LINEAR SOILS SURVEY AND RECOMMENDATIONS

PROJECT NO. NH-3-281(118)190

PCN 20683

COUNTY Towner

Cando North to West Junction ND 66

PREPARED BY: Matthew C. Kurle, P.E.

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

December 2015

NH-3-281(118)190

Highway 281: Cando North to West Junction ND 66.

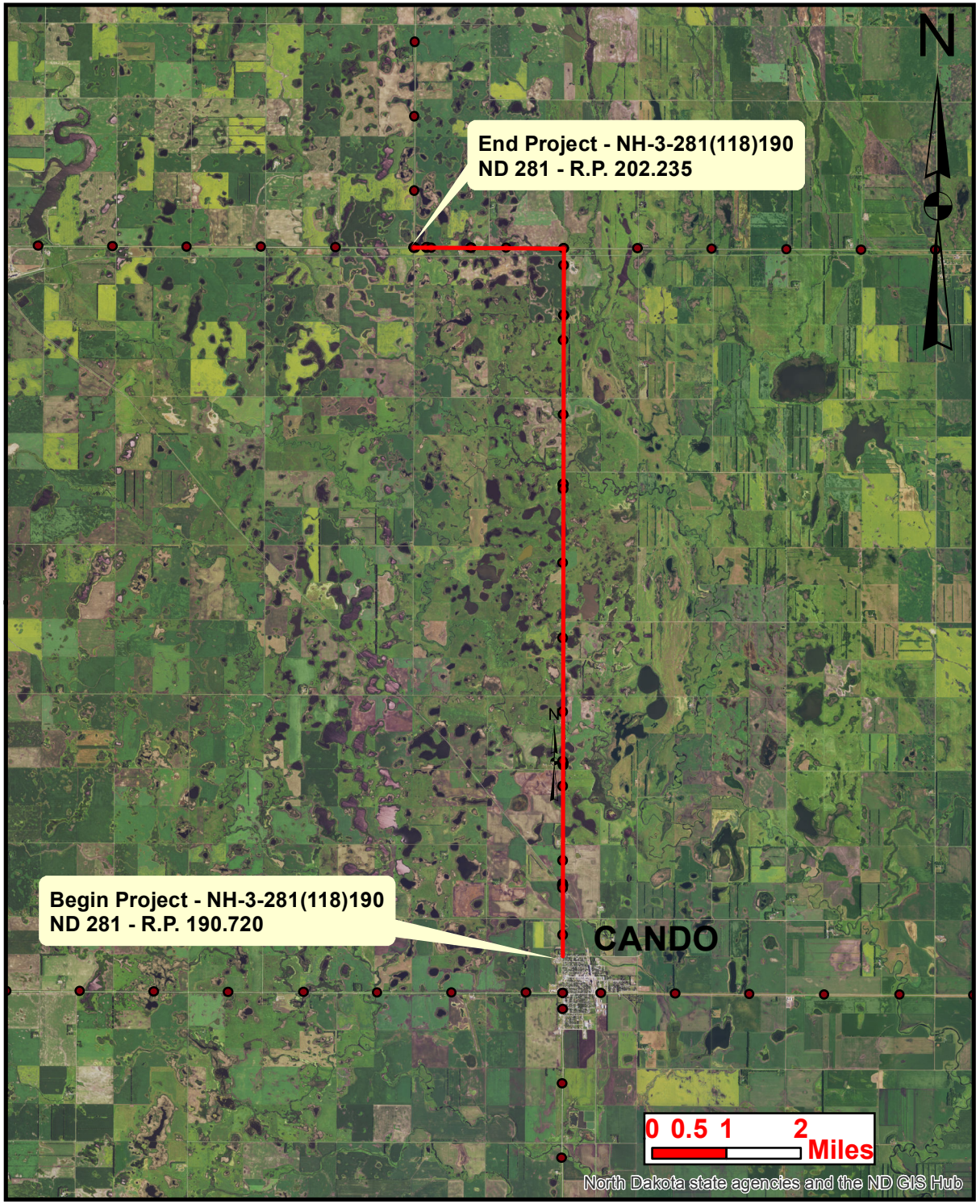
CERTIFICATION

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of North Dakota. This document was originally issued and sealed by Matthew C. Kurle, Registration number PE-8777 on 12/1/2015 and the original document is stored at the North Dakota Department of Transportation.

REGISTERED PROFESSIONAL ENGINEER
MATTHEW C. KURLE
PE-8777
DATE 12-1-2015
NORTH DAKOTA

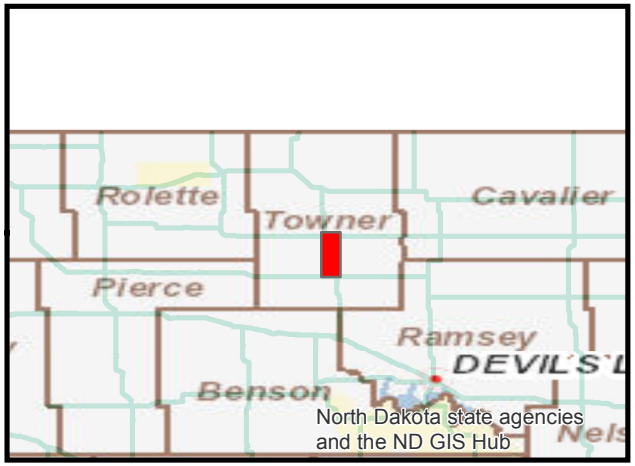
Matthew C. Kurle, P.E.

1 DEC 2015
Date



Linear Soils Report and Recommendation

Project: NH-3-281(118)190
PCN: 20683
Scope: Mill and Overlay, Shoulders, Subcut, Pipe Repair/Replacement
Length: 15.515 Miles
Location: Highway 281:N of Cando N and W to Intersection of Highway 66



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Introduction

Location: Highway 281: Cando north to the west junction of ND 66.
Reference Points: 190.720 to 202.235
Project Length: 11.515
Proposed Project Scope: RAP Mill and Overlay, RAP Shoulders, Subcuts, Pipe Rehabilitation
Investigation Scope: Identified Areas

Existing Roadway Section

Construction History

Table 1 - Construction History (RP 190.219 to RP 202.235)

Construction History				
Year	**Construction**	**Depth (in)**	**Width (ft)**	**Oil**
2000	Grade		56.0	
2000	Blended Base	15.0	41.0	
2001	Hot Bituminous Pavement	3.0	38.0	PG 58-28
2001	Hot Bituminous Pavement	2.0	36.0	PG 58-34
2006	Federal Aid Chip Seal	2.0	8.5,25.0,8.5	HFMS-2

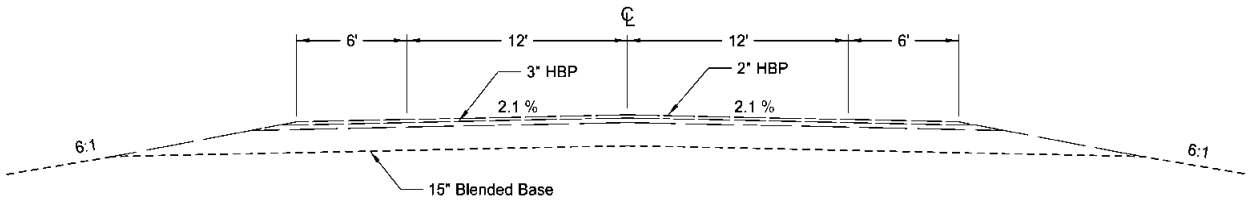


Figure 1 - Existing Typical Section (RP 190.219 to RP 202.235)

Existing Roadway Condition

Distress Data

Table 2 - Distress Data (2014)

Reference Point	Alligator Cracking (0-9)	Longitudinal Cracking (0-9)	Transverse Cracking (0-9)	Block Cracking (0-9)	Bituminous Patching (0-9)	Rutting (0-9)
190	3	0	4	0	0	0
191	3	7	7	0	0	0
192	3	4	7	0	0	0
193	3	7	7	0	0	0
194	3	7	7	0	0	0
195	3	4	7	0	0	0
196	3	7	7	0	0	0
197	3	4	7	0	2	0
198	3	0	7	0	0	0
199	3	4	7	0	0	0
200	3	0	7	0	2	0
201	3	7	7	0	2	0
202	3	4	7	0	0	0
Average	**3**	**4.2**	**6.8**	**0**	**0.5**	**0**

Ride Data

Table 3 - Ride Data (2014)

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**
190	92		0.05		94	
191	82		0.07		81	
192	85		0.06		80	
193	82		0.09		91	
194	82		0.08		81	
195	85		0.08		71	
196	82		0.07		79	
197	83		0.07		89	
198	89		0.06		61	
199	85		0.08		76	
200	87		0.08		97	
201	80		0.10		116	
202	85		0.08		117	
Average	**84.5**		**0.07**		**87.2**	

Maintenance Review

Date of Maintenance Review: 9/9/2015
Materials and Research Person Conducting the Review: Jamie Naumann
District Maintenance Person Conducting Review: Lynn Lawler – Rolla

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	Maintenance Comments
Project Length	Depressed Transverse Cracking	Minimac in 2015
191+3477	Frost Heave	
193+1584	Frost Heave	Northbound Lane
194+4224	Dip	Pipe Location
197+0317	Dip	Pipe Location
197+1584	Dip	Pipe Location
197+2640	Dip	Pipe Location
199+1700	Frost Heave	Pipe Location, Heaves on both sides of Pipe
200+3168	Dip	Pipe Location
200+4752	Dip	Pipe Location
201+1584	Dip	Pipe Location
201+2112	Dip	Pipe Location
201+2640	Dip	Pipe Location
201+4224	Dip	Pipe Location
202+0000	Dip	Pipe Location
202+1100 to 202+1241	Alligator Cracking, Shoving	This area is at the intersection of Hwy 281 and Hwy 66. Maintenance Blade Patch in 2015. Patches run north and east. This area experiences heavy truck traffic. Patch areas experience heaving in the winter

Summary of Soil Analysis

A summary of the locations that were drilled I shown in the following table. A map of the Boring Locations is shown in Appendix C.

Table 5 - Boring Locations Summary

Location RP + Feet	Boring Interval, Depth and Method	Reason for Boring
191+3290 to 191+3575	In the distress area and Adjacent to the distress area,10 feet deep using a solid flight auger	Obtain subgrade information throughout the area
193+1475 to 193+1748	In the distress area and Adjacent to the distress area, 10 feet deep using a solid flight auger	Obtain subgrade information throughout the area
197+0281 to 197+0338	Adjacent to pipe and 30’ on each side of the pipe, 10 feet deep using a solid flight auger	Obtain subgrade information throughout the area
199+1721 to 199+1788	Adjacent to pipe and 30’ on each side of the pipe, 10 feet deep using a solid flight auger	Obtain subgrade information throughout the area
201+2462 to 201+2520	Adjacent to pipe and 30’ on each side of the pipe, 10 feet deep using a solid flight auger	Obtain subgrade information throughout the area
202+0291 to 202+0376	Adjacent to pipe and 30’ on each side of the pipe, 10 feet deep using a solid flight auger	Obtain subgrade information throughout the area
202+1139 to 202+1215 (Intersection of Hwy 281 and Hwy 66)	In the distress area, 10 feet deep using a solid flight auger	Obtain subgrade information throughout the area

Soil Sample Distribution

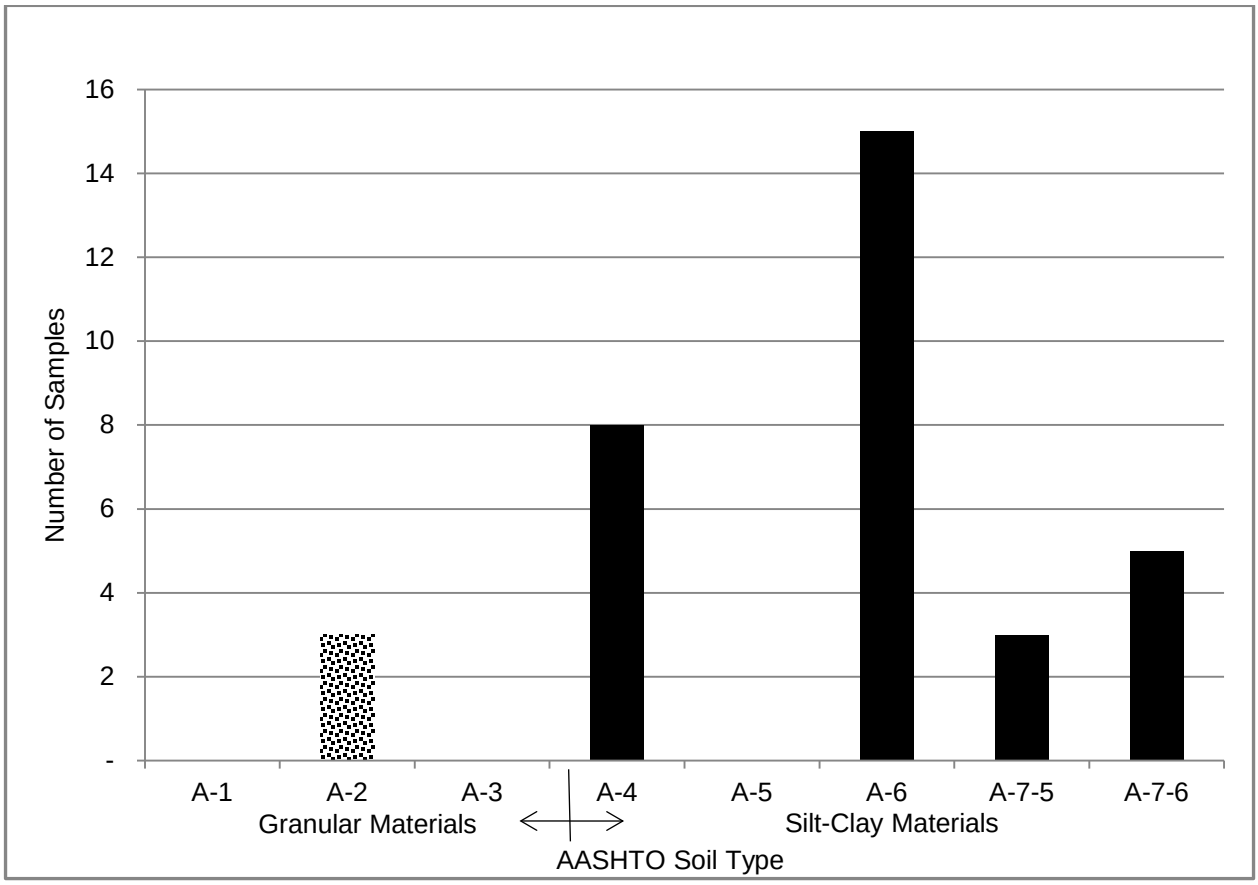


Figure 2 - Soil Sample Distribution

Moisture

The moisture contents provided in this report and summarized below have been obtained from samples taken on 9/30/2015.

Table 6 - 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 (%)
2	A-2-4	11.5-13.6	12.6	11	1.6
1	A-2-6	-	17.9	11.9	6
8	A-4	14.5-24	19.8	14.1	5.7
15	A-6	16.9-29.6	22.1	17	5.1
3	A-7-5	24.4-26.8	25.8	18	7.8
5	A-7-6	21.4-24.7	23.2	17.2	6

Table 7 - 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)
2	A-2-4	0%	100%	0%	0%	0%
1	A-2-6	0%	100%	0%	0%	0%
8	A-4	0%	63%	25%	13%	0%
15	A-6	7%	53%	33%	7%	0%
3	A-7-5	0%	0%	100%	0%	0%
5	A-7-6	0%	80%	20%	0%	0%

Atterberg Limits

Table 8 - 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	24-29	26	18-20	19	4-11	8
A-2-6	-	32	-	15	-	17
A-4	21-39	29	13-31	22	2-10	7
A-6	28-40	35	15-23	19	11-21	16
A-7-5	46-67	54	-	32	14-35	22
A-7-6	42-52	49	18-27	23	24-29	26

Swell Potential

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

Table 9 - Swell Potential

Low (Plasticity Index < 25)	**Marginal** (25 ≤ Plasticity Index ≤ 35)	**High** (Plasticity Index > 35)
85%	15%	0%

Frost Susceptibility

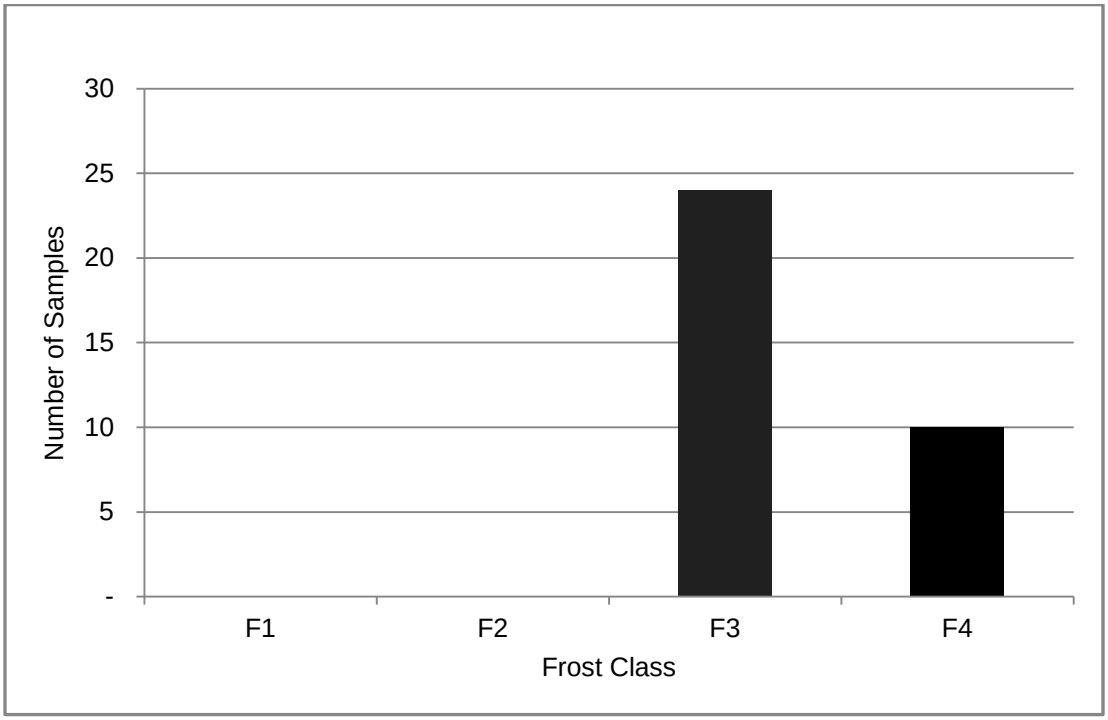


Figure 3 - Frost Susceptibility Distribution

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 10 - Group Indices

AASHTO Classification	Group Index Range	Group Index Average
A-2-4	0-0	0
A-2-6	1-1	1
A-4	0-8	2
A-6	3-11	6
A-7-5	17-33	22
A-7-6	12-17	14

Existing Surface and Base Section at the Boring Locations

The soil borings were performed on 9/30/2015 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 11 - Surface and Base Section at the Boring Locations

RP + Feet	Offset	Surfacing Thickness (ft)	Base Thickness (ft)
191+3290	Lt 8 SB	0.5	2.0
191+3429	Lt 8 SB	0.6	2.2
191+3457	Lt 8 SB	0.7	1.3
191+3575	Lt 8 SB	0.5	1.0
193+1475	Lt 8 SB	0.5	1.0
193+1621	Lt 8 SB	0.5	1.2
193+1635	Lt 8 SB	0.5	1.2
193+1648	Lt 8 SB	0.5	1.2
193+1748	Lt 8 SB	0.5	1.1
197+0281	Lt 8 SB	0.6	1.1
197+0307	Lt 8 SB	0.7	1.1
197+0338	Lt 8 SB	0.5	1.2
199+1721	Lt 8 SB	0.5	0.6
199+1758	Lt 8 SB	0.5	0.5
199+1788	Lt 8 SB	0.5	0.5
201+2462	Rt 8 WB	0.6	0.6
201+2489	Rt 8 WB	0.5	0.6
201+2520	Rt 8 WB	0.5	0.6
202+0291	Rt 8 WB	0.5	0.4
202+0346	Rt 8 WB	0.5	0.4
202+0376	Rt 8 WB	0.5	0.4
202+1139	Lt 8 EB	0.4	0.5
202+1180	Lt 8 EB	1.0	0.8
202+1215	Rt 8 WB	1.4	0.7

Design Recommendations

Table 12 - Recommendations

Location RP + Feet	Distress Identified	Recommendation*	Justification
Project Length	Transverse Cracking	Do Nothing	• The transverse cracking is a pavement distress that is not related to the specific subgrade issues • No subgrade work required
191+3295 to 191+3570	Frost Heave	Subcut	• Based on the borings, reinforcement fabric was present in this area. A 1999 memo regarding the grading of this section of roadway recommended a 12" subcut with reinforcement in areas where the subgrade failed during construction. The 12" subcut was not sufficient to prevent pavement issues. • Subcut to 2/3 of extreme frost depth below top of pavement (Extreme Frost Depth = 88" per NOAA) • Subcut depth = 35" below top of existing subgrade (Pavement Section - on average in area = 24" per measured pavement and base)
193+1480 to 193+1745	Frost Heave	Subcut	• Although the soil analysis indicates low group indices, and moisture contents, the soils in this area consist mainly of silt. Silt has a tendency to be highly susceptible to frost action. With the presence of water on both sides of the road, the formation of frost lenses in the soil during freezing conditions is likely to occur. • Subcut to 2/3 of extreme frost depth below top of pavement (Extreme Frost Depth = 88" per NOAA) • Subcut depth = 39" below top of existing subgrade (Pavement Section - on average in area =20" per measured pavement and base)
194+4224, 197+0317, 197+2640	Dip at Centerline Pipe Location	Do Nothing	• Based on the performance of recently replaced pipes in this area of the state, repair of centerline pipes are not advised until a better understanding of the soil mechanics at work.

Location RP + Feet	Distress Identified	Recommendation*	Justification
199+1590 to 199+1810	Frost Heave	Subcut	• The presence of water on both sides of the road in combination with the silt content of the soils increases the likelihood of formation of frost lenses in the soil during freezing conditions. • Subcut to 2/3 of extreme frost depth below top of pavement (Extreme Frost Depth = 88” per NOAA) • Subcut depth = 39” below top of existing subgrade (Pavement Section - on average in area =20” per measured pavement and base)
200+3168,200+4752,201+1584,201+2112,201+2640,201+4224,202+0000	Dip at Centerline Pipe Location	Do Nothing	• Based on the performance of recently replaced pipes in this area of the state, repair of centerline pipes are not advised until a better understanding of the soil mechanics at work.
202+1135 to 202+1220 (Intersection of Hwy 281 and Hwy 66)	Alligator Cracking, Shoving	Reconstruct Pavement and Base	• The distress in the pavement at this location is more indicative to distress caused by heavy loading. • The soils are similar to those in the frost heave areas; however the pavement distress does not indicate significant heaving issues. • Remove the existing pavement and base section to accommodate the pavement section as listed in the pavement recommendation. Place Geosynthetic Material Type G directly on the subgrade prior to reconstruction of the pavement and base.

*See Design Information Below

Design Information

Compaction Method: T-99

Subgrade Prep: None

Subcut: Calculate the subcut quantity based on the lengths and depths as shown in Table 14 and adhere to the guidelines stated below.

Table 13 – Subcut Recommendations

Location	Length	Depth
191+3295 to 191+3570	275’	35 Inches
193+1480 to 193+1745	265’	39 Inches
199+1590 to 199+1810	220’	39 Inches

Remarks: Subcut to depth listed in the above table below the top of the existing subgrade. Place reinforcement fabric (R1) at the bottom of all subcut excavations and backfill with Class 3 or Class 5 aggregate. Place 12” of aggregate on the fabric prior to compacting. Do not scarify the bottom of the subcut.

Replace Pavement Section & Subgrade Reinforcement:

Table 14 – Reinforcement Recommendations

Location	Length
202+1135 to 202+1220 (Intersection of Hwy 281 and Hwy 66)	85’

Remarks: Remove the existing pavement, aggregate base, and subgrade to a depth to accommodate the section as outlined in the Pavement Design Recommendation Addendum. Place Geosynthetic Material Type G directly on the subgrade prior to reconstructing the aggregate base and pavement.

Drainage: 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 AND PHOTOS

PAVEMENT EVALUATION LOG FOR LINEAR SOIL SURVEY

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

Project Number	PCN	Date of Survey
NH-3-281(118)190	20683	9/9/2015
Section Maintenance Contact: Lynn Lawler		Completed By: Jamie Naumann
Highway Reference Points: 190+2782 to 200+4752	Surface Type: Asphalt	

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
190+2782 to 202+1241	Transv. Cracks	Depressed	Mini Mac-2015		No
191+3477	Other	Frost Heave	Mini Mac-2015	1	Yes
193+1584	Culvert	Northbound Lane	Dip		Yes
194+4224	Culvert		Dip		No
197+0317	Culvert		Dip		Yes
197+1584	Culvert		Dip		No
197+2640	Culvert		Dip		No
199+1700	Culvert	Frost Heave	Heaves on both sides of culvert		Yes
200+3168	Culvert		Dip		No

Comments

Met with Lynn Lawler on 9-9-2015 and he indicated these areas of greatest distress. He did mention all of the culverts from a previous report and all were end section and poor concrete quality issues. All were dips in the road.

PAVEMENT EVALUATION LOG FOR LINEAR SOIL SURVEY

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

Project Number	PCN	Date of Survey
NH-3-281(118)190	20683	9/9/2015
Section Maintenance Contact: Lynn Lawler		Completed By: Jamie Naumann
Highway Reference Points: 200+4752 to 202+1241	Surface Type: Asphalt	

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
200+4752	Culvert	Dip			No
201+1584	Culvert	Dip			No
201+2112	Culvert	Dip			No
201+2640	Culvert	Dip			Yes
201+4224	Culvert	Dip			No
202+0000	Culvert	Dip			No
202+1100 to 202+1241	Aligator Cracking	Shoving, Maintenance Blade Patch -2015	Patches run north and East . Heavy truck traffic. Says patch ares heave in winter.	2,3	Yes
	Select One				Select One
	Select One				Select One

Comments

1

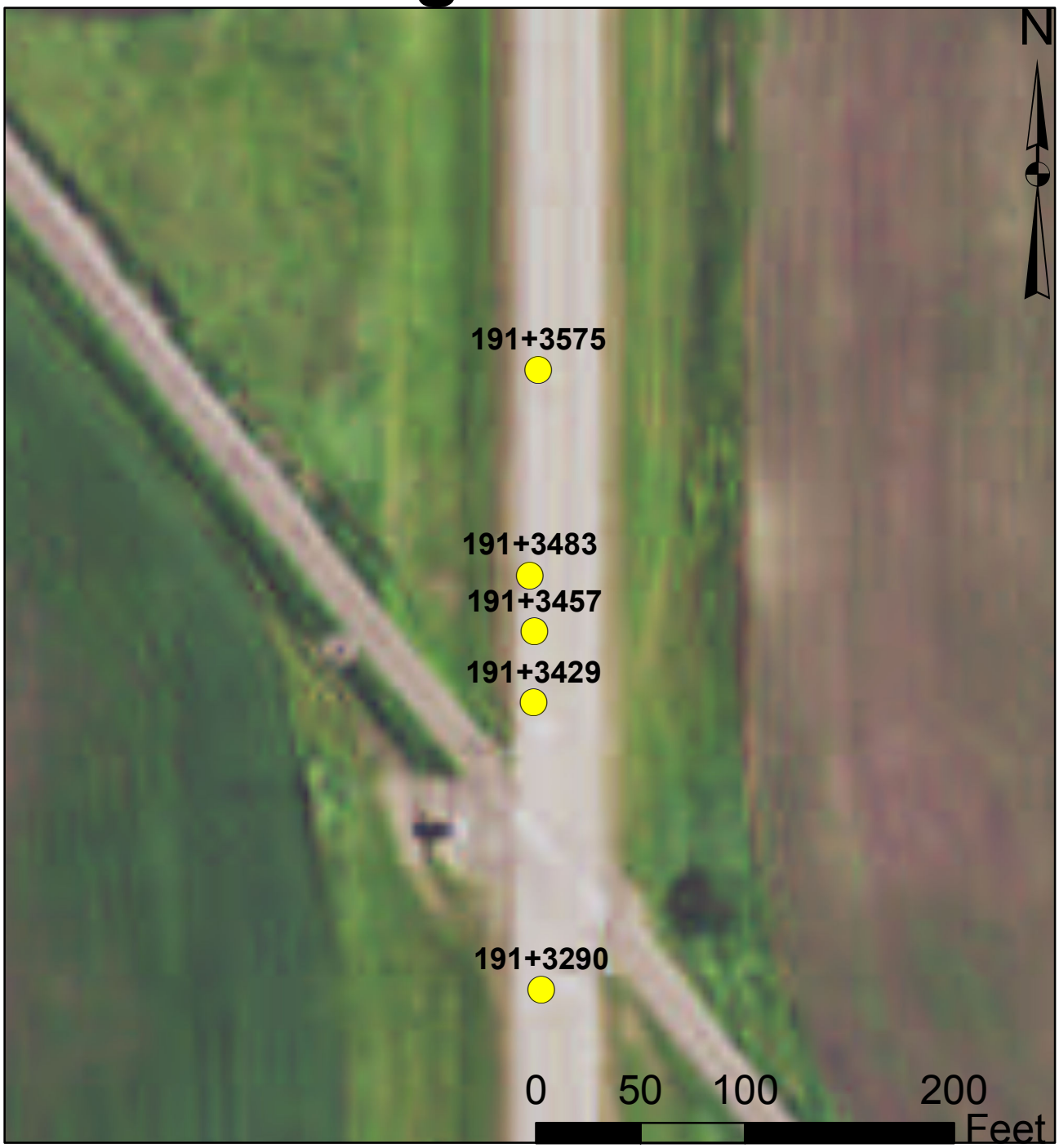
2

3

APPENDIX C

BORING LOCATIONS

Boring Locations

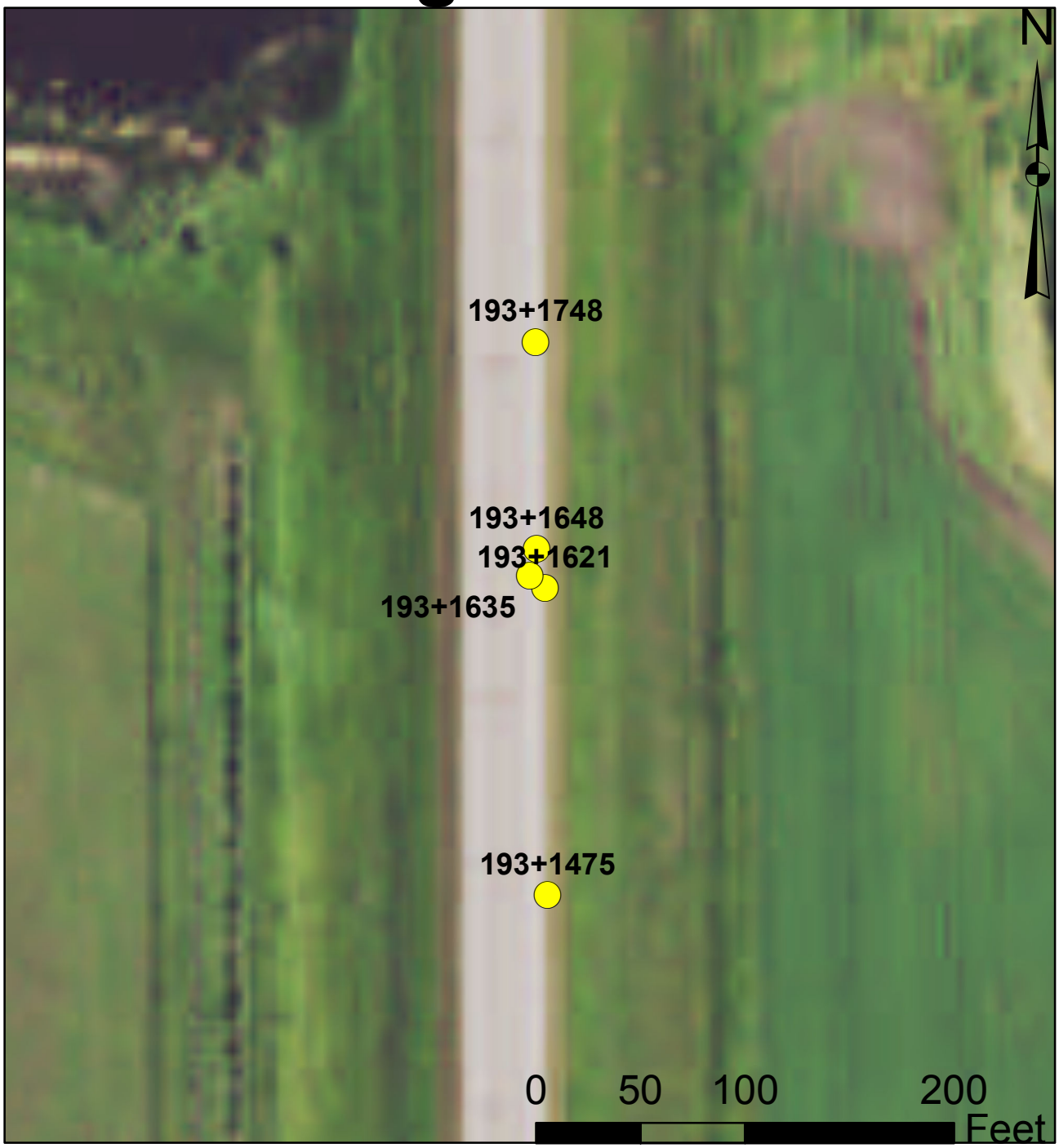


Legend

- Reference Points
- LinearSoils

Project # NH-3-281(118)190

Boring Locations



Legend

- Reference Points
- LinearSoils

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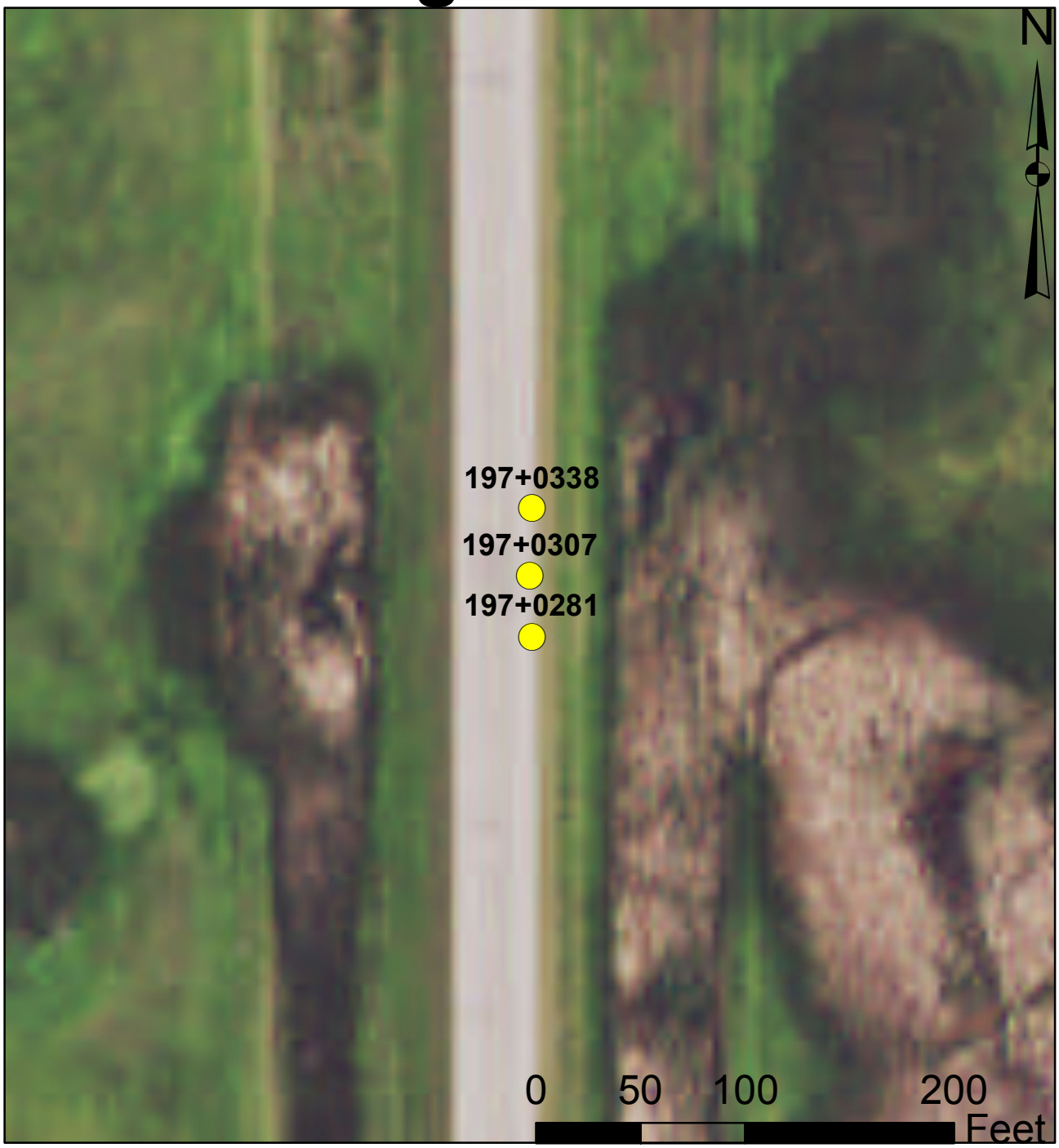
Boring Locations



Legend

- Reference Points
- LinearSoils

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Boring Locations

Legend

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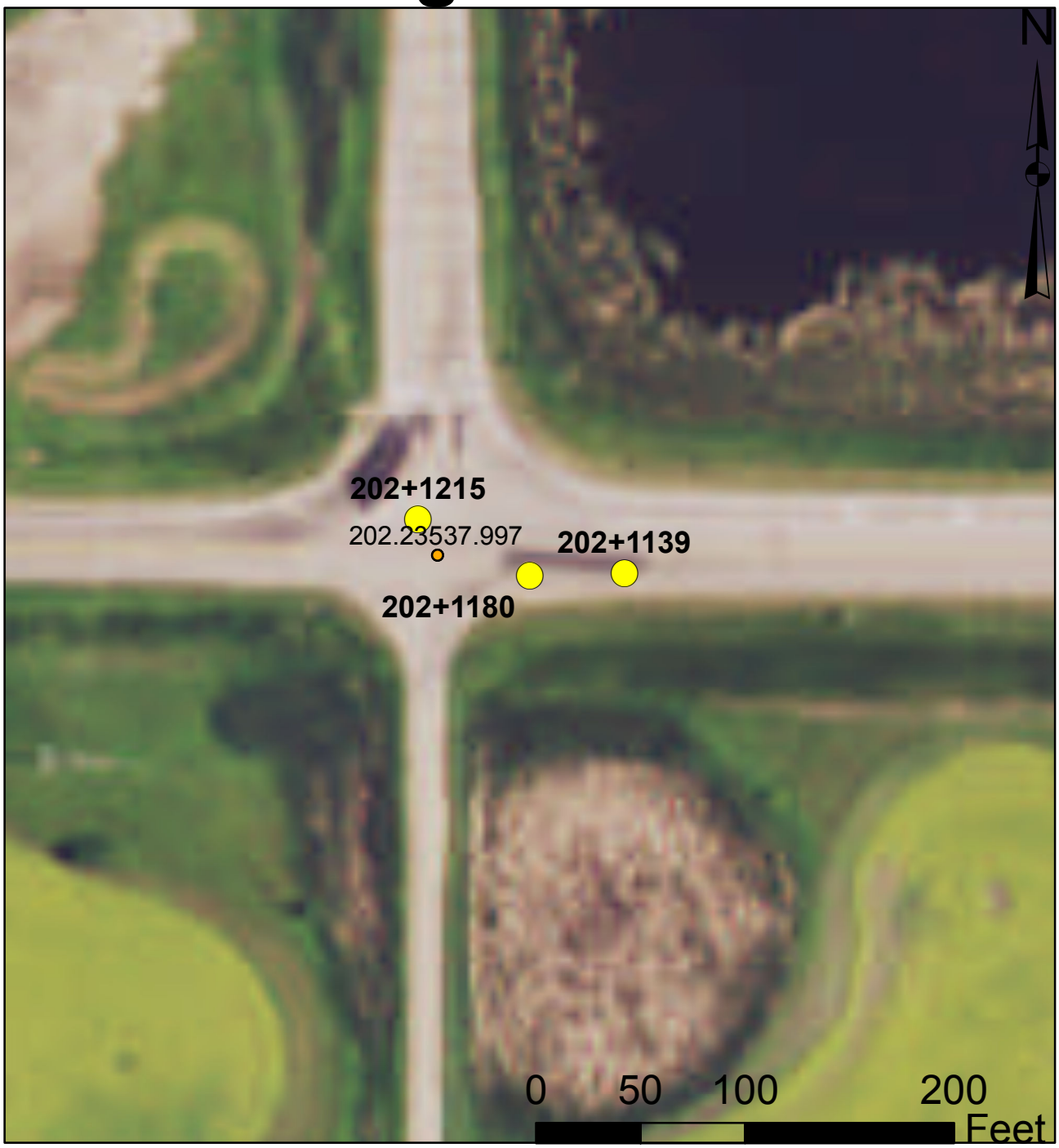
Boring Locations



Legend

- Reference Points
- LinearSoils

Project # NH-3-281(118)190

APPENDIX D

SUMMARY OF SOILS ANALYSIS

Project No.: NH-3-281(118)190

PCN: 20683

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
1473	191+3290	Lt 8 SB	0.5-10	31.8	A-7-5(17)	17	17.3	14	26.1	6.6	29.9	32.7	24.8	30.2	33.2	31.7	20.5	25.3																F4
1472	191+3429	Lt 8 SB	0.6-10	31.8	A-7-5(33)	33	18.8	35	26.8	7.9	17.0	29.3	28.8	26.7	26.8	35.3	35.0	34.2																F3
1471	191+3457	Lt 8 SB	0.7-10	22.1	A-4(5)	5	15.7	9	24.0	8.7	16.0	22.8	24.4	21.2	30.7	31.0	25.1	36.2																F4
1470	191+3483	Lt 8 SB	0.6-10	19.7	A-2-4(0)	0	11.1	4	13.6	11.2	12.3	19.9	14.5	12.1	22.8	10.7	8.2	10.9																F3
1468	191+3575	Lt 8 SB	0.5-7	23.0	A-4(2)	2	12.5	5	20.7	10.7	15.9	29.6	33.3	18.3	16.4																			F4
1469	191+3575	Lt 8 SB	7-10	17.6	A-2-4(0)	0	10.9	11	11.5							9.8	7.6	17.2																F3
1474	193+1475	Lt 8 SB	0.5-10	32.2	A-7-5(17)	17	17.9	17	24.4	11.8	14.3	18.0	16.8	25.7	36.8	22.4	37.3	36.7																F4
1475	193+1621	Lt 8 SB	0.5-8.5	26.0	A-4(0)	0	14.5	2	19.7	12.4	12.2	15.7	15.9	27.2	34.1	20.6	13.8	25.1																F3
1476	193+1635	Lt 8 SB	0.5-10	29.7	A-4(0)	0	14.2	2	18.2	15.1	14.5	13.7	14.5	19.1	14.4	11.7	28.1	32.5																F3
1477	193+1648	Lt 8 SB	0.5-10	20.2	A-6(3)	3	13.8	12	16.9	15.0	14.5	13.0	8.3	11.6	11.7	12.4	33.2	32.8																F4
1478	193+1748	Lt 8 SB	0.5-10	30.7	A-4(8)	8	16.6	9	21.1	15.3	12.6	9.2	16.4	23.7	21.6	29.1	31.3	31.1																F4
1479	197+0281	Lt 8 SB	0.6-10	17.3	A-6(5)	5	22.1	11	24.5	15.0	12.4	16.1	17.2	27.0	30.4	41.3	38.9	22.4																F4
1480	197+0307	Lt 8 SB	0.7-7.5	17.2	A-4(1)	1	14.2	7	16.0	11.2	15.9	17.1	16.6	17.0	18.0																			F4

Project No.: NH-3-281(118)190

PCN: 20683

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
1481	197+0307	Lt 8 SB	7.5-10	15.1	A-2-6(1)	1	11.9	17	17.9							21.7	15.3	16.6																F3
1482	197+0338	Lt 8 SB	0.5-6.5	18.3	A-6(5)	5	17.8	16	17.1	14.8	12.5	17.4	18.6	22.3																				F3
1483	197+0338	Lt 8 SB	6.5-10	25.2	A-7-6(12)	12	19.3	26	22.9						24.6	20.9	24.8	21.2																F3
1484	199+1721	Lt 8 SB	0.5-10	22.0	A-6(4)	4	17.4	17	20.5	17.1	17.6	15.6	16.7	22.9	27.9	21.0	21.0	24.5																F3
1485	199+1758	Lt 8 SB	0.5-10	18.4	A-6(4)	4	16.3	21	18.6	17.4	17.4	19.8	18.3	18.2	20.0	20.1	17.7	18.5																F3
1486	199+1788	Lt 8 SB	0.5-10	19.9	A-6(5)	5	17.9	19	23.5	18.6	18.2	18.1	18.2	19.8	21.0	41.4	31.9	24.4																F3
1487	201+2462	Rt 8 WB	0.6-10	27.3	A-7-6(14)	14	17.2	24	22.9	16.2	16.1	11.7	21.8	29.7	22.4	27.9	29.9	30.6																F3
1488	201+2489	Rt 8 WB	0.5-10	21.5	A-7-6(15)	15	15.6	29	21.4	14.4	15.8	13.8	16.3	16.5	18.6	32.2	22.3	42.8																F3
1489	201+2520	Rt 8 WB	0.5-10	17.8	A-6(8)	8	16.1	20	21.2	16.3	13.3	13.9	18.3	22.1	18.7	20.8	24.9	42.2																F3
1490	202+0291	Rt 8 WB	0.5-7.3	22.1	A-7-6(17)	17	19.1	28	24.7	17.9	20.9	25.9	18.3	34.6	30.7																			F3
1491	202+0291	Rt 8 WB	7.3-10	17.5	A-7-6(13)	13	14.9	25	24.1							25.2	23.7	23.4																F3
1492	202+0346	Rt 8 WB	0.5-7.5	18.2	A-6(9)	9	16.8	21	23.7	18.0	18.8	31.4	26.5	21.5	25.8																			F3
1493	202+0346	Rt 8 WB	7.5-10	16.9	A-6(11)	11	16.9	16	25.2							21.8	27.2	26.7																F3

Project No.: NH-3-281(118)190

PCN: 20683

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
1494	202+0376	Rt 8 WB	0.5-7.5	17.8	A-6(5)	5	17.2	16	26.9	16.8	19.3	19.1	32.3	40.9	32.7																			F3
1495	202+0376	Rt 8 WB	7.5-10	17.4	A-6(9)	9	18.5	18	29.6							32.3	28.4	28.1																F3
1500	202+1139	Lt 8 EB	0.4-4.5	23.4	A-6(5)	5	17.5	15	20.8	11.2	27.5	23.7																						F3
1501	202+1139	Lt 8 EB	4.5-10	15.4	A-6(7)	7	13.2	16	22.0				25.7	22.9	23.3	23.2	20.9	15.9																F3
1498	202+1180	Lt 8 EB	1-4.5	23.0	A-6(4)	4	17.2	14	23.3	22.1	27.4	20.3																						F3
1499	202+1180	Lt 8 EB	4.5-10	14.8	A-4(2)	2	12.8	10	24.0				28.3	20.4	16.9	36.3	21.3	21.0																F4
1496	202+1215	Rt 8 WB	1.4-7.5	19.7	A-6(3)	3	16.6	12	17.8	5.8	16.7	18.4	30.5	20.8	14.8																			F3
1497	202+1215	Rt 8 WB	7.5-10	13.4	A-4(1)	1	12.0	8	14.5							16.6	13.8	13.2																F4

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-51-2015	**Date Reported**	10/12/2015	**District**	Bismarck
County	TOWNER	**Submitted By**	Naumann	**Project Number**	NH-3-281(118)190
		AASHTO Test Method	T-99	**PCN**	20683

Comments

Lab Number	1473	1472	1471	1470
Reference Pt + Feet	191+3290	191+3429	191+3457	191+3483
Distance From CenterLine (Ft.)	Lt 8 SB	Lt 8 SB	Lt 8 SB	Lt 8 SB
Depth, Ft.	0.5 - 10.0	0.6 - 10.0	0.7 - 10.0	0.6 - 10.0
Field Sample No.	1473	1472	1471	1470
% Pass. 3/8" Sieve	100	100	100	94
% Pass. No. 4 Sieve	100	99	98	89
% Pass. No. 10 Sieve	99	97	94	82
% Coarse Sand (-No. 10 + No. 40)	3	7	12	21
% Fine Sand (-No. 40 + No. 200)	4	8	12	31
% Silt (0.074 - 0.005 mm)	68	58	49	18
% Clay (-0.005 mm)	25	24	22	12
Liquid Limit (-No. 40)	46	67	31	24
Plasticity Index (-No. 40)	15	35	9	4
Plastic Limit	32	32	22	20
Soil Color	BRN	BRN	BRN	BRN
Textural Class	SLTY CLY LM	SLTY CLY LM	CLY LM	SNDY LM
Soil Class (AASHTO M-145)	A-7-5(17)	A-7-5(33)	A-4(5)	A-2-4(0)
Frost Class	F4	F3	F4	F3
Optimum Moisture (%)	17.3	18.8	15.7	11.1
Maximum Dry Density (pcf)	107.8	103.4	109.5	121.7
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 6.6	2 | 7.9	2 | 8.7	2 | 11.2
	3 | 29.9	3 | 17.0	3 | 16.0	3 | 12.3
	4 | 32.7	4 | 29.3	4 | 22.8	4 | 19.9
	5 | 24.8	5 | 28.8	5 | 24.4	5 | 14.5
	6 | 30.2	6 | 26.7	6 | 21.2	6 | 12.1
	7 | 33.2	7 | 26.8	7 | 30.7	7 | 22.8
	8 | 31.7	8 | 35.3	8 | 31.0	8 | 10.7
	9 | 20.5	9 | 35.0	9 | 25.1	9 | 8.2
	10 | 25.3	10 | 34.2	10 | 36.2	10 | 10.9
Avg. Moisture of Sample Depth	26.1	26.7	24.0	13.7

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 11/12/2015

Linear Laboratory Analysis

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

Report Number	SS-51-2015	**Date Reported**	10/12/2015	**District**	Bismarck
County	TOWNER	**Submitted By**	Naumann	**Project Number**	NH-3-281(118)190
		AASHTO Test Method	T-99	**PCN**	20683

Comments

Lab Number	1468	1469	1474	1475
Reference Pt + Feet	191+3575	191+3575	193+1475	193+1621
Distance From CenterLine (Ft.)	Lt 8 SB	Lt 8 SB	Lt 8 SB	Lt 8 SB
Depth, Ft.	0.5 - 7.0	7.0 - 10.0	0.5 - 10.0	0.5 - 8.5
Field Sample No.	1468	1469	1474	1475
% Pass. 3/8" Sieve	100	94	100	100
% Pass. No. 4 Sieve	97	90	100	98
% Pass. No. 10 Sieve	94	82	100	94
% Coarse Sand (-No. 10 + No. 40)	9	15	2	6
% Fine Sand (-No. 40 + No. 200)	14	31	15	40
% Silt (0.074 - 0.005 mm)	54	21	59	31
% Clay (-0.005 mm)	16	14	24	18
Liquid Limit (-No. 40)	28	29	49	29
Plasticity Index (-No. 40)	5	11	17	3
Plastic Limit	23	18	32	26
Soil Color	BRN	BRN	BRN/BLK	BRN/BLK
Textural Class	SLTY LM	SNDY LM	SLTY CLY LM	SNDY LM
Soil Class (AASHTO M-145)	A-4(2)	A-2-4(0)	A-7-5(17)	A-4(0)
Frost Class	F4	F3	F4	F3
Optimum Moisture (%)	12.5	10.9	17.9	14.5
Maximum Dry Density (pcf)	117.3	124.1	106.0	113.3
% Organic Content				

Depth (Ft.)	**Moisture (%)**	**Depth (Ft.)**	**Moisture (%)**	**Depth (Ft.)**	**Moisture (%)**	**Depth (Ft.)**	**Moisture (%)**
2	10.7	8	9.8	2	11.8	2	12.4
3	15.9	9	7.6	3	14.3	3	12.2
4	29.6	10	17.2	4	18.0	4	15.7
5	33.3	11.5		5	16.8	5	15.9
6	18.3			6	25.7	6	27.2
7	16.4			7	36.8	7	34.1
Avg. Moisture of Sample Depth	20.7			8	22.4	8	20.6
				9	37.3	9	13.8
				10	36.7	10	25.1
				24.4		19.7	

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 11/12/2015

Linear Laboratory Analysis

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

Report Number	SS-51-2015	**Date Reported**	10/12/2015	**District**	Bismarck
County	TOWNER	**Submitted By**	Naumann	**Project Number**	NH-3-281(118)190
		AASHTO Test Method	T-99	**PCN**	20683

Comments

Lab Number	1476	1477	1478	1479
Reference Pt + Feet	193+1635	193+1648	193+1748	197+0281
Distance From CenterLine (Ft.)	Lt 8 SB	Lt 8 SB	Lt 8 SB	Lt 8 SB
Depth, Ft.	0.5 - 10.0	0.5 - 10.0	0.5 - 10.0	0.6 - 10.0
Field Sample No.	1476	1477	1478	1479
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	99	99	100	99
% Pass. No. 10 Sieve	98	98	100	98
% Coarse Sand (-No. 10 + No. 40)	3	5	1	5
% Fine Sand (-No. 40 + No. 200)	47	41	19	27
% Silt (0.074 - 0.005 mm)	32	33	62	38
% Clay (-0.005 mm)	17	19	18	30
Liquid Limit (-No. 40)	32	32	39	28
Plasticity Index (-No. 40)	2	12	9	11
Plastic Limit	30	20	31	17
Soil Color	BRN/BLK	BRN	BRN	BRN/GRY/BLK
Textural Class	SNDY LM	LM	SLTY LM	CLY LM
Soil Class (AASHTO M-145)	A-4(0)	A-6(3)	A-4(8)	A-6(5)
Frost Class	F3	F4	F4	F4
Optimum Moisture (%)	14.2	13.8	16.6	22.1
Maximum Dry Density (pcf)	113.0	114.8	108.5	100.8
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 15.1	2 | 15.0	2 | 15.3	2 | 15.0
	3 | 14.5	3 | 14.5	3 | 12.6	3 | 12.4
	4 | 13.7	4 | 13.0	4 | 9.2	4 | 16.1
	5 | 14.5	5 | 8.3	5 | 16.4	5 | 17.2
	6 | 19.1	6 | 11.6	6 | 23.7	6 | 27.0
	7 | 14.4	7 | 11.7	7 | 21.6	7 | 30.4
	8 | 11.7	8 | 12.4	8 | 29.1	8 | 41.3
	9 | 28.1	9 | 33.2	9 | 31.3	9 | 38.9
	10 | 32.5	10 | 32.8	10 | 31.1	10 | 22.4
Avg. Moisture of Sample Depth	18.1	17.0	21.1	24.5

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-51-2015	**Date Reported**	10/12/2015	**District**	Bismarck
County	TOWNER	**Submitted By**	Naumann	**Project Number**	NH-3-281(118)190
		AASHTO Test Method	T-99	**PCN**	20683

Comments

Lab Number	1480	1481	1482	1483
Reference Pt + Feet	197+0307	197+0307	197+0338	197+0338
Distance From CenterLine (Ft.)	Lt 8 SB	Lt 8 SB	Lt 8 SB	Lt 8 SB
Depth, Ft.	0.7 - 7.5	7.5 - 10.0	0.5 - 6.5	6.5 - 10.0
Field Sample No.	1480	1481	1482	1483
% Pass. 3/8" Sieve	100	99	100	100
% Pass. No. 4 Sieve	99	91	99	100
% Pass. No. 10 Sieve	94	81	97	99
% Coarse Sand (-No. 10 + No. 40)	13	18	9	7
% Fine Sand (-No. 40 + No. 200)	32	30	35	36
% Silt (0.074 - 0.005 mm)	22	17	23	21
% Clay (-0.005 mm)	28	17	31	35
Liquid Limit (-No. 40)	24	32	34	51
Plasticity Index (-No. 40)	7	17	16	26
Plastic Limit	17	15	18	25
Soil Color	BRN/BLK	BRN	GRY	BLK/GRY
Textural Class	CLY LM	SNDY LM	CLY	CLY
Soil Class (AASHTO M-145)	A-4(1)	A-2-6(1)	A-6(5)	A-7-6(12)
Frost Class	F4	F3	F3	F3
Optimum Moisture (%)	14.2	11.9	17.8	19.3
Maximum Dry Density (pcf)	113.5	119.9	108.6	101.9
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 11.2	8 | 21.7	2 | 14.8	7 | 24.6
	3 | 15.9	9 | 15.3	3 | 12.5	8 | 20.9
	4 | 17.1	10 | 16.6	4 | 17.4	9 | 24.8
	5 | 16.6	17.9	5 | 18.6	10 | 21.2
	6 | 17.0		6 | 22.3	22.9
	7 | 18.0		17.1	
Avg. Moisture of Sample Depth	16.0			

Scott W. Wutzke, Testing Lab Supervisor
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Linear Laboratory Analysis

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

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County	TOWNER	**Submitted By**	Naumann	**Project Number**	NH-3-281(118)190
		AASHTO Test Method	T-99	**PCN**	20683

Comments

Lab Number	1484	1485	1486	1487
Reference Pt + Feet	199+1721	199+1758	199+1788	201+2462
Distance From CenterLine (Ft.)	Lt 8 SB	Lt 8 SB	Lt 8 SB	Rt 8 WB
Depth, Ft.	0.5 - 10.0	0.5 - 10.0	0.5 - 10.0	0.6 - 10.0
Field Sample No.	1484	1485	1486	1487
% Pass. 3/8" Sieve	100	99	100	100
% Pass. No. 4 Sieve	99	96	98	97
% Pass. No. 10 Sieve	95	92	95	92
% Coarse Sand (-No. 10 + No. 40)	14	16	13	10
% Fine Sand (-No. 40 + No. 200)	37	35	36	20
% Silt (0.074 - 0.005 mm)	16	18	21	28
% Clay (-0.005 mm)	28	23	26	34
Liquid Limit (-No. 40)	39	39	39	52
Plasticity Index (-No. 40)	17	21	19	24
Plastic Limit	22	18	20	27
Soil Color	BRN/GRY/BLK	BRN/GRY/BLK	BRN/BLK	BRN/GRY/BLK
Textural Class	SNDY CLY LM	SNDY CLY LM	SNDY CLY LM	CLY
Soil Class (AASHTO M-145)	A-6(4)	A-6(4)	A-6(5)	A-7-6(14)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	17.4	16.3	17.9	17.2
Maximum Dry Density (pcf)	106.8	133.0	104.9	107.3
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 17.1	2 | 17.4	2 | 18.6	2 | 16.2
	3 | 17.6	3 | 17.4	3 | 18.2	3 | 16.1
	4 | 15.6	4 | 19.8	4 | 18.1	4 | 11.7
	5 | 16.7	5 | 18.3	5 | 18.2	5 | 21.8
	6 | 22.9	6 | 18.2	6 | 19.8	6 | 29.7
	7 | 27.9	7 | 20.0	7 | 21.0	7 | 22.4
	8 | 21.0	8 | 20.1	8 | 41.4	8 | 27.9
	9 | 21.0	9 | 17.7	9 | 31.9	9 | 29.9
	10 | 24.5	10 | 18.5	10 | 24.4	10 | 30.6
Avg. Moisture of Sample Depth	20.4	18.6	23.5	22.9

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-51-2015	**Date Reported**	10/12/2015	**District**	Bismarck
County	TOWNER	**Submitted By**	Naumann	**Project Number**	NH-3-281(118)190
		AASHTO Test Method	T-99	**PCN**	20683

Comments

Lab Number	1488	1489	1490	1491
Reference Pt + Feet	201+2489	201+2520	202+0291	202+0291
Distance From CenterLine (Ft.)	Rt 8 WB	Rt 8 WB	Rt 8 WB	Rt 8 WB
Depth, Ft.	0.5 - 10.0	0.5 - 10.0	0.5 - 7.3	7.3 - 10.0
Field Sample No.	1488	1489	1490	1491
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	98	97	98	98
% Pass. No. 10 Sieve	95	90	95	94
% Coarse Sand (-No. 10 + No. 40)	10	13	8	10
% Fine Sand (-No. 40 + No. 200)	24	23	20	21
% Silt (0.074 - 0.005 mm)	28	24	34	23
% Clay (-0.005 mm)	32	29	34	41
Liquid Limit (-No. 40)	50	38	50	42
Plasticity Index (-No. 40)	29	20	28	25
Plastic Limit	22	18	22	18
Soil Color	BRN/GRY/BLK	BRN/BLK	BRN/GRY/BLK	BRN
Textural Class	CLY	CLY LM	CLY	CLY
Soil Class (AASHTO M-145)	A-7-6(15)	A-6(8)	A-7-6(17)	A-7-6(13)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	15.6	16.1	19.1	14.9
Maximum Dry Density (pcf)	111.4	110.5	101.8	113.5
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 14.4	2 | 16.3	2 | 17.9	8 | 25.2
	3 | 15.8	3 | 13.3	3 | 20.9	9 | 23.7
	4 | 13.8	4 | 13.9	4 | 25.9	10 | 23.4
	5 | 16.3	5 | 18.3	5 | 18.3	24.1
	6 | 16.5	6 | 22.1	6 | 34.6	
	7 | 18.6	7 | 18.7	7 | 30.7	
	8 | 32.2	8 | 20.8	24.8	
	9 | 22.3	9 | 24.9		
	10 | 42.8	10 | 42.2		
Avg. Moisture of Sample Depth	21.4	21.1		

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 11/12/2015

Linear Laboratory Analysis

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

Report Number	SS-51-2015	**Date Reported**	10/12/2015	**District**	Bismarck
County	TOWNER	**Submitted By**	Naumann	**Project Number**	NH-3-281(118)190
		AASHTO Test Method	T-99	**PCN**	20683

Comments

Lab Number	1492	1493	1494	1495
Reference Pt + Feet	202+0346	202+0346	202+0376	202+0376
Distance From CenterLine (Ft.)	Rt 8 WB	Rt 8 WB	Rt 8 WB	Rt 8 WB
Depth, Ft.	0.5 - 7.5	7.5 - 10.0	0.5 - 7.5	7.5 - 10.0
Field Sample No.	1492	1493	1494	1495
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	98	100	99	98
% Pass. No. 10 Sieve	92	98	92	93
% Coarse Sand (-No. 10 + No. 40)	13	5	12	9
% Fine Sand (-No. 40 + No. 200)	24	12	28	22
% Silt (0.074 - 0.005 mm)	25	42	23	28
% Clay (-0.005 mm)	30	39	30	35
Liquid Limit (-No. 40)	40	33	34	36
Plasticity Index (-No. 40)	21	16	16	18
Plastic Limit	18	17	18	17
Soil Color	BRN/GRY/BLK	BRN/GRY	BRN/GRY/BLK	BRN/GRY
Textural Class	CLY	CLY	CLY LM	CLY
Soil Class (AASHTO M-145)	A-6(9)	A-6(11)	A-6(5)	A-6(9)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	16.8	16.9	17.2	18.5
Maximum Dry Density (pcf)	108.9	110.8	107.0	105.6
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 18.0	8 | 21.8	2 | 16.8	8 | 32.3
	3 | 18.8	9 | 27.2	3 | 19.3	9 | 28.4
	4 | 31.4	10 | 26.7	4 | 19.1	10 | 28.1
	5 | 26.5	25.2	5 | 32.3	29.6
	6 | 21.5		6 | 40.9	
	7 | 25.8		7 | 32.7	
Avg. Moisture of Sample Depth	23.6		26.9	

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 11/12/2015

Linear Laboratory Analysis

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

Report Number	SS-51-2015	**Date Reported**	10/12/2015	**District**	Bismarck
County	TOWNER	**Submitted By**	Naumann	**Project Number**	NH-3-281(118)190
		AASHTO Test Method	T-99	**PCN**	20683

Comments

Lab Number	1500	1501	1498	1499
Reference Pt + Feet	202+1139	202+1139	202+1180	202+1180
Distance From CenterLine (Ft.)	Lt 8 EB	Lt 8 EB	Lt 8 EB	Lt 8 EB
Depth, Ft.	0.4 - 4.5	4.5 - 10.0	1.0 - 4.5	4.5 - 10.0
Field Sample No.	1500	1501	1498	1499
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	96	98	95	98
% Pass. No. 10 Sieve	91	93	88	91
% Coarse Sand (-No. 10 + No. 40)	15	9	14	12
% Fine Sand (-No. 40 + No. 200)	24	22	24	25
% Silt (0.074 - 0.005 mm)	26	31	28	32
% Clay (-0.005 mm)	26	32	22	23
Liquid Limit (-No. 40)	38	32	37	25
Plasticity Index (-No. 40)	15	16	14	10
Plastic Limit	23	15	23	15
Soil Color	BRN/BLK	BRN/BLK	BRN/GRY/BLK	BRN/GRY
Textural Class	CLY LM	CLY	SNDY CLY LM	CLY LM
Soil Class (AASHTO M-145)	A-6(5)	A-6(7)	A-6(4)	A-4(2)
Frost Class	F3	F3	F3	F4
Optimum Moisture (%)	17.5	13.2	17.2	12.8
Maximum Dry Density (pcf)	106.2	117.7	107.6	118.3
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 11.2	5 | 25.7	2 | 22.1	5 | 28.3
	3 | 27.5	6 | 22.9	3 | 27.4	6 | 20.4
	4 | 23.7	7 | 23.3	4 | 20.3	7 | 16.9
Avg. Moisture of Sample Depth	20.8	8 | 23.2	23.3	8 | 36.3
		9 | 20.9		9 | 21.3
		10 | 15.9		10 | 21.0
		22.0		24.1

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 11/12/2015

Linear Laboratory Analysis

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

Report Number	SS-51-2015	**Date Reported**	10/12/2015	**District**	Bismarck
County	TOWNER	**Submitted By**	Naumann	**Project Number**	NH-3-281(118)190
		AASHTO Test Method	T-99	**PCN**	20683

Comments

Lab Number	1496	1497
Reference Pt + Feet	202+1215	202+1215
Distance From CenterLine (Ft.)	Rt 8 WB	Rt 8 WB
Depth, Ft.	1.4 - 7.5	7.5 - 10.0
Field Sample No.	1496	1497
% Pass. 3/8" Sieve	100	100
% Pass. No. 4 Sieve	95	99
% Pass. No. 10 Sieve	87	93
% Coarse Sand (-No. 10 + No. 40)	16	16
% Fine Sand (-No. 40 + No. 200)	22	25
% Silt (0.074 - 0.005 mm)	25	32
% Clay (-0.005 mm)	25	20
Liquid Limit (-No. 40)	32	21
Plasticity Index (-No. 40)	12	8
Plastic Limit	20	13
Soil Color	BRN	BRN/GRY/BLK
Textural Class	SNDY CLY LM	LM
Soil Class (AASHTO M-145)	A-6(3)	A-4(1)
Frost Class	F3	F4
Optimum Moisture (%)	16.6	12.0
Maximum Dry Density (pcf)	108.4	121.6
% Organic Content		

Depth (Ft.)	**Moisture (%)**		**Depth (Ft.)**	**Moisture (%)**
2	5.8		8	16.6
3	16.7		9	13.8
4	18.4		10	13.2
5	30.5			14.5
6	20.8			
7	14.8			
Avg. Moisture of Sample Depth	17.8			

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 11/12/2015

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1468**

Density

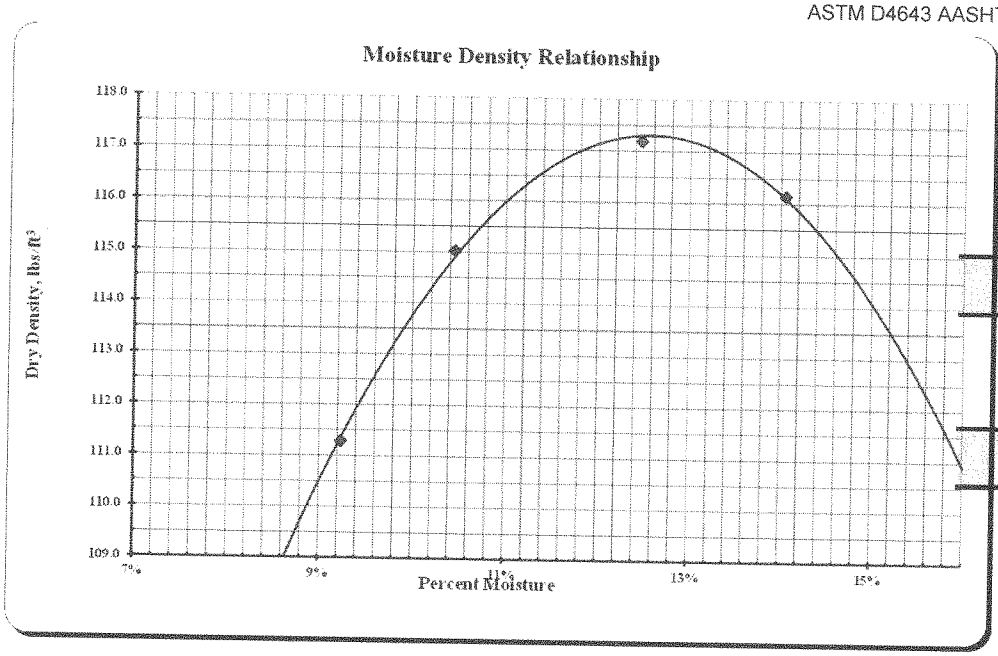
		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.43	8.61	8.77	8.79		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.04	4.22	4.38	4.40		
E Wet Density = D / A	lbs./cu.ft.	121.6	127.0	131.8	132.5		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**111.3**	**115.0**	**117.2**	**116.1**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		1	2	3	4		
G Wet Weight / Container	grams	159.6	152.5	163.4	162.5		
H Dry Weight / Container	grams	149.2	141.6	149.4	147.0		
I Moisture Loss = G - H	grams	10.4	10.9	14.0	15.5		
J Tare Weight of Container	grams	36.6	37.3	37.1	36.7		
K Dry Soil = H - J	grams	112.6	104.3	112.3	110.3		
L %Moisture = (I / K) x 100	%	**9.2%**	**10.5%**	**12.5%**	**14.1%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

117.3 lbs./cu.ft.

Optimum Moisture

12.5%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-99	**11/4/2015**		**1469**

Density

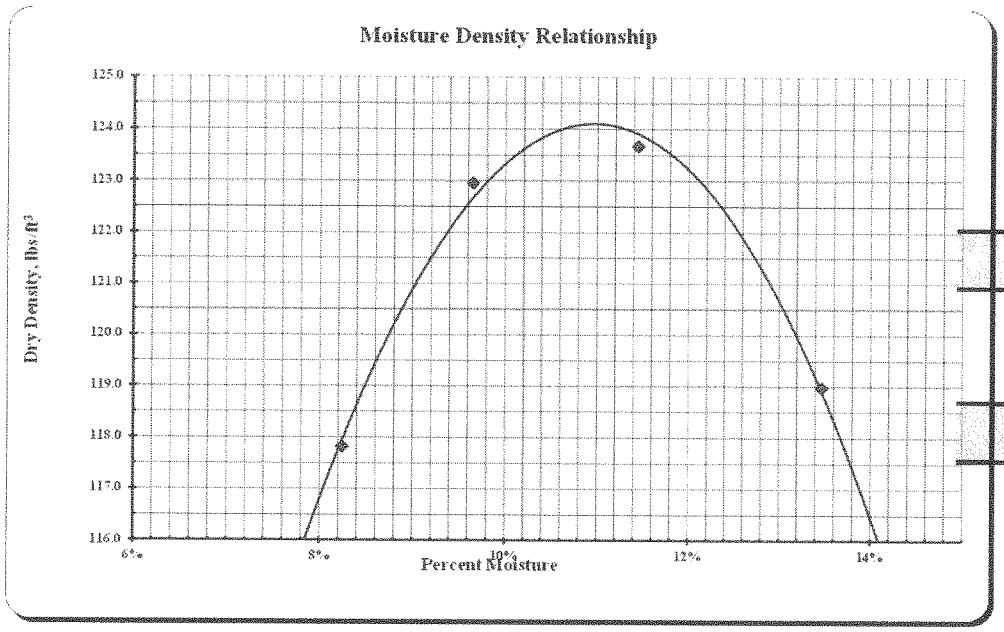
	Test Count	4				
Determination No.	1	2	3	4	5	6
A Volume of Mold cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
lbs.	8.63	8.87	8.97	8.88		
C Weight of Mold lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C lbs.	4.23	4.48	4.58	4.48		
E Wet Density = D / A lbs./cu.ft.	127.5	134.8	137.8	135.0		
F Dry Density = (E x 100) / (100 + L) lbs./cu.ft.	**117.8**	**123.0**	**123.7**	**119.0**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.	5	6	7	8		
G Wet Weight / Container grams	155.3	153.0	158.0	160.0		
H Dry Weight / Container grams	146.3	142.8	145.5	145.4		
I Moisture Loss = G - H grams	9.0	10.2	12.5	14.6		
J Tare Weight of Container grams	37.1	37.1	36.3	37.0		
K Dry Soil = H - J grams	109.2	105.7	109.2	108.4		
L %Moisture = (I / K) x 100 %	**8.2%**	**9.6%**	**11.4%**	**13.5%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

124.1 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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation: T-99	Date: 11/4/2015		

Density

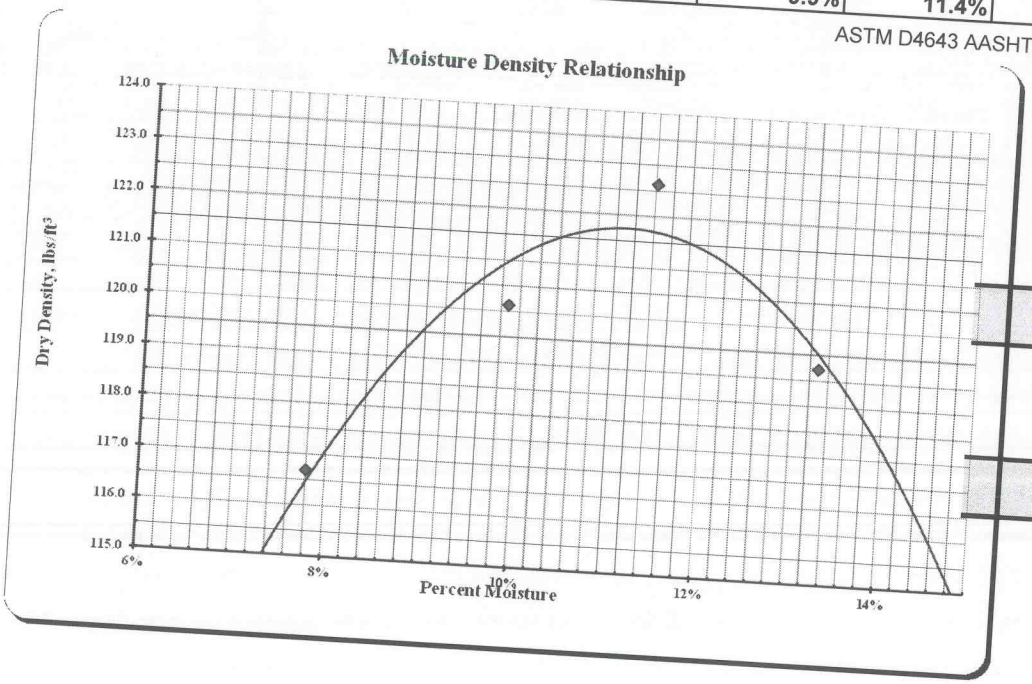
	Test Count	4		1470			
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
C Weight of Mold	lbs.	8.57	8.78	8.93	8.88		
D Weight of Compacted Soil = B - C	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
E Wet Density = D / A	lbs./cu.ft.	4.18	4.38	4.54	4.48		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	125.8	132.0	136.6	135.1		
		116.7	**120.1**	**122.6**	**119.2**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		9	10	11	12		
G Wet Weight / Container	grams	153.3	145.7	149.4	155.4		
H Dry Weight / Container	grams	144.9	135.9	137.9	141.5		
I Moisture Loss = G - H	grams	8.4	9.8	11.5	13.9		
J Tare Weight of Container	grams	37.2	36.7	37.2	36.9		
K Dry Soil = H - J	grams	107.7	99.2	100.7	104.6		
L %Moisture = (I / K) x 100	%	**7.8%**	**9.9%**	**11.4%**	**13.3%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

121.7 lbs./cu.ft.

Optimum Moisture

11.1%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1471**

Density

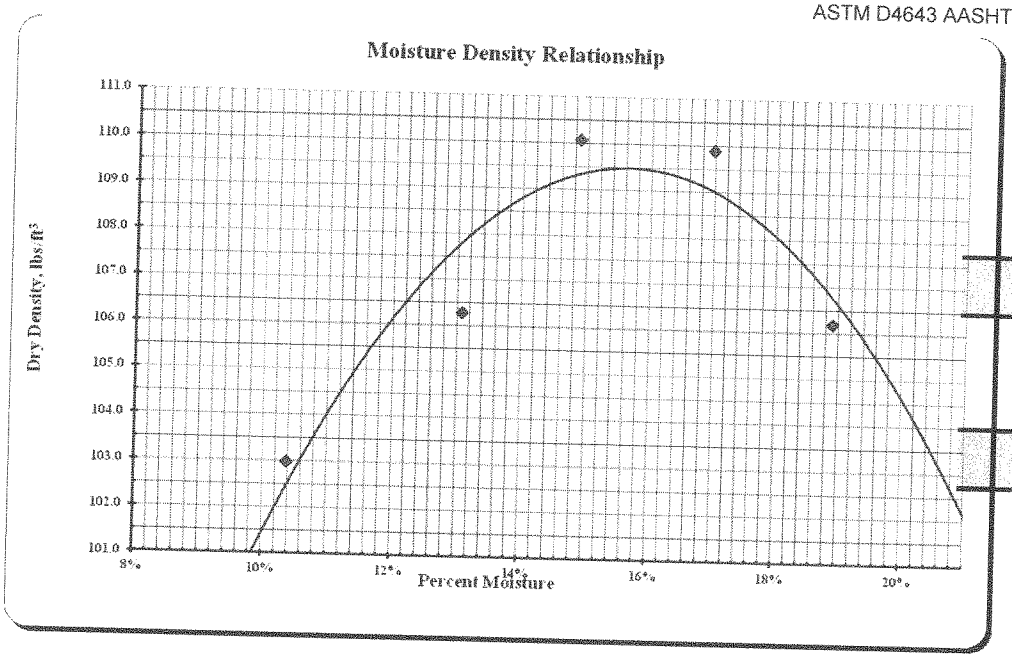
		Test Count	5				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.17	8.39	8.59	8.66	8.59	
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.77	3.99	4.20	4.27	4.19	
E Wet Density = D / A	lbs./cu.ft.	113.7	120.2	126.4	128.6	126.3	
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**103.0**	**106.3**	**110.1**	**109.9**	**106.2**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		13	14	15	16	17	
G Wet Weight / Container	grams	144.5	145.1	146.2	148.1	145.6	
H Dry Weight / Container	grams	134.4	132.7	132.1	132.0	128.3	
I Moisture Loss = G - H	grams	10.1	12.4	14.1	16.1	17.3	
J Tare Weight of Container	grams	37.1	37.9	37.3	37.2	36.8	
K Dry Soil = H - J	grams	97.3	94.8	94.8	94.8	91.5	
L %Moisture = (I / K) x 100	%	**10.4%**	**13.1%**	**14.9%**	**17.0%**	**18.9%**	

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

109.5 lbs./cu.ft.

Optimum Moisture

15.7%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1472**

Density

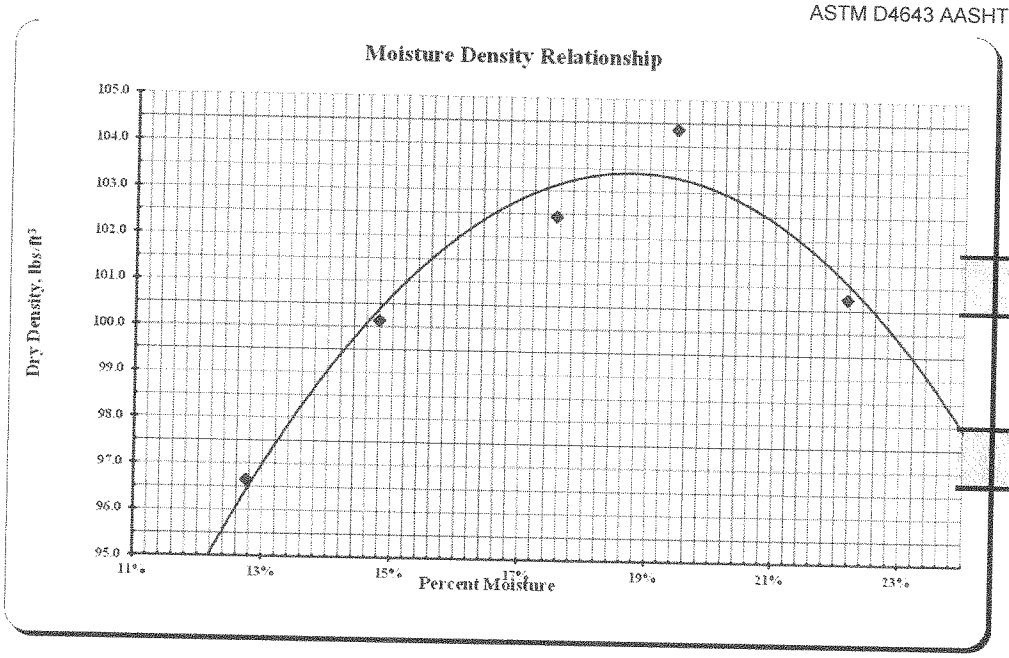
		Test Count	5				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.01	8.21	8.39	8.53	8.48	
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.62	3.82	4.00	4.14	4.09	
E Wet Density = D / A	lbs./cu.ft.	109.0	114.9	120.4	124.6	123.1	
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**96.7**	**100.1**	**102.4**	**104.4**	**100.7**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		18	19	20	21	22	
G Wet Weight / Container	grams	143.2	147.3	143.7	159.4	155.5	
H Dry Weight / Container	grams	131.2	133.1	127.7	139.5	134.0	
I Moisture Loss = G - H	grams	12.0	14.2	16.0	19.9	21.5	
J Tare Weight of Container	grams	37.1	37.1	36.5	37.1	37.0	
K Dry Soil = H - J	grams	94.1	96.0	91.2	102.4	97.0	
L %Moisture = (I / K) x 100	%	**12.8%**	**14.8%**	**17.5%**	**19.4%**	**22.2%**	

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

103.4 lbs./cu.ft.

Optimum Moisture

18.8%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1473**

Density

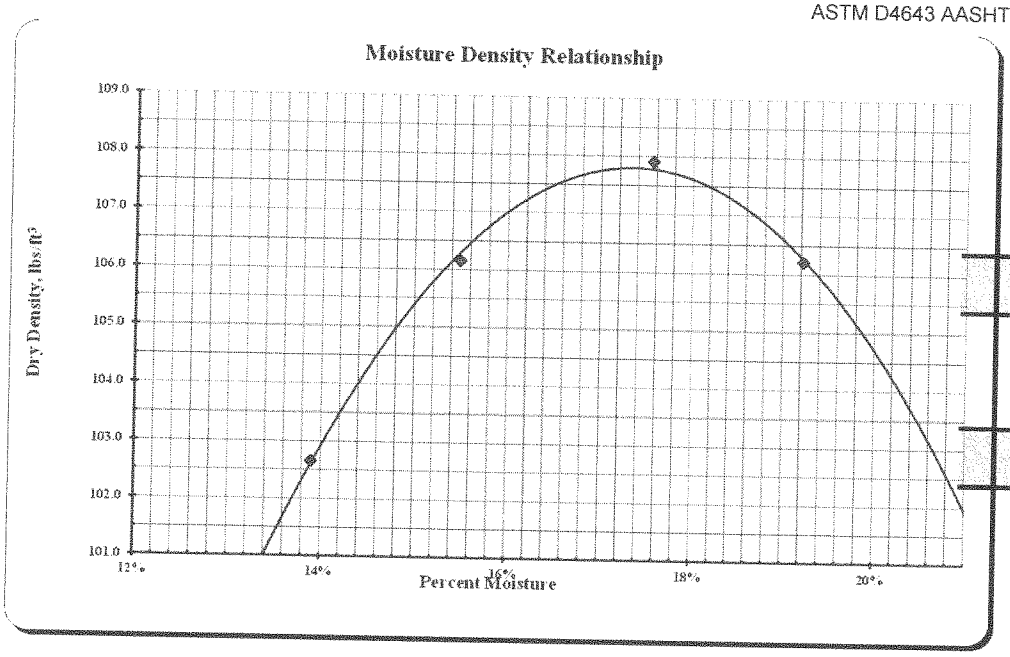
		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.28	8.47	8.61	8.60		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.88	4.07	4.21	4.20		
E Wet Density = D / A	lbs./cu.ft.	116.9	122.6	126.9	126.6		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**102.7**	**106.2**	**107.9**	**106.2**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		23	24	25	26		
G Wet Weight / Container	grams	146.4	151.3	155.0	156.0		
H Dry Weight / Container	grams	133.1	136.0	137.4	136.8		
I Moisture Loss = G - H	grams	13.3	15.3	17.6	19.2		
J Tare Weight of Container	grams	37.4	37.2	37.2	36.9		
K Dry Soil = H - J	grams	95.7	98.8	100.2	99.9		
L %Moisture = (I / K) x 100	%	**13.9%**	**15.5%**	**17.6%**	**19.2%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

107.8 lbs./cu.ft.

Optimum Moisture

17.3%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1474**

Density

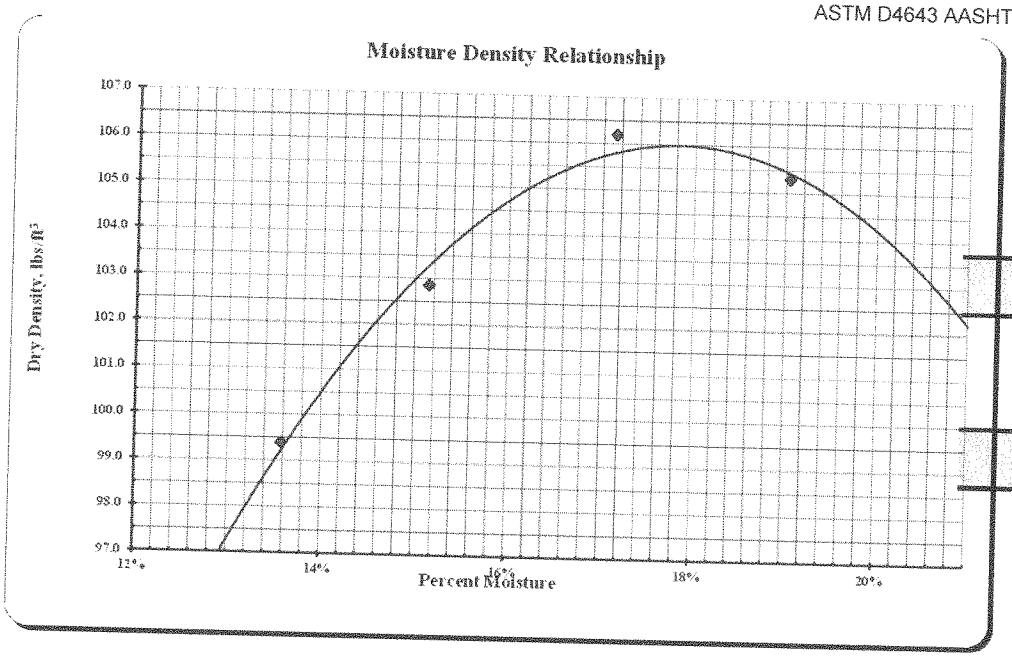
	Test Count	4					
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.14	8.33	8.53	8.56		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.75	3.93	4.13	4.16		
E Wet Density = D / A	lbs./cu.ft.	112.9	118.4	124.4	125.4		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**99.4**	**102.9**	**106.2**	**105.3**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.	27	28	29	30		
G Wet Weight / Container	grams	149.6	152.0	152.0	151.5		
H Dry Weight / Container	grams	136.1	136.9	135.2	133.2		
I Moisture Loss = G - H	grams	13.5	15.1	16.8	18.3		
J Tare Weight of Container	grams	36.7	37.2	37.2	37.1		
K Dry Soil = H - J	grams	99.4	99.7	98.0	96.1		
L %Moisture = (I / K) x 100	%	**13.6%**	**15.1%**	**17.1%**	**19.0%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

106.0 lbs./cu.ft.

Optimum Moisture

17.9%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1475**

Density

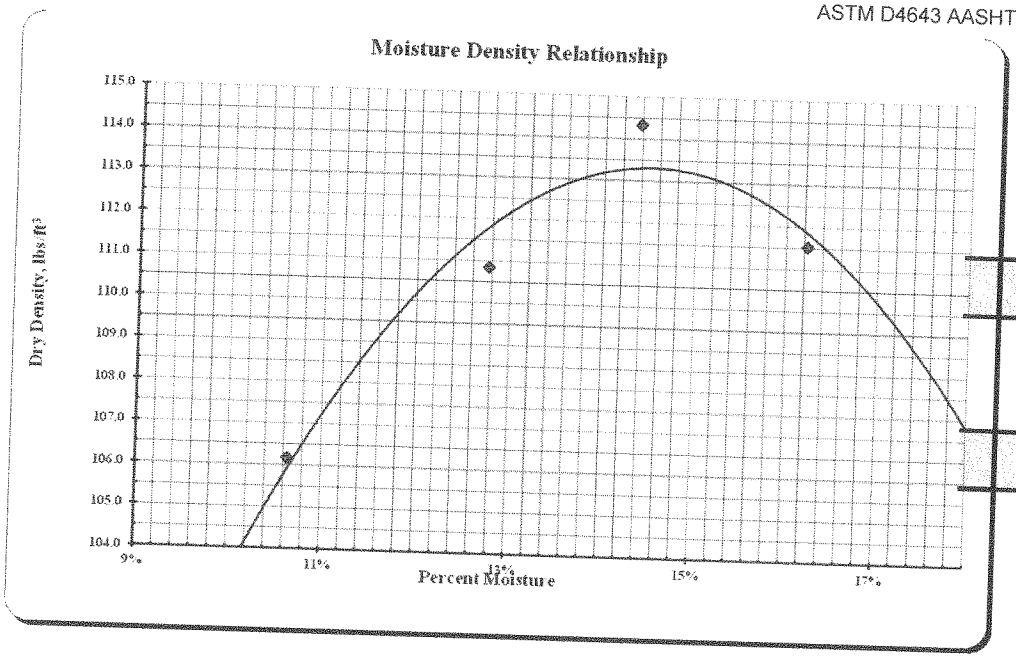
		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.30	8.55	8.74	8.70		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.90	4.15	4.34	4.30		
E Wet Density = D / A	lbs./cu.ft.	117.5	125.0	130.8	129.6		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**106.2**	**110.8**	**114.3**	**111.5**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		31	32	33	34		
G Wet Weight / Container	grams	142.0	151.7	149.2	158.3		
H Dry Weight / Container	grams	131.9	138.7	135.1	141.5		
I Moisture Loss = G - H	grams	10.1	13.0	14.1	16.8		
J Tare Weight of Container	grams	37.0	36.9	37.1	38.0		
K Dry Soil = H - J	grams	94.9	101.8	98.0	103.5		
L %Moisture = (I / K) x 100	%	**10.6%**	**12.8%**	**14.4%**	**16.2%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

113.3 lbs./cu.ft.

Optimum Moisture

14.5%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-99	**11/4/2015**		**1476**

Density

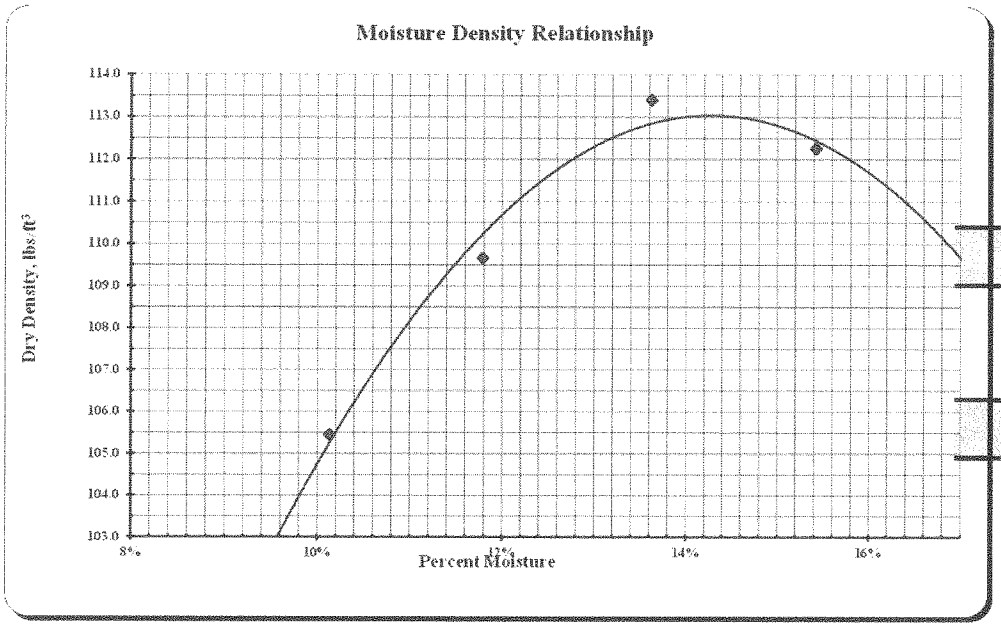
			Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
		lbs.	8.25	8.47	8.67	8.70		
C	Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C	lbs.	3.86	4.07	4.28	4.30		
E	Wet Density = D / A	lbs./cu.ft.	116.1	122.6	128.9	129.6		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**105.5**	**109.7**	**113.4**	**112.3**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		35	36	37	38		
G	Wet Weight / Container	grams	145.1	143.4	143.2	149.9		
H	Dry Weight / Container	grams	135.2	132.2	130.5	134.8		
I	Moisture Loss = G - H	grams	9.9	11.2	12.7	15.1		
J	Tare Weight of Container	grams	37.5	37.2	37.3	36.9		
K	Dry Soil = H - J	grams	97.7	95.0	93.2	97.9		
L	%Moisture = (I / K) x 100	%	**10.1%**	**11.8%**	**13.6%**	**15.4%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

113.0 lbs./cu.ft.

Optimum Moisture

14.2%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation: T-99	Date: 11/4/2015		1477

Density

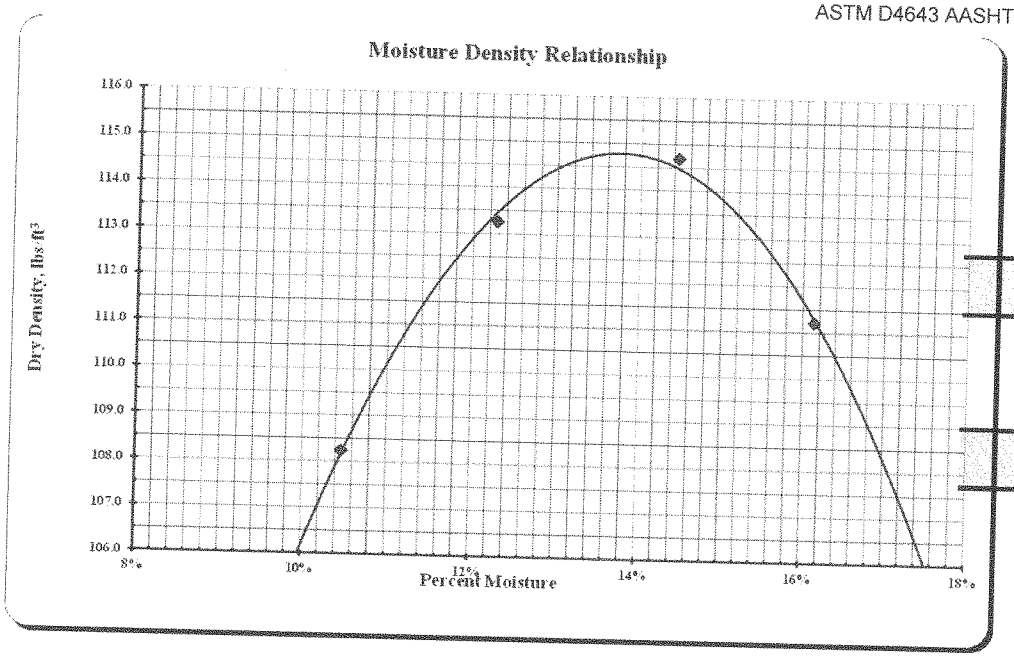
		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.37	8.62	8.75	8.68		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.97	4.22	4.36	4.29		
E Wet Density = D / A	lbs./cu.ft.	119.6	127.2	131.3	129.2		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**108.2**	**113.3**	**114.7**	**111.2**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		39	40	41	42		
G Wet Weight / Container	grams	148.3	146.8	146.5	153.3		
H Dry Weight / Container	grams	137.8	134.8	132.7	137.1		
I Moisture Loss = G - H	grams	10.5	12.0	13.8	16.2		
J Tare Weight of Container	grams	37.5	37.1	37.2	36.7		
K Dry Soil = H - J	grams	100.3	97.7	95.5	100.4		
L %Moisture = (I / K) x 100	%	**10.5%**	**12.3%**	**14.5%**	**16.1%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

114.8 lbs./cu.ft.

Optimum Moisture

13.8%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1478**

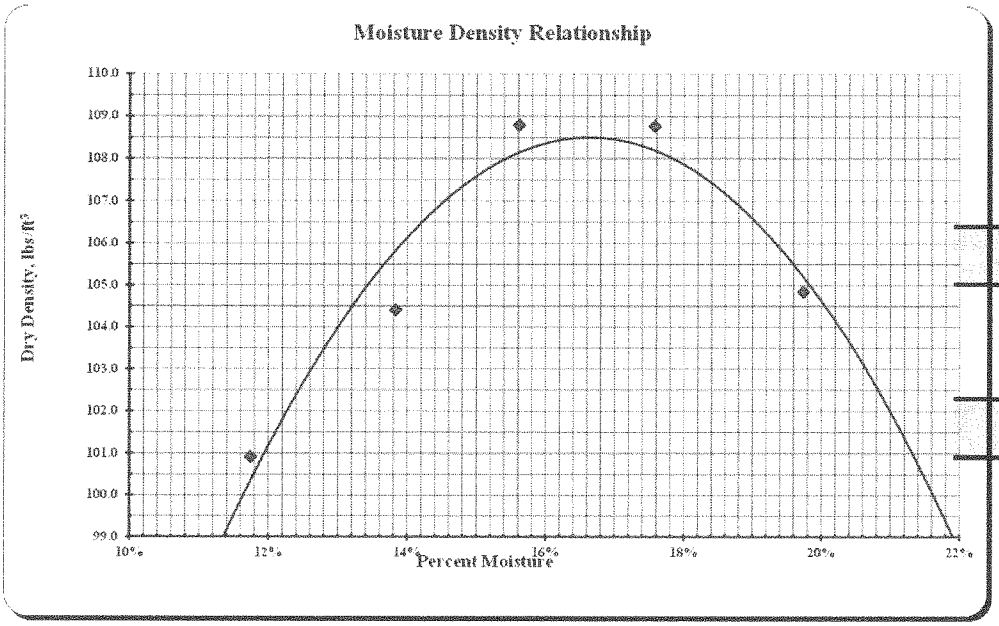
Density		Test Count	5				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.14	8.34	8.57	8.64	8.56	
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.74	3.95	4.18	4.25	4.17	
E Wet Density = D / A	lbs./cu.ft.	112.8	118.9	125.8	127.9	125.5	
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**100.9**	**104.4**	**108.8**	**108.8**	**104.8**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		43	44	45	46	47	
G Wet Weight / Container	grams	142.6	141.5	145.7	157.5	156.5	
H Dry Weight / Container	grams	131.5	128.8	131.1	139.5	136.8	
I Moisture Loss = G - H	grams	11.1	12.7	14.6	18.0	19.7	
J Tare Weight of Container	grams	37.0	37.0	37.6	37.1	37.0	
K Dry Soil = H - J	grams	94.5	91.8	93.5	102.4	99.8	
L %Moisture = (I / K) x 100	%	**11.7%**	**13.8%**	**15.6%**	**17.6%**	**19.7%**	

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

108.5 lbs./cu.ft.

Optimum Moisture

16.6%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-99	**11/4/2015**		**1479**

Density

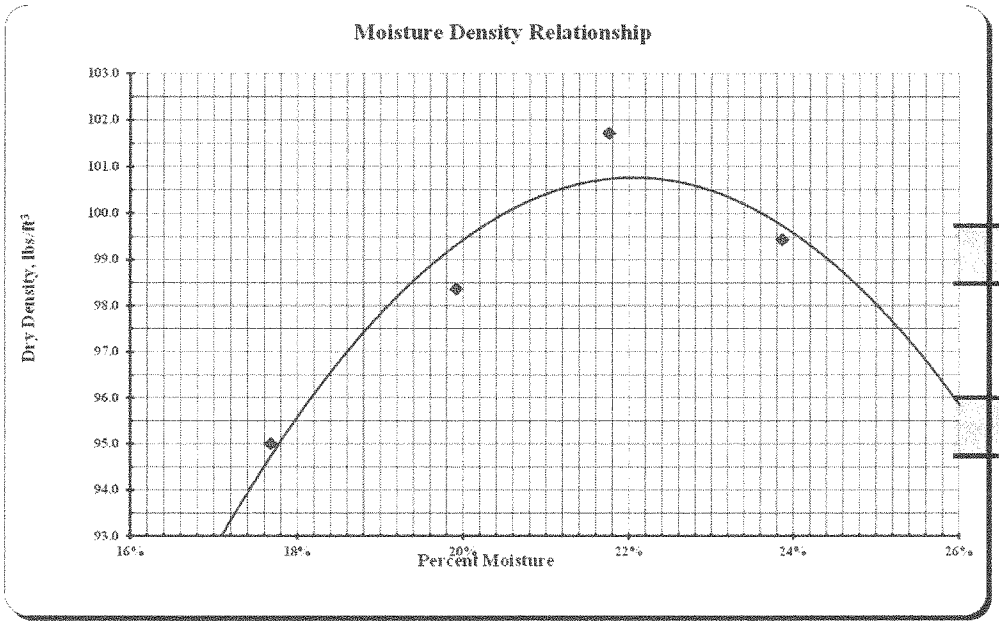
			Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
		lbs.	8.11	8.31	8.51	8.49		
C	Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C	lbs.	3.71	3.92	4.11	4.09		
E	Wet Density = D / A	lbs./cu.ft.	111.8	118.0	123.9	123.2		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**95.0**	**98.4**	**101.7**	**99.4**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		89	90	91	92		
G	Wet Weight / Container	grams	161.4	148.1	160.7	151.6		
H	Dry Weight / Container	grams	142.8	129.8	138.7	129.6		
I	Moisture Loss = G - H	grams	18.6	18.3	22.0	22.0		
J	Tare Weight of Container	grams	37.6	37.9	37.6	37.4		
K	Dry Soil = H - J	grams	105.2	91.9	101.1	92.2		
L	%Moisture = (I / K) x 100	%	**17.7%**	**19.9%**	**21.8%**	**23.9%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

100.8 lbs./cu.ft.

Optimum Moisture

22.1%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-99	**11/4/2015**		**1480**

Density

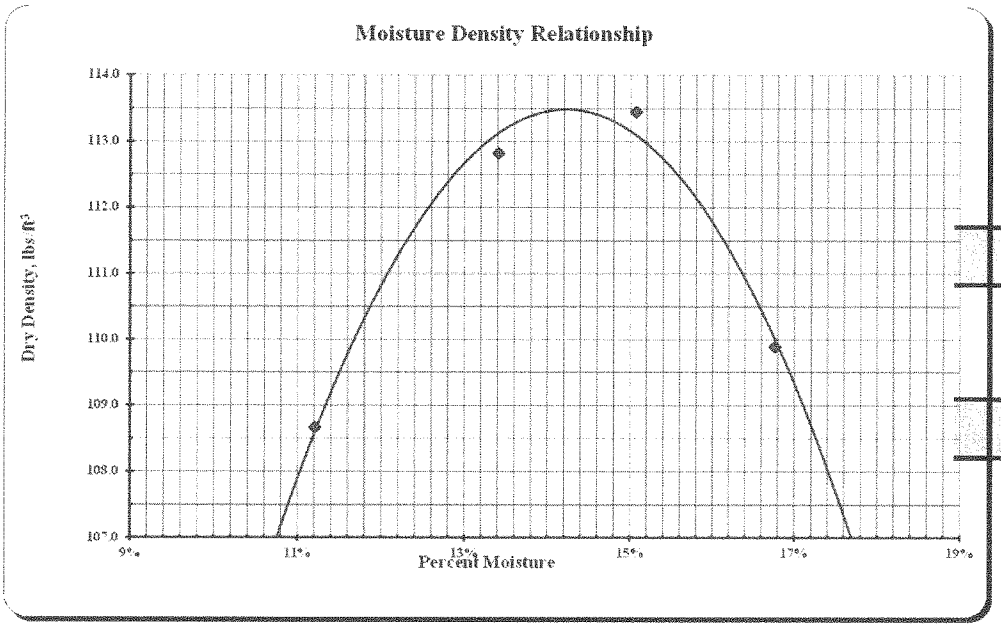
			Test Count	4				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
		lbs.	8.41	8.65	8.73	8.66		
C	Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C	lbs.	4.01	4.25	4.33	4.26		
E	Wet Density = D / A	lbs./cu.ft.	120.8	128.0	130.5	128.3		
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**108.7**	**112.8**	**113.4**	**109.9**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		93	94	95	96		
G	Wet Weight / Container	grams	154.7	167.1	146.7	220.4		
H	Dry Weight / Container	grams	142.9	151.8	132.4	194.1		
I	Moisture Loss = G - H	grams	11.8	15.3	14.3	26.3		
J	Tare Weight of Container	grams	37.6	37.7	37.5	37.2		
K	Dry Soil = H - J	grams	105.3	114.1	94.9	156.9		
L	%Moisture = (I / K) x 100	%	**11.2%**	**13.4%**	**15.1%**	**16.8%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

113.5 lbs./cu.ft.

Optimum Moisture

14.2%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1481**

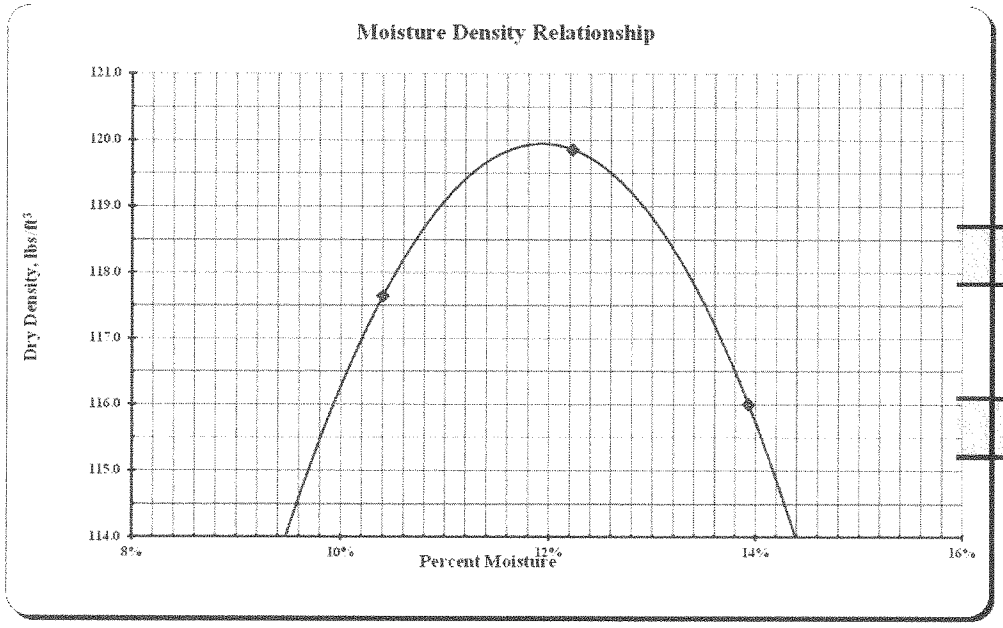
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.71	8.86	8.78			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.31	4.47	4.39			
E Wet Density = D / A	lbs./cu.ft.	129.9	134.5	132.2			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**117.6**	**119.9**	**116.0**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		48	49	50			
G Wet Weight / Container	grams	149.6	150.2	156.4			
H Dry Weight / Container	grams	139.0	137.9	141.8			
I Moisture Loss = G - H	grams	10.6	12.3	14.6			
J Tare Weight of Container	grams	37.1	37.3	37.0			
K Dry Soil = H - J	grams	101.9	100.6	104.8			
L %Moisture = (I / K) x 100	%	**10.4%**	**12.2%**	**13.9%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

119.9 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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1482**

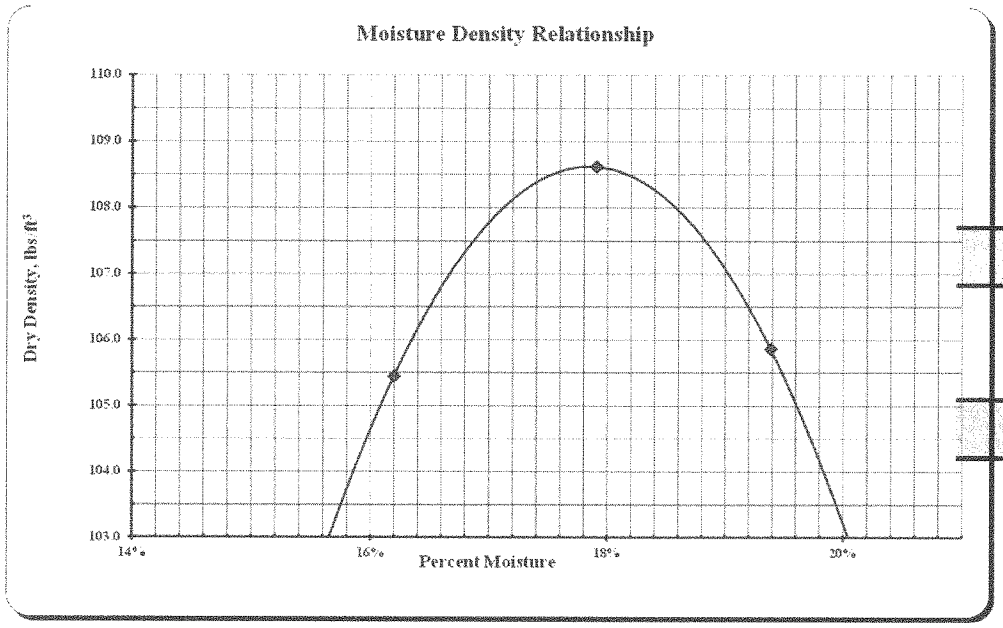
Density		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.46	8.65	8.59			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.07	4.25	4.20			
E Wet Density = D / A	lbs./cu.ft.	122.5	128.1	126.4			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**105.4**	**108.6**	**105.9**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		51	52	53			
G Wet Weight / Container	grams	140.5	151.2	173.2			
H Dry Weight / Container	grams	126.1	133.9	151.1			
I Moisture Loss = G - H	grams	14.4	17.3	22.1			
J Tare Weight of Container	grams	37.2	37.3	37.1			
K Dry Soil = H - J	grams	88.9	96.6	114.0			
L %Moisture = (I / K) x 100	%	**16.2%**	**17.9%**	**19.4%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

108.6 lbs./cu.ft.

Optimum Moisture

17.8%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-99	**11/4/2015**		**1483**

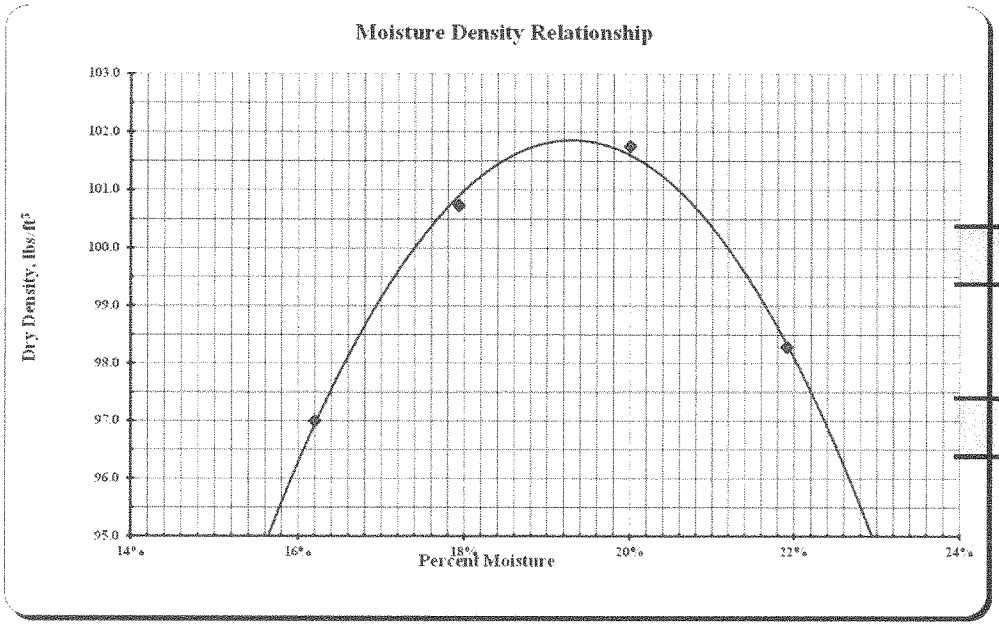
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.14	8.34	8.45	8.38		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.74	3.94	4.05	3.98		
E Wet Density = D / A	lbs./cu.ft.	112.7	118.8	122.1	119.8		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**97.0**	**100.7**	**101.8**	**98.3**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		97	98	99	100		
G Wet Weight / Container	grams	166.1	155.9	158.2	140.7		
H Dry Weight / Container	grams	148.2	137.9	138.1	122.1		
I Moisture Loss = G - H	grams	17.9	18.0	20.1	18.6		
J Tare Weight of Container	grams	37.7	37.5	37.6	37.2		
K Dry Soil = H - J	grams	110.5	100.4	100.5	84.9		
L %Moisture = (I / K) x 100	%	**16.2%**	**17.9%**	**20.0%**	**21.9%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

101.9 lbs./cu.ft.

Optimum Moisture

19.3%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-99	**11/4/2015**		**1484**

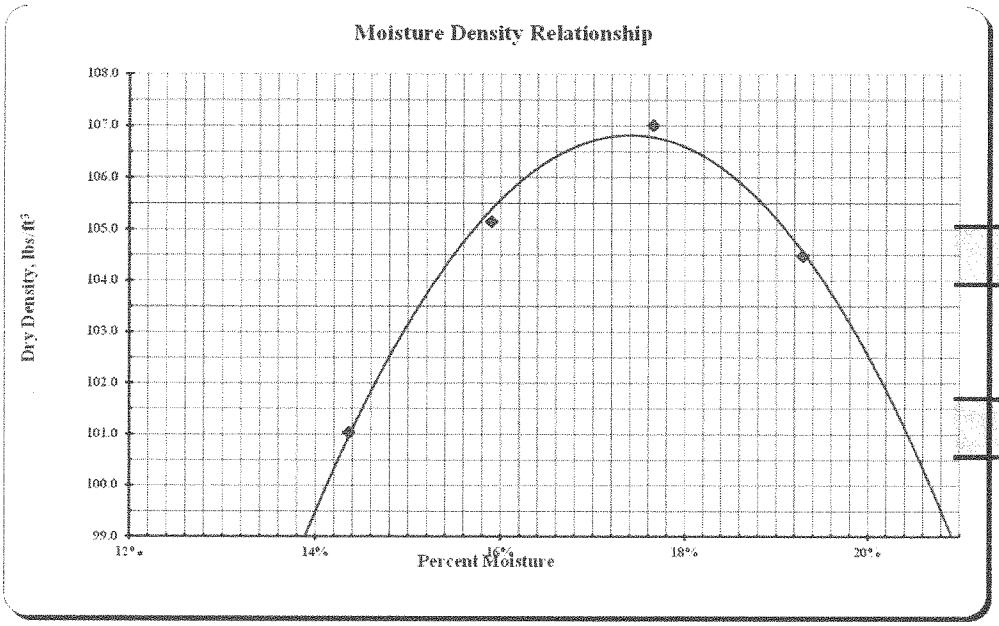
Density		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.23	8.44	8.58	8.53		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.84	4.05	4.18	4.14		
E Wet Density = D / A	lbs./cu.ft.	115.5	121.9	125.9	124.6		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**101.0**	**105.1**	**107.0**	**104.5**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		54	55	56	57		
G Wet Weight / Container	grams	148.5	145.2	142.6	148.0		
H Dry Weight / Container	grams	134.5	130.3	126.8	130.1		
I Moisture Loss = G - H	grams	14.0	14.9	15.8	17.9		
J Tare Weight of Container	grams	37.0	36.6	37.3	37.3		
K Dry Soil = H - J	grams	97.5	93.7	89.5	92.8		
L %Moisture = (I / K) x 100	%	**14.4%**	**15.9%**	**17.7%**	**19.3%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

106.8 lbs./cu.ft.

Optimum Moisture

17.4%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		

Density

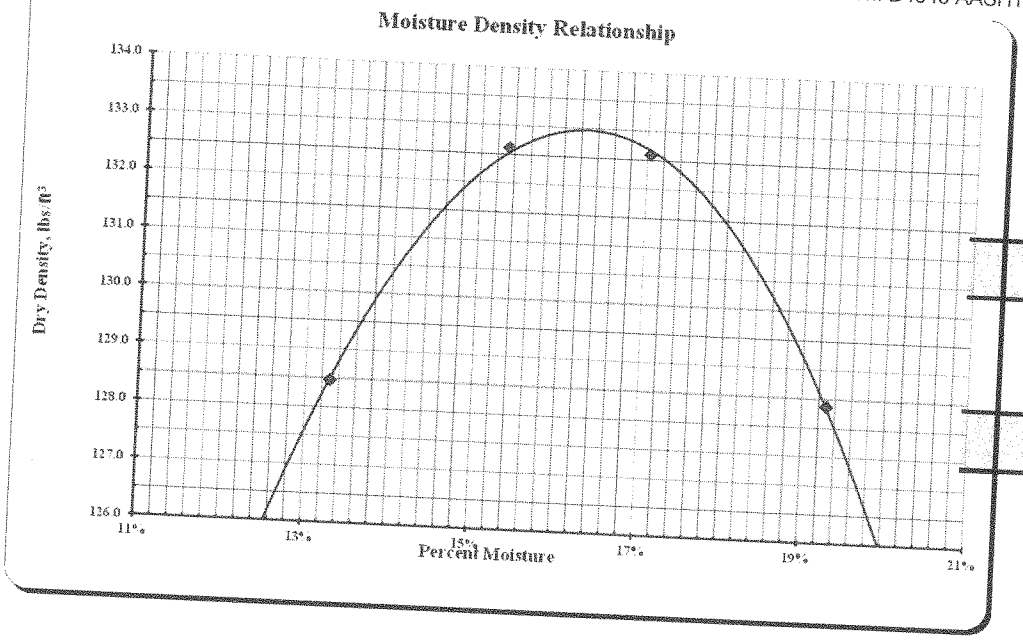
		Test Count	4		**1485**		
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.23	8.48	8.55	8.48		
C Weight of Mold	lbs.	3.40	3.40	3.40	3.40	3.40	3.40
D Weight of Compacted Soil = B - C	lbs.	4.83	5.08	5.15	5.08		
E Wet Density = D / A	lbs./cu.ft.	145.5	153.0	155.2	153.1		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**128.5**	**132.6**	**132.6**	**128.4**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		101	102	103	104		
G Wet Weight / Container	grams	166.3	166.3	164.3	155.3		
H Dry Weight / Container	grams	151.2	149.2	145.8	136.2		
I Moisture Loss = G - H	grams	15.1	17.1	18.5	19.1		
J Tare Weight of Container	grams	37.6	37.7	37.2	37.2		
K Dry Soil = H - J	grams	113.6	111.5	108.6	99.0		
L %Moisture = (I / K) x 100	%	**13.3%**	**15.3%**	**17.0%**	**19.3%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

133.0 lbs./cu.ft.

Optimum Moisture

16.3%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-99	**11/4/2015**		**1486**

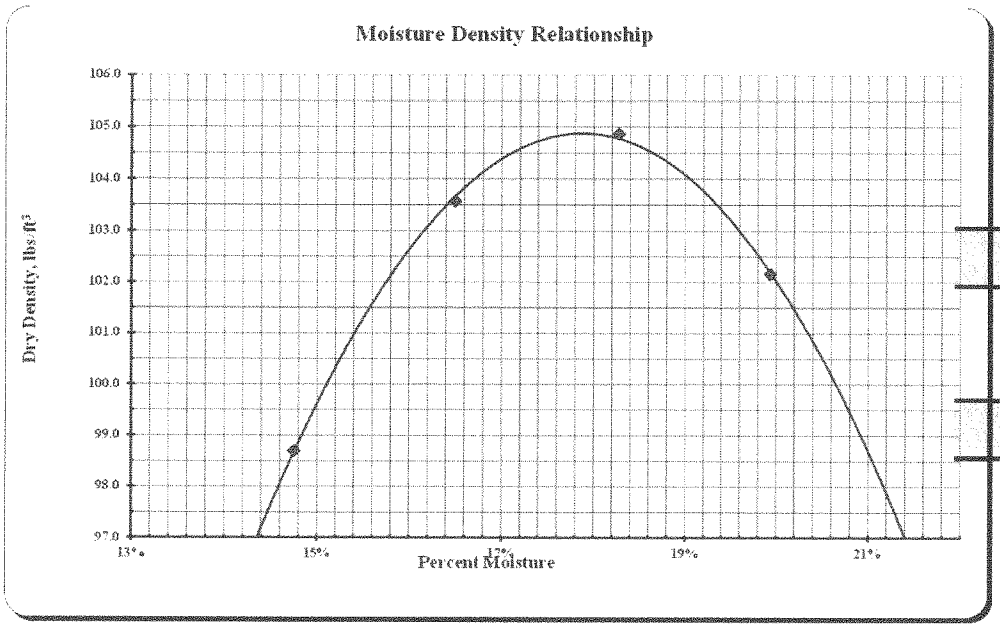
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.16	8.40	8.51	8.46		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.76	4.01	4.12	4.07		
E Wet Density = D / A	lbs./cu.ft.	113.3	120.7	124.0	122.5		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**98.7**	**103.6**	**104.9**	**102.2**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		58	59	60	61		
G Wet Weight / Container	grams	149.6	153.0	151.3	149.2		
H Dry Weight / Container	grams	135.1	136.6	133.7	130.6		
I Moisture Loss = G - H	grams	14.5	16.4	17.6	18.6		
J Tare Weight of Container	grams	36.8	37.2	37.4	37.3		
K Dry Soil = H - J	grams	98.3	99.4	96.3	93.3		
L %Moisture = (I / K) x 100	%	**14.8%**	**16.5%**	**18.3%**	**19.9%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

104.9 lbs./cu.ft.

Optimum Moisture

17.9%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1487**

Density

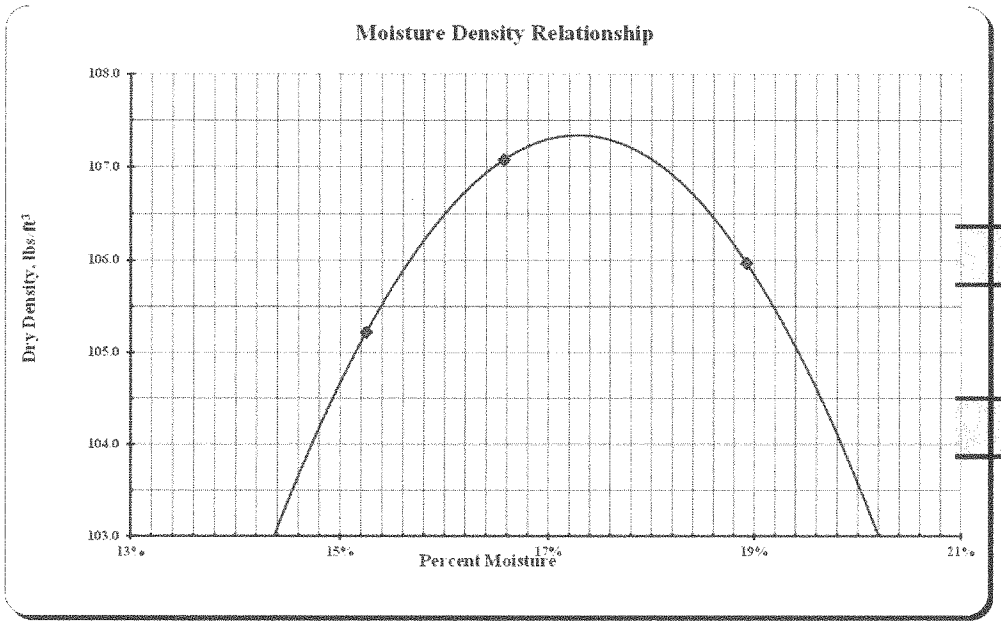
			Test Count	3				
	Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
		lbs.	8.42	8.54	8.58			
C	Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D	Weight of Compacted Soil = B - C	lbs.	4.03	4.14	4.18			
E	Wet Density = D / A	lbs./cu.ft.	121.3	124.8	126.0			
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**105.2**	**107.1**	**106.0**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.		62	63	64			
G	Wet Weight / Container	grams	141.9	156.2	152.3			
H	Dry Weight / Container	grams	128.1	139.3	134.0			
I	Moisture Loss = G - H	grams	13.8	16.9	18.3			
J	Tare Weight of Container	grams	37.6	37.3	37.3			
K	Dry Soil = H - J	grams	90.5	102.0	96.7			
L	%Moisture = (I / K) x 100	%	**15.2%**	**16.6%**	**18.9%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

107.3 lbs./cu.ft.

Optimum Moisture

17.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

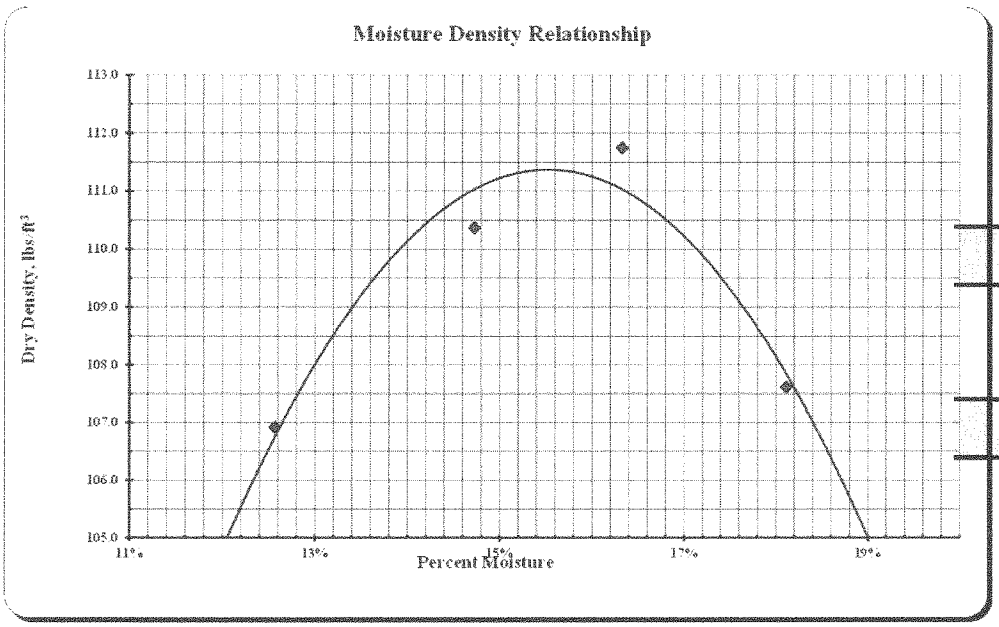
Project No.	PCN	Station	Depth Below Grade
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/5/2015**		**1488**

Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.39	8.60	8.71	8.62		
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.	4.00	4.20	4.32	4.22		
E Wet Density = D / A	lbs./cu.ft.	120.4	126.6	130.0	127.1		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**106.9**	**110.4**	**111.8**	**107.6**	**#VALUE!**	**#VALUE!**

Moisture Content AASHTO T99 or T180 Tested by:

Container No.		65	66	67	68		
G Wet Weight / Container	grams	142.6	149.1	163.3	158.3		
H Dry Weight / Container	grams	130.9	134.8	145.6	139.7		
I Moisture Loss = G - H	grams	11.7	14.3	17.7	18.6		
J Tare Weight of Container	grams	37.8	37.7	37.2	37.0		
K Dry Soil = H - J	grams	93.1	97.1	108.4	102.7		
L %Moisture = (I / K) x 100	%	**12.6%**	**14.7%**	**16.3%**	**18.1%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

111.4 lbs./cu.ft.

Optimum Moisture

15.6%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

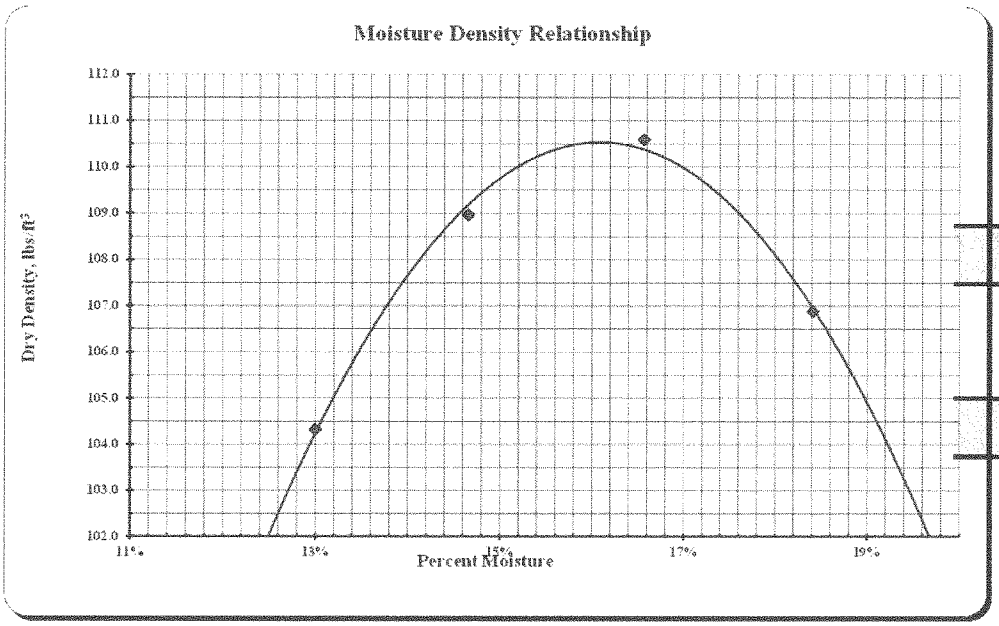
Project No.	PCN	Station	Depth Below Grade
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/5/2015**		**1489**

Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.31	8.55	8.68	8.60		
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.	3.91	4.15	4.28	4.20		
E Wet Density = D / A	lbs./cu.ft.	117.9	124.9	128.9	126.6		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**104.3**	**109.0**	**110.6**	**106.9**	**#VALUE!**	**#VALUE!**

Moisture Content AASHTO T99 or T180 Tested by:

Container No.		105	106	107	108		
G Wet Weight / Container	grams	155.7	155.6	158.8	154.8		
H Dry Weight / Container	grams	142.1	140.5	141.5	136.5		
I Moisture Loss = G - H	grams	13.6	15.1	17.3	18.3		
J Tare Weight of Container	grams	37.5	37.5	37.1	37.1		
K Dry Soil = H - J	grams	104.6	103.0	104.4	99.4		
L %Moisture = (I / K) x 100	%	**13.0%**	**14.7%**	**16.6%**	**18.4%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

110.5 lbs./cu.ft.

Optimum Moisture

16.1%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/5/2015**		**1490**

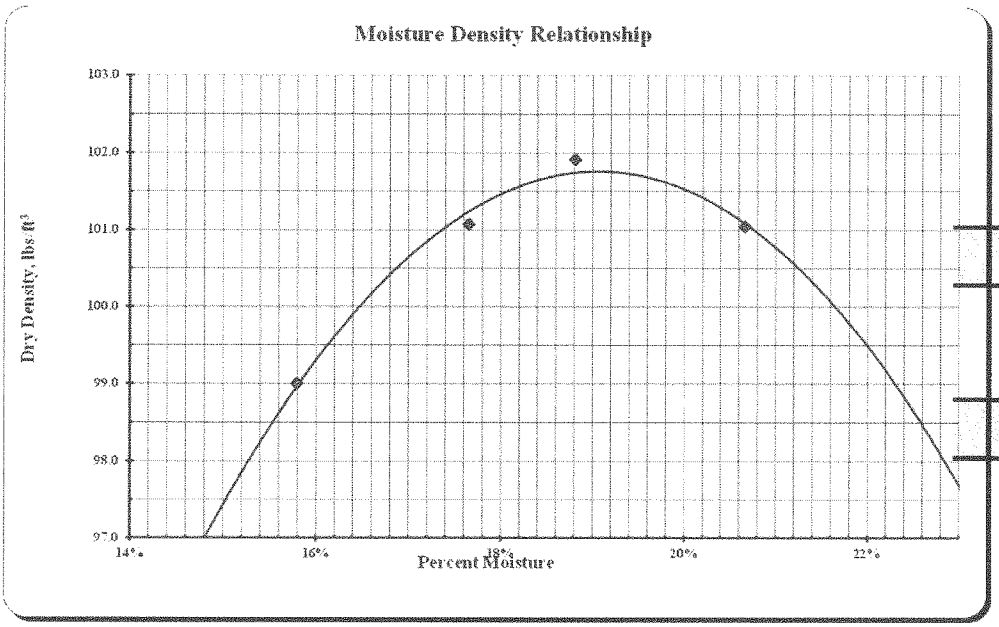
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.20	8.34	8.42	8.44		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.81	3.95	4.02	4.05		
E Wet Density = D / A	lbs./cu.ft.	114.6	118.9	121.1	121.9		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**99.0**	**101.1**	**101.9**	**101.0**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		109	110	111	112		
G Wet Weight / Container	grams	141.9	142.4	145.9	164.2		
H Dry Weight / Container	grams	127.7	126.6	128.8	142.5		
I Moisture Loss = G - H	grams	14.2	15.8	17.1	21.7		
J Tare Weight of Container	grams	37.8	37.1	37.9	37.5		
K Dry Soil = H - J	grams	89.9	89.5	90.9	105.0		
L %Moisture = (I / K) x 100	%	**15.8%**	**17.7%**	**18.8%**	**20.7%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

101.8 lbs./cu.ft.

Optimum Moisture

19.1%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1491**

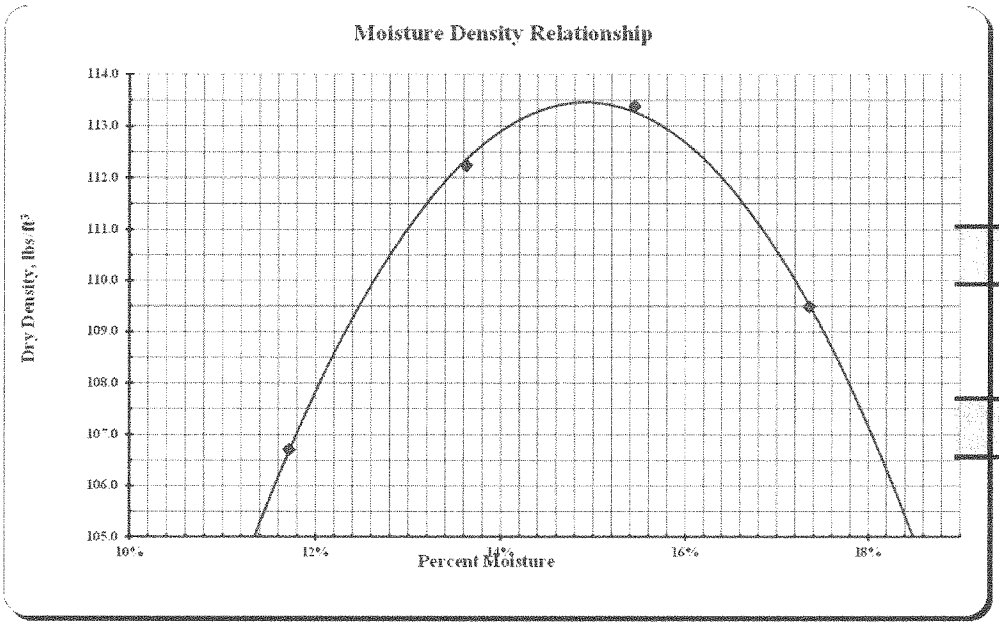
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.35	8.63	8.74	8.66		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.96	4.23	4.35	4.27		
E Wet Density = D / A	lbs./cu.ft.	119.2	127.5	130.9	128.5		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**106.7**	**112.2**	**113.4**	**109.5**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		69	70	71	72		
G Wet Weight / Container	grams	146.4	165.2	159.0	176.7		
H Dry Weight / Container	grams	135.0	149.9	142.7	156.0		
I Moisture Loss = G - H	grams	11.4	15.3	16.3	20.7		
J Tare Weight of Container	grams	37.7	37.6	37.2	36.7		
K Dry Soil = H - J	grams	97.3	112.3	105.5	119.3		
L %Moisture = (I / K) x 100	%	**11.7%**	**13.6%**	**15.5%**	**17.4%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

113.5 lbs./cu.ft.

Optimum Moisture

14.9%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1492**

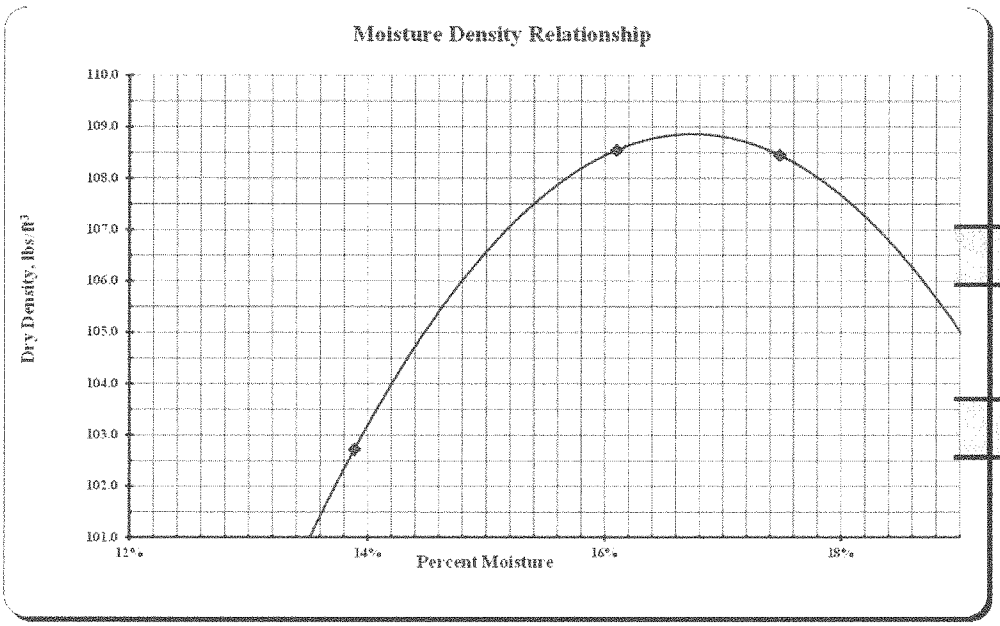
Density		Test Count	3				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.28	8.58	8.63			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.88	4.18	4.23			
E Wet Density = D / A	lbs./cu.ft.	117.0	126.0	127.4			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**102.7**	**108.5**	**108.5**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		1	2	3			
G Wet Weight / Container	grams	143.2	159.9	157.4			
H Dry Weight / Container	grams	130.2	142.9	139.5			
I Moisture Loss = G - H	grams	13.0	17.0	17.9			
J Tare Weight of Container	grams	36.6	37.3	37.1			
K Dry Soil = H - J	grams	93.6	105.6	102.4			
L %Moisture = (I / K) x 100	%	**13.9%**	**16.1%**	**17.5%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

108.9 lbs./cu.ft.

Optimum Moisture

16.8%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-99	**11/4/2015**		**1493**

Density

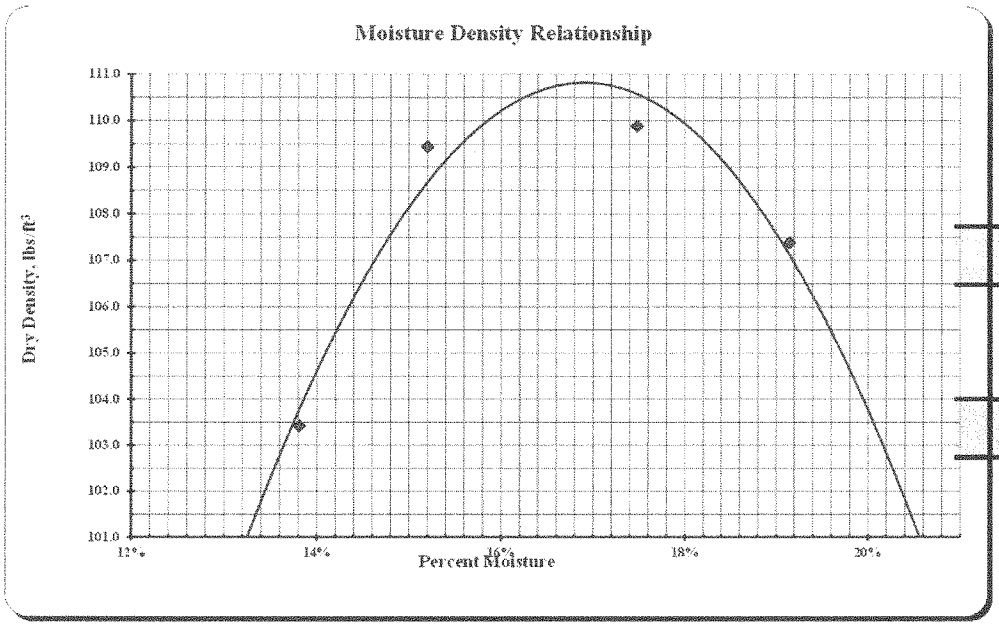
		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.31	8.58	8.68	8.65		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.91	4.19	4.29	4.25		
E Wet Density = D / A	lbs./cu.ft.	117.7	126.1	129.1	128.0		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**103.4**	**109.4**	**109.9**	**107.4**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.	4	5	6	7		
G Wet Weight / Container	grams	160.3	157.6	152.7	159.5		
H Dry Weight / Container	grams	145.3	141.7	135.5	139.7		
I Moisture Loss = G - H	grams	15.0	15.9	17.2	19.8		
J Tare Weight of Container	grams	36.7	37.1	37.1	36.3		
K Dry Soil = H - J	grams	108.6	104.6	98.4	103.4		
L %Moisture = (I / K) x 100	%	**13.8%**	**15.2%**	**17.5%**	**19.1%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

110.8 lbs./cu.ft.

Optimum Moisture

16.9%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No. **NH-3-281(118)190**	PCN	Station	Depth Below Grade
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1494**

Density

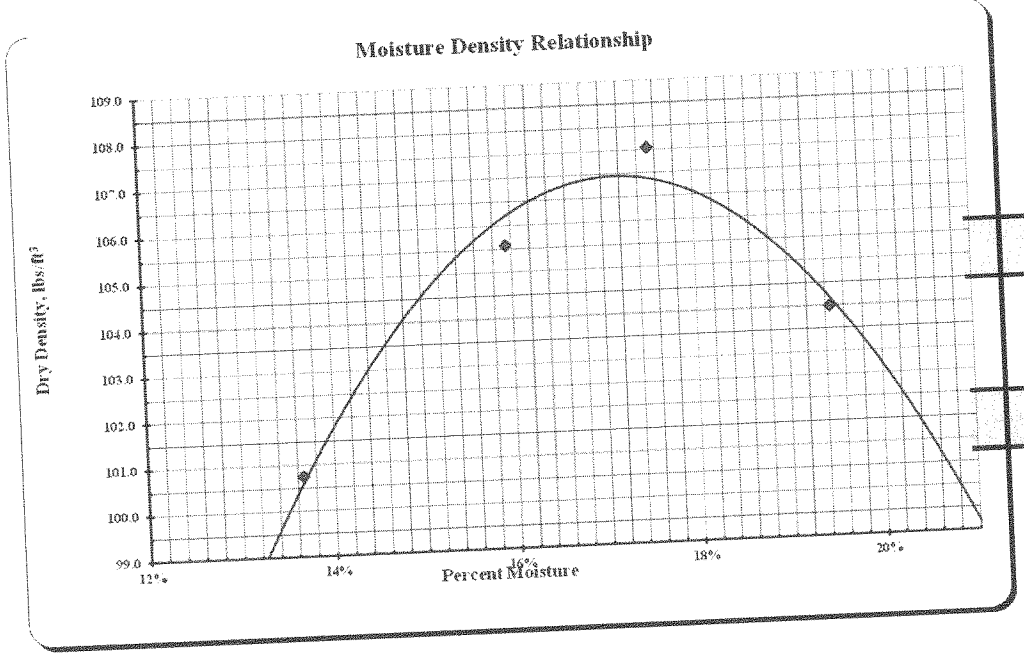
		Test Count	4				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.20	8.46	8.60	8.52		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.80	4.06	4.20	4.12		
E Wet Density = D / A	lbs./cu.ft.	114.5	122.4	126.4	124.2		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**100.8**	**105.6**	**107.5**	**104.0**	**#VALUE!**	**#VALUE!**

AASHTO T99 or T180 Tested by:

Moisture Content

	Container No.	8	9	10	11		
G Wet Weight / Container	grams	154.3	154.3	156.1	162.5		
H Dry Weight / Container	grams	140.2	138.2	138.3	142.1		
I Moisture Loss = G - H	grams	14.1	16.1	17.8	20.4		
J Tare Weight of Container	grams	37.0	37.2	36.7	37.2		
K Dry Soil = H - J	grams	103.2	101.0	101.6	104.9		
L %Moisture = (I / K) x 100	%	**13.7%**	**15.9%**	**17.5%**	**19.4%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

107.0 lbs./cu.ft.

Optimum Moisture

17.2%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation	Date		
T-99	**11/4/2015**		**1495**

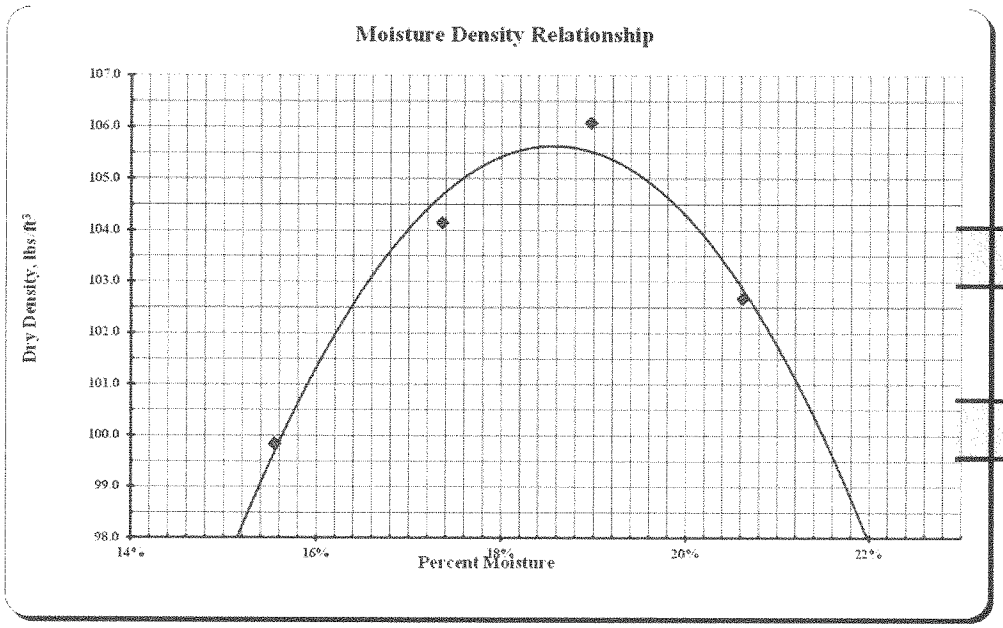
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.23	8.46	8.59	8.51		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.83	4.06	4.19	4.11		
E Wet Density = D / A	lbs./cu.ft.	115.4	122.2	126.2	123.9		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**99.8**	**104.1**	**106.1**	**102.7**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		12	13	14	15		
G Wet Weight / Container	grams	145.4	147.3	164.6	161.3		
H Dry Weight / Container	grams	130.8	131.0	144.4	140.1		
I Moisture Loss = G - H	grams	14.6	16.3	20.2	21.2		
J Tare Weight of Container	grams	36.9	37.1	37.9	37.3		
K Dry Soil = H - J	grams	93.9	93.9	106.5	102.8		
L %Moisture = (I / K) x 100	%	**15.5%**	**17.4%**	**19.0%**	**20.6%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

105.6 lbs./cu.ft.

Optimum Moisture

18.5%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1496**

Density

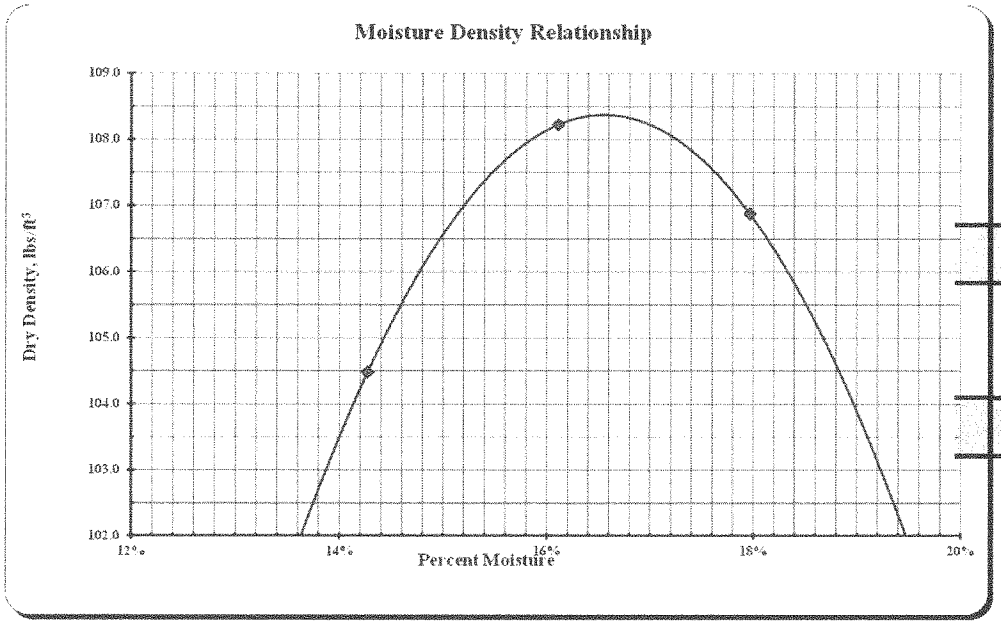
		Test Count	3				
	Determination No.	1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.36	8.57	8.58			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.96	4.17	4.19			
E Wet Density = D / A	lbs./cu.ft.	119.4	125.7	126.1			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**104.5**	**108.2**	**106.9**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

	Container No.	16	17	18			
G Wet Weight / Container	grams	154.9	155.0	152.0			
H Dry Weight / Container	grams	140.2	138.6	134.5			
I Moisture Loss = G - H	grams	14.7	16.4	17.5			
J Tare Weight of Container	grams	37.2	36.8	37.1			
K Dry Soil = H - J	grams	103.0	101.8	97.4			
L %Moisture = (I / K) x 100	%	**14.3%**	**16.1%**	**18.0%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

108.4 lbs./cu.ft.

Optimum Moisture

16.6%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

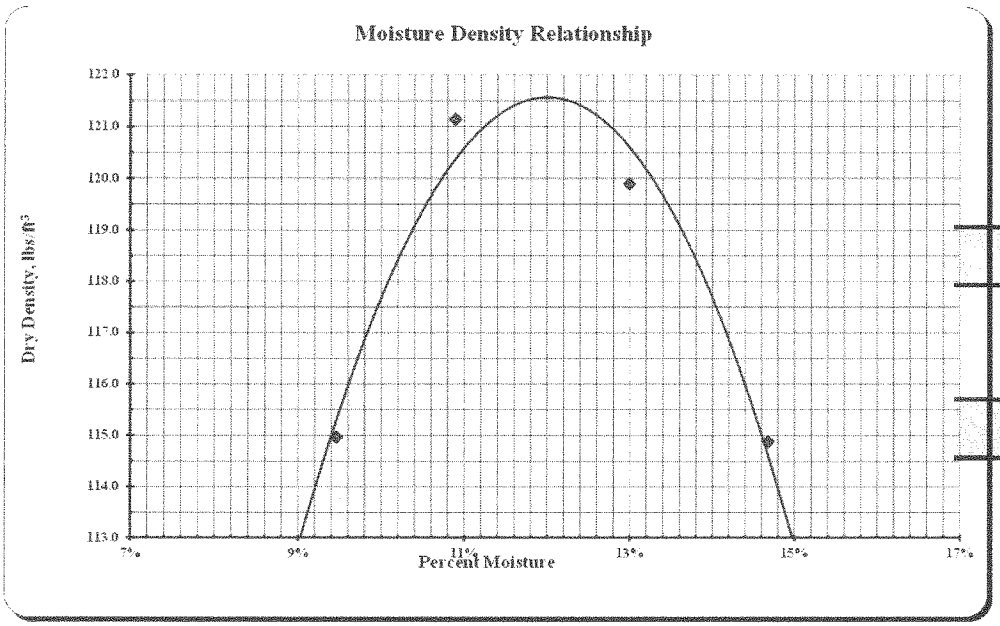
Project No.	PCN	Station	Depth Below Grade
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1497**

Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.58	8.86	8.90	8.77		
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	4.46	4.50	4.37		
E Wet Density = D / A	lbs./cu.ft.	125.8	134.3	135.5	131.7		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**115.0**	**121.1**	**119.9**	**114.9**	**#VALUE!**	**#VALUE!**

Moisture Content AASHTO T99 or T180 Tested by:

Container No.		19	20	21	22		
G Wet Weight / Container	grams	160.9	152.6	153.6	158.1		
H Dry Weight / Container	grams	150.2	141.2	140.2	142.6		
I Moisture Loss = G - H	grams	10.7	11.4	13.4	15.5		
J Tare Weight of Container	grams	37.1	36.5	37.1	37.0		
K Dry Soil = H - J	grams	113.1	104.7	103.1	105.6		
L %Moisture = (I / K) x 100	%	**9.5%**	**10.9%**	**13.0%**	**14.7%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

121.6 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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1498**

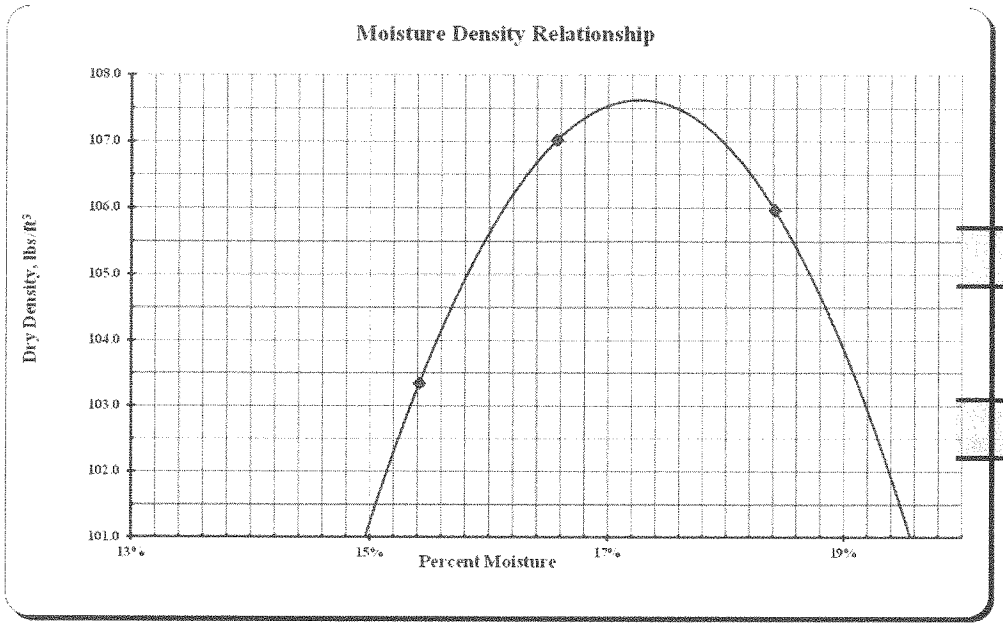
Density		Test Count	3				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.36	8.54	8.56			
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.96	4.14	4.17			
E Wet Density = D / A	lbs./cu.ft.	119.3	124.8	125.5			
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**103.3**	**107.0**	**106.0**	**#VALUE!**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		23	24	25			
G Wet Weight / Container	grams	155.7	158.9	152.3			
H Dry Weight / Container	grams	139.9	141.6	134.4			
I Moisture Loss = G - H	grams	15.8	17.3	17.9			
J Tare Weight of Container	grams	37.4	37.2	37.2			
K Dry Soil = H - J	grams	102.5	104.4	97.2			
L %Moisture = (I / K) x 100	%	**15.4%**	**16.6%**	**18.4%**			

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

107.6 lbs./cu.ft.

Optimum Moisture

17.2%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

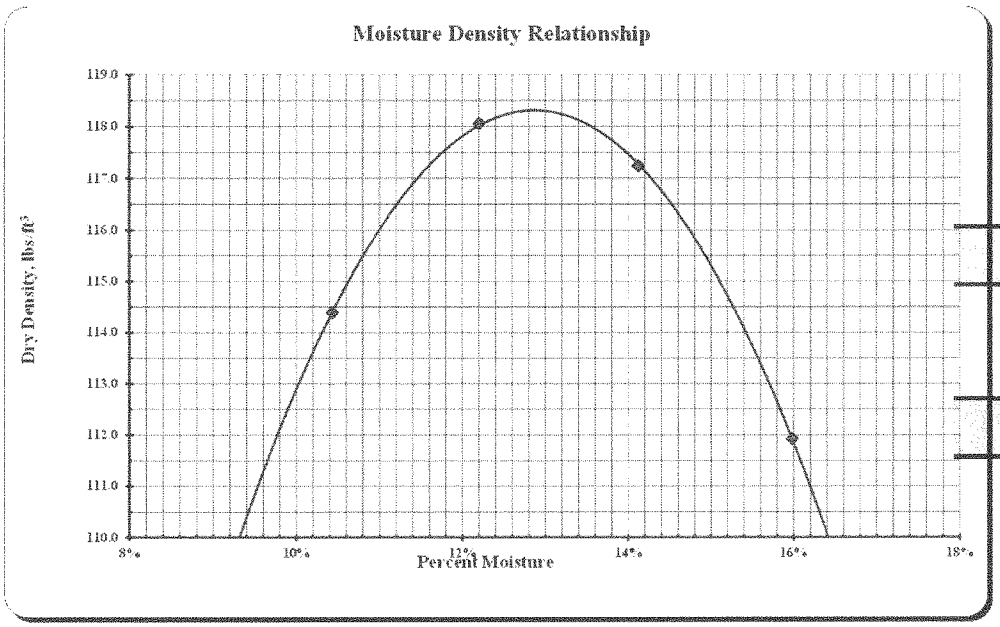
Project No.	PCN	Station	Depth Below Grade
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1499**

Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.59	8.80	8.84	8.71		
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	4.40	4.44	4.31		
E Wet Density = D / A	lbs./cu.ft.	126.3	132.5	133.8	129.8		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**114.4**	**118.1**	**117.2**	**111.9**	**#VALUE!**	**#VALUE!**

Moisture Content AASHTO T99 or T180 Tested by:

Container No.		26	27	28	29		
G Wet Weight / Container	grams	149.1	159.9	154.4	164.2		
H Dry Weight / Container	grams	138.5	146.5	139.9	146.7		
I Moisture Loss = G - H	grams	10.6	13.4	14.5	17.5		
J Tare Weight of Container	grams	36.9	36.7	37.2	37.2		
K Dry Soil = H - J	grams	101.6	109.8	102.7	109.5		
L %Moisture = (I / K) x 100	%	**10.4%**	**12.2%**	**14.1%**	**16.0%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

118.3 lbs./cu.ft.

Optimum Moisture

12.8%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1500**

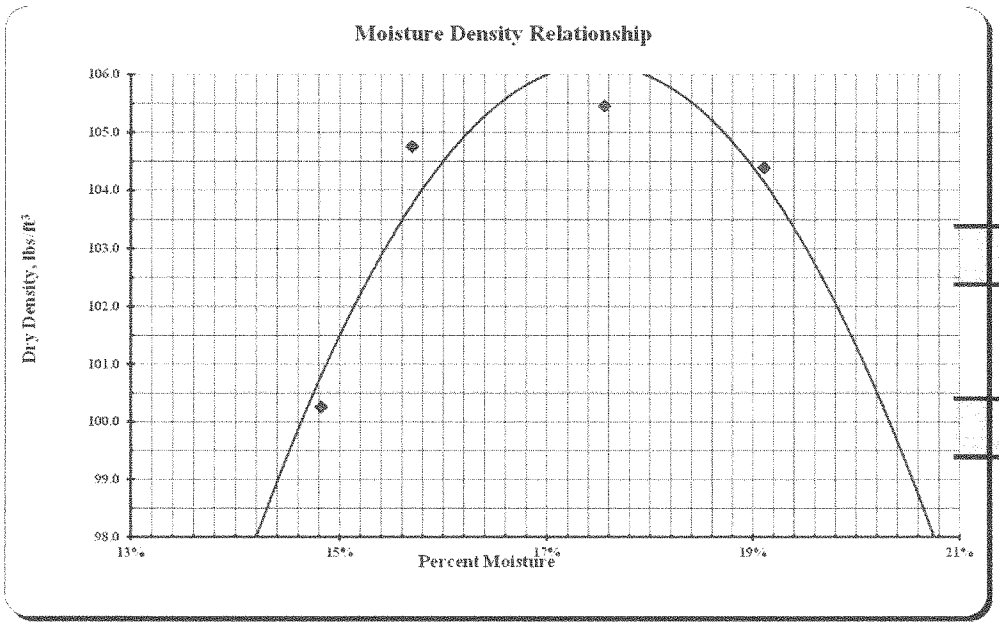
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.22	8.42	8.51	8.53		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	3.82	4.02	4.12	4.13		
E Wet Density = D / A	lbs./cu.ft.	115.1	121.2	124.0	124.3		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**100.3**	**104.8**	**105.5**	**104.4**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		30	31	32	33		
G Wet Weight / Container	grams	156.4	150.5	158.1	149.3		
H Dry Weight / Container	grams	141.0	135.1	140.0	131.3		
I Moisture Loss = G - H	grams	15.4	15.4	18.1	18.0		
J Tare Weight of Container	grams	37.1	37.0	36.9	37.1		
K Dry Soil = H - J	grams	103.9	98.1	103.1	94.2		
L %Moisture = (I / K) x 100	%	**14.8%**	**15.7%**	**17.6%**	**19.1%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

106.2 lbs./cu.ft.

Optimum Moisture

17.5%

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
NH-3-281(118)190			
Offset From Centerline		Type of Soil	
AASTHO Designation **T-99**	Date **11/4/2015**		**1501**

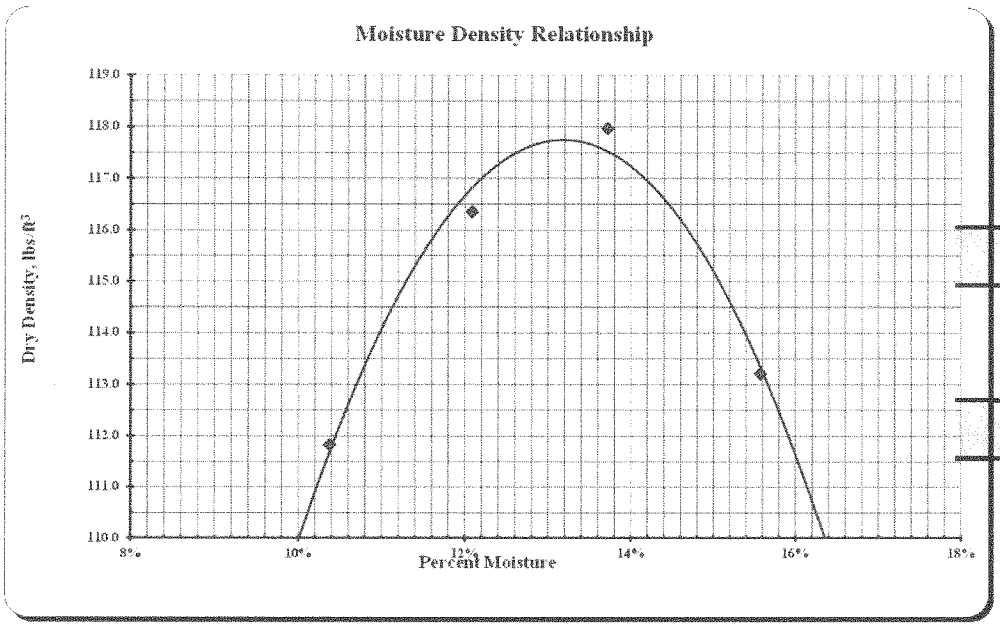
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A Volume of Mold	cu. ft.	0.0332	0.0332	0.0332	0.0332	0.0332	0.0332
	lbs.	8.50	8.73	8.85	8.74		
C Weight of Mold	lbs.	4.40	4.40	4.40	4.40	4.40	4.40
D Weight of Compacted Soil = B - C	lbs.	4.10	4.33	4.45	4.34		
E Wet Density = D / A	lbs./cu.ft.	123.4	130.4	134.2	130.8		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	**111.8**	**116.4**	**118.0**	**113.2**	**#VALUE!**	**#VALUE!**

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		34	35	36	37		
G Wet Weight / Container	grams	149.7	156.2	154.9	169.4		
H Dry Weight / Container	grams	139.2	143.4	140.7	151.6		
I Moisture Loss = G - H	grams	10.5	12.8	14.2	17.8		
J Tare Weight of Container	grams	38.0	37.5	37.2	37.3		
K Dry Soil = H - J	grams	101.2	105.9	103.5	114.3		
L %Moisture = (I / K) x 100	%	**10.4%**	**12.1%**	**13.7%**	**15.6%**		

ASTM D4643 AASHTO T217 or T265 Tested by: ML



Max Dry Density

117.7 lbs./cu.ft.

Optimum Moisture

13.2%