ADDENDUM NO. 01

Cirrus Aircraft Completion Center
Soil Corrections Package

For the Owner:	City of Duluth Property and Facilities Management 1532 W Michigan Street Duluth, MN 55806
Duluth Project No.	15-05AA
Prepared by:	Burns & McDonnell 8201 Norman Center Drive Suite 300 Bloomington, MN 55437
BMcD Project No.:	86198

CIVIL ENGINEER'S CERTIFICATION:
NORTHLAND CONSULTING ENGINEERS, LLP (sub to Burns & McDonnell)

I HEREBY CERTIFY THAT THE PLANS AND SPECIFICATIONS FOR CIVIL WORK WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Date: 26 October 2015

Signature: 

Printed Name: David G. Bolf **License No. 40926**

This Addendum forms a part of the Contract Documents and modifies the original Contract Documents as described. Acknowledge receipt of this Amendment/Addendum as directed on the 004113 Bid Form. Failure to acknowledge receipt of the Amendment/Addendum may be cause for disqualification.

SPECIFICATIONS

1. DIVISION 00, Section 00 41 13 – BID FORM – STIPULATED SUM (SINGLE-PRIME CONTRACT)

   Add the following to Para 1.2.A:

   3. Base Bid shall be inclusive of the following quantities of excavation and replacement:

      a) Excavation volume estimate: 24,700 CY (LV)
      b) Engineered backfill volume estimate: 19,500 CY (LV)

2. DIVISION 00, Section 00 43 22 – UNIT PRICES FORM

   Replace this section in its entirety – see attached.

3. DIVISION 01, Section 01 22 00 – UNIT PRICES

   Replace this section in its entirety – see attached.

4. DIVISION 01, Section 01 73 00 – EXECUTION

   Add the following:

1.5 SUBSURFACE SOIL EXPLORATION (GEOTECHNICAL) REPORT

A. General: The Subsurface Soil Exploration Report prepared by EPC Engineering & Testing for the City of Duluth is included as an Attachement to this Specification.

DRAWINGS

1. C2 EXISTING CONDITIONS AND REMOVALS
   a. Modify Note on Sanitary Waste piping and manhole located within Airport Road to read:

      "TO BE CONSTRUCTED OCT 2015 UNDER SEPARATE CONTRACT BY OTHERS"

ATTACHMENTS

1. GENERAL

   Subsurface Soil Exploration Report (prepared by EPC Engineering & Testing and dated 9/9/2015)

2. SPECIFICATIONS

00 43 22	UNIT PRICES FORM
01 22 00	UNIT PRICES

END OF ADDENDUM NO. 01

SUBSURFACE SOIL EXPLORATION REPORT

Proposed Cirrus Completion Center
Airport Road, between Vandenberg Drive and Stebner Road
Duluth, MN

Prepared For:

City of Duluth
Property & Facilities Management
1532 West Michigan Street
Duluth, MN 55806

Prepared By:

EPC Engineering & Testing
539 Garfield Avenue
Duluth, MN 55802

SUBSURFACE SOIL EXPLORATION REPORT

Proposed Cirrus Completion Center
Airport Road, between Vandenberg Drive and Stebner Road
Duluth, MN

PREPARED FOR:

City of Duluth
Property & Facilities Management
1532 West Michigan Street
Duluth, MN 55806

EPC Engineering & Testing Project No. 15G1018

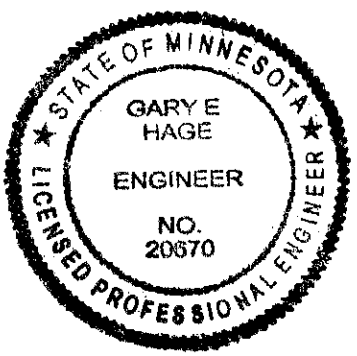
I hereby certify that this report was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the Laws of the State of Minnesota.

Gary E. Hage, P.E.

Registration No. 20670

09/09/15

Date



EPC Engineering & Testing
Geotechnical-Environmental-Materials-Engineering
539 Garfield Avenue
Duluth, MN 55802

Phone: (218) 727 1239
Fax: (218) 727-1248

September 9, 2015
EPC #15G1018

City of Duluth
Property & Facilities Management
1532 West Michigan Street
Duluth, MN 55806

Attn: Mr. Robert Hurd

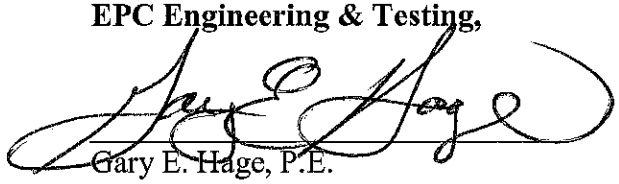
Re: Subsurface Soil Exploration Report
Proposed Cirrus Completion Center
Airport Road, between Vandenberg Drive and Stebner Road
Duluth, MN

Dear Mr. Hurd,

Enclosed is EPC Engineering & Testing's (EPC) geotechnical engineering report for the above-referenced project. We have prepared this report, and based our conclusions and recommendations upon current applicable professional standards. Copies of this report are furnished only to provide the factual data that was gathered and our interpretations with respect to this project, not to provide information regarding environmental concerns potentially associated with this site. Soil samples from this project will be saved for a period of two months from the date of this report, unless we are instructed in writing to do otherwise.

If you have any questions concerning the data or recommendations presented, or if we may be of further service on this project, please call. We appreciate the opportunity to be of service to the City on this project.

Respectfully submitted,
EPC Engineering & Testing,



Gary E. Hage, P.E.
Principal Engineer

C: Northland Consulting Engineers – Mr. Jon Aamodt, P.E.

SUBSURFACE SOIL EXPLORATION REPORT

Proposed Cirrus Completion Center
Airport Road, between Vandenberg Drive and Stebner Road
Duluth, MN

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The subsurface conditions beneath the site were found to be somewhat difficult due to fill, organic containing, variable strength and variable sand/silt/clay content soils, and a relatively shallow water table, but acceptable for the proposed project, as we understand the intended scope of construction. In summary, we recommend removing all fill, organic containing and all soft/loose soils (two to eight feet in the 14 borings), and using a maximum allowable bearing capacity of 2000 psf to design the foundations, placed on the native soils and/or on compacted engineered backfill placed on the native soils. More specific details are summarized in the Conclusions and Recommendations sections of this report.

SUBSURFACE SOIL EXPLORATION REPORT

Proposed Cirrus Completion Center
Airport Road, between Vandenberg Drive and Stebner Road
Duluth, MN

SCOPE OF INVESTIGATION

This report presents the results of a subsurface soil exploration program for the proposed project referenced above.

This investigation was performed at the direction of the owner's representative Mr. Robert Hurd of the City of Duluth, and the project structural engineer Mr. Jon Aamodt of Northland Consulting Engineers, by EPC Engineering & Testing (EPC) verbal proposal to the City. Mr. Aamodt defined the scope of work performed in this subsurface exploration program.

This investigation was directed towards defining the subsurface conditions beneath the proposed site for this new building construction project. Field explorations and laboratory studies were performed to evaluate soil engineering properties at the site. Mr. Aamodt provided information about the project. A preliminary geotechnical investigation had been conducted on this site before this investigation, by EPC, in November of 2014. Information on these borings is included in the appendix of this report.

EPC Engineering & Testing (EPC) has prepared this project report for design purposes only; it may not have sufficient subsurface information to prepare an accurate construction bid. EPC recommends that the contractors preparing bids or proposals for this project be provided with copies of this report and the soil boring logs, as supplemental information to the drawings and specifications, not as a part of the Contract Documents.

PROPOSED PROJECT

The proposed project, as described by project structural engineer, Mr. Jon Aamodt of Northland Consulting Engineers, consists of a 70,200 square foot, approximately 390 by 180-foot, single story, continuously heated prefab concrete building. Standard frost depth spread footings and tilt-up concrete panels are proposed, with interior columns and a steel bar joist roof. Maximum structural loading conditions are 280 kips for columns and 10.5 klf for strip footings. The proposed finished floor elevation is to be 1422.00 feet, resulting in up to about 3-feet of elevation change (cut and fill) to the proposed building site.

Changes in the nature, design, or location of all or parts of this project may occur during development. The conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed by the soils engineer. EPC will then make recommended changes or modifications to this report in writing only.

SITE CONDITIONS

Geological Setting

Through an understanding of the geological history and processes of any area, we are better able to define and understand the range of geotechnical properties observed in the geological materials encountered at the site. Knowledge of the anticipated subsurface profile at the site is essential for interpreting and correlating the borings from any geotechnical exploration program.

Based upon information from geological survey reports, and previous soils investigations in the area, the properties of the surficial soils are at or near this project site are interpreted as being related to geological deposits of man-made fill and organic deposits, over glacial till and outwash soils, and relatively shallow (less than 50 feet) bedrock.

The unconsolidated materials consist of outwash (undivided as to moraine association), and sandy and stony till (ground and end moraine) of the Mille Lacs-Highland Moraine Association, all associated with the Superior Lobe of the Wisconsinan Pleistocene glaciation (Geologic Map of MN, Quanternary Geology, MN Geologic Survey, 1982). Bedrock consists generally of Gabbro of the Middle Proterozoic Duluth Complex (Geologic map of the Duluth Complex and related rocks, northeastern MN J.D. Miller et. al. 2001).

Site Topography

Site topography is relative flat in the proposed building site, due to previous filling and grading. Maximum elevation change between borings was about five feet.

Existing Adjacent Structures

Existing adjacent structures include a relatively small concrete block structure, which is to be raised. Many other structures, similar and smaller than the proposed structure, exist near-by. No documented data was provided on any of these structures, but they appear visually from the outside to be operating satisfactorily.

FIELD EXPLORATIONS

The subsurface exploration program consisted of 14 soil borings. Boring locations are shown on the boring location map in the Appendix. Locations of these boring were staked in the field by others. Boring surface elevations were also provided by others. Borings were conducted to depths below existing grade (BEG) considered practical to identify adverse soils for the proposed project.

Borings were made with EPC's CME 850 track and 55 truck mounted drill rigs using 3-1/4 inch inner diameter hollow stem augers. Drilling and field-testing operations were performed during the time period from August 8 to 15, 2015.

At selected depth intervals in the borings, Standard Penetration Tests (SPT) were conducted in substantial compliance with ASTM Method D1586. The SPT data listed on the boring logs is the number of blows required to drive a standard split-tube sampler 12 inches (two six-inch increments) into undisturbed soil using a 140-pound drive hammer dropped 30 inches per blow. After an initial "set" of six inches, the number of blows required to drive the sampler an additional 12 inches is known as the

penetration resistance or "N" value. The "N" value is an index of the relative density of cohesionless soils and the consistency of cohesive soils.

Partially disturbed samples were obtained from the split-spoon Standard Penetration sampler. All samples were recovered and sealed in the field to preserve natural moisture content and returned to the laboratory for testing.

A field log was prepared for each boring by EPC's drilling supervisor. These logs contain factual information and field interpretation of the soil conditions observed between samples, as described in substantial compliance with ASTM D420 and D2488. These field logs are on file in EPC's office.

The final logs are included in the Appendix. These final logs represent the interpretation of the contents of the field logs after laboratory observations and testing of the field samples were complete. Final soil descriptions are based upon visual observation / laboratory testing methods. Soils are described in this report according to the Unified Soil Classification System (USCS), as outlined in the boring log key in the Appendix.

Water level readings were observed in the drill holes at the times and under the conditions stated on the boring logs. However, it must be noted that fluctuations in the level of the ground water may occur because of variations in the rainfall, temperature, subsurface materials and other conditions or factors different from those observed at the time of the measurements. It should be noted that such conditions are subject to change.

SUBSURFACE CONDITIONS

Soil Conditions

The subsurface soils encountered beneath this site generally consisted of three(3) basic stratigraphic units: (1) Silty Clayey Sand FILL soils; (2) Silty Clayey Sand Organic containing soils; and (3) Silty Clayey Sand and Sandy Silty Clay native soils. More specifically, the soil units are described as follows:

UNIT 1 – Man-Made/Placed FILL
This soil unit was observed in all of the borings, from the existing ground surface to depths of two to eight feet. These soils were generally silty clayey sand, with varying amounts of gravel, organics, silt and clay. Lesser amounts of boulder/cobble were also encountered in some of these soils. These soils were in a non-uniform very loose to very dense relative density state. Some of the more organic of these soils (both fill and native) are described in Unit 2, below.

UNIT 2 – ORGANIC Containing FILL / Could Be FILL / Native Soils
Organic containing silty clayey sand / sandy silty clay soils similar to those soils described in Unit 1 above, were encountered in Boring 1 (2 to 4-feet), Boring 5 (6 to 8-feet), Boring 7 (6 to 7-feet), Boring 8 (2 to 4-feet), Boring 9 (4 to 10-feet), and Boring 14 (6 to 8-feet). The organics observed in these soils indicate that some or all of the material at and/or above these depths could be fill soil. Organic/loose soils were observed as deep as elevation 1411.9 feet in Boring 5.

UNIT 3 – SILTY CLAYEY SAND (SC-SM) – OUTWASH/TILL
Native silty clayey sand soils, similar to those of Unit 1, were observed below the fill/could be fill soils, to the termination depth of the borings at 16-feet below existing grade (BEG). In Boring 5 at 5-feet BEG, the visually highest clay/silt content of all of the soils was tested and classified as Sandy Silty

Clay (CL-ML), based on 62% passing the #200 sieves. The majority of all of the soils on this site are silty clayey sand with less than 40% passing the #200 sieve, based on visual classification. The relative density of the native soils generally increases significantly compared to that of most of the fill/could be fill soils.

Six of the 12 borings that were attempted to be drilled to 16-feet, reached substantial refusal of the auger and/or SPT sampler prior to reaching that depth, on what are believed to be boulders. The shallowest refusal elevation was in Boring 14 at 9.8-feet BEG (elevation 1417.4 feet). Of the eight borings performed in the proposed building footprint, only Boring 5 reached substantial refusal, at 14.3-feet (elevation 1405.6 feet). Bedrock cores were not performed to verify the origin of the refusal material.

Water Table Conditions and Cave-in Levels

Water table observations at the times noted in the boring logs indicated that water was observed from about 5 to 13-feet in nine of the borings, during and up to 2.5-days after the borings were completed. Most of the water level observations were at or below elevation 1415 feet. Boring cave-in levels were observed from elevation 1417.5 to 1411 feet, averaging 1415 feet, in seven of the borings, after the auger casing was removed.

LABORATORY TESTING

Results of the field testing and observed subsurface conditions were evaluated to develop a laboratory testing program. Laboratory testing was directed towards determining existing natural moisture content and visual classification of all samples. Organic content and approximate unconfined compressive strength (UCS) by hand/pocket penetrometer (PP) and approximate dry density (DD) was determined for selected SPT samples. A grain size analysis was performed on the most visually highest clay/silt content soil.

Results of the laboratory tests are shown on the enclosed boring logs in the Appendix. Moisture and organic content test results are expressed in percent (%) on an oven dry weight basis, UCS/PP in tons per square foot (tsf), DD in pounds per cubic foot (pcf) and gradation in percent of total dry weight passing a particular size sieve.

ANALYSIS OF FIELD/LABORATORY DATA

The basic criterion for the design of a foundation requires that the probability of a shear failure in the underlying soils to be reduced to an allowable level of risk for a given project. In addition, settlements or other vertical movements within these soils must not exceed the limits set for the particular type of structure to be supported.

The ultimate bearing capacity of a foundation soil depends upon the size, shape and type of foundation element, depth below the surface, and other related physical characteristics of the supporting soils. Bearing capacity failures will usually be confined to a depth beneath the footing equal to the footing width. For cohesive soils, the average undrained strength is evaluated within this zone as a measure of the shearing resistance against a bearing capacity failure. For granular soils, the ultimate bearing capacity is evaluated from the penetration record ("N" values) within the zone of failure, with due regard to the position of the water table. For long term sustained loading, a factor of safety (FS) of 3.0 against bearing capacity failure by structure overloading is recommended. This usually provides an FS

of about 1.5 with respect to mobilization of available shear strength, which is acceptable. For the most unfavorable loading condition, a minimum bearing capacity FS of 2.0 is recommended.

Settlement is an equally important criteria for determining the allowable bearing capacity or type of foundation for a project. In fact, the allowable bearing pressure or foundation type is controlled by the settlement criteria on most projects.

Bearing Capacity Shear Failure

Results of the field and laboratory testing program were used to evaluate the allowable bearing capacity for the proposed project. A total of 11 SPT's were used in evaluation of the more sandy soils of Unit 3, ranging from 10 to 23 blows per foot, with an average of 17 blows per foot, and standard deviation of 4.78. These data resulted in a 95% confidence interval ranging from 14 to 20 blows per foot. Using 17 blows per foot, a soil unit weight of 115 below the footing and 105 pcf above, and a footing depth of six feet and width of 1.5 feet, an allowable bearing capacity with a FS of 3.0 of over 4000 psf was determined with respect to shear failure. For an interior strip footing with 1.5 feet of cover the allowable bearing pressure reduces to 2100 psf.

For the more clayey soils of Unit 3, four SPTs were considered, those being 16, 13, 11 and 8 blows per foot. Using 8 blows per foot, an estimated UCS of 2000 psf and cohesion of 1000 psf, a soil unit weight of 105 pcf, and a footing depth of six feet, an allowable bearing capacity with a FS of 3.0 of about 2100 psf was determined with respect to shear failure. For an interior strip footing with two feet of cover allowable bearing pressure reduces to 2000 psf with an FS of 3.

Bearing Capacity Settlement

As discussed, settlement is an equally important criteria for determining the allowable bearing capacity or type of foundation. Settlement generally takes place quickly in granular soils, with the bulk of settlement occurring during or shortly after construction. Settlement of these soils is usually estimated from the standard penetration test (SPT) "N" values. Settlement of structures founded on cohesive soils generally takes place very slowly, over a long period of time compared to granular soils. The exact magnitude and time of settlement varies widely, depending upon the loading history of the soil, foundation type and size, and the magnitude of loads applied to the proposed foundations. Settlements on cohesive soils are usually estimated by performing a consolidation test or from the index and estimated soil strength and settlement properties.

Analysis of the above data related to the settlement of the more sandy soils of Unit 3 indicated that one inch of settlement is estimated to occur under a footing six feet square at a bearing pressure of 4000 psf. For a wider footing, say 12-feet square, one inch of settlement is estimated to occur at a bearing pressure of 2000 psf. A six foot wide continuous footing was estimated to settle 0.75-inches at 2000 psf. Differential settlement is estimated to be on the order of one-half of these amounts.

Analysis of the data related to settlement of the more clayey soils of Unit 3 indicated that a precise prediction may not realistically be made without the benefit of an actual consolidation test. However, with our knowledge of the sandy silty clay soils in this area and with the proposed footing loads, settlement has proven to be limited to an acceptable amount over the economic life of similar structures, with minimal site elevation increase.

DESIGN REQUIREMENTS

Based upon the above analysis of the shear strength of the soil units observed beneath this site, it appears that a spread footing type of foundation is appropriate for this project.

Footings

For a spread footing foundation, we offer the following recommendations for this project:

1. Excavation requirements:

Remove all topsoil, fill, organic containing and all soft/loose soils (two to eight feet in the 14 borings) according to the table below. Excavated soils should not be reused as engineered backfill. If reused, they should be used in non-drainage sensitive areas or as parking/drive area subgrade. It should be noted that a significant time consuming effort could be required to adjust the moisture content to achieve adequate compaction of some of the most clayey of these soils.

Boring Number SB-15-	Surface Elevation (ft)	Depth/Elevation to Bottom of FILL (ft)	Depth/Elevation to Bottom of Could Be Fill (ft)	Depth/Elevation to Bottom of Native Soils / Boring (ft)	Depth/Elevation to Observed Water / Cave-in Level (ft)	Required Minimum Excavation Depth/Elevation (ft)
* 1	1419.26	5.0 / 1414.3	N/A	10 / 1409.3	N/A	N/A
* 2	1420.40	5.0 / 1415.4	N/A	10 / 1410.4	N/A	N/A
3	1417.93	4.0 / 1413.9	8.0 / 1409.9	** 10.3 / 1407.6	4.5 / 1413.4	4.0 / 1413.9
*** 4	1419.20	2.0 / 1417.2	7.0 / 1412.2	16 / 1403.2	6.5 / 1412.7	2.0 / 1417.2
*** 5	1419.87	8.0 / 1411.9	N/A	** 14.3 / 1405.6	N/A	8.0 / 1411.9
*** 6	1423.55	8.0 / 1415.5	N/A	15.2 / 1408.3	5.2 / 1418.3	8.0 / 1415.5
7	1425.59	7.0 / 1418.6	N/A	16 / 1409.6	8.3 / 1417.7	7.0 / 1418.6
*** 8	1420.48	4.0 / 1416.5	N/A	16 / 1404.5	5.5 / 1415.0	4.0 / 1416.5
*** 9	1424.00	8.0 / 1416.0	10 / 1414.0	16 / 1408.0	13.5 / 1410.5	8.0 / 1416.0
10	1418.56	6.0 / 1412.6	N/A	** 12 / 1406.6	7.5 / 1411.1	6.0 / 1412.6
*** 11	1420.00	4.0 / 1416.0	N/A	16 / 1404.0	N/A	4.0 / 1416.0
*** 12	1423.96	6.0 / 1418.0	7.5 / 1416.5	16 / 1408.0	9.0 / 1415.0	6.0 / 1418.0
*** 13	1424.37	5.0 / 1419.4	N/A	14.6 / 1409.8	7.3 / 1417.1	5.0 / 1419.4
14	1427.17	4.0 / 1423.2	9.8 / 1417.9	** 9.8 / 1417.4	N/A	4.0 / 1423.2

* Indicates performed in Airport Road for utility design.
** Indicates substantial auger refusal.
*** Indicates boring performed in proposed building footprint

2. Frost Cover:

Provide at least six feet of frost cover to the bottom of all exterior and perimeter footings. Interior column footings and/or load bearing wall footings may be placed as shallow as 1.5-feet below finished floor grade, to the bottom of the footing, provided the soil correction for the building is not performed under freezing conditions.

3. Bearing Capacity

A maximum allowable bearing capacity of 2000 psf was determined for spread footings placed on the soils of Unit 3, or on compacted engineering backfill placed on these with an FS of 3.0 against shear failure. Strip footing up to 6-feet wide and column pads up to 12-feet square are estimated to settle up to one inch total and one-half inch differential.

Floor Slabs

For floor slabs we recommend the following:

1. Remove all topsoil, fill and organics, which should consist of the upper two to eight feet of soil, as recommended in the above table.

2. Proof-roll all surfaces to receive slab concrete and/or engineered backfill with a loaded dump truck and/or multiple passes with a large vibratory sheeps foot roller, and remove any soft areas noticed. Compact (seal) with a large smooth drum roller (multiple passes) after proof rolling.

3. A subgrade modulus k-value of 150 pci is estimated for the more clayey soils of Unit 3.

4. A conventional clean sand cushion layer or a moisture barrier (vapor retarder) and a "base material" may be necessary under the concrete floor, pending any proposed floor coverings. The project architect or engineer should specify the type and placement / location of the base layer and moisture barrier, if required. The American Concrete Institute (ACI) Section 302 of the *Manual of Concrete Practice* discusses vapor retarders and base layers.

Parking/Drive Areas

For a no frost heave parking/drive area, the complete frost protection method is recommended, which requires the entire potential frost depth be removed, plus two feet, for a total of eight feet of removal. If some frost heave can be tolerated, EPC recommends the following:

For parking/drive areas, the entirety of the fill (two to eight feet) should be removed, as recommended in the table above. The subgrade should be proof-rolled and any soft areas removed. The subgrade should be pre-compacted and shaped to drain water naturally. A subgrade drainage system would be beneficial for this site. For use in designing the engineered pavement cross-section we off the following:

1. Engineering properties of the soils are estimated as follows:

   A. Soil Classification of the more clayey soils:
   USCS Sandy Silty Clay; AASHTO A-4 Silty Soils.

B. Frost Susceptibility/Drainage: The more clayey soils are deemed to have a medium to very high frost susceptibility and fair to practically impervious drainage characteristics.

C. Subgrade Strength/Rating: The more clayey soils are deemed to have low subgrade strength and general subgrade rating of fair to poor.

D. Compressibility:
The compressibility of the more clayey soils is judged to be low or slight to medium.

E. CBR / R-Value / k-Value:
Estimated values: CBR 5, R-Value 20 and k-Value 150 pci.

2. Underground utilities that may be placed as part of the construction should be placed prior to constructing the engineered section to avoid mixing the lesser quality native/existing fill soils with the high quality imported engineered backfill soils.

3. Drainage - A subgrade drainage system would be beneficial for the poorly drained subgrade soils. If proper subgrade shaping is performed to drain the subgrade soils naturally, a subgrade drainage system is not mandatory.

4. Transition from the new parking/drive areas to the adjacent roads should be gradual to reduce the risk of differential movement. If different thicknesses of engineered sections exist, the transition zone should be on the order of 10H to 1V.

5. The side-slopes should be constructed with maximum slopes of 4H to 1V.

Geotechnical

We also offer the following geotechnical related design recommendations for this project.

1. Slope backfill next to the building away from the foundation at a minimum slope of 10H to 1V to promote drainage away from the structure.

2. Use footings constructed to the same depth of cover as the rest of the building to support canopy footings, door stoop slabs, porch floors or exterior planters, to reduce the risk of movement due to fill settlement or from frost heave. These areas should also be properly over-excavated. The stoop slabs should be constructed as structural members with a minimum six inch air gap between the concrete and soil below.

3. Remove all underground utilities that may exist and fill associated with them and replace with compacted engineered backfill.

4. Foundation drain recommendation: Use a factory wrapped, perforated perimeter foundation drain near, but below the exterior base of the footings (at the lowest limits of the subgrade outside the footing influence zone) and route to daylight or a storm sewer to reduce the risk of water ponding in the granular backfill. Surround the drain with filter aggregate and wrap it with filter fabric to reduce the risk of clogging. The subgrade inside the building should be sloped to drain to a low point and an interior foundation drain should also be used, connected to the exterior drain, or sumped out. Weep holes through the footings are an acceptable alternative to an interior drain tile for structures without basements.

5. Clay cap: After completing foundation construction, place a one-foot thick clay (native/existing fill soil) cap around the building, beneath the final topsoil. Extend the cap back to the native/fill soil. This procedure should create a virtually "closed system" which reduces the potential risk of water entering the foundation area after construction.

GENERAL CONSTRUCTION REQUIREMENTS

We offer the following recommendations for use in preparing plans and specifications for construction of this project.

General Excavation Requirements

1. Remove all topsoil, vegetation, roots, grass or other visible organic material from areas that are to be excavated or receive fill. Separate topsoil required for the surface of the final site grading. Stockpile in a careful manner to the extent it is not mixed with other materials and will be available for landscaping uses on the site.

2. All soft or spongy areas found during foundation excavation should be over-excavated and replaced with suitable approved compacted backfill material. All subgrade should be sloped to drain naturally. Water must not pond on the subgrade during or after construction.

3. If foundation construction occurs under conditions of freezing temperatures, the base of all foundation excavations and backfill materials should be protected from freezing before and after concrete placement. Surfaces which may become frozen should be thawed before placing of foundation concrete. If freezing has loosened and reduced the bearing capacity of the excavation surface, remove the frozen (previously frozen) material to the undisturbed surface. Place the foundation upon that undisturbed soil or compacted engineered backfill. Slab-on-grade soils should not be constructed over frozen soils. Frozen material should not be used as backfill.

4. Foundation excavations in cohesionless soils (sands and gravels) will often result in considerable disturbance of the top one to three inches of soil at the surface of the foundation load bearing soil. In cohesive soils (clays and silts), excavation with a toothless bucket reduces the disturbance. The surface of such soils should be re-compacted before placement of the foundation concrete or engineered backfill, to avoid unnecessary settlement during or after construction.

5. Excavations for the placement of engineered backfill should extend horizontally a minimum of one foot beyond the outside edge on all sides of the foundation element for every one foot of over-excavation depth required below the footing elevation, beginning two feet outside the edge of the footing. In peat soils the excavation should extend 1H to 1V plus an additional five feet outside the edge of the footing.

6. The surface of all excavated areas upon which engineered backfill will be placed should be prepared by scarifying to a depth of at least six inches and re-compacting to achieve uniform subgrade conditions before backfill is placed. Selection of procedures and equipment should be the responsibility of the contractor. In general, compaction of cohesive soils is usually best achieved with a sheeps foot compactor. Cohesionless soils are usually best compacted with a vibrating roller or vibrating plate compactor.

General Backfill Requirements

A wide variety of materials may usually be considered as suitable for engineered backfill. The choice of materials is a function of the structural requirements, water table conditions, seasonal construction constraints, placement and compaction methods, and other site/project specific needs. Granular materials which classify as GW, GC, SW, SM, and SC according to the USCS (ASTM D4287) are usually the most suitable engineered backfill. Poorly graded gravels and sand (GP and SP) are generally less desirable because they are usually more difficult to compact. Where frost action is of concern, silty or clayey granular soils with as little as 3-5% of the particles passing the No. 200 sieve can be unacceptable. Inorganic clays and silts of low to medium plasticity (CL and ML) are not suitable for backfill on this project, but may be used for general site grading and landscaping. Soils of high plasticity (CH, MH) are unsuitable.

Specification for the gradation of engineered backfill used on this project should comply with the following general requirements:

1. No organic or other deleterious material.

2. Gradation (Except Class 5 and sand cushion or base layer):

Sieve Size	Percent Passing
3 inch	100
2 inch	85-100
3/4 inch	71-100
# 4	50-80
#200	7 max

3. The upper 12 inches, directly under slab and foundation concrete, should contain no material larger than one inch.

4. Where wet subgrade conditions exist for placement of the first lift, a maximum of 5% passing a No. 200 sieve is recommended.

5. Alternative gradations should be evaluated by the soils engineer for acceptability if these guidelines cannot be satisfied by locally available backfill materials within an economical distance of this project.

General Compaction Requirements

The following compaction requirements are recommended for use in the project specifications.

1. Laboratory compaction standard for granular (non-cohesive) soils: ASTM D1557 - Modified Proctor.

2. Compact backfill to a minimum of the following percentage of the above compaction standard for the respective types of fill material.

Type of Engineered Backfill (Granular)	Compaction/ Density
Foundation Structural Backfill	**95%**
Slab-on grade Backfill	**95%**
Non-structural Backfill	**90%**
Sidewalks	**90%**
Landscaped Areas	**85%**
Utility Trenches	**95%**
Parking Lot / Drive Area Subbase	**95%**
Parking Lot / Drive Area Aggregate Base	**95%**

3. Place engineered backfill or other fill materials in lifts not to exceed eight inches in a loose condition, unless the contractor can demonstrate satisfactory results by placing thicker lifts.

4. In general, fill materials should be placed and compacted within two percent of optimum moisture content, as determined by above applicable compaction standard. When fill materials are not in this range of moisture content, compaction to the required density may be difficult or not possible. The excavating contractor should be required to be responsible for controlling and adjusting moisture content.

5. Flooding is not an acceptable procedure for compacting of backfill materials and should not be permitted.

6. Compaction of utility trenches in all areas of the project should not be overlooked. Narrow trenches and small areas often require use of small compaction equipment or tools. Thinner (four- to six-inch) lifts may be required to achieve successful compaction. This requirement should be clearly defined in the specifications and reviewed with the contractor or subcontractors performing utility work.

7. Excavation and engineered backfill operations should be observed by a qualified soils engineer or their designated representative. In-place density testing should be performed to document that the geotechnical recommendations and compaction requirements in this report are achieved.

8. For this project, we recommend a minimum density testing frequency of one test per 100 l.f. of footing backfill, one per column pad location and one per 4000 s.f. of floor slab backfill, per lift. For isolated locations or doubtful areas we recommend a minimum of one test per occasion, as recommended by the soils engineer.

CONCLUSIONS

Based upon the 14 soil borings drilled in the authorized exploration program and the above-described laboratory testing program, we have drawn the following general conclusions about the subsurface conditions beneath this site:

Soil Conditions

The borings consisted of two to eight feet of silty clayey sand fill over silty clayey sand and lesser amounts of sandy silty clay soils to 16-feet. In six of the 12 borings that were attempted to be drilled to 16-feet, four of these borings reached substantial auger refusal at depths of 10 to 14 feet, as shallow as elevation 1417.4 feet, on what are believed to be boulders. Of the eight borings performed in the proposed building footprint, only Boring 5 reached substantial refusal, at 14.3-feet (elevation 1405.6 feet). Fill/soft/loose/organic soils were observed as deep as elevation 1412.0 feet in Boring 5.

Water Table Conditions

Water was observed in most of the borings during and up to 2.5-days after boring completion. Most of the water levels were observed at and below elevation 1415.0 feet. Water should not be a significant problem during excavation above elevation 1415-feet, unless it is allowed to drain into and pond in open excavations. Dewatering is the responsibility of the contractor.

Allowable Bearing Capacity

A maximum allowable bearing capacity of 2000 psf was determined with an F.S. of 3.0 against shear failure for footings up to 6-feet wide and 12-feet square with at least 1.5-feet of cover. Settlement is estimated to be 1-inch total and 0.5-inch differential for these footings.

RECOMMENDATIONS

In summary, we offer the following specific recommendations regarding design of the foundation and other geotechnical engineering aspects of this project.

1. Remove all topsoil, fill and all soft/loose soils (two to eight feet in the soil borings) from the entire building footprint. Use the proposed spread footing foundation with a maximum allowable bearing capacity of 2000 psf for footings up to 6-feet wide and 12-feet square with at least 1.5-feet of cover.

2. The design recommendations and specifications in the "Design Requirements" and "Construction Requirements" sections of this report should be followed.

LIMITATIONS OF EXPLORATION AND REPORT

We have based the analysis and recommendations submitted in this report in part upon the data obtained from the 14 soil borings. The nature and extent of variations between the borings may not become evident until construction. If variations then appear evident, it will be necessary for the soils engineer to re-evaluate the recommendations of this report.

As the soils engineer for this project, we recommend that we be provided an opportunity to do a general review of final design drawings and specifications for this project to determine that earth work and foundation recommendations contained herein have been properly interpreted and included in the design and specifications. We can assume no responsibility for misinterpretation or improper application of our recommendations and conclusions by others.

EPC further recommends that soil engineering and testing services be performed during construction of the excavation and foundation phases of the work. This procedure is to observe compliance with the design drawings, specifications and EPC's recommendations, and it also allows design changes to be made in the event that subsurface conditions differing from those anticipated before construction started are discovered and necessary changes can be recommended in a timely manner.

Responsibility to provide safe working conditions for earthwork and below grade aspects of this project is solely that of the contractors or subcontractors working on the project and is not the responsibility of EPC Engineering & Testing. All local, state and federal requirements, statutes, ordinances, or building codes relating to slopes or temporary sheeting and bracing of trenches and excavations must be observed by contractors during construction.

EPC has prepared this report, consisting of 13 pages, Appendix and letter of transmittal, for the exclusive use of the City of Duluth and it's designated representatives, for specific application to the design of the Cirrus Completion Center building, south of Airport Road between Vandenberg Drive and Stebner Road in Duluth, MN, at the specific locations drilled. Copies of this report are furnished only to provide the factual data which were gathered and summarized in the report.

Professional services provided to this project by EPC Engineering & Testing were completed, findings obtained and recommendations prepared using generally accepted engineering principles and practices. Conclusions and recommendations contained herein are based upon the applicable standards of our profession at the time this report was prepared. This warranty is in lieu of all other warranties, either expressed or implied.

Respectfully submitted,

EPC Engineering & Testing

Gary E. Hage, P.E.
Principal Engineer

Reviewed by;

Brian E. McVean, P.E.
Principal Engineer

APPENDIX

SUBSURFACE SOIL EXPLORATION REPORT

Proposed Cirrus Completion Center
Airport Road, between Vandenberg Drive and Stebner Road
Duluth, MN

EPC ENGINEERING & TESTING Project # 15G1018

COMMON SOIL REPORT ABBREVIATION DEFINITIONS

AASHTO	American Association of State Highway and Transportation Officials
AB	After Boring Completion
BEG	Below Existing Grade
BFG	Below Finished Grade
CI	Confidence Interval
DD	Dry Density
DL	Dead Load
EOB	End of Boring
FS	Factor of Safety
kcf	Kips per Cubic Foot
LL	Live Load
mg/mk	Milligrams per Kilogram
N	Standard Penetration Resistance Value
pcf	Pounds per Cubic Foot
PID	Photoionization Detector
plf	Pounds per Lineal Foot
ppm	Parts Per Million
psf	Pounds per Square Foot
SPT	Standard Penetration Test
UCS	Unconfined Compressive Strength
WRT	With Respect To
WT	Water Table

BORING LOG KEY and SOIL CLASSIFICATION DATA

BORING LOG KEY

Water Level
Water levels indicated on the boring logs are as measured at stated times. In pervious soils the elevations indicated are considered reliable levels. However, in impervious soils, even after several days of monitoring, accurate determinations may not be possible. Therefore, additional/alternate methods of ground water elevations should be sought.

Commonly Used Moisture Conditions of Soils are as Follows

Term	Meaning
Dry	- Requires the addition of considerable moisture to attain optimum for compaction
Moist	- near optimum moisture for compaction
Wet	- requires drying to attain optimum moisture for compaction
Saturated (Water Bearing)	- very wet

Gradation Description and Terminology

Soil Type	Particle Name	Size Range
Coarse Grained Soils	Boulders	over 12"
	Cobbles	3" - 12"
	Gravels	#4 - 3"
	Coarse	¾" - 3"
	Fine	#4 - ¾"
	Sands	#200 - #4
	Coarse	#10 - #4
	Medium	#40 - #10
	Fine	#200 - #40
Fine Grained Soils	Silt*	0.074 mm (#200) - 0.005 mm
	Clay*	less than 0.005 mm

Descriptive Terms of Components Present in Sample (other than ASTM D 2487)

Term	Percent of Dry Weight
Trace	1 - 9
Little	10 - 19
Some	20 - 34
With	35 - 50

Relative Density of Granular Soils

N-Blows/ft	Relative Density	Standard "N" Penetration
0 - 4	Very Loose	Blows per foot of a 140
4 - 10	Loose	pound hammer falling 30"
10 - 30	Medium Dense	on a 2" outside diameter
30 - 50	Dense	split barrel sampler
over 50	Very Dense	

Consistency of Cohesive Soils

Unconfined Compressive Strength (Qu, tsf, or Kg/cm^2)	Consistency	N (SPT)
<0.25	Very Soft	0 - 2
0.25 - 0.50	Soft	2 - 4
0.50 - 1.00	Medium	4 - 8
1.00 - 2.00	Stiff	8 - 15
2.00 - 4.00	Very Stiff	15 - 30
4.00 - 8.00	Hard	over 30

* Silt and Clay sizes are best determined by Atterberg Limits.

TABLE 1 - SOIL CLASSIFICATION CHART ASTM D2487, USC SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests (A)					Soil Classification	
					Group Symbol	Group Name
Coarse-Grained Soils More Than 50% retained on #200 Sieve	Gravels More than 50% of coarse fraction retained on #4 sieve	Clean Gravels Less then 5% fines (C)	Cu>4 and 1<Cc<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 #4 sieve	Clean Sands Less than 5% fines (D)	Cu>6 and 1<Cc<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 #200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI>7 and plots on or above "A" line		CL	Lean clay (K,L,M)
			PI<4 or plots below the "A" line		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 the "A" line		CH	Fat clay (K,L,M)
			PI plots below the "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" (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) $Cu = D60/D10 \quad Cc = D30^2/(D10 \times D60)$

(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 hatched area, soil is CL-ML, silty clay.

(K) If soil contains 15 to 29% plus #200, add "with sand" or "with gravel," whichever is predominant.

(L) If soil contains >30% plus #200, predominantly sand, add "sandy" to group name.

(M) If soil contains >30% plus #200, predominantly gravel, add "gravelly" to group name.

(N) PI>4 and plots on or above "A" line. (see fig. 1)

(O) PI<4 or plots below "A" line.

(P) PI plots on or above "A" line.

(Q) PI plots below "A" line.

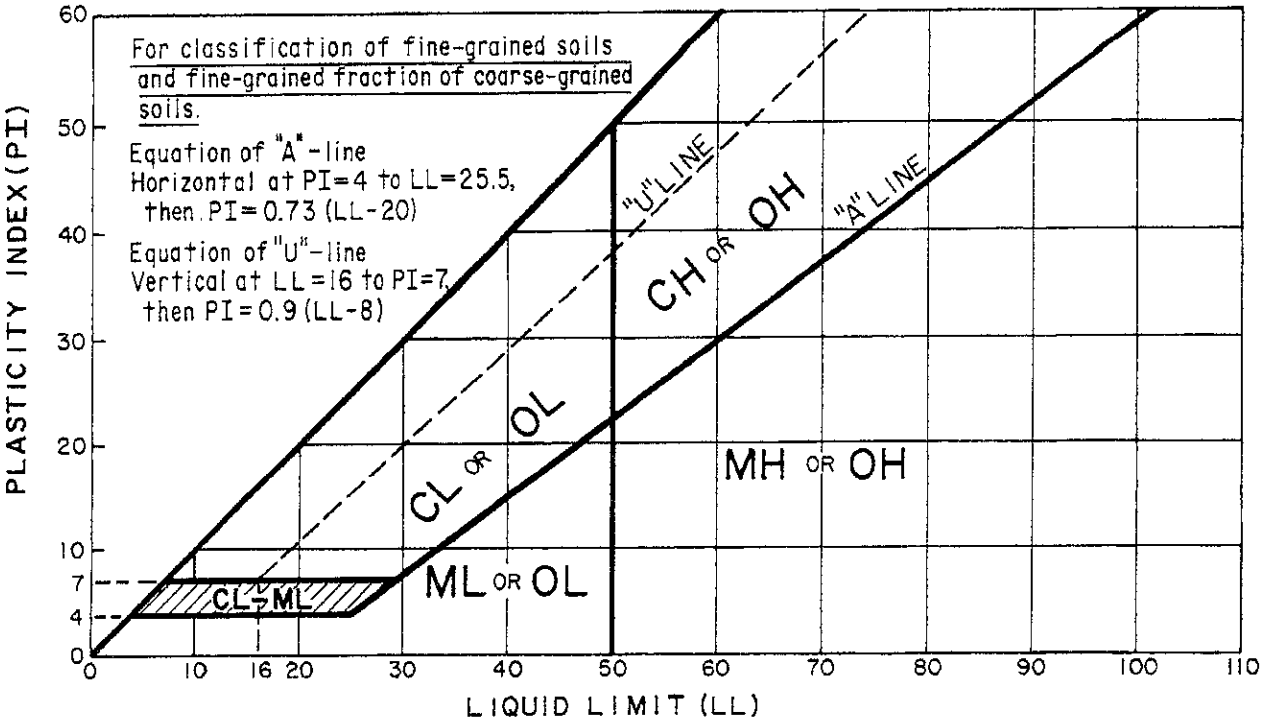
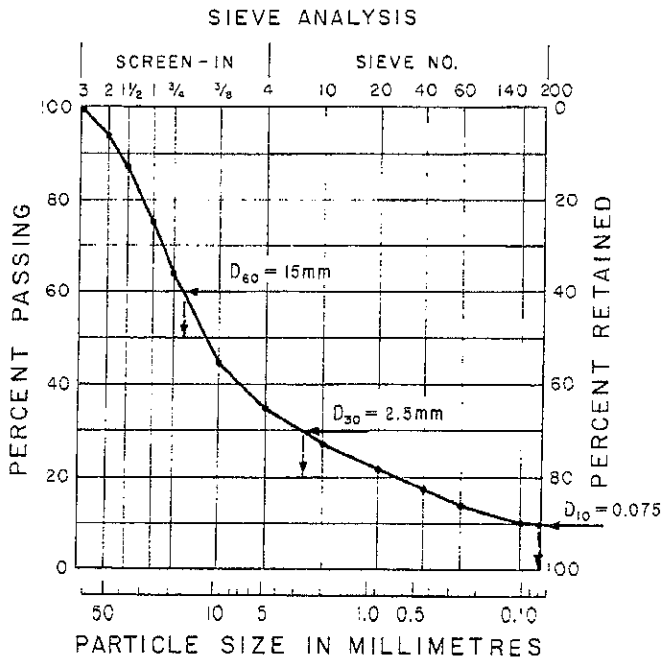


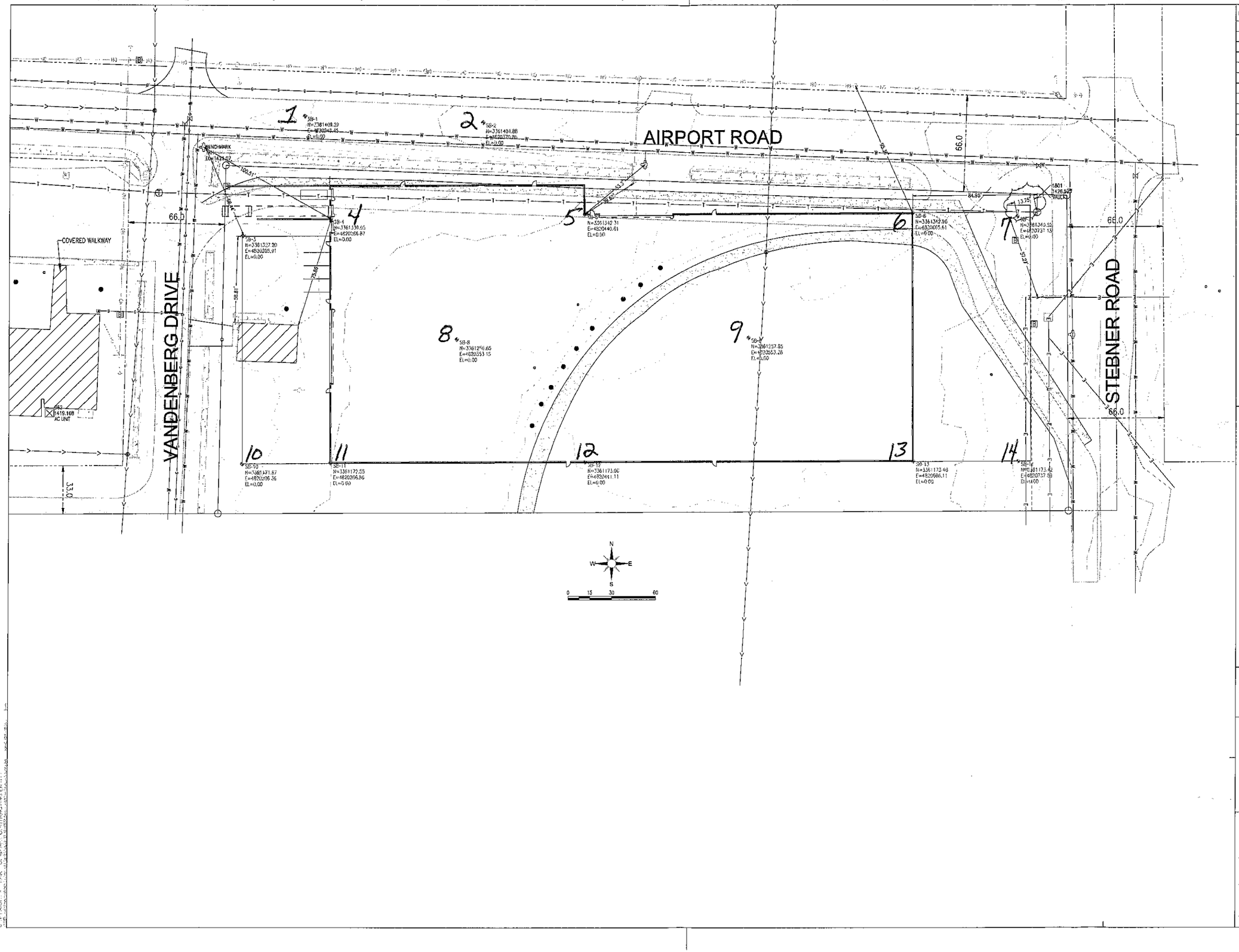
FIG. 4 Plasticity Chart



$$Cu = \frac{D_{60}}{D_{10}} = \frac{15}{0.075} = 200 \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{(2.5)^2}{0.075 \times 15} = 5.6$$

FIG. 5 Cumulative Particle-Size Plot

BORING LOCATION MAP



no.	date	by	ckd	description

PRELIMINARY - NOT FOR CONSTRUCTION

BURNS McDONNELL

MEYER GROUP

RESPECTING OUR CLIENTS. RESPECTING OUR [illegible]

Northland Consulting Engineers L.L.P.
Structural, Civil and Forensic Engineering Services

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

NAME:

REGISTRATION #: 40926

xxx xx, 2015
SIGNATURE: DATE

date	detailed
DATE	DETAILER
designed	checked
DESIGNER	TPD

CIRRUS

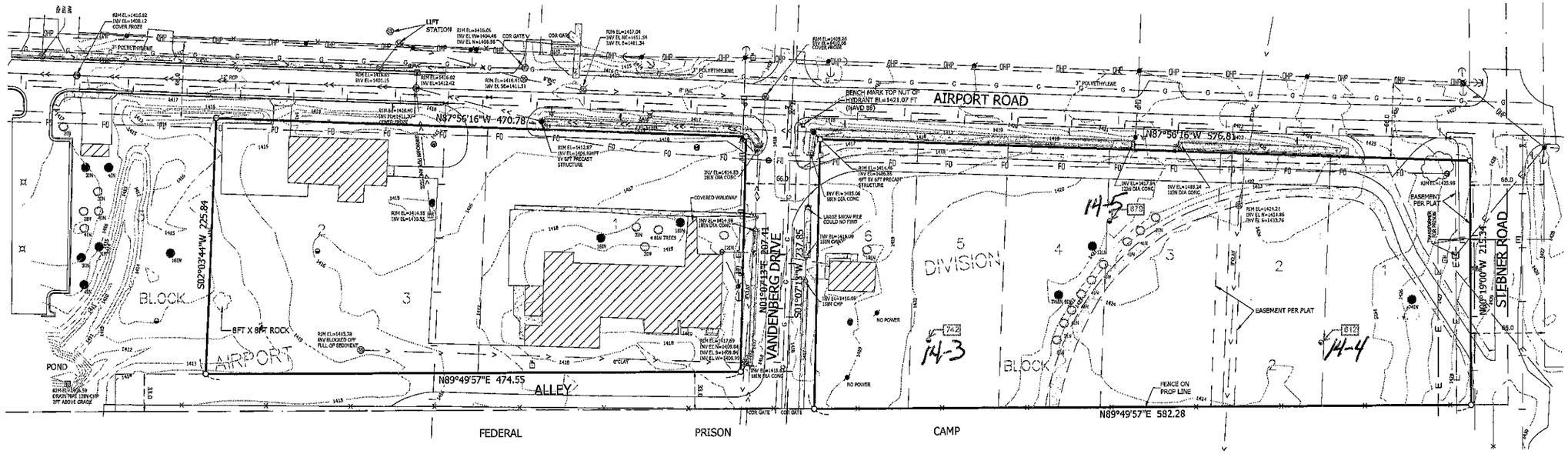
CIRRUS AIRCRAFT
4970 AIRPORT ROAD
DULTH, MN 55811

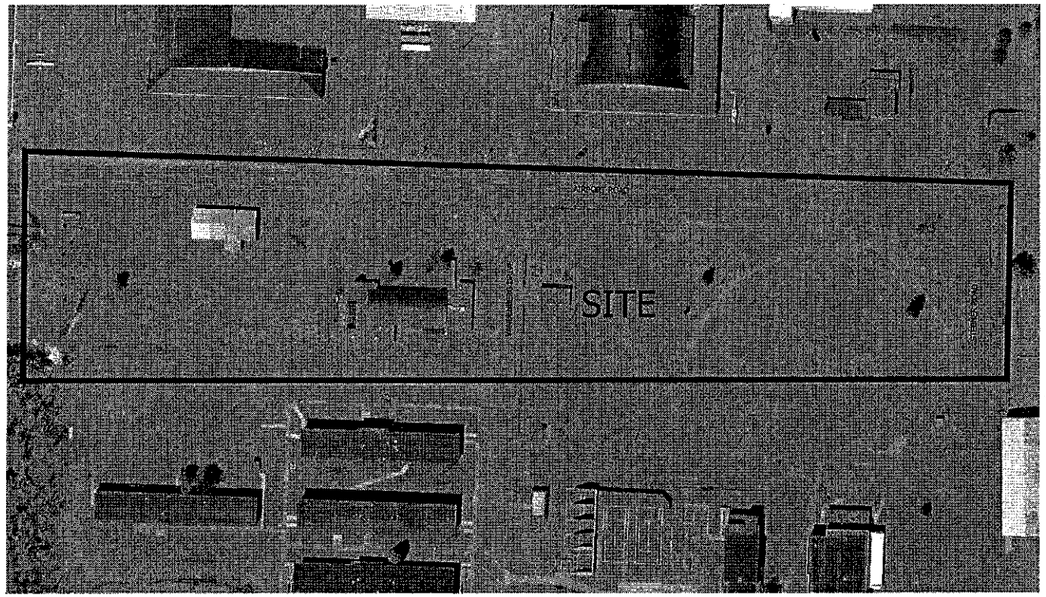
PAINT HANGAR - CIRRUS AIRCRAFT
EXHIBIT 2.0 - BORINGS - TO LOCATE
SECONDLINE
THIRDLINE

project	contract
86198 NCE 15-322-C	CONTRACT

drawing rev.

DWGNO – REV





VICINITY MAP
NO SCALE

LEGEND

- EXISTING EASEMENT LINE
- FENCE LINE
- OHP — OVERHEAD UTILITIES
- TREE/BRUSH LINE
- WATER MAIN
- SANITARY SEWER
- STORM SEWER
- G — UNDERGROUND GAS
- E — UNDERGROUND ELECTRIC
- FO — UNDERGROUND FIBER OPTIC
- EXISTING BUILDINGS
- CONCRETE SURFACE
- GRAVEL SURFACE
- BITUMINOUS SURFACE
- SQUARE GRATE CATCH BASIN
- CONTROL POINT
- FENCE CORNER
- GAS METER
- GAS VALVE
- GUY WIRE
- HYDRANT
- METAL PIPE
- LIGHT POLE
- POST/BOLLARD
- UTILITY POLE
- SIGN
- STORM MANHOLE
- TELE COM PEDESTAL
- CONIFEROUS TREE
- DECIDUOUS TREE
- WELL
- WATER VALVE
- MONITOR WELL
- CIRCULAR GRATE CATCH BASIN
- TELE COM MANHOLE
- SANITARY MANHOLE
- SOIL BORING
- CULVERT
- SET REBAR RLS. NO. 49505

N

0 50
SCALE IN FEET

LEGAL DESCRIPTION PER CLIENT

Lots 1, 2, 3, 4, 5 and 6, Block 2 and Lots 1 and 2, Block 3, AIRPORT DIVISION, according to the recorded plat thereof, St. Louis County, Minnesota.

PROPERTY ADDRESS
4970 AIRPORT ROAD, DULUTH, MN

TOTAL PROPERTY AREA
233,481.6 SQ. FT OR 5.36 ACRES

BENCH MARK
TOP NUT OF HYDRANT LOCATED AT THE SE QUADRANT OF THE INTERSECTION OF AIRPORT ROAD AND VANDENBERG DRIVE. ELEVATION =1421.07 FEET (NAVD 88).

ZONING
MU-N-MIXED USE- NEIGHBORHOOD PER CITY OF DULUTH ZONING.

BEARINGS ARE BASED ON THE ST. LOUIS COUNTY TRANSVERSE MERCATOR COORDINATE SYSTEM OF 1996.

DUE TO SNOW AND ICE SOME SURFACE FEATURES MAY HAVE NOT BEEN VISIBLE TO LOCATE ON THIS SURVEY.

UNDERGROUND UTILITIES WERE LOCATED IN THE FIELD BY OBSERVED EVIDENCE UTILITY SKETCHES PROVIDED BY UTILITY COMPANIES AND THE CITY OF DULUTH GIS MAPS AND BY GOPHER STATE ONE CALL TICKET NUMBERS 150080223 AND 150080226.

THIS SURVEY HAS BEEN PREPARED WITHOUT BENEFIT OF A TITLE COMMITMENT OR TITLE OPINION. A TITLE SEARCH FOR RECORDED OR UNRECORDED EASEMENTS WHICH MAY BENEFIT OR ENCUMBER THIS PROPERTY HAS NOT BEEN COMPLETED BY ALTA LAND SURVEY COMPANY.

ALTA
LAND SURVEY COMPANY
5421 MAIN ROAD
TOWER, MINNESOTA 55790
PHONE 218-753-6310
WWW.ALTALANDSURVEY.COM

BOUNDARY & TOPOGRAPHIC SURVEY
CLIENT: FEDERAL BUREAU OF PRISONS
PROJECT NO.
DATE: 9-14-15
ADDRESS: 4970 AIRPORT ROAD
SCALE: 1"=50'
SHEET NO. 1

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Land Surveyor under the laws of the State of Minnesota.
Date: 9-14-15
License No. 49505
David R. Evans
Land & Surveyor Not Licensed No. 49505

BORING LOGS

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

BORING NUMBER 15-SB-01

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/8/15 **COMPLETED** 8/8/15
GROUND ELEVATION 1419.259 ft **HOLE SIZE** 6-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 55 Truck Rig with FA
AT TIME OF DRILLING ---
LOGGED BY NW **CHECKED BY** BEM
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
	0		Bituminous pavment, 5 inches in thickness.	FA	100				
			Class 5, 6 inches in thickness.	FA	100				
			Silty Sand with Gravel, Brown, moist to wet.						
				FA 1	100				6.9
1415	5								
			Silty Sandy Clay, Brown, wet, trace gravel and cobbles.						
				FA 2	100				21.5
1410	10		Bottom of hole at 10.0 feet.						

GEOTECH BH PLOTS 15G1018 COD CIRRUS COMPLETION CENTER.GPJ GINT US LAB.GDT 9/8/15

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

BORING NUMBER 15-SB-02

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/8/15 **COMPLETED** 8/8/15
GROUND ELEVATION 1420.402 ft **HOLE SIZE** 6-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 55 Truck Rig with FA
AT TIME OF DRILLING ---
LOGGED BY NW **CHECKED BY** BEM
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

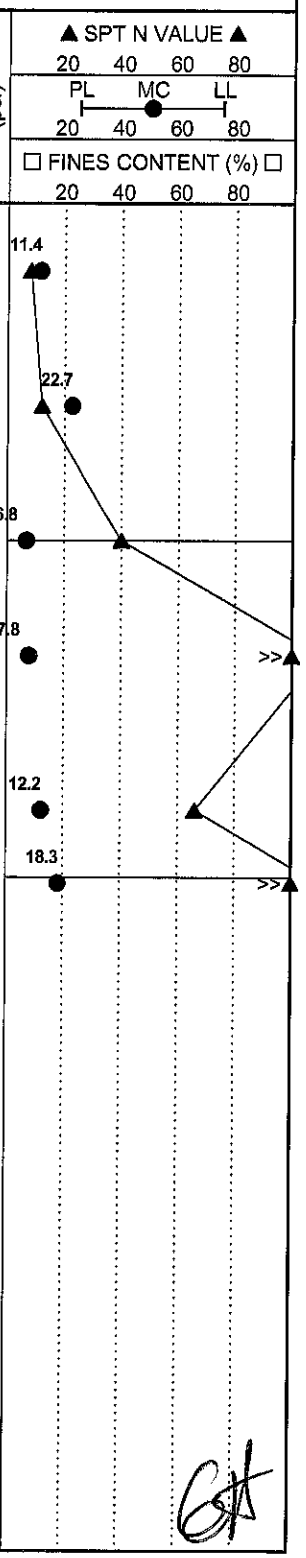
ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ / PL MC LL / ☐ FINES CONTENT (%) ☐
1420	0		Bituminous pavement, 4 inches in thickness.	FA	100				
			Class 5, 5 inches thick.	FA	100				
			Silty Sand with gravel, Brown, moist to wet	FA 1	100			5.9	
			Sand with Gravel, Brown, moist.	FA 2	100			7.1	
	5		Silty Sand with Gravel, Brown, moist.	FA 3	100			7.0	
1415			Silty Sandy Clay, Brown, wet, trace gravel and cobbles.	FA 4	100			15.2	
	10		Bottom of hole at 10.0 feet.						

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

BORING NUMBER 15-SB-03

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/11/15 **COMPLETED** 8/11/15
GROUND ELEVATION 1417.93 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
▽ **AT TIME OF DRILLING** 8.0 ft / Elev 1409.9 ft
LOGGED BY AS **CHECKED BY** GH
▼ **AT END OF DRILLING** 5.5 ft / Elev 1412.4 ft
NOTES Proposed NW building corner. Boring left open (uncased) over night. ▼ **18hrs AFTER DRILLING** 4.5 ft / Elev 1413.4 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
	0		3-inches Topsoil.					
			SILTY SAND (SM) to SAND with Silt (SP-SM) (FILL) Brown, moist to wet, little gravel, loose relative density.	SPT 1	29	4-5-3-3 (8)		
1415			SANDY SILTY CLAY (CL-ML) (FILL / ORGANIC) Gray, brown, black mottle, moist, trace gravel, stiff consistency. Organic content of sample from 2 to 4-feet = 5.4% (slightly organic to organic).	SPT 2	63	4-5-7-8 (12)		
	5		SILTY SAND (SM) (Could Be FILL) Grayish brown to brown, dry to moist to wet, some gravel, dense to very dense relative density. Cave-in level = 4.5-feet.	SPT 3	50	10-18-22-23 (40)		
				SPT 4	47	20-46-50/5"		
1410			SILTY CLAYEY SAND (SC-SM) (Could Be FILL) Brown, water bearing, with to little gravel, trace to with cobbles, very dense relative density.	SPT 5	67	5-24-42-48 (66)		
	10		Substantial auger refusal at 10.3-feet. Bottom of hole at 10.3 feet.	SPT 6	100	50/2"		



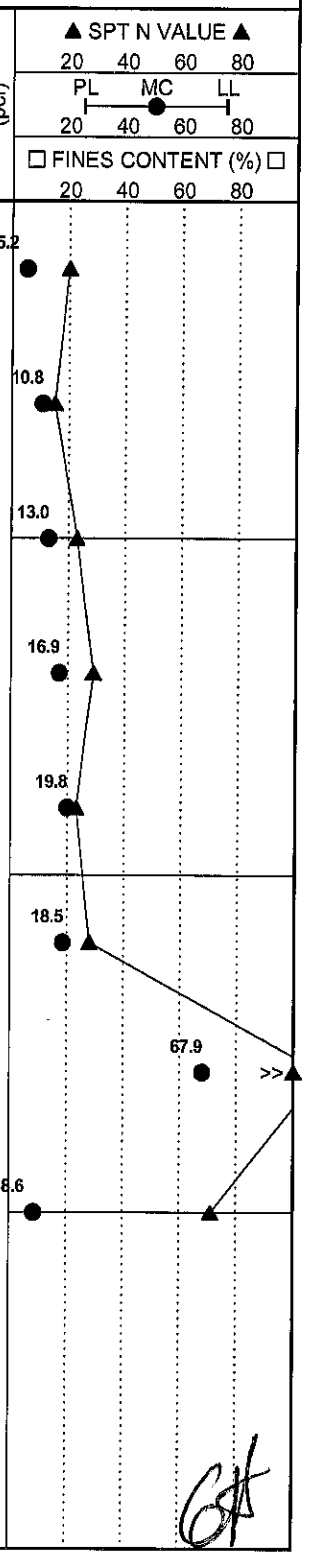
GEOTECH BH PLOTS 15G1018 COD CIRRUS COMPLETION CENTER.GPJ GINT US LAB.GDT 9/8/15

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

BORING NUMBER 15-SB-04

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/11/15 **COMPLETED** 8/11/15
GROUND ELEVATION 1419.2 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
AT TIME OF DRILLING 8.0 ft / Elev 1411.2 ft
LOGGED BY AS **CHECKED BY** GH
AT END OF DRILLING 13.0 ft / Elev 1406.2 ft
NOTES Boring left open (uncased) over night.
2hrs AFTER DRILLING 6.5 ft / Elev 1412.7 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
	0		5-Inches Topsoil.					
			SILTY SAND (SM) to SAND with Silt (SP-SM) (FILL) Brown, dry to moist, little gravel, medium dense relative density.	SPT 1	83	8-10-10-10 (20)		
			SILTY CLAYEY SAND (SC-SM) (Could Be FILL) Brown, moist, trace gravel, medium dense relative density.	SPT 2	75	6-7-8-8 (15)		
1415								
	5		SILTY SAND (SM) (Could Be FILL) Brown, moist to wet, trace gravel, medium dense relative density.	SPT 3	75	4-11-12-26 (23)		
			Water and cave-in level = 5-feet after 18 hours uncased.					
			SILTY CLAYEY SAND (SC-SM) (Could Be FILL) Brown, wet to water bearing at 7.5-feet, medium dense relative density. Cave-in level = 7-feet, two hours after casing removal.	SPT 4	75	17-14-15-13 (29)		
1410			SILTY CLAYEY SAND (SC-SM) to SANDY SILTY CLAY (CL-ML) (Probable Native) Brown, wet to water bearing, trace sand and black colored weathered rock, trace gravel and cobbles, medium dense relative density / very stiff consistency.	SPT 5	67	3-10-13-18 (23)		
	10			SPT 6	75	2-10-18-25 (28)		
			SILTY CLAYEY SAND (SC-SM) to SANDY SILTY CLAY (CL-ML) Brown, water bearing to wet to moist, with gravel, trace cobbles, very dense relative density / hard consistency.	SPT 7	45	12-19-30-50/4"		
1405								
	15			SPT 8	42	26-33-38-43 (71)		
			Bottom of hole at 16.0 feet.					



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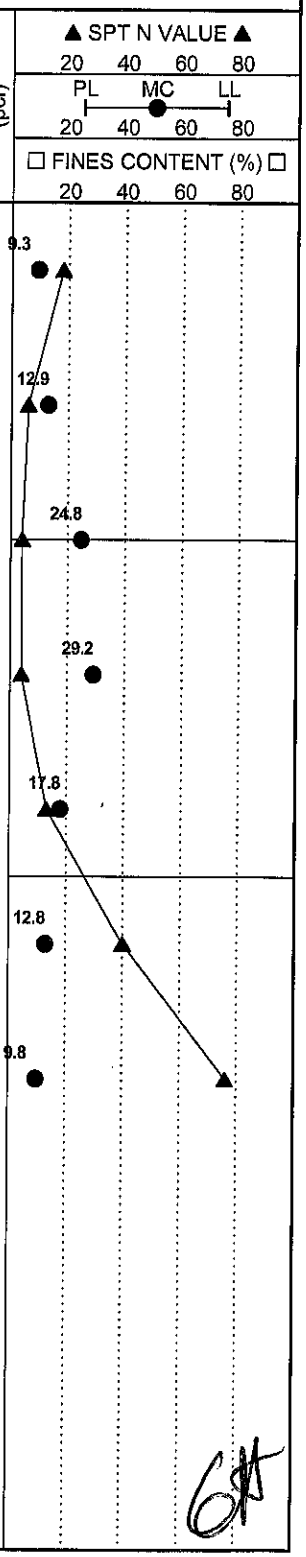
BORING NUMBER 15-SB-05

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/11/15 **COMPLETED** 8/11/15
GROUND ELEVATION 1419.87 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
AT TIME OF DRILLING None to 4-feet
LOGGED BY AS **CHECKED BY** GH
AT END OF DRILLING N/A due to drilling fluid
NOTES Boring offset 3-feet S (toward Prison) due to pavement.
AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
	0		SILTY SAND (SM) to SILTY CLAYEY SAND (SC-SM) (FILL) Brown, moist, trace to little gravel, medium dense relative density.	SPT 1	50	12-9-9-7 (18)		
			SILTY CLAYEY SAND (SC-SM) (FILL) Brown, wet, little gravel, loose relative density.	SPT 2	21	5-3-3-4 (6)		
			Drilled with head of drilling fluid in auger beginning at 4-feet.					
1415	5		SILTY CLAYEY SAND (SC-SM) to SANDY SILTY CLAY (CL-ML) (FILL) Brown, water bearing, very loose to loose relative density, soft to consistency.	SPT 3	50	4-2-2-3 (4)		
			SILTY CLAYEY SAND (SC-SM) (FILL / ORGANIC) Grayish brown, wet to water bearing, with to trace organics (root fibers), very loose to loose relative density. Organic content of sample from 6 to 8-feet = 1.6 (slightly organic).	SPT 4	100	3-2-2-5 (4)		
			SILTY CLAY (CL-ML) Brown, wet to water, with to trace sand, stiff consistency.	SPT 5	75	6-4-9-14 (13)		
1410	10		SILTY CLAYEY SAND (SC-SM) Brown, water bearing to wet to moist, with to some gravel, dense to very dense relative density.	SPT 6	42	5-16-24-30 (40)		
				SPT 7	42	20-47-29-35 (76)		
			Substantial auger refusal at 14.3-feet. Bottom of hole at 14.3 feet.					



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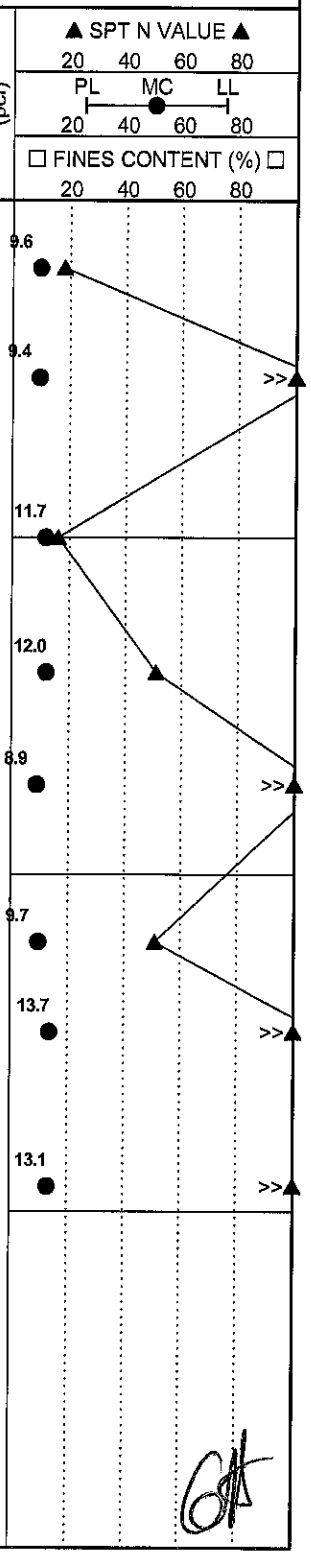
BORING NUMBER 15-SB-06

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/15/15 **COMPLETED** 8/15/15
GROUND ELEVATION 1423.55 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 55 Truck w/HSA and SPT Calibrated to N68
▽ **AT TIME OF DRILLING** 10.0 ft / Elev 1413.6 ft
LOGGED BY AS **CHECKED BY** GH
AT END OF DRILLING 5.5 ACR
NOTES Boring offset 10-feet W due to shallow refusal.
▼ **3hrs AFTER DRILLING** 5.2 ft / Elev 1418.4 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
	0		SILTY CLAYEY SAND (SC-SM) (FILL) Brown, moist, trace gravel, yellow brick, fiber wire and concrete, medium dense to loose relative density.	SPT 1	42	6-8-10-6 (18)		
				SPT 2	27	2-2-50/3"		
1420			Sample from 2 to 4-feet pushed concrete.					
	5		SILTY CLAYEY SAND (SC-SM) to SILTY SAND (SM) (FILL) Brown, water bearing to wet, little gravel, trace cobbles/boulders, medium to very dense relative density. ▽ Cave-in level = 5.8-feet.	SPT 3	33	4-4-12-12 (16)		
				SPT 4	42	6-20-31-35 (51)		
			Substantial auger refusal of first attempt at 8-feet. Moved 10-feet W and continued drilling.					
1415			SILTY CLAYEY SAND (SC-SM) Brown, moist to wet to wet to water bearing, some to little gravel, very dense relative density.	SPT 5	69	5-22-50/4"		
	10		▽					
				SPT 6	83	11-20-31-36 (51)		
				SPT 7	50	16-50/2"		
1410								
	15			SPT 8	67	11-35-50/3"		
			Bottom of hole at 15.2 feet.					



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BORING NUMBER 15-SB-07

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/15/15 **COMPLETED** 8/15/15
GROUND ELEVATION 1425.59 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 55 Truck w/HSA and SPT Calibrated to N68
AT TIME OF DRILLING None
LOGGED BY AS **CHECKED BY** GH
AT END OF DRILLING 10.0 ft / Elev 1415.6 ft
NOTES
0hrs AFTER DRILLING None to 8.3-feet.

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
1425	0		2-inches Topsoil.						
			SILTY SAND (SM) (FILL) Brown, dry trace gravel and organics, medium dense relative density.	SPT 1	42	2-10-11-12 (21)			8.6
			SILTY CLAYEY SAND (SC-SM) (FILL) Light brown to brown to dark brown to brown, wet to moist to wet to water bearing at 6-feet, trace gravel and organics, loose to medium dense relative density.	SPT 2	50	2-3-5-4 (8)			23.0
	5			SPT 3	21	1-7-7-8 (14)			12.4
1420			Organic content of sample from 6 to 7-feet = 2.6% (slightly organic).	SPT 4	50	5-12			24.2
			SILTY CLAYEY SAND (SC-SM) Brown to grayish brown at 12-feet, wet to water bearing to wet to moist @ 12-feet, to wet to waterbearing, trace to little to some to with gravel, dense to very dense relative density.	SPT 5	75	30-29			14.1
			Cave-in level = 8.3-feet.	SPT 6	83	5-15-26-27 (41)			10.4
	10			SPT 7	63	11-21-24-19 (45)			12.6
1415			Grayish brown and wet to moist in sample from 12 to 14-feet.	SPT 8	79	7-25-27-22 (52)			10.2
	15			SPT 9	71	8-32-30-40 (62)			11.7
1410			Bottom of hole at 16.0 feet.						

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BORING NUMBER 15-SB-08

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/11/15 **COMPLETED** 8/11/15
GROUND ELEVATION 1420.48 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
▽ **AT TIME OF DRILLING** 13.0 ft / Elev 1407.5 ft
LOGGED BY AS **CHECKED BY** GH
▼ **AT END OF DRILLING** 7.0 ft / Elev 1413.5 ft
NOTES Auger casing left in ground over night.
▼ **13hrs AFTER DRILLING** 5.5 ft / Elev 1415.0 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
1420	0		4-inches Topsoil.						
			SILTY CLAYEY SAND (SC-SM) (FILL) Brown, moist, little gravel, medium dense relative density.	SPT 1	83	3-9-12-10 (21)			11.9
			SANDY SILTY CLAY (CL-ML) (FILL / ORGANIC) Black, gray and light brown, moist to wet, trace gravel, very stiff consistency. Organic content of sample from 2 - 4-feet= 5.6% (organic).	SPT 2	58	3-9-12-10 (21)			26.1
	5		SANDY SILTY CLAY (CL-ML) Light brown to brown, wet, very stiff consistency.	SPT 3	58	2-9-7-5 (16)			19.7 ☐ 62.5
1415			Laboratory Tested: 88% passing #4 and 62% passing #200 sieve.						
				SPT 4	75	2-3-8-12 (11)			17.4
			SILTY CLAYEY SAND (SC-SM) Brown to grayish brown, wet to water bearing to wet, little to with to little gravel, medium to dense relative density.	SPT 5	50	5-10-11-21 (21)			12.7
	10			SPT 6	58	4-7-15-17 (22)			13.0
1410			Water bearing and with gravel in sample from 12 to 14-feet.	SPT 7	33	6-12-14-20 (26)			13.4
	15			SPT 8	63	9-17-14-16 (31)			11.5
1405			Bottom of hole at 16.0 feet.						

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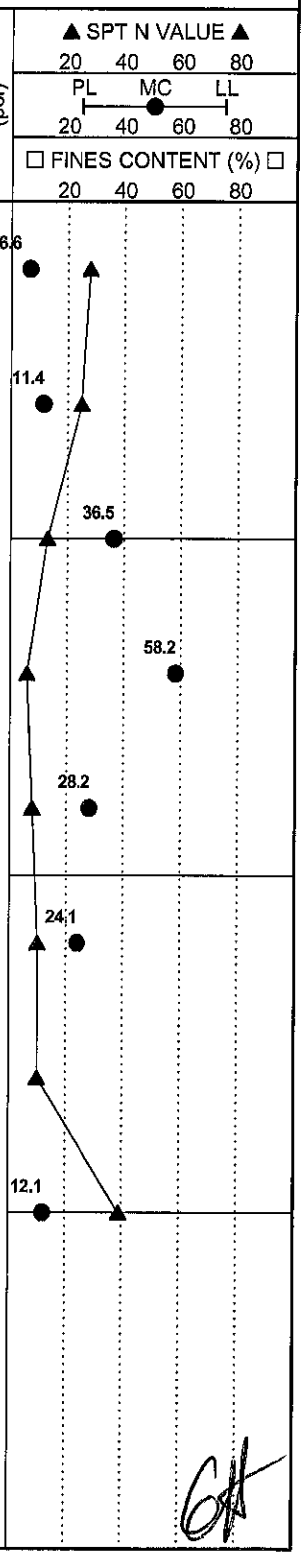
BORING NUMBER 15-SB-09

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/12/15 **COMPLETED** 8/12/15
GROUND ELEVATION 1424 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 55 Truck w/HSA and SPT Calibrated to N68
▽ **AT TIME OF DRILLING** 13.5 ft / Elev 1410.5 ft
LOGGED BY AS **CHECKED BY** GH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
	0		SILTY SAND (SM) (FILL) Light brown, dry, trace gravel, medium dense relative density.	SPT 1	75	5-16-12-8 (28)		
1420			SILTY CLAYEY SAND (SC-SM) (FILL) Brown, moist, trace gravel, medium dense relative density.	SPT 2	33	4-12-13-9 (25)		
	5		SANDY SILTY CLAY (CL-ML) (FILL) Brown and dark gray, moist, trace gravel, with to trace organics, stiff consistency. Organic content of sample from 4 to 6-feet = 10.7% (organic to highly organic).	SPT 3	38	5-5-8-5 (13)		
			ORGANIC SILTY CLAY (OL-OH) to SILTY CLAY (CL-ML) (Could Be FILL) Black to dark gray, moist, trace organics, loose relative density / medium consistency. Organic content of sample from 6 to 8-feet = 4.0% (slightly organic to organic).	SPT 4	83	2-3-3-4 (6)		
1415			SILTY CLAY (CL-ML) (Could Be FILL) Dark gray, moist, trace organics, medium to stiff consistency. Organic content of sample from 8 to 10-feet = 1.5% (not organic to slightly organic).	SPT 5	83	2-3-5-5 (8)	1.5	97
	10		SILTY CLAY (CL-ML) to SILTY CLAYEY SAND (SC-SM) (Could Be FILL) Dark gray, wet, stiff consistency / loose to medium dense relative density.. Organic content of sample from 10 to 12-feet = 1.2% (not organic).	SPT 6	58	1-4-6-5 (10)		
1410			No recovery in sample from 12 to 14-feet.	SPT 7	0	2-6-4-6 (10)		
	15		SILTY CLAYEY SAND (SC-SM) (Could Be FILL) Brown, wet to water bearing, little gravel (one, 1.5-inch diameter piece), dense relative density.	SPT 8	42	13-20-19-18 (39)		
			Bottom of hole at 16.0 feet.					



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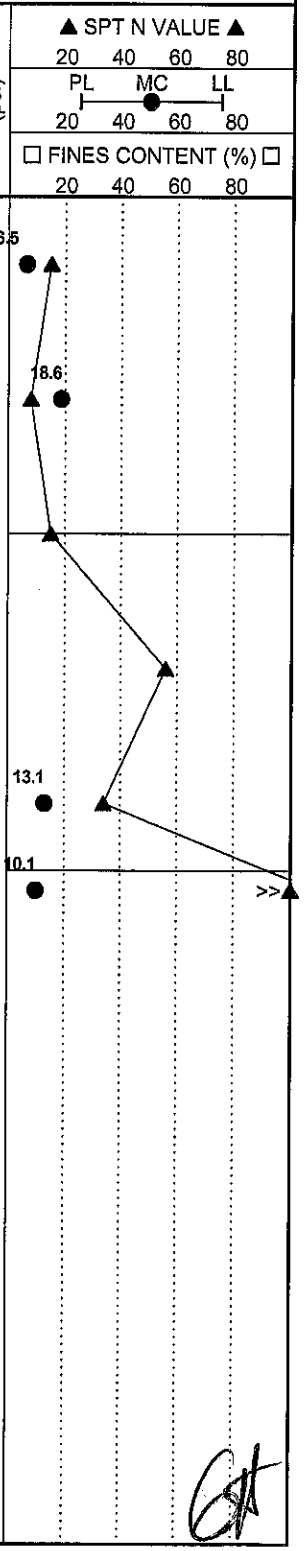
BORING NUMBER 15-SB-10

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/12/15 **COMPLETED** 8/15/15
GROUND ELEVATION 1418.56 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 55 Truck w/HSA and SPT Calibrated to N68
AT TIME OF DRILLING ---
LOGGED BY AS **CHECKED BY** GH
AT END OF DRILLING None
NOTES Auger casing left in ground for 2.5-days.
60hrs AFTER DRILLING 9.0 ft / Elev 1409.6 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
	0		5-inches Topsoil.					
			SILTY SAND (SM) (FILL) Light brown to brown, dry to moist, trace gravel, medium dense relative density.	SPT 1	63	2-9-6-5 (15)		
1415			SILTY CLAYEY SAND (SC-SM) to SANDY SILTY CLAY (CL-ML) (Could Be FILL) Light brown, grayish brown and brown, wet, trace organics, loose to medium dense to very dense relative density.	SPT 2	92	3-4-4-5 (8)	.9	111
	5		No recovery in sample from 4 to 6-feet.	SPT 3	0	3-7-8-7 (15)		
			Probable native. Very dense relative density. No recovery in sample from 6 to 8-feet. Cave-in level = 7.5-feet.	SPT 4	0	7-27-29-31 (56)		
1410			SILTY CLAYEY SAND (SC-SM) Brown, wet, little to some gravel, trace to with cobbles, dense to very dense relative density.	SPT 5	75	5-19-15-17 (34)		
	10		Auger casing left in ground for 60 hours = water level 9-feet. With cobbles from 10 to 12-feet.	SPT 6	43	5-50/1"		
			Substantial auger refusal at 12-feet. Bottom of hole at 12.0 feet.					



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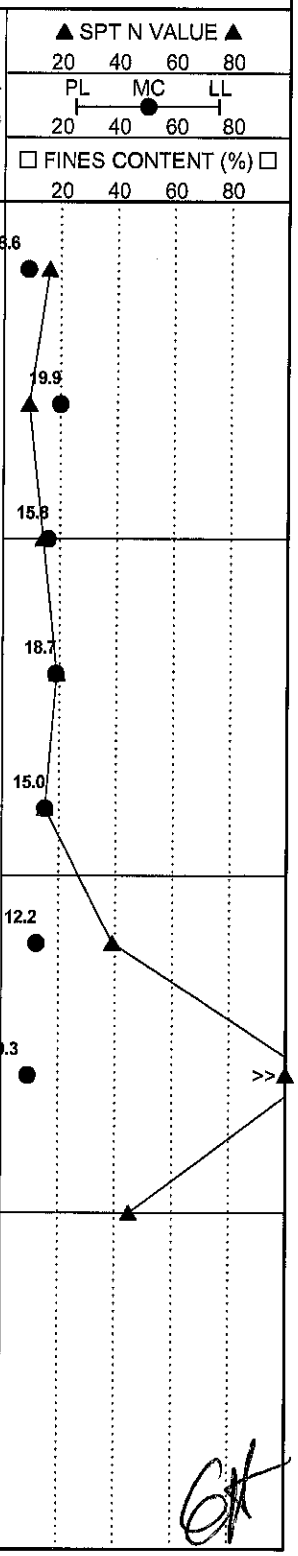
BORING NUMBER 15-SB-11

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/12/15 **COMPLETED** 8/12/15
GROUND ELEVATION 1420 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 55 Truck w/HSA and SPT Calibrated to N68
AT TIME OF DRILLING None to 8-feet
LOGGED BY AS **CHECKED BY** GH
AT END OF DRILLING N/A due to drilling fluid in auger
NOTES
AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
1420	0		5-inches Topsoil.					
			SILTY CLAYEY SAND (SC-SM) (FILL) Brown, dry to moist, trace gravel, trace root fibers, medium dense relative density.	SPT 1	42	4-9-7-5 (16)		
			SANDY SILTY CLAY (CL-ML) (Could Be FILL) Light brown and gray mottling, moist to wet, stiff consistency.	SPT 2	75	2-5-4-5 (9)		
1415	5		SANDY SILTY CLAY (CL-ML) to SILTY CLAYEY SAND (SC-SM) Brown, wet, trace gravel, stiff to very stiff consistency / medium dense relative density.	SPT 3	92	5-7-7-7 (14)	1.8	116
			Drilled with head of drilling fluid in auger below 8-feet.	SPT 4	67	3-9-10-9 (19)	1.9	
				SPT 5	58	3-6-9-14 (15)	1.2	116
1410	10		SILTY CLAYEY SAND (SC-SM) Brown, wet to water bearing, some to with gravel, dense to very dense relative density.	SPT 6	50	3-12-27-33 (39)		
				SPT 7	52	10-29-35-50/5"		
1405	15		Sample from 14 to 16-feet pushed rock - no recovery.	SPT 8	0	9-19-26-34 (45)		
			Bottom of hole at 16.0 feet.					



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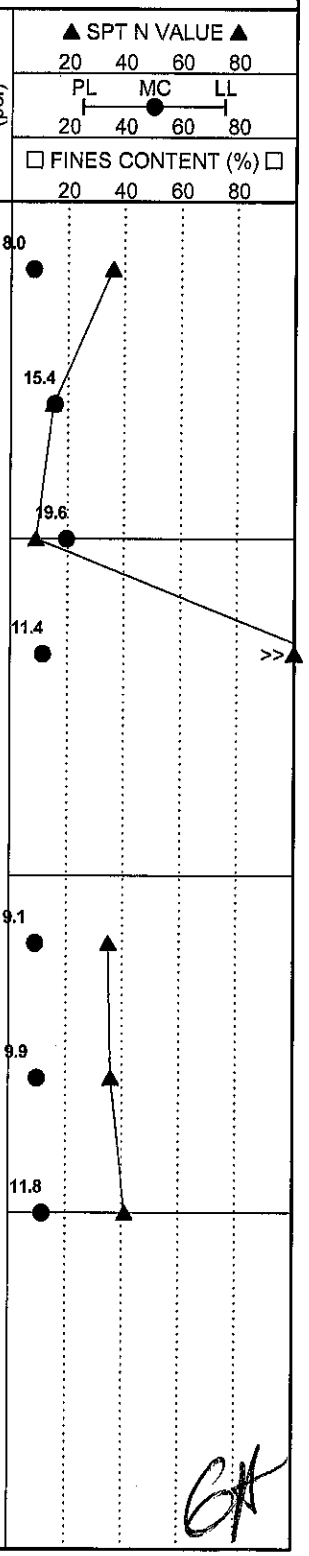
BORING NUMBER 15-SB-12

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/12/15 **COMPLETED** 8/12/15
GROUND ELEVATION 1423.96 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 55 Truck w/HSA and SPT Calibrated to N68
AT TIME OF DRILLING ---
LOGGED BY AS **CHECKED BY** GH
AT END OF DRILLING 14.0 ft / Elev 1410.0 ft
NOTES Boring left upen, uncased for 2.5-days.
60hrs AFTER DRILLING 9.0 ft / Elev 1415.0 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
	0		4-inches Topsoil.					
			SILTY CLAYEY SAND (SC-SM) to SANDY SILTY CLAY (CL-ML) (FILL) Brown to dark brown to brown, dry to moist, trace to little gravel, trace wood and bituminous pavement, dense to medium dense to loose relative density.	SPT 1	92	5-19-17-12 (36)		
				SPT 2	75	8-9-6-10 (15)		
1420	5			SPT 3	42	6-4-5-5 (9)		
			SILTY CLAYEY SAND (SC-SM) (Could Be FILL) brown with trace light brown mottling, moist to wet, little gravel (one, i-inch diameter piece).	SPT 4	59	7-13-50/5"		
			Boulder.					
1415			Water level = 9-feet, 6- hours after boring completion.	AUGER	0			
	10		SILTY CLAYEY SAND (SC-SM) Brown to grayish brown, moist to wet, some to little gravel, dense relative density.					
			Cave-in level = 9.5-feet after 60 hours uncased.	SPT 5	67	5-17-18-18 (35)		
			Water level = 10.5-feet, two hours after casing removal.					
			Cave-in level = 11-feet two hours after casing removal.	SPT 6	67	7-17-19-20 (36)		
1410	15			SPT 7	83	6-17-24-30 (41)		
			Bottom of hole at 16.0 feet.					



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539 Garfield Avenue
Duluth, Minnesota 55802

BORING NUMBER 15-SB-13

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/15/15 **COMPLETED** 8/15/15
GROUND ELEVATION 1424.37 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 55 Truck w/HSA and SPT Calibrated to N68
AT TIME OF DRILLING None
LOGGED BY AS **CHECKED BY** GH
AT END OF DRILLING None
NOTES
2hrs AFTER DRILLING 7.3 ft / Elev 1417.1 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
	0		1-inch Topsoil.						
			SILTY CLAYEY SAND (SC-SM) to SILTY SAND (SM) (FILL) Brown, dry, trace gravel, medium dense relative density.	SPT 1	50	6-8-11-4 (19)			6.2
			SILTY SAND (SM) (FILL) Light brown, dry, trace gravel, loose to medium dense relative density.	SPT 2	17	4-6-4-6 (10)			6.4
1420	5		SILTY CLAYEY SAND (SC-SM) Brown, moist to wet, trace to with gravel, medium dense relative density.	SPT 3	63	5-12-16-16 (28)			14.4
			Cave-in level = 7.5-feet, two hours after casing removal.	SPT 4	13	7-13-16-21 (29)			14.5
1415	10		SILTY CLAYEY SAND (SC-SM) to SANDY SILTY CLAY (CL-ML) Brown, wet, trace gravel, medium dense relative density / very stiff consistency.	SPT 5	75	12-15-12-15 (27)			15.7
			SILTY CLAYEY SAND (SC-SM) Brown, moist to wet, trace gravel, dense to very dense relative density.	SPT 6	58	7-11-21-15 (32)			12.1
				SPT 7	67	14-26-50/3"			12.1 >>
			SILTY SAND (SM) Grayish brown, wet to water bearing, little gravel, very dense relative density.						
1410				SPT 8	75	18-50/2"			10.8 >>
			Bottom of hole at 14.6 feet.						

GEOTECH BH PLOTS 15G1018 COD CIRRUS COMPLETION CENTER.GPJ GINT US LAB.GDT 9/8/15

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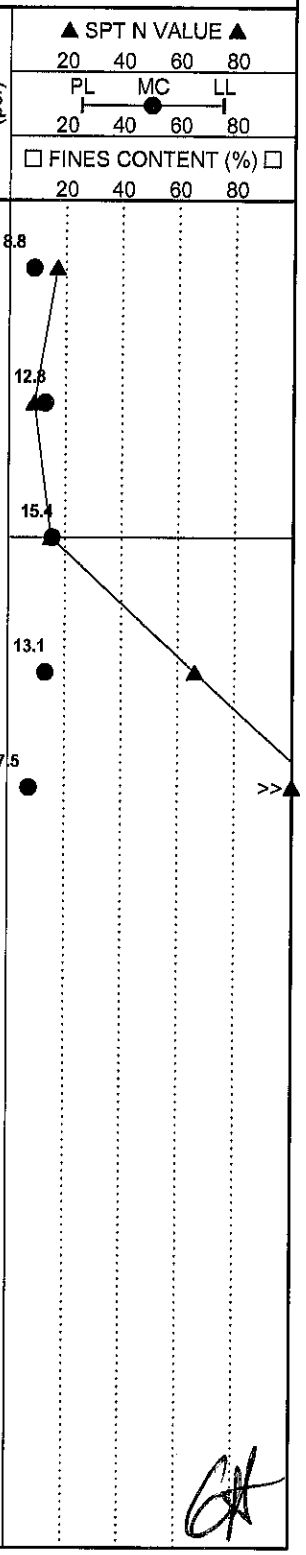
Duluth, Minnesota 55802

BORING NUMBER 15-SB-14

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 8/15/15 **COMPLETED** 8/15/15
GROUND ELEVATION 1427.17 ft **HOLE SIZE** 8-in
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 55 Truck w/HSA and SPT Calibrated to N68
AT TIME OF DRILLING None
LOGGED BY AS **CHECKED BY** GH
AT END OF DRILLING None to 9.8-feet.
NOTES
0hrs AFTER DRILLING None to 5.5-feet.

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
	0		1-inch Topsoil.					
			SILTY CLAYEY SAND (SC-SM) (FILL) Brown, moist, trace to little gravel, medium dense to loose relative density.	SPT 1	38	4-9-8-6 (17)		
1425				SPT 2	79	2-4-5-7 (9)		
	5		SILTY CLAYEY SAND (SC-SM) to SANDY SILTY CLAY (CL-ML) (Could Be FILL) Brown, wet, trace gravel, medium dense relative density / stiff to very stiff consistency.	SPT 3	88	3-6-9-15 (15)	1.1	115
			Cave-in level = 5.5-feet.					
1420			SILTY CLAYEY SAND (SC-SM) (Could Be FILL) Dark brown to brown, moist, some gravel, dense relative density.	SPT 4	38	6-21-45-30 (66)		
			Organic content of sample from 6 to 8-feet = 3.7% (slightly organic).					
			With cobbles / weathered rock in sample from 6 to 8-feet.	SPT 5	41	8-22-50/5"		
			Substantial auger refusal at 9.8-feet. Bottom of hole at 9.8 feet.					



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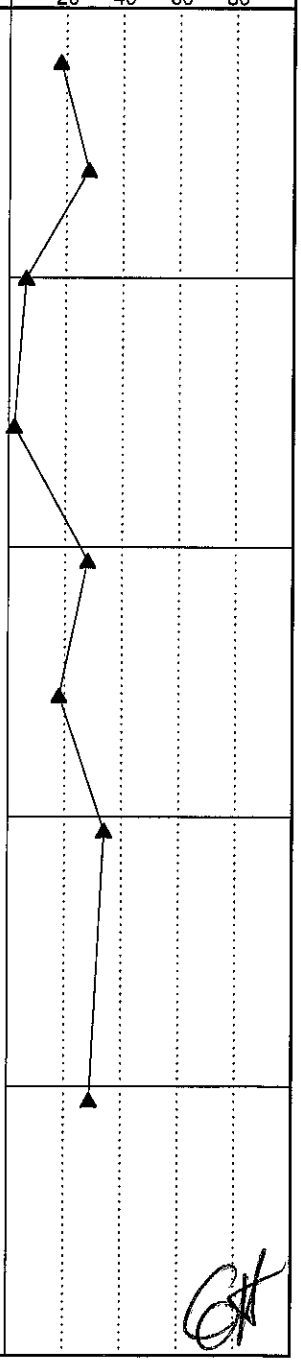
Duluth, Minnesota 55802

BORING NUMBER SB-14-3

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 11/25/14 **COMPLETED** 11/25/14
GROUND ELEVATION 1420.324 ft **HOLE SIZE** 7-inch
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
▽ **AT TIME OF DRILLING** 6.0 ft / Elev 1414.3 ft
LOGGED BY NEW **CHECKED BY** GH
▼ **AT END OF DRILLING** 13.0 ft / Elev 1407.3 ft
NOTES South-central portion of east-central one-quarter of parcel.
▼ **0hrs AFTER DRILLING** 7.0 ft / Elev 1413.3 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
1420	0		SILTY CLAYEY SAND (SC-SM) (FILL) Brown, trace black, moist, medium dense relative density.	SPT 1	67	3-8-10-16 (18)		
			SILTY SAND (SM) to SAND with Silt (SP-SM) (FILL) Brown, moist to wet, trace gravel, medium dense to loose relative density. Boulder at 3-feet.	SPT 2	29	11-16-12-8 (28)		
1415	5			SPT 3	25	1-3-3-3 (6)		
			SAND with Silt (SP-SM) Black, water bearing, fine to medium grained, with gravel, very loose relative density. Organic content of sample from 7.0 to 8.5-feet = 0.5%. Cave-in level = 7-feet.	SPT 4	33	0-1-1 (2)		
1410	10		SILTY CLAYEY SAND (SC-SM) Brown to dark brown, wet to water bearing to wet, trace to little gravel, medium dense to dense to medium dense relative density.	SPT 5	72	6-10-18 (28)		
				SPT 6	56	1-10-8 (18)		
1405	15			SPT 7	72	11-14-20 (34)		
1400	20			SPT 8	83	10-12-17 (29)		
			Bottom of hole at 21.0 feet.					



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Duluth, Minnesota 55802

BORING NUMBER SB-14-4

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 11/26/14 **COMPLETED** 11/26/14
GROUND ELEVATION 1424.67 ft **HOLE SIZE** 7-Inch
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
▽ **AT TIME OF DRILLING** 9.0 ft / Elev 1415.7 ft
LOGGED BY NEW **CHECKED BY** GH
▼ **AT END OF DRILLING** 18.0 ft / Elev 1406.7 ft
NOTES Southeast portion of east-most one-quarter of parcel.
▽ **0hrs AFTER DRILLING** 14.0 ft / Elev 1410.7 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
	0		SILTY CLAYEY SAND (SC-SM) (FILL) Dark brown, wet, with to trace organics.	SPT 1	25	8-7-6-5 (13)		
			SANDY SILTY CLAY (CL-ML) (Topsoil-like) (FILL) Black and dark brown, moist, with organics.	SPT 2	33	2-3-5-3 (8)		
1420	5		SANDY SILTY CLAY (CL-ML) to SANDY SILT (ML) (Could Be Fill) Brown, wet, trace gravel, medium to stiff to medium consistency. Organic content of sample from 4.0 to 6.0-feet = 1.0%.	SPT 3	50	1-2-3-4 (5)	1.0	
				SPT 4	78	4-4-5 (9)	2.2	
1415	10			SPT 5	72	1-3-4 (7)	2.1	
			SANDY SILTY GRAVEL (GP-GM) Brown, water bearing, fine to medium grained, trace cobbles and boulders, very dense relative density.	SPT 6	89	12-35-35 (70)		
1410	15		SANDY SILTY CLAY (CL-ML) Dark brown, wet, little gravel, very stiff consistency. Cave-in level = 15-feet.	SPT 7	100	7-8		
			SILTY SAND (SM) Dark brown, wet to water bearing, dense to medium dense relative density.	SPT 8	67	25		
1405	20			SPT 9	67	5-15-13 (28)		
			Bottom of hole at 21.0 feet.					

▲ SPT N VALUE ▲ (20 40 60 80)
PL MC LL (20 40 60 80)
☐ FINES CONTENT (%) ☐ (20 40 60 80)

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BORING NUMBER SB-14-5

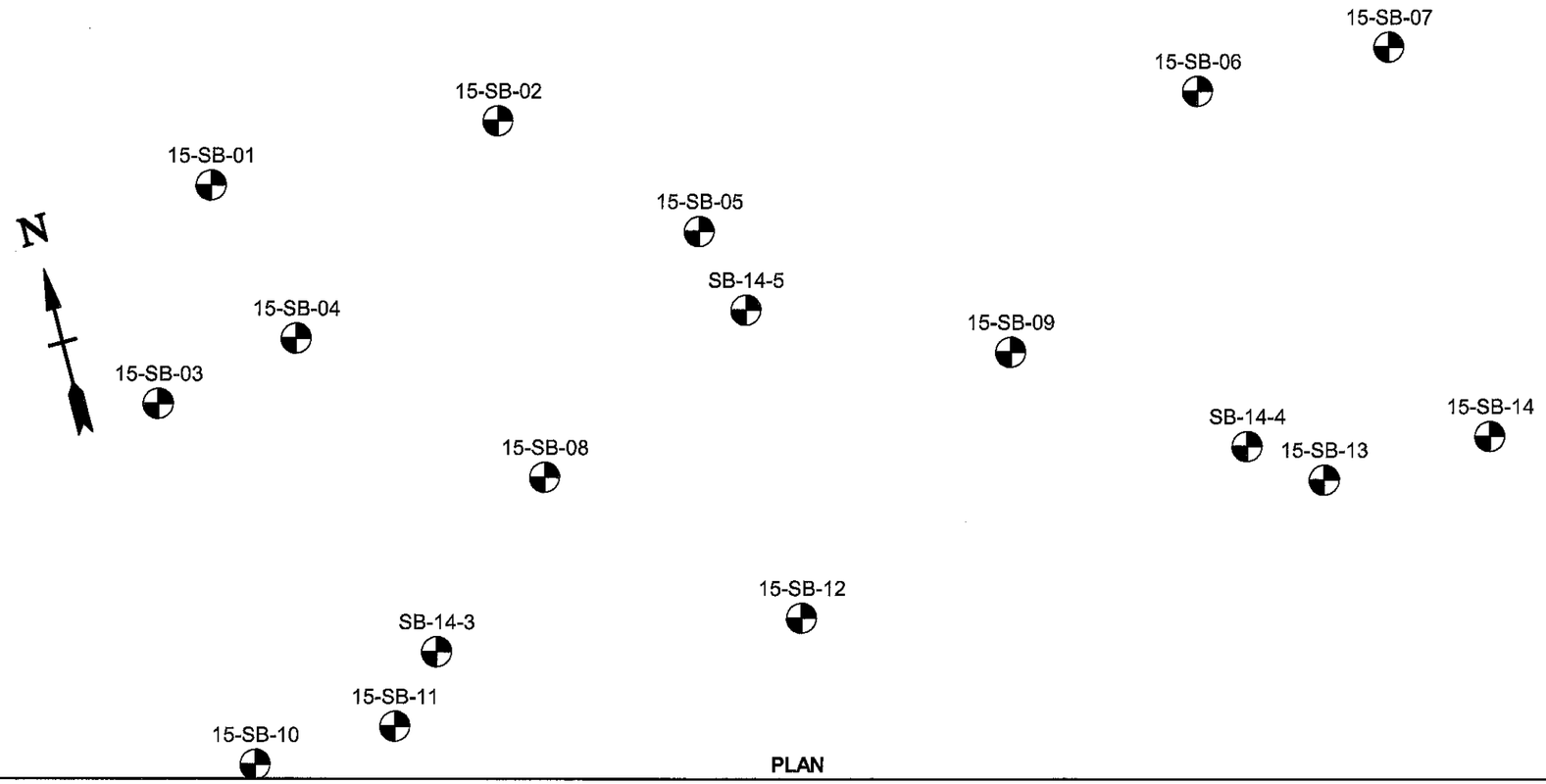
CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road
DATE STARTED 11/26/14 **COMPLETED** 11/26/14
GROUND ELEVATION 1420.94 ft **HOLE SIZE** 7-inch
DRILLING CONTRACTOR EPC Engineering & Testing
GROUND WATER LEVELS:
DRILLING METHOD CME 850 Track with HSA & Auto-SPT-Hammer
▽ **AT TIME OF DRILLING** 12.0 ft / Elev 1408.9 ft
LOGGED BY NEW **CHECKED BY** GH
▼ **AT END OF DRILLING** 18.0 ft / Elev 1402.9 ft
NOTES Northeast corner of east-central one-quarter of parcel.
▼ **0hrs AFTER DRILLING** 10.0 ft / Elev 1410.9 ft

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Pocket Penetrometer (tsf)	DRY UNIT WT. (pcf)
1420	0		SILTY CLAYEY SAND (SC-SM) (FILL) Brown, moist, little gravel.	SPT 1	63	1-8-11-10 (19)		
			SILTY CLAYEY SAND (SC-SM) (FILL) Black and brown, wet.	SPT 2	67	5-7-11-6 (18)		
1415	5		SANDY SILTY CLAY (CL-ML) to SANDY SILT (ML) (Could Be Fill) Brown, wet, stiff consistency.	SPT 3	25	4-4-5-5 (9)		
				SPT 4	39	3-5-8 (13)		
	10	▼		SPT 5	67	8-8		
1410			SILTY CLAYEY SAND (SC-SM) Dark brown, wet to moist, little gravel, dense relative density.	SPT 6	33	16		
				SPT 7	78	6-13-28 (41)		
	15		SILTY SAND (SM) Dark brown to brown, water bearing, little gravel, trace cobbles and boulders, very dense relative density.	SPT 8	72	23-34-21 (55)		
1405			Cave-in level = 15-feet.					
			SILTY CLAYEY SAND (SC-SM) to SANDY SILTY CLAY (CL-ML) Dark grayish brown, wet, little gravel, trace cobbles and boulders, very dense relative density.					
	20			SPT 9	88	50-50/2"		
			Substantial sampler refusal at 20.2-feet. Bottom of hole at 20.2 feet.					

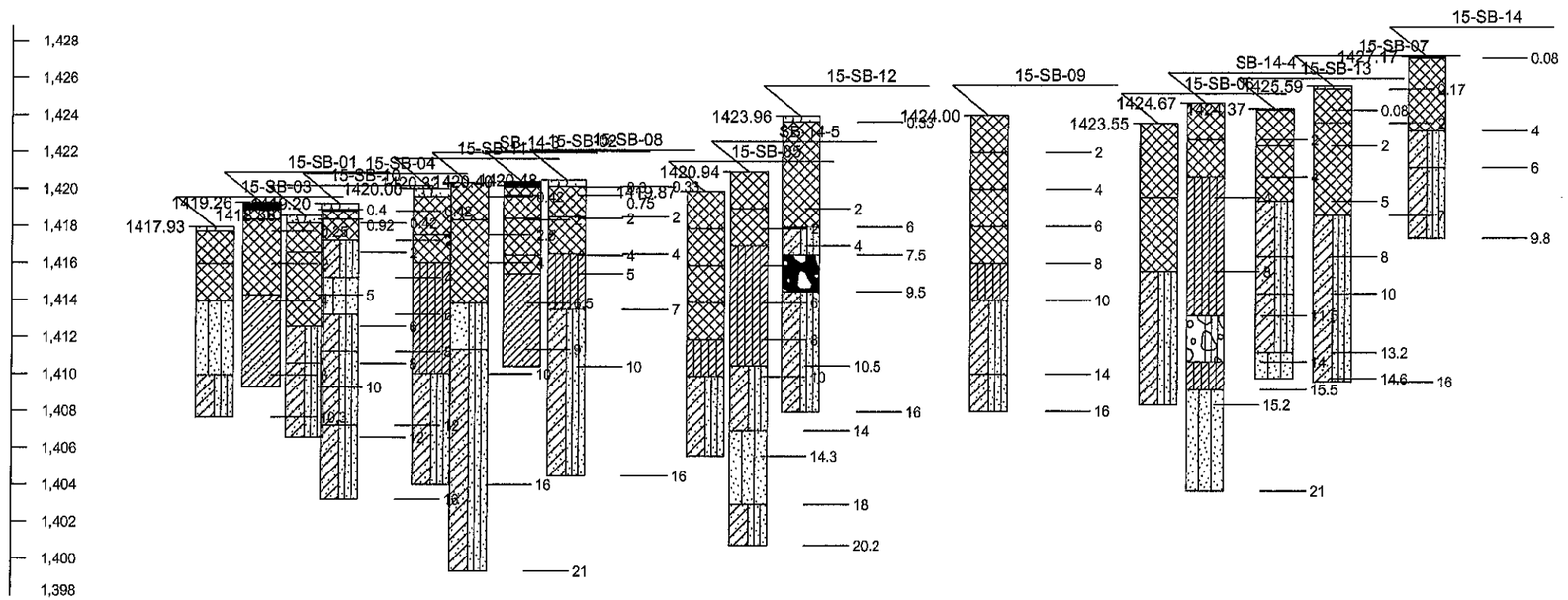
▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

BORING PLAN/ELEVATION & CROSS-SECTIONS

REGION	STATE	PROJECT	SHEET NO.	TOTAL SHEETS



PLAN



ELEVATION

LEGEND

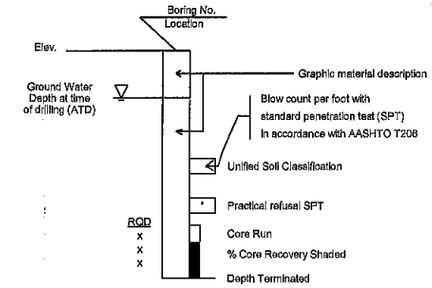
- Asphalt
- Fill (made ground)
- USCS Low Plasticity Sandy Clay
- Topsoil
- silty Sand
- Clayey Sand
- USCS Low Plasticity Silty Clay
- Boulders and cobbles

TYPICAL TEST HOLE SYMBOL

Plan View

Location of any test hole

TYPICAL TEST HOLE LOG



For additional information, refer to Geotechnical Report Cirrus Completion Center,

EPC ENGINEERING & TESTING
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SUBSURFACE PROFILE

Cirrus Completion Center

Airport Road, btwn Vandenberg Dr & Stebner Road

DRAWING NO.

EPC Engineering & Testing
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539 Garfield Avenue
Duluth, Minnesota 55802

CLIENT City of Duluth

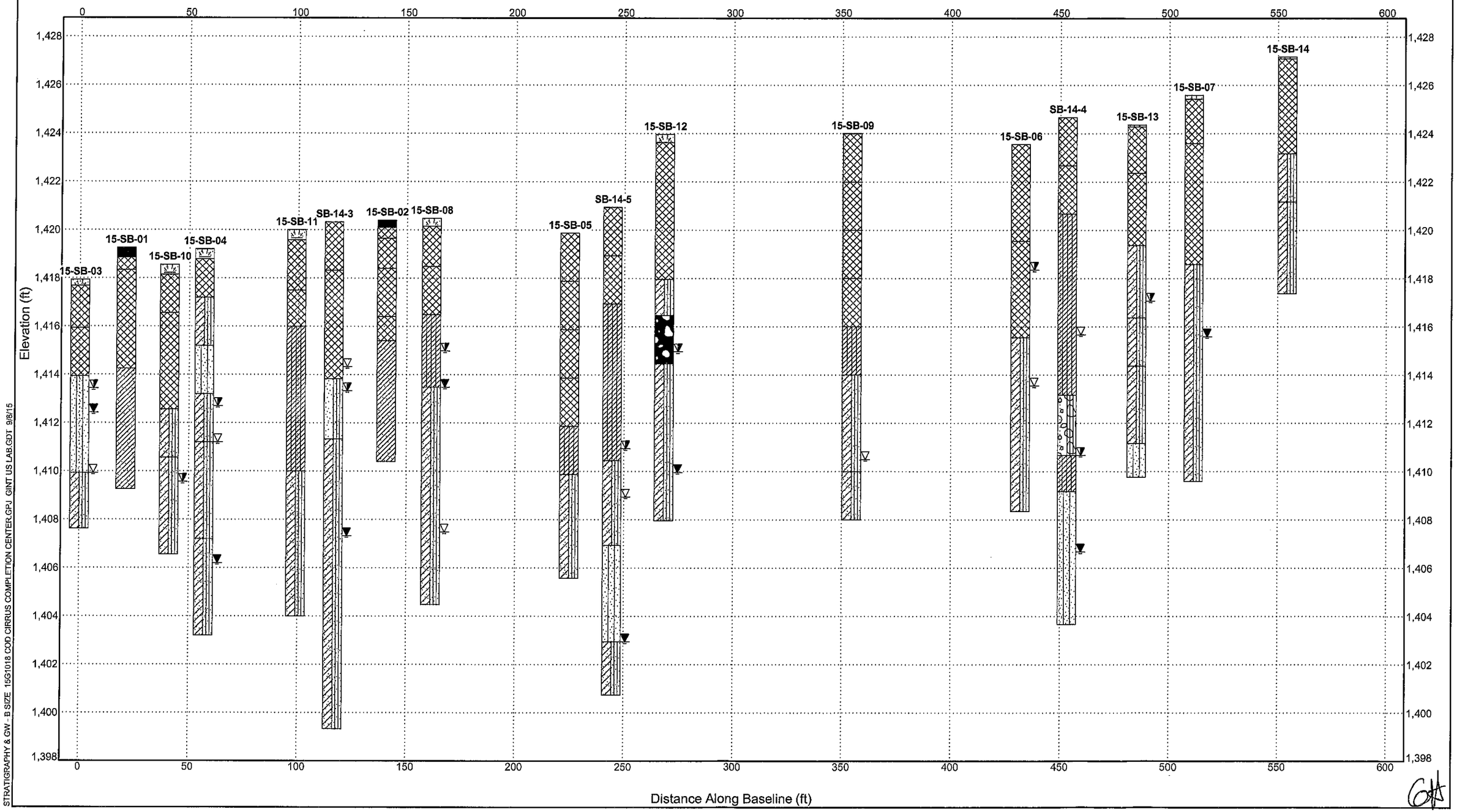
PROJECT NUMBER 15G1018

SUBSURFACE DIAGRAM

PROJECT NAME Cirrus Completion Center

PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road

- Asphalt
- Topsoil
- USCS Low Plasticity Silty Clay
- Poorly-graded Gravel with Silt
- Fill (made ground)
- [illegible] silty Sand
- Boulders and cobbles
- USCS Low Plasticity Sandy Clay
- Clayey Sand
- Poorly-graded Sand with Silt



STRATIGRAPHY & GW - B SIZE 15G1018 COD CIRRUS COMPLETION CENTER.GPJ GINT US LAB.GDT 9/8/15

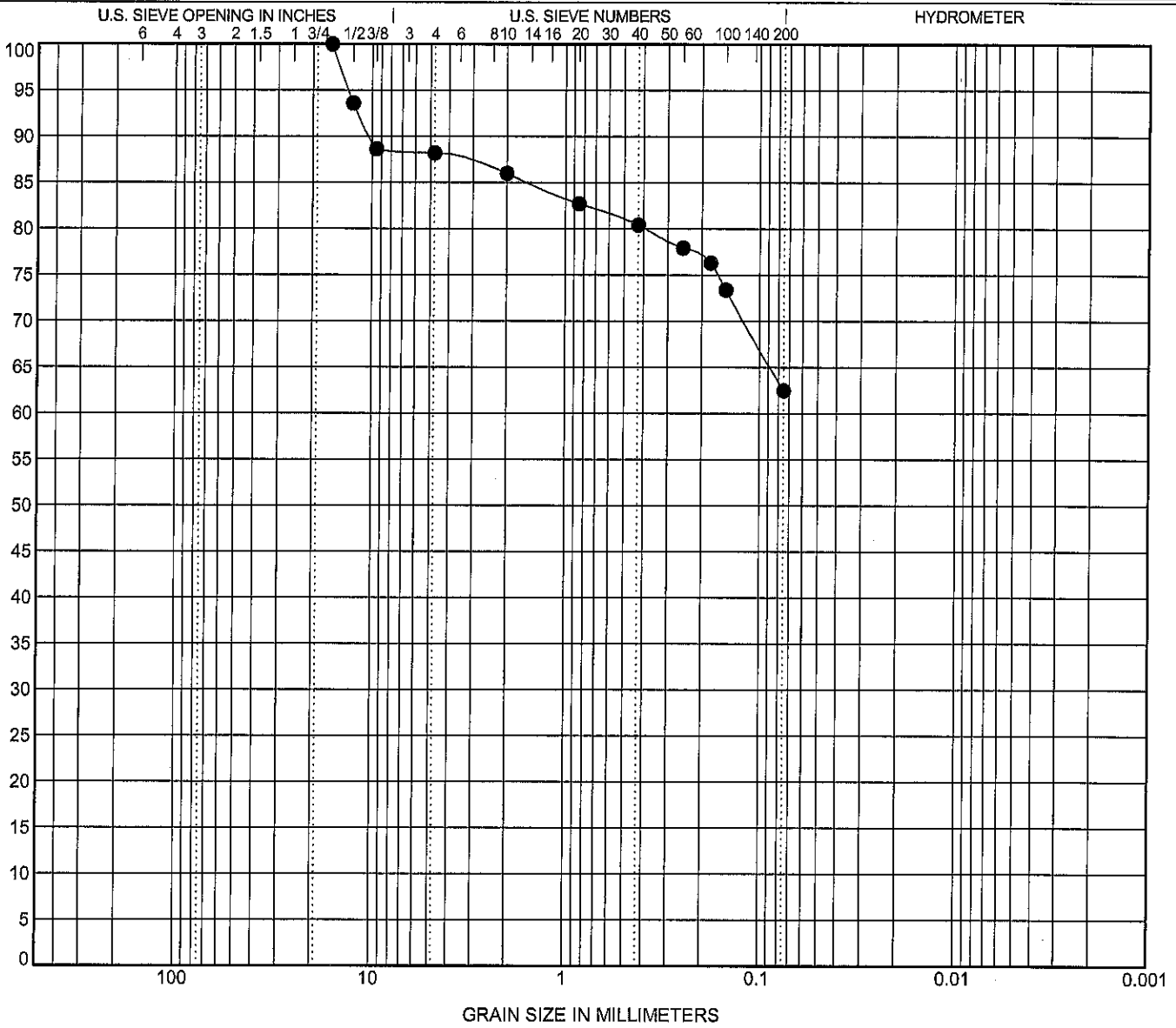
LABORATORY TEST REPORT

EPC Engineering & Testing
Geotechnical • Environmental • Materials Engineering
539 Garfield Avenue
Duluth, Minnesota 55802

GRAIN SIZE DISTRIBUTION

CLIENT City of Duluth **PROJECT NAME** Cirrus Completion Center

PROJECT NUMBER 15G1018 **PROJECT LOCATION** Airport Road, btwn Vandenberg Dr & Stebner Road



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● 15-SB-08	SANDY SILTY CLAY(CL-ML)					

D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
16				11.8	25.7	62.5	

SIEVE	% PASS	SPEC	SIEVE	% PASS	SPEC	NOTES
3"			#10	86		Boring 8 (4 to 7-feet).
2"			#16			
1.5"			#20	83		
1"			#30			
3/4"			#40	80		
5/8"	100		#50			
1/2"	94		#60	78		
3/8"	89		#80	76		
#4	88		#100	73		
#8			#200	62.5		

GRAIN SIZE WITH SPEC BANDS 15G1018 COD CIRRUS COMPLETION CENTER.GPJ GINT STD US LAB.GDT 9/8/15

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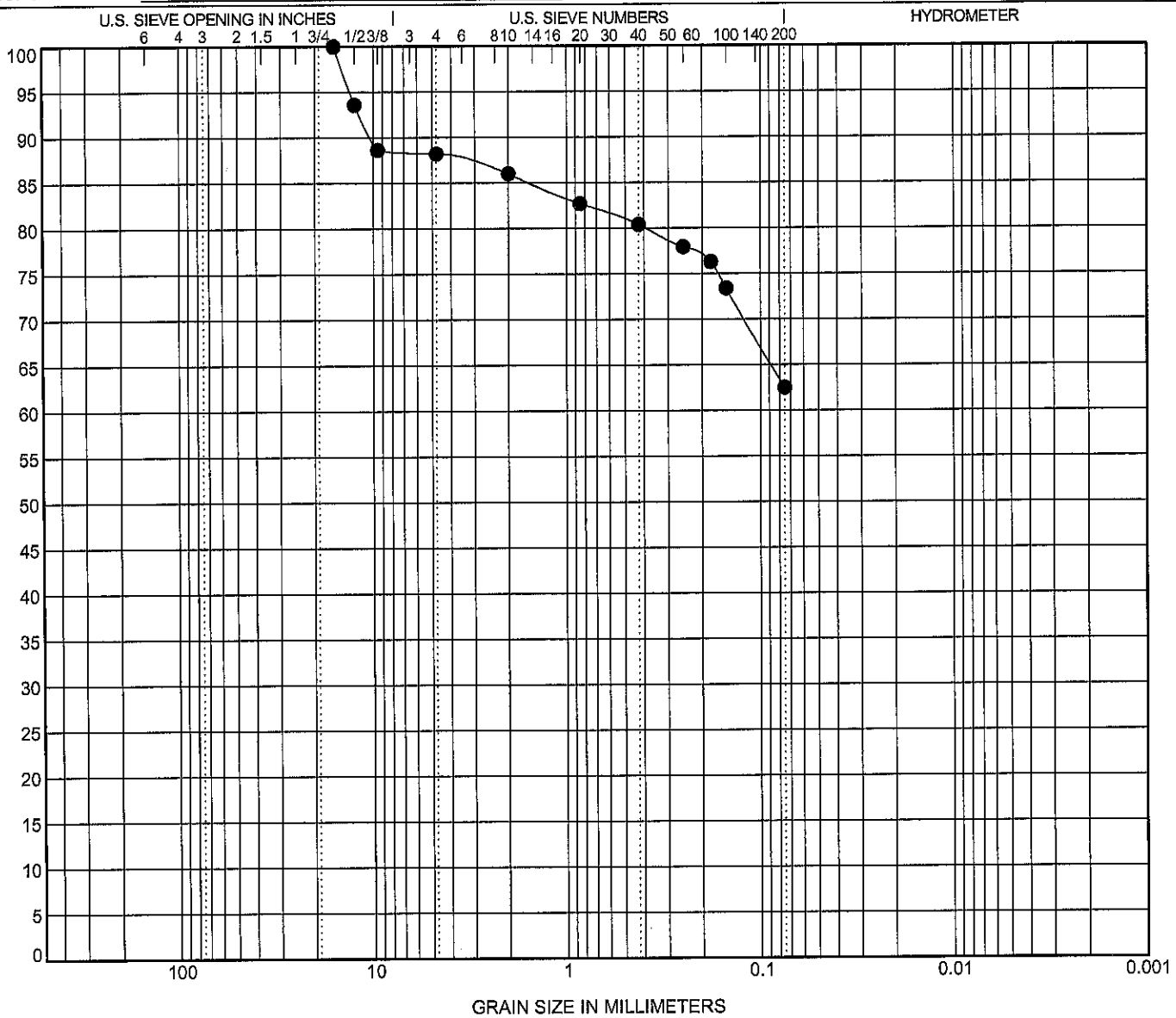
Duluth, Minnesota 55802

GRAIN SIZE DISTRIBUTION

CLIENT City of Duluth
PROJECT NAME Cirrus Completion Center
PROJECT NUMBER 15G1018
PROJECT LOCATION Airport Road, btwn Vandenberg Dr & Stebner Road



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● Lab Sample # 15-SB-08	2(A-4)					

D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
16				14.0	23.5	62.5	

SIEVE	% PASS	SPEC	SIEVE	% PASS	SPEC	NOTES
3"			#10	86		Boring 8 (4 to 7-feet).
2"			#16			
1.5"			#20	83		
1"			#30			
3/4"			#40	80		
5/8"	100		#50			
1/2"	94		#60	78		
3/8"	89		#80	76		
#4	88		#100	73		
#8			#200	62.5		

AASHTO GRAIN SIZE WITH AASHTO CLASS 15G1018 COD CIRRUS COMPLETION CENTER.GPJ GINT US LAB.GDT 9/8/15

DOCUMENT 004322 - UNIT PRICES FORM

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: **Cirrus Aircraft Completion Center – Soil Corrections Package**

C. Project Location: **4946 Airport Road, Duluth MN**.

D. Owner: **City of Duluth, MN**.

E. Owner Project Number: **15-05AA**

F. Engineer: **Burns & McDonnell / Northland Consulting Engineers (sub)**.

G. Engineer's Project Number: **86198**.

H. Construction Manager: **McGough Construction Company**.

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

B. The undersigned Bidder proposes the amounts below be added to or deducted from the Contract Sum on performance and measurement of the individual items of Work and for adjustment of the quantity given in the Unit-Price Allowance for the actual measurement of individual items of the Work.

C. If the unit price does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."

1.3 UNIT PRICES

A. Unit-Price No. 1: Excavation of unsatisfactory soil, quantities more/less than 24,700 CY (LV)

1. $_____ per unit.

B. Unit-Price No. 2: Engineered Backfill, quantities more/less than 19,500 CY (LV)

1. $_____ per unit.

1.4 SUBMISSION OF BID SUPPLEMENT

A. Respectfully submitted this ____ day of _____, 2012.

B. Submitted By:_____(Insert name of bidding firm or corporation).

C. Authorized Signature:_____(Handwritten signature).

D. Signed By:_____(Type or print name).

E. Title:_____(Owner/Partner/President/Vice President).

END OF DOCUMENT 004322

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price 1: Excavation of unsatisfactory soil.

1. Description: Unsatisfactory soil excavation and disposal off site and replacement with satisfactory fill material or engineered fill from off site, as required, according to the City of Duluth Standard Specifications, as directed on the Drawings.
2. Unit of Measurement: Cubic Yard (LV) of soil excavated, based on survey of volume removed and in a unit quantity more/less than the volume identified on the pricing sheet.

B. Unit Price No. 2: Engineered Backfill.

1. Description: Engineered fill from off site, as required, according to the City of Duluth Standard Specifications, as directed on the Drawings.
2. Unit of Measurement: Cubic Yard (LV) of Engineered Backfill, based on survey of volume removed and in a unit quantity more/less than the volume identified on the pricing sheet.

END OF SECTION 012200