GEOTECHNICAL ENGINEERING REPORT
for
ARCTIC COLD
OXNARD, CALIFORNIA

Project No.: 303415-002
March 31, 2020

PREPARED FOR

Fisher Construction Group
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BY

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File No.: 303415-002
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Project: Arctic Cold
Proposed Processing and Cold Storage Building
Oxnard, California
Subject: Geotechnical Engineering Report

As authorized, Earth Systems Pacific (Earth Systems) has performed a geotechnical engineering study for a processing and cold storage facility at the southeast corner of Rice Avenue and "A" Street in the proposed Sakioka Farms industrial tract in Oxnard, California. The accompanying Geotechnical Engineering Report presents the results of our site exploration and testing, as well as our conclusions and recommendations pertaining to geotechnical aspects of project design. This report completes Phase I of our proposal VEN-20-01-004 dated January 6, 2020 and authorized by Fisher Construction Group on February 12, 2020 with Change Order Number 1 to Contract 19F077-014649.

We have appreciated the opportunity to be of service to you on this project. Please call if you have any questions, or if we can be of further service.

Respectfully submitted,

EARTH SYSTEMS PACIFIC

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Copies: 4 - Fisher Construction Group (3 mail, I email)
1 - Delane Engineering (email)
1 - Project File

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INTRODUCTION

Project Description

The proposed project is a processing and cold storage building on a 32-acre site located southeast of the intersection of Rice Avenue and a proposed street ("A" Street) within the to-be-developed Sakioka Farms industrial tract on the north side of Oxnard, California. The proposed building and associated canopies and dock areas will have a variety of components and will occupy about 13 acres of the project site. There will be a 30,000 square-foot off-load canopy area, a 117,000 square-foot dry/storage/processor area, a 143,000 square-foot cooler storage area, a 17,000 square-foot finished goods area, a 187,000 square-foot freezer storage area, two separate two-story office areas totaling 12,000 square-feet, a 6,000 square-foot mechanical/electrical area, a 37,000 square-foot truck dock area, a future 10,000 square-foot railroad dock, and a future 15,000 square-foot packing area. These square footages are estimates and are provided for illustrative purposes. The location of these building areas can be found on the site plan in Appendix A. The building will be a dock-high structure. The rail dock will be located on the east side of the building and will be serviced by a rail spur located adjacent and south of the project site.

The building is understood to be steel frame structure with concentrated loads. According to provided building sections, roof height will range from about 28 to 48 feet above the building's floor. Wall loads are expected to be about 1,500 pounds per lineal foot. In the main building areas, maximum interior column loads will be in the range of 150 kips, and around the perimeter of the buildings maximum column loads will be in the range of 75 kips.

It is understood that in the cooler and freezer areas the floor loads will be a gross average of about 550 psf, but in other areas the floor loads will be about 250 psf. Forklift point loads may be in the range of 25 kips. To create the dock-high structure, some cutting and filling will be done to bring the building areas to pad grades and achieve a finish floor elevation of about 68 feet. A few small areas will have a finish floor elevation of 64.5 feet. Because floor systems will vary in thickness and composition according to the function of the different building areas, finish pad elevations will be variable.

In general, grading in the building area will involve cutting in the northwest and filling in the southeast with cuts and fills of 2 feet or less in height. The drive and parking areas that surround the proposed building will mostly be cut to achieve finish subgrades upon which pavements

sections will be constructed. The truck stalls at the dock on the north side of the building may involve cuts of 4 to 6 feet to achieve finish subgrade.

Auto and truck traffic will enter the site from an industrial street along the north side of the project and a cul-de-sac on the east side of the project. Some pavements areas are expected to receive significant truck traffic based on the approximately 30 loading dock slots that appear on the plans. Also, the site will be serviced by a rail spur on the east side of the proposed building that enters the site from the south.

It is understood that the project does not need to provide for on-site stormwater infiltration.

Purpose and Scope of Work

The purpose of this geotechnical study was to evaluate the soil conditions that might impact the site development. The soil conditions evaluated include surface and subsurface soil types, liquefaction potential, expansion potential, settlement potential, bearing capacity, and the presence or absence of subsurface water. The scope of our work included:

1. Reconnaissance of the site.
2. Performing nine cone penetrometer test (CPT) soundings to depths between 38.5 and 74.5 feet below the existing ground surface.
3. Drilling 15 borings on the site to a maximum depth of 76.5 feet below the ground surface to study soil and groundwater conditions.
4. Setting two temporary piezometers to determine the current groundwater depth.
5. Laboratory testing of soil samples obtained from the subsurface exploration to determine their physical and engineering properties.
6. Consulting with owner representatives.
7. Preparing this report.

Contained in this report are:

1. Descriptions and results of field and laboratory tests that were performed.
2. Discussions pertaining to the soil and groundwater conditions.
3. Conclusions and recommendations pertaining to site grading, ground improvement, and structural design.

Site Setting

The project site is a 32-acre vacant parcel located east of Rice Avenue and south of proposed "A" Street within the to be developed Sakioka Farms industrial tract on the north side of Oxnard, California. The project site lies west of Del Norte Boulevard, east of Rice Avenue, south of U.S. Route 101, and north developed industrial properties. The geographic coordinates of the site are about 34.2134° north latitude and 119.1393° west longitude.

Ground surface elevations are about 70 feet in the northwest corner of the site and 66.5 feet in the southeast corner of the site. Within the proposed building's footprint, the ground elevation is about 69.5 feet at the northwest corner and 66.5 feet at the southeast corner. The most recent site use has been agriculture and it appears from aerial photographs that site use has been agricultural for about 100 years. There are two abandoned oil wells on the site at approximate coordinates 34.2130° north latitude and 119.1408° west longitude (McGrath 13-3) and 34.2131° north latitude and 119.1376° west longitude (McGrath 13-1A). Shortly after our field exploration was completed, the site was disked and was essentially weed free. The site is bounded by industrial properties to the south, Rice Avenue and industrial properties to the west, and fallow agricultural land (to be developed into industrial use) to the north and east.

SEISMIC SHAKING

Southern California is a seismically active region where the potential for significant ground shaking is universal. Earthquakes of a size large enough to cause structural damage are relatively common in the region. The Ventura area has not experienced any local large earthquakes since records have been kept; however, regional earthquakes have led to significant ground shaking and structural damage. Notable regional earthquakes include the 1812 Santa Barbara Channel and 1857 Fort Tejon events. The epicenter of the 1812 earthquake is thought to have been in the western part of the Santa Barbara Channel. Associated with this earthquake, a tsunami with a disputed run up height of up to 15 feet impacted the Ventura coastal area. On January 9, 1857, the Fort Tejon earthquake with an estimated Richter magnitude of 8.25 impacted the region.

For industrial projects, the latest adopted version of the California Building Code (CBC, 2019) requires several seismic design parameters that are influenced by the geographic site location with respect to active and potentially active faults, and with respect to subsurface soil or rock conditions. The "general procedure" (i.e. probabilistic) seismic design parameters presented below were determined using the U.S. Seismic Design Maps "risk-targeted" calculator on the SEAOC/OSHPD website for the jobsite coordinates (34.2134° North latitude and 119.1393° West longitude). The

parameters are appropriate for a 2 percent probability of exceedance in 50 years. The calculator adjusts for Soil Site Class (in this case Site Class D, "Stiff Soil"), and for Occupancy Risk Category (in this case, Risk Category II). The calculated 2019 CBC and ASCE 7-16 seismic parameters typically used for structural design are summarized in the following table.

Summary of Seismic Parameters –2019 CBC "General Procedure"

Site Class (ASCE 7-16)	D
Occupancy (Risk) Category	II
Seismic Design Category	D
Maximum Considered Earthquake (MCE) Ground Motion	
Spectral Response Acceleration, Short Period - S_s	1.763 g
Spectral Response Acceleration at 1 sec. - S_1	0.653 g
Site Coefficient - F_a	1.0
Site Coefficient - F_v	1.7
Site-Modified Spectral Response Acceleration, Short Period - S_{MS}	1.763 g
Site-Modified Spectral Response Acceleration at 1 sec. - S_{M1}	1.110 g
Design Earthquake Ground Motion	
Short Period Spectral Response -S_{DS}	1.176 g
One Second Spectral Response - S_{D1}	0.740 g
Site Modified Peak Ground Acceleration - PGA_M	0.851 g

The seismic factor S_1 is greater than 0.2 g and the Site Class is "D". If the structural engineer determines that ASCE 7-16, Section 11.4.8, Exception 2 does not apply, a site-specific (i.e. deterministic) ground motion hazard analysis is required. The site-specific study considers soil amplification effects. The United States Geological Survey (USGS, 2009) has undertaken a probabilistic earthquake analyses that covers the continental United States. A reasonable site-specific spectral response curve may be developed from USGS Unified Hazard Tool web page, which adjusts for site-specific ground factors. The interactive webpage appears to be a precise calculation based on site coordinates. For the purposes of this study, the Dynamic: Conterminous U.S. 2014 (Update) (Version 4.20) values have been chosen for use in the analysis.

NGA West 2014 attenuation relationships were used in the analyses. These attenuations included those of Abrahamson, Silva and Kamai, Boore and Stewart, Campbell and Bozorgnia, Chiou and Youngs, and Idriss.

Summary of Seismic Parameters –2019 CBC "Site-Specific Procedure"

Site Class (ASCE 7-16)	D
Occupancy (Risk) Category	II
Seismic Design Category	D
Seismic Design Category	
Maximum Considered Earthquake (MCE) Ground Motion	
Spectral Response Acceleration, Short Period - S_s	1.763 g
Spectral Response Acceleration at 1 sec. - S_1	0.653 g
Site Coefficient - F_a	1.00
Site Coefficient - F_v	2.50
Site-Modified Spectral Response Acceleration, Short Period - S_{MS}	1.886 g
Site-Modified Spectral Response Acceleration at 1 sec. - S_{M1}	1.853 g
Design Earthquake Ground Motion	
Short Period Spectral Response -S_{DS}	1.257 g
One Second Spectral Response - S_{D1}	1.235 g
Site Modified Peak Ground Acceleration - PGA_M	0.800 g

The Fault Parameters Table (attached) lists the significant "active" and "potentially active" faults within a 35-mile (57-kilometer) radius of the subject site. The distance between the site and the nearest portion of each fault is shown, as well as the respective estimated maximum earthquake magnitudes, and the deterministic mean site peak ground accelerations.

LIQUEFACTION

Earthquake-induced cyclic loading can be the cause of several significant phenomena, including liquefaction in fine sands and silty sands. Liquefaction results in a loss of soil strength and can cause structures to settle and, in extreme cases, to experience bearing failure. Cyclic softening in clays during earthquakes has resulted in buildings experiencing foundation failure and ground surface deformation similar to that resultant from liquefaction. If liquefaction or cyclic softening occurs beneath sloping ground, a phenomenon known as lateral spreading can occur. Liquefaction and cyclic softening are typically limited to the upper 50 feet of the subsurface soils. There are several conditions that need to be satisfied for liquefaction or cyclic softening to occur. Of primary importance is that groundwater, perched or otherwise, usually must be within the upper 50 feet of soils.

Groundwater at the subject site was encountered to a depth of about 20 feet during recent site exploration. Historical high groundwater is estimated about 6 feet below the existing ground surface based on a mapping of historical high groundwater by the California Geologic Survey and data from nearby sites that have been explored. This depth of groundwater (6 feet) and current seismic standards (2019 CBC, PGA_M = 0.851 g) have been used to analyze liquefaction potential. The analysis was done with a proprietary spreadsheet using the data from five CPTs soundings performed at the site to a depth of 50 feet or more. However, only the results of the deepest soundings, CPT-1, CPT-5, and CPT-9, are presented in Appendix E.

The results indicate liquefaction to be a potential at the locations of all the CPTs. The cumulative thicknesses of the potentially liquefiable layers range from about 5.4 to 12.4 feet at the various CPT locations and the cumulative amount of liquefaction-induced settlement is estimated to range from about 0.9 to 2.0 inches. At each location, most of the seismic induced settlement is predicted to occur below a depth of 20 feet. The thickest liquefiable layer is about 5 feet thick and at the location of CPT-3. Most of the liquefiable layers are 1 to 2 feet thick.

Although the sum of estimated seismic-induced (liquefaction) settlement is estimated to be about 0.9 to 2.0 inches, according to a paper by Cetin, et al. (2009), the surficial effect of the compression of deeper soil layers is reduced by upward seepage, reduced induced shear stresses in deeper layers, and possible arching effects. In the paper, a weighting procedure is proposed in which the surface effect of layer compression is reduced with increasing depth. By applying the procedure, the maximum expected surface total settlement at the project site resulting from seismicity is 1.2 inches, and the anticipated differential settlement resulting from the design level earthquake is estimated to be about 0.7 inches.

The shallowest predicted liquefied layer of soil varies from a depth of about 6 to 11 feet at CPT-3. However, these shallow soils are not loose. Post-liquefaction residual strengths were estimated from the CPT data and used to evaluate post-liquefaction bearing capacity. The result was an estimated post-liquefaction factor of safety to bearing failure of about 3 or greater. Based on these analyses, liquefaction-induced bearing failure is a low potential.

In general, the $N_{1(60)}$ equivalent SPT blow counts of the potentially liquefied soil layers identified at the site are 15 or greater. When the $N_{1(60)}$ blow counts are 15 or greater, lateral spreading is typically precluded. We identified all the layers in the CPTs that had $N_{1(60)}$ blow counts less

than 15. For lateral spreading to be a potential, such layers need to be continuous across the site. However, they are not. Hence, lateral spreading appears to be a low potential at the site.

SEISMIC INDUCED SETTLEMENT OF DRY SANDS

Dry (unsaturated) soils tend to settle and densify when subjected to earthquake shaking. The amount of settlement is a function of relative density, cyclic shear strain magnitude, and the number of strain cycles. A procedure to evaluate this type of settlement was developed by Seed and Silver (1972) and later modified by Pyke, et al. (1975). Tokimatsu and Seed (1987) presented a simplified procedure that has been reduced to a series of equations by Pradel (1998). Research on this subject is continuing (Stewart, et al., 2004).

Concurrent with the liquefaction analyses performed, seismic induced settlement of dry sands was analyzed for each set of CPT data with groundwater at its current depth of 20 feet and at the historical high level of about 6 feet. The analyses indicate that seismic induced settlement of dry sands is a low potential at the site.

STATIC SETTLEMENT

Static settlement at the site is expected to be caused by several potential load sources; fill placed on the existing grade to build fills for the dock-high construction in some areas of the building, the building's floor and loads placed/stored on the building's floor, and concentrated structural loads on the foundations. The fills placed on the site and the floor loads have the potential to increase the state of stress in the ground to considerable depths because they will cover large areas. The structural loads transferred to the ground at foundations have the potential to cause compression in the underlying soils to a depth equal to about twice the foundation widths.

Earth Systems has analyzed potential settlement at the site using the computer program Settle3D in conjunction with engineering characteristics of the compressible soil layers measured in our laboratory and a typical soil profile developed from the CPT logs. Consolidation test data were analyzed to determine recompression and virgin compression indices, and maximum past pressures. Data from six time-rate consolidation test increments were analyzed to determine the approximate time-rate coefficient of consolidation.

Settlement potential from the fill, construction, and floor loads was analyzed by adding variable fill loads determined from the grading plan on seven areas of the building. These areas were

designated Dock West, Dock East, Cooler, Freezer, Future Packing, Rail Dock, and Processor. Settlement potentials in these areas were predicted using the weight of cuts and fills, and floor loads provided by the Fisher Construction Group. The increase in soil density in recompacted soils below the existing grade was also considered. The floor loads were 550 psf in the Cooler and Freezer, and 250 psf in all other areas of the building. The floors themselves were assumed to be of density about equal to soil and were combined with cut and fill loads.

The maximum predicted settlement in the various building areas resulting from the approximate load combinations is 4.4 inches at the freezer, 4.1 inches at the Cooler, 3.3 inches at the Processor, 2.6 inches at the Rail Dock, 3.0 inches at the Future Packing, and 2.5 inches at the West Dock and East Dock.

Settlement potential can also be estimated from CPT data, and Earth Systems has done that for comparison to settlement predicted from the laboratory data. The CPT data yielded settlement estimates in the same range as those predicted using the laboratory data.

Settlements in the ranges predicted are typically not tolerable and can lead to uneven and damaged floors. An option to mitigating future settlement is to induce it to occur prior to construction. This is usually done by grading the building pad and surcharging the pad with a stockpile of fill to simulate the floor and the floor loads. Surcharging recommendations are provided elsewhere in this report.

The CPT data were used to estimate the settlement of the column loads at the perimeter (75 kips) of the building and at the interior (150 kips) of the building. Without overexcavation and recompaction the estimates were 1.3 and 1.7 inches, respectively. These estimated settlement potentials are independent of settlement caused by any other load source.

HYDROCONSOLIDATION

Hydroconsolidation is a phenomenon in which naturally occurring soil deposits, or non-engineered fill soils, collapse when wetted. Natural soils that are susceptible to this phenomenon are typically aeolian, debris flow, alluvial, or colluvial deposits with high apparent strength when dry. The dry strength is attributed to salts, clays, silts, and in some cases capillary tension, "bonding" larger soil grains together. So long as these soils remain dry, their strength and resistance to compression are retained. However, when wetted, the salt, clay, or silt bonding agent is weakened or dissolved, or

capillary tension reduced, eventually leading to collapse. Soils susceptible to this phenomenon are found throughout the southwestern United States.

Methods to analyze hydroconsolidation include double oedometer tests proposed by Jennings and Knight (1956), and a modified version of the Jennings and Knight procedure presented by Houston, et al. (1988) involving a single oedometer test on a soil sample.

Because the historical high groundwater at the site is shallow and the site has been under cultivation and irrigation for about 100 years, hydroconsolidation potential seems improbable. In addition, when a soil's degree of saturation exceeds 60%, hydroconsolidation is unlikely. Analysis shows that most of the soils above the historical high groundwater are above 60% saturation. Hence, hydroconsolidation seems unlikely.

SOIL CONDITIONS

The site is underlain by alluvium to the maximum depth explored, which was 76.5 feet. The upper 8 feet of the alluvium is a variety of silty fine sand with some clay, silts, and some lean clays. Of this surface soil, the upper about 3 to 4 feet is thought to be disturbed by farming activity and was loose to medium dense based on sampler driving resistance. Relative compaction of the near surface soil averages about 80%, but is as low as 70%, of the maximum dry density determined by ASTM D 1557. Below these soils and to a depth of about 13 feet, is sand that is medium dense to dense. Between the depths of about 13 feet and 22 feet is soft to firm clay. Soil consisting of interbedded silts, clays, and sands was encountered between the depths of about 22 feet and 32 feet. Between the depths of about 32 feet and 48 feet is mostly dense sand. Below this layer of sand and to the maximum depth explored of 76.5 feet are interbedded sands, silts, and clays. Please refer to the boring and CPT logs for a more complete description of the soil profiles at the site.

Groundwater was encountered in the borings at a depth of about 20 feet. Two piezometers were set and the stabilized depth to groundwater about one week after installation was about 20 feet. Historical high groundwater is estimated to be 6 feet below the ground surface based on data in the Seismic Hazards Report for the Oxnard Quadrangle (CGS, 2003a). Soil moisture contents with anticipated grading depths were of variable moisture content; ranging from below to more than double the optimum moisture content for compaction.

The expansion characteristics of the soils were evaluated by two expansion index tests of near surface soils. The results ranged were 30 and 63, which places the soil in the “Low” (EI = 21 to 50) and “Medium” (EI = 51 to 90) expansion ranges of ASTM D 4813. After soil mixing during grading, the expansion indices of the building pad should be re-determined.

Soil chemistry testing results for soluble sulfates, soluble chlorides, pH, and resistivity of five samples are presented in Appendix B. The data should be interpreted by your design team. The soluble sulfate results ranged from 366 to 680 ppm. This puts the soils in the “S0" exposure class (“not applicable” range) of Table 19.3.1.1, Exposure Categories and Classes, of ACI-318-14. Based on the soluble sulfate results, ACI-318-14 places no restrictions on the concrete because of sulfate exposure. The soil resistivity results ranged from 1,575 to 2,625 ohm-cm, or from “corrosive” to “moderately corrosive” to ferrous metals. At the completion of grading, addition sampling and testing should be performed so that final designs can be made concerning the effects of soil corrosion. Earth Systems does not practice corrosion engineering.

CONCLUSIONS AND RECOMMENDATIONS

The site is suitable for the proposed development from a Geotechnical Engineering standpoint provided that the recommendations contained in this report are successfully implemented into the project.

Liquefaction and seismic induced settlement are potentials at the site. However, the amount of seismic induced settlement ground surface is moderate (1.2 to 0.5 inches) and the anticipated differential seismic-induced settlement is estimated to be about 0.7 inches. Bearing failure and lateral spreading caused by liquefaction are low potentials and unlikely to occur.

Maximum static settlement from wide-spread surface loading caused by the dock-high construction and anticipated floor loads is in the range of 4 to 5 inches. This settlement potential can be mitigated by completing the building pad grading and surcharging the completed building pad area with a stockpile of fill that is allowed to settle for about two months. Alternately, the building area could be surcharged before the building pad is graded. Recommendations for grading and surcharging will be found elsewhere in this report.

After recommended grading, estimated static settlement at column loads in the range of 150 kips will be about 3/4-inch and estimated settlement at column loads in the range of 75 kips will be

about1/2-inch. These estimated settlements are in addition to settlement caused by any other loading.

Recompaction of loose disturbed surface soils will be necessary in building and building foundation areas, in miscellaneous foundation areas, in pavement areas, and in areas to receive fill.

Groundwater was found about 20 feet below the existing ground surface. However, the historical high groundwater depth is considerably less, about 6 feet. If the groundwater rises to historic high levels, it could influence grading. The moisture content of the soils within the anticipated depths of grading are variable, sometimes found below (sands) and sometimes above (silts and clays) the optimum moisture content for compaction. If these moisture levels persist, soils will need to be dried before compaction can be achieved.

A. Grading

1. Pre-Grading Considerations

   a. Grading at a minimum should conform to Appendix J of the 2019 California Building Code.
   b. The existing ground surface should be initially prepared for grading by removing all debris and organics from the construction areas to preclude their inclusion in fills. Voids created by removing such material should be properly backfilled and compacted. No compacted fill should be placed unless a representative of the Geotechnical Engineer has observed the underlying soil.
   c. All excavations should be sloped or shored in accordance with OSHA guidelines. Stability of those slopes will depend to a great extent on keeping traffic and outside loads away from the slope top, at a minimum distance equal to the excavation depth. No water should run over the slope faces.
   d. On-site soils may be used for fill once they are cleaned of all organic material, debris and irreducible material larger than 8 inches, and moisture conditioned to enhance compaction. Alternately, a commercial quality granular import soil may be used for fill.
   e. Fill and backfill placed above optimum moisture in layers with loose thickness not greater than 8 inches should be compacted to a minimum of 90% of the maximum dry density obtainable by the ASTM D 1557 test method unless otherwise recommended or specified. Random compaction tests by Earth Systems can assist the Grading Contractor in evaluating whether the Grading Contractor is meeting compaction requirements. However, compaction tests pertain only to a specific location and do not guaranty that all fill has been compacted to the prescribed percentage of maximum density. It is the

ultimate responsibility of the Grading Contractor to achieve uniform compaction in accordance with the requirements of this report and the grading ordinance.

f. Shrinkage of soils affected by compaction is expected to be about 15%. Subsidence of underlying soils affected by compaction is estimated to be about 0.2 feet. Shrinkage from clearing should be considered when estimating quantities.
g. Import soils should be equal to, or better than, on-site soils in strength, expansion, and compressibility characteristics. Import soil can be evaluated but will not be prequalified by the Geotechnical Engineer. Final comments on the characteristics of the import will be given after the material is at the project site.
h. Roof draining systems should be designed so that water is not discharged into bearing soils or near structures. Roofs should be fitted with gutters and downspouts. Final site grade could be such that all water is diverted away from the structures toward either hardscapes or drain inlets and is not allowed to pond. In landscape areas adjacent to the buildings, the CBC requires a minimum gradient of 5% away from the edge of the foundations for a minimum distance of 10 feet.
i. Pumping soils or otherwise unstable soils are may be encountered if current soils moisture conditions persist or in deeper excavations. If they are encountered, stabilization of the excavation bottom by drying the soils may be the most efficient way to proceed. If drying of the soils is not feasible because of time constraints, stabilization of the bottoms with aggregates and geotextile fabric, or lime treatment, are options.
j. Earth Systems should be retained to provide Geotechnical Engineering services during site development and grading, and foundation construction phases of the work to observe compliance with the design concepts, specifications and recommendations. This will allow for timely design changes if subsurface conditions differ from those anticipated prior to the start of construction.
k. Plans and specifications should be provided to Earth Systems prior to grading. Plans should include the grading plans, foundation plans, and foundation details. Earth Systems will review these plans only for conformity with geotechnical parameters not including drainage. It is the responsibility of the Client and other Engineers to review and approve designs and plans for conformity with all engineering and design requirements necessary to the proper function and performance of the structure.

2. <u>Grading/ Development</u>
   a. Because the site is blanketed by 3 to 4 feet of fairly low-density alluvium disturbed by agricultural activity, over-excavation and recompaction of soils in the building area will be necessary. The over-excavation and recompaction will improve bearing capacity and

reduce settlement potential. Soils in foundation areas should be overexcavated to the deeper depth of 4 feet below the exiting grade or 4 feet below the bottom of foundations to a distance of 5 feet beyond the foundation perimeters. Building slab areas and to a distance of 5 feet beyond the slab perimeters should be overexcavated to the deeper depth of 4 feet below existing grade or 2 feet below the bottom of finish subgrade. The exposed surface should be scarified to a depth of 8 inches, moisture conditioned to above optimum moisture, and compacted.

b. Areas outside the building to receive paving, slabs-on-grade, should be over-excavated to the deeper depth of 1.5 foot below the existing ground surface, 1.5 feet below finish subgrade, or through any disturbed soil. The exposed surface should be scarified to a depth of 8 inches, brought to above optimum moisture, and compacted.
c. Grading at the rail spur can be the same as for pavements. However, the design of the rail bed is beyond the scope of this report and is the responsibility of others. The rail bed subgrade design will supersede the recommendations of this report.
d. Removed soils can then be replaced in 6- to 8-inch thick lifts, moisture conditioned to above optimum moisture, and compacted. This process should be repeated until finish grade is reached.
e. If pumping soils or otherwise unstable soils are encountered, stabilization of the excavation bottoms will be required prior to placing fill. This can be accomplished by drying the soils, working thin lifts of 1-1/2-inch rock (minimum size) float rock into the excavation bottom until stabilization is achieved, or by lime or cement treatment of the soils. Use of geotextiles I another possibility. Based on our experience in the area, and the boring logs, wet unstable soils are a potential at the site. Hence, the grading contractor should be aware of and prepared for this potential.

3. <u>Surcharging</u>
   a. Predicted settlements could lead to floor damage and structural distress and should be mitigated. This can be accomplished by surcharging the building area before or after the building pad is graded.
   b. If all building overexcavation and recompaction, and pad construction is accomplished before surcharging, then additional loads from 550 psf in the Cooler and Freezer areas and 250 psf in all other areas should be placed on the pad. These loads can be simulated by fill surcharges about 5.5 feet and 2.5 feet high above the finish floor elevation, respectively. Hence, the Cooler and Freezer should be blanketed with about 6 feet of soil stockpile, and the remainder of the building should be blanketed with

about 3 feet of soil relative to finish floor. Thus, the stockpile finish grades should be about 74 feet in the Cooler and Freezer areas, and about 71 feet in all other areas.

c. If the surcharge is placed on the existing grade without overexcavation and recompaction of the building area, the situation is different. In this case, the surcharge needs to account for the increase in soil density that will result from eventual recompaction, pad cut or fill, floor constructions, and floor loads. This can be done by increasing the stockpile heights outlined above by about 1.5 feet. Thus, the stockpile finish grades would be about 75.5 feet in the Cooler and Freezer areas, and about 72.5 feet in all other areas.
d. The surcharge does not need to be compacted to a minimum of 90% of the maximum dry density, but it should be rolled to densify it sufficiently to minimize erosion and attain a minimum density of 100 pcf. Side slopes should be at approximately 2-horizontal to 1-vertical or flatter.
e. The time to achieve most (about 90%) of the settlement to be induced is estimated to be about two months. This has been estimated using an average consolidation coefficient determined from time-rate consolidation testing. This estimate compares well to experience with other surcharging projects on the Oxnard Plain.
f. Surcharge settlement can be monitored with settlement plates and riser pipes placed at or just below the bottom of overexcavations in the building area. Surveying should be initiated before any fill is placed above the overexcavation bottom, continue through the grading and stockpiling process, and thereafter. The riser pipes should be surveyed to a fixed benchmark well outside the fill area. Readings should be made every 2 or 3 days while fill is being placed and about weekly after the stockpiling is complete.

4. <u>Utility Trenches</u>
   a. Utility trench backfill should be governed by the provisions of this report relating to minimum compaction standards. In general, on-site service lines may be backfilled with processed on-site soils, placed in up to 8-inch thick lifts at above optimum moisture, and compacted to 90% of the maximum dry density. Backfill of offsite service lines will be subject to the specifications of the jurisdictional agency or this report, whichever are greater.
   b. Trenches parallel to foundations should be above a 1-horizontal to 1-vertical projection from the footing. If the Structural Engineer has a more stringent criterion, that criterion will govern.
   b. Shoring of deeper trenches may be required due to the potential presence of caving sand and/or shallow groundwater.

c. If water is present in trenches, backfilling should be with gravel to 6-inches above the water.
d. Jetting of native soils is not recommended.
e. Trench backfill material in City right-of-ways or easements is required to have a sand equivalence of 20 or greater.
f. Backfill operations should be observed and tested by the Geotechnical Engineer to monitor compliance with these recommendations.
g. Jetting should not be utilized for compaction in utility trenches.

B. Structural Design

1. Conventional Spread Foundations

a. Spread foundations (continuous and isolated pads) supporting the proposed buildings should bear into the compacted fill as recommended elsewhere in this report. Foundation excavations should be cleaned of all loose or unsuitable soils and debris prior to placing concrete.
b. Continuous foundations (a minimum of 18 inches wide) and isolated pad foundations (a minimum of 24 inches wide) should bear a minimum of 24 inches below lowest adjacent grade.
c. Continuous and isolated pad foundations bearing as described above can be designed for an allowable bearing capacity of 2,500 psf. This value includes a factor of safety of three and should not be increased because of settlement potential. Groundwater was encountered about 20 feet below the existing ground surface, but the historical high groundwater is estimated to be about 6 feet below the existing ground surface. However, even if groundwater was to rise to its maximum historical level, it is not expected to materially affect the allowable bearing capacity. Analysis indicates that settlement potential limits bearing capacity and it has been selected on that basis.
d. When transient loads such as those from wind or seismicity are included, the bearing value can be increased by one-third.
e. The allowable bearing values are net (weight of foundation and soil surcharge may be neglected).
f. Lateral loads may be resisted by soil friction on floors and foundations and by passive resistance of the soils acting on foundation edges and foundation stem walls. Lateral bearing is based partially on the assumption that soils adjacent to foundations are properly compacted.
g. Foundations at a minimum should be designed to meet the requirements of the Minimum Foundation Design Criteria table in Appendix D for soils in the "Medium "

expansion range. At a minimum, continuous foundations should be reinforced with one No. 4 bar top and bottom. When other requirements of this report exceed those of the table, the report's requirements will govern. However, when the requirements of the Structural Engineer exceed those of this report, the Structural Engineer's requirements will govern.

h. Because bearing soils are in the "Low" and "Medium" expansion ranges, foundation subgrade soils require pre-saturation depending on the foundation depth. In general, when the foundation depth exceeds the required pre-saturation depth (18 inches), pre-saturation is not required. However, the soils should be moistened prior to pouring concrete to aide in proper curing. When foundation depths are less than the pre-saturation depth, pre-saturation according to the Minimum Foundation Design Criteria table in Appendix D for soils in the "Medium" expansion range will be required.

i. A member of Earth Systems should check footing excavations prior to placing reinforcing to confirm bearing conditions.

2. Slabs-on-Grade

a. Concrete slabs-on-grade should be supported by compacted fill as recommended elsewhere in this report. Reinforcing and thickness provided below are for non-structural slabs-on-grade.

b. It is anticipated that there will be both industrial slab-on-grade floors subjected to forklift traffic and typical office slab-on-grade floors. Slabs-on-grade subjected to forklift traffic should be a minimum of 6 inches thick. Slabs-on-grade subjected to office use should be a minimum of 4 inches thick. Actual designs should be prepared by the project Structural Engineer for the anticipated loading. When designing for wheel loads, a subgrade modulus of 100 psi/in. can be used.

c. Some areas of the floor will be occupied by freezers and cold storage spaces. In those areas, there should be adequate protection to prevent ground freeze below the floor slabs. In all areas, floor slabs should be underlain by a minimum of 4 inches of sand or similar capillary break. In areas where moisture sensitive floor coverings are to be used or where it is desired to limit moisture transmission through the slab, the subgrade should be covered by a vapor barrier before placing the sand.

d. Exterior slabs-on-grade (near or at existing grades) such as sidewalks and patios should be underlain with a minimum of 4 inches of sand. The sand should be lightly moistened just prior to placing concrete.

e. It is recommended that perimeter slabs (walks, patios, etc.) be designed relatively independent of footing stems (i.e., free floating), so foundation adjustment will be less likely to cause cracking.
f. Reinforcement and premoistening data given herein for slabs are generally the same as those given in Minimum Foundation Design Criteria table in Appendix D for soils in the "Medium" expansion range. However, Earth Systems recommends minimum slab reinforcement of No. 4 reinforcing bars spaced 18 inches on center each way. It should be noted that these values are minima and that other more stringent structural considerations may govern. Actual reinforcement and slab thickness should be determined by the project Structural Engineer but should not be less than values recommended in the table or this report.
g. Because the bearing soils are anticipated to be in the "Medium" expansion range, slab subgrade soils will require pre-saturation according the Minimum Foundation Design Criteria table in Appendix D for soils in the “Medium” expansion range.

3. Frictional and Lateral Coefficients
   a. Resistance to lateral loading may be provided by friction acting on the base of foundations. A coefficient of friction of 0.65 may be applied to dead load forces. This value does not include a factor of safety.
   b. Passive resistance acting on the sides of foundation stems equal to 420 pcf of equivalent fluid weight may be included for resistance to lateral load. This value does not include a factor of safety. The upper one foot of soils should be disregarded in determining passive resistance unless the ground surface is covered by a durable surface.
   c. Passive resistance may be combined with frictional resistance provided that a one-third reduction in the coefficient of friction is used.
   d. A minimum factor-of-safety of 1.5 should be applied to these ultimate values.

4. Settlement Considerations
   a. Based on assumed fill and service loads, engineering calculations indicate that maximum expected static settlement for the building slabs could be about as much as 4 to 5 inches. Because slab settlements of this magnitude would be detrimental, the building area should be graded and then should be surcharged with a stockpile of soil to simulate the anticipated floor and floor loads.
   b. Spread foundations designed as recommended and supported by compacted fill are estimated to settle about 3/4-inch for 150-kip interior foundations and about 1/2-inch for 75-kip perimeter foundations. Static differential settlement between adjacent load

bearing members could be about half these amounts. This settlement will be in addition to settlement caused by the dock-high construction and floor service loads (which will be mitigated by pre-consolidating soils in the building area).

c. The sum of estimated seismic-induced (liquefaction and dry sand seismic settlement) settlement experienced at the ground surface is estimated to be about 0.5 to 1.2 inches by applying the procedures in Cetin, et al. (2009). The anticipated differential settlement resulting from the design level earthquake is estimated to be about 0.7 inches which could occur over distances of 30 to 40 feet.

d. Settlement from hydroconsolidation is not anticipated.

5. Preliminary Asphalt Pavement Sections

a. Three samples of the anticipated subgrade soils were tested to determine R-values. The tests yielded R-values of 5, 13, and 5. The lowest value is used in the preliminary paving designs that follow. Additional sampling and testing are recommended toward the end of rough grading to confirm or correct the preliminary design sections.

b. Preliminary asphalt pavement sections for a 20-year design-life using untreated subgrade soils are presented below based on the lowest measured R-value, current Caltrans design procedures, and traffic indices ranging from 4.0 to 9.0. The traffic index (TI) is a measure of traffic wheel loading frequency and intensity of anticipated traffic. For comparison, TIs between 4 and 5 are often suitable for design of automobile parking areas, and TIs between 5 and 6 are commonly used for design of fire truck access lanes and areas subject to light to moderate truck traffic, and TIs between 7 and 8 are for areas subjected to heavier truck traffic (an average of 9 and 27 five-axle trucks per day). A TI of 9.0 is for areas subjected to an average of about 73 five-axle trucks per day. Traffic indices assumed above should be reviewed by the project Owner, Architect, and/or Civil Engineer to evaluate their suitability for this project.

TRAFFIC INDEX	ASPHALT-CONCRETE (INCH)	AGGREGATE BASE (INCH)
4.0	3.0	6.5
4.5	3.0	8.0
5.0	3.0	10.0
6.0	3.0	13.5
7.0	4.0	15.5
8.0	4.5	18.5
9.0	5.5	20.5

c. The preliminary paving sections provided above have been designed for the type of traffic indicated. If the pavement is placed before construction on the project is complete, construction loads, which could increase the traffic index values assumed above, should be considered.
d. The subgrade soils in the upper 12 inches below the finished subgrade elevation should be properly moisture conditioned to above optimum moisture and compacted to achieve a minimum relative compaction of 90 percent of the ASTM D1557 maximum dry density. The subgrade soils should be in a stable, non-pumping condition at the time the aggregate base material is placed and compacted.
e. Aggregate base materials should conform to the specifications stated in the latest edition of the "Greenbook" and be compacted as engineered fill to at least 95 percent compaction. Asphalt paving materials and placement methods should meet specifications stated in the "Greenbook" for asphalt concrete and be compacted to a minimum of 95% of maximum density.
f. Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become continuously wet. All concrete curbs separating pavement and landscaped areas should extend at least 6 inches into the subgrade and below the bottom of the adjacent aggregate base to provide a barrier against lateral migration of landscape water or runoff into the pavement section.
g. Periodic maintenance should be performed to repair degraded areas and seal cracks with appropriate filler.

6. <u>Preliminary Concrete Paving Sections</u>
   a. For those areas that will be subjected to heavy truck traffic and will be paved with concrete, we have assumed a TI of 8 to 9, and a design life of 20 years. We also have used the lowest measured R-value of 5, which is approximately equivalent to a coefficient of subgrade reaction of k = 75 pounds per cubic inch when a layer aggregate base on the subgrade is included. Based on these values and design methods described by the American Concrete Institute (ACI 330R-01), the following minimum paving section was determined:

Concrete thickness (entrance and exterior lanes) =	8.5 inches
PMB or Class II base thickness under concrete =	4.0 inches
Compressive strength of concrete, fc =	3,250 psi at 28 days
Modulus of flexural strength of 3,250 psi concrete =	500 psi

b. The above design is for unreinforced paving. For crack control, contraction joints should be spaced no more than 20 feet on center in each direction and should create panels with aspect ratios of about 1-to-1. Additional crack control can be provided by steel reinforcing specified by the project Structural Engineer. Reinforcing bars should be placed at mid-height of the concrete slab and maintained at mid height during placement of concrete.
c. The preliminary paving sections discussed above have been designed for the type of traffic indicated. If the pavement is placed before construction on the project is complete, construction loads should be considered. Traffic should not be allowed on the pavement until 28 days after concrete placement, or until the 28-day design strength is achieved

7. Retaining Walls
   a. Conventional cantilever retaining walls are anticipated at the loading dock and at other locations of the dock-high building pad.
   b. Conventional cantilever and restrained retaining walls backfilled with compacted on-site soils may be designed for active pressures of 37 pcf and 58 pcf of equivalent fluid weight, respectively, for well-drained, level backfill.
   c. The equivalent fluid weights listed above assume that backfill soils will be compacted to 90 percent of the maximum dry density as determined by the ASTM D 1557 Test Method.
   d. Retaining walls may need to be designed for a seismic loading force that is applied in addition to the static forces when seismic shaking occurs. A seismic increment of earth pressure equal to 16 pcf of additional equivalent fluid weight needs to be considered for cantilever walls retaining more than 6 feet of soil. For restrained retaining walls retaining more than 6 feet of soil, an additional seismic increment of pressure equal to 29 pcf of additional equivalent fluid weight needs to be considered. These pressure increments have been determined by a procedure presented by Al Atik and Sitar (2010). The seismic increments of pressure can be assumed to be distributed so that the centroid of pressure acts at 0.33H above the base of a retaining wall, where H is the wall height in feet. Because a seismic force is transient, and in accordance with CBC Section 1807.2.3, a minimum factor of safety of 1.1 may be used for sliding and overturning when seismic loads are included.
   e. The lateral earth pressure to be resisted by the retaining walls or similar structures should also be increased to allow for any other applicable surcharge loads. The

surcharges considered should include forces generated by any structures or temporary loads that would influence the wall design. The coefficient to apply to uniform surface loads is 0.30.

f. A system of backfill drainage should be incorporated into retaining wall designs. Backfill comprising the drainage system immediately behind retaining structures should be free-draining granular material with a filter fabric between it and the rest of the backfill soils. As an alternative, the backs of walls could be lined with geodrain systems. The backdrains should extend from the bottoms of the walls to about 18 inches from finished backfill grade. Waterproofing may aid in reducing the potential for efflorescence on the faces of retaining walls.
g. Compaction on the uphill sides of walls within a horizontal distance equal to one wall height should be performed by hand-operated or another lightweight compaction equipment. This is intended to reduce potential "locked-in" lateral pressures caused by compaction with heavy grading equipment.
h. Water should not be allowed to pond near the tops of retaining walls. To accomplish this, final backfill site grades should be such that all water is diverted away from retaining walls.

ADDITIONAL SERVICES

This report assumes that an adequate program of monitoring and testing will be performed by Earth Systems Pacific during construction to check compliance with the recommendations given in this report. The recommended tests and observations include, but are not necessarily limited to the following:

1. Review of the plans during the design phase of the project.
2. Observation and testing during site preparation, grading, placing of engineered fill, and foundation construction.
3. Consultation as required during construction.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The analysis and recommendations submitted in this report are based in part upon the data obtained from site exploration by borings and CPTs. The nature and extent of variations between and beyond the borings and CPTs may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around this site. Any statements in this report or on the soil logs regarding odors noted, unusual or suspicious items or conditions observed, are strictly for the information of our client.

Findings of this report are valid as of this date; however, changes in conditions of a property can occur with passage of time whether they be due to natural processes or works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of 1 year.

In the event that any changes in the nature, design, or location of the buildings and other improvements are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and conclusions of this report modified or verified in writing.

This report is issued with the understanding that it is the responsibility of the Owner, or of his representative to insure that the information and recommendations contained herein are called to the attention of the Architect and Engineers for the project and incorporated into the plan and that the necessary steps are taken to see that the Contractor and Subcontractors carry out such recommendations in the field.

As the Geotechnical Engineers for this project, Earth Systems strives to provide our services in accordance with the generally accepted geotechnical engineering practices in this community at this time. No warranty or guarantee is expressed or implied. This report was prepared for the exclusive use of the Client and their authorized agents.

It is recommended that Earth Systems be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If Earth is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation of our recommendations.

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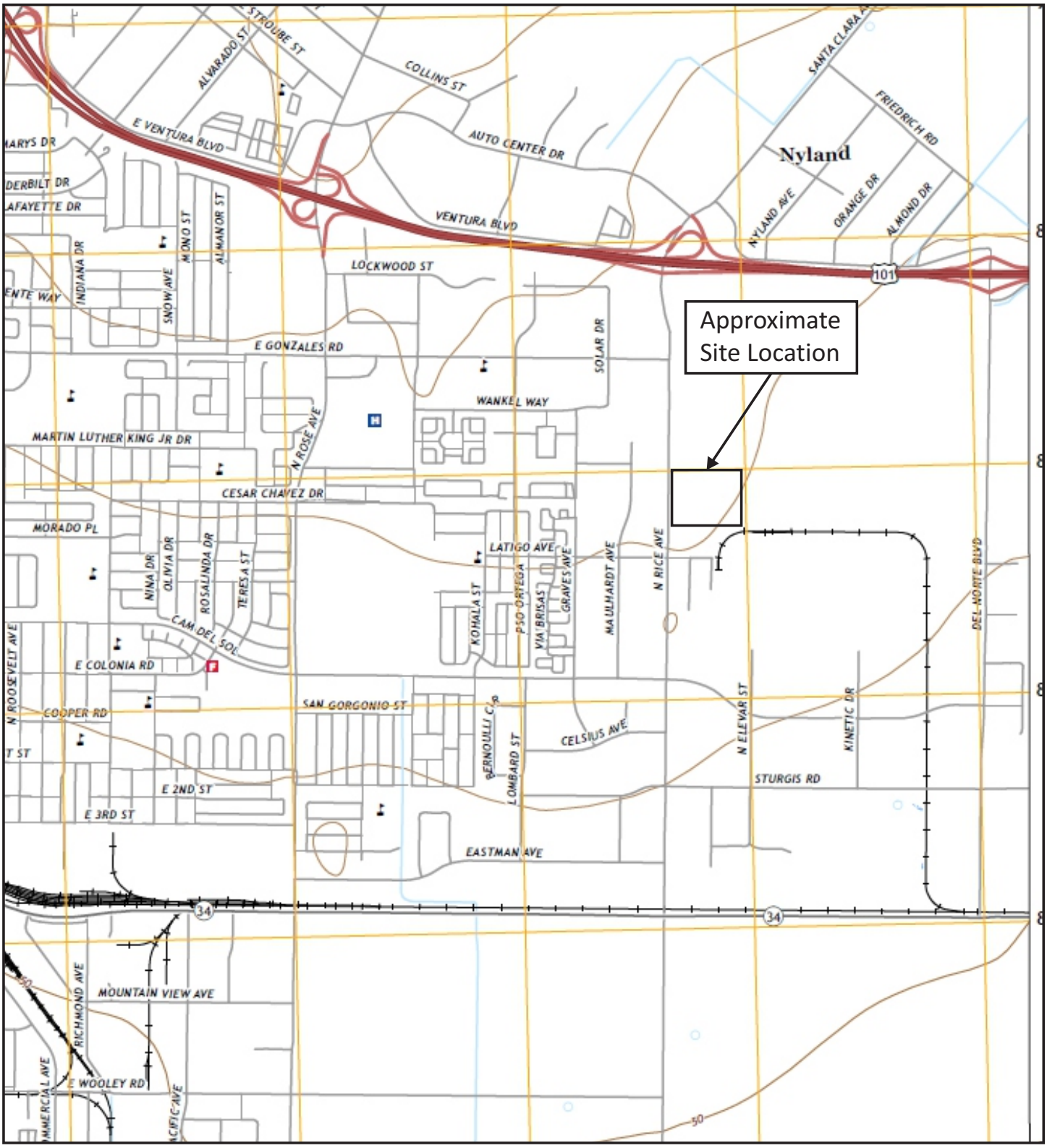
APPENDIX A

Vicinity Map
Regional Geologic Map
Seismic Hazard Zones Map
Historical High Groundwater Map
Site Plan
Field Study
Boring Logs
Symbols Commonly Used on Boring Logs
Unified Soil Classification
Cone Penetration Test Logs and Interpretations



*Taken from USGS Topo Map, Oxnard Quadrangle, California, 2018.

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

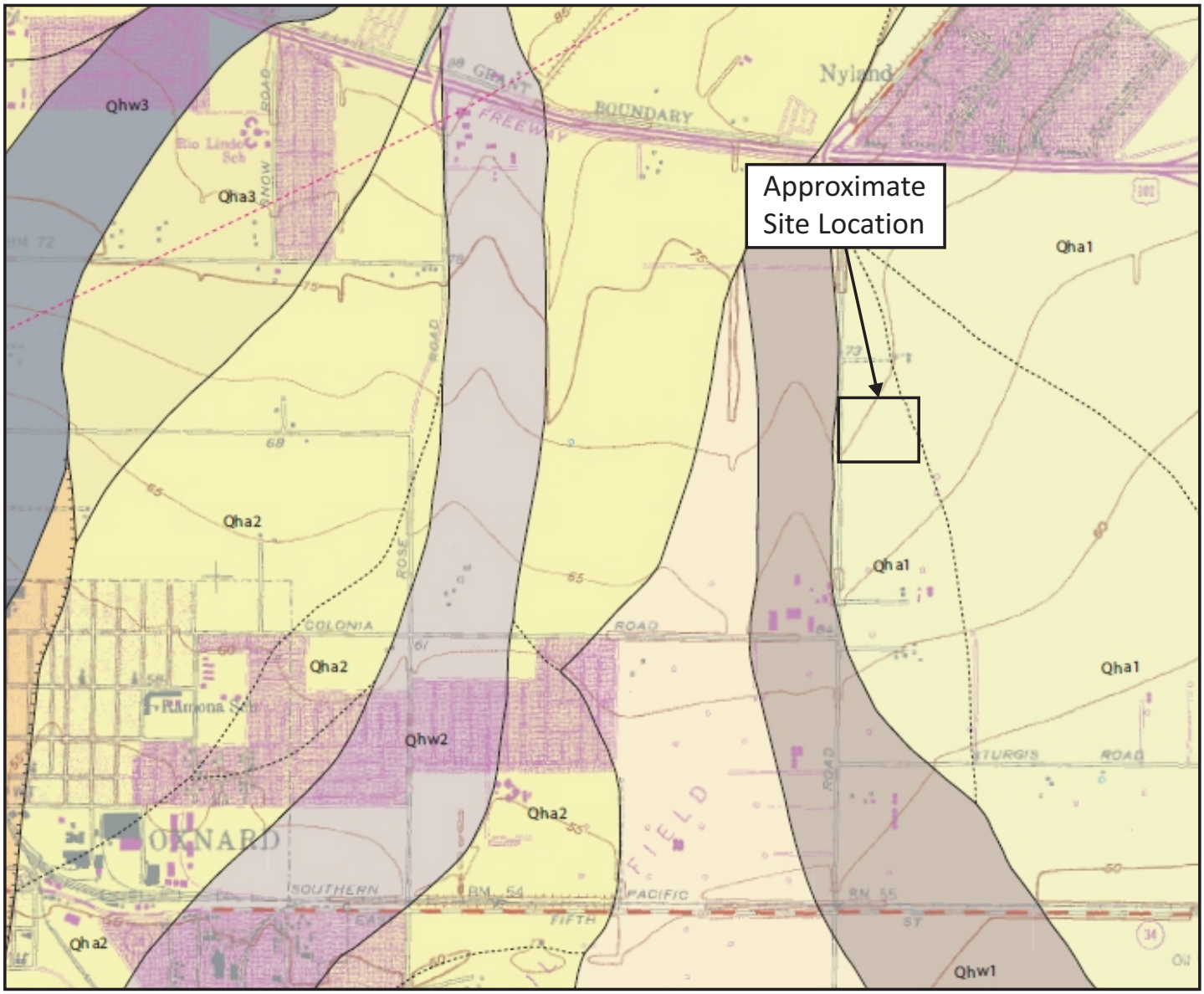
N

VICINITY MAP

Arctic Cold
Oxnard, California

Earth Systems

March 2020	303415-002



*Taken from USGS, SCAMP Geologic Map of the Oxnard 7.5' Quadrangle, Ventura County, California, 2003.

Qha_1	Holocene alluvial deposits, deposited as overbank material associated with unit Qhw1, recognized by scour and incised channeling features; composed of unconsolidated, sandy clay with some gravel.
Qhw_1	Holocene wash deposit; composed of unconsolidated sand, silt and gravel.

- Contact between map units of different relative age; generally approximately located.
- Contact between terraced alluvial units; hachures point towards topographically lower surface.
- Contact between similar map units; generally approximately located.
- Fault; dotted where concealed.
- Axis of anticline; dotted where concealed.
- Axis of syncline; dotted where concealed.

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

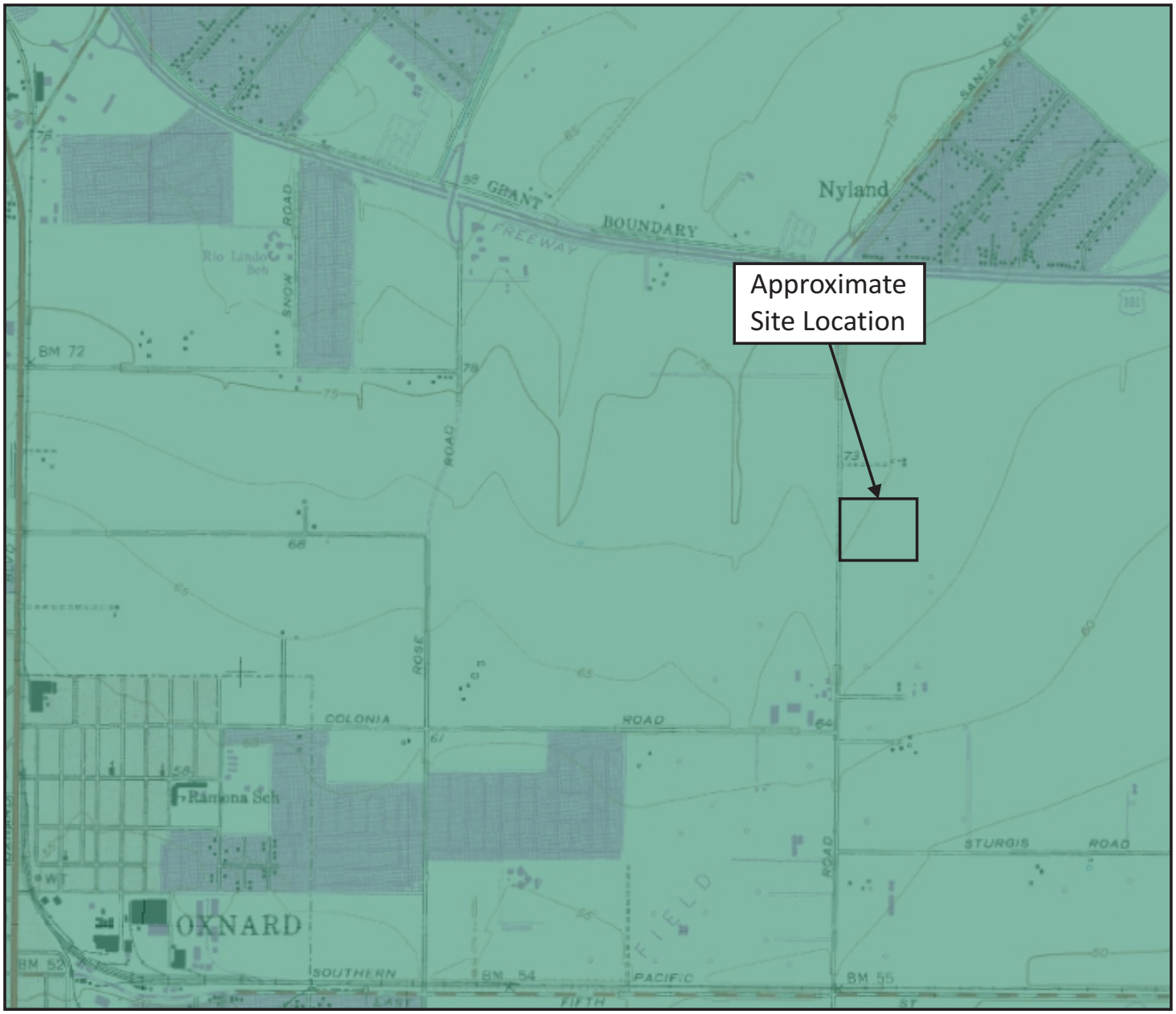
N

REGIONAL GEOLOGIC MAP

Arctic Cold
Oxnard, California

Earth Systems

March 2020	303415-002



MAP EXPLANATION

Zones of Required Investigation:

Liquefaction

Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground-water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslides

Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

NOTE: Seismic Hazard Zones identified on this map may include developed land where delineated hazards have already been mitigated to city or county standards. Check with your local building/planning department for information regarding the location of such mitigated areas.

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

STATE OF CALIFORNIA

SEISMIC HAZARD ZONES

Delineated in compliance with
Chapter 7.8, Division 2 of the California Public Resources Code
(Seismic Hazards Mapping Act)

OXNARD QUADRANGLE

REVISED OFFICIAL MAP

Released: December 20, 2002

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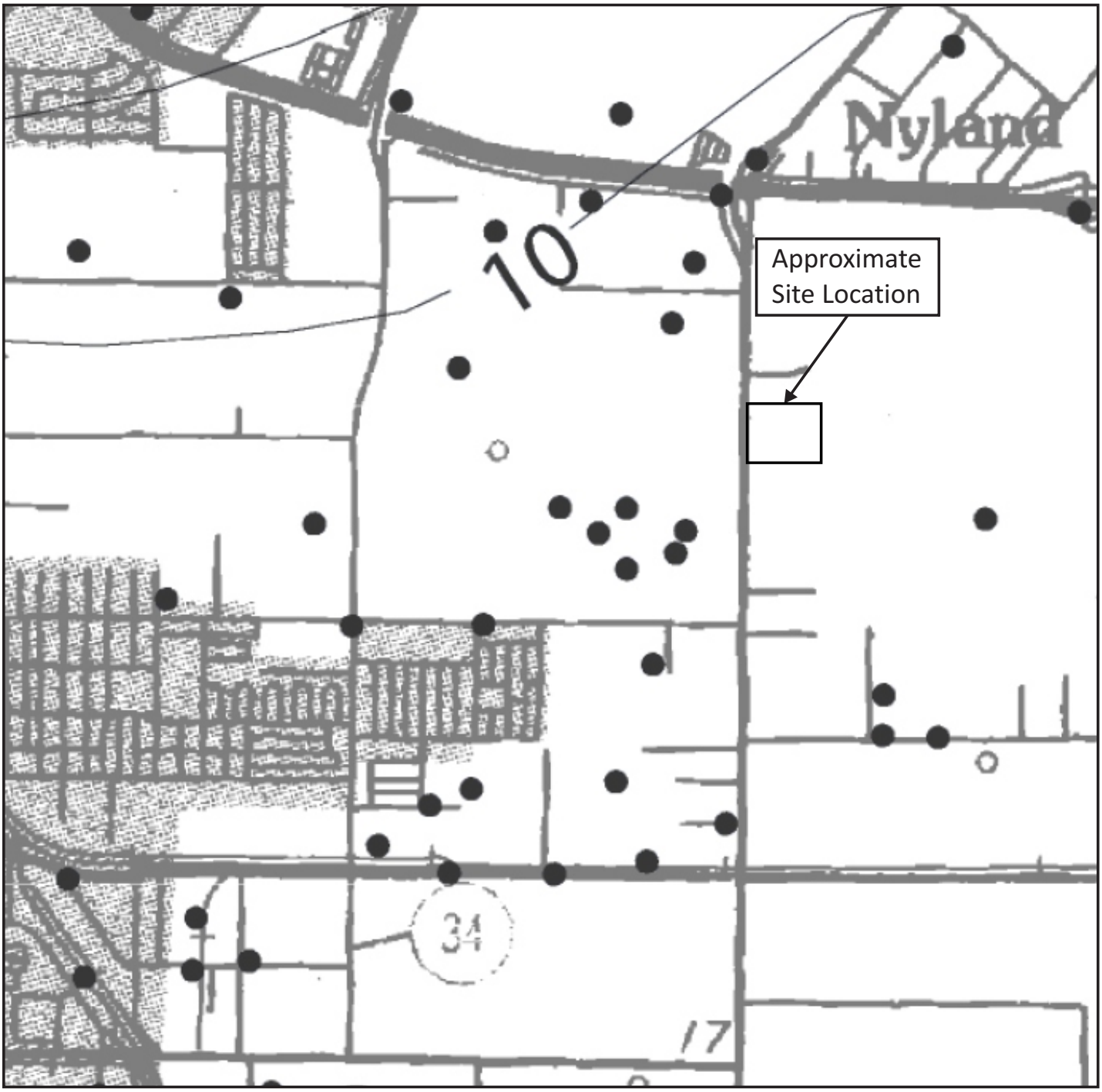
SEISMIC HAZARD ZONES MAP

Arctic Cold
Oxnard, California

Earth Systems

March 2020	303415-002



*Taken from CGS, Seismic Hazard Zone Report For The Oxnard 7.5-Minute Quadrangle, Ventura County, California, 2002.

30 Depth to ground water in feet

● Borehole Site

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

N

HISTORICAL HIGH GROUNDWATER MAP

Arctic Cold
Oxnard, California

Earth Systems

March 2020	303415-002

POTENTIAL FUTURE BUILDING 63,000 SF

ASPHALT SITE PAVING

TWO STORY OFFICE 3,585 SF

50' LOADING DOCK 37,157 SF

MECHANICAL /ELECTRICAL 5,090 SF

FUTURE PACKING 14,979 SF

FINISHED GOODS 17,050 SF

COOLER STORAGE 143,382 SF

FROZEN RACKED STORAGE 187,233 SF

FINISH FLOOR 65.73

(FUTURE) RAIL DOCK 9,996 SF

2 STORY OFFICE/SUPPORT 8,498 SF

PROCESSOR & DRY STORAGE 117,165 SF

OFFLOAD CANOPY 30,212 SF

POTENTIAL FUTURE PARKING

142,422.76 SF 3.270 ACRES

150,112.53 SF

358,209.14 SF 8.223 ACRES

CONCRETE TRUCK APRON

500 GAL PROPANE TANK W/ CONCRETE PAD AND PROTECTION BOLLARDS

BIKE RACKING

EMPLOYEE PARKING

ADA PARKING STALL 9'x18' (TYP)

TRASH ENCLOSURE

6' DECORATIVE METAL FENCE

N88°45'07"W 313.37'

L=226.75' Δ=15°17'03" R=850.00'

N75°57'50"E 300.00'

N01°14'28"E 650.00'

N88°56'12"W 1059.76'

PZ-2 B-12 B-10 B-9 B-13 B-11 B-2 B-8 B-1 B-3 B-4 B-7 B-14 B-15 B-5 PZ-1 B-6

CPT-1 CPT-2 CPT-3 CPT-4 CPT-5 CPT-6 CPT-7 CPT-8 CPT-9

R : Approximate R-Value sample locations.

PZ-2 : Approximate piezometer testing locations.

B-15 : Approximate boring locations.

CPT-9 : Approximate Cone Penetrometer Test (CPT) sounding location.

Approximate Scale: 1" = 120'

0 120' 240'

N

SITE PLAN

Arctic Cold
Oxnard, California

Earth Systems

March 2020	303415-002

FIELD STUDY

A. On March 5 and 6, 2020, nine cone penetrometer test (CPT) soundings were completed on the subject lot by Kehoe Testing and Engineering. Information generated by the testing was used to characterize the subsurface units for the analysis of site liquefaction potential. The soundings were taken to depths of about 38.5 to 74.5 feet. The cone penetrometer test involves hydraulically pushing a sensored 1.4-inch diameter rod into the ground. At the tip of the rod (which is a series of 1-meter lengths of threaded rod with electrical wire attachment to the tip) is a cone sensor that has a 60-degree apex angle. Within the cone are strain gauges that take readings on tip pressure and side friction. The readings are recorded at intervals of 0.05 meters as the rod is advanced. The approximate locations of the CPT soundings were determined in the field by pacing and sighting and are shown on the Site Plan in this Appendix. The locations were approximately at the four corners and the center of the proposed building.

B. Fifteen borings were drilled to a maximum depth of 76.5 feet below the existing ground surface to observe the soil profile and to obtain samples for laboratory analysis. The borings were drilled between March 2 and 4, 2020. The borings were drilled using mud-rotary techniques with an about 4-inch diameter bit, and 8-inch diameter hollow-stem auger powered by a GTech 8 truck mounted drilling rig. The approximate locations of the test borings were determined in the field by pacing and sighting and are shown on the Site Plan in this appendix.

C. Samples were obtained within the borings with a Modified California (M.C.) ring sampler (ASTM D 3550 with shoe similar to ASTM D 1586,) a standard split spoon (SPT) sampler, and thin-walled push tubes. The M.C. sampler has a 3-inch outside diameter and a 2.37-inch inside diameter. The SPT sampler has a 2-inch outside diameter and a 1.38-inch inside diameter. The samples were obtained by driving the samplers with a 140-pound down hole safety hammer dropping 30 inches in accordance with ASTM D 1586. The hammer was operated with an auto-trip hammer. The thin-walled sample tubes were pushed into the bottom of the boreholes using the drill rig's hydraulics. The recovered samples were sealed in containers and returned to our laboratory for testing.

D. Bulk samples of the near surface soils encountered was gathered from the excavation spoils in Boring Nos. 1, 2, 3, 6, and 11 between the ground surface and a depth of 5 feet. These samples were placed in bags and returned to our laboratory for testing.

E. Also, on March 4,2020., two 8-inch diameter piezometer test borings were drilled to a depth of about 25 feet using a The GTech 8 drill rig. There approximate locations are shown on the Site Plan in this appendix. The piezometers were fitted with 2-inch diameter slotted pipe and the annuli between the pipes and the boriding sidewalls filled with pea-gravel. Static groundwater levels were determined several days later.

F. The final logs of the boring, and CPT soundings represent our interpretation of the contents of the field logs and the results of laboratory testing performed on the samples obtained during the subsurface investigation. The final logs are included in this Appendix.

Boring Logs

Symbols Commonly Used on Boring Logs
Unified Soil Classification

EARTH SYSTEMS PACIFIC

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-1
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 2, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Mud Rotary
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0									**DISTURBED ALLUVIUM:** Brown fine sandy Silt with few clay, very loose, damp
				3/3/4		ML	102.9	19.1	
5				3/3/6		ML	88.7	32.9	**ALLUVIUM:** Brown fine sandy Silt with few clay, loose, damp
						SM			**ALLUVIUM:** Brown silty fine to medium Sand, loose, dry to damp
				6/12/18		SP	99.6	7.1	**ALLUVIUM:** Light gray brown fine Sand, medium dense, dry to damp
10				8/11/14		SW-SM	99.5	4.4	**ALLUVIUM:** Light brown fine to coarse Sand, with few silt, medium dense, dry to damp
15				3/4/4		CL	98.5	25	**ALLUVIUM:** Gray silty Clay with fine sand, medium stiff, moist
20				3/3/2			83.6	43.2	
				Shelby					**ALLUVIUM**: Same as above
25						CL			
				3/3/4					
30									**ALLUVIUM**: Same as above
35				2/4/10		SP-SM			**ALLUVIUM:** Gray fine to medium Sand with trace fine gravel and few silt, medium dense, very moist to wet

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-1
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 2, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Mud Rotary
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
40		■		13/21/26		SP-SM			**ALLUVIUM:** Gray fine Sand, trace fine gravel and few silt, dense, wet
45									**ALLUVIUM:** Gray silty Clay, trace fine sand, very stiff, wet
50		■		6/4/12		CL			
55			■	14/11/12		CL	100.4	24.0	**ALLUVIUM:** Gray to dark gray silty Clay to clayey Silt, stiff, very moist
60									
65		■		7/5/7		CL			**ALLUVIUM:** Gray silty Clay, little fine sand, stiff, wet
70									
75		■		13/13/19		SM - ML			**ALLUVIUM:** Gray silty fine Sand to fine sandy Silt, dense, moist
									Total Depth: 76.5 feet **Groundwater Depth: 22.0 feet**

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-2
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 2, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Mud Rotary
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0	X		■	3/3/3		CL	86.3	34.7	**DISTURBED ALLUVIUM:** Yellow brown silty Clay, trace fine sand, soft, damp
5			■	4/6/9		SP-SM	98.5	6.8	**ALLUVIUM:** Light yellow brown fine to medium Sand, few silt, loose, damp
10			■	7/10/14		SP-SM	105.2	7.1	**ALLUVIUM**: Same as above. Becomes medium dense.
15			■	Shelby		ML	95.7	27.7	**ALLUVIUM:** Dark brown fine sandy Silt, little clay, medium dense, moist
20	▼	■		2/3/3		CL			**ALLUVIUM:** Gray silty Clay, trace calcareous nodules, medium stiff, very moist
25			■	Shelby		ML	106.2	23.8	**ALLUVIUM:** Gray fine sandy Silt, little clay, medium dense, very moist
30		■		6/12/18		SP-SM			**ALLUVIUM:** Yellow brown fine to medium Sand, few silt, medium dense to dense, wet
35		■		13/16/19		SM			**ALLUVIUM:** Yellow brown silty fine to medium Sand, dense, wet

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-2
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 2, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Mud Rotary
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
40				10/16/22		SM			**ALLUVIUM:** Gray silty fine to medium Sand, dense, wet
									Total Depth: 41.5 feet
									Groundwater Depth: 23.0 feet
45									
50									
55									
60									
65									
70									
75									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-3
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 3, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Mud Rotary
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0	X		■	3/3/5		ML	102.3	15.9	**DISTURBED ALLUVIUM:** Light brown fine sandy Silt, some clay, loose, damp
5			■	6/10/11		SP	100.0	3.9	**ALLUVIUM:** Light gray brown fine Sand, trace silt, medium dense, dry to damp
10									
15			■	4/3/3		CL	97.8	27.1	**ALLUVIUM:** Dark gray silty Clay, soft, moist to very moist
20	▼	■		2/3/3		ML			**ALLUVIUM:** Gray brown fine sandy Silt, trace to little clay, medium stiff, damp to moist
25		■		Push/1/1		CL			**ALLUVIUM:** Dark gray to black silty Clay, very soft, very moist to wet
			■	Shelby			110.7	19.7	**ALLUVIUM:** Same as above
30			■	3/5/6		ML	88.0	32.1	**ALLUVIUM:** Gray clayey Silt, trace fine sand, medium stiff, very moist to wet
35		■		7/14/28		SM			**ALLUVIUM:** Gray brown silty fine Sand, dense, wet
						SM			**ALLUVIUM:** Gray brown silty fine to coarse Sand, trace fine gravel, dense, wet

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-3
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 3, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Mud Rotary
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
40		■		13/17/19		SM			**ALLUVIUM:** Gray brown silty fine to coarse Sand, trace fine gravel, dense, wet
									Total Depth: 41.5 feet
									Groundwater Depth: 22 feet
45									
50									
55									
60									
65									
70									
75									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-4
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 3, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	3/4/7		SM	101.2	22.9	**DISTURBED ALLUVIUM:** Brown silty fine Sand, loose, moist
5			■	5/6/6		ML	94.7	14.3	**ALLUVIUM:** Light brown fine sandy Silt, loose, damp to moist
			■	5/7/10		SM	107.2	20.8	**ALLUVIUM:** Brown silty fine Sand, medium dense, damp
10			■	7/9/12		SW	100.0	8.5	**ALLUVIUM:** Light brown fine to coarse Sand, trace fine gravel, medium dense, dry to damp
15		■		1/1/1		ML			**ALLUVIUM:** Dark gray clayey Silt, little fine sand, very soft, very moist
20	▼		■	Shelby		ML	91.0	35.7	**ALLUVIUM**: Same as above
25			■	4/4/5		ML	87.9	25.7	**ALLUVIUM**: Same as above. Becomes medium stiff.
30		■		7/12/9		SM	108.8	17	**ALLUVIUM:** Gray silty fine Sand, medium dense, wet
35			■	15/34/49		SM			**ALLUVIUM:** Gray silty fine Sand, very dense, wet
						SM			**ALLUVIUM:** Gray silty fine Sand, dense, wet

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-4
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 3, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
40				8/13/20		SM			**ALLUVIUM:** Gray silty fine Sand, dense, wet
									Total Depth: 41.5 feet
									Groundwater Depth: 23.0 feet
45									
50									
55									
60									
65									
70									
75									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-5
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 3, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	4/4/4		ML	101.6	14.6	**DISTURBED ALLUVIUM:** Dark brown fine sandy Silt, little clay, loose, damp
			■	4/5/6		SM	105.8	9.8	**ALLUVIUM:** Brown silty fine Sand, some clay, loose, damp
5			■	4/5/7		ML	97.6	21.0	**ALLUVIUM:** Brown fine sandy Silt, little clay, loose, damp
									Total Depth: 6.5 feet
									No Groundwater Encountered
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-6
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 3, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0	X		■	6/5/4		ML	113.1	11.4	**DISTURBED ALLUVIUM:** Brown clayey Silt, medium stiff, moist
	X		■	3/4/4		CL	93.3	26.7	**ALLUVIUM:** Light brown silty Clay, trace calcareous veining, medium stiff, moist
5			■	4/5/5		SM	104.5	10.6	**ALLUVIUM:** Light brown silty fine Sand, little medium sand, loose, damp
			■	4/7/12			112.8	16.2	**ALLUVIUM:** Same as above**.** Becomes medium dense.
10			■	6/9/16		SW	106.8	5.0	**ALLUVIUM:** Light yellow brown fine to coarse Sand, trace fine gravel, medium dense, dry to damp
15									**Total Depth: 11.5 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-7
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 3, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SM			**DISTURBED ALLUVIUM:** Brown Silty fine Sand, loose to medium dense, damp
5, 10						SW-SM			**ALLUVIUM:** Brown fine to medium Sand, few silt, medium dense, dry to damp
15						CL			**ALLUVIUM:** Dark gray brown fine sandy Clay, stiff, moist to very moist
20	▼					ML			**ALLUVIUM:** Dark gray fine sandy Silt, some clay, loose to medium dense, very moist
25						SM			**ALLUVIUM:** Gray silty fine Sand, some clay, loose to medium dense, wet
30, 35									**Total Depth: 25.0 feet** **Groundwater Depth: 22.0 feet**

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-8
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 3, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	5/5/4		CL	110.3	13.3	**DISTURBED ALLUVIUM:** Brown silty Clay, medium stiff, damp to moist
			■	5/7/9		CL	110.7	13.3	**DISTURBED ALLUVIUM**: Same as above
5			■	7/8/6		SM	104.1	6.1	**ALLUVIUM:** Light brown silty fine Sand, loose, damp
									Total Depth: 6.5 feet
									No Groundwater Encountered
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-9
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 4, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	5/4/4		ML	104.2	20.6	**DISTURBED ALLUVIUM:** Gray brown clayey Silt, some fine sand, medium stiff, moist to very moist
			■	3/5/8		SM	104.3	19.5	**ALLUVIUM:** Light brown silty fine Sand, loose, damp
5			■	5/9/11			105.4	11.6	**ALLUVIUM**: Same as above. Becomes medium dense.
			■	5/5/5		SM	100.9	13.0	**ALLUVIUM:** Light brown fine Sand, some silt, loose, moist.
10			■	5/7/13			108.7	6.6	**ALLUVIUM**: Same as above. Becomes medium dense.
									Total Depth: 11.5 feet
									No Groundwater Encountered
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-10
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 4, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	4/4/3		SC	112.3	11.9	**DISTURBED ALLUVIUM:** Gray brown clayey fine Sand, loose, damp
			■	3/4/5		CL	91.7	25.0	**ALLUVIUM:** Light brown silty Clay, medium stiff, moist
5			■	4/5/6		ML	99.4	20.0	**ALLUVIUM:** Light brown fine sandy Silt, loose, damp
			■	5/8/12		SP	94.9	5.8	**ALLUVIUM:** Light yellow brown fine Sand, medium dense, dry to damp
10			■	9/13/16		SW	104.0	3.6	**ALLUVIUM:** Light yellow brown fine to coarse Sand, medium dense, dry to damp
									Total Depth: 11.5 feet
									No Groundwater Encountered
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-11
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 4, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0	X					ML			**DISTURBED ALLUVIUM:** Dark brown fine sandy Silt, loose, damp to moist
	X		■	3/3/5		ML	98.1	20.2	**ALLUVIUM:** Light brown fine sandy Silt, loose, damp
5	X					ML	87.7	33.1	**ALLUVIUM:** Light yellow brown fine sandy Silt, loose, moist
			■	2/2/7		SW			**ALLUVIUM:** Light yellow brown fine to coarse Sand, trace fine gravel, loose, damp
			■	4/8/12		SM	94.7	9.4	**ALLUVIUM:** Light brown silty fine Sand, medium dense, damp
10									
15		■		3/2/2		CL			**ALLUVIUM:** Gray silty Clay, trace calcareoues veining, soft, very moist
20			■	3/6/9			93.8	28.2	**ALLUVIUM:** Same as above. Becomes medium stiff.
	▼					ML			**ALLUVIUM:** Gray fine sandy Silt, trace iron oxide staining, medium dense, very moist to wet
25			■	3/6/8		CL	102.2	25.6	**ALLUVIUM:** Dark gray silty Clay, stiff, wet
30		■		4/4/4		ML			**ALLUVIUM:** Gray fine sandy Silt, trace clay, loose, wet
35			■	16/30/42		SM	108.4	20.7	**ALLUVIUM:** Gray brown silty fine Sand, very dense, wet
						SM			**ALLUVIUM:** Dark gray brown silty fine to medium Sand, dense, wet

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-11
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 4, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
40		■		13/19/20		SM			**ALLUVIUM:** Dark gray brown silty fine to medium Sand, dense, wet
									Total Depth: 41.5 feet
									Groundwater Depth: 22.0 feet
45									
50									
55									
60									
65									
70									
75									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-12
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 4, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	5/3/4		ML	105.9	12.8	**DISTURBED ALLUVIUM:** Brown fine sandy Silt, trace clay, loose, damp to moist
			■	3/3/4		SM	92.8	21.4	**ALLUVIUM:** Light brown silty fine Sand, loose damp
5			■	2/3/6		SM	98.5	6.8	**ALLUVIUM:** Same as above
			■	5/8/11		SW	96.8	5.2	**ALLUVIUM:** Light brown fine to coarse Sand, medium dense, dry to damp
10			■	5/9/17		SW	107.0	4.0	**ALLUVIUM**: Same as above
									Total Depth: 11.5 feet
									No Groundwater Encountered
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-13
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 4, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	5/4/4		ML	103.1	17.3	**DISTURBED ALLUVIUM:** Brown fine sandy Silt, little clay, loose, moist
			■	2/4/5		SM	95.5	26.3	**ALLUVIUM:** Brown silty fine Sand, trace clay, loose, damp
5			■	4/6/8		SM	98.5	6.8	ALLUVIUM: Same as above
									Total Depth: 6.5 feet
									No Groundwater Encountered
10									
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-14
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 4, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0						SM			**DISTURBED ALLUVIUM:** Dark brown silty fine Sand, loose, damp
5						SM	98.5	6.8	**ALLUVIUM:** Brown silty fine Sand, loose to medium dense, dry to damp
10, 15						SW			**ALLUVIUM:** Light brown fine to medium Sand, trace silt, loose to medium dense, dry to damp
						CL			**ALLUVIUM:** Gray silty Clay, stiff, moist
20	▼					ML			**ALLUVIUM:** Gray fine sandy Silt, medium dense, damp to moist
25						SP-SM			**ALLUVIUM:** Yellow brown fine to medium Sand, little silt, wet
30, 35									**Total Depth: 26.5 feet** **Groundwater Depth: 22.0 feet**

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-15
PROJECT NAME: Arctic Cold
PROJECT NUMBER: 303415-002
BORING LOCATION: Per Plan

DRILLING DATE: March 4, 2020
DRILL RIG: GTech 8
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: AL

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■	5/5/6		SM	110.4	9.3	**DISTURBED ALLUVIUM:** Dark brown silty fine Sand, loose, damp
			■	3/2/3		SM	92.9	11.4	**ALLUVIUM:** Light brown silty fine Sand, very loose, damp
5			■	3/3/5		SM	98.5	6.8	**ALLUVIUM**: Same as above. Becomes loose.
						CL			**ALLUVIUM:** Gray silty Clay, trace calcareous veining, stiff, moist
			■			SP	105.7	5.9	**ALLUVIUM:** Light Brown fine Sand, trace silt, medium dense, dry to damp
10			■	5/9/13		SW	99.9	3.3	**ALLUVIUM:** Light brown fine to medium Sand, little coarse sand, trace fine Gravel, medium dense, dry to damp
									Total Depth: 11.5 feet
									No Groundwater Encountered
15									
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

BORING LOG SYMBOLS

Modified California Split Barrel Sampler

Modified California Split Barrel Sampler - No Recovery

Standard Penetration Test (SPT) Sampler

Standard Penetration Test (SPT) Sampler - No Recovery

Perched Water Level

Water Level First Encountered

Water Level After Drilling

Pocket Penetrometer (tsf)

Vane Shear (ksf)

1. The location of borings were approximately determined by pacing and/or siting from visible features. Elevations of borings are approximately determined by interpolating between plan contours. The location and elevation of the borings should be considered.

2. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. This data has been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, tides, temperature, and other factors at the time measurements were made.

BORING LOG SYMBOLS

Earth Systems

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNTOF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

Earth Systems

Cone Penetrometer Test Logs
and
Interpretations

EARTH SYSTEMS PACIFIC

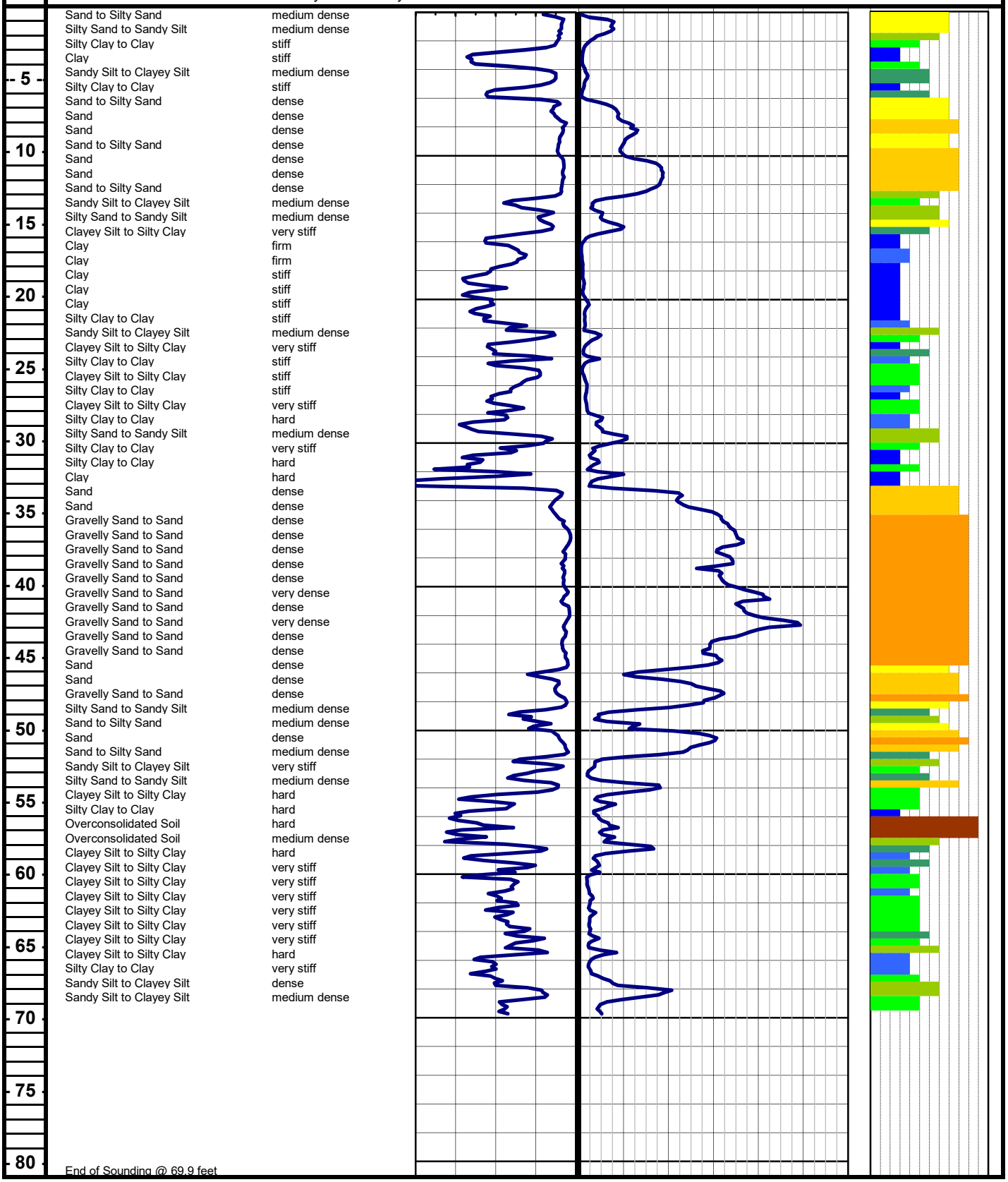
Earth Systems
Pacific

CPT No : CPT-1
Project Name: Arctic Cold
Project No.: 303415-002
Location: See Site Exploration Plan

Cone Penetrometer: **Kehoe Testing and Engineerin**
Truck Mounted Electric Cone
with 23-ton reaction weight
Date: 3/5/2020

Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
Sand to Silty Sand	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Clay to Clay	stiff
Clay	stiff
Sandy Silt to Clayey Silt	medium dense
Silty Clay to Clay	stiff
Sand to Silty Sand	dense
Sand	dense
Sand	dense
Sand to Silty Sand	dense
Sand	dense
Sand	dense
Sand to Silty Sand	dense
Sandy Silt to Clayey Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Clayey Silt to Silty Clay	very stiff
Clay	firm
Clay	firm
Clay	stiff
Clay	stiff
Clay	stiff
Silty Clay to Clay	stiff
Sandy Silt to Clayey Silt	medium dense
Clayey Silt to Silty Clay	very stiff
Silty Clay to Clay	stiff
Clayey Silt to Silty Clay	stiff
Silty Clay to Clay	stiff
Clayey Silt to Silty Clay	very stiff
Silty Clay to Clay	hard
Silty Sand to Sandy Silt	medium dense
Silty Clay to Clay	very stiff
Silty Clay to Clay	hard
Clay	hard
Sand	dense
Sand	dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	very dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	very dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	dense
Sand	dense
Sand	dense
Gravelly Sand to Sand	dense
Silty Sand to Sandy Silt	medium dense
Sand to Silty Sand	medium dense
Sand	dense
Sand to Silty Sand	medium dense
Sandy Silt to Clayey Silt	very stiff
Silty Sand to Sandy Silt	medium dense
Clayey Silt to Silty Clay	hard
Silty Clay to Clay	hard
Overconsolidated Soil	hard
Overconsolidated Soil	medium dense
Clayey Silt to Silty Clay	hard
Clayey Silt to Silty Clay	very stiff
Clayey Silt to Silty Clay	very stiff
Clayey Silt to Silty Clay	very stiff
Clayey Silt to Silty Clay	very stiff
Clayey Silt to Silty Clay	very stiff
Clayey Silt to Silty Clay	very stiff
Clayey Silt to Silty Clay	hard
Silty Clay to Clay	very stiff
Sandy Silt to Clayey Silt	dense
Sandy Silt to Clayey Silt	medium dense

End of Sounding @ 69.9 feet



Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold

Project No: 303415-002

Date: 03/05/20

CPT SOUNDING: CPT-1 Plot: 1 Density: 1 SPT N Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** Dr correlation: 0 Baldi Qc/N: 1.00 Robertson Phi Correlation: 4 SPT N

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17 Su (tsf)	OCR
0.15	0.5	55.18	0.77	Sand to Silty Sand	SP/SM	medium dense	100	4.0	14	0.01	0.01	0.77	0.57	1.70	88.7	1.88	104.0	23	21	25	72	34		
0.30	1.0	74.58	0.72	Sand to Silty Sand	SP/SM	dense	100	4.0	19	0.04	0.04	0.72	0.54	1.70	119.8	1.76	129.2	32	26	20	84	36		
0.46	1.5	56.07	0.82	Sand to Silty Sand	SP/SM	medium dense	100	4.0	14	0.06	0.06	0.82	0.58	1.70	90.1	1.89	106.6	24	21	25	72	34		
0.61	2.0	26.51	0.90	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	9	0.09	0.09	0.91	0.66	1.70	42.6	2.19	69.5	15	14	40	41	32		
0.76	2.5	12.42	1.67	Clayey Silt to Silty Clay	ML/CL	stiff	110	2.0	6	0.12	0.12	1.69	0.79	1.70	20.0	2.61		6		75			0.72	31.8
0.91	3.0	8.57	4.83	Clay	CL/CH	firm	110	1.0	9	0.14	0.14	4.91	0.91	1.70	13.8	3.01		9		100			0.50	17.6
1.07	3.5	7.92	5.15	Clay	CL/CH	firm	110	1.0	8	0.17	0.17	5.26	0.93	1.70	12.7	3.06		8		100			0.46	13.6
1.22	4.0	13.21	2.22	Clayey Silt to Silty Clay	ML/CL	stiff	110	2.0	7	0.20	0.20	2.25	0.81	1.70	21.2	2.66		7		80			0.77	19.6
1.37	4.5	18.81	1.00	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	8	0.23	0.23	1.02	0.71	1.70	30.2	2.34	62.7	13	13	55	27	31		
1.52	5.0	13.13	1.39	Sandy Silt to Clayey Silt	ML	loose	110	2.5	5	0.25	0.25	1.42	0.77	1.70	21.1	2.55	63.7	9	13	70	12	30		
1.68	5.5	8.22	3.88	Clay	CL/CH	firm	110	1.0	8	0.28	0.28	4.02	0.90	1.70	13.2	2.97		8		100			0.47	8.5
1.83	6.0	22.19	2.36	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	9	0.31	0.31	2.39	0.76	1.70	35.7	2.50	98.2	15	20	65	34	32		
1.98	6.5	72.97	1.01	Sand to Silty Sand	SP/SM	dense	100	4.0	18	0.34	0.34	1.01	0.57	1.70	117.2	1.86	135.3	31	27	25	83	36		
2.13	7.0	87.29	1.13	Sand to Silty Sand	SP/SM	dense	100	4.0	22	0.36	0.36	1.13	0.56	1.70	140.3	1.84	159.1	36	32	20	91	38		
2.29	7.5	98.67	0.72	Sand to Silty Sand	SP/SM	dense	100	4.0	25	0.39	0.39	0.72	0.51	1.67	156.1	1.67	159.0	40	32	15	95	38		
2.44	8.0	122.79	0.62	Sand	SP	dense	100	5.0	25	0.41	0.41	0.62	0.50	1.61	186.4	1.57	186.4	38	37	10	100	38		
2.59	8.5	119.18	0.72	Sand	SP	dense	100	5.0	24	0.44	0.44	0.73	0.50	1.56	175.7	1.63	175.7	36	35	15	100	38		
2.74	9.0	101.37	0.83	Sand to Silty Sand	SP/SM	dense	100	4.0	25	0.46	0.46	0.84	0.53	1.55	148.7	1.73	157.2	37	31	15	93	38		
2.90	9.5	93.30	0.90	Sand to Silty Sand	SP/SM	dense	100	4.0	23	0.49	0.49	0.91	0.54	1.53	134.9	1.78	147.7	33	30	20	89	37		
3.05	10.0	107.79	0.78	Sand	SP	dense	100	5.0	22	0.51	0.51	0.79	0.52	1.46	149.2	1.71	155.9	30	31	15	93	36		
3.20	10.5	168.04	0.61	Sand	SP	dense	100	5.0	34	0.54	0.54	0.61	0.50	1.41	223.4	1.51	223.4	46	45	10	100	40		
3.35	11.0	185.29	0.64	Sand	SP	dense	100	5.0	37	0.56	0.56	0.64	0.50	1.37	240.7	1.50	240.7	50	48	10	100	40		
3.51	11.5	185.88	0.64	Sand	SP	dense	100	5.0	37	0.59	0.59	0.64	0.50	1.34	236.3	1.50	236.3	49	47	10	100	40		
3.66	12.0	178.22	0.69	Sand	SP	dense	100	5.0	36	0.61	0.61	0.69	0.50	1.32	221.8	1.55	221.8	46	44	10	100	40		
3.81	12.5	146.49	0.74	Sand	SP	dense	100	5.0	29	0.64	0.64	0.74	0.50	1.29	178.7	1.64	178.7	37	36	15	100	38		
3.96	13.0	65.86	2.06	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	22	0.66	0.66	2.08	0.66	1.37	85.0	2.18	137.1	27	27	40	70	35		
4.11	13.5	29.59	3.09	Clayey Silt to Silty Clay	ML/CL	medium dense	110	2.0	15	0.69	0.69	3.16	0.77	1.39	39.0	2.55	117.8	18	24	70	38	33		
4.27	14.0	47.15	1.47	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	16	0.72	0.72	1.50	0.67	1.30	57.9	2.20	97.2	19	19	45	54	33		
4.42	14.5	56.21	1.75	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	19	0.74	0.74	1.78	0.67	1.27	67.3	2.20	112.8	22	23	45	60	34		
4.57	15.0	93.10	1.20	Sand to Silty Sand	SP/SM	medium dense	100	4.0	23	0.77	0.77	1.21	0.59	1.21	106.2	1.94	131.1	27	26	25	79	35		
4.72	15.5	45.25	2.65	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	18	0.80	0.80	2.70	0.73	1.23	52.7	2.41	122.9	20	25	60	50	33		
4.88	16.0	10.50	4.22	Clay	CL/CH	stiff	110	1.0	10	0.82	0.82	4.58	0.92	1.26	12.5	3.03		10		100			0.57	3.5
5.03	16.5	5.82	2.95	Clay	CL/CH	firm	110	1.0	6	0.85	0.85	3.45	0.98	1.24	6.8	3.17		6		100			0.29	1.8
5.18	17.0	7.21	2.65	Silty Clay to Clay	CL	firm	120	1.5	5	0.88	0.88	3.02	0.94	1.19	8.1	3.07		5		100			0.37	2.2
5.33	17.5	8.90	3.34	Silty Clay to Clay	CL	firm	120	1.5	6	0.91	0.91	3.72	0.94	1.15	9.7	3.06		6		100			0.47	2.6
5.49	18.0	9.13	4.32	Clay	CL/CH	firm	120	1.0	9	0.94	0.94	4.82	0.96	1.12	9.7	3.13		9		100			0.48	2.6
5.64	18.5	9.93	5.43	Clay	CL/CH	stiff	120	1.0	10	0.97	0.97	6.02	0.97	1.09	10.2	3.17		10		100			0.53	2.8
5.79	19.0	11.45	4.46	Clay	CL/CH	stiff	120	1.0	11	1.00	1.00	4.89	0.94	1.05	11.4	3.08		11		100			0.61	3.1
5.94	19.5	9.49	5.12	Clay	CL/CH	firm	120	1.0	9	1.03	1.03	5.75	0.98	1.03	9.2	3.19		9		100			0.50	2.5
6.10	20.0	16.85	4.50	Clay	CL/CH	stiff	120	1.0	17	1.06	1.06	4.80	0.90	1.00	15.9	2.96		17		100			0.93	4.5
6.25	20.5	19.16	4.54	Clay	CL/CH	very stiff	120	1.0	19	1.09	1.07	4.82	0.89	0.99	17.9	2.92		19		100			1.06	5.0
6.40	21.0	13.39	4.86	Clay	CL/CH	stiff	120	1.0	13	1.12	1.09	5.31	0.94	0.97	12.3	3.07		13		100			0.72	3.4
6.55	21.5	13.74	4.24	Clay	CL/CH	stiff	120	1.0	14	1.15	1.10	4.63	0.93	0.96	12.5	3.03		14		100			0.74	3.4
6.71	22.0	12.83	3.09	Silty Clay to Clay	CL	stiff	120	1.5	9	1.18	1.12	3.40	0.91	0.95	11.5	2.98		9		100			0.69	3.1
6.86	22.5	42.87	1.24	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	14	1.21	1.13	1.28	0.70	0.95	38.6	2.30	75.8	13	15	50	37	31		
7.01	23.0	23.41	3.28	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	12	1.24	1.15	3.47	0.85	0.93	20.7	2.78		12		95			1.31	5.8
7.16	23.5	11.53	4.20	Clay	CL/CH	stiff	120	1.0	12	1.27	1.16	4.72	0.95	0.92	10.0	3.11		12		100			0.61	2.7
7.32	24.0	25.41	2.51	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	10	1.30	1.18	2.65	0.82	0.92	22.0	2.69		10		85			1.43	6.2
7.47	24.5	15.40	3.84	Silty Clay to Clay	CL	stiff	120	1.5	10	1.33	1.19	4.20	0.91	0.90	13.1	2.99		10		100			0.84	3.5
7.62	25.0	8.21	2.08	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	4	1.36	1.20	2.49	0.95	0.88	6.9	3.09		4		100			0.41	1.7
7.77	25.5	12.83	2.05	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.39	1.22	2.30	0.89	0.88	10.7	2.91		6		100			0.68	2.8
7.92	26.0	17.64	2.84	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	9	1.42	1.23	3.09	0.88	0.87	14.6	2.87		9		100			0.96	3.9
8.08	26.5	16.58	3.65	Silty Clay to Clay	CL	stiff	120	1.5	11	1.45	1.25	4.00	0.91	0.86	13.5	2.97		11		100			0.90	3.6
8.23	27.0	16.02	4.23	Clay	CL/CH	stiff	120	1.0	16	1.48	1.26	4.66	0.92	0.85	12.9	3.02		16		100			0.87	3.5
8.38	27.5	18.41	3.05	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	9	1.51	1.28	3.33	0.88	0.85	14.8	2.89		9		100			1.01	4.0
8.53	28.0	37.34	3.77	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	19	1.54	1.29	3.93	0.82	0.85	30.0	2.70		19		85			2.12	8.3
8.69	28.5	42.92	4.85	Silty Clay to Clay	CL	hard	120	1.5	29	1.57	1.30	5.03	0.83	0.84	34.1	2.73		29		90			2.45	9.5
8.84	29.0	50.79	5.17	Silty Clay to Clay	CL	hard	120	1.5	34	1.60	1.32	5.33	0.82	0.83	40.1	2.70		34		85			2.91	11.2
8.99	29.5	97.25	2.03	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	32	1.63	1.33	2.06	0.67	0.86	78.7	2.20	130.8	28	26	45	67	36		
9.14	30.0	69.59	1.85	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	23	1.66	1.35	1.89	0.70	0.84	55.6	2.28	105.6	20	21	50	52	33		
9.30	30.5	32.22	3.34	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	16	1.69	1.36	3.53	0.83	0.81	24.7	2.73		16		90			1.81	6.7
9.45	31.0	31.02	5.15	Clay	CL/CH	very stiff	120	1.0	31	1.72	1.38	5.45	0.87	0.79	23.3	2.87		31		100			1.74	6.4
9.60	31.5	34.44	5.17	Clay	CL/CH	very stiff	120	1.0	34	1.75	1.39	5.45	0.86	0.79	25.7	2.84		34		100			1.94	7.1
9.75	32.0	54.03	4.43	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	27	1.78	1.41	4.58	0.80	0.80	40.6	2.65		27		80			3.10	11.2
9.91	32.5	48.07	6.39	Clay	CL/CH	hard	120	1.0	48	1.81	1.42	6.64	0.85	0.78	35.4	2.80		48		100			2.74	9.8
10.06	33.0	40.86	6.33	Clay	CL/CH	hard	120	1.0	41	1.84	1.43	6.63	0.87	0.77	29.7	2.86		41		100			2.32	8.2
10.21	33.5	207.19	0.80	Sand	SP	dense	120	5.0	41	1.87	1.45	0.80	0.51	0.85	166.7	1.68	170.7	34	34	15	98	37		
10.36	34.0	221.27	1.01	Sand	SP	dense	120	5.0	44	1.90	1.46	1.01	0.53	0.84	176.2	1.73	186.7	37	37	15	100	38		
10.52	34.5	250.02	1.24	Sand	SP	dense	120	5.0	50	1.93	1.48	1.25	0.54	0.84	197.4	1.76	213.5	41	43	20	100	39		
10.67	35.0	308.00	1.03	Sand	SP	very dense	120	5.0	62	1.96	1.49	1.04	0.50	0.84	245.0	1.64	244.3	50	49	15	100	41		
10.82	35.5	323.68	0.69	Gravelly Sand to Sand	SW	dense	120	6.0	54	1.99	1.51	0.69	0.50	0.84	256.4	1.50	256.4	44	51	10	100	39		
10.97	36.0	340.57	0.47	Gravelly Sand to Sand	SW	dense	120	6.0	57	2.02	1.52	0.47	0.50	0.83	268.5	1.37	268.5	46	54	5	100	40		
11.13	36.5	355.03	0.28	Gravelly Sand to Sand	SW	dense	120	6.0	59	2.05	1.54	0.28	0.50	0.83	278.6	1.23	278.6	48	56	0	100	40		
11.28	37.0	345.44	0.41	Gravelly Sand to Sand	SW	dense	120	6.0	58	2.08	1.55	0.41	0.50	0.83	269.8	1.33	269.8	46	54	5	100	40		

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 303415-002 | Date: 03/05/20

CPT SOUNDING: CPT-1 | Plot: 1 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N

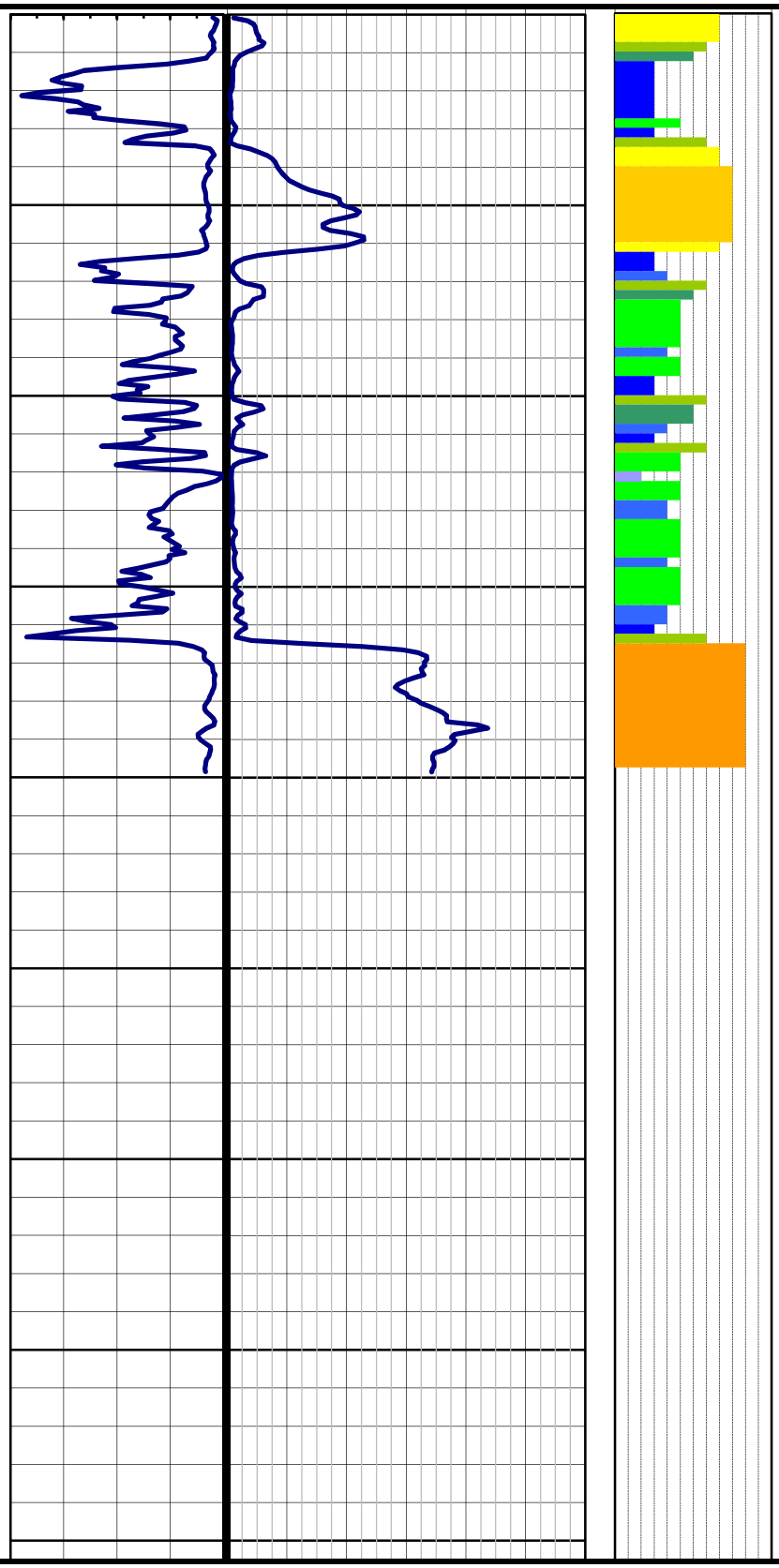
Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17 Su (tsf)	OCR
11.43	37.5	312.61	0.57	Gravelly Sand to Sand	SW	dense	120	6.0	52	2.11	1.56	0.57	0.50	0.82	243.0	1.46	243.0	42	49	5	100	39		
11.58	38.0	339.99	0.56	Gravelly Sand to Sand	SW	dense	120	6.0	57	2.14	1.58	0.56	0.50	0.82	263.1	1.43	263.1	45	53	5	100	40		
11.73	38.5	303.76	0.67	Gravelly Sand to Sand	SW	dense	120	6.0	51	2.17	1.59	0.67	0.50	0.82	234.0	1.52	234.0	40	47	10	100	38		
11.89	39.0	314.48	0.58	Gravelly Sand to Sand	SW	dense	120	6.0	52	2.20	1.61	0.58	0.50	0.81	241.2	1.47	241.2	41	48	5	100	39		
12.04	39.5	320.47	0.62	Gravelly Sand to Sand	SW	dense	120	6.0	53	2.23	1.62	0.62	0.50	0.81	244.7	1.48	244.7	42	49	10	100	39		
12.19	40.0	351.31	0.55	Gravelly Sand to Sand	SW	dense	120	6.0	59	2.26	1.64	0.56	0.50	0.80	267.0	1.42	267.0	46	53	5	100	40		
12.34	40.5	404.75	0.48	Gravelly Sand to Sand	SW	very dense	120	6.0	67	2.29	1.65	0.48	0.50	0.80	306.3	1.34	306.3	53	61	5	100	41		
12.50	41.0	379.94	0.68	Gravelly Sand to Sand	SW	dense	120	6.0	63	2.32	1.66	0.68	0.50	0.80	286.3	1.46	286.3	49	57	5	100	40		
12.65	41.5	364.73	0.35	Gravelly Sand to Sand	SW	dense	120	6.0	61	2.35	1.68	0.35	0.50	0.79	273.6	1.28	273.6	47	55	0	100	40		
12.80	42.0	392.34	0.34	Gravelly Sand to Sand	SW	very dense	120	6.0	65	2.38	1.69	0.34	0.50	0.79	293.1	1.25	293.1	50	59	0	100	41		
12.95	42.5	478.92	0.51	Gravelly Sand to Sand	SW	very dense	120	6.0	80	2.41	1.71	0.51	0.50	0.79	356.3	1.31	356.3	61	71	5	100	43		
13.11	43.0	401.50	0.56	Gravelly Sand to Sand	SW	very dense	120	6.0	67	2.44	1.72	0.56	0.50	0.78	297.4	1.39	297.4	51	59	5	100	41		
13.26	43.5	343.02	0.57	Gravelly Sand to Sand	SW	dense	120	6.0	57	2.47	1.74	0.57	0.50	0.78	253.0	1.45	253.0	43	51	5	100	39		
13.41	44.0	293.56	0.68	Gravelly Sand to Sand	SW	dense	120	6.0	49	2.50	1.75	0.69	0.50	0.78	215.7	1.55	215.7	37	43	10	100	38		
13.56	44.5	281.69	0.59	Gravelly Sand to Sand	SW	dense	120	6.0	47	2.53	1.77	0.59	0.50	0.77	206.1	1.52	206.1	35	41	10	100	37		
13.72	45.0	311.15	0.49	Gravelly Sand to Sand	SW	dense	120	6.0	52	2.56	1.78	0.50	0.50	0.77	226.7	1.44	226.7	39	45	5	100	38		
13.87	45.5	281.91	0.42	Gravelly Sand to Sand	SW	dense	120	6.0	47	2.59	1.79	0.43	0.50	0.77	204.6	1.44	204.6	35	41	5	100	37		
14.02	46.0	139.91	1.65	Sand to Silty Sand	SP/SM	medium dense	120	4.0	35	2.62	1.81	1.68	0.63	0.71	94.1	2.08	133.8	26	27	35	74	35		
14.17	46.5	179.81	1.29	Sand	SP	medium dense	120	5.0	36	2.65	1.82	1.31	0.59	0.73	123.5	1.92	149.4	27	30	25	86	35		
14.33	47.0	278.59	0.98	Sand	SP	dense	120	5.0	56	2.68	1.84	0.99	0.52	0.75	198.0	1.69	203.9	41	41	15	100	39		
14.48	47.5	312.18	0.78	Sand	SP	dense	120	5.0	62	2.71	1.85	0.78	0.50	0.76	223.0	1.58	223.0	46	45	10	100	40		
14.63	48.0	267.47	0.49	Gravelly Sand to Sand	SW	dense	120	6.0	45	2.74	1.87	0.49	0.50	0.75	190.3	1.50	190.3	33	38	10	100	37		
14.78	48.5	132.99	1.69	Sand to Silty Sand	SP/SM	medium dense	120	4.0	33	2.77	1.88	1.73	0.64	0.69	86.7	2.11	128.5	24	26	35	71	34		
14.94	49.0	41.50	2.73	Sandy Silt to Clayey Silt	ML	hard	120	2.5	17	2.80	1.90	2.93	0.82	0.62	24.4	2.68		17		85			2.33	6.1
15.09	49.5	106.14	1.76	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	35	2.83	1.91	1.81	0.67	0.67	67.4	2.21	113.8	26	23	45	60	35		
15.24	50.0	197.30	1.54	Sand to Silty Sand	SP/SM	dense	120	4.0	49	2.86	1.92	1.57	0.60	0.70	130.4	1.96	163.0	36	33	30	88	37		
15.39	50.5	300.91	0.83	Sand	SP	dense	120	5.0	60	2.89	1.94	0.84	0.50	0.74	210.1	1.62	210.1	43	42	10	100	39		
15.54	51.0	269.28	0.57	Gravelly Sand to Sand	SW	dense	120	6.0	45	2.92	1.95	0.58	0.50	0.74	187.3	1.55	187.3	32	37	10	100	37		
15.70	51.5	217.77	0.47	Sand	SP	dense	120	5.0	44	2.95	1.97	0.48	0.50	0.73	150.9	1.57	150.9	31	30	10	94	36		
15.85	52.0	64.09	2.47	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	26	2.98	1.98	2.59	0.76	0.62	37.5	2.50	104.3	18	21	65	36	33		
16.00	52.5	33.45	1.03	Silty Sand to Sandy Silt	SM/ML	loose	120	3.0	11	3.01	2.00	1.13	0.77	0.61	19.3	2.53	56.3	8	11	70	9	29		
16.15	53.0	20.18	2.51	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	10	3.04	2.01	2.96	0.91	0.56	10.6	2.97		10		100			1.07	2.6
16.31	53.5	61.47	2.41	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	25	3.07	2.02	2.54	0.77	0.61	35.3	2.52	100.8	17	20	70	34	32		
16.46	54.0	172.23	0.99	Sand	SP	medium dense	120	5.0	34	3.10	2.04	1.01	0.57	0.69	111.7	1.88	130.4	24	26	25	81	34		
16.61	54.5	72.17	3.69	Clayey Silt to Silty Clay	ML/CL	medium dense	120	2.0	36	3.13	2.05	3.86	0.79	0.59	40.4	2.60	133.3	25	27	75	39	35		
16.76	55.0	55.74	4.36	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	28	3.16	2.07	4.62	0.83	0.57	30.1	2.74		28		90			3.16	7.6
16.92	55.5	49.95	4.03	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	25	3.19	2.08	4.31	0.84	0.57	26.7	2.76		25		95			2.82	6.7
17.07	56.0	40.74	6.03	Clay	CL/CH	hard	120	1.0	41	3.22	2.10	6.54	0.90	0.54	20.8	2.96		41		100			2.27	5.4
17.22	56.5	62.26	5.16	Overconsolidated Soil	??	hard	120	6.0	10	3.25	2.11	5.44	0.84	0.56	32.9	2.76		10		95			3.54	8.4
17.37	57.0	63.15	5.10	Overconsolidated Soil	??	hard	120	6.0	11	3.28	2.13	5.38	0.84	0.56	33.2	2.76		11		95			3.59	8.4
17.53	57.5	62.88	5.70	Overconsolidated Soil	??	hard	120	6.0	10	3.31	2.14	6.02	0.85	0.55	32.6	2.80		10		95			3.57	8.4
17.68	58.0	144.77	2.45	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	48	3.34	2.15	2.51	0.68	0.62	84.3	2.24	148.6	33	30	45	70	37		
17.83	58.5	68.78	3.44	Sandy Silt to Clayey Silt	ML	hard	120	2.5	28	3.37	2.17	3.62	0.79	0.57	36.8	2.61		28		75			3.92	9.0
17.98	59.0	38.31	4.43	Silty Clay to Clay	CL	hard	120	1.5	26	3.40	2.18	4.86	0.89	0.53	19.1	2.90		26		100			2.13	4.8
18.14	59.5	37.76	2.79	Sandy Silt to Clayey Silt	ML	hard	120	2.5	15	3.43	2.20	3.06	0.85	0.54	19.2	2.77		15		95			2.09	4.7
18.29	60.0	30.39	4.43	Silty Clay to Clay	CL	very stiff	120	1.5	20	3.46	2.21	5.00	0.92	0.51	14.6	3.00		20		100			1.66	3.7
18.44	60.5	18.62	3.09	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	9	3.49	2.23	3.80	0.95	0.49	8.7	3.11		9		100			0.96	2.0
18.59	61.0	21.68	3.31	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	11	3.52	2.24	3.95	0.94	0.49	10.1	3.06		11		100			1.14	2.4
18.75	61.5	28.48	4.02	Silty Clay to Clay	CL	very stiff	120	1.5	19	3.55	2.26	4.59	0.92	0.50	13.4	3.00		19		100			1.54	3.3
18.90	62.0	24.89	3.27	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	12	3.58	2.27	3.82	0.92	0.50	11.7	3.00		12		100			1.33	2.8
19.05	62.5	28.12	3.84	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	14	3.61	2.28	4.40	0.92	0.49	13.1	3.00		14		100			1.52	3.2
19.20	63.0	26.83	3.75	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	3.64	2.30	4.34	0.92	0.49	12.4	3.02		13		100			1.44	3.0
19.35	63.5	23.48	3.38	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	12	3.67	2.31	4.01	0.93	0.48	10.7	3.05		12		100			1.24	2.6
19.51	64.0	24.92	2.80	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	12	3.70	2.33	3.29	0.91	0.49	11.5	2.97		12		100			1.33	2.7
19.66	64.5	35.98	2.22	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	14	3.73	2.34	2.47	0.84	0.51	17.4	2.75		14		90			1.98	4.1
19.81	65.0	22.45	3.27	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	11	3.76	2.36	3.93	0.94	0.47	10.0	3.06		11		100			1.18	2.4
19.96	65.5	62.42	2.12	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	21	3.79	2.37	2.25	0.77	0.54	31.7	2.52	91.0	14	18	70	29	31		
20.12	66.0	29.47	4.66	Silty Clay to Clay	CL	very stiff	120	1.5	20	3.82	2.38	5.35	0.93	0.47	13.0	3.06		20		100			1.59	3.2
20.27	66.5	22.53	4.06	Silty Clay to Clay	CL	very stiff	120	1.5	15	3.85	2.40	4.89	0.96	0.46	9.7	3.13		15		100			1.18	2.3
20.42	67.0	32.80	4.68	Silty Clay to Clay	CL	very stiff	120	1.5	22	3.88	2.41	5.30	0.92	0.47	14.5	3.02		22		100			1.79	3.6
20.57	67.5	66.42	3.92	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	33	3.91	2.43	4.16	0.82	0.51	31.7	2.69		33		85			3.76	7.7
20.73	68.0	159.68	2.44	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	53	3.94	2.44	2.50	0.68	0.57	85.4	2.23	149.6	34	30	45	70	37		
20.88	68.5	136.10	1.87	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	45	3.97	2.46	1.92	0.67	0.57	73.0	2.20	121.8	29	24	45	64	36		
21.03	69.0	51.59	3.66	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	26	4.00	2.47	3.96	0.85	0.49	23.8	2.77		26		95			2.89	5.8
21.18	69.5	46.35	3.60	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	23	4.03	2.49	3.94	0.86	0.48	21.1	2.81		23		100			2.58	5.1

Earth Systems
Pacific

CPT No : CPT-2
Project Name: Arctic Cold
Project No.: 303415-002
Location: See Site Exploration Plan

Cone Penetrometer: **Kehoe Testing and Engineerin**
Truck Mounted Electric Cone
with 23-ton reaction weight
Date: 3/5/2020

DEPTH (FEET)	Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
	Sand to Silty Sand	medium dense
	Sand to Silty Sand	medium dense
	Silty Clay to Clay	stiff
	Clay	firm
5	Clay	firm
	Silty Clay to Clay	stiff
	Sandy Silt to Clayey Silt	medium dense
	Sand to Silty Sand	dense
	Sand	dense
10	Sand	very dense
	Sand	very dense
	Sand	very dense
	Sandy Silt to Clayey Silt	medium dense
	Silty Clay to Clay	stiff
15	Silty Sand to Sandy Silt	medium dense
	Clayey Silt to Silty Clay	stiff
	Clayey Silt to Silty Clay	firm
	Clayey Silt to Silty Clay	firm
	Clayey Silt to Silty Clay	stiff
20	Clay	firm
	Sandy Silt to Clayey Silt	medium dense
	Clayey Silt to Silty Clay	stiff
	Sandy Silt to Clayey Silt	very stiff
	Clayey Silt to Silty Clay	stiff
25	Sensitive fine grained	firm
	Clayey Silt to Silty Clay	firm
	Clayey Silt to Silty Clay	stiff
	Clayey Silt to Silty Clay	stiff
	Clayey Silt to Silty Clay	stiff
30	Clayey Silt to Silty Clay	stiff
	Clayey Silt to Silty Clay	stiff
	Silty Clay to Clay	very stiff
	Clayey Silt to Silty Clay	dense
	Gravelly Sand to Sand	dense
35	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	very dense
	Gravelly Sand to Sand	dense
40		
45		
50		
55		
60		
65		
70		
75		
80	End of Sounding @ 39.9 feet	



Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold

Project No: 303415-002

Date: 03/05/20

CPT SOUNDING: CPT-2 Plot: 2 Density: 1 SPT N Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** Dr correlation: 0 Baldi Qc/N: 1.00 Robertson Phi Correlation: 4 SPT N

Nk: 17

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
0.15	0.5	41.98	0.28	Sand to Silty Sand	SP/SM	medium dense	100	4.0	10	0.01	0.01	0.28	0.54	1.70	67.5	1.77	67.5	18	13	20	60	33		
0.30	1.0	50.12	0.44	Sand to Silty Sand	SP/SM	medium dense	100	4.0	13	0.04	0.04	0.44	0.54	1.70	80.5	1.79	80.5	21	16	20	68	34		
0.46	1.5	57.53	0.39	Sand to Silty Sand	SP/SM	medium dense	100	4.0	14	0.06	0.06	0.39	0.52	1.70	92.4	1.71	92.4	24	18	15	74	35		
0.61	2.0	32.58	0.45	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	11	0.09	0.09	0.45	0.60	1.70	52.3	1.96	52.3	18	10	30	50	33		
0.76	2.5	13.86	1.36	Sandy Silt to Clayey Silt	ML	loose	110	2.5	6	0.12	0.12	1.37	0.76	1.70	22.3	2.52	63.8	9	13	70	15	30		
0.91	3.0	9.34	4.94	Clay	CL/CH	stiff	110	1.0	9	0.14	0.14	5.02	0.91	1.70	15.0	2.99		9		100			0.54	19.2
1.07	3.5	9.25	6.19	Clay	CL/CH	stiff	110	1.0	9	0.17	0.17	6.31	0.93	1.70	14.9	3.06		9		100			0.53	15.9
1.22	4.0	6.92	5.85	Clay	CL/CH	firm	110	1.0	7	0.20	0.20	6.03	0.95	1.70	11.1	3.14		7		100			0.40	10.1
1.37	4.5	5.44	6.45	Clay	CL/CH	firm	110	1.0	5	0.23	0.23	6.73	0.99	1.70	8.7	3.25		5		100			0.31	6.9
1.52	5.0	6.21	5.26	Clay	CL/CH	firm	110	1.0	6	0.25	0.25	5.48	0.96	1.70	10.0	3.15		6		100			0.35	7.0
1.68	5.5	7.29	3.99	Clay	CL/CH	firm	110	1.0	7	0.28	0.28	4.15	0.92	1.70	11.7	3.02		7		100			0.41	7.5
1.83	6.0	12.51	1.60	Clayey Silt to Silty Clay	ML/CL	medium dense	110	2.0	6	0.31	0.31	1.64	0.79	1.70	20.1	2.60	66.7	11	13	75	10	30		
1.98	6.5	6.07	3.34	Clay	CL/CH	firm	110	1.0	6	0.34	0.34	3.53	0.93	1.70	9.8	3.05		6		100			0.34	5.1
2.13	7.0	36.98	0.68	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	12	0.36	0.36	0.69	0.61	1.70	59.4	2.00	77.1	20	15	30	55	33		
2.29	7.5	73.80	0.45	Sand to Silty Sand	SP/SM	medium dense	100	4.0	18	0.39	0.39	0.45	0.51	1.66	115.5	1.66	115.5	30	23	15	83	36		
2.44	8.0	85.41	0.55	Sand to Silty Sand	SP/SM	dense	100	4.0	21	0.42	0.42	0.56	0.51	1.61	129.9	1.66	131.7	33	26	15	88	37		
2.59	8.5	98.47	0.65	Sand	SP	medium dense	100	5.0	20	0.44	0.44	0.65	0.51	1.56	145.5	1.67	147.6	30	30	15	92	36		
2.74	9.0	125.57	0.73	Sand	SP	dense	100	5.0	25	0.47	0.47	0.74	0.50	1.51	179.0	1.63	179.0	37	36	15	100	38		
2.90	9.5	173.16	0.67	Sand	SP	dense	100	5.0	35	0.49	0.49	0.67	0.50	1.47	240.5	1.51	240.5	49	48	10	100	40		
3.05	10.0	198.36	0.58	Sand	SP	very dense	100	5.0	40	0.52	0.52	0.59	0.50	1.43	268.7	1.44	268.7	55	54	5	100	42		
3.20	10.5	210.82	0.57	Sand	SP	very dense	100	5.0	42	0.54	0.54	0.57	0.50	1.40	278.9	1.41	278.9	57	56	5	100	42		
3.35	11.0	164.32	0.59	Sand	SP	dense	100	5.0	33	0.57	0.57	0.59	0.50	1.37	212.5	1.51	212.5	44	43	10	100	39		
3.51	11.5	202.90	0.77	Sand	SP	very dense	100	5.0	41	0.59	0.59	0.78	0.50	1.34	256.8	1.53	256.8	53	51	10	100	41		
3.66	12.0	212.30	0.65	Sand	SP	very dense	100	5.0	42	0.62	0.62	0.65	0.50	1.31	263.2	1.47	263.2	54	53	5	100	41		
3.81	12.5	98.94	1.10	Sand to Silty Sand	SP/SM	dense	100	4.0	25	0.64	0.64	1.11	0.57	1.33	124.6	1.87	144.5	31	29	25	86	36		
3.96	13.0	17.71	4.45	Clay	CL/CH	very stiff	110	1.0	18	0.67	0.67	4.63	0.85	1.48	24.8	2.80		18		100			1.00	7.7
4.11	13.5	10.07	4.33	Clay	CL/CH	stiff	110	1.0	10	0.69	0.69	4.65	0.91	1.47	14.0	2.99		10		100			0.55	4.1
4.27	14.0	23.46	3.93	Silty Clay to Clay	CL	very stiff	110	1.5	16	0.72	0.72	4.06	0.82	1.37	30.4	2.70		16		85			1.34	9.5
4.42	14.5	59.89	1.28	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	20	0.75	0.75	1.30	0.64	1.25	70.6	2.10	102.6	23	21	35	62	34		
4.57	15.0	48.12	2.07	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	19	0.78	0.78	2.11	0.70	1.24	56.5	2.31	111.9	22	22	50	53	34		
4.72	15.5	23.53	3.66	Clayey Silt to Silty Clay	ML/CL	very stiff	110	2.0	12	0.80	0.80	3.79	0.82	1.25	27.9	2.71		12		85			1.34	8.5
4.88	16.0	9.17	2.36	Clayey Silt to Silty Clay	ML/CL	firm	110	2.0	5	0.83	0.83	2.59	0.90	1.24	10.8	2.94		5		100			0.49	3.0
5.03	16.5	8.12	1.67	Clayey Silt to Silty Clay	ML/CL	firm	110	2.0	4	0.86	0.86	1.87	0.90	1.21	9.3	2.91		4		100			0.43	2.5
5.18	17.0	8.90	1.77	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	4	0.89	0.89	1.96	0.89	1.17	9.8	2.90		4		100			0.47	2.7
5.33	17.5	7.54	1.72	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	4	0.92	0.92	1.95	0.91	1.14	8.1	2.97		4		100			0.39	2.2
5.49	18.0	9.23	2.85	Silty Clay to Clay	CL	firm	120	1.5	6	0.95	0.95	3.18	0.93	1.11	9.7	3.02		6		100			0.49	2.6
5.64	18.5	16.11	2.31	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	8	0.98	0.98	2.46	0.85	1.07	16.3	2.77		8		95			0.89	4.6
5.79	19.0	12.39	2.66	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.01	1.01	2.90	0.89	1.04	12.2	2.92		6		100			0.67	3.4
5.94	19.5	7.74	3.34	Clay	CL/CH	firm	120	1.0	8	1.04	1.04	3.85	0.97	1.02	7.5	3.16		8		100			0.39	1.9
6.10	20.0	9.21	3.73	Clay	CL/CH	firm	120	1.0	9	1.07	1.07	4.21	0.96	0.99	8.6	3.13		9		100			0.48	2.3
6.25	20.5	49.15	1.19	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	16	1.10	1.08	1.22	0.68	0.98	45.8	2.23	79.9	16	16	45	44	32		
6.40	21.0	28.69	2.60	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	11	1.13	1.10	2.71	0.80	0.97	26.4	2.63		11		80			1.62	7.5
6.55	21.5	20.82	1.48	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	8	1.16	1.11	1.57	0.80	0.96	18.9	2.61		8		75			1.16	5.3
6.71	22.0	10.63	2.77	Silty Clay to Clay	CL	stiff	120	1.5	7	1.19	1.13	3.12	0.93	0.94	9.5	3.03		7		100			0.56	2.5
6.86	22.5	7.85	3.52	Clay	CL/CH	firm	120	1.0	8	1.22	1.14	4.17	0.99	0.93	6.9	3.21		8		100			0.39	1.7
7.01	23.0	43.54	1.31	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	15	1.25	1.15	1.35	0.71	0.94	38.7	2.32	77.4	14	15	50	37	31		
7.16	23.5	25.33	2.77	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	1.28	1.17	2.92	0.83	0.92	22.1	2.71		13		90			1.42	6.2
7.32	24.0	7.70	1.28	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	4	1.31	1.18	1.54	0.93	0.90	6.6	3.00		4		100			0.38	1.6
7.47	24.5	7.15	0.33	Sensitive fine grained	ML	firm	120	2.0	4	1.34	1.20	0.40	0.87	0.90	6.1	2.81		4		100			0.35	1.5
7.62	25.0	8.38	1.41	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	4	1.37	1.21	1.68	0.93	0.88	7.0	3.00		4		100			0.42	1.7
7.77	25.5	8.78	1.99	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	4	1.40	1.23	2.37	0.94	0.87	7.2	3.06		4		100			0.44	1.8
7.92	26.0	8.97	2.41	Silty Clay to Clay	CL	firm	120	1.5	6	1.43	1.24	2.87	0.95	0.86	7.3	3.10		6		100			0.45	1.8
8.08	26.5	8.04	2.64	Silty Clay to Clay	CL	firm	120	1.5	5	1.46	1.25	3.23	0.98	0.85	6.4	3.17		5		100			0.40	1.6
8.23	27.0	12.42	2.25	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.49	1.27	2.56	0.91	0.85	10.0	2.96		6		100			0.66	2.6
8.38	27.5	9.49	2.04	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	5	1.52	1.28	2.43	0.94	0.83	7.5	3.05		5		100			0.48	1.9
8.53	28.0	11.86	1.68	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.55	1.30	1.93	0.90	0.83	9.3	2.92		6		100			0.62	2.4
8.69	28.5	11.71	2.08	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.58	1.31	2.40	0.91	0.82	9.1	2.98		6		100			0.61	2.3
8.84	29.0	13.60	3.23	Silty Clay to Clay	CL	stiff	120	1.5	9	1.61	1.33	3.66	0.93	0.81	10.4	3.03		9		100			0.72	2.7
8.99	29.5	20.14	3.25	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	10	1.64	1.34	3.53	0.88	0.81	15.4	2.89		10		100			1.11	4.1
9.14	30.0	14.65	3.13	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	7	1.67	1.36	3.54	0.92	0.80	11.0	3.00		7		100			0.78	2.9
9.30	30.5	18.12	2.54	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	9	1.70	1.37	2.80	0.88	0.80	13.7	2.87		9		100			0.99	3.6
9.45	31.0	17.32	2.93	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	9	1.73	1.38	3.26	0.90	0.79	12.9	2.93		9		100			0.94	3.4
9.60	31.5	19.00	3.96	Silty Clay to Clay	CL	very stiff	120	1.5	13	1.76	1.40	4.37	0.91	0.78	13.9	2.98		13		100			1.04	3.7
9.75	32.0	27.41	4.49	Silty Clay to Clay	CL	very stiff	120	1.5	18	1.79	1.41	4.81	0.88	0.78	20.1	2.88		18		100			1.53	5.4
9.91	32.5	17.92	6.46	Clay	CL/CH	stiff	120	1.0	18	1.82	1.43	7.19	0.96	0.75	12.7	3.15		18		100			0.97	3.4
10.06	33.0	131.11	2.12	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	44	1.85	1.44	2.15	0.65	0.82	101.4	2.13	154.1	36	31	40	77	38		
10.21	33.5	316.40	0.76	Gravelly Sand to Sand	SW	dense	120	6.0	53	1.88	1.46	0.76	0.50	0.85	254.9	1.53	254.9	44	51	10	100	39		
10.36	34.0	331.99	0.57	Gravelly Sand to Sand	SW	dense	120	6.0	55	1.91	1.47	0.57	0.50	0.85	266.1	1.43	266.1	46	53	5	100	40		
10.52	34.5	327.05	0.37	Gravelly Sand to Sand	SW	dense	120	6.0	55	1.94	1.49	0.37	0.50	0.84	260.9	1.32	260.9	45	52	5	100	39		
10.67	35.0	298.09	0.35	Gravelly Sand to Sand	SW	dense	120	6.0	50	1.97	1.50	0.35	0.50	0.84	236.7	1.33	236.7	41	47	5	100	39		
10.82	35.5	290.41	0.41	Gravelly Sand to Sand	SW	dense	120	6.0	48	2.00	1.51	0.41	0.50	0.84	229.5	1.39	229.5	39	46	5	100	38		
10.97	36.0	314.61	0.57	Gravelly Sand to Sand	SW	dense	120	6.0	52	2.03	1.53	0.58	0.50	0.83	247.4	1.46	247.4	42	49	5	100	39		
11.13	36.5	354.32	0.64	Gravelly Sand to Sand	SW	dense	120	6.0	59	2.06	1.54	0.64	0.50	0.83	277.3	1.45	277.3	48	55	5	100	40		
11.28	37.0	384.92	0.35	Gravelly Sand to Sand	SW	very dense	120	6.0	64	2.09	1.56	0.36	0.50	0.82	299.9	1.26	299.9	51	60	0	100	41		

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 303415-002 | Date: 03/05/20

CPT SOUNDING: CPT-2 | Plot: 2 | Density: 1 | SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 | Baldi | Qc/N: 1.00 | Robertson | Phi Correlation: 4 | SPT N

Nk: 17

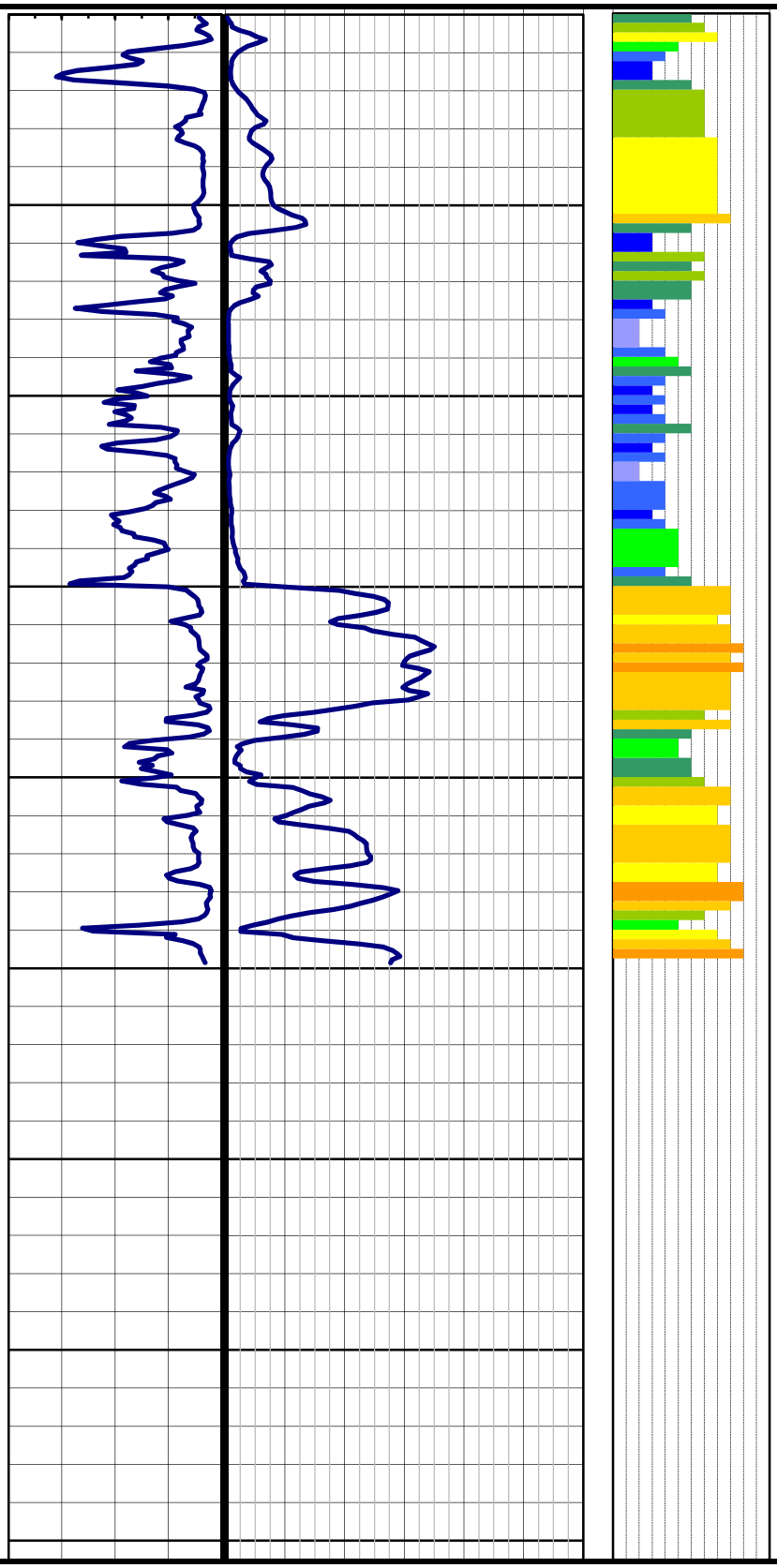
Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	Ic 2.6	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
11.43	37.5	409.18	0.79	Gravelly Sand to Sand	SW	very dense	120	6.0	68	2.12	1.57	0.79	0.50	0.82	317.3	1.48	317.3	54	63	10	100	41		
11.58	38.0	378.76	0.82	Gravelly Sand to Sand	SW	very dense	120	6.0	63	2.15	1.59	0.82	0.50	0.82	292.4	1.52	292.4	50	58	10	100	41		
11.73	38.5	361.04	0.50	Gravelly Sand to Sand	SW	dense	120	6.0	60	2.18	1.60	0.50	0.50	0.81	277.5	1.38	277.5	48	55	5	100	40		
11.89	39.0	345.01	0.61	Gravelly Sand to Sand	SW	dense	120	6.0	58	2.21	1.61	0.62	0.50	0.81	264.0	1.46	264.0	45	53	5	100	40		
12.04	39.5	344.58	0.68	Gravelly Sand to Sand	SW	dense	120	6.0	57	2.24	1.63	0.69	0.50	0.81	262.5	1.49	262.5	45	52	10	100	40		

Earth Systems
Pacific

CPT No : CPT-3
Project Name: Arctic Cold
Project No.: 303415-002
Location: See Site Exploration Plan

Cone Penetrometer: **Kehoe Testing and Engineerin**
Truck Mounted Electric Cone
with 23-ton reaction weight
Date: 3/5/2020

DEPTH (FEET)	Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
	Silty Sand to Sandy Silt	medium dense
	Sandy Silt to Clayey Silt	medium dense
	Clay	stiff
	Clayey Silt to Silty Clay	stiff
5	Silty Sand to Sandy Silt	medium dense
	Silty Sand to Sandy Silt	dense
	Silty Sand to Sandy Silt	medium dense
	Sand to Silty Sand	medium dense
	Sand to Silty Sand	medium dense
10	Sand to Silty Sand	medium dense
	Sand	dense
	Clayey Silt to Silty Clay	medium dense
	Sandy Silt to Clayey Silt	medium dense
	Silty Sand to Sandy Silt	medium dense
15	Sandy Silt to Clayey Silt	medium dense
	Silty Clay to Clay	firm
	Sensitive fine grained	firm
	Silty Clay to Clay	firm
	Clayey Silt to Silty Clay	stiff
20	Silty Clay to Clay	firm
	Clay	stiff
	Clayey Silt to Silty Clay	stiff
	Silty Clay to Clay	stiff
	Sensitive fine grained	firm
25	Silty Clay to Clay	firm
	Silty Clay to Clay	firm
	Clay	stiff
	Clayey Silt to Silty Clay	stiff
	Clayey Silt to Silty Clay	very stiff
30	Sandy Silt to Clayey Silt	medium dense
	Sand	dense
	Sand	dense
	Sand	very dense
	Sand	very dense
35	Sand	very dense
	Sand	dense
	Sand to Silty Sand	medium dense
	Sand to Silty Sand	medium dense
	Clayey Silt to Silty Clay	very stiff
40	Sandy Silt to Clayey Silt	hard
	Sand to Silty Sand	medium dense
	Sand to Silty Sand	medium dense
	Sand to Silty Sand	dense
	Sand	dense
45	Sand	medium dense
	Sand	dense
	Sand	medium dense
	Sandy Silt to Clayey Silt	medium dense
	Sand	dense
50		
55		
60		
65		
70		
75		
80	End of Sounding @ 49.9 feet	



Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 303415-002 | Date: 03/05/20

CPT SOUNDING: CPT-3 | Plot: 3 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17 Su (tsf)	OCR
0.15	0.5	9.43	0.72	Sandy Silt to Clayey Silt	ML	loose	110	2.5	4	0.01	0.01	0.72	0.77	1.70	15.2	2.53	44.3	6	9	70	-1	29		
0.30	1.0	38.79	0.69	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	13	0.04	0.04	0.69	0.60	1.70	62.3	1.98	79.6	22	16	30	57	34		
0.46	1.5	53.39	0.85	Sand to Silty Sand	SP/SM	medium dense	100	4.0	13	0.07	0.07	0.86	0.58	1.70	85.8	1.92	103.7	23	21	25	70	34		
0.61	2.0	22.23	3.22	Clayey Silt to Silty Clay	ML/CL	medium dense	110	2.0	11	0.09	0.09	3.24	0.78	1.70	35.7	2.58	115.0	19	23	75	34	33		
0.76	2.5	11.14	3.19	Silty Clay to Clay	CL	stiff	110	1.5	7	0.12	0.12	3.22	0.85	1.70	17.9	2.81		7		100			0.65	27.3
0.91	3.0	9.14	5.22	Clay	CL/CH	stiff	110	1.0	9	0.15	0.15	5.31	0.91	1.70	14.7	3.01		9		100			0.53	18.1
1.07	3.5	10.36	5.13	Clay	CL/CH	stiff	110	1.0	10	0.18	0.18	5.22	0.90	1.70	16.7	2.97		10		100			0.60	17.3
1.22	4.0	19.28	1.22	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	8	0.20	0.20	1.23	0.72	1.70	31.0	2.37	68.4	13	14	55	28	31		
1.37	4.5	34.32	0.64	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	11	0.23	0.23	0.65	0.61	1.70	55.1	2.01	72.6	19	15	30	52	33		
1.52	5.0	45.90	0.78	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	15	0.26	0.26	0.78	0.59	1.70	73.7	1.95	91.5	26	18	30	64	35		
1.68	5.5	61.73	1.24	Silty Sand to Sandy Silt	SM/ML	dense	110	3.0	21	0.29	0.29	1.25	0.60	1.70	99.2	1.98	125.9	35	25	30	76	37		
1.83	6.0	45.68	1.58	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	15	0.31	0.31	1.59	0.65	1.70	73.4	2.14	113.0	26	23	40	64	35		
1.98	6.5	42.16	1.56	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	14	0.34	0.34	1.58	0.66	1.70	67.7	2.17	107.7	24	22	40	61	34		
2.13	7.0	62.20	0.86	Sand to Silty Sand	SP/SM	medium dense	100	4.0	16	0.37	0.37	0.87	0.57	1.70	99.9	1.87	116.3	26	23	25	77	35		
2.29	7.5	76.44	0.69	Sand to Silty Sand	SP/SM	dense	100	4.0	19	0.39	0.39	0.70	0.53	1.69	122.4	1.74	130.7	31	26	15	85	36		
2.44	8.0	66.12	0.71	Sand to Silty Sand	SP/SM	medium dense	100	4.0	17	0.42	0.42	0.71	0.55	1.67	104.3	1.81	115.8	26	23	20	79	35		
2.59	8.5	64.22	0.68	Sand to Silty Sand	SP/SM	medium dense	100	4.0	16	0.44	0.44	0.68	0.55	1.62	98.4	1.82	110.0	24	22	20	76	34		
2.74	9.0	73.43	0.69	Sand to Silty Sand	SP/SM	medium dense	100	4.0	18	0.47	0.47	0.70	0.55	1.56	108.3	1.79	118.8	27	24	20	80	35		
2.90	9.5	76.37	0.72	Sand to Silty Sand	SP/SM	medium dense	100	4.0	19	0.49	0.49	0.73	0.55	1.52	109.7	1.79	120.8	27	24	20	81	35		
3.05	10.0	82.59	1.00	Sand to Silty Sand	SP/SM	medium dense	100	4.0	21	0.52	0.52	1.01	0.57	1.50	117.1	1.86	135.1	29	27	25	83	36		
3.20	10.5	113.32	0.93	Sand to Silty Sand	SP/SM	dense	100	4.0	28	0.54	0.54	0.93	0.54	1.43	153.1	1.75	164.3	38	33	20	95	38		
3.35	11.0	128.75	0.85	Sand	SP	dense	100	5.0	26	0.57	0.57	0.85	0.52	1.38	168.0	1.69	173.8	34	35	15	98	37		
3.51	11.5	46.33	2.24	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	19	0.59	0.59	2.27	0.70	1.49	65.4	2.28	124.4	24	25	50	59	34		
3.66	12.0	9.82	4.89	Clay	CL/CH	stiff	110	1.0	10	0.62	0.62	5.22	0.91	1.63	15.1	3.00		10		100			0.54	4.4
3.81	12.5	9.78	4.17	Clay	CL/CH	stiff	110	1.0	10	0.65	0.65	4.46	0.91	1.56	14.4	2.97		10		100			0.54	4.2
3.96	13.0	63.41	1.72	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	21	0.68	0.68	1.74	0.65	1.34	80.2	2.14	123.0	26	25	40	68	35		
4.11	13.5	65.16	2.36	Sandy Silt to Clayey Silt	ML	dense	110	2.5	26	0.70	0.70	2.39	0.68	1.32	81.2	2.23	142.3	31	28	45	68	36		
4.27	14.0	73.22	1.61	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	24	0.73	0.73	1.63	0.64	1.27	87.6	2.09	126.5	29	25	35	71	36		
4.42	14.5	48.49	2.01	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	19	0.76	0.76	2.04	0.70	1.26	57.8	2.29	111.2	22	22	50	54	34		
4.57	15.0	40.46	2.44	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	16	0.79	0.79	2.49	0.73	1.24	47.6	2.41	112.7	18	23	60	46	33		
4.72	15.5	10.13	4.78	Clay	CL/CH	stiff	110	1.0	10	0.81	0.81	5.19	0.94	1.28	12.2	3.07		10		100			0.55	3.4
4.88	16.0	5.25	1.84	Silty Clay to Clay	CL	firm	110	1.5	4	0.84	0.84	2.19	0.96	1.25	6.2	3.10		4		100			0.26	1.6
5.03	16.5	5.19	1.21	Sensitive fine grained	ML	firm	110	2.0	3	0.87	0.87	1.46	0.94	1.20	5.9	3.03		3		100			0.25	1.5
5.18	17.0	5.44	1.42	Sensitive fine grained	ML	firm	120	2.0	3	0.90	0.90	1.70	0.95	1.17	6.0	3.06		3		100			0.27	1.5
5.33	17.5	6.03	1.53	Sensitive fine grained	ML	firm	120	2.0	3	0.93	0.93	1.80	0.94	1.13	6.4	3.04		3		100			0.30	1.6
5.49	18.0	7.39	2.25	Silty Clay to Clay	CL	firm	120	1.5	5	0.96	0.96	2.58	0.94	1.10	7.7	3.06		5		100			0.38	2.0
5.64	18.5	9.64	2.34	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	5	0.99	0.99	2.61	0.91	1.06	9.7	2.97		5		100			0.51	2.6
5.79	19.0	19.69	1.58	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	8	1.02	1.02	1.67	0.80	1.03	19.2	2.62		8		80			1.10	5.5
5.94	19.5	10.76	3.11	Silty Clay to Clay	CL	stiff	120	1.5	7	1.05	1.05	3.44	0.93	1.01	10.3	3.02		7		100			0.57	2.8
6.10	20.0	7.24	3.34	Clay	CL/CH	firm	120	1.0	7	1.08	1.08	3.93	0.99	0.98	6.7	3.21		7		100			0.36	1.7
6.25	20.5	11.04	3.66	Silty Clay to Clay	CL	stiff	120	1.5	7	1.11	1.09	4.07	0.94	0.97	10.1	3.07		7		100			0.59	2.7
6.40	21.0	9.57	3.66	Clay	CL/CH	firm	120	1.0	10	1.14	1.11	4.16	0.96	0.96	8.7	3.13		10		100			0.50	2.3
6.55	21.5	13.54	3.38	Silty Clay to Clay	CL	stiff	120	1.5	9	1.17	1.12	3.70	0.91	0.95	12.1	2.98		9		100			0.73	3.3
6.71	22.0	22.54	1.77	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	9	1.20	1.14	1.87	0.80	0.95	20.1	2.63		9		80			1.26	5.6
6.86	22.5	12.84	3.64	Silty Clay to Clay	CL	stiff	120	1.5	9	1.23	1.15	4.02	0.93	0.93	11.2	3.03		9		100			0.69	3.0
7.01	23.0	6.67	3.09	Clay	CL/CH	firm	120	1.0	7	1.26	1.16	3.81	1.00	0.91	5.7	3.26		7		100			0.32	1.4
7.16	23.5	5.44	1.73	Silty Clay to Clay	CL	firm	120	1.5	4	1.29	1.18	2.27	1.00	0.90	4.6	3.22		4		100			0.25	1.1
7.32	24.0	6.75	1.38	Sensitive fine grained	ML	firm	120	2.0	3	1.32	1.19	1.71	0.95	0.89	5.7	3.08		3		100			0.33	1.4
7.47	24.5	6.23	1.40	Sensitive fine grained	ML	firm	120	2.0	3	1.35	1.21	1.78	0.97	0.88	5.2	3.12		3		100			0.30	1.2
7.62	25.0	6.74	2.29	Silty Clay to Clay	CL	firm	120	1.5	4	1.38	1.22	2.88	0.99	0.87	5.5	3.20		4		100			0.32	1.3
7.77	25.5	7.92	2.17	Silty Clay to Clay	CL	firm	120	1.5	5	1.41	1.24	2.64	0.96	0.86	6.4	3.13		5		100			0.39	1.6
7.92	26.0	10.32	2.99	Silty Clay to Clay	CL	stiff	120	1.5	7	1.44	1.25	3.47	0.95	0.85	8.3	3.10		7		100			0.53	2.1
8.08	26.5	10.05	4.02	Clay	CL/CH	stiff	120	1.0	10	1.47	1.26	4.70	0.98	0.84	8.0	3.19		10		100			0.52	2.0
8.23	27.0	11.69	3.62	Silty Clay to Clay	CL	stiff	120	1.5	8	1.50	1.28	4.15	0.95	0.83	9.2	3.11		8		100			0.61	2.4
8.38	27.5	12.28	2.66	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.53	1.29	3.04	0.92	0.83	9.6	3.01		6		100			0.65	2.5
8.53	28.0	16.18	2.18	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	8	1.56	1.31	2.41	0.87	0.83	12.7	2.86		8		100			0.87	3.4
8.69	28.5	20.00	2.93	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	10	1.59	1.32	3.19	0.87	0.82	15.6	2.86		10		100			1.10	4.2
8.84	29.0	25.72	3.37	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	1.62	1.34	3.59	0.85	0.82	19.9	2.80		13		100			1.43	5.4
8.99	29.5	31.86	4.16	Silty Clay to Clay	CL	very stiff	120	1.5	21	1.65	1.35	4.38	0.85	0.81	24.5	2.79		21		95			1.79	6.7
9.14	30.0	109.63	3.01	Sandy Silt to Clayey Silt	ML	dense	120	2.5	44	1.68	1.37	3.06	0.70	0.84	86.7	2.29	166.9	38	33	50	71	38		
9.30	30.5	244.09	1.03	Sand	SP	dense	120	5.0	49	1.71	1.38	1.04	0.52	0.87	201.0	1.70	208.6	42	42	15	100	39		
9.45	31.0	272.59	0.83	Sand	SP	dense	120	5.0	55	1.74	1.39	0.84	0.50	0.87	224.4	1.60	224.4	46	45	10	100	40		
9.60	31.5	222.36	0.99	Sand	SP	dense	120	5.0	44	1.77	1.41	1.00	0.53	0.86	180.8	1.72	190.2	37	38	15	100	38		
9.75	32.0	200.09	1.48	Sand to Silty Sand	SP/SM	dense	120	4.0	50	1.80	1.42	1.49	0.57	0.84	159.5	1.88	187.3	42	37	25	96	39		
9.91	32.5	281.33	1.02	Sand	SP	dense	120	5.0	56	1.83	1.44	1.02	0.51	0.86	227.7	1.66	229.8	47	46	15	100	40		
10.06	33.0	339.19	0.85	Sand	SP	very dense	120	5.0	68	1.86	1.45	0.85	0.50	0.85	273.7	1.55	273.7	56	55	10	100	42		
10.21	33.5	326.05	0.67	Gravelly Sand to Sand	SW	dense	120	6.0	54	1.89	1.47	0.67	0.50	0.85	261.8	1.49	261.8	45	52	10	100	40		
10.36	34.0	299.58	0.74	Sand	SP	dense	120	5.0	60	1.92	1.48	0.75	0.50	0.85	239.4	1.54	239.4	49	48	10	100	40		
10.52	34.5	333.14	0.76	Gravelly Sand to Sand	SW	dense	120	6.0	56	1.95	1.50	0.76	0.50	0.84	264.9	1.52	264.9	45	53	10	100	40		
10.67	35.0	314.96	0.91	Sand	SP	very dense	120	5.0	63	1.98	1.51	0.91	0.50	0.84	249.2	1.60	249.2	51	50	10	100	41		
10.82	35.5	315.28	0.91	Sand	SP	very dense	120	5.0	63	2.01	1.52	0.92	0.50	0.83	248.3	1.60	248.3	51	50	10	100	41		
10.97	36.0	292.34	0.89	Sand	SP	dense	120	5.0	58	2.04	1.54	0.89	0.50	0.83	229.2	1.61	229.2	47	46	10	100	40		
11.13	36.5	161.78	0.64	Sand	SP	medium dense	120	5.0	32	2.07	1.55	0.64	0.52	0.82	125.0	1.72	131.1	26	26	15	86	35		
11.28	37.0	80.64	1.68	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	27	2.10	1.57	1.73	0.68	0.76	58.3	2.24	103.6	21	21	45	54	34		

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold Project No: 303415-002 Date: 03/05/20

CPT SOUNDING: CPT-3 Plot: 3 Density: 1 SPT N Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** Dr correlation: 0 Baldi Qc/N: 1.00 Robertson Phi Correlation: 4 SPT N

Nk: 17

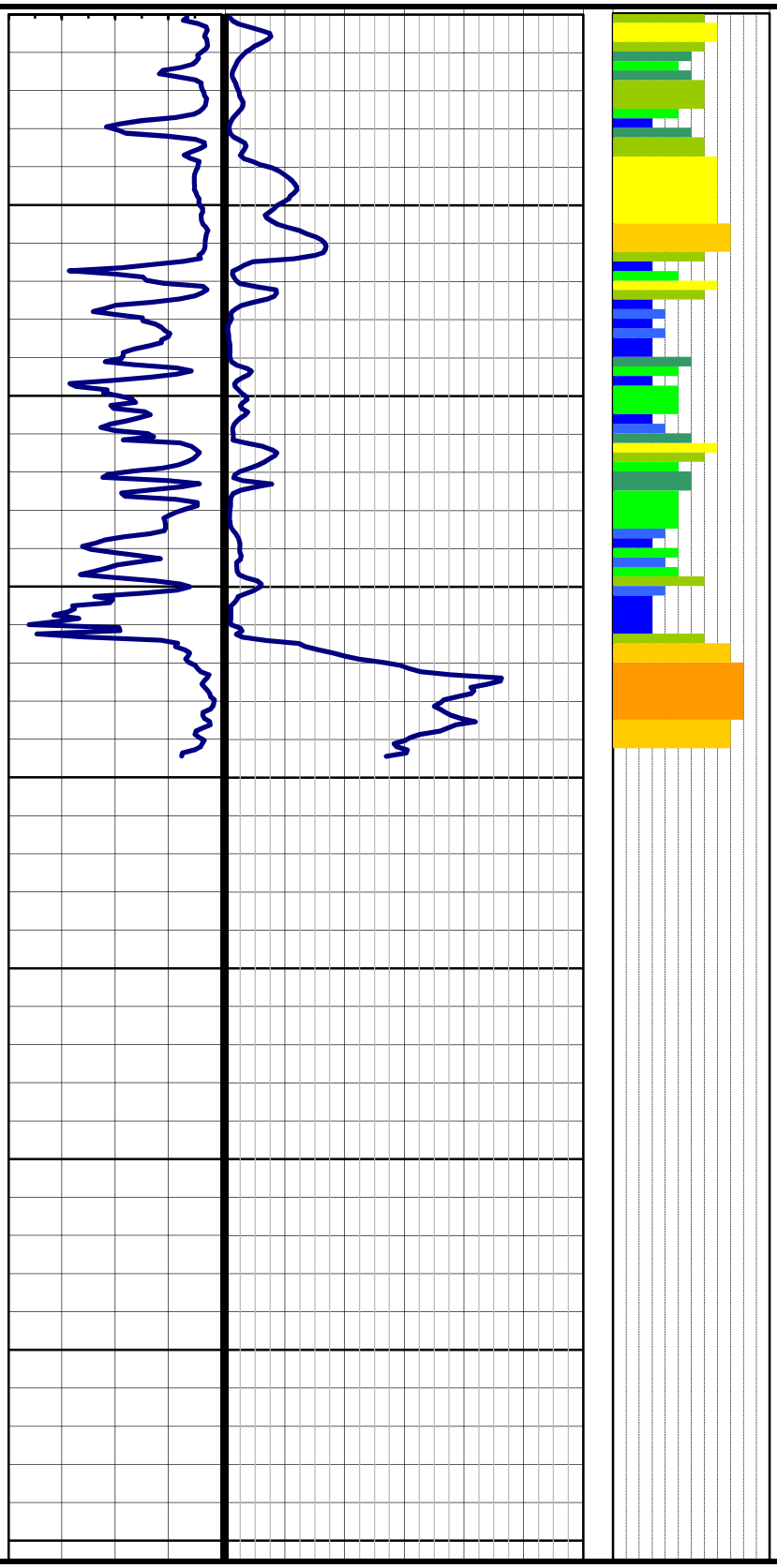
Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
11.43	37.5	146.90	0.55	Sand	SP	medium dense	120	5.0	29	2.13	1.58	0.56	0.53	0.81	112.4	1.72	118.0	23	24	15	82	34		
11.58	38.0	57.16	2.44	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	23	2.16	1.60	2.53	0.75	0.73	39.6	2.48	105.4	18	21	65	38	33		
11.73	38.5	22.77	2.52	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	11	2.19	1.61	2.79	0.87	0.69	15.0	2.84		11		100			1.24	3.8
11.89	39.0	16.55	2.68	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	8	2.22	1.62	3.10	0.91	0.68	10.6	2.99		8		100			0.88	2.6
12.04	39.5	28.72	2.70	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	11	2.25	1.64	2.92	0.85	0.69	18.7	2.77		11		95			1.59	4.8
12.19	40.0	49.37	2.73	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	20	2.28	1.65	2.86	0.78	0.70	32.9	2.57	104.3	15	21	75	31	32		
12.34	40.5	98.59	2.09	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	33	2.31	1.67	2.14	0.69	0.73	68.2	2.25	123.5	25	25	45	61	35		
12.50	41.0	159.78	0.87	Sand	SP	medium dense	120	5.0	32	2.34	1.68	0.88	0.56	0.77	116.6	1.82	131.2	25	26	20	83	35		
12.65	41.5	143.55	0.87	Sand	SP	medium dense	120	5.0	29	2.37	1.70	0.88	0.57	0.76	103.7	1.86	120.0	22	24	25	78	34		
12.80	42.0	99.06	1.43	Sand to Silty Sand	SP/SM	medium dense	120	4.0	25	2.40	1.71	1.46	0.65	0.73	68.4	2.14	105.1	19	21	40	61	33		
12.95	42.5	130.55	1.55	Sand to Silty Sand	SP/SM	medium dense	120	4.0	33	2.43	1.73	1.58	0.63	0.73	90.6	2.07	127.8	25	26	35	73	35		
13.11	43.0	214.92	1.07	Sand	SP	dense	120	5.0	43	2.46	1.74	1.08	0.55	0.76	154.7	1.79	170.3	33	34	20	95	37		
13.26	43.5	234.74	1.08	Sand	SP	dense	120	5.0	47	2.49	1.75	1.10	0.54	0.76	168.8	1.77	183.2	35	37	20	99	37		
13.41	44.0	239.76	0.91	Sand	SP	dense	120	5.0	48	2.52	1.77	0.92	0.52	0.76	173.3	1.71	180.9	36	36	15	100	38		
13.56	44.5	230.14	0.88	Sand	SP	dense	120	5.0	46	2.55	1.78	0.89	0.52	0.76	165.5	1.71	173.1	34	35	15	98	37		
13.72	45.0	136.20	1.67	Sand to Silty Sand	SP/SM	medium dense	120	4.0	34	2.58	1.80	1.70	0.64	0.71	91.8	2.09	132.2	25	26	35	73	35		
13.87	45.5	160.57	1.48	Sand to Silty Sand	SP/SM	medium dense	120	4.0	40	2.61	1.81	1.51	0.61	0.72	109.3	2.00	142.2	30	28	30	81	36		
14.02	46.0	277.00	0.43	Gravelly Sand to Sand	SW	dense	120	6.0	46	2.64	1.83	0.43	0.50	0.76	199.3	1.45	199.3	34	40	5	100	37		
14.17	46.5	245.55	0.50	Gravelly Sand to Sand	SW	dense	120	6.0	41	2.67	1.84	0.50	0.50	0.76	176.0	1.53	176.0	30	35	10	100	36		
14.33	47.0	160.92	0.57	Sand	SP	medium dense	120	5.0	32	2.70	1.86	0.58	0.53	0.74	113.0	1.73	119.2	24	24	15	82	34		
14.48	47.5	68.59	1.82	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	23	2.73	1.87	1.89	0.72	0.66	43.0	2.37	94.2	17	19	55	42	32		
14.63	48.0	48.98	3.93	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	24	2.76	1.88	4.17	0.83	0.62	28.7	2.73		24		90			2.77	7.4
14.78	48.5	167.70	1.53	Sand to Silty Sand	SP/SM	dense	120	4.0	42	2.79	1.90	1.55	0.61	0.70	110.8	2.01	145.0	30	29	30	81	36		
14.94	49.0	277.81	0.81	Sand	SP	dense	120	5.0	56	2.82	1.91	0.82	0.50	0.74	195.2	1.64	195.2	40	39	15	100	39		
15.09	49.5	282.91	0.68	Gravelly Sand to Sand	SW	dense	120	6.0	47	2.85	1.93	0.68	0.50	0.74	198.1	1.58	198.1	34	40	10	100	37		

Earth Systems
Pacific

CPT No : CPT-4
Project Name: Arctic Cold
Project No.: 303415-002
Location: See Site Exploration Plan

Cone Penetrometer: **Kehoe Testing and Engineerin**
Truck Mounted Electric Cone
with 23-ton reaction weight
Date: 3/5/2020

Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
Silty Sand to Sandy Silt	medium dense
Sand to Silty Sand	medium dense
Sandy Silt to Clayey Silt	medium dense
Sandy Silt to Clayey Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Clay to Clay	stiff
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Sand to Silty Sand	dense
Sand to Silty Sand	dense
Sand to Silty Sand	medium dense
Sand	dense
Sand to Silty Sand	dense
Silty Clay to Clay	stiff
Silty Sand to Sandy Silt	medium dense
Silty Clay to Clay	stiff
Silty Clay to Clay	firm
Clay	firm
Sandy Silt to Clayey Silt	medium dense
Silty Clay to Clay	very stiff
Clayey Silt to Silty Clay	very stiff
Silty Clay to Clay	stiff
Silty Sand to Sandy Silt	medium dense
Sandy Silt to Clayey Silt	medium dense
Sandy Silt to Clayey Silt	medium dense
Clayey Silt to Silty Clay	firm
Clayey Silt to Silty Clay	stiff
Silty Clay to Clay	very stiff
Clayey Silt to Silty Clay	very stiff
Sandy Silt to Clayey Silt	medium dense
Clay	stiff
Clay	stiff
Clayey Silt to Silty Clay	medium dense
Sand	dense
Gravelly Sand to Sand	very dense
Gravelly Sand to Sand	very dense
Gravelly Sand to Sand	very dense
Sand	very dense



End of Sounding @ 39.0 feet

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 303415-002 | Date: 03/05/20

CPT SOUNDING: CPT-4 | Plot: 4 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17 Su (tsf)	OCR
0.15	0.5	25.18	0.97	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	8	0.01	0.01	0.97	0.67	1.70	40.5	2.22	69.6	14	14	45	39	31		
0.30	1.0	69.95	0.59	Sand to Silty Sand	SP/SM	medium dense	100	4.0	17	0.04	0.04	0.59	0.53	1.70	112.4	1.73	119.1	30	24	15	82	36		
0.46	1.5	60.52	0.55	Sand to Silty Sand	SP/SM	medium dense	100	4.0	15	0.07	0.07	0.55	0.54	1.70	97.2	1.76	105.2	26	21	20	76	35		
0.61	2.0	34.90	0.74	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	12	0.09	0.09	0.75	0.62	1.70	56.1	2.04	75.9	20	15	35	53	33		
0.76	2.5	20.40	0.97	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	8	0.12	0.12	0.98	0.70	1.70	32.8	2.30	63.7	14	13	50	31	31		
0.91	3.0	12.86	2.03	Clayey Silt to Silty Clay	ML/CL	stiff	110	2.0	6	0.15	0.15	2.06	0.80	1.70	20.7	2.64		6		80			0.75	26.1
1.07	3.5	14.56	1.14	Sandy Silt to Clayey Silt	ML	loose	110	2.5	6	0.17	0.17	1.15	0.75	1.70	23.4	2.46	60.3	10	12	65	17	30		
1.22	4.0	20.94	0.72	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	7	0.20	0.20	0.73	0.68	1.70	33.7	2.22	58.1	12	12	45	32	31		
1.37	4.5	27.09	0.60	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	9	0.23	0.23	0.61	0.64	1.70	43.5	2.09	62.4	15	12	35	42	32		
1.52	5.0	26.42	0.71	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	9	0.26	0.26	0.72	0.65	1.70	42.5	2.13	64.4	15	13	40	41	32		
1.68	5.5	11.91	2.39	Clayey Silt to Silty Clay	ML/CL	stiff	110	2.0	6	0.28	0.28	2.45	0.83	1.70	19.1	2.72		6		90			0.68	12.3
1.83	6.0	7.18	3.93	Clay	CL/CH	firm	110	1.0	7	0.31	0.31	4.11	0.92	1.70	11.5	3.03		7		100			0.40	6.6
1.98	6.5	22.96	1.22	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	9	0.34	0.34	1.23	0.70	1.70	36.9	2.31	73.2	16	15	50	35	32		
2.13	7.0	31.74	0.87	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	11	0.37	0.37	0.88	0.64	1.70	51.0	2.11	75.4	17	15	35	49	32		
2.29	7.5	34.11	1.14	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	11	0.39	0.39	1.16	0.66	1.70	54.8	2.15	85.7	18	17	40	52	33		
2.44	8.0	75.97	0.91	Sand to Silty Sand	SP/SM	medium dense	100	4.0	19	0.42	0.42	0.92	0.56	1.67	120.1	1.83	135.2	29	27	20	84	36		
2.59	8.5	104.64	1.02	Sand to Silty Sand	SP/SM	dense	100	4.0	26	0.45	0.45	1.03	0.54	1.60	157.9	1.77	171.3	39	34	20	96	38		
2.74	9.0	118.47	1.02	Sand to Silty Sand	SP/SM	dense	100	4.0	30	0.47	0.47	1.02	0.53	1.54	172.4	1.74	183.8	43	37	15	99	39		
2.90	9.5	109.76	0.91	Sand to Silty Sand	SP/SM	dense	100	4.0	27	0.50	0.50	0.92	0.53	1.50	155.4	1.74	165.6	39	33	15	95	38		
3.05	10.0	88.08	0.80	Sand to Silty Sand	SP/SM	dense	100	4.0	22	0.52	0.52	0.80	0.54	1.47	122.5	1.78	133.9	31	27	20	85	36		
3.20	10.5	70.21	0.74	Sand to Silty Sand	SP/SM	medium dense	100	4.0	18	0.55	0.55	0.75	0.56	1.45	96.5	1.85	110.1	24	22	20	75	34		
3.35	11.0	89.76	0.69	Sand to Silty Sand	SP/SM	medium dense	100	4.0	22	0.57	0.57	0.69	0.54	1.39	118.2	1.75	126.9	30	25	20	84	36		
3.51	11.5	137.26	0.55	Sand	SP	dense	100	5.0	27	0.60	0.60	0.56	0.50	1.33	173.0	1.57	173.0	36	35	10	100	37		
3.66	12.0	165.28	0.61	Sand	SP	dense	100	5.0	33	0.62	0.62	0.62	0.50	1.31	204.1	1.54	204.1	42	41	10	100	39		
3.81	12.5	160.39	0.74	Sand	SP	dense	100	5.0	32	0.65	0.65	0.74	0.50	1.28	194.2	1.61	194.2	40	39	10	100	38		
3.96	13.0	64.70	1.61	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	22	0.67	0.67	1.63	0.64	1.34	82.0	2.11	121.4	26	24	35	69	35		
4.11	13.5	15.91	4.49	Clay	CL/CH	stiff	110	1.0	16	0.70	0.70	4.70	0.87	1.43	21.6	2.85		16		100			0.89	6.5
4.27	14.0	19.21	2.65	Clayey Silt to Silty Clay	ML/CL	very stiff	110	2.0	10	0.73	0.73	2.75	0.81	1.36	24.6	2.66		10		80			1.09	7.6
4.42	14.5	75.05	0.66	Sand to Silty Sand	SP/SM	medium dense	100	4.0	19	0.75	0.75	0.67	0.57	1.21	86.0	1.86	99.0	22	20	25	71	34		
4.57	15.0	65.37	1.74	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	22	0.78	0.78	1.76	0.66	1.22	75.6	2.16	119.6	25	24	40	65	35		
4.72	15.5	18.19	4.40	Clay	CL/CH	very stiff	110	1.0	18	0.81	0.81	4.60	0.87	1.27	21.8	2.84		18		100			1.02	6.5
4.88	16.0	8.35	3.09	Silty Clay to Clay	CL	firm	110	1.5	6	0.83	0.83	3.44	0.93	1.25	9.8	3.04		6		100			0.44	2.7
5.03	16.5	4.59	2.12	Clay	CL/CH	soft	110	1.0	5	0.86	0.86	2.61	0.99	1.23	5.3	3.20		5		100			0.22	1.3
5.18	17.0	6.41	2.17	Silty Clay to Clay	CL	firm	120	1.5	4	0.89	0.89	2.52	0.95	1.18	7.1	3.08		4		100			0.32	1.9
5.33	17.5	7.75	3.24	Clay	CL/CH	firm	120	1.0	8	0.92	0.92	3.68	0.95	1.14	8.4	3.11		8		100			0.40	2.2
5.49	18.0	8.71	3.94	Clay	CL/CH	firm	120	1.0	9	0.95	0.95	4.43	0.96	1.11	9.1	3.13		9		100			0.46	2.4
5.64	18.5	32.45	2.05	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	13	0.98	0.98	2.12	0.76	1.06	32.5	2.49	89.1	13	18	65	30	31		
5.79	19.0	29.11	2.84	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	15	1.01	1.01	2.94	0.80	1.04	28.6	2.63		15		80			1.65	8.3
5.94	19.5	18.36	5.15	Clay	CL/CH	very stiff	120	1.0	18	1.04	1.04	5.46	0.90	1.02	17.6	2.96		18		100			1.02	5.0
6.10	20.0	33.14	3.87	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	17	1.07	1.07	4.00	0.82	0.99	31.0	2.69		17		85			1.89	9.0
6.25	20.5	27.41	3.82	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	14	1.10	1.08	3.98	0.84	0.98	25.4	2.75		14		90			1.55	7.3
6.40	21.0	31.63	2.90	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	16	1.13	1.10	3.01	0.80	0.97	29.0	2.63		16		80			1.80	8.3
6.55	21.5	15.37	4.12	Clay	CL/CH	stiff	120	1.0	15	1.16	1.11	4.45	0.91	0.95	13.9	2.99		15		100			0.84	3.8
6.71	22.0	13.02	3.11	Silty Clay to Clay	CL	stiff	120	1.5	9	1.19	1.13	3.42	0.91	0.94	11.6	2.98		9		100			0.70	3.1
6.86	22.5	37.44	2.12	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	15	1.22	1.14	2.20	0.76	0.94	33.4	2.50	91.7	14	18	65	31	31		
7.01	23.0	82.02	0.92	Sand to Silty Sand	SP/SM	medium dense	120	4.0	21	1.25	1.16	0.93	0.61	0.95	73.4	2.00	95.2	19	19	30	64	33		
7.16	23.5	64.59	1.34	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	22	1.28	1.17	1.37	0.67	0.93	57.1	2.19	93.1	20	19	40	54	33		
7.32	24.0	26.49	3.27	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	1.31	1.19	3.44	0.84	0.91	22.8	2.75		13		90			1.49	6.4
7.47	24.5	40.48	2.42	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	16	1.34	1.20	2.50	0.77	0.91	34.7	2.52	99.4	15	20	70	33	32		
7.62	25.0	29.75	2.64	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	12	1.37	1.21	2.77	0.81	0.89	25.2	2.65		12		80			1.68	7.0
7.77	25.5	9.12	2.08	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	5	1.40	1.23	2.46	0.94	0.87	7.5	3.05		5		100			0.46	1.9
7.92	26.0	8.00	1.30	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	4	1.43	1.24	1.59	0.93	0.86	6.5	3.01		4		100			0.40	1.6
8.08	26.5	7.67	2.09	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	4	1.46	1.26	2.58	0.97	0.85	6.1	3.14		4		100			0.38	1.5
8.23	27.0	13.72	2.32	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	7	1.49	1.27	2.61	0.90	0.85	11.0	2.93		7		100			0.73	2.9
8.38	27.5	22.79	4.28	Silty Clay to Clay	CL	very stiff	120	1.5	15	1.52	1.29	4.58	0.88	0.84	18.1	2.90		15		100			1.26	5.0
8.53	28.0	24.22	4.71	Clay	CL/CH	very stiff	120	1.0	24	1.55	1.30	5.04	0.89	0.83	19.1	2.91		24		100			1.35	5.2
8.69	28.5	23.66	2.84	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	12	1.58	1.31	3.05	0.85	0.83	18.6	2.78		12		95			1.31	5.0
8.84	29.0	19.38	4.35	Silty Clay to Clay	CL	very stiff	120	1.5	13	1.61	1.33	4.74	0.91	0.81	14.9	2.98		13		100			1.06	4.0
8.99	29.5	37.37	3.94	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	19	1.64	1.34	4.12	0.83	0.82	29.0	2.72		19		90			2.12	8.0
9.14	30.0	55.36	1.49	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	18	1.67	1.36	1.54	0.70	0.84	43.9	2.31	86.5	16	17	50	43	32		
9.30	30.5	24.88	3.93	Silty Clay to Clay	CL	very stiff	120	1.5	17	1.70	1.37	4.22	0.87	0.80	18.7	2.87		17		100			1.38	5.1
9.45	31.0	11.02	5.11	Clay	CL/CH	stiff	120	1.0	11	1.73	1.39	6.06	1.00	0.76	7.9	3.26		11		100			0.57	2.0
9.60	31.5	9.35	5.82	Clay	CL/CH	firm	120	1.0	9	1.76	1.40	7.17	1.00	0.76	6.7	3.36		9		100			0.47	1.6
9.75	32.0	14.30	5.73	Clay	CL/CH	stiff	120	1.0	14	1.79	1.42	6.55	0.98	0.75	10.2	3.20		14		100			0.76	2.7
9.91	32.5	25.27	5.32	Clay	CL/CH	very stiff	120	1.0	25	1.82	1.43	5.74	0.90	0.76	18.2	2.97		25		100			1.40	4.9
10.06	33.0	109.08	1.89	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	36	1.85	1.44	1.92	0.66	0.82	84.0	2.16	131.7	30	26	40	70	36		
10.21	33.5	178.71	1.29	Sand	SP	medium dense	120	5.0	36	1.88	1.46	1.31	0.57	0.83	140.5	1.88	164.4	30	33	25	91	36		
10.36	34.0	260.64	1.20	Sand	SP	dense	120	5.0	52	1.91	1.47	1.21	0.53	0.84	206.7	1.74	220.0	43	44	15	100	39		
10.52	34.5	337.70	0.73	Gravelly Sand to Sand	SW	dense	120	6.0	56	1.94	1.49	0.73	0.50	0.84	269.2	1.50	269.2	46	54	10	100	40		
10.67	35.0	454.15	0.65	Gravelly Sand to Sand	SW	very dense	120	6.0	76	1.97	1.50	0.65	0.50	0.84	360.3	1.38	360.3	62	72	5	100	43		
10.82	35.5	413.38	0.54	Gravelly Sand to Sand	SW	very dense	120	6.0	69	2.00	1.52	0.54	0.50	0.84	326.4	1.35	326.4	56	65	5	100	42		
10.97	36.0	371.82	0.33	Gravelly Sand to Sand	SW	very dense	120	6.0	62	2.03	1.53	0.33	0.50	0.83	292.2	1.25	292.2	50	58	0	100	41		
11.13	36.5	364.86	0.54	Gravelly Sand to Sand	SW	dense	120	6.0	61	2.06	1.55	0.54	0.50	0.83	285.4	1.39	285.4	49	57	5	100	40		
11.28	37.0	400.07	0.50	Gravelly Sand to Sand	SW	very dense	120	6.0	67	2.09	1.56	0.51	0.50	0.82	311.4	1.35	311.4	53	62	5	100	41		

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 303415-002 | Date: 03/05/20

CPT SOUNDING: CPT-4 | Plot: 4 | Density: 1 | SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 | Baldi | Qc/N: 1.00 | Robertson | Phi Correlation: 4 | SPT N

Nk: 17

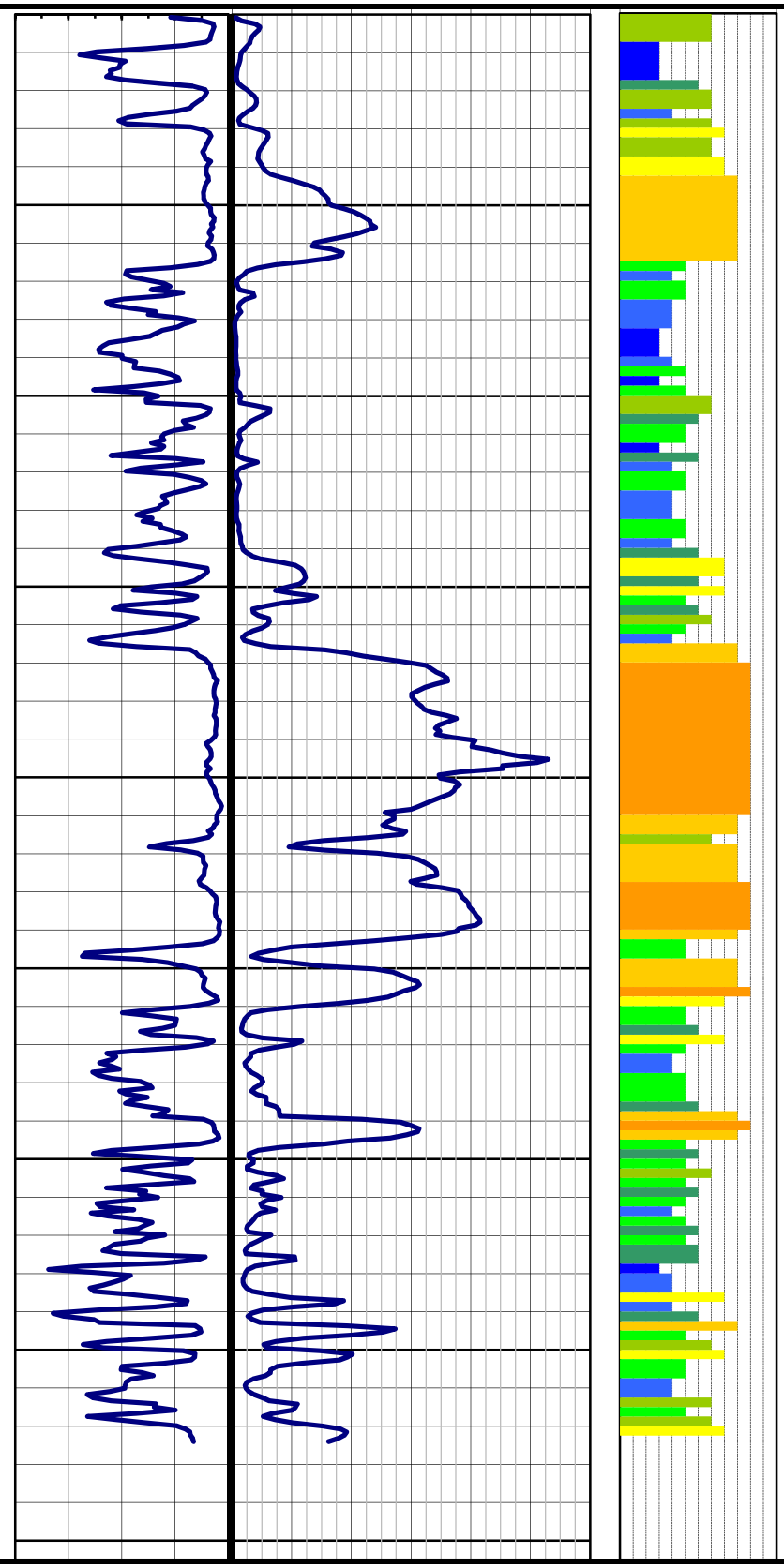
Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	Ic 2.6	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
11.43	37.5	352.36	0.89	Sand	SP	very dense	120	5.0	70	2.12	1.57	0.89	0.50	0.82	273.0	1.56	273.0	56	55	10	100	42		
11.58	38.0	298.28	0.74	Sand	SP	dense	120	5.0	60	2.15	1.59	0.75	0.50	0.82	230.1	1.56	230.1	47	46	10	100	40		
11.73	38.5	298.63	1.09	Sand	SP	dense	120	5.0	60	2.18	1.60	1.10	0.51	0.81	228.1	1.68	233.7	47	47	15	100	40		

Earth Systems
Pacific

CPT No : CPT-5
Project Name: Arctic Cold
Project No.: 303415-002
Location: See Site Exploration Plan

Cone Penetrometer: **Kehoe Testing and Engineerin**
Truck Mounted Electric Cone
with 23-ton reaction weight
Date: 3/5/2020

DEPTH (FEET)	Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
	Silty Sand to Sandy Silt	medium dense
	Clayey Silt to Silty Clay	medium dense
	Clay	stiff
	Clayey Silt to Silty Clay	stiff
5	Silty Sand to Sandy Silt	medium dense
	Sandy Silt to Clayey Silt	medium dense
	Sand to Silty Sand	medium dense
	Silty Sand to Sandy Silt	medium dense
	Sand to Silty Sand	dense
10	Sand	dense
	Sand	very dense
	Sand	dense
	Sand	dense
	Clayey Silt to Silty Clay	very stiff
15	Clayey Silt to Silty Clay	very stiff
	Silty Clay to Clay	stiff
	Clay	firm
	Clay	firm
	Silty Clay to Clay	firm
20	Silty Clay to Clay	stiff
	Silty Sand to Sandy Silt	medium dense
	Sandy Silt to Clayey Silt	very stiff
	Silty Clay to Clay	stiff
	Clayey Silt to Silty Clay	very stiff
25	Clayey Silt to Silty Clay	stiff
	Silty Clay to Clay	firm
	Silty Clay to Clay	stiff
	Clayey Silt to Silty Clay	stiff
	Silty Sand to Sandy Silt	medium dense
30	Silty Sand to Sandy Silt	dense
	Silty Sand to Sandy Silt	medium dense
	Silty Sand to Sandy Silt	medium dense
	Clayey Silt to Silty Clay	very stiff
	Sand	dense
35	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	very dense
40	Gravelly Sand to Sand	very dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Sand	dense
	Sand to Silty Sand	dense
45	Sand	dense
	Sand	very dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Silty Sand to Sandy Silt	dense
50	Silty Sand to Sandy Silt	dense
	Sand	dense
	Sand	medium dense
	Clayey Silt to Silty Clay	very stiff
	Silty Sand to Sandy Silt	medium dense
55	Silty Clay to Clay	very stiff
	Clayey Silt to Silty Clay	hard
	Clayey Silt to Silty Clay	hard
	Sand to Silty Sand	medium dense
	Sand	dense
60	Sandy Silt to Clayey Silt	hard
	Sandy Silt to Clayey Silt	hard
	Clayey Silt to Silty Clay	hard
	Clayey Silt to Silty Clay	hard
	Clayey Silt to Silty Clay	hard
65	Clayey Silt to Silty Clay	hard
	Clayey Silt to Silty Clay	hard
	Silty Clay to Clay	very stiff
	Sandy Silt to Clayey Silt	medium dense
	Silty Sand to Sandy Silt	dense
70	Sandy Silt to Clayey Silt	medium dense
	Silty Sand to Sandy Silt	medium dense
	Clayey Silt to Silty Clay	very stiff
	Clayey Silt to Silty Clay	hard
	Sandy Silt to Clayey Silt	medium dense
75		
80	End of Sounding @ 75.0 feet	



Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 303415-002 | Date: 03/05/20

CPT SOUNDING: CPT-5 | Plot: 5 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17 Su (tsf)	OCR
0.15	0.5	33.78	0.70	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	11	0.01	0.01	0.70	0.62	1.70	54.3	2.04	73.4	19	15	35	51	33		
0.30	1.0	38.68	0.63	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	13	0.04	0.04	0.63	0.60	1.70	62.2	1.96	77.8	22	16	30	57	34		
0.46	1.5	28.53	1.07	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	10	0.07	0.07	1.07	0.67	1.70	45.8	2.20	76.3	16	15	45	44	32		
0.61	2.0	16.74	4.52	Clay	CL/CH	stiff	110	1.0	17	0.10	0.10	4.55	0.84	1.70	26.9	2.77		17		95			0.98	51.9
0.76	2.5	12.41	4.22	Clay	CL/CH	stiff	110	1.0	12	0.12	0.12	4.26	0.86	1.70	19.9	2.85		12		100			0.72	29.8
0.91	3.0	8.42	4.31	Clay	CL/CH	firm	110	1.0	8	0.15	0.15	4.39	0.91	1.70	13.5	2.99		8		100			0.49	16.4
1.07	3.5	8.54	3.69	Clay	CL/CH	firm	110	1.0	9	0.18	0.18	3.77	0.89	1.70	13.7	2.94		9		100			0.49	14.0
1.22	4.0	24.00	1.01	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	10	0.21	0.21	1.02	0.68	1.70	38.6	2.25	69.2	16	14	45	37	32		
1.37	4.5	39.47	1.02	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	13	0.23	0.23	1.02	0.63	1.70	63.4	2.07	89.2	22	18	35	58	34		
1.52	5.0	33.42	1.57	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	11	0.26	0.26	1.58	0.68	1.70	53.7	2.25	95.9	19	19	45	51	33		
1.68	5.5	13.48	3.66	Silty Clay to Clay	CL	stiff	110	1.5	9	0.29	0.29	3.74	0.85	1.70	21.7	2.79		9		95			0.78	13.7
1.83	6.0	46.99	1.01	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	16	0.32	0.32	1.02	0.61	1.70	75.5	2.01	99.2	27	20	30	65	35		
1.98	6.5	57.51	0.72	Sand to Silty Sand	SP/SM	medium dense	100	4.0	14	0.34	0.34	0.72	0.56	1.70	92.4	1.85	105.9	24	21	20	74	35		
2.13	7.0	47.61	0.90	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	16	0.37	0.37	0.91	0.60	1.70	76.5	1.98	97.1	26	19	30	66	35		
2.29	7.5	44.51	0.81	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	15	0.40	0.40	0.82	0.60	1.70	71.5	1.97	90.6	24	18	30	63	34		
2.44	8.0	52.68	0.80	Sand to Silty Sand	SP/SM	medium dense	100	4.0	13	0.42	0.42	0.81	0.58	1.70	84.6	1.91	101.4	20	20	25	70	33		
2.59	8.5	82.46	0.77	Sand to Silty Sand	SP/SM	dense	100	4.0	21	0.45	0.45	0.78	0.54	1.59	124.0	1.77	134.5	31	27	20	86	36		
2.74	9.0	133.42	0.87	Sand	SP	dense	100	5.0	27	0.47	0.47	0.88	0.51	1.51	190.0	1.66	192.5	39	39	15	100	38		
2.90	9.5	155.79	0.93	Sand	SP	dense	100	5.0	31	0.50	0.50	0.93	0.50	1.46	215.1	1.65	215.2	44	43	15	100	39		
3.05	10.0	171.85	0.76	Sand	SP	dense	100	5.0	34	0.52	0.52	0.77	0.50	1.42	231.1	1.56	231.1	48	46	10	100	40		
3.20	10.5	213.97	0.61	Sand	SP	very dense	100	5.0	43	0.55	0.55	0.61	0.50	1.39	281.1	1.44	281.1	58	56	5	100	42		
3.35	11.0	234.55	0.59	Sand	SP	very dense	100	5.0	47	0.57	0.57	0.59	0.50	1.36	301.4	1.40	301.4	62	60	5	100	43		
3.51	11.5	206.80	0.68	Sand	SP	very dense	100	5.0	41	0.60	0.60	0.68	0.50	1.33	260.1	1.49	260.1	54	52	10	100	41		
3.66	12.0	144.82	0.73	Sand	SP	dense	100	5.0	29	0.62	0.62	0.73	0.50	1.30	178.5	1.63	178.5	37	36	15	100	38		
3.81	12.5	177.85	0.57	Sand	SP	dense	100	5.0	36	0.65	0.65	0.57	0.50	1.28	214.9	1.50	214.9	44	43	10	100	39		
3.96	13.0	116.73	0.79	Sand	SP	medium dense	100	5.0	23	0.67	0.67	0.79	0.53	1.27	140.3	1.73	148.7	28	30	15	91	36		
4.11	13.5	28.95	3.28	Clayey Silt to Silty Clay	ML/CL	medium dense	110	2.0	14	0.70	0.70	3.36	0.78	1.38	37.9	2.57	120.3	17	24	75	37	32		
4.27	14.0	9.66	3.01	Silty Clay to Clay	CL	stiff	110	1.5	6	0.73	0.73	3.25	0.90	1.40	12.8	2.93		6		100			0.53	3.7
4.42	14.5	18.98	2.26	Clayey Silt to Silty Clay	ML/CL	very stiff	110	2.0	9	0.75	0.75	2.36	0.80	1.31	23.6	2.63		9		80			1.07	7.3
4.57	15.0	24.41	3.64	Clayey Silt to Silty Clay	ML/CL	very stiff	110	2.0	12	0.78	0.78	3.76	0.82	1.28	29.6	2.69		12		85			1.39	9.1
4.72	15.5	12.68	3.60	Silty Clay to Clay	CL	stiff	110	1.5	8	0.81	0.81	3.84	0.89	1.27	15.2	2.91		8		100			0.70	4.4
4.88	16.0	6.82	1.96	Silty Clay to Clay	CL	firm	110	1.5	5	0.84	0.84	2.23	0.92	1.24	8.0	3.01		5		100			0.35	2.1
5.03	16.5	5.32	2.39	Silty Clay to Clay	CL	firm	110	1.5	4	0.86	0.86	2.85	0.98	1.22	6.1	3.16		4		100			0.26	1.5
5.18	17.0	6.89	3.73	Clay	CL/CH	firm	120	1.0	7	0.89	0.89	4.28	0.98	1.18	7.7	3.18		7		100			0.35	2.0
5.33	17.5	6.43	4.80	Clay	CL/CH	firm	120	1.0	6	0.92	0.92	5.61	1.00	1.15	7.0	3.28		6		100			0.32	1.8
5.49	18.0	6.79	3.82	Clay	CL/CH	firm	120	1.0	7	0.95	0.95	4.44	0.99	1.11	7.1	3.22		7		100			0.34	1.8
5.64	18.5	8.85	3.22	Silty Clay to Clay	CL	firm	120	1.5	6	0.98	0.98	3.62	0.95	1.07	9.0	3.08		6		100			0.46	2.4
5.79	19.0	8.32	1.97	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	4	1.01	1.01	2.24	0.92	1.04	8.2	3.00		4		100			0.43	2.2
5.94	19.5	6.87	3.69	Clay	CL/CH	firm	120	1.0	7	1.04	1.04	4.35	1.00	1.01	6.6	3.24		7		100			0.34	1.7
6.10	20.0	13.39	2.97	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	7	1.07	1.07	3.23	0.90	0.99	12.5	2.94		7		100			0.72	3.4
6.25	20.5	39.13	1.59	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	13	1.10	1.09	1.64	0.73	0.98	36.3	2.39	82.3	13	16	55	35	31		
6.40	21.0	52.52	0.92	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	18	1.13	1.10	0.94	0.65	0.97	48.4	2.15	74.8	17	15	40	47	32		
6.55	21.5	25.86	1.53	Sandy Silt to Clayey Silt	ML	loose	120	2.5	10	1.16	1.12	1.61	0.77	0.96	23.5	2.54	69.6	10	14	70	17	30		
6.71	22.0	12.49	2.32	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.19	1.13	2.57	0.89	0.94	11.1	2.92		6		100			0.67	3.0
6.86	22.5	12.22	2.57	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.22	1.14	2.86	0.91	0.93	10.8	2.96		6		100			0.65	2.9
7.01	23.0	8.65	3.49	Clay	CL/CH	firm	120	1.0	9	1.25	1.16	4.08	0.98	0.91	7.5	3.18		9		100			0.44	1.9
7.16	23.5	29.91	1.61	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	12	1.28	1.17	1.68	0.77	0.92	26.1	2.51	73.8	11	15	70	21	30		
7.32	24.0	9.94	3.07	Silty Clay to Clay	CL	stiff	120	1.5	7	1.31	1.19	3.53	0.95	0.90	8.4	3.10		7		100			0.52	2.2
7.47	24.5	10.67	1.11	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	5	1.34	1.20	1.27	0.87	0.89	9.0	2.84		5		100			0.56	2.3
7.62	25.0	10.22	1.58	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	5	1.37	1.22	1.83	0.90	0.88	8.5	2.94		5		100			0.53	2.2
7.77	25.5	7.44	2.39	Silty Clay to Clay	CL	firm	120	1.5	5	1.40	1.23	2.95	0.98	0.86	6.1	3.17		5		100			0.37	1.5
7.92	26.0	7.83	2.77	Silty Clay to Clay	CL	firm	120	1.5	5	1.43	1.25	3.39	0.98	0.85	6.3	3.19		5		100			0.39	1.5
8.08	26.5	9.03	3.01	Silty Clay to Clay	CL	firm	120	1.5	6	1.46	1.26	3.60	0.97	0.84	7.2	3.16		6		100			0.46	1.8
8.23	27.0	12.06	2.13	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.49	1.27	2.43	0.91	0.84	9.6	2.96		6		100			0.63	2.5
8.38	27.5	14.60	2.01	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	7	1.52	1.29	2.24	0.88	0.84	11.6	2.87		7		100			0.78	3.0
8.53	28.0	20.15	4.20	Silty Clay to Clay	CL	very stiff	120	1.5	13	1.55	1.30	4.55	0.90	0.83	15.8	2.95		13		100			1.11	4.3
8.69	28.5	54.54	3.35	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	22	1.58	1.32	3.45	0.77	0.84	43.5	2.54	129.2	19	26	70	42	33		
8.84	29.0	113.66	1.04	Sand to Silty Sand	SP/SM	medium dense	120	4.0	28	1.61	1.33	1.06	0.59	0.87	93.7	1.95	116.0	25	23	25	74	35		
8.99	29.5	121.52	1.09	Sand to Silty Sand	SP/SM	medium dense	120	4.0	30	1.64	1.35	1.10	0.59	0.87	99.6	1.94	122.3	26	24	25	77	35		
9.14	30.0	92.38	2.73	Sandy Silt to Clayey Silt	ML	dense	120	2.5	37	1.67	1.36	2.78	0.70	0.84	73.2	2.31	145.7	32	29	50	64	36		
9.30	30.5	123.92	1.51	Sand to Silty Sand	SP/SM	medium dense	120	4.0	31	1.70	1.37	1.53	0.62	0.85	99.6	2.04	134.3	26	27	30	77	35		
9.45	31.0	59.13	3.65	Clayey Silt to Silty Clay	ML/CL	medium dense	120	2.0	30	1.73	1.39	3.76	0.78	0.81	45.2	2.55	137.9	25	28	70	44	35		
9.60	31.5	46.85	2.08	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	19	1.76	1.40	2.16	0.75	0.81	35.8	2.47	93.4	16	19	65	34	32		
9.75	32.0	57.38	1.71	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	19	1.79	1.42	1.77	0.71	0.81	44.0	2.34	92.1	16	18	55	43	32		
9.91	32.5	25.04	3.66	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	1.82	1.43	3.95	0.87	0.77	18.2	2.86		13		100			1.39	4.9
10.06	33.0	41.59	4.50	Silty Clay to Clay	CL	hard	120	1.5	28	1.85	1.45	4.71	0.84	0.77	30.3	2.75		28		90			2.36	8.2
10.21	33.5	189.01	1.26	Sand	SP	dense	120	5.0	38	1.88	1.46	1.27	0.57	0.83	148.8	1.85	170.8	31	34	25	93	36		
10.36	34.0	291.75	0.77	Sand	SP	dense	120	5.0	58	1.91	1.48	0.78	0.50	0.85	233.5	1.56	233.5	48	47	10	100	40		
10.52	34.5	342.20	0.60	Gravelly Sand to Sand	SW	dense	120	6.0	57	1.94	1.49	0.61	0.50	0.84	272.5	1.44	272.5	47	55	5	100	40		
10.67	35.0	353.66	0.47	Gravelly Sand to Sand	SW	dense	120	6.0	59	1.97	1.50	0.47	0.50	0.84	280.3	1.36	280.3	48	56	5	100	40		
10.82	35.5	311.67	0.53	Gravelly Sand to Sand	SW	dense	120	6.0	52	2.00	1.52	0.54	0.50	0.83	245.9	1.44	245.9	42	49	5	100	39		
10.97	36.0	305.82	0.48	Gravelly Sand to Sand	SW	dense	120	6.0	51	2.03	1.53	0.49	0.50	0.83	240.1	1.42	240.1	41	48	5	100	39		
11.13	36.5	333.40	0.50	Gravelly Sand to Sand	SW	dense	120	6.0	56	2.06	1.55	0.50	0.50	0.83	260.5	1.40	260.5	45	52	5	100	39		
11.28	37.0	361.30	0.45	Gravelly Sand to Sand	SW	dense	120	6.0	60	2.09	1.56	0.45	0.50	0.82	281.0	1.35	281.0	48	56	5	100	40		
11.43	37.5	343.66	0.48	Gravelly Sand to Sand	SW	dense	120	6.0	57	2.12	1.58	0.48	0.50	0.82	266.1	1.38	266.1	46	53	5	100	40		
11.58	38.0	393.13	0.67	Gravelly Sand to Sand	SW	very dense	120	6.0	66	2.15	1.59	0.68	0.50	0.82	303.0	1.44	303.0	52	61	5	100	41		
11.73	38.5	429.71	0.69	Gravelly Sand to Sand	SW	very dense	120	6.0	72	2.18	1.61	0.70	0.50	0.81	329.7	1.43	329.7	57	66	5	100	42		
11.89	39.0	507.53	0.72	Gravelly Sand to Sand	SW	very dense	120	6.0	85	2.21	1.62	0.72	0.50	0.81	387.7	1.39	387.7	66	78	5	100	43		
12.04	39.5	429.81	0.76	Gravelly Sand to Sand	SW	very dense	120	6.0	72	2.24	1.63	0.77	0.50	0.80	326.9	1.46	326.9	56	65	5	100	42		

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 303415-002 | Date: 03/05/20

CPT SOUNDING: CPT-5 | Plot: 5 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N

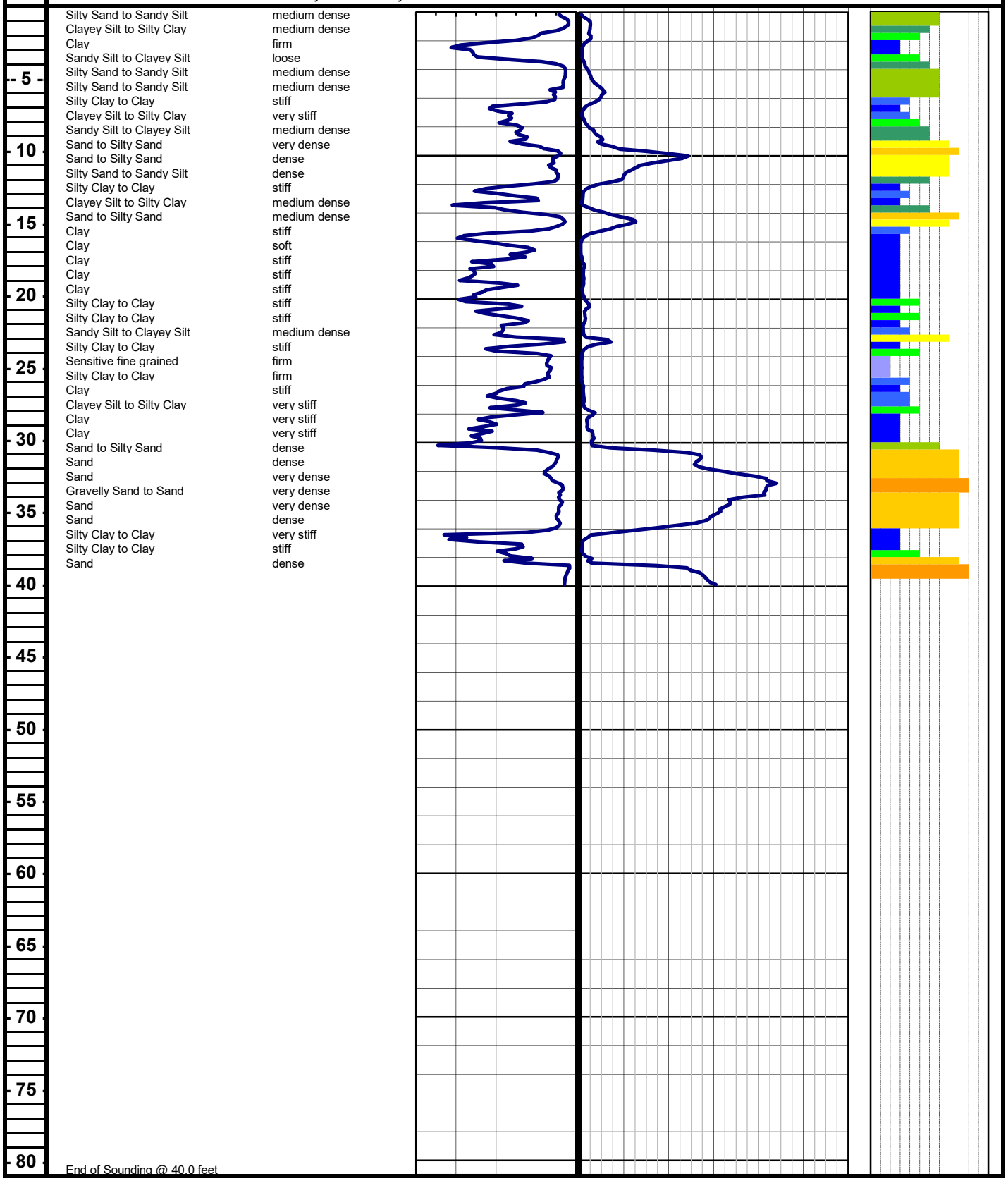
Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17 Su (tsf)	OCR
12.19	40.0	356.47	0.74	Gravelly Sand to Sand	SW	dense	120	6.0	59	2.27	1.65	0.75	0.50	0.80	269.9	1.51	269.9	46	54	10	100	40		
12.34	40.5	375.62	0.56	Gravelly Sand to Sand	SW	dense	120	6.0	63	2.30	1.66	0.56	0.50	0.80	283.2	1.41	283.2	49	57	5	100	40		
12.50	41.0	351.05	0.43	Gravelly Sand to Sand	SW	dense	120	6.0	59	2.33	1.68	0.43	0.50	0.79	263.5	1.35	263.5	45	53	5	100	40		
12.65	41.5	311.94	0.28	Gravelly Sand to Sand	SW	dense	120	6.0	52	2.36	1.69	0.29	0.50	0.79	233.2	1.29	233.2	40	47	0	100	38		
12.80	42.0	266.55	0.42	Gravelly Sand to Sand	SW	dense	120	6.0	44	2.39	1.71	0.42	0.50	0.79	198.4	1.45	198.4	34	40	5	100	37		
12.95	42.5	259.94	0.50	Sand	SP	dense	120	5.0	52	2.42	1.72	0.51	0.50	0.78	192.7	1.50	192.7	40	39	10	100	38		
13.11	43.0	268.03	0.71	Sand	SP	dense	120	5.0	54	2.45	1.73	0.72	0.50	0.78	197.8	1.59	197.8	41	40	10	100	39		
13.26	43.5	119.01	2.20	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	40	2.48	1.75	2.25	0.68	0.71	80.1	2.22	137.3	30	27	45	68	36		
13.41	44.0	230.61	1.29	Sand	SP	dense	120	5.0	46	2.51	1.76	1.31	0.56	0.75	163.7	1.83	185.4	35	37	20	97	37		
13.56	44.5	322.49	0.91	Sand	SP	dense	120	5.0	64	2.54	1.78	0.92	0.50	0.77	235.1	1.61	235.1	48	47	10	100	40		
13.72	45.0	341.97	0.90	Sand	SP	very dense	120	5.0	68	2.57	1.79	0.91	0.50	0.77	248.3	1.60	248.3	51	50	10	100	41		
13.87	45.5	310.89	1.06	Sand	SP	dense	120	5.0	62	2.60	1.81	1.07	0.51	0.76	223.3	1.68	228.6	46	46	15	100	40		
14.02	46.0	371.01	0.71	Gravelly Sand to Sand	SW	dense	120	6.0	62	2.63	1.82	0.72	0.50	0.76	267.3	1.50	267.3	46	53	10	100	40		
14.17	46.5	390.75	0.45	Gravelly Sand to Sand	SW	dense	120	6.0	65	2.66	1.84	0.45	0.50	0.76	280.4	1.35	280.4	48	56	5	100	40		
14.33	47.0	403.61	0.48	Gravelly Sand to Sand	SW	dense	120	6.0	67	2.69	1.85	0.48	0.50	0.76	288.5	1.36	288.5	49	58	5	100	40		
14.48	47.5	412.80	0.35	Gravelly Sand to Sand	SW	very dense	120	6.0	69	2.72	1.86	0.35	0.50	0.75	293.9	1.26	293.9	50	59	0	100	41		
14.63	48.0	368.76	0.34	Gravelly Sand to Sand	SW	dense	120	6.0	61	2.75	1.88	0.35	0.50	0.75	261.5	1.30	261.5	45	52	5	100	40		
14.78	48.5	232.55	0.65	Sand	SP	dense	120	5.0	47	2.78	1.89	0.66	0.50	0.75	164.3	1.63	164.3	34	33	15	97	37		
14.94	49.0	70.01	3.75	Clayey Silt to Silty Clay	ML/CL	medium dense	120	2.0	35	2.81	1.91	3.91	0.79	0.63	41.6	2.59	135.9	25	27	75	40	35		
15.09	49.5	62.16	3.67	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	31	2.84	1.92	3.84	0.80	0.62	36.5	2.63		31		80			3.54	9.3
15.24	50.0	219.30	1.35	Sand	SP	dense	120	5.0	44	2.87	1.94	1.37	0.57	0.71	146.5	1.88	171.6	32	34	25	93	36		
15.39	50.5	296.50	0.92	Sand	SP	dense	120	5.0	59	2.90	1.95	0.93	0.51	0.73	205.4	1.66	207.3	42	41	15	100	39		
15.54	51.0	303.00	0.90	Sand	SP	dense	120	5.0	61	2.93	1.97	0.91	0.50	0.73	209.6	1.65	209.9	43	42	15	100	39		
15.70	51.5	253.49	0.50	Gravelly Sand to Sand	SW	dense	120	6.0	42	2.96	1.98	0.50	0.50	0.73	175.2	1.53	175.2	30	35	10	100	36		
15.85	52.0	117.38	1.63	Sand to Silty Sand	SP/SM	medium dense	120	4.0	29	2.99	1.99	1.67	0.66	0.66	73.1	2.16	114.9	21	23	40	64	33		
16.00	52.5	25.90	2.95	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	3.02	2.01	3.34	0.89	0.57	13.8	2.91		13		100			1.41	3.4
16.15	53.0	17.34	2.15	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	9	3.05	2.02	2.61	0.92	0.55	9.0	3.00		9		100			0.90	2.1
16.31	53.5	30.63	2.46	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	12	3.08	2.04	2.73	0.85	0.57	16.5	2.80		12		95			1.68	4.1
16.46	54.0	98.03	0.99	Sand to Silty Sand	SP/SM	medium dense	120	4.0	25	3.11	2.05	1.03	0.64	0.66	60.7	2.09	87.1	17	17	35	56	32		
16.61	54.5	36.11	4.01	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	18	3.14	2.07	4.39	0.88	0.56	19.0	2.88		18		100			2.00	4.8
16.76	55.0	23.59	4.54	Silty Clay to Clay	CL	very stiff	120	1.5	16	3.17	2.08	5.25	0.94	0.53	11.8	3.09		16		100			1.27	2.9
16.92	55.5	33.73	4.68	Silty Clay to Clay	CL	very stiff	120	1.5	22	3.20	2.09	5.17	0.90	0.54	17.2	2.95		22		100			1.86	4.4
17.07	56.0	49.28	3.55	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	25	3.23	2.11	3.80	0.83	0.56	26.2	2.73		25		90			2.77	6.5
17.22	56.5	36.80	3.59	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	18	3.26	2.12	3.94	0.87	0.55	19.0	2.85		18		100			2.04	4.7
17.37	57.0	57.10	3.52	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	29	3.29	2.14	3.73	0.82	0.56	30.4	2.68		29		85			3.23	7.5
17.53	57.5	77.85	2.64	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	31	3.32	2.15	2.76	0.75	0.59	43.1	2.48	114.0	21	23	65	42	34		
17.68	58.0	266.25	0.70	Sand	SP	dense	120	5.0	53	3.35	2.17	0.71	0.50	0.70	175.8	1.63	175.8	36	35	15	100	38		
17.83	58.5	305.45	0.48	Gravelly Sand to Sand	SW	dense	120	6.0	51	3.38	2.18	0.48	0.50	0.70	201.1	1.48	201.1	34	40	5	100	37		
17.98	59.0	203.98	0.68	Sand	SP	medium dense	120	5.0	41	3.41	2.20	0.69	0.53	0.68	131.2	1.72	137.7	28	28	15	88	35		
18.14	59.5	50.17	4.07	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	25	3.44	2.21	4.37	0.85	0.54	25.4	2.78		25		95			2.82	6.3
18.29	60.0	33.14	2.00	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	13	3.47	2.22	2.24	0.84	0.54	16.8	2.74		13		90			1.82	4.0
18.44	60.5	31.46	3.34	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	16	3.50	2.24	3.76	0.89	0.51	15.3	2.91		16		100			1.72	3.7
18.59	61.0	74.21	1.73	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	25	3.53	2.25	1.81	0.73	0.58	40.5	2.38	90.1	16	18	55	39	32		
18.75	61.5	39.98	3.56	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	20	3.56	2.27	3.91	0.86	0.52	19.5	2.83		20		100			2.22	4.8
18.90	62.0	63.42	3.26	Sandy Silt to Clayey Silt	ML	hard	120	2.5	25	3.59	2.28	3.46	0.80	0.54	32.3	2.63		25		80			3.60	7.9
19.05	62.5	57.25	4.43	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	29	3.62	2.30	4.73	0.84	0.52	28.1	2.77		29		95			3.23	7.0
19.20	63.0	41.09	4.34	Silty Clay to Clay	CL	hard	120	1.5	27	3.65	2.31	4.77	0.88	0.50	19.5	2.89		27		100			2.28	4.9
19.35	63.5	27.14	3.13	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	14	3.68	2.33	3.62	0.91	0.49	12.6	2.96		14		100			1.46	3.0
19.51	64.0	47.92	3.23	Sandy Silt to Clayey Silt	ML	hard	120	2.5	19	3.71	2.34	3.51	0.84	0.51	23.3	2.75		19		90			2.68	5.7
19.66	64.5	32.75	4.03	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	16	3.74	2.35	4.55	0.91	0.48	15.0	2.96		16		100			1.79	3.7
19.81	65.0	50.01	3.20	Sandy Silt to Clayey Silt	ML	hard	120	2.5	20	3.77	2.37	3.47	0.83	0.51	24.2	2.73		20		90			2.80	5.9
19.96	65.5	70.80	3.03	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	28	3.80	2.38	3.20	0.79	0.53	35.3	2.58	113.8	18	23	75	34	33		
20.12	66.0	22.86	5.15	Clay	CL/CH	very stiff	120	1.0	23	3.83	2.40	6.19	0.98	0.45	9.7	3.20		23		100			1.20	2.4
20.27	66.5	18.94	4.29	Silty Clay to Clay	CL	stiff	120	1.5	13	3.86	2.41	5.38	0.99	0.44	7.9	3.23		13		100			0.97	1.9
20.42	67.0	39.87	4.65	Silty Clay to Clay	CL	hard	120	1.5	27	3.89	2.43	5.16	0.90	0.47	17.9	2.94		27		100			2.20	4.4
20.57	67.5	152.32	1.89	Sand to Silty Sand	SP/SM	medium dense	120	4.0	38	3.92	2.44	1.94	0.66	0.58	82.9	2.16	131.1	24	26	40	69	35		
20.73	68.0	53.34	5.10	Silty Clay to Clay	CL	hard	120	1.5	36	3.95	2.45	5.51	0.87	0.48	24.2	2.86		36		100			2.99	6.0
20.88	68.5	92.08	3.71	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	37	3.98	2.47	3.88	0.78	0.52	44.9	2.56	139.8	23	28	75	44	34		
21.03	69.0	241.60	1.14	Sand	SP	dense	120	5.0	48	4.01	2.48	1.16	0.56	0.62	141.0	1.84	160.7	31	32	20	91	36		
21.18	69.5	82.05	4.29	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	41	4.04	2.50	4.51	0.81	0.50	38.7	2.66		41		80			4.68	9.4
21.34	70.0	135.40	2.55	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	45	4.07	2.51	2.63	0.70	0.54	69.6	2.31	137.9	28	28	50	62	36		
21.49	70.5	163.12	1.69	Sand to Silty Sand	SP/SM	medium dense	120	4.0	41	4.10	2.53	1.74	0.65	0.57	87.9	2.11	129.8	26	26	35	71	35		
21.64	71.0	68.23	3.74	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	34	4.13	2.54	3.99	0.82	0.49	31.5	2.68		34		85			3.86	7.6
21.79	71.5	38.65	3.43	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	19	4.16	2.56	3.84	0.88	0.46	16.8	2.88		19		100			2.12	4.0
21.95	72.0	24.65	4.07	Silty Clay to Clay	CL	very stiff	120	1.5	16	4.19	2.57	4.90	0.96	0.43	10.0	3.12		16		100			1.30	2.4
22.10	72.5	50.33	4.92	Silty Clay to Clay	CL	hard	120	1.5	34	4.22	2.58	5.38	0.88	0.46	21.7	2.89		34		100			2.81	5.4
22.25	73.0	105.73	2.50	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	35	4.25	2.60	2.61	0.73	0.52	51.7	2.40	119.7	22	24	60	49	34		
22.40	73.5	64.17	4.31	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	32	4.28	2.61	4.62	0.84	0.47	28.3	2.76		32		95			3.62	6.9
22.56	74.0	144.90	2.23	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	48	4.31	2.63	2.30	0.69	0.53	73.3	2.25	132.4	30	26	45	64	36		
22.71	74.5	186.03	1.40	Sand to Silty Sand	SP/SM	medium dense	120	4.0	47	4.34	2.64	1.43	0.62	0.57	100.1	2.01	131.8	29	26	30	77	36		

Earth Systems
Pacific

CPT No : CPT-6
Project Name: Arctic Cold
Project No.: 09340-01
Location: See Site Exploration Plan

Cone Penetrometer: **Kehoe Testing and Engineerin**
Truck Mounted Electric Cone
with 23-ton reaction weight
Date: 3/5/2020

Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
Silty Sand to Sandy Silt	medium dense
Clayey Silt to Silty Clay	medium dense
Clay	firm
Sandy Silt to Clayey Silt	loose
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Clay to Clay	stiff
Clayey Silt to Silty Clay	very stiff
Sandy Silt to Clayey Silt	medium dense
Sand to Silty Sand	very dense
Sand to Silty Sand	dense
Silty Sand to Sandy Silt	dense
Silty Clay to Clay	stiff
Clayey Silt to Silty Clay	medium dense
Sand to Silty Sand	medium dense
Clay	stiff
Clay	soft
Clay	stiff
Clay	stiff
Clay	stiff
Silty Clay to Clay	stiff
Silty Clay to Clay	stiff
Sandy Silt to Clayey Silt	medium dense
Silty Clay to Clay	stiff
Sensitive fine grained	firm
Silty Clay to Clay	firm
Clay	stiff
Clayey Silt to Silty Clay	very stiff
Clay	very stiff
Clay	very stiff
Sand to Silty Sand	dense
Sand	dense
Sand	very dense
Gravelly Sand to Sand	very dense
Sand	very dense
Sand	dense
Silty Clay to Clay	very stiff
Silty Clay to Clay	stiff
Sand	dense



End of Sounding @ 40.0 feet

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 09340-01 | Date: 03/05/20

CPT SOUNDING: CPT-6 | Plot: 6 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17 Su (tsf)	OCR
0.15	0.5	18.39	0.52	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	6	0.01	0.01	0.52	0.67	1.70	29.5	2.21	49.8	10	10	45	26	30		
0.30	1.0	25.00	0.51	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	8	0.04	0.04	0.51	0.63	1.70	40.2	2.08	57.3	14	11	35	39	31		
0.46	1.5	23.96	1.58	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	10	0.07	0.07	1.58	0.72	1.70	38.5	2.36	82.9	16	17	55	37	32		
0.61	2.0	19.96	3.25	Clayey Silt to Silty Clay	ML/CL	very stiff	110	2.0	10	0.10	0.10	3.27	0.79	1.70	32.1	2.62		10		80			1.17	61.9
0.76	2.5	8.13	5.79	Clay	CL/CH	firm	110	1.0	8	0.12	0.12	5.88	0.93	1.70	13.1	3.08		8		100			0.47	19.4
0.91	3.0	7.43	5.08	Clay	CL/CH	firm	110	1.0	7	0.15	0.15	5.19	0.93	1.70	11.9	3.08		7		100			0.43	14.4
1.07	3.5	10.81	2.09	Clayey Silt to Silty Clay	ML/CL	stiff	110	2.0	5	0.18	0.18	2.12	0.82	1.70	17.4	2.71		5		90			0.63	17.8
1.22	4.0	18.00	0.57	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	7	0.21	0.21	0.58	0.68	1.70	28.9	2.24	50.9	12	10	45	25	31		
1.37	4.5	25.45	0.56	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	8	0.23	0.23	0.56	0.64	1.70	40.9	2.10	59.3	14	12	35	40	31		
1.52	5.0	35.57	0.65	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	12	0.26	0.26	0.65	0.61	1.70	57.1	2.00	74.3	20	15	30	54	33		
1.68	5.5	52.51	1.04	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	18	0.29	0.29	1.04	0.60	1.70	84.4	1.98	107.5	30	21	30	70	36		
1.83	6.0	43.23	1.19	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	14	0.32	0.32	1.20	0.63	1.70	69.5	2.08	99.0	24	20	35	62	35		
1.98	6.5	16.18	3.72	Silty Clay to Clay	CL	stiff	110	1.5	11	0.34	0.34	3.81	0.83	1.70	26.0	2.73		11		90			0.93	13.8
2.13	7.0	7.24	3.50	Clay	CL/CH	firm	110	1.0	7	0.37	0.37	3.69	0.91	1.70	11.6	3.00		7		100			0.40	5.5
2.29	7.5	11.78	3.51	Silty Clay to Clay	CL	stiff	110	1.5	8	0.40	0.40	3.63	0.86	1.70	18.9	2.82		8		100			0.67	8.6
2.44	8.0	24.86	2.82	Clayey Silt to Silty Clay	ML/CL	medium dense	110	2.0	12	0.43	0.43	2.87	0.76	1.70	40.0	2.51	112.8	19	23	70	39	33		
2.59	8.5	40.78	2.79	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	16	0.45	0.45	2.82	0.71	1.70	65.5	2.35	139.0	24	28	55	59	34		
2.74	9.0	48.10	2.86	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	19	0.48	0.48	2.89	0.70	1.70	77.3	2.31	152.6	28	31	50	66	35		
2.90	9.5	103.37	1.46	Sand to Silty Sand	SP/SM	dense	100	4.0	26	0.51	0.51	1.47	0.58	1.53	149.4	1.90	177.2	36	35	25	93	38		
3.05	10.0	223.89	0.95	Sand	SP	very dense	100	5.0	45	0.53	0.53	0.95	0.50	1.41	298.3	1.56	298.3	61	60	10	100	43		
3.20	10.5	165.01	1.23	Sand to Silty Sand	SP/SM	very dense	100	4.0	41	0.56	0.56	1.23	0.53	1.40	218.8	1.73	231.7	55	46	15	100	42		
3.35	11.0	115.35	1.10	Sand to Silty Sand	SP/SM	dense	100	4.0	29	0.58	0.58	1.10	0.55	1.39	151.5	1.81	168.2	38	34	20	94	38		
3.51	11.5	97.92	0.91	Sand to Silty Sand	SP/SM	dense	100	4.0	24	0.61	0.61	0.92	0.55	1.36	125.8	1.81	140.1	31	28	20	86	36		
3.66	12.0	48.26	2.25	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	19	0.63	0.63	2.28	0.70	1.43	65.2	2.29	124.3	24	25	50	59	34		
3.81	12.5	11.65	4.53	Clay	CL/CH	stiff	110	1.0	12	0.66	0.66	4.80	0.90	1.52	16.8	2.94		12		100			0.65	5.0
3.96	13.0	7.94	2.32	Silty Clay to Clay	CL	firm	110	1.5	5	0.69	0.69	2.54	0.89	1.47	11.0	2.92		5		100			0.43	3.2
4.11	13.5	12.36	4.98	Clay	CL/CH	stiff	110	1.0	12	0.72	0.72	5.29	0.91	1.42	16.6	2.97		12		100			0.68	4.9
4.27	14.0	55.36	2.57	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	22	0.74	0.74	2.60	0.71	1.28	67.1	2.32	134.9	26	27	50	60	35		
4.42	14.5	114.69	0.67	Sand	SP	medium dense	100	5.0	23	0.77	0.77	0.68	0.53	1.18	128.1	1.72	134.7	26	27	15	87	35		
4.57	15.0	86.46	1.01	Sand to Silty Sand	SP/SM	medium dense	100	4.0	22	0.80	0.80	1.02	0.59	1.18	96.7	1.93	117.4	24	23	25	75	34		
4.72	15.5	27.97	4.09	Silty Clay to Clay	CL	very stiff	110	1.5	19	0.82	0.82	4.21	0.82	1.23	32.5	2.69		19		85			1.60	9.9
4.88	16.0	5.29	4.65	Clay	CL/CH	firm	110	1.0	5	0.85	0.85	5.54	1.00	1.25	6.2	3.32		5		100			0.26	1.6
5.03	16.5	3.87	2.33	Clay	CL/CH	soft	110	1.0	4	0.88	0.88	3.01	1.00	1.21	4.4	3.30		4		100			0.18	1.0
5.18	17.0	5.93	3.12	Clay	CL/CH	firm	120	1.0	6	0.91	0.91	3.68	0.99	1.17	6.5	3.20		6		100			0.30	1.7
5.33	17.5	10.20	4.53	Clay	CL/CH	stiff	120	1.0	10	0.94	0.94	4.98	0.95	1.12	10.8	3.10		10		100			0.55	3.0
5.49	18.0	9.62	5.16	Clay	CL/CH	stiff	120	1.0	10	0.97	0.97	5.73	0.97	1.09	9.9	3.17		10		100			0.51	2.7
5.64	18.5	10.28	5.49	Clay	CL/CH	stiff	120	1.0	10	1.00	1.00	6.07	0.97	1.06	10.3	3.17		10		100			0.55	2.8
5.79	19.0	9.01	3.53	Clay	CL/CH	firm	120	1.0	9	1.03	1.03	3.98	0.96	1.03	8.8	3.11		9		100			0.47	2.3
5.94	19.5	8.05	4.77	Clay	CL/CH	firm	120	1.0	8	1.06	1.06	5.49	1.00	1.00	7.6	3.25		8		100			0.41	2.0
6.10	20.0	13.82	5.47	Clay	CL/CH	stiff	120	1.0	14	1.09	1.09	5.93	0.94	0.98	12.8	3.09		14		100			0.75	3.5
6.25	20.5	20.48	3.28	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	10	1.12	1.10	3.47	0.86	0.97	18.7	2.82		10		100			1.14	5.3
6.40	21.0	12.84	4.44	Clay	CL/CH	stiff	120	1.0	13	1.15	1.11	4.87	0.94	0.95	11.6	3.07		13		100			0.69	3.1
6.55	21.5	12.94	2.67	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.18	1.13	2.93	0.90	0.94	11.5	2.94		6		100			0.69	3.1
6.71	22.0	9.08	3.68	Clay	CL/CH	firm	120	1.0	9	1.21	1.14	4.24	0.97	0.93	8.0	3.16		9		100			0.47	2.1
6.86	22.5	12.16	3.62	Silty Clay to Clay	CL	stiff	120	1.5	8	1.24	1.16	4.03	0.93	0.92	10.6	3.05		8		100			0.65	2.8
7.01	23.0	57.18	0.97	Sand to Silty Sand	SP/SM	medium dense	120	4.0	14	1.27	1.17	0.99	0.65	0.94	50.6	2.15	78.0	13	16	40	49	31		
7.16	23.5	13.27	3.95	Clay	CL/CH	stiff	120	1.0	13	1.30	1.19	4.38	0.93	0.90	11.3	3.05		13		100			0.71	3.0
7.32	24.0	6.54	1.53	Clayey Silt to Silty Clay	ML/CL	firm	120	2.0	3	1.33	1.20	1.91	0.97	0.89	5.5	3.12		3		100			0.31	1.3
7.47	24.5	5.88	1.45	Sensitive fine grained	ML	firm	120	2.0	3	1.36	1.21	1.89	0.98	0.87	4.8	3.16		3		100			0.27	1.1
7.62	25.0	5.97	1.31	Sensitive fine grained	ML	firm	120	2.0	3	1.39	1.23	1.71	0.98	0.86	4.9	3.14		3		100			0.28	1.1
7.77	25.5	5.99	1.47	Sensitive fine grained	ML	firm	120	2.0	3	1.42	1.24	1.92	0.98	0.85	4.8	3.17		3		100			0.28	1.1
7.92	26.0	8.35	2.42	Silty Clay to Clay	CL	firm	120	1.5	6	1.45	1.26	2.92	0.97	0.85	6.7	3.14		6		100			0.42	1.6
8.08	26.5	9.68	3.96	Clay	CL/CH	firm	120	1.0	10	1.48	1.27	4.67	0.98	0.83	7.6	3.20		10		100			0.49	1.9
8.23	27.0	10.95	3.14	Silty Clay to Clay	CL	stiff	120	1.5	7	1.51	1.29	3.64	0.95	0.83	8.6	3.10		7		100			0.57	2.2
8.38	27.5	14.79	3.45	Silty Clay to Clay	CL	stiff	120	1.5	10	1.54	1.30	3.85	0.92	0.83	11.6	3.01		10		100			0.79	3.1
8.53	28.0	29.01	2.98	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	15	1.57	1.32	3.15	0.83	0.83	22.9	2.72		15		90			1.63	6.3
8.69	28.5	18.05	4.40	Clay	CL/CH	stiff	120	1.0	18	1.60	1.33	4.83	0.92	0.81	13.8	3.01		18		100			0.98	3.7
8.84	29.0	22.30	4.71	Clay	CL/CH	very stiff	120	1.0	22	1.63	1.34	5.08	0.90	0.81	17.0	2.95		22		100			1.23	4.6
8.99	29.5	31.47	4.92	Clay	CL/CH	very stiff	120	1.0	31	1.66	1.36	5.19	0.87	0.81	23.9	2.85		31		100			1.77	6.6
9.14	30.0	28.49	5.64	Clay	CL/CH	very stiff	120	1.0	28	1.69	1.37	5.99	0.89	0.79	21.3	2.93		28		100			1.59	5.9
9.30	30.5	158.50	2.47	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	53	1.72	1.39	2.50	0.65	0.84	125.8	2.12	187.8	45	38	40	86	40		
9.45	31.0	269.99	0.93	Sand	SP	dense	120	5.0	54	1.75	1.40	0.94	0.50	0.87	221.7	1.64	221.7	46	44	15	100	40		
9.60	31.5	261.68	1.10	Sand	SP	dense	120	5.0	52	1.78	1.42	1.11	0.52	0.86	212.5	1.70	221.2	44	44	15	100	39		
9.75	32.0	321.13	1.51	Sand	SP	very dense	120	5.0	64	1.81	1.43	1.51	0.54	0.85	258.3	1.76	277.7	54	56	20	100	41		
9.91	32.5	408.98	1.27	Sand	SP	very dense	120	5.0	82	1.84	1.45	1.28	0.50	0.86	330.8	1.63	330.8	68	66	15	100	44		
10.06	33.0	425.55	0.75	Gravelly Sand to Sand	SW	very dense	120	6.0	71	1.87	1.46	0.75	0.50	0.85	342.5	1.44	342.5	59	68	5	100	42		
10.21	33.5	413.97	0.78	Gravelly Sand to Sand	SW	very dense	120	6.0	69	1.90	1.47	0.79	0.50	0.85	331.5	1.46	331.5	57	66	5	100	42		
10.36	34.0	345.72	0.81	Sand	SP	very dense	120	5.0	69	1.93	1.49	0.81	0.50	0.84	275.5	1.53	275.5	57	55	10	100	42		
10.52	34.5	324.30	0.83	Sand	SP	very dense	120	5.0	65	1.96	1.50	0.84	0.50	0.84	257.2	1.56	257.2	53	51	10	100	41		
10.67	35.0	305.37	0.93	Sand	SP	dense	120	5.0	61	1.99	1.52	0.93	0.50	0.84	241.0	1.61	241.0	50	48	10	100	40		
10.82	35.5	276.21	0.89	Sand	SP	dense	120	5.0	55	2.02	1.53	0.90	0.50	0.83	217.0	1.63	217.0	45	43	15	100	39		
10.97	36.0	171.27	1.10	Sand	SP	medium dense	120	5.0	34	2.05	1.55	1.12	0.57	0.81	130.6	1.85	150.1	28	30	25	88	35		
11.13	36.5	32.93	5.22	Clay	CL/CH	very stiff	120	1.0	33	2.08	1.56	5.57	0.88	0.71	22.1	2.90		33		100			1.85	5.9
11.28	37.0	7.47	3.41	Clay	CL/CH	firm	120	1.0	7	2.11	1.57	4.75	1.00	0.67	4.7	3.38		7		100			0.35	1.0

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold Project No: 09340-01 Date: 03/05/20

CPT SOUNDING: CPT-6 Plot: 6 Density: 1 SPT N Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** Dr correlation: 0 Baldi Qc/N: 1.00 Robertson Phi Correlation: 4 SPT N

Nk: 17

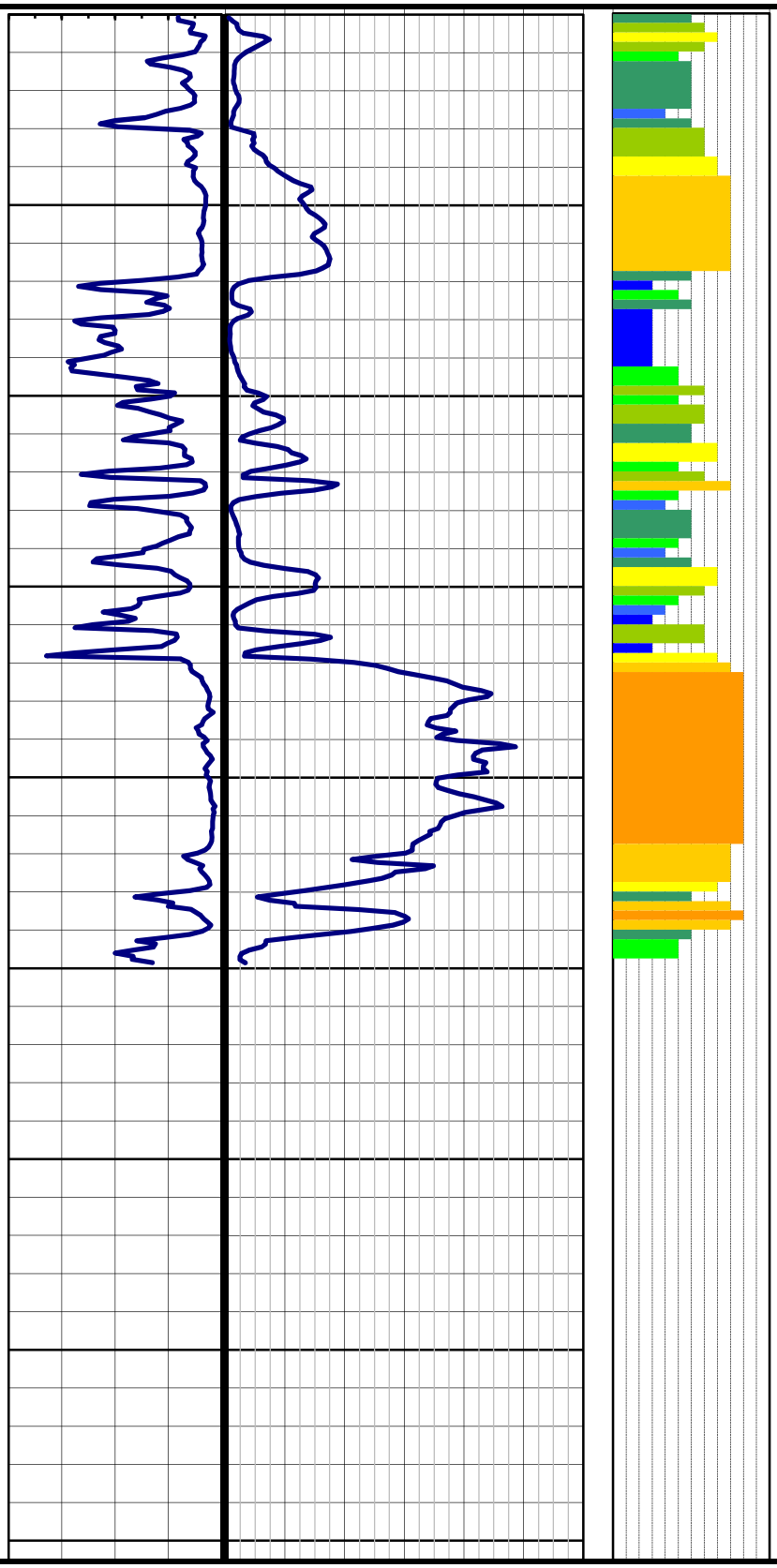
Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
11.43	37.5	7.28	3.49	Clay	CL/CH	firm	120	1.0	7	2.14	1.59	4.94	1.00	0.67	4.6	3.40		7		100			0.33	1.0
11.58	38.0	20.85	3.03	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	10	2.17	1.60	3.38	0.89	0.69	13.6	2.92		10		100			1.13	3.5
11.73	38.5	146.93	1.05	Sand	SP	medium dense	120	5.0	29	2.20	1.62	1.07	0.58	0.78	108.5	1.90	129.2	23	26	25	80	34		
11.89	39.0	264.85	0.45	Gravelly Sand to Sand	SW	dense	120	6.0	44	2.23	1.63	0.46	0.50	0.81	201.5	1.46	201.5	35	40	5	100	37		
12.04	39.5	286.27	0.56	Gravelly Sand to Sand	SW	dense	120	6.0	48	2.26	1.65	0.57	0.50	0.80	216.9	1.49	216.9	37	43	10	100	38		

Earth Systems
Pacific

CPT No : **CPT-7**
Project Name: Arctic Cold
Project No.: 09340-01
Location: See Site Exploration Plan

Cone Penetrometer: **Kehoe Testing and Engineerin**
Truck Mounted Electric Cone
with 23-ton reaction weight
Date: 3/6/2020

DEPTH (FEET)	Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
	Silty Sand to Sandy Silt	medium dense
	Silty Sand to Sandy Silt	medium dense
	Clayey Silt to Silty Clay	medium dense
	Sandy Silt to Clayey Silt	medium dense
	Sandy Silt to Clayey Silt	medium dense
5	Clayey Silt to Silty Clay	very stiff
	Silty Sand to Sandy Silt	medium dense
	Sand to Silty Sand	medium dense
	Sand to Silty Sand	dense
	Sand	dense
10	Sand	dense
	Sand	dense
	Sand	dense
	Silty Sand to Sandy Silt	dense
	Silty Clay to Clay	stiff
15	Clayey Silt to Silty Clay	very stiff
	Clay	firm
	Clay	stiff
	Clay	very stiff
	Sandy Silt to Clayey Silt	medium dense
20	Sandy Silt to Clayey Silt	medium dense
	Silty Sand to Sandy Silt	medium dense
	Silty Sand to Sandy Silt	medium dense
	Silty Sand to Sandy Silt	medium dense
	Sand to Silty Sand	medium dense
25	Clayey Silt to Silty Clay	very stiff
	Sandy Silt to Clayey Silt	very stiff
	Sandy Silt to Clayey Silt	very stiff
	Sandy Silt to Clayey Silt	medium dense
	Sand to Silty Sand	dense
30	Sandy Silt to Clayey Silt	medium dense
	Clay	stiff
	Silty Sand to Sandy Silt	dense
	Sandy Silt to Clayey Silt	dense
	Sand	very dense
35	Gravelly Sand to Sand	very dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	very dense
	Gravelly Sand to Sand	very dense
	Gravelly Sand to Sand	very dense
40	Gravelly Sand to Sand	very dense
	Gravelly Sand to Sand	very dense
	Gravelly Sand to Sand	dense
	Sand	dense
	Sand	dense
45	Sand	medium dense
	Sand to Silty Sand	dense
	Sand	dense
	Sandy Silt to Clayey Silt	medium dense
50		
55		
60		
65		
70		
75		
80	End of Sounding @ 49.9 feet	



Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 09340-01 | Date: 03/06/20

CPT SOUNDING: CPT-7 | Plot: 7 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N | Nk: 17

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
0.15	0.5	16.99	1.26	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	7	0.01	0.01	1.26	0.74	1.70	27.3	2.42	66.0	12	13	60	23	31		
0.30	1.0	39.08	0.99	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	13	0.04	0.04	0.99	0.63	1.70	62.8	2.07	87.8	22	18	35	58	34		
0.46	1.5	63.94	0.77	Sand to Silty Sand	SP/SM	medium dense	100	4.0	16	0.07	0.07	0.78	0.56	1.70	102.7	1.83	116.2	27	23	20	78	35		
0.61	2.0	35.24	1.12	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	12	0.09	0.09	1.13	0.65	1.70	56.6	2.14	86.4	20	17	40	53	33		
0.76	2.5	18.03	2.56	Clayey Silt to Silty Clay	ML/CL	medium dense	110	2.0	9	0.12	0.12	2.58	0.78	1.70	29.0	2.59	94.1	15	19	75	25	32		
0.91	3.0	15.11	1.51	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	6	0.15	0.15	1.53	0.76	1.70	24.3	2.51	68.9	10	14	70	18	30		
1.07	3.5	13.75	1.32	Sandy Silt to Clayey Silt	ML	loose	110	2.5	6	0.18	0.18	1.33	0.76	1.70	22.1	2.52	62.9	9	13	70	14	30		
1.22	4.0	17.42	1.22	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	7	0.20	0.20	1.23	0.73	1.70	28.0	2.41	66.0	12	13	60	24	31		
1.37	4.5	22.92	1.02	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	9	0.23	0.23	1.03	0.69	1.70	36.8	2.27	68.1	16	14	50	35	32		
1.52	5.0	16.60	1.61	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	7	0.26	0.26	1.64	0.76	1.70	26.7	2.50	73.4	11	15	65	22	30		
1.68	5.5	11.21	3.47	Silty Clay to Clay	CL	stiff	110	1.5	7	0.29	0.29	3.56	0.86	1.70	18.0	2.84		7		100			0.64	11.5
1.83	6.0	29.28	1.96	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	12	0.31	0.31	1.98	0.71	1.70	47.0	2.35	100.0	20	20	55	46	33		
1.98	6.5	47.44	1.20	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	16	0.34	0.34	1.21	0.63	1.70	76.2	2.05	105.1	27	21	35	66	35		
2.13	7.0	48.94	1.12	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	16	0.37	0.37	1.13	0.62	1.70	78.6	2.02	104.8	27	21	30	67	35		
2.29	7.5	66.46	1.12	Silty Sand to Sandy Silt	SM/ML	dense	110	3.0	22	0.40	0.40	1.13	0.59	1.70	106.8	1.92	129.3	35	26	25	80	37		
2.44	8.0	80.79	1.12	Sand to Silty Sand	SP/SM	dense	100	4.0	20	0.42	0.42	1.13	0.57	1.68	128.6	1.86	148.6	31	30	25	87	36		
2.59	8.5	104.68	1.05	Sand to Silty Sand	SP/SM	dense	100	4.0	26	0.45	0.45	1.05	0.54	1.59	157.8	1.78	172.2	39	34	20	96	38		
2.74	9.0	138.16	0.80	Sand	SP	dense	100	5.0	28	0.47	0.47	0.80	0.50	1.50	195.4	1.63	195.4	40	39	15	100	39		
2.90	9.5	130.10	0.60	Sand	SP	dense	100	5.0	26	0.50	0.50	0.61	0.50	1.46	179.3	1.58	179.3	37	36	10	100	38		
3.05	10.0	132.96	0.60	Sand	SP	dense	100	5.0	27	0.52	0.52	0.61	0.50	1.42	178.8	1.58	178.8	37	36	10	100	38		
3.20	10.5	149.38	0.67	Sand	SP	dense	100	5.0	30	0.55	0.55	0.68	0.50	1.39	196.3	1.58	196.3	40	39	10	100	39		
3.35	11.0	165.43	0.70	Sand	SP	dense	100	5.0	33	0.57	0.57	0.70	0.50	1.36	212.6	1.56	212.6	44	43	10	100	39		
3.51	11.5	150.79	0.84	Sand	SP	dense	100	5.0	30	0.60	0.60	0.85	0.50	1.33	190.2	1.65	191.3	39	38	15	100	38		
3.66	12.0	158.79	0.74	Sand	SP	dense	100	5.0	32	0.62	0.62	0.75	0.50	1.30	195.7	1.61	195.7	40	39	10	100	39		
3.81	12.5	170.87	0.74	Sand	SP	dense	100	5.0	34	0.65	0.65	0.75	0.50	1.28	206.4	1.59	206.4	42	41	10	100	39		
3.96	13.0	173.96	0.71	Sand	SP	dense	100	5.0	35	0.67	0.67	0.71	0.50	1.25	206.2	1.58	206.2	42	41	10	100	39		
4.11	13.5	146.16	0.86	Sand	SP	dense	100	5.0	29	0.70	0.70	0.86	0.52	1.24	171.3	1.69	176.8	35	35	15	99	37		
4.27	14.0	45.57	3.07	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	18	0.72	0.72	3.12	0.74	1.32	57.0	2.42	137.5	21	27	60	53	34		
4.42	14.5	12.52	4.21	Clay	CL/CH	stiff	110	1.0	13	0.75	0.75	4.48	0.90	1.36	16.1	2.94		13		100			0.69	4.7
4.57	15.0	11.52	2.46	Clayey Silt to Silty Clay	ML/CL	stiff	110	2.0	6	0.78	0.78	2.64	0.87	1.30	14.2	2.84		6		100			0.63	4.1
4.72	15.5	35.65	2.12	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	14	0.81	0.81	2.17	0.74	1.22	41.2	2.42	98.9	16	20	60	40	32		
4.88	16.0	20.62	4.52	Clay	CL/CH	very stiff	110	1.0	21	0.83	0.83	4.71	0.86	1.23	23.9	2.82		21		100			1.16	7.1
5.03	16.5	8.20	4.03	Clay	CL/CH	firm	110	1.0	8	0.86	0.86	4.50	0.96	1.22	9.4	3.12		8		100			0.43	2.6
5.18	17.0	7.78	4.51	Clay	CL/CH	firm	120	1.0	8	0.89	0.89	5.09	0.97	1.18	8.7	3.18		8		100			0.41	2.3
5.33	17.5	9.53	3.94	Clay	CL/CH	stiff	120	1.0	10	0.92	0.92	4.36	0.94	1.14	10.3	3.08		10		100			0.51	2.8
5.49	18.0	14.53	5.09	Clay	CL/CH	stiff	120	1.0	15	0.95	0.95	5.45	0.92	1.10	15.2	3.01		15		100			0.80	4.3
5.64	18.5	19.93	5.61	Clay	CL/CH	very stiff	120	1.0	20	0.98	0.98	5.90	0.90	1.07	20.2	2.94		20		100			1.11	5.8
5.79	19.0	26.38	3.65	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	1.01	1.01	3.79	0.83	1.04	25.9	2.73		13		90			1.49	7.5
5.94	19.5	33.40	2.92	Clayey Silt to Silty Clay	ML/CL	medium dense	120	2.0	17	1.04	1.04	3.01	0.79	1.01	32.0	2.60	106.0	16	21	75	30	32		
6.10	20.0	62.89	2.12	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	21	1.07	1.07	2.16	0.70	0.99	59.0	2.30	115.5	20	23	50	55	33		
6.25	20.5	50.05	3.58	Clayey Silt to Silty Clay	ML/CL	medium dense	120	2.0	25	1.10	1.08	3.66	0.77	0.98	46.4	2.54	137.3	24	27	70	45	34		
6.40	21.0	82.11	2.33	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	27	1.13	1.10	2.36	0.68	0.97	75.6	2.25	136.3	26	27	45	65	35		
6.55	21.5	87.82	1.74	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	29	1.16	1.11	1.76	0.65	0.97	80.3	2.14	123.7	28	25	40	68	35		
6.71	22.0	42.08	2.62	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	17	1.19	1.13	2.70	0.76	0.95	37.9	2.51	106.9	16	21	70	37	32		
6.86	22.5	54.14	2.39	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	22	1.22	1.14	2.44	0.73	0.95	48.4	2.40	112.4	20	22	60	47	33		
7.01	23.0	114.61	1.39	Sand to Silty Sand	SP/SM	medium dense	120	4.0	29	1.25	1.16	1.40	0.61	0.95	102.6	2.00	133.3	27	27	30	78	35		
7.16	23.5	120.43	1.19	Sand to Silty Sand	SP/SM	medium dense	120	4.0	30	1.28	1.17	1.21	0.59	0.94	107.2	1.94	131.9	28	26	25	80	35		
7.32	24.0	48.23	3.94	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	24	1.31	1.19	4.05	0.79	0.91	41.7	2.60		24		75			2.77	11.9
7.47	24.5	119.31	1.87	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	40	1.34	1.20	1.89	0.63	0.92	104.1	2.09	148.7	36	30	35	79	38		
7.62	25.0	139.15	0.78	Sand	SP	medium dense	120	5.0	28	1.37	1.21	0.79	0.54	0.93	122.1	1.78	133.2	25	27	20	85	35		
7.77	25.5	29.25	3.64	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	15	1.40	1.23	3.82	0.84	0.88	24.4	2.75		15		90			1.65	6.8
7.92	26.0	9.85	3.46	Silty Clay to Clay	CL	stiff	120	1.5	7	1.43	1.24	4.05	0.97	0.86	8.0	3.15		7		100			0.51	2.0
8.08	26.5	15.82	1.35	Sandy Silt to Clayey Silt	ML	stiff	120	2.5	6	1.46	1.26	1.48	0.84	0.87	12.9	2.74		6		90			0.86	3.4
8.23	27.0	22.41	1.18	Sandy Silt to Clayey Silt	ML	loose	120	2.5	9	1.49	1.27	1.26	0.79	0.87	18.3	2.57	58.0	8	12	75	6	29		
8.38	27.5	21.91	1.92	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	9	1.52	1.29	2.07	0.83	0.85	17.6	2.70		9		85			1.21	4.8
8.53	28.0	23.98	2.78	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	12	1.55	1.30	2.98	0.84	0.84	19.0	2.77		12		95			1.33	5.2
8.69	28.5	33.87	4.42	Silty Clay to Clay	CL	very stiff	120	1.5	23	1.58	1.31	4.64	0.85	0.83	26.6	2.78		23		95			1.92	7.4
8.84	29.0	100.84	2.72	Sandy Silt to Clayey Silt	ML	dense	120	2.5	40	1.61	1.33	2.76	0.69	0.85	81.4	2.28	153.1	35	31	50	68	37		
8.99	29.5	153.05	1.54	Sand to Silty Sand	SP/SM	dense	120	4.0	38	1.64	1.34	1.56	0.60	0.87	125.3	1.97	158.2	33	32	30	86	37		
9.14	30.0	150.28	1.21	Sand to Silty Sand	SP/SM	dense	120	4.0	38	1.67	1.36	1.22	0.58	0.87	122.9	1.90	146.3	32	29	25	85	37		
9.30	30.5	84.22	2.37	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	28	1.70	1.37	2.42	0.70	0.83	66.4	2.30	129.3	24	26	50	60	34		
9.45	31.0	30.46	3.21	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	15	1.73	1.39	3.40	0.84	0.80	23.0	2.74		15		90			1.71	6.2
9.60	31.5	13.84	3.84	Silty Clay to Clay	CL	stiff	120	1.5	9	1.76	1.40	4.39	0.95	0.77	10.0	3.09		9		100			0.73	2.6
9.75	32.0	18.63	4.63	Clay	CL/CH	very stiff	120	1.0	19	1.79	1.42	5.12	0.93	0.76	13.4	3.03		19		100			1.01	3.6
9.91	32.5	131.26	1.98	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	44	1.82	1.43	2.01	0.64	0.82	102.2	2.11	150.6	37	30	35	78	38		
10.06	33.0	125.55	2.03	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	42	1.85	1.44	2.06	0.65	0.82	96.9	2.13	147.2	35	29	40	76	37		
10.21	33.5	38.91	5.33	Clay	CL/CH	hard	120	1.0	39	1.88	1.46	5.60	0.86	0.76	27.9	2.82		39		100			2.20	7.6
10.36	34.0	203.75	1.33	Sand to Silty Sand	SP/SM	dense	120	4.0	51	1.91	1.47	1.34	0.56	0.83	159.8	1.85	182.8	42	37	20	96	39		
10.52	34.5	293.28	1.07	Sand	SP	dense	120	5.0	59	1.94	1.49	1.08	0.51	0.84	233.0	1.67	236.9	48	47	15	100	40		
10.67	35.0	368.90	0.72	Gravelly Sand to Sand	SW	very dense	120	6.0	61	1.97	1.50	0.73	0.50	0.84	292.6	1.47	292.6	50	59	5	100	41		
10.82	35.5	424.53	0.52	Gravelly Sand to Sand	SW	very dense	120	6.0	71	2.00	1.52	0.53	0.50	0.84	335.2	1.33	335.2	57	67	5	100	42		
10.97	36.0	411.26	0.46	Gravelly Sand to Sand	SW	very dense	120	6.0	69	2.03	1.53	0.47	0.50	0.83	323.2	1.31	323.2	55	65	5	100	42		
11.13	36.5	377.22	0.45	Gravelly Sand to Sand	SW	very dense	120	6.0	63	2.06	1.55	0.45	0.50	0.83	295.0	1.33	295.0	51	59	5	100	41		
11.28	37.0	340.91	0.69	Gravelly Sand to Sand	SW	dense	120	6.0	57	2.09	1.56	0.70	0.50	0.82	265.4	1.49	265.4	45	53	10	100	40		

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 09340-01 | Date: 03/06/20

CPT SOUNDING: CPT-7 | Plot: 7 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N | Nk: 17

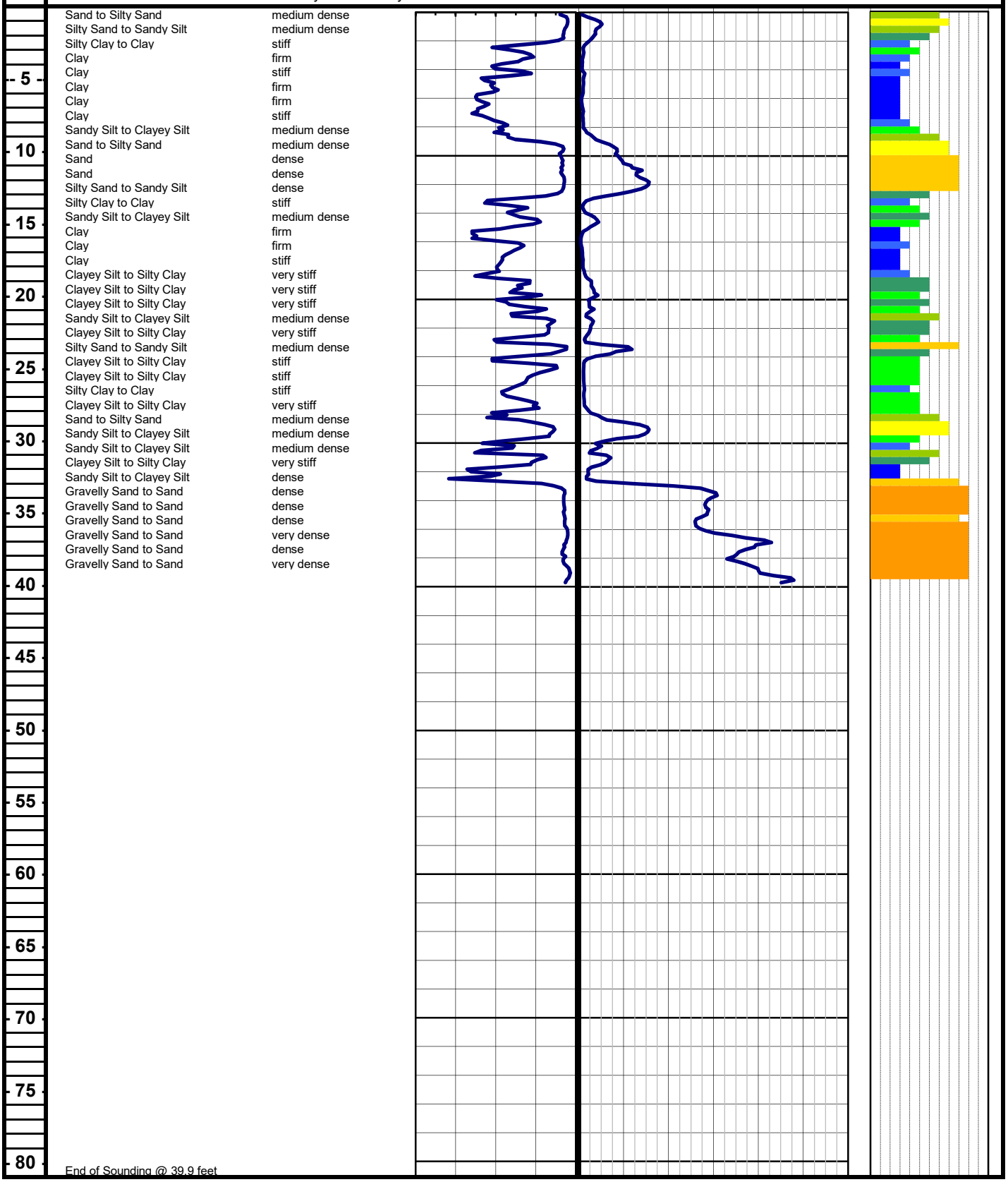
Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
11.43	37.5	368.04	0.90	Gravelly Sand to Sand	SW	dense	120	6.0	61	2.12	1.57	0.90	0.50	0.82	285.2	1.55	285.2	49	57	10	100	40		
11.58	38.0	400.67	0.63	Gravelly Sand to Sand	SW	very dense	120	6.0	67	2.15	1.59	0.63	0.50	0.82	309.1	1.42	309.1	53	62	5	100	41		
11.73	38.5	445.25	0.61	Gravelly Sand to Sand	SW	very dense	120	6.0	74	2.18	1.60	0.61	0.50	0.81	341.9	1.37	341.9	59	68	5	100	42		
11.89	39.0	422.78	0.40	Gravelly Sand to Sand	SW	very dense	120	6.0	70	2.21	1.62	0.41	0.50	0.81	323.2	1.27	323.2	55	65	0	100	42		
12.04	39.5	434.51	0.57	Gravelly Sand to Sand	SW	very dense	120	6.0	72	2.24	1.63	0.58	0.50	0.81	330.7	1.37	330.7	57	66	5	100	42		
12.19	40.0	366.53	0.49	Gravelly Sand to Sand	SW	dense	120	6.0	61	2.27	1.65	0.50	0.50	0.80	277.7	1.38	277.7	48	56	5	100	40		
12.34	40.5	360.91	0.45	Gravelly Sand to Sand	SW	dense	120	6.0	60	2.30	1.66	0.46	0.50	0.80	272.3	1.36	272.3	47	54	5	100	40		
12.50	41.0	415.25	0.41	Gravelly Sand to Sand	SW	very dense	120	6.0	69	2.33	1.67	0.41	0.50	0.79	312.0	1.28	312.0	53	62	0	100	41		
12.65	41.5	451.00	0.30	Gravelly Sand to Sand	SW	very dense	120	6.0	75	2.36	1.69	0.30	0.50	0.79	337.4	1.17	337.4	58	67	0	100	42		
12.80	42.0	384.90	0.31	Gravelly Sand to Sand	SW	dense	120	6.0	64	2.39	1.70	0.31	0.50	0.79	286.7	1.24	286.7	49	57	0	100	40		
12.95	42.5	359.52	0.34	Gravelly Sand to Sand	SW	dense	120	6.0	60	2.42	1.72	0.34	0.50	0.78	266.7	1.29	266.7	46	53	0	100	40		
13.11	43.0	339.72	0.37	Gravelly Sand to Sand	SW	dense	120	6.0	57	2.45	1.73	0.37	0.50	0.78	250.9	1.33	250.9	43	50	5	100	39		
13.26	43.5	317.21	0.42	Gravelly Sand to Sand	SW	dense	120	6.0	53	2.48	1.75	0.43	0.50	0.78	233.3	1.39	233.3	40	47	5	100	38		
13.41	44.0	287.94	0.99	Sand	SP	dense	120	5.0	58	2.51	1.76	1.00	0.51	0.77	209.6	1.68	214.2	43	43	15	100	39		
13.56	44.5	272.14	0.99	Sand	SP	dense	120	5.0	54	2.54	1.78	1.00	0.52	0.76	196.7	1.70	203.5	41	41	15	100	39		
13.72	45.0	299.01	0.74	Sand	SP	dense	120	5.0	60	2.57	1.79	0.74	0.50	0.77	217.3	1.57	217.3	45	43	10	100	39		
13.87	45.5	233.74	0.48	Sand	SP	dense	120	5.0	47	2.60	1.80	0.48	0.50	0.77	169.2	1.53	169.2	35	34	10	99	37		
14.02	46.0	130.51	1.34	Sand to Silty Sand	SP/SM	medium dense	120	4.0	33	2.63	1.82	1.37	0.62	0.71	88.0	2.04	119.6	24	24	35	72	34		
14.17	46.5	81.17	2.50	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	32	2.66	1.83	2.59	0.73	0.67	51.3	2.40	118.8	24	24	60	49	34		
14.33	47.0	230.99	1.22	Sand	SP	dense	120	5.0	46	2.69	1.85	1.24	0.56	0.73	160.1	1.82	179.9	34	36	20	96	37		
14.48	47.5	295.17	0.53	Gravelly Sand to Sand	SW	dense	120	6.0	49	2.72	1.86	0.54	0.50	0.75	210.3	1.49	210.3	36	42	10	100	38		
14.63	48.0	206.15	0.81	Sand	SP	dense	120	5.0	41	2.75	1.88	0.82	0.53	0.74	143.8	1.73	152.5	30	30	15	92	36		
14.78	48.5	81.93	2.59	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	33	2.78	1.89	2.68	0.74	0.65	50.5	2.42	120.1	24	24	60	48	34		
14.94	49.0	41.81	3.29	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	21	2.81	1.91	3.53	0.83	0.61	24.2	2.73		21		90			2.35	6.1
15.09	49.5	27.48	3.10	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	14	2.84	1.92	3.45	0.88	0.59	15.4	2.88		14		100			1.50	3.9

Earth Systems
Pacific

CPT No : CPT-8
Project Name: Arctic Cold
Project No.: 09340-01
Location: See Site Exploration Plan

Cone Penetrometer: **Kehoe Testing and Engineerin**
Truck Mounted Electric Cone
with 23-ton reaction weight
Date: 3/6/2020

Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
Sand to Silty Sand	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Clay to Clay	stiff
Clay	firm
Clay	stiff
Clay	firm
Clay	firm
Clay	stiff
Sandy Silt to Clayey Silt	medium dense
Sand to Silty Sand	medium dense
Sand	dense
Sand	dense
Silty Sand to Sandy Silt	dense
Silty Clay to Clay	stiff
Sandy Silt to Clayey Silt	medium dense
Clay	firm
Clay	firm
Clay	stiff
Clayey Silt to Silty Clay	very stiff
Clayey Silt to Silty Clay	very stiff
Clayey Silt to Silty Clay	very stiff
Sandy Silt to Clayey Silt	medium dense
Clayey Silt to Silty Clay	very stiff
Silty Sand to Sandy Silt	medium dense
Clayey Silt to Silty Clay	stiff
Clayey Silt to Silty Clay	stiff
Silty Clay to Clay	stiff
Clayey Silt to Silty Clay	very stiff
Sand to Silty Sand	medium dense
Sandy Silt to Clayey Silt	medium dense
Sandy Silt to Clayey Silt	medium dense
Clayey Silt to Silty Clay	very stiff
Sandy Silt to Clayey Silt	dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	very dense
Gravelly Sand to Sand	dense
Gravelly Sand to Sand	very dense



End of Sounding @ 39.9 feet

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 09340-01 | Date: 03/06/20

CPT SOUNDING: CPT-8 | Plot: 8 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Nk: 17 Su (tsf)	OCR
0.15	0.5	34.53	0.44	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	12	0.01	0.01	0.44	0.59	1.70	55.5	1.93	55.5	20	11	25	52	33		
0.30	1.0	45.93	0.48	Sand to Silty Sand	SP/SM	medium dense	100	4.0	11	0.04	0.04	0.48	0.56	1.70	73.8	1.84	73.8	20	15	20	64	33		
0.46	1.5	36.06	0.62	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	12	0.07	0.07	0.62	0.60	1.70	57.9	1.98	74.1	20	15	30	54	33		
0.61	2.0	23.73	1.02	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	9	0.09	0.09	1.02	0.68	1.70	38.1	2.25	69.0	16	14	45	37	32		
0.76	2.5	10.79	3.52	Silty Clay to Clay	CL	stiff	110	1.5	7	0.12	0.12	3.56	0.86	1.70	17.3	2.85		7		100			0.63	26.4
0.91	3.0	10.39	2.35	Clayey Silt to Silty Clay	ML/CL	stiff	110	2.0	5	0.15	0.15	2.38	0.84	1.70	16.7	2.76		5		95			0.60	20.7
1.07	3.5	8.12	3.09	Silty Clay to Clay	CL	firm	110	1.5	5	0.18	0.18	3.16	0.89	1.70	13.0	2.92		5		100			0.47	13.5
1.22	4.0	8.19	3.65	Clay	CL/CH	firm	110	1.0	8	0.20	0.20	3.74	0.90	1.70	13.2	2.96		8		100			0.47	11.8
1.37	4.5	11.91	3.40	Silty Clay to Clay	CL	stiff	110	1.5	8	0.23	0.23	3.47	0.85	1.70	19.1	2.81		8		100			0.69	15.2
1.52	5.0	10.59	4.29	Clay	CL/CH	stiff	110	1.0	11	0.26	0.26	4.40	0.88	1.70	17.0	2.91		11		100			0.61	12.0
1.68	5.5	9.45	4.29	Clay	CL/CH	stiff	110	1.0	9	0.29	0.29	4.42	0.90	1.70	15.2	2.95		9		100			0.54	9.6
1.83	6.0	6.47	4.87	Clay	CL/CH	firm	110	1.0	6	0.31	0.31	5.12	0.95	1.70	10.4	3.12		6		100			0.36	5.9
1.98	6.5	8.11	4.61	Clay	CL/CH	firm	110	1.0	8	0.34	0.34	4.82	0.92	1.70	13.0	3.03		8		100			0.46	6.8
2.13	7.0	9.44	4.91	Clay	CL/CH	stiff	110	1.0	9	0.37	0.37	5.11	0.91	1.70	15.2	2.99		9		100			0.53	7.4
2.29	7.5	9.96	4.02	Clay	CL/CH	stiff	110	1.0	10	0.40	0.40	4.19	0.89	1.70	16.0	2.92		10		100			0.56	7.2
2.44	8.0	11.81	3.63	Silty Clay to Clay	CL	stiff	110	1.5	8	0.42	0.42	3.77	0.86	1.70	19.0	2.83		8		100			0.67	8.1
2.59	8.5	25.67	3.61	Clayey Silt to Silty Clay	ML/CL	medium dense	110	2.0	13	0.45	0.45	3.68	0.78	1.70	41.3	2.57	130.9	19	26	75	40	33		
2.74	9.0	53.39	1.93	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	18	0.48	0.48	1.95	0.66	1.68	84.9	2.16	133.2	26	27	40	70	35		
2.90	9.5	82.52	0.64	Sand to Silty Sand	SP/SM	medium dense	100	4.0	21	0.51	0.51	0.65	0.53	1.48	115.7	1.74	123.6	29	25	15	83	36		
3.05	10.0	87.37	0.76	Sand to Silty Sand	SP/SM	dense	100	4.0	22	0.53	0.53	0.77	0.54	1.46	120.2	1.78	130.9	30	26	20	84	36		
3.20	10.5	104.16	0.67	Sand	SP	medium dense	100	5.0	21	0.56	0.56	0.67	0.52	1.40	137.5	1.69	142.1	28	28	15	90	36		
3.35	11.0	129.78	0.73	Sand	SP	dense	100	5.0	26	0.58	0.58	0.73	0.50	1.35	166.1	1.65	167.1	34	33	15	98	37		
3.51	11.5	137.48	0.61	Sand	SP	dense	100	5.0	27	0.61	0.61	0.62	0.50	1.32	171.8	1.60	171.8	35	34	10	99	37		
3.66	12.0	153.85	0.59	Sand	SP	dense	100	5.0	31	0.63	0.63	0.60	0.50	1.30	188.4	1.56	188.4	39	38	10	100	38		
3.81	12.5	115.01	0.75	Sand	SP	medium dense	100	5.0	23	0.66	0.66	0.76	0.53	1.29	139.9	1.72	147.2	28	29	15	91	36		
3.96	13.0	35.44	2.95	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	14	0.68	0.68	3.01	0.75	1.39	46.7	2.48	123.6	17	25	65	45	32		
4.11	13.5	9.92	3.45	Silty Clay to Clay	CL	stiff	110	1.5	7	0.71	0.71	3.72	0.90	1.43	13.4	2.95		7		100			0.54	3.9
4.27	14.0	17.56	3.13	Clayey Silt to Silty Clay	ML/CL	stiff	110	2.0	9	0.74	0.74	3.26	0.83	1.35	22.5	2.74		9		90			0.99	6.9
4.42	14.5	39.97	2.16	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	16	0.76	0.76	2.20	0.72	1.27	47.8	2.38	106.1	18	21	55	46	33		
4.57	15.0	26.68	3.02	Clayey Silt to Silty Clay	ML/CL	very stiff	110	2.0	13	0.79	0.79	3.11	0.79	1.26	31.8	2.61		13		75			1.52	9.8
4.72	15.5	7.63	5.10	Clay	CL/CH	firm	110	1.0	8	0.82	0.82	5.72	0.98	1.28	9.3	3.19		8		100			0.40	2.5
4.88	16.0	5.08	3.67	Clay	CL/CH	soft	110	1.0	5	0.85	0.85	4.41	1.00	1.25	6.0	3.27		5		100			0.25	1.5
5.03	16.5	7.95	3.04	Silty Clay to Clay	CL	firm	110	1.5	5	0.87	0.87	3.42	0.94	1.20	9.0	3.07		5		100			0.42	2.4
5.18	17.0	9.10	3.61	Clay	CL/CH	firm	120	1.0	9	0.90	0.90	4.01	0.94	1.16	10.0	3.07		9		100			0.48	2.7
5.33	17.5	9.19	3.84	Clay	CL/CH	firm	120	1.0	9	0.93	0.93	4.28	0.95	1.13	9.8	3.09		9		100			0.49	2.7
5.49	18.0	12.06	4.08	Clay	CL/CH	stiff	120	1.0	12	0.96	0.96	4.43	0.92	1.09	12.4	3.02		12		100			0.65	3.5
5.64	18.5	21.22	3.73	Silty Clay to Clay	CL	very stiff	120	1.5	14	0.99	0.99	3.91	0.86	1.06	21.2	2.81		14		100			1.19	6.1
5.79	19.0	29.44	2.63	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	12	1.02	1.02	2.73	0.79	1.03	28.6	2.61		12		75			1.67	8.3
5.94	19.5	37.07	2.71	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	15	1.05	1.05	2.79	0.77	1.00	35.2	2.54	105.7	14	21	70	33	31		
6.10	20.0	25.96	3.27	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	1.08	1.08	3.41	0.83	0.98	24.1	2.73		13		90			1.46	6.9
6.25	20.5	27.10	2.44	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	11	1.11	1.10	2.55	0.80	0.97	24.9	2.64		11		80			1.53	7.1
6.40	21.0	19.65	2.78	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	10	1.14	1.11	2.95	0.85	0.96	17.8	2.79		10		95			1.09	5.0
6.55	21.5	29.86	1.27	Silty Sand to Sandy Silt	SM/ML	loose	120	3.0	10	1.17	1.13	1.32	0.74	0.95	26.9	2.44	67.0	9	13	60	22	30		
6.71	22.0	26.23	1.37	Sandy Silt to Clayey Silt	ML	loose	120	2.5	10	1.20	1.14	1.44	0.77	0.94	23.4	2.51	66.3	10	13	70	17	30		
6.86	22.5	18.44	1.96	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	7	1.23	1.15	2.10	0.84	0.93	16.2	2.74		7		90			1.02	4.5
7.01	23.0	26.45	3.10	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	1.26	1.17	3.26	0.83	0.92	23.0	2.73		13		90			1.49	6.5
7.16	23.5	103.93	0.59	Sand	SP	medium dense	120	5.0	21	1.29	1.18	0.60	0.55	0.94	92.4	1.80	102.5	19	20	20	74	33		
7.32	24.0	41.42	2.70	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	17	1.32	1.20	2.79	0.77	0.91	35.6	2.54	106.1	15	21	70	34	32		
7.47	24.5	11.78	2.50	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.35	1.21	2.83	0.92	0.88	9.8	2.99		6		100			0.62	2.6
7.62	25.0	10.75	1.36	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	5	1.38	1.23	1.57	0.89	0.88	8.9	2.89		5		100			0.56	2.3
7.77	25.5	10.71	2.33	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	5	1.41	1.24	2.69	0.93	0.86	8.7	3.02		5		100			0.56	2.2
7.92	26.0	11.95	2.79	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.44	1.26	3.17	0.93	0.85	9.6	3.02		6		100			0.63	2.5
8.08	26.5	11.89	3.53	Silty Clay to Clay	CL	stiff	120	1.5	8	1.47	1.27	4.03	0.95	0.84	9.5	3.09		8		100			0.62	2.5
8.23	27.0	12.24	2.40	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.50	1.28	2.73	0.92	0.84	9.7	2.99		6		100			0.64	2.5
8.38	27.5	17.19	2.27	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	9	1.53	1.30	2.49	0.87	0.84	13.6	2.84		9		100			0.93	3.6
8.53	28.0	39.96	4.03	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	20	1.56	1.31	4.20	0.82	0.84	31.6	2.70		20		85			2.27	8.8
8.69	28.5	101.06	2.20	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	34	1.59	1.33	2.24	0.67	0.86	82.0	2.21	138.9	29	28	45	69	36		
8.84	29.0	153.99	1.12	Sand to Silty Sand	SP/SM	dense	120	4.0	38	1.62	1.34	1.13	0.57	0.87	127.1	1.87	147.4	33	29	25	87	37		
8.99	29.5	120.98	1.71	Sand to Silty Sand	SP/SM	medium dense	120	4.0	30	1.65	1.36	1.74	0.63	0.85	97.7	2.08	138.5	26	28	35	76	35		
9.14	30.0	47.97	3.80	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	24	1.68	1.37	3.94	0.80	0.81	36.9	2.63		24		80			2.74	10.1
9.30	30.5	30.96	4.32	Silty Clay to Clay	CL	very stiff	120	1.5	21	1.71	1.38	4.57	0.86	0.79	23.2	2.82		21		100			1.74	6.3
9.45	31.0	66.29	1.70	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	22	1.74	1.40	1.75	0.70	0.82	51.6	2.29	98.3	19	20	50	49	33		
9.60	31.5	45.06	2.76	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	18	1.77	1.41	2.87	0.78	0.80	34.0	2.56	105.8	15	21	75	32	32		
9.75	32.0	21.15	4.81	Clay	CL/CH	very stiff	120	1.0	21	1.80	1.43	5.25	0.92	0.76	15.2	3.00		21		100			1.16	4.1
9.91	32.5	24.60	4.90	Clay	CL/CH	very stiff	120	1.0	25	1.83	1.44	5.30	0.90	0.76	17.6	2.95		25		100			1.36	4.7
10.06	33.0	201.14	1.19	Sand	SP	dense	120	5.0	40	1.86	1.46	1.20	0.55	0.84	159.3	1.81	177.9	33	36	20	96	37		
10.21	33.5	300.88	0.57	Gravelly Sand to Sand	SW	dense	120	6.0	50	1.89	1.47	0.58	0.50	0.85	241.2	1.46	241.2	41	48	5	100	39		
10.36	34.0	288.32	0.61	Gravelly Sand to Sand	SW	dense	120	6.0	48	1.92	1.49	0.62	0.50	0.84	230.0	1.50	230.0	39	46	10	100	38		
10.52	34.5	284.32	0.58	Gravelly Sand to Sand	SW	dense	120	6.0	47	1.95	1.50	0.58	0.50	0.84	225.7	1.49	225.7	39	45	10	100	38		
10.67	35.0	282.43	0.60	Gravelly Sand to Sand	SW	dense	120	6.0	47	1.98	1.51	0.60	0.50	0.84	223.1	1.50	223.1	38	45	10	100	38		
10.82	35.5	260.49	0.55	Sand	SP	dense	120	5.0	52	2.01	1.53	0.56	0.50	0.83	204.8	1.51	204.8	42	41	10	100	39		
10.97	36.0	271.11	0.48	Gravelly Sand to Sand	SW	dense	120	6.0	45	2.04	1.54	0.48	0.50	0.83	212.2	1.46	212.2	36	42	5	100	38		
11.13	36.5	357.72	0.43	Gravelly Sand to Sand	SW	dense	120	6.0	60	2.07	1.56	0.43	0.50	0.82	278.6	1.34	278.6	48	56	5	100	40		
11.28	37.0	405.02	0.55	Gravelly Sand to Sand	SW	very dense	120	6.0	68	2.10	1.57	0.55	0.50	0.82	314.0	1.37	314.0	54	63	5	100	41		

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold Project No: 09340-01 Date: 03/06/20

CPT SOUNDING: CPT-8 Plot: 8 Density: 1 SPT N Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** Dr correlation: 0 Baldi Qc/N: 1.00 Robertson Phi Correlation: 4 SPT N

Nk: 17

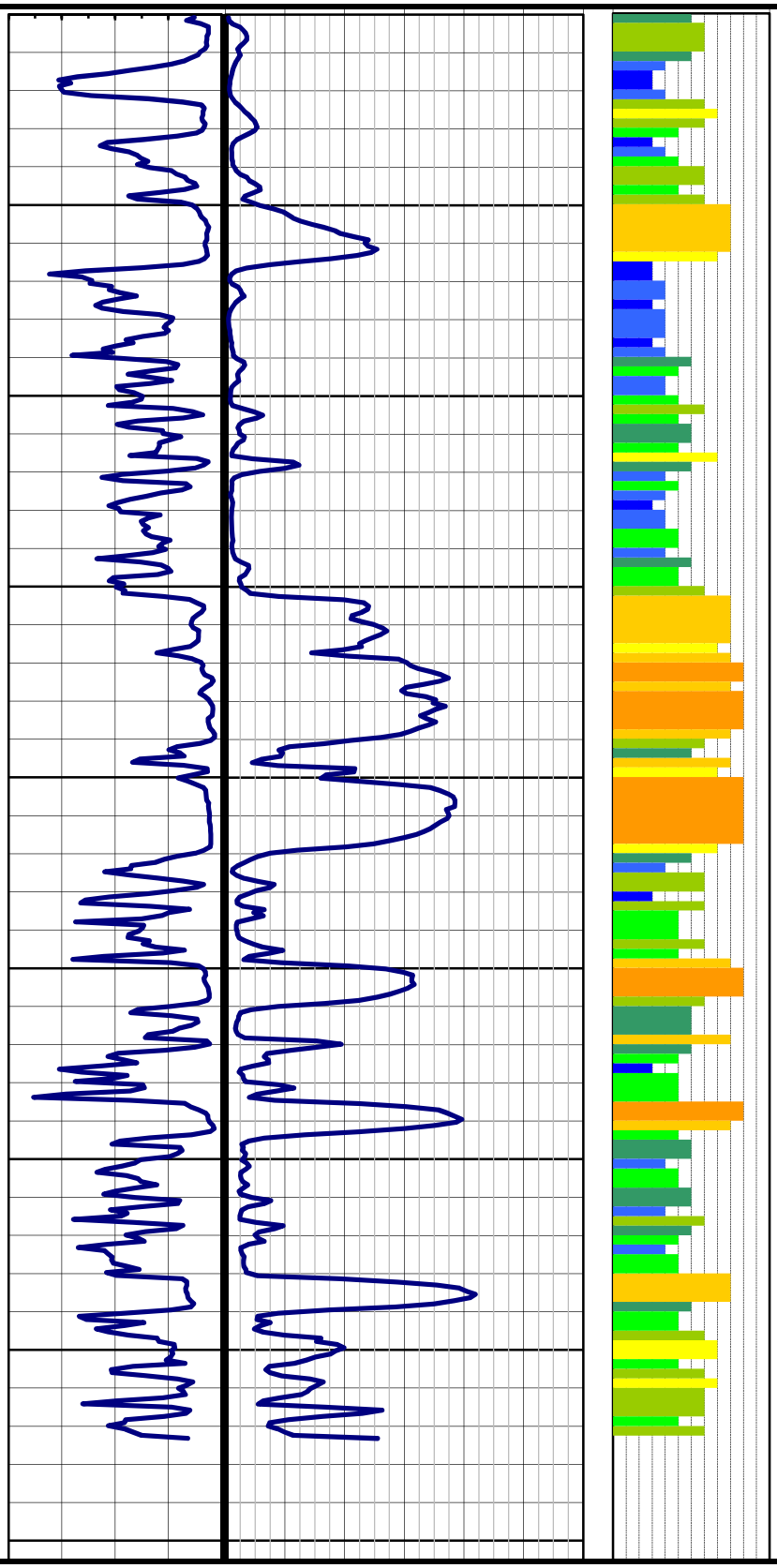
Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	Ic 2.6	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
11.43	37.5	359.62	0.67	Gravelly Sand to Sand	SW	dense	120	6.0	60	2.13	1.59	0.67	0.50	0.82	277.6	1.47	277.6	48	56	5	100	40		
11.58	38.0	342.76	0.60	Gravelly Sand to Sand	SW	dense	120	6.0	57	2.16	1.60	0.60	0.50	0.81	263.4	1.45	263.4	45	53	5	100	40		
11.73	38.5	384.53	0.47	Gravelly Sand to Sand	SW	very dense	120	6.0	64	2.19	1.62	0.47	0.50	0.81	294.1	1.34	294.1	50	59	5	100	41		
11.89	39.0	412.77	0.30	Gravelly Sand to Sand	SW	very dense	120	6.0	69	2.22	1.63	0.31	0.50	0.81	314.4	1.20	314.4	54	63	0	100	41		
12.04	39.5	467.51	0.45	Gravelly Sand to Sand	SW	very dense	120	6.0	78	2.25	1.64	0.45	0.50	0.80	354.5	1.27	354.5	61	71	0	100	43		

Earth Systems
Pacific

CPT No : CPT-9
Project Name: Arctic Cold
Project No.: 09340-01
Location: See Site Exploration Plan

Cone Penetrometer: **Kehoe Testing and Engineerin**
Truck Mounted Electric Cone
with 23-ton reaction weight
Date: 3/6/2020

DEPTH (FEET)	Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
	Silty Sand to Sandy Silt	medium dense
	Silty Sand to Sandy Silt	medium dense
	Clayey Silt to Silty Clay	stiff
	Clay	firm
5	Sandy Silt to Clayey Silt	medium dense
	Silty Sand to Sandy Silt	medium dense
	Silty Clay to Clay	stiff
	Clayey Silt to Silty Clay	stiff
	Silty Sand to Sandy Silt	medium dense
10	Sandy Silt to Clayey Silt	medium dense
	Sand	dense
	Sand	very dense
	Sand	dense
	Clay	stiff
15	Silty Clay to Clay	very stiff
	Silty Clay to Clay	firm
	Silty Clay to Clay	firm
	Silty Clay to Clay	stiff
	Sandy Silt to Clayey Silt	very stiff
20	Silty Clay to Clay	stiff
	Sandy Silt to Clayey Silt	medium dense
	Clayey Silt to Silty Clay	very stiff
	Clayey Silt to Silty Clay	stiff
	Silty Sand to Sandy Silt	medium dense
25	Clayey Silt to Silty Clay	stiff
	Silty Clay to Clay	stiff
	Silty Clay to Clay	stiff
	Clayey Silt to Silty Clay	stiff
	Clayey Silt to Silty Clay	very stiff
30	Clayey Silt to Silty Clay	very stiff
	Sand to Silty Sand	dense
	Sand	dense
	Sand	dense
	Sand to Silty Sand	dense
35	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Silty Sand to Sandy Silt	medium dense
40	Sand	medium dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Gravelly Sand to Sand	dense
	Sand	medium dense
45	Clayey Silt to Silty Clay	very stiff
	Silty Sand to Sandy Silt	medium dense
	Clayey Silt to Silty Clay	hard
	Clayey Silt to Silty Clay	very stiff
	Sandy Silt to Clayey Silt	medium dense
50	Silty Sand to Sandy Silt	dense
	Gravelly Sand to Sand	dense
	Sand to Silty Sand	dense
	Sandy Silt to Clayey Silt	very stiff
	Silty Sand to Sandy Silt	medium dense
55	Clayey Silt to Silty Clay	medium dense
	Silty Clay to Clay	hard
	Clayey Silt to Silty Clay	dense
	Gravelly Sand to Sand	dense
	Silty Sand to Sandy Silt	medium dense
60	Sandy Silt to Clayey Silt	very stiff
	Clayey Silt to Silty Clay	very stiff
	Clayey Silt to Silty Clay	hard
	Clayey Silt to Silty Clay	very stiff
	Sandy Silt to Clayey Silt	medium dense
65	Silty Clay to Clay	very stiff
	Clayey Silt to Silty Clay	very stiff
	Sand	dense
	Silty Sand to Sandy Silt	very dense
	Clayey Silt to Silty Clay	hard
70	Silty Sand to Sandy Silt	dense
	Sandy Silt to Clayey Silt	medium dense
	Sand to Silty Sand	medium dense
	Silty Sand to Sandy Silt	medium dense
	Sandy Silt to Clayey Silt	dense
75		
80	End of Sounding @ 74.8 feet	



Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 09340-01 | Date: 03/06/20

CPT SOUNDING: CPT-9 | Plot: 9 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N | Nk: 17

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
0.15	0.5	14.40	0.87	Sandy Silt to Clayey Silt	ML	loose	110	2.5	6	0.01	0.01	0.87	0.73	1.70	23.1	2.40	53.8	10	11	60	16	30		
0.30	1.0	33.46	0.51	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	11	0.04	0.04	0.51	0.60	1.70	53.8	1.97	68.1	19	14	30	51	33		
0.46	1.5	30.65	0.56	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	10	0.07	0.07	0.56	0.62	1.70	49.3	2.02	65.7	17	13	30	47	32		
0.61	2.0	22.56	0.77	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	8	0.10	0.10	0.78	0.67	1.70	36.2	2.21	61.3	13	12	45	35	31		
0.76	2.5	18.27	1.50	Sandy Silt to Clayey Silt	ML	medium dense	110	2.5	7	0.12	0.12	1.51	0.74	1.70	29.4	2.44	73.2	12	15	60	26	31		
0.91	3.0	12.13	3.46	Silty Clay to Clay	CL	stiff	110	1.5	8	0.15	0.15	3.50	0.85	1.70	19.5	2.80		8		100			0.70	23.8
1.07	3.5	8.22	5.74	Clay	CL/CH	firm	110	1.0	8	0.18	0.18	5.87	0.93	1.70	13.2	3.08		8		100			0.47	13.5
1.22	4.0	7.12	6.01	Clay	CL/CH	firm	110	1.0	7	0.21	0.21	6.19	0.95	1.70	11.4	3.14		7		100			0.41	10.1
1.37	4.5	12.53	3.03	Silty Clay to Clay	CL	stiff	110	1.5	8	0.23	0.23	3.09	0.84	1.70	20.1	2.76		8		95			0.72	15.8
1.52	5.0	27.49	0.70	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	9	0.26	0.26	0.71	0.64	1.70	44.2	2.11	65.5	16	13	35	43	32		
1.68	5.5	45.49	0.70	Sand to Silty Sand	SP/SM	medium dense	100	4.0	11	0.29	0.29	0.70	0.59	1.70	73.1	1.93	88.8	19	18	25	64	33		
1.83	6.0	47.43	0.79	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	16	0.31	0.31	0.79	0.59	1.70	76.2	1.94	93.9	27	19	25	66	35		
1.98	6.5	20.14	2.97	Clayey Silt to Silty Clay	ML/CL	medium dense	110	2.0	10	0.34	0.34	3.02	0.79	1.70	32.4	2.59	106.6	17	21	75	30	32		
2.13	7.0	10.79	4.05	Clay	CL/CH	stiff	110	1.0	11	0.37	0.37	4.19	0.88	1.70	17.3	2.89		11		100			0.61	8.5
2.29	7.5	11.32	2.99	Silty Clay to Clay	CL	stiff	110	1.5	8	0.40	0.40	3.10	0.85	1.70	18.2	2.79		8		95			0.64	8.3
2.44	8.0	15.56	2.58	Clayey Silt to Silty Clay	ML/CL	stiff	110	2.0	8	0.42	0.42	2.65	0.80	1.70	25.0	2.64		8		80			0.89	10.7
2.59	8.5	33.59	1.46	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	11	0.45	0.45	1.48	0.68	1.70	54.0	2.23	93.4	17	19	45	51	32		
2.74	9.0	55.25	1.11	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	18	0.48	0.48	1.12	0.61	1.62	84.6	2.00	109.8	27	22	30	70	35		
2.90	9.5	36.10	3.00	Clayey Silt to Silty Clay	ML/CL	medium dense	110	2.0	18	0.51	0.51	3.04	0.73	1.70	58.0	2.41	136.8	25	27	60	54	35		
3.05	10.0	60.87	1.19	Silty Sand to Sandy Silt	SM/ML	medium dense	110	3.0	20	0.53	0.53	1.20	0.61	1.52	87.4	2.01	114.4	28	23	30	71	35		
3.20	10.5	105.13	0.80	Sand	SP	medium dense	100	5.0	21	0.56	0.56	0.80	0.53	1.40	139.3	1.74	148.3	28	30	15	91	36		
3.35	11.0	145.38	0.55	Sand	SP	dense	100	5.0	29	0.59	0.59	0.56	0.50	1.34	184.8	1.54	184.8	38	37	10	100	38		
3.51	11.5	197.88	0.54	Sand	SP	very dense	100	5.0	40	0.61	0.61	0.54	0.50	1.32	246.3	1.44	246.3	51	49	5	100	41		
3.66	12.0	237.82	0.60	Sand	SP	very dense	100	5.0	48	0.64	0.64	0.60	0.50	1.29	290.1	1.42	290.1	60	58	5	100	42		
3.81	12.5	239.65	0.55	Sand	SP	very dense	100	5.0	48	0.66	0.66	0.56	0.50	1.27	286.8	1.40	286.8	59	57	5	100	42		
3.96	13.0	124.36	0.99	Sand to Silty Sand	SP/SM	dense	100	4.0	31	0.69	0.69	1.00	0.54	1.27	148.9	1.78	162.6	38	33	20	93	38		
4.11	13.5	20.89	4.87	Clay	CL/CH	very stiff	110	1.0	21	0.71	0.71	5.04	0.85	1.40	27.7	2.79		21		95			1.19	8.5
4.27	14.0	8.70	5.01	Clay	CL/CH	firm	110	1.0	9	0.74	0.74	5.48	0.95	1.41	11.6	3.10		9		100			0.47	3.2
4.42	14.5	24.48	4.06	Silty Clay to Clay	CL	very stiff	110	1.5	16	0.77	0.77	4.19	0.82	1.30	30.2	2.71		16		90			1.39	9.3
4.57	15.0	23.91	3.85	Silty Clay to Clay	CL	very stiff	110	1.5	16	0.79	0.79	3.98	0.83	1.27	28.7	2.71		16		90			1.36	8.7
4.72	15.5	10.20	4.30	Clay	CL/CH	stiff	110	1.0	10	0.82	0.82	4.68	0.93	1.27	12.2	3.04		10		100			0.55	3.4
4.88	16.0	5.72	2.04	Silty Clay to Clay	CL	firm	110	1.5	4	0.85	0.85	2.39	0.95	1.23	6.7	3.09		4		100			0.29	1.7
5.03	16.5	7.33	2.10	Silty Clay to Clay	CL	firm	110	1.5	5	0.88	0.88	2.39	0.93	1.19	8.2	3.01		5		100			0.38	2.2
5.18	17.0	9.63	3.29	Silty Clay to Clay	CL	stiff	120	1.5	6	0.91	0.91	3.64	0.93	1.16	10.5	3.03		6		100			0.51	2.9
5.33	17.5	11.96	4.18	Clay	CL/CH	stiff	120	1.0	12	0.94	0.94	4.53	0.92	1.12	12.7	3.02		12		100			0.65	3.5
5.49	18.0	21.30	3.82	Silty Clay to Clay	CL	very stiff	120	1.5	14	0.97	0.97	4.01	0.85	1.08	21.8	2.80		14		100			1.20	6.3
5.64	18.5	28.35	2.01	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	11	1.00	1.00	2.08	0.77	1.05	28.1	2.54	83.7	11	17	70	24	30		
5.79	19.0	21.52	2.70	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	11	1.03	1.03	2.83	0.83	1.03	20.9	2.72		11		90			1.21	6.0
5.94	19.5	12.04	3.48	Silty Clay to Clay	CL	stiff	120	1.5	8	1.06	1.06	3.82	0.92	1.00	11.4	3.01		8		100			0.65	3.1
6.10	20.0	8.74	3.08	Silty Clay to Clay	CL	firm	120	1.5	6	1.09	1.09	3.52	0.96	0.98	8.1	3.11		6		100			0.45	2.1
6.25	20.5	17.09	3.16	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	9	1.12	1.10	3.38	0.88	0.97	15.6	2.87		9		100			0.94	4.4
6.40	21.0	54.24	1.08	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	18	1.15	1.11	1.10	0.66	0.97	49.6	2.18	80.0	17	16	40	48	32		
6.55	21.5	25.03	3.51	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	1.18	1.13	3.69	0.84	0.95	22.4	2.77		13		95			1.41	6.3
6.71	22.0	26.50	1.98	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	11	1.21	1.14	2.08	0.79	0.94	23.6	2.60		11		75			1.49	6.6
6.86	22.5	22.69	2.21	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	9	1.24	1.16	2.34	0.82	0.93	19.9	2.69		9		85			1.27	5.6
7.01	23.0	11.34	2.77	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.27	1.17	3.12	0.92	0.91	9.8	3.02		6		100			0.60	2.6
7.16	23.5	94.24	0.70	Sand to Silty Sand	SP/SM	medium dense	120	4.0	24	1.30	1.19	0.71	0.57	0.94	83.4	1.88	97.9	22	20	25	69	34		
7.32	24.0	61.25	2.27	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	25	1.33	1.20	2.32	0.72	0.91	52.9	2.36	113.9	22	23	55	50	34		
7.47	24.5	12.38	3.17	Silty Clay to Clay	CL	stiff	120	1.5	8	1.36	1.21	3.56	0.93	0.88	10.3	3.03		8		100			0.66	2.7
7.62	25.0	10.13	1.66	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	5	1.39	1.23	1.93	0.91	0.87	8.4	2.96		5		100			0.52	2.1
7.77	25.5	10.72	3.39	Silty Clay to Clay	CL	stiff	120	1.5	7	1.42	1.24	3.90	0.95	0.86	8.7	3.11		7		100			0.56	2.2
7.92	26.0	11.07	3.96	Clay	CL/CH	stiff	120	1.0	11	1.45	1.26	4.56	0.96	0.85	8.9	3.15		11		100			0.58	2.3
8.08	26.5	10.41	2.76	Silty Clay to Clay	CL	stiff	120	1.5	7	1.48	1.27	3.22	0.95	0.84	8.3	3.08		7		100			0.54	2.1
8.23	27.0	11.16	2.85	Silty Clay to Clay	CL	stiff	120	1.5	7	1.51	1.29	3.29	0.94	0.83	8.8	3.07		7		100			0.58	2.3
8.38	27.5	12.00	2.26	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.54	1.30	2.59	0.92	0.83	9.4	2.98		6		100			0.63	2.4
8.53	28.0	11.75	2.35	Clayey Silt to Silty Clay	ML/CL	stiff	120	2.0	6	1.57	1.32	2.71	0.92	0.82	9.1	3.01		6		100			0.61	2.3
8.69	28.5	19.19	3.76	Silty Clay to Clay	CL	very stiff	120	1.5	13	1.60	1.33	4.11	0.90	0.81	14.8	2.94		13		100			1.05	4.0
8.84	29.0	38.34	2.06	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	15	1.63	1.34	2.15	0.77	0.83	30.1	2.52	87.2	13	17	70	27	31		
8.99	29.5	26.65	3.56	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	13	1.66	1.36	3.80	0.86	0.81	20.3	2.81		13		100			1.49	5.5
9.14	30.0	29.87	3.76	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	15	1.69	1.37	3.99	0.85	0.80	22.6	2.79		15		95			1.68	6.2
9.30	30.5	109.89	2.36	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	37	1.72	1.39	2.40	0.67	0.83	86.5	2.22	147.7	31	30	45	71	36		
9.45	31.0	237.13	0.75	Sand	SP	dense	120	5.0	47	1.75	1.40	0.76	0.50	0.87	194.7	1.61	194.7	40	39	10	100	38		
9.60	31.5	217.06	0.92	Sand	SP	dense	120	5.0	43	1.78	1.42	0.93	0.52	0.86	176.3	1.70	183.5	36	37	15	100	38		
9.75	32.0	247.25	1.12	Sand	SP	dense	120	5.0	49	1.81	1.43	1.12	0.53	0.85	199.3	1.73	210.6	41	42	15	100	39		
9.91	32.5	260.11	0.86	Sand	SP	dense	120	5.0	52	1.84	1.45	0.87	0.50	0.86	210.4	1.63	210.4	43	42	15	100	39		
10.06	33.0	229.31	1.03	Sand	SP	dense	120	5.0	46	1.87	1.46	1.04	0.53	0.84	182.9	1.73	193.3	38	39	15	100	38		
10.21	33.5	182.44	1.96	Sand to Silty Sand	SP/SM	dense	120	4.0	46	1.90	1.47	1.98	0.61	0.82	140.7	2.01	185.3	38	37	30	91	38		
10.36	34.0	301.78	0.85	Sand	SP	dense	120	5.0	60	1.93	1.49	0.86	0.50	0.84	240.5	1.59	240.5	49	48	10	100	40		
10.52	34.5	343.20	0.70	Gravelly Sand to Sand	SW	dense	120	6.0	57	1.96	1.50	0.70	0.50	0.84	272.2	1.49	272.2	47	54	10	100	40		
10.67	35.0	355.25	0.36	Gravelly Sand to Sand	SW	dense	120	6.0	59	1.99	1.52	0.37	0.50	0.84	280.4	1.29	280.4	48	56	0	100	40		
10.82	35.5	300.55	0.72	Sand	SP	dense	120	5.0	60	2.02	1.53	0.73	0.50	0.83	236.1	1.54	236.1	49	47	10	100	40		
10.97	36.0	345.40	0.50	Gravelly Sand to Sand	SW	dense	120	6.0	58	2.05	1.55	0.51	0.50	0.83	270.1	1.39	270.1	46	54	5	100	40		
11.13	36.5	347.35	0.34	Gravelly Sand to Sand	SW	dense	120	6.0	58	2.08	1.56	0.34	0.50	0.82	270.4	1.28	270.4	46	54	0	100	40		
11.28	37.0	343.57	0.50	Gravelly Sand to Sand	SW	dense	120	6.0	57	2.11	1.57	0.50	0.50	0.82	266.2	1.39	266.2	46	53	5	100	40		
11.43	37.5	309.28	0.35	Gravelly Sand to Sand	SW	dense	120	6.0	52	2.14	1.59	0.35	0.50	0.82	238.5	1.33	238.5	41	48	5	100	39		
11.58	38.0	212.34	0.50	Sand	SP	dense	120	5.0	42	2.17	1.60	0.50	0.50	0.81	163.0	1.56	163.0	34	33	10	97	37		
11.73	38.5	97.64	1.74	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	33	2.20	1.62	1.78	0.67	0.75	69.5	2.19	114.8	26	23	45	62	35		
11.89	39.0	65.85	2.61	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	26	2.23	1.63	2.70	0.75	0.72	45.0	2.46	114.8	21	23	65	44	33		
12.04	39.5	173.60	0.83	Sand	SP	medium dense	120	5.0	35	2.26	1.65	0.84	0.54	0.79	129.0	1.78	140.8	27	28	20	87	35		

Earth Systems
Pacific

CONE PENETROMETER INTERPRETATION

(based on Robertson & Campanella, 1989)

Project: Arctic Cold | Project No: 09340-01 | Date: 03/06/20

CPT SOUNDING: CPT-9 | Plot: 9 | Density: 1 SPT N | Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **20.0** | Dr correlation: 0 Baldi | Qc/N: 1.00 Robertson | Phi Correlation: 4 SPT N | Nk: 17

Base Depth meters	Base Depth feet	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	Qc to N	SPT N(60)	Total po tsf	p'o tsf	F	n	Cq	Norm. Qc1n	2.6 Ic	Clean Sand Qc1n	$N_{1(60)}$	Clean Sand $N_{1(60)}$	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
12.19	40.0	183.48	1.34	Sand to Silty Sand	SP/SM	dense	120	4.0	46	2.29	1.66	1.36	0.58	0.77	133.4	1.91	159.5	36	32	25	89	37		
12.34	40.5	330.86	0.75	Gravelly Sand to Sand	SW	dense	120	6.0	55	2.32	1.68	0.76	0.50	0.79	248.5	1.54	248.5	43	50	10	100	39		
12.50	41.0	380.03	0.58	Gravelly Sand to Sand	SW	dense	120	6.0	63	2.35	1.69	0.58	0.50	0.79	284.2	1.41	284.2	49	57	5	100	40		
12.65	41.5	379.75	0.48	Gravelly Sand to Sand	SW	dense	120	6.0	63	2.38	1.70	0.49	0.50	0.79	282.8	1.36	282.8	48	57	5	100	40		
12.80	42.0	373.05	0.46	Gravelly Sand to Sand	SW	dense	120	6.0	62	2.41	1.72	0.46	0.50	0.78	276.7	1.36	276.7	47	55	5	100	40		
12.95	42.5	352.64	0.43	Gravelly Sand to Sand	SW	dense	120	6.0	59	2.44	1.73	0.44	0.50	0.78	260.4	1.36	260.4	45	52	5	100	39		
13.11	43.0	317.81	0.41	Gravelly Sand to Sand	SW	dense	120	6.0	53	2.47	1.75	0.41	0.50	0.78	233.7	1.38	233.7	40	47	5	100	38		
13.26	43.5	242.49	0.41	Gravelly Sand to Sand	SW	dense	120	6.0	40	2.50	1.76	0.42	0.50	0.77	177.6	1.48	177.6	30	36	10	100	36		
13.41	44.0	83.44	1.10	Sand to Silty Sand	SP/SM	medium dense	120	4.0	21	2.53	1.78	1.14	0.65	0.71	56.2	2.14	86.3	16	17	40	53	32		
13.56	44.5	31.58	2.68	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	13	2.56	1.79	2.91	0.84	0.64	19.2	2.76		13		95			1.75	4.9
13.72	45.0	14.17	3.75	Silty Clay to Clay	CL	stiff	120	1.5	9	2.59	1.81	4.59	0.98	0.59	7.9	3.19		9		100			0.73	1.9
13.87	45.5	56.15	1.51	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	19	2.62	1.82	1.58	0.73	0.67	35.8	2.38	80.5	14	16	55	34	31		
14.02	46.0	54.54	1.83	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	18	2.65	1.83	1.93	0.75	0.66	34.2	2.45	86.8	13	17	65	32	31		
14.17	46.5	21.02	4.88	Clay	CL/CH	very stiff	120	1.0	21	2.68	1.85	5.59	0.95	0.59	11.7	3.10		21		100			1.13	3.0
14.33	47.0	51.67	2.03	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	17	2.71	1.86	2.14	0.76	0.65	31.7	2.51	88.8	13	18	70	29	31		
14.48	47.5	27.27	3.81	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	14	2.74	1.88	4.23	0.90	0.60	15.4	2.94		14		100			1.49	3.9
14.63	48.0	19.66	3.20	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	10	2.77	1.89	3.72	0.93	0.58	10.9	3.02		10		100			1.05	2.7
14.78	48.5	34.48	3.06	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	17	2.80	1.91	3.33	0.85	0.61	19.8	2.79		17		95			1.92	5.0
14.94	49.0	76.97	2.02	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	26	2.83	1.92	2.10	0.72	0.65	47.3	2.37	103.2	19	21	55	46	33		
15.09	49.5	54.46	3.98	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	27	2.86	1.93	4.20	0.82	0.61	31.3	2.70		27		85			3.09	8.0
15.24	50.0	257.68	0.72	Sand	SP	dense	120	5.0	52	2.89	1.95	0.73	0.50	0.74	179.4	1.63	179.4	37	36	15	100	38		
15.39	50.5	313.01	0.63	Gravelly Sand to Sand	SW	dense	120	6.0	52	2.92	1.96	0.64	0.50	0.73	217.2	1.53	217.2	37	43	10	100	38		
15.54	51.0	304.96	0.52	Gravelly Sand to Sand	SW	dense	120	6.0	51	2.94	1.98	0.53	0.50	0.73	210.8	1.48	210.8	36	42	10	100	38		
15.70	51.5	251.37	0.49	Gravelly Sand to Sand	SW	medium dense	120	6.0	42	2.97	1.99	0.50	0.50	0.73	173.1	1.53	173.1	30	35	10	100	36		
15.85	52.0	99.40	1.99	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	33	3.00	2.01	2.05	0.70	0.64	60.2	2.28	113.8	23	23	50	56	34		
16.00	52.5	23.03	2.07	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	9	3.03	2.02	2.39	0.88	0.57	12.3	2.87		9		100			1.24	3.0
16.15	53.0	18.05	1.21	Sandy Silt to Clayey Silt	ML	stiff	120	2.5	7	3.06	2.04	1.46	0.88	0.56	9.6	2.85		7		100			0.94	2.2
16.31	53.5	24.06	2.49	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	10	3.09	2.05	2.86	0.89	0.56	12.6	2.90		10		100			1.29	3.1
16.46	54.0	166.95	0.68	Sand	SP	medium dense	120	5.0	33	3.12	2.06	0.69	0.55	0.69	109.6	1.78	119.7	23	24	20	81	34		
16.61	54.5	82.02	3.42	Sandy Silt to Clayey Silt	ML	medium dense	120	2.5	33	3.15	2.08	3.56	0.77	0.59	46.1	2.53	134.8	23	27	70	45	34		
16.76	55.0	63.53	3.80	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	32	3.18	2.09	4.00	0.81	0.58	34.6	2.65		32		80			3.61	8.7
16.92	55.5	26.14	4.97	Clay	CL/CH	very stiff	120	1.0	26	3.21	2.11	5.66	0.94	0.52	12.9	3.07		26		100			1.41	3.3
17.07	56.0	51.08	4.19	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	26	3.24	2.12	4.47	0.84	0.56	26.9	2.77		26		95			2.88	6.8
17.22	56.5	84.15	4.06	Clayey Silt to Silty Clay	ML/CL	medium dense	120	2.0	42	3.27	2.14	4.22	0.79	0.58	45.8	2.58	148.0	29	30	75	44	36		
17.37	57.0	115.98	3.96	Clayey Silt to Silty Clay	ML/CL	dense	120	2.0	58	3.30	2.15	4.07	0.75	0.59	64.3	2.47	169.2	40	34	65	58	38		
17.53	57.5	353.98	0.79	Gravelly Sand to Sand	SW	dense	120	6.0	59	3.33	2.16	0.80	0.50	0.70	233.9	1.57	233.9	40	47	10	100	38		
17.68	58.0	378.13	0.43	Gravelly Sand to Sand	SW	dense	120	6.0	63	3.36	2.18	0.43	0.50	0.70	249.0	1.37	249.0	43	50	5	100	39		
17.83	58.5	219.15	0.62	Sand	SP	medium dense	120	5.0	44	3.39	2.19	0.63	0.51	0.69	142.7	1.66	144.6	30	29	15	92	36		
17.98	59.0	43.49	3.55	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	22	3.42	2.21	3.86	0.85	0.53	22.0	2.79		22		95			2.43	5.4
18.14	59.5	30.74	1.57	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	12	3.45	2.22	1.77	0.83	0.54	15.7	2.71		12		85			1.68	3.7
18.29	60.0	31.90	2.76	Sandy Silt to Clayey Silt	ML	very stiff	120	2.5	13	3.48	2.24	3.10	0.87	0.52	15.7	2.85		13		100			1.75	3.8
18.44	60.5	33.41	4.26	Silty Clay to Clay	CL	very stiff	120	1.5	22	3.51	2.25	4.76	0.90	0.51	16.0	2.96		22		100			1.83	4.0
18.59	61.0	27.13	3.25	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	14	3.54	2.27	3.74	0.91	0.50	12.9	2.96		14		100			1.46	3.1
18.75	61.5	29.93	3.22	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	15	3.57	2.28	3.65	0.89	0.50	14.2	2.92		15		100			1.63	3.5
18.90	62.0	48.47	3.08	Sandy Silt to Clayey Silt	ML	hard	120	2.5	19	3.60	2.29	3.33	0.83	0.53	24.1	2.72		19		90			2.72	5.9
19.05	62.5	42.99	2.95	Sandy Silt to Clayey Silt	ML	hard	120	2.5	17	3.63	2.31	3.23	0.84	0.52	21.1	2.76		17		90			2.39	5.1
19.20	63.0	24.85	4.30	Silty Clay to Clay	CL	very stiff	120	1.5	17	3.66	2.32	5.04	0.95	0.48	11.2	3.09		17		100			1.33	2.7
19.35	63.5	76.56	2.16	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	26	3.69	2.34	2.27	0.75	0.55	40.1	2.44	100.0	17	20	60	39	32		
19.51	64.0	53.53	3.20	Sandy Silt to Clayey Silt	ML	hard	120	2.5	21	3.72	2.35	3.44	0.82	0.52	26.2	2.70		21		85			3.01	6.4
19.66	64.5	43.16	4.20	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	22	3.75	2.37	4.60	0.88	0.49	20.2	2.87		22		100			2.40	5.0
19.81	65.0	28.53	4.26	Silty Clay to Clay	CL	very stiff	120	1.5	19	3.78	2.38	4.92	0.93	0.47	12.7	3.04		19		100			1.54	3.1
19.96	65.5	30.46	3.93	Clayey Silt to Silty Clay	ML/CL	very stiff	120	2.0	15	3.81	2.40	4.49	0.91	0.47	13.6	2.99		15		100			1.65	3.3
20.12	66.0	41.09	3.79	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	21	3.84	2.41	4.18	0.87	0.49	18.9	2.86		21		100			2.28	4.6
20.27	66.5	278.28	1.37	Sand	SP	dense	120	5.0	56	3.87	2.42	1.39	0.57	0.63	164.4	1.85	188.5	36	38	20	97	37		
20.42	67.0	405.61	1.33	Sand	SP	very dense	120	5.0	81	3.90	2.44	1.34	0.53	0.64	246.6	1.73	260.2	52	52	15	100	41		
20.57	67.5	381.14	1.16	Sand	SP	dense	120	5.0	76	3.93	2.45	1.17	0.52	0.65	232.7	1.70	240.8	49	48	15	100	40		
20.73	68.0	150.09	3.02	Sandy Silt to Clayey Silt	ML	dense	120	2.5	60	3.96	2.47	3.10	0.71	0.55	77.8	2.33	159.0	38	32	55	66	38		
20.88	68.5	61.91	3.88	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	31	3.99	2.48	4.14	0.83	0.49	28.8	2.72		31		90			3.50	7.0
21.03	69.0	70.28	4.16	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	35	4.02	2.50	4.41	0.82	0.49	32.8	2.70		35		85			3.99	8.0
21.18	69.5	166.72	2.19	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	56	4.05	2.51	2.24	0.67	0.56	88.5	2.19	144.9	35	29	40	72	37		
21.34	70.0	186.55	1.83	Sand to Silty Sand	SP/SM	medium dense	120	4.0	47	4.08	2.52	1.87	0.64	0.57	101.2	2.09	145.5	29	29	35	77	36		
21.49	70.5	134.19	1.79	Sand to Silty Sand	SP/SM	medium dense	120	4.0	34	4.11	2.54	1.85	0.67	0.56	70.4	2.20	117.5	21	23	45	62	34		
21.64	71.0	72.09	3.86	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	36	4.14	2.55	4.10	0.82	0.49	33.2	2.67		36		85			4.09	8.0
21.79	71.5	133.71	1.87	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	45	4.17	2.57	1.93	0.68	0.55	69.3	2.22	118.7	28	24	45	62	35		
21.95	72.0	145.05	1.45	Sand to Silty Sand	SP/SM	medium dense	120	4.0	36	4.20	2.58	1.50	0.65	0.56	77.1	2.11	113.5	23	23	35	66	34		
22.10	72.5	94.26	2.50	Silty Sand to Sandy Silt	SM/ML	medium dense	120	3.0	31	4.23	2.60	2.62	0.75	0.51	45.6	2.44	113.7	19	23	60	44	33		
22.25	73.0	161.71	2.76	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	54	4.26	2.61	2.84	0.70	0.53	81.4	2.29	155.3	33	31	50	68	37		
22.40	73.5	165.67	2.37	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	55	4.29	2.63	2.43	0.68	0.54	84.4	2.23	146.6	34	29	45	70	37		
22.56	74.0	78.14	3.85	Clayey Silt to Silty Clay	ML/CL	hard	120	2.0	39	4.32	2.64	4.07	0.81	0.48	35.2	2.65		39		80			4.44	8.4
22.71	74.5	156.10	2.54	Silty Sand to Sandy Silt	SM/ML	dense	120	3.0	52	4.35	2.65	2.61	0.69	0.53	77.9	2.27	145.6	32	29	50	66	37		

APPENDIX B

Laboratory Testing
Tabulated Test Results
Individual Test Results

LABORATORY TESTING

A. Samples were reviewed along with field logs to determine which would be analyzed further. Those chosen for laboratory analysis were considered representative of soils that would be exposed and/or used during grading, and those deemed to be within the influence of proposed structures. Test results are presented in graphic and tabular form in this Appendix.

B. In-situ moisture content and unit dry weight for the ring samples were determined in general accordance with ASTM D 2937.

C. The relative strength characteristics of the soils were determined from the results of a direct shear tests on remolded and undisturbed samples. Shear specimens were placed in contact with water at least 24 hours before testing and were then sheared under normal loads ranging from 1.0 to 3 kips per square foot in general accordance with ASTM D 3080.

D. Expansion index tests were performed on bulk soil samples in accordance with ASTM D 4829. The samples were surcharged under 144 pounds per square foot at moisture content of near 50% saturation. The samples were then submerged in water for 24 hours and the amount of expansion was recorded with a dial indicator.

E. Maximum density tests were performed to estimate the moisture-density relationships of typical soil materials. The tests were performed in accordance with ASTM designation D 1557.

F. The gradation characteristics of a selected samples were made by hydrometer (in accordance with ASTM D 422) and sieve analysis procedures. The samples were soaked in water until individual soil particles were separated and then washed on the No. 200 mesh sieve, oven-dried, weighed to calculate the percent passing the No. 200 sieve, and then mechanically sieved. Additionally, hydrometer analyses were performed to assess the distribution of the minus No. 200 mesh material of selected samples. The hydrometer test was run using sodium hexametaphosphate as a dispersing agent.

G. The consolidation characteristics of samples were determined in accordance with ASTM D 2435. The samples were loaded to 500 psf (their approximate in-situ overburden pressure) and then flooded with water to check for hydroconsolidation potential, and then incrementally loaded to 16,000 psf. The samples were allowed to consolidate under each load increment. Rebound was measured by unloading the samples to 2,000 psf. Time rate of consolidation was measured on several test specimens under loads of 4,000 and 8,000 psf. Compression was measured by dial gauges accurate to 0.0001 inch. Results of the consolidation tests in the form of percent consolidation versus log of pressure curves are presented in this Appendix.

H. Concrete and metal corrosion potential of the near surface soil was determined by measuring pH, resistivity, and soluble sulfate and soluble chloride contents. The tests were performed Capco Analytical.

I. Resistance ("R") Value tests were conducted on bulk samples secured during the field studies. The tests were performed in accordance with California Method 301. Three specimens at different moisture contents were tested for each sample, and the R-Value at 300 psi exudation pressure was determined from the plotted results.

Tabulated Test Data

REMOLDED SAMPLE DATA

BORING AND DEPTH	B-1 @ 0'-5'	B-2 @ 0'-5'	B-3 @ 0'-5'	B-11 @ 0'-5"
USCS	ML	CL	ML	ML
MAXIMUM DENSITY (pcf)	125.0	124.5	--	124.5
OPTIMUM MOISTURE (%)	10.5	10.5	--	10.5
PEAK ANGLE OF INT. FRICTION	40°	36°	--	--
PEAK COHESION (psf)	0	10	--	--
ULTIMATE ANGLE OF INT. FRICTION	34°	33°	--	--
ULTIMATE COHESION (psf)	0	0	--	--
EXPANSION INDEX	30	63	--	--
pH	8.0	8.0	--	--
RESISTIVITY (ohms/cm)	2,625	1,575	--	--
SOLUBLE CHLORIDE (mg/kg)	22.7	36.3	--	--
SOLUBLE SULFATE (mg/kg)	366	680	--	--
GRAIN SIZE DISTRIBUTION (%)				
GRAVEL	0.1	0.2	0.4	--
SAND (2mm - 74µm)	44.5	39.2	49.5	--
SILT (74µm - 5µm)	38.0	36.4	30.3	--
CLAY (5µm - 2µm)	6.7	6.6	5.8	--
CLAY (2µm)	10.7	17.3	14.0	--

RELATIVELY UNDISTURBED DIRECT SHEAR TESTS

BORING AND DEPTH	B-1 @ 2.5'	B-2 @ 5'	B-4 @ 7.5'	B-10 @ 7.5'
GEOLOGIC UNIT	Alluvium	Alluvium	Alluvium	Alluvium
USCS/SOIL DESCRIPTION	ML	SP-SM	SM	SP
IN-PLACE DRY DENSITY (pcf)	102.3	98.5	107.2	94.9
IN-PLACE MOISTURE (%)	19.1	6.8	20.8	5.8
PEAK FRICTION ANGLE	31°	36°	30°	34°
PEAK COHESION (psf)	180	0	380	0
ULTIMATE FRICTION ANGLE	31°	32°	32°	32°
ULTIMATE COHESION (psf)	0	0	0	0

GRAIN SIZE DISTRIBUTIONS

BORING AND DEPTH	B-1 @ 10’	B-1 @ 15’	B-1 @ 35’	B-1 @ 65’
USCS	SW-SM	CL	SP-SM	CL
GRAIN SIZE DISTRIBUTION (%)				
GRAVEL	7.7	0.0	6.0	0.0
SAND	84.0	33.8	88.3	15.4
SILT	6.3	35.2	3.0	59.1
CLAY (5µm - 2µm)	1.6	8.4	1.6	8.3
CLAY (2µm)	0.4	22.6	1.1	17.2

BORING AND DEPTH	B-4 @ 15’
USCS	ML
GRAIN SIZE DISTRIBUTION (%)	
GRAVEL	0.0
SAND	30.8
SILT	47.2
CLAY (5µm - 2µm)	6.5
CLAY (2µm)	15.5

ATTERBURG LIMITS

BORING and DEPTH	B-1 @ 21.5'	B-2 @ 15’	B-1 @ 50’	B-4 @ 20’
SOIL TYPE	CL	ML	CL	ML
LIQUID LIMIT (% moisture)	49	27	29	43
PLASTIC LIMIT (% moisture)	27	22	22	32
PLASTICITY INDEX (% moisture)	22	5	7	11

RESISTANCE VALUES (R-VALUES)

BORING and DEPTH	West Central	Southeast Area	Northeast Area
R-VALUE	5	13	5

Individual Test Results

File Number: 303415-002 Lab Number: 098398

MAXIMUM DENSITY / OPTIMUM MOISTURE

ASTM D 1557-12 (Modified)

Job Name: Arctic Cold
Sample ID: B 1 @ 0-5'

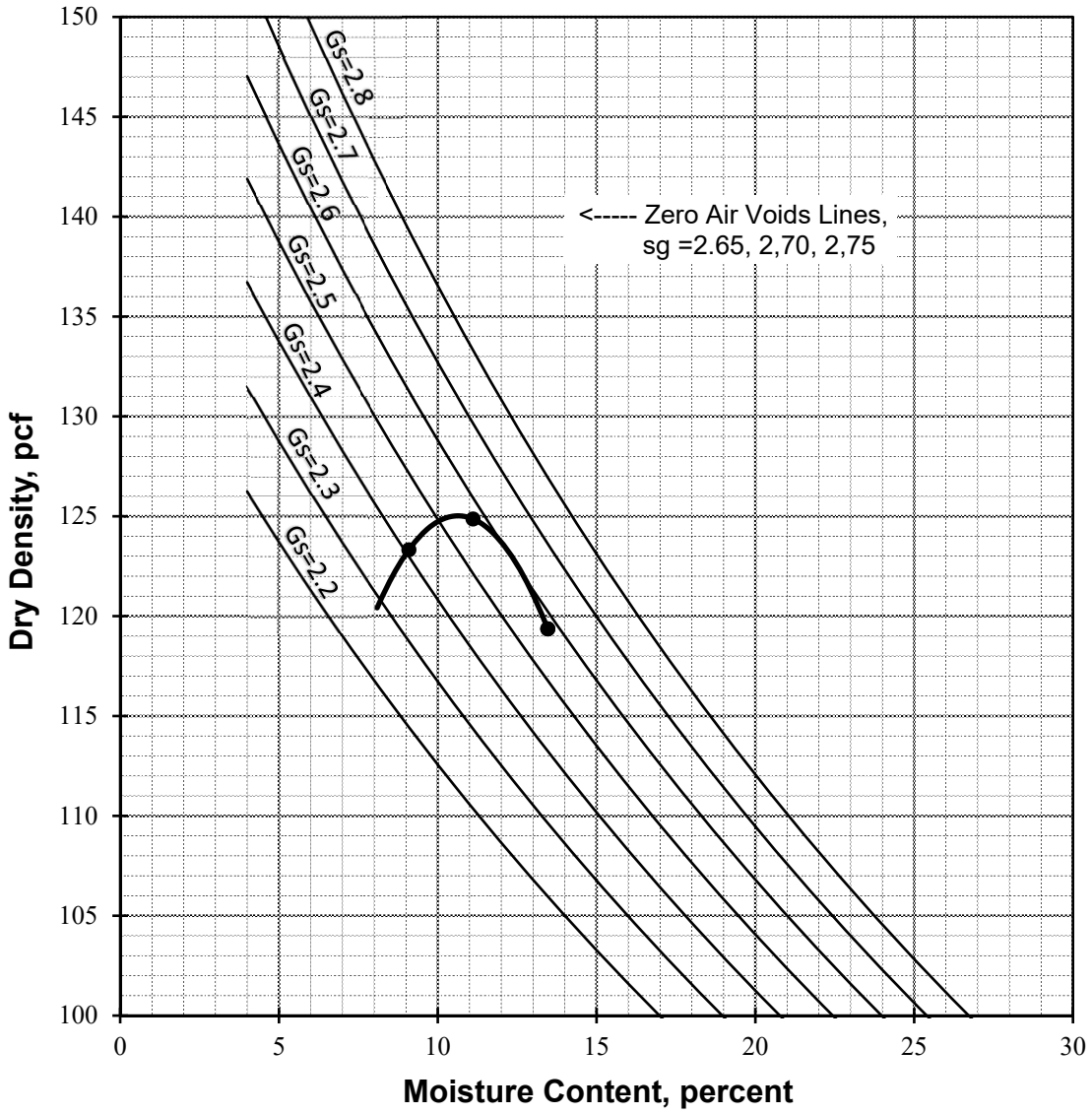
Procedure Used: A
Prep. Method: Moist

Date: 3/16/2020
Description: Brown sandy Silt with some clay
SG: 2.54

Rammer Type: Automatic

Maximum Density: **125 pcf**
Optimum Moisture: **10.5%**

Sieve Size	% Retained
3/4"	0.0
3/8"	0.0
#4	0.1



File Number: 303415-002 Lab Number: 098398

MAXIMUM DENSITY / OPTIMUM MOISTURE

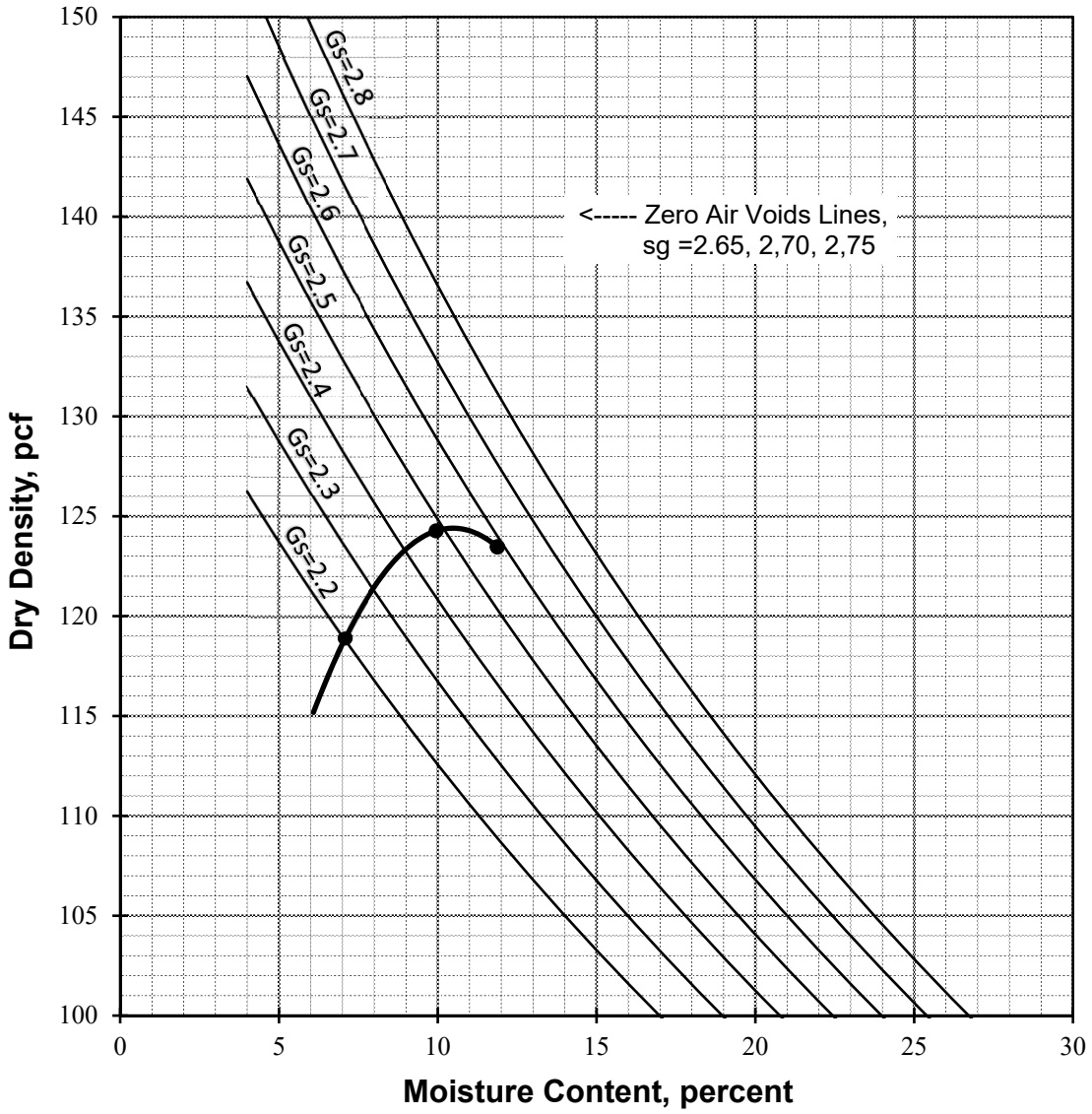
ASTM D 1557-12 (Modified)

Job Name: Arctic Cold
Sample ID: B 2 @ 0-5'
Date: 3/16/2020
Description: Yellow brown silty Clay, trace fine sand
SG: 2.52

Procedure Used: A
Prep. Method: Moist
Rammer Type: Automatic

Maximum Density: 124.5 pcf
Optimum Moisture: 10.5%

Sieve Size	% Retained
3/4"	0.0
3/8"	0.0
#4	0.2



File Number: 303415-002 Lab Number: 098398

MAXIMUM DENSITY / OPTIMUM MOISTURE

ASTM D 1557-12 (Modified)

Job Name: Arctic Cold
Sample ID: B 11 @ 0-5'

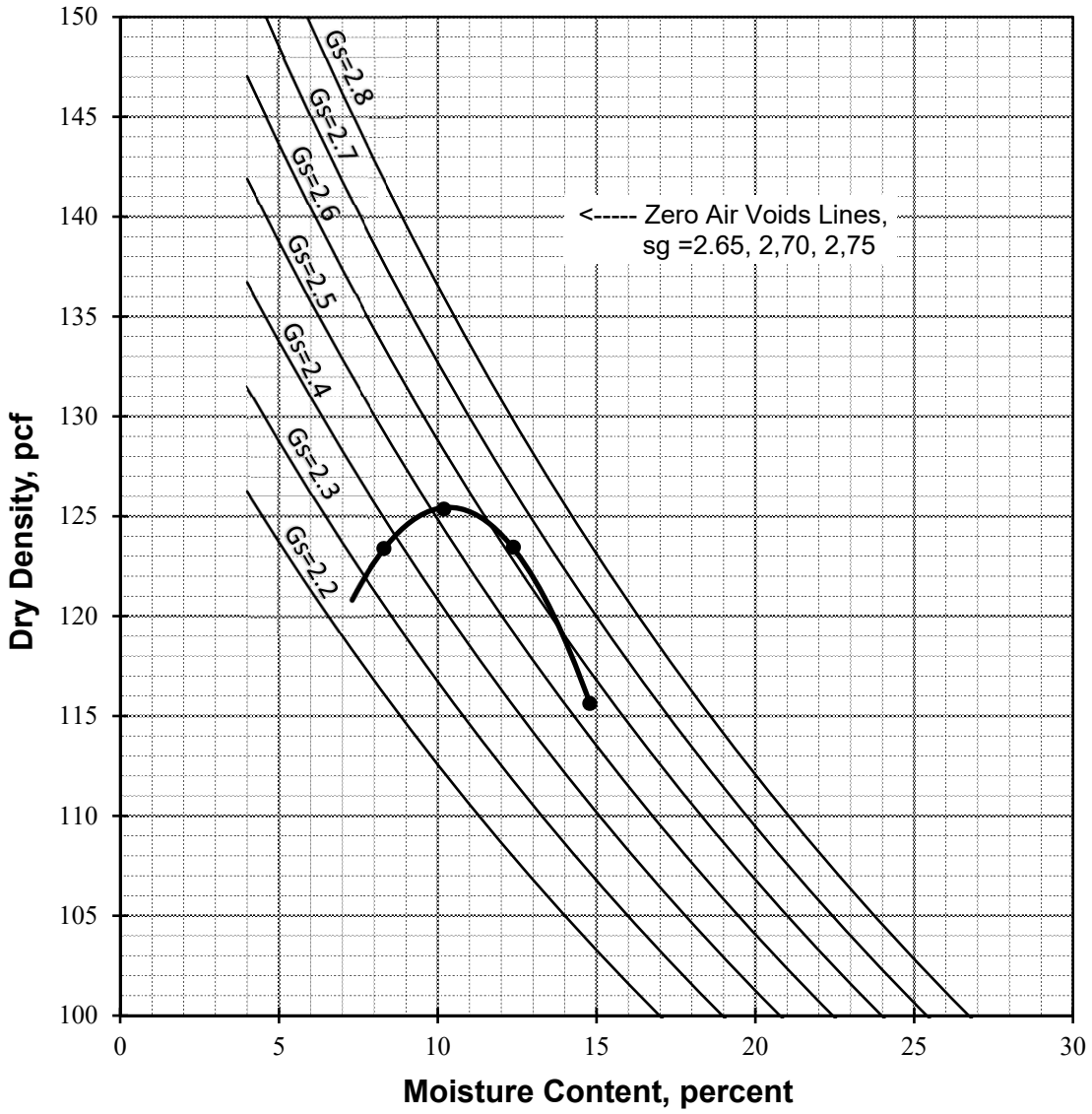
Procedure Used: A
Prep. Method: Moist

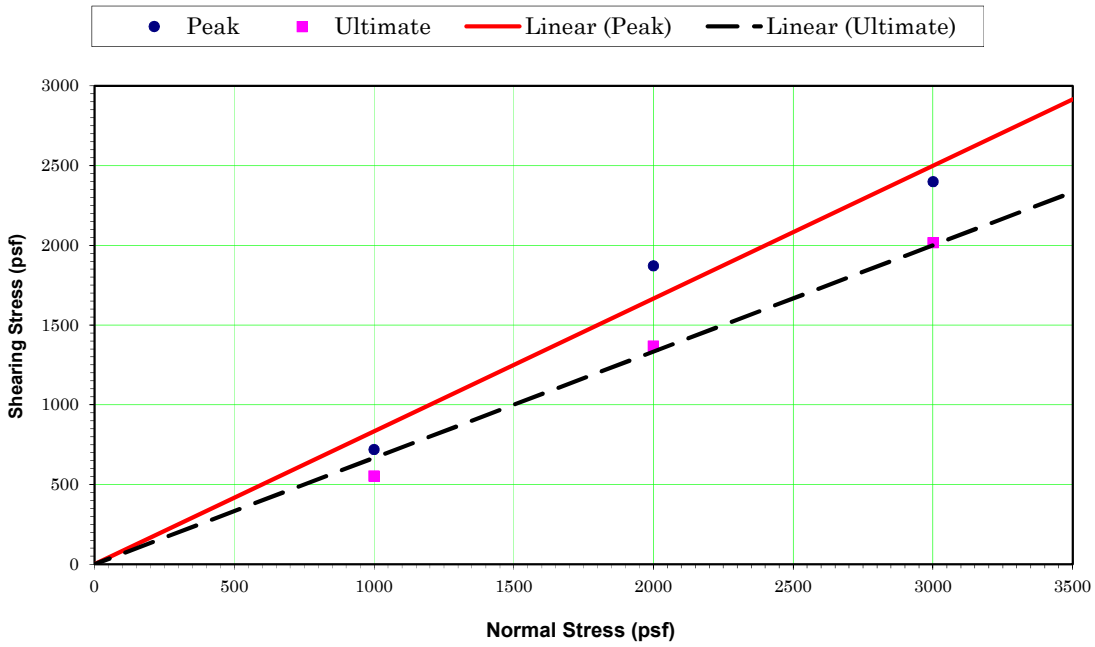
Date: 3/16/2020
Description: Dark brown fine sandy Silt
SG: 2.54

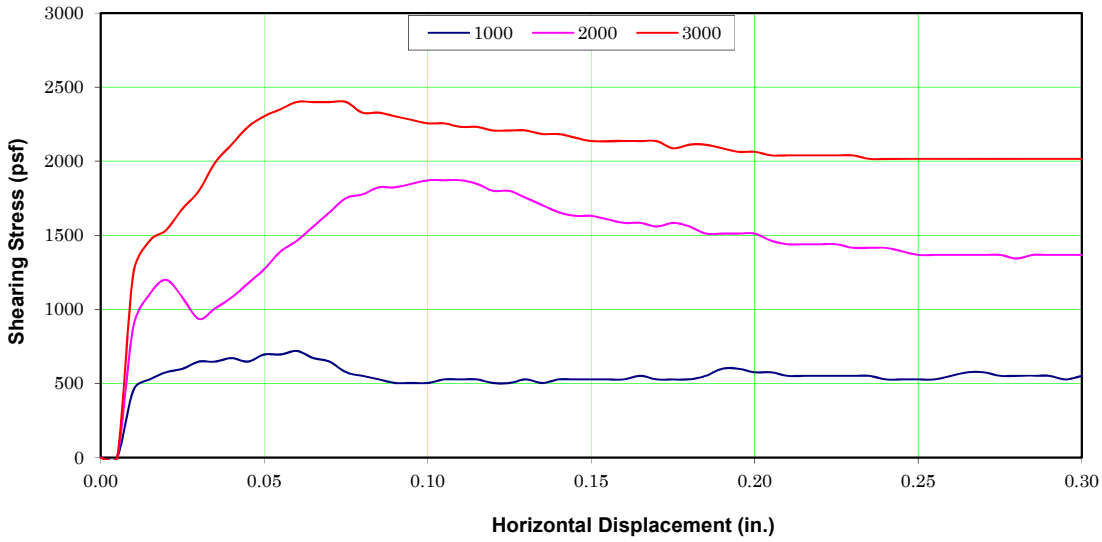
Rammer Type: Automatic

Maximum Density: 124.5 pcf
Optimum Moisture: 10.5%

Sieve Size	% Retained
3/4"	0.0
3/8"	0.0
#4	0.0







DIRECT SHEAR DATA*

Sample Location: B 1 @ 0-5'
Sample Description: Brwon sandy Silt with some clay
Dry Density (pcf): 112.3
Intial % Moisture: 10.6
Average Degree of Saturation: 94.2
Shear Rate (in/min): 0.005 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	720	1872	2400
Ultimate stress (psf)	552	1368	2016

	Peak	Ultimate
ϕ Angle of Friction (degrees):	40	34
c Cohesive Strength (psf):	0	0

Test Type: Peak & Ultimate

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

Arctic Cold

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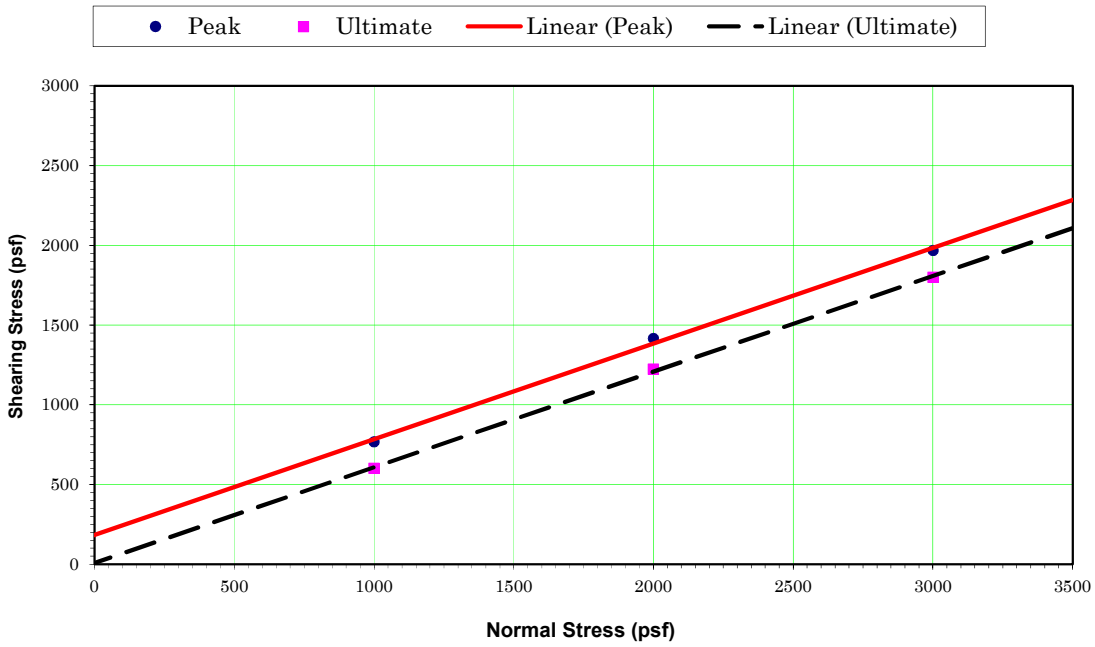

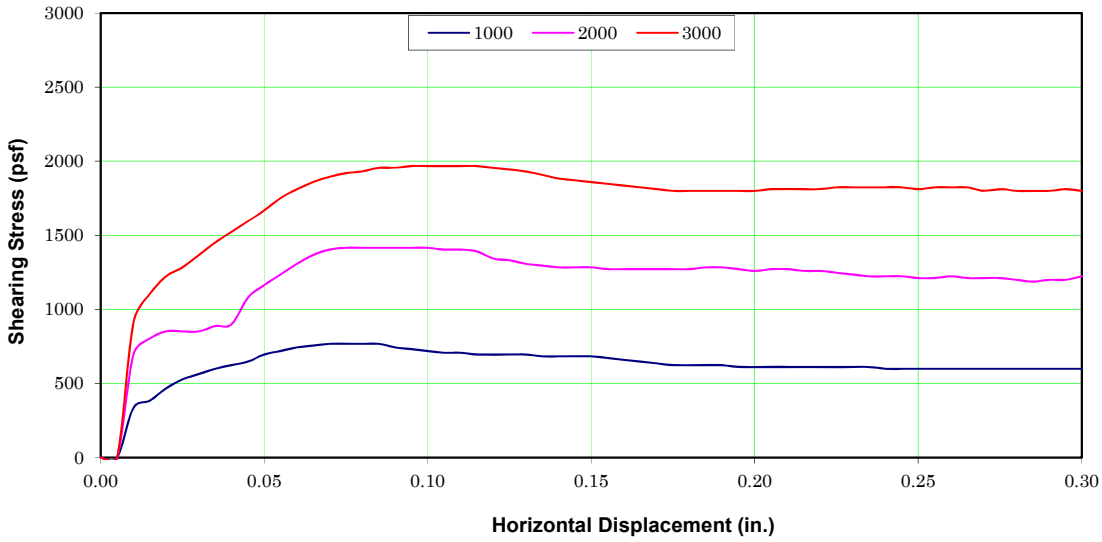

DIRECT SHEAR DATA*

Sample Location: B 1 @ 2.5'
Sample Description: Brown sandy Silt with some clay
Dry Density (pcf): 102.3
Intial % Moisture: 19.1
Average Degree of Saturation: 100.0
Shear Rate (in/min): 0.005 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	768	1416	1968
Ultimate stress (psf)	600	1224	1800

	Peak	Ultimate
ϕ Angle of Friction (degrees):	31	31
c Cohesive Strength (psf):	180	0

Test Type: Peak & Ultimate

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

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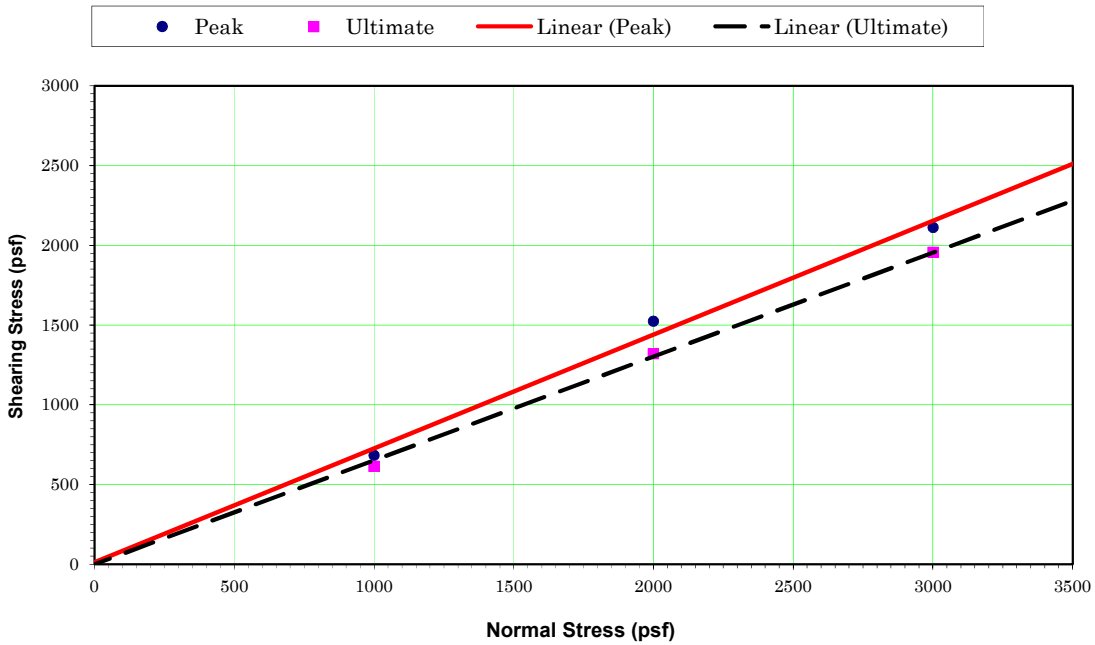

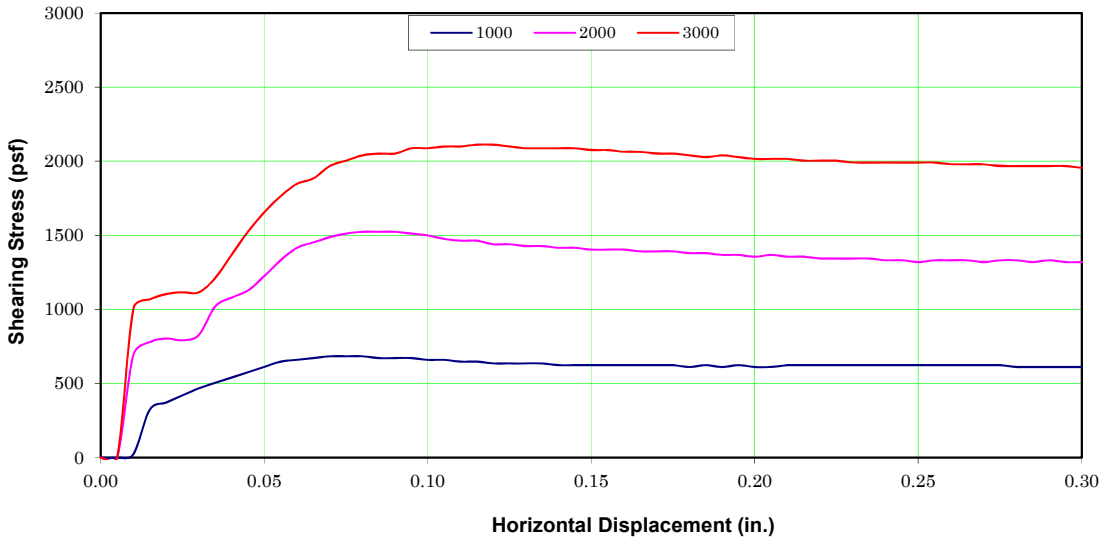

DIRECT SHEAR DATA*

Sample Location: B 2 @ 0-5'
Sample Description: Yellwo brown silty Clay, trace fine sand
Dry Density (pcf): 111.9
Intial % Moisture: 10.5
Average Degree of Saturation: 100.0
Shear Rate (in/min): 0.005 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	684	1524	2112
Ultimate stress (psf)	612	1320	1956

	Peak	Ultimate
ϕ Angle of Friction (degrees):	36	33
c Cohesive Strength (psf):	10	0

Test Type: Peak & Ultimate

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

Arctic Cold

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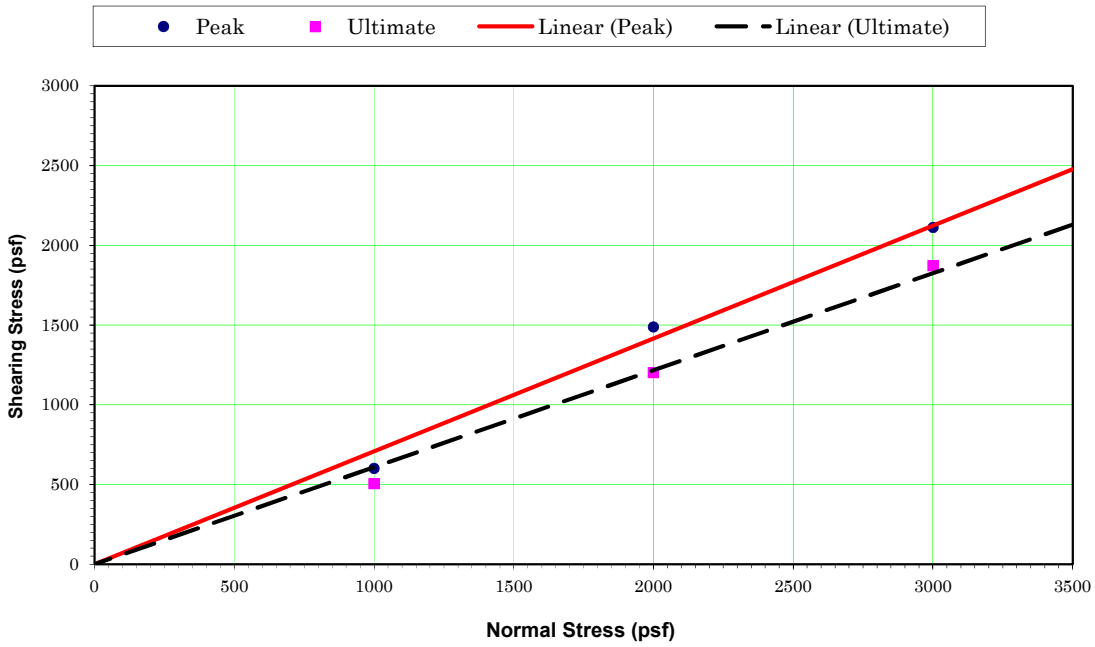

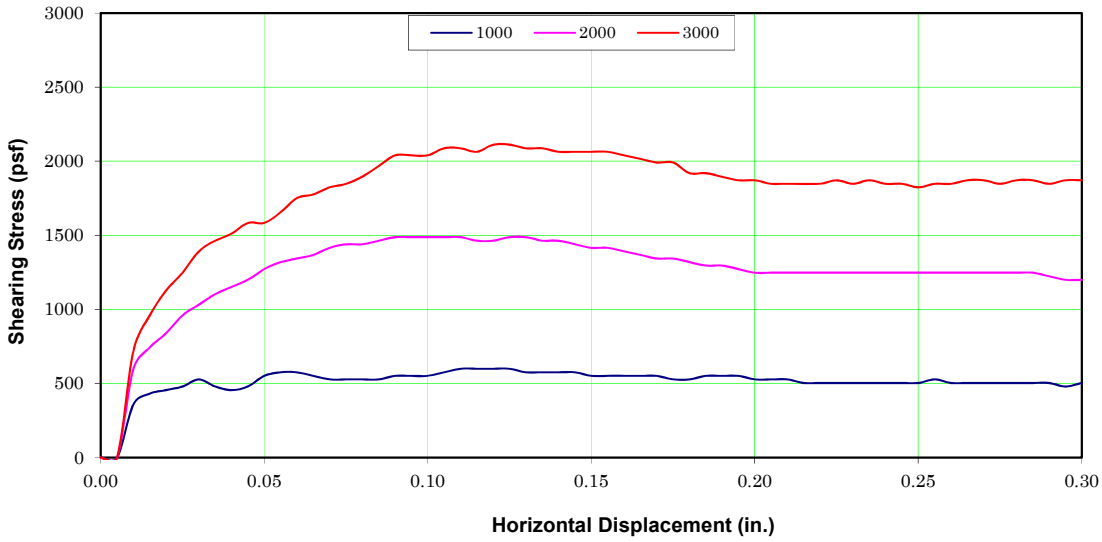

DIRECT SHEAR DATA*

Sample Location: B 2 @ 5'
Sample Description: Light yellow brown fine to medium Sand, few silt
Dry Density (pcf): 98.5
Intial % Moisture: 6.8
Average Degree of Saturation: 87.1
Shear Rate (in/min): 0.005 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	600	1488	2112
Ultimate stress (psf)	504	1200	1872

	Peak	Ultimate
ϕ Angle of Friction (degrees):	36	32
c Cohesive Strength (psf):	0	0

Test Type: Peak & Ultimate

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

Arctic Cold

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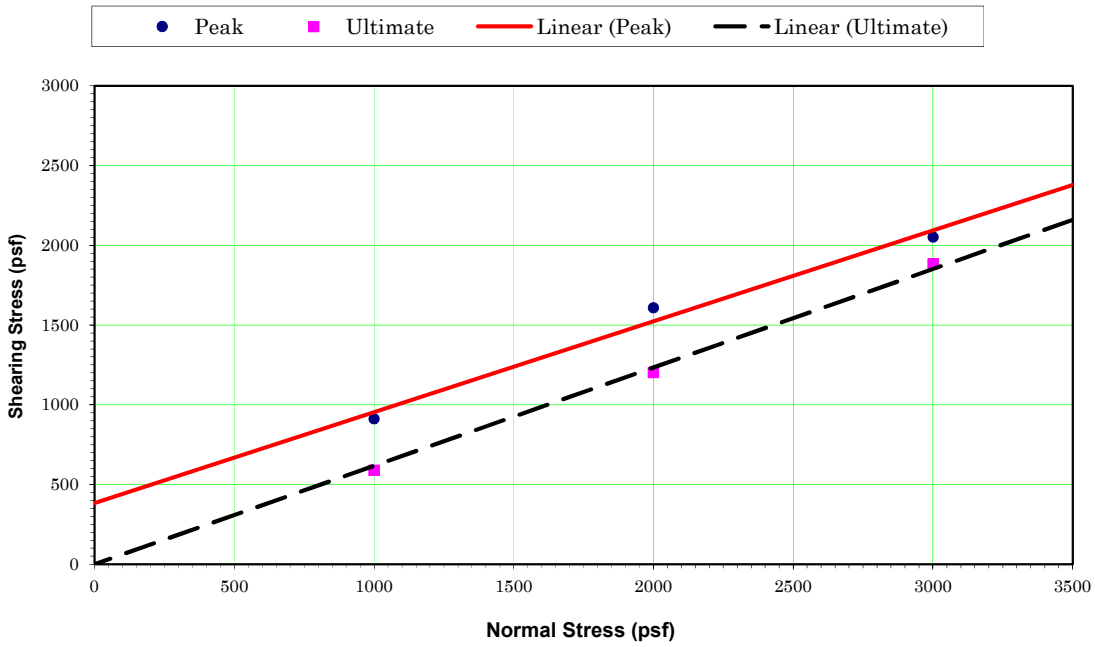
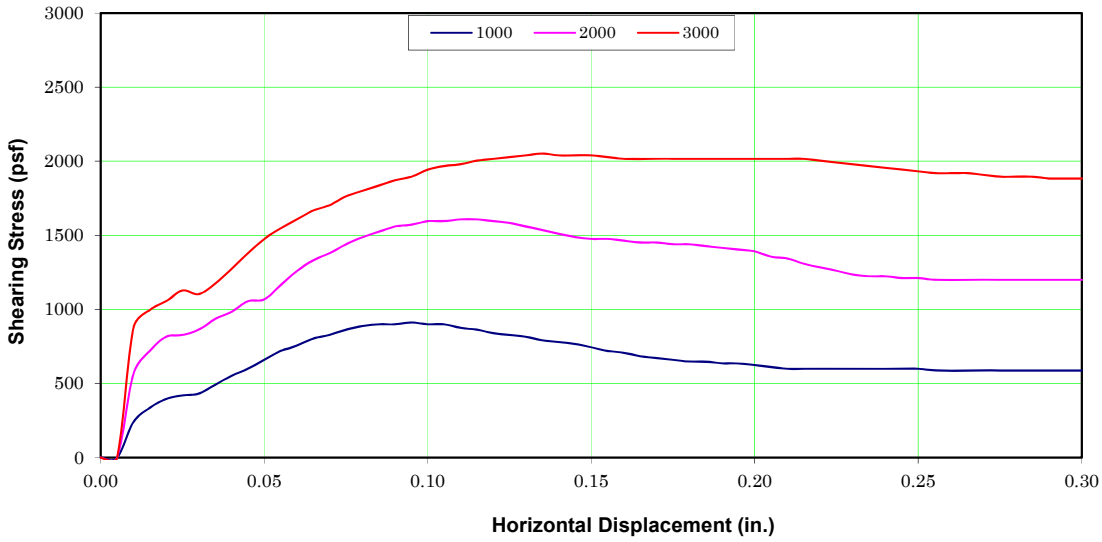




DIRECT SHEAR DATA*

Sample Location: B 4 @ 7.5'
Sample Description: Brown silty fine Sand
Dry Density (pcf): 107.2
Intial % Moisture: 20.8
Average Degree of Saturation: 100.0
Shear Rate (in/min): 0.005 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	912	1608	2052
Ultimate stress (psf)	588	1200	1884

	Peak	Ultimate
ϕ Angle of Friction (degrees):	30	32
c Cohesive Strength (psf):	380	0

Test Type: Peak & Ultimate

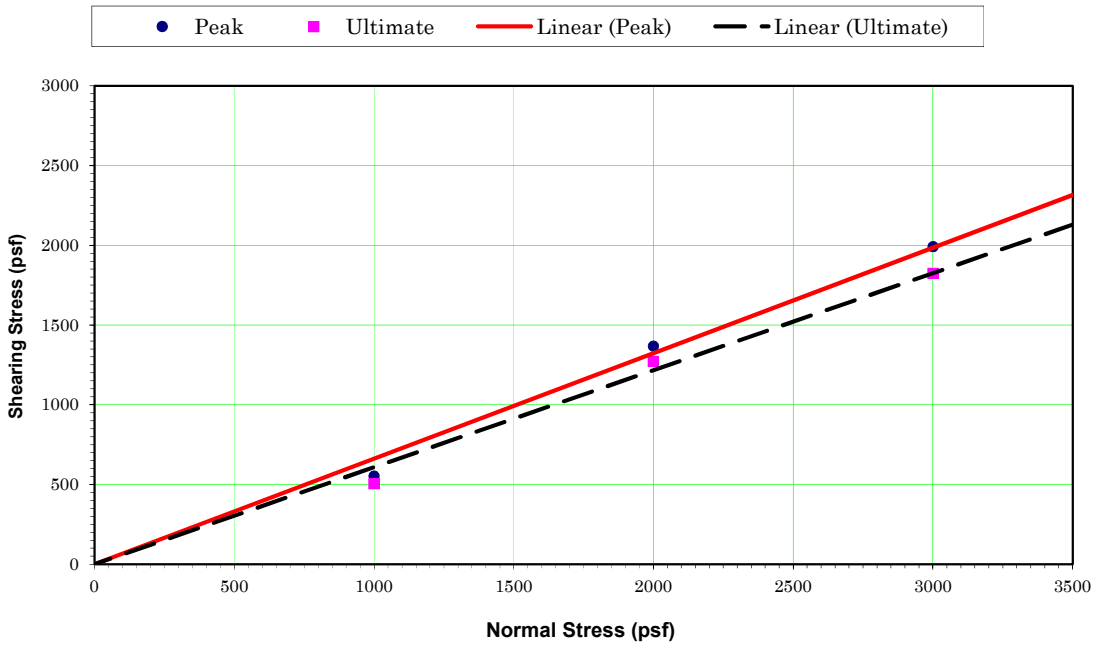
* Test Method: ASTM D-3080

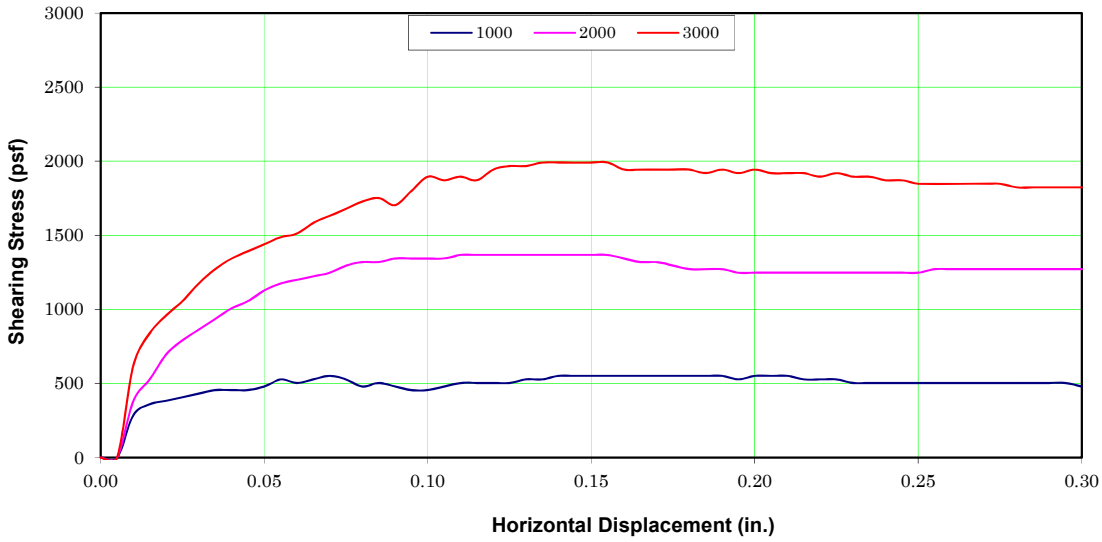
DIRECT SHEAR TEST

Arctic Cold

Earth Systems

3/29/2020 | 303415-002





DIRECT SHEAR DATA*

Sample Location: B 10 @ 7.5'
Sample Description: Light yellow brown fine Sand
Dry Density (pcf): 94.9
Intial % Moisture: 5.8
Average Degree of Saturation: 89.1
Shear Rate (in/min): 0.005 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	552	1368	1992
Ultimate stress (psf)	504	1272	1824

	Peak	Ultimate
ϕ Angle of Friction (degrees):	34	32
c Cohesive Strength (psf):	0	0

Test Type: Peak & Ultimate

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

Arctic Cold

Earth Systems

3/29/2020 | 303415-002

File No.: 303415-002

EXPANSION INDEX

ASTM D-4829, UBC 18-2

Job Name: Arctic Cold
Sample ID: B 1 @ 0-5'
Soil Description: ML

Initial Moisture, %:	9.5
Initial Compacted Dry Density, pcf:	111.4
Initial Saturation, %:	50
Final Moisture, %:	18.0
Volumetric Swell, %:	3.0
Expansion Index:	**30** **Low**

EI	UBC Classification
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
130+	Very High

File No.: 303415-002

EXPANSION INDEX

ASTM D-4829, UBC 18-2

Job Name: Arctic Cold
Sample ID: B 2 @ 0-5'
Soil Description: CL

Initial Moisture, %:	9.5
Initial Compacted Dry Density, pcf:	110.7
Initial Saturation, %:	49
Final Moisture, %:	18.6
Volumetric Swell, %:	6.3
Expansion Index:	**63** **Medium**

EI	UBC Classification
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
130+	Very High

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Arctic Cold
Job No.: 303415-002
Sample ID: **B 1 @ 0-5'**
Soil Description: **ML**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	100.0
% Moisture:	0.0

Air Dry Sample Wt., g:	245
Corrected Wt., g:	245.0

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	0.0	0.00	100.00
3/8 inch	0.0	0.00	100.00
#4	0.2	0.08	99.92
#8	0.2	0.08	99.92
#10	0.3	0.12	99.88

Air Dry Hydro Sample Wt., g:	60.4
Corrected Wt., g:	60.4
Calculation Factor	0.6047

Hydrometer Analysis for <#10 Material

Start time: 1:27:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	1:27:20 AM	39	18	5.5	33.5
1 hour	2:27:00 AM	16	18	5.5	10.5
6 hour	7:27:00 AM	12	18	5.5	6.5

% Gravel:	0.1
% Sand(2mm - 74µm):	44.5
% Silt(74µm- 5µm):	38.0
% Clay(5µm - 2µm):	6.7
% Clay(≤2µm):	10.7

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Arctic Cold
Job No.: 303415-002
Sample ID: **B 1 @ 10'**
Soil Description: **SW-SM**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	100.0
% Moisture:	0.0

Air Dry Sample Wt., g:	721.8
Corrected Wt., g:	721.8

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	17.7	2.45	97.55
3/8 inch	25.0	3.46	96.54
#4	55.5	7.69	92.31
#8	97.6	13.52	86.48
#10	109.7	15.20	84.80

Air Dry Hydro Sample Wt., g:	107.6
Corrected Wt., g:	107.6
Calculation Factor	1.2689

Hydrometer Analysis for <#10 Material

Start time: 1:10:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	1:10:20 AM	16	18	5.5	10.5
1 hour	2:10:00 AM	8	18	5.5	2.5
6 hour	7:10:00 AM	6	18	5.5	0.5

% Gravel:	7.7
% Sand(2mm - 74µm):	84.0
% Silt(74µm- 5µm):	6.3
% Clay(5µm - 2µm):	1.6
% Clay(≤2µm):	0.4

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Arctic Cold
Job No.: 303415-002
Sample ID: **B 1 @ 15'**
Soil Description: **CL**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	100.0
% Moisture:	0.0

Air Dry Sample Wt., g:	721.2
Corrected Wt., g:	721.2

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	0.0	0.00	100.00
3/8 inch	0.0	0.00	100.00
#4	0.0	0.00	100.00
#8	0.0	0.00	100.00
#10	0.0	0.00	100.00

Air Dry Hydro Sample Wt., g:	59.7
Corrected Wt., g:	59.7
Calculation Factor	0.5970

Hydrometer Analysis for <#10 Material

Start time: 1:17:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	1:17:20 AM	45	18	5.5	39.5
1 hour	2:17:00 AM	24	18	5.5	18.5
6 hour	7:17:00 AM	19	18	5.5	13.5

% Gravel:	0.0
% Sand(2mm - 74µm):	33.8
% Silt(74µm- 5µm):	35.2
% Clay(5µm - 2µm):	8.4
% Clay(≤2µm):	22.6

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Arctic Cold
Job No.: 303415-002
Sample ID: **B 1 @ 35'**
Soil Description: **SP-SM**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	100.0
% Moisture:	0.0

Air Dry Sample Wt., g:	457
Corrected Wt., g:	457.0

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	17.9	3.92	96.08
3/8 inch	17.9	3.92	96.08
#4	27.4	6.00	94.00
#8	43.0	9.41	90.59
#10	47.0	10.28	89.72

Air Dry Hydro Sample Wt., g:	118.4
Corrected Wt., g:	118.4
Calculation Factor	1.3197

Hydrometer Analysis for <#10 Material

Start time: 1:12:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	1:12:20 AM	13	18	5.5	7.5
1 hour	2:12:00 AM	9	18	5.5	3.5
6 hour	7:12:00 AM	7	18	5.5	1.5

% Gravel:	6.0
% Sand(2mm - 74µm):	88.3
% Silt(74µm- 5µm):	3.0
% Clay(5µm - 2µm):	1.6
% Clay(≤2µm):	1.1

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Arctic Cold
Job No.: 303415-002
Sample ID: **B 1 @ 65'**
Soil Description: **CL**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	100.0
% Moisture:	0.0

Air Dry Sample Wt., g:	317.6
Corrected Wt., g:	317.6

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	0.0	0.00	100.00
3/8 inch	0.0	0.00	100.00
#4	0.0	0.00	100.00
#8	0.7	0.22	99.78
#10	0.9	0.28	99.72

Air Dry Hydro Sample Wt., g:	60.7
Corrected Wt., g:	60.7
Calculation Factor	0.6087

Hydrometer Analysis for <#10 Material

Start time: 1:22:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	1:22:20 AM	57	18	5.5	51.5
1 hour	2:22:00 AM	21	18	5.5	15.5
6 hour	7:22:00 AM	16	18	5.5	10.5

% Gravel:	0.0
% Sand(2mm - 74µm):	15.4
% Silt(74µm- 5µm):	59.1
% Clay(5µm - 2µm):	8.3
% Clay(≤2µm):	17.2

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Arctic Cold
Job No.: 303415-002
Sample ID: **B 2 @ 0-5'**
Soil Description: **CL**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	100.0
% Moisture:	0.0

Air Dry Sample Wt., g:	295.2
Corrected Wt., g:	295.2

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	0.0	0.00	100.00
3/8 inch	0.0	0.00	100.00
#4	0.6	0.20	99.80
#8	1.1	0.37	99.63
#10	1.2	0.41	99.59

Air Dry Hydro Sample Wt., g:	60.3
Corrected Wt., g:	60.3
Calculation Factor	0.6055

Hydrometer Analysis for <#10 Material

Start time: 1:25:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	1:25:20 AM	42	18	5.5	36.5
1 hour	2:25:00 AM	20	18	5.5	14.5
6 hour	7:25:00 AM	16	18	5.5	10.5

% Gravel:	0.2
% Sand(2mm - 74µm):	39.5
% Silt(74µm- 5µm):	36.4
% Clay(5µm - 2µm):	6.6
% Clay(≤2µm):	17.3

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Arctic Cold
Job No.: 303415-002
Sample ID: **B 3 @ 0-5'**
Soil Description: **ML**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	100.0
% Moisture:	0.0

Air Dry Sample Wt., g:	399
Corrected Wt., g:	399.0

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	0.0	0.00	100.00
3/8 inch	0.0	0.00	100.00
#4	1.5	0.38	99.62
#8	2.4	0.60	99.40
#10	2.7	0.68	99.32

Air Dry Hydro Sample Wt., g:	68.8
Corrected Wt., g:	68.8
Calculation Factor	0.6927

Hydrometer Analysis for <#10 Material

Start time: 2:37:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	2:37:20 AM	40	19	5.3	34.7
1 hour	3:37:00 AM	19	19	5.3	13.7
6 hour	8:37:00 AM	15	19	5.3	9.7

% Gravel:	0.4
% Sand(2mm - 74µm):	49.5
% Silt(74µm- 5µm):	30.3
% Clay(5µm - 2µm):	5.8
% Clay(≤2µm):	14.0

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Arctic Cold
Job No.: 303415-002
Sample ID: **B 4 @ 15'**
Soil Description: **ML**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	100.0
% Moisture:	0.0

Air Dry Sample Wt., g:	491.8
Corrected Wt., g:	491.8

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	0.0	0.00	100.00
3/8 inch	0.0	0.00	100.00
#4	0.0	0.00	100.00
#8	0.0	0.00	100.00
#10	0.0	0.00	100.00

Air Dry Hydro Sample Wt., g:	61.4
Corrected Wt., g:	61.4
Calculation Factor	0.6140

Hydrometer Analysis for <#10 Material

Start time: 1:18:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	1:18:20 AM	48	18	5.5	42.5
1 hour	2:18:00 AM	19	18	5.5	13.5
6 hour	7:18:00 AM	15	18	5.5	9.5

% Gravel:	0.0
% Sand(2mm - 74µm):	30.8
% Silt(74µm- 5µm):	47.2
% Clay(5µm - 2µm):	6.5
% Clay(≤2µm):	15.5

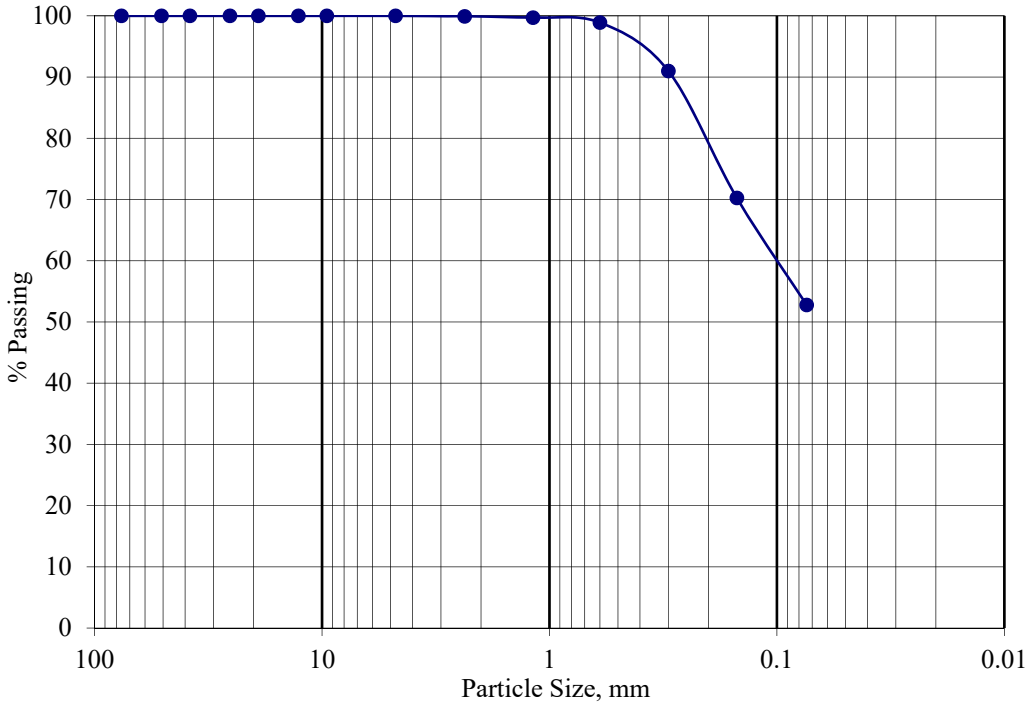
File No.: Arctic Cold March 27, 2020

SIEVE ANALYSIS

ASTM C-136

Job Name: 303415-002
Sample ID: B 11 @ 0-5'
Description: ML

Sieve Size	% Passing
3"	100
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	100
#8	100
#16	100
#30	99
#50	91
#100	70
#200	53



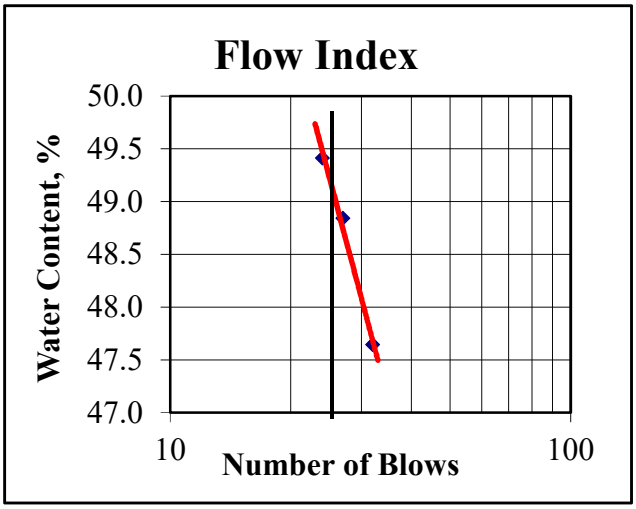
File No.: 303415-002 January 0, 1900

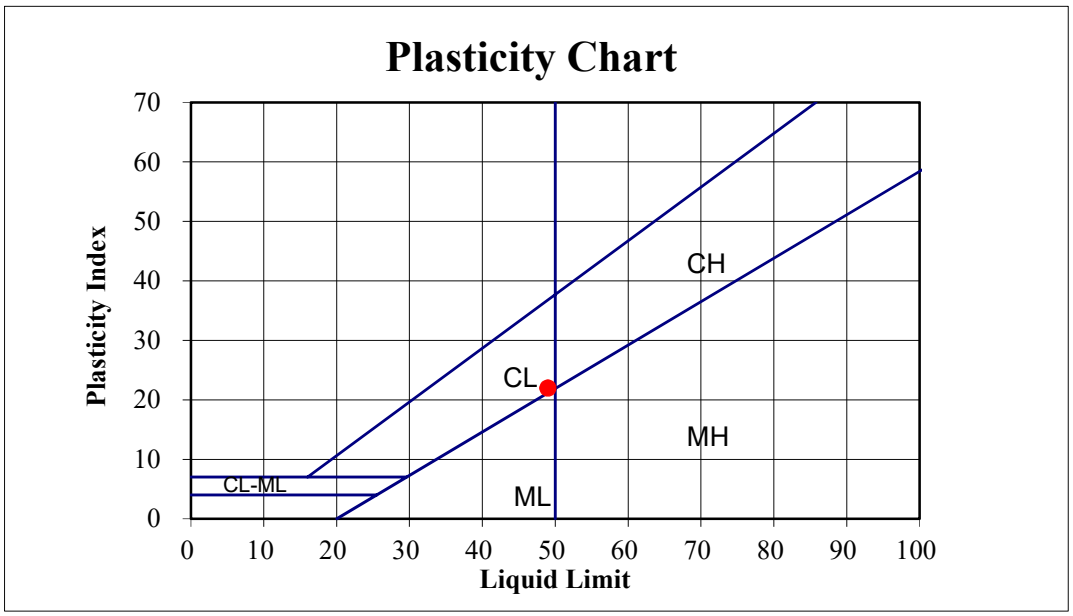
PLASTICITY INDEX

ASTM D-4318

Job Name: Arctic Cold
Sample ID: B 1 @ 21.5'
Soil Description: CL

DATA SUMMARY				TEST RESULTS	
Number of Blows:	24	27	32	**LIQUID LIMIT**	**49**
Water Content, %	49.4	48.8	47.6	**PLASTIC LIMIT**	**27**
Plastic Limit:	26.7	26.5		**PLASTICITY INDEX**	**22**





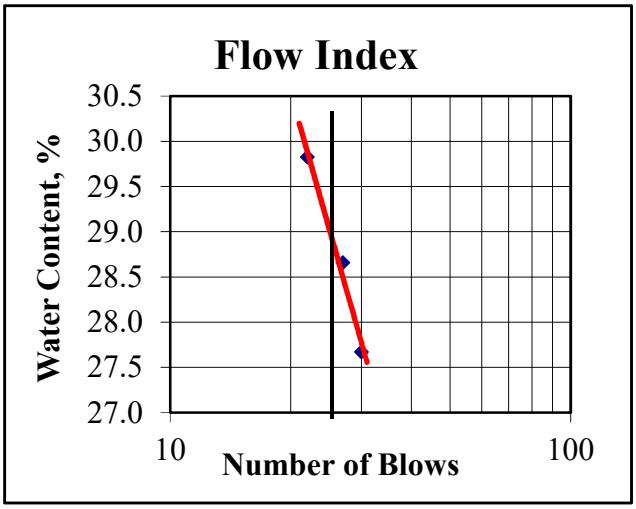
File No.: 303415-002 January 0, 1900

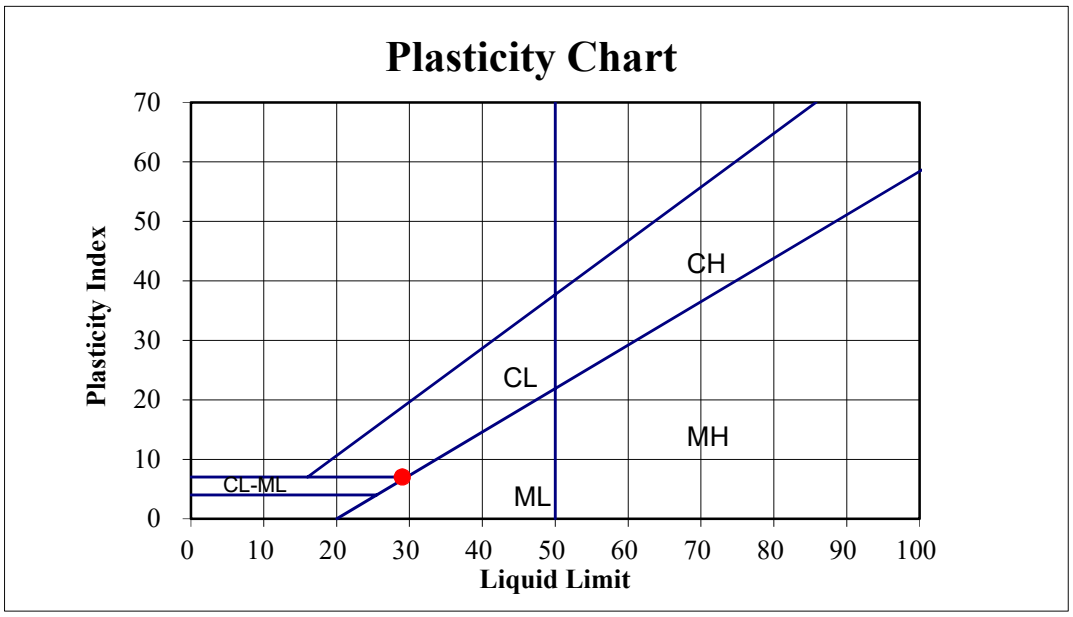
PLASTICITY INDEX

ASTM D-4318

Job Name: Arctic Cold
Sample ID: B 1 @ 50'
Soil Description: CL

DATA SUMMARY				TEST RESULTS	
Number of Blows:	22	27	30	**LIQUID LIMIT**	**29**
Water Content, %	29.8	28.7	27.7	**PLASTIC LIMIT**	**22**
Plastic Limit:	21.6	21.6		**PLASTICITY INDEX**	**7**





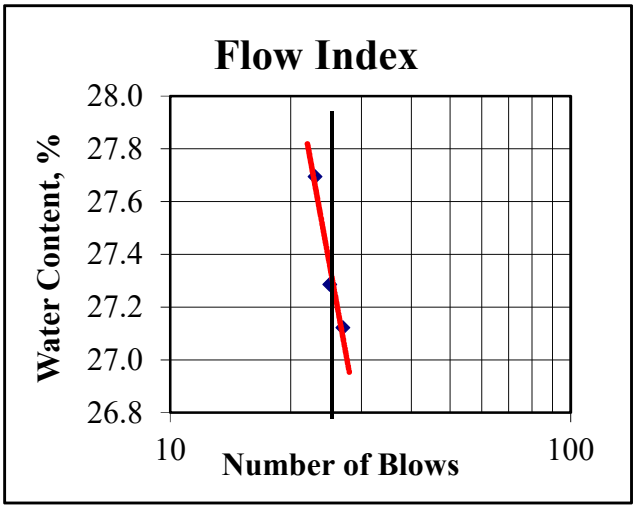
File No.: 303415-002 January 0, 1900

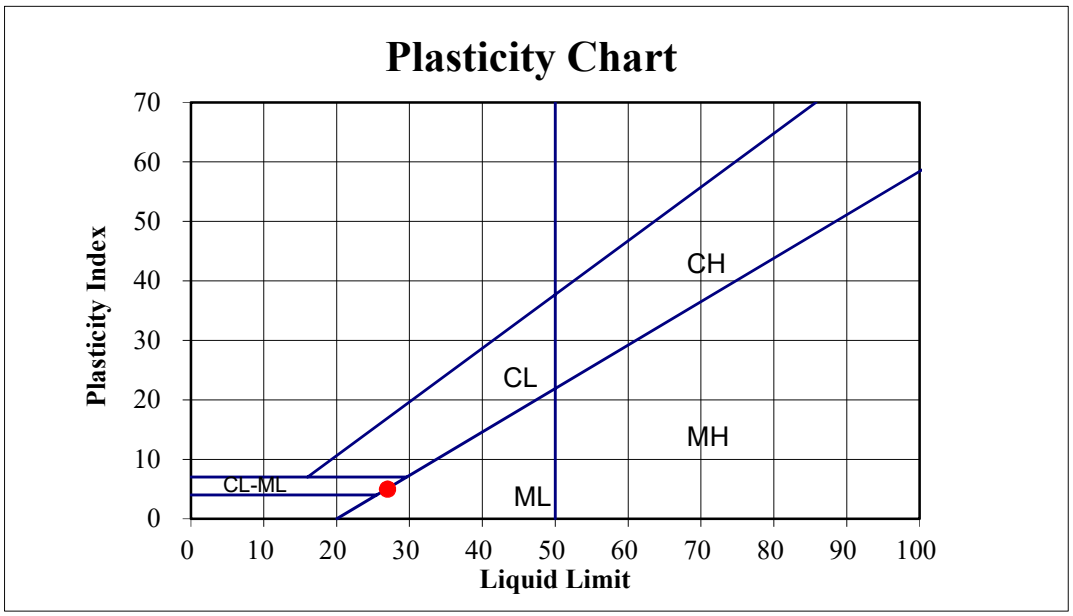
PLASTICITY INDEX

ASTM D-4318

Job Name: Arctic Cold
Sample ID: B 2 @ 15'
Soil Description: ML

DATA SUMMARY				TEST RESULTS	
Number of Blows:	23	25	27	**LIQUID LIMIT**	**27**
Water Content, %	27.7	27.3	27.1	**PLASTIC LIMIT**	**22**
Plastic Limit:	21.7	21.7		**PLASTICITY INDEX**	**5**





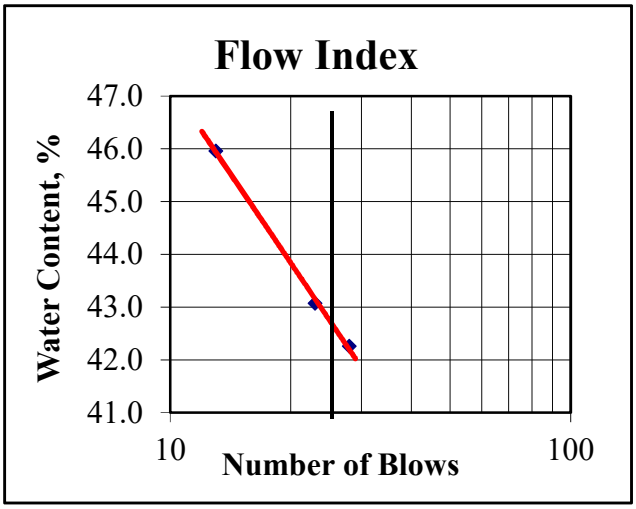
File No.: 303415-002 January 0, 1900

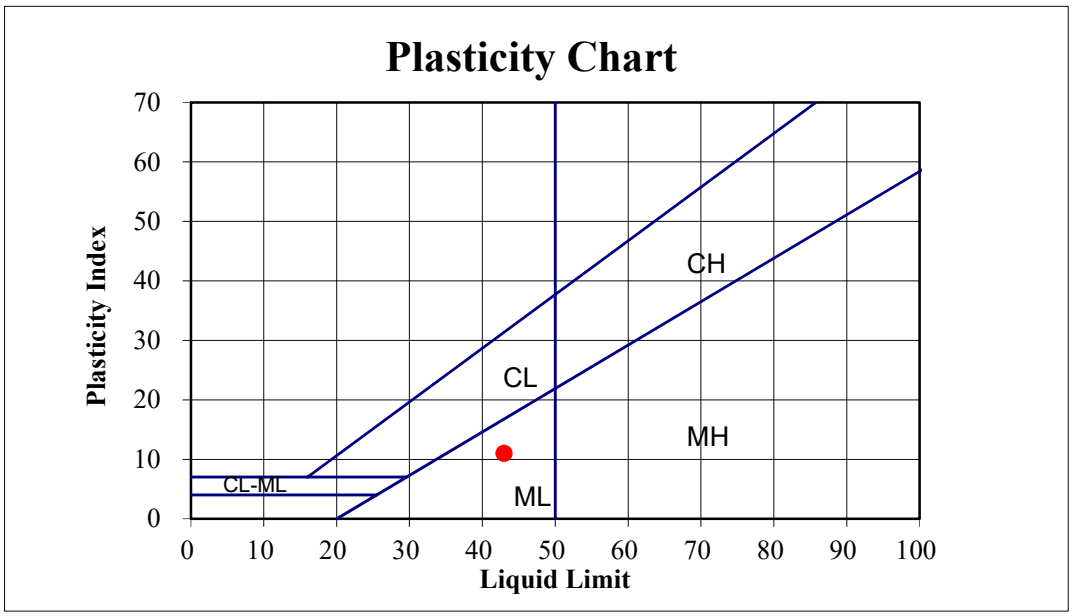
PLASTICITY INDEX

ASTM D-4318

Job Name: Arctic Cold
Sample ID: B 4 @ 20'
Soil Description: ML

DATA SUMMARY				TEST RESULTS	
Number of Blows:	13	23	28	**LIQUID LIMIT**	**43**
Water Content, %	46.0	43.1	42.3	**PLASTIC LIMIT**	**32**
Plastic Limit:	32.2	32.8		**PLASTICITY INDEX**	**11**



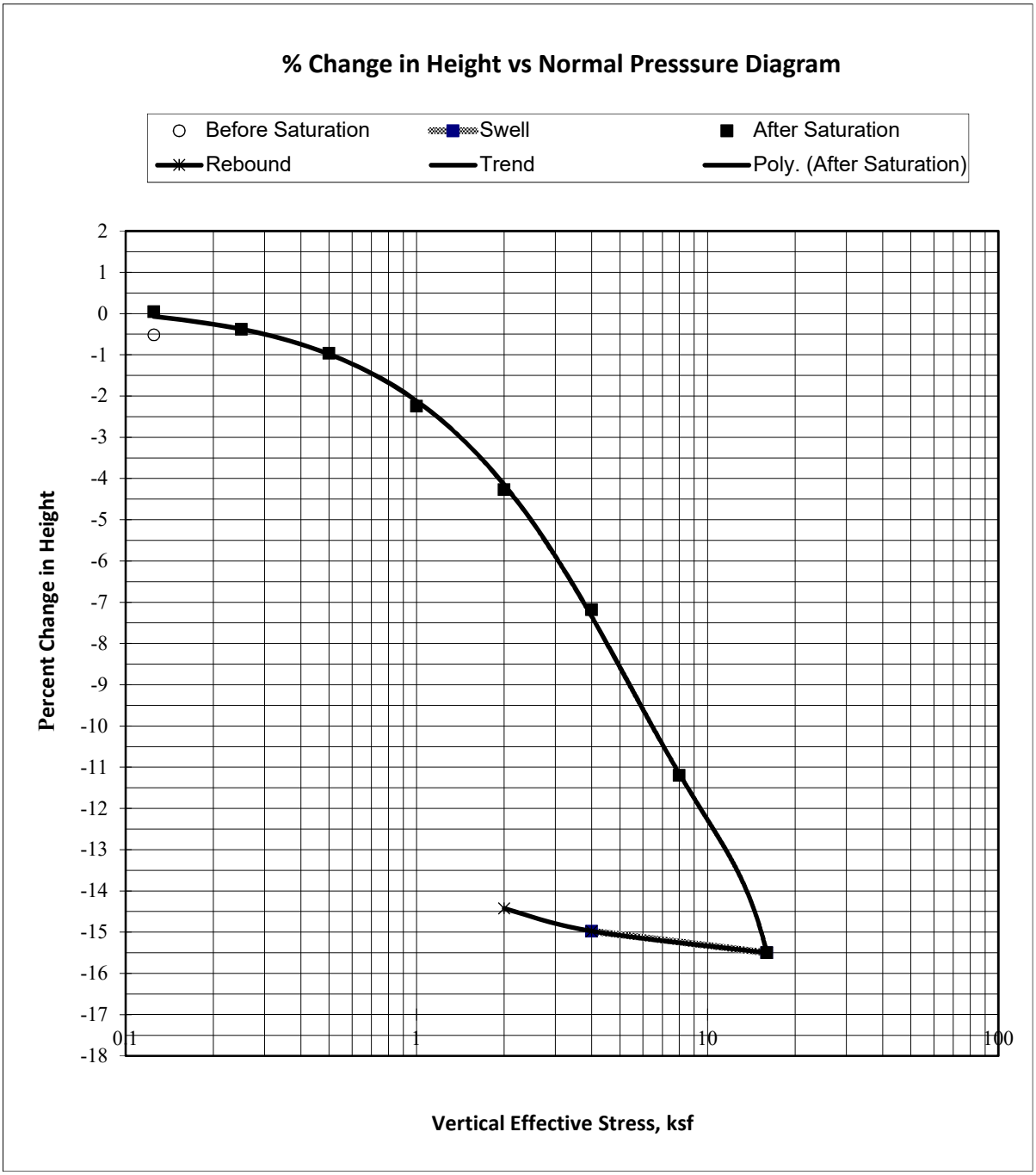


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 1 @ 21.5'
CL
Ring Sample

Initial Dry Density: 83.6 pcf
Initial Moisture, %: 43.2%
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.995

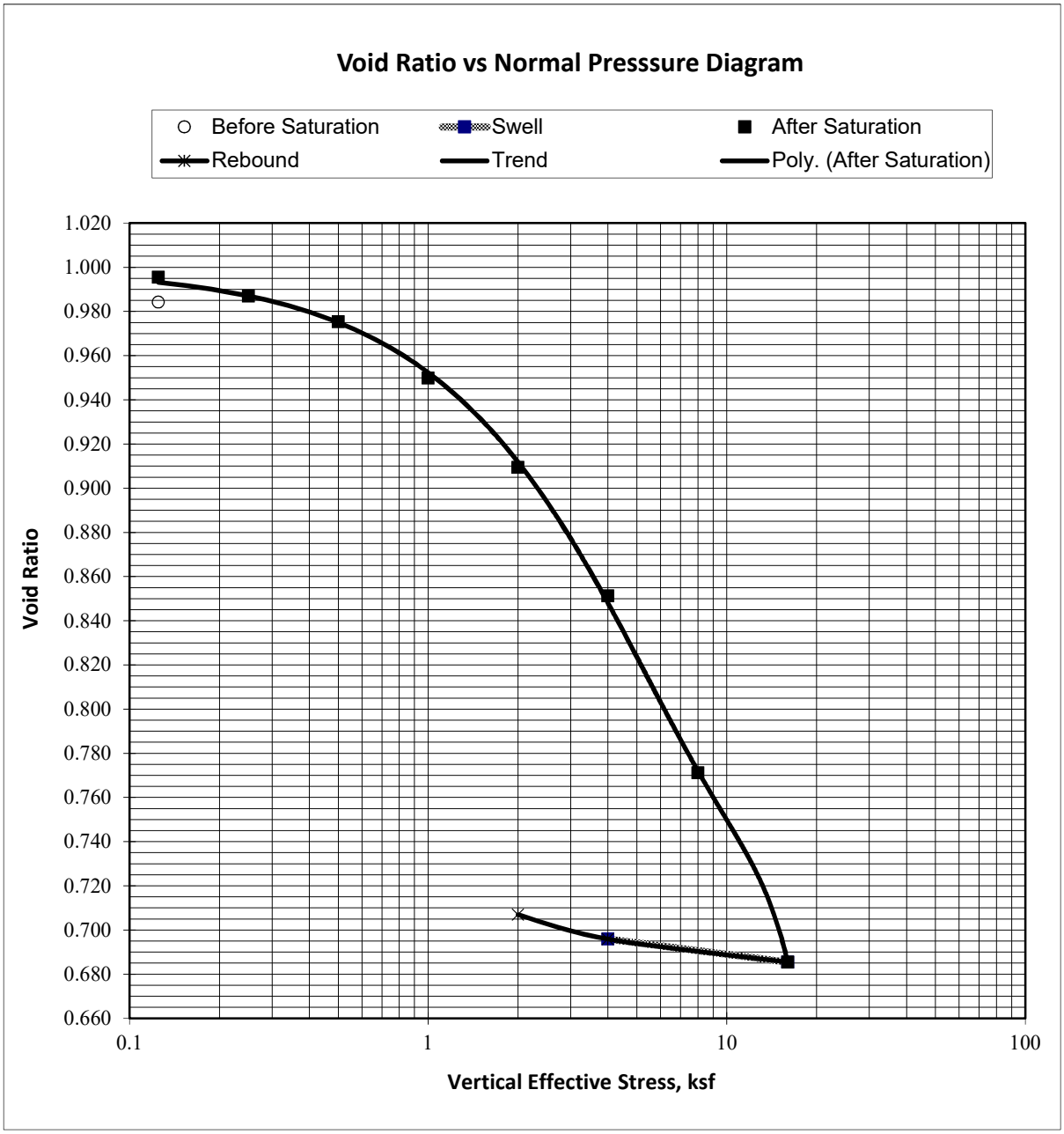


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 1 @ 21.5'
CL
Ring Sample

Initial Dry Density: 83.6
Initial Moisture, %: 43.2
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.995

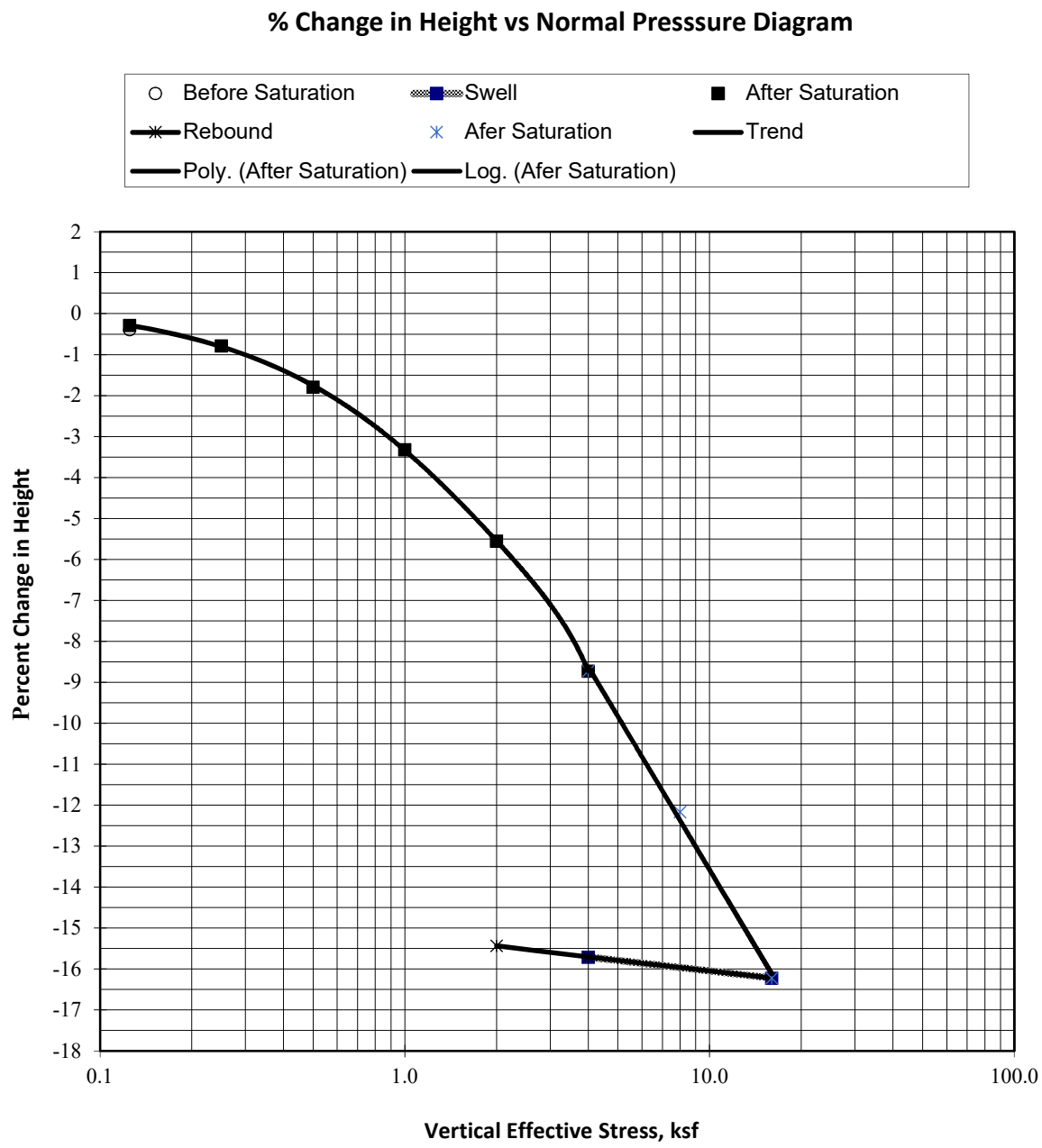


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 2 @ 15'
ML
Ring Sample

Initial Dry Density: 95.7 pcf
Initial Moisture, %: 27.7%
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.743

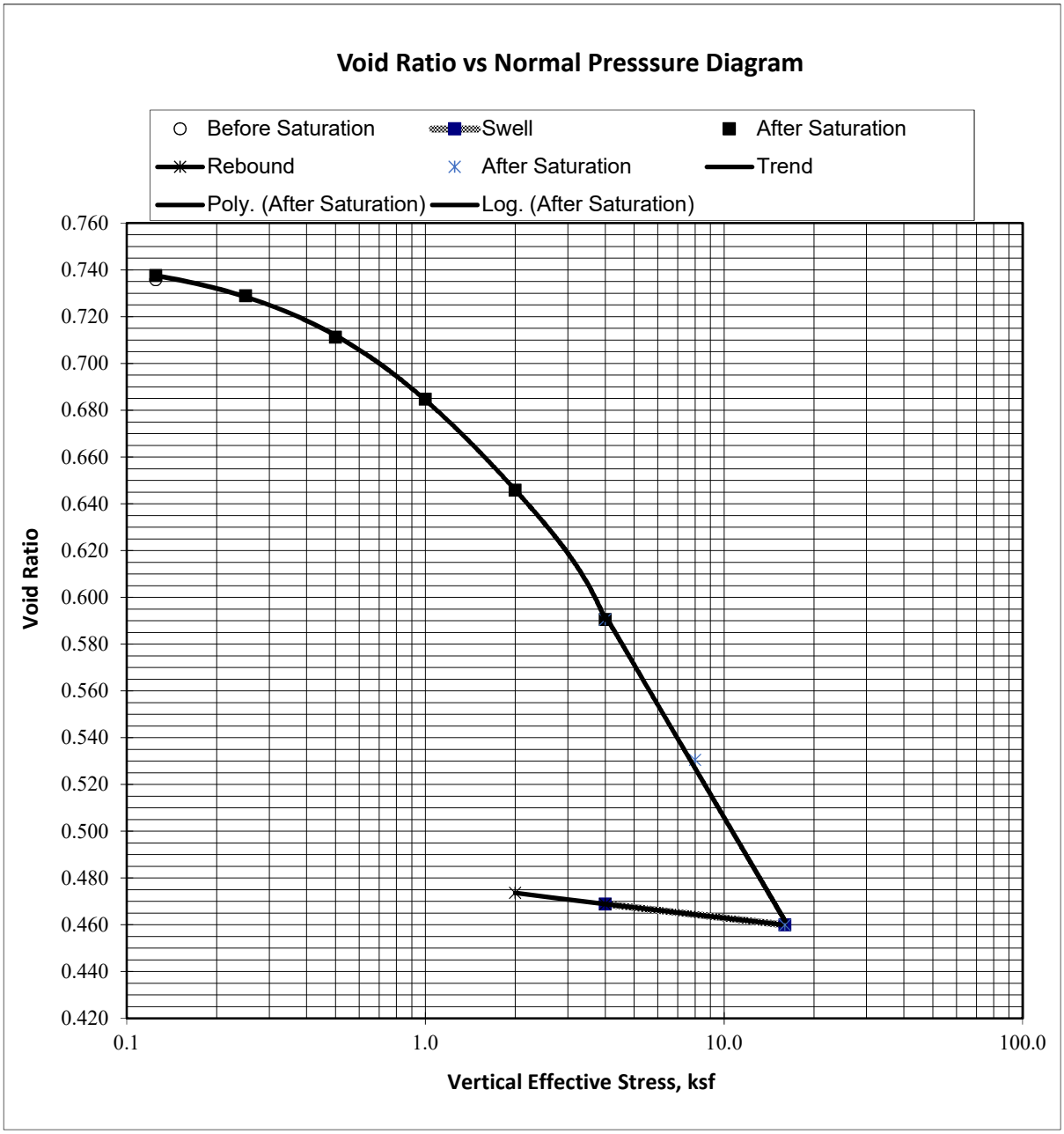


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 2 @ 15'
ML
Ring Sample

Initial Dry Density: 95.7
Initial Moisture, %: 27.7
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.743

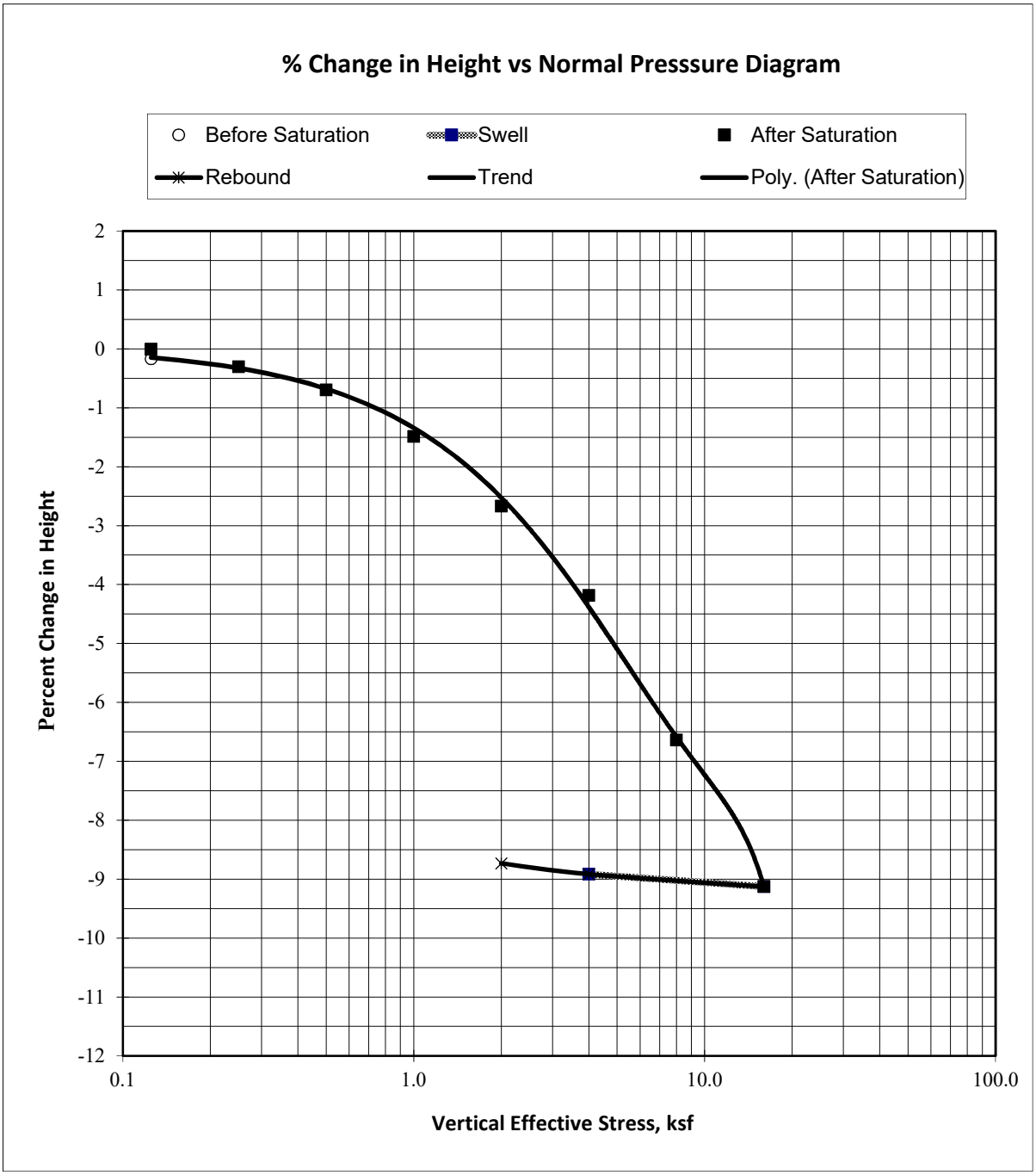


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 2 @ 25'
ML
Ring Sample

Initial Dry Density: 106.2 pcf
Initial Moisture, %: 23.8%
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.570

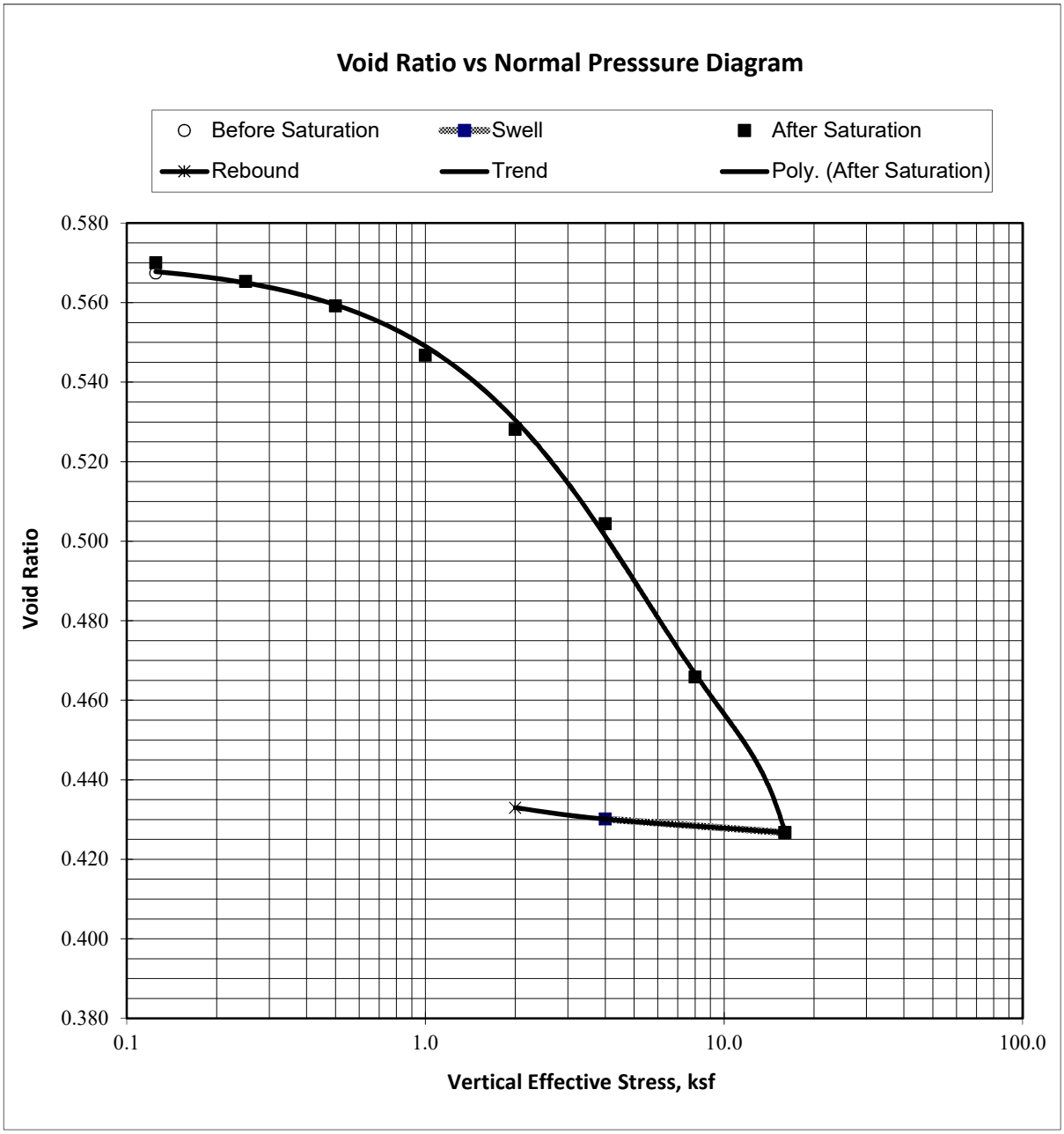


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 2 @ 25'
ML
Ring Sample

Initial Dry Density: 106.2
Initial Moisture, %: 23.8
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.570

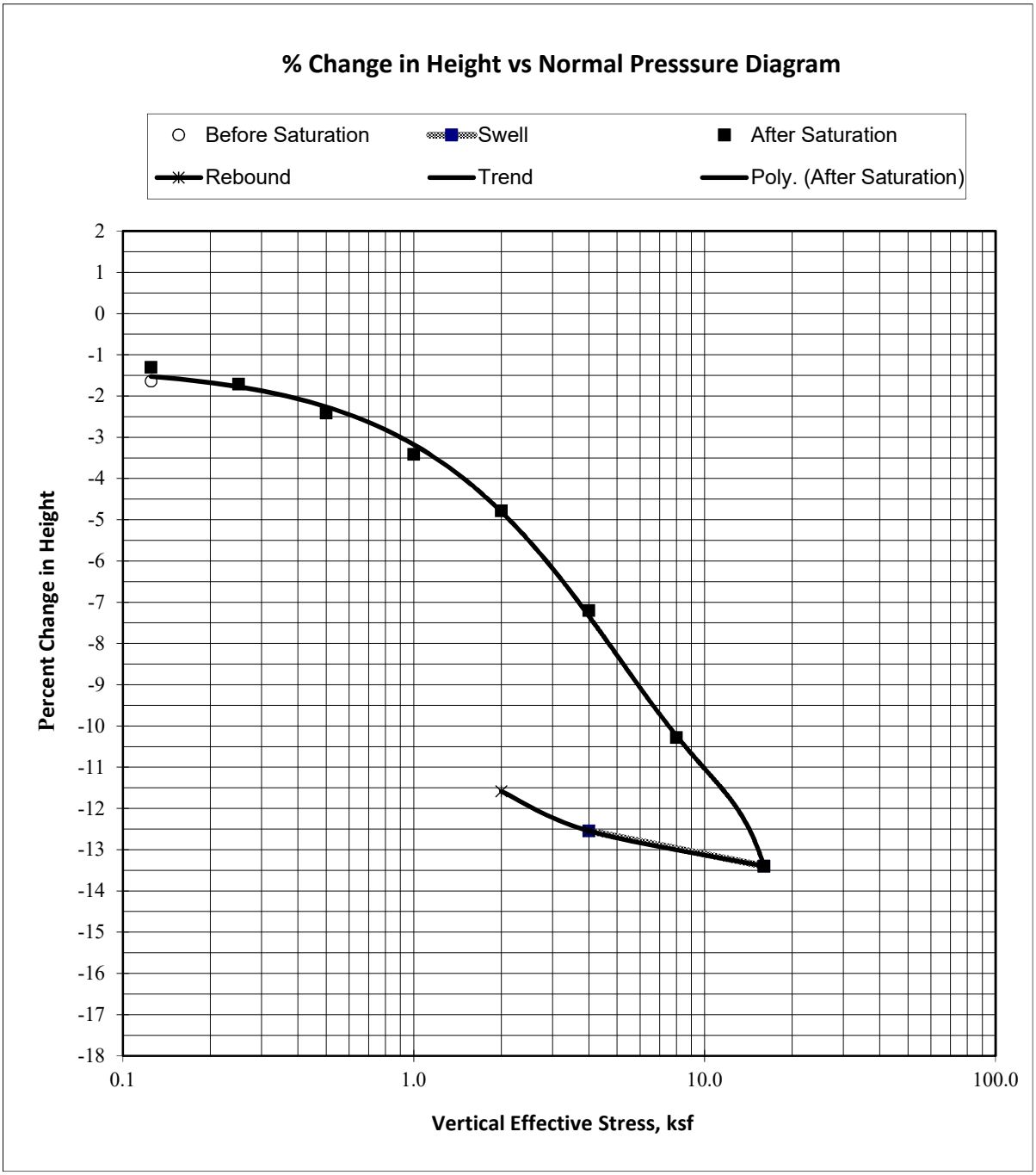


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 3 @ 15'
CL
Ring Sample

Initial Dry Density: 97.9 pcf
Initial Moisture, %: 27.1%
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.703

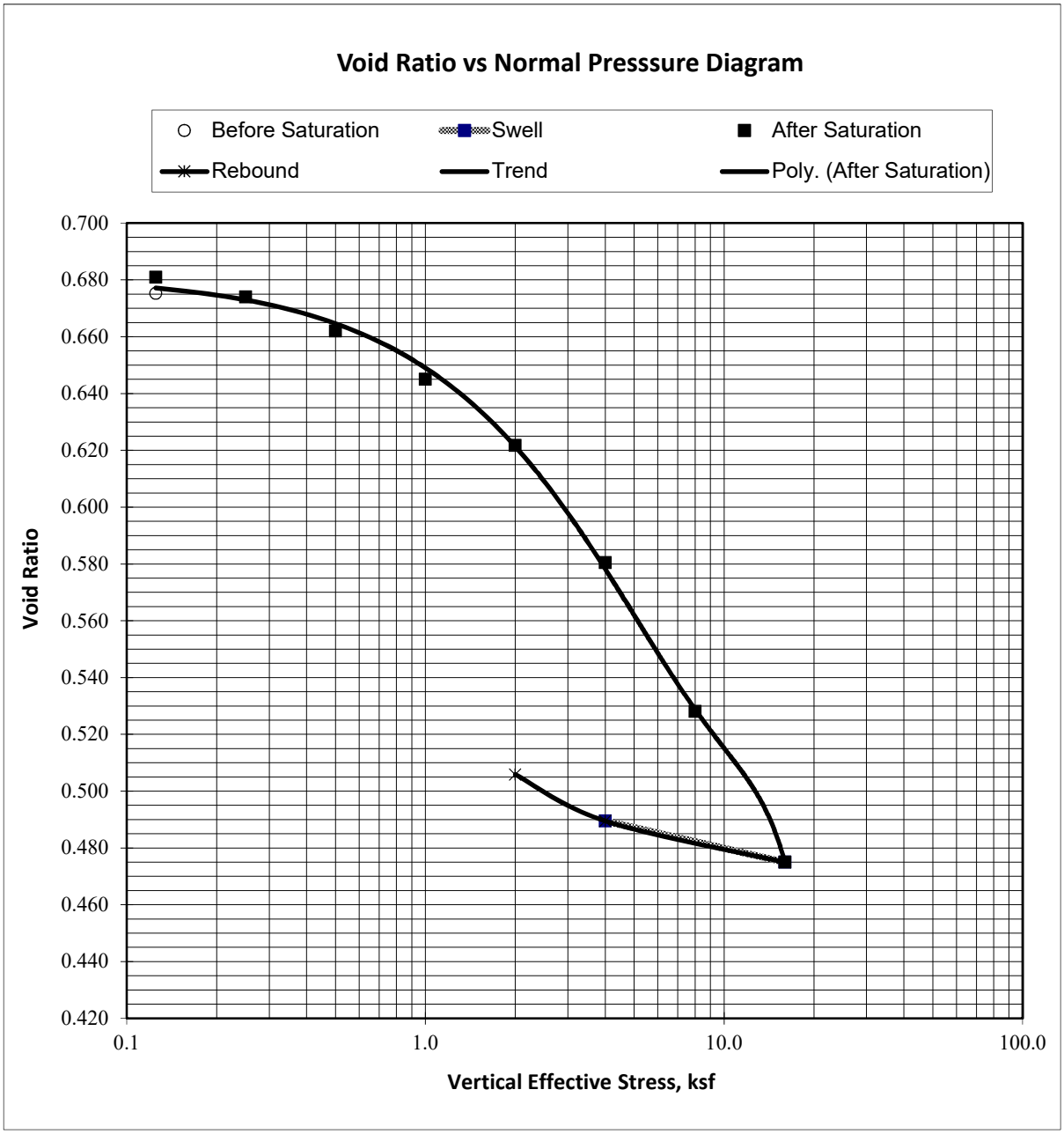


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 3 @ 15'
CL
Ring Sample

Initial Dry Density: 97.9
Initial Moisture, %: 27.1
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.703

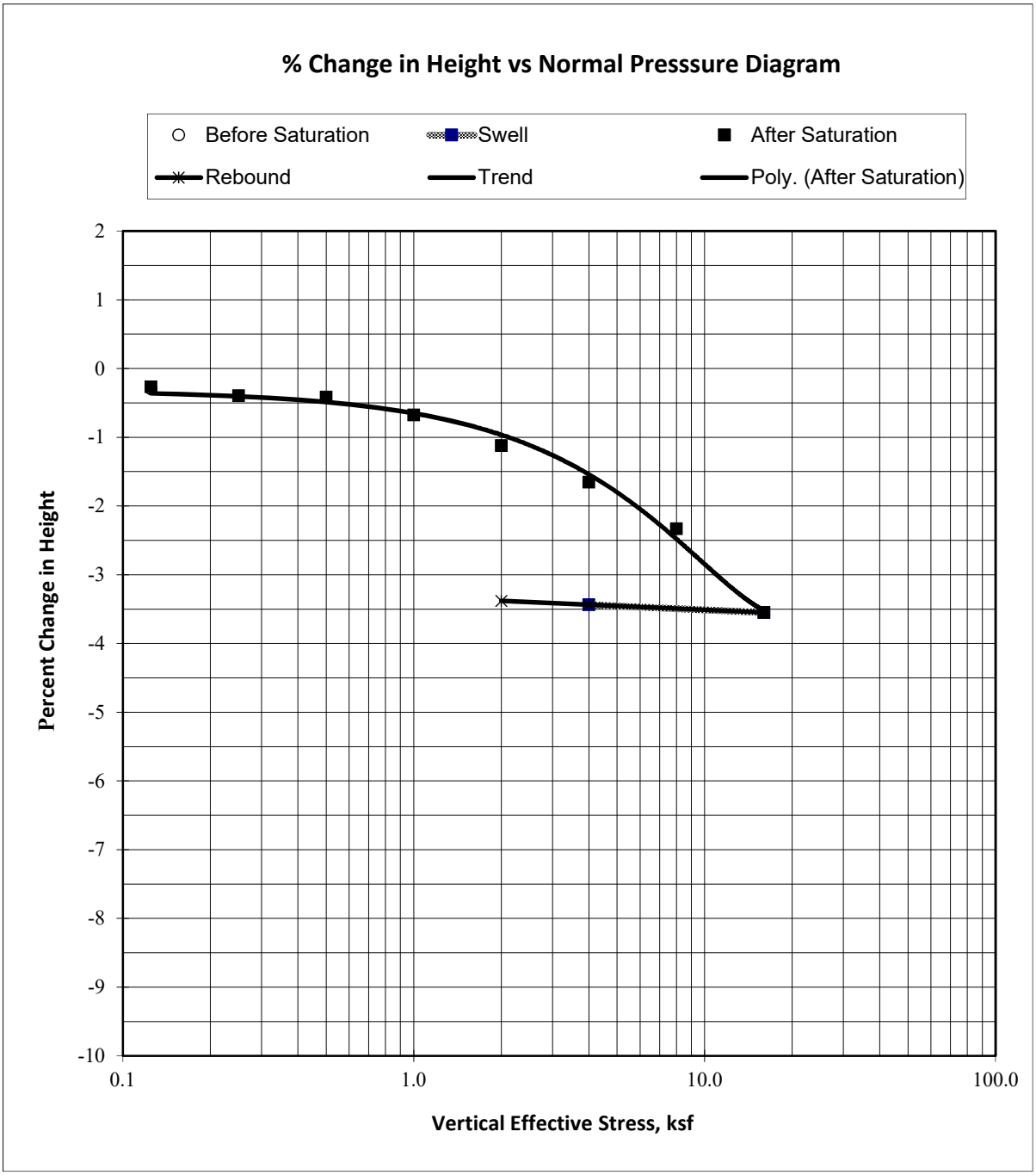


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 3 @ 26.5'
CL
Ring Sample

Initial Dry Density: 110.6 pcf
Initial Moisture, %: 19.7%
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.507

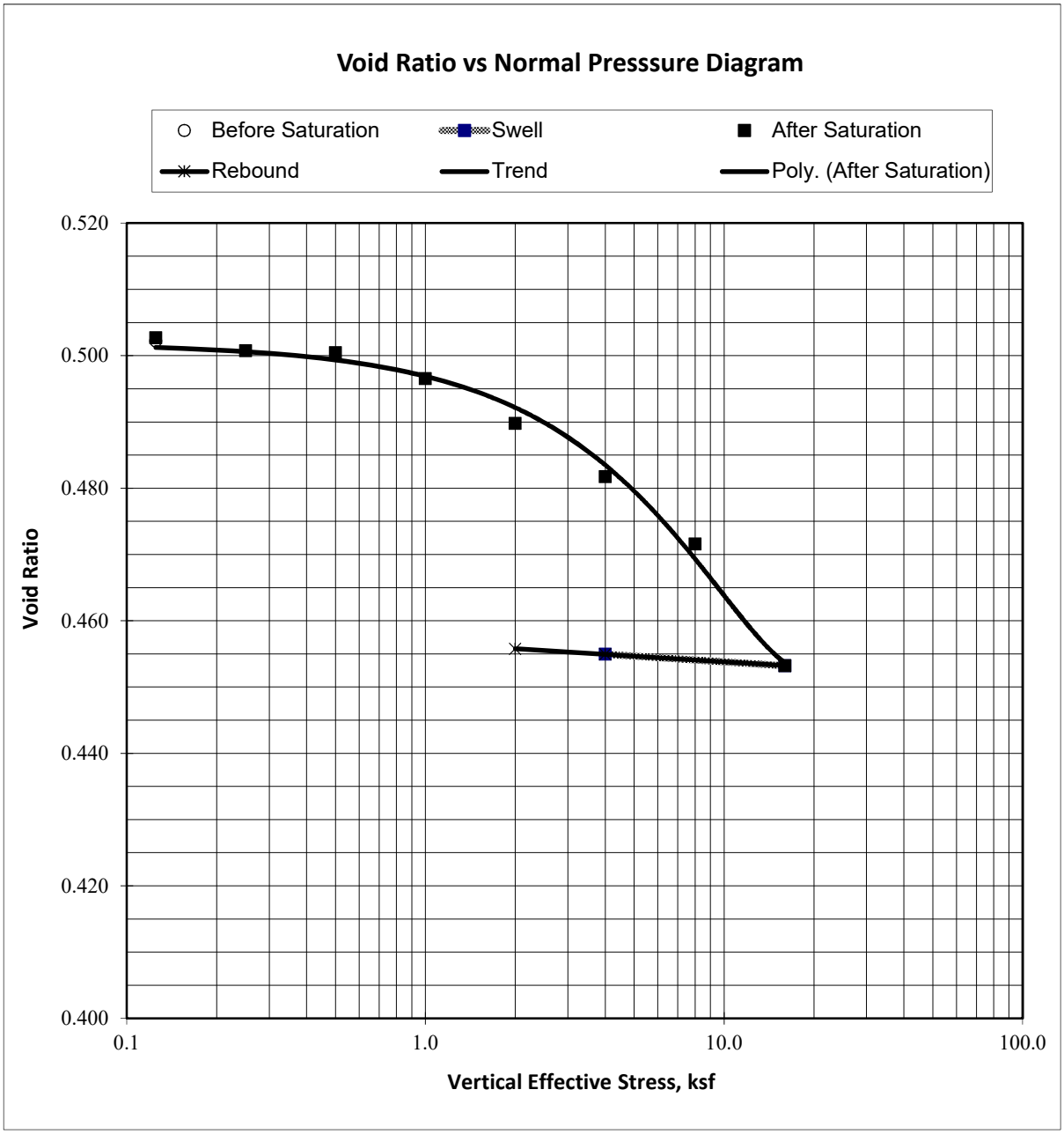


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 3 @ 26.5'
CL
Ring Sample

Initial Dry Density: 110.6
Initial Moisture, %: 19.7
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.507

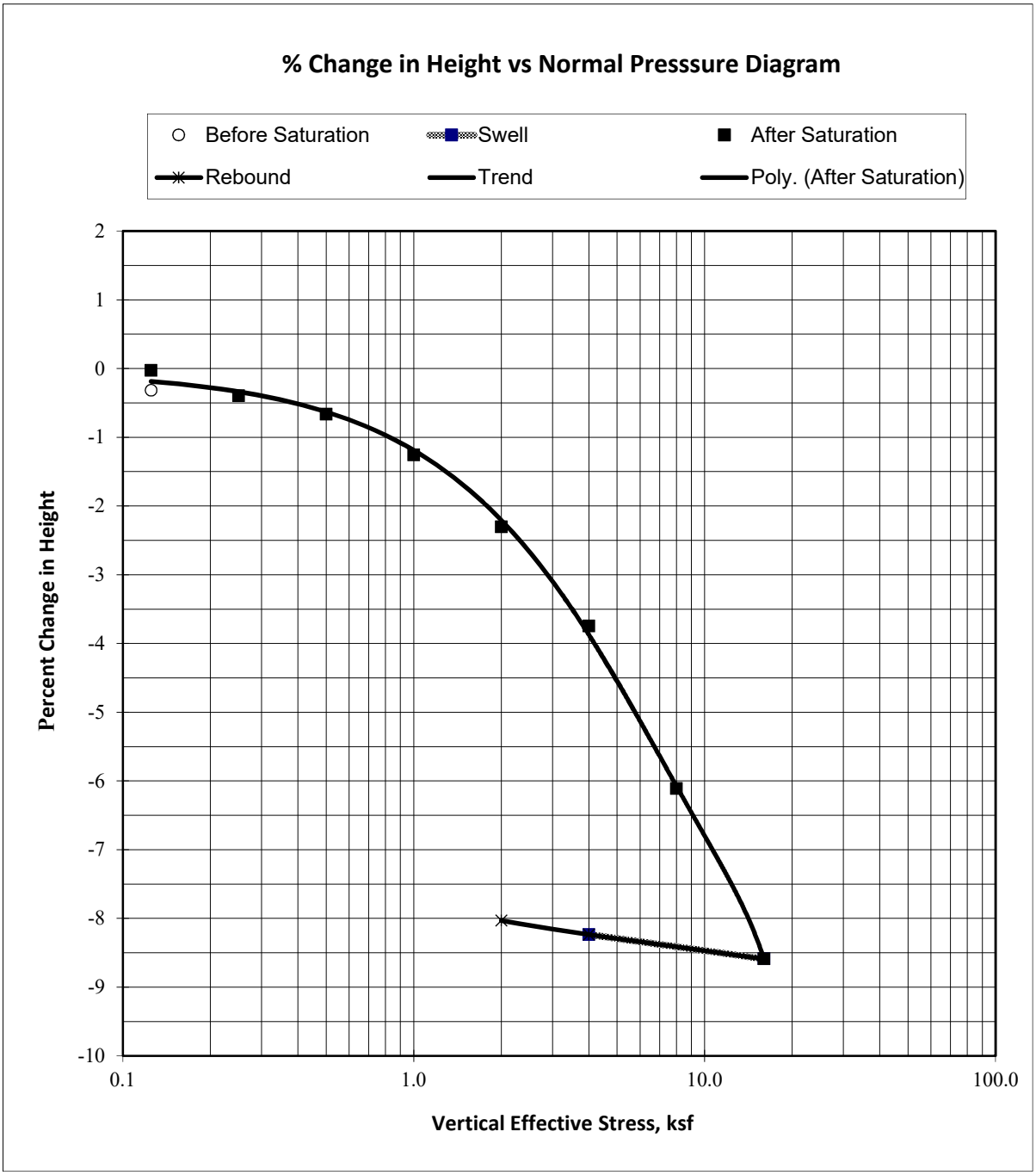


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 4 @ 20'
ML
Ring Sample

Initial Dry Density: 91.0 pcf
Initial Moisture, %: 35.7%
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.832

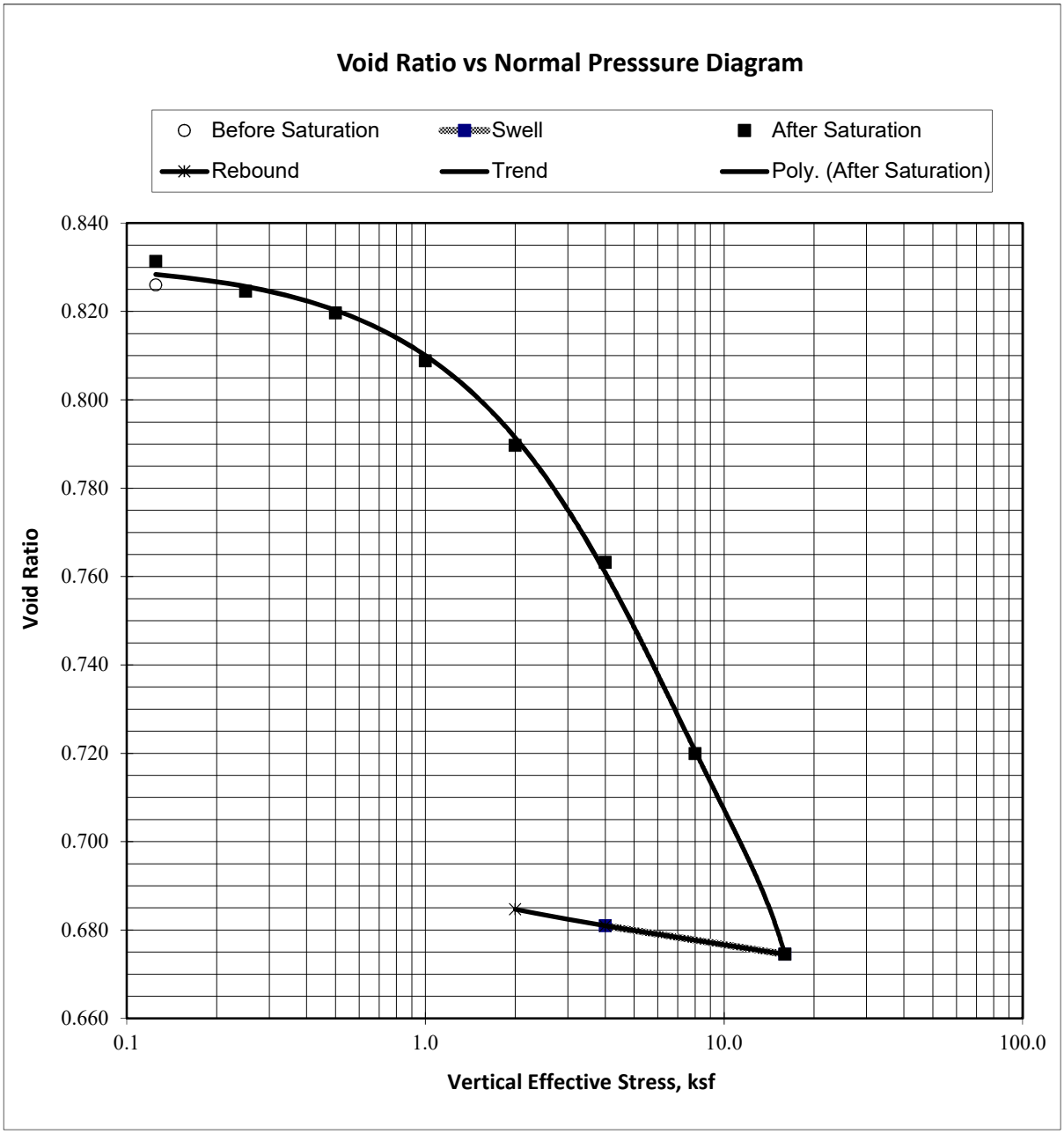


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 4 @ 20'
ML
Ring Sample

Initial Dry Density: 91.0
Initial Moisture, %: 35.7
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.832

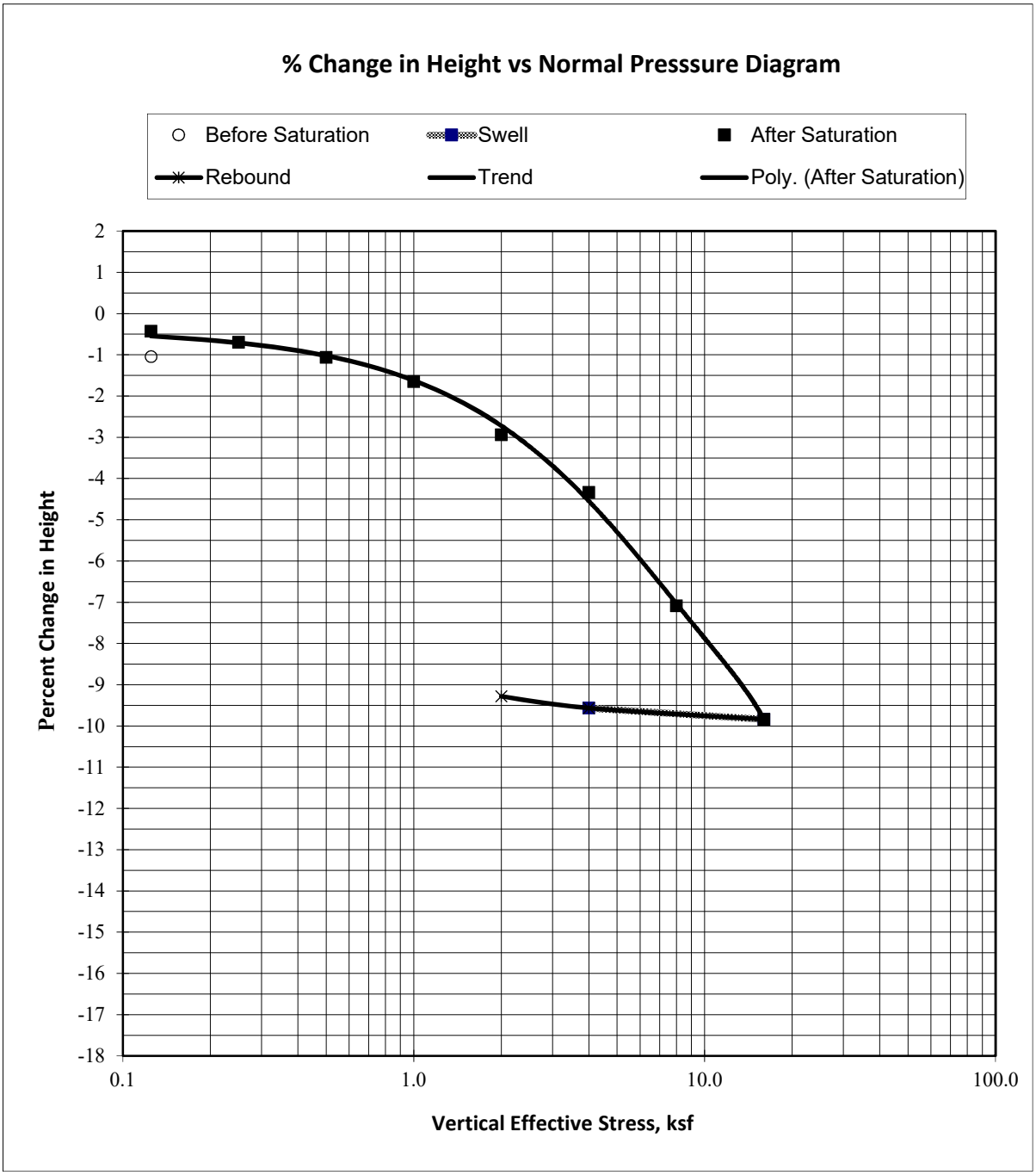


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 11 @ 25'
CL
Ring Sample

Initial Dry Density: 102.2 pcf
Initial Moisture, %: 25.6%
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.631

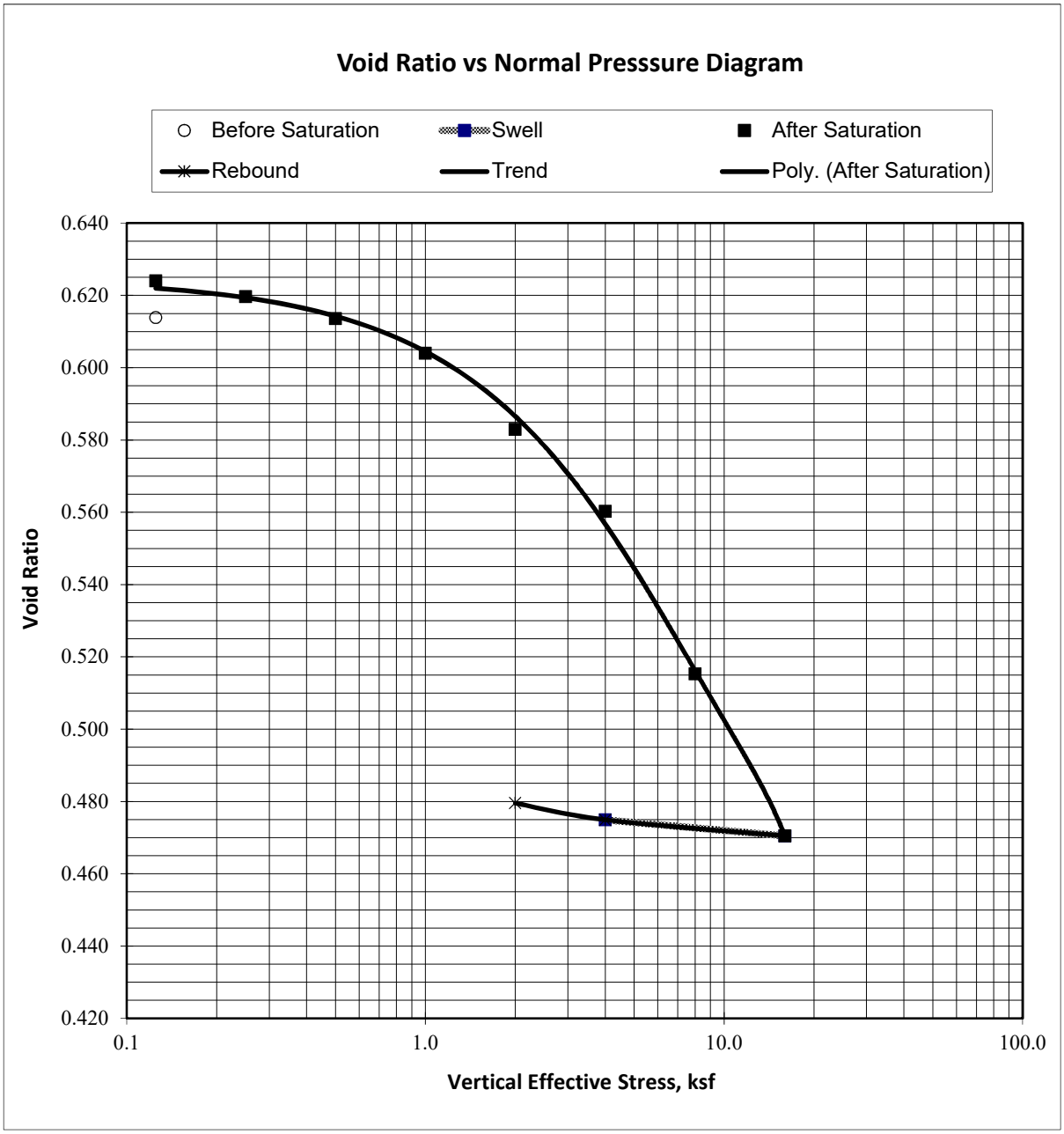


CONSOLIDATION TEST

ASTM D 2435-90

Arctic Cold
B 11 @ 25'
CL
Ring Sample

Initial Dry Density: 102.2
Initial Moisture, %: 25.6
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.631



Artic Cold 303415-002

RESISTANCE '*R*' VALUE AND EXPANSION PRESSURE

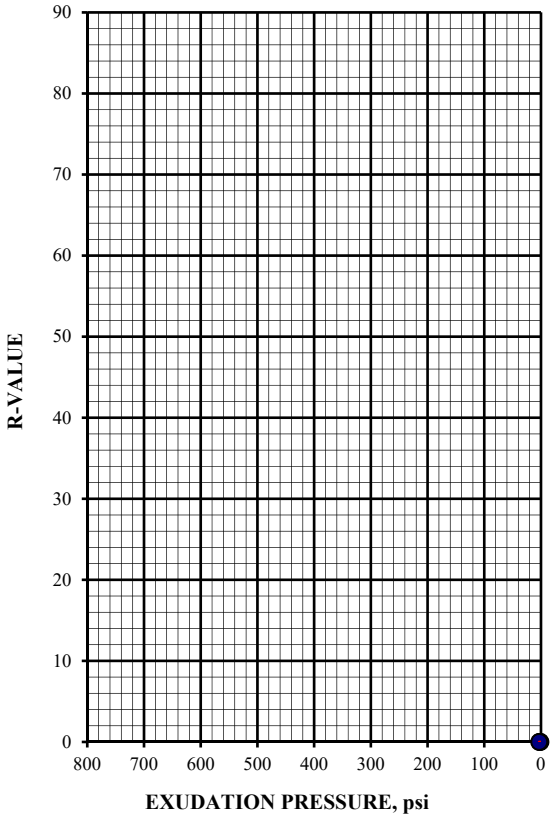
ASTM D 2844/D2844M-13

March 20, 2020

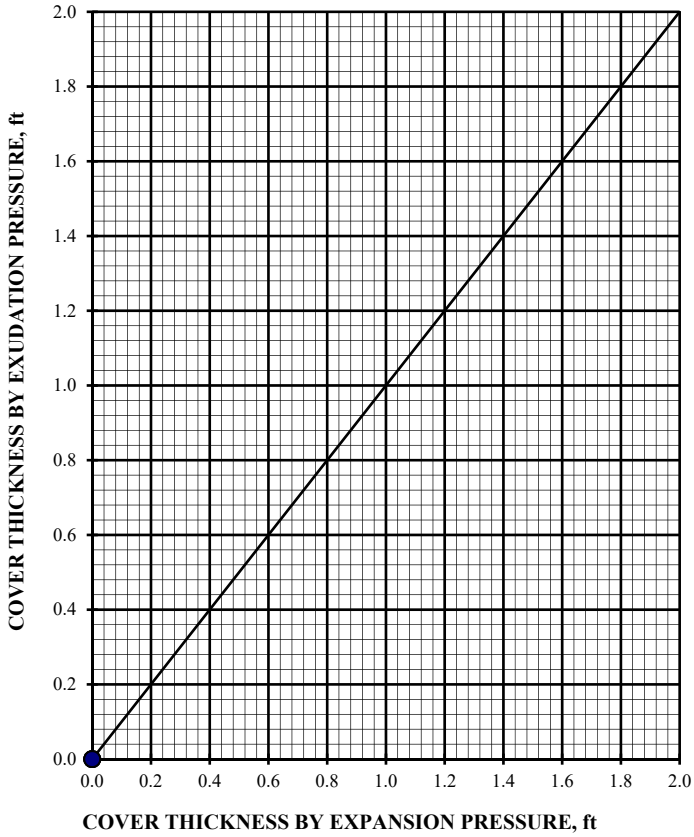
Bulk Sample @ 0.0 - 5.0', Northeast Area
Brown Sandy Fat Clay (CH)

Dry Density @ 300 psi Exudation Pressure: N/A
%Moisture @ 300 psi Exudation Pressure: N/A
R-Value - Exudation Pressure: N/A
R-Value - Expansion Pressure: N/A
R-Value @ Equilibrium: Less than 5
(sample extruded from mold during testing)

EXUDATION PRESSURE CHART



EXPANSION PRESSURE CHART



Artic Cold 303415-002

RESISTANCE '*R*' VALUE AND EXPANSION PRESSURE

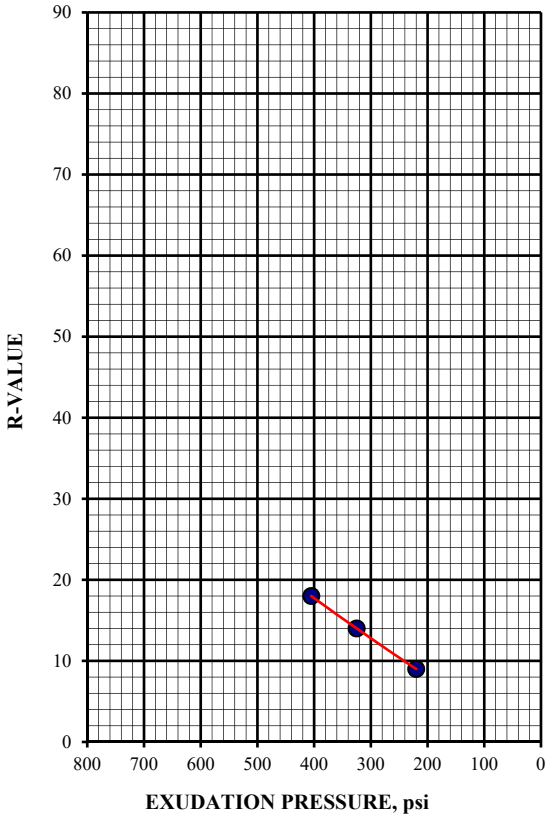
ASTM D 2844/D2844M-13

March 20, 2020

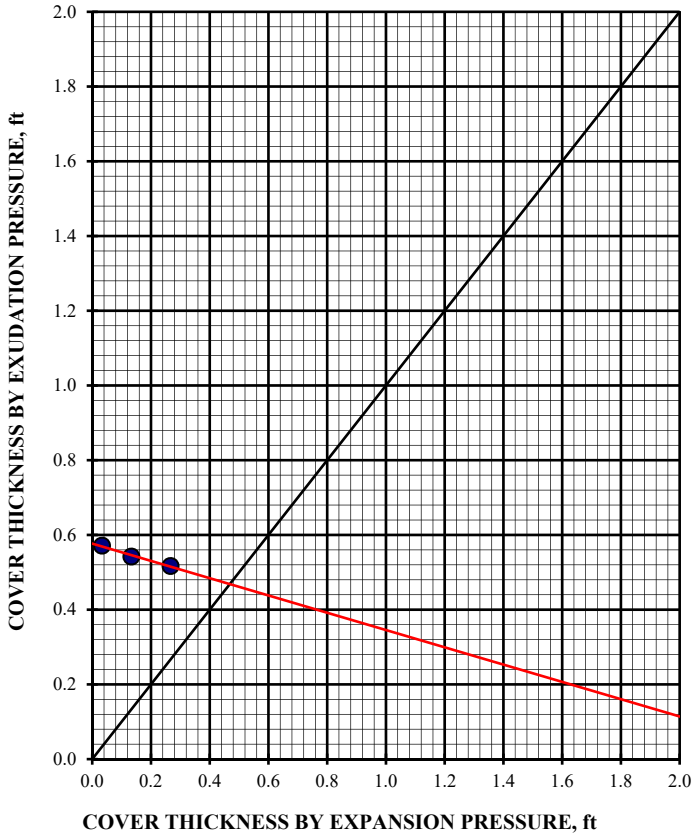
Bulk Sample @ 0.0 - 5.0', Southeast Area
Brown Sandy Lean Clay (CL)
Specified Traffic Index: 5.0

Dry Density @ 300 psi Exudation Pressure: 123.7-pcf
%Moisture @ 300 psi Exudation Pressure: 15.9%
R-Value - Exudation Pressure: 13
R-Value - Expansion Pressure: 26
R-Value @ Equilibrium: 13

EXUDATION PRESSURE CHART



EXPANSION PRESSURE CHART



Artic Cold 303415-002

RESISTANCE '*R*' VALUE AND EXPANSION PRESSURE

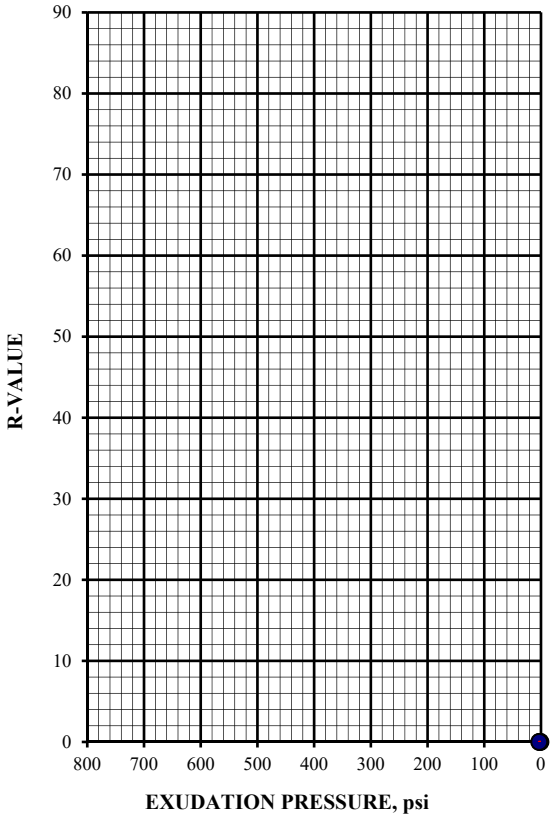
ASTM D 2844/D2844M-13

March 20, 2020

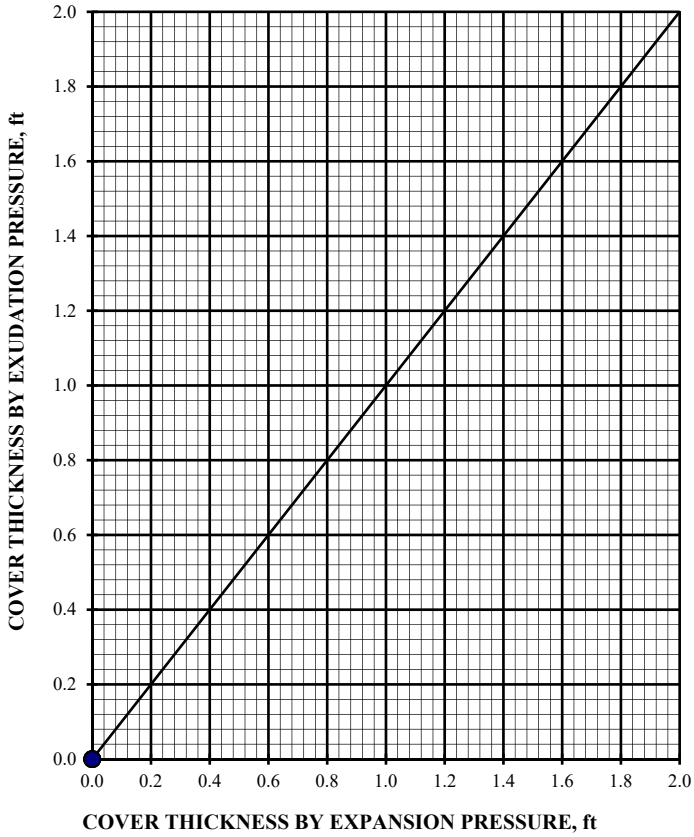
Bulk Sample @ 0.0 - 5.0', West Central Area
Brown Sandy Silt (ML)

Dry Density @ 300 psi Exudation Pressure: N/A
%Moisture @ 300 psi Exudation Pressure: N/A
R-Value - Exudation Pressure: N/A
R-Value - Expansion Pressure: N/A
R-Value @ Equilibrium: Less than 5
(sample extruded from mold during testing)

EXUDATION PRESSURE CHART



EXPANSION PRESSURE CHART



CERTIFICATE OF ANALYSIS

Client: Earth Systems Pacific
CAS LAB NO: 200441-01
Sample ID: B1@0-5'
Analyst: AN

Date Sampled: 03/05/20
Date Received: 03/06/20
Sample Matrix: Soil

WET CHEMISTRY SUMMARY

COMPOUND	RESULTS	UNITS	DF	PQL	METHOD	ANALYZED
pH (Corrosivity)	8.0	S.U.	1	---	9045	03/23/20
Resistivity*	2625	Ohms-cm	1	---	SM 120.1M	03/23/20
Chloride	22.7	mg/Kg	1	10	4500Cl-C	03/23/20
Sulfate	366	mg/Kg	1	5	4500SO_4^{2-}D	03/23/20

*Sample was extracted using a 1:3 ratio of soil and DI water.

DF: Dilution Factor
PQL: Practical Quantitation Limit
BQL: Below Quantitation Limit
mg/Kg: Milligrams/Kilograms(ppm)

CERTIFICATE OF ANALYSIS

Client: Earth Systems Pacific
CAS LAB NO: 200441-02
Sample ID: B2@0-5'
Analyst: AN

Date Sampled: 03/05/20
Date Received: 03/06/20
Sample Matrix: Soil

WET CHEMISTRY SUMMARY

COMPOUND	RESULTS	UNITS	DF	PQL	METHOD	ANALYZED
pH (Corrosivity)	8.0	S.U.	1	---	9045	03/23/20
Resistivity*	1575	Ohms-cm	1	---	SM 120.1M	03/23/20
Chloride	36.3	mg/Kg	1	10	4500Cl-C	03/23/20
Sulfate	680	mg/Kg	1	5	4500SO_4^{2-}D	03/23/20

*Sample was extracted using a 1:3 ratio of soil and DI water.

DF: Dilution Factor
PQL: Practical Quantitation Limit
BQL: Below Quantitation Limit
mg/Kg: Milligrams/Kilograms(ppm)

APPENDIX C

SEISMIC DESIGN

2019 California Building Code and ASCE 7-16 Seismic Design Parameters
Fault Parameters
SEAOC/OSHPD Design Maps Summary Report

EARTH SYSTEMS PACIFIC

2019 California Building Code (CBC) (ASCE 7-16) Seismic Design Parameters

(Values presented should only be used by a Structural Engineer to determine if the exception in 11.4.8 (ASCE 7-16) can be used)

				CBC Reference	ASCE 7-16 Reference
Seismic Design Category		**D**			
Site Class		**D**		Table 1613.5.6	Table 11.6-1
Latitude:		34.213	N	Table 1613.5.2	Table 20.3-1
Longitude:		-119.139	W		
Maximum Considered Earthquake (MCE) Ground Motion					
Short Period Spectral Reponse	S_S	**1.763**	**g**	Figure 1613.5	Figure 22-1
1 second Spectral Response	S_1	**0.653**	**g**	Figure 1613.5	Figure 22-2
Site Coefficient	F_a	1.00		Table 1613.5.3(1)	Table 11.4-1
Site Coefficient	F_v	1.70		Table 1613.5.3(2)	Table 11-4.2
	S_{MS}	1.763	g	$= F_a*S_S$	
	S_{M1}	1.110	g	$= F_v*S_1$	
Design Earthquake Ground Motion					
Short Period Spectral Reponse	S_{DS}	**1.175**	**g**	$= 2/3*S_{MS}$	
1 second Spectral Response	S_{D1}	**0.740**	**g**	$= 2/3*S_{M1}$	

Site Specific Evaluation May Be Required Due to Site Class = D or E and S1>=0.2. The Presented SDS and SD1 are NOT Valid Unless the Exception of ASCE7-16, Section 11.4.8 Applies

To	0.13	sec	$= 0.2*S_{D1}/S_{DS}$
Ts (11.4.8 ASCE 7-16 Exception Assumed)	0.63	sec	$= S_{D1}/S_{DS}$
Risk Category	II		Table 1604.5
Seismic Importance Factor	1.00		
F_{PGA}	1.10		
PGA_M	**0.85**		
Vertical Coefficient (C_V)	1.45		Table 11.9-1

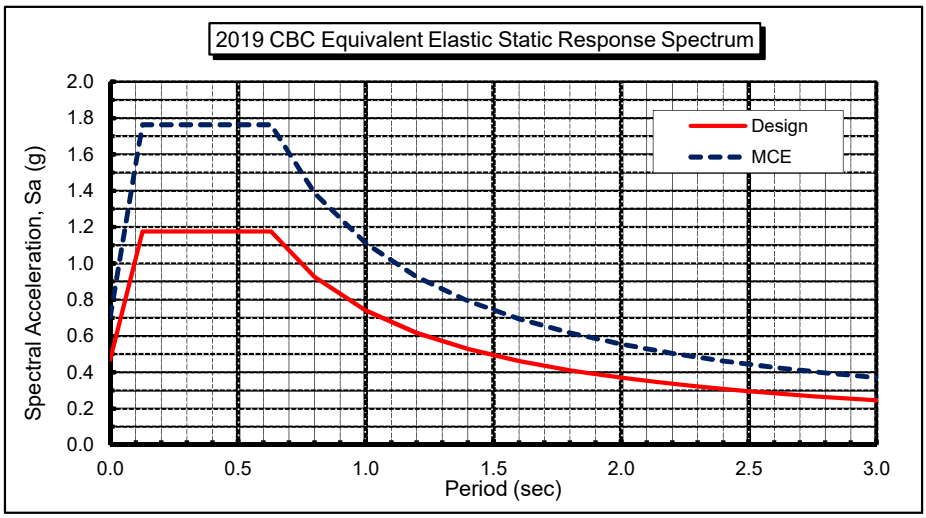


Table 11.5-1

Period T (sec)	Design Sa (g)
0.00	0.470
0.05	0.750
0.13	1.175
0.63	1.175
0.80	0.925
1.00	0.740
1.20	0.617
1.40	0.529
1.60	0.463
1.80	0.411
2.00	0.370
2.20	0.336
2.40	0.308
2.60	0.285
2.80	0.264
3.00	0.247

34.2134 -119.1393 Lat/Long

Spectral Response Values
Probabilistic and Deterministic Response Spectra for MCE compared to Code Spectra for 5% Viscous Damping Ratio

Natural Period T (seconds)	GeoMean Probab. 2% in 50 year MCE Spectrum (1) 2475-year (ASCE 21.2.1)	Max Rotated Probab. 2% in 50 year MCEr Spectrum (2) 2475-year (ASCE 21.2.1.1)	Max 84th Percentile Determ. MCE Spectrum (3) 1.5*Fa = 1.500 (ASCE 21.2.2)	Determ. Lower Limit MCE Spectrum (4) (3) * 1.00=Scaling (ASCE 21.2.2)	Determ. MCE Spectrum (5) Max (3),(4) (ASCE 21.2.2)	Site Specific MCE Ground Response (6) Min (2),(5) (ASCE 21.2.3)	Site Specific MCE Spectrum Comparator (6b) Max (6),1.5*(8) (ASCE 21.2.3)	2019 CBC MCE Spectrum (7)	Site Specific Design Spectrum (8) (ASCE 21.3)	2019 CBC Design Spectrum (9) 2/3*(7)
0.00	0.800	0.782	1.117	1.117	1.117	0.782	0.782	0.705	0.522	0.470
0.05	1.051	1.028	1.201	1.201	1.201	1.028	1.028	0.991	0.685	0.661
0.10	1.302	1.273	1.590	1.590	1.590	1.273	1.273	1.276	0.849	0.851
0.15	1.525	1.491	1.918	1.918	1.918	1.491	1.491	1.562	0.994	1.041
0.20	1.748	1.710	2.205	2.205	2.205	1.710	1.710	1.763	1.140	1.175
0.30	2.027	2.028	2.618	2.618	2.618	2.028	2.028	1.763	1.352	1.175
0.40	2.017	2.017	2.792	2.792	2.792	2.017	2.017	1.763	1.345	1.175
0.50	2.006	2.095	2.762	2.762	2.762	2.095	2.095	1.763	1.397	1.175
0.75	1.699	1.775	2.408	2.408	2.408	1.775	1.775	1.763	1.183	1.175
1.00	1.393	1.609	2.093	2.093	2.093	1.609	1.609	1.633	1.073	1.088
1.50	1.069	1.235	1.537	1.537	1.537	1.235	1.235	1.088	0.823	0.726
2.00	0.745	0.894	1.180	1.180	1.180	0.894	0.894	0.816	0.596	0.544
3.00	-	-	-	-	-	-	-	-	-	-
4.00	-	-	-	-	-	-	-	-	-	-
5.00	-	-	-	-	-	-	-	-	-	-
8.00	-	-	-	-	-	-	-	-	-	-
10.00	-	-	-	-	-	-	-	-	-	-

C_{RS}:	0.889	
C_{R1}:	0.889	
Site Specific To:	0.197	$= 0.2*S_{D1}/S_{DS}$
Site Specific Ts:	0.983	$= S_{D1}/S_{DS}$

The value of Fa used in Column (3) is defined within ASCE 21.2.2 Supplement 1. This Fa value only applies within Column (3).

Probabilistic Spectrum from 2014 USGS Ground Motion Mapping Program adjusted for site conditions and maximum rotated component of ground motion using NGA, Column 2 has risk coefficients C_R applied if ASCE7-16 Section 21.2.1.1 - Method 1 is used.

Reference: ASCE 7-16, Chapters 21.2, 21.3, 21.4, 21.5, 11.4, and 11.8

Calculation Utilized ASCE7-16, Section 21.2.1.1 - Method 1

Short-Period Seismic Design Category:	1-Second Period Seismic Design Category:
D	D

Vertical Coefficient (C_V)
1.45

1 g = 980.6 cm/sec^2 =32.2 ft/sec^2
PSV (ft/sec) = 32.2(S_a)T/(2p)

Site Coefficients		
F_{PGA}	1.10	
F_a	1.00	
F_v	2.50	

Mapped MCE Acceleration Values		
PGA	0.774	g
S_S	1.763	g
S_1	0.653	g

Site Class	**D**	
Risk Category		**II**

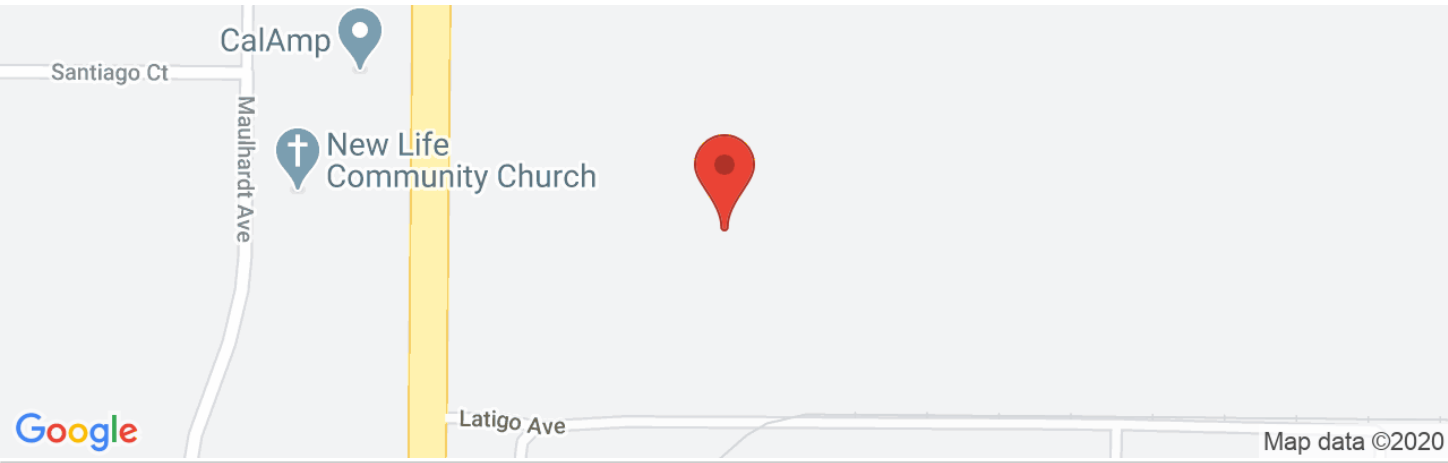
Site-Specific Design Acceleration Values		
PGA_M	**0.800**	**g**
S_{DS}	**1.257**	**g**
S_{D1}	**1.235**	**g**

Site-Specific MCE_R, 5% damped, Spectral Response Acceleration Parameter		
S_{MS}	**1.886**	**g**
S_{M1}	**1.853**	**g**

Key: Probab. = Probabilistic, Determ. = Deterministic, MCE = Maximum Considered Earthquake

Arctic Cold

Latitude, Longitude: 34.2134, -119.1393



Date	3/11/2020, 7:35:13 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.763	MCE_R ground motion. (for 0.2 second period)
S_1	0.653	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.763	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.176	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.774	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.851	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.763	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.984	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.322	Factored deterministic acceleration value. (0.2 second)
S1RT	0.653	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.735	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.772	Factored deterministic acceleration value. (1.0 second)
PGAd	0.926	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.889	Mapped value of the risk coefficient at short periods
C_{R1}	0.889	Mapped value of the risk coefficient at a period of 1 s

Table 1
Fault Parameters

Fault Section Name	Distance (miles)	Distance (km)	Upper Seis. Depth (km)	Lower Seis. Depth (km)	Avg Dip Angle (deg.)	Avg Dip Direction (deg.)	Avg Rake (deg.)	Trace Length (km)	Fault Type	**Mean Mag**	Mean Return Interval (years)	Slip Rate (mm/yr)
Simi-Santa Rosa	2.3	3.6	1.0	12.1	60	346	30	39	B	**6.8**		1
Oak Ridge (Onshore)	3.6	5.8	1.0	19.4	65	159	90	49	B	**7.2**		4
Ventura-Pitas Point	7.2	11.6	1.0	15.0	64	353	60	44	B	**6.9**		1
Oak Ridge (Offshore)	8.1	13.0	0.0	7.9	32	180	90	38	B	**6.9**		3
Malibu Coast (Extension), alt 1	10.3	16.6	0.0	7.8	74	4	30	35	B'	**6.5**		
Malibu Coast (Extension), alt 2	10.3	16.6	0.0	16.6	74	4	30	35	B'	**6.9**		
Red Mountain	12.8	20.5	0.0	14.1	56	2	90	101	B	**7.4**		2
Sisar	14.3	23.0	0.0	17.4	29	168	na	20	B'	**7.0**		
Channel Islands Thrust	14.8	23.7	5.0	12.3	20	354	90	59	B	**7.3**		1.5
San Cayetano	15.3	24.6	0.0	16.0	42	3	90	42	B	**7.2**		6
Anacapa-Dume, alt 1	16.5	26.5	0.0	15.5	45	354	60	51	B	**7.2**		3
Anacapa-Dume, alt 2	16.5	26.5	1.2	11.4	41	352	60	65	B	**7.2**		3
Malibu Coast, alt 1	16.5	26.5	0.0	7.8	75	3	30	38	B	**6.6**		0.3
Malibu Coast, alt 2	16.5	26.5	0.0	16.6	74	3	30	38	B	**6.9**		0.3
Mission Ridge-Arroyo Parida-Santa Ana	16.7	26.9	0.0	7.6	70	176	90	69	B	**6.8**		0.4
Santa Cruz Island	17.4	27.9	0.0	13.3	90	188	30	69	B	**7.1**		1
North Channel	17.9	28.7	1.1	4.5	26	10	90	51	B	**6.7**		1
Channel Islands Western Deep Ramp	18.2	29.4	4.8	12.5	21	204	90	62	B'	**7.3**		
Pitas Point (Lower)-Montalvo	19.5	31.4	0.4	12.7	16	359	90	30	B	**7.3**		2.5
Shelf (Projection)	21.2	34.1	2.0	18.1	17	21	na	70	B'	**7.8**		
Santa Ynez (East)	22.0	35.4	0.0	13.3	70	172	0	68	B	**7.2**		2
Santa Susana, alt 1	23.5	37.8	0.0	16.3	55	9	90	27	B	**6.8**		5
Santa Susana, alt 2	23.7	38.1	0.0	10.6	53	10	90	43	B'	**6.8**		
Pine Mtn	25.1	40.4	0.0	16.3	45	5	na	62	B'	**7.3**		
Santa Cruz Catalina Ridge	25.5	41.0	0.0	11.0	90	38	na	137	B'	**7.3**		
Northridge Hills	25.5	41.0	0.0	14.9	31	19	90	25	B'	**7.0**		
Pitas Point (Upper)	26.3	42.3	1.4	10.0	42	15	90	35	B	**6.8**		1
Del Valle	26.6	42.8	0.0	18.8	73	195	90	9	B'	**6.3**		
Santa Monica Bay	26.7	43.0	2.3	18.0	20	44	na	17	B'	**7.0**		
Holser, alt 1	26.9	43.4	0.0	18.6	58	187	90	20	B	**6.7**		0.4
Holser, alt 2	26.9	43.4	0.0	18.5	58	182	90	17	B'	**6.7**		
San Pedro Basin	27.1	43.7	0.8	12.3	88	51	na	69	B'	**7.0**		
Northridge	28.1	45.3	7.4	16.8	35	201	90	33	B	**6.8**		1.5
Oak Ridge (Offshore), west extension	30.8	49.6	0.0	3.1	67	195	na	28	B'	**6.1**		
Compton	32.8	52.9	5.2	15.6	20	34	90	65	B'	**7.5**		
Big Pine (Central)	33.9	54.6	0.0	6.6	76	167	na	23	B'	**6.3**		
Santa Ynez (West)	34.5	55.5	0.0	9.2	70	182	0	63	B	**6.9**		2
San Pedro Escarpment	34.6	55.6	1.0	16.0	17	38	na	27	B'	**7.3**		
San Gabriel	34.8	56.0	0.0	14.7	61	39	180	71	B	**7.3**		1
Big Pine (West)	35.2	56.7	0.0	11.0	50	2	na	18	B'	**6.5**		

Reference: USGS OFR 2007-1437 (CGS SP 203)

Based on Site Coordinates of 34.2134 Latitude, -119.1393 Longitude

Mean Magnitude for Type A Faults based on 0.1 weight for unsegmented section, 0.9 weight for segmented model (weighted by probability of each scenario with section listed as given on Table 3 of Appendix G in OFR 2007-1437). Mean magntude is average of Ellworths-B and Hanks & Bakun moment area relationship.

APPENDIX D

Minimum Foundation Design Criteria

Minimum Foundation Design Criteria

Weighted Expansion Index	Foundations For Slab & Raised Floor Systems (2)(5)(7)							Concrete Slabs		Premoistening of Soils Under Footings, Piers and Slabs (5) (6)	Restrictions on Piers Under Raised Floors
	# of Stories	Stem Thickness (8)	Footing Width (9)	Footing Thickness	All Perimeter Footings (6)	Interior Figs. For Slab & Raised Floors (6)	Reinforcement for Continuous Foundations (3) (8)	3½" Minimum Thickness 4" Over 51 E1			
					Depth Below Natural Surface of Ground and Finish Grade			Reinforcement (4)	Total Thickness of Sand		
		(inches)									
0—20 Very Low (Non-expansive)	1 2 3	6 8 10	12 15 18	6 7 8	12 18 24	12 18 24	1 - #4 Top & Bottom	#4 at 48" o.c. each way, or #3 at 36" o.c. each way	2"	Moistening of Ground Prior to Placing Concrete is Recommended	Piers allowed for single floor loads only
21—50 Low	1 2 3	6 8 10	12 15 18	6 7 8	15 18 24	1 2 18 24	1 - #4 Top & Bottom		4"	3% over Optimum Moisture required to a depth of 18" below lowest adjacent grade, testing required	Piers allowed for single floor loads only
51—90 Medium	1 2 3	6 8 10	12 15 18	6 8 8	21 21 24	12 18 24	1 - #4 Top & Bottom	#3 at 24" o.c. each way	4"	3% over Optimum Moisture required to a depth of 18" below lowest adjacent grade, testing required	Piers not allowed
							#3 at 24" o.c. each way				
91—130 High	1 2 3	6 8 10	12 15 18	8 8 8	27 27 27	12 18 24	2 - #4 Top & Bottom	#3 at 24" o.c. each way		3% over Optimum Moisture required to a depth of 24" below lowest adjacent grade, testing required	Piers not allowed
							#3 at 24" o.c. each way		4"		
Above 130 Very High	Special Design by Licensed Engineer or Architect Required										

FOOTNOTES ON FOLLOWING PAGE

FOOTNOTES

1. Premoistening is required where specified in Table 1809.7(1)1809.7 in order to achieve maximum and uniform expansion of the soil prior to construction and thus limit structural distress caused by uneven expansion and shrinkage. Other systems which do not include premoistening may be approved by the Building Official when such alternatives are shown to provide equivalent safeguards against the adverse effects of expansive soil.
2. Reinforcement for continuous foundations shall be placed not less than 3" above the bottom of the footing and not less than 3" below the top of the stem.
3. Reinforcement shall be placed at mid-depth of slab.
4. After premoistening, the specified moisture content of soils shall be maintained until concrete is placed. Required moisture content shall be verified by an approved testing laboratory not more than 24 hours prior to placement of concrete.
5. Crawl spaces under raised floors need not be pre-moistened except under interior footings. Interior footings which are not enclosed by a continuous perimeter foundation system or equivalent concrete or masonry moisture barrier complying with Footnote # 12 of Table 1809.7(1)1809.7 shall be designed and constructed as specified for perimeter footings in Table 1809.7(1)1809.7.
6. Foundation stem walls which exceed a height of three times the stem thickness above lowest adjacent grade shall be reinforced in accordance with Chapter 21 and Section 1914 in the IBC, or as required by engineering design, whichever is more restrictive.
7. Bent reinforcing bars between exterior footing and slab shall be omitted when floor is designed as an independent, "floating' slab.
8. Underfloor access crawl holes must be provided with curbs extending not less than six (6) inches above adjacent grade to prevent surface water from entering the foundation area. thickness of 4 inches when the expansion index exceeds 50.
9. The ground under a raised floor system may be excavated to the elevation of the top of the perimeter footing, except where otherwise required by engineering design or to mitigate groundwater conditions.
10. GRADE BEAM, GARAGE OPENING. A grade beam not less than 12" x 12" in cross section, or 12" x depth required by Table 1809.7(1)1809.7, whichever is deeper, reinforced as specified for continuous foundations in Table 1809.7(1)1809.7, shall be provided at garage door openings.
11. Where a post-tensioning slab system is used, the width and depth of the perimeter footings shall meet the requirements of this table.
12. An approved vapor barrier shall be installed below concrete slab-on-grade floors of all residential occupancies in such a manner as to form an effective barrier against the migration of moisture into the slab. When sheet plastic material is employed for this purpose it shall be not less than 6 mils (.006 inch) in thickness. The installation of a vapor barrier shall not impair the effectiveness of required anchor bolts or other structural parts of a building. Foundations at the perimeter of concrete floor slabs shall form a continuous moisture barrier of Portland cement concrete or solid grouted masonry to the depths required by Table 1809.7(1)1809.7.
13. When buildings are located on expansive soil having an expansion index greater than 50, gutters, downspouts, piping, and/or other non-erosive devices shall be provided to collect and conduct rainwater to a street, storm drain, or other approved watercourse or disposal area.
14. Fireplace footings shall be reinforced with a horizontal grid located 3" above the bottom of the footing and consisting of not less than No. 4 Bars at 12" on center each way. Vertical chimney reinforcing bars shall be hooked under the grid. Depth of fireplace chimney footings shall be no less than that required by Table 1809.7(1)1809.7.

APPENDIX E

Liquefaction and Seismic-Induced Settlement Analyses
(CPTs 1, 5, and 9)

CPT-LIQUEFY.XLS - A SPREADSHEET FOR EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL USING CPT DATA
Developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Project: Arctic Cold
Job No: 303415-002
Date: 3/29/2020
Sounding: CPT-1

Liquefaction Analysis using 1998 NCEER (Robertson & Wride) method
Settlement Analysis using Tokimatsu & Seed (1987), clean sand Qc1n/N1(60) ratio =5

Plot: 1
Method Used: 1 1998 NCEER (Robertson & Wride)

EARTHQUAKE INFORMATION:
Magnitude: 7.2 7.5
PGA, g: 0.85 0.77
MSF: 1.11
GWT, feet: 20.0
Calc GWT, feet: 6.0

Averaging Increment: 3 0.15 m
Induced CSR (M=7.5) = 0.65*PGA*(po/p'o)*rd/MSF
Clean Sand Qc1n = C_Q*K_C*K_H*Qc
SF = $CRR_{7.5}$*Kσ/CSR

Ignore 1st/last increment into sand/silt soils: 1 yes
Ignore/remediate upper: 1.5 m
Unit Weight of unsaturated soils: 115 pcf
Unit Weight of saturated soils: 130 pcf
Limiting Ic for liquefiable soils: 2.50 Limiting Ic for K_H: 2.5

Use Moss @ P_L: 15%
Use Tokimatsu & Seed (0) or Ishihara &Yoshmine (1): 0
Required SF: 1.50 Max $\Delta N_{1(60)}$ - post liquefied: 5.5
Min SF of Liquefiable Layers: 0.26 Max $\Delta N_{1(60)}$ - non liquefied: 10.0
Avg SF of Liquefiable Layers: 0.53 0.485

Total Liquefied Thickness (feet)	Juang et al (2000) Probab - NCEER method
7.4	Mapping Coeff.
Total Induced Subsidence (inches)	A
1.0	B
0.9	3.3

Depth (feet)	(m)	Tip Qc (tsf)	Friction Fs (tsf)	Friction Ratio Rf %	qc MPa	Total Unit Wt. (pcf)	Total Stress po (tsf)	Eff. Stress p'o (tsf)	rd	F %	n	Max 1.70 Cq	Q	Moss qc1 MPa	Moss Δqc MPa	Moss qc_{1mod} MPa	Moss eff K_C	Qc1n	Ic	Overide	Liquef. Suscept. (0 or 1)	Rel. Dens. Dr (%)	K_C	K_H	Clean Sand Qc1n	1.0 Kσ	CRR	Induced M=7.5 CSR	**Liquefac. Safety Factor**	Qc1n $N_{1(60)}$ Ratio	Equiv. $N_{1(60)}$	FC Adj. $\Delta N_{1(60)}$	Equiv. $N_{1(60)cs}$	***Volumetric Strain (%)***	Induced Subsidence (inches)
0.49	0.15	31.15	0.25	0.79	2.98	115	0.028	0.028	1.000	0.79	0.64	1.70	50.01	5.07	0.30	5.37		50.05	2.09		0			1.00		1.00		0.332	**Non-Liq.**	4.9	10.2			**0.00**	0.0000
0.98	0.30	74.78	0.23	0.31	7.16	115	0.057	0.057	1.000	0.31	0.50	1.70	120.07	12.17	0.00	12.17		120.16	1.56		0			1.00		1.00		0.332	**Non-Liq.**	5.9	20.2			**0.00**	0.0000
1.48	0.45	75.40	0.55	0.73	7.22	115	0.085	0.085	0.999	0.73	0.54	1.70	121.02	12.28	0.24	12.51		121.16	1.76		0			1.00		1.00		0.332	**Non-Liq.**	5.6	21.8			**0.00**	0.0000
1.97	0.60	41.13	0.46	1.11	3.94	115	0.113	0.113	0.997	1.11	0.63	1.70	65.91	6.70	0.63	7.33		66.09	2.08		0			1.00		1.00		0.331	**Non-Liq.**	4.9	13.4			**0.00**	0.0000
2.46	0.75	15.49	0.26	1.66	1.48	115	0.141	0.141	0.996	1.67	0.77	1.70	24.67	2.52	1.20	3.72		24.89	2.53		0			1.00		1.00		0.331	**Non-Liq.**	4.0	6.2			**0.00**	0.0000
2.95	0.90	9.44	0.26	2.80	0.90	115	0.170	0.170	0.995	2.85	0.86	1.70	14.89	1.54	2.39	3.92		15.16	2.84		0			1.00		1.00		0.331	**Non-Liq.**	3.4	4.4			**0.00**	0.0000
3.44	1.05	7.78	0.38	4.91	0.74	130	0.202	0.202	0.994	5.04	0.93	1.70	12.17	1.27	4.58	5.85		12.50	3.06		0			1.00		1.00		0.330	**Non-Liq.**	3.0	4.2			**0.00**	0.0000
3.94	1.20	10.98	0.38	3.48	1.05	130	0.234	0.234	0.993	3.55	0.86	1.70	17.27	1.79	3.09	4.88		17.65	2.85		0			1.00		1.00		0.330	**Non-Liq.**	3.4	5.2			**0.00**	0.0000
4.43	1.35	17.70	0.27	1.54	1.69	130	0.266	0.266	0.992	1.56	0.75	1.70	28.01	3.64	1.08	4.72		35.96	2.47		0			1.26		1.00		0.329	**Non-Liq.**	4.2	8.6			**0.00**	0.0000
4.92	1.50	15.13	0.18	1.19	1.45	130	0.298	0.298	0.990	1.22	0.75	1.70	23.83	3.11	0.72	3.83		30.73	2.47		0			1.26		1.00		0.329	**Non-Liq.**	4.2	7.4			**0.00**	0.0000
5.41	1.65	10.54	0.22	2.12	1.01	130	0.330	0.330	0.989	2.19	0.83	1.70	16.40	1.72	1.68	3.40		16.93	2.74		0			1.00		1.00		0.329	**Non-Liq.**	3.6	4.7			**0.00**	0.0000
5.91	1.80	6.97	0.29	4.21	0.67	130	0.362	0.362	0.988	4.44	0.93	1.70	10.62	1.14	3.84	4.98		11.20	3.08		0			1.00		1.00		0.328	**Non-Liq.**	3.0	3.8			**0.00**	0.0000
6.40	1.95	40.39	0.35	0.88	3.87	130	0.394	0.394	0.987	0.89	0.62	1.70	64.26	6.60	0.45	7.05		65.14	2.03		0			1.00		1.00		0.498	**Non-Liq.**	5.0	13.0			**0.00**	0.0000
6.89	2.10	81.02	0.67	0.82	7.76	130	0.426	0.426	0.986	0.83	0.55	1.65	125.36	11.83	0.39	12.22	1.03	126.02	1.78		1	86	1.09	1.00	137.9	1.00	0.324	0.516	**0.63**	5.5	22.9	4.7	27.6	**1.03**	0.0606
7.38	2.25	88.00	0.91	1.04	8.43	130	0.458	0.458	0.985	1.04	0.56	1.60	132.53	11.98	0.66	12.64	1.05	133.22	1.83		1	89	1.13	1.00	150.5	1.00	0.397	0.532	**0.75**	5.4	24.6	5.5	30.1	**0.76**	0.0447
7.87	2.40	101.44	0.78	0.77	9.71	130	0.490	0.490	0.984	0.78	0.53	1.50	143.11	13.72	0.34	14.06	1.02	143.80	1.72		1	92	1.05	1.00	151.2	1.00	0.402	0.547	**0.73**	5.6	25.5	4.7	30.2	**0.74**	0.0438
8.37	2.55	122.79	0.72	0.59	11.76	130	0.522	0.522	0.983	0.59	0.50	1.42	164.58	16.44	0.11	16.55	1.01	165.28	1.60		1	98	1.00	1.00	165.3	1.00	Infin.	0.561	**Non-Liq.**	5.9	28.2	4.9	33.1	**0.00**	0.0000
8.86	2.70	119.18	0.81	0.68	11.41	130	0.554	0.554	0.982	0.68	0.51	1.39	155.55	15.30	0.22	15.52	1.01	156.27	1.66		1	95	1.01	1.00	157.6	1.00	0.444	0.574	**0.77**	5.8	27.2	4.4	31.5	**0.60**	0.0354
9.35	2.85	101.37	0.85	0.84	9.71	130	0.586	0.586	0.981	0.84	0.54	1.38	131.28	12.56	0.43	12.99	1.03	132.04	1.77		1	88	1.09	1.00	143.6	1.00	0.355	0.586	**0.61**	5.5	23.9	4.8	28.7	**1.00**	0.0591
9.84	3.00	93.30	0.84	0.90	8.93	130	0.618	0.618	0.979	0.91	0.56	1.35	118.38	11.28	0.51	11.79	1.05	119.17	1.83		1	84	1.13	1.00	134.3	1.00	0.305	0.597	**0.51**	5.4	22.0	4.9	26.9	**1.07**	0.0633
10.33	3.15	107.79	0.84	0.78	10.32	130	0.650	0.650	0.978	0.78	0.54	1.30	131.46	12.80	0.35	13.15	1.03	132.26	1.75		1	88	1.07	1.00	141.8	1.00	0.345	0.607	**0.57**	5.6	23.7	4.6	28.4	**1.00**	0.0591
10.83	3.30	168.04	0.93	0.55	16.09	130	0.682	0.682	0.977	0.55	0.50	1.25	197.08	19.64	0.07	19.71	1.00	197.89	1.52		1	100	1.00	1.00	197.9	1.00	Infin.	0.616	**Non-Liq.**	6.0	32.9	6.7	39.6	**0.00**	0.0000
11.32	3.45	185.29	1.10	0.59	17.74	130	0.714	0.714	0.976	0.60	0.50	1.22	212.43	21.04	0.12	21.16	1.01	213.25	1.52		1	100	1.00	1.00	213.3	1.00	Infin.	0.625	**Non-Liq.**	6.0	35.4	7.3	42.7	**0.00**	0.0000
11.81	3.60	185.88	1.18	0.64	17.80	130	0.746	0.746	0.975	0.64	0.50	1.19	208.45	20.63	0.18	20.80	1.01	209.28	1.54		1	100	1.00	1.00	209.3	1.00	Infin.	0.634	**Non-Liq.**	6.0	35.0	6.9	41.9	**0.00**	0.0000
12.30	3.75	178.22	1.21	0.68	17.07	130	0.778	0.778	0.974	0.68	0.50	1.17	195.64	19.40	0.23	19.62	1.01	196.49	1.58		1	100	1.00	1.00	196.5	1.00	Infin.	0.642	**Non-Liq.**	5.9	33.3	6.0	39.3	**0.00**	0.0000
12.80	3.90	146.49	1.16	0.79	14.03	130	0.810	0.810	0.973	0.79	0.52	1.15	158.11	15.65	0.37	16.03	1.02	158.99	1.69		1	96	1.03	1.00	164.3	1.00	Infin.	0.649	**Non-Liq.**	5.7	28.0	4.9	32.9	**0.00**	0.0000
13.29	4.05	65.86	1.11	1.69	6.31	130	0.842	0.842	0.972	1.71	0.66	1.16	71.53	6.89	1.55	8.44		72.46	2.17		0			1.00		1.00		0.656	**Non-Liq.**	4.7	15.3			**0.00**	0.0000
13.78	4.20	29.59	1.03	3.49	2.83	130	0.874	0.874	0.971	3.59	0.81	1.17	31.69	3.06	3.89	6.96		32.65	2.65		0			1.00		1.00		0.662	**Non-Liq.**	3.8	8.6			**0.00**	0.0000
14.27	4.35	47.15	0.80	1.69	4.52	130	0.906	0.906	0.970	1.72	0.70	1.12	48.76	5.56	1.56	7.12		57.30	2.30		0			1.15		1.00		0.668	**Non-Liq.**	4.5	12.8			**0.00**	0.0000
14.76	4.50	56.21	0.83	1.47	5.38	130	0.938	0.938	0.969	1.50	0.67	1.08	56.68	6.53	1.27	7.80	1.19	66.44	2.21		1	60	1.70	1.15	112.7	1.00	0.213	0.674	**0.32**	4.7	14.2	5.5	19.7	**1.53**	0.0906
15.26	4.65	93.10	1.05	1.12	8.92	130	0.969	0.969	0.968	1.14	0.60	1.05	91.78	10.64	0.82	11.46	1.08	106.90	1.97		1	80	1.27	1.15	135.5	1.00	0.311	0.680	**0.46**	5.1	20.8	5.5	26.3	**1.11**	0.0656
15.75	4.80	45.25	1.09	2.40	4.33	130	1.001	1.001	0.967	2.46	0.74	1.04	43.56	5.10	2.51	7.61		51.35	2.44		0			1.15		1.00		0.685	**Non-Liq.**	4.2	12.2			**0.00**	0.0000
16.24	4.95	11.80	0.80	6.75	1.13	130	1.033	1.033	0.966	7.40	0.98	1.02	10.42	1.14	5.93	7.08		11.41	3.22		0			1.00		1.00		0.689	**Non-Liq.**	2.7	4.2			**0.00**	0.0000
16.73	5.10	6.07	0.36	5.94	0.58	130	1.065	1.065	0.965	7.21	1.00	0.99	4.70	0.58	5.95	6.52		5.70	3.49		0			1.00		1.00		0.694	**Non-Liq.**	2.2	2.6			**0.00**	0.0000
17.22	5.25	6.64	0.18	2.75	0.64	130	1.097	1.097	0.964	3.29	0.99	0.96	5.05	0.62	2.97	3.59		6.05	3.27		0			1.00		1.00		0.698	**Non-Liq.**	2.6	2.3			**0.00**	0.0000
17.72	5.40	8.39	0.21	2.55	0.80	130	1.129	1.129	0.962	2.95	0.95	0.94	6.45	0.77	2.72	3.49		7.45	3.15		0			1.00		1.00		0.702	**Non-Liq.**	2.8	2.6			**0.00**	0.0000
18.21	5.55	9.15	0.32	3.45	0.88	130	1.161	1.161	0.961	3.95	0.96	0.91	6.91	0.82	3.92	4.74		7.91	3.20		0			1.00		1.00		0.706	**Non-Liq.**	2.7	2.9			**0.00**	0.0000
18.70	5.70	9.12	0.42	4.60	0.87	130	1.193	1.193	0.960	5.29	0.99	0.89	6.65	0.81	5.45	6.26		7.65	3.28		0			1.00		1.00		0.710	**Non-Liq.**	2.6	3.0			**0.00**	0.0000
19.19	5.85	11.68	0.53	4.56	1.12	130	1.225	1.225	0.959	5.10	0.96	0.87	8.59	1.03	5.41	6.44		9.60	3.19		0			1.00		1.00		0.713	**Non-Liq.**	2.8	3.5			**0.00**	0.0000
19.69	6.00	9.57	0.51	5.32	0.92	130	1.257	1.257	0.958	6.13	1.00	0.84	6.61	0.82	6.00	6.82		7.61	3.32		0			1.00		1.00		0.716	**Non-Liq.**	2.5	3.1			**0.00**	0.0000
20.18	6.15	13.57	0.54	3.95	1.30	130	1.289	1.289	0.956	4.37	0.93	0.83	9.66	1.17	4.61	5.78		10.67	3.10		0			1.00		1.00		0.719	**Non-Liq.**	2.9	3.7			**0.00**	0.0000
20.67	6.30	20.74	0.77	3.73	1.99	130	1.321	1.308	0.955	3.98	0.88	0.83	15.25	1.80	4.32	6.12		16.27	2.92		0			1.00		1.00		0.722	**Non-Liq.**	3.3	5.0			**0.00**	0.0000
21.16	6.45	14.02	0.80	5.72	1.34	130	1.353	1.325	0.954	6.31	0.96	0.81	9.67	1.20	6.02	7.22		10.68	3.20		0			1.00		1.00		0.725	**Non-Liq.**	2.7	3.9			**0.00**	0.0000
21.65	6.60	13.50	0.66	4.89	1.29	130	1.385	1.341	0.952	5.43	0.95	0.80	9.17	1.14	5.88	7.02		10.18	3.18		0			1.00		1.00		0.727	**Non-Liq.**	2.8	3.7			**0.00**	0.0000
22.15	6.75	13.73	0.52	3.75	1.31	130	1.417	1.358	0.951	4.17	0.93	0.79	9.27	1.14	4.36	5.50		10.29	3.11		0			1.00		1.00		0.729	**Non-Liq.**	2.9	3.5			**0.00**	0.0000
22.64	6.90	32.86	0.44	1.34	3.15	130	1.449	1.375	0.950	1.39	0.75	0.82	24.47	4.35	1.12	5.47		40.34	2.49		0			1.58		1.00		0.731	**Non-Liq.**	4.1	9.8			**0.00**	0.0000
23.13	7.05	31.72	0.57	1.80	3.04	130	1.481	1.391	0.948	1.88	0.77	0.81	23.19	2.67	1.74	4.41		24.25	2.58		0			1.00		1.00		0.733	**Non-Liq.**	3.9	6.1			**0.00**	0.0000
23.62	7.20	13.65	0.64	4.69	1.31	130	1.513	1.408	0.946	5.23	0.95	0.76	8.82	1.12	5.63	6.75		9.83	3.18		0			1.00		1.00		0.735	**Non-Liq.**	2.8	3.5			**0.00**	0.0000
24.11	7.35	13.55	0.51	3.77	1.30	130	1.545	1.425	0.945	4.21	0.93	0.76	8.68	1.10	4.39	5.49		9.70	3.13		0			1.00		1.00		0.737	**Non-Liq.**	2.9	3.4			**0.00**	0.0000
24.61	7.50	27.40	0.53	1.92	2.62	130	1.577	1.441	0.943	2.02	0.80	0.78	19.17	2.25	1.91	4.16		20.23	2.67		0			1.00		1.00		0.738	**Non-Liq.**	3.8	5.4			**0.00**	0.0000
25.10	7.65	8.73	0.44	5.01	0.84	130	1.609	1.458	0.941	6.01	1.00	0.73	4.99	0.68	6.05	6.73		5.99	3.42		0			1.00		1.00		0.740	**Non-Liq.**	2.3	2.6			**0.00**	0.0000

Depth (feet)	(m)	Tip Qc (tsf)	Friction Fs (tsf)	Friction Ratio Rf %	qc MPa	Total Unit Wt. (pcf)	Total Stress po (tsf)	Eff. Stress p'o (tsf)	rd	F %	n	Max 1.70 Cq	Q	Moss qc1 MPa	Moss Δqc MPa	Moss qc_{1mod} MPa	Moss eff K_C	Qc1n	Ic	Overide	Liquef. Suscept. (0 or 1)	Rel. Dens. Dr (%)	K_C	K_H	Clean Sand Qc1n	1.0 Kσ	CRR	Induced M=7.5 CSR	Liquefac. Safety Factor	Qc1n $N_{1(60)}$ Ratio	Equiv. $N_{1(60)}$	FC Adj. $\Delta N_{1(60)}$	Equiv. $N_{1(60)cs}$	*Volumetric Strain (%)*	Induced Subsidenc (inches)
25.59	7.80	10.83	0.23	2.09	1.04	130	1.641	1.474	0.940	2.42	0.92	0.74	6.51	0.83	2.14	2.97		7.53	3.10		0			1.00		1.00		0.741	**Non-Liq.**	2.9	2.6			**0.00**	0.0000
26.08	7.95	16.42	0.32	1.93	1.57	130	1.673	1.491	0.938	2.12	0.86	0.74	10.49	1.28	1.92	3.20		11.54	2.90		0			1.00		1.00		0.742	**Non-Liq.**	3.3	3.5			**0.00**	0.0000
26.57	8.10	17.85	0.50	2.82	1.71	130	1.705	1.508	0.936	3.08	0.88	0.73	11.31	1.42	3.12	4.54		12.35	2.96		0			1.00		1.00		0.743	**Non-Liq.**	3.2	3.8			**0.00**	0.0000
27.07	8.25	15.30	0.60	3.91	1.47	130	1.737	1.524	0.934	4.34	0.93	0.71	9.28	1.21	4.60	5.81		10.31	3.12		0			1.00		0.99		0.744	**Non-Liq.**	2.9	3.6			**0.00**	0.0000
27.56	8.40	17.08	0.65	3.79	1.64	130	1.769	1.541	0.932	4.16	0.91	0.71	10.43	1.35	4.43	5.79		11.46	3.07		0			1.00		0.99		0.744	**Non-Liq.**	3.0	3.8			**0.00**	0.0000
28.05	8.55	19.71	0.68	3.44	1.89	130	1.801	1.558	0.930	3.73	0.89	0.71	12.18	1.57	3.96	5.52		13.22	2.98		0			1.00		0.99		0.745	**Non-Liq.**	3.2	4.2			**0.00**	0.0000
28.54	8.70	46.73	1.16	2.48	4.47	130	1.833	1.574	0.928	2.57	0.76	0.74	31.49	3.84	2.67	6.51		32.59	2.56		0			1.00		0.99		0.745	**Non-Liq.**	4.0	8.2			**0.00**	0.0000
29.04	8.85	41.53	1.95	4.71	3.98	130	1.865	1.591	0.925	4.89	0.83	0.71	26.87	3.48	5.67	9.15		27.94	2.79		0			1.00		0.98		0.745	**Non-Liq.**	3.5	7.9			**0.00**	0.0000
29.53	9.00	61.07	2.43	3.98	5.85	130	1.897	1.608	0.923	4.09	0.78	0.72	40.54	5.16	4.69	9.85		41.64	2.61		0			1.00		0.98		0.745	**Non-Liq.**	3.9	10.7			**0.00**	0.0000
30.02	9.15	102.20	2.04	2.00	9.79	130	1.929	1.624	0.920	2.03	0.67	0.75	71.38	13.47	2.02	15.49		114.58	2.22		0			1.58		0.98		0.745	**Non-Liq.**	4.6	24.7			**0.00**	0.0000
30.51	9.30	49.42	1.33	2.68	4.73	130	1.961	1.641	0.918	2.78	0.77	0.71	32.24	4.03	2.94	6.97		33.35	2.57		0			1.00		0.97		0.745	**Non-Liq.**	4.0	8.4			**0.00**	0.0000
31.00	9.45	30.72	1.17	3.80	2.94	130	1.993	1.657	0.915	4.01	0.85	0.68	18.76	2.46	4.44	6.91		19.83	2.85		0			1.00		0.97		0.745	**Non-Liq.**	3.4	5.8			**0.00**	0.0000
31.50	9.60	40.28	1.58	3.92	3.86	130	2.025	1.674	0.913	4.09	0.82	0.69	25.01	3.28	4.61	7.90		26.09	2.77		0			1.00		0.97		0.745	**Non-Liq.**	3.6	7.3			**0.00**	0.0000
31.99	9.75	29.12	1.72	5.92	2.79	130	2.057	1.691	0.910	6.29	0.89	0.66	17.04	2.36	6.06	8.42		18.09	3.01		0			1.00		0.97		0.744	**Non-Liq.**	3.1	5.8			**0.00**	0.0000
32.48	9.90	71.50	2.05	2.87	6.85	130	2.089	1.707	0.907	2.94	0.74	0.70	46.33	6.30	3.19	9.49		50.85	2.47		0			1.07		0.96		0.743	**Non-Liq.**	4.2	12.2			**0.00**	0.0000
32.97	10.05	26.19	2.41	9.19	2.51	130	2.121	1.724	0.904	9.83	0.95	0.63	14.56	2.13	6.06	8.19		15.59	3.20		0			1.00		0.96		0.742	**Non-Liq.**	2.7	5.7			**0.00**	0.0000
33.46	10.20	154.80	1.94	1.25	14.82	130	2.153	1.741	0.901	1.27	0.59	0.75	107.87	12.55	1.01	13.56		109.50	1.95		0			1.00		0.96		0.741	**Non-Liq.**	5.2	21.2			**0.00**	0.0000
33.96	10.35	223.58	1.82	0.81	21.41	130	2.185	1.757	0.898	0.82	0.52	0.77	161.35	17.75	0.42	18.17	1.02	162.63	1.70		1	97	1.04	1.00	168.4	0.92	Infin.	0.740	**Non-Liq.**	5.7	28.7	5.0	33.7	**0.00**	0.0000
34.45	10.50	234.19	2.40	1.02	22.43	130	2.217	1.774	0.894	1.03	0.53	0.76	166.80	18.86	0.70	19.56	1.04	168.07	1.75		1	98	1.07	1.00	180.6	0.91	Infin.	0.739	**Non-Liq.**	5.6	30.2	5.9	36.1	**0.00**	0.0000
34.94	10.65	292.77	3.06	1.05	28.04	130	2.249	1.791	0.891	1.05	0.51	0.76	209.77	23.73	0.73	24.47	1.03	211.07	1.69		1	100	1.03	1.00	217.8	0.91	Infin.	0.738	**Non-Liq.**	5.7	37.1	6.4	43.6	**0.00**	0.0000
35.43	10.80	318.81	2.88	0.90	30.53	130	2.281	1.807	0.888	0.91	0.50	0.77	229.25	25.59	0.54	26.13	1.02	230.56	1.62		1	100	1.00	1.00	230.6	0.90	Infin.	0.736	**Non-Liq.**	5.8	39.6	6.6	46.1	**0.00**	0.0000
35.93	10.95	335.27	2.19	0.65	32.11	130	2.313	1.824	0.884	0.66	0.50	0.76	240.05	26.24	0.21	26.45	1.01	241.36	1.50		1	100	1.00	1.00	241.4	0.90	Infin.	0.735	**Non-Liq.**	6.1	39.9	8.4	48.3	**0.00**	0.0000
36.42	11.10	349.45	1.50	0.43	33.46	130	2.345	1.840	0.880	0.43	0.50	0.76	249.11	26.32	0.00	26.32	1.00	250.42	1.37		1	100	1.00	1.00	250.4	0.89	Infin.	0.733	**Non-Liq.**	6.3	39.7	10.0	49.7	**0.00**	0.0000
36.91	11.25	361.90	1.08	0.30	34.66	130	2.377	1.857	0.877	0.30	0.50	0.75	256.86	26.18	0.00	26.18	1.00	258.19	1.27		1	100	1.00	1.00	258.2	0.89	Infin.	0.731	**Non-Liq.**	5.5	46.7	5.0	51.6	**0.00**	0.0000
37.40	11.40	326.14	1.31	0.40	31.23	130	2.409	1.874	0.873	0.40	0.50	0.75	230.31	24.12	0.00	24.12	1.00	231.64	1.38		1	100	1.00	1.00	231.6	0.88	Infin.	0.729	**Non-Liq.**	6.3	36.8	9.5	46.3	**0.00**	0.0000
37.89	11.55	321.91	1.68	0.52	30.83	130	2.441	1.890	0.869	0.52	0.50	0.75	226.29	24.32	0.03	24.35	1.00	227.63	1.46		1	100	1.00	1.00	227.6	0.88	Infin.	0.727	**Non-Liq.**	6.1	37.1	8.5	45.5	**0.00**	0.0000
38.39	11.70	342.25	1.97	0.58	32.77	130	2.473	1.907	0.865	0.58	0.50	0.74	239.61	26.09	0.10	26.19	1.00	240.95	1.47		1	100	1.00	1.00	241.0	0.88	Infin.	0.725	**Non-Liq.**	6.1	39.4	8.8	48.2	**0.00**	0.0000
38.88	11.85	293.35	1.97	0.67	28.09	130	2.505	1.924	0.861	0.67	0.50	0.74	204.28	22.43	0.23	22.66	1.01	205.63	1.56		1	100	1.00	1.00	205.6	0.87	Infin.	0.723	**Non-Liq.**	5.9	34.6	6.5	41.1	**0.00**	0.0000
39.37	12.00	316.07	1.85	0.59	30.27	130	2.537	1.940	0.857	0.59	0.50	0.74	219.25	23.88	0.11	23.99	1.00	220.61	1.50		1	100	1.00	1.00	220.6	0.87	Infin.	0.720	**Non-Liq.**	6.1	36.4	7.7	44.1	**0.00**	0.0000
39.86	12.15	325.79	1.95	0.60	31.20	130	2.569	1.957	0.852	0.60	0.50	0.74	225.06	24.61	0.13	24.74	1.01	226.42	1.50		1	100	1.00	1.00	226.4	0.87	Infin.	0.718	**Non-Liq.**	6.1	37.4	7.9	45.3	**0.00**	0.0000
40.35	12.30	370.90	1.87	0.50	35.52	130	2.601	1.974	0.848	0.51	0.50	0.73	255.32	27.63	0.01	27.64	1.00	256.68	1.41		1	100	1.00	1.00	256.7	0.86	Infin.	0.715	**Non-Liq.**	6.2	41.1	10.0	51.1	**0.00**	0.0000
40.85	12.45	415.95	2.05	0.49	39.83	130	2.633	1.990	0.843	0.49	0.50	0.73	285.28	30.98	0.00	30.98	1.00	286.65	1.37		1	100	1.00	1.00	286.7	0.86	Infin.	0.713	**Non-Liq.**	6.3	45.3	10.0	55.3	**0.00**	0.0000
41.34	12.60	357.66	2.23	0.62	34.25	130	2.665	2.007	0.839	0.63	0.50	0.73	244.08	26.98	0.16	27.15	1.01	245.46	1.49		1	100	1.00	1.00	245.5	0.85	Infin.	0.710	**Non-Liq.**	6.1	40.3	8.8	49.1	**0.00**	0.0000
41.83	12.75	369.89	1.66	0.45	35.42	130	2.697	2.023	0.834	0.45	0.50	0.72	251.43	26.95	0.00	26.95	1.00	252.81	1.38		1	100	1.00	1.00	252.8	0.85	Infin.	0.707	**Non-Liq.**	6.3	40.2	10.0	50.2	**0.00**	0.0000
42.32	12.90	419.81	1.40	0.33	40.20	130	2.729	2.040	0.830	0.34	0.50	0.72	284.36	29.64	0.00	29.64	1.00	285.75	1.26		1	100	1.00	1.00	285.8	0.85	Infin.	0.704	**Non-Liq.**	5.5	51.6	5.5	57.2	**0.00**	0.0000
42.81	13.05	468.34	2.12	0.45	44.85	130	2.761	2.057	0.825	0.46	0.50	0.72	316.10	34.33	0.00	34.33	1.00	317.49	1.31		1	100	1.00	1.00	317.5	0.84	Infin.	0.701	**Non-Liq.**	5.5	57.4	6.1	63.5	**0.00**	0.0000
43.31	13.20	381.93	2.33	0.61	36.57	130	2.793	2.073	0.820	0.61	0.50	0.71	256.47	28.49	0.14	28.63	1.01	257.87	1.46		1	100	1.00	1.00	257.9	0.84	Infin.	0.698	**Non-Liq.**	6.1	42.0	9.5	51.6	**0.00**	0.0000
43.80	13.35	319.73	1.99	0.62	30.62	130	2.825	2.090	0.816	0.63	0.50	0.71	213.61	23.63	0.16	23.79	1.01	215.02	1.53		1	100	1.00	1.00	215.0	0.84	Infin.	0.695	**Non-Liq.**	6.0	35.8	7.2	43.0	**0.00**	0.0000
44.29	13.50	292.13	1.98	0.68	27.97	130	2.857	2.107	0.811	0.68	0.50	0.71	194.27	21.61	0.24	21.84	1.01	195.68	1.58		1	100	1.00	1.00	195.7	0.83	Infin.	0.691	**Non-Liq.**	5.9	33.2	6.0	39.1	**0.00**	0.0000
44.78	13.65	286.34	1.76	0.62	27.42	130	2.889	2.123	0.806	0.62	0.50	0.71	189.63	20.88	0.15	21.03	1.01	191.05	1.56		1	100	1.00	1.00	191.0	0.83	Infin.	0.688	**Non-Liq.**	5.9	32.2	6.0	38.2	**0.00**	0.0000
45.28	13.80	312.57	1.48	0.47	29.93	130	2.921	2.140	0.801	0.48	0.50	0.70	206.31	22.17	0.00	22.17	1.00	207.74	1.46		1	100	1.00	1.00	207.7	0.83	Infin.	0.685	**Non-Liq.**	6.1	33.9	7.7	41.5	**0.00**	0.0000
45.77	13.95	241.32	1.35	0.56	23.11	130	2.953	2.156	0.796	0.57	0.50	0.70	158.34	17.14	0.08	17.22	1.00	159.76	1.60		1	96	1.00	1.00	159.8	0.82	0.459	0.681	**0.56**	5.9	27.2	4.7	32.0	**0.57**	0.0336
46.26	14.10	119.50	1.81	1.51	11.44	130	2.985	2.173	0.791	1.54	0.64	0.63	69.79	8.96	1.33	10.29	1.15	71.09	2.15		1	63	1.56	1.00	110.6	0.86	0.206	0.678	**0.26**	4.8	14.8	5.5	20.3	**1.49**	0.0880
46.75	14.25	221.40	2.21	1.00	21.20	130	3.017	2.190	0.786	1.01	0.55	0.67	139.28	16.52	0.65	17.17	1.04	140.67	1.80		1	91	1.11	1.00	156.1	0.82	0.434	0.674	**0.53**	5.5	25.7	5.5	31.2	**0.65**	0.0385
47.24	14.40	287.66	2.52	0.88	27.55	130	3.049	2.206	0.781	0.88	0.51	0.69	185.52	21.45	0.49	21.94	1.02	186.95	1.67		1	100	1.02	1.00	190.7	0.81	Infin.	0.671	**Non-Liq.**	5.7	32.7	5.5	38.1	**0.00**	0.0000
47.74	14.55	312.18	2.69	0.86	29.89	130	3.081	2.223	0.776	0.87	0.50	0.69	202.01	23.27	0.47	23.75	1.02	203.46	1.64		1	100	1.00	1.00	203.0	0.81	Infin.	0.667	**Non-Liq.**	5.8	35.2	5.4	40.6	**0.00**	0.0000
48.23	14.70	267.47	1.87	0.70	25.61	130	3.113	2.240	0.771	0.70	0.50	0.69	172.30	19.30	0.26	19.55	1.01	173.75	1.63		1	100	1.00	1.00	173.8	0.81	Infin.	0.663	**Non-Liq.**	5.8	29.9	4.8	34.8	**0.00**	0.0000
48.72	14.85	132.99	1.54	1.16	12.74	130	3.145	2.256	0.766	1.18	0.61	0.63	77.76	9.66	0.86	10.52		79.10	2.04		0			1.00		0.90		0.660	**Non-Liq.**	5.0	15.8			**0.00**	0.0000
49.21	15.00	41.50	1.46	3.52	3.97	130	3.177	2.273	0.761	3.72	0.83	0.53	19.68	3.02	3.92	6.94		20.82	2.82		0			1.00		0.90		0.656	**Non-Liq.**	3.5	6.0			**0.00**	0.0000
49.70	15.15	106.14	1.47	1.39	10.16	130	3.209	2.290	0.756	1.42	0.65	0.61	59.39	7.84	1.15	9.00		61.95	2.18		0			1.02		0.89		0.652	**Non-Liq.**	4.7	13.1			**0.00**	0.0000
50.20	15.30	197.30	2.25	1.14	18.89	130	3.241	2.306	0.751	1.15	0.57	0.64	118.04	14.86	0.83	15.69	1.06	121.90	1.90		1	85	1.19	1.02	144.6	0.80	0.361	0.649	**0.44**	5.3	23.1	5.5	28.6	**1.00**	0.0591
50.69	15.45	300.91	2.60	0.86	28.82	130	3.273	2.323	0.746	0.87	0.51	0.67	189.50	22.52	0.47	22.99	1.02	194.91	1.66		1	100	1.01	1.02	197.4	0.79	Infin.	0.645	**Non-Liq.**	5.7	33.9	5.5	39.5	**0.00**	0.0000
51.18	15.60	269.28	2.02	0.75	25.79	130	3.305	2.339	0.741	0.76	0.51	0.67	168.96	19.68	0.32	20.00	1.02	173.95	1.66		1	100	1.01	1.02	175.7	0.79	Infin.	0.641	**Non-Liq.**	5.7	30.3	4.9	35.1	**0.00**	0.0000
51.67	15.75	217.77	1.28	0.59	20.85	130	3.337	2.356	0.736	0.59	0.51	0.67	135.65	15.20	0.11	15.31	1.01	139.96	1.67		1	91	1.01	1.02	142.0	0.79	0.346	0.638	**0.43**	5.7	24.4	4.0	28.4	**1.00**	0.0591
52.17	15.90	64.09	1.20	1.87	6.14	130	3.369	2.373	0.731	1.94	0.73	0.55	32.33	4.62	1.76	6.37		34.26	2.47		0			1.02		0.89		0.634	**Non-Liq.**	4.2	8.2			**0.00**	0.0000
52.66	16.05	33.45	0.86	2.58	3.20	130	3.401	2.389	0.726	2.78	0.83	0.51	14.92	2.27	2.67	4.94		16.07	2.84		0			1.00		0.88		0.630	**Non-Liq.**	3.4	4.7			**0.00**	0.0000
53.15	16.20	20.18	0.42	2.10	1.93	130	3.433	2.406	0.721	2.39	0.88	0.49	8.16	1.24	2.05	3.30		9.27	3.02		0			1.00		0.88		0.627	**Non-Liq.**	3.1	3.0			**0.00**	0.0000
53.64	16.35	61.47	0.84	1.37	5.89	130	3.465	2.423	0.716	1.43	0.71	0.55	30.93	5.84	1.12	6.96		45.30	2.41		0			1.41		0.88		0.623	**Non-Liq.**	4.3	10.6			**0.00**	0.0000
54.13	16.50	172.23	1.44	0.83	16.49	130	3.497	2.439	0.712	0.85	0.56	0.63	100.37	16.79	0.43	17.22		143.24	1.86		0			1.41		0.88		0.619	**Non-Liq.**	5.3	26.8			**0.00**	0.0000
54.63	16.65	72.17	1.98	2.75	6.91	130	3.529	2.456	0.707	2.84	0.75	0.53	34.96	5.27	2.86	8.14		36.19	2.55		0			1.00		0.88		0.616	**Non-Liq.**	4.0	9.0			**0.00**	0.0000
55.12	16.80	55.74	2.25	4.03	5.34	130	3.561	2.473	0.702	4.22	0.81	0.50	25.23	4.10	4.50	8.60		26.40	2.77		0			1.00		0.88		0.612	**Non-Liq.**	3.6	7.4			**0.00**	0.0000
55.61	16.95	49.95	2.06	4.13	4.78	130	3.593	2.489	0.698	4.35	0.83	0.49	22.09	3.64	4.62	8.26		23.25	2.82		0			1.00		0.88		0.609	**Non-Liq.**	3.5	6.7			**0.00**	0.0000
56.10	17.10	40.74	2.18	5.35	3.90	130	3.625	2.506	0.693	5.70	0.87	0.47	17.03	2.96	5.71	8.67		18.14	2.99		0			1.00		0.87		0.605	**Non-Liq.**	3.2	5.8			**0.00**	0.0000
56.59	17.25	62.26	2.81	4.52	5.96	130	3.656	2.522	0.689	4.71	0.81	0.49	27.83	4.64	5.09	9.74		29.01	2.77		0			1.00		0.87		0.602	**Non-Liq.**	3.6	8.1			**0.00**	0.0000
57.09	17.40	63.15	3.07	4.86	6.05	130	3.688	2.539	0.684	5.06	0.82	0.49	27.95	4.74	5.51	10.25		29.12	2.79		0			1.00		0.87		0.598	**Non-Liq.**	3.5	8.2			**0.00**	0.0000
57.58	17.55	64.99	3.21	4.94	6.22	130	3.720	2.556	0.680	5.14	0.82	0.49	28.66	4.88	5.60	10.48		29.84	2.79		0			1.00		0.87		0.595	**Non-Liq.**	3.5	8.4			**0.00**	0.0000

Depth (feet)	(m)	Tip Qc (tsf)	Friction Fs (tsf)	Friction Ratio Rf %	qc MPa	Total Unit Wt. (pcf)	Total Stress po (tsf)	Eff. Stress p'o (tsf)	rd	F %	n	Max 1.70 Cq	Q	Moss qc1 MPa	Moss Δqc MPa	Moss qc_{1mod} MPa	Moss eff K_C	Qc1n	Ic	Overide	Liquef. Suscept. (0 or 1)	Rel. Dens. Dr (%)	K_C	K_H	Clean Sand Qc1n	1.0 Kσ	CRR	Induced M=7.5 CSR	**Liquefac. Safety Factor**	Qc1n $N_{1(60)}$ Ratio	Equiv. $N_{1(60)}$	FC Adj. $\Delta N_{1(60)}$	Equiv. $N_{1(60)cs}$	***Volumetric Strain (%)***	Induced Subsidenc (inches)
58.07	17.70	107.99	3.59	3.33	10.34	130	3.752	2.572	0.675	3.41	0.73	0.52	51.95	11.49	3.56	15.05		74.87	2.48		0			1.41		0.87		0.592	**Non-Liq.**	4.1	18.1			**0.00**	0.0000
58.56	17.85	112.02	2.93	2.61	10.73	130	3.784	2.589	0.671	2.68	0.71	0.53	54.92	11.68	2.66	14.34		79.09	2.39		0			1.41		0.87		0.588	**Non-Liq.**	4.3	18.3			**0.00**	0.0000
59.06	18.00	36.37	1.99	5.46	3.48	130	3.816	2.606	0.667	5.88	0.89	0.45	14.32	2.58	5.65	8.23		15.42	3.05		0			1.00		0.87		0.585	**Non-Liq.**	3.0	5.1			**0.00**	0.0000
59.55	18.15	42.35	1.46	3.45	4.06	130	3.848	2.622	0.663	3.68	0.83	0.47	17.63	2.93	3.70	6.63		18.79	2.85		0			1.00		0.86		0.582	**Non-Liq.**	3.4	5.5			**0.00**	0.0000
60.04	18.30	34.18	1.17	3.41	3.27	130	3.880	2.639	0.659	3.69	0.86	0.46	13.62	2.29	3.64	5.94		14.76	2.94		0			1.00		0.86		0.579	**Non-Liq.**	3.2	4.6			**0.00**	0.0000
60.53	18.45	18.35	0.99	5.38	1.76	130	3.912	2.655	0.655	6.29	0.97	0.41	6.07	1.16	5.63	6.79		7.09	3.36		0			1.00		0.86		0.576	**Non-Liq.**	2.4	2.9			**0.00**	0.0000
61.02	18.60	20.15	0.68	3.36	1.93	130	3.944	2.672	0.651	3.88	0.92	0.43	7.03	1.24	3.57	4.81		8.10	3.19		0			1.00		0.86		0.573	**Non-Liq.**	2.8	2.9			**0.00**	0.0000
61.52	18.75	25.62	0.83	3.22	2.45	130	3.976	2.689	0.647	3.60	0.89	0.44	9.46	1.62	3.39	5.02		10.57	3.06		0			1.00		0.86		0.570	**Non-Liq.**	3.0	3.5			**0.00**	0.0000
62.01	18.90	27.56	1.00	3.62	2.64	130	4.008	2.705	0.643	4.02	0.89	0.43	10.19	1.78	3.89	5.67		11.30	3.06		0			1.00		0.86		0.567	**Non-Liq.**	3.0	3.8			**0.00**	0.0000
62.50	19.05	23.47	0.93	3.97	2.25	130	4.040	2.722	0.640	4.49	0.92	0.42	8.24	1.49	4.31	5.81		9.33	3.17		0			1.00		0.86		0.564	**Non-Liq.**	2.8	3.3			**0.00**	0.0000
62.99	19.20	31.27	0.99	3.16	2.99	130	4.072	2.739	0.636	3.46	0.86	0.44	11.86	2.02	3.30	5.32		13.00	2.97		0			1.00		0.86		0.561	**Non-Liq.**	3.2	4.1			**0.00**	0.0000
63.48	19.35	23.85	0.97	4.05	2.28	130	4.104	2.755	0.633	4.58	0.92	0.42	8.28	1.51	4.40	5.92		9.36	3.17		0			1.00		0.85		0.558	**Non-Liq.**	2.8	3.4			**0.00**	0.0000
63.98	19.50	25.00	0.76	3.03	2.39	130	4.136	2.772	0.629	3.41	0.89	0.42	8.92	1.55	3.13	4.68		10.03	3.07		0			1.00		0.85		0.555	**Non-Liq.**	3.0	3.4			**0.00**	0.0000
64.47	19.65	33.10	0.74	2.25	3.17	130	4.168	2.789	0.626	2.46	0.83	0.45	12.80	2.06	2.16	4.22		13.98	2.86		0			1.00		0.85		0.553	**Non-Liq.**	3.4	4.1			**0.00**	0.0000
64.96	19.80	25.28	0.75	2.97	2.42	130	4.200	2.805	0.622	3.34	0.89	0.42	8.95	1.56	3.05	4.60		10.06	3.06		0			1.00		0.85		0.550	**Non-Liq.**	3.0	3.3			**0.00**	0.0000
65.45	19.95	51.95	0.83	1.60	4.98	130	4.232	2.822	0.619	1.70	0.75	0.48	22.19	3.29	1.36	4.65		23.46	2.57		0			1.00		0.85		0.548	**Non-Liq.**	4.0	5.9			**0.00**	0.0000
65.94	20.10	39.71	1.29	3.25	3.80	130	4.264	2.838	0.616	3.50	0.84	0.44	15.20	2.63	3.38	6.01		16.37	2.89		0			1.00		0.85		0.545	**Non-Liq.**	3.3	4.9			**0.00**	0.0000
66.44	20.25	22.37	1.26	5.64	2.14	130	4.296	2.855	0.613	6.46	0.96	0.39	7.14	1.43	5.52	6.95		8.19	3.31		0			1.00		0.85		0.543	**Non-Liq.**	2.5	3.3			**0.00**	0.0000
66.93	20.40	26.68	1.08	4.03	2.55	130	4.328	2.872	0.610	4.52	0.91	0.40	9.10	1.70	4.33	6.02		10.20	3.13		0			1.00		0.85		0.540	**Non-Liq.**	2.9	3.6			**0.00**	0.0000
67.42	20.55	55.43	1.71	3.08	5.31	130	4.360	2.888	0.607	3.25	0.80	0.45	22.24	3.78	3.16	6.94		23.46	2.74		0			1.00		0.85		0.538	**Non-Liq.**	3.6	6.5			**0.00**	0.0000
67.91	20.70	105.42	2.81	2.66	10.10	130	4.392	2.905	0.604	2.74	0.72	0.48	46.78	7.57	2.64	10.21		48.28	2.45		0			1.00		0.84		0.535	**Non-Liq.**	4.2	11.5			**0.00**	0.0000
68.41	20.85	191.66	3.25	1.70	18.35	130	4.424	2.922	0.601	1.72	0.62	0.53	94.82	13.67	1.46	15.13	1.11	96.28	2.09		1	75	1.43	1.00	137.6	0.71	0.322	0.533	**0.43**	4.9	19.6	5.5	25.1	**1.17**	0.0688
68.90	21.00	97.85	2.70	2.76	9.37	130	4.456	2.938	0.598	2.84	0.73	0.47	42.47	6.95	2.75	9.70		43.79	2.49		0			1.00		0.84		0.531	**Non-Liq.**	4.1	10.6			**0.00**	0.0000
69.39	21.15	44.47	1.96	4.40	4.26	130	4.488	2.955	0.595	4.71	0.86	0.42	16.29	3.04	4.75	7.79		17.45	2.95		0			1.00		0.84		0.529	**Non-Liq.**	3.2	5.4			**0.00**	0.0000

EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Arctic Cold **Project No: 303415-002**

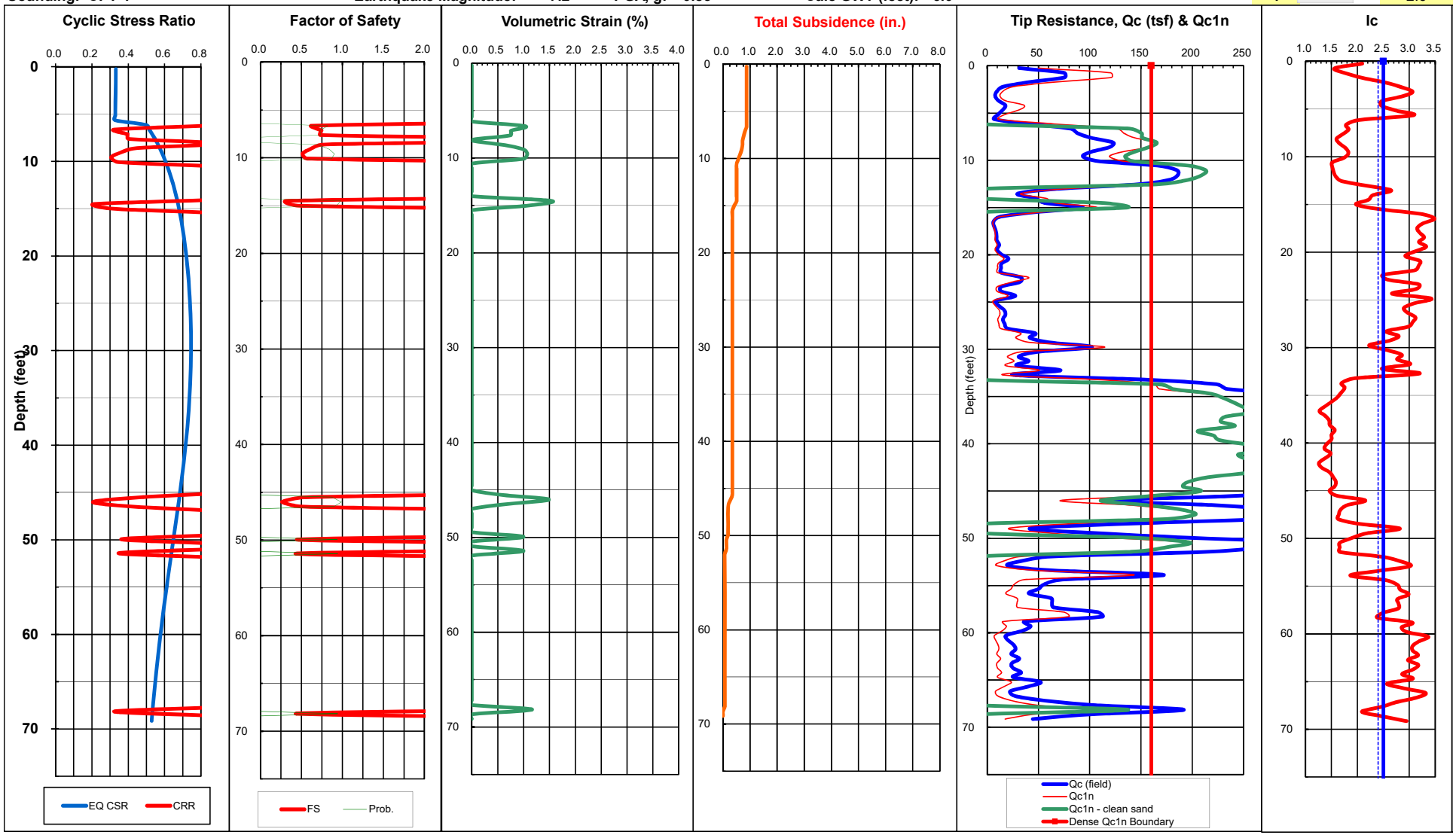
Method Used: 1 1998 NCEER (Robertson & Wride)

Settlement Analysis using Tokimatsu & Seed (1987), clean sand Qc1n/N1(60) ratio =5

Plot 1

Limiting Ic: 2.6

Sounding: CPT-1 **Earthquake Magnitude: 7.2** **PGA, g: 0.85** **Calc GWT (feet): 6.0**



Total Thickness of Liquefiable Layers: 7.4 feet **Estimated Total Ground Subsidence (Settlement): 0.9 inches**

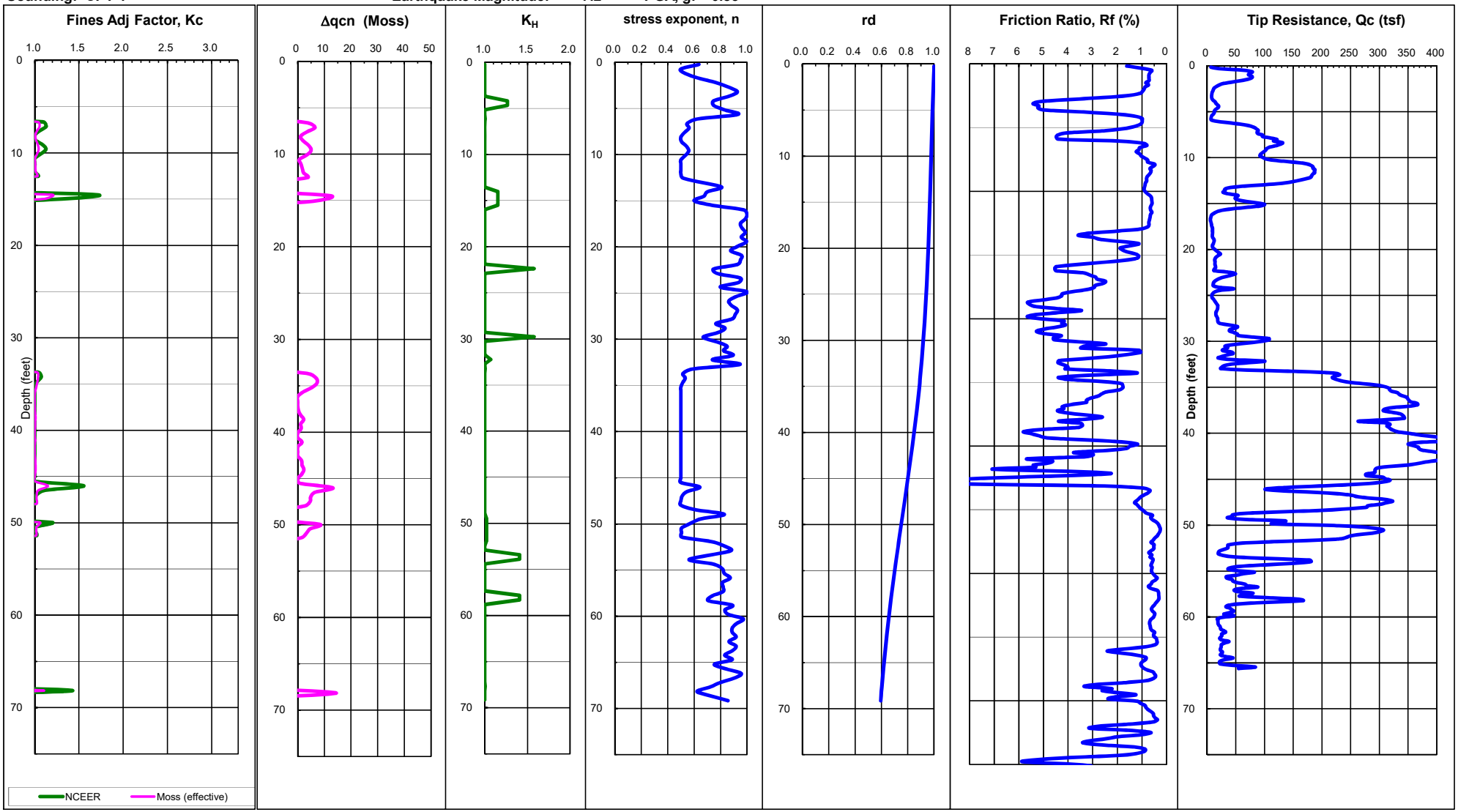
EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

3 avg increment =0.15m Qc1n/N1(60): 5

Ignore 1st/last increment into sand/silt soils: 0

Method Used: 1998 NCEER (Robertson & Wride)

Sounding: CPT-1 **Earthquake Magnitude: 7.2** **PGA, g: 0.85**



CPT-LIQUEFY.XLS - A SPREADSHEET FOR EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL USING CPT DATA
Developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Project: Arctic Cold
Job No: 303415-002
Date: 3/29/2020
Sounding: CPT-5

Liquefaction Analysis using 1998 NCEER (Robertson & Wride) method
Settlement Analysis using Tokimatsu & Seed (1987), clean sand Qc1n/N1(60) ratio =5

Plot: 5
Method Used: 1 1998 NCEER (Robertson & Wride)
Averaging Increment: 3 0.15 m
Ignore 1st/last increment into sand/silt soils: 1 yes
Use Moss @ P_L: 15%
Induced CSR (M=7.5) = 0.65*PGA*(po/p'o)*rd/MSF
Ignore/remediate upper: 1.5 m
Use Tokimatsu & Seed (0) or Ishihara &Yoshmine (1): 0
Clean Sand Qc1n = C_Q*K_C*K_H*Qc
Unit Weight of unsaturated soils: 115 pcf
Required SF: 1.50
Max $\Delta N_{1(60)}$ - post liquefied: 5.5
SF = $CRR_{7.5}$*Kσ/CSR
Unit Weight of saturated soils: 130 pcf
Min SF of Liquefiable Layers: 0.27
Max $\Delta N_{1(60)}$ - non liquefied: 10.0
Limiting Ic for liquefiable soils: 2.50
Limiting Ic for K_H: 2.5
Avg SF of Liquefiable Layers: 0.35
0.540

EARTHQUAKE INFORMATION:
Magnitude: 7.2 7.5
PGA, g: 0.85 0.77
MSF: 1.11
GWT, feet: 20.0
Calc GWT, feet: 6.0

Total Liquefied Thickness (feet)	Juang et al (2000) Probab - NCEER method
5.4	Mapping Coeff.
Total Induced Subsidence (inches)	A
1.0	B
0.9	3.3

Depth (feet)	(m)	Tip Qc (tsf)	Friction Fs (tsf)	Friction Ratio Rf %	qc MPa	Total Unit Wt. (pcf)	Total Stress po (tsf)	Eff. Stress p'o (tsf)	rd	F %	n	Max 1.70 Cq	Q	Moss qc1 MPa	Moss Δqc MPa	Moss qc_{1mod} MPa	Moss eff K_C	Qc1n	Ic	Overide	Liquef. Suscept. (0 or 1)	Rel. Dens. Dr (%)	K_C	K_H	Clean Sand Qc1n	1.0 Kσ	CRR	Induced M=7.5 CSR	**Liquefac. Safety Factor**	Qc1n $N_{1(60)}$ Ratio	Equiv. $N_{1(60)}$	FC Adj. $\Delta N_{1(60)}$	Equiv. $N_{1(60)cs}$	***Volumetric Strain (%)***	Induced Subsidenc (inches)
0.49	0.15	20.41	0.17	0.85	1.95	115	0.028	0.028	1.000	0.85	0.69	1.70	32.75	3.32	0.37	3.69		32.80	2.27		0			1.00		1.00		0.332	**Non-Liq.**	4.6	7.2			**0.00**	0.0000
0.98	0.30	42.94	0.13	0.30	4.11	115	0.057	0.057	1.000	0.30	0.54	1.70	68.91	6.99	0.00	6.99		69.00	1.77		0			1.00		1.00		0.332	**Non-Liq.**	5.5	12.5			**0.00**	0.0000
1.48	0.45	32.74	0.24	0.72	3.14	115	0.085	0.085	0.999	0.72	0.62	1.70	52.47	5.33	0.23	5.56		52.61	2.06		0			1.00		1.00		0.332	**Non-Liq.**	5.0	10.6			**0.00**	0.0000
1.97	0.60	23.47	0.35	1.49	2.25	115	0.113	0.113	0.997	1.50	0.71	1.70	37.52	3.82	1.03	4.85		37.71	2.35		0			1.00		1.00		0.331	**Non-Liq.**	4.4	8.6			**0.00**	0.0000
2.46	0.75	13.57	0.56	4.15	1.30	115	0.141	0.141	0.996	4.19	0.85	1.70	21.58	2.21	3.80	6.00		21.81	2.82		0			1.00		1.00		0.331	**Non-Liq.**	3.5	6.3			**0.00**	0.0000
2.95	0.90	9.38	0.52	5.53	0.90	115	0.170	0.170	0.995	5.63	0.92	1.70	14.79	1.53	4.68	6.20		15.07	3.03		0			1.00		1.00		0.331	**Non-Liq.**	3.1	4.9			**0.00**	0.0000
3.44	1.05	7.73	0.36	4.67	0.74	130	0.202	0.202	0.994	4.79	0.92	1.70	12.10	1.26	4.33	5.59		12.43	3.05		0			1.00		1.00		0.330	**Non-Liq.**	3.0	4.1			**0.00**	0.0000
3.94	1.20	17.17	0.28	1.65	1.64	130	0.234	0.234	0.993	1.67	0.76	1.70	27.22	3.54	1.19	4.73		34.89	2.50		0			1.26		1.00		0.330	**Non-Liq.**	4.1	8.5			**0.00**	0.0000
4.43	1.35	36.01	0.28	0.78	3.45	130	0.266	0.266	0.992	0.79	0.62	1.70	57.43	7.41	0.29	7.70		73.16	2.04		0			1.26		1.00		0.329	**Non-Liq.**	5.0	14.6			**0.00**	0.0000
4.92	1.50	38.41	0.41	1.08	3.68	130	0.298	0.298	0.990	1.09	0.64	1.70	61.23	7.91	0.60	8.50		78.03	2.10		0			1.26		1.00		0.329	**Non-Liq.**	4.9	16.0			**0.00**	0.0000
5.41	1.65	18.80	0.50	2.67	1.80	130	0.330	0.330	0.989	2.71	0.79	1.70	29.67	3.06	2.25	5.31		30.20	2.59		0			1.00		1.00		0.329	**Non-Liq.**	3.9	7.7			**0.00**	0.0000
5.91	1.80	18.15	0.48	2.64	1.74	130	0.362	0.362	0.988	2.69	0.79	1.70	28.58	2.95	2.22	5.17		29.16	2.60		0			1.00		1.00		0.328	**Non-Liq.**	3.9	7.5			**0.00**	0.0000
6.40	1.95	56.98	0.44	0.77	5.46	130	0.394	0.394	0.987	0.78	0.57	1.70	90.92	9.12	0.33	9.44		91.89	1.88		0			1.00		1.00		0.498	**Non-Liq.**	5.3	17.3			**0.00**	0.0000
6.89	2.10	54.16	0.42	0.78	5.19	130	0.426	0.426	0.986	0.79	0.59	1.70	86.35	8.33	0.34	8.67	1.04	87.03	1.90		1	71	1.19	1.00	103.2	1.00	0.182	0.516	**0.35**	5.3	16.5	4.2	20.6	**1.45**	0.0854
7.38	2.25	45.46	0.42	0.93	4.35	130	0.458	0.458	0.985	0.94	0.62	1.68	71.55	6.72	0.52	7.24	1.08	72.28	2.01		1	63	1.31	1.00	94.6	1.00	0.159	0.532	**0.30**	5.1	14.3	4.7	18.9	**1.57**	0.0930
7.87	2.40	44.20	0.39	0.87	4.23	130	0.490	0.490	0.984	0.88	0.62	1.62	66.77	6.37	0.46	6.83	1.07	67.52	2.02		1	61	1.32	1.00	89.3	1.00	0.146	0.547	**0.27**	5.1	13.4	4.5	17.9	**1.66**	0.0981
8.37	2.55	52.68	0.39	0.73	5.04	130	0.522	0.522	0.983	0.74	0.59	1.52	75.06	7.36	0.29	7.65	1.04	75.82	1.93		1	65	1.22	1.00	92.5	1.00	0.154	0.561	**0.27**	5.2	14.5	4.0	18.5	**1.61**	0.0952
8.86	2.70	82.46	0.53	0.64	7.90	130	0.554	0.554	0.982	0.64	0.54	1.42	109.76	10.93	0.17	11.10	1.02	110.51	1.76		1	81	1.08	1.00	119.3	1.00	0.238	0.574	**0.41**	5.5	19.9	3.9	23.9	**1.24**	0.0734
9.35	2.85	133.42	0.90	0.68	12.78	130	0.586	0.586	0.981	0.68	0.50	1.34	168.75	16.60	0.22	16.82	1.01	169.49	1.63		1	99	1.00	1.00	169.5	1.00	Infin.	0.586	**Non-Liq.**	5.8	29.2	4.7	33.9	**0.00**	0.0000
9.84	3.00	155.79	1.31	0.84	14.92	130	0.618	0.618	0.979	0.84	0.50	1.31	192.25	18.45	0.43	18.88	1.02	193.02	1.65		1	100	1.00	1.00	193.5	1.00	Infin.	0.597	**Non-Liq.**	5.8	33.5	5.3	38.7	**0.00**	0.0000
10.33	3.15	171.85	1.38	0.80	16.46	130	0.650	0.650	0.978	0.80	0.50	1.28	206.51	19.94	0.38	20.32	1.02	207.29	1.61		1	100	1.00	1.00	207.3	1.00	Infin.	0.607	**Non-Liq.**	5.8	35.5	6.0	41.5	**0.00**	0.0000
10.83	3.30	213.97	1.31	0.61	20.49	130	0.682	0.682	0.977	0.61	0.50	1.25	251.17	24.60	0.14	24.74	1.01	251.97	1.47		1	100	1.00	1.00	252.0	1.00	Infin.	0.616	**Non-Liq.**	6.1	41.2	9.2	50.4	**0.00**	0.0000
11.32	3.45	234.55	1.34	0.57	22.46	130	0.714	0.714	0.976	0.57	0.50	1.22	269.12	26.48	0.09	26.58	1.00	269.95	1.43		1	100	1.00	1.00	269.9	1.00	Infin.	0.625	**Non-Liq.**	6.2	43.5	10.0	53.5	**0.00**	0.0000
11.81	3.60	206.80	1.40	0.67	19.80	130	0.746	0.746	0.975	0.68	0.50	1.19	232.01	22.81	0.22	23.03	1.01	232.85	1.52		1	100	1.00	1.00	232.8	1.00	Infin.	0.634	**Non-Liq.**	6.0	38.7	7.8	46.6	**0.00**	0.0000
12.30	3.75	144.82	1.23	0.85	13.87	130	0.778	0.778	0.974	0.85	0.52	1.17	159.90	15.69	0.45	16.14	1.03	160.76	1.71		1	97	1.05	1.00	168.1	1.00	Infin.	0.642	**Non-Liq.**	5.6	28.5	5.2	33.6	**0.00**	0.0000
12.80	3.90	177.85	1.03	0.58	17.03	130	0.810	0.810	0.973	0.58	0.50	1.14	191.30	19.16	0.10	19.26	1.01	192.17	1.54		1	100	1.00	1.00	192.2	1.00	Infin.	0.649	**Non-Liq.**	6.0	32.2	6.3	38.4	**0.00**	0.0000
13.29	4.05	116.73	0.92	0.79	11.18	130	0.842	0.842	0.972	0.80	0.54	1.13	123.99	12.34	0.38	12.71		124.89	1.77		0			1.00		1.00		0.656	**Non-Liq.**	5.5	22.6			**0.00**	0.0000
13.78	4.20	28.95	0.85	2.95	2.77	130	0.874	0.874	0.971	3.04	0.80	1.17	30.91	3.01	3.20	6.21		31.87	2.61		0			1.00		1.00		0.662	**Non-Liq.**	3.9	8.2			**0.00**	0.0000
14.27	4.35	9.66	0.59	6.08	0.93	130	0.906	0.906	0.970	6.71	0.98	1.17	9.64	1.02	5.88	6.90		10.64	3.22		0			1.00		1.00		0.668	**Non-Liq.**	2.7	3.9			**0.00**	0.0000
14.76	4.50	18.98	0.34	1.81	1.82	130	0.938	0.938	0.969	1.91	0.81	1.10	18.81	1.95	1.72	3.67		19.79	2.66		0			1.00		1.00		0.674	**Non-Liq.**	3.8	5.2			**0.00**	0.0000
15.26	4.65	24.41	0.60	2.44	2.34	130	0.969	0.969	0.968	2.55	0.81	1.07	23.78	2.44	2.55	4.99		24.76	2.65		0			1.00		1.00		0.680	**Non-Liq.**	3.8	6.5			**0.00**	0.0000
15.75	4.80	12.68	0.63	4.93	1.21	130	1.001	1.001	0.967	5.36	0.94	1.05	11.62	1.25	5.83	7.09		12.62	3.10		0			1.00		1.00		0.685	**Non-Liq.**	2.9	4.3			**0.00**	0.0000
16.24	4.95	7.60	0.31	4.06	0.73	130	1.033	1.033	0.966	4.70	0.99	1.02	6.36	0.74	4.70	5.44		7.36	3.27		0			1.00		1.00		0.689	**Non-Liq.**	2.6	2.8			**0.00**	0.0000
16.73	5.10	4.93	0.14	2.77	0.47	130	1.065	1.065	0.965	3.53	1.00	0.99	3.62	0.47	3.00	3.47		4.62	3.41		0			1.00		1.00		0.694	**Non-Liq.**	2.3	2.0			**0.00**	0.0000
17.22	5.25	6.46	0.15	2.37	0.62	130	1.097	1.097	0.964	2.86	0.98	0.96	4.89	0.60	2.48	3.08		5.89	3.25		0			1.00		1.00		0.698	**Non-Liq.**	2.6	2.2			**0.00**	0.0000
17.72	5.40	6.68	0.26	3.88	0.64	130	1.129	1.129	0.962	4.67	1.00	0.94	4.92	0.61	4.48	5.09		5.92	3.36		0			1.00		1.00		0.702	**Non-Liq.**	2.4	2.4			**0.00**	0.0000
18.21	5.55	6.40	0.29	4.57	0.61	130	1.161	1.161	0.961	5.59	1.00	0.91	4.51	0.57	5.41	5.98		5.51	3.44		0			1.00		1.00		0.706	**Non-Liq.**	2.3	2.4			**0.00**	0.0000
18.70	5.70	8.05	0.28	3.45	0.77	130	1.193	1.193	0.960	4.05	0.98	0.89	5.76	0.71	3.92	4.63		6.76	3.27		0			1.00		1.00		0.710	**Non-Liq.**	2.6	2.6			**0.00**	0.0000
19.19	5.85	9.29	0.25	2.64	0.89	130	1.225	1.225	0.959	3.05	0.95	0.87	6.63	0.80	2.86	3.66		7.64	3.15		0			1.00		1.00		0.713	**Non-Liq.**	2.8	2.7			**0.00**	0.0000
19.69	6.00	6.73	0.19	2.86	0.64	130	1.257	1.257	0.958	3.51	1.00	0.84	4.35	0.56	3.14	3.70		5.35	3.34		0			1.00		1.00		0.716	**Non-Liq.**	2.5	2.2			**0.00**	0.0000
20.18	6.15	11.60	0.28	2.43	1.11	130	1.289	1.289	0.956	2.73	0.91	0.83	8.13	0.98	2.57	3.55		9.15	3.05		0			1.00		1.00		0.719	**Non-Liq.**	3.0	3.0			**0.00**	0.0000
20.67	6.30	22.06	0.40	1.80	2.11	130	1.321	1.308	0.955	1.91	0.81	0.84	16.50	1.88	1.74	3.62		17.54	2.71		0			1.00		1.00		0.722	**Non-Liq.**	3.7	4.7			**0.00**	0.0000
21.16	6.45	60.15	0.42	0.71	5.76	130	1.353	1.325	0.954	0.72	0.63	0.87	48.25	7.20	0.27	7.48		69.40	2.09		0			1.41		1.00		0.725	**Non-Liq.**	4.9	14.1			**0.00**	0.0000
21.65	6.60	32.54	0.46	1.41	3.12	130	1.385	1.341	0.952	1.47	0.75	0.84	24.67	3.89	1.22	5.11		36.20	2.50		0			1.41		1.00		0.727	**Non-Liq.**	4.1	8.8			**0.00**	0.0000
22.15	6.75	15.22	0.38	2.46	1.46	130	1.417	1.358	0.951	2.71	0.88	0.80	10.51	1.26	2.63	3.89		11.54	2.95		0			1.00		1.00		0.729	**Non-Liq.**	3.2	3.6			**0.00**	0.0000
22.64	6.90	13.14	0.31	2.34	1.26	130	1.449	1.375	0.950	2.61	0.90	0.79	8.78	1.07	2.46	3.53		9.81	3.01		0			1.00		1.00		0.731	**Non-Liq.**	3.1	3.2			**0.00**	0.0000
23.13	7.05	8.87	0.29	3.32	0.85	130	1.481	1.391	0.948	3.93	0.98	0.76	5.41	0.70	3.78	4.48		6.41	3.28		0			1.00		1.00		0.733	**Non-Liq.**	2.6	2.5			**0.00**	0.0000
23.62	7.20	24.01	0.33	1.36	2.30	130	1.513	1.408	0.946	1.44	0.79	0.80	17.06	1.96	1.15	3.11		18.12	2.63		0			1.00		1.00		0.735	**Non-Liq.**	3.9	4.7			**0.00**	0.0000
24.11	7.35	16.30	0.42	2.55	1.56	130	1.545	1.425	0.945	2.80	0.88	0.77	10.82	1.32	2.76	4.08		11.86	2.95		0			1.00		1.00		0.737	**Non-Liq.**	3.2	3.7			**0.00**	0.0000
24.61	7.50	9.07	0.28	3.09	0.87	130	1.577	1.441	0.943	3.67	0.97	0.74	5.34	0.70	3.48	4.19		6.34	3.27		0			1.00		1.00		0.738	**Non-Liq.**	2.6	2.4			**0.00**	0.0000
25.10	7.65	11.60	0.13	1.14	1.11	130	1.609	1.458	0.941	1.31	0.87	0.76	7.24	0.88	0.87	1.74		8.29	2.93		0			1.00		1.00		0.740	**Non-Liq.**	3.3	2.5			**0.00**	0.0000

Depth (feet)	(m)	Tip Qc (tsf)	Friction Fs (tsf)	Friction Ratio Rf %	qc MPa	Total Unit Wt. (pcf)	Total Stress po (tsf)	Eff. Stress p'o (tsf)	rd	F %	n	Max 1.70 Cq	Q	Moss qc1 MPa	Moss Δqc MPa	Moss qc_{1mod} MPa	Moss eff K_C	Qc1n	Ic	Overide	Liquef. Suscept. (0 or 1)	Rel. Dens. Dr (%)	K_C	K_H	Clean Sand Qc1n	1.0 Kσ	CRR	Induced M=7.5 CSR	Liquefac. Safety Factor	Qc1n $N_{1(60)}$ Ratio	Equiv. $N_{1(60)}$	FC Adj. $\Delta N_{1(60)}$	Equiv. $N_{1(60)cs}$	*Volumetric Strain (%)*	Induced Subsidenc (inches)
25.59	7.80	7.70	0.16	2.02	0.74	130	1.641	1.474	0.940	2.49	0.97	0.72	4.26	0.57	2.04	2.61		5.27	3.27		0			1.00		1.00		0.741	**Non-Liq.**	2.6	2.0			**0.00**	0.0000
26.08	7.95	8.04	0.19	2.35	0.77	130	1.673	1.491	0.938	2.89	0.98	0.72	4.43	0.59	2.49	3.08		5.44	3.29		0			1.00		1.00		0.742	**Non-Liq.**	2.6	2.1			**0.00**	0.0000
26.57	8.10	7.44	0.22	2.92	0.71	130	1.705	1.508	0.936	3.66	1.00	0.70	3.93	0.54	3.25	3.80		4.93	3.38		0			1.00		1.00		0.743	**Non-Liq.**	2.4	2.1			**0.00**	0.0000
27.07	8.25	10.87	0.26	2.44	1.04	130	1.737	1.524	0.934	2.83	0.94	0.71	6.28	0.82	2.61	3.43		7.30	3.15		0			1.00		0.99		0.744	**Non-Liq.**	2.8	2.6			**0.00**	0.0000
27.56	8.40	12.99	0.27	2.04	1.24	130	1.769	1.541	0.932	2.32	0.90	0.71	7.71	0.98	2.08	3.06		8.75	3.03		0			1.00		0.99		0.744	**Non-Liq.**	3.1	2.9			**0.00**	0.0000
28.05	8.55	15.59	0.33	2.09	1.49	130	1.801	1.558	0.930	2.32	0.88	0.71	9.44	1.19	2.15	3.33		10.49	2.96		0			1.00		0.99		0.745	**Non-Liq.**	3.2	3.3			**0.00**	0.0000
28.54	8.70	25.48	0.78	3.05	2.44	130	1.833	1.574	0.928	3.25	0.85	0.71	16.13	2.04	3.44	5.48		17.19	2.85		0			1.00		0.99		0.745	**Non-Liq.**	3.4	5.0			**0.00**	0.0000
29.04	8.85	78.64	1.44	1.83	7.53	130	1.865	1.591	0.925	1.86	0.69	0.76	55.06	6.97	1.79	8.76		60.21	2.28		0			1.07		0.98		0.745	**Non-Liq.**	4.5	13.3			**0.00**	0.0000
29.53	9.00	118.93	1.36	1.14	11.39	130	1.897	1.608	0.923	1.16	0.60	0.78	86.13	10.42	0.87	11.29	1.08	93.54	2.00		1	74	1.30	1.07	121.7	0.96	0.248	0.745	**0.32**	5.1	18.4	5.5	23.9	**1.26**	0.0745
30.02	9.15	118.44	1.29	1.09	11.34	130	1.929	1.624	0.920	1.11	0.60	0.77	85.34	10.31	0.80	11.11	1.08	92.70	1.99		1	74	1.29	1.07	119.5	0.95	0.239	0.745	**0.31**	5.1	18.2	5.5	23.7	**1.28**	0.0753
30.51	9.30	88.86	2.02	2.27	8.51	130	1.961	1.641	0.918	2.31	0.69	0.74	60.79	7.92	2.39	10.31	1.30	66.35	2.31		1	60	1.99	1.07	132.3	0.96	0.295	0.745	**0.38**	4.5	14.8	5.5	20.3	**1.50**	0.0886
31.00	9.45	108.83	2.17	1.99	10.42	130	1.993	1.657	0.915	2.02	0.66	0.74	75.22	9.68	2.01	11.69		81.83	2.21		0			1.07		0.97		0.745	**Non-Liq.**	4.7	17.5			**0.00**	0.0000
31.50	9.60	37.88	1.52	4.02	3.63	130	2.025	1.674	0.913	4.21	0.83	0.68	23.36	3.08	4.75	7.83		24.44	2.80		0			1.00		0.97		0.745	**Non-Liq.**	3.5	6.9			**0.00**	0.0000
31.99	9.75	61.22	1.00	1.64	5.86	130	2.057	1.691	0.910	1.69	0.71	0.72	40.42	5.61	1.54	7.14		47.91	2.36		0			1.15		0.97		0.744	**Non-Liq.**	4.4	10.9			**0.00**	0.0000
32.48	9.90	35.95	0.91	2.52	3.44	130	2.089	1.707	0.907	2.64	0.80	0.68	22.08	2.82	2.72	5.54		23.18	2.69		0			1.00		0.96		0.743	**Non-Liq.**	3.7	6.2			**0.00**	0.0000
32.97	10.05	25.90	1.11	4.27	2.48	130	2.121	1.724	0.904	4.58	0.88	0.65	14.87	2.03	5.08	7.11		15.93	2.97		0			1.00		0.96		0.742	**Non-Liq.**	3.2	5.0			**0.00**	0.0000
33.46	10.20	137.12	1.76	1.28	13.13	130	2.153	1.741	0.901	1.30	0.60	0.74	94.73	11.08	1.06	12.14		96.31	2.00		0			1.00		0.96		0.741	**Non-Liq.**	5.1	19.0			**0.00**	0.0000
33.96	10.35	256.82	2.29	0.89	24.59	130	2.185	1.757	0.898	0.90	0.51	0.77	186.00	20.63	0.53	21.16	1.03	187.28	1.68		1	100	1.02	1.00	191.7	0.92	Infin.	0.740	**Non-Liq.**	5.7	32.8	5.5	38.3	**0.00**	0.0000
34.45	10.50	332.83	2.23	0.67	31.87	130	2.217	1.774	0.894	0.67	0.50	0.77	241.66	26.36	0.23	26.59	1.01	242.95	1.51		1	100	1.00	1.00	243.0	0.91	Infin.	0.739	**Non-Liq.**	6.0	40.2	8.4	48.6	**0.00**	0.0000
34.94	10.65	358.10	1.95	0.54	34.29	130	2.249	1.791	0.891	0.55	0.50	0.77	258.87	27.88	0.06	27.94	1.00	260.18	1.43		1	100	1.00	1.00	260.2	0.91	Infin.	0.738	**Non-Liq.**	6.2	41.9	10.0	51.9	**0.00**	0.0000
35.43	10.80	324.53	1.71	0.53	31.08	130	2.281	1.807	0.888	0.53	0.50	0.77	233.39	25.01	0.04	25.05	1.00	234.70	1.45		1	100	1.00	1.00	234.7	0.90	Infin.	0.736	**Non-Liq.**	6.2	38.1	8.8	46.9	**0.00**	0.0000
35.93	10.95	302.72	1.61	0.53	28.99	130	2.313	1.824	0.884	0.54	0.50	0.76	216.61	23.19	0.04	23.24	1.00	217.92	1.48		1	100	1.00	1.00	217.9	0.90	Infin.	0.735	**Non-Liq.**	6.1	35.7	7.9	43.6	**0.00**	0.0000
36.42	11.10	316.35	1.53	0.48	30.29	130	2.345	1.840	0.880	0.49	0.50	0.76	225.39	23.98	0.00	23.98	1.00	226.71	1.44		1	100	1.00	1.00	226.7	0.89	Infin.	0.733	**Non-Liq.**	6.2	36.7	8.7	45.3	**0.00**	0.0000
36.91	11.25	356.98	1.64	0.46	34.18	130	2.377	1.857	0.877	0.46	0.50	0.75	253.35	26.97	0.00	26.97	1.00	254.68	1.38		1	100	1.00	1.00	254.7	0.89	Infin.	0.731	**Non-Liq.**	6.3	40.5	10.0	50.5	**0.00**	0.0000
37.40	11.40	349.54	1.69	0.48	33.47	130	2.409	1.874	0.873	0.48	0.50	0.75	246.93	26.42	0.00	26.42	1.00	248.26	1.41		1	100	1.00	1.00	248.3	0.88	Infin.	0.729	**Non-Liq.**	6.2	39.8	9.9	49.7	**0.00**	0.0000
37.89	11.55	352.95	1.68	0.47	33.80	130	2.441	1.890	0.869	0.48	0.50	0.75	248.24	26.55	0.00	26.55	1.00	249.57	1.40		1	100	1.00	1.00	249.6	0.88	Infin.	0.727	**Non-Liq.**	6.3	39.9	10.0	49.9	**0.00**	0.0000
38.39	11.70	404.24	2.40	0.59	38.71	130	2.473	1.907	0.865	0.60	0.50	0.74	283.25	31.11	0.12	31.24	1.00	284.60	1.42		1	100	1.00	1.00	284.6	0.88	Infin.	0.725	**Non-Liq.**	6.2	45.8	10.0	55.8	**0.00**	0.0000
38.88	11.85	456.43	3.01	0.66	43.71	130	2.505	1.924	0.861	0.66	0.50	0.74	318.60	35.52	0.21	35.73	1.01	319.94	1.42		1	100	1.00	1.00	319.9	0.87	Infin.	0.723	**Non-Liq.**	6.2	51.5	10.0	61.5	**0.00**	0.0000
39.37	12.00	497.95	3.43	0.69	47.68	130	2.537	1.940	0.857	0.69	0.50	0.74	346.19	38.91	0.25	39.16	1.01	347.55	1.41		1	100	1.00	1.00	347.5	0.87	Infin.	0.720	**Non-Liq.**	6.2	55.7	10.0	65.7	**0.00**	0.0000
39.86	12.15	394.32	3.43	0.87	37.76	130	2.569	1.957	0.852	0.87	0.50	0.74	272.69	31.02	0.49	31.51	1.02	274.05	1.56		1	100	1.00	1.00	274.0	0.87	Infin.	0.718	**Non-Liq.**	6.0	46.0	8.8	54.8	**0.00**	0.0000
40.35	12.30	367.90	2.73	0.74	35.23	130	2.601	1.974	0.848	0.75	0.50	0.73	253.24	28.40	0.32	28.72	1.01	254.61	1.53		1	100	1.00	1.00	254.6	0.86	Infin.	0.715	**Non-Liq.**	6.0	42.4	8.5	50.9	**0.00**	0.0000
40.85	12.45	370.18	2.18	0.59	35.45	130	2.633	1.990	0.843	0.59	0.50	0.73	253.74	27.91	0.12	28.03	1.00	255.11	1.46		1	100	1.00	1.00	255.1	0.86	Infin.	0.713	**Non-Liq.**	6.1	41.5	9.5	51.0	**0.00**	0.0000
41.34	12.60	337.72	1.57	0.47	32.34	130	2.665	2.007	0.839	0.47	0.50	0.73	230.39	24.67	0.00	24.67	1.00	231.77	1.42		1	100	1.00	1.00	231.8	0.85	Infin.	0.710	**Non-Liq.**	6.2	37.3	9.1	46.4	**0.00**	0.0000
41.83	12.75	289.05	1.07	0.37	27.68	130	2.697	2.023	0.834	0.37	0.50	0.72	196.17	20.34	0.00	20.34	1.00	197.56	1.42		1	100	1.00	1.00	197.6	0.85	Infin.	0.707	**Non-Liq.**	6.2	31.8	7.7	39.5	**0.00**	0.0000
42.32	12.90	267.61	1.01	0.38	25.63	130	2.729	2.040	0.830	0.38	0.50	0.72	180.76	18.72	0.00	18.72	1.00	182.15	1.45		1	100	1.00	1.00	182.2	0.85	Infin.	0.704	**Non-Liq.**	6.2	29.6	6.8	36.4	**0.00**	0.0000
42.81	13.05	270.45	1.41	0.52	25.90	130	2.761	2.057	0.825	0.53	0.50	0.72	181.95	19.57	0.03	19.59	1.00	183.34	1.53		1	100	1.00	1.00	183.3	0.84	Infin.	0.701	**Non-Liq.**	6.0	30.6	6.1	36.7	**0.00**	0.0000
43.31	13.20	222.06	1.77	0.80	21.26	130	2.793	2.073	0.820	0.80	0.52	0.70	146.22	16.54	0.39	16.93	1.02	147.60	1.72		1	93	1.05	1.00	155.5	0.84	0.429	0.698	**0.52**	5.6	26.2	4.8	31.1	**0.67**	0.0396
43.80	13.35	119.98	2.28	1.90	11.49	130	2.825	2.090	0.816	1.93	0.66	0.64	71.05	9.28	1.85	11.13	1.20	72.31	2.21		1	63	1.69	1.00	122.5	0.87	0.251	0.695	**0.32**	4.7	15.5	5.5	21.0	**1.45**	0.0855
44.29	13.50	282.90	2.78	0.98	27.09	130	2.857	2.107	0.811	0.99	0.52	0.70	185.59	21.63	0.63	22.26	1.03	186.98	1.71		1	100	1.04	1.00	195.2	0.83	Infin.	0.691	**Non-Liq.**	5.7	33.1	6.0	39.0	**0.00**	0.0000
44.78	13.65	331.58	2.89	0.87	31.75	130	2.889	2.123	0.806	0.88	0.50	0.71	219.82	25.21	0.49	25.70	1.02	221.23	1.62		1	100	1.00	1.00	221.2	0.83	Infin.	0.688	**Non-Liq.**	5.8	38.0	6.3	44.2	**0.00**	0.0000
45.28	13.80	336.31	3.06	0.91	32.21	130	2.921	2.140	0.801	0.92	0.50	0.70	222.09	25.62	0.54	26.16	1.02	223.51	1.63		1	100	1.00	1.00	223.5	0.83	Infin.	0.685	**Non-Liq.**	5.8	38.5	6.2	44.7	**0.00**	0.0000
45.77	13.95	320.46	3.18	0.99	30.69	130	2.953	2.156	0.796	1.00	0.51	0.70	209.20	24.49	0.65	25.14	1.03	210.62	1.68		1	100	1.02	1.00	215.2	0.82	Infin.	0.681	**Non-Liq.**	5.7	36.8	6.2	43.0	**0.00**	0.0000
46.26	14.10	382.09	2.72	0.71	36.59	130	2.985	2.173	0.791	0.72	0.50	0.70	250.56	28.47	0.28	28.74	1.01	251.99	1.52		1	100	1.00	1.00	252.0	0.82	Infin.	0.678	**Non-Liq.**	6.0	41.8	8.6	50.4	**0.00**	0.0000
46.75	14.25	394.76	2.01	0.51	37.80	130	3.017	2.190	0.786	0.51	0.50	0.70	257.91	28.34	0.01	28.35	1.00	259.35	1.41		1	100	1.00	1.00	259.4	0.82	Infin.	0.674	**Non-Liq.**	6.2	41.6	10.0	51.6	**0.00**	0.0000
47.24	14.40	405.81	1.87	0.46	38.86	130	3.049	2.206	0.781	0.46	0.50	0.69	264.17	28.74	0.00	28.74	1.00	265.61	1.37		1	100	1.00	1.00	265.6	0.81	Infin.	0.671	**Non-Liq.**	6.3	42.1	10.0	52.1	**0.00**	0.0000
47.74	14.55	412.80	1.71	0.41	39.53	130	3.081	2.223	0.776	0.42	0.50	0.69	267.72	28.79	0.00	28.79	1.00	269.17	1.34		1	100	1.00	1.00	269.2	0.81	Infin.	0.667	**Non-Liq.**	6.4	42.2	10.0	52.2	**0.00**	0.0000
48.23	14.70	368.76	1.36	0.37	35.31	130	3.113	2.240	0.771	0.37	0.50	0.69	238.11	25.08	0.00	25.08	1.00	239.56	1.35		1	100	1.00	1.00	239.6	0.81	Infin.	0.663	**Non-Liq.**	6.4	37.7	10.0	47.7	**0.00**	0.0000
48.72	14.85	232.55	1.33	0.57	22.27	130	3.145	2.256	0.766	0.58	0.50	0.68	149.05	16.21	0.09	16.30		150.51	1.63		0			1.00		0.90		0.660	**Non-Liq.**	5.8	25.9			**0.00**	0.0000
49.21	15.00	70.01	1.86	2.66	6.70	130	3.177	2.273	0.761	2.75	0.75	0.56	36.11	5.22	2.81	8.03		37.32	2.53		0			1.00		0.90		0.656	**Non-Liq.**	4.0	9.2			**0.00**	0.0000
49.70	15.15	62.16	2.14	3.44	5.95	130	3.209	2.290	0.756	3.57	0.78	0.55	30.89	4.67	3.82	8.49		32.07	2.66		0			1.00		0.89		0.652	**Non-Liq.**	3.8	8.4			**0.00**	0.0000
50.20	15.30	219.30	2.37	1.08	21.00	130	3.241	2.306	0.751	1.09	0.56	0.65	132.93	17.35	0.75	18.10		143.93	1.84		0			1.07		0.89		0.649	**Non-Liq.**	5.4	26.7			**0.00**	0.0000
50.69	15.45	296.50	2.76	0.93	28.39	130	3.273	2.323	0.746	0.94	0.51	0.67	185.50	23.46	0.56	24.01	1.02	200.30	1.69		1	100	1.03	1.07	206.9	0.79	Infin.	0.645	**Non-Liq.**	5.7	35.2	6.1	41.4	**0.00**	0.0000
51.18	15.60	303.00	2.73	0.90	29.02	130	3.305	2.339	0.741	0.91	0.51	0.67	189.57	23.87	0.52	24.38	1.02	204.68	1.68		1	100	1.02	1.07	209.1	0.79	Infin.	0.641	**Non-Liq.**	5.7	35.8	6.0	41.8	**0.00**	0.0000
51.67	15.75	253.49	2.01	0.79	24.27	130	3.337	2.356	0.736	0.80	0.52	0.66	156.98	19.44	0.38	19.82	1.02	169.76	1.70		1	99	1.04	1.07	176.1	0.79	Infin.	0.638	**Non-Liq.**	5.7	29.9	5.3	35.2	**0.00**	0.0000
52.17	15.90	117.38	1.40	1.19	11.24	130	3.369	2.373	0.731	1.22	0.63	0.60	65.37	8.91	0.89	9.81		71.48	2.11		0			1.07		0.89		0.634	**Non-Liq.**	4.9	14.7			**0.00**	0.0000
52.66	16.05	25.90	1.16	4.47	2.48	130	3.401	2.389	0.726	4.93	0.91	0.48	10.63	1.78	5.10	6.89		11.71	3.10		0			1.00		0.88		0.630	**Non-Liq.**	2.9	4.0			**0.00**	0.0000
53.15	16.20	17.34	0.58	3.37	1.66	130	3.433	2.406	0.721	3.91	0.93	0.46	6.55	1.09	3.68	4.77		7.61	3.21		0			1.00		0.88		0.627	**Non-Liq.**	2.7	2.8			**0.00**	0.0000
53.64	16.35	30.63	0.49	1.61	2.93	130	3.465	2.423	0.716	1.75	0.81	0.51	13.67	1.94	1.42	3.37		14.84	2.75		0			1.00		0.88		0.623	**Non-Liq.**	3.6	4.1			**0.00**	0.0000
54.13	16.50	98.03	0.76	0.77	9.39	130	3.497	2.439	0.712	0.79	0.62	0.60	53.96	10.16	0.35	10.51		87.41	2.07		0			1.58		0.88		0.619	**Non-Liq.**	5.0	17.6			**0.00**	0.0000
54.63	16.65	36.11	1.15	3.19	3.46	130	3.529	2.456	0.707	3.42	0.84	0.49	15.67	2.49	3.43	5.92		16.82	2.87		0			1.00		0.88		0.616	**Non-Liq.**	3.4	5.0			**0.00**	0.0000
55.12	16.80	23.59	1.24	5.26	2.26	130	3.561	2.473	0.702	5.87	0.93	0.45	9.05	1.60	5.73	7.33		10.10	3.21		0			1.00		0.88		0.612	**Non-Liq.**	2.7	3.7			**0.00**	0.0000
55.61	16.95	33.73	1.33	3.95	3.23	130	3.593	2.489	0.698	4.26	0.87	0.48	14.06	2.34	4.38	6.72		15.18	2.97		0			1.00		0.88		0.609	**Non-Liq.**	3.2	4.8			**0.00**	0.0000
56.10	17.10	49.28	1.67	3.39	4.72	130	3.625	2.506	0.693	3.58	0.81	0.50	21.94	3.52	3.67	7.19		23.12	2.77		0			1.00		0.87		0.605	**Non-Liq.**	3.6	6.5			**0.00**	0.0000
56.59	17.25	36.80	1.53	4.17	3.52	130	3.656	2.522	0.689	4.47	0.86	0.47	15.31	2.58	4.65	7.23		16.44	2.95		0			1.00		0.87		0.602	**Non-Liq.**	3.2	5.1			**0.00**	0.0000
57.09	17.40	57.10	1.66	2.91	5.47	130	3.688	2.539	0.684	3.04	0.78	0.50	25.95	4.06	3.05	7.11		27.16	2.67		0			1.00		0.87		0.598	**Non-Liq.**	3.8	7.2			**0.00**	0.0000
57.58	17.55	77.08	1.99	2.58	7.38	130	3.720	2.556	0.680	2.67	0.74	0.52	36.58	5.56	2.63	8.19		37.84	2.52		0			1.00		0.87		0.595	**Non-Liq.**	4.1	9.3			**0.00**	0.0000

Depth (feet)	(m)	Tip Qc (tsf)	Friction Fs (tsf)	Friction Ratio Rf %	qc MPa	Total Unit Wt. (pcf)	Total Stress po (tsf)	Eff. Stress p'o (tsf)	rd	F %	n	Max 1.70 Cq	Q	Moss qc1 MPa	Moss Δqc MPa	Moss qc_{1mod} MPa	Moss eff K_C	Qc1n	Ic	Overide	Liquef. Suscept. (0 or 1)	Rel. Dens. Dr (%)	K_C	K_H	Clean Sand Qc1n	1.0 Kσ	CRR	Induced M=7.5 CSR	**Liquefac. Safety Factor**	Qc1n $N_{1(60)}$ Ratio	Equiv. $N_{1(60)}$	FC Adj. $\Delta N_{1(60)}$	Equiv. $N_{1(60)cs}$	***Volumetric Strain (%)***	Induced Subsidenc (inches)
58.07	17.70	193.16	2.00	1.04	18.50	130	3.752	2.572	0.675	1.05	0.57	0.60	108.47	15.65	0.68	16.32		126.71	1.90		0			1.15		0.87		0.592	**Non-Liq.**	5.3	24.0			**0.00**	0.0000
58.56	17.85	307.64	1.83	0.59	29.46	130	3.784	2.589	0.671	0.60	0.50	0.64	184.32	23.93	0.12	24.05	1.00	214.25	1.56		1	100	1.00	1.15	214.3	0.75	Infin.	0.588	**Non-Liq.**	5.9	36.1	6.8	42.9	**0.00**	0.0000
59.06	18.00	250.49	1.34	0.54	23.99	130	3.816	2.606	0.667	0.54	0.50	0.64	149.30	18.88	0.05	18.92	1.00	173.89	1.61		1	100	1.00	1.15	173.9	0.75	Infin.	0.585	**Non-Liq.**	5.8	29.7	5.0	34.8	**0.00**	0.0000
59.55	18.15	91.78	1.49	1.62	8.79	130	3.848	2.622	0.663	1.67	0.69	0.54	45.20	7.33	1.41	8.74		53.63	2.32		0			1.15		0.86		0.582	**Non-Liq.**	4.5	12.0			**0.00**	0.0000
60.04	18.30	30.76	1.43	4.64	2.95	130	3.880	2.639	0.659	5.08	0.90	0.44	11.73	2.09	5.18	7.28		12.83	3.08		0			1.00		0.86		0.579	**Non-Liq.**	3.0	4.3			**0.00**	0.0000
60.53	18.45	28.84	0.85	2.94	2.76	130	3.912	2.655	0.655	3.24	0.87	0.45	11.16	1.86	3.05	4.91		12.29	2.98		0			1.00		0.86		0.576	**Non-Liq.**	3.2	3.9			**0.00**	0.0000
61.02	18.60	68.06	1.12	1.65	6.52	130	3.944	2.672	0.651	1.72	0.72	0.51	31.68	7.20	1.43	8.63		52.10	2.45		0			1.58		0.86		0.573	**Non-Liq.**	4.2	12.4			**0.00**	0.0000
61.52	18.75	43.67	1.31	2.99	4.18	130	3.976	2.689	0.647	3.18	0.82	0.47	18.04	2.96	3.10	6.06		19.22	2.81		0			1.00		0.86		0.570	**Non-Liq.**	3.5	5.5			**0.00**	0.0000
62.01	18.90	61.19	1.47	2.40	5.86	130	4.008	2.705	0.643	2.51	0.76	0.49	26.97	4.20	2.37	6.57		28.22	2.60		0			1.00		0.86		0.567	**Non-Liq.**	3.9	7.2			**0.00**	0.0000
62.50	19.05	52.15	2.07	3.97	4.99	130	4.040	2.722	0.640	4.19	0.83	0.46	21.42	3.70	4.32	8.01		22.60	2.82		0			1.00		0.86		0.564	**Non-Liq.**	3.5	6.5			**0.00**	0.0000
62.99	19.20	53.44	2.31	4.32	5.12	130	4.072	2.739	0.636	4.55	0.83	0.45	21.76	3.82	4.73	8.55		22.93	2.84		0			1.00		0.86		0.561	**Non-Liq.**	3.4	6.7			**0.00**	0.0000
63.48	19.35	30.98	1.62	5.24	2.97	130	4.104	2.755	0.633	5.75	0.91	0.42	11.19	2.10	5.57	7.68		12.29	3.13		0			1.00		0.85		0.558	**Non-Liq.**	2.9	4.3			**0.00**	0.0000
63.98	19.50	38.81	1.07	2.76	3.72	130	4.136	2.772	0.629	2.98	0.83	0.45	15.34	2.54	2.80	5.34		16.52	2.84		0			1.00		0.85		0.555	**Non-Liq.**	3.4	4.8			**0.00**	0.0000
64.47	19.65	41.62	1.30	3.13	3.99	130	4.168	2.789	0.626	3.36	0.83	0.45	16.40	2.78	3.25	6.03		17.58	2.85		0			1.00		0.85		0.553	**Non-Liq.**	3.4	5.1			**0.00**	0.0000
64.96	19.80	23.40	1.23	5.27	2.24	130	4.200	2.805	0.622	5.98	0.94	0.40	7.76	1.51	5.55	7.06		8.82	3.26		0			1.00		0.85		0.550	**Non-Liq.**	2.6	3.4			**0.00**	0.0000
65.45	19.95	93.03	1.15	1.23	8.91	130	4.232	2.822	0.619	1.27	0.67	0.52	44.32	8.55	0.90	9.45		64.31	2.25		0			1.41		0.85		0.548	**Non-Liq.**	4.6	14.0			**0.00**	0.0000
65.94	20.10	28.81	1.46	5.07	2.76	130	4.264	2.838	0.616	5.63	0.92	0.41	9.95	1.91	5.53	7.44		11.03	3.16		0			1.00		0.85		0.545	**Non-Liq.**	2.8	3.9			**0.00**	0.0000
66.44	20.25	19.06	1.20	6.32	1.82	130	4.296	2.855	0.613	7.43	0.99	0.38	5.75	1.20	5.52	6.72		6.77	3.42		0			1.00		0.85		0.543	**Non-Liq.**	2.3	2.9			**0.00**	0.0000
66.93	20.40	26.08	1.03	3.94	2.50	130	4.328	2.872	0.610	4.43	0.91	0.40	8.86	1.65	4.21	5.86		9.96	3.14		0			1.00		0.85		0.540	**Non-Liq.**	2.9	3.5			**0.00**	0.0000
67.42	20.55	115.64	1.93	1.67	11.07	130	4.360	2.888	0.607	1.71	0.67	0.51	54.37	11.16	1.43	12.59		78.45	2.26		0			1.41		0.85		0.538	**Non-Liq.**	4.6	17.2			**0.00**	0.0000
67.91	20.70	108.60	2.63	2.42	10.40	130	4.392	2.905	0.604	2.49	0.71	0.49	48.80	10.84	2.35	13.19		70.54	2.40		0			1.41		0.84		0.535	**Non-Liq.**	4.3	16.4			**0.00**	0.0000
68.41	20.85	31.15	2.27	7.27	2.98	130	4.424	2.922	0.601	8.03	0.94	0.39	10.27	2.14	5.49	7.63		11.34	3.25		0			1.00		0.84		0.533	**Non-Liq.**	2.6	4.3			**0.00**	0.0000
68.90	21.00	171.67	2.19	1.27	16.44	130	4.456	2.938	0.598	1.30	0.61	0.54	85.75	16.48	0.94	17.43		122.73	2.03		0			1.41		0.84		0.531	**Non-Liq.**	5.0	24.5			**0.00**	0.0000
69.39	21.15	190.31	2.71	1.43	18.22	130	4.488	2.955	0.595	1.45	0.61	0.54	94.87	18.65	1.13	19.77		135.58	2.03		0			1.41		0.84		0.529	**Non-Liq.**	5.0	27.0			**0.00**	0.0000
69.88	21.30	61.70	2.95	4.78	5.91	130	4.520	2.972	0.593	5.02	0.83	0.42	23.58	4.41	5.20	9.61		24.77	2.84		0			1.00		0.84		0.527	**Non-Liq.**	3.4	7.2			**0.00**	0.0000
70.37	21.45	180.36	2.74	1.52	17.27	130	4.552	2.988	0.590	1.55	0.62	0.53	88.15	17.67	1.24	18.91		126.10	2.08		0			1.41		0.84		0.525	**Non-Liq.**	4.9	25.6			**0.00**	0.0000
70.87	21.60	123.99	2.63	2.12	11.87	130	4.584	3.005	0.587	2.17	0.69	0.49	55.87	12.22	1.97	14.19		80.55	2.32		0			1.41		0.84		0.523	**Non-Liq.**	4.5	18.1			**0.00**	0.0000
71.36	21.75	61.27	2.43	3.96	5.87	130	4.616	3.021	0.585	4.17	0.81	0.43	23.44	4.28	4.19	8.47		24.65	2.79		0			1.00		0.84		0.521	**Non-Liq.**	3.5	7.0			**0.00**	0.0000
71.85	21.90	27.71	1.56	5.62	2.65	130	4.648	3.038	0.582	6.31	0.93	0.37	8.71	1.80	5.45	7.24		9.79	3.24		0			1.00		0.84		0.519	**Non-Liq.**	2.7	3.7			**0.00**	0.0000
72.34	22.05	29.55	1.21	4.09	2.83	130	4.680	3.055	0.580	4.56	0.90	0.39	9.65	1.87	4.34	6.21		10.76	3.12		0			1.00		0.83		0.517	**Non-Liq.**	2.9	3.7			**0.00**	0.0000
72.83	22.20	74.52	2.08	2.79	7.14	130	4.712	3.071	0.578	2.91	0.76	0.44	29.93	5.09	2.77	7.86		31.22	2.61		0			1.00		0.83		0.515	**Non-Liq.**	3.9	8.0			**0.00**	0.0000
73.33	22.35	91.87	2.62	2.85	8.80	130	4.744	3.088	0.575	2.95	0.74	0.45	37.83	6.42	2.83	9.25		39.14	2.54		0			1.00		0.83		0.513	**Non-Liq.**	4.0	9.7			**0.00**	0.0000
73.82	22.50	75.25	2.71	3.60	7.21	130	4.776	3.105	0.573	3.76	0.79	0.43	29.27	5.27	3.74	9.02		30.53	2.69		0			1.00		0.83		0.511	**Non-Liq.**	3.7	8.2			**0.00**	0.0000
74.31	22.65	175.16	2.94	1.68	16.77	130	4.808	3.121	0.571	1.71	0.63	0.50	81.99	12.20	1.42	13.61		83.78	2.13		0			1.00		0.83		0.509	**Non-Liq.**	4.8	17.3			**0.00**	0.0000
74.80	22.80	175.93	2.64	1.50	16.85	130	4.840	3.138	0.569	1.53	0.62	0.51	82.97	12.03	1.20	13.23	1.10	84.48	2.09		1	70	1.44	1.00	121.7	0.75	0.248	0.508	**0.37**	4.9	17.2	5.5	22.7	**1.31**	0.0771

EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Arctic Cold **Project No: 303415-002**

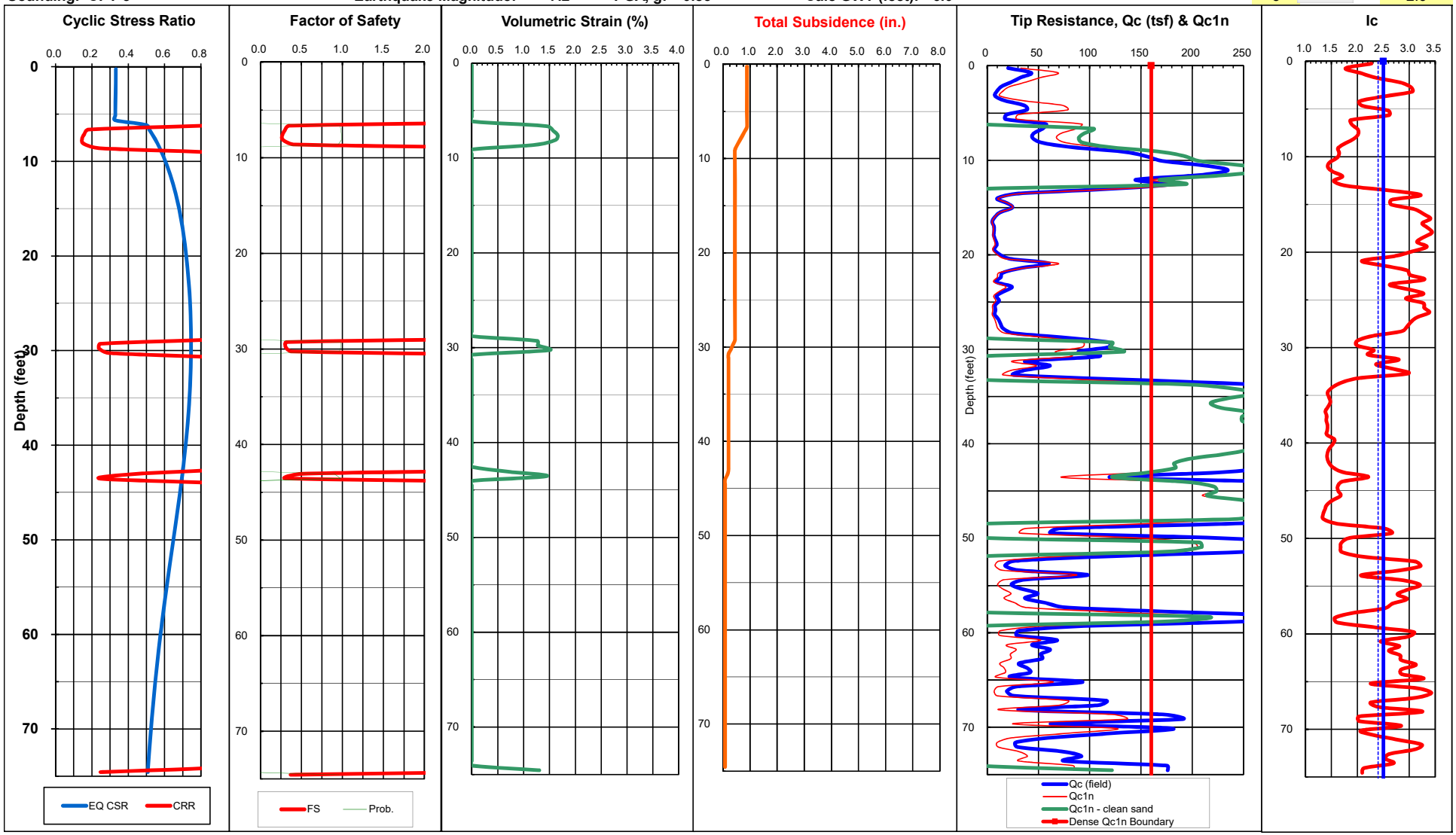
Method Used: 1 1998 NCEER (Robertson & Wride)

Settlement Analysis using Tokimatsu & Seed (1987), clean sand Qc1n/N1(60) ratio =5

Plot 5

Limiting Ic: 2.6

Sounding: CPT-5 **Earthquake Magnitude: 7.2** **PGA, g: 0.85** **Calc GWT (feet): 6.0**



Total Thickness of Liquefiable Layers: 5.4 feet **Estimated Total Ground Subsidence (Settlement): 0.9 inches**

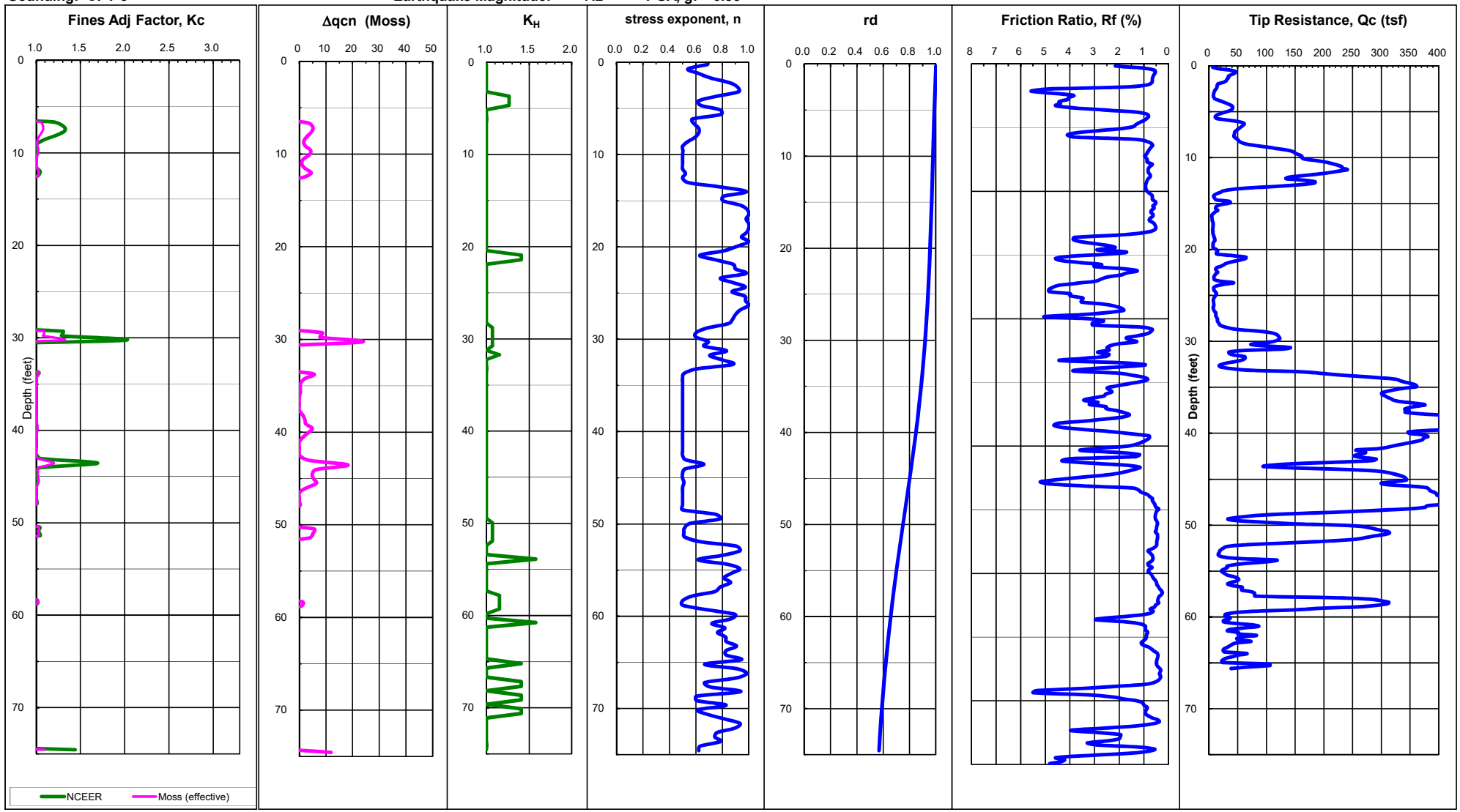
EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

3 avg increment =0.15m Qc1n/N1(60): 5

Ignore 1st/last increment into sand/silt soils: 0

Method Used: 1998 NCEER (Robertson & Wride)

Sounding: CPT-5 **Earthquake Magnitude: 7.2** **PGA, g: 0.85**



CPT-LIQUEFY.XLS - A SPREADSHEET FOR EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL USING CPT DATA
Developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Project: Arctic Cold
Job No: 303415-002
Date: 3/29/2020
Sounding: CPT-9

Liquefaction Analysis using 1998 NCEER (Robertson & Wride) method
Settlement Analysis using Tokimatsu & Seed (1987), clean sand Qc1n/N1(60) ratio =5

Plot: 9
Method Used: 1 1998 NCEER (Robertson & Wride)
Averaging Increment: 3 0.15 m
Ignore 1st/last increment into sand/silt soils: 1 yes
Use Moss @ P_L: 15%
Induced CSR (M=7.5) = 0.65*PGA*(po/p'o)*rd/MSF
Ignore/remediate upper: 1.5 m
Use Tokimatsu & Seed (0) or Ishihara &Yoshmine (1): 0
Clean Sand Qc1n = C_Q*K_C*K_H*Qc
Unit Weight of unsaturated soils: 115 pcf
Required SF: 1.50
Max $\Delta N_{1(60)}$ - post liquefied: 5.5
SF = $CRR_{7.5}$*Kσ/CSR
Unit Weight of saturated soils: 130 pcf
Min SF of Liquefiable Layers: 0.22
Max $\Delta N_{1(60)}$ - non liquefied: 10.0
Limiting Ic for liquefiable soils: 2.50
Limiting Ic for K_H: 2.5
Avg SF of Liquefiable Layers: 0.38
0.439

EARTHQUAKE INFORMATION:
Magnitude: 7.2 7.5
PGA, g: 0.85 0.77
MSF: 1.11
GWT, feet: 20.0
Calc GWT, feet: 6.0

Total Liquefied Thickness (feet)	Juang et al (2000) Probab - NCEER method
5.4	Mapping Coeff.
Total Induced Subsidence (inches)	A
1.0	B
0.9	3.3

Depth (feet)	(m)	Tip Qc (tsf)	Friction Fs (tsf)	Friction Ratio Rf %	qc MPa	Total Unit Wt. (pcf)	Total Stress po (tsf)	Eff. Stress p'o (tsf)	rd	F %	n	Max 1.70 Cq	Q	Moss qc1 MPa	Moss Δqc MPa	Moss qc_{1mod} MPa	Moss eff K_C	Qc1n	Ic	Overide	Liquef. Suscept. (0 or 1)	Rel. Dens. Dr (%)	K_C	K_H	Clean Sand Qc1n	1.0 Kσ	CRR	Induced M=7.5 CSR	**Liquefac. Safety Factor**	Qc1n $N_{1(60)}$ Ratio	Equiv. $N_{1(60)}$	FC Adj. $\Delta N_{1(60)}$	Equiv. $N_{1(60)cs}$	***Volumetric Strain (%)***	Induced Subsidenc (inches)
0.49	0.15	7.95	0.08	0.99	0.76	115	0.028	0.028	1.000	0.99	0.81	1.70	12.73	1.29	0.51	1.80		12.77	2.66		0			1.00		1.00		0.332	**Non-Liq.**	3.8	3.4			**0.00**	0.0000
0.98	0.30	29.59	0.07	0.23	2.83	115	0.057	0.057	1.000	0.23	0.57	1.70	47.45	5.55	0.00	5.55		54.80	1.88		0			1.15		1.00		0.332	**Non-Liq.**	5.3	10.3			**0.00**	0.0000
1.48	0.45	36.11	0.17	0.48	3.46	115	0.085	0.085	0.999	0.48	0.59	1.70	57.89	6.78	0.00	6.78		66.88	1.93		0			1.15		1.00		0.332	**Non-Liq.**	5.2	12.8			**0.00**	0.0000
1.97	0.60	26.14	0.18	0.70	2.50	115	0.113	0.113	0.997	0.70	0.65	1.70	41.81	4.90	0.21	5.11		48.41	2.13		0			1.15		1.00		0.331	**Non-Liq.**	4.8	10.0			**0.00**	0.0000
2.46	0.75	21.36	0.20	0.96	2.05	115	0.141	0.141	0.996	0.96	0.69	1.70	34.10	4.01	0.48	4.48		39.57	2.28		0			1.15		1.00		0.331	**Non-Liq.**	4.5	8.7			**0.00**	0.0000
2.95	0.90	13.71	0.30	2.18	1.31	115	0.170	0.170	0.995	2.21	0.80	1.70	21.75	2.23	1.75	3.98		22.02	2.64		0			1.00		1.00		0.331	**Non-Liq.**	3.8	5.8			**0.00**	0.0000
3.44	1.05	9.22	0.42	4.52	0.88	130	0.202	0.202	0.994	4.62	0.90	1.70	14.49	1.50	4.17	5.67		14.81	2.98		0			1.00		1.00		0.330	**Non-Liq.**	3.2	4.7			**0.00**	0.0000
3.94	1.20	7.15	0.45	6.29	0.68	130	0.234	0.234	0.993	6.51	0.96	1.70	11.11	1.16	4.67	5.84		11.48	3.16		0			1.00		1.00		0.330	**Non-Liq.**	2.8	4.1			**0.00**	0.0000
4.43	1.35	9.66	0.42	4.31	0.93	130	0.266	0.266	0.992	4.43	0.89	1.70	15.09	1.57	3.96	5.53		15.52	2.96		0			1.00		1.00		0.329	**Non-Liq.**	3.2	4.8			**0.00**	0.0000
4.92	1.50	22.08	0.30	1.37	2.11	130	0.298	0.298	0.990	1.39	0.72	1.70	35.01	4.14	0.90	5.05		40.90	2.36		0			1.15		1.00		0.329	**Non-Liq.**	4.4	9.3			**0.00**	0.0000
5.41	1.65	38.28	0.23	0.61	3.67	130	0.330	0.330	0.989	0.62	0.60	1.70	60.98	7.18	0.12	7.30	1.02	70.90	1.96		1	63	1.26	1.15	89.1	1.00	0.146	0.329	**Non-Liq.**	5.2	13.8	4.1	17.8	**0.22**	0.0127
5.91	1.80	50.90	0.31	0.60	4.87	130	0.362	0.362	0.988	0.61	0.56	1.70	81.20	9.55	0.10	9.66	1.01	94.26	1.85		1	74	1.15	1.15	108.3	1.00	0.198	0.328	**Non-Liq.**	5.4	17.6	4.1	21.7	**0.14**	0.0081
6.40	1.95	39.21	0.37	0.95	3.75	130	0.394	0.394	0.987	0.96	0.63	1.70	62.37	7.34	0.54	7.88		72.62	2.06		0			1.15		1.00		0.498	**Non-Liq.**	5.0	14.6			**0.00**	0.0000
6.89	2.10	14.41	0.48	3.31	1.38	130	0.426	0.426	0.986	3.41	0.84	1.70	22.46	2.29	3.39	5.68		23.15	2.75		0			1.00		1.00		0.516	**Non-Liq.**	3.6	6.4			**0.00**	0.0000
7.38	2.25	10.67	0.46	4.34	1.02	130	0.458	0.458	0.985	4.53	0.90	1.70	16.41	1.70	4.69	6.38		17.14	2.93		0			1.00		1.00		0.532	**Non-Liq.**	3.3	5.3			**0.00**	0.0000
7.87	2.40	11.37	0.36	3.15	1.09	130	0.490	0.490	0.984	3.29	0.87	1.70	17.48	1.76	3.26	5.02		18.26	2.82		0			1.00		1.00		0.547	**Non-Liq.**	3.5	5.3			**0.00**	0.0000
8.37	2.55	15.56	0.36	2.32	1.49	130	0.522	0.522	0.983	2.40	0.82	1.70	24.16	2.25	2.26	4.50		25.00	2.63		0			1.00		1.00		0.561	**Non-Liq.**	3.9	6.5			**0.00**	0.0000
8.86	2.70	33.59	0.43	1.29	3.22	130	0.554	0.554	0.982	1.31	0.69	1.56	48.79	4.50	0.99	5.49		49.80	2.23		0			1.00		1.00		0.574	**Non-Liq.**	4.6	10.7			**0.00**	0.0000
9.35	2.85	55.25	0.55	0.99	5.29	130	0.586	0.586	0.981	1.00	0.62	1.44	74.49	7.03	0.62	7.65	1.09	75.29	2.01		1	65	1.31	1.00	99.0	1.00	0.170	0.586	**0.29**	5.1	14.9	4.9	19.8	**1.52**	0.0896
9.84	3.00	36.10	0.83	2.31	3.46	130	0.618	0.618	0.979	2.35	0.73	1.49	49.81	4.35	2.29	6.64	1.53	50.68	2.38		1	49	2.24	1.00	113.6	1.00	0.216	0.597	**0.36**	4.3	11.7	5.5	17.2	**1.72**	0.1018
10.33	3.15	60.87	0.87	1.43	5.83	130	0.650	0.650	0.978	1.45	0.64	1.37	77.92	7.14	1.18	8.33	1.17	78.76	2.10		1	67	1.45	1.00	114.1	1.00	0.218	0.607	**0.36**	4.9	16.1	5.5	21.6	**1.39**	0.0823
10.83	3.30	105.13	0.76	0.73	10.07	130	0.682	0.682	0.977	0.73	0.53	1.26	124.88	12.30	0.29	12.58	1.02	125.69	1.75		1	86	1.07	1.00	134.7	1.00	0.307	0.616	**0.50**	5.6	22.6	4.4	26.9	**1.07**	0.0633
11.32	3.45	145.38	0.82	0.56	13.92	130	0.714	0.714	0.976	0.56	0.50	1.22	166.50	16.72	0.08	16.79	1.00	167.32	1.58		1	98	1.00	1.00	167.3	1.00	Infin.	0.625	**Non-Liq.**	5.9	28.4	5.1	33.5	**0.00**	0.0000
11.81	3.60	197.88	0.94	0.47	18.95	130	0.746	0.746	0.975	0.47	0.50	1.19	221.96	22.30	0.00	22.30	1.00	222.80	1.44		1	100	1.00	1.00	222.8	1.00	Infin.	0.634	**Non-Liq.**	6.2	36.0	8.5	44.6	**0.00**	0.0000
12.30	3.75	237.82	1.25	0.52	22.77	130	0.778	0.778	0.974	0.53	0.50	1.17	261.34	26.01	0.03	26.04	1.00	262.20	1.41		1	100	1.00	1.00	262.2	1.00	Infin.	0.642	**Non-Liq.**	6.2	42.1	10.0	52.1	**0.00**	0.0000
12.80	3.90	239.65	1.37	0.57	22.95	130	0.810	0.810	0.973	0.57	0.50	1.14	258.08	25.66	0.09	25.75	1.00	258.95	1.44		1	100	1.00	1.00	259.0	1.00	Infin.	0.649	**Non-Liq.**	6.2	41.9	9.8	51.8	**0.00**	0.0000
13.29	4.05	124.36	1.21	0.97	11.91	130	0.842	0.842	0.972	0.98	0.55	1.13	132.50	13.03	0.62	13.65		133.40	1.81		0			1.00		1.00		0.656	**Non-Liq.**	5.4	24.5			**0.00**	0.0000
13.78	4.20	20.89	0.98	4.69	2.00	130	0.874	0.874	0.971	4.89	0.87	1.18	22.36	2.18	5.46	7.63		23.33	2.85		0			1.00		1.00		0.662	**Non-Liq.**	3.4	6.8			**0.00**	0.0000
14.27	4.35	8.70	0.65	7.47	0.83	130	0.906	0.906	0.970	8.33	1.00	1.17	8.60	0.92	5.88	6.80		9.60	3.32		0			1.00		1.00		0.668	**Non-Liq.**	2.5	3.8			**0.00**	0.0000
14.76	4.50	24.48	0.71	2.92	2.34	130	0.938	0.938	0.969	3.03	0.82	1.10	24.57	2.48	3.16	5.64		25.54	2.69		0			1.00		1.00		0.674	**Non-Liq.**	3.7	6.8			**0.00**	0.0000
15.26	4.65	23.91	0.94	3.93	2.29	130	0.969	0.969	0.968	4.10	0.85	1.08	23.35	2.38	4.51	6.89		24.34	2.79		0			1.00		1.00		0.680	**Non-Liq.**	3.5	6.9			**0.00**	0.0000
15.75	4.80	10.20	0.67	6.56	0.98	130	1.001	1.001	0.967	7.28	0.99	1.06	9.18	1.01	5.92	6.93		10.18	3.26		0			1.00		1.00		0.685	**Non-Liq.**	2.6	3.9			**0.00**	0.0000
16.24	4.95	5.68	0.28	4.97	0.54	130	1.033	1.033	0.966	6.08	1.00	1.02	4.50	0.55	5.90	6.45		5.50	3.46		0			1.00		1.00		0.689	**Non-Liq.**	2.2	2.5			**0.00**	0.0000
16.73	5.10	6.61	0.13	1.91	0.63	130	1.065	1.065	0.965	2.28	0.96	0.99	5.21	0.63	1.86	2.49		6.21	3.17		0			1.00		1.00		0.694	**Non-Liq.**	2.8	2.2			**0.00**	0.0000
17.22	5.25	8.70	0.20	2.26	0.83	130	1.097	1.097	0.964	2.58	0.93	0.97	6.94	0.81	2.33	3.14		7.95	3.09		0			1.00		1.00		0.698	**Non-Liq.**	2.9	2.7			**0.00**	0.0000
17.72	5.40	11.05	0.35	3.13	1.06	130	1.129	1.129	0.962	3.48	0.93	0.94	8.82	1.02	3.48	4.50		9.83	3.08		0			1.00		1.00		0.702	**Non-Liq.**	3.0	3.3			**0.00**	0.0000
18.21	5.55	15.46	0.56	3.61	1.48	130	1.161	1.161	0.961	3.90	0.90	0.92	12.42	1.41	4.13	5.54		13.43	2.99		0			1.00		1.00		0.706	**Non-Liq.**	3.2	4.3			**0.00**	0.0000
18.70	5.70	30.84	0.62	2.01	2.95	130	1.193	1.193	0.960	2.09	0.78	0.91	25.52	2.79	2.01	4.80		26.54	2.57		0			1.00		1.00		0.710	**Non-Liq.**	4.0	6.7			**0.00**	0.0000
19.19	5.85	21.87	0.60	2.75	2.09	130	1.225	1.225	0.959	2.91	0.84	0.88	17.24	1.95	2.99	4.94		18.26	2.80		0			1.00		1.00		0.713	**Non-Liq.**	3.5	5.2			**0.00**	0.0000
19.69	6.00	16.47	0.53	3.24	1.58	130	1.257	1.257	0.958	3.51	0.89	0.86	12.33	1.44	3.65	5.09		13.35	2.96		0			1.00		1.00		0.716	**Non-Liq.**	3.2	4.2			**0.00**	0.0000
20.18	6.15	8.98	0.36	4.05	0.86	130	1.289	1.289	0.956	4.73	0.99	0.82	5.98	0.75	4.74	5.49		6.99	3.29		0			1.00		1.00		0.719	**Non-Liq.**	2.6	2.7			**0.00**	0.0000
20.67	6.30	10.05	0.33	3.32	0.96	130	1.321	1.308	0.955	3.82	0.96	0.82	6.74	0.84	3.77	4.61		7.75	3.20		0			1.00		1.00		0.722	**Non-Liq.**	2.7	2.8			**0.00**	0.0000
21.16	6.45	47.02	0.43	0.92	4.50	130	1.353	1.325	0.954	0.95	0.68	0.86	37.09	5.64	0.57	6.21		53.69	2.25		0			1.41		1.00		0.725	**Non-Liq.**	4.6	11.7			**0.00**	0.0000
21.65	6.60	35.12	0.69	1.96	3.36	130	1.385	1.341	0.952	2.04	0.77	0.83	26.61	3.02	1.96	4.98		27.67	2.55		0			1.00		1.00		0.727	**Non-Liq.**	4.0	6.9			**0.00**	0.0000
22.15	6.75	22.83	0.73	3.22	2.19	130	1.417	1.358	0.951	3.42	0.86	0.81	16.39	1.95	3.64	5.59		17.43	2.86		0			1.00		1.00		0.729	**Non-Liq.**	3.4	5.1			**0.00**	0.0000
22.64	6.90	27.61	0.56	2.02	2.64	130	1.449	1.375	0.950	2.12	0.80	0.81	20.12	2.33	2.04	4.37		21.18	2.66		0			1.00		1.00		0.731	**Non-Liq.**	3.8	5.6			**0.00**	0.0000
23.13	7.05	13.54	0.42	3.12	1.30	130	1.481	1.391	0.948	3.48	0.92	0.78	8.93	1.11	3.52	4.63		9.96	3.07		0			1.00		1.00		0.733	**Non-Liq.**	3.0	3.3			**0.00**	0.0000
23.62	7.20	56.62	0.39	0.69	5.42	130	1.513	1.408	0.946	0.70	0.64	0.83	43.47	6.54	0.25	6.80		62.71	2.12		0			1.41		1.00		0.735	**Non-Liq.**	4.8	12.9			**0.00**	0.0000
24.11	7.35	93.49	0.73	0.78	8.95	130	1.545	1.425	0.945	0.79	0.59	0.84	72.95	11.00	0.38	11.38		104.22	1.96		0			1.41		1.00		0.737	**Non-Liq.**	5.2	20.2			**0.00**	0.0000
24.61	7.50	17.45	0.85	4.86	1.67	130	1.577	1.441	0.943	5.30	0.92	0.75	11.37	1.44	5.86	7.31		12.39	3.10		0			1.00		1.00		0.738	**Non-Liq.**	2.9	4.2			**0.00**	0.0000
25.10	7.65	11.07	0.42	3.78	1.06	130	1.609	1.458	0.941	4.35	0.96	0.73	6.67	0.87	4.41	5.28		7.69	3.23		0			1.00		1.00		0.740	**Non-Liq.**	2.7	2.9			**0.00**	0.0000

Depth (feet)	(m)	Tip Qc (tsf)	Friction Fs (tsf)	Friction Ratio Rf %	qc MPa	Total Unit Wt. (pcf)	Total Stress po (tsf)	Eff. Stress p'o (tsf)	rd	F %	n	Max 1.70 Cq	Q	Moss qc1 MPa	Moss Δqc MPa	Moss qc_{1mod} MPa	Moss eff K_C	Qc1n	Ic	Overide	Liquef. Suscept. (0 or 1)	Rel. Dens. Dr (%)	K_C	K_H	Clean Sand Qc1n	1.0 Kσ	CRR	Induced M=7.5 CSR	**Liquefac. Safety Factor**	Qc1n $N_{1(60)}$ Ratio	Equiv. $N_{1(60)}$	FC Adj. $\Delta N_{1(60)}$	Equiv. $N_{1(60)cs}$	***Volumetric Strain (%)***	Induced Subsidenc (inches)
25.59	7.80	9.59	0.21	2.22	0.92	130	1.641	1.474	0.940	2.62	0.94	0.73	5.61	0.73	2.32	3.04		6.62	3.18		0			1.00		1.00		0.741	**Non-Liq.**	2.8	2.4			**0.00**	0.0000
26.08	7.95	11.65	0.37	3.19	1.12	130	1.673	1.491	0.938	3.66	0.94	0.72	6.95	0.90	3.62	4.53		7.97	3.18		0			1.00		1.00		0.742	**Non-Liq.**	2.8	2.9			**0.00**	0.0000
26.57	8.10	10.34	0.39	3.74	0.99	130	1.705	1.508	0.936	4.37	0.97	0.71	5.91	0.79	4.36	5.15		6.92	3.28		0			1.00		1.00		0.743	**Non-Liq.**	2.6	2.7			**0.00**	0.0000
27.07	8.25	10.68	0.31	2.88	1.02	130	1.737	1.524	0.934	3.36	0.95	0.71	6.11	0.81	3.21	4.02		7.13	3.20		0			1.00		0.99		0.744	**Non-Liq.**	2.7	2.6			**0.00**	0.0000
27.56	8.40	11.53	0.32	2.74	1.10	130	1.769	1.541	0.932	3.16	0.94	0.70	6.63	0.87	3.02	3.89		7.66	3.16		0			1.00		0.99		0.744	**Non-Liq.**	2.8	2.7			**0.00**	0.0000
28.05	8.55	11.62	0.29	2.47	1.11	130	1.801	1.558	0.930	2.85	0.93	0.70	6.64	0.87	2.65	3.52		7.67	3.13		0			1.00		0.99		0.745	**Non-Liq.**	2.9	2.7			**0.00**	0.0000
28.54	8.70	12.84	0.30	2.37	1.23	130	1.833	1.574	0.928	2.71	0.91	0.70	7.40	0.96	2.53	3.49		8.44	3.08		0			1.00		0.99		0.745	**Non-Liq.**	3.0	2.8			**0.00**	0.0000
29.04	8.85	27.40	0.59	2.16	2.62	130	1.865	1.591	0.925	2.29	0.81	0.72	17.50	2.16	2.24	4.40		18.58	2.73		0			1.00		0.98		0.745	**Non-Liq.**	3.7	5.1			**0.00**	0.0000
29.53	9.00	36.40	0.79	2.18	3.49	130	1.897	1.608	0.923	2.28	0.78	0.72	23.70	2.91	2.26	5.17		24.80	2.62		0			1.00		0.98		0.745	**Non-Liq.**	3.9	6.4			**0.00**	0.0000
30.02	9.15	24.36	0.86	3.55	2.33	130	1.929	1.624	0.920	3.80	0.87	0.69	14.81	1.93	4.11	6.04		15.87	2.92		0			1.00		0.98		0.745	**Non-Liq.**	3.3	4.8			**0.00**	0.0000
30.51	9.30	35.22	1.14	3.25	3.37	130	1.961	1.641	0.918	3.41	0.82	0.70	22.14	2.84	3.71	6.55		23.22	2.75		0			1.00		0.97		0.745	**Non-Liq.**	3.6	6.4			**0.00**	0.0000
31.00	9.45	175.84	1.65	0.94	16.84	130	1.993	1.657	0.915	0.95	0.55	0.78	128.65	14.32	0.59	14.91		130.36	1.81		0			1.00		0.97		0.745	**Non-Liq.**	5.5	23.9			**0.00**	0.0000
31.50	9.60	226.46	1.86	0.82	21.69	130	2.025	1.674	0.913	0.83	0.51	0.79	167.85	18.32	0.44	18.76	1.02	169.10	1.69		1	99	1.03	1.00	174.0	0.94	Infin.	0.745	**Non-Liq.**	5.7	29.7	5.1	34.8	**0.00**	0.0000
31.99	9.75	229.59	2.16	0.94	21.99	130	2.057	1.691	0.910	0.95	0.52	0.78	168.43	18.68	0.60	19.27	1.03	169.68	1.73		1	99	1.06	1.00	179.1	0.93	Infin.	0.744	**Non-Liq.**	5.6	30.2	5.6	35.8	**0.00**	0.0000
32.48	9.90	265.23	2.52	0.95	25.40	130	2.089	1.707	0.907	0.96	0.51	0.78	194.89	21.63	0.61	22.24	1.03	196.15	1.68		1	100	1.03	1.00	201.5	0.93	Infin.	0.743	**Non-Liq.**	5.7	34.4	5.9	40.3	**0.00**	0.0000
32.97	10.05	235.98	2.32	0.98	22.60	130	2.121	1.724	0.904	0.99	0.53	0.77	171.18	19.14	0.65	19.79	1.03	172.44	1.73		1	99	1.06	1.00	182.9	0.92	Infin.	0.742	**Non-Liq.**	5.6	30.8	5.8	36.6	**0.00**	0.0000
33.46	10.20	189.81	2.72	1.44	18.18	130	2.153	1.741	0.901	1.45	0.58	0.75	132.99	15.58	1.26	16.84	1.08	134.22	1.93		1	89	1.22	1.00	163.3	0.92	Infin.	0.741	**Non-Liq.**	5.2	25.7	7.0	32.7	**0.00**	0.0000
33.96	10.35	267.03	3.12	1.17	25.57	130	2.185	1.757	0.898	1.18	0.53	0.76	191.34	21.85	0.90	22.75	1.04	192.61	1.75		1	100	1.07	1.00	206.9	0.92	Infin.	0.740	**Non-Liq.**	5.6	34.6	6.8	41.4	**0.00**	0.0000
34.45	10.50	326.14	2.65	0.81	31.23	130	2.217	1.774	0.894	0.82	0.50	0.77	236.77	26.17	0.42	26.59	1.02	238.06	1.58		1	100	1.00	1.00	238.1	0.91	Infin.	0.739	**Non-Liq.**	5.9	40.3	7.4	47.6	**0.00**	0.0000
34.94	10.65	364.83	1.97	0.54	34.94	130	2.249	1.791	0.891	0.54	0.50	0.77	263.77	28.42	0.05	28.47	1.00	265.07	1.42		1	100	1.00	1.00	265.1	0.91	Infin.	0.738	**Non-Liq.**	6.2	42.6	10.0	52.6	**0.00**	0.0000
35.43	10.80	310.42	1.70	0.55	29.73	130	2.281	1.807	0.888	0.55	0.50	0.77	223.19	23.95	0.06	24.02	1.00	224.50	1.48		1	100	1.00	1.00	224.5	0.90	Infin.	0.736	**Non-Liq.**	6.1	36.8	8.1	44.9	**0.00**	0.0000
35.93	10.95	330.45	1.94	0.59	31.64	130	2.313	1.824	0.884	0.59	0.50	0.76	236.58	25.63	0.12	25.75	1.00	237.89	1.48		1	100	1.00	1.00	237.9	0.90	Infin.	0.735	**Non-Liq.**	6.1	39.0	8.6	47.6	**0.00**	0.0000
36.42	11.10	356.65	1.68	0.47	34.15	130	2.345	1.840	0.880	0.47	0.50	0.76	254.27	27.12	0.00	27.12	1.00	255.58	1.39		1	100	1.00	1.00	255.6	0.89	Infin.	0.733	**Non-Liq.**	6.3	40.7	10.0	50.7	**0.00**	0.0000
36.91	11.25	334.91	1.30	0.39	32.07	130	2.377	1.857	0.877	0.39	0.50	0.75	237.60	24.83	0.00	24.83	1.00	238.93	1.36		1	100	1.00	1.00	238.9	0.89	Infin.	0.731	**Non-Liq.**	6.3	37.8	10.0	47.8	**0.00**	0.0000
37.40	11.40	339.08	1.48	0.44	32.47	130	2.409	1.874	0.873	0.44	0.50	0.75	239.50	25.34	0.00	25.34	1.00	240.83	1.39		1	100	1.00	1.00	240.8	0.88	Infin.	0.729	**Non-Liq.**	6.3	38.4	9.8	48.2	**0.00**	0.0000
37.89	11.55	288.52	1.23	0.42	27.63	130	2.441	1.890	0.869	0.43	0.50	0.75	202.68	21.26	0.00	21.26	1.00	204.02	1.44		1	100	1.00	1.00	204.0	0.88	Infin.	0.727	**Non-Liq.**	6.2	33.0	7.8	40.8	**0.00**	0.0000
38.39	11.70	160.92	1.09	0.68	15.41	130	2.473	1.907	0.865	0.69	0.54	0.73	109.40	12.00	0.24	12.24	1.02	110.71	1.78		1	81	1.09	1.00	120.8	0.88	0.244	0.725	**0.30**	5.5	20.1	4.1	24.2	**1.24**	0.0734
38.88	11.85	92.64	1.43	1.55	8.87	130	2.505	1.924	0.861	1.58	0.66	0.67	57.63	7.15	1.40	8.55	1.20	58.85	2.22		1	55	1.72	1.00	101.3	0.90	0.177	0.723	**0.22**	4.7	12.7	5.5	18.2	**1.67**	0.0983
39.37	12.00	64.52	1.53	2.37	6.18	130	2.537	1.940	0.857	2.45	0.74	0.64	37.79	5.00	2.50	7.50	1.50	38.96	2.48		1	38	2.69	1.00	104.7	0.93	0.187	0.720	**0.24**	4.1	9.4	5.5	14.9	**2.00**	0.1181
39.86	12.15	200.25	1.46	0.73	19.18	130	2.569	1.957	0.852	0.74	0.52	0.72	135.83	15.05	0.31	15.35	1.02	137.17	1.72		1	90	1.05	1.00	144.5	0.87	0.361	0.718	**0.43**	5.6	24.4	4.5	28.9	**1.00**	0.0591
40.35	12.30	224.19	2.07	0.92	21.47	130	2.601	1.974	0.848	0.93	0.53	0.72	150.66	17.24	0.57	17.81	1.03	152.00	1.76		1	94	1.08	1.00	163.5	0.86	Infin.	0.715	**Non-Liq.**	5.6	27.3	5.4	32.7	**0.00**	0.0000
40.85	12.45	358.52	2.51	0.70	34.33	130	2.633	1.990	0.843	0.70	0.50	0.73	245.70	27.42	0.27	27.69	1.01	247.07	1.52		1	100	1.00	1.00	247.1	0.86	Infin.	0.713	**Non-Liq.**	6.0	41.0	8.4	49.4	**0.00**	0.0000
41.34	12.60	383.86	2.16	0.56	36.76	130	2.665	2.007	0.839	0.57	0.50	0.73	262.06	28.78	0.08	28.86	1.00	263.44	1.43		1	100	1.00	1.00	263.4	0.85	Infin.	0.710	**Non-Liq.**	6.2	42.5	10.0	52.5	**0.00**	0.0000
41.83	12.75	375.76	1.93	0.51	35.98	130	2.697	2.023	0.834	0.52	0.50	0.72	255.44	27.79	0.02	27.81	1.00	256.82	1.41		1	100	1.00	1.00	256.8	0.85	Infin.	0.707	**Non-Liq.**	6.2	41.2	10.0	51.2	**0.00**	0.0000
42.32	12.90	369.10	1.74	0.47	35.35	130	2.729	2.040	0.830	0.47	0.50	0.72	249.85	26.94	0.00	26.94	1.00	251.24	1.40		1	100	1.00	1.00	251.2	0.85	Infin.	0.704	**Non-Liq.**	6.3	40.1	10.0	50.1	**0.00**	0.0000
42.81	13.05	343.38	1.56	0.46	32.88	130	2.761	2.057	0.825	0.46	0.50	0.72	231.39	24.79	0.00	24.79	1.00	232.78	1.41		1	100	1.00	1.00	232.8	0.84	Infin.	0.701	**Non-Liq.**	6.2	37.4	9.2	46.6	**0.00**	0.0000
43.31	13.20	298.88	1.32	0.44	28.62	130	2.793	2.073	0.820	0.45	0.50	0.71	200.40	21.27	0.00	21.27	1.00	201.80	1.46		1	100	1.00	1.00	201.8	0.84	Infin.	0.698	**Non-Liq.**	6.1	32.8	7.5	40.4	**0.00**	0.0000
43.80	13.35	190.54	1.05	0.55	18.25	130	2.825	2.090	0.816	0.56	0.51	0.71	125.86	13.50	0.07	13.57	1.00	127.25	1.68		1	87	1.02	1.00	130.0	0.84	0.284	0.695	**0.34**	5.7	22.3	3.7	26.0	**1.13**	0.0668
44.29	13.50	57.33	0.87	1.52	5.49	130	2.857	2.107	0.811	1.58	0.72	0.61	31.80	4.12	1.35	5.47		33.01	2.43		0			1.00		0.91		0.691	**Non-Liq.**	4.3	7.8			**0.00**	0.0000
44.78	13.65	21.78	0.75	3.44	2.09	130	2.889	2.123	0.806	3.81	0.90	0.54	9.95	1.51	3.87	5.38		11.02	3.06		0			1.00		0.91		0.688	**Non-Liq.**	3.0	3.7			**0.00**	0.0000
45.28	13.80	20.56	0.64	3.11	1.97	130	2.921	2.140	0.801	3.47	0.90	0.53	9.26	1.40	3.43	4.83		10.33	3.06		0			1.00		0.91		0.685	**Non-Liq.**	3.0	3.4			**0.00**	0.0000
45.77	13.95	70.26	0.66	0.94	6.73	130	2.953	2.156	0.796	0.97	0.66	0.62	40.18	7.66	0.57	8.24		65.48	2.22		0			1.58		0.91		0.681	**Non-Liq.**	4.6	14.1			**0.00**	0.0000
46.26	14.10	37.69	0.84	2.22	3.61	130	2.985	2.173	0.791	2.35	0.80	0.56	18.89	2.66	2.25	4.91		20.05	2.71		0			1.00		0.91		0.678	**Non-Liq.**	3.7	5.4			**0.00**	0.0000
46.75	14.25	23.19	0.97	4.19	2.22	130	3.017	2.190	0.786	4.62	0.91	0.52	10.26	1.62	4.83	6.45		11.33	3.10		0			1.00		0.90		0.674	**Non-Liq.**	2.9	3.9			**0.00**	0.0000
47.24	14.40	58.83	1.00	1.71	5.63	130	3.049	2.206	0.781	1.77	0.73	0.59	31.33	6.64	1.58	8.22		51.41	2.46		0			1.58		0.90		0.671	**Non-Liq.**	4.2	12.3			**0.00**	0.0000
47.74	14.55	27.27	1.02	3.73	2.61	130	3.081	2.223	0.776	4.06	0.88	0.52	12.32	1.92	4.22	6.14		13.41	3.00		0			1.00		0.90		0.667	**Non-Liq.**	3.1	4.3			**0.00**	0.0000
48.23	14.70	19.66	0.81	4.10	1.88	130	3.113	2.240	0.771	4.62	0.93	0.50	8.22	1.33	4.69	6.02		9.27	3.18		0			1.00		0.90		0.663	**Non-Liq.**	2.8	3.3			**0.00**	0.0000
48.72	14.85	34.48	0.83	2.41	3.30	130	3.145	2.256	0.766	2.58	0.82	0.54	16.39	2.39	2.49	4.88		17.54	2.78		0			1.00		0.90		0.660	**Non-Liq.**	3.6	4.9			**0.00**	0.0000
49.21	15.00	76.97	1.26	1.64	7.37	130	3.177	2.273	0.761	1.69	0.70	0.59	41.40	5.94	1.48	7.42		45.70	2.35		0			1.07		0.90		0.656	**Non-Liq.**	4.4	10.4			**0.00**	0.0000
49.70	15.15	54.46	1.62	2.98	5.22	130	3.209	2.290	0.756	3.11	0.79	0.55	26.89	4.00	3.22	7.22		28.07	2.66		0			1.00		0.89		0.652	**Non-Liq.**	3.8	7.4			**0.00**	0.0000
50.20	15.30	257.68	1.79	0.69	24.68	130	3.241	2.306	0.751	0.70	0.50	0.68	163.21	19.64	0.25	19.89		176.43	1.65		0			1.07		0.89		0.649	**Non-Liq.**	5.8	30.6			**0.00**	0.0000
50.69	15.45	313.01	1.90	0.61	29.97	130	3.273	2.323	0.746	0.61	0.50	0.67	198.19	23.70	0.14	23.84	1.01	213.92	1.55		1	100	1.00	1.07	213.9	0.79	Infin.	0.645	**Non-Liq.**	6.0	35.8	7.0	42.8	**0.00**	0.0000
51.18	15.60	304.96	1.79	0.59	29.20	130	3.305	2.339	0.741	0.59	0.50	0.67	192.35	22.90	0.11	23.01	1.00	207.67	1.55		1	100	1.00	1.07	207.7	0.79	Infin.	0.641	**Non-Liq.**	6.0	34.8	6.7	41.5	**0.00**	0.0000
51.67	15.75	251.37	1.41	0.56	24.07	130	3.337	2.356	0.736	0.57	0.50	0.67	157.72	18.49	0.08	18.57	1.00	170.57	1.60		1	99	1.00	1.07	170.6	0.79	Infin.	0.638	**Non-Liq.**	5.9	29.1	5.0	34.1	**0.00**	0.0000
52.17	15.90	99.40	1.37	1.38	9.52	130	3.369	2.373	0.731	1.41	0.66	0.59	53.86	7.57	1.13	8.70		59.11	2.21		0			1.07		0.89		0.634	**Non-Liq.**	4.7	12.7			**0.00**	0.0000
52.66	16.05	23.03	1.00	4.36	2.21	130	3.401	2.389	0.726	4.87	0.92	0.47	9.24	1.56	4.96	6.52		10.31	3.15		0			1.00		0.88		0.630	**Non-Liq.**	2.8	3.6			**0.00**	0.0000
53.15	16.20	18.05	0.35	1.96	1.73	130	3.433	2.406	0.721	2.27	0.89	0.48	7.12	1.08	1.88	2.96		8.22	3.05		0			1.00		0.88		0.627	**Non-Liq.**	3.0	2.7			**0.00**	0.0000
53.64	16.35	24.06	0.42	1.74	2.30	130	3.465	2.423	0.716	1.93	0.84	0.50	10.17	1.49	1.59	3.07		11.31	2.89		0			1.00		0.88		0.623	**Non-Liq.**	3.3	3.4			**0.00**	0.0000
54.13	16.50	166.95	0.86	0.52	15.99	130	3.497	2.439	0.712	0.52	0.53	0.64	99.99	15.24	0.02	15.26		142.75	1.74		0			1.41		0.88		0.619	**Non-Liq.**	5.6	25.6			**0.00**	0.0000
54.63	16.65	82.02	1.86	2.27	7.85	130	3.529	2.456	0.707	2.34	0.72	0.54	40.91	8.38	2.25	10.63		59.33	2.44		0			1.41		0.88		0.616	**Non-Liq.**	4.2	14.1			**0.00**	0.0000
55.12	16.80	63.53	2.49	3.91	6.08	130	3.561	2.473	0.702	4.07	0.80	0.51	29.32	4.72	4.35	9.07		30.51	2.71		0			1.00		0.88		0.612	**Non-Liq.**	3.7	8.3			**0.00**	0.0000
55.61	16.95	26.14	1.82	6.95	2.50	130	3.593	2.489	0.698	7.68	0.94	0.45	9.96	1.84	5.72	7.56		11.01	3.25		0			1.00		0.88		0.609	**Non-Liq.**	2.6	4.2			**0.00**	0.0000
56.10	17.10	51.08	1.60	3.13	4.89	130	3.625	2.506	0.693	3.29	0.80	0.50	23.00	3.63	3.33	6.96		24.19	2.73		0			1.00		0.87		0.605	**Non-Liq.**	3.7	6.6			**0.00**	0.0000
56.59	17.25	84.15	2.51	2.98	8.06	130	3.656	2.522	0.689	3.07	0.75	0.52	40.35	6.22	3.14	9.36		41.59	2.53		0			1.00		0.87		0.602	**Non-Liq.**	4.1	10.3			**0.00**	0.0000
57.09	17.40	115.98	3.01	2.60	11.11	130	3.688	2.539	0.684	2.66	0.70	0.54	57.96	9.28	2.66	11.94		63.49	2.37		0			1.07		0.87		0.598	**Non-Liq.**	4.4	14.6			**0.00**	0.0000
57.58	17.55	343.66	2.95	0.86	32.91	130	3.720	2.556	0.680	0.86	0.50	0.64	207.44	26.33	0.45	26.79	1.02	223.90	1.63		1	100	1.00	1.07	223.9	0.76	Infin.	0.595	**Non-Liq.**	5.8	38.6	6.2	44.8	**0.00**	0.0000

Depth (feet)	(m)	Tip Qc (tsf)	Friction Fs (tsf)	Friction Ratio Rf %	qc MPa	Total Unit Wt. (pcf)	Total Stress po (tsf)	Eff. Stress p'o (tsf)	rd	F %	n	Max 1.70 Cq	Q	Moss qc1 MPa	Moss Δqc MPa	Moss qc_{1mod} MPa	Moss eff K_C	Qc1n	Ic	Overide	Liquef. Suscept. (0 or 1)	Rel. Dens. Dr (%)	K_C	K_H	Clean Sand Qc1n	1.0 Kσ	CRR	Induced M=7.5 CSR	**Liquefac. Safety Factor**	Qc1n $N_{1(60)}$ Ratio	Equiv. $N_{1(60)}$	FC Adj. $\Delta N_{1(60)}$	Equiv. $N_{1(60)cs}$	***Volumetric Strain (%)***	Induced Subsidenc (inches)
58.07	17.70	389.74	2.44	0.63	37.32	130	3.752	2.572	0.675	0.63	0.50	0.64	234.69	28.90	0.16	29.06	1.01	253.10	1.50		1	100	1.00	1.07	253.1	0.76	Infin.	0.592	**Non-Liq.**	6.1	41.8	8.9	50.6	**0.00**	0.0000
58.56	17.85	291.44	1.45	0.50	27.91	130	3.784	2.589	0.671	0.50	0.50	0.64	174.53	20.47	0.00	20.47	1.00	188.66	1.54		1	100	1.00	1.07	188.7	0.75	Infin.	0.588	**Non-Liq.**	6.0	31.5	6.2	37.7	**0.00**	0.0000
59.06	18.00	78.71	1.28	1.63	7.54	130	3.816	2.606	0.667	1.69	0.70	0.53	38.17	5.78	1.42	7.20		42.30	2.38		0			1.07		0.87		0.585	**Non-Liq.**	4.3	9.7			**0.00**	0.0000
59.55	18.15	28.68	1.13	3.92	2.75	130	3.848	2.622	0.663	4.32	0.89	0.45	10.99	1.91	4.29	6.20		12.10	3.06		0			1.00		0.86		0.582	**Non-Liq.**	3.0	4.0			**0.00**	0.0000
60.04	18.30	31.27	0.68	2.17	2.99	130	3.880	2.639	0.659	2.37	0.83	0.47	12.65	1.97	2.09	4.07		13.81	2.86		0			1.00		0.86		0.579	**Non-Liq.**	3.4	4.0			**0.00**	0.0000
60.53	18.45	36.60	1.03	2.81	3.50	130	3.912	2.655	0.655	3.03	0.83	0.46	14.89	2.42	2.89	5.32		16.06	2.86		0			1.00		0.86		0.576	**Non-Liq.**	3.4	4.7			**0.00**	0.0000
61.02	18.60	26.07	1.18	4.54	2.50	130	3.944	2.672	0.651	5.06	0.91	0.43	9.48	1.72	5.05	6.77		10.57	3.15		0			1.00		0.86		0.573	**Non-Liq.**	2.8	3.7			**0.00**	0.0000
61.52	18.75	32.00	0.95	2.98	3.06	130	3.976	2.689	0.647	3.25	0.86	0.45	12.48	2.08	3.08	5.17		13.62	2.94		0			1.00		0.86		0.570	**Non-Liq.**	3.2	4.2			**0.00**	0.0000
62.01	18.90	30.82	1.04	3.36	2.95	130	4.008	2.705	0.643	3.68	0.87	0.44	11.74	2.01	3.56	5.57		12.87	2.99		0			1.00		0.86		0.567	**Non-Liq.**	3.1	4.1			**0.00**	0.0000
62.50	19.05	59.20	1.14	1.93	5.67	130	4.040	2.722	0.640	2.03	0.75	0.49	26.27	3.95	1.78	5.73		27.53	2.56		0			1.00		0.86		0.564	**Non-Liq.**	4.0	6.9			**0.00**	0.0000
62.99	19.20	25.89	1.06	4.11	2.48	130	4.072	2.739	0.636	4.60	0.91	0.42	9.23	1.67	4.48	6.15		10.32	3.13		0			1.00		0.86		0.561	**Non-Liq.**	2.9	3.6			**0.00**	0.0000
63.48	19.35	57.27	1.24	2.16	5.48	130	4.104	2.755	0.633	2.27	0.76	0.48	24.80	3.84	2.06	5.89		26.05	2.61		0			1.00		0.85		0.558	**Non-Liq.**	3.9	6.7			**0.00**	0.0000
63.98	19.50	62.62	1.54	2.45	6.00	130	4.136	2.772	0.629	2.57	0.76	0.48	27.07	4.29	2.41	6.70		28.33	2.61		0			1.00		0.85		0.555	**Non-Liq.**	3.9	7.3			**0.00**	0.0000
64.47	19.65	52.86	1.68	3.17	5.06	130	4.168	2.789	0.626	3.35	0.81	0.46	21.68	3.64	3.30	6.94		22.89	2.76		0			1.00		0.85		0.553	**Non-Liq.**	3.6	6.4			**0.00**	0.0000
64.96	19.80	26.65	1.50	5.64	2.55	130	4.200	2.805	0.622	6.30	0.93	0.40	9.08	1.77	5.55	7.32		10.15	3.22		0			1.00		0.85		0.550	**Non-Liq.**	2.7	3.8			**0.00**	0.0000
65.45	19.95	30.69	1.25	4.08	2.94	130	4.232	2.822	0.619	4.50	0.89	0.42	11.01	2.01	4.41	6.42		12.13	3.07		0			1.00		0.85		0.548	**Non-Liq.**	3.0	4.0			**0.00**	0.0000
65.94	20.10	33.30	1.24	3.73	3.19	130	4.264	2.838	0.616	4.08	0.87	0.42	12.17	2.18	3.97	6.15		13.31	3.01		0			1.00		0.85		0.545	**Non-Liq.**	3.1	4.3			**0.00**	0.0000
66.44	20.25	178.25	2.07	1.16	17.07	130	4.296	2.855	0.613	1.18	0.59	0.55	91.90	14.04	0.81	14.85		107.65	1.98		0			1.15		0.85		0.543	**Non-Liq.**	5.1	21.1			**0.00**	0.0000
66.93	20.40	384.00	4.03	1.05	36.77	130	4.328	2.872	0.610	1.06	0.51	0.60	216.00	31.46	0.67	32.14	1.02	250.84	1.68		1	100	1.03	1.15	257.7	0.72	Infin.	0.540	**Non-Liq.**	5.7	44.0	7.5	51.5	**0.00**	0.0000
67.42	20.55	404.46	5.07	1.25	38.73	130	4.360	2.888	0.607	1.26	0.53	0.59	223.90	33.88	0.92	34.80	1.03	259.93	1.73		1	100	1.06	1.15	275.4	0.71	Infin.	0.538	**Non-Liq.**	5.6	46.4	8.7	55.1	**0.00**	0.0000
67.91	20.70	269.03	4.21	1.57	25.76	130	4.392	2.905	0.604	1.58	0.58	0.55	139.56	22.47	1.30	23.78		162.62	1.94		0			1.15		0.84		0.535	**Non-Liq.**	5.2	31.3			**0.00**	0.0000
68.41	20.85	65.22	3.18	4.88	6.25	130	4.424	2.922	0.601	5.10	0.82	0.43	25.49	4.72	5.34	10.06		26.68	2.82		0			1.00		0.84		0.533	**Non-Liq.**	3.5	7.7			**0.00**	0.0000
68.90	21.00	60.28	2.56	4.25	5.77	130	4.456	2.938	0.598	4.47	0.82	0.43	23.45	4.27	4.58	8.84		24.65	2.81		0			1.00		0.84		0.531	**Non-Liq.**	3.5	7.1			**0.00**	0.0000
69.39	21.15	107.52	2.77	2.58	10.30	130	4.488	2.955	0.595	2.65	0.72	0.48	47.33	8.80	2.53	11.33		56.10	2.43		0			1.15		0.84		0.529	**Non-Liq.**	4.2	13.2			**0.00**	0.0000
69.88	21.30	179.64	3.41	1.90	17.20	130	4.520	2.972	0.593	1.93	0.64	0.52	86.25	14.81	1.70	16.51	1.12	101.09	2.15		1	77	1.55	1.15	157.0	0.71	0.440	0.527	**0.59**	4.8	21.1	5.5	26.6	**1.08**	0.0637
70.37	21.45	170.46	3.34	1.96	16.32	130	4.552	2.988	0.590	1.99	0.65	0.51	80.79	14.02	1.77	15.79	1.13	94.78	2.18		1	75	1.62	1.15	153.4	0.70	0.416	0.525	**0.56**	4.7	20.0	5.5	25.5	**1.14**	0.0672
70.87	21.60	108.51	2.75	2.53	10.39	130	4.584	3.005	0.587	2.61	0.72	0.47	47.26	8.83	2.47	11.30		56.03	2.43		0			1.15		0.84		0.523	**Non-Liq.**	4.2	13.2			**0.00**	0.0000
71.36	21.75	79.12	2.58	3.26	7.58	130	4.616	3.021	0.585	3.39	0.77	0.45	32.06	5.56	3.35	8.91		33.33	2.63		0			1.00		0.84		0.521	**Non-Liq.**	3.8	8.7			**0.00**	0.0000
71.85	21.90	153.60	2.46	1.60	14.71	130	4.648	3.038	0.582	1.63	0.64	0.51	72.42	10.61	1.33	11.94		74.16	2.16		0			1.00		0.84		0.519	**Non-Liq.**	4.8	15.5			**0.00**	0.0000
72.34	22.05	136.14	2.03	1.49	13.04	130	4.680	3.055	0.580	1.52	0.65	0.50	63.38	9.17	1.20	10.37		64.83	2.18		0			1.00		0.83		0.517	**Non-Liq.**	4.7	13.7			**0.00**	0.0000
72.83	22.20	70.10	2.24	3.19	6.71	130	4.712	3.071	0.578	3.34	0.78	0.43	27.55	4.83	3.25	8.08		28.81	2.68		0			1.00		0.83		0.515	**Non-Liq.**	3.8	7.7			**0.00**	0.0000
73.33	22.35	219.63	2.79	1.27	21.03	130	4.744	3.088	0.575	1.29	0.59	0.53	109.30	15.10	0.93	16.03		111.27	1.95		0			1.00		0.83		0.513	**Non-Liq.**	5.2	21.5			**0.00**	0.0000
73.82	22.50	114.07	3.23	2.83	10.92	130	4.776	3.105	0.573	2.91	0.72	0.46	48.20	8.11	2.81	10.92		49.55	2.46		0			1.00		0.83		0.511	**Non-Liq.**	4.2	11.8			**0.00**	0.0000
74.31	22.65	86.47	3.26	3.77	8.28	130	4.808	3.121	0.571	3.92	0.78	0.43	34.02	6.16	3.94	10.11		35.29	2.65		0			1.00		0.83		0.509	**Non-Liq.**	3.8	9.3			**0.00**	0.0000
74.80	22.80	#N/A	#N/A	#N/A	#N/A	130	4.840	#N/A	0.569	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	**Non-Liq.**	#N/A	#N/A	#N/A	#N/A	**#N/A**	0.0000

EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Arctic Cold **Project No: 303415-002**

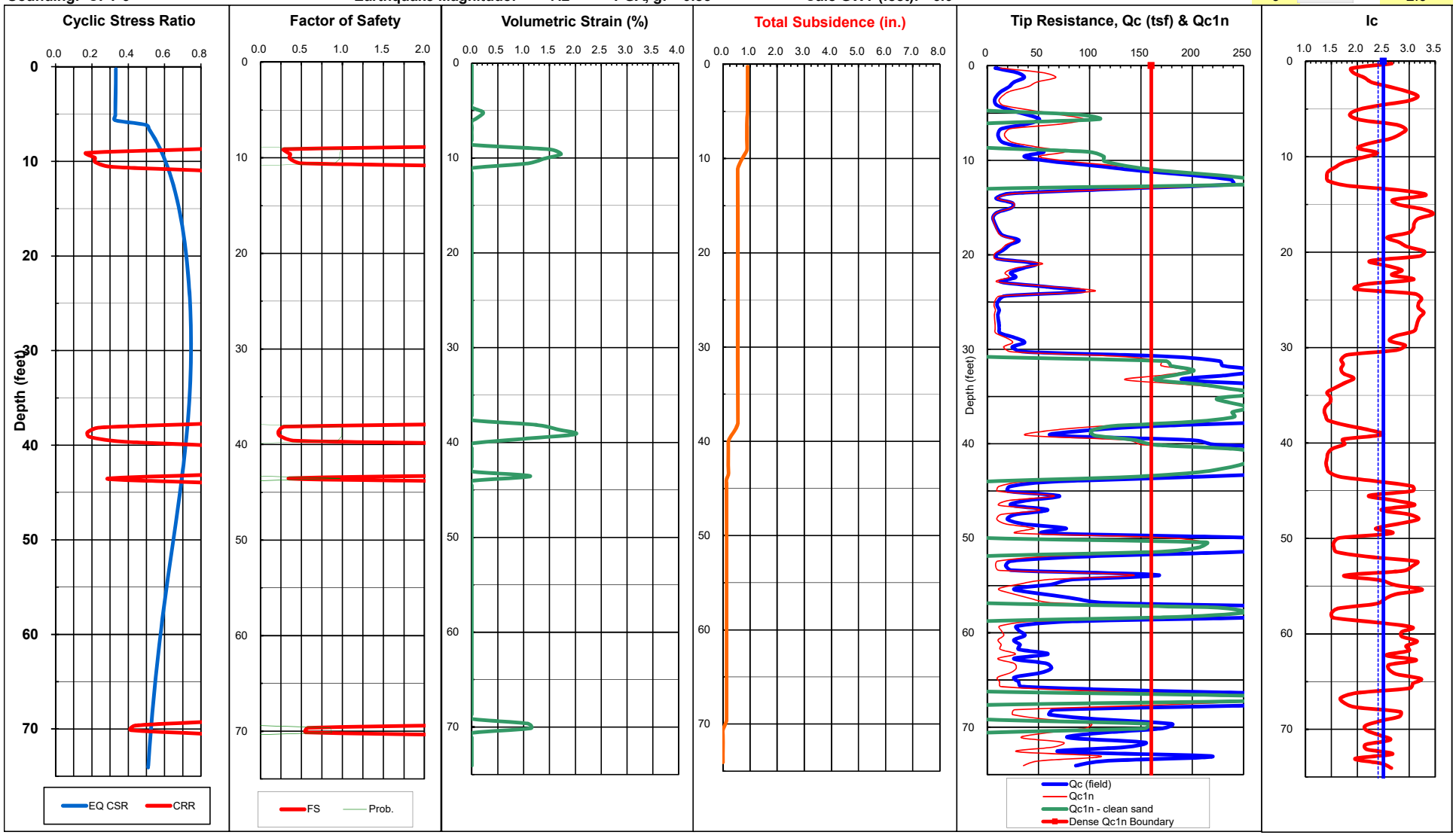
Method Used: 1 1998 NCEER (Robertson & Wride)

Settlement Analysis using Tokimatsu & Seed (1987), clean sand Qc1n/N1(60) ratio =5

Plot 9

Limiting Ic: 2.6

Sounding: CPT-9 **Earthquake Magnitude: 7.2** **PGA, g: 0.85** **Calc GWT (feet): 6.0**



Total Thickness of Liquefiable Layers: 5.4 feet **Estimated Total Ground Subsidence (Settlement): 0.9 inches**

EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

3 avg increment =0.15m Qc1n/N1(60): 5

Ignore 1st/last increment into sand/silt soils: 0

Method Used: 1998 NCEER (Robertson & Wride)

Sounding: CPT-9 **Earthquake Magnitude: 7.2** **PGA, g: 0.85**