Appendix E

Geotechnical Investigation

GEOTECHNICAL INVESTIGATION

Proposed Warehouse Development
SW Corner of Morgan Street and Perris Boulevard
Perris, California

Patriot Partners
12126 West Sunset Boulevard
Los Angeles, California 90094

Project Number 21749-20
March 31, 2020

NorCal Engineering

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS
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March 31, 2020 Project Number 21749-20

Patriot Partners
12126 West Sunset Boulevard
Los Angeles, California 90094

Attn: Kevin Rice

RE: **GEOTECHNICAL INVESTIGATION** - Proposed Warehouse Development - Located at the Southwest Corner of Morgan Street and Perris Boulevard, in the City of Perris, California

Dear Mr. Rice:

Pursuant to your request, this firm has performed a Geotechnical Investigation for the above referenced project. The purpose of this investigation is to evaluate the geotechnical conditions of the subject site and to provide recommendations for the proposed development. This geotechnical engineering report presents the findings of our study along with conclusions and recommendations for development.

1.0 STRUCTURAL CONSIDERATIONS

1.1 Proposed Development

It is proposed to construct a new warehouse development consisting of four concrete tilt-up structures totaling 311,619 square feet along with associated pavement areas on the 15.41-acre site. Grading for the future development will include cut and fill procedures. Final building plans shall be reviewed by this firm prior to submittal for city approval to determine the need for any additional study and revised recommendations pertinent to the proposed development, if necessary.

2.0 SITE DESCRIPTION

2.1 **Location:** The L-shaped subject property is located at the southwest corner of Morgan Street and Perris Boulevard, in the City of Perris, as illustrated on Figure 1, Vicinity Map.

2.2 **Existing Improvements:** The property is currently vacant and covered with low vegetation, some trees and scattered debris. Some small concrete slabs are located at the northwest corner of the site.

2.3 **Topography/Drainage:** The site topography is generally level and drainage appears to be via sheetflow toward the south.

3.0 SEISMICITY EVALUATION

The proposed development lies outside of any Alquist Priolo Special Studies Zone and the potential for damage due to direct fault rupture is considered unlikely.

The following seismic design parameters are provided and are in accordance with the 2019 California Building Code (CBC) as determined using the ASCE 7 Hazard Tool (https://asce7hazardtool.online/) for the referenced project. Complete printout from the source is included in Appendix A.

Seismic Design Parameters

Site Location	Latitude	33.8366°
	Longitude	-117.2268°
Site Class		D
Risk Category		III
Maximum Spectral Response Acceleration	S_S	1.500g
	S_1	0.574g
Adjusted Maximum Acceleration	S_{MS}	1.500g
Design Spectral Response Acceleration Parameters	S_{DS}	1.000g

The San Jacinto (San Jacinto Valley) Fault zone is located approximately 13 kilometers from the site and is capable of producing a Magnitude 6.9 earthquake and a PGA_M of 0.55g. Ground shaking originating from earthquakes along other active faults in the region is expected to induce lower horizontal accelerations due to smaller anticipated earthquakes and/or greater distances to other faults.

4.0 LIQUEFACTION EVALUATION

The site is expected to experience ground shaking and earthquake activity that is typical of Southern California area. Due to groundwater depths in excess of 50 feet in the vicinity, the potential for liquefaction is considered low.

5.0 FIELD INVESTIGATION

5.1 Site Exploration

The purpose of the investigation was to explore the subsurface conditions and to provide preliminary geotechnical engineering design parameters for evaluation of the site with respect to the proposed development.

The investigation consisted of the placement of fifteen (15) excavations by backhoe. The explorations extended to a maximum depth of 20.5 feet below current ground elevations.

The explorations were visually classified and logged by a field engineer with locations of the subsurface borings and excavations shown on the attached Figure 2. Detailed descriptions of the subsurface conditions are listed on the excavation logs in Appendix B. It should be noted that the transition from one soil type to another as shown on the logs is approximate and may in fact be a gradual transition. The soils encountered are described as follows:

Disturbed Topsoils/Fill Soils – Disturbed topsoils and minor amounts of fill soils classifying as clayey and sandy SILTS with some gravel, roots and minor debris were encountered in the explorations to depths ranging from 12 to 18 inches below existing surface. These soils were noted to be soft and damp.

Native Soils – Native soils also classifying as clayey and sandy SILT were encountered beneath the upper fill soils. These soils were noted to be medium stiff to stiff and damp to moist. Sand, silt and clay content varied significantly with depth of explorations.

5.2 Groundwater

Groundwater was *not* encountered in any of our subsurface explorations. Based upon information from the California Department of Water Resources database http://www.water.ca.gov/waterdatalibrary/, groundwater in the site vicinity is 50 feet or greater below grade.

6.0 LABORATORY TESTS

Relatively undisturbed samples of the subsurface soils were obtained to perform laboratory testing and analysis for direct shear, consolidation tests, and to determine in-place moisture/densities. These relatively undisturbed ring samples were obtained by driving a thin-walled steel sampler lined with one-inch long brass rings with an inside diameter of 2.42 inches into the undisturbed soils.

Bulk bag samples were obtained in the upper soils for expansion index tests, corrosion tests and maximum density tests. Wall loadings on the order of 4,000 lbs./lin.ft. and maximum compression loads on the order of 100 kips were utilized for testing and design purposes. All test results are included in Appendix C, unless otherwise noted.

6.1 **Field moisture content** (ASTM:D 2216-10) and the dry density of the ring samples were determined in the laboratory. This data is listed on the logs of explorations.

6.2 **Maximum density tests** (ASTM: D-1557-12) were performed on typical samples of the upper soils. Results of these tests are shown on Table I.

6.3 **Expansion index tests** (ASTM: D-4829-11) were performed on remolded samples of the upper soils to determine the expansive characteristics and to provide any necessary recommendations for reinforcement of the slabs-on-grade and the foundations. Results of these tests are provided on Table II and are discussed later in this report.

6.4 **Atterberg Limits** (ASTM: D 4318-05) consisting of liquid limit, plastic limit and plasticity index were performed on selected soil samples. Results are shown on Table III.

6.5 **Sieve analyses** and the percent by weight of soil finer than the No. 200 sieve (ASTM: 1140-00) were performed on selected soil samples. These results are detailed later in this report along with discussion of the liquefaction potential at the site.

6.6 **Direct shear tests** (ASTM: D-3080-11) were performed on undisturbed and disturbed samples of the subsurface soils. These tests were performed to determine parameters for the calculation of the safe bearing capacity. The test is performed under saturated conditions at loads of 1,000 lbs./sq.ft., 2,000 lbs./sq.ft., and 3,000 lbs./sq.ft. with results shown on Plates A-C.

6.7 **Consolidation tests** (ASTM: D-2435-11) were performed on undisturbed samples to determine the differential and total settlement which may be anticipated based upon the proposed loads. Water was added to the samples at a surcharge of one KSF and the settlement curves are plotted on Plates D-F.

6.8 **Soluble sulfate, pH, Resistivity and Chloride tests** to determine potential corrosive effects of soils on concrete and metal structures were performed in the laboratory. Test results are given in Tables IV - VII.

6.9 **Resistance 'R' Value tests** (CA 301) were conducted on a representative soil sample to determine preliminary pavement section design for the proposed pavement areas. Test results are provided in Table VIII and recommended pavement sections are provided later within the text of this report.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon our evaluations, the proposed development is acceptable from a geotechnical engineering standpoint. By following the recommendations and guidelines set forth in our report, the structures and grading will be safe from excessive settlements under the anticipated design loadings and conditions. The proposed grading and development shall meet all requirements of the City Building Ordinance and will not impose any adverse effect on existing adjacent land or structures.

The following recommendations are based upon soil conditions encountered in our field investigation; these near-surface soil conditions could vary across the site. Variations in the soil conditions may not become evident until the commencement of grading operations for the proposed development and revised recommendations from the soils engineer may be necessary based upon the conditions encountered.

7.1 Site Grading Recommendations

It is recommended that site inspections be performed by a representative of this firm during all grading and construction of the development to verify the findings and recommendations documented in this report. Any unusual conditions which may be encountered in the course of the project development may require the need for additional study and revised recommendations.

Any vegetation shall be removed and hauled from proposed grading areas prior to the start of grading operations. Existing vegetation shall not be mixed or disced into the soils. Any removed soils may be reutilized as compacted fill once any deleterious material or oversized materials (in excess of eight inches) is removed. Grading operations shall be performed in accordance with the attached *Specifications for Placement of Compacted Fill*.

7.1.1 **Removal and Recompaction Recommendations**

The upper 18 inches of existing fill soils and any other low-density soils encountered shall be removed to competent native materials, the exposed surface scarified to a depth of 8 inches, brought to within 3% of optimum moisture content and compacted to a minimum of 90% of the laboratory standard (ASTM: D-1557-12) prior to placement of any additional compacted fill soils and pavement. *The upper 12 inches of soils beneath building floor slabs and truck traffic slabs shall be compacted to a minimum of 95% relative compaction.* Grading shall extend a minimum of 5 horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater. Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase. Adequate drainage away from the structures, pavement and slopes should be provided at all times.

It is likely that isolated areas of undiscovered fill, subsurface structures and utility lines not described in this report or materials disturbed during demolition operations will be encountered during site grading; If found, these areas should be excavated and backfilled as discussed earlier. Any existing structures and lines shall be either removed or properly abandoned prior to the proposed construction. Abandonment procedures will be provided if/when underground structures are encountered.

If placement of slabs-on-grade and pavement is not performed immediately upon completion of grading operations, additional testing and grading of the areas may be necessary prior to continuation of construction operations. Likewise, if adverse weather conditions occur which may damage the subgrade soils, additional assessment by the soils engineer as to the suitability of the supporting soils may be needed.

7.1.2 **Fill Blanket Recommendations**

Due to the medium density of some of the upper native soils and the potential for differential settlement of structures supported on both compacted fill and native soils, it is recommended that all foundations be underlain by a uniform compacted fill blanket at least 3 feet in thickness. The fill blanket shall extend a minimum of 5 horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

7.2 Shrinkage and Subsidence

Results of our in-place density tests reveal that the soil shrinkage will be on the order of 5 to 8% due to excavation and recompaction, based upon the assumption that the fill is compacted to 92% of the maximum dry density per ASTM standards. Subsidence should be 0.10 feet due to earthwork operations. The volume change does not include any allowance for vegetation or organic stripping, removal of subsurface improvements or topographic approximations.

Although these values are only approximate, they represent our best estimate of shrinkage values which will likely occur during grading. If more accurate shrinkage and subsidence factors are needed, it is recommended that field testing using the actual equipment and grading techniques should be conducted.

7.3 Temporary Excavations and Shoring Design

Temporary unsurcharged excavations including utility trenches less than 4 feet in height may be excavated at vertical inclinations. Excavations over 4 feet in height in the existing site materials may be trimmed at a 1 to 1 (horizontal to vertical) gradient. Any excavation in excess of 8 feet in height should be evaluated further by the soil engineer prior to work. In areas where soils with little or no binder are encountered, where adverse geological conditions are exposed, or where excavations are adjacent to existing structures, shoring, slot-cutting, or flatter excavations may be required.

The temporary cut slope gradients given above do not preclude local raveling and sloughing. All excavations shall be made in accordance with the requirements of the soils engineer, CAL-OSHA and other public agencies having jurisdiction.

Temporary shoring design may utilize an active earth pressure of 25 pcf without any surcharge due to adjacent traffic, equipment or structures. The passive fluid pressures of 250 pcf may be doubled to 500 pcf for temporary design.

7.4 Foundation Design

All foundations may be designed utilizing the following allowable soil bearing capacities for embedded depths of 24 inches into dense compacted fill materials with the corresponding widths. Footings shall be situated on the recommended compacted fill blanket and shall not traverse from compacted fill to native soils due to the potential for differential settlement of structures.

Allowable Soil Bearing Capacity (psf)

Width (ft)	Continuous Foundation	Isolated Foundation
1.5	2000	2500
2.0	2075	2575
4.0	2375	2875
6.0	2675	3175

The bearing value may be increased by 500 psf for each additional foot of depth in excess of the 24-inch minimum depth, up to a maximum of 4,000 psf. Property line screen wall foundations extended a minimum of 24 inches in depth and at least 8 inches into medium stiff native soils may be designed using a reduced allowable soil bearing capacity of 1,700 psf. A one-third increase may be used when considering short term loading from wind and seismic forces.

All continuous foundations shall be reinforced with a minimum of two #4 bars top and two bottom. Isolated pad foundations shall be reinforced at the discretion of the project structural engineer. An increase in steel reinforcement due to soil expansion or proposed loadings may be necessary and shall be determined by the project engineers. A representative of this firm shall observe foundation excavations prior placement of reinforcement steel and concrete.

7.5 Settlement Analysis

Resultant pressure curves for the consolidation tests are shown on Plates D-F. Computations utilizing these curves and the recommended allowable soil bearing capacities reveal that the foundations will experience normal settlements on the order of 3/4 inch and differential settlements of less than 1/4 inch.

7.6 Lateral Resistance

The following values may be utilized in resisting lateral loads imposed on the structure. Requirements of the California Building Code should be adhered to when the coefficient of friction and passive pressures are combined.

Coefficient of Friction - 0.35
Equivalent Passive Fluid Pressure = 200 lbs./cu.ft.
Maximum Passive Pressure = 2,000 lbs./cu.ft.

The passive pressure recommendations are valid only for approved compacted fill soils or competent native ground.

7.7 Retaining Wall Design Parameters

Active earth pressures against retaining walls will be equal to the pressures developed by the following fluid densities. These values are for **granular backfill material** placed behind the walls at various ground slopes above the walls. If fine-grained soils are exposed behind retaining walls, revised recommendations may be required.

Surface Slope of Retained Materials (Horizontal to Vertical)	Equivalent Fluid Density (lb./cu.ft.)
Level	30
5 to 1	35
4 to 1	38
3 to 1	40
2 to 1	45

Any applicable short-term construction surcharges and seismic forces should be added to the above lateral pressure values. All walls shall be waterproofed as needed and protected from hydrostatic pressure by a reliable permanent subdrain system.

During a local Magnitude 6.9 earthquake along the San Jacinto fault zone, additional lateral pressures will occur along the back of retaining walls. The seismic-induced lateral soil pressure may be computed using a triangular pressure distribution with the maximum value at the top of the wall. The maximum lateral pressure of (20 pcf) H where H is the height of the retained soils above the wall footing should be applied to the final design of walls retaining 6 feet or more of soil.

Sliding resistance values and passive fluid pressure values may be increased by 1/3 during short-term wind and seismic loading conditions.

7.8 **Floor Slab Design**

Concrete floor slabs-on-grade shall be a minimum of 5 and 6 inches in thickness in office and warehouse areas, respectively, and may be placed upon fill soils compacted to a minimum of 95% relative compaction in the upper 12 inches. In addition, an effective plasticity index of 15 may be used in slab design. Reinforcement requirements and an increase in thickness of the slabs-on-grade may be necessary based upon soils expansion potential and proposed loading conditions in the structures and should be evaluated further by the project engineers and/or architect.

A vapor retarder should be utilized in areas which would be sensitive to the infiltration of moisture. This retarder shall meet requirements of ASTM E 96, *Water Vapor Transmission of Materials* and ASTM E 1745, *Standard Specification for Water Vapor Retarders used in Contact with Soil or Granular Fill Under Concrete Slabs.* The vapor retarder shall be installed in accordance with procedures stated in ASTM E 1643, *Standard practice for Installation of Water Vapor Retarders used in Contact with Earth or Granular Fill Under Concrete Slabs.* The moisture retarder may be placed directly upon 4 inches of gravel.

Subgrade soils shall be moistened to approximately 3% above optimum moisture levels to a depth of 18 inches immediately prior to pouring of concrete, as verified by the soil engineer. All concrete slab areas to receive floor coverings should be moisture tested to meet all manufacturer requirements prior to placement.

7.9 Expansive Soil

The upper on-site soils at the site are low in expansion potential (Expansion Index = 21-50). Sites with expansive soils (Expansion Index >20) require special attention during project design and maintenance. The attached *Expansive Soil Guidelines* should be reviewed by the engineers, architects, owner, maintenance personnel and other interested parties and considered during the design of the project and future property maintenance.

7.10 Utility Trench and Excavation Backfill

Trenches from installation of utility lines and other excavations may be backfilled with on-site soils or approved imported soils compacted to a minimum of 90% relative compaction. All utility lines shall be properly bedded and shaded with clean sand having a sand equivalency rating of 30 or more. This material shall be thoroughly water jetted around the pipe structure prior to placement of compacted backfill soils.

7.11 Corrosion Design Criteria

Representative samples of the surficial soils revealed negligible sulfate concentrations and no special concrete design recommendations are deemed necessary at this time. It is recommended that additional sulfate tests be performed at the completion of rough grading to assure that the as graded conditions are consistent with the recommendations stated in this design. Sulfate test results may be found on the attached Table IV.

Tests were also conducted on a random representative sample of soils to determine the potential corrosive effects on buried metallic structures. Tests for pH, resistivity and chloride are included on Tables V – VII. Soil pH indicates a slightly alkaline condition. Resistivity was measured at 2219 ohm-centimeters, a condition which may be considered moderately corrosive to metallic structures. Chloride content tested at 210 ppm.

A corrosion engineer may be consulted regarding protection of buried metallic piping and reinforcing steel.

7.12 Preliminary Pavement Design

The table below provides a preliminary pavement design based upon a tested R-Value of 13 for the proposed pavement areas. Final pavement design may need to be based on R-Value testing of the subgrade soils near the conclusion of rough grading to assure that the as-graded conditions are consistent with those used in this preliminary design.

On-Site Flexible (Asphaltic) Pavement Section Design

Type of Traffic	Traffic Index	Inches Asphalt	Inches Base
Auto Parking/Circulation	5.0	4.0	6.5
Truck	7.0	5.0	13.0

Subgrade soils to receive base material shall be compacted to a minimum of 90% relative compaction; base material shall be compacted to at least 95%.

Any concrete slab-on-grade in pavement areas shall be a minimum of 6 inches in thickness and may be placed on subgrade soils compacted to at least 95% relative compaction and moistened to approximately 3% above optimum levels to a depth of 18 inches. An increase in slab thickness and placement of steel reinforcement due to loading conditions and soil expansion may be necessary and should be reviewed by the structural engineer.

The above recommendations are based upon estimated traffic loadings. Client should submit anticipated traffic loadings for the pavement areas to the soils engineer, when available, so that pavement sections may be reviewed to determine adequacy to support the proposed loadings.

8.0 INFILTRATION TESTING

Three test locations (T-2, T-7 and T-15) were excavated to determine the infiltration rate of the proposed infiltration/bio-retention systems. The test locations were excavated by backhoe to depths ranging from 5 to 10 feet below existing ground surface (bgs). Excavations were trimmed at 1:1 (horizontal to vertical) inclinations in order to provide safe entry into the excavations. No significant caving occurred to the depths of these test excavations

The infiltration test consisted of the double ring infiltration test per ASTM Method D 3385. The double ring infiltrometer method consists of driving two open cylinders, one inside the other, into the ground, partially filling the ring with water, and then maintaining the liquid at a constant level. The volume of liquid added to the inner ring, to maintain the liquid level constant is the measure of the volume of liquid that infiltrates into the soil.

The volume infiltrated during timed intervals is converted to an incremental infiltration velocity, usually expressed in centimeters per hour or inches per hour and plotted verses elapsed time. The maximum-steady state or average incremental infiltration velocity, depending on the purpose/application of the test is equivalent to the infiltration rate.

Water levels were maintained at a constant level in both the inner ring and annular space between rings throughout the test, to prevent flow of water from one ring to the other.

The volume of liquid used during each measured time interval was converted into an incremental infiltration velocity of both the inner ring in the annular space using the following equations:

For the inner ring calculated as follows:
$Vir=\Delta Vir/(Air\Delta t)$
where:
Vir = inner ring incremental infiltration velocity, cm/hr
ΔVir = volume of water used during time interval to maintain constant head in the inner ring, cm^3
Air = internal area of the inner ting, cm^2
Δt = time interval, hr

An average of the final readings obtained was used for design purposes in each of the basins. The testing data sheets are attached in Appendix D and summarized below.

The use of on-site disposal system by means of retention/infiltration basins appears to be geotechnically feasible for future development. The field infiltration rates given below may be utilized in the final basin design with a safety factor of 2.0 or greater.

Test No.	Depth (feet bgs)	Soil Type	Infiltration Rate (cm/hr)	Infiltration Rate (in/hr)
T-2	5.0	clayey, sandy Silt	2.0	0.8
T-7	10.0	clayey, sandy Silt	1.7	0.7
T-15	7.5	silty Sand	30.5	12.2

It is our opinion that the site is generally suitable for stormwater infiltration without increasing the potential of settlement of proposed and existing structures located 10 feet or more away from the system or adversely affecting retaining/basement walls located either on or adjacent to the subject site. The variability of infiltration rates should also be considered in the design or any system. In addition, the potential for hydro-consolidation and the susceptibility for any ground settlements are considered low. All systems shall meet the California Regional Water Quality Control Board (CRWQCB) requirements.

9.0 CLOSURE

The recommendations and conclusions contained in this report are based upon the soil conditions uncovered in our test excavations. No warranty of the soil condition between our excavations is implied. NorCal Engineering should be notified for possible further recommendations if unexpected to unfavorable conditions are encountered during construction phase. It is the responsibility of the owner to ensure that all information within this report is submitted to the Architect and appropriate Engineers for the project.

This firm should have the opportunity to review the final plans (72 hours for review required) to verify that all our recommendations are incorporated. This report and all conclusions are subject to the review of the controlling authorities for the project.

A preconstruction conference should be held between the developer, general contractor, grading contractor, city inspector, architect, and soil engineer to clarify any questions relating to the grading operations and subsequent construction. Our representative should be present during the grading operations and construction phase to certify that such recommendations are complied within the field.

This geotechnical investigation has been conducted in a manner consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the Southern California area. No other warranty, expressed or implied is made.

We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING

REGISTERED PROFESSIONAL ENGINEER
KEITH D. TUCKER
No. 841
Exp. 12/31/2020
GEOTECHNICAL
STATE OF CALIFORNIA

Keith D. Tucker
Project Engineer
R.G.E. 841

Mark A. Burkholder
Project Manager

SPECIFICATIONS FOR PLACEMENT OF COMPACTED FILL

Excavation

Any existing low-density soils and/or saturated soils shall be removed to competent natural soil under the inspection of the Soils Engineering Firm. After the exposed surface has been cleansed of debris and/or vegetation, it shall be scarified until it is uniform in consistency, brought to the proper moisture content and compacted to a minimum of 90% relative compaction (in accordance with ASTM: D-1557-12).

In any area where a transition between fill and native soil or between bedrock and soil are encountered, additional excavation beneath foundations and slabs will be necessary in order to provide uniform support and avoid differential settlement of the structure. Verification of elevations during grading operations will be the responsibility of the owner or his designated representative.

Material For Fill

The on-site soils or approved import soils may be utilized for the compacted fill provided they are free of any deleterious materials and shall not contain any rocks, brick, asphaltic concrete, concrete or other hard materials greater than eight inches in maximum dimensions. Any import soil must be approved by the Soils Engineering firm a minimum of 72 hours prior to importation of site.

Placement of Compacted Fill Soils

The approved fill soils shall be placed in layers not excess of six inches in thickness. Each lift shall be uniform in thickness and thoroughly blended. The fill soils shall be brought to within 2% of the optimum moisture content, unless otherwise specified by the Soils Engineering firm. Each lift shall be compacted to a minimum of 90% relative compaction (in accordance with ASTM: D-1557-12) and approved prior to the placement of the next layer of soil. Compaction tests shall be obtained at the discretion of the Soils Engineering firm but to a minimum of one test for every 500 cubic yards placed and/or for every 2 feet of compacted fill placed.

The minimum relative compaction shall be obtained in accordance with accepted methods in the construction industry. The final grade of the structural areas shall be in a dense and smooth condition prior to placement of slabs-on-grade or pavement areas. No fill soils shall be placed, spread or compacted during unfavorable weather conditions. When the grading is interrupted by heavy rains, compaction operations shall not be resumed until approved by the Soils Engineering firm.

Grading Observations

The controlling governmental agencies should be notified prior to commencement of any grading operations. This firm recommends that the grading operations be conducted under the observation of a Soils Engineering firm as deemed necessary. A 24-hour notice must be provided to this firm prior to the time of our initial inspection.

Observation shall include the clearing and grubbing operations to assure that all unsuitable materials have been properly removed; approve the exposed subgrade in areas to receive fill and in areas where excavation has resulted in the desired finished grade and designate areas of overexcavation; and perform field compaction tests to determine relative compaction achieved during fill placement. In addition, all foundation excavations shall be observed by the Soils Engineering firm to confirm that appropriate bearing materials are present at the design grades and recommend any modifications to construct footings.

EXPANSIVE SOIL GUIDELINES

The following expansive soil guidelines are provided for your project. The intent of these guidelines is to inform you, the client, of the importance of proper design and maintenance of projects supported on expansive soils. ***You, as the owner or other interested party, should be warned that you have a duty to provide the information contained in the soil report including these guidelines to your design engineers, architects, landscapers and other design parties in order to enable them to provide a design that takes into consideration expansive soils.***

In addition, you should provide the soil report with these guidelines to any property manager, lessee, property purchaser or other interested party that will have or assume the responsibility of maintaining the development in the future.

Expansive soils are fine-grained silts and clays which are subject to swelling and contracting. The amount of this swelling and contracting is subject to the amount of fine-grained clay materials present in the soils and the amount of moisture either introduced or extracted from the soils. Expansive soils are divided into five categories ranging from "very low" to "very high". Expansion indices are assigned to each classification and are included in the laboratory testing section of this report. *If the expansion index of the soils on your site, as stated in this report, is 21 or higher, you have expansive soils.* The classifications of expansive soils are as follows:

Classification of Expansive Soil*

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

*From Table 18A-I-B of California Building Code (1988)

When expansive soils are compacted during site grading operations, care is taken to place the materials at or slightly above optimum moisture levels and perform proper compaction operations. Any subsequent excessive wetting and/or drying of expansive soils will cause the soil materials to expand and/or contract. These actions are likely to cause distress of foundations, structures, slabs-on-grade, sidewalks and pavement over the life of the structure. ***It is therefore imperative that even after construction of improvements, the moisture contents are maintained at relatively constant levels, allowing neither excessive wetting or drying of soils.***

Evidence of excessive wetting of expansive soils may be seen in concrete slabs, both interior and exterior. Slabs may lift at construction joints producing a trip hazard or may crack from the pressure of soil expansion. Wet clays in foundation areas may result in lifting of the structure causing difficulty in the opening and closing of doors and windows, as well as cracking in exterior and interior wall surfaces. In extreme wetting of soils to depth, settlement of the structure may eventually result. Excessive wetting of soils in landscape areas adjacent to concrete or asphaltic pavement areas may also result in expansion of soils beneath pavement and resultant distress to the pavement surface.

Excessive drying of expansive soils is initially evidenced by cracking in the surface of the soils due to contraction. Settlement of structures and on-grade slabs may also eventually result along with problems in the operation of doors and windows.

Projects located in areas of expansive clay soils will be subject to more movement and "hairline" cracking of walls and slabs than similar projects situated on non-expansive sandy soils. There are, however, measures that developers and property owners may take to reduce the amount of movement over the life the development. The following guidelines are provided to assist you in both design and maintenance of projects on expansive soils:

- Drainage away from structures and pavement is essential to prevent excessive wetting of expansive soils. Grades of at least 3% should be designed and maintained to allow flow of irrigation and rain water to approved drainage devices or to the street. Any "ponding" of water adjacent to buildings, slabs and pavement after rains is evidence of poor drainage; the installation of drainage devices or regrading of the area may be required to assure proper drainage. Installation of rain gutters is also recommended to control the introduction of moisture next to buildings. Gutters should discharge into a drainage device or onto pavement which drains to roadways.

- Irrigation should be strictly controlled around building foundations, slabs and pavement and may need to be adjusted depending upon season. This control is essential to maintain relatively uniform moisture content in the expansive soils and to prevent swelling and contracting. Over-watering adjacent to improvements may result in damage to those improvements. NorCal Engineering makes no specific recommendations regarding landscape irrigation schedules.

- Planting schemes for landscaping around structures and pavement should be analyzed carefully. Plants (including sod) requiring high amounts of water may result in excessive wetting of soils. Trees and large shrubs may actually extract moisture from the expansive soils, thus causing contraction of the fine-grained soils.

- Thickened edges on exterior slabs will assist in keeping excessive moisture from entering directly beneath the concrete. A six-inch thick or greater deepened edge on slabs may be considered. Underlying interior and exterior slabs with 6 to 12 inches or more of non-expansive soils and providing presaturation of the underlying clayey soils as recommended in the soil report will improve the overall performance of on-grade slabs.

- Increase the amount of steel reinforcing in concrete slabs, foundations and other structures to resist the forces of expansive soils. The precise amount of reinforcing should be determined by the appropriate design engineers and/or architects.

- Recommendations of the soil report should always be followed in the development of the project. Any recommendations regarding presaturation of the upper subgrade soils in slab areas should be performed in the field and verified by the Soil Engineer.

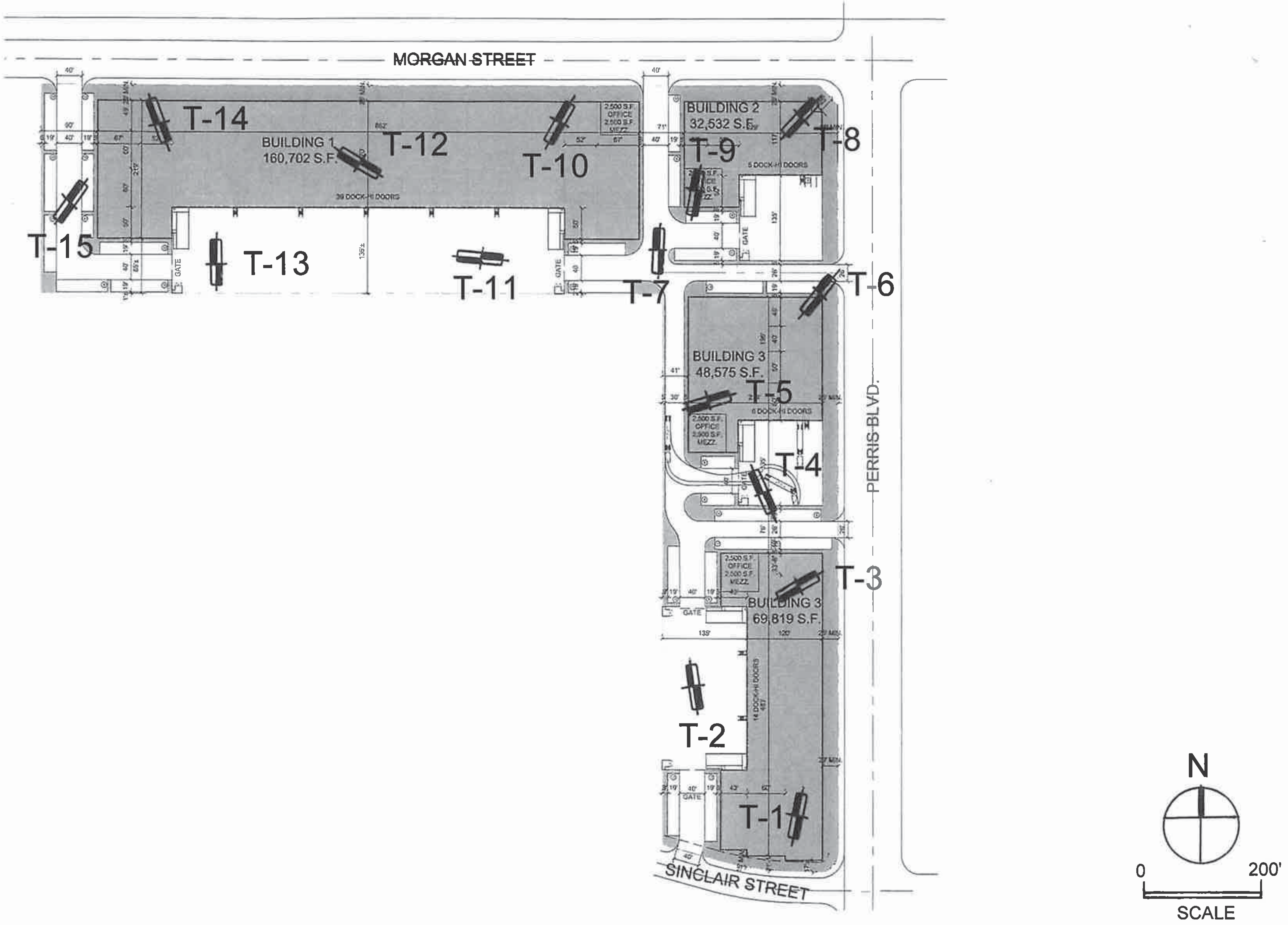
NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT 21749-20 **DATE** MAR. 2020

VICINITY MAP

FIGURE 1



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SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT 21749-20 **DATE** MAR. 2020

APPROXIMATE LOCATIONS OF SOIL BORINGS

FIGURE 2

APPENDICES

(In order of appearance)

Appendix A – Seismic Design

Appendix B –Logs of Test Explorations
  *Logs of Test Excavations T-1 to T-15

Appendix C - Laboratory Analysis
  *Table I - Maximum Dry Density Tests
  *Table II - Expansion Index Tests
  *Table III - Atterberg Limits Tests
  *Table IV - Sulfate Tests
  *Table V - pH Tests
  *Table VI - Resistivity Tests
  *Table VII - Chloride Tests
  *Table VIII - Resistance 'R' Value Tests

  *Plates A-C - Direct Shear Tests
  *Plates D-F - Consolidation Tests

Appendix D – Infiltration Test Data

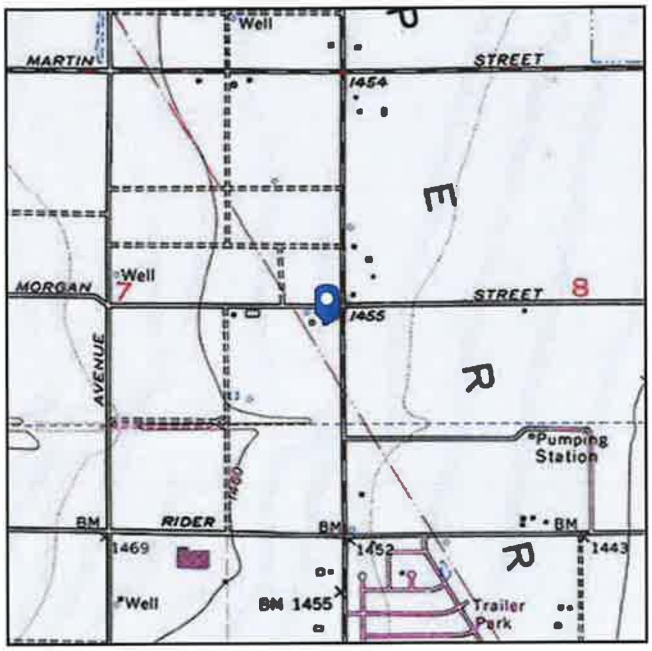
APPENDIX A

ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-16
Risk Category: III
Soil Class: D - Stiff Soil

Elevation: 1457.05 ft (NAVD 88)
Latitude: 33.8366
Longitude: -117.2268



Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.5	S_{D1} :	N/A
S_1 :	0.574	T_L :	8
F_a :	1	PGA :	0.5
F_v :	N/A	PGA_M :	0.55
S_{MS} :	1.5	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1.25
S_{DS} :	1	C_v :	1.4

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Mon Mar 30 2020

Date Source: USGS Seismic Design Maps

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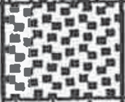
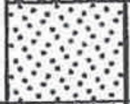
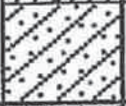
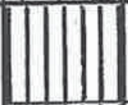
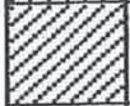
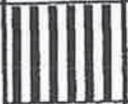
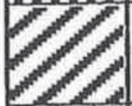
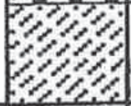
APPENDIX B

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

KEY:

■	Indicates 2.5-inch Inside Diameter. Ring Sample.
☒	Indicates 2-inch OD Split Spoon Sample (SPT).
⧅	Indicates Shelby Tube Sample.
◫	Indicates No Recovery.
◧	Indicates SPT with 140# Hammer 30 in. Drop.
🖂	Indicates Bulk Sample.
◩	Indicates Small Bag Sample.
◨	Indicates Non-Standard
⧗	Indicates Core Run.

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace	1 - 5%
Few	5 - 10%
Little	10 - 20%
Some	20 - 35%
And	35 - 50%

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
DAMP	Some perceptible moisture; below optimum
MOIST	No visible water; near optimum moisture content
WET	Visible free water, usually soil is below water table.

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N -VALUE

COHESIONLESS SOILS		COHESIVE SOILS		
Density	N (blows/ft)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	Very Soft	0 to 2	< 250
Loose	4 to 10	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	Very Stiff	15 to 30	2000 - 4000
		Hard	over 30	> 4000

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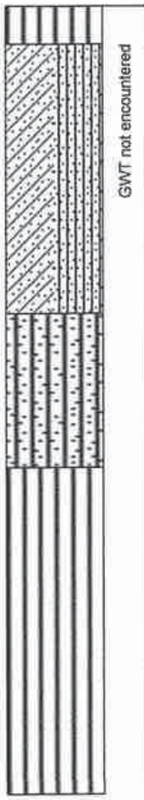
Log of Trench T-1

Boring Location: Morgan & Perris, Perris
Date of Drilling: 3/18/2020
Groundwater Depth: None Encountered
Drilling Method: Backhoe
Hammer Weight:
Drop:
Surface Elevation: Not Measured



Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	FILL SOILS Sandy clayey SILT with rootlets Brown, soft, damp	▽ ■ ▽		12.8	108.1	
	NATURAL SOILS Clayey silty SAND Brown, medium stiff, moist					
5		■		8.6	104.8	
	Slightly silty SAND Brown, dense, damp					
10		■		3.0	121.1	
	Sandy clayey SILT Brown, medium stiff, damp					
15		■		7.9	94.8	
20		■		5.2	100.1	
	Trench completed at depth of 20.5'					
25						
30						
35						

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Log of Trench T-2

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

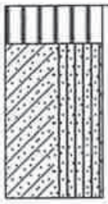
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith- ology		Material Description	Samples		Laboratory		
				Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		GWT not encountered	FILL SOILS Sandy clayey SILT with rootlets Brown, soft, damp					
			NATURAL SOILS Clayey silty SAND Brown, medium stiff, damp					
5			Trench completed at depth of 5'	☒		5.7		
10								
15								
20								
25								
30								
35								

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Log of Trench T-3

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

Groundwater Depth: None Encountered

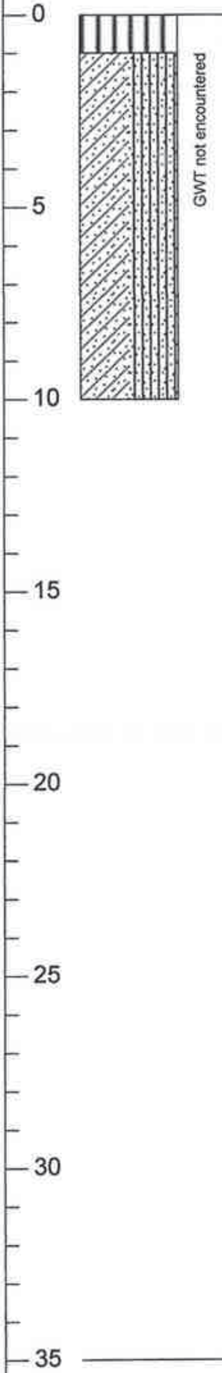
Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet) | **Lith- ology** | **Material Description**



FILL SOILS
Sandy clayey SILT with rootlets and gravel
Brown, soft, damp

NATURAL SOILS
Clayey silty SAND
Brown, medium stiff, moist

Trench completed at depth of 10'

Samples		Laboratory		
Type	Blow Counts	Moisture	Dry Density	Fines Content %
■		11.4	103.9	
■		7.7	105.7	
■		6.9	111.3	

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Log of Trench T-4

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

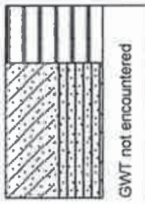
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured



Depth (feet)	Lith- ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL SOILS Sandy clayey SILT with some minor debris, rootlets Brown, soft, damp					
		NATURAL SOILS Clayey silty SAND Brown, medium stiff, damp					
5		Trench completed at depth of 5'					
10							
15							
20							
25							
30							
35							

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Log of Trench T-5

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		GWT not encountered FILL SOILS Sandy SILT with some clay, rootlets Brown, soft, moist					
			■		7.2	110.4	
		NATURAL SOILS Sandy clayey SILT Brown, medium stiff, damp to moist					
5			■		6.5	115.4	
10			■		8.6	116.5	
		Trench completed at depth of 12'					
15							
20							
25							
30							
35							

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Log of Trench T-6

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL SOILS Sandy SILT with rootlets Brown, soft, moist					
	GWT not encountered	NATURAL SOILS Clayey SILT Brown, medium stiff to stiff, moist	■		12.1	123.4	
5		Trench completed at depth of 5'					
10							
15							
20							
25							
30							
35							

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Log of Trench T-7

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL SOILS Clayey sandy SILT with rootlets Brown, soft, damp					
		NATURAL SOILS Sandy clayey SILT Brown, medium stiff to stiff, damp					
5							
10		Trench completed at depth of 10'	☒		7.2		
15							
20							
25							
30							
35							

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Log of Trench T-8

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	GWT not encountered	FILL SOILS Clayey SILT with some sand, minor debris, rootlets Brown, soft, damp	■		6.3	105.6	
		NATURAL SOILS Clayey SILT with some sand Brown, medium stiff, damp	■		6.9	103.1	
5							
			■		10.1	111.4	
10		Trench completed at depth of 10'					
15							
20							
25							
30							
35							

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Log of Trench T-9

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith- ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	GWT not encountered	FILL SOILS Sandy SILT with occasional gravel Brown, soft, damp					
		NATURAL SOILS Sandy clayey SILT Brown, medium stiff, dense to moist	■		6.5	109.5	
5			■		8.1	108.7	
		Trench completed at depth of 7'					
10							
15							
20							
25							
30							
35							

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Log of Trench T-10

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith- ology		Material Description	Samples		Laboratory		
				Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	▥	GWT not encountered	FILL SOILS Sandy clayey SILT with rootlets Brown, soft, moist	■		9.2	119.3	
	▥		NATURAL SOILS Sandy clayey SILT Brown, stiff, moist					
5	▥		Damp @ 5'	■		3.5	115.4	
			Trench completed at depth of 6'					
10								
15								
20								
25								
30								
35								

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Log of Trench T-11

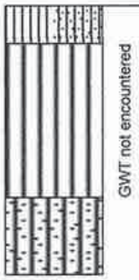
Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020 | **Groundwater Depth: None Encountered**

Drilling Method: Backhoe

Hammer Weight: | **Drop:**

Surface Elevation: Not Measured



Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	FILL SOILS Sandy SILT to Silty SAND with occasional gravel and rootlets Brown, soft, moist					
	NATURAL SOILS Sandy clayey SILT Brown, medium stiff to stiff, moist					
5	Silty SAND with some clay Brown, dense, moist	■		8.7	113.2	
	Trench completed at depth of 7'					
10						
15						
20						
25						
30						
35						

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Log of Trench T-12

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

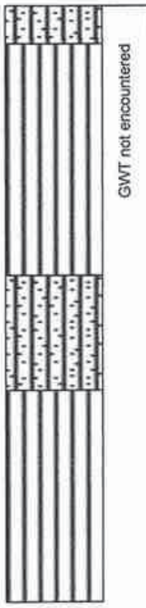
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured



Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	FILL SOILS Silty SAND with traces of clay and rootlets Brown, loose, moist	■		13.9	119.5	
5	NATURAL SOILS Sandy clayey SILT Brown, medium stiff to stiff, moist Increase in clay @ 4'	■		22.2	108.7	
	Silty SAND Brown, very dense, moist	■		11.5	111.3	
10	Sandy clayey SILT Brown, stiff, damp to moist	■		10.2	121.2	
15		■		8.7	116.3	
	Trench completed at depth of 15.5'					
20						
25						
30						
35						

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Log of Trench T-13

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith-ology		Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		GWT not encountered	FILL SOILS Sandy SILT with occasional gravel and rootlets Brown, soft, damp					
			NATURAL SOILS Sandy SILT with clay Brown,stiff, damp	■		5.8	110.4	
5			Trench completed at depth of 5'					
10								
15								
20								
25								
30								
35								

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Log of Trench T-14

Boring Location: Morgan & Perris, Perris

Date of Drilling: 3/18/2020

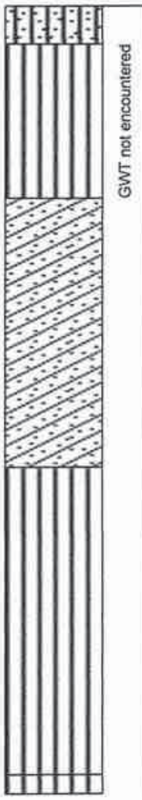
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured



Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	FILL SOILS Silty SAND with occasional gravel, some clay and rootlets Brown, medium dense, moist	■		10.4	119.3	
	NATURAL SOILS Sandy clayey SILT Brown, stiff, moist					
5	Clayey SAND Brown, dense, damp	■		4.4	118.3	
10		■		4.9	121.5	
	Clayey sandy SILT Brown, stiff, moist					
15		■		11.3	115.6	
20	Sandy SILT Brown, stiff, damp Trench completed at depth of 20.5'	■		7.9	100.0	
25						
30						
35						

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Log of Trench T-15

Boring Location: Morgan & Perris, Perris	
Date of Drilling: 3/18/2020	**Groundwater Depth: None Encountered**
Drilling Method: Backhoe	
Hammer Weight:	**Drop:**
Surface Elevation: Not Measured	

Depth (feet)	Lith- ology	Material Description	Samples Type	Samples Blow Counts	Laboratory Moisture	Laboratory Dry Density	Laboratory Fines Content %
0	▥	FILL SOILS Sandy clayey SILT with occasional gravel Brown, firm, damp					
	▥	NATURAL SOILS Sandy clayey SILT Brown, stiff, moist	☒				
5	⁙	Silty SAND Brown, dense, damp					
		Trench completed at depth of 7.5'	☒		4.1		
10							
15							
20							
25							
30							
35							

GWT not encountered

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APPENDIX C

TABLE I
MAXIMUM DENSITY TESTS
(ASTM: D-1557-12)

Sample	Classification	Optimum Moisture	Maximum Dry Density (lbs./cu.ft.)
T-1 @ 2-4'	clayey, sandy SILT	9.5	131.0

TABLE II
EXPANSION INDEX TESTS
(ASTM: D-4829-11)

Sample	Classification	Expansion Index
T-1 @ 2-4'	clayey, sandy SILT	25

TABLE III
ATTERBERG LIMITS
(ASTM: D-4318-10)

Sample	Liquid Limit	Plastic Limit	Plasticity Index
T-1 @ 2-4'	21	16	5

TABLE IV
SOLUBLE SULFATE TESTS
(CT 417)

Sample	Sulfate Concentration (%)
T-1 @ 1-2'	.0031

TABLE V
pH TESTS

Sample	pH
T-1 @ 1-2'	7.3

TABLE VI
RESISTIVITY TESTS
(CT 643)

Sample	Resistivity (ohm-cm)
T-1 @ 1-2'	2219

TABLE VII
CHLORIDE TESTS
(CT 422))

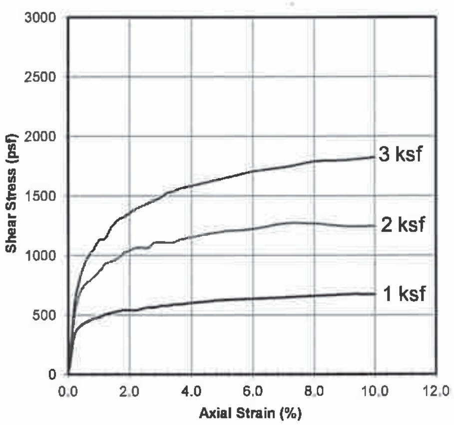
Sample	Concentration (ppm)
T-1 @ 1-2'	210

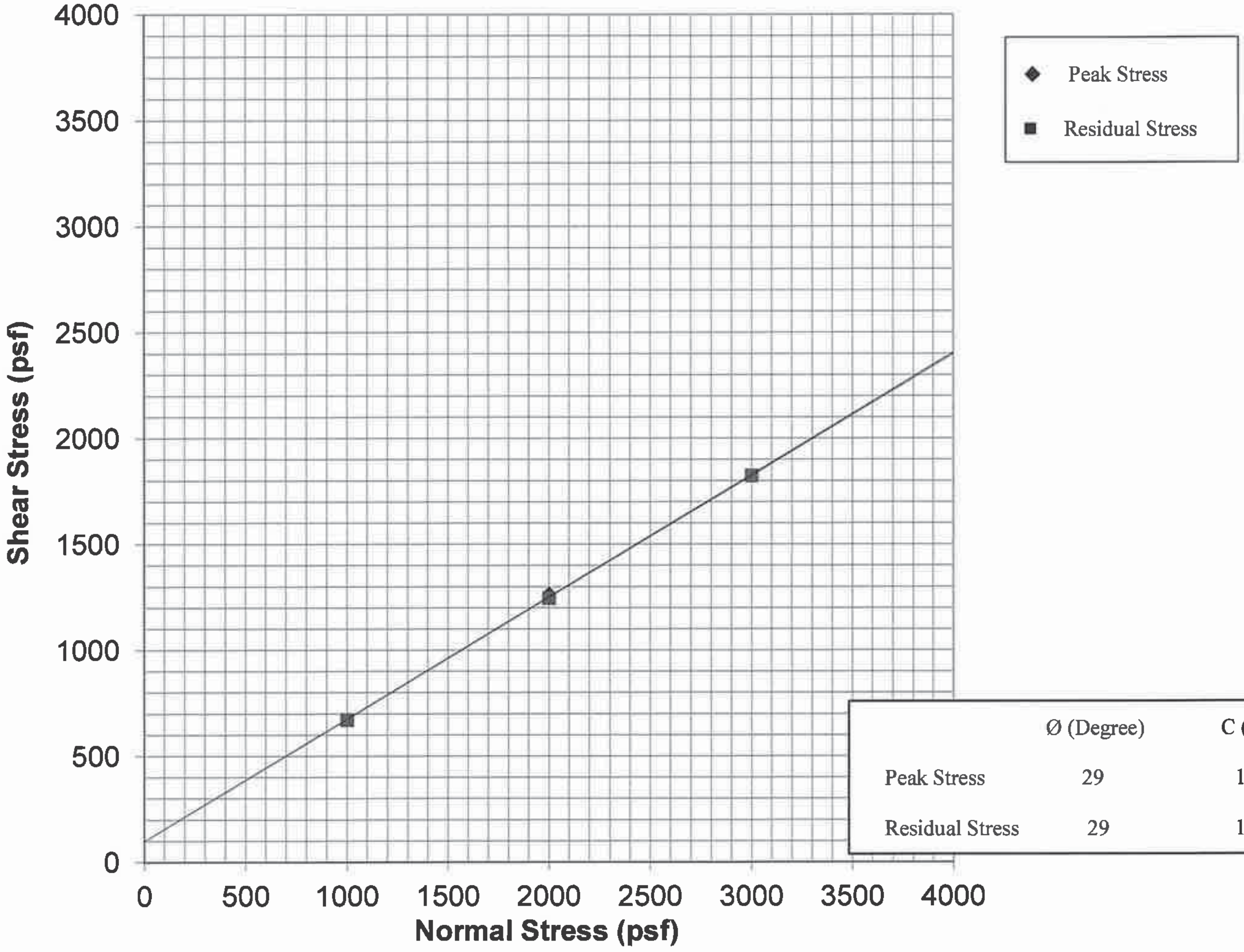
TABLE VIII
RESISTANCE 'R' VALUE TESTS
(CA 301))

Sample	'R' Value
T-15 @ 1-2'	13

Sample No. T1@2'
Sample Type: Remolded/Saturated
Soil Description: Silty Sand & Clay

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	672	1268	1824
Displacement	(in)	0.225	0.175	0.250
Residual Stress	(psf)	672	1245	1824
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	119.7	119.7	119.7
In Situ Water Content	(%)	9.0	9.0	9.0
Saturated Water Content	(%)	15.0	15.0	15.0
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	29	100
Residual Stress	29	100

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PROJECT NUMBER: 21749-20 DATE: 3/31/2020

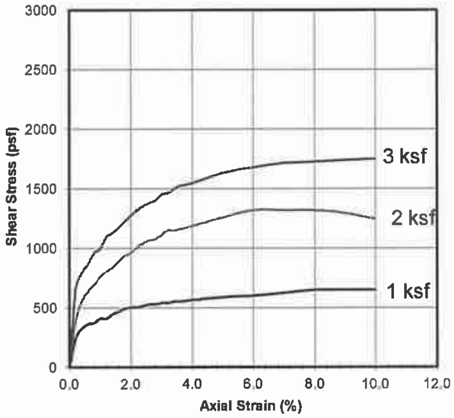
DIRECT SHEAR TEST

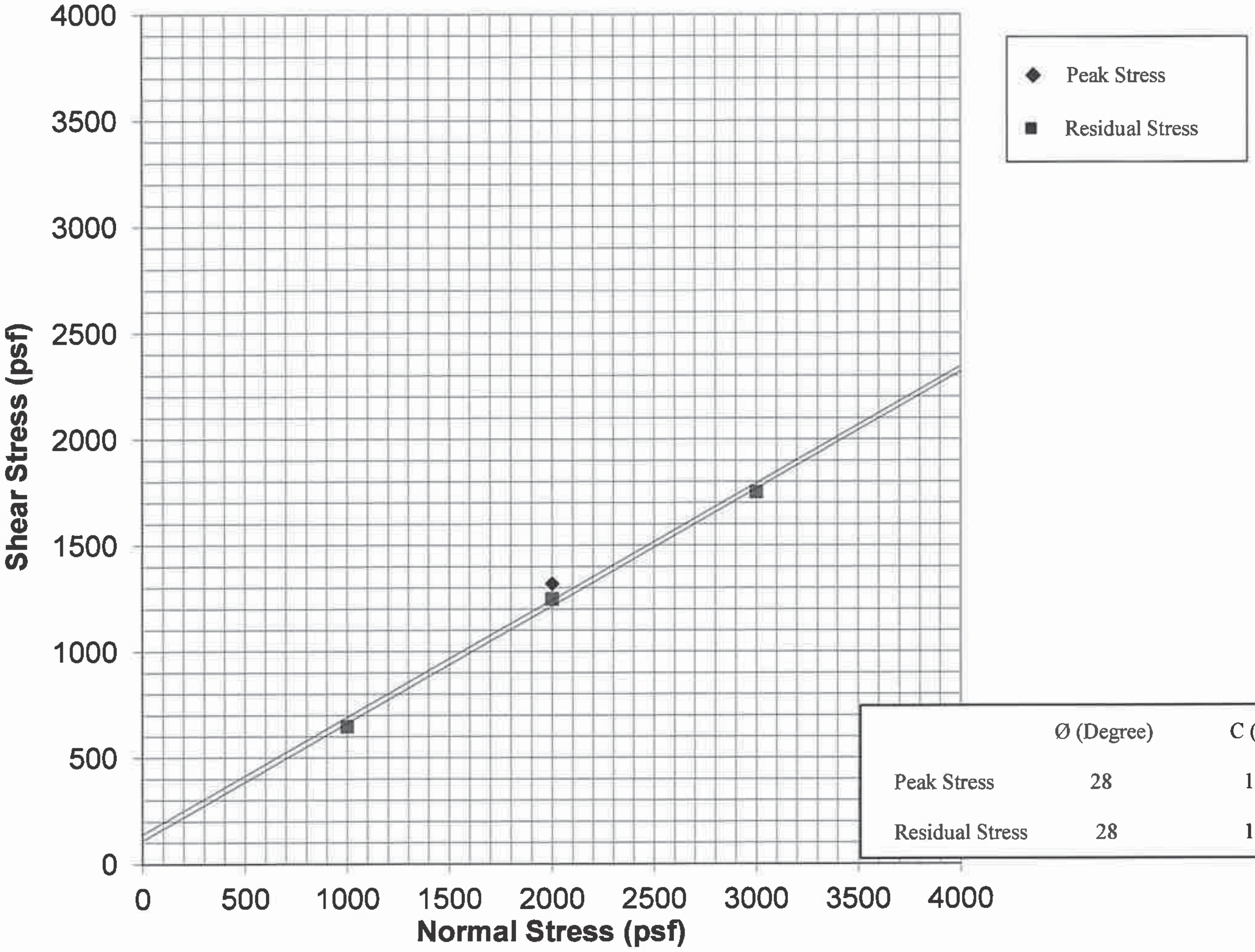
ASTM D3080

Plate A

Sample No.	T8@4'
Sample Type:	Undisturbed/Saturated
Soil Description:	Silty Clay w/ Some Sand

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	648	1320	1752
Displacement	(in.)	0.200	0.150	0.250
Residual Stress	(psf)	648	1248	1752
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	103.1	103.1	103.1
In Situ Water Content	(%)	6.9	6.9	6.9
Saturated Water Content	(%)	23.3	23.3	23.3
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	28	140
Residual Stress	28	110

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DIRECT SHEAR TEST

ASTM D3080

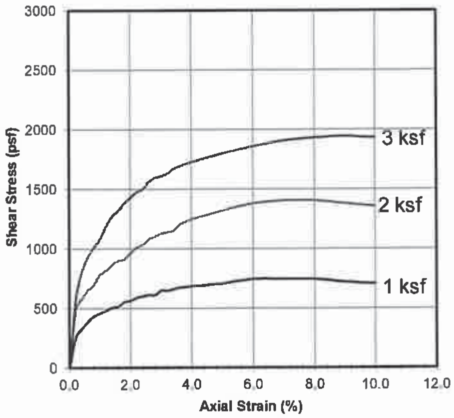
Plate B

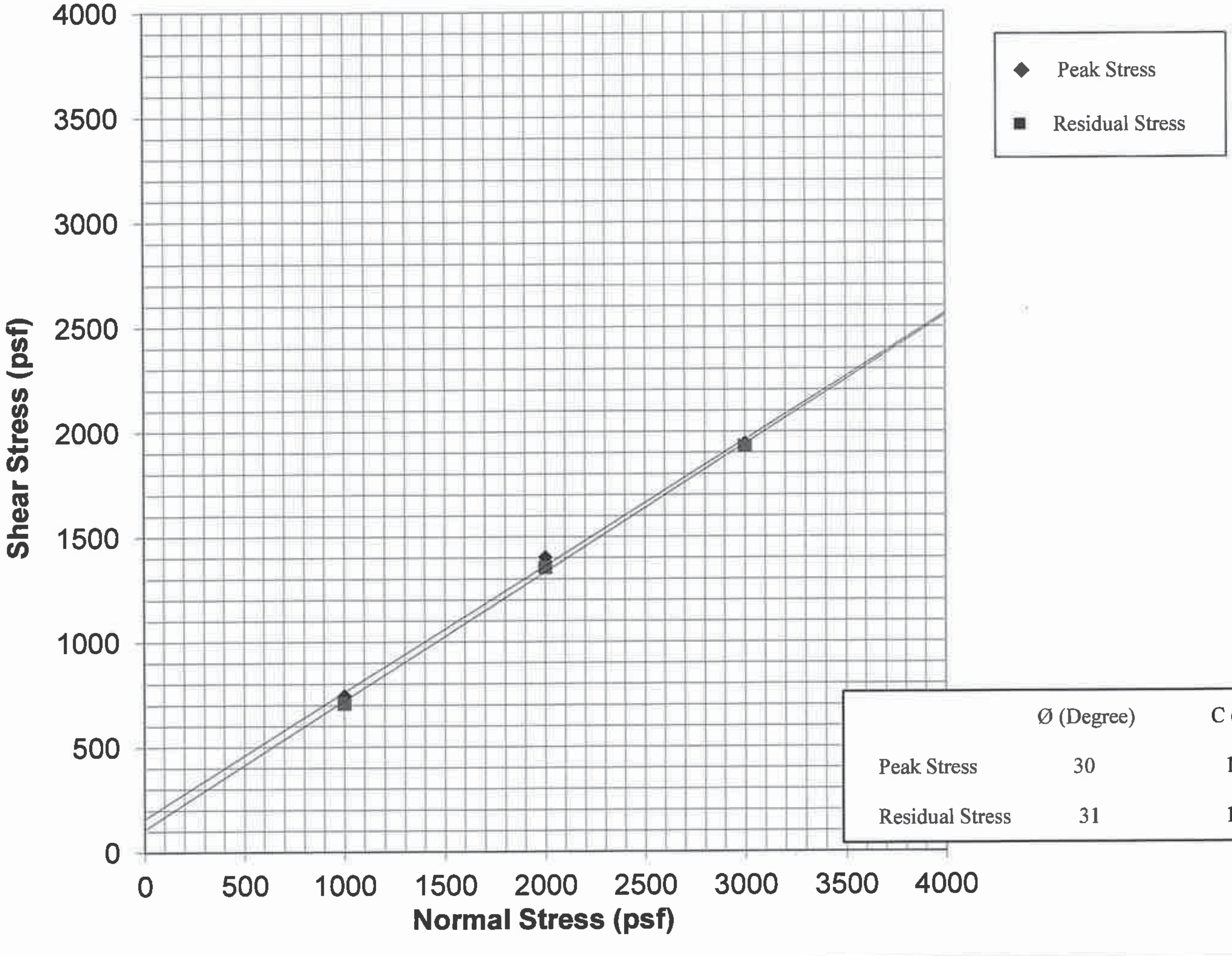
Sample No. T14@5'

Sample Type: Undisturbed/Saturated

Soil Description: Silty Fine-Coarse Grained Sand w/ Trace Clay

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	744	1404	1944
Displacement	(in)	0.150	0.175	0.225
Residual Stress	(psf)	708	1356	1932
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	118.3	118.3	118.3
In Situ Water Content	(%)	4.4	4.4	4.4
Saturated Water Content	(%)	15.7	15.7	15.7
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	30	160
Residual Stress	31	110

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DIRECT SHEAR TEST

ASTM D3080

Plate C

Sample No. T1

Depth 15'

Date 3/31/2020

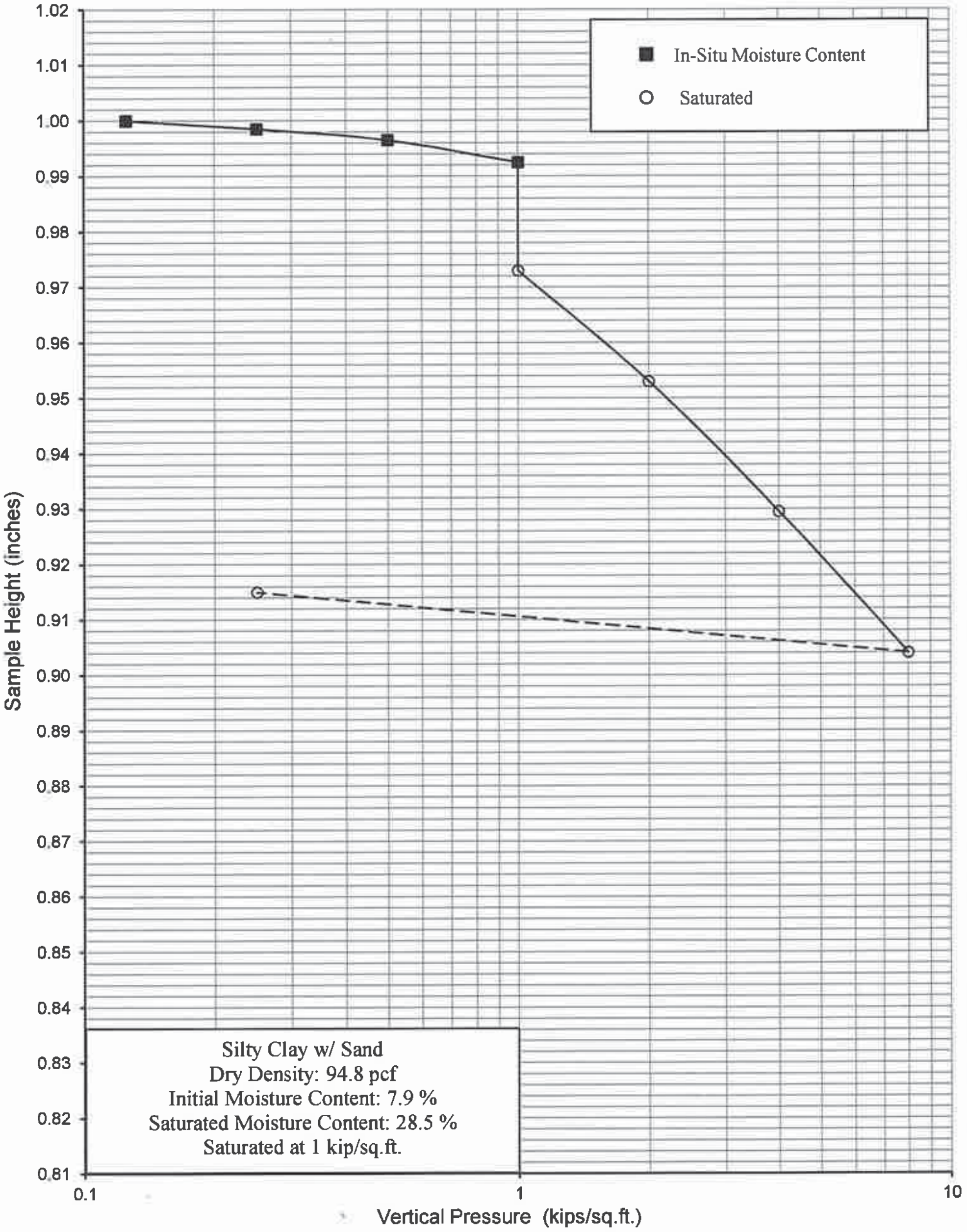
Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	1.0000	0.0
0.25	0.9985	0.2
0.5	0.9965	0.4
1	0.9925	0.8
1	0.9730	2.7
2	0.9530	4.7
4	0.9295	7.1
8	0.9040	9.6
0.25	0.9150	8.5

Saturated

Date Tested: 3/25/2020

Sample: T1

Depth: 15'



Silty Clay w/ Sand
Dry Density: 94.8 pcf
Initial Moisture Content: 7.9 %
Saturated Moisture Content: 28.5 %
Saturated at 1 kip/sq.ft.

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PROJECT NUMBER: 21749-20 DATE: 3/31/2020

CONSOLIDATION TEST

ASTM D2435

Plate D

Sample No. T10

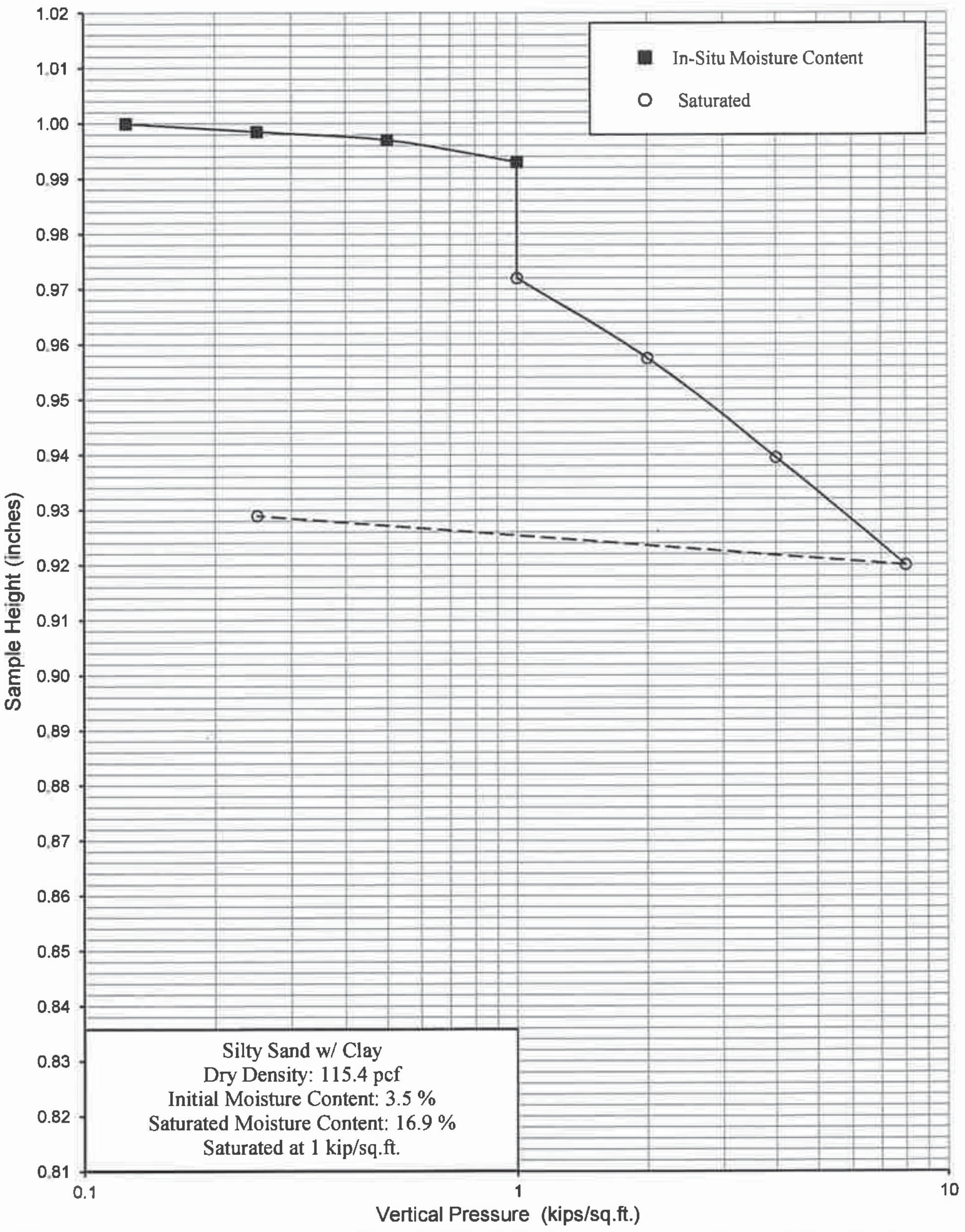
Depth 5'

Date 3/31/2020

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	1.0000	0.0
0.25	0.9985	0.2
0.5	0.9970	0.3
1	0.9930	0.7
1	0.9720	2.8
2	0.9575	4.3
4	0.9395	6.1
8	0.9200	8.0
0.25	0.9290	7.1

Saturated

Date Tested:	3/25/2020
Sample:	T10
Depth:	5'



Silty Sand w/ Clay
Dry Density: 115.4 pcf
Initial Moisture Content: 3.5 %
Saturated Moisture Content: 16.9 %
Saturated at 1 kip/sq.ft.

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PROJECT NUMBER: 21749-20 DATE: 3/31/2020

CONSOLIDATION TEST

ASTM D2435

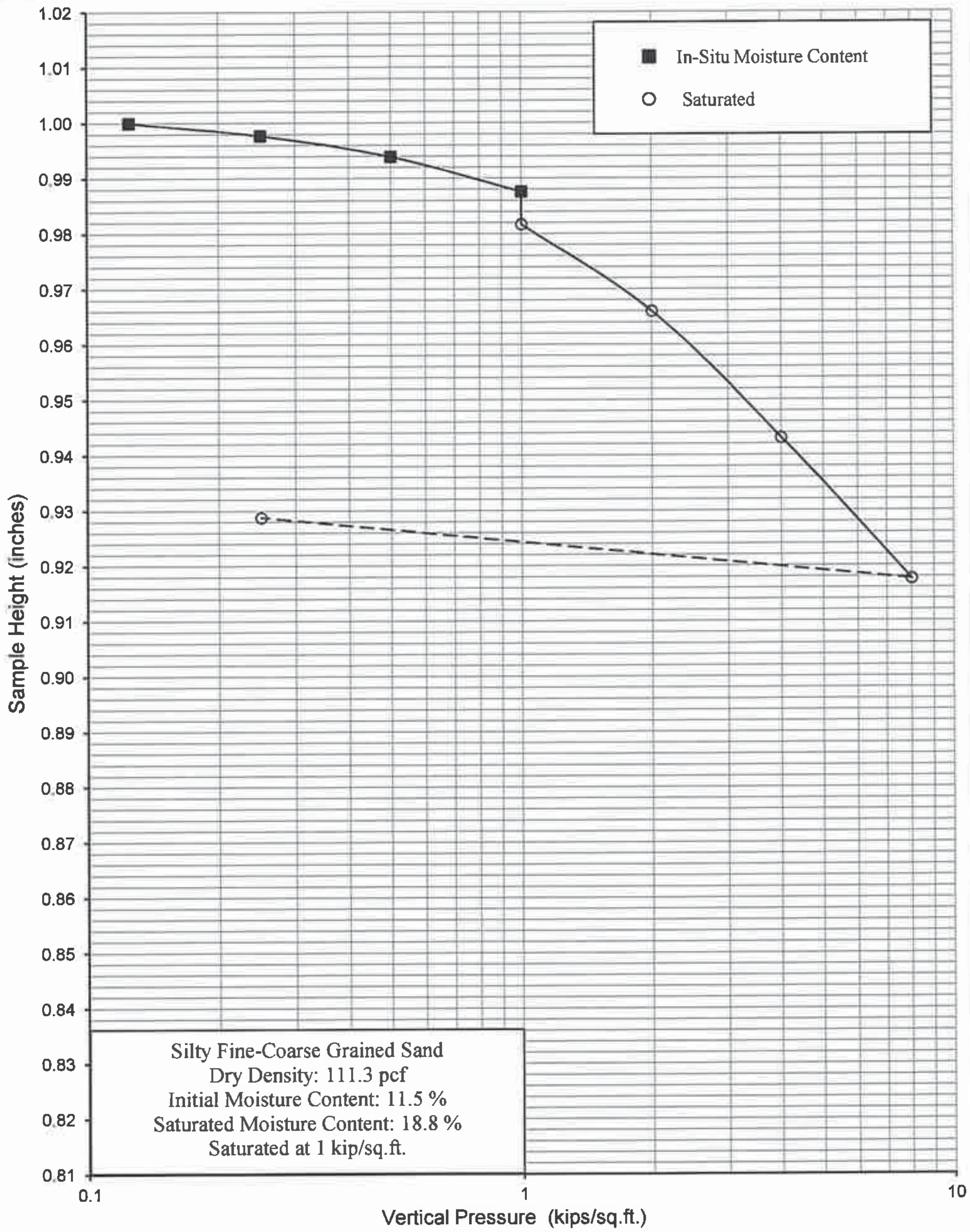
Plate E

Sample No. T12 Depth 8' Date 3/31/2020

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	1.0000	0.0
0.25	0.9977	0.2
0.5	0.9939	0.6
1	0.9876	1.2
1	0.9817	1.8
2	0.9660	3.4
4	0.9431	5.7
8	0.9176	8.2
0.25	0.9288	7.1

Saturated

Date Tested: 3/25/2020
Sample: T12
Depth: 8'



Silty Fine-Coarse Grained Sand
Dry Density: 111.3 pcf
Initial Moisture Content: 11.5 %
Saturated Moisture Content: 18.8 %
Saturated at 1 kip/sq.ft.

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PROJECT NUMBER: 21749-20 DATE: 3/31/2020

CONSOLIDATION TEST

ASTM D2435

Plate F

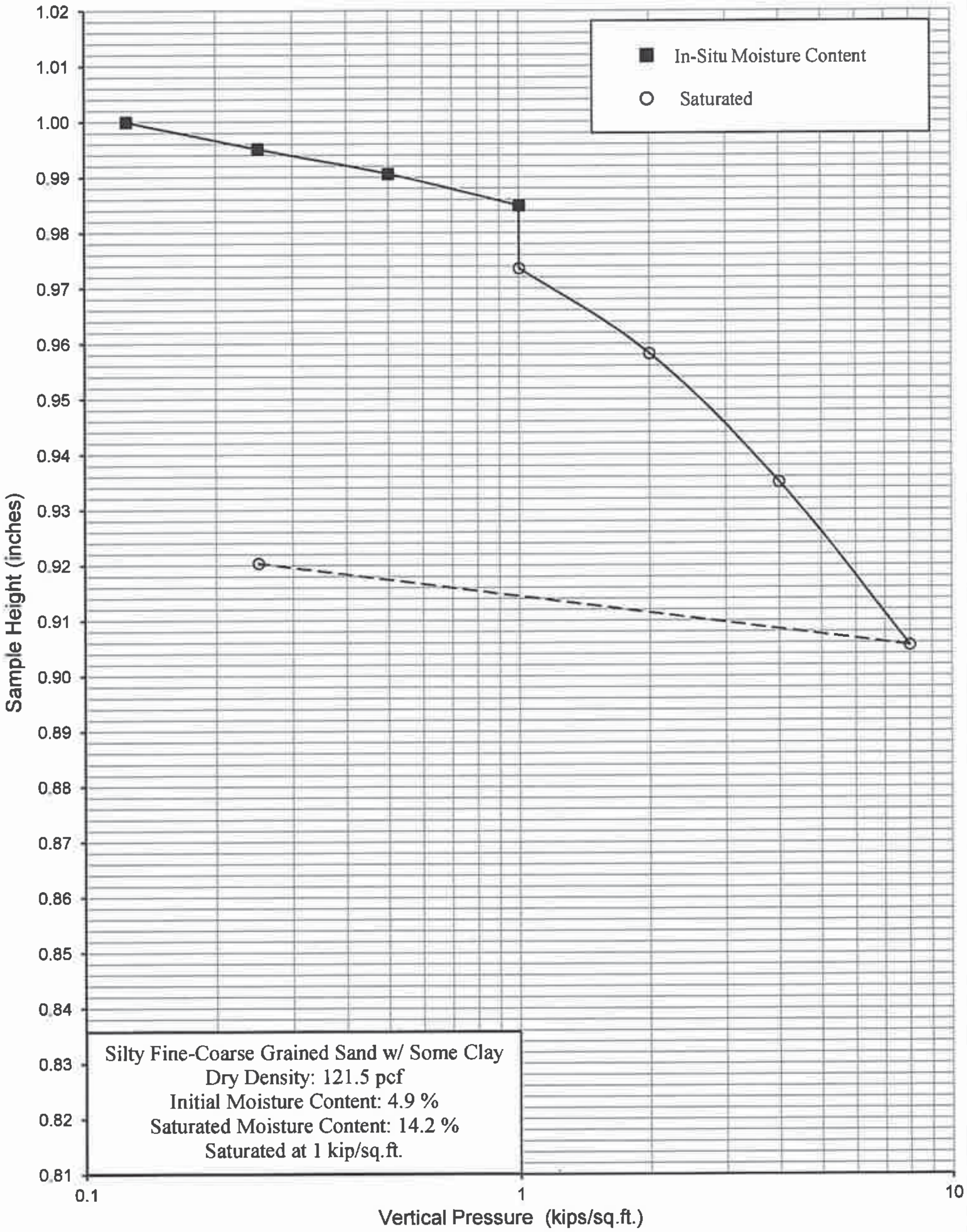
Sample No. T14 | Depth 10' | Date 3/31/2020

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	
0.125	1.0000	0.0	
0.25	0.9951	0.5	
0.5	0.9906	0.9	
1	0.9849	1.5	
1	0.9736	2.6	**Saturated**
2	0.9582	4.2	
4	0.9350	6.5	
8	0.9055	9.5	
0.25	0.9204	8.0	

Date Tested: 3/29/2020

Sample: T14

Depth: 10'



Silty Fine-Coarse Grained Sand w/ Some Clay
Dry Density: 121.5 pcf
Initial Moisture Content: 4.9 %
Saturated Moisture Content: 14.2 %
Saturated at 1 kip/sq.ft.

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SOILS AND GEOTECHNICAL CONSULTANTS

Patriot Partners

PROJECT NUMBER: 21749-20 DATE: 3/31/2020

CONSOLIDATION TEST

ASTM D2435

Plate G

APPENDIX D

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Project: Patriot Partners
Project No.: 21749-20
Date: 3/18/2020
Test No. T-2
Depth: 5'
Tested By: J.S.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
8:18			99.3			38.3					
8:33	15	15	100.3	1.0		38.7	0.4				
8:33			100.3			38.7					
8:48	15	30	101.3	1.0		39.3	0.6				
8:48			101.3			39.3					
9:03	15	45	102.2	0.9		39.7	0.4				
9:03			100.2			39.7					
9:18	15	60	100.9	0.7		39.9	0.2				
9:18			100.9			39.9					
9:33	15	75	101.5	0.6		40.5	0.6				
9:33			101.5			40.5					
9:48	15	90	102.0	0.5		41.0	0.5				
9:48			102.0			41.0					
10:03	15	105	102.5	0.5		41.5	0.5		2.0	2.0	
10:03			102.5			41.5					
10:18	15	120	103.0	0.5		42.1	0.6		2.0	2.4	
10:18			103.0			42.1					
10:33	15	135	103.5	0.5		42.5	0.4		2.0	1.6	
10:33			103.5			42.5					
10:48	15	150	104.0	0.5		43.0	0.5		2.0	2.0	
10:48			104.0			43.0					
11:03	15	165	104.5	0.5		43.5	0.5		2.0	2.0	
11:03			104.5			43.5					
11:18	15	180	105.0	0.5		44.0	0.5		2.0	2.0	

Average = 2.0 / 2.0 cm/hr

Project: Patriot Partners
Project No.: 21749-20
Date: 3/18/2020
Test No. T-7
Depth: 10'
Tested By: D.L.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
11:23			105.9			46.9					
11:38	15	15	106.5	0.7		47.8	0.9				
11:38			106.5			47.8					
11:53	15	30	107.1	0.6		48.4	0.6				
11:53			107.1			48.4					
12:08	15	45	107.8	0.7		48.7	0.3				
12:08			107.8			48.7					
12:23	15	60	108.1	0.3		49.0	0.3				
12:23			108.1			49.0					
12:38	15	75	108.5	0.4		49.4	0.4				
12:38			108.5			49.4					
12:53	15	90	108.8	0.4		49.8	0.4				
12:53			108.8			49.8					
1:08	15	105	109.2	0.3		50.2	0.4		1.2	1.6	
1:08			109.2			50.2					
1:23	15	120	109.6	0.4		50.6	0.4		1.6	1.6	
1:23			102.0			43.2					
1:38	15	135	102.5	0.5		43.6	0.4		2.0	1.6	
1:38			102.5			43.6					
1:53	15	150	103.0	0.5		44.0	0.4		2.0	1.6	
1:53			103.0			44.0					
2:08	15	165	103.4	0.4		44.5	0.5		1.6	2.0	
2:08			103.4			44.5					
1:23	15	180	103.8	0.4		45.0	0.5		1.6	2.0	

Average = 1.7 / 1.7 cm/hr

Project: Patriot Partners
Project No.: 21749-20
Date: 3/18/2020
Test No. T-15
Depth: 7.5'
Tested By: D.R.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
9:40			69.0			37.6					
9:50	10	10	76.8	7.8		45.5	7.9				
9:50			68.8			36.5					
10:00	10	20	76.6	7.8		44.9	8.4				
10:00			70.2			39.2					
10:10	10	30	77.9	7.7		47.0	7.8				
10:10			69.6			37.1					
10:20	10	40	76.5	6.9		44.6	7.5				
10:20			69.5			37.6					
10:30	10	50	76.0	6.5		44.6	7.0				
10:30			71.1			38.4					
10:40	10	60	77.5	6.4		45.2	6.8				
10:40			71.2			39.2					
10:50	10	70	77.7	6.5		45.7	6.5		39.0	39.0	
10:50			71.2			39.5					
11:00	10	80	76.9	5.7		45.6	6.1		34.2	36.6	
11:00			70.7			38.3					
11:10	10	90	75.8	5.1		43.5	5.2		30.6	31.2	
11:10			69.7			37.5					
11:20	10	100	74.2	4.5		42.3	4.8		27.0	28.8	
11:20			68.0			35.8					
11:30	10	110	72.5	4.5		40.5	4.7		27.0	28.2	
11:30			72.5			40.5					
11:40	10	120	76.7	4.2		44.7	4.2		25.2	25.2	

Average = 30.5 / 31.5 cm/hr