Geotechnical Engineering Report

Proposed 16th Avenue North Reconstruction
Wahpeton, North Dakota
January 31, 2013
Terracon Project No. M1125078

Prepared for:
Interstate Engineering, Inc.
Wahpeton, North Dakota

Prepared by:
Midwest Testing Laboratory/Terracon
Fargo, North Dakota

Midwest Testing Laboratory, Inc.
A Terracon Company

January 31, 2013

Midwest Testing LABORATORY, INC. A Terracon COMPANY

Interstate Engineering, Inc.
P.O. Box 667
Wahpeton, ND 58074-0667

Attn: Mr. Randy Pope, P.E.
Randall.pope@interstateeng.com

Re: Geotechnical Engineering Report
Proposed 16th Avenue North Reconstruction
Wahpeton, North Dakota
MTL/Terracon Project Number: M1125078

Dear Mr. Pope:

Midwest Testing Laboratory (A Terracon Company) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our Proposal Number PM1120160 dated July 3, 2012. This report presents our findings of the subsurface exploration and provides geotechnical recommendations concerning the design and construction of the proposed street and utility improvements.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Midwest Testing Laboratory - A Terracon Company

Loel M. Fetting, PE
Geotechnical Department Manager

Theodore J. Engelstad, PE
Office Manager

LOEL M. FETTING REGISTERED PROFESSIONAL PE-3096 ENGINEER NORTH DAKOTA

Date 1-31-13

Enclosures
cc: 1 – Client (mail)
1 – Client
1 – File

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EXECUTIVE SUMMARY

Geotechnical engineering services have been completed for the proposed 16th Avenue North Reconstruction project in Wahpeton, North Dakota. As requested, six (6) soil test borings were performed to depths ranging from 5 to 25 feet below the existing ground surface. This report specifically addresses recommendations regarding the proposed street improvements.

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. The following geotechnical considerations were identified:

- Due to the extensive amount of organic soils encountered at the test boring locations, we anticipate the new roadway would likely be constructed over these existing organic soils. The best option for pavement support would be to remove all organic soils and replacement with a well compacted, inorganic, engineered fill. Due to the excessive depth of organic soils within the project area, we understand this may not be cost effective. Therefore, the owner must be willing to accept some risk of pavement settlement in these areas due to the uncontrolled nature of the fill and the presence of organic soils beneath the pavement.

- The natural inorganic soils encountered at our boring locations should be suitable for support of underground utilities.

- The subgrade soils beneath the existing road consist primarily of organic soil (topsoil) extending to depths on the order of four to five feet below the existing ground surface. We anticipate underground utilities would be supported below these organic soils or the organic soils are removed and replaced with a well compacted engineered fill.

- The utility trenches should be backfilled with native soils placed in thin lifts and compacted as recommended to prevent detrimental settlement of the utility trenches after completion of the project. Imported sand fill should not be substituted for native clay soils, due to the potential for differential frost heave.

- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that MTL/Terracon be retained to monitor this portion of the work.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED 16TH AVENUE NORTH RECONSTRUCTION
WAHPETON, NORTH DAKOTA
MTL/Terracon Project No. M1125078
January 31, 2013

1.0 INTRODUCTION

Geotechnical engineering services have been completed for the proposed 16th Avenue North reconstruction project in Wahpeton, North Dakota. Six (6) soil test borings were performed to depths ranging from 5 to 25 feet below the existing ground surface. The borings were performed at locations selected by Interstate Engineering, Inc. Logs of the borings along with a Site Location Map and Boring Location Plan are included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- utility trench backfill
- street improvements
- utility support

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	See Appendix A, Exhibit A-2: Boring Location Plan
Street Improvements	No specific information regarding street improvements was provided. We understand the project will feature a new street section, which will include new curb and gutter. We anticipate the street section will be lower somewhat from the existing rural section with ditches.
Utility Improvements	We anticipate excavation depths would not exceed a depth of approximately six feet below grade, based upon the shallow boring depth requested.

2.2 Site Location and Description

Item	Description
Location	16th Avenue North from the 210 Bypass Road east to 11th Street North in Wahpeton, North Dakota.

Item	Description
Current ground cover	Asphalt pavement
Existing topography	Relatively flat

3.0 SUBSURFACE CONDITIONS

3.1 Typical Pavement and Soil Profile

The test borings indicate the pavement ranges in thickness from approximately 3 ½ to 4 inches. Below the asphalt, granular base material was encountered which ranges in thickness from approximately 3½ to 6 inches. Below the granular base, fill soils consisting primarily of sandy organic soil and lean clays were encountered to depths approximately 4 to 5 feet below the existing ground surface. Most of the fill is black in color and contains a trace of gravel. Below the fill and organic soil, the soil conditions consist primarily of lean clay, lean clay with sand and fat clay. These natural clays are typically medium stiff to stiff in consistency. At Boring B-1, the natural lean clay with sand is found to extend to a depth of approximately 16.5 feet and was underlain by a fine grained silty sand with a loose density. At 25 feet, a gray lean clay was encountered which extends to the termination depth of the boring (26 feet).

Conditions at each boring location are indicated on the attached individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report. A discussion of the field sampling is included in Appendix A.

3.2 Groundwater

Groundwater was not measurable in any of the five shallow borings performed within the street section. Boring B-1 was extended to a depth of 25 feet and a ground water level of approximately 21 feet was measured upon completion of the boring. After a period of 3 hours, our final ground water level measurement was 10.5 feet below the ground surface. Due to safety concerns, each boring was backfilled and patched with asphalt. Due to the low permeability of the clay soils encountered within the borings, a long period of time may be needed to establish a ground water level. Long-term observations from piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in cohesive soils. Based on the measurement data, we estimate the ground water level was located approximately 6 to 10 feet below grade at the time of our field activities.

Groundwater level fluctuations should be expected to occur due to seasonal variations in rainfall, runoff and other factors. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The test borings indicate the existing pavement thickness ranges from approximately 3.5 to 4 inches. Below the pavement, we measured approximately 3½ to 6 inches of aggregate base material.

The subgrade soils within the road bed consist mostly of a sandy organic soil which is black in color and extends approximately 4 to 5 feet below grade. Generally, to obtain improved pavement performance, the best option for a new roadway would be remove these organic soils from beneath the paved areas. However, we understand this amount of excavation and fill replacement may be cost prohibitive, depending upon the new elevation of the street. If the black organic soils are allowed to remain below the new street, the owner must be willing to accept some risk of settlement and a lower level of pavement performance. We would expect the new street would have similar performance to the previous street section.

To reduce the potential for differential frost heave, we recommend reusing the native inorganic soils excavated from utility trenches for trench backfill. Utility trenches which are backfilled with clean sand can exhibit undesirable differential frost heaving on an annual basis.

The clay subgrade soils should be considered highly susceptible to frost heaving. Therefore, seasonal movement should be expected as frost penetrates the clay subgrade to depths on the order of 6 to 8 feet. These soils will also experience a significant loss of strength during spring thaw. Therefore, cracking of the pavement should be expected due to frost action and extreme temperature variations. Frost heaving could be prevented by replacing the clay subgrade soils with a clean, non-frost susceptible sand and gravel maintained in a drained condition. We understand this option is cost prohibitive.

4.2 Earthwork

4.2.1 Site Preparation

As discussed above, the best option for subgrade preparation in the street areas would be to remove all organic soils from below the new pavement. The test borings indicate excavation depths on the order of 4 to 5 feet below existing grade would be needed. If this amount of overexavation is cost prohibitive, organic soils could remain below the pavement areas and a reduced level of pavement performance would be expected, as compared to an inorganic soil subgrade.

4.2.2 Material Types

Compacted structural fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Select Granular Fill	SP, SP-SM, SP-SC, SW, SW-SM, SW-SC (P200<12%)	Pavement Subgrade
On-site soils	CL, CH, OL	Utility Trench Backfill and Pavement Subgrade

1. Controlled, compacted fill should consist of approved materials that are free of debris, or other deleterious substance. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.

4.2.3 Compaction Requirements

ITEM	DESCRIPTION
Fill Lift Thickness	9-inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack, plate compactor, etc.) is used
Compaction Requirements [1]	98% for final 1 foot below pavement cross-section 95% deeper than 1 foot below the pavement cross-section
Moisture Content Cohesive Soil	+/- 3% of Standard Proctor optimum moisture
Moisture Content Granular Material[2]	Workable moisture levels

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved. Compaction levels are relative to the soil's Standard Proctor maximum dry density (ASTM D698).
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

4.2.4 Utility Trench Backfill

Utility trench backfill should be compacted as recommended in Section 4.2.3. Excavations should be performed in accordance with governing safety regulations. All vehicles and soil piles should be kept back from the crest of excavation slopes. The stability of excavation slopes should be reviewed continuously by qualified personnel. The responsibility for excavation safety and temporary construction slopes lies solely with the contractor. Trenches that remain open for an extended period of time should be protected by changes in moisture by covering with plastic sheeting or another suitable method.

4.2.5 Construction Considerations

Based upon relatively shallow excavation depths of subgrade preparation and utility placement, we would expect groundwater could be adequately controlled by sump pumping, if encountered. At Boring B-1, any excavation which penetrates the wet silty sand below a depth of 16.5 feet should expect a significant flow of groundwater into the excavation and sump pumping may not be feasible to adequately control groundwater seepage. If needed, temporary dewatering wells could be placed in this area to lower the groundwater level during construction.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Safety and Health Administration (OSHA) regulations to provide stable and safe working conditions. The grading contractor, by his contract, is usually responsible for designing and constructing stable temporary excavations, and should shore, slope or bench the sides of the excavations as required to maintain stability of the excavation sides and bottom. All excavations should comply with the applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards. All excavations greater than 20 feet below grade are required by OSHA to be designed by a registered professional engineer.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observation during subgrade preparation, and compaction of engineered fill.

4.3 Subgrade Preparation

Upon excavating of the street section to the desired subgrade elevation, we recommend the exposed surface be scarified and recompacted as recommended in Section 4.2.3. After recompacting the exposed surface, we recommend placing the granular subbase and aggregate base material as recommended in Sections 4.2.2 and 4.2.3.

The subgrade should be successfully proof rolled prior to placement of the granular base material. If any areas fail the proof roll test, the soils in these areas should be removed and replaced with engineered fill as recommended above until the entire area is successfully proof rolled.

We recommend the moisture content and density of the upper 1 foot of the subgrade be evaluated and the pavement subgrade proof rolled within 2 days prior to commencement of the actual paving operations.

4.4 Pavement Design Parameters

One CBR test was performed on a composite sample collected from Borings B-2 and B-5 from 2 to 4½ feet below grade. When compacted to approximately 95 percent of the Standard Proctor maximum density, a CBR value of 5.8 was measured. We recommend using a CBR value of no greater than 5 in the pavement thickness design for the roadway.

We recommend consideration be given to the use of a separate fabric between the clay subgrade and any aggregate base or subbase material. The separation fabric will help improve the performance of the clay subgrade during spring thaw and other wet seasonal periods.

4.5 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable day light outlet should be provided to remove water from the granular base/sub-base.

4.5.1 Pavement Maintenance

Pavement maintenance should be planned and provided though an on-going pavement management program. Preventative maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventative maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventative maintenance. Even with periodic maintenance, movements and cracking related to frost heaving and extreme temperature variations will still occur and repairs may be required.

5.0 GENERAL COMMENTS

MTL/Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. MTL/Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless MTL/Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager:	LMF	Project No.	M1125078
Drawn by:	lmf	Scale:	See above
Checked by:	LMF		
Approved by:	LMF	Date:	1-29-2013

Midwest Testing LABORATORY, INC.
A Terracon COMPANY
4102 7th Avenue North Fargo, North Dakota 58102
PH. (701) 282-9633 FAX. (701) 282-9635

SITE LOCATION MAP

Proposed 16th Avenue North Reconstruction

210 Bypass Road to 11th Street North

Wahpeton, North Dakota

EXHIBIT

A-1

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager:	LMF	Project No.	M1125078
Drawn by:	lmf	Scale:	
Checked by:	LMF		
Approved by:	LMF	Date:	1-29-2013

Midwest Testing Laboratory, Inc.
A Terracon Company
4102 7th Avenue North Fargo, North Dakota 58102
PH. (701) 282-9633 FAX. (701) 282-9635

BORING LOCATION PLAN

Proposed 16TH Avenue North Reconstruction
210 Bypass Road to 11th Street North
Wahpeton, North Dakota

EXHIBIT
A-2

BORING LOG NO. B-1

PROJECT: Proposed 16th Avenue Reconstruction

CLIENT: Interstate Engineering, Inc. Wahpeton, North Dakota

SITE: 16th Avenue North Wahpeton, North Dakota

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)
0.3	**4" ASPHALT**						
0.7	**FILL, 4" AGGREGATE BASE**						
	FILL, SANDY ORGANIC SOIL AND LEAN CLAY, trace gravel, black, frozen to 2'			X	9	4-5-5 N=10	13
5.0		5		X	12	4-5-6 N=11	
	LEAN CLAY WITH SAND (CL), grayish brown to brown and light gray mottled, stiff to medium stiff			X	14	3-4-5 N=9	32
		10	▼	X	18	3-3-3 N=6	
			▽	X	18	2-2-3 N=5	33
16.5		15		X	18	3-4-3 N=7	
	SILTY SAND (SM), fine grained, brown, loose, wet	20	▽	X	18	2-2-3 N=5	
25.0		25					
26.0	**LEAN CLAY (CL)**, gray, medium stiff			X	18	2-3-3 N=6	
	Boring Terminated at 26 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.
26'S of C/L

Hammer Type: Mobile Downhole

Advancement Method:
3¼" HSA 0-24½'

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-9 for description of field procedures

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *21.2' initially observed before HSA removal.*
- ▽ *12.4' after 0 hrs (cave-in at 12.5').*
- ▼ *10.5' after 3 hrs (cave-in at 13.5').*

Midwest Testing Laboratory, Inc. A Terracon Company
4102 7th Ave. North
Fargo, North Dakota

Boring Started: 1/7/2013	Boring Completed: 1/7/2013
Drill Rig: Mobile B-53	Driller: DW
Project No.: M1125078	Exhibit: A-3

BORING LOG NO. B-2

PROJECT: **Proposed 16th Avenue Reconstruction**

SITE: **16th Avenue North Wahpeton, North Dakota**

CLIENT: **Interstate Engineering, Inc. Wahpeton, North Dakota**

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)
0.3	**3 3/4" ASPHALT**			Hand			29
0.8	**FILL, 6" AGGREGATE BASE**						
4.5	**FILL, SANDY ORGANIC SOIL AND LEAN CLAY**, trace gravel, mostly black, frozen to 2'			Split spoon	14	5-8-9 N=17	29
6.0	**LEAN CLAY WITH SAND (CL)**, grayish brown, stiff	5		Split spoon	12	4-3-5 N=8	31
	Boring Terminated at 6 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.
8'N of C/L

Hammer Type: Mobile Downhole

Advancement Method:
3¼" HSA 0-4½'

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-9 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not measurable before HSA removal.
Reversed auger upon completion.

Midwest Testing Laboratory, Inc. A Terracon Company
4102 7th Ave. North
Fargo, North Dakota

Boring Started: 1/7/2013	Boring Completed: 1/7/2013
Drill Rig: Mobile B-53	Driller: DW
Project No.: M1125078	Exhibit: A-4

BORING LOG NO. B-3

PROJECT: Proposed 16th Avenue Reconstruction

CLIENT: Interstate Engineering, Inc. Wahpeton, North Dakota

SITE: 16th Avenue North Wahpeton, North Dakota

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)
0.3	**3-1/2" ASPHALT**						
0.6	**FILL, 3-1/2" AGGREGATE BASE**						24
	FILL, SANDY ORGANIC SOIL, trace gravel, black, frozen to 2'				14	6-7-11 N=18	21
5.0		5					
6.0	**LEAN CLAY WITH SAND (CL)**, grayish brown, stiff				14	2-3-5 N=8	21

Boring Terminated at 6 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.
8'S of C/L

Hammer Type: Mobile Downhole

Advancement Method:
3¼" HSA 0-4½'

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-9 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not measurable before HSA removal.

Reversed auger upon completion.

Midwest Testing Laboratory, Inc. A Terracon Company
4102 7th Ave. North
Fargo, North Dakota

Boring Started: 1/7/2013	Boring Completed: 1/7/2013
Drill Rig: Mobile B-53	Driller: DW
Project No.: M1125078	Exhibit: A-5

BORING LOG NO. B-4

PROJECT: Proposed 16th Avenue Reconstruction

CLIENT: Interstate Engineering, Inc. Wahpeton, North Dakota

SITE: 16th Avenue North Wahpeton, North Dakota

LOCATION See Exhibit A-2

GRAPHIC LOG / DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)
0.3	**4" ASPHALT**						
0.8	**FILL, 6" AGGREGATE BASE**			Grab			24
	FILL, SANDY ORGANIC SOIL, trace gravel, black, frozen to 2'			Split spoon	16	22-16-9 N=25	19
5.0		5					
6.0	**LEAN CLAY WITH SAND (CL)**, light grayish brown, stiff			Split spoon	12	3-4-6 N=10	27
	Boring Terminated at 6 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.
7'N of C/L

Hammer Type: Mobile Downhole

Advancement Method:
3¼" HSA 0-4½'

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-9 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not measurable before HSA removal.

Reversed auger upon completion.

Midwest Testing Laboratory, Inc. A Terracon Company
4102 7th Ave. North
Fargo, North Dakota

Boring Started: 1/7/2013	Boring Completed: 1/7/2013
Drill Rig: Mobile B-53	Driller: DW
Project No.: M1125078	Exhibit: A-6

BORING LOG NO. B-5

PROJECT: Proposed 16th Avenue Reconstruction

CLIENT: Interstate Engineering, Inc. Wahpeton, North Dakota

SITE: 16th Avenue North Wahpeton, North Dakota

LOCATION See Exhibit A-2

GRAPHIC LOG	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)
	0.3	**4" ASPHALT**						
	0.7	**FILL, 4" AGGREGATE BASE**						
	4.5	**FILL, SANDY ORGANIC SOIL AND LEAN CLAY**, trace gravel, mostly black, frozen to 2'			Hand			
					Split spoon	14	7-5-6 N=11	17
	6.0	**LEAN CLAY WITH SAND (CL)**, brown, stiff	5		Split spoon	10	3-4-5 N=9	19
		Boring Terminated at 6 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.
6.5'S of C/L

Hammer Type: Mobile Downhole

Advancement Method:
3¼" HSA 0-4½'

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-9 for description of field procedures

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not measurable before HSA removal.

Reversed auger upon completion.

Midwest Testing Laboratory, Inc. A Terracon Company
4102 7th Ave. North
Fargo, North Dakota

Boring Started: 1/7/2013	Boring Completed: 1/7/2013
Drill Rig: Mobile B-53	Driller: DW
Project No.: M1125078	Exhibit: A-7

BORING LOG NO. B-6

PROJECT: Proposed 16th Avenue Reconstruction

CLIENT: Interstate Engineering, Inc. Wahpeton, North Dakota

SITE: 16th Avenue North Wahpeton, North Dakota

LOCATION See Exhibit A-2

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)
0.3	**4" ASPHALT**					
0.7	**FILL, 4-1/2" AGGREGATE BASE**					
3.0	**FILL, LEAN CLAY WITH SAND AND SANDY ORGANIC SOIL**, trace gravel, dark gray and black, frozen to 2'				3-4-7 N=11	30
4.0	**TOPSOIL, ORGANIC SOIL (OL)**, black					
6.0	**FAT CLAY (CH)**, dark grayish brown, stiff	5			4-4-7 N=11	27
	Boring Terminated at 6 Feet					

Stratification lines are approximate. In-situ, the transition may be gradual.
10'N of C/L

Hammer Type: Mobile Downhole

Advancement Method:
3¼" HSA 0-4½'

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-9 for description of field procedures

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not measurable before HSA removal.

Reversed auger upon completion.

Midwest Testing Laboratory, Inc. A Terracon Company
4102 7th Ave. North
Fargo, North Dakota

Boring Started: 1/7/2013	Boring Completed: 1/7/2013
Drill Rig: Mobile B-53	Driller: DW
Project No.: M1125078	Exhibit: A-8

Field Exploration Description

Six soil test borings were completed for the project on January 7, 2013. The borings were advanced at the approximate locations indicated on Exhibit A-2. The borings were performed at staked locations provided by Interstate Engineering, Inc. Ground surface elevations at the boring locations were not determined.

The test borings were completed with a Mobile B-53 truck-mounted drill rig using 3¼ hollow stem to advance boreholes. Soil samples were obtained using both split-barrel and Shelby tube sampling procedures. In the split-barrel sampling procedure the number of blows required to advance a standard 2-inch O.D., 1-3/8-inch I.D spilt-barrel sampler from 6 to 18 inches of penetration by means of a 140-pound hammer with a free fall of 30 inches is used to obtain the Standard Penetration Test (SPT) or N-value. The SPT is used to estimate the in-situ relative density of cohesionless soils and the consistency of cohesive soils. In the Shelby tube sampling procedure, a thin wall seamless steel tube with a sharp cutting edge is pushed into the soil by hydraulic pressure to obtain a relatively undisturbed sample of cohesive soil.

A Mobile down-hole hammer was used to advance the split spoon sampler. A somewhat reduced efficiency is typically achieved with the down-hole hammer compared to the conventional safety hammer operated with a cathead and rope. The efficiency of the hammer can have an appreciable affect on the standard penetration resistance blow count (N) values. The effect of the down-hole hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings prior to the drill crew leaving the site.

A field log of each boring was prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

APPENDIX B
SUPPORTING INFORMATION

Laboratory Testing

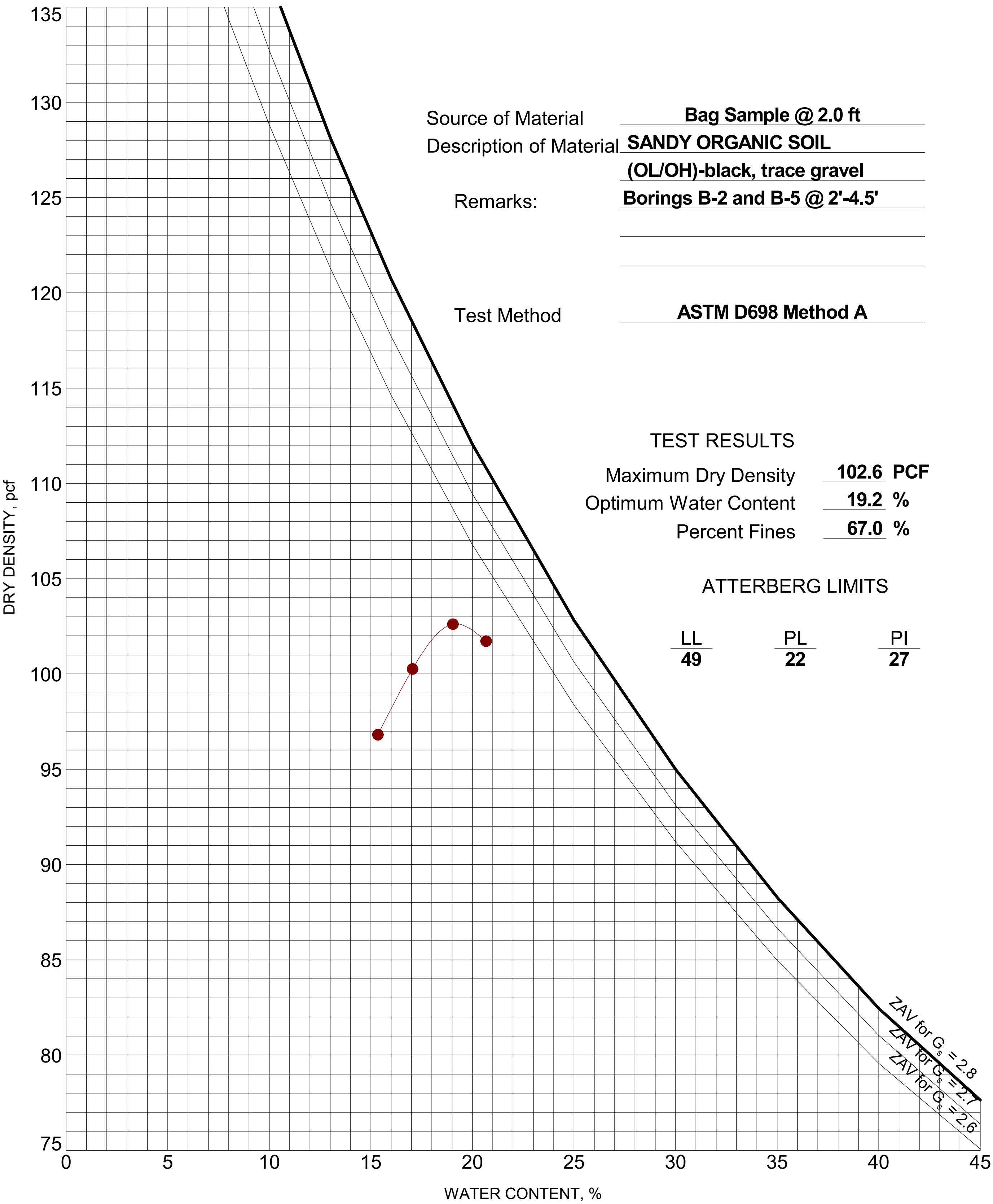
Representative samples were selected for laboratory analysis. The testing program consisted of determining the moisture content of the subgrade soils. The laboratory test results are found on the boring logs opposite the samples they represent.

Bag samples of subgrade soils collected from Borings B-2 and B-5 were tested to determine the moisture-density relationship (ASTM D698), Atterberg limits and percent passing the #200 sieve. A sample of the subgrade material was then recompacted to 96 percent of ASTM D698 and tested to determine the California Bearing Ratio (CBR). The moisture-density relation, Atterberg, minus 200 and CBR test results are shown on Exhibits B-2 and B-3.

Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report. All classification was by visual manual procedures. Selected samples were further classified using the results of Atterberg limit testing. The Atterberg limit test results are also provided on the boring logs.

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **Bag Sample @ 2.0 ft**

Description of Material: **SANDY ORGANIC SOIL (OL/OH)-black, trace gravel**

Remarks: **Borings B-2 and B-5 @ 2'-4.5'**

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**102.6**	**PCF**
Optimum Water Content	**19.2**	**%**
Percent Fines	**67.0**	**%**

ATTERBERG LIMITS

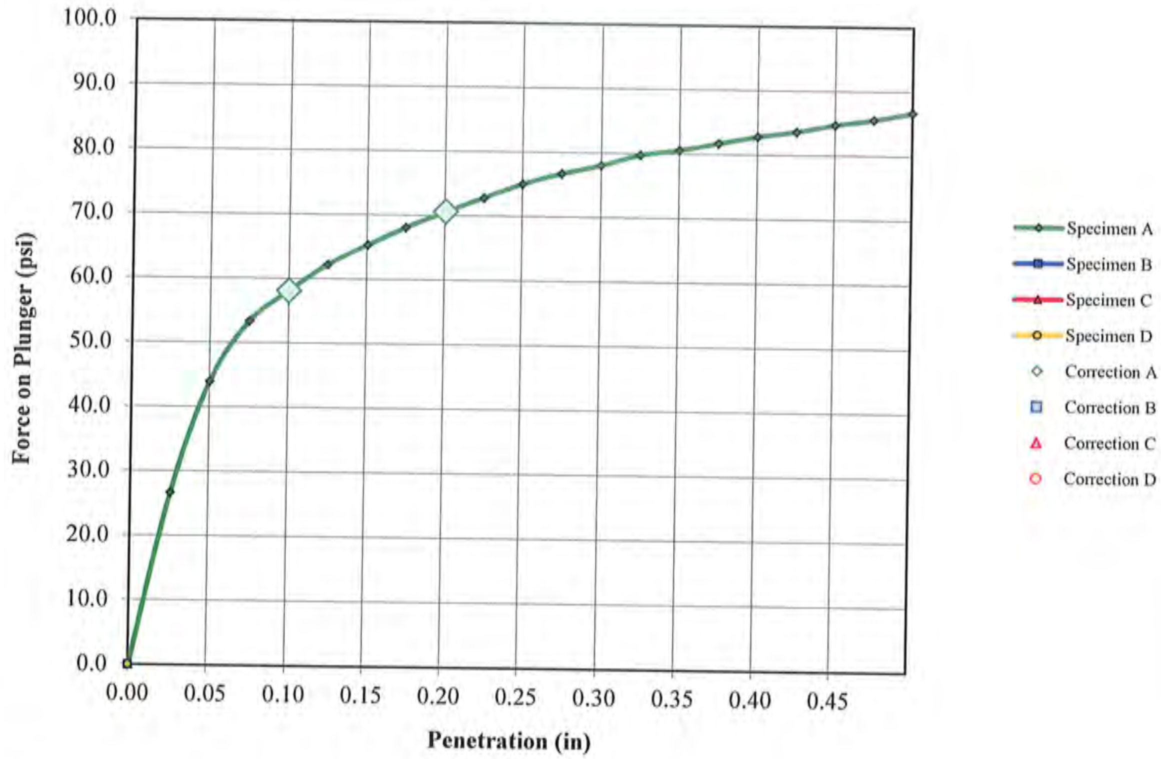
LL	PL	PI
49	**22**	**27**

PROJECT: Proposed 16th Avenue Reconstruction	Midwest Testing Laboratory, Inc. A Terracon Company	PROJECT NUMBER: M1125078
SITE: 16th Avenue North Wahpeton, North Dakota	4102 7th Ave. North Fargo, North Dakota	CLIENT: Interstate Engineering, Inc. Wahpeton, North Dakota
		EXHIBIT: B-2

Terracon

California Bearing Ratio Test Report

Load Penetration Curve



CBR Results					
Results	**A**	**B**	**C**	**D**	**Average**
0.1 in Pen.	5.8				5.8
0.2 in Pen.	4.7				4.7
Moisture (%)	20.3				20.3
Density (pcf)	98.4				98.4
Final Moisture (%)	23.9				23.9
Final Density (pcf)	97.8				97.8

Project Information			
Project Num	M1125078	**Sample Location**	
Project	Proposed 16th Ave North	Specimen A	Wahpeton, ND
Date		Specimen B	
Client	Interstate Engineering, Inc.	Specimen C	
		Specimen D	
		Test Variables	
Job Ref.		Liquid Limit:	
Sample Num.		Plastic Limit:	
Remarks			

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	**Split Spoon**
Shelby Tube	**Macro Core**
Ring Sampler	**Rock Core**
Grab Sample	**No Recovery**

WATER LEVEL

- **Water Initially Encountered**
- **Water Level After a Specified Period of Time**
- **Water Level After a Specified Period of Time**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	**Hand Penetrometer**
(T)	**Torvane**
(b/f)	**Standard Penetration Test (blows per foot)**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	5 - 7	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 14	10 - 18
Very Dense	> 50	$\geq$ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Midwest Testing Laboratory, Inc. A Terracon Company

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	**Group Name** [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			$PI < 4$ or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains $\geq$ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains $\geq$ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] $PI \geq 4$ and plots on or above "A" line.
[O] $PI < 4$ or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

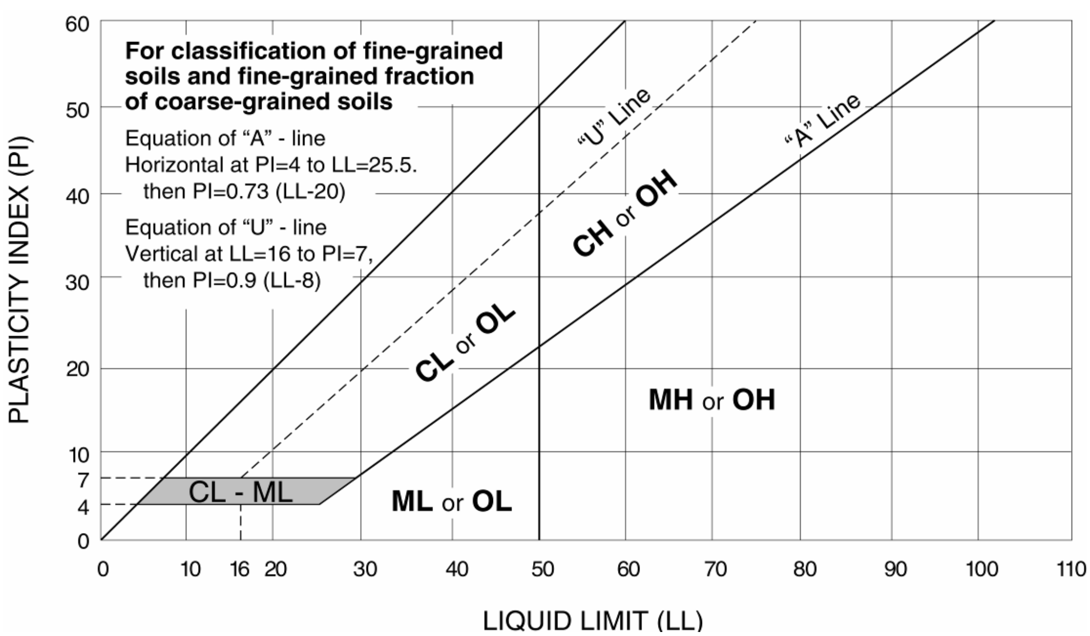


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Exhibit C-2