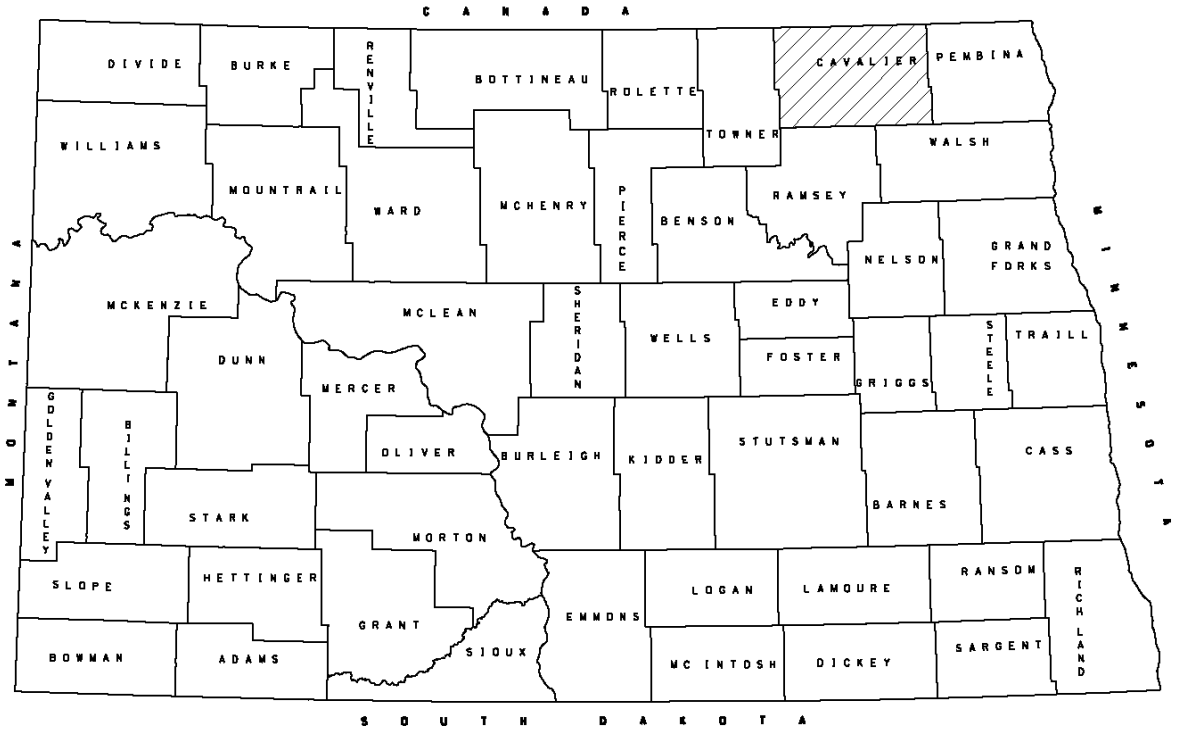
# LINEAR SOILS SURVEY AND RECOMMENDATIONS

## PROJECT NO. NH-3-001(031)201 & NH-3-001(033)200

## PCN 22616 & 23109

## COUNTY Cavalier

## Hwy 1, RP 200.526 to 201.773 & 201.773 to 213.926




**PREPARED BY: Riley McAdoo-Roesler**

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

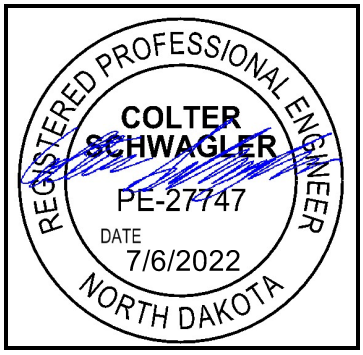
**July 2022**

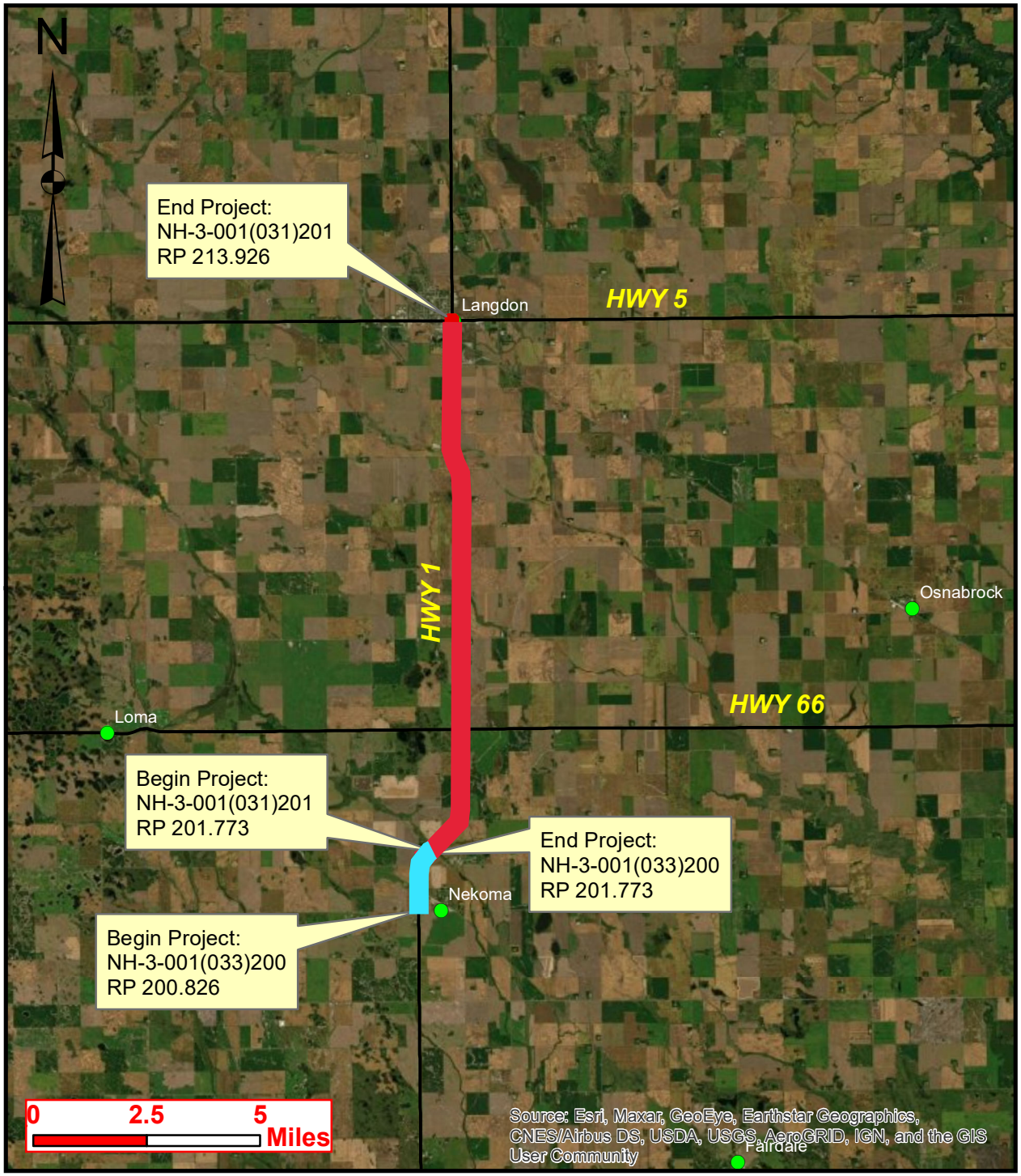
## NH-3-001(031)201 & NH-3-001(033)200

Nekoma to Jct 5 Langdon

# *CERTIFICATION*

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of North Dakota. This document was originally issued and sealed by Colter J. Schwagler, Registration number PE-27747 on 07/06/2022 and the original document is stored at the North Dakota Department of Transportation.

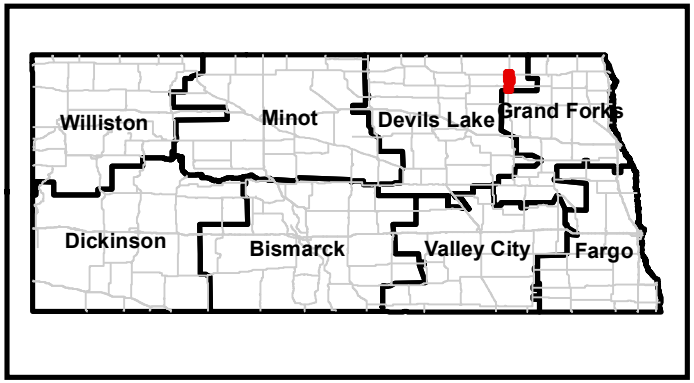





## Project Location

**Project: NH-3-001(031)201**
**PCN: 22616**
**Scope: Structural Overlay**
**Location: RP 201.773 to RP 213.926**

**Project: NH-3-001(033)200**
**PCN: 23109**
**Scope: Major Rehabilitation**
**Location: RP 200.526 to RP 201.773**



## Table of Contents

Introduction ..... 1
Maintenance Review ..... 1
Summary of Soil Investigation ..... 3
Summary of Soil Analysis ..... 4
  Soil Sample Distribution ..... 4
Design Recommendations ..... 8
  Design Information ..... 9
  Plan Notes ..... 9

## List of Figures

Figure 1 - Soil Sample Distribution ..... 7

## List of Tables

Table 1 – Identified Maintenance Areas ..... 1
Table 2 – Boring Locations Summary ..... 3

## Appendices

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

## Introduction

PCN: 23109
Location: Hwy 1, Nekoma to Nekoma Separation
Reference Points: 200.5260 to 201.7730
Project Length: 1.2484 Miles
Proposed Project Scope: Major Rehabilitation
Investigation Scope:1000' intervals and Identified Maintenance Areas

PCN: 22616
Location: Nekoma Separation N to JCT 5 Langdon
Reference Points: 201.7730 to 213.926
Project Length: 12.1550 miles
Proposed Project Scope: Structural Overlay
Investigation Scope: Identified Maintenance Areas

## Maintenance Review

Date of Maintenance Review: 03/30/2021
Materials and Research Person Conducting the Review: Jamie Naumann
Maintenance Person Conducting Review: Rory Freer

Table 1 – Identified Maintenance Areas

**PCN: 23109**

| Location RP + Feet | Distress Identified | Maintenance Comments | Drilling Required |
|---|---|---|---|
| 200+2381 to 200+5197 | Transv. Cracks | Dura-patched all summer last year. | No |
| 201+1228 to 201+2836 | Transv. Cracks | Yearly patching required. | Yes |

**PCN: 22616**

| Location RP + Feet | Distress Identified | Maintenance Comments | Drilling Required |
|---|---|---|---|
| 201+4070 | Transv. Cracks | Fixed annually. | Yes |
| 208+4293 | Culvert | Almost all culverts are separating or breaking apart. Some have sinking end sections. | Yes |
| 209+3540 to 209+3800 | Transv. Cracks | Patched twice a year. | Yes |
| 211+0490 | Culvert | Double barrel culvert holes filled yearly. | Yes |
| 213+3000 | Alligator Cracking | Railroad tracks included. Dura-patch twice a year. | No |
| 213+4730 to 213+4750 | Alligator Cracking | Showed up last year | Yes |

## Summary of Soil Investigation

The soil investigation was completed on 6/15/2021. The investigation consisted of 32 borings.

Table 2 – Boring Locations Summary

**PCN: 23109**

| Boring Location | Pavement Distress | Justification for Boring | Boring Depth | Boring Locations/Comments |
|---|---|---|---|---|
| 200+2777 to 201+4081 | N/A | Major Rehabilitation | 5 feet | Conduct borings at 1000' intervals along the project limits (taking into account previous borings, do not redrill). A total number of approximately 8 borings. |
| 201+1228 to 201+2836 | Transverse Cracking. | Identified Maintenance Area | 10 feet | Conduct 4 boring in distressed area and one boring on either side approximately 100 feet away. A total number of 6 borings. |

**PCN: 22616**

| Boring Location | Pavement Distress | Justification for Boring | Boring Depth | Boring Locations/Comments |
|---|---|---|---|---|
| 201+4070 | Transverse Cracking | Identified Maintenance Area | 10 feet | Conduct 2 borings in the distressed area and 1 boring on either side approximately. A total number of 4 boring. |
| 208+4293 | Culvert Separation | Identified Maintenance Area | 10 feet | Conduct 2 borings in the distressed area and 1 boring on either side approximately. A total number of 4 boring. |
| 209+3540 to 209+3800 | Transverse Cracking | Identified Maintenance Area | 10 feet | Conduct 1 borings in distressed area and one boring on either side approximately 100 feet away. A total number of 3 borings. |
| 211+0490 | Culvert Separation | Identified Maintenance Area | 10 feet | Conduct 2 borings in the distressed area and 1 boring on either side approximately. A total number of 4 boring. |
| 213+4730 to 213+4750 | Alligator cracking | Identified Maintenance Area | 10 feet | Conduct 1 borings in the distressed area and 1 boring on either side approximately. A total number of 3 boring. |

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

## Summary of Soil Analysis

**PCN: 23109**

**Project Limits**

**– 200+2777 to 201+3000:** The majority of the soils within this area of the project are sandy lean clay with an AASHTO classifications of A-7-6 and A-6. These soils have on average a maximum dry density of approximately 110.8 lb/ft$^3$ and an optimum water content of approximately 16%. The in-place moisture of the soils are on average 8% to 13% over optimum.

**– 201+3000 to 201+4081:** The majority of the soils within this area of the project are silt and lean clay with a low sand content that have an AASHTO classifications of A-7-6 and A-7-5. These soils have on average a maximum dry density of approximately 94.6 lb/ft$^3$ and an optimum water content of approximately 24.5%. The in-place moisture of the soils are on average 6.5% to 21.5% over optimum.

**Identified Maintenance Area – 201+1228 to 201+2836:** The majority of the soils within the identified maintenance area are sandy lean clays with AASHTO classifications of A-7-6 and A-6. These soils have on average a maximum dry density of approximately 111.22 lb/ft$^3$ and an optimum water content of approximately 16%. The in-place moistures of the soils are on average 8% to 13% over optimum.

**PCN: 22616**

**Identified Maintenance Area – 201+4070:** The majority of the soils within the identified maintenance area are sandy lean clays with AASHTO classifications of A-7-6. These soils have a maximum dry density of approximately 103 lb/ft$^3$ and an optimum water content of approximately 20%. The in-place moistures of the soil is on average 12% over optimum.

**Identified Maintenance Area – 208+4293:** The majority of the soils within the identified maintenance area are both elastic silt and lean clays with sand content that have an AASHTO classifications of A-7-6 and A-7-5. These soils have a maximum dry density of approximately 103 lb/ft$^3$ and an optimum water content of approximately 19%. The in-place moistures of the soils are on average 9.5% to 15% over optimum.

**Identified Maintenance Area – 209+3540 to 209+3800:** The majority of the soils within the identified maintenance area are lean and fat clays with low sand content that have an AASHTO classifications of A-7-6. These soils have a maximum dry density of approximately 106 lb/ft$^3$ and an optimum water content of approximately 18.5%. The in-place moistures of the soils are on average 9% to 13% over optimum.

**Identified Maintenance Area – 211+0490:** The majority of the soils within the identified maintenance area are silt with AASHTO classifications of A-7-5. These soils have a maximum dry density of approximately 97 lb/ft$^3$ and an optimum water content of approximately 22%. The in-place moistures of the soils are on average 4% to 12% over optimum.

**Identified Maintenance Area – 213+4730 to 213+4750:** The soils within the identified maintenance area are both silt and clays with sand content that have an AASHTO classifications of A-7-6. These soils have a maximum dry density of approximately 103 $lb/ft^3$ and an optimum water content of approximately 20%. The in-place moistures of the soils are on average 7% to 12% over optimum.

**Soil Sample Distribution**

**PCN 23109**

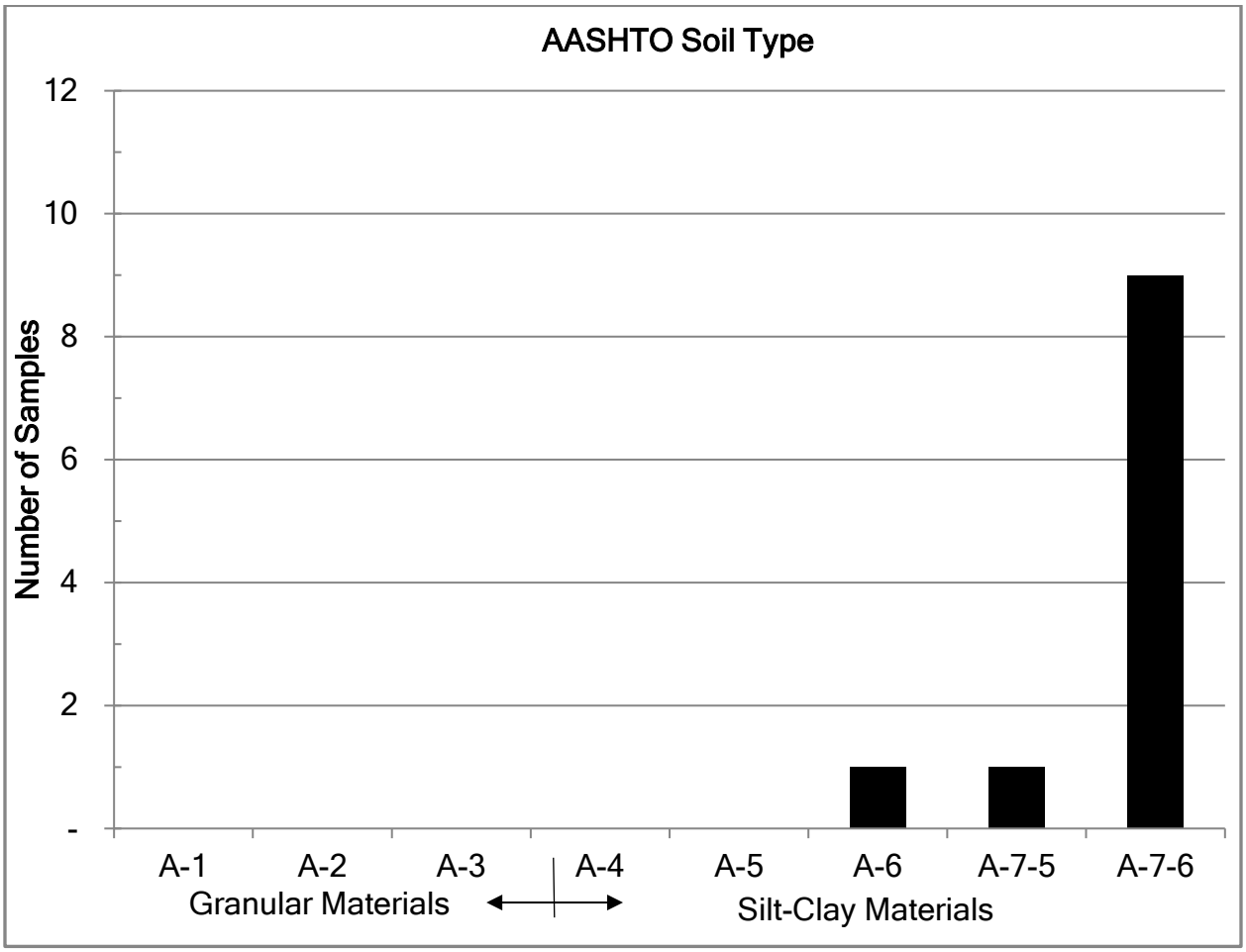



Figure 1 - Soil Sample Distribution

**PCN 22616**

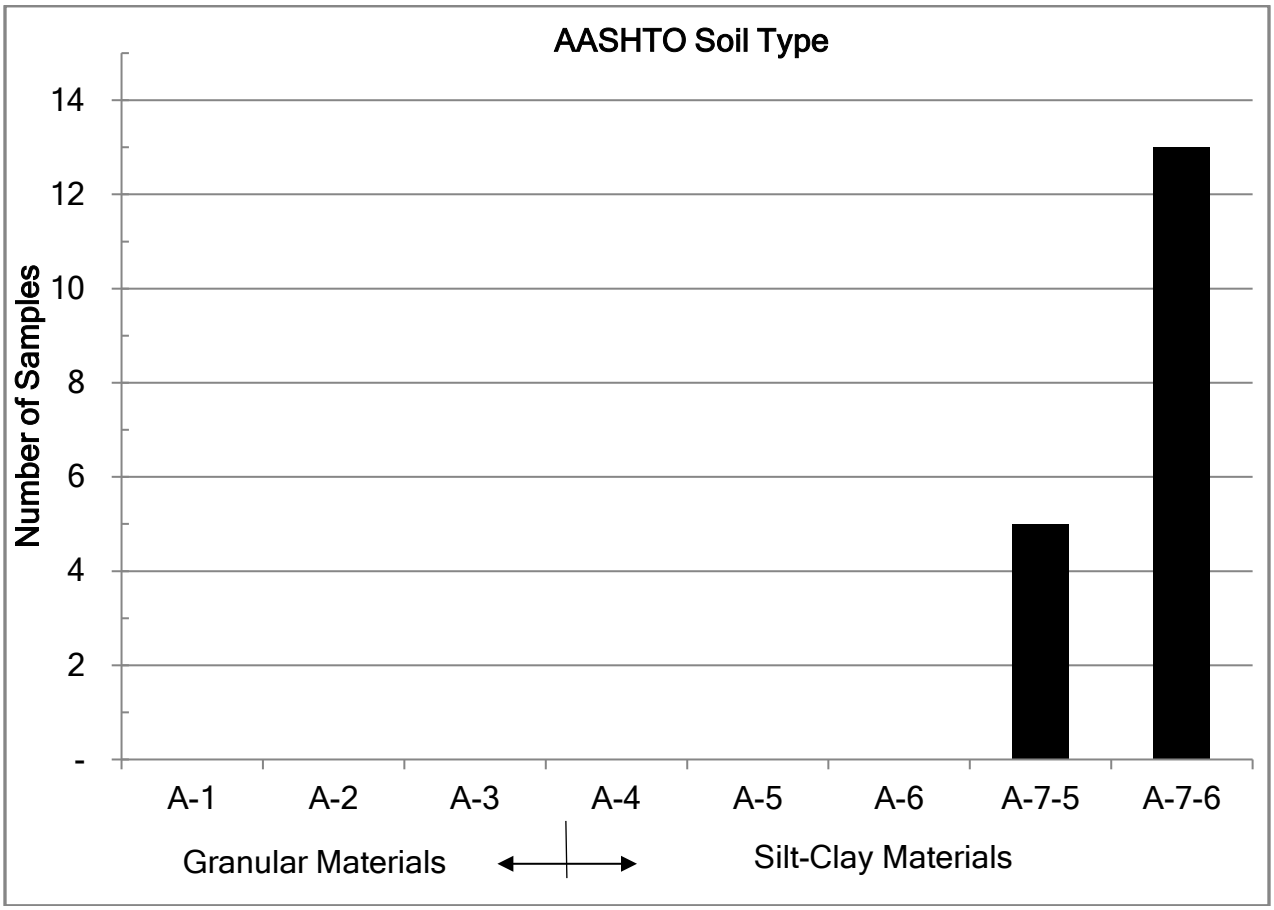



Figure 2 - Soil Sample Distribution

## Design Recommendations

**General Project Guidelines:** The soils encountered on this project are poor and will not perform well as a subgrade material. However, the soils encounter on the project are uniformly poor both inside and outside the identified maintenance areas. It is recommended to design the pavement section to accommodate the poor soils encountered.

**PCN: 23109**

**Project Limits – 200+2777 to 201+4081:** The soils within the project limits are lean clays and silts with high sand content. To accommodate these soils, it is recommended to place Geosynthetic Geogrid (Type G) on top of the existing subgrade without disturbing or scarifying the subgrade. Place a minimum of 10 inches of base material over the geogrid prior to compacting the base material.

**Identified Maintenance Area – 201+1228 to 201+2836:** The existing soils in this area are lean clays with high sand contents. The in-place moistures of the soils are on average 8% to 13% over optimum. 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 subgrade mitigation is recommended for this maintenance area.

**Identified Maintenance Area – 201+4070:** The existing soils within this area are sandy lean clays. The in-place moistures of the soils are on average 12% over optimum. 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 subgrade mitigation is recommended for this maintenance area.

**PCN: 22616**

**Identified Maintenance Area – 208+4293:** The soils within the area are both elastic silt and lean clays with high sand content. The in-place moistures of the soils are on average 9.5% to 15% over optimum. 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 subgrade mitigation is recommended for this maintenance area.

**Identified Maintenance Area – 209+3540 to 209+3800:** The existing soils within the area are lean clays with low sand content. The in-place moistures of the soils are on average 9% to 13% over optimum. 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 subgrade mitigation is recommended for this maintenance area.

**Identified Maintenance Area – 211+0490:** The existing soils within the area are silt with high sand content. The in-place moistures of the soils are on average 4% to 12% over optimum. 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 subgrade mitigation is recommended for this maintenance area.

**Identified Maintenance Area – 213+4730 to 213+4750:** The existing soils within the area are both silt and clays with high sand content. The in-place moistures of the soils are on average 7% to 12% over optimum. 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 subgrade mitigation is recommended for this maintenance area.

## Design Information

**Pipe Replacement:** None

**Compaction Method:** T-180

**Geosynthetics:**

200+2777 to 201+4081: Place Geosynthetic Geogrid (Type G) on top of the existing subgrade without disturbing or scarifying the subgrade. Place a minimum of 10 inches of base material over the geogrid prior to compacting the base material.

**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.

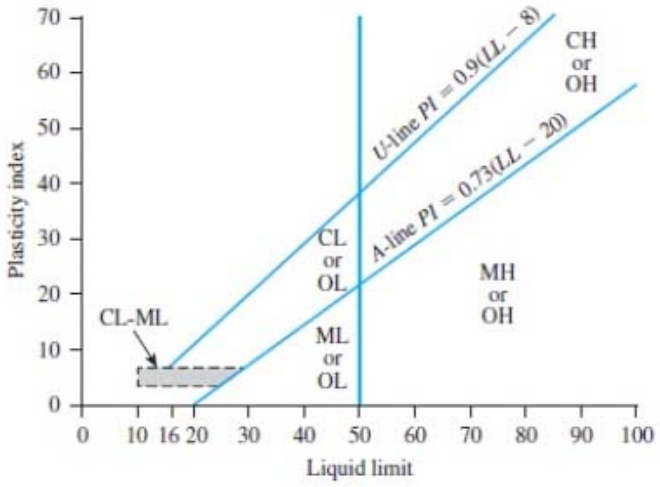
[b] Sands with 5 to 12% fines require dual symbols: SW-SM, SW-SC, SP-SM, SP-SC.

[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 |

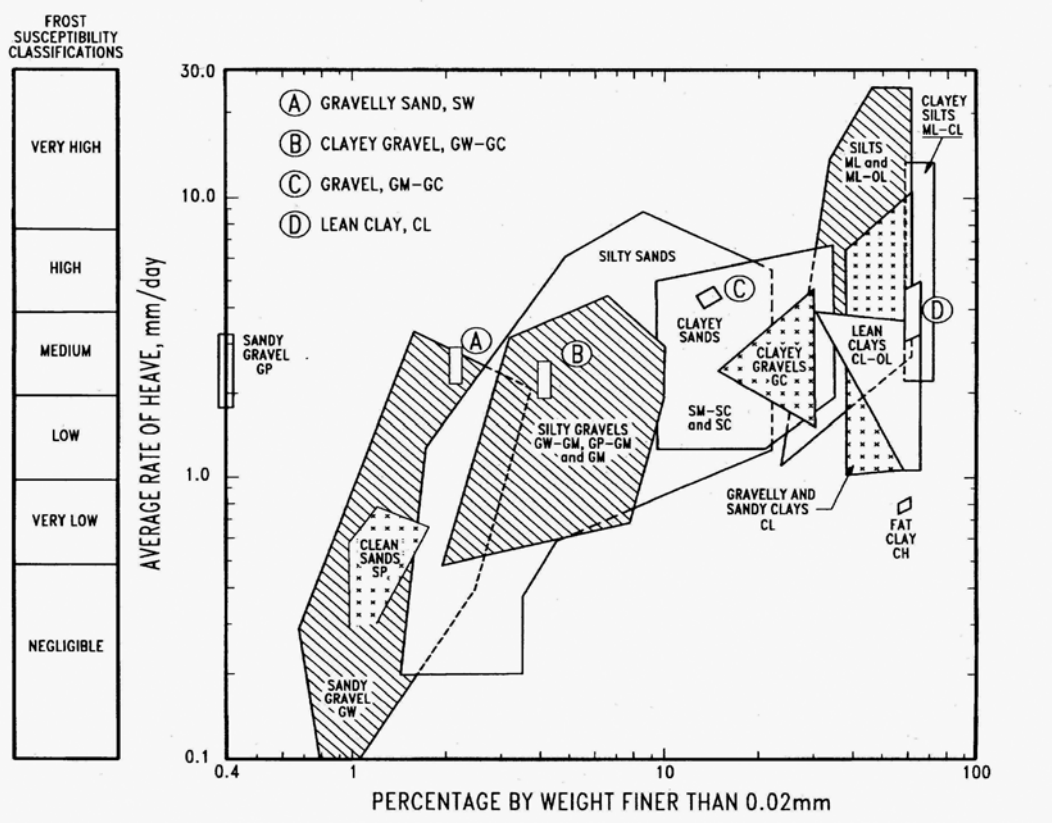



Figure 7-20. Average rate of heave versus % fines for natural soil gradations (Kaplar, 1974).

# 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 |
|---|---|---|
| NH-3-001(033)200 | 23109 | 03/30/2021 |

| Section Maintenance Contact | Completed By |
|---|---|
| Rory Freer | Jamie Naumann |

| Highway Reference Points | Surface Types |
|---|---|
| 200+2777 to 201+4081 | Asphalt |

| Location | Pavement Distress | Description | Maintenance Comment | Picture Number | Drilling Required |
|---|---|---|---|---|---|
| 200+2381 to 200+5197 | Transv. Cracks | Deep transverse cracks with raveling and weathering. Both lanes affected. Centerline deteriorating. | Dura-patched all summer last year. | 1 | No |
| 201+1228 to 201+2836 | Transv. Cracks | Deep transverse cracks with raveling and weathering. Both lanes affected. Centerline deteriorating. | Yearly patching required. | 2-6 | Yes |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Comments

1
200+2381 to 200+5197

2
201+1228 to 201+2836

3
201+1228 to 201+2836

4
201+1228 to 201+2836

5
201+1228 to 201+2836

6
201+1228 to 201+2836

# 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 |
|---|---|---|
| NH-3-001(031)201 | 22616 | 03/30/2021 |

| Section Maintenance Contact | Completed By |
|---|---|
| Rory Freer | Jamie Naumann |

| Highway Reference Points | Surface Types |
|---|---|
| 201+0000 to 213+4889 | Asphalt |

| Location | Pavement Distress | Description | Maintenance Comment | Picture Number | Drilling Required |
|---|---|---|---|---|---|
| 201+4070 | Transv. Cracks | Deep transverse cracking with rutting. Pot holing showing up in transverse cracks. | Fixed annually. | 1 | Yes |
| 208+4293 | Culvert | Culvert separation. | Almost all culverts are separating or breaking apart. Some have sinking end sections. | 2 | Yes |
| 209+3540 to 209+3800 | Transv. Cracks | Rutting and deep transverse cracks. Southbound lane. | Patched twice a year. | 3 | Yes |
| 211+0490 | Culvert | Culvert is sinking and separating. | Double barrel culvert holes filled yearly. | 4 | Yes |
| 213+3000 | Alligator Cracking | | Railroad tracks included. Durapatch twice a year. | 5 | No |
| 213+4730 to 213+4750 | Alligator Cracking | Alligator cracking with rutting and fixed with a hand patch. Likely caused by heavy trucks. | Showed up last year. | 6 | Yes |
| | | | | | |
| | | | | | |
| | | | | | |

Comments
Almost all culverts are separating or breaking apart. Some have sinking end sections.

Much of the pipe issues described could be attributed to frost heaving. We recommend doing a pipe survey to identify the pipe installations experiencing this distress throughout this project.

1
201+4070

2
208+4293

3
209+3540 to 209+3800

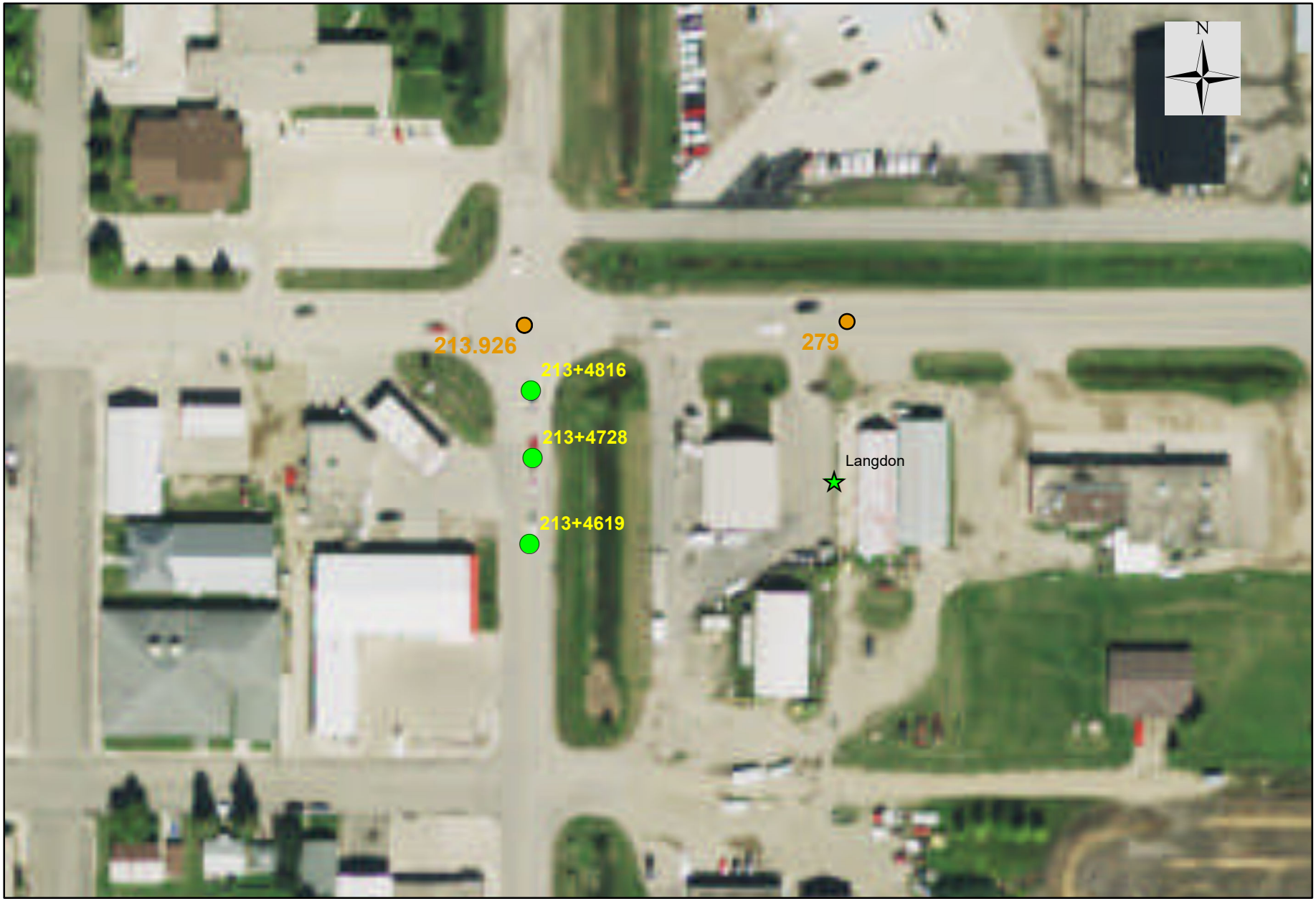
4
211+0490

5
213+3000

6
213+4730 to 213+4750

# APPENDIX C

# BORING LOCATIONS




## Legend

- Reference Point
- Boring locations

0 200 400 Feet

Project Number: NH-3-001(031)201


## Legend

- Reference Point
- Boring locations

0 200 400 Feet

Project Number: NH-3-001(031)201


## Legend

- Reference Point
- Boring locations

0 200 400 Feet

Project Number: NH-3-001(031)201


**Legend**

- Reference Point
- Boring locations

0 200 400 Feet

Project Number: NH-3-001(031)201


## Legend

- Reference Point
- Boring locations

0 200 400
Feet

Project Number: NH-3-001(031)201


## Legend

- Reference Point
- Boring locations

0 600 1,200 Feet

Project Number: NH-3-001(033)200


## Legend

- Reference Point
- Boring locations

0 600 1,200 Feet

Project Number: NH-3-001(033)200


## Legend

- Reference Point
- Boring locations

0 600 1,200 Feet

Project Number: NH-3-001(033)200

# APPENDIX D

# SUMMARY OF SOILS ANALYSIS

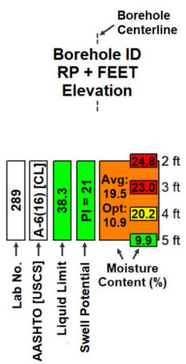
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
300 AIRPORT ROAD
BISMARCK, ND 58504

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **PCN** 22616 & 23109

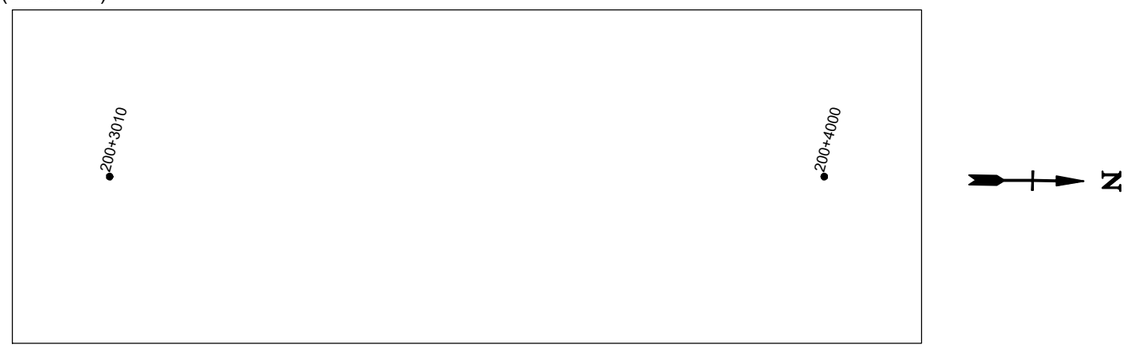
**LOCATION** Cavalier County


Boreholes Equally Spaced (0 to 350 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 |

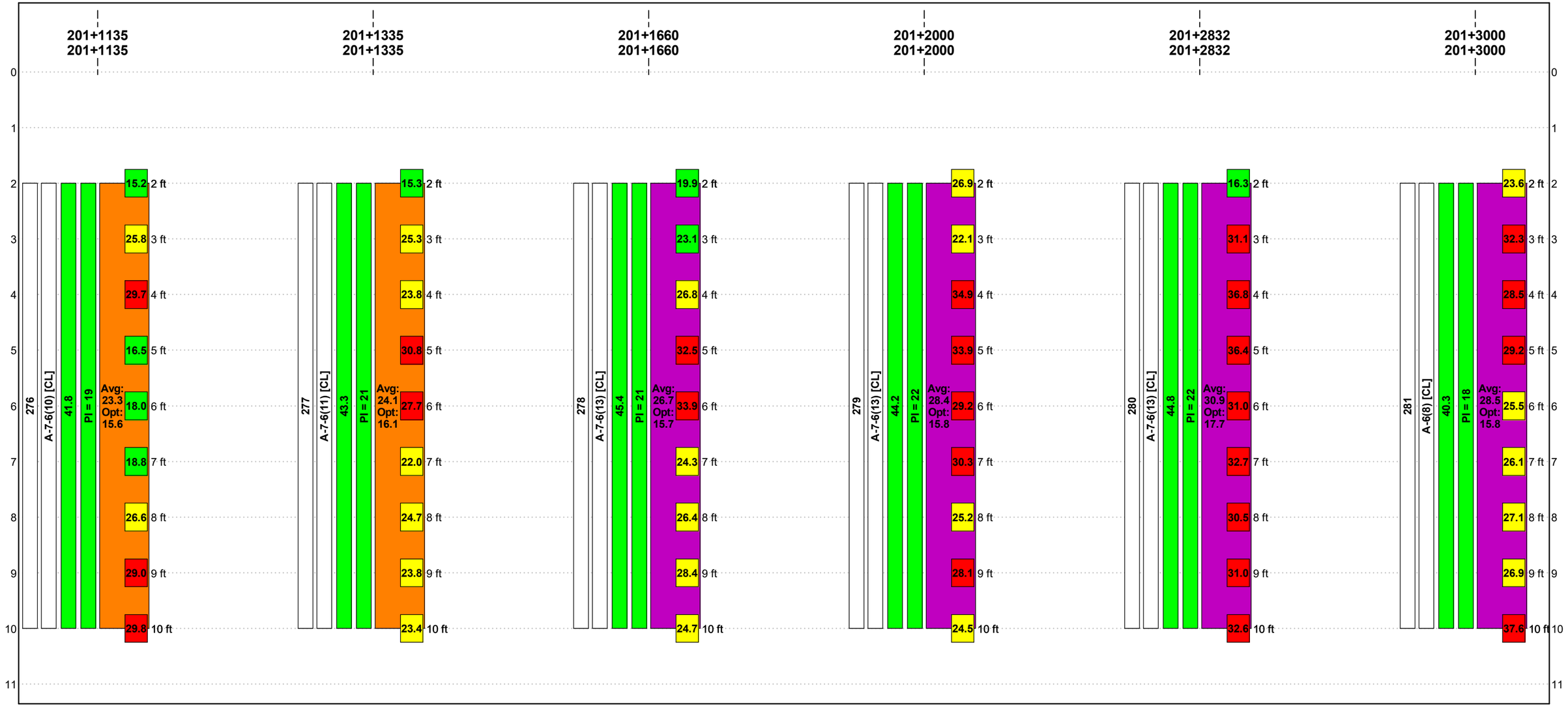


NDDOT
North Dakota Department of Transportation

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

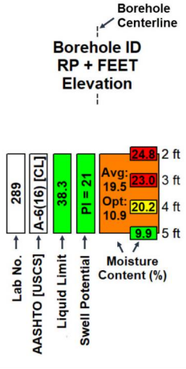
**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **PCN** 22616 & 23109

**LOCATION** Cavalier County

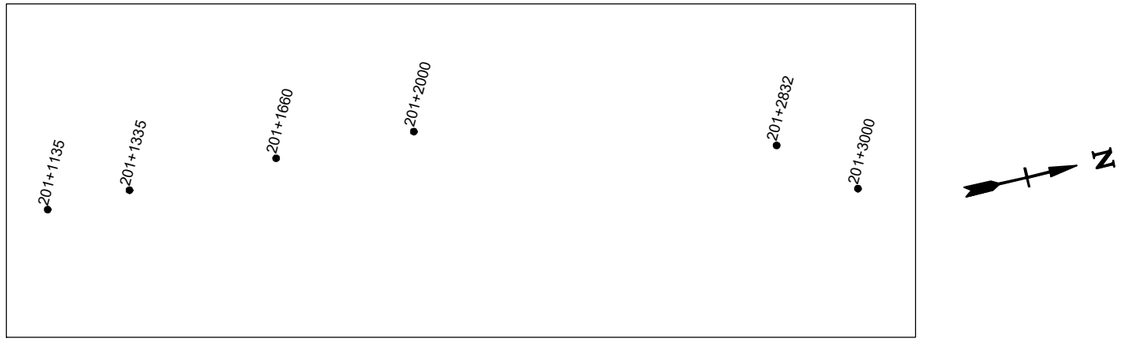



Boreholes Equally Spaced (0 to 550 ft)

## LEGEND




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




NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/3/22 09:49 - R:\PROJECT\30001200.031\MATERIAL\NEKOMA COMBINED\3-001(031&033)200 NEKOMA .GPJ

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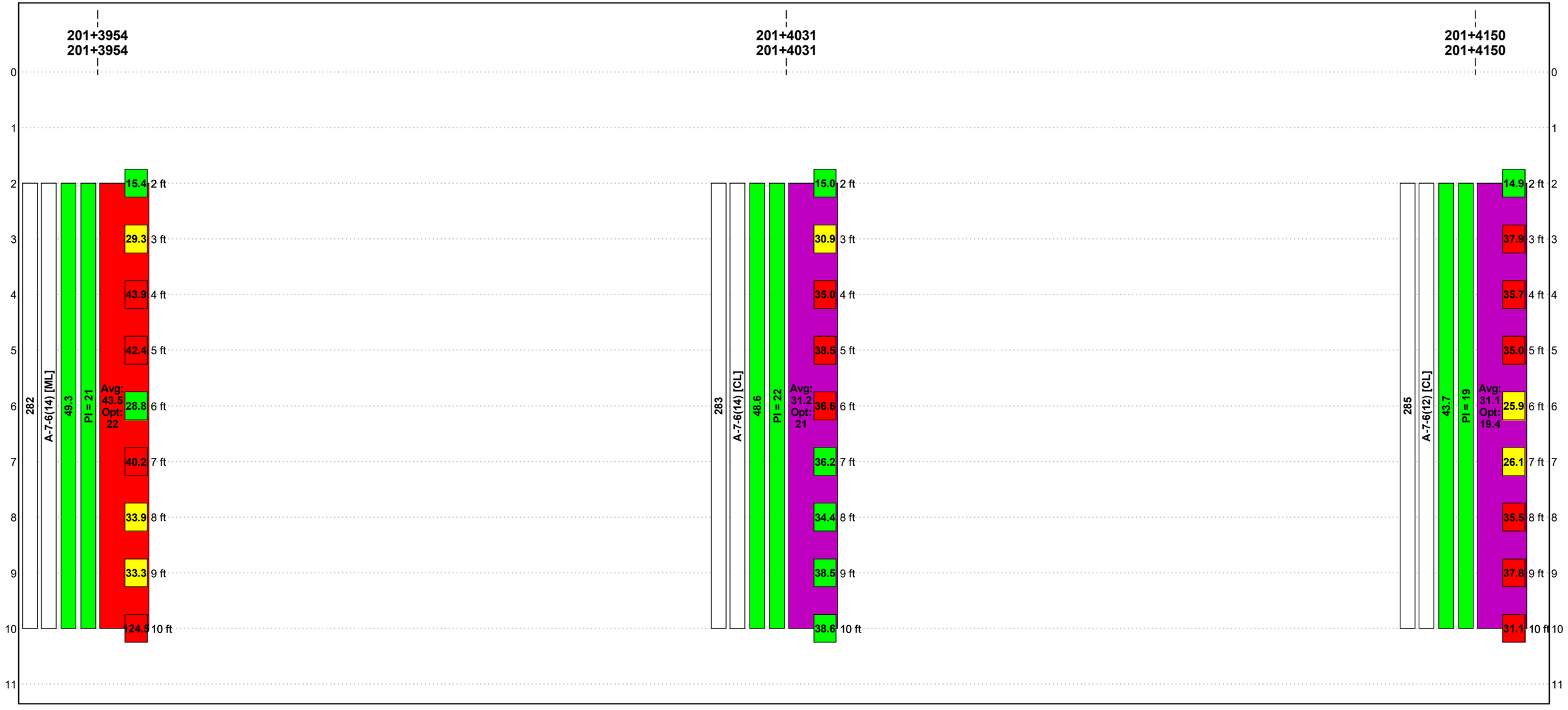
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

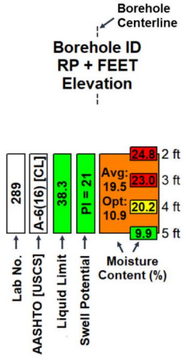
**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **PCN** 22616 & 23109

**LOCATION** Cavalier County

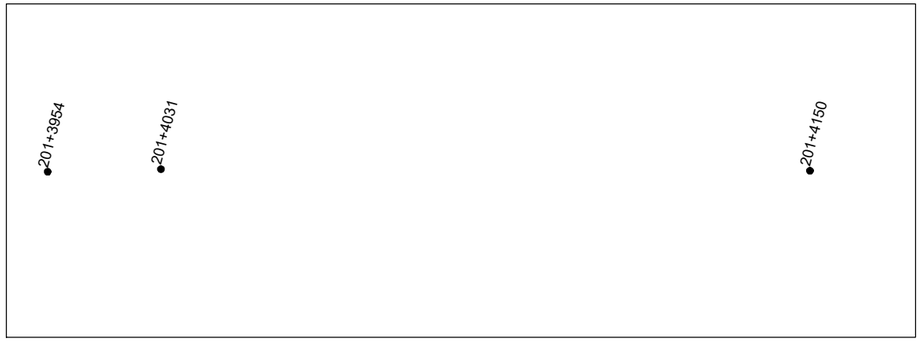



Boreholes Equally Spaced (0 to 180 ft)

**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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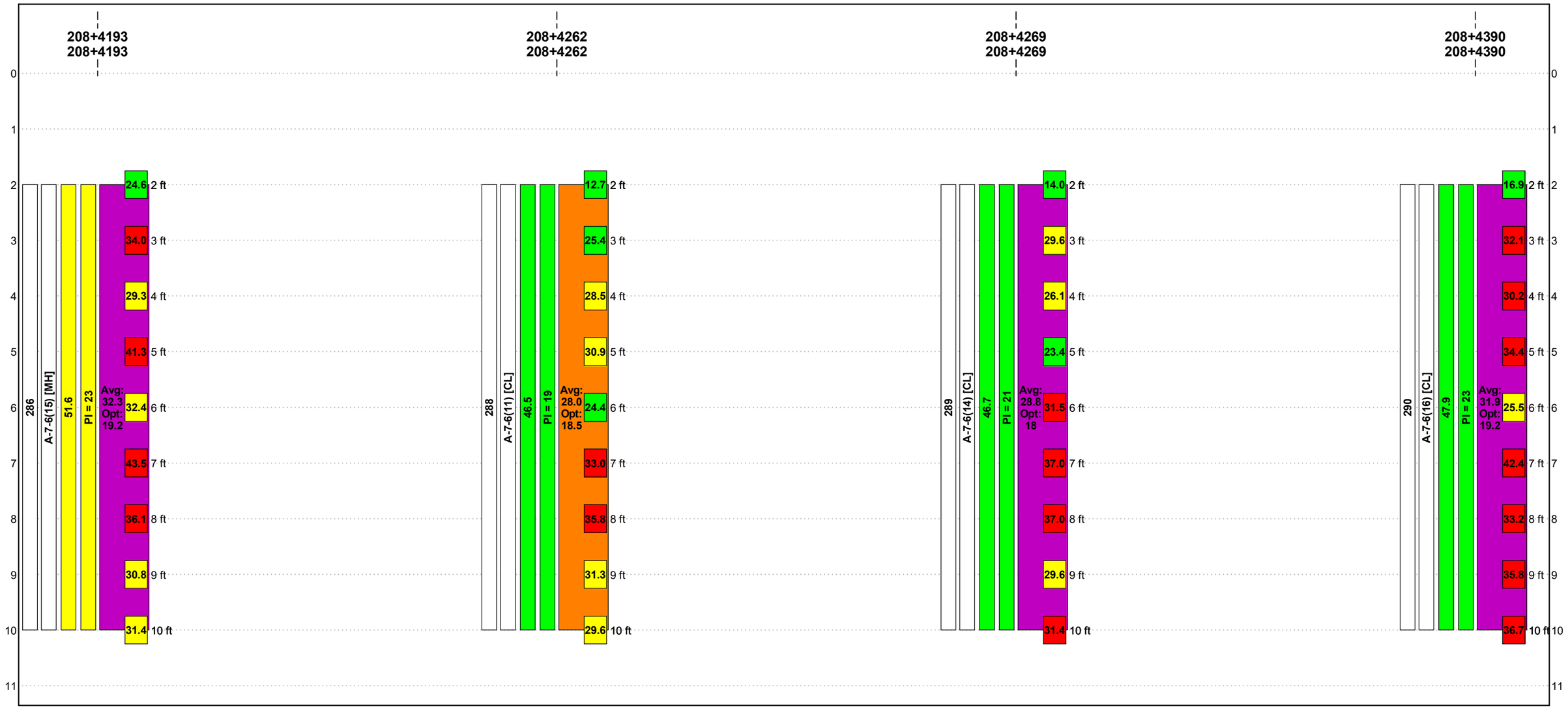
NDDOT North Dakota Department of Transportation

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

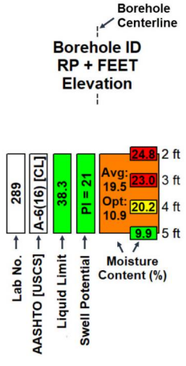
**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **PCN** 22616 & 23109

**LOCATION** Cavalier County

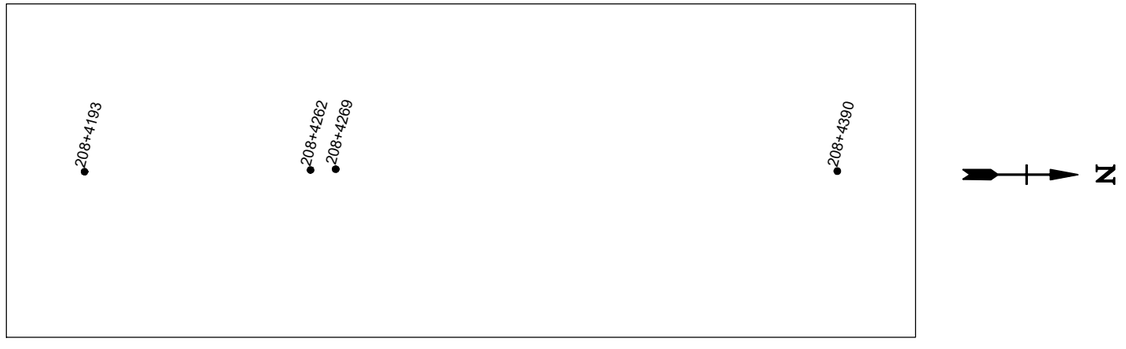



Boreholes Equally Spaced (0 to 50 ft)

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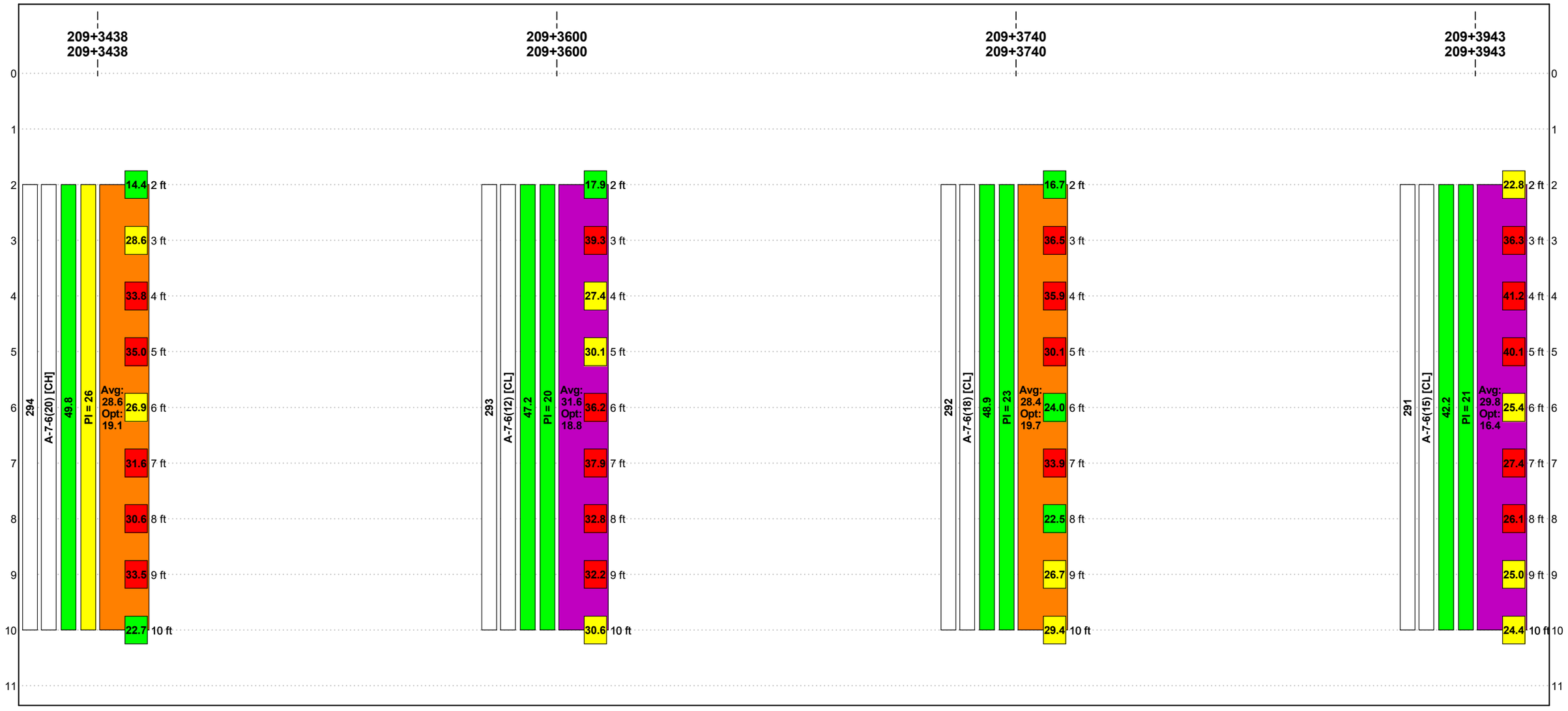
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

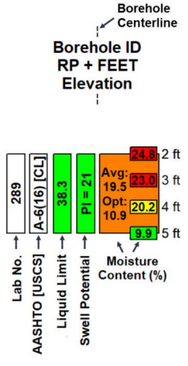
**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **PCN** 22616 & 23109

**LOCATION** Cavalier County

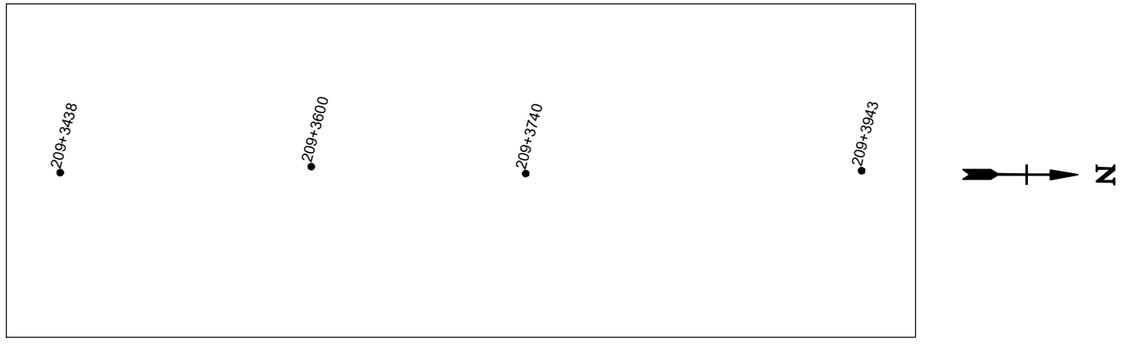



Boreholes Equally Spaced (0 to 110 ft)

**LEGEND**




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




NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/3/22 09:52 - R:\PROJECT\30001200.031\MATERIAL\NEKOMA COMBINED\3-001(031&033)200 NEKOMA .GPJ

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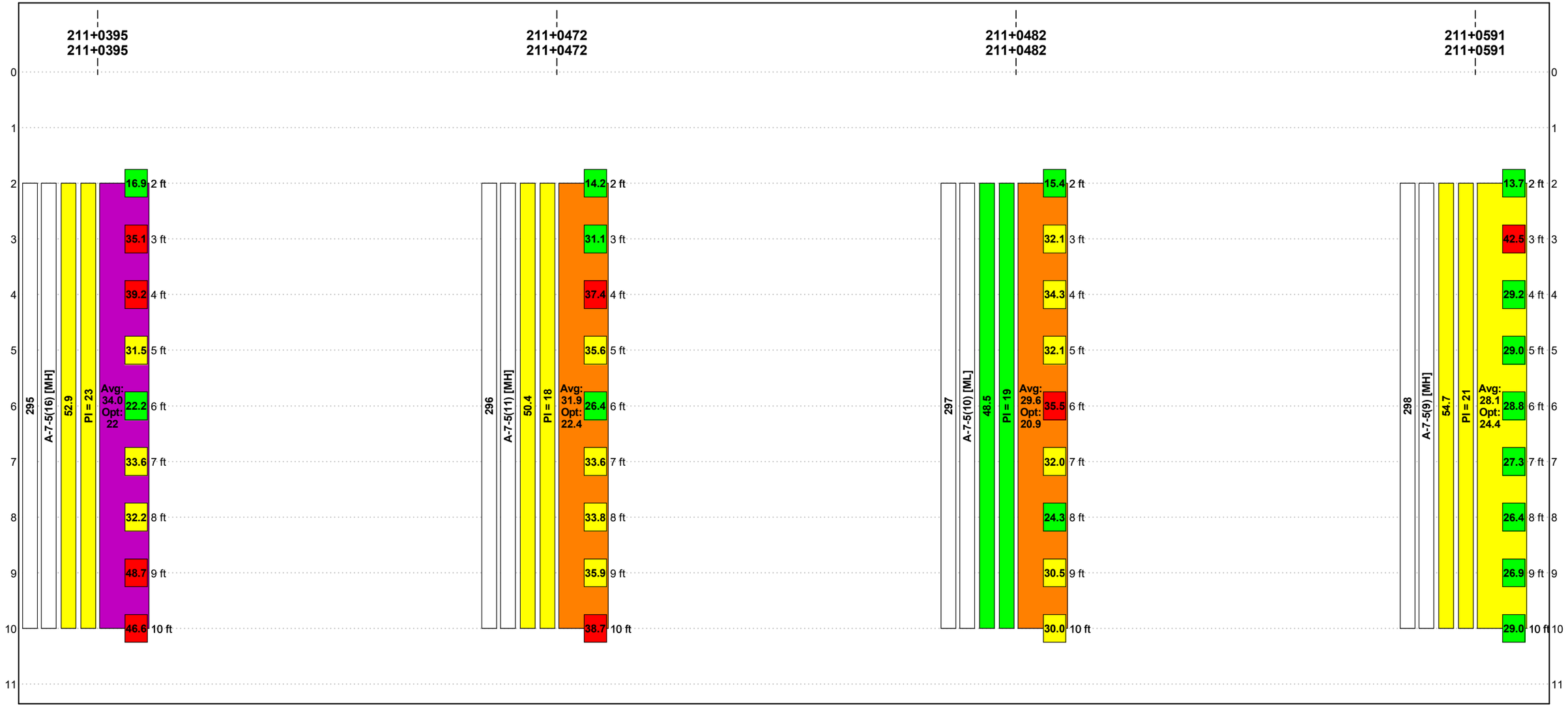
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

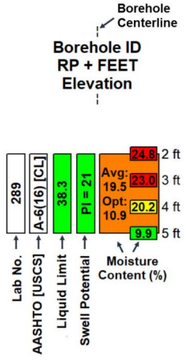
**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **PCN** 22616 & 23109

**LOCATION** Cavalier County

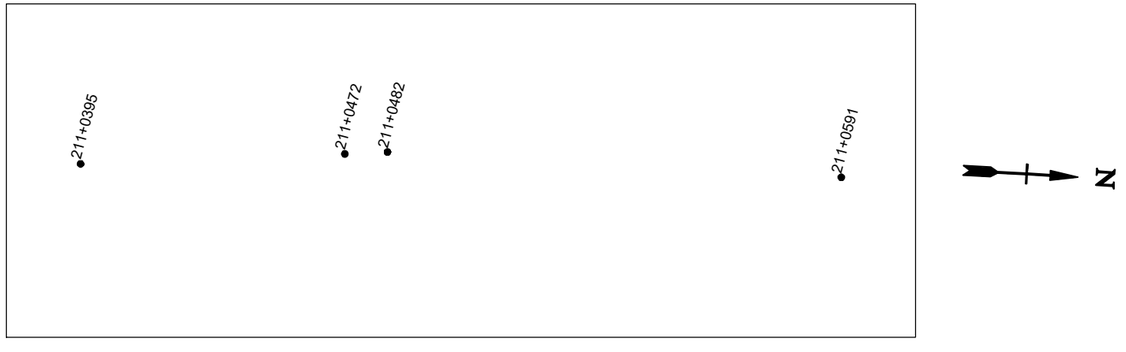



Boreholes Equally Spaced (0 to 45 ft)

**LEGEND**




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

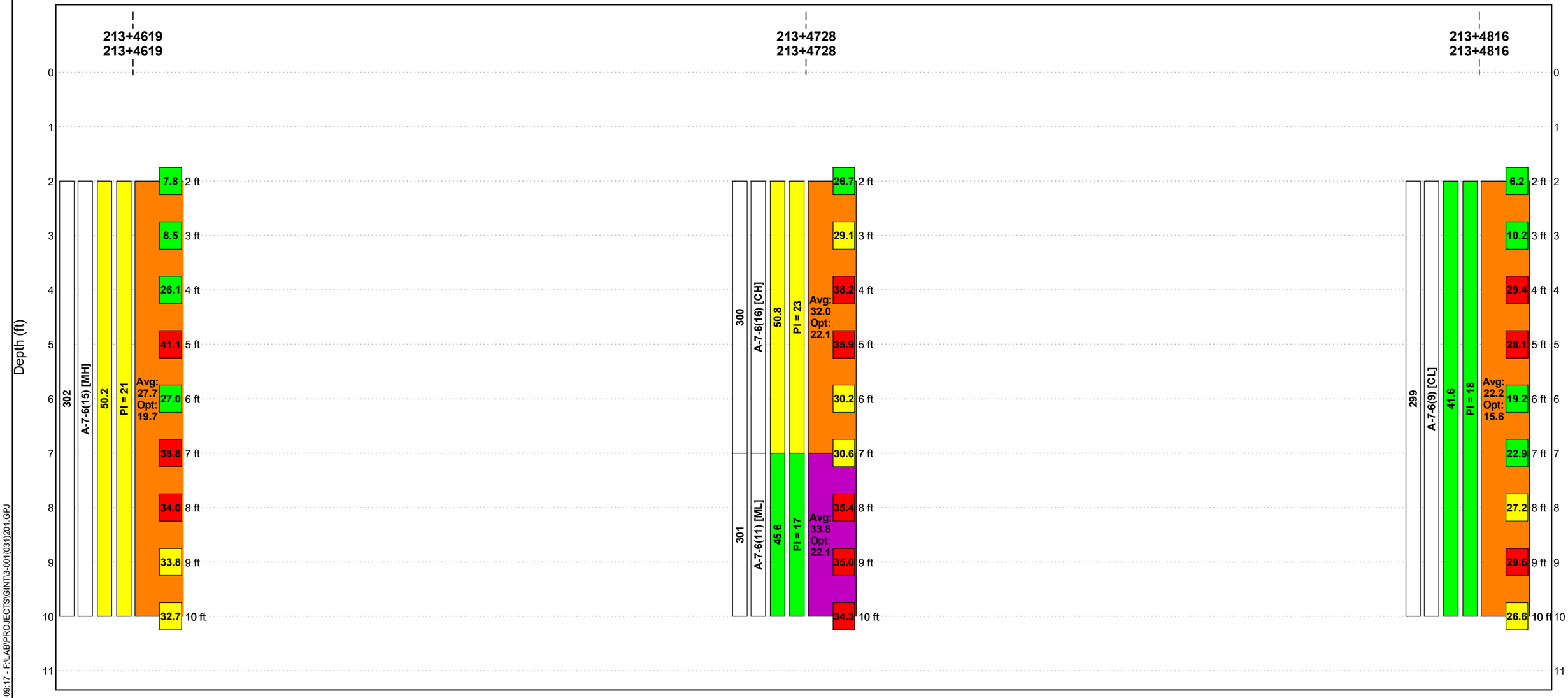



NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/3/22 09:53 - R:\PROJECT\30001200.031\MATERIAL\NEKOMA COMBINED\3-001(031&033)200 NEKOMA .GPJ

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

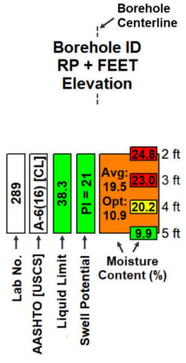
**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **PCN** 22616 & 23109

**LOCATION** Cavalier County

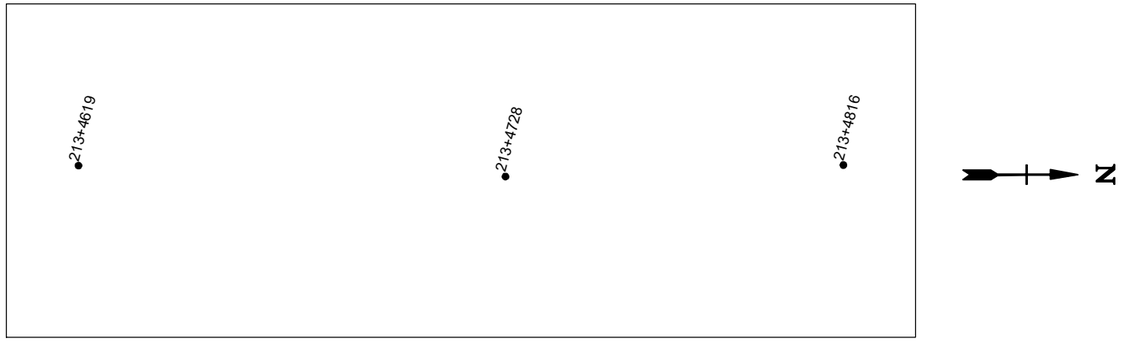



Boreholes Equally Spaced (0 to 40 ft)

**LEGEND**




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




NDDOT_LINEARCOLORFENCE_DEPTH - 20171219.GDT - 6/15/22 09:17 - F:\LAB\PROJECTS\GINT\3-001(031)201.GPJ

# APPENDIX E

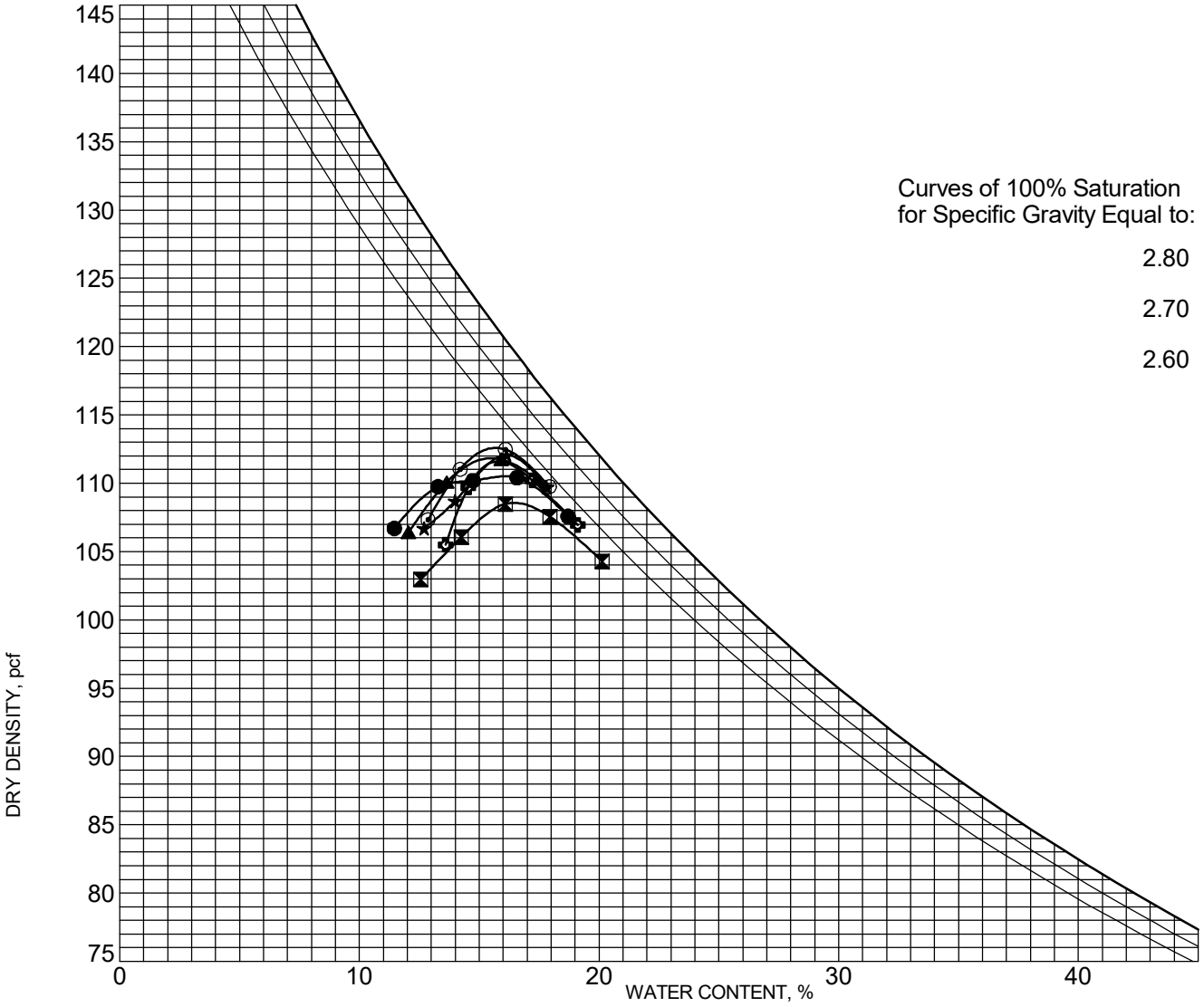
# LAB RESULTS

# MOISTURE-DENSITY RELATIONSHIP

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| BOREHOLE | | DEPTH | AASHTO Classification | USCS Description |
|---|---|---|---|---|
| ● | **200+3010** | **2.0** | **A-7-6 (11)** | **SANDY LEAN CLAY(CL)** |
| ⊠ | **200+4000** | **2.0** | **A-7-6 (12)** | **SANDY LEAN CLAY(CL)** |
| ▲ | **201+1135** | **2.0** | **A-7-6 (10)** | **SANDY LEAN CLAY(CL)** |
| ★ | **201+1335** | **2.0** | **A-7-6 (11)** | **SANDY LEAN CLAY(CL)** |
| ⊙ | **201+1660** | **2.0** | **A-7-6 (13)** | **SANDY LEAN CLAY(CL)** |
| ✪ | **201+2000** | **2.0** | **A-7-6 (13)** | **SANDY LEAN CLAY(CL)** |

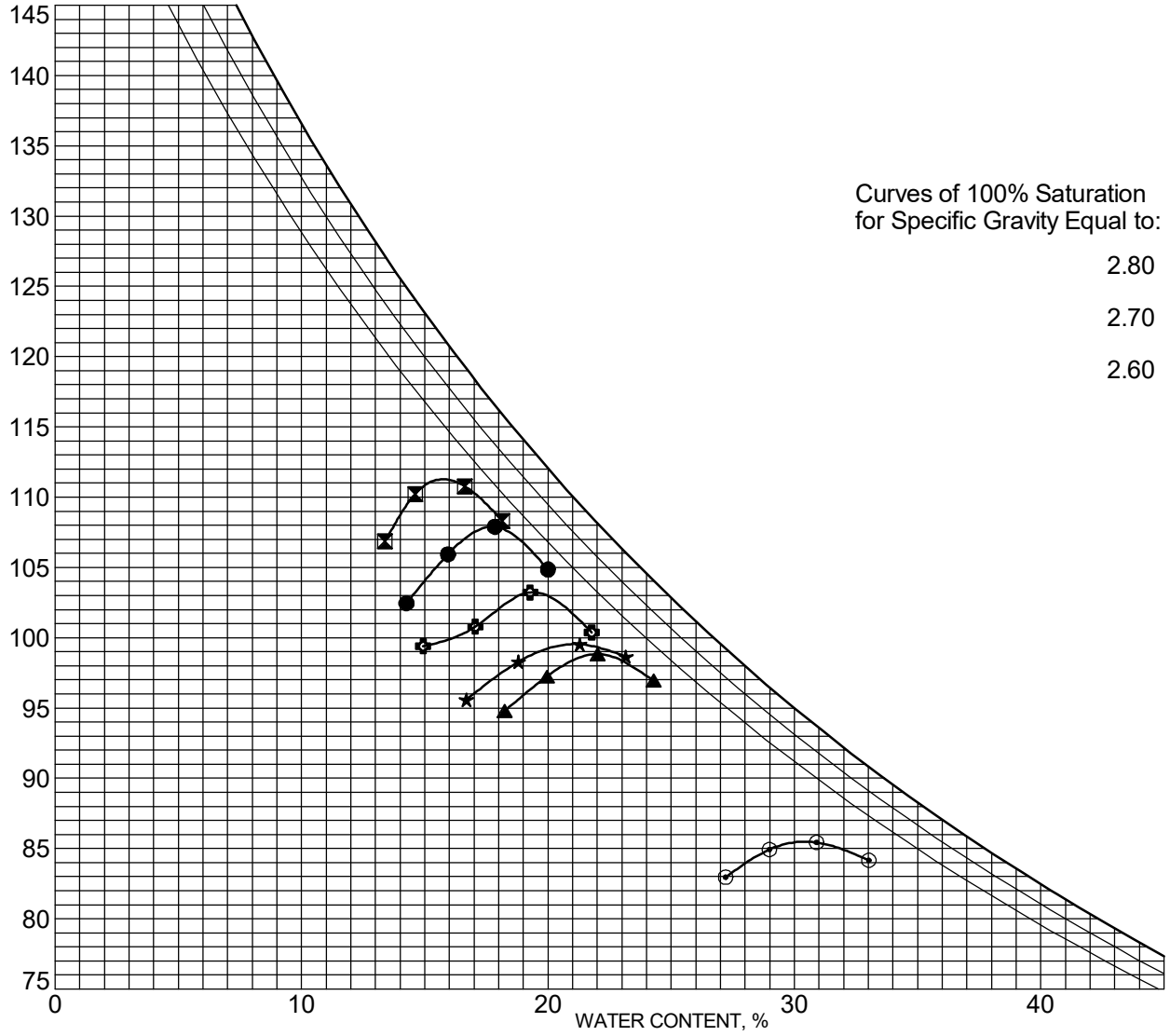
| BOREHOLE | | DEPTH | Test Method | LL | PL | PI | Max DD | Optimum WC |
|---|---|---|---|---|---|---|---|---|
| ● | **200+3010** | **2.0** | **AASHTO T-180 Method A** | **43** | **23** | **20** | **110.5 PCF** | **16.1 %** |
| ⊠ | **200+4000** | **2.0** | **AASHTO T-180 Method A** | **46** | **25** | **21** | **108.6 PCF** | **16.5 %** |
| ▲ | **201+1135** | **2.0** | **AASHTO T-180 Method A** | **42** | **23** | **19** | **111.8 PCF** | **15.6 %** |
| ★ | **201+1335** | **2.0** | **AASHTO T-180 Method A** | **43** | **22** | **21** | **112.1 PCF** | **16.1 %** |
| ⊙ | **201+1660** | **2.0** | **AASHTO T-180 Method A** | **45** | **24** | **21** | **112.6 PCF** | **15.7 %** |
| ✪ | **201+2000** | **2.0** | **AASHTO T-180 Method A** | **44** | **22** | **22** | **111.6 PCF** | **15.8 %** |

# MOISTURE-DENSITY RELATIONSHIP

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| BOREHOLE | | DEPTH | AASHTO Classification | USCS Description |
|---|---|---|---|---|
| ● | 201+2832 | 2.0 | A-7-6 (13) | SANDY LEAN CLAY(CL) |
| ⊠ | 201+3000 | 2.0 | A-6 (8) | SANDY LEAN CLAY(CL) |
| ▲ | 201+3954 | 2.0 | A-7-6 (14) | SILT with SAND(ML) |
| ★ | 201+4031 | 2.0 | A-7-6 (14) | SANDY LEAN CLAY(CL) |
| ⊙ | 201+4031 | 7.0 | A-7-5 (26) | ELASTIC SILT with SAND(MH) |
| ✪ | 201+4150 | 2.0 | A-7-6 (12) | SANDY LEAN CLAY(CL) |

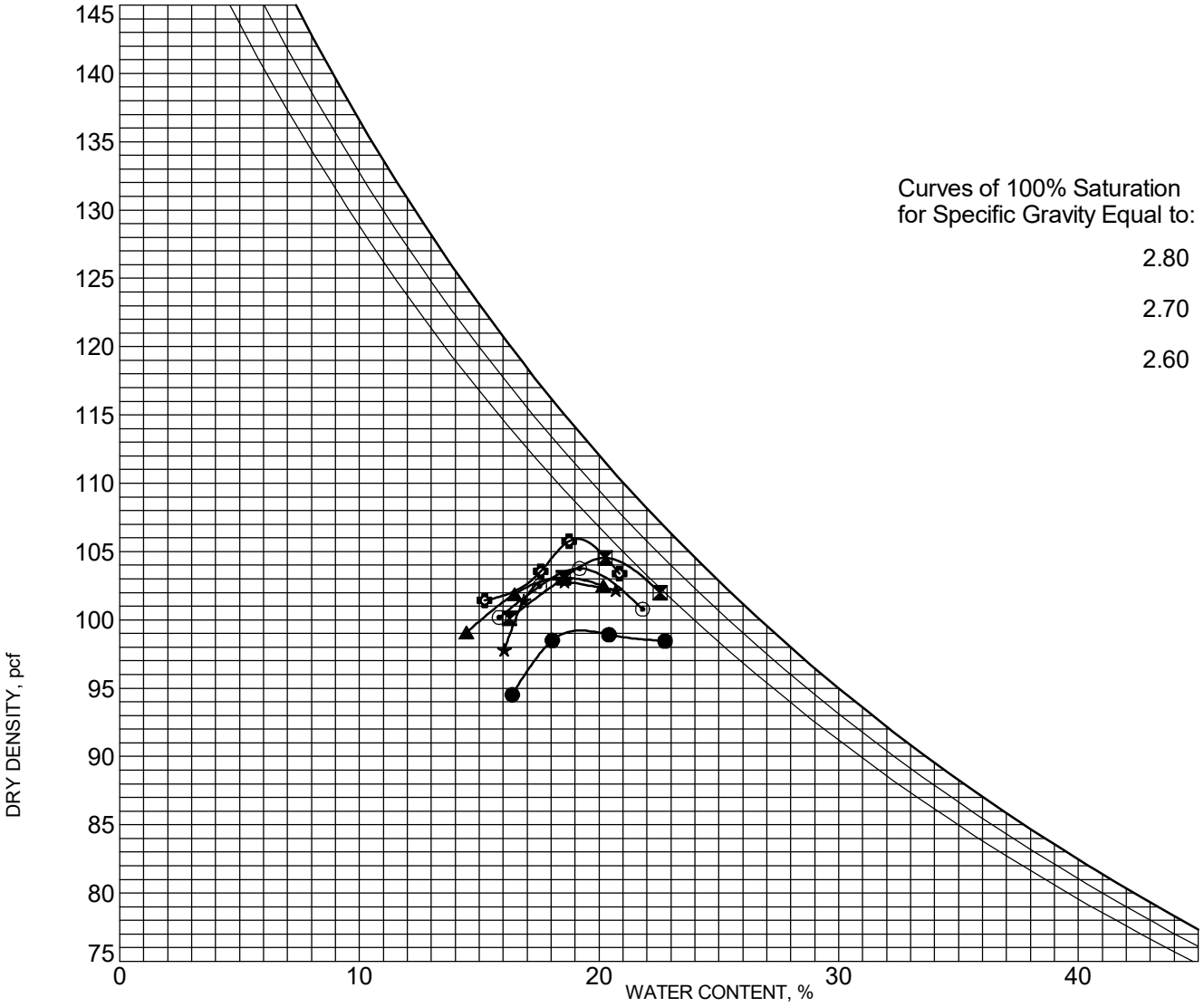
| BOREHOLE | | DEPTH | Test Method | LL | PL | PI | Max DD | Optimum WC |
|---|---|---|---|---|---|---|---|---|
| ● | 201+2832 | 2.0 | AASHTO T-180 Method A | 45 | 23 | 22 | 107.9 PCF | 17.7 % |
| ⊠ | 201+3000 | 2.0 | AASHTO T-180 Method A | 40 | 23 | 17 | 111.3 PCF | 15.8 % |
| ▲ | 201+3954 | 2.0 | AASHTO T-180 Method A | 49 | 29 | 20 | 98.8 PCF | 22.0 % |
| ★ | 201+4031 | 2.0 | AASHTO T-180 Method A | 49 | 27 | 22 | 99.5 PCF | 21.0 % |
| ⊙ | 201+4031 | 7.0 | AASHTO T-180 Method A | 68 | 39 | 29 | 85.5 PCF | 30.4 % |
| ✪ | 201+4150 | 2.0 | AASHTO T-180 Method A | 44 | 24 | 20 | 103.2 PCF | 19.4 % |

# MOISTURE-DENSITY RELATIONSHIP

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| BOREHOLE | | DEPTH | AASHTO Classification | USCS Description |
|---|---|---|---|---|
| ● | 208+4193 | 2.0 | A-7-6 (15) | SANDY ELASTIC SILT(MH) |
| ⊠ | 208+4193 | 7.0 | A-7-5 (14) | SANDY ELASTIC SILT(MH) |
| ▲ | 208+4262 | 2.0 | A-7-6 (11) | SANDY LEAN CLAY(CL) |
| ★ | 208+4269 | 2.0 | A-7-6 (14) | SANDY LEAN CLAY(CL) |
| ⊙ | 208+4390 | 2.0 | A-7-6 (16) | LEAN CLAY with SAND(CL) |
| ✿ | 209+3438 | 2.0 | A-7-6 (20) | FAT CLAY with SAND(CH) |

| BOREHOLE | | DEPTH | Test Method | LL | PL | PI | Max DD | Optimum WC |
|---|---|---|---|---|---|---|---|---|
| ● | 208+4193 | 2.0 | AASHTO T-180 Method A | 52 | 29 | 23 | 99.2 PCF | 19.2 % |
| ⊠ | 208+4193 | 7.0 | AASHTO T-180 Method A | 50 | 30 | 20 | 104.5 PCF | 20.3 % |
| ▲ | 208+4262 | 2.0 | AASHTO T-180 Method A | 46 | 27 | 19 | 103.1 PCF | 18.5 % |
| ★ | 208+4269 | 2.0 | AASHTO T-180 Method A | 47 | 26 | 21 | 103.0 PCF | 18.0 % |
| ⊙ | 208+4390 | 2.0 | AASHTO T-180 Method A | 48 | 25 | 23 | 103.8 PCF | 19.2 % |
| ✿ | 209+3438 | 2.0 | AASHTO T-180 Method A | 50 | 24 | 26 | 105.9 PCF | 19.1 % |

# MOISTURE-DENSITY RELATIONSHIP

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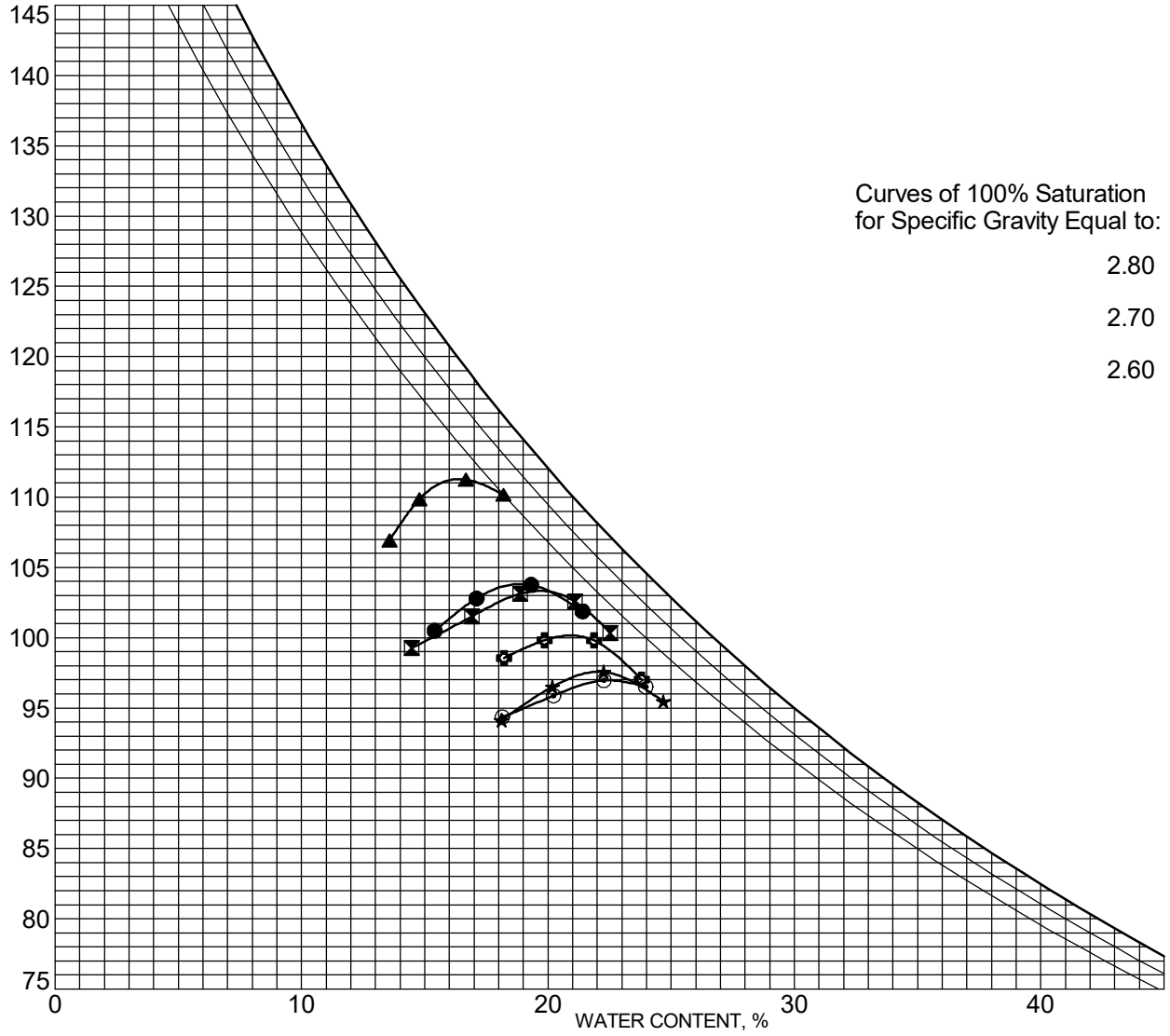
300 AIRPORT ROAD
BISMARCK, ND 58504

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| BOREHOLE | | DEPTH | AASHTO Classification | USCS Description |
|---|---|---|---|---|
| ● | 209+3600 | 2.0 | A-7-6 (12) | SANDY LEAN CLAY(CL) |
| ⊠ | 209+3740 | 2.0 | A-7-6 (18) | LEAN CLAY with SAND(CL) |
| ▲ | 209+3943 | 2.0 | A-7-6 (15) | LEAN CLAY with SAND(CL) |
| ★ | 211+0395 | 2.0 | A-7-5 (16) | ELASTIC SILT with SAND(MH) |
| ⊙ | 211+0472 | 2.0 | A-7-5 (11) | SANDY ELASTIC SILT(MH) |
| ✿ | 211+0482 | 2.0 | A-7-5 (10) | SANDY SILT(ML) |

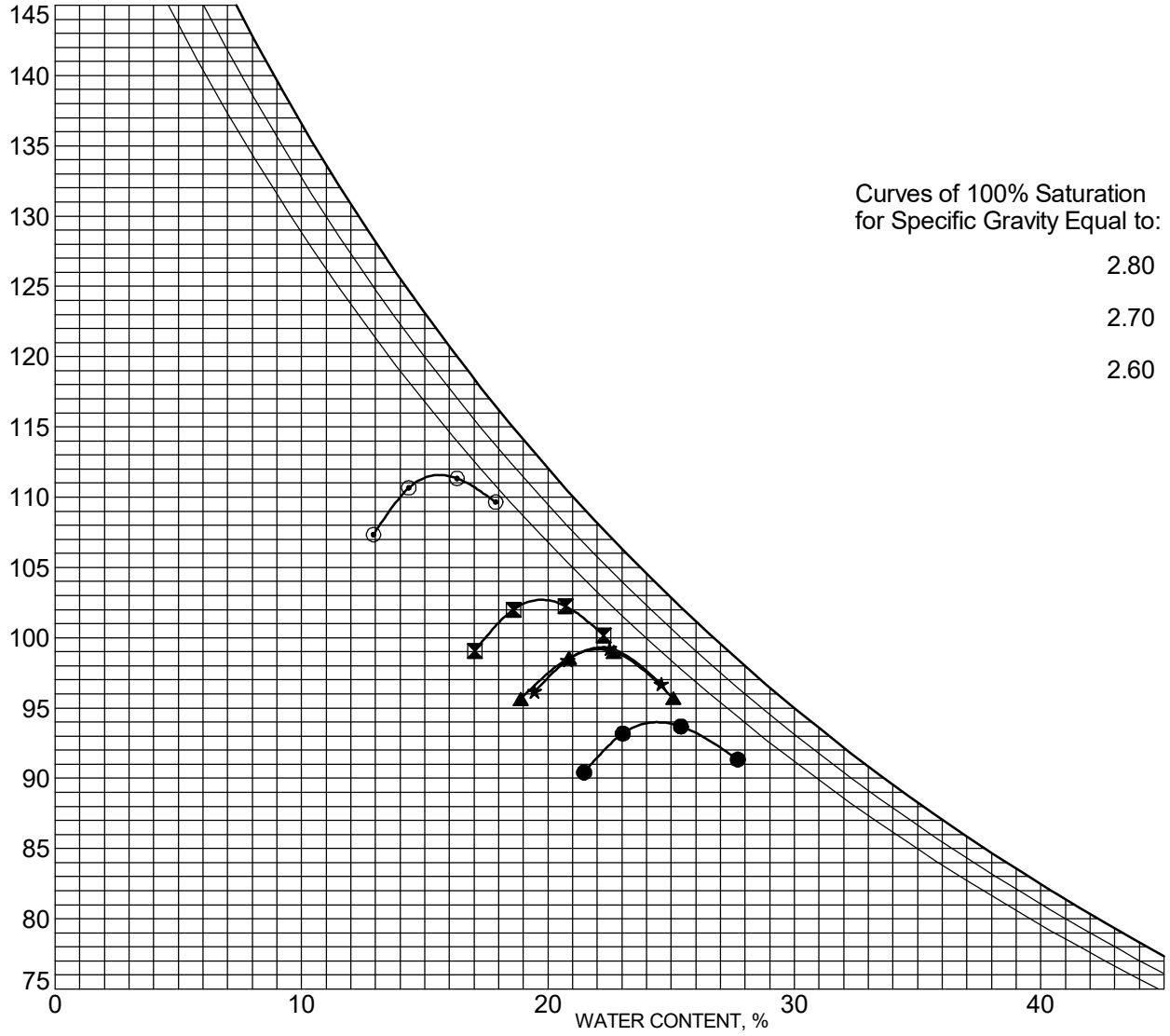
| BOREHOLE | | DEPTH | Test Method | LL | PL | PI | Max DD | Optimum WC |
|---|---|---|---|---|---|---|---|---|
| ● | 209+3600 | 2.0 | AASHTO T-180 Method A | 47 | 27 | 20 | 103.8 PCF | 18.8 % |
| ⊠ | 209+3740 | 2.0 | AASHTO T-180 Method A | 49 | 25 | 24 | 103.3 PCF | 19.7 % |
| ▲ | 209+3943 | 2.0 | AASHTO T-180 Method A | 42 | 21 | 21 | 111.3 PCF | 16.4 % |
| ★ | 211+0395 | 2.0 | AASHTO T-180 Method A | 53 | 30 | 23 | 97.6 PCF | 22.0 % |
| ⊙ | 211+0472 | 2.0 | AASHTO T-180 Method A | 50 | 32 | 18 | 97.0 PCF | 22.4 % |
| ✿ | 211+0482 | 2.0 | AASHTO T-180 Method A | 49 | 30 | 19 | 100.2 PCF | 20.9 % |

# MOISTURE-DENSITY RELATIONSHIP

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| BOREHOLE | | DEPTH | AASHTO Classification | USCS Description |
|---|---|---|---|---|
| ● | 211+0591 | 2.0 | A-7-5 (9) | SANDY ELASTIC SILT(MH) |
| ⊠ | 213+4619 | 2.0 | A-7-6 (15) | ELASTIC SILT with SAND(MH) |
| ▲ | 213+4728 | 2.0 | A-7-6 (16) | SANDY FAT CLAY(CH) |
| ★ | 213+4728 | 7.0 | A-7-6 (11) | SANDY SILT(ML) |
| ⊙ | 213+4816 | 2.0 | A-7-6 (9) | SANDY LEAN CLAY(CL) |
| | | | | |

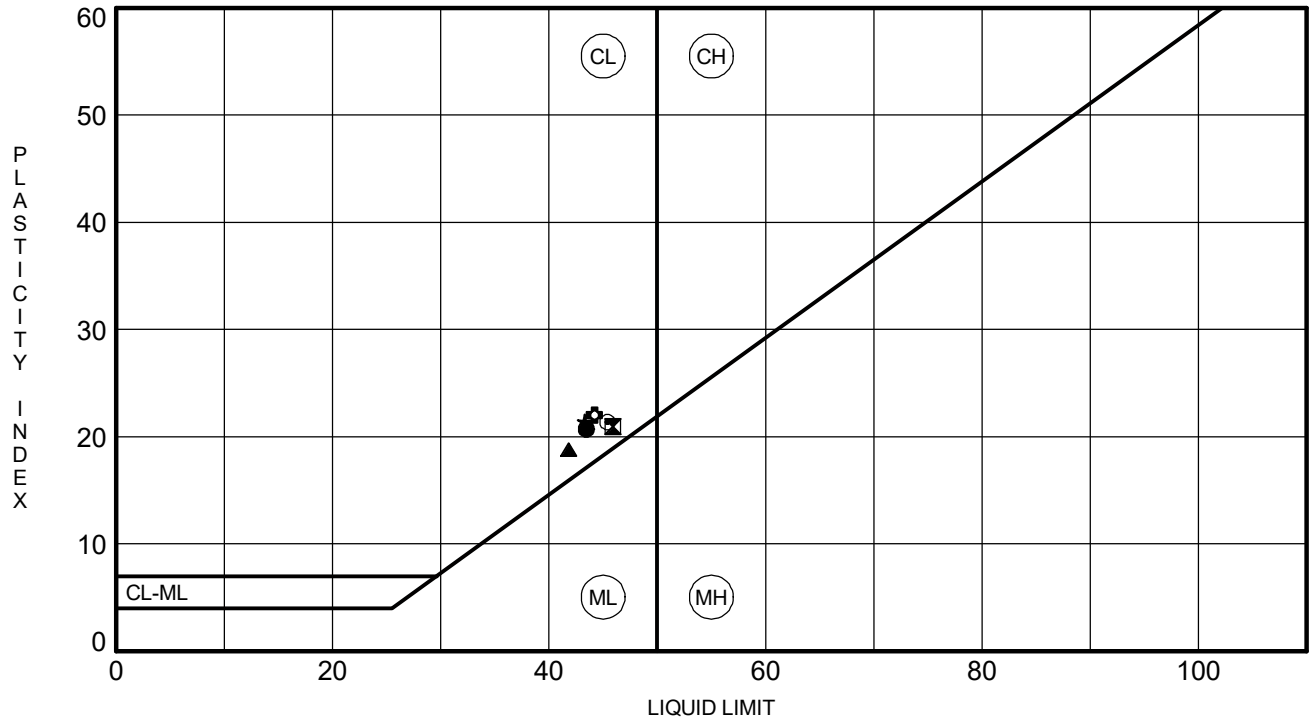
| BOREHOLE | | DEPTH | Test Method | LL | PL | PI | Max DD | Optimum WC |
|---|---|---|---|---|---|---|---|---|
| ● | 211+0591 | 2.0 | AASHTO T-180 Method A | 55 | 33 | 22 | 94.0 PCF | 24.4 % |
| ⊠ | 213+4619 | 2.0 | AASHTO T-180 Method A | 50 | 29 | 21 | 102.7 PCF | 19.7 % |
| ▲ | 213+4728 | 2.0 | AASHTO T-180 Method A | 51 | 27 | 24 | 99.2 PCF | 22.1 % |
| ★ | 213+4728 | 7.0 | AASHTO T-180 Method A | 46 | 28 | 18 | 99.3 PCF | 22.1 % |
| ⊙ | 213+4816 | 2.0 | AASHTO T-180 Method A | 42 | 23 | 19 | 111.6 PCF | 15.6 % |
| | | | | | | | | |

# ATTERBERG LIMITS' RESULTS

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

**PROJECT NUMBER** NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 23109




| | BOREHOLE | DEPTH | LL | PL | PI | Fines | AASHTO [USCS] |
|---|---|---|---|---|---|---|---|
| ● | **200+3010** | **2.0** | **43** | **23** | **20** | **65** | **A-7-6 (11) [SANDY LEAN CLAY(CL)]** |
| ⊠ | **200+4000** | **2.0** | **46** | **25** | **21** | **65** | **A-7-6 (12) [SANDY LEAN CLAY(CL)]** |
| ▲ | **201+1135** | **2.0** | **42** | **23** | **19** | **63** | **A-7-6 (10) [SANDY LEAN CLAY(CL)]** |
| ★ | **201+1335** | **2.0** | **43** | **22** | **21** | **63** | **A-7-6 (11) [SANDY LEAN CLAY(CL)]** |
| ⊙ | **201+1660** | **2.0** | **45** | **24** | **21** | **68** | **A-7-6 (13) [SANDY LEAN CLAY(CL)]** |
| ✿ | **201+2000** | **2.0** | **44** | **22** | **22** | **65** | **A-7-6 (13) [SANDY LEAN CLAY(CL)]** |

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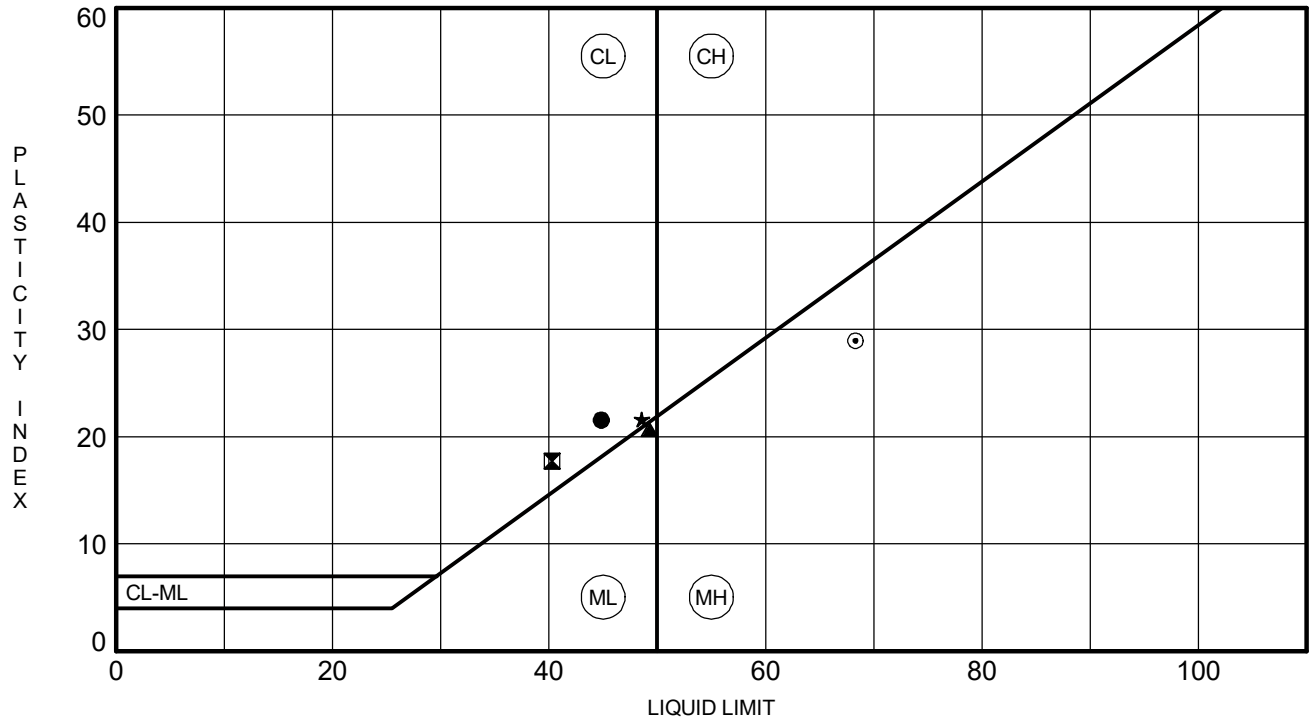
# ATTERBERG LIMITS' RESULTS

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

**PROJECT NUMBER** NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 23109



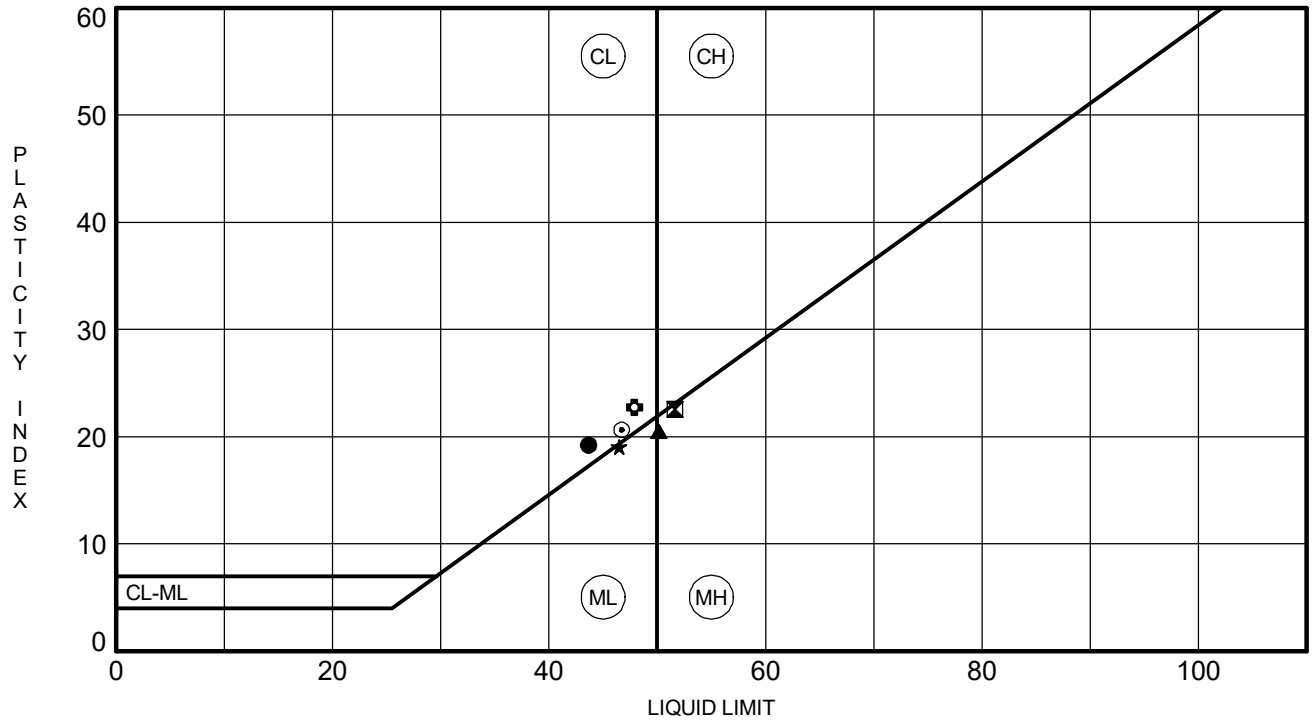

| | BOREHOLE | DEPTH | LL | PL | PI | Fines | AASHTO [USCS] |
|---|---|---|---|---|---|---|---|
| ● | **201+2832** | **2.0** | **45** | **23** | **22** | **65** | **A-7-6 (13) [SANDY LEAN CLAY(CL)]** |
| ⊠ | **201+3000** | **2.0** | **40** | **23** | **17** | **59** | **A-6 (8) [SANDY LEAN CLAY(CL)]** |
| ▲ | **201+3954** | **2.0** | **49** | **29** | **20** | **70** | **A-7-6 (14) [SILT with SAND(ML)]** |
| ★ | **201+4031** | **2.0** | **49** | **27** | **22** | **67** | **A-7-6 (14) [SANDY LEAN CLAY(CL)]** |
| ⊙ | **201+4031** | **7.0** | **68** | **39** | **29** | **76** | **A-7-5 (26) [ELASTIC SILT with SAND(MH)]** |

# ATTERBERG LIMITS' RESULTS

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

**PROJECT NUMBER** NH-3-001(031)201 **LOCATION** Cavalier County

**PCN** 22616



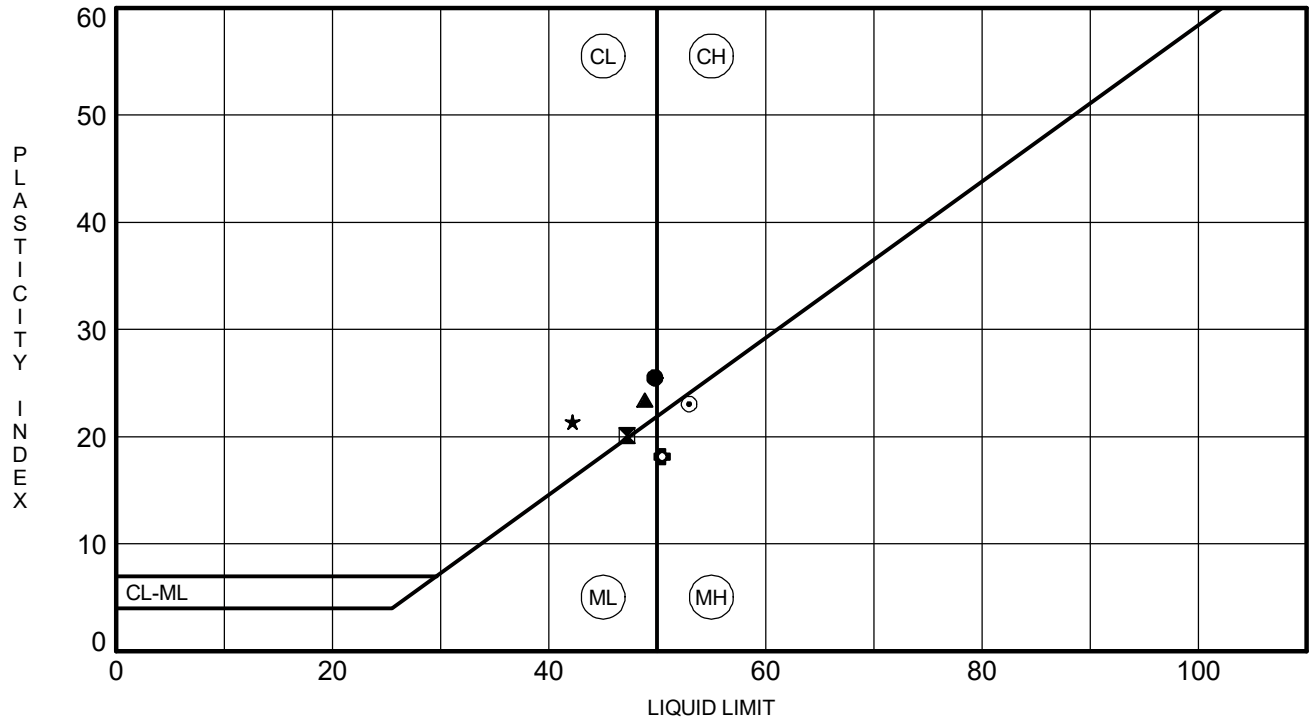

| | BOREHOLE | DEPTH | LL | PL | PI | Fines | AASHTO [USCS] |
|---|---|---|---|---|---|---|---|
| ● | **201+4150** | **2.0** | **44** | **24** | **20** | **65** | **A-7-6 (12) [SANDY LEAN CLAY(CL)]** |
| ⊠ | **208+4193** | **2.0** | **52** | **29** | **23** | **68** | **A-7-6 (15) [SANDY ELASTIC SILT(MH)]** |
| ▲ | **208+4193** | **7.0** | **50** | **30** | **20** | **69** | **A-7-5 (14) [SANDY ELASTIC SILT(MH)]** |
| ★ | **208+4262** | **2.0** | **46** | **27** | **19** | **64** | **A-7-6 (11) [SANDY LEAN CLAY(CL)]** |
| ⊙ | **208+4269** | **2.0** | **47** | **26** | **21** | **69** | **A-7-6 (14) [SANDY LEAN CLAY(CL)]** |
| ✿ | **208+4390** | **2.0** | **48** | **25** | **23** | **72** | **A-7-6 (16) [LEAN CLAY with SAND(CL)]** |

# ATTERBERG LIMITS' RESULTS

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

**PROJECT NUMBER** NH-3-001(031)201 **LOCATION** Cavalier County

**PCN** 22616



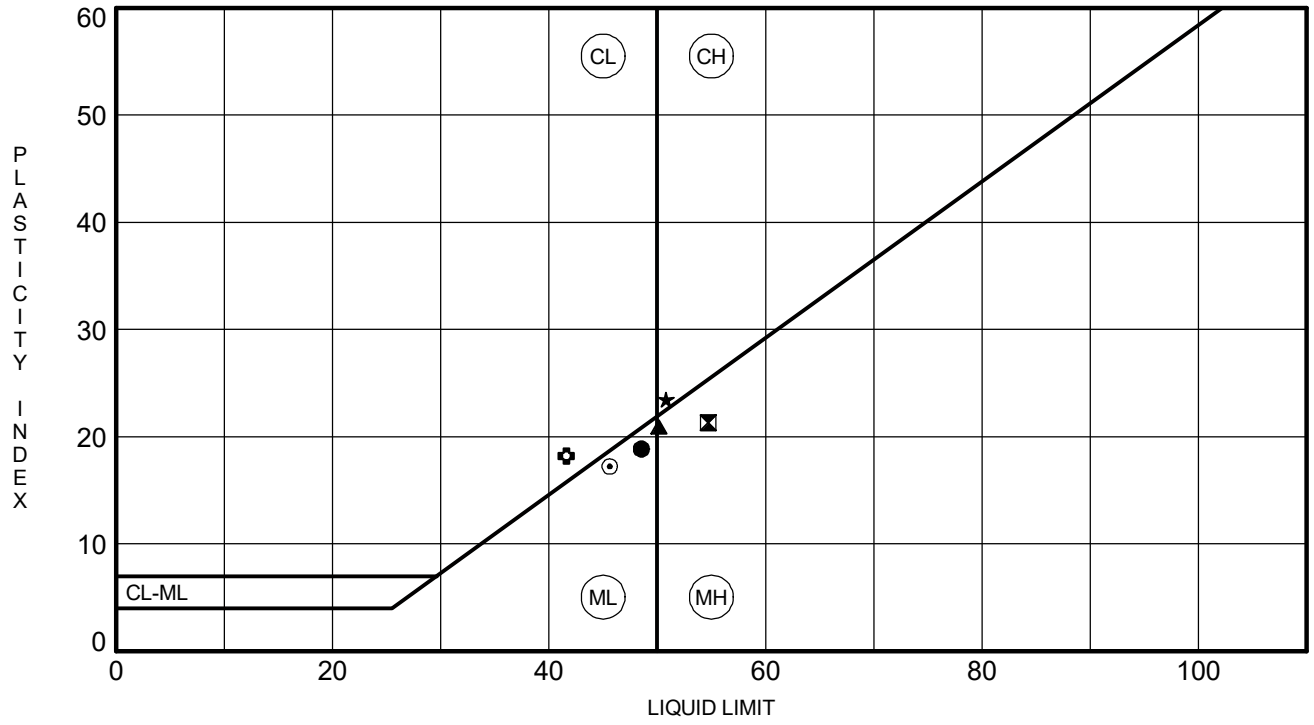

| | BOREHOLE | DEPTH | LL | PL | PI | Fines | AASHTO [USCS] |
|---|---|---|---|---|---|---|---|
| ● | **209+3438** | **2.0** | **50** | **24** | **26** | **77** | **A-7-6 (20) [FAT CLAY with SAND(CH)]** |
| ⊠ | **209+3600** | **2.0** | **47** | **27** | **20** | **64** | **A-7-6 (12) [SANDY LEAN CLAY(CL)]** |
| ▲ | **209+3740** | **2.0** | **49** | **25** | **24** | **74** | **A-7-6 (18) [LEAN CLAY with SAND(CL)]** |
| ★ | **209+3943** | **2.0** | **42** | **21** | **21** | **75** | **A-7-6 (15) [LEAN CLAY with SAND(CL)]** |
| ⊙ | **211+0395** | **2.0** | **53** | **30** | **23** | **70** | **A-7-5 (16) [ELASTIC SILT with SAND(MH)]** |
| ✿ | **211+0472** | **2.0** | **50** | **32** | **18** | **63** | **A-7-5 (11) [SANDY ELASTIC SILT(MH)]** |

# ATTERBERG LIMITS' RESULTS

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

**PROJECT NUMBER** NH-3-001(031)201 **LOCATION** Cavalier County

**PCN** 22616




| | BOREHOLE | DEPTH | LL | PL | PI | Fines | AASHTO [USCS] |
|---|---|---|---|---|---|---|---|
| ● | **211+0482** | **2.0** | **49** | **30** | **19** | **58** | **A-7-5 (10) [SANDY SILT(ML)]** |
| ⊠ | **211+0591** | **2.0** | **55** | **33** | **22** | **52** | **A-7-5 (9) [SANDY ELASTIC SILT(MH)]** |
| ▲ | **213+4619** | **2.0** | **50** | **29** | **21** | **71** | **A-7-6 (15) [ELASTIC SILT with SAND(MH)]** |
| ★ | **213+4728** | **2.0** | **51** | **27** | **24** | **69** | **A-7-6 (16) [SANDY FAT CLAY(CH)]** |
| ⊙ | **213+4728** | **7.0** | **46** | **28** | **18** | **65** | **A-7-6 (11) [SANDY SILT(ML)]** |
| ✿ | **213+4816** | **2.0** | **42** | **23** | **19** | **60** | **A-7-6 (9) [SANDY LEAN CLAY(CL)]** |

# SUMMARY OF LABORATORY RESULTS



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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 200+3010 | 2.0 | 43 | 23 | 20 | 9.5 | 65 | A-7-6 (11) | CL | 21.6 | 24.6 | | | |
| 200+3010 | 3.0 | | | | | | | | 22.2 | 24.6 | | | |
| 200+3010 | 4.0 | | | | | | | | 26.3 | 24.6 | | | |
| 200+3010 | 5.0 | | | | | | | | 28.3 | 24.6 | | | |
| 200+4000 | 2.0 | 46 | 25 | 21 | 9.5 | 65 | A-7-6 (12) | CL | 19.4 | 27.7 | | | |
| 200+4000 | 3.0 | | | | | | | | 33.0 | 27.7 | | | |
| 200+4000 | 4.0 | | | | | | | | 30.5 | 27.7 | | | |
| 200+4000 | 5.0 | | | | | | | | 27.9 | 27.7 | | | |
| 201+1135 | 2.0 | 42 | 23 | 19 | 9.5 | 63 | A-7-6 (10) | CL | 15.2 | 23.3 | | | |
| 201+1135 | 3.0 | | | | | | | | 25.8 | 23.3 | | | |
| 201+1135 | 4.0 | | | | | | | | 29.7 | 23.3 | | | |
| 201+1135 | 5.0 | | | | | | | | 16.5 | 23.3 | | | |
| 201+1135 | 6.0 | | | | | | | | 18.0 | 23.3 | | | |
| 201+1135 | 7.0 | | | | | | | | 18.8 | 23.3 | | | |
| 201+1135 | 8.0 | | | | | | | | 26.6 | 23.3 | | | |
| 201+1135 | 9.0 | | | | | | | | 29.0 | 23.3 | | | |
| 201+1135 | 10.0 | | | | | | | | 29.8 | 23.3 | | | |
| 201+1335 | 2.0 | 43 | 22 | 21 | 9.5 | 63 | A-7-6 (11) | CL | 15.3 | 24.1 | | | |
| 201+1335 | 3.0 | | | | | | | | 25.3 | 24.1 | | | |
| 201+1335 | 4.0 | | | | | | | | 23.8 | 24.1 | | | |
| 201+1335 | 5.0 | | | | | | | | 30.8 | 24.1 | | | |
| 201+1335 | 6.0 | | | | | | | | 27.7 | 24.1 | | | |
| 201+1335 | 7.0 | | | | | | | | 22.0 | 24.1 | | | |
| 201+1335 | 8.0 | | | | | | | | 24.7 | 24.1 | | | |
| 201+1335 | 9.0 | | | | | | | | 23.8 | 24.1 | | | |
| 201+1335 | 10.0 | | | | | | | | 23.4 | 24.1 | | | |
| 201+1660 | 2.0 | 45 | 24 | 21 | 9.5 | 68 | A-7-6 (13) | CL | 19.9 | 26.7 | | | |
| 201+1660 | 3.0 | | | | | | | | 23.1 | 26.7 | | | |
| 201+1660 | 4.0 | | | | | | | | 26.8 | 26.7 | | | |
| 201+1660 | 5.0 | | | | | | | | 32.5 | 26.7 | | | |
| 201+1660 | 6.0 | | | | | | | | 33.9 | 26.7 | | | |
| 201+1660 | 7.0 | | | | | | | | 24.3 | 26.7 | | | |
| 201+1660 | 8.0 | | | | | | | | 26.4 | 26.7 | | | |
| 201+1660 | 9.0 | | | | | | | | 28.4 | 26.7 | | | |
| 201+1660 | 10.0 | | | | | | | | 24.7 | 26.7 | | | |
| 201+2000 | 2.0 | 44 | 22 | 22 | 9.5 | 65 | A-7-6 (13) | CL | 26.9 | 28.4 | | | |
| 201+2000 | 3.0 | | | | | | | | 22.1 | 28.4 | | | |
| 201+2000 | 4.0 | | | | | | | | 34.9 | 28.4 | | | |
| 201+2000 | 5.0 | | | | | | | | 33.9 | 28.4 | | | |
| 201+2000 | 6.0 | | | | | | | | 29.2 | 28.4 | | | |
| 201+2000 | 7.0 | | | | | | | | 30.3 | 28.4 | | | |
| 201+2000 | 8.0 | | | | | | | | 25.2 | 28.4 | | | |
| 201+2000 | 9.0 | | | | | | | | 28.1 | 28.4 | | | |

# SUMMARY OF LABORATORY RESULTS



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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 201+2000 | 10.0 | | | | | | | | 24.5 | 28.4 | | | |
| 201+2832 | 2.0 | 45 | 23 | 22 | 9.5 | 65 | A-7-6 (13) | CL | 16.3 | 30.9 | | | |
| 201+2832 | 3.0 | | | | | | | | 31.1 | 30.9 | | | |
| 201+2832 | 4.0 | | | | | | | | 36.8 | 30.9 | | | |
| 201+2832 | 5.0 | | | | | | | | 36.4 | 30.9 | | | |
| 201+2832 | 6.0 | | | | | | | | 31.0 | 30.9 | | | |
| 201+2832 | 7.0 | | | | | | | | 32.7 | 30.9 | | | |
| 201+2832 | 8.0 | | | | | | | | 30.5 | 30.9 | | | |
| 201+2832 | 9.0 | | | | | | | | 31.0 | 30.9 | | | |
| 201+2832 | 10.0 | | | | | | | | 32.6 | 30.9 | | | |
| 201+3000 | 2.0 | 40 | 23 | 17 | 9.5 | 59 | A-6 (8) | CL | 23.6 | 28.5 | | | |
| 201+3000 | 3.0 | | | | | | | | 32.3 | 28.5 | | | |
| 201+3000 | 4.0 | | | | | | | | 28.5 | 28.5 | | | |
| 201+3000 | 5.0 | | | | | | | | 29.2 | 28.5 | | | |
| 201+3000 | 6.0 | | | | | | | | 25.5 | 28.5 | | | |
| 201+3000 | 7.0 | | | | | | | | 26.1 | 28.5 | | | |
| 201+3000 | 8.0 | | | | | | | | 27.1 | 28.5 | | | |
| 201+3000 | 9.0 | | | | | | | | 26.9 | 28.5 | | | |
| 201+3000 | 10.0 | | | | | | | | 37.6 | 28.5 | | | |
| 201+3954 | 2.0 | 49 | 29 | 20 | 9.5 | 70 | A-7-6 (14) | ML | 15.4 | 43.5 | | | |
| 201+3954 | 3.0 | | | | | | | | 29.3 | 43.5 | | | |
| 201+3954 | 4.0 | | | | | | | | 43.9 | 43.5 | | | |
| 201+3954 | 5.0 | | | | | | | | 42.4 | 43.5 | | | |
| 201+3954 | 6.0 | | | | | | | | 28.8 | 43.5 | | | |
| 201+3954 | 7.0 | | | | | | | | 40.2 | 43.5 | | | |
| 201+3954 | 8.0 | | | | | | | | 33.9 | 43.5 | | | |
| 201+3954 | 9.0 | | | | | | | | 33.3 | 43.5 | | | |
| 201+3954 | 10.0 | | | | | | | | 124.5 | 43.5 | | | |
| 201+4031 | 2.0 | 49 | 27 | 22 | 9.5 | 67 | A-7-6 (14) | CL | 15.0 | 31.2 | | | |
| 201+4031 | 3.0 | | | | | | | | 30.9 | 31.2 | | | |
| 201+4031 | 4.0 | | | | | | | | 35.0 | 31.2 | | | |
| 201+4031 | 5.0 | | | | | | | | 38.5 | 31.2 | | | |
| 201+4031 | 6.0 | | | | | | | | 36.6 | 31.2 | | | |
| 201+4031 | 7.0 | 68 | 39 | 29 | 9.5 | 76 | A-7-5 (26) | MH | 36.2 | 36.9 | | | |
| 201+4031 | 8.0 | | | | | | | | 34.4 | 36.9 | | | |
| 201+4031 | 9.0 | | | | | | | | 38.5 | 36.9 | | | |
| 201+4031 | 10.0 | | | | | | | | 38.6 | 36.9 | | | |
| 201+4150 | 2.0 | 44 | 24 | 20 | 9.5 | 65 | A-7-6 (12) | CL | 14.9 | 31.1 | | | |
| 201+4150 | 3.0 | | | | | | | | 37.9 | 31.1 | | | |
| 201+4150 | 4.0 | | | | | | | | 35.7 | 31.1 | | | |
| 201+4150 | 5.0 | | | | | | | | 35.0 | 31.1 | | | |
| 201+4150 | 6.0 | | | | | | | | 25.9 | 31.1 | | | |
| 201+4150 | 7.0 | | | | | | | | 26.1 | 31.1 | | | |

# SUMMARY OF LABORATORY RESULTS

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 201+4150 | 8.0 | | | | | | | | 35.5 | 31.1 | | | |
| 201+4150 | 9.0 | | | | | | | | 37.8 | 31.1 | | | |
| 201+4150 | 10.0 | | | | | | | | 31.1 | 31.1 | | | |
| 208+4193 | 2.0 | 52 | 29 | 23 | 9.5 | 68 | A-7-6 (15) | MH | 24.6 | 32.3 | | | |
| 208+4193 | 3.0 | | | | | | | | 34.0 | 32.3 | | | |
| 208+4193 | 4.0 | | | | | | | | 29.3 | 32.3 | | | |
| 208+4193 | 5.0 | | | | | | | | 41.3 | 32.3 | | | |
| 208+4193 | 6.0 | | | | | | | | 32.4 | 32.3 | | | |
| 208+4193 | 7.0 | 50 | 30 | 20 | 9.5 | 69 | A-7-5 (14) | MH | 43.5 | 35.5 | | | |
| 208+4193 | 8.0 | | | | | | | | 36.1 | 35.5 | | | |
| 208+4193 | 9.0 | | | | | | | | 30.8 | 35.5 | | | |
| 208+4193 | 10.0 | | | | | | | | 31.4 | 35.5 | | | |
| 208+4262 | 2.0 | 46 | 27 | 19 | 9.5 | 64 | A-7-6 (11) | CL | 12.7 | 28.0 | | | |
| 208+4262 | 3.0 | | | | | | | | 25.4 | 28.0 | | | |
| 208+4262 | 4.0 | | | | | | | | 28.5 | 28.0 | | | |
| 208+4262 | 5.0 | | | | | | | | 30.9 | 28.0 | | | |
| 208+4262 | 6.0 | | | | | | | | 24.4 | 28.0 | | | |
| 208+4262 | 7.0 | | | | | | | | 33.0 | 28.0 | | | |
| 208+4262 | 8.0 | | | | | | | | 35.8 | 28.0 | | | |
| 208+4262 | 9.0 | | | | | | | | 31.3 | 28.0 | | | |
| 208+4262 | 10.0 | | | | | | | | 29.6 | 28.0 | | | |
| 208+4269 | 2.0 | 47 | 26 | 21 | 9.5 | 69 | A-7-6 (14) | CL | 14.0 | 28.8 | | | |
| 208+4269 | 3.0 | | | | | | | | 29.6 | 28.8 | | | |
| 208+4269 | 4.0 | | | | | | | | 26.1 | 28.8 | | | |
| 208+4269 | 5.0 | | | | | | | | 23.4 | 28.8 | | | |
| 208+4269 | 6.0 | | | | | | | | 31.5 | 28.8 | | | |
| 208+4269 | 7.0 | | | | | | | | 37.0 | 28.8 | | | |
| 208+4269 | 8.0 | | | | | | | | 37.0 | 28.8 | | | |
| 208+4269 | 9.0 | | | | | | | | 29.6 | 28.8 | | | |
| 208+4269 | 10.0 | | | | | | | | 31.4 | 28.8 | | | |
| 208+4390 | 2.0 | 48 | 25 | 23 | 25 | 72 | A-7-6 (16) | CL | 16.9 | 31.9 | | | |
| 208+4390 | 3.0 | | | | | | | | 32.1 | 31.9 | | | |
| 208+4390 | 4.0 | | | | | | | | 30.2 | 31.9 | | | |
| 208+4390 | 5.0 | | | | | | | | 34.4 | 31.9 | | | |
| 208+4390 | 6.0 | | | | | | | | 25.5 | 31.9 | | | |
| 208+4390 | 7.0 | | | | | | | | 42.4 | 31.9 | | | |
| 208+4390 | 8.0 | | | | | | | | 33.2 | 31.9 | | | |
| 208+4390 | 9.0 | | | | | | | | 35.8 | 31.9 | | | |
| 208+4390 | 10.0 | | | | | | | | 36.7 | 31.9 | | | |
| 209+3438 | 2.0 | 50 | 24 | 26 | 9.5 | 77 | A-7-6 (20) | CH | 14.4 | 28.6 | | | |
| 209+3438 | 3.0 | | | | | | | | 28.6 | 28.6 | | | |
| 209+3438 | 4.0 | | | | | | | | 33.8 | 28.6 | | | |
| 209+3438 | 5.0 | | | | | | | | 35.0 | 28.6 | | | |

# SUMMARY OF LABORATORY RESULTS

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 209+3438 | 6.0 | | | | | | | | 26.9 | 28.6 | | | |
| 209+3438 | 7.0 | | | | | | | | 31.6 | 28.6 | | | |
| 209+3438 | 8.0 | | | | | | | | 30.6 | 28.6 | | | |
| 209+3438 | 9.0 | | | | | | | | 33.5 | 28.6 | | | |
| 209+3438 | 10.0 | | | | | | | | 22.7 | 28.6 | | | |
| 209+3600 | 2.0 | 47 | 27 | 20 | 25 | 64 | A-7-6 (12) | CL | 17.9 | 31.6 | | | |
| 209+3600 | 3.0 | | | | | | | | 39.3 | 31.6 | | | |
| 209+3600 | 4.0 | | | | | | | | 27.4 | 31.6 | | | |
| 209+3600 | 5.0 | | | | | | | | 30.1 | 31.6 | | | |
| 209+3600 | 6.0 | | | | | | | | 36.2 | 31.6 | | | |
| 209+3600 | 7.0 | | | | | | | | 37.9 | 31.6 | | | |
| 209+3600 | 8.0 | | | | | | | | 32.8 | 31.6 | | | |
| 209+3600 | 9.0 | | | | | | | | 32.2 | 31.6 | | | |
| 209+3600 | 10.0 | | | | | | | | 30.6 | 31.6 | | | |
| 209+3740 | 2.0 | 49 | 25 | 24 | 9.5 | 74 | A-7-6 (18) | CL | 16.7 | 28.4 | | | |
| 209+3740 | 3.0 | | | | | | | | 36.5 | 28.4 | | | |
| 209+3740 | 4.0 | | | | | | | | 35.9 | 28.4 | | | |
| 209+3740 | 5.0 | | | | | | | | 30.1 | 28.4 | | | |
| 209+3740 | 6.0 | | | | | | | | 24.0 | 28.4 | | | |
| 209+3740 | 7.0 | | | | | | | | 33.9 | 28.4 | | | |
| 209+3740 | 8.0 | | | | | | | | 22.5 | 28.4 | | | |
| 209+3740 | 9.0 | | | | | | | | 26.7 | 28.4 | | | |
| 209+3740 | 10.0 | | | | | | | | 29.4 | 28.4 | | | |
| 209+3943 | 2.0 | 42 | 21 | 21 | 9.5 | 75 | A-7-6 (15) | CL | 22.8 | 29.8 | | | |
| 209+3943 | 3.0 | | | | | | | | 36.3 | 29.8 | | | |
| 209+3943 | 4.0 | | | | | | | | 41.2 | 29.8 | | | |
| 209+3943 | 5.0 | | | | | | | | 40.1 | 29.8 | | | |
| 209+3943 | 6.0 | | | | | | | | 25.4 | 29.8 | | | |
| 209+3943 | 7.0 | | | | | | | | 27.4 | 29.8 | | | |
| 209+3943 | 8.0 | | | | | | | | 26.1 | 29.8 | | | |
| 209+3943 | 9.0 | | | | | | | | 25.0 | 29.8 | | | |
| 209+3943 | 10.0 | | | | | | | | 24.4 | 29.8 | | | |
| 211+0395 | 2.0 | 53 | 30 | 23 | 9.5 | 70 | A-7-5 (16) | MH | 16.9 | 34.0 | | | |
| 211+0395 | 3.0 | | | | | | | | 35.1 | 34.0 | | | |
| 211+0395 | 4.0 | | | | | | | | 39.2 | 34.0 | | | |
| 211+0395 | 5.0 | | | | | | | | 31.5 | 34.0 | | | |
| 211+0395 | 6.0 | | | | | | | | 22.2 | 34.0 | | | |
| 211+0395 | 7.0 | | | | | | | | 33.6 | 34.0 | | | |
| 211+0395 | 8.0 | | | | | | | | 32.2 | 34.0 | | | |
| 211+0395 | 9.0 | | | | | | | | 48.7 | 34.0 | | | |
| 211+0395 | 10.0 | | | | | | | | 46.6 | 34.0 | | | |
| 211+0472 | 2.0 | 50 | 32 | 18 | 9.5 | 63 | A-7-5 (11) | MH | 14.2 | 31.9 | | | |
| 211+0472 | 3.0 | | | | | | | | 31.1 | 31.9 | | | |

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

# SUMMARY OF LABORATORY RESULTS



**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 211+0472 | 4.0 | | | | | | | | 37.4 | 31.9 | | | |
| 211+0472 | 5.0 | | | | | | | | 35.6 | 31.9 | | | |
| 211+0472 | 6.0 | | | | | | | | 26.4 | 31.9 | | | |
| 211+0472 | 7.0 | | | | | | | | 33.6 | 31.9 | | | |
| 211+0472 | 8.0 | | | | | | | | 33.8 | 31.9 | | | |
| 211+0472 | 9.0 | | | | | | | | 35.9 | 31.9 | | | |
| 211+0472 | 10.0 | | | | | | | | 38.7 | 31.9 | | | |
| 211+0482 | 2.0 | 49 | 30 | 19 | 9.5 | 58 | A-7-5 (10) | ML | 15.4 | 29.6 | | | |
| 211+0482 | 3.0 | | | | | | | | 32.1 | 29.6 | | | |
| 211+0482 | 4.0 | | | | | | | | 34.3 | 29.6 | | | |
| 211+0482 | 5.0 | | | | | | | | 32.1 | 29.6 | | | |
| 211+0482 | 6.0 | | | | | | | | 35.5 | 29.6 | | | |
| 211+0482 | 7.0 | | | | | | | | 32.0 | 29.6 | | | |
| 211+0482 | 8.0 | | | | | | | | 24.3 | 29.6 | | | |
| 211+0482 | 9.0 | | | | | | | | 30.5 | 29.6 | | | |
| 211+0482 | 10.0 | | | | | | | | 30.0 | 29.6 | | | |
| 211+0591 | 2.0 | 55 | 33 | 22 | 9.5 | 52 | A-7-5 (9) | MH | 13.7 | 28.1 | | | |
| 211+0591 | 3.0 | | | | | | | | 42.5 | 28.1 | | | |
| 211+0591 | 4.0 | | | | | | | | 29.2 | 28.1 | | | |
| 211+0591 | 5.0 | | | | | | | | 29.0 | 28.1 | | | |
| 211+0591 | 6.0 | | | | | | | | 28.8 | 28.1 | | | |
| 211+0591 | 7.0 | | | | | | | | 27.3 | 28.1 | | | |
| 211+0591 | 8.0 | | | | | | | | 26.4 | 28.1 | | | |
| 211+0591 | 9.0 | | | | | | | | 26.9 | 28.1 | | | |
| 211+0591 | 10.0 | | | | | | | | 29.0 | 28.1 | | | |
| 213+4619 | 2.0 | 50 | 29 | 21 | 9.5 | 71 | A-7-6 (15) | MH | 7.8 | 27.7 | | | |
| 213+4619 | 3.0 | | | | | | | | 8.5 | 27.7 | | | |
| 213+4619 | 4.0 | | | | | | | | 26.1 | 27.7 | | | |
| 213+4619 | 5.0 | | | | | | | | 41.1 | 27.7 | | | |
| 213+4619 | 6.0 | | | | | | | | 27.0 | 27.7 | | | |
| 213+4619 | 7.0 | | | | | | | | 38.8 | 27.7 | | | |
| 213+4619 | 8.0 | | | | | | | | 34.0 | 27.7 | | | |
| 213+4619 | 9.0 | | | | | | | | 33.8 | 27.7 | | | |
| 213+4619 | 10.0 | | | | | | | | 32.7 | 27.7 | | | |
| 213+4728 | 2.0 | 51 | 27 | 24 | 9.5 | 69 | A-7-6 (16) | CH | 26.7 | 32.0 | | | |
| 213+4728 | 3.0 | | | | | | | | 29.1 | 32.0 | | | |
| 213+4728 | 4.0 | | | | | | | | 38.2 | 32.0 | | | |
| 213+4728 | 5.0 | | | | | | | | 35.9 | 32.0 | | | |
| 213+4728 | 6.0 | | | | | | | | 30.2 | 32.0 | | | |
| 213+4728 | 7.0 | 46 | 28 | 18 | 9.5 | 65 | A-7-6 (11) | ML | 30.6 | 33.8 | | | |
| 213+4728 | 8.0 | | | | | | | | 35.4 | 33.8 | | | |
| 213+4728 | 9.0 | | | | | | | | 35.0 | 33.8 | | | |
| 213+4728 | 10.0 | | | | | | | | 34.3 | 33.8 | | | |

# SUMMARY OF LABORATORY RESULTS



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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109

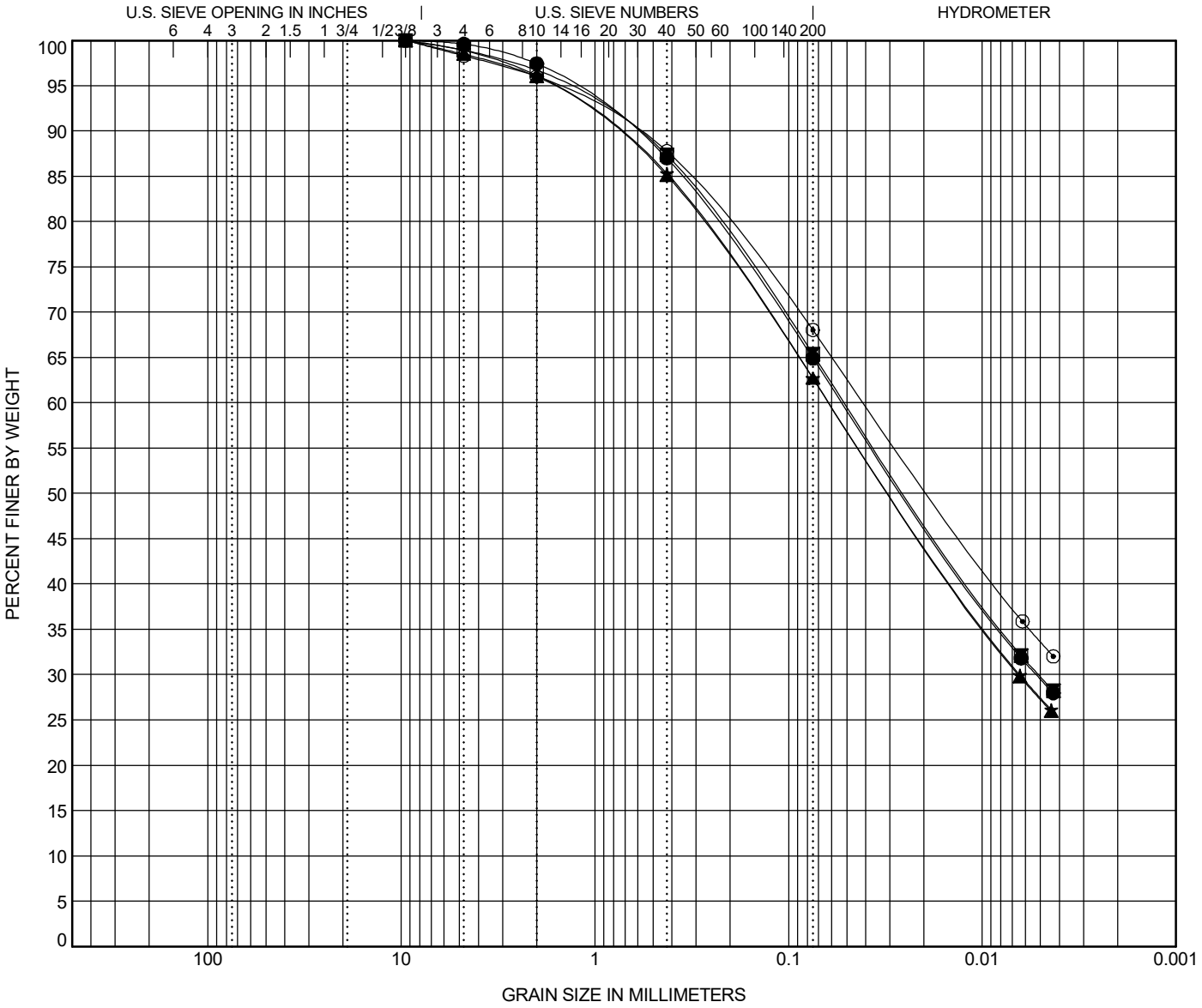
| Borehole | Depth | Liquid Limit | Plastic Limit | Plasticity Index | Maximum Size (mm) | %<#200 Sieve | AASHTO Classification | USCS Class-ification | Water Content (%) | Avg. Water Content (%) | Dry Density (pcf) | Satur-ation (%) | Void Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 213+4816 | 2.0 | 42 | 23 | 19 | 9.5 | 60 | A-7-6 (9) | CL | 6.2 | 22.2 | | | |
| 213+4816 | 3.0 | | | | | | | | 10.2 | 22.2 | | | |
| 213+4816 | 4.0 | | | | | | | | 29.4 | 22.2 | | | |
| 213+4816 | 5.0 | | | | | | | | 28.1 | 22.2 | | | |
| 213+4816 | 6.0 | | | | | | | | 19.2 | 22.2 | | | |
| 213+4816 | 7.0 | | | | | | | | 22.9 | 22.2 | | | |
| 213+4816 | 8.0 | | | | | | | | 27.2 | 22.2 | | | |
| 213+4816 | 9.0 | | | | | | | | 29.6 | 22.2 | | | |
| 213+4816 | 10.0 | | | | | | | | 26.6 | 22.2 | | | |

# GRAIN SIZE DISTRIBUTION

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| BOREHOLE | DEPTH | AASHTO Classification | USCS Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● 200+3010 | 2.0 | A-7-6 (11) | CL | 43 | 23 | 20 | | |
| ⊠ 200+4000 | 2.0 | A-7-6 (12) | CL | 46 | 25 | 21 | | |
| ▲ 201+1135 | 2.0 | A-7-6 (10) | CL | 42 | 23 | 19 | | |
| ★ 201+1335 | 2.0 | A-7-6 (11) | CL | 43 | 22 | 21 | | |
| ⊙ 201+1660 | 2.0 | A-7-6 (13) | CL | 45 | 24 | 21 | | |

| BOREHOLE | DEPTH | D100 | D50 | D30 | D15 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|
| ● 200+3010 | 2.0 | 9.5 | 0.025 | 0.005 | | 0.4 | 34.7 | 64.9 | |
| ⊠ 200+4000 | 2.0 | 9.5 | 0.024 | 0.005 | | 1.1 | 33.5 | 65.4 | |
| ▲ 201+1135 | 2.0 | 9.5 | 0.029 | 0.007 | | 1.5 | 35.8 | 62.7 | |
| ★ 201+1335 | 2.0 | 9.5 | 0.029 | 0.006 | | 1.1 | 36.2 | 62.7 | |
| ⊙ 201+1660 | 2.0 | 9.5 | 0.019 | | | 1.7 | 30.3 | 68.0 | |

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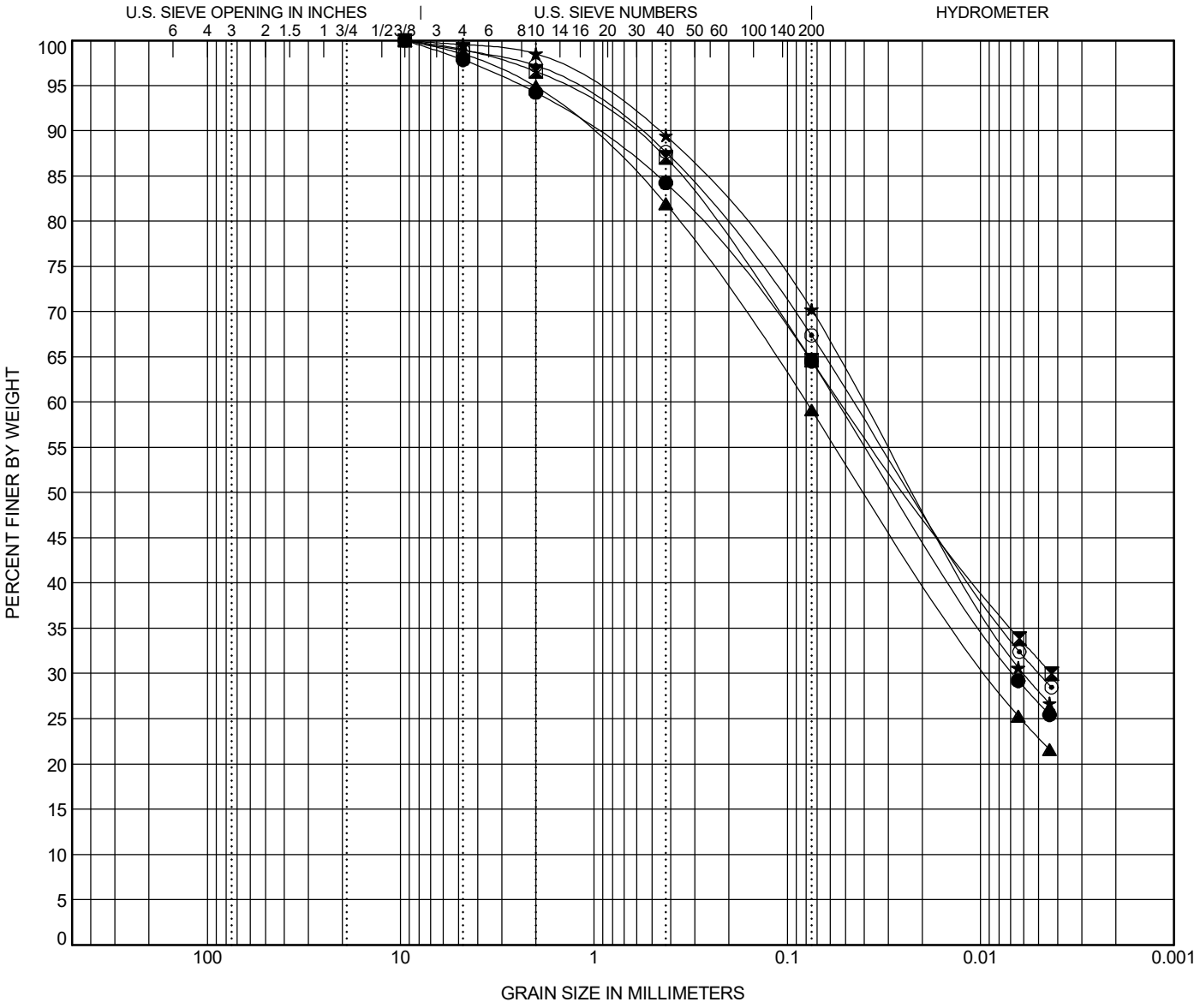
# GRAIN SIZE DISTRIBUTION

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BOREHOLE | DEPTH | AASHTO Classification | USCS Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|
| ● | 201+2000 | 2.0 | A-7-6 (13) | CL | 44 | 22 | 22 | | |
| ⊠ | 201+2832 | 2.0 | A-7-6 (13) | CL | 45 | 23 | 22 | | |
| ▲ | 201+3000 | 2.0 | A-6 (8) | CL | 40 | 23 | 17 | | |
| ★ | 201+3954 | 2.0 | A-7-6 (14) | ML | 49 | 29 | 20 | | |
| ⊙ | 201+4031 | 2.0 | A-7-6 (14) | CL | 49 | 27 | 22 | | |

| | BOREHOLE | DEPTH | D100 | D50 | D30 | D15 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | 201+2000 | 2.0 | 9.5 | 0.027 | 0.007 | | 2.2 | 33.3 | 64.5 | |
| ⊠ | 201+2832 | 2.0 | 9.5 | 0.023 | 0.004 | | 1.0 | 34.4 | 64.6 | |
| ▲ | 201+3000 | 2.0 | 9.5 | 0.039 | 0.009 | | 1.5 | 39.4 | 59.1 | |
| ★ | 201+3954 | 2.0 | 9.5 | 0.021 | 0.006 | | 0.5 | 29.3 | 70.2 | |
| ⊙ | 201+4031 | 2.0 | 9.5 | 0.022 | 0.005 | | 1.1 | 31.5 | 67.4 | |

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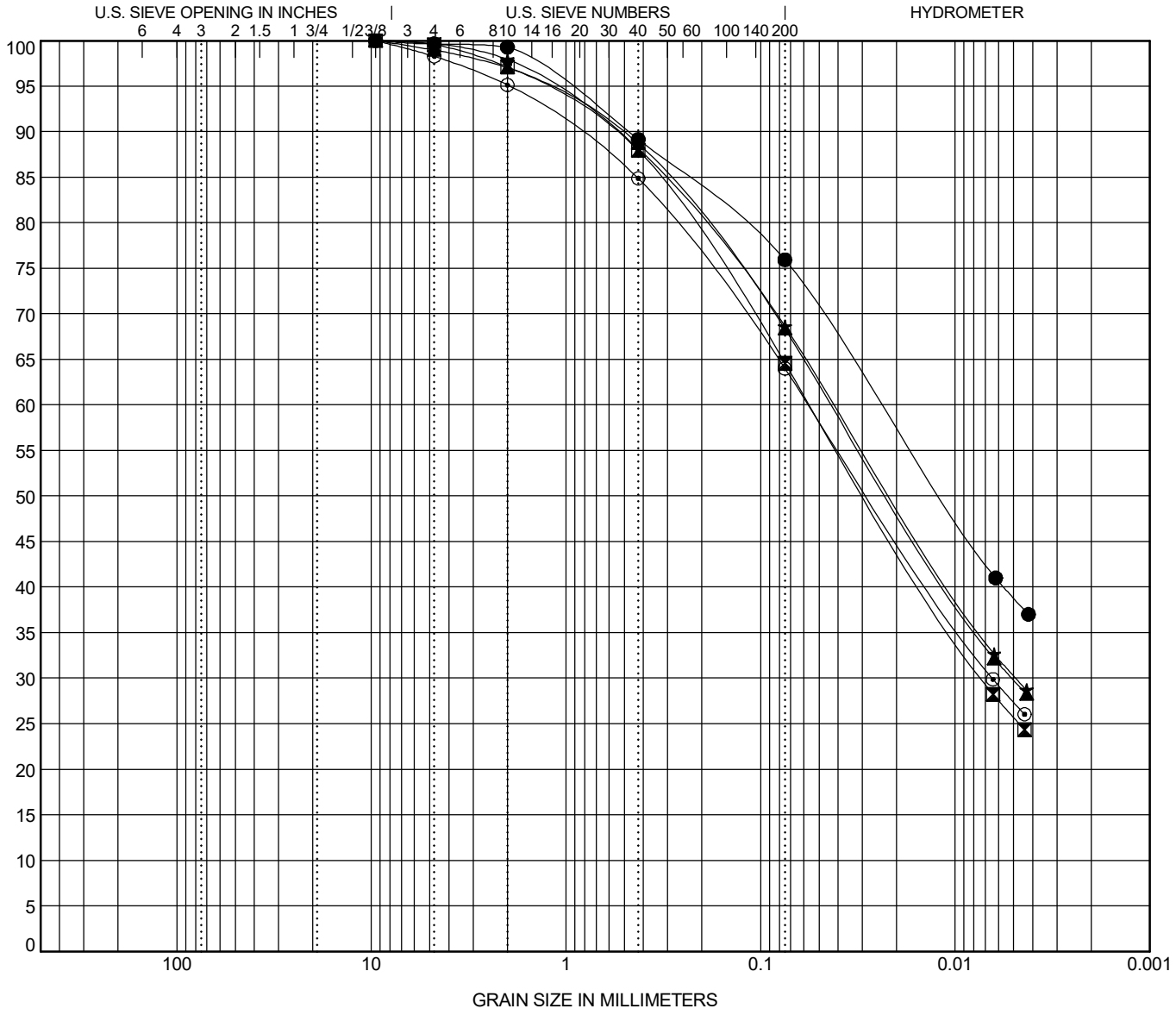
# GRAIN SIZE DISTRIBUTION

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| BOREHOLE | DEPTH | AASHTO Classification | USCS Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● 201+4031 | 7.0 | A-7-5 (26) | MH | 68 | 39 | 29 | | |
| ⊠ 201+4150 | 2.0 | A-7-6 (12) | CL | 44 | 24 | 20 | | |
| ▲ 208+4193 | 2.0 | A-7-6 (15) | MH | 52 | 29 | 23 | | |
| ★ 208+4193 | 7.0 | A-7-5 (14) | MH | 50 | 30 | 20 | | |
| ⊙ 208+4262 | 2.0 | A-7-6 (11) | CL | 46 | 27 | 19 | | |

| BOREHOLE | DEPTH | D100 | D50 | D30 | D15 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|
| ● 201+4031 | 7.0 | 9.5 | 0.012 | | | 0.3 | 23.7 | 75.9 | |
| ⊠ 201+4150 | 2.0 | 9.5 | 0.028 | 0.007 | | 0.4 | 34.9 | 64.6 | |
| ▲ 208+4193 | 2.0 | 9.5 | 0.021 | 0.005 | | 1.0 | 30.6 | 68.3 | |
| ★ 208+4193 | 7.0 | 9.5 | 0.021 | 0.005 | | 0.3 | 31.0 | 68.6 | |
| ⊙ 208+4262 | 2.0 | 9.5 | 0.027 | 0.006 | | 1.7 | 34.3 | 64.0 | |

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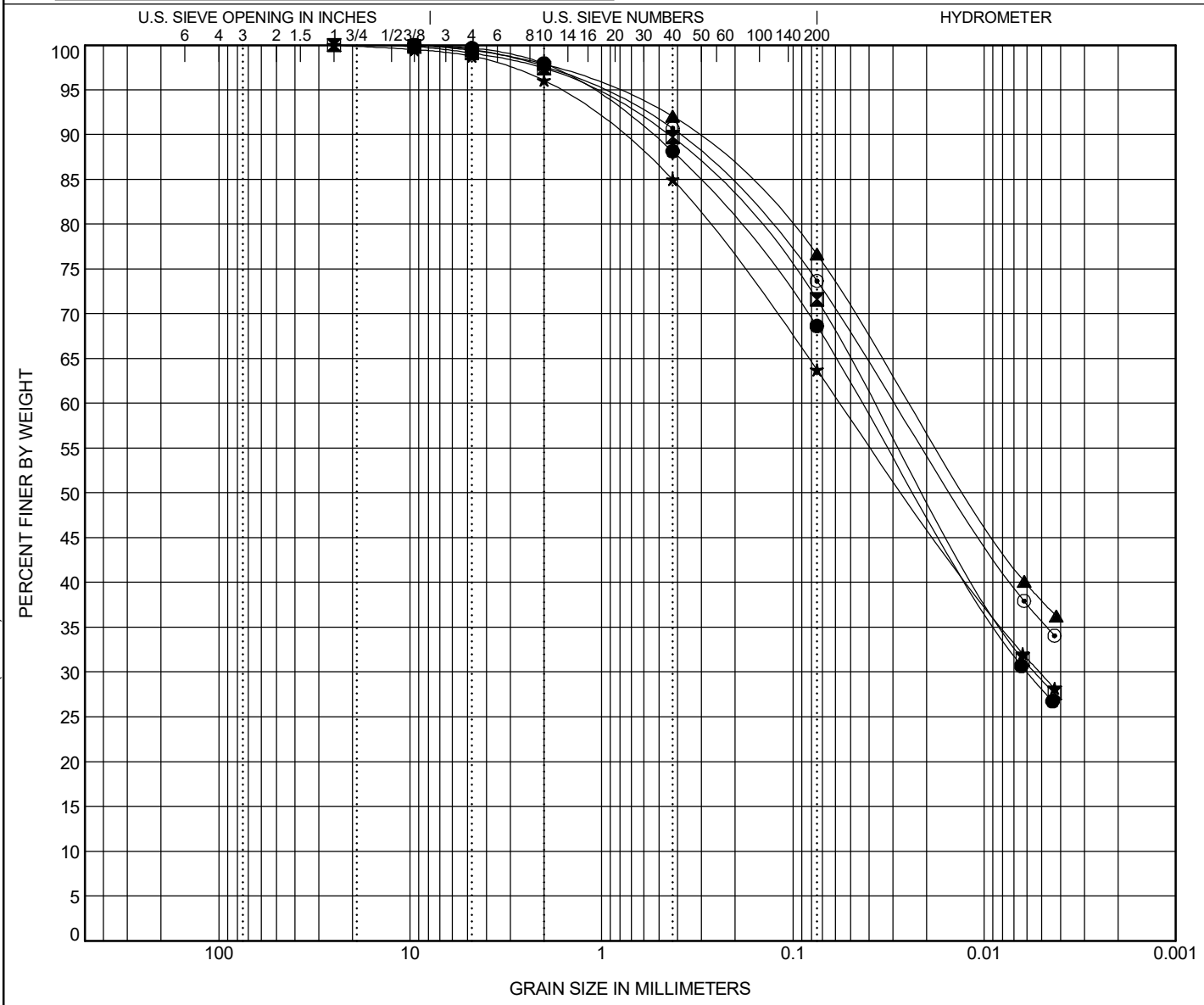
# GRAIN SIZE DISTRIBUTION

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BOREHOLE | DEPTH | AASHTO Classification | USCS Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|
| ● | 208+4269 | 2.0 | A-7-6 (14) | CL | 47 | 26 | 21 | | |
| ⊠ | 208+4390 | 2.0 | A-7-6 (16) | CL | 48 | 25 | 23 | | |
| ▲ | 209+3438 | 2.0 | A-7-6 (20) | CH | 50 | 24 | 26 | | |
| ★ | 209+3600 | 2.0 | A-7-6 (12) | CL | 47 | 27 | 20 | | |
| ⊙ | 209+3740 | 2.0 | A-7-6 (18) | CL | 49 | 25 | 24 | | |

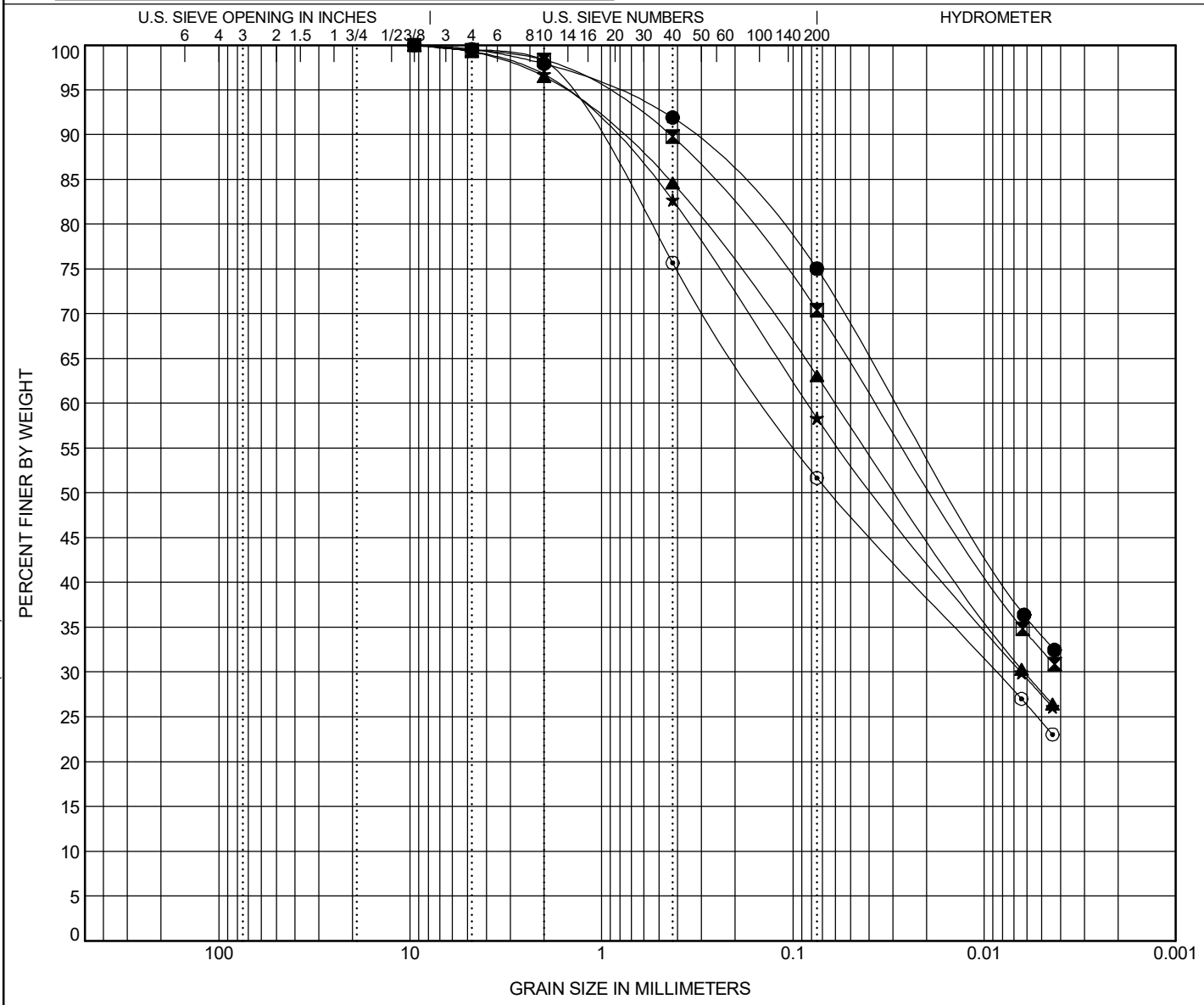
| | BOREHOLE | DEPTH | D100 | D50 | D30 | D15 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | 208+4269 | 2.0 | 9.5 | 0.022 | 0.006 | | 0.3 | 31.0 | 68.6 | |
| ⊠ | 208+4390 | 2.0 | 25 | 0.02 | 0.005 | | 0.9 | 27.5 | 71.6 | |
| ▲ | 209+3438 | 2.0 | 9.5 | 0.012 | | | 0.6 | 22.8 | 76.6 | |
| ★ | 209+3600 | 2.0 | 25 | 0.026 | 0.005 | | 1.2 | 35.0 | 63.7 | |
| ⊙ | 209+3740 | 2.0 | 9.5 | 0.014 | | | 0.5 | 25.9 | 73.7 | |

# GRAIN SIZE DISTRIBUTION

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BOREHOLE | DEPTH | AASHTO Classification | USCS Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|
| ● | 209+3943 | 2.0 | A-7-6 (15) | CL | 42 | 21 | 21 | | |
| ⊠ | 211+0395 | 2.0 | A-7-5 (16) | MH | 53 | 30 | 23 | | |
| ▲ | 211+0472 | 2.0 | A-7-5 (11) | MH | 50 | 32 | 18 | | |
| ★ | 211+0482 | 2.0 | A-7-5 (10) | ML | 49 | 30 | 19 | | |
| ⊙ | 211+0591 | 2.0 | A-7-5 (9) | MH | 55 | 33 | 22 | | |

| | BOREHOLE | DEPTH | D100 | D50 | D30 | D15 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | 209+3943 | 2.0 | 9.5 | 0.015 | | | 0.5 | 24.5 | 75.0 | |
| ⊠ | 211+0395 | 2.0 | 9.5 | 0.018 | | | 0.5 | 29.0 | 70.4 | |
| ▲ | 211+0472 | 2.0 | 9.5 | 0.028 | 0.006 | | 0.7 | 36.2 | 63.1 | |
| ★ | 211+0482 | 2.0 | 9.5 | 0.036 | 0.006 | | 0.7 | 40.9 | 58.3 | |
| ⊙ | 211+0591 | 2.0 | 9.5 | 0.064 | 0.009 | | 0.5 | 47.8 | 51.7 | |

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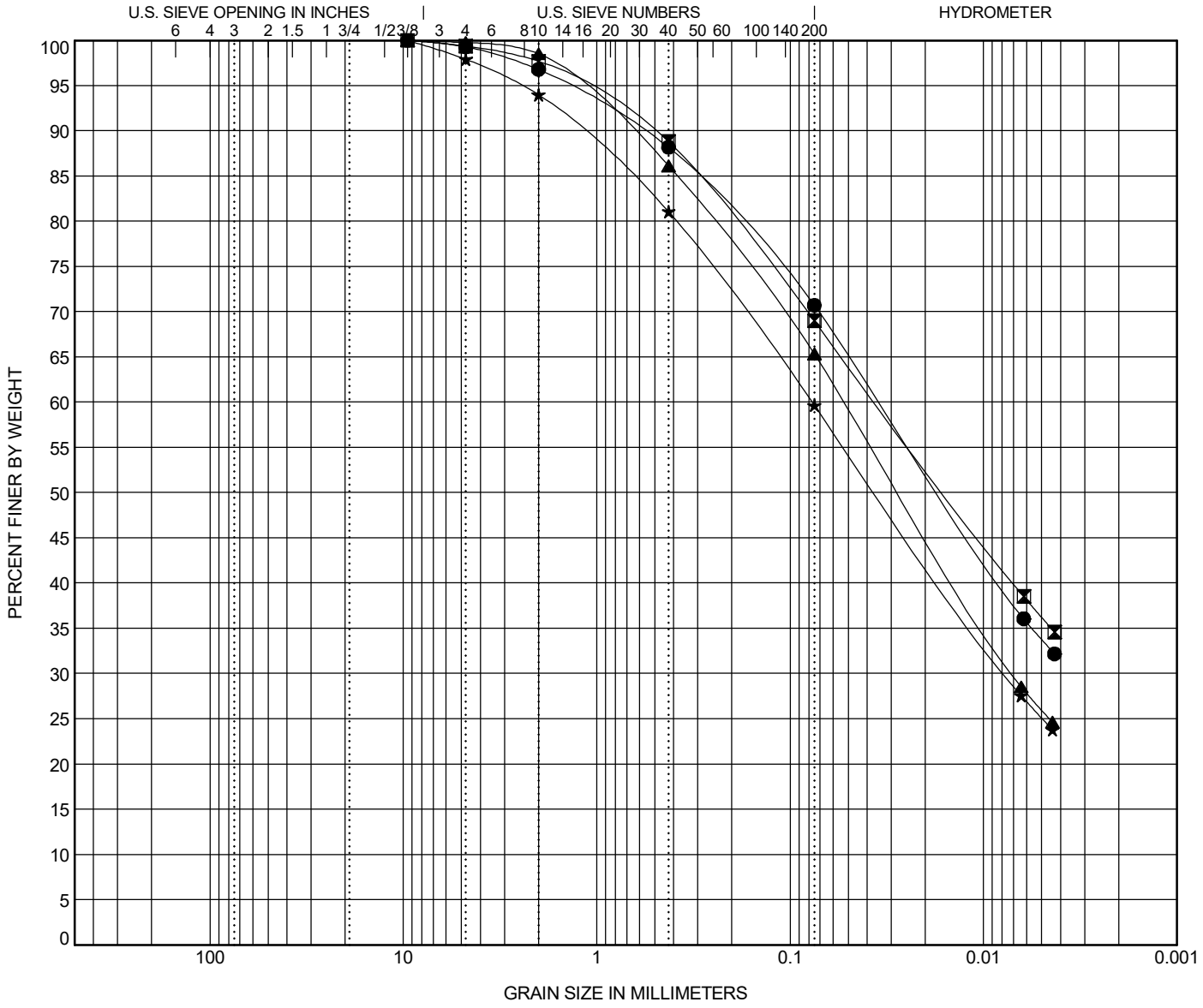
# GRAIN SIZE DISTRIBUTION

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

**PROJECT NUMBER** NH-3-001(031)201 & NH-3-001(033)200 **LOCATION** Cavalier County

**PCN** 22616 & 23109




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | BOREHOLE | DEPTH | AASHTO Classification | USCS Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|
| ● | 213+4619 | 2.0 | A-7-6 (15) | MH | 50 | 29 | 21 | | |
| ⊠ | 213+4728 | 2.0 | A-7-6 (16) | CH | 51 | 27 | 24 | | |
| ▲ | 213+4728 | 7.0 | A-7-6 (11) | ML | 46 | 28 | 18 | | |
| ★ | 213+4816 | 2.0 | A-7-6 (9) | CL | 42 | 23 | 19 | | |

| | BOREHOLE | DEPTH | D100 | D50 | D30 | D15 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | 213+4619 | 2.0 | 9.5 | 0.017 | | | 0.7 | 28.6 | 70.7 | |
| ⊠ | 213+4728 | 2.0 | 9.5 | 0.016 | | | 0.6 | 30.4 | 69.0 | |
| ▲ | 213+4728 | 7.0 | 9.5 | 0.027 | 0.007 | | 0.2 | 34.4 | 65.3 | |
| ★ | 213+4816 | 2.0 | 9.5 | 0.036 | 0.008 | | 2.1 | 38.3 | 59.6 | |