Appendix G

Geotechnical Engineering Report

Raising Cane's Restaurant (RC-1051) – Victorville

Geotechnical Engineering Report

Prepared for:

Raising Cane's Restaurant, LLC
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July 28, 2023

Raising Cane's Restaurant, LLC
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Attn: Ms. Kristen Roberts
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Re: Geotechnical Engineering Report
Raising Cane's Restaurant (RC-1051) – Victorville
North of Roy Rogers Drive and West of Civic Drive
Victorville, San Bernardino County, California
Terracon Project No. CB235076

Dear Ms. Roberts:

We have completed the scope of Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PCB235076 dated May 9, 2023. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

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

Sincerely,

Terracon

Ali Tabatabaei, Ph.D., G.E.	Scott Lawson, P.E., G.E.
Geotechnical Project Engineer	Senior Engineer

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Exploration and Testing Procedures
Site Location and Exploration Plans
Exploration and Laboratory Results
Supporting Information

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed Raising Cane's restaurant to be located North of Roy Rogers Drive and West of Civic Drive in Victorville, San Bernardino County, California. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions and historic high groundwater
- 2022 California Building Code (CBC) seismic design parameters
- Subgrade preparation/earthwork recommendations
- Foundation design and construction
- Floor slab design and construction
- Preliminary pavement section design
- Infiltration and drainage

The geotechnical engineering Scope of Services for this project included the advancement of nine test borings to depths ranging from approximately 5 to 26½ feet below existing site grades (bgs), laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs and/or as separate graphs in the **Exploration Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Project information was furnished to us via email dated May 3, 2023, with attachments including maps and site plans.
Project Description	Based on our review of the site plans provided to us, a new Raising Cane's building and appurtenant infrastructure will be constructed, including paved roadway/parking, and stormwater infiltration/retention facilities.

Item	Description
Proposed Structure	Structure consists of a single-story restaurant building (approximately 3,181 sf) with appurtenant improvements.
Building Construction	The proposed building will consist of a single-story wood- frame structure supported on a shallow foundation system with slabs on grade.
Finished Floor Elevation	Anticipated to be within 2 feet of existing grade
Maximum Loads (assumed)	▪ Columns: 40 to 80 kips ▪ Walls: 1 to 3 kips per linear foot (klf) ▪ Slabs: 150 pounds per square foot (psf)
Grading/Slopes	Design grades are anticipated to be similar to the existing grades; however, remedial grading is anticipated.
Below-Grade Structures	None
Free-Standing Retaining Walls	None
Pavements	Paved driveway and parking will be constructed on site. We assume flexible (asphalt concrete) and rigid (Portland cement concrete) pavement sections should be considered. Anticipated traffic indices (TIs) are as follows for pavement: ▪ Auto Parking Areas: TI=4.5 ▪ Auto Driveways: TI=5.5 ▪ Pavement design period: 20 years
Infiltration Systems	An on-site stormwater retention/infiltration system is planned. However, the location, type and depth of system were not available at the time of preparation of this report.
Building Code	California Building Code 2022

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project site is located North of Roy Rogers Drive and West of Civic Drive in Victorville, San Bernardino County, California. Approximate coordinates of the center of the site: Latitude: 34.5218, Longitude: -117.3252 See **Site Location**
Existing Improvements	Currently consists of an undeveloped tract of land.
Current Ground Cover	Exposed soils with a light growth of grass and vegetation.
Existing Topography	Site is relatively flat.

Geotechnical Characterization

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. The following table provides our geotechnical characterization. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results**. The table below summarizes our geotechnical characterization.

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
Stratum I	26 ½	Interbedded layers of silty sand, poorly graded sand with silt, lean clay with sand and silt with sand	Granular soils: medium dense to very dense Fine grained soils: hard

Groundwater

The borings were advanced using a hollow-stem-auger drilling technique that allows short term groundwater observations to be made while drilling. Groundwater seepage was not encountered within the maximum drilled depth of 26.5 feet below ground surface (bgs) at the time of our field exploration. Our review of historical information regarding groundwater levels indicates that historical high groundwater levels are deeper than 50 feet bgs. 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.

Seismic Site Class

The 2022 California Building Code (CBC) Seismic Design Parameters have been generated using the SEAOC/OSHPD Seismic Design Maps Tool. This web-based software application calculates seismic design parameters in accordance with ASCE 7-16, and 2022 CBC. The 2022 CBC requires that a site-specific ground motion study be performed in accordance with Section 11.4.8 of ASCE 7-16 for Site Class D sites with a mapped S_S value greater than or equal 0.2.

However, Section 11.4.8 of ASCE 7-16 includes an exception from such analysis for specific structures on Site Class D sites. The commentary for Section 11 of ASCE 7-16 (Page 534 of Section C11 of ASCE 7-16) states that "In general, this exception effectively limits the requirements for site-specific hazard analysis to very tall and or flexible structures at Site Class D sites." Based on our understanding of the proposed structures, it is our assumption that the exception in Section 11.4.8 applies to the proposed structure. However, the structural engineer should verify the applicability of this exception.

Based on this exception, the spectral response accelerations presented below were determined using the site coefficients (Fa and Fv) from Tables 1613.2.3(1) and 1613.2.3(2) presented in Section 16.4.4 of the 2022 CBC.

Description	Value
2019 California Building Code Site Classification (CBC)[1]	D[2]
Site Latitude (°N)	34.5218
Site Longitude (°W)	117.3252
S_S Spectral Acceleration for a 0.2-Second Period	1.155
S_1 Spectral Acceleration for a 1-Second Period	0.447
F_a Site Coefficient for a 0.2-Second Period	1.038
F_v Site Coefficient for a 1-Second Period	1.85
Site Modified Peak Ground Acceleration (PGA_M)	0.548g
De-aggregated Modal Magnitude[3]	7.91

Description	Value

1. Seismic site classification in general accordance with the *2022 California Building Code*.
2. The 2022 California Building Code (CBC) requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the 100-foot soil profile determination. Borings were extended to a maximum depth of 26½ feet, and this seismic site class definition considers that similar or denser soils continue below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.
3. These values were obtained using on-line Unified Hazard Tool by the USGS (**https://earthquake.usgs.gov/hazards/interactive/**) for return period of 2% in 50 years accessed

In some cases, a site-specific ground motion study may generate less conservative coefficients and acceleration values which may reduce construction costs. We recommend consulting with a structural engineer to evaluate the need for such study and its potential impact on construction costs. Terracon should be contacted if a site-specific ground motion study is desired.

Faulting and Estimated Ground Motions

The site is located in southern California, which is a seismically active area. The type and magnitude of seismic hazards affecting the site are dependent on the distance to causative faults, the intensity, and the magnitude of the seismic event. As calculated using the USGS Unified Hazard Tool, the San Andreas (San Bernardino N segment), which is considered to have the most significant effect at the site from a design standpoint, has a maximum magnitude of 7.98 and is located approximately 30 kilometers from the site. Furthermore, the site is not located within an Alquist-Priolo Earthquake Fault Zone based on our review of the State Fault Hazard Maps.

Liquefaction

Liquefaction is a mode of ground failure that results from the generation of high pore-water pressures during earthquake ground shaking, causing loss of shear strength, and is typically a hazard where loose sandy soils exist below groundwater. San Bernardino County has designated certain areas as potential liquefaction hazard zones. These are areas considered at a risk of liquefaction-related ground failure during a seismic event, based upon mapped surficial deposits and the presence of a relatively shallow water table.

According to the County of San Bernardino Geologic Hazard Maps, the site is located within an area having low liquefaction potential. Moreover, historic groundwater levels are deeper than 50 feet. Based on the County mapping and encountered subsurface conditions, it is our opinion that liquefaction potential/seismic settlement is low for this site.

Geotechnical Overview

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings, provided that the recommendations provided in this report are implemented in the design and construction phases of this project.

On-site soils generally consisted of interbedded layers of silty sand, poorly graded sand with silt, lean clay with sand and silt with sand, extending to the maximum boring termination depth of about 26½ feet below ground surface (bgs).

Based on the conditions encountered, the proposed buildings can be supported on shallow foundations, such as spread footings, provided the recommendations outlined herein are followed.

Groundwater was not encountered within the maximum depths of exploration during or at the completion of drilling. Groundwater is not expected to affect shallow foundation construction on this site.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

Earthwork

Earthwork is anticipated to include clearing and grubbing, excavations, and engineered fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Strip and remove existing vegetation, debris, pavements, and other deleterious materials from proposed building and pavement areas. Exposed surfaces should be free of mounds and depressions which could prevent uniform compaction. The site should be initially graded to create a relatively level surface to receive fill and provide for a relatively uniform thickness of fill beneath proposed building structures.

Although no evidence of underground facilities such as septic tanks, cesspools, or basements were observed during the site reconnaissance, such features could be encountered during construction. If unexpected fills, utilities, or underground facilities are encountered, such features should be removed, and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Subgrade Preparation

We recommend that the proposed structures be supported on engineered fill extending to a minimum depth of 2 feet below the bottom of foundations, or 4 feet below existing grades, whichever is greater. Engineered fill placed beneath the entire footprint of the structures should extend horizontally a minimum distance of 3 feet beyond the outside edge of perimeter footings.

Subgrade soils beneath exterior slabs and pavements should be removed and replaced with engineered compacted fill to a depth of 1 foot below existing grade, or proposed pavement sections, whichever is greater.

Exposed areas which will receive fill, once properly cleared and benched where necessary, should be scarified to a minimum depth of 10 inches, moisture conditioned, and compacted per the compaction requirements in this report. Compacted fill soils should then be placed to the design elevations per the recommendations of this report. The moisture content and compaction of subgrade soils should be maintained until foundation, slab, or pavement construction.

Based upon the subsurface conditions observed from the geotechnical exploration, subgrade soils exposed during construction are anticipated to be relatively workable. However, the workability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unworkable conditions develop, workability may be improved by scarifying and drying.

Excavation

Due to very dense soil encountered near the surface in some areas, excavation may require the use of specialized heavy-duty equipment. Consideration should be given to obtaining a unit price for difficult excavation in the contract documents for the project.

Individual contractors are responsible for designing and constructing stable, temporary excavations. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

Fill Material Types

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than 3 inches in size. Pea gravel or other similar non-cementitious, poorly-graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer.

Clean on-site soils or approved imported materials may be used as fill material for the following:

- general site grading
- foundation areas
- interior floor slab areas
- foundation backfill
- pavement areas
- exterior slab areas

Imported Fill Materials: Imported fill materials should meet the following material property requirements. Regardless of its source, compacted fill should consist of approved materials that are free of organic matter and debris.

Gradation	Percent Finer by Weight (ASTM C 136)
3"	100
No. 4 Sieve	50-100
No. 200 Sieve	10-40

- Liquid Limit .... 30 (max)
- Plasticity Index .... 15 (max)
- Maximum expansion index* .... 20 (max)

*ASTM D 4829

The contractor shall notify the Geotechnical Engineer of import sources sufficiently ahead of their use so that the sources can be observed and approved as to the physical characteristic of the import material. For all import material, the contractor shall also submit current verified reports from a recognized analytical laboratory indicating that the import has a "not applicable" (Class S0) potential for sulfate attack based upon current ACI criteria and is "mildly corrosive" to ferrous metal and copper. The reports shall be accompanied by a written statement from the contractor that the laboratory test results are representative of all import material that will be brought to the job.

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed 10 inches loose thickness.

Fill Placement and Compaction Requirements

Engineered fill should meet the following compaction requirements.

Material Type and Location	Per the Modified Proctor Test (ASTM D 1557)		
	Minimum Compaction Requirement (%)	Range of Moisture Contents for Compaction Above Optimum	
		Minimum	Maximum
On-site soils and/or low volume change imported fill:			
Beneath foundations:	90	0%	+3%
Beneath interior slabs:	90	0%	+3%
Fill greater than 5 feet in depth:	95	0%	+3%
Miscellaneous backfill:	90	0%	+3%
Beneath pavements:	95	0%	+3%
Utility trenches: [1]	90	0%	+3%
Bottom of excavation receiving fill:	90	0%	+3%
Aggregate base (beneath pavements)	95	0%	+3%

1. Upper 12 inches should be compacted to 95% within pavement and structural areas.

Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with public works specifications for the utility be supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1:1 projection from existing foundations or existing utilities without engineering review of shoring requirements and geotechnical observation during construction.

A non-expansive granular material with a sand equivalent greater than 30 should be used for bedding and shading of utilities, unless allowed or specified otherwise by the utility manufacturer. On-site materials are considered suitable for backfill of utility and pipe trenches from 1 foot above the top of the pipe to the final ground surface, provided the material is free of organic matter and deleterious substances.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and expansion index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

Exterior Slab Design and Construction

Compacted subgrade composed of on-site clayey or silty soils may expand with increasing moisture content; therefore, exterior concrete slabs may heave, resulting in cracking or vertical offsets. The potential for damage would be greatest where exterior slabs are constructed adjacent to the building or other structural elements. To reduce the potential for damage caused by movement, we recommend:

- exterior slabs should be supported directly on subgrade fill (not ABC) with no, or very low expansion potential;
- strict moisture-density control during placement of subgrade fills;
- maintain proper subgrade moisture until placement of slabs;
- placement of effective control joints on relatively close centers and isolation joints between slabs and other structural elements;
- provision for adequate drainage in areas adjoining the slabs;
- use of designs which allow vertical movement between the exterior slabs and adjoining structural elements.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs and pavements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our scope of services does not include review of available final grading information or consider potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

We recommend that the earthwork portion of this project be completed during extended periods of dry weather if possible. If earthwork is completed during the wet season (typically November through April) it may be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork operations may require additional mitigative measures beyond that which would be expected during the drier summer and fall months. This could include diversion of surface runoff around exposed soils and draining of ponded water on the site. Once subgrades are established, it may be necessary to protect the exposed subgrade soils from construction traffic.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and pavements), evaluation and remediation of existing fill materials, as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. Where not specified by local ordinance, one density and water content test should be performed for every 50 linear feet of compacted utility trench backfill and a minimum of one test performed for every 12 vertical inches of compacted backfill. This testing frequency criteria may be adjusted during construction as specified by the geotechnical engineer of record.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer. If unanticipated conditions are observed, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Shallow Foundations

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for mat foundation.

Design Parameters

Item	Description
Foundation Type	Shallow Spread Footings
Net Allowable Bearing Pressure [1, 2]	3,000 psf

Foundation Support [3]	Engineered fill extending 2 feet below the bottom of foundations, or 4 feet below existing grades, whichever is greater.
Minimum Foundation Dimensions	Continuous: 18 inches wide Columns: 24 inches wide
Minimum Embedment below Finished Grade [4]	18 inches
Ultimate Passive Resistance[5] **(Equivalent fluid pressures)**	375 pcf
Ultimate Coefficient of Sliding Friction [6]	0.36
Estimated Static Settlement from Structural Loads [2]	About 1 inch
Estimated Differential Settlement [2, 7]	About ½ of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.
2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated. Does not include seismically induced settlement.
3. Unsuitable or soft soils should be over excavated and replaced per the recommendations presented in **Earthwork**.
4. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
5. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed, and compacted structural fill be placed against the vertical footing face. Assumes no hydrostatic pressure.
6. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance for granular materials is dependent on the bearing pressure which may vary due to load combinations.
7. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.

Shallow Foundations Designed for Uplift Conditions

Reinforced concrete footings or dead-man foundations, cast against undisturbed subsoils, are recommended for resistance to uplift. Footings may be designed using the cone method. The equation for determining the ultimate uplift capacity as a function of footing dimension, foundation depth, and soil weight is:

$$T_u = 0.8 \cdot \gamma \cdot D^2 \cdot (B + L) + W$$

Where:

Variable	Description	Unit
T_u	Ultimate uplift capacity	pounds
γ	Unit weight of soil[1]	pcf
D	Depth to base of footing/dead-man foundation below final grade	feet
B	Width of footing/dead-man foundation	feet
L	Length of footing/dead-man foundation	feet
W	Weight of footing/dead-man + weight of soil directly over the top of the footing/block	pounds

Notes: [1]A unit weight (γ) of 120 pounds per cubic foot (pcf) is recommended for soil (either undisturbed or compacted backfill) at this site.

The design uplift resistance should be calculated by dividing the ultimate resistance obtained from the equation above by an appropriate factor of safety. A factor of safety of at least 2 is recommended for live uplift loads in the analysis.

Foundations should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of joints at openings or other discontinuities in masonry walls is recommended.

Foundation excavations should be observed by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the observation of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Over excavation for engineered fill placement below footings should be conducted as shown below. The over excavation should be backfilled up to the footing base elevation, with low volume change engineered fill placed, as recommended in the **Earthwork** section.

Drilled Pier Design Parameters

Drilled pier recommendations are provided for the proposed exterior canopies. We recommend drilled piers be designed and constructed as presented below.

Drilled Pier Foundation – Design Parameters

Axial Loading: Axial compressive loads may be supported on straight-sided drilled piers. Compressive axial loads on pier foundations are resisted by both side friction along the pier and by end bearing at the base of the pier if above groundwater, while uplift loads are resisted solely by side friction along the pier and by the weight of the pier.

Allowable compressive side friction and allowable total compressive axial capacity for the canopy piers are provided for pile diameters of 2, 2.5, and 3 feet in the attachments of this report. The allowable uplift capacities should only be based on two-thirds of the allowable side friction of the shaft; however, the weight of the foundation should be added to these values to obtain the actual allowable uplift capacities for drilled shafts. The allowable end bearing capacity and skin friction values are based on factors of safety of 3 and 2, respectively. Skin friction within the upper 2 feet of piers should be ignored for foundation areas not protected by pavements. The minimum center to center spacing of the piers should be 3 times the diameter of the shaft to develop full axial resistance. If closer center-to-center spacing are needed, geotechnical engineer should be consulted to evaluate the reduction in capacity.

Post-construction settlements of drilled piers designed and constructed as described in this report are estimated to range from about ¾ to 1 inch. Differential settlement between individual piers is expected to be ½ to ⅔ of the total settlement.

Lateral Loading: Since the proposed drilled shafts are short piles, we recommend that the pile embedment length to resist lateral loads may be calculated based on the Section 1807.3 of 2022 California Building Code. An allowable equivalent fluid with a density of 225 pounds per cubic foot may be assumed for estimating the lateral resistance of the soils against the projected width of the shaft. The maximum lateral resistance should be capped at 2,250 pounds per square foot at depths greater than 10 feet below the ground surface. The contribution of lateral resistance to a depth equal to two pier diameters or three feet from finished grade, whichever is less, should be neglected. For temporary loading conditions, lateral capacity could be increased by 33%.

The above parameters assumed the groundwater level is below the maximum depth of the drilled shaft. The load capacities provided are based only on the stresses induced in the supporting soils; the structural capacity of the shafts should be checked to assure that they can safely accommodate the combined stresses induced by axial and lateral forces. The response of the drilled shaft foundations to lateral loads is dependent upon the soils/structure interaction as well as the shaft's actual diameter, length, stiffness, and "fixity" (fixed or free-head condition). Tensile reinforcement should extend to the bottom of piers subjected to uplift loading, while maintaining appropriate concrete coverage.

Drilled Pier Construction Recommendations

The Geotechnical Engineer should observe the installation of drilled piers to verify the soil conditions and the diameter and depth of piers. Drilled piers should be constructed true and plumb.

Because of the granular nature of the soils encountered, and the anticipated diameter of the drilled holes, it is anticipated that caving could occur during the drilling and construction of piers within the on-site soils. Appropriate precautions should therefore be taken during the construction of piers to reduce caving and raveling.

Temporary steel casing may be required to properly drill and clean drilled piers prior to concrete placement. Foundation concrete should be placed immediately after completion of drilling and cleaning. If foundation concrete cannot be placed in dry conditions, a tremie should be used for concrete placement. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes.

If casing is used for foundation construction, it should be withdrawn in a slow continuous manner, maintaining a sufficient head of concrete to prevent caving or the creation of voids in pier concrete. Foundation concrete should have a relatively high fluidity when placed in cased pier holes or through a tremie. Foundation concrete with slump in the range of 6 to 8 inches is recommended when temporary casing is utilized.

Free-fall concrete placement in drilled piers will only be acceptable if provisions are taken to avoid striking the concrete on the sides of the hole or reinforcing steel. The use of a bottom-dump hopper, or an "elephant's trunk" discharging near the bottom of the hole where concrete segregation will be minimized, is recommended.

Drilled pier end bearing surfaces must be thoroughly cleaned prior to concrete placement. A representative of the Geotechnical Engineer should inspect the bearing surface and foundation pier configuration. If the subsurface soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

The contractor should check for gas and/or oxygen deficiency before any workers enter the excavation for observation and manual cleanup. All necessary monitoring and safety precautions as required by OSHA, State or local codes should be strictly enforced.

The drilling speed should be reduced as necessary to minimize vibration and caving of the silty sand materials. Based on the data developed during our investigation, drilling for the piers may need casing as caving soils may be encountered; the contractor should be prepared to use casing or other approved means to prevent caving. The contractor should review the boring logs to make sure he is familiar with the anticipated subsurface conditions prior to beginning construction of the deep foundations.

Closely spaced piers should be drilled and filled alternately, allowing the concrete to set at least eight hours before drilling the adjacent pier. All excavations should be filled with concrete as soon after drilling as possible. In no event should pier holes be left open overnight. To prevent concrete from striking the walls of the pier and causing caving, the concrete should be placed with appropriate equipment so that the concrete is not allowed to fall freely more than 5 feet. All loose materials should be thoroughly cleaned from the bottom of the pier excavation. This is especially important because end bearing has been considered in determining the provided pier capacities. If casing is necessary and is utilized, then the casing should be withdrawn concurrently with the concrete placement.

Floor Slabs

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.

Floor Slab Design Parameters

Item	Description
Floor Slab Support[1]	Engineered fill extending 2 feet below the bottom of foundations, or 4 feet below existing grades, whichever is greater.
Subbase	Minimum 4 inches of Aggregate Base
Estimated Modulus of Subgrade Reaction [2]	200 pounds per square inch per inch (psi/in) for point loads. (The modulus was obtained based on estimates obtained from NAVFAC 7.1 design charts). This value is for a small loaded area (1 Sq. ft or less) such as for forklift wheel loads or point loads and should be adjusted for larger loaded areas.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, 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.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

LATERAL EARTH PRESSURES

Design Parameters

For engineered fill comprised of on-site soils above any free water surface, recommended equivalent fluid pressures for unrestrained foundation elements are:

ITEM	VALUE[a, b]
Active Case	40 psf/ft
Passive Case	375 psf/ft
At-Rest Case	60 psf/ft
Coefficient of Friction	0.36

[a]Note: The values are based on on-site soils used as backfill.
[b]Note: Uniform, horizontal backfill, compacted to at least 90% of the ASTM D 1557 maximum dry density, rendering a maximum unit weight of 125 pcf.

The lateral earth pressures herein do not include any factor of safety and are not applicable for submerged soils/hydrostatic loading. Additional recommendations may be necessary if such conditions are to be included in the design.

Fill against foundation and retaining walls should be compacted to densities specified in the Earthwork section of this report. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors.

Pavements

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

Design of asphalt concrete (AC) pavements is based on the procedures outlined in the Caltrans "Highway Design Manual" (Caltrans, 2018). Design of Portland cement concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330R-08; "Guide for Design and Construction of Concrete Parking Lots."

An estimated correlated R-value of 25 was used to calculate the AC pavement thickness sections. A modulus of subgrade reaction of 120 pci and a modulus of rupture of 600 psi were used for the PCC pavement designs. R-value testing should be completed prior to pavement construction to verify the design R-value.

The structural sections are predicated upon proper compaction of the utility trench backfills and the subgrade soils as prescribed by in **Earthwork**, with the upper 12 inches of subgrade soils and all aggregate base material brought to a minimum relative compaction of 95 percent in accordance with ASTM D 1557 prior to paving. The aggregate base should meet Caltrans requirements for Class 2 base.

The pavement designs were based upon the results of preliminary sampling and testing and should be verified by additional sampling and testing during construction when the actual subgrade soils are exposed.

Pavement Section Thicknesses

The following tables provides our opinion of minimum thickness for AC and PCC sections:

Asphalt Concrete Design		
Usage	Assumed Traffic Index	Recommended Structural Section
Auto Parking Areas	4.5	3" HMA[1]/5" Class 2 AB[2]
Drive lanes	5.5	3" HMA[1]/8" Class 2 AB[2]
Truck Delivery Areas	6.0	3.5" HMA[1]/9" Class 2 AB[2]

1. **HMA = hot mix asphalt**
2. **AB = aggregate base**

Portland Cement Concrete Design			
Layer	Thickness (inches)		
	Light Duty[1]	Medium Duty[2]	Dumpster Pad[3]
PCC	5.0	6.0	7.5
Aggregate Base	4.0	4.0	4.0

1. **Car Parking and Access Lanes, Average Daily Truck Traffic (ADTT) = 1 (Category A).**
2. **Truck Parking Areas, Multiple Units, ADTT = 25 (Category B)**
3. **In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g., dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles, ADTT = 700 (Category C).**

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles.

Although not required for structural support, a minimum 4-inch thick base course layer is recommended to help reduce potential for slab curl, shrinkage cracking, and subgrade pumping through joints. 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 doweled where necessary for load transfer. PCC pavement details for joint spacing, joint reinforcement, and joint sealing should be prepared in accordance with ACI 330 and ACI 325.

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.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. Islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils are particular areas of concern. The civil design for the pavements with these conditions should include features to restrict or collect and discharge excess water from the islands. Examples of features are edge drains connected to the stormwater collection system, longitudinal subdrains, or other suitable outlets and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Pavement Drainage

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

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic upkeep should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Pavement care consists of both localized (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Additional engineering consultation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.

- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

STORM WATER MANAGEMENT

Three in-situ percolation tests (falling head borehole permeability) were performed at approximate depths of 5 and 10 feet bgs within boreholes drilled with an 8-inch diameter auger. The objective of the testing is to provide infiltration rates for designing the proposed infiltration system. A 2-inch thick, 3/4-inch gravel layer was placed in the bottom of each boring after the borings were drilled to investigate the soil profile. Three-inch diameter perforated pipes were installed on top of the gravel layer and gravel was used to backfill between the perforated pipes and the boring sidewall. The borings were then filled with water for a pre-soak period.

At the beginning of each test, the pipes were refilled with water and readings were taken at periodic time intervals as the water level dropped. The soil at the percolation test locations was classified in the field using a visual/manual procedure. The infiltration velocity is presented as the infiltration rate and is summarized in the following table. The infiltration rates provided do not include safety factors.

Test Location	Boring Depth (ft.) [1]	Test Depth Range (ft.) [1]	Soil Type	Water Head (ft)	Percolation Rate Average (in./hr.)	Infiltration Rate Average (in./hr.) [2]
P-1	5	0 to 5	SM	5	24	0.8
P-2	10	5 to 10	SM	5	116	4.4
P-3	5	0 to 5	SC	5	30	1.0

1. Below existing ground surface.
2. If proposed infiltration system will mainly rely on vertical downward seepage, the correlated infiltration rates should be used. The correlation rate is based on the Porchet Method.

The above infiltration rates determined by the percolation test method are based on field test results utilizing clear water. Infiltration rates can be affected by silt buildup, debris, degree of soil saturation, site variability and other factors. The rate obtained at specific location and depth is representative of the location and depth tested and may not be representative of the entire site. Application of an appropriate safety factor is prudent to account for subsoil inconsistencies, possible compaction related to site grading, and potential silting of the percolating soils, depending on the application.

The design engineer should also check with the local agency for the limitation of the infiltration rate allowed in the design. If the maximum allowable design infiltration rate is lower than the above recommended rate, the maximum allowable design infiltration rate should be used. The designer of the basins should also consider other possible site variability in the design.

The percolation tests were performed with clear water, whereas the storm water will likely not be clear, but may contain organics, fines, and grease/oil. The presence of these deleterious materials will tend to decrease the rate that water percolates from the infiltration systems. Design of the storm water infiltration systems should account for the presence of these materials and should incorporate structures/devices to remove these deleterious materials.

Based on the soils encountered in our borings, we expect the percolation rates of the soils could be different than measured in the field due to variations in fines and gravel content. The design elevation and size of the proposed infiltration system should account for this expected variability in infiltration rates.

Infiltration testing should be performed after construction of the infiltration system to verify the design infiltration rates. It should be noted that siltation and vegetation growth along with other factors may affect the infiltration rates of the infiltration areas. The actual infiltration rate may vary from the values reported here. Infiltration systems should be located at least 10 feet from any existing or proposed foundation system.

Corrosivity

The results of laboratory sulfides, soluble sulfate, chlorides, electrical resistivity, redox potential, total salts, and pH testing are presented in our appendix within the **Exploration Results** section. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Results of soluble sulfate testing indicate samples of the on-site soils tested possess negligible sulfate concentrations when classified in accordance with Table 19.3.1.1 of the

ACI Design Manual. Concrete should be designed in accordance with the exposure class S0 provisions of the ACI Design Manual, Section 318, Chapter 19.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services 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 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. The findings and recommendations presented in this report were prepared in a manner consistent with the standards of care and skill ordinarily exercised by members of its profession completing similar studies and practicing under similar conditions in the geographic vicinity and at the time these services have been performed. 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.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Figures

Attachments

Exploration and Testing Procedures

Field Exploration

Boring Number and Designation	Approximate Boring Depth or Refusal (feet)	Location
3 (B-1 to B-3)	26 ½	Planned building area and drive through canopy
3 (B-4 to B-6)	6	Planned parking/driveway area
3 (Perc-1 to Perc-3)	5 and 10	Parking and Infiltration areas

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ±10 feet) and referencing existing site features. If elevations and a more precise boring layout are desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted drill rig using continuous flight hollow stem augers. Four samples were generally obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. 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. A 3-inch O.D. split-barrel sampling spoon with 2.5-inch I.D. ring lined sampler was also used for sampling soils at the project site. Ring-lined, split-barrel sampling procedures are similar to standard split spoon sampling procedure. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. 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. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Dry Unit Weight
- Particle-size Distribution (Gradation) of Soils Using Sieve Analysis
- Maximum Dry Density/Optimum Moisture Content
- Expansion Index
- Corrosion Suite
- Horticulture testing results

The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location

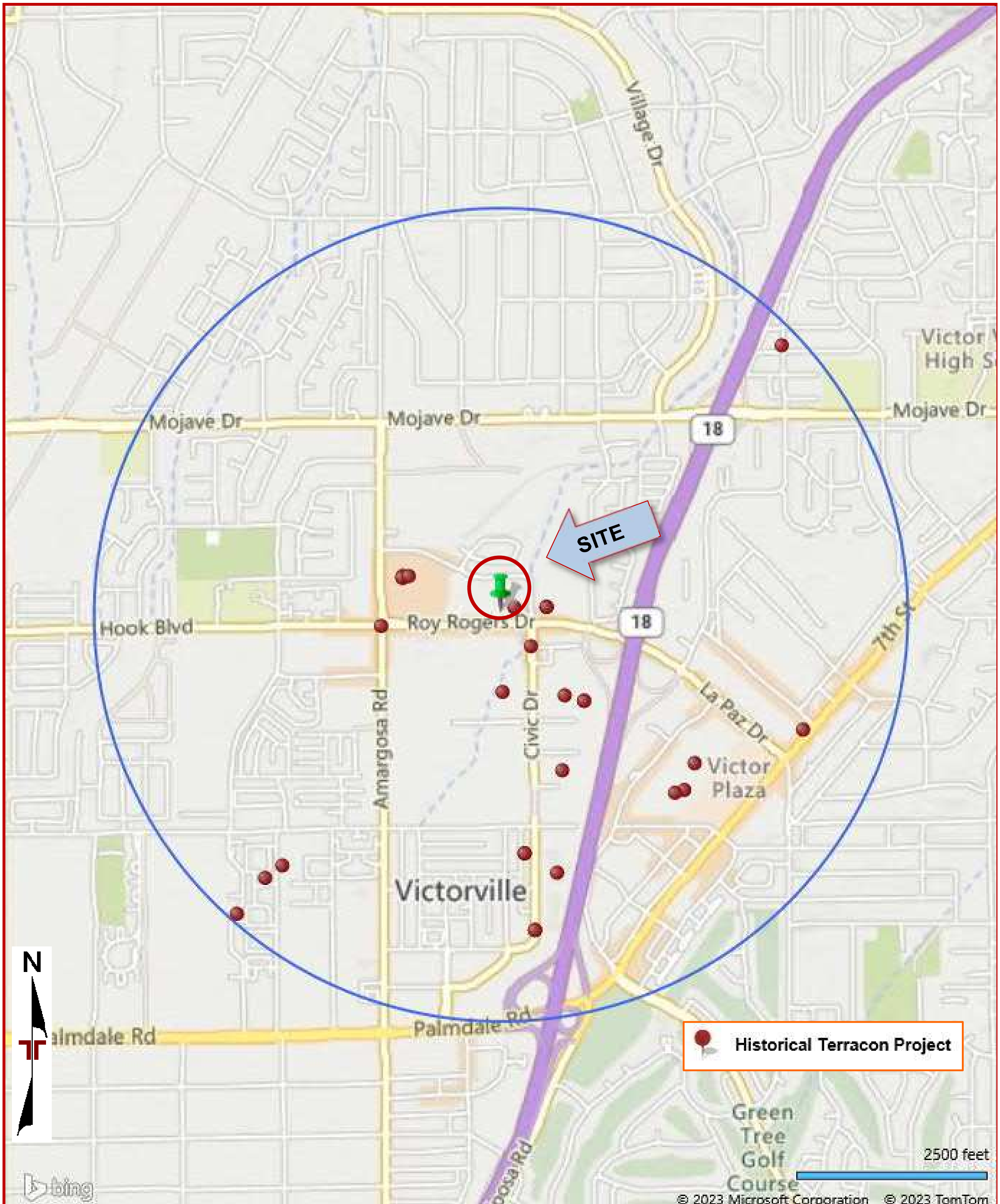


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

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

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Boring Logs (B-1 through B-6, P-1 through P-3)
Grain Size Distribution
Moisture/Density Relationship
Corrosivity
Horticulture Test

Note: All attachments are one page unless noted above.

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-1

Location: See Exploration Plan

Depth (Ft.)	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Percent Fines
	SILTY SAND (SM), light brown, very dense								
					23-50/3"		5.1		48
	dense	5			20-37-43		6.5	113	24
7.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown, dense				19-31-50		4.9		5
	very dense	10			24-50/4"				
		15			14-17-18 N=35				5
20.0	**LEAN CLAY WITH SAND (CL)**, brown, hard	20			11-16-19 N=35				76
25.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, light brown, dense	25			14-20-27 N=47				
26.5	***Boring Terminated at 26.5 Feet***								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
None observed while drilling

Advancement Method
HSA

Abandonment Method

Drill Rig

Hammer Type
Automatic

Driller
2R Drilling

Logged by
AS

Boring Started
06-06-2023

Boring Completed
06-06-2023

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-2

Location: See Exploration Plan

Depth (Ft.)	Description	Sample Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Percent Fines
	SILTY SAND (SM), light brown, very dense	2.5			50/4"		4.7		48
		5			21-50/6"		1.7	107	
7.5	**SANDY LEAN CLAY (CL)**, brown, hard	7.5			16-23-41		9.4	109	68
9.0	**SILTY SAND (SM)**, brown to light brown, very dense	10			50/6"				
	medium dense	15			12-13-15 N=28				21
20.0	**LEAN CLAY WITH SAND (CL)**, brown, hard	20			11-16-24 N=40				83
25.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown, very dense	25			14-23-28 N=51				
26.5	***Boring Terminated at 26.5 Feet***								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
None observed while drilling

Advancement Method
HSA

Abandonment Method

Drill Rig

Hammer Type
Automatic

Driller
2R Drilling

Logged by
AS

Boring Started
06-06-2023

Boring Completed
06-06-2023

1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-3

Location: See Exploration Plan

Depth (Ft.)	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Percent Fines
	SILTY SAND (SM), light tan, medium dense					1			
					15-17-17		1.0	117	
	dense	5			9-25-45		3.1	111	
	very dense				50/6"				
	very dense	10			50/5"				
15.0	**SILTY SAND WITH CLAY (SM)**, brown, very dense	15			12-20-37 N=57				
	dense	20			17-21-21 N=42				
25.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, light brown, very dense	25			14-20-31 N=51				
26.5	***Boring Terminated at 26.5 Feet***								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
None observed while drilling

Advancement Method
HSA

Abandonment Method

Drill Rig

Hammer Type
Automatic

Driller
2R Drilling

Logged by
AS

Boring Started
06-06-2023

Boring Completed
06-06-2023

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-4

Location: See Exploration Plan

Depth (Ft.)	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Percent Fines
	SILT WITH SAND (ML), tan, hard								
					19-50/6"				80
6.0		5							
	Boring Terminated at 6 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
None observed while drilling

Advancement Method
HSA

Abandonment Method

Drill Rig

Hammer Type
Automatic

Driller
2R Drilling

Logged by
AS

Boring Started
06-06-2023

Boring Completed
06-06-2023

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-5

Graphic Log	Location: See Exploration Plan Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Percent Fines
	SANDY SILT (ML), trace gravel, tan, dry, hard				14-27-40				
	6.0	5							
	Boring Terminated at 6 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
None observed while drilling

Advancement Method
HSA

Abandonment Method

Drill Rig

Hammer Type
Automatic

Driller
2R Drilling

Logged by
AS

Boring Started
06-06-2023

Boring Completed
06-06-2023

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-6

Location: See Exploration Plan

Graphic Log	Depth (Ft.)	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Percent Fines
		SILT WITH SAND (ML), trace gravel, tan, hard								
						25-39-50/5"				69
	6.0		5							
		Boring Terminated at 6 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
None observed while drilling

Advancement Method
HSA

Abandonment Method

Drill Rig

Hammer Type
Automatic

Driller
2R Drilling

Logged by
AS

Boring Started
06-06-2023

Boring Completed
06-06-2023

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. P-1

Graphic Log	Location: See Exploration Plan Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Percent Fines
	SILTY SAND (SM), brown 5.0	5							48
	Boring Terminated at 5 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.	**Water Level Observations** None observed while drilling	**Drill Rig** **Hammer Type** Automatic **Driller** 2R Drilling **Logged by** AS **Boring Started** 06-06-2023 **Boring Completed** 06-06-2023
Notes	**Advancement Method** HSA **Abandonment Method**	

1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. P-2

Location: See Exploration Plan

Graphic Log	Depth (Ft.)	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Percent Fines
		SILTY SAND (SM), trace gravel, light brown to brown	5							22
	10.0		10							
		Boring Terminated at 10 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
None observed while drilling

Advancement Method
HSA

Abandonment Method

Drill Rig

Hammer Type
Automatic

Driller
2R Drilling

Logged by
AS

Boring Started
06-06-2023

Boring Completed
06-06-2023

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. P-3

Location: See Exploration Plan

Graphic Log	Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Percent Fines
	CLAYEY SAND (SC), trace gravel, tan								45
	5.0	5							
	Boring Terminated at 5 Feet								

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Water Level Observations
None observed while drilling

Advancement Method
HSA

Abandonment Method

Drill Rig

Hammer Type
Automatic

Driller
2R Drilling

Logged by
AS

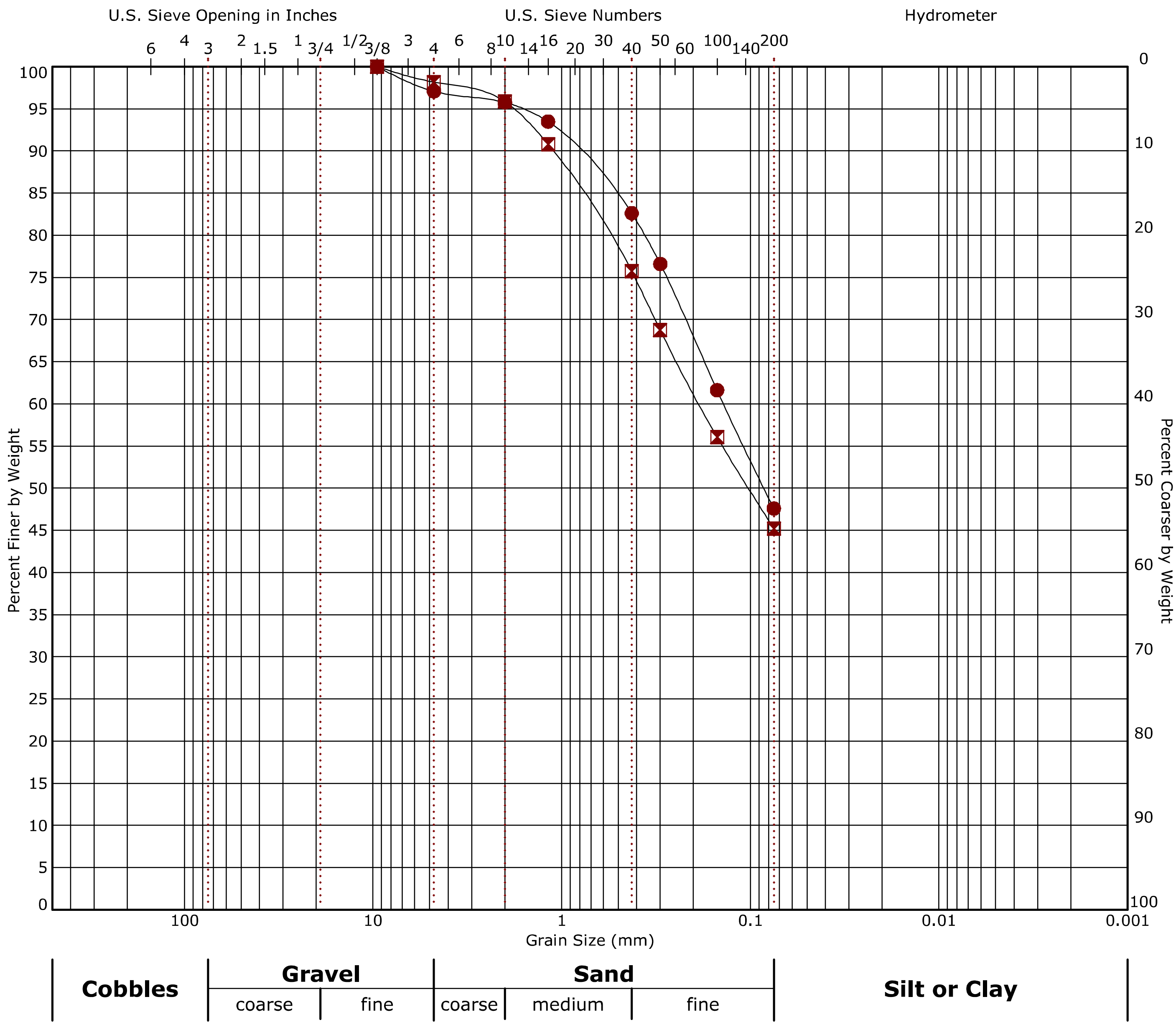
Boring Started
06-06-2023

Boring Completed
06-06-2023

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Grain Size Distribution

ASTM D422 / ASTM C136



Boring ID		Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
●	P-1	0 - 5								
⊠	P-3	0 - 5								

Boring ID		Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●	P-1	0 - 5	9.5	0.138			0.0	2.9	49.5	47.6		
⊠	P-3	0 - 5	9.5	0.186			0.0	1.8	52.9	45.2		

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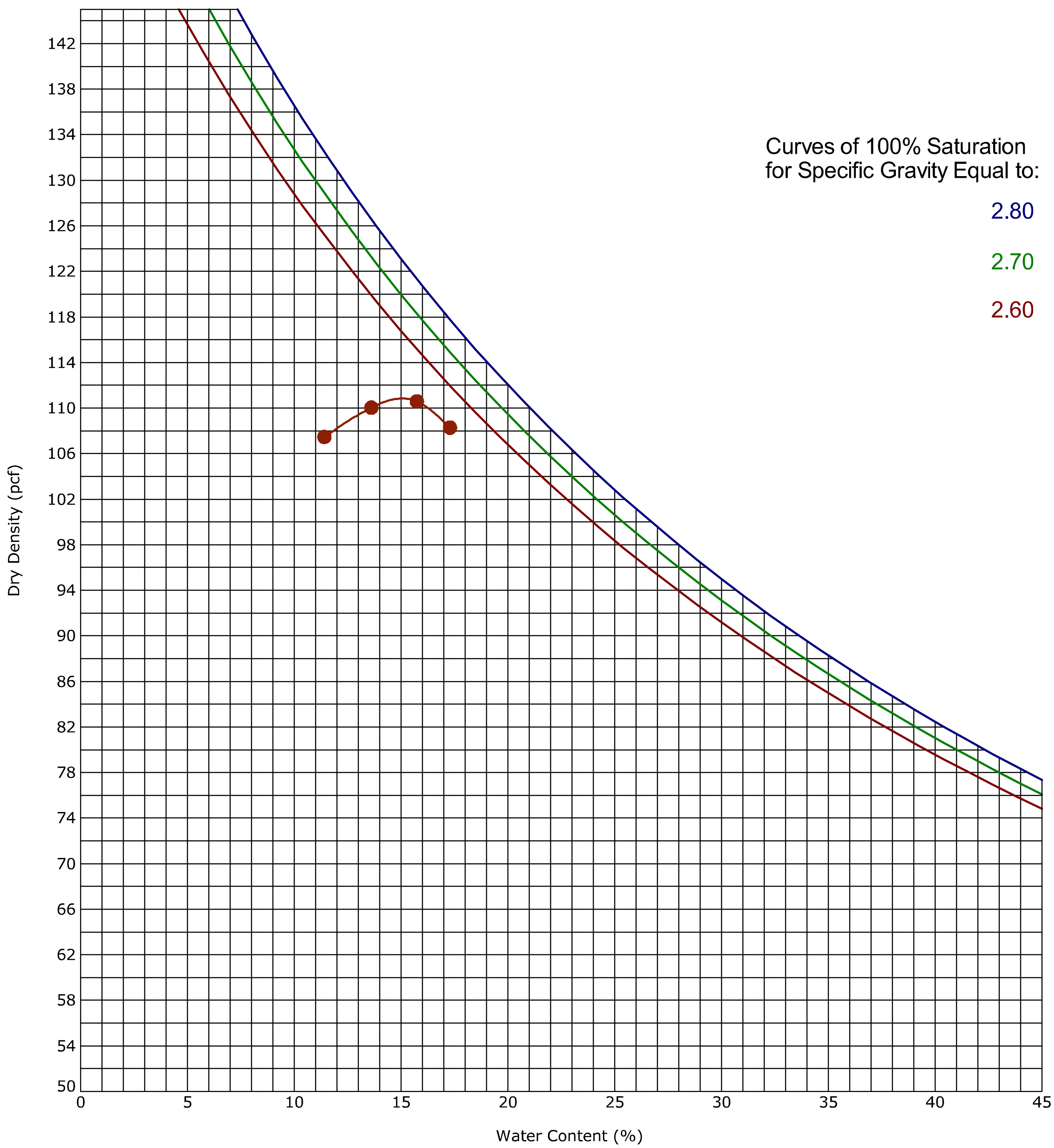
Moisture-Density Relationship

ASTM D1557-Method B



Boring ID	Depth (Ft)	Description of Materials
B-2	0 - 2.5	

Fines (%)	Fraction > mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
	0.0				ASTM D1557-Method B	110.8	15.1

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client
Raising Cane's Restaurants, LLC

Project
Raising Cane's Restaurant (RC-1051)
Victorville

Sample Submitted By: Terracon (CB) **Date Received:** 6/16/2023 **Lab No.: 23-0346**

Results of Corrosion Analysis

Sample Number	Bulk
Sample Location	B-3
Sample Depth (ft.)	0.0-2.5
pH Analysis, ASTM G51	8.46
Water Soluble Sulfate (SO4), ASTM C 1580 (mg/kg)	31
Sulfides, AWWA 4500-S D, (mg/Kg)	Nil
Chlorides, ASTM D512, (mg/kg)	45
Red-Ox, ASTM G200, (mV)	+733
Total Salts, AWWA 2540, (mg/Kg)	268
As-Received Resitivity, ASTM G-57, (ohm-cm)	97000
Saturated Minimum Resistivity, ASTM G-57, (ohm-cm)	3007

Analyzed By N. Campo
Nathan Campo
Engineering Technician III

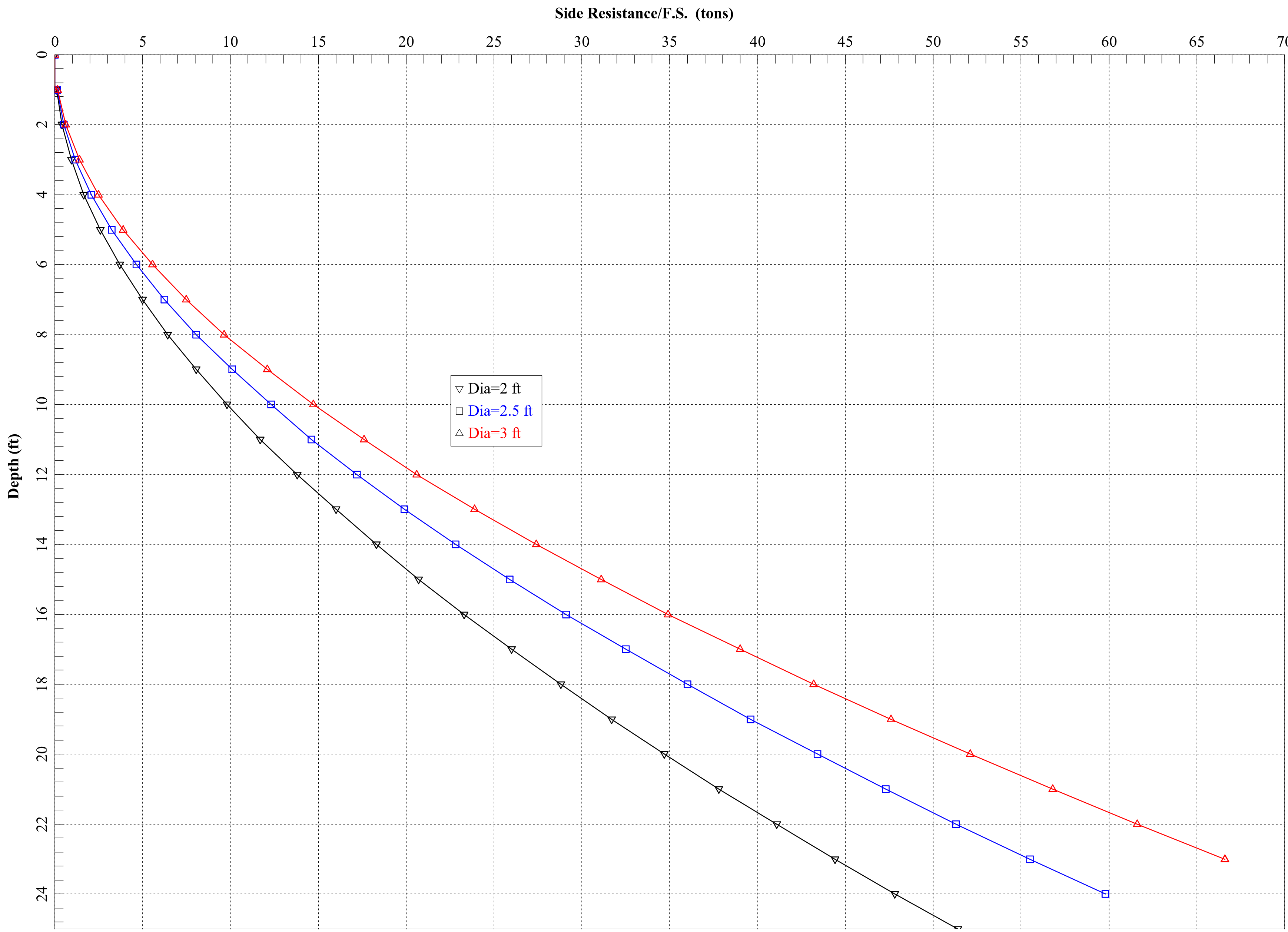
The tests were performed in general accordance with applicable ASTM and AWWA test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

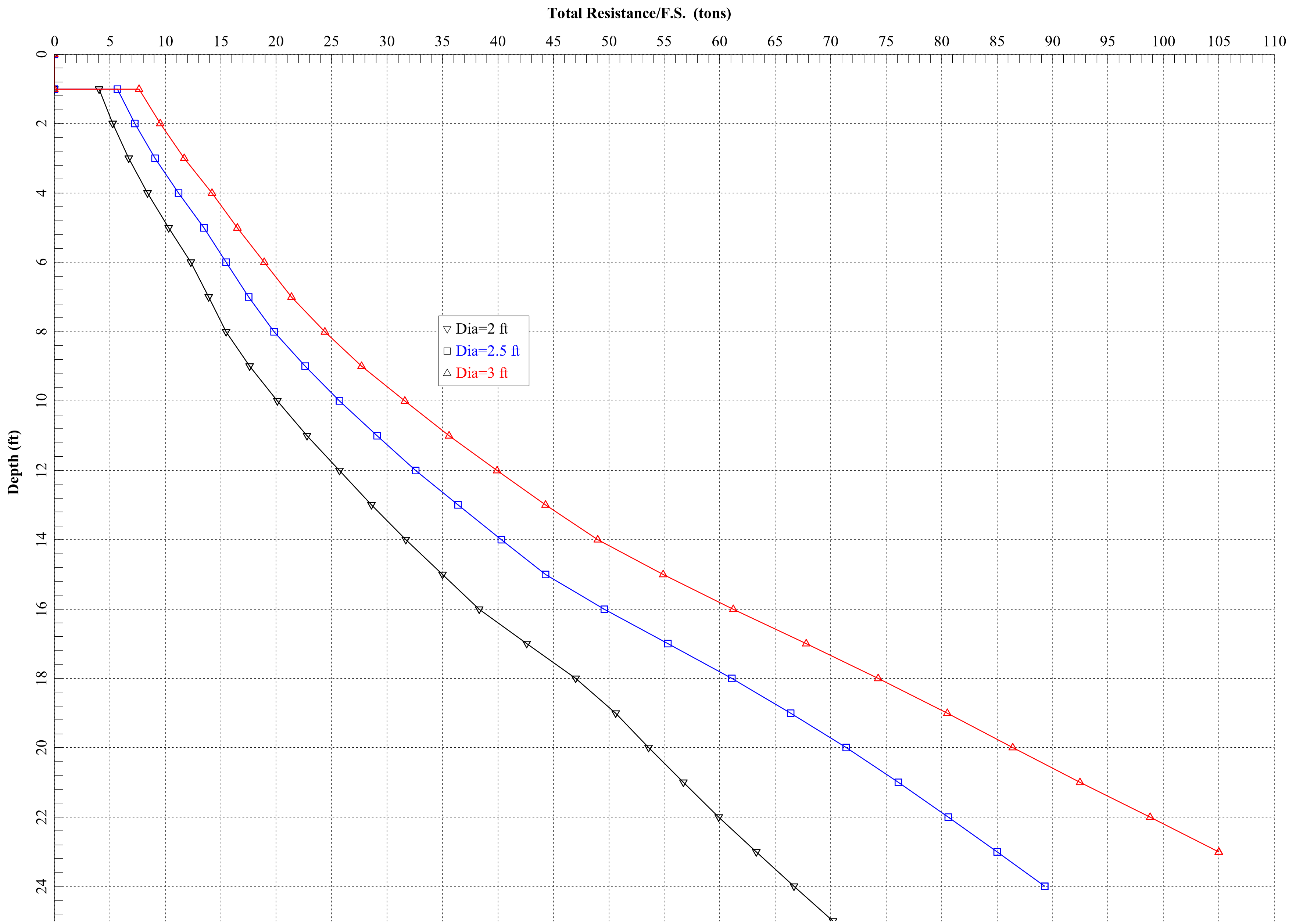
Supporting Information

Contents:

Drilled Pier Skin Friction & Total Capacity Analysis
General Notes
Unified Soil Classification System

Note: All attachments are one page unless noted above.


Side Resistance/F.S. (tons)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
Dia=2 ft
Dia=2.5 ft
Dia=3 ft


Total Resistance/F.S. (tons)
Depth (ft)
Dia=2 ft
Dia=2.5 ft
Dia=3 ft
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
0
2
4
6
8
10
12
14
16
18
20
22
24

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Colton, CA

General Notes

Sampling	Water Level	Field Tests
Auger Cuttings; Modified Dames & Moore Ring Sampler; Split Spoon	Water Initially Encountered; Water Level After a Specified Period of Time; Water Level After a Specified Period of Time; Cave In Encountered	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

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.

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			
Relative Density	**Standard Penetration or N-Value (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**	**Consistency**	**Unconfined Compressive Strength Qu (tsf)**	**Standard Penetration or N-Value (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**
Very Loose	0 - 3	0 - 5	Very Soft	less than 0.25	0 - 1	< 3
Loose	4 - 9	6 - 14	Soft	0.25 to 0.50	2 - 4	3 - 5
Medium Dense	10 - 29	15 - 46	Medium Stiff	0.50 to 1.00	4 - 8	6 - 10
Dense	30 - 50	47 - 79	Stiff	1.00 to 2.00	8 - 15	11 - 18
Very Dense	> 50	> 80	Very Stiff	2.00 to 4.00	15 - 30	19 - 36
			Hard	> 4.00	> 30	> 36

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: 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 above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					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:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					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] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[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.