Appendix F

Preliminary Geotechnical Engineering Report

Kimley»Horn

Terracon GeoReport

Preliminary Geotechnical Engineering Report

Vidal Solar
Vidal, San Bernardino County, California
May 10, 2022, Revised May 10, 2022
Terracon Project No. 60215247

Prepared for:
CORE Development Group
Mahwah, New Jersey

Prepared by:
Terracon Consultants, Inc.
Tustin, California

May 10, 2022, Revised May 10, 2022

CORE Development Group
860 Wyckoff Avenue, Suite 200
Mahwah, New Jersey 07430

Attn: Mr. Eliseo Reynoso
P: (201) 825-2195
E: ereynoso@coredevusa.com

Re: Preliminary Geotechnical Engineering Report
Vidal Solar
Vidal, San Bernardino County, California
Terracon Project No. 60215247

Dear Mr. Reynoso:

We have completed the Preliminary Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P60215247 dated September 29, 2021 and revised on October 5, 2021. This report presents the findings of the subsurface exploration and provides preliminary geotechnical recommendations concerning the development of the proposed solar facility. It is our understanding that further geotechnical exploration and a final report will be performed in the future for design and construction purposes.

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

Sincerely,
Terracon Consultants, Inc.

for Abigail K. McCranie, E.I.T.
Staff Engineer

Joshua R. Morgan, P.E.
Solar Subject Matter Expert

APR review by Brian C. Ridley, P.E. (TX)

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REPORT TOPICS

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 Terracon GeoReport logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Page references refer to the printable document formatted page.

Preliminary Geotechnical Engineering Report

Vidal Solar

Vidal, San Bernardino County, California

Terracon Project No. 60215247

May 10, 2022, Revised May 10, 2022

INTRODUCTION

This report presents the results of our preliminary subsurface exploration and geotechnical engineering services performed for the proposed Vidal Solar Project to be located in Vidal, San Bernardino County, California. The purpose of these services is to provide preliminary information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater observations
- Site preparation and earthwork
- Field Electrical Resistivity Test Results
- Foundation design and construction
- Thermal Resistivity Test Results
- Seismic site classification per CBC
- Roadway design and construction

Terracon's geotechnical engineering scope of work for this project, which has been completed to date and is incorporated in this preliminary report, includes the following:

- Four (4) soil test borings to depths of approximately 20¼ to 21½ feet below ground surface (bgs) in the proposed solar array area
- One (1) soil test boring to depth of approximately 51½ feet bgs in the proposed substation area.
- Field electrical resistivity testing at one (1) location
- Corrosion testing on soil samples obtained from one (1) location
- Laboratory thermal resistivity testing on a soil sample obtained from one (1) location
- Laboratory testing of soil samples

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

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 approximately 5 miles north of the intersection of U.S. Route 95 and Agnes Wilson Road in Vidal, San Bernardino County, California. The project site is separated into separate parcels and encompasses a total area of approximately 1,225 acres. The approximate center of the solar site is located at 34.08957°N, 114.45864°W.
Existing Improvements	The area proposed to be developed is generally undeveloped land. Several cinderblock and other abandoned structures exist throughout the site. It is unknown whether or not these will be demolished prior to construction.
Current Ground Cover	The majority of the surface of the site is covered by soils and vegetation.
Existing Topography	The site is relatively flat.

PROJECT DESCRIPTION

Item	Description
Information Provided	Project information was provided by Mr. Eliseo Reynoso with CORE Development Group which included a site plan and a KML showing the project boundary.
Project Description	The proposed solar project array area will occupy approximately 850 acres. The solar facility will also include invertors, transformers, switchgear, Battery Energy Storage System (BESS) equipment, and buried power lines. Based on review of the provided plans, we understand a substation is also proposed at the site in the southern parcel.
Proposed PV Module Structure	■ Ground-mounted, single axis tracker photovoltaic modules ■ Other various project components could include electric cable/conduit laid in trenches, equipment and appurtenances (e.g., invertors, meteorological stations, and combiner boxes)
Proposed Construction	Photovoltaic modules aligned in arrays and affixed to a single-axis tracking system supported on driven pile foundations. Switchgear, transformers, and other electronic equipment such as BESS equipment are expected to be supported on concrete mat foundations. Substation structures are anticipated to be supported on shallow footings or mat foundations. Deep foundations are anticipated for turning poles and transmission towers within the substations.
Maximum Loads (assumed)	Structural loads for single axis tracking rack systems were assumed based on our experience with similar projects: ■ Downward: 2 to 8 kips ■ Lateral 1 to 3 kips ■ Uplift: 1 to 3 kips
Grading	We anticipate the solar array field grade will follow the existing site grade with minimal grading required to bring the site to finished grade.
Access Roadways	We anticipate access roads on site will consist of compacted native soil or aggregate base.

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 geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, foundation options and pavement options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Subsurface Soils

Based on the results of the borings, on-site soils generally consist of medium dense to very dense sand with varying amounts of silt and gravel to the maximum depth explored of 51½ feet bgs. Additionally, a layer of silty clay was encountered in boring SUB-1 at an approximate depth of 15 to 25 feet bgs.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Laboratory Results

Laboratory tests were conducted on selected soil samples and the test results are presented in the **Exploration Results** section and on the boring logs. Atterberg limit test results indicate that the on-site soils generally are non-plastic. Laboratory Moisture-Density test (Modified Proctor) results indicate that the near surface materials have a maximum dry-density of 124.7 pounds per cubic foot (pcf) with a corresponding optimum moisture content of 8.8%.

Groundwater Conditions

Groundwater was not observed in the borings while drilling or for the short duration they could remain open. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations.

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 be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

According to data collected from the Water Data Library for the State of California from a nearby well, located approximately 25 miles west of the site in State Well Number 01S21E32B001S, historic groundwater levels between January 1, 1963 and January 1, 1984 were recorded at greater than 100 feet bgs.[1]

Field Soil Electrical Resistivity Test Results

Field measurements of on-site soil electrical resistivity values were performed in general accordance with ANSI/IEEE Standard 81-1983 Part 1 and ASTM Test Method G57, using the Wenner Four-Pin Method along the north-south and east-west directions. The Wenner arrangement (equal electrode spacing) tests were conducted in the solar array areas with the "a" spacings of 2.5, 5, 10, 25, 50, 75, and 100 feet. Test results are provided in the **Exploration Results** section of this report.

Laboratory Thermal Resistivity Test Results

A thermal resistivity test was performed by Geotherm USA on a sample taken from the substation area between depths of 0 to 2.5 feet below existing grade. The bulk sample was tested for thermal resistivity on a sample remolded to 85% of the material's maximum dry density as determined by test method ASTM D698 (Standard Proctor). The results of this testing is attached in the **Exploration Results** section of this report.

SEISMIC CONSIDERATIONS

The 2019 California Building Code (CBC) Seismic Design Parameters have been generated using the Structural Engineers Association of California (SEAOC)/Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps Tool. This web-based software application calculates seismic design parameters in accordance with ASCE 7-16 and 2019 CBC. The 2019 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_1 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.

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[1] *Groundwater elevation was obtained from the Water Data Library for the State of California Well Station 340500N1147941W001 (https://wdl.water.ca.gov/WaterDataLibrary/GroundwaterBrowseData.aspx?LocalWellNumber=&StationId=2549&StateWellNumber=01S21E32B001S&SelectedCounties=&SiteCode=340500N1147941W001&SelectedGWBasins=*

Based on this exception, the spectral response accelerations presented below were calculated using the site coefficients (F_a and F_v) from Tables 1613.2.3(1) and 1613.2.3(2) presented in Section 16.4.4 of the 2019 CBC.

Description	Value
2019 California Building Code Site Classification (CBC) [1]	D [2]
Site Latitude (°N)	34.0895
Site Longitude (°W)	114.4586
S_s Spectral Acceleration for a 0.2-Second Period	0.217
S_1 Spectral Acceleration for a 1-Second Period	0.128
F_a Site Coefficient for a 0.2-Second Period	1.600
F_v Site Coefficient for a 1-Second Period	2.344

1. Seismic site classification in general accordance with the *2019 California Building Code*.
2. The 2019 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 required 100-foot soil profile determination. Borings were extended to a maximum depth of 51½ 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.

Typically, a site-specific ground motion study will 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 fault which is considered to have the most significant effect at the site from a design standpoint is a unnamed point source, which has a maximum credible earthquake magnitude of 5.71 and is located approximately 13.73 kilometers from the site. The closest pre-Quaternary faults to the project site are the Blythe Graben faults located approximately 25 miles south-southwest from the site.

Based on the USGS Design Maps Summary Report, using the American Society of Civil Engineers (ASCE 7-16) standard, the peak ground acceleration (PGA_M) at the project site is expected to be 0.158g. Based on the USGS Unified Hazard Tool, the project site has a mean magnitude of 6.7. Furthermore, the site is not located within an Alquist-Priolo Earthquake Fault Zone based on our review of the State Fault Hazard Maps.[2]

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. Liquefaction is typically a hazard where loose sandy soils exist below groundwater. The California Geological Survey (CGS) 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.

The project site is not mapped for liquefaction hazard by the CGS. Based on the anticipated depth to groundwater, liquefaction hazard potential at the site is considered low. Other geologic hazards related to liquefaction, such as subsidence or lateral spreading (the lateral displacement of soils as a result of a seismic event), are therefore also considered low.

Geologic Hazards

- Slope stability – The project site is relatively flat therefore slope stability is not considered a concern.
- Rock fall hazards – The project site is relatively flat therefore rock hazard is not considered a concern.
- Landslide hazards - The site is relatively flat and there are no slopes near the site; therefore, landslide hazards are negligible.
- Surface fault rupture – The site is not located within an Alquist-Priolo Special Study Zone.
- Soil erosion and Loss of topsoil – Granular soils were encountered near the surface. These soils are subject to erosion. We recommend the site civil engineer perform a scour analysis to assess potential for soil erosion at the site as part of the final site design.
- Expansive soils – expansive soils were not observed to be present.

CORROSIVITY

Results of laboratory soluble sulfate, soluble chloride, electrical resistivity, and pH testing are included in the **Exploration Results** section of this report. 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.

[2] California Geological Survey (CGS), https://maps.conservation.ca.gov/cgs/informationwarehouse/regulatorymap

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 with cement type V in accordance with the exposure class S0 provisions of the ACI Design Manual, Section 318, Chapter 19.

GEOTECHNICAL OVERVIEW

The site generally appears suitable for the proposed construction based upon geotechnical conditions encountered in the explorations. The purpose of this report is to provide preliminary information and geotechnical engineering recommendations for this project.

It is our understanding that the photovoltaic (PV) solar panels and inverter skids will be supported by W-section galvanized steel piles or similar. Relatively high blow counts were encountered within the upper 10 feet in multiple areas across the site, which indicates the presence of very dense materials that can cause difficult pile driving. Difficult pile driving should be expected and verified through a pile testing program across the site. Further recommendation will be provided if pile driving refusal is encountered during the pile testing program. Construction methods such as pre-drilling may be necessary. If pre-drilling methods are selected, we recommend pile testing in pre-drilling holes be performed in the final geotechnical phase for this project The most effective means of verifying pile drivability and capacities for either axial tension, axial compression, and lateral loads is through pile load tests, which are recommended to be completed at a later phase.

Based on the geotechnical engineering analyses, subsurface exploration, and laboratory test results, we recommend that electrical equipment within the substation and inverters and other self-contained electrical equipment within the solar arrays be supported on shallow mat foundations bearing on engineered fill. We recommend mat foundations should bear on engineered fill extending to a minimum depth of 1 foot below the bottom of foundations, or 3 feet below existing grades, whichever is greater. Grading for the proposed foundations should incorporate the limits of the shallow foundations plus a lateral distance of 1 foot beyond the outside edge of the footings.

The on-site soils are generally suitable for reuse as engineered fill. The substation is also anticipated to include turning poles and bus supports which are likely to be supported on drilled pier foundations.

Preliminary geotechnical engineering recommendations for foundation systems and other earth connected phases of the project are outlined below. The preliminary recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, and our current understanding of the proposed project.

The **Future Services / General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project. The following sections provide recommendations for use in the preparation of specifications for the work.

Site Preparation

Strip and remove existing vegetation and other deleterious materials from proposed substation 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.

We recommend mat foundations should bear on engineered fill extending to a minimum depth of 1 foot below the bottom of foundations, or 3 feet below existing grades, whichever is greater. Grading for the proposed foundations should incorporate the limits of the shallow foundations plus a lateral distance of 1 foot beyond the outside edge of the footings.

Roadway aggregate sections may be supported on a minimum of 10 inches of scarified, moisture conditioned, and compacted native soils. Construction of the un-surfaced native roadways should consist of a minimum of 12-inches of compacted on-site soils. The moisture content and compaction of subgrade soils should be maintained until construction. The compaction requirements provided in the **Compaction Requirements** section of this report should be adhered to.

Care should be taken to prevent wetting or drying of the bearing materials during construction. Wet, dry, or loose/disturbed material in the bottom of the footing excavations should be removed before foundation concrete is placed. Place a lean concrete mud-mat over the bearing soils if the excavations must remain open for an extended period of time.

Fill Materials and Placement

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than three inches in size. Pea gravel or other open-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
- foundation backfill
- roadway areas

Imported soils for use as fill material within proposed structural areas should conform to low volume change materials as indicated in the following specifications:

Gradation	Percent Finer by Weight (ASTM C 136)
3"	100
No. 4 Sieve	50-100
No. 200 Sieve	20 – 50

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

*ASTM D4829

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 ten inches loose thickness.

Compaction Requirements

Recommended compaction, moisture content criteria, and testing frequency for engineered fill materials are as follows:

Material Type and Location	Per the Modified Maximum Density Test (ASTM D1557) [1]		
	Minimum Compaction Requirement	Range of Moisture Contents for Compaction (% over optimum) [2]	
		Minimum	Maximum
On-site native soils and/or approved imported engineered fill:			
Beneath foundations:	90%	-1%	+3%
Beneath aggregate base roadways:	90%	-1%	+3%
Miscellaneous backfill:	90%	-1%	+3%
Compacted native soils for roadways:	90%	-1%	+3%
Utility trench backfill:[3]	90%	-1%	+3%
General site grading:	90%	-1%	+3%
Aggregate Base			
Roadways:	90%	-1%	+3%

1. Maximum lift thickness of 8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used. A maximum lift thickness of 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the fill material pumping when compacted.

Material Type and Location	Per the Modified Maximum Density Test (ASTM D1557) [1]		
	Minimum Compaction Requirement	Range of Moisture Contents for Compaction (% over optimum) [2]	
		Minimum	Maximum

3. Minimum compaction of 95% is required in the top 12 inches beneath roadways and structural areas. Compaction requirements may be modified by the electrical engineer based on thermal resistivity.

Earthwork Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.

At the time of our geotechnical exploration of the site, moisture contents of the surface and near-surface native soils ranged from about 1.7 to 3.2 percent. Based on these moisture contents, some moisture conditioning of the soils may be needed during construction and grading/engineered fill placement on the project.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of the access roads. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and re-compacted prior to access road construction.

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, it may be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork may require additional construction means and methods 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.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved 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 structural areas. This testing frequency criteria, and non-structural test frequency criteria, may be adjusted during construction as specified by the geotechnical engineer of record.

The individual contractors are responsible for designing and constructing stable, temporary excavations (including utility trenches) as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proof-rolling, placement and compaction of controlled compacted fills and backfilling of excavations to the completed subgrade.

SHALLOW FOUNDATIONS

Self-contained electrical elements within the substation and solar fields can be supported by mat foundations and/or support slabs with thickened edges. Preliminary design recommendations for foundations for the proposed structures and related structural elements are presented in the following paragraphs.

Preliminary Design Parameters

Item	Description
Maximum Net Allowable Bearing pressure [1,7]	3,000 psf for mat foundations or support slabs with thickened edges
Required Bearing Stratum [3]	Engineered fill extending to a minimum depth of 1 foot below the bottom of foundations, or 3 feet below existing grades, whichever is greater.
Minimum Foundation Width	2 feet
Maximum Mat Foundation Width	20 feet[7]
Ultimate Coefficient of Sliding Friction [4]	0.35
Ultimate Passive Resistance [5] **(equivalent fluid pressures)**	460 psf/ft
Minimum Embedment below Finished Grade	12 inches
Estimated Total Settlement from Structural Loads [2]	1 inch
Estimated Differential Settlement [2,6]	About ½ of total settlement

Item	Description

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied.
2. Unsuitable or loose/soft, dry, and low-density soils should be removed and replaced per the recommendations presented in the **Earthwork**.
3. 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.
4. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
5. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure. The designer should select an appropriate factor of safety during design.
6. Differential settlements are as measured over a span of 40 feet.
7. Maximum width is based on settlement analysis with allowable settlement of 1 inch. Higher bearing pressures or settlement values can be provided if settlement is allowed to exceed 1 inch

Settlement calculations were performed utilizing Westergaard and Hough's methods[3] to estimate the static settlement and allowable bearing pressure for various foundation widths.

Since there are several factors that will control the design of mat foundations besides vertical load, Terracon should be consulted when the final foundation depth and width are determined to assist the structural designer in the evaluation of anticipated settlement.
For structural design of mat foundations, a short term modulus of subgrade reaction (Kv_1) of 200 pounds per cubic inch (pci) may be used. Other details including treatment of soft foundation soils, superstructure reinforcement and observation of foundation excavations as outlined in the Earthwork section of this report are applicable for the design and construction of a mat foundation at the site.

The subgrade modulus (Kv) for the mat is affected by the size of the mat foundation and would vary according the following equation:

$$K_v = K_{v1} (B+1)^2 / 4B^2$$

Where: K_v is the modulus for the size footing being analyzed
B is the width of the mat foundation.

Foundation Construction Considerations

The on-site soils are generally considered to be stable and workable. If unstable subgrade conditions develop during construction, suitable methods of stabilization will be dependent upon factors such as schedule, weather, size of area to be stabilized, and the nature of the instability. If soil stabilization is needed, Terracon should be consulted to evaluate the situation as needed.

[3] *FHWA Geotechnical Engineering Circular No. 6 – Shallow Foundations, FHWA-SA-02-054.*

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations (including utility trenches) as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations to the completed subgrade.

DEEP FOUNDATIONS

Preliminary Drilled Shaft Design Recommendations

The proposed substation can be supported on drilled shafts. Total required embedment of the drilled shafts should be determined by the structural engineer based on structural loading and parameters provided in this report.

The allowable end bearing and side friction components of resistance were evaluated and are presented in the graphs provided in the **Supporting Documents** section of this report. The allowable axial downward capacities are based on a minimum factor of safety of 2.5. The weight of the drilled pier may be added to the uplift capacity in the attached charts.

Recommended geotechnical parameters for lateral load analyses of drilled shaft foundations have been developed for use in the LPILE computer program. Based on our review of the subsurface conditions within the outline of the substation and the Standard Penetration Test (SPT) results, engineering properties have been estimated for the soils conditions as shown in the following table. Due to potential disturbance within the upper soils around the shaft, lateral and axial capacity of soils within the upper 2 feet should be neglected. In the event disturbance is expected in a deeper depth, such depth should be neglected. We recommend that Terracon review the final drilled shaft design to verify that sufficient embedment is achieved.

Top Depth / Bottom Depth	Effective Unit Weight (pcf)	LPILE/ GROUP Soil Type	Internal Friction (degrees) / Cohesion (psf)
2 / 7	115	Sand	38°
7 / 10	115	Sand	34°
10 / 15	120	Sand	38°
15 / 25	120	Stiff Clay w/o free water	4800 psf

Top Depth Bottom Depth	Effective Unit Weight (pcf)	LPILE/ GROUP Soil Type	Internal Friction (degrees) / Cohesion (psf)
25 40	120	Sand	33°
40 52	120	Sand	35°

The depth below ground surface indicated in the table above is referenced from the existing site surface at the time of the field exploration. If fill is placed to raise the site grades, the depths shown in the charts and table above must be increased by the thickness of fill placed. The required depths of shaft embedment should also be determined for design lateral loads and overturning moments to determine the most critical design condition. Lateral load design parameters are valid within the elastic range of the soil.

It should be noted that the loaded capacities provided herein are based 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. Furthermore, the response of the drilled shaft foundations to lateral loads is dependent upon the soil/structure interaction as well as the shaft's actual diameter, length, stiffness and "fixity" (fixed or freehead condition).

Drilled Shaft Construction Considerations

Drilling to design depths should be possible with conventional single flight power augers. For drilled shaft depths above the depth of groundwater, temporary steel casing will likely be required to properly drill and clean shafts prior to concrete placement.

Drilled shaft 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 drilled shaft construction, it should be withdrawn in a slow continuous manner maintaining a sufficient head of concrete to prevent infiltration of water or the creation of voids in shaft concrete. Shaft concrete should have a relatively high fluidity when placed in cased shaft holes or through a tremie. Shaft concrete with slump in the range of 6 to 8 inches is recommended.

We recommend that all drilled shaft installations be observed on a full-time basis by an experienced geotechnical engineer in order to evaluate that the soils encountered are consistent with the recommended design parameters. 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 prior to any workers entering 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 by the owner and the EPC.

DRIVEN PILES

Proposed solar PV panels can be supported on driven steel W-section foundations (assumed to be W6x9 or similar) in general accordance with the following sections.

Preliminary Driven Pile Considerations

The proposed solar PV panels may be supported on a driven pile foundation system. The design capacity of a single-driven pile is a function of several factors including:

- Size and type of pile;
- Type and capacity of pile installation equipment;
- Pile integrity after installation; and
- Engineering properties of the subsurface soils.

Based on specific conditions encountered on site, the soils are generally considered drivable for pile installation. Relatively high blow counts were encountered within the upper 10 feet, which indicates the presence of very dense materials that can cause difficult driving. The most effective means of verifying pile drivability and capacities for either tension or lateral loads is through pile load tests. Pile foundation design parameters have been based upon correlated capacities utilizing soil strength criteria determined from the soil borings and laboratory testing.

The tables below neglect a depth of 1 foot for axial and lateral resistance. This neglect is due to depth of scour and/or disturbance from utilities near the piles. Depth of neglect should be verified by the design engineer based on the scour analysis.

The axial capacity of the proposed driven piles was determined using the computer program APILE Version 2019 produced by Ensoft, Inc and the soil strengths based on our field and laboratory testing. Allowable capacities were based on a safety factor of 2.0.

Description	Top Depth Bottom Depth	Total Unit Weight (pcf)	Allowable Compression Unit Skin friction (psf)[A]	Allowable Bearing Pressure (psf)[B]
Stratum 1	1 7	115	130	--
Stratum 2	7 10	115	190	7,000
Stratum 3	10	115	200	10,000

Description	Top Depth Bottom Depth	Total Unit Weight (pcf)	Allowable Compression Unit Skin friction (psf)[A]	Allowable Bearing Pressure (psf)[B]
	15			

[A] Allowable uplift capacity is on the order of 70% of the compression capacity values in the table. The values provided should be multiplied by the box perimeter of the pile times the depth. The box perimeter is considered two times the width of the flange plus two times the depth of the web.
[B] The values provided should be multiplied by the box area of the pile and be used for compression resistance only.

Recommended soil parameters for lateral load analysis of driven pile foundations have been developed for use in LPILE computer programs. Engineering properties have been estimated as outlined below:

Description	Top Depth Bottom Depth	Effective Unit Weight (pcf)	L-PILE/ GROUP Soil Type	Friction Angle (degrees)
Stratum 1	1 5	115	Sand	34
Stratum 2	5 10	115	Sand	32
Stratum 3	10 15	115	Sand	31

ACCESS ROADWAYS

Preliminary Compacted Native Soils Access Road Design Recommendations

Based upon the soil conditions encountered in the test borings, the use of on-site soils for construction of on-site roads is considered acceptable. Without the use of asphalt concrete or other hardened material to surface the roadways, there is an increased potential for erosion and deep rutting of the roadway to occur, however, post construction traffic is anticipated to only consist of pickup trucks for operations and maintenance personnel. Therefore, construction of the un-surfaced native roadways should consist of a minimum of 12-inches of compacted on-site soils.

It is our understanding that proposed compacted native roadway grades will match adjacent existing grades so that the existing natural drainage patterns are generally unchanged. The un-surfaced roads are expected to function with periodic maintenance.

Preliminary Aggregate Surface Roadway Design Recommendations

Aggregate surface roadway design was conducted in general accordance with the Army Corps of Engineers (ACOE) Technical Manual TM-5-822, Design of Aggregate Surface Roads and Airfields (1990). The design was based on Category III, traffic containing as much as 15% trucks, but with not more than 1% of the total traffic composed of trucks having three or more axles (Group 3 vehicles), and Road Class G (Under 70 vehicles per day). Based on the Category and Road Class, a Design Index of 1 was utilized, along with a correlated CBR. Terracon should be contacted if significant changes in traffic loads or in the characteristics described are anticipated.

As a minimum, the aggregate surface course should have a minimum thickness of 5 inches and should be constructed over a minimum of 10 inches of scarified, moisture conditioned, and compacted native soils to 90% of the maximum dry density using ASTM D 1557. The recommended thicknesses should be measured after full compaction. The width of the roadway should extend a minimum distance of 1 foot on each side of the desired surface width.

It is our understanding that aggregate surfaced roads and parking areas will be utilized during the construction of this project. Aggregate materials should conform to the specifications of Class II aggregate base in accordance with the requirements and specifications of the State of California Department of Transportation (CalTrans), or other approved local governing specifications.

Positive drainage should be provided during construction and maintained throughout the life of the roadways. Proposed roadway design should maintain the integrity of the road and eliminate ponding.

Roadway Design and Construction Considerations

Regardless of the design, un-surfaced roadways will display varying levels of wear and deterioration. We recommend an implementation of a site inspection program at a frequency of at least once per year to verify the adequacy of the roadways. Preventative measures should be applied as needed for erosion control and re-grading. An initial site inspection should be completed approximately three months following construction.

Preventative maintenance should be planned and provided for through an on-going management program to enhance future roadway performance. Preventative maintenance activities are intended to slow the rate of deterioration, and to preserve the roadway investment.

Surfacing materials should not be placed when the surface is wet. Surface drainage should be provided away from the edge of roadways to reduce lateral moisture transmission into the subgrade.

If rut depths become excessive as construction work progresses, re-grading and re-compaction should be performed as necessary. Care should be taken to reduce or eliminate trafficking of the unpaved access road when the subgrade is wet as this will result in accelerated rutting conditions. Scarification, moisture treatment as necessary, and re-compaction of the roadways will likely be necessary as the roadways deteriorate.

Materials and construction of roadways for the project should be in accordance with the requirements and specifications of the California Department of Transportation or the applicable local governing body.

FUTURE SERVICES/ GENERAL COMMENTS

The comments contained in this preliminary report are intended only for planning purposes, are preliminary in nature, and are based on widely spaced borings. Variations will likely occur in the subgrade which have not been detected in the boring program.

Additional geotechnical services will be required for each individual phase of development and as more information regarding the nature and locations of the various improvements planned is made available. Terracon will not be responsible for any final design and/or construction which is based on the information presented in this preliminary report.

This preliminary report only addresses items related to the geotechnical engineering aspects of the site development. The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, and 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 services should be undertaken.

This preliminary report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted Geotechnical Engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this preliminary report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D7263 Standard Test Methods for Laboratory Determination of Dry Density (Unit Weight) of Soil Specimens
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM C136 Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
- Corrosivity Testing will include pH, chlorides, sulfates, sulfides, Redox potential, and electrical lab resistivity
- ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
- ASTM D5534 Standard Test Method for Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure

The laboratory testing program included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

SITE LOCATION

Vidal Solar ■ Vidal, California

December 1, 2021 ■ Terracon Project No. 60215247

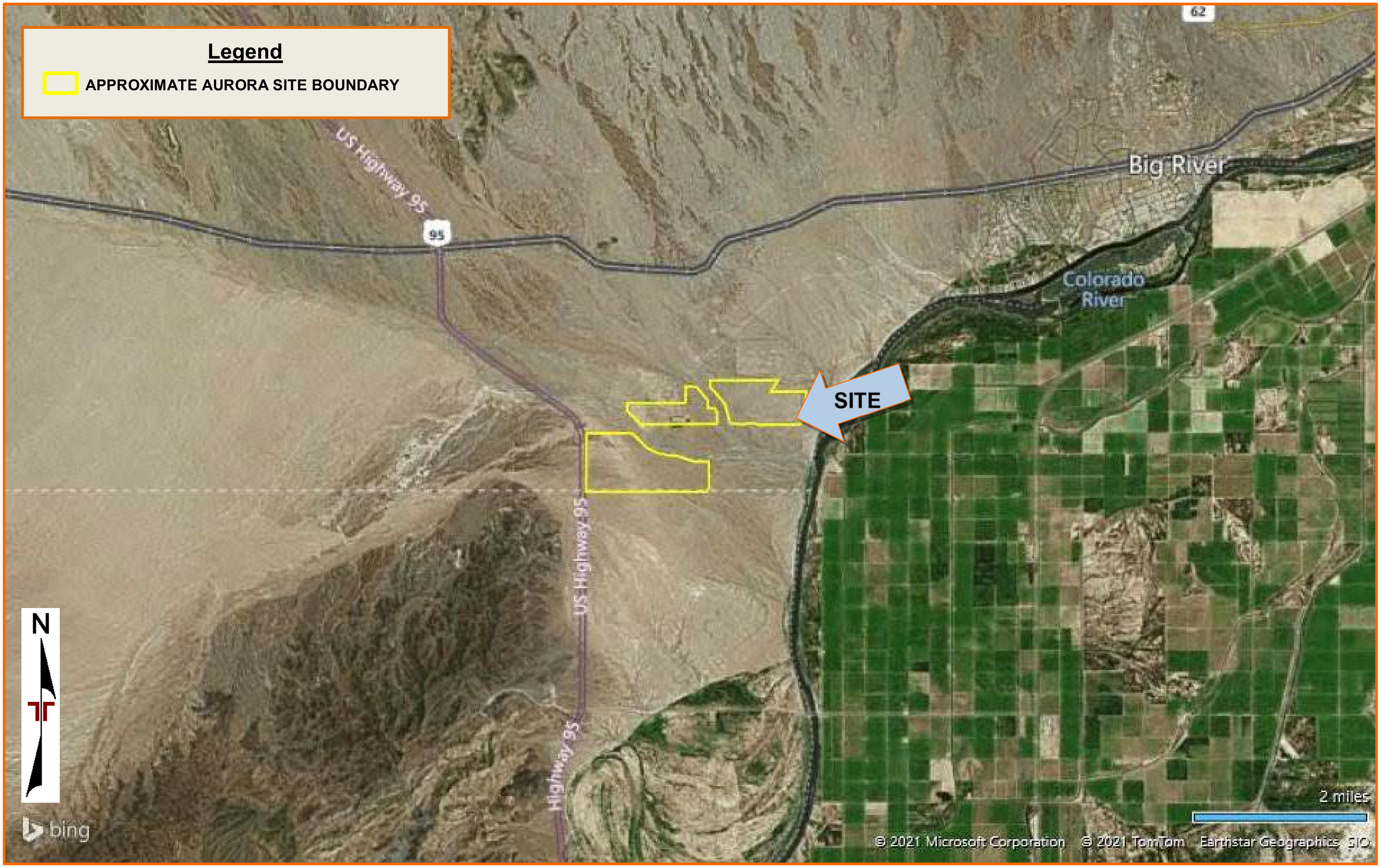


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: PARKER SW, CA (1/1/1975).

EXPLORATION PLAN

Vidal Solar ■ Vidal, California

December 1, 2021 ■ Terracon Project No. 60215247

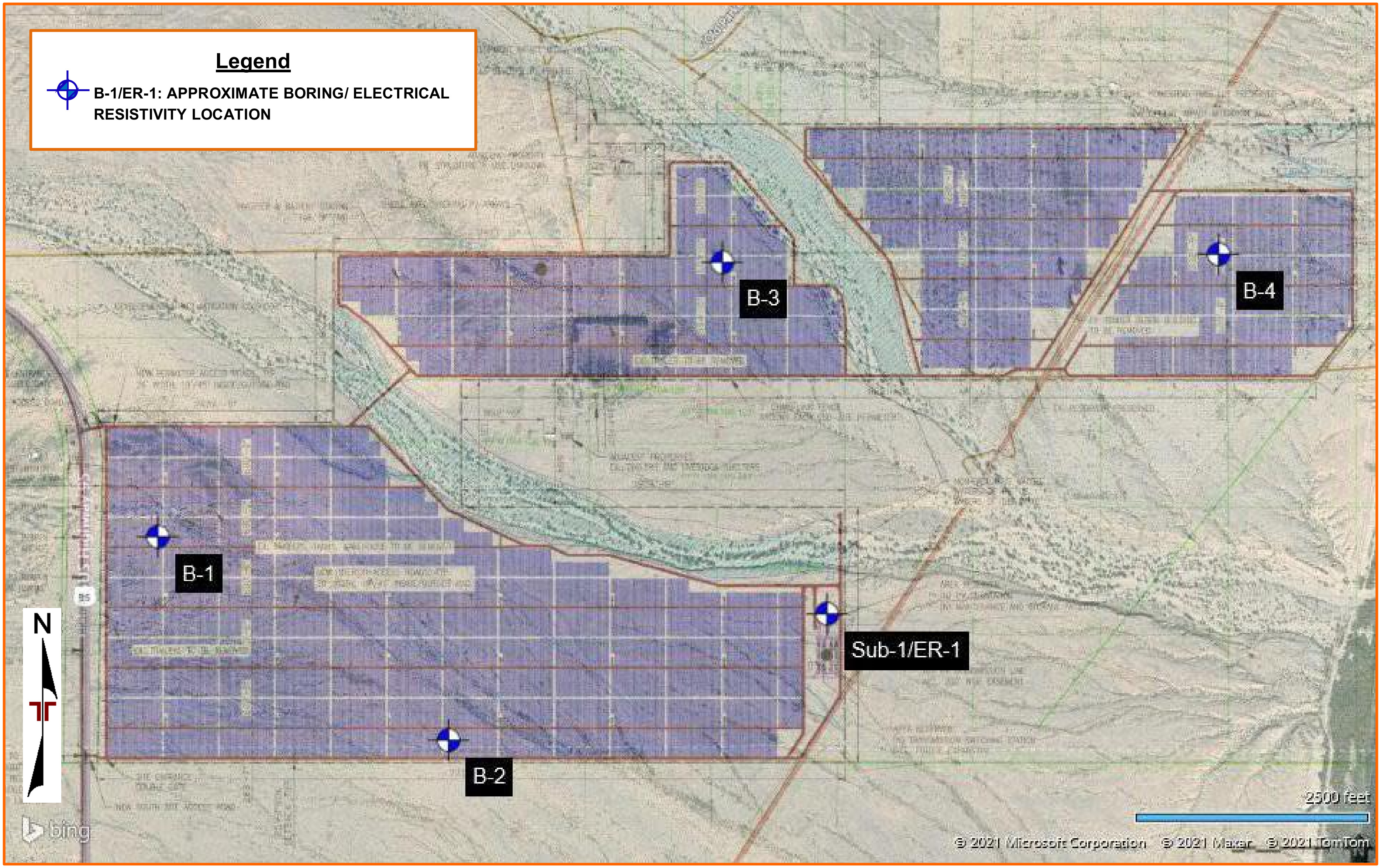


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

BORING LOG NO. B-1

PROJECT: Vidal Solar

CLIENT: CORE Development
Mahwah, NJ

SITE: Route 95 and Agnes Wilson Road
Vidal, CA

LOCATION See Exploration Plan

Latitude: 34.0871° Longitude: -114.4777°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), beige			Grab							NP	12
	medium dense				15-16-13				1.7			
		5			6-13-16							
	medium dense				7-11-10 N=21							
		10			13-13-11							
	tan, very dense	15			11-50							
20.3		20			50/4"							
	Boring Terminated at 20.33 Feet											

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

Hammer Type: Automatic

Advancement Method:
Truck mounted hollow stem auger drill rig

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 10-18-2021	Boring Completed: 10-18-2021
Drill Rig: CME-75	Driller: 2R
Project No.: 60215247	

BORING LOG NO. B-2

PROJECT: Vidal Solar

CLIENT: CORE Development
Mahwah, NJ

SITE: Route 95 and Agnes Wilson Road
Vidal, CA

LOCATION See Exploration Plan

Latitude: 34.0800° Longitude: -114.4683°

DEPTH	Description	Sample Type	Field Test Results	Test Type	Compressive Strength (tsf)	Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), light brown	Grab							NP	6
	medium dense	Ring	12-22-36				1.9			
		Ring	25-25-25				2.6	114		
		SPT	9-9-15 N=24							
	dense	Ring	33-39-47				2.4	113		
15.0	**SILTY SAND WITH GRAVEL (SM)**, light orangish brown, dense	SPT	15-23-21 N=44							
20.0	**SILTY SAND (SM)**, light brown, medium dense	Ring	11-17-28				3.7	96		
21.5	***Boring Terminated at 21.5 Feet***									

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

Hammer Type: Automatic

Advancement Method:
Truck mounted hollow stem auger drill rig

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 10-18-2021	Boring Completed: 10-18-2021
Drill Rig: CME-75	Driller: 2R
Project No.: 60215247	

BORING LOG NO. B-3

PROJECT: Vidal Solar

CLIENT: CORE Development
Mahwah, NJ

SITE: Route 95 and Agnes Wilson Road
Vidal, CA

LOCATION See Exploration Plan

Latitude: 34.0941° Longitude: -114.4586°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), light brown	0–2.5		Grab							NP	8
	medium dense	2.5–4		Ring	10-18-23				2.4	118		
		5–6.5		SPT	3-6-8 N=14							
		7.5–9		Ring	8-15-17				2.1	117		
	very dense	10		SPT	36-50/5"							
		15		Ring	32-50/3"				1.6			
21.5	medium dense	20–21.5		SPT	10-12-13 N=25							

Boring Terminated at 21.5 Feet

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

Hammer Type: Automatic

Advancement Method:
Truck mounted hollow stem auger drill rig

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 10-18-2021	Boring Completed: 10-18-2021
Drill Rig: CME-75	Driller: 2R
Project No.: 60215247	

BORING LOG NO. B-4

PROJECT: Vidal Solar

CLIENT: CORE Development
Mahwah, NJ

SITE: Route 95 and Agnes Wilson Road
Vidal, CA

LOCATION See Exploration Plan

Latitude: 34.0943° Longitude: -114.4410°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), light brown and beige			Grab							NP	14
	medium dense			Ring	13-23-27				3.2	114		
	dense	5		SPT	12-17-20 N=37							
	very dense			Ring	33-50/5"				3.4	111		
	dense	10		SPT	14-14-17 N=31							
15.0	**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)**, light beige, medium dense	15		Ring	10-19-22				0.6			
21.5		20		SPT	6-6-7 N=13							

Boring Terminated at 21.5 Feet

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

Hammer Type: Automatic

Advancement Method:
Truck mounted hollow stem auger drill rig

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 10-18-2021	Boring Completed: 10-18-2021
Drill Rig: CME-75	Driller: 2R
Project No.: 60215247	

BORING LOG NO. SUB-1

PROJECT: Vidal Solar

CLIENT: CORE Development
Mahwah, NJ

SITE: Route 95 and Agnes Wilson Road
Vidal, CA

LOCATION See Exploration Plan

Latitude: 34.0839° Longitude: -114.4554°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), light brown										NP	14
	dense				10-30-35				2.0	116		
		5			17-22-23 N=45							
7.5	**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)**, light brown, medium dense				13-14-30				2.1			
	dense	10			23-20-16 N=36							
15.0	**SILTY CLAY WITH SAND (CL-ML)**, light brown, hard	15			15-28-48				9.6	92		
		20			10-18-22 N=40						20-15-5	81
25.0	**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)**, light beige, medium dense	25			11-16-20							
		30			11-11-11 N=22							

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

Hammer Type: Automatic

Advancement Method:
Truck mounted hollow stem auger drill rig

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 10-18-2021	Boring Completed: 10-18-2021
Drill Rig: CME-75	Driller: 2R
Project No.: 60215247	

BORING LOG NO. SUB-1

PROJECT: Vidal Solar

CLIENT: CORE Development
Mahwah, NJ

SITE: Route 95 and Agnes Wilson Road
Vidal, CA

LOCATION See Exploration Plan

Latitude: 34.0839° Longitude: -114.4554°

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), light beige, medium dense *(continued)*											
			35			14-18-20				0.5			
			40			11-14-14 N=28							
		gray and beige	45			15-19-28				1.1			
		dense	50			36-20-16 N=36							
	51.5	***Boring Terminated at 51.5 Feet***											

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

Hammer Type: Automatic

Advancement Method:
Truck mounted hollow stem auger drill rig

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

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

Groundwater not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 10-18-2021	Boring Completed: 10-18-2021
Drill Rig: CME-75	Driller: 2R
Project No.: 60215247	

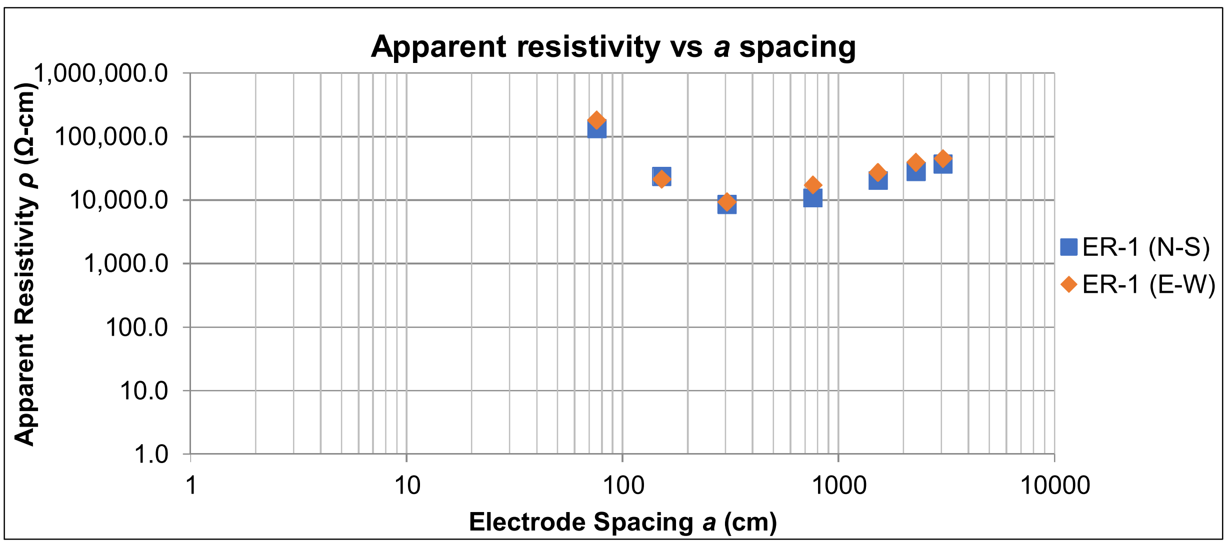
FIELD ELECTRICAL RESISTIVITY DATA SHEET
Vidal Solar ■ Vidal, California
November 18, 2021 ■ Terracon Project No. 60215247

NORCAL GEOPHYSICAL CONSULTANTS INC. A Terracon COMPANY

Array Loc.	ER-1		
Instrument	AGI Ministing	**Weather**	Cool, Sunny
Serial #	S2107129	**Ground Cond.**	Exposed Soils
Cal. Check	7/14/2021	**Tested By**	CM
Test Date	October 14, 2021	**Method**	Wenner 4-pin ASTM G57-06 (2012); IEEE 81-2012

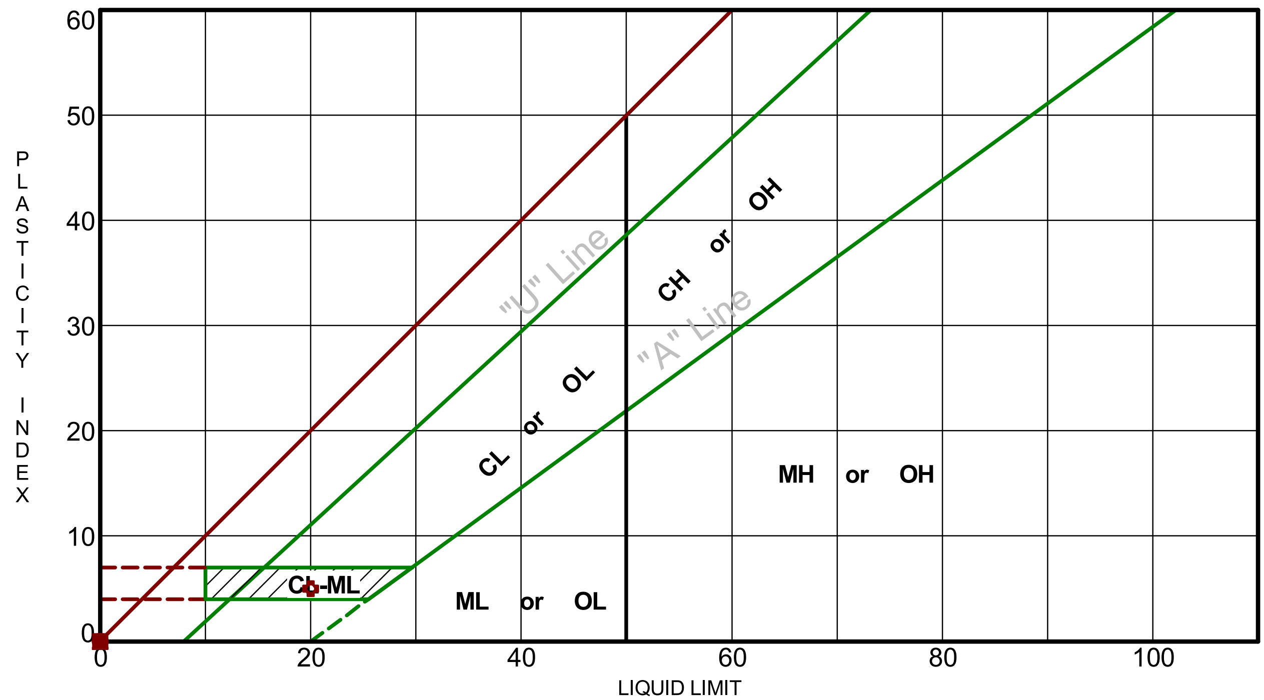
Apparent resistivity ρ is calculated as : $$\rho = \frac{4\pi a R}{1 + \frac{2a}{\sqrt{a^2 + 4b^2}} - \frac{a}{\sqrt{a^2 + b^2}}}$$

Electrode Spacing *a*		**Electrode Depth *b***		**ER-1 (N-S)**		**ER-1 (E-W)**	
(feet)	(centimeters)	(inches)	(centimeters)	Measured Resistance *R* Ω	Apparent Resistivity *ρ* (Ω-cm)	Measured Resistance *R* Ω	Apparent Resistivity *ρ* (Ω-cm)
2.5	76	6	15	259.90	132080	355.30	180570
5	152	6	15	24.100	23400	21.80	21170
10	305	6	15	4.378	8430	4.867	9370
25	762	12	30	2.225	10680	3.590	17230
50	1524	12	30	2.107	20190	2.813	26950
75	2286	12	30	1.962	28190	2.735	39300
100	3048	12	30	1.9060	36510	2.3450	44920



ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-1	0 - 2.5	NP	NP	NP	12.4	SM	SILTY SAND WITH GRAVEL
⊠	B-2	0 - 2.5	NP	NP	NP	5.7	SP-SM	POORLY GRADED SAND WITH SILT AND GRAVEL
▲	B-3	0 - 2.5	NP	NP	NP	7.8	SP-SM	POORLY GRADED SAND WITH SILT AND GRAVEL
★	B-4	0 - 2.5	NP	NP	NP	13.5	SM	SILTY SAND
⊙	SUB-1	0 - 2.5	NP	NP	NP	14.3	SM	SILTY SAND WITH GRAVEL
✿	SUB-1	20 - 21.5	20	15	5	80.9	CL-ML	SILTY CLAY with SAND

PROJECT: Vidal Solar

SITE: Route 95 and Agnes Wilson Road
Vidal, CA

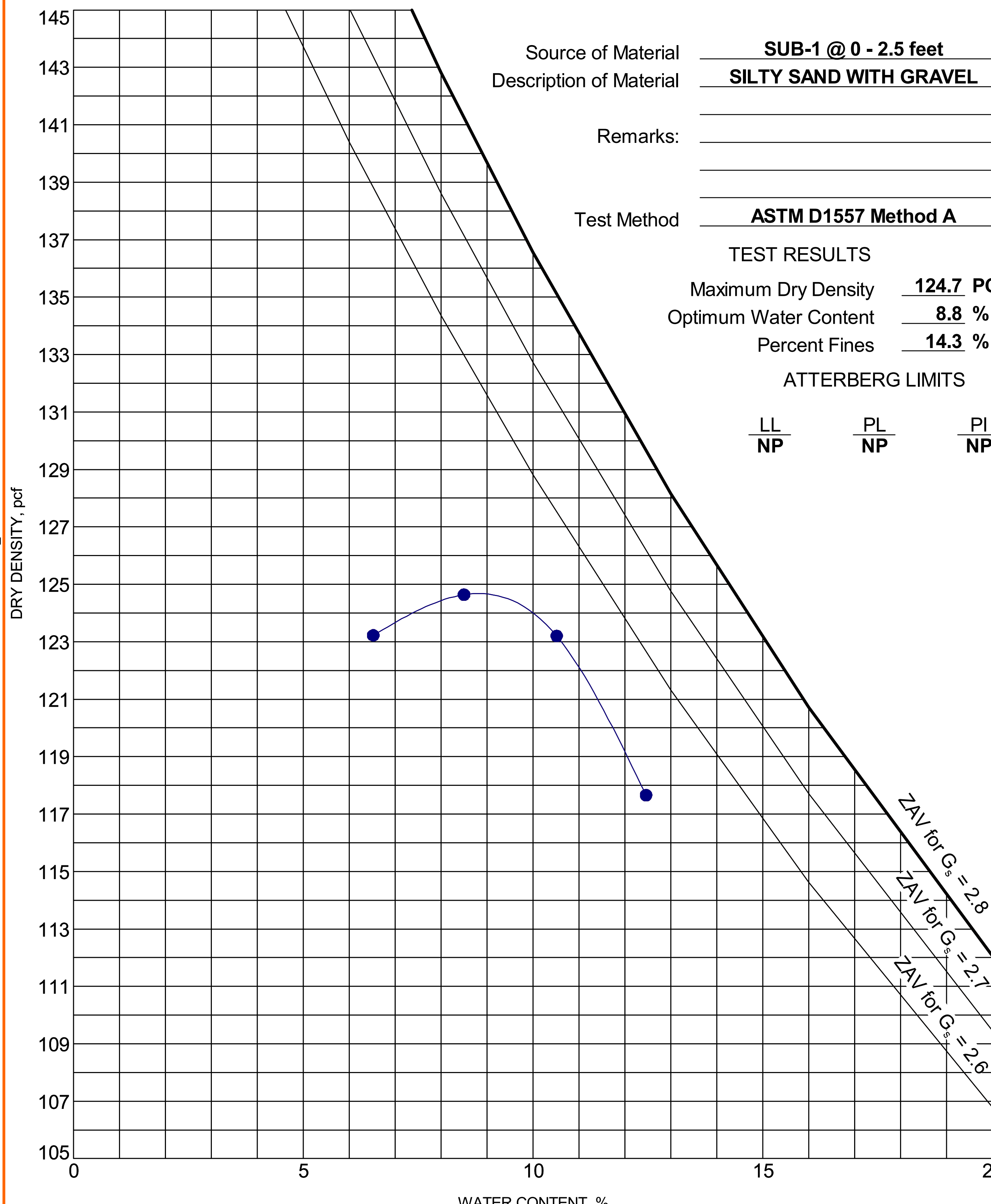
Terracon
1421 Edinger Ave, Ste C
Tustin, CA

PROJECT NUMBER: 60215247

CLIENT: CORE Development
Mahwah, NJ

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**SUB-1 @ 0 - 2.5 feet**
Description of Material	**SILTY SAND WITH GRAVEL**
Remarks:	
Test Method	**ASTM D1557 Method A**

TEST RESULTS

Maximum Dry Density	**124.7**	**PCF**
Optimum Water Content	**8.8**	**%**
Percent Fines	**14.3**	**%**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

PROJECT: Vidal Solar	Terracon 1421 Edinger Ave, Ste C Tustin, CA	PROJECT NUMBER: 60215247
SITE: Route 95 and Agnes Wilson Road Vidal, CA		CLIENT: CORE Development Mahwah, NJ

ANAHEIM TEST LAB, INC

196 Technology Drive, Unit D
Irvine, CA 92618
Phone (949)336-6544

DATE: 11/5/2021

Terracon Consultants, Inc.
1421 Edinger Ave.
Tustin, CA 92780

P.O. NO.: Chain of Custody

LAB NO.: C-5390

SPECIFICATION: CTM-643/417/422

MATERIAL: Soil

Project No.: 60215247
Project: Vidal Solar
Sample ID: Sub-1 @ 0-2.5'

ANALYTICAL REPORT

CORROSION SERIES

SUMMARY OF DATA

pH	MIN. RESISTIVITY per CT. 643 ohm-cm	SOLUBLE SULFATES per CT. 417 (% by weight)	SOLUBLE CHLORIDES per CT. 422 ppm
8.0	4,700	0.0156%	52

RESPECTFULLY SUBMITTED

WES BRIDGER LAB MANAGER

21239 FM529 Rd., Bldg. F
Cypress, TX 77433
Tel: 281-985-9344
Fax: 832-427-1752
info@geothermusa.com
http://www.geothermusa.com

November 1, 2021

Terracon Consultants, Inc.
1421 Edinger Avenue, Suite C
Tustin, CA 92780
Attn: Abigail McCranie, EIT

Re: Thermal Analysis of Native Soil Sample
Vidal Solar – Vidal, CA (Project No. 60215247)

The following is the report of thermal dryout characterization tests conducted on one (1) native soil sample from the referenced project sent to our laboratory.

Thermal Resistivity Tests: The sample was tested at the 'optimum' moisture content and 85% of standard Proctor dry density ***provided by Terracon***. The tests were conducted in accordance with the IEEE standard 442-2017. The results are tabulated below and the thermal dryout curve is presented in **Figure 1.**

Sample ID, Description, Thermal Resistivity, Moisture Content and Density

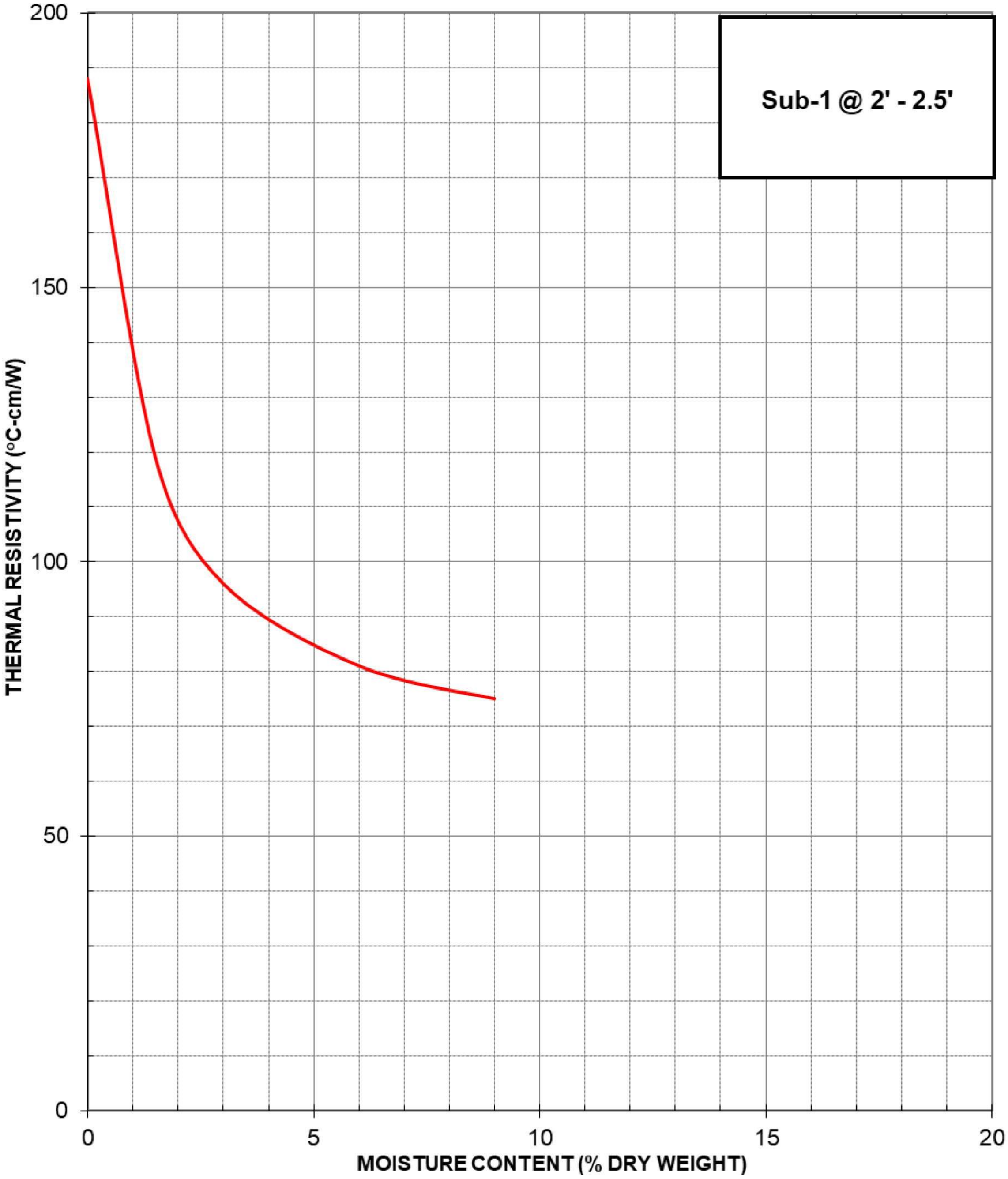
Sample ID	Depth (ft)	Description (Terracon)	Thermal Resistivity (°C-cm/W)		Moisture Content (%)	Dry Density (lb/ft^3)
			Wet	Dry		
Sub-1	0-2.5	Silty sand with gravel	75	188	9	106

Please contact us if you have any questions or if we can be of further assistance.

Geotherm USA

Deepak Parmar

THERMAL DRYOUT CURVE



Terracon Consultants, Inc. (Project No. 60215247)

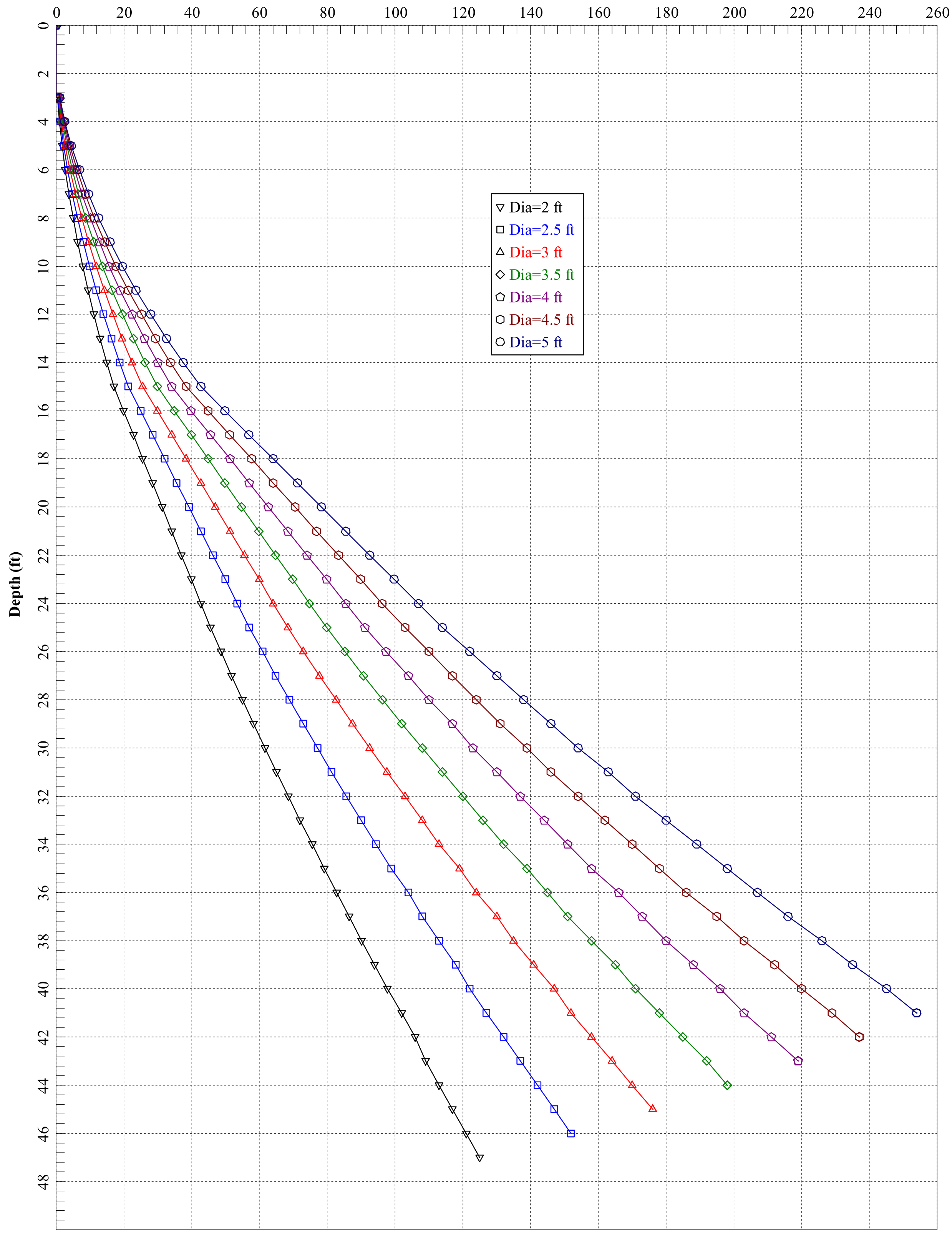
Vidal Solar – Vidal, CA

Thermal Analysis of Native Soil Sample

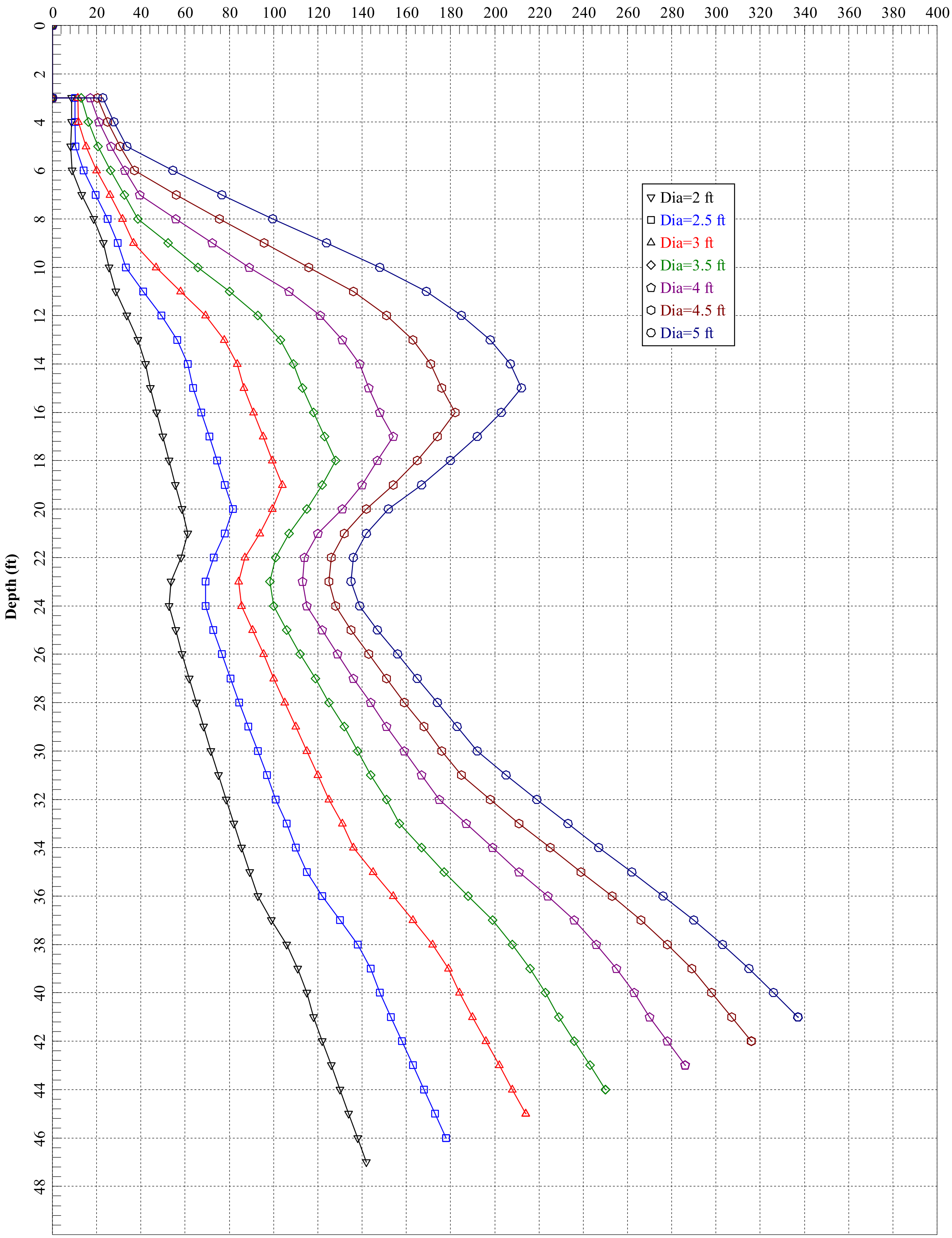
November 2021 **Figure 1**

SUPPORTING INFORMATION

Substation Allowable Side Resistance
Side Resistance/F.S. (tons)



Substation Allowable Downward Capacity
Total Resistance/F.S. (tons)



GENERAL NOTES

Terracon GeoReport

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Shelby Tube	Split Spoon
Rock Core	Macro Core	Modified California Ring Sampler
Grab Sample	No Recovery	Modified Dames & Moore Ring Sampler

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
N	N value
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer
(WOH)	Weight of Hammer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			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.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 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 / Liquid limit - 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:	Liquid limit - oven dried / Liquid limit - 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.