Attachment H

Preliminary Geotechnical Engineering Report

Lake Manawa Lot 10
35th Avenue and Power Drive
Council Bluffs, Iowa
February 9, 2021
Terracon Project No. 05215015

Prepared for:
City+Ventures
Omaha, NE.

Prepared by:
Terracon Consultants, Inc.
Omaha, NE



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

February 9, 2021

Edward D. Prost, Jr., P.E. (date)

My license renewal date is December 31, 2022.

Pages or sheets covered by this seal:
Preliminary Geotechnical Engineering Report

February 9, 2021

City+Ventures
222 South 15th Street, Suite 1404s
Omaha, NE. 68102

Attn: Mr. Adam Ramaekers, Project Manager
P: 402.690.6627
E: aramaekers@city-ventures.com

Re: Preliminary Geotechnical Engineering Report
Lake Manawa Lot 10
35th Avenue and Power Drive
Council Bluffs, Iowa
Terracon Project No. 05215015

Dear Mr. Ramaekers:

We have completed the Preliminary Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P05215015 dated February 5, 2021. This report presents the findings of the subsurface exploration and provides preliminary geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed Lake Manawa Lot 10 project. The geotechnical exploration on which this report is based was completed in 2013 for another project being considered for this site. Additional exploration is currently being planned to provide design-level recommendations for the project.

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

Sincerely,
Terracon Consultants, Inc.

Sajjad Satvati, Ph.D., E.I.
Senior Staff Engineer

Edward D. Prost Jr., P.E.
Principal/Dept. Manager

Distribution: Addressee (pdf)

REPORT TOPICS

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Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Preliminary Geotechnical Engineering Report

Lake Manawa Lot 10
35th Avenue and Power Drive
Council Bluffs, Iowa

Terracon Project No. 05215015
February 9, 2021

INTRODUCTION

This report presents the results of our preliminary subsurface exploration and geotechnical engineering services performed for the proposed carwash, apartments, and clubhouse to be located at 35th Avenue and Power Drive in Council Bluffs, Iowa.

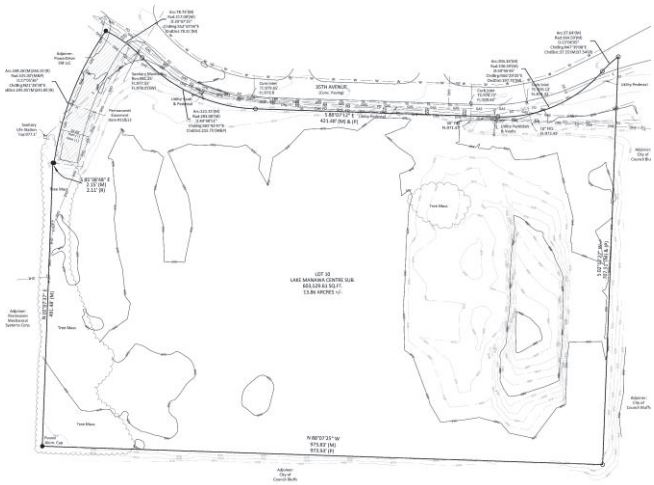
The field exploration included four soil borings extending to depths of about 30 feet below existing grade, and two cone penetrometer tests to depths of about 50 feet completed across the site to obtain subsurface information. Maps showing the site and boring locations are shown on **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained during the field exploration are included on the boring logs in **Exploration Results**.

Our work was completed in general accordance with Terracon proposal-agreement no. P05215015 dated February 5, 2021.

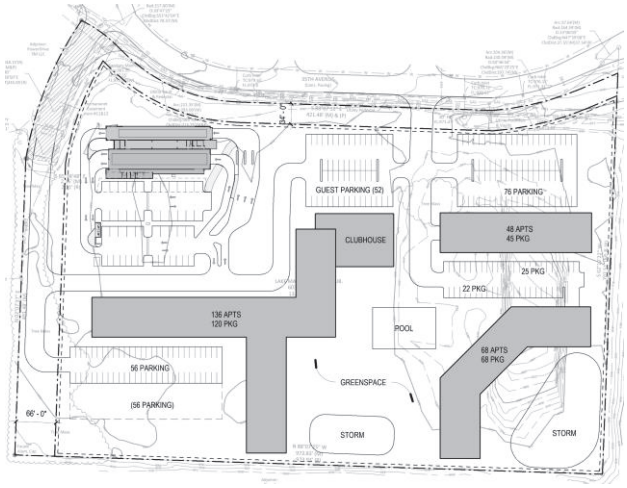
The purposes of this exploration and report are to provide preliminary information and preliminary geotechnical engineering recommendations relative to:

- Soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Stormwater pond considerations
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification per IBC
- Pavement design and construction
- Frost considerations

SITE CONDITIONS

Item	Description
Parcel Information	The project is located in the southeast quadrant of the intersection of 35th Avenue and Power Drive in Council Bluffs, Iowa. Approx. Latitude/Longitude; 41.224113° N / 95.843607° W. See **Site Location**
Existing Improvements	None.
Current Ground Cover	Vacant, grass and weed-covered lot with a few scattered trees.
Existing Topography	Based on review of the ALTA survey provided to Terracon (see below), the majority of the site is relatively flat. An area of stockpiled soil is present in the east portion of the site. 

PROJECT DESCRIPTION

Item	Description
Information Provided	Site Plan and Renderings prepared by TACK Architects dated 1/12/2021 ALTA Survey prepared by FoleyShald Engineering dated 9/30/2020. Sanitary Sewer Extension Concept Plan prepared by FoleyShald.
Project Description	Construction of a Rocket Carwash facility and three, five-story apartment buildings. The multi-family housing project will include a clubhouse and swimming pool. Extension of a sanitary sewer will also be completed. 
Proposed Structures	Rocket Carwash: single-story, slab-on-grade building. Multi-Family Housing: five-story, slab-on-grade building. First floor will contain automobile parking and the upper four floors will be apartment units. Clubhouse: single-story, slab-on-grade building.
Building Construction	Rocket Carwash: wood-framed with support provided by a conventional shallow footing foundation. Multi-Family Housing: first floor is anticipated to have concrete or masonry walls and a pre-cast concrete ceiling slab. Upper apartment levels are expected to be wood-framed. Support is anticipated to be provided by a shallow footing foundation, likely bearing on a ground improvement system. Clubhouse: wood-framed with support provided by a conventional shallow footing foundation.
Finished Floor Elevation	977 feet.
Maximum Loads	Rocket Carwash: Columns: 250 kips; Walls: 5 to 7 klf; Slabs: 150 psf Multi-Family Housing: Columns: 75 kips; Walls: 2 to 3 klf; Slabs: 150 psf Clubhouse: Columns: 75 kips; Walls: 2 to 3 klf; Slabs: 100 psf
Grading/Slopes	Up to about 2 feet of fill is estimated to be required to develop final grades.
Below Grade Structures	Outdoor swimming pool. Depth of pool is assumed to be about 5 feet below final grade.

Item	Description
Pavements	Paved driveway and parking will be constructed throughout the development. We assume all paving will consist of Portland cement concrete.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the soil and groundwater conditions based upon our review of the boring information, the geologic setting, and our understanding of the project. This characterization, termed GeoModel, forms the basis for our geotechnical evaluations and recommendations for site preparation, earthwork, and foundation options. Conditions encountered at each boring location are indicated on the individual boring logs. The GeoModel and individual logs are provided in **Exploration Results**.

The GeoModel is based upon our boring information. Variations can occur between borings and across the site. Previous construction and grading may have created additional variations.

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes are provided on the boring logs in **Exploration Results**, and are summarized below.

Boring Number	Approximate Depth to Groundwater (feet) [1]	Approximate Depth to Cave In (feet) [1]
B-1	14	Not Recorded
B-2	18	Not Recorded
B-3	13	13
B-4	8	7

1. Below ground surface

A relatively long period of time is necessary for a groundwater level to develop and stabilize in a borehole. Longer term monitoring in cased holes or piezometers would be required for a more accurate evaluation of the groundwater conditions.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may vary from than the levels indicated on the boring logs. In addition, perched water can occur overlying compacted cohesive

fill or over dense clay layers. The possibility of groundwater level fluctuations and development of perched water conditions should be considered when developing the design and construction plans for the project.

PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The recommendations contained in this report are considered preliminary and should not be utilized for design, unless confirmed based on additional, design-level, exploration and review of the project and site characteristics. Terracon has provided a proposal with our recommended scope for additional design-level exploration

GEOTECHNICAL OVERVIEW

Native clay soil consisting of fat clay was encountered to depths of between about 8 to 18.5 feet in all borings. Our boring information indicates the fat clays have measured dry densities between about 78 to 91 pcf. We recommend these soils not be used as fill materials in the building areas. However, these soils could be used as fill materials more than 2 to 3 feet below the pavements and in the landscape areas.

We understand up to two feet of fill may be placed across the project site. The lower portion of the fat clay layer is medium to soft. In combination with building loads, we estimate settlements of about 1-inch for the majority of the site. However, Boring B-2 encountered deeper, soft clay soils that may experience greater consolidation settlement. These locations and possibly others may require preloading with a surcharge fill, depending on the amount of grade raise planned, building loads, and data obtained from our design-level exploration. The **General Comments** section provides an understanding of the report limitations.

Grade-Supported Floor Slabs: We recommend a layer (at least 24 inches) of low plasticity cohesive fill be provided below the grade-supported floor slab. Depending on the final grading plan, this may require undercut and replacement of on-site high plasticity soils.

Exterior Pavements: We recommend a layer of (at least 18 inches) of low plasticity cohesive fill be provided below exterior pavements. Depending on the final grading plan, this may require undercut and replacement of on-site high plasticity soils.

EARTHWORK

Site Preparation

Stripping of all vegetation, organic topsoil, and other materials unsuitable for re-use as engineered fill should be performed within all paving and building areas. A typical stripping depth of about 8 inches is expected to be adequate in most areas. However, areas of both deeper and shallower stripping could be encountered. A Terracon geotechnical representative should help evaluate actual stripping depths at the time of construction. Where feasible, we recommend site stripping and subgrade preparation procedures extend at least 5 feet beyond the building perimeter, and at least 2 feet beyond the edges of the proposed pavements.

The composition of the existing soil stockpile is not currently known. Investigation of this stockpile should be completed as part of the design-level exploration.

Depending on final design grades, additional excavation may be required in order to provide the 24 and 18 inches of low-plasticity, compacted fill recommended below floor slabs and pavements, respectively.

Prior to placing fill in areas to receive fill, the subgrade should be proofrolled in the presence of a Terracon geotechnical representative and upper 8 inches of existing soils should be scarified and recompacted. Proofrolling aids in providing a firm base for compaction of fill and delineating soft, or disturbed areas that may exist below subgrade level. Unsuitable areas observed at this time should be improved by scarification and recompaction or by undercutting and replacement with structural fill. Proofrolling may be accomplished with a fully loaded, tandem-axle, dump truck with a minimum gross weight of 25 tons or other equipment providing an equivalent subgrade loading.

Terracon should be retained to monitor stripping, subgrade stability, existing fill and structure removal, utility abandonment, site excavation, removal of unsuitable materials, and proofrolling. Terracon can assist in identifying existing fill soils or low-strength native soils that should be undercut and removed, as well as identifying additional corrective measures for conditions that may become apparent during construction.

Fill Material Types

Structural fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Low-plasticity, cohesive soil	CL (LL ≤ 45 and 10 ≤ PI ≤ 20) [2]	All locations and elevations.
Granular [3]	SP, SW, GW	Below interior slabs-on-grade.
On-site soil [4]	CH	Outside of building footprints and in areas deeper than 18 inches below bottom of paving.

1. Structural fill should consist of approved materials that are free of organic matter or debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. Each proposed fill material should be sampled and evaluated by the geotechnical engineer prior to its delivery and/or use.
2. LL = Liquid Limit, PI = Plasticity Index.
3. A well graded granular material, with 100 percent passing the 1-inch sieve, less than 6 percent passing the No. 200 sieve and less than about 40 percent passing the No. 40 sieve. Terracon can review proposed materials. Using crushed stone for this layer will improve subgrade stability during compaction and slab construction.
4. Sorting of topsoil and on-site soils containing debris, organics, etc., will be necessary. Delineation of unsuitable on-site soils should be performed in the field by a Terracon representative. Moisture conditioning of the on-site soils will be necessary to facilitate compaction.

Terracon should be retained to evaluate proposed fill materials, including sampling and performing laboratory tests on proposed fill to evaluate compliance with the project specifications. We can also review data for proposed materials which are generated by the contractor or suppliers.

Fill Compaction Requirements

Structural fill should meet the following compaction requirements.

Item	Structural Fill
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-operated equipment (i.e. jumping jack or plate compactor) is used 9 to 12 inches for a granular stabilization layer on soft or wet clay subgrade
Minimum Compaction Requirements [1, 2, 3, 4, 5]	98% of maximum below foundations and within 8 inches of finished pavement subgrade 95% of maximum above foundations, below floor slabs, and more than 8 inches below finished pavement subgrade
Water Content Range [6]	Low plasticity cohesive: -2% to +3% of optimum Existing Fat Clay Soils: 0% to +4% of optimum

1. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254).
3. Crushed stone / crushed concrete placed over a subgrade composed of wet or soft clay should not be overcompacted; overcompaction can cause subgrade disturbance and loss of strength of the underlying subgrade. In these areas, we recommend that the granular layer be drifted into place in advance of compaction equipment. Compaction be accomplished with 2 or 3 mutually perpendicular passes of each thin lift with light-weight vibratory compaction equipment. Instead of a strict compaction requirement, consideration should be given to using visual evaluation of material stability using factors such as surface stability and aggregate interlock when evaluating compaction and performance of the granular material.
4. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled or containing excess water (ponding).

Terracon should be retained to monitor fill placement and to perform field density tests as each lift of fill is placed in order to evaluate compliance with the design requirements. Terracon should be retained to observe and test floor slab and pavement subgrades immediately prior to paving.

Utility Trench Bedding and Backfill

All trench excavations should be made with sufficient working space to permit construction, including backfill placement and compaction. Utility trenches are a common source of water infiltration and migration. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of cohesive fill to reduce the infiltration and conveyance of surface water through the trench backfill.

We also recommend constructing an effective clay “trench plug” that extends at least 5 feet out from the face of the building exterior. The plug material should consist of either cementitious flowable fill or low permeability clay. The trench plug should be placed to completely surround the utility line.

Construction Considerations

Any areas of standing surface water should be drained as far in advance of construction as possible. Any saturated soils should be removed prior to placing fill or proceeding with construction.

The clays encountered in the borings will be sensitive to disturbance from construction activity and water seepage. If precipitation occurs immediately prior to or during construction, the near-surface clay soils could increase in moisture content and become more susceptible to disturbance. Construction activity should be monitored, and should be curtailed if the construction activity is causing subgrade disturbance. A Terracon representative can help with monitoring and developing recommendations to avoid subgrade disturbance.

Surface water should not be allowed to pond and soak into the soil during construction. Construction staging should provide drainage of surface water and precipitation away from the building and pavement areas. Any water that collects over or adjacent to construction areas should be promptly removed, along with any softened or disturbed soils. Surface water control in the form of sloping surfaces, drainage ditches and trenches, and sump pits and pumps will be important to avoid ponding and associated delays due to precipitation and seepage.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Safety and Health Administration (OSHA) regulations to provide stability and safe working conditions. Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Exterior Grading

Poor site drainage and ponding of surface water can increase the potential for frost heave or settlement. Excessive moisture can reduce bearing capacity and contribute to slab and pavement settlement and cracking.

Finished grading slopes should promote drainage away from the buildings and pavements. We recommend final grades for seeded and landscaped areas be sloped at least 5 percent within 10 feet around the buildings. We recommend cohesive backfill be placed in utility trenches and adjacent to building foundations, and this fill be compacted to at least 95 percent of standard Proctor maximum dry density to help prevent surface water infiltration. Roof drains should be extended to discharge on pavements or in lawn areas more than 5 feet from the buildings. Pavements or sidewalks installed adjacent to the building should slope away from the building at a grade of 2% or more.

Overwatering of grass or landscaping vegetation is a significant source of water, and should be avoided near the buildings and pavements. Sprinkler heads should be adjusted to miss the exterior building walls and pavements. Automated watering systems should be programmed to not run after natural rain events, and to not overwater. Any utility leaks should be promptly repaired. Lining the bottom of irrigated planter areas along the buildings with an impermeable moisture barrier, and installing tile lines leading to gravity outlets or sump pits and pumps, would also help to control surface water that infiltrates into these features.

SHALLOW FOUNDATIONS

Preliminary Design Parameters – Compressive Loads

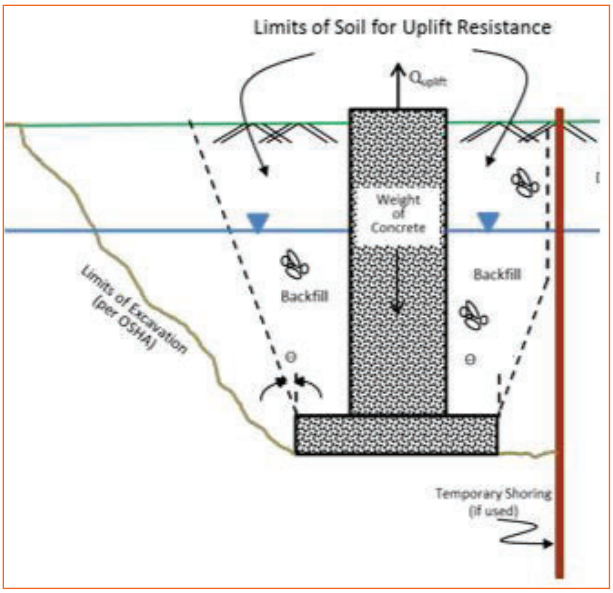
In our opinion, the proposed buildings can be supported by a shallow, spread footing foundation system bearing on tested and approved soil. Preliminary design recommendations for shallow foundations for the proposed additions are presented in the following table.

Preliminary Design Recommendations – Spread Footing Foundations		
Description	**Column**	**Wall**
Net allowable soil bearing pressure [1, 6]	2,000 psf	2,000 psf
Minimum dimensions	30 inches	18 inches
Minimum embedment [2]	42 inches	42 inches
Estimated total settlement [3]	< 1 inch	< 1 inch
Estimated differential settlement [3]	2/3-inch between columns	2/3-inch over 30 feet
Equivalent fluid pressure [4]	290 pcf	
Ultimate coefficient of sliding friction [5]	0.4	

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any fill, or disturbed or soft soils, will be undercut and replaced with engineered fill.
2. For perimeter footings and footings in unheated areas. For frost protection and to reduce the effects of seasonal moisture variations in the subgrade soils. If construction extends into freezing weather, we recommend that either all footings extend to frost depth (as measured from adjacent grade at the time of construction) or that the foundations be protected from the elements by straw, frost blankets, or similar means.
3. The foundation settlement will depend upon the variations within the soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations. The above settlement estimates assume the maximum footing size is 5 feet for column footings, 2 feet for continuous footings, and relatively uniform loading.
4. The sides of the excavation for the spread footing foundation must be nearly vertical and the concrete should be placed neat against these vertical faces for the passive earth pressure values to be valid. If the loaded side is sloped or benched and then backfilled, the allowable passive pressure will be significantly reduced. Passive resistance in the upper 42 inches of the soil profile should be neglected.
5. Neglect for foundations subject to net uplift conditions.
6. Ground improvement may be considered in order to increase the allowable bearing pressure or reduce potential settlement. Additional discussion would be provided, if deemed appropriate for the project, in the design-level geotechnical report.

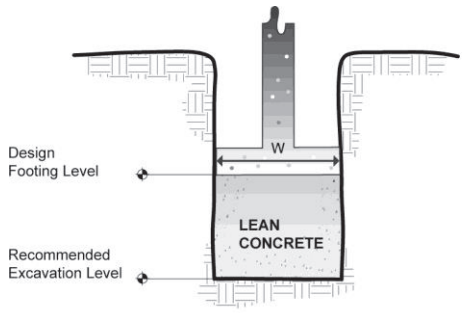
Preliminary Design Parameters - Uplift Loads

Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils. As illustrated on the subsequent figure, the effective weight of the soil prism defined by diagonal planes extending up from the top of the perimeter of the foundation to the ground surface at an angle, θ, of 20 degrees from the vertical can be included in uplift resistance. The maximum allowable uplift capacity should be taken as a sum of the effective weight of soil plus the dead weight of the foundation, divided by an appropriate factor of safety. A maximum total unit weight of 100 pcf should be used for the backfill. This unit weight should be reduced to 40 pcf for portions of the backfill or natural soils below the groundwater elevation.

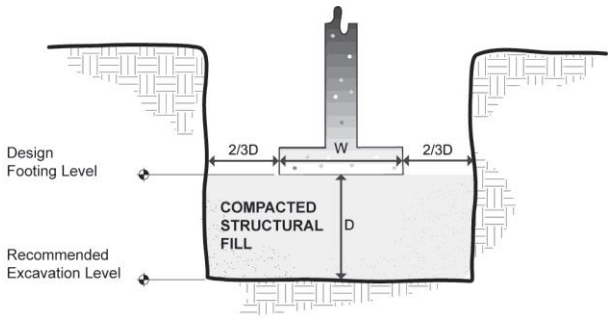


Foundation Construction Considerations

Terracon should be retained to observe and test the bearing materials exposed in all foundation excavations. If disturbed or otherwise unsuitable bearing materials are encountered in a footing excavation, the excavation should be extended deeper, as necessary, to suitable materials. The footing could bear directly on the suitable materials at the lower level or on lean concrete backfill placed back up to design bearing level. The footings could also bear on approved, properly compacted backfill extending down to the suitable materials. Overexcavation for compacted backfill placement below footings should extend laterally at least 8 inches beyond the edges of the footings for each foot of depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation with approved fill placed and compacted as recommended in **Earthwork**. The adjacent figures depict these options.



Lean Concrete Backfill



Overexcavation / Backfill

NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

The clay soils on this site are susceptible to disturbance from construction activities, particularly if the soils have high natural moisture contents or become wetted by surface water or seepage. Care should be taken during excavation and construction of footings to avoid disturbing the bearing soils. The base of all foundation excavations should be free of water and loose material prior to placement of concrete. Concrete should be placed within a few hours after excavating to reduce disturbance of the bearing materials. If the materials at bearing level become excessively dry, disturbed or saturated, the affected material should be removed prior to placing concrete.

SEISMIC CONSIDERATIONS

Based upon the results of the borings, we estimate the project site as "Site Class D" according to the 2018 International Building Code (IBC), which references Chapter 20 of ASCE-7. This site class assumes that soils similar to the native soils encountered at the bottom of the borings and cone soundings continue to a depth of 100 feet. A more detailed and accurate Site Class evaluation can be achieved by retaining Terracon to perform a deeper soil boring, to perform a cone sounding with shear wave measurements, or to use the SeisOpt®ReMi™ method to develop the full depth shear wave profile.

FLOOR SLABS

Preliminary Design Recommendations

Item	Description
Floor slab support [1]	Aggregate base (see below) underlain by low-plasticity cohesive fill prepared according to **Earthwork.**
Modulus of subgrade reaction [2]	100 pounds per square inch per inch (psi/in) for point loading conditions.
Aggregate base course/capillary break [3]	4 inches of free draining granular material

1. Floor slabs should be structurally independent of any building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction will be lower.
3. The floor slab design should include a capillary break, comprised of compacted, granular material, as described in **Earthwork**.

Slabs-on-grade should be isolated from structures and utilities to allow independent movement. Joints should be constructed at regular intervals as recommended by the American Concrete Institute (ACI) to help control the location of any cracking. Keyed and doweled joints should be

considered. The owner should be made aware that differential movement between the slabs and foundations could occur.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Construction Considerations

On most project sites, the floor slab subgrades are developed early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of base rock and concrete and corrective action will be required.

We recommend the floor slab subgrade be rough graded and then proofrolled with a loaded tandem axle dump truck prior to fine grading and placement of base rock. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with compacted fill. All floor slab subgrades should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the aggregate base course and concrete.

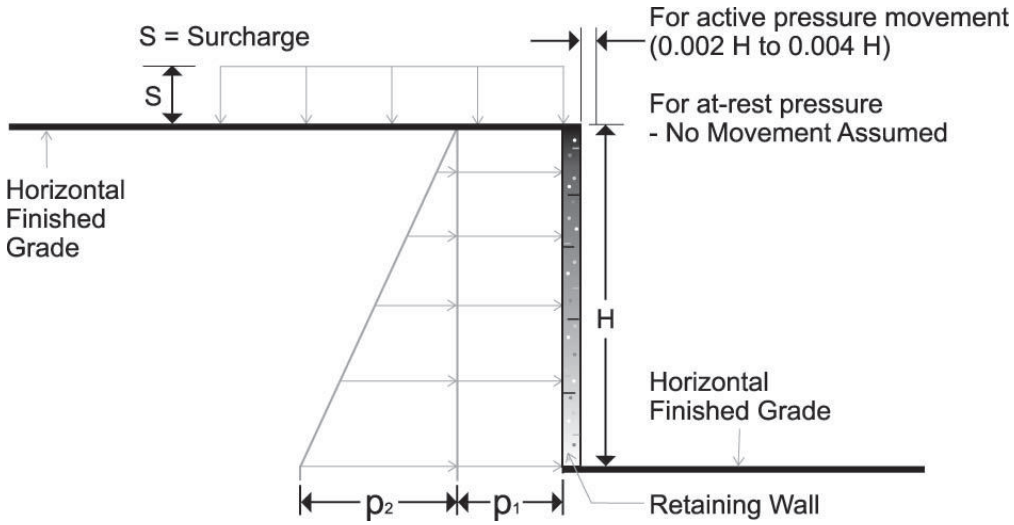
Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and. positive drainage of the aggregate base beneath the floor slab.

LATERAL EARTH PRESSURES

Design Parameters

The lateral earth pressure recommendations given in this section are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular-block retaining walls (also termed segmental retaining walls).

Reinforced concrete walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement. The recommended design lateral earth pressures do not include a factor of safety and do not provide for hydrostatic pressure on the walls.



Earth Pressure Coefficients				
Earth Pressure Conditions	**Coefficient for Backfill Type**	**Equivalent Fluid Density (pcf)**	**Surcharge Pressure, p_1 (psf)**	**Earth Pressure, p_2 (psf)**
Active (Ka)	Granular - 0.33	40	(0.33)S	(40)H
	Lean Clay - 0.42	50	(0.42)S	(50)H
At-Rest (Ko)	Granular - 0.46	55	(0.46)S	(55)H
	Lean Clay - 0.56	67	(0.56)S	(67)H
Passive (Kp)	Granular - 3.0	360	---	---
	Lean Clay - 2.4	290	---	---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 **H** to 0.004 **H**, where **H** is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance.
- Uniform surcharge, where **S** is surcharge pressure
- In-situ soil backfill weight a maximum of 120 pcf
- Horizontal backfill, compacted between 95 and 98 percent of standard Proctor maximum dry density
- No hydrostatic pressure acting on wall
- No loading from compaction equipment
- No loading from nearby footings or slabs
- No dynamic loading
- No safety factor included in soil parameters
- Ignore passive pressure in frost zone

Backfill placed against structures should consist of granular drainage fill or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively. To calculate the resistance to sliding, a value of 0.45 should be used as the ultimate coefficient of friction between the footing and the underlying soil.

To control the water level behind the retaining wall, we recommend a perimeter drain be installed behind the wall as described in **Drainage of Cantilever Retaining Walls**. If this is not possible, then combined hydrostatic and lateral earth pressures should be calculated using the values shown in the following table.

Undrained Lateral Earth Pressure Parameters		
Backfill Type	**Active Condition [1, 2]**	**At-Rest Condition [1, 2]**
Clay Backfill	85 pcf	96 pcf
Granular Backfill	83 pcf	91 pcf

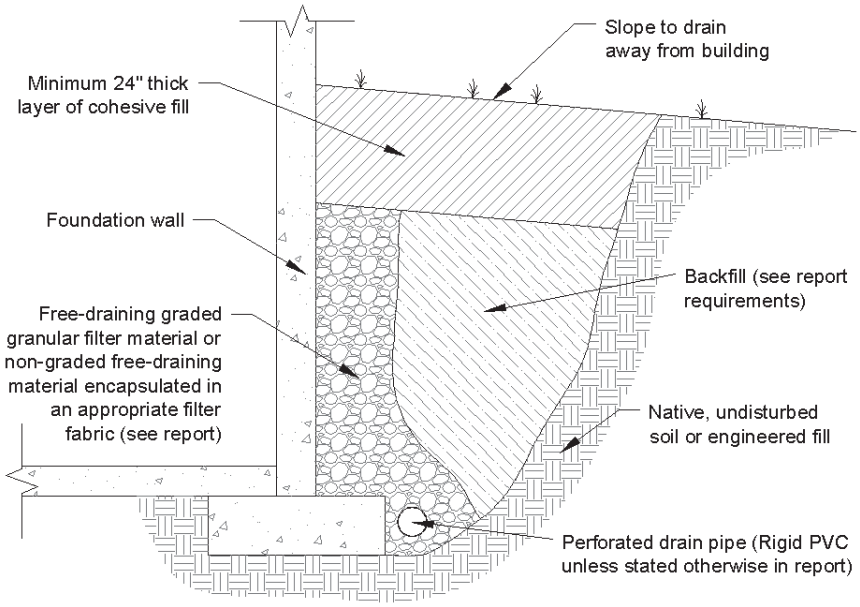
1. These pressures do not include the influence of surcharge, equipment, or floor loading, which should be added.
2. Calculated using a saturated soil unit weight of 125 pcf.

These pressures do not include the influence of surcharge, equipment or floor loading, which should be added. Footings and other loads located adjacent to walls may have a significant effect on lateral pressures. Placement of footings in wall backfill should be avoided unless structural analyses are performed to evaluate the resulting loads and effects on the wall. To avoid excessive lateral wall loads, heavy compaction equipment should not be operated within a distance out from new or existing walls equal to the height above the base of the wall.

Drainage of Cantilever Retaining Walls

A perforated rigid plastic or metal drain line should be installed behind the walls to prevent hydrostatic loading on the walls. The invert of a drain line around the walls should be at least 6 inches below the adjacent slabs. The drain line should be sloped to provide positive gravity drainage to a sump or other suitable outlet. The drain line should be surrounded by free-draining granular material graded to prevent the intrusion of soil fines into the granular material or the intrusion of the granular material into the drain pipe perforations. Alternatively, a coarse, clean, free-draining granular material could be used to surround the pipe if this material is encapsulated with suitable filter fabric.

At least a 2-foot wide section of free-draining granular fill is recommended for backfill above the drain line and adjacent to the wall and should extend up to the slab; if the drain pipe is around the exterior of the building, then a cohesive fill cap should be installed as shown in the schematic.



A prefabricated drainage structure may be used above a drain line and the surrounding filter, in lieu of free-draining granular fill. A prefabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion, and is fastened to the wall prior to placing backfill.

PAVEMENTS

General Pavement Comments

At a minimum, pavement subgrades should be prepared in accordance with the recommendations presented in **Earthwork**. Typical construction in this area is not to place a granular base below exterior pavements for this type of project. Rather, the exterior pavements are supported directly on the cohesive subgrade soils. We have provided preliminary recommendations for pavement sections for full depth pavements over clay subgrade. However, the incorporation of a drained granular base may be considered to significantly improve the pavement performance and anticipated life. If the project design results in a granular base being installed below exterior pavements, Terracon should be retained to provide additional recommendations. For example, subdrains are recommended in conjunction with a granular base to prevent water from ponding in the granular base. If a granular base is not incorporated, we recommend finger drains surrounded by drainage aggregate be installed in low areas of the pavement to allow drainage of surface water that infiltrates into the subgrade.

Preliminary Design Recommendations

We recommend the following pavement sections:

- Standard Duty Pavements: For parking areas subjected to low volumes of automobile traffic, a full-depth ACC section having a total thickness of at least 6 inches, or a PCC pavement section having a thickness of at least 5 inches, is recommended.

- Heavy-Duty Pavements: Entry drives and truck driveways require increased pavement thicknesses. A minimum 8-inch thick ACC section or a minimum 7-inch thick PCC section, is recommended in these areas.

- Truck Pads: A minimum 8-inch thick PCC section is recommended for aprons in truck loading docks, delivery truck parking areas, and refuse pick-up areas. Such areas should have a concrete section wide enough to accommodate the vehicles that would use it. (Thickness is only sufficient for limited truck traffic. Pavement thickness for truck aprons or areas of significant truck traffic should be determined based on a pavement thickness analysis.)

We recommend that ACC pavement specifications reference Chapter 5, Section 5D-1 of the 2021 Statewide Urban Design and Specifications (SUDAS). For ACC mix design, we recommend that Tables 1 and 2 from Section 5D-1 be referenced.

Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. Joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer. The contractor should submit a joint layout plan for approval by the engineer prior to placement of concrete. The plan should identify the location of all joints in the pavement which should be designed to avoid acute angles in accordance with the guidance in ACI 330R-33 sections 3.7, 3.11 and Figure C.1 *Typical Joint Layout for Parking Area.*

Where practical, we recommend early-entry cutting of crack-control joints in PCC pavements. Cutting of the concrete in its "green" state typically reduces the potential for micro-cracking of the pavements prior to the crack control joints being formed, compared to cutting the joints after the concrete has fully set. Micro-cracking of pavements may lead to crack formation in locations other than the sawed joints, and/or reduction of fatigue life of the pavement.

We recommend joints be sealed to help prevent moisture infiltration, including a sprayed concrete sealer and a hot-pour joint sealer. The use of backer rods is not recommended.

In addition to the joint sealing recommendations above, modifying the concrete mix can also be considered to improve the durability of the concrete. To reduce Alkali Silica Reactivity (ASR) and help reduce the concrete permeability, consideration should be given to using Type IP and IPF (Duracem F) cement. Other pozzolans such as slag can also be considered to decrease permeability. We also recommend a water-reducing admixture be utilized to facilitate a water-cement ratio of not more than 0.42, preferably closer to 0.4. A ready-mixed concrete producer, local to the project, should be consulted regarding mix performance and material availability. In addition, a mix design prepared in accordance with ACI 211.5R should be submitted for review by the design team prior to construction.

A formal pavement design has not been completed for this project. The above recommended pavement sections are typical minimum values and thicker pavement sections could be used to reduce maintenance and extend the expected service life of the pavements. Periodic maintenance will also extend the service life of the pavements and should include patching and repair of deteriorated areas, crack sealing, and surface sealing. We recommend that a California Bearing Ratio (CBR) test and a formal pavement design be completed if unusually high vehicle loads or frequencies are anticipated.

Construction Considerations

Construction scheduling often involves grading and paving by separate contractors and can involve a time lapse between the end of grading operations and the commencement of paving. Disturbance, desiccation or wetting of the subgrade soils between grading and paving can result in deterioration of the previously completed subgrade. A non-uniform subgrade can result in poor pavement performance and local failures relatively soon after pavements are constructed. We recommend the moisture content and density of the top 1 foot of the subgrade be evaluated within two days prior to commencement of actual paving operations. A proof roll using heavy equipment similar to that required for pavement construction is also recommended to verify subgrade stability for pavement construction. Scarification and recompaction may also be required.

Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and recompacted. If significant precipitation occurs after the evaluation or if the surface becomes disturbed, the subgrade condition should be reviewed by Terracon personnel immediately prior to paving.

Drainage Considerations

Preventing subgrade saturation is an important factor in maintaining the subgrade strength. Water allowed to pond on or next to pavements could saturate the subgrade and cause premature pavement deterioration. Positive surface drainage should be provided away from the edges of paved areas, and all pavements should be sloped to provide rapid surface drainage. Pavements should drain toward the edges rather than the center, and perimeter subsurface drains should be installed next to irrigated planters or other areas where surface water could pond.

FROST CONSIDERATIONS

The clayey soils on this site are considered frost susceptible. Grade-supported exterior slabs and unheated slabs within the building are expected to heave. The amount of heave may be reduced by providing surface drainage away from the building and slabs and toward the site storm drainage system. Structural stoops are recommended adjacent to exterior doors and other movement-sensitive exterior slabs. Consideration should be made to installing drain-tile around the perimeter of exterior slabs that connect directly to the storm drainage system to help further reduce the potential for frost heave. Installing finger drains along low points and around intakes should also be considered.

GENERAL COMMENTS

The preliminary discussions and recommendations presented in this report are based upon the limited data obtained from the widely-spaced borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations which may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until additional subsurface exploration is performed, or during or after construction.

Terracon should be retained to provide the additional subsurface exploration once the structure and building locations, layout, roadway, structural loads, and grading are determined. Upon completion of the additional exploration and preparation of our geotechnical engineering report, Terracon should be retained to review the design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction, and other earth-related construction phases of the project.

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

Our services and any correspondence or collaboration are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Boring Layout and Elevations: Terracon personnel provided the boring layout. The drill crew staked the boring and cone sounding locations relative to existing physical features at the site. Distances were measured with a mechanical wheel and right angles for these measurements were estimated. The locations of the borings and cones should be considered accurate only to the degree implied by the means and methods used to define them. If more precise locations are desired, we recommend borings be surveyed following completion of fieldwork.

The elevation shown on the boring logs and cone soundings were measured by the drill crew using a surveyor's level and rod, and rounded to the nearest ½ foot. The elevations were measured relative to the north flange bolt of the existing fire hydrant located on the north side of Metro Drive, north of Boring B-1. An elevation of 100 feet was assigned to this benchmark. The elevation of the boring should be considered accurate only to the degree implied by the means and methods used to define it.

Subsurface Exploration Procedures: We advanced the borings with an ATV-mounted rotary drill rig using continuous-flight hollow-stem augers. Samples were obtained using thin-walled tube and split-barrel sampling methods. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. The samples were placed in appropriate containers and taken to our soil laboratory for testing and review.

Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Typed boring logs were prepared from the field logs, and represent the engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Cone soundings were performed with a piezometric electronic cone penetrometer (CPTU) at the locations indicated on the attached diagram. CPT testing is conducted in general accordance with ASTM D5778 "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils." This device includes a cone-tipped sounding unit attached to steel rods with flush joint couplings. The sounding unit has electronic strain gauges that measure point resistance and sleeve friction, a transducer that measures pore water pressure, and an inclinometer

that measures verticality of the sounding unit. The readings from the cone instruments are transmitted via a cable to a computer at the surface that stores the data and provides real-time display of the cone results. A depth encoder device monitors penetration depth and speed as the rods are pushed slowly into the ground. The cone unit records the measured values at 2-cm intervals.

The data from the soundings are plotted and included in **Exploration Results**. No soil samples are gathered through this subsurface investigation technique. The soil behavior types notes on the plots are based on empirical correlations and should be evaluated accordingly.

In addition to the q_c and fs readings obtained as described above, we also performed shear wave tests in the sounding. The shear wave tests were conducted by placing a concrete beam on the ground and striking the beam with a hammer. The time for the shear wave to transmit through the soil was then recorded by a receiver embedded in the cone tip. The shear wave tests were performed at about 1-meter (3.281-foot) intervals for the entire depth of the cone sounding. The data were plotted and interpreted by our engineers. The shear wave data are presented on the SCPTu data plot in the **Exploration Results** section of this report.

Laboratory Testing

Water content tests were performed on the samples, and density determinations were performed on the thin-walled tube samples. Unconfined compression tests were performed on selected thin-walled tube samples. The unconfined compressive strength of many samples was estimated with a hand penetrometer test. In addition, Atterberg Limits tests were performed on two selected samples. The results of these laboratory tests are provided on the boring.

The samples were classified in the laboratory based on visual observation and texture. Additional laboratory testing could be performed to more accurately classify the samples. The soil descriptions presented on the boring logs for native soils are in general accordance with the General Notes and Unified Soil Classification System (USCS), both of which are included in **Exploration Results**. The estimated group symbol for the USCS is also shown on the boring logs, and a brief description of the USCS is included in **Exploration Results**.

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

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan
Exploration Plan

SITE LOCATION

Lake Manawa Centre ■ Council Bluffs, IA
February 9, 2021 ■ Terracon Project No. 05215015

Terracon GeoReport

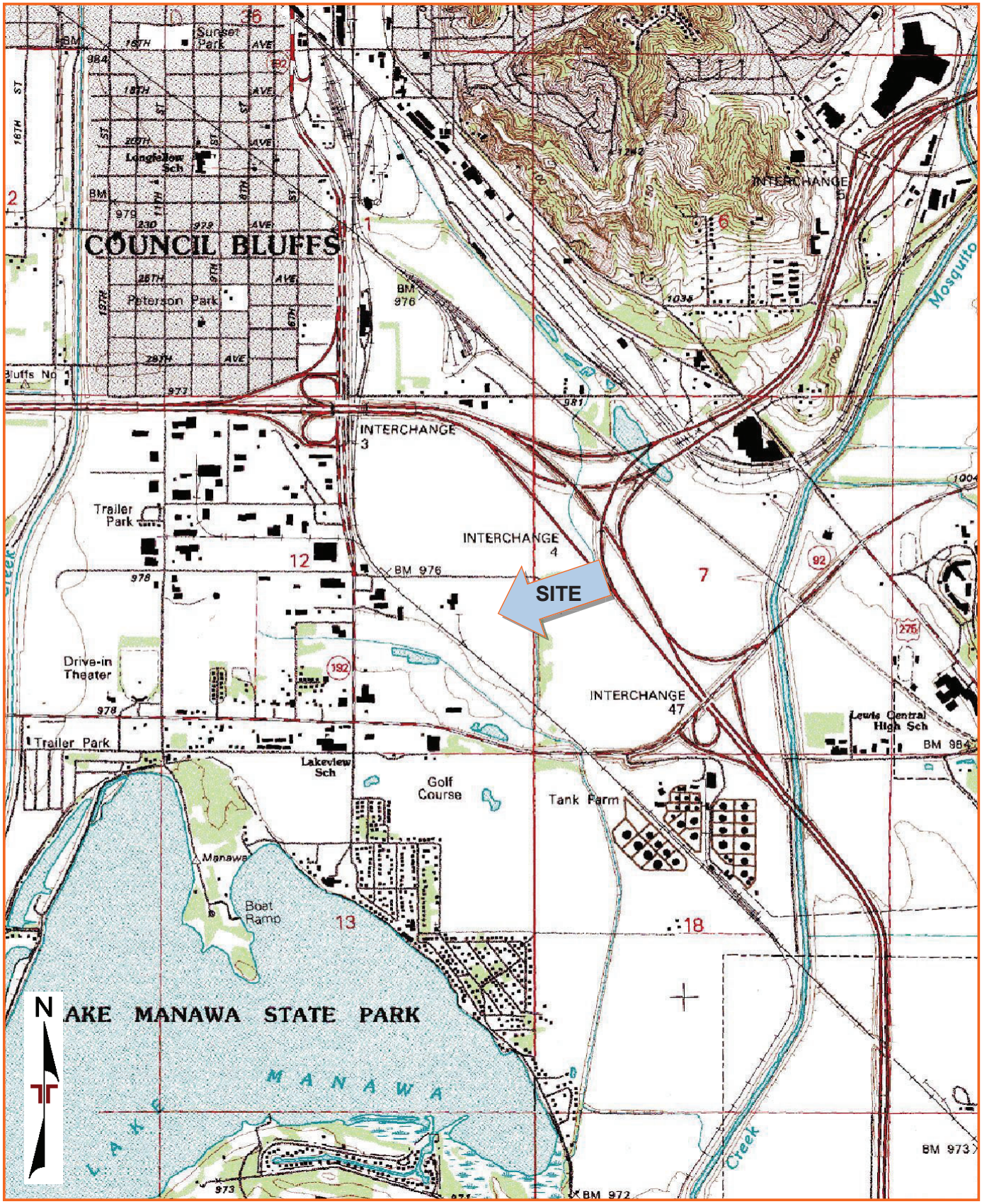


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: COUNCIL BLUFFS SOUTH, IA (1/1/1994).

EXPLORATION PLAN

Lake Manawa Centre ■ Council Bluffs, IA
February 9, 2021 ■ Terracon Project No. 05215015

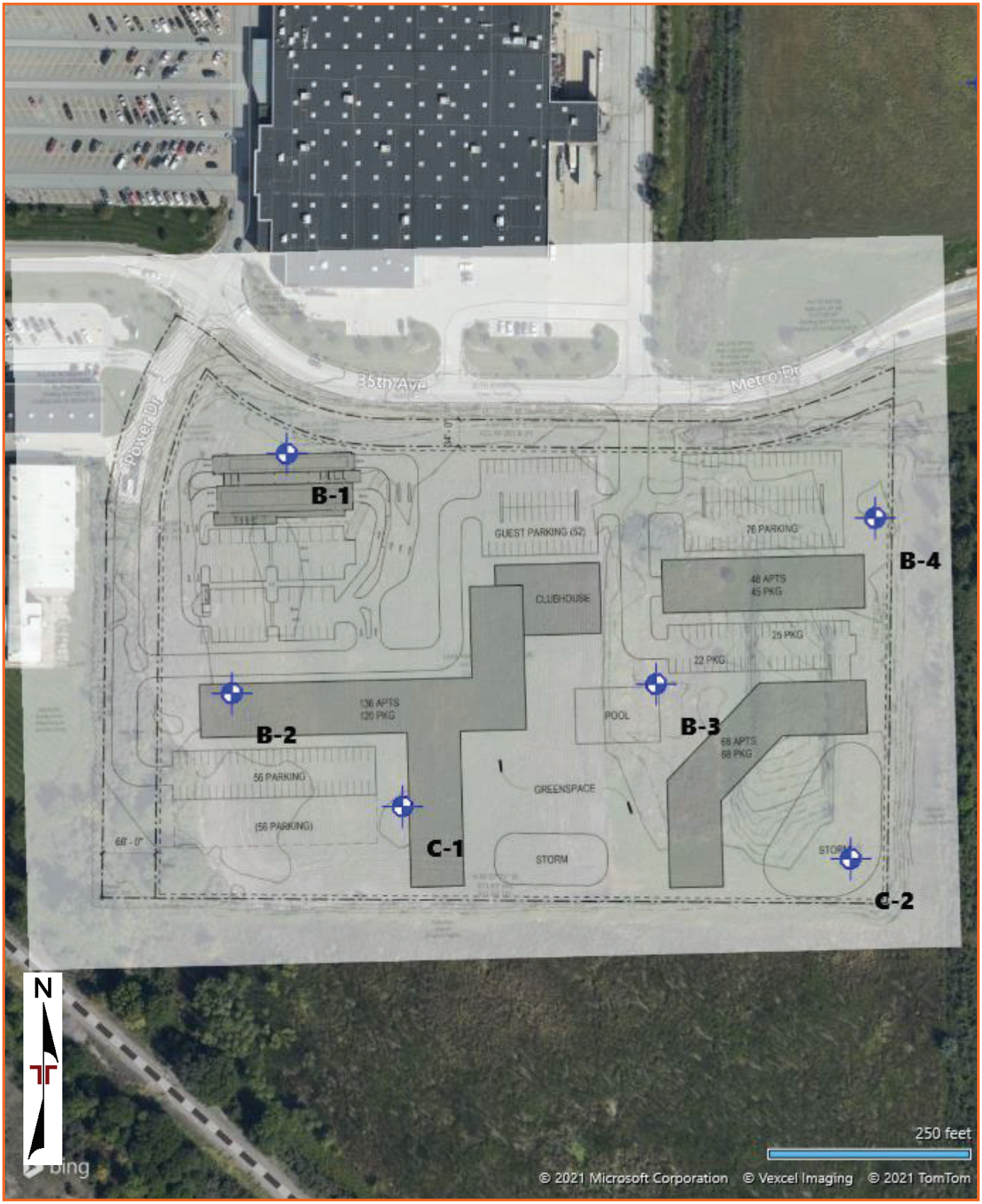


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Logs
Cone Sounding Logs
Atterberg Limits Results Data Plot

BORING LOG NO. B-1

PROJECT: Lot 10 Retail Development

CLIENT: DP Management, LLC
Omaha, NE

SITE: Metro Dr
Council Bluffs, IA

LOCATION See Exhibit A-2

Approximate Surface Elev: 95.5 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
						7		3000 (HP)		30	83	66-21-45
						10		2000 (HP)	2010	36	84	
			5									
						20		2000 (HP)	1550	40	78	
						6		1500 (HP)		38	79	
			10									
				▽		13		1000 (HP)		28	91	
			15									
18.5	77+/-											
						18	1-0-1 N=1			25		
			20									
						18	9-18-13 N=31			24		
			25									
30.0	65.5+/-					18	5-3-7 N=10			20		
			30									
			35									

Grass with a shallow root zone at surface.

FAT CLAY (CH), gray, stiff to soft

brown at 3 to 5 ft

FINE SAND (SP), with silt, gray, loose

dense at 23.5 to 25 ft

medium dense at 28.5 to 30 ft

Boring Terminated at 30 Feet

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.

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

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *14 ft While Sampling*

Terracon
15080 A Circle
Omaha, Nebraska

Boring Started: 6/5/2013 | Boring Completed: 6/5/2013

Drill Rig: #958 | Driller: M. Ramirez

Project No.: 05135060 | Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO LOG-DEPTH TO BOTTOM OF PAGE 05135060 LOGS.GPJ TERRACON2012.GDT 7/15/13

BORING LOG NO. B-2

PROJECT: Lot 10 Retail Development

CLIENT: DP Management, LLC
Omaha, NE

SITE: Metro Dr
Council Bluffs, IA

LOCATION See Exhibit A-2

Approximate Surface Elev: 96 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
		Grass with a shallow root zone at surface.
		FAT CLAY (CH), gray, stiff to soft
		brown at 3 to 5 ft
		sand seam at 13 ft
15.0	81+/-	
		FINE SAND (SP), with silt, gray, loose
		medium dense at 23.5 to 25 ft
30.0	66+/-	
		Boring Terminated at 30 Feet

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		10		4500 (HP)	3180	32	86	
		7		2500 (HP)		30	91	
5								
		11		1500 (HP)	1640	40	79	
		5		1000 (HP)		35	87	
10								
		16	0-0-1 N=1			31		
15								
		17	1-1-1 N=2			22		
20								
		18	8-12-17 N=29			23		
25								
		18	3-3-4 N=7			27		
30								
35								

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.

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

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

18 ft While Sampling

Terracon
15080 A Circle
Omaha, Nebraska

Boring Started: 6/5/2013 | Boring Completed: 6/5/2013

Drill Rig: #958 | Driller: M. Ramirez

Project No.: 05135060 | Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO LOG-DEPTH TO BOTTOM OF PAGE 05135060 LOGS.GPJ TERRACON2012.GDT 7/15/13

BORING LOG NO. B-3

PROJECT: Lot 10 Retail Development

CLIENT: DP Management, LLC
Omaha, NE

SITE: Metro Dr
Council Bluffs, IA

LOCATION See Exhibit A-2

Approximate Surface Elev: 95.5 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		Grass with a shallow root zone at surface.									
		FAT CLAY (CH), dark gray, stiff to soft									
					6		2500 (HP)		32	88	
		grayish-brown from 3 to 8 ft			12		3000 (HP)	2240	40	82	
5											
					10		3000 (HP)	1910	37	82	
		gray below 8 ft			12		500 (HP)	1150	37	83	
10											
13.0	82.5+/-		▽								
		FINE SAND (SP), with silt, grayish-brown			14				26	94	
15											
		medium dense at 18.5 to 20 ft			18	6-8-13 N=21			20		
20											
		very loose at 23.5 to 25 ft			17	0-0-1 N=1			25		
25											
		loose at 28.5 to 30 ft			18	1-3-4 N=7			22		
30.0	65.5+/-										
		Boring Terminated at 30 Feet									
35											

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.

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

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *13 ft While Sampling*

Wet Cave In at 13 ft After Boring Completion

Terracon
15080 A Circle
Omaha, Nebraska

Boring Started: 6/5/2013 | Boring Completed: 6/5/2013

Drill Rig: #958 | Driller: M. Ramirez

Project No.: 05135060 | Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO LOG-DEPTH TO BOTTOM OF PAGE 05135060 LOGS.GPJ TERRACON2012.GDT 7/15/13

BORING LOG NO. B-4

PROJECT: Lot 10 Retail Development

CLIENT: DP Management, LLC
Omaha, NE

SITE: Metro Dr
Council Bluffs, IA

LOCATION See Exhibit A-2

Approximate Surface Elev: 96 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
		Grass with a shallow root zone at surface.
		FAT CLAY (CH), dark gray, stiff to soft
		grayish brown at 3 to 5 ft
		gray at 6 to 8 ft
8.0	88+/-	**SILTY SAND (SM)**, gray and brown
13.5	82.5+/-	**FINE SAND (SP)**, with silt, gray, very loose to medium dense
		loose at 28.5 to 30 ft
30.0	66+/-	***Boring Terminated at 30 Feet***

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY TORVANE/HP (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
			6		3500 (HP)		31	88	68-20-48
			10		2500 (HP)	2930	36	83	
5									
			5		2500 (HP)		39	81	
	▽		10		1000 (HP)		25	100	
10									
			18	1-0-1 N=1			23		
15									
			18	3-4-6 N=10			25		
20									
			18	10-10-6 N=16			24		
25									
			18	2-2-4 N=6			27		
30									
35									

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.

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

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *8 ft While Sampling*

Wet Cave In at 7 ft After Boring Completion

Terracon
15080 A Circle
Omaha, Nebraska

Boring Started: 6/5/2013 | Boring Completed: 6/5/2013

Drill Rig: #958 | Driller: M. Ramirez

Project No.: 05135060 | Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO LOG-DEPTH TO BOTTOM OF PAGE 05135060 LOGS.GPJ TERRACON2012.GDT 7/15/13

Terracon

Lot 10 Retail Development
Metro Drive (Council Bluffs,Iowa)
Project Number :05135060

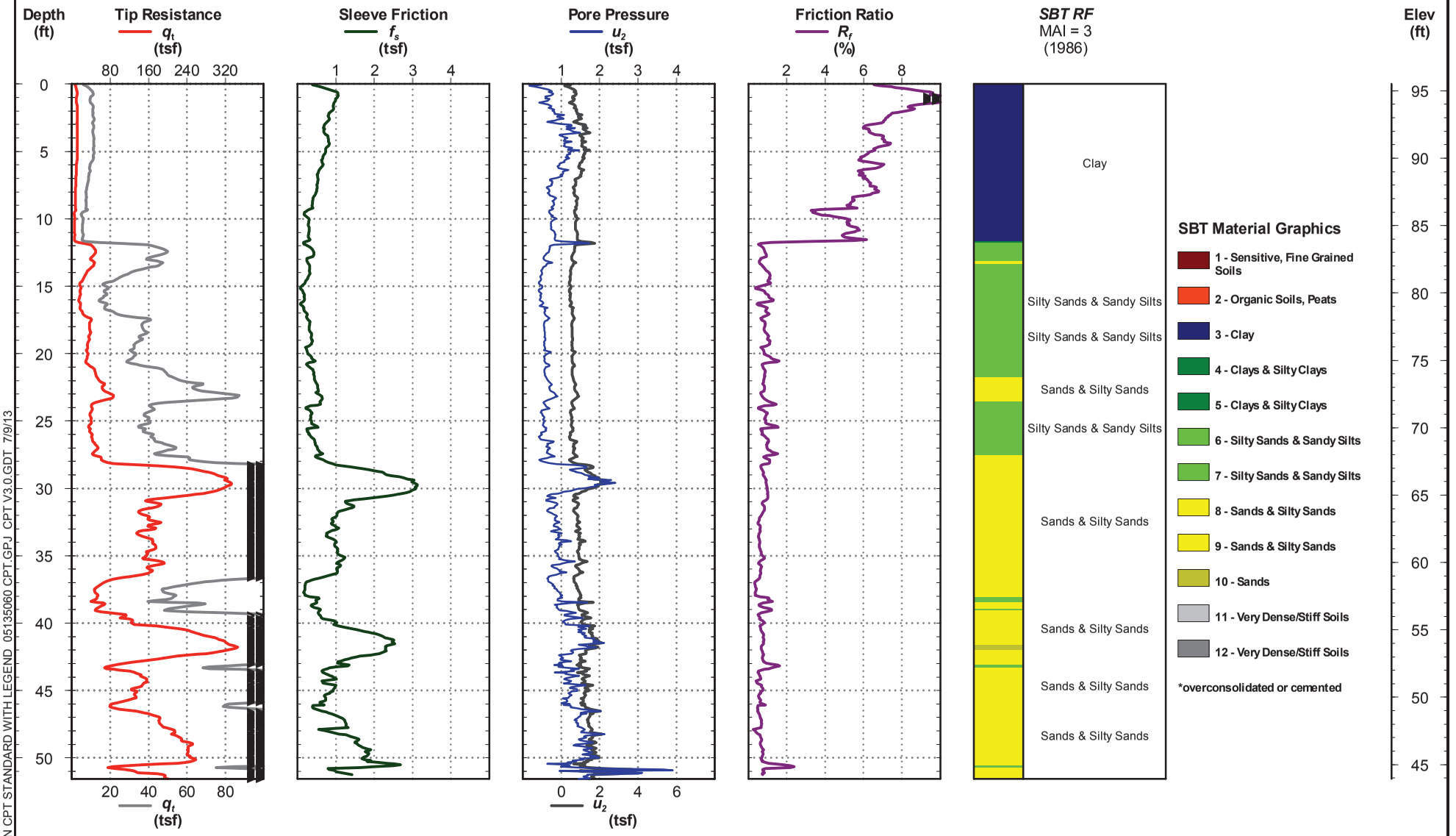
Cone Penetration Test

C-1

Date: Jun. 6, 2013
Estimated Water Depth:
Rig/Operator: Michael May

Northing:
Easting:
Elevation: 95.5

Total Depth: 51.6 ft
Note:
Cone Size: Hogentogler 10 cm2



TERRACON CPT STANDARD WITH LEGEND 05135060 CPT.GPJ CPT V3.0.GDT 7/9/13

Electronic File Name: 05135060C - 1.cpt

C-1

Terracon

Lot 10 Retail Development
Metro Drive (Council Bluffs,Iowa)
Project Number :05135060

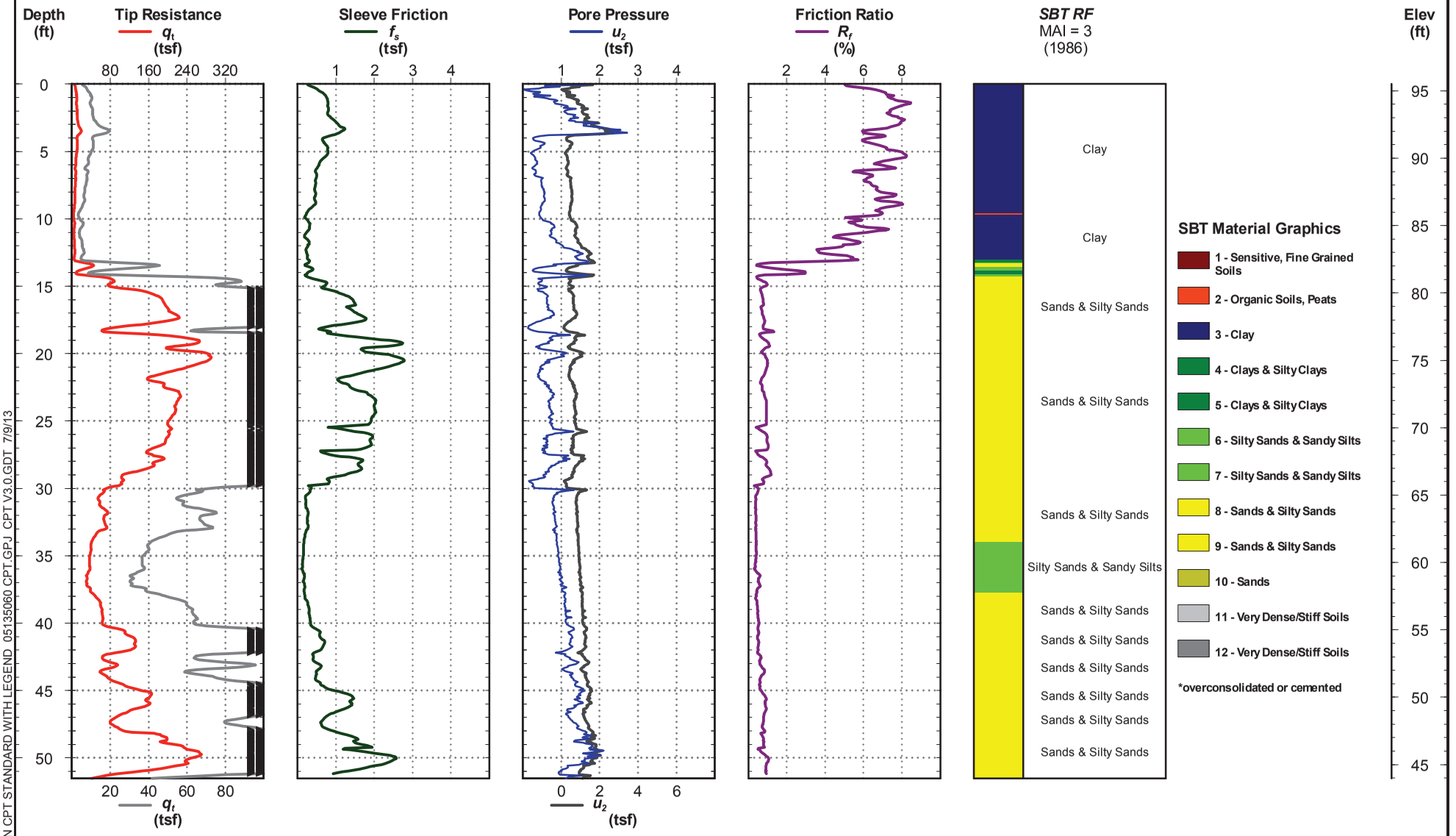
Cone Penetration Test

C-2

Date: Jun. 6, 2013
Estimated Water Depth:
Rig/Operator: Michael May

Northing:
Easting:
Elevation: 95.5

Total Depth: 51.5 ft
Note:
Cone Size: Hogentogler 10 cm2



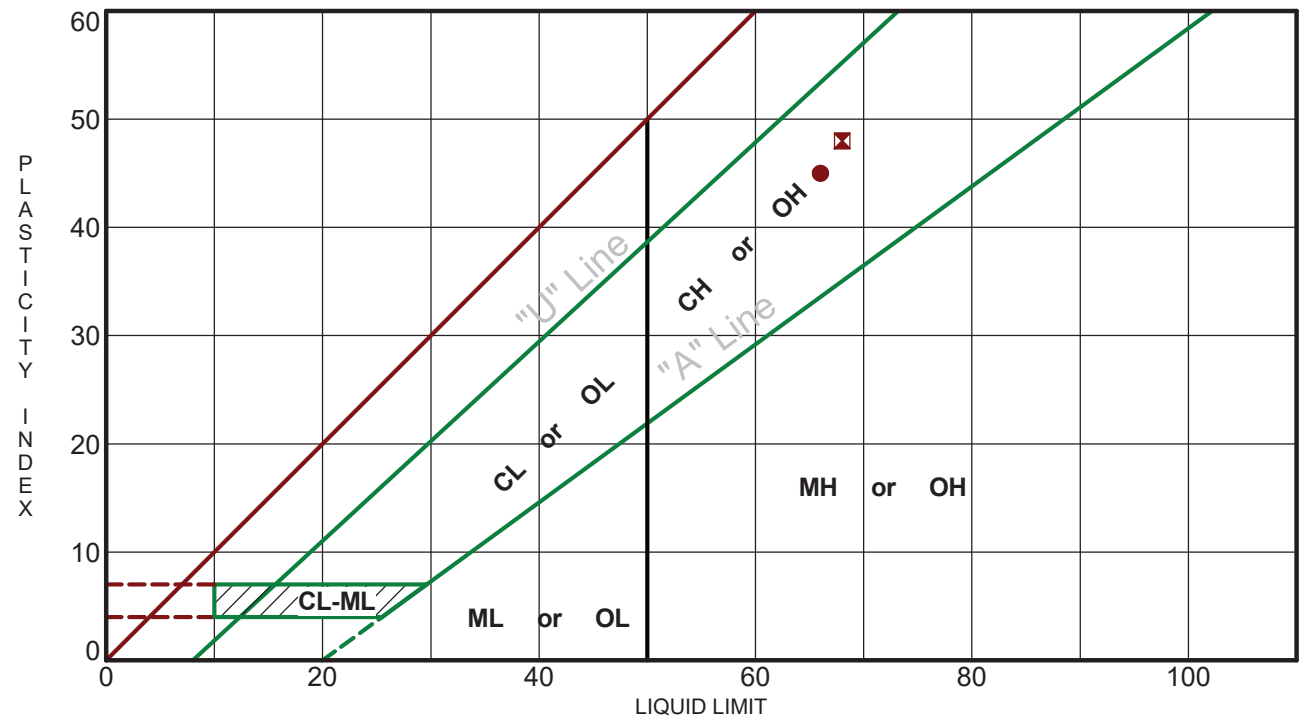
TERRACON CPT STANDARD WITH LEGEND 05135060 CPT.GPJ CPT V3.0.GDT 7/9/13

Electronic File Name: 05135060C - 2.cpt

C-2

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
● B-1	1 - 3	66	21	45			
⊠ B-4	1 - 3	68	20	48			

PROJECT: Lake Manawa Centre

SITE: 35th Ave and Power Dr
Council Bluffs, IA

Terracon
15080 A Cir
Omaha, NE

PROJECT NUMBER: 05215015

CLIENT: City Ventures, LLC
Omaha, NE

EXHIBIT: B-1

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 05215015 LAKE MANAWA CENTR.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

SUPPORTING INFORMATION

Contents:

General Notes
Unified Soil Classification System
CPT General Notes

GENERAL NOTES

SAMPLING	WATER LEVEL	FIELD TESTS
Shelby Tube	**Water Initially Encountered** **Water Level After a Specified Period of Time** **Water Level After a Specified Period of Time** **Cave In Encountered** Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**N** Standard Penetration Test Resistance (Blows/Ft.) **(HP)** Hand Penetrometer **(T)** Torvane **(DCP)** Dynamic Cone Penetrometer **UC** Unconfined Compressive Strength **(PID)** Photo-Ionization Detector **(OVA)** Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Terracon GeoReport

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

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

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

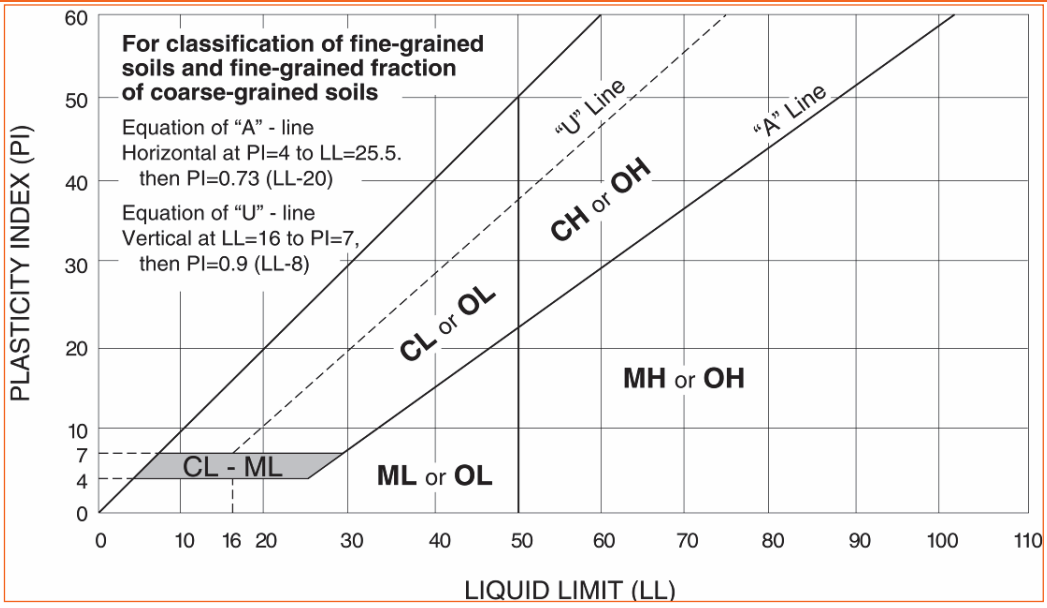
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



CPT GENERAL NOTES

DESCRIPTION OF MEASUREMENTS AND CALIBRATIONS

To be reported per ASTM D5778:

Uncorrected Tip Resistance, q_c
Measured force acting on the cone divided by the cone's projected area

Corrected Tip Resistance, q_t
Cone resistance corrected for porewater and net area ratio effects
$q_t = q_c + u_2(1 - a)$
Where a is the net area ratio, a lab calibration of the cone typically between 0.70 and 0.85

Pore Pressure, u
Pore pressure measured during penetration
u_1 - sensor on the face of the cone
u_2 - sensor on the shoulder (more common)

Sleeve Friction, f_s
Frictional force acting on the sleeve divided by its surface area

Normalized Friction Ratio, F_r
The ratio as a percentage of f_s to q_t, accounting for overburden pressure

To be reported per ASTM D7400, if collected:

Shear Wave Velocity, V_s
Measured in a Seismic CPT and provides direct measure of soil stiffness

DESCRIPTION OF GEOTECHNICAL CORRELATIONS

Normalized Tip Resistance, Q_{tn}
$Q_{tn} = ((q_t - \sigma_{v0})/P_a)(P_a/\sigma'_{v0})^n$
$n = 0.381(I_c) + 0.05(\sigma'_{v0}/P_a) - 0.15$

Over Consolidation Ratio, OCR
$OCR\ (1) = 0.25(Q_{tn})^{1.25}$
$OCR\ (2) = 0.33(Q_{tn})$

Undrained Shear Strength, S_u
$S_u = Q_{tn} \times \sigma'_{v0}/N_{kt}$
N_{kt} is a soil-specific factor (shown on S_u plot)

Sensitivity, S_t
$S_t = (q_t - \sigma_{v0}/N_{kt}) \times (1/f_s)$

Effective Friction Angle, ϕ'
$\phi'\ (1) = \tan^{-1}(0.373[\log(q_t/\sigma'_{v0}) + 0.29])$
$\phi'\ (2) = 17.6 + 11[\log(Q_{tn})]$

Unit Weight, γ
$\gamma = (0.27[\log(F_r)]+0.36[\log(q_t/atm)]+1.236) \times \gamma_{water}$
σ_{v0} is taken as the incremental sum of the unit weights

Small Strain Shear Modulus, G_0
$G_0\ (1) = \rho V_s^2$
$G_0\ (2) = 0.015 \times 10^{(0.55Ic + 1.68)}(q_t - \sigma_{v0})$

Soil Behavior Type Index, I_c
$I_c = [(3.47 - \log(Q_{tn}))^2 + (\log(F_r) + 1.22)^2]^{0.5}$

SPT N_{60}
$N_{60} = (q_t/atm) / 10^{(1.1268 - 0.2817Ic)}$

Elastic Modulus, E_s (assumes $q/q_{ultimate} \sim 0.3$, i.e. FS = 3)
$E_s\ (1) = 2.6\psi G_0$ where $\psi = 0.56 - 0.33\log Q_{tn,clean\ sand}$
$E_s\ (2) = G_0$
$E_s\ (3) = 0.015 \times 10^{(0.55Ic + 1.68)}(q_t - \sigma_{v0})$
$E_s\ (4) = 2.5q_t$

Constrained Modulus, M
$M = \alpha_M(q_t - \sigma_{v0})$
For $I_c > 2.2$ (fine-grained soils)
$\alpha_M = Q_{tn}$ with maximum of 14
For $I_c < 2.2$ (coarse-grained soils)
$\alpha_M = 0.0188 \times 10^{(0.55Ic + 1.68)}$

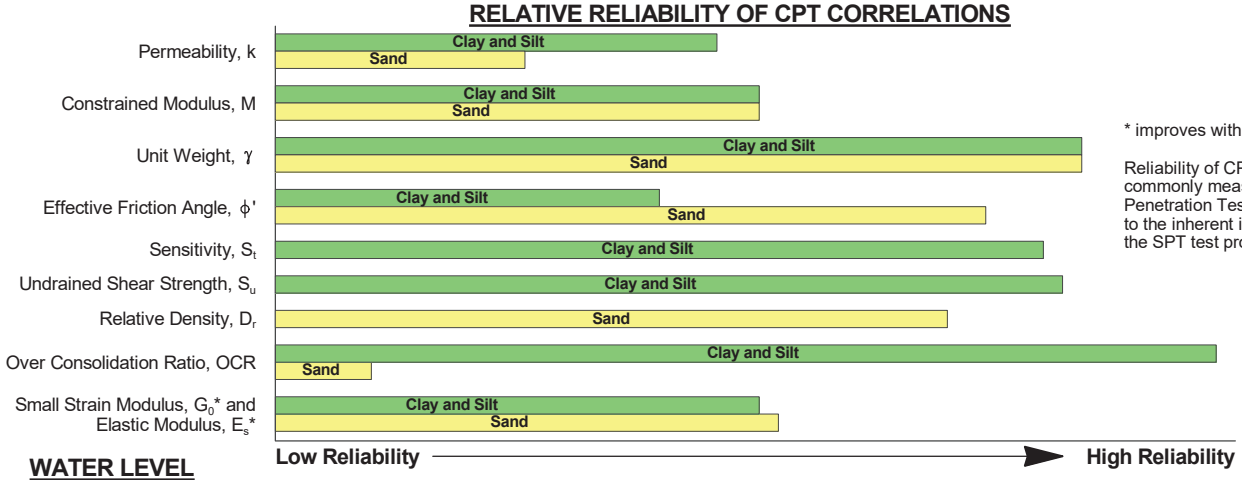
Hydraulic Conductivity, k
For $1.0 < I_c < 3.27$ $k = 10^{(0.952 - 3.04Ic)}$
For $3.27 < I_c < 4.0$ $k = 10^{(-4.52 - 1.37Ic)}$

Relative Density, D_r
$D_r = (Q_{tn} / 350)^{0.5} \times 100$

REPORTED PARAMETERS

CPT logs as provided, at a minimum, report the data as required by ASTM D5778 and ASTM D7400 (if applicable). This minimum data include q_t, f_s, and u. Other correlated parameters may also be provided. These other correlated parameters are interpretations of the measured data based upon published and reliable references, but they do not necessarily represent the actual values that would be derived from direct testing to determine the various parameters. To this end, more than one correlation to a given parameter may be provided. The following chart illustrates estimates of reliability associated with correlated parameters based upon the literature referenced below.

RELATIVE RELIABILITY OF CPT CORRELATIONS



* improves with seismic V_s measurements

Reliability of CPT-predicted N_{60} values as commonly measured by the Standard Penetration Test (SPT) is not provided due to the inherent inaccuracy associated with the SPT test procedure.

WATER LEVEL

The groundwater level at the CPT location is used to normalize the measurements for vertical overburden pressures and as a result influences the normalized soil behavior type classification and correlated soil parameters. The water level may either be "measured" or "estimated:"

Measured - Depth to water directly measured in the field

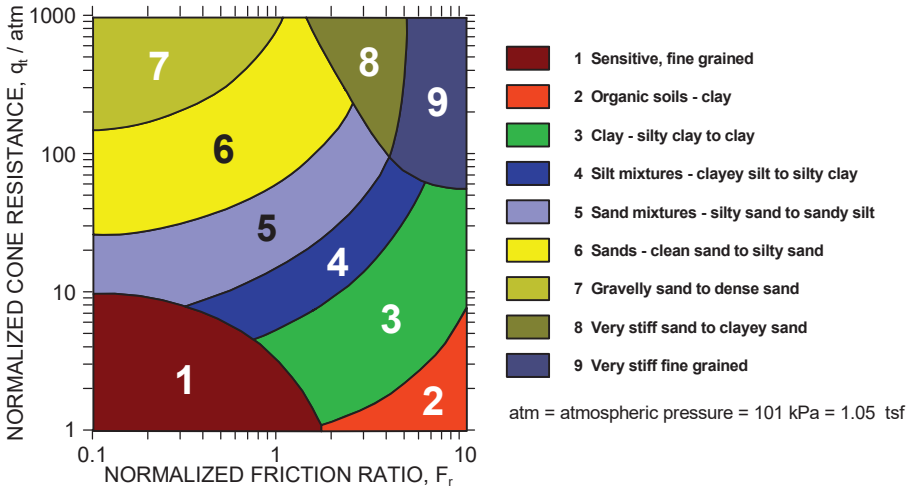
Estimated - Depth to water interpolated by the practitioner using pore pressure measurements in coarse grained soils and known site conditions

While groundwater levels displayed as "measured" more accurately represent site conditions at the time of testing than those "estimated," in either case the groundwater should be further defined prior to construction as groundwater level variations will occur over time.

CONE PENETRATION SOIL BEHAVIOR TYPE

The estimated stratigraphic profiles included in the CPT logs are based on relationships between corrected tip resistance (q_t), friction resistance (f_s), and porewater pressure (u_2). The normalized friction ratio (F_r) is used to classify the soil behavior type.

Typically, silts and clays have high F_r values and generate large excess penetration porewater pressures; sands have lower F_r's and do not generate excess penetration porewater pressures. The adjacent graph (Robertson *et al.*) presents the soil behavior type correlation used for the logs. This normalized SBT chart, generally considered the most reliable, does not use pore pressure to determine SBT due to its lack of repeatability in onshore CPTs.



atm = atmospheric pressure = 101 kPa = 1.05 tsf

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Mayne, P.W., (2013). "Geotechnical Site Exploration in the Year 2013," Georgia Institue of Technology, Atlanta, GA.

Robertson, P.K., Cabal, K.L. (2012). "Guide to Cone Penetration Testing for Geotechnical Engineering," Signal Hill, CA.

Schmertmann, J.H., (1970). "Static Cone to Compute Static Settlement over Sand," *Journal of the Soil Mechanics and Foundations Division*, 96(SM3), 1011-1043.

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Exhibit: