Appendix E

Geotech Engineering Investigation

Geotechnical Engineering Investigation
Proposed Multi-Unit Residential Development
8550 Warner Avenue
Fountain Valley, California

The Stellrecht Company
15261 Transistor Lane
Huntington Beach, California 92649

Attn: Mr. Robert Stellrecht

Project Number 23999-23
June 21, 2023

NorCal Engineering

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NorCal Engineering

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June 21, 2023

Project Number 23999-23

The Stellrecht Company
15261 Transistor Lane
Huntington Beach, California 92649

Attn.: Mr. Robert Stellrecht

RE: **Geotechnical Engineering Investigation** - Proposed Multi-Unit Residential Development - Located at 8550 Warner Avenue, in the City of Fountain Valley, California

Dear Mr. Stellrecht:

Pursuant to your request, this firm has performed a Geotechnical Engineering Investigation for the above referenced project in accordance with your approval of our proposal dated March 6, 2023. The purpose of this investigation is to evaluate the geotechnical conditions of the subject site and to provide recommendations for the proposed residential development.

The scope of work included the following: 1) site reconnaissance; 2) subsurface geotechnical exploration and sampling; 3) laboratory testing; 4) soil infiltration testing; 5) engineering analysis of field and laboratory data; 6) preparation of a geotechnical engineering report. It is the opinion of this firm that the proposed development is feasible from a geotechnical standpoint provided that the recommendations presented in this report are followed in the design and construction of the project.

1.0 Project Description

It is proposed to construct a 72-unit, three-story residential development as shown on the attached Site Plan. The 63,435 square feet structure will be supported by a conventional slab-on-grade foundation system with perimeter-spread footings and isolated interior footings. Other improvements will consist of concrete/asphalt pavement, hardscape and landscaping. It is assumed that the proposed grading for the development will include cuts on the order of a few feet with minor fill procedures on to achieve finished grade elevations. 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

The 2.12-acre subject property is located within the 8500 block and south side of Warner Avenue, in the City of Fountain Valley. The generally rectangular-shaped parcel is elongated in an east to west direction with topography of the relatively level property descending slightly from back to front on the order of a few feet. The site is currently occupied by a multi-unit retail center surrounding asphalt pavement.

3.0 Site Exploration

The investigation consisted of the placement of six (6) subsurface exploratory borings by a truck mounted hollow stem auger and hand operated auger to depths ranging between 5 and 50 feet below current ground elevations. The explorations were visually classified and logged by a field engineer with locations of the subsurface explorations shown on the attached site plan.

The exploratory borings revealed the existing earth materials to consist of fill and natural soil. Detailed descriptions of the subsurface conditions are listed on the boring logs in Appendix A. It should be noted that the transition from one soil type to another as shown on the boring logs is approximate and may in fact be a gradual transition. The soils encountered are described as follows:

Fill: A fill soil classifying predominantly as a brown, sandy SILT was encountered to a depth of 1 to 2 feet below existing ground surface. These soils were noted to be soft to medium stiff and moist.

Natural: A natural undisturbed soil classifying as a brown, sandy SILT was encountered beneath the fill soils. These native soils were observed to be medium stiff and moist to very moist. Deeper soils were observed to consist of a silty CLAY which were noted to be firm and saturated to wet.

The overall engineering characteristics of the earth material were relatively uniform with each excavation. Groundwater was encountered at a depth of 19 feet below ground surface in Exploratory Borings B-3 and B-5.

4.0 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 and maximum density tests.

Standard penetration tests were obtained by driving a steel sampler unlined with an inside diameter of 1.5 inches into the soils. This standard penetrometer sampler was driven a total of eighteen inches with blow counts tallied every six inches. Blow count data is given on the Boring Logs in Appendix A. Bulk bag samples were obtained in the upper soils for expansion index tests and maximum density tests. All test results are included in Appendix B, unless otherwise noted.

4.1 **Field Moisture Content** (ASTM: D 2216) and the dry density of the ring samples were determined in the laboratory. This data is listed on the logs of explorations.

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

4.3 **Expansion Index tests** (ASTM: D 4829) were performed on remolded samples of the upper soils to determine expansive characteristics. Results of these tests are provided on Table II.

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

4.5 **Corrosion tests** consisting of sulfate, pH, resistivity and chloride analysis to determine potential corrosive effects of soils on concrete and underground utilities. Test results are provided on Table IV.

4.6 **R-Value test** per California Test Method 301 was performed on a representative sample, which may be anticipated to be near subgrade to determine pavement design. Results are provided within the pavement design section of the report.

4.7 **Direct Shear tests** (ASTM: D 3080) were performed on undisturbed and/or remolded samples of the subsurface soils. 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 Plate A.

4.8 **Consolidation tests** (ASTM: D 2435) 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 B and C.

5.0 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 nearest fault is the Newport-Inglewood fault located 4 kilometers from the site and is capable of producing a Magnitude 6.9 earthquake. 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.

The seismic design acceleration parameters for the project site are provided below based on the ASCE/SEI 7-16 American Society of Civil Engineers (ASCE) website, https://asce7hazardtool.online/. The seismic design report is attached is Appendix C.

Seismic Design Acceleration Parameters

Latitude	33.715
Longitude	-118.979
Site Class	D
Risk Category	II
Mapped Spectral Response Acceleration	S_S = 1.357 S_1 = 0.500
Adjusted Maximum Acceleration	S_{MS} = 1.387
Design Spectral Response Acceleration Parameters	S_{DS} = 1.925
Peak Ground Acceleration	PGA_M = 0.659

Use of these values is dependent on requirements of Section 11-4.8, ASCE 7, exception 2 that requires the value of the seismic response coefficient C_s be determined by Equation 12.8.2 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either 12.8-3 for $T_L \geq T \geq 1.5T_s$ or Equation 12.8-4 for $T > T_L$. Computations and verification of these conditions is referred to the structural engineer.

6.0 Liquefaction Evaluation

The site is expected to experience ground shaking and earthquake activity that is typical of Southern California area. It is during severe ground shaking that loose, granular soils below the groundwater table can liquefy. Based upon information in the California Division of Mines and Geology “Seismic Hazard Zone Map – Newport Beach Quadrangle”, dated April 17, 1997, the subject site is situated in an area of historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions to indicate a potential for permanent ground displacement.

A review of the exploratory boring log and the laboratory test results on selected soil samples obtained indicate the following soil classifications, field blowcounts and amounts of fines passing through the No. 200 sieve.

Field Blowcount and Gradation Data

Boring No.	Classification	Blowcounts (blows/ft)	Relative Density	% Passing No. 200 Sieve
B-3 @ 5'	CL	7	Medium Stiff	92
B-3 @ 10'	CL	5	Firm	96
B-3 @ 15'	CL	6	Firm	82
B-3 @ 20'	CL	8	Firm	88
B-3 @ 25'	CL	11	Medium Stiff	73
B-3 @ 30'	ML	13	Medium Stiff	55
B-3 @ 35'	SM	16	Medium Dense	27
B-3 @ 40'	CH	15	Medium Stiff	93
B-3 @ 45'	SW	20	Dense	9
B-3 @ 50'	SW	22	Dense	6

Our liquefaction evaluation utilized the nearest mode of predominate Magnitude 6.9 Mw earthquake. Review of the *California Department of Conservation – Division of Mines and Geology Open File Report 98-03, Plate 1.2,* indicates a historic high groundwater level greater than 5 feet below ground surface. The results of our analysis indicates the liquefaction potential at this site to be high based upon the historic groundwater depth and a Peak Ground Acceleration (PGA_M) of 0.659g.

The associated seismic-induced settlements would be on the order of 3¼ inches and would occur rather uniformly across the site. Differential settlements would be on the order of 2 inches over a 50-foot (horizontal) distance. Our seismic settlement calculations are included in Appendix C.

It is recommended that a stiffened foundation system be utilized for the proposed structure to mitigate for the seismic-induced settlements. The stiffened system shall consist of either a post-tensioned slab design, mat foundation or a system of grade beams connecting the foundations in two directions throughout the new structure.

7.0 Infiltration Characteristics

Infiltration tests were performed in accordance with the Orange County Technical Guidance Document (OCTGD) Appendix VII – Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations dated December 20, 2013. A truck mounted Simco 2800 Drill Rig equipped with a hollow stem auger was used to excavate the exploratory borings to depths of 5 and 10 below existing ground surface. The borings consisted of six-inch diameter test holes. A three-inch diameter perforated PVC casing with solid end cap was installed in the borings and then surrounded with gravel materials to prevent caving.

The infiltration holes were carefully filled with clean water and refilled after two initial readings. Based upon the initial rates of infiltration at each location, test measurements were measured at selected maximum intervals thereafter. Measurements were obtained by using an electronic tape measure with 1/16-inch divisions and timed with a stopwatch.

Based upon the results of our testing, the soils encountered in the planned on-site drainage disposal system area exhibit the following field infiltration rates which do not include a factor of safety. The drainage disposal system shall also incorporate the safety factor required by the county standard. Calculations are based using the Porchet Method (aka Inverse Borehole Method) and are provided in Appendix D.

Boring/Test No.	Depth	Soil Classification	Field Infiltration Rate
B-1/TH-1	5'	Sandy SILT	3.6 in/hr
B-2/TH-2	10'	Silty CLAY	0.1 in/hr

Groundwater was encountered at a depth of 19 feet below existing ground surface across the site. Review of our exploratory boring logs reveal sandy silts from existing ground surface to a depth of 4.5 to 8 feet. The underlying silty clays below the sandy silts resulted in very low field infiltration rates and may not be suitable for on-site water disposal.

It is recommended that foundations shall be setback a minimum distance of 10 feet from the drainage disposal system and the bottom of footing shall be a minimum of 10 feet from the expected zone of saturation. The boundary of the zone of saturation may be assumed to project downward from the top of the permeable portion of the disposal system at an inclination of 1 to 1 or flatter, as determined by the geotechnical engineer.

8.0 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 will be safe from excessive settlements under the anticipated design loadings and conditions. The proposed development shall meet all requirements of the City Building Ordinance and will not impose any adverse effect on existing adjacent 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 geotechnical engineer may be necessary based upon the conditions encountered.

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.

8.1 Site Grading Recommendations

Any vegetation and/or demolition debris 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.*

All disturbed soils and/or fill (about 1 to 2 feet below ground surface) shall be removed to competent native material, the exposed surface scarified to a depth of 12 inches, brought to within 2% of optimum moisture content and compacted to a minimum of 90% of the laboratory standard (ASTM: D 1557) prior to placement of any additional compacted fill soils, foundations, slabs-on-grade and pavement. Grading shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

Due to the potential for differential settlement of foundations placed on compacted fill and medium dense/stiff native materials, it is recommended that all foundations including slab areas be underlain by a uniform compacted fill blanket at least two feet in thickness. This fill blanket shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

Since the subsurface soils were noted to be excessive in moisture, soil stabilization may be required at the bottom of the building pad overexcavation. These soils will need the placement of an approved geofabric (Mirafi 600x or equivalent) and layer of approved gravel to stabilize the native soils prior to placement of engineered fill. Specific recommendations will need to be addressed during grading based on actual field conditions.

It is possible that isolated areas of undiscovered fill not described in this report are present on site; if found, these areas should be treated as discussed earlier. A diligent search shall also be conducted during grading operations in an effort to uncover any underground structures, irrigation or utility lines. If encountered, these structures and lines shall be either removed or properly abandoned prior to the proposed construction.

Any imported fill material should be preferably soil similar to the upper soils encountered at the subject site. All soils shall be approved by this firm prior to importing at the site and will be subjected to additional laboratory testing to assure concurrence with the recommendations stated in this report.

If placement of slabs-on-grade and pavement is not completed 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.

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.

8.2 Shrinkage and Subsidence

Results of our in-place density tests reveal that the soil shrinkage will be on the order of 15 to 20% 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 0.2 feet die 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 lost yardage, which will likely occur during grading. If more accurate shrinkage and subsidence factors are needed, it is recommended that field testing the actual equipment and grading techniques should be conducted.

8.3 Temporary Excavations

Temporary unsurcharged excavations in the existing site materials may be made at vertical inclinations up to 4 feet in height unless cohesionless soils are encountered. 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 or flatter excavations may be required. Additional recommendations regarding specific excavations may be provided once typical detail sections are made available.

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. 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.

8.4 **Foundation Design**

All foundations may be designed utilizing the following allowable bearing capacities for an embedded depth of 24 inches into approved engineered fill with the corresponding widths:

Allowable Bearing Capacity (psf)		
Width (feet)	Continuous Foundation	Isolated Foundation
1.5	1500	2000
2.0	1575	2075
4.0	1875	2375
6.0	2000	2500

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 3,000 psf. A one-third increase may be used when considering short-term loading and seismic forces.

Any foundations located along property line or where lateral overexcavation is not possible may utilize an allowable bearing capacity of 1,000 psf and embedded into competent native soils. All foundations shall be reinforced a minimum of two No. 4 bars, top and bottom. A representative of this firm shall inspect all foundation excavations prior to pouring concrete.

A stiffened foundation system should be utilized to support the proposed structure to mitigate for seismic induced settlements. The stiffened system shall consist of a post-tensioned slab design, mat foundation or a conventional slab with a system of grade beams connecting the foundations in two directions throughout the new structure.

In lieu of grade beams, an allowable bearing pressure of 1,500 psf may be used for the mat foundation with a minimum 24-inch footing embedment depth. The mat foundation slab shall be a minimum of xx inches in thickness and placed on a blanket of engineered fill soils compacted to a minimum of 90% of the laboratory standard. A one-third increase may be used when considering short-term loading and seismic forces. A modulus of subgrade reaction (k) of 150 pci may be used for design of slabs placed on engineered fill soils supporting sustained concentrated loads.

8.5 Settlement Analysis

Resultant pressure curves for the consolidation tests are shown on Plates B and C. Computations utilizing these curves and the recommended allowable soil bearing capacities reveal that the foundations will experience settlements on the order of ¾ inch and differential settlements of less than ¼ inch.

8.6 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 materials.

8.7 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 **approved granular backfill material** placed behind the walls at various ground slopes above the walls.

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. An equivalent fluid pressure of 45 pcf may be utilized for the restrained wall condition with a level grade behind the wall.

The seismic-induced lateral soil pressure for walls greater than 6 feet 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 used in final design of retaining walls. Sliding resistance values and passive fluid pressure values may be increased by 1/3 during short-term wind and seismic loading conditions.

All walls shall be waterproofed as needed and protected from hydrostatic pressure by a reliable permanent subdrain system. The granular backfill to be utilized immediately adjacent to retaining walls shall consist of an approved select granular soil with a sand equivalency greater than 30. This backfill zone of free draining material shall consist of a wedge beginning a minimum of one horizontal foot from the base of the wall extending upward at an inclination of no less than ¾ to 1 (horizontal to vertical).

8.8 **Slab Design**

All concrete slabs including driveway and hardscape shall be a minimum of four inches in thickness reinforced a minimum of No. 3 bars, sixteen inches in each direction positioned in the center of the slab and placed on approved subgrade soils. The subgrade soils shall be moisture conditioned to slightly over optimum moisture levels in the upper one foot.

A vapor retarder (10-mil minimum thickness) 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 compacted subgrade soils conditioned to near optimum moisture levels, although one to two inches of sand beneath the membrane is desirable.

The subgrade upon which the retarder is placed shall be smooth and free of rocks, gravel or other protrusions which may damage the retarder. Use of sand above the retarder is under the purview of the structural engineer; if sand is used over the retarder, it should be placed in a dry condition.

8.9 Pavement Section Design

The table below provides a preliminary pavement design based upon an R-Value of 60 for the subgrade soils 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 site grading to assure that these soils are consistent with those assumed in this preliminary design.

Type of Traffic	Traffic Index	Asphalt (in.)	Base Material (in.)
Automobile Parking Stalls	4.0	3.0	3.0
Light Vehicle Circulation Areas	6.0	3.0	4.0

Any concrete slab-on-grade in pavement areas shall be a minimum of six inches in thickness reinforced and placed on approved subgrade soils. *The recommendations are based upon estimated traffic loads. Client should submit any other anticipated traffic loadings to the geotechnical engineer, if necessary, so that pavement sections may be reviewed to determine adequacy to support the proposed loadings.*

All pavement areas shall have positive drainage toward an approved outlet from the site. Drain lines behind curbs and/or adjacent to landscape areas should be considered by client and the appropriate design engineers to prevent water from infiltrating beneath pavement. If such infiltration occurs, damage to pavement, curbs and flow lines, especially on sites with expansive soils, may occur during the life of the project.

Any approved base material shall consist of a Class II aggregate or equivalent and should be compacted to a minimum of 95% relative compaction. All pavement materials shall conform to the requirements set forth by the City of Fountain Valley. The base material; and asphaltic concrete should be tested prior to delivery to the site and during placement to determine conformance with the project specifications. A pavement engineer shall designate the specific asphalt mix design to meet the required project specifications.

8.10 **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 with clean sand having a sand equivalency rating of 30 or more. This bedding material shall be thoroughly water jetted around the pipe structure prior to placement of compacted backfill soils.

8.11 **Corrosion Design Criteria**

Representative samples of the surficial soils, typical of the subgrade soils expected to be encountered within foundation excavations and underground utilities were tested for corrosion potential. The minimum resistivity value obtained for the samples tested is representative of an environment that may be severely corrosive to metals. The soil pH value was considered mildly alkaline and may not have a significant effect on soil corrosivity.

Consideration should be given to corrosion protection systems for buried metal such as protective coatings, wrappings or the use of PVC where permitted by local building codes. According to Table 4.3.1 of ACI 318 Building Code and Commentary, these contents revealed negligible sulfate concentrations. Therefore, a Type II cement according to latest CBC specifications may be utilized for building foundations at this time.

It is recommended that additional sulfate tests be performed at the completion of site grading to assure that the as graded conditions are consistent with the recommendations stated in this design. Corrosion test results may be found on the attached Table IV.

8.12 Expansive Soil

If expansive soils are encountered, special attention should be given to the 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.

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.

A preconstruction conference should be held between the developer, general contractor, grading contractor, city inspector, architect, and geotechnical 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. 12/31/2024
GEOTECHNICAL
STATE OF CALIFORNIA

Keith D. Tucker
Project Engineer
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Scott D. Spensiero
Project Manager

References

1. American Society of Civil Engineers (ASCE) website, https://asce7hazardtool.online/

2. California Building Code, 2022.

3. California Department of Water Resources, Internet Website, http://www.water.ca.gov/waterdatalibrary/index.cfm.

4. California Division of Mines and Geology, 1997, Seismic Hazard Zone for the Anaheim and Newport Beach 7.5-Minute Quadrangle, Orange County, California - Seismic Hazard Zone Report 98-03

5. California Division of Mines and Geology, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California: Special Publication 117A.

6. Earthquake Zones of Required Investigation, Seismic Hazard Zones, Newport Beach Quadrangle, published by the California Geological Survey.

7. Orange County Technical Guidance Document (OCTGD) Appendix VII – Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations dated December 20, 2013.

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 Geotechnical 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).

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.

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 Geotechnical 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) and approved prior to the placement of the next layer of soil. Compaction tests shall be obtained at the discretion of the Geotechnical 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 Geotechnical 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 Geotechnical 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 should be designed to the latest building code 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.

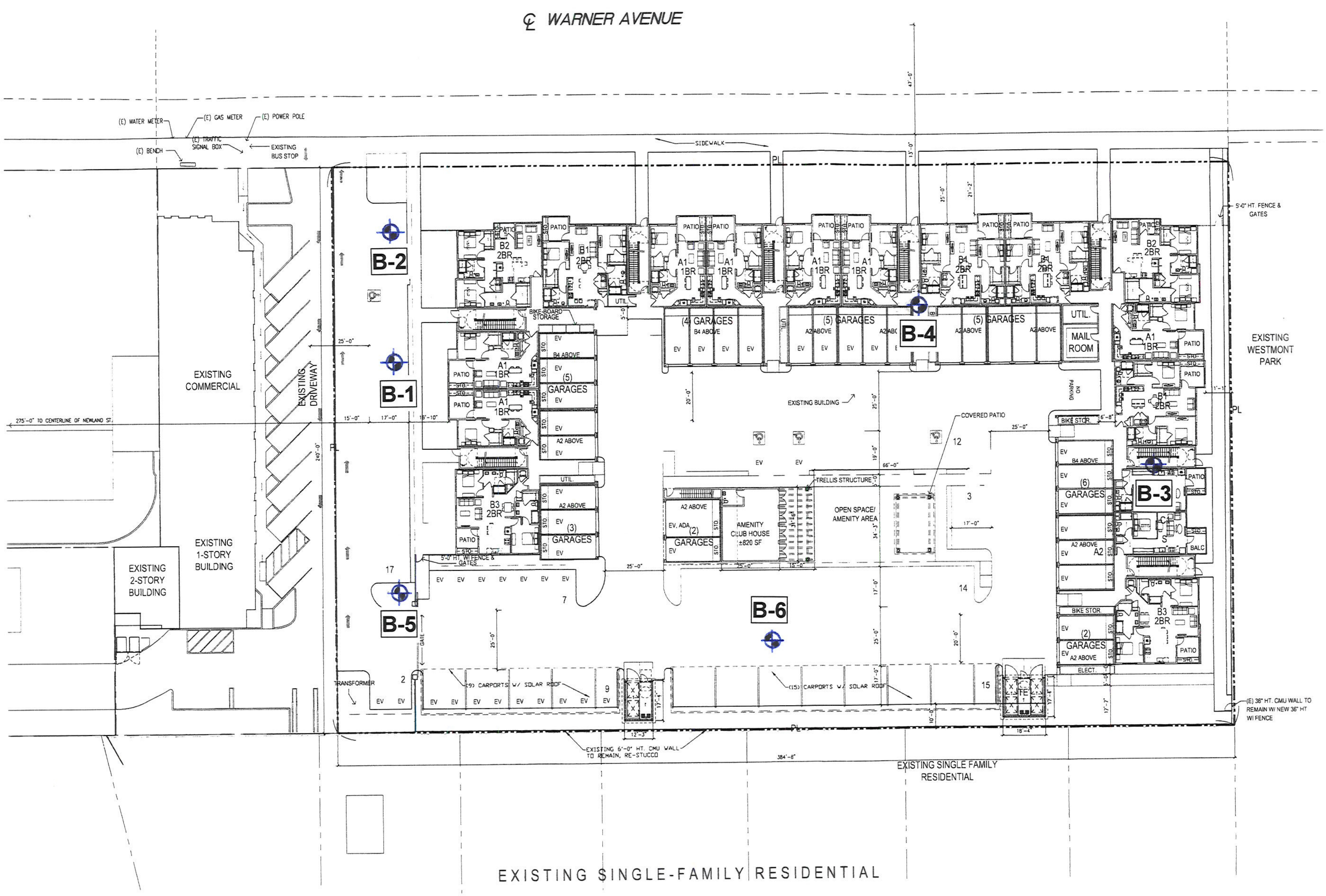
- Irrigation should be strictly controlled around building foundations, slabs and pavement and may need to be adjusted depending upon season. This control is essential to maintain a relatively uniform moisture content in the expansive soils and to prevent swelling and contracting. Over-watering adjacent 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: 23999-23

DATE: JUNE 2023

SITE PLAN

List of Appendices
(in order of appearance)

Appendix A
Log of Excavations

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

The Stellrecht Company 23999-23	Log of Boring B-1

Boring Location: 8550 Warner Ave, Fountain Valley	
Date of Drilling: 6/7/2023	Groundwater Depth: None Encountered
Drilling Method: Simco 2800HS	
Hammer Weight: 140 lbs	Drop: 30"
Surface Elevation:	

Depth (feet)	Lith-ology		Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		GWT not encountered	FILL Sandy SILT Brown, loose to medium stiff, moist					
			NATURAL Sandy SILT Brown, medium dense, moist to very moist					
5			Boring completed at depth of 5'					
10								
15								
20								
25								
30								
35								

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The Stellrecht Company 23999-23	Log of Boring B-2

Boring Location: 8550 Warner Ave, Fountain Valley	
Date of Drilling: 6/7/2023	Groundwater Depth: None Encountered
Drilling Method: Simco 2800HS	
Hammer Weight: 140 lbs	Drop: 30"
Surface Elevation:	

Depth (feet)	Lithology		Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		GWT not encountered	FILL Sandy SILT Brown, loose to medium stiff, moist					
			NATURAL Sandy SILT Brown, medium stiff, moist to very moist					
5								
			Silty CLAY Grey brown, medium stiff, saturated					
10			Boring completed at depth of 10'					
15								
20								
25								
30								
35								

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The Stellrecht Company
23999-23

Log of Boring B-3

Boring Location: 8550 Warner Ave, Fountain Valley

Date of Drilling: 6/7/2023	Groundwater Depth: 19'
Drilling Method: Simco 2800HS	
Hammer Weight: 140 lbs	Drop: 30"
Surface Elevation:	

Depth (feet)	Lithology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		Asphalt pavement, base material					
		FILL Sandy SILT Brown, medium stiff, moist					
		NATURAL Sandy SILT Brown, medium stiff, moist					
5		Silty CLAY Brown, medium stiff, saturated to wet	⊠	3/3/4	34.4		92
10			⊠	2/2/3	35.9		96
15			⊠	3/3/3	32.5		82
	▽	Groundwater encountered at 19' bgs					
20			⊠	3/3/5	34.1		88
25		Clayey SILT Grey, medium stiff, wet	⊠	5/5/6	35.1		73
30		Sandy SILT grey, firm, wet	⊠	3/5/8	31.8		55
35		Silty (fine to medium grained) SAND Brown, medium dense, wet					

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The Stellrecht Company 23999-23	Log of Boring B-3

Boring Location: 8550 Warner Ave, Fountain Valley

Date of Drilling: 6/7/2023 | Groundwater Depth: 19'

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs | Drop: 30"

Surface Elevation:

Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
35	Silty (fine to medium grained) SAND Grey, medium dense, wet	☒	5/7/9	31.9		27
	Silty CLAY Dark grey, medium stiff, wet					
40		☒	5/7/8	33.5		93
	Silty (fine to medium grained) SAND Grey, medium dense, wet; slightly silty to slight silty content					
45		☒	7/8/12	19.6		9
50		☒	7/10/12	16.1		6
	Boring completed at depth of 51.5'					
55						
60						
65						
70						

The Stellrecht Company
23999-23

Log of Boring B-4

Boring Location: 8550 Warner Ave, Fountain Valley

Date of Drilling: 6/7/2023 | **Groundwater Depth:** None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs | **Drop:** 30"

Surface Elevation:

Depth (feet)	Lith-ology		Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		GWT not encountered	Asphalt pavement					
			FILL Sandy SILT Brown, medium dense, moist					
			NATURAL Sandy SILT Brown, medium stiff, moist to very moist	■	4/5	17.0	94.0	
5				■	3/3	23.9	87.9	
			Silty CLAY Brown, firm, saturated	■	3/3	36.1	82.9	
10			Boring completed at depth of 10'					
15								
20								
25								
30								
35								

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The Stellrecht Company
23999-23

Log of Boring B-5

Boring Location: 8550 Warner Ave, Fountain Valley

Date of Drilling: 6/7/2023 | **Groundwater Depth:** 19'

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs | **Drop:** 30"

Surface Elevation:

Depth (feet)	Material Description	Sample Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	Asphalt pavement, base material					
	FILL Sandy SILT Brown, medium stiff, moist	■	3/5	16.3	91.0	
	NATURAL Sandy SILT Brown, medium stiff, moist	■	5/5	26.2	93.2	
	Silty CLAY Brown, firm, saturated to wet					
10		■	3/5	35.9	87.4	
15		■	5/5	30.9	92.1	
19	Groundwater encountered at 19' bgs					
20		■	3/4	42.9	84.4	
21	Boring completed at depth of 21'					

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

The Stellrecht Company
23999-23

Log of Boring B-6

Boring Location: 8550 Warner Ave, Fountain Valley

Date of Drilling: 6/7/2023 | Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs | Drop: 30"

Surface Elevation:

GWT not encountered

Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	FILL Sandy SILT Brown, soft, moist					
	NATURAL Sandy SILT Brown, medium stiff, moist	■	5/6	25.4	91.5	
5		■	4/7	28.3	92.2	
	Silty CLAY Brown, firm, saturated					
10	Boring completed at depth of 10'					
15						
20						
25						
30						
35						

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\23999-23.log Date: 6/15/2023

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Appendix B
Laboratory Tests

TABLE I
MAXIMUM DENSITY TESTS

Sample	Classification	Optimum Moisture (%)	Maximum Dry Density (lbs/cu.ft)
B-5 @ 2'	Sandy SILT	12.5	112.0

TABLE II
EXPANSION TESTS

Sample	Classification	Expansion Index
B-5 @ 2'	Sandy SILT	30

TABLE III
ATTERBERG LIMITS

Sample	Liquid Limit	Plastic Limit	Plasticity Index
B-3 @ 5'	39	24	15
B-3 @ 10'	41	23	18
B-3 @ 15'	36	23	13
B-3 @ 20'	39	21	18
B-3 @ 25'	30	28	2
B-3 @ 40'	43	24	19

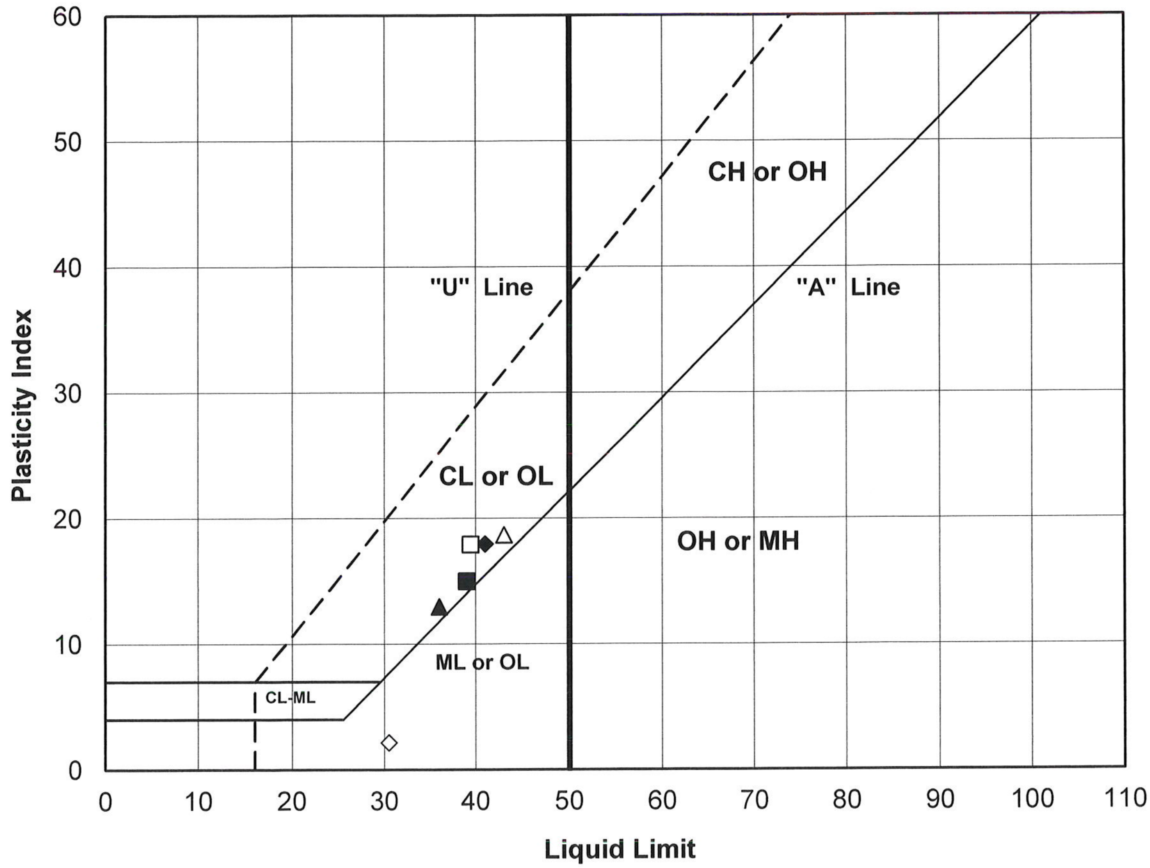
TABLE IV
CORROSION TESTS

Sample	pH	Electrical Resistivity	Sulfate (%)	Chloride (ppm)
B-5 @ 2'	7.4	7,719	0.002	140

% by weight
ppm – mg/kg

PLASTICITY INDEX

ASTM D4318



Symbol	Sample	Depth	LL	PL	PI	USCS	Soil Description
■	B3	5'	**39**	**24**	**15**	CL	Lean Clay
◆	B3	10'	**41**	**23**	**18**	CL	Lean Clay
▲	B3	15'	**36**	**23**	**13**	CL	Lean Clay
□	B3	20'	**39**	**21**	**18**	CL	Lean Clay
◇	B3	25'	**30**	**28**	**2**	ML	Silt
△	B3	40'	**43**	**24**	**19**	CL	Lean Clay

NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

The Stellrecht Company

PROJECT NUMBER: 23999-23 DATE: 6/28/2023

PLASTICITY INDEX

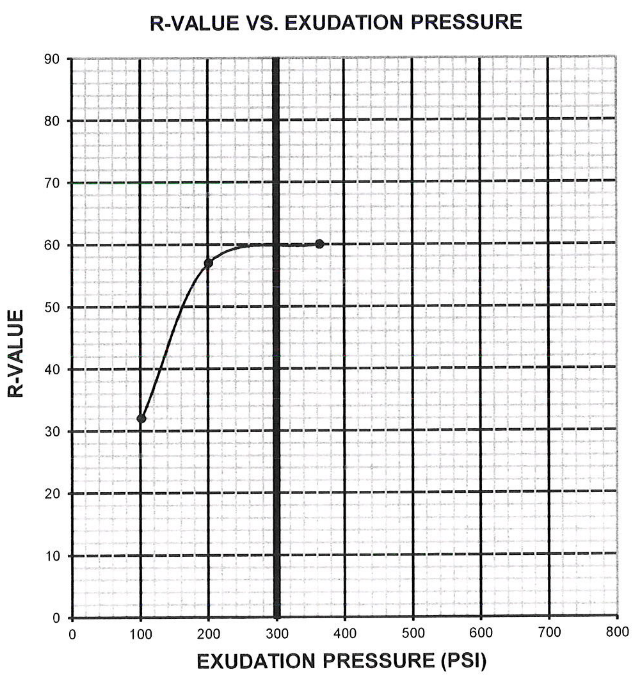
ASTM D4318

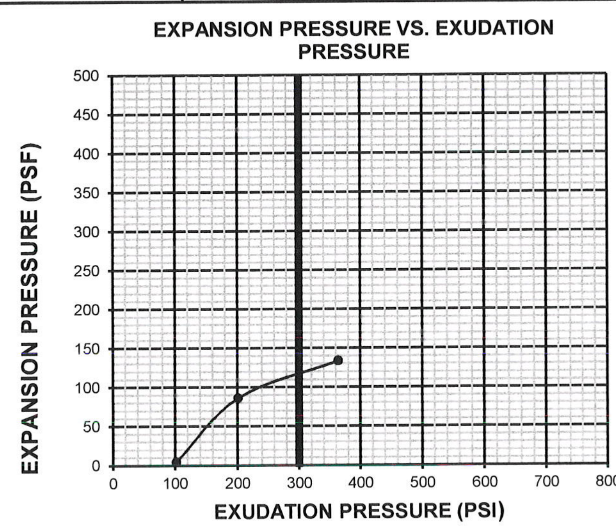
R-VALUE TEST REPORT

☑ CT-301 ☐ ASTM-D2844

PROJECT NAME:	Norcal: The Stellrecht Company	PROJECT NUMBER:	L-230601
SAMPLE LOCATION:	8550 Warner Ave, Fountain Valley, CA	SAMPLE NUMBER:	B3
SAMPLE DESCRIPTION:	SANDY SILT (ML), brown	SAMPLE DEPTH:	2'
SAMPLED BY:	Norcal, 6/7/23	TESTED BY:	JPG
		DATE TESTED:	6/8/2023

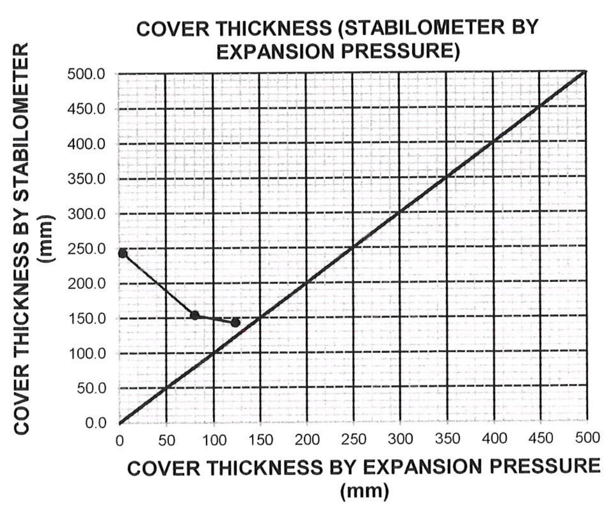
TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	21.1	18.7	17.4
WEIGHT OF SAMPLE, grams	1036	972	969
HEIGHT OF SAMPLE, Inches	2.62	2.45	2.47
DRY DENSITY, pcf	99.0	101.3	101.3
COMPACTOR AIR PRESSURE, psi	150	150	150
EXUDATION PRESSURE, psi	102	201	364
EXPANSION, Inches x 10exp-4	1	20	31
STABILITY Ph 2,000 lbs (160 psi)	75	42	38
TURNS DISPLACEMENT	6.75	5.39	5.44
R-VALUE UNCORRECTED	30	57	60
R-VALUE CORRECTED	32	57	60
EXPANSION PRESSURE (psf)	4.3	86.4	133.9





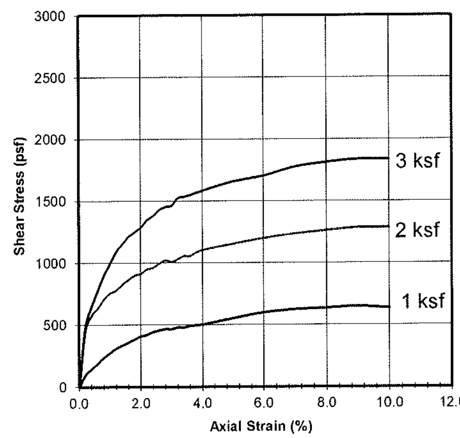
R-VALUE AT EQUILIBRIUM:	60

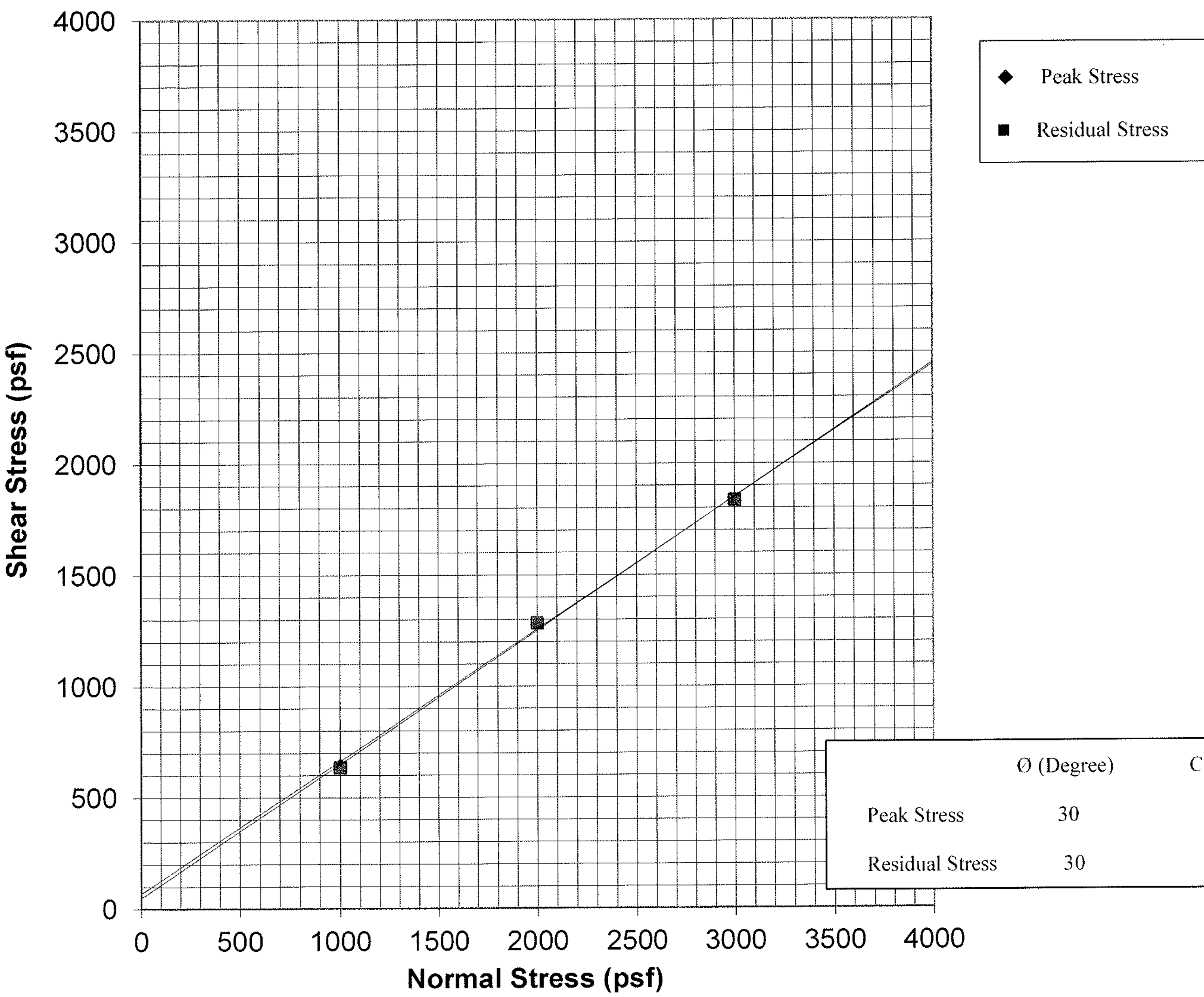
R-VALUE BY EXUDATION PRESSURE:	60
R-VALUE BY EXPANSION PRESSURE:	N/A
EXPANSION PRESSURE AT 300 PSI EXUDATION:	115
TRAFFIC INDEX (Assumed):	5.5
GRAVEL FACTOR (Assumed):	1.5
UNIT MASS OF COVER MATERIAL, kg/m^3 (Assumed):	2100.0



Sample No.	B5@2'	
Sample Type:	Undisturbed/Saturated	
Soil Description:	Silty Fine Grained Sand	

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	648	1284	1836
Displacement	(in)	0.225	0.225	0.225
Residual Stress	(psf)	636	1284	1836
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	91.0	91.0	91.0
In Situ Water Content	(%)	16.3	16.3	16.3
Saturated Water Content	(%)	28.6	28.6	28.6
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	30	70
Residual Stress	30	50

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SOILS AND GEOTECHNICAL CONSULTANTS

The Stellrecht Company

PROJECT NUMBER: 23999-23 DATE: 6/28/2023

DIRECT SHEAR TEST

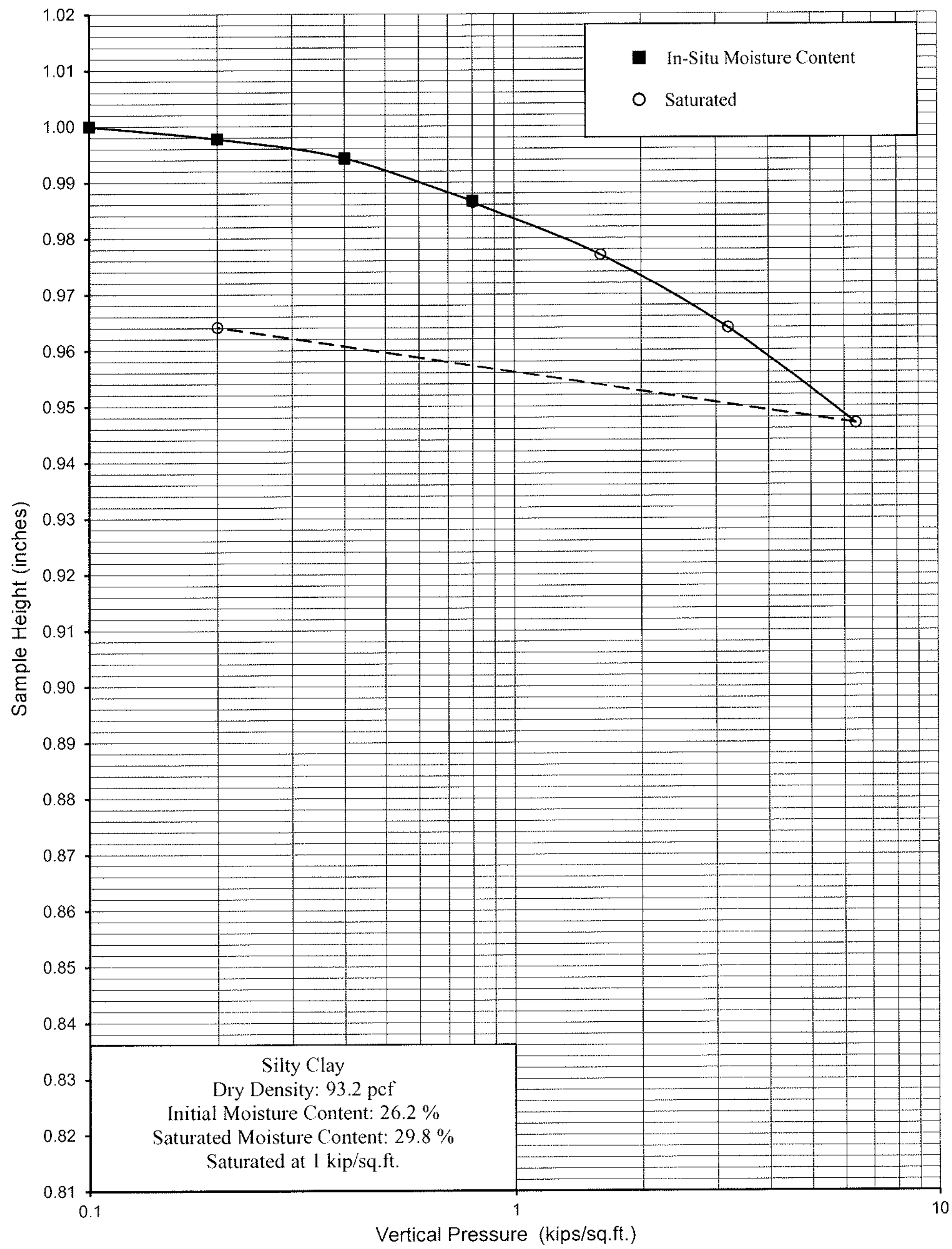
ASTM D3080

Plate A

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.1	1.0000	0.0
0.2	0.9978	0.2
0.4	0.9943	0.6
0.8	0.9867	1.3
0.8	0.9864	1.4
1.6	0.9770	2.3
3.2	0.9640	3.6
6.4	0.9469	5.3
0.2	0.9642	3.6

Saturated

Sample No.	B5	Depth	5'	Date	6/28/2023



Date Tested: 6/19/2023
Sample: B5
Depth: 5'

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SOILS AND GEOTECHNICAL CONSULTANTS

The Stellrecht Company

PROJECT NUMBER: 23999-23 DATE: 6/28/2023

CONSOLIDATION TEST

ASTM D2435

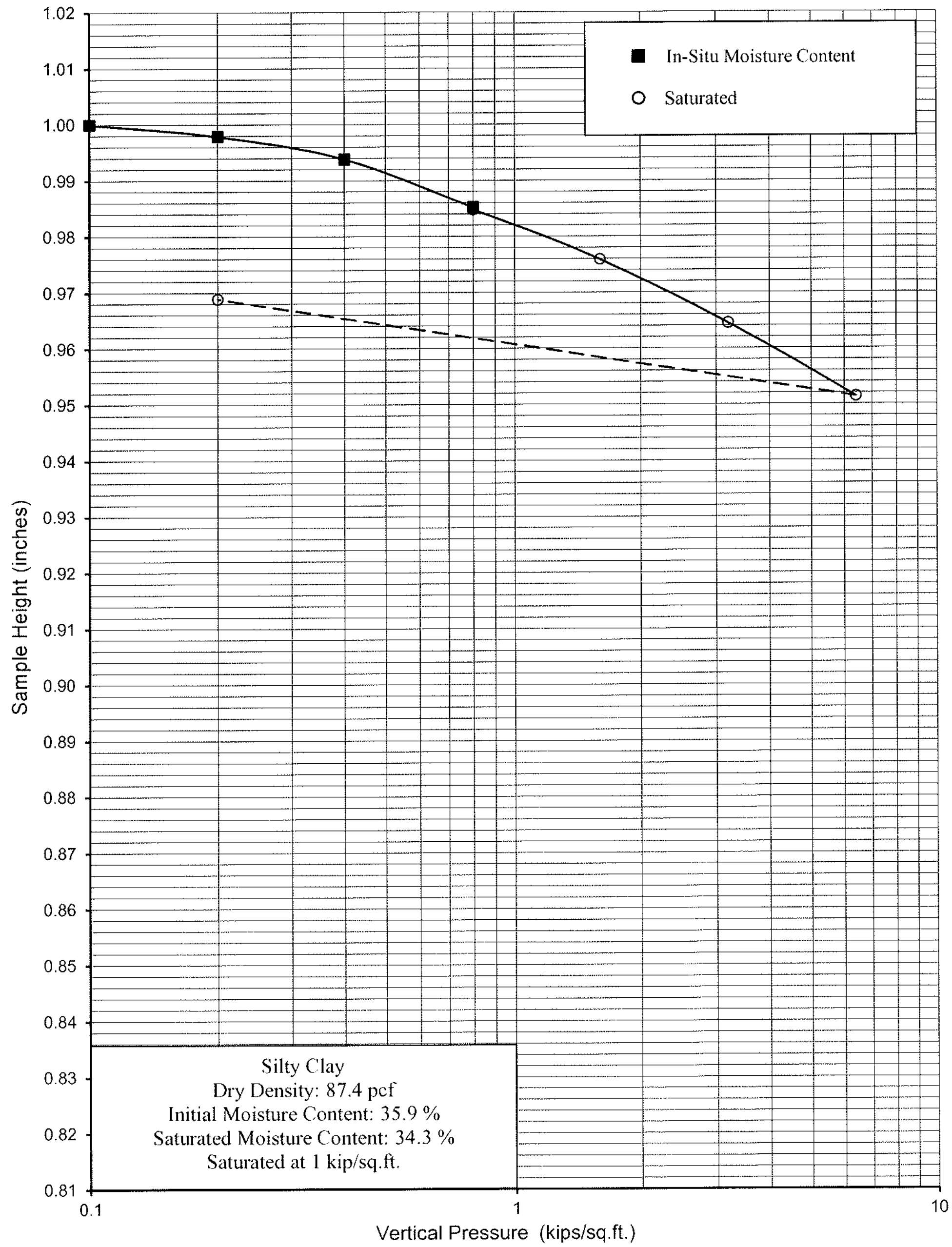
Plate B

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.1	1.0000	0.0
0.2	0.9979	0.2
0.4	0.9938	0.6
0.8	0.9852	1.5
0.8	0.9848	1.5
1.6	0.9759	2.4
3.2	0.9645	3.6
6.4	0.9514	4.9
0.2	0.9689	3.1

Saturated

Date Tested: 6/19/2023
Sample: B5
Depth: 10'

Sample No. B5 Depth 10' Date 6/28/2023



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SOILS AND GEOTECHNICAL CONSULTANTS

The Stellrecht Company

PROJECT NUMBER: 23999-23 DATE: 6/28/2023

CONSOLIDATION TEST

ASTM D2435

Plate C

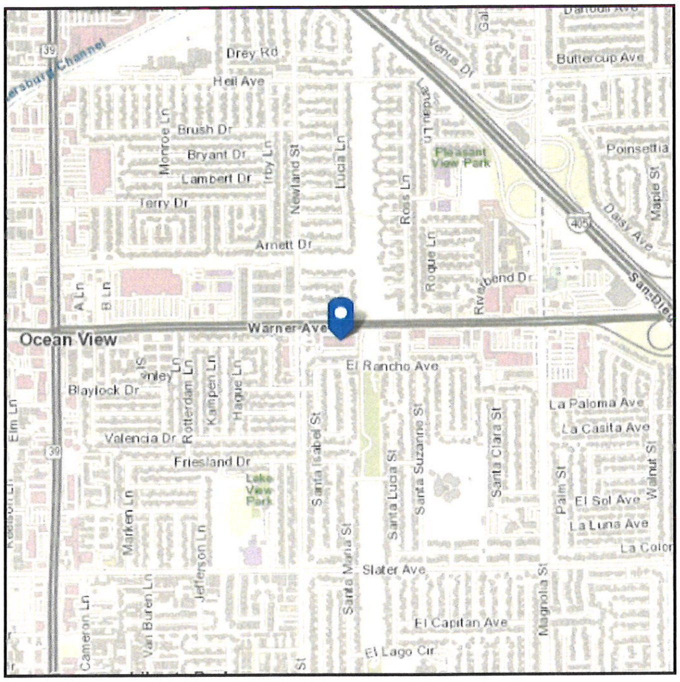
Appendix C
Liquefaction Analysis

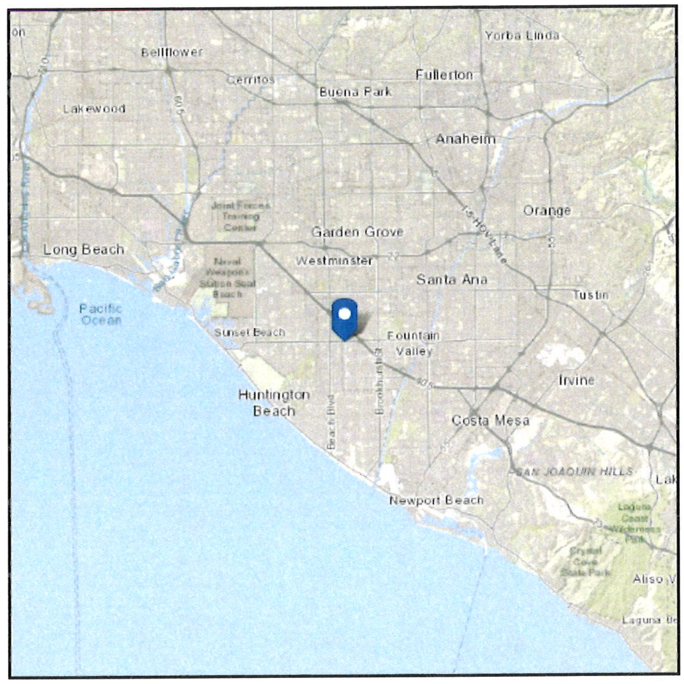
ASCE 7 Hazards Report

Address:
8550 Warner Ave
Fountain Valley, California
92708

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

Latitude: 33.715266
Longitude: -117.979025
Elevation: 30.347901410765356 ft (NAVD 88)





ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.387	S_{D1} :	N/A
S_1 :	0.5	T_L :	8
F_a :	1	PGA :	0.599
F_v :	N/A	PGA_M :	0.659
S_{MS} :	1.387	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	0.925	C_v :	1.377

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

Data Accessed: Fri Jun 09 2023

Date Source: USGS Seismic Design Maps

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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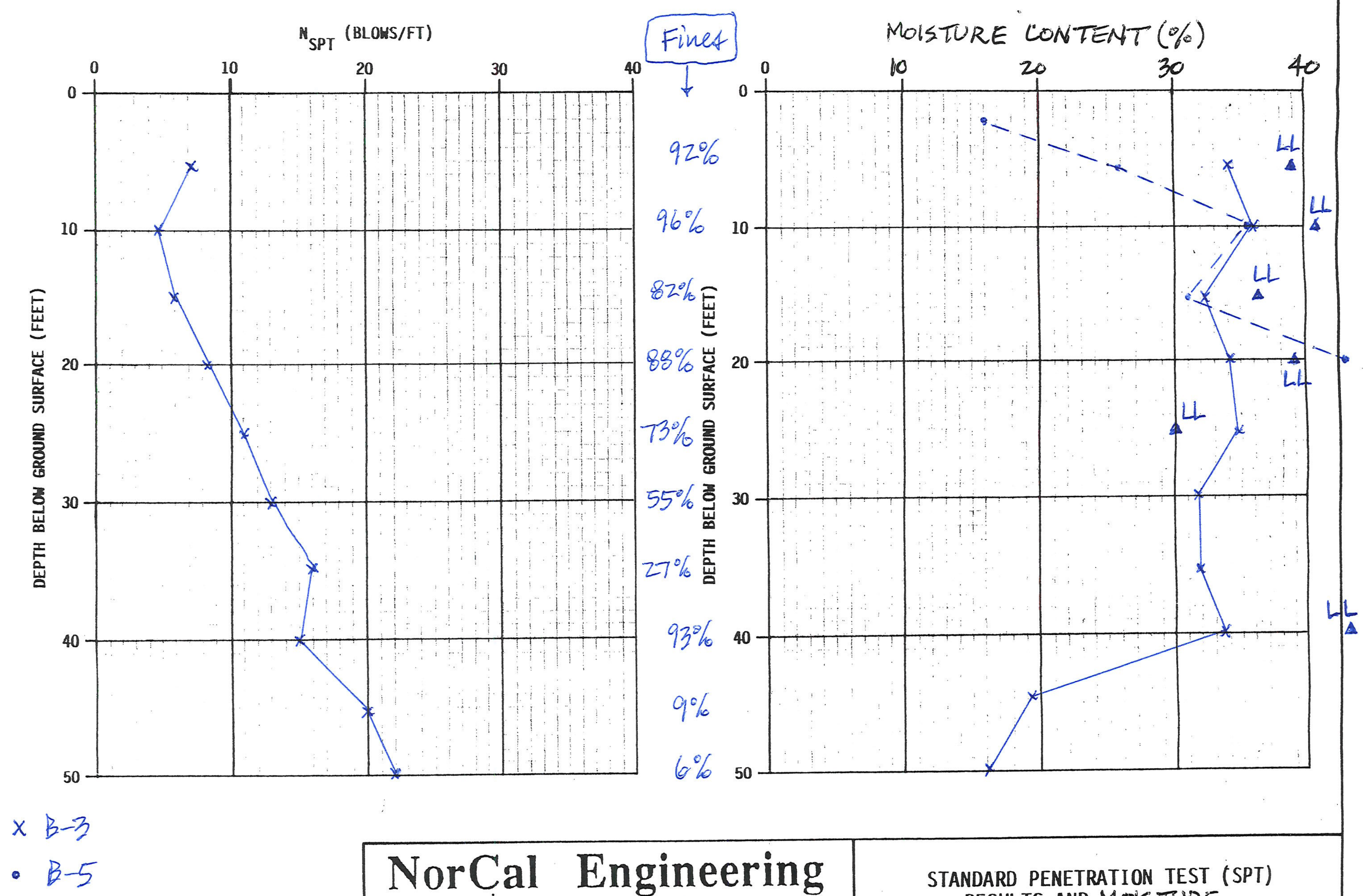

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PROJECT

DATE

STANDARD PENETRATION TEST (SPT) RESULTS AND MOISTURE CONTENT VERSUS DEPTH

SITE LOCATION: ______

GEOTECHNICAL REPORT: ______

GEOLOGY REPORT: ______

DEPTH TO WATER TABLE = 5'

EARTHQUAKE MAGNITUDE = 6.9

PEAK GROUND ACCELERATION = 0.66g

DEPTH BELOW FINAL GRADE (FEET)	MOIST DENSITY (PCF)	σ_o TOTAL STRESS (PSF)	$\bar{\sigma}_o$ EFFECTIVE STRESS (PSF)	$\sigma_o/\bar{\sigma}_o$ (-)	r_d (-)	① $\tau_h/\bar{\sigma}_o$ (-)	N VALUE (BLOWS/FT)	RELATIVE DENSITY (%)	C_N (-)	C_E (-)	C_B (-)	C_R (-)	C_S (-)	$(N_1)_{60}$ (BLOWS/ft)	FINES (%)	CRR M=7.5	MSF (-)	CRR M=6.9	LIQ. F.S.	
5	110	550	Same	1.00	0.99	0.43	7	60	>1.6	1.00	1.05	0.70	1.20	>10	92	>0.19	1.3	>0.25	>0.6	NL
10	115	1125	813	1.38	0.96	0.57	5	50	1.5	↓	↓	0.75	↓	7	96	>0.15	↓	>0.20	>0.3	NL
15	120	1725	1101	1.57	0.92	0.62	6	55	1.3			0.85		8.5	82	>0.17		>0.22	>0.3	NL
20	↓	2325	1389	1.67	0.87	0.63	8	55	1.2			0.90		11	88	>0.20		>0.26	>0.4	NL
25		2925	1677	1.74	0.80	0.60	11	60	1.1			0.95		14.5	73	>0.25		>0.33	>0.5	
30		3525	1965	1.79	0.74	0.57	13	60	1.0			1.00		16.5	55	>0.28		>0.36	>0.6	
35		4125	2253	1.83	0.68	0.54	16	65	0.95			↓		19	27	0.31		0.40	0.7	
40		4725	2541	1.86	0.64	0.51	15	65	0.90					17	93	>0.29		>0.38	>0.7	NL
45		5325	2829	1.88	0.61	0.49	20	70	0.86					22	9	0.27		0.35	0.7	
50		5925	3117	1.90	0.58	0.47	22	70	0.82					23	6	0.26		0.34	0.7	

① INDUCED CYCLIC STRESS RATIO = $\tau_{ave}/\bar{\sigma}_o = 0.65 \cdot \frac{a_{max}}{g} \cdot \frac{\sigma_o}{\bar{\sigma}_o} \cdot r_d$

- C_E = Corr. - Energy Ratio = Energy Ratio/60%
- C_B = Corr. - Borehole Dia. = 1.15 for 8" dia. borehole
- C_R = Corr. - Rod Length
- C_S = Corr. - Sampling Method

Actual Energy Ratio = 0.67-1.17 (Safety Hammer)
= 0.50-1.00 (Donut Hammer)

Sampling Method = 1.0 Standard sampler
~~= 1.2 Sampler W/o liners~~

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EVALUATION OF LIQUEFACTION POTENTIAL

SEISMIC SETTLEMENT EVALUATION ⇒ GWT @ 5',

EQ Magnitude = 6.9, Hor. Ground Acceleration = 0.66g

Depth (ft)	$N_{1,60}$ (Blows/ft)	Fines (%)	EQ CSR	M_{design} / $M_{7.5}$	Design CSR	Vert. Strain	Seismic Settle	Liquefaction F.S.	
5-10'	>10 (>15)	92 (5)	0.43	1.30	0.33	1.9%	1.14" x	>0.6	NL
10-15'	7 (12)	96 (5)	0.57	↓	0.44	2.2%	1.32" x	>0.3	NL
15-20'	8.5 (13.5)	82 (5)	0.62		0.48	2.0%	1.20" x	>0.3	NL
20-24'	11 (16.5)	88 (5)	0.63		0.48	1.8%	0.86" x	>0.4	NL
24-29'	14.5 (22)	73 (5)	0.60		0.46	1.4%	0.84"	>0.5	
29-34'	16.5 (25)	55 (5)	0.57		0.44	1.2%	0.72"	>0.6	
34-37'	19 (26)	27 (5)	0.54		0.42	1.1%	0.40"	0.7	
37-42'	17 (25)	93 (5)	0.51		0.39	1.2%	0.72" x	>0.7	NL
42-46'	22	9	0.49		0.38	1.4%	0.67"	0.7	
46-50'	23	6	0.47	↓	0.36	1.3%	0.62"	0.7	

ΣS = 8.49"

Say $\Delta_{EQ} \leq 3\frac{1}{4}$" ←

NL - Non liquefiable soil layers with LL > 39% and PL > 18%

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Appendix D
Soil Infiltration Data

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PERCOLATION TEST DATA

Client: The Stellrecht Company	**Date:** 6/7/2023
Project No.: 23999-23	**Tested By:** J.S.
Test Hole: 1	**USCS Soil Classification:**
Depth of Test Hole: 5' (60")	**Sides (if rectangular):**
Diameter of Test Hole: 6"	**Length:**
Sandy Soil Criteria Test*:	**Width:**

TRIAL NO.	START TIME	STOP TIME	TIME INTERVAL (MIN)	INITIAL DEPTH TO WATER (IN)	FINAL DEPTH TO WATER (IN)	CHANGE IN WATER LEVEL (IN)	GREATER THAN OR EQUAL TO 6"
1	8:12	8:37	25	44.5	57.0	12.5	
2	8:37	9:02	25	45.0	57.0	12.0	

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30-minute intervals) with a precision of at least 0.25".

TRIAL NO	START TIME	STOP TIME	ΔT TIME INTERVAL (MIN)	Do INITIAL DEPTH TO WATER (IN)	Df FINAL DEPTH TO WATER (IN)	ΔD CHANGE IN WATER LEVEL (IN)	PERCOLATION RATE (MIN/IN)
1	9:02	9:12	10	45.0	50.5	5.5	
2	9:12	9:22	10	45.0	50.5	5.5	
3	9:22	9:32	10	45.0	50.5	5.5	
4	9:32	9:42	10	45.0	50.5	5.5	
5	9:42	9:52	10	45.0	50.5	5.5	
6	9:52	10:02	10	45.0	50.5	5.5	
7							
8							
9							
10							
11							
12							
13							
14							
15							

COMMENTS:

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PERCOLATION TEST DATA

Client: The Stellrecht Company	**Date:** 6/7/2023
Project No.: 23999-23	**Tested By:** J.S.
Test Hole: 2	**USCS Soil Classification:**
Depth of Test Hole: 10' (120")	**Sides (if rectangular):**
Diameter of Test Hole: 6"	**Length:**
Sandy Soil Criteria Test*:	**Width:**

TRIAL NO.	START TIME	STOP TIME	TIME INTERVAL (MIN)	INITIAL DEPTH TO WATER (IN)	FINAL DEPTH TO WATER (IN)	CHANGE IN WATER LEVEL (IN)	GREATER THAN OR EQUAL TO 6"
1	8:21	8:46	25	105.0	105.0	0.0	
2	8:46	9:11	25	105.0	105.5	0.5	

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30-minute intervals) with a precision of at least 0.25".

TRIAL NO	START TIME	STOP TIME	ΔT TIME INTERVAL (MIN)	Do INITIAL DEPTH TO WATER (IN)	Df FINAL DEPTH TO WATER (IN)	ΔD CHANGE IN WATER LEVEL (IN)	PERCOLATION RATE (MIN/IN)
1	7:04	7:34	30	105.0	105.5	0.5	
2	7:34	8:04	30	105.0	105.0	0.0	
3	8:04	8:34	30	105.0	105.0	0.0	
4	8:34	9:04	30	105.0	105.5	0.5	
5	9:04	9:34	30	105.0	105.0	0.0	
6	9:34	10:04	30	105.0	105.0	0.0	
7	10:04	10:34	30	105.0	105.5	0.5	
8	10:34	11:04	30	105.0	105.5	0.5	
9	11:04	11:34	30	105.0	105.0	0.0	
10	11:34	12:04	30	105.0	105.5	0.5	
11	12:04	12:34	30	105.0	105.0	0.0	
12	12:34	1:04	30	105.0	105.0	0.0	
13							
14							
15							

COMMENTS:

SOIL INFILTRATION RATE CALCS ⇒ PORCHET METHOD

Location:	TH-1	TH-2
• Depth of Hole =	5.0'	10.0'
• Hole Radius =	3"	3"
• Drop = Δh	5.5"	0.5"
• Time Interval = Δt	10 min	30 min
• Initial Water Depth = H_o	15.0"	15.0"
• Final Water Depth = H_t	9.5"	14.5"
• Average Water Head = H_{avg}	12.25"	14.75"
• INFILTRATION RATE	3.6 in/hr	0.1 in/hr

$$\text{Infiltration Rate} = \frac{\Delta h \,(60)(r)}{\Delta t \,(r + 2 \cdot H_{avg})}$$

$$\text{Average Water Head} = \tfrac{1}{2}(H_t - H_o)$$

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