

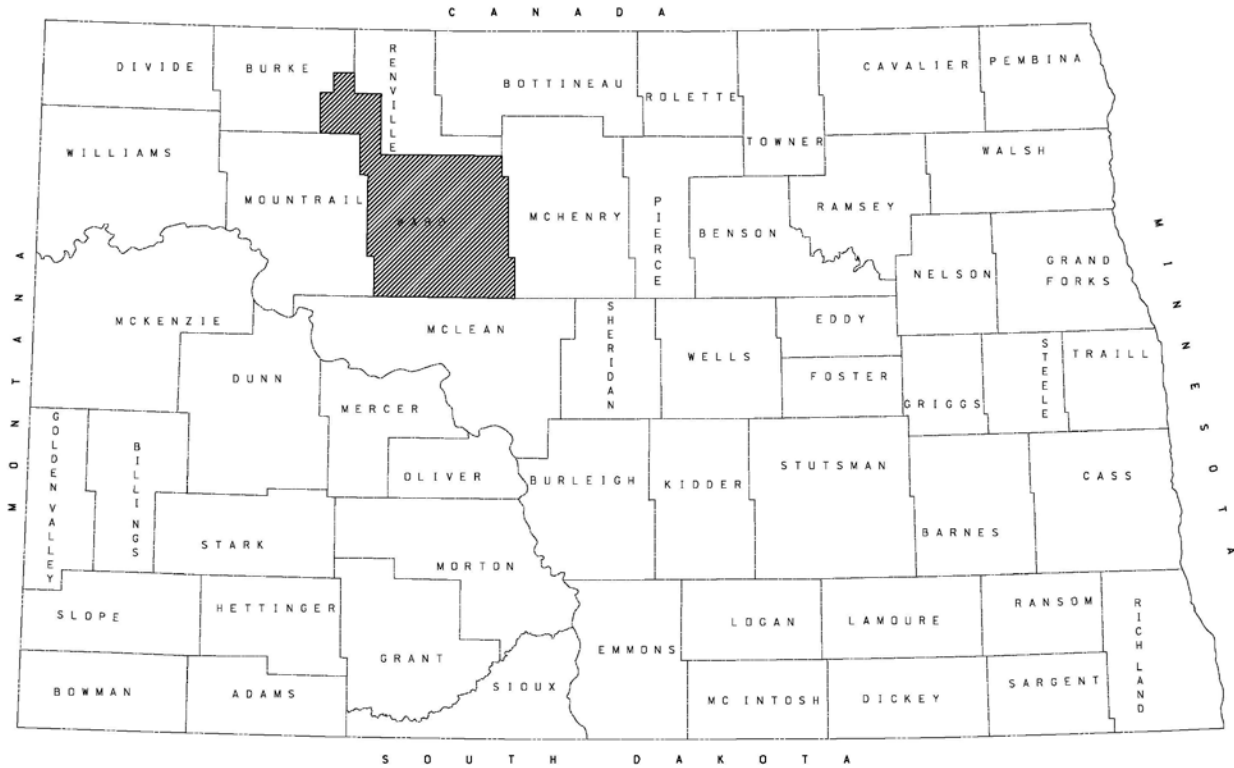
LINEAR SOILS SURVEY AND RECOMMENDATIONS

PROJECT NO. NHU-4-002(116)149

PCN 21174

COUNTY Ward

Minot Intersection of US 2 and 42nd St SE



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

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

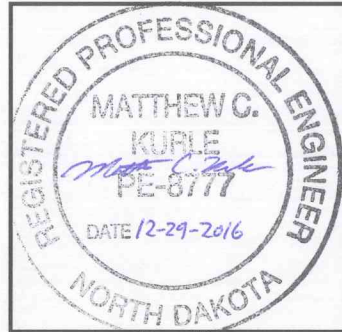
December 2016

NHU-4-002(116)149

Minot Intersection of US Highway 2 and 42nd Street SE

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 12/29/2016 and the original document is stored at the North Dakota Department of Transportation.



Matthew C. Kurle
Matthew C. Kurle, P.E.

29 DEC 2016
Date



Linear Soils Report and Recommendation

Project: NHU-4-002(116)149

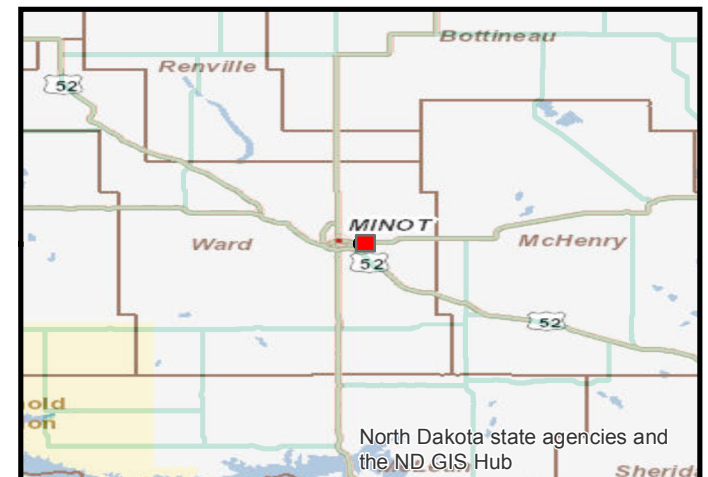
PCN: 21174

Scope: Intersection Realignment, Turn lanes, Signals

Length: NA

Location: Intersection of US Highway 2 and 42nd St SE - Minot

North Dakota state agencies and the ND GIS Hub, Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, TomTom, MapmyIndia, © StreetMap contributors, and the GIS user community



North Dakota state agencies and the ND GIS Hub

Table of Contents

Introduction	1
Existing Roadway Section	1
Construction History	1
Maintenance Review	2
Summary of Soil Analysis.....	2
Moisture.....	3
Swell Potential	3
Frost Susceptibility.....	3
Group Index.....	3
Proposed Intersection	4
Figure 3 – Proposed Intersection Configuration	4
Design Recommendations	5
Design Information.....	5
Plan Notes	5

List of Figures

Figure 1 – Existing Intersection and Boring Locations.....	1
Figure 2 - Frost Susceptibility Distribution.....	3
Figure 3 – Proposed Intersection Configuration.....	4

List of Tables

Table 1 - Construction History – US Hwy 2 Eastbound RP 148.753 to RP 150.841	1
Table 2 - Construction History – US Hwy 2 Westbound RP 148.753 to RP 150.841	2
Table 3 – Soil Analysis	2
Table 4 - Group Indices.....	3

Appendices

Appendix A – Soil Classification and Frost Susceptibility	
Appendix B – Pavement Evaluation Log	
Appendix C – Summary of Soils Analysis	
Appendix D – Lab Results	

Introduction

Location: Minot, Intersection of US Highway 2 and 42nd Street SE
 Proposed Project Scope: Intersection realignment, turn lanes, and signals.
 Investigation Scope: Existing intersection

Existing Roadway Section

Construction History



Figure 1 – Existing Intersection and Boring Locations

Table 1 - Construction History – US Hwy 2 Eastbound RP 148.753 to RP 150.841

Construction History				
Year	Construction	Depth(in)	Width (ft)	Oil
1960	Grade		50.0	
1960	Aggregate Base	4.5	48.0	
1960	Emulsified Base	4.5	46.0	SS-1
1960	Hot Bituminous Pavement	2.0	44.0	150-200
1985	Hot Bituminous Pavement	2.0	35.0	120-150
1992	District Chip Seal		26.0	MC-3000
1997	Int Cont Patch-1.5"		24.0	120-150
1998	Int Cont Patch-2.0"		24.0	120-150
2003	District Chip Seal		24.0	CRS-2
2013	HBP-Superpave-FAA 45	3.0	7.5-24.0-7.5	PG 64-28

Table 2 - Construction History – US Hwy 2 Westbound RP 148.753 to RP 150.841

Construction History				
Year	Construction	Depth(in)	Width (ft)	Oil
1980	Grade		48.0	
1981	Aggregate Base	8.0	37.0	
1981	Hot Bituminous Pavement	2.0	30.0	120-150
1981	Hot Bituminous Pavement	1.5	27.0	120-150
1981	Aggregate Base	3.5	7.0-0.0-3.0	
1992	District Chip Seal		26.0	MC-3000
1997	Int Cont Patch-1.5"		24.0	120-150
1998	Int Cont Patch-2.0"		24.0	120-150
2003	District Chip Seal		24.0	CRS-2
2013	HBP-Superpave-FAA 45	3.0	7.5-24.0-7.5	PG 64-28

Maintenance Review

Date of Maintenance Review(s): 7/6/2016

Materials and Research Person Conducting the Review: Jamie Naumann

District Maintenance Person Conducting Review: Jody Luck – Minot East

No maintenance related problems were indicated in the maintenance review. The pavement evaluation log can be found in Appendix B (Pavement Evaluation Log).

Summary of Soil Analysis

The soil borings were performed on 9/22/2016 using a 6 inch solid flight auger. The following is a summary of the laboratory analysis of the samples obtained.

Table 3 – Soil Analysis

Boring Number	Lab #	NDDOT Textural Class	AASHTO Class	Depth of Sample	Average In Place Moisture Content	Optimum Moisture Content T-180	Max Dry Density
				feet	%	%	lb/ft ³
1	1149	SNDY CLY LM	A-6(3)	1.3-10.0	13.8	9.0	129.1
2	1150	SNDY CLY LM	A-6(6)	0.2-6.0	10.8	8.8	131.5
	1151	SND/GRVL	A-2-4(0)	6.0-10.0	3.7	6.0	140.2
3	1152	SND/GRVL	A-1-a(0)	0.3-5.0	7.8	6.8	137.3
4	1153	SND/GRVL	A-1-a(0)	2.5-7.0	6.1	6.4	138.4
5	1154	SND	A-1-b(0)	3.5-10.0	5.2	6.7	135.5
6	1155	SNDY LM	A-6(3)	1.0-10.0	11.8	8.7	130.3

Moisture

All of the soils encountered had in place moisture contents that were on average below optimum moisture or less than 6% over of their optimum moisture.

Swell Potential

All of the soils encountered had plasticity indices less than 25 which indicates the swell potential of these soils are low.

Frost Susceptibility

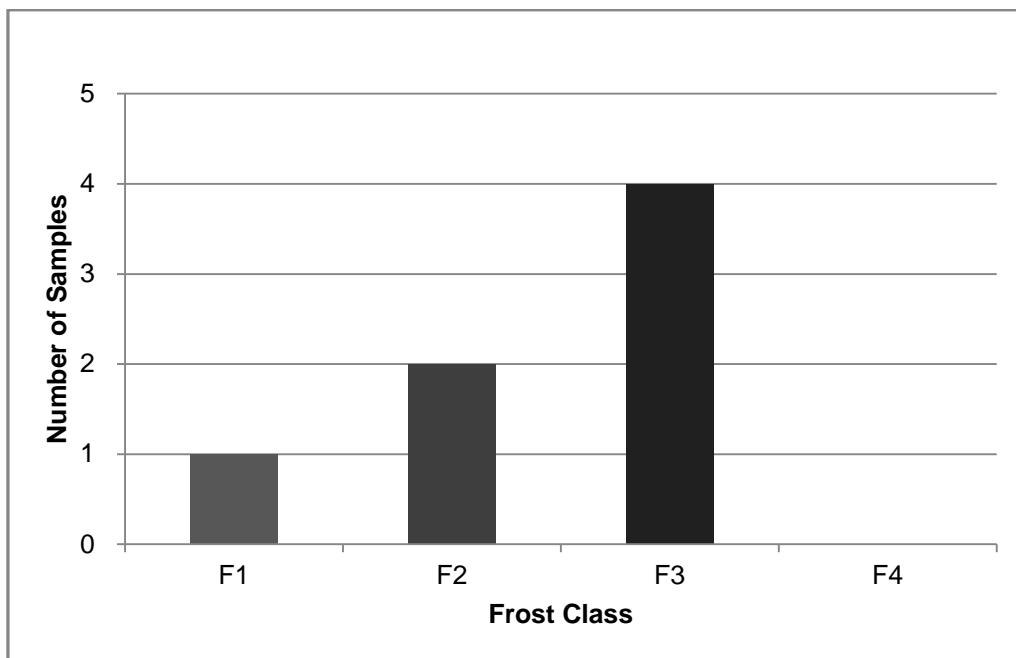


Figure 2 - Frost Susceptibility Distribution

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 4 - Group Indices

AASHTO Classification	Group Index Range	Group Index Average
A-1-a	0-0	0
A-1-b	0-0	0
A-2-4	0-0	0
A-6	3-6	4

Proposed Intersection

The following figure shows the proposed layout of the intersection of US Highway 2 and 42nd street SE as shown in the Draft Documented CATEX dated October 2016.

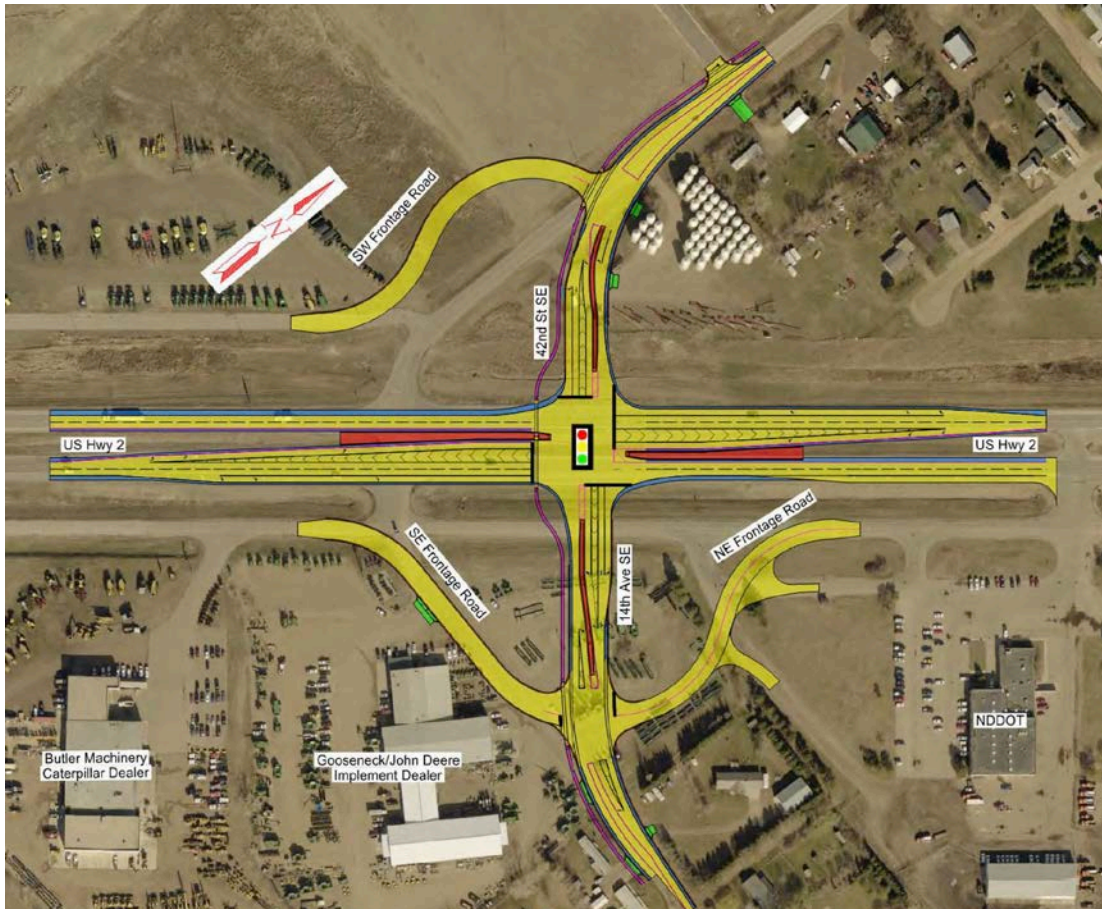


Figure 3 – Proposed Intersection Configuration

Based on information available at the time, the borings that were conducted within the existing intersection that is located to the southwest of the proposed intersection. The soils information included in this report may not be completely indicative of the soils encountered during construction of this proposed configuration.

Design Recommendations

Design Information

Compaction Method: T-180

Subgrade Prep: Subgrade prep 12-inches below the proposed finished grade in the areas of the reconstruction of mainline Highway US-2

Subcut: None

Drainage: None

Plan Notes

None

The recommendations in this report are based on the scope specified in the Introduction. If the scope of work, vertical profile or horizontal alignment is changed, in either the conceptual phase or the design phase, the Geotechnical Engineer must be notified as soon as possible to ensure that there is adequate geotechnical information addressing these areas.

APPENDIX A

SOIL CLASSIFICATION 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	• Gravelly Soils	3 – 10
F2	Low to Medium	• Gravelly 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

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 NHU-4-002(116)149	PCN 21174	Date of Survey 7/6/2016
Section Maintenance Contact Jody Luck		Completed By Jamie Naumann
Highway Reference Points to	Surface Type Asphalt	

Location	Pavement Distress	Description	Maintenance Comment	Picture Number	Drilling Required
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One
	Select One				Select One

Comments
 I met with Jody Luck on 7/6/2016 and he indicated there were no problems with the intersection and connecting side roads. The city has taken over the intersection and side roads.

APPENDIX C

SUMMARY OF SOILS ANALYSIS

Project No.: NHU-4-002(116)149

PCN: 21174

Swell Potential: Low Marginal High Moisture Content: Below PL 0-5% Over PL >5% Over PL

Color Key

Group Index: GI≤20 GI>20 Ave. In-Place: 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)															Frost Class				
										2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		17	18	19	20
1152	149+4472	Rt 38 NB	0.3-5	0.0	A-1-a(0)	0	6.8	0	7.8	8.2	8.0	5.5	4.3																F1
1149	149+4482	Lt 41 NB	1.3-10	15.4	A-6(3)	3	9.0	18	13.2	13.6	14.4	15.0	14.2	12.2	12.4	13.3	13.4	15.0											F3
1153	149+4484	Rt 32 NB	2.5-7	0.0	A-1-a(0)	0	6.4	0	6.6	6.8	15.3	2.8	5.0	4.3	3.5														F2
1154	149+4514	Rt 30 SB	3.5-10	17.7	A-1-b(0)	0	6.7	9	6.5	9.4	10.5	8.2	4.3	4.8	4.6	5.4	4.1	5.2											F2
1150	149+4602	Lt 41 NB	0.2-6	14.6	A-6(6)	6	8.8	20	10.8	12.9	11.2	16.9	11.7	3.5															F3
1151	149+4602	Lt 41 NB	6-10	16.3	A-2-4(0)	0	6.0	8	3.7						3.8	3.2	3.8	4.0											F3
1155	149+4607	Rt 30 SB	1-10	14.7	A-6(3)	3	8.7	14	11.7	11.2	11.7	12.2	9.2	13.3	13.1	11.2	13.6	14.1											F3

APPENDIX D
LAB RESULTS

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division

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

Report Number	SS-59-2016	Date Reported	10/4/2016	District	Minot
County	WARD	Submitted By	Naumann	Project Number	NHU-4-002(116)149
AASHTO Test Method				PCN	21174

Comments

Lab Number	1152	1149	1153	1154
Reference Pt + Feet	149+4472	149+4482	149+4484	149+4514
Distance From CenterLine (Ft.)	Rt 38 NB	Lt 41 NB	Rt 32 NB	Rt 30 SB
Depth, Ft.	0.3 - 5.0	1.3 - 10.0	2.5 - 7.0	3.5 - 10.0
Field Sample No.	1152	1149	1153	1154
% Pass. 3/8" Sieve	60	96	71	77
% Pass. No. 4 Sieve	48	91	60	66
% Pass. No. 10 Sieve	38	76	40	52
% Coarse Sand (-No. 10 + No. 40)	15	14	18	14
% Fine Sand (-No. 40 + No. 200)	12	23	12	18
% Silt (0.074 - 0.005 mm)	8	19	6	13
% Clay (-0.005 mm)	4	21	4	7
Liquid Limit (-No. 40)	0	33	0	24
Plasticity Index (-No. 40)	NP	18	NP	6
Plastic Limit	0	15	0	18
Soil Color	BRN	BRN	BRN/BLK	BRN/BLK
Textural Class	SND/GRVL	SNDY CLY LM	SND/GRVL	SND
Soil Class (AASHTO M-145)	A-1-a(0)	A-6(3)	A-1-a(0)	A-1-b(0)
Frost Class	F1	F3	F2	F2
Optimum Moisture (%)	6.8	9.0	6.4	6.7
Maximum Dry Density (pcf)	137.3	129.1	138.4	135.5
% Organic Content				
Depth (Ft.) Moisture (%)	1 13.2	1 8.1	1 8.3	1 8.5
	2 8.2	2 13.6	2 6.8	2 9.4
	3 8.0	3 14.4	3 15.3	3 10.5
	4 5.5	4 15.0	4 2.8	4 8.2
	5 4.3	5 14.2	5 5.0	5 4.3
Avg. Moisture of Sample Depth	7.8	6 12.2	6 4.3	6 4.8
		7 12.4	7 3.5	7 4.6
		8 13.3	6.1	8 5.4
		9 13.4		9 4.1
		10 15.0		10 5.2
		13.8		5.2

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division

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

Report Number	SS-59-2016	Date Reported	10/4/2016	District	Minot
County	WARD	Submitted By	Naumann	Project Number	NHU-4-002(116)149
AASHTO Test Method				PCN	21174

Comments

Lab Number	1150	1151	1155
Reference Pt + Feet	149+4602	149+4602	149+4607
Distance From CenterLine (Ft.)	Lt 41 NB	Lt 41 NB	Rt 30 SB
Depth, Ft.	0.2 - 6.0	6.0 - 10.0	1.0 - 10.0
Field Sample No.	1150	1151	1155
% Pass. 3/8" Sieve	92	89	96
% Pass. No. 4 Sieve	90	70	94
% Pass. No. 10 Sieve	79	43	90
% Coarse Sand (-No. 10 + No. 40)	11	17	12
% Fine Sand (-No. 40 + No. 200)	19	11	33
% Silt (0.074 - 0.005 mm)	24	8	25
% Clay (-0.005 mm)	25	6	19
Liquid Limit (-No. 40)	35	24	29
Plasticity Index (-No. 40)	20	8	14
Plastic Limit	15	16	15
Soil Color	BRN/BLK	BRN	BRN
Textural Class	SNDY CLY LM	SND/GRVL	SNDY LM
Soil Class (AASHTO M-145)	A-6(6)	A-2-4(0)	A-6(3)
Frost Class	F3	F3	F3
Optimum Moisture (%)	8.8	6.0	8.7
Maximum Dry Density (pcf)	131.5	140.2	130.3
% Organic Content			
Depth (Ft.) Moisture (%)	1 8.7	7 3.8	1 7.6
	2 12.9	8 3.2	2 11.2
	3 11.2	9 3.8	3 11.7
	4 16.9	10 4.0	4 12.2
	5 11.7	3.7	5 9.2
	6 3.5		6 13.3
Avg. Moisture of Sample Depth	10.8		7 13.1
			8 11.2
			9 13.6
			10 14.1
			11.8

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

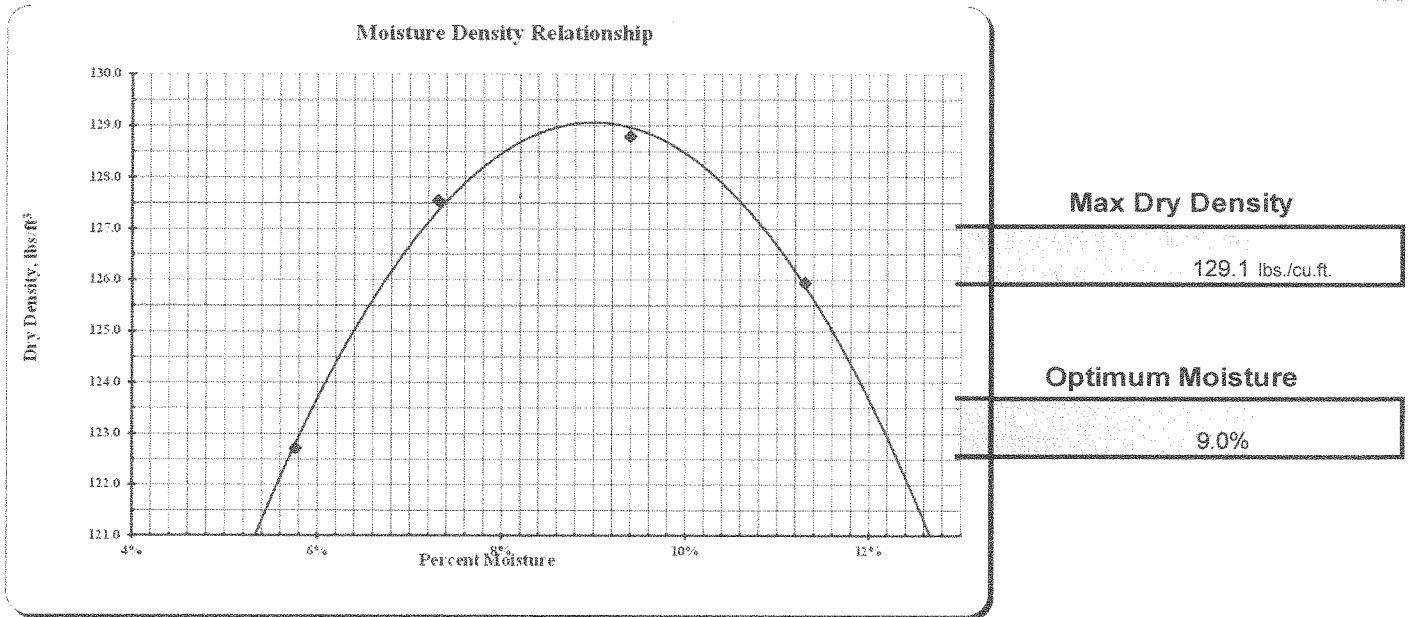
Project No. NHU-4-002(116)149	PCN	Station	Depth Below Grade				
Offset From Centerline		Type of Soil					
AASHTO Designation T-180	Date 12/7/2016				1149		
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.73	8.97	9.10	9.08	
C	Weight of Mold	lbs.	4.41	4.41	4.41	4.41	4.41
D	Weight of Compacted Soil = B - C	lbs.	4.32	4.56	4.69	4.67	
E	Wet Density = D / A	lbs./cu.ft.	129.8	136.9	140.9	140.2	
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	122.7	127.6	128.8	125.9	#VALUE!

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		19	20	21	22	
G	Wet Weight / Container	grams	152.7	151.0	147.7	152.2
H	Dry Weight / Container	grams	146.4	143.2	138.2	140.5
I	Moisture Loss = G - H	grams	6.3	7.8	9.5	11.7
J	Tare Weight of Container	grams	37.1	36.5	37.1	37.0
K	Dry Soil = H - J	grams	109.3	106.7	101.1	103.5
L	%Moisture = (I / K) x 100	%	5.8%	7.3%	9.4%	11.3%

ASTM D4643 AASHTO T217 or T265 Tested by: ss



MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

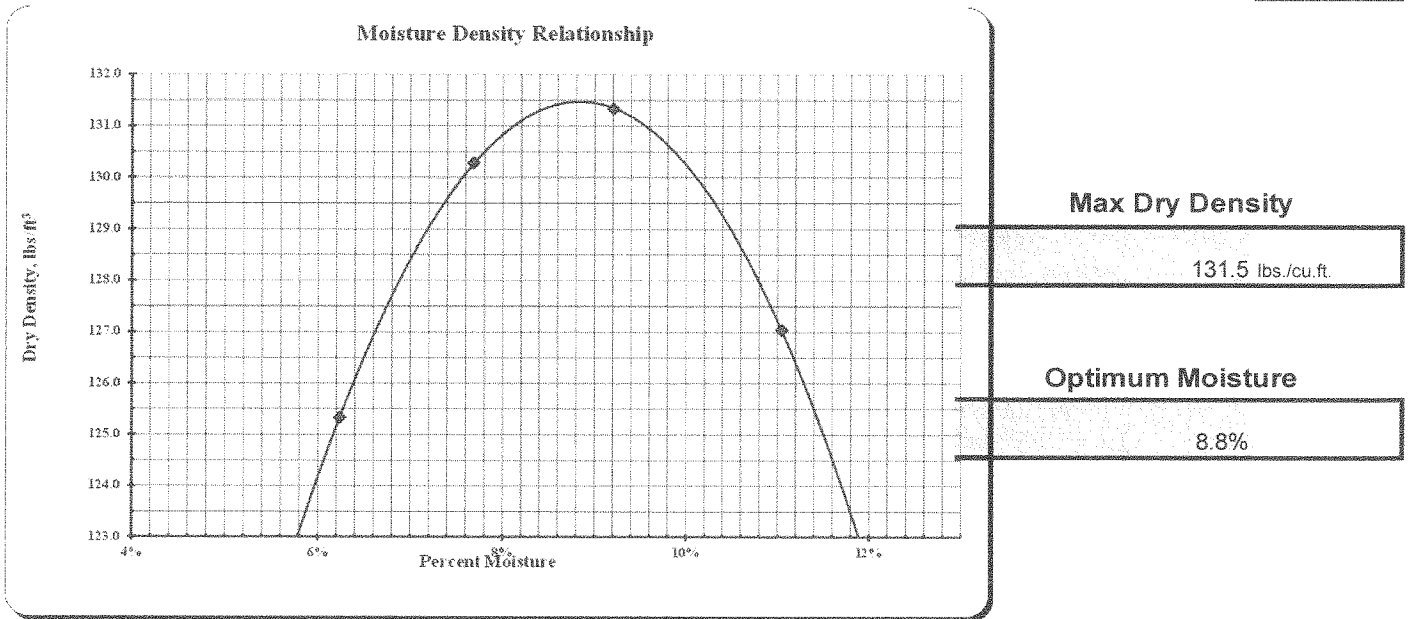
Project No. NHU-4-002(116)149	PCN	Station	Depth Below Grade				
Offset From Centerline		Type of Soil					
ASTHO Designation T-180	Date 12/7/2016				1150		
Density	Test Count	4					
Determination No.	1	2	3	4	5	6	
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.85	9.08	9.19	9.11		
C Weight of Mold	lbs.	4.41	4.41	4.41	4.41	4.41	4.41
D Weight of Compacted Soil = B - C	lbs.	4.43	4.67	4.78	4.70		
E Wet Density = D / A	lbs./cu.ft.	133.2	140.3	143.4	141.1		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	125.3	130.3	131.3	127.0	#VALUE!	#VALUE!

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		23	24	25	26		
G Wet Weight / Container	grams	153.2	146.5	157.0	148.5		
H Dry Weight / Container	grams	146.4	138.7	146.9	137.4		
I Moisture Loss = G - H	grams	6.8	7.8	10.1	11.1		
J Tare Weight of Container	grams	37.4	37.2	37.2	36.9		
K Dry Soil = H - J	grams	109.0	101.5	109.7	100.5		
L %Moisture = (I / K) x 100	%	6.2%	7.7%	9.2%	11.0%		

ASTM D4643 AASHTO T217 or T265 Tested by: ss



MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

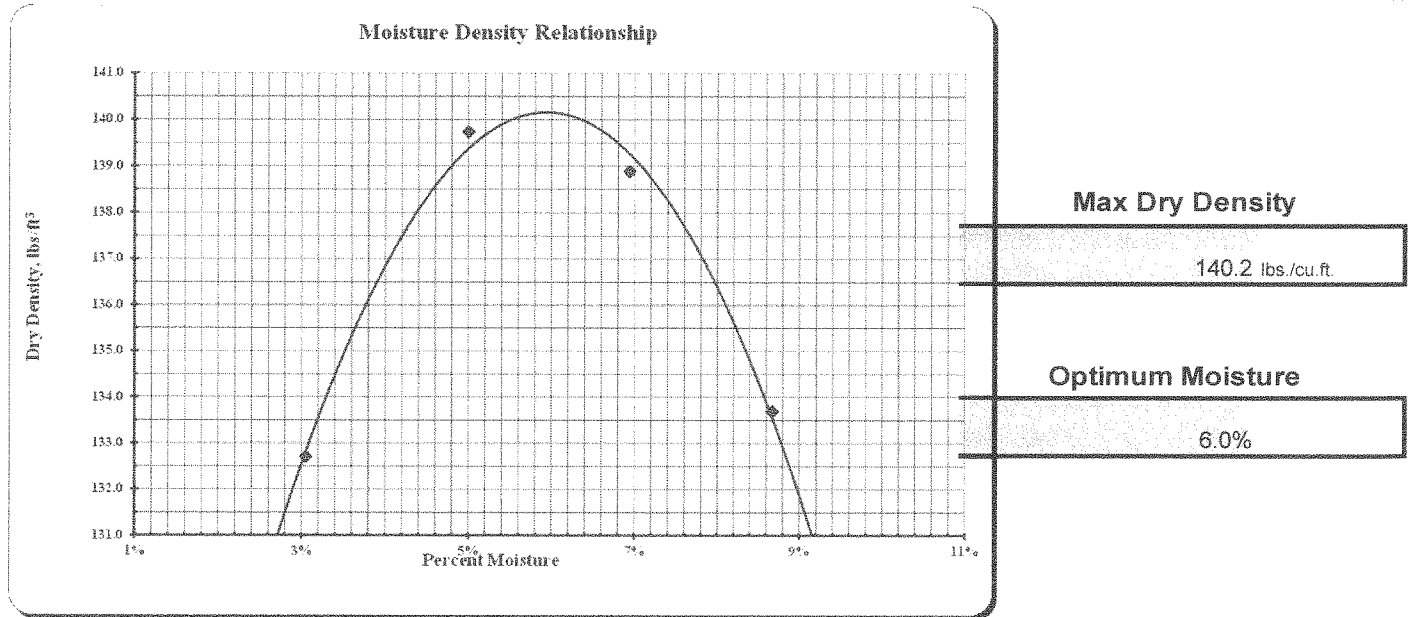
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Offset From Centerline		Type of Soil					
ASTHO Designation T-180	Date 12/7/2016				1151		
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.97	9.30	9.36	9.25	
C	Weight of Mold	lbs.	4.41	4.41	4.41	4.41	4.41
D	Weight of Compacted Soil = B - C	lbs.	4.55	4.89	4.95	4.84	
E	Wet Density = D / A	lbs./cu.ft.	136.8	146.7	148.5	145.3	
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	132.7	139.7	138.9	133.7	#VALUE!

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.		27	28	29	30		
G	Wet Weight / Container	grams	154.8	150.6	143.5	152.4	
H	Dry Weight / Container	grams	151.3	145.2	136.6	143.2	
I	Moisture Loss = G - H	grams	3.5	5.4	6.9	9.2	
J	Tare Weight of Container	grams	36.7	37.2	37.2	37.1	
K	Dry Soil = H - J	grams	114.6	108.0	99.4	106.1	
L	%Moisture = (I / K) x 100	%	3.1%	5.0%	6.9%	8.7%	

ASTM D4643 AASHTO T217 or T265 Tested by: ss



MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

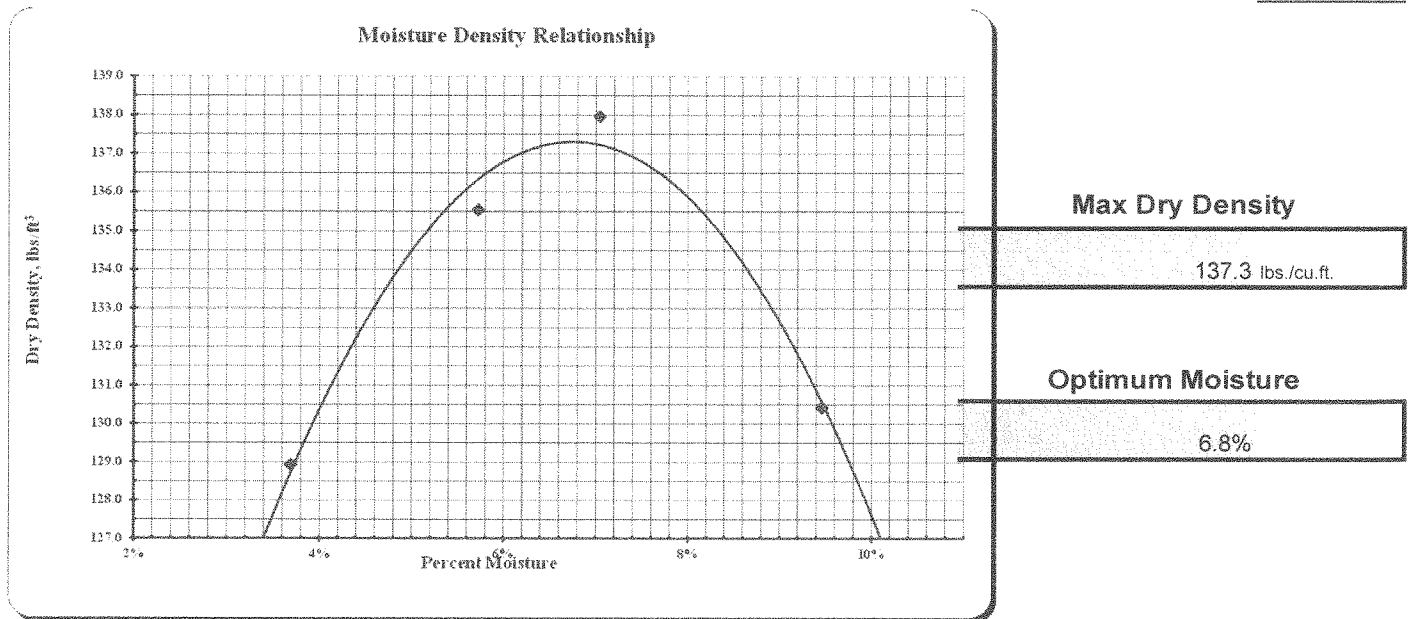
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Offset From Centerline		Type of Soil					
AASTHO Designation T-180	Date 12/7/2016	1152					
Density	Test Count	4					
Determination No.	1	2	3	4	5	6	
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.86	9.18	9.33	9.17		
C Weight of Mold	lbs.	4.41	4.41	4.41	4.41	4.41	4.41
D Weight of Compacted Soil = B - C	lbs.	4.45	4.77	4.92	4.75		
E Wet Density = D / A	lbs./cu.ft.	133.7	143.3	147.7	142.8		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	128.9	135.5	138.0	130.4	#VALUE!	#VALUE!

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.	31	32	33	34		
G Wet Weight / Container	grams	152.1	145.9	148.0	153.7	
H Dry Weight / Container	grams	148.0	140.0	140.7	143.7	
I Moisture Loss = G - H	grams	4.1	5.9	7.3	10.0	
J Tare Weight of Container	grams	37.0	36.9	37.1	38.0	
K Dry Soil = H - J	grams	111.0	103.1	103.6	105.7	
L %Moisture = (I / K) x 100	%	3.7%	5.7%	7.0%	9.5%	

ASTM D4643 AASHTO T217 or T265 Tested by: ss



MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

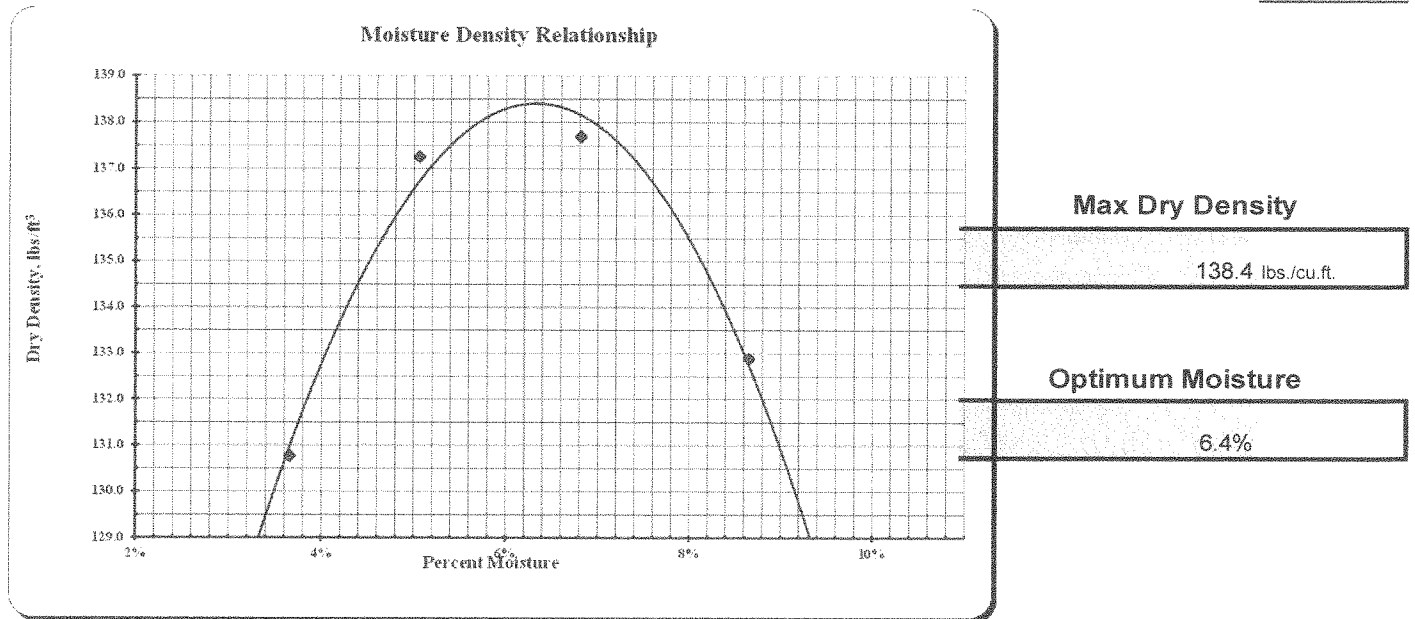
Project No. NHU-4-002(116)149	PCN	Station	Depth Below Grade				
Offset From Centerline		Type of Soil					
AASHTO Designation T-180	Date 12/7/2016				1153		
Density	Test Count	4					
Determination No.	1	2	3	4	5	6	
A Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333	0.0333
	lbs.	8.93	9.21	9.31	9.22		
C Weight of Mold	lbs.	4.41	4.41	4.41	4.41	4.41	4.41
D Weight of Compacted Soil = B - C	lbs.	4.51	4.80	4.90	4.81		
E Wet Density = D / A	lbs./cu.ft.	135.6	144.2	147.1	144.4		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	130.8	137.3	137.7	132.9	#VALUE!	#VALUE!

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.	35	36	37	38		
G Wet Weight / Container	grams	150.8	151.4	151.7	149.9	
H Dry Weight / Container	grams	146.8	145.9	144.4	140.9	
I Moisture Loss = G - H	grams	4.0	5.5	7.3	9.0	
J Tare Weight of Container	grams	37.5	37.2	37.3	36.9	
K Dry Soil = H - J	grams	109.3	108.7	107.1	104.0	
L %Moisture = (I / K) x 100	%	3.7%	5.1%	6.8%	8.7%	

ASTM D4643 AASHTO T217 or T265 Tested by: ss



MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

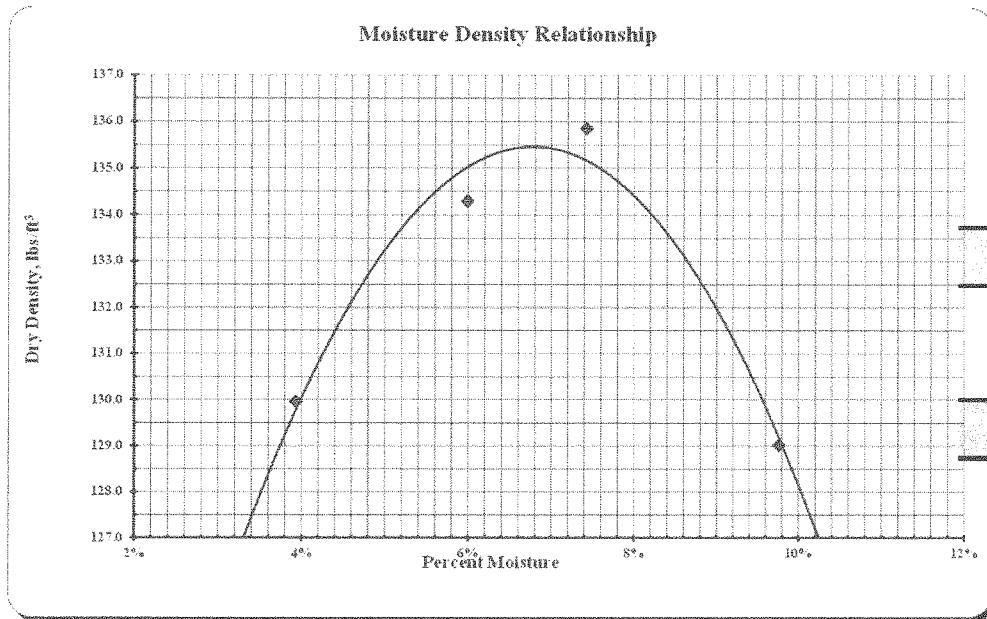
Project No. NHU-4-002(116)149	PCN	Station	Depth Below Grade				
Offset From Centerline		Type of Soil					
AASTHO Designation T-180	Date 12/7/2016				1154		
Density		Test Count	4				
Determination No.		1	2	3	4	5	6
A	Volume of Mold	cu. ft.	0.0333	0.0333	0.0333	0.0333	0.0333
		lbs.	8.91	9.15	9.27	9.13	
C	Weight of Mold	lbs.	4.41	4.41	4.41	4.41	4.41
D	Weight of Compacted Soil = B - C	lbs.	4.50	4.74	4.86	4.72	
E	Wet Density = D / A	lbs./cu.ft.	135.1	142.3	145.9	141.6	
F	Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	130.0	134.3	135.9	129.0	#VALUE!

Moisture Content

AASTHO T99 or T180 Tested by:

Container No.		39	40	41	42		
G	Wet Weight / Container	grams	148.5	153.9	148.6	157.0	
H	Dry Weight / Container	grams	144.3	147.3	140.9	146.3	
I	Moisture Loss = G - H	grams	4.2	6.6	7.7	10.7	
J	Tare Weight of Container	grams	37.5	37.1	37.2	36.7	
K	Dry Soil = H - J	grams	106.8	110.2	103.7	109.6	
L	%Moisture = (I / K) x 100	%	3.9%	6.0%	7.4%	9.8%	

ASTM D4643 AASHTO T217 or T265 Tested by: ss



Max Dry Density
135.5 lbs./cu.ft.

Optimum Moisture
6.7%

MOISTURE-DENSITY RELATIONS OF SOILS

North Dakota Department Of Transportation, Materials & Research Division

SFN 10063 (Rev. 03-2006)

Project No. NHU-4-002(116)149	PCN	Station	Depth Below Grade				
Offset From Centerline		Type of Soil					
ASTHO Designation T-180	Date 12/7/2016	1155					
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.	8.77	9.03	9.14	9.04		
C Weight of Mold	lbs.	4.41	4.41	4.41	4.41	4.41	4.41
D Weight of Compacted Soil = B - C	lbs.	4.35	4.62	4.73	4.63		
E Wet Density = D / A	lbs./cu.ft.	130.8	138.7	142.1	139.0		
F Dry Density = (E x 100) / (100 + L)	lbs./cu.ft.	123.6	129.1	129.8	125.0	#VALUE!	#VALUE!

Moisture Content

AASHTO T99 or T180 Tested by:

Container No.	43	44	45	46		
G Wet Weight / Container	grams	157.1	150.3	152.3	150.1	
H Dry Weight / Container	grams	150.5	142.4	142.4	138.7	
I Moisture Loss = G - H	grams	6.6	7.9	9.9	11.4	
J Tare Weight of Container	grams	37.0	37.0	37.6	37.1	
K Dry Soil = H - J	grams	113.5	105.4	104.8	101.6	
L %Moisture = (I / K) x 100	%	5.8%	7.5%	9.4%	11.2%	

ASTM D4643 AASHTO T217 or T265 Tested by: ss

