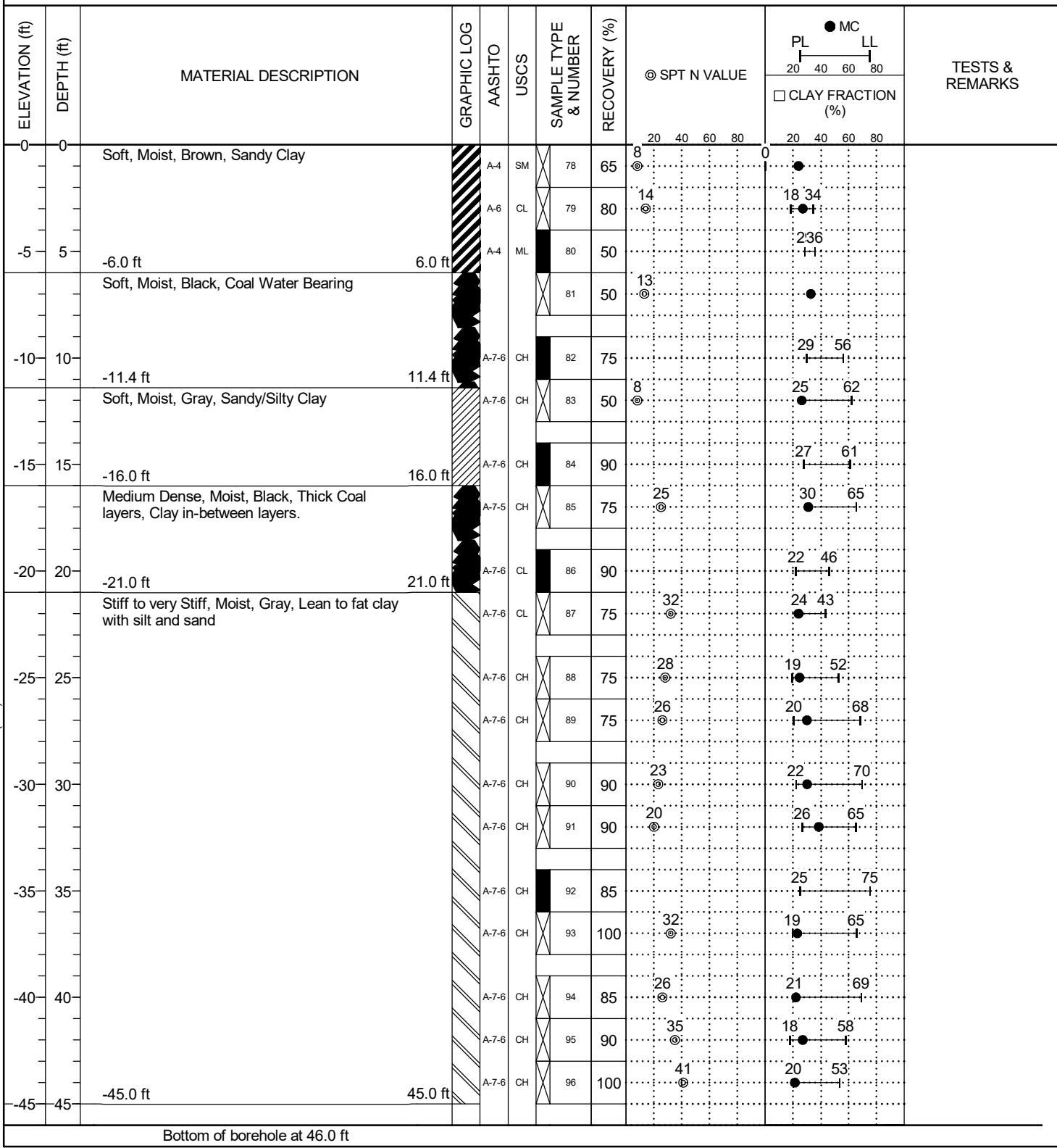
DRILLED BY Dallan

LOGGED BY Jamie

DRILLING METHOD

ENGINEER

NOTES





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

# LOG OF BORING SB - 3

PAGE 1 OF 1

PROJECT NUMBER IM-5-094(147)063 B1,2,3

DATE STARTED 5/21/20 COMPLETED 5/21/20

PCN 22839

ELEVATION 0 ft

LOCATION Stark County

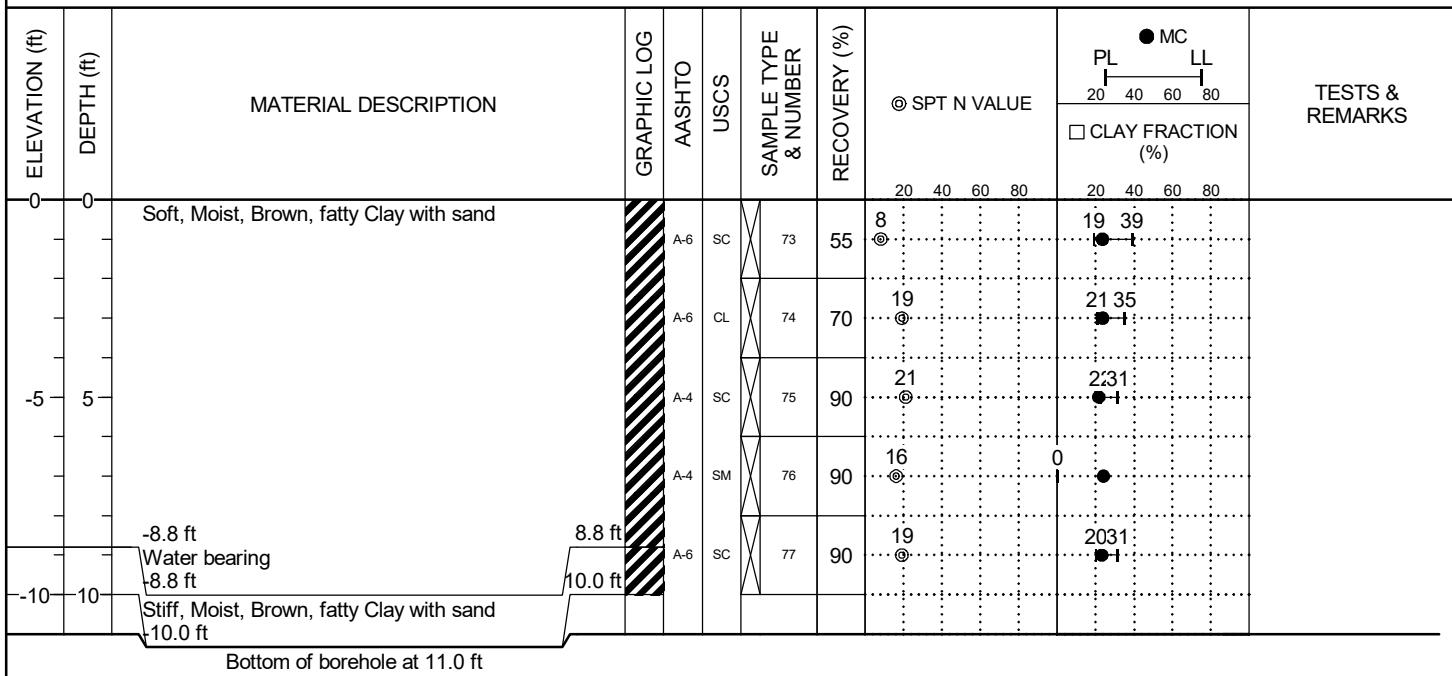
Northing 5199377.41 ft Easting 215636.29 ft

DRILLED BY Dallan LOGGED BY Jamie

DRILLING METHOD

ENGINEER

NOTES





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

# LOG OF BORING SB - 4

PAGE 1 OF 1

PROJECT NUMBER IM-5-094(147)063 B1,2,3

DATE STARTED 5/21/20 COMPLETED 5/21/20

PCN 22839

ELEVATION 0 ft

LOCATION Stark County

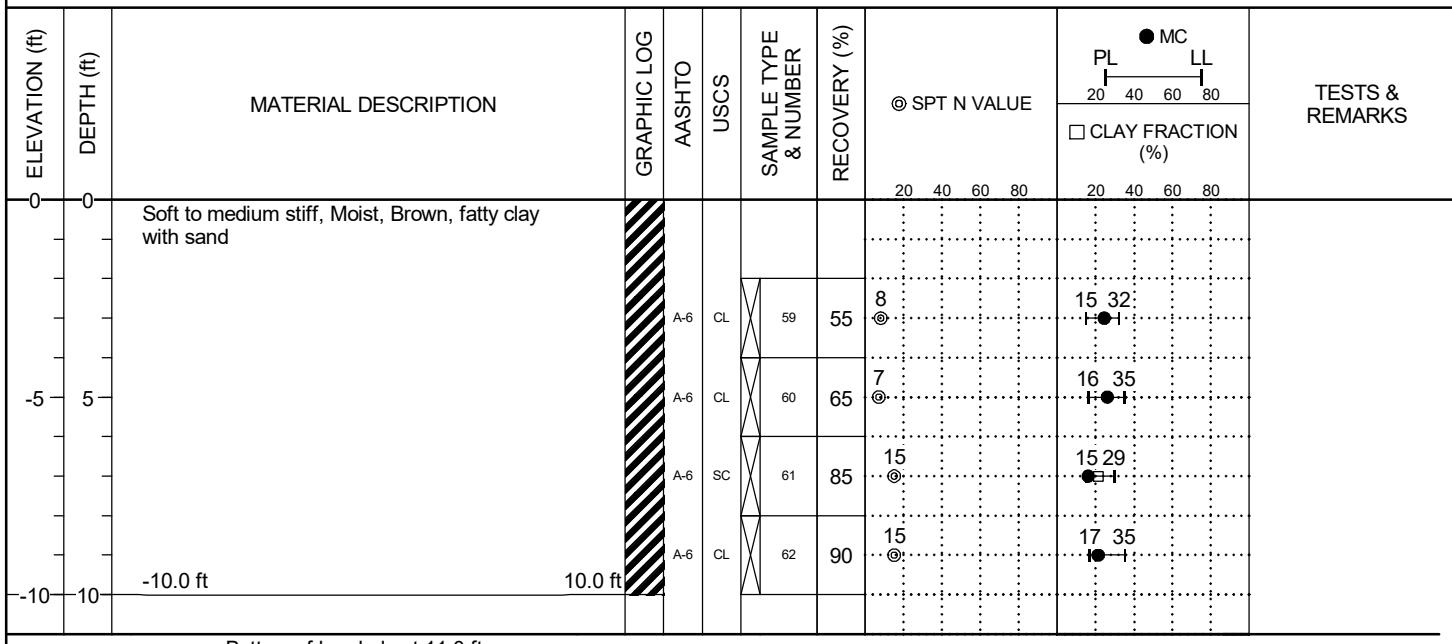
Northing 5199253.99 ft Easting 215689.80 ft

DRILLED BY Dallan LOGGED BY Jamie

DRILLING METHOD

ENGINEER

NOTES



Bottom of borehole at 11.0 ft



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

# LOG OF BORING SB - 5

PAGE 1 OF 1

PROJECT NUMBER IM-5-094(147)063 B1,2,3

DATE STARTED 5/21/20 COMPLETED 5/21/20

PCN 22839

ELEVATION 0 ft

LOCATION Stark County

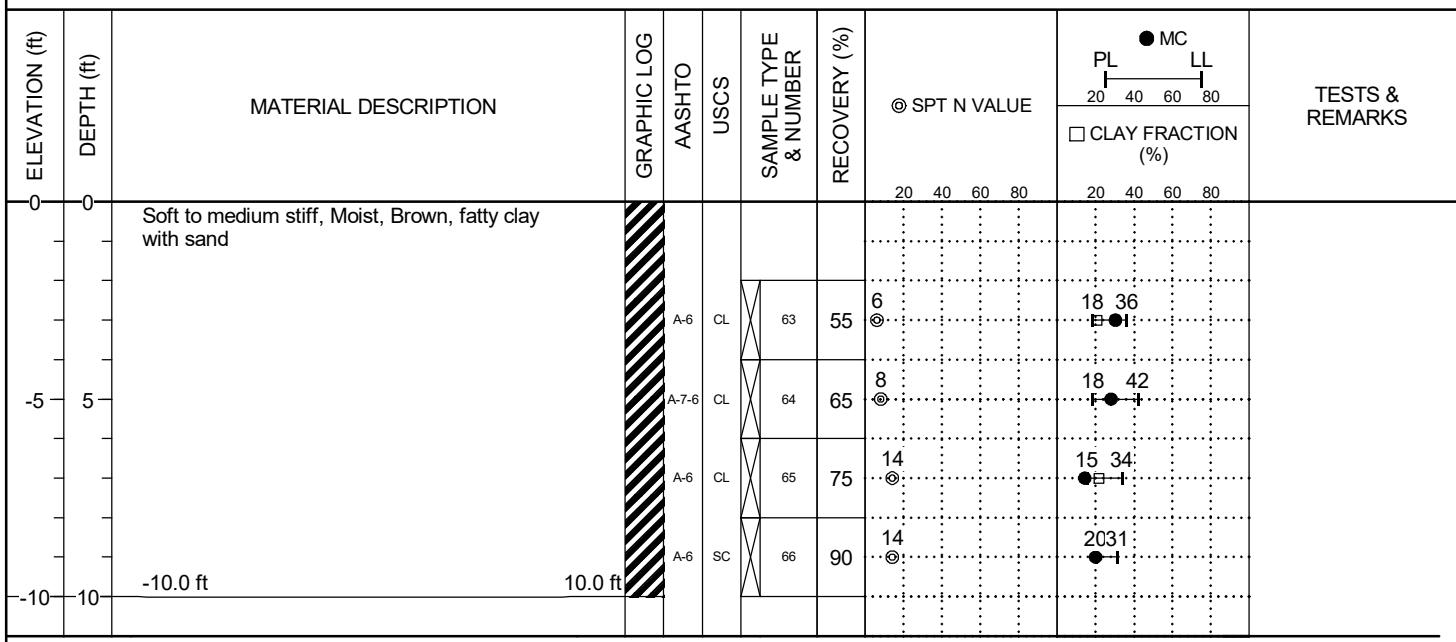
Northing 5199320.01 ft Easting 215656.19 ft

DRILLED BY Dallan LOGGED BY Jamie

DRILLING METHOD

ENGINEER

NOTES



Bottom of borehole at 11.0 ft

## **APPENDIX E**

## **LAB RESULTS**



PROJECT NUMBER IM-5-094(147)063 B1,2,3

LOCATION Stark County

PCN 22839

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Classification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
SB - 1	0.0	35	19	16	25	59	A-6 (7)	CL	24.2	24.2			
SB - 1	2.0	35	20	15	25	57	A-6 (6)	CL	28.7	28.7			
SB - 1	4.0	41	23	18	9.5	89	A-7-6 (17)	CL	23.2	23.2			
SB - 1	6.0	NP	NP	NP	25	40	A-4 (0)	SM	18.3	18.3			
SB - 1	9.0	NP	NP	NP	9.5	42	A-4 (0)	SM	21.9	21.9			
SB - 1	11.0	NP	NP	NP	9.5	39	A-4 (0)	SM	21.8	21.8			
SB - 1	14.0	29	24	5	4.75	53	A-4 (1)	ML	21.6	21.6			
SB - 1	16.0								35.1	35.1			
SB - 1	19.0	55	32	23	9.5	74	A-7-5 (18)	MH	9.3	9.3			
SB - 1	21.0	60	27	33	9.5	94	A-7-6 (36)	CH	25.4	25.4			
SB - 1	24.0	61	28	33	4.75	89	A-7-6 (33)	CH	24.1	24.1			
SB - 1	26.0	39	19	20	9.5	94	A-6 (19)	CL	21.3	21.3			
SB - 1	29.0	56	21	35	9.5	98	A-7-6 (38)	CH	23.0	23.0			
SB - 1	31.0	65	21	44	9.5	99	A-7-6 (49)	CH	28.6	28.6			
SB - 1	34.0	75	23	52	9.5	97	A-7-6 (58)	CH	23.3	23.3			
SB - 1	36.0	76	24	52	4.75	97	A-7-6 (58)	CH	26.2	26.2			
SB - 1	39.0	75	21	54	4.75	99	A-7-6 (61)	CH	24.8	24.8			
SB - 1	41.0	65	19	46	4.75	100	A-7-6 (52)	CH	21.0	21.0			
SB - 1	43.0	69	20	49	4.75	100	A-7-6 (56)	CH	22.8	22.8			
SB - 2	0.0	NP	NP	NP	9.5	46	A-4 (0)	SM	23.9	23.9			
SB - 2	2.0	34	18	16	2	73	A-6 (10)	CL	27.0	27.0			
SB - 2	4.0	36	29	7	2	71	A-4 (5)	ML					
SB - 2	6.0								32.7	32.7			
SB - 2	9.0	56	29	27	2	87	A-7-6 (27)	CH					
SB - 2	11.0	62	25	37	4.75	97	A-7-6 (41)	CH	26.2	26.2			
SB - 2	14.0	61	27	34	4.75	97	A-7-6 (39)	CH					
SB - 2	16.0	65	30	35	4.75	84	A-7-5 (33)	CH	30.9	30.9			
SB - 2	19.0	46	22	24	9.5	86	A-7-6 (22)	CL					
SB - 2	21.0	43	24	19	4.75	98	A-7-6 (21)	CL	23.9	23.9			
SB - 2	24.0	52	19	33	9.5	95	A-7-6 (34)	CH	24.6	24.6			
SB - 2	26.0	68	20	48	9.5	99	A-7-6 (54)	CH	29.9	29.9			
SB - 2	29.0	70	22	48	9.5	95	A-7-6 (51)	CH	30.1	30.1			
SB - 2	31.0	65	26	39	4.75	96	A-7-6 (43)	CH	38.4	38.4			
SB - 2	34.0	75	25	50	9.5	98	A-7-6 (57)	CH					
SB - 2	36.0	65	19	46	2	100	A-7-6 (52)	CH	23.0	23.0			
SB - 2	39.0	69	21	48	2	100	A-7-6 (55)	CH	22.0	22.0			
SB - 2	41.0	58	18	40	9.5	94	A-7-6 (41)	CH	26.9	26.9			
SB - 2	43.0	53	20	33	2	96	A-7-6 (35)	CH	21.2	21.2			
SB - 3	0.0	39	19	20	50	49	A-6 (6)	SC	23.5	23.5			
SB - 3	2.0	35	21	14	9.5	56	A-6 (5)	CL	23.6	23.6			
SB - 3	4.0	31	22	9	2	46	A-4 (1)	SC	21.5	21.5			
SB - 3	6.0	NP	NP	NP	4.75	42	A-4 (0)	SM	24.0	24.0			
SB - 3	8.0	31	20	11	4.75	43	A-6 (2)	SC	23.2	23.2			



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

## SUMMARY OF LABORATORY RESULTS

PAGE 2 OF 2

PROJECT NUMBER IM-5-094(147)063 B1,2,3

LOCATION Stark County

PCN 22839

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Classification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Saturation (%)	Void Ratio
SB - 4	2.0	32	15	17	9.5	53	A-6 (6)	CL	24.4	24.4			
SB - 4	4.0	35	16	19	9.5	68	A-6 (11)	CL	26.0	26.0			
SB - 4	6.0	29	15	14	25	49	A-6 (3)	SC	16.0	16.0			
SB - 4	8.0	35	17	18	9.5	52	A-6 (6)	CL	21.2	21.2			
SB - 5	2.0	36	18	18	9.5	73	A-6 (11)	CL	30.2	30.2			
SB - 5	4.0	42	18	24	9.5	74	A-7-6 (16)	CL	27.9	27.9			
SB - 5	6.0	34	15	19	9.5	55	A-6 (7)	CL	14.3	14.3			
SB - 5	8.0	31	20	11	9.5	45	A-6 (2)	SC	19.9	19.9			