LINEAR SOILS SURVEY AND RECOMMENDATIONS

PROJECT NO. SS-5-021(016)000

PCN 18244

COUNTY Slope & Hettinger

ND Highway 21 From RP 0.000 to RP 15.775

PREPARED BY: Jordan M. Nehls, P.E.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

FEBRUARY 2017

SS-5-021(016)000

Highway 21 From Junction Highway 85 to North Junction Highway 22 - New England

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 Jordan M. Nehls, Registration number PE-8782 on 2/28/17 and the original document is stored at the North Dakota Department of Transportation.

REGISTERED PROFESSIONAL ENGINEER
JORDAN M. NEHLS
PE-8782
DATE 2/28/17
NORTH DAKOTA

Jordan M. Nehls
Jordan M. Nehls, P.E.

2/28/17
Date

Linear Soils Report and Recommendation

Project: SS-5-021(016)000
PCN: 18244
Scope: Minor Rehabilitation HBP Overlay, Sliver Grading
Length: 15.775 Miles
Location: ND Highway 21 From Junction Highway 85 To North Junction Highway 22

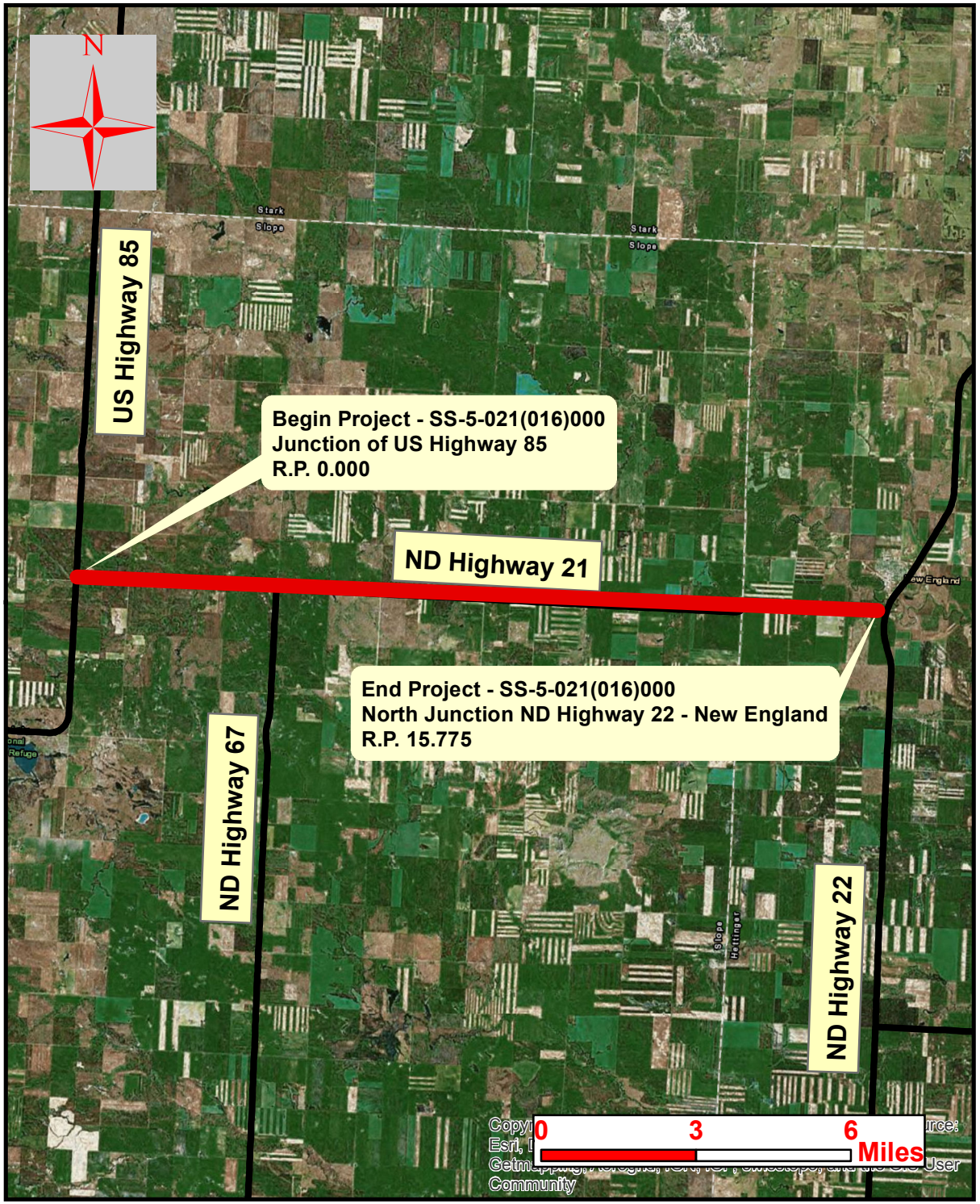


Table of Contents

Existing Roadway Section 1
Construction History 1
Existing Roadway Condition 2
Distress Data 2
Ride Data 3
Soil Sample Distribution 4
Moisture 5
Atterberg Limits 5
Swell Potential 5
Frost Susceptibility 6
Group Index 6
Existing Surface and Base Section at the Boring Locations 7
Design Recommendations 9
Design Information 10
Plan Notes 10

List of Figures

Figure 1 – Typical Section R.P. 0.000 to R.P. 15.775 1
Figure 2 - Soil Sample Distribution 4
Figure 3 - Frost Susceptibility Distribution 6

List of Tables

Table 1 - Construction History – R.P. 0.000 to R.P. 15.775 1
Table 2 – 2015 Distress Data 2
Table 3 – 2015 Ride Data 3
Table 4 - Identified Maintenance Areas 4
Table 5 - Summary of In-Place and Optimum Moisture Contents 5
Table 6 - Summary of In-Place versus Optimum Moisture Content 5
Table 7 - Summary of Atterberg Limits 5
Table 8 - Swell Potential 5
Table 9 - Group Indices 6
Table 10 - Surface and Base Section at the Boring Locations 7
Table 11 – Design Recommendations 9

Appendices

Appendix A – Soil Classification and Frost Susceptibility
Appendix B – Pavement Evaluation Log and Subsurface Investigation Scope
Appendix C – Boring Locations
Appendix D – Summary of Soils Analysis
Appendix E – Lab Results
Appendix F – HES-5-021(023)000 Linear Soils Report and Recommendation

Introduction

Location: Highway 21 From Junction Highway 85 to North Junction Highway 22 - New England
Reference Points: 0.000 to 15.775
Project Length: 15.775 Miles
Proposed Project: Minor Rehabilitation HBP Overlay, Sliver Grading
Investigation Scope: 1000' intervals along Highway 21

Existing Roadway Section

Construction History

Table 1 - Construction History – R.P. 0.000 to R.P. 15.775

Construction History				
Year	Construction	Depth (in)	Width (ft)	Oil
1950	Traffic Surface Gravel	4.0	22.0	---
1955	MTCE Shoulder Widening	---	28.0	---
1955	Stabilized Base	5.0	26.0	---
1992	District Chip Seal	---	22.0	---
2001	Int Cont Patch – 1.0"	---	26.0	PG 58-28
2002	District Chip Seal	---	1.0 - 24.0 - 1.0	HFMS-2
2009	Hot Bit Pavement	2.0	22.0	PG 58-28
2012	Federal Aid Chip Seal	---	22.0	CRS2P

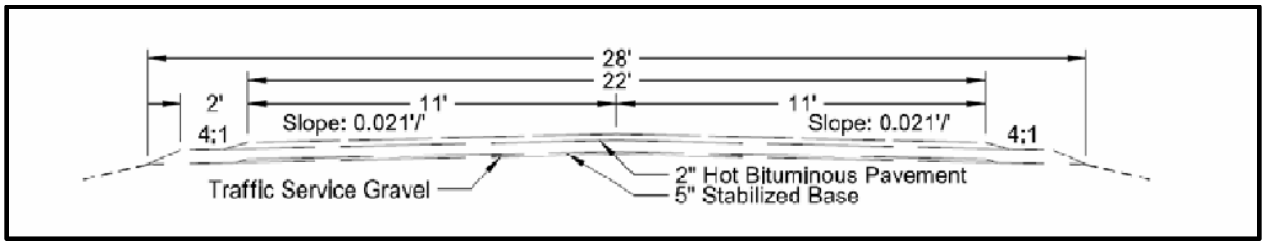


Figure 1 – Typical Section R.P. 0.000 to R.P. 15.775

Existing Roadway Condition

Distress Data

Table 2 – 2015 Distress Data

Reference Point	Alligator Cracking	Longitudinal Cracking	Transverse Cracking	Block Cracking	Bituminous Patching	Rutting
	(0-27)	(0-9)	(0-9)	(0-9)	(0-18)	(0-27)
0	3	1	4	0	0	0
1	3	1	4	0	0	0
2	3	1	4	0	0	0
3	3	4	7	0	2	0
4	3	4	7	0	6	0
5	3	1	4	0	2	0
6	3	4	4	0	0	0
7	0	1	4	0	0	0
8	3	1	4	0	0	0
9	3	1	4	0	0	0
10	3	1	4	0	0	0
11	3	4	4	0	0	0
12	3	4	4	0	6	0
13	3	4	4	0	6	0
14	3	1	4	0	0	0
15	3	7	7	0	0	0
Average	**3**	**3**	**5**	**0**	**1**	**0**

Ride Data

Table 3 – 2015 Ride Data

Reference Point	Distress Score		Rut (inches)		International Roughness Index (inches/mile)	
	Excellent	**≥ 98**	**Excellent**	**< 0.25**	**Excellent**	**< 61**
	Good	**88 - 97**	**Good**	**0.25 - 0.375**	**Good**	**61 - 99**
	Fair	**77 - 87**	**Fair**	**0.376 - 0.50**	**Fair**	**100 - 145**
	Poor	**≤ 76**	**Poor**	**> 0.50**	**Poor**	**>145**
0	91		0.08		91	
1	91		0.08		75	
2	91		0.08		70	
3	83		0.09		108	
4	79		0.09		85	
5	89		0.10		97	
6	88		0.08		68	
7	94		0.08		85	
8	91		0.09		79	
9	91		0.10		80	
10	91		0.07		69	
11	88		0.09		82	
12	82		0.10		90	
13	82		0.09		87	
14	91		0.09		88	
15	82		0.10		95	
Average	**88**		**0.09**		**84**	

Maintenance Review

Date of Maintenance Review(s): 6/29/2016
Materials and Research Person Conducting the Review: Jamie Naumann
District Maintenance Person Conducting Review: Dom Howie, New England Section Supervisor

The summary of the identified maintenance areas are shown in the following table. The pavement evaluation log can be found in Appendix B.

Table 4 - Identified Maintenance Areas

Location RP + Feet	Distress Identified	Drilling Required (Yes or No)
0+0000 To 15+4147	Transverse Cracks	No
3+0430 To 3+0600	Bituminous Patch – Bridge Ends	No
3+3924 To 3+4000	Rutting – Blade Patch	No
3+5142 To 4+1870	New Asphalt – Vertical curve correction in 2014	No
4+1870 To 5+0980	Rutting – EB Lane	No
5+1185 To 5+1235	Alligator Cracking – Hand Patch - EB Lane	No
8+4700	Alligator Cracking – Hand Patch - Rt Wheel Path - EB Lane	No
12+3100 To 13+1400	New Asphalt – Horizontal curve correction in 2014	No

Summary of Soil Analysis

A total of 78 borings were performed throughout the project. Based on the similarity of the soils and the scope of the project the samples were paired back and some were only tested for moisture content. Additional testing was performed on 54 samples.

Soil Sample Distribution

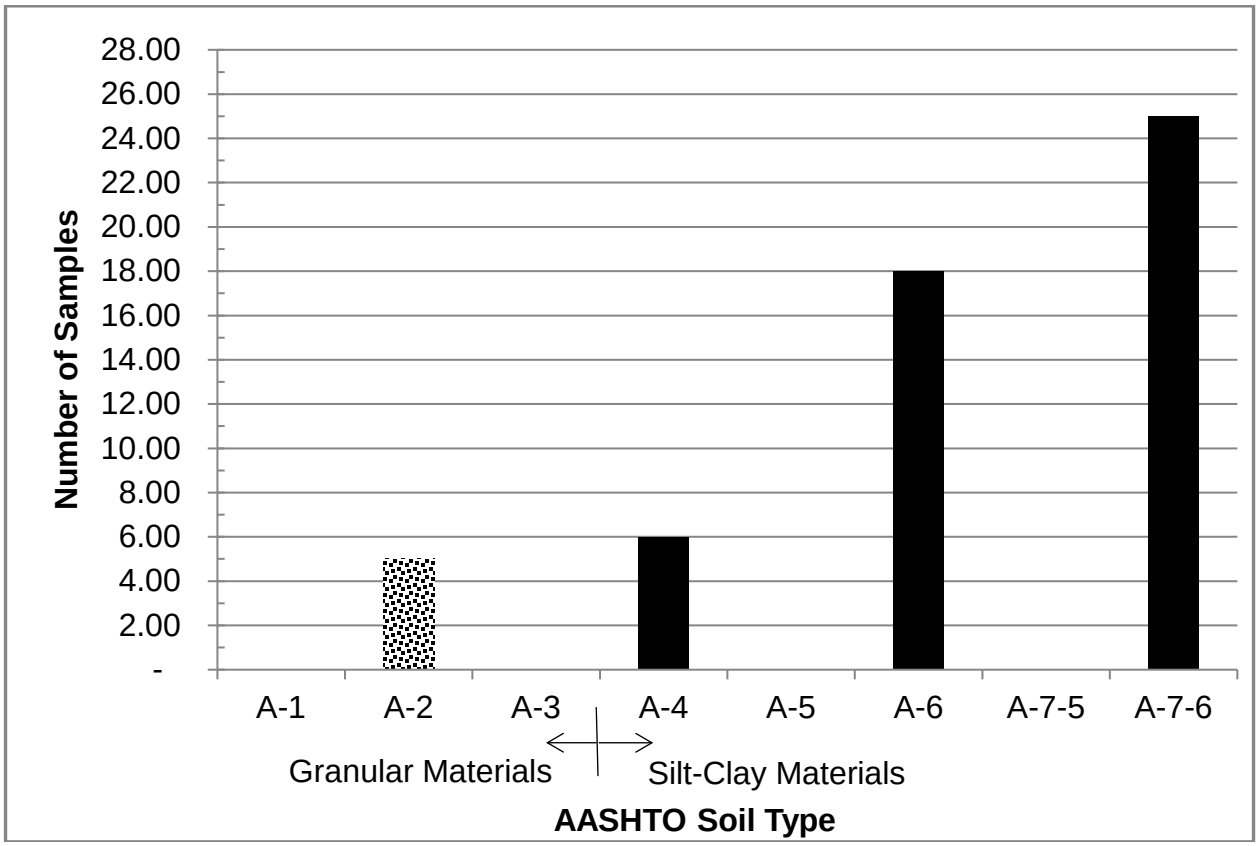


Figure 2 - Soil Sample Distribution

Moisture

The moisture contents provided in this report and summarized below have been obtained from samples taken between 10/5/16 & 10/6/16.

Table 5 - Summary of In-Place and Optimum Moisture Contents

Quantity	AASHTO Classification	In-Place Moisture Range (%)	In-Place Moisture Average (%)	Optimum Moisture Average (%)	Difference Between Average In-Place and Optimum Moistures (%)
5	A-2-4	9.7-11.2	10.6	9.7	0.9
6	A-4	12.8-18.5	14.4	10.3	4.1
18	A-6	13.3-25.7	18.0	11.0	7.0
25	A-7-6	10.6-27.3	21.8	12.8	9.0

Table 6 - Summary of In-Place versus Optimum Moisture Content

Quantity	AASHTO Classification	Below Optimum	Optimum to Moderate (0 to 6% over optimum)	Moderate to High (6 to 10% over optimum)	High (10 to 16% over optimum)	Very High (> 16% over optimum)
5	A-2-4	0%	100%	0%	0%	0%
6	A-4	0%	100%	0%	0%	0%
18	A-6	0%	50%	39%	11%	0%
25	A-7-6	4%	0%	68%	24%	4%

Atterberg Limits

Table 7 - Summary of Atterberg Limits

AASHTO Classification	Liquid Limit Range (%)	Liquid Limit Average (%)	Plastic Limit Range (%)	Plastic Limit Average (%)	Plasticity Index Range (%)	Plasticity Index Average (%)
A-2-4	0-25	5	0-18	4	0-7	1
A-4	0-25	16	0-18	11	0-9	5
A-6	26-39	34	13-19	16	11-22	17
A-7-6	41-63	48	16-22	19	23-41	29

Swell Potential

The swell potential, which is based on the Plasticity Index (PI), is shown in the following table.

Table 8 - Swell Potential

Low (Plasticity Index < 25)	Marginal (25 ≤ Plasticity Index ≤ 35)	High (Plasticity Index > 35)
61%	33%	6%

Frost Susceptibility

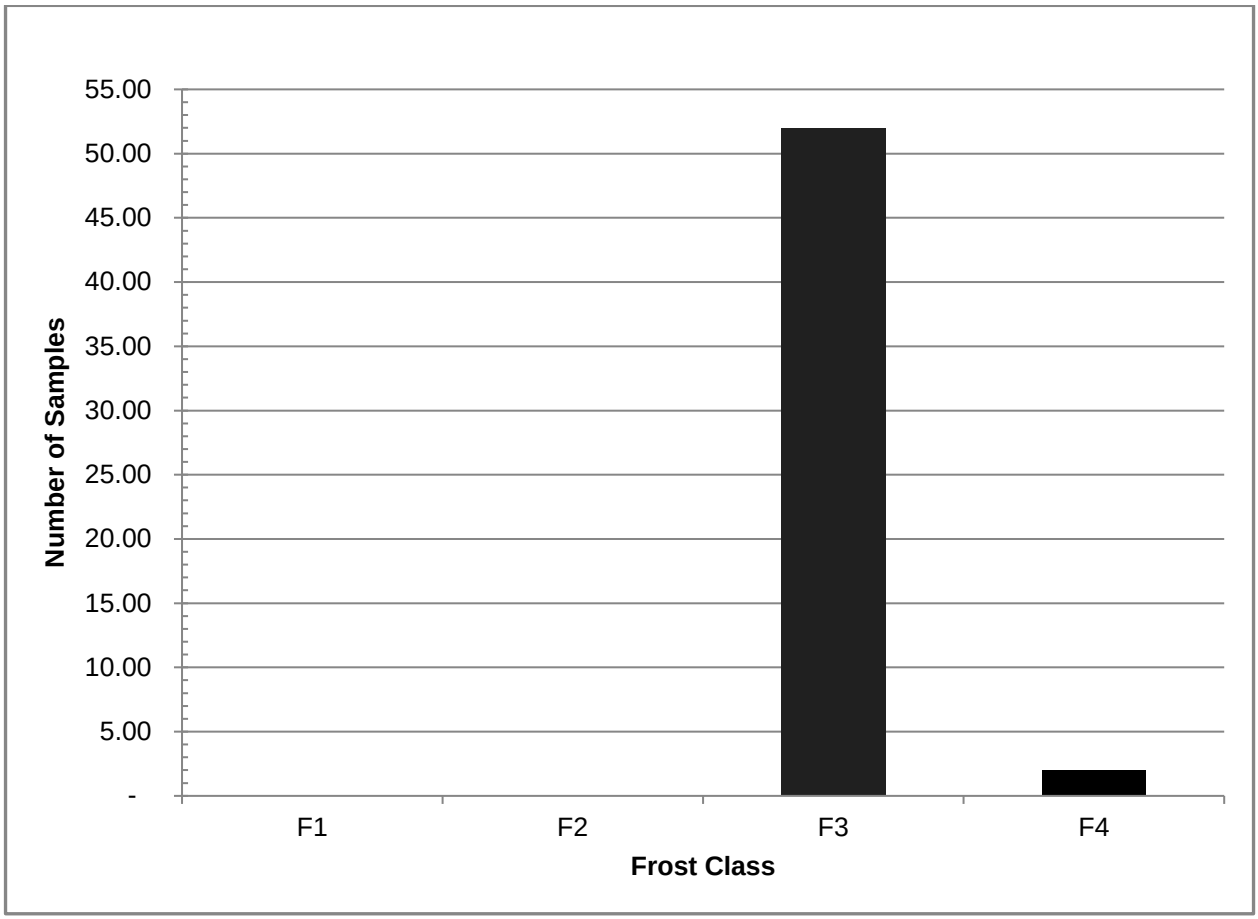


Figure 3 - Frost Susceptibility Distribution

Group Index

The Group Index is a parameter used to evaluate the quality of a soil as a subgrade material. The group index is always zero for A-1, A-2 and A-3 soils (Granular Soils). A group index of 20 or greater indicates a “very poor” subgrade material. The group indices are summarized in the following table.

Table 9 - Group Indices

AASHTO Classification	Group Index Range	Group Index Average
A-2-4	0-0	0
A-4	0-3	1
A-6	1-17	9
A-7-6	16-42	26

Existing Surface and Base Section at the Boring Locations

The soil borings were performed on 10/5/16 and 10/6/2016 using a 6 inch solid flight auger. The following table represents the pavement section as reported in the field log at the boring locations.

Table 10 - Surface and Base Section at the Boring Locations

RP + Feet	Offset	Asphalt Thickness (ft)	Base Thickness (ft)
0+0118	Rt 8 EB	0.9	0.5
0+1000	Rt 8 EB	0.9	0.4
0+2000	Rt 8 EB	0.8	0.5
0+3000	Rt 7 EB	0.9	0.5
0+4000	Rt 7 EB	0.9	0.7
1+0000	Rt 7 EB	0.9	0.7
1+1000	Rt 7 EB	0.7	0.4
1+2000	Rt 7 EB	0.7	0.4
1+3000	Rt 7 EB	1.2	0.4
1+4000	Rt 7 EB	0.9	0.3
2+0000	Rt 7 EB	0.6	0.3
2+1000	Rt 7 EB	0.6	0.5
2+2000	Rt 7 EB	0.6	0.5
2+3000	Rt 7 EB	0.7	0.3
2+4000	Rt 7 EB	0.6	0.4
3+0000	Rt 7 EB	0.6	0.5
3+1000	Rt 7 EB	0.7	0.5
3+2000	Rt 7 EB	0.6	0.4
3+3000	Rt 7 EB	0.6	0.4
3+4000	Rt 7 EB	0.6	0.3
4+0000	Rt 9 EB	0.4	1.1
4+1000	Rt 9 EB	0.4	0.8
4+2000	Rt 9 EB	0.6	0.3
4+3000	Rt 9 EB	0.7	0.4
5+0000	Rt 9 EB	0.7	0.4
5+1000	Rt 9 EB	0.6	0.4
5+2000	Rt 9 EB	0.6	0.9
5+3000	Rt 9 EB	0.5	0.3
5+4000	Rt 9 EB	0.6	0.3
6+0000	Rt 9 EB	0.6	0.3
6+1000	Rt 9 EB	0.3	0.6
6+2000	Rt 9 EB	0.4	0.7
6+3000	Rt 9 EB	0.4	0.8
6+4000	Rt 9 EB	0.5	0.5
7+0000	Rt 9 EB	0.7	0.4
7+1000	Rt 9 EB	0.5	0.2
7+2000	Rt 9 EB	0.5	0.5
7+3000	Rt 9 EB	0.5	0.4
7+4000	Rt 9 EB	0.6	0.3
8+0000	Rt 9 EB	0.6	0.3

RP + Feet	Offset	Asphalt Thickness	Base Thickness
8+1000	Rt 9 EB	0.5	0.3
8+2000	Rt 9 EB	0.4	0.5
8+3000	Rt 9 EB	0.4	0.3
8+4000	Rt 9 EB	0.5	0.4
9+0000	Rt 9 EB	0.4	0.3
9+1000	Rt 9 EB	0.5	0.2
9+2000	Rt 9 EB	0.5	0.3
9+3000	Rt 9 EB	0.5	0.3
9+4000	Rt 9 EB	0.5	0.4
10+0000	Rt 9 EB	0.5	0.3
10+1000	Rt 9 EB	0.5	0.2
10+2000	Rt 9 EB	0.4	0.4
10+3000	Rt 9 EB	0.4	0.4
10+4000	Rt 9 EB	0.5	0.4
11+0000	Rt 9 EB	0.5	0.3
11+1000	Rt 9 EB	0.4	0.5
11+2000	Rt 9 EB	0.5	0.4
11+3000	Rt 9 EB	0.5	0.3
11+4000	Rt 9 EB	0.5	0.3
12+0000	Rt 9 EB	0.5	0.2
12+1000	Rt 9 EB	0.5	0.4
12+2000	Rt 9 EB	0.5	0.4
12+3000	Rt 9 EB	0.5	0.4
12+4000	Rt 9 EB	0.4	1.0
13+0000	Rt 9 EB	0.4	0.8
13+1000	Rt 9 EB	0.4	1.1
13+2000	Rt 9 EB	0.5	0.4
13+3000	Rt 9 EB	0.5	0.4
13+4000	Rt 9 EB	0.5	0.4
14+0000	Rt 9 EB	0.5	0.4
14+1000	Rt 9 EB	0.5	0.3
14+2000	Rt 9 EB	0.6	0.3
14+3000	Rt 9 EB	0.6	0.3
14+4000	Rt 9 EB	0.5	0.4
15+0000	Rt 9 EB	0.5	0.4
15+1000	Rt 9 EB	0.5	0.4
15+2000	Rt 9 EB	0.6	0.3
15+3000	Rt 9 EB	0.5	0.4

Design Recommendations

Table 11 – Design Recommendations

Location RP + Feet	Distress Identified	Recommendation*	Justification
0+0000 To 15+4147	Transverse Cracks	Do Nothing	• The transverse cracking is a pavement distress that is not related to the subgrade • No borings required
3+0430 To 3+0600	Bituminous Patch – Bridge Ends	Do Nothing	• Investigated in HES-5-021(023)000 Linear Soils Report and Recommendation (See Appendix F) • Attributed to the impact force of traffic coming and going from the rigid bridge structure to the flexible pavement • No borings required
3+3924 To 3+4000	Rutting – Blade Patch	Do Nothing	• Soils have moderate moisture content, marginal swell potential, and a high group index • Distress only in EB lane in outside wheel path • Rutting caused by a weaker subgrade getting pushed or shoved out on outside of lane with less confinement • The widening and extra pavement surfacing should improve this issue • No subgrade work required
3+5142 To 4+1870	New Asphalt – Vertical curve correction in 2014	Do Nothing	• Vertical curved corrected during in 2014 under project HES-5-021(023)000. • No borings required
4+1870 To 5+0980	Rutting – EB Lane	Do Nothing	• Soils have low moisture content, low swell potential, and a low group index • Soils appear to be uniform throughout the area • No subgrade work required
5+1185 To 5+1235	Alligator Cracking – Hand Patch - EB Lane	Do Nothing	• Soils have moderate to high moisture content, marginal to high swell potential, and a high group index • This area was not investigated in project HES-5-021(023)000 as it was deemed not a significant problem area. • Distress only in EB lane in outside wheel path • Rutting caused by a weaker subgrade getting pushed or shoved out on outside of lane with less confinement • The widening and extra pavement surfacing should improve this issue • No subgrade work required

Location RP + Feet	Distress Identified	Recommendation*	Justification
8+4700	Alligator Cracking – Hand Patch - Rt Wheel Path - EB Lane	Do Nothing	• Investigated in HES-5-021(023)000 Linear Soils Report and Recommendation (See Appendix F) • Distress only in EB lane in outside wheel path • Rutting caused by a weaker subgrade getting pushed or shoved out on outside of lane with less confinement • The widening and extra pavement surfacing should improve this issue • No subgrade work required
12+3100 To 13+1400	New Asphalt – Horizontal curve correction in 2014	Do Nothing	• Horizontal curve corrected during in 2014 under project HES-5-021(023)000. • No borings required

Design Information

Compaction Method: T-180

Subgrade Prep: None

Subcut: 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 AND FROST SUSCEPTIBILITY

AASHTO Soil 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%)

Frost Susceptibility Index (Bases on US Army Corps of Engineers)

Frost Class	Frost Susceptibility	Soil Type	Percent Finer than 0.02 mm by weight %
F1	Negligible to Low	• Gravely Soils	3 – 10
F2	Low to Medium	• Gravely Soils • Sands	10 – 20 3 – 15
F3	High	• Gravelly Soils • Sands, except very fine silty sands • Clays, PI > 12	Greater than 20 Greater than 15 ----
F4	Very High	• All Silts • Very Fine Silty Sands • Clays, PI > 12 • Varved Clays and other fine-grained banded sediments	--- Greater than 15 --- ---

APPENDIX B

PAVEMENT EVALUATION LOG AND SUBSURFACE INVESTIGATION SCOPE

PAVEMENT EVALUATION LOG FOR LINEAR SOIL SURVEY

North Dakota Department of Transportation, Materials & Research
SFN 60472 (9-2013)

Sheet 1 of 1

Project Number	PCN	Date of Survey
SS-5-021(016)000	18244	6/29/2016

Section Maintenance Contact	Completed By
Dom Howie	Jamie Naumann

Highway Reference Points	Surface Type
0+0000 to 15+4147	Asphalt

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
0+0000 to 15+4147	Transv. Cracks	Depressed	Throughout project		No
3+0430 to 3+0600	Bituminous Patch	Bridge ends	This location was investigated in 2013 under project HES-5-021(023)000	1-3	No
3+3924 to 3+4000	Rutting	Blade patch	Right lane, Right wheel path, East bound lane only- Loaded truck traffic		No
3+5142 to 4+1870	Other	New Asphalt	Vertical curve correction constructed in 2014		No
4+1870 to 5+0980	Rutting	0.5" deep	East Bound Lane-Loaded truck traffic		No
5+1185 to 5+1235	Aligator Cracking	Hand patch area	East Bound Lane -Loaded truck traffic	4,5	No
8+4700	Aligator Cracking	Pothole-Hand patch ares	Yearly fix, Right Wheel Path,East bound lane This location was investigated in 2013 under project HES-5-021(023)000		No
12+3100 to 13+1400	Other	New Asphalt	Horizontal curve correction constructed in 2014		No
	Select One				Select One

Comments

Met with Don Howie on 6/29/2016 and he indicated these areas of greatest distress. Crack spacing was 20.0' approximately. Last crack seal was in 2015. Chip seal in 2015. Rutting was approximately 0.25". His biggest concern was all pipes and box culverts to be replaced throughout the project.

DSC00001

DSC00002

DSC00003

DSC00004

DSC00005

LINEAR SOILS SURVEY FIELD INVESTIGATION SCOPE

TO:	**File**
FROM:	**Jordan Nehls – Geotech Section**
DATE:	**9/27/2016**
HIGHWAY:	**21**
PROJECT NUMBER:	**SS-5-021(016)000**
PCN:	**18244**
LOCATION:	**Jct 85 to N Jct 22 – New England**
IMPROVEMENT SCOPE:	**Mine and Blend, Culvert Rehabilitation, Riprap**
SUBJECT:	**Linear Soils Survey Subsurface Investigation Scope**

We have completed the Maintenance Review of the roadway (attached to this memo) and have circulated it to the Dickinson District for comments. 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: 1000' Intervals along Highway 21

The following table shows the proposed subsurface investigation scope.

Boring Location	Justification for Boring	Boring Depth	Location
0+0000 to 15+3700	Major Rehabilitation project	5 feet	Conduct 1 boring every 1000' along Highway 21 (78 borings)

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

Task	Completion (*Anticipated*) Date
Maintenance Review with District Maintenance Forces	6/29/2016
Linear Soils Survey Field Work Complete	*10/5/2016*
Linear Soils Survey Lab Work	*1/1/2016*
Linear Soils Survey Report	*1/27/2017**
*Milestone Task	

APPENDIX C

Boring Locations

Legend

- Reference Point
- Boring Locations

0 1,250 2,500 Feet

Project Number: SS-5-021(016)000

0 1,250 2,500 Feet

Legend

- Reference Point
- Boring Locations

Project Number: SS-5-021(016)000

0 1,250 2,500 Feet

Legend

- Reference Point
- Boring Locations

Project Number: SS-5-021(016)000

Legend

- Reference Point
- Boring Locations

0 1,250 2,500 Feet

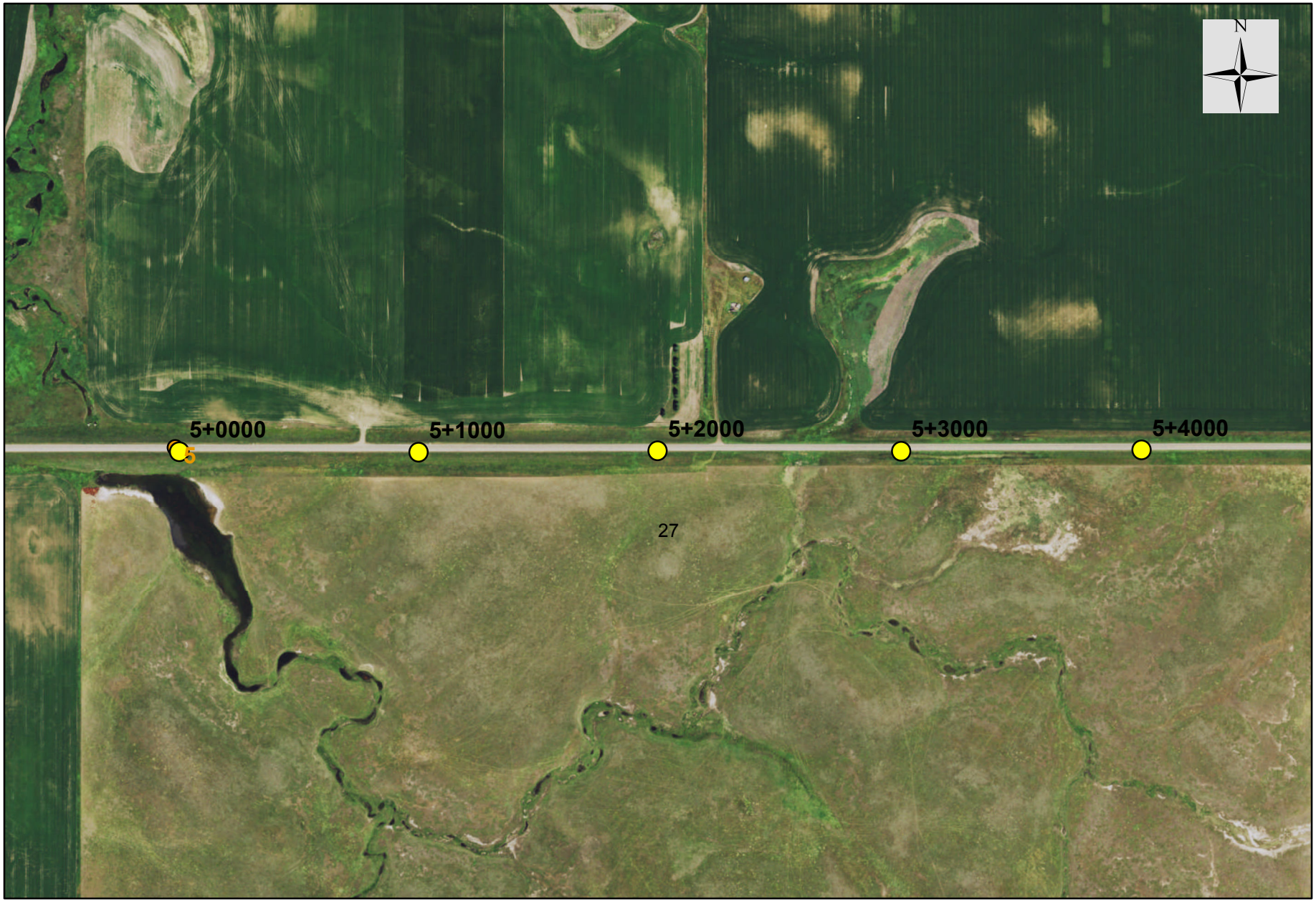
Project Number: SS-5-021(016)000

Legend

- Reference Point
- Boring Locations

0 1,250 2,500 Feet

Project Number: SS-5-021(016)000

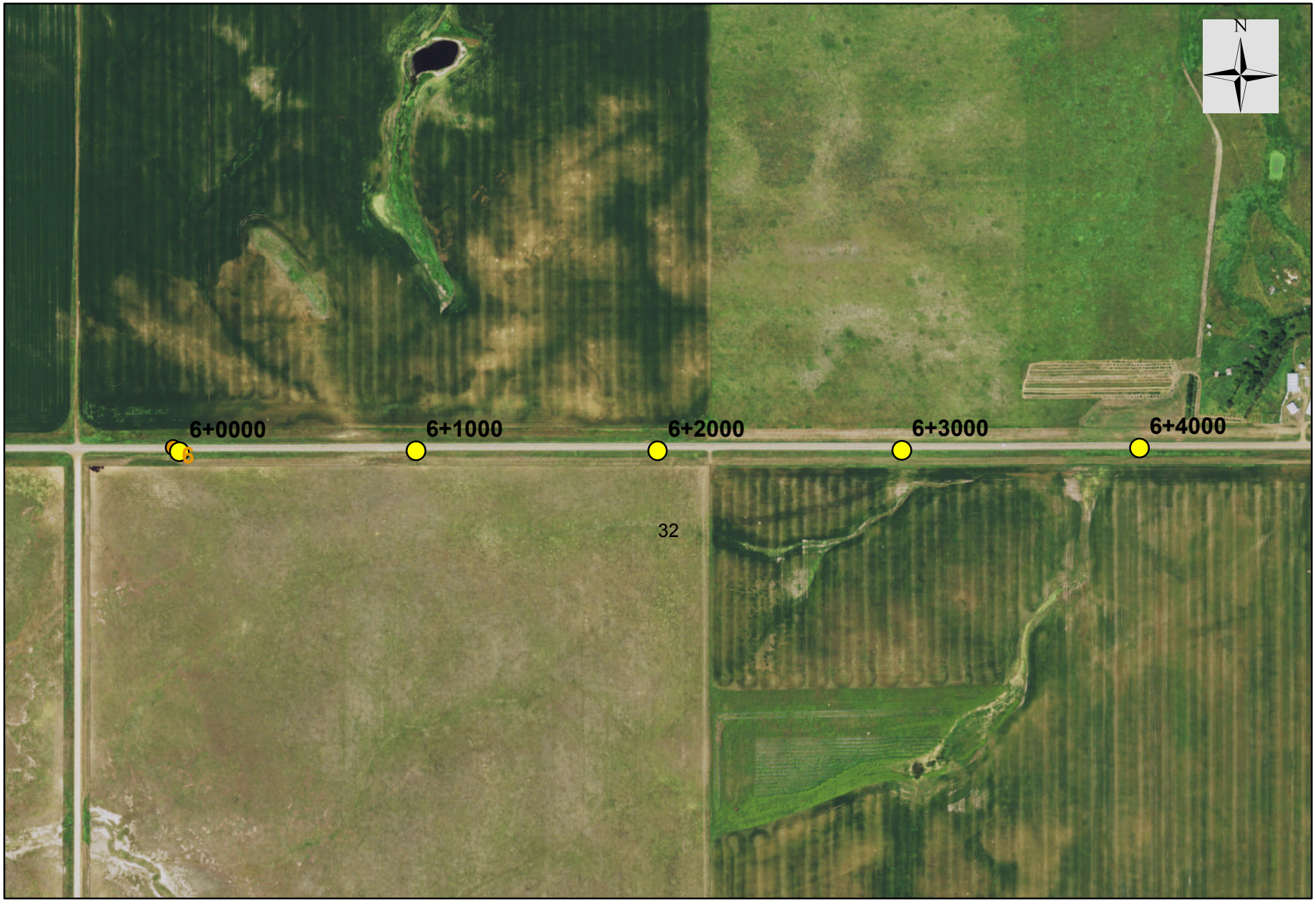


Legend

- Reference Point
- Boring Locations

0 1,250 2,500 Feet

Project Number: SS-5-021(016)000



Legend

- Reference Point
- Boring Locations

0 1,250 2,500 Feet

Project Number: SS-5-021(016)000

Legend

- Reference Point
- Boring Locations

0 1,250 2,500 Feet

Project Number: SS-5-021(016)000

0 1,250 2,500 Feet

Legend

- Reference Point
- Boring Locations

Project Number: SS-5-021(016)000

Legend

- Reference Point
- Boring Locations

0 1,250 2,500 Feet

Project Number: SS-5-021(016)000

0 1,250 2,500 Feet

Legend

- Reference Point
- Boring Locations

Project Number: SS-5-021(016)000

Legend

- Reference Point
- Boring Locations

0 1,250 2,500 Feet

Project Number: SS-5-021(016)000

Legend

- Reference Point
- Boring Locations

0 1,250 2,500 Feet

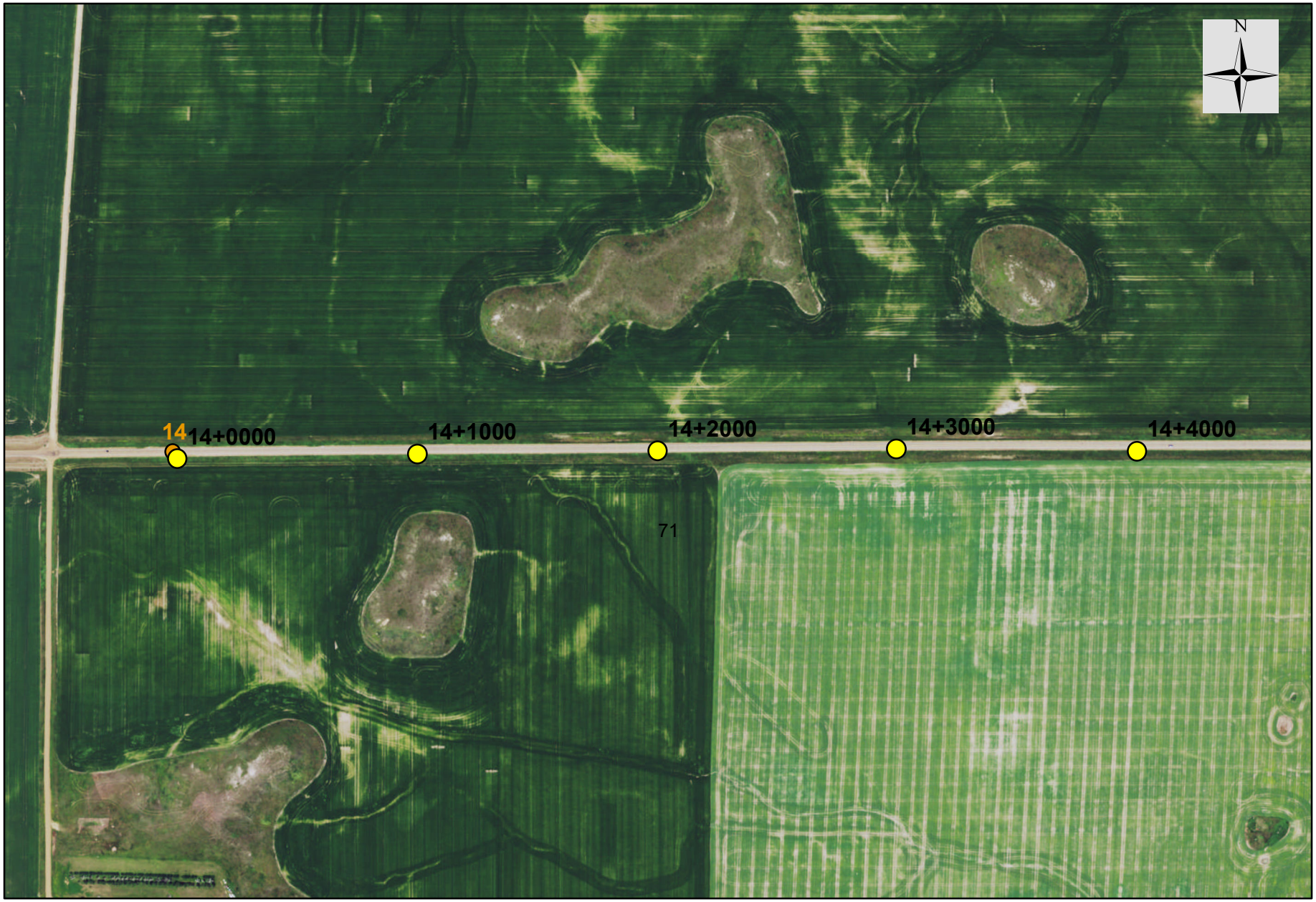
Project Number: SS-5-021(016)000

Legend

- Reference Point
- Boring Locations

0 1,250 2,500 Feet

Project Number: SS-5-021(016)000



0 1,250 2,500 Feet

Legend

- Reference Point
- Boring Locations

Project Number: SS-5-021(016)000

0 1,250 2,500 Feet

Legend

- Reference Point
- Boring Locations

Project Number: SS-5-021(016)000

APPENDIX D

SUMMARY OF SOILS ANALYSIS

Project No.: SS-5-021(016)000

PCN: 18244

Color Key

Swell Potential:	Low	Marginal	High	Moisture Content:	Below PL / 0-5% Over PL / >5% Over PL
Group Index:	GI≤20	GI>20		Ave. 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.

Lab No.	STA	Offset	Depth of Sample (ft)	Plastic Limit (PL)	AASHTO Class	Group Index	Optimum Moisture	Swell Potential (PI)	Ave. In-Place Moisture	Moisture Content @ Depth (ft) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Frost Class
1270	0+0118	Rt 8 EB	0.9-5	15.3	A-6(11)	11	10.9	22	15.7	10.3	17.7	15.4	19.3																					F3
1271	0+1000	Rt 8 EB	0.9-5	15.8	A-6(9)	9	11.9	20	18.6	17.4	18.9	20.6	17.3																					F3
1272	0+2000	Rt 8 EB	0.8-5	13.2	A-6(9)	9	10.0	18	16.0	16.7	17.7	14.0	15.4																					F3
1273	0+3000	Rt 7 EB	0.9-5	0.0	A-2-4(0)	0	9.3	0	9.7	8.8	9.7	10.9	9.5																					F3
1274	0+4000	Rt 7 EB	0.9-5	0.0	A-2-4(0)	0	9.2	0	11.2	11.5	10.0	12.4	11.0																					F3
			0-0						21.0	24.5	18.8	18.1	22.4																					
			0-0						20.3	16.3	23.7	21.6	19.7																					
			0-0						20.8	22.7	18.7	19.9	22.1																					
			0-0						21.5	19.7	24.0	20.1	22.2																					
			0-0						21.1	20.0	23.3	20.0	21.2																					
			0-0						23.1	20.9	23.1	25.1	23.4																					
			0-0						22.6	28.8	20.8	19.8	21.0																					
			0-0						18.0	19.8	16.2	18.2	17.6																					

Project No.:

PCN:

Color Key

Swell Potential:	Low	Marginal	High	Moisture Content:	Below PL / 0-5% Over PL / >5% Over PL
Group Index:	GI≤20	GI>20		Ave. 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.

Lab No.	STA	Offset	Depth of Sample (ft)	Plastic Limit (PL)	AASHTO Class	Group Index	Optimum Moisture	Swell Potential (PI)	Ave. In-Place Moisture	Moisture Content @ Depth (ft) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Frost Class
			0-0						19.3	25.6	17.6	18.7	15.2																					
			0-0						20.4	20.3	18.9	19.4	23.2																					
			0-0						18.4	18.1	18.5	15.3	21.6																					
			0-0						13.2	14.5	9.8	15.4	13.1																					
			0-0						21.8	23.0	18.0	23.2	22.8																					
			0-0						23.0	21.9	23.7	26.0	20.4																					
			0-0						15.0	10.8	13.9	19.9	15.3																					
			0-0						21.1	15.6	16.2	23.0	29.7																					
			0-0						22.6	21.7	23.4	22.8	22.4																					
			0-0						22.0	22.6	21.1	21.2	22.9																					
			0-0						21.2	23.6	16.7	18.6	25.8																					
			0-0						23.6	23.1	18.2	24.0	29.0																					
			0-0						25.0	23.5	21.5	27.9	27.1																					

Project No.:

PCN:

Color Key

Swell Potential:	Low	Marginal	High	Moisture Content:	Below PL / 0-5% Over PL / >5% Over PL
Group Index:	GI≤20	GI>20		Ave. 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.

Lab No.	STA	Offset	Depth of Sample (ft)	Plastic Limit (PL)	AASHTO Class	Group Index	Optimum Moisture	Swell Potential (PI)	Ave. In-Place Moisture	Moisture Content @ Depth (ft) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Frost Class
			0-0						20.0	23.8	18.1	17.8	20.3																					
			0-0						28.4	60.4	16.1	20.9	16.1																					
1275	1+0000	Rt 7 EB	0.9-5	0.0	A-2-4(0)	0	9.4	0	10.2	11.8	9.4	8.0	11.8																					F3
1276	1+1000	Rt 7 EB	0.7-5	0.0	A-2-4(0)	0	9.9	0	11.0	12.1	10.9	7.8	13.3																					F3
1277	1+2000	Rt 7 EB	0.7-5	17.5	A-2-4(0)	0	10.5	7	10.9	12.3	10.3	11.0	9.9																					F3
1278	1+3000	Rt 7 EB	1.2-5	15.0	A-6(6)	6	11.3	16	17.7	14.2	17.0	17.5	22.2																					F3
1279	1+4000	Rt 7 EB	0.9-5	17.1	A-7-6(23)	23	13.5	28	21.0	20.5	20.4	21.0	22.3																					F3
1280	2+0000	Rt 7 EB	0.6-5	18.7	A-7-6(16)	16	12.6	22	21.0	24.2	20.6	21.8	17.4																					F3
1281	2+1000	Rt 7 EB	0.6-5	17.6	A-6(2)	2	10.5	11	15.4	16.4	18.5	12.9	13.9																					F3
1282	2+2000	Rt 7 EB	0.6-5	0.0	A-4(0)	0	10.2	0	13.6	14.5	11.8	13.8	14.4																					F3
1283	2+3000	Rt 7 EB	0.7-5	16.5	A-6(4)	4	10.4	14	15.6	22.5	12.4	13.2	14.5																					F3
1284	2+4000	Rt 7 EB	0.6-5	16.1	A-6(16)	16	11.3	22	20.6	19.7	22.0	23.0	17.5																					F3
1285	3+0000	Rt 7 EB	0.6-5	17.3	A-7-6(22)	22	13.1	26	22.5	22.8	22.7	23.7	20.7																					F3

Project No.: SS-5-021(016)000

PCN: 18244

Color Key

Swell Potential:	Low	Marginal	High	Moisture Content:	Below PL	0-5% Over PL	>5% Over PL
Group Index:	GI≤20	GI>20		Ave. 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.

Lab No.	STA	Offset	Depth of Sample (ft)	Plastic Limit (PL)	AASHTO Class	Group Index	Optimum Moisture	Swell Potential (PI)	Ave. In-Place Moisture	Moisture Content @ Depth (ft) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Frost Class
1286	3+1000	Rt 7 EB	0.7-5	16.6	A-7-6(21)	21	13.2	25	21.3	15.3	23.4	23.7	22.9																					F3
1287	3+2000	Rt 7 EB	0.6-5	15.8	A-7-6(21)	21	12.0	26	18.2	16.1	16.7	16.6	23.4																					F3
1288	3+3000	Rt 7 EB	0.6-5	16.1	A-4(0)	0	9.7	8	12.8	11.2	12.6	14.1	13.3																					F3
1289	3+4000	Rt 7 EB	0.6-5	21.1	A-7-6(35)	35	13.7	35	23.2	24.5	19.8	23.4	25.0																					F3
1290	4+0000	Rt 9 EB	0.4-5	15.1	A-6(3)	3	10.7	13	15.7	14.3	13.4	15.0	20.1																					F3
1291	4+1000	Rt 9 EB	0.4-5	15.1	A-6(7)	7	11.0	19	16.4	18.5	15.2	16.3	15.6																					F3
1292	4+2000	Rt 9 EB	0.6-5	16.8	A-4(3)	3	10.2	8	15.7	10.4	12.2	20.5	19.6																					F4
1293	4+3000	Rt 9 EB	0.7-5	14.8	A-6(10)	10	11.3	20	23.2	26.9	25.8	11.5	28.8																					F3
1294	5+0000	Rt 9 EB	0.7-5	20.7	A-7-6(40)	40	14.7	39	26.2	23.7	25.2	26.3	29.4																					F3
1295	5+1000	Rt 9 EB	0.6-5	19.8	A-7-6(34)	34	14.4	36	27.3	25.6	30.8	21.9	30.8																					F3
1296	5+2000	Rt 9 EB	0.6-5	22.0	A-7-6(42)	42	16.2	41	20.3	30.0	17.5	16.7	17.0																					F3
1297	5+3000	Rt 9 EB	0.5-5	17.4	A-7-6(17)	17	12.6	25	21.5	19.2	16.2	25.2	25.4																					F3
1298	5+4000	Rt 9 EB	0.6-5	18.3	A-7-6(22)	22	12.9	28	20.7	19.2	20.8	19.0	23.8																					F3

Project No.: SS-5-021(016)000

PCN: 18244

Color Key

Swell Potential:	Low	Marginal	High	Moisture Content:	Below PL / 0-5% Over PL / >5% Over PL
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Lab No.	STA	Offset	Depth of Sample (ft)	Plastic Limit (PL)	AASHTO Class	Group Index	Optimum Moisture	Swell Potential (PI)	Ave. In-Place Moisture	Moisture Content @ Depth (ft) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Frost Class
1300	6+1000	Rt 9 EB	0.3-5	18.3	A-7-6(21)	21	13.9	30	10.6	8.9	10.8	10.4	12.2																					F3
1302	6+3000	Rt 9 EB	0.4-5	17.3	A-6(2)	2	11.2	12	17.0	19.6	21.0	13.2	14.1																					F3
1304	7+0000	Rt 9 EB	0.7-5	16.9	A-6(8)	8	12.2	19	25.8	21.4	27.7	23.4	30.6																					F3
1305	7+1000	Rt 9 EB	0.5-5	0.0		0		0	20.2	22.0	18.9	19.0	20.8																					
1306	7+2000	Rt 9 EB	0.5-5	19.2	A-7-6(19)	19	14.0	23	22.4	22.8	23.6	19.5	23.7																					F3
1308	7+4000	Rt 9 EB	0.6-5	17.3	A-6(10)	10	12.1	16	21.8	24.4	17.9	16.7	28.1																					F3
1310	8+1000	Rt 9 EB	0.5-5	17.7	A-6(14)	14	12.3	19	20.0	20.3	21.1	19.1	19.4																					F3
1312	8+3000	Rt 9 EB	0.4-5	19.8	A-7-6(20)	20	14.1	25	24.2	27.4	23.1	21.6	24.8																					F3
1314	9+0000	Rt 9 EB	0.4-5	19.2	A-7-6(20)	20	11.3	24	19.4	21.3	21.3	20.1	15.1																					F3
1316	9+2000	Rt 9 EB	0.5-5	18.1	A-7-6(23)	23	12.1	29	21.0	19.6	20.1	21.7	22.5																					F3
1318	9+4000	Rt 9 EB	0.5-5	19.1	A-7-6(25)	25	12.6	30	21.1	17.6	22.3	22.0	22.4																					F3
1320	10+1000	Rt 9 EB	0.5-5	17.0	A-4(0)	0	8.8	8	12.8	12.7	10.2	12.3	16.1																					F3
1322	10+3000	Rt 9 EB	0.4-5	18.1	A-6(11)	11	10.2	19	13.8	17.0	12.3	10.9	14.8																					F3

Project No.: SS-5-021(016)000

PCN: 18244

Color Key

Swell Potential:	Low	Marginal	High	Moisture Content:	Below PL	0-5% Over PL	>5% Over PL
Group Index:	GI≤20	GI>20		Ave. 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.

Lab No.	STA	Offset	Depth of Sample (ft)	Plastic Limit (PL)	AASHTO Class	Group Index	Optimum Moisture	Swell Potential (PI)	Ave. In-Place Moisture	Moisture Content @ Depth (ft) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Frost Class
1324	11+0000	Rt 9 EB	0.5-5	22.4	A-7-6(28)	28	11.7	29	22.7	24.0	22.2	21.6	22.8																					F3
1326	11+2000	Rt 9 EB	0.5-5	20.6	A-7-6(24)	24	11.7	29	24.8	20.1	26.1	25.6	27.4																					F3
1328	11+4000	Rt 9 EB	0.5-5	17.0	A-7-6(19)	19	10.9	26	20.6	23.0	20.8	16.7	21.7																					F3
1330	12+1000	Rt 9 EB	0.5-5	17.0	A-6(12)	12	10.6	22	18.3	17.9	17.9	13.7	23.7																					F3
1332	12+3000	Rt 9 EB	0.5-5	21.0	A-7-6(30)	30	10.2	32	26.2	25.3	27.6	24.9	27.1																					F3
1334	13+0000	Rt 9 EB	0.4-5	18.3	A-7-6(18)	18	11.4	24	20.4	17.9	19.5	23.1	21.0																					F3
1336	13+2000	Rt 9 EB	0.5-5	15.4	A-6(1)	1	9.2	11	13.2	15.3	12.6	13.7	11.3																					F3
1338	13+4000	Rt 9 EB	0.5-5	18.8	A-6(17)	17	10.3	21	19.7	20.8	18.1	19.5	20.2																					F3
1340	14+1000	Rt 9 EB	0.5-5	20.8	A-7-6(28)	28	11.9	32	20.6	20.8	19.0	20.8	21.8																					F3
1342	14+3000	Rt 9 EB	0.6-5	19.0	A-7-6(28)	28	11.8	33	25.8	21.1	24.4	29.7	28.2																					F3
1344	15+0000	Rt 9 EB	0.5-5	18.9	A-7-6(32)	32	14.4	35	22.6	22.9	19.4	24.1	23.9																					F3
1346	15+2000	Rt 9 EB	0.6-5	18.0	A-4(2)	2	13.1	7	18.5	23.2	15.0	14.1	21.8																					F4
1347	15+3000	Rt 9 EB	0.5-5	0.0	A-4(0)	0	9.8	0	13.0	14.3	13.5	12.7	11.6																					F3

APPENDIX E

LAB RESULTS

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1270	1271	1272	1273
Reference Pt + Feet	0+0118	0+1000	0+2000	0+3000
Distance From CenterLine (Ft.)	Rt 8 EB	Rt 8 EB	Rt 8 EB	Rt 7 EB
Depth, Ft.	0.9 - 5.0	0.9 - 5.0	0.8 - 5.0	0.9 - 5.0
Field Sample No.	1270	1271	1272	1273
% Pass. 3/8" Sieve	99	100	100	100
% Pass. No. 4 Sieve	99	99	99	99
% Pass. No. 10 Sieve	97	96	99	97
% Coarse Sand (-No. 10 + No. 40)	6	6	3	3
% Fine Sand (-No. 40 + No. 200)	26	30	31	64
% Silt (0.074 - 0.005 mm)	29	26	31	14
% Clay (-0.005 mm)	36	35	35	17
Liquid Limit (-No. 40)	37	36	31	0
Plasticity Index (-No. 40)	22	20	18	NP
Plastic Limit	15	16	13	0
Soil Color	BRN/GRY	BRN/GRY	BRN	BRN
Textural Class	CLY	CLY	CLY	SNDY LM
Soil Class (AASHTO M-145)	A-6(11)	A-6(9)	A-6(9)	A-2-4(0)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	10.9	11.9	10.0	9.3
Maximum Dry Density (pcf)	125.2	122.4	128.2	126.3
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 10.3	2 | 17.4	2 | 16.7	2 | 8.8
	3 | 17.7	3 | 18.9	3 | 17.7	3 | 9.7
	4 | 15.4	4 | 20.6	4 | 14.0	4 | 10.9
	5 | 19.3	5 | 17.3	5 | 15.4	5 | 9.5
Avg. Moisture of Sample Depth	15.7	18.5	15.9	9.7

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1274	1275	1276	1277
Reference Pt + Feet	0+4000	1+0000	1+1000	1+2000
Distance From CenterLine (Ft.)	Rt 7 EB	Rt 7 EB	Rt 7 EB	Rt 7 EB
Depth, Ft.	0.9 - 5.0	0.9 - 5.0	0.7 - 5.0	0.7 - 5.0
Field Sample No.	1274	1275	1276	1277
% Pass. 3/8" Sieve	96	86	97	91
% Pass. No. 4 Sieve	95	80	96	90
% Pass. No. 10 Sieve	93	75	93	86
% Coarse Sand (-No. 10 + No. 40)	4	5	7	5
% Fine Sand (-No. 40 + No. 200)	57	42	53	49
% Silt (0.074 - 0.005 mm)	13	12	13	16
% Clay (-0.005 mm)	20	16	21	17
Liquid Limit (-No. 40)	0	0	0	25
Plasticity Index (-No. 40)	NP	NP	NP	7
Plastic Limit	0	0	0	18
Soil Color	BRN	BRN	BRN	BRN
Textural Class	SNDY LM	SNDY LM	SNDY CLY LM	SNDY LM
Soil Class (AASHTO M-145)	A-2-4(0)	A-2-4(0)	A-2-4(0)	A-2-4(0)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	9.2	9.4	9.9	10.5
Maximum Dry Density (pcf)	128.6	129.8	127.3	125.5
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 11.5	2 | 11.8	2 | 12.1	2 | 12.3
	3 | 10.0	3 | 9.4	3 | 10.9	3 | 10.3
	4 | 12.4	4 | 8.0	4 | 7.8	4 | 11.0
	5 | 11.0	5 | 11.8	5 | 13.3	5 | 9.9
Avg. Moisture of Sample Depth	11.2	10.2	11.0	10.9

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1278	1279	1280	1281
Reference Pt + Feet	1+3000	1+4000	2+0000	2+1000
Distance From CenterLine (Ft.)	Rt 7 EB	Rt 7 EB	Rt 7 EB	Rt 7 EB
Depth, Ft.	1.2 - 5.0	0.9 - 5.0	0.6 - 5.0	0.6 - 5.0
Field Sample No.	1278	1279	1280	1281
% Pass. 3/8" Sieve	95	100	99	100
% Pass. No. 4 Sieve	95	100	98	100
% Pass. No. 10 Sieve	94	99	97	99
% Coarse Sand (-No. 10 + No. 40)	2	2	4	1
% Fine Sand (-No. 40 + No. 200)	37	13	16	50
% Silt (0.074 - 0.005 mm)	28	34	33	27
% Clay (-0.005 mm)	28	50	44	22
Liquid Limit (-No. 40)	31	45	41	29
Plasticity Index (-No. 40)	16	28	23	11
Plastic Limit	15	17	19	18
Soil Color	BRN	BRN/GRY	BRN	BRN
Textural Class	CLY LM	CLY	CLY	SNDY CLY LM
Soil Class (AASHTO M-145)	A-6(6)	A-7-6(23)	A-7-6(16)	A-6(2)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	11.3	13.5	12.6	10.5
Maximum Dry Density (pcf)	123.0	119.4	119.9	126.3
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 14.2	2 | 20.5	2 | 24.2	2 | 16.4
	3 | 17.0	3 | 20.4	3 | 20.6	3 | 18.5
	4 | 17.5	4 | 21.0	4 | 21.8	4 | 12.9
	5 | 22.2	5 | 22.3	5 | 17.4	5 | 13.9
Avg. Moisture of Sample Depth	17.7	21.0	21.0	15.5

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1282	1283	1284	1285
Reference Pt + Feet	2+2000	2+3000	2+4000	3+0000
Distance From CenterLine (Ft.)	Rt 7 EB	Rt 7 EB	Rt 7 EB	Rt 7 EB
Depth, Ft.	0.6 - 5.0	0.7 - 5.0	0.6 - 5.0	0.6 - 5.0
Field Sample No.	1282	1283	1284	1285
% Pass. 3/8" Sieve	100	99	100	100
% Pass. No. 4 Sieve	100	99	100	100
% Pass. No. 10 Sieve	100	98	99	100
% Coarse Sand (-No. 10 + No. 40)	2	2	3	2
% Fine Sand (-No. 40 + No. 200)	57	42	18	12
% Silt (0.074 - 0.005 mm)	22	29	41	42
% Clay (-0.005 mm)	19	25	37	43
Liquid Limit (-No. 40)	0	31	38	43
Plasticity Index (-No. 40)	NP	14	22	26
Plastic Limit	0	17	16	17
Soil Color	BRN	BRN	BRN/GRY	BRN
Textural Class	SNDY LM	CLY LM	CLY	CLY
Soil Class (AASHTO M-145)	A-4(0)	A-6(4)	A-6(16)	A-7-6(22)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	10.2	10.4	11.3	13.1
Maximum Dry Density (pcf)	125.7	127.8	123.5	122.3
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 14.5	2 | 22.5	2 | 19.7	2 | 22.8
	3 | 11.8	3 | 12.4	3 | 22.0	3 | 22.7
	4 | 13.8	4 | 13.2	4 | 23.0	4 | 23.7
	5 | 14.4	5 | 14.5	5 | 17.5	5 | 20.7
Avg. Moisture of Sample Depth	13.6	15.7	20.5	22.4

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1286	1287	1288	1289
Reference Pt + Feet	3+1000	3+2000	3+3000	3+4000
Distance From CenterLine (Ft.)	Rt 7 EB	Rt 7 EB	Rt 7 EB	Rt 7 EB
Depth, Ft.	0.7 - 5.0	0.6 - 5.0	0.6 - 5.0	0.6 - 5.0
Field Sample No.	1286	1287	1288	1289
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	100	100	99	100
% Pass. No. 10 Sieve	100	100	99	99
% Coarse Sand (-No. 10 + No. 40)	1	0	3	2
% Fine Sand (-No. 40 + No. 200)	12	17	53	5
% Silt (0.074 - 0.005 mm)	40	36	20	19
% Clay (-0.005 mm)	46	47	23	74
Liquid Limit (-No. 40)	42	42	24	56
Plasticity Index (-No. 40)	25	26	8	35
Plastic Limit	17	16	16	21
Soil Color	BRN/GRY/BLK	BRN/GRY	BRN	BRN
Textural Class	CLY	CLY	SNDY CLY LM	CLY
Soil Class (AASHTO M-145)	A-7-6(21)	A-7-6(21)	A-4(0)	A-7-6(35)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	13.2	12.0	9.7	13.7
Maximum Dry Density (pcf)	120.3	122.8	127.7	120.2
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 15.3	2 | 16.1	2 | 11.2	2 | 24.5
	3 | 23.4	3 | 16.7	3 | 12.6	3 | 19.8
	4 | 23.7	4 | 16.6	4 | 14.1	4 | 23.4
	5 | 22.9	5 | 23.4	5 | 13.3	5 | 25.0
Avg. Moisture of Sample Depth	21.3	18.2	12.8	23.1

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Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1290	1291	1292	1293
Reference Pt + Feet	4+0000	4+1000	4+2000	4+3000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.4 - 5.0	0.4 - 5.0	0.6 - 5.0	0.7 - 5.0
Field Sample No.	1290	1291	1292	1293
% Pass. 3/8" Sieve	95	98	100	100
% Pass. No. 4 Sieve	92	96	98	99
% Pass. No. 10 Sieve	90	93	96	98
% Coarse Sand (-No. 10 + No. 40)	6	9	4	4
% Fine Sand (-No. 40 + No. 200)	36	27	25	32
% Silt (0.074 - 0.005 mm)	14	10	42	23
% Clay (-0.005 mm)	35	47	26	39
Liquid Limit (-No. 40)	28	34	25	35
Plasticity Index (-No. 40)	13	19	9	21
Plastic Limit	15	15	17	15
Soil Color	BRN	BRN/GRY/BLK	BRN	BRN/TAN
Textural Class	CLY	CLY	CLY LM	CLY
Soil Class (AASHTO M-145)	A-6(3)	A-6(7)	A-4(3)	A-6(10)
Frost Class	F3	F3	F4	F3
Optimum Moisture (%)	10.7	11.0	10.2	11.3
Maximum Dry Density (pcf)	127.4	127.3	128.4	125.1
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 14.3	2 | 18.5	2 | 10.4	2 | 26.9
	3 | 13.4	3 | 15.2	3 | 12.2	3 | 25.8
	4 | 15.0	4 | 16.3	4 | 20.5	4 | 11.5
	5 | 20.1	5 | 15.6	5 | 19.6	5 | 28.8
Avg. Moisture of Sample Depth	15.7	16.3	15.7	23.3

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Date Printed: 2/7/2017

Linear Laboratory Analysis

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300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1294	1295	1296	1297
Reference Pt + Feet	5+0000	5+1000	5+2000	5+3000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.7 - 5.0	0.6 - 5.0	0.6 - 5.0	0.5 - 5.0
Field Sample No.	1294	1295	1296	1297
% Pass. 3/8" Sieve	100	100	100	99
% Pass. No. 4 Sieve	100	100	100	99
% Pass. No. 10 Sieve	99	100	100	98
% Coarse Sand (-No. 10 + No. 40)	2	2	2	3
% Fine Sand (-No. 40 + No. 200)	4	10	5	22
% Silt (0.074 - 0.005 mm)	47	22	21	27
% Clay (-0.005 mm)	47	67	72	46
Liquid Limit (-No. 40)	59	56	63	43
Plasticity Index (-No. 40)	39	36	41	25
Plastic Limit	21	20	22	17
Soil Color	BRN/GRY/BLK	BRN	BRN	BRN
Textural Class	CLY	CLY	CLY	CLY
Soil Class (AASHTO M-145)	A-7-6(40)	A-7-6(34)	A-7-6(42)	A-7-6(17)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	14.7	14.4	16.2	12.6
Maximum Dry Density (pcf)	116.6	117.2	112.2	122.0
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 23.7	2 | 25.6	2 | 30.0	2 | 19.2
	3 | 25.2	3 | 30.8	3 | 17.5	3 | 16.2
	4 | 26.3	4 | 21.9	4 | 16.7	4 | 25.2
	5 | 29.4	5 | 30.8	5 | 17.0	5 | 25.4
Avg. Moisture of Sample Depth	26.2	27.3	20.3	21.5

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Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1298	1299	1300	1301
Reference Pt + Feet	5+4000	6+0000	6+1000	6+2000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.6 - 5.0	0.6 - 5.0	0.3 - 5.0	0.4 - 5.0
Field Sample No.	1298	1299	1300	1301
% Pass. 3/8" Sieve	100		100	
% Pass. No. 4 Sieve	99		99	
% Pass. No. 10 Sieve	98		97	
% Coarse Sand (-No. 10 + No. 40)	3		6	
% Fine Sand (-No. 40 + No. 200)	15		19	
% Silt (0.074 - 0.005 mm)	35		20	
% Clay (-0.005 mm)	46		53	
Liquid Limit (-No. 40)	46		48	
Plasticity Index (-No. 40)	28		30	
Plastic Limit	18		18	
Soil Color	BRN	BRN	BRN	BRN
Textural Class	CLY		CLY	
Soil Class (AASHTO M-145)	A-7-6(22)		A-7-6(21)	
Frost Class	F3		F3	
Optimum Moisture (%)	12.9		13.9	
Maximum Dry Density (pcf)	120.0		117.7	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 19.2	2 | 23.0	2 | 8.9	2 | 14.5
	3 | 20.8	3 | 18.0	3 | 10.8	3 | 9.8
	4 | 19.0	4 | 23.2	4 | 10.4	4 | 15.4
	5 | 23.8	5 | 22.8	5 | 12.2	5 | 13.1
Avg. Moisture of Sample Depth	20.7	21.8	10.6	13.2

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Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1302	1303	1304	1305
Reference Pt + Feet	6+3000	6+4000	7+0000	7+1000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.4 - 5.0	0.5 - 5.0	0.7 - 5.0	0.5 - 5.0
Field Sample No.	1302	1303	1304	1305
% Pass. 3/8" Sieve	95		99	0
% Pass. No. 4 Sieve	93		97	0
% Pass. No. 10 Sieve	91		94	0
% Coarse Sand (-No. 10 + No. 40)	4		7	
% Fine Sand (-No. 40 + No. 200)	43		27	
% Silt (0.074 - 0.005 mm)	24		34	0
% Clay (-0.005 mm)	20		26	0
Liquid Limit (-No. 40)	30		36	0
Plasticity Index (-No. 40)	12		19	NP
Plastic Limit	17		17	0
Soil Color	BRN	BRN	BRN/GRY/BLK	BRN
Textural Class	SNDY LM		CLY LM	
Soil Class (AASHTO M-145)	A-6(2)		A-6(8)	
Frost Class	F3		F3	
Optimum Moisture (%)	11.2		12.2	
Maximum Dry Density (pcf)	127.4		122.3	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 19.6	2 | 18.1	2 | 21.4	2 | 22.0
	3 | 21.0	3 | 18.5	3 | 27.7	3 | 18.9
	4 | 13.2	4 | 15.3	4 | 23.4	4 | 19.0
	5 | 14.1	5 | 21.6	5 | 30.6	5 | 20.8
Avg. Moisture of Sample Depth	16.9	18.4	25.7	20.1

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1306	1307	1308	1309
Reference Pt + Feet	7+2000	7+3000	7+4000	8+0000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.5 - 5.0	0.5 - 5.0	0.6 - 5.0	0.6 - 5.0
Field Sample No.	1306	1307	1308	1309
% Pass. 3/8" Sieve	100		100	
% Pass. No. 4 Sieve	99		99	
% Pass. No. 10 Sieve	98		98	
% Coarse Sand (-No. 10 + No. 40)	3		4	
% Fine Sand (-No. 40 + No. 200)	13		21	
% Silt (0.074 - 0.005 mm)	44		41	
% Clay (-0.005 mm)	38		32	
Liquid Limit (-No. 40)	43		33	
Plasticity Index (-No. 40)	23		16	
Plastic Limit	19		17	
Soil Color	BRN	BRN	BRN	BRN/GRY
Textural Class	CLY		CLY	
Soil Class (AASHTO M-145)	A-7-6(19)		A-6(10)	
Frost Class	F3		F3	
Optimum Moisture (%)	14.0		12.1	
Maximum Dry Density (pcf)	116.9		121.7	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 22.8	2 | 25.6	2 | 24.4	2 | 20.3
	3 | 23.6	3 | 17.6	3 | 17.9	3 | 18.9
	4 | 19.5	4 | 18.7	4 | 16.7	4 | 19.4
	5 | 23.7	5 | 15.2	5 | 28.1	5 | 23.2
Avg. Moisture of Sample Depth	22.4	19.2	21.8	20.4

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1310	1311	1312	1313
Reference Pt + Feet	8+1000	8+2000	8+3000	8+4000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.5 - 5.0	0.4 - 5.0	0.4 - 5.0	0.5 - 5.0
Field Sample No.	1310	1311	1312	1313
% Pass. 3/8" Sieve	100		100	
% Pass. No. 4 Sieve	99		99	
% Pass. No. 10 Sieve	98		98	
% Coarse Sand (-No. 10 + No. 40)	4		3	
% Fine Sand (-No. 40 + No. 200)	14		14	
% Silt (0.074 - 0.005 mm)	46		50	
% Clay (-0.005 mm)	34		31	
Liquid Limit (-No. 40)	37		45	
Plasticity Index (-No. 40)	19		25	
Plastic Limit	18		20	
Soil Color	BRN	BRN/GRY	BRN	BRN
Textural Class	CLY		CLY	
Soil Class (AASHTO M-145)	A-6(14)		A-7-6(20)	
Frost Class	F3		F3	
Optimum Moisture (%)	12.3		14.1	
Maximum Dry Density (pcf)	121.0		116.3	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 20.3	2 | 21.9	2 | 27.4	2 | 28.8
	3 | 21.1	3 | 23.7	3 | 23.1	3 | 20.8
	4 | 19.1	4 | 26.0	4 | 21.6	4 | 19.8
	5 | 19.4	5 | 20.4	5 | 24.8	5 | 21.0
Avg. Moisture of Sample Depth	20.0	23.0	24.3	22.6

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1314	1315	1316	1317
Reference Pt + Feet	9+0000	9+1000	9+2000	9+3000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.4 - 5.0	0.5 - 5.0	0.5 - 5.0	0.5 - 5.0
Field Sample No.	1314	1315	1316	1317
% Pass. 3/8" Sieve	100		100	
% Pass. No. 4 Sieve	99		98	
% Pass. No. 10 Sieve	97		96	
% Coarse Sand (-No. 10 + No. 40)	4		6	
% Fine Sand (-No. 40 + No. 200)	11		10	
% Silt (0.074 - 0.005 mm)	52		45	
% Clay (-0.005 mm)	31		35	
Liquid Limit (-No. 40)	43		47	
Plasticity Index (-No. 40)	24		29	
Plastic Limit	19		18	
Soil Color	BRN	BRN	BRN	BRN
Textural Class	CLY		CLY	
Soil Class (AASHTO M-145)	A-7-6(20)		A-7-6(23)	
Frost Class	F3		F3	
Optimum Moisture (%)	11.3		12.1	
Maximum Dry Density (pcf)	121.2		119.6	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 21.3	2 | 20.9	2 | 19.6	2 | 20.0
	3 | 21.3	3 | 23.1	3 | 20.1	3 | 23.3
	4 | 20.1	4 | 25.1	4 | 21.7	4 | 20.0
	5 | 15.1	5 | 23.4	5 | 22.5	5 | 21.2
Avg. Moisture of Sample Depth	19.4	23.1	21.0	21.1

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1318	1319	1320	1321
Reference Pt + Feet	9+4000	10+0000	10+1000	10+2000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.5 - 5.0	0.5 - 5.0	0.5 - 5.0	0.4 - 5.0
Field Sample No.	1318	1319	1320	1321
% Pass. 3/8" Sieve	97		98	
% Pass. No. 4 Sieve	97		96	
% Pass. No. 10 Sieve	96		93	
% Coarse Sand (-No. 10 + No. 40)	3		3	
% Fine Sand (-No. 40 + No. 200)	10		53	
% Silt (0.074 - 0.005 mm)	41		25	
% Clay (-0.005 mm)	43		13	
Liquid Limit (-No. 40)	49		25	
Plasticity Index (-No. 40)	30		8	
Plastic Limit	19		17	
Soil Color	BRN	BRN	BRN	BRN
Textural Class	CLY		SNDY LM	
Soil Class (AASHTO M-145)	A-7-6(25)		A-4(0)	
Frost Class	F3		F3	
Optimum Moisture (%)	12.6		8.8	
Maximum Dry Density (pcf)	119.5		129.9	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 17.6	2 | 19.7	2 | 12.7	2 | 22.7
	3 | 22.3	3 | 24.0	3 | 10.2	3 | 18.7
	4 | 22.0	4 | 20.1	4 | 12.3	4 | 19.9
	5 | 22.4	5 | 22.2	5 | 16.1	5 | 22.1
Avg. Moisture of Sample Depth	21.1	21.5	12.8	20.8

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Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1322	1323	1324	1325
Reference Pt + Feet	10+3000	10+4000	11+0000	11+1000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.4 - 5.0	0.5 - 5.0	0.5 - 5.0	0.4 - 5.0
Field Sample No.	1322	1323	1324	1325
% Pass. 3/8" Sieve	99		100	
% Pass. No. 4 Sieve	98		100	
% Pass. No. 10 Sieve	96		99	
% Coarse Sand (-No. 10 + No. 40)	4		2	
% Fine Sand (-No. 40 + No. 200)	25		7	
% Silt (0.074 - 0.005 mm)	43		55	
% Clay (-0.005 mm)	25		36	
Liquid Limit (-No. 40)	37		51	
Plasticity Index (-No. 40)	19		29	
Plastic Limit	18		22	
Soil Color	BRN	BRN/GRY	BRN/GRY	BRN
Textural Class	CLY LM		CLY	
Soil Class (AASHTO M-145)	A-6(11)		A-7-6(28)	
Frost Class	F3		F3	
Optimum Moisture (%)	10.2		11.7	
Maximum Dry Density (pcf)	123.1		119.6	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 17.0	2 | 16.3	2 | 24.0	2 | 24.5
	3 | 12.3	3 | 23.7	3 | 22.2	3 | 18.8
	4 | 10.9	4 | 21.6	4 | 21.6	4 | 18.1
	5 | 14.8	5 | 19.7	5 | 22.8	5 | 22.4
Avg. Moisture of Sample Depth	13.7	20.3	22.7	20.9

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1326	1327	1328	1329
Reference Pt + Feet	11+2000	11+3000	11+4000	12+0000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.5 - 5.0	0.5 - 5.0	0.5 - 5.0	0.5 - 5.0
Field Sample No.	1326	1327	1328	1329
% Pass. 3/8" Sieve	100		100	
% Pass. No. 4 Sieve	99		100	
% Pass. No. 10 Sieve	96		100	
% Coarse Sand (-No. 10 + No. 40)	4		2	
% Fine Sand (-No. 40 + No. 200)	10		20	
% Silt (0.074 - 0.005 mm)	35		41	
% Clay (-0.005 mm)	47		37	
Liquid Limit (-No. 40)	49		43	
Plasticity Index (-No. 40)	29		26	
Plastic Limit	21		17	
Soil Color	BRN/GRY	BRN/BLK	BRN/GRY/BLK	BRN/GRY/BLK
Textural Class	CLY		CLY	
Soil Class (AASHTO M-145)	A-7-6(24)		A-7-6(19)	
Frost Class	F3		F3	
Optimum Moisture (%)	11.7		10.9	
Maximum Dry Density (pcf)	121.0		120.8	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 20.1	2 | 19.8	2 | 23.0	2 | 15.6
	3 | 26.1	3 | 16.2	3 | 20.8	3 | 16.2
	4 | 25.6	4 | 18.2	4 | 16.7	4 | 23.0
	5 | 27.4	5 | 17.6	5 | 21.7	5 | 29.7
Avg. Moisture of Sample Depth	24.8	18.0	20.6	21.1

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1330	1331	1332	1333
Reference Pt + Feet	12+1000	12+2000	12+3000	12+4000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.5 - 5.0	0.5 - 5.0	0.5 - 5.0	0.4 - 5.0
Field Sample No.	1330	1331	1332	1333
% Pass. 3/8" Sieve	100		100	
% Pass. No. 4 Sieve	100		100	
% Pass. No. 10 Sieve	99		99	
% Coarse Sand (-No. 10 + No. 40)	4		3	
% Fine Sand (-No. 40 + No. 200)	29		9	
% Silt (0.074 - 0.005 mm)	37		39	
% Clay (-0.005 mm)	30		49	
Liquid Limit (-No. 40)	39		53	
Plasticity Index (-No. 40)	22		32	
Plastic Limit	17		21	
Soil Color	BRN/BLK	BRN/BLK	BRN/GRY	BRN
Textural Class	CLY LM		CLY	
Soil Class (AASHTO M-145)	A-6(12)		A-7-6(30)	
Frost Class	F3		F3	
Optimum Moisture (%)	10.6		10.2	
Maximum Dry Density (pcf)	123.4		122.4	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 17.9	2 | 23.6	2 | 25.3	2 | 10.8
	3 | 17.9	3 | 16.7	3 | 27.6	3 | 13.9
	4 | 13.7	4 | 18.6	4 | 24.9	4 | 19.9
	5 | 23.7	5 | 25.8	5 | 27.1	5 | 15.3
Avg. Moisture of Sample Depth	18.3	21.2	26.3	14.9

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1334	1335	1336	1337
Reference Pt + Feet	13+0000	13+1000	13+2000	13+3000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.4 - 5.0	0.4 - 5.0	0.5 - 5.0	0.5 - 5.0
Field Sample No.	1334	1335	1336	1337
% Pass. 3/8" Sieve	100		100	
% Pass. No. 4 Sieve	100		100	
% Pass. No. 10 Sieve	99		99	
% Coarse Sand (-No. 10 + No. 40)	3		2	
% Fine Sand (-No. 40 + No. 200)	16		54	
% Silt (0.074 - 0.005 mm)	35		25	
% Clay (-0.005 mm)	45		19	
Liquid Limit (-No. 40)	42		26	
Plasticity Index (-No. 40)	24		11	
Plastic Limit	18		15	
Soil Color	BRN	BRN/GRY	BRN	BRN/GRY
Textural Class	CLY		SNDY LM	
Soil Class (AASHTO M-145)	A-7-6(18)		A-6(1)	
Frost Class	F3		F3	
Optimum Moisture (%)	11.4		9.2	
Maximum Dry Density (pcf)	120.7		127.6	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 17.9	2 | 60.4	2 | 15.3	2 | 23.1
	3 | 19.5	3 | 16.1	3 | 12.6	3 | 18.2
	4 | 23.1	4 | 20.9	4 | 13.7	4 | 24.0
	5 | 21.0	5 | 16.1	5 | 11.3	5 | 29.0
Avg. Moisture of Sample Depth	20.4	28.4	13.3	23.6

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1338	1339	1340	1341
Reference Pt + Feet	13+4000	14+0000	14+1000	14+2000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.5 - 5.0	0.5 - 5.0	0.5 - 5.0	0.6 - 5.0
Field Sample No.	1338	1339	1340	1341
% Pass. 3/8" Sieve	100		97	
% Pass. No. 4 Sieve	99		96	
% Pass. No. 10 Sieve	98		94	
% Coarse Sand (-No. 10 + No. 40)	3		5	
% Fine Sand (-No. 40 + No. 200)	13		8	
% Silt (0.074 - 0.005 mm)	45		35	
% Clay (-0.005 mm)	38		48	
Liquid Limit (-No. 40)	39		53	
Plasticity Index (-No. 40)	21		32	
Plastic Limit	19		21	
Soil Color	BRN	DRK BRN	BRN	BRN/GRY
Textural Class	CLY		CLY	
Soil Class (AASHTO M-145)	A-6(17)		A-7-6(28)	
Frost Class	F3		F3	
Optimum Moisture (%)	10.3		11.9	
Maximum Dry Density (pcf)	121.6		119.6	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 20.8	2 | 23.8	2 | 20.8	2 | 23.5
	3 | 18.1	3 | 18.1	3 | 19.0	3 | 21.5
	4 | 19.5	4 | 17.8	4 | 20.8	4 | 27.9
	5 | 20.2	5 | 20.3	5 | 21.8	5 | 27.1
Avg. Moisture of Sample Depth	19.7	20.0	20.6	25.0

Scott W. Wutzke, Testing Lab Supervisor
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Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1342	1343	1344	1345
Reference Pt + Feet	14+3000	14+4000	15+0000	15+1000
Distance From CenterLine (Ft.)	Rt 9 EB	Rt 9 EB	Rt 9 EB	Rt 9 EB
Depth, Ft.	0.6 - 5.0	0.5 - 5.0	0.5 - 5.0	0.5 - 5.0
Field Sample No.	1342	1343	1344	1345
% Pass. 3/8" Sieve	100		100	
% Pass. No. 4 Sieve	99		99	
% Pass. No. 10 Sieve	97		98	
% Coarse Sand (-No. 10 + No. 40)	4		3	
% Fine Sand (-No. 40 + No. 200)	10		8	
% Silt (0.074 - 0.005 mm)	41		38	
% Clay (-0.005 mm)	42		50	
Liquid Limit (-No. 40)	52		54	
Plasticity Index (-No. 40)	33		35	
Plastic Limit	19		19	
Soil Color	BRN	BRN	BRN	BRN
Textural Class	CLY		CLY	
Soil Class (AASHTO M-145)	A-7-6(28)		A-7-6(32)	
Frost Class	F3		F3	
Optimum Moisture (%)	11.8		14.4	
Maximum Dry Density (pcf)	119.8		116.9	
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 21.1	2 | 22.6	2 | 22.9	2 | 21.7
	3 | 24.4	3 | 21.1	3 | 19.4	3 | 23.4
	4 | 29.7	4 | 21.2	4 | 24.1	4 | 22.8
	5 | 28.2	5 | 22.9	5 | 23.9	5 | 22.4
Avg. Moisture of Sample Depth	25.8	21.9	22.6	22.6

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-61-2016	**Date Reported**	10/14/2016	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	SS-5-021(016)000
		AASHTO Test Method	T-180	**PCN**	18244

Comments

Lab Number	1346			1347		
Reference Pt + Feet	15+2000			15+3000		
Distance From CenterLine (Ft.)	Rt 9 EB			Rt 9 EB		
Depth, Ft.	0.6 - 5.0			0.5 - 5.0		
Field Sample No.	1346			1347		
% Pass. 3/8" Sieve	100			100		
% Pass. No. 4 Sieve	98			99		
% Pass. No. 10 Sieve	96			98		
% Coarse Sand (-No. 10 + No. 40)	5			2		
% Fine Sand (-No. 40 + No. 200)	23			55		
% Silt (0.074 - 0.005 mm)	37			30		
% Clay (-0.005 mm)	31			11		
Liquid Limit (-No. 40)	25			0		
Plasticity Index (-No. 40)	7			NP		
Plastic Limit	18			0		
Soil Color	BRN			GRY		
Textural Class	CLY			SNDY LM		
Soil Class (AASHTO M-145)	A-4(2)			A-4(0)		
Frost Class	F4			F3		
Optimum Moisture (%)	13.1			9.8		
Maximum Dry Density (pcf)	118.3			126.4		
% Organic Content						
Depth (Ft.) | Moisture (%)	2	|	23.2	2	|	14.3
	3	|	15.0	3	|	13.5
	4	|	14.1	4	|	12.7
	5	|	21.8	5	|	11.6
Avg. Moisture of Sample Depth	18.5			13.0		

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 2/7/2017

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			

Offset From Centerline	Type of Soil

AASTHO Designation	Date	
T-180	**1/11/2017**	**1270**

Density

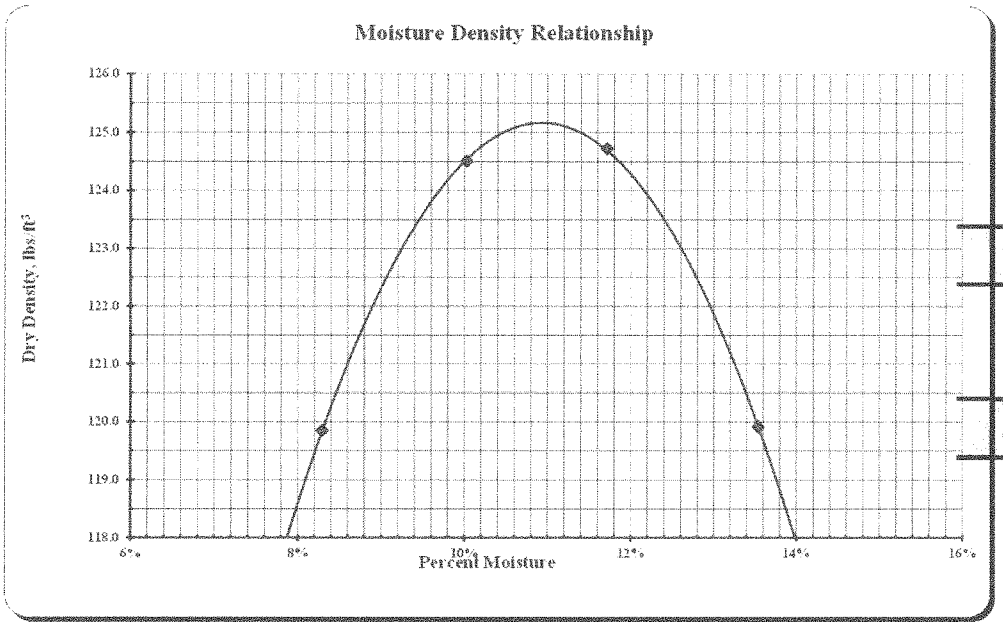
	Test Count	4				
Determination No.	1	2	3	4	5	6
A Volume of Mold cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
lbs.	8.73	8.96	9.04	8.93		
C Weight of Mold lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C lbs.	4.32	4.56	4.64	4.53		
E Wet Density = D / A lbs./cu.ft.	129.8	137.0	139.3	136.2		
F Dry Density = (E x 100) / (100 + L) lbs./cu.ft.	**119.9**	**124.5**	**124.7**	**119.9**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.	67	68	69	70		
G Wet Weight / Container grams	149.5	157.7	158.8	148.3		
H Dry Weight / Container grams	140.9	146.7	146.1	135.1		
I Moisture Loss = G - H grams	8.6	11.0	12.7	13.2		
J Tare Weight of Container grams	37.2	37.0	37.7	37.6		
K Dry Soil = H - J grams	103.7	109.7	108.4	97.5		
L %Moisture = (I / K) x 100 %	**8.3%**	**10.0%**	**11.7%**	**13.5%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

125.2 lbs./cu.ft.

Optimum Moisture

10.9%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/11/2017**		**1271**

Density

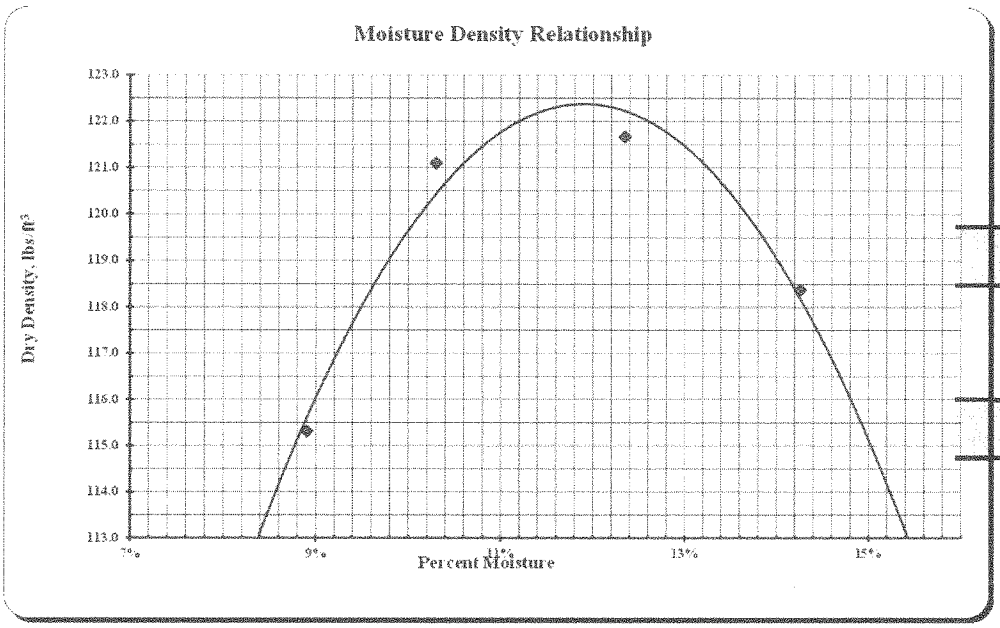
	Test Count	4				
Determination No.	1	2	3	4	5	6
A Volume of Mold cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
lbs.	8.59	8.85	8.95	8.90		
C Weight of Mold lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C lbs.	4.18	4.45	4.55	4.50		
E Wet Density = D / A lbs./cu.ft.	125.6	133.6	136.7	135.3		
F Dry Density = (E x 100) / (100 + L) lbs./cu.ft.	**115.3**	**121.1**	**121.7**	**118.4**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.	71	72	73	74		
G Wet Weight / Container grams	154.6	158.8	149.3	156.0		
H Dry Weight / Container grams	145.0	147.4	137.0	141.2		
I Moisture Loss = G - H grams	9.6	11.4	12.3	14.8		
J Tare Weight of Container grams	37.2	36.7	37.4	37.4		
K Dry Soil = H - J grams	107.8	110.7	99.6	103.8		
L %Moisture = (I / K) x 100 %	**8.9%**	**10.3%**	**12.3%**	**14.3%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

122.4 lbs./cu.ft.

Optimum Moisture

11.9%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/11/2017**		**1272**

Density

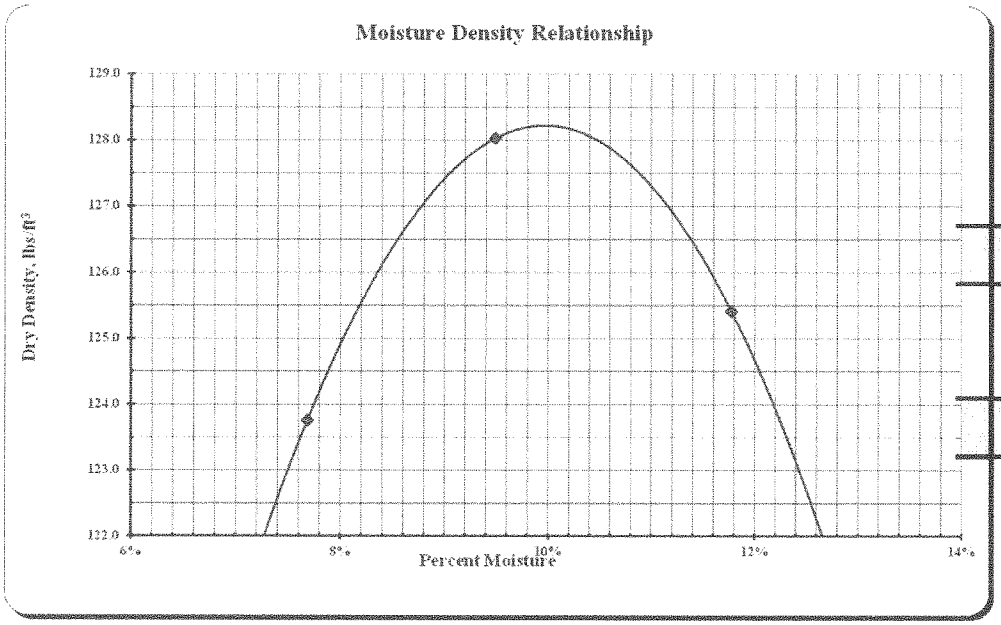
		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.84	9.07	9.07			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.44	4.67	4.67			
E Wet Density = D / A	lbs./cu.ft.	133.3	140.2	140.2			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**123.8**	**128.0**	**125.4**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		75	76	77			
G Wet Weight / Container	grams	153.6	160.3	150.7			
H Dry Weight / Container	grams	145.3	149.7	138.7			
I Moisture Loss = G - H	grams	8.3	10.6	12.0			
J Tare Weight of Container	grams	37.3	38.0	36.8			
K Dry Soil = H - J	grams	108.0	111.7	101.9			
L %Moisture = (I / K) x 100	%	**7.7%**	**9.5%**	**11.8%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

128.2 lbs./cu.ft.

Optimum Moisture

10.0%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/11/2017**		**1273**

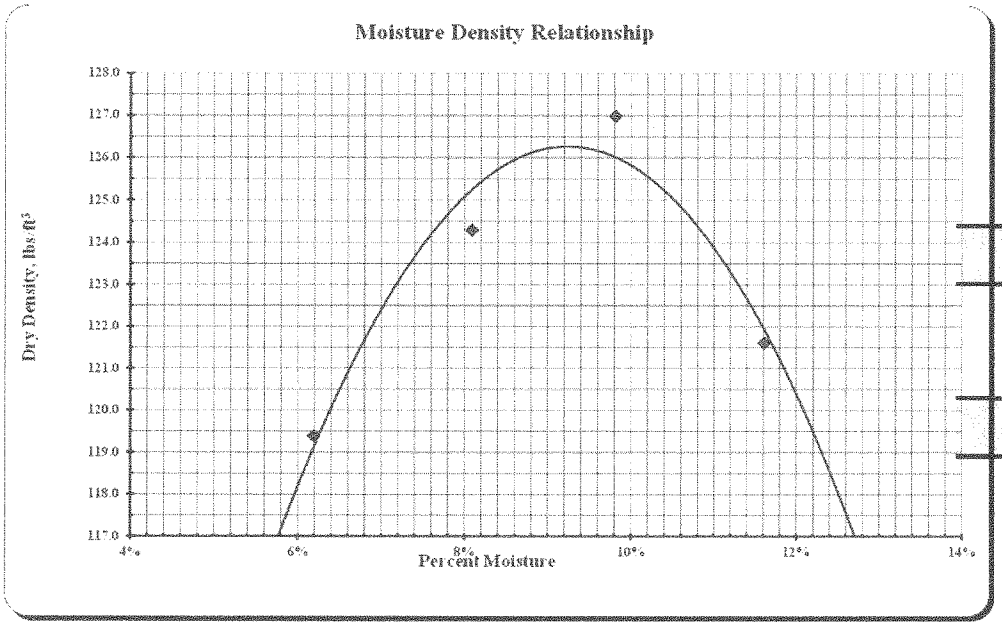
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.63	8.87	9.04	8.92		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.22	4.47	4.64	4.52		
E Wet Density = D / A	lbs./cu.ft.	126.8	134.4	139.5	135.7		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**119.4**	**124.3**	**127.0**	**121.6**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		78	79	80	81		
G Wet Weight / Container	grams	155.6	154.7	144.5	157.0		
H Dry Weight / Container	grams	148.7	145.9	134.9	144.6		
I Moisture Loss = G - H	grams	6.9	8.8	9.6	12.4		
J Tare Weight of Container	grams	37.2	37.1	37.1	37.8		
K Dry Soil = H - J	grams	111.5	108.8	97.8	106.8		
L %Moisture = (I / K) x 100	%	**6.2%**	**8.1%**	**9.8%**	**11.6%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

126.3 lbs./cu.ft.

Optimum Moisture

9.3%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/11/2017**		**1274**

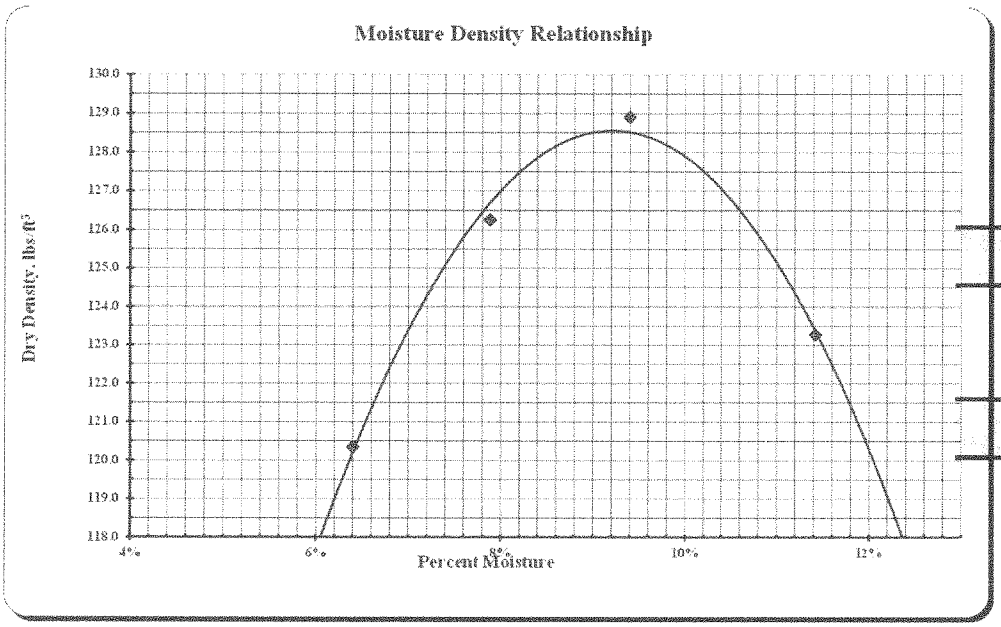
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.67	8.94	9.10	8.97		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.26	4.54	4.70	4.57		
E Wet Density = D / A	lbs./cu.ft.	128.0	136.2	141.0	137.4		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**120.3**	**126.3**	**128.9**	**123.3**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		82	83	84	85		
G Wet Weight / Container	grams	153.8	157.6	153.3	157.8		
H Dry Weight / Container	grams	146.8	148.8	143.3	145.5		
I Moisture Loss = G - H	grams	7.0	8.8	10.0	12.3		
J Tare Weight of Container	grams	37.4	37.2	36.9	37.8		
K Dry Soil = H - J	grams	109.4	111.6	106.4	107.7		
L %Moisture = (I / K) x 100	%	**6.4%**	**7.9%**	**9.4%**	**11.4%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

128.6 lbs./cu.ft.

Optimum Moisture

9.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/11/2017**		**1275**

Density

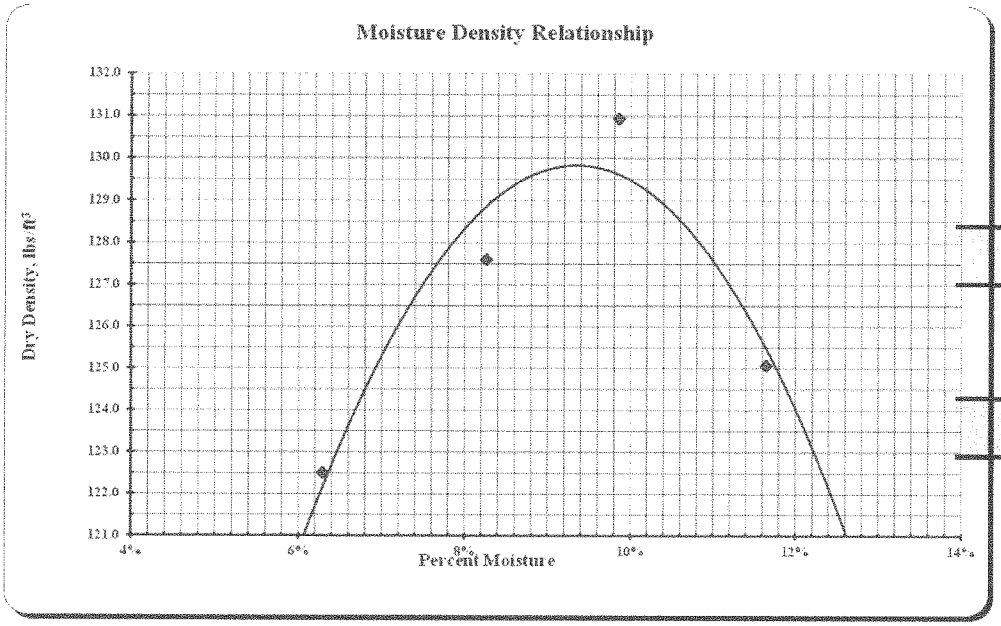
		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.74	9.00	9.19	9.05		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.34	4.60	4.79	4.65		
E Wet Density = D / A	lbs./cu.ft.	130.2	138.1	143.8	139.6		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**122.5**	**127.6**	**130.9**	**125.1**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		86	87	88	89		
G Wet Weight / Container	grams	157.6	145.0	160.4	145.0		
H Dry Weight / Container	grams	150.5	136.8	149.4	133.8		
I Moisture Loss = G - H	grams	7.1	8.2	11.0	11.2		
J Tare Weight of Container	grams	37.6	37.5	37.8	37.6		
K Dry Soil = H - J	grams	112.9	99.3	111.6	96.2		
L %Moisture = (I / K) x 100	%	**6.3%**	**8.3%**	**9.9%**	**11.6%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

129.8 lbs./cu.ft.

Optimum Moisture

9.4%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/11/2017**		**1276**

Density

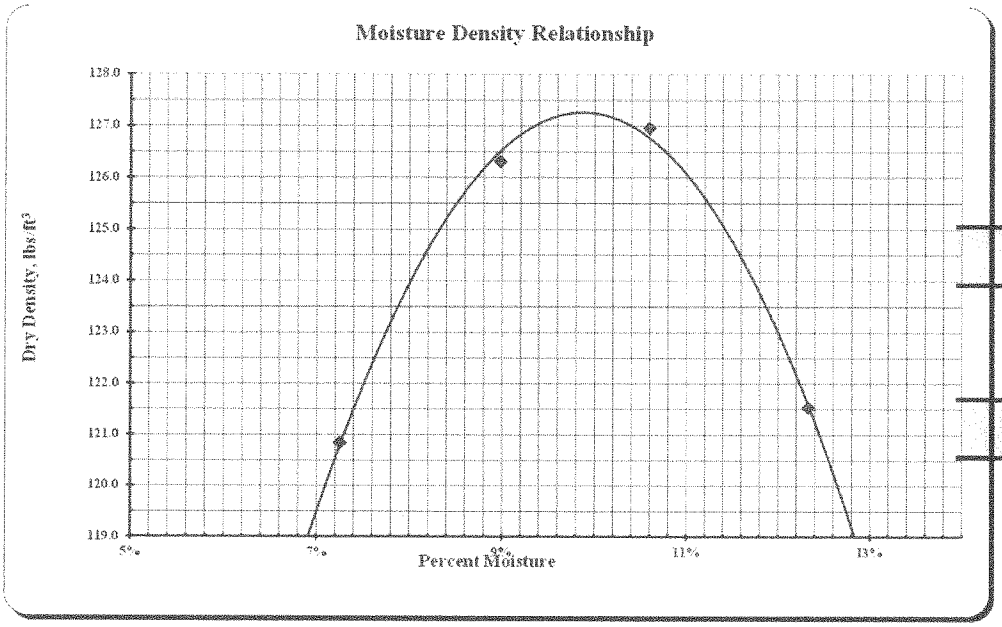
			Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.72	8.98	9.08	8.95		
C	Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C	lbs.	4.32	4.58	4.68	4.55		
E	Wet Density = D / A	lbs./cu.ft.	129.6	137.7	140.4	136.5		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**120.8**	**126.3**	**127.0**	**121.5**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		90	91	92	93		
G	Wet Weight / Container	grams	157.7	152.9	154.3	150.6		
H	Dry Weight / Container	grams	149.6	143.4	143.1	138.2		
I	Moisture Loss = G - H	grams	8.1	9.5	11.2	12.4		
J	Tare Weight of Container	grams	37.9	37.6	37.4	37.6		
K	Dry Soil = H - J	grams	111.7	105.8	105.7	100.6		
L	%Moisture = (I / K) x 100	%	**7.3%**	**9.0%**	**10.6%**	**12.3%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

127.3 lbs./cu.ft.

Optimum Moisture

9.9%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/11/2017**		**1277**

Density

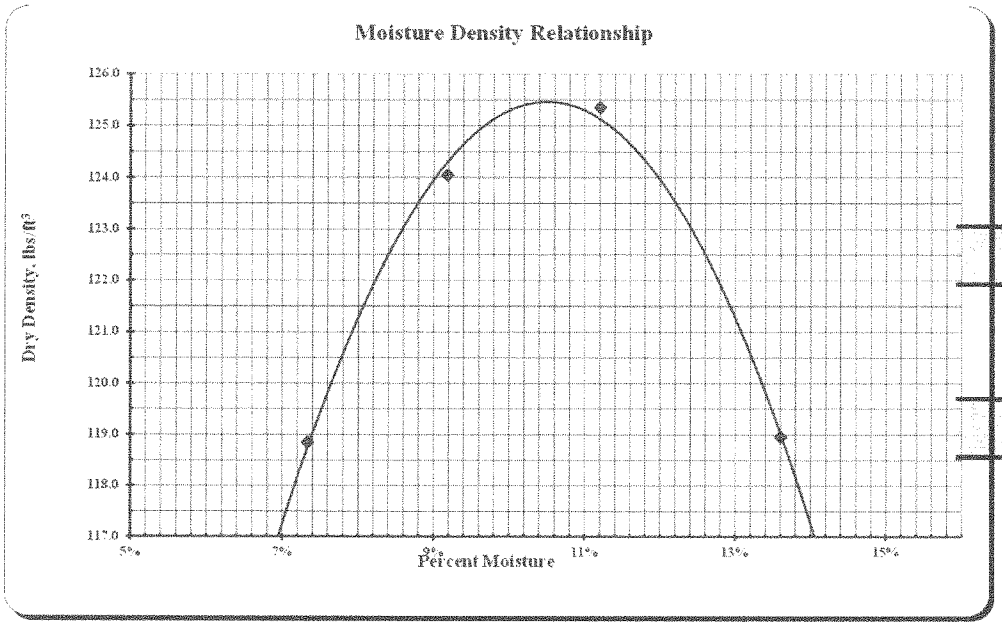
	Test Count	4				
Determination No.	1	2	3	4	5	6
A Volume of Mold cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
lbs.	8.65	8.91	9.04	8.90		
C Weight of Mold lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C lbs.	4.25	4.51	4.64	4.50		
E Wet Density = D / A lbs./cu.ft.	127.6	135.4	139.4	135.1		
F Dry Density = (E x 100) / (100 + L) lbs./cu.ft.	**118.8**	**124.0**	**125.4**	**119.0**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.	94	95	96	97		
G Wet Weight / Container grams	156.2	157.6	156.3	153.8		
H Dry Weight / Container grams	148.1	147.5	144.3	139.9		
I Moisture Loss = G - H grams	8.1	10.1	12.0	13.9		
J Tare Weight of Container grams	37.7	37.5	37.2	37.7		
K Dry Soil = H - J grams	110.4	110.0	107.1	102.2		
L %Moisture = (I / K) x 100 %	**7.3%**	**9.2%**	**11.2%**	**13.6%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

125.5 lbs./cu.ft.

Optimum Moisture

10.5%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1278**

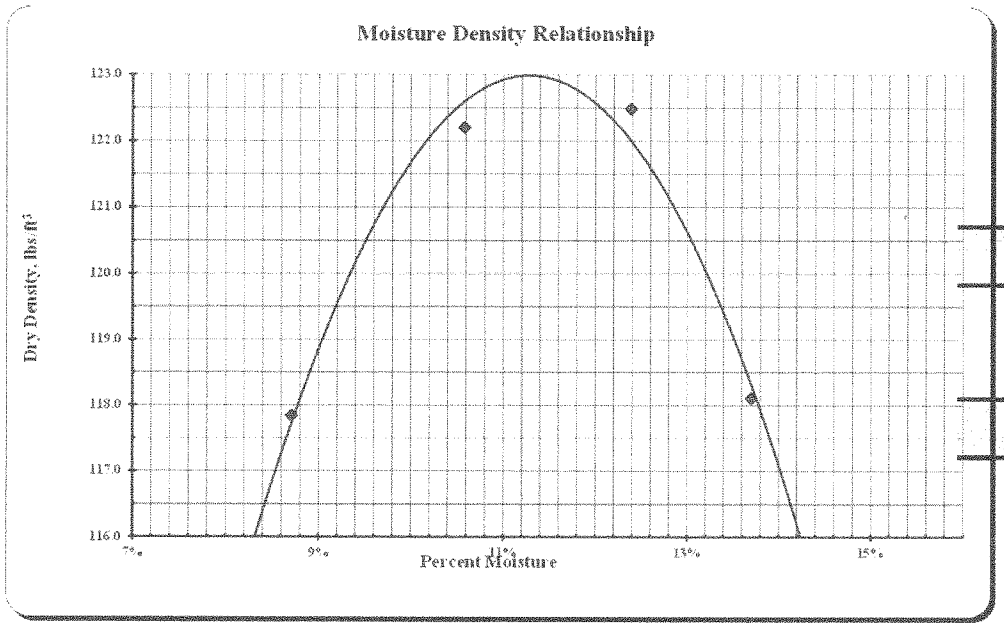
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.67	8.90	8.98	8.87		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.27	4.50	4.58	4.47		
E Wet Density = D / A	lbs./cu.ft.	128.1	135.1	137.7	134.3		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**117.8**	**122.2**	**122.5**	**118.1**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		1	2	3	4		
G Wet Weight / Container	grams	150.2	153.3	147.8	145.4		
H Dry Weight / Container	grams	141.1	142.2	135.6	132.3		
I Moisture Loss = G - H	grams	9.1	11.1	12.2	13.1		
J Tare Weight of Container	grams	36.6	37.3	37.1	36.7		
K Dry Soil = H - J	grams	104.5	104.9	98.5	95.6		
L %Moisture = (I / K) x 100	%	**8.7%**	**10.6%**	**12.4%**	**13.7%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

123.0 lbs./cu.ft.

Optimum Moisture

11.3%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1279**

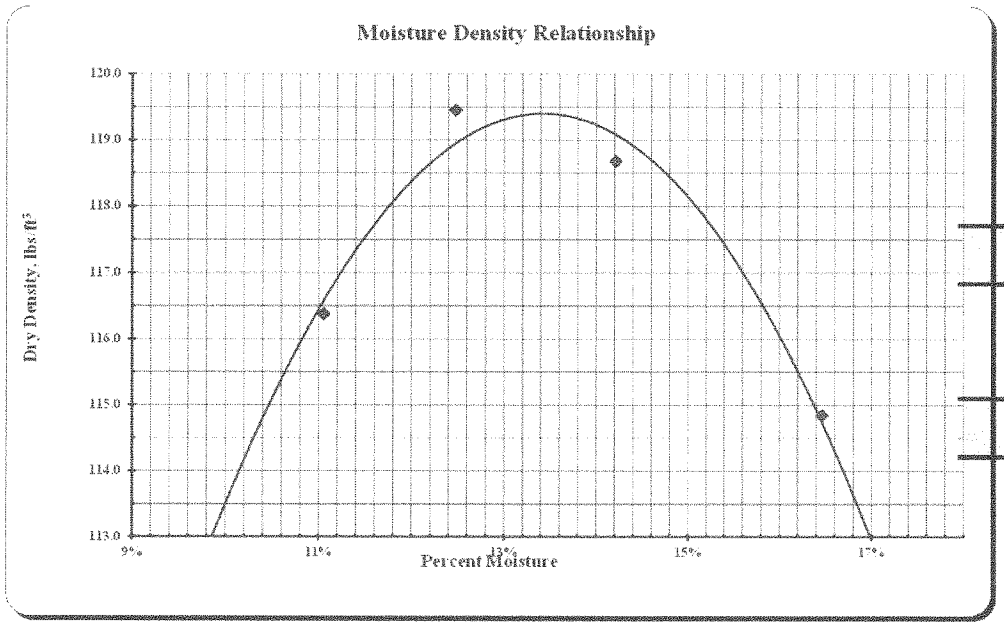
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.71	8.87	8.91	8.85		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.30	4.47	4.51	4.45		
E Wet Density = D / A	lbs./cu.ft.	129.2	134.4	135.6	133.8		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**116.4**	**119.5**	**118.7**	**114.8**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		5	6	7	8		
G Wet Weight / Container	grams	152.6	155.2	150.4	150.2		
H Dry Weight / Container	grams	141.1	142.1	136.2	134.2		
I Moisture Loss = G - H	grams	11.5	13.1	14.2	16.0		
J Tare Weight of Container	grams	37.1	37.1	36.3	37.0		
K Dry Soil = H - J	grams	104.0	105.0	99.9	97.2		
L %Moisture = (I / K) x 100	%	**11.1%**	**12.5%**	**14.2%**	**16.5%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

119.4 lbs./cu.ft.

Optimum Moisture

13.5%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1280**

Density

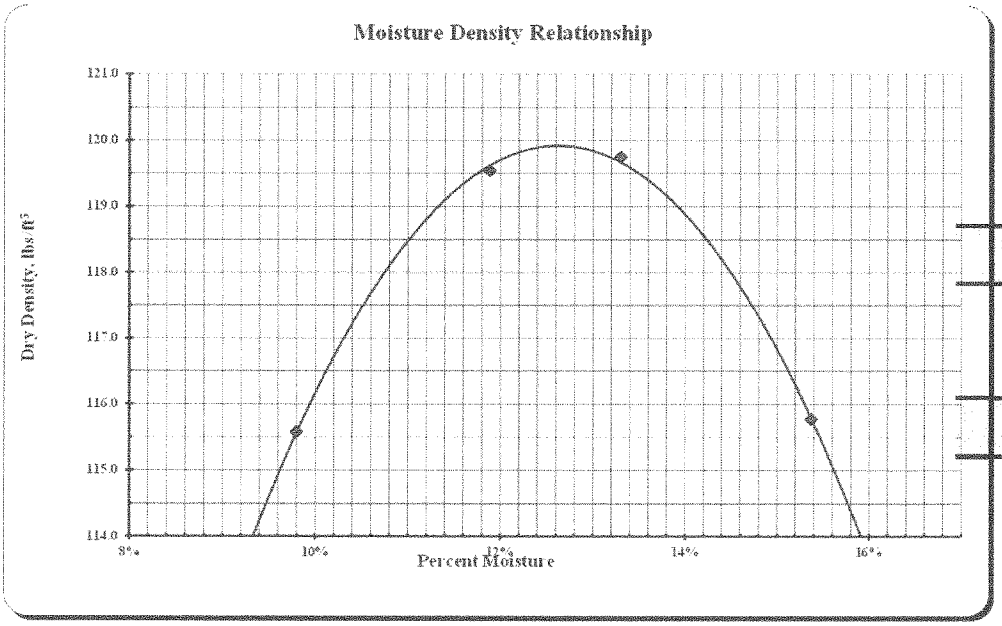
			Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.63	8.85	8.92	8.85		
C	Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C	lbs.	4.23	4.45	4.52	4.45		
E	Wet Density = D / A	lbs./cu.ft.	126.9	133.8	135.7	133.6		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**115.6**	**119.5**	**119.7**	**115.8**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		9	10	11	12		
G	Wet Weight / Container	grams	151.5	141.2	148.8	151.0		
H	Dry Weight / Container	grams	141.3	130.1	135.7	135.8		
I	Moisture Loss = G - H	grams	10.2	11.1	13.1	15.2		
J	Tare Weight of Container	grams	37.2	36.7	37.2	36.9		
K	Dry Soil = H - J	grams	104.1	93.4	98.5	98.9		
L	%Moisture = (I / K) x 100	%	**9.8%**	**11.9%**	**13.3%**	**15.4%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

119.9 lbs./cu.ft.

Optimum Moisture

12.6%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/17/2017**		**1281**

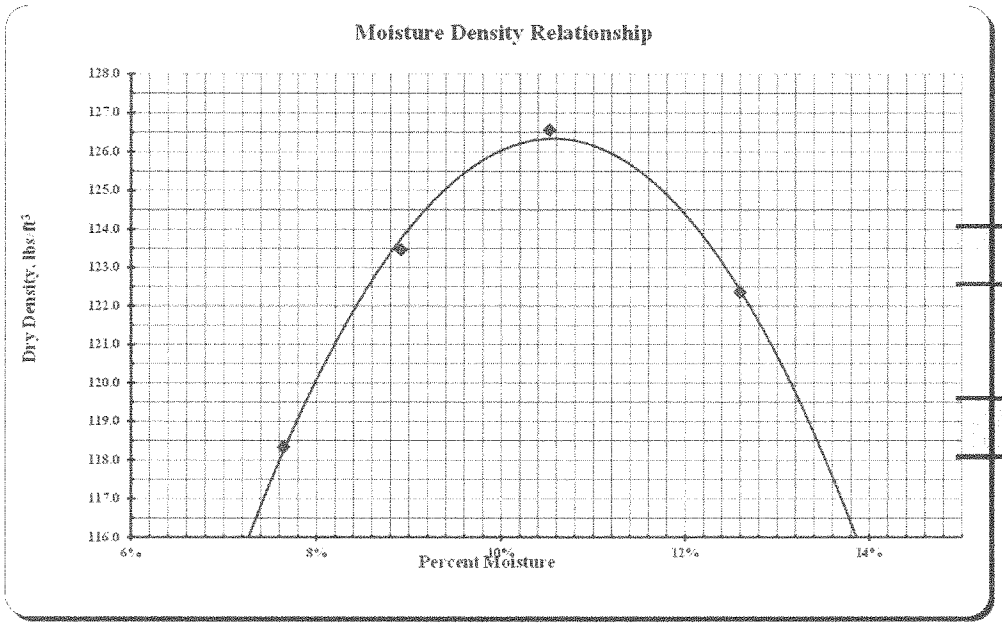
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.65	8.88	9.06	8.99		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.24	4.48	4.66	4.59		
E Wet Density = D / A	lbs./cu.ft.	127.4	134.5	139.9	137.8		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**118.3**	**123.5**	**126.6**	**122.4**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		13	14	15	16		
G Wet Weight / Container	grams	155.4	150.3	143.4	154.3		
H Dry Weight / Container	grams	147.0	141.1	133.3	141.2		
I Moisture Loss = G - H	grams	8.4	9.2	10.1	13.1		
J Tare Weight of Container	grams	37.1	37.9	37.3	37.2		
K Dry Soil = H - J	grams	109.9	103.2	96.0	104.0		
L %Moisture = (I / K) x 100	%	**7.6%**	**8.9%**	**10.5%**	**12.6%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

126.3 lbs./cu.ft.

Optimum Moisture

10.5%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/17/2017**		**1282**

Density

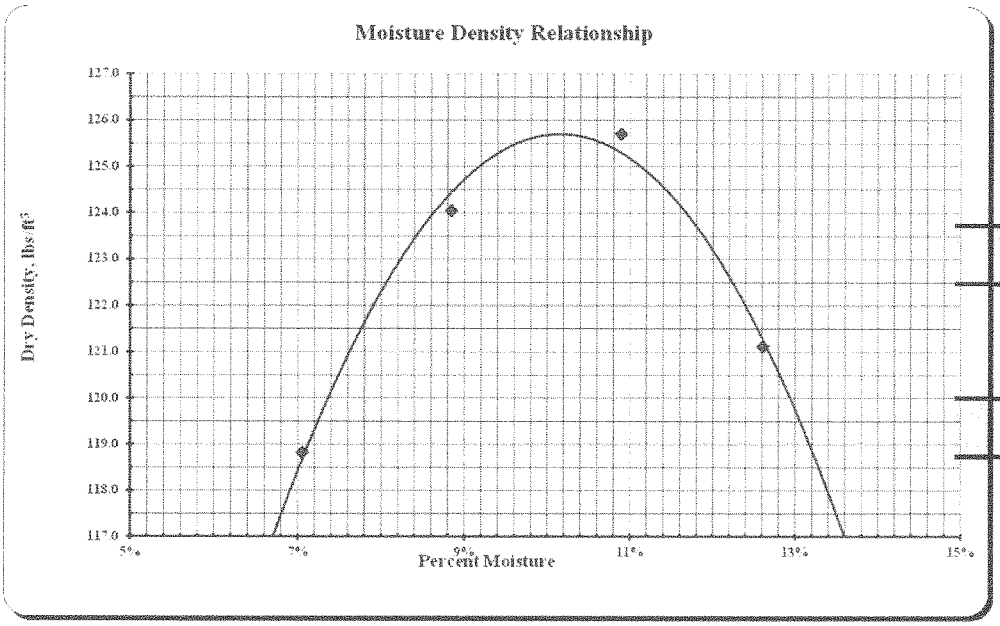
		Test Count	4				
	Determination No.	1	2	3	4	5	6
A	Volume of Mold cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.64	8.90	9.04	8.94		
C	Weight of Mold lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C lbs.	4.24	4.50	4.64	4.54		
E	Wet Density = D / A lbs./cu.ft.	127.2	135.0	139.4	136.4		
F	Dry Density = (E x 100) / (100 + L) lbs./cu.ft.	**118.8**	**124.0**	**125.7**	**121.1**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.	17	18	19	20		
G	Wet Weight / Container grams	152.1	147.9	155.2	151.7		
H	Dry Weight / Container grams	144.5	138.9	143.6	138.8		
I	Moisture Loss = G - H grams	7.6	9.0	11.6	12.9		
J	Tare Weight of Container grams	36.8	37.1	37.1	36.5		
K	Dry Soil = H - J grams	107.7	101.8	106.5	102.3		
L	%Moisture = (I / K) x 100 %	**7.1%**	**8.8%**	**10.9%**	**12.6%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

125.7 lbs./cu.ft.

Optimum Moisture

10.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/17/2017**		**1283**

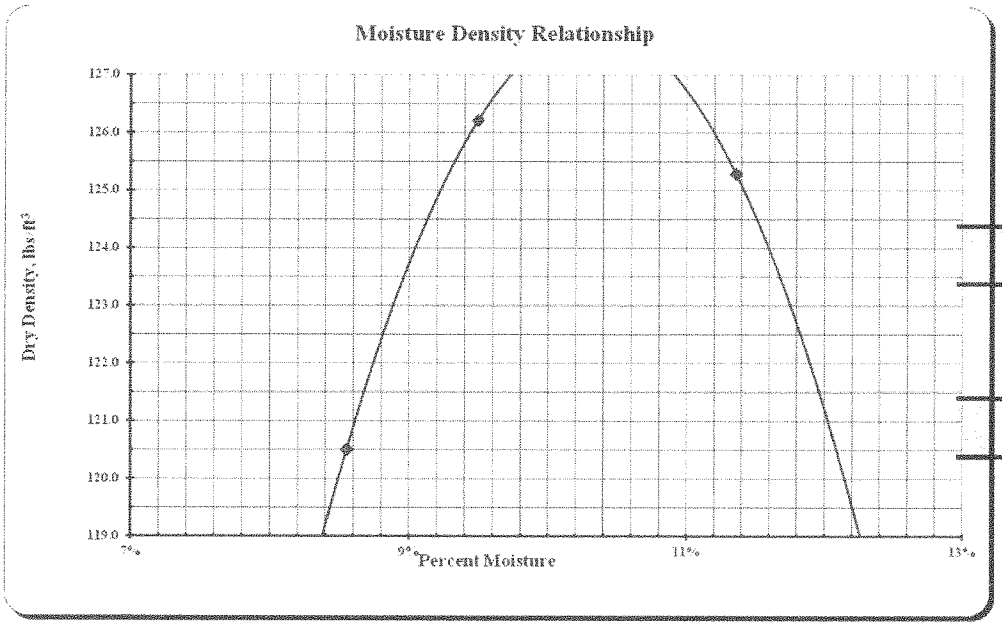
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.76	9.00	9.05			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.36	4.60	4.65			
E Wet Density = D / A	lbs./cu.ft.	130.8	138.2	139.5			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**120.5**	**126.2**	**125.3**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		21	22	23			
G Wet Weight / Container	grams	145.0	158.1	147.2			
H Dry Weight / Container	grams	136.5	147.6	136.0			
I Moisture Loss = G - H	grams	8.5	10.5	11.2			
J Tare Weight of Container	grams	37.1	37.0	37.4			
K Dry Soil = H - J	grams	99.4	110.6	98.6			
L %Moisture = (I / K) x 100	%	**8.6%**	**9.5%**	**11.4%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

127.8 lbs./cu.ft.

Optimum Moisture

10.4%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/17/2017**		**1284**

Density

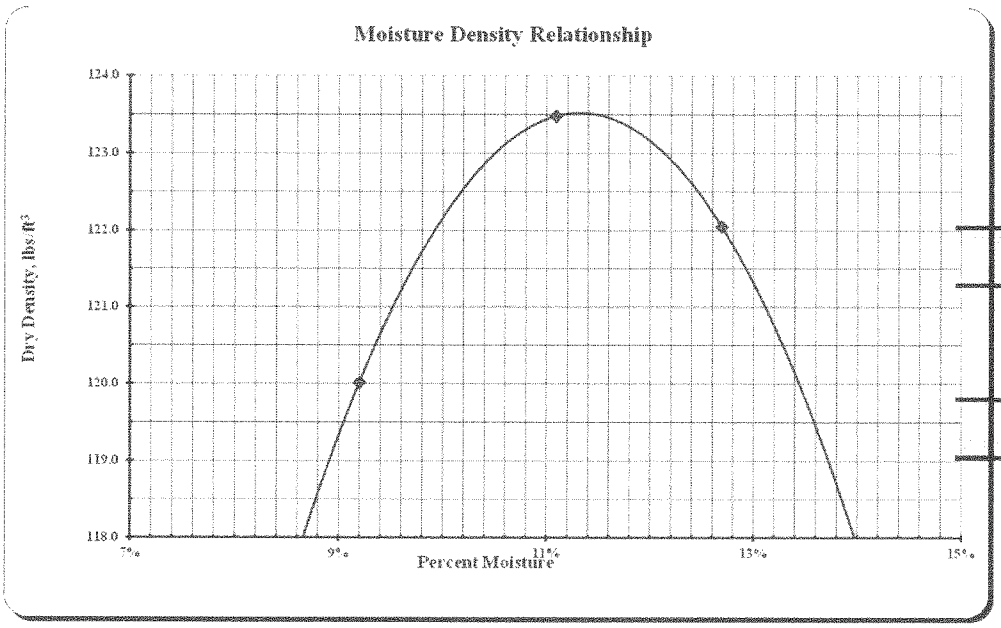
		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.77	8.97	8.98			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.36	4.57	4.58			
E Wet Density = D / A	lbs./cu.ft.	131.1	137.2	137.5			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**120.0**	**123.5**	**122.0**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.	24	25	26			
G Wet Weight / Container	grams	148.8	155.4	147.0			
H Dry Weight / Container	grams	139.4	143.6	134.6			
I Moisture Loss = G - H	grams	9.4	11.8	12.4			
J Tare Weight of Container	grams	37.2	37.2	36.9			
K Dry Soil = H - J	grams	102.2	106.4	97.7			
L %Moisture = (I / K) x 100	%	**9.2%**	**11.1%**	**12.7%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

123.5 lbs./cu.ft.

Optimum Moisture

11.3%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1285**

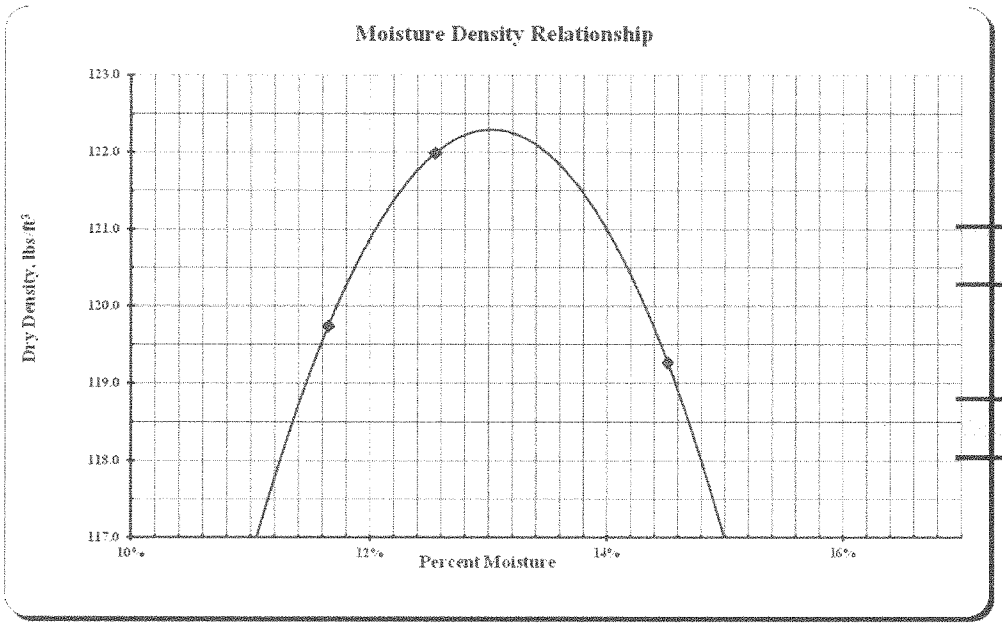
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.86	8.97	8.95			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.45	4.57	4.55			
E Wet Density = D / A	lbs./cu.ft.	133.7	137.3	136.6			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**119.7**	**122.0**	**119.3**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		27	28	29			
G Wet Weight / Container	grams	146.9	152.9	151.6			
H Dry Weight / Container	grams	135.4	140.0	137.1			
I Moisture Loss = G - H	grams	11.5	12.9	14.5			
J Tare Weight of Container	grams	36.7	37.2	37.2			
K Dry Soil = H - J	grams	98.7	102.8	99.9			
L %Moisture = (I / K) x 100	%	**11.7%**	**12.5%**	**14.5%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

122.3 lbs./cu.ft.

Optimum Moisture

13.1%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			

Offset From Centerline	Type of Soil

AASTHO Designation	Date	
T-180	**1/17/2017**	**1286**

Density

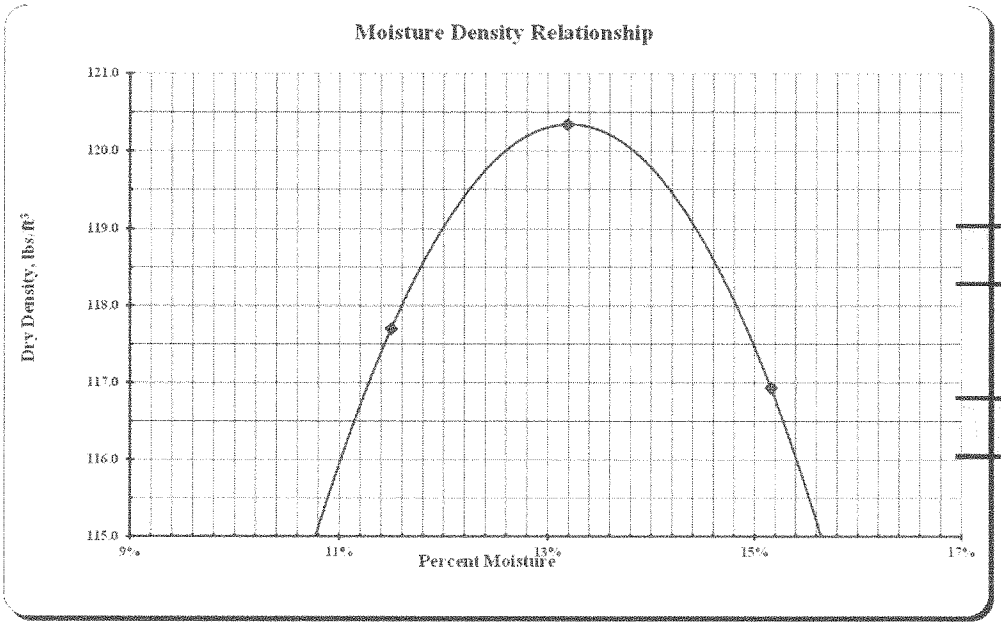
		Test Count	3				
	Determination No.	1	2	3	4	5	6
A	Volume of Mold cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.77	8.94	8.88			
C	Weight of Mold lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C lbs.	4.37	4.54	4.48			
E	Wet Density = D / A lbs./cu.ft.	131.2	136.2	134.7			
F	Dry Density = (E x 100) / (100 + L) lbs./cu.ft.	**117.7**	**120.3**	**116.9**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.	30	31	32			
G	Wet Weight / Container grams	149.6	152.0	146.3			
H	Dry Weight / Container grams	138.0	138.6	131.9			
I	Moisture Loss = G - H grams	11.6	13.4	14.4			
J	Tare Weight of Container grams	37.1	37.0	36.9			
K	Dry Soil = H - J grams	100.9	101.6	95.0			
L	%Moisture = (I / K) x 100 %	**11.5%**	**13.2%**	**15.2%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

120.3 lbs./cu.ft.

Optimum Moisture

13.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1287**

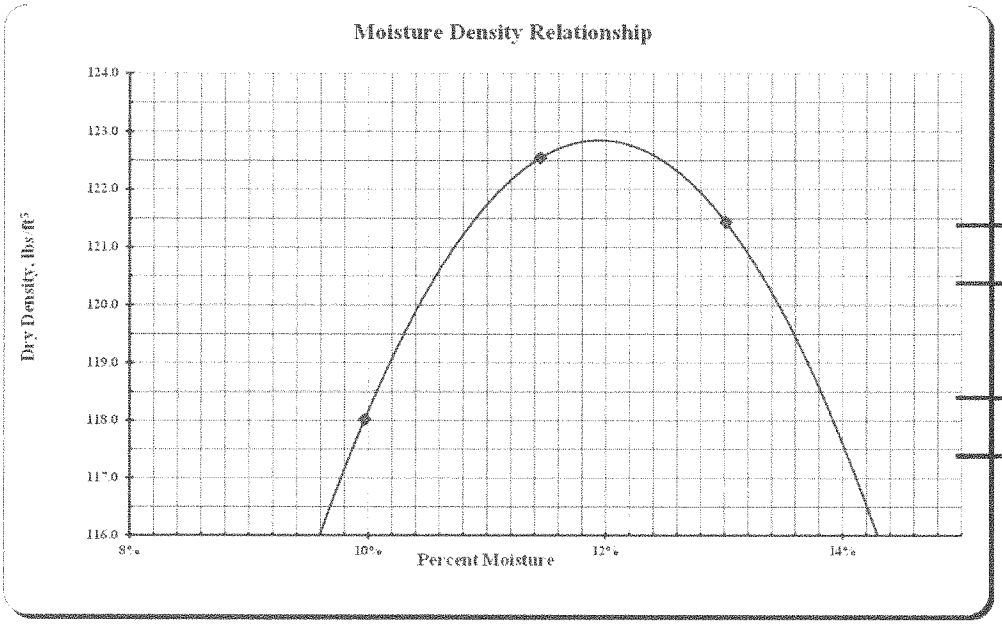
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.72	8.95	8.97			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.32	4.55	4.57			
E Wet Density = D / A	lbs./cu.ft.	129.8	136.6	137.2			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**118.0**	**122.5**	**121.4**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		61	62	63			
G Wet Weight / Container	grams	150.9	162.2	158.9			
H Dry Weight / Container	grams	140.6	149.4	144.9			
I Moisture Loss = G - H	grams	10.3	12.8	14.0			
J Tare Weight of Container	grams	37.3	37.6	37.3			
K Dry Soil = H - J	grams	103.3	111.8	107.6			
L %Moisture = (I / K) x 100	%	**10.0%**	**11.4%**	**13.0%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

122.8 lbs./cu.ft.

Optimum Moisture

12.0%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1288**

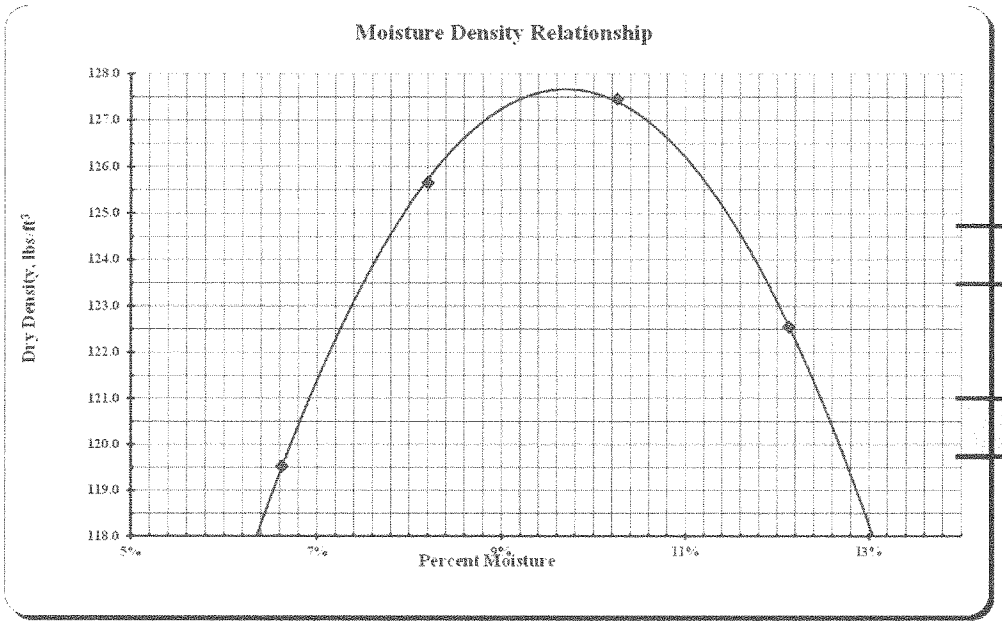
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.65	8.93	9.08	8.98		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.24	4.53	4.68	4.58		
E Wet Density = D / A	lbs./cu.ft.	127.4	136.0	140.5	137.4		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**119.5**	**125.7**	**127.5**	**122.6**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		64	65	66	67		
G Wet Weight / Container	grams	153.2	148.6	152.7	161.1		
H Dry Weight / Container	grams	146.0	140.2	142.0	147.7		
I Moisture Loss = G - H	grams	7.2	8.4	10.7	13.4		
J Tare Weight of Container	grams	37.3	37.8	37.7	37.2		
K Dry Soil = H - J	grams	108.7	102.4	104.3	110.5		
L %Moisture = (I / K) x 100	%	**6.6%**	**8.2%**	**10.3%**	**12.1%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

127.7 lbs./cu.ft.

Optimum Moisture

9.7%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/17/2017**		**1289**

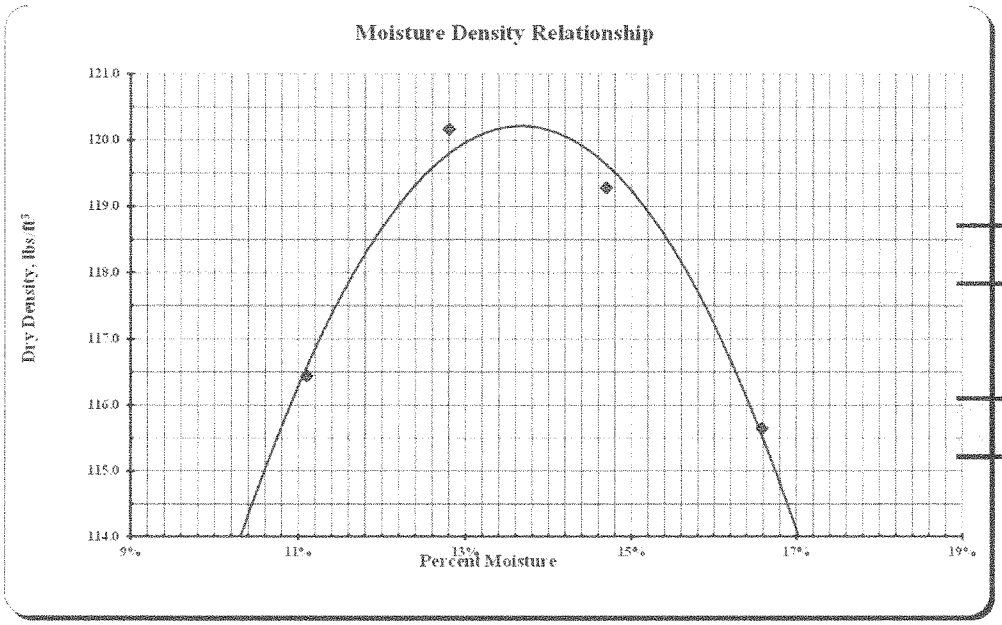
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.71	8.91	8.96	8.89		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.31	4.51	4.56	4.49		
E Wet Density = D / A	lbs./cu.ft.	129.4	135.6	136.8	134.8		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**116.4**	**120.2**	**119.3**	**115.7**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		68	69	70	71		
G Wet Weight / Container	grams	156.1	158.4	157.0	154.6		
H Dry Weight / Container	grams	144.2	144.7	141.7	137.9		
I Moisture Loss = G - H	grams	11.9	13.7	15.3	16.7		
J Tare Weight of Container	grams	37.0	37.7	37.6	37.2		
K Dry Soil = H - J	grams	107.2	107.0	104.1	100.7		
L %Moisture = (I / K) x 100	%	**11.1%**	**12.8%**	**14.7%**	**16.6%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

120.2 lbs./cu.ft.

Optimum Moisture

13.7%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1290**

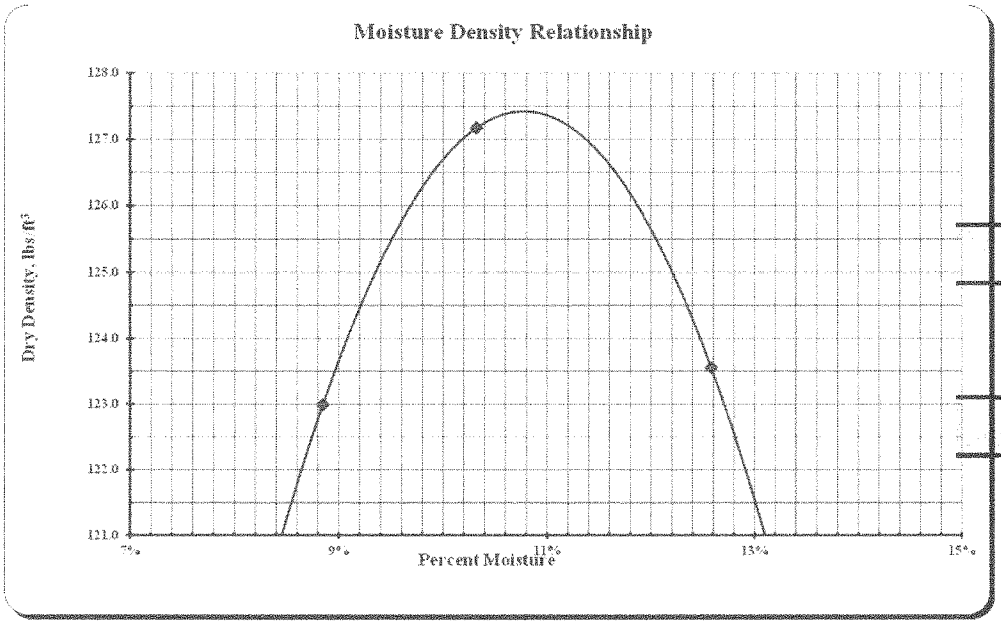
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.86	9.07	9.03			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.46	4.67	4.63			
E Wet Density = D / A	lbs./cu.ft.	133.9	140.3	139.1			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**123.0**	**127.2**	**123.6**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		73	73	74			
G Wet Weight / Container	grams	155.5	161.4	159.1			
H Dry Weight / Container	grams	145.9	149.8	145.5			
I Moisture Loss = G - H	grams	9.6	11.6	13.6			
J Tare Weight of Container	grams	37.4	37.4	37.4			
K Dry Soil = H - J	grams	108.5	112.4	108.1			
L %Moisture = (I / K) x 100	%	**8.8%**	**10.3%**	**12.6%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

127.4 lbs./cu.ft.

Optimum Moisture

10.7%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/17/2017**		**1291**

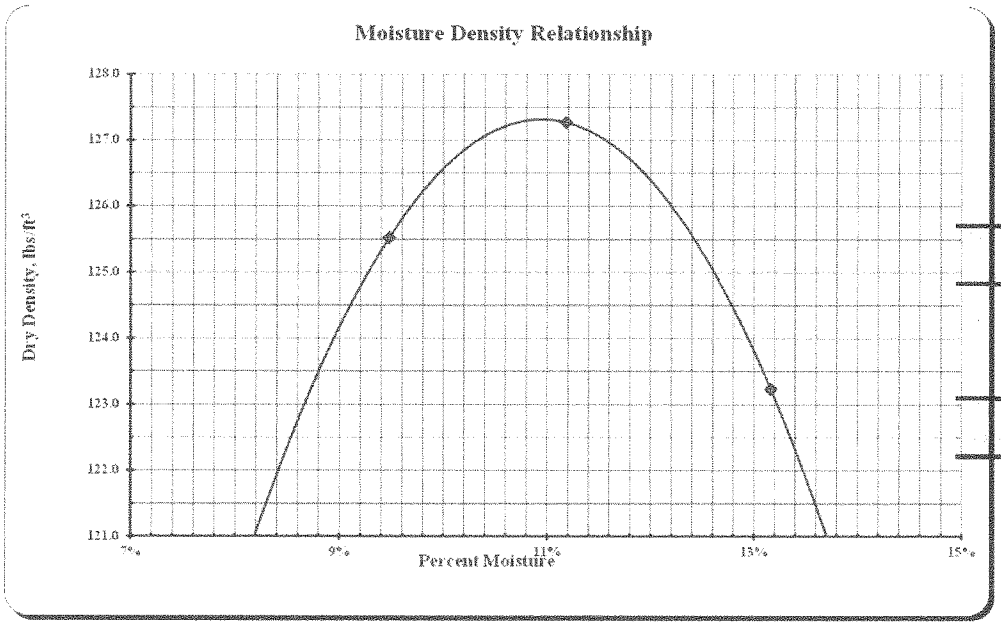
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.98	9.11	9.04			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.58	4.71	4.64			
E Wet Density = D / A	lbs./cu.ft.	137.4	141.5	139.5			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**125.5**	**127.3**	**123.2**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		75	76	77			
G Wet Weight / Container	grams	156.3	161.3	160.6			
H Dry Weight / Container	grams	146.0	148.9	146.2			
I Moisture Loss = G - H	grams	10.3	12.4	14.4			
J Tare Weight of Container	grams	37.3	38.0	36.8			
K Dry Soil = H - J	grams	108.7	110.9	109.4			
L %Moisture = (I / K) x 100	%	**9.5%**	**11.2%**	**13.2%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

127.3 lbs./cu.ft.

Optimum Moisture

11.0%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/17/2017**		**1292**

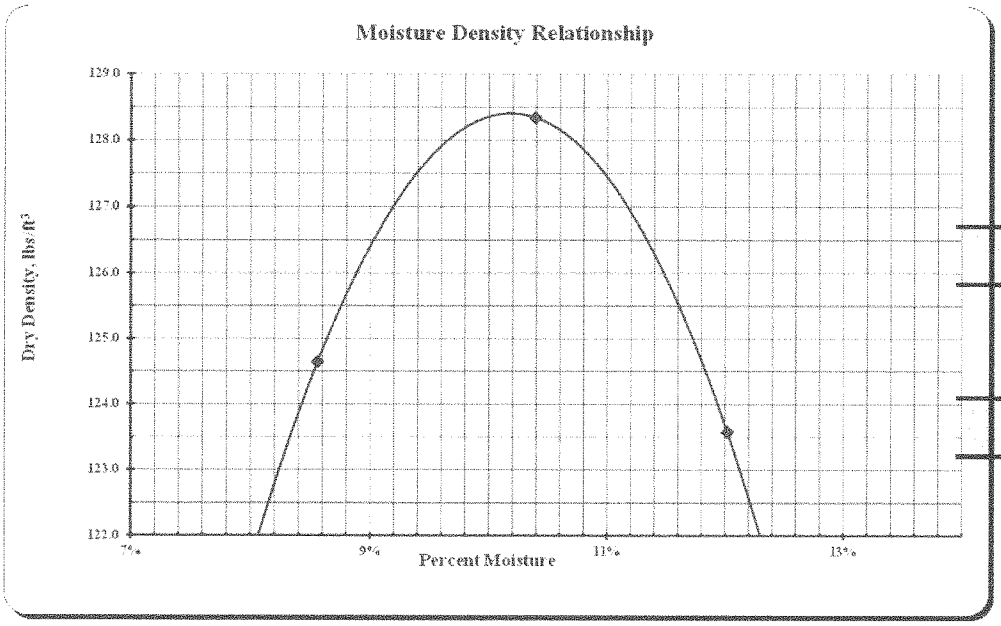
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.91	9.12	9.01			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.51	4.72	4.61			
E Wet Density = D / A	lbs./cu.ft.	135.3	141.7	138.4			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**124.6**	**128.3**	**123.6**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		78	79	80			
G Wet Weight / Container	grams	148.8	149.7	159.2			
H Dry Weight / Container	grams	140.0	139.1	146.1			
I Moisture Loss = G - H	grams	8.8	10.6	13.1			
J Tare Weight of Container	grams	37.2	37.1	37.1			
K Dry Soil = H - J	grams	102.8	102.0	109.0			
L %Moisture = (I / K) x 100	%	**8.6%**	**10.4%**	**12.0%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

128.4 lbs./cu.ft.

Optimum Moisture

10.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1293**

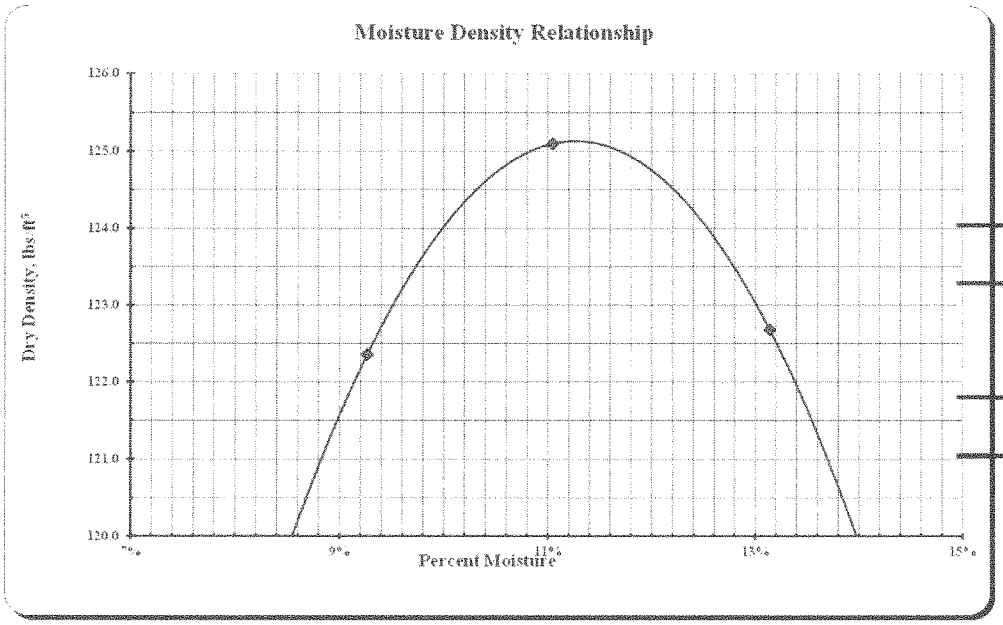
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.85	9.03	9.02			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.45	4.63	4.62			
E Wet Density = D / A	lbs./cu.ft.	133.7	138.9	138.8			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**122.4**	**125.1**	**122.7**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		1	2	3			
G Wet Weight / Container	grams	149.8	152.9	149.9			
H Dry Weight / Container	grams	140.2	141.4	136.8			
I Moisture Loss = G - H	grams	9.6	11.5	13.1			
J Tare Weight of Container	grams	36.6	37.3	37.1			
K Dry Soil = H - J	grams	103.6	104.1	99.7			
L %Moisture = (I / K) x 100	%	**9.3%**	**11.0%**	**13.1%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

125.1 lbs./cu.ft.

Optimum Moisture

11.3%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1294**

Density

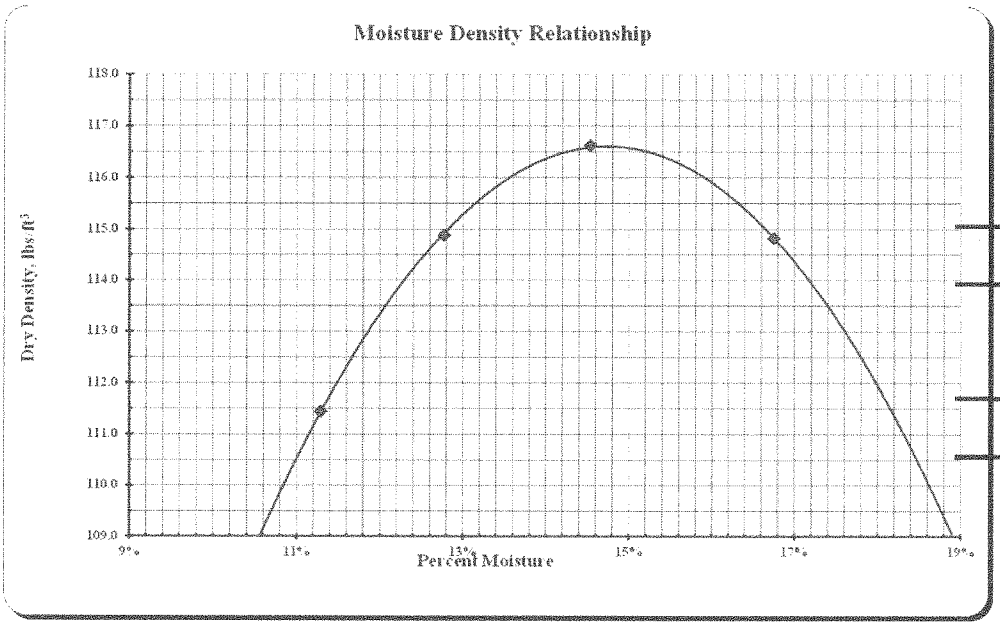
			Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.53	8.71	8.85	8.86		
C	Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C	lbs.	4.13	4.31	4.45	4.46		
E	Wet Density = D / A	lbs./cu.ft.	124.0	129.5	133.6	134.1		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**111.4**	**114.9**	**116.6**	**114.8**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		4	5	6	7		
G	Wet Weight / Container	grams	155.0	151.9	155.3	152.7		
H	Dry Weight / Container	grams	143.0	138.9	140.3	136.0		
I	Moisture Loss = G - H	grams	12.0	13.0	15.0	16.7		
J	Tare Weight of Container	grams	36.7	37.1	37.1	36.3		
K	Dry Soil = H - J	grams	106.3	101.8	103.2	99.7		
L	%Moisture = (I / K) x 100	%	**11.3%**	**12.8%**	**14.5%**	**16.8%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

116.6 lbs./cu.ft.

Optimum Moisture

14.7%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1295**

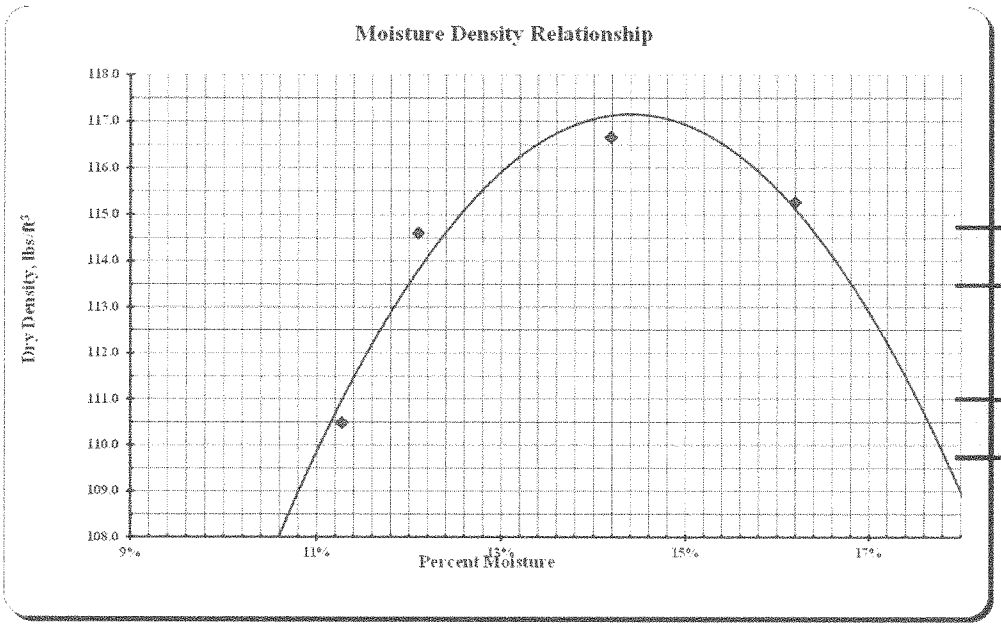
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.50	8.68	8.84	8.86		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.09	4.28	4.44	4.46		
E Wet Density = D / A	lbs./cu.ft.	122.9	128.5	133.2	133.9		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**110.5**	**114.6**	**116.7**	**115.3**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		8	9	10	11		
G Wet Weight / Container	grams	152.5	158.6	153.4	156.3		
H Dry Weight / Container	grams	140.8	145.5	138.9	139.7		
I Moisture Loss = G - H	grams	11.7	13.1	14.5	16.6		
J Tare Weight of Container	grams	37.0	37.2	36.7	37.2		
K Dry Soil = H - J	grams	103.8	108.3	102.2	102.5		
L %Moisture = (I / K) x 100	%	**11.3%**	**12.1%**	**14.2%**	**16.2%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

117.2 lbs./cu.ft.

Optimum Moisture

14.4%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/17/2017**		**1296**

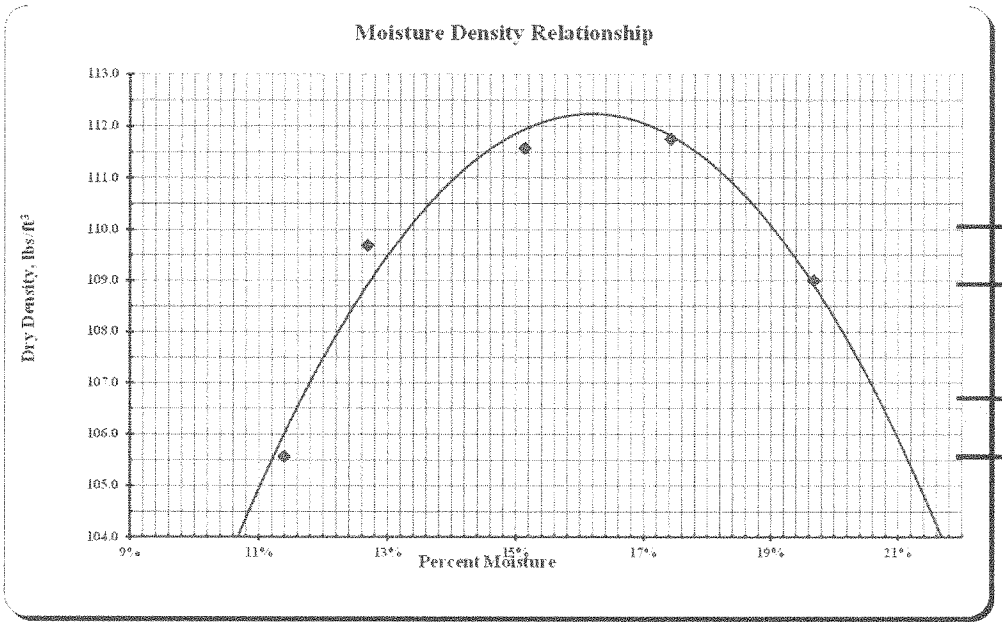
Density		Test Count	5				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.32	8.52	8.68	8.77	8.74	
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.92	4.12	4.28	4.37	4.34	
E Wet Density = D / A	lbs./cu.ft.	117.6	123.6	128.5	131.2	130.5	
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**105.6**	**109.7**	**111.6**	**111.8**	**109.0**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		12	13	14	15	16	
G Wet Weight / Container	grams	155.2	159.7	159.6	163.3	147.3	
H Dry Weight / Container	grams	143.1	145.9	143.6	144.6	129.2	
I Moisture Loss = G - H	grams	12.1	13.8	16.0	18.7	18.1	
J Tare Weight of Container	grams	36.9	37.1	37.9	37.3	37.2	
K Dry Soil = H - J	grams	106.2	108.8	105.7	107.3	92.0	
L %Moisture = (I / K) x 100	%	**11.4%**	**12.7%**	**15.1%**	**17.4%**	**19.7%**	

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

112.2 lbs./cu.ft.

Optimum Moisture

16.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1297**

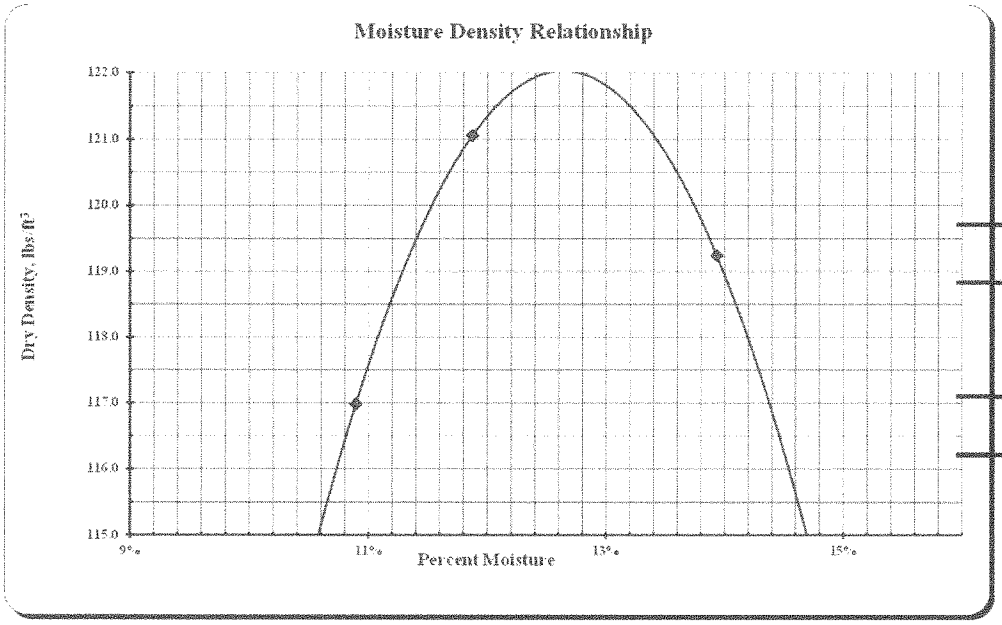
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.72	8.91	8.92			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.32	4.51	4.52			
E Wet Density = D / A	lbs./cu.ft.	129.7	135.4	135.9			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**117.0**	**121.1**	**119.2**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		17	18	19			
G Wet Weight / Container	grams	155.9	157.7	152.4			
H Dry Weight / Container	grams	144.2	144.9	138.3			
I Moisture Loss = G - H	grams	11.7	12.8	14.1			
J Tare Weight of Container	grams	36.8	37.1	37.1			
K Dry Soil = H - J	grams	107.4	107.8	101.2			
L %Moisture = (I / K) x 100	%	**10.9%**	**11.9%**	**13.9%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

122.0 lbs./cu.ft.

Optimum Moisture

12.6%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/17/2017**		**1298**

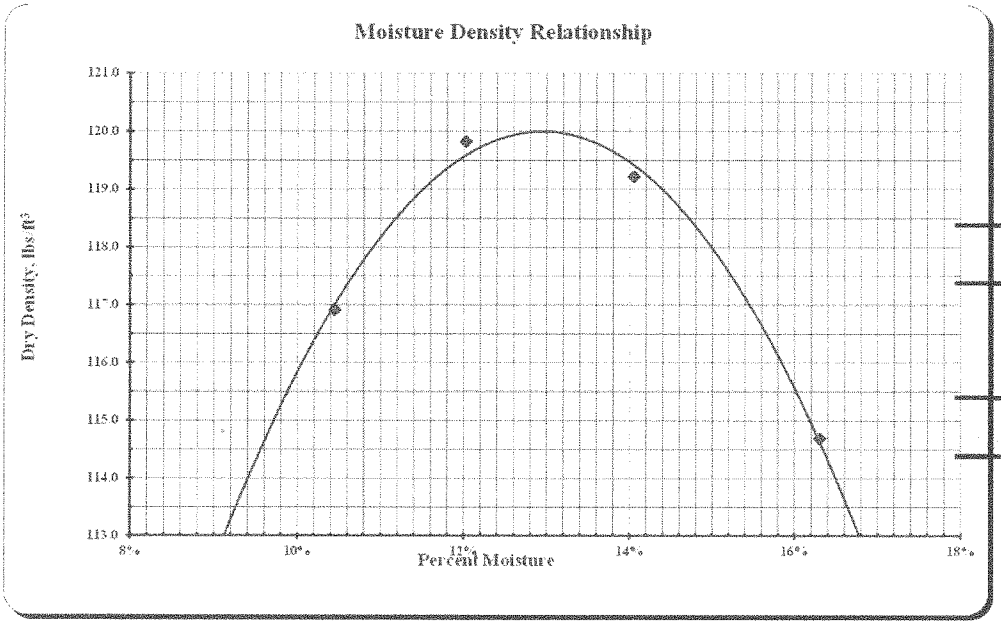
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.70	8.87	8.93	8.84		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.30	4.47	4.53	4.44		
E Wet Density = D / A	lbs./cu.ft.	129.1	134.2	136.0	133.4		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**116.9**	**119.8**	**119.2**	**114.7**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		20	21	22	23		
G Wet Weight / Container	grams	157.0	158.2	149.0	159.4		
H Dry Weight / Container	grams	145.6	145.2	135.2	142.3		
I Moisture Loss = G - H	grams	11.4	13.0	13.8	17.1		
J Tare Weight of Container	grams	36.5	37.1	37.0	37.4		
K Dry Soil = H - J	grams	109.1	108.1	98.2	104.9		
L %Moisture = (I / K) x 100	%	**10.4%**	**12.0%**	**14.1%**	**16.3%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

120.0 lbs./cu.ft.

Optimum Moisture

12.9%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/19/2017**		**1300**

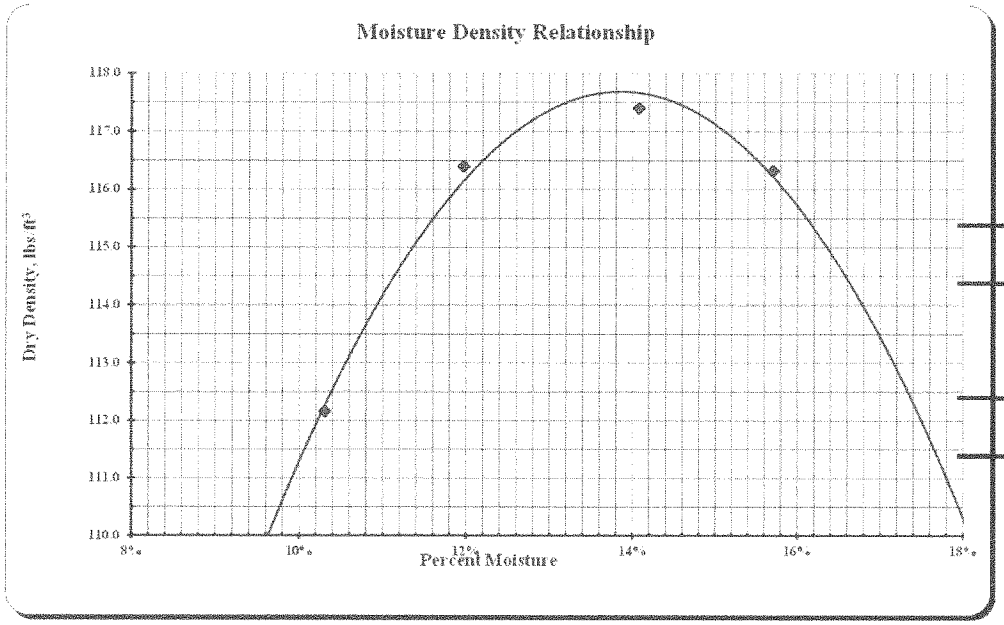
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.52	8.74	8.86	8.88		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.12	4.34	4.46	4.48		
E Wet Density = D / A	lbs./cu.ft.	123.7	130.3	133.9	134.6		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**112.2**	**116.4**	**117.4**	**116.3**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		24	25	26	27		
G Wet Weight / Container	grams	156.0	152.3	155.2	150.9		
H Dry Weight / Container	grams	144.9	140.0	140.6	135.4		
I Moisture Loss = G - H	grams	11.1	12.3	14.6	15.5		
J Tare Weight of Container	grams	37.2	37.2	36.9	36.7		
K Dry Soil = H - J	grams	107.7	102.8	103.7	98.7		
L %Moisture = (I / K) x 100	%	**10.3%**	**12.0%**	**14.1%**	**15.7%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

117.7 lbs./cu.ft.

Optimum Moisture

13.9%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/19/2017**		**1302**

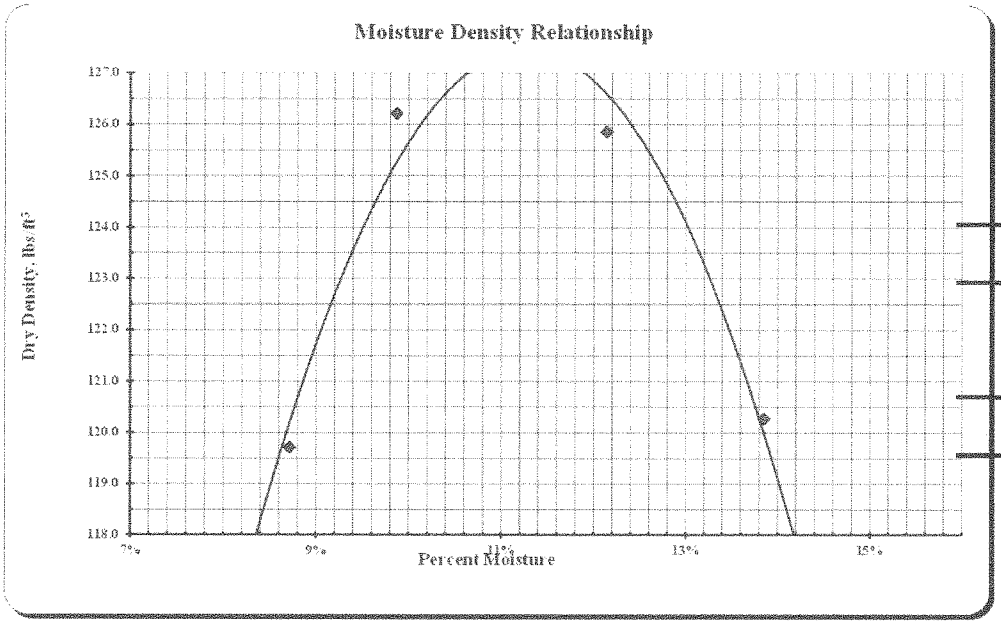
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.74	9.02	9.10	8.96		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.33	4.62	4.70	4.56		
E Wet Density = D / A	lbs./cu.ft.	130.2	138.7	141.1	136.9		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**119.7**	**126.2**	**125.9**	**120.3**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		28	29	30	31		
G Wet Weight / Container	grams	148.2	157.4	150.7	152.9		
H Dry Weight / Container	grams	139.3	146.6	138.4	138.8		
I Moisture Loss = G - H	grams	8.9	10.8	12.3	14.1		
J Tare Weight of Container	grams	37.2	37.2	37.1	37.0		
K Dry Soil = H - J	grams	102.1	109.4	101.3	101.8		
L %Moisture = (I / K) x 100	%	**8.7%**	**9.9%**	**12.1%**	**13.9%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

127.4 lbs./cu.ft.

Optimum Moisture

11.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/19/2017**		**1304**

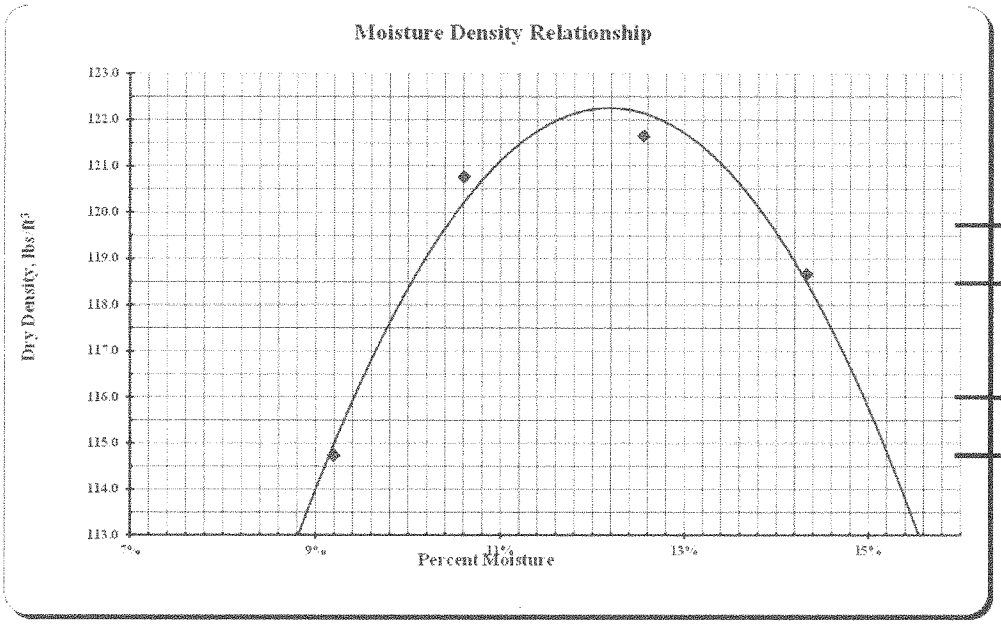
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.57	8.85	8.96	8.92		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.17	4.45	4.56	4.52		
E Wet Density = D / A	lbs./cu.ft.	125.3	133.6	136.9	135.7		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**114.7**	**120.8**	**121.7**	**118.7**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		32	33	34	35		
G Wet Weight / Container	grams	160.4	152.9	159.0	156.4		
H Dry Weight / Container	grams	150.0	141.8	145.5	141.5		
I Moisture Loss = G - H	grams	10.4	11.1	13.5	14.9		
J Tare Weight of Container	grams	36.9	37.1	38.0	37.5		
K Dry Soil = H - J	grams	113.1	104.7	107.5	104.0		
L %Moisture = (I / K) x 100	%	**9.2%**	**10.6%**	**12.6%**	**14.3%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

122.3 lbs./cu.ft.

Optimum Moisture

12.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/19/2017**		**1306**

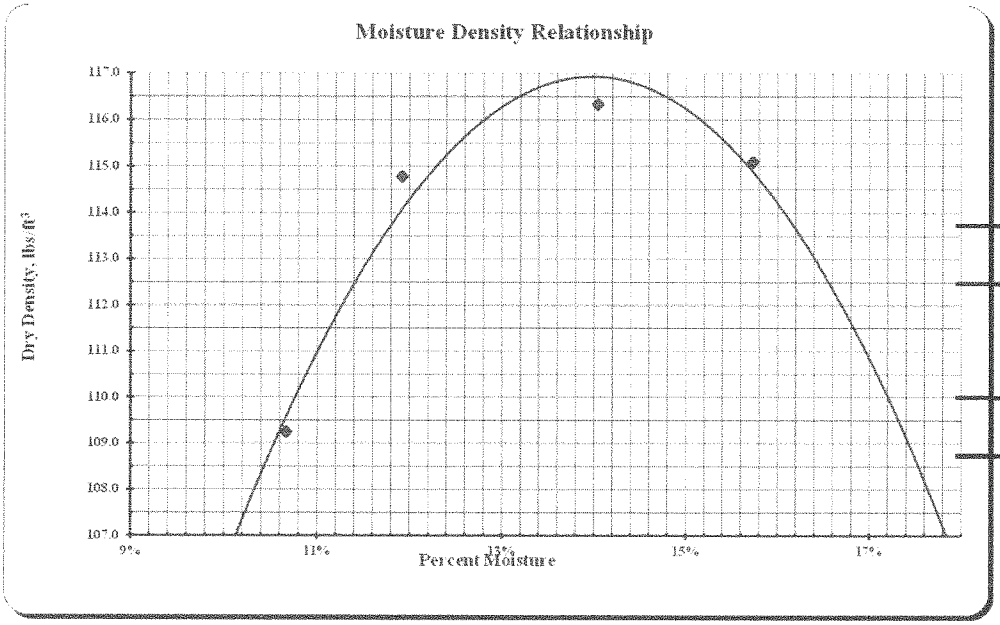
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.43	8.68	8.82	8.84		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.03	4.28	4.42	4.44		
E Wet Density = D / A	lbs./cu.ft.	120.9	128.5	132.7	133.2		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**109.2**	**114.8**	**116.3**	**115.1**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		36	37	38	39		
G Wet Weight / Container	grams	159.6	150.9	150.6	157.4		
H Dry Weight / Container	grams	147.8	138.8	136.6	141.1		
I Moisture Loss = G - H	grams	11.8	12.1	14.0	16.3		
J Tare Weight of Container	grams	37.2	37.3	36.9	37.5		
K Dry Soil = H - J	grams	110.6	101.5	99.7	103.6		
L %Moisture = (I / K) x 100	%	**10.7%**	**11.9%**	**14.0%**	**15.7%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

116.9 lbs./cu.ft.

Optimum Moisture

14.0%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/19/2017**		**1308**

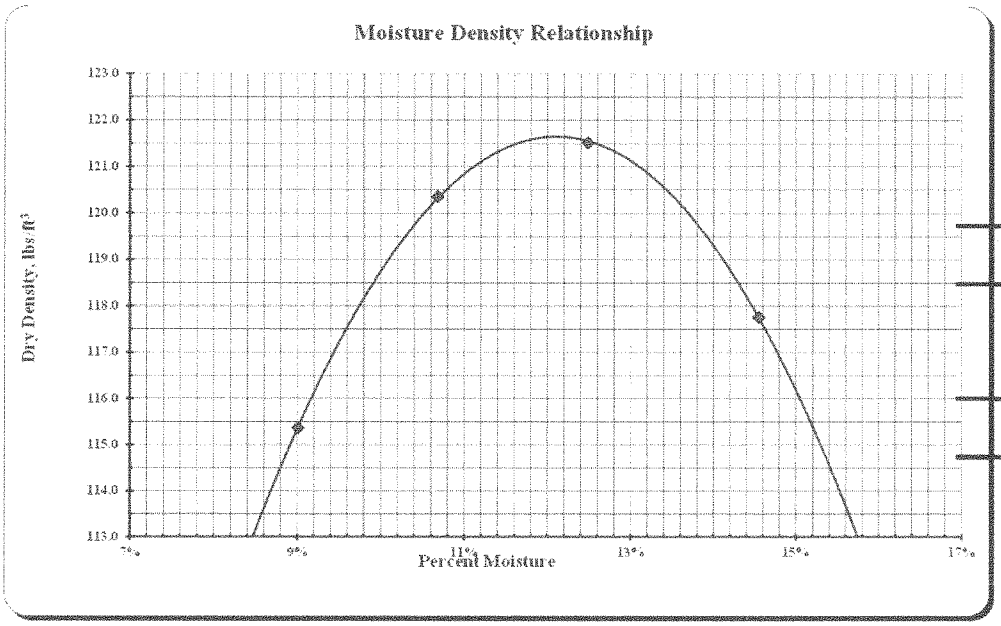
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.59	8.84	8.95	8.89		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.19	4.44	4.55	4.49		
E Wet Density = D / A	lbs./cu.ft.	125.8	133.2	136.7	134.9		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**115.4**	**120.4**	**121.5**	**117.8**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		40	41	42	43		
G Wet Weight / Container	grams	147.2	151.2	154.7	154.3		
H Dry Weight / Container	grams	138.1	140.2	141.6	139.4		
I Moisture Loss = G - H	grams	9.1	11.0	13.1	14.9		
J Tare Weight of Container	grams	37.1	37.2	36.7	37.0		
K Dry Soil = H - J	grams	101.0	103.0	104.9	102.4		
L %Moisture = (I / K) x 100	%	**9.0%**	**10.7%**	**12.5%**	**14.6%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

121.7 lbs./cu.ft.

Optimum Moisture

12.1%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/19/2017**		**1310**

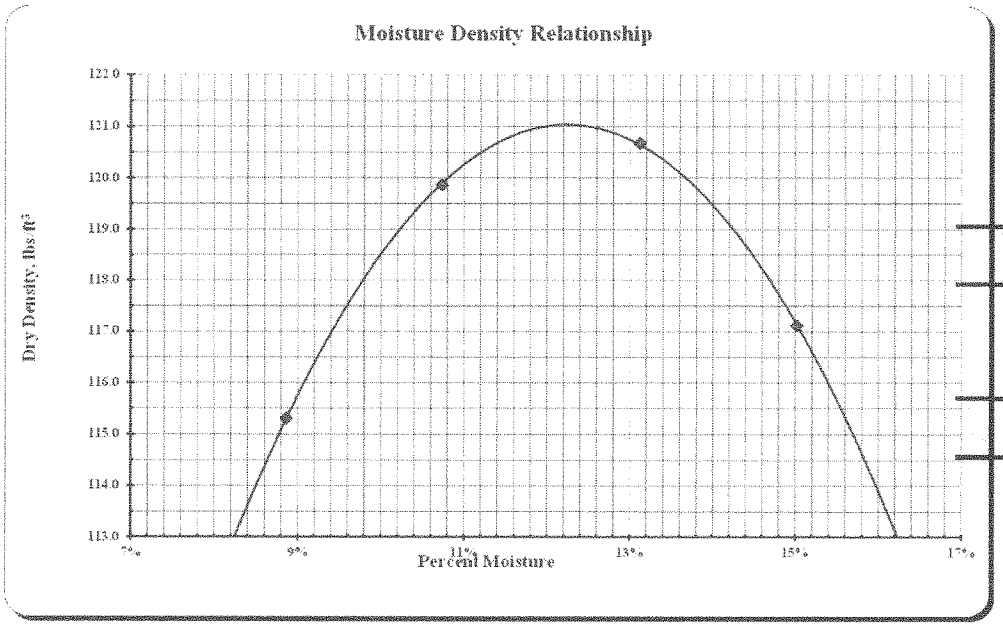
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.58	8.82	8.95	8.89		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.18	4.42	4.55	4.49		
E Wet Density = D / A	lbs./cu.ft.	125.5	132.7	136.5	134.7		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**115.3**	**119.9**	**120.7**	**117.1**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		44	45	46	47		
G Wet Weight / Container	grams	150.0	155.2	157.8	153.4		
H Dry Weight / Container	grams	140.8	143.8	143.8	138.2		
I Moisture Loss = G - H	grams	9.2	11.4	14.0	15.2		
J Tare Weight of Container	grams	37.0	37.6	37.1	37.0		
K Dry Soil = H - J	grams	103.8	106.2	106.7	101.2		
L %Moisture = (I / K) x 100	%	**8.9%**	**10.7%**	**13.1%**	**15.0%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

121.0 lbs./cu.ft.

Optimum Moisture

12.3%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/19/2017**		**1312**

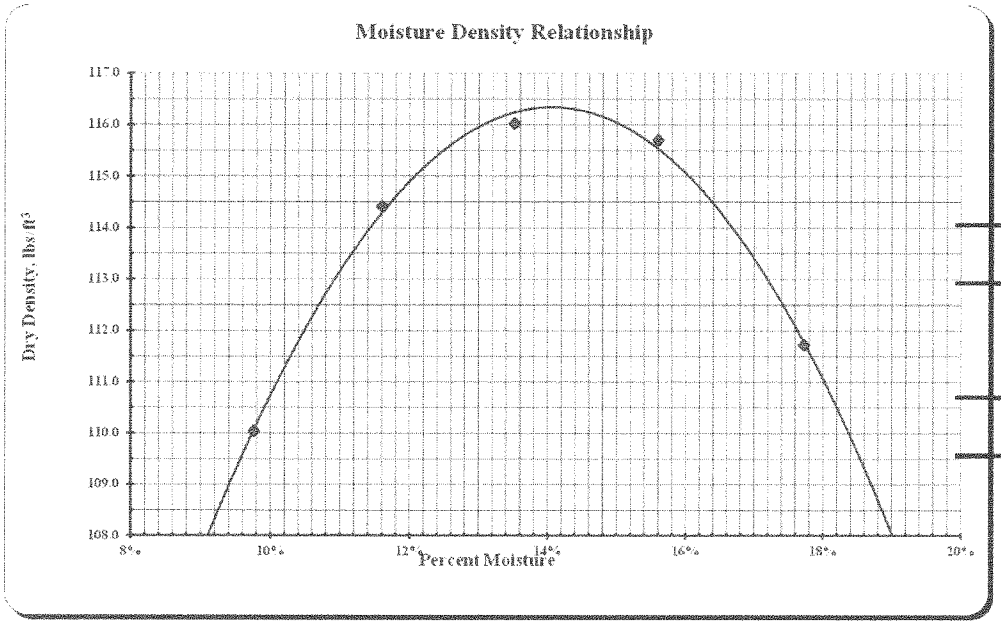
Density		Test Count	5				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.42	8.65	8.79	8.85	8.78	
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.02	4.25	4.39	4.45	4.38	
E Wet Density = D / A	lbs./cu.ft.	120.8	127.7	131.7	133.8	131.5	
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**110.0**	**114.4**	**116.0**	**115.7**	**111.7**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		48	49	50	51	52	
G Wet Weight / Container	grams	151.8	155.6	155.4	152.8	156.2	
H Dry Weight / Container	grams	141.6	143.3	141.3	137.2	138.3	
I Moisture Loss = G - H	grams	10.2	12.3	14.1	15.6	17.9	
J Tare Weight of Container	grams	37.1	37.3	37.0	37.2	37.3	
K Dry Soil = H - J	grams	104.5	106.0	104.3	100.0	101.0	
L %Moisture = (I / K) x 100	%	**9.8%**	**11.6%**	**13.5%**	**15.6%**	**17.7%**	

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

116.3 lbs./cu.ft.

Optimum Moisture

14.1%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/23/2017**		**1314**

Density

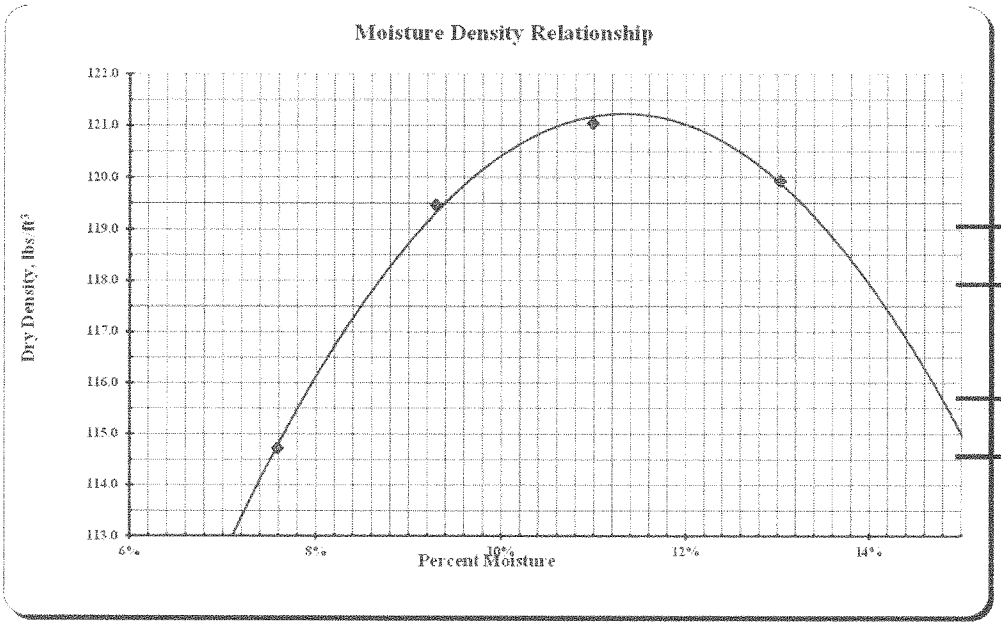
		Test Count	4				
	Determination No.	1	2	3	4	5	6
A	Volume of Mold cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.51	8.75	8.87	8.91		
C	Weight of Mold lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C lbs.	4.11	4.35	4.47	4.51		
E	Wet Density = D / A lbs./cu.ft.	123.4	130.6	134.4	135.6		
F	Dry Density = (E x 100) / (100 + L) lbs./cu.ft.	**114.7**	**119.5**	**121.0**	**119.9**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.	5	6	7	8		
G	Wet Weight / Container grams	146.3	148.8	151.4	146.3		
H	Dry Weight / Container grams	138.6	139.3	140.0	133.7		
I	Moisture Loss = G - H grams	7.7	9.5	11.4	12.6		
J	Tare Weight of Container grams	37.1	37.1	36.3	37.0		
K	Dry Soil = H - J grams	101.5	102.2	103.7	96.7		
L	%Moisture = (I / K) x 100 %	**7.6%**	**9.3%**	**11.0%**	**13.0%**		

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

121.2 lbs./cu.ft.

Optimum Moisture

11.3%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/23/2017**		**1316**

Density

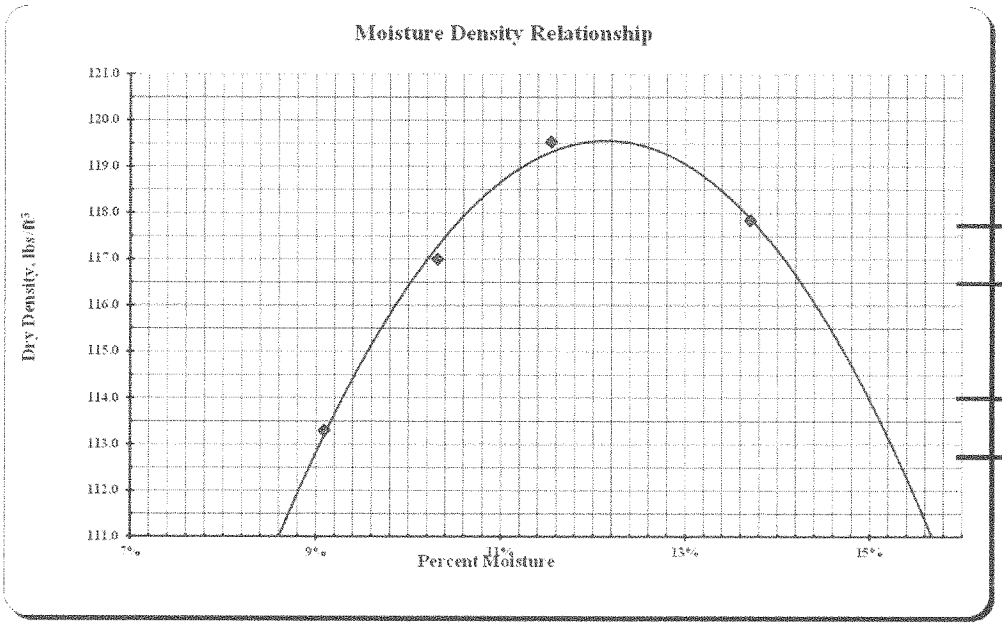
		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.53	8.72	8.86	8.88		
C Weight of Mold	lbs.	4.42	4.42	4.42	4.42	4.42	4.42
D Weight of Compacted Soil = B - C	lbs.	4.12	4.30	4.44	4.46		
E Wet Density = D / A	lbs./cu.ft.	123.6	129.1	133.3	134.0		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**113.3**	**117.0**	**119.5**	**117.8**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.	1	2	3	4		
G Wet Weight / Container	grams	107.4	135.7	155.0	142.9		
H Dry Weight / Container	grams	101.5	126.5	142.8	130.1		
I Moisture Loss = G - H	grams	5.9	9.2	12.2	12.8		
J Tare Weight of Container	grams	36.6	37.3	37.1	36.7		
K Dry Soil = H - J	grams	64.9	89.2	105.7	93.4		
L %Moisture = (I / K) x 100	%	**9.1%**	**10.3%**	**11.5%**	**13.7%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

119.6 lbs./cu.ft.

Optimum Moisture

12.1%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

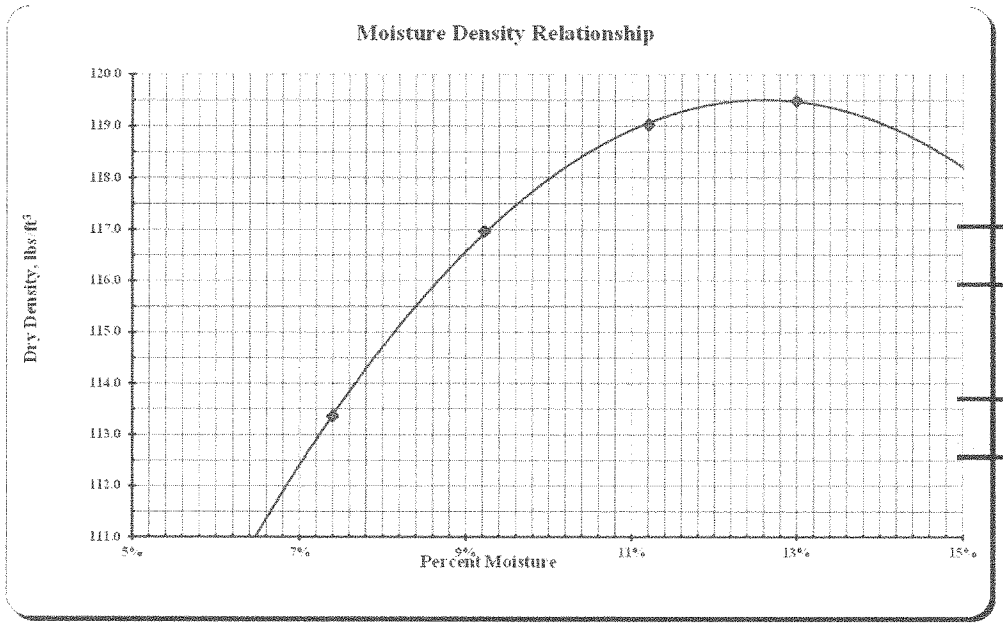
Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/23/2017**		**1318**

Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.47	8.67	8.83	8.92		
C Weight of Mold	lbs.	4.42	4.42	4.42	4.42	4.42	4.42
D Weight of Compacted Soil = B - C	lbs.	4.05	4.25	4.41	4.50		
E Wet Density = D / A	lbs./cu.ft.	121.7	127.7	132.4	135.0		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**113.4**	**117.0**	**119.0**	**119.5**	**#VALUE!**	**#VALUE!**

Moisture Content AASHTO T99 or T180 Tested by:

Container No.		9	10	11	12		
G Wet Weight / Container	grams	165.0	149.2	141.4	139.5		
H Dry Weight / Container	grams	156.2	139.7	130.9	127.7		
I Moisture Loss = G - H	grams	8.8	9.5	10.5	11.8		
J Tare Weight of Container	grams	37.2	36.7	37.2	36.9		
K Dry Soil = H - J	grams	119.0	103.0	93.7	90.8		
L %Moisture = (I / K) x 100	%	**7.4%**	**9.2%**	**11.2%**	**13.0%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

119.5 lbs./cu.ft.

Optimum Moisture

12.6%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/23/2017**		**1320**

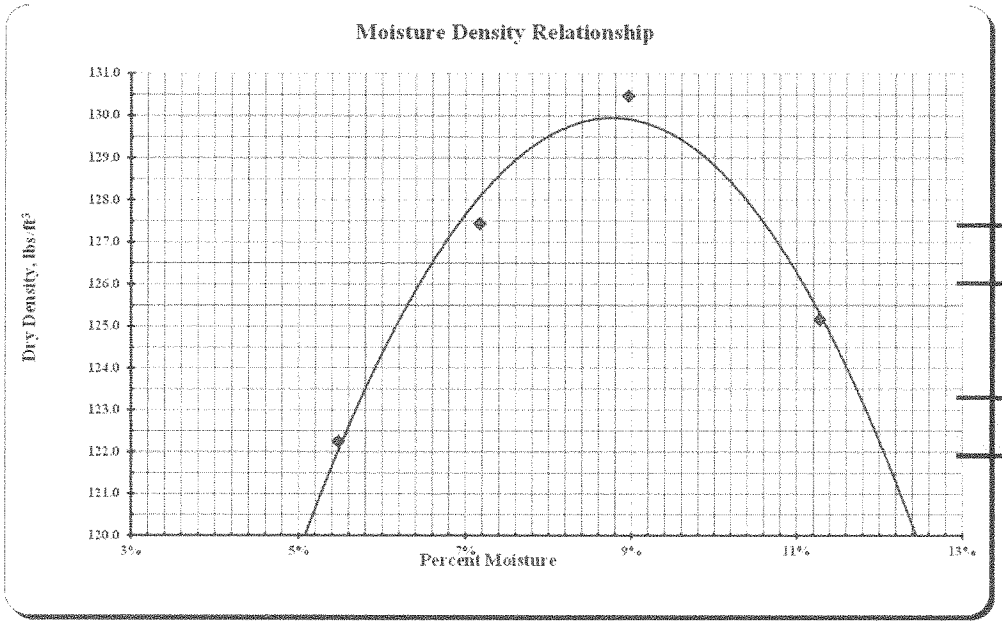
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.70	8.95	9.13	9.04		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.29	4.55	4.73	4.64		
E Wet Density = D / A	lbs./cu.ft.	128.9	136.6	142.2	139.3		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**122.3**	**127.4**	**130.5**	**125.2**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		13	14	15	16		
G Wet Weight / Container	grams	173.9	165.0	158.9	148.7		
H Dry Weight / Container	grams	166.8	156.5	148.9	137.4		
I Moisture Loss = G - H	grams	7.1	8.5	10.0	11.3		
J Tare Weight of Container	grams	37.1	37.9	37.3	37.2		
K Dry Soil = H - J	grams	129.7	118.6	111.6	100.2		
L %Moisture = (I / K) x 100	%	**5.5%**	**7.2%**	**9.0%**	**11.3%**		

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

129.9 lbs./cu.ft.

Optimum Moisture

8.8%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/23/2017**		**1322**

Density

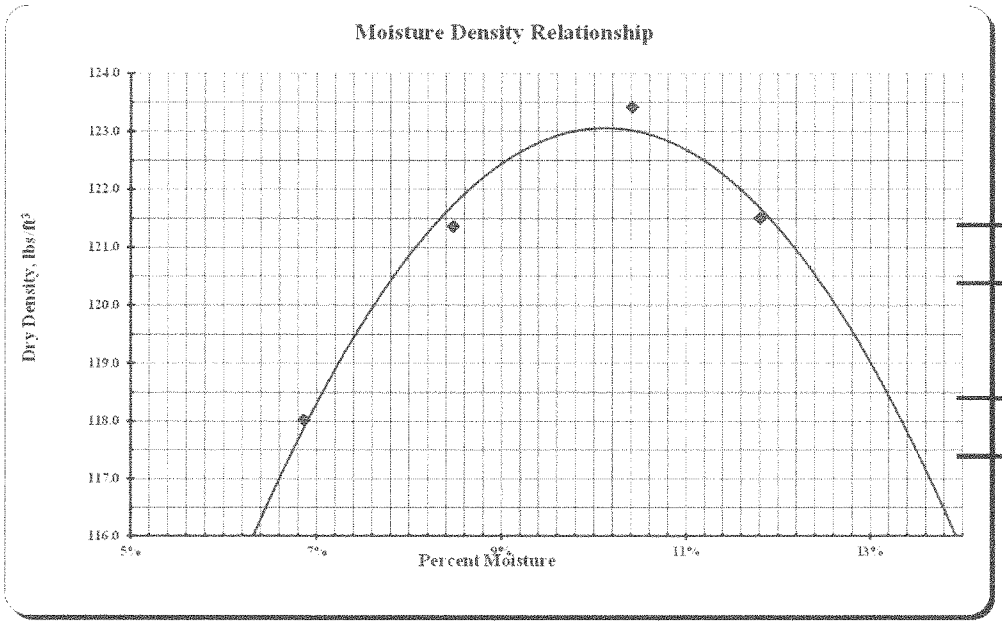
			Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.60	8.78	8.94	8.92		
C	Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C	lbs.	4.20	4.38	4.54	4.52		
E	Wet Density = D / A	lbs./cu.ft.	126.1	131.7	136.3	135.9		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**118.0**	**121.4**	**123.4**	**121.5**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		17	18	19	20		
G	Wet Weight / Container	grams	169.1	170.2	151.6	161.5		
H	Dry Weight / Container	grams	160.6	159.8	140.8	148.3		
I	Moisture Loss = G - H	grams	8.5	10.4	10.8	13.2		
J	Tare Weight of Container	grams	36.8	37.1	37.1	36.5		
K	Dry Soil = H - J	grams	123.8	122.7	103.7	111.8		
L	%Moisture = (I / K) x 100	%	**6.9%**	**8.5%**	**10.4%**	**11.8%**		

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

123.1 lbs./cu.ft.

Optimum Moisture

10.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/23/2017**		**1324**

Density

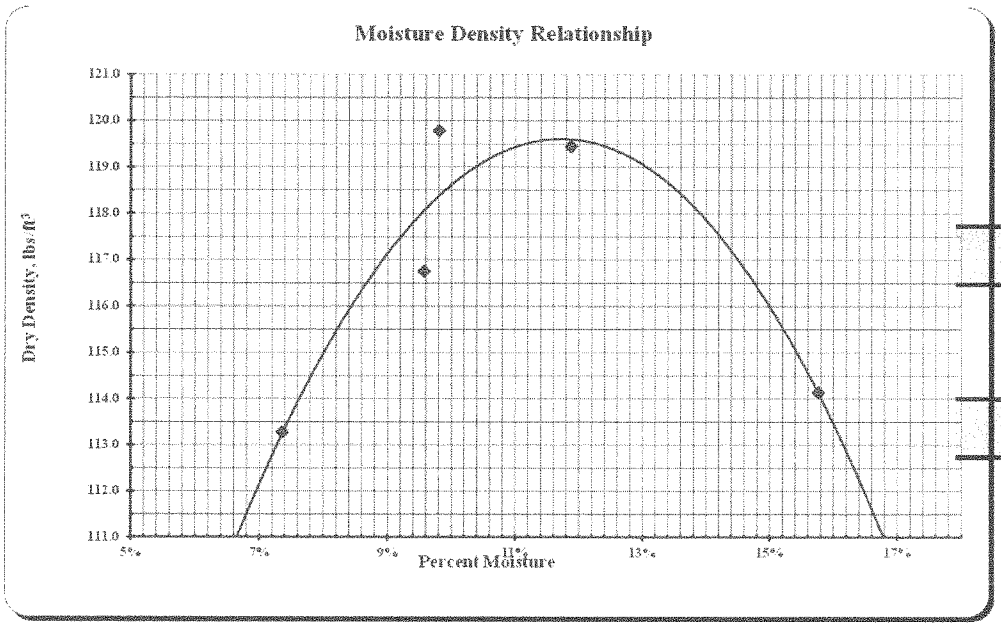
	Test Count	5				
Determination No.	1	2	3	4	5	6
A Volume of Mold cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
lbs.	8.47	8.68	8.80	8.87	8.82	
C Weight of Mold lbs.	4.42	4.42	4.42	4.42	4.42	4.42
D Weight of Compacted Soil = B - C lbs.	4.05	4.26	4.38	4.45	4.40	
E Wet Density = D / A lbs./cu.ft.	121.6	127.9	131.5	133.6	132.1	
F Dry Density = (E x 100) / (100 + L) lbs./cu.ft.	**113.3**	**116.8**	**119.8**	**119.5**	**114.1**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.	21	22	23	24	29	
G Wet Weight / Container grams	177.1	156.1	183.0	179.5	145.9	
H Dry Weight / Container grams	167.5	145.7	170.0	164.4	131.1	
I Moisture Loss = G - H grams	9.6	10.4	13.0	15.1	14.8	
J Tare Weight of Container grams	37.1	37.0	37.4	37.2	37.2	
K Dry Soil = H - J grams	130.4	108.7	132.6	127.2	93.9	
L %Moisture = (I / K) x 100 %	**7.4%**	**9.6%**	**9.8%**	**11.9%**	**15.8%**	

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

119.6 lbs./cu.ft.

Optimum Moisture

11.8%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/23/2017**		**1326**

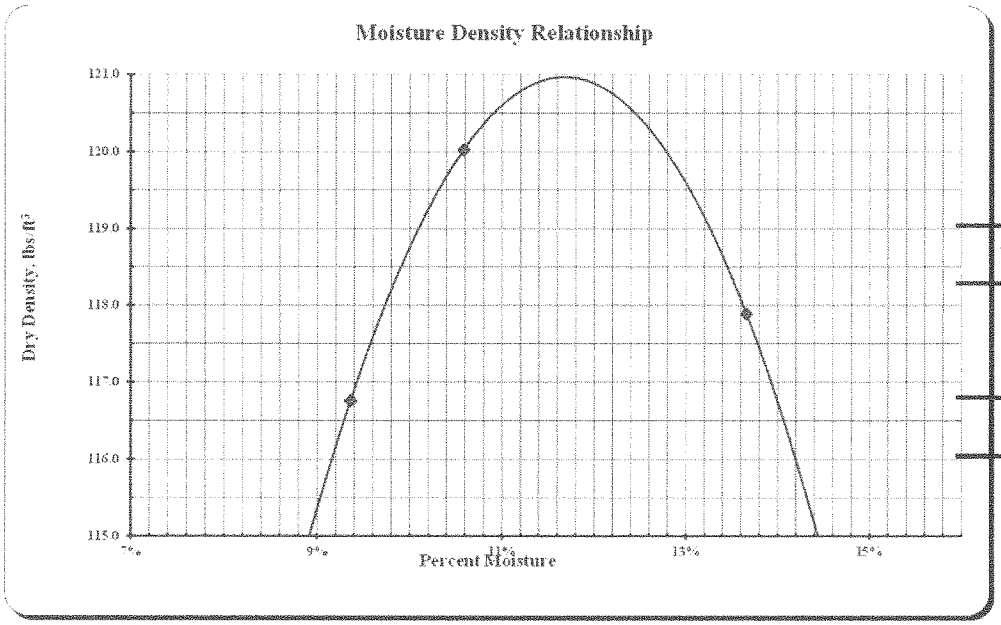
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.65	8.82	8.86			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.25	4.42	4.46			
E Wet Density = D / A	lbs./cu.ft.	127.7	132.7	134.0			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**116.8**	**120.0**	**117.9**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		25	26	27			
G Wet Weight / Container	grams	170.4	167.5	164.0			
H Dry Weight / Container	grams	159.0	155.0	148.7			
I Moisture Loss = G - H	grams	11.4	12.5	15.3			
J Tare Weight of Container	grams	37.2	36.9	36.7			
K Dry Soil = H - J	grams	121.8	118.1	112.0			
L %Moisture = (I / K) x 100	%	**9.4%**	**10.6%**	**13.7%**			

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

121.0 lbs./cu.ft.

Optimum Moisture

11.7%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/23/2017**		**1328**

Density

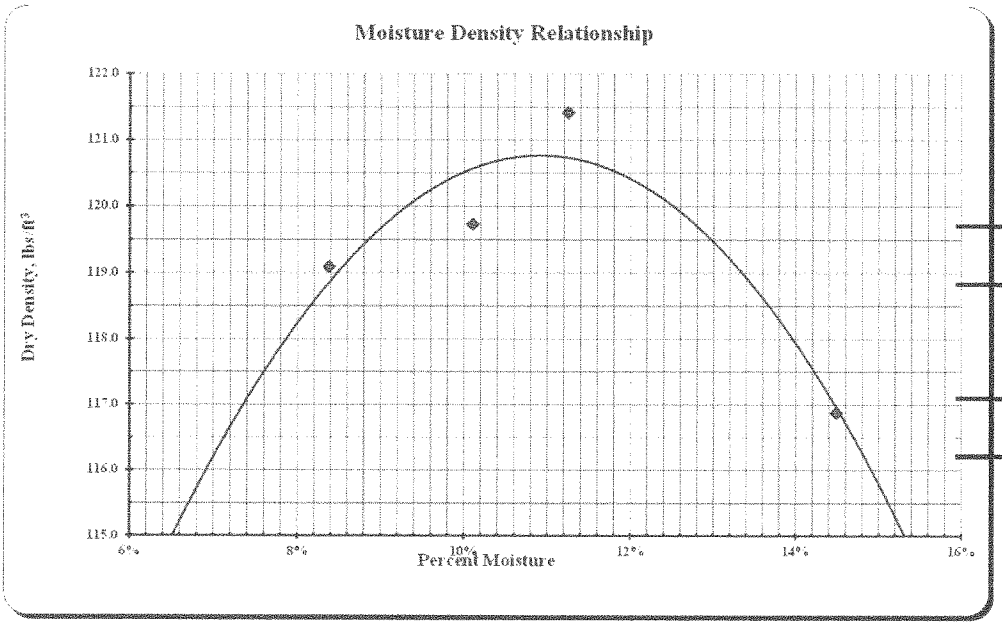
		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.72	8.81	8.92	8.88		
C Weight of Mold	lbs.	4.42	4.42	4.42	4.42	4.42	4.42
D Weight of Compacted Soil = B - C	lbs.	4.30	4.39	4.50	4.46		
E Wet Density = D / A	lbs./cu.ft.	129.1	131.8	135.1	133.8		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**119.1**	**119.7**	**121.4**	**116.9**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.	30	31	32	33		
G	Wet Weight / Container grams	179.4	155.8	169.4	149.3		
H	Dry Weight / Container grams	168.4	144.9	156.0	135.1		
I	Moisture Loss = G - H grams	11.0	10.9	13.4	14.2		
J	Tare Weight of Container grams	37.1	37.0	36.9	37.1		
K	Dry Soil = H - J grams	131.3	107.9	119.1	98.0		
L	%Moisture = (I / K) x 100 %	**8.4%**	**10.1%**	**11.3%**	**14.5%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

120.8 lbs./cu.ft.

Optimum Moisture

10.9%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/23/2017**		**1330**

Density

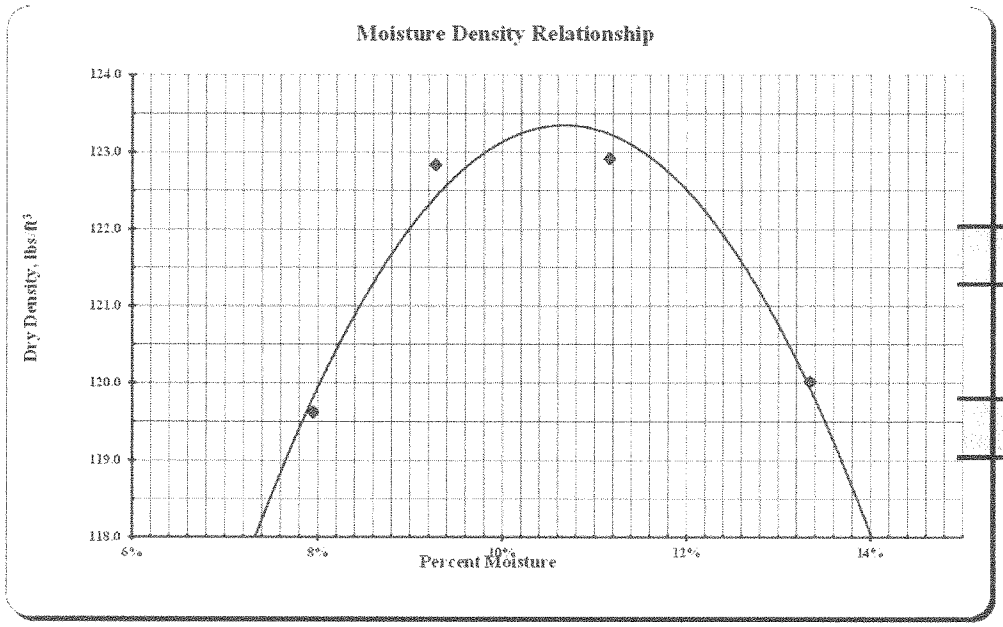
			Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.70	8.87	8.95	8.93		
C	Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C	lbs.	4.30	4.47	4.55	4.53		
E	Wet Density = D / A	lbs./cu.ft.	129.1	134.2	136.6	136.0		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**119.6**	**122.8**	**122.9**	**120.0**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		28	34	35	36		
G	Wet Weight / Container	grams	163.5	171.1	160.0	154.4		
H	Dry Weight / Container	grams	154.2	159.8	147.7	140.6		
I	Moisture Loss = G - H	grams	9.3	11.3	12.3	13.8		
J	Tare Weight of Container	grams	37.2	38.0	37.5	37.2		
K	Dry Soil = H - J	grams	117.0	121.8	110.2	103.4		
L	%Moisture = (I / K) x 100	%	**7.9%**	**9.3%**	**11.2%**	**13.3%**		

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

123.4 lbs./cu.ft.

Optimum Moisture

10.6%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/23/2017**		**1332**

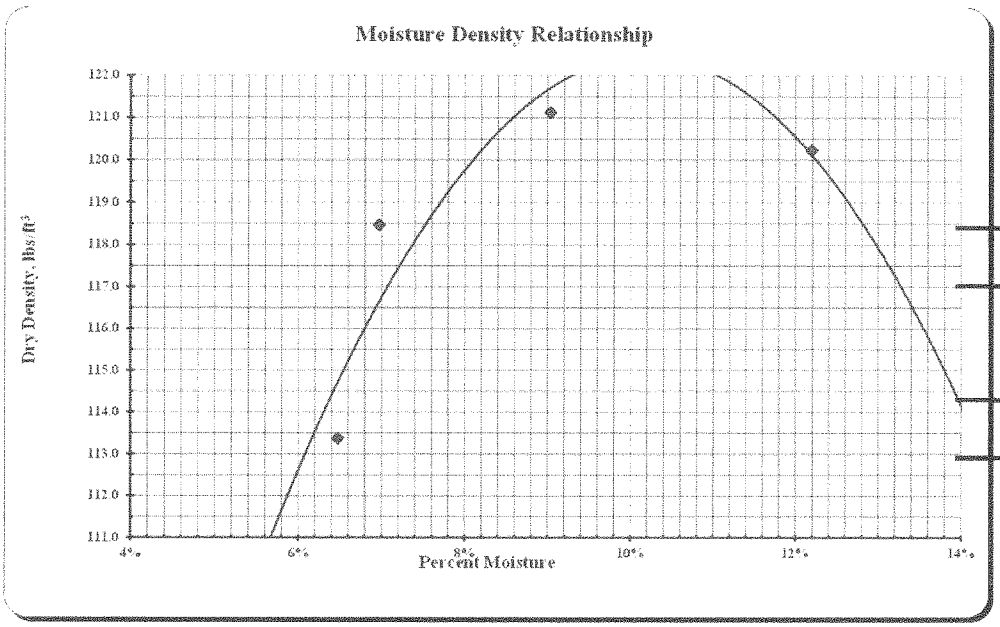
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.44	8.64	8.82	8.91		
C Weight of Mold	lbs.	4.42	4.42	4.42	4.42	4.42	4.42
D Weight of Compacted Soil = B - C	lbs.	4.02	4.22	4.40	4.49		
E Wet Density = D / A	lbs./cu.ft.	120.7	126.7	132.1	134.9		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**113.4**	**118.5**	**121.1**	**120.2**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		37	38	39	40		
G Wet Weight / Container	grams	178.7	202.7	178.7	178.8		
H Dry Weight / Container	grams	170.1	191.9	167.0	163.4		
I Moisture Loss = G - H	grams	8.6	10.8	11.7	15.4		
J Tare Weight of Container	grams	37.3	36.9	37.5	37.1		
K Dry Soil = H - J	grams	132.8	155.0	129.5	126.3		
L %Moisture = (I / K) x 100	%	**6.5%**	**7.0%**	**9.0%**	**12.2%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

122.4 lbs./cu.ft.

Optimum Moisture

10.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/23/2017**		**1334**

Density

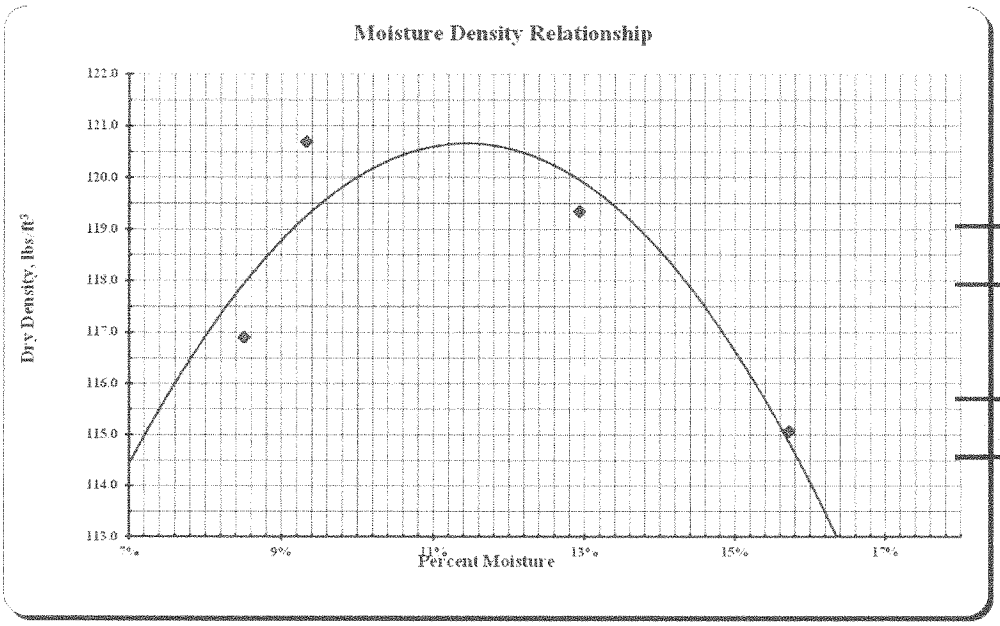
			Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.62	8.79	8.89	8.83		
C	Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C	lbs.	4.22	4.39	4.49	4.43		
E	Wet Density = D / A	lbs./cu.ft.	126.8	132.0	134.8	133.2		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**116.9**	**120.7**	**119.3**	**115.1**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		41	42	43	44		
G	Wet Weight / Container	grams	158.4	171.5	148.8	146.7		
H	Dry Weight / Container	grams	148.9	160.0	136.0	131.8		
I	Moisture Loss = G - H	grams	9.5	11.5	12.8	14.9		
J	Tare Weight of Container	grams	37.2	36.7	37.0	37.0		
K	Dry Soil = H - J	grams	111.7	123.3	99.0	94.8		
L	%Moisture = (I / K) x 100	%	**8.5%**	**9.3%**	**12.9%**	**15.7%**		

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

120.7 lbs./cu.ft.

Optimum Moisture

11.4%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/23/2017**		**1336**

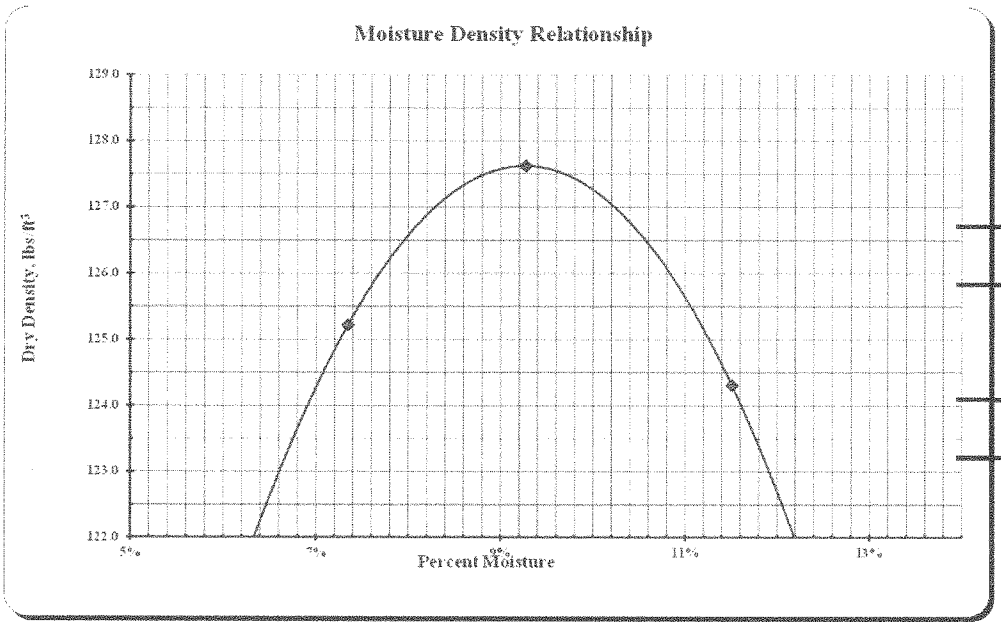
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.89	9.06	9.04			
C Weight of Mold	lbs.	4.42	4.42	4.42	4.42	4.42	4.42
D Weight of Compacted Soil = B - C	lbs.	4.48	4.64	4.62			
E Wet Density = D / A	lbs./cu.ft.	134.4	139.5	138.6			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**125.2**	**127.6**	**124.3**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		52	53	54			
G Wet Weight / Container	grams	177.6	157.3	152.3			
H Dry Weight / Container	grams	168.0	147.1	140.4			
I Moisture Loss = G - H	grams	9.6	10.2	11.9			
J Tare Weight of Container	grams	37.3	37.1	37.0			
K Dry Soil = H - J	grams	130.7	110.0	103.4			
L %Moisture = (I / K) x 100	%	**7.3%**	**9.3%**	**11.5%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

127.6 lbs./cu.ft.

Optimum Moisture

9.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/23/2017**		**1338**

Density

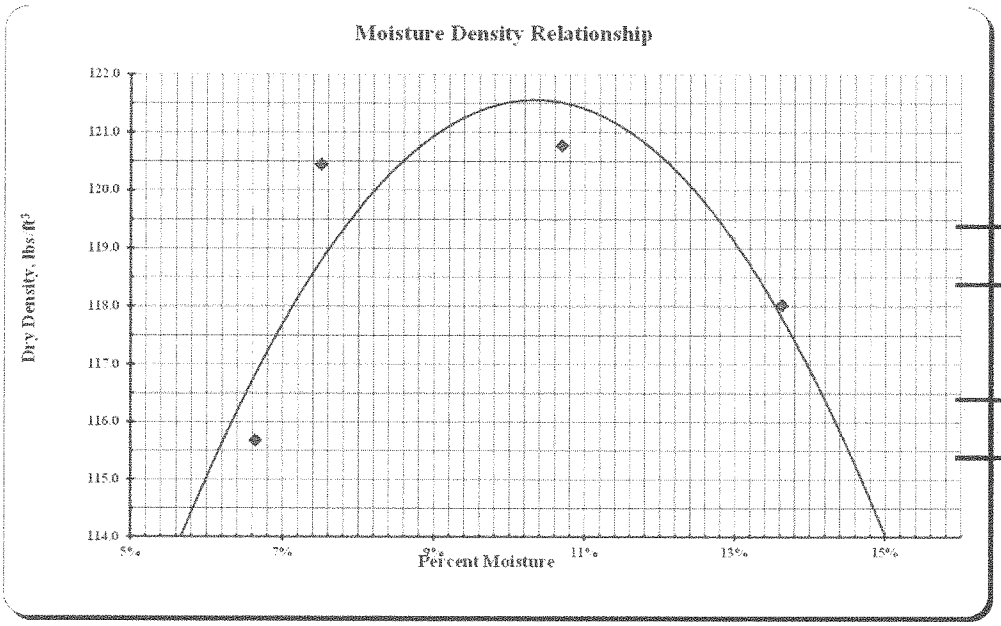
			Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.53	8.73	8.87	8.89		
C	Weight of Mold	lbs.	4.42	4.42	4.42	4.42	4.42	4.42
D	Weight of Compacted Soil = B - C	lbs.	4.11	4.31	4.45	4.47		
E	Wet Density = D / A	lbs./cu.ft.	123.4	129.5	133.7	134.1		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**115.7**	**120.4**	**120.8**	**118.0**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		39	45	46	47		
G	Wet Weight / Container	grams	188.5	199.4	167.5	172.9		
H	Dry Weight / Container	grams	179.1	188.1	154.9	156.6		
I	Moisture Loss = G - H	grams	9.4	11.3	12.6	16.3		
J	Tare Weight of Container	grams	37.5	37.6	37.1	37.0		
K	Dry Soil = H - J	grams	141.6	150.5	117.8	119.6		
L	%Moisture = (I / K) x 100	%	**6.6%**	**7.5%**	**10.7%**	**13.6%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density

121.6 lbs./cu.ft.

Optimum Moisture

10.3%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/23/2017**		**1340**

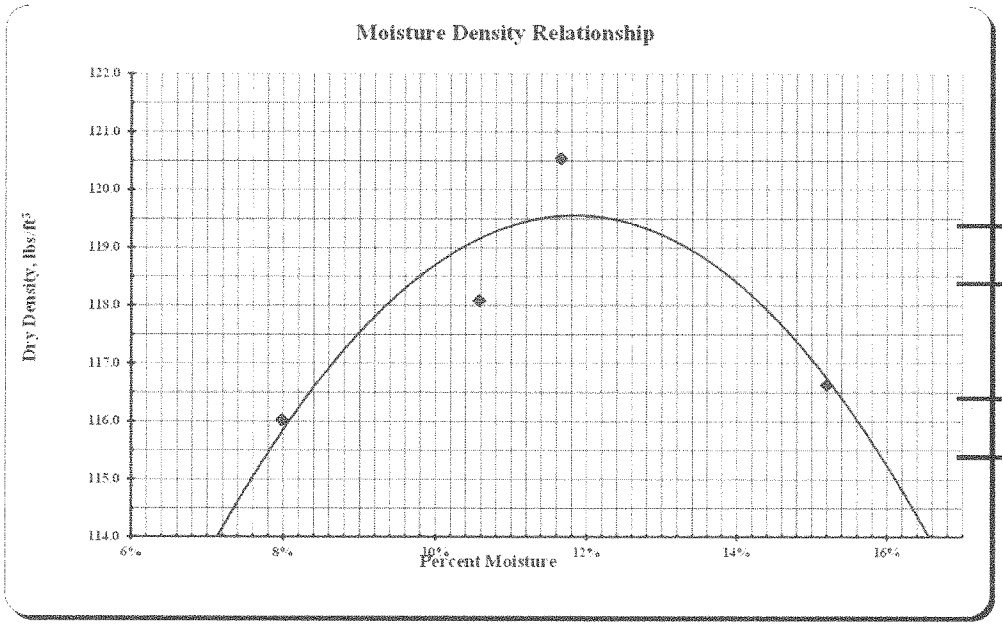
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.57	8.75	8.88	8.87		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.17	4.35	4.48	4.47		
E Wet Density = D / A	lbs./cu.ft.	125.3	130.6	134.6	134.4		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**116.0**	**118.1**	**120.5**	**116.6**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		48	49	50	51		
G Wet Weight / Container	grams	172.4	145.0	161.5	145.6		
H Dry Weight / Container	grams	162.4	134.7	148.5	131.3		
I Moisture Loss = G - H	grams	10.0	10.3	13.0	14.3		
J Tare Weight of Container	grams	37.1	37.3	37.0	37.2		
K Dry Soil = H - J	grams	125.3	97.4	111.5	94.1		
L %Moisture = (I / K) x 100	%	**8.0%**	**10.6%**	**11.7%**	**15.2%**		

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

119.6 lbs./cu.ft.

Optimum Moisture

11.9%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/23/2017**		**1342**

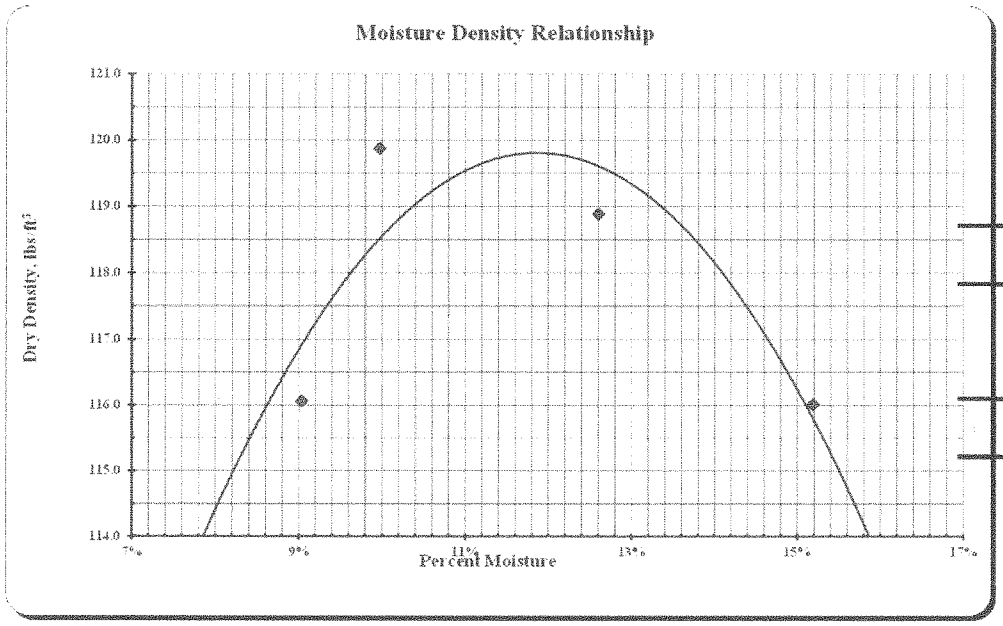
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.61	8.79	8.86	8.85		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.21	4.39	4.46	4.45		
E Wet Density = D / A	lbs./cu.ft.	126.5	131.8	133.9	133.6		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**116.1**	**119.9**	**118.9**	**116.0**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		56	57	58	59		
G Wet Weight / Container	grams	155.6	157.5	145.8	144.9		
H Dry Weight / Container	grams	145.8	146.6	133.6	130.7		
I Moisture Loss = G - H	grams	9.8	10.9	12.2	14.2		
J Tare Weight of Container	grams	37.3	37.3	36.8	37.2		
K Dry Soil = H - J	grams	108.5	109.3	96.8	93.5		
L %Moisture = (I / K) x 100	%	**9.0%**	**10.0%**	**12.6%**	**15.2%**		

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

119.8 lbs./cu.ft.

Optimum Moisture

11.8%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/24/2017**		**1344**

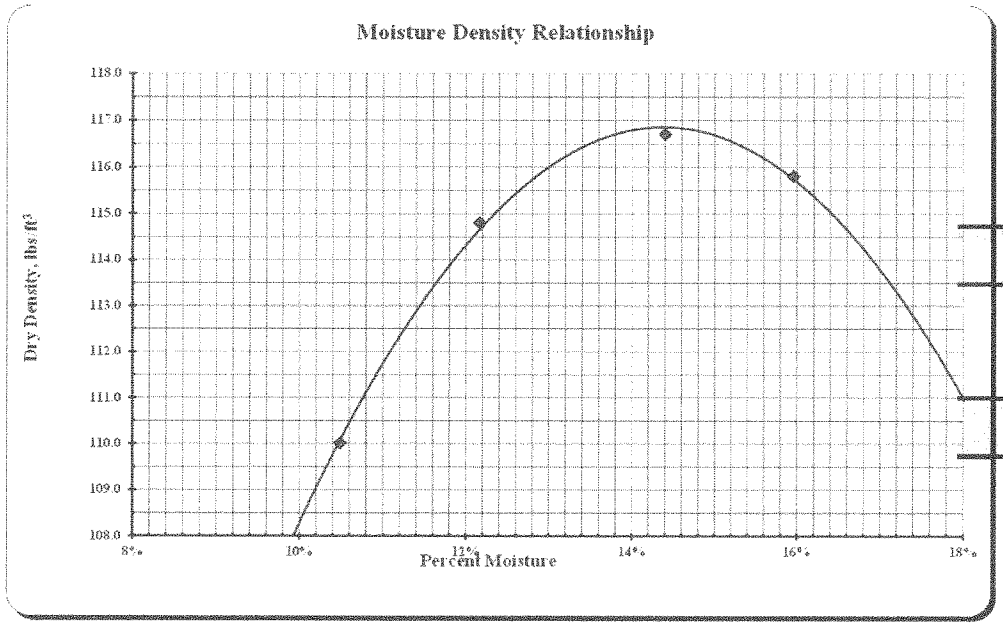
Density — Test Count: 4

	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.47	8.71	8.87	8.89		
C	Weight of Mold	lbs.	4.42	4.42	4.42	4.42	4.42	4.42
D	Weight of Compacted Soil = B - C	lbs.	4.05	4.29	4.45	4.47		
E	Wet Density = D / A	lbs./cu.ft.	121.6	128.8	133.5	134.3		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**110.0**	**114.8**	**116.7**	**115.8**	**#VALUE!**	**#VALUE!**

Moisture Content — AASHTO T99 or T180 Tested by:

	Container No.		61	62	63	64		
G	Wet Weight / Container	grams	173.2	162.1	166.0	154.3		
H	Dry Weight / Container	grams	160.3	148.6	149.8	138.2		
I	Moisture Loss = G - H	grams	12.9	13.5	16.2	16.1		
J	Tare Weight of Container	grams	37.3	37.6	37.3	37.3		
K	Dry Soil = H - J	grams	123.0	111.0	112.5	100.9		
L	%Moisture = (I / K) x 100	%	**10.5%**	**12.2%**	**14.4%**	**16.0%**		

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

116.9 lbs./cu.ft.

Optimum Moisture

14.4%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-180**	Date **1/24/2017**		**1346**

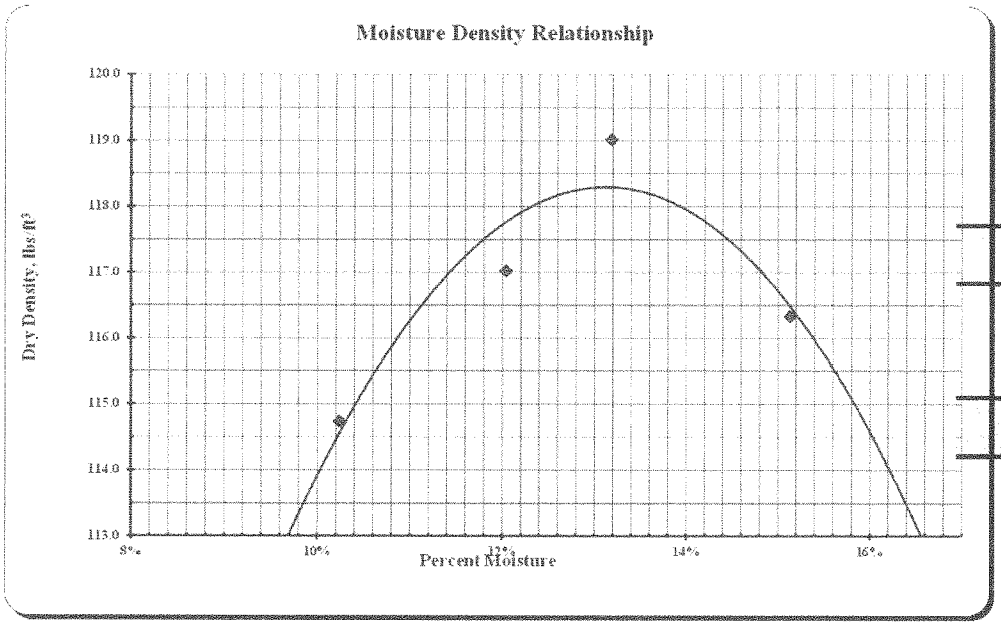
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.61	8.79	8.91	8.88		
C Weight of Mold	lbs.	4.40	4.42	4.42	4.42	4.42	4.42
D Weight of Compacted Soil = B - C	lbs.	4.21	4.37	4.49	4.46		
E Wet Density = D / A	lbs./cu.ft.	126.5	131.1	134.7	133.9		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**114.7**	**117.0**	**119.0**	**116.3**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		55	60	65	66		
G Wet Weight / Container	grams	161.5	164.9	161.4	162.5		
H Dry Weight / Container	grams	149.9	151.2	147.0	146.1		
I Moisture Loss = G - H	grams	11.6	13.7	14.4	16.4		
J Tare Weight of Container	grams	36.6	37.4	37.8	37.7		
K Dry Soil = H - J	grams	113.3	113.8	109.2	108.4		
L %Moisture = (I / K) x 100	%	**10.2%**	**12.0%**	**13.2%**	**15.1%**		

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

118.3 lbs./cu.ft.

Optimum Moisture

13.1%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No.	PCN	Station	Depth Below Grade
SS-5-021(016)000			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-180	**1/24/2017**		**1347**

Density

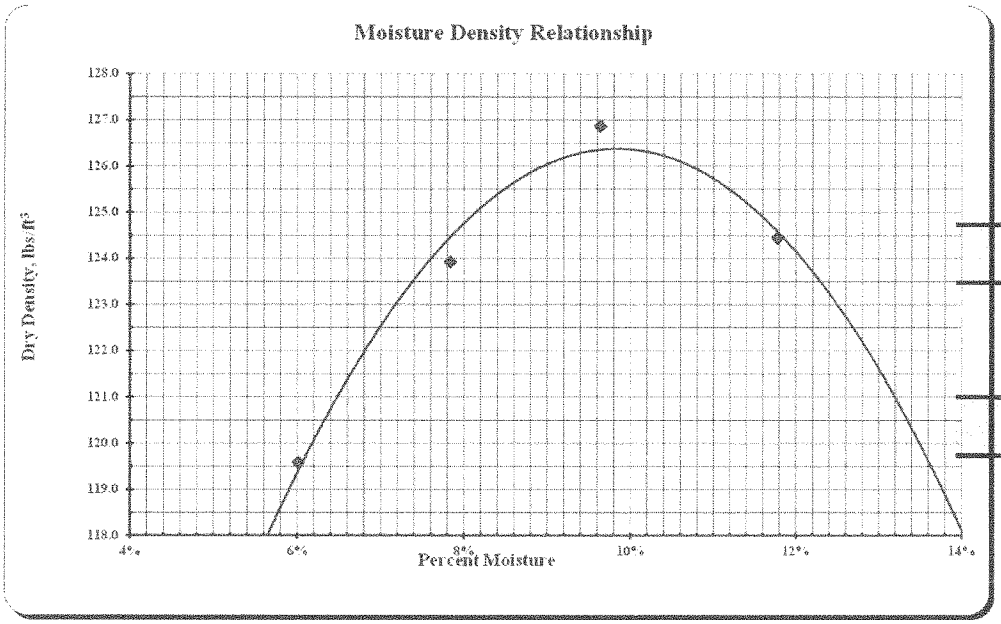
		Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.64	8.87	9.05	9.05		
C	Weight of Mold	lbs.	4.42	4.42	4.42	4.42	4.42	4.42
D	Weight of Compacted Soil = B - C	lbs.	4.22	4.45	4.63	4.63		
E	Wet Density = D / A	lbs./cu.ft.	126.8	133.6	139.1	139.1		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**119.6**	**123.9**	**126.9**	**124.4**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		67	68	69	70		
G	Wet Weight / Container	grams	174.7	170.5	162.8	166.7		
H	Dry Weight / Container	grams	166.9	160.8	151.8	153.1		
I	Moisture Loss = G - H	grams	7.8	9.7	11.0	13.6		
J	Tare Weight of Container	grams	37.2	37.0	37.7	37.6		
K	Dry Soil = H - J	grams	129.7	123.8	114.1	115.5		
L	%Moisture = (I / K) x 100	%	**6.0%**	**7.8%**	**9.6%**	**11.8%**		

ASTM D4643 AASHTO T217 or T265 Tested by: BU



Max Dry Density

126.4 lbs./cu.ft.

Optimum Moisture

9.8%

APPENDIX F

HES-5-021(023)000 Linear Soils Report and Recommendation

TO: Roger Weigel
Design Division

ATTN: Travis Brossart
Design Division

FROM: /s/Ron Horner
Materials and Research Engineer
/s/Matt Kurle
Geotechnical Section

PROJECT: HES-5-021(023)000

PCN: 19988

LOCATION: Junction US 85 to Junction ND 22

LENGTH: 15.775

DATE: October 1, 2013

SUBJECT: Linear Soils Report and Recommendations

Attached is the Linear Soils Report and Recommendation for the above referenced project. If there are any changes made to the project after the report is issued that may require alteration to this recommendation or if you have any questions please contact Matt Kurle at 328-6924 or mkurle@nd.gov.

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HES-5-021(023)000

Junction US 85 to Junction ND 22

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 Matt Kurle, Registration number PE-8777 on 10/1/13 and the original document is stored at the North Dakota Department of Transportation.

REGISTERED PROFESSIONAL ENGINEER
MATTHEW C. KURLE
PE-8777
DATE 10-1-2013
NORTH DAKOTA

Matthew C. Kurle, P.E.

10-1-2013
Date

Linear Soils Survey

Project: HES-5-021(023)000
PCN: 19988
Scope: Safety Improvements
Length: 15.775 Miles
Location: JCT US 85 to JCT ND 22

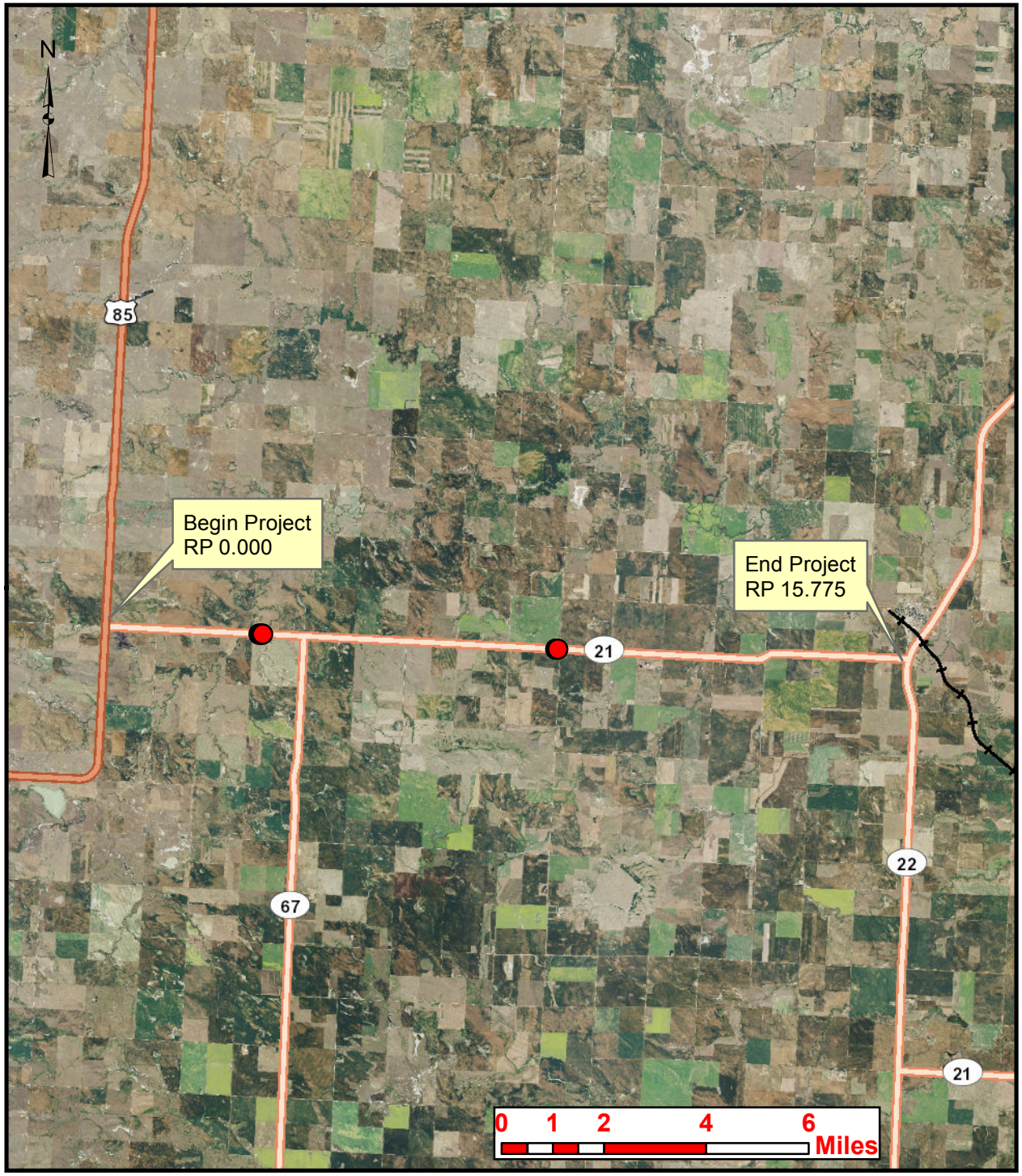

Table of Contents

Introduction 1
Existing Roadway Section 1
Maintenance Review 1
Soil Borings 3
Summary of Soil Analysis 3
  Soil Descriptions 3
  Moisture 4
  Swell Potential 4
  Frost Susceptibility 4
  Group Index 5
Design Recommendations 5
  Design Information 5
  Plan Notes 5

List of Figures

Figure 1 - Existing Typical Section - RP 0.000 to RP 12.380 1
Figure 2 – Bridge #21-003.078 Distress 2
Figure 3 – Maintenance patch RP 5+0200 to RP 5+0300 2
Figure 4 – Maintenance patch RP 8+4700 to RP 8+4750 3

List of Tables

Table 1 - Construction History (RP 0.000 to 15.775) 1
Table 2 – Identified Maintenance Areas 2
Table 3 – Investigated Maintenance Areas 3
Table 4 - Summary of In-Place and AASHTO T-180 Optimum Moisture Contents 4
Table 5 - Summary of In-Place versus AASHTO T-180 Optimum Moisture Contents 4
Table 6 - Summary of Atterberg Limits 4
Table 7 - Swell Potential 4
Table 8 - Group Indices 5

Appendices

Appendix A – Summary of Soil Analysis
Appendix B – Lab Results

Introduction

This report will provide soils information and recommendations for the proposed safety improvement project from the junction of US Highway 85 to ND Highway 22 along ND Highway 21. The Vertical Curve from RP 3.909 to RP 4.250 is to be reconstructed to increase stopping sight distance. Two horizontal curves from RP 12.630 to RP 13.294 are to be reconstructed to meet a 65 MPH design speed.

Existing Roadway Section

The construction history for the project limits can be found in Table 1 and the existing typical section can be found in Figure 1 below.

Table 1 - Construction History (RP 0.000 to 15.775)

Construction History				
Year	Construction	Depth (in)	Width (ft)	Oil
1950	Traffic Service Gravel	4.0	22.0	---
1955	Maintenance Shoulder Widening		28.0	---
1955	Stabilized Base	5.0	26.0	---
1992	District Chip Seal		22.0	---
2001	Intermittent Continuous Patch – 1.0”		26.0	PG 58-28
2002	District Chip Seal		1.0-24.0-1.0	HFMS-2
2009	Hot Bituminous Pavement	2.0	22.0	PG 58-28
2012	Federal Aid Chip Seal		22.0	CRS2P

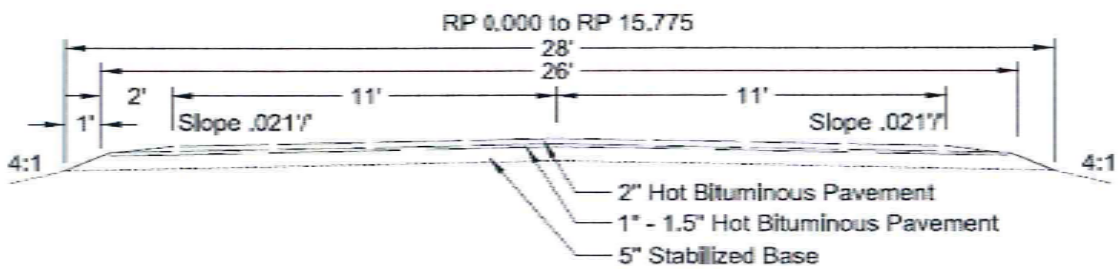

Figure 1 - Existing Typical Section - RP 0.000 to RP 12.380

Maintenance Review

Jamie Naumann, Geotechnical Drill Crew Chief, met with Kirk Erickson, New England Maintenance Section, to discuss and evaluate any maintenance areas on the roadway. Mr. Erickson indicated that the majority of the roadway was in good condition. Three specific areas were indicated that he said were problem areas.

Table 2 – Identified Maintenance Areas

Location	Distress	Drilling Required
Bridge # 21-003.078	Maintenance patching required yearly off of the bridge ends	Yes
RP 5+0200 to RP 5+0300	Area was patched in 2008 prior to the 2009 asphalt overlay. Has not been a maintenance problem since that time	No
RP 8+4700 to RP 8+4750	According to maintenance personnel, this area needs to be patched every 3 years	Yes

Figure 2 – Bridge #21-003.078 Distress

Figure 3 – Maintenance patch RP 5+0200 to RP 5+0300

Figure 4 – Maintenance patch RP 8+4700 to RP 8+4750

Soil Borings

The soil borings were performed on 8/5/2013 using a 6 inch solid flight auger. All of the borings were taken 8 feet from centerline in the eastbound lane and were advanced to a depth of 5 feet below the existing pavement surface.

Table 3 – Investigated Maintenance Areas

Location	Investigation
Bridge # 21-003.078	A total of four borings were conducted at this location (two Borings on each side of the bridge)
RP 8+4700 to RP 8+4750	Three borings were performed in this area. (One boring before the patch, one within the patch, and one after the patch)

Summary of Soil Analysis

Soil Descriptions

The analysis of the soil samples indicated that all soils sampled were classified as A-7-6.

AASHTO A-7-6 soils typically consist of plastic clays. They have high liquid limits and may be elastic as well as subject to extremely high volume change. The plasticity index in these soils is high in relation to liquid limit.

Moisture

The moisture contents provided in this report and summarized below have been obtained from samples taken on 8/5/2013.

Table 4 - Summary of In-Place and AASHTO T-180 Optimum Moisture Contents

Quantity	AASHTO Classification	In-Place Moisture Range (%)	In-Place Moisture Average (%)	Optimum Moisture Average (%)	Difference Between Average In-Place and Optimum Moistures (%)
7	A-7-6	17.6-24.1	21.7	12.4	9.3

Table 5 - Summary of In-Place versus AASHTO T-180 Optimum Moisture Contents

In-Place Moisture vs. Optimum Moisture						
Quantity	**AASHTO Classification**	**Below Optimum**	**Optimum to Moderate** (0 to 6% over optimum)	**Moderate to High** (6 to 10% over optimum)	**High** (10 to 16% over optimum)	**Very High** (> 16% over optimum)
7	A-7-6	0%	14%	29%	57%	0%

Atterberg Limits

Table 6 - Summary of Atterberg Limits

AASHTO Classification	Liquid Limit Range (%)	Liquid Limit Average (%)	Plastic Limit Range (%)	Plastic Limit Average (%)	Plasticity Index Range (%)	Plasticity Index Average (%)
A-7-6	41-46	44	17-20	19	25-27	26

Swell Potential

The swell potential, which is based on the Plasticity Index (PI), is shown in the following table.

Table 7 - Swell Potential

Low (Plasticity Index < 25)	**Marginal** (25 ≤ Plasticity Index ≤ 35)	**High** (Plasticity Index > 35)
0%	100%	0%

Frost Susceptibility

None of the samples obtained were F4 soils. The F4 designation indicates that under the right conditions these soils have a higher probability of heaving during freeze/thaw cycles.

Group Index

The Group Indexes from the samples ranged from a low of 15 to a high of 25. A group index of 20 or greater indicates a “very poor” subgrade material. The following table shows the respective group indices.

Table 8 - Group Indices

AASHTO Classification	Group Index Range	Group Index Average
A-7-6	15-25	20

Design Recommendations

In order to achieve a uniform subgrade in the areas of the vertical and horizontal reconstruction areas, it is recommended to prepare the subgrade to a depth of 18 inches.

The maintenance problem area associated with the pavement off the ends of Bridge # 21-003.078 can be attributed to the impact force of traffic coming and going from the rigid bridge structure to the flexible pavement. Replacement or reinforcement of subgrade soils will have little influence on the performance of this area and is not recommended.

The maintenance patch area near RP 5+0200 to RP 5+0300 was not investigated as it was deemed in the field to not be a significant issue or problem area.

The analysis of maintenance patch area near RP 8+4700 to RP 8+4750 revealed that this was a minor issue within the project limits. Subgrade work in this area is not necessary based on the scope of this project.

Design Information

Subgrade Prep Type A 18”:
Perform subgrade prep in the area of the vertical curve reconstruction where the subgrade will be exposed and in the areas of the horizontal curve reconstruction where new embankment will be built.

Plan Notes

None

The recommendations in this report are based on the safety improvement project information gathered from the Project Concept Report dated March 5, 2013. If the scope of work, vertical profile or horizontal alignment is changed, in either the conceptual phase or the design phase, Materials and Research must be notified as soon as possible to ensure that there is adequate geotechnical information addressing these areas.

APPENDIX A

Summary of Soil Analysis

Project No.: HES-5-021(023)000

PCN: 19988

Color Key

Swell Potential:	Low	Marginal	High	Moisture Content:	Below PL / 0-5% Over PL / >5% Over PL
Group Index:	GI≤20	GI>20		Ave. 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.

Lab No.	STA	Offset	Depth of Sample (ft)	Plastic Limit (PL)	AASHTO Class	Group Index	Optimum Moisture	Swell Potential (PI)	Ave. In-Place Moisture	Moisture Content @ Depth (ft) 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Frost Class
510	3+0340	Rt 8 EB	0.9-5	17.6	A-7-6(15)	15	12.4	25	18.7	19.3	16.9	16.5	21.8																					F3
511	3+0439	Rt 8 EB	0.7-5	17.9	A-7-6(23)	23	12.9	26	17.6	9.9	12.9	23.5	24.1																					F3
512	3+0678	Rt 8 EB	0.6-5	18.1	A-7-6(21)	21	13.0	26	24.1	17.3	23.2	30.0	26.1																					F3
513	3+0725	Rt 8 EB	0.6-5	16.7	A-7-6(19)	19	11.9	25	21.4	18.7	23.5	19.7	23.9																					F3
514	8+4550	Rt 8 EB	0.6-5	20.3	A-7-6(18)	18	11.9	25	23.0	28.7	18.1	22.2	23.0																					F3
515	8+4650	Rt 8 EB	0.6-5	19.6	A-7-6(18)	18	12.2	25	23.2	28.1	21.0	22.1	21.4																					F3
516	8+4750	Rt 8 EB	0.5-5	19.6	A-7-6(25)	25	12.7	27	23.8	27.4	19.9	24.2	23.7																					F3

Soil Properties Table

AASHTO Classification	Quantity	In-Place Vs Optimum Moisture									Atterberg Limits						Group Indices	
		In-Place Moisture Range (%)	In-Place Moisture Average (%)	Optimum Moisture Average (%)	Difference Between Average In-Place Moist. and Optimum Moist. (%)	Below Optimum (%)	Optimum to Movderate (0 to 6% over opt.) (%)	Moderate to High (6 to 10% over opt.) (%)	High (10 to 16% over opt.) (%)	Very High (> 16% over opt.) (%)	Liquid Limit Range (%)	Liquid Limit Average (%)	Plastic Limit Range (%)	Plastic Limit Average (%)	Plasticity Index Range (%)	Plasticity Index Average (%)	Group Index Range	Group Index Average
A-7-6	7	17.6-24.1	21.7	12.4	9.3	0%	14%	29%	57%	0%	41-46	44	17-20	19	25-27	26	15-25	20

APPENDIX B

Lab Results

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-20-2013	**Date Reported**	8/19/2013	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	HES-5-021(023)000
		AASHTO Test Method	T-180	**PCN**	19988

Comments

Lab Number	510	511	512	513
Reference Pt + Feet	3+0340	3+0439	3+0678	3+0725
Distance From CenterLine (Ft.)	Rt 8 EB	Rt 8 EB	Rt 8 EB	Rt 8 EB
Depth, Ft.	0.9 - 5.0	0.7 - 5.0	0.6 - 5.0	0.6 - 5.0
Field Sample No.	510	511	512	513
% Pass. 3/8" Sieve	98	100	100	99
% Pass. No. 4 Sieve	96	100	99	99
% Pass. No. 10 Sieve	90	98	96	97
% Coarse Sand (-No. 10 + No. 40)	6	2	1	1
% Fine Sand (-No. 40 + No. 200)	16	10	13	17
% Silt (0.074 - 0.005 mm)	31	41	37	35
% Clay (-0.005 mm)	38	46	46	44
Liquid Limit (-No. 40)	43	44	44	41
Plasticity Index (-No. 40)	25	26	26	25
Plastic Limit	18	18	18	17
Soil Color	BRN/BLK	BRN	BRN/GRY	BRN/GRY
Textural Class	CLY	CLY	CLY	CLY
Soil Class (AASHTO M-145)	A-7-6(15)	A-7-6(23)	A-7-6(21)	A-7-6(19)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	12.4	12.9	13.0	11.9
Maximum Dry Density (pcf)	121.3	120.8	121.3	121.2
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 19.3	2 | 9.9	2 | 17.3	2 | 18.7
	3 | 16.9	3 | 12.9	3 | 23.2	3 | 23.5
	4 | 16.5	4 | 23.5	4 | 30.0	4 | 19.7
	5 | 21.8	5 | 24.1	5 | 26.1	5 | 23.9
Avg. Moisture of Sample Depth	18.7	17.6	24.1	21.4

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 9/10/2013

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-20-2013	**Date Reported**	8/19/2013	**District**	Dickinson
County	SLOPE	**Submitted By**	Naumann	**Project Number**	HES-5-021(023)000
		AASHTO Test Method	T-180	**PCN**	19988

Comments

Lab Number	514			515			516	
Reference Pt + Feet	8+4550			8+4650			8+4750	
Distance From CenterLine (Ft.)	Rt 8 EB			Rt 8 EB			Rt 8 EB	
Depth, Ft.	0.6 - 5.0			0.6 - 5.0			0.5 - 5.0	
Field Sample No.	514			515			516	
% Pass. 3/8" Sieve	100			100			100	
% Pass. No. 4 Sieve	98			98			99	
% Pass. No. 10 Sieve	89			93			98	
% Coarse Sand (-No. 10 + No. 40)	4			5			2	
% Fine Sand (-No. 40 + No. 200)	12			13			7	
% Silt (0.074 - 0.005 mm)	41			39			47	
% Clay (-0.005 mm)	32			35			41	
Liquid Limit (-No. 40)	46			44			47	
Plasticity Index (-No. 40)	25			25			27	
Plastic Limit	20			20			20	
Soil Color	BRN			BRN/GRY/BLK			BRN/GRY	
Textural Class	CLY			CLY			CLY	
Soil Class (AASHTO M-145)	A-7-6(18)			A-7-6(18)			A-7-6(25)	
Frost Class	F3			F3			F3	
Optimum Moisture (%)	11.9			12.2			12.7	
Maximum Dry Density (pcf)	122.8			121.3			118.8	
% Organic Content								
Depth (Ft.) | Moisture (%)	2	|	28.7	2	|	28.1	2	| 27.4
	3	|	18.1	3	|	21.0	3	| 19.9
	4	|	22.2	4	|	22.1	4	| 24.2
	5	|	23.0	5	|	21.4	5	| 23.7
Avg. Moisture of Sample Depth	23.0			23.2			23.8	

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 9/10/2013