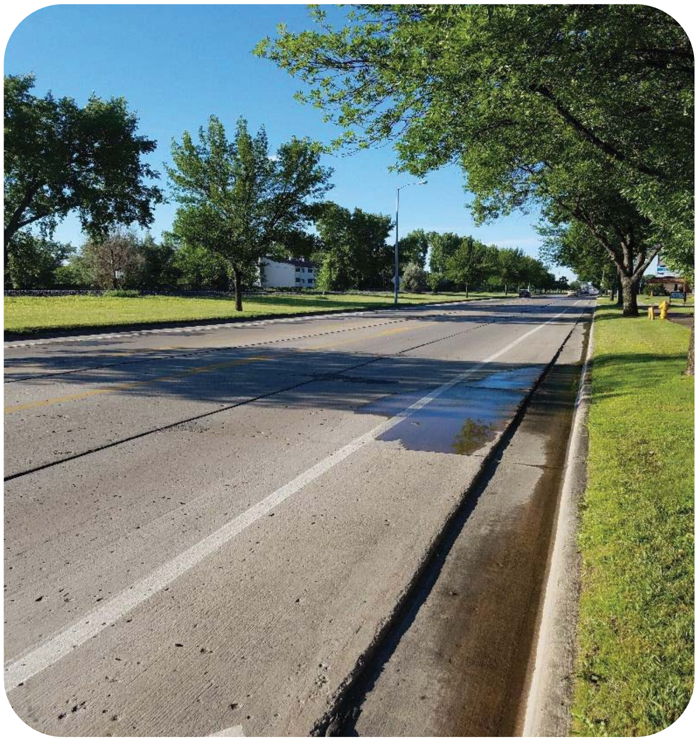
# Geotechnical Engineering Report

**North 42nd Street Reconstruction**
**University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

December 27, 2016
Terracon Project No. M5165003

**Prepared for:**
CPS, Ltd.
Grand Forks, North Dakota



**Prepared by:**
Terracon Consultants, Inc.
Grand Forks, North Dakota

December 27, 2016

CPS, Ltd.
308 2nd Avenue North
Grand Forks, ND 58203

Attn: Mr. Deon Wawrzyniak, PE
P: [701] 738-4056
E: deon.wawrzyniak@cpsengineering.net

Re: Geotechnical Engineering Report
North 42nd Street
University Avenue to Gateway Drive
Grand Forks, North Dakota
Terracon Project Number: M5165003

Dear Mr. Wawrzyniak:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal dated January 28, 2016. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of pavements.

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,
**Terracon Consultants, Inc.**

REGISTERED PROFESSIONAL ENGINEER
LOEL M. FETTING
PE-3096
DATE 12/27/16
NORTH DAKOTA

Jonathan J. Malaterre, EI
Staff Engineer

Loel M. Fetting, PE
Senior Engineer

William R. Olson, PE
Geotechnical Department Manager

Enclosures
cc: 1 – Client

Terracon Consultants, Inc. 1555 N. 42nd Street – Unit B Grand Forks, ND 58203-0809
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## TABLE OF CONTENTS

# EXECUTIVE SUMMARY

Geotechnical engineering services have been completed for the proposed street reconstruction of North 42$^{nd}$ Street in Grand Forks, North Dakota. Fifteen (15) soil test borings were advanced to depths ranging from 15 to 40 feet below the existing ground surface. Based on the information obtained from our subsurface exploration, the following geotechnical considerations were identified:

- The soils encountered beneath the existing concrete roadway consists of fill containing lean clay with sand and traces of gravel. The fill was underlain by inorganic lean clays containing various amounts of silt followed by fat clays which extends to the termination depth of our borings. A number of our borings also encountered topsoil/organic fill in the upper 3 feet.

- Use of the existing subgrade soils for support of the proposed pavement is feasible. However, soils encountered in our borings are highly susceptible to frost heaving and ice lens formation. Therefore, seasonal pavement movement and cracking should be expected due to the extreme temperature changes that will occur.

- Supporting the proposed traffic signal on a drilled pier foundation is feasible.

- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that 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
# NORTH 42ND STREET RECONSTRUCTION
# UNIVERSITY AVENUE TO GATEWAY DRIVE
# GRAND FORKS, NORTH DAKOTA

**Terracon Project No. M5165003**
**December 27, 2016**

## 1.0 INTRODUCTION

Geotechnical engineering services have been completed for the proposed street reconstruction of North 42nd Street in Grand Forks, North Dakota. Fifteen (15) soil test borings were advanced to depths ranging from 15 to 40 feet below the existing ground surface. Logs of the borings along with a Site Location Map and Exploration 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
- signal base design and construction
- earthwork
- pavement design and construction

## 2.0 PROJECT INFORMATION

### 2.1 Project Description

| Item | Description |
|---|---|
| **Site layout** | See Appendix A, Exhibit A-2 and A-3: Exploration Plan |
| **Proposed improvements** | The project will include construction of the roadway and installation of underground utilities and traffic signals. We anticipate underground utilities will be installed below the pavement to depths of approximately 8 to 10 feet. Both Portland cement concrete and asphalt cement concrete pavement sections are being considered. |
| **Structure** | Traffic signal |
| **Maximum loads** | Signal bases - 30 kips vertical (assumed) |

### 2.2 Site Location and Description

| Item | Description |
|---|---|
| **Location** | North 42nd Street from University Avenue to Gateway Drive. See Appendix A, Exhibit A-1: Site Location Map |
| **Existing improvements** | Existing street; we understand the Portland cement concrete pavement is on the order of 40 years old and has experienced distress due to age and movement and faulting due to frost heaving and a weak subgrade. |
| **Current ground cover** | Concrete pavement |
| **Existing topography** | Relatively level |

## 3.0 SUBSURFACE CONDITIONS

### 3.1 Geology

The near surface soils encountered at the site were deposited by Glacial Lake Agassiz which covered the area approximately 9,000 to 13,000 years ago. The lake was created when the Late Wisconsian ice mass retreated northward to expose the drainage divide in northern South Dakota and south-central Minnesota and meltwater ponded north of this divide. Clay particles were carried to the lake by runoff where they settled to the bottom and accumulated over time. The lake deposited clays are underlain by glacial tills that are expected to extend to depths in excess of 300 feet, where bedrock would be encountered

### 3.2 Typical Profile

Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

| Stratum | Approximate Depth to Bottom of Stratum[1] (feet) | Material Description | Consistency/Density |
|---|---|---|---|
| 1 | ¾ | Concrete pavement | N/A |
| 2 | 3 | Existing fill consisting of lean clays with sand, traces of gravel and organic material | N/A |
| 3 | 6 | Inorganic lean clays containing lenses and layers of silt | Ranges from soft to medium stiff |

| Stratum | Approximate Depth to Bottom of Stratum[1] (feet) | Material Description | Consistency/Density |
|---|---|---|---|
| 1 | ¾ | Concrete pavement | N/A |
| 4 | Undetermined | Fat clays containing varying amounts of silt | Ranges from soft to medium stiff |

1. Boring B-11 was terminated at 41 feet below the existing ground surface. All other borings were terminated at their planned depths of 16 feet below the existing ground surface within this stratum.

Conditions encountered at each boring location are indicated on the 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.

### 3.3 Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was not observed in the borings while drilling, or for the short duration that the borings were allowed to remain open. However, this does not necessarily mean these borings terminated above groundwater. Due to the low permeability of the soils encountered in the borings, a relatively long period of time may be necessary for a groundwater level to develop and stabilize in a borehole in these materials. Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type. Based on our previous experience in the area, we estimate that the groundwater level is on the order of 5 to 10 feet below the existing ground surface.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the roadway 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

In our opinion, use of the existing subgrade for pavement support is feasible. The native silt and clay soils encountered in our borings are highly susceptible to frost heaving and ice lens formation, especially when the water table is in the freezing zone. Therefore, seasonal pavement movement and cracking should be expected due to the extreme temperature changes that will occur. To prevent movement from frost action, the entire pavement area would need to be sub cut to frost depth (6 – 8 feet) and the material replaced with a free draining granular fill maintained in a drained condition. This is usually cost prohibitive. Therefore, seasonal movement from frost action should be expected if the silts and lean clays are not removed. Increasing the thickness of a granular subbase should provide improved pavement performance. The thickness of granular soils below the pavement should be uniform to prevent differential frost heave (such as within utility trenches backfilled with sand).

Our borings encountered topsoil at various depths extending to approximately 3 feet below the existing grade. Organic soils are generally considered undesirable for support of pavements since they have a reduced level of performance as compared to inorganic soils. If topsoil is encountered at or near our recommended pavement subcut elevation, we recommend removing the existing topsoil and replacing it with controlled engineered fill or additional subbase material to subbase depth. If the existing, organic soils are used for the support of the pavement, there would be an increased risk of poor pavement performance.

The soils at this site are also susceptible to a significant loss of strength during spring thaw. Load-supporting capacity of the pavement is decreased during frost melting since water cannot drain through the soil that is still frozen below. Also, if the aggregate base course becomes saturated, its strength is significantly reduced. Therefore, consideration should be given to providing internal drainage within the aggregate base/subbase section.

For long term pavement performance, the pavement should have good surface drainage to catch basins. A maintenance program consisting of filling and maintaining the cracks that develop are needed for long term pavement performance.

## 4.2 Pavement Construction

### 4.2.1 Subgrade Preparation

After excavation to the desired subgrade elevation, we recommend subgrade soils be scarified to a depth of 12 inches, and recompacted to a minimum of 95 percent of maximum density as determined by the Standard Proctor AASHTO T-99. The water content at the time of compaction should be within zero to four percent below optimum. Moisture conditioning may be needed to obtain the recommended water contents. We recommend installing an appropriate geotextile fabric be placed as a separator between the subgrade and the granular base or subbase course.

If additional fill is needed to obtain the subgrade elevation, we recommend inorganic lean or fat clays be used. The fill should be placed in loose lift thicknesses of 6 inches or less and compacted to a minimum of 95 percent of the maximum density as determined by AASHTO T-99. The water content at the time of compaction should be within zero to four below optimum.

To avoid potential construction delays associated with moisture conditioning of the subgrade soils, consideration should be given to placing the subbase over the existing subgrade soils without scarification or recompaction. In this case, we recommend a minimum 6 inches of additional subbase be placed in lieu of subgrade preparation. The soils encountered in our borings are sensitive to disturbance; therefore, the excavation should be completed by a backhoe with a smooth cutting surface. Construction traffic should not be allowed to travel directly on the exposed soils. We recommend close construction observation by a geotechnical engineer during excavation of subgrade soils prior to placement of subbase soils. Any areas of excessively soft or otherwise unsuitable soils should be corrected before placing aggregate materials. The subbase course should be placed using low ground pressure equipment. Heavy construction traffic should not be allowed to travel on the roadway until the subbase course has been placed.

### 4.2.2 Utility Trench Backfill

It is our understanding that the underground utilities will be installed approximately 8 to 10 feet below the pavement. We recommend the utility trenches be backfilled with soils similar to the surrounding area to reduce the potential for differential frost heave. We recommend all trench backfill below paved areas be placed in loose lift thicknesses of 6 inches or less and compacted to a minimum of 95 percent of maximum density as determined by AASHTO T-99. The water content at the time of compaction should be within three percent of optimum. Moisture conditioning of the soils would likely be needed to obtain the recommended water content.

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.

### 4.2.3 Design Recommendations

Estimates of minimum thicknesses for new pavement sections for this project have been based on the procedures outlined in the 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993). The following minimum thicknesses were estimated based upon the provided traffic loading, variation across the project area, and experience with similar project sites. The table below includes the variables used for our pavement analyses:

| Bituminous Pavement Design Parameters | |
|---|---|
| **Design Parameter** | **Value** |
| Design ESALs | 1,594,064 |
| Design Life | 20 years |

| Bituminous Pavement Design Parameters | |
|---|---|
| **Design Parameter** | **Value** |
| Subgrade Support ($M_R$) | 4,350 psi |
| Asphalt Pavement Coefficient | 0.36 |
| Aggregate Base Layer Coefficient | 0.10 |
| Subbase Layer Coefficient | 0.08 |
| Initial Serviceability | 4.2 |
| Terminal Serviceability | 2.0 |
| Reliability | 85% |
| Standard Deviation | 0.49 |

| Portland Cement Design Parameters | |
|---|---|
| **Design Parameter** | **Value** |
| Design ESALs | 3,287,204 |
| Design Life | 30 years |
| Subgrade Support (K) | 200 pci |
| Compressive Strength | 4,000 psi |
| Modulus of Elasticity | 3,600 ksi |
| Modulus of Rupture | 580 psi |
| Initial Serviceability | 4.5 |
| Terminal Serviceability | 2.5 |
| Drainage Coefficient | 1.0 |
| Load Transfer ("J" Factor) | 2.7 |
| Reliability | 95% |
| Standard Deviation | 0.39 |

### 4.2.4 Asphaltic Cement Concrete Thickness Design Recommendations

| Minimum Recommended ACC Pavement Section Thickness (inches) | | | | |
|---|---|---|---|---|
| **Traffic Area** | **Asphalt Pavement** [1] | **Aggregate Base** [2] | **Aggregate Subbase** [3, 4] | **Total Thickness** |
| Two-lane street with turn lanes | 6.0 | 12.0 | 12.0 | 30.0 |

1. We recommend a mix meeting the FAA 43 in Section 430.03 of the NDDOT manual. A tack coat between the lifts is recommended for the asphalt pavements.
2. The base course should meet the requirements of North Dakota 816.03 Class 5. As an alternative, a recycled concrete aggregate meeting the requirements of North Dakota 817 may be used. We recommend the aggregate base course be placed in loose lift thicknesses of 6 inches or less and compacted to a minimum of 98 percent of the Standard Proctor maximum density.

***Continued from Page 6:***

3. The subbase course should meet the requirements of North Dakota 816.01 Class 3. We recommend the subbase course be placed in loose lift thicknesses of 6 inches or less and compacted to a minimum of 98 percent of the Standard Proctor maximum density. We recommend a geotextile fabric, meeting the requirements of NDDOT Section 858 Type R1, be provided between the aggregate base and the subgrade where asphalt pavement is implemented.
4. In lieu of subgrade preparation, an additional 4 inches of subgrade may be placed.

### 4.2.5 Portland Cement Concrete Thickness Design Recommendations

| Minimum Recommended PCC Pavement Section Thickness (inches) | | | | | |
|---|---|---|---|---|---|
| **Traffic Area** | **Pavement Type** | **Portland Cement Concrete [1]** | **Aggregate Base [2]** | **Aggregate Subbase [3, 4]** | **Total Thickness** |
| Two-lane street with turn lanes | Doweled jointed plain concrete | 8.0 | 12.0 | 12.0 | 32.0 |

1. 4,000 psi at 28 days, 5 to 7 percent air entrained, and a maximum 0.45 water to cement ratio cement mix PCC pavement is recommended.
2. The base course should meet the requirements of North Dakota 816.03 Class 5. As an alternative, a recycled concrete aggregate meeting the requirements of North Dakota 817 may be used. We recommend the aggregate base course be placed in loose lift thicknesses of 6 inches or less and compacted to a minimum of 98 percent of the Standard Proctor maximum density.
3. The subbase course should meet the requirements of North Dakota 816.01 Class 3. We recommend the subbase course be placed in loose lift thicknesses of 6 inches or less and compacted to a minimum of 98 percent of the Standard Proctor maximum density.
4. In lieu of subgrade preparation, an additional 6 inches of subgrade may be placed.

### 4.2.6 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 daylight outlet should be provided to remove water from the granular subbase.

### 4.2.7 Pavement Maintenance

The pavement sections provided in this report represent the minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventative maintenance should be planned and provided for through 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. Additional engineering observation is recommended to determine the type and extent of a cost effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

## 4.3 Signal Foundation

In our opinion, a drilled pier foundation is feasible for support of the traffic signals. Design recommendations for drilled piers are provided in the following paragraphs. The analyses performed for foundation design recommendations is based on soils encountered in boring B-11 at the 6th Street intersection.

### 4.3.1 Drilled Pier Design Recommendations

We recommend the drilled piers extend well below frost depth to prevent movement from frost action. We further recommend the drilled piers extend to a minimum depth of 12 feet below the final exterior grade.

Soil parameters which may be used in design of the drilled piers are presented in the following table. The values provided in the table are based on our analysis of the existing subsurface conditions and were estimated using generally accepted engineering correlations. The values are based on undisturbed soil conditions. We recommend neglecting the upper 6 feet of soils due to softening during spring thaw.

| Depth (feet) | Description and Soil Model Type | Wet Unit Weight (pcf) | Submerged Unit Weight (pcf) | Allowable Skin Friction (psf) | Allowable End Bearing Pressure (psf) | Internal Angle of Friction (degrees) | Cohesion (psf) | Soil Modulus Parameter k (pci) | Soil Strain Parameter E50 (in/in) |
|---|---|---|---|---|---|---|---|---|---|
| 0 – 6 | Frost Zone | 120 | 58 | Ignore | Ignore | Ignore | Ignore | Ignore | Ignore |
| 6 – 21 | Fat Clay | 112 | 50 | 300 | 1,250 | 0 | 1,000 | 100 | 0.01 |
| 21 – 34 | Fat Clay | 108 | 45 | 300 | 1,000 | 0 | 700 | 100 | 0.01 |
| 34 – 37 | Lean Clay | 116 | 54 | 200 | 1,000 | 0 | 500 | 100 | 0.01 |
| 37 – 41 | Fat Clay | 110 | 48 | 300 | 1,000 | 0 | 700 | 30 | 0.02 |

The soil modulus parameter and soil strain parameter are for use in lateral and moment load analysis using the computer program L-PILE. These values are not factored (i.e., they represent the ultimate soil parameters with no factor of safety applied). However, the skin friction and bearing pressure each have a factor of safety of 2 and 3, respectively.

### 4.3.2 Drilled Pier Foundation Construction Considerations

We anticipate conventional drilling equipment would be able to penetrate the native soils. Temporary casing will be needed during the pier excavation to prevent the sidewall soils from collapsing. We anticipate any groundwater encountered in short term excavations would be controllable by sump pumping.

The geotechnical engineer should be notified if the subsurface conditions differ from those encountered at our test boring locations. We recommend a geotechnical engineer or a representative be on site during construction to observe the drilled pier excavations.

## 5.0 GENERAL COMMENTS

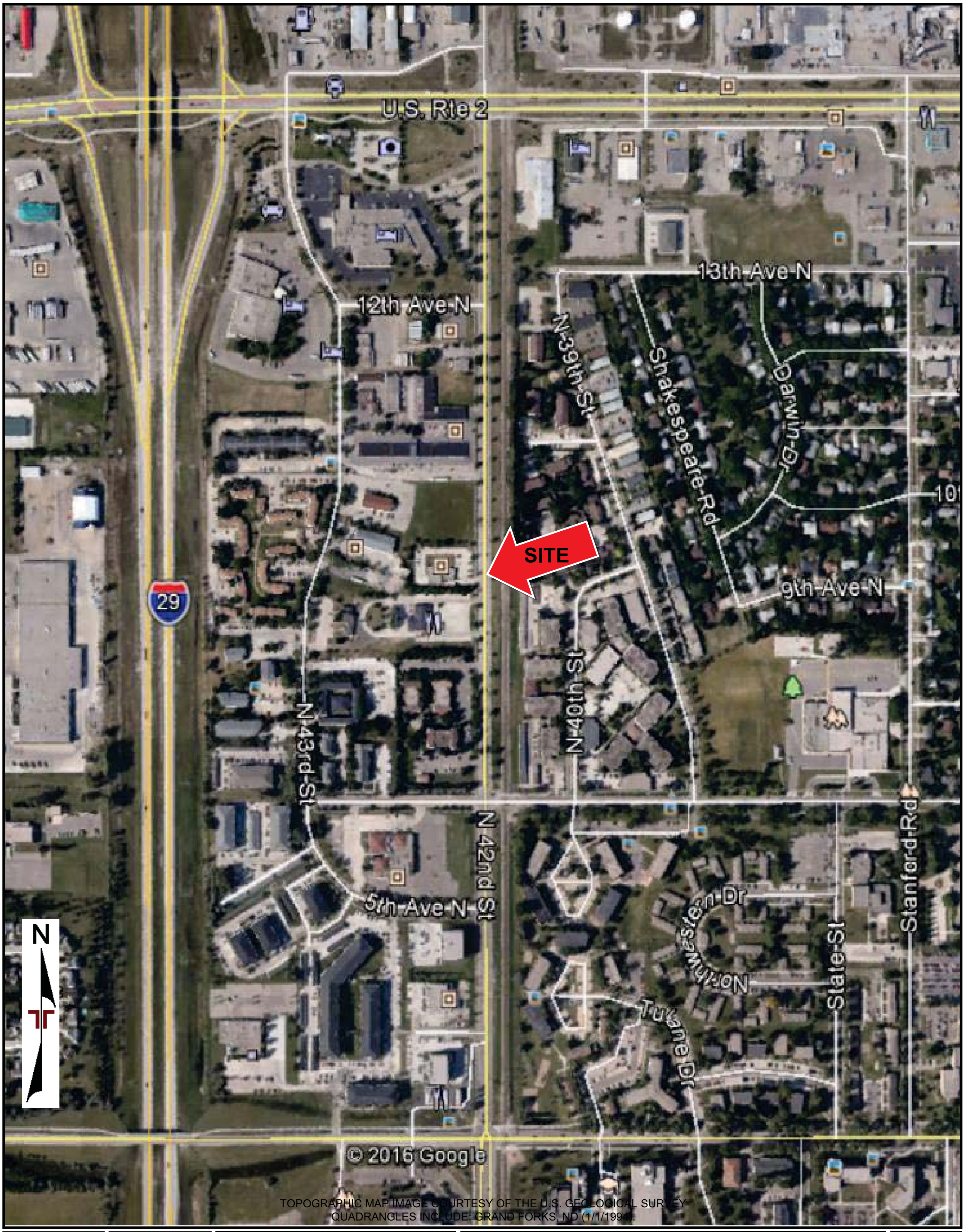
Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during 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 expressed 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 Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

# APPENDIX A
# FIELD EXPLORATION




| | | | | |
|---|---|---|---|---|
| Project Manager: CDL | Project No. M5165003 | Terracon | SITE LOCATION MAP | Exhibit |
| Drawn by: JJM | Scale: 1"=2,000' | 1555 N 42nd Street, Unit B | North 42nd Street Reconstruction | A-1 |
| Checked by: WRO | File Name: | Grand Forks, ND 58203-0809 | University Avenue to Gateway Drive | |
| Approved by: WRO | Date: 7/8/2016 | | Grand Forks, North Dakota | |

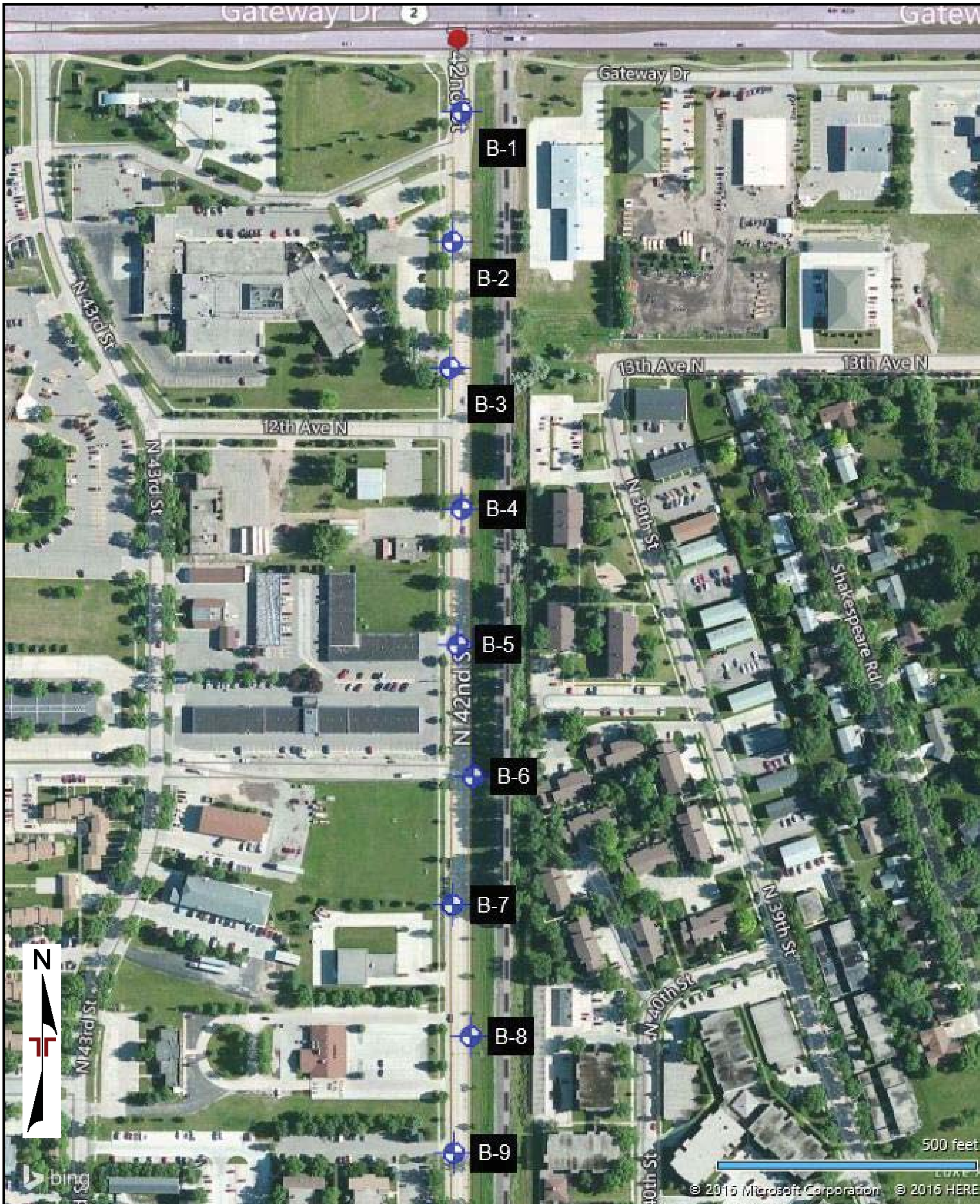



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

| | | | | |
|---|---|---|---|---|
| Project Manager: CDL | Project No. M5165003 | Terracon | EXPLORATION PLAN | Exhibit |
| Drawn by: JJM | Scale: AS SHOWN | 1555 N 42nd Street, Unit B | North 42nd Street Reconstruction | A-2 |
| Checked by: WRO | File Name: | Grand Forks, ND 58203-0809 | University Avenue to Gateway Drive | |
| Approved by: WRO | Date: 7/8/2016 | | Grand Forks, North Dakota | |


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

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

| | | | | |
|---|---|---|---|---|
| Project Manager: CDL | Project No. M5165003 | Terracon | EXPLORATION PLAN | Exhibit |
| Drawn by: JJM | Scale: AS SHOWN | 1555 N 42nd Street, Unit B | North 42nd Street Reconstruction | A-3 |
| Checked by: WRO | File Name: | Grand Forks, ND 58203-0809 | **University Avenue to Gateway Drive** | |
| Approved by: WRO | Date: 7/8/2016 | | **Grand Forks, North Dakota** | |

## Field Exploration Description

Fifteen (15) soil test borings ranging from approximately 15 to 40 feet were completed on July 12, 2016. The borings were advanced at the approximate locations indicated on Exhibit A-2. The boring locations were laid out in the field by a Terracon representative using a hand-held GPS equipment which is typically accurate within about 20 feet. Ground surface elevations indicated on the boring logs were measure in the field using a surveyor's level and grade rod. The locations and elevation of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled with a track-mounted rotary drill rig using 3 ¼ hollow stem auger to advance the 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.

An automatic SPT hammer was used to advance the split-barrel sampler in the borings performed at this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic 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.

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.

# BORING LOG NO. B-1



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.**
**Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.9326° Longitude: -97.0881°

| DEPTH | DESCRIPTION (ELEVATION (Ft.)) | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | **6" CONCRETE PAVEMENT** | | | | | | | | | | | | |
| 2.5 | **FILL - LEAN CLAY WITH SAND**, very dark gray | | | | 0.6 | 3-5-5 N=10 | | 3000 (HP) | | 17 | | | |
| 3.0 | **FILL - POORLY GRADED SAND WITH GRAVEL**, gray | | | | 0.5 | 3-4-5 N=9 | | | | 27 | | | |
| 4.0 | **LEAN CLAY (CL)**, old topsoil, black, soft | | | | | | | | | | | | |
| 6.0 | **LEAN CLAY (CL)**, lenses of silt, light olive brown, soft | 5 | | | 0.3 | 1-1-2 N=3 | | 3500 (HP) | | 28 | | | |
| 14.0 | **FAT CLAY (CH)**, iron nodules, iron staining, olive brown and gray, soft | | | | 0.7 | 1-2-1 N=3 | | 2000 (HP) | | 39 | | | |
| | | 10 | | | 1.2 | 2-1-2 N=3 | | 2000 (HP) | | 40 | | | |
| | | | | | 1.3 | 1-2-2 N=4 | | 2000 (HP) | | 48 | | | |
| 16.0 | **FAT CLAY (CH)**, iron staining, grayish brown mottled, soft | 15 | | | 1.5 | 1-1-2 N=3 | | 1500 (HP) | | 49 | | | |
| | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**
*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-5 |

# BORING LOG NO. B-2



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.**
**Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.93192° Longitude: -97.08817°

| DEPTH | Description | ELEVATION (Ft.) | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.6 | **7.5" CONCRETE PAVEMENT** | | | | | | | | | | | | | |
| 3.0 | **FILL - LEAN CLAY WITH SAND**, trace gravel, dark olive brown | | | | | 0.7 | 3-4-4 N=8 | | 7000 (HP) | | 13 | | | |
| | | | | | | 0.7 | 2-2-3 N=5 | | 2000 (HP) | | 33 | | | |
| 3.5 | **FILL - SANDY LEAN CLAY**, olive brown | | | | | | | | | | | | | |
| 6.0 | **LEAN CLAY (CL)**, iron nodules, olive brown and gray, soft | | 5 | | | 0.8 | 1-1-2 N=3 | | 1000 (HP) | | 33 | | | |
| 11.0 | **FAT CLAY (CH)**, iron nodules, olive brown and gray, soft | | | | | 1.2 | 1-1-1 N=2 | | 1500 (HP) | | 40 | | | |
| | | | 10 | | | 1.5 | 1-2-2 N=4 | | 3000 (HP) | | 40 | | | |
| 16.0 | **FAT CLAY (CH)**, lenses of silt, grayish brown, medium stiff to soft | | | | | 1.2 | 2-2-3 N=5 | | 2500 (HP) | | 41 | | | |
| | | | 15 | | | 1.5 | 1-2-2 N=4 | | 4000 (HP) | | 44 | | | |
| | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**
*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-6 |

# BORING LOG NO. B-3



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.**
**Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.93126° Longitude: -97.08819°

| DEPTH | DESCRIPTION | ELEVATION (Ft.) | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.6 | **7.5" CONCRETE PAVEMENT** | | | | | | | | | | | | | |
| 3.0 | **FILL - LEAN CLAY WITH SAND**, trace gravel, dark olive brown | | | | | 0.5 | 2-3-3 N=6 | | | | 16 | | | |
| | | | | | | 0.2 | 1-2-1 N=3 | | | | 26 | | | |
| 4.0 | **LEAN CLAY (CL)**, lenses and laminations of silt, olive brown, soft | | | | | | | | | | | | | |
| 6.0 | **FAT CLAY (CH)**, iron staining, lenses of silt, olive brown mottled, soft | | 5 | | | 0.8 | 1-1-2 N=3 | | 1500 (HP) | | 36 | | | |
| 9.0 | **FAT CLAY (CH)**, iron staining, olive brown mottled, soft | | | | | 1.2 | 2-2-2 N=4 | | 2500 (HP) | | 39 | | | |
| 12.0 | **FAT CLAY (CH)**, lenses and laminations of silt, olive brown and gray, soft | | 10 | | | 1.3 | 2-2-2 N=4 | | 3000 (HP) | | 40 | | | |
| | **FAT CLAY (CH)**, lenses of silt, grayish brown, medium stiff | | | | | 1.2 | 1-2-3 N=5 | | 2500 (HP) | | 40 | | | |
| 16.0 | | | 15 | | | 1.3 | 1-2-3 N=5 | | 4000 (HP) | | 45 | | | |
| | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**
*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-7 |

# BORING LOG NO. B-4

**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.**
**Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.93052° Longitude: -97.0881°

| DEPTH | DESCRIPTION (ELEVATION (Ft.)) | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.8 | **9" CONCRETE PAVEMENT** | | | | | | | | | | | | |
| 2.5 | **FILL - LEAN CLAY WITH SAND**, trace gravel, dark olive brown | | | | 0.2 | 3-6-5 N=11 | | | | | | | |
| 4.0 | **LEAN CLAY (CL)**, iron staining, lenses of silt, olive brown and gray, medium stiff | | | | 0.5 | 3-4-4 N=8 | | 2500 (HP) | | 24 | | | |
| | **FAT CLAY (CH)**, iron staining, olive brown, soft to medium stiff | 5 | | | 1 | 2-1-2 N=3 | | 2000 (HP) | | 39 | | | |
| | | | | | 1.2 | 2-2-3 N=5 | | 2000 (HP) | | 37 | | | |
| 11.0 | | 10 | | | 1.3 | 2-2-3 N=5 | | 3500 (HP) | | 40 | | | |
| 14.0 | **FAT CLAY (CH)**, iron staining, laminations of silt, olive brown, medium stiff | | | | 1.5 | 2-3-3 N=6 | | 3500 (HP) | | 39 | | | |
| 16.0 | **FAT CLAY (CH)**, iron staining, laminations of silt, dark grayish brown, medium stiff | 15 | | | 1.3 | 3-2-3 N=5 | | 3000 (HP) | | 41 | | | |
| | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**

*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-8 |

# BORING LOG NO. B-5



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.
Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive
Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92981° Longitude: -97.08813°

| GRAPHIC LOG | DEPTH | DESCRIPTION / ELEVATION (Ft.) | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.6 | **7.5" CONCRETE PAVEMENT** | | | | | | | | | | | | |
| | 2.0 | **FILL - LEAN CLAY**, olive brown | | | | 0.7 | 3-3-2 N=5 | | | | 20 | | | |
| | 6.0 | **LEAN CLAY (CL)**, iron staining, lenses of silt, olive brown, soft to medium stiff | | | | 0.8 | 2-2-2 N=4 | | 1500 (HP) | | 32 | | | |
| | | | 5 | | | 1.2 | 2-2-3 N=5 | | 2500 (HP) | | 31 | | | |
| | 12.0 | **FAT CLAY (CH)**, iron nodules, olive brown and gray, soft | | | | 1.3 | 2-2-2 N=4 | | 3000 (HP) | | 39 | | | |
| | | | 10 | | | 1.2 | 2-1-2 N=3 | | 2500 (HP) | | 41 | | | |
| | 16.0 | **FAT CLAY (CH)**, olive brown, medium stiff to soft | | | | 0.8 | 2-2-3 N=5 | | 3000 (HP) | | 40 | | | |
| | | | 15 | | | 1.5 | 2-1-3 N=4 | | 2500 (HP) | | 46 | | | |
| | | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**

*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-9 |

# BORING LOG NO. B-6



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.**
**Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92912° Longitude: -97.08801°

| GRAPHIC LOG | DEPTH | DESCRIPTION (ELEVATION (Ft.)) | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.6 | **7" CONCRETE PAVEMENT** | | | | | | | | | | | | |
| | 2.0 | **FAT CLAY (CH)**, lenses and laminations of silt, olive brown and gray mottled, soft | | | | 0.8 | 1-1-2 N=3 | | 1000 (HP) | | 33 | | | |
| | 3.0 | **SILT (ML)**, gray and olive brown, very loose | | | | 0.5 | 1-2-2 N=4 | | 1500 (HP) | | 29 | | | |
| | 4.0 | **LEAN CLAY (CL)**, lenses of silt, gray and olive brown, soft | | | | | | | | | | | | |
| | 6.0 | **SILT (ML)**, iron staining, olive brown and gray, soft | 5 | | | 1 | 2-1-2 N=3 | | 1500 (HP) | | 33 | | | |
| | 9.0 | **FAT CLAY (CH)**, iron staining, lenses of gypsum, olive brown, soft | | | | 1.2 | 1-1-2 N=3 | | 2000 (HP) | | 43 | | | |
| | 12.0 | **FAT CLAY (CH)**, iron staining, lenses and laminations of silt, olive brown and gray, soft | 10 | | | 1.2 | 2-1-2 N=3 | | 1000 (HP) | | 43 | | | |
| | 16.0 | **FAT CLAY (CH)**, lenses of silt, dark grayish brown, soft | | | | 1.5 | 2-2-2 N=4 | | 1000 (HP) | | 48 | | | |
| | | | 15 | | | 0.8 | 2-2-2 N=4 | | 2000 (HP) | | 35 | | | |
| | | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**

*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-10 |

# BORING LOG NO. B-7



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.
Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive
Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92845° Longitude: -97.08817°

| DEPTH | Description (ELEVATION (Ft.)) | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | **6.5" CONCRETE PAVEMENT** | | | | | | | | | | | | |
| 1.5 | **FILL - LEAN CLAY**, very dark gray | | | X | 0.7 | 2-2-3 N=5 | | 2500 (HP) | | 26 | | | |
| 4.0 | **LEAN CLAY (CL)**, laminations of silt, olive brown mottled, medium stiff | | | X | 0.7 | 2-2-3 N=5 | | 3500 (HP) | | 23 | | | |
| 12.0 | **FAT CLAY (CH)**, iron staining, grayish brown and olive brown mottled, medium stiff to soft | 5 | | X | 1.2 | 2-3-3 N=6 | | 1500 (HP) | | 37 | | | |
| | | | | X | 1.2 | 3-3-3 N=6 | | 2500 (HP) | | 39 | | | |
| | | 10 | | X | 1.5 | 2-2-2 N=4 | | 3000 (HP) | | 39 | | | |
| 16.0 | **FAT CLAY (CH)**, lenses of silt, dark grayish brown, medium stiff | | | X | 1.3 | 3-2-3 N=5 | | 3000 (HP) | | 44 | | | |
| | | 15 | | X | 1.5 | 2-3-3 N=6 | | 3500 (HP) | | 47 | | | |
| | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**

*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-11 |

# BORING LOG NO. B-8



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.**
**Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92776° Longitude: -97.08803°

| DEPTH | Description | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.6 | **7" CONCRETE PAVEMENT** | | | | | | | | | | | | |
| | **FILL - LEAN CLAY**, dark gray | | | | 0.8 | 2-3-5 N=8 | | 5000 (HP) | | 23 | | | |
| | | | | | 0.8 | 3-4-5 N=9 | | 5000 (HP) | | 26 | | | |
| 5.5 | | 5 | | | 1 | 3-2-3 N=5 | | | | 32 | | | |
| 7.0 | **FAT CLAY (CH)**, dark grayish brown, medium stiff | | | | | | | | | | | | |
| 9.0 | **FAT CLAY (CH)**, lenses of silt, light grayish brown, medium stiff | | | | 1.3 | 3-3-4 N=7 | | 3000 (HP) | | 37 | | | |
| 12.0 | **FAT CLAY (CH)**, iron staining, olive brown, medium stiff | 10 | | | 1.3 | 2-3-2 N=5 | | 2000 (HP) | | 44 | | | |
| 14.0 | **FAT CLAY (CH)**, iron staining, lenses and laminations of silt, olive brown and gray, soft | | | | 1.3 | 2-2-2 N=4 | | 4000 (HP) | | 41 | | | |
| 16.0 | **FAT CLAY (CH)**, iron staining, laminations of silt, dark grayish brown, soft | 15 | | | 1.5 | 1-2-2 N=4 | | 2500 (HP) | | 42 | | | |
| | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | |

ELEVATION (Ft.)

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**

*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-12 |

# BORING LOG NO. B-9



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.**
**Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92715° Longitude: -97.08816°

| DEPTH | DESCRIPTION | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | **6.5" CONCRETE PAVEMENT** | | | | | | | | | | | | |
| 2.0 | **FILL - LEAN CLAY**, dark gray | | | | 0.8 | 2-4-4 N=8 | | | | 28 | | | |
| 5.0 | **FAT CLAY (CH)**, old topsoil, black, medium stiff | | | | 0.7 | 2-3-3 N=6 | 10.8 | | | 48 | | | |
| 6.0 | **FAT CLAY (CL)**, very dark grayish brown, medium stiff | 5 | | | 1 | 2-2-3 N=5 | | | | 48 | | | |
| 9.0 | **FAT CLAY (CH)**, olive brown, medium stiff | | | | 1 | 2-2-3 N=5 | | 2500 (HP) | | 39 | | | |
| 14.0 | **FAT CLAY (CH)**, olive brown and gray mottled, medium stiff | 10 | | | 1.2 | 2-2-3 N=5 | | 2000 (HP) | | 43 | | | |
| | | | | | 1.5 | 2-2-3 N=5 | | 3000 (HP) | | 42 | | | |
| 16.0 | **FAT CLAY (CH)**, very dark grayish brown, medium stiff | 15 | | | 0.8 | 2-2-3 N=5 | | 2500 (HP) | | 44 | | | |
| | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | |

ELEVATION (Ft.)

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**
*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-13 |

# BORING LOG NO. B-10



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.**
**Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92644° Longitude: -97.0881°

| DEPTH | Description | ELEVATION (Ft.) |
|---|---|---|
| 0.5 | **6" CONCRETE PAVEMENT** | |
| 0.8 | **FILL - SILT**, brown | |
| 2.0 | **SILT (ML)**, light olive brown, loose | |
| 6.0 | **LEAN CLAY (CL)**, iron staining, lenses of silt, olive brown and gray mottled, soft | |
| 12.0 | **FAT CLAY (CH)**, iron staining, olive brown, medium stiff | |
| 14.0 | **FAT CLAY (CH)**, olive brown mottled, medium stiff | |
| 16.0 | **FAT CLAY (CH)**, dark grayish brown, medium stiff | |
| | ***Boring Terminated at 16 Feet*** | |

| WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|
| | Split spoon | 0.7 | 2-3-3 N=6 | | | | 20 | | | |
| | Split spoon | 0.5 | 2-2-2 N=4 | | 1500 (HP) | | 32 | | | |
| | Split spoon | 1 | 2-1-2 N=3 | | 2000 (HP) | | 35 | | | |
| | Split spoon | 1.3 | 2-3-3 N=6 | | 3500 (HP) | | 40 | | | |
| | Split spoon | 1.5 | 3-3-3 N=6 | | 4000 (HP) | | 37 | | | |
| | Split spoon | 1.3 | 2-2-3 N=5 | | 4000 (HP) | | 41 | | | |
| | Split spoon | 1.2 | 2-3-2 N=5 | | 1000 (HP) | | 43 | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**
*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-14 |

# BORING LOG NO. B-11



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.
Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive
Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92561° Longitude: -97.08818°

| DEPTH | DESCRIPTION | DEPTH (Ft.) | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | **6" CONCRETE PAVEMENT** | | | | | | | | | | | |
| 2.5 | **FILL - SANDY LEAN CLAY**, trace gravel, dark olive brown | | Split spoon | 1.2 | 4-5-6 N=11 | | | | 16 | | | |
| 4.0 | **SILT (ML)**, light olive brown, loose | | Split spoon | 0.8 | 4-3-4 N=7 | | | | 22 | | | |
| | **FAT CLAY (CH)**, iron nodules, lenses and laminations of silt, olive brown, soft to medium stiff | 5 | Split spoon | 1 | 3-2-2 N=4 | | 1500 (HP) | | 34 | | | |
| | | | Shelby tube | 0.5 | | | | | | | | |
| | | 10 | Split spoon | 1.5 | 2-2-3 N=5 | | 3000 (HP) | | 40 | | | |
| 14.0 | | | Shelby tube | 2.2 | | | 3000 (HP) | 2570 | 42 | 79 | 63-28-35 | |
| | **FAT CLAY (CH)**, dark grayish brown, medium stiff to soft | 15 | Split spoon | 1.5 | 2-2-3 N=5 | | 3000 (HP) | | 43 | | | |
| | | 20 | Shelby tube | 2 | | | 2500 (HP) | 2270 | 44 | 75 | | |
| | | 25 | Split spoon | 1.5 | 1-1-2 N=3 | | 2000 (HP) | | 43 | | | |
| 34.0 | | 30 | Split spoon | 1.7 | 1-2-2 N=4 | | 1500 (HP) | | 44 | | | |
| 37.0 | **LEAN CLAY (CL)**, lenses and laminations of silt, dark grayish brown, medium stiff | 35 | Shelby tube | 2.2 | | | 1000 (HP) | 1400 | 43 | 81 | 41-26-15 | |
| 41.0 | **FAT CLAY (CH)**, laminations silt, dark grayish brown, soft | 40 | Split spoon | 1.2 | 2-2-2 N=4 | | 2000 (HP) | | 37 | | | |
| | ***Boring Terminated at 41 Feet*** | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**

*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-15 |

# BORING LOG NO. B-12



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.
Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive
Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92506° Longitude: -97.08803°

| GRAPHIC LOG | DEPTH | ELEVATION (Ft.) | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.6 | **7" CONCRETE PAVEMENT** | | | | | | | | | | | | |
| | | **FILL - LEAN CLAY**, dark gray | | | | 0.8 | 2-3-4 N=7 | | | | 26 | | | |
| | 3.0 | | | | | 0.2 | 2-2-3 N=5 | | | | 32 | | | |
| | | **FAT CLAY (CH)**, lenses and laminations of silt, olive brown and gray, soft | 5 | | | 0.7 | 2-2-2 N=4 | | 2000 (HP) | | 38 | | | |
| | 9.0 | | | | | 0.7 | 2-2-2 N=4 | | 1500 (HP) | | 38 | | | |
| | | **FAT CLAY (CH)**, iron staining, olive brown and gray, medium stiff | 10 | | | 1.3 | 2-2-3 N=5 | | 3000 (HP) | | 41 | | | |
| | 14.0 | | | | | 1.3 | 2-2-3 N=5 | | 2500 (HP) | | 42 | | | |
| | 16.0 | **FAT CLAY (CH)**, laminations of silt, dark grayish brown, medium stiff | 15 | | | 1.3 | 2-3-2 N=5 | | 2500 (HP) | | 43 | | | |
| | | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**
*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-16 |

# BORING LOG NO. B-13



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.
Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive
Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92412° Longitude: -97.08813°

| DEPTH | Description | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | **6" CONCRETE PAVEMENT** | | | | | | | | | | | | |
| 2.5 | **FILL - SANDY LEAN CLAY**, trace gravel, dark gray | | | | 0.3 | 1-2-3 N=5 | | | | 18 | | | |
| 4.0 | **SILT (ML)**, light olive brown, very loose | | | | 0.5 | 2-1-2 N=3 | | | | 32 | | | |
| 6.0 | **LEAN CLAY (CL)**, iron nodules, lenses and laminations of silt, lenses of gypsum, olive brown and gray, soft | 5 | | | 0.8 | 1-1-2 N=3 | | | | 40 | | | |
| 9.0 | **SILT (ML)**, olive brown, loose | | | | 1.2 | 1-2-2 N=4 | | 1500 (HP) | | 36 | | | |
| 12.0 | **FAT CLAY (CH)**, iron staining, lenses of silt, dark grayish brown, soft | 10 | | | 1.3 | 2-2-2 N=4 | | 2000 (HP) | | 41 | | | |
| 16.0 | **FAT CLAY (CH)**, laminations of silt, dark grayish brown, soft | 15 | | | 1.5 | 2-2-2 N=4 | | 2500 (HP) | | 41 | | | |
| | | | | | 1.7 | 2-2-2 N=4 | | 3000 (HP) | | 47 | | | |
| | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**
*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-17 |

# BORING LOG NO. B-14



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.**
**Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92346° Longitude: -97.08804°

| DEPTH | DESCRIPTION | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | **6" CONCRETE PAVEMENT** | | | | | | | | | | | | |
| 1.5 | **FILL - LEAN CLAY**, light grayish brown | | | | 0.7 | 2-3-3 N=6 | | | | 21 | | | |
| 2.0 | **FILL - LEAN CLAY**, dark gray | | | | | | | | | | | | |
| 2.8 | **FILL - LEAN CLAY**, asphalt fragments, grayish brown and black | | | | 1 | 3-2-2 N=4 | | | | 13 | | | |
| 4.0 | **SILT (ML)**, light olive brown, loose | | | | | | | | | | | | |
| 7.0 | **FAT CLAY (CH)**, iron staining, lenses and laminations of silt, lenses of gypsum, olive brown, soft | 5 | | | 1.2 | 2-2-1 N=3 | | 1500 (HP) | | 41 | | | |
| 12.0 | **FAT CLAY (CH)**, iron staining, olive, soft | | | | 1 | 2-2-2 N=4 | | 2000 (HP) | | 39 | | | |
| | | 10 | | | 1.5 | 2-1-2 N=3 | | 3000 (HP) | | 47 | | | |
| 16.0 | **FAT CLAY (CH)**, dark grayish brown, medium stiff to soft | | | | 1.3 | 2-2-3 N=5 | | 3000 (HP) | | 44 | | | |
| | | 15 | | | 1.5 | 2-2-2 N=4 | | 1500 (HP) | | 51 | | | |
| | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**
*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-18 |

# BORING LOG NO. B-15



**PROJECT: North 42nd Street Reconstruction**

**CLIENT: CPS, LTD.**
**Grand Forks, North Dakota**

**SITE: University Avenue to Gateway Drive**
**Grand Forks, North Dakota**

LOCATION See Exhibit A-2

Latitude: 47.92263° Longitude: -97.08813°

| DEPTH | Description | ELEVATION (Ft.) | DEPTH (Ft.) | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | RECOVERY (Ft.) | FIELD TEST RESULTS | ORGANIC CONTENT (%) | LABORATORY TORVANE/HP (psf) | UNCONFINED COMPRESSIVE STRENGTH (psf) | WATER CONTENT (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.8 | **9" CONCRETE PAVEMENT** | | | | | | | | | | | | | |
| 2.5 | **FILL - CLAYEY SAND WITH GRAVEL**, olive brown | | | | | 0.8 | 7-5-4 N=9 | | | | 9 | | | |
| 4.0 | **FILL - SANDY LEAN CLAY**, trace gravel, olive brown | | | | | 0.7 | 7-6-9 N=15 | | | | 13 | | | |
| 6.0 | **FILL - SANDY LEAN CLAY**, very dark grayish brown | | 5 | | | 1.2 | 4-5-8 N=13 | | | | 21 | | | |
| 12.0 | **FAT CLAY (CH)**, iron nodules, olive brown, medium stiff | | | | | 1.2 | 3-2-3 N=5 | | 2000 (HP) | | 35 | | | |
| | | | 10 | | | 1.2 | 2-3-3 N=6 | | 2000 (HP) | | 38 | | | |
| 16.0 | **FAT CLAY (CH)**, dark grayish brown, medium stiff | | | | | 1.5 | 2-2-3 N=5 | | 3500 (HP) | | 48 | | | |
| | | | 15 | | | 1.3 | 2-3-3 N=6 | | 3000 (HP) | | 44 | | | |
| | ***Boring Terminated at 16 Feet*** | | | | | | | | | | | | | |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings and patched with cold patch asphalt upon completion.

See Exhibit A-4 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**

*No free water observed*

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

| | |
|---|---|
| Boring Started: 6/30/2016 | Boring Completed: 6/30/2016 |
| Drill Rig: Diedrich D-90 | Driller: cas |
| Project No.: M5165003 | Exhibit: A-19 |

# APPENDIX B
# LABORATORY TESTING

**Laboratory Testing**

Samples retrieved during the field exploration were returned to the laboratory for observation by the project geotechnical engineer, and were classified in general accordance with the Unified Soil Classification System described in Appendix C. All classification was by visual-manual procedures.

Representative samples were selected for laboratory analysis. Selected soil samples were tested for the following engineering properties:

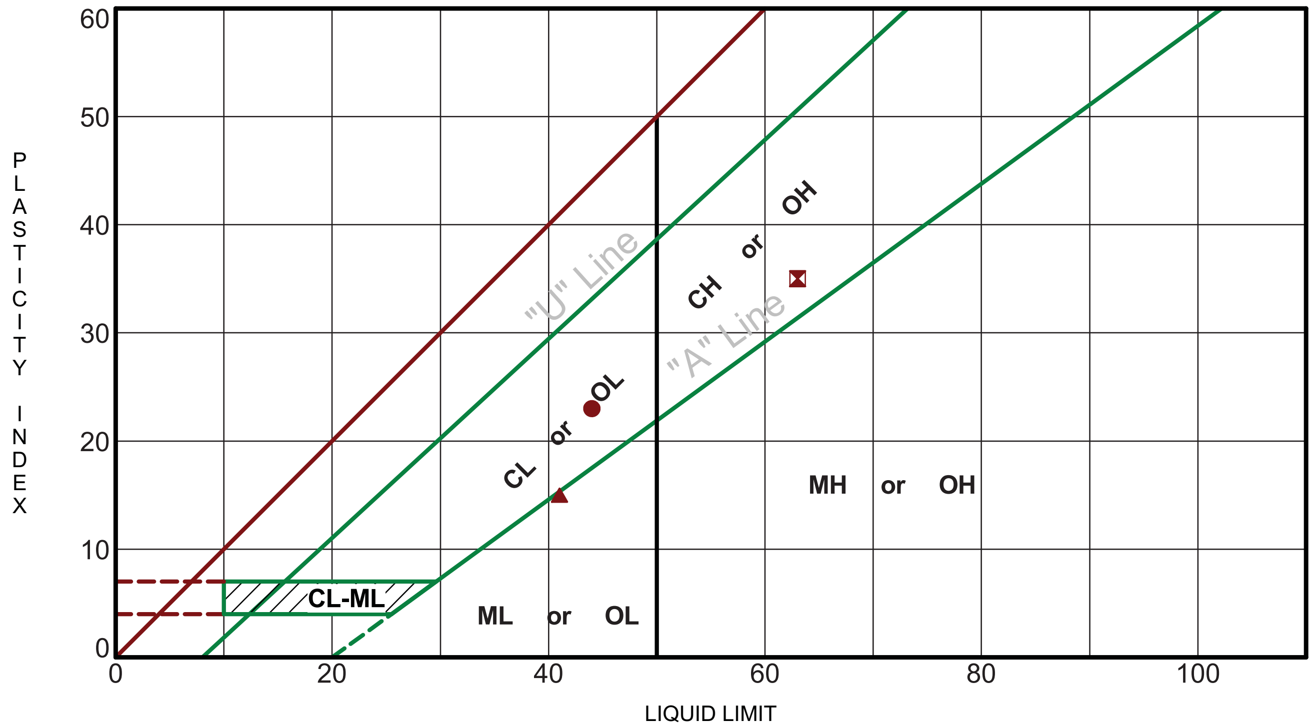
- Water content (ASTM D2216)
- Atterberg limits (ASTM D4318)
- Unconfined compression testing (ASTM D2166)
- Grain size distribution (hydrometer) (ASTM D422)
- Moisture-density relationship testing (AASHTO T-99)
- California bearing ratio testing (ASTM D1883)
- Dry density (ASTM D7262-09)
- Hand penetrometer

The laboratory test results are found on the boring logs opposite the samples they represent and on the attached laboratory data sheets.

Procedural standards noted above are for reference to methodology in general. In some cases variations to methods are applied as a result of local practice or professional judgment.

# ATTERBERG LIMITS RESULTS

**ASTM D4318**




| | Boring ID | Depth | LL | PL | PI | Fines | USCS | Description |
|---|---|---|---|---|---|---|---|---|
| ● | **Bag-1** | **0.5 - 3** | **44** | **21** | **23** | **56** | **CL** | **SANDY LEAN CLAY with GRAVEL** |
| ⊠ | **B-11** | **12 - 14** | **63** | **28** | **35** | | **CH** | **FAT CLAY** |
| ▲ | **B-11** | **34.5 - 36.5** | **41** | **26** | **15** | | **CL** | **LEAN CLAY** |

PROJECT: North 42nd Street Reconstruction

SITE: University Avenue to Gateway Drive
Grand Forks, North Dakota

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

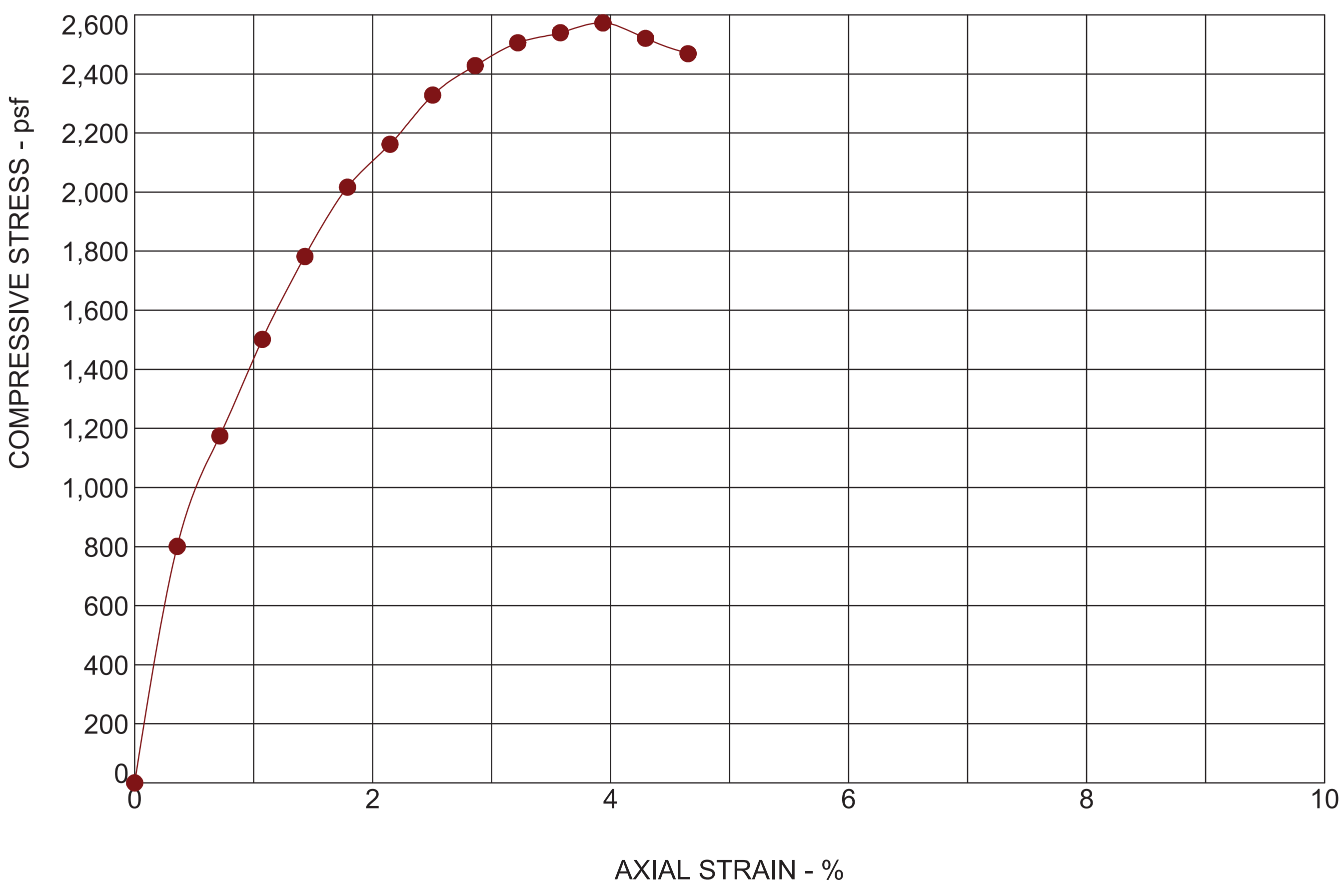
PROJECT NUMBER: M5165003

CLIENT: CPS
Grand Forks, North Dakota

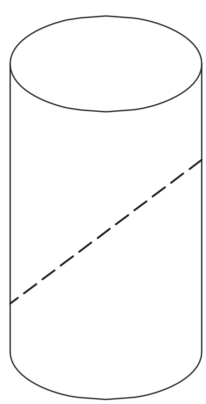
EXHIBIT: B-2

# UNCONFINED COMPRESSION TEST

**ASTM D2166**




## SPECIMEN FAILURE MODE



Failure Mode: Shear (dashed)

## SPECIMEN TEST DATA

| | | |
|---|---|---|
| Moisture Content: | % | 42 |
| Dry Density: | pcf | 79 |
| Diameter: | in. | 2.87 |
| Height: | in. | 5.59 |
| Height / Diameter Ratio: | | 1.95 |
| Calculated Saturation: | % | 100.97 |
| Calculated Void Ratio: | | 1.12 |
| Assumed Specific Gravity: | | 2.7 |
| Failure Strain: | % | 3.94 |
| Unconfined Compressive Strength | (psf) | 2573 |
| Undrained Shear Strength: | (psf) | 1286 |
| Strain Rate: | in/min | 0.0800 |
| Remarks: | | |

| | | | | |
|---|---|---|---|---|
| SAMPLE TYPE: Shelby Tube | SAMPLE LOCATION: B-11 @ 12 - 14 feet | | | |
| DESCRIPTION: FAT CLAY | LL<br>63 | PL<br>28 | PI<br>35 | Percent < #200 Sieve |

PROJECT: North 42nd Street Reconstruction

SITE: University Avenue to Gateway Drive
Grand Forks, North Dakota

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

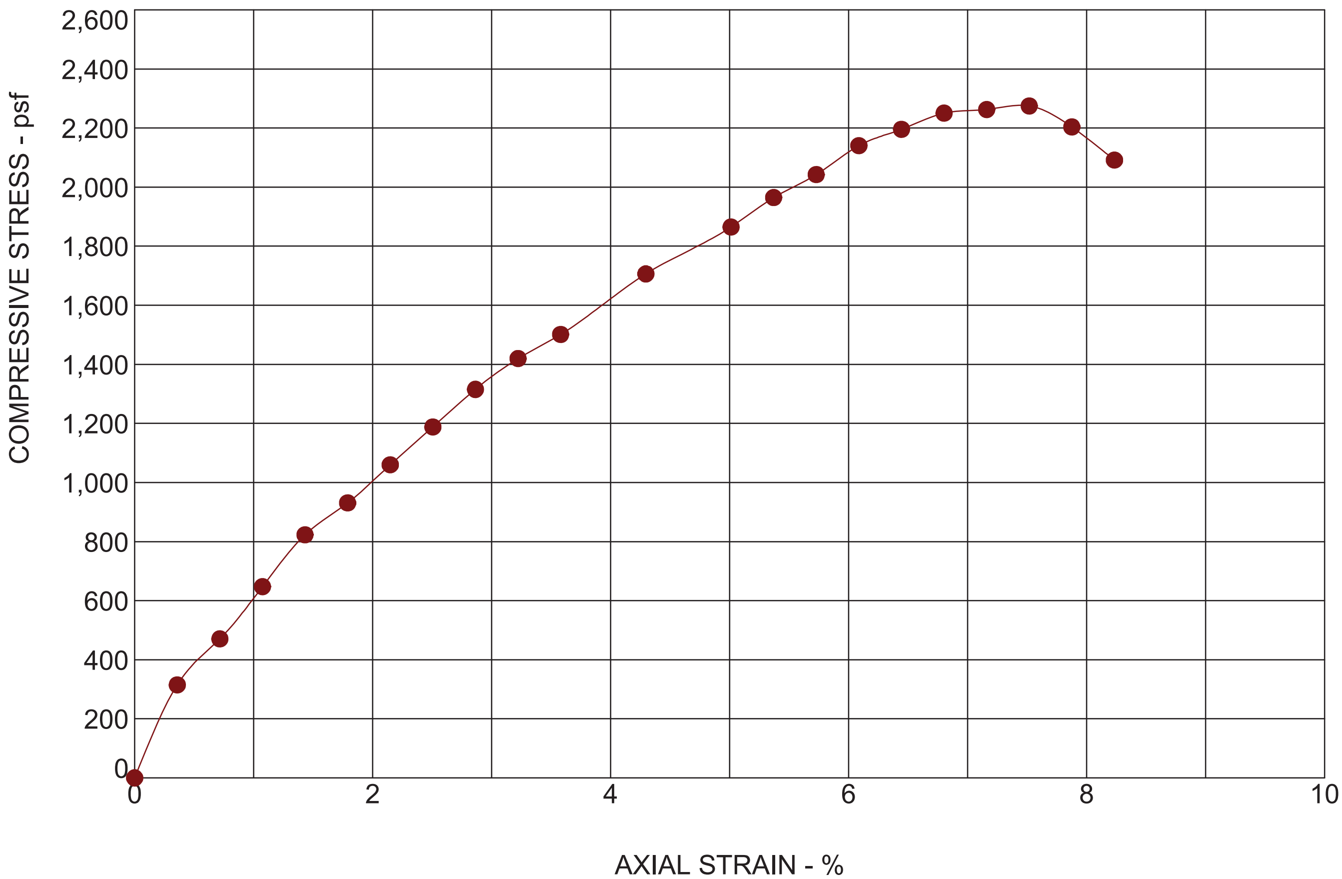
PROJECT NUMBER: M5165003

CLIENT: CPS
Grand Forks, North Dakota

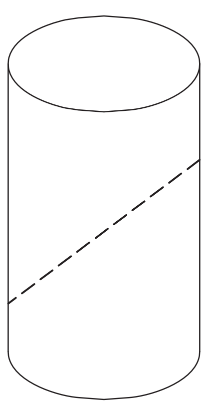
EXHIBIT: B-3

# UNCONFINED COMPRESSION TEST

**ASTM D2166**




| SPECIMEN FAILURE MODE | SPECIMEN TEST DATA | | |
|---|---|---|---|
| | Moisture Content: | % | 44 |
| | Dry Density: | pcf | 75 |
| | Diameter: | in. | 2.85 |
| | Height: | in. | 5.59 |
| | Height / Diameter Ratio: | | 1.96 |
| | Calculated Saturation: | % | 94.89 |
| | Calculated Void Ratio: | | 1.24 |
| | Assumed Specific Gravity: | | 2.7 |
| | Failure Strain: | % | 7.52 |
| | Unconfined Compressive Strength | (psf) | 2275 |
| | Undrained Shear Strength: | (psf) | 1137 |
| | Strain Rate: | in/min | 0.0800 |
| | Remarks: | | |



Failure Mode: Shear (dashed)

| SAMPLE TYPE: Shelby Tube | SAMPLE LOCATION: B-11 @ 19.5 - 21.5 feet | | | |
|---|---|---|---|---|
| DESCRIPTION: FAT CLAY | LL | PL | PI | Percent < #200 Sieve |

PROJECT: North 42nd Street Reconstruction

SITE: University Avenue to Gateway Drive
Grand Forks, North Dakota

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

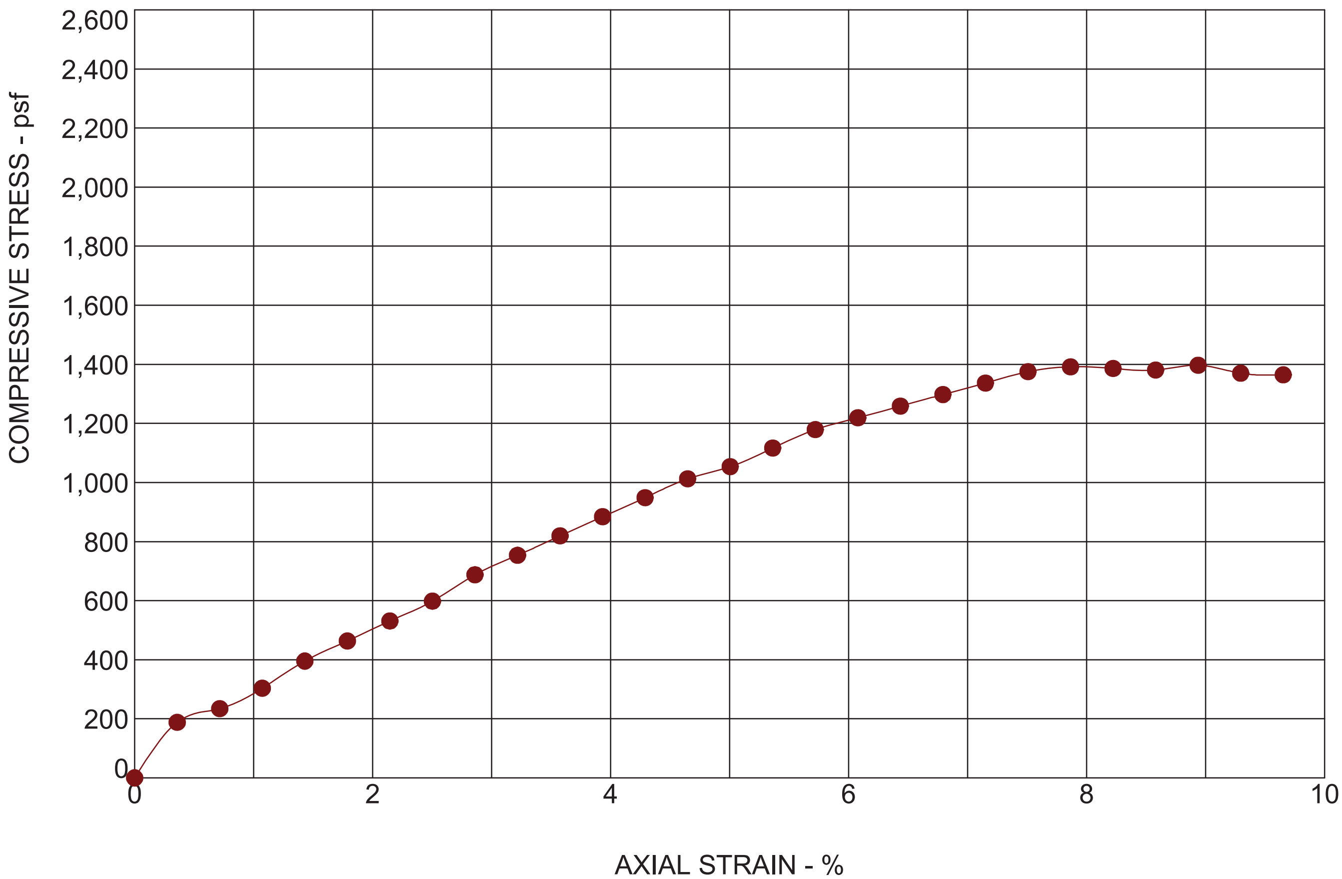
PROJECT NUMBER: M5165003

CLIENT: CPS
Grand Forks, North Dakota

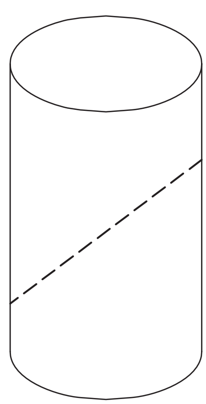
EXHIBIT: B-4

# UNCONFINED COMPRESSION TEST

ASTM D2166




| SPECIMEN FAILURE MODE | SPECIMEN TEST DATA | | |
|---|---|---|---|
| | Moisture Content: | % | 43 |
| | Dry Density: | pcf | 81 |
| | Diameter: | in. | 2.79 |
| | Height: | in. | 5.59 |
| | Height / Diameter Ratio: | | 2.01 |
| | Calculated Saturation: | % | 106.38 |
| | Calculated Void Ratio: | | 1.08 |
| | Assumed Specific Gravity: | | 2.69 |
| | Failure Strain: | % | 8.94 |
| | Unconfined Compressive Strength | (psf) | 1397 |
| | Undrained Shear Strength: | (psf) | 698 |
| | Strain Rate: | in/min | 0.0800 |
| Failure Mode: Shear (dashed) | Remarks: | | |



SAMPLE TYPE: Shelby Tube

SAMPLE LOCATION: B-11 @ 34.5 - 36.5 feet

| DESCRIPTION: LEAN CLAY | LL | PL | PI | Percent < #200 Sieve |
|---|---|---|---|---|
| | 41 | 26 | 15 | |

PROJECT: North 42nd Street Reconstruction

SITE: University Avenue to Gateway Drive
Grand Forks, North Dakota

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

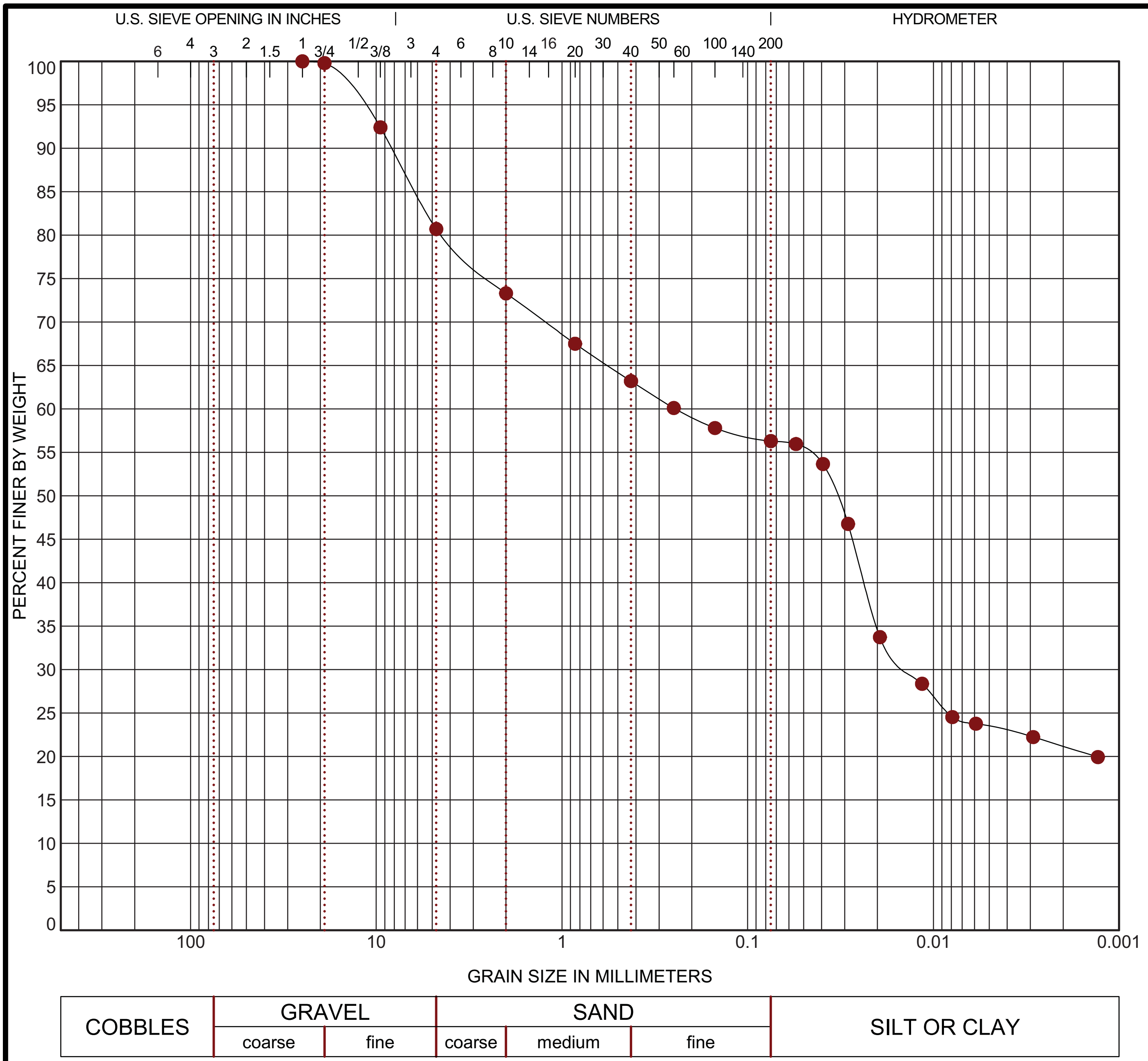
PROJECT NUMBER: M5165003

CLIENT: CPS
Grand Forks, North Dakota

EXHIBIT: B-5

# GRAIN SIZE DISTRIBUTION

**ASTM D422 / ASTM C136**




| Boring ID | | Depth | USCS Classification | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | Bag-1 | 0.5 - 3 | SANDY LEAN CLAY with GRAVEL (CL) | 44 | 21 | 23 | | |

| Boring ID | | Depth | $D_{100}$ | $D_{60}$ | $D_{30}$ | $D_{10}$ | %Gravel | %Sand | %Fines | |
|---|---|---|---|---|---|---|---|---|---|---|
| ● | Bag-1 | 0.5 - 3 | 25 | 0.245 | 0.013 | | 19.3 | 24.4 | 32.9 | 23.4 |

PROJECT: North 42nd Street Reconstruction

SITE: University Avenue to Gateway Drive
Grand Forks, North Dakota

Terracon
1555 N 42nd ST Unit B
Grand Forks, ND

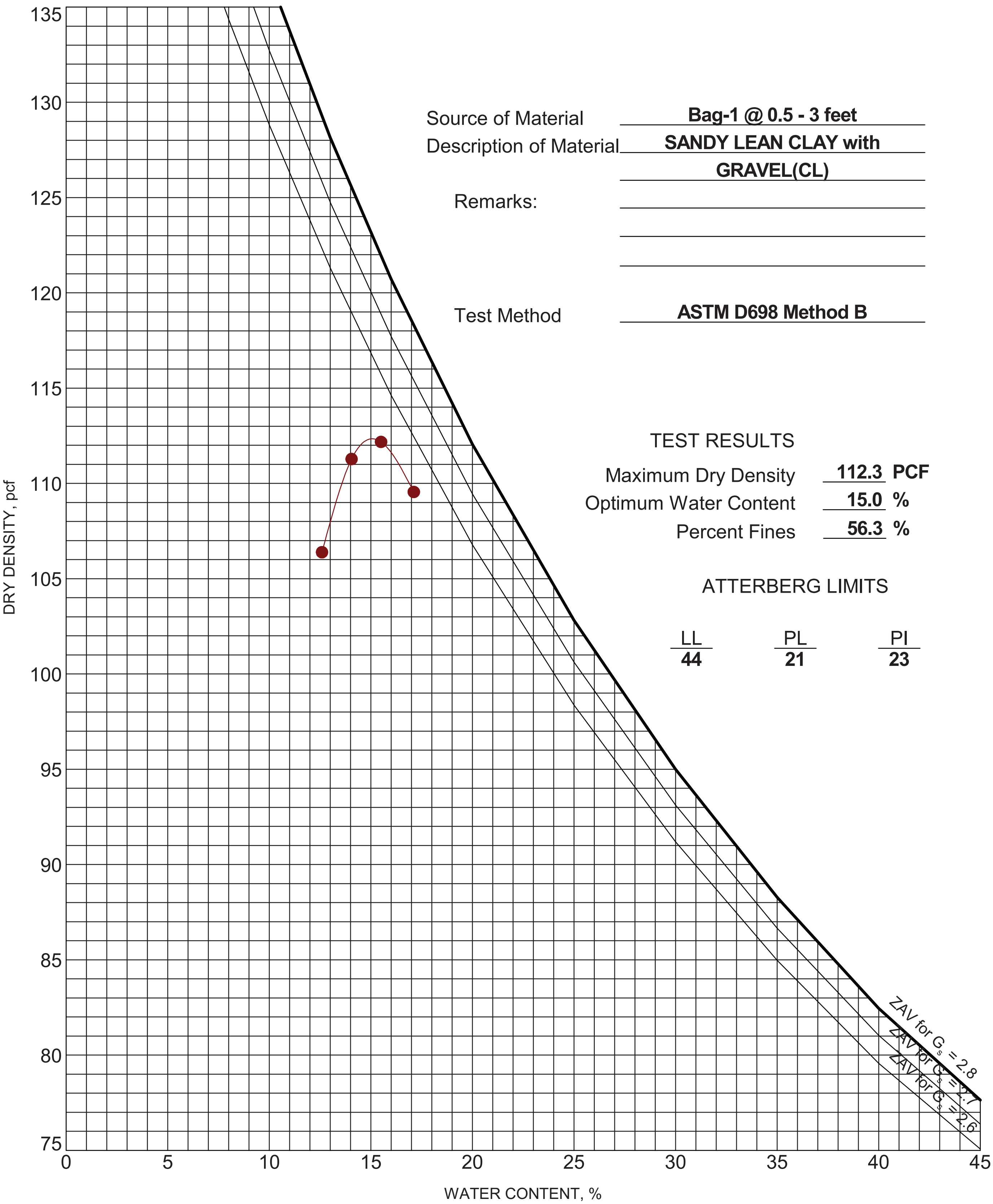
PROJECT NUMBER: M5165003

CLIENT: CPS
Grand Forks, North Dakota

EXHIBIT: B-6

# MOISTURE-DENSITY RELATIONSHIP

**ASTM D698/D1557**




Source of Material: **Bag-1 @ 0.5 - 3 feet**

Description of Material: **SANDY LEAN CLAY with GRAVEL(CL)**

Remarks:

Test Method: **ASTM D698 Method B**

TEST RESULTS

| | | |
|---|---|---|
| Maximum Dry Density | **112.3** | **PCF** |
| Optimum Water Content | **15.0** | **%** |
| Percent Fines | **56.3** | **%** |

ATTERBERG LIMITS

| LL | PL | PI |
|---|---|---|
| **44** | **21** | **23** |

| | | |
|---|---|---|
| PROJECT: North 42nd Street Reconstruction | Terracon | PROJECT NUMBER: M5165003 |
| SITE: University Avenue to Gateway Drive<br>Grand Forks, North Dakota | 1555 N 42nd ST Unit B<br>Grand Forks, ND | CLIENT: CPS<br>Grand Forks, North Dakota |
| | | EXHIBIT: B-7 |

## California Bearing Ratio of Laboratory-Compacted Soils

**Report Number:** M5165003
**Service Date:** 07/24/16
**Report Date:** 07/25/16
**Task:**

### Client
CPS, Ltd.
Grand Forks, North Dakota

### Project
North 42nd Street Reconstruction
University Avenue to Gateway Drive
Grand Forks, North Dakota

Project No. M5165003

## SAMPLE INFORMATION

| | | | |
|---|---|---|---|
| Sample Number: | Bag-1 | Proctor Method: | ASTM D698 - Method B |
| Boring Number: | B-1, B-2, B-15 | Maximum Dry Density (pcf): | 112.3 |
| Sample Location: | n/a | Optimum Moisture: | 15.0 |
| Depth: | 0.5-3' | Liquid Limit: | 44 |
| Material Description: | SANDY LEAN CLAY with GRAVEL | Plasticity Index: | 23 |

## CBR TEST DATA

| | |
|---|---|
| **CBR Value at 0.100 inch** | **5.0** |
| **CBR Value at 0.200 inch** | **4.3** |

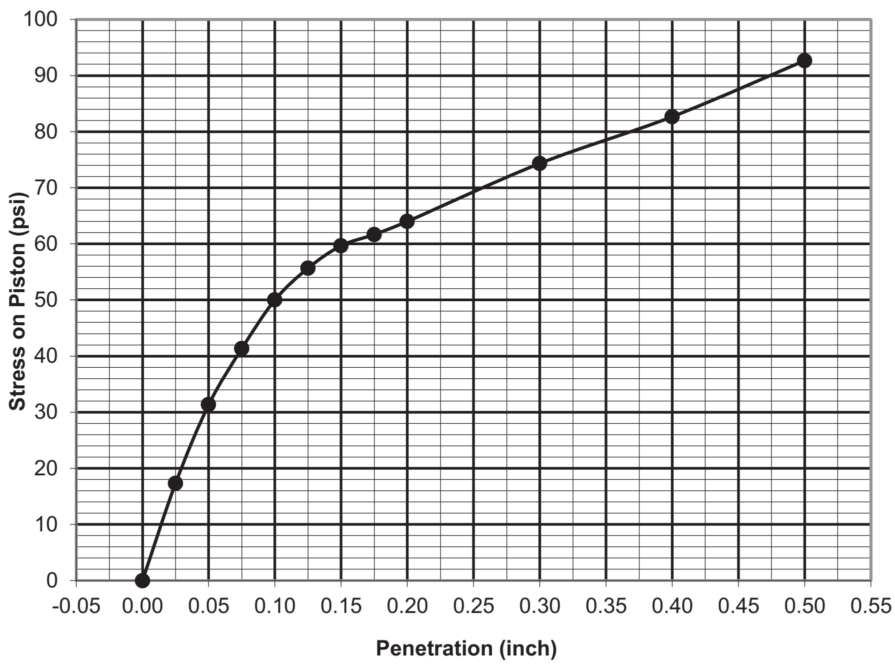
| | |
|---|---|
| Surcharge Weight (lbs) | 10 |
| Soaking Condition | Soaked |
| Length of Soaking (hours) | 96 |
| Swell (%) | 1.2 |

**DENSITY DATA**

| | |
|---|---|
| Dry Density Before Soaking (pcf) | 105.7 |
| Compaction of Proctor (%) | 94.1 |

**MOISTURE DATA**

| | |
|---|---|
| Before Compaction (%) | 16.2 |
| After Compaction (%) | 16.2 |
| Top 1" After Soaking (%) | 24.7 |
| Average After Soaking (%) | 20.3 |




**Comments:**
**Test Methods:** ASTM D1883

Exhibit B-8

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | by: | 10/26/2016 shs | |
| **ESALs Calculations** | | | | | | | | | Checked: | 10/27/2016_jhn | |
| Design Year | Average Annual Daily Traffic | | g = growth rate/year | | | | | | | Growth Factor | |
| | | | Base AADT x $(i)^n$=Design AADT **or** (i) = (Desing AADT/Base AADT)$^{(1/n)}$ | | | | | | | (F/A,g%,n) or $((1+g)^n-1)/g$ | |
| (n) | AADT Year | AADT | (g) | g% | | | | | | (GF) | Round (GF) |
| Base | 2018 AADT | 10200 | | | | | | | | | |
| 20 | 2038 ADDT | 13000 | 0.012202 | 1.2 | | | | | | 22.4528635 | 22.45 |
| 30 | 2048 AADT | 14600 | 0.012026 | 1.2 | | | | | | 35.8551049 | 35.86 |

**20 YR Flexible ESALs**

| | A | B | C | D | E | F | |
|---|---|---|---|---|---|---|---|
| Vehicle Classification | Base Year AADT 10200 x (B/100) | Vehicle Class % of AADT | ESAL Factors (TF) | Base Daily Esals A x C | Days per Year | Growth Factor (g) | Accumulated Design Year ESALs D x E x F |
| Passenger Cars | 4896 | 48.0 | 0.0007 | 3.43 | 365 | 22.45 | 28,083.33 |
| Panels & Pickups (under 1 ton) (light) | 4896 | 48.0 | 0.0007 | 3.43 | 365 | 22.45 | 28,083.33 |
| SU - 2 axle, 4 tire | 51 | 0.5 | | 0.00 | 365 | 22.45 | 0.00 |
| SU - 2 axle, 6 tire | 51 | 0.5 | 0.25 | 12.75 | 365 | 22.45 | 104,476.69 |
| SU - 3 & 4 axle | 51 | 0.5 | 0.58 | 29.58 | 365 | 22.45 | 242,385.92 |
| TST - 3 axle | 0 | 0.0 | 0.39 | 0.00 | 365 | 22.45 | 0.00 |
| TST - 4 axle | 0 | 0.0 | 0.51 | 0.00 | 365 | 22.45 | 0.00 |
| TST - 5 axle | 0 | 0.0 | 1.13 | 0.00 | 365 | 22.45 | 0.00 |
| TST - 6 axle | 0 | 0.0 | 0.78 | 0.00 | 365 | 22.45 | 0.00 |
| Trucks w/ trailers & buses (medium) | 255 | 2.5 | 0.57 | 145.35 | 365 | 22.45 | 1,191,034.24 |
| Twin Trailers | 0 | 0.0 | 2.4 | 0.00 | 365 | 22.45 | 0.00 |
| check | 10200 | | | | | | |
| TOTAL | **10200** | | TOTAL | 194.53 | | **TOTAL ESALs** | **1,594,063.51** |

| | |
|---|---|
| **2036 - 20 YR FLEXIBLE ESALs** | **1,594,063.51** |

**30 YR RIGID ESALs**

| | A | B | C | D | E | F | |
|---|---|---|---|---|---|---|---|
| Vehicle Classification | Base Year AADT 10200 x (B/100) | Vehicle Class % of AADT | ESAL Factors (TF) | Base Daily Esals A x C | Days per Year | Growth Factor (g) | Accumulated Design Year ESALs D x E x F |
| Passenger Cars | 4896 | 48.0 | 0.0007 | 3.43 | 365 | 35.86 | 44,858.28 |
| Panels & Pickups (under 1 ton) | 4896 | 48.0 | 0.0007 | 3.43 | 365 | 35.86 | 44,858.28 |
| SU - 2 axle, 4 tire | 51 | 0.5 | | 0.00 | 365 | 35.86 | 0.00 |
| SU - 2 axle, 6 tire | 51 | 0.5 | 0.24 | 12.24 | 365 | 35.86 | 160,208.14 |
| SU - 3 & 4 axle | 51 | 0.5 | 0.85 | 43.35 | 365 | 35.86 | 567,403.82 |
| TST - 3 axle | 0 | 0.0 | 0.37 | 0.00 | 365 | 35.86 | 0.00 |
| TST - 4 axle | 0 | 0.0 | 0.53 | 0.00 | 365 | 35.86 | 0.00 |
| TST - 5 axle | 0 | 0.0 | 1.89 | 0.00 | 365 | 35.86 | 0.00 |
| TST - 6 axle | 0 | 0.0 | 0.8 | 0.00 | 365 | 35.86 | 0.00 |
| Trucks w/ trailers & buses | 255 | 2.5 | 0.74 | 188.70 | 365 | 35.86 | 2,469,875.43 |
| Twin Trailers | 0 | 0.0 | 2.33 | 0.00 | 365 | 35.86 | 0.00 |
| check | 10200 | | | | | | |
| TOTAL | **10200** | | TOTAL | 251.14 | | **TOTAL ESALs** | **3,287,203.94** |

| | |
|---|---|
| **2046 - 30 YR RIGID ESALs** | **3,287,203.94** |

# APPENDIX C
# SUPPORTING DOCUMENTS

# GENERAL NOTES

## DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

**SAMPLING**

- Auger Cuttings
- No Recovery
- Shelby Tube
- Split Spoon

**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**

| | |
|---|---|
| **N** | **Standard Penetration Test Resistance (Blows/Ft.)** |
| **(HP)** | **Hand Penetrometer** |
| **(T)** | **Torvane** |
| **(DCP)** | **Dynamic Cone Penetrometer** |
| **(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 | | **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.** | **Descriptive Term (Consistency)** | **Unconfined Compressive Strength Qu, (psf)** | **Standard Penetration or N-Value Blows/Ft.** |
| Very Loose | 0 - 3 | Very Soft | less than 500 | 0 - 1 |
| Loose | 4 - 9 | Soft | 500 to 1,000 | 2 - 4 |
| Medium Dense | 10 - 29 | Medium Stiff | 1,000 to 2,000 | 4 - 8 |
| Dense | 30 - 50 | Stiff | 2,000 to 4,000 | 8 - 15 |
| Very Dense | > 50 | Very Stiff | 4,000 to 8,000 | 15 - 30 |
| | | Hard | > 8,000 | > 30 |

## 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 |

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# 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 ≥ 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 ≥ 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 ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 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.

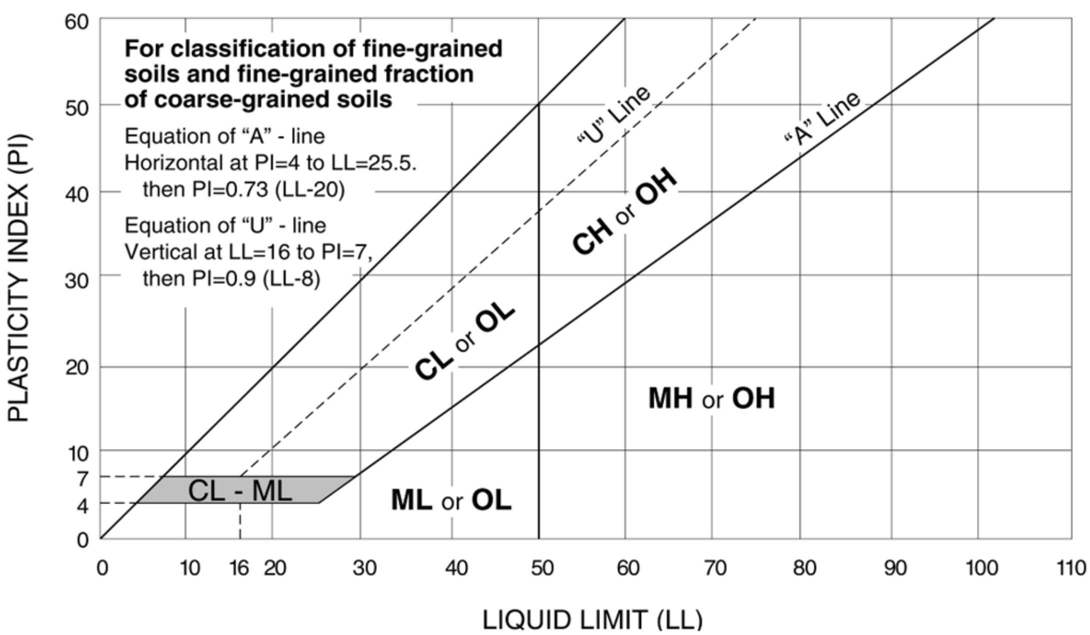


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Exhibit C-2